Vernon Turnbaugh Jr

1971

CHEVROLET TRUCK CHASSIS SERVICE MANUAL

CHEVROLET

SERIES 40-60

ST-331-71

1971

SERIES 40 through 60

CHEVROLET TRUCK CHASSIS SERVICE MANUAL

FOREWORD

This manual includes procedures for maintenance and adjustments, minor service operations, and removal and installation for components of Chevrolet Series 40 through 60 Trucks. Procedures involving disassembly and assembly of major components for these vehicles are contained in the 1971 Chevrolet Passenger Car and Series 10-30 Truck Overhaul Manual or the 1971 Series 40-60 Truck Overhaul Manual Supplement.

This manual should be kept in a handy place for ready reference. If properly used, it will enable the technician to better serve the owners of Chevrolet built vehicles.

All information, illustrations and specifications contained in this literature are based on the latest product information available at the time of publication approval. The right is reserved to make changes at any time without notice.

CHEVROLET MOTOR DIVISION
General Motors Corporation
DETROIT, MICHIGAN

SECTION INDEX

 Printed in U.S.A.

INTRODUCTION

This manual contains on-the-vehicle maintenance, light repair information, and unit replacement on all truck series listed on page v. Overhaul procedures for major units will be published in separate "Unit Overhaul" manuals. Important information on the arrangement and use of this manual will be found on page iv. Operation of the vehicles from the standpoint of the driver is contained in a separate Owner's and Driver's manual which is furnished with every new Chevrolet Truck.

Every effort has been made to include timely and adequate information on the various units and systems used on Chevrolet Trucks. The general maintenance and light repair procedures in the various manual sections are the result of extensive service experience. This information should serve not only as a reference for the experienced mechanical force, but also as a comprehensive text for training purposes.

In some cases, considerable space is devoted to describing the operation of a unit or system. The use of this space is justified by the presumption that in order for a mechanic to maintain a unit or system in a serviceable condition, he must first understand how the unit or system should function.

All information contained in this manual is based on the latest product information available at the time of publication approval. Chevrolet Motor Division reserves the right to make changes in design or add improvements at any time without incurring any obligation to install same on vehicles previously purchased.

TRUCK MODEL DESIGNATION

CHASSIS TYPE SYMBOL
(C) Conv. Cab (96" BBC) (4x2)
(M) Conv. Cab (96" BBC) (6x4)
(T) Tilt Cab
(S) Schoolbus Cowl

GVW RANGE NUMBER
See "Load Capacity Chart" in Owner's and Driver's Manual.

MODEL YEAR

PLANT

SERIAL NUMBER

C | E | 4 | 13 | 1 | P 1 1 0 0 0 1

ENGINE TYPE SYMBOL
(E) V8 Gasoline
(S) In-Line Gasoline

BODY AND BRAKE TYPE
03–Cab & Chassis (Hyd. Brakes)
13–Cab & Chassis (Air Brakes)
02–Cowl & Chassis (Hyd. Brakes)

GENERAL INFORMATION

IMPORTANT—READ THIS PAGE

TRUCK MODELS COVERED

This manual contains "on-the-vehicle" maintenance and light repair information on Chevrolet Truck Models listed on page v. Since many truck models with various combinations of equipment are covered in this manual, the reader must necessarily refer to truck model applications and methods of distinguishing design differences in each manual section.

All standard equipment and the most commonly used regular production options are included in this manual. Many special equipment and accessory items are available on Chevrolet Trucks, however, these items are too numerous to permit their coverage in this manual.

MANUAL ARRANGEMENT

This manual is divided into major sections in the sequence shown on the margin of the title page. A black tab bearing the major section number is placed on the first page of each major section which indexes with the tab on the title page. Many of the major sections are divided into sub-sections, each sub-section containing important and specific information on related units or components. A section index is also included on the first page of each major section, when the major section is divided into sub-sections.

PAGE AND ILLUSTRATION NUMBERS

The manual pages are numbered consecutively within each section. Illustrations are numbered consecutively within each section, or within each sub-section when the major section is so divided.

SPECIFICATIONS

Service data, fits, and tolerances are listed at end of each section or sub-section under the heading "Specifications." In some cases reference must also be made to these "Specifications" for model application and methods of distinguishing the various design and construction differences.

Manufacturers model or part numbers are used in many instances in the "Specifications" tabulations. These numbers are provided primarily for unit identification or truck model application reference, and should be referred to when ordering parts. All detail service part numbers must be obtained from the applicable Parts Book.

SPECIAL TOOLS

Special tools and equipment are mentioned, and in many instances illustrated, throughout the text. These tools are specially designed to accomplish certain operations efficiently and readily. Such tools are mentioned in the text by tool vendor's numbers. These tools are not offered for sale by Chevrolet Motor Division. Information regarding availability of these tools can be obtained from your Zone Office.

SERVICE BULLETINS

Service bulletins are issued, when required, supplementing or in some cases superseding information in this manual. Information in these bulletins should be noted in the text of the applicable manual section and the bulletin filed for ready reference.

OPERATION

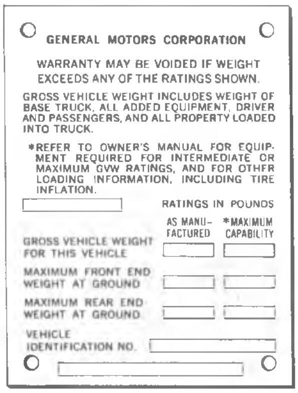
Operating instructions from the standpoint of the driver are included in a booklet entitled "Owner's and Driver's Manual" which is placed in the cab of every new Chevrolet Truck.

ALPHABETICAL INDEX

Important subjects, with manual page number references, are alphabetically listed in the index in the back of this manual.

MODEL DATA

TRUCK SERIES	GMC ENGINE		CLUTCH		FRONT AXLE		REAR AXLE		TRANSMISSION	
	STD.	OPT.	STD.	OPT.	STD.	OPT.	STD.	OPT.	STD.	OPT.
CE-40	350	–	12"-1	–	F050	–	H110	H135	CH465	AT540
CS-40	250	292	11"-1	–	F050	–	H110	H135	CH465	–
SS-40	250	292	11"-1	–	F050	–	H110	H135	CH465	–
CE-50	350	366	13"-1	–	F050	F070	H150	T150, H170, T170	CH465	282V, 285V, 542GD, 542GL, AT540
CS-50	292	–	12"-1	–	F050	F070	H150	T150, H170, T170	CH465	540CL
SE-50	350	366	13"-1	–	F055	F070	H150	T150, H170, T170	CH465	285V,542GL,AT540,
SS-50	292	–	12"-1	–	F055	F070	H150	T150, H170, T170	CH465	540CL
TE-50	350	366	13"-1	–	F070	F090	H150	T150, H170, T170	435GL	282V, 285V, 542GD, 542GL, AT540
TS-50	292	–	12"-1	–	F070	F090	H150	T150, H170, T170	CH465	540CL
CE-60	366	427	13"-1	12"-2	F070	F090, F110	H170	T170, 17121, 17221, 19201	CH465	282V, 285V, 325V, 327V,542GD,542GL, 5652B,5756B,AT540
ME-60	366	427	13"-1	12"-2	F070	F090, F110	30DSC	34DSC	542GL	285V,325V,5652B, 542GL, MT40, 6041 Aux., 7041 Aux.
TE-60	366	427	13"-1	12"-2	F070	F090, F120	H170	T170, 17121, 17221, 19201	435GL	282V, 285V, 542GL, 5752C, AT540



VEHICLE MODEL IDENTIFICATION AND WEIGHT RATING PLATE

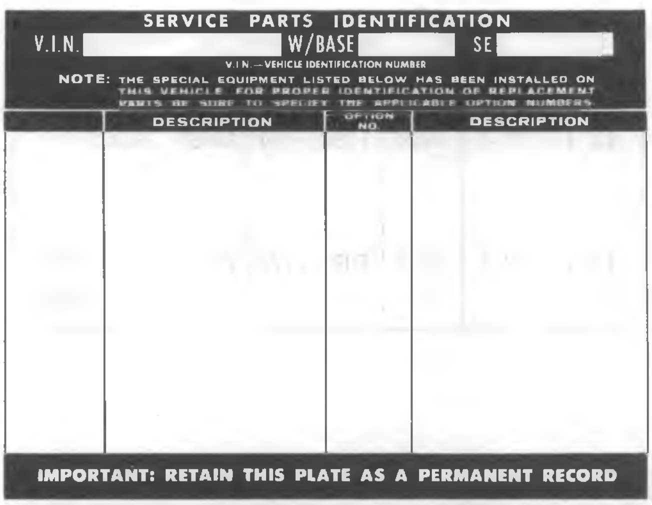
The vehicle identification and weight rating plate is located on the cab left door pillar of all models except cowl models. Plate location on cowl models is on the engine side of cowl.

ENGINE SERIAL NUMBERS

The engine serial number on "V" engines is stamped on top of the cylinder block ahead of the right-bank cylinder head. Engine serial numbers are not used on In-line engines; numbers appearing on crankcase boss at rear of distributor are manufacturing location and buidling date codes.

SERVICE PARTS IDENTIFICATION

The "Service Parts Identification" label is located on inside of glove compartment door of steel tilt and conventional cab models. Location of label on cowl models is determined by the body manufacturer. This label lists all special equipment installed on the vehicle. This information is imprinted on the label at the factory and represents only the special equipment on the vehicle when it was shipped from the factory. Always refer to this information when ordering parts.



SECTION 0

Lubrication

INDEX

GENERAL INFORMATION

One of the most important items to good truck care is the lubrication of all necessary points with the right lubricant, at the right time, and in the right way. It is the responsibility of the owner to maintain proper lubrication practices as recommended in this service manual.

Chassis Lubrication Charts (figs. 1, 2, and 3) will locate each lubrication point on the series shown under each chart. Each point is numbered on the charts, and each number is keyed to explanatory text on opposite page.

Refer to "Engines and Accessories Lubrication Chart" (fig. 4) for information relative to location, interval, and lubrication to be used in specific engine areas.

Each item shown on charts requiring lubrication is covered with a lubricant symbol. Explanations of symbols start on page following charts. Explanations include type of lubricant recommended, and instructions regarding its application. The charts show recommended intervals when various items should be lubricated. The intervals are recommended for normal use; however, operating conditions may require more frequent intervals. Recommended intervals should be followed until operating experience indicates other periods.

No particular brand of lubricant is recommended as many reputable oil dealers can furnish the right lubricants when advised of the correct specifications or descriptions. The lubricant manufacturer must be responsible for the quality and satisfactory performance of his product. His reputation is your best indication of quality.

LUBRICANT SYMBOLS

Symbol	Explanation
"E"	Engine Oil
"MPO"	Multi-Purpose Gear Oil
"GO"	Gear Oil
"ES"	Lubricating Oil - Special
"MPG"	Multi-Purpose Grease
"SG"	Steering Gear Lubricant
"S3"	Petroleum Jelly
"S7"	Refrigeration Machine Oil
"S12"	Hydraulic Brake Fluid
"S17"	Special Grease
"S19"	Automatic Transmission Fluid
"S27"	High Temperature Grease - Special
"S28"	High Temperature Grease - Special

> Lubricants Must Be Stored and Dispensed in Such a Manner That They Will Be Clean and Free of Contamination, Due to Dirt or Other Foreign Matter.

LUBRICATION

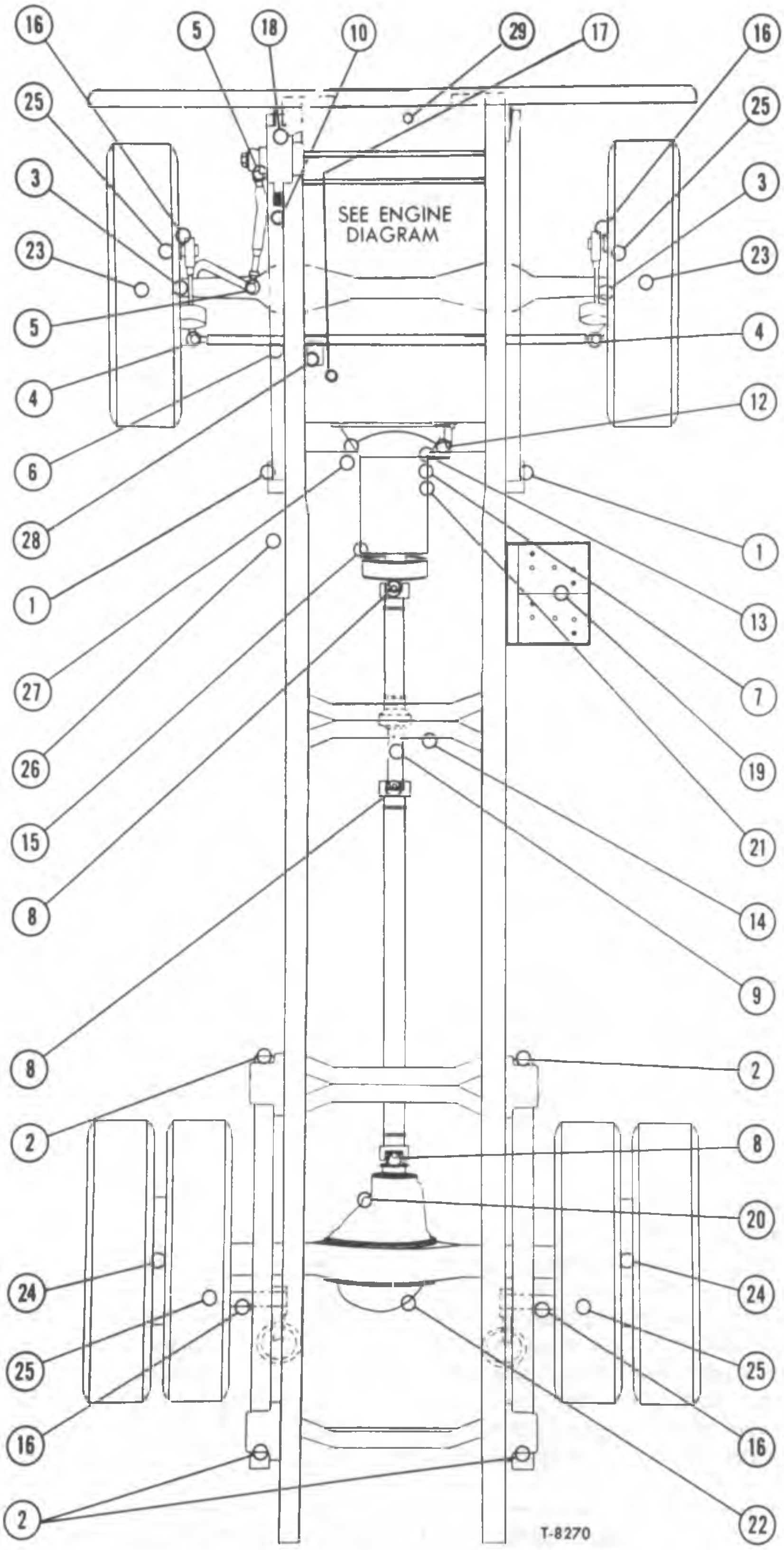


Figure 1—Lubrication Chart (All Except Steel Tilt Cab Models)

LUBRICATION DATA
(CHART ON OPPOSITE PAGE)

Item No.	Item	Remarks	Symbol	Miles‡
1	Front Spring Slip Pads	Apply as required	MPG	6,000
2	Rear Spring Slip Pads	Apply each end	MPG	6,000
3	Steering Knuckles	2 fittings each side	MPG	6,000
4	Steering Tie Rod Ends	1 fitting each end	MPG	6,000
5	Steering Drag Link Ends	1 fitting each end	MPG	6,000
6	Power Steering Cylinder Ends (a)	2 fittings	MPG	6,000
7	Aux. Transmission Shift Tower (a)	1 fitting	MPG	6,000
8	Propeller Shaft U-Joints	1 fitting each joint	MPG	6,000
9	Propeller Shaft Slip Joint	1 fitting each joint	MPG	6,000
10	Steering Column U-Joints	1 fitting each joint	MPG	6,000
12	Clutch Release Cross Shaft (a)	1 fitting each end	MPG	6,000
13	Clutch Release Bearing	427 Eng.- cup	S27	6,000
14	Tru-Stop Brake (a)	4 or 8 fittings	MPG	6,000
15	Speedometer Adapter	1 fitting	MPG	6,000
16	Brake Camshaft (b)	1 fitting each (apply sparingly)	MPG	6,000
17	Clutch Pedal Lever Shaft	1 fitting	MPG	6,000
18	Steering Gear Housing	To level of filler plug	SG	6,000
19	Battery Terminals	Keep coated (except ST batteries)	S3	6,000
20	Electric Shift Unit (2-Spd.) (a)	To level of filler plug	S7	12,000
21	Transmission (N.P. & Chev.)	To level of filler plug	MPO	6,000
		Drain and refill	MPO	12,000
21	Transmission (Clark)	To level of filler plug	GO	6,000
		Drain and refill	GO	12,000
21	Transmission (Spicer)	To level of filler plug	ES	6,000
		Drain and refill	ES	12,000
21	Transmission - Auxiliary (a)	To level of filler plug	ES	6,000
		Drain and refill	ES	12,000
21	Transmission - Automatic	Check level	S19	6,000
		Drain and refill	S19	24,000**
22	Rear Axle	To level of filler plug	MPO	6,000
		Drain and refill	MPO	24,000#
23	Front Wheel Bearings (d)	Hand pack or use lubricator	MPG	20,000*
24	Rear Wheel Bearings (e)	Hand pack or use lubricator	MPG	20,000*
25	Brake Cam Roller Pins (b)	Apply	E	20,000
27	Brake & Axle Cylinder Air Cleaner (a)	Clean and refill	-	6,000
28	Brake Master Cylinder (c)	Fill - ½" below opening	S12	3,000@
29	Hood Latch	Apply with brush	S17	6,000

(a) Some vehicles.
(b) Air Brake only.
(c) Hydraulic Brakes only.
(d) Optional oil lubricated - use "GO" type oil.
(e) Optional oil lubricated type requires no periodic servicing.
* Or once a year, whichever occurs first.
** 12,000miles under severe operation (change filter when changing oil).
# Or every 6 months, whichever occurs first.
‡ When "MPG" Multi-Purpose Grease is specified, lubricate every 6,000 miles or 60 days, whichever occurs first.
@ Or every 30 days, whichever occurs first.

NOTE: Engine oil is used also to lubricate clevis pins, linkage, clevises, door hinges, etc. Application should be made by brush or spray.

LUBRICATION

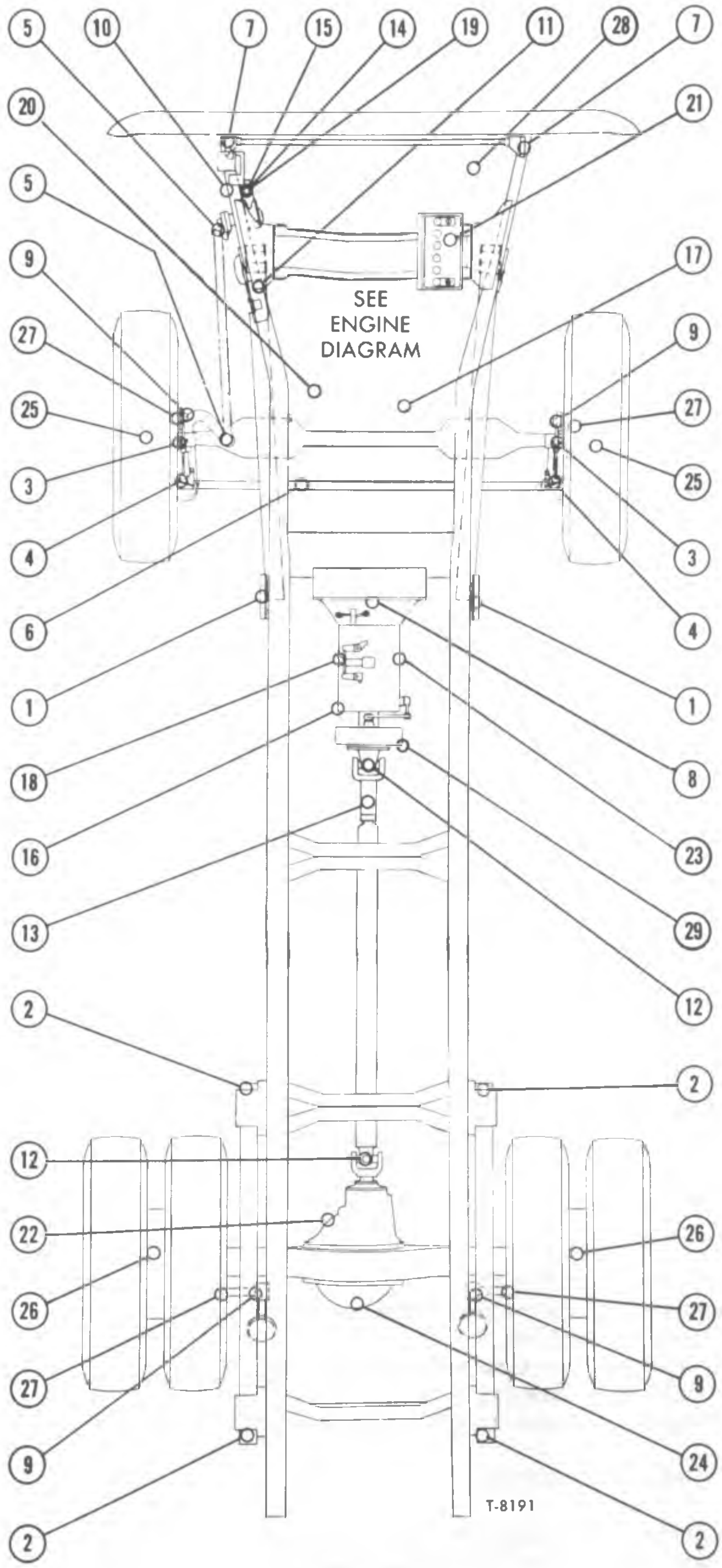


Figure 2—Lubrication Chart (Steel Tilt Cab Models)

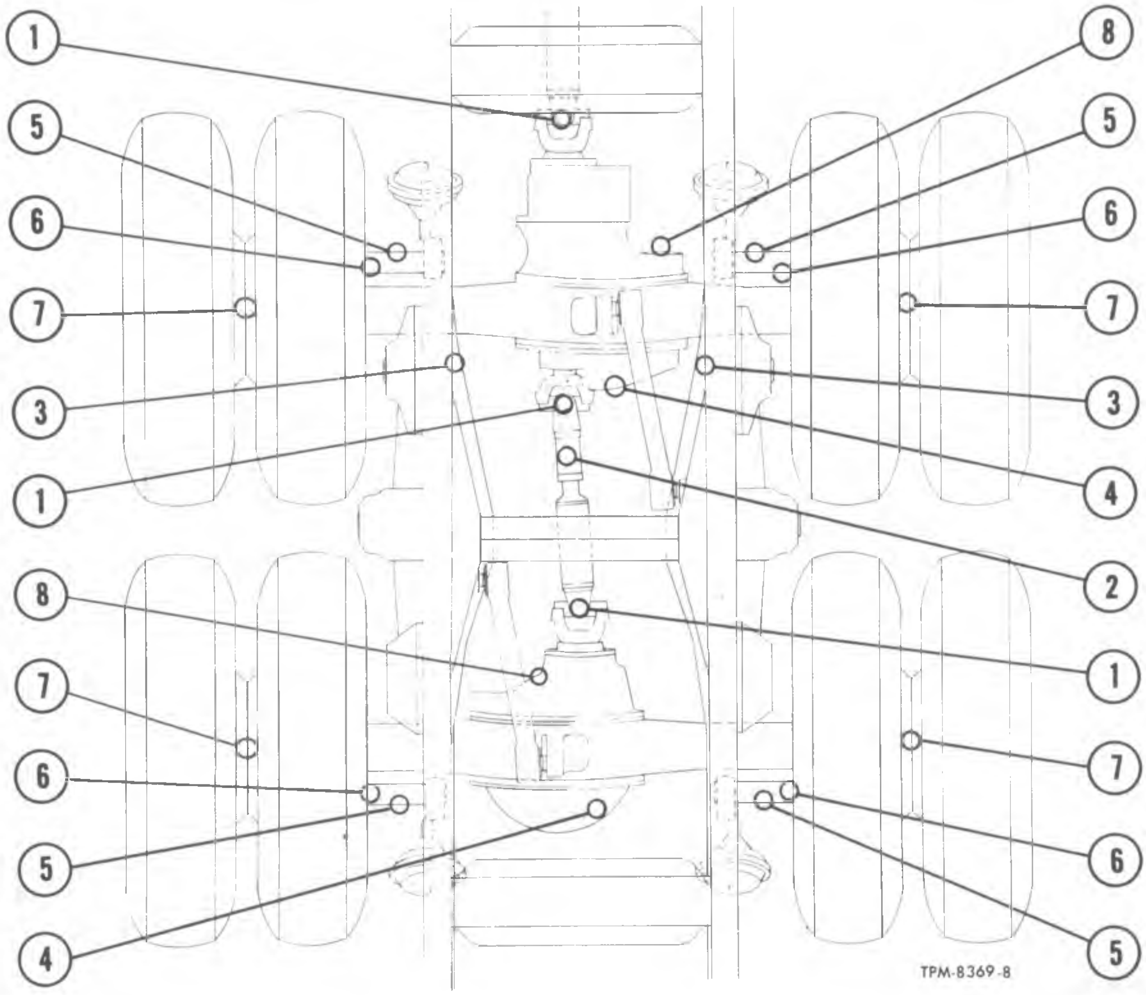
LUBRICATION DATA
(CHART ON OPPOSITE PAGE)

Item No.	Item	Remarks	Symbol	Miles‡
1	Front Spring Slip Pads and Brackets	Apply as required	MPG	6,000
2	Rear Spring Slip Pads	Apply each end	MPG	6,000
3	Steering Knuckles	2 fittings each side	MPG	6,000
4	Steering Tie Rod Ends	1 fitting each end	MPG	6,000
5	Steering Drag Links	1 fitting each end	MPG	6,000
6	Power Steering Cylinder Ends (a)	2 fittings	MPG	6,000
7	Cab Hinges	1 fitting each side	MPG	6,000
8	Cab Hold-Down Latch	1 fitting	MPG	6,000
9	Brake Camshafts (b)	1 fitting each (apply sparingly)	MPG	6,000
10	Clutch and Brake Pedals	2 fittings	MPG	6,000
11	Steering Idler Lever (a)	1 fitting	MPG	6,000
12	Propeller Shaft U-Joints	1 fitting each joint	MPG	6,000
13	Propeller Shaft Slip Joints	1 fitting each joint	MPG	6,000
14	Steering Column U-Joints	1 fitting each joint	MPG	6,000
15	Steering Column Slip Joint	1 fitting	MPG	6,000
16	Speedometer Adapter	1 fitting	MPG	6,000
17	Transmission Shift Levers	2 fittings	MPG	6,000
18	Transmission Shift Linkage (NP 540)	1 fitting	MPG	6,000
19	Steering Gear Housing	To level of filler plug	SG	6,000
20	Clutch and Brake Master Cylinder (a)	Fill - ½" below opening	S12	3,000 (c)
21	Battery Terminals	Keep coated (except ST batteries)	S3	6,000
22	Electric Shift (2-Spd.) (a)	To level of filler plug	S7	12,000
23	Transmission (N.P.)	To level of filler plug	MPO	6,000
		Drain and refill	MPO	12,000
23	Transmission (Clark)	To level of filler plug	GO	6,000
		Drain and refill	GO	12,000
23	Transmission (Spicer)	To level of filler plug	ES	6,000
		Drain and refill	ES	12,000
23	Transmission - Automatic	Check level	S19	6,000
		Drain and refill	S19	24,000**
24	Rear Axle	To level of filler plug	MPO	6,000
		Drain and refill	MPO	24,000#
25	Front Wheel Bearings	Hand Pack or use lubricator	MPG	20,000*
26	Rear Wheel Bearings	Hand pack or use lubricator	MPG	20,000*
27	Brake Cam Roller Pins (b)	Apply	E	20,000
28	Brake Power and Axle Cylinder Air Cleaner (a)	Clean and reinstall	-	6,000
29	Hand Brake Bell Crank (a)	1 fitting	MPG	6,000
30	Clutch Release Bearing	Cup (427 Eng. only)	S27	6,000

* Or once a year, whichever occurs first.
** 12,000 miles under severe operation (change filter when changing oil).
# Or every 6 months, whichever occurs first.
‡ When "MPG" Multi-Purpose Grease is specified, lubricate every 6,000 miles or 60 days, whichever occurs first.
(a) Some models.
(b) Air brakes only.
(c) Or every 30 days, whichever occurs first.

NOTE: Engine oil is used also to lubricate clevis pins, linkage, clevises, door hinges, etc. Application should be made by brush or spray.

LUBRICATION



Item No.	Item	Remarks	Symbol	Miles ‡
1	Propeller Shaft U-Joint	1 fitting each joint	MPG	3,000
2	Propeller Shaft Slip Joint	1 fitting each joint	MPG	3,000
3	Rear Spring Pin (c)	1 fitting each side	MPG	6,000
4	Rear Axles	To level of filler plug	MPO	6,000
		Drain and refill	MPO	24,000(b)
5	Brake Camshafts (c)	1 fitting each	MPG	6,000
6	Brake Shoe Roller Pins (c)	Apply	E	20,000
7	Wheel Bearings (d)	Hand pack or use lubricator . . .	MPG	20,000(a)
8	Axle Shift Unit (2 or 3 Speed) (c) . . .	To level of filler plug	S7	12,000

‡ When "MPG" Multi-Purpose Grease is specified lubricate every 6,000 miles or 60 days, whichever occurs first.

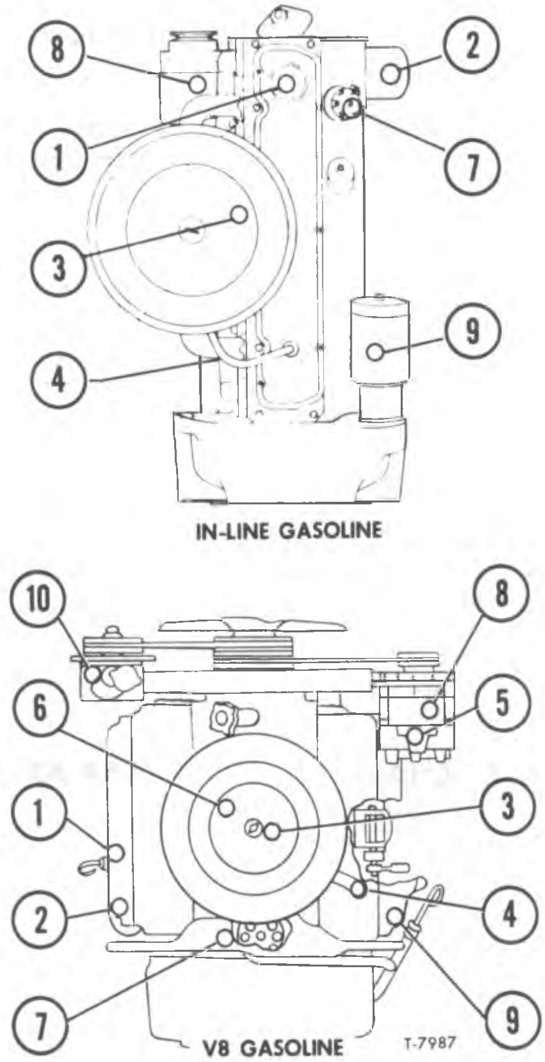
(a) Or once a year, whichever occurs first.

(b) Or every 6 months, whichever occurs first.

(c) If used.

(d) Optional oil lubricated type require no periodic service.

Figure 3—Lubrication Chart Tandem Bevel 30DSC and 34DSC



Item No.	Item	Remarks	Symbol	Miles
1	Engine Oil	Keep to "FULL" mark	E	Daily
2	Engine Oil Filter	At each oil change (Sec. 6A)	-	-
3	Engine Air Cleaner	See instructions (Sec. 6M)	-	6,000
4	Crankcase Ventilation	See instructions (Sec. 6A)	-	-
5	Air Compressor Filter (3)	Clean and install (Sec. 6T)	-	6,000
6	Governor Air Filter	Clean and install (Sec. 6T)	-	6,000
7	Distributor (2)	½ turn of cam lubricator		12,000#
		Breaker Pivot - 1 drop	E	6,000
		Rotor felt - 4 drops	E	6,000
8	Generator	No lubrication required		
9	Starter	See instructions (Sec. 6Y)	E	-
10	Power Steering Reservoir (1)	To oil level mark (Sec. 9B)	S19	6,000

\# Replace lubricator at 24,000 mile intervals.
(1) Some Models.
(2) If used (V8) fill hinge type oiler with engine oil every 12,000 miles.
(3) Vehicles with air brakes.

Figure 4—Engine and Accessories Lubrication Chart (Typical)

LUBRICANT CAPACITIES

CRANKCASE CAPACITY CHART

ENGINE MODEL	QTS. Less Filter U.S.	QTS. Less Filter IMP.	QTS. With Filter U.S.	QTS. With Filter IMP.
S - IN-LINE				
250	4	3¼	5	4¼
292*	5	4¼	6	5
E - V8				
350	5	4¼	6	5
366	6	5	8	6¾
427	6	5	8	6¾

* Add one quart when 2-quart filter is used.

Crankcase capacities are for normal refill. Add oil as indicated when oil filter is drained and element changed. Capacities given may be approximate. Keep level as close as possible to "FULL" mark without over-filling. Do not operate with level below "ADD" mark.

TRANSMISSION CAPACITY CHART

MANUAL TRANSMISSION	PINTS U.S.	PINTS IMP.
CH465	8	6¾
NP435	7	5¾
NP540	10	8¼
NP542	10	8¼
CL282	12	10
CL285	12	10
CL325	14	11¾
CL327	14	11¾
SP5652	13	10¾
SP5752	13	10¾
SP5756	13	10¾
AUTOMATIC TRANSMISSION		
MT40	18*	15
AT540	18*	15
AUXILIARY TRANSMISSION		
SP6041	8	6¾
SP7041	11	9¼

*Filter change only.

REAR AXLE CAPACITY CHART

BEVEL	PINTS U.S.	PINTS IMP
H110	14	11¾
H135	20	16¾
H150	20	16¾
H170	19½	16½
17121	29	24¼
18121	29	24¼
TWO-SPEED		
T150	18	15
T170	29½	24½
17221	29	24¼
19201	34	28¼

TANDEM-BEVEL	U.S. Front	U.S. Rear	IMP. Front	IMP. Rear
30DSC	30*	27	25*	22½
34DSC	29*	32	24½*	26¾

* Add 2 pints at forward hole in top of differential carrier.

POWER STEERING CAPACITY CHART

NOTE: This is approximate quantity due to hose length and cylinder sizes on various models.

	U.S.	IMP.
Power Steering	8 Pts.	6¾ Pts.

LUBRICANT DESCRIPTION

ENGINE OIL (SYMBOL "E" ON CHARTS)

RECOMMENDATIONS

The oil industry markets various types of engine oil under certain service designations and specification numbers.

The selection of a reliable supplier, with close attention to his oil and filter element change recommendations can provide satisfactory lubrication and longer life for engine.

Gasoline Engine and Diesel

Use Only High Quality Oils Which Are:

(1) Intended for Service Designations "MS" and "DM" (see Note).
- or -
(2) Products passing vehicle manufacturer's tests (including General Motors Standard GM 6042M).

NOTE: Supplement 1 engine oils based upon now obsoleted MIL-L-2104A) have been superseded by MIL-L-2104B engine oils. However, Supplement 1 engine oils (MS - DM) with a history of satisfactory performance are available and may be used.

The following additive limitations, which require emphasis, have been placed on the recommended MIL-L-2104B and Supplement 1 oils:

1. Sufficient zinc dithiophosphate to produce a minimum of 0.07 and a maximum of 0.10 per cent zinc by weight.

2. Sulfated ash (ASTM D-874) of 1.00 per cent maximum by weight, except lubricants that contain only barium detergent-dispersants where 1.50 per cent by weight is allowed.

The use of proper engine oils and oil change intervals are your best assurance of continued reliability and performance of engine.

IMPORTANT: Non-detergent and other lower quality engine oils are specifically not recommended.

Break-in Oils and Additives

The regular use of supplemental additives is specifically not recommended and will increase operating costs. However, in cases of specific problems which may arise under certain conditions, additive supplements are available that can effectively and economically solve these problems without causing other difficulties. For example, if higher detergency is required to reduce varnish and sludge deposits resulting from some unusual operational difficulty, a thoroughly tested and approved concentrate—"Engine Oil Supplement"—is available.

NOTE: Refer to figure 4 for Engines and Accessories Lubrication Chart.

VISCOSITIES

Atmospheric temperatures and severity of service determine the viscosity grade of engine oil to use. Viscosity numbers constitute a classification of lubricants in terms of viscosity or fluidity, but with no reference to any other characteristics or properties.

Gasoline Engines

As a guide to the selection of the proper grade or viscosity of oil to be used in gasoline engines at various atmospheric temperatures, refer to "Viscosity Chart" (fig. 5).

The proper viscosity helps assure good cold and hot starting by reducing friction and thus increasing cranking speed.

S.A.E. 5W and 5W-20 oils are not recommended for sustained high speed driving.

S.A.E. 30 oils may be used at temperatures above 40° F.

OIL CHANGE INTERVALS

It is recommended that new engines should have the first oil change at 3,000 miles. However, the oil level should be checked more frequently during the break-in period since somewhat higher oil consumption is normal until piston rings become seated.

The drain interval may then be increased or decreased, depending upon experience with specific oils or the recommendations and used oil analyses as furnished by the supplier. Such a procedure would be helpful in establishing the most practical oil change period for the particular service.

The kind of oil used (MIL-L-2104B, GM 6042M, etc.), the efficiency of the filtering system and condition of engine must be considered in determining when to change oil.

The most satisfactory method for determining when to change lubricating oil is by oil analysis using laboratory tests.

NOTE: Sample of the engine oil can be obtained from the drain plug on the engine oil filter.

After several test periods (gallons fuel consumed, miles, hours, weeks, etc.), a time interval for oil change can be established. However, a new series of tests should be run if filters, oil brands, or grades are changed.

The drain interval may then be increased or decreased, depending upon experience with specific oils or the recommendations and used oil analysis as furnished by the supplier. Such a procedure would be helpful in establishing the most practical oil change period for the particular service.

Wide variations in different types and brands of lubricating oil make it profitable to contact the oil supplier to assist in the development of the oil change period.

NOTE: Filter element or elements should be changed at each oil change as directed in GASOLINE ENGINES (SEC. 6A) in this manual.

MULTI-PURPOSE GEAR OIL (SYMBOL "MPO" ON CHART)

Multi-Purpose Gear Oil, meeting U.S. Army Ordnance Specifications MIL-L-2105 of latest issue and/or A.P.I. GL-5 and indicated by the Symbol "MPO" on charts, must satisfactorily lubricate heavy duty truck hypoid or bevel axles, and transmissions, under maximum torque and speed conditions. It must provide necessary and suitable load-carrying characteristics to prevent scoring and wear, good stability in storage and service, and give good resistance to corrosion. Suppliers should assure these characteristics, and be responsible for the quality and satisfactory performance of their products.

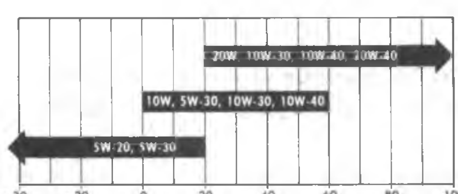
VISCOSITIES

Rockwell Axles

In Rockwell axles, S.A.E. 140 should be used the year around except in cases of extremely low temperatures. If trucks are parked in temperatures below +20°F., or operated in temperatures consistently below 0°F., it is advisable to use S.A.E. 90.

Other Units (Axles and Transmissions)

S.A.E. 90 may be used the year around. If truck is operated in temperatures consistently below 0°F., use S.A.E. 80. If the truck is operated in consistently high temperatures (over 100°F.), S.A.E. 140 may be used.



VISCOSITY CHART (ENGINES 250, 292, 350, 366 & 427)

Figure 5—Engine Viscosity Charts

NOTE: Refer to Lubrication Charts (figs. 1 or 2) for axle or transmission using Multi-Purpose Gear Oil. Also, refer to "REAR AXLE AND CONTROLS" (SEC. 4A) for axle, and TRANSMISSIONS AND CLUTCHES (SEC. 7) for transmission maintenance procedures.

GEAR OIL (SYMBOL "GO" ON CHARTS)

Type of lubricant indicated by the symbol "GO" on charts must be straight mineral gear oil of the best quality. Oxidation inhibitors or anti-foam agents may be added to these oils to gain greater stability and resistance to thickening.

Use S.A.E. 90 above 10°F., or S.A.E. 80 below +10°F.

NOTE: Refer to Lubrication Charts (fig. 1 or 2) for transmissions using gear oil. Also, refer to "TRANSMISSION ON-VEHICLE SERVICE OPERATIONS" (SEC. 7B) for transmission maintenance procedures.

LUBRICATING OIL—SPECIAL (SYMBOL "ES" ON CHARTS)

Oils such as "Aviation Grade Engine Oil" or S.A.E. 50 Heavy Duty engine oils may be used. Use of S.A.E. 30 is recommended when temperature falls below 0°F.

NOTE: Refer to Lubrication Charts (fig. 1 or 2) for transmission using special lubricating oil. Also, refer to "TRANSMISSION ON-VEHICLE SERVICE OPERATIONS" (SEC. 7B) for transmission procedures.

MULTI-PURPOSE GREASE (SYMBOL "MPG" ON CHARTS)

The lubricant indicated by the symbol "MPG" on charts, should be a high temperature, good quality lithium soap, multi-purpose, extreme pressure grease, which meets GM Specification GM 6031M.

LUBRICATING CHASSIS
(Refer to Figures 1 and 2)

All lubrication fittings must be clean before applying lubricant. Also, always be sure equipment used in applying lubricant is clean. Every precaution should be taken to prevent entry of dirt, grit, lint, or other foreign matter into lubricant containers.

NOTE: Fittings that have become broken, or damaged, should always be replaced with new part, and can be removed with a wrench or suitable extracting tool. Also, refer to "PROPELLER SHAFTS" (SEC. 4D) for packing of center bearings.

WHEEL BEARINGS

All wheel bearings (except oil lubricated type) require high temperature grease. Instructions for cleaning, packing and the adjustment of wheel bearings will be found in "FRONT HUBS AND BEARINGS" (SEC. 3D) of this manual.

STEERING GEAR LUBRICANT (SYMBOL "SG" ON CHARTS)

The lubricant indicated by the symbol "SG" is a special steering gear lubricant, No. 0 grade with low cold test characteristics and extreme pressure properties meeting GM 4673M specification. This type of lubricant is marketed by many oil companies.

Multi-Purpose Gear Oil "MPO" previously described, may be used to replenish steering gear housing when additional lubricant is required; however, lubricant described as "SG" must be used as initial fill after overhaul, or in a new gear.

At specified intervals, remove filler plug in housing and add lubricant to bring level up to filler plug opening. Do not overfill housing.

When hard steering is encountered as a result of cold weather, the steering system should be lubricated as follows:

Use steering gear lubricant (Symbol "SG") or Multi-Purpose Grease (N.L.G.I. #0) to lubricate all steering linkage such as steering knuckles, tie rod ends, drag link ends, and (if used) power steering booster cylinder ends.

NOTE: Refer to STEERING GEAR (SEC. 9), for maintenance procedures.

PETROLEUM JELLY (SYMBOL "S3" ON CHARTS)

The type lubricant indicated by the symbol "S3" is petroleum jelly or petrolatum.

BATTERY TERMINALS

To prevent corrosion, remove cables, clean terminals on cable and battery, and reinstall cables to battery terminals. Tighten cables securely, then apply petroleum jelly (except ST batteries).

DISTRIBUTOR BREAKER CAM

At recommended intervals, apply a small amount of petroleum jelly on distributor breaker cam. Do not use an excessive amount.

REFRIGERANT MACHINE OIL (SYMBOL "S7" ON CHARTS)

Refrigeration machine oil is a highly refined straight mineral petroleum oil.

Refer to "REAR AXLE AND CONTROLS" (SEC. 4A) of this manual for application procedure.

HYDRAULIC BRAKE FLUID (SYMBOL "S12" ON CHARTS)

The fluid indicated by the symbol "S12" must be genuine heavy duty brake fluid meeting the heavy duty standards of S.A.E. J-1703 (formerly S.A.E. 70R3).

NOTE: Refer to "HYDRAULIC BRAKES" (SEC. 5A) of this manual for maintenance procedures on hydraulic brakes, and "CLUTCHES" (SEC. 7D) on hydraulic clutch maintenance.

SPECIAL GREASE (SYMBOL "S17" ON CHARTS)

A semi-fluid grease having extreme pressure properties and containing zinc oxide.

At regular lubrication intervals, or whenever accessible during repairs or overhaul, apply lubricant sparingly to the following items and areas:

Door Striker Plates
Door Checks and Trunnions
Door Lock Remote Control Link
Cowl Ventilator Linkage
Door Striker Bolts
Door Lock Plunger
Speedometer Cable
Seat Adjuster Slides
Door Lock Mechanism
Door Dove Tails
Window Regulator Channels
Window Regulators
Hood Hinges and Latch
Tilt Cab Guide Pin and Release Mechanism

In addition to items just mentioned, which are lubricated periodically, many other units use this lubricant at time of assembly after overhaul, as indicated in various sections of this manual.

LUBRICATION

AUTOMATIC TRANSMISSION FLUID (SYMBOL "S19" ON CHARTS)

General Motors Dexron® Automatic Transmission Fluid, Part Number 1050568-69-70 which has been especially formulated and tested for use in automatic transmission is recommended for use in power steering. Other Automatic Transmission Fluids identified with the mark DEXRON® are also recommended. DO NOT USE ANY OTHER FLUID.

POWER STEERING

Refer to "POWER STEERING" (SEC. 9B) of this manual for servicing and maintenance of power steering.

AUTOMATIC TRANSMISSION

Refer to "TRANSMISSION ON-VEHICLE SERVICE" (SEC. 7B) of this manual for servicing and maintenance of automatic transmission.

HIGH TEMPERATURE GREASE (SPECIAL) (SYMBOL "S27" ON CHARTS)

The High Temperature Grease indicated by the Symbol "S27" on charts should be a short fiber, non-fluid, sodium soap grease having a high melting point (500°F.) and a #3 N.L.G.I. consistency.

The following points require use of high temperature grease at assembly. Methods of applying grease to these points are covered in applicable sections of this manual.

Clutch Pilot Bearing
Clutch Release Bearing Collar
Clutch Shift Fork Ball Stud
Steering Column Upper Bearing

HIGH TEMPERATURE GREASE (SPECIAL) (SYMBOL "S28" ON CHARTS)

The lubricant indicated by the symbol "S28" must be a water-proof, non-soap, smooth fiber grease having a #1 N.L.G.I. stable consistency, and must withstand extended high temperatures.

STOPMASTER BRAKE UNIT

At time of assembly after overhaul apply above lubricant to areas indicated in "AIR BRAKES" (SEC. 5B) of this manual.

> The use of proper engine oils and oil change intervals are your best assurance of continued reliability and performance from your Chevrolet engine.

SECTION 1

Cabs, Heating, and Air Conditioning

Contents of this section are listed in Index below:

All illustrations are numbered consecutively within each sub-section.

Information on sheet metal and fiberglass components as used with Conventional Cab is described in SHEET METAL (SEC. 11) of this manual. Description of each type cab is explained in respective cab section.

Maintenance information on subjects common to all cabs, such as painting, checking for water and dust leaks, correcting cab alignment, windshield wipers, and replacement of windshield glass is covered in the "GENERAL CAB MAINTENANCE" section following. For all other information, refer to respective cab section.

For information pertaining to cab wiring and dash gauges, refer to CHASSIS ELECTRICAL AND INSTRUMENTS (SEC. 12) of this manual.

SECTION 1A

General Cab Maintenance

NOTE: This section includes general maintenance information on subjects which are common to all cabs. Subjects are listed in Index below:

NOTE: Refer to respective CAB section for all other information.

GENERAL

All cab assemblies for models covered by this manual are of welded steel construction. Heavy box-type cab framing is used to form a stress-resistant foundation to fortify cab against twisting and flexing.

Principle steel panels are lap-jointed and welded for maximum sealing and structural strength Further rigidity is achieved by strategically located reinforcement braces and brackets. Sturdy steel door frames serve as upright structural members for rigid cab side support to assure proper door fit. Heavy duty hinges assure sag-resistant doors while doors are of double-panel construction for extra strength. Primary sheet metal panels have stamped depressions to minimize cab drumming and vibration. Sheet metal components receive several protective finishes to provide ample resistance to rust and corrosion.

Flexible mounts cushion cab assembly against shock and protect cab panels from stress and strain. Periodic inspections are recommended to ensure that all cab mounting bolts and sheet metal screws are properly tightened.

Refer to LUBRICATION (SEC. 0) in this manual for information regarding lubrication of cab components such as door hinges and door lock mechanism. Information on sheet metal components used with conventional cab is described in SHEET METAL (SEC. 11) of this manual.

KEY INFORMATION

All models have lock cylinders incorporating coded keyways and keys. The code letter is located on key shank and the code number is stamped on the knock-out portion of the key head. These numbers identify the locks in which the keys are used and are required when ordering or making new keys.

GENERAL MAINTENANCE

Notch depth information on current production keys will be provided upon request through the manufacturer of your key cutting equipment or his locksmith association. Also, he will be able to furnish a conversion package for your cutter, if required, for grinding new keys.

EXTERIOR MAINTENANCE

Entire vehicle should be regularly inspected for condition of paint and for corrosion damage, with particular attention given to chrome. Inspection should be made more frequently in freezing weather due to the corrosive effect of road de-icing materials (salt, calcium chloride, etc.) on metal. If inspection discloses any evidences of corrosion, paint failure, or bare metal, corrective measures as outlined under "Painting" (later in this section) should be immediately employed.

Body painted surfaces and chrome plating should be protected by a coating of wax, applied at regular intervals. Periods between applications should be sufficiently short to assure continuous protection of the finish; 30 days after delivery, and at least once a year thereafter. Any good body wax can be used for both painted and chrome surfaces. Wax should be applied immediately after vehicle has been cleaned.

NOTE: Calcium chloride and other salts, road tar, excretion from insects ("tree sap"), chemicals from factory chimneys and other foreign matter may permanently damage paint and chrome. Frequent, regular washing and a thorough cleaning after exposure is recommended to prevent damage by these substances. Use either cold or lukewarm water. Never wash vehicle in direct rays of the sun and always wait until painted surfaces have cooled.

INTERIOR MAINTENANCE

Care of the upholstery is a relatively simple but important matter. Accumulation of dirt on the surface eventually turns into a hard, gritty, substance which cuts into the surface of the upholstery.

VINYL COATED CLOTH

To clean the seats, use lukewarm, not hot or cold water, and any mild soap or liquid household detergent. Work up thin suds on a piece of cheesecloth and rub upholstery briskly. Remove suds with a damp cheesecloth, using no soap, and finish by wiping lightly with a dry soft cloth. Do not use furniture polishes, oils, varnishes, or ammonia. As required, stubborn stains may be removed with common foaming-type upholstery cleaner prepared for use on vinyl cloth.

WOVEN NYLON FABRIC

1. Carefully brush all loose particles of dirt and soil.

2. Immerse small cloth in solvent type cleaning solution, wring out thoroughly, open cloth and allow medium evaporation.

IMPORTANT: Use only solvent cleaning solutions prepared specifically for use on nylon fabrics. DO NOT USE gasoline, bleaches, reducing agents, acetone, lacquer thinners, enamel reducers, nail polish remover, or cleaning solvents which contain dyes or caustic agents. Use of these solvents tends to weaken and change the color of the fabric.

3. Place cloth on soiled spot and blot the area gently - DO NOT RUB. This will pick up particles which are too embedded to be removed in the brushing operation. Repeat this operation several times - in each instance using a clean area of cloth.

IMPORTANT: DO NOT use too much cleaning fluid; some interior trim assemblies are padded with rubber and solvent cleaners are generally solvents for rubber. The application of too much cleaner may destroy these rubber pads or cause the rubber itself to penetrate the upholstery fabric and soil appearance.

4. Immerse second cloth, wring out, and allow evaporation until barely damp, then apply to both the soiled and the area surrounding same, using a light swabbing motion.

5. Repeat brushing operation.

6. If a cleaning ring should form, the entire

PRECAUTIONS FOR CLEANING FABRICS

1. DO NOT use as a cleaning solvent, any gasoline which is colored or which contains tetraethyl lead.
2. DO NOT use solvents such as acetone, lacquer thinners, enamel reducers or nail polish remover, as a cleaning solvent.
3. DO NOT use laundry soaps, bleaches, or reducing agents, such as the following: Chloride of lime, javelle water hydrogen peroxide, sodium hydrosulphate, potassium permanganate, chlorine or shlorine water, sulphurous acid (sulphur diodide), soidum thiosulphate (photographers' hypo). The use of these agents tends to weaken fabric and to change its color.
4. DO NOT use too much cleaning fluid; some interior trim assemblies are padded with rubber and solvent cleaners are generally solvents for rubber. The application of too much cleaner may destroy these rubber pads or leave a solvent ring.

area of the assembly which is being cleaned should be thoroughly brushed and gone over lightly with the solvent.

FLOOR AND SIDE PANELS

Floor should be cleared of debris by sweeping or vacuuming. Using mild soap and water sparingly, sponge clean side panels and floor. Repeat cleaning operation with clean damp sponge or towel to remove soap film and allow to dry thoroughly.

Pressure spray cleaning and use of strong solvents are not recommended since damage to interior finishes and upholstery could result.

DUST AND WATER LEAKS

Test windshield, windows, and cab underflooring for leaks by spraying water under pressure against cab while assistant inside cab marks points of leakage, if any exist.

If location of leak has been determined to be around glass, dry surface and apply rubber cement. Apply cement to outside, both between glass and weatherstrip and between weatherstrip and body.

A quick method for locating many air and water leaks at windshield, back glass, bolt holes, weatherstripping and joints is as follows:

Close all windows and vents, turn air conditioning or heater blower motor to high position and outside air and close doors. Run water over suspected leak area in a small controllable stream and observe area for pressure bubbles.

To determine the exact location of leak at flooring or cowl, remove floor mat and dash panel pad. Water which shows up at a certain place inside cab may actually be entering at a point other than where water is found. Back-track path of water to point of entry. Apply body sealing compound over all leak points. If leakage occurs at door opening, check weatherstrip. Seal with rubber cement or replace if necessary. If door does not firmly contact weatherstrip, align door as described in applicable CAB section.

CAB ALIGNMENT

Since cab is an integrally welded structure, repair should be attempted only by competent craftsman using proper tools and equipment. For best results, only genuine factory parts should be used for replacement. As work progresses, cross-checking with an adjustable tram bar is recommended for obtaining proper alignment.

STRAIGHTENING

Before attempting repair of a damaged cab, the chassis frame must be checked and aligned as described in FRAME (SEC. 2). To straighten the frame, it may be necessary to remove cab.

Never attempt to straighten cab unless cab is firmly attached to chassis. The inner paneling of cab should be straightened first. Use of a push-pull hydraulic jack, together with extension and adapters is recommended for this type of repair.

After straightening, it is important that strains set up in cab framing be relieved or "normalized." Normalizing consists of heating areas of greatest stress with a torch. Holding torch nozzle about 2 inches from metal, move torch over an area of 3 to 4 inches until the metal barely begins to turn red. Cooling must be slow to avoid changing characteristics of the metal. Apply slight heat with a torch, if necessary, to retard cooling.

DINGING AND FINISHING

Paint is quickly scuffed off sharp dents leaving metal exposed to rusting and corrosion; therefore, damaged panels should be repaired as soon as possible. Proper metal finishing is required to assure a smooth surface. Application of hammer directly to panel tends to stretch the metal and cause a great deal of unnecessary work. Whenever possible, a spoon should be used under the hammer when bumping a panel. Repair damaged panels by forcing outward in direction opposite to force which caused damage. In this way metal strains, set up when damage occurred, are relieved.

PAINTING

REPAINTING

1. Thorough cleaning is essential. All corrosion products, grease, and other foreign matter must be removed. Use of phosphoric base metal conditioners, such as "Metalprep" (Neilson Chemical Co.) or "Dioxidine" (American Chemical Paint Co.) or equivalent is recommended in preparing steel for painting. These materials vary in method of application and use, and should be employed only as directed by the manufacturer. Solvent cleaning, pressure steam cleaning, wire brushing, and hand sanding methods are recommended.

2. Completely remove old paint by use of organic or alkaline solvents. However, if alkaline removers are used, all traces of alkali must be washed off before primer is applied. If old primer is very difficult to remove, and if there is no evidence of metal corrosion, old primer may be left on, but all loose paint must be removed.

3. Apply primer, preferably by spraying, and allow to dry. Use a good oxide primer obtained from a reputable manufacturer.

4. Apply finish coats:

a. For understructure or other parts not requiring color, apply two coats of a good air-drying black or other automotive lacquer.

b. To exposed body parts, apply surfacer and paint in accordance with standard practice.

PAINTING NEW PARTS

New replacement parts should be thoroughly cleaned and painted, as outlined previously under "Repainting," after installation in vehicle. In addition, hidden surfaces of panels should be cleaned and coated with one heavy coat of sheet metal deadener.

WINDSHIELD GLASS REPLACEMENT

CONVENTIONAL CAB MODELS

The windshield is a one-piece type and is retained in the windshield opening by a molded rubber weatherstrip. This weatherstrip is sealed in the windshield opening and sealed to the windshield glass.

When replacing a cracked windshield glass, it is important that the cause of the glass breakage be determined and the condition corrected before a new glass is installed. Otherwise, it is highly possible that a small obstruction or high spot somewhere around the windshield opening will continue to crack or break the newly installed windshield; especially when the strain on the glass caused by this obstruction is increased by such conditions as wind pressures, extremes of temperature, motion of the vehicle, etc.

The procedure for removal of the windshield applies to the complete windshield assembly.

Removal

1. Before removing the windshield, mark the location of the break on the windshield rubber channel and the body. Protect the paint finish inside of the cab. Mask around the windshield opening and outside, lay a suitable covering across the hood and fenders.

NOTE: The windshield glass rubber weatherstrip is one-piece. The glass is held in a channel within the weatherstrip (fig. 1).

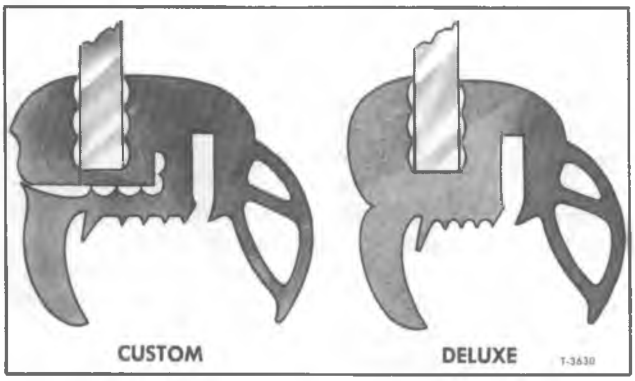


Figure 1—Cross Section of Windshield Weatherstrip (Conventional Cab Model)

2. Do not try to remove reveal moulding while windshield is in body opening. Remove from custom weatherstrip retention groove (fig. 1) after windshield removal from body opening.

3. To free windshield rubber channel of weatherstrip loosen the lip of the windshield weatherstrip from the pinchweld flange along the top and at the sides by applying pressure with palm of the hand to the edge of the glass. At the same time assist the lip of the rubber weatherstrip channel over the pinchweld flange with a flat-bladed tool such as a tongue depressor, or shaped blade (fig. 2).

Checking Windshield Opening

Due to the expanse and contour of the windshield it is imperative in the event of a strain break that the windshield opening be thoroughly checked before installing a replacement windshield. The replacement glass is used as a template.

1. Check for the following conditions at the previous marked point of fracture.

a. Chipped edges of glass.

b. Irregularities in body opening.

c. Irregularities in rubber channel weatherstrip.

2. Remove all sealer from flange and body around windshield opening.

3. Check flange area for solder, weld high spots, or hardened spot-weld sealer. Remove all high spots.

4. Check windshield glass to opening, by supporting glass with six spacers contained in packet (J-22577).

CAUTION: Do not strike glass against body metal. Chipped edges on the glass can lead to future breaks.

Figure 2—Loosening Weatherstrip (Conv. Cab Model)

GENERAL MAINTENANCE

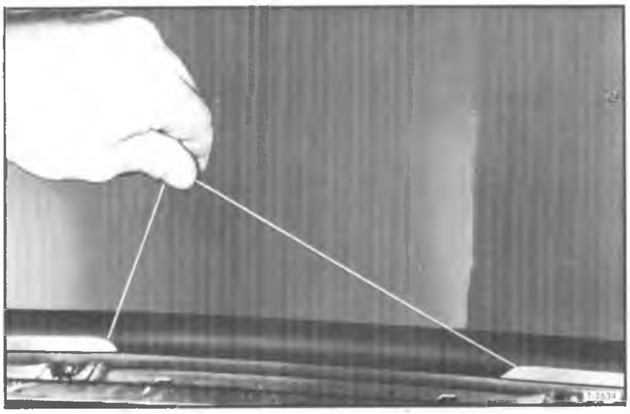


Figure 5—Pulling Cord to Seat Rubber Lip (Conv. Cab Model)

This will ensure proper positioning of the critical upper corners.

STEEL TILT CAB MODELS

Windshield glass is retained in cab opening by a molded rubber weatherstrip with an insert-type rubber seal as illustrated in figure 6. Two glass sections are used on steel tilt models.

When replacing a cracked windshield glass, it is very important that the cause of the glass breakage be determined and the condition corrected before a new glass is installed. Otherwise, it is highly possible that a small obstruction or high spot somewhere around the windshield opening will continue to crack or break the newly installed windshield; especially when the strain on the glass caused by the obstruction is increased by such conditions as wind pressures, extremes of temperature, motion of the vehicle, etc.

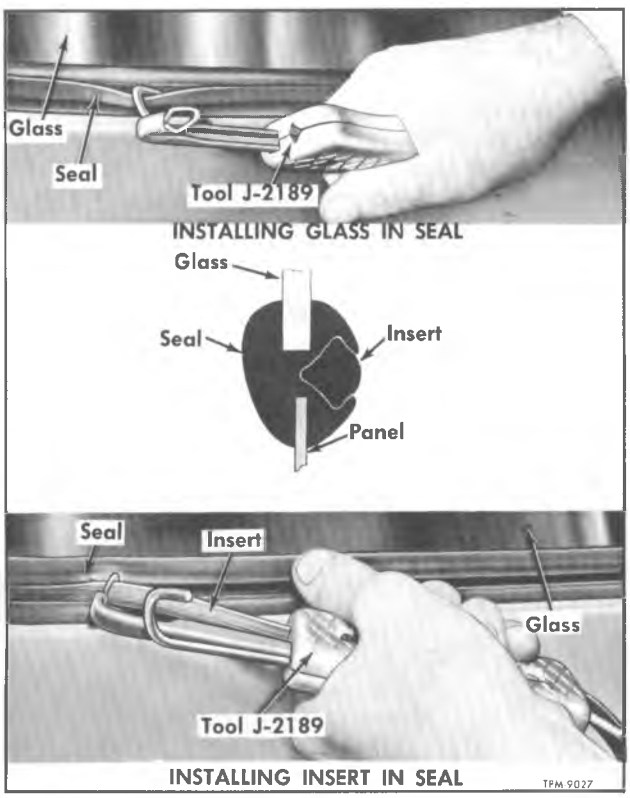


Figure 6—Installing Insert-Retained Glass (Tilt Cab Model)

Removal (Fig. 6)

If cracks in glass extend to outer edge of glass, mark cab or cowl with chalk at these points so that weatherstrip flange in cab opening can be examined later for possible distortion.

Protect the interior paint finish by placing a protective covering over steering wheel and dash panel. Mask around the windshield opening and lay a suitable cover to protect cab.

CAUTION: ALWAYS WEAR HEAVY GLOVES TO PREVENT POSSIBLE INJURY WHEN HANDLING GLASS.

1. Pry end of insert out of rubber seal with a pointed tool; pull insert completely out of seal.
2. With aid of an assistant to hold glass outside cab, push glass forward from inside cab.

Inspection

Due to the expanse and contour of the windshield, it is imperative in the event of a strain break that the windshield opening be thoroughly checked before installing a replacement windshield.

1. Check for the following conditions at the previous marked point of fracture:
   a. Chipped edges on glass.
   b. Irregularities in body opening.
   c. Irregularities in rubber channel weatherstrip.
2. Remove all sealer from flange and body around windshield opening.
3. Check flange area for solder, weld high spots, or hardened spot-weld sealer. Remove all high spots.

Glass-to-Opening Clearance Check

Before installing new glass, check glass opening for proper clearance, using five special spacer blocks (J-9316) as shown in figure 7. With the aid of an assistant, place blocks around perimeter of new glass, two at bottom and top and one at outer side of opening. A 5/16 to 3/8 inch clearance should exist between glass and opening flange. Insert the blocks into gap, then rotate blocks perpendicular to flange surfaces. If all blocks cannot be installed, rework metal flange or grind off edge of glass at the side where block or blocks could not be installed.

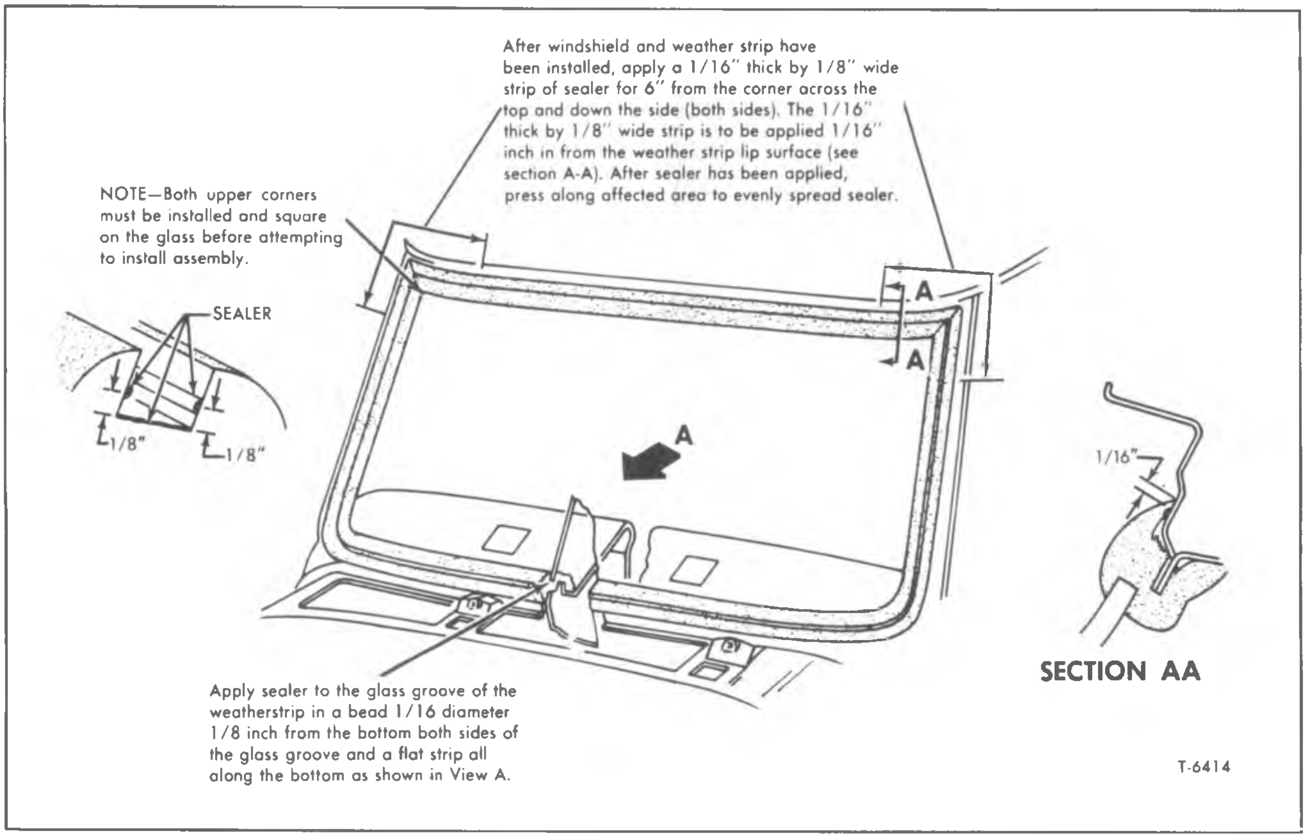


Figure 3—Windshield Glass, Weatherstrip, and Sealing (Conv. Cab Model)

5. With the windshield supported and centered in its opening, check the relationship of the glass to the body opening flange around the entire perimeter of the glass.

6. Check the relationship of glass to opening as follows:

a. Inside edge of glass to body flange.

b. Outer edge of glass to parallel body metal.

7. Mark areas of body metal or flange to be reformed, remove glass and correct as necessary.

8. Recheck windshield in its opening and if satisfactory proceed as follows. Note figure 3 before proceeding.

Installation

CAUTION: ALWAYS WEAR GLOVES WHEN HANDLING GLASS.

1. Apply sealer to areas indicated in figure 3 and install on glass. Centralize weatherstrip around edge of glass to avoid cocking of square corners during assembly.

2. Install a cord around periphery of weatherstrip, leaving a loop at the top and the loose ends at the bottom as shown in figure 4.

3. Place protective covering over the plenum grille, front fenders and hood. Apply sealer to weatherstrip in areas noted in figure 3.

4. Place windshield and weatherstrip assembly in opening. With one technician lightly pushing in on windshield, another technician within the cab should pull on the cord as follows:

a. Pull on loose ends (fig. 5) until each is within 2 inches of its respective upper corner.

b. Pull on loop until cord is within 2 inches of the upper corners.

c. Finish seating corners by simultaneously pulling on both ends of the cord at each corner.

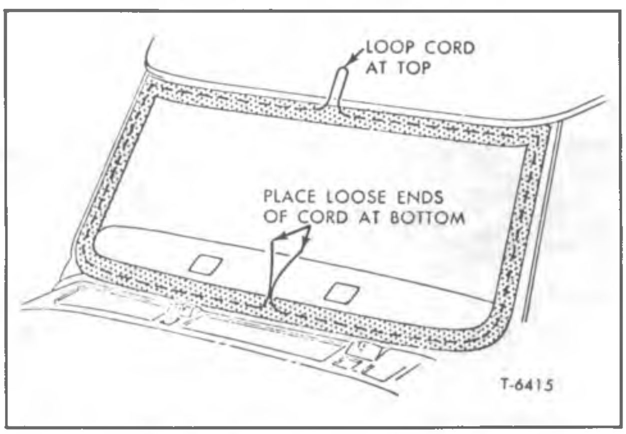


Figure 4—Cord Installation (Conv. Cab Model)

CAUTION: DO NOT strike glass against body metal. Chipped edges on the glass can lead to future breaks.

If glass clearance is too small and glass is to be ground off, place a strip of tape on a line where glass is to be removed. Grind up to edge of tape.

If glass clearance is found too large, braze a continuous piece of 1/8 inch diameter wire to edge of cab windshield glass opening flange. This will provide a closer glass and seal fit.

NOTE: Add build-up to flange where necessary. Usually the building up to only one side and one-half way around one corner will provide proper glass and seal fit. Taper off ends of build-up to conform to edge of glass, otherwise glass breakage may occur, originating at a point adjacent to the end of flange build-up.

Installation (Fig. 6)

NOTE: If desired, sealing cement can be applied between lip of seal and glass and seal lip at cab opening flange.

1. Reposition rubber seal on cab opening flange. Raise new glass to outside of seal; then with hook end of installer tool (J-2189) in glass groove of seal as shown in figure 6, move tool around glass to force outer lip of seal over edge of glass.
2. Thread end of rubber insert through handle and loop of installer tool (fig. 6). Push tool loop and end of insert into groove of seal. Feed in rubber insert, while proceeding around window. Use a hitching movement of tool to avoid elongating insert. If new insert is being used, cut off insert allowing sufficient overlap for a tight joint; then butt into groove.
3. Install insert in center vertical seal (2-piece windshield) in same manner previously described in Step 2.

REAR WINDOW GLASS REPLACEMENT

CONVENTIONAL CAB MODELS

The rear window glass rubber weatherstrip is one-piece. The glass is held in a channel within the weatherstrip similar to the windshield glass and weatherstrip.

Refer to "Windshield Glass Replacement" for typical replacement procedures.

STEEL TILT CAB MODELS

Rear window glass is retained by means of rubber seal and seal insert (fig. 6). No sealing compound or cement is used.

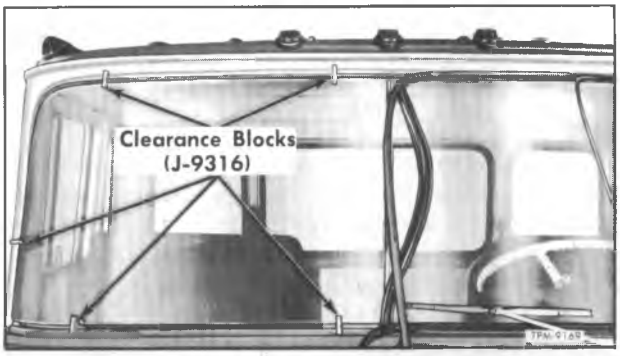


Figure 7—Checking Glass Clearance (Tilt Cab Model)

If body prevents access to rear window, glass can be installed from inside cab by reversing seal so that insert is located inside cab.

1. Pry end of seal insert out of seal with a pointed tool; then remove rubber insert completely. Push glass from inside cab. Pull seal from opening.
2. If necessary, straighten any irregularities of seal flange in cab opening which may have caused breakage of glass.
3. Install new rubber seal over panel flange, pushing it completely into corners. Avoid stretching seal during installation. Cut seal to allow sufficient overlap for a tight joint, then butt ends.
4. Position glass to seal and insert hook end of installer tool (fig. 6) into seal groove. Move tool around glass to force outer lip of seal over glass.
5. Thread end of rubber insert through handle and loop of installer (fig. 6). Push tool loop and end of insert into groove at bottom center of window. Feed in the rubber insert while proceeding around window. Use a hitching movement to avoid elongation of insert.
6. Cut off end of insert, allowing sufficient overlap for a tight joint; then butt into groove.

LAP BELT MAINTENANCE

Keep belts clean and dry. Clean periodically with a mild soap solution and lukewarm water. Keep sharp edges and damaging objects away from belts. Periodically inspect belts, buckles, retractors, and anchors for damage that could materially lessen the effectiveness of the belt installation and repair or replace the questionable parts. Do not bleach or dye belts as this may cause severe loss of strength.

If necessary, to replace belts or related attaching parts be sure to tighten lap belt anchor bolts to 55-65 foot-pounds torque.

WINDSHIELD WIPERS

GENERAL DESCRIPTION

Conventional cab and steel tilt cab models have two-speed electric E-type windshield wipers with washers as standard equipment. The wiper assembly used on cowl and school bus models is determined by the body manufacturer.

A single wiper motor, mounted on engine side of cowl, powers both wiper blades on conventional cab models. Two separate motors are used with tilt cab models where each wiper motor is bracket-mounted to rear side of cowl under dash.

Tilt cab models employ separate wiper motor control switches. The left switch incorporates a push-type control for operation of windshield washers.

WIPER ARM ADJUSTMENT

To adjust sweep of blades to provide maximum visibility, turn on wipers, then note sweep of arms.

CAUTION: DO NOT ATTEMPT TO MANUALLY MOVE WIPER ARMS AS DAMAGE TO LINKAGE OR MOTOR MAY OCCUR.

If necessary, remove arms as follows:

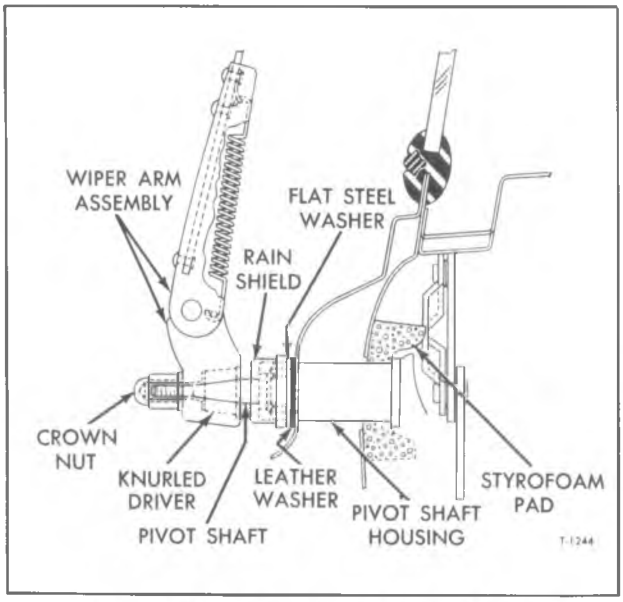


Figure 8—Wiper Arm Installed (Tilt Cab Model)

CONVENTIONAL CAB MODELS

1. Pull outer end of arm away from glass which will trip lock spring at base of arm and release spring from undercut of pivot shaft.

2. While holding arm in this position, pull outward on cap section at base of arm to remove the arm.

3. Arm can be reinstalled in any one of several positions due to serrations on pivot shaft and in arm cap.

TILT CAB MODELS

Wiper Arm Adjustment (Fig. 8)

Wiper arm can be repositioned on pivot shaft to provide proper sweep as follows:

1. Remove hex crown nut and washer which attach wiper arm to knurled driver and pivot shaft.

2. Relocate arm on driver to desired position.

3. Install washer and hex crown nut.

Wiper Blade Replacement (Fig. 9)

Hold fillister head screw with screwdriver and remove lock nut. Remove screw which is threaded into wiper arm and remove blade. Reverse procedure to install.

IMPORTANT: Turning the fillister head blade attaching screw too far into the wiper arm will bend the blade arm and cause blade to bind and wipe erratic.

NOTE: The curved windshield wiper blade is designed to accept a refill insert for service replacement.

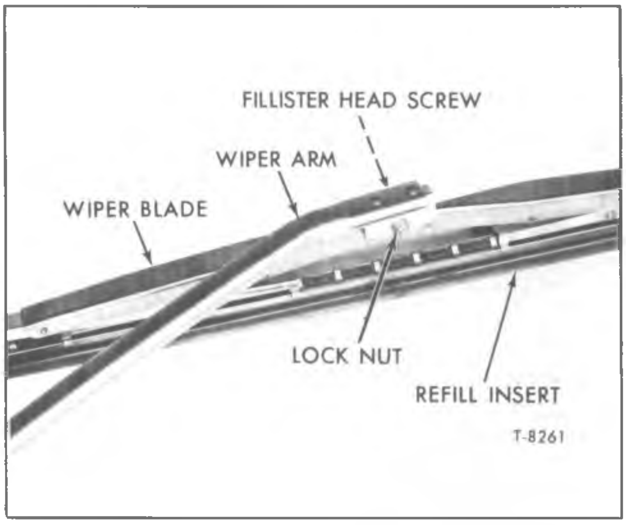


Figure 9—Wiper Blade Installed (Tilt Cab Model)

GENERAL MAINTENANCE

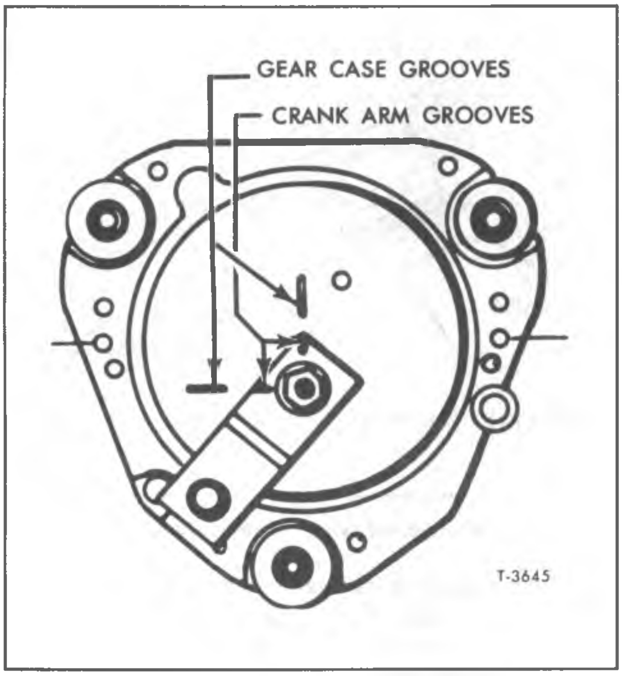


Figure 12—Wiper Crank Arm in Park Position (Conv. Cab Model)

WIPER MOTOR CRANK ARM
"PARK" POSITION

NOTE: When installing crank arm to gear shaft, place wiper in "PARK" position, rotate the arm so alignment marks match with respective marks on cover as shown in figure 12.

WIPER MOTOR REPLACEMENT (TILT CAB MODEL)

REMOVAL (Figs. 8 and 14)

1. Remove hex crown nut and lock washer which attaches wiper arm to knurled driver and pivot shaft. Remove arm and driver.
2. Remove rubber rainshield, hex nut, flat steel washer, and leather washer from pivot shaft housing.
3. Inside of cab, disconnect electrical wiring at connector on motor drive unit. If equipped with washers, disconnect hoses.
4. Remove four cap screws which attach motor and drive unit to cab panel.

INSTALLATION (Figs. 8 and 14)

1. Position styrofoam pad on pivot shaft housing, then locate motor and drive unit to cab panel. Attach unit mounting bracket to panel with four cap screws and washers.

IMPORTANT: Be sure a good metal-to-metal contact is made between panel and mounting bracket so as to provide an electrical ground for motor.

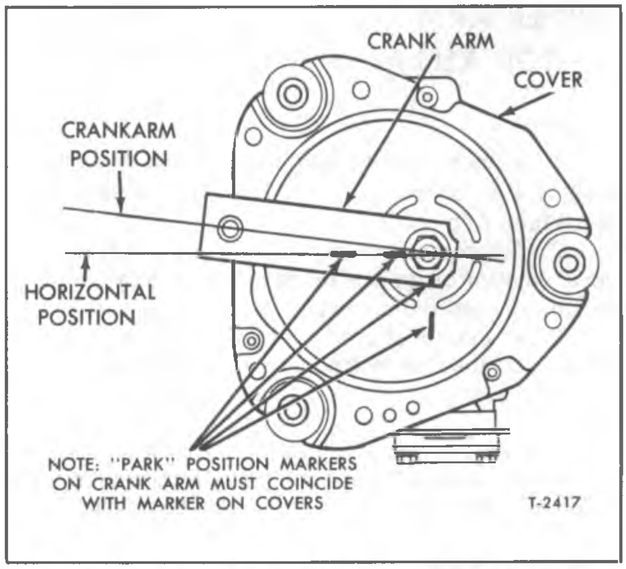


Figure 13—Crank Arm in Park Position (Tilt Cab Model)

2. Connect electrical wiring to terminals on drive unit. If equipped with washers, connect hoses.
3. Install leather washer, flat steel washer, hex nut, and rubber shield on pivot shaft housing. Position arm driver on pivot shaft.
4. Before installing wiper arms, operate wiper motor momentarily, then turn it off, which should rotate pivot shaft to "PARK" position (fig. 13).
5. Install arm on driver of shaft so that it is located in the "PARK" position. Wet windshield, then again operate wiper and check arm sweep. Reposition arm on shaft driver if necessary. Secure arm on shaft with crown nut.

WIPER TRANSMISSION LINKAGE AND MOUNTING BRACKET REPLACEMENT (TILT CAB MODEL)

REMOVAL (Fig. 14)

1. Remove small retaining ring near end of transmission shaft, then slide the flat washer and thrust washer from end of shaft.
2. Remove the three small screws which attach motor mounting bracket to motor. Move motor with attached linkage from mounting bracket sufficiently to allow access to connecting link retaining rings.
3. Remove connecting link retaining rings, then link. Separate motor from mounting bracket.
4. The transmission shaft can be removed only after the shaft housing is separated from mounting bracket. Housing is attached with two screws, nuts, and washers.

INSTALLATION (Fig. 14)

1. If transmission shaft was separated from

WIPER ARM PIVOT SHAFTS AND LINK ROD REPLACEMENT (CONV. CAB)

REMOVAL

1. Remove windshield wiper arms from pivot shafts. Procedure for removing arms is explained in "Wiper Arm Adjustment."

2. Remove screws which attach outside air cowl ventilator grille to cowl. Carefully remove grille forward from cowl.

3. At center of cowl, remove retainer (fig. 10) which attaches each link rod to motor drive linkage and arm assembly. Disengage link rods from pins.

4. Remove two screws which attach arm transmission pivot shaft assembly to cowl. Remove pivot shaft assembly with link rod from plenum chamber.

INSTALLATION

1. Place pivot shaft assembly with link rod into position at cowl bracket. Secure assembly to bracket with two screws (fig. 10).

2. Attach end of link rod to linkage of motor drive and arm assembly at center of cowl. Secure rod with retainer. If opposite pivot shaft and link rod was removed, install it at the same time. Make sure the seal washers located below the transmission units at front of windshield are new or in good condition before installing; otherwise leakage may occur later at these two points.

IMPORTANT: Before locating the wiper arms on pivot shafts, make sure wiper motor was stopped in the "PARK" position (fig. 12). Operate the motor, then turn switch off and allow it to stop in "PARK" position. If motor is not in "PARK" position and arms are installed, the arm travel may be restricted when motor is started, resulting in a blown fuse. In any case when motor is first started, be prepared to turn wiper switch off in the event wiper arms were installed out of proper sweep position. Reposition arms if necessary.

3. Install outside air cowl ventilator grille to top of cowl using screws (fig. 10).

4. Before installing wiper arms, operate wiper motor momentarily which should rotate pivot shafts to "PARK" position. Install arms and shafts.

WIPER MOTOR REPLACEMENT (CONV. CAB)

(Refer to Figure 11)

1. Disconnect battery ground cable.

2. Remove wiper arms and blades from the transmission shaft.

3. Remove plenum chamber grille.

4. Disconnect wiper drive rods from crank arm. Remove crank arm nut and arm from motor shaft.

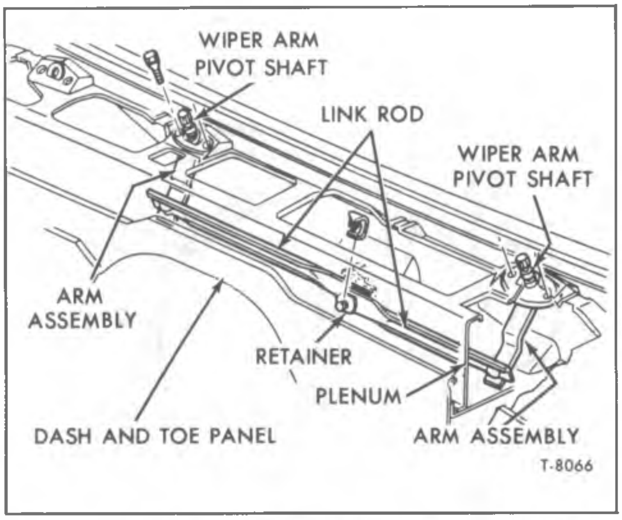


Figure 10—Windshield Wiper Linkage (Conv. Cab Model)

5. Working under instrument console, disconnect wiper motor and washer wiring connectors.

6. Disconnect washer hoses from washer pump.

7. Remove motor attaching screws and motor from cowl mounting position.

8. Before installing motor, scrape any of the old sealing compound from around cowl opening, then apply a bead of new compound around the opening.

Perform the installation procedures in the reverse of "Removal" procedures.

IMPORTANT: Make sure motor ground strap is free of paint before installing motor mounting screws; otherwise motor will not operate. Also, be sure that wiper motor crank arm is in "PARK" position before attaching linkage and wiring harness.

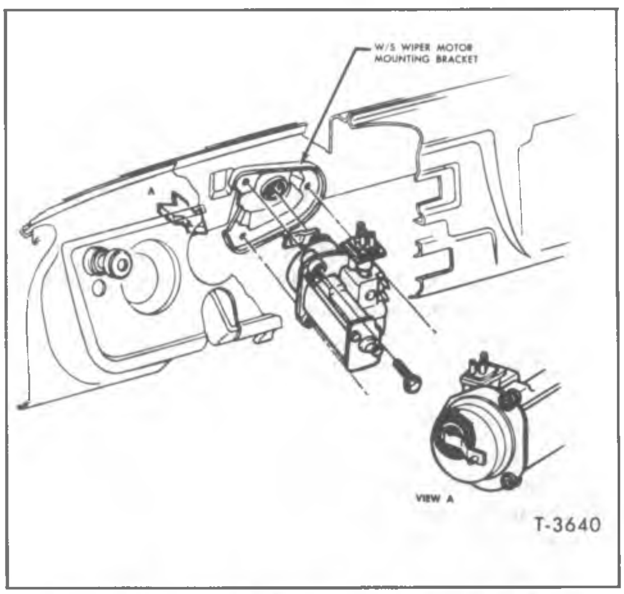


Figure 11—Wiper Motor Installed (Conv. Cab Model)

GENERAL MAINTENANCE

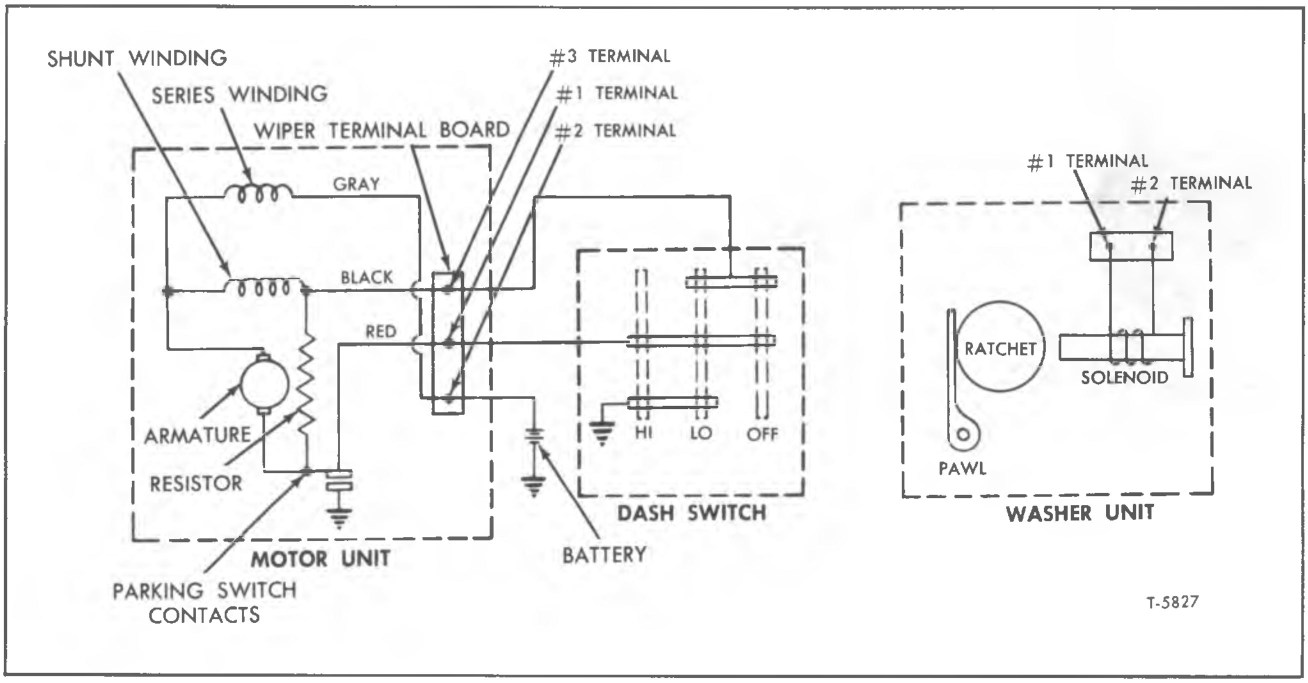


Figure 15—Wiper Motor and Washer Wiring Diagram

continues to flow through motor, through the parking switch contacts to ground. When wiper blades reach "PARK" position at the inboard end of wiper pattern, the parking switch contacts open, stopping the motor.

TROUBLESHOOTING WIPER MOTOR (ALL MODELS)

Refer to figures 15, 16, and 17 when troubleshooting two-speed wiper.

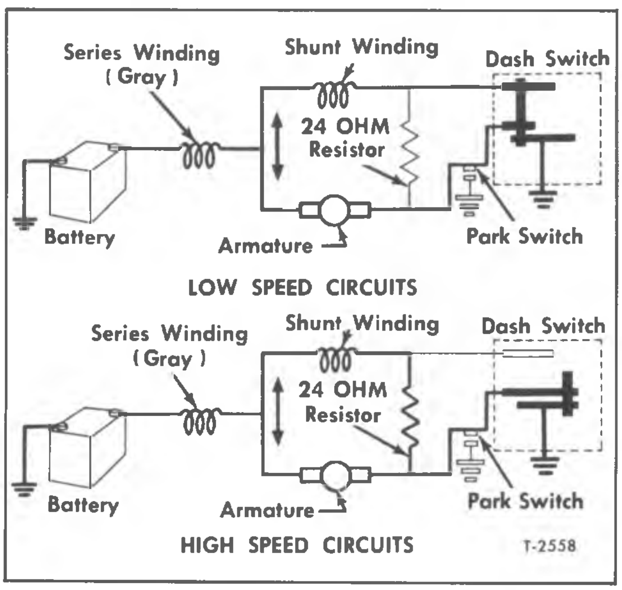


Figure 16—High-Low Speed Circuit

TYPICAL TROUBLE CONDITIONS

1. Wiper will not shut off.
2. Wiper inoperative.
3. Wiper has one speed (HIGH).
4. Wiper has one speed (LOW) and shuts off with dash switch in "HIGH" position.
5. Blades do not return to "PARK" position when wiper is turned "OFF."
6. Wiper speed normal in "LOW" speed position but too fast in "HIGH" speed position.
7. Wiper operates intermittently.

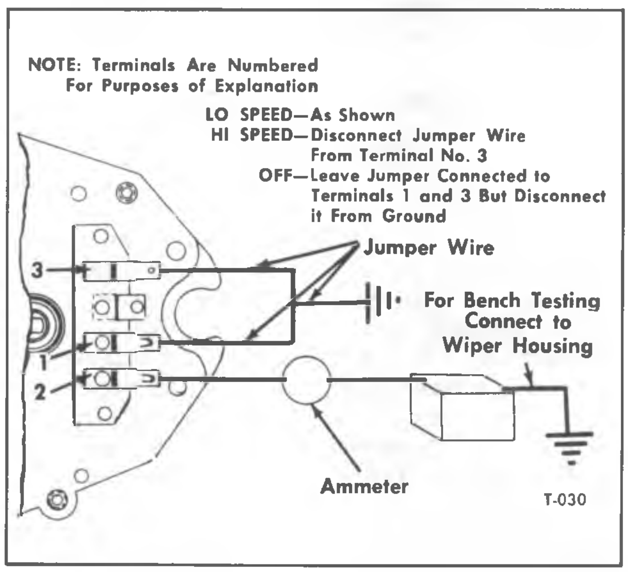


Figure 17—Troubleshooting Wiper Motor Circuit

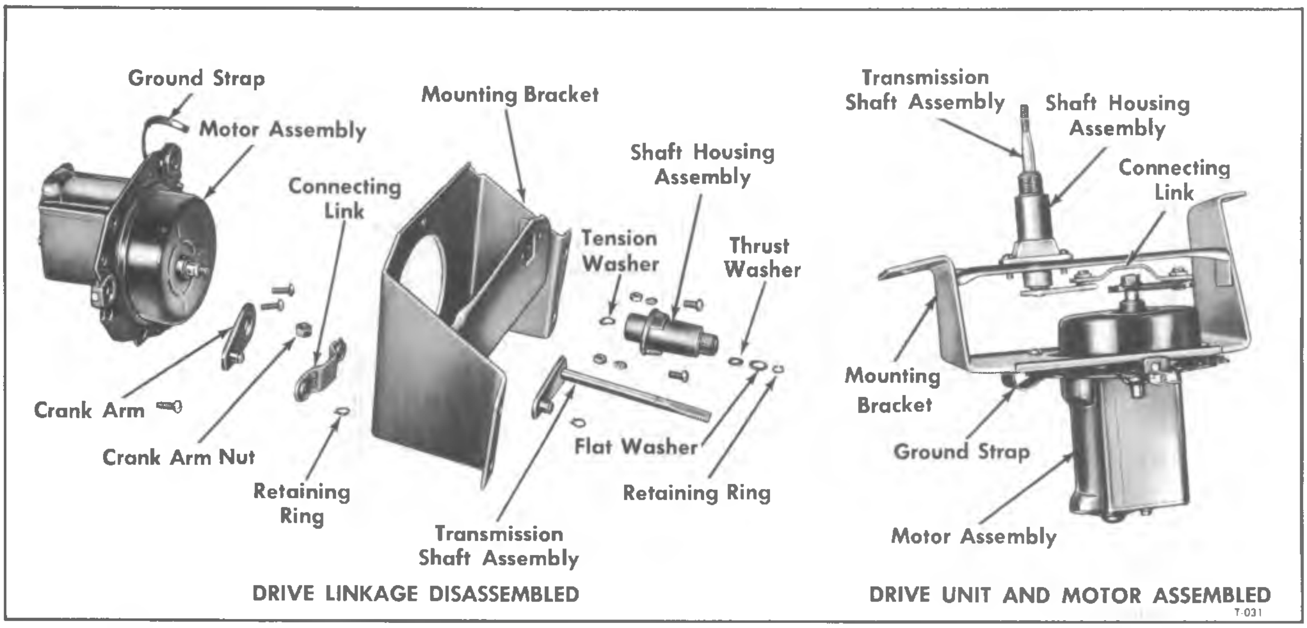


Figure 14—Wiper Motor and Bracket Components (Tilt Cab Model)

housing, locate small tension washer on shaft before inserting shaft into housing.

2. Locate shaft and housing assembly to mounting bracket and attach housing to bracket with two screws, nuts, and washers.

3. Locate motor into mounting bracket, then install connecting link.

IMPORTANT: Make sure end of link marked "Crank End" is connected to motor crank arm. Install link retaining rings.

4. Attach motor to mounting bracket with three screws. Make sure motor ground strap is sandwiched between motor and bracket.

5. At outer end of wiper transmission shaft, install bronze thrust washer, flat steel washer, and the shaft retaining ring.

WIPER OPERATION (ALL MODELS)

DESCRIPTION

The type "E" two-speed electric windshield wiper assembly incorporates a non-depressed type (blades park approximately 2 inches above windshield molding) motor and gear train. The rectangular, 12-volt, compound wound motor is coupled to a train consisting of a helical drive gear at the end of the motor armature shaft, an intermediate gear and pinion assembly, and an output gear and shaft assembly. The crank arm is attached to the output gear shaft.

Two switches, a control switch on dash and a parking switch within wiper unit, control the starting and stopping of wiper. Parking switch contacts, located on a terminal board at bottom of drive unit are actually connected across the dash switch and act as a set of holding contacts when the dash switch is turned off. This keeps the wiper circuit closed so wiper can keep operating until the blades reach their predetermined "PARK" position.

When the wipers are turned on, current flows from battery through the circuit breaker or fuse through the motor field and armature to the dash switch and on to ground, starting the wiper.

NOTE: Refer to "Windshield Washer" later in this section for operation of washers.

TWO-SPEED OPERATION (Figs. 15 and 16)

Low Speed Operation

When the dash switch is placed in "LOW" speed position, current from the battery flows through the series field coil and divides; part passing through the shunt field coil to ground at the dash switch, the remaining part passing through the armature to ground at the dash switch.

High Speed Operation

Moving the dash switch to "HIGH" Speed position opens the shunt field circuit to ground at dash switch and keeps the armature circuit closed to ground. The shunt field current must then pass through a resistor located on the wiper terminal board, and then through the same lead that connects the armature circuit to ground through the dash switch.

Parking Circuit

When wiper is turned off, circuit is broken at the dash switch. However, current from battery

GENERAL MAINTENANCE

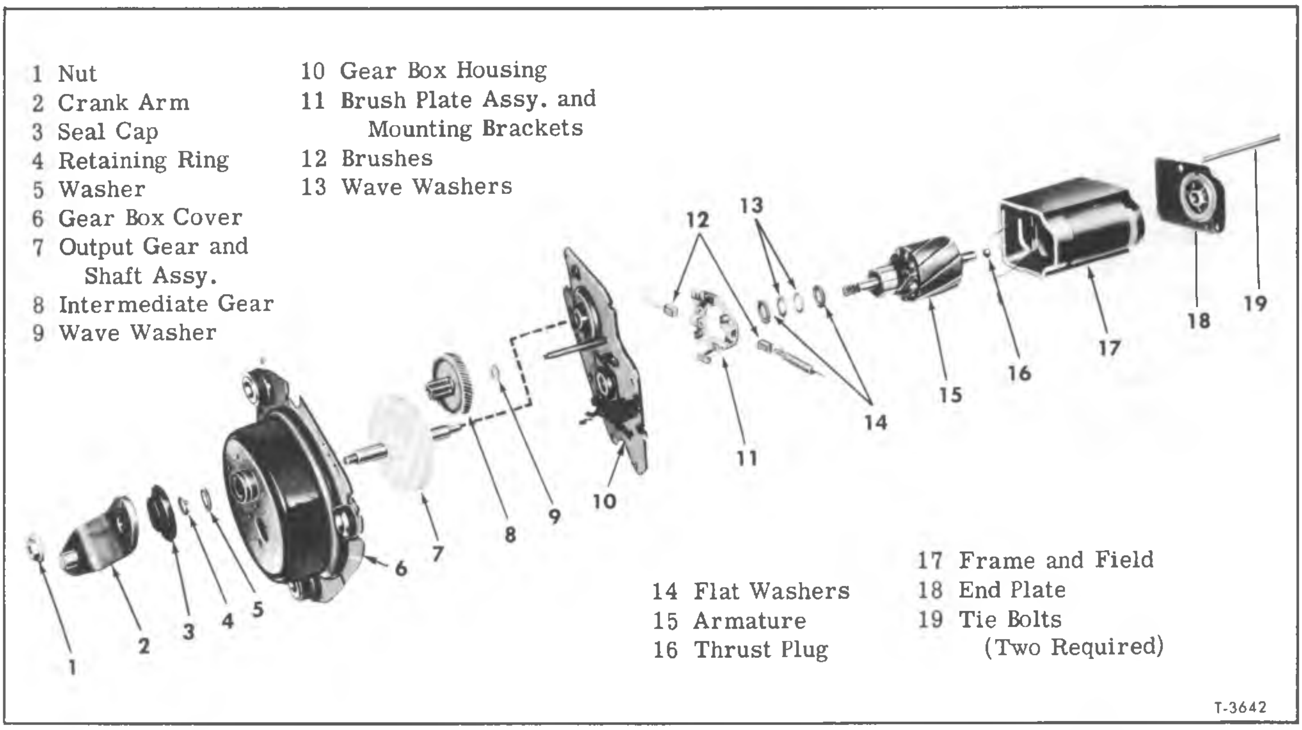


Figure 18—Wiper Motor and Gear Box Assembly

INSPECTION

Check armature shaft, gears, and supporting bushings for wear. Inspect commutator for evidence of arcing or loose solder joints to armature windings. Check "PARK" contacts for dirt or oxidation. Inspect for worn brushes, weak springs, and binding in holders.

In general, inspect all parts for serviceability and replace as required. All parts can be replaced individually except motor frame and field which is serviced as an assembly. Service kits provide all necessary attaching parts for installation of gear cover and terminal board.

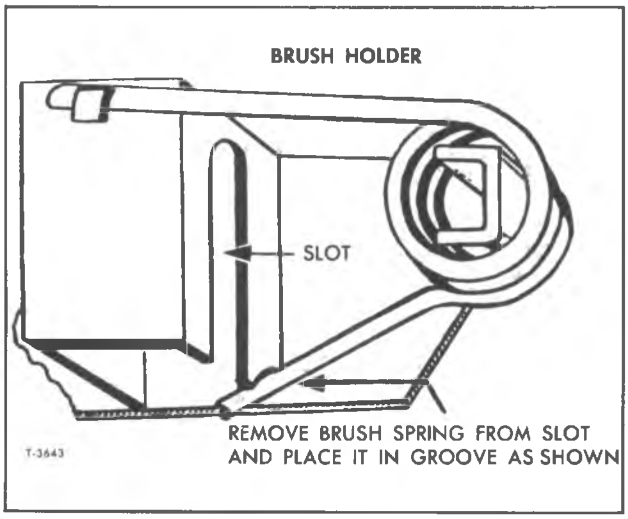


Figure 19—Releasing Brush Spring Tension

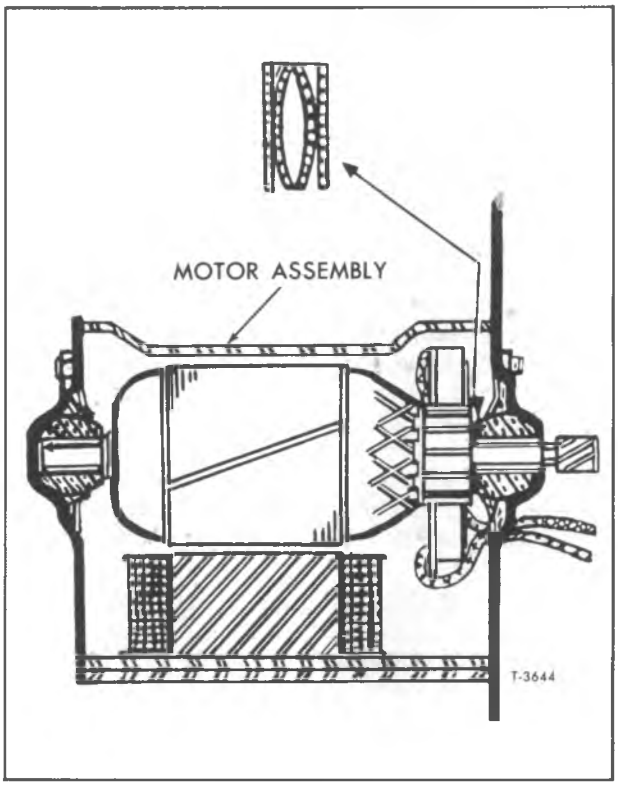


Figure 20—End Play Wave Washer Installation

CHECKING INSTALLED WIPER

Wiper Will Not Shut Off

1. Determine if woper operates in both "HIGH" and "LOW" speeds, "LOW" speed only, or "HIGH" speed only.

IMPORTANT: Wiper must operate in "LOW" speed during parking cycle.

2. Disconnect the wiring harness from wiper motor and try operating wiper independently of the dash switch as shown in figure 17. If wiper operates correctly independently of the dash switch (shuts off correctly with crank arm in "PARK" position) refer to possible causes below:

a. If wiper operates in both speeds, lead between wiper terminal No. 1 and dash switch is grounded, or the dash switch is defective.

b. If wiper operates in "LOW" speed only, the lead between wiper terminal No. 3 and dash switch is grounded, or the dash switch is defective.

c. If wiper operates in "HIGH" speed only, the lead between wiper terminal and dash switch is open, or the dash switch is defective.

3. If wiper still fails to operate correctly, remove it from cab, then remove covering from over drive gears and check parking switch contacts which may be broken or stuck in closed position; check for a grounded lead at No. 1 or 3 terminals (fig. 17), or for a grounded shunt field.

Wiper Inoperative

1. Check wiring harness connections at motor and at dash switch.

2. Check fuse (if used) or circuit breaker.

3. See if wiper motor ground strap is secure.

4. Check for loosely mounted dash switch.

5. If wiper still fails to operate, disconnect wiring from motor, and check for 12 volts at motor No. 2 terminal (fig. 17). No voltage indicates defective wiring.

6. With harness disconnected from motor, try operating motor as shown in figure 11. If wiper fails to operate, remove wiper transmission linkage and recheck wiper operation. If wiper operates, linkage is at fault. If wiper does not operate, remove unit from vehicle for disassembly.

Wiper Has One Speed - Fast

Check for a defective dash switch or open lead between motor No. 3 terminal and dash switch.

Wiper Has One Speed (LOW) and Shuts Off With Dash Switch in "HIGH" Speed Position

Reverse harness leads that connect to motor terminals Nos. 1 and 3.

Blades Do Not Return to "PARK" Position When Wiper is Turned Off

1. Check wiper motor ground connection to the cab.

2. Remove wiper motor from cab and check for dirty, bent or broken "PARK" switch contacts.

Wiper Speed Normal in "LOW" But Too Fast in "HIGH"

Remove wiper motor from cab and check for an open motor resistor.

Intermittent Operation

Check for loose wiper ground connection and/or loose dash switch mounting.

WIPER MOTOR AND GEAR BOX DISASSEMBLY AND ASSEMBLY

DISASSEMBLY (Fig. 18)

Gear Box

1. Remove washer pump mounting screws and lift pump from motor.

2. Remove washer pump drive cam (fig. 22). Cam is pressed on shaft but may be removed by carefully wedging two screwdrivers between cam and plate.

3. Lightly clamp crank arm in a vise and remove crank arm retaining nut. Separate arm from shaft.

NOTE: Failure to clamp crank arm may result in stripping of drive gears when retaining nut is removed.

4. Remove seal cap, retaining ring, and end-play washers.

5. Drill out gear box cover attaching rivets and remove cover from motor assembly.

NOTE: Necessary parts for reassembly of gear box cover to motor is contained in service repair package.

6. Remove output gear and shaft assembly, then slide intermediate gear and pinion assembly off shaft. Note position of wave washers.

7. If necessary, remove terminal board and "PARK" switch by marking wires and unsoldering at terminal lugs. Drill out terminal board attaching rivets and remove board.

Motor

1. Remove motor through bolts, tap motor frame lightly, and separate motor assembly from gear box housing.

2. Remove brush tension by placing brush spring in holder groove as shown in figure 19.

3. Slide armature and end plate from motor frame and field. Note arrangement of wave washers (fig. 20) on gear end of armature shaft before removing to assure proper installation upon motor assembly.

4. Pull end plate from armature. Note thrust plug between tip of armature shaft and end plate.

ASSEMBLY (Fig. 18)

Motor

Reassemble motor using reverse order of "Disassembly" procedures.

NOTE: Be sure wave washers on armature shaft are installed properly as shown in figure 20. Lightly lubricate armature shaft bushings with light machine oil. Be sure brushes are properly positioned in holders before armature commutator protrudes between brushes.

Gear Box

1. Assemble gear box in reverse order of "Disassembly" procedures.

NOTE: Lubricate gear teeth with Delco Cam and Ball Bearing Lubricant or equivalent. Be sure cover is properly located over dowel pins and that ground strap is properly positioned before securing cover. Seal cap (fig. 18) should be cleaned and repacked with water-proof grease before reassembly.

2. Install crank arm on output shaft so that alignment marks line up with those on cover when wiper motor is in "PARK" position (fig. 13). Replace and tighten retaining nut after placing crank arm in vise.

3. Check operation by connecting assembled motor to battery as shown in figure 17.

WINDSHIELD WASHER PUMP

GENERAL INFORMATION

The "E" type washer pump used on the "E" type rectangular non-depressed park wiper motors resembles previous models somewhat in physical appearance but it has been changed considerably internally. Refer to figure 21 for view of pump mounted on wiper motor assembly. Past model pumps used a bellows system for the pumping mechanism whereas the new design incorporates a piston enclosed in a plastic cylinder housing. The piston type pump provides higher pressures and increased volume (fig. 24).

The basic principle of operation is very similar to past model pumps of this type. The pumping mechanism is powered by a four-lobe cam which is pressed on wiper motor output shaft. This cam rotates whenever the wiper motor is running. Programming is accomplished electrically and mechanically through use of a pump solenoid circuit and ratchet wheel arrangement.

OPERATION

Conventional Cab Models (Single Wiper Motor)

Pushing in on the wiper switch knob causes the washer to activate and also causes wipers to activate in "LOW" speed. If operator wishes high speed wiper action he must manually switch to "HIGH" speed. At the end of washer cycle, washer will automatically shut off; wiper must be shut off manually, regardless of high or low speed.

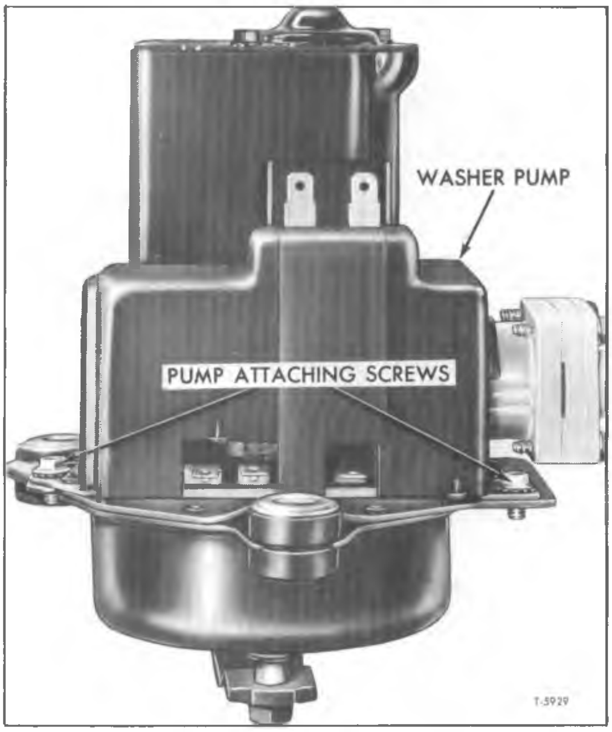


Figure 21—Water Pump Attaching Screws

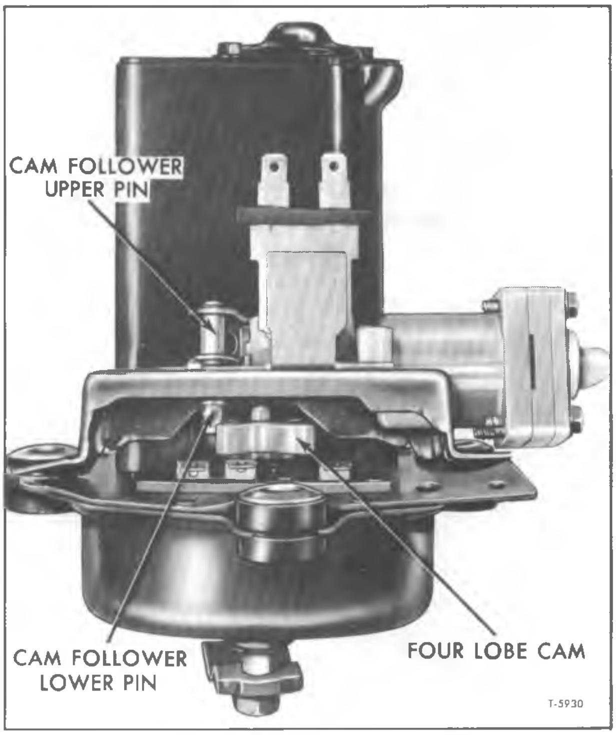


Figure 22—Separating Pump From Motor

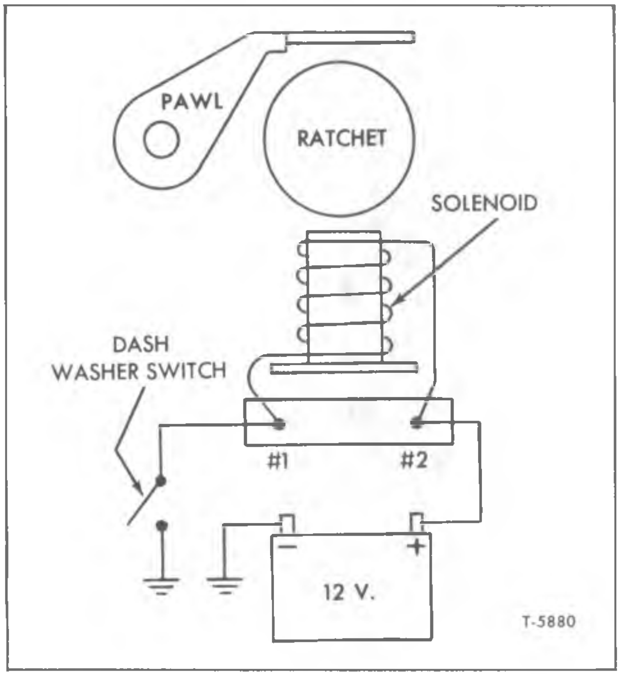


Figure 23—Checking Washer Solenoid

Tilt Cab Models (Two Wiper Motors)

Pushing in switch knob of left-hand wiper switch causes washer to activate, and also causes left-hand wiper to activate in "LOW" speed. If operator wishes "HIGH" speed and/or right-hand wiper action also, he must manually control both. At the end of washer cycle, washer will automatically shut off; wiper(s) must be shut off manually regardless of speed (both left- and right-hand).

PUMP REMOVAL (Figs. 21 and 22)

1. Disconnect water hoses to washer pump making certain they are properly marked to assure correct installation.
2. Disconnect electric wiring from washer terminals.
3. Remove washer pump attaching screws, then lift pump off wiper motor.

PUMP INSTALLATION (Figs. 21 and 22)

1. Place washer pump in position on wiper motor making sure lever arm pin properly engages four-lobe cam.
2. Secure pump to motor with two mounting screws.
3. Reconnect electric wiring.
4. Reconnect water hoses.

TROUBLESHOOTING WASHER PUMP
(Refer to Fig. 23)

On-Vehicle Check

1. If washer pumps continuously when wiper is on, disconnect wiring from washer pump.
   a. If pump shuts off, trouble is located in wiring harness or dash switch.
   b. If pump fails to shut off in Step a, remove pump assembly from vehicle for further checking.
2. Check the following items if pump is inoperative:
   a. Reservoir contains water solution.
   b. Hoses are not damaged and hose connections are tight.
   c. Screen at end of jar cover hose is not plugged.
   d. Electrical connections to washer pump and dash switch are secure.
   e. Nozzles are not plugged.
3. If all items in Step 2 check out, start wiper motor only, then push washer button and listen for "click" as washer solenoid pulls in. If no "click" is heard, check for 12 volts at terminal No. 2 (fig. 23). No voltage indicates defective wiring. If "click" is heard, proceed to Step 5.
4. If correct voltage was found in Step 3, connect a jumper wire from washer terminal No. 1 to ground (fig. 23) and operate wiper. If washer relay "click" is heard and pump functions correctly, a defective dash switch or an open circuit between washer pump and dash switch is indicated; "No Click" indicates an open pump solenoid.
5. If relay "click" is heard in Step 3, listen for the soft clicking as the pump ratchet wheel is rotated.
   a. If soft clicking is not heard, the pump mechanism is faulty and should be removed from the wiper motor and checked.
   b. If soft clicking is heard but no pumping action occurs, replace the valve assembly and recheck pump.

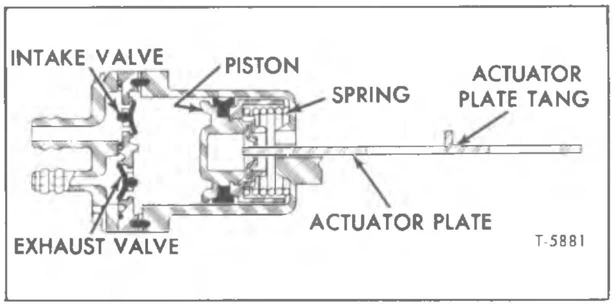
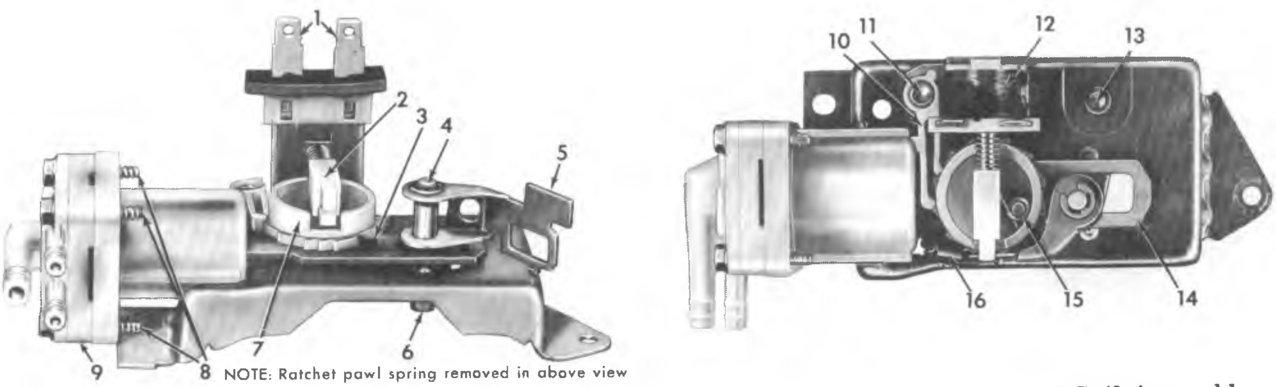


Figure 24—Washer Pump Piston and Valve Assembly

Bench Check

1. Manually actuate the solenoid plunger and check for binding condition.
2. Check relay coil as follows: Connect 12 volt supply to washer terminals (fig. 23). Observe if solenoid plunger pulls in. Failure of solenoid plunger to pull in indicates as open solenoid coil or poor solder connections.



NOTE: Ratchet pawl spring removed in above view

1 Coil Terminals
2 Solenoid Plunger
3 Actuator Plate Tang
4 Cam Follower Upper Pin
5 Ratchet Pawl
6 Cam Follower Lower Pin
7 Ratchet Wheel
8 Valve Assy. Mtg. Screws
9 Valve Assembly
10 Ratchet Dog
11 Dog Retaining Screw
12 Solenoid Coil Assembly
13 Pivot Pin
14 Piston Actuator Plate
15 Ratchet Wheel Spring
16 Ratchet Pawl Spring

Figure 25—Washer Pump Mechanism

3. If solenoid plunger pulls in correctly, manually actuate the cam follower lower pin and observe if pump piston and actuator plate operate freely. Locate and correct cause if binding occurs.

4. Attach a hose to the large or intake pipe. You should be able to blow, but not draw, through intake pipe (fig. 24).

5. Attach a hose individually to each of the small exhaust pipes. You should be able to draw, but not blow, through them. If any of the valves allow air to pass in both directions, the valve assembly is defective and must be replaced.

PUMP DISASSEMBLY AND ASSEMBLY (Fig. 25)

1. Remove washer pump cover.

2. Remove ratchet dog retaining screw. Hold spring loaded solenoid plunger in position and carefully lift the solenoid assembly and ratchet dog off the frame of the pump.

3. Disconnect ratchet pawl spring. Remove ratchet pawl retaining ring and slide ratchet pawl off cam follower shaft.

4. Move ratchet wheel spring out of shaft groove and slide ratchet wheel off shaft.

5. Pull pump housing away from frame until housing grooves clear frame. Remove actuator plate from ratchet wheel and cam follower shafts.

6. Remove screws that attach valve assembly to pump housing. Separate valve assembly from pump housing.

NOTE: Observe direction of pipes before removing pipe assembly from pump housing.

7. To assemble, reverse "Removal" procedure

NOTE: During reassembly, be sure gasket between housing and valve plate is properly positioned in the housing and valve plate grooves. Also, be sure triple O-ring is properly installed between valve body and pipe assembly. Hose connections on pipe assembly should be pointed in same direction as original position.

SECTION 1B

Conventional Cab (Includes Heating System)

Contents of this section are listed in Index below:

NOTE: Maintenance information on painting, windshield glass, and windshield wipers which is common to all types of cabs is explained at beginning of this group in "GENERAL MAINTENANCE" (SEC. 1A). Information on sheet metal components is covered in SHEET METAL (SEC. 11) of this manual.

CAB DESCRIPTION

The basic conventional cab is of all steel welded construction (fig. 1). Cab side construction consists of a one-piece body door opening frame which assures more positive sealing around the door when closed.

The one-piece roof panel has longitudinal ribbing to stiffen and reinforce the roof. The floor panel, also of one-piece construction eliminates joints, pockets and seams which normally act as moisture traps. In most cases, all paneling pieces are lap-jointed and welded for maximum in sealing and structural strength.

Front outside air intake is located at top center of cowl. Opening and closing of intake is controlled by push-pull lever at top of dash panel. Outside air for the heating system enters through a separate louvered opening at right side of cowl.

Doors are of double-wall construction. Lower inner panel of door has a cut-out allowing access to door control mechanism for adjustment and parts replacement. Horizontal slots in door hinge assembly provides for adjustment of door in cab opening. Door vent window is of friction-type with positive theft-resistant latch.

The windshield used on all conventional cab models covered in this manual is of the one-piece type.

CAB MOUNTINGS

Four point type cab mountings are used on these vehicles. The front mount consists of an upper and lower cushion assembly as shown in figure 2. Cab rear mounts are of the compression type (fig. 3), utilizing rubber biscuit cushions. This compression-type mounting is readily replaced by removing one mounting bolt.

At regular intervals, all cab mountings should be checked for loose attaching parts and for deteriorated or collapsed rubber cushions.

Any one cab mounting can be readily replaced after removing the weight of cab at that particular mounting.

IMPORTANT: Raise cab only to height necessary to replace mounting components. If cab is raised too high, damage to vehicle operating controls, wiring and lines may occur. Before lowering cab, be sure cushion is properly centered between frame and cab.

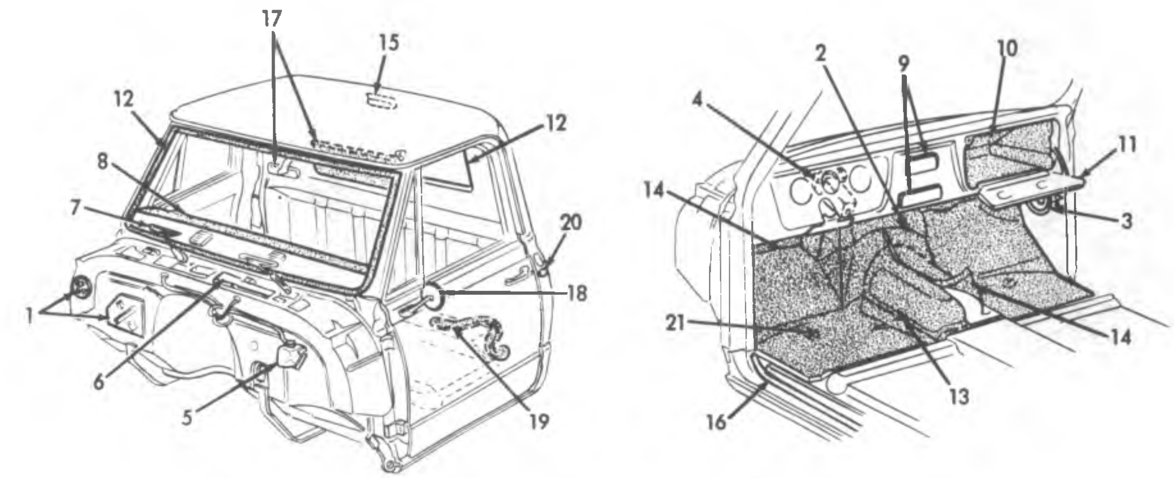
CAB SEALING

Cab construction details showing location and application of sealing compound and undercoating are shown in figure 4. In servicing complete panels or only a portion of a particular section it is helpful to know where the panel is sealed.

COWL VENTILATOR GRILLE REPLACEMENT

(Refer to Figure 5)

The plenum chamber, located below the air inlet grille, can be flushed out without having to remove the air inlet grille from the cowl. However,



1 Heater Hole Cover Assembly
2 Hole Tapping - Dash and Toe
3 Side Cowl Ventilator Cab and W/S Cowl
4 W/S Wiper Motor
5 W/S Washer Jar and Hoses
6 W/S Wiper Linkage
7 W/S Wiper Blades
8 Pad Assembly and Defroster Outlet
9 Ash Tray Assembly and Cover Cab and W/S Cowl
10 Instrument Panel Compartment
11 Instrument Panel Compartment Door
12 W/S and Back Window Installation
13 Transmission Cover
14 Dash Mats and Floor Insulators
15 Dome Lamp Assembly
16 Door Sill Plate and Plugs Cab
17 Sunshade and Inside Mirror
18 Short and Long Arm Mirror
19 Seat Belt Installation
20 Fuel Caution Plate
21 Body Mounting

T-3650

Figure 1—Cab and Components (Typical)

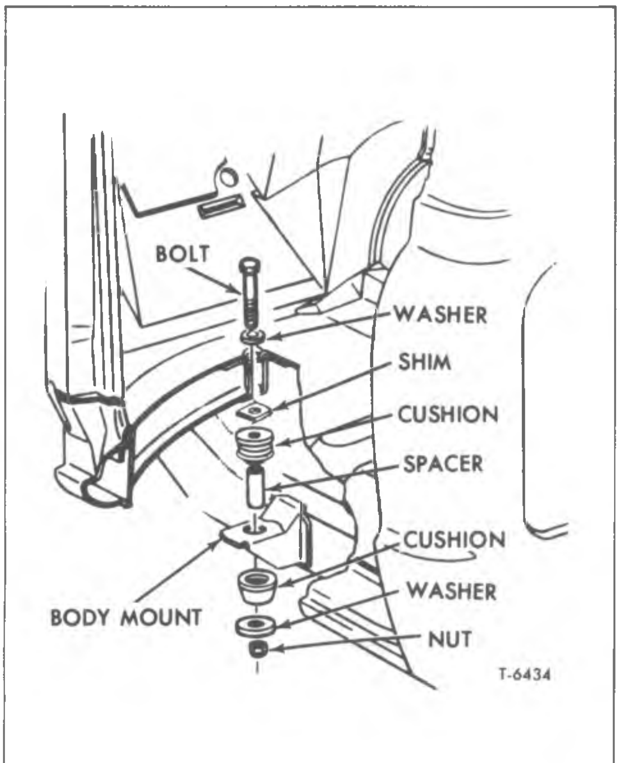


Figure 2—Cab Front Mounting

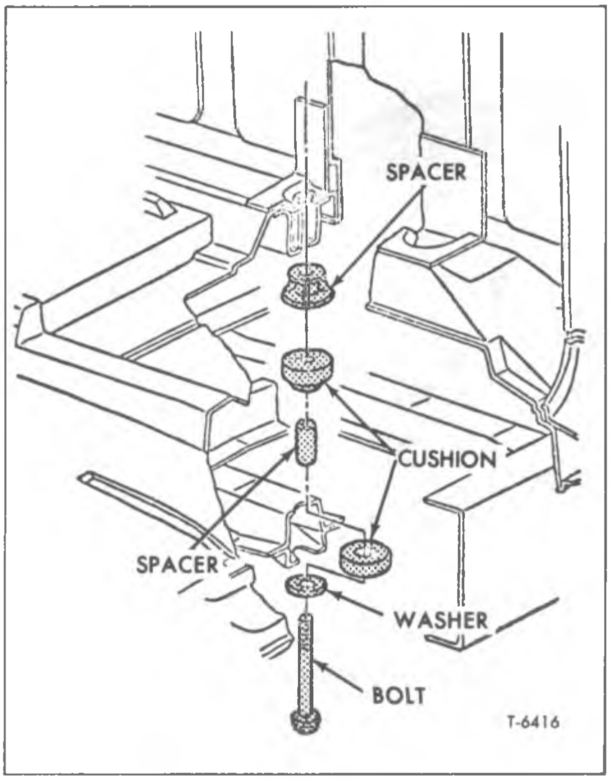
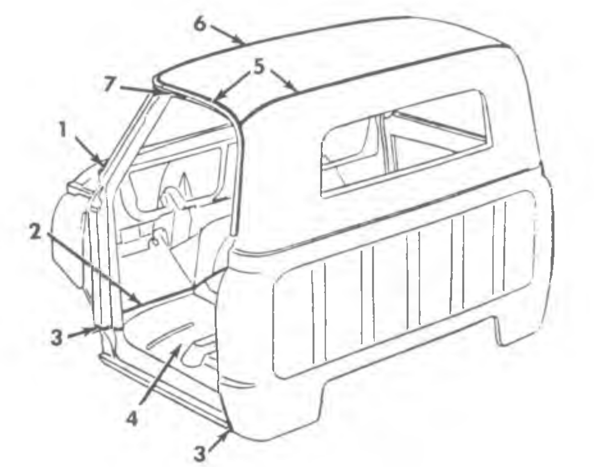


Figure 3—Cab Rear Mounting



1 Hinge Pillar to Cowl Side & Cowl Top to Plenum
2 Dash Panel & Cowl Side Panel to Floor Panel
3 Hinge Pillar & Lock Pillar
4 Undercoating
5 Roof Outer & Back Panel
6 Roof Outer & Front Panel
7 Upper Cab & Drip Molding Cab - Windshield Pillar to Windshield Header to Rocker

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Figure 4—Cab Sealing Area

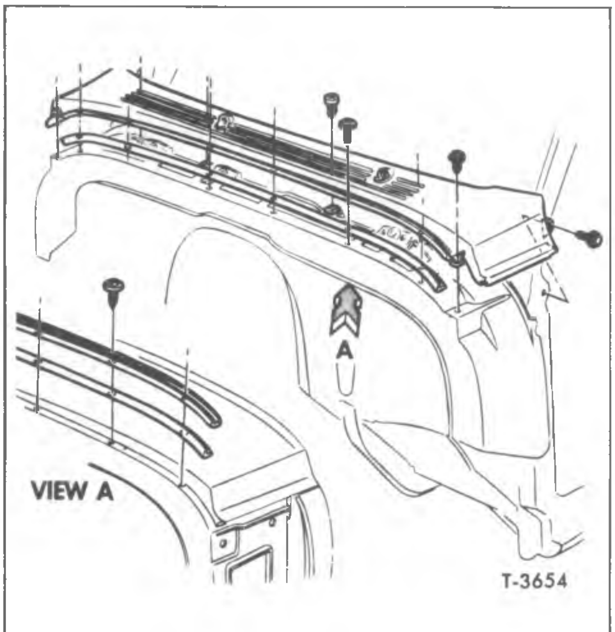


Figure 5—Cowl Ventilator Grille Intake

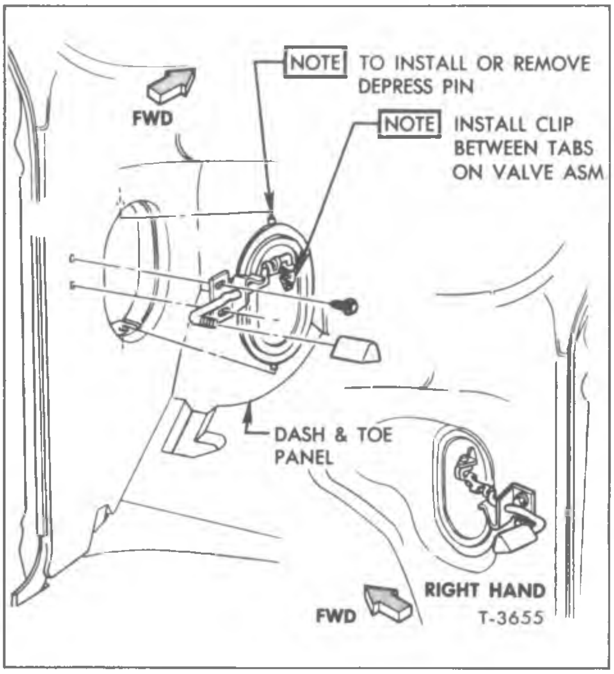


Figure 6—Side Cowl Ventilator

if necessary, air inlet grille can be readily removed from cowl opening as follows:

1. Remove windshield wiper arms from wiper pivot shafts.

2. Raise hood and remove screws, retaining cowl ventilator grille and cowl hood ledge seal.

3. Remove four screws from the rear recessed louvers.

4. Remove the six screws retaining the front of the grille to the cowl.

5. Remove the two larger size screws from each end of the grille at the forward corners.

6. Remove one screw each side which is exposed when the door is opened.

7. Inspect cowl hood ledge seal for fatigue or cuts and replace if necessary.

8. Reverse removal procedure to install.

SIDE COWL VENTILATOR REPLACEMENT

The entire outlet valve assembly may be removed from the vehicle by removing two screws and depressing the pins. Refer to figure 6.

The quality of maintenance is as important as the regularity with which it is serviced.

SEATS

NOTE: No attempt is made herein to cover all the available optional seats.

SEAT REPLACEMENT

NOTE: Seat with slide adjusters and seat back can be removed as a unit.

1. Remove four cap screws and washers which attach each seat to cab floor (fig. 7).
2. Tilt seat back forward, then lift seal assembly from cab.
3. Seat adjuster can be removed from seat after disengaging end of seat return spring and locking. Remove rod and four cap screws and washers attaching adjusters to seat.
4. Install seat adjusters to seat with eight attaching cap screws and washers.

ADJUSTMENT

Seat is provided with two adjustments. A lever at left of cab for positioning seat "Fore" or "AFT." Push down on lever to disengage seat position lock. An adjusting screw is provided at each side of the seat back frame for tilting seat back to the position desired. The release action of right-hand adjuster lock may be adjusted by kinking the locking rod.

NOTE: A minimum clearance of 7/16" should exist between the seat back and gas tank.

LEVEL RIDE SEAT SERVICE

To get full benefit from the optional level ride seat, proper adjustment is of primary importance.

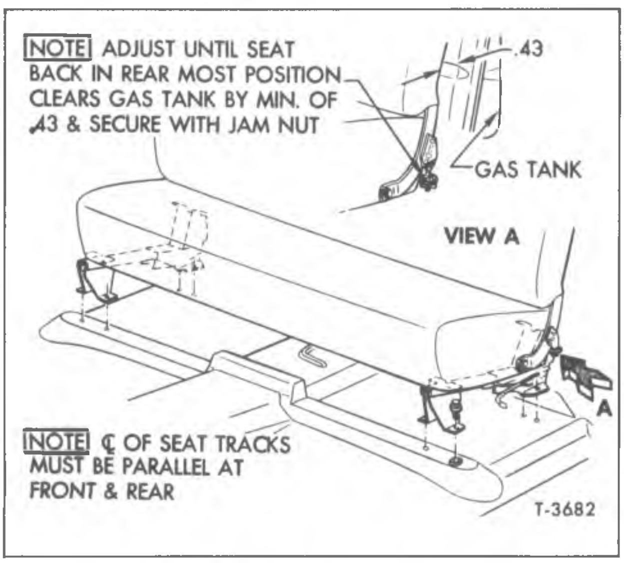


Figure 7—Front Seat Installation

BACK REST ADJUSTMENT

To adjust back rest angle (A, fig. 8), depress top of seat back and move to desired position.

FORE AND AFT ADJUSTMENT

Any point within the 4-inch travel may be selected by moving lever (B) in figure 8, toward the right-hand side of the vehicle to disengage seat lock.

SEAT TORSION BAR ADJUSTMENT
(Refer to Figs. 8 and 10)

The ratcheting adjuster lever (C, fig. 8) regulates the amount of weight the seat will support. Proper adjustment places the up and down travel of the seat suspension of the midpoint, limiting the occurrence of bottoming or topping of the suspension.

Proper adjustment is indicated by the ride level indicator (fig. 10), which is located behind left frame upright. Position 3 in figure 10 indicates correct adjustment (tip just flush with forward edge of upright). If seat is too stiff, the indicator will be in position 1; if too soft, in position 2. Adjust for position 3 by moving lever (C, fig. 8). Direction of ratcheting action may be changed by moving control at base of lever. Turning lever

Figure 8—Level Ride Adjustment

CONVENTIONAL CAB

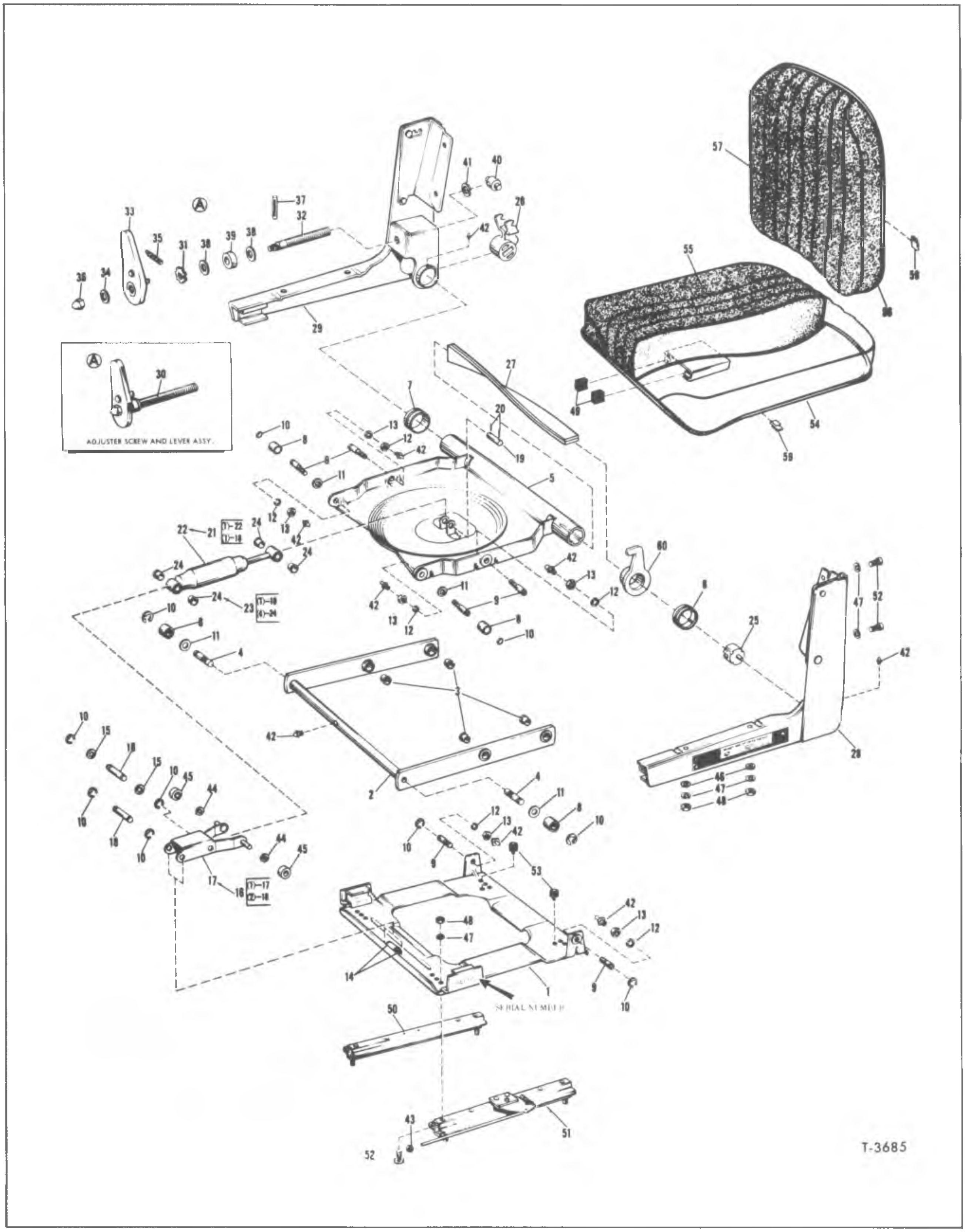


Figure 9—Exploded View of Level Ride Seat

clockwise increases the amount of weight the seat will support.

LEVEL RIDE SEAT SERVICE

NOTE: Key numbers in following text refer to figure 9.

TORSION BAR

Removal

1. Wedge upper seat in top position by using wood shim under tube located under front of seat cushion or by shim under tube located below back cushion.
2. Remove preload on torsion bars by rotating adjuster lever assembly (30) counterclockwise until adjuster assembly is disengaged from seat.
3. Disengage back cushion from seat assembly by removing bolts and lock washers (52 and 47).
4. Disengage seat cushion from assembly by removing nuts, lock washers and washers (48, 47, and 46). Move seat cushion forward to free rubber rollers (45) from housing under seat cushion.
5. Remove right-hand side panel assembly (29) by tapping out sideways. This allows yoke (26) to drop free (figs. 10 and 11).
6. Remove torsion bar set (27) from tube.

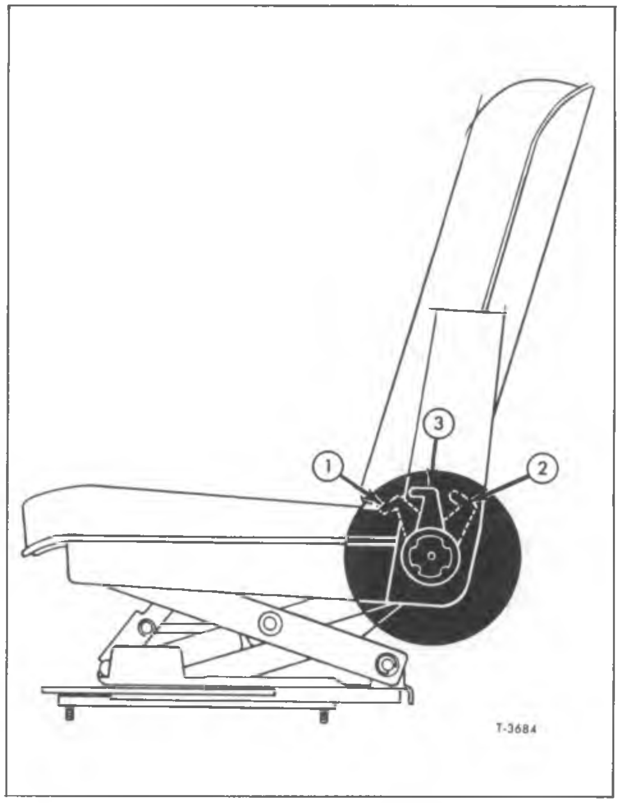


Figure 10—Ride Level Indicator

Installation

1. Insert torsion bar set (27) in tube being sure that bars are engaged in retainer (25) inside tube at left-hand side of seat.
2. Replace right-hand side panel assembly (29) with yoke (26) held in position inside housing

1 Base Assy., w/Bearings
2 Outer Lever Assy., w/Pins and Bearings
3 Bearing, Flanged
4 Pin-Drive
5 Center Lever Assy.
6 Bearing, Housing, L.H.
7 Bearing, Housing, R.H.
8 Roller and Bearing Assy.
9 Stud
10 Snap Ring
11 Washer, Plain
12 Lock Washer, 3/8 S.A.E. Med.
13 Nut, Hex. 3/8-16 (UNC-2B)
14 Bearing, Flanged
15 Washer, Plain 7 Ga. x 17/32 x 7/8
16 Shock Lever Assy. Kit
17 Shock Lever Assy.
18 Hinge Shaft, Shock
19 Hinge Shaft, Shock, Rear
20 Roll Pin
21 Shock Absorber Assy. Kit
22 Shock Absorber Assy., w/Bearings
23 Bearing Kit (Shock Absorber)
24 Bearing, Flanged
25 Retainer (T-Bar)
26 Yoke (Adjuster)
27 Torsion Bar Set (2 Bars per Set)
28 Side Panel Assy., L.H.
29 Side Panel Assy., R.H.
30 Adjuster Screw and Lever Assy.
31 Gear
32 Adjuster Screw
33 Lever Assy.
34 Washer
35 Spring (Tension)
36 Acorn Nut (Self Locking)
37 Pin, Drive
38 Washer, Plain
39 Thrust Ball Bearing
40 Adjuster
41 Washer, Plain 5/16 Thick
42 Lub. Fittings (3/32 Shank)
43 Knob (Plastic)
44 Thrust Washer
45 Roller and Bearing Assy., (Rubber)
46 Washer, Plain 5/16 S.A.E.
47 Lock Washer, 5/16 S.A.E. Med.
48 Nut, Hex. 5/16-18 (UNC-2B)
49 Bumper (Topping)
50 Seat Adjuster, R.H.
51 Seat Adjuster, L.H.
52 Cap Screw, 5/16-18 x 5/8
53 Bumper (Bottom)
54 Seat Cushion Assy.
55 Cover Assy., Seat Cushion
56 Pad, Seat Cushion
57 Back Cushion Assy.
58 Universal Riser Kit
59 Fastener Clip, Cushion
60 Ride Level Indicator

Legend for Figure 9

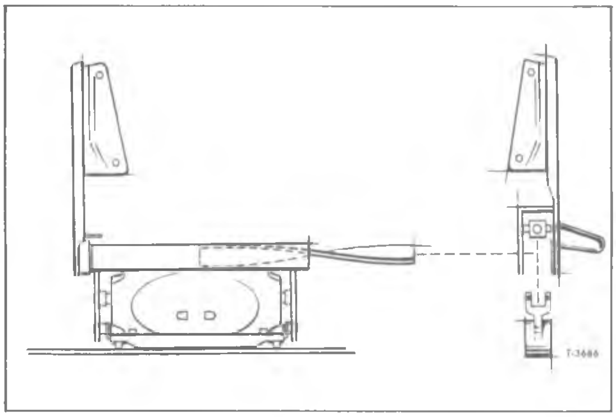


Figure 11—Side Panel Removed

in side panel. Engage yoke (26) on free end of torsion bar set (27).

3. Line up side panels right-hand and left-hand retaining the 20-inch dimension over side panels.

4. Reassemble seat cushion moving from front of seat toward rear in order to engage rubber rollers (45) properly in housing under seat cushion.

5. Reassemble back cushion.

6. Replace preload adjuster assembly being sure that items (38 thru 41) are in their proper positions. Engage yoke (26) hooked ends over lugs on adjuster pin (40).

7. Preload torsion bars by rotating adjuster lever assembly (30) clockwise (figs. 9 and 12).

8. Remove wood shims.

LEVEL RIDE SEAT SHOCK ABSORBERS

Removal

1. Wedge upper seat in top position following operation 1, of "Torsion Bar Removal."

2. Remove preload on torsion bars following

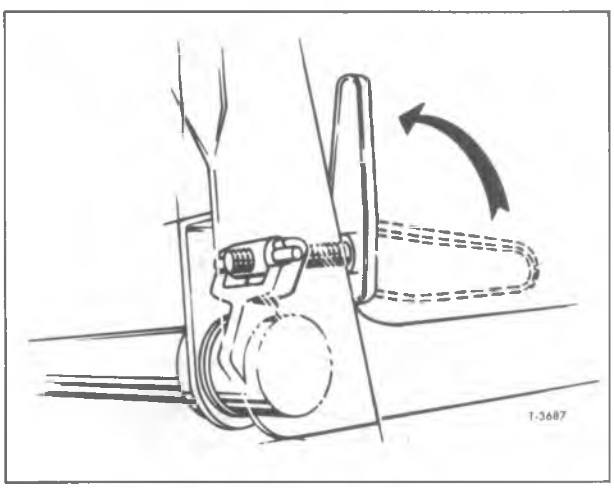


Figure 12—Adjuster Level

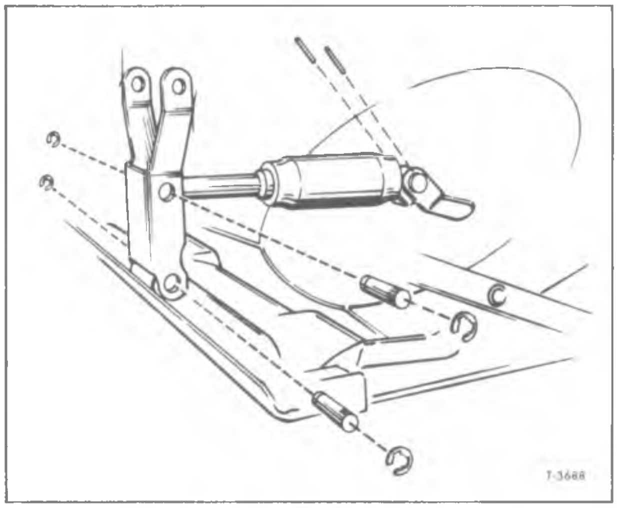


Figure 13—Shock Absorber

procedure similar to operation 2, of "Torsion Bar Removal." Do not disengage adjuster assembly.

3. Remove seat cushion following operation 4, of "Torsion Bar Removal."

4. Wire side panel assemblies (28 and 29) across front of seat to retain their position (19¾" from outer surface to outer surface).

5. Remove two snap rings (10) from ends of hinge shaft (18) at front of shock absorber.

6. Remove hinge shaft (18) by tapping out from

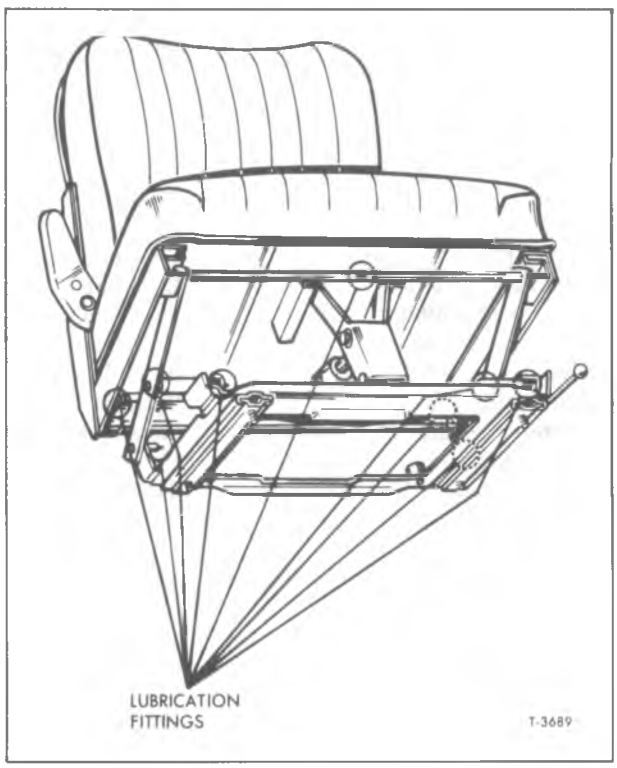


Figure 14—Seat Lubrication Fitting

left-hand to right-hand side. This operation frees two washers (15).

7. Remove two roll pins (20) from hinge shaft at rear of shock absorber. Use small diameter punch.

8. Remove hinge shaft (19) at rear of shock absorber. This frees shock absorber.

Installation

1. With shock absorber (22) in proper position, replace hinge shaft (19) at rear of shock. (Also refer to fig. 13.)

2. Replace two roll pins (20) in hinge shaft, locking roll pin on right-hand side in nibs in bent-up ear.

3. Replace hinge shaft (18) at front of shock absorber, driving shaft from right-hand to left-hand side. Serrated end of shaft to enter shock lever (17) last. Drive shaft through two washers (15) and through shock absorber loop.

4. Replace two snap rings (10) at ends of front hinge shaft (18).

5. Line up side panels right-hand and left-hand retaining the 19¾" dimension over side panels.

6. Reassemble seat cushion following operation 4 of "Torsion Bar Installation."

7. Preload torsion bars by rotating adjuster lever assembly (30) clockwise.

8. Remove shims.

LEVEL RIDE SEAT LUBRICATION

Lubrication fittings are shown in figure 14. Level ride seat should be lubricated whenever vehicle is lubricated.

DOOR ASSEMBLY

DOOR REPLACEMENT

Remove the door assembly from the body by removing the hinges from the door.

DOOR ADJUSTMENT

Door adjustment may be accomplished at two places; at the hinge straps-to-door panel and at the hinge cage-to-pillar. Before adjustment is made on any door, however, the striker plate should be removed. The door can be moved fore, aft, up and down at the hinge pillar and the door also can be moved in or out at the hinge-to-door panel. However, in order to adjust the door assembly at the body hinger pillar it is necessary to use special door hinge bolt wrench Tool (J-22585) (fig. 15). Move door as required and tighten bolts.

The door should have a normal clearance of 5/32" around the entire lip of door except at the bottom where it should be ¼" from the door sill.

The door should be adjusted in the opening so the edge of the door across the top and also at the lock side is parallel with the body opening as nearly as possible.

Tighten bolts to 20 to 25 foot-pounds after adjustment and replace and adjust the door striker plate as outlined later under "Door Lock and Striker Plate."

DOOR LOCK AND STRIKER REPLACEMENT

NOTE: Door lock striker and attaching screws are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

Adjustment of the door lock and striker plate should be made after the door hinges have been assembled to the doors.

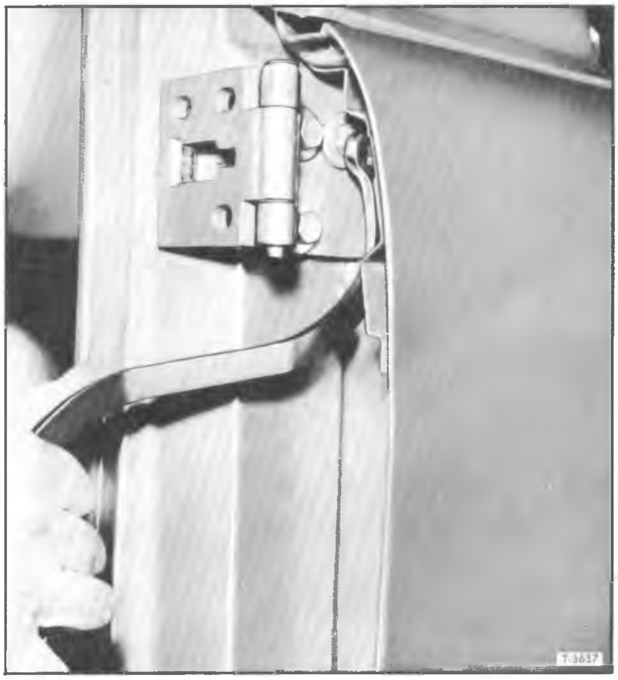


Figure 15—Door Hinge Bolt Wrench J-22585 (Typical)

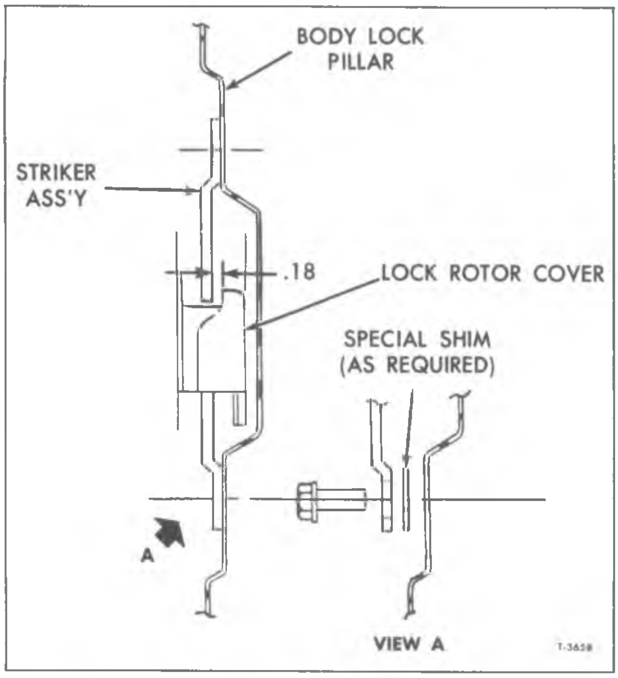


Figure 16—Striker Assembly on Body Lock Pillar

NOTE: Refer to "Door Lock Replacement" later in this section for the door lock replacement.

Remove and replace four bolts for replacing the striker plate at the door lock pillar and adjust as required following:

ADJUSTMENT

1. Position striker assembly on body lock pillar so that the rotor cover outer face on the door

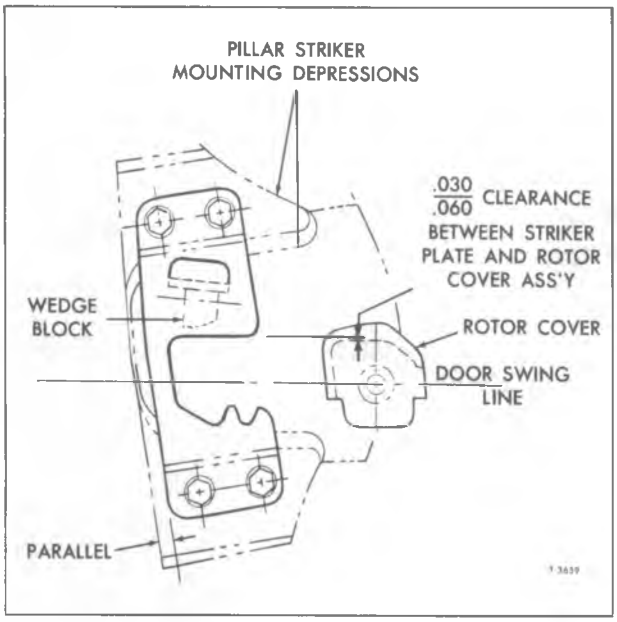


Figure 17—Lock Rotor Cover Assembly and Striker Plate

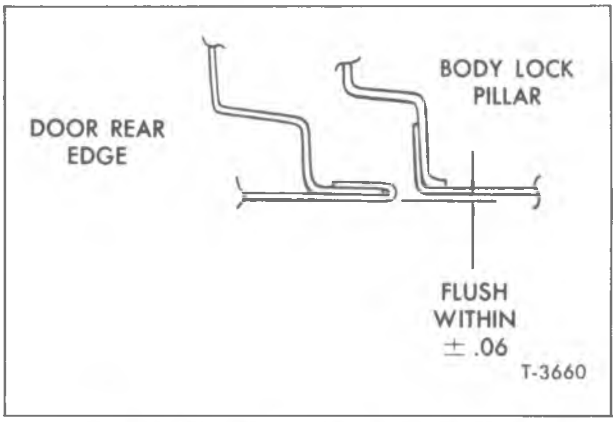


Figure 18—Door Surface Adjustment (at Striker)

swings into the striker assembly with 0.10" clearance to the lock rotor cover. Use special burred shims as required (fig. 16).

NOTE: Under usual conditions, shims are not required.

2. Vertical slots are provided in the body lock pillar to vertically position the striker so that the lock rotor and rotor cover assembly swing smoothly into the opening between the teeth and striker wedge block (fig. 17).

NOTE: The lock rotor cover assembly must clear the striker plate as the lock enters the striker.

3. As an aid to striker adjustment, outline the striker in pencil or crayon for use as a base for adjustment. Horizontal slots are provided in the striker plate to position the striker assembly laterally so that the door outer surface is flush with the pillar surface at the door rear edge within 1/16" (fig. 18).

NOTE: The striker inner edge must be parallel to the striker mounting depression on the pillar.

DOOR CHECK AND UPPER HINGE

The door check is part of the front door upper hinge. The new front door check hinge combination allows a friction load to hold the door in any position between full open and closed. The front door check-hinge assembly is replaced as a complete unit as follows:

REMOVAL

1. Remove windshield wiper blade assemblies.
2. Remove cowl vent grille screws and lift off grille.
3. Loosen front fender rear bolts.
4. With special Tool (J-22585) remove three bolts securing front door upper hinge to cowl pillar. Refer to figure 15.

a. Remove the door to upper hinge retaining bolts.

b. With aid of an assistant to support weight of door, remove the door to lower hinge retaining bolts and remove door.

INSTALLATION

1. Install hinge securely on pillar in same location as before removed.

2. With the aid of an assistant fasten the door to the hinge.

3. Adjustment of the door lock and striker plate should be made after the door is positioned in the opening.

4. Position striker assembly on body lock pillar so the rotor cover outer face on the door swings into the striker assembly with 0.10 inch clearance to the lock rotor cover. Use special burred shims as required.

NOTE: Usually shims are not required.

5. As an aid to striker adjustment outline the striker in pencil or crayon for use as a base for adjustment. Horizontal slots are provided in the striker plate to position the striker assembly laterally so that the door outer surface is flush with the pillar surface at the door rear edge within 1/16". Refer to figure 18.

NOTE: The striker inner edge must be parallel to the striker mounting depression on the pillar.

6. Tighten front fender rear bolt, replace cowl vent grille with screws and install windshield wiper blades.

DOOR VENTILATOR ASSEMBLY REPLACEMENT

REMOVAL

NOTE: The channel between the door window glass and door vent is removed as part of the vent assembly.

1. Regulate the door window glass to the full down position.

2. Remove one clip each from the door lock handle and window regulator handle using Tool (J-9886).

3. Remove four trim panel screws and trim panel. Remove water deflector (fig. 22).

4. Remove the bottom two screws directly below the window regulator mechanism (fig. 19).

5. Slide door window glass rearward away from ventilation.

6. Remove three sheet metal screws at the upper front of the door (fig. 20).

7. Turn the vent assembly 90 degrees and carefully remove by guiding up and out (fig. 20).

INSTALLATION

NOTE: Replace the door window glass and regulate to the full down position before installing the door ventilator assembly.

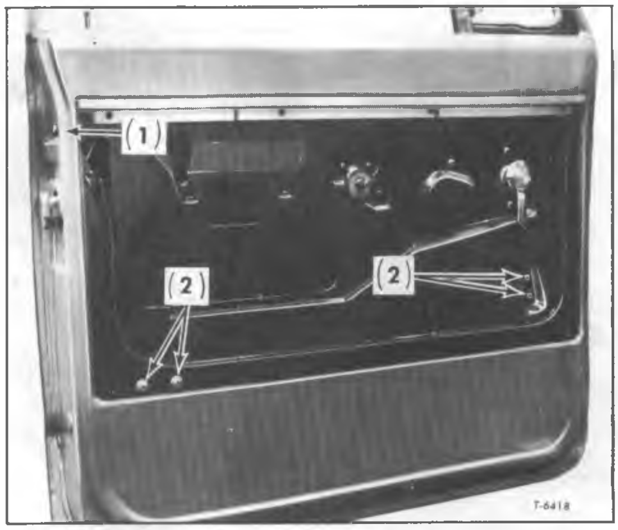


Figure 19—Vent Assembly Inner Door Panel Attachment

1. Lower the ventilator assembly into the door frame; center into position.

2. Make certain the rubber lip is positioned before tightening screws.

3. Slide door glass forward engaging glass in vent channel.

Figure 20—Vent Window Assembly Removal

Figure 21—Adjusting Ventilator Operating Tension

4. Attach the two screws below regulator assembly.

5. Install and tighten the three screws at the upper front of the door.

ADJUSTMENT

1. Adjust the ventilator adjusting nut by turning clockwise to increase operating tension (fig. 21).

2. After making adjustment bend tabs over the hex nut.

3. Install water deflector (fig. 22). Install four trim panel screws and trim panel.

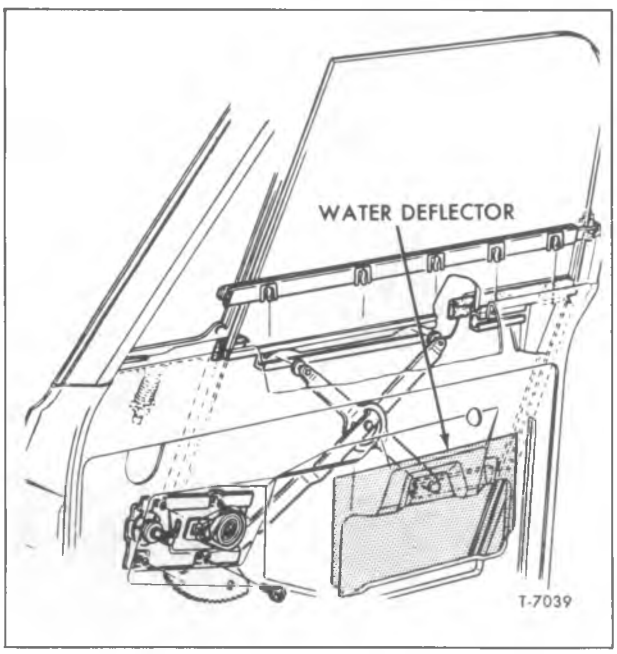


Figure 22—Regulator Assembly and Glass

4. Install door and window regulator handles in horizontal position with handles pointing forward and window fully closed.

DOOR VENTILATOR GLASS REPLACEMENT

1. Using an oil can or similar means, squirt Prepsol or equivalent on the glass filler all around the glass channel or frame to soften the oil seal. When the seal has softened, remove glass from the channel.

2. Thoroughly clean the inside of the glass channel with sandpaper, removing all rust, etc.

3. Using new glass channel filler, cut the piece to be installed two inches longer than necessary for the channel. Place this piece of filler (soapstoned side of filler away from glass) evenly over the edge of the glass which will fit in the channel. The extra filler extending beyond the rear edge of the glass should be pinched together to hold it in place during glass installation.

NOTE: One side of this filler (the outside of the roll) is soapstoned. This is the side which goes into the metal channel.

4. Brush the inside of the metal glass channel freely with ordinary engine oil. This will enable the glass and filler to slide freely into the channel. Push the glass with the filler around it into the channel until it is firmly seated. After the glass is firmly in place, the oil softens the filler, causing it to swell, thereby making a perfect, water-tight seal. Trim off the excess filler material around the channel and at the ends of the channel.

NOTE: Glass should be installed so that rear edge is parallel to the division post. Allow full cure before water testing.

DOOR WINDOW ASSEMBLY REPLACEMENT

1. Completely lower glass to bottom of door.

2. Remove inside door and window regulator handles using Tool (J-9886). Mark location of the handles for correct assembly.

3. Remove door arm rest and trim pad. Remove rain shield (fig. 22).

4. Mask or cover upper portion of door window frame. Remove ventilator assembly as previously outlined.

5. Slide glass forward until front roller is in line with notch in sash channel. Disengage roller from channel.

6. Push window forward and tilt front portion of window up until rear roller is disengaged.

7. Put window assembly in normal position (level) and raise straight up and out.

8. Reverse above procedure for installation.

DOOR WINDOW REGULATOR REPLACEMENT

(Refer to Figure 22)

REMOVAL

1. Wind window all the way up.
2. Remove the inside door handles with Tool (J-9886). Mark the location of the handles for correct assembly.
3. Remove door trim pad secured with four screws. Remove rain shield (fig. 22).
4. Remove four screws securing regulator to inner panel.
5. Push regulator out of circular opening while holding rear of assembly, then slide assembly to the notches in the carrier channel and out through the door access hole.

INSTALLATION

Install regulator in reverse order of removal. Lubricate regulator gears with Lubriplate.

DOOR OPENING WEATHERSTRIP REPLACEMENT

Side door sealing incorporates an inner seal. The inner seal is mounted on the body opening welding flange (fig. 23) and goes completely around the periphery of the opening. The molded weatherstrip material is cemented (fig. 23).

Success of weatherstrip replacement depends entirely upon the quality of the cement used and the care with which it is applied. All rust, road dirt, and grease or oil must be completely removed as should all old cement and bits of old weatherstrip. After removing all foreign material from door opening surface, wipe down with Prepsol or its equivalent. Use only a good quality cement which is made specially for weatherstrip installation, following the manufacturer's directions. Proceed as follows:

1. Open door and block open.
2. Remove sill plate retaining screws and remove sill plate.
3. Remove side door inner weatherstrip seal.
4. Remove used adhesive from cab door opening with adhesive or cement remover.
5. Apply adhesive to cab opening.
6. Install molded corner of inner weatherstrip starting where windshield post joins the header panel.
7. Trim inner weatherstrip with a notch as shown in figure 23 and butt ends together.
8. Reinstall sill plate and sill plate retaining screws.

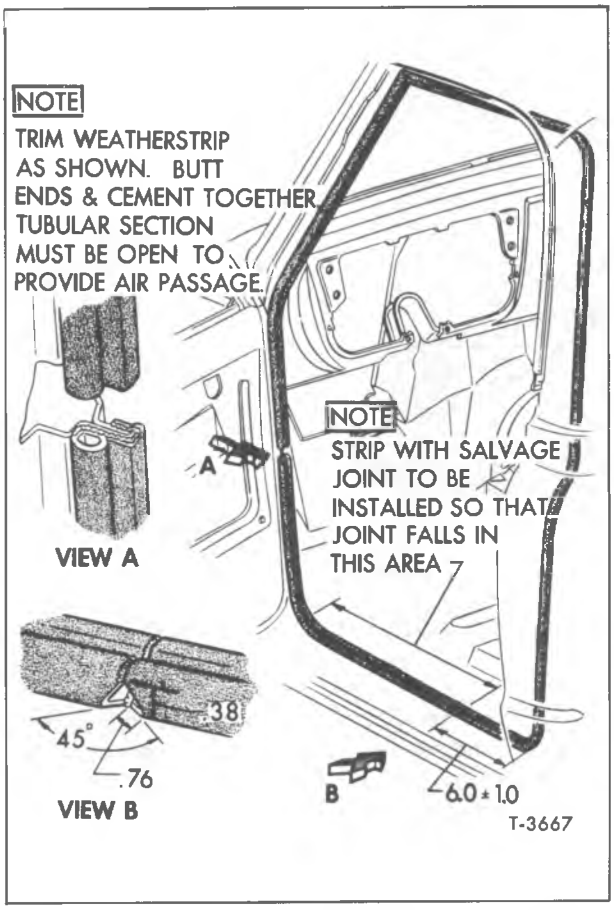


Figure 23—Door Opening Weatherstrip

Figure 24—Installing Trim Panel Seal

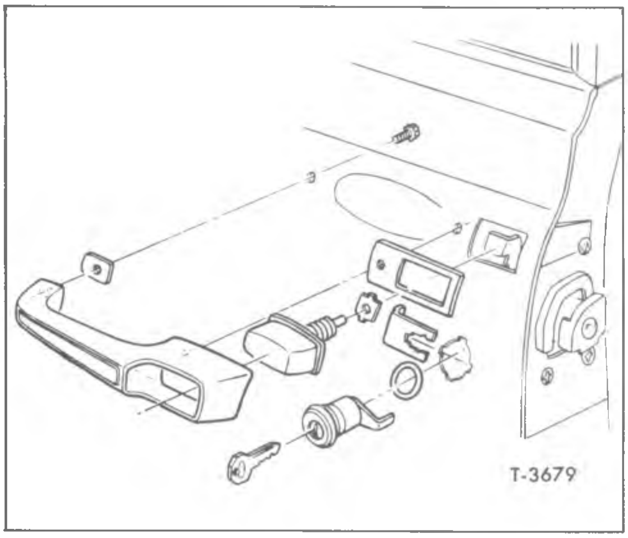


Figure 25—Handle and Lock Outside Door

DOOR TRIM PANEL SEAL REPLACEMENT

1. Remove window regulator and door remote control handles. Handles are retained by clips.
2. Remove trim panel from door (fig. 24). Trim panel is retained by four screws.
3. Remove trim panel seal (fig. 24).
4. Apply cement to seal if necessary, then start at one end of groove applying seal.

Figure 26—Lock Cylinder Installed

DOOR LOCK REPLACEMENT

(Refer to Figures 25, 26, and 27)

The locks are of the free rotor type. They include a safety interlock feature. Where necessary, striker spacers should be used to ensure satisfactory lock and striker engagement.

REMOVAL

1. Raise window.
2. Remove inside handles with Tool (J-9886). Mark location of handles for correct assembly.
3. Remove trim panel.
4. Remove remote control sill knob.
5. From outside the door remove screws retaining lock to door edge and lower the lock assembly.
6. Remove screws retaining remote control.
7. Remove lock, push button rod and remote control rod as an assembly (fig. 27).

INSTALLATION

1. Transfer remote rod with clip to new lock.
2. Connect remote door handle rod to lock after lock is positioned.
3. Secure lock screws.
4. Temporarily install remote handle.
5. Install remote control sill knob.
6. Check all controls for proper operation before reinstalling trim and handles.

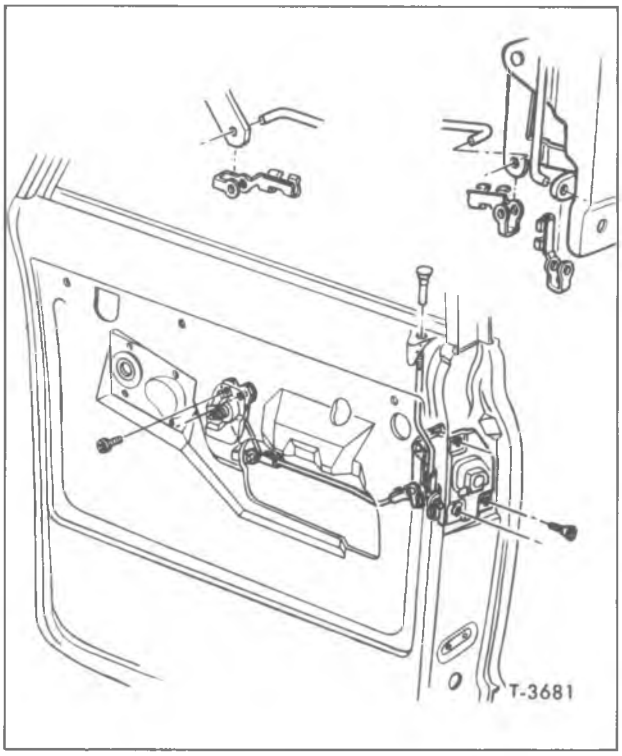


Figure 27—Remote Control and Side Door Lock

7. Remove remote handle.

8. Install trim pad.

9. Secure inside handles. Position horizontal with handles pointing forward and window fully closed.

DOOR LOCK CYLINDER ASSEMBLY REPLACEMENT

1. Raise door window and remove door trim pad.

2. With a screwdriver, or other suitable tool, slide lock cylinder retaining clip (on door outer panel) out of engagement and remove lock cylinder.

3. To install, reverse removal procedure.

DOOR LOCK REMOTE CONTROL AND CONNECTING ROD REPLACEMENT

(Refer to Figure 27)

The remote control is secured to the door inner panel by the three attaching bolts.

1. Raise door window and remove door trim pad.

2. Remove bolts securing remote control to door inner panel.

3. Pivot remote control inboard slightly, to disengage connecting rod, and remove remote control from door.

4. To install, reverse removal procedure.

NOTE: Connecting rod can be removed at this point by disconnecting spring clip from lock.

CAB REPLACEMENT

REMOVAL

NOTE: Necessary equipment for efficient and safe replacement of cab consists of a chain hoist (¾-ton minimum capacity), a sling having padded hangers, and two or more support blocks to rest cab on once the cab is removed from chassis.

1. Disconnect the battery.

2. Remove the hood panels.

3. Drain cooling system if equipped with heater and disconnect heater hoses at cab cowl.

4. If equipped with air brakes, exhaust the pressure from air system.

5. Disconnect all necessary wiring harnesses and cables from cab or chassis.

6. If air conditioned, refer to "AIR CONDITIONING" section and open system and cap lines observing precautions found in above references.

7. Detach and/or disconnect all lines between cab and chassis.

NOTE: Do not attempt to salvage clutch or brake hydraulic fluid.

8. Disconnect accelerator linkage at cab cowl.

9. Disconnect mechanical parking brake.

10. Remove closure panel from cab floor at transmission shift lever.

11. Disconnect speedometer cable at transmission or at the dash unit.

12. Mark for alignment purposes later, the steering shaft joint flange-to-steering gear shaft, then remove the flange clamp bolt. When cab is raised later, this connection will separate.

13. Remove the cab mounting bolts.

14. With a hoist sling device having padded hangers, open doors and engage hangers to cab door openings. DO NOT ATTACH HANGERS TO DOORS.

NOTE: If sling device of type described above is not available, a solid hardwood 4 x 4, 7½ feet long, positioned through the cab with hoist chain attached securely to each end, can be used. Place padding at points where beam contacts cab.

15. Raise cab and remove from chassis.

INSTALLATION

1. Place cab mounting components in position on chassis frame brackets. If desired, masking tape can be applied to retain loose parts temporarily in position.

2. Carefully lower the cab to chassis and at same time engage the steering shaft to gear shaft using marks made prior to removal for alignment. Tighten shaft clamp bolt (when used) to 35 to 40 foot-pounds torque or clamp bolt nut (when used) to 40 to 50 foot-pounds torque.

3. Install balance of cab mounting components.

4. Connect speedometer cable.

5. Connect hand brake if mechanical.

6. Connect accelerator linkage.

7. Connect all control and gauge lines.

8. Connect fuel line, if previously disconnected.

9. Connect heater hoses (if used), then fill cooling system.

10. Service the hydraulic brake system, if used.

11. Service the clutch hydraulic system. Use new fluid.

12. Connect all electrical wiring.

13. Refer to "AIR CONDITIONING" (SEC. 1E) later in this section, for service of the air conditioning system, if used.

14. Connect battery cables.

15. Install hood panels and align, if necessary. Refer to SHEET METAL (SEC. 11) of this manual.

16. Recheck all connections of wiring, lines, and control linkage.

17. With wheels blocked as a safety measure, start engine, then final check all connections and linkage.

HEATER—GENERAL DESCRIPTION

DELUXE AIR-FLOW HEATER

Components of the heater attach to the right side of the fire wall. The blower motor, heater core, and hose assembly mount on the engine side of the fire wall while the distributor ducting, and controls are under the dash (fig. 28).

The heater operates on outside air only with the blower receiving its air-flow from the cowl vent plenum chamber.

Engine coolant constantly flows through the heater core during engine operation. Heater output is adjusted by varying the air-flow through the system. A dash-mounted three-lever control system is employed (fig. 29). One lever controls the defroster air deflector. The second lever opens the air door and operates the three-speed fan switch. The third lever operates a temperature door which passes the air-flow either through the heater core, around the core, or partially through and partially around the core.

HEATER CONTROLS

DEFROSTER LEVER (Fig. 30)

Moving the "DEF." (defroster) lever to the right, moves an air deflector in the distributor duct which channels the air-flow partially or fully to the defroster air outlets.

AIR FAN LEVER (Fig. 30)

When "AIR FAN" lever is fully left, no air passes through the system. Moving the lever to the right about one-third of its travel opens the air door in the air distributor duct. Moving the lever further to the right operates the three-speed blower switch.

HEAT LEVER (Fig. 30)

When "HEAT" lever is fully left, the temperature door in the blower duct causes the air-flow to bypass the heater core. Moving the lever to the right moves the temperature door allowing some air to pass through the core and some to bypass the core. With the lever fully right, all air flowing through the system passes through the core.

BLOWER ASSEMBLY REPLACEMENT

REMOVAL

1. Disconnect battery ground cable.

2. Support the right front of the hood in the fully raised position.

3. Carefully scribe the hood and fender locations of the right hood hinge and remove the hinge.

4. Unclip the blower wire at the blower flange terminal and note or mark the motor flange position in relation to the blower case.

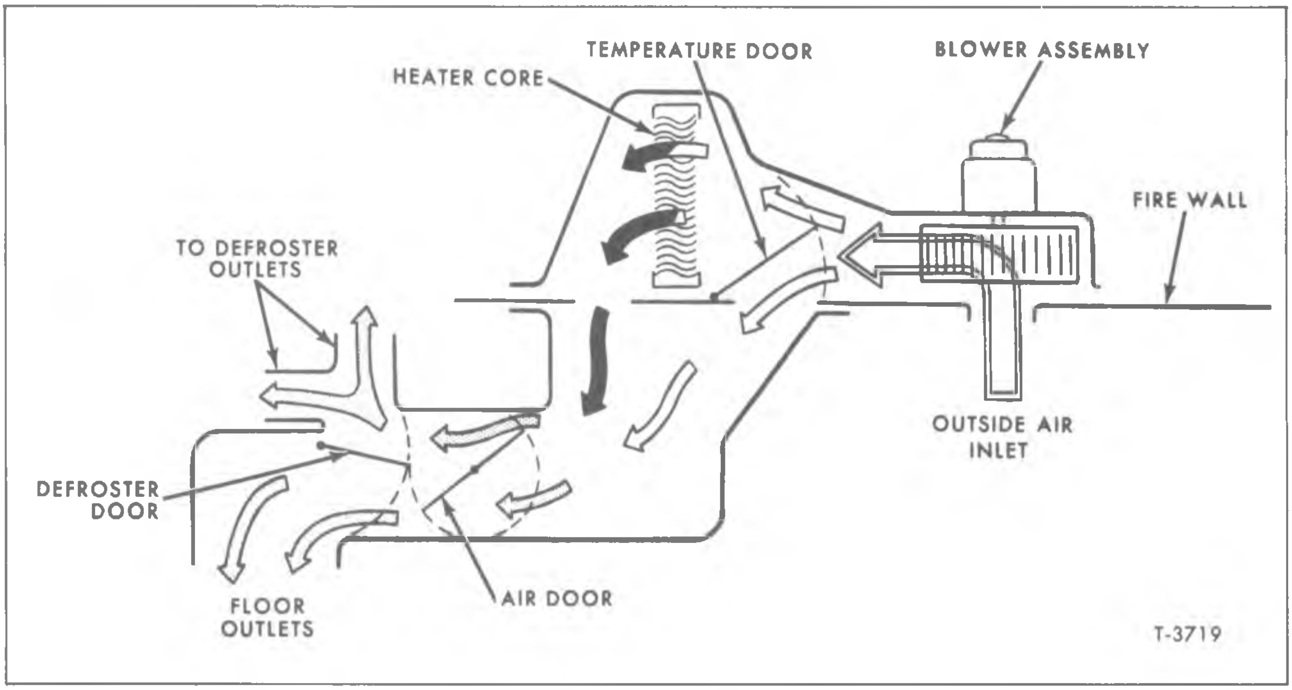


Figure 28—Deluxe Air-Flow Heater Schematic

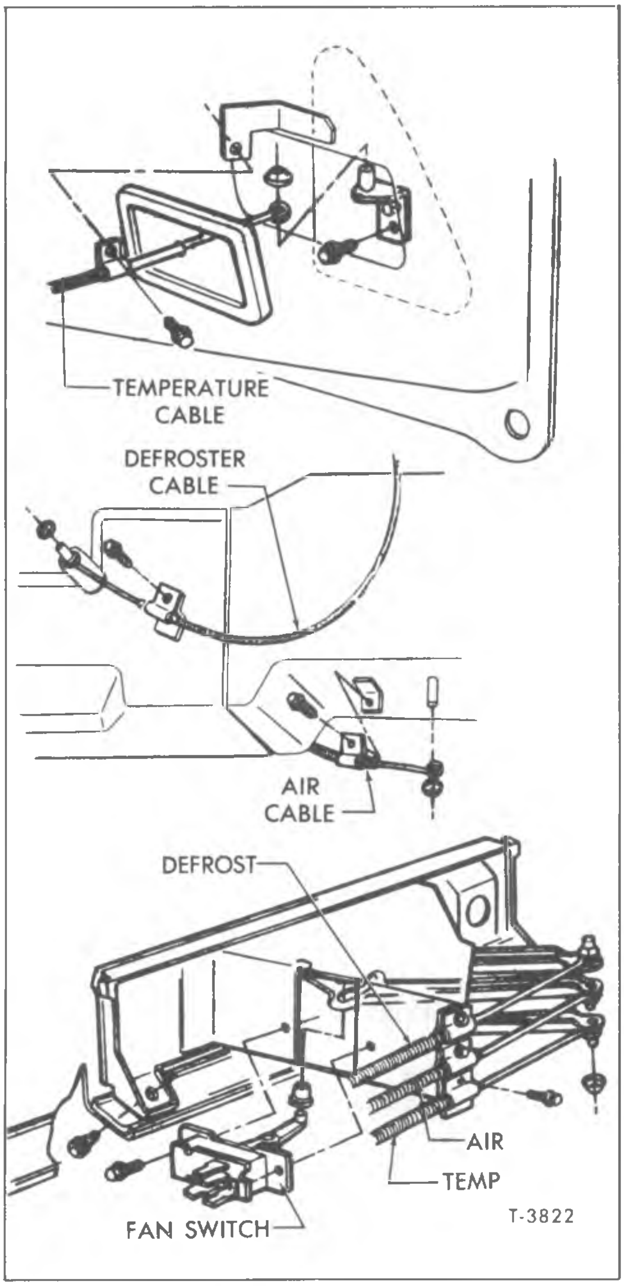


Figure 29—Deluxe Air-Flow Heater Controls

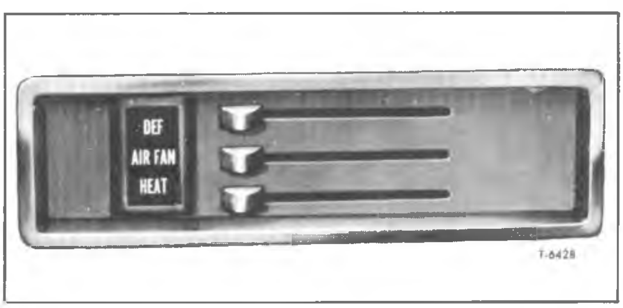


Figure 30—Deluxe Air-Flow Heater Control Panel

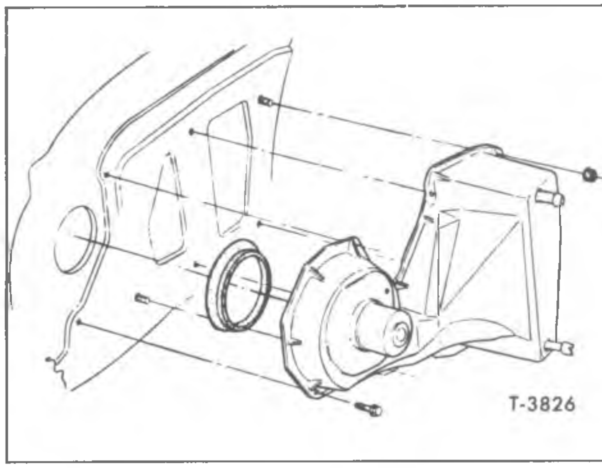


Figure 31—Deluxe Air-Flow Heater Assembly

5. Remove the blower assembly mounting screws.

6. Remove the blower assembly (pry the flange away from the case carefully if the sealer acts as an adhesive). Turn the motor until its flange clears the hood hinge.

7. Remove the nut which attaches the blower wheel to the motor shaft and separate the assembly.

INSTALLATION

1. Assemble the blower wheel to the motor with the open end of the blower away from the motor.

2. Install the assembly to the blower case, connect ground strap, and connect the motor wire.

3. Remount the hood hinge aligning it carefully with the scribed lines. Check hood alignment.

4. Connect battery ground cable.

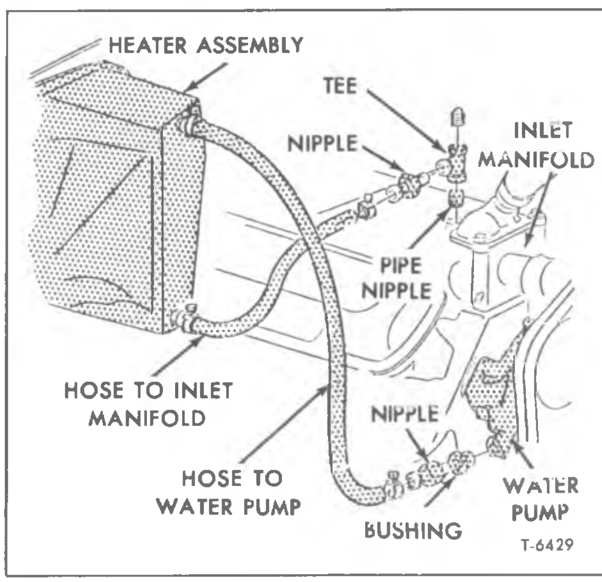


Figure 32—Heater Hoses (60 Series) (Typical)

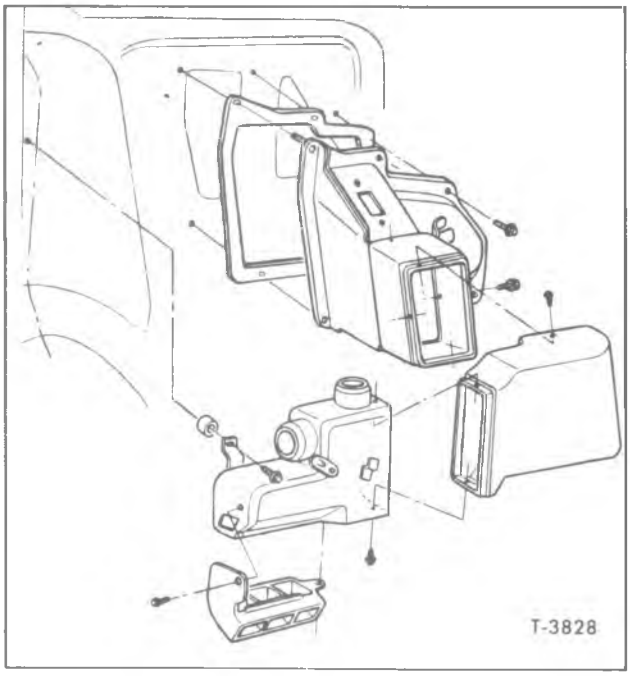


Figure 33—Heater Distributor and Ducts

BLOWER, CORE CASE, AND CORE REPLACEMENT

REMOVAL (Fig. 31)

1. Drain radiator.
2. Disconnect battery ground cable.
3. Unclip the blower motor wire at the blower flange terminal.
4. Disconnect heater hoses at the core tubes (fig. 32).
5. Under dash, remove the seal on the temperature door cable at the distributor duct adapter and disconnect the cable from the temperature door.
6. Remove the case retaining screws and sheet metal nuts. Pull the case away from the mounting studs and inboard to remove it.
7. Remove the screws which attach the core retainers to the case and remove the core.

NOTE: If desired, the air duct and distributor can readily be separated as shown in figure 33.

INSTALLATION

1. Replace the core in the case using non-hardening sealer. Attach the core with the core retainers and screws.
2. Remount the case to the fire wall.
3. Connect the temperature door cable to the door and replace the seal.
4. Connect the heater hoses to the core tubes (the hose to the water pump attaches to the upper core tube).
5. Connect the motor wire and battery ground cable.
6. Refill the cooling system.

AIR DISTRIBUTOR DUCT ASSEMBLY

Figure 33 illustrates the air distributor duct installed on vehicles with Deluxe Air-Flow heaters.

DEFROSTER DUCT ASSEMBLY

The defroster hose and outlets assemblies are illustrated in figure 34.

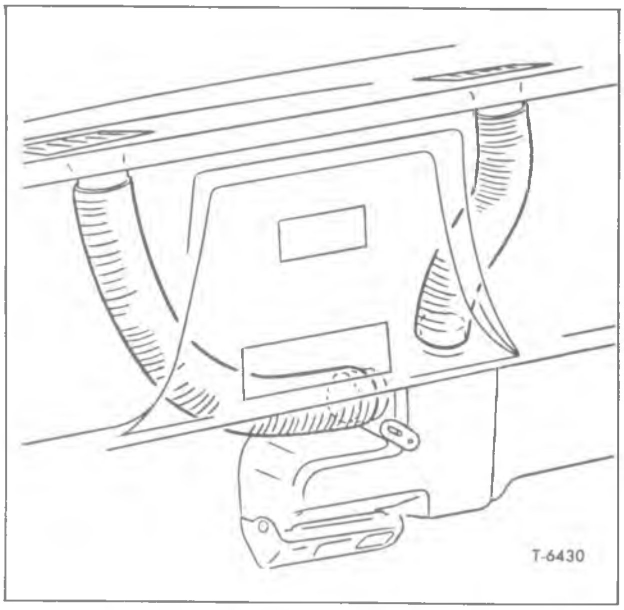


Figure 34—Defroster Hose and Outlet

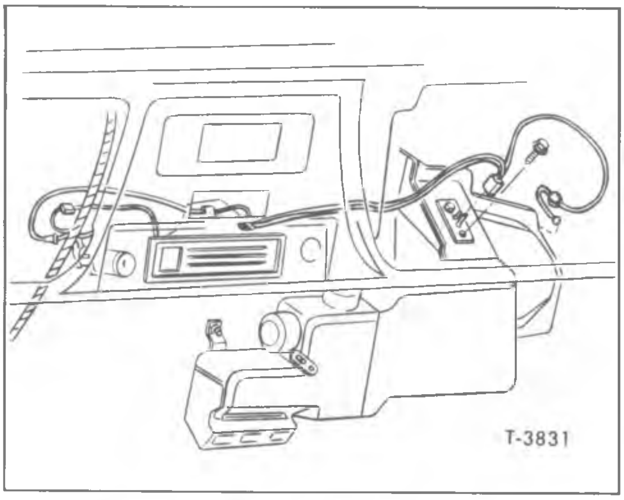


Figure 35—Deluxe Air-Flow Heater Wiring

CONTROL ASSEMBLY REPLACEMENT

REMOVAL (Fig. 30)

1. Remove the control assembly retaining screws at the lower edge of the dash.
2. Lower the unit and remove the blower switch.
3. Remove the cables from the control unit one by one and mount them in their respective positions on the replacement unit. Check cable adjustment.

INSTALLATION

1. Attach the blower switch and wiring to the control unit.
2. Place the unit in position in the dash and install mounting screws.

CONTROL CABLES REPLACEMENT

(Refer to Figure 29)

Remove the control assembly as outlined under "Control Assembly Replacement" and replace the affected cable or cables. Check cable adjustment before installing control assembly in dash. Access to the temperature door cable at the heater is through the plastic seal at the duct adapter.

BLOWER SWITCH REPLACEMENT

Blower switch replacement is covered as a part of "Control Assembly Replacement." Refer to that section for the necessary steps.

RESISTOR UNIT REPLACEMENT

(Refer to Figure 35)

REMOVAL

1. Remove glove box assembly.
2. Unplug harness connector from resistor unit. Remove the unit attaching screws and remove unit.

INSTALLATION

1. Place resistor unit in distributor duct and install attaching screws. Connect harness connector to unit.
2. Install glove box assembly.

Refer to "GENERAL MAINTENANCE" at beginning of this section for information on straightening, refinishing, and painting of cab which will apply.

For All Air Conditioning Information Refer to Separate "AIR CONDITIONING" sub-section at end of this section.

Some solvent cleaners are toxic and harmful; therefore, the following safety precautions should be used:

1. Always use in a well ventilated area. Car windows and garage doors must be open when such cleaners are used.

2. Avoid prolonged or repeated breathing of vapors from cleaner.

3. Avoid prolonged or repeated contact with the skin.

4. Keep away from eyes and mouth.

5. Some cleaners are flammable and every precaution and care must be exercised in handling these cleaners.

6. Always follow directions specified by the manufacturer of the product used (label directions).

SECTION 1C
Steel Tilt Cab

Maintenance information on windshield wipers, windshield and rear window glass replacement, and cab painting is explained in "GENERAL MAINTENANCE" section at beginning of this group. Refer to LUBRICATION (SEC. 0) for cab lubrication information. Contents of this section are listed in Index below:

CAB DESCRIPTION

The series 40 through 60 tilt cab is of all-steel welded construction (fig. 1). Cab fully surrounds engine and can be tilted 55 degrees to expose engine for servicing. The cab tilting mechanism is integral with cab front mountings and tilting is accomplished by means of a torsion bar extending across cab front hinge mountings. One end of torsion bar is anchored to cab, whereas opposite end is anchored to chassis. Cab is retained in lowered (operating) position by positive locking mechanism located at rear of cab.

Access for minor engine servicing, such as oil and engine coolant, is accomplished without tilting cab through access doors in panel at rear of passenger seat and at top of seat back riser. A concealed step is constructed in floor of each door opening. Also, a central island shifting area that is not disturbed with the cab tilted, is located between the seats. Island contains transmission shift lever and hand brake lever.

Two-piece windshield is retained in cab openings with a one-piece rubber seal expanded into position by a small rubber insert. No sealing compound or cement is used. Rear window glass and rear side glass is retained in same manner as windshield glass.

Doors are on swing-out type hinges with the upper hinge incorporating a spring-loaded door check for holding door open. Door is retained at the rear by a striker bolt on cab pillar. Outside handles are stationary-type screw retained to door and have a push button-type latch control.

Vent window in forward portion of door is of friction-type having a positive theft-resistant latch. Friction mechanism consists of a nylon bushing on lower pivot of vent which exerts frictional force against tension clamp mounted to door paneling.

Outside air enters cab through a vent directly in front of driver and through the outside air heating system. Air entry from outside of cab is made through a louvered, removable panel, located in front center of cab just above radiator grille opening. Air flows through plenum chamber between

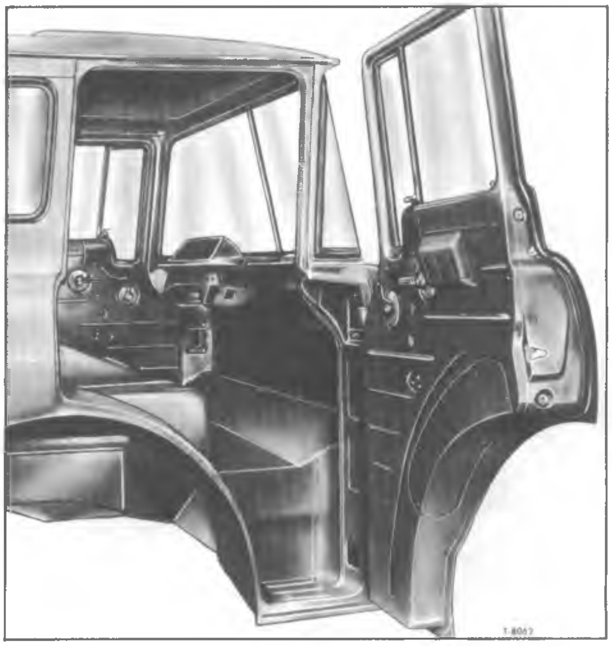


Figure 1—Tilt Cab Interior Construction

STEEL TILT CAB

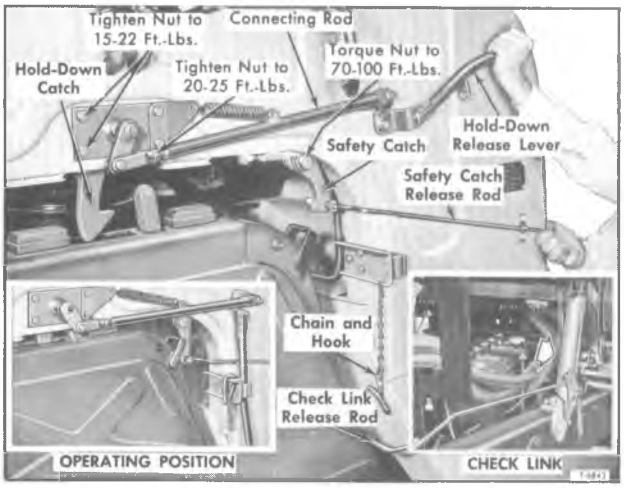


Figure 2—Releasing Cab Hold-Down Mechanism

outer and inner cab paneling and is dispersed to heater and vent outlet.

Cab is three-point mounted to chassis. Weight of cab at front is supported on cab right and left tilt hinges and a support bracket having rubber cushions, supports cab at rear center. Cab tilt hold-down mechanism locks cab firmly on cushions.

The underside of cab is completely insulated to deaden sound and prevent corrosion. A rubber weatherstrip around perimeter of door is used for sealing door to cab opening.

CAB TILTING INSTRUCTIONS

TO RAISE CAB (Fig. 2)

IMPORTANT: Before tilting cab forward, remove loose articles in cab; also place transmission shift lever in neutral and apply hand brake.

1. Close both doors of cab.
2. At right rear of cab remove safety chain hook.
3. While holding safety catch release rod to the right, pull hold-down release lever out and upward until hold-down catch becomes disengaged and rear of cab raises from mount (fig. 2). Tilt the cab completely forward until check link at right front mounting locks cab safely in full-tilt position.

IMPORTANT: Make sure check link is properly engaged with frame anchor pin.

TO LOWER CAB (Fig. 2)

IMPORTANT: Before lowering the cab to operating position, make sure transmission shift lever is in neutral position and that hand brake lever is in the applied position.

1. Release check link at right front mounting (see inset, fig. 2) by pulling rearward on link release rod, then pull cab back to operating position.
2. Safety catch at rear of cab will automatically become engaged. Pull downward on hold-down release lever and engage lower end of lever in lever spring catch, bracket-mounted to rear of cab.
3. Engage safety hook through matching holes in clip bracket and lug on lever by inserting the chain hook from underside.

NOTE: The raising and lowering effort of cab can be adjusted as desired by means of relocating torsion bar anchor lever at left frame bracket. If required, make adjustment as directed later under "Torsion Bar Tension Adjustment."

CAB MOUNTINGS

Cab is three-point mounted with two pivot-type mountings at front and twin cushion-type mountings at rear. Refer to figure 3 for typical views of mountings.

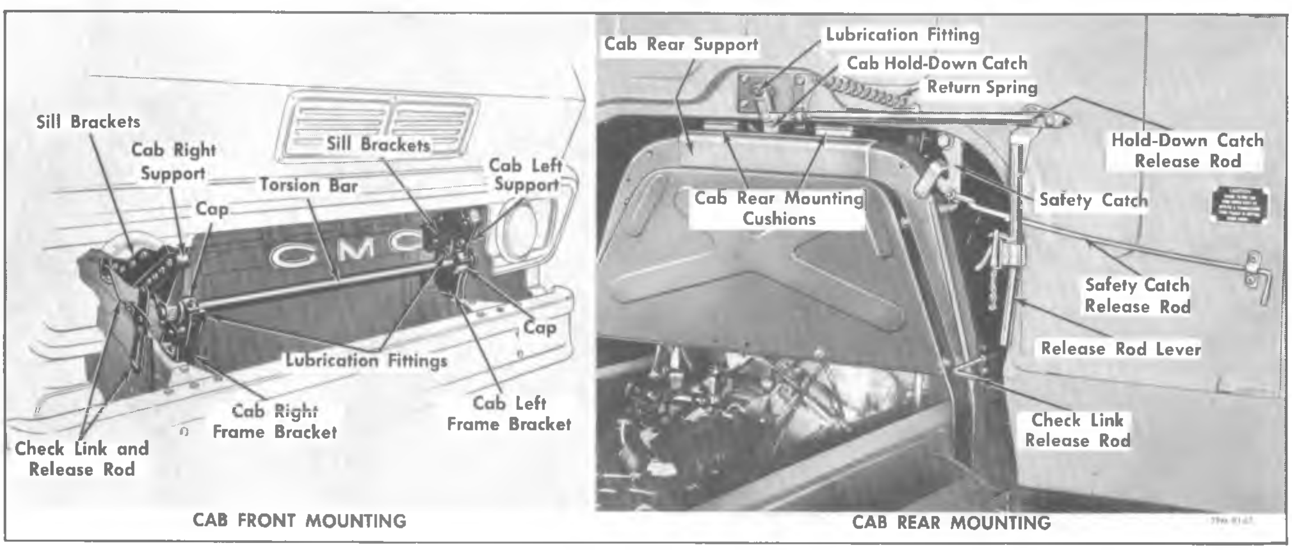


Figure 3—Cab Mountings

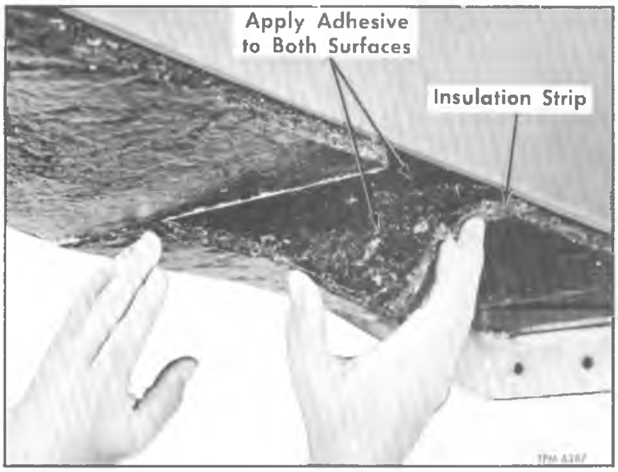


Figure 4—Applying Insulation

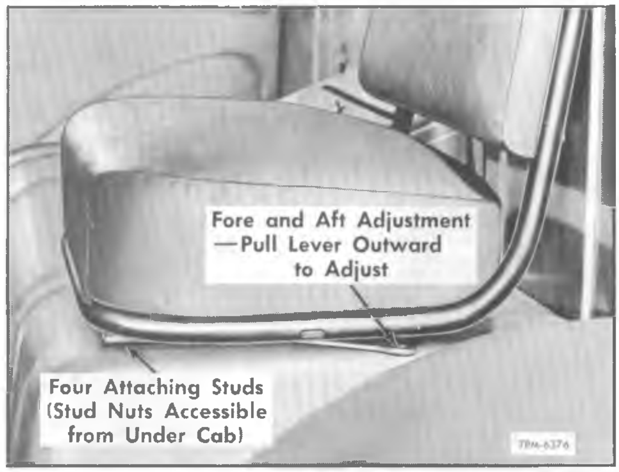


Figure 5—Driver's Seat Mounting and Adjustment

Interconnected with the cab front mountings is a torsion bar (fig. 3) which is under load when cab is in either the operating or full-tilted position. Right end of bar is anchored to cab bracket and left end is anchored by lever to frame bracket as shown in figure 3. Bar is unloaded when cab is tilted approximately 45 degrees, therefore, torsion bar assists operator in both the raising and lowering of cab.

CAUTION: UNDER NO CIRCUMSTANCES SHOULD THE BOLTS WHICH ATTACH TORSION BAR RIGHT ANCHOR BRACKET TO CAB AND THE TORSION BAR LEFT ANCHOR LEVER TO FRAME BE LOOSENED OR REMOVED WHEN CAB IS IN OPERATING OR FULL TILT POSITIONS WHICH IS WHEN BAR IS LOADED. AN INJURY COULD RESULT WHEN ANCHOR BRACKET AND TORSION BAR IS ALLOWED TO RELEASE.

Attaching bolts can be removed safely when bar is unloaded, cab tilted part way (approx. 45 degrees). Normally it should never be necessary to remove bolts. Whenever torsion bar is inoperative, cab must be supported safely.

Attaching bolts at front pivot mountings should be checked at regular intervals for tightness. Loose mountings will allow shifting of cab and eventual failure of other items connecting cab to chassis. Front pivot mountings have fittings for lubrication purposes. Lubricate as directed under LUBRICATION (SEC. 0) of this manual.

Rear mounting has positive locking mechanism to retain cab in normal operating position in relation to chassis frame. The rear mounting also includes an additional safety catch. Tightness of cab hold-down lock can be adjusted by shortening or lengthening catch release rod. After adjusting rod, tighten end yoke lock nut. Cab hold-down catch shaft is equipped with a lubrication fitting.

A check link is provided near the right front mounting (see inset, fig. 2) which limits the distance cab can be tilted forward and automatically locks the cab in the full-tilt position. Check link must be released before cab can be returned to normal operating position.

INSULATION

Insulation, applied to cab understructure directly over engine, is highly resistant to abrasion and corrosion and is designed to give maximum sound deadening and insulation.

In the event a repair such as welding is required to that part of cab covered with insulation, it is first necessary to remove the insulation from that area. After completing repair, insulation sections can be cut to size and cemented over the repaired area (fig. 4). Be sure to clean area thoroughly before installing new section of insulation.

SEATS

SEAT ADJUSTMENT (Fig. 5)

Driver's seat is provided with "fore" and "aft" adjustment only. Pull out on lever at left side of seat to disengage seat position lock.

SEAT TRACK REPLACEMENT (Fig. 5)

1. Tilt cab forward, then remove four nuts and washers from studs which attach seat tracks to seat riser of cab.
2. Lower cab to operating position, then lift seat assembly from cab.
3. Remove four nuts which attach each track assembly to seat assembly and remove track.
4. Reverse the above procedure to install track assembly.

Figure 6—Door Clearances

DOORS

Component sub-assemblies of cab doors, such as window regulator, door lock, remote control, vent window, and door window can be replaced without necessity of removing door from cab. Doors can be removed, however, without prior removal of above components. Removal and installation of door window glass is described later in this section.

DOOR REPLACEMENT

REMOVAL

1. With the aid of an assistant to support weight of door, remove the screws which attach hinge straps to door. Access to one cap screw at door upper hinge is gained by removing plug from door inner panel.
2. Carefully remove door assembly from cab.

INSTALLATION

Attach door to hinge straps with six cap screws. Adjust door in cab opening as instructed later under "Door Adjustments."

DOOR ADJUSTMENTS

Doors can be adjusted for alignment or clearance in the cab door opening (fig. 6), and for proper latching. Door alignment adjustments are made at the striker bolt, and at door hinges. The door, when properly located in door opening, will have equal clearance around its perimeter.

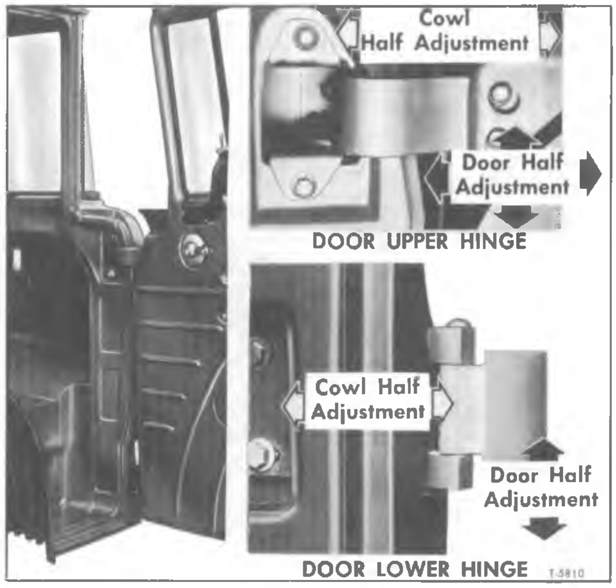


Figure 7—Door Hinges

If door has been replaced, adjustments should be made in sequence described in the following paragraphs:

REPOSITION DOOR "UP" OR "DOWN" (Fig. 7)

Door "up" and "down" adjustment in cab opening is provided by means of floating hinge cap screw tapping plates within door framing. Horizontal slotted cap screw holes in cab half of hinge assembly provide the "in" or "out" adjustment of door.

1. Remove striker bolt from cab pillar.
2. Loosen hinge-to-door cap screws slightly. Reposition door on hinges to provide equal clearance around perimeter of door in cab opening.

NOTE: Access to one cap screw at door upper hinge is gained after removing plug from door inner panel.

3. After satisfactory adjustment has been obtained, tighten hinge cap screws firmly. Open and close door to check operation. If necessary, repeat adjustment. Install hinge cap screw access plug in door inner paneling after making final adjustment.
4. Install striker bolt and adjust as directed later under "Striker Bolt Adjustment."

REPOSITION DOOR "FORE" OR "AFT" (Fig. 7)

Only the upper portion of door can be adjusted "fore" or "aft." This adjustment is made at the upper hinge. No means for this adjustment exists at the lower hinge.

1. Remove striker bolt from cab pillar.
2. Loosen upper hinge-to-door cap screws slightly. Access to one cap screw at door upper hinge is gained after removing plug from door inner panel.

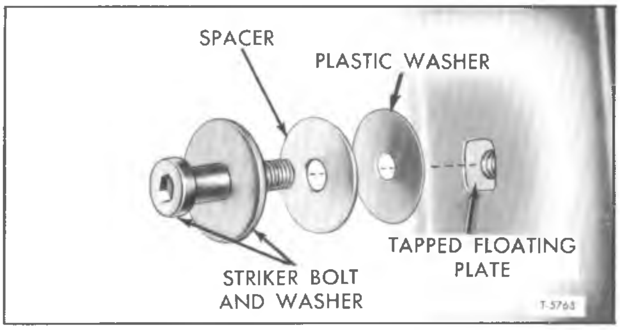


Figure 8—Door Striker Bolt and Washers

3. Lift upward or pull downward at rear of door to tilt upper portion of door "fore" or "aft" as desired.

4. Tighten hinge cap screws firmly after making adjustment. Open and close door to check operation. Repeat adjustment if necessary. Install cap screw access plug in door inner paneling.

5. Install striker bolt and adjust as directed later under "Striker Bolt Adjustment."

REPOSITION DOOR "IN" OR "OUT" (Fig. 7)

Horizontal cap screw slots exist in cab half of hinge assembly to permit this adjustment.

The outer surface of door, when properly installed, should be flush with adjacent surfaces of cab. If necessary, reposition door as follows:

1. Loosen slightly all cap screws which attach hinge half to cab pillar.

2. If door is to be brought outward from cab opening, apply pressure at door hinge area from inside cab. If door is to be moved inward, apply pressure on door outer panel at hinge area. Be careful not to damage door paneling by applying excessive pressure.

3. After adjustment has been made, tighten hinge cap screws firmly. Open and close door to check operation. Readjust if necessary.

DOOR STRIKER

NOTE: The door lock striker is an important attaching part, in that it could affect the performance of vital components. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary.

The door striker consists of a special bolt and washer assembly which is threaded into a tapped, floating cage plate located behind the cab lock pillar as shown in figure 8. The door is secured in closed position when the lock cam in door engages and snaps-over the striker bolt.

STRIKER BOLT REPLACEMENT (Fig. 8)

1. Mark position of striker bolt spacer or washer on door pillar using pencil or crayon.

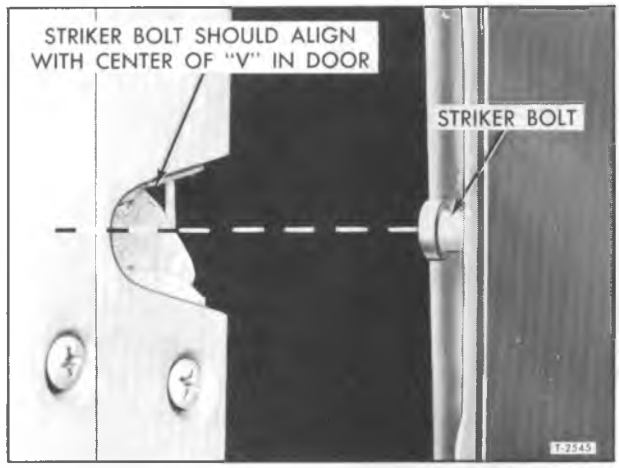


Figure 9—Sight Checking Striker Bolt Alignment

2. Insert a 5/16-inch hex wrench into head of striker bolt, then turn bolt counterclockwise from plate in cab pillar.

3. Reverse above procedure to install striker bolt. Make sure the thin plastic washer is positioned against the painted door opening pillar and center the bolt washer within marks on pillar.

4. If door has been removed and then installed or aligned in opening, the door should not be closed completely until a visual check is made to determine if lock cam in door will engage the striker bolt correctly. Center of striker bolt should be in direct alignment with "V" slot in door. See figure 9. If necessary, reposition striker bolt as directed below under "Striker Bolt Adjustment."

STRIKER BOLT ADJUSTMENT (Fig. 10)

Striker bolt on cab pillar is adjustable vertically and transversely after loosening the bolt with a 5/16-inch hex wrench. The bolt fore and aft adjustment is obtained by use of shim spacers located between the bolt washer and the cab pillar. Figure 8 illustrates location of bolt, washers, and spacer.

Striker Bolt Fore and Aft Adjustment

1. To check striker bolt for proper fore and aft adjustment, smear grease or paint to contact side of bolt as shown in figure 10.

2. Slowly close door until lock cam of door just contacts the side of striker bolt and makes an impression in the grease or paint.

3. Measure distance between head of bolt and the cam impression in grease. Distance should measure 1/8-inch as shown in right view of figure 10. This dimension is necessary to assure that the head of striker bolt will ride at center of nylon shoe which is located just in back of the lock cam.

To obtain this dimension, remove the striker bolt and install or remove shim spacers. Spacers

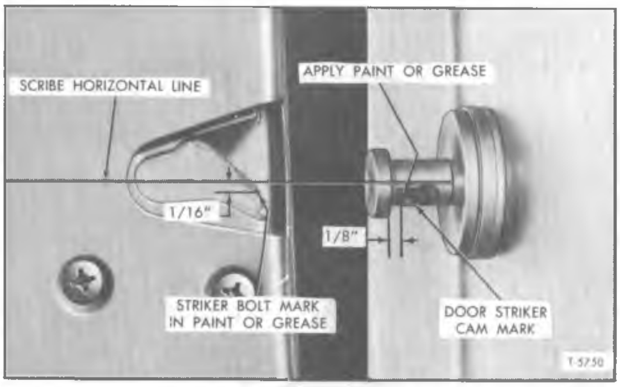


Figure 10—Striker Bolt Alignment

are available in two thicknesses: 5/64-inch and 5/32-inch. Make sure the thin plastic washer is located next to cab pillar.

After obtaining proper fore and aft adjustment, tighten bolt snug only at this time and then proceed with the "Striker Bolt Height Adjustment."

Striker Bolt Height Adjustment

This adjustment is important to assure that the right proportion of door's weight will rest on striker bolt when door is closed. If bolt is positioned too high on pillar, rapid wear will occur to the lock cam: if too low, an extra load will be placed on door hinges as well as pull door downward and out of alignment.

Generally the striker bolt height adjustment can be checked quite accurately by just sighting the center of "V" slot on door with the center of striker bolt as illustrated in figure 9. However,

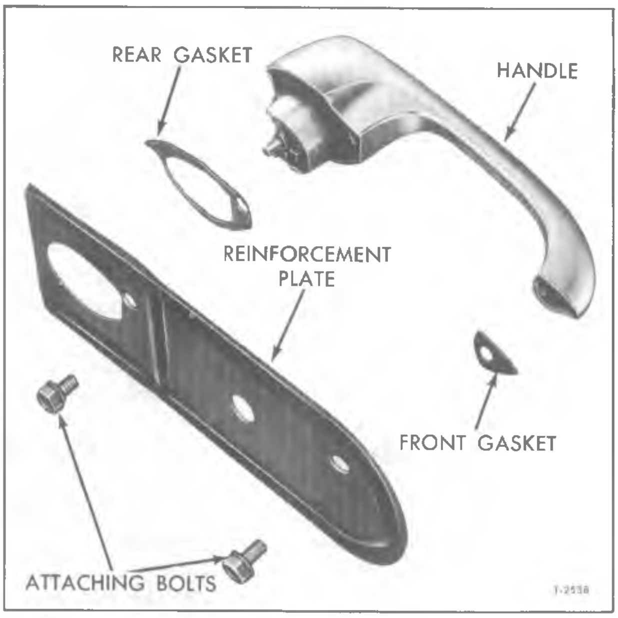


Figure 11—Door Handle Installation

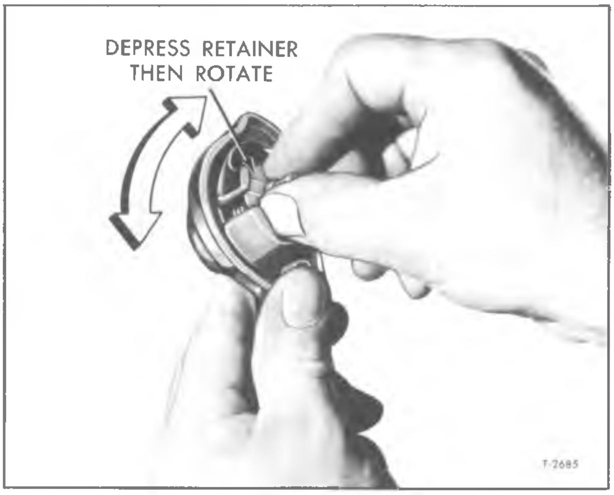


Figure 12—Disengaging Handle Spring Retainer

to make a more positive check, perform the following:

1. Mark a horizontal line through center of "V" slot and on door lock cam as shown in left view of figure 10.

2. Smear some grease or paint on contact edge of lock cam as shown in same view.

3. Slowly close door until cam barely contacts the striker bolt to leave an impression in grease. Open door and check contact mark on edge of cam. Mark should be located approximately 1/16-inch below the horizontal mark if properly aligned.

4. If necessary, raise or lower the loosened striker bolt up or down by tapping on the washer or spacer at base of striker bolt. DO NOT TAP ON HEAD OF BOLT.

Door Rear Edge "In" or "Out" Adjustment

This adjustment is for purpose of aligning the rear surface of door flush with adjacent surfaces of cab. If surfaces are not flush, proceed as follows:

1. Mark a horizontal line on cab pillar at top of striker bolt base washer or spacer.

2. Loosen striker bolt slightly, then tap against bolt base washer, to move bolt "in" or "out" as necessary to locate door surface flush with cab surface when door is closed. Before tightening the striker bolt make sure top bolt base washer is contacting the horizontal mark on cab pillar. Final tighten striker bolt.

DOOR OUTSIDE HANDLE REPLACEMENT

REMOVAL

1. Remove eight screws which attach access panel to lower portion of door. Remove access panel.

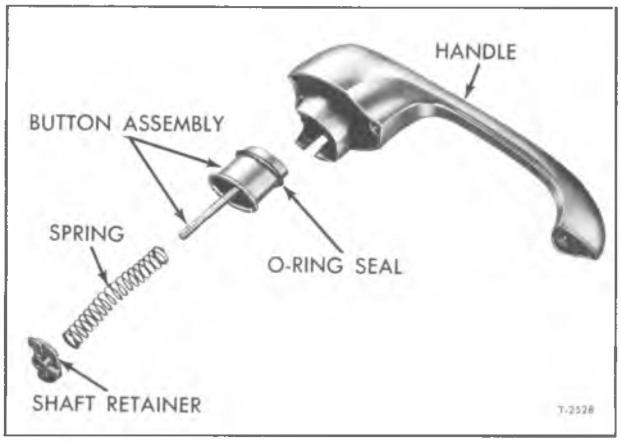


Figure 13—Door Handle Components

2. Roll door glass to top, then through access opening, using a 7/16" wrench, remove two bolts which attach door handle to door outer panel. Remove handle and handle gaskets (fig. 11).

NOTE: Reinforcement plate is spot-welded to inside of door outer panel.

3. Remove the button shaft retainer by first depressing, then rotating retainer as shown in figure 12. Remove shaft spring and button assembly with O-ring seal from handle (fig. 13).

INSTALLATION

1. Place button assembly with installed O-ring seal in handle.
2. Locate spring over button shaft, then install spring retainer (fig. 12).
3. Position door handle with gaskets to door outer panel, then through access opening at bottom of door, install two attaching bolts.
4. Install access panel to bottom of door.

DOOR LOCK CYLINDER REPLACEMENT

REMOVAL (Fig. 14)

1. Remove access panel at bottom of door.

2. Through access panel opening, pull lock cylinder retainer from beneath the lock cylinder grooves by grasping retainer lip with pliers.

3. Tilt lock assembly to permit cylinder lug to disengage from lock mechanism lever. Remove lock cylinder and gasket from door.

INSTALLATION (Fig. 14)

1. With gasket in position on lock cylinder, insert cylinder in door and engage lug over lock mechanism lever.
2. While holding cylinder, insert legs of re-

Figure 14—Door Lock Cylinder Replacement

tainer into grooves of lock cylinder body. Be certain legs of retainer are fully engaged. It may be necessary to drive retainer into final engagement with a light hammer.

3. Insert key and check operation of lock. If lock operates freely, install lower access panel to door.

DOOR INSIDE HANDLE REPLACEMENT

Window regulator crank handle and door lock handle are retained on shafts by lock springs. If

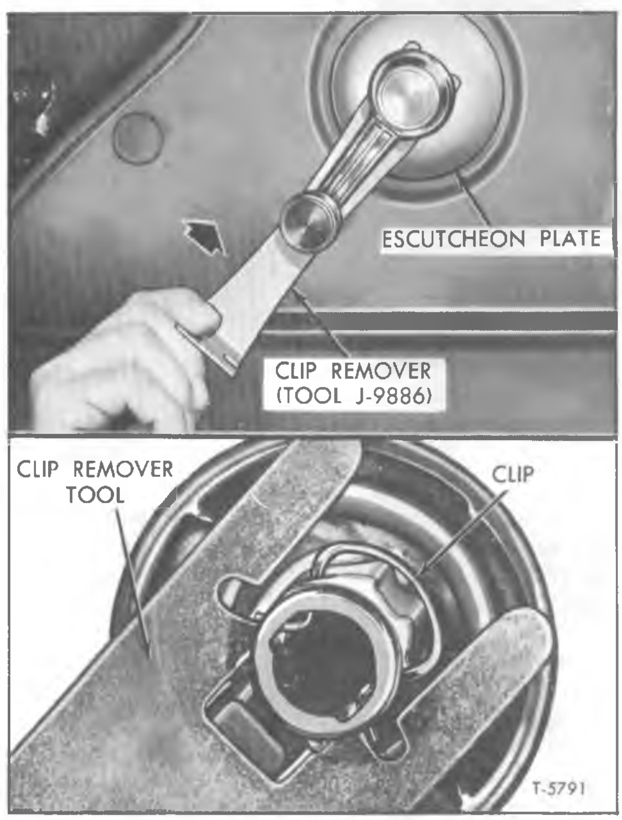
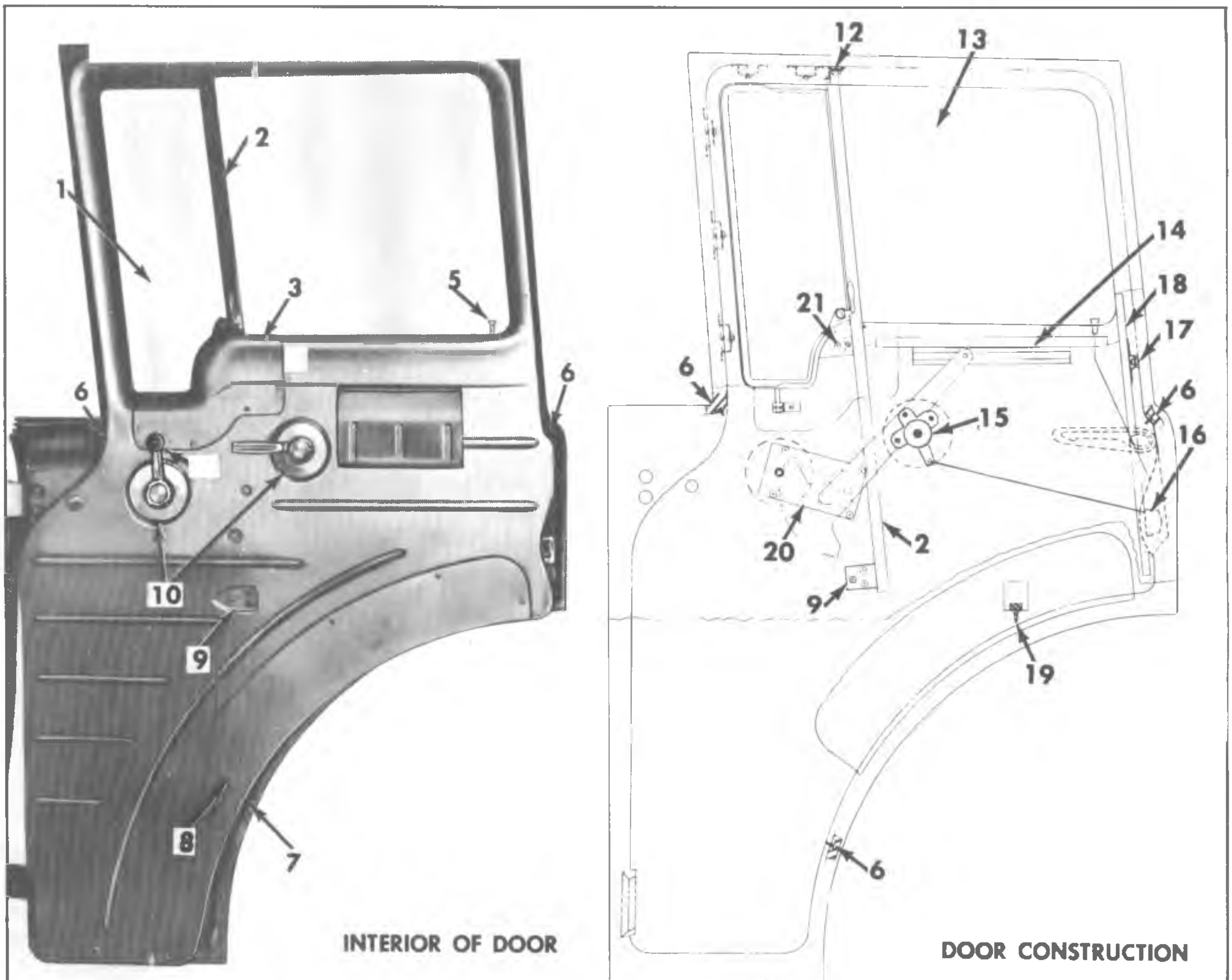


Figure 15—Disengaging Door Inside Handle



1 Vent Window Glass
2 Division Channel
3 Access Panel
4 Remote Control Handle
5 Inside Lock Knob
6 Weatherstrip Seal Clip and Screw
7 Weatherstrip Seal
8 Access Panel
9 Division Channel Lower Attaching Screws
10 Escutcheon Plates
11 Regulator Handle
12 Division Channel Upper Attaching Screws
13 Door Window
14 Sash Channel
15 Door Lock Remote Control Assembly
16 Door Lock Mechanism
17 Run Channel Retainer Screw
18 Run Channel Retainer
19 Door Window Stop Bumper
20 Window Regulator Assy.
21 Division Channel Center Attaching Screw T-8067

Figure 16—Door Construction

removing door lock inside handle, the handle position should be marked in relation to door panel to assure that handle is installed later at the same operating angle.

REMOVAL (Fig. 15)

1. Insert tool (J-9886) between handle flange and escutcheon plate.
2. Force lock spring from grooves in base of handle. DO NOT LOSE SPRING. Remove handle and escutcheon plate.

NOTE: The lower view in figure 15 shows how the tool engages the clip at underside of handle when removing. Clip may be installed in opposite direction than shown.

INSTALLATION

1. Insert lock spring in handle grooves.
2. Place the escutcheon plate on handle spindle.
3. If installing door lock handle, make sure handle is in position previously marked on door inner panel. To install either handle, force handle with installed lock spring over spindle until lock spring becomes fully engaged.

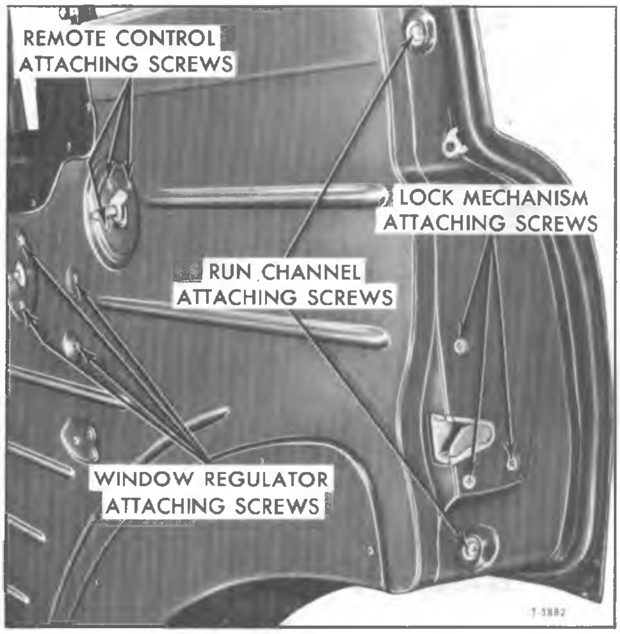


Figure 17—Door Lock Attaching Screws (Typical)

DOOR LOCK AND REMOTE CONTROL MECHANISM REPLACEMENT

NOTE: Figure 16 illustrates the position of the lock and remote control mechanism components.

REMOVAL (Fig. 17)

1. Remove the door inside lock knob which is threaded on lock rod.
2. Remove the lower access panel from door inner panel as directed previously.
3. Raise window and then remove the door inside handle as directed previously.
4. Remove three screws which attach remote control to door inner panel. Lower control to door access opening, then disengage fastener at pull-rod. Separate rod and remove control from door.
5. Remove the lock cylinder assembly from outer side of door as directed previously.
6. At rear edge of door, remove two run channel retainer screws to provide clearance for removal of lock mechanism.
7. At rear edge of door, remove three special locking-type screws which attach lock mechanism to door frame. Lower the lock and attached two rods out through access opening in door.
8. Separate rods from lock mechanism by disengaging fasteners.

INSTALLATION (Figs. 16 and 17)

Install lock mechanism with rods and remote control in reverse of the "Removal" procedures.

IMPORTANT: Make sure to use the three special locking-type screws which attach lock mechanism to door frame. Check operation of door lock and remote control mechanism after installation. As required, remote control unit may be shifted slightly on door inner panel to obtain satisfactory lock operation.

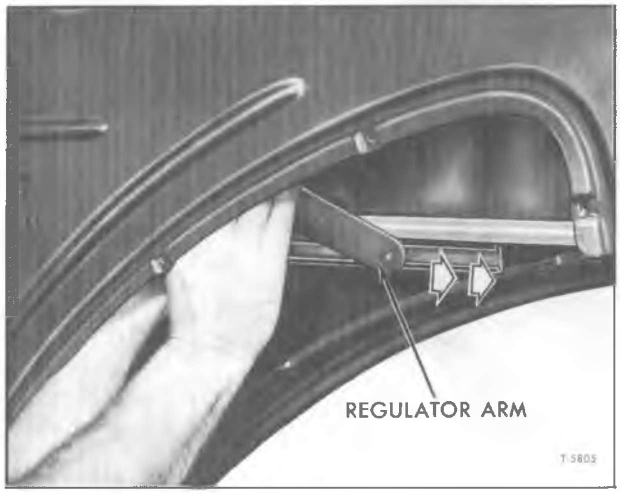


Figure 18—Removing Regulator Arm from Track

DOOR WINDOW REGULATOR REPLACEMENT

REMOVAL

1. Remove access panel from lower portion of door.
2. Lower window and remove window regulator handle and escutcheon plate.

Figure 19—Lowering Regulator from Door

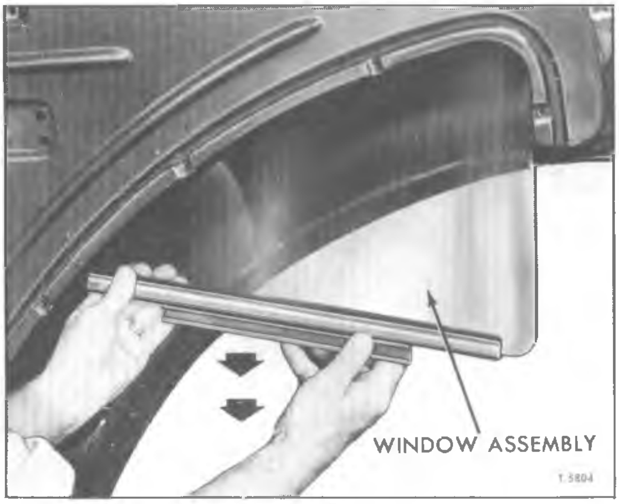


Figure 20—Removing Door Window Glass

3. While holding regulator assembly through opening in door, remove four screws (figs. 16 and 17) which attach regulator assembly to door inner panel.

4. Guide regulator arm to remove roller from window channel track (fig. 18). Carefully lower regulator assembly from door (fig. 19).

INSTALLATION

Install door window regulator in reverse order of "Removal" procedures. Before installing access door, operate window regulator to be sure roller is not binding in window channel track. If binding occurs, bend window regulator arm slightly until roller turns freely in channel. Also, check division and run channels for alignment.

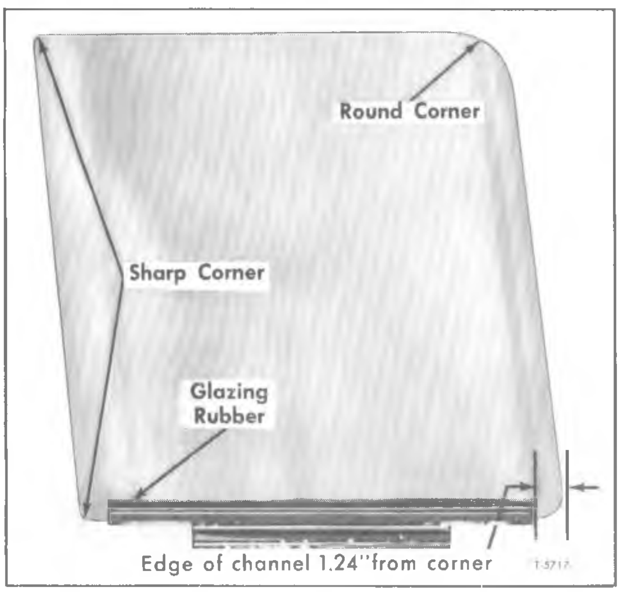


Figure 21—Door Glass Assembly (Right Side Shown)

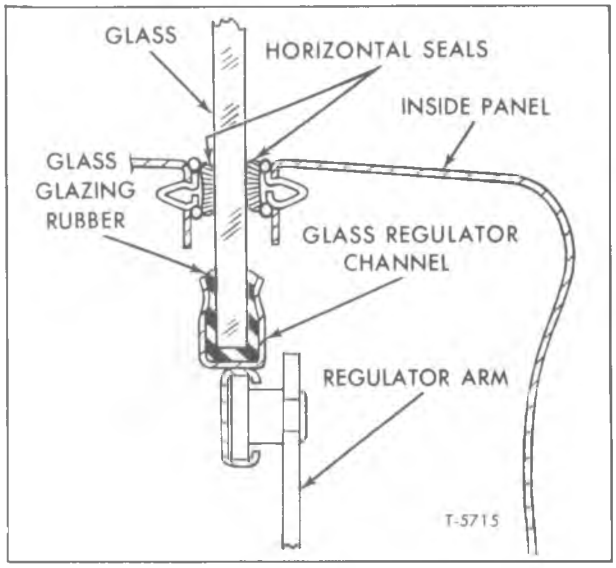


Figure 22—Cross Section of Window Regulator Channel

DOOR WINDOW GLASS REPLACEMENT

REMOVAL

1. Remove access panel from door inner panel below vent window.
2. Unlatch vent window and swing outward.
3. Remove five screws which attach access trim panel to door just below vent window.
4. Remove frame to door screw and frame to divisional channel screw (fig. 16).
5. Remove three division channel lower attaching screws (fig. 16).
6. Remove division channel screws at top of door (fig. 16).
7. Remove two screws at edge of door which attach run channel to door (figs. 16 and 17).
8. Lower window and remove window regulator assembly as described previously (figs. 18 and 19).
9. Tilt and lower glass assembly through lower access opening (fig. 20).

INSTALLATION

1. Squirt Prepsol or equivalent along glass filler on both sides of glass to soften seal. Remove glass from channel when filler is sufficiently soft.
2. Thoroughly clean inside of glass channel by removing all rust and old glazing rubber filler.
3. Cut new piece of glazing rubber filler to length of glass regulator channel.
4. Position glazing rubber filler (soapstone side away from glass) on bottom edge of glass 1.24-inch from lower corner as shown in figure 21.
5. Carefully position edge of glass regulator channel 1.24-inch from lower right corner (fig. 21) and then press channel over glass and glazing

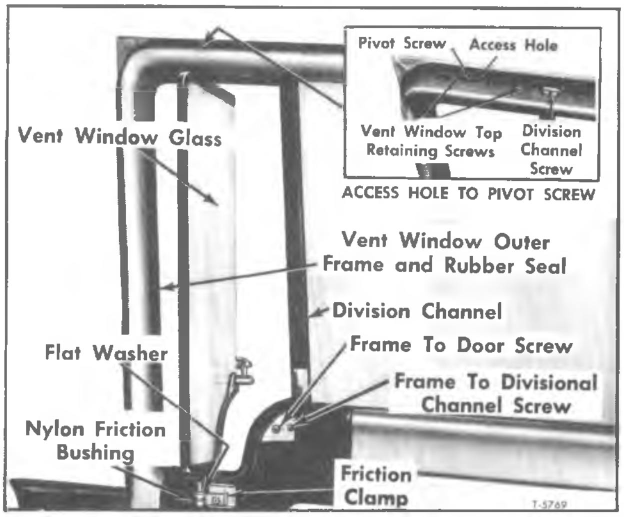


Figure 23—Door Vent Window Installed

rubber filler. Lightly tap channel with rubber hammer to firmly seat channel over glass and filler.

6. Install assembled window into door in reverse order of "Removal" procedures.

NOTE: When inserting glass assembly into door run channels, be careful not scratch or place undue stress on glass. After installation, raise and lower window to check for binding. If binding occurs, adjust appropriate run channels by loosening applicable channel attaching screws.

DOOR WINDOW GLASS HORIZONTAL SEALS REPLACEMENT

1. Remove access panel from bottom of door. This will remove window stop attached to access panel and allow top of window to be lowered to a point below horizontal weatherstrips.
2. Using a flat-blade screwdriver, pry weatherstrips from door (fig. 22).
3. Install weatherstrips to door, making sure retaining clips are fully engaged.
4. Raise window, then install access panel to bottom of door.

DOOR WINDOW RUN CHANNEL REPLACEMENT

1. Remove door window as explained previously under "Door Window Glass Replacement."
2. Remove applicable screws which attach either division channel or run channel to door framing (fig. 16) and lower channel(s) through access opening at bottom of door.
3. Install channel(s) in reverse order of removal procedures.

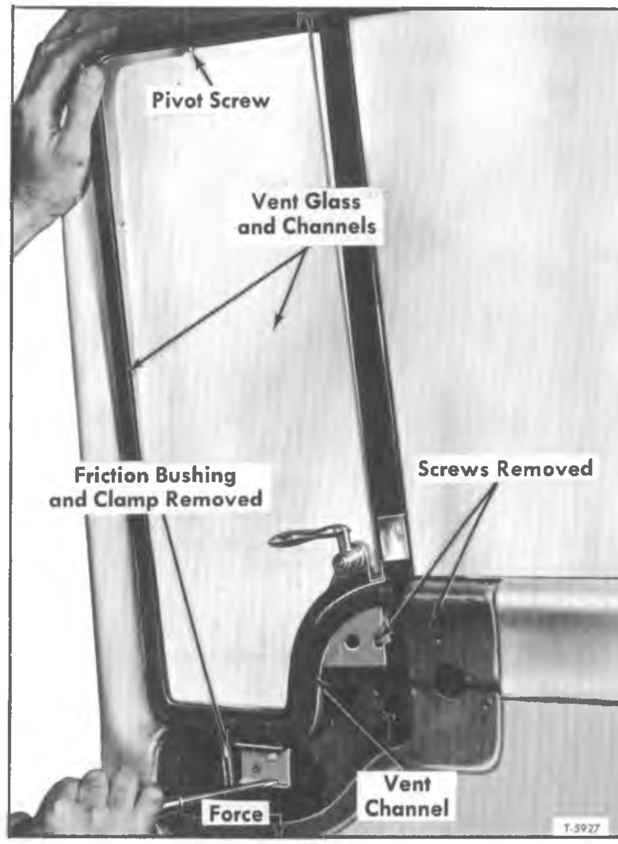


Figure 24—Removing Vent Window

4. Install and adjust window glass as explained previously under "Door Window Glass Replacement."

DOOR VENT WINDOW TENSION ADJUSTMENT

Cab vent windows are of friction type having a positive theft-resistant latch. Friction mechanism consists of a bushing attached at lower end of vent shaft which rotates in a stationary friction clamp.

If friction mechanism is adjusted too tight, it will be difficult to open or close vent. Too loose an adjustment will result in a fluttering vent or one having a tendency to close with wind pressure.

If necessary to change vent friction, perform procedures as follows:

1. Remove access trim panel attached to door just below vent window with five screws. Figure 23 shows access opening to friction components.
2. Using screwdriver, turn clamp screw (fig. 23) to obtain two to four pounds torque while moving vent window from a ten-degree open position to a full-open position. Use either a push or pull-type spring scale positioned at rear edge of glass.

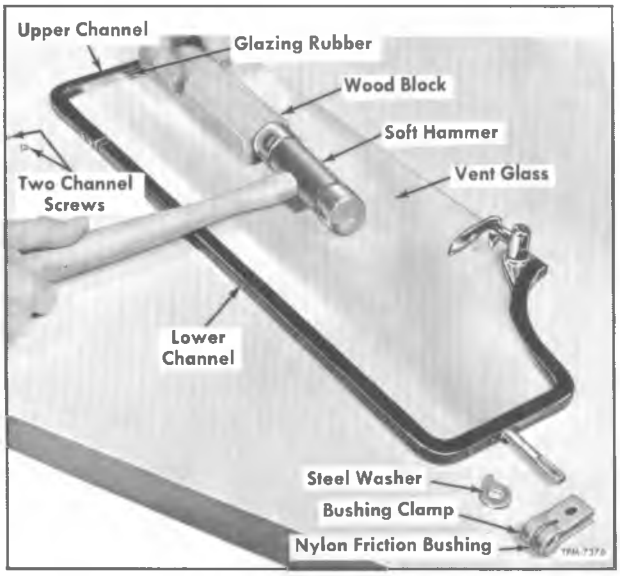


Figure 25—Vent Window Disassembled

3. After obtaining proper tension, install access trim panel.

DOOR VENT GLASS REPLACEMENT

REMOVAL

1. Remove small access panel from inner side of door below vent window.
2. At bottom of vent glass (fig. 23), place hand to catch vent friction components, then remove screw from friction clamp. Slide clamp, friction bushing, and flat steel washer from vent shaft.
3. At top of door through small access opening (see inset, fig. 23), turn vent upper pivot screw from vent frame.

NOTE: Screw need not be removed completely, just enough to become disengaged from vent glass channel.

4. Remove three screws which attach division channel to vent channel just below vent latch. Using a screwdriver, pry down on vent channel as shown in figure 24, which will cause upper part of channel to become disengaged from pivot screw. Rotate glass channel lower pivot shaft up out of vent channel.
5. Remove two screws which attach glass upper channel to glass lower channel (fig. 25).
6. Apply Prepsol or equivalent on vent glazing rubber to soften old rubber. When rubber softens sufficiently, separate upper and lower glass channels, then remove old glass.

INSTALLATION

1. Thoroughly clean inside of glass channels

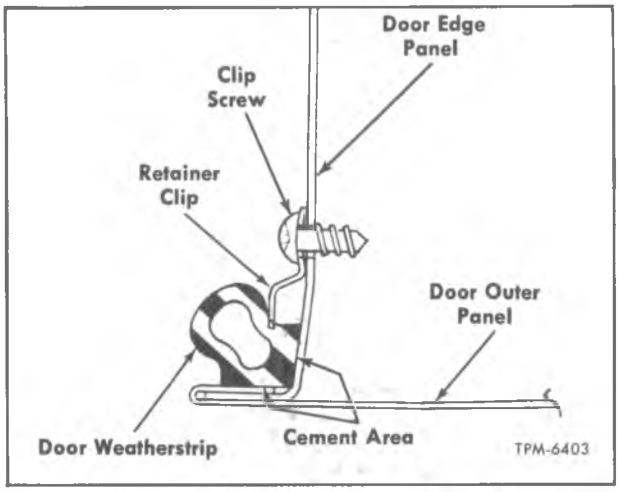


Figure 26—Door Weatherstrip Installed

to remove old glazing rubber, rust, or other foreign matter.

2. Position new glazing rubber (soapstone side away from glass) around edge of glass. Press glass with glazing rubber into lower channel, then press upper channel over top of glass. Make sure channels are firmly seated, then install two small screws which attach channels together (fig. 25).
3. If necessary, trim glazing rubber at ends of channels and along sides of channel each side of glass. As required, seal cracks at latch bracket.
4. Insert pivot stud of vent lower channel into hole of vent frame as shown in figure 24. Through small access hole at top of door, install vent upper pivot screw. Install three screws which attach bracket of vent channel to glass division channel just below vent latch.
5. Install special flat washer, nylon friction bushing, and friction clamp on vent lower channel pivot shaft, positioned as shown in figure 23.

NOTE: Make sure that tab on special flat washer is positioned properly to act as a stop of vent when it is in full open position. Attach friction clamp to vent lower frame with screw. Tighten screw to obtain two to four pounds torque while moving vent window from a ten-degree to a full-open position. Use either a push or pull type spring scale positioned at rear edge of glass.

6. Install access panel to inner side of door.

DOOR WEATHERSTRIP REPLACEMENT

1. Remove screw-retained clips from weatherstrip around perimeter of door. Figure 26 shows view of weatherstrip installed at retainer.
2. Pull weatherstrip from door, then scrape any rubber or adhesive material which may have become bonded to door surface.

3. Apply coat of weatherstrip adhesive to seal and seal surfaces of door as directed by manufacturer of adhesive. Directions for application are usually found on adhesive container.

4. Position seal around perimeter of door, making sure corners of seal engage respective corners of door.

5. Install screw-retained clips (fig. 26) to door and weatherstrip. Tighten clip screws firmly but be careful not to tear weatherstrip.

CAB VENTILATION AND HEATING

VENTILATION

A single grilled intake at front center of cab (fig. 26) permits outside air to enter plenum chamber located between the cab outer and inner panels. From the plenum chamber, outside air can be directed into cab interior through opening at front of driver and through opening at front of passenger. When heater is used, the outside air enters heating system through the right side opening.

The outlet located ahead of driver is opened and closed manually by control knob on dash. The control knob pushed inward closes outlet door and pulling out on knob opens outlet door. A spring-loaded door prop retains door snug in either the fully opened or closed positions. A rubber seal around perimeter of outlet door provides positive sealing of outlet. Seal, which is glued to door, can be readily replaced if necessary.

CONTROL ADJUSTMENT (DRIVER"S SIDE)

NOTE: Refer to inset of figure 27.

When control knob on dash is pushed completely in, the air outlet door should close snug to outlet opening.

If door is not seated completely with control knob in this position, loosen screw at control conduit clamp above door which will allow compression spring within door telescopic prop to force door tight to opening. Retighten clamp screw after making adjustment.

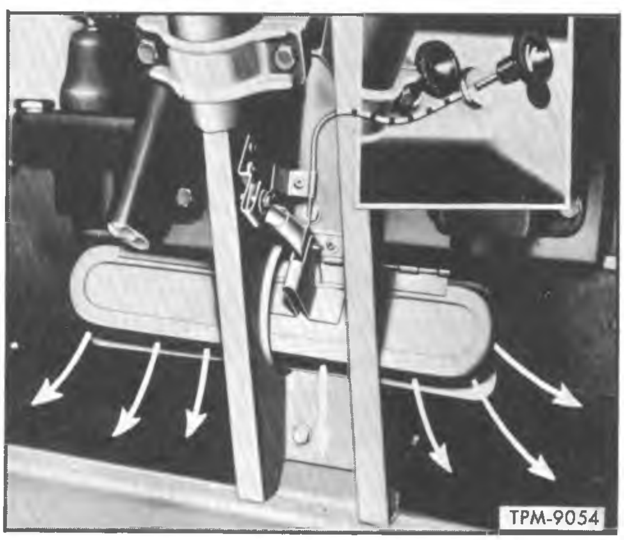


Figure 27—Outside Air Intake

HEATING (STEEL TILT CAB MODELS)

The heater is of the water valve temperature control type (fig. 28). It provides heated outside air for heating and defrosting requirements.

Air is drawn from outside, down through the heater core and blown out into cab through the distributor duct.

The thermostatic valve is a manually set temperature control to limit core, and outlet air temperature.

The heater unit attaching parts are shown in figure 28.

RESISTOR UNIT

The resistor is located at the back of the duct assembly within the cab of the vehicle. Since the resistor provides the different blower speeds, it should be checked first when blower malfunctions occur.

HEATER CONTROLS

All control levers are in the "OFF" position with knobs at top of panel.

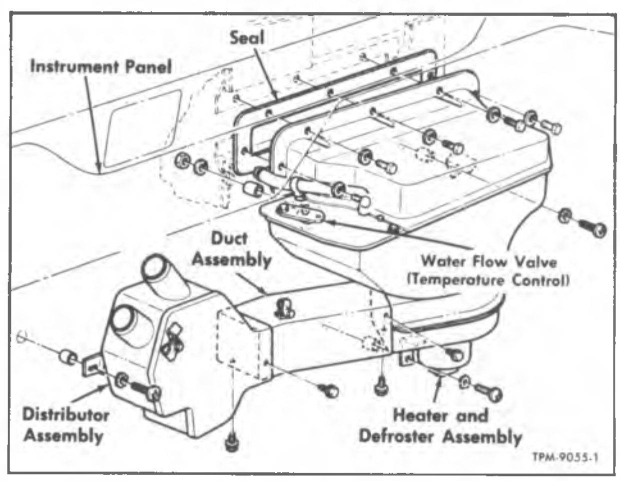


Figure 28—Heater Installation

"FAN" knob provides three blower speeds -- low speed at first detent position, medium speed at second detent position, and high speed at bottom position.

"DEF." knob controls flow of heated air to the windshield defroster ducts. With knob all the way down, entire heater output is diverted to the defroster ducts for defrosting.

"HEAT" knob sets a thermostatically controlled valve in heater water inlet. Bottom position provides maximum heat. Knob can be set at any position to maintain the desired heat.

"AIR" knob controls flow of outside air through heater core. After engine has warmed up, push knob all the way down to admit outside air through heater.

At low vehicle speeds, operate the blower at high speed while regulating the heat with the "HEAT" lever. At high vehicle speeds, use low blower speed.

For summer ventilation, leave "DEF." and "HEAT" knob in up position. Push "AIR" knob down to pass unheated outside air through the heater ducts to augment that supplied through the cowl vents. The blower fan may be turned on if desired.

HEATER CORE, BLOWER AND DISTRIBUTOR DUCT REPLACEMENT

Both the distributor duct and the blower assembly can be readily replaced separately without having to remove the heater core unit from cab. The replacement procedure following describes the method for replacing the heater air distributor, the blower and motor assembly, and the heater core unit.

Removal (Fig. 28)

1. Drain the cooling system to just below level of heater core fittings.
2. Mark the heater hoses and piping below front of cab for identification purposes later at installation, then disconnect hoses.
3. Separate the defroster air duct tubes from air distributor.
4. Disconnect electrical wiring from heater speed control resistor and from blower motor. Resistor is located behind distributor duct assembly.
5. Remove screws which attach the air distributor to cab and to blower duct assembly. Remove air distributor.
6. To remove the heater core and blower unit as an assembly, remove the screws which attach the heater core housing to the outside air inlet duct. Carefully lower heater unit and remove from compartment.
7. To remove the outside air inlet duct, remove screws which attach duct to fire wall and instrument panel, then remove duct and seal gasket.
8. Remove screws which attach heater core in housing. Remove core.
9. Remove screws which attach blower motor to heater core housing. Remove motor and blower fan assembly.

NOTE: The heater core can be repaired by a competent radiator core repairman.

Installation (Fig. 28)

Assemble and install the heater components in reverse of "Removal" procedures using new gaskets and seals where necessary.

IMPORTANT: When connecting heater hoses to core piping make sure the 5/8-inch I.D. hose is connected to small core pipe and that ¾-inch I.D. hose is connected to larger pipe.

If hoses are not installed as directed, poor heat output and/or a ruptured heater core may result. The core, internally, is designed to accept the higher pressure at the inlet (5/8-inch I.D. pipe) side of core only.

HEATER CONTROL CABLE ADJUSTMENT

Each control wire conduit is equipped with a lock screw which can be adjusted to obtain full opening and closing of air doors and to even up the heater knobs on control panel. Make adjustment to control wire conduit if desired.

TROUBLESHOOTING HEATING SYSTEM

Poor Or No Heating

1. Check and if necessary, adjust control cable at thermostatic valve.
2. Check for kinked, deteriorated, or reversed heater water hoses.
3. Check circuit through heater control switch.
4. Check for inoperative thermostatic valve.
5. Check for plugged heater core.
6. Low coolant temperature.

Too Much Heat

Broken capillary tube at thermostatic valve.

Heater Will Not Shut Off

1. Check and if necessary adjust control cable at thermostatic valve.
2. Check for inoperative thermostatic valve.

Blower Operates at High Speed Only

Resistor defective.

Blower Inoperative

1. Check dash switch and blower motor connections.
2. Check the blower motor.

CAB REPLACEMENT

Necessary equipment for efficient and safe replacement of cab consists of a chain hoist (1-ton minimum capacity), a sling having padded hangers, and two or more support blocks to rest cab on when it is removed from chassis.

NOTE: A wood 4 x 4, 7½ feet long positioned through cab door openings with a hoist chain attached securely to each end can be used. However, means of protecting top of cab from chain must be provided. Also, be sure to provide padding at points where beam contacts cab openings and carefully position beam to assure proper cab support.

CAB REMOVAL

1. Disconnect battery ground strap.
2. On vehicles with air brakes, exhaust air supply from air tank at drain fitting. Remove bumper (with attached air tank, if used).
3. Open heater temperature control on dash to full open position, and drain radiator. Disconnect heater hoses at cab connections.
4. Disconnect accelerator linkage and steering flexible coupling, marking for later alignment. Disconnect brake lines and clutch line.
5. Disconnect speedometer cable and all electric connectors that junction cab with the chassis. Remove cab-to-chassis ground straps.

NOTE: REMOVE OR SECURE ALL LOOSE ITEMS IN CAB BEFORE TILTING. PLACE SHIFT LEVER IN NEUTRAL AND THE HAND BRAKE IN FULL-APPLIED POSITION.

6. Attach a suitable padded lifting sling (fig. 29) to cab with doors partly open (lifting cab with doors closed will disturb door alignment later).

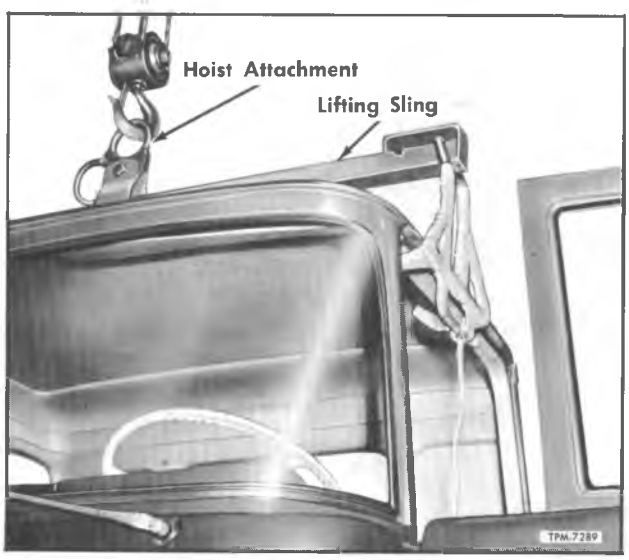


Figure 29—Lifting Sling Attached to Cab

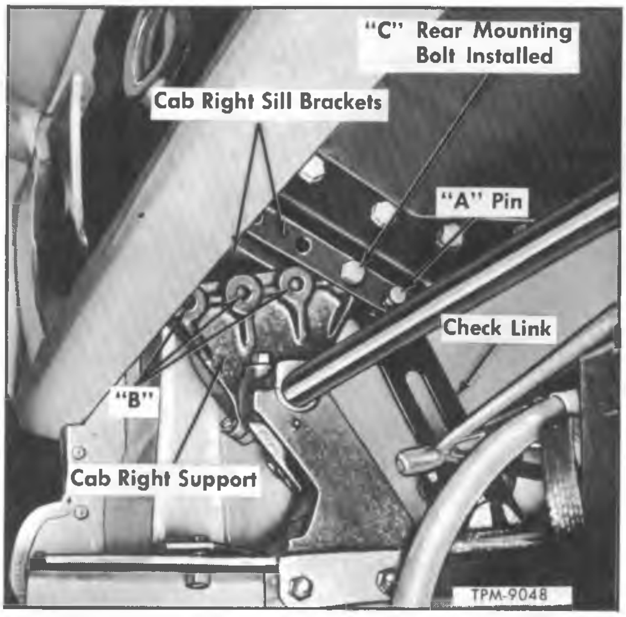


Figure 30—Mounting at Cab Rear Support

7. Using aid of assistant and hoist, tilt cab approximately 45° to the unloaded position of cab mounting torsion bar (refer to preceding caution) and suspend safely there. While cab is in this position, insert a pry bar in between cab right support and cab sill. Remove three forward bolts, lock washers and nuts from cab right support to sill brackets (B, fig. 30). Use pry bar to assist in removing bolts. Disconnect check link at right side of cab.
8. Place a short piece of wood 2" x 4" over catch hole in cab rear support (fig. 31), then with aid of assistant, lower cab until catch at bottom of cab rests on block. This will prevent engagement of cab hold-down catch. Remove two retaining bolts

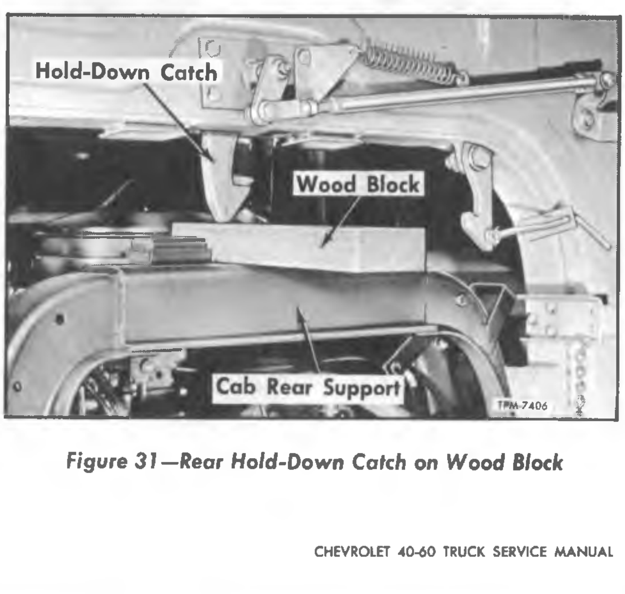


Figure 31—Rear Hold-Down Catch on Wood Block

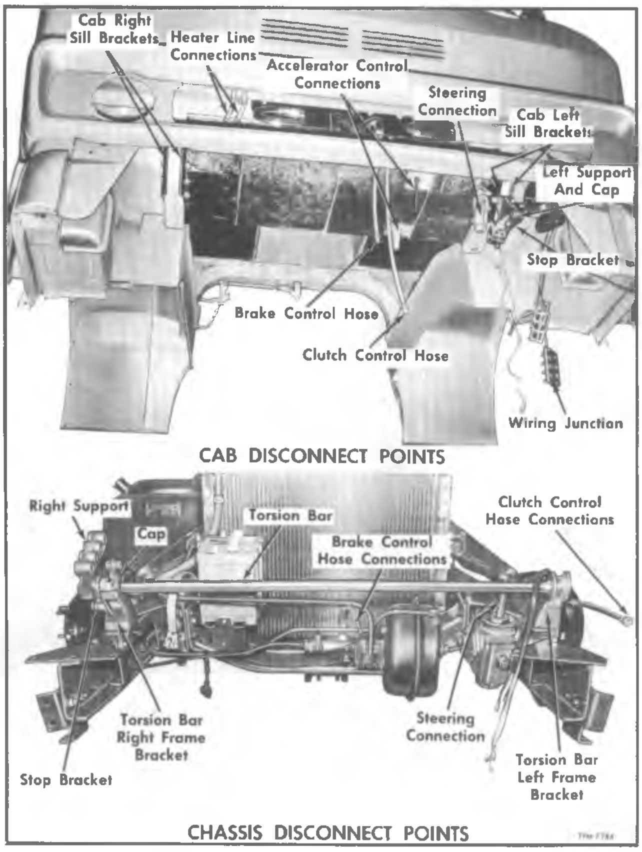


Figure 32—Cab and Chassis Disconnect Points (Typical)

from torsion bar at cab left support and remove support cap. Raise cab slightly, and remove rear mounting bolt (C, fig. 30) attaching right support to sill brackets.

9. Raise cab slightly to clear cab lift mechanism, then forward and up to clear shift control panel. Figure 32 shows cab and chassis disconnect points.

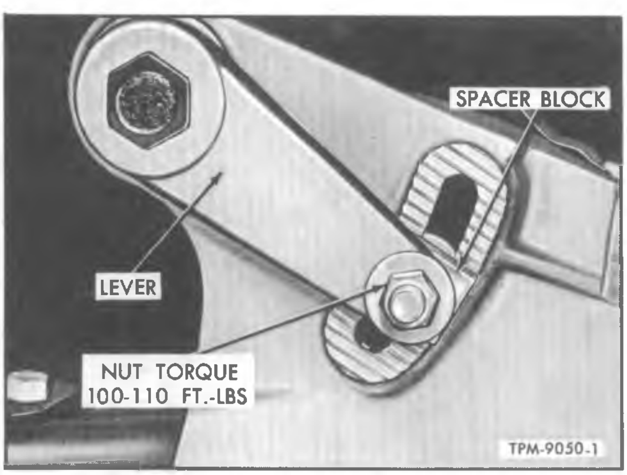


Figure 33—Torsion Bar Tension Adjustment Lever Installed

10. Lower cab onto suitable blocks, then remove chainfall and lifting sling.

NOTE: Left support can be removed from cab, if desired.

CAB INSTALLATION

1. Install lifting sling and chainfall to cab with doors slightly open (fig. 29).
2. Raise cab and install support (if previously removed) loosely to cab left sill brackets.

NOTE: Cab tilt torsion bar, check link, and right cab to sill support should be in position on chassis as shown in lower view of figure 32.

3. Raise cab over chassis and lower into position, forward slightly to clear shift control panel, then back and down until steering gear coupling can be engaged using marks made previously for proper alignment.
4. Finish lowering cab until left support rests on torsion bar. Install support cap with two bolts, torque bolts to 50-60 foot-pounds.
5. Install check link retaining clevis pin with cotter pin (A, fig. 30). Install bolt (C, fig. 30) into rear hole of cab right sill brackets and support.
6. Insert a pry bar in between cab right support and cab sill.
7. With two assistants, one holding pry bar and the other helping to tilt cab forward (approximately 45 degrees), install the three remaining bolts, lock washers, and nuts (B, fig. 30) in the right cab support and sill brackets. Use pry bar to align bolt holes. Torque bolt nuts to 40-50 foot-pounds.
8. Tighten steering coupling clamp bolt to 40-50 foot-pounds torque. Connect speedometer cable and all electric connectors that junction with the cab-to-chassis.
9. Connect accelerator linkage and adjust as outlined under ENGINE FUEL SYSTEM (SEC. 6M). Connect all ground straps.
10. Connect brake lines and hoses. Bleed the brakes as outlined under "HYDRAULIC BRAKES" (SEC. 5A) if equipped with hydraulic brakes.
11. Connect clutch flexible line and bleed as outlined under "CLUTCH CONTROLS" (SEC. 7D).
12. Connect heater hoses and fill radiator.
13. Install bumper to front of frame. If vehicle is equipped with air brakes, connect air lines.
14. Check cab tilting and lock action.

TILT CAB TORSION BAR REPLACEMENT

A chain hoist and a lifting sling are required to properly replace cab torsion bar as the weight of cab must be removed from bar. Also, the aid of one or more assistants is recommended.

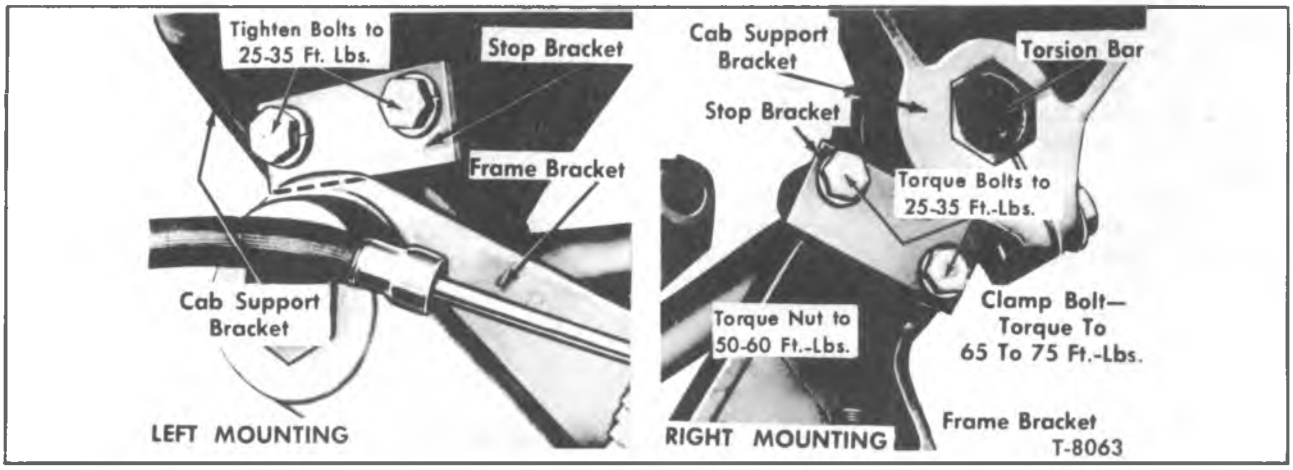


Figure 34—Cab Torsion Bar Stop Brackets Installed

REMOVAL

Instructions below pertain to cab replacement procedures when cab is tilted (approximately 45 degrees) and suspended safely with weight of cab removed from chassis. A chain from hoist hook, down over rear center of cab and attached to cab rear hold-down catch will assist in maintaining cab safely at a 45-degree angle.

IMPORTANT: Protect top of cab from damage by hoist equipment.

1. Secure hoist sling at rear of door openings.
2. Remove weight of cab from chassis.
3. Remove two retaining bolts from mounting cap at torsion bar right frame bracket and from support cap left support.
4. Remove bolt, nut, and washers which attach torsion bar anchor lever to cab mounting left frame bracket. Remove arm from bar and bracket.
5. Loosen cap screw which clamps cab right mounting bracket to right end of torsion bar.
6. Slide torsion bar from cab right frame bracket, then slide bar in opposite direction from cab left support.

CAUTION: DO NOT hammer on end of bar.

INSTALLATION

1. Before replacement of torsion bar, inspect frame brackets (castings) and cab supports (castings) for cracks. DO NOT WELD OR BRAZE BRACKETS. If cracked, replace.
2. Prelubricate left frame bracket opening and right frame bracket. Slide hex end of torsion bar into left frame bracket, then insert opposite end into cab right support.
3. Install torsion bar anchor lever over end of bar and into frame bracket.

NOTE: Lever should be located on bar so that opposite end of anchor lever is located near center of serrations on cab bracket (fig. 33).

4. Install cab stop brackets (if previously removed) to torsion bar cab and frame brackets as shown in figure 34. Torque attaching bolts to 40 to 50 foot-pounds. Make sure stop brackets are installed as shown.
5. Install torsion bar right frame bracket cap and cab left support cap with two bolts and washers. Torque bolts to 50-60 foot-pounds.
6. Tighten bolt which clamps cab right mounting bracket to end of torsion bar (fig. 34) to 65-75 foot-pounds.
7. Lubricate all cab tilt lubrication fittings with lubricant specified in LUBRICATION (SEC. 0).
8. Raise and lower cab to check operation. If cab rises too fast from operating position or if considerable effort is required to raise cab, make torsion bar tension adjustment as directed later.

TORSION BAR TENSION ADJUSTMENT

1. Tilt cab forward to an angle whereby the torsional load is removed from torsion bar. Usually the bar will become unloaded when cab is tilted 45 to 50 degrees. This unloaded angle position may vary slightly on different vehicles.

IMPORTANT: Before continuing, check tightness of screw which clamps cab right mounting bracket to torsion bar. Tighten screw firmly ONLY when torsion bar is unloaded - cab tilted part way. If screw is loose, cab bracket may fracture when torsion bar is loaded.

2. SAFELY support cab at angle at which torsion bar becomes unloaded. An overhead hoist is recommended for supporting cab in this position as it will allow cab to tilt slightly fore or aft to facilitate alignment of torsion bar anchor lever to cab frame bracket.
3. Loosen nut on bolt which attaches the anchor lever and serrated spacer block to the cab frame

STEEL TILT CAB

bracket (fig. 33). Loosen nut only enough for spacer to clear serrations.

4. By tilting cab slightly fore and aft, the small serrated spacer block can be relocated to new related serrations on cab frame bracket as desired.

5. Tighten anchor bolt nut to 100-110 ft.-lbs.

6. Check cab tilting action. If necessary, reposition anchor point of torsion bar anchor lever as directed above.

NOTE: If adjustment is such that cab rises rapidly to full-tilt position, damage to cab check link could occur and also upon lowering of the cab to operating position, considerable effort may be required.

IMPORTANT: Final check tightness of anchor lever bolt nut.

> Refer to LUBRICATION (SEC. 0) for the proper lubricants to be used at the various lube points of cab. The recommended intervals of application are also given in Section 0.

> Avoid tampering with any attaching bolts or nuts at cab tilting torsion bar UNLESS cab is tilted part way - torsion bar unloaded. Damage to adjacent parts and possible bodily harm could occur if bar is loaded - cab tilted completely forward or in operating position.

SECTION 1D
Body Mountings
PLATFORM BODY MOUNTINGS

Before any body mounting is attempted, this section should be studied carefully and the recommendations followed as closely as possible.

When mounting bodies, certain important procedures should be followed. Unless such practices are followed, strains of load and chassis weave may not be distributed correctly, causing damage to body or frame.

IMPORTANT: Avoid drilling additional holes in frame for mounting bolts. Use existing holes if possible; if additional holes are necessary, close unused holes by welding.

LONGITUDINAL SILL MOUNTING

If body is equipped with longitudinal sills, observe following standard practices.

1. Wooden longitudinal sill should rest directly on top flange of chassis frame side rail. If projecting rivet heads prevent a solid bearing, countersink longitudinal sills just enough to clear rivet heads.

IMPORTANT: Do not use spacers to raise sills above rivet heads. If body longitudinal sill is of metal, it will be necessary to use a one-piece full length hardwood strip, with holes to clear rivet heads between body sill and frame rail. Wood strip should be firmly fastened to body sill.

2. Sill should extend as close as possible to back of cab without interfering with mounting or movement of cab.

3. Make sure height of sill is sufficient to prevent body from striking tires, or other parts of chassis, with maximum spring deflection. Take into consideration full load operation over extremely rough terrain.

4. Sill must rest squarely on frame flange and not overhang outside of frame. If sill width does not cover entire width of frame, install a spacer block as shown in figures 1 and 2. Blocks should

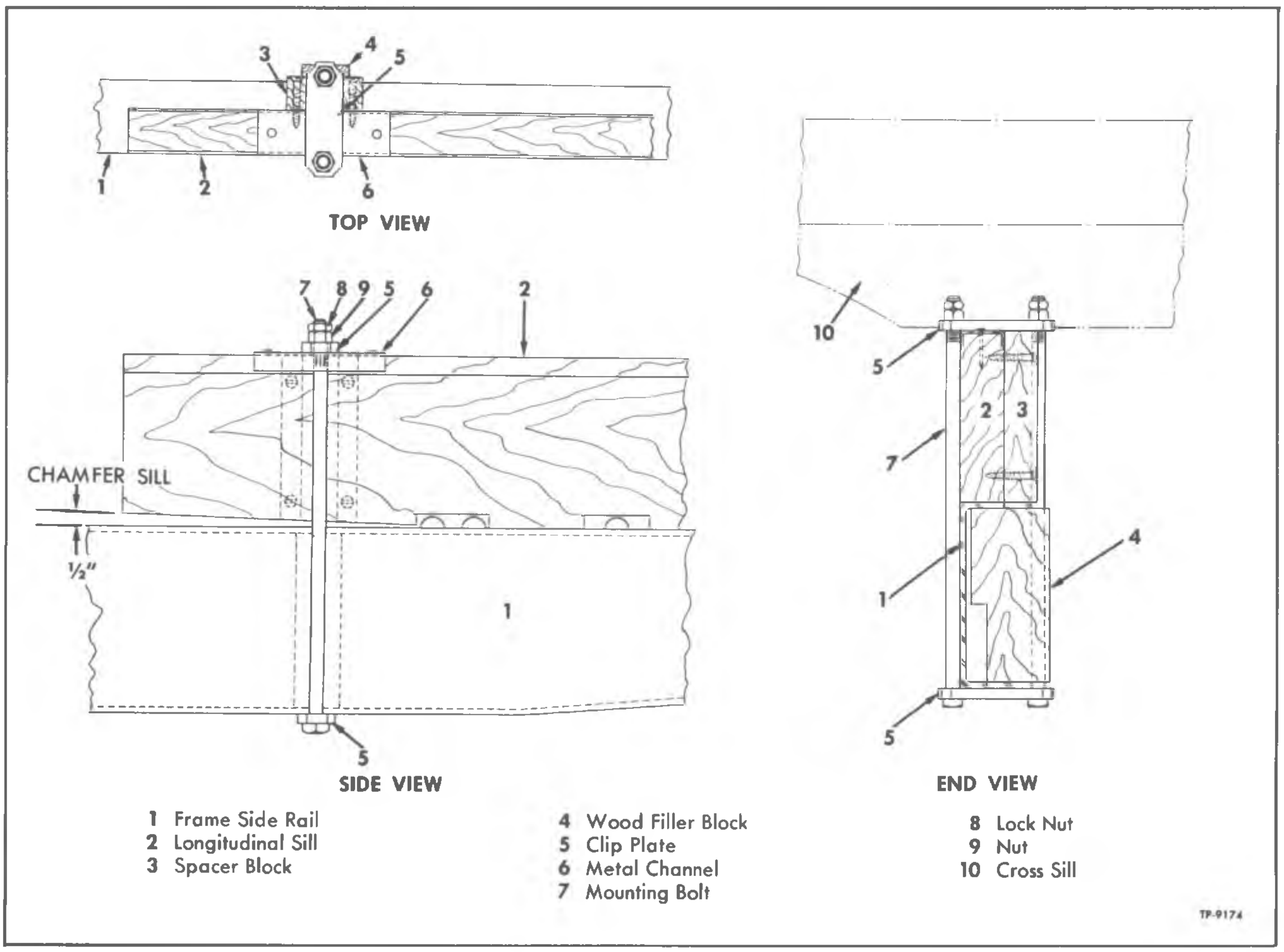
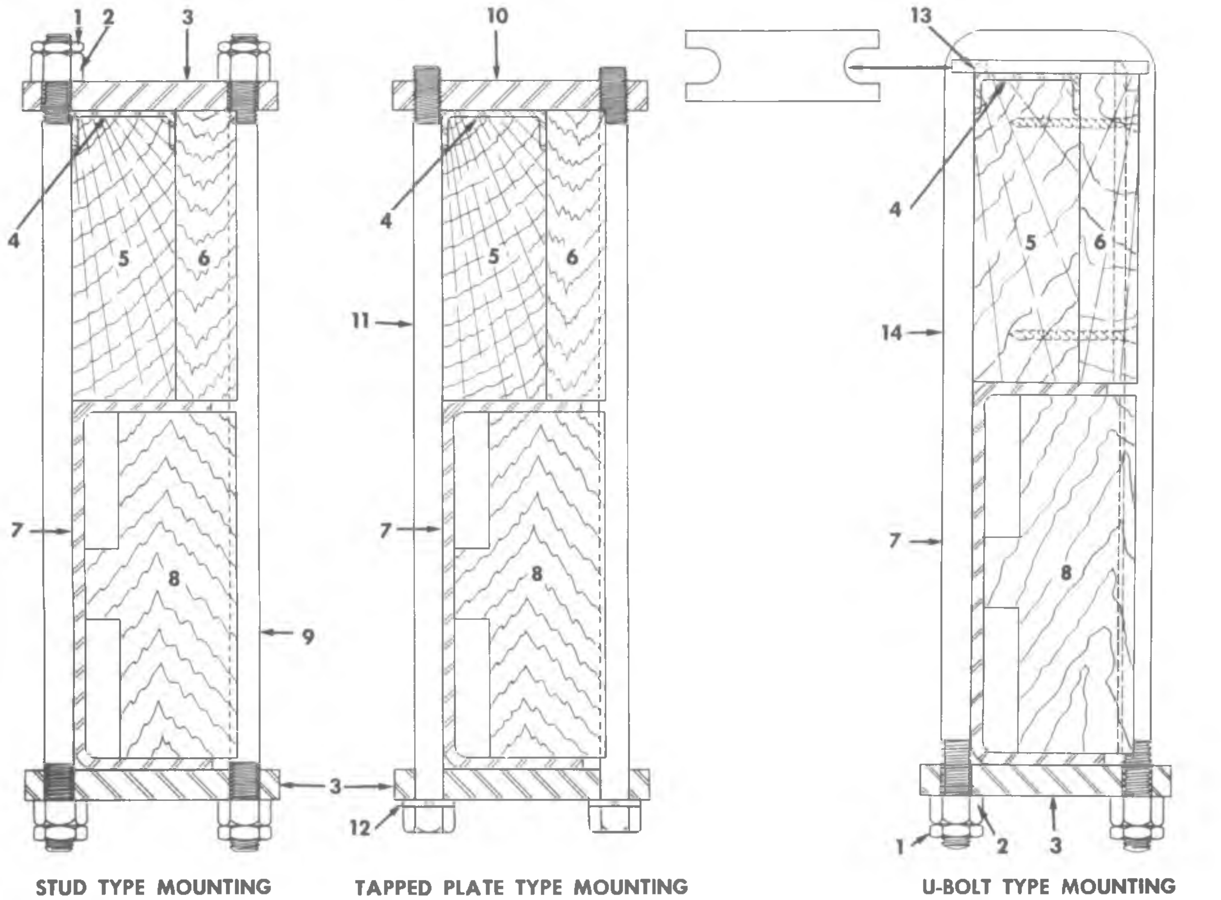


Figure 1—Typical Body Mountings



1 Lock Nut
2 Nut
3 Clip Plate (not tapped)
4 Metal Channel
5 Longitudinal Sill
6 Spacer Block
7 Frame Side Rail
8 Wood Filler Block
9 Mounting Stud
10 Clip Plate (Tapped)
11 Mounting Bolt
12 Lock Washer
13 U-Bolt Clip
14 U-Bolt

TP-9732-1

Figure 2—Recommended Methods of Mounting Body

extend beyond width of frame flanges to permit grooving blocks to maintain position of mounting bolts. If desired, block can be attached to sill with screws as shown in figure 2.

Wood grain of block should be perpendicular (up and down) to grain of sill.

5. Wood sills must be chamfered 1/2" at the front end, tapering to meet the frame 12 to 18 inches from end of sill (fig. 1). Tapered front of sill is required for all Van or torsionally rigid bodies. Notch or spot drill sill to clear the rivet heads.

6. To prevent mounting clip plate becoming embedded in longitudinal sill, install a sheet metal channel on top of sill at each mounting point (figs. 1, 2, and 3). Rabbet grooves along each side of top edges of longitudinal sills to permit flush mounting of sill channels.

MOUNTING BOLTS

1. Install one mounting near front end of sill, one near rear end of sill, and space others as nearly equal as possible between front and rear mountings. It may be necessary to vary distances to clear chassis brackets, etc., but approximately equal spacing should be maintained.

2. Use two bolts or studs of proper length with a diameter of at least 7/16" and preferably 1/2" for each mounting. Use a clip plate, of same thickness as diameter of bolts, at upper and lower end of bolts. Use at least three, and preferably four mountings on each side.

3. Hex head bolts are preferred for body mountings; however, carriage bolts, U-bolts, and threaded rods (studs) can also be successfully employed. If design of body does not permit use

of nuts at top of sill, tapped plate, as shown in figure 2 can be used.

4. Insert a block of hard, dry wood (with grain running up and down) in channel of frame at each mounting. Block must be of sufficient length to extend well under clip plates. Thickness of block should extend beyond width of frame flanges to permit grooving the blocks. Inner mounting bolt will fit into groove and hold block firmly in place (fig. 1 or 2).

5. If shoulder on bolt head is square, as on carriage bolts, the holes in upper clip plates should also be square. Shoulder of bolts should be driven into holes to prevent bolts turning. If U-bolts are used, bolt must be of "flatted" type as shown in figure 2. A clip or spreader must be used on each U-bolt, and bolt must not be used in reverse of position shown in figure 2.

6. Use two nuts on threaded end of each bolt. Tighten inner nut firmly, then tighten outer (lock) nut firmly against inner nut. DO NOT USE SINGLE NUT AND LOCK WASHER. However, lock washer should be used with tapped plate type of mounting.

CROSS SILL MOUNTING

If body is not equipped with longitudinal sills, attach sills, if possible, as shown in figure 3, since mounting on cross sills (bolsters) is not recommended. Longitudinal sills can be easily made of dry hardwood and attached to either wood or metal cross sills by means of angle irons and bolts. General practice of body mounting is on longitudinal sills; however, where the conditions necessitate mounting directly on cross sills, the following practices should be observed:

1. Sills must rest squarely on frame top flange. Countersink sill, if necessary, to clear rivet heads -- do not use spacer.

2. Use same type of mounting bolts and clip plates as described in "Mounting Bolts." The number of clips to use is of course dependent upon load, body style, etc. Carriage or step bolts are useful in this type mounting, since bolt heads project above floor.

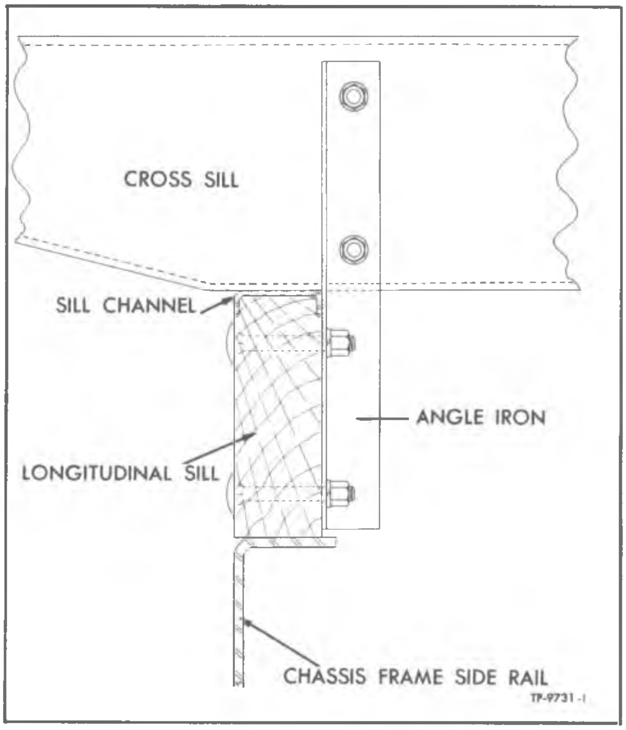


Figure 3—Method of Attaching Longitudinal Sills to Body

3. Use wood blocks in frame channel whenever mountings are used on frame. Mount clip plates diagonally across frame rail -- with one bolt forward of cross sill and inside frame rail and other bolt to rear of cross sill and outside frame rail.

4. U-bolts cannot be used with this type of mounting since mounting bolts, of necessity, project through floor or platform of body. Make sure that heads of bolts are well supported at body floor with plates or washers.

IMPORTANT

DO NOT drill additional holes in frame.
Refer to FRAME (SEC. 2) for additional cautions.

Air Conditioning

INDEX

GENERAL DESCRIPTION

AIR CONDITIONING SYSTEM

(Refer to Figures 2 and 4)

The Air Conditioning system uses an evaporator pressure control known as the P.O.A. (Pilot Operated Absolute) valve. The six-cylinder reciprocating compressor is bracket-mounted to the engine and belt driven from the crankshaft pulley.

The condenser is mounted ahead of the engine cooling radiator and the receiver-dehydrator is mounted in the refrigerant line downstream of the condenser. All cooling system components are connected by means of flexible refrigerant lines.

Both the heating and cooling functions are performed by this system. Air entering the vehicle must pass either through the cooling unit (evaporator) or through the heating unit, or through both. The system is thus referred to as a parallel system.

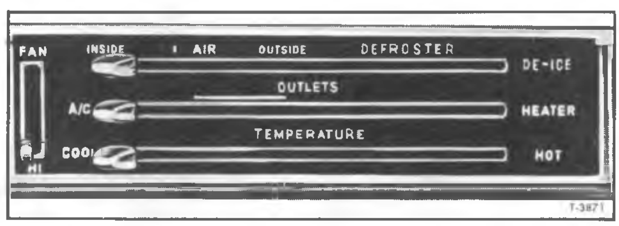


Figure 1—Air Conditioning Controls

AIR CONDITIONING

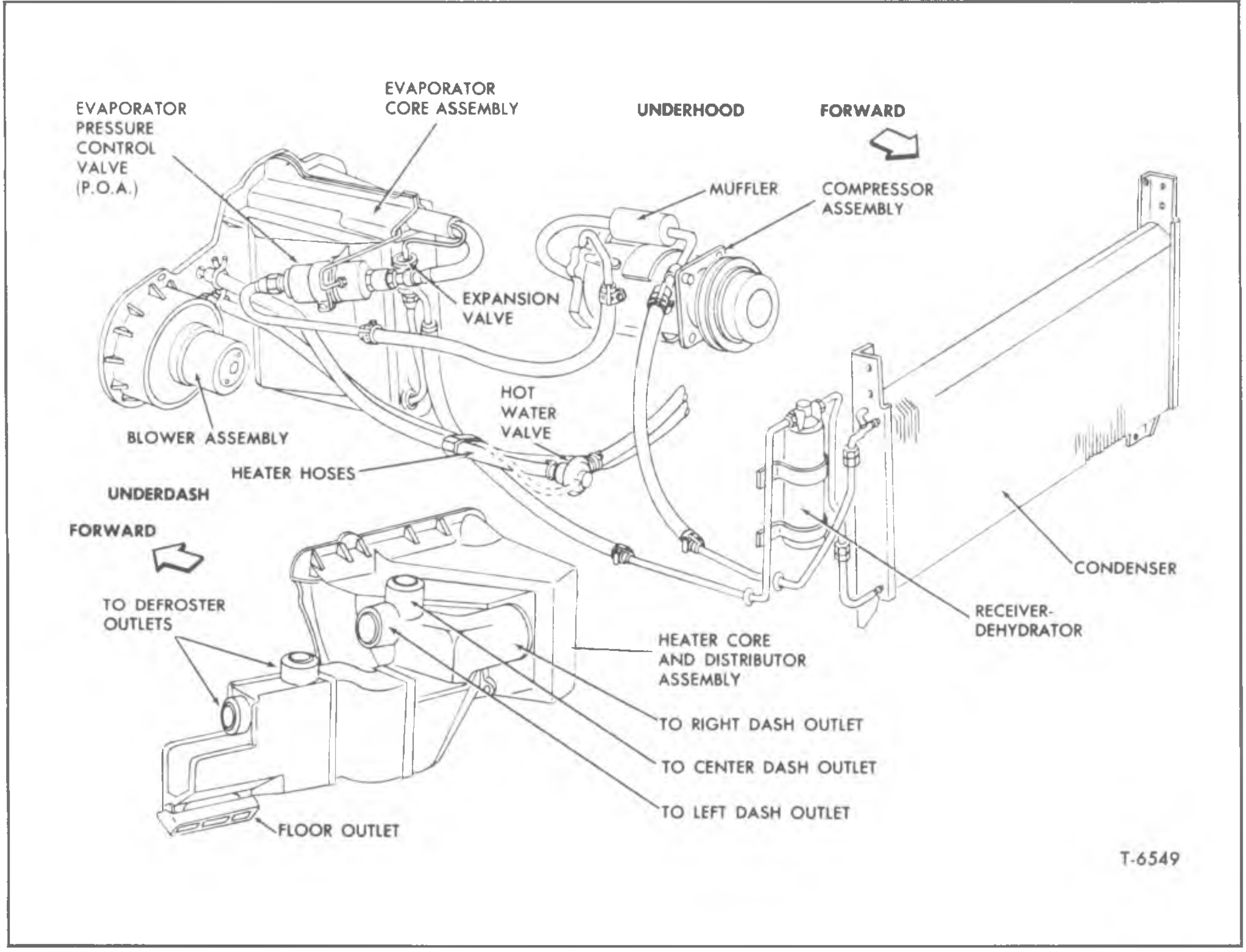


Figure 2—Air Conditioning System Components

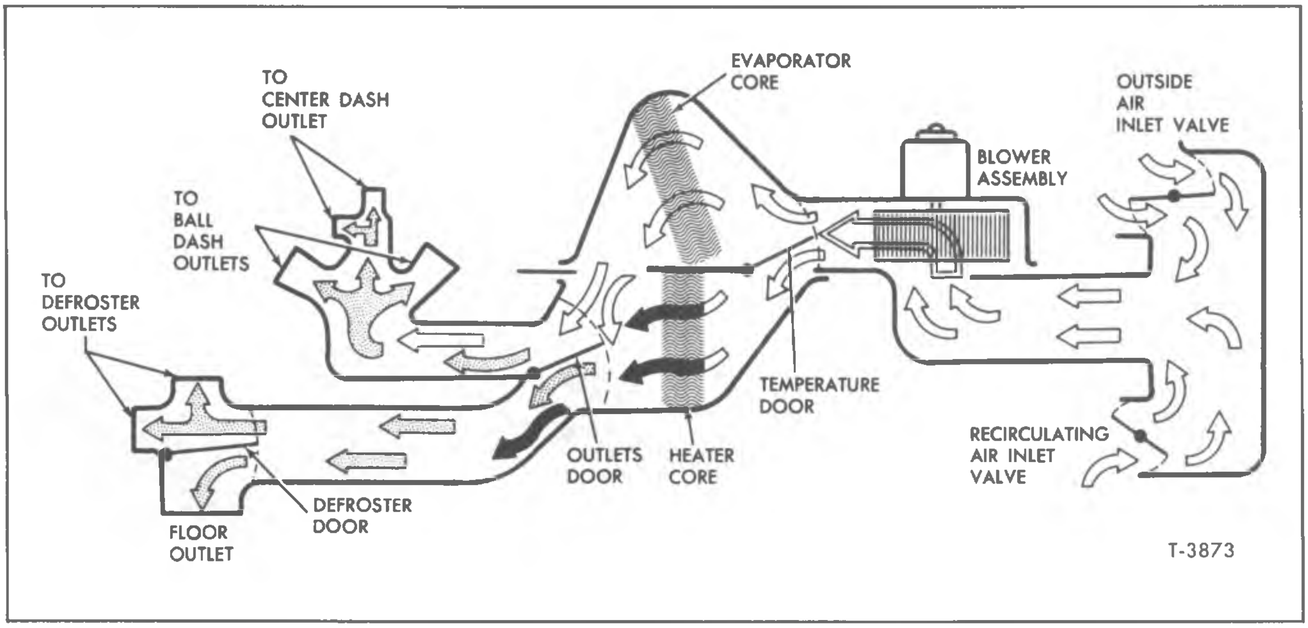


Figure 3—Air-Flow Schematic

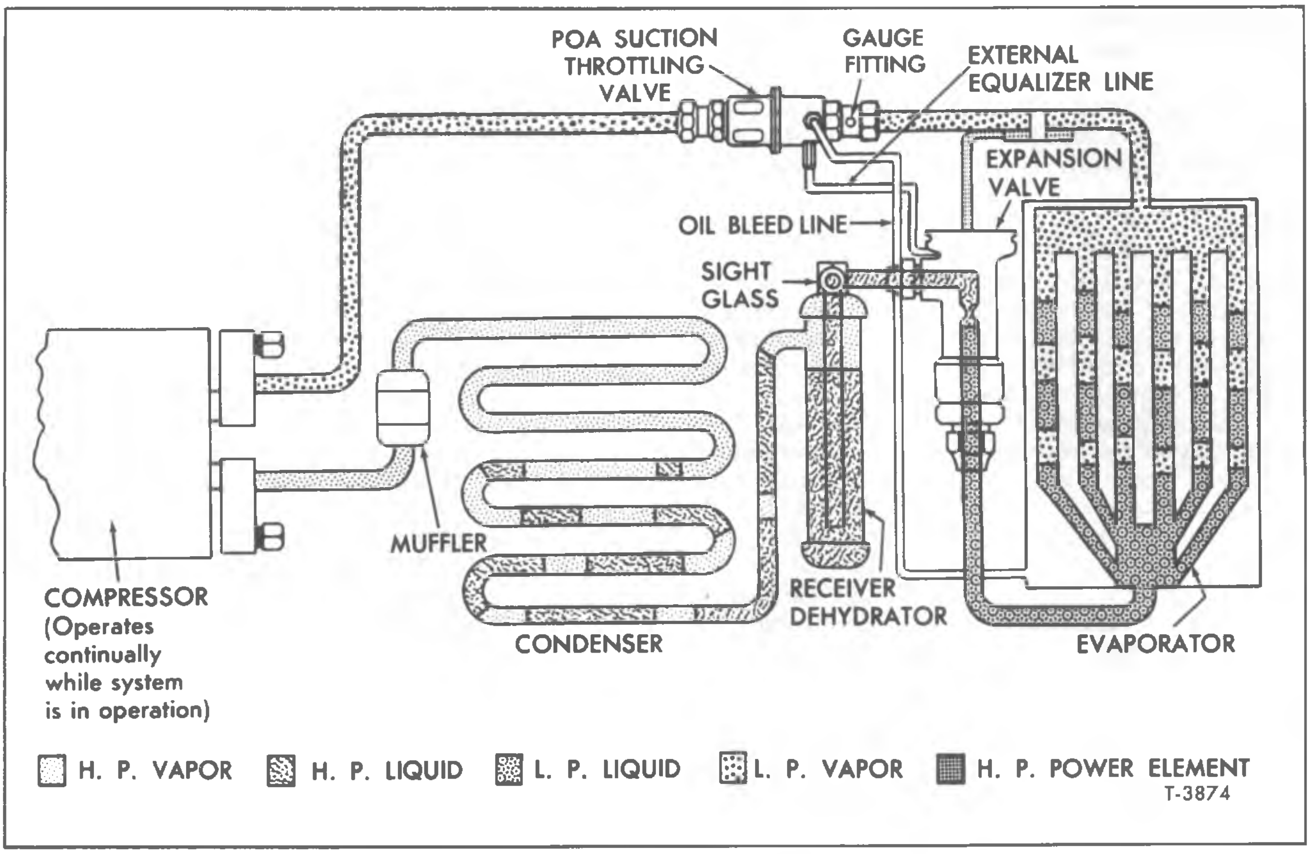


Figure 4—Air Conditioning Cycle of Operation

The evaporator provides maximum cooling of the air passing through the core when the air conditioning system is calling for cooling. The control valve acts in the system only to control the evaporator pressure so that minimum possible temperature is achieved without core freeze-up. The valve is pre-set, has no manual control, is automatically altitude compensated, and non-repairable.

System operation is as follows (refer to fig. 3): Air, either outside air. recirculated air, or a mixture, enters the system and is forced through the system by the blower.

The air passes by the temperature door and is directed through the heating or cooling cores, or split to flow through both. After flowing through the core, or cores, the air passes the outlets door which directs it to the dash or floor outlets or both. Air directed to the dash outlets is finally controlled by the position of the air outlets. Air directed to the floor outlets passes the defroster door which directs the air out the floor outlets, the defroster outlets, or both.

Linkage is so designed that when the system controls are calling for heat, air will enter the vehicle through the floor distributor duct, and when the system controls call for cooling, air will enter through the three dash outlets. The side dash outlets may be rotated to provide either soft, diffused air-flow or spot cooling. Rotate half-way to shut off air-flow. The barrel type outlet in the center of the dash will direct air up or down or, if desired, shut it off.

CONTROLS

Full control of the "Air Conditioning" is obtained through the use of a single control panel (fig. 1). The control levers make use of Bowden cables and vacuum to activate the various doors and switches necessary for system operation. Therefore, control adjustment is a matter of properly setting these Bowden cables. The following paragraphs explain each control.

OUTLETS Lever

This lever actuates an air diverter door within the duct assembly which routes air-flow when fully right ("HEATER") to the floor distributor ducts (for heater operation) or when fully left ("A/C") to the dash outlets (for cooling operation).

Moving this lever toward the left from the "HEATER" position will activate the compressor clutch switch and set the cooling portion of the system in operation providing the "FAN" switch is turned on.

When the lever is moved fully toward the right ("HEATER" position) the "AIR" control lever will automatically move to the "OUTSIDE" air position.

TEMPERATURE Lever

The "TEMPERATURE" lever, through its Bowden cable, actuates the door which controls outlet temperature. This door is necessary to permit mixing of hot and cool air to provide the desired conditioned air outlet temperature whether during heating or cooling operations.

The temperature door directs the air-flow through either the heater core, the evaporator core or through both. When the system is set for full cooling, all air passes through the evaporator core. When warmer outlet air is desired, the temperature door is moved by the "TEMPERATURE" lever so that some air passes through the heater core. The warmed air mixes with the cooled air resulting in a higher outlet air temperature. In the full "HOT" position, all air flows through the heater core. For cooler air, moving the lever toward "COOL" position will send some air through the evaporator core (inoperative when the "OUTLETS" lever is set for heater operation) which in effect bypasses the heater core resulting in less heat output.

AIR CONTROL Lever

When the control is properly adjusted, full left ("INSIDE") position will supply 100% recirculated inside air, and moving the lever to the word "OUTSIDE" will supply 100% outside air to the system. Lever movement controls a vacuum switch which in turn actuates an air inlet door in the plenum below the air inlet grille and a recirculating air door in the kick pad. In the full left position, vacuum also closes the hot water shut-off valve, preventing coolant flow through the heater core.

DEFROSTER Position

As the "AIR CONTROL" lever is moved to the right from the "OUTSIDE" position toward the word "DEFROSTER" the diverter door within the distributor duct moves to send a portion of the air-flow to the defroster ducts. Full "right" position of the "AIR CONTROL" lever, as indicated on the panel, is the "DE-ICE" position which sends the total air-flow to the defroster ducts.

FAN Switch

The fan switch controls the operation of the three-speed blower motor.

GENERAL INFORMATION

PRECAUTIONS IN HANDLING REFRIGERANT-12

In any vocation or trade, there are established procedures and practices that have been developed after many years of experience. In addition, occupation hazards may be present that require the observation of certain precautions or use of Special Tools and Equipment. Observing the procedures, practices and precautions of servicing refrigeration equipment will greatly reduce the possibilities of damage to the customer's equipment as well as virtually eliminating the element of hazard to the serviceman.

Refrigerant-12 is transparent and colorless in both the gaseous and liquid state. It has a boiling point of 21.7°F., below zero and, therefore, at all normal temperatures and pressures it will be a vapor. The vapor is heavier than air and is non-inflammable, nonexplosive, nonpoisonous (except when in contact with an open flame) and noncorrosive (except when in contact with water). The following precautions in handling R-12 should be observed at all times.

1. All refrigerant drums are shipped with a heavy metal screw cap. The purpose of the cap is to protect the valve and safety plug from damage. It is good practice to replace the cap after each use of the drum.

2. If it is ever necessary to transport or carry a drum or can of refrigerant in a car, keep it in the luggage compartment. Refrigerant should not be exposed to the radiant heat from the sun for the resulting increase in pressure may cause the safety plug to release or the drum or can to burst.

3. Drums or disposable cans should never be subjected to high temperature when adding refrigerant to the system. In most instances, heating the drum or can is required to raise the pressure in the container higher than the pressure in the system during the operation. It would be unwise to place the drum on a gas stove, radiator or use a blow torch while preparing for the charging operation, for a serious accident can result. Do not depend on the safety plug - many drums have burst when the safety plug failed. Remember, high pressure means that great forces are being exerted against the walls of the container. A bucket of warm water, not over 125°F., or warm wet rags around the container is all the heat that is required.

4. Do not weld or steam clean on or near the system. Welding or steam cleaning can result in a dangerous pressure build-up in the system.

5. When filling a small drum from a large one, never fill the drum completely. Space should always be allowed above the liquid for expansion. If the drum were completely full and the temperature was increased, hydraulic pressure with its tremendous force would result.

6. Discharging large quantities of R-12 into a room can usually be done safely as the vapor would produce no ill effects, however, in the event of an accidental rapid discharge of the system, it is recommended that inhalation of large quantities of R-12 be avoided. This caution is especially important if the area contains a flame producing device such as a gas heater. While R-12 normally is nonpoisonous, heavy concentrations of it in contact with a live flame will produce a toxic gas. The same gas will also attack all bright metal surfaces.

7. DO NOT EXPOSE EYES TO REFRIGERANT. One of the most important precautions is protection of the eyes when handling refrigerant. Any liquid refrigerant which may accidentally escape is approximately 21.7°F., below zero. If any refrigerant comes in contact with the eyes, serious injury could result. Always wear goggles to protect the eyes when handling refrigerant.

If refrigerant should come in contact with the eyes:

a. DO NOT rub the eyes. Splash the eyes with cold water to gradually get the temperature above the freezing point.

b. Apply a protective film of an antiseptic oil over the eye-ball to reduce the possibility of infection.

c. Consult a doctor or an eye specialist immediately.

Should liquid refrigerant come in contact with the skin, the injury should be treated the same as though the skin had been frostbitten or frozen.

PRECAUTIONS IN HANDLING REFRIGERANT LINES

1. All metal tubing lines should be free of kinks, because of the restriction that kinks will offer to the flow of refrigerant. The refrigeration capacity of the entire system can be greatly reduced by a single kink.

2. The flexible hose lines should never be bent to a radius of less than 10 times the diameter of the hose.

3. The flexible hose lines should never be allowed to come within a distance of 2-1/2" of the exhaust manifold.

4. Flexible hose lines should be inspected at least once a year for leaks or brittleness. If found brittle or leaking they should be replaced with new lines.

5. Use only sealed lines from Parts Stock.

6. When disconnecting any fitting in the refrigeration system, the system must first be discharged of all refrigerant. However, proceed very cautiously, regardless of gauge readings. Open very slowly, keeping face and hands away so that no injury can occur, if there happens to be liquid refrigerant in the line. If pressure is noticed when fitting is loosened, allow it to bleed off very slowly.

CAUTION: Always wear safety goggles when opening refrigerant lines.

7. In the event any line is opened to atmosphere, it should be immediately capped to prevent entrance of moisture and dirt.

8. The use of the proper wrenches when making connections on O-ring fittings, is important. The use of improper wrenches may damage the connection. The opposing fitting should always be backed up with a wrench to prevent distortion of connecting lines or components. When connecting the flexible hose connections it is important that the swaged fitting and the flare nut, as well as the coupling to which it is attached, be held at the same time using three different wrenches to prevent turning the fitting and damaging the ground seat.

9. O-rings and seats must be in perfect condition. The slightest burr or piece of dirt may cause a leak.

10. Sealing beads on hose clamp connections must be free of nicks and scratches to assure a perfect seal.

MAINTAINING CHEMICAL STABILITY IN THE REFRIGERATION SYSTEM

The metal internal parts of the refrigeration system and the refrigerant and oil contained in the system are designed to remain in a state of chemical stability as long as pure R-12 and uncontaminated refrigeration oil is used in the system.

However, when abnormal amounts of foreign materials, such as dirt, air, or moisture are allowed to enter the system, the chemical stability may be upset. When accelerated by heat, these contaminants may form acids and sludge and eventually cause the break down of components within the system. In addition, contaminants may affect the temperature-pressure relationship of R-12, resulting in improper operating temperature and pressures and decreased efficiency of the system.

The following general practices should be observed to assure chemical stability in the system.

1. Whenever it becomes necessary to disconnect a refrigerant or gauge line, it should be immediately capped. Capping the tubing will also prevent dirt and foreign matter from entering.

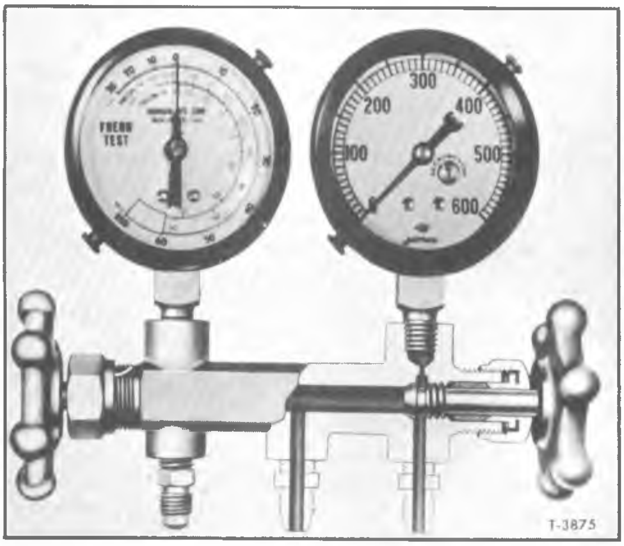


Figure 5—Gauge Set

2. Tools should be kept clean and dry. This also includes the gauge set and replacement parts.

3. When adding oil, the container should be exceptionally clean and dry due to the fact that the refrigeration oil in the container is as moisture-free as it is possible to make it. Therefore, it will quickly absorb any moisture with which it comes in contact. For this same reason the oil container should not be opened until ready for use and then it should be capped immediately after use.

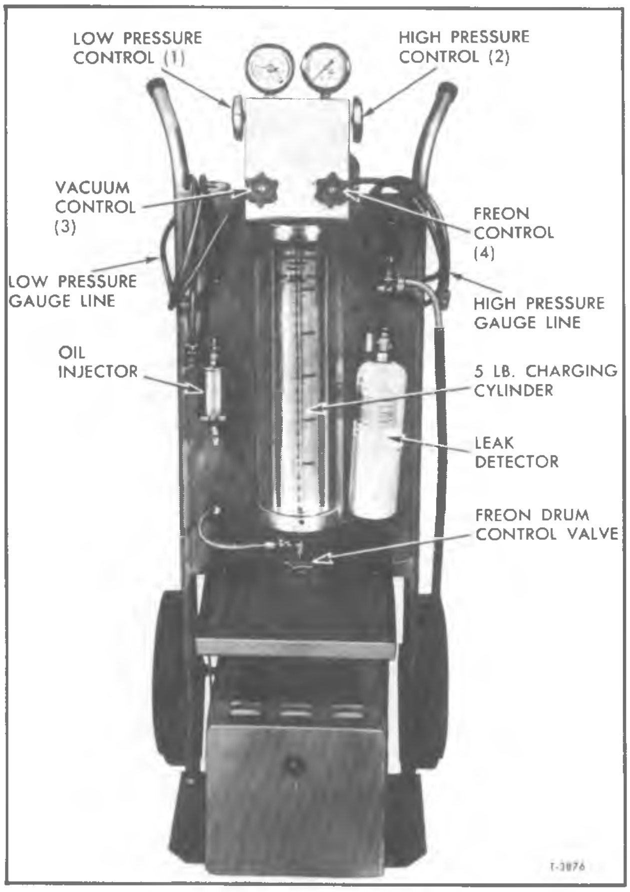


Figure 6—J-8393 Charging Station

4. When it is necessary to open a system, have everything you will need ready and handy, so that as little time as possible will be required to perform the operation. Do not leave the system open any longer than is necessary.

5. Finally, after the operation has been completed and the system sealed again, air and moisture should be evacuated from the system before recharging.

GAUGE SET

The gauge set (fig. 5) is used when purging, evacuating, charging or diagnosing trouble in the system. The gauge at the left is known as the low pressure gauge.

The face is graduated into pounds of pressure and, in the opposite direction, in inches of vacuum. This is the gauge that should always be used in checking pressures on the low pressure side of the system. When all parts of the system are functioning properly the refrigerant pressure on the low pressure side never falls below 0 pounds pressure. However, several abnormal conditions can occur that will cause the low pressure to fall into a partial vacuum. Therefore, a low pressure gauge is required.

The high pressure gauge is used for checking pressures on the high pressure side of the system.

The connection at the left is for attaching the low pressure gauge line and the one at the right the high pressure gauge line. The center connector is common to both and is for the purpose of attaching a line for adding refrigerant, discharging refrigerant, evacuating the system and other uses. When not required, this line or connection should be capped.

NOTE: Gauge fitting connections should be installed hand-tight only and the connections leak-tested before proceeding.

The hand shutoff valves on the gauge manifold do not control the opening or closing off of pressure to the gauges. They merely close each opening to the center connector and to each other. During most diagnosing and service operation, the valves must be closed. The only occasion for opening both at the same time would be to bypass refrigerant vapor from the high pressure to the low pressure side of the system, or in evacuating both sides of the system.

J-8393 CHARGING STATION

The J-8393 Charging Station (fig. 6) is a portable assembly consisting of a vacuum pump, refrigerant supply, gauges, valves, and most important, a five (5) pound metering refrigerant charging cylinder. The use of a charging cylinder eliminates the need for scales, hot water pails, etc.

The refrigerant is metered into the system by volume, the correct amount may be added to the system and the unit remains "plumbed" at all times and thus eliminates loss of refrigerant in purging of lines and hook-up, combines to enable the operator to get full use of all refrigerant.

All evacuation and charging equipment is hooked together in a compact portavle unit (fig. 6). It brings air conditioning service down to the basic problem of hooking on two hoses, and manipulating clearly labeled valves.

LEAK TESTING THE SYSTEM

Whenever a refrigerant leak is suspected in the system or a service operation performed which results in disturbing lines or connections, it is advisable to test for leaks. Common sense should be the governing factor in performing any leak test, since the necessity and extent of any such test will, in general, depend upon the nature of the complaint and the type of service performed on the system. It is better to test and be sure, if in doubt, than to risk possibility of having to do the job over again.

NOTE: The use of a leak detecting dye within the system is not recommended because of the following reasons:

1. Refrigerant leakage can exist without any oil leakage. In this case the dye will not indicate the leak, however, a torch detector will.
2. The addition of additives, other than inhibitors, may alter the stability of the refrigeration system and cause malfunctions.
3. Dye type leak detectors which are insoluble form a curdle which can block the inlet screen of the expansion valve.

LEAK DETECTOR

Tool J-6084 (fig. 7) is a propane gas-burning torch which is used to locate a leak in any part of the system. Refrigerant gas drawn into the sampling tube attached to the torch will cause the torch flame to change color in proportion to the size of the leak. Propane gas fuel cylinders used with the torch are readily available commercially throughout the country.

> CAUTION: Do not use lighted detector in any place where combustible or explosive gases, dusts, or vapors may be present.

Operating Detector

1. Open the control valve only until a low hiss of gas is heard, then light the gas at opening in the chimney.
2. Adjust the flame until desired volume is obtained. This is most satisfactory when the blue flame is approximately 3/8" above the reactor plate. The reaction plate will quickly heat to a cherry red.
3. Explore for leaks by moving the end of the sampling hose around possible leak points in the system. Do not pinch or kink hose.

NOTE: Since R-12 is heavier than air, it is good practice to place open end of sampling tube immediately below point being tested, particularly in cases of small leaks.

> CAUTION: Do not breathe the fumes that are produced by the burning of R-12 gas in the detector flame, since such fumes can be toxic in large concentrations of R-12.

4. Watch for color changes. The color of the flame which passes through the reaction plate will change to yellow when sampling hose draws in very small leaks of R-12. Large leaks will be indicated by a change in color to a vivid purplish-blue. When the sampling hose passes the leak, the flame will clear to an almost colorless pale-blue again. If the flame remains yellow when unit is removed from leak, insufficient air is being drawn in or the reaction plate is dirty.

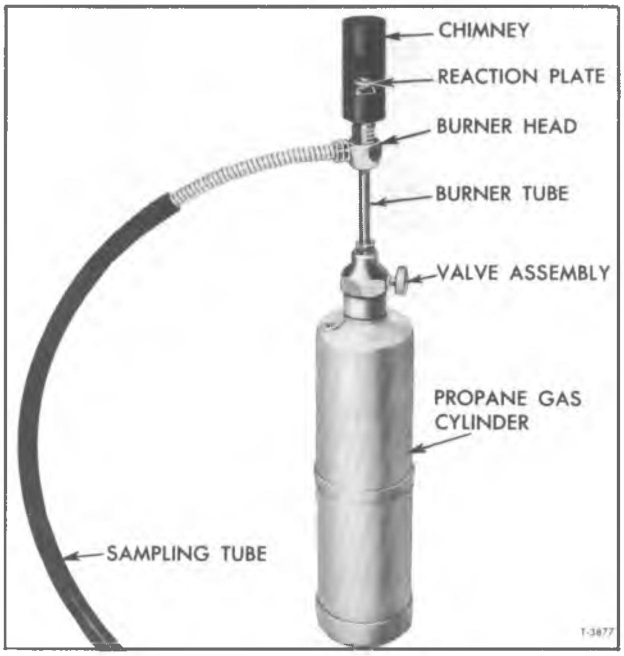


Figure 7—Leak Detector

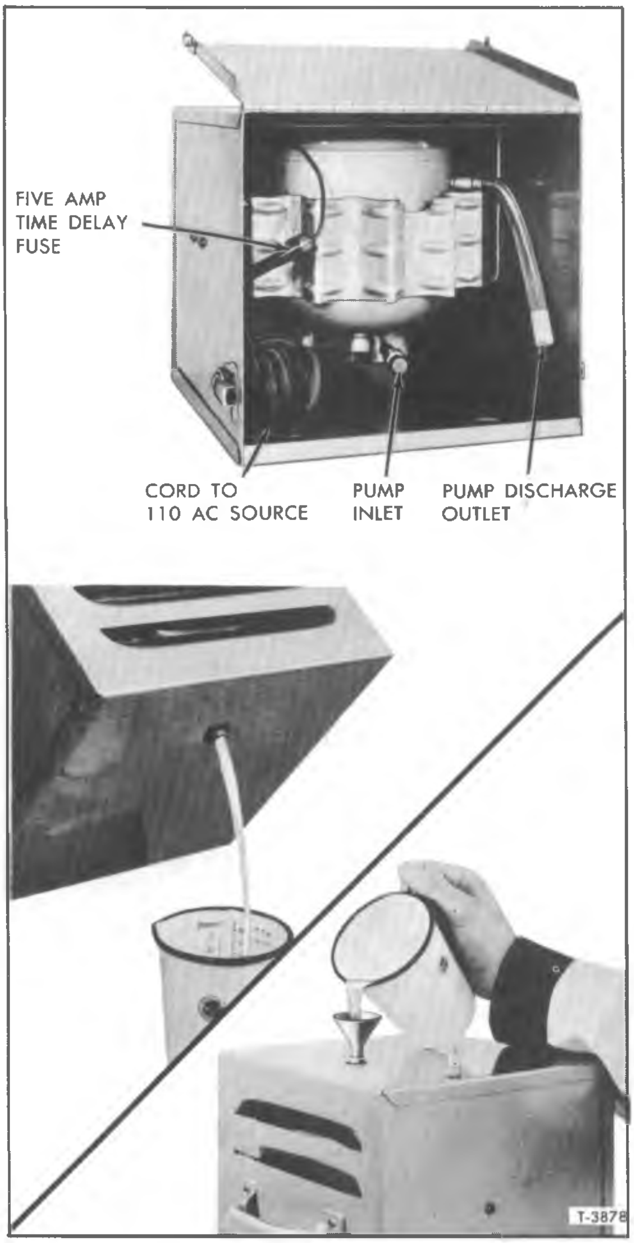


Figure 8—Vacuum Pump

NOTE: A refrigerant leak in the high pressure side of the system may be more easily detected when, if possible, the system is in operation. A leak on the low pressure side may be most easily detected after the engine has been shutoff for several minutes to allow system pressures to equalize. This particularly applies to the front seal.

VACUUM PUMP

A vacuum pump should be used for evacuating air and moisture from the air conditioning system.

Vacuum pump (Tool J-5428-02) (fig. 8), is available for this purpose. It is used as a component part of the Charging Station (J-8393), described previously. The following precautions should be observed relative to the operation and maintenance of this pump.

1. Make sure dust cap on discharge outlet of vacuum pump is removed before operating.
2. Keep all openings capped when not in use, to avoid moisture being drawn into the system.
3. Oil should be changed after every 250 hours of normal operation.

To change oil, simply unscrew hex nut located on back side of pump, tilt backward and drain out oil (fig. 8). Recharge with eight ounces of vacuum pump oil Frigidaire-150 or equivalent (fig. 8). If you desire to flush out the pump, use this same type clean oil. Do not use solvent.

NOTE: Improper lubrication will shorten the life of pump.

1. If this pump is subjected to extreme or prolonged cold, allow it to remain indoors until oil has reached approximate room temperature. Failure to warm oil will result in a blown fuse.
2. A five ampere time delay cartridge fuse has been installed in the common line to protect the windings of the compressor. The fuse will blow, if an excessive load is placed on the pump. In the event the fuse is blow, replace with a five ampere time delay fuse - DO NOT USE A SUBSTITUTE FUSE as it will result in damage to the starting windings.
3. If the pump is being utilized to evacuate a burnt-out system, a filter must be connected to the intake fitting to prevent any sludge from contaminating the working parts, which will result in malfunction of the pump.
4. Do not use the vacuum pump as an air compressor.

AVAILABILITY OF REFRIGERANT-12

Refrigerant-12 is available through Parts Stock in 25 lb. drums and in 15 oz. disposable cans. Valves are available for the disposable cans, which may be used as individual cans or as a group of up to four cans (refer to fig. 9).

Tool J-6272-01 is used with one through four cans. The use of the four-can fixture makes it possible to charge the system with a known quantity of refrigerant without the use of weighing equipment necessary with the larger drum. The single can Valve J-6271 can be used for completing the charge and for miscellaneous operations such as flushing. The valves are installed by piercing the top seal of the cans.

Evacuating and charging procedures later in this section will make use of the J-8393 Charging Station which uses the 25 pound drum of refrigerant.

COMPRESSOR OIL

Special refrigeration lubricant should be used in the system. It is available in one quart graduated bottles through Parts Stock. This oil is as free from moisture and contaminants as it is possible to attain by human processes. This condition should be preserved by immediately capping the bottle when not in use.

Refer to "Air Conditioning System Capacities" for the total system oil capacity.

Due to the porosity of the refrigerant hoses and connections, the system refrigerant level will show a definite drop after a period of time. Since the compressor oil is carried throughout the entire system mixed with the refrigerant a low refrigerant level will cause a dangerous lack of lubrication. Therefore the refrigerant charge in the system has a definite tie-in with the amount of oil found in the compressor and an insufficient charge may eventually lead to an oil build-up in the evaporator.

Figure 9—Refrigerant—12 Disposable Cans and Valves

COMPRESSOR SERIAL NUMBER

The compressor serial number is located on the serial number plate on top of the compressor. The serial number consists of a series of numbers and letters. This serial number should be referenced on all forms and correspondence related to the servicing of this part.

INSPECTION AND PERIODIC SERVICE

PRE-DELIVERY INSPECTION

1. Check that engine exhaust is suitably ventilated.
2. Check the compressor belt for proper tension.
3. With controls positioned for operation of the system, operate the unit for ten minutes at approximately 2,000 rpm. Observe the clutch pulley bolt to see that the compressor is operating at the same speed as the clutch pulley. Any speed variation indicates clutch slippage.
4. Before turning off the engine, check the sight glass to see that the unit has a sufficient Refrigerant charge. The glass should be clear, although during milder weather it may show traces of bubbles. Foam in the flow indicates a low charge. No liquid visible indicates no charge.
5. Check hose clamp connections. If clamp screw torque is less than 10 lb. in., retighten to 20-25 lb. in. Do not tighten to new hose specifications or hose leakage may occur. Leak test the complete system.
6. If there is evidence of oil leak, check compressor to see that the oil charge is satisfactory.
7. Check the system controls for proper operation.

6,000 MILE INSPECTION

1. Check for indication of a refrigerant leak.
2. If there is an indication of an oil leak, check the compressor proper oil charge.
3. Check sight glass for proper charge of Refrigerant-12.
4. Tighten the compressor brace and support bolts and check the compressor belt tension.
5. Check hose clamp connections as directed in previous Step 5.

NOTE: A slight amount of oil leakage at the compressor front seal is considered normal.

PERIODIC SERVICE

1. Inspect condenser regularly to be sure it is not plugged with leaves or other foreign material.
2. Check evaporator drain tubes regularly for dirt or restrictions.
3. At least once a year, check the system for proper refrigerant charge and the flexible hoses for brittleness, wear, or leaks.
4. Every 6,000 miles check sight glass for low refrigerant level.
5. Check belt tension regularly.
6. Every week - during winter months or

other periods when the system is not being operated regularly - run the system, set for maximum cooling, for 10 or 15 minutes to insure proper lubrication of seals and moving parts.

INSTALLING GAUGE SET TO CHECK SYSTEM OPERATION

The Air Conditioning high pressure gauge connection is located on the muffler. The low pressure connection is located on the P.O.A. valve.

1. Install Gauge Adapter (J-5420 or J-9459) onto high and low pressure hoses of gauge set.
2. With the engine stopped, remove the caps from the cored valve gauge connector on the compressor fittings block and P.O.A. valve.
3. Connect the gauge lines with adapters to the threaded connector on the compressor fittings block and P.O.A. valve.

> CAUTION: When removing gauge lines from the compressor fittings block, be sure to remove the adapters rather than the gauge lines from the adapters.

PERFORMANCE TEST

This test may be conducted to determine if the system is performing in a satisfactory manner and should be used as a guide by the serviceman in diagnosing trouble within the system. The following fixed conditions must be adhered to in order to make it possible to compare the performance of the system being tested with the standards below:

1. Doors and windows closed. (Vehicle inside or in shade.)
2. Hood up and engine exhaust suitably ventilated.
3. Vehicle in "NEUTRAL" with engine running at 2,000 rpm.
4. "AIR CONDITIONING" controls set for maximum cooling and high blower speed.
5. "TEMPERATURE" knob and "AIR" knob set for full recirculating air.
6. Gauge set installed.
7. System settled out (run-in approximately 10 minutes).
8. A thermometer placed in front of vehicle grille and another in the right-hand diffuser outlet.

PERFORMANCE DATA

The following "Performance Data" defines normal operation of the system under above conditions. Relative humidity does not appear in "Data Chart" because after running prescribed length of time on recirculated air and maximum cooling, the relative humidity of air passing over evaporator core will remain at approximately 35% to 40% regardless of the ambient temperature of humidity.

Should excessive head pressures be encountered at higher ambient temperatures, an 18-inch fan placed in front of the vehicle and blowing into the condenser will provide the extra circulation of air needed to bring the pressures to within the limits specified.

NOTE: Higher temperatures and pressures will occur at higher ambient temperatures. In areas of high humidity it is possible to have thermometer and gauge readings approach but not reach the figures listed in the performance tables and still have a satisfactory operating unit. However, it is important to remember that low pressure has a direct relationship to nozzle outlet temperature. If pressure is too low, ice will gradually form on the evaporator fins, restricting air-flow into the passenger area and resulting in insufficient or no cooling.

PERFORMANCE DATA CHART

(Refrigerant Charge = 3 lbs. - 4 Oz.)

Temperature of Air Entering Condenser	70°	80°	90°	100°	110°	120°
Engine rpm	2000					
Compressor Head Pressure	145 155	185 195	200 210	215 225	255 265	285 295
Evaporator Pressure at P.O.A.	Dependent Upon Altitude. See Chart at bottom of page.					
Discharge Air Temperature at Right-Hand Outlet	38 41	38 41	40 43	41 44	43 46	48 51

EVAPORATOR CONTROL VALVE (P.O.A.) (FIG. 10)

The only check for proper P.O.A. valve operation is to check the suction pressure at the valve as during a performance test. The P.O.A. valve is an absolute valve and will provide different gauge readings based on the altitude where the readings are being taken. Correct gauge reading at sea level is 29.5 psig. Gauge readings will be one-half psi higher for each additional 1,000 feet of elevation. The following table lists gauge readings at different altitudes. If a valve gives improper gauge readings, it must be replaced since it is neither repairable nor adjustable.

29.5 psig. -- Sea Level	32.5 psig. -- 6000 ft.
30.0 psig. -- 1000 ft.	33.0 psig. -- 7000 ft.
30.5 psig. -- 2000 ft.	33.5 psig. -- 8000 ft.
31.0 psig. -- 3000 ft.	34.0 psig. -- 9000 ft.
31.5 psig. -- 4000 ft.	34.5 psig. -- 10,000 ft.
32.0 psig. -- 5000 ft.	

EXPANSION VALVE

(Refer to Figure 11)

A malfunction of the expansion valve will be caused by one of the following conditions: valve stuck open, valve stuck closed, broken power element, a restricted screen or an improperly located or installed power element bulb. The first three conditions require valve replacement. The last two may be corrected by replacing the valve inlet screen and by properly installing the power element bulb.

Attachment of the expansion valve bulb to the evaporator outlet line is very critical. The bulb must be attached tightly to the line and must make good contact with the line along the entire length of the bulb. A loose bulb will result in high low side pressures and poor cooling. On bulbs located outside the evaporator case insulation must be properly installed.

Indications of expansion valve trouble provided by the "Performance Test" are as follows:

VALVE STUCK OPEN
Noisy Compressor.
No Cooling.

VALVE STUCK CLOSED, PLUGGED SCREEN OR BROKEN POWER ELEMENT
Very Low Suction Pressure.
No Cooling.

POORLY LOCATED POWER ELEMENT BULB
Normal Pressure.
Poor Cooling.

Check For Defective Valve

The following procedure must be followed to determine if a malfunction is due to a defective expansion valve.

1. Check to determine if the system will meet the performance test as outlined previously. If the expansion valve is defective, the low pressure readings (P.O.A. or evaporator pressure) will be above specification.

2. The loss of system performance is not as evident when the compressor head pressure is below 200 psi. Therefore, it may be necessary to increase the system head pressure by partially blocking the condenser. Disconnect the blower lead wire and repeat the "Performance Check" to determine if the evaporator pressure can be obtained.

3. The system will also indicate a low refrigerant charge by bubbles occurring in the sight glass. Systems equipped with a P.O.A. valve require the following additional test to determine if the deficiency is the expansion valve.

4. Remove the expansion valve bulb from the evaporator outlet pipe, and the connector on the blower resistor. Place the blower on "LOW." With

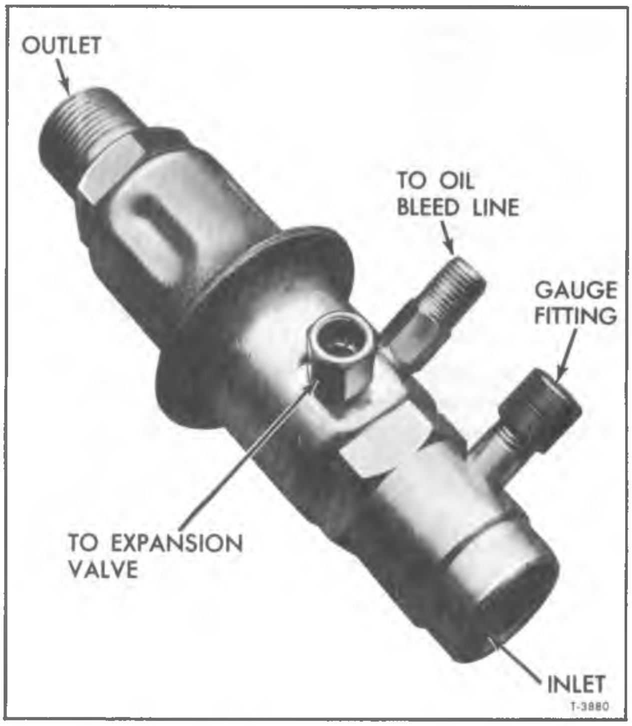


Figure 10—Evaporator Pressure Control Valve (P.O.A.)

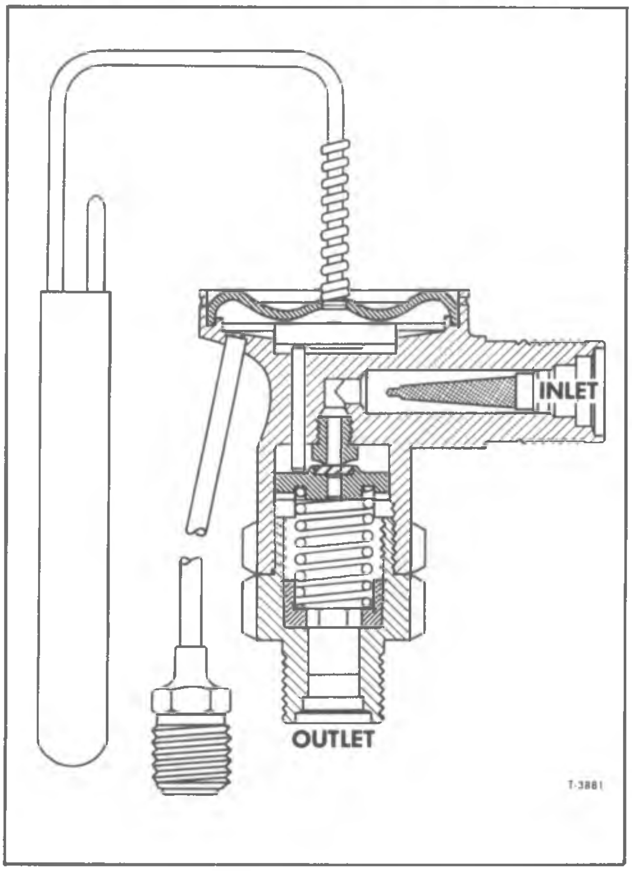


Figure 11—Expansion Valve

the engine operating at 2,000 rpm, observe the P.O.A. gauge pressure.

5. Insert the expansion valve bulb in a cup of ice. This should result in the P.O.A. pressure being reduced to approximately 30 psi. If the pressure does not reduce to this level, the P.O.A. valve is defective. If the pressure falls considerably below 30 psi, the expansion valve is defective.

ENGINE IDLE COMPENSATOR

This additional aid to prevent stalling during prolonged hot weather periods is included with all air conditioned vehicles. The idle compensator is a thermostatically controlled air bleed which supplies additional air to the idle mixture. The idle compensator is located near the carburetor.

REFRIGERANT QUICK CHECK PROCEDURE

A quick reference chart below has been provided for use in determining whether or not the air conditioning system has a proper charge of refrigerant. These simple checks can be made in matter of minutes, thus facilitating system diagnosis by pinpointing the problem to the amount of charge in the system or by eliminating this possibility from the overall checkout. Refer to "Refrigerant Quick Check Procedures" chart for exact step-by-step procedure.

REFRIGERANT QUICK CHECK PROCEDURES

(Check procedures should be made at 70° F.)

Start engine and place on fast idle. Set controls for maximum cold with blower on high.

Bubbles present in sight glass.	No bubbles. Sight glass clear.
System low on charge. Check with leak detector. Correct leak, if any, and fill system to proper charge.	System is either charged or empty. Feel high and low pressure pipes at compressor. High pressure pipe should be warm; low pressure pipe should be cold.
No appreciable temperature differential noted at compressor.	Temperature differential noted at the compressor.
System empty or nearly empty. Turn off engine and connect charging station. Induce 1/2 lb. of refrigerant in system (if system will not accept charge, start engine and draw 1/2 lb. in through low pressure side). Check system with leak detector.	Even though a differential is noted, there exists a possibility of overcharge. An overfilled system will result in poor cooling during low speed operation (as a result of excessive head pressure). An overfill is easily checked by disconnecting the compressor clutch connector while observing the sight glass.
If refrigerant in sight glass remains clear for more than 45 seconds (before foaming and then settling away from sight glass) an overcharge is indicated. Verify with a performance check.	If refrigerant foams and then settles away from sight glass in less than 45 seconds, it can be assumed that there is a proper charge of refrigerant in system. Continue checking out system using performance checks outlined in this manual.

EVACUATING AND CHARGING PROCEDURES

AIR CONDITIONING SYSTEM CAPACITIES

Refrigerant Charge	Oil Charge
3 lbs. 4 oz.	10 ozs. 525 viscosity

PURGING THE SYSTEM

In replacing any of the air conditioning components, the system must be completely purged or drained of refrigerant. The purpose is to lower the pressure inside the system so that a component part can be safely removed.

1. With engine stopped, install high and low pressure lines of gauge set to the proper high and low pressure gauge fittings (see "Installing Gauge Set to Check System Operation").

NOTE: Before installing lines, be sure that all four controls on gauge set are closed.

2. With plug removed from gauge center line, open high pressure gauge valve slightly to allow refrigerant vapor to slowly escape through center line.

> CAUTION: Do not open valve too fast as compressor oil may be discharged with the refrigerant. A rag wrapped around the end of the center gauge line will prevent the splashing of oil in the event of accidental rapid discharge.

3. When the pressure is reduced to below 100 pounds on the high pressure gauge, open the low pressure gauge valve and continue discharging until all refrigerant has been released. Close both gauge valves.

EVACUATING AND CHARGING THE SYSTEM

> GENERAL NOTE: In all evacuating procedures shown following, the specification of 26-28 inches of mercury vacuum is used. These figures are only attainable at or near Sea Level Elevation. For each 1,000 feet above Sea Level where this operation is being performed, the specifications should be lowered by 1 inch. Example: At 5,000 feet elevation, only 21 to 23 inches of vacuum can normally be obtained.

Whenever the air conditioning system is open for any reason, it should not be put into operation again until it has been evacuated to remove air and moisture which may have entered the system.

The following procedures are based on the use of the J-8393 Charging Station:

FILLING CHARGING CYLINDER

1. Open control valve on refrigerant drum.
2. Open valve on bottom of charging cylinder allowing refrigerant to enter cylinder.
3. Bleed cylinder valve on top (behind control panel) as required to allow refrigerant to enter. When refrigerant reaches desired level (see "Air Conditioning System Capacities"), close valve at bottom of cylinder and be certain bleed valve is closed securely.

NOTE: It will be necessary to close bleed valve periodically to allow boiling to subside to check level in sight glass.

INSTALLING CHARGING STATION TO SYSTEM

1. Be certain all valves on charging station are closed.
2. Connect high pressure gauge line to high pressure gauge fitting. (See "Installing Gauge Set to Check System Operation.")
3. See figure 12. Turn high pressure control (2) one turn counterclockwise (open). Crack open low pressure control (1) and allow refrigerant gas to hiss from low pressure gauge line for three seconds, then connect low pressure gauge line to low pressure gauge fitting.
4. System is now ready for performance testing.

EVACUATING AND CHARGING SYSTEM

1. Install charging station as previously described. Refer to figures 12 and 13 while performing the following operation.
2. Remove low pressure gauge line from P.O.A. valve.

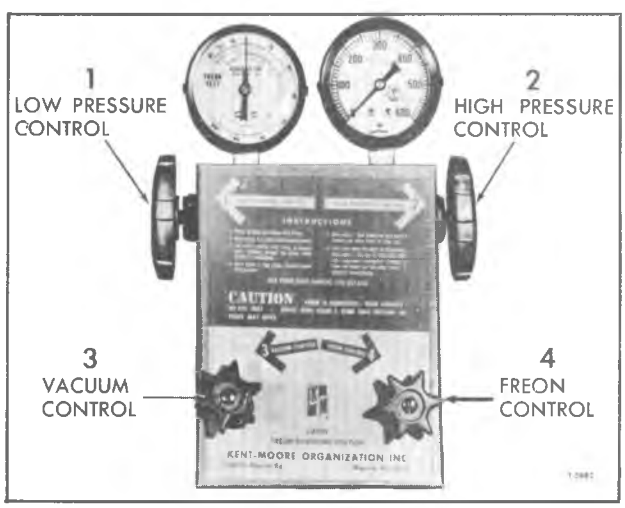


Figure 12—Charging Station Controls

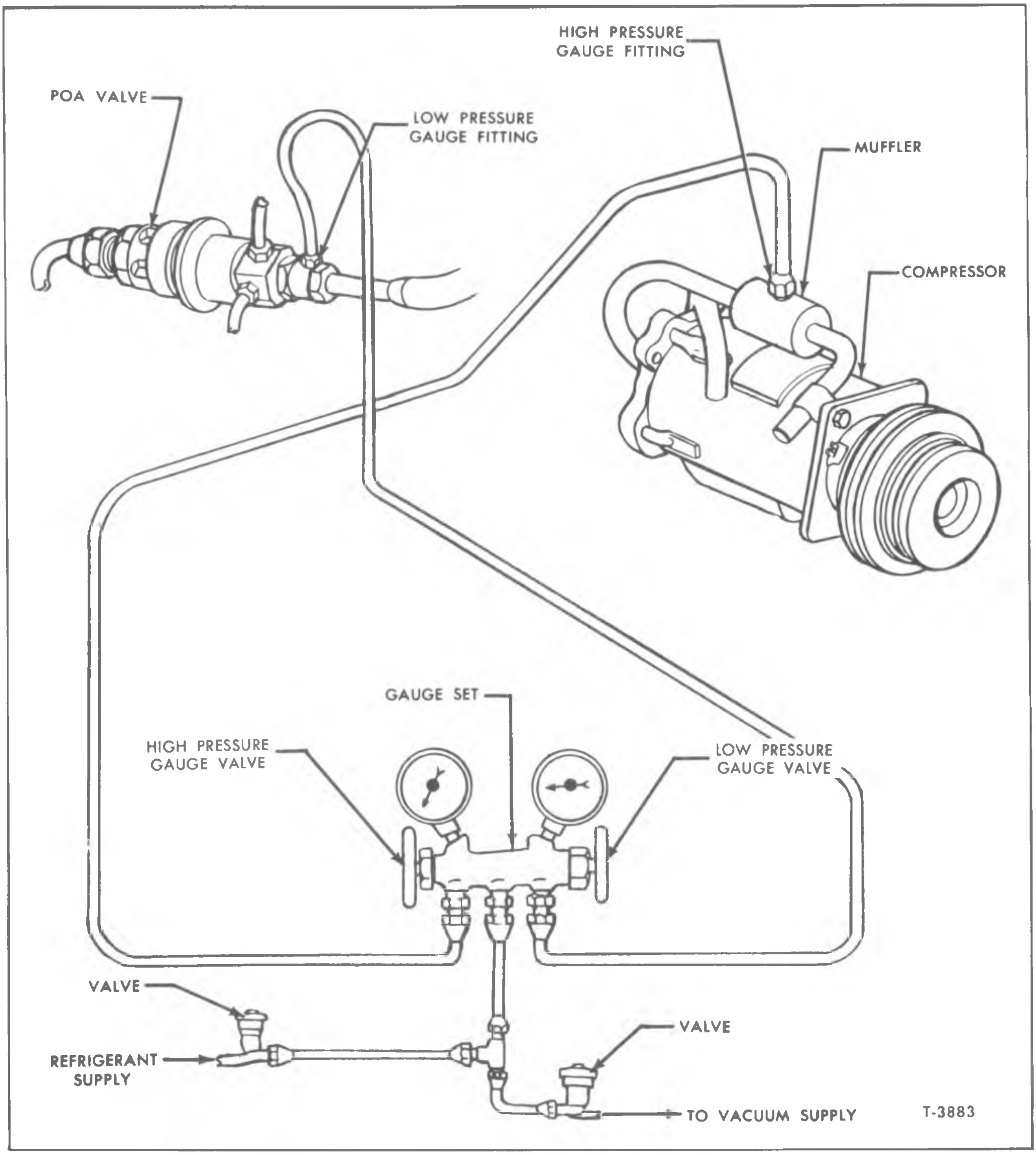


Figure 13—Charging Schematic

3. Crack open high (2) and low (1) pressure control valves (fig. 12), and allow refrigerant gas to purge from system. Purge slow enough so that oil does not escape along with the refrigerant.

4. When refrigerant flow stops, connect low pressure gauge line to P.O.A. valve.

5. Turn on vacuum pump and open vacuum control valve (3).

6. With system purged as directed previously, run pump until 28-29 inches of vacuum is obtained.

Continue to run pump for 15 minutes after the system reaches 28-29 inches vacuum.

7. If 28-29 inches cannot be obtained, close vacuum control valve (3) and shut off vacuum pump. Open refrigerant control valve (4) allow 1/2 pound of R-12 to enter system. Locate and repair all leaks.

8. After evacuating for 15 minutes, add 1/2 pound of R-12 to system as described in Step 7 above. Purge this 1/2 pound and re-evacuate for 5 minutes. This second evacuation is to be certain that as much contamination is removed from the system as possible.

9. Only after evacuating as above, system is ready for charging. Note reading on sight glass of charging cylinder. If it does not contain a sufficient amount for a full charge, fill to the proper level.

10. With high and low pressure valves (1 and 2) open, close vacuum control valve (3) and open Freon control valve (4). Operating the heater and air conditioner blower with the controls set for cooling will help complete the charging operation.

NOTE: If the charge will not transfer completely from the station to the system, close the high pressure valve at the gauge set, set the air conditioning controls for cooling, check that the engine compartment is clear of obstructions, and start the engine. Compressor operation will decrease the low side pressure in the system.

System is now charged and should be performance tested before removing gauges.

CHECKING OIL

In the compressor, it is not recommended that the oil be checked as a matter of course. Generally, compressor oil level should be checked only where there is evidence of a major loss of system oil such as might be caused by:

1. A broken refrigerant hose.
2. A severe hose fitting leak.
3. A very badly leaking compressor seal.
4. Collision damage to the system components.

As a quick check on compressor oil charge, with the engine off, carefully crack open the oil drain plug on the bottom of the compressor. If oil comes out, the compressor has the required amount of oil. To further check the compressor oil charge, should the above test show insufficient oil, it is necessary to remove the compressor from the vehicle, drain and measure the oil.

CHECKING COMPRESSOR OIL CHARGE

1. Run the system for 10 minutes at 500-600 engine rpm with controls set for maximum cooling and high blower speed.

2. Turn off engine, discharge the system, remove compressor from vehicle, place it in a horizontal position with the drain plug downward. Remove the drain plug and, tipping the compressor back and forth and rotating the compressor shaft, drain the oil into a clean container, measure and discard the oil.

3. a. If the quantity drained was 4 fluid ounces or more, add the same amount of new refrigerant oil to the replacement compressor.

b. If the quantity drained was less than 4 fluid ounces, add 6 fluid ounces of new refrigeration oil to the replacement compressor.

c. If a new service compressor is being installed, drain all oil from it and replace only the amount specified in Steps 3a and 3b above.

d. If a field repaired compressor is being installed, add an additional 1 fluid ounce to the compressor.

4. In the event that it is not possible to idle the compressor as outlined in Step 1 to effect oil return to it, proceed as follows:

a. Remove the compressor, drain, measure and discard the oil.

b. If the amount drained is more than 1-1/2 fluid ounces and the system shows no signs of a major leak, add the same amount to the replacement compressor.

c. If the amount drained is less than 1-1/2 fluid ounces, and the system appears to have lost an excessive amount of oil, add 6 fluid ounces of clean refrigeration oil to replacement compressor, 7 fluid ounces to a repaired compressor.

If the oil contains chips or other foreign material, replace the receiver-dehydrator and flush or replace all component parts as necessary. Add the full 11 fluid ounces of new refrigeration oil to the replacement compressor.

5. Add additional oil in the following amounts for any system components being replaced:

Evaporator	3 fluid oz.
Condenser	1 fluid oz.
Receiver-Dehydrator . . .	1 fluid oz.

NOTE: When adding oil to the compressor, it will be necessary to tilt the rear end of the compressor up so that the oil will not run out of the suction and discharge ports. Do not set the compressor on the shaft end.

ADDING OIL TO THE SYSTEM

The system should be completely assembled and discharged before adding oil. Use only uncontaminated refrigerant oil and add as follows:

1. Connect the low pressure gauge line to the low pressure gauge fitting on the P.O.A. valve.

2. Connect the high pressure line from the charging station gauge set to compressor muffler.

3. Disconnect the high pressure line from the

AIR CONDITIONING

gauge set, make certain that the line is clean, and place the end in a graduated oil container.

4. Pour enough refrigerant oil in the container so that the required volume may be drawn into the system by the high pressure hose.

5. Close the high pressure valve at the gauge set, and open the low pressure valve.

6. Operate the vacuum pump to drop the pressure within the system and cause atmospheric pressure to force oil through the high pressure line into the system. When the oil level has dropped the required volume, pull the line out of the oil container and continue vacuum pump operation to force the oil contained in the line into the system.

7. Shut off the vacuum pump and connect the high pressure line to the gauge set. Open the high pressure valve and evacuate the system through the high and low pressure side of the system. Complete the charging operation as outlined in Step 10 under "Evacuating and Charging System."

COMPONENT REPLACEMENT AND MINOR REPAIRS

REFRIGERANT LINE CONNECTIONS

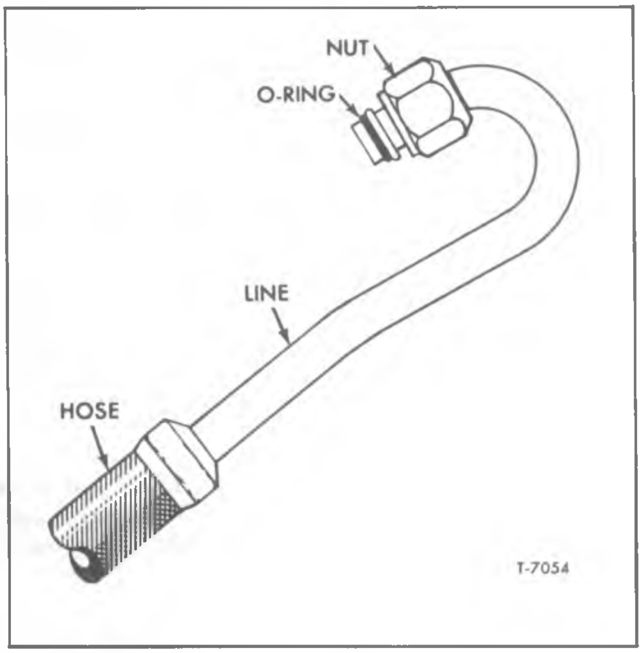


Figure 14—Line Connections (Late Models)

O-RINGS

Always replace O-ring (fig. 14) when a connection has been broken. When replacing O-ring, first dip it in refrigeration oil. Always use a backing wrench on O-ring fittings to prevent the pipe from twisting and damaging O-ring. Do not overtighten. Correct Torque Specifications (ft.-lbs.) follows:

Metal Tube O.D.	Thread & Fitting Size	Steel Tubing Torque (Ft.-Lbs.)	Alum. Tubing Torque (Ft.-Lbs.)
1/4	7/16	10 to 15	5 to 7
3/8	5/8	30 to 35	11 to 13
1/2	3/4	30 to 35	15 to 20
5/8	7/8	30 to 35	21 to 27
3/4	1-1/16	30 to 35	28 to 33

NOTE: Where steel to aluminum connections are being made, use torque for aluminum tubing.

REPAIR OF REFRIGERANT LEAKS

Any refrigerant leaks found in the system should be repaired in the following manner:

LEAKS AT O-RING CONNECTION

1. Check the torque on the fitting and, if too loose, tighten to the proper torque. Always use a backing wrench to prevent twisting and damage to the O-ring. Do not overtighten. Again leak test the joint.

2. If the leak is still present, discharge the refrigerant from the system as described under "Evacuating and Charging Procedures."

3. Inspect the O-ring and the fitting and replace if damaged in any way. Coat the O-ring before reinstalled with refrigeration oil and install carefully.

4. Retorque the fitting, using a backing wrench, and then add 1/2 to 1 lb. of R-12 to the system and recheck for leaks.

CAUTION: Do not operate the system with this small refrigerant charge.

5. Purge the system, thus removing the 1/2 to 1 lb. of R-12 installed in Step 4 above.

6. Evacuate and charge the system.

LEAKS AT HOSE CLAMP CONNECTION

1. Check the tightness of the clamp itself and tighten, if necessary. Recheck for leak.

2. If leak has not been corrected, discharge the system and loosen clamp and remove hose from connection. Inspect condition of hose and connector. Replace scored or damaged parts.

3. Dip end of new hose in refrigerant oil and carefully reinstall over connector. Never push end of hose beyond the locating bead. Properly torque the clamp.

4. Recheck the system for leaks by installing 1/2 to 1 lb. of R-12 into the system. Do not run compressor.

5. Purge the system, thus removing the 1/2 to 1 lb. of R-12 installed in Step 4 above.

6. Evacuate and charge the system.

COMPRESSOR LEAKS

If leaks are located around the compressor shaft seal or shell, replacement of necessary seals should be made.

NOTE: A slight amount of oil leakage past the compressor front seal is considered normal.

REFRIGERANT HOSE FAILURE

After a leak or rupture has occurred in a refrigerant hose, or if a fitting has loosened and caused a considerable loss of refrigerant and oil, the entire system should be flushed and recharged after repairs have been made. If the system has been open to atmosphere for any prolonged period of time the receiver-dehydrator should be replaced.

NOTE: The inlet and outlet hoses are swaged to the compressor connector block inlet and outlet lines. If either hose has failed, the entire assembly (inlet hose, connector block and muffler assembly and outlet hose) must be replaced as a unit. It is not recommended that any hose be repaired by cutting and splicing.

PREPARING SYSTEM FOR REPLACEMENT OF COMPONENT PARTS

Air conditioning, like many other things, is fairly simple to service once it is understood. However, there are certain procedures, practices and precautions that should be followed to prevent costly repairs, personal injury or damage to equipment. For this reason it is strongly recommended that the preceding information in this section be studied thoroughly before attempting to service the system.

Great emphasis must be placed upon keeping the system clean. Use plugs or caps to close system components and hoses when they are opened to the atmosphere. Keep your work area clean.

In removing and replacing any part which requires unsealing the refrigerant circuit the following operations, which are described in this section, must be performed in the sequence shown:

1. Purge the system by releasing the refrigerant to the atmosphere.

2. Remove and replace the defective part.

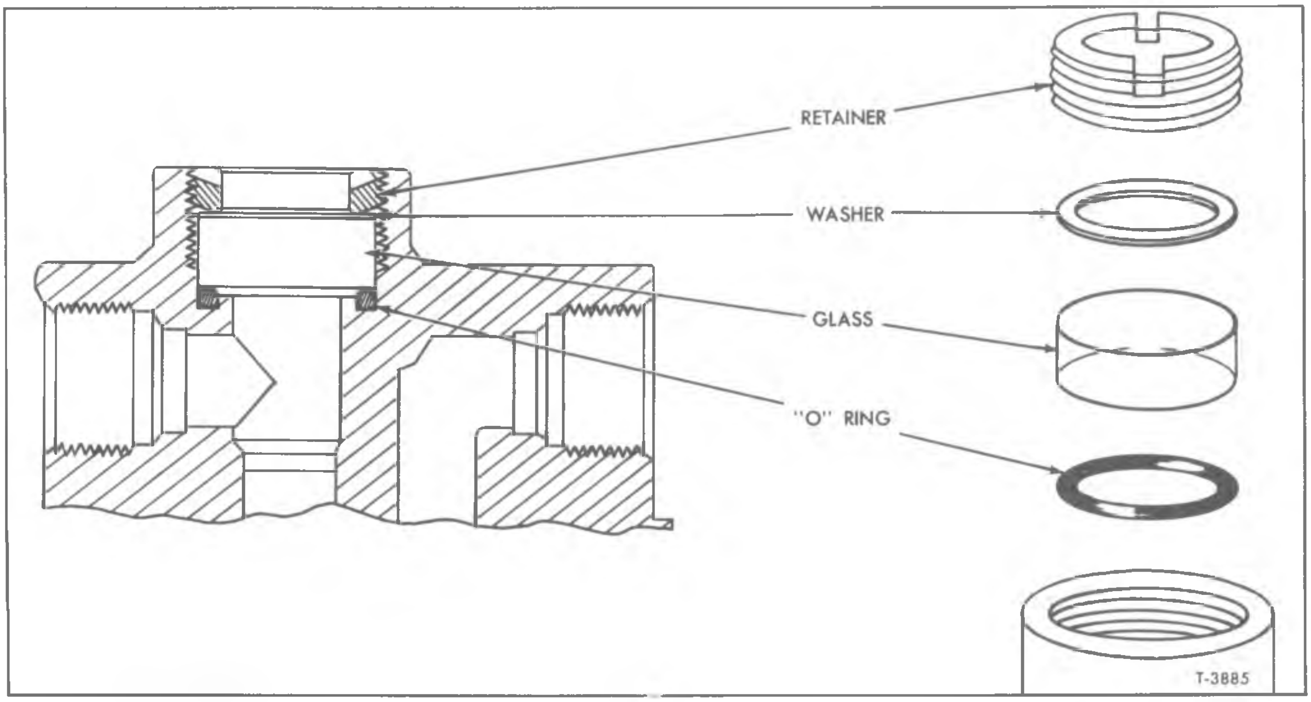


Figure 15 —Sight Glass Replacement

3. Evacuate and charge the system with R-12 refrigerant.

> **CAUTION: Always wear protective goggles when working on refrigeration systems. Goggles (J-5453) are included in the set of air conditioning special tools. Also, beware of the danger of carbon monoxide fumes by avoiding running the engine in closed or improperly ventilated garages.**

FOREIGN MATERIAL IN THE SYSTEM

Whenever foreign material is found in the system, it must be removed before restoring the system to operation.

In the case of compressor mechanical failure, perform the following operations:

1. Remove the compressor.
2. Remove the receiver-dehydrator and discard the unit.
3. Flush the condenser to remove foreign material which has been pumped into it.
4. Disconnect the line from the receiver dehydrator at the inlet connection of the expansion valve. Inspect the inlet screen for the presence of metal chips or other foreign material. If the screen is plugged, replace it. Reconnect the line to the expansion valve.
5. Install a new receiver-dehydrator.
6. Install the replacement compressor.
7. Add the necessary quantity of oil to the system (one fluid ounce because of receiver-dehydrator replacement plus the quantity needed for the replacement compressor (refer to "Checking Compressor Oil Charge" under "Checking Oil."
8. Evacuate and charge the system.
9. Check system performance.

SIGHT GLASS REPLACEMENT

If damage to the sight glass should occur, a new sight glass kit (fig. 15) should be installed immediately. Entire dehydrator must be replaced if glass is broken for any length of time.

1. Purge system.
2. Remove the sight glass retainer nut using a screwdriver, and remove old glass and seal.
3. Install the new glass and seal and retainer nut, being careful not to turn the nut past the face of the housing. To do so may damage O-ring seal.
4. Evacuate and recharge the system.

CONTROL ASSEMBLY

(Refer to Figure 16)

REMOVAL

1. Disconnect battery ground cable.
2. Remove screws in lower lip of dash which attach the control assembly bracket to the dash.
3. Move the unit toward the front of the vehicle and lower it.
4. Disconnect the blower harness connector and illuminating lamp sockets. Remove the blower switch and mounting bracket.

5. Remove the control cables and transfer them to the replacement control unit. Check them for adjustment.

INSTALLATION

1. Attach the blower switch to the unit. Connect the harness connector and illuminating lamps. Attach the mounting bracket.
2. Lift the unit into position and attach it to the dash.
3. Connect the battery ground cable.

CONDENSER

REMOVAL

1. Purge the refrigerant from the system.
2. Drain the radiator.
3. Loosen the radiator hose clamps at the radiator inlet and outlet and disconnect the hoses at the radiator.
4. Remove the two upper radiator mounts.
5. Push the top of the fan shroud rearward and lift the radiator out of the truck.
6. Disconnect the condenser inlet and outlet fittings and cap the open pipes. If the condenser is to be reused, cap the inlet and outlet pipes.
7. Remove the screws which attach the lower frame of the condenser to lower mounting brackets.
8. Remove the screws which attach the upper condenser mounting brackets to the grille header bar and lift the condenser out of the truck.
9. Remove the upper brackets from the condenser frame if a new condenser will be installed.

INSTALLATION

1. Mount the upper condenser mounting brackets (loosely) to the condenser frame.
2. Lower the condenser into position behind the grille.
3. Mount the upper condenser mounting brackets (loosely) to the grille header bar.
4. Mount the condenser frame (firmly) to the lower condenser mounting brackets.
5. Tighten the upper condenser brackets to the condenser frame and grille header bar.
6. Uncap the refrigerant lines and condenser pipes and connect the lines to the condenser using new O-rings wetted with clean refrigeration oil.
7. Hold the top of the fan shroud rearward and lower the radiator into place. Be certain that the rubber pads are in place in the lower radiator mounts and that the header tank flange seats squarely in the pads.
8. Mount the two upper radiator mounts observing the rubber pad location as in the previous step. Attach the fan shroud to the rear of the mounts.
9. Connect the coolant hoses from the engine to the radiator inlet and outlet. Clamp securely.

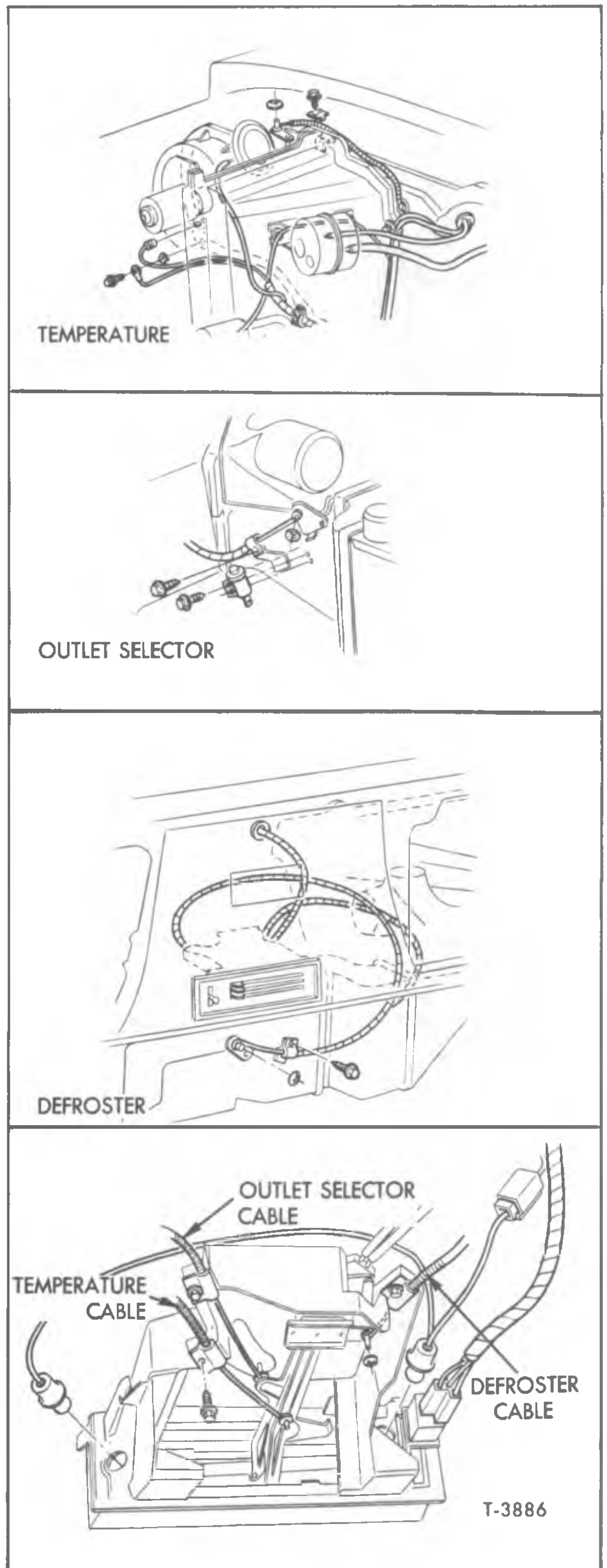


Figure 16 —Air Conditioning Controls

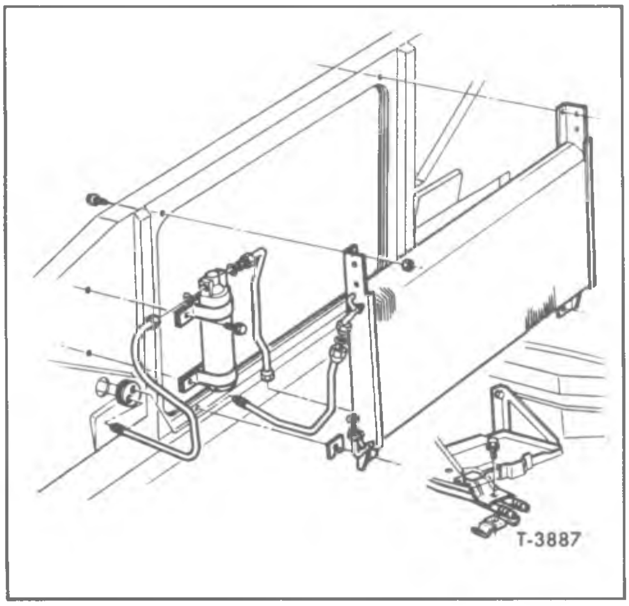


Figure 17—Condenser and Receiver-Dehydrator

10. Check that the radiator drain plug (or valve) is installed (or shut off).

11. Refill the cooling system.

12. Evacuate and recharge the refrigeration system. If a new condenser was installed, add one fluid ounce of refrigeration oil to the system before recharging. Check system performance and leak test.

RECEIVER-DEHYDRATOR

The receiver-dehydrator should be replaced if it has been damaged through an accident, or if it leaks or becomes restricted or clogged. Do not attempt to repair the receiver-dehydrator.

The receiver-dehydrator is merely a moisture collecting device and a refrigerant storage area and is the least likely component of the system to cause a malfunction.

If at any time when examining the compressor oil, moisture is found or there is an indication of moisture at the expansion valve needle, the receiver should be replaced as follows (fig. 17):

NOTE: If the receiver-dehydrator is to be reused, cap the inlet and outlet connections immediately. When installing a receiver-dehydrator, do not uncap the connections until the last possible moment.

REMOVAL

1. Purge the system.
2. Remove the inlet and outlet connections from the receiver-dehydrator.
3. Remove the receiver-dehydrator mounting bolts and carefully remove it.
4. Cap the system if the receiver-dehydrator will not be replaced immediately. Cap the receiver if it will be reused.

INSTALLATION

1. Place the receiver-dehydrator in position and replace attaching bolts. Do not uncap the unit until immediately before connecting lines.
2. Uncap any previously capped connections and connect the fittings using new O-ring seals.
3. Evacuate and recharge the system. If a new receiver-dehydrator was installed, add one fluid ounce refrigerant oil to the system.

EXPANSION VALVE

REMOVAL

1. Purge the system.
2. Loosen the clamp retaining the high pressure line to the bracket next to the expansion valve.
3. Disconnect the capillary bulb from the evaporator outlet pipe. Disconnect the equalizer line from the P.O.A. Cap the P.O.A. connector.
4. Disconnect the expansion valve inlet and outlet connections and cap the lines.
5. Remove expansion valve to bracket mounting screw and remove expansion valve.

INSTALLATION

1. Mount the expansion valve to the bracket.
2. Connect the inlet and outlet connections. Tighten the inlet pipe clamp.
3. Connect the equalizer line to the P.O.A. and mount the capillary bulb to the evaporator outlet pipe.
4. Evacuate and charge the system. Check performance.

P.O.A. VALVE

REMOVAL

1. Purge the system.
2. Remove evaporator oil bleed line and expansion valve equalizer line. Cap the connections.
3. Remove retaining clamp screw and loosen P.O.A. valve outlet pipe clamp mounting screw.
4. Remove P.O.A. valve inlet and outlet connections and remove P.O.A. valve. Cap the open tubes.
5. Remove clamp from P.O.A. valve.

INSTALLATION

1. Assemble clamp on P.O.A. valve and connect inlet and outlet connections.
2. Secure P.O.A. valve clamp and outlet line clamp.
3. Connect the evaporator oil bleed line and the expansion valve equalizing line to the P.O.A. valve.

BLOWER ASSEMBLY

(Refer to Figure 18)

REMOVAL

1. Disconnect battery ground cable.
2. Support the right front of the hood in the fully raised position.
3. Carefully scribe the hood and fender locations of the right hood hinge and remove the hinge.
4. Unclip the blower wire at the blower flange terminal and note or mark the motor flange position in relation to the blower case. Disconnect the rubber cooling tube to the motor.
5. Remove the blower assembly mounting screws.
6. Remove the blower assembly (pry the flange away from the case carefully if the sealer acts as an adhesive).
7. Remove the nut attaching the blower wheel to the motor shaft and separate the assembly.

INSTALLATION

1. Assemble the blower wheel to the motor with the open end of the blower away from the motor.
2. Install the assembly to the blower case, connect ground strap, and connect the motor wire. Connect cooling tube to motor.
3. Remount the hood hinge aligning it carefully with the scribed lines. Check hood alignment.
4. Connect battery ground cable.

EVAPORATOR

(Refer to Figure 18)

REMOVAL

1. Purge the system.
2. Disconnect the line (between the evaporator and the thermostatic expansion valve) at the expansion valve. Cap the open connections.
3. Disconnect the evaporator oil bleed line at the P.O.A. valve. Cap the open connections.
4. Disconnect the evaporator outlet pipe at the P.O.A. valve. Cap the open connections. Remove the evaporator outlet pipe clamp.
5. Detach the expansion valve capillary bulb from the evaporator outlet pipe.
6. Disconnect the vacuum lines at the vacuum reservoir.
7. Remove the screws attaching the inboard case half to the outboard case half, back up plate, and firewall.
8. Remove inboard case half and evaporator core.

INSTALLATION

1. Assemble evaporator core and inboard case half to the outboard case half. Replace case to case, case to backup plate, and case to firewall mounting screws.

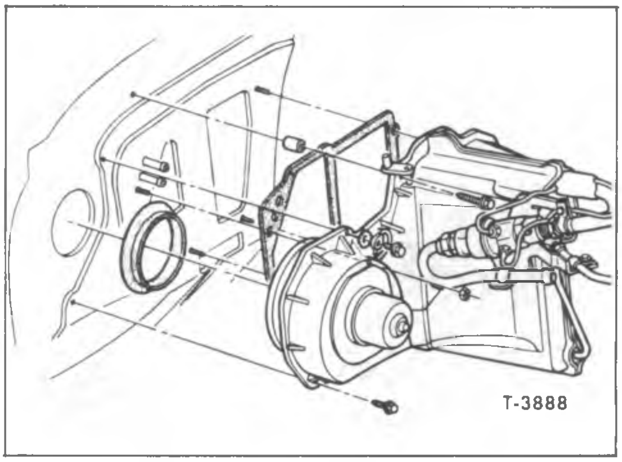


Figure 18—Evaporator and Blower Assembly

2. Attach vacuum lines to vacuum reservoir.
3. Mount the expansion valve capillary bulb to the evaporator core outlet pipe.
4. Connect the evaporator outlet pipe to the P.O.A. valve using a new O-ring. Install the pipe clamp.
5. Connect the evaporator oil bleed line to the P.O.A. valve.
6. Connect the line from the evaporator to the expansion valve.
7. If a new evaporator was installed, add three fluid ounces of refrigerant oil to the system. Evacuate and charge the system. Check performance.

BLOWER AND EVAPORATOR CASE

(Refer to Figure 18)

REMOVAL

1. Purge the refrigeration system and drain the radiator.
2. Disconnect battery ground cable.
3. Unclip the blower motor wire at the blower flange terminal.
4. Disconnect heater hoses at the core tubes (fig. 19).
5. Disconnect the refrigerant lines at the P.O.A. valve outlet and the expansion valve inlet. Cap all open connections (fig. 19).
6. Remove vacuum hoses to vacuum reservoir and plenum air valve actuator.
7. Disconnect temperature door cable.
8. It may be necessary in order to gain access to the lower outboard case attachments, the right front fender skirt should be loosened and moved. Remove enough skirt mounting screws and bolts (from the rear forward) to move the skirt a sufficient amount.
9. Remove the case retaining screws and sheet metal nuts. Pull the case away from the mounting studs and inboard to remove it.

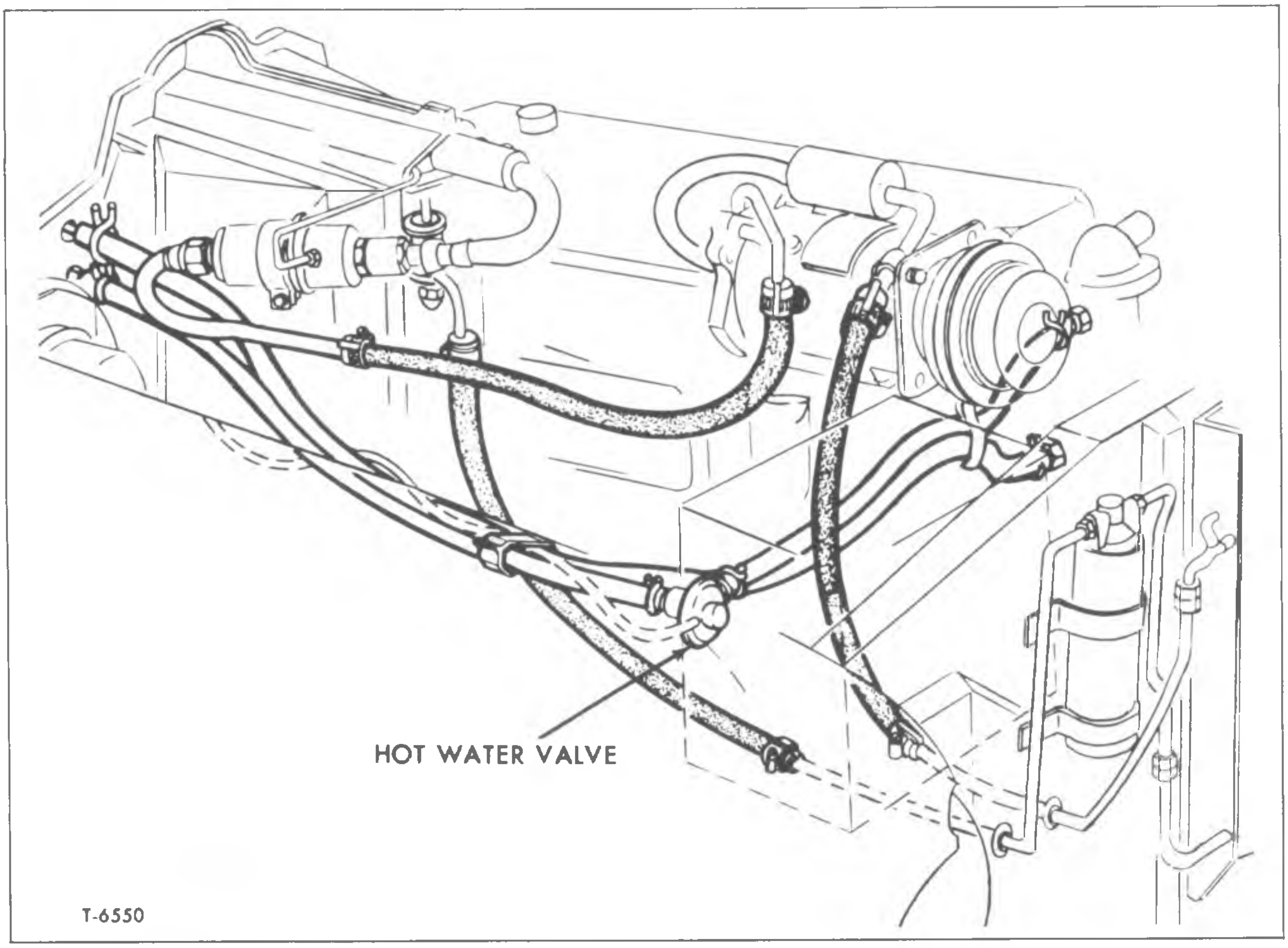


Figure 19—Air Conditioning and Heater Hose Routing

INSTALLATION

1. Check the position of the blower and evaporator case to fire wall seals, then position the case over the studs projecting through the fire wall and attach the screws and nuts to retain the case. Connect the blower motor ground strap. Replace spacer between case and fire wall at the screw next to the temperature door lever.

2. If removed, remount the right front fender skirt.

3. Connect temperature door cable and vacuum hoses (hose to engine vacuum source attaches to vacuum tank connection nearest the engine).

4. Connect the refrigerant hoses to the expansion valve inlet and the P.O.A. outlet using new O-ring seals, coated with clean refrigeration oil.

5. Connect the heater hoses to the core tubes.

6. Connect the blower motor wire to the motor flange terminal, and connect the battery ground cable.

7. Refill the cooling system, and evacuate and charge the refrigeration system.

HEATER CASE

(Refer to Figure 20)

REMOVAL

1. Drain the radiator.

2. Remove the heater hoses from the core tubes (fig. 19).

3. Remove the sheet metal nuts from the heater case studs which project through the fire wall to the engine side.

4. Remove the glove box.

5. Unplug the relay connector.

6. Remove the right ball outlet hose.

7. Remove the screw attaching the dash outlets air distributor to the heater case and move distributor away from case.

8. Remove the heater case to fire wall retaining screws.

9. Pull heater case away from the fire wall and reach in and disconnect the resistor connector.

10. Remove the resistor harness grommet and remove the harness from the case. Withdraw the heater case.

INSTALLATION

1. Place the heater case under the dash and insert the resistor harness and install the grommet and connect the resistor connector.

2. Position the heater case against the firewall and push it into place. Check that nothing is pinched between the case and firewall. Install the heater case to firewall retaining screws.

3. Position the dash outlets distributor against the heater case, insert the forward lip into the retaining clip, and install the retaining screw.

4. Install the right dash outlet hose.

5. Connect the relay connector.

6. Install the glove box.

7. Install sheet metal nuts to the heater case studs which project forward through the firewall.

8. Attach the heater hoses to the core tubes.

9. Refill the engine cooling system and test system operation.

HEATER CORE

REMOVAL

1. Remove the heater case as outlined under "Heater Case."

2. Remove the screws retaining core mounting straps. Remove core.

INSTALLATION

1. Install the core into the case and seal it with non-hardening sealer.

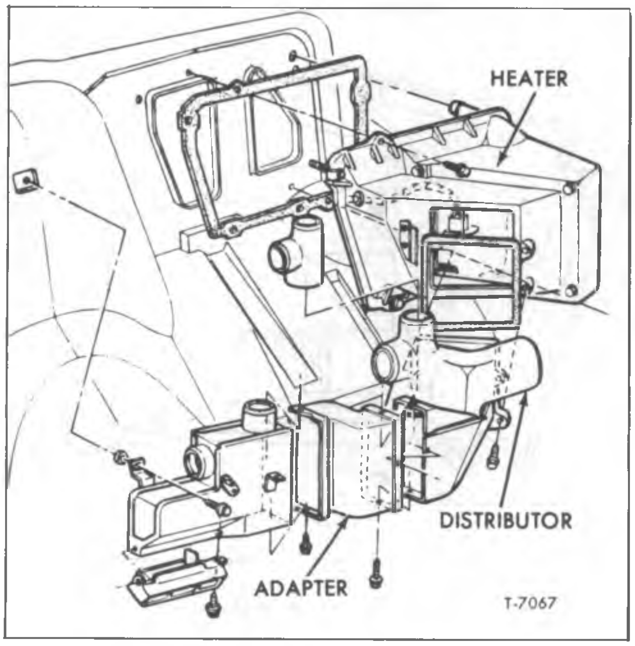


Figure 20—Heater and Ducts

2. Mount the core with the core straps and retaining screws.

3. Replace the heater case in the vehicle as outlined under "Heater Case."

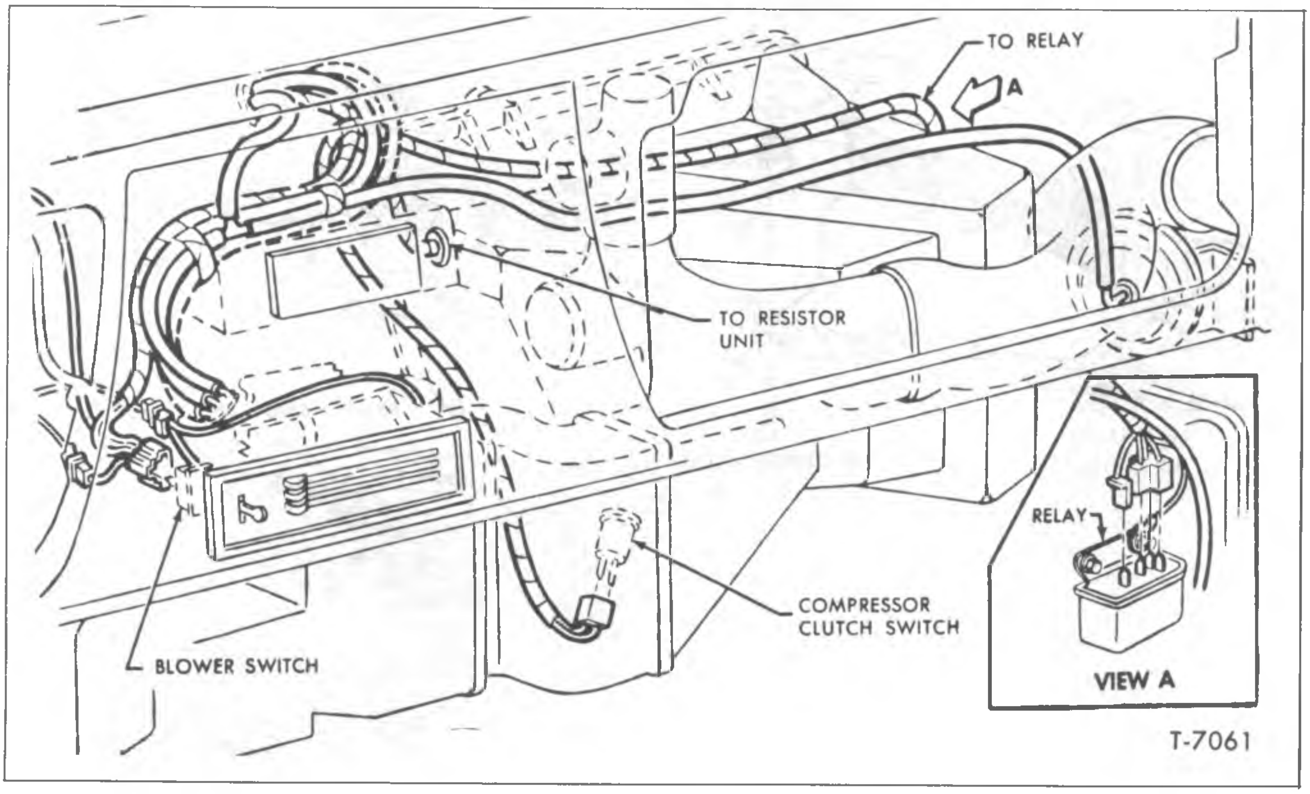


Figure 21—Wiring Harness

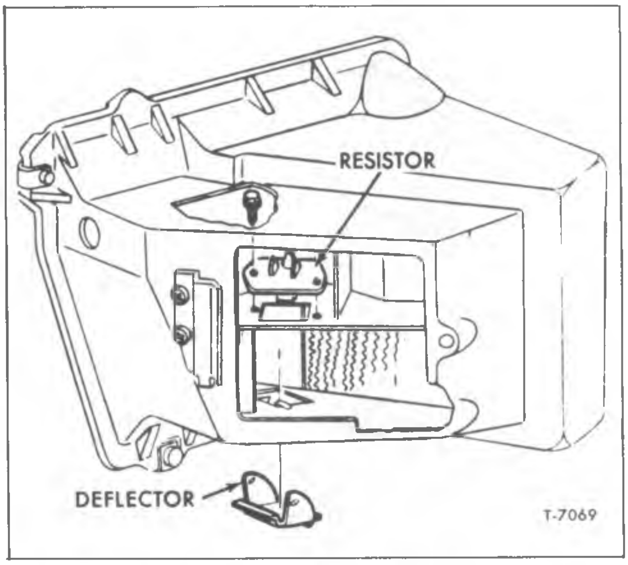


Figure 22—Resistor Unit

BLOWER MOTOR SWITCH

(Refer to Figure 21)

NOTE: Refer to figure 28 for Air Conditioning Wiring Diagram.

REMOVAL

1. Disconnect battery ground cable.
2. Disconnect wiring harness connector at blower switch.
3. Remove blower switch mounting screws and remove switch.

INSTALLATION

1. Place blower switch in position and install mounting screws.
2. Connect wiring harness to switch.
3. Connect battery ground cable.

BLOWER MOTOR RELAY

REMOVAL (Fig. 21)

1. Disconnect wiring harness at relay connector.
2. Remove two relay mounting screws and remove relay.

INSTALLATION

1. Place relay in position and drive mounting screws. Connect wiring harness to relay.

COMPRESSOR CLUTCH SWITCH

REMOVAL (Fig. 21)

1. Disconnect wiring harness at compressor

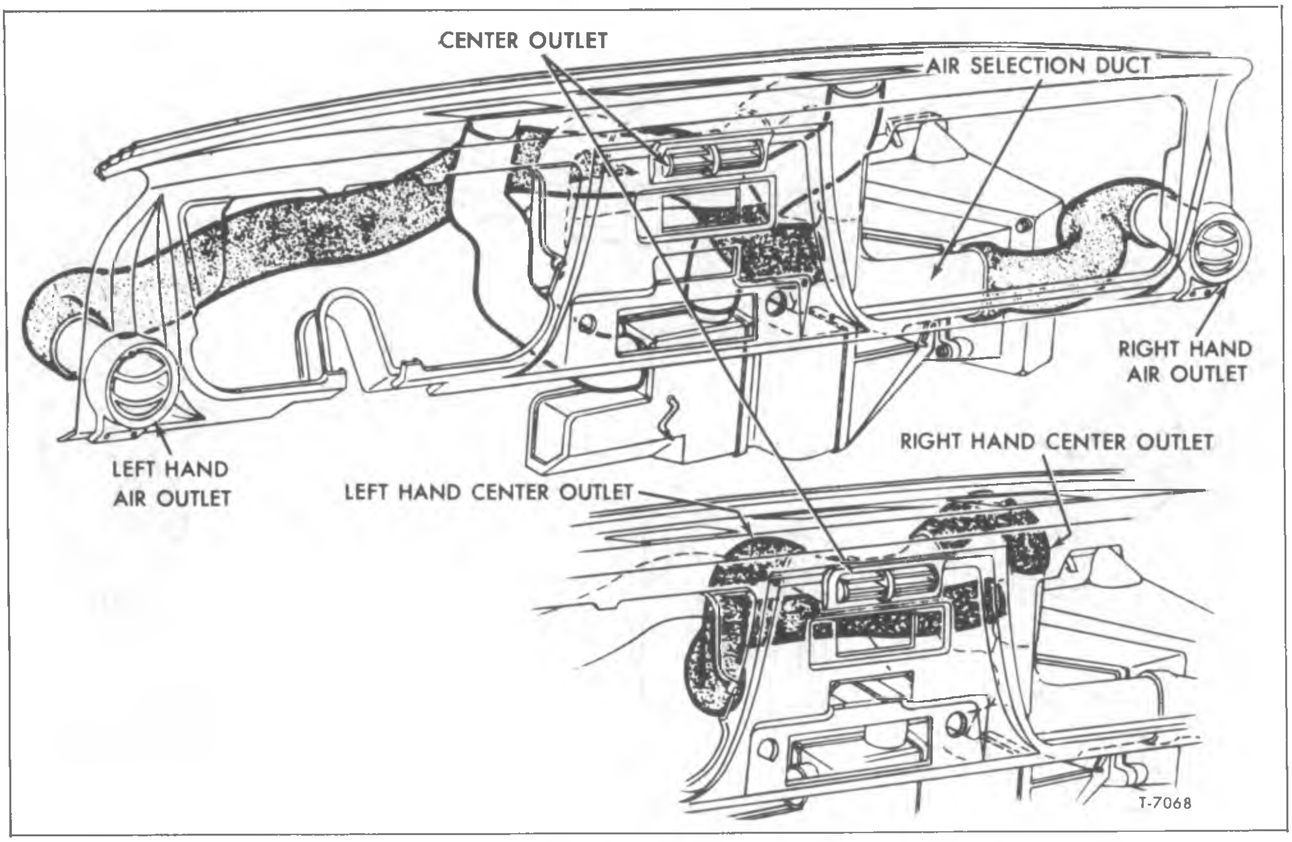


Figure 23—Air Outlets and Hoses

clutch switch.

2. Remove two mounting screws and remove switch.

INSTALLATION

1. Place switch in position and drive the two mounting screws.

2. Connect wiring harness to switch.

BLOWER RESISTOR UNIT

(Refer to Figure 22)

REMOVAL

1. Remove the screw attaching the floor outlet duct (above the heater outlet) to the fire wall.

2. Disconnect the dash outlet air hoses from the distributor (fig. 23).

3. Remove the screws (top, bottom, and seat side) attaching the dash outlet distributor to the floor outlet adapter.

4. Remove the screw attaching the distributor to the heater case, slide the distributor to the heater case, slide the distributor rearward and remove it.

5. Unplug the resistor unit connector.

6. Remove the resistor unit retaining screws. Remove the unit.

INSTALLATION

1. Place the replacement unit in position and install mounting screws.

2. Connect the resistor connector.

3. Position the dash outlet air distributor against the heater case, insert the forward lip into the retaining clip, and install the retaining screw.

4. Install the screws which attach the dash air distributor to the floor outlet adapter.

5. Attach the dash outlet air hoses to the distributor.

6. Mount the floor outlet duct to the fire wall with the attaching screw.

HOT WATER SHUT-OFF VALVE

(Refer to Figure 19)

REMOVAL

1. Place a container under the vehicle and then disconnect the shut-off valve inlet and outlet lines. Drain coolant into container.

2. Disconnect the valve vacuum line and remove the valve.

INSTALLATION

1. Install the coolant lines onto the new valve, making sure that coolant flows through the valve in the right direction.

2. Install the vacuum line onto the valve.

3. Refill the radiator.

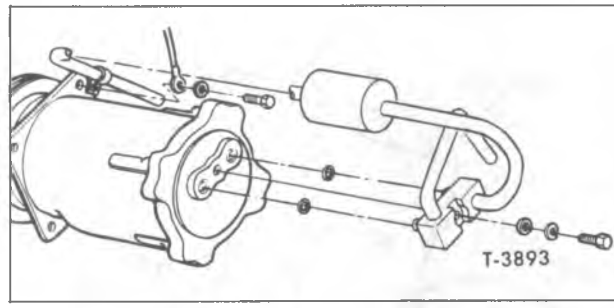


Figure 24—Compressor Connector Block and Muffler

MUFFLER AND CONNECTOR BLOCK

REMOVAL (Fig. 24)

1. Purge the system.

2. Remove hoses at the compressor inlet and muffler outlet pipes. Cap the connections.

3. Remove muffler outlet pipe clamp.

4. Remove bolt retaining connector block to compressor and remove the connector and muffler assembly. Cap the compressor ports if not immediately remounting muffler assembly.

INSTALLATION (Fig. 24)

1. Assemble the connector block to the compressor using new O-ring seals wetted with clean refrigeration oil.

2. Secure the muffler outlet pipe in the pipe clamp.

3. Connect the refrigerant hoses to the compressor inlet and muffler outlet pipes.

4. Evacuate and recharge the system.

KICK PANEL AIR VALVE ACTUATOR

(Refer to Figure 27)

REMOVAL (Fig. 25)

1. Disconnect vacuum hose from actuator.

2. Disconnect valve return spring.

3. Remove actuator bracket mounting screws.

4. Disconnect one link pin and remove actuator assembly. Remove actuator from bracket.

INSTALLATION

1. Attach actuator to bracket.

2. Connect actuator rod to link and install pin.

3. Mount the bracket to the kick panel.

4. Connect the valve return spring. Connect the vacuum hose to the actuator.

KICK PANEL AIR VALVE

(Refer to Figure 26)

REMOVAL

1. Remove actuator mounting bracket from kick panel.

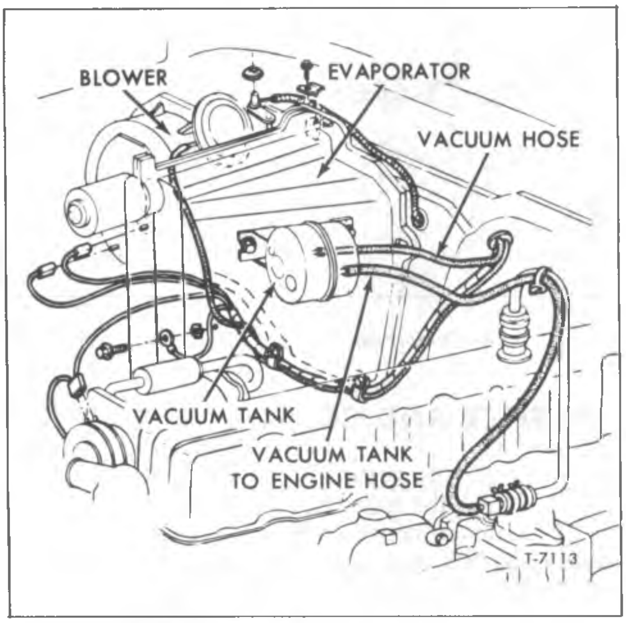


Figure 25—Vacuum Harness

2. Remove valve return spring.

3. Pull the top pivot pin downward against spring tension until it clears the upper pivot hole. Pull valve inward and withdraw lower pivot from pivot hole.

4. Remove the valve from the actuator link.

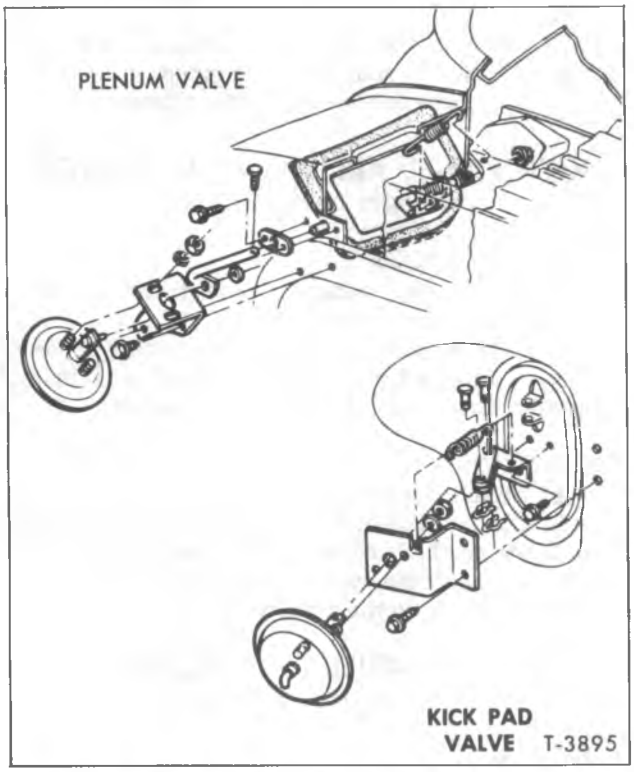


Figure 26—Air Inlet Valve and Recirculating Air Valve

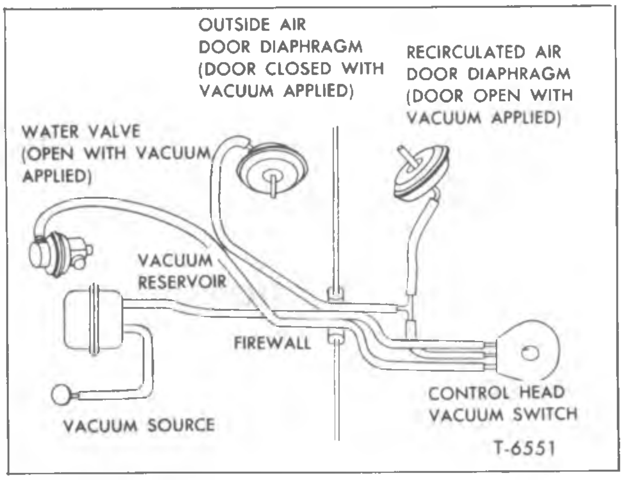


Figure 27—Vacuum Diagram

INSTALLATION

1. Attach the valve to the actuator link.

2. Insert the lower pivot pin into the lower hole, retract the upper pivot pin and insert into the upper pivot hole.

3. Install the valve return spring and mount the actuator bracket to the kick panel.

PLENUM AIR VALVE

(Refer to Figure 26)

REMOVAL

1. Remove cowl grille panel. Refer to SHEET METAL (SEC. 11) of this manual.

2. Disconnect the diaphragm link from the connecting shaft arm.

3. Remove the screw attaching the connecting shaft to the tube extending forward from the valve.

4. Remove the screws attaching the nylon bearing plate to the firewall and slide it forward. Remove valve return spring.

5. Pull the rear valve pivot pin forward against spring tension until it clears the rear bearing. Lift the valve at the rear and withdraw the valve shaft from the firewall.

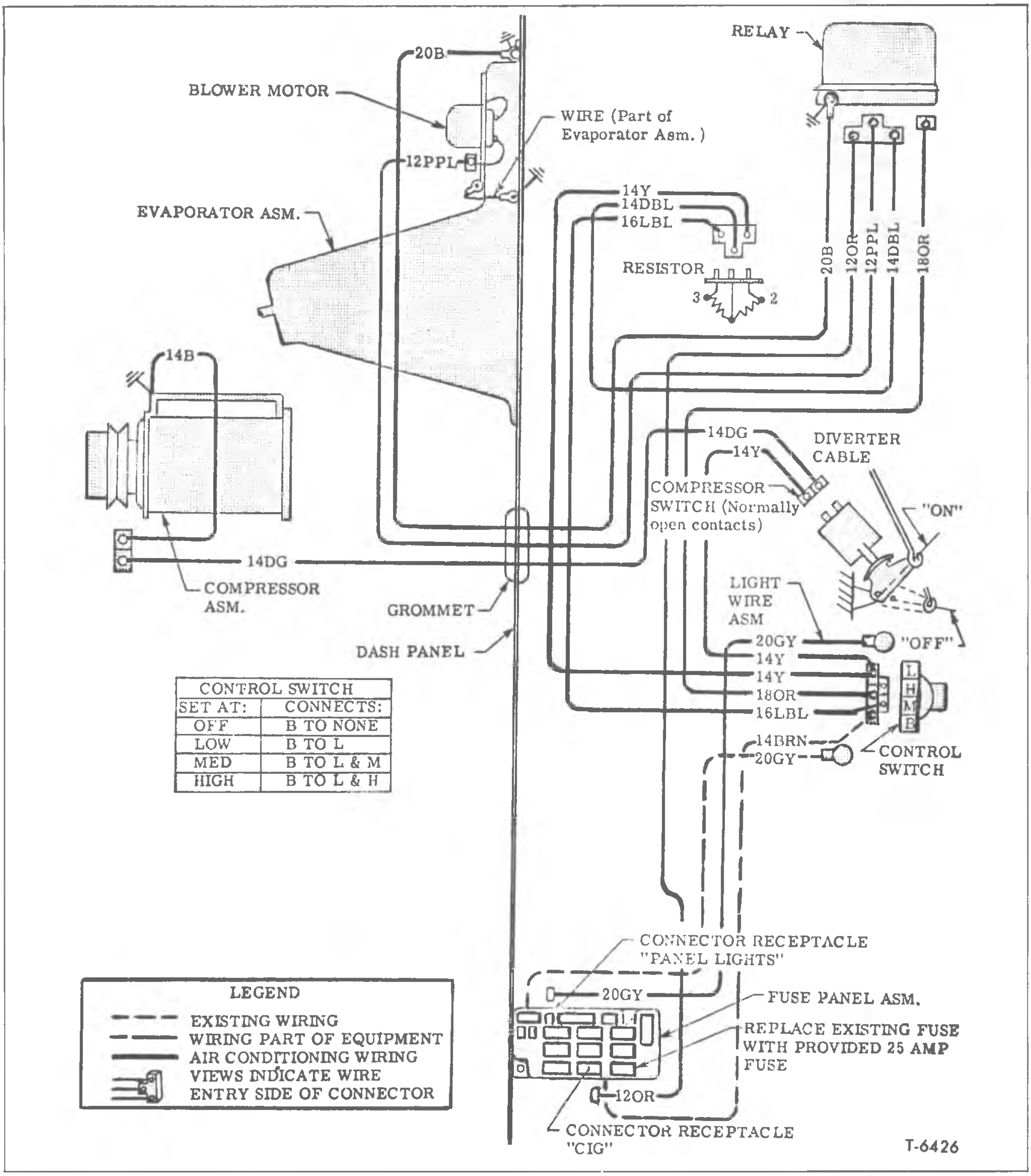
INSTALLATION

1. Insert the tube shaft on the valve into the firewall hole and lower the valve into position with the rear pivot pin retracted. When the rear pin is aligned with its bearing, allow it to extend into position.

2. Attach the valve return spring and nylon bushing.

3. Assemble the connecting shaft to the valve and actuating diaphragm.

4. Replace the cowl grille panel.

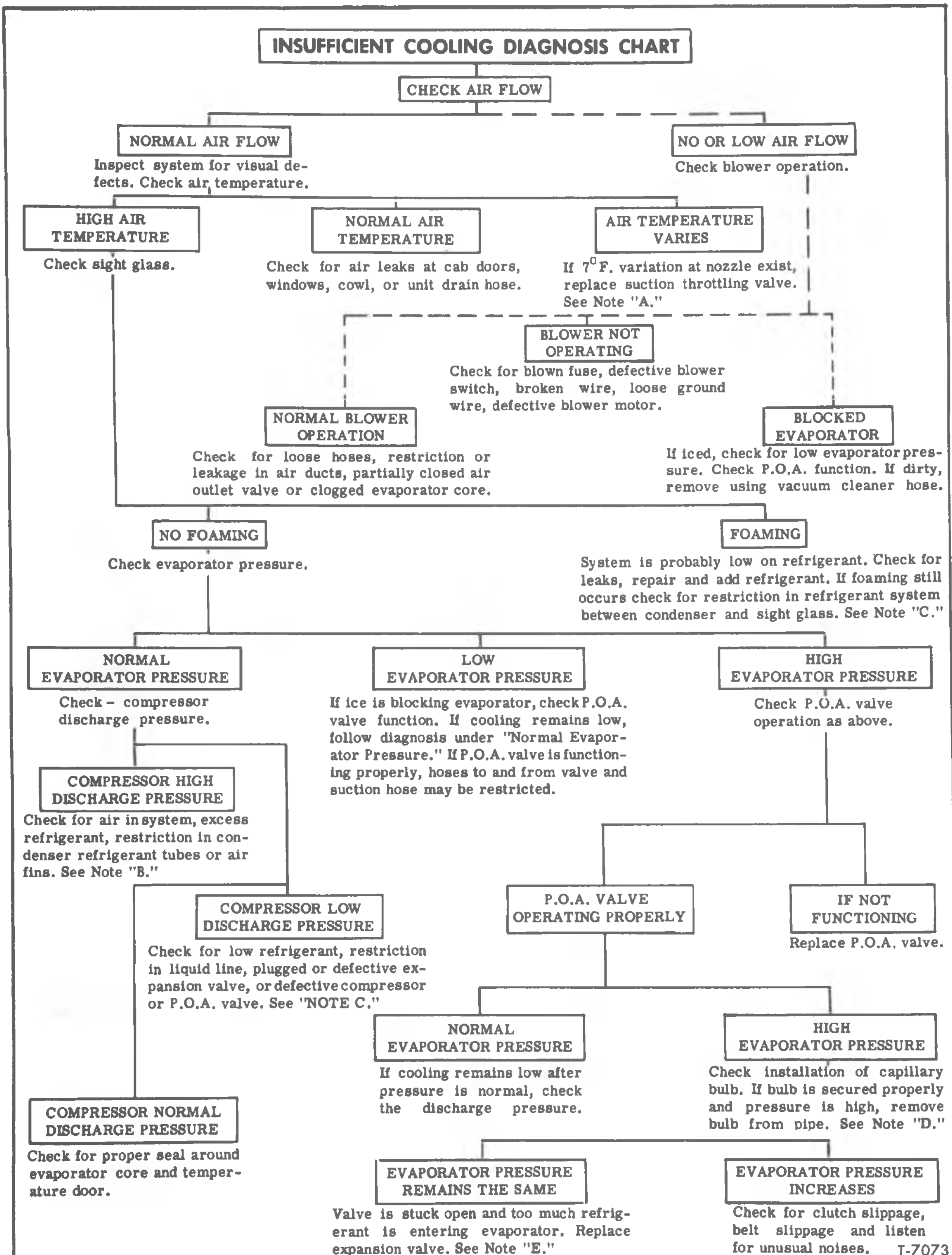


CONTROL SWITCH	
SET AT:	CONNECTS:
OFF	B TO NONE
LOW	B TO L
MED	B TO L & M
HIGH	B TO L & H

Figure 28—Air Conditioning Wiring Diagram

Disconnect Battery Before Working on Electrical Equipment.

AIR CONDITIONING



INSUFFICIENT COOLING DIAGNOSIS CHART NOTES

(Used in Conjunction With Chart on Opposite Page)

NOTE "A"

P.O.A. valve piston sticking; if stuck closed, no cooling due to lack of flow of refrigerant through the evaporator core; if stuck open, no controlled cooling and cab may get too cold - evaporator may freeze. Replace valve.

NOTE "B"

System with excess discharge pressure should be slowly depressurized at the receiver-dehydrator inlet connection, observing the behavior of the high pressure gauge indicator.

1. If discharge pressure drops rapidly, it indicates air (with the possibility of moisture) in the system. When pressure drop levels but still indicates in excess of specifications shown in the OPERATIONAL TEST DATA CHART, slowly bleed system until bubbles appear in the sight glass and stop. Add refrigerant until bubbles clear, then add one (1) pound of refrigerant. Recheck operational pressures. If discharge pressure still remains above specifications and the suction pressure is slightly above normal, then a restriction exists in the high pressure side of the system.

2. If discharge pressure drops slowly, it indicates excessive refrigerant. If pressure drops to specifications and sight glass remains clear, stop depressurizing and recheck operational pressures. If pressures are satisfactory, depressurize until bubbles appear in the sight glass, stop depressurizing, then add one (1) pound of refrigerant. Recheck operational pressures.

3. If discharge pressure remains high after depressurizing the system, continue depressurizing until bubbles appear in the sight glass. If suction pressures also remain high, then the P.O.A. valve may require replacement, as well as a restriction in the high pressure side of the refrigeration system. The system will have high pressure control more frequently under this condition.

Install gauge set and bleed off refrigerant from compressor suction and discharge side for 20 seconds. After 20 seconds close valves and recheck operating pressures. Repeat until discharge pressure is normal. Check sight glass; if bubbles appear it indicates that air was in system. Charge with refrigerant as follows: 2000 engine rpm, "OUTSIDE" air, "HI" blower and maximum cooling. Add refrigerant until sight glass clears, then add 1 pound additional.

NOTE "C"

Check for presence of bubbles or foam. If bubbles or foam is noted, charge with refrigerant as follows: 2000 engine rpm, "OUTSIDE" air, "HI" blower and Maximum Cooling. Add refrigerant until sight glass clears, then add an additional 1 pound.

NOTE: It is not unusual for bubbling to occur on minimum cooling and "LO" blower in mild weather even with a fully charged system.

NOTE "D"

Remove insulation and inspect for clearance between tube and bulb. If gap exists, move bulb to establish contact, reclamp and reinsulate.

NOTE "E"

Remove expansion valve and inspect internal screen for foreign objects. If present, there is a possibility seat is being held open. Install new expansion valve; if condition is corrected, discard the valve removed.

T-7074

ALWAYS WEAR PROTECTIVE GOGGLES WHEN WORKING ON REFRIGERATION SYSTEMS. ALSO BEWARE OF THE DANGER OF CARBON MONOXIDE FUMES BY AVOIDING RUNNING THE ENGINE IN CLOSED OR IMPROPERLY VENTILATED GARAGES.

COMPRESSOR

(Refer to Figure 29)

REMOVAL

1. Purge the refrigerant from the system.
2. Remove connector attaching bolt and connector. Seal connector outlets.
3. Disconnect electrical lead to clutch actuating coil.
4. Loosen brace and pivot bolts and detach belt.
5. Remove the nuts and bolts attaching the compressor brackets to the mounting bracket.
6. Before beginning any compressor disassembly, drain and measure oil in the compressor. Check for evidence of contamination to determine if remainder of system requires servicing.

INSTALLATION

1. If oil previously drained from the compressor upon removal shows no evidence of contamination, replace a like amount of fresh refrigeration oil into the compressor before reinstallation. If it was necessary to service the entire system because of excessive contamination in the oil removed, install a full charge of fresh refrigeration oil in the compressor.
2. Position compressor on the mounting bracket and install all nuts, bolts, and lock washers.
3. Install the connector assembly to the compressor rear head, using new O-rings.
4. Connect the electrical lead to the coil and install and adjust compressor belt. Refer to figures 28 and 29.
5. Evacuate and charge the system.
6. Leak test the system and check for proper operation.

COMPRESSOR BELT TENSION ADJUSTMENT

Adjust compressor belt, using a belt tension dial gauge (J-23573). Tension should be within 90-100 lbs. (used belt), or 135-145 lbs. (new belt).

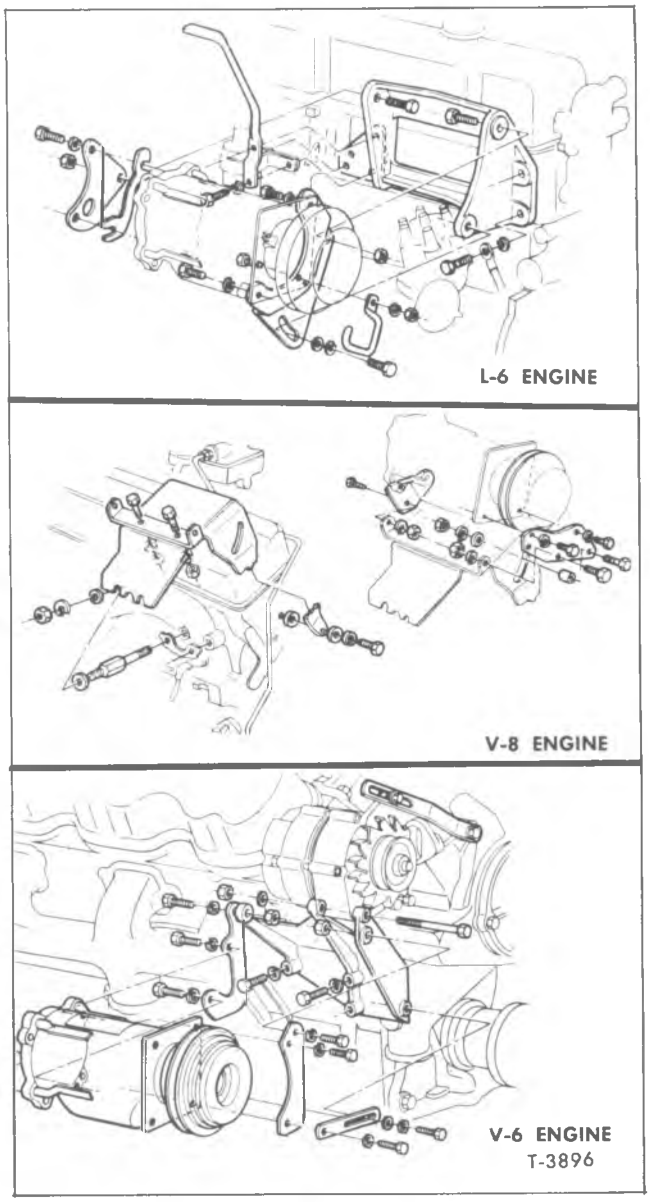


Figure 29—Compressor Mountings

SPECIFICATIONS

Compressor

Type	6 Cylinder Axial
Displacement	12.6 Cu. In.
Rotation	Clockwise

Blower Motor

Volts	14
Amps (Cold)	20 (Max.)
RPM (Cold)	4000

Compressor Clutch Coil

Ohms (at 80° F)	3.85
Amps (at 80° F)	3.2 @ 12 volts

System Capacities

Refrigerant 12	3 lbs., 4 oz.
525 Viscosity Compressor Oil	10 fluid oz.

Torque Specifications

Compressor Suction and Discharge Connector Bolt	20 ft. lbs.
Rear Head to Shell Stud Nuts	20 ft. lbs.
Shaft Mounting Nut	15 ft. lbs.

Fuses	25 Amp.

SECTION 2
Frame

GENERAL

This section includes general instructions for checking frame alignment and recommendations for frame repair and reinforcement. It must be pointed out that the information is provided to assist in the repair or reinforcement of frames, using the most desirable practices. This section was prepared to aid competent personnel in the repair or reinforcement of frames.

Channel-type frame (fig. 1) construction with riveted crossmembers is used on all models. Frame side rails are usually of S.A.E. 1023 steel. Figure 1 illustrates typical arrangement of frame mounted suspension and body attaching brackets.

In the event the vehicle is damaged in a collision, carefully check for proper frame alignment in addition to steering geometry and axle alignment.

FRAME ALIGNMENT CHECK

The most convenient way to check frame alignment, particularly when the cab or body is on the chassis, is to select various corresponding points of measurement on the outside of each side rail and then, by use of a plumb bob, transfer these points to a layout on a level floor. (Note: Flange width may vary ± 3/16".) The selection of these points is an arbitrary matter; however, it is an important factor to remember that for each point selected on the left side rail, a corresponding point must be used on the right rail. The illustration (fig. 1) is used merely to serve as a guide in the selection of checking points "M."

In order to obtain reliable results, checking must be done thoroughly and accurately. After all corresponding points have been carefully transferred from the vehicle frame to the floor layout, move the vehicle away from the layout and proceed as directed in the following steps:

NOTE: Key letters in the following text refer to figure 1.

1. Check the frame width at front and rear ends using the corresponding marks on the floor. If widths correspond to "Specifications" (at end of this section), draw center line full length of vehicle layout bisecting points indicating front width (WF) and rear width (WR). If frame widths are not correct, lay out center line as directed in Step 4.

2. With center line properly laid out, measure the distance perpendicular from the center line to corresponding points on each side over the entire length of the chassis. If the frame is in proper alignment, measurement should not vary more than an 1/8" at any corresponding point.

3. Where improper alignment is encountered, the point at which the frame is sprung may be located by measuring pairs of corresponding diagonals marked "A" or "B." If the length of each pair of diagonals ("A" or "B") are within 1/8" and the intersection point of the diagonal pairs is within 1/8" of the center line, the portion of the frame included between the points of measurement may

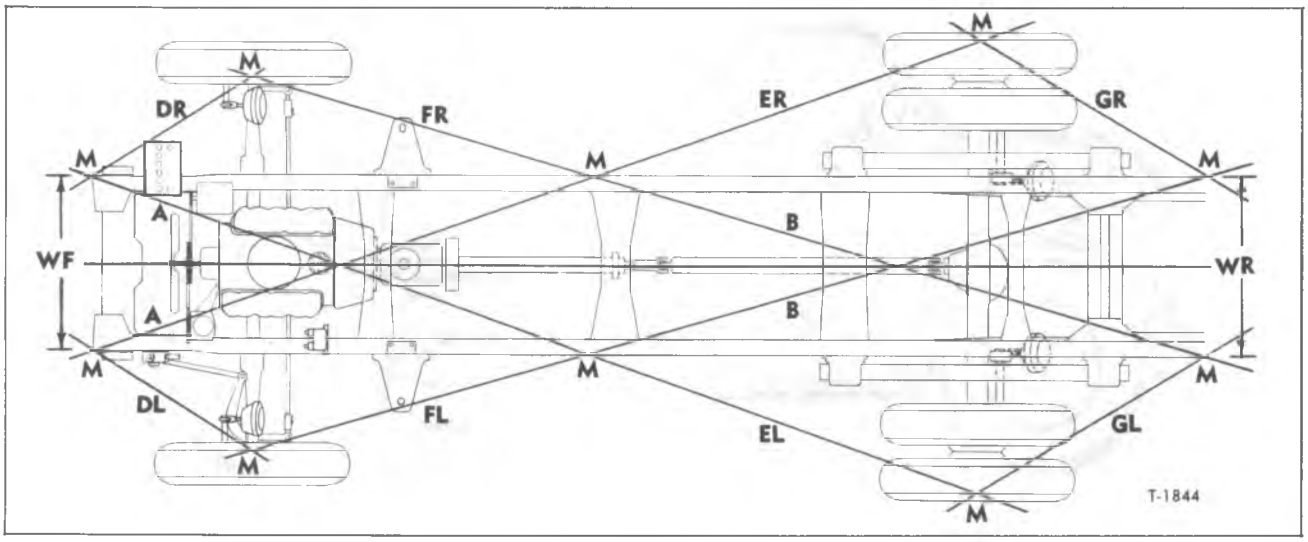


Figure 1—Typical Frame Alignment Points

be considered to be in proper alignment. Variation of more than a 1/8" indicates misalignment.

4. If the frame center line cannot be determined by method indicated in Step 1, the center line may be established by drawing a line through the intersection points of equal pairs of diagonals or from the intersection of equal diagonals through the midpoint of either correctly established front or rear frame widths. This method is usually required when front or rear end damage is incurred as the result of a collision.

5. After it has been determined that the frame is properly aligned, axle alignment with respect to the frame can be checked as directed below (see fig. 1):

a. Front axle alignment with respect to the frame is correct if "FR" equals "FL" and "DR" equals "DL." This can be concluded if both front and rear frame ends have been established as properly aligned (Step 3).

b. Rear axle alignment with respect to the frame is correct if "ER" equals "EL" and "GR" equals "GL."

NOTE: Refer to pages 110, 111, and 112 and figures 9, 10, and 11 for frame alignment dimensions.

STRAIGHTENING FRAMES

The practice of straightening frames should not be attempted by inexperienced personnel, as more damage can result from improper methods. Internal stresses can be introduced into the material by improper frame straightening. For this reason the following restrictions should be adhered to completely:

1. Frame straightening should be attempted only by experienced personnel.

2. Heat may be applied to S.A.E. 1023 steel only by competent personnel. The material temperature should not exceed 1200^{O} (dull red glow). It must be strongly pointed out that excessive heat will damage the material structure characteristics of the frame rail.

3. Frame members which are bent or buckled sufficiently to show strains or cracks after straightening should be replaced.

IDENTIFICATION OF MATERIAL

The importance of properly identifying the base rail before attempting to straighten or repair cannot be overemphasized. The results of incorrect welding or straightening methods may cause more damage to the frame than was originally experienced. Frame stress concentrations resulting from improper welding methods are a major cause of future frame failures.

The standard models as quoted in the GMC Data Book describe the physical dimension of the frame rail and specify the type of material used. However, due to the number of RPO's and Special Quotations available on most models, the Data Book inspection is not always a valid identification.

The material can be identified by the type of cut-out in the frame side rail at the front axle center line.

Any reinforcements added must be of the same or better material than the base frame rail. This would permit the use of S.A.E. 950 reinforcements on S.A.E. 1023 base rails.

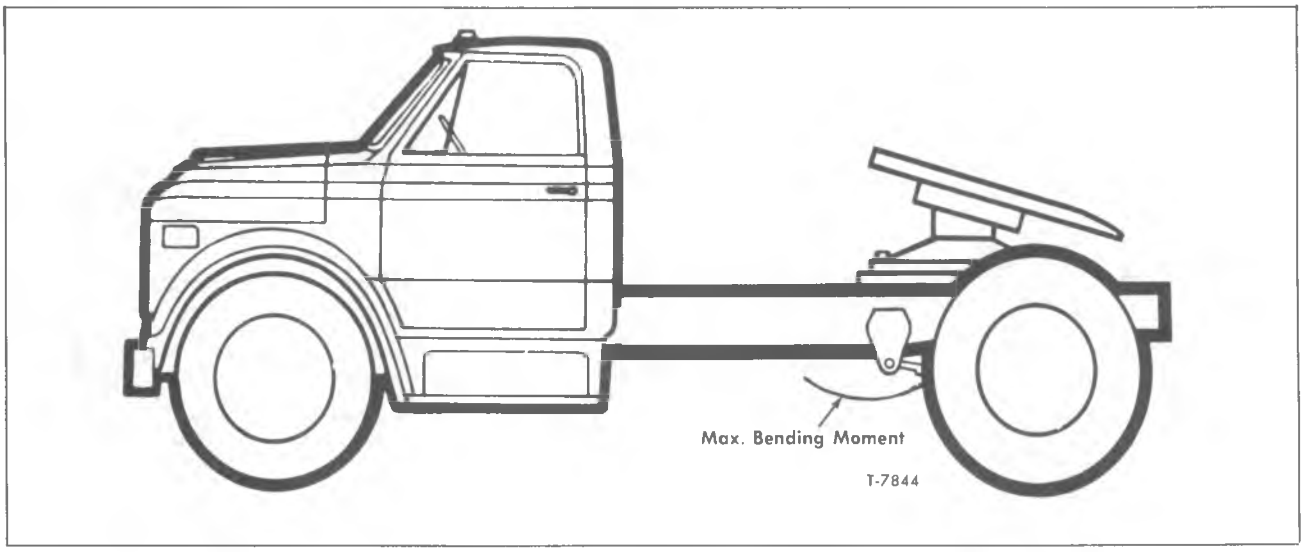


Figure 2—Frame Bending Moment (Typical Tractor)

Listed under "Specifications" at end of this section are selected sizes of welding electrodes for use in repairing frame side rails. Recommended current ranges for various electrodes are given when performing either flat or overhead welding. When welding S.A.E. 1023 steel, type E-7014 electrodes are recommended with type E-7018 suggested as an alternate. To ensure permanent frame repairs, correct material identification, proper electrode selection, and professional welding techniques are required.

ANALYZING FAILURE CAUSES

This analysis is not intended to cover the causes of all possible frame problems; however, it should be of valuable assistance in preparing complete, concise reports.

The purpose of this discussion is to emphasize the fact that frame failure doesn't just happen, there must be a cause or reason. An example of this would be a vehicle involved in a collision. The reason for failure in this case is apparent; however, other failures can be encountered where the reasons are not so apparent.

Three types of frame failures can be classified as follows:

1. Collisions.
2. Excessive bending moment.
3. Localized stress concentration.

Failures caused by collision should be repaired, using proper methods and reinforcements, where necessary.

Excessive bending moment failures are caused by overload, improper weight distribution, or misapplication of the vehicle. Excessive bending moment failure will occur at different areas on various types of vehicles; therefore, for easier understanding, the effects of excessive bending moments will be discussed by type of vehicle.

TRACTORS

The maximum bending moment of vehicles used in tractor service is in the area of the leading edge of fifth wheel (fig. 2). Failures may be caused by overload, excessive fifth wheel setting, excessive fifth wheel heights, poor fifth wheel installations, severe operating conditions and severe braking operations (inertia of certain loads), which induce excessive bending moments in the frame. These failures will start at edge of lower flanges and progress across the frame flange and up the web section of the frame rail. Instances may occur where upper or lower frame flanges buckle.

STRAIGHT TRUCKS

The maximum bending moment occurs in the area near the rear of the cab on vehicles having van or platform bodies (fig. 3). Failures may be caused by overload or can occur when loads are dispersed in diminishing quantities allowing the balance of a load to remain in the extreme front of the body.

In both tractor and straight truck operation the highest tensile stress is applied to the bottom side of the lower frame flange. However, it must be pointed out that dump trucks, as an example, when operated with the box in a raised position causes the center of gravity of the load to move

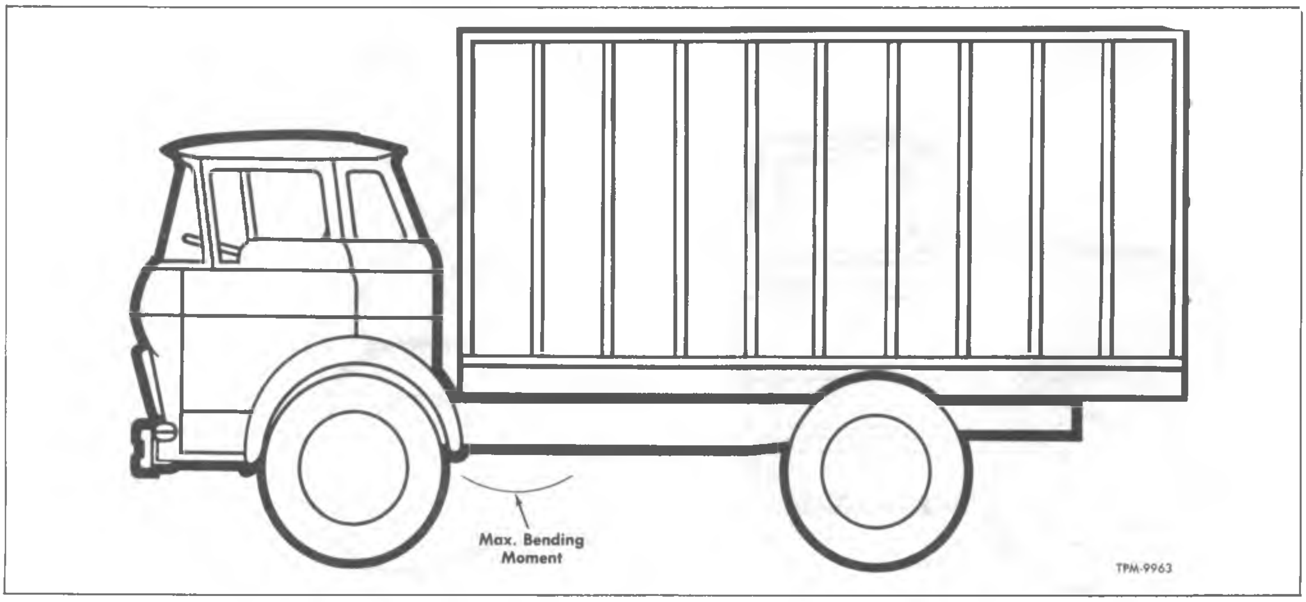


Figure 3—Frame Bending Moment (Typical Straight Truck)

behind the rear axle center line resulting in a change of maximum tensile stress location from the bottom of the lower flanges to the top of the upper flanges (fig. 4). This information can be very useful when examining cracks on vehicles used in dump service, as it would appear that the vehicle has been operated at excessive speed over rough terrain while spreading with the dump box in the raised position or with too long a dump box for wheelbase selected.

Localized stress concentration failures may be the result of bending moment stresses; however, it must be pointed out that the stress levels would not be high enough to cause any difficulty without localized stress concentration points. These localized stress concentration points may be caused by poor body or fifth wheel mountings, special equipment or accessory installation, improper welding or welding methods, improper reinforcements, loose bolts or rivets and defective material. They may also occur as a result of high bending loads, coupled with severe torsional loads as may be found in off-road service.

The proper installation of fifth wheels or bodies is covered in the "Body Builder's Book"; however, it should be re-emphasized that the use of U-bolts for attachment of fifth wheels or bodies is not an approved installation as high stress concentration may develop. The desired fifth wheel or body mounting is attached to the frame rail web section, not through flanges.

Wood sills should be used between main rails and sub-frame on body installations to ensure good load distribution.

Special equipment or accessory installation can cause high stress concentrations due to the method of attachment or the weight of the equipment. Holes should never be drilled through the flanges and rapid changes of section modulus should be avoided. These section modulus changes usually occur when large mounting plates are added for supporting special equipment. Heavy equipment mounted across the flanges or on the web of a side rail may cause enough stress concentration to cause failures at the nearest crossmember, bracket, or other frame stiffener or through a nearby hole in the frame flange.

IMPORTANT

Improper welding or welding methods are a major cause of stress concentration points, which may ultimately result in frame failure. (Refer to "General Welding Instructions.")

Improper reinforcement or attachment of reinforcement may cause more difficulty than the original problem as the creation of localized stress concentrations may reduce the frame load carrying capacity below the original frame before adding reinforcements. The use of rivets for attaching

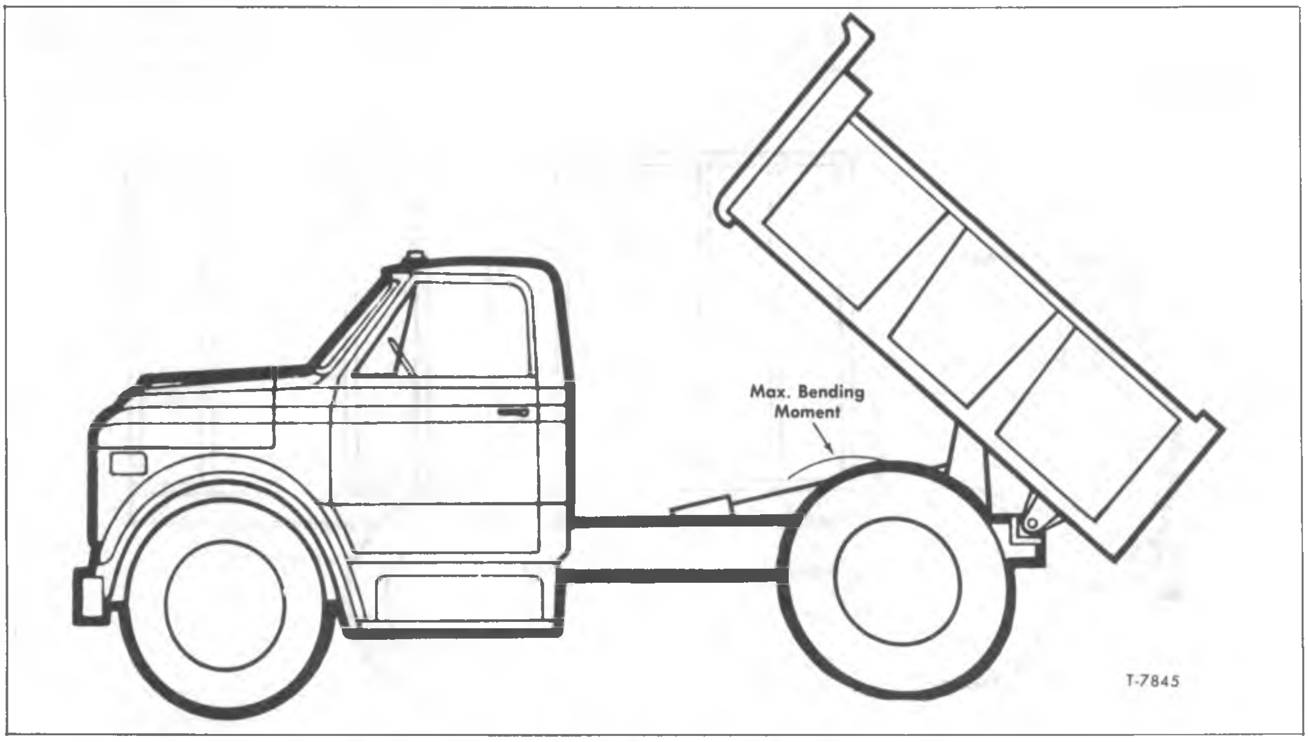


Figure 4—Frame Bending Moment (Typical Dump Truck)

reinforcement during field modification is generally not recommended due to the lack of proper riveting equipment in most service locations. For this reason it is recommended that most reinforcements be attached with 300-M bolts and that hardened washers be placed on both ends of the bolt to provide a good torquing surface and to maintain tight bolts.

GENERAL WELDING INSTRUCTIONS

Good welding is a very favorable method of attachment or repair; however, improper welding or welding procedure may result in further frame damage. Additions of reinforcements may be necessary in the repair area to prevent reoccurrence.

> WARNING: Before welding, disconnect one or both battery cables.

WELDING EQUIPMENT

> **CAUTION**
>
> NEVER USE OXYACETYLENE FOR WELDING FRAME RAILS.

There are several types of welding machines that are used for welding on frame rails. Listed below are the three most commonly used machines and their advantages:

1. DC (Rectifier Type) - This machine requires very little service as there are no moving parts, also reduces chance of arc blows.

2. DC (Motor-Generator Type) - The principle advantage is the power supply may be self-contained; thereby, this machine is readily portable and has very good voltage variation control and versatility with all types of electrodes.

3. AC - This is the least expensive and reduces possibility of arc blows; however, some difficulty may be encountered in striking an arc when using small diameter electrodes.

It is recommended that for all purpose welding, the minimum capacity of any machine should be 350 amperes. There are four basic types of welding used in the repair or reinforcing of frame rails. All of these can be used with any type of material except heat-treated material which requires electrodes E12016 or E12018. Following are the descriptions of the types of welds:

a. Continuous Fillet Weld - This is used to weld a continuous bead along a reinforcement placed on the web section of the frame rail or for adding gussets or plates to crossmembers. Continuous fillet welds should never be made across frame flanges or along inside edges of the frame flanges. When welding in the flat position use high range of electrode current and voltage chart. When welding overhead or in difficult areas, use low range of the electrode chart.

b. Groove Welding - This is a basic repair weld which is applied after the surface has been vee ground for good penetration. Particular care should be taken when welding cracks which cross either the upper or lower flanges. Weld completely then grind off the excess weld to eliminate the possibility of notches or weld build-ups on the flange edge. Use medium range of electrode chart.

c. Plug Welding - This is a good method of attaching reinforcements as it eliminates the possibility of loose fitting bolts; however, care must be exercised in locating plug welds in different types of reinforcements. E-7016 electrode is highly recommended for plug welding because of its good penetration and light coating. Use high range of electrode chart for flat or vertical plug welds. Overhead plug welding is very difficult and should not be used unless other approaches are not practical, then use high range for first pass and complete plug at medium range. Refer to plug weld table for size of hole to use for variations of material thickness.

d. Stitch (Intermittent Fillet) Welding - This type is not generally used on frames as continuous fillet welding provides better attachment; however, where warpage and heat control is critical, use stitch welding at medium range of electrode chart.

Other recommendations for all types of welding include:

1. Connect welding machine ground cables as close to working area as possible.

2. Where possible, use smaller diameter electrode and make several passes rather than large diameter electrode and single pass.

FRAME RAIL REPAIR

It is very important that repairs be correctly applied, as inadequate repairs will create additional localized stress concentration which may result in repeat failures. There are two basic types of cracks which may be encountered in frame difficulties (fig. 5). The straight crack or the multiple sunburst cracks which will radiate from a hole in the web section.

The straight crack will normally start from the edge of a flange and progress across the flange and then travel through the web section toward the opposite flange of the same rail. This may be caused either by localized stress concentration, excessive bending moment, or torsional loading. The sunburst type cracks are caused by high loads applied locally at the mounting bracket or crossmember whose attachment is not sufficiently adequate or is not securely fastened to the side rail.

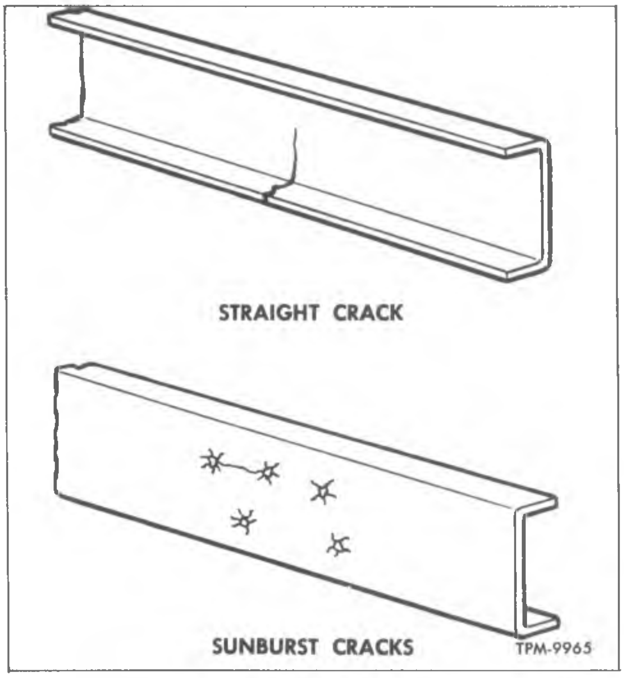


Figure 5—Types of Cracks

In either case both types of cracks may be repaired using similar methods. The procedure for repairing frame rail cracks is as follows:

1. Remove any equipment that will interfere with workable access to the failure.
2. Locate the extreme end of the crack and drill a quarter inch hole.

NOTE: It may be necessary to align the frame and level the rails before repairing the frame.

3. Vee grind the entire length of the crack from the starting point to the quarter inch hole at the extreme end. Using a hack-saw blade, the crack should be opened (1/16") to allow complete penetration of the weld.
4. Weld with proper electrode corresponding to the material of the basic rail.
5. Grind the weld smooth on both inside and outside of rail or reinforcement, being extremely careful to eliminate weld build-up or notches on the flange edges.

NOTE: Care should be taken when grinding not to reduce thickness of base rail.

6. Quality and neatness of workmanship cannot be overemphasized. After the repair is completed, the repaired area should be painted and should not be readily discernible from the unrepaired area of side rail. Use a copper spacer between the flanges of cracked base rail flanges and reinforcement flanges and repair each flange separately as the flanges must react independently to prevent localized stress concentration.

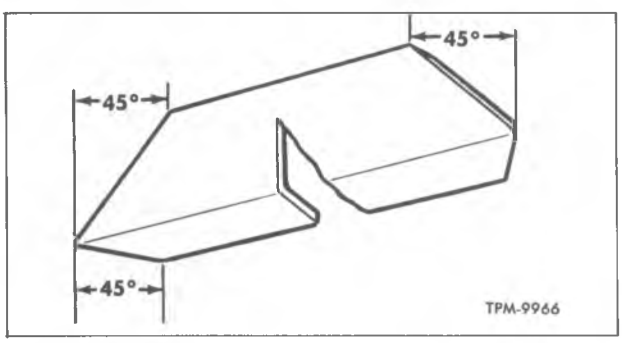


Figure 6—Scarfed (Tapered) Ends of Reinforcement

Buckled frame flanges should be straightened using proper alignment procedures, then an adequate reinforcement should be used (see "Frame Reinforcements") or offending equipment remounted to obtain an improved transition of loaded to non-loaded areas. DO NOT USE OXYACETYLENE FOR WELDING FRAME RAILS.

CROSSMEMBER AND BRACKETS

The repair of crossmembers may be accomplished if the damage is not extensive. Crossmember mounting flange cracks may be repaired in the same manner as side rail cracks; however, the weld bead should be built up to provide a good smooth radius. If extensive damage is incurred to a crossmember, the crossmember should be replaced, using bolts rather than rivets. All cast mounting brackets that are damaged should be replaced as it is not practical to weld a cast bracket. In the event that a frame crack appears in the area of cast bracket, the bracket must be removed while repair is made. Under no circumstances should a cast bracket be welded to the frame side rail.

FRAME REINFORCEMENTS

Review the discussion on analyzing causes of failures before applying reinforcement. A common misconception in the past was to patch a cracked frame. This is incorrect; reinforce the failed area. A reinforcement must be large enough (approx. 30 inches) to provide adequate stress relief from rapid changes in section modulus. For this reason it is extremely important that all reinforcement ends be scarfed to change section modulus as gradually as possible with the longest section installed (fig. 6) in the area of highest loads.

There are five basic types of reinforcements that may be used on truck frames. However, it must be pointed out that the material used for the reinforcement must be similar to that of the base rail. Base rails of S.A.E. 1023 material could use reinforcements of S.A.E. 950 material. S.A.E. 1023 rails may be reinforced with S.A.E. 1023 steel, but under no circumstances should strength of reinforcement be less than base rail. Figures 7 and 8 illustrate the five basic reinforcements.

1. Upright "L" Reinforcement - May be placed on either the inside or outside of the frame side rail. It should be used where maximum stress occurs at the bottom of the lower flange and buckling of the upper flange is not a problem. This reinforcement is quite versatile as it may be used in full length or in a short localized reinforcement. The configuration of the frame or spring hanger brackets may limit the use of the upright "L" reinforcement.

2. Inverted "L" Reinforcement - This may be used on the inside or outside of the frame rail. It is recommended where the maximum stress area is transferred to the upper flange; for example, dump trucks with the box in the raised position. This is also readily adapted where frame and hanger bracket design restricts using an upright "L" reinforcement or where frame upper flange buckling has been noted.

3. Channel Reinforcement - This may also be installed on the inside or outside of the frame side rail and can be full length or a localized reinforcement. The principle disadvantage of the channel is additional weight and hours of labor required to make an installation. Additional difficulty may arise when attempting to place the channel inside or over the existing rail due to manufacturing tolerances, cross members or mounting brackets.

4. Strap Reinforcements - This type of reinforcement may also be used to increase the section modulus of a frame if previous damage and repair has resulted in a loss of frame strength which would require additional modulus to return the frame strength to original design. These reinforcements are plug welded at 6 to 8 inch intervals. Do not weld across the end or along the flange edges. Ends should be cut at an angle and edges of plug welds must not be closer than ¾" to the edge of a frame flange.

5. Inverted "J" Reinforcement - This is a rather new type of frame reinforcement that is designed to increase the flange strength to prevent flange buckling due to high torsional inputs or shock loading during tractor hook-up operations. The inverted "J" reinforcement is attached to the web section only with a spaced bolt pattern. This reinforcement has been released in 6-foot lengths through the Factory Warehouse under Part No. 2446489.

The attachment of reinforcement to the basic rail may vary somewhat with materials. The following general rules apply:

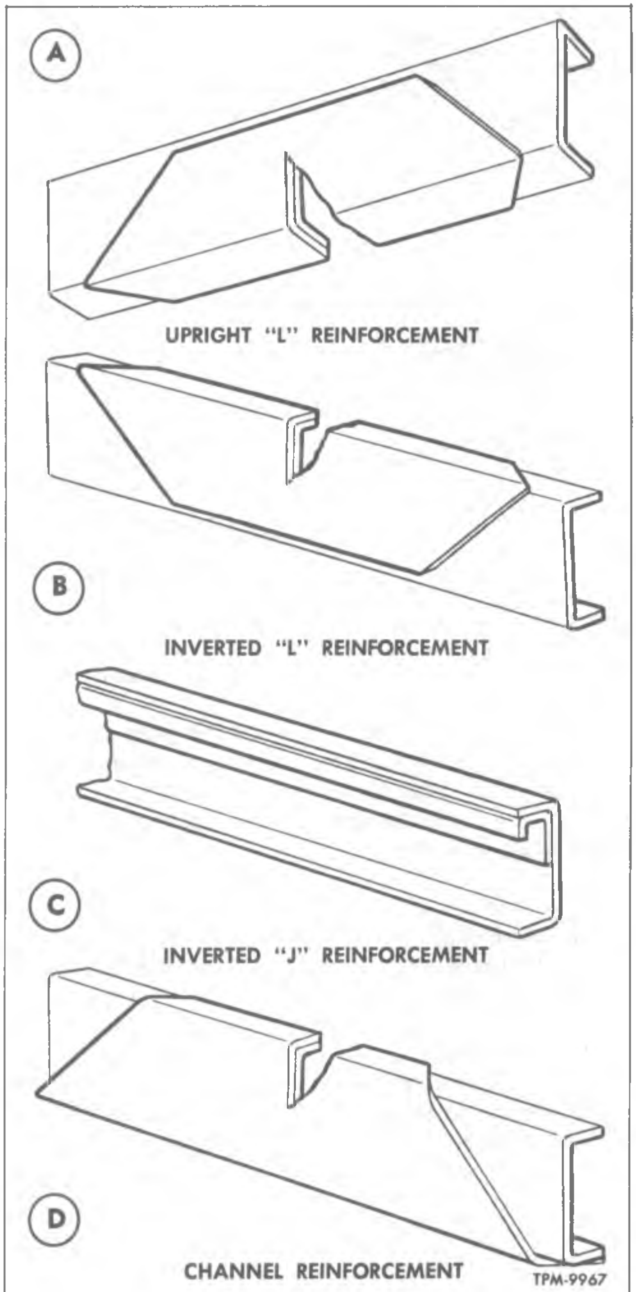


Figure 7—Frame Reinforcements

1. Do not use rivets. Proper riveting equipment is not generally available in most field service outlets; therefore, the use of 300M bolts and hardened flat washers are recommended.

2. Reinforcements, with the exception of strap type, should not be attached to the flanges except in the case where a mounting bracket or crossmember holes are already through the frame flange.

3. Plug welds may be used in a staggered 8 to 10 inch pattern when attaching reinforcements to the web section (fig. 8).

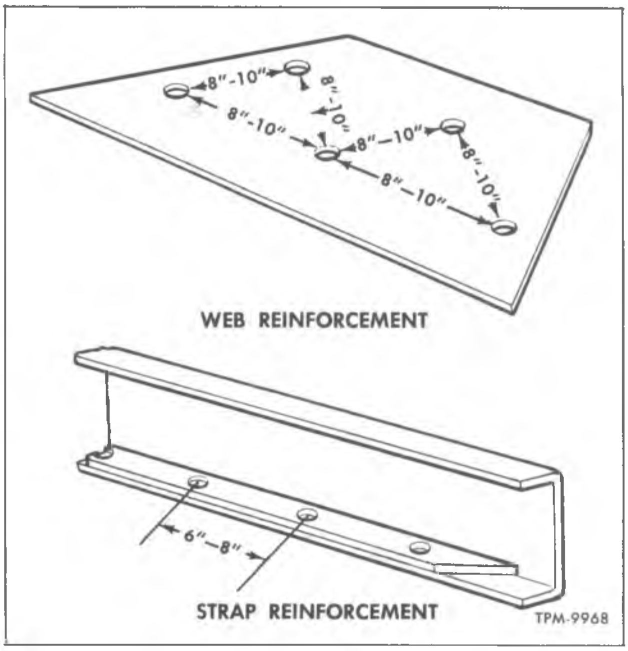


Figure 8—Plug Patterns of Strap Reinforcements

4. Strap reinforcements may be plug welded at 6 to 8 inch intervals to the flanges in some cases; however, as pointed out, this is for section modulus increase and should only be attempted by highly qualified specialists.

The termination of reinforcements is very important. Reinforcement ends must be scarfed or stress relieved to prevent localized stress concentration. This scarfing should not be greater than 45 degrees (fig. 6). It should also be strongly emphasized that in cases where several reinforcements are used, the ends of the reinforcements must overlap and be staggered so that the reinforcement ends overlap by 8 to 10 inches.

—CAUTION— GENERAL RULES

Listed below are general rules which apply to frame repair and reinforcements. Most of these rules are discussed earlier in this section; however, the importance of adhering to them cannot be overemphasized.

1. Always identify the material of base rail.
2. Frame straightening or repair must be attempted only by highly qualified specialists.
3. Always attempt to identify the cause of failure.
4. Fifth wheel, body, and accessory mountings should not be made through frame flanges (see "Body Builder's Book").
5. Do not drill holes in the lower flanges.
6. Use only proper electrodes as specified for base rail material when welding is necessary.
7. Do not use oxyacetylene welding equipment on frames.
8. Do not weld reinforcements across the frame flanges.
9. Do not weld within ¾-inch of the edge of a frame flange.
10. Remove all notches or weld build-ups from flange edge when repairing a broken frame.
11. Do not weld cast brackets to frame.
12. Do not weld the flanges of cracked reinforcements and base rails together.
13. Do not patch cracks. Reinforce the area.
14. Reinforcement should be of the same or better material than base rail.
15. Always scarf reinforcement ends to provide adequate stress relief.
16. Always stagger ends of reinforcements by a minimum of eight inches apart.
17. Before welding, disconnect negative battery cable to prevent possible electrical damage to generating system.

FRAME ALIGNMENT DIMENSIONS

FRAME ALIGNMENT (SINGLE AXLE DIMENSIONS)
(CONVENTIONAL CABS)
(REFER TO FIGURE 9-DIMENSIONS ARE IN INCHES)

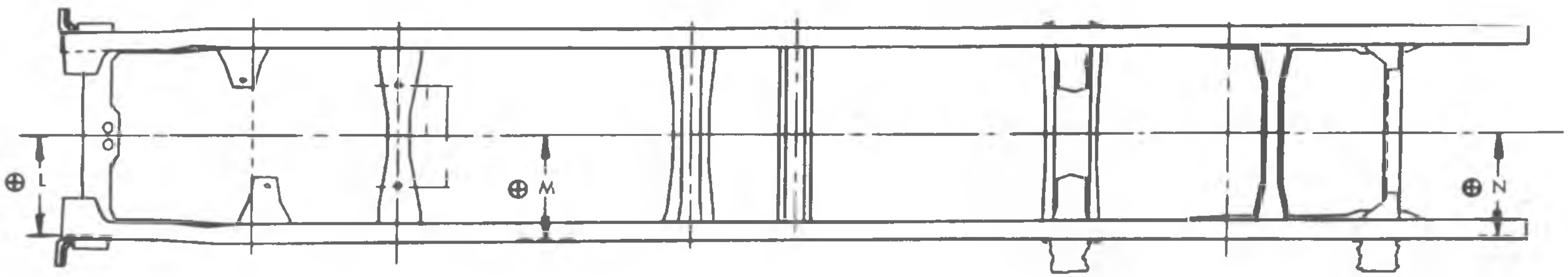
MODEL	A	B	C	D	E	F	G	H	I	J	K	L	M	N	WHEEL-BASE
CS-CE 40-60	15⅞	13½	20	15¾	15¾	17	20	36	82¼	132	147¾	14⅝	16¾	16¾	125⅜
CS-CE 40-60	15⅞	13½	20	15¾	15¾	17	20	36	94¼	144	159¾	14⅝	16¾	16¾	137⅜
CS-CE 40-60	15⅞	13½	20	15¾	15¾	17	20	36	106¼	156	185¼	14⅝	16¾	16¾	149⅜
CS-CE 40-60	15⅞	13½	20	15¾	15¾	17	20	36	124¼	174	215¼	14⅝	16¾	16¾	167⅜
SS-SE-CS-CE 40-60	15⅞	13½	20	15¾	15¾	17	20	36	146¼	196	280¼	14⅝	16¾	16¾	189⅜
CS-CE 40-60	15⅞	13½	20	15¾	15¾	17	20	36	160¼	210	285¼	14⅝	16¾	16¾	203⅜
CS-CE 50-60	15⅞	13½	20	15¾	15¾	17	20	36	130¼	180	221¼	14⅝	16¾	16¾	173½
CS-CE 50-60	15⅞	13½	20	15¾	15¾	17	20	36	136¼	186	227¼	14⅝	16¾	16¾	179½
CS-CE 50-60	15⅞	13½	20	15¾	15¾	17	20	36	146¼	196	280¼	14⅝	16¾	16¾	189⅜
CS-CE-SS-SE 50 and CE 60	15⅞	13½	20	15¾	15¾	17	20	36	174¾	224½	282¾	14⅝	16¾	16¾	218
SS-SE 50	15⅞	13½	20	15¾	15¾	17	20	36	192¼	257¾	326¼	14⅝	16¾	16¾	235⅜
SE 50	15⅞	13½	20	15¾	15¾	17	20	36	210¾	260½	344¾	14⅝	16¾	16¾	253⅞

FRAME ALIGNMENT (TANDEM AXLE DIMENSIONS)
(REFER TO FIGURE 10-DIMENSIONS ARE IN INCHES)

MODEL	A	B	C	D	E	F	G	H	I	J	K	L	M	N	WHEEL-BASE
ME 60	15⅞	13½	20	15¾	15¾	15¾	20	36	107¼	137¼	192¼	14⅝	16¾	16¾	149⅛
ME 60	15⅞	13½	20	15¾	15¾	15¾	20	36	137¼	168¼	222¼	14⅝	16¾	16¾	167⅛
ME 60	15⅞	13½	20	15¾	15¾	15¾	20	36	137¼	192¼	252¼	14⅝	16¾	16¾	185⅛

FRAME ALIGNMENT (TILT CABS)
(REFER TO FIGURE 11-DIMENSIONS ARE IN INCHES)

MODEL	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	WHEEL-BASE
TE 50-60	14½	11¾	13⅛	14⅛	16⅞	15¾	20	15¾	17	20	15⅜	62½	112¼	141½	33½	26⅜	16¾	16¾	97
TE 50-60	14½	11¾	13⅛	14⅛	16⅞	15¾	20	15¾	17	20	15⅜	57½	124¼	157½	33½	26⅜	16¾	16¾	109
TE-TS 50 & TE 60	14½	11¾	13⅛	14⅛	16⅞	15¾	20	15¾	17	20	15⅜	98½	148¼	177½	33½	26⅜	16¾	16¾	133
TE-TS 50 & TE 60	14½	11¾	13⅛	14⅛	16⅞	15¾	20	15¾	17	20	15⅜	110½	160¼	201½	33½	26⅜	16¾	16¾	145
TE-TS 50 & TE 60	14½	11¾	13⅛	14⅛	16⅞	15¾	20	15¾	17	20	15⅜	140½	190¼	257½	33½	26⅜	16¾	16¾	175



DIMENSIONS TO HOLES OR SLOTS ARE MEASURED TO THE CENTER OF HOLE OR SLOT
GAUGE HOLES ARE ⅝" DIAMETER
⊕ INDICATES THAT THE DIMENSION IS TO THE UNDERSIDE OF THE FRAME TOP SURFACE OR INSIDE OF THE FRAME OUTER SURFACE.

NOTE: FRAME ILLUSTRATED IS TYPICAL. FRAME DESIGN VARIES ACCORDING TO TRUCK MODEL

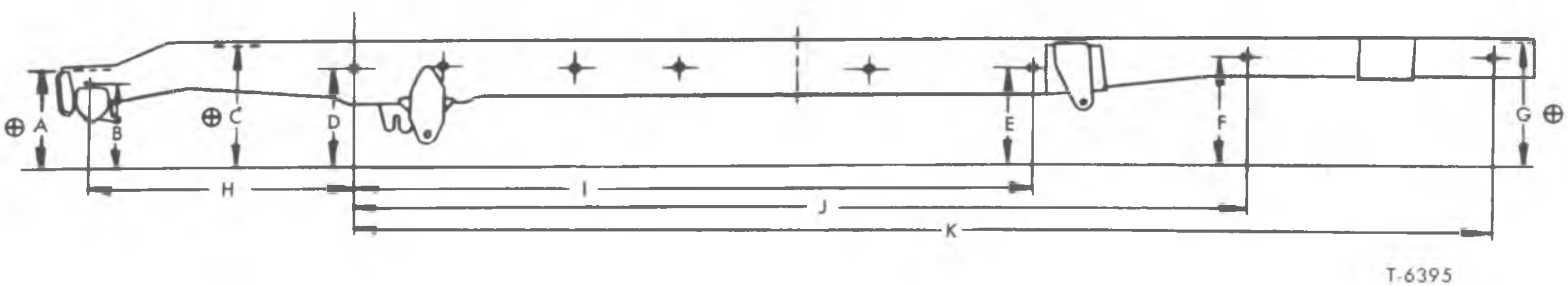
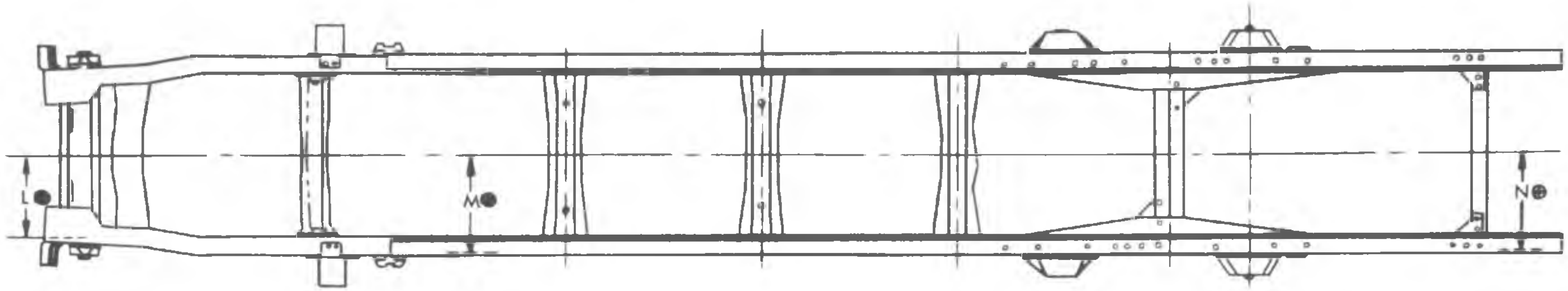


Figure 9—Single Axle Truck Frame (Typical)



DIMENSIONS TO HOLES OR SLOTS ARE MEASURED TO THE CENTER OF HOLE OR SLOT
GAUGE HOLES ARE ⅝" DIAMETER
⊕ INDICATES THAT THE DIMENSION IS TO THE UNDERSIDE OF THE FRAME TOP SURFACE OR INSIDE OF THE FRAME OUTER SURFACE.

NOTE: FRAME ILLUSTRATED IS TYPICAL. FRAME DESIGN VARIES ACCORDING TO TRUCK MODEL

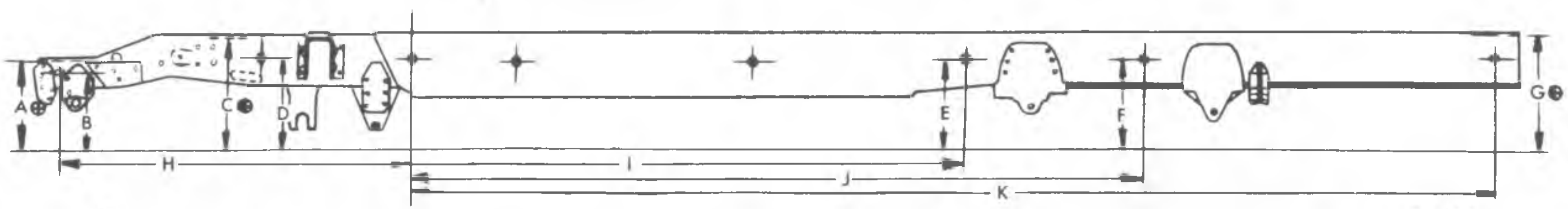


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Figure 10-Tandem Axle Truck Frame (Typical)

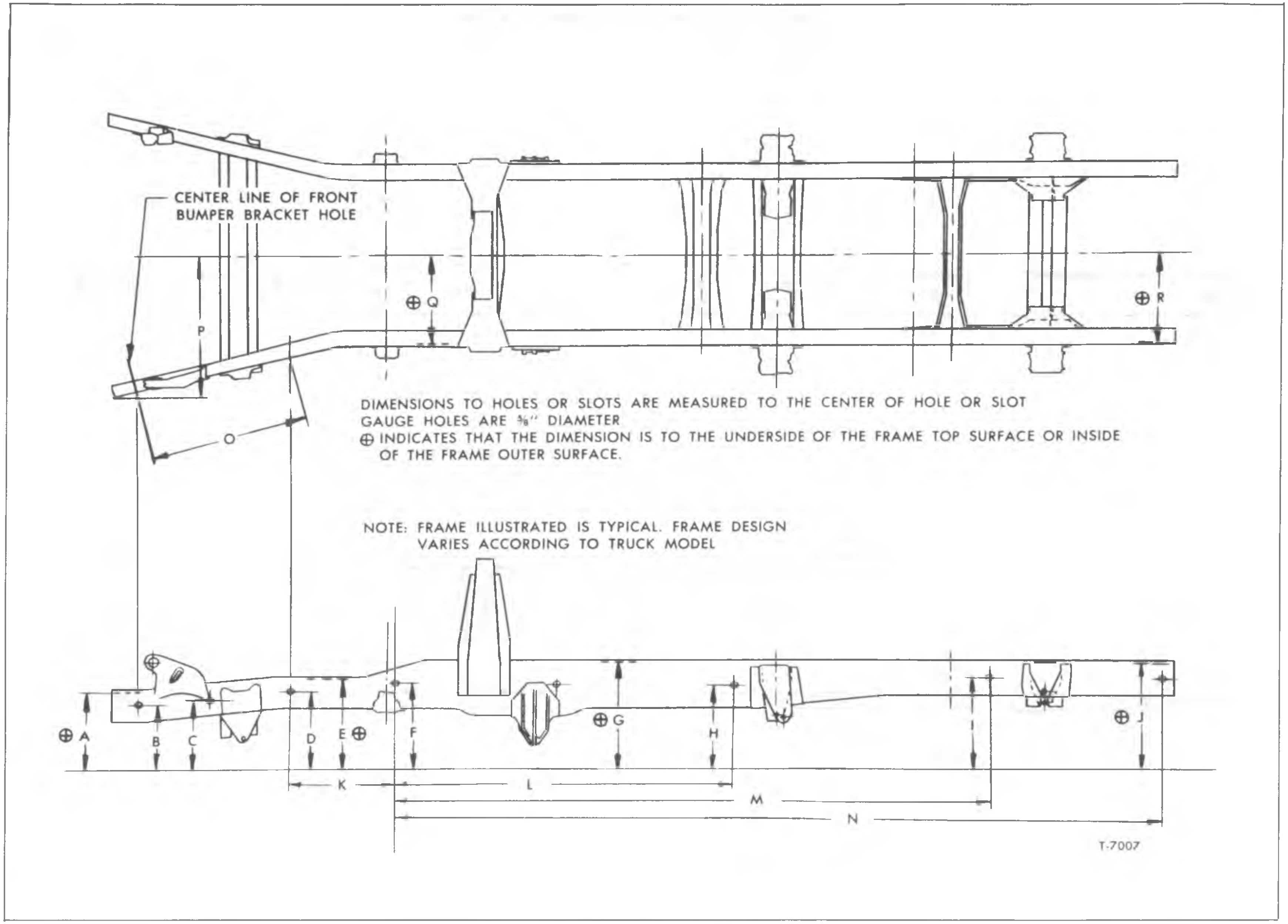


Figure 11—Tilt Cab Truck Frame (Typical)

FRAME SPECIFICATIONS

ELECTRODE CHARTS

E-7014

Available Sizes	Flat Welding Current Range	Arc Voltage
3/32" X 12"	45— 80	21—23
1/8" X 14"	80—115	21—23
5/32" X 14"	125—165	22—24
3/16" X 14"	160—200	22—24
7/32" X 18"	200—250	23—25
1/4" X 18"	250—320	23—25
5/16" X 18"	325—400	24—28
	Overhead Welding	
5/32" X 12"	45— 75	20—22
1/8" X 14"	80—110	20—22
5/32" X 14"	125—150	21—23
3/16" X 14"	150—175	21—23
E-7018	**Flat Welding**	
5/64" X 9"	30— 60	20—22
3/32" X 12"	50— 80	20—22
1/8" X 14"	90—125	22—24
5/32" X 14"	120—190	22—24
3/16" X 14"	175—240	22—24

PLUG WELD CHART

Thickness of Material (Inches)	Diameter of Plug	Depth of Plug
1/4	3/4	1/4
5/16	7/8	5/16
3/8	1	3/8
1/2	1 1/8	7/16
5/8	1 1/4	1/2
3/4	1 3/8	9/16
1	1 1/2	9/16

FRAME WIDTHS

Model	Front Width*	Rear Width*
Cowl and Conv. Cab	30"	34"
Tilt Cab	53 3/8"	34 1/16"

*Outside Dimension of Base Rails

ELECTRODE USAGE WITH FRAME MATERIAL

Material	SAE-1023
Type of Electrode	E-7014
Alternate Electrode	E-7018

Side Rail Material Identification
(Location—Centerline of Front Axle)

SAE1023 SA950

STD. OPT.

FRAME

Vehicle load capacity is dependent upon frame strength and rigidity. To assure effective repairs in the event of damage, frame service should be undertaken only by competent personnel using proper materials and equipment.

Before stripping the vehicle down preparatory to frame repairs, be certain the frame is well supported on a smooth level floor. The frame should be level to facilitate frequent checking for alignment as straightening and replacement of sections progress.

Improper welding or welding methods are a major cause of stress concentration points, which may ultimately result in frame failure.

SECTION 3
Front Suspension

This group is divided into four sub-sections as shown in index below:

SECTION 3A
Front End Alignment

Front end alignment should be checked at regular intervals, and particularly after front axle has been subjected to heavy impacts such as a collision or a hard curb bump. Before checking alignment, wheel bearings must be properly adjusted since loose wheel bearings will affect instrument readings when checking wheel toe-in, wheel camber, and axle caster.

When checking alignment, instructions outlined in this section should be followed carefully, as well as instructions covering related units such as brakes, springs, steering gear, hubs and bearings, and wheels and tires, which are given in other sections of this manual. Front End Alignment Chart (fig. 1) indicates points at which alignment dimensions are taken.

The caster, camber, and toe-in dimensions are for vehicle at design load (with frame level). If frame is not level on alignment equipment, the frame angle must be considered. This is especially important when making caster check for the frame angle must be added to or subtracted from the caster angle to obtain a true setting. All alignment checking should be done with precision equipment and instruments. Refer to "Alignment Specifications" at end of this section.

DEFINITION OF TERMS

WHEEL TOE-IN

Distance front wheels are closer together at front than at rear of axle (see "E" and "F," fig. 1).

WHEEL CAMBER

Amount wheels are inclined from vertical plane (see "C," fig. 1).

FRONT AXLE CASTER

Inclination of king pin from the vertical in the fore and aft direction of the vehicle (see "G," fig. 1).

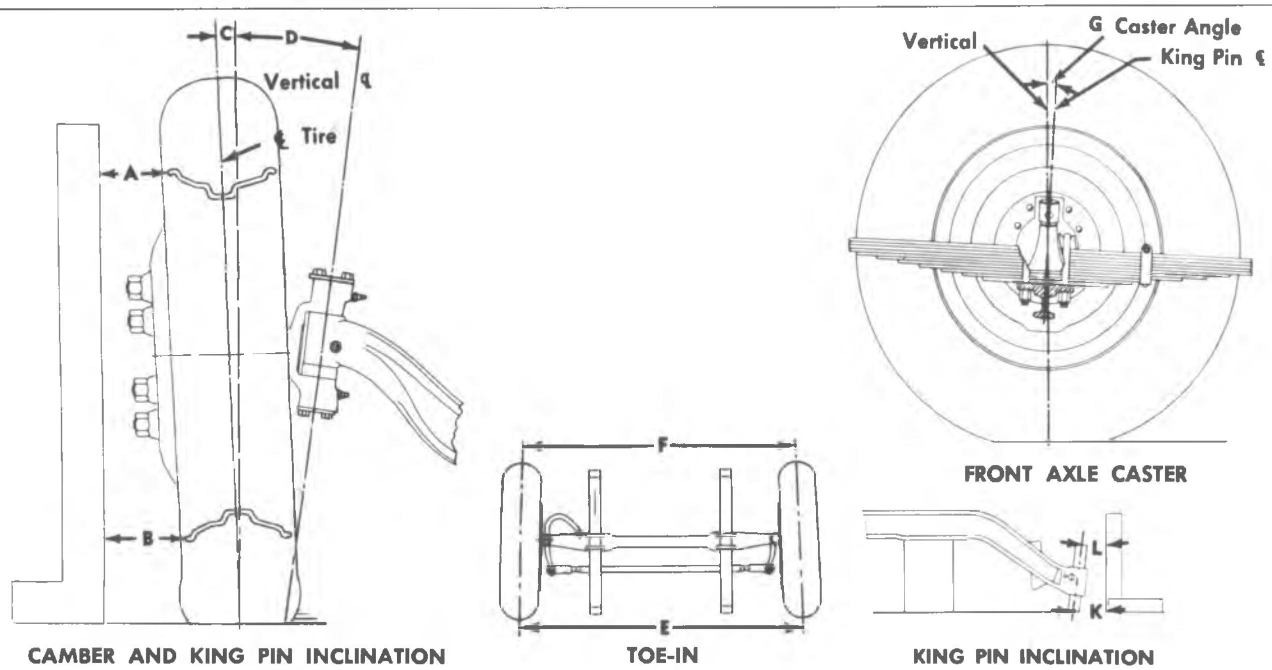
KING PIN INCLINATION

The slant of the king pin toward the center of the vehicle at the top and outward at the bottom (see "D," fig. 1).

SERVICE DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Noisy Front End	1. Loose tie rod ends.	1. Replace ends.
	2. Lack of proper lubrication.	2. Refer to LUBRICATION (SEC. 0).
	3. Broken spring leaf.	3. Replace spring leaf.
	4. Loose U-bolts or spring clips.	4. Tighten
Wheel Bounce	1. Unbalanced wheels or tires.	1. Refer to "Balancing" (SEC. 10).
	2. Unequal tire pressure.	2. See "Load and Inflation Table" (SEC. 10).
	3. Weak or broken front spring.	3. Replace.
	4. Excessive wheel or tire runout.	4. Refer to WHEELS AND TIRES (SEC. 10).
Excessive Tire Wear	1. Failure to rotate tires.	1. Refer to WHEELS AND TIRES (SEC. 10).
	2. Improper tire inflation.	2. Refer to "Load and Inflation Table"(SEC.10)
	3. Overloaded or improperly loaded.	3. Avoid overloading vehicle.

FRONT END ALIGNMENT



B MINUS A . . . . Camber (Inches)

C . . . . Camber (Degrees Positive)

D . . . . King Pin Inclination (Degrees)

E MINUS F . . . . Toe-in (Inches)

G . . . . Caster (Degrees Positive)

K MINUS L . . . . King Pin Inclination (Inches)

Refer to "Specifications" for correct dimensions.

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Figure 1—Front End Alignment Chart

FRONT END INSPECTION

Before checking front end alignment, the following front end inspection should always be made:

1. Check tires for proper inflation. NOTE: Rim-to-floor dimension should be the same at each wheel.
2. Check wheel installation and run-out.
3. Check wheel bearing adjustment.
4. Check steering tie rod and drag link ends for looseness.
5. Check king pins for looseness.

CHECKING AND CORRECTING FRONT WHEEL TOE-IN

Incorrect toe-in results in excessive tire wear caused by side slippage. Toe-in may be measured from center of tire treads or from inside of tires. Measurements at both front and rear of axle (see "C" and "F," fig. 1).

When setting "toe-in" adjustment, the front suspension must be neutralized; that is, all component parts must be in the same relative position when making the adjustment as they will be when in operation. To neutralize the suspension, the vehicle must be rolled forward 12 to 15 feet. By rolling the vehicle forward, all tolerances in the front suspension are taken up and the suspension is then in normal operating position. Neutralizing the front suspension is extremely important, especially if the vehicle has been jacked up in order to scribe the tires, otherwise the front wheels will not return to the normal operating position due to the tires gripping the floor surface when the vehicle is lowered on the jack.

IMPORTANT

"TOE-IN" MEASUREMENTS MUST BE MADE AT THE HORIZONTAL AXIS OF THE WHEEL.

"Toe-in" is corrected by loosening clamp bolt at tie rod ends, then turning tie rod with pipe wrench until wheels have proper toe-in. On some vehicles with power steering, loosen the power cylinder-to-tie rod "U" bolt nuts. With both tie rod ends in same plane, tighten clamp bolts securely. Refer to "Specifications" for correct toe-in.

On some vehicles with power steering, tighten power cylinder to tie rod bracket "U" bolt nuts. Adjust power cylinder as directed in "POWER STEERING" (SEC. 9B) of this manual.

IMPORTANT: Tie rod clamps must be lined up with slots in tie rod tube or difficulty in tightening clamps securely will be experienced.

TURNING ANGLE

Turning angle, or toe-out on turns is determined by the angle of the steering arms. If when checking this angle, toe-out does not fall within specified limits, it will be necessary to replace defective steering arm.

FRONT WHEEL CAMBER

Positive camber is the amount in inches or degrees that front wheels are titled outward at top from vertical position (see "C," fig. 1). Positive camber offsets wheel deflection, due to wear of front axle parts, and prevents a reverse or negative camber condition. A reverse or negative camber is an inward inclination of wheels at the top.

Camber variations may be caused by wear at wheel bearings and steering knuckle bushings, or by a bent steering knuckle or axle center.

Specifications are listed at end of this section.

CHECKING AND CORRECTING CAMBER

Before checking camber, check wear at king pins as follows:

Jack up front of vehicle, pull bottom of wheel outward and take a camber reading; then pull top of wheel outward and take a camber reading. If readings vary more than 1/4 degree, make following adjustments:

1. Adjust the wheel bearings as directed in "FRONT HUBS AND BEARINGS" (SEC. 3D), then take camber readings as shown on "Front End Alignment Chart" (fig. 1). If readings still vary over 1/4-degree, replace steering knuckle bushings and king pins as instructed in "FRONT AXLE" (SEC. 3B).

2. Check the wheel run-out as instructed in WHEELS AND TIRES (SEC. 10). If run-out is excessive, straighten or replace wheel.

3. Place vehicle on level surface, with normal weight of vehicle on wheels, then take final camber reading. If camber gauge is not available, readings can be taken as shown on "Front End Alignment Chart" in figure 1. Place square as shown and measure distances "A" and "B." "B" SHOULD EXCEED "A" by amount specified. Camber dimensions of right wheel should not vary over 3/32" from camber dimensions of left wheel. If final camber reading is incorrect, either steering knuckle or axle center is bent.

4. To determine which part is bent, check king pin inclination ("D," fig. 1). Camber plus king pin inclination is the "included angle" of steering knuckle. If "included angle" of knuckle varies more than ½-degree from value specified in "Specifications," knuckle is bent and should be replaced.

AXLE CASTER

Positive caster is the rearward tilt from the vertical of the king pin. Negative or reverse caster is the forward tilt from the vertical of the king pin.

Incorrect caster may result from sagging springs, bent axle, twisted axle, or uneven tightening of spring U-bolt nuts. Tighten all U-bolt nuts equally. Refer to "FRONT SPRINGS" (SEC. 3C) for U-bolt torque specifications. Generally, if the axle is twisted, the caster will be unequal for right and left side.

Conventional cab models use flat spacers and the steel tilt models use tapered spacers. Additional shims of various degree taper are generally available if necessary to adjust caster.

CHECKING AND CORRECTING CASTER

IMPORTANT: Caster, camber, and toe-in dimensions are for vehicle carrying its design load whereby the frame in most instances would be level. If alignment check is to be made with frame NOT LEVEL the frame angle (fig. 2) must be determined and added to or subtracted from the caster angle to obtain a true caster reading.

1. Position vehicle on a smooth level surface.

2. Using a bubble protractor, measure the

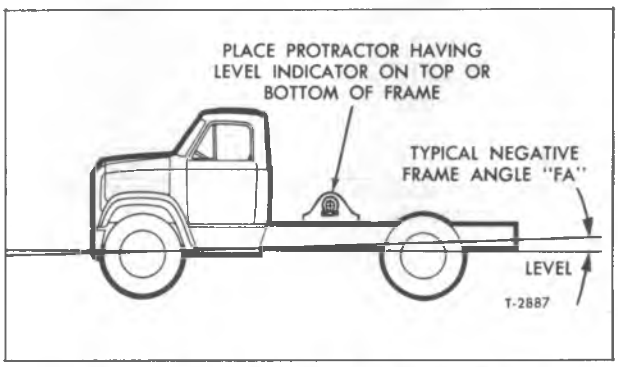


Figure 2—Method of Checking Frame Angle

FRONT END ALIGNMENT

frame angle (FA). See figure 2. Frame angle is the degree of tilt in the frame from the level position. Negative frame angle is when the frame is high (above level) in the rear. Positive frame angle is when the frame is low (below level) in the rear.

3. Determine the caster angle for the left wheel using the alignment equipment.

4. Add or subtract the frame angle (FA) found in step 2 to the left wheel caster reading found in step 3 to determine the "corrected caster" for left wheel.

To determine "corrected caster" with various frame and caster readings the following rules apply:

(a) - Negative frame angle must be added to positive caster reading.

(b) - Positive frame angle must be subtracted from positive caster reading.

(c) - Negative frame angle must be subtracted from negative caster reading.

(d) - Positive frame angle must be added to negative caster reading.

Example: T-50 has a left wheel caster reading of 1¼ degree positive, but the frame angle is negative (high in the rear) ½ degree; therefore ½ degree negative frame angle plus 1¼ degree positive caster gives 1¾ degree positive as the "corrected caster" for that wheel. Referring to "Specifications," we find that 1¾ degree positive caster is within the specified setting.

5. Repeat Steps 2 through 4 for the right wheel.

6. If the caster is not within specifications, caster can be corrected by selecting proper caster shims between the axle and spring.

KING PIN INCLINATION

King pin inclination is the amount that top of king pin is inclined toward center of vehicle. King pins are inclined (D, fig. 1), to decrease friction between tires and road when turning. Precision instruments must be used to check king pin inclination when axle is installed in vehicle. When axle is removed, check can be made on bench as follows:

Place two uniform blocks on level surface, rest spring seats on blocks. Using a square, measure "K" and "L" (fig. 1). "K" minus "L" equals king pin inclination in inches. If axle is bent or twisted, refer to "FRONT AXLE" (SEC. 3B) in this manual for corrective information. Straightening axle center to correct king pin inclination will also change camber. Recheck camber after correcting king pin inclination.

FRONT END ALIGNMENT SPECIFICATIONS

TRUCK MODEL	CAMBER L.H.	CAMBER R.H.	CASTER MANUAL & POWER	TOTAL TOE IN (Inch)	AXLE	*TURNING ANGLES IN-SIDE	OUT-SIDE	KING PIN INCLINATION LEFT	RIGHT
C-40	+ 1° ± ½°	+ 1° ± ½°	+ 2½° ± ½°	⅛″-3/16″	F-050	20°	17¾°	7¼°	7¼°
S/C-50	+ 1° ± ½°	+ 1° ± ½°	+ 2½° ± ½°	3/32″-3/16″	F-050-055-070	20°	17¾°	7¼°	7¼°
C/M-60	+ 1° ± ½°	+ 1° ± ½°	+ 2½° ± ½°	3/32″-3/16″	F-070	20°	17¾″	7¼°	7¼°
C/M-60	+ 0¼°	−0¼°	+2½° ± ½°	⅛″-7/32″	F-090-120	20°	17¾°	5¾°	6¼°
T-50	+ 1°30′ ± 30′	+ 1°30′ ± 30′	+1°15′ ± 30′	⅛″-¼″	F-070	39°	27°45′	7°	7°
T-50	+ 0°15′ ± 30′	−0°15′ ± 30′	+1°15′ ± 30′	⅛″-¼″	F-090	39°	27°45′	5.45°	6.15°
T-60	+ 1°30′ ± 30′	+ 1°30′ ± 30′	+ 1°15′ ± 30′	⅛″-¼″	F-070	39°	27°45′	7°	7°
T-60	+ 0°15′ ± 30′	−0°15′ ± 30′	+ 1°15′ ± 30′	⅛″-¼″	F-090	39°	27°45′	5.45°	6.15°
T-60	+ 0°15′ ± 30′	−0°15′ ± 30′	+ 1°15′ ± 30′	⅛″-¼″	F-120	39°	27°45′	5.45°	6.15°

*Regardless of maximum turning angles specified, adjustment of stop screws must provide ⅝-inch minimum clearance of tire with any chassis components.

SECTION 3B

Front Axle

Reference is made to axle models in this section. Specifications are listed at the end of this section for each axle model. For truck series application, refer to "Model Data" at the front of this manual.

Axle steering knuckles are constructed as shown in figures 1 and 3. Wheel bearings, springs, steering, and brake parts which are mounted on front axle are described in their respective section in this manual.

FRONT AXLE CONSTRUCTION

Front axle center section is one-piece steel forging with I-beam section in which dowel pins are installed to locate spring seats. Outer ends of axle center are machined to accommodate steering knuckles and kingpins

FRONT AXLE GENERAL MAINTENANCE

Following maintenance operations should be performed at intervals determined by severity of service:

1. Inspect spring U-bolts for tightness. If they are loose, tighten as directed in "FRONT SPRINGS" (SEC. 3C) later in this group.

2. Tighten steering arm and tie rod end stud nuts to torque specified in STEERING SYSTEM (SEC. 9) of this manual.

3. When lubricating front axle parts, observe condition of seals at tie rod ends. If seals are found to be damaged or missing, new seals should be installed immediately. Refer to STEERING SYSTEM (SEC. 9) of this manual.

4. Examine steering knuckle bearing caps for tightness and evidence of lubricant leakage. Tighten or replace parts as required.

5. On F-050, F-055 and F-070 axles (fig. 2), inspect and tighten kingpin draw key nuts. Loose draw keys will permit kingpin to turn in axle center, thus enlarging kingpin hole. If hole becomes too greatly enlarged, replacement of axle center may be necessary. If draw key holes become enlarged beyond use of new key, replace axle center.

6. Inspect kingpin and steering knuckle bushings for wear.

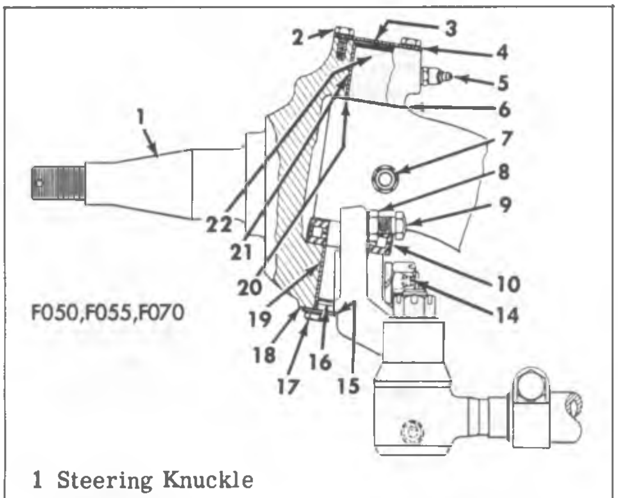
7. Check up and down movement of knuckles on kingpins. Refer to "Specifications" for maximum axle-to-knuckle clearance.

8. Check stop screws and adjust when necessary.

9. When steering difficulty or abnormal tire wear is indicated, check front end alignment as previously instructed under "FRONT END ALIGNMENT" (SEC. 3A) of this manual.

STOP SCREWS

Stop screws shown in figure 4 for F-050 and F-055 axles are installed on steering arms and stop against axle center. Stop screws for F-070, F-090 and F-120 axles are installed in the steering knuckles and stop against the axle center (refer to fig. 5).



1 Steering Knuckle
2 Cap Screw
3 Upper King Pin Bearing Cap
4 King Pin Bearing Cap Gasket
5 Lubrication Fitting
6 Shim
7 Draw Key
8 Stop Screw Lock Nut
9 Stop Screw
10 Thrust Bearing
14 Lubrication Fitting
15 Lower King Pin Bearing Cap
16 Spacer - Steering Knuckle Bushing (Some Models)
17 Cap Screw
18 King Pin Bearing Cap Gasket
19 Lower Bushing
20 O-ring Seal
21 Upper Bushing
22 King Pin

Figure 1—Typical Steering Knuckle Construction

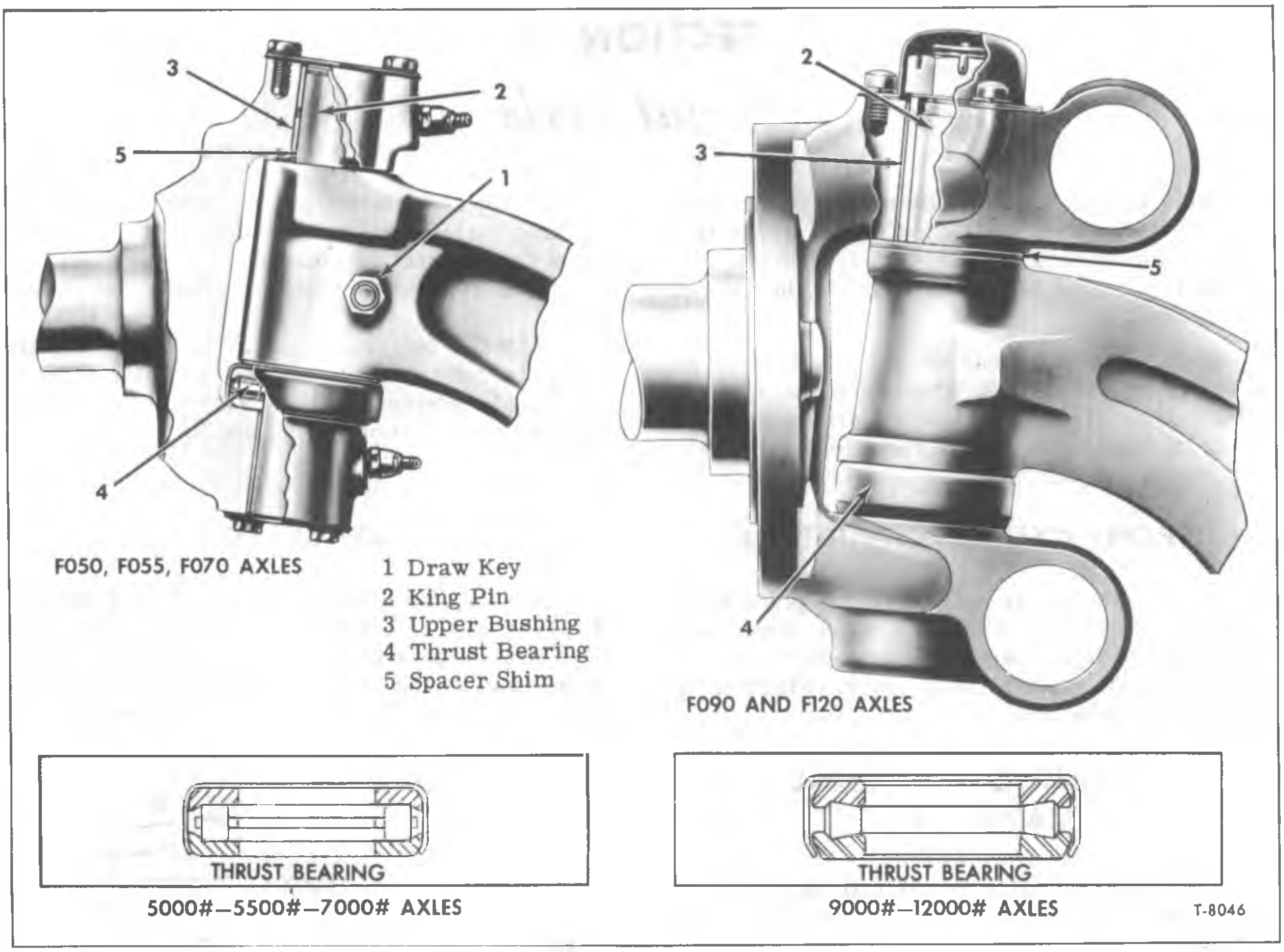


Figure 2—Steering Knuckle and Thrust Bearing

Steering gears are equipped with built-in stops to prevent steering mechanism from bottoming at extreme turns. Screws are set to obtain the maximum turning angles provided in these models. Refer to "Specifications" in "FRONT END ALIGNMENT" (SEC. 3A) for turn angles.

1. Pitman arm must be installed correctly on steering gear. Refer to STEERING SYSTEM (SEC. 9) of this manual for installation instructions.
2. Turn in the right stop screw so that screw will not contact its stop when wheels are turned to extreme right.
3. With wheels turned to extreme right, hold right wheel tightly against right turn position, then turn out stop screw until it contacts firmly against its stop. Turn screw about 1 turn more against its stop, and tighten lock nut. Check position of tire. If tire has less than 5/8" clearance from any chassis obstruction, adjust screw to obtain clearance.
4. Repeat steps on left side.

IMPORTANT: When installing oversize tires, recheck turning clearance and stop screw setting.

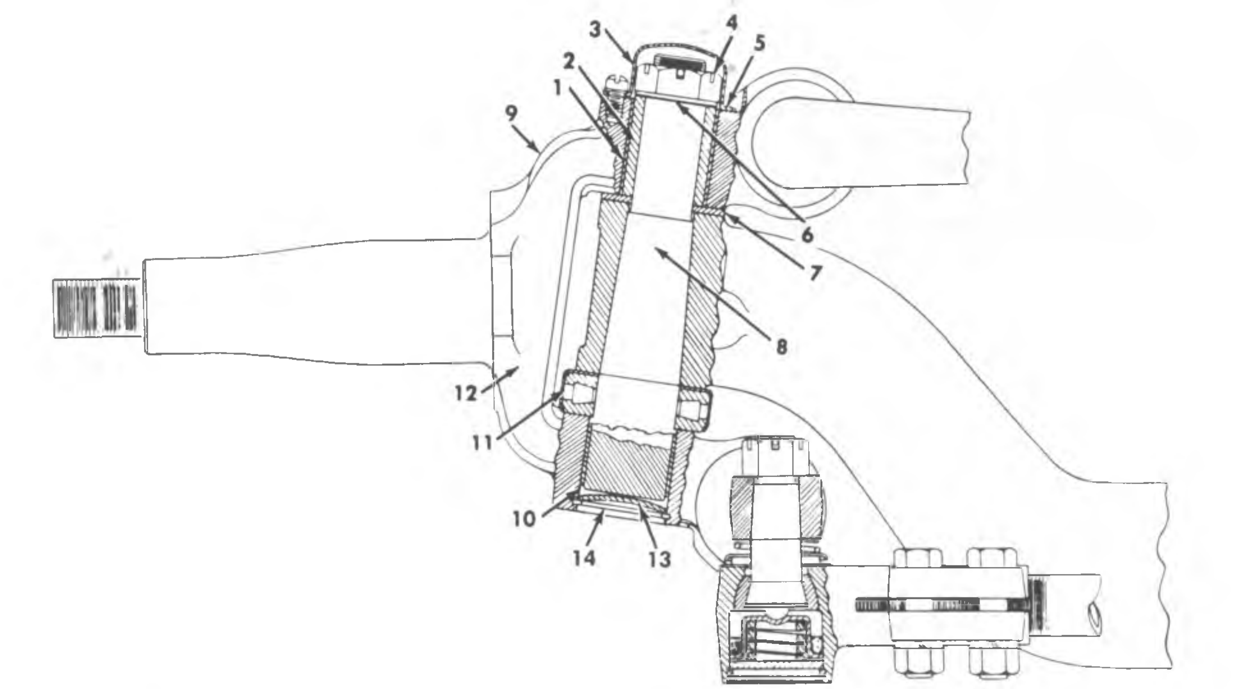
FRONT AXLE REPLACEMENT

All component parts of the front axle assembly except axle center can be replaced without removing assembly from vehicle, if necessary. Any minor straightening with suitable equipment can be accomplished with assembly in vehicle. When the front axle requires a complete overhaul, the assembly can be replaced as described following:

NOTE: The letter "F" is stamped on front of spring pad on F-090 and F-120 Series axles; this indicates front of axle. If this identification mark is not visible, make a punch mark on front of the spring pad before removing ends from I-beam. If I-beam is not marked, it could be installed backwards, and camber would be wrong.

REMOVAL

1. Jack up and support vehicle frame to relieve load from springs.
2. Remove wheels and hubs. Disconnect brake lines at axle. Disconnect drag link from steering arm.



1 Knuckle Upper Bushing
2 King Pin Bushing (Steel Sleeve)
3 Upper Dust Cap
4 King Pin Nut
5 Dust Cap Gasket
6 Spacer
7 Spacing Washer
8 King Pin
9 Steering Knuckle
10 Knuckle Lower Bushing
11 Thrust Bearing
12 Knuckle
13 Lower Expansion Plug
14 Expansion Plug Lock

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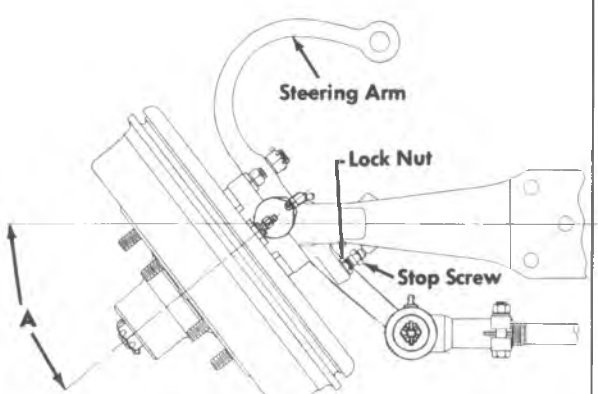
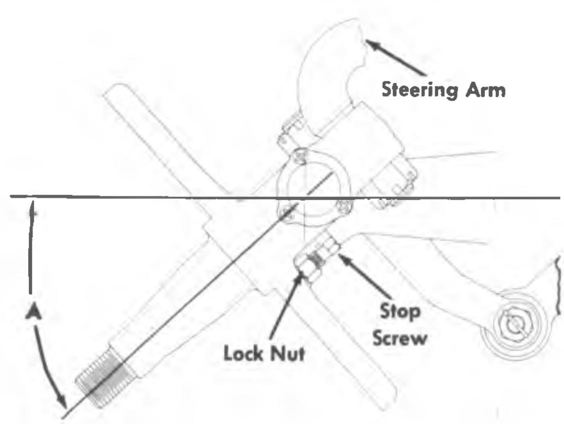
Figure 3—Steering Knuckle Construction (F090 and F120)



A – Dimension Varies with Different Size Tires. Set Stop Screws to Provide ⅝" Clearance Between Tires and Chassis at Extreme Turn Positions. T-1500

Figure 4—Stop Screw Adjustment (F050 and F055) (Typical)



A—Dimension varies with different size tires. Set stop screws to provide ⅝" clearance between tires and chassis at extreme turn positions. TPM-7608

Figure 5—Stop Screw Adjustment (F070, F090, and F120) (Typical)

FRONT AXLE

3. While supporting axle center with suitable jack, remove spring U-bolts. Lower assembly and remove from under vehicle.

INSTALLATION

1. Place assembly on dolly and roll into position under vehicle. Raise axle up against springs, making sure spring center bolts enter alignment holes in spring seats. Be sure caster angle shims if used, are in place between spring and axle with thick edge facing correct direction (see "FRONT SPRINGS" (SEC. 3C) later in this group). Attach axle to springs, tightening U-bolts as described in "FRONT SPRINGS" (SEC. 3C).

2. Install hubs and bearings as described in "FRONT HUBS AND BEARINGS" (SEC. 3D). Connect drag link as directed in STEERING SYSTEM (SEC. 9) of this manual. Connect brake lines. If hydraulic brakes are used, bleed brakes as described in "HYDRAULIC BRAKES" (SEC. 5A).

3. Check stop screws and adjust as previously described. Check front end alignment and adjust.

FRONT AXLE OVERHAUL

Steering knuckles, kingpins, bushings, and thrust bearings can be replaced without removing front axle from vehicle. Minor axle straightening can also be accomplished without removing assembly from vehicle. Preliminary inspection can be made while axle is still mounted. These inspections should aid in determining the amount of repair necessary. Check the front end alignment as directed previously under "FRONT END ALIGNMENT" (SEC. 3A). Inability to correctly align the wheels indicates that the axle center or steering knuckle is distorted, tie rod bent, or knuckle bushings are worn beyond limits. If axle is believed to be bent or warped it may be checked when removed from vehicle by following instructions in "FRONT END ALIGNMENT" (SEC. 3A). Precision equipment is necessary to check axle on vehicle.

STEERING KNUCKLE (F050, F055, AND F070 AXLE)

DESCRIPTION

The kingpin is held in place with a tapered draw key, installed as shown in figure 1. The draw key is retained in place by a lock washer and nut. Steering knuckles on the F-070 axle have split Delrin bushings. Steering knuckles on F-050 and F-055 have split bushings of polycarbonate construction and can be washed in most conventional solvents, except keytone or chlorinated solvents.

Upper and lower ends of knuckles are sealed with kingpin bearing caps and gaskets and an O-ring seal at the bottom of upper bushings, to prevent lubricant leakage and to exclude dirt and moisture. Some models are equipped with steering knuckle bushing spacer shim (fig. 1). The vertical thrust loads are carried by thrust bearing installed between lower face of axle center and steering knuckle lower yoke. Lubrication fittings are provided at upper and lower ends of knuckle.

REMOVAL

1. Jack up axle and remove hubs and bearings as directed in "FRONT HUBS AND BEARINGS" (SEC. 3D). Remove brake backing plate from steering knuckle. Remove tie-rod as directed in STEERING SYSTEM (SEC. 9) of this manual.

2. Remove steering arm from steering knuckle

3. Remove kingpin draw key nut and washer. Thread nut on draw key far enough to protect the threads. Strike nut with hammer to loosen draw key. Remove nut, then drive pin out with brass drift and hammer.

4. Remove cap screws attaching upper and lower kingpin bearing caps and gaskets to steering knuckle, then remove caps and gaskets.

5. Using brass drift and hammer drive kingpin out of axle.

6. Remove steering knuckle thrust bearing, shims, and O-ring.

7. Refer to "Inspection and Repair" later in this section for inspection and repair procedure.

INSTALLATION

1. Before assembly, thoroughly clean all parts; then coat kingpin with light coat of S.A.E. 10 engine oil.

2. Position steering knuckle on axle, then insert the thrust bearing into place.

NOTE: On models shown in figure 1 place steel washer between bronze washers, with lubricating grooves facing steel washer. Always place larger dust shield over top of washers.

3. Install a new O-ring seal at bottom of upper bushing.

4. Align kingpin holes in steering knuckle yoke, axle end, and thrust bearing, then partially install kingpin through top.

5. With axle center held firmly, place a jack under steering knuckle, then raise until all clearance between knuckle lower yoke, thrust bearing and axle center is taken up. Check clearance between top of axle center and knuckle upper yoke. If clearance exceeds 0.005", place a shim between axle center and knuckle upper yoke.

6. Install kingpin, with milled slot in side of pin registering with draw key hole in axle center.

Install kingpin from top, inserting through steering knuckle yoke, shim, thrust bearing and axle center end. Press pin down until milled slot in pin lines up with draw key hole.

7. Insert draw key into axle center, registering with kingpin, then install lock washer and nut. Tighten nut firmly. If nut bottoms on knuckle before kingpin is secure, replace draw key or use a draw key with more taper.

8. On models using steering knuckle bushing spacer, install spacer at lower end of kingpin.

9. Install new gaskets, then install upper and lower kingpin bearing caps with cap screws. Tighten cap screws to torque listed in "Specifications."

10. Lubricate kingpins thoroughly through lubrication fittings as directed in LUBRICATION (SEC. 0) of this manual. Try action of steering knuckle for binding condition.

11. Install steering arms to knuckles. Install tie-rod as directed in STEERING SYSTEM (SEC. 9) of this manual. Install brake backing plate assembly. Install hubs and bearings and wheels as directed in "FRONT HUBS AND BEARINGS" (SEC. 3D) of this manual.

12. Check front end alignment and stop screw adjustment as previously directed.

STEERING KNUCKLES (F090 AND F120 AXLES)

NOTE: Key numbers in text refer to figure 3.

The steering knuckles are supported on solid kingpins which are tapered at center section to fit snugly in tapered holes in axle center outer ends. A steel sleeve bushing (2) is located between the knuckle upper Delrin bushing (1) and the kingpin to maintain the same size bearing at top and bottom. Bushings are split Delrin and are of floating type.

Bushings are held in place at upper end by the kingpin nut and spacer (6). Vertical thrust is taken by a roller-type thrust bearing (11). Thrust movement is held to a minimum by the use of spacing washers (7) between upper knuckle yoke and axle center end. Upper end of knuckle pins are sealed with dust caps and gaskets, retained in place with screws. Lower end of knuckle on axles are sealed with an inverted expansion plug (13) held in place with a lock ring (14).

STEERING KNUCKLE REMOVAL
(Refer to Fig. 3)

If desired, steering knuckles may be removed from front axle without removing front axle assembly from the vehicle. To remove steering knuckles from the axle either with or without removing the front axle assembly from the vehicle, proceed as follows:

1. Remove hubs, bearings, and brake mechanism. Disconnect tie rod and drag link from arms.

2. Remove cap screws which attach dust cap and gasket to knuckle.

3. Remove the lower expansion plug lock ring (13) and plug (14).

4. Remove cotter pin, kingpin nut, and steel spacer (6). Using suitable brass drift, drive the kingpin (8) downward out of axle and knuckle. Remove knuckle (9), thrust bearing (11), and spacing washer (7) from the axle. Sleeve bushing (2) and bushing (1) can now be removed from knuckle (9).

STEERING KNUCKLE INSTALLATION
(Refer to Fig. 3)

1. Refer to "Inspection and Repair" for inspection and repair procedures.

2. Position knuckle (9) to axle center, then slide thrust bearing assembly between lower face of axle center and steering knuckle lower yoke. MAKE CERTAIN THE RETAINER IS ON TOP OF BEARING (11) WITH LIP OF RETAINER DOWN. Align kingpin holes in knuckle yoke with kingpin hole in axle center.

3. With axle center held rigidly, place a jack under knuckle yoke, then raise knuckle sufficiently to take up all clearance between lower yoke, thrust bearing, and lower face of axle center end.

4. Check clearance between top face of axle center end and face of knuckle yoke. Select, and install spacing washer (7) of correct size to provide thrust clearance listed in "Specifications" at end of this section. These are available in different thicknesses.

5. Make certain kingpin hole in axle center, the kingpin, and nut are clean and dry. Kingpin nut should thread on kingpin freely without bind.

6. Insert kingpin through the bottom yoke of knuckle; then drive pin into place with lead hammer. Place kingpin sleeve bushing (2) and bushing (1) over kingpin, then press into place. Be sure sleeve bushing is installed flush with pin. Install steel spacer (6) on top of bushing.

7. Make sure threads on kingpin and nut are clean and dry, then install kingpin nut. Tighten nut to minimum torque specified in "Specifications," then tighten nut until next slot on nut lines up with cotter pin hole through kingpin. Install new cotter pin, full size of hole.

8. Install new inverted expansion plug in lower hole. Install plug lock ring, seating ring securely in groove.

9. Install new kingpin dust cap gasket (5) at

top, then install dust cap (3). Tighten screws firmly.

10. Connect tie rod and drag link to steering arms. Install brake mechanism and hubs. Check front end alignment factors and stop screw setting.

11. Lubricate knuckles with grease as described in LUBRICATION (SEC. 0) of this manual.

INSPECTION AND REPAIR

Wash steering knuckle parts (except Delrin bushing), in cleaning solution, being sure to remove all dirt and lubricant. If necessary, soak thrust bearings in cleaner until all old lubricant is dissolved, then slush bearings in cleaning solution until all grit is removed.

> **CAUTION: DO NOT wash bushings in keytone or chlorinated solvent.**
>
> **Avoid turning bearings in races when bearing assemblies are dirty, since small particles of grit will damage bearings. "Specifications" at end of this group itemize the various fits and tolerances which apply to all front axles covered by this manual. It is recommended that all parts which do not meet these specifications be replaced.**

1. Steering Knuckles. After steering knuckles have been cleaned thoroughly, examine knuckles for distortion, damage, cracks, or fractures. If Magna-Flux inspection equipment is available, use this method to inspect steering knuckles and kingpins for minute cracks, checks, or fractures which otherwise would not be visible to the naked eye.

2. Thrust Bearings. Examine thrust bearings for excessive wear, pitting, or other damage. If these conditions are evident or if bearing retainers are bent or damaged, bearings should be replaced.

3. Steering Knuckle Bushings. Replace steering knuckle bushings if wear is indicated, or if results given previously under "Front Wheel Camber" in "FRONT END ALIGNMENT" (SEC. 3A). indicates replacement is necessary.

a. Bushing Removal. Bushings are split floating-type. To remove, slide bushings out of knuckle bore.

b. Bushing Installation. When installing bushings, remove nicks and burrs from knuckle bushing bore and polish with medium grit abrasive paper or cloth. Apply lubricant specified in LUBRICATION (SEC. 0) of this manual, to all parts and install the bushings in the knuckle bores.

4. Kingpin Inspection. Check diameter of kingpin. Also, check for minute cracks or other damage. If inspection reveals excessive wear, replace kingpin.

5. Axle Center. There are two conditions which, if either exists, will necessitate replacement of axle center.

a. If kingpin holes in axle center ends are worn to such an extent that a new or oversize kingpin fits loosely, axle center must be replaced.

b. If axle center has been twisted or bent more than 5 degrees from original shape, the center should be replaced. When an extreme bent condition exists, minute invisible fractures may occur and cause failure under ordinary operating conditions.

c. Check axle center for twist with alignment instruments, or on a bench as illustrated in "Front End Alignment Chart" in "FRONT END ALIGNMENT" (SEC. 3A) (fig. 1). If equipment is available, use Magna-Flux Method to check axle center for minute fractures.

FRONT AXLE SPECIFICATIONS

AXLE MODEL	F050-F055	F070	F090	F120
KING PIN LENGTH	6 23/64"	7 57/64"	8 3/4"	9 3/4"
DIAMETER—TOP	1.1090"	1.2492"	1.1855" 1.1865"	1.3085" 1.3095"
BOTTOM	1.1094"	1.2496"	1.4330" 1.4340"	1.6060" 1.6070"
KING PIN BUSHING				
LENGTH	—	—	1 29/32"	2 3/8"
DIAMETER—OUTER	—	—	1.4330" 1.4340"	1.6060" 1.6070"
INNER	—	—	1.1870" 1.1880"	*1.2970" 1.3000" *Ream after installation.
STEERING KNUCKLE BUSHING				
LENGTH—UPPER	1 11/32"	1 7/8"	1.760"	2 7/32"
LOWER	1.1094"	1.2496"	2.150"	2 7/32"
I.D. INSTALLED	1.1124"	1.2526"	1.4340" 1.4370"	1.607" 1.610"
STEERING KNUCKLE THRUST—Maximum	0.005"	0.005"	0.004" 0.012"	0.015" Max.
SPACING SHIMS AVAILABLE	0.005"	0.005"	Use Spacing Washer	0.010" 0.015"
SPACING WASHERS AVAILABLE	—	—	0.114" 0.116" White 0.121" 0.123" Yellow 0.128" 0.130" Blue	0.093" 0.125"
TORQUE SPECIFICATIONS				
KING PIN NUT	—	—	250 Ft. Lbs. Then Advance to Next Cotter Pin Hole	250 Ft. Lbs. Then Advance to Next Cotter Pin Hole
KING PIN BEARING CAP CAP-SCREW	50-70 In.-Lbs.	60-70 In.-Lbs.	—	—

SECTION 3C

Front Springs

DESCRIPTION

Suspension and front springs on all models are I-beam type as shown in figure 1. Springs are vari-rate leaf type and bushed at front end only. These springs are mounted to rigid hangers (fig. 2), and attached to front axle with U-bolts as shown in figures 3 and 4. U-bolts also secure shock absorber brackets.

The front spring rear hangers on some vehicles have a floating cushion. The cushion (fig. 5) is held in place by the spring rear hanger rebound bolt, and can be reversed to extend wear life of spring end-to-cushion metal contact area.

Spring eye bushings are rubber-mounted and replaceable on all models. Figure 6 illustrates the three types of spring bushings used with various axles. Rubber-mounted bushings with solid eye bolts require no lubrication.

GENERAL SPRING MAINTENANCE

LUBRICATION

Spring leaves are lubricated at time of assembly and require no further lubrication unless spring is disassembled.

TIGHTENING

IMPORTANT: U-bolt nuts must be retightened to initial torque listed in "Specifications" at end of this section, after 500 miles. Thereafter, U-bolts should be checked at regular intervals. U-bolts must be kept TIGHT at all times to hold axle in place at springs.

The center bolt serves only to hold the spring together while in shipment and during installation, and as a locating point when assembling spring to axle. After assembly, it is strictly the function of the U-bolts to hold the spring and axle in alignment, and the importance of keeping the U-bolts tight, cannot be overemphasized.

Check, and tighten if necessary, all spring bracket bolt nuts and bracket pin clamp bolts. Rebound clips should be tightened just enough to hold spring leaves in alignment without restricting free movement of leaves.

REPAIR OPERATIONS

FRONT SPRING REMOVAL (Fig. 5)

1. Raise vehicle frame to take weight off the spring. Make sure vehicle is supported safely.
2. Support axle on floor jack.
3. Remove spring shackle U-bolt nuts, then lower axle.
4. At front of vehicle, remove spring eye bolt, nut, and washer; withdraw eye bolt from bracket and spring eye.
5. On tilt cab models, remove retainer bolt, pin retainer and rebound pin at rear hanger. On

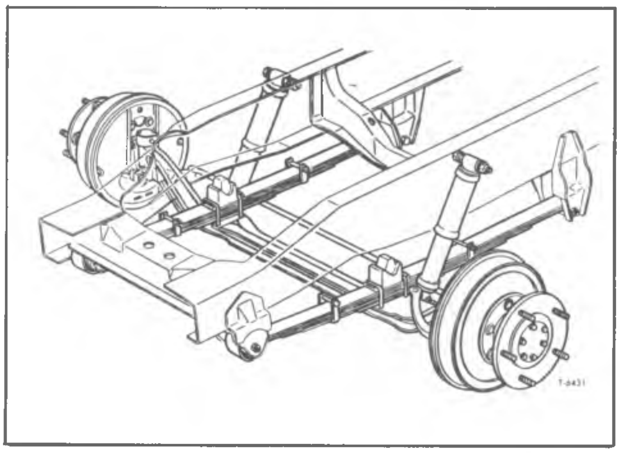


Figure 1—Beam Suspension

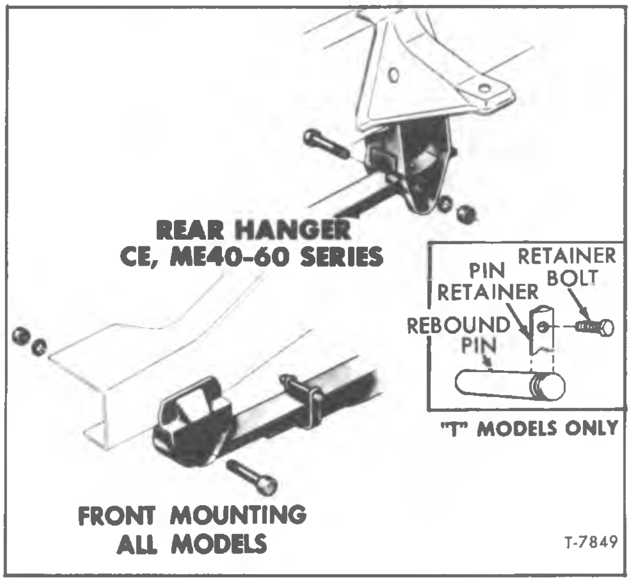


Figure 2—Spring Mounting (Typical)

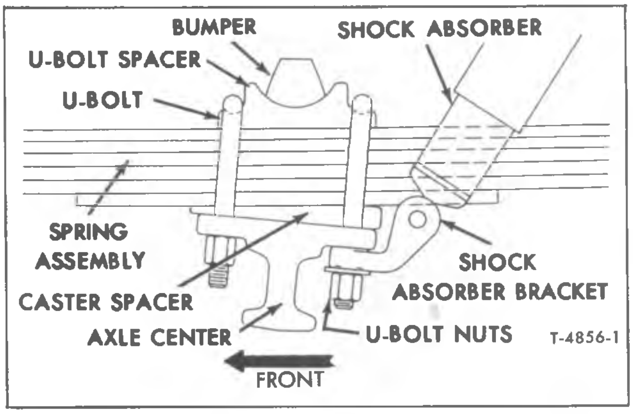


Figure 3—Front Spring Center Mounting (Tilt Model)

conventional and cowl models, remove nut, lock washer, rebound bolt and cushion at rear hanger.

6. Remove shock absorber bracket (if used) (figs 3 and 4), U-bolt spacer and U-bolts, spring caster spacer, tow eye (if used) and dowel pins (when used). Also, front spring rear hanger cushion (when used). Remove spring.

NOTE: Refer to figures 3 and 4 for correct position of caster spacer at time of installation.

INSPECTION

1. Thoroughly clean spring eye bushings, bolts, and pins.
2. Insert bolts or pins into bushings in spring eyes, and check for looseness. If excessive looseness is evident, bolt pin or bushing must be replaced.
3. Inspect spring assembly for broken or fractured leaves. Number 1 and 2 leaves can be replaced, however, if other leaves are broken, replace complete spring assembly. Replace broken leaves as directed later in this section.
4. Inspect spring for loose or broken rebound clips. Rebound clips should be tight enough to hold spring leaves in alignment, but not tight enough to restrict free movement of leaves.
5. Check for broken, loose, or sprung spring center bolt. Replace or tighten as necessary.

BUSHING REPLACEMENT
- AXLES (F-050 AND F-055)

Removal (With Spring on Vehicle)
(Refer to Fig. 7)

1. Place vehicle on hoist to take weight off spring and remove spring eye nut and bolt.
2. Raise vehicle further until spring eye clears hanger.
3. Using remover adapter (J-21978-1), nut and screw (J-21058) and receiver and bridge (J-21830-4, 7) remove bushing from spring eye.

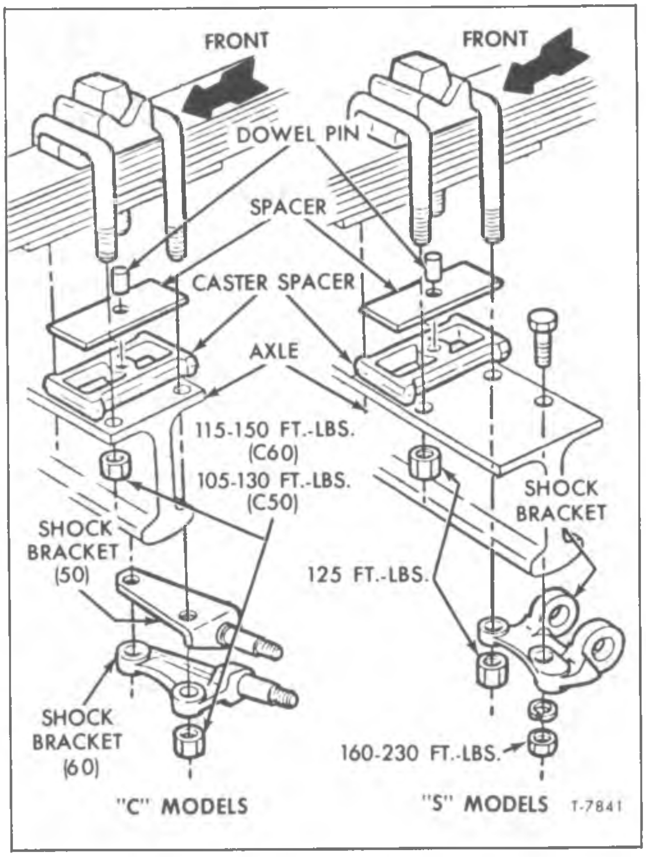


Figure 4—Front Spring Center Mounting ("C" and "S" Models)

Installation (With Spring on Vehicle)
(Refer to Fig. 8)

1. Using installer adapter (J-21978-2) and tools called out in Step 3 of removal procedure, install bushing with offset of bushing at top of spring eye as shown in figure 6.
2. Lower vehicle to position spring eye in hanger.
3. Install spring eye bolt and nut. Torque nut to "Specifications" at end of this section, and remove vehicle from hoist.

Replacement (With Spring Off Vehicle)

If bushing is replaced with spring off vehicle, use a press, if available, and adapters (J-21978-1, 2) to remove and reinstall bushing.

BUSHING REPLACEMENT
- AXLE (F-070)

Removal and installation procedures are the same as outlined for the F-050 and F-055 axle, except use oval adapter (J-21979) for removal and installation of the spring eye bushing (fig. 6).

There is no restriction on the installed position of the oval (F-070 axle) bushing as to the case of the offset type (F-050, F-055 axle) bushing.

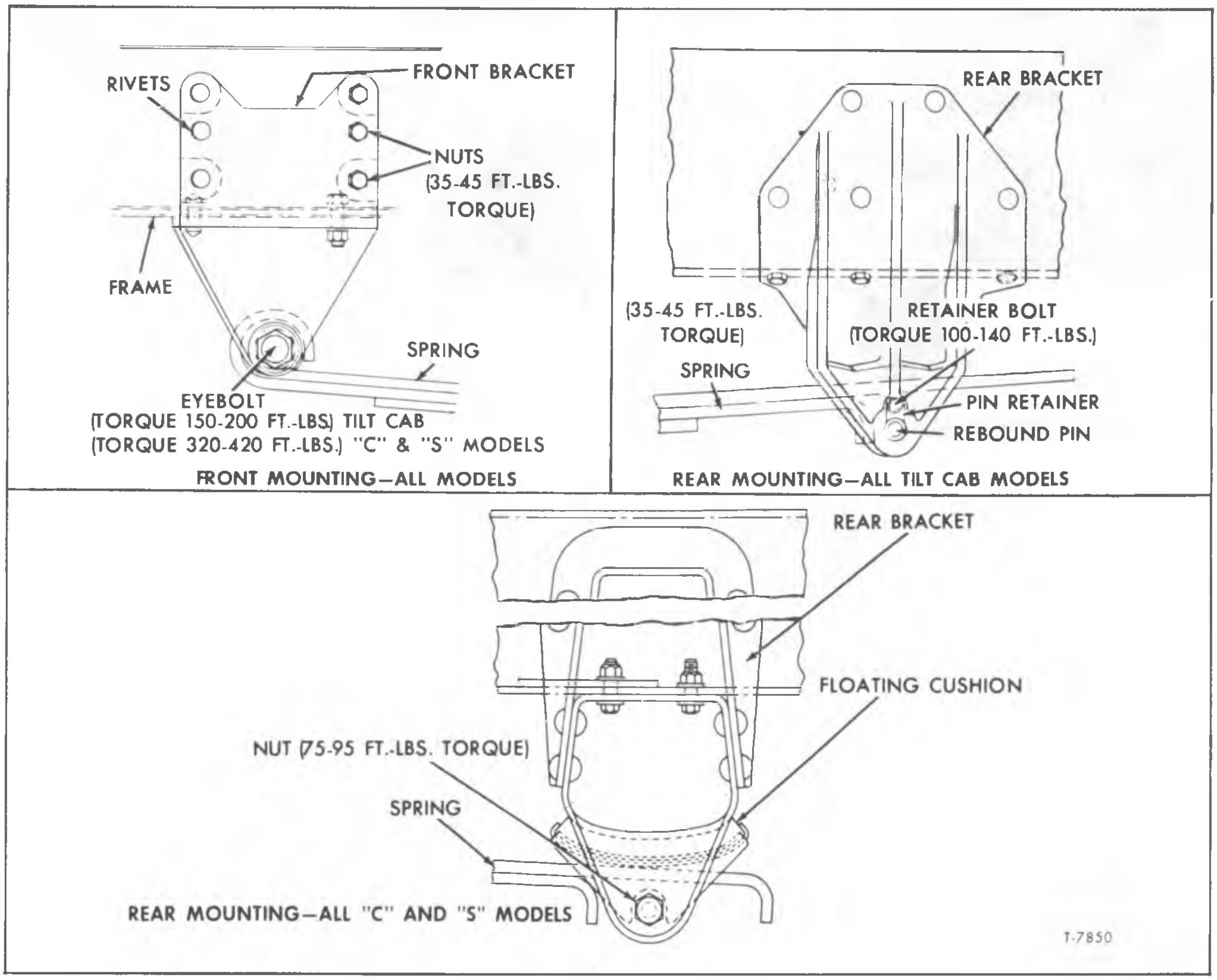


Figure 5—Front Spring Mounting

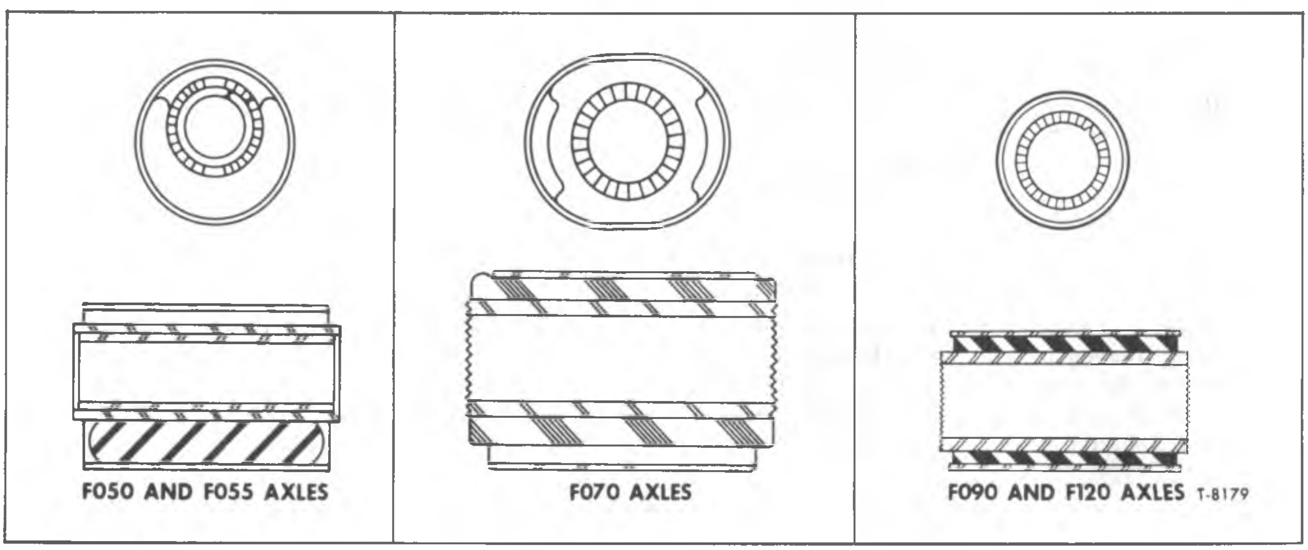


Figure 6—Spring Eye Bushing

FRONT SPRINGS

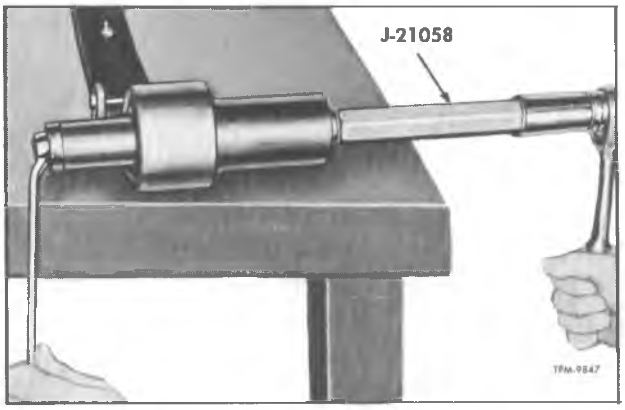


Figure 7—Removing Rubber Type Eye Bushing

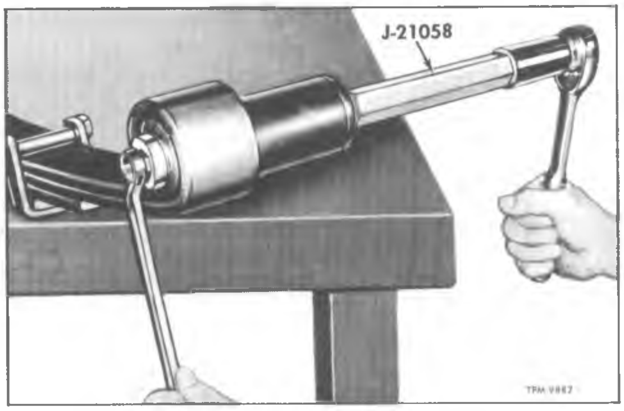


Figure 8—Installing Rubber Type Eye Bushing

BUSHING REPLACEMENT
- AXLES (F-090 AND F-120)

Remove and replace front eye bushing using bushing remover/installer (J-21058-3) with correct bushing adapter plug. Refer to figure 6 for bushing design.

NOTE: U-bolts must be kept TIGHT at all times to hold axle in place at springs.

SPRING LEAF REPLACEMENT

1. Mark down one side of springs to assure original position of leaves, then place spring assembly in a vise or arbor press near center bolt.

2. When bolted type is used, remove rebound clip, nuts, bolts, and spacers.

3. File off peened end of center bolt, then remove nut and bolt.

4. Release vise or arbor press slowly to avoid possible injury. Separate spring leaves and clean thoroughly, using a wire brush if necessary.

5. Replace any broken rebound clips by cutting old rivet, and riveting new clip to spring leaf.

6. Replace broken leaft and stack leaves in correct order, applying a thin film of graphite grease to each leaf. Align center bolt holes in spring leaves with long drift, then compress spring leaves in vise or arbor press.

7. Install center bolt and nut and tighten firmly. Peen end of bolt to prevent nut loosening.

8. Remove spring from vise or arbor press. Align spring leaves by tapping with hammer. Install rebound clip, spacers, bolts, and nuts. Tighten enough to hold spring leaves in alignment, but not enough to restrict free movement of leaves.

FRONT SPRING INSTALLATION
(Refer to Fig. 5)

1. Place rear end of spring in rear hanger. On tilt cabs install retainer bolt, pin retainer and rebound pin. On "C" and "S" models, install cushion, rebound bolt, lock washer and nut.

2. Raise front end of spring into forward hanger brackets; install spring eye bushing, spring eye bolt, washer and nut.

3. Install shock absorber bracket (fig. 3), at spring, U-bolt spacer, and shock absorber (when used). Install U-bolts and nuts.

4. With dowel pins (when used) tow eye (when used) and caster spacer (when used) on axle pad, raise axle to spring, making sure spring center bolt or dowel pin engages hole in axle pad.

NOTE: On tilt cab models, install caster spacers with thick edge facing proper direction as shown in figure 3. On "C" and "S" Models, caster spacer is the same thickness at either end (fig. 4).

5. Tighten front spring eye bolt nut, U-bolt nuts, rebound bolt nuts, to torque listed in "Specifications" at end of this section.

6. Lubricate as instructed in LUBRICATION (SEC. 0) of this manual.

7. Lower vehicle to floor.

SHOCK ABSORBERS

Shock absorbers are non-adjustable and non-repairable. Maintenance requirements involve replacement of the rubber mounting grommets, and tightening all shock absorber pin nuts at regular intervals. If a shock absorber becomes inoperative, the complete unit must be replaced.

SERVICE DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Spring Noise	1. Loose U-bolts. 2. Loose or worn shackle bushings. 3. Lack of lubrication. 4. Defective shock absorber.	1. Tighten to recommended torque. 2. Replace shackle bushings. 3. Lubricate as required. 4. Replace shock absorber.
Spring Sag or Bottom	1. Inoperative shock absorbers. 2. Broken spring leaf. 3. Severe operation or overloading.	1. Replace shock absorbers. 2. Replace leaf or spring assy. 3. Check load capacity rating.
Spring Breakage	1. Loose U-bolts. 2. Normal fatigue. 3. Overloading.	1. Tighten to recommended torque. 2. Replace spring. 3. Check load capacity rating.

TORQUE SPECIFICATIONS

	C-M-S MODELS FT. LBS.	T MODELS FT. LBS.
SHOCK ABSORBER UPPER EYE BOLT (NUT)	65-95	40-50
LOWER EYE BOLT (NUT)	65-95	40-50
SPRING U-BOLT (NUT)	105-130	90-110
SPRING FRONT EYEBOLT (NUT)	320-420	150-200
SPRING REAR REBOUND BOLT (NUT) (ALL AXLES EXCEPT F090)	—	—
SPRING REAR REBOUND BOLT (NUT) (F-090)	—	—
SHOCK ABSORBER STUD TO FRAME (NUT)	130-190	50-60

IMPORTANT

U-bolts must be retightened to initial torque listed in "Specifications" after 500 miles.

SECTION 3D

Front Hubs and Bearings

DESCRIPTION

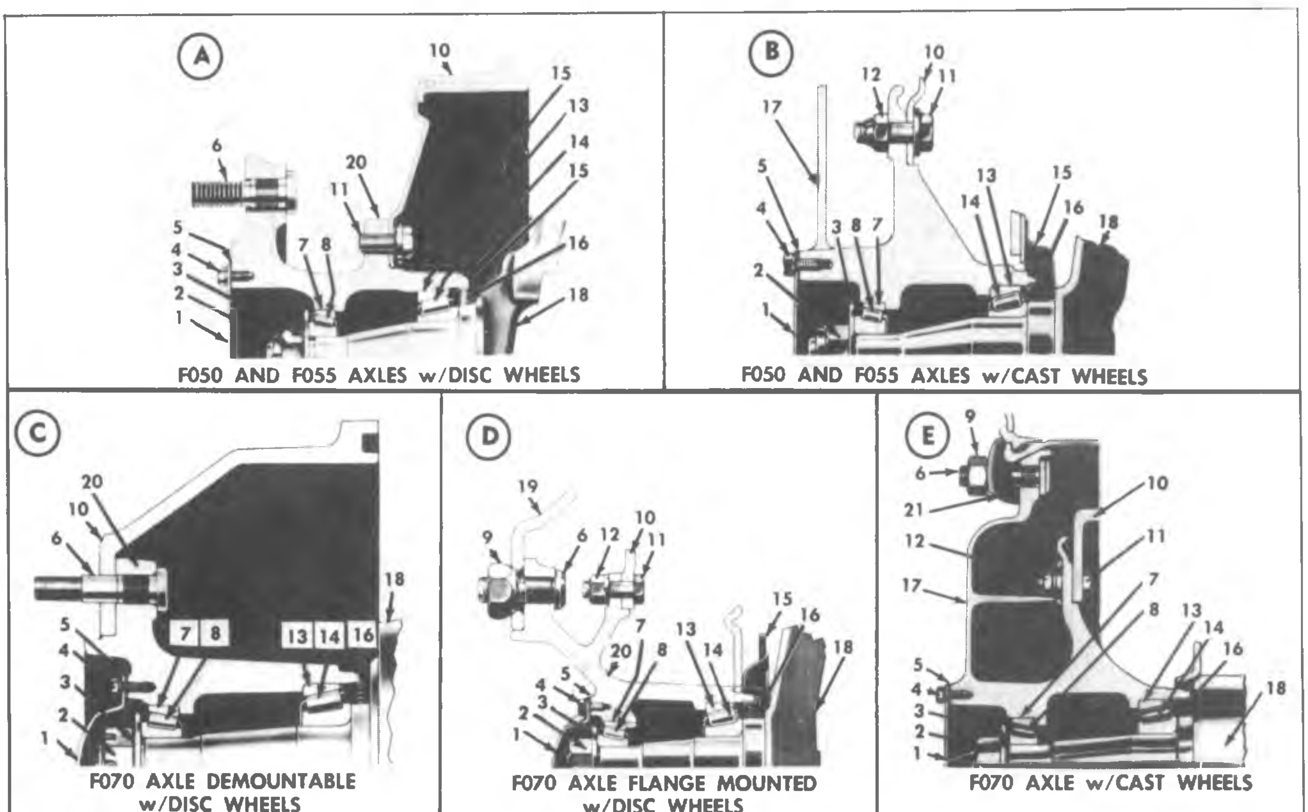
Front hubs are mounted on steering knuckle spindle on opposed tapered roller bearing as illustrated in figures 1, 2, and 3. Refer to "Service Parts Identification" decal on dash compartment door to determine type of axle used on a specific vehicle. Mounting parts (mainly bearings, spindle nuts, and seals) shown in figures 1, 2, and 3, are of primary importance. Brake drum mounting bolts, studs, and nuts differ in type and method of installation on various series vehicles.

BEARING MAINTENANCE

All wheel bearings are adjustable for wear. Satisfactory operation and long life of bearings depend upon proper adjustment and correct lubrication. If bearings are adjusted too tight, they will overheat and wear rapidly. Loose adjustment will cause pounding. Bearing adjustment should be checked at regular inspection periods.

Front hubs and bearings should be cleaned, inspected, and lubricated whenever hubs are removed, or at intervals indicated in LUBRICATION (SEC. 0) of this manual.

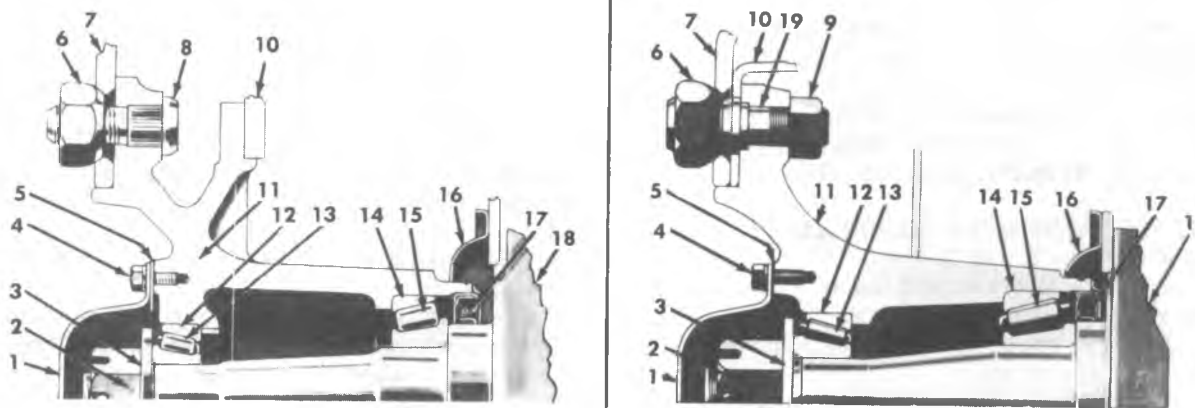
New hub oil seals should be installed when servicing bearings if there is the slightest indication of wear or damage.



1 Hub Cap or Closure Plate
2 Bearing Adjusting Nut
3 Adjusting Nut Washer
4 Cap Screw
5 Gasket
6 Wheel Bolt
7 Outer Bearing Cup
8 Outer Bearing Cone and Roller
9 Wheel Bolt Nut
10 Brake Drum
11 Hub to Brake Drum Bolt
12 Lock Nut
13 Inner Bearing Cup
14 Inner Bearing Cone and Rollers
15 Oil Shield or Deflector
16 Inner Oil Seal
17 Wheel (Cast Type)
18 Steering Knuckle
19 Wheel (Budd Type)
20 Hub
21 Wheel Clamp

T-7846

Figure 1—Front Hub and Bearing



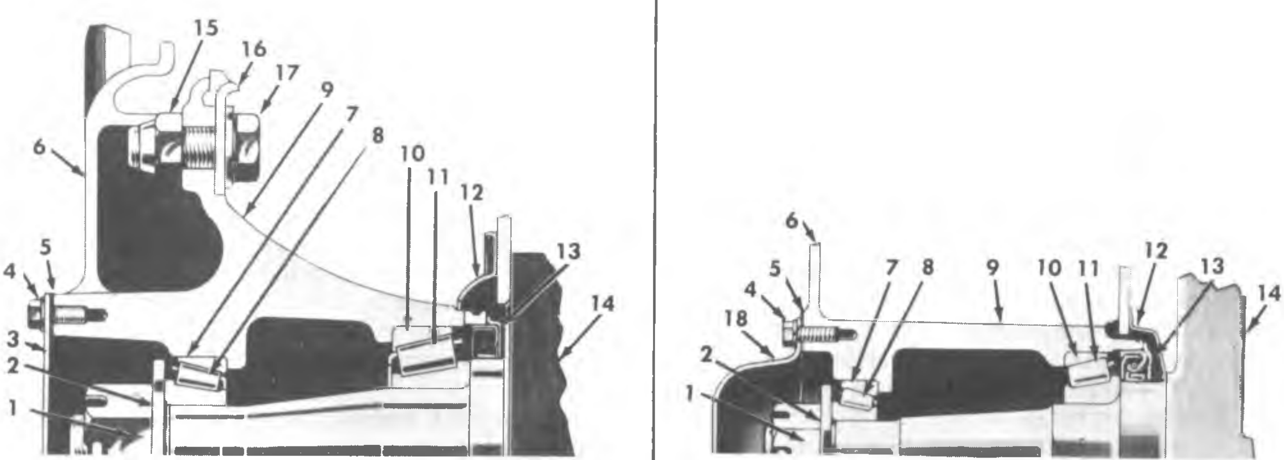
F090 AXLE

F120 AXLE

1 Hub Cap
2 Bearing Adjusting Nut
3 Adjusting Nut Washer
4 Cap Screw
5 Gasket
6 Wheel Nut
7 Wheel
8 Wheel Stud
9 Nut
10 Brake Drum
11 Hub and Drum Assembly
12 Outer Bearing Cup
13 Outer Bearing Cone and Rollers
14 Inner Bearing Cup
15 Inner Bearing Cone and Rollers
16 Oil Shield
17 Inner Oil Seal
18 Steering Knuckle
19 Wheel Stud

T-8169

Figure 2—Front Hubs and Bearings (Disc Type Wheels)



F120 AXLE

F090 AXLE

1 Bearing Adjusting Nut
2 Adjusting Nut Washer
3 Hub Closure Plate
4 Cap Screw
5 Gasket
6 Wheel and Drum Assembly
7 Outer Bearing Cup
8 Outer Bearing Cone and Rollers
9 Hub
10 Inner Bearing Cup
11 Inner Bearing Cone and Rollers
12 Oil Shield
13 Inner Oil Seal
14 Steering Knuckle
15 Lock Nut
16 Brake Drum
17 Hub to Brake Drum Bolt
18 Hub Cap

T-8170

Figure 3—Front Hubs and Bearings (Cast Type Wheels)

FRONT HUBS AND BEARINGS

BEARING ADJUSTMENT CHECK

Before checking wheel bearing adjustment, jack up the front axle until wheels clear floor.

Check bearing play, by grasping tire at top and pulling back and forth, or by using a pry bar under tire. If bearings are properly adjusted, movement of brake drum in relation to backing plate will be barely noticeable and wheel will turn freely. If movement is excessive, adjust as follows:

FRONT WHEEL BEARING ADJUSTMENT
(Refer to Figs. 1, 2, and 3)

1. With the wheel raised and axle safely supported, remove hub cap and gasket.
2. Remove cotter pin securing adjusting nut to axle.
3. Tighten adjusting nut to 50 foot-pounds torque while rotating wheel in both directions.
4. Back off nut 1/3 turn and install new cotter pin. If spindle hole does not line up, tighten nut until alignment is obtained. This adjustment should result in bearing end play of 0.001" to 0.007".
5. Spin hub to make sure it turns freely. Lock cotter pin by spreading the end and bending it around spindle nut. Install dust cap and wheel and tire. Lower vehicle.

FRONT HUB AND BEARING REPLACEMENT

REMOVAL (Figs. 1, 2, and 3)

1. Jack up front wheel and remove tire and rim assembly if cast wheels are used. Remove tire and wheel assembly if ventilated disc or Budd type wheels are used.
2. Remove hub cap or hub closure plate and gasket.
3. Remove cotter pin, bearing adjusting nut, and adjusting nut washer.
4. Pull hub and drum assembly straight off steering knuckle spindle, using care to prevent outer bearing from dropping on floor. Remove outer bearing cone and roller assembly from hub.
5. Pull inner oil seal out of hub, then remove inner bearing from hub.
6. Clean, inspect, and repair parts as necessary, as directed later in this section under "Cleaning, Inspection, and Repair."

INSTALLATION (Figs. 1, 2, and 3)

1. Lubricate bearings, spindle, and inside of hub as directed in LUBRICATION (SEC. 0) of this manual. Coat lip of seal with wheel bearing grease or equivalent before installing.
2. Place inner bearing cone in hub. Coat oil seal bore in hub with a thin layer of non-hardening sealing compound, then press seal in until seal case seats against shoulder in hub or against inner bearing cup.

   NOTE: Seal must be installed with lip pointing inward.
3. On trucks so equipped, make sure the oil deflector and oil shield are in place on spindle.
4. Carefully install hub assembly on spindle, being careful not to damage inner oil seal.
5. Place outer bearing cone and roller assembly on spindle, pressing firmly into hub with fingers. Install adjusting nut washer and adjusting nut.
6. Install tire and rim or tire and wheel assembly.
7. Adjust bearings and complete the installation as previously directed under "Front Bearing Adjustment." Adjust brakes as directed in BRAKES (SEC. 5) of this manual.

CLEANING, INSPECTION, AND REPAIR

CLEANING

1. Immerse bearing assemblies in suitable cleaning solvent. Clean with stiff brush if necessary to remove old lubricant. Blow bearings dry with compressed air, directing air stream across bearings. Do not spin bearings while blowing them dry.
2. Thoroughly clean all lubricant out of inside of hub and wipe dry. Make sure all particles of gasket are removed from outer end of hub, and that all sealing compound is cleaned out of oil seal bore in inner end of hub.
3. Clean lubricant off steering knuckle spindle, wash bearing adjusting nut and washer in cleaning solvent and wipe dry.

INSPECTION

1. Inspect bearings for excessive wear, chipped edges, and other damage. Slowly roll rollers around cone to detect any flat or rough spots. Replace damaged parts. If either the cone and roller assembly or the cup of the roller bearings are damaged, the complete bearing assembly must be replaced.
2. Examine bearing cups which are still installed in hub. If cups are pitted or cracked, they must be replaced as directed later under "Repair."
3. Examine brake drums for scoring or other damage. Non-demountable brake drums can be refinished while mounted on hubs (refer to "HYDRAULIC BRAKES" (SEC. 5A) of this manual under "Brake Drums"). if necessary to replace demountable brake drum, refer to "Repair" later in this section.
4. Examine wheel studs or rim clamp studs for damaged threads and replace, if necessary, as directed later under "Repair."

5. Discard old oil seals and obtain new oil seals to be used at assembly.

REPAIR

Bearing Cup Replacement

1. Bearing cups are removed by using a mild steel rod through opposite end of hub and driving against inner edge of bearing cup. Alternately drive on opposite sides of cup to avoid cocking cup and damaging inside of hub.

2. To install new cups, position cup in hub and drive into place, using a suitable driver or by using a mild steel rod against outer edge of cup. If drift is used, alternately drive against opposite sides to assure driving cup in squarely. Cups must seat against shoulder in hub.

Brake Drum Replacement

1. Demountable Type. The demountable type drum may be separated from the hub and removed from the vehicle without disturbing the hub. The drum is held to the hub by countersunk, slotted screws, which are easily removed with a screwdriver.

2. Non-Demountable Type. Non-demountable type hub and drum assembly is such that replacement cannot be accomplished with the hub assembly installed on the vehicle.

a. Separate the drums and hub by removing the drum-to-hub retaining bolts, hub stud nuts, or by pressing out the wheel studs, as applicable.

b. Position brake drum to hub assembly, making certain that all drain holes are in alignment.

c. Apply a light, even coating of sealing compound to the hub oil deflector contact surface, and position deflector to drum.

d. Install drum-to-hub retaining bolts, hub stud nuts, or press wheel studs into drum.

Wheel Bolt Replacement

Wheel bolts are serrated and may also be swaged in place; however, replacement procedure remains the same for both types of installation. Press bolts out of hub flange, using suitable press, then press new bolts into place, making sure bolts are a tight fit. If all bolts were removed, be sure that hub oil deflector is in position under bolt heads.

IMPORTANT: If any one wheel experiences a single stud failure caused by a loose running wheel, all studs should be replaced. A loose running wheel may cause only one stud to break, but several more studs may become fatigued to the point of failure, but not actually breaking. Replacing only the one broken stud and remounting wheel will then set the stage for a second and possibly more serious failure. If holes in wheel have become elongated, or enlarged, replace wheel.

Hub Stud Replacement

Hub studs can be removed and replaced by using a conventional stud remover and replacer. Make sure that studs are firmly bottomed in holes and that threads are not damaged during installation.

HUB STUD REPLACEMENT

Hub studs can be removed and replaced by using a conventional stud remover and replacer tool. Make sure that studs are firmly bottomed in holes and that threads are not damaged during installation.

NOTE

Wheel-to-hub stud and nut fasteners are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in maior repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of part(s).

SECTION 4
Rear Suspension

This section is divided into sub-sections as shown in Index below:

SECTION 4A
Rear Axle and Controls

Contents of this sub-section are listed in Index below:

GENERAL DESCRIPTION

Rear axles used on all vehicles covered by this publication are full floating type, using Hotchkiss or leaf spring drive.

Rear axles are Hypoid or spiral bevel pinion gear type. Pinion is straddle mounted between roller bearing and two adjustable tapered roller bearings. Differential is supported by adjustable tapered roller bearings in differential carrier.

Housing is either banjo or bowl type, with spring seats and brackets, also brake mounting brackets welded to housing. This type construction provides exact alignment and location of the axle assembly at time of assembly and installation.

Axle shafts are full-floating type. Inner end of shaft is splined and engages similar splines in differential side gear. Outer end of shaft is flanged and is attached to the wheel hub by studs, tapered dowels, and nuts.

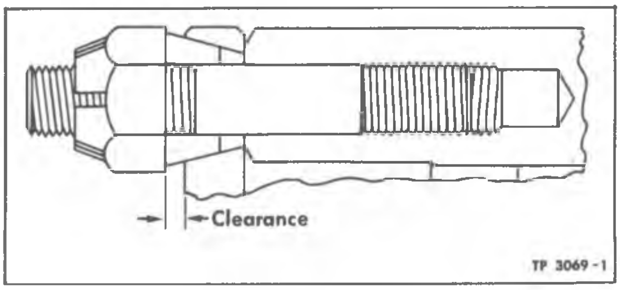


Figure 1—Clearance Between Axle Shaft Flange and Stud Nut

REAR AXLE SERVICE DIAGNOSIS

SYMPTOM	PROBABLE REMEDY
NOISE ON DRIVE	
Excessive Pinion to Bevel Gear Backlash	Adjust
Worn Pinion and Bevel Gear	Replace
Worn Pinion Bearings	Replace
Loose Pinion Bearings	Adjust
Excessive Pinion End Play	Adjust
Worn Differential Bearings	Replace
Loose Differential Bearings	Adjust
Excessive Bevel Gear Run-Out	Replace
Low Lubricant Level	Replenish
Wrong or Poor Grade Lubricant	Replace
Bent Axle Housing	Straighten or Replace
NOISY ON COAST	
Axle noises heard on drive will usually be heard also on coasting; although not as loud	Adjust or Replace
Pinion and bevel gear too tight (audible when decelerating and disappears when driving)	Adjust
INTERMITTENT NOISE	
Warped Bevel Gear	Replace
Loose Differential Case Bolts	Tighten

SYMPTOM	PROBABLE REMEDY
CONSTANT NOISE	
Flat Spot on Pinion or Bevel Gear Teeth	Replace
Flat Spot on Bearings	Replace
Worn Pinion Splines	Replace
Worn Axle Shaft Dowel Holes	Replace
Worn Hub Studs	Replace
Bent Axle Shaft	Replace
NOISY ON TURNS	
Worn Differential Side Gears & Pinions	Replace
Worn Differential Spider	Replace
Worn Differential Thrust Washers	Replace
Worn Axle Shaft Splines	Replace
FAILS TO SHIFT INTO HIGH OR LOW	
Defective Electrical Circuit	Correct
Defective Shift Unit	Replace
Lack of Air Pressure	Correct
Low Vacuum	Correct

REAR AXLE AND UNIT REPLACEMENT

AXLE ASSEMBLY REPLACEMENT

REMOVAL

1. Jack up rear of vehicle until load is removed from springs, then place blocks under frame to prevent accidental dropping of vehicle.
2. Disconnect hydraulic or air brake lines, whichever is used. Refer to BRAKES (SEC. 5) of this manual.
3. Disconnect electric wiring or line from shift chamber if vehicle is equipped with a 2-speed axle.
4. Disconnect propeller shafts as directed in "PROPELLER SHAFTS" (SEC. 4D) of this manual.
5. Disconnect torque or radius rods, if used, as directed in "REAR SPRINGS" (SEC. 4B) of this manual.
6. Disconnect spring U-bolts as directed in "REAR SPRINGS" (SEC. 4B) of this manual.
7. Roll axle out from under vehicle, then remove wheels, hubs, and bearings as directed in "REAR HUBS AND BEARINGS" (SEC. 4C).
8. Whenever another axle is to be installed instead of the one removed, it may be necessary to remove two speed shift unit, and brake chambers. Refer to respective sub-sections for instructions.

INSTALLATION

1. If brake chambers or two-speed shift unit has been removed, they should be reinstalled as directed in respective sections.
2. Install hubs, wheels and tires as directed in "REAR HUBS AND BEARINGS" (SEC. 4C) of this manual. Roll axle into position under vehicle.
3. Connect springs to axle as directed in "REAR SPRINGS" (SEC. 4B) of this manual.
4. Reconnect the torque rods as directed in "REAR SPRINGS" (SEC. 4B) to secure proper axle alignment.
5. Reconnect propeller shafts as directed in "PROPELLER SHAFTS" (SEC. 4D) of this manual.
6. Reconnect electric wiring or line at shift chamber if vehicle is equipped with a 2-speed axle.
7. Reconnect air brake lines as directed in BRAKES (SEC. 5).
8. Check lubricant level and fill with type and grade of lubricant in the manner instructed in "Rear Axle Lubrication." Some types of axles require

additional lubricant at pinion cage when filled initially or after overhaul.

9. Remove blocks and lower vehicle to the ground. Retighten spring U-bolts as instructed in "REAR SPRINGS" (SEC. 4B of this manual.

10. After all installation procedures have been completed, check air or vacuum lines for leaks, also test brakes for proper application.

DIFFERENTIAL CARRIER UNIT REPLACEMENT

In some instances it may be desirable to remove the differential carrier assembly from the axle housing, while the housing remains installed under the vehicle.

To assist in handling the differential carrier assembly, a roller jack should be available; also, a pan for draining lubricant.

Inspect axle housing for lubricant leaks before cleaning, then steam clean thoroughly to remove all dirt or other foreign matter.

REMOVAL

1. Remove plug at bottom of housing to drain lubricant.

2. Remove axle shafts as directed under heading "Axle Shaft Replacement" in this section.

3. On 2-speed axles disconnect lines from shift chamber or wiring from shift electric unit.

4. Disconnect propeller shaft from yoke as directed in "PROPELLER SHAFTS" (SEC. 4D) of this manual.

5. Remove cap screws or stud nuts, and lock washers, except two near top. Loosen two at top and leave installed to prevent carrier falling.

6. Support carrier on roller jack, remove top stud nuts or cap screws, then work carrier free of housing. A small pinch bar may be used to keep carrier straight in housing bore, while carrier is withdrawn. End of bar must be rounded to prevent damage to carrier flange.

INSTALLATION

1. Install new differential carrier to housing gasket over studs or align bolt holes in gasket with holes in housing. On axles using cap screws, install four temporary studs which will simplify locating carrier and gasket and assist in drawing carrier into place.

2. Roll carrier into place using roller jack. Start carrier over studs and into housing, using flat washers under four equally spaced stud nuts.

3. Tighten all nuts evenly and alternately until carrier is in position. Replace temporary flat washers. Install lock washers, then tighten all nuts to specified torque.

4. Connect propeller shaft to rear axle yoke as directed in "PROPELLER SHAFTS" (SEC. 4D) of this manual.

5. On 2-speed axles, connect wiring to electric shift unit or line to shift chamber.

6. Install axle shafts as directed under heading "Axle Shaft Replacement" in this section.

7. Fill to level of filler plug opening with lubricant recommended in LUBRICATION (SEC. 0) of this manual.

AXLE SHAFT REPLACEMENT

REMOVAL

Procedure for removal of axle shafts is the same with axle assembly removed or installed in the vehicle.

1. Remove nuts from studs attaching axle shaft flange to wheel hub.

2. Strike center of flange with a lead hammer to loosen flange and split tapered dowels from studs.

3. Remove split tapered dowels from studs. In some instances it may be necessary to spread dowels, while being removed.

4. Grasp axle shaft flange and pull outward to remove. Remove and discard gasket.

INSTALLATION

1. Install new gasket over hub studs and against hub.

2. Dip splined end of shaft in axle lubricant, and insert shaft through hub.

3. Turn shaft as necessary to index shaft splines with differential side gear splines.

4. As shaft is pushed inward, rotate as necessary to align flange holes with hub studs, then press shaft inward until flange is against hub.

5. Install split tapered dowel over each stud. Install and tighten 5/8" nuts to 90-110 foot-pounds torque or ½" nuts to 50-60 foot-pounds torque.

6. Observe that clearance exists between nut and flange (fig. 1). If no clearance exists, this indicates excessive wear at studs, dowels, or flange holes. Replace worn parts if necessary.

PINION OIL SEAL REPLACEMENT

Several types of oil seal installation are used on axles covered by this publication. One type has the seal assembly installed directly into differential carrier, while another has the seal installed in a retainer which is attached to carrier.

REMOVAL

1. Remove propeller shaft from yoke at axle as directed in "PROPELLER SHAFTS" (SEC. 4D) of this manual.

2. Hold propeller shaft yoke with holding bar

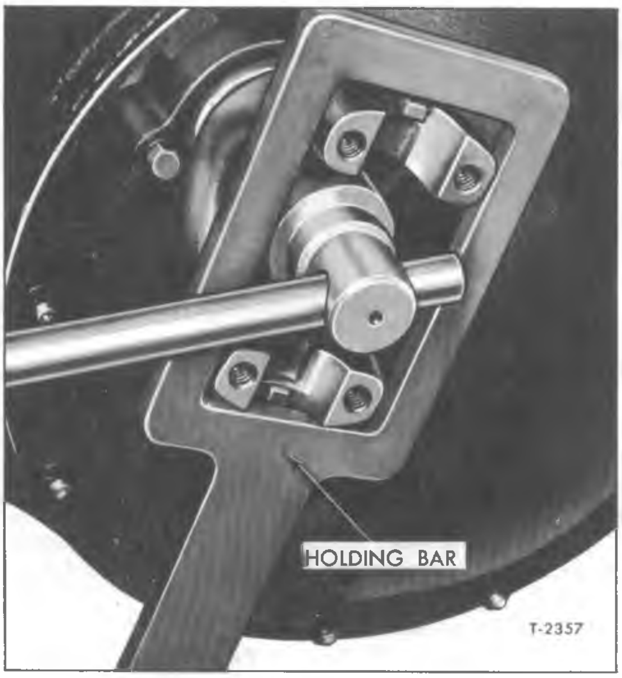


Figure 2—Propeller Shaft Yoke Holding Bar

(fig. 2) while removing yoke retaining nut and washer.

3. Use suitable puller in manner typically illustrated in figure 3 to remove propeller shaft yoke.

4. On axle where seal and retainer is pressed into carrier, use available removing tool such as

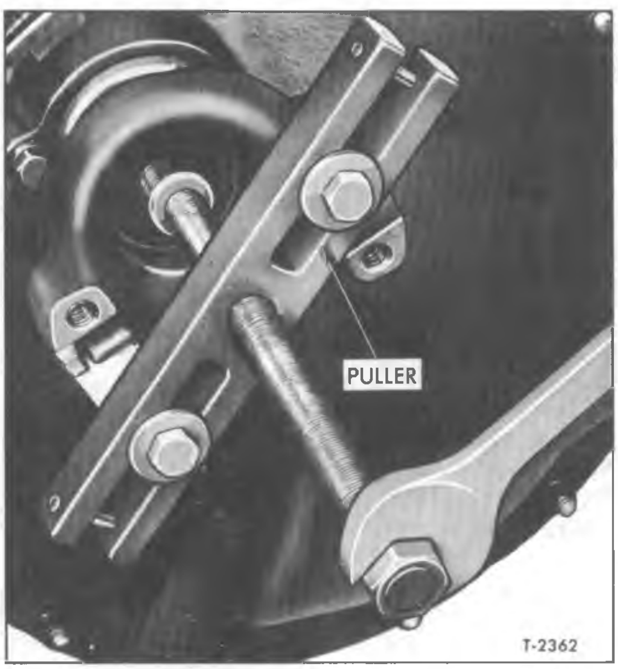


Figure 3—Propeller Shaft Yoke Puller (Typical)

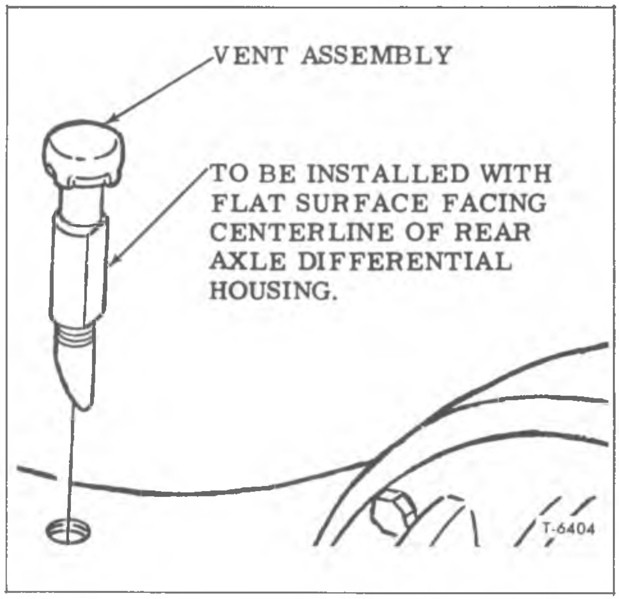


Figure 4—Axle Vent Replacement

punch or pry bar. Remove flat washer from counterbore in carrier.

5. On axles where seal and retainer assembly are attached to carrier by cap screws, remove screws and washers, then lift assembly from carrier.

NOTE: Some axles also have a cork seal installed in a groove in pinion cage, which should be replaced.

INSTALLATION

1. Before installing new seal, be sure that differential carrier is cleaned of all deposits, such as oil, dirt, etc.

2. On axles where seal and retainer is pressed into carrier, install flat washer in carrier, then install strip sealer around carrier counterbore and against washer.

3. Coat outer surface of seal retainer with sealing compound, then position assembly in carrier. Use suitable available tool to press or drive retainer into carrier until seated against flat washer.

4. On axles where seal and retainer assembly is attached to carrier by cap screws, install cork seal in groove or gasket on pinion cage.

NOTE: Be sure that gasket does not cover any oil passage holes in pinion cage.

5. Install oil seal and retainer assembly over pinion and against pinion cage. Secure with cap screws and lock washers, tightened securely.

6. Coat lip of oil seal with axle lubricant, then install propeller shaft yoke, washer, and nut. Hold yoke with holding bar (fig. 2) while tightening nut to recommended torque.

AXLE VENT REPLACEMENT

Service replacement axle housing assemblies are not equipped with an axle vent; therefore, always make sure that a new vent assembly is installed when replacing the housing. If axle vent requires replacement, pry old vent from housing being sure that entire vent is removed. Prickpunch around carrier hole to ensure fit of replacement vent. Tap new vent into housing using a hammer. Vent should be positioned in housing so that flat surface is toward center line of differential (fig. 4).

GENERAL MAINTENANCE ON VEHICLE

At regular intervals, the following lubrication, inspection, and maintenance procedures should be accomplished and corrective measures taken whenever necessary.

REAR AXLE LUBRICATION

CHECKING LEVEL

Remove filler plug and if necessary, add sufficient lubricant to bring the level up to filler plug level. Install and tighten plug. On the forward rear axle with torque divider, be sure that vehicle has stood for at least 5 minutes before checking level, then check level AT REAR FILLER HOLE.

DRAINING AND FILLING

When axle is new, or after overhaul, it is recommended that lubricant be drained after the first 3,000 miles of operation, and thereafter at recommended intervals. Draining at an early mileage removes fine particles of metal or other foreign material.

At specified intervals remove plug at bottom of axle housing, also at bottom of torque divider or inter-axle differential housing on tandem bevel axles. Drain when unit is hot, preferably immediately after operation. Reinstall drain plugs.

Fill axle to level of filler plug opening. On tandem axles with torque divider, add specified quantity through filler plug on side of case or add two pints of lubricant at top of inter-axle differential housing.

SPECIAL AXLE LUBRICATION

Special lubrication is required on all axles as follows: (1) when axle has not been operated for a long period (2) has been out of normal position or (3) after overhaul.

Add one pint of lubricant through plug opening in top of pinion cage or differential carrier. Recheck lubricant level at filler plug.

Examine housing cover, pinion oil seal retainers, and axle shaft flanges for lubricant leaks. Tighten bolts or nuts, or replace gaskets and seals as necessary to correct leaks.

Lubrication intervals, also type of lubricant and capacities for all axles are covered in LUBRICATION (SEC. 0) of this manual.

MOUNTING

Check for axle misalignment. Select a point at one side of vehicle and a corresponding point at opposite side. Measure distances between points selected and identical points at each end of axle assembly. If distances are not equal, axle misalignment is indicated and rear spring should be checked for correct installation.

Refer to "REAR SPRINGS" (SEC. 4B) of this manual for spring U-bolt tightening instructions, also for torque rod inspection and maintenance.

AXLE SHAFT FLANGE MOUNTING

Axle shaft flanges are retained to hubs by hub caps or stud nuts and dowels.

1. Check tightness of stud nuts at regular intervals. Tighten ½" nuts to 50-60 foot-pounds torque, or 5/8" nuts to 90-110 foot-pounds torque.
2. The studs must be straight and dowels of correct taper must be used. There should always be a slight clearance between nuts and driving flange when nuts are drawn up (fig. 1). No clearance at this point indicates excessive wear at the studs, dowels, or holes in flange. Replacement of worn parts is the only remedy.
3. If stud nuts are not tightened to torque specified, play between flange and studs will cause bent or broken studs, also worn tapered holes in flange of axle shaft.

BENT HOUSING CHECK

A check for bent axle housing can be made with unit in vehicle in following manner; however, conventional alignment instruments can be used if available:

1. Raise rear axle with a jack until wheels clear floor. Block up axle under each spring seat.
2. Check wheel bearing adjustment and adjust if necessary, then check wheels for looseness and tighten wheel nuts if necessary. Refer to "REAR HUBS AND BEARINGS" (SEC. 4C) of this manual.
3. Place a chalk mark on outer side wall of tires at bottom. Measure across tires at chalk marks with a toe-in gauge.
4. Turn wheels half-way around so that chalk marks are positioned at top of wheel. Measure

across tires again. If measurement at top is 1/8" or more smaller than previous measurement noted at bottom of wheels, axle housing has sagged and is bent. If measurement at top exceeds bottom dimension by 1/8", axle housing is bent at ends.

5. Turn chalk marks on both wheels so that marks are level with axle and toward rear of vehicle. Take measurement with toe-in gauge at chalk marks, then turn both chalk marks to front and level with axle and take another measurement. If measurement at front exceeds rear dimension by 1/8" or more, axle is bent to the rear. If the measurement condition is the reverse, the axle is bent forward.

TWO-SPEED AXLE ELECTRIC SHIFT SYSTEM

GENERAL DESCRIPTION AND OPERATION

The electric shift control system consists of a control switch, speedometer adapter, shift units, and interconnecting wiring harness.

CONTROL SWITCH

The control switch, mounted on transmission shift lever consists of a shift button which is positioned by the driver to operate a shift unit at axle. The driver selects the axle ratio by moving control button (fig. 5) to select "LOW" and "HIGH" axle range. Movement of control button completes circuit to one field of shift unit motor when in "HIGH" and to opposite field when in "LOW." Refer to applicable "Wiring Diagrams" booklet.

SHIFT UNIT

The shift unit and automatic switch assembly is mounted on differential carrier (fig. 6). This unit, controlled by the control switch, shifts the axle into "LOW" or "HIGH" range.

When the control switch button is in "HI" range, wiring carries current to one field of the unit motor. The armature and drive screw turn in a clockwise direction and move the nut down (fig. 7).

When the nut has traveled a sufficient distance to wind the torsion spring, a contact bumper on the nut breaks an electrical connection on the automatic switch so that motor is no longer energized and the armature stops rotating. To make sure that the nut cannot travel back on the screw due to vibration, a ball screw detent spring, holds the nut at the end of its travel on the screw.

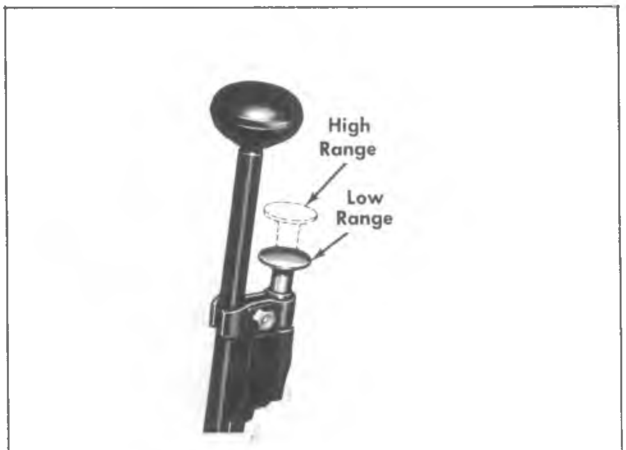


Figure 5—Two-Speed Axle Shift Control (Typical)

The nut moves the spring winding lever down pivoting on winding and actuating lever shaft, winds the torsion spring for high. Thus, an increased load is put on the spring, and in this position the axle is ready to snap into high speed ratio as soon as the load on the axle gears is relieved.

The torsion spring is assembled in the unit so that it is under approximately 50 to 90 pounds pressure, depending upon the size of the axle. When the spring winding lever is moved so that the spring is wound, the pressure of the spring is raised to approximately 90 to 140 pounds, depending upon size of axle.

The additional pressure is used to shift the axle. When the shift is completed, the ends of the spring come together leaving the original tension on the spring. Thus, pre-load tension holds the axle in either selected gear.

When the shift button is in "LO" range, the motor is energized so that the motor armature and drive screw rotate to drive nut in opposite direction for shift into "LOW" range, in the same manner as previously described for "HIGH" range operation.

SPEEDOMETER ADAPTER

The speedometer adapter is mounted to back of speedometer and is electrically connected to control switch. When the control switch button is placed into "LO" range position, an electro-magnet shifts the adapter mechanism to compensate for the difference in gear reduction between "HIGH" and "LOW" range in the axle. When shift button is in "HI" range position, current is released from electro-magnet, and a spring holds the adapter mechanism in "HIGH" range position.

Speedometer adapters used on these vehicles are 12-volt type. Voltage of the unit is stamped on the housing below the wire terminal. Care should be used to select unit of same voltage as vehicle.

WIRING SYSTEM

Reference should be made to optional equipment wiring diagrams in "Wiring Diagrams" booklet. The ignition switch must be on before electric shift mechanism will operate.

A separate circuit breaker in the circuit protects the shift circuit in the event of a short. Refer to applicable "Wiring Diagrams" booklet for circuit breaker connections.

ELECTRIC SHIFT MAINTENANCE AND DIAGNOSIS

The only general maintenance necessary on the shift control system is periodic lubrication of unit. Fill to level of filler plug with "S7" as described in LUBRICATION (SEC. 0) of this manual. The wiring connectors should be kept tight, and wires to the various units should be kept in good condition.

DIAGNOSING TROUBLE

If the electric shift fails to operate properly, the system should be tested and the trouble diagnosed as described in following paragraphs. A test light consisting of a 12-volt bulb with two wires a few feet long with small battery clips on the ends. Refer to Wiring Diagram and test in following sequence:

1. Disconnect two wires from shift unit at rear axle. Place engine control or ignition switch in "ON" position, also place axle shift switch at shift lever in "HI" position.

2. Connect one lead of test light to ribbed wire and opposite lead to ground. One of the following conditions should exist:

a. Should light come on and stay on, the circuit is satisfactory and any trouble will probably be found in the shift unit. Repeat check for "LO" position as directed in Step 3 below.

b. If the light fails to come on, this indicates that the circuit is open between the control switch and the shift unit and further tests will be required.

c. If the light comes on but cycles, this indicates that there is a short between the control or ignition switch and shift unit, and further tests will be required.

3. Remove test light lead from ribbed wire and connect to smooth wire, also place axle shift switch in "LO" position. Observe conditions as outlined in sub-paragraphs above.

4. Connect one lead of test light to control switch side of circuit breaker and opposite lead to ground. Should light come on, and stay on, the circuit is satisfactory. However, if the light fails to come on the circuit between the control switch and circuit breaker is either open or shorted.

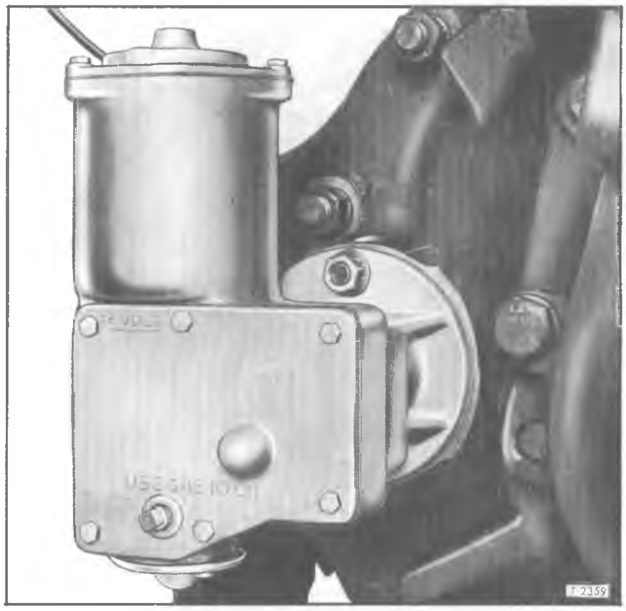


Figure 6—Two-Speed Electric Shift Unit Installed (Eaton Axle Shown)

5. Connect one test lead to load side of circuit breaker and opposite lead to ground. Should light come on, and stay on, the circuit breaker is satisfactory. However, if the light fails to come on the circuit breaker is faulty.

6. At chassis junction, remove both wires, then test circuit through red wire with white stripe. Reconnect both wires to terminal.

7. At chassis junction, remove wire from terminal. Place axle shift lever switch in "LO" position and test circuit.

8. At chassis junction, remove wire from terminal. Place axle shift lever switch in "HI" position and test circuit.

The preceding tests should readily localize any trouble within the system. When checking the wiring harness for shorts or open circuits, examine for broken insulation.

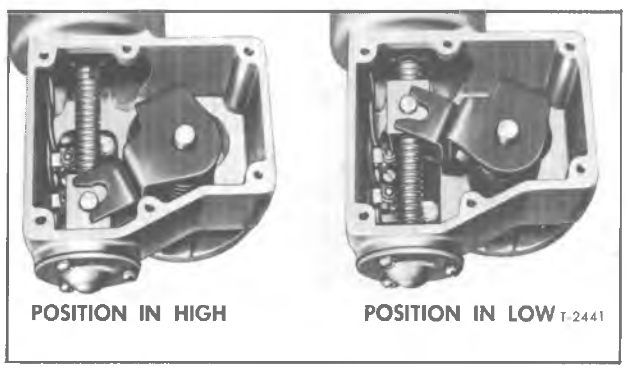


Figure 7—Position of Drive Screw in High and Low Range

Figure 8—Electric Shift Unit Seal Markings

The control or ignition switch can be best tested by substituting a new unit.

If the vehicle shifts normally, but the speedometer adapter fails to operate, make the test to determine whether the adapter is getting current in "LO" range. If current is present, replace the adapter. When the trouble is traced to the shift unit, it should be replaced.

ELECTRIC SHIFT UNIT REPLACEMENT

REMOVAL

1. Remove two shift housing to carrier stud nuts and lock washers (fig. 6).

2. Remove shift unit assembly.

3. Remove lock nuts and the two wires from shift housing. Note that the long or black ribbed wire is attached to the bottom terminal.

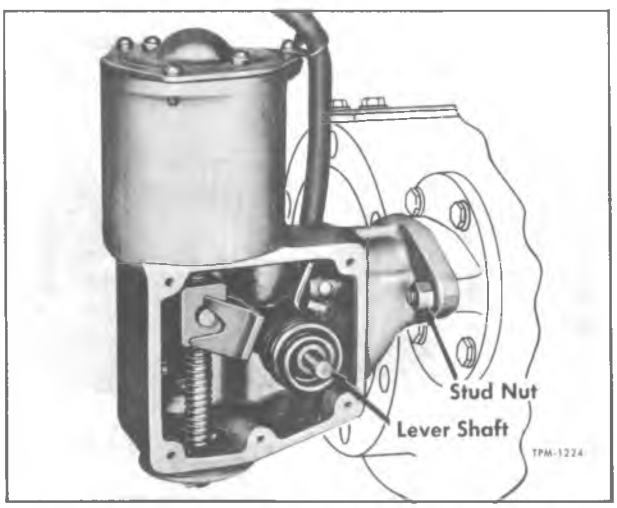


Figure 9—Shift Unit Cover Removed (Rockwell Axles)

INSTALLATION

1. Check condition of rubber seal between shift unit and carrier. Seal must be in good condition to prevent lubricant leaking into shift unit.

NOTE: Seal bears lettering "BOTTOM - FORWARD TANDEM" and "BOTTOM - SINGLE AND REAR TANDEM," as indicated in insert of figure 8. Be sure seal is properly installed.

2. Install wires to outside terminals. The long black ribbed wire is attached to bottom terminal. Harness is clipped to cable clip on housing.

3. With seal between carrier and shift unit in place, install shift unit over carrier studs. Make certain that the swivel block of the shift fork actuating lever fits into the slot in carrier shift fork. Tighten stud nuts firmly.

4. Check installation by making a "LO" and "HI" range shift. Ignition or control switch must be turned on before check can be made.

NOTE: The shift unit motor is designed to be reversible and runs equally well in either direction. If the terminal wires are reversed, the unit will shift to "LOW" when the control switch button is in "HI" position, and will shift to "HIGH" when the button is in "LO" position.

REMOVAL OF ROCKWELL SHIFT UNIT

It is necessary to partially disassemble the Rockwell electric two-speed unit to remove it from axle housing. This may be accomplished in the following manner:

1. Remove five screws from shift unit housing cover (25) (refer to fig. 11), then remove cover. This also drains the lubricant. After cover is removed, note that drive screw nut is either at top or bottom (fig. 7) depending on whether axle is in "HIGH" or "LOW" range position.

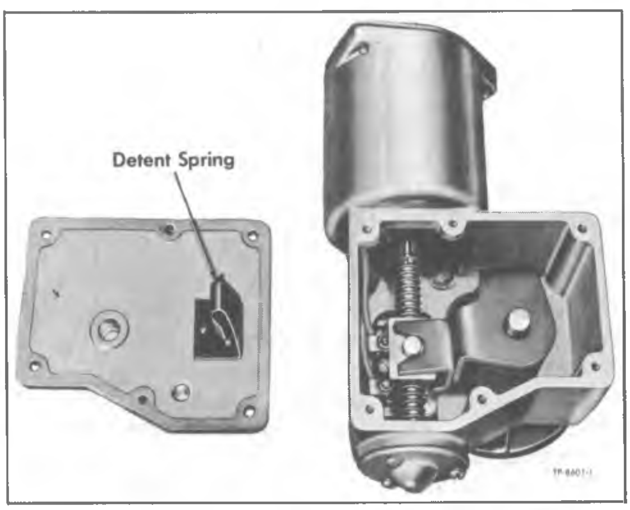


Figure 10—Position of Drive Nut When Disassembling

2. Loosen shift unit-to-differential carrier stud nuts (fig. 9) to remove preload from shift unit spring.

3. Turn drive screw by hand to run nut to mid-way position on drive screw, similar to figure 10. This is necessary to prevent damage to drive nut contact bumper.

4. Pull out lever shaft (fig. 9). Disconnect torsion spring from push rod, then remove spring and spring winding lever.

5. Remove shift unit-to-differential housing stud nuts, then remove shift unit from axle.

6. Remove wire cable clip from shift unit cover. Note to which terminal each wire is attached, then disconnect the two wires from shift unit terminals.

1 Motor Cover to Housing Screw (with Washer)
2 Motor to Cover Nut
3 Motor Cover Cable Clip
4 Motor Cover
5 Motor Cover Gasket
6 Electric Motor
7 Motor Grommet
8 Shift Unit Housing
9 Switch Terminal Nut (outside)
10 Switch Terminal Washer (outside)
11 Switch Terminal Bushing
12 Bearing (with Snap Ring)
13 Bearing Lock Nut
14 Bearing Cover Gasket
15 Bearing Cover
16 Bearing Cover to Housing Screw (with Washer)
17 Automatic Switch Assembly
18 Switch to Housing Screw (inside)
19 Switch Terminal Nut (inside)
20 Drive Screw Assembly
21 Winding and Actuating Lever Shaft
22 Spring Winding Lever
23 Torsion Spring
24 Shift Housing Cover Gasket
25 Shift Housing Cover and Detent Spring
26 Lubricant Plug
27 Housing Cover to Housing Screw (with Washer)
28 Housing to Carrier Seal

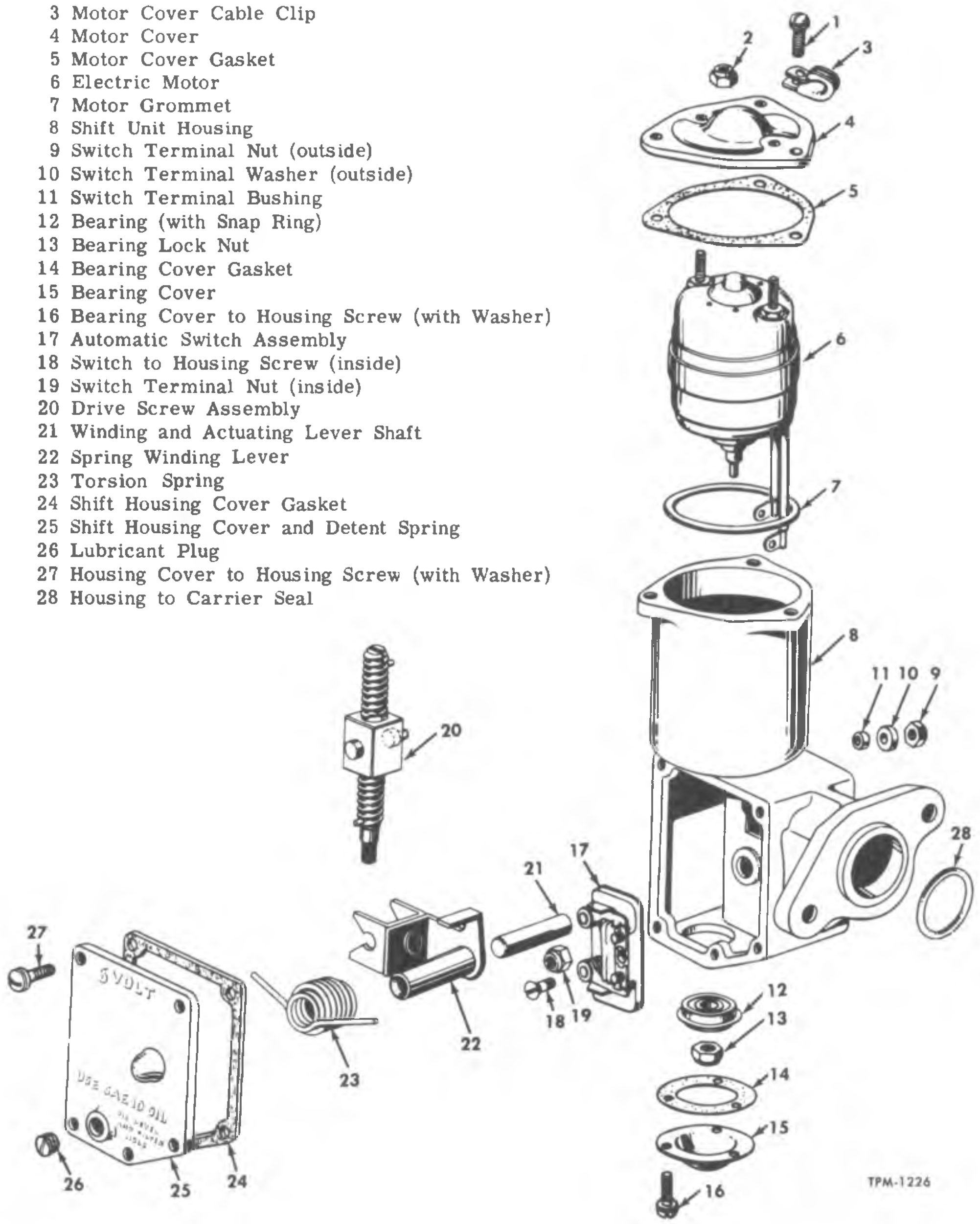


Figure 11—Electric Shift Unit Components (Rockwell)

ELECTRIC SHIFT UNIT OVERHAUL

The following information is provided on the assumption that shift unit has been tested and removed as previously instructed.

DISASSEMBLY (EATON AND CORP.)

Key numbers in text refer to figure 12.

1. Remove six screws (28) and lock washers which attach cover (26) to shift motor housing (8). Drain lubricant from housing. Remove gasket (25).

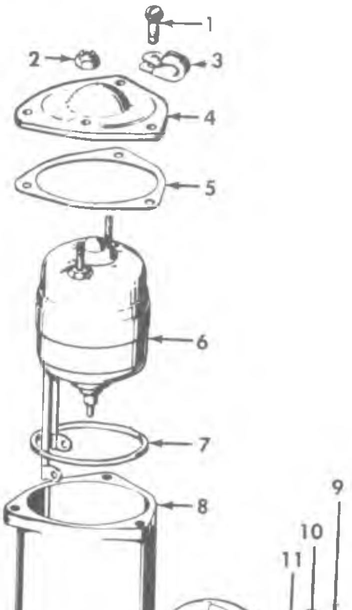
2. After removing cover (26), the drive screw (20) nut will be at either top or bottom depending upon the position in which the control switch was last left.

3. By turning drive screw, run nut from top or bottom to the center of the screw (fig. 11).

IMPORTANT: The previous step is essential to prevent damage to drive nut contact bumper, and is also necessary in assembly.

4. Remove shift fork actuating lever (22), torsion spring (23), and spring winding lever (24) as

1 Motor Cover to Housing Screw (with Washer)
2 Motor to Cover Nut
3 Motor Cover Cable Clip
4 Motor Cover
5 Motor Cover Gasket
6 Electric Motor
7 Motor Grommet
8 Shift Unit Housing
9 Switch Terminal Nut (outside)
10 Switch Terminal Washer (outside)
11 Switch Terminal Bushing
12 Bearing (with snap ring)
13 Bearing Lock Nut
14 Bearing Cover Gasket
15 Bearing Cover
16 Bearing Cover to Housing Screw (With Washer)
17 Automatic Switch Assembly
18 Switch to Housing Screw (inside)
19 Switch Terminal Nut (inside)
20 Drive Screw Assembly
21 Winding and Actuating Lever Shaft
22 Shift Fork Actuating Lever Assembly
23 Torsion Spring
24 Spring Winding Lever Assembly
25 Shift Housing Cover Gasket
26 Shift Housing Cover and Detent Spring
27 Lubricant Plug
28 Housing Cover to Housing Screw (with Washer)



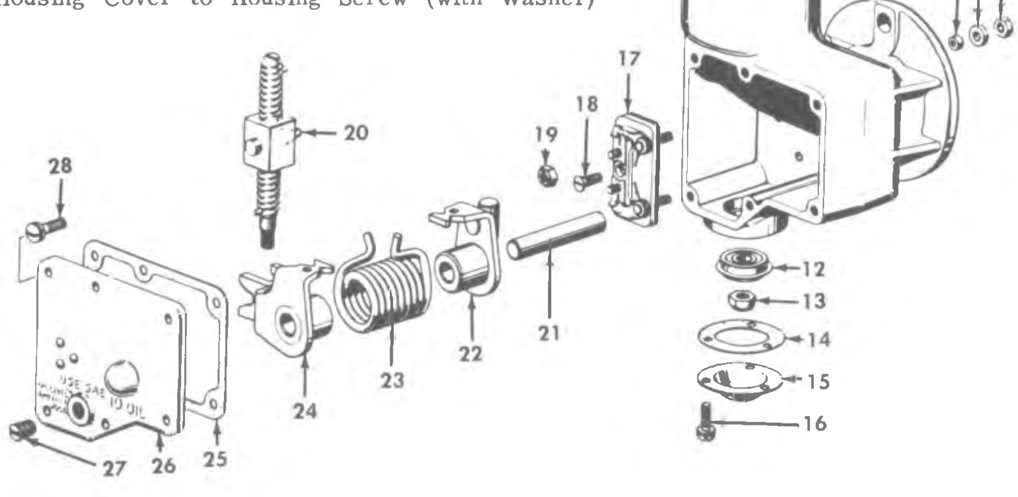


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Figure 12—Electric Shift Motor Unit Components (Eaton and Corporation)

an assembly by pulling shaft (21) up. Swing the assembly away from the drive nut and lift out of the housing (fig. 13).

5. Remove three screws and lock washers (16) which attach bearing cover (15). Remove cover and gasket (14).

6. Push down on drive screw assembly (20) until bearing assembly (12) is free of housing.

7. Insert screwdriver in drive slot of screw (fig. 14), then remove bearing lock nut (13) and bearing with snap ring (12). Drive screw assembly (20) can then be lifted out of housing.

8. Remove the two lock nuts (19) from switch terminals (17). Pull off motor wires (fig. 15).

9. Remove three screws and lock washers (1) which attach motor cover (4) to housing. Pull out motor (6) with cover (4) attached to motor with two cover nuts (2). Remove grommet (7).

10. Remove two jam nuts (9) and fiber washers (10) from outside of housing. On inside remove switch center screw (18). Pull out automatic switch (17).

11. Do not disassemble the shift fork actuating lever (22), torsion spring (23), and spring winding lever (24) unless necessary to replace one of the parts. If necessary to disassemble, mount assembly in vise as shown in figure 16. Turn spring winding lever (24) clockwise and pull to separate.

DISASSEMBLY (ROCKWELL)
(Refer to Fig. 9)

1. Remove three screws and lock washers (16) which attach bearing cover (15) to bottom of shift unit housing. Remove cover and gasket (14).

2. Push down on drive screw assembly (20) until bearing assembly (12) is free of housing.

3. Insert screwdriver in drive slot of screw (fig. 14), then remove bearing lock nut (13) and bearing with snap ring (12). Drive screw assembly (20) can then be lifted out housing.

4. Remove the two lock nuts (19) from switch terminals (17). Pull off motor wires (fig. 15).

5. Remove three screws and lock washers (1) which attach motor cover (4) to housing. Pull out motor (6) with cover (4) attached to motor, with two cover nuts (2). Grommet (7) can then be removed.

6. Remove two jam nuts (9) and fiber washers (10) from outside of housing. On inside remove switch to housing screws (18). Remove automatic switch.

7. Do not disassemble torsion spring (23), and spring winding lever (22) unless necessary to replace one of the parts. If necessary to disassemble, mount assembly in vise as shown in figure 17. Place a short piece of rod in hub of spring winding lever as a safety factor to prevent injury should torsion spring slip out of control. Next, place two lengths of tubing over ends of spring, pull spring

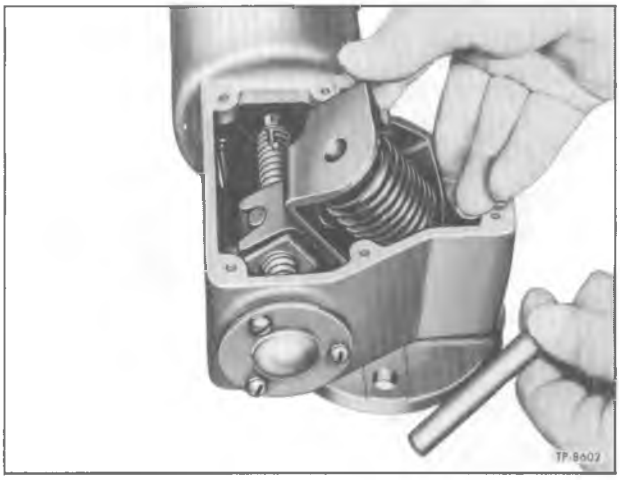


Figure 13—Removing Shaft, Actuating Lever, and Spring

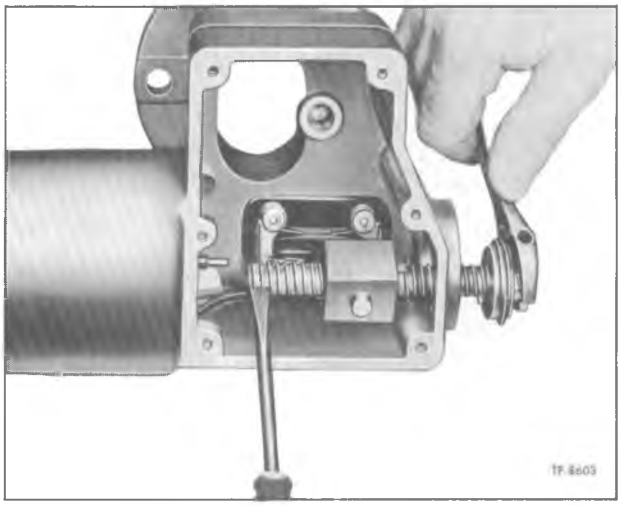


Figure 14—Removing Drive Screw Bearing

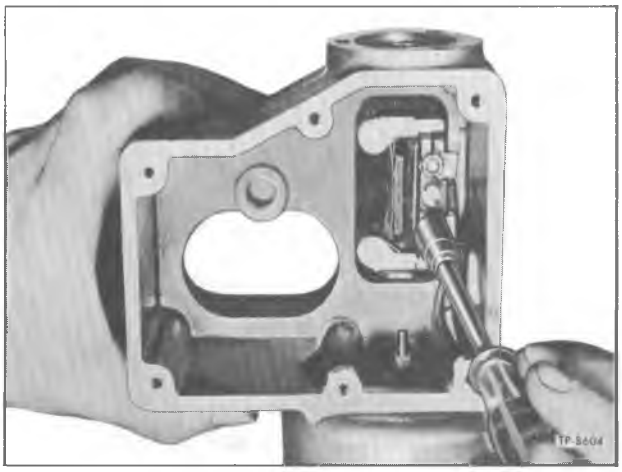


Figure 15—Removing Motor Wires

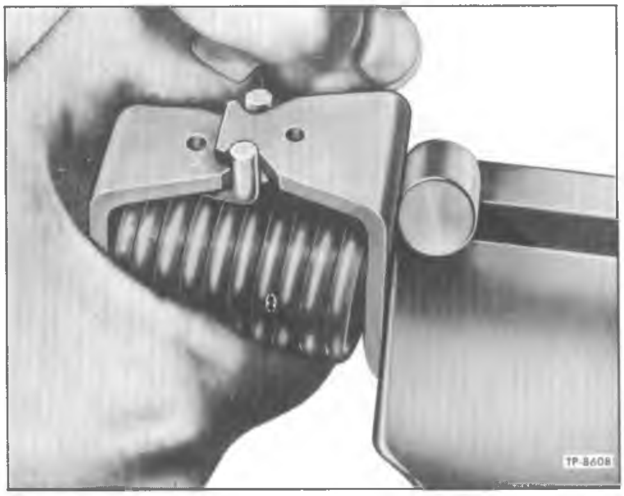


Figure 16—Disassembling Torsion Spring From Lever

ends apart, then raise spring above spring winding lever (fig. 18). To assemble, reverse the preceding procedure.

CLEANING AND INSPECTION

Clean all parts except motor in cleaning solvent. Inspect as follows:

Automatic Switch

The switch assembly is serviced only as an assembly. The switch should have clean free moving points which close firmly under spring tension.

Drive Screw

The drive screw assembly is serviced only as an assembly. While holding the nut, rotate the screw from one end to the other. It should rotate freely. When the nut gets to either end of the screw,

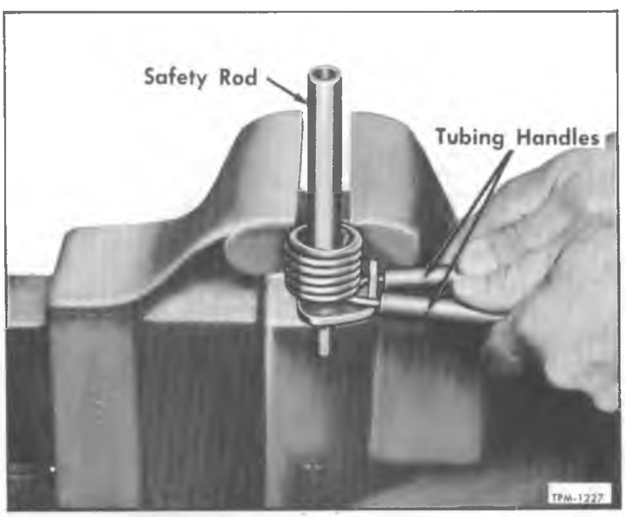


Figure 17—Removing Torsion Spring (Rockwell)

the screw should continue to turn, but the nut should not jam or run off the ends.

Electric Motor

The motor (serviced only as an assembly) is reversible. With the motor housing connected to one battery terminal, and either one of the two motor wires connected to the other battery terminal the motor will run in one direction. With the other motor wire connected to the battery, motor will run in the opposite direction.

The motor has a stall torque of approximately 6 inch-pounds. Clamp a small crescent wrench on the rectangular drive on the armature shaft. Place motor in vise, and grasp wrench handle with one hand. Connect one motor wire to a battery terminal and connect motor housing to the other battery terminal. The wrench should tend to turn with a torque of about 6 inch-pounds. Allow wrench to turn VERY SLOWLY, making sure that this pull or torque is present the FULL 360 degrees turn of the wrench. If one armature is burned out, the torque will disappear for a small part of the 360 degrees. Do not overheat the motor while making test. Motor must be replaced as an assembly, and is lubricated for life of motor. The motor used is 12-volt type which is the same as truck electrical system. When installing a new motor use care to select motor of proper voltage. Voltage is stamped on motor housing and on side cover of shift unit.

Miscellaneous Parts

Gaskets should be replaced at assembly.

Inspect bearing. If balls are rough or chipped, replace with new bearing and snap ring assembly. Pack bearing assembly with clean grease (Chassis Grease) - Symbol "C" in LUBRICATION (SEC. 0) of this manual.

Inspect torsion spring (23, figs. 9 and 12) for breaks or wear at lever contact points. Make certain that correct replacement spring is used.

ASSEMBLY (EATON AND CORP.)

Key numbers in text refer to figure 12.

1. Install automatic switch assembly (17) into housing. Use flat head screw (18) to attach switch to housing. On outside of housing, install two bushings (11), fiber washers (10), and jam nuts (9) over switch terminal screws. Tighten nuts firmly.

2. Install motor assembly grommet (7), then install gasket (5) on housing. Install motor (6) and cover (4) into housing. Install three screws and lock washers (1) and two stop nuts (2). Install motor cover cable clip (3) under outer screw. Tighten screws and nuts firmly.

3. Attach motor wires to switch terminals.

The red or longer wire attaches to bottom terminal. Tighten inside terminal nuts (19) firmly.

4. With a screwdriver inserted into slot of drive screw (20), install bearing (12) on end of screw with shielded side of bearing toward inside. Retain bearing with bearing lock nut (13).

5. Run nut to center of screw, then insert slotted end of screw into housing, meshing slotted end with armature shaft.

NOTE: Fiber bumper contacts on drive nut must be toward switch.

6. Install gasket (14) and cover (15) with three screws and lock washers (16). Tighten screws firmly.

7. If the assembly consisting of shift fork actuating lever (22), torsion spring (23), and spring winding lever (24) has been separated, reassemble. With shift fork actuating lever (22) in vise, assemble parts as shown in figure 19. Turn the spring winding lever (24) with one end of spring, in clockwise direction until end of spring is past shift fork actuating lever; then push in on assembly until positioned as shown in figure 16.

8. Dip above assembly in lubricant. With drive nut on drive screw assembly in center of screw, and fiber contact bumper down toward switch, position the slots of winding lever over the drive nut. Install the shaft (21) through center of the assembly into depression in housing.

9. Install new gasket (25) on housing. Install cover (26) with spring detent against drive nut. Retain cover with screws and lock washers (28).

10. Remove oil plug (27). With unit standing with motor up, lubricate in accordance with instructions given in LUBRICATION (SEC. 0). Reinstall plug and tighten firmly.

ASSEMBLY (ROCKWELL)

Key numbers in text refer to figure 11.

1. Install automatic switch assembly (17) into housing. Use flat head screw (18) to attach switch to housing. On outside of housing, install two bushings (11), fiber washers (10), and jam nuts (9) over switch terminal screws. Tighten nuts firmly.

2. Install motor assembly grommet (7), then install gasket (5) on housing. Install motor (6) and cover (4) into housing. Install three screws and lock washers (1) and two stop nuts (2). Install motor cover cable clip (3) under outer screw. Tighten screws and nuts firmly.

3. Attach motor wires to switch terminals. The red or longer wire attaches to bottom terminal. Tighten inside terminal nuts (19) firmly.

4. With a screwdriver inserted into slot of drive screw (20), install bearing (12) on end of screw with shielded side of bearing toward inside. Retain bearing with bearing lock nut (13).

5. Run nut to center of screw, then insert slotted end of screw into housing, meshing slotted end with armature shaft.

NOTE: Fiber bumper contact on drive nut must be toward switch.

6. Install gasket (14) and cover (15) with three screws and lock washers (16). Tighten screws firmly.

NOTE: Remainder of assembly of shift unit used on Rockwell axles must be completed when unit is installed on housing as described previously in the section under "Two-Speed Shift Unit Replacement."

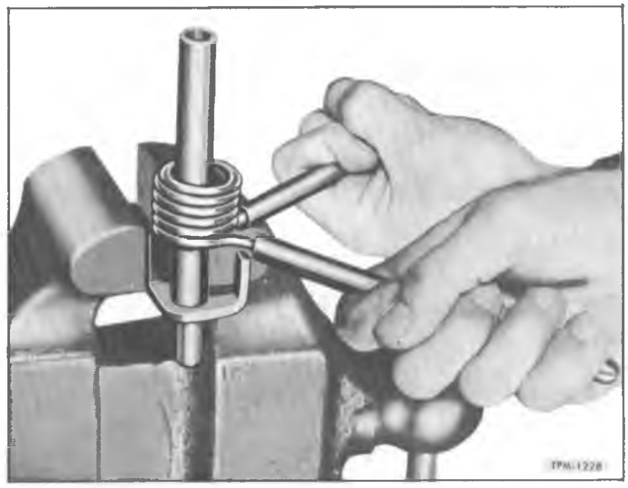


Figure 18—Removing Torsion Spring (Rockwell)

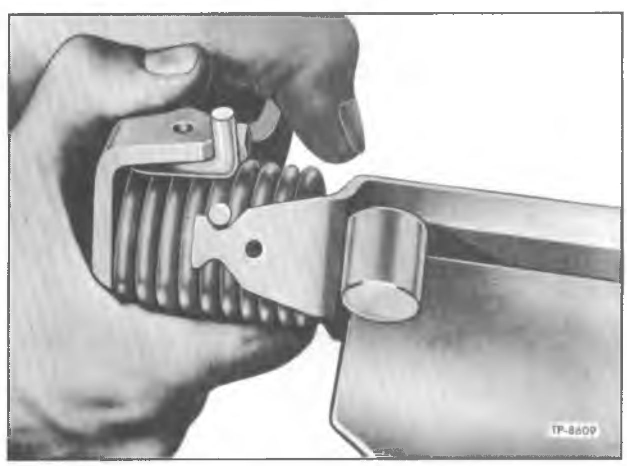


Figure 19—Assembling Torsion Spring and Levers (Eaton)

TWO-SPEED AXLE VACUUM SHIFT SYSTEM

DESCRIPTION AND OPERATION

Vacuum operated power shift system is used on some vehicle equipped with 2-speed rear axle. A typical system arrangement is shown in figure 20.

Vacuum power shift system utilizes engine intake manifold vacuum and atmospheric pressure for its operation. Units used in vacuum power shift system are: Control Button, located on gearshift lever; Control Valve, mounted on frame side rail at left-hand side; Vacuum Check Valve, installed in vacuum line at dash junction; Speedometer Adapter and Adapter Shift Diaphragm, mounted at speedometer head under instrument panel; Rear Axle Power Shift Chamber, mounted on differential carrier; and interconnecting vacuum lines and fittings.

LOW SPEED

With shift control button in "LO" position, control valve opens one side of shift chamber at rear axle to vacuum and opposite side to atmosphere. In "LO" speed position, vacuum is supplied to speedometer adapter causing rod to move inward shifting speedometer into low ratio.

HIGH SPEED

With shift control button on gearshift lever up, in "HI" position, rear axle power shift chamber is subjected to vacuum through the control valve. With vacuum present on one side of the shift chamber diaphragm, the atmospheric pressure on the opposite side of the diaphragm forces the diaphragm to move toward the vacuum side. Movement of the diaphragm is transmitted to the rear axle sliding clutch shift fork through the shift rod, and the axle gears are shifted into high speed. At the same time, vacuum is removed from the speedometer adapter causing the spring to move the diaphragm and rod, shifting speedometer into high speed.

SHIFTING

When shifting from "LO" to "HI" the operator pulls on control button, which is attached to valve through a cable. This raises the cable trunnion and operating lever up as shown in figure 21. The tension springs are therefore moved "over center" causing poppet lever to rotate, lifting one poppet valve and lowering the opposite valve.

When shifting from "HI" to "LO" the operator presses on control button. This moves the cable trunnion and operating lever downward as shown in figure 21. The tension springs are therefore moved "over center" causing poppet lever to rotate, lifting one poppet valve and lowering the opposite valve.

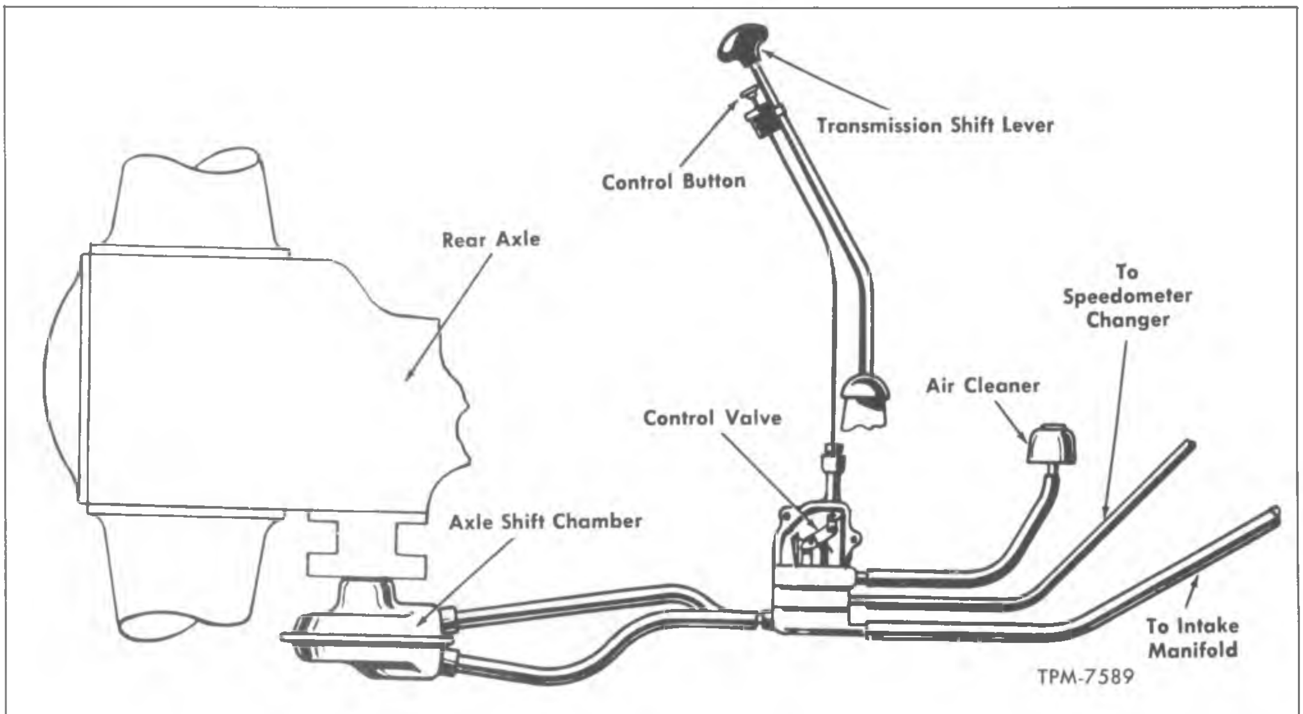
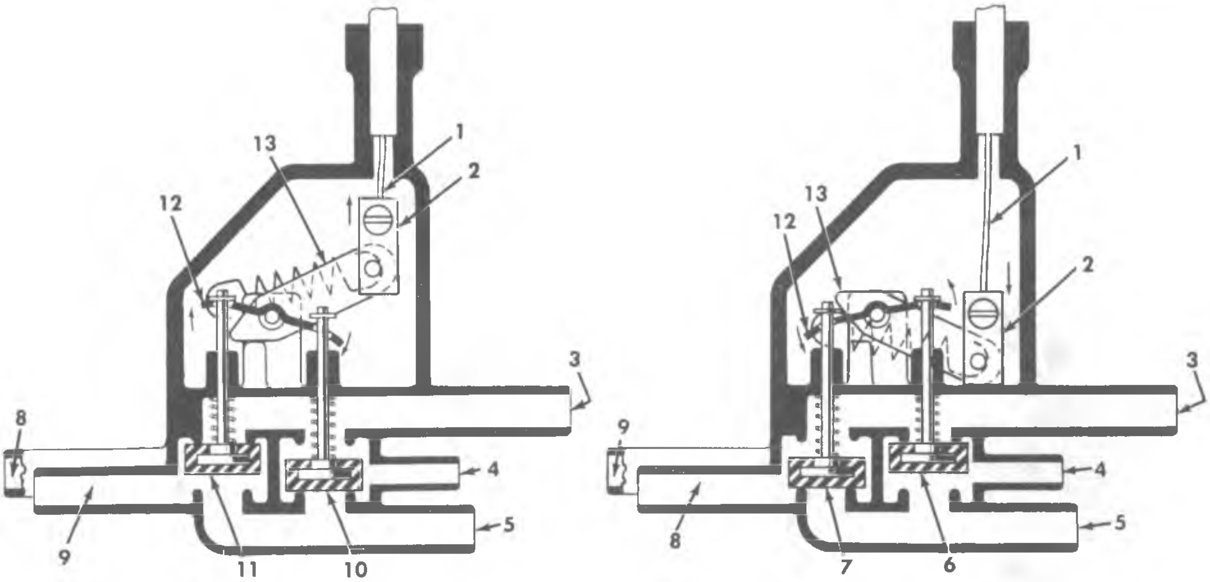


Figure 20—Arrangement of Two-Speed Axle Vacuum Control Units (Typical)



HIGH AXLE POSITION

LOW AXLE POSITION

1 Control Cable
2 Cable Trunnion
3 Atmosphere Port
4 Speedometer Shift Port
5 Vacuum Port
6 Atmosphere Closed - Vacuum Open
7 Atmosphere Open - Vacuum Closed
8 Atmosphere Open to Axle
9 Vacuum Open to Axle
10 Atmosphere Open - Vacuum Closed
11 Atmosphere Closed - Vacuum Open
12 Poppet Lever
13 Operating Lever

TPM-7591

Figure 21—Operating Positions of Vacuum Shift Control Units

VACUUM SHIFT SYSTEM MAINTENANCE

All lines and units in vacuum power shift system must be kept free of vacuum leaks. When vacuum leaks exist, rear axle shift mechanism will operate sluggish and in some instances may not shift axle. If this condition exists make tests to determine location of leaks.

VACUUM LEAKAGE TEST

1. Disconnect flexible lines one at a time, at axle shift chamber and insert a vacuum gauge in line, using a "Tee" fitting.

2. Start engine and place axle shift button in "HI" or "LO" depending upon location of vacuum gauge. Run engine long enough to obtain maximum vacuum, then stop engine and note rate of vacuum drop on gauge. If drop exceeds 1 inch to 10 minutes, leakage is excessive.

3. If leakage is indicated, coat all vacuum line connections with hydraulic brake fluid. If leak exists, fluid will be drawn into connection with engine idling and control lever in "LOCK" position.

4. Remove line having leaking connection. Slide tube nut back on tube and remove all particles of seal ring from tube and from inside of nut. Slip new seal ring over tube end. Insert tube into fitting and seat solidly. Slide seal ring (do not roll) into fitting (fig. 22). Thread tube nut into fitting and tighten slowly and firmly.

5. Repeat above test on opposite vacuum line, being sure to change shift button.

6. If vacuum drop is still excessive after all connections have been checked, leakage in one of the units is indicated. Remove each unit and overhaul or replace as required.

AIR CLEANER

Air cleaner removes dirt particles from atmosphere which passes into the control valve and other units. Air cleaner should be removed and cleaned at regular intervals.

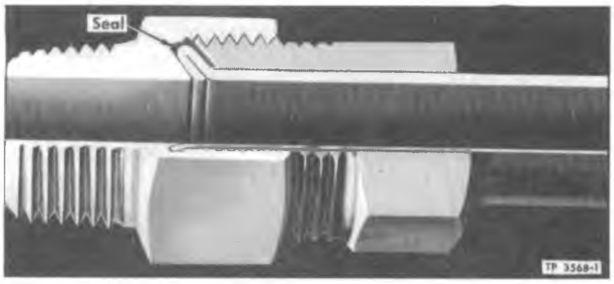
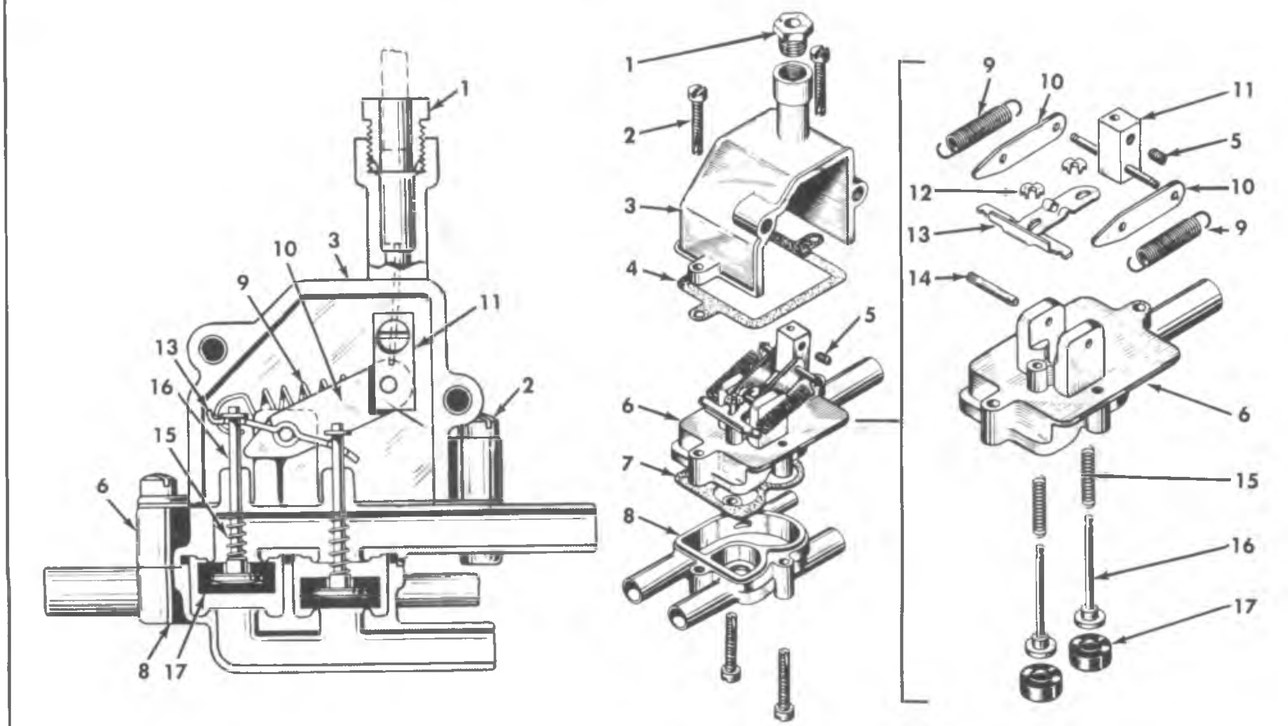


Figure 22—Vacuum Tubing Connection Seal



1 Compression Nut	7 Body Gasket	13 Poppet Lever
2 Screw	8 Lower Valve Body	14 Pivot Pins
3 Valve Cover	9 Tension Spring	15 Poppet Spring
4 Cover Gasket	10 Operating Lever	16 Poppet Stem
5 Trunnion Screw	11 Trunnion	17 Poppet (Valve)
6 Valve Body	12 Retaining Washer	TPM-7590

Figure 23—Sectional and Disassembled Views of Vacuum Control Valve

VACUUM SHIFT CONTROL VALVE

Control valve (fig. 23) requires very little maintenance, unless cleaning of air cleaner has been neglected and valve has become contaminated as a result of neglect. However, should tests indicate that valve is faulty it should be repaired or replaced.

REMOVAL

1. Remove manifold to valve vacuum line, air cleaner line, and speedometer shift line from respective valve ports.
2. Remove two axle shift chamber lines from valve ports.
3. Loosen cable clamp nut at top of valve.
4. Remove two mounting screws, separate valve from mounting surface, and loosen cable trunnion screw.
5. Remove valve from control cable.

DISASSEMBLY (Fig. 23)

1. Remove four screws, and separate cover, cover gasket, valve body assembly, body gasket, and lower body.
2. Remove two tension springs from ends of poppet lever and trunnion pin.
3. Remove two retaining washers, poppet springs and poppet valve assemblies from valve body. Remove discs from valve stems.

INSPECTION

1. Check poppet valve seats in valve body and lower valve body for evidence of nicks or scratches which may cause vacuum leak.
2. Inspect poppet levers, springs, operating levers, trunnion pin, and pivot pin for wear or other damage.
3. Inspect poppet discs and replace if not in new condition, since these items are included in a repair kit.

ASSEMBLY (Fig. 23)

During assembly operations apply a light film of Lubriplate, or equivalent, to all friction surfaces.

1. Place rounded end of operating levers over ends of pin in cable trunnion.

2. Align poppet lever between holes at pointed end of operating levers, and align to valve body.

NOTE: Be sure parts are assembled with trunnion pin off-center toward operating levers. Install pivot pins, driving pin in until ends are flush with valve body.

3. Install new poppet discs to ends of poppet stems. Install poppet springs.

4. Install poppet valve stems through holes in body and through elongated holes in poppet lever. Install new retaining washers.

5. Install tension springs. One end of spring attaches to trunnion pin and opposite end to notch in poppet lever arm.

NOTE: Test operation of valve by moving trunnion up and down several times by hand, while noting if "over center" action of the tension springs cause poppets to operate freely and without binding.

6. Install new gasket to lower valve body and align body with valve body.

7. Hold these two parts in place while positioning new gasket and valve cover to top of valve body. Install and tighten four screws.

BENCH TEST

The following test will determine if the valve has been correctly assembled and is operating properly without serious vacuum leakage.

1. Attach vacuum source to vacuum port and install a shut-off valve in line.

2. Attach a vacuum line to each of the valve ports leading to axle shift chamber. Each line should have a vacuum gauge.

3. Supply 20 inches of mercury vacuum to valve with valve trunnion in "up" position. One gauge should read 20 inches of mercury and opposite gauge should read zero.

4. Push valve trunnion down and close speedometer adapter outlet port. Reading on vacuum gauges will now be opposite to previous reading.

5. Check "snap over" position of cable trunnion, which should occur when trunnion is not less than 1/8" from valve body in each direction.

6. Whenever tests outlined in previous paragraphs indicate that leakage is greater than 1 inch in 15 seconds, the valve must be inspected for faulty seats.

INSTALLATION

1. At cable button clamping bracket, loosen cable jacket clamp nut allowing cable to turn freely.

2. Insert cable into hole at top of valve cover and insert cable into hole in cable trunnion. Install and tighten cable securely, using trunnion screw.

3. Mount valve in the original location using mounting screws. Tighten cover tube nut.

4. Attach intake manifold, air cleaner, speedometer shifter adapter, and shift chamber lines to valve in their original location.

5. With cable button pushed down, position operating button bracket to shift lever so that clearance exists between bottom of button and bracket.

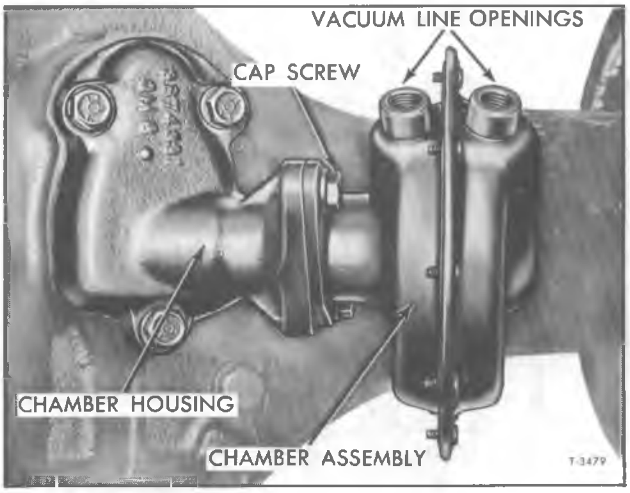


Figure 24—Two-Speed Axle Vacuum Shift Chamber Installed (Corporation Axle)

SHIFT CHAMBER (CORP. AXLE)

REMOVAL (Fig. 24)

1. Remove hose clamps, then remove vacuum hose from cylinder. Tag each hose so that it will be replaced in proper position.

2. Remove three bolts and lock washers attaching cylinder to differential carrier, then remove cylinder and housing assembly.

DISASSEMBLY (Fig. 25)

1. Remove screws attaching two halves of cylinder to each other, then separate two halves.

2. Using two wrenches, remove outer push rod nut, then separate push rod from diaphragm.

3. Push piston rod in to relieve spring load, then remove snap ring from inside of piston rod. Pull push rod and spring assembly from piston rod.

4. Should inspection indicate necessity, oil seal can be removed from housing at this time.

ASSEMBLY (Fig. 25)

1. Install washer, long spacer, spring, washer, snap spring, short spacer, and nut on push rod.

2. Tighten adjusting nut until dimension over washers at each end is 2-27/32" (fig. 26). Install and tighten lock nut, being careful not to change dimension.

3. Lubricate inside of piston rod, then install push rod and spring assembly.

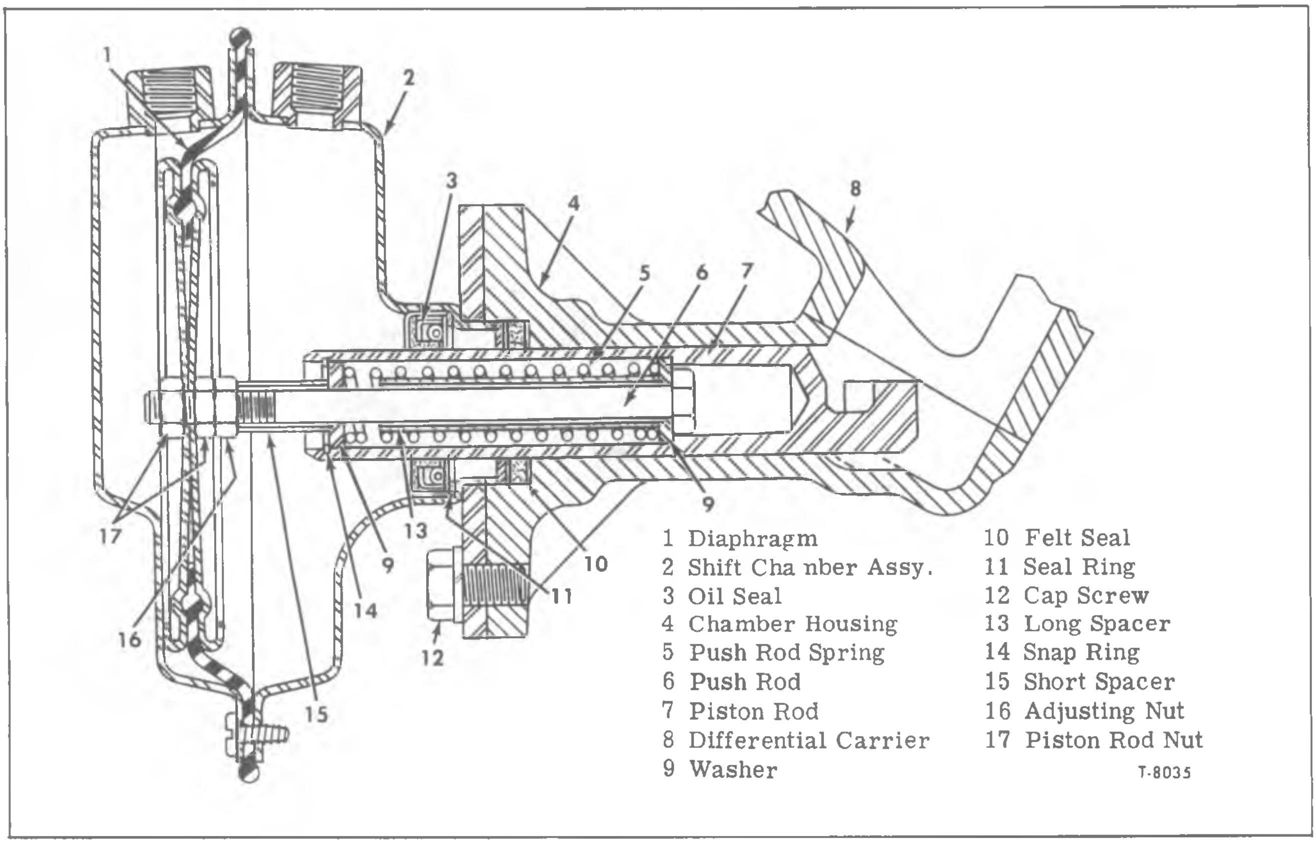


Figure 25—Sectional View of Two-Speed Axle Vacuum Shift Chamber (Corporation Axle)

4. Compress push rod spring and install snap ring.

5. Install push rod assembly in housing.

6. Install new diaphragm and plates to push rod and tighten nut securely.

NOTE: Apply sealing compound around push rod hole in diaphragm plates.

7. Install outer half of cylinder to inner half and secure with screws tightened securely.

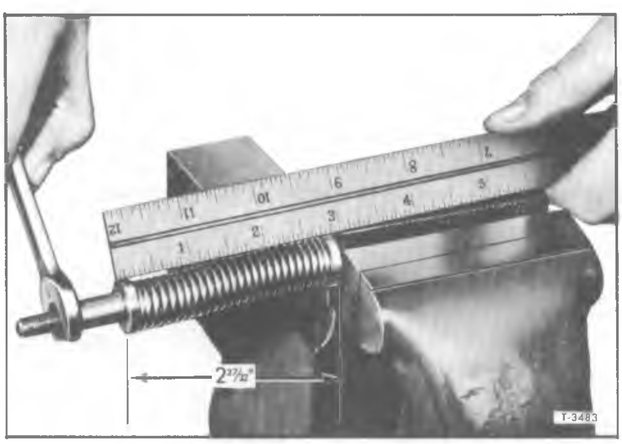


Figure 26—Adjusting Push Rod (Corporation Axle)

8. Attach assembly to differential carrier, using new gasket. Tighten cap screws securely.

9. Attach hoses to cylinder, as tagged previously, being sure connections are tight.

CHECK VALVE

Check valve, in intake manifold line, is used to prevent vacuum loss or drop when engine is accelerated or is pulling under heavy load. Check valve also effectively retards loss of vacuum when engine is stopped. Refer to "HYDRAULIC BRAKES" (SEC. 5A) of this manual for service maintenance information.

AIR CLEANER

An air cleaner is used at atmospheric inlet line to filter air entering control valve and shift units.

MAINTENANCE

At regular intervals remove air cleaner and immerse in cleaning solvent to remove all accumulated dirt or other foreign material. Drain cleaning solvent from element. Reinstall dry.

SPEEDOMETER ADAPTER SHIFT DIAPHRAGM

When shift control lever is moved to "HI" position, cavity behind speedometer adapter shift diaphragm (fig. 27) is subjected to atmosphere through the shift control valve. Spring movement of diaphragm is transmitted to the speedometer adapter lever by the diaphragm rod, shifting the speedometer adapter gears into high ratio. When the control lever is moved to "LO" position, the control valve admits vacuum to the cavity behind the diaphragm and forces diaphragm and rod inward, shifting the speedometer adapter gears into low ratio.

REMOVAL AND DISASSEMBLY

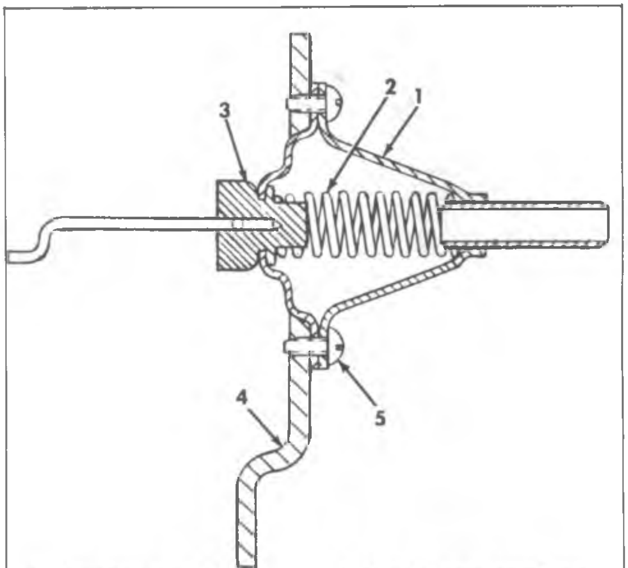
1. Disconnect vacuum line from the shift diaphragm body.
2. Remove two screws attaching diaphragm bracket to speedometer adapter. Lift diaphragm and bracket to unhook diaphragm rod from adapter lever and remove diaphragm and bracket assembly.
3. Remove four screws attaching body to bracket. Remove body, spring and diaphragm and rod assembly from bracket.

INSPECTION

1. Examine diaphragm for cracks or other damage. Replace assembly if diaphragm is damaged.
2. Check condition and tension of diaphragm spring. If spring is corroded or if tension is not sufficient to return diaphragm to release position, replace assembly.

ASSEMBLY AND INSTALLATION

1. Position the diaphragm and rod assembly, spring, and body on diaphragm bracket and attach with four screws. Screws must be tightened sufficiently to make the assembly air-tight with two pounds of air pressure.
2. Position diaphragm and bracket assembly at speedometer adapter, hooking diaphragm rod into adapter lever. Attach diaphragm bracket to adapter with two screws and washers.
3. Connect vacuum line to diaphragm body. Tighten connection firmly.



1 Diaphragm Body
2 Diaphragm Return Spring
3 Diaphragm and Rod Assembly
4 Mounting Bracket
5 Screws TPM-9083

Figure 27—Speedometer Adapter Shift Diaphragm

TWO-SPEED AXLE AIR SHIFT SYSTEM

DESCRIPTION

An air shift control is used optionally in conjunction with the Eaton Model 19201 two-speed axle. Service operations and trouble shooting procedures pertaining to this system are outlined below:

AIR SHIFT SYSTEM TROUBLESHOOTING

(Refer to Figure 28)

If axle will not shift, test system and components as follows:

NOTE: Test lamp voltage must be same as system rated voltage.

CIRCUIT BREAKER CHECK

Disconnect circuit breaker lead wire at terminal (A) and connect test lamp from terminal (A) to ground. Turn on ignition switch and observe test lamp.

1. If lamp lights and stays on, circuit breaker and lead wire are satisfactory.

2. If lamp does not light, check for poor electrical connections or broken lead wire. If lead wire and connections are satisfactory, circuit breaker is faulty.

3. If lamp does not light immediately but then starts to flash (also a faint clicking of the circuit breaker may be heard), the circuit breaker is faulty.

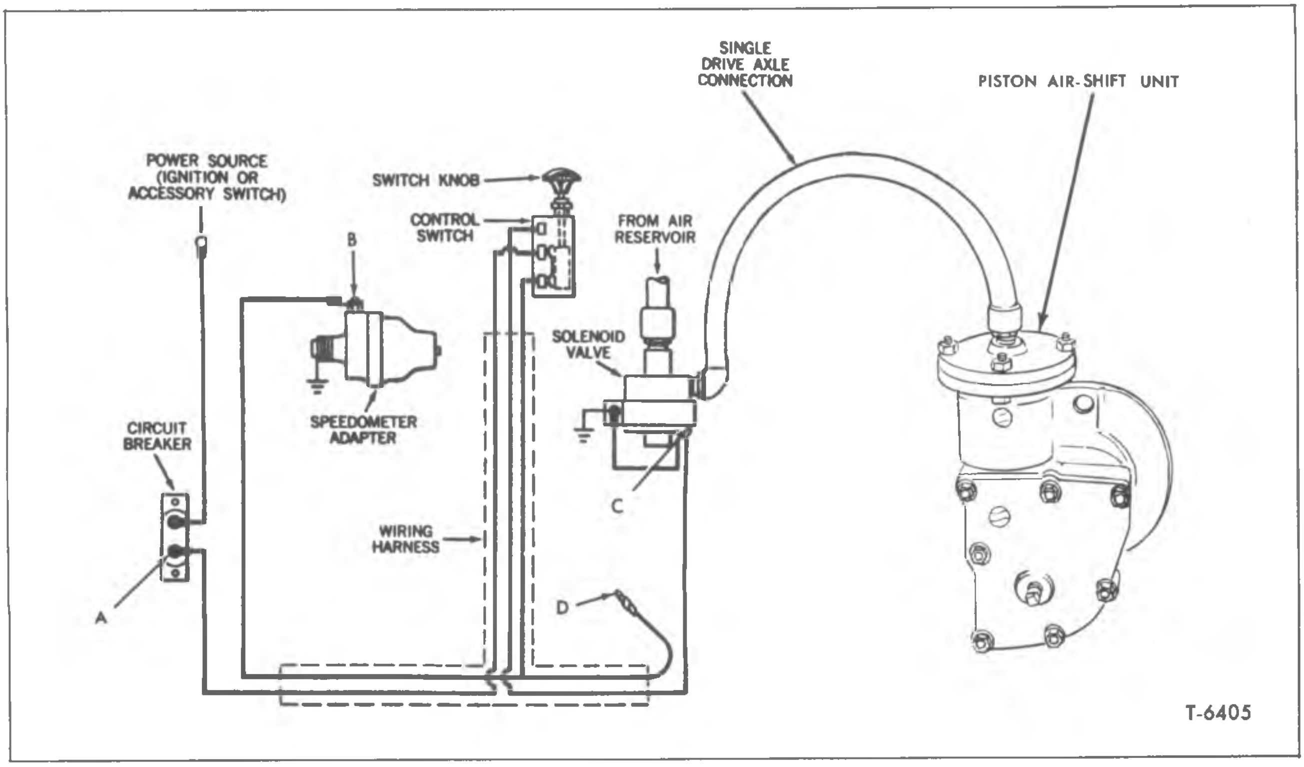


Figure 28—Piston Air Shift System

CONTROL SWITCH AND WIRING HARNESS CHECK

If trouble in control switch or wiring harness is suspected, visually check harness for damaged or worn insulation that could cause a ground connection. Check for accidental grounding of wire terminals to transmission lever. Check for short circuits between wire terminals. Check for poor insulation or accidental ground at end of lead wire (D).

To determine condition of control switch, a new control switch may be temporarily installed. However, if desired, control switch operation may be checked with a test lamp, using the following procedure:

1. Disconnect lead wires at B and C.

2. Turn ignition switch on and alternately connect test lamp leads to disconnected lead wires.

3. Operate control switch and observe test lamp for the following conditions:

a. When test lamp is connected to lead (B), lamp should light in low range position of control switch. Lamp should go out with control switch in high range position.

b. When test lamp is connected to lead (C), lamp should light in high range position of control switch. Lamp should go out with control switch in low range position.

c. If test lamp indications are correct in the preceding tests, current supply to speedometer adapter and solenoid valve is correct.

d. If test lamp does not light, trouble may be a short circuit in wiring harness or control switch. or a wire in harness may be broken. Plug assembly in wiring harness may also be faulty.

SOLENOID VALVE CHECK

The solenoid valve is energized to supply air to shift the unit into high axle range only. The valve must have a good ground connection to vehicle in order to operate satisfactorily. Make certain that ground connection is satisfactory before checking valve.

Disconnect lead wire at C and disconnect air line leading to shift unit. Install air pressure gauge in air line opening in solenoid valve. Apply voltage to solenoid valve terminal and observe pressure gauge reading.

If gauge indication is approximately that of reservoir pressure, solenoid valve is satisfactory. If gauge indication is low or no pressure, solenoid valve is faulty.

PISTON AIR-SHIFT UNIT CHECK

If electrical system is satisfactory and axle does not shift properly, trouble may be caused by a faulty shift unit. Disassemble and repair unit as outlined in this manual.

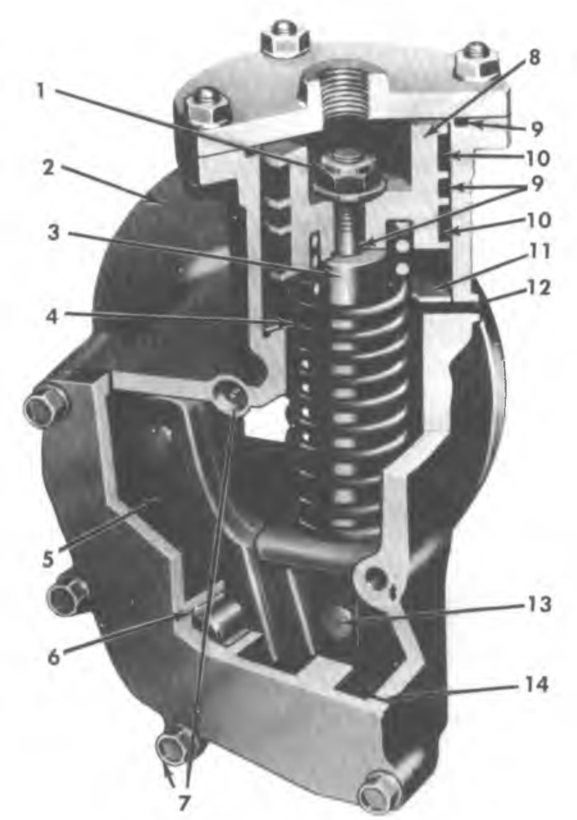


Figure 29—Piston Air Shift Unit Cross Section

SPEEDOMETER ADAPTER CHECK

The speedometer adapter is energized in low axle range only. The adapter is grounded through speedometer mounting or speedometer cable and cable housing. Make certain that proper ground is present before checking adapter.

Disconnect lead wire at B and connect test lamp to lead B and vehicle ground. Turn ignition switch on and observe test lamp.

The test lamp should light in low range position of control switch. Lamp should go out when control switch is in high range position.

If lamp indications are correct, current supply to adapter is correct. If lamp indications are correct and axle shifts properly but speedometer does not operate properly, replace adapter.

If test lamp indications are not correct, trouble is in wiring harness or control switch.

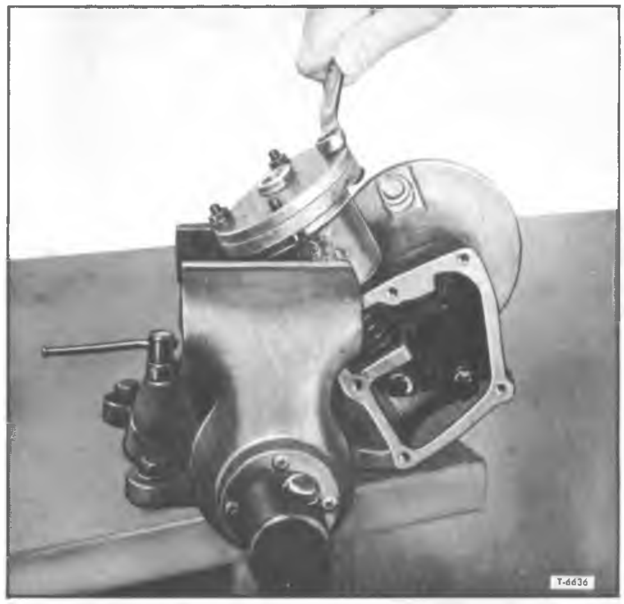


Figure 30—Piston Housing Cover Removal or Installation

PISTON AIR SHIFT UNIT REPAIR

A Piston Air-Shift Unit is used with the 23,000 lb. Eaton Two-Speed Axles (figs 28 and 29). This unit is operated when a supply of air is released into the cylinder. The piston travels downward against a compression spring, transferring motion through the push rod and actuating lever to the shift fork, shifting the axle into "HI" ratio. Exhaust of air pressure from the cylinder permits the piston and spring to return the axle gearing to "LO" ratio.

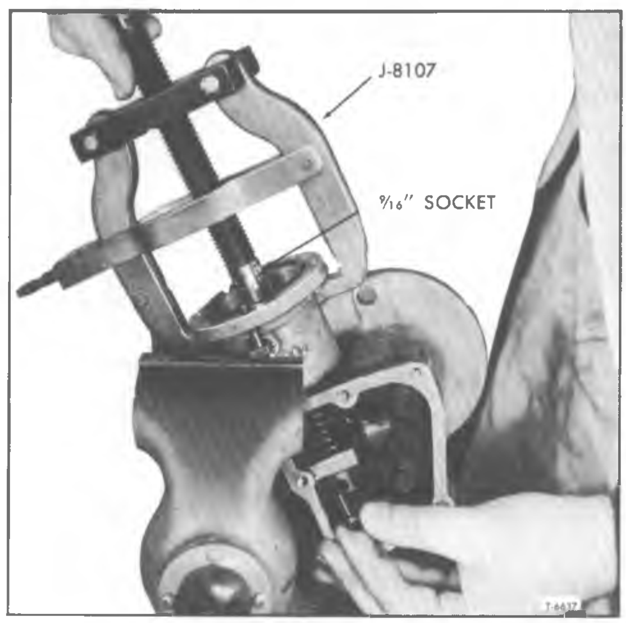


Figure 31—Clevis Pin Removal or Installation

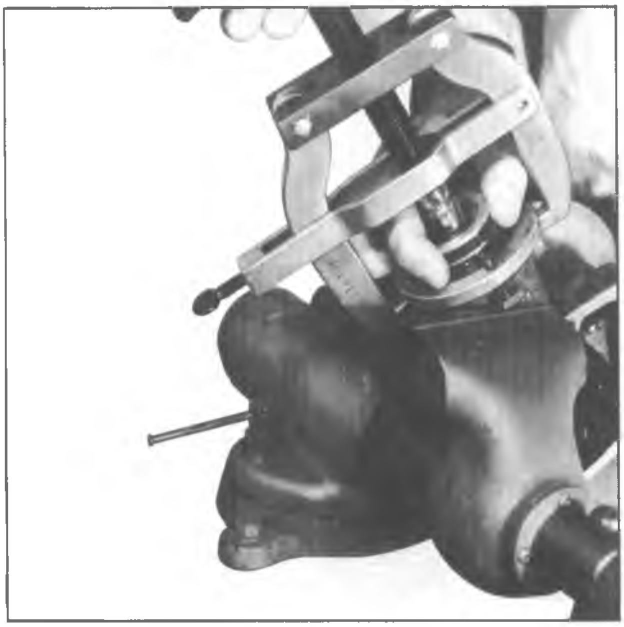


Figure 32—Piston Replacing Tool J-8107

REMOVAL

1. Bleed air from shift unit cylinder and disconnect air line at piston housing cover.
2. Remove two stud nuts retaining shifting unit and pull unit from differential carrier.
3. Remove shift fork seal and spring.

DISASSEMBLY

1. Remove bolts, lock washers, housing cover and gasket from shift unit housing. Drain lubricant.
2. Position housing in vise (refer to fig. 30).
3. Remove nuts and bolts retaining piston housing cover to unit. Remove piston housing cover and O-ring seal, replace seal when cover is removed.
4. Install Tool (J-8107) (fig. 31), over piston bore and clamp onto flange, install a 9/16" socket over self-locking nut and tighten down on tool until tension is relieved on clevis pin. Remove clevis pin (fig. 31).
5. Unscrew Tool (J-8107) until compression spring tension is relieved and remove Tool (fig. 32).
6. Push piston, push rod and compression spring through top of cylinder.
7. Remove actuating lever from housing.

INSPECTION

1. Inspect shift fork seal for good condition and tight fit on shift fork. Check shift fork seal spring for distortion and tension.
2. Inspect housing for cracks and cylinder bore for worn or grooved condition. Check piston stop cushion for worn or cracked condition.
3. Inspect piston for a worn or grooved condition. Check felt wipers for distortion. Felt wipers are oil-soaked to ensure proper lubrication of the cylinder wall. Check O-rings for worn condition.
4. Inspect compression spring for distortion, tension and other visual defects. Check push rod and actuating lever for elongated holes, worn or cracked conditions.
5. Inspect bearing surface on actuating arm for wear.
6. Inspect bushings in both the housing and housing cover for wear.
7. Replace faulty or doubtful parts as required.

REASSEMBLY

1. Soak felt wipers in S.A.E. 30 oil for one hour and install felt wipers, O-ring on piston and O-ring on push rod.
2. Install piston stop cushion in cylinder bore, if removed.
3. Install actuating lever in housing.
4. Install piston and washer on push rod and torque self-locking nut to 135 inch-pounds. Install push rod, spring, and piston into cylinder bore using 9/16" socket on piston self-locking nut and Tool (J-8107) clamp to push piston into bore. Care must be taken to ensure proper fit of felt wipers and O-ring on piston (fig. 32).
5. Install clevis pin at push rod and actuator arm connection (fig. 31).
6. Install housing cover and gasket. Torque cover screws to 100 inch-pounds.
7. Install new O-ring in housing and install piston housing cover. Torque piston housing cover nuts to 120 inch-pounds.

INSTALLATION

1. Place shift fork seal on differential carrier mounting studs and install seal spring.
2. Place shift unit on mounting studs, make sure shift fork actuating lever engages slot in shift fork. Install studs, nuts, and lock washers. Torque nut to 60 foot-pounds.
3. Fill unit with lubricant.
4. Connect air line to shift unit and check shift unit system for proper operation.

TANDEM REAR AXLE

GENERAL DESCRIPTION

The tandem rear axle installation (fig. 33) consists of a rearward rear axle (Eaton Models 30R and 34R) and a forward rear axle (Eaton Models 30D and 34D) which carries a single speed power divider with an inter-axle differential. An air or vacuum operated shift mechanism is used to lock

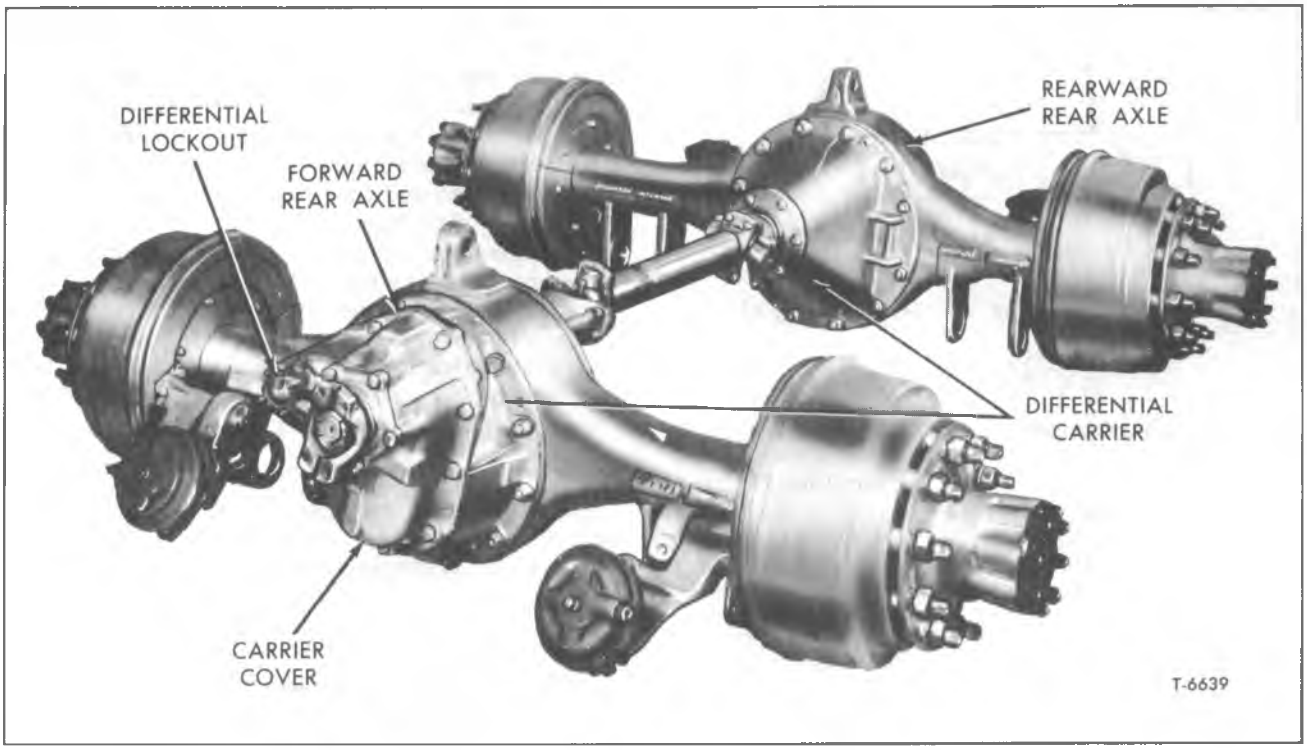


Figure 33—Tandem Rear Axle and Power Divider

out the inter-axle differential to provide positive drive to both axles when required.

Drive is transmitted from the transmission through a conventional propeller shaft to the power divider input shaft. The input shaft supports the inter-axle differential which transmits equal driving force to two helical gears, one mated to a gear on the forward rear axle pinion shaft to drive the forward axle and the other mated to a gear on the power divider output shaft to transmit drive force through an inter-axle propeller shaft to the rearward axle. Both axles drive at all times, so the inter-axle differential (3rd differential) is provided to allow differential action between the two axles. When extra traction is required to move the vehicle, the inter-axle differential can be locked out so equal power can be delivered to each axle. A toggle switch in the driver's compartment actuates the solenoid-controlled, vacuum operated, lock-out shift lever at the axle. The air system is controlled by a lever operated valve in the driver's compartment. Air pressure actuates a shift cylinder which is mounted on the axle. Both systems move the sliding clutch into engagement with the input shaft helical gear. A light installed on the dash warns when differential is locked out.

NOTE: Use lockout only in slippery going. When differential is to be locked out, vehicle must be completely stopped. Continuous unnecessary use of lockout must be avoided.

MAINTENANCE AND ADJUSTMENTS

REARWARD REAR AXLE

The rearward axle assembly is maintained in the same manner as outlined for the single speed Eaton rear axle.

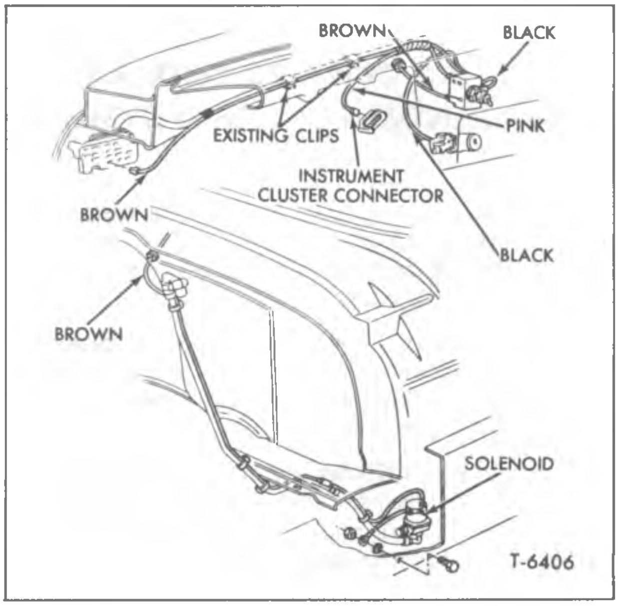
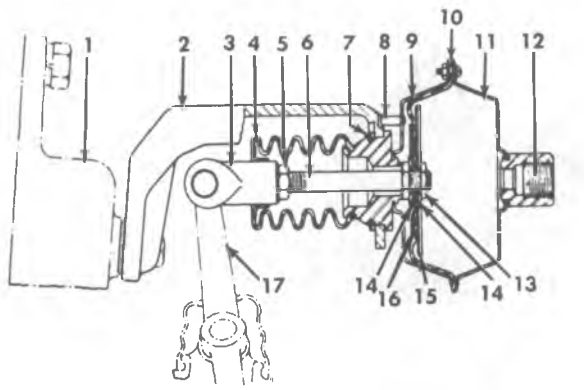


Figure 34—Differential Lock Switch and Warning Light Installation



1 Differential Carrier Cover
2 Bracket
3 Push Rod Yoke
4 Boot
5 Locknut
6 Push Rod
7 Snap Ring
8 Dowel
9 Cylinder (Inner Half)
10 Diaphragm
11 Cylinder (Outer Half)
12 Vacuum Line Fitting
13 Nut
14 Plate Washer
15 Plate (Large)
16 Plate (Small)
17 LockOut Shift Lever

T-6407

Figure 35—Differential Locking Cylinder

FORWARD REAR AXLE

The power divider and inter-axle differential are part of the forward rear axle differential carrier cover assembly and may be removed when the carrier is either in or out of the vehicle. The differential, ring gear and pinion are serviced in the same manner as outlined for the single speed Eaton rear axle.

VACUUM OPERATED INTER-AXLE DIFFERENTIAL LOCK SHIFT SYSTEM

OPERATION

The toggle switch on the center instrument panel controls the warning light in the instrument cluster (fig. 34) and the solenoid operated lock valve at the frame side rail.

The solenoid, when energized, actuates the lock valve connected between the locking cylinder, mounted at the front of the forward rear axle, and the engine vacuum supply.

The locking cylinder (fig. 35) operates the lock-out shift lever so the sliding clutch engages the input shaft helical and differential side gear to divide power equal to both axles.

CHECKING FOR LEAKAGE

Place the truck on level ground with the parking brake released and the transmission in neutral. Start the engine with the control switch at "ON" (the power divider differential locked out). Accelerate the engine for a few seconds, release the accelerator, and turn off the ignition switch. Immediately measure the distance between the face of the locking cylinder mounting bracket and the center of the push rod yoke to the lever pin and make note of the dimension. At the end of ten minutes, re-measure the distance. If the distance has not increased, the system may be considered vacuum tight. However, if the distance has increased, a vacuum leak exists in the system.

First check all connections. After all the hoses and the pipe connections have been checked and tightened, test the system again.

SOLENOID LOCK VALVE

The solenoid valve is positioned at the frame left side rail by the vacuum pipe clips and may be removed by disconnecting the three fittings at the valve.

LOCKING CYLINDER

When leakage tests indicate the locking cylinder assembly leaks, it must be removed and disassembled, and the rubber diaphragm in the cylinder must be replaced.

1. Disconnect the control valve hose from the cylinder. Remove the cotter pin and the clevis pin which secure the bracket lever to the push rod. Remove the snap ring which secures the cylinder in the bracket, and remove the assembly from the bracket. Remove the boot from the push rod.

2. Remove the clevis yoke and nut from the push rod (fig. 35). Remove the screws, nuts, and lock washers which attach the two halves of the cylinder and the rubber diaphragm together. Remove the outer half of the cylinder, and separate the rubber diaphragm from the inner half of the cylinder.

3. Install a new diaphragm and push rod assembly in the rear half of the cylinder.

4. Make certain the mating faces of the cylinder halves are clean. Position the outer half of the cylinder on the rubber diaphragm, and install the screws, nuts, and new lock washers. Install the boot, nut, and clevis yoke on the push rod.

5. Make certain that the snap ring groove on the inner half of the cylinder is clean. Position the cylinder in the bracket on the power divider with the slot in the rear half of the cylinder at the bottom.

6. Install the retaining snap ring and seat it solidly in the groove. Attach the bracket lever to the rod clevis with a clevis pin and a new cotter pin. Attach the vacuum line to the locking cylinder. Test the system for vacuum leaks.

AIR OPERATED INTER-AXLE DIFFERENTIAL LOCK SHIFT SYSTEM

OPERATION

Air-operated differential lock utilizes air pressure from the air brake system for its operation. Units used in air-operated power shift system are: Shift Control Valve, mounted on engine side of dash; check valve, installed in air line at control valve air inlet; differential lock shift cylinder, mounted on forward rear axle torque divider case cover; and interconnecting air lines and fittings

With lock control knob (fig. 35) in "UNLOCK" position, there is no air pressure in differential lock shift cylinder. Shift return compression spring holds cylinder piston and lock linkage in unlocked position.

When lock control knob (fig. 36) is moved to "LOCK" position, air pressure is admitted behind lock shift cylinder piston. As air pressure forces the piston outward, the differential lock is shifted into locked position.

CHECKING FOR LEAKAGE

1. Build up air pressure in system to maximum pressure limit (100 to 105 lbs.). Place lock control knob in "LOCK" position.

2. Coat all air line connections with soap suds to check for leakage. No leakage is permissible. Leakage can sometimes be eliminated by tightening the connection. If this fails to correct leakage, disconnect leaking fitting and replace seal ring around tube flare.

3. Coat entire surface of lock shift cylinder and control valve with soap suds to check for leakage. If leakage is evident in either unit, remove faulty unit and overhaul as directed under individual headings.

CONTROL VALVE (Fig. 37)

<u>Removal</u>

1. Disconnect cable assembly at control lever (4).

2. Disconnect air outlet line at control valve outlet port (12).

3. Disconnect check valve fitting from valve inlet port (11).

4. Disconnect connectors at switch assembly.

<u>Disassembly</u>

1. Remove tell-tale lamp switch.

2. Using a small drift, drive fulcrum pin (3) from control lever (4) and remove lever.

3. Remove cap nut (10), cap nut O-ring (9), valve spring (8), and valve (7).

4. Push against stem of control valve plunger (14) to remove plunger through top of control valve body. Remove plunger spring (13).

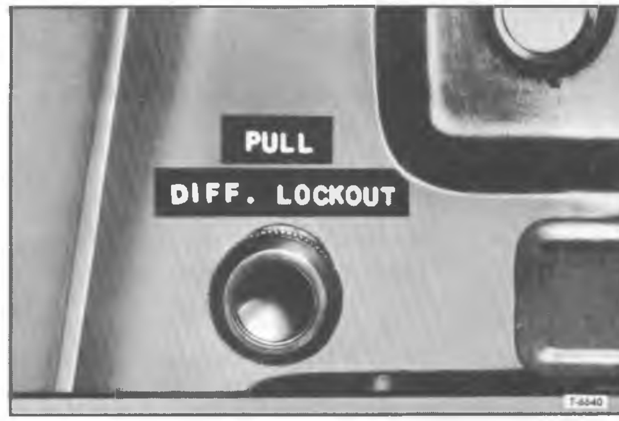
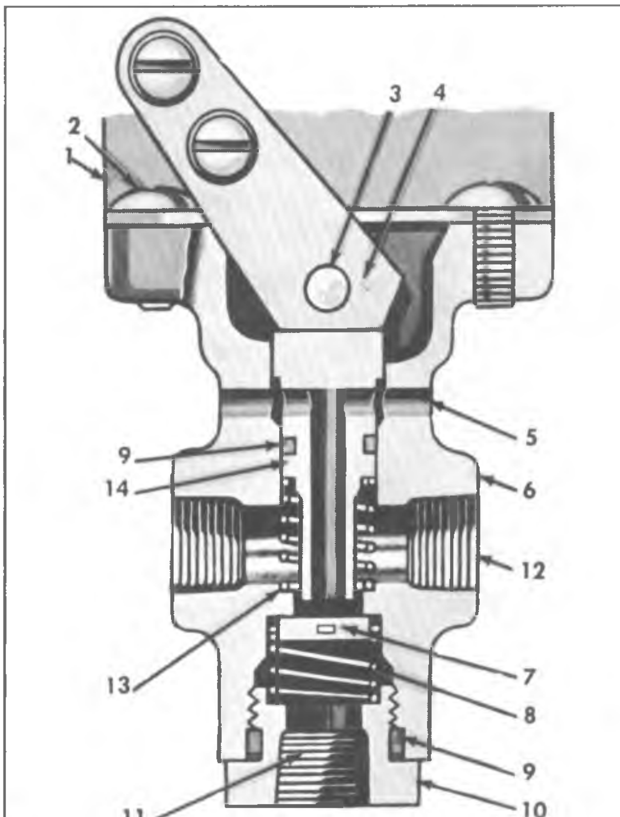


Figure 36—Differential Lock Control Knob

5. Remove O-rings (9) from cap nut (10) and plunger (14).



1 Mounting Bracket
2 Mounting Screw
3 Fulcrum Pin
4 Control Lever
5 Exhaust Port
6 Body
7 Valve Disc
8 Valve Spring
9 O-ring
10 Cap Nut
11 Inlet
12 Outlet
13 Plunger Spring
14 Plunger T-6641

Figure 37—Sectional View of Control Valve

Cleaning and Inspection

1. Wash all parts except O-rings in cleaning fluid.

2. Inspect all parts for wear, replace if damaged in any way.

Assembly

1. Install new plunger O-ring (9) on plunger (14), and new cap nut O-ring (9) on cap nut (10).

2. Install plunger return spring (13) on plunger (14), then install assembly in valve body.

3. Coat fulcrum pin (3) and control lever cam (4) lightly with chassis lubricant. Position control lever (4) in valve body and install fulcrum pin. Stake edge of fulcrum pin hole in valve body to hold pin in place.

4. Position new valve (7) and valve spring (8) in valve body (6) and install cap nut (10). Tighten nut firmly.

5. Install tell-tale lamp switch.

Installation

1. Position control valve on mounting bracket and install two screws.

2. Connect control cable to control lever.

3. Connect air inlet and check valve fittings.

4. Connect tell-tale lamp connectors to switch.

5. Check the system for leaks and proper operation.

AIR SHIFT CYLINDER

A piston type shift cylinder is mounted on forward rear axle torque divider case cover. Piston rod is connected to sliding clutch. As air pressure is applied to piston, sliding clutch is shifted into locked position. When air pressure is exhausted from shift cylinder, spring pressure returns sliding clutch to unlocked position.

Shift cylinder should be removed, disassembled, and the piston seals replaced whenever leakage is indicated at the cylinder.

REAR AXLE TORQUE SPECIFICATIONS

ITEM	TORQUE (FT. LB.)
DRIVE PINION YOKE NUT	
Eaton	
1⅛"-18	320-450
1¼"-12	400-600
1½"-18	500-700
Rockwell	
1"-20	300-400
1¼"-18	700-900
1½"-18	800-1100
Corporation	
1⅛"-18	160-280
DIFFERENTIAL CARRIER TO HOUSING	
Eaton	
½"-13 Cap Screw	75-85
⅝"-11 Cap Screw	160-175
⅝"-18 Stud Nut	220-240
Rockwell	
½"-20 Stud Nut	92-118
⅝"-18 Stud Nut	185-235
Corporation	
7/16"-20 Cap Screw	75-90
9/16"-18	130-170

ITEM	TORQUE (FT. LB.)
OIL SEAL RETAINER & PINION CAGE	
Eaton	
9/16"-12	115-125
Rockwell	
7/16"-14	60-70
½"-13	80-105
9/16"-12	115-150
Corporation	
½"-13 (H135)	160-170
½"-13 (H150)	80-105
½"-13 (T150)	80-105
⅝"-11 (H110)	160-170
SHIFT CHAMBER	
Stud Nut—⅜"-24	30-35
Bolt—7/16"-14	40-50
AXLE SHAFT FLANGE	
Stud Nut—½"	50-60
Stud Nut—⅝"	90-110
Cap Screw—5/16"-24	11-18

SECTION 4B
Rear Springs and Suspension

Progressive type, two-stage rear springs, as used on all 40 Series (refer to figure 1), have a straight-ended main leaf which rests against the cam surface of the front and rear hangers. Cam action of the spring leaf produces a variable deflection rate as contact point changes under varying load. The second or third leaf has hooked ends which contact rebound pins in the spring hangers to prevent excessive fore and aft travel in event of radius leaf rod failure.

The radius leaf rods maintain axle alignment and transmit driving and braking forces to the frame. A spacer is used at bottom of each spring pile to separate the last leaf from the radius leaf which is half-leaf formed with an eye and bushed for attachment to the front hanger.

Two slanted U-bolts attach the spring pile and radius leaf to the axle housing.

NOTE: If maintenance of springs and rear suspension components is neglected, costly damage to wheel bearing, propeller shaft, and tires etc., could result. Refer to "Service Diagnosis Chart" in "FRONT SPRINGS" (SEC. 3C) of this manual.

GENERAL SPRING MAINTENANCE

LUBRICATION

Spring leaves are lubricated at time of manufacturing and require no further lubrication unless spring is disassembled. Spring eye or radius leaf bushings that are rubber-mounted do not require lubrication.

TIGHTENING

At regular intervals, spring U-bolts should be checked and tightened if necessary to torque listed in "Specifications" at end of this section.

IMPORTANT: U-bolts must be kept TIGHT at all times to hold axle in place at springs. Otherwise, axle may shift, causing misalignment; also, spring leaf failure in the vicinity of the spring center bolt could result.

> **NOTE**
>
> U-bolts must be retightened to initial torque listed in "Specifications" after 500 miles when new, or when spring repairs are made.

NOTE: The center bolt serves only to hold the spring together while in shipment and during installation, and as a locating point when assembling spring to axle. After assembly, it is strictly the function of the U-bolts to hold the spring and axle in alignment, and the importance of keeping the U-bolts tight cannot be overemphasized.

REPAIR OPERATIONS

REAR SPRING REMOVAL (Figs. 1, 2, and 3)

1. Raise vehicle frame to take weight off the spring. Make sure vehicle is supported safely.

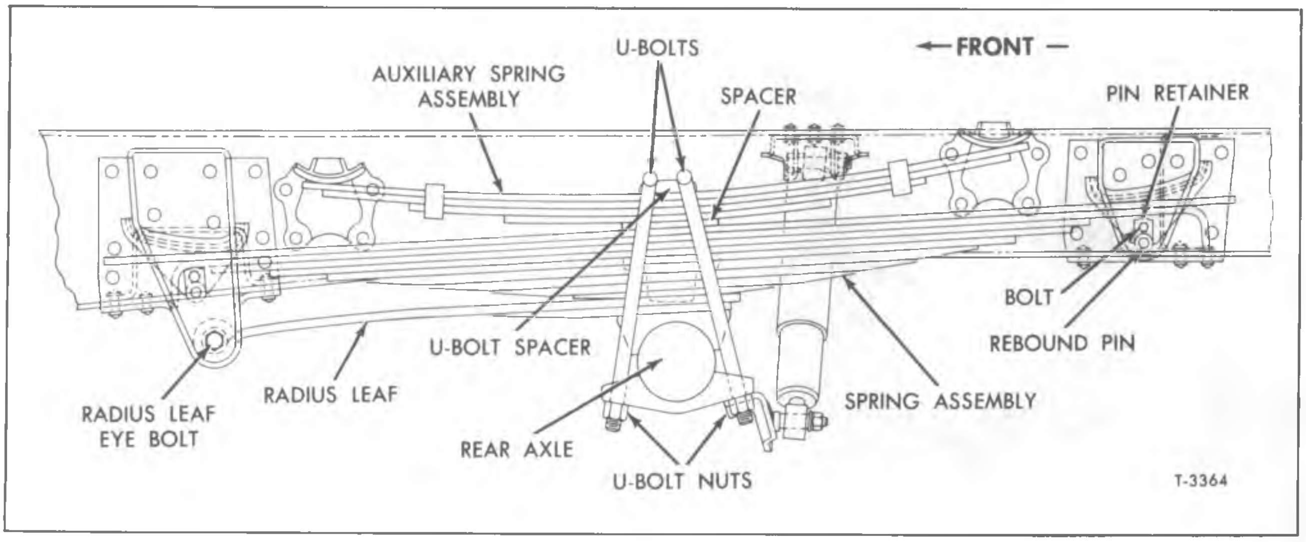


Figure 1—Rear Springs Installed (Series 40) (Typical)

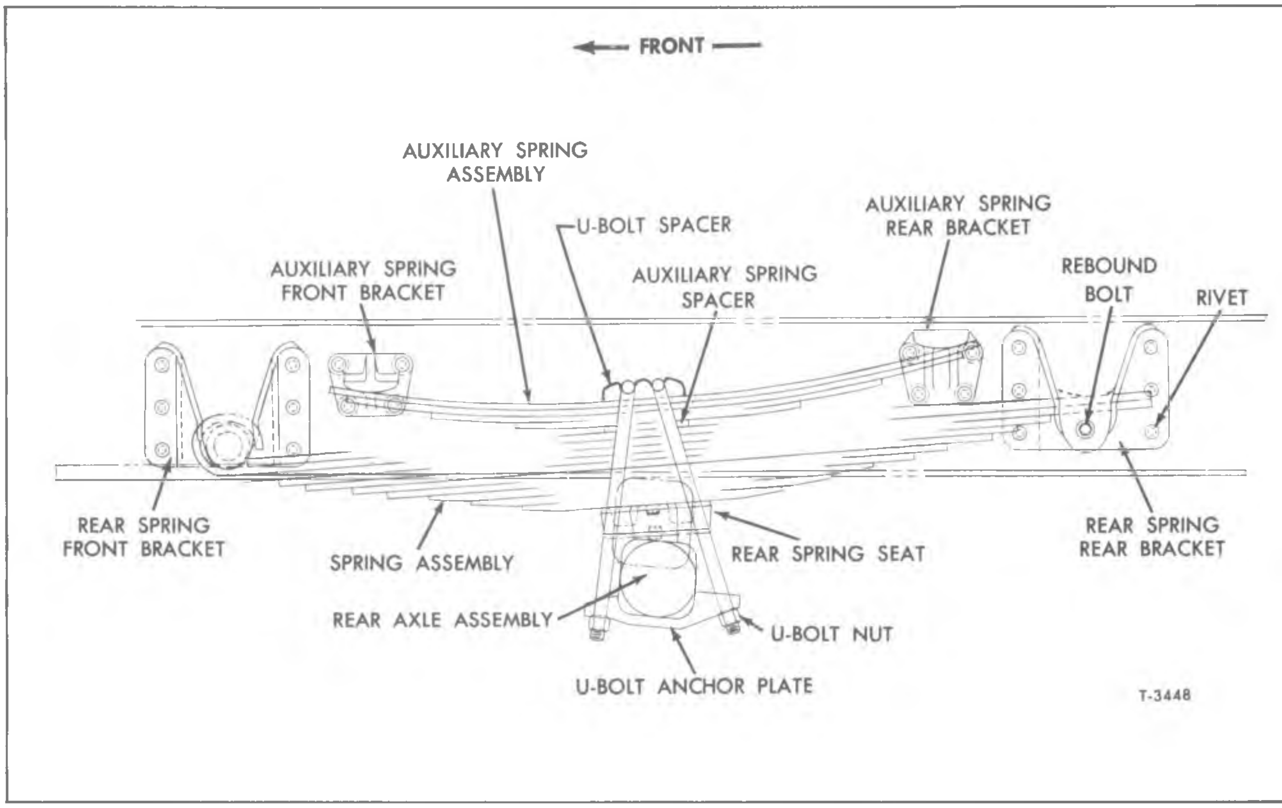


Figure 2—Rear Springs Installed (Typical for "S" Models)

Remove rear wheels to provide access to spring assembly.

2. Safely support axle on floor jack.

3. Install a C-clamp on radius leaf as shown in figure 3, to relieve load on radius leaf eye bolt on 4500 Series vehicles.

4. On 40 Series (see figure 1), at the front and rear hanger, remove rebound pin retainer bolt, then remove retainer. Install suitable puller into tapped hole at end of rebound pin, then remove pin.

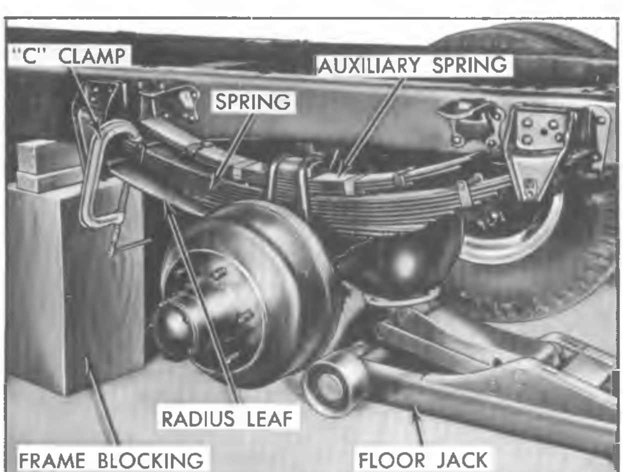


Figure 3—Using C-Clamp at Radius Leaf

5. On "S" Series, remove rebound bolt nut and washer, then remove the rebound bolt (refer to fig. 2).

6. Remove spring U-bolt nuts, shock absorber bracket (when used) U-bolt anchor plate and U-bolts and U-bolt spacer, then lower axle slightly.

7. Remove spring eye or radius bolt nut and washer, then remove spring eye bolt from spring eye or radius leaf.

NOTE: When tapered shim is used, the position of shim thin and thick edge should be noted so that shim can be installed properly at assembly.

8. Inspect spring. Replace bushing, repair or replace spring unit as outlined later in this section.

SPRING LEAF REPLACEMENT

NOTE: Auxiliary springs should be disassembled in an arbor press. When assembling springs, make sure spacer is installed between the auxiliary and main spring.

1. Mark one side of spring assembly to assure original position of springs when assembling.

2. Place spring in a vise and remove spring clip, bolt, nut, and spacer.

3. File peened end of center bolt and remove center bolt nut.

4. Open vise slowly and carefully to let spring assembly expand. Wire brush and clean spring leaves.

5. Replace weak or broken spring leaf.

6. Align center bolt holes in spring leaves using a long drift.

7. Compress spring leaves in a vise, then remove drift and install a new center bolt.

8. Install nut on center bolt and tighten securely. Peen end of bolt to prevent nut from loosening.

9. Align springs by tapping with a hammer. Install spring clip, bolts, spacers, and nuts.

SPRING EYE OR RADIUS LEAF BUSHING REPLACEMENT (WITH SPRINGS REMOVED)

Steel Backed Rubber Bushings

Remove and replace radius leaf eye bushing using bushing remover and installer (J-21058 Tool Set) as shown in figures 4 and 5.

REAR SPRING INSTALLATION
(Refer to Figs. 1, 2, and 3)

1. Set spring assembly and tapered shim or spacer (if used) at axle pad.

IMPORTANT: Tapered shim must be installed on axle in same position that was noted at removal.

NOTE: If auxiliary springs are used, place spring assembly and spacer in position.

2. Install U-bolt spacer over center bolt.

3. Seat U-bolts in spacer grooves, then secure spring to axle by installing anchor plates, shock absorber bracket (when used) and nuts on U-bolts. Tighten nuts to torque listed in "Specifications" at end of this section.

4. On "S" Series, lower frame until spring enters hanger with spring eye and hanger hole aligned at front and spring touches cam surface of hanger at rear.

5. On 40 Series, lower frame until ends of spring enter the hanger and touch the cam surface of hanger. Compress radius leaf with a C-clamp (fig. 3) until radius leaf eye and hanger holes are aligned.

6. On 40 Series, torque nut to torque listed in "Specifications." On "S" Series, torque the eye bolt to torque listed in "Specifications."

7. On 40 Series, remove C-clamp from radius leaf.

8. On 40 Series, install rebound pin at front and rear hangers. Install rebound pin retainer and secure with retainer bolt.

9. On "S" Series, install rebound bolt, washer, and nut at rear hanger. Tighten rebound bolt nut to torque listed in "Specifications."

10. Install wheels.

11. Remove blocking and lower frame to place weight on springs. Check U-bolt nuts for proper torque. Refer to "Specifications" at end of this section.

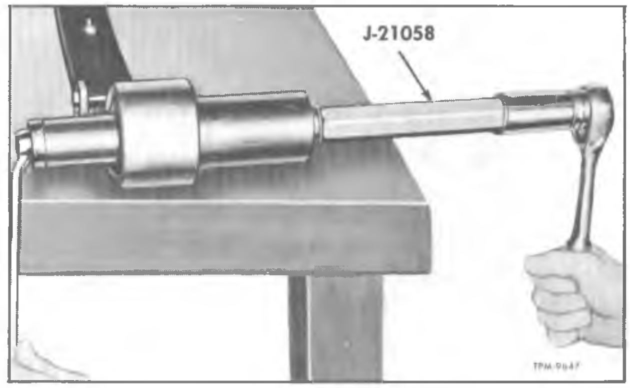


Figure 4—Removing Rubber Type Eye Bushing

AUXILIARY SPRINGS

Some vehicles have auxiliary rear springs which are necessary for certain types of operation. When used, the auxiliary spring leaves or leaf (Single Leaf Auxiliary) are installed above the regular rear spring assembly and are held in place by long U-bolts. Brackets are installed on frame and are contacted by the auxiliary spring to provide added stability required for these unusual conditions.

SHOCK ABSORBERS

Shock absorbers (when used) are non-adjustable and non-repairable. Maintenance operations are limited to replacement of rubber mounting grommets and periodically tightening all mountings. If a shock absorber becomes inoperative, the complete unit must be replaced.

NOTE: When replacing a shock absorber, check the model number stamped on the unit to make sure it is the same model as the one removed.

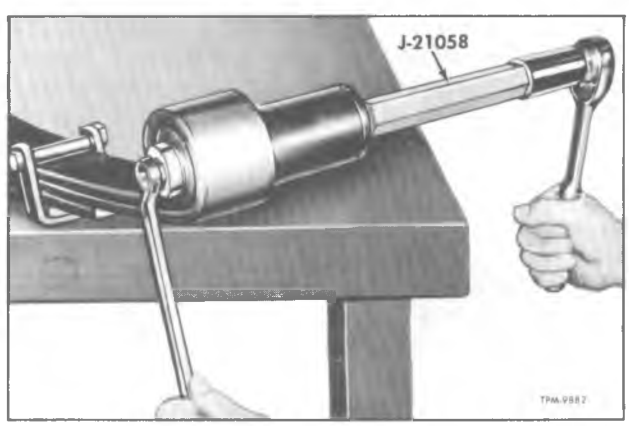


Figure 5—Installing Rubber Type Eye Bushing

HENDRICKSON TANDEM REAR SUSPENSION

DESCRIPTION

In the Hendrickson RT type suspension, equalizing beams are used to tie front and rear axles together, and permit independent vertical movement of each axle as required by road surface. Road shocks are partially absorbed through use of rubber bushings at beam center, ends, and torque arms. Driving and braking forces are transmitted to the vehicle chassis through solid torque rods and the equalizer beams. The springs carry the load and maintain transverse relationship of frame to axle. Torque rods are positioned to maintain proper drive line alignment and stabilize driving and braking forces.

The RT type embodies a spring top saddle pad that uses bolts to secure spring to axle. Figure 6 shows typical arrangement of Hendrickson suspension units described.

TANDEM UNIT REMOVAL AND INSTALLATION

When a major overhaul is required, the complete tandem unit should be removed from the frame; however, torque rods, springs, equalizing beams, and other parts may be removed separately as required.

> **CAUTION: Before removing the tandem unit, use jacks and other equipment to block vehicle securely to prevent axle assemblies from rolling or pivoting at equalizer beam ends when torque rods are disconnected.**

REMOVAL (Refer to Fig. 6)

NOTE: The following procedure explains the method whereby the spring eyes are separated from frame brackets. However, if frame can be raised to any height and the spring forward brackets are bolted to frame and not riveted, separation can be made between brackets and frame rails. Also, it would not be necessary to remove the forward duals:

1. Block wheels on rear axle and disconnect brake lines from axles. Raise and safely support forward axle, then remove forward duals.
2. Disconnect propeller shaft from forward rear axle as explained in "PROPELLER SHAFTS" (SEC. 4D) of this manual.
3. Raise vehicle frame to remove load from springs. Support frame securely and remove rebound bolt from bottom of spring rear bracket.
4. Remove lock bolt securing spring pin in front bracket. Remove lubrication fitting from inner end of pin. In some cases pin may be removed with slide hammer and adapter from inner side of hanger. If this is not possible, remove pin using soft drift and hammer from outer side of hanger.
5. Temporarily install single wheel on each side of front axle so assembly can be removed from under chassis.
6. Place jacks and other equipment at each axle to prevent axle assemblies from rolling or pivoting at equalizer beam ends when torque rods are disconnected.
7. Note number of shims between torque rod brackets and bogie crossmember on RT suspension to assure same dimension at installation, then at each axle end, remove nut from torque rod end stud and drive end stud out of axle bracket using a soft hammer.
8. Using a suitable hoist, raise rear end of frame, and roll axles, with equalizer beams and springs, out from under frame.

INSTALLATION (Refer to Fig. 1)

1. Roll axles and wheels, with equalizer beams and springs attached, in position under frame.
2. Lower frame as required to align spring front pin with bracket raise and support forward axle, then remove wheels. Install spring front pin through bracket and spring eye, with milled flat near end of pin aligned with lock bolt hole in bracket. Use a soft hammer to drive pin in.
3. Install spring front pin lock bolt and nut and tighten firmly. Install lubrication fitting in inner end of pin.
4. Install rebound bolt in rear bracket.
5. Install torque rods to axle brackets.

NOTE: When tightening nuts, rap bracket with hammer to drive taper of torque rod stud into bracket. Tighten nut to torque listed in "Specifications" at end of this section.

6. Connect brake lines to each axle assembly; then connect propeller shaft and check drive line alignment.
7. Install front duals, then remove supports from under axle.
8. Lubricate shackle pin at lube fitting.

SPRING REPLACEMENT

REMOVAL (Refer to Fig. 6)

1. Remove duals from front and rear tandems to facilitate removal of spring eye pin if pin must be driven from bracket. Raise and support vehicle frame to remove load from springs.
2. Remove rebound bolt from bottom of spring rear bracket.
3. Remove lock bolt securing spring pin in

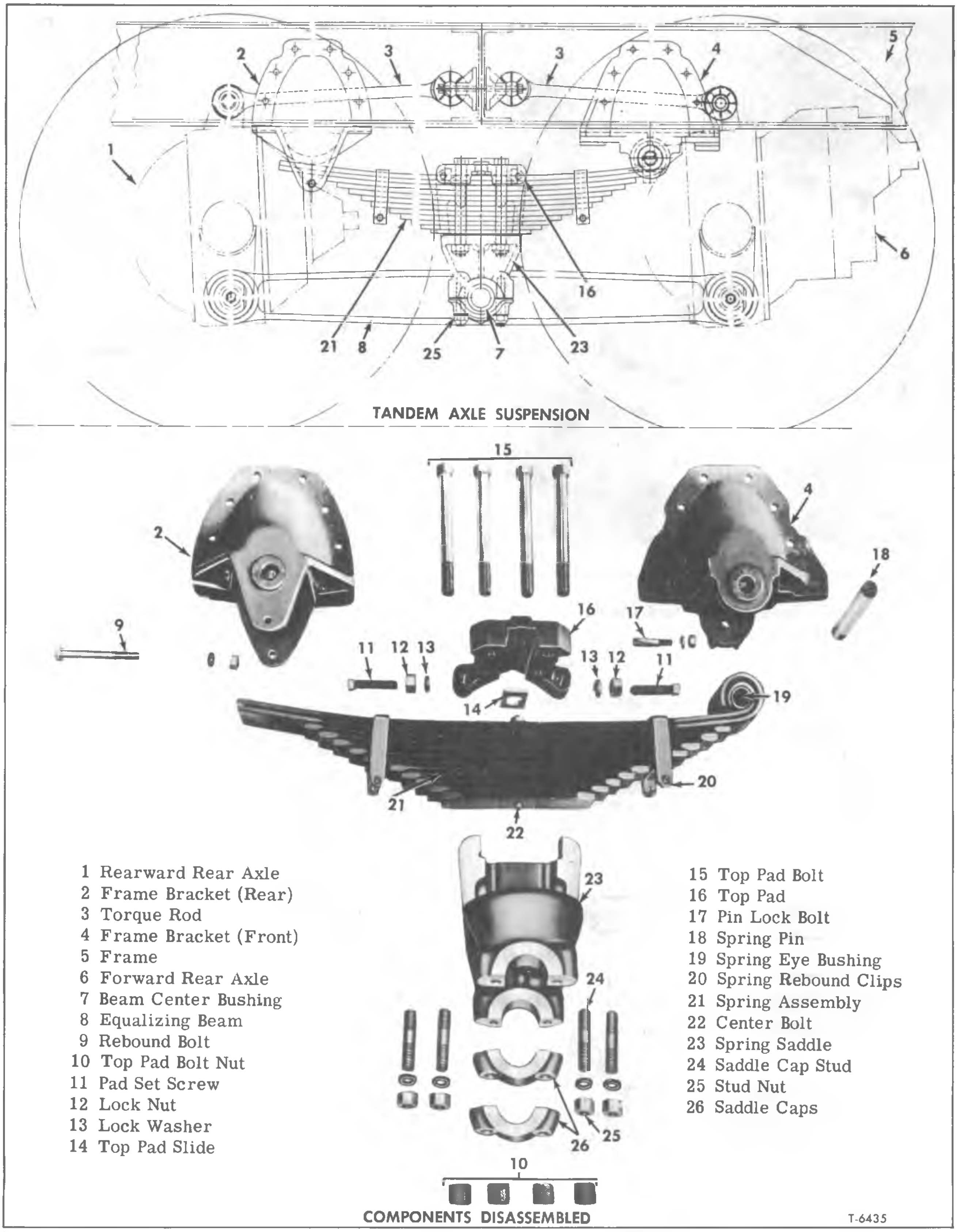


Figure 6—Tandem Rear Axle Suspension (Hendrickson R.T.) (Typical)

REAR SPRINGS AND SUSPENSION

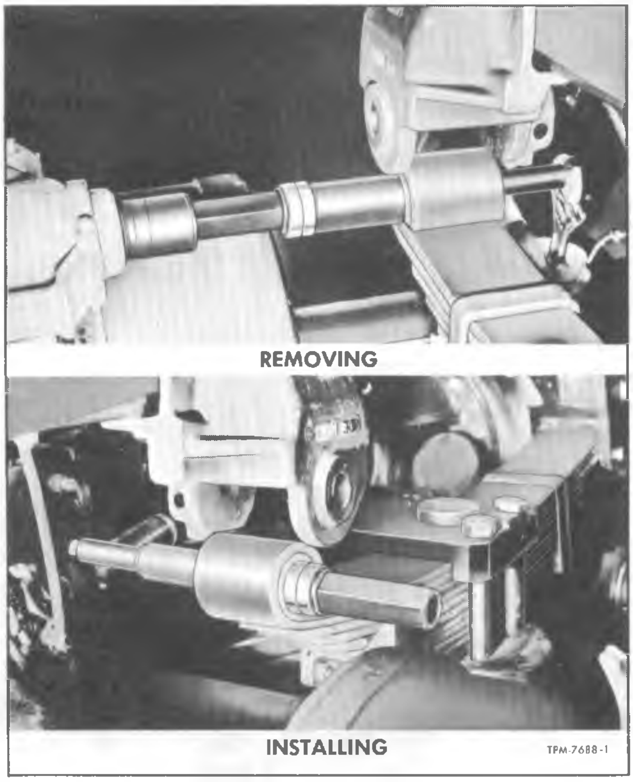


Figure 7—Tool Application for Replacing Spring Eye Bushing

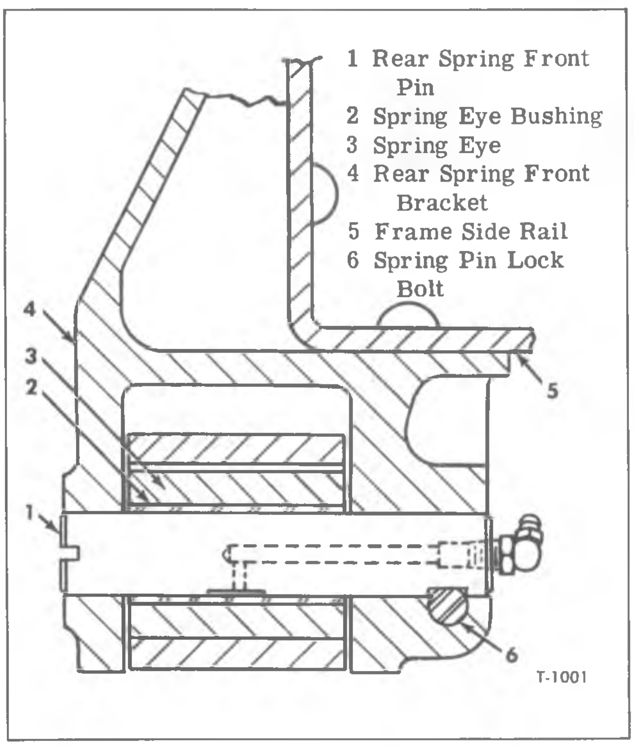


Figure 8—Section Through Spring Eye and Front Bracket (Typical)

front bracket. Remove lubrication fitting from inner end of pin, pin may be removed with slide hammer. In some cases it may be necessary to drive pin out with soft drift and hammer from outer side.

4. On vehicles equipped with the "RT" type suspension shown in figure 6, remove four bolts which attach spring saddle top pad to spring saddle; hold nuts at bottom while turning bolt at top. Loosen lock nuts on top pad setscrew, then loosen setscrew and lift top pad and the slide from top of spring. Lift spring assembly up and rearward to remove from spring saddle.

INSPECTION OF SPRING

1. Thoroughly wash spring eye bushings and bracket pins to remove all old lubricant. Make sure lubricant passages in pins are open.

2. Insert pins into plain bushings in spring eyes and bracket and check for looseness. If excessive looseness is evident, pins and bushings must be replaced. Refer to "Replacing Radius Leaf Eye Bushing" earlier in this section for bushing replacement procedure. Figure 7 shows arrangement of tools for removing and installing spring eye bushing on tandem suspension.

3. Inspect spring assembly for broken leaves. Nos. 1 and 2 leaves can be replaced. If other leaves are broken, replace complete spring assembly. Replace broken leaves as directed later under "Repair."

4. Inspect spring for loose or broken rebound clips. Rebound clips should be tight enough to hold spring leaves in alignment, but not tight enough to restrict free movement of leaves.

5. Check for broken or loose spring center bolt. Replace or tighten as necessary.

6. Make sure machined surfaces of spring saddle are clean. Spring leaves must be free of rust and scale build-up if they are to be retained securely by clamp bolts.

SPRING LEAF REPLACEMENT

1. Scribe down one side of springs to assure original position of springs when assembling later, then place spring in a vise or arbor press, next to center bolt.

2. Remove nuts and bolts from spring rebound clips.

3. File off peened end of center bolt, then remove nut and bolt.

4. Release vise or arbor press slowly to avoid possible injury. Separate spring leaves and clean thoroughly, using a wire brush if necessary.

5. Replace any broken rebound clips.

6. Replace broken leaf and stack leaves in correct order, applying a thin film of graphite grease to each leaf. Align center bolt holes in spring leaves with long drift, then compress spring leaves in vise or arbor press.

7. Install center bolt and nut and tighten nut. Peen end of bolt to prevent nut loosening.

8. Remove spring from vise or arbor press. Align spring leaves by tapping with hammer; then install rebound clips, bolts, and nuts. Tighten enough to hold spring leaves in alignment, but not enough to restrict free movement of leaves.

INSTALLATION (Fig. 6)

1. Position spring assembly on spring saddle with head of center bolt in locating hole in saddle and with spring ends in place in frame brackets.

2. Place top pad slide on top spring leaf, then position top pad over spring and saddle.

3. Install top pad to saddle bolts and nuts and tighten snugly. Tighten top pad setscrews to torque listed in "Specifications" at end of this section. Tighten setscrew lock nuts.

IMPORTANT: The top pad setscrews must be tightened to specified torque to properly seat the spring against machined face of saddle before torquing top-pad-to-saddle bolts.

4. Tighten top-pad-to-saddle bolts to torque listed in "Specifications." Hold nuts at bottom while using torque wrench on bolt heads at top.

5. Install spring eye pin through bracket and spring eye, with milled flat near end of pin aligned with lock bolt hole in bracket. Use a soft hammer to drive pin in from outer side. Install spring front pin lock bolt and nut with washer and tighten firmly. Install lubrication fitting in inner end of eye pin. Figure 8 illustrates section through pin, spring eye, and frame bracket.

6. Install spring rebound bolt in lower end of rear frame bracket. Lubricate spring ends with type of Lubricant and at proper intervals as directed in LUBRICATION (SEC. 0) of this manual. Remove support from under frame.

EQUALIZING BEAM REMOVAL AND REPAIR

The following procedures cover removal and installation of either equalizing beam without removing any other units of the suspension system. When removing an axle assembly, accomplish only steps required to loosen axle at each end of beam.

EQUALIZING BEAM REMOVAL (Fig. 9)

1. Raise and support frame to remove weight from beams.

2. At axle brackets, remove nuts (5), washers (7), and bolt (1). Pry adapters (2) from bushings and brackets.

3. With blocking under beam cross tube (fig. 10) to support weight of beams, remove saddle caps (fig. 6) attached with four nuts and flat washers.

4. Lower the cross tube and beams, then slide beams from tube ends.

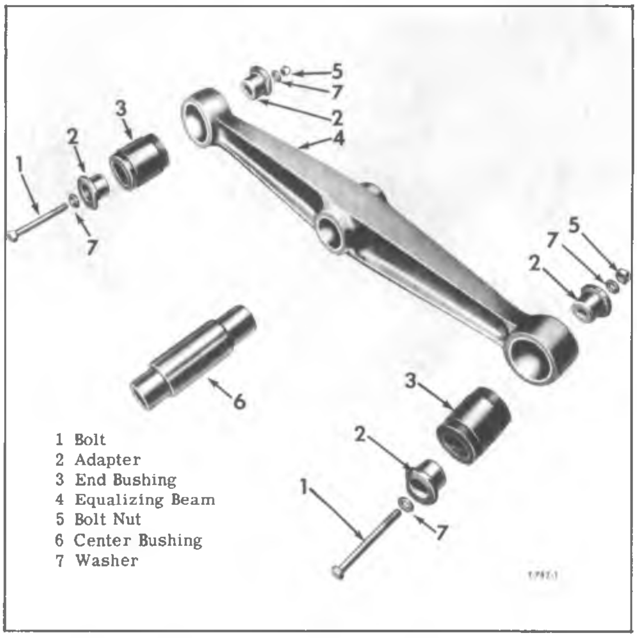


Figure 9—Equalizing Beam Components (Typical)

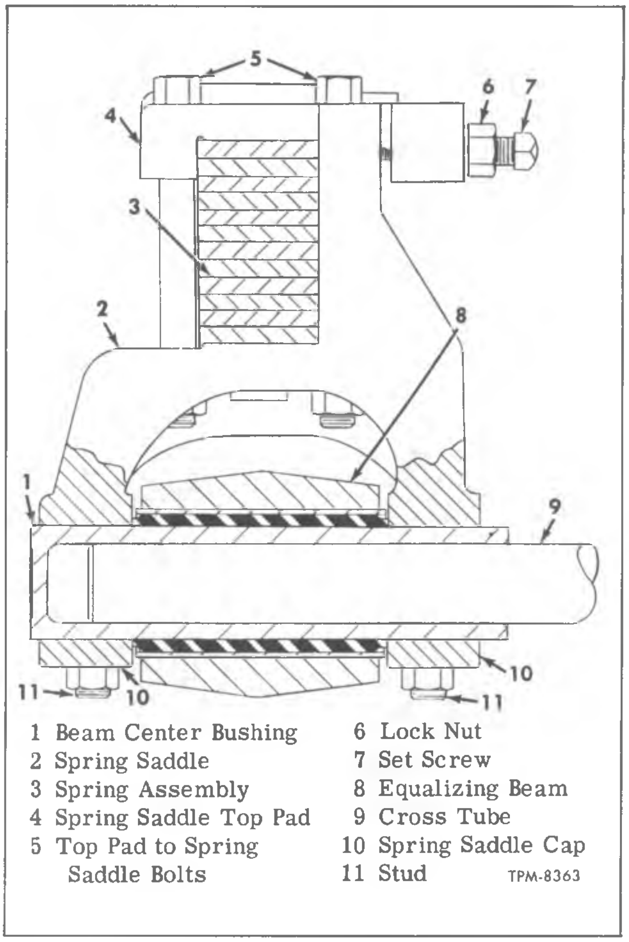


Figure 10—Section Through Spring Saddle and Beam

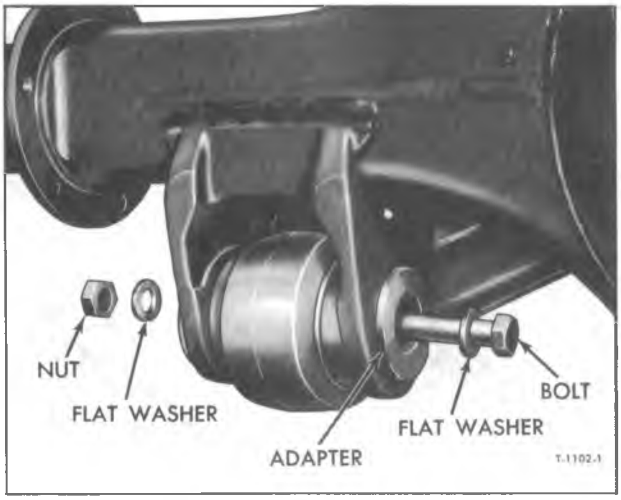


Figure 11—Adapter and Retaining Bolt at Axle Bracket

EQUALIZING BEAM INSPECTION

1. Inspect beam end bushings and beam center bushing for evidence of damage or deterioration of the rubber. If any damage is evident, replace bushings as directed under "Equalizing Beam Bushing Replacement" later in this section.
2. Inspect cross tube and replace if bent or worn.

EQUALIZING BEAM BUSHING REPLACEMENT

Press old bushing out, using a suitable driver or press to exert force on bushing outer sleeve. Press new bushing into place, exerting force on bushing outer sleeve until outer sleeve extends an equal distance through beam at both sides.

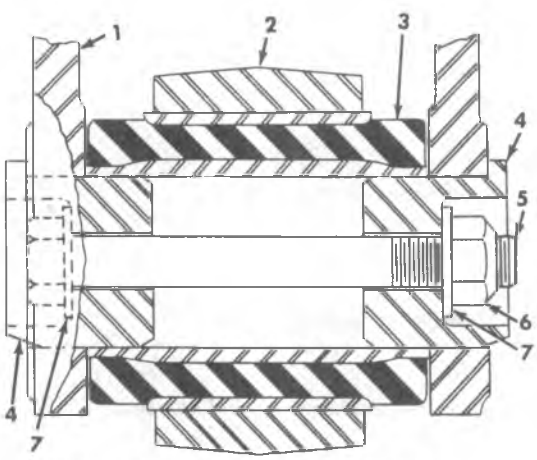


Figure 12—Equalizing Beam Mounting at Axle Bracket

EQUALIZING BEAM INSTALLATION
(Refer to Fig. 9)

1. Position beams, with cross tube in place at spring saddles (fig. 6) and axle brackets.

NOTE: At axle end of beam, install adapters (2, fig. 9) at each side of bracket and into bushing.

IMPORTANT: The cut-off (flat) side of each adapter must be located in a vertical position as shown in figure 11.

2. Install bolt and washer through adapter and axle bracket at each end of equalizing beam (fig. 11).

NOTE: Install bolt and washer from inner side with nut located toward wheels (fig. 11). Tighten nuts or bolts to torque listed in "Specifications" at end of this section. Figure 12 shows section through mounting.

3. Install spring saddle caps to attach beam center bushing to spring saddle. Install saddle cap stud nuts or cap screws and tighten to torque listed in "Specifications" at end of this section.

TORQUE RODS

Pre-lubricated, non-adjustable torque rods are used on all vehicles equipped with the tandem suspension system. The torque rods serve to maintain proper drive line angles and stabilize driving and braking forces.

NOTE: Refer to "PROPELLER SHAFTS" (SEC. 4D) in this manual for drive line angle adjustment procedure.

TORQUE ROD REMOVAL
(Refer to Figs. 13 and 14)

1. Remove nuts and washers from torque rod end studs.
2. Strike top of torque rod brackets with a soft hammer to break end studs free from brackets.
3. Drive end studs out of brackets using a soft hammer.

Straddle Mount Type

1. Remove nut and washer from torque rod end stud.
2. Strike top of torque rod bracket with a soft hammer to break end stud from bracket.
3. Remove nuts, washers, spacers and bracket from crossmember.
4. Drive end stud from bracket with soft hammer and remove torque rod.

TORQUE ROD INSPECTION

Examine ball studs for damaged threads and for looseness in bushings in torque rod ends. If any

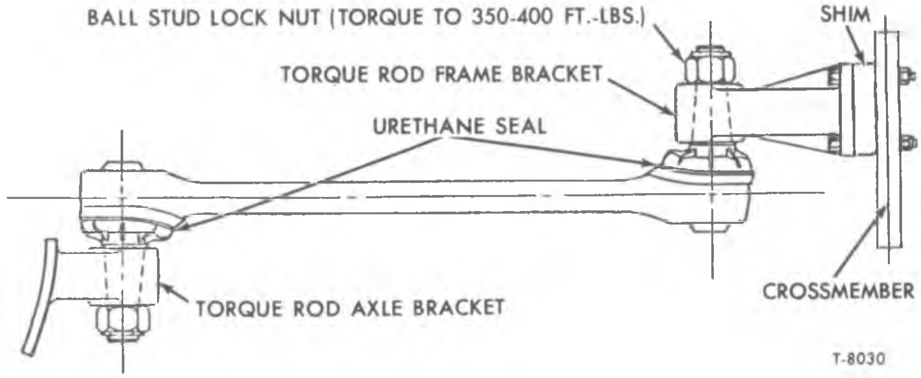


Figure 13—Torque Rod Installation

damage or looseness of bushings is evident, the complete torque rod assembly should be replaced.

Inspect tapered surfaces on torque rod end studs and in frame and axle brackets for wear. Replace bracket if looseness or excessive wear is evident. Remove all burrs, grease, paint, or other foreign material from bracket holes or stud taper before torque rod installation.

For frame bracket removal (if necessary) remove self-locking nuts from bolts attaching bracket to crossmember. Note the number and positions of shims or spacers (if used) between bracket and frame crossmember, and remove bracket.

TORQUE ROD INSTALLATION (Figs. 13 and 14)

1. Install torque rod bracket on frame crossmember if removed, and tighten nuts to torque listed at end of this section.

IMPORTANT: Use same number of spacers or shims as previously used to assure original drive line alignment.

2. Install torque rod with end studs inserted through brackets at axle and crossmember. Install nut and washer on each end stud.

3. With weight of unloaded vehicle on suspension, tighten ball stud nuts to 350-400 foot-pounds torque.

4. Strike torque rod brackets with a soft hammer to seat tapered surfaces, and retorque.

Straddle Mount Type

1. Install ball stud in axle bracket with washer and nut.

2. Install bracket, spacers, torque rod, nuts and washers and tighten to torque listed at end of this section.

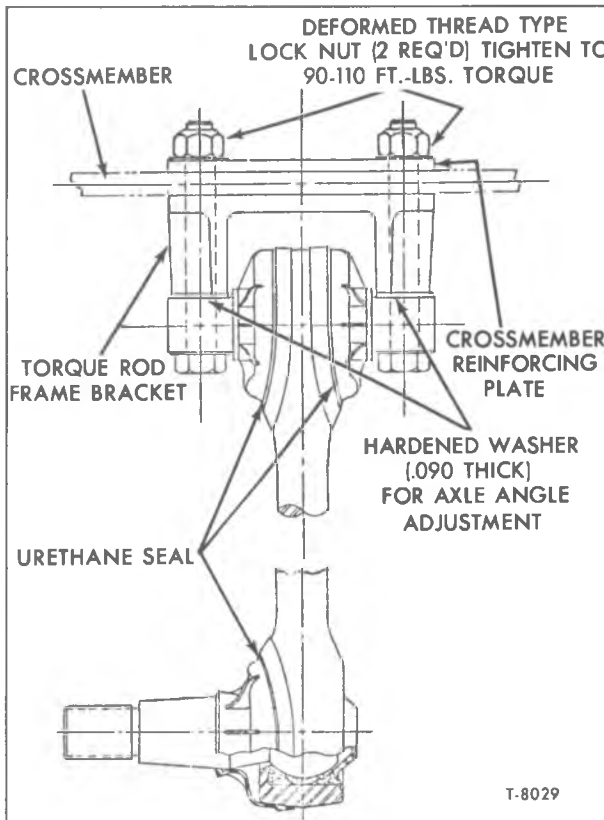


Figure 14—Straddle Type Torque Rod

REAR SPRINGS AND SUSPENSION

SPECIFICATIONS

REAR SUSPENSION SPECIFICATIONS

SPRING EYE BUSHING—(40) (Steel Backed Rubber Type)		(Width)	3.270"-3.300"
		(O.D.)	1.750"-1.755"
		(I.D.)	0.940"-0.950"
RADIUS LEAF BUSHING—(All 40) (Steel Backed Rubber Type)	(⅝" x 18 Bolt Size)	(Width)	2.725"-2.750"
		(O.D.)	1.375"-1.380"
		(I.D.)	0.627"-0.632"
	(1" x 14 Bolt Size)	(Width)	3.215"-3.240"
		(O.D.)	1.815"-1.821"
		(I.D.)	1.002"-1.009"

TORQUE SPECIFICATIONS

PART	FT. LBS. TORQUE
Spring U-Bolt Nuts (All "C/S" Series)	250-350
(All "T" Series)	190-210
Shock Absorber Nuts (when used) Upper Nut	85-90
Lower Nut	25-30
Rear Spring Radius Leaf Bolt Nut Bolt Nut (All 40 Series)	175-225
(All T Series)	290-320
(All "C/S" Series with ⅝" x 18 Bolt)	60-80
(All "C/S" Series with 1" x 14 Bolt)	150-200
Rebound Pin Retainer Bolt (All Except "T" Series)	10-14
("T" Series)	
50	5-10
60	20-25
Rear Axle Bumper Bolt Nuts (All Except "T" Series)	6-8
("T" Series)	10-12

HENDRICKSON TANDEM SUSPENSION SPECIFICATIONS

Spring Eye Bushing		
I.D.	1.247" installed*	1.253"
O.D.	1.498"	1.501"
LGT		3.96"
Spring Eye Pin (O.D.)	1.247"	1.248"
LGT		7³⁄₁₆"

*Ream at assembly.

HENDRICKSON (SERIES RT) TORQUE SPECIFICATIONS

			Ft. Lbs.
Spring Center Bolt	Bolt	7/16"-20	50-60
	Bolt	½"-20	65-75
Spring Saddle Top Pad Bolt	Nut		275-300
Spring Saddle Cap Stud	—		55-65
	Nut		275-300
	Nut*		225-275
Spring Saddle Top Pad Set Screw	—		100-150
Rear Spring Rear Rebound Bolt	Nut		40-50
Rear Spring Front Pin Lock Bolt	Nut		30-40
Equalizing Beam End Adapter	Bolt		300-320
	Nut		190-210
Torque Rod to Axle Housing Stud	Nut		110-120
Torque Rod Bracket to Side Rail Lower Flange Bolt	Nut		40-50
Torque Rod Bracket to Crossmember	Bolt		100-120
		⅝" x 11	90-110 Straddle Mount
		½" x 13	50-60 Straddle Mount
Torque Rod Ball Stud	Nut		450-500

*With Hardened Washers.

SECTION 4C
Rear Hubs and Bearings

DESCRIPTION

Rear hubs on all series trucks are mounted to axle housing tube on opposed tapered roller bearings as shown in figure 2. Hubs, bearings, and oil seals are identified with the type of rear axle. Refer to "Service Parts Identification Decal" to determine type of axle used on a specific vehicle.

Mounting parts (mainly bearings, seals, and sleeves) are of primary importance. Brake drum mounting bolts, studs, and nuts differ in type and their method of installation on the various series vehicles will vary.

NOTE: ALL HUB AND BEARING ATTACHMENTS, ARE IMPORTANT ATTACHING PARTS IN THAT THEY COULD AFFECT THE PERFORMANCE OF VITAL COMPONENTS AND SYSTEMS, AND/OR COULD RESULT IN MAJOR REPAIR EXPENSE. THEY MUST BE REPLACED WITH PARTS OF THE SAME PART NUMBERS OR WITH EQUIVALENT PARTS IF REPLACEMENT BECOMES NECESSARY. DO NOT USE REPLACEMENT PARTS OF LESSER QUALITY OR SUBSTITUTE DESIGN. TORQUE VALUES MUST BE USED AS SPECIFIED DURING REASSEMBLY TO ASSURE PROPER RETENTION OF THESE PARTS.

BEARING MAINTENANCE

All wheel bearings are adjustable for wear. Satisfactory operation and long life of bearings depend upon proper adjustment and correct lubrication. If bearings are adjusted too tight, they will overheat and wear rapidly. Loose adjustment will cause pounding and will also contribute to steering difficulties, uneven tire wear, and inefficient brakes. Bearing adjustment should be checked at regular inspection periods.

Hubs and bearings should be cleaned, inspected, and lubricated whenever hubs are removed, or at intervals indicated in LUBRICATION (SEC. 0) of this manual.

CLEANING

With a stiff bristle brush and cleaning solvent, thoroughly clean bearings and hubs, making sure that all old lubricant and dirt is removed. Check bearings and cups, replace damaged parts.

PACKING

Some wheel bearings are lubricated from axle differential after the initial lubrication. However, whenever wheel hub is removed, bearings should be cleaned, inspected, and re-lubricated. Some rear wheel bearings require cleaning, inspection, and lubrication at regular intervals as specified on lubrication charts.

When packing by hand, be sure that lubricant is kneaded between rollers and races. A mechanical lubricator can be used; however, bearings must be thoroughly lubricated.

DO NOT FILL HUB. Coat inside hub and axle spindle with thin coat (1/8" thick) of grease to retard rusting. Allow some excess grease at inner side of bearings and around adjusting nut. DO NOT PACK HUB WITH GREASE. The lubricant applied to bearings is sufficient to provide lubrication until next service period.

New hub oil seals should be installed when servicing bearings if there is the slightest indication of wear or damage. An imperfect seal may permit bearing lubricant to reach brake linings, resulting in faulty brake operation and necessitating premature replacement of linings.

BEARING ADJUSTMENT

BEARING ADJUSTMENT CHECK

Before checking wheel bearing adjustment, make sure brakes are fully released and do not

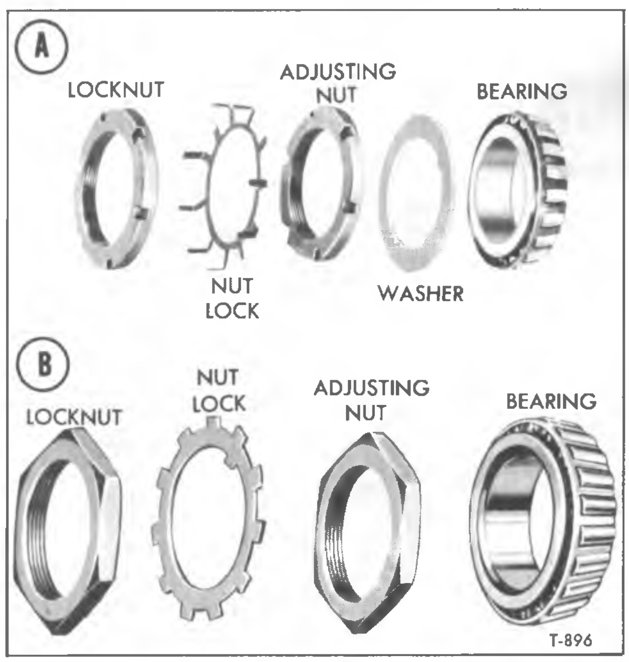


Figure 1—Rear Wheel Bearing Adjusting Nuts

REAR HUBS AND BEARINGS

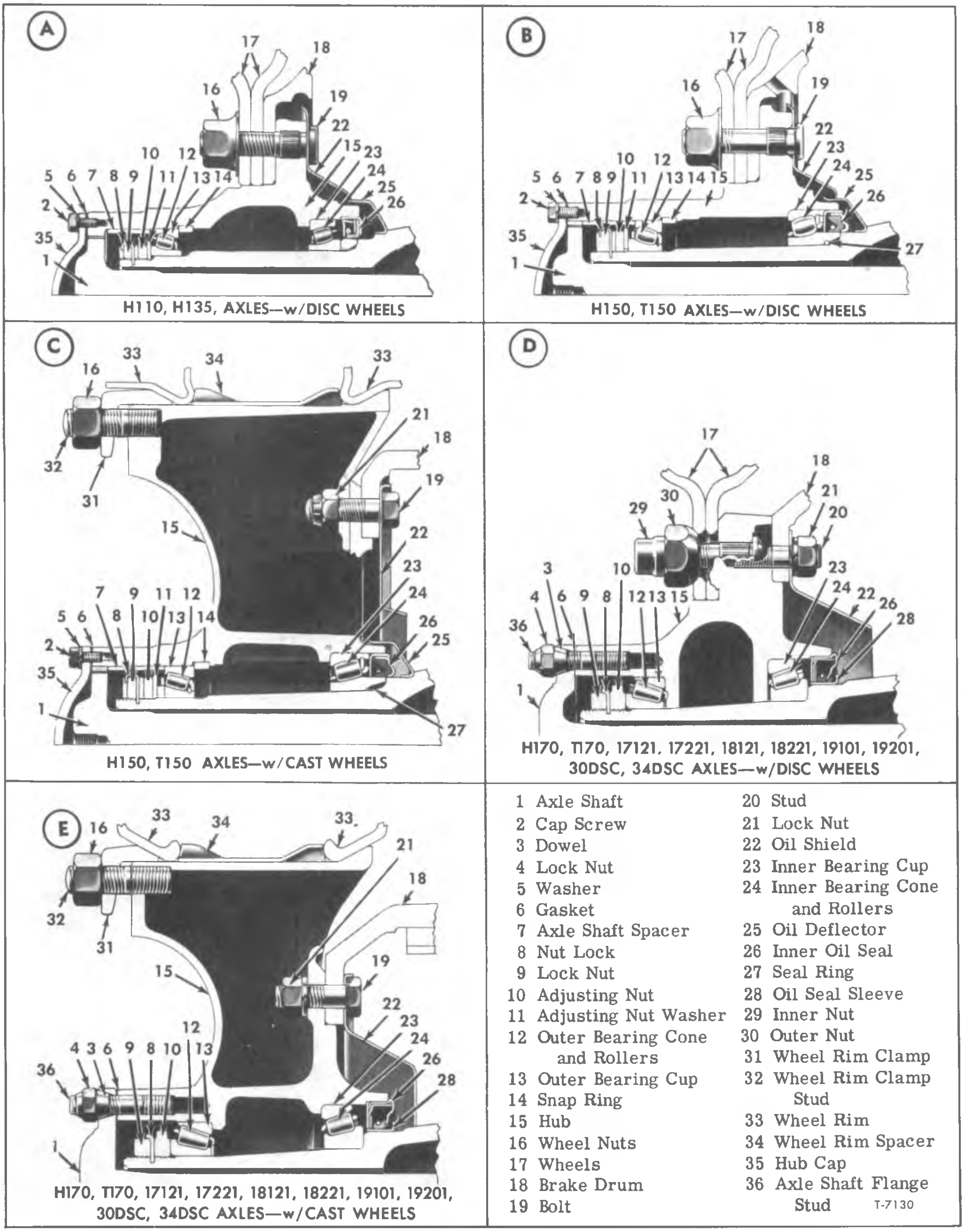


Figure 2—Rear Hubs, Bearings, and Oil Seals

drag. Jack up axle until tires clear the floor. Remove axle shafts as directed in "REAR AXLES" (SEC. 4A) of this manual.

Check bearing play by grasping tire at top and pulling back and forth, or by using a pry bar under tire. If bearings are properly adjusted, movement of brake drum in relation to backing plate or brake spider will be barely noticeable and wheel will turn freely. If movement is excessive, adjust as follows:

ADJUSTMENT

1. Jack up axle and remove axle shaft as directed in "REAR AXLES" (SEC. 4A) of this manual
2. Remove bearing lock nut and nut lock.
3. With a wrench, tighten adjusting nut to torque listed in "Specifications," while the wheel is being rotated in both directions to correctly position the bearings.
4. Back off the adjusting nut 1/8 to ¼ turn.
5. Install bearing adjusting nut lock, referring to figure 1.

a. If vehicle is equipped with type shown in View A, figure 1, align nearest slot in adjusting nut with short tang on nut lock and bend tang into slot on nut. Install lock nut with slots outward and tighten to torque listed in "Specifications." Then bend tangs of nut lock into slots in lock nut and adjusting nut.

b. If vehicle is equipped with type shown in View B, figure 1, align flat on adjusting nut with nearest lip of nut lock. Make sure wheel turns freely; then install nut lock and lock nut. Tighten lock nut to torque listed in "Specifications." Bend one lip of nut lock over one flat on each nut.

6. After completing bearing adjustment, recheck adjustment to make sure wheel turns freely. Final bearing adjustment should be within 0.001" to 0.007" end play.
7. Install axle shaft as directed in "REAR AXLES" (SEC. 4A) of this manual.

REAR HUB AND BEARING REMOVAL

(Refer to Figure 2)

1. Jack up rear axle and remove tire and rim assembly on vehicles having cast wheels. Remove tire and wheel assembly from trucks having ventilated disc or Budd type wheels.
2. If brake drum is demountable type, remove brake drum.
3. Remove axle shaft as directed in "REAR AXLES" (SEC. 4A) of this manual.

TYPES D AND E

1. Remove lock nut, nut lock, and adjusting nut from axle housing tube.
2. On Type E in figure 2, lift wheel (hub) and drum assembly straight off axle housing, using care to prevent outer cone and roller assembly from dropping out of hub. Remove outer bearing cone and roller from hub.
3. On Type D in figure 2, carefully pull hub assembly straight off axle housing, using care to prevent outer cone and roller assembly from dropping out of hub. Remove outer bearing cone and roller from hub.
4. Pull inner oil seal out of hub, then lift out inner bearing cone and roller assembly. Discard oil seal.
5. Clean, inspect, and repair parts as directed later under "Cleaning, Inspection, and Repair."

TYPES A, B, AND C

1. Raise tang of nut lock out of slot in lock nut; then using wheel bearing nut wrench listed in SPECIAL TOOLS at end of this manual, remove lock nut.
2. Remove nut lock, bearing adjusting nut, and washer from axle housing.
3. Carefully pull wheel (hub) and drum assembly or hub off axle housing.
4. Using a mild steel rod through outer end of hub, drive against inner bearing cup to drive inner cone and roller assembly and oil seal out of hub. Drive alternately on opposite sides of cup to prevent cocking of cup in hub. Discard oil seal.
5. Using a mild steel rod through inner end of hub, tap outer bearing cup outward away from the snap ring just enough to remove tension on snap ring.
6. Remove the snap ring, using Tru-arc or snap ring pliers through inner end of hub.
7. Using a mild steel rod against outer end of axle shaft spacer, drive outer bearing out of hub. Care must be taken to engage edge of spacer with punch and not damage bearing seat in hub. Alternately drive on opposite sides of spacer to avoid cocking bearing cup in hub.
8. Clean, inspect, and repair parts as follows:

CLEANING, INSPECTION, AND REPAIR

CLEANING

1. Immerse bearing assemblies in suitable cleaning solvent. Clean with stiff brush if necessary to remove old lubricant. Blow bearings dry with compressed air, directing air stream across bearings. Do not spin bearings while blowing them dry.
2. Thoroughly clean all lubricant out of inside of hub and wipe dry. Make sure all particles of gasket are removed from outer end of hub, and that all sealing compound is cleaned out of oil seal bore in inner end of hub.

REAR HUBS AND BEARINGS

3. Clean lubricant off axle housing tube.

4. Wash small parts such as nuts, spacers, and nut locks in cleaning solvent and wipe dry.

INSPECTION

1. Inspect bearings for excessive wear, chipped edges, or other damage. Slowly roll the rollers around cone to detect any flat or rough spots. Replace damaged parts. If either the cone and roller assembly or the cup of the roller bearings are damaged, the complete bearing assembly must be replaced.

2. Examine bearing cups which are still installed in hub. If cups are pitted or cracked, they must be replaced as directed later under "Repair."

3. Examine oil seal sleeve (when used) on which the hub inner oil seal lip wipes for evidence of wear or roughness. If any damage is evident, sleeve must be replaced. Oil seal sleeves are replaced as directed later under "Repair."

4. Examine axle shaft flange studs (Views D and E, fig. 2) for damaged threads or bent studs. Clean up threads or replace studs as necessary. On Views A, B and C, figure 2, check for damaged threads in tapped holes in outer end of hub. If threads are damaged, holes can be filled, drilled, and tapped, otherwise hub must be replaced. On hubs having internal splines, check condition of splines in outer end of hub. If any damage is evident, replace hub.

5. Examine brake drums for scoring or other damage. Non-demountable brake drums can be refinished while mounted on hubs. If necessary to replace brake drum refer to "Repair" later in this section.

6. Examine wheel studs or rim clamp studs for damaged threads and replace, if necessary, as directed later under "Repair."

7. Discard old oil seals and obtain new oil seals to be used at assembly.

REPAIR

<u>Bearing Cup Replacement</u>

1. Bearing cups are removed by using a mild steel rod through opposite end of hub and driving against inner edge of bearing cup. Alternately drive on opposite sides of cup to avoid cocking cup and damaging inside of hub.

2. To install new cups, position cup in hub and drive into place, using a suitable driver or by using a mild steel rod against outer edge of cup. If drift is used, alternately drive against opposite sides to assure driving cup in squarely. Cups must seat firmly against shoulder in hub.

<u>Inner Oil Seal Sleeve Replacement</u>

1. To remove oil seal sleeve (when used) tap sleeve around entire circumference with hammer to stretch the metal; then use a blunt chisel to cut into the sleeve inner flange. This will loosen the sleeve sufficiently to permit removal.

IMPORTANT: DO NOT damage axle housing tube when chiseling on sleeve.

2. Slide new sleeve over axle housing tube, then using axle oil seal sleeve driver set (J-3822-02), drive sleeve into place. Use care not to damage surface on sleeve which will be contacted by the inner oil seal.

<u>Brake Drum Replacement</u>

1. <u>Demountable Type.</u> The demountable type drum may be separated from the hub and removed from the vehicle without disturbing the axle shaft and hub. The drum is held to the hub by countersunk, slotted screws, which are easily removed with a screwdriver.

2. <u>Non-Demountable Type.</u> Construction of the non-demountable type hub and drum assembly is such that replacement cannot be accomplished with the hub assembly installed on the vehicle.

a. Separate the drums and hub by removing the drum-to-hub retaining bolts, hub stud nuts, or by pressing out the wheel studs, as applicable.

b. Position brake drum to hub assembly, making certain that all drain holes are in alignment.

c. Apply a light, even coating of sealing compound to the hub oil deflector contact surface, and position deflector to drum.

d. Install drum-to-hub retaining bolts, hub stud nuts, or press wheel studs into drum, as applicable.

<u>Wheel Bolt Replacement</u>

Wheel bolts are serrated and may also be swaged in place; however, replacement procedure remains the same for both types of installation. Press bolts out of hub flange, using suitable press, then press new bolts into place, making sure bolts are a tight fit. If all bolts were removed, be sure that hub oil deflector is in position under bolt heads.

IMPORTANT: If any wheel experiences a single stud failure, caused by a loose running wheel, all wheel studs should be replaced.

A loose running wheel may cause only one stud to break, but several more studs may become fatigued to the point of failure, but not actually breaking. Replacing only the one broken stud and remounting wheel will then set the stage for a second and possibly more serious failure. If holes in wheel have become elongated or enlarged, replace wheel.

<u>Hub Stud Replacement</u>

Hub studs can be removed and replaced by using a conventional stud remover and replacer. Make sure that studs are firmly bottomed in holes and that threads are not damaged during installation.

REAR HUB AND BEARING INSTALLATION

(Refer to Figure 2)

After completing cleaning, inspection, and repair operations, lubricate bearings, axle housing tube, and inside of hub as directed in LUBRICATION (SEC. 0) of this manual. Coat lip of oil seal and surface contacted by seal lip with wheel bearing grease or equivalent.

TYPE D AND E (Fig. 2)

1. Position inner bearing cone and roller in hub or wheel (hub) and drum assembly. Coat oil seal case with a thin layer of non-hardening sealing compound; then press seal in hub until seal lip seats against hub. Seal lip must point inward and driving tool used must exert force on outer edge of oil seal.
2. Make sure oil seal sleeve is in place on axle housing. Place wheel (hub) and drum assembly or hub on axle housing tube using care not to damage the inner oil seal.
3. Place outer bearing cone and roller assembly on axle housing tube and press firmly into place. Install bearing adjusting nut, nut lock, and lock nut on axle housing tube.
4. Install tire and rim assemblies or tire and wheel assemblies. Adjust wheel bearings as previously described under "Bearing Adjustment."
5. Install axle shafts as directed in "REAR AXLES" (SEC. 4A). Adjust brakes as directed in BRAKES (SEC. 5) of this manual.

TYPES A, B, AND C
(Refer to Fig. 2)

1. From inner end of hub place axle shaft spacer in hub, install outer bearing cone and roller assembly; then install outer bearing cup with thin edge of cup toward outer end of hub until it clears the snap ring groove, using a suitable sleeve. Install the snap ring in groove in hub.
2. Using a punch, drive axle shaft spacer to force outer bearing cup back against the snap ring.

IMPORTANT: This procedure must be followed to assure a wheel bearing adjustment that will not work loose.

3. Place inner bearing cup in hub with wide side of cup toward inside of hub. Press cup into hub until it seats against shoulder in hub, using a suitable sleeve.
4. Press new oil seal into hub flush or until it seats against bearing cup, on types shown in Views B, and C, in figure 2, make sure seal ring is in place in axle housing.
5. Carefully install wheel (hub) and drum assembly or hub.
6. Install adjusting nut washer, adjusting nut, nut lock, and lock nut on axle housing tube. Install brake drum if previously removed.
7. Install tire and rim assemblies or tire and wheel assemblies. Adjust wheel bearings as previously described under "Bearing Adjustment."
8. Install axle shafts as directed in "REAR AXLES" (SEC. 4A). Adjust brakes as directed in BRAKES (SEC. 5) of this manual.

SPECIFICATIONS

TORQUE SPECIFICATIONS

ADJUSTING NUT	FT. LBS.
All Axles Except Corp. H-110	50
Corp. H-110	75-100
LOCK NUT	
W/Rockwell and Eaton	100-150
W/Corp. T, H-150	135
W/Corp. H-110	250

IMPORTANT

At installation, always coat the oil seal bore in hub with a thin layer of non-hardening sealing compound and always be sure that the oil seals are properly seated.

SECTION 4D
Propeller Shafts

DESCRIPTION

Power is transmitted from transmission to rear axle through one or more propeller shaft and universal joint assemblies (fig. 1). The number of propeller shafts and universal joint assemblies vary with vehicle wheelbases and combination of transmission and rear axle equipment.

PROPELLER SHAFTS (Fig. 1)

All propeller shafts are tubular type. A splined slip joint is provided in each drive line. If a single propeller shaft is used, slip joint is at transmission end of shaft; if two or more shafts are used, slip joint is at forward end of rear shaft. End of slip yoke is sealed by a cork washer, held in place by a steel washer and a dust cap which threads onto end of yoke. Fixed yoke may be either welded to propeller shaft tube or it may be splined to a stub shaft and secured with a nut and cotter pin as shown in figure 2. It is recommended that a scribe mark be made on slip yoke and shaft to provide for alignment of yokes later at assembly.

UNIVERSAL JOINTS (Fig. 1)

Two types of universal joint assemblies are used on vehicles covered by this manual. Refer to "Specifications" at end of this section for type of joint used on any vehicle with standard equipment. Refer to applicable Parts Book for universal joint application with optional transmission and axles. Universal joints are described as follows:

Joint bearing cages are retained in yoke flanges on propeller shaft by snap rings. Bearings

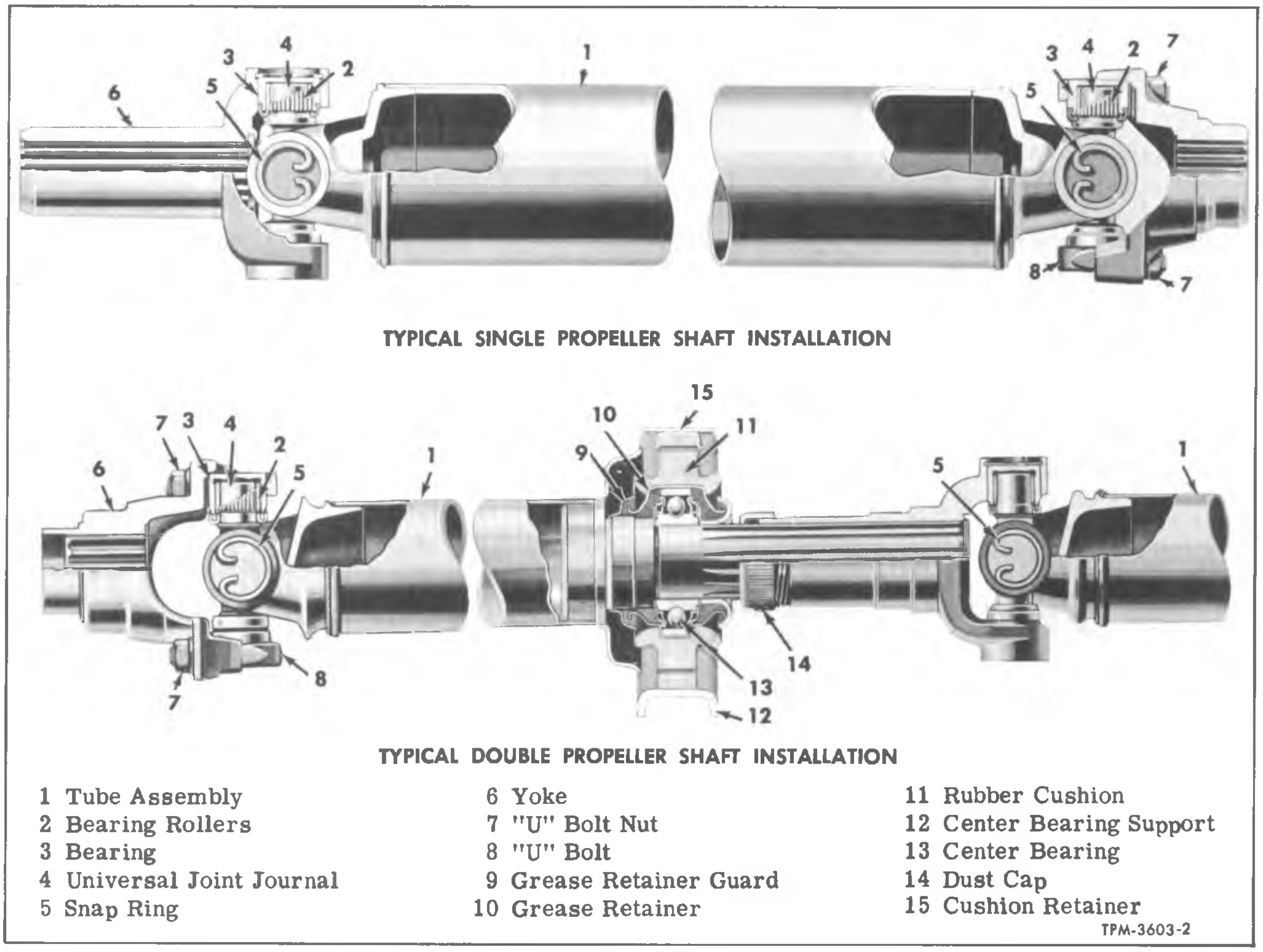


Figure 1—Typical Propeller Shaft and Universal Joints

SERVICE DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
Propeller Shaft Vibration	1. Propeller Shaft Out of Balance.	1. Check for Foreign Material on Propeller Shaft.
	2. Parking Brake Drum Out of Balance.	2. Replace Drum.
	3. Distorted or Damaged Yokes.	3. Install New Yokes.
	4. Yokes Out of Parallel to Each Other.	4. Change Propeller Shaft.
Universal Joint Noise	1. Center Bearing Worn.	1. Replace Center Bearing.
	2. Worn Universal Joint Bearings.	2. Replace Bearings.
	3. Improper Lubrication.	3. Lubricate as Directed.
	4. Loose Flange Bolts.	4. Tighten to Specifications.

at opposite end of propeller shaft are attached to journal cross with snap rings and U-bolts, lock washers and nuts. A visual inspection must be made of vehicle to determine at which end of propeller shaft U-bolts and lock rings are used and at which end of propeller shaft lock rings only are used. Needle rollers are installed in bearing cages and oil seals are installed on inner ends of cages.

Repair Kits

Universal joint repair kits are available for all types of universal joints. Each kit contains a journal, bearings and seals, and retaining components which should always be replaced when overhauling a universal joint.

CENTER BEARING (Fig. 2)

Center bearings are used to support center portion of drive line when two or more propeller shafts are used. Bearing is ball type, mounted in a rubber cushion which is attached to frame crossmember by the center bearing support. The two center bearings shown in cross section in figure 2 are of the same construction except for shape and location of dust slinger. View B illustrates center bearing used at shaft end with slip yoke; View A illustrates center bearing used at shaft end with fixed yoke. Bearing is prelubricated and permanently sealed. Cavities in grease retainers on both sides of bearing are packed with waterproof grease to exclude dirt and water.

LUBRICATION

Journals of universal joints are drilled and provided with lubrication fittings through which lubricant travels to all four oil reservoirs, then through a small hole in side of each reservoir, direct to needle bearings. Bearings are protected against lubricant leakage and entrance of foreign matter by seals. Splines of slip joint are lubricated through lubrication fitting installed in slip yoke.

NOTE: Universal joints and slip yoke splines should be lubricated periodically with grease as specified in LUBRICATION (SEC. 0) of this manual.

Use pressure gun to apply lubricant through fitting in universal joint trunnion. To ensure proper lubrication of all four trunnion bearings, it is important that lubricant be added until it appears at all four journal bearing seals. It should not be assumed that bearings are lubricated unless lubricant is observed coming from around all four bearing seals. However, if lubricant does not appear at all seals, move the universal joint trunnion in all four directions while applying lubricant under pressure.

PROPELLER SHAFT REMOVAL

Disconnecting propeller shaft permits removal of transmission or rear axle without disturbing unit at opposite end of shaft. On some vehicles, propeller shaft may be removed at any flange joint by removing nuts from bolts holding flanges. On other vehicles, propeller shafts must be disconnected at universal joints as described later in this section. Propeller shaft should be supported before removing to prevent damage by dropping. To remove complete drive line, on models in which center bearings are used, it is necessary to disconnect center bearing bracket from hanger and remove propeller shaft guards (when used) from supports. Refer to figure 3.

DISASSEMBLY OPERATIONS

SLIP JOINT DISASSEMBLY

With propeller shaft removed, scribe a mark on slip yoke and shaft to insure assembly is in exactly same relative position. When clearly marked, unscrew dust cap and withdraw shaft. Remove cork washer, steel washer, and dust cap from shaft.

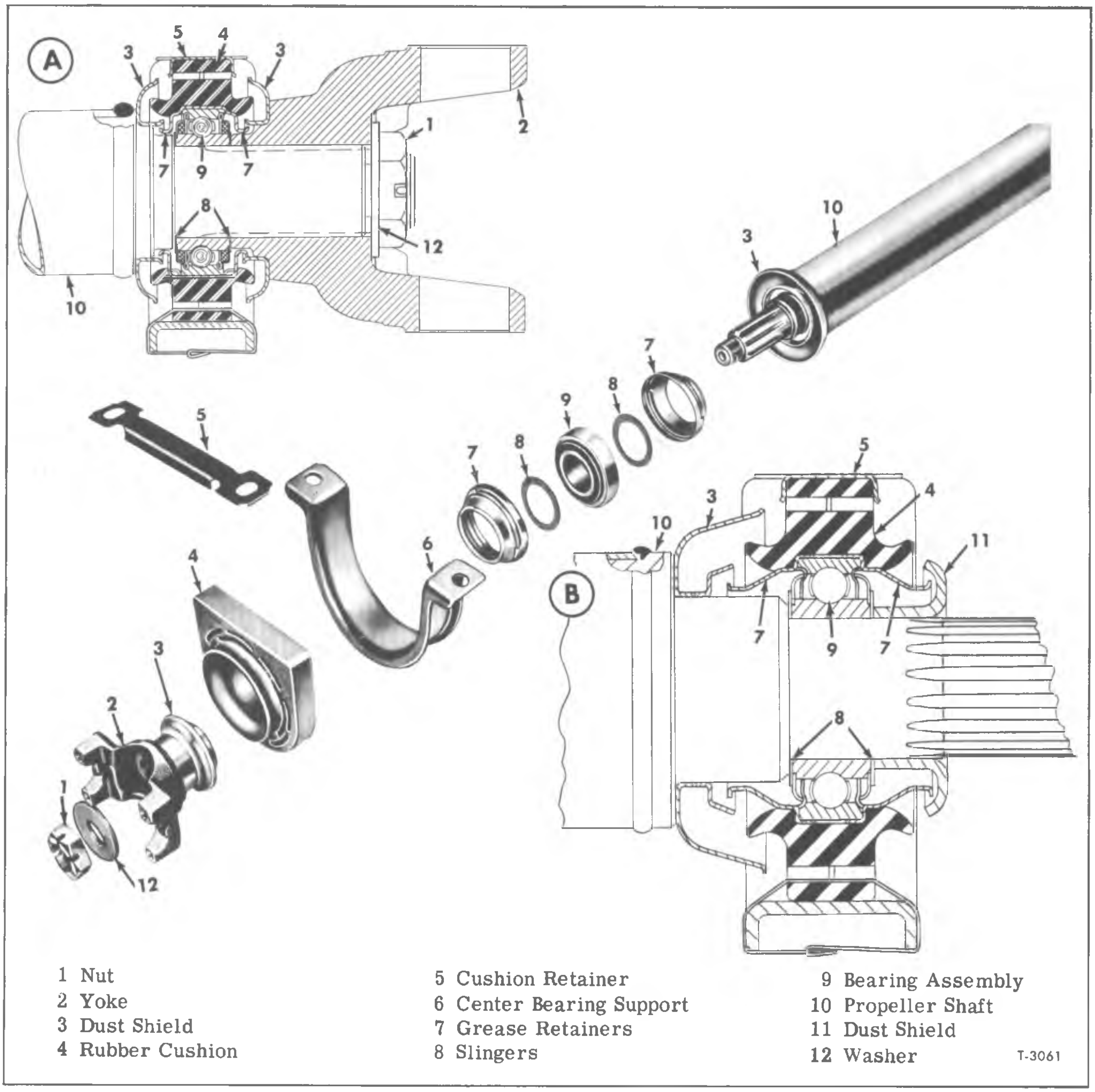


Figure 2—Typical Propeller Shaft Center Bearings

UNIVERSAL JOINT DISASSEMBLY

1. On universal joints using snap rings to retain bearings on journal cross, remove snap rings (fig. 1).

2. On universal joints using U-bolts to retain bearings on journal cross, remove nuts and washers from U-bolts, then remove U-bolts (fig. 1).

3. Strike one side of yoke with hammer to force one bearing out of yoke. Strike opposite side of yoke to force opposite bearing out.

CAUTION: Use care not to permit bearings to drop on floor, or irreparable damage may result.

4. Journal can now be tilted to permit removal of yoke from journal.

5. Remove the other two bearings in same manner to permit removing journal from opposite yoke.

CENTER BEARING DISASSEMBLY

The following procedure covers disassembly of center bearing with propeller shaft removed from vehicle. Key numbers in text refer to figure 2.

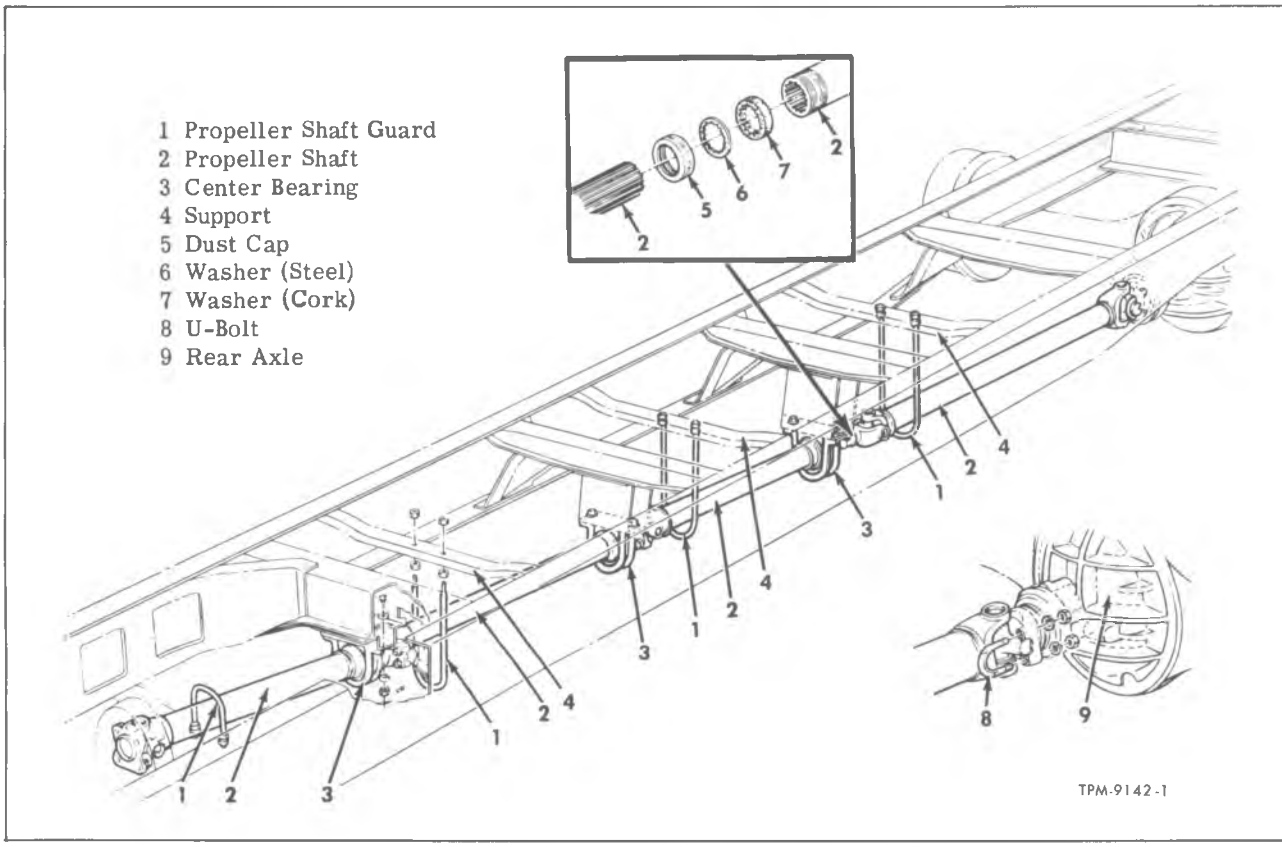


Figure 3—Propeller Shaft Guards Installed ("S" Series Shown)

1. Remove retainer (5) from support (6), then remove support from cushion (4).

2. On type shown in View A, figure 2, remove cotter pin and nut securing yoke (2) on shaft, then pull yoke off shaft. On type shown in View B, remove dust shield (11) from shaft.

3. Remove rubber cushion (4) from bearing (9), then pull bearing assembly from shaft.

4. Remove grease retainers (7) from bearing, and remove slingers (8).

IMPORTANT: Do not attempt to disassemble ball bearing. This is a sealed bearing and cannot be disassembled without being destroyed.

5. If dust shields (3) are damaged, use a chisel to break welds and remove shields.

CLEANING AND INSPECTION

PROPELLER SHAFT

Thoroughly clean old grease and dirt from shaft splines, then check splines for wear, warpage, and cracks. If shaft is worn, warped, or cracked, replace with new shaft. Welding of broken shaft is not recommended, since this operation requires special balancing facilities.

UNIVERSAL JOINT

Wash all parts in cleaning fluid. Make sure lubricant passages in journal cross are clean. Soak needle bearings and cages in cleaning fluid to soften particles of hardened grease, then wash in cleaning fluid, using a stiff brush if necessary to remove all old lubricant. Check each bearing for missing rollers. Refer to "Specifications" at end of this section for correct number of rollers. After needle bearing assemblies are thoroughly clean, apply clean lubricant to rollers and turn on trunnion of journal to check wear. Refer to LUBRICATION (SEC. 0) for type of lubricant and mileage intervals.

If excessive clearance is noted, discard journal and bearings and replace with new parts contained in universal joint repair kit.

SLIP JOINT

Using a suitable cleaning fluid, clean all dirt and old grease from slip yoke, slip yoke splines, and shaft splines. Carefully inspect slip yoke splines for wear or evidence of twisting. Check clearance between slip yoke splines and shaft splines. If backlash is excessive, replace parts.

CENTER BEARING

Wash all parts except ball bearing and rubber cushion in suitable cleaning fluid.

DO NOT IMMERSE SEALED BEARING IN CLEANING FLUID.

Wipe bearing and cushion clean with a cloth dampened with cleaning fluid.

Check the bearing for wear or rough action by rotating inner race while holding outer race. If wear or roughness is evident, replace with new bearing.

Examine rubber cushion for evidence of hardening, cracking, or deterioraton. Replace with new part if damaged in any way.

Grease retainers and slingers are serviced only as a part of the bearing assembly.

ASSEMBLY OPERATIONS

CENTER BEARING ASSEMBLY

Key numbers in text refer to figure 2.

1. If removed, install new dust shields (3) on shaft or yoke. Tack weld or stake shields in place.
2. Press a grease retainer (7) over each side of bearing outer race. Pack cavities in retainers with "MPG" type grease recommended in LUBRICATION (SEC. 0) of this manual.
3. Install one slinger (8) over end of shaft. Start bearing and retainer assembly straight on shaft, then using a suitable sleeve to exert force on bearing inner race, press bearing and slinger against shoulder on shaft. Install the other slinger (8) over shaft and position against bearing.
4. Install rubber cushion (4) over bearing assembly, making sure bearing is centered in hole in cushion.
5. Position support (6) around cushion and install cushion retainer (5).
6. On type shown in View B, figure 2, press dust shield (11) onto shaft against slinger (8). On type shown in View A, install yoke (2) on shaft.

IMPORTANT: Centerline through yoke flanges must be aligned with centerline of yoke flanges on other end of shaft. Install nut (1), tighten firmly, and secure with cotter pin.

SLIP JOINT ASSEMBLY (Fig. 1)

1. Position dust cap on shaft, then install steel washer and new cork or felt washer on shaft. Coat shaft splines with lubricant specified in LUBRICATION (SEC. 0) of this manual.
2. Align arrows or markings on splined shaft and slip yoke and insert shaft into slip yoke. Make certain yokes on both joints are exactly aligned.

IMPORTANT: Journal crosses must be in same plane, otherwise serious vibration will occur, with resultant damage to both shaft and connected units.

3. Thread dust cap onto end of slip yoke. Tighten dust cap by hand only; use of wrench will damage cork or felt washer.
4. Install lubrication fitting in slip yoke.

UNIVERSAL JOINT ASSEMBLY

NOTE: Make sure seals are in place on inner end of bearing cages. Apply lubricant recommended in LUBRICATION (SEC. 0) to needle rollers in each bearing to provide initial lubrication.

1. Install lubrication fitting in journal.
2. Install journal in yoke, then install bearing assemblies in yoke over journal trunnions. Use a plastic or rawhide hammer to tap bearings into place.
3. On universal joints using snap rings to retain bearings, press bearings in far enough to clear snap ring grooves, then install snap rings. Hold journal and lightly tap yoke to seat bearings outward against snap rings.
4. On universal joints using U-bolts, install U-bolts, washers, and nuts on journal bearing assembly and tighten nuts to torque listed in "Specifications."

PROPELLER SHAFT INSTALLATION

If propeller shaft has been removed at flange joint, position propeller shaft at joint, and install bolts, washers, and nuts. If propeller shaft has been removed at universal joints, assemble universal as previously described under "Universal Joint Assembly." Where complete drive line has been removed on models having center bearing, connect center bearing support to crossmember. On "S" models, install propeller shaft guards to frame supports. Refer to figure 3 for typical propeller shaft installation on "S" models. A visual inspection must be made of vehicle to determine the number of propeller shaft guards and center bearings used.

SLIP JOINT

NOTE: If a new propeller shaft is to be installed or slip joint(s) replaced, splines should be lubricated carefully before assembly to prevent alling during the initial break-in period. It is not safe

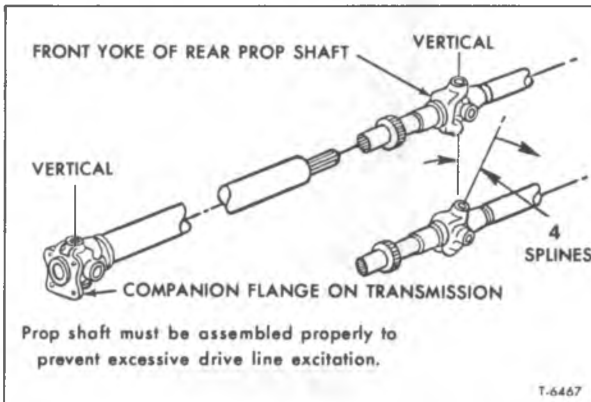
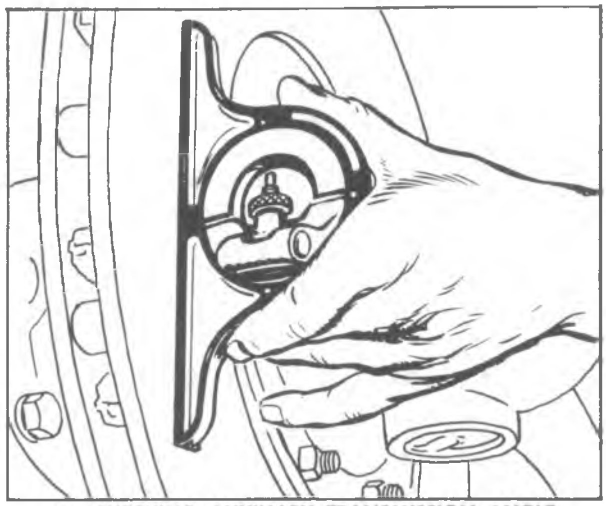
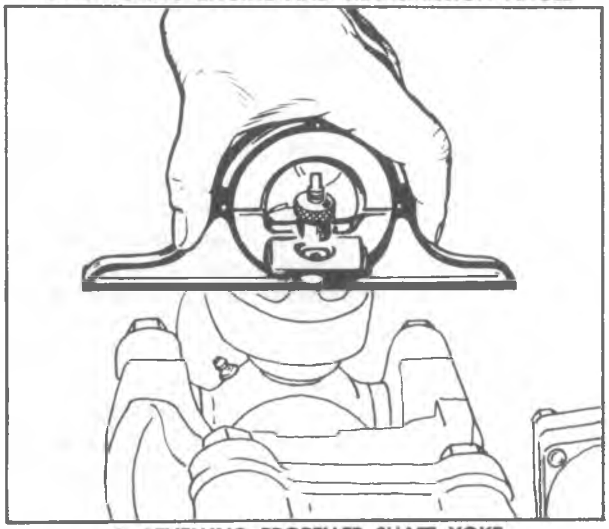


Figure 4—Propeller Shaft Spline Setting Chart

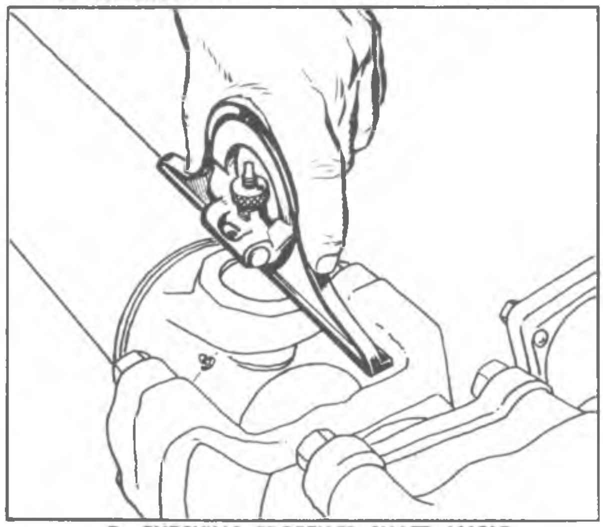
A—CHECKING ENGINE AND TRANSMISSION ANGLE



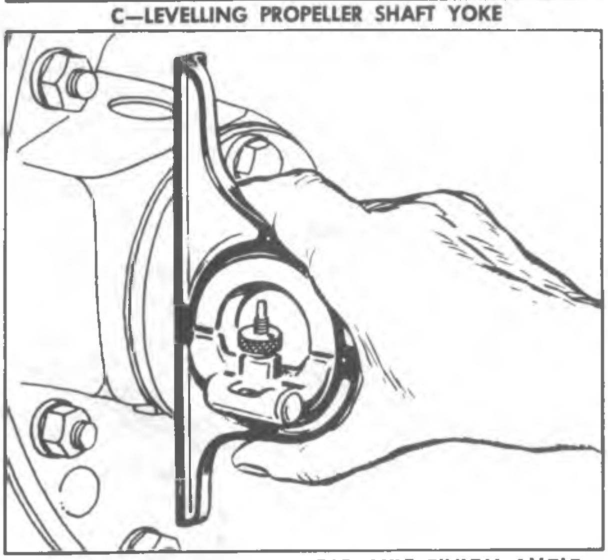
B—CHECKING AUXILIARY TRANSMISSION ANGLE



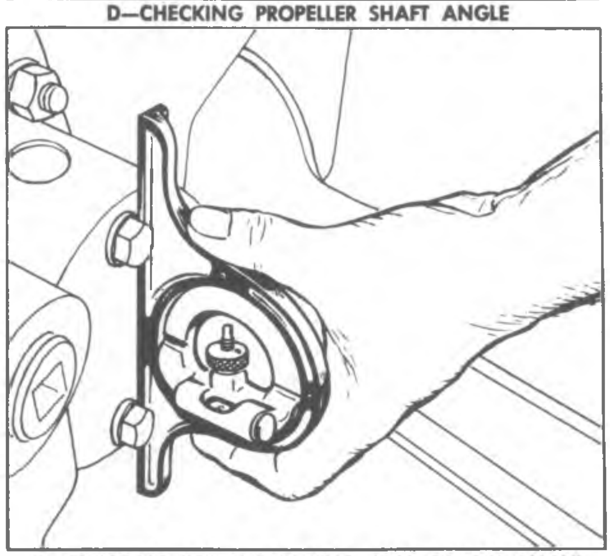
C—LEVELLING PROPELLER SHAFT YOKE



D—CHECKING PROPELLER SHAFT ANGLE



E—CHECKING FORWARD REAR AXLE PINION ANGLE



F—CHECKING REARWARD REAR AXLE PINION ANGLE

TPM-9995

Figure 5—Checking Drive Line Angles

to rely on lubrication after assembly only, since some of the splines may remain dry and burning of spline teeth could occur.

PROPELLER SHAFT YOKE ALIGNMENT

When assembling multi-shaft drive lines, care must be exercised to prevent excessive vibration. The following procedure must be carefully performed if drive line excitation is to be held to a minimum.

1. Companion flange on transmission must first be placed in vertical position.

2. Align front yoke of rear propeller shaft in identical position. Rotate (when necessary, to specified spline setting) in direction indicated in figure 4. Then assemble rear shaft to forward propeller shaft.

Propeller shaft spline settings are as follows:

Two-piece propeller shaft - 4 splines
Three-piece propeller shaft - Vertical
Four-piece propeller shaft - 4 splines

TANDEM AXLE DRIVE LINE ANGLES

Correct drive line angles are necessary to prevent torsional vibration on tandem rear axle models. On some vehicles adjustable auxiliary transmission mountings are provided for adjusting the angle of the various drive line components. On vehicles of the various drive line components. On vehicles not having adjustable auxiliary transmission mountings and adjustable torque rods at rear axles, proper adjustment of the angle of the drive line components must be accomplished by the use of spacers or shims at the frame crossmember. The following procedure covers checking and adjusting drive line angles on vehicles equipped with an auxiliary transmission. Without an auxiliary transmission, the same procedures apply, omitting steps applying to the auxiliary transmission.

DRIVE LINE ANGLE ADJUSTMENT

All angles must be checked with a maximum amount of exactness. The use of a devil level or other such instruments is not sufficient; a bevel protractor must be used.

1. The vehicle should be set on a reasonably flat surface. Do not zero the frame.

2. Clean machined surface at rear of main transmission, then use a protractor as shown in View A, figure 5, to check engine and main transmission angle. Protractor must be held straight up and down to get the proper reading. This angle is important, as this is the key angle and the auxiliary and forward rear axle pinion must be set to this angle.

3. Check angle of auxiliary transmission at the Tru-Stop brake disc as shown in View B, figure 5. Surface of disc must be smooth and not warped. The angle of the auxiliary transmission must be the same as the engine and main transmission (step 2). Adjust, if necessary, by raising or lowering front or rear of auxiliary transmission by removing or adding plates, washers, spacers, etc. (refer to "AUXILIARY TRANSMISSIONS" (SEC. 7C) of this manual for auxiliary transmission mountings).

4. After adjusting auxiliary transmission angle make sure the auxiliary is properly centered in the vehicle as follows: Measure from ends of the transmission rear cross beam to the frame (also at front cross beam when used). Measure from auxiliary transmission frame brackets to the ends of the rear cross beam (and front cross beam, when used). Measurements at both ends of each cross beam must be equal. Make adjustments as necessary. If adjustment is made, it is mandatory to recheck the auxiliary transmission angle as described in Step 3.

5. Check angle of propeller shaft between the main transmission and auxiliary transmission. This shaft angle is important.

a. Clean dirt and paint off machined surface of propeller shaft yoke, and make sure surface is free from nicks or burrs. Set bevel protractor to zero, place protractor on yoke surface as shown in View C, figure 5, then rotate shaft until bubble is centered in glass. Reposition protractor on yoke as shown in View D, figure 5, holding in line with shaft, and note the shaft angle. This shaft angle must be held within a maximum of 1 degree less than the engine and auxiliary transmission angles; i.e., if engine and transmission angles are 3° 45', shaft angle must be within 2° 45' minimum to 3° 45' maximum.

b. The shaft angle can be adjusted, if necessary, by raising or lowering the auxiliary transmission by taking an equal number of turns at each of the adjustable mounting bolts on some vehicles. On other vehicles it will be necessary to add or subtract plates, washers, spacers, etc., to raise or lower the auxiliary transmission.

NOTE: It is important to make adjustment at each mounting bolt an equal amount so the auxiliary transmission angle will not be changed.

6. On rear axles which have a machined surface on the differential carrier at right angles to the pinion shaft, such as 2-speed shift motor adapter, check angle of the forward rear axle pinion by

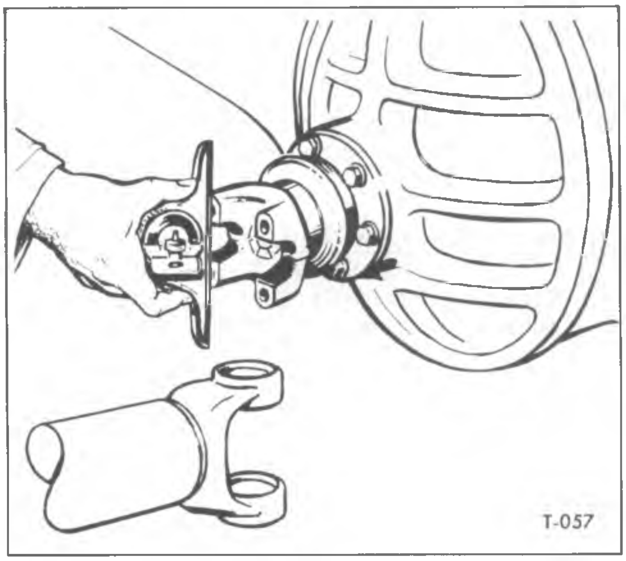


Figure 6–Checking Pinion Angles

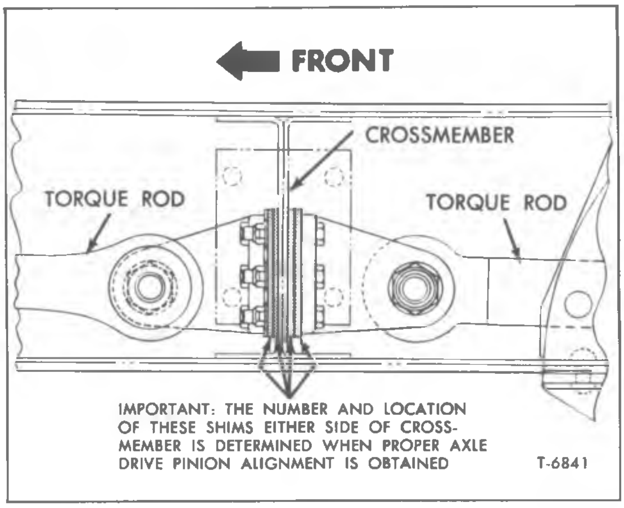


Figure 7–Torque Rods Installed at Frame Crossmember with Shims Installed (Typical)

cleaning the two-speed adapter cover and placing the protractor as shown in View E, figure 5. Make sure protractor is held straight up and down to get a correct angle reading. Pinion angle should be the same as engine and auxiliary transmission angles. Adjustment can be made, if necessary, by using shims at upper torque rod mountings.

7. On rear axles that do not have a machined surface on the differential carrier housing it will be necessary to remove the inter-axle shaft. Rotate the rear pinion yoke on the forward rear axle into a vertical position. Clean the four machined ends of the yoke of dirt, nicks, and burrs. Place the protractor across ends of the yoke on either side in as close as possible to a vertical position as shown in figure 6 and read the angle. Pinion angle should be the same as the engine and auxiliary transmission angles. Adjustment can be made, if necessary, by using shims at upper torque rod mountings.

8. Clean machined surface of yoke on the inter-axle propeller shaft and check the shaft angle in same manner described in Step 5a.

9. Check rearward rear axle pinion angle as described in Step 6 and as shown in View F, figure 5, on rear axles which have a machined surface on the differential carrier housing. On rear axles not having a machined surface on the differential carrier housing, check rearward rear axle pinion angle as described in Step 7 and shown in figure 6.

IMPORTANT: The rear axle pinion must be adjusted up or down by shims at torque rod mounting bracket until the resultant angle of the forward axle pinion angle, subtracted from the inter-axle shaft angle, is equal to the resultant angle of the inter-axle shaft angle subtracted from the rear axle pinion angle. Refer to figure 7 for location of shims.

Example: Forward axle pinion angle = 3°.
Inter-axle shaft angle = 6°.
Rear axle pinion angle = 9°.

Forward axle pinion angle (3°) subtracted from inter-axle shaft angle (6°) equals 3°.

Inter-axle shaft angle (6°) subtracted from rear axle pinion angle (9°) equals (3°).

When repairing universal joints do not mix used parts with new. Install new cross and bearing repair kit only.

See following page for "Specifications."

SPECIFICATIONS

UNIVERSAL JOINT APPLICATION

The following tabulation lists universal joints used with standard equipment only. Refer to parts book for universal joints used with optional equipment.

TRUCK SERIES	UNIVERSAL JOINT
CE-40	1350
CE-50	1410
CS-50	1410
SE-50	1410
TE-50	1480
TS-50	1410
CE-60	1410
ME-60	1480—58 WB
TE-60	1480

UNIVERSAL JOINT SPECIFICATIONS

JOINT SERIES	JOURNAL DIAMETER	NO. OF NEEDLES PER BEARING	DIAMETER OF NEEDLES	LENGTH OF NEEDLES
1350	0.7730"-0.7735"	34	0.0783"-0.0785"	0.625"
1410	0.7730"-0.7735"	34	0.0783"-0.0785"	0.625"
1480	0.8942"-0.8947"	33	0.0936"-0.0938"	0.765"
58 WB	1.0621"-1.0625"	39	0.0928"-0.0930"	0.829"

TORQUE SPECIFICATIONS

UNIVERSAL JOINT U-BOLT NUT		
⅜" x 24 Nut	1350-1410	20-24 ft. lbs.
7/16"-20 Nut	1480	32-37 ft. lbs.
PROPELLER SHAFT-TO-HANGER ATTACHING PARTS		
7/16" x 20 Nut		25-30 ft. lbs.
PROPELLER SHAFT TO REAR AXLE		
⅜" x 24 Nut	1350-1410	20-24 ft. lbs.
7/16" x 20 Nut	1480	32-37 ft. lbs.
	58 WB	40-50 ft. lbs.
PROPELLER SHAFT TO TRANS.		
7/16" x 20 Nut	1350-1410	50-60 ft. lbs.
½" x 20 Nut	1480	60-70 ft. lbs.
	58 WB	40-50 ft. lbs.
PROPELLER SHAFT TO PROPELLER SHAFT		
⅜" x 24 Nut	1350-1410	20-24 ft. lbs.
7/16" x 20 Nut	1480	32-37 ft. lbs.
	58 WB	40-50 ft. lbs.
PROPELLER SHAFT HANGER-TO-CROSSMEMBER		
⅜" x 16 Nut		15-20 ft. lbs.
TRANSMISSION COMPANION FLANGE (NUT) (Except ME-60)		30-40 ft. lbs.
TRANSMISSION COMPANION FLANGE (NUT) (ME-60)		65-85 ft. lbs.
PROPELLER SHAFT GUARD (NUT)		50-60 ft. lbs.
YOKE BOLT TO FRONT DIFFERENTIAL		90-130 ft. lbs.
YOKE U-BOLT TO FRONT AND REAR DIFFERENTIAL (NUT)		40-55 ft. lbs.

Proper torque of all mounting flange bolts and universal joint U-bolts should be maintained to prevent vibration and damage to needle bearings, and mounting components.

SECTION 5

Brakes

This group is divided into three sections as shown in Index below:

BRAKE SYSTEM EQUIPMENT

There are four different brake systems used on vehicles covered by this manual.

1. Straight Hydraulic brakes are used as Standard equipment on all 40 Series trucks.

2. Vacuum Assisted Hydraulic brakes are used as standard and/or optional equipment.

3. Vacuum assisted split systems are used as standard equipment on school bus models and as optional equipment on conventional models.

4. Full air brakes are available on all models covered by this manual when specified on the sales order or as optional equipment, except 40 series.

5. Optional Equipment is available in both systems. Such items as vacuum reserve tank, heavy duty boosters, vacuum gauges, trailer brake connections, air parking brake, moisture ejector, etc., are factory installed options.

IMPORTANT: The following brake maintenance schedules, adjustments, procedures, and replacement techniques are required and are applicable to normal vehicle usage. Unusual or severe operations require greater attention to the normal maintenance approach commensurate with the usage severity.

SECTION 5A

Hydraulic Brakes

GENERAL

The vacuum power assisted system used on vehicles covered by this manual is described as a "one to one" system; that is the volume of hydraulic fluid output of the vacuum booster is the same as the input volume. This type system eliminates the need for compensating lines and also the need for "pumping" the brake pedal in the event of loss of vacuum power assist.

The vacuum system on these vehicles contains a check valve which maintains enough vacuum in

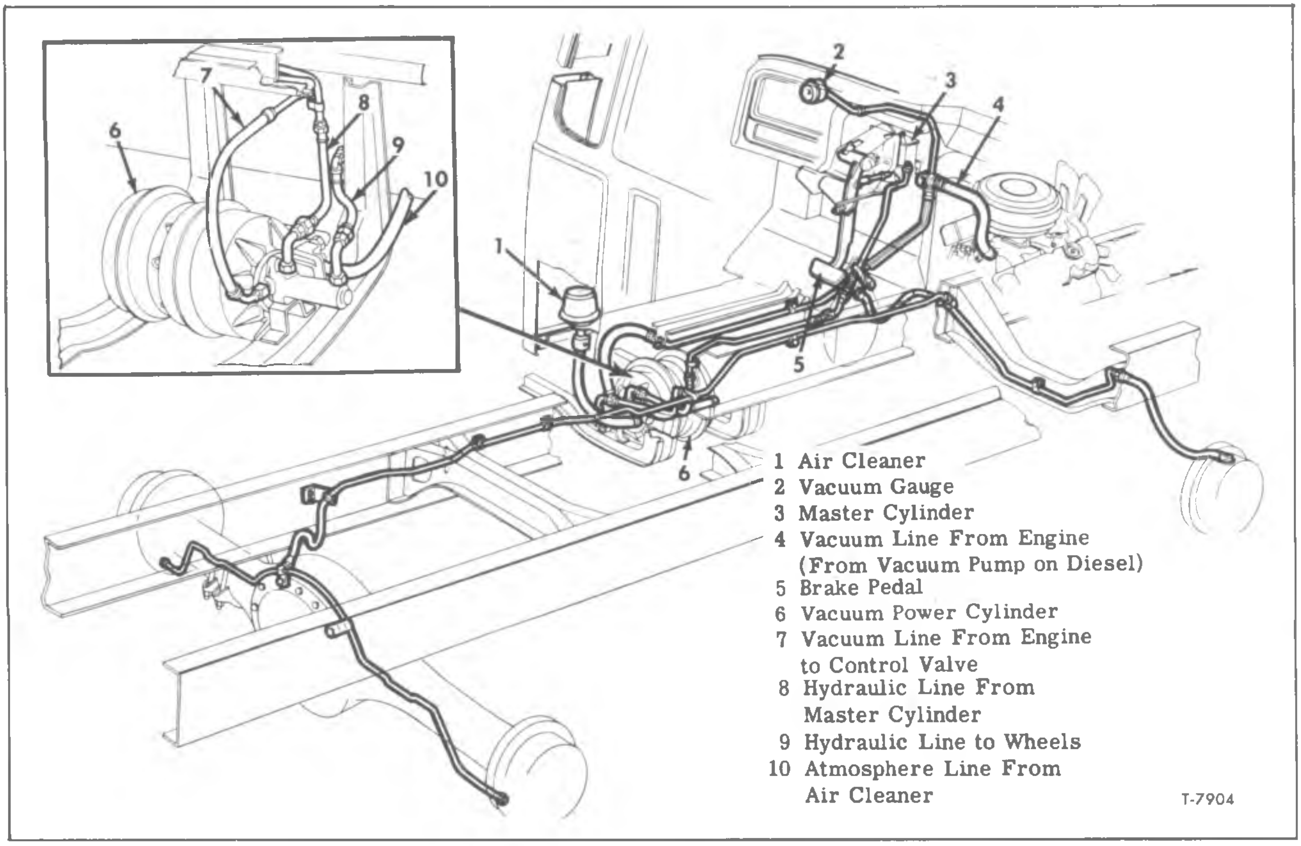


Figure 1—Typical Vacuum and Hydraulic Lines Installed

the booster chamber to permit at least one power assisted brake application after loss of vacuum.

The various components of the brake system, such as shoe and lining assemblies, pedal and linkage, power boosters, master cylinders, wheel cylinders, lines, gauges, reserve tanks, etc., are covered under respective headings in this section.

For illustration of typical system installation see figure 1.

BRAKE SYSTEM MAINTENANCE

1. Maintain proper level of brake fluid in master cylinder. Refer to LUBRICATION (SEC. 0) for recommended fluid and checking intervals.
2. Adjust brake shoes at regular intervals. After two or three adjustments, check brake linings for wear. Reline brakes before lining is worn sufficiently to permit rivets to damage brake drums.
3. Keep pedal and linkage lubricated to assure free movement and rapid release of brakes.
4. Inspect entire brake system regularly for fluid leakage. Correct leakage immediately.
5. Make sure brake shoes are free on their mountings, that shoe return springs are not weak or broken, and that backing plates are not sprung or loose on axle or steering knuckle.
6. To service power cylinder air cleaner, refer to LUBRICATION (SEC. 0) for recommended intervals. For service instructions see "Vacuum Power Cylinder Air Cleaner" later in this section.
7. Tighten all vacuum and atmosphere line fittings and connections.
8. Perform "Power Brake System Tests" as directed later under "Power Cylinders." These tests may reveal sub-standard performance before the condition becomes bad enough to cause driver complaints or brake failure on the road.

NOTE: The use of alcohol for cleaning component parts is acceptable provided parts are completely air dried and coated with brake fluid before installation. DO NOT USE ALCOHOL FOR FLUSHING SYSTEM OR CLEANING ASSEMBLIES WHERE ALCOHOL COULD BE TRAPPED AND SUBSEQUENTLY CONTAMINATE BRAKE FLUID.

BRAKE ADJUSTMENTS

There are six different type brakes used on these vehicles:

1. Type "F" manual adjusting - FRONT.
2. Type "FA" automatic adjusting - FRONT.
3. Type "FR-3" manual adjusting - REAR.
4. Type "FR-3A" automatic adjusting - REAR.
5. Duo-Servo automatic adjusting - FRONT.
6. Twin-Action automatic adjusting - REAR.

MANUAL ADJUSTMENT

All manual brake adjustments to compensate for normal lining wear can be made without removing wheels and brake drums. Adjustment points are accessible through openings in brake backing plate or are external type.

NOTE: Wheel bearings must be properly adjusted before attempting to adjust brake shoes. Refer to "HUBS AND BEARINGS" (SEC. 3D for FRONT and SEC. 4C for REAR).

Brake shoe adjustment points for front brakes (Type "F") are illustrated in figure 2. Adjustment points for rear brakes (Type "FR-3") are shown in figure 3.

Type "F" (Fig. 2)

1. Jack up front end of vehicle until wheels clear floor. Place wrench on one adjusting cam stud to adjust one shoe. Rotate wrench in direction of forward wheel rotation to decrease lining-to-drum clearance. Reduce clearance until brake drag is felt as wheel is turned in forward direction by hand.

2. Move wrench slightly in opposite direction until brake drag is relieved, then move wrench an additional 7 to 10 degrees to provide running clearance. (7 to 10 degrees is equal to 1 to 1½ inches of travel at end of an 8-inch wrench.)

3. Place wrench on opposite adjusting cam stud and adjust second shoe by repeating Steps 1 and 2.

Type "FR-3" (Fig. 3)

1. Jack up vehicle until wheels are clear of floor. Remove adjusting hole covers from backing plate.

2. At one adjusting slot, insert suitable adjusting tool through slot and engage adjusting wheel and decrease lining clearance until lining drags on drum.

3. Relieve drag by rotating adjusting wheel in opposite direction. Back off adjustment as follows:

For worn lining - 3 notches (clicks).
For new lining - 5 notches (clicks).

4. At other adjusting slot, repeat Steps 2 and 3 to adjust other shoe.

5. Install hole covers in backing plate.

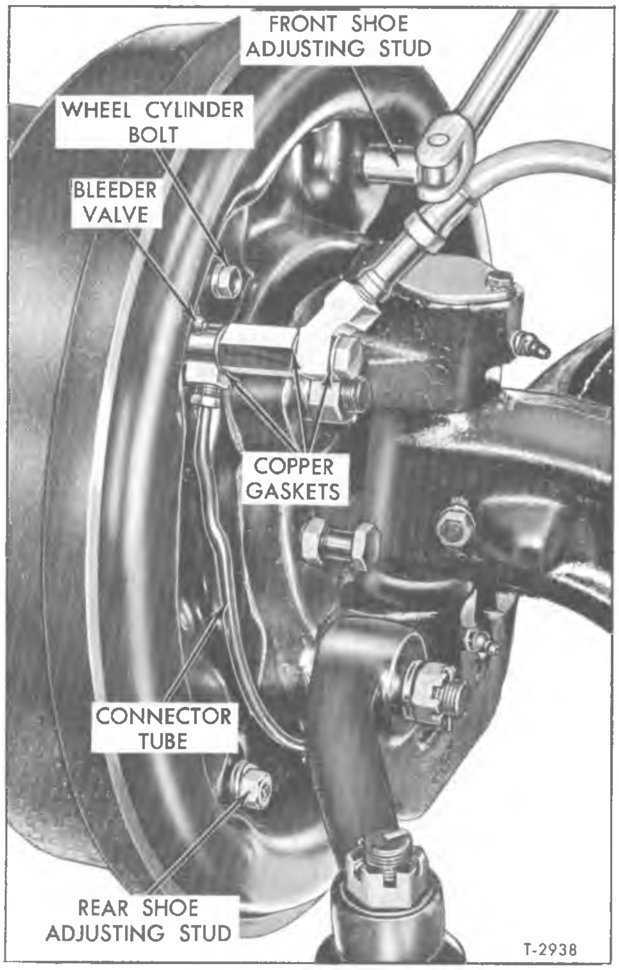


Figure 2—Type "F" Brake Adjustment

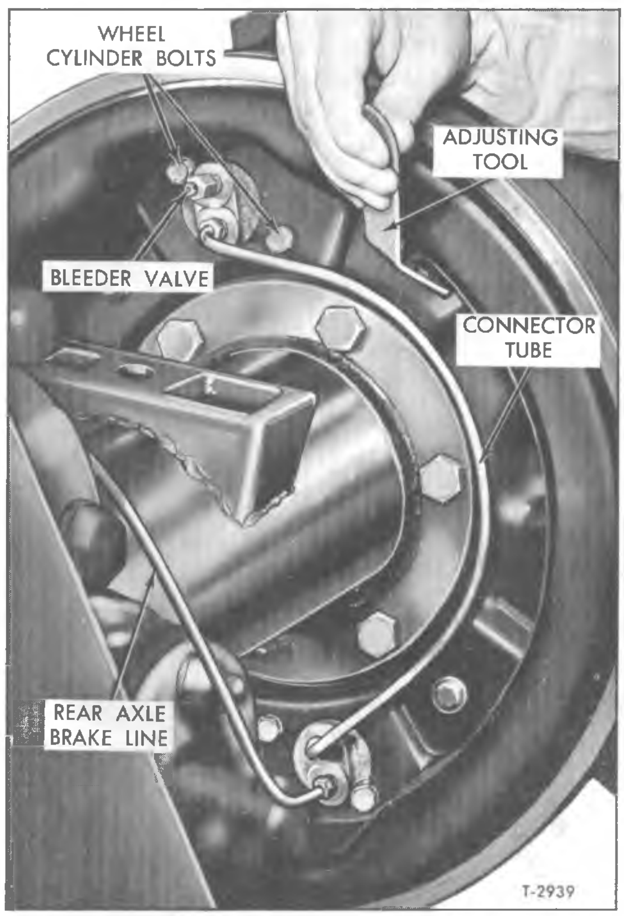


Figure 3—Type "FR-3" Brake Adjustment

HYDRAULIC BRAKES

AUTOMATIC ADJUSTMENT

Duo-Servo

As the brakes are applied, when vehicle is traveling in reverse, the shoes contact the drum and revolve with the wheel until the web of the primary shoe contacts the anchor pin. This motion causes the secondary shoe to move away from the anchor pin, thus increasing the distance between the actuating lever pivot point and the anchor pin. Since the actuating link maintains a constant length, the actuating lever assembly pivots on the secondary shoe hold-down pin location and the pawl end of the lever rocks down against the adjusting screw star wheel. If the lining is worn enough to allow sufficient movement of the secondary shoe, the pawl will advance the star wheel one or two teeth. If the brake linings are not worn enough to require an adjustment, the restricted movement of the secondary shoe prohibits over-adjustment.

When the brakes are released, the pull-back springs return the shoes to the rest position. At the same time, the actuating lever return spring moves the linkage to the rest position. The contour of the actuating lever pawl allows the lever to ratchet back to the rest position and in effect "take a new bite" on the star wheel. As a result of this action, the linkage is in position to make the next adjustment as it is needed.

Under normal operating conditions it is not necessary to make any manual adjustment to this type brake. However, when it is necessary to remove a brake drum it may also be necessary to "back-off" the adjustment in order to pull edge of drum past linings. In such cases, insert a screwdriver or awl through hole in backing plate and hold adjusting lever or pawl away from adjusting screw. Then turn screw with proper brake tool to loosen adjustment. See figures 4 and 5.

Twin-Action

Brake shoe adjustment takes place when brakes are applied with a firm pedal effort while the vehicle is backing up. Applying the brakes moves adjusting levers which turn the star wheels and rotate the adjusting screws outward from the anchor brackets. This action adjusts the shoe until clearance between the lining and drum is within proper limits.

Should low pedal heights be encountered, it is recommended that numerous forward and reverse stops be performed with a firm pedal effort until a satisfactory pedal height results.

Access holes are located in the flange plate. These holes are for service purposes in the event retracting of the brake shoes is required to remove the drum. In order to back off the adjusting screws, remove the cover from the access hole and insert a screwdriver. Place a corner of the screwdriver blade in the hole in the adjusting lever and push the lever away from the star wheel. Using a brake adjusting tool, back off the star wheel. See figures 4 and 5.

BLEEDING BRAKES

Use only Hydraulic Brake Fluid recommended in LUBRICATION (SEC. 0). When other than recommended fluid has been used, drain and flush the entire hydraulic system, using only new, clean brake fluid as a cleaning agent. Disassemble, clean, and inspect hydraulic units. Replace all rubber parts. Refill system with recommended fluid.

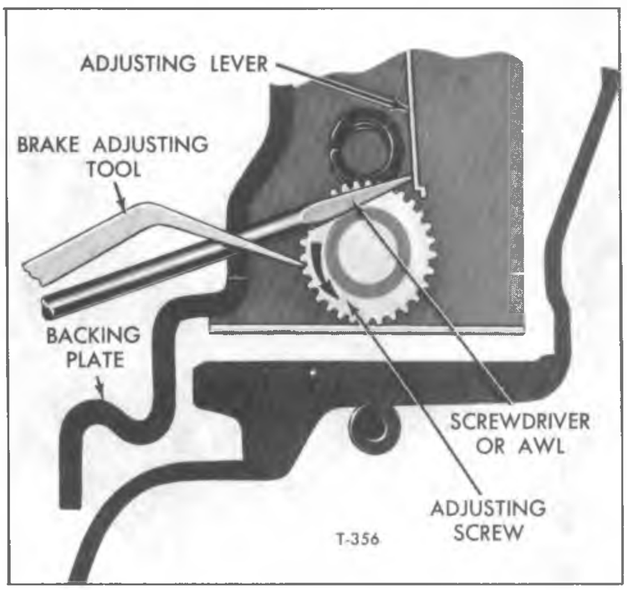


Figure 4—Backing Off Adjusting Screw (Cross Section View)

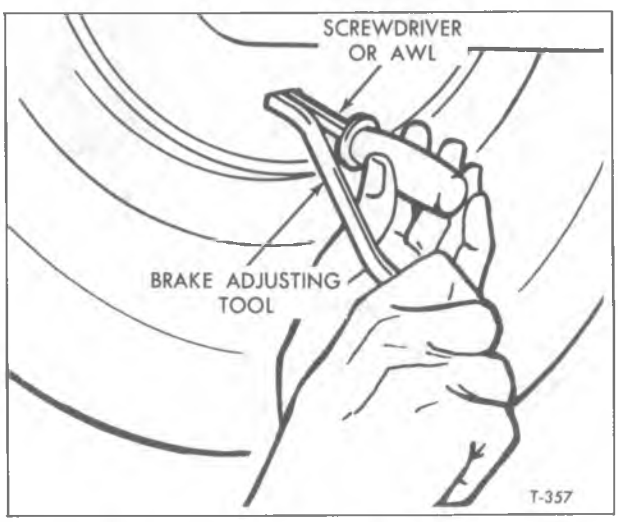


Figure 5—Backing Off Adjusting Screw (Outside View)

The need for bleeding air from system is generally indicated by a springy, spongy pedal action. The presence of air in system is a result of low fluid level in master cylinder, or of some part of the system having been disconnected. Bleeder valves are provided on the power cylinder (some models), master cylinder (some models) and at wheel cylinders. Type "F" and type "FA" front brakes have two cylinders per wheel and each has a bleeder valve. Type "FR-3" and type "FR-3A" rear brakes have two cylinders per wheel with a bleeder screw at the top cylinder only. Duo-Servo front brakes have one cylinder per wheel and each has a bleeder screw. Twin-Action rear brakes have two cylinders per wheel with a bleeder screw at the top cylinder only. Refer to figure 7 for bleeding sequence by type of brakes. There are many different combinations of brake types used, depending on whether standard or optional equipment is ordered.

Master cylinder is accessible under the hood on conventional models and through access door in seat riser on tilt cab models. Bleeder valves at wheel cylinders are accessible at inner sides of the backing plates.

It is recommended that brake system is bled in a definite sequence to obtain best result. Figure 7 illustrates various combinations of brake equipment used, with bleeder valves numbered in the recommended sequence in which they should be bled.

IMPORTANT: If neither master cylinder nor power cylinder is equipped with a bleeder valve and bleeding at the wheels only does not produce satisfactory results, it will be necessary to disconnect line from master cylinder and bleed it through output port. Then reconnect line and disconnect power cylinder output line and bleed. Reconnect line and check operation of brakes. If still not satisfactory, re-bleed wheel cylinders in sequence shown.

There are two methods of bleeding hydraulic brake systems used on these vehicles; pressure bleeding and manual bleeding. Both are acceptable and adequate, but pressure bleeding is recommended, if equipment is available.

CAUTION: Before starting pressure bleeding operations, stop engine and destroy vacuum in system before opening any bleeder valve.

SPLIT SYSTEM (STANDARD ON "S" MODELS)

The split system on single axle conventional and school buses consists of two separate brake systems split as follows:

1. Main System - front wheel brakes plus one cylinder on each rear wheel brake.
2. Secondary System - one cylinder on each rear wheel brake.

The system on both models consists of a dash mounted master cylinder and two frame mounted power cylinders.

On tandem axle models the system is split as follows:

1. Main System - front wheel brakes plus rear rear axle brakes.
2. Secondary System - the front rear axle brakes.

It does not matter which system (main or secondary) is bled first, however, each must be bled separately.

Figure 6 illustrates a tool which can be made locally for use in pressure bleeding the split brake system (both standard and optional).

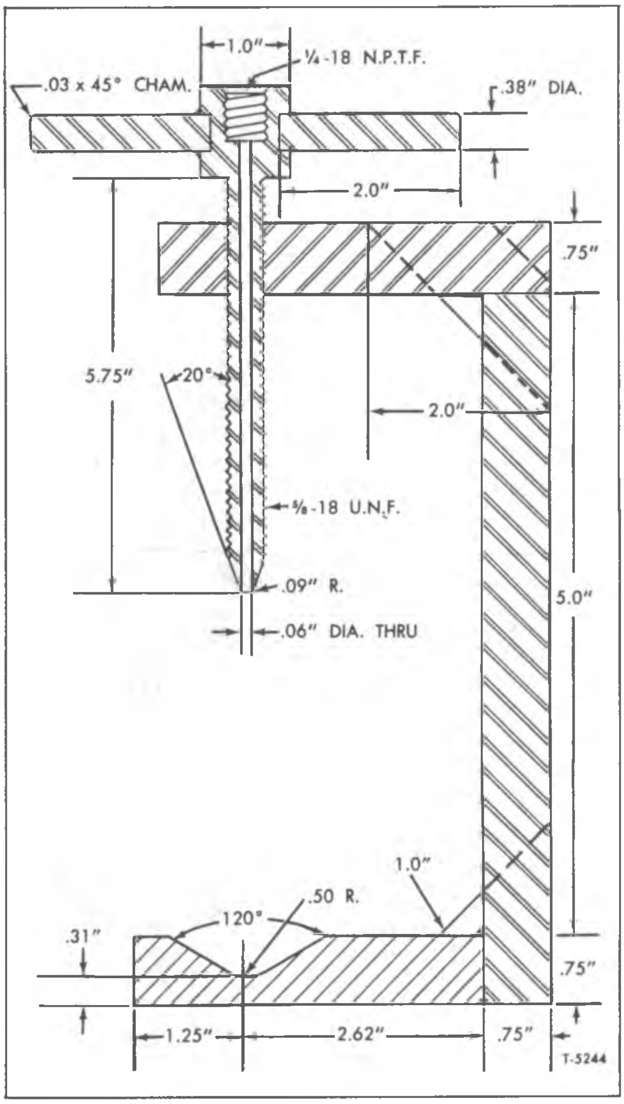


Figure 6—Brake Bleeding Tool for Split System Master Cylinder

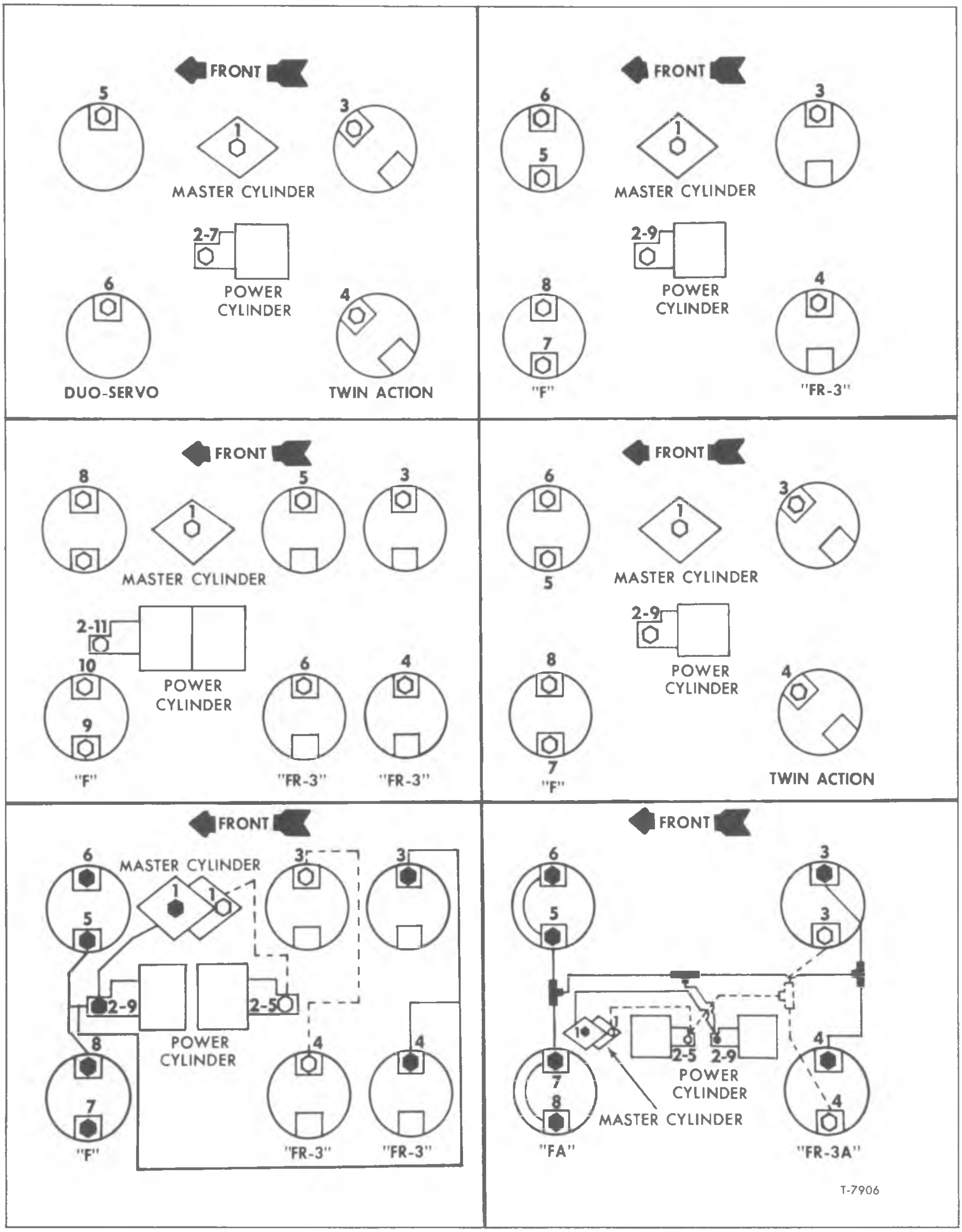


Figure 7—Hydraulic Brake Bleeding Sequence Chart

PRESSURE BLEEDING

Refer to figure 7 for bleeding sequence.

1. Make sure fluid level in pressure tank is up to petcock above outlet and that tank is charged with 40 to 50 psi air pressure.

2. Clean dirt from around master cylinder filler cap or cover. Remove standard cover and install special cover required to fit the model cylinder used. Connect pressure tank hose to filler cap or cover opening. Bleed air from hose before tightening connection. Open valves at both ends of hose.

3. First bleed master cylinder valve on models where used. Slip end of bleeder hose over bleeder valve No. 1 and place other end in a glass jar containing enough hydraulic fluid to cover end of hose. Open bleeder valve with wrench and observe flow of fluid from hose. Close bleeder valve as soon as bubbles stop and fluid flows in a solid stream.

4. Bleed valve No. 2 (on power cylinder where used), then bleed wheel cylinders in sequence shown in figure 7. After bleeding wheel cylinders, repeat bleeding operations at power cylinder (where used).

5. If, after bleeding, the pedal "feel" is not satisfactory, it is recommended that the residual check valve in the master cylinder or the check valve in the power cylinder piston be inspected (on those models which have check valves). Improper operation of either or both of these valves will result in the same pedal "feel" as air in the system. Refer to applicable procedures for repair. If these valves are operating properly, or if "feel" is not satisfactory on models not using check valves, then air is still present in system and bleeding again will be necessary.

MANUAL BLEEDING

Manual bleeding is the same as pressure bleeding, except that the brake fluid is forced through the lines by pumping the brake pedal instead of by air pressure. Fluid in master cylinder must be replenished after bleeding at each valve. Brake pedal should be pumped up and down slowly, and should be on downstroke as valve is closed.

BRAKE PEDAL AND LINKAGE

There are three basic types of brake pedal and linkage installations used on vehicles covered by this manual. They are illustrated in figures 8, 9 and 10.

Figure 8 illustrates the clutch and brake pedal installation used on S-50 school bus models with a dash mounted master cylinder (split system) and remote mounted vacuum boosters.

Figure 9 illustrates the clutch and brake pedal installation used on conventional cab models with a dash mounted master cylinder (single system) and remote mounted vacuum booster (when used).

Figure 10 illustrates the brake pedal installation used on all tilt cabs with a double barrel master cylinder mounted under the cab and a remote mounted booster.

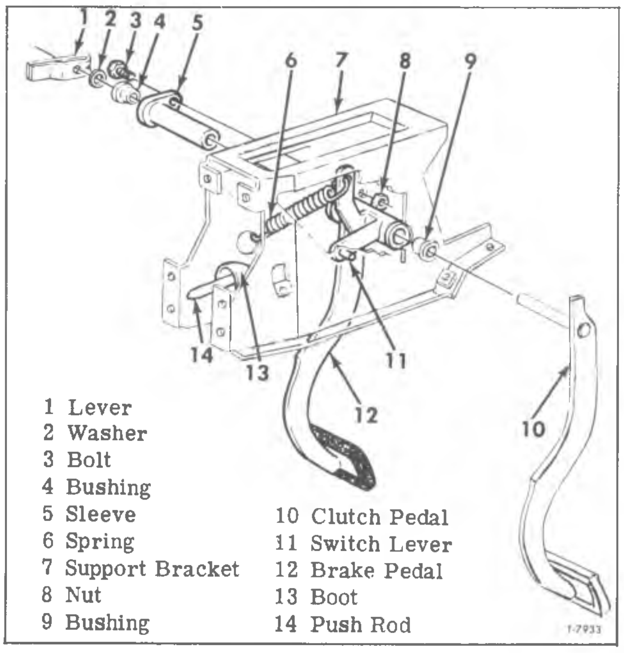


Figure 8—Clutch and Brake Pedal Installation (S50 Models)

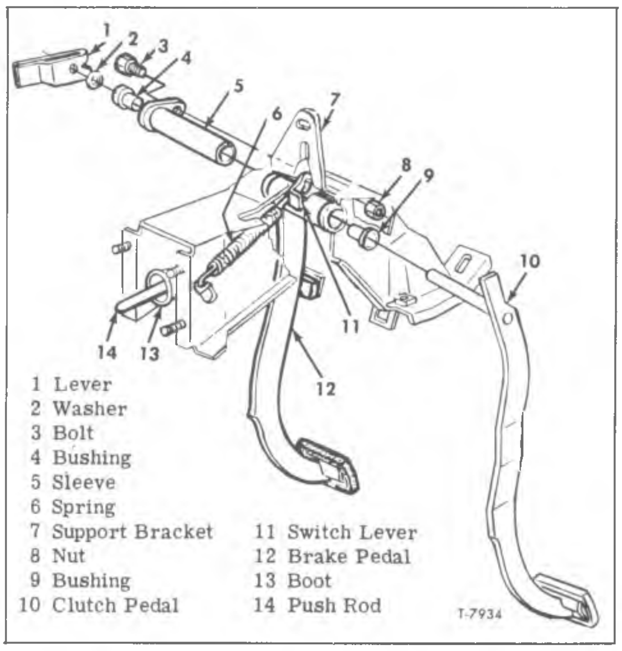


Figure 9—Clutch and Brake Pedal Installation (Conv. Models)

BRAKE PEDAL REPLACEMENT (ALL EXCEPT TILT CAB)

These models have a suspended type brake pedal mounted in a bracket which is secured on the underside of the instrument panel.

As indicated on figures 8 and 9, the brake pedal pivots on the outside of sleeve, and clutch pedal shaft extends through inside of sleeve. Nylon bushings are installed in each end of brake pedal tube, forming the contact between pedal tube and pedal sleeve. Clutch pedal shaft is carried in nylon bushings installed in each end of sleeve. The brake master cylinder is mounted on the engine side of the dash. Adjustable push rod, extending through dash into master cylinder bore, is attached by special bolt to brake pedal lever.

In released position, each pedal is held against a rubber bumper by pedal return springs. The following pedal replacement procedures cover both clutch and brake pedals.

PEDAL REMOVAL (Figs. 8 and 9)

In order to remove the brake pedal, the clutch pedal must also be removed.

1. Remove bolt attaching brake master cylinder push rod to pedal lever.
2. Unhook pedal return springs.
3. Loosen clamp bolt securing clutch pedal shaft lever on end of clutch pedal shaft and remove lever from shaft. Remove spring washer, bushings, and clutch pedal and shaft from sleeve.
4. Remove bolt attaching pedal sleeve to panel-to-dash brace. Remove sleeve from brace, at the same time removing brake pedal and bushings.

PEDAL INSTALLATION

Before installing pedals, check bushings in brake pedal and in pedal sleeve for evidence of wear or deterioration. Bushings are split type and can easily be removed and replaced.

1. Install bushings in pedal tube. Position brake pedal at underside of instrument panel-to-dash brace. Insert pedal sleeve through brace and pedal and attach sleeve to brace with bolt and nut.
2. Install bushings in sleeve. Insert clutch pedal shaft through sleeve and install spring washer and pedal shaft lever on end of shaft. Tighten lever clamp bolt firmly.
3. Connect pedal return springs.
4. Connect master cylinder push rod to brake pedal, using special shoulder bolt, lock washer, and nut. Tighten nut.
5. Adjust push rod to provide rod to piston clearance as directed under "Push Rod Adjustment."

BRAKE PEDAL REPLACEMENT (TILT CAB)

(Refer to Figure 10)

REMOVAL

In order to remove the brake pedal on tilt cab models, it is necessary to first remove the clutch pedal assembly to obtain enough clearance to remove brake pedal.

1. Remove clutch pedal (for details see "Clutch Pedal and Bushing Replacement" in "CLUTCH CONTROLS" (SEC. 7D) of this manual.
2. Remove upper to lower pedal connector bolt. Remove pedal upper half.
3. Remove pedal return spring.
4. Remove pedal to push rod bolt.
5. Remove lock ring and washer from outside end of pin and bushing assembly.
6. Remove grease fitting from bushing.
7. Remove bolts which fasten bushing assembly to cab sill.
8. Simultaneously slide pedal assembly and bushing assembly out of cab sill in opposite directions, twisting each as necessary to clear sill and other obstructions.

INSTALLATION

1. Simultaneously insert bushing assembly from outer side of cab sill and brake pedal assembly from inner side of cab sill, twisting each as necessary to allow pedal pin to slide completely through bushing and bushing assembly to slide completely through cab sill.
2. Install bolts which fasten bushing assembly to cab sill. Tighten securely.
3. Install grease fitting.
4. Install washer and lock ring on outside end of pin and bushing assembly.
5. Install pedal to push rod bolt.
6. Install pedal return spring.
7. Insert pedal upper half through seals and fasten upper and lower pedal halves with bolt.
8. Install clutch pedal (for details see "Clutch Pedal and Bushing Replacement" in "CLUTCH CONTROLS" (SEC. 7D) of this manual.

PUSH ROD ADJUSTMENT

Instructions covering push rod adjustment varies according to model. The amount of free play and the location for measuring free play is the same on all models and type of equipment used.

Push rod adjustment is very important on all models and tolerance given should be adhered to. If the push rod is too long, brakes will not release completely. If the push rod is too short excessive pedal travel will be required to apply the brakes.

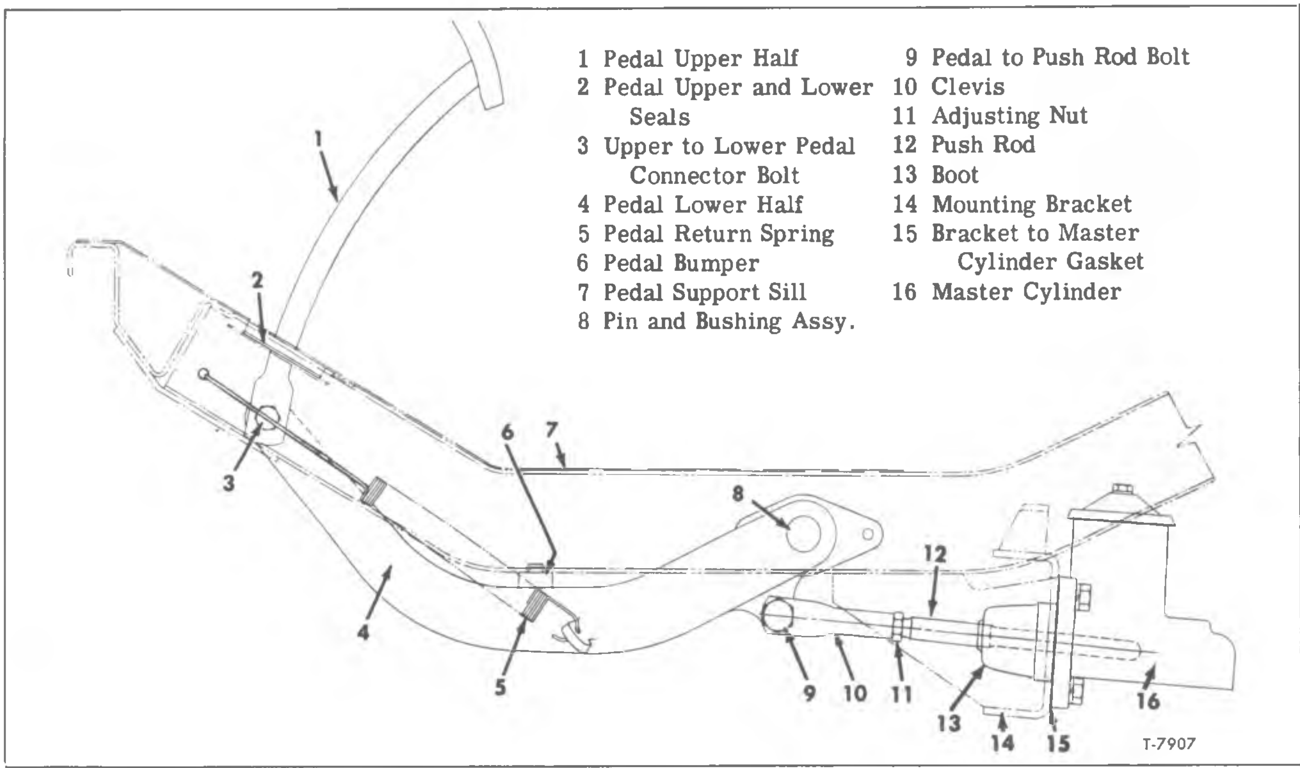


Figure 10—Brake Pedal and Master Cylinder Installation (Tilt Cab Models)

> IMPORTANT: If any doubt exists relative to push rod adjustment, always remember it is better to have push rod adjusted too short than for it to be too long.

TILT CAB MODELS
(Refer to Fig. 10)

1. Set emergency brake or block wheels.
2. Tilt cab (See instructions in Section 1).
3. To adjust, loosen adjusting nut and turn rod in or out of rod end as necessary. Adjust so that there is 1/8" free play movement of brake pedal at pad before end of push rod contacts piston. See figure 11.
4. Tighten adjusting nut.
5. Check operation of brakes.

CONVENTIONAL AND "S" MODELS
(Refer to Figs. 8 and 9)

1. Set emergency brake or block wheels.
2. Loosen adjusting nut on push rod.
3. Turn rod in or out of rod endas necessary. Adjust so that there is 1/8" free play movement of brake pedal at pad before end of push rod contacts piston.
4. Tighten adjusting nut.
5. Check operation of brakes.

NOTE: Pedal free play for all models is 1/8" at pedal pad.

Figure 11—Brake Pedal Free Movement

MASTER CYLINDERS

DESCRIPTION

There are three different type brake master cylinders used on these vehicles; single barrel (models with mechanical clutch controls), double barrel (models with hydraulic clutch controls), and split system.

On conventional cab models the master cylinder is mounted on the engine side of the fire wall and is fastened by two bolts.

On tilt cab models the double-barrel cylinder is mounted under the cab on a bracket with three bolts.

The split system type master cylinder is standard on "S" Models and optional on others. It is mounted on engine side of the fire wall and is fastened by four bolts.

All master cylinders, except split system type, have bleeder screws (refer to "Brake Bleeding Sequence Chart," figure 6).

FILLER CAPS

Filler cap on single and double barrel cylinders is rectangular and incorporates a combination seal and diaphragm made of rubber. The purpose of this is to prevent dirt from entering the reservoir, to prevent brake fluid from leaking out and to allow for expansion and contraction of fluid level as the result of changes in temperature as well as changes in fluid level as the result of normal brake operation. These caps are fastened to the top of the master cylinder by a single bolt down through the center which fits in a threaded hole in the master cylinder body (see fig. 14).

Filler cap used on split system is a single cap covering both reservoirs and is fastened by a single bolt in the center as shown in figure 15.

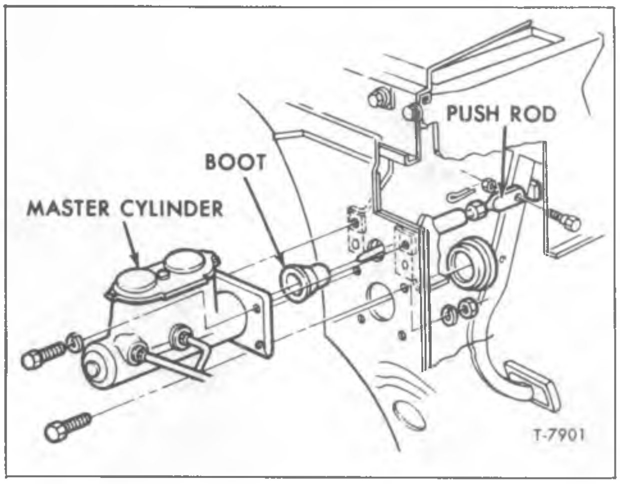


Figure 12—Split System Master Cylinder Installed

Brake fluid level in all master cylinders should be checked periodically by removing filler cap and making visual inspection. On conventional models the master cylinder is accessible by lifting the hood to the engine compartment on the left side of vehicle. On tilt cab models the master cylinder is accessible by removing the metal plate on the riser panel below the front of the driver's seat. On "S" Models the master cylinder is accessible by lifting the hood to the engine compartment.

MAINTENANCE (ALL TYPES)

Filler caps on all master cylinders are designed to vent the fluid reservoir without permitting loss of fluid. By-pass port between cylinder bore and reservoir and vent hole in filler cap must be kept open to assure proper operation. An obstructed by-pass port will prevent return of fluid to reservoir, preventing full release of brakes. By-pass ports may be obstructed by one of the following causes:

1. Clogged with dirt -- remove master cylinder and disassemble and clean all parts.

2. Swollen primary cup due to the use of wrong fluid -- overhaul master cylinder, drain and flush entire brake system, and refill with proper fluid.

3. Pedal binding on shaft, preventing full return of piston -- free up and lubricate pedal.

4. Improper push rod adjustment -- adjust push rod.

MASTER CYLINDER REPLACEMENT

TILT CAB MODELS

Removal

1. Tilt cab forward and place a suitable container under master cylinder to catch fluid when hydraulic lines are disconnected. DO NOT RE-USE THIS FLUID.
2. Disconnect hydraulic lines from outlets of brake and clutch cylinders.
3. Remove three bolts attaching master cylinder to support bracket and remove master cylinder assembly. Boots will remain on push rods.

Installation

1. Position master cylinder assembly at support bracket and guide push rods into pistons. Attach cylinder with three bolts. Tighten bolts firmly.
2. Connect hydraulic lines to brake and clutch cylinder outlets.

3. Adjust push rods as directed under "Brake Pedal and Linkage."

4. Fill master cylinder reservoir and bleed brake system as directed under "Bleeding Brakes."

CONVENTIONAL MODELS

Removal

1. Place a suitable container under master cylinder to catch fluid when hydraulic lines are disconnected. DO NOT RE-USE THIS FLUID.

2. Disconnect hydraulic lines from outlet of brake cylinder.

3. Remove two bolts and lock washers attaching master cylinder to dash (nuts are welded to inner side of dash) and remove master cylinder assembly.

Installation

1. Position master cylinder assembly at dash, while an assistant inside cab guides push rod into piston. Attach cylinder to dash with two bolts and lock washers.

2. Connect hydraulic line to brake (and clutch on dual) cylinder outlet.

3. Adjust push rod as directed under "Brake Pedal and Linkage."

4. Fill master cylinder reservoir and bleed brake system as directed under "Bleeding Brakes."

"S" MODELS AND CONVENTIONAL
(SPLIT MASTER CYLINDER)

Removal (Refer to Fig. 12)

1. Wipe master cylinder and lines clean with a clean cloth. Place dry cloths below master cylinder to absorb any fluid spillage.

2. Disconnect hydraulic lines at master cylinder. Cover line ends with clean, lint-free material to prevent foreign matter from entering system.

3. Remove nuts, bolts, and washers which fasten master cylinder to dash. Pull master cylinder straight off push rod and remove from engine compartment.

4. Remove master cylinder cover and pour out fluid from reservoirs. Pump the remaining fluid out by depressing piston.

Installation (Refer to Fig. 12)

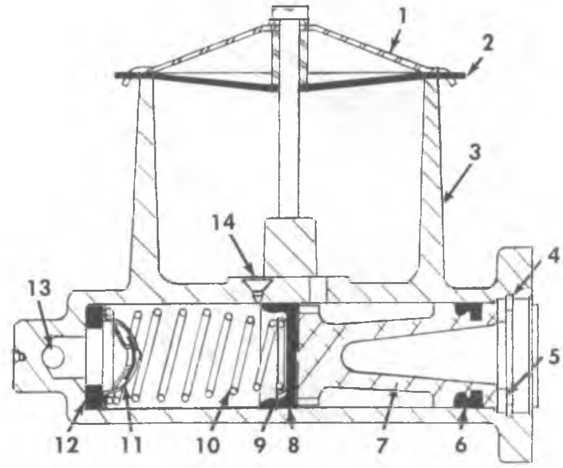
1. Place master cylinder in position in engine compartment. Make certain that push rod and boot are in proper position.

2. Fasten master cylinder to dash with nuts, bolts, and washers.

3. Connect brake lines to master cylinder.

4. Fill reservoirs with recommended brake fluid.

5. Follow instructions in this manual under heading of "Bleeding Brakes."



1 Cover Assembly	8 Primary Cup
2 Cover Gasket	9 Spring Retainer
3 Reservoir Body	10 Return Spring
4 Snap Ring	11 Check Valve
5 Stop Plate	12 Check Valve Seat
6 Secondary Cup	13 Outlet Port
7 Piston Assembly	14 By-Pass Port

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Figure 13—Single Barrel Master Cylinder (Typical)

6. If necessary, adjust the brake pedal free-play as directed.

7. Test brakes and make any necessary adjustments if operation is not satisfactory.

MASTER CYLINDER OVERHAUL

The following procedures cover disassembly, cleaning, inspection and repair, and assembly of components used in both the brake and clutch cylinder bores on double barrel master cylinders and on brake cylinder bores on single barrel cylinders.

OVERHAUL (EXCEPT SPLIT-TYPE)
(Refer to Figures 13 and 14)

1. Clean all dirt from outside of unit, using a non-petroleum solvent.

2. Remove snap ring from groove in both cylinder bores.

3. Remove piston assembly, primary cup, return spring and retainer assembly, check valve and check valve seat from brake cylinder bore.

4. Remove piston assembly, primary cup, and return spring and retainer assembly from clutch cylinder bore.

5. Remove cover from cylinder housing.

6. Remove bleeder screw.

Cleaning

Immerse parts in brake fluid or alcohol and wash thoroughly. Wipe small parts dry and blow out inside of reservoir and cylinder bores. Make

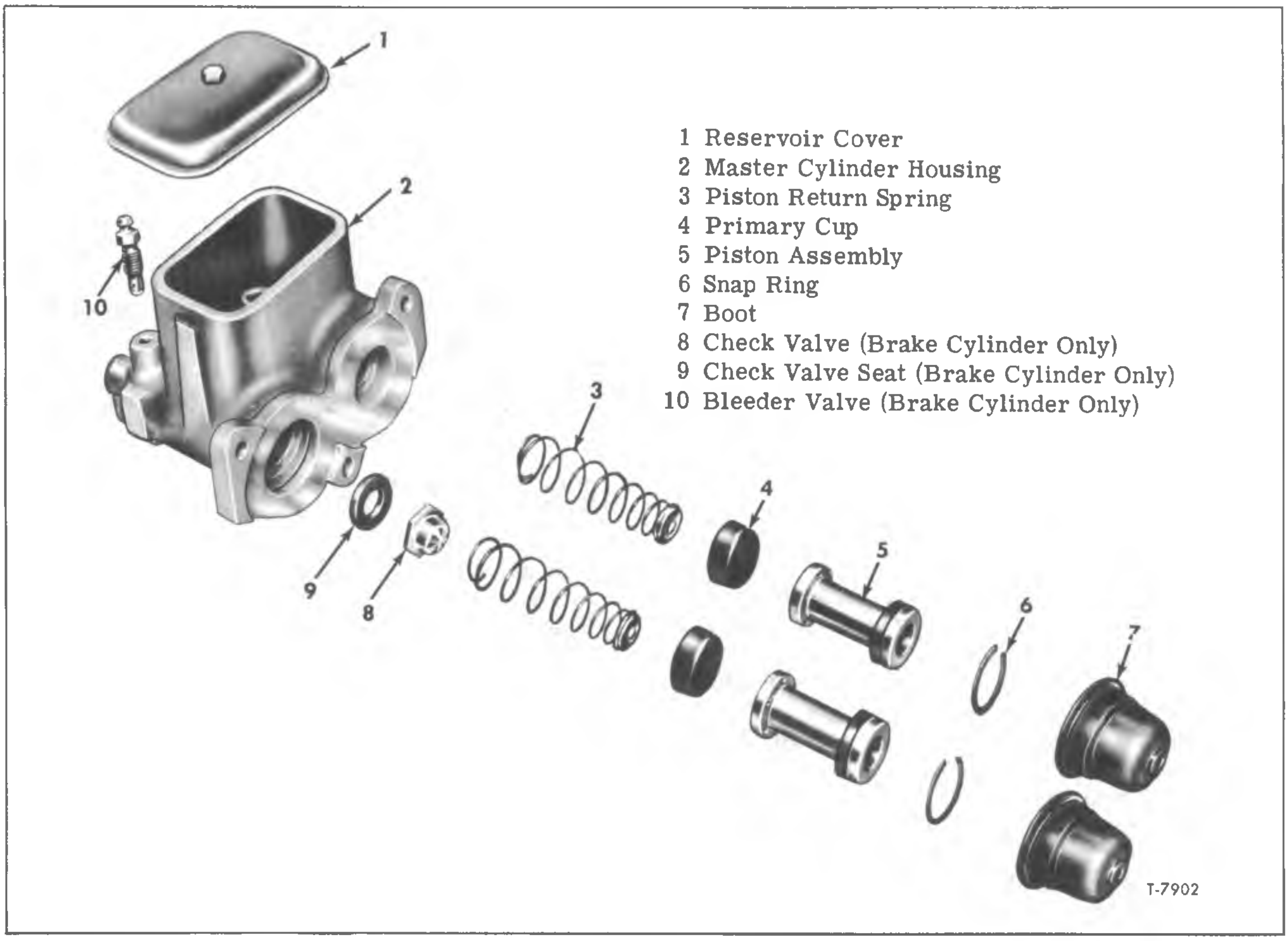


Figure 14—Double Barrel Master Cylinder Components

sure intake and by-pass ports in cylinder housing and bleeder holes in piston are clean.

> **CAUTION: DO NOT use kerosene or gasoline for cleaning master cylinder components.**

Inspection and Repair

Master cylinder repair kits are available which contain all the parts ordinarily required when overhauling master cylinders. Refer to applicable Parts Book for part number of repair kit. In addition to replacement of parts contained in repair kit, master cylinder should be inspected and repaired, if necessary, as follows:

1. Examine cylinder bores. DO NOT HONE THE MASTER CYLINDER OR WHEEL CYLINDER BORES.

NOTE: When brake master cylinders or wheel cylinders are overhauled, it is recommended that the cylinder body be replaced rather than "cleaned up" by honing the bore. Master cylinder and wheel cylinder bores have a hard, highly polished "bearingized" surface, which is produced by diamond boring followed by ball or roller burnishing under heavy pressure. Honing will destroy this surface, leaving a softer and rougher surface which will cause more rapid wear of rubber cups.

It is permissible to clean up minute surface irregularities with crocus cloth, providing the irregularity is small enough to clean up by this method.

2. Check piston fit in cylinder bore. Clearance between piston and cylinder wall should be within 0.001" to 0.005" when checked with feeler gauge.

Assembly (Figs. 13 and 14)

1. Before assembling, coat inside of cylinder bores and dip all internal parts in hydraulic brake fluid.

2. Install components in brake cylinder bore of double barrel cylinders as follows:

a. Install check valve seat in cylinder bore, then position check valve on seat.

b. Install return spring (shortest of the two) in bore with large diameter end of spring over check valve.

c. Install primary cup in cylinder bore with lip of cup toward outlet end. Make sure end of return spring seats inside the cup.

d. Insert piston and secondary cup assembly into cylinder bore, with open end of piston toward open end of cylinder.

e. Press piston into cylinder bore, compressing spring, and install snap ring in groove in bore. Make sure snap ring is fully seated in groove.

3. Install components in clutch cylinder bore as follows:

a. Install return spring (longest of the two) in cylinder bore, large diameter end first.

b. Install primary cup in cylinder bore with lip of cup toward outlet end. Make sure end of spring seats indide the cup.

c. Insert piston and secondary cup into cylinder bore, with open end of piston toward open end of cylinder.

d. Press piston into cylinder bore, compressing spring, and install snap ring in groove in bore. Make sure snap ring is fully seated in groove.

4. Install cover on cylinder reservoir.

5. Install bleeder screw.

OVERHAUL (SPLIT-TYPE)

Disassembly (Refer to Fig. 15)

1. Remove cylinder cover bolt and gasket.

2. Lift off reservoir cover and cover seal. Pour out any excess fluid and stroke piston to force fluid through outlet ports.

3. Remove piston stop bolt and gasket from bottom of reservoir housing.

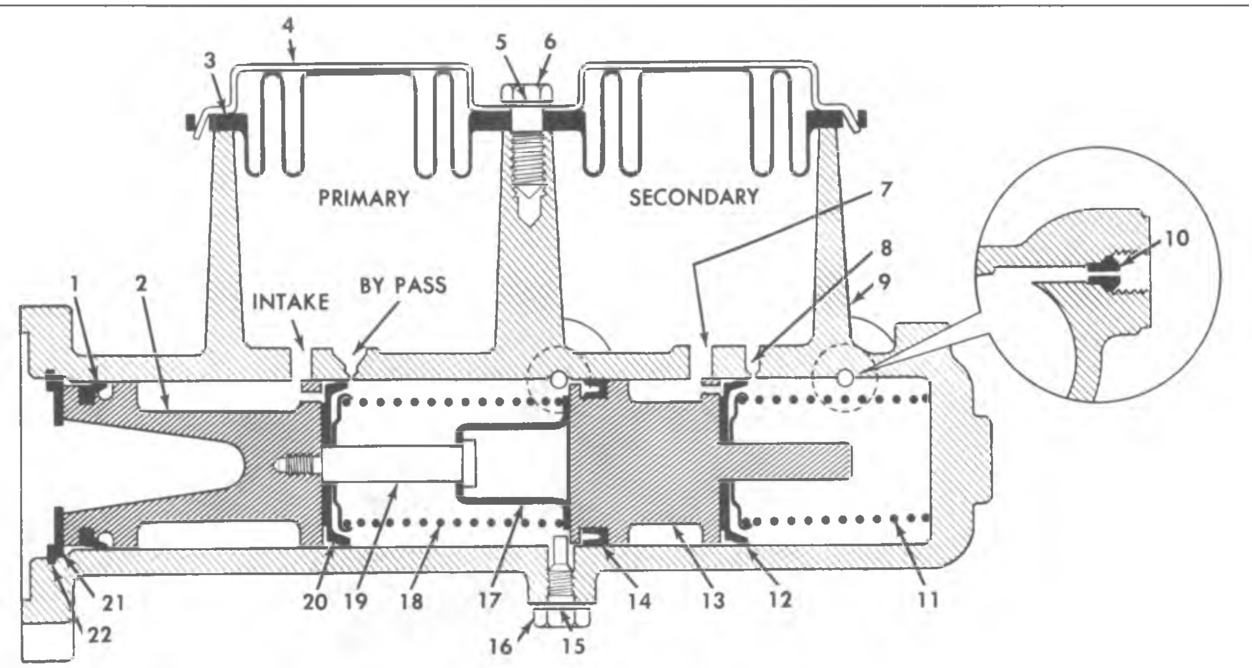
4. Use snap ring pliers and remove retainer ring from groove in end of cylinder bore.

5. Remove stop plate.

6. All internal parts should slide easily out of cylinder bore. If they do not, apply compressed air carefully at front outlet port. If parts do not remove easily, examine bore carefully for extensive damage which may eliminate the possibility of reconditioning the master cylinder.

Cleaning and Inspection

Clean all parts in clean brake fluid or alcohol. If the reservoir housing is degreased, finish clean to remove all trace of other solvents. Inspect the cylinder bore for scratches or corrosion. Minor blemishes can be removed with crocus cloth. DO



1 Primary Piston Seal Cup
2 Primary Piston
3 Cover Seal
4 Reservoir Cover
5 Gasket
6 Cover Bolt
7 Intake Port
8 By-Pass Port
9 Reservoir Housing
10 Tube Seat
11 Secondary Piston Return Spring
12 Secondary Piston Pressure Cup
13 Floating Secondary Piston
14 Secondary Piston Seal Cup
15 Gasket
16 Stop Bolt
17 Primary Return Spring Retainer
18 Primary Return Spring
19 Primary Piston Stop Pin
20 Primarv Piston Pressure Cup
21 Stop Plate
22 Retainer Ring

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Figure 15—Split System Master Cylinder

NOT OVERSIZE CYLINDER OVER NOMINAL INSIDE DIAMETER. DO NOT HONE.

Check by-pass ports in both reservoirs to make sure they are open and free of burrs. Probe parts with soft copper wire 0.020-inch in diameter, or smaller. Do not use steel wire to check ports. This may scratch bore of master cylinder or cause burrs in port.

Remove and discard all rubber parts. All rubber parts are included in repair kit which is available from regular service parts sources.

Assembly (Refer to Fig. 15)

1. Coat all parts with a liberal amount of brake fluid.

2. Install rubber seal cup on secondary piston with cup lip facing rear (open end of cylinder).

NOTE: All other cup lips face opposite direction (closed end of cylinder).

3. Stack and install secondary piston spring, pressure cup and piston in cylinder bore.

4. Install piston stop bolt and new gasket, making sure screw enters cylinder bore behind rear of piston. Using new gasket will prevent leakage.

5. Assemble and install primary piston parts in cylinder bore.

6. Install stop plate in cylinder bore.

7. Compress all parts in cylinder bore and install retainer ring in groove.

8. Install reservoir cover and seal.

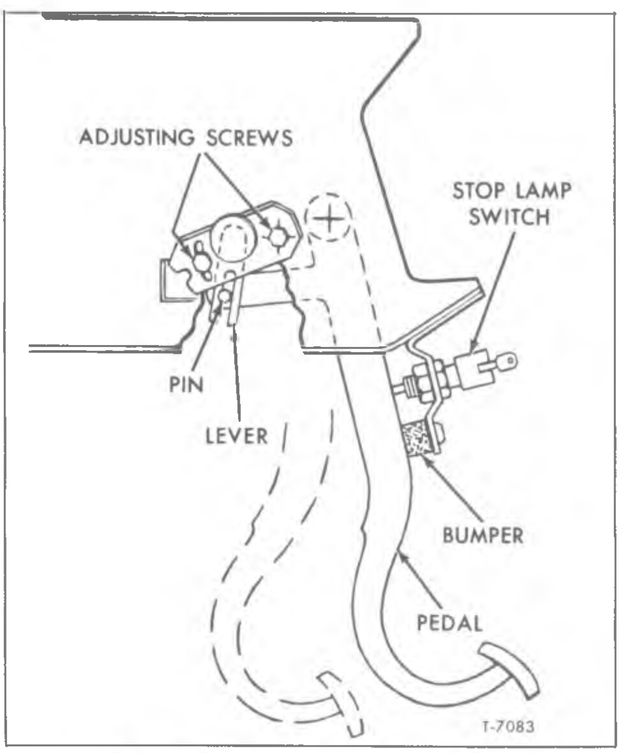


Figure 16—Brake Failure Warning Switch

BRAKE FAILURE WARNING SWITCH

S-50 and conventional cab and cowl models equipped with dual hydraulic brake systems have a brake failure and travel warning switch located above the brake pedal pivot. A red light is provided to warn the operator of a brake line failure and/or excessive brake pedal travel.

The indicator switch is wired so as to cause the bulb to light in the ignition "START" position providing for a functional bulb check.

Should the indicator light come on during the brake application, the following conditions may exist and corrective action should be taken immediately:

1. Hydraulic leakage or pressure loss.
2. Loss of brake adjustment.
3. Severe usage or worn out brake linings.

REMOVAL (Refer to Fig. 16)

1. Disconnect battery cables.

2. Disconnect electrical lead from switch (under dash).

3. Remove screws holding switch and remove switch.

NOTE: This switch is a non-adjustable, non-serviceable item. If defective, it must be replaced.

INSTALLATION

1. Install switch in reverse order of removal and follow adjustment procedure.

Figure 17—Pedal Travel Tool Installed

ADJUSTMENT

1. With the brake pedal pulled back against the stop lamp switch bracket bumper and with brake failure warning switch lever riding on pin on the brake pedal bracket, snug up screws on switch bracket.

2. Remove the push rod from the brake pedal.

3. Apply the brake pedal far enough to install tool (J-23449-2 - painted yellow on S-50 models) (or J-23449 - painted blue on other models) between the pedal arm and the rubber bumpers (see fig. 17). Allow the brake pedal and tool to rest against the rubber bumper.

4. Connect a test light across the switch. (Ignition unfused to switch.)

5. If the lamp is off, rotate the bracket upward until the test light "just" comes on.

6. If the lamp is on, rotate the bracket downward until the test light "just" goes out.

7. Hold the bracket in this position and tighten the screws to 18 foot-pounds torque.

8. Remove the test light.

9. Connect the electrical lead to the switch and test the operation at the warning light.

NOTE: The brake failure warning light should come on at approximately 60 per cent of available brake pedal travel.

10. Connect the push rod to the brake pedal. Install the attaching bolt and nut. Torque nut to 30 foot-pounds. Install the cotter pin.

WHEEL CYLINDERS

There are four different type wheel cylinders used on vehicles covered by this manual. Front brakes are either Type "F," "FA," or Duo-Servo. Rear brakes are either Type "FR-3," "FR-3A," or Twin-Action.

Since wheel cylinders can be disassembled and repaired without removing them from the vehicle the procedures are covered in this manual along with "Replacement" procedures.

NOTE: DO NOT HONE MASTER CYLINDER OR WHEEL CYLINDER BORES.

When brake master cylinders or wheel cylinders are overhauled, it is recommended that the cylinder body be replaced rather than "cleaned up" by honing the bore. Master cylinder and wheel cylinder bores have a hard, highly polished "bearingized" surface, which is produced by diamond boring followed by ball or roller burnishing under heavy pressure. Honing will destroy this surface.

It is permissible to clean up minute surface irregularities with crocus cloth, providing the irregularity is small enough to clean up by this method.

WHEEL CYLINDER REPLACEMENT

TYPES "F" AND "FA"

Removal

1. Jack up axle and remove brake shoes as directed under "Brake Shoe Removal."

2. Disconnect axle brake tube from inlet connector at upper cylinder. Remove inlet connector attaching connecting tube fitting to upper cylinder, and remove bolt attaching connecting tube fitting to lower cylinder. Remove connecting tube and fitting assembly.

3. Remove one large and two small bolts attaching each cylinder to backing plate, then remove cylinders from backing plate.

Installation

NOTE: The two wheel cylinders mounted on each brake are identical; however, cylinders on right- and left-hand brakes have opposite cylinder castings. Clean mating surfaces of cylinders and backing plate to ensure proper alignment.

1. Place each cylinder on backing plate and attach with one large and two small bolts and lock washers.

2. Position wheel cylinder connecting tube and fittings assembly and attach fitting to lower opening in upper cylinder with inlet connector, using new copper gasket on both sides of fitting. Attach fitting to lower opening in lower cylinder with special bolt, using new copper gasket on both sides of fitting. Tighten inlet connector and special bolt firmly.

3. Install bleeder valve in upper opening in each cylinder.

4. Install the brake shoes as directed under "Brake Shoe Installation." Bleed brake system as directed under "Bleeding Brakes."

DUO-SERVO

Removal

1. Jack up axle and remove wheel, brake drum, and brake shoes as directed later under "Brake Shoe Removal."

2. Disconnect metal brake tube from flexible hose at frame, disconnect hose from frame, then unscrew hose fitting from wheel cylinder housing.

3. Remove cap screws and washers attaching wheel cylinder to backing plate and remove cylinder assembly.

Installation

1. Position wheel cylinder on backing plate and attach with cap screws and lock washers.

2. Thread brake hose fitting into wheel cylinder housing using a new copper gasket on hose fitting. Insert fitting at other end of hose through frame and secure with toothed lock washer and nut or with spring lock, depending upon type used. Connect metal brake tube to hose fitting inside frame side rail.

3. Install the brake shoes as directed under "Brake Shoe Installation." Bleed brake system as directed under "Bleeding Brakes."

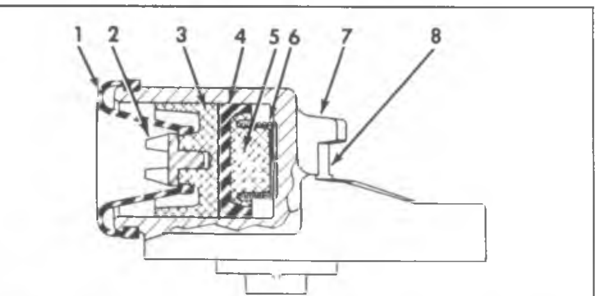
TYPE "FR-3" AND "FR-3A"

Removal

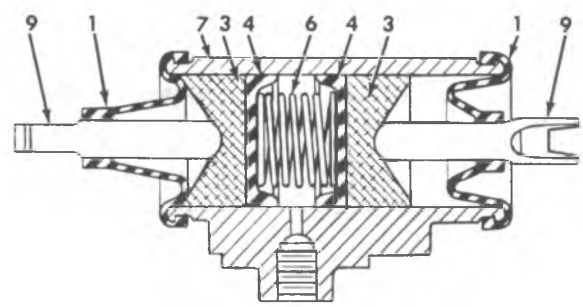
1. Jack up axle and remove brake shoes as directed under "Brake Shoe Removal."

2. Disconnect axle brake tube from upper cylinder at inner side of backing plate. Remove wheel cylinder connecting tube at inner side of backing plate.

3. Remove two bolts and lock washers attaching each wheel cylinder to backing plate. Remove wheel cylinders and heat shields, then remove heat shields from cylinders.



TYPE "F" AND TYPE "FA"—FRONT



TYPE "FR-3" AND TYPE "FR-3A"—REAR

1 Boot
2 Brake Shoe Guide
3 Piston
4 Piston Cup
5 Cup Filler
6 Piston Spring
7 Cylinder
8 Brake Shoe Anchor Slot
9 Push Rod

T-4566

Figure 18—Wheel Cylinders Used with Type "F," "FA," "FR-3", and "FR-3A" Brakes

Installation

NOTE: Upper and lower wheel cylinders on both right- and left-hand brakes are interchangeable. Cylinders must be positioned on backing plate so that the long stroke end of the cylinder faces the shoe toe (adjustment end of shoe) or the adjusting slot in backing plate. Make sure mating surfaces of cylinders, heat shields, and backing plate are clean to assure proper alignment.

1. Position heat shield on each wheel cylinder and install on backing plate, and attach each cylinder with two bolts and lock washers.

2. Attach connecting tube to upper opening in lower cylinder and to lower opening in upper cylinder. Connect axle brake tube to lower opening in lower cylinder, and install bleeder valve in upper opening in upper cylinder.

3. Install the brake shoes as directed under "Brake Shoe Installation." Bleed brake system as directed under "Bleeding Brakes."

TWIN-ACTION

Removal

1. Jack up axle and remove brake shoes as directed later under "Brake Shoe Removal."

2. Disconnect brake tube from rear wheel cylinder connector at inner side of backing plate. Remove brake tube connecting wheel cylinders at outer side of backing plate. Remove dust shield from upper end of each cylinder.

3. Remove cap screws and lock washers attaching wheel cylinders to backing plate, then remove wheel cylinders and heat shield. Remove brake line connectors from cylinder housings.

Installation

NOTE: Forward and rearward wheel cylinders are not interchangeable. Rearward cylinder has threaded inlet opening near center of cylinder bore. Forward cylinder has threaded bleeder valve opening at extreme outer edge of cylinder bore. Cylinders must be positioned with connecting tube openings toward each other.

1. Position heat shields on cylinders, place wheel cylinders on backing plate, and attach with cap screws and lock washers. Tighten cap screws firmly. Install dust shield on upper end of each cylinder.

2. Install connecting tube between the two cylinders and tighten connections firmly. Connect brake tube to inlet opening in rearward cylinder at inner side of backing plate. Install bleeder valve in threaded opening in forward cylinder.

3. Install the brake shoes as directed under "Brake Shoe Installation." Bleed brake system as directed under "Bleeding Brakes."

WHEEL CYLINDER REPAIR

TYPES "F" AND "FA" (Fig. 18)

Disassembly

Pull boot off end of cylinder, then remove boot and piston. Pull boot off piston. Brake shoe guide is pressed into piston and cannot be removed. Remove piston cup, cup filler, and spring from cylinder. Remove bleeder valve from cylinder.

Inspection and Repair

1. Repair kits are available which contain the parts to be replaced when overhauling wheel cylinders. Refer to Parts Book for repair kit part numbers.
2. Inspect cylinder bore for scores, scratches, or corrosion. Light scratches or slightly corroded spots may be polished out with crocus cloth. Never use emery cloth or sandpaper. If scratches or corrosion are too deep to be polished out, replace cylinder.
3. Check fit of new pistons in cylinder bore, using a feeler gauge (fig. 19). Clearance should be within 0.0025" to 0.0065" on "F" and "FA" type cylinders. Replace cylinder if clearance exceeds the maximum.

Assembly

Before assembling wheel cylinder, clean each part in brake fluid or alcohol.

CAUTION: DO NOT use kerosene or gasoline for cleaning wheel cylinder parts. Dip each internal part in hydraulic brake fluid before assembling.

1. Insert piston spring, cup filler, and cup into cylinder bore. Cup filler bumper and cup lip must face closed end of cylinder.
2. Assemble boot on piston, making sure the boot snaps over the brake shoe guide.
3. Install piston and boot, inserting piston into cylinder and engaging boot lip in groove in edge of cylinder. Position brake shoe guide so slot in guide is parallel with flat mounting surface of cylinder.

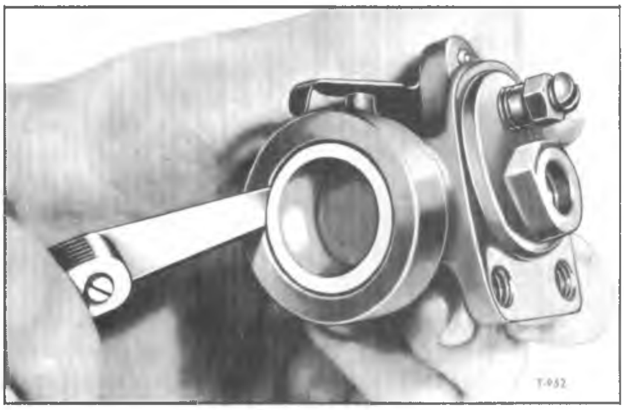


Figure 19—Checking Fit of Piston in Wheel Cylinder

DUO-SERVO (Fig. 20)

Disassembly

Pull boots off ends of cylinder and remove push rods from boots. Push pistons, cups, and spring out of cylinder. Remove bleeder valve from cylinder.

Inspection and Repair

1. Repair kits are available which contain the parts to be replaced when overhauling wheel cylinders. Refer to Parts Book for repair kit part numbers.

2. Inspect cylinder bore for scores, scratches, or corrosion. Light scratches or slightly corroded spots may be polished out with crocus cloth. Never use emery cloth or sandpaper. If scratches or corrosion are too deep to be polished out, replace cylinder.

3. Check fit of new pistons in cylinder bore, using a feeler gauge. Clearance should be within 0.002" to 0.004". Replace cylinder if clearance exceeds 0.004". Refer to figure 19.

Assembly

Before assembling wheel cylinder clean each part in brake fluid or alcohol.

CAUTION: DO NOT use kerosene or gasoline for cleaning wheel cylinder parts. Dip each internal part in hydraulic brake fluid before assembling.

Insert pistons, cups, and spring into cylinder bore. Assemble push rods in boots and install boots over ends of cylinder. Install bleeder valve.

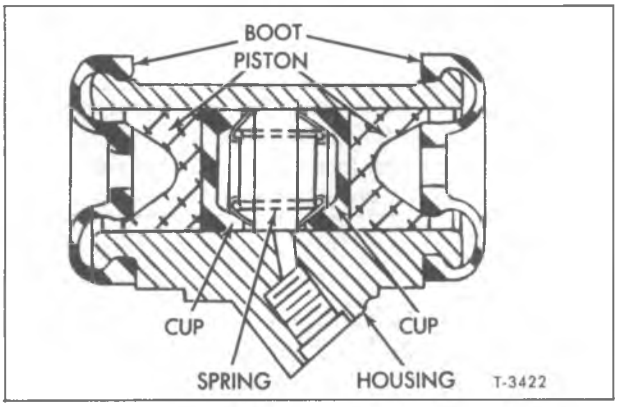
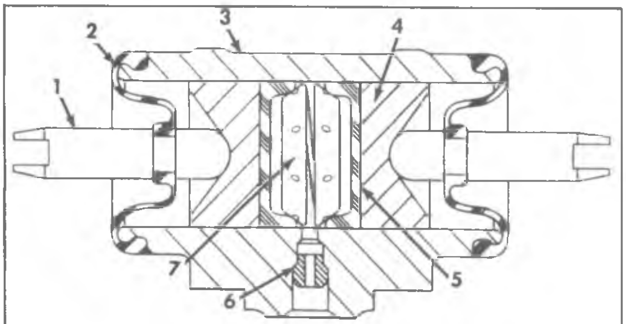


Figure 20—Duo-Servo Wheel Cylinder



1 Connecting Rod
2 Seal
3 Wheel Cylinder Body
4 Piston
5 Cup
6 Connector Insert
7 Spring Assembly
T-2699

Figure 21—Twin-Action Wheel Cylinder

TYPES "FR-3" AND "FR-3A" (Fig. 18)

Disassembly

Pull boots off ends of cylinders and remove push rods from boots. Push pistons, cups, and spring out of cylinder. Remove bleeder valve from upper cylinder.

Inspection and Repair

1. Repair kits are available which contain the parts to be replaced when overhauling wheel cylinders.

2. Inspect cylinder bore for scores, scratches, or corrosion. Light scratches or slightly corroded spots may be polished out with crocus cloth. Never use emery cloth or sandpaper. If scratches or corrosion are too deep to be polished out, replace cylinder.

3. Check fit of new pistons in cylinder bore, using a feeler gauge as shown in figure 19. Clearance should be within 0.001" to 0.005" on "FR-3" type. Replace cylinder if clearance exceeds the maximum.

Assembly

Before assembling wheel cylinder, clean each part in brake fluid or alcohol.

CAUTION: DO NOT use kerosene, or gasoline for cleaning wheel cylinder parts. Dip each internal part in hydraulic brake fluid before assembling.

1. Install pistons, piston cups, and spring, with cup lips toward inside of cylinder.
2. Assemble push rods and boots, then install on cylinder. Seat boots evenly in cylinder grooves. Align push rod slots as shown in figure 18.
3. Install bleeder valve in upper cylinder.

TWIN-ACTION (Fig. 21)

Disassembly

Pull boots off ends of cylinder and remove push rods from boots. Push pistons, cups, and spring out of cylinder. Remove cups from pistons. Remove bleeder valve from upper cylinder.

Inspection and Repair

1. Repair kits are available which contain the parts to be replaced when overhauling wheel cylinders. Refer to Parts Book for repair kit part numbers.
2. Inspect cylinder bore for scores, scratches, or corrosion. Light scratches or slightly corroded spots may be polished out with crocus cloth. Never use emery cloth or sandpaper. If scratches or corrosion are too deep to be polished out, replace cylinder.
3. Check fit of new pistons in cylinder bore, using a feeler gauge. Clearance should be within 0.002" to 0.004". Replace cylinder if clearance exceeds 0.004". Refer to figure 19.

Assembly

Before assembling wheel cylinder clean each part in brake fluid or alcohol.

CAUTION: DO NOT use kerosene, or gasoline for cleaning wheel cylinder parts. Dip each internal part in hydraulic brake fluid before assembling.

1. Install new cup on each piston so open end of cup will be toward flat end of piston.
2. Assemble boots on push rods, being sure bead on boot engages groove in push rod. Install boots and push rods on cylinders, engaging bead on outer edges of cylinder housing.

HYDRAULIC LINES

Hydraulic brake system units are interconnected by flexible hose and special metal tubing. Flexible hose is used between master cylinder (on cab) and frame connection, between frame and front wheel cylinders, and between frame and rear axle brake line. When the hydraulic lines have been disconnected for any reason, brake system must be bled, after connecting lines, as directed under "Bleeding Brakes."

FLEXIBLE HOSE

At front wheels on type "F" and type "FA." hose fitting is threaded into wheel cylinder connector, with a copper gasket used between shoulder on hose fitting and connector. On Duo-Servo a connector is not used. Fitting at other end of hose is inserted through hole in frame and secured by a toothed lock washer and nut or by a spring lock. Brake tube connector or tee fitting threads into end of hose fitting.

At rear axle, fitting at one end of hose is threaded into axle tee, with a copper gasket used to seal the connection. Other end of hose is inserted through frame bracket and secured by a toothed lock washer and nut or by a spring lock. Brake tube connector or tee fitting threads into end of hose fitting.

To remove hose, disconnect end at frame or frame bracket, then unscrew hose fitting from wheel cylinder or rear axle tee. When installing hose, always use a new copper gasket at wheel cylinder and rear axle tee. When frame end of hose is secured by a nut, always hold hose fitting with a wrench while tightening nut to prevent twisting hose.

METAL TUBING

When necessary to replace metal brake tubing, always use special metal tubing which is designed to withstand high pressure and to resist corrosion. Ordinary copper tubing is not satisfactory for use as hydraulic brake lines. When replacing tubing, always use the same size as that removed.

TUBE FLARING

In order to ensure a proper flare, a special flaring tool must be used. When using tool, instructions furnished by the tool manufacturer should be followed. Always inspect newly formed flares for cracks or malformations which might cause leaks.

VACUUM POWER CYLINDERS

Vacuum power cylinders are used as standard equipment or are available as optional equipment on all vehicles with hydraulic brakes covered by this manual.

All the power cylinders used on these vehicles are the type used in the "one to one" hydraulic system. That is, the hydraulic fluid volume output is equal to input.

The power cylinder is a combined vacuum-hydraulic power unit, utilizing vacuum and atmospheric pressure for its operation.

The vacuum source is the engine intake manifold.

The combination of vacuum in front of the diaphragm and atmospheric pressure behind the diaphragm results in the power application of the brakes.

VACUUM POWER BRAKE SYSTEM TESTS

VACUUM TEST

With engine stopped, hand brake applied and transmission in neutral, apply brakes several times to destroy all vacuum in system.

Depress brake pedal, and while holding foot pressure on pedal, start engine. If vacuum system is operating, pedal will tend to fall away under foot pressure when engine starts, and less pressure will be required to hold pedal in applied position. If no action is felt, vacuum system is not functioning.

Inspect vacuum lines and fittings for leaks or restriction caused by bent or kinked tube or hose before replacing any components. If no fault is found in lines, trouble is in power cylinder control valve, necessitating overhaul of power cylinder.

HYDRAULIC TEST

Stop engine and again destroy all vacuum in system. Depress brake pedal and hold foot pressure on pedal. If brake pedal gradually falls away

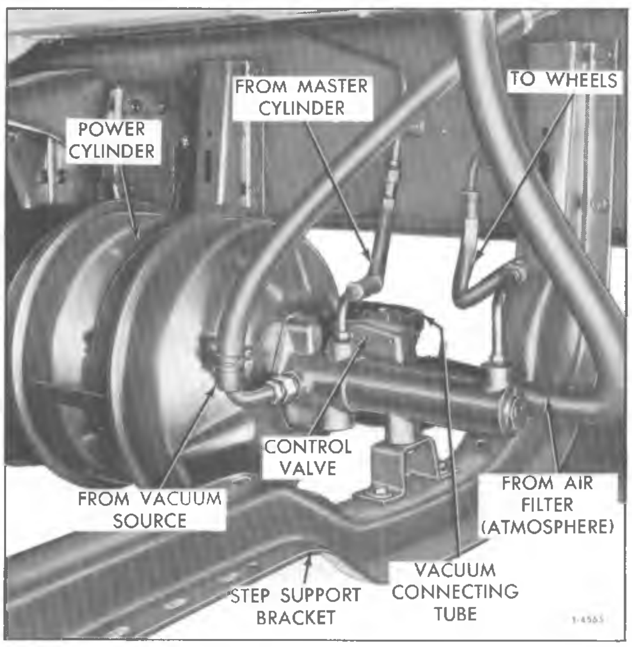


Figure 22—Power Cylinder Installed (Conventional)

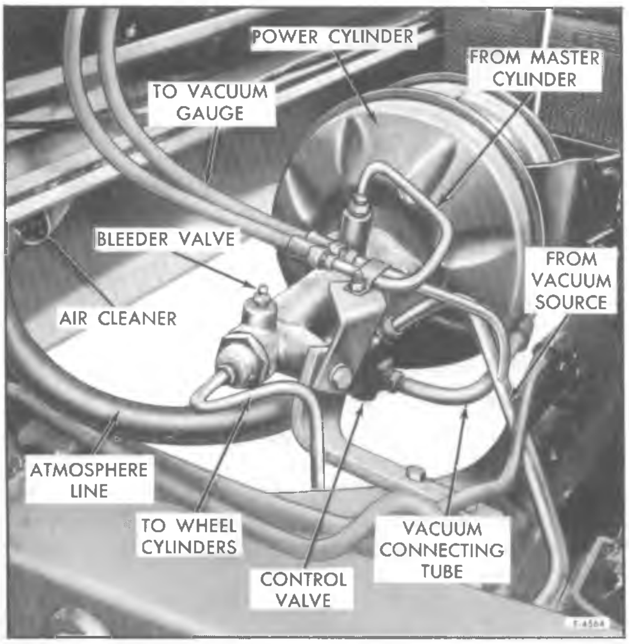


Figure 23—Power Cylinder Installed (Tilt Cab)

under foot pressure hydraulic system is leaking, either internally or externally.

Inspect all hydraulic line connections for leakage and make the necessary repairs. If no external leaks are evident, inspect master cylinder and wheel cylinders and replace parts as necessary. If the condition still exists, an internal leak in power cylinder is indicated, necessitating overhaul of power cylinder.

POWER CYLINDER REPLACEMENT

The installed location of vacuum power cylinders varies by model.

Conventional - behind cab step, immediately below left-hand door. Vacuum reserve tank is located in this same area, when used. See figure 22.

Tilt Cab - between frame side rails in front of the radiator and behind the front bumper. See figure 23.

"S" Models - on the outside of the left-hand frame side rail.

REMOVAL

1. For easier accessibility, it is recommended that cab step be removed on conventional models and that cab be tilted forward on tilt cab models.
2. Clean away as much road dirt and grease as possible to prevent contamination of vacuum or hydraulic systems.
3. Have suitable container available to catch hydraulic brake fluid which will flow from system. DO NOT RE-USE THIS FLUID.
4. Disconnect all hydraulic, vacuum, and atmospheric lines and hoses from power cylinder.
5. Remove bolts and nuts which fasten cylinder to vehicle frame and support brackets. Remove power cylinder.

INSTALLATION

1. Place power cylinder in position and fasten with nuts and bolts to vehicle frame and support brackets.
2. Connect all hydraulic, vacuum, and atmospheric lines and hoses to power cylinder.
3. Bleed master cylinder and vacuum power cylinder as directed under "Bleeding Brakes" in this manual. If ONLY the power cylinder has been removed, it should not be necessary to bleed the wheel cylinders IF the master cylinder and power cylinders are bled first AND lines to wheel cylinder have not been disturbed.
4. Start engine and test operation of brake system as directed. Refer to "Trouble Shooting" chart in this manual if the operation is not satisfactory.

VACUUM POWER CYLINDER AIR CLEANER

There are three different types of air cleaners used on vehicles with vacuum assisted hydraulic brakes.

SERVICING AIR CLEANERS

The air cleaner used on Conventional and S-50 Models is the metal cup type which uses a hog's hair type element. This cup is a friction fit on the air intake pipe and can be removed by pulling straight off. It can be cleaned by rinsing in a suitable solvent and reused. Refer to LUBRICATION (SEC. 0) in this manual for service intervals. If cleaner has become so laden with an accumulation of dirt, that satisfactory cleaning cannot be done, replace with a new cleaner.

The air cleaner used on all Tilt-Cab Models is a plastic encased, synthetic element type filter and cleaning is NOT recommended. When cleaner becomes so laden with dirt, that tapping it against some solid surface (such as a work bench) will not remove foreign matter, then a new cleaner should be installed.

LOCATION OF AIR CLEANERS

The air cleaner on the school bus and cowl model vehicles is located on the dash panel on the right-hand side and is readily accessible. See figure 24.

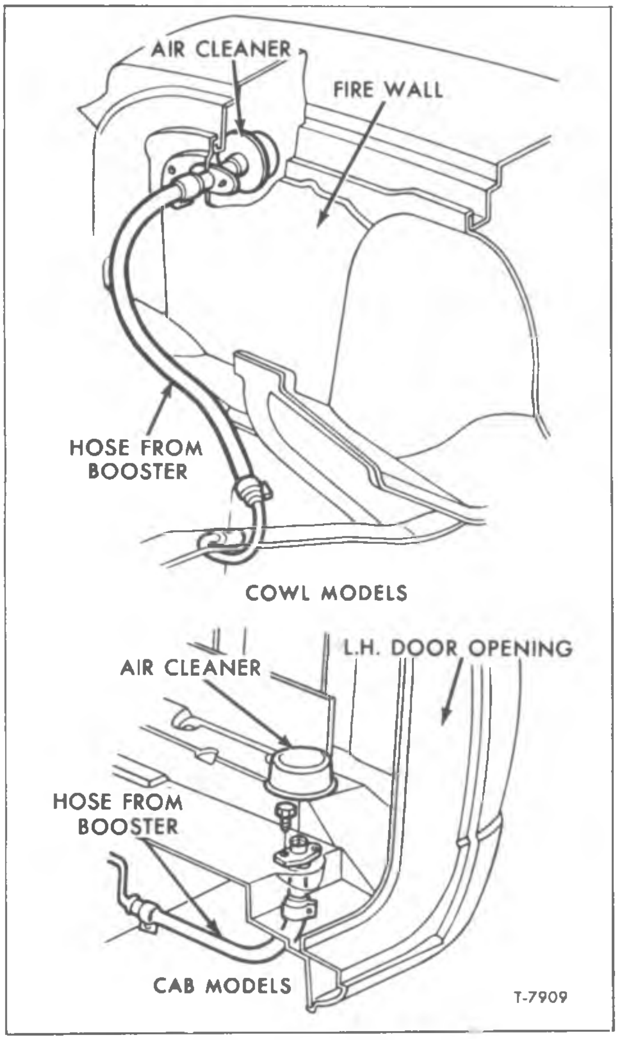


Figure 24—Air Cleaners Installed (Conv. and Cowl)

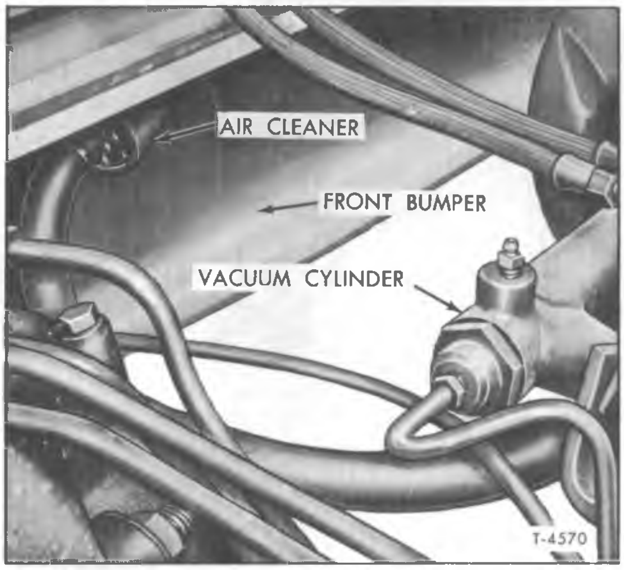


Figure 25—Air Cleaner Installed (Tilt Cab)

The air cleaner on the conventional models is located in the left rear corner of the cab, directly behind the driver's seat. The air cleaner on the Tilt-Cab Models is located in front of the radiator near the vacuum power cylinder and is accessible by tilting cab forward. To remove cleaner from Conventional or Tilt Cab, unfasten nut and bolt holding cleaner to bracket and pull cleaner off air hose (see fig. 25).

IMPORTANT: DO NOT OPERATE VEHICLE WITH AIR CLEANER DISCONNECTED OR REMOVED. ENTRANCE OF DIRT INTO VACUUM CYLINDER COULD CAUSE SERIOUS DAMAGE.

VACUUM CHECK VALVE

On all vehicles with vacuum power assisted hydraulic brakes a check valve is used somewhere in the vacuum line between the engine intake manifold and the vacuum power cylinder (see fig. 26).

Purpose of check valve is to seal vacuum in power cylinder (and in vacuum reserve tank, when used), assuring sufficient vacuum for at least one power brake application in case the engine stalls.

Check valve can be tested for leakage by disconnecting power cylinder vacuum line from valve fitting and connecting a vacuum gauge, using a length of hose between gauge and check valve. Start engine, run at idle for a few seconds, and note reading on gauge. Stop engine and observe rate of vacuum drop. If drop exceeds 1 inch in 15 seconds, leakage must be considered excessive, and check

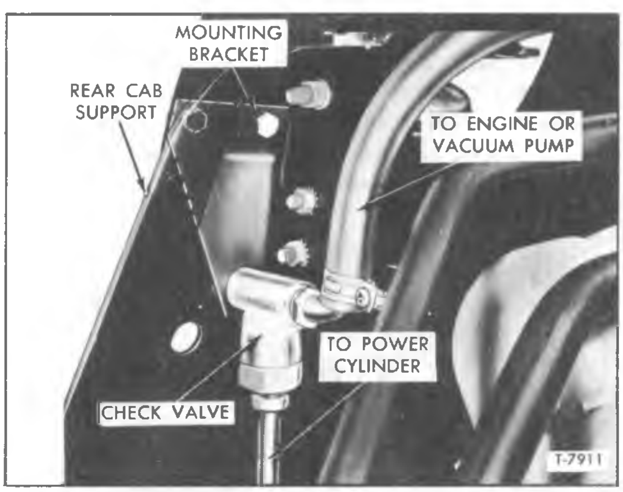


Figure 26—Vacuum Check Valve Installed (Typical)

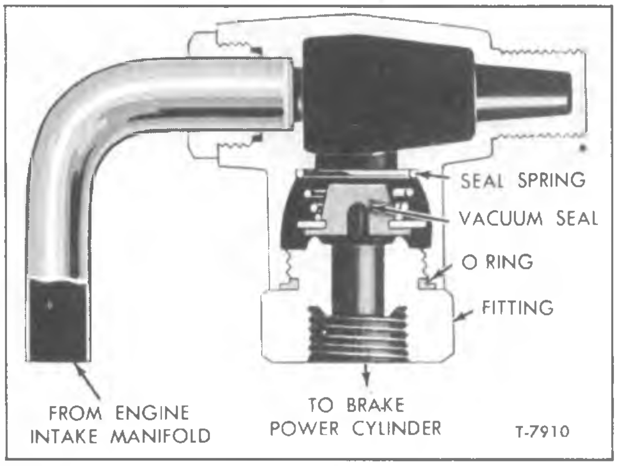


Figure 27—Vacuum Check Valve

valve must be repaired or replaced. Refer to figure 27 for cross-section view of check valve.

Removal and installation of valves on "S" Models, conventional and Tilt Cab Models is the same. Disconnect all lines and hoses and remove bolts or screws which fasten valve to vehicle.

Valve on the tilt cab model is at the front of the engine fastened to a bracket which is bolted on cab rear support, inside the channel on left-hand side.

Valve on conventional and "S" Models is located in the engine compartment and is fastened to a bracket attached to the fire wall.

VACUUM RESERVE TANK

Two vacuum reserve tanks are used as standard equipment on S-50 Models. One or more vacuum reserve tanks are available as optional equipment on all other models using vacuum assisted hydraulic brakes. This tank has a minimum capacity of 1,000 cubic inches and is installed in the vacuum line between the vacuum check valve and the power cylinder.

On conventional cab models, the tank is installed immediately below the left-hand door, behind the cab step.

On tilt cab models, the tank is installed above the engine on the underside of the cab.

On "S" Models, the tank is installed on the outside of the left-hand side rail just to the rear of the batteries.

To replace tank, disconnect lines and brackets connecting tank to vehicle.

VACUUM GAUGE

The vacuum gauges used on vehicles covered by this manual all operate on the same principle and are factory set and sealed units which are not adjustable or repairable. If a gauge fails to operate or operates improperly, it must be replaced. All vacuum gauges are located in the instrument panel.

If a vacuum gauge is suspected of operating improperly, it may be checked by comparing readings with a test gauge which is known to be accurate. Observe readings on vehicle gauge at engine idle speed and at various, specific engine rpm up to maximum. Install test gauge in conventional location in vacuum line and observe readings on test gauge at same, specific engine rpm. The manufacturer's specifications permit a variation of: 1-inch of mercury at 5 inches, and 2 inches of mercury at 20 inches. Any variation beyond these limits is an indication that the vehicle vacuum gauge should be replaced. Before condemning a gauge which does not register, or registers improperly, make certain that all vacuum lines in the system are free of dirt and/or kinks and that all connections are tight. System leakage can result in registration on gauge which is not normal.

BRAKE SHOES AND LININGS

TYPE "F" FRONT BRAKE
(Refer to Figure 28)

Two identical brake shoes are arranged on backing plate so that their toes are diagonally opposite. Two single-end wheel cylinders are arranged so that each cylinder is mounted between the toe of one shoe and the heel of the other.

Each shoe is adjusted by means of an eccentric cam which contacts a pin pressed into brake shoe web.

With vehicle moving forward, both shoes are forward acting (primary shoes), self-energizing in forward direction of drum rotation. With vehicle in reverse, both shoes are reverse acting since neither is self-energized in the reverse direction of drum rotation.

BRAKE SHOE REMOVAL (Fig. 28)

1. Jack up axle; remove hub and brake drum.
2. Remove both brake shoe return springs.
3. Remove C-washers and flat washer from each adjusting cam and hold-down stud. Lift shoes off backing plate.

CLEANING AND INSPECTION

1. Clean all dirt out of brake drum. Inspect drum for roughness, scoring, or out-of-round. Replace or recondition brake drum as necessary.

1 Wheel Cylinder
2 Brake Shoe Return Spring
3 Backing Plate
4 Brake Shoe
5 Brake Lining
6 Brake Shoe Adjusting Cam
7 Brake Shoe Guide Washer
8 Brake Shoe Guide C-Washer
9 Adjusting Cam and Shoe Guide Stud
10 Shoe Guide Anti-Rattle Washer
11 Adjusting Cam Spring

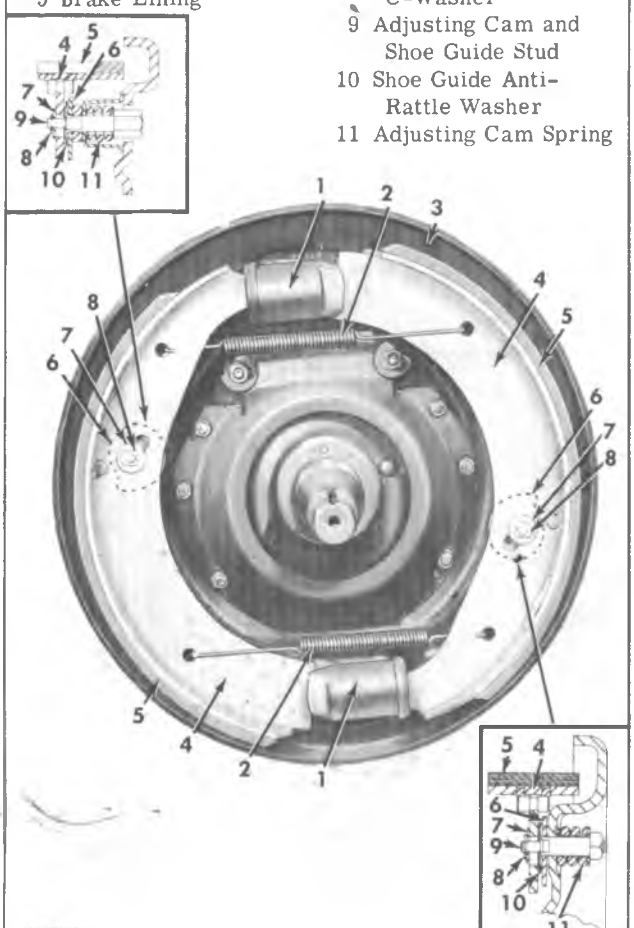


Figure 28—Type "F" Front Brake Assembly

2. Inspect wheel bearings and oil seals.
3. Check backing plate attaching bolts to make sure they are tight. Clean all dirt off backing plate.
4. Inspect brake shoe return springs. If broken, cracked, or weakened, replace with new springs.
5. Check cam and shoe guide stud and friction spring on backing plate for corrosion or binding. Cam stud should turn easily with an 8-inch wrench, but should not be loose. If frozen, lubricate with kerosene or penetrating oil and work free.
6. Examine brake shoe linings for wear. Linings should be replaced if worn down close to rivet heads. Refer to "Brake Shoe Relining" later.

BRAKE SHOE INSTALLATION

1. Install anti-rattle spring washer on each cam and shoe guide stud, pronged side facing adjusting cam.
2. Place shoe assembly on backing plate with cam and shoe guide stud inserted through hole in shoe web; locate shoe toe in wheel cylinder piston shoe guide and position shoe heel in slot in anchor block.
3. Install flat washer and C-washer on cam and shoe guide stud. Crimp ends of C-washer together.
4. After installing both shoes, install brake shoe return spring.
5. Install hub and brake drum assembly.

DUO-SERVO FRONT BRAKE

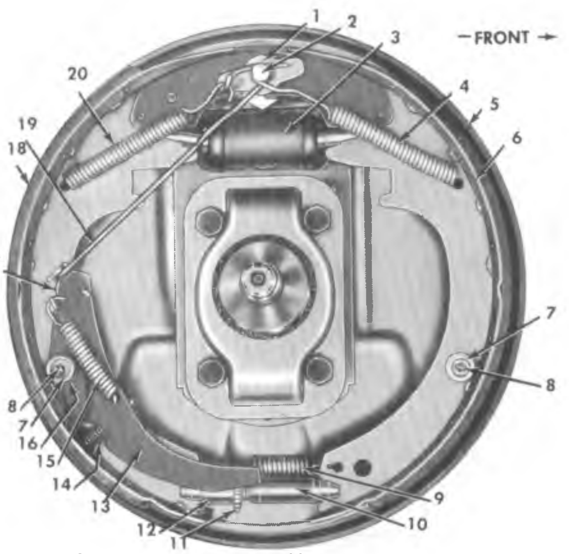
(Refer to Figure 29)

The Duo-Servo front brakes used on these vehicles are self-adjusting. Primary linings (shoe toward front of vehicle) are shorter than secondary linings (shoe toward rear of vehicle).

Self-adjusting actuating levers are attached to the secondary (rear) shoes on all models and operate when the brakes are applied while the vehicle is traveling in reverse.

BRAKE SHOE REMOVAL

1. Jack up vehicle and remove wheel.
2. If drum cannot be removed readily, back off adjustment (refer to "Brake Adjustments").
3. Block up brake pedal so it will not be depressed while drums are removed.
4. Unhook primary shoe return spring first from anchor pin and secondary shoe return spring from actuating link. Refer to figure 30.
5. Remove actuating lever return spring.
6. Disengage actuating link end first from anchor pin, then from adjusting lever pivot.
7. Remove hold-down pins and springs. Refer to figure 31.



1 Shoe Guide Plate
2 Anchor Pin
3 Wheel Cylinder
4 Primary Shoe Return Spring
5 Brake Backing Plate
6 Primary Brake Shoe and Lining
7 Hold-Down Washer
8 Hold-Down Pin
9 Connecting Spring
10 Adjusting Nut
11 Adjusting Screw
12 Adjusting Socket
13 Actuating Lever
14 Lever Return Spring
15 Lever Override Spring
16 Hold-Down Spring
17 Adjusting Lever Pivot
18 Secondary Brake Shoe and Lining
19 Actuating Link
20 Secondary Shoe Return Spring

T-2697

Figure 29 —Duo-Servo Front Brake (Automatic Adjuster)

8. Remove the actuating lever assembly.

NOTE: The actuating lever, adjusting lever pivot and lever override spring are removed as an assembly. It is not recommended that they be disassembled for service purpose unless one or more of the components is damaged. It is much easier to assemble and disassemble the brakes by leaving this assembly intact.

9. Remove brake shoe guide plate.

10. Pull top of shoes away from anchor pin and wheel cylinder push rods and remove shoes from backing plate.

11. Move top of brake shoes toward one another crossing them until adjusting screw assembly and spring fall off, permitting shoes to separate.

CLEANING AND INSPECTION

1. Clean all dirt out of brake drum. Inspect drum for roughness, scoring, or out-of-round. Replace or recondition drum as necessary. Refer to "Brake Drums" in this section.

2. Carefully pull lower edge of wheel cylinder

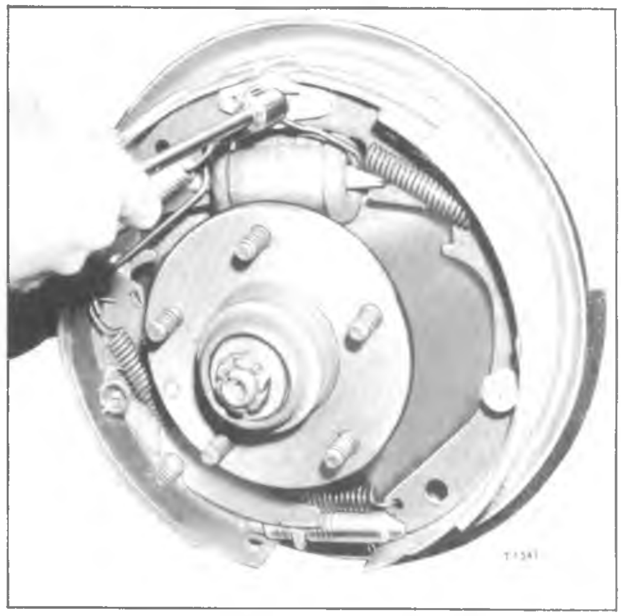


Figure 30 —Unhooking Brake Shoe Return Spring

boots away from cylinders and note whether interior is excessively wet with brake fluid. Excessive fluid indicates leakage past piston cups, requiring overhaul of wheel cylinder.

NOTE: A slight amount of fluid is nearly always present and acts as lubricant for pistons.

3. Check all backing plate attaching bolts to make sure bolts are tight. Clean all rust and dirt

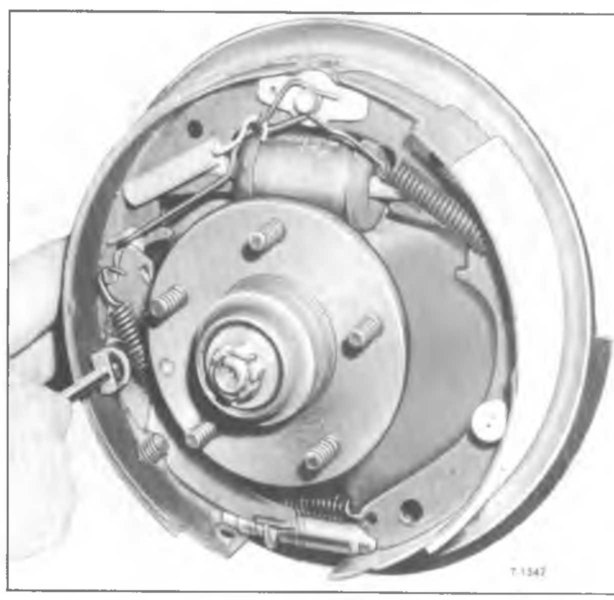


Figure 31—Removing Hold Down Springs and Pins

Figure 32—Installing Primary Shoe Return Spring

from brake shoe contact surfaces on backing plate using fine emery cloth.

4. Inspect brake shoe return springs. If broken, cracked, or weakened, replace springs.

5. If lining is worn to the extent that replacement is necessary, replace lining as directed under "Brake Shoe Relining."

BRAKE SHOE INSTALLATION

1. Inspect new brake shoe and lining assemblies and make sure there are no nicks or burrs on edges of shoes which contact backing plate.

NOTE: Keep hand clean while handling brake shoes. Do not permit oil or grease to come in contact with linings.

Figure 33—Brake Shoe Contact Surfaces and Backing Plate

Figure 34—Checking Operation of Actuating Lever

2. Connect brake shoes together with connecting spring and place adjusting screw assembly in position.

CAUTION: Make sure the proper adjusting screw assembly is used (left- or right-hand). The adjusting screw assembly must be installed with the star wheel (adjusting screw) nearest to the secondary shoe. The connecting spring must be installed with the long end hooked on the secondary shoe, so that the spring coils will not interfere with movement of star wheel.

3. Spread brake shoes apart at top and place against backing plate so that primary shoe (short lining) is toward front of vehicle. Secondary shoe (long lining) is toward rear of vehicle.

4. Insert brake shoe webs into slots in wheel cylinder rods.

5. Secure primary shoe to backing plate with hold-down pin, spring and washers.

6. Place the actuating lever assembly (including pivot and override spring) in position on secondary shoe and attach both shoe and actuating lever assembly to backing plate with hold-down pin, spring, and washers.

7. Install guide plate over anchor pin.

8. Install actuating link.

CAUTION: DO NOT hook the actuating link over the anchor pin with a regular spring hook tool. This may damage the wheel cylinder boot. Place the actuating link over the anchor pin first and then fasten link to actuating lever assembly by holding this assembly in the full "DOWN" position.

9. Install primary shoe return spring in shoe and pull over anchor pin. Refer to figure 32.

IMPORTANT: Return spring for primary shoe is always installed AFTER actuating link, regardless of right or left, so that it will be in the OUTSIDE position on the anchor pin.

10. Install secondary shoe return spring in shoe and pull over actuating link.

11. Pry shoes away from backing plate and lubricate shoe contact surfaces with special lubricant (S-17). Be careful to keep lubricant off linings. Refer to figure 33.

12. Check operation of self-adjusting mechanism by hand operating. If there is any binding, locate trouble and correct. Refer to figure 34.

13. Expand adjustment as far as possible to still permit brake drums to clear linings. Install brake drums.

14. Install wheels, lower vehicle to ground and finish adjustment by applying brakes as many times as required, while vehicle is traveling in reverse, until proper pedal height is attained.

TYPE "FA" FRONT BRAKE

(Refer to Figure 35)

The type "FA" front brake is the same as the type "F" brake except for method of adjustment. The type "FA" brake has an automatic adjusting mechanism.

On each shoe, a lever is pivot-pinned on the inner side of the shoe web so that it rests against the manual adjusting cam. A drum contact plug, centered in the lined shoe table, has a shank pinned on this lever on the outside of the web. A spring loaded, serrated wedge slides on the lever pivot pin, between a washer and the shoe web, and under the contact plug shank into the space between the plug pin and a wedge guide also pinned on the shoe. An adjuster torsion spring is hooked over the plug pin, lever pivot pin and edge of shoe web. It holds the assembly stable, keeping the plug surface flush with lining surface.

As lining wears, the drum depresses the contact plug and it swings the adjuster lever away from the shoe table. In this gradual action, the spring loaded wedge moves to keep the gap between

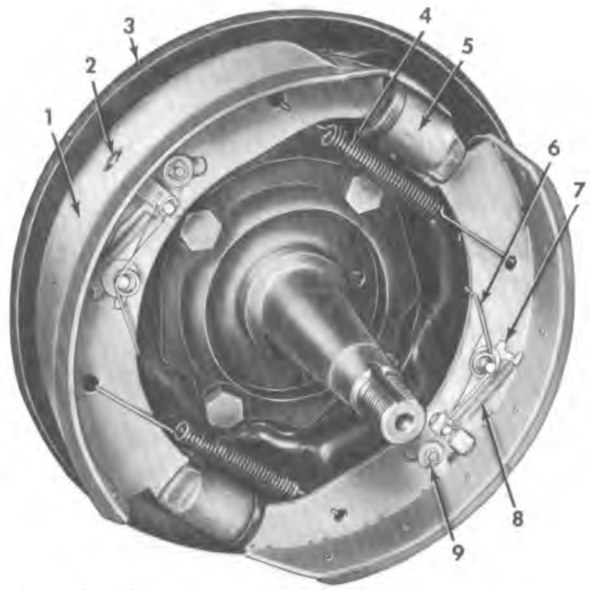


Figure 35—Type "FA" Front Brake Installed

plug pin and wedge guide closed and holds the lever (and shoe) in adjusted position.

At maximum lining wear, the plug pin bottoms on the inner side of its over-sized hole in the shoe web, completing the full stroke of the mechanism.

BRAKE SHOE REMOVAL
(Refer to Figure 36)

1. Jack up axle and remove hub and brake drum assembly as directed in "FRONT HUBS AND BEARINGS" (SEC. 3D) in this manual.
2. Remove both brake shoe return springs, using brake spring pliers.
3. Remove C-washer, flat washer, anti-rattle washer and another flat washer from each pin and remove shoes from backing plate.

DISASSEMBLE AUTOMATIC ADJUSTER
(Refer to Figure 36)

1. Unhook wedge spring from wedge and remove spring.
2. Unhook torsion spring from shoe web, work spring coil off lever pivot pin and slide end of torsion spring off contact plug pin.
3. Pull adjuster lever from opposite side of shoe web.
4. Pull contact plug through shoe table.
5. Lift off retainer washer, wedge, and guide.

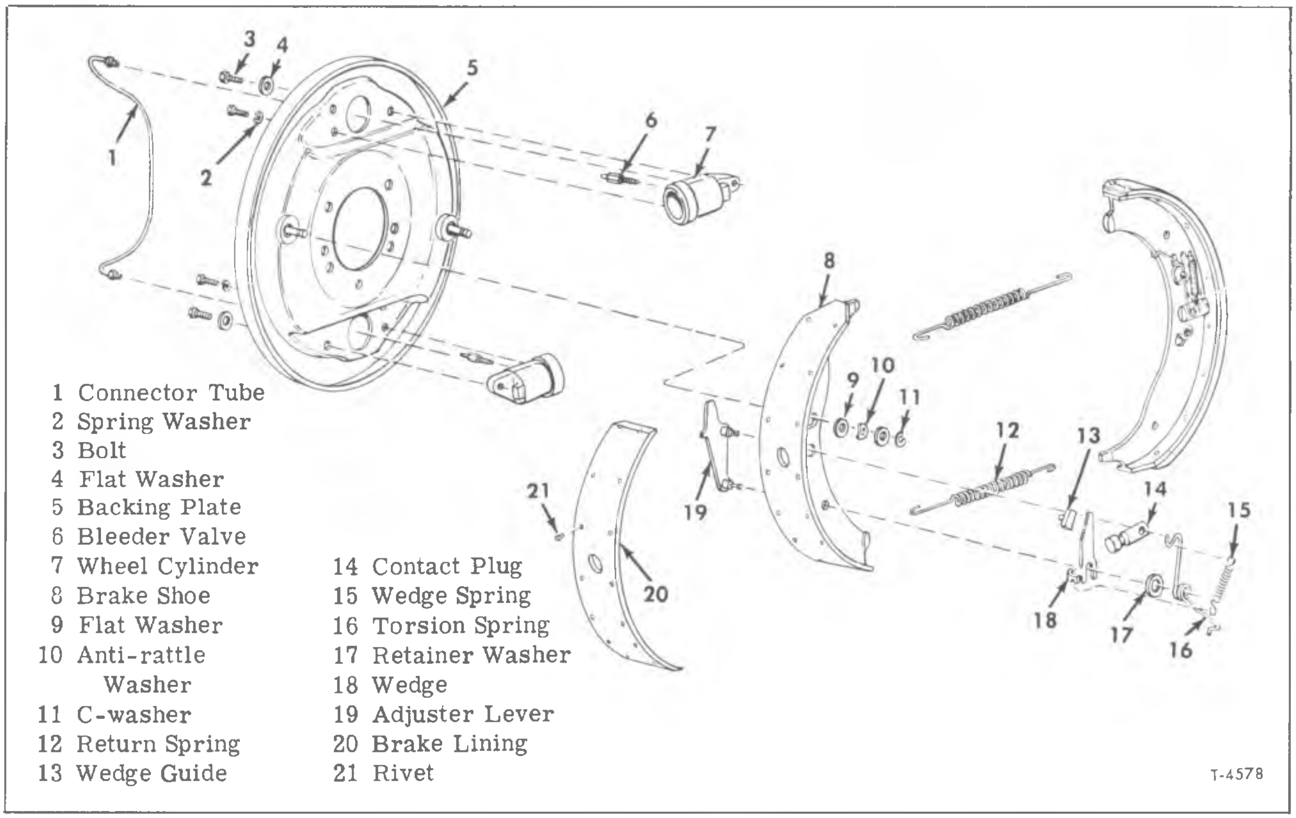


Figure 36—Type "FA" Front Brake Components

CLEANING AND INSPECTION

1. Clean all dirt out of brake drum. Inspect drum for roughness, scoring, or out-of-round. Replace or recondition brake drum as necessary. Refer to "Brake Drums" in this section.

2. Inspect bearings and oil seals as directed in "FRONT HUBS AND BEARINGS" (SEC. 3D) in this manual.

3. Check backing plate attaching bolts to make sure they are tight. Clean all dirt off backing plate.

4. Inspect brake shoe return springs. If broken, cracked, or weakened, replace with new springs.

5. Check cam and shoe guide stud and friction spring on backing plate for corrosion or binding. Cam stud should turn easily with an 8-inch wrench, but should not be loose. If frozen, lubricate with kerosene or penetrating oil and work free.

6. Check all automatic adjuster components and replace any which are worn or damaged. Replace springs if broken, cracked, or weakened.

7. Check wheel cylinders as instructed under "Wheel Cylinder Repair" in this section. Replace with new cylinders if necessary.

8. Examine brake shoe linings for wear. Linings should be replaced if worn down close to rivet heads. Refer to "Brake Shoe Relining" in this section.

ASSEMBLE AUTOMATIC ADJUSTER
(Refer to Figure 36)

1. Place the wedge guide on the shoe web (side away from mounting plate) with the serrations facing away from the shoe table.

2. Lay the wedge on the shoe with the serrations against matching serrations on the wedge guide. Align wedge slot with pivot pin hole.

3. Insert contact plug from inside of shoe, guiding its shank through the hole in the shoe table and over the wedge guide and wedge.

4. Place adjuster lever on opposite side of shoe web and insert pins through holes in shoe web and mating hole in contact plug shank.

5. Place retainer washer over wedge pivot pin.

6. Slide "U" hook of torsion spring on pin over contact plug shank. Attach end of wedge spring to this hook, then install coil of torsion spring over the pivot pin and pull the spring hook over the edge of shoe web.

7. Connect wedge spring on raised hook on the wedge "fork."

8. Fully retract the wedge against the lever pivot pin, pressing on the contact plug to permit this movement. If the plug now protrudes more than 0.005" above lining, clamp shoe in vise jaws bear against the adjuster lever and dress down the

plug. This can be done with a file, taking care to not create a "flat spot" on the lining. (An alternate method is to block adjuster lever in extended position and grind plug with lining.) If fully extended plug is more than 0.005" BELOW lining surface, replace with new plug.

BRAKE SHOE INSTALLATION

1. Place brake shoes over hold-down pins on backing plate and install a flat washer, an anti-rattle washer, a flat washer, and a C-washer (in that order) on each pin. Note that each shoe has a "heel" and "toe." The "heel" fits in the anchor slot of wheel cylinder, the "toe" fits in the piston end of wheel cylinder.

2. After installing both shoes on backing plate, install return springs. To install each spring, place spring end with short hook in "toe" of shoe, then using brake spring pliers, stretch spring and secure long hook end in "heel" of opposite shoe.

3. Center each shoe, before installing drum, by sliding shoe up or down in its anchor slot until the leading and trailing edges of the lining are equidistant from the inner curl of the brake mounting plate.

4. Back off manual adjustment cam.

5. Install hub and brake drum as directed in "FRONT HUBS AND BEARINGS" (SEC. 3D) in this manual.

INITIAL MANUAL LINING ADJUSTMENT

1. Rotate adjuster cam stud in the direction of forward drum rotation. Tighten adjustment until the lining drags on the brake drum, but not to exceed 120 inch-pounds torque.

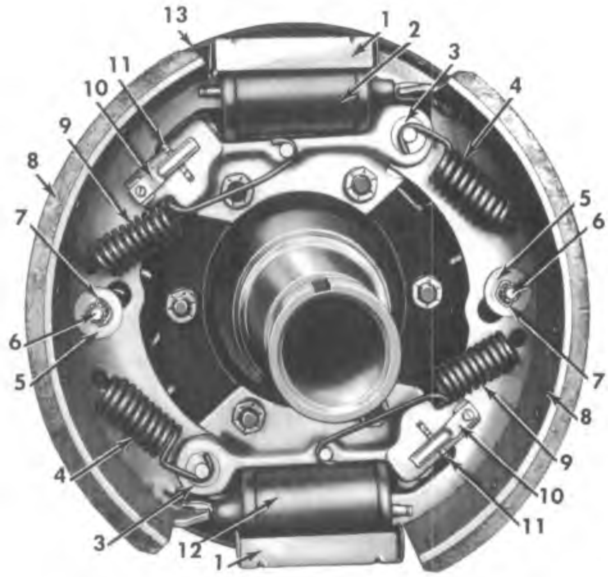
2. Back off the adjuster cam stud while rotating drum forward, until drag is just relieved.

3. Adjust the second manual shoe adjuster cam stud in the same manner, forward to tighten and reverse to relieve drag, and permit automatic adjustment to take over.

TYPE "FR-3" REAR BRAKE

(Refer to Figure 37)

Each brake is equipped with two double-end wheel cylinders which apply hydraulic pressure to both the toe and the heel of two identical, self-centering shoes. The shoes anchor at either toe or heel, depending upon the direction of drum rotation. Brake anchor supports and backing plate are bolted to the axle housing flange. The supports have removable slotted anchor pins at the shoe heels, and adjusting screws at the shoe toes. Adjusting screws act as anchors in the reverse direction of rotation. Each adjusting screw is threaded into or out of its support by means of an adjusting wheel. Adjusting wheels are accessible through adjusting slots in the backing plate.



1 Wheel Cylinder Heat Shield
2 Upper Wheel Cylinder
3 Anchor Pin
4 Return Spring (Short)
5 Guide Washer
6 Guide Bolt
7 Guide Bolt Nut Lock Wire
8 Brake Shoe and Lining Assembly
9 Return Spring (Long)
10 Adjusting Wheel Lock Spring
11 Adjusting Wheel
12 Lower Wheel Cylinder
13 Backing Plate

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Figure 37—Type "FR-3" Rear Brake Assembly

BRAKE SHOE REMOVAL

1. Jack up axle and remove hub and brake drum assembly as directed in "REAR HUBS AND BEARINGS" (SEC. 4C) of this manual.

2. Install wheel cylinder clamps to hold piston in cylinders.

3. Remove brake shoe return springs.

4. Remove lock wires, nuts, and washers from brake shoe guide bolts, then remove brake shoe assemblies.

5. Remove screws attaching adjusting wheel lock springs to anchor supports. Thread each adjusting screw from the shoe side of its anchor support by turning adjusting wheels, then lift adjusting wheels out of slots in anchor supports.

CLEANING AND INSPECTION

1. Clean all dirt out of brake drum. Inspect drum for roughness, scoring, or out-of-round. Recondition or replace drum as necessary. Refer to "Brake Drums" in this section.

2. Clean all dirt out of anchor pin holes and adjusting screw openings in anchor supports.

3. Inspect wheel bearings and oil seals as directed in "REAR HUBS AND BEARINGS" (SEC. 4C) of this manual.

4. Inspect brake shoe return springs. If broken,

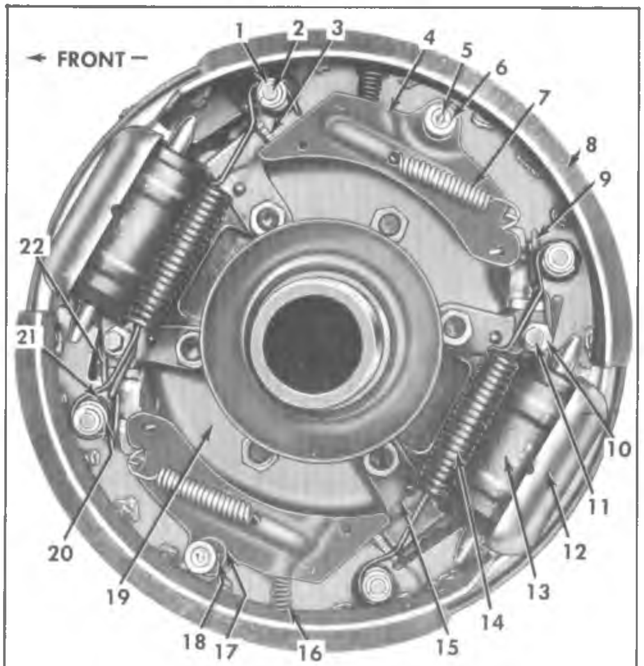
cracked, or weakened, replace with new springs.

5. Inspect threads on adjusting screws and in adjusting wheels for wear or damage. Replace as necessary.

6. Examine brake shoe linings for wear. Linings should be replaced if worn down close to rivet heads. Refer to "Brake Shoe Relining" in this section.

BRAKE SHOE INSTALLATION

1. Install adjusting screws and wheels in anchor supports dry; use no lubricant. Insert each adjusting wheel in slot in anchor support, insert threaded end of adjusting screw in anchor support, then turn adjusting wheel to thread adjusting screw into anchor support. Insert anchor pins into holes in anchor supports, with slots in pins facing slots in supports.



1 Hold-Down Pin Spring Lock
2 Hold-Down Pin
3 Adjusting Screw
4 Adjusting Lever
5 Adjusting Lever Pin
6 Hold-Down Spring Cup
7 Lever Override Spring
8 Brake Shoe and Lining
9 Adjusting Lever Pivot
10 Adjusting Lever Cam
11 Adjusting Lever Bolt
12 Wheel Cylinder Shield
13 Wheel Cylinder
14 Brake Shoe Return Spring
15 Brake Shoe Anchor
16 Lever Return Spring
17 Adjusting Lever Pin Sleeve
18 Hold-Down Spring
19 Brake Backing Plate
20 Hold-Down Pin Retainer
21 Hold-Down Pin Spring
22 Adjusting Lever Link

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Figure 38—Twin-Action Rear Brake Assembly (Automatic Adjuster)

2. Install brake shoes with cut-away end of shoe web next to adjusting screw and with ends of shoes engaging slots in wheel cylinder push rods and anchor pins. Install flat washer and nut on each brake shoe guide bolt. Tighten nuts finger-tight, then back off nuts only far enough to allow movement of shoes without binding.

3. Install brake shoe return springs, hooking one end of each spring in brake shoe web, then hook other end over anchor pins.

4. Remove wheel cylinder clamps.

5. Install hub and brake drum assembly as directed in "REAR HUBS AND BEARINGS" (SEC. 4C) of this manual.

6. Adjust brakes as directed under "Brake Adjustments."

TWIN-ACTION TYPE REAR BRAKE

(Refer to Figure 38)

BRAKE SHOE REMOVAL

1. Raise the vehicle and place on jack stands.
2. Remove brake drums.

NOTE: If brake drums are worn severely, it may be necessary to retract the adjusting screws.

3. Using Tool (J-22348), remove the brake shoe pull-back springs (fig. 39).

NOTE: Since wheel cylinder piston stops are incorporated in the anchor brackets, it is not necessary to install wheel cylinder clamps when the brake shoes are removed. However, the brake pedal must not be depressed while the drums are removed.

4. Loosen the adjusting lever cam cap screw and while holding the star wheel end of the adjusting lever past the star wheel, remove the cap screw and cam.

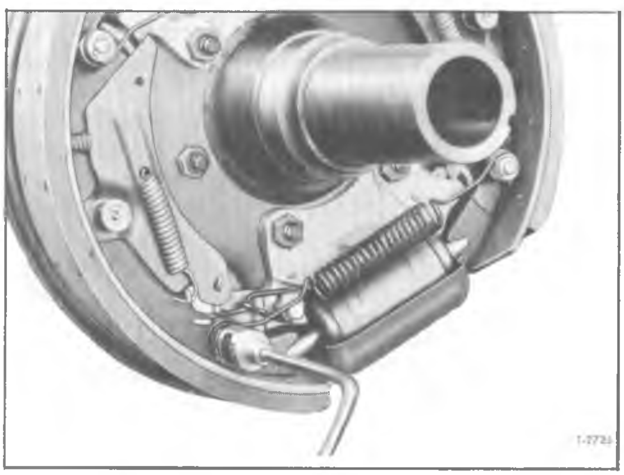


Figure 39 —Removing Pull Back Springs

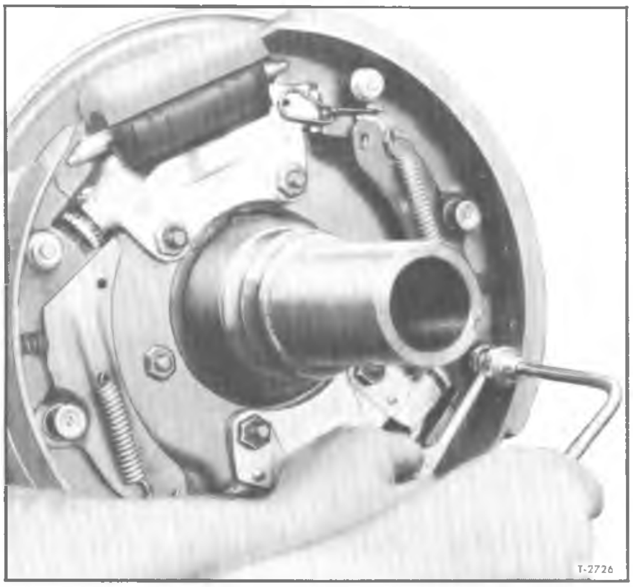


Figure 40—Removing Brake Shoe Hold Down Pins

5. Remove the brake shoe hold-down springs and pins by compressing the spring with Tool (J-22348) and, at the same time, pushing the pin back through the flange plate toward the tool. Then, keeping the spring compressed, remove the lock (C-washer) from the pin with a magnet (fig. 40).

6. Lift off the brake shoe and self-adjuster lever as an assembly.

7. The self-adjuster lever can now be removed from the brake shoe by removing the hold-down spring and pin. Remove lever return spring also.

NOTE: The adjusting lever, override spring and pivot are an assembly. It is not recommended that they be disassembled for service purposes unless they are broken. It is much easier to assemble and disassemble the brake leaving them intact.

8. Thread the adjusting screw out of the brake shoe anchor and remove and discard the friction spring (not shown in figure 38).

9. Clean all dirt out of brake drum. Inspect drums for roughness, scoring or out-of-round. Replace or recondition drums as necessary.

10. Carefully pull lower edges of wheel cylinder boots away from cylinders. If brake fluid flows out, overhaul of the wheel cylinders is necessary.

NOTE: A slight amount of fluid is nearly always present and acts as a lubricant for the piston.

11. Inspect flange plate for oil leakage past axle shaft oil seals. Install seals if necessary.

12. Check all flange plate attaching bolts to make sure they are tight. Clean all dirt and rust

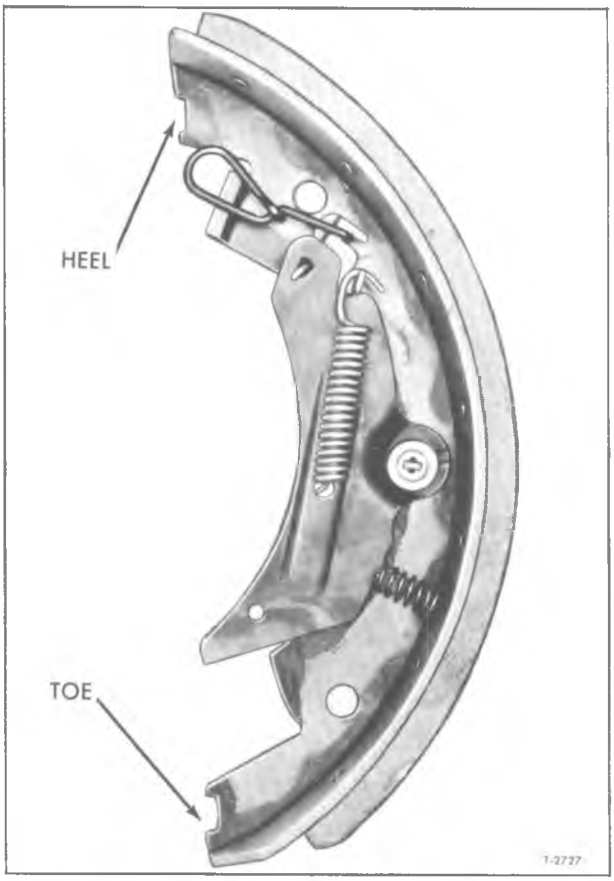


Figure 41—Brake Shoe and Automatic Adjuster Assembly

from shoe contact faces on flange plate using emery cloth.

13. Thoroughly clean adjusting screws and threads in the anchors.

BRAKE SHOE INSTALLATION

1. Put a light film of lubricant on shoe bearing surfaces of brake flange plate and on threads of adjusting screw.

2. Thread adjusting screw completely into anchor without friction spring to be sure threads are clean and screw turns easily. Then remove screws, position a new friction spring on screw and reinstall in anchor.

3. Assemble self-adjuster assembly and lever return spring to brake shoe and position adjusting lever link on adjusting lever pivot.

4. Position hold-down pins in flange plate.

5. Install brake shoe and self-adjuster assemblies onto hold-down pins. Insert ends of shoes in wheel cylinder push rods and legs of friction springs.

NOTE: Make sure the toe of the shoe is against the adjusting screw (fig. 41).

Figure 42—Measuring Points for Brake Shoe Centering

6. Install cup, spring, and retainer on end of hold-down pin. Using Tool (J-22348) compress the spring. With spring compressed, push the hold-down pin back through the flange plate toward the tool and install the lock on the pin.

7. Using Tool (J-22348) install brake shoe return springs.

8. Holding the star wheel end of the adjusting lever as far as possible past the star wheel, position the adjusting lever cam into the adjusting lever link and assemble with cap screw.

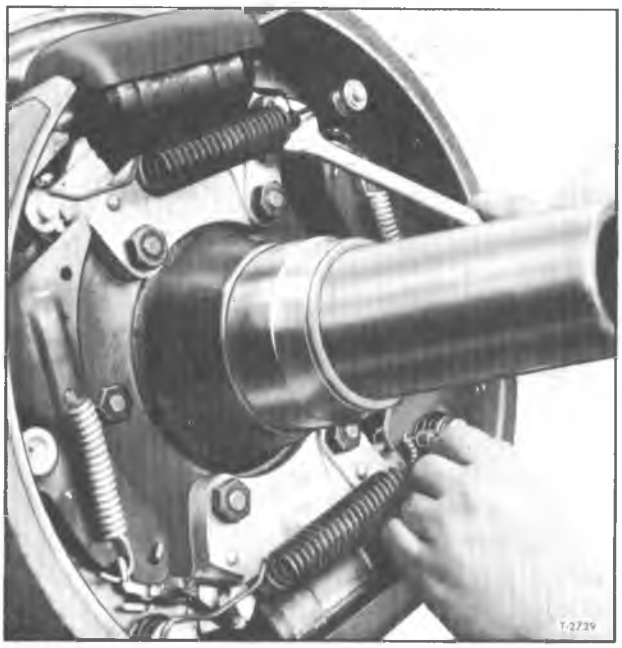


Figure 43—Positioning Adjusting Lever

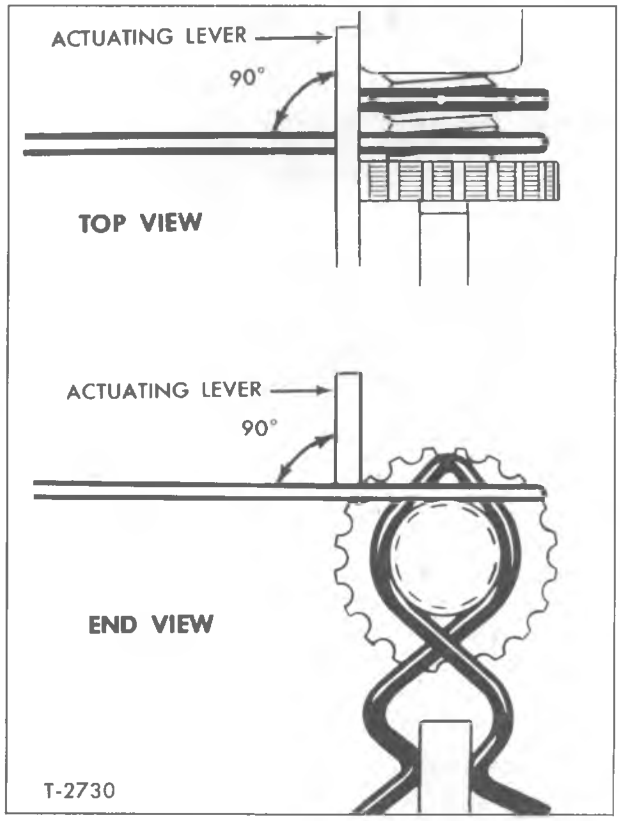


Figure 44—Wire Gauge Position for Correct Adjusting Lever Adjustment

9. Check the brake shoes for being centered by measuring the distance from the lining surface to the edge of the flange plate at the points shown in figure 42. To center the shoes, tap the upper or lower end of the shoes with a plastic mallet until the distances at each end become equal.

10. Locate the adjusting lever 0.020" to 0.039" above the outside diameter of the adjusting screw thread by loosening the cap screw and turning the adjusting cam.

NOTE: To determine 0.020" to 0.039", turn the adjusting screw 2 full turns out from the fully retracted position. Hold a 0.060" wire gauge at a 90° angle with the star wheel edge of the adjusting lever. Turn the adjusting cam until the adjusting lever and threaded area on the adjusting screw just touch the wire (figs. 43 and 44).

11. Secure the adjusting cam cap screw and retract the adjusting screw.

12. Install brake drums and wheels.

13. Adjust the brakes by making several forward and reverse stops until a satisfactory brake pedal height results.

TYPE "FR-3A" REAR BRAKE

The type "FR-3A" rear brake is the same as the type "FR-3" brake except for method of adjustment. The type "FR-3A" brake has an automatic adjusting mechanism. Refer to figure 45.

Shoes are kept in adjustment individually by identical link-crank adjuster systems. On a reverse braking application, the heel of a shoe moves away from its forward-acting anchor, an action which places a cocking motion in its link-crank system. An adjustable eccentric on the shoe web provides a hinge for a short link which carries this motion to a crank lever fastened on the forward acting anchor pin by a "c" clip. From this crank, motion transfers through a longer link to an adjusting lever mounted on the opposite anchor bracket so that a pawl on the lever meshes with the starwheel. The motion pivots (cocks) the adjusting lever back, the force overcoming an adjuster spring connected between a finger of the lever and the spring pin. If lining clearance permits sufficient movement, the adjusting lever pawl picks up the next tooth on the starwheel.

Unintentional back-off of the starwheel is prevented by a friction ring located on the adjuster screw. This ring applies sufficient drag to prevent an automatic back-off, but not enough to exclude manual adjustments at the starwheel.

The adjustment is completed upon brake release, as the adjuster spring returns the adjusting lever pawl, advancing the starwheel one tooth. Completion may be delayed by anchoring pressure against the adjuster screw; in this case it is completed as the anchor pressure is relieved by the next forward brake application.

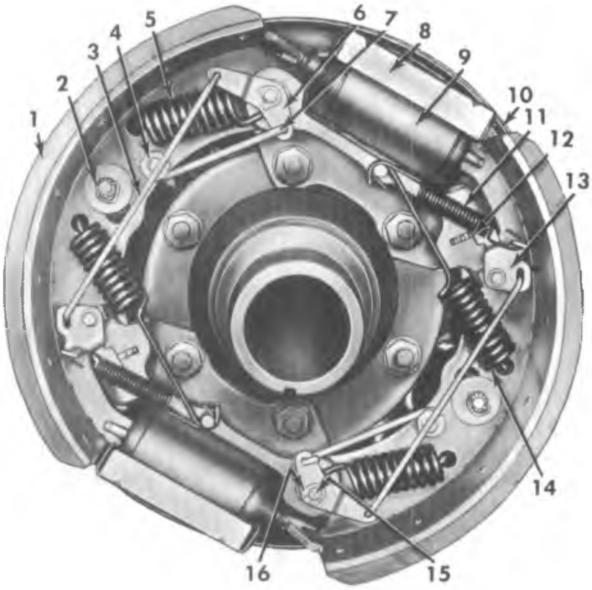
BRAKE SHOE REMOVAL
(Refer to Figure 46)

1. Jack up axle and remove hub and brake drum assembly as directed in "REAR HUBS AND BEARINGS" (SEC. 4C) of this manual. It may be necessary to back off adjuster star wheels slightly to free grooved drums.

> **CAUTION: DO NOT back off adjustment so much that star wheel is jammed against the friction ring on the star wheel screw; this may damage the friction ring.**

2. Unhook the two automatic adjuster springs.

3. Remove the two long crank links by pivoting back the star wheel cranks until their slots align with the link "U" hooks. Lift out links, then slide their "S" hooks from the adjuster cranks.



1 Brake Shoe and Lining Assembly	8 Wheel Cylinder Cover
2 Hold-down Bolt, Washer, Nut, and Lock Wire	9 Wheel Cylinder
	10 Backing Plate
	11 Adjuster Spring
3 Crank Link (Long)	12 Starwheel
4 Eccentric and Screw	13 Starwheel Crank
5 Shoe Return Spring (Short)	14 Shoe Return Spring (Long)
6 Adjuster Crank	15 Anchor Pin
7 Crank Link (Short)	16 "C" Washer

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Figure 45—Type "FR-3A" Rear Brake Installed

4. Remove short crank links by rotating adjuster cranks until link "U" hooks clear the eccentrics on shoe webs, then remove the smaller "U" hooks from the adjuster cranks.

5. Spread adjuster crank C-washers and lift off cranks.

6. Remove bolt which fastens star wheel crank to anchor support and remove crank.

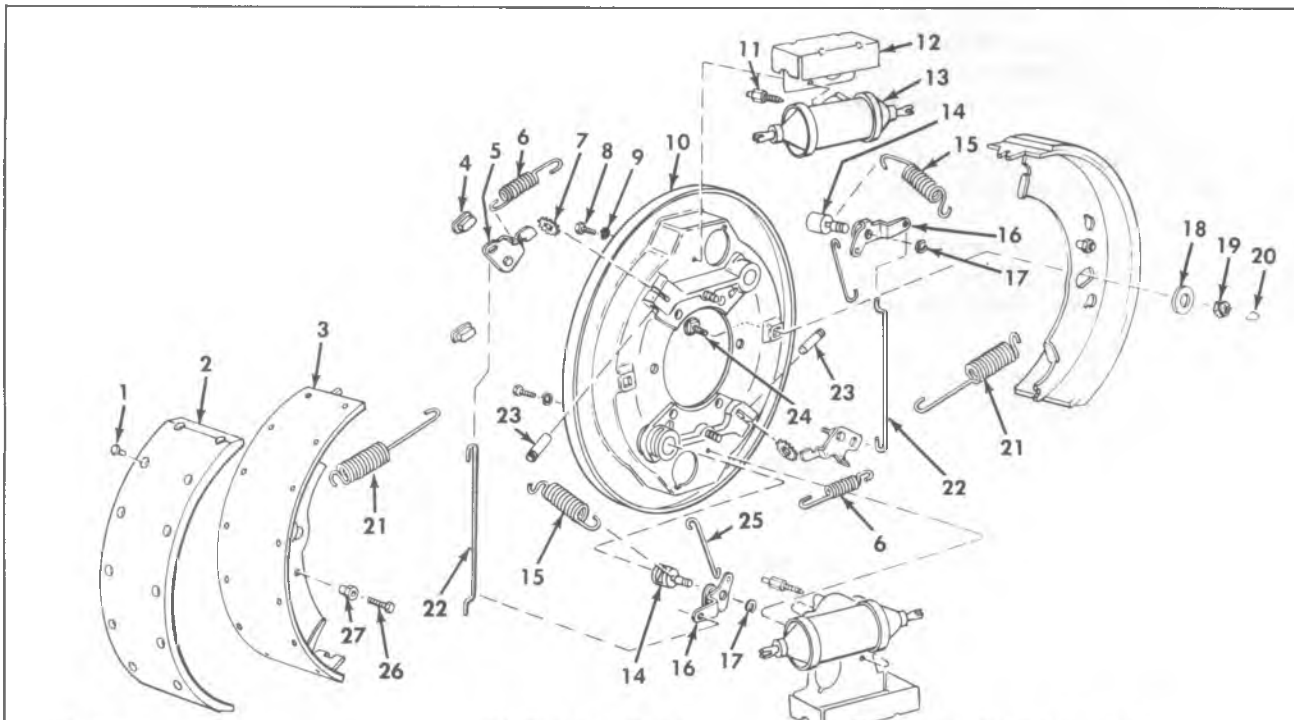
7. Remove adjuster eccentric screw and eccentric from brake shoe.

8. Remove two long shoe return springs and two short return springs by sliding looped ends off pins.

9. Remove lock wires, hold-down nuts, and washers from hold-down bolts and lift off brake shoes.

10. Thread each star wheel screw out of anchor support from shoe side of support. Lift star wheels from support slots.

NOTE: DO NOT attempt to remove a friction ring from a star wheel screw; if necessary, replace with a new screw and friction ring assembly.



1 Rivet
2 Brake Lining
3 Brake Shoe
4 Hole Cover
5 Starwheel Crank
6 Adjuster Spring
7 Starwheel
8 Bolt
9 Spring Washer
10 Backing Plate
11 Bleeder Valve
12 Wheel Cylinder Cover
13 Wheel Cylinder
14 Anchor Pin
15 Shoe Return Spring (Short)
16 Adjuster Crank
17 C-washer
18 Hold-down Washer
19 Hold-down Nut
20 Lock Wire
21 Shoe Return Spring (Long)
22 Crank Link (Long)
23 Starwheel Screw
24 Hold-down Bolt
25 Crank Link (Short)
26 Eccentric Screw
27 Eccentric

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Figure 46—Type "FR-3A" Rear Brake Components

CLEANING AND INSPECTION

1. Clean all dirt out of brake drum. Inspect drum for roughness, scoring, or out-of-round. Recondition or replace drum as necessary. Refer to "Brake Drums" in this section.
2. Clean all dirt out of anchor pin holes and adjusting screw openings in anchor supports.
3. Inspect wheel bearings and oil seals as directed in "REAR HUBS AND BEARINGS" (SEC. 4C) of this manual.
4. Inspect brake shoe return springs. If they are broken, cracked, or weakened, replace with new springs.
5. Inspect threads on adjusting screws and in adjusting wheels for wear or damage. Replace as necessary.
6. Check all automatic adjuster components and replace any which are worn or damaged. Replace springs if broken, cracked, or weakened.
7. Check wheel cylinders as instructed under "Wheel Cylinder Repair" in this section. Replace with new cylinders if necessary.
8. Examine brake shoe linings for wear. Linings should be replaced if worn down close to rivet heads. Refer to "Brake Shoe Relining" in this section.

BRAKE SHOE INSTALLATION

1. Insert star wheels in anchor support slots and thread in star wheel screw from the shoe side. friction ring end toward the shoe. For new linings, back off screws, taking care to not jam star wheels.

NOTE: DO NOT LUBRICATE STAR WHEEL SCREWS.

2. Position one brake shoe with its "toe" (cut-away portion of web) located in the adjuster slot and the "heel" in the anchor pin slot of anchor supports.
3. Install brake shoe hold-down bolt, hold-down washer and hold-down nut. Tighten nut finger-tight and then back off nut one turn and insert nut lock wire.

4. Install the other brake shoe in same manner as described in paragraphs 2 and 3.

5. Install long brake shoe return springs in shoe web, longest shank at adjuster, and hook springs over pins.

6. Install short brake shoe return springs in shoe web and hook springs over pins at anchor end.

7. Place adjuster eccentrics on shoe webs and fasten with self-tapping screw. Tighten screw only finger-tight to permit final adjustment later.

8. Place adjuster cranks on anchor pins, their long arms toward shoes, bushing toward backing plate, so that they rotate freely while resting against return spring hooks.

9. Install and crimp adjuster crank C-washer.

10. Place star wheel crank on anchor support and fasten with crank bolt.

11. At each adjuster crank assemble the short link small hook into the short arm of the crank from the lower side and hook the other end of link around the eccentric on the shoe web.

12. Assemble long link "S" hook to long arm of adjuster crank from upper side, rotate star wheel crank so that slot lines up with link "U" hook. Insert "U" hook and rotate star wheel crank back to approximate adjusting position.

13. Install adjuster spring with short hook on star wheel crank finger so that its long shank hook assembles on the outer groove of the pin from the wheel cylinder side.

INITIAL MANUAL LINING ADJUSTMENT

1. If shoes have been relined, back off star wheel adjustments.

2. Center each shoe; insert a pry tool against backing plate curl and shoe (do not mar lining). Slide shoe up or down in anchor slots until leading and trailing edges of the lining are equidistant from the inner curl of the brake backing plate.

3. On each shoe web, rotate hex eccentric, as required, until linkage aligns star wheel crankpawl with center line of star wheel screw. A SMALL MILLED SLOT ON THE ANCHOR SUPPORT IS THE ALIGNING MARK.

4. When aligned, lock eccentrics by tightening self-tapping screws to 19 foot-pounds torque.

5. Install hub and drum as described in "REAR HUBS AND BEARINGS" (SEC. 4C) of this manual.

6. Remove both adjustment slot covers from back of backing plate.

7. Insert adjusting tool and turn each star wheel until lining drags on drum while drum is rotated. To tighten adjustment, move tool handle toward axle while using inner side of adjuster slot as fulcrum for the tool, rotating the star wheel teeth away from the axle.

8. Back off star wheels while rotating drum forward, until drag is just relieved. Provide additional running clearance by backing off 8 to 10 more notches and replace slot covers. Automatic adjustment now takes over.

BRAKE SHOE RELINING

Brake linings on these models are riveted to the brake shoes and may be replaced. These linings may be purchased in replacement sets of four linings and sufficient rivets of correct specifications. Refer to Parts Book for lining replacement kits. When replacing linings, make sure that shoes are clean and that linings are installed in a manner that will prevent gaps between lining and shoe.

Conventional lining replacement equipment should be used. Make sure lining fits firmly against shoe, and that rivets are properly upset.

BRAKE DRUMS

Brake drum installations are illustrated in "FRONT HUBS AND BEARINGS" (SEC. 3D) and "REAR HUBS AND BEARINGS" (SEC. 4C) of this manual. Procedures for replacing brake drums are also included in the above mentioned sections.

Whenever brake drums are removed for servicing brakes, inspect drums. If found to be scored, rough, or out-of-round, drums should be machined.

Machining or grinding of brake drums increases the inside diameter of the drum and changes the lining to drum fit. When machining drums, it is recommended that the following maximum oversizes not be exceeded:

(a) Drums with standard diameter up to 14" can be machined up to 0.060" oversize.

(b) Drums with standard diameter over 14" can be machined up to 0.080" oversize.

When it is found that machining to these maximum limits does not provide a suitable braking surface, discard the worn drum and replace with a new standard drum.

DO NOT EXCEED THESE LIMITS. THIS IS A SAFETY PRECAUTION.

TROUBLESHOOTING CHART

LOW PEDAL OR PEDAL GOES TO TOE BOARD

PROBABLE CAUSE	REMEDY
1. Excessive clearance between linings and drum.	1. Adjust brakes.
2. Automatic adjusters not working.	2. Make forward and reverse stops; if pedal stays low, repair faulty adjusters.
3. Weak brake hose.	3. Replace with new hose.
4. Leaking conduits.	4. Repair or replace faulty parts.
5. Leaking wheel cylinder.	5. Clean and rebuild.
6. Leaking master cylinder.	6. Clean and rebuild.
7. Leaking master cylinder check valve.	7. Install new check valve.
8. Air in system.	8. Bleed system.
9. Plugged master cylinder filler cap.	9. Clean filler cap vent holes; bleed system.
10. Improper brake fluid.	10. Flush system and refill with recommended brake fluid.
11. Low fluid level.	11. Fill reservoir with brake fluid; bleed system.

SPRINGY, SPONGY PEDAL

PROBABLE CAUSE	REMEDY
1. Air trapped in hydraulic system.	1. Remove air by bleeding.
2. Improper brake fluid.	2. Flush, refill and bleed system. Use recommended brake fluid.
3. Improper lining thickness or location.	3. Install specified lining or replace shoe and lining.
4. Drums worn too thin.	4. Replace drums.
5. Master cylinder filler vent clogged.	5. Clean vent or replace cap; bleed brakes.
6. Weak hose.	6. Install new hose.

EXCESSIVE PEDAL PRESSURE REQUIRED TO STOP

PROBABLE CAUSE	REMEDY
1. Brake adjustment not correct.	1. Adjust the brakes.
2. Incorrect lining.	2. Install specified linings.
3. Grease or fluid soaked lining.	3. Repair grease seal or wheel cylinder. Install new linings.
4. Lining not in full contact.	4. Grind lining to proper radius.
5. Improper fluid.	5. Flush out system; fill with recommended fluid; bleed.
6. Frozen master or wheel cylinder pistons.	6. Recondition or replace all cylinders.
7. Brake pedal binding on shaft.	7. Lubricate.
8. Linings installed on wrong shoes.	8. Install primary and secondary linings correctly.
9. Glazed linings.	9. Sand surface of linings.
10. Bellmouthed, barrel-shaped or scored drums.	10. Replace or resurface drums in R.H. and L.H. pairs.

LIGHT PEDAL PRESSURE -- BRAKES TOO SEVERE	
PROBABLE CAUSE	REMEDY
1. Brake adjustment not correct.	1. Adjust the brakes.
2. Loose backing plate on front axle.	2. Tighten plates.
3. A small amount of grease or fluid on linings.	3. Replace the linings.
4. Charred linings.	4. Sand the surfaces of the linings.
5. Incorrect lining.	5. Install factory specified linings.
6. Wheel bearings loose.	6. Adjust wheel bearings.
7. Lining loose on shoe.	7. Replace lining or shoe and lining.
8. Excessive dust and dirt in drums.	8. Clean and sand drums and linings.
9. Bad drum.	9. Turn drums in pairs or replace.

BRAKE PEDAL TRAVEL DECREASING	
PROBABLE CAUSE	REMEDY
1. Master cylinder compensating port plugged.	1. Open, use air or .015 wire. Remove any burr in bore.
2. Swollen cup in master cylinder.	2. Replace rubber parts flush system. Refill with recommended fluid.
3. Master cylinder piston not returning.	3. Rebuild master cylinder.
4. Weak shoe retracting springs.	4. Replace springs.
5. Wheel cylinder pistons sticking.	5. Clean cylinder bores and parts. Replace bad parts.

PULSATING BRAKE PEDAL	
PROBABLE CAUSE	REMEDY
1. Drums out-of-round.	1. Refinish drums.
2. Loose brake drums on hub.	2. Tighten.
3. Worn or loose wheel bearings.	3. Replace or adjust.
4. Bent rear axle.	4. Replace axle.

BRAKES FADE	
PROBABLE CAUSE	REMEDY
1. Incorrect lining.	1. Replace lining with lining recommended.
2. Poor lining contact.	2. Grind lining to proper radius; adjust.
3. Thin drum.	3. Replace drum.
4. Dragging brakes.	4. Adjust.

ALL BRAKES DRAG WHEN ADJUSTMENT IS KNOWN TO BE CORRECT	
PROBABLE CAUSE	REMEDY
1. Pedal does not return to stop.	1. Lubricate the pedal.

ALL BRAKES DRAG WHEN ADJUSTMENT IS KNOWN TO BE CORRECT (Cont'd.)

PROBABLE CAUSE	REMEDY
2. Improper fluid.	2. Replace rubber parts and fill with recommended brake fluid.
3. Compensating or bypass port of master cylinder closed.	3. Open by air or .015 wire. Remove any burr in bore.
4. Use of inferior rubber parts.	4. Install proper parts.

ONE WHEEL DRAGS

PROBABLE CAUSE	REMEDY
1. Weak or broken shoe retracting springs.	1. Replace the defective brake shoe springs and lubricate the brake shoe ledges.
2. Brake shoe to drum clearance too small.	2. Adjust.
3. Loose wheel bearings.	3. Adjust wheel bearings.
4. Wheel cylinder piston cups swollen and distorted or the piston stuck.	4. Rebuild cylinders.
5. Pistons sticking in wheel cylinder.	5. Clean or replace pistons; clean cylinder bore.
6. Drum out-of-round.	6. Grind or turn both front or rear drums.
7. Obstruction in line.	7. Clean out or replace.
8. Distorted shoe.	8. Replace.
9. Defective lining.	9. Replace with specified lining.

PULLS TO ONE SIDE

PROBABLE CAUSE	REMEDY
1. Grease or fluid soaked lining.	1. Replace with new linings.
2. Loose wheel bearings, loose packing plate on rear axle or front axle or loose spring bolts.	2. Adjust the wheel bearing, tighten the backing plate on the rear and front axles and tighten spring bolts.
3. Linings not of specified kind or primary and secondary shoes reversed.	3. Install specified linings. Install shoes correctly.
4. Tires not properly inflated or unequal wear of tread. Different tread non-skid design.	4. Inflate the tires to recommended pressures. Rearrange the tires so that a pair of non-skid tread surfaces of similar design and equal wear will be installed on the front wheels, and another pair with like tread will be installed on the rear wheels.
5. Linings charred.	5. Sand the surfaces of the lining.
6. Water, mud, etc., in brakes.	6. Remove any foreign material from all of the brake parts and inside of the drums. Lubricate the shoe ledges and rear brake cable ramps.
7. Wheel cylinder sticking.	7. Repair or replace wheel cylinder.
8. Weak or broken retracting springs.	8. Check springs -- replace bent, open-coiled or cracked springs.
9. Out-of-round drums.	9. Resurface or replace drums in left- and right-hand pairs (both front and both rear).

HYDRAULIC BRAKES

PULLS TO ONE SIDE (Cont'd.)

PROBABLE CAUSE	REMEDY
10. Brake dragging.	10. Check for loose lining. Adjust.
11. Weak chassis springs, loose U-bolts, loose steering gear, etc.	11. Replace spring, tighten U-bolts, adjust steering gear, etc.
12. Loose steering.	12. Repair and adjust.
13. Unequal camber.	13. Adjust to "Specifications."
14. Clogged or crimped hydraulic line.	14. Repair or replace line.
15. Wheel cylinder size different on opposite sides.	15. Replace with correct cylinders.
16. Loose king pin.	16. Replace king pins or bushings.
17. Bad drum.	17. Refinish drums in pairs.

ONE WHEEL LOCKS

PROBABLE CAUSE	REMEDY
1. Gummy lining.	1. Reline.
2. Tire tread slick.	2. Match up tire treads from side to side.

WET WEATHER: BRAKES GRAB OR WON'T HOLD

PROBABLE CAUSE	REMEDY
1. Linings too sensitive to water.	1. Reline.
2. Dirty brakes.	2. Clean out.
3. Bent backing plate -- opening.	3. Straighten.
4. Scored drums.	4. Grind or turn in pairs.

BRAKES SQUEAK

PROBABLE CAUSE	REMEDY
1. Backing plate bent or shoes twisted.	1. Straighten or replace damaged parts.
2. Metallic particles or dust imbedded in lining.	2. Sand the surfaces of the linings and drums. Remove all particles of metal that may be found in the surfaces of the linings.
3. Lining rivets loose or lining not held tightly against the shoe at the ends.	3. Replace rivets and/or tighten lining by re-riveting.
4. Drums not square or distorted.	4. Turn or grind or replace drums.
5. Incorrect lining.	5. Replace lining.
6. Shoes scraping on backing plate ledges.	6. Apply brake lube to ledges. Replace with new shoe and linings, if distorted.
7. Weak or broken hold down springs.	7. Replace defective parts.
8. Loose wheel bearings.	8. Tighten to proper setting.
9. Loose backing plate, anchor, drum, wheel cylinder.	9. Tighten.
10. Linings located wrong on shoes.	10. Install linings correctly.

BRAKES CHATTER

PROBABLE CAUSE	REMEDY
1. Incorrect lining to drum clearance.	1. Readjust to recommended clearances.
2. Loose backing plate.	2. Tighten securely.
3. Grease, fluid, road dust on lining.	3. Clean or reline.
4. Weak or broken retractor spring.	4. Replace.
5. Loose wheel bearings.	5. Readjust.
6. Drums out-of-round.	6. Grind or turn drums in pairs.
7. Cocked or distorted shoes.	7. Straighten or replace.
8. Tapered or barrel-shaped drums.	8. Grind or turn in pairs.

SHOE CLICK

PROBABLE CAUSE	REMEDY
1. Shoes lift off backing plate and snap back.	1. Change drums side to side or grind drums (in pairs).
2. Hold down springs weak.	2. Replace springs.
3. Shoe bent.	3. Straighten.
4. Grooves in backing plate pads.	4. Grind and lubricate.

TROUBLE SHOOTING POWER HYDRAULIC BRAKES (Vacuum Assist Units)

NOTE: The same types of brake troubles are encountered with power brakes as with standard brakes. Before checking the power brake system for source of trouble, refer to trouble diagnosis of standard hydraulic brakes. After these possible causes have been eliminated, check for cause as outlined below.

NOTE: Make the following test before checking hard pedal for the cause. With the engine stopped, depress the brake pedal several times to eliminate all vacuum from the system. Apply the brakes, and while holding the foot pressure on the brake pedal, start the engine. If the unit is operating correctly, the brake pedal will move forward when the engine vacuum power is added to the pedal pressure. If this test shows that the power unit is not operating, the trouble may be one of the following:

BRAKE SYSTEM LOSES FLUID

PROBABLE CAUSE	REMEDY
1. External Leak: Leaking-pipe connections, hose, wheel cylinders, master cylinder head nut, etc.	1. Clean parts. Tighten. Replace defective parts.
2. Internal Leaks: Past secondary seals into power unit. Check vacuum hose for fluid.	2. Rebuild master cylinder.

HYDRAULIC BRAKES

NO BOOST -- HARD PEDAL

PROBABLE CAUSE	REMEDY
1. Bent, broken obstructed tube. Collapsed hose.	1. Replace defective parts.
2. Stuck check valve.	2. Replace valve.
3. Air inlet blocked.	3. Replace filter. Open passages.
4. Air valve stuck.	4. Disassemble unit -- clean -- replace defective parts.
5. Faulty diaphragm.	5. Replace diaphragm.
6. Faulty piston seal.	6. Replace seal.
7. Leaks internally.	7. Rebuild.
8. Leaking vacuum tank.	8. Repair tank.

SLOW BRAKE PEDAL RETURN

PROBABLE CAUSE	REMEDY
1. Excessive seal friction in power unit.	1. Rebuild unit.
2. Faulty valve action.	2. Rebuild unit.
3. Broken return spring.	3. Replace spring.

BRAKES GRABBY

PROBABLE CAUSE	REMEDY
1. Broken valve spring.	1. Rebuild unit.
2. Sticking vacuum valve.	2. Clean and lubricate.
3. Reaction diaphragm leakage.	3. Rebuild unit.

SPECIFICATIONS

FRONT BRAKES

TRUCK MODELS	CE, CS40 CE, CS50 SE, SS50	CE, CS50(1) CE, ME60(3) TE, TS50 (3) TE60	CE, CS50 (2) SE, SS50
Type	Duo-Servo	"F"	"FA"
Adjustment	Automatic	Manual	Automatic
Size	14 x 2½	15 x 3	15 x 3
Lining Width	2½"	3"	3"
Lining Thickness	9/32"	5/16"	5/16"
Lining Area—Sq. In. per Axle	136.4	198.1	198.1

(1) Cab Models—Only.
(2) Cowl Models—Only.
(3) Available with 15 x 3.5 Shoes.

SPECIFICATIONS (CONT.)

REAR BRAKES

TRUCK MODELS	CE, CS40(1) CE, CS50 SE, SS50 TE, TS50	CE, CS50 CE, ME60(2) TE, TS50 TE 60(2)	SE, SS50
Type	Twin-Action	"FR-3"	"FR-3A"
Adjustment	Automatic	Manual	Automatic
Size	15 x 4	15 x 6	15 x 6
Lining Width	4"	6"	6"
Lining Thickness	17/32"	½"	½"
Lining Area—Sq. In. per Axle	249.4	377.3	377.3

(1) Available with 15 x 5 Shoes.
(2) Available with 15 x 7 Shoes.

POWER CYLINDERS

TRUCK MODELS	STANDARD OR OPTIONAL	*MFG.	MFG. MODEL NO.	OVERALL DIAMETER	CYLINDER BORE	POWER DIAPHRAGM STROKE	HYDRAULIC PISTON STROKE
CE, CS, PS40	Opt.	B-P	2508827	12.78"	—	5.44"	5.31"
CE50	Std.						
CE60	Std.						
CE60	Opt.						
ME60	Std.	B-P	2508643	12.78"	—	4.30"	4.19"
SE, SS50	Std.	B-P	2508829	12.78"	—	5.44"	5.31"
All Models with Split Brakes	Opt.						
TE, TS50	Std.	B-P	2503139	12.78"	—	4.70"	4.66"
TE60	Std.						

*B-P—Bendix Products

BRAKE CONTROLS

MASTER CYLINDER

TRUCK MODELS	MASTER CYLINDER*	MASTER CYLINDER BORE
CE, CS40	Std.	1¼"
	Opt.	1½"
CE50	Std.	1½"
	Opt.	1¾"
CE60	Std.	1½"
	Opt.	1¾"
ME60	Std.	1¾"
SE, SS50	Std.	1¾"
TE, TS50	Std.	1½"
TE 60	Std.	1½"
	Opt.	1¾"

*All Models with Optional Split Brake System have a 1¾" Master Cylinder Bore.

WHEEL CYLINDERS

TYPE BRAKE	AXLE MODEL	WHEEL CYLINDER BORE
Duo-Servo	F-050, F-055	⅞"
"F"	F-070. F-090	1⅛"
	F-110	1⅜"
"FA"	F-070	1⅛"
Twin-Action	H-110, H-135	1½"
	H-150, T-150	1½"
"FR-3"	H-170, T-170	1⅝"
	30DSC	1⅝"
	17121, 17221	1¾"
"FR-3A"	H-170, T-170	1⅝"

Only genuine Hydraulic Brake Fluid as specified in LUBRICATION (SEC. 0), should be used in the hydraulic brake system. The use of other fluids may cause deterioration of rubber cups in master and wheel cylinders, and may induce corrosion of the metal parts of the cylinders.

SECTION 5B

Air Brakes

INDEX

BRAKE SYSTEM EQUIPMENT

The air brake system comprises a group of devices, some of which maintain a supply of compressed air, some of which direct and control the flow of the compressed air, and others which transform the energy of compressed air into the mechanical force and motion necessary to apply the brakes. Refer to figure 1 for typical schematic diagram.

Information in this section covers all standard air brake equipment, as well as other units which are used as optional equipment on some models.

There are two basically different types of air actuated brakes used on vehicles covered by this manual. One type is the cam-type brake which is energized by an air chamber and slack adjuster arrangement. The other is called Stopmaster, which is a complete assembly consisting of two air chambers connected to two brake shoes through tubes containing push-rod and plunger assemblies. All information relative to Stopmaster brakes is found under the heading of "Stopmaster Brakes" in this section. Unless otherwise specified, all pedals, valves, controls, etc., covered in this manual apply to both cam-type and Stopmaster type brake systems.

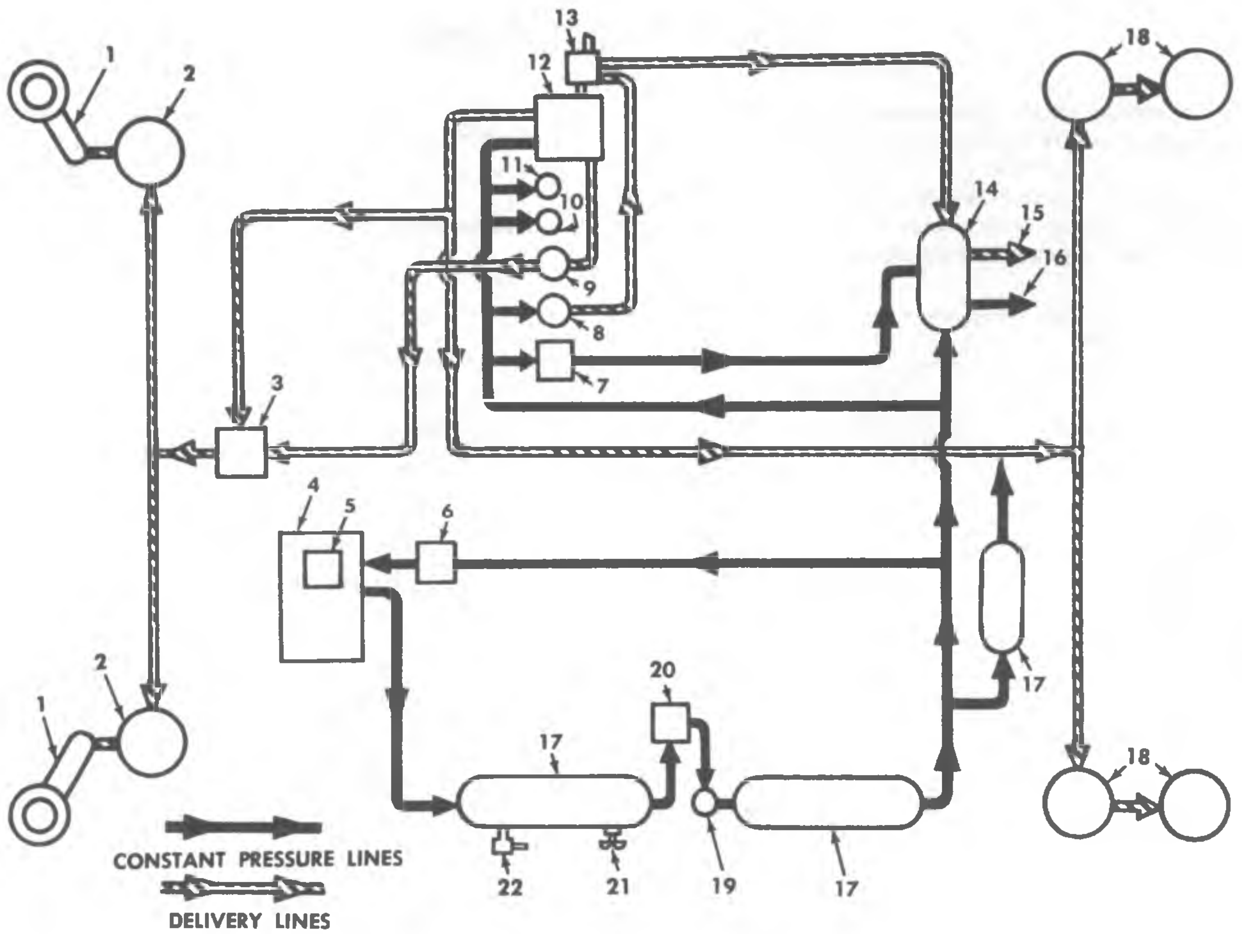
Refer to AIR COMPRESSOR AND GOVERNOR (SEC. 5D) for information relative to air compressors and governors.

BRAKE SYSTEM MAINTENANCE

Normal operation of braking system necessitates periodic tests, inspection, and adjustments to assure safe, efficient operation. Test, inspection and adjustment procedures for each air brake control unit are described under individual headings in this section. Since the vehicles covered by this Service Manual will be used in a wide variety of operation types, it is impossible to fix maintenance intervals (either time or mileage) which will satisfactorily suit all conditions. Therefore, any such intervals stated in these maintenance procedures must be related to the type of usage to which a particular vehicle is put. Obviously, a truck used in city "stop and start" driving will require different service operations and intervals than one hauling "over the road" for long distance. With this in mind, all service intervals should be related to a specific vehicle.

Compression and subsequent cooling of air causes the moisture in the air to condense. This moisture collects in air tank and should be drained daily. Drain cocks are provided at bottom of air tanks for this purpose. Satisfactory draining is accomplished only by leaving the drain cocks open after compressed air has escaped and until all drainage stops.

Some vehicles are equipped with a moisture ejector valve (optional), which eliminates the need for daily drainage of air tanks. For description of how this valve works, refer to procedures under heading of "Moisture Ejector Valve."



1 Slack Adjuster
2 Standard Brake Chamber
3 Limiting and Quick Release Valve
4 Air Compressor
5 Air Intake
6 Governor
7 Emergency Parking "Push-Pull" Valve
8 Trailer Brake Hand Control Valve
9 Two-Way Valve
10 Low Air Buzzer Switch
11 Air Gauge
12 Application Valve
13 Double Check Valve
14 Tractor Protection Valve
15 Trailer Brake Service Line
16 Trailer Brake Emergency Line
17 Air Tanks
18 Stopmaster Brake Chambers
19 Check Valve
20 Moisture Ejector Valve
21 Drain Valve
22 Safety Valve

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Figure 1—Schematic Diagram of Typical Air Brake System

The complete air system should be checked for leakage at regular intervals. Build up air pressure in system to governor cut-out point, then with engine stopped and brakes released, observe rate of air pressure drop registered by the dash air pressure gauge. The rate of drop should not exceed two pounds per minute.

With engine stopped amd brakes fully applied, observe rate of air pressure drop registered by the dash gauge. Rate of drop should not exceed three pounds per minute.

If leakage is excessive, leakage test should be made at air line connections and at all air brake control units as directed under individual headings later in this section.

In cold weather, particular attention should be given to draining of moisture from air system.

PREVENTIVE MAINTENANCE CHART

THE PREVENTIVE MAINTENANCE CHART ON THE OPPOSITE PAGE IS PROVIDED TO MAKE SUGGESTED RECOMMENDATIONS RELATIVE TO SCHEDULED MAINTENANCE OF AIR BRAKE SYSTEM COMPONENTS. PROPER MAINTENANCE WILL HELP TO REDUCE PREMATURE FAILURE AND PROMOTE SAFETY.

PREVENTIVE MAINTENANCE CHART

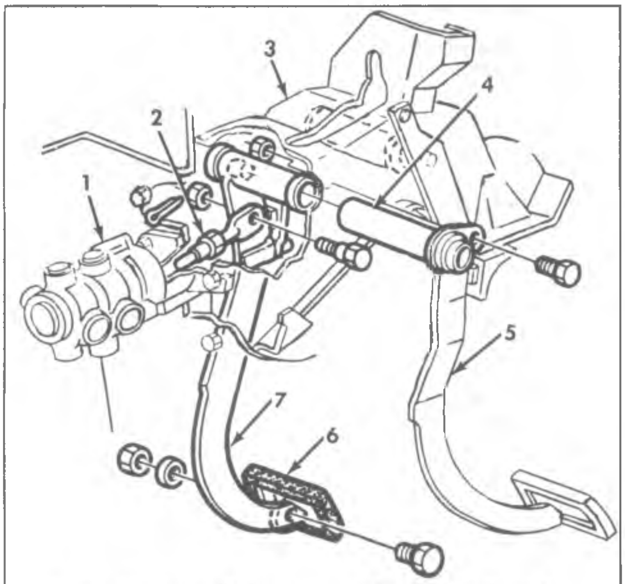
The vehicles covered by this Maintenance Manual are used in different types of operation. With these conditions, it is impossible to establish the maintenance intervals (either time or mileage). Therefore, any such intervals given in the following Maintenance Chart must be related to the type of operation in which a particular vehicle is used. Intervals given are manufacturer's recommendations and should be considered as maximum periods. Maintenance operations at shorter intervals are preferable to longer intervals.

Whenever any assembly is removed and disassembled for maintenance it is advisable to replace all grommets, gaskets, O-rings etc., and any other parts which show wear or deterioration.

ITEM	INTERVAL (1)	MAINTENANCE OPERATION
Check Valves	6 Mos.—50,000 Miles—1800 Hrs.	Remove, disassemble, clean, inspect
Air Tank Check Valve	6 Mos.—50,000 Miles—1800 Hrs.	Remove, disassemble, clean, inspect
Low Air Pressure Switch	300 Hrs.—8,000 Miles	Check Electrical Connections
	3,600 Hrs.—100,000 Miles—1 Year	Remove, disassemble, clean, inspect
Safety Valve	Annually	Remove, disassemble, clean, inspect
Air Lines	5,000 Miles	Test for leaks; tighten as necessary
Moisture Ejector Valve	1800 Hrs.—50,000 Miles—6 Mos.	Remove, disassemble, clean, inspect
Alcohol Evaporator	10,000 Miles—2 Months	Remove and clean strainer
	50,000 Miles—1 Year	Remove, disassemble, clean, inspect
Brake Shoe Assemblies	(2)	Check lining thickness (5/16" or less, reline)
Slack Adjuster	3,000 Miles	Lubricate at chassis lubrication
Std. Brake Chamber	3,600 Hrs.—100,000 Miles—1 Year	Remove, disassemble, clean, inspect
Anchorlok Brake Chamber Stopmaster Brake Chamber "Fail-Safe" Brake Chamber "Super Fail-Safe" Brake Chamber	2 Months—25,000 Miles	Check operation and air lines
	Annually—100,000 Miles or at Brake Reline	Remove, disassemble, clean, inspect
Application Valve	300 Hrs.—8,000 Miles—30 Days	Lubricate treadle pin and roller pin
	3,600 Hrs.—100,000 Miles—1 Year	Remove, disassemble, clean, inspect
Relay Valve	3,600 Hrs.—100,000 Miles—1 Year	Remove, disassemble, clean, inspect
Push-Pull Valve	3,600 Hrs.—100,000 Miles—1 Year	Remove, disassemble, clean, inspect
Limiting-Quick Release Valve	Annually	Remove, disassemble, clean, inspect
Pressure Protection Valve	6 Months—50,000 Miles	Remove, disassemble, clean, inspect
Trailer Brake Hand Control Valve	1500 Hrs.—50,000 Miles	Check operation—lubricate cam and follower
	3000 Hrs.—100,000 Miles—1 Year	Remove, disassemble, clean, inspect
Tractor Protection Valve	Annually	Remove, disassemble, clean, inspect
Double Check Valve and Stop Light Switch	Monthly—10,000 miles	Check electrical connections and operation
	Annually—50,000 Miles	Remove, disassemble, clean, inspect
Trailer Emergency Stop Light Switch	900 Hrs.—25,000 Miles	Check electrical connections and operation
	Annually—50,000 Miles	Remove, disassemble, clean, inspect
Air Compressor	(2)	Clean carbon from valves and discharge line. Check mounting bolts and tighten. Check lines for leaks.
Governor	500 Hrs.—15,000 Miles	Clean or replace filters
	3000 Hrs.—100,000 Miles	Remove, disassemble, clean, inspect, re-set

(1) Where more than one interval is given, operation to be performed at time of whichever occurs first.

(2) Determined by severity of service.



1 Application Valve
2 Push Rod
3 Support Bracket
4 Pedal Sleeve
5 Clutch Pedal
6 Brake Pedal Pad
7 Brake Pedal

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Figure 2—Brake Pedal and Linkage (Conv. Models)

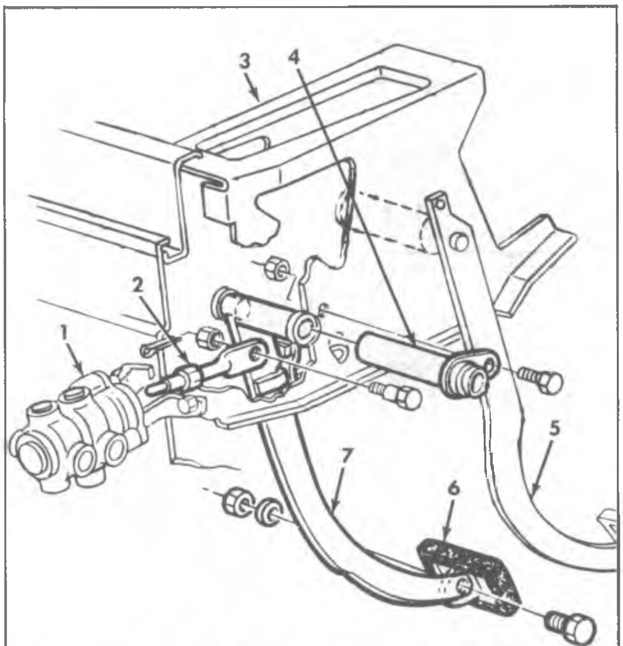
BRAKE ADJUSTMENTS

Brake adjustments to compensate for normal lining wear are made at slack adjuster at each wheel. Adjustment must be made before the brake chamber push rod travel reaches the maximum working stroke listed in "Specifications" at end of this section.

On S-50 and conventional 60 Series models, an adjustable push rod is used between the brake pedal and the brake application valve. On tilt cab models, an adjustable stop screw is provided to control the pedal push rod to application valve relationship. These adjustments are not normally required except when the application valve, pedal, or push rod have been removed and reinstalled.

PUSH ROD ADJUSTMENT
(CONV. AND "S" MODELS) (Figs. 2 and 3)

Push rod adjustment controls the exhaust opening between the hollow end of the application valve piston and the exhaust valve, and the pedal travel before brake application begins. If push rod is too long, it will prevent the piston from leaving the exhaust valve and brakes will not release, or if it does not open far enough it can result in slow brake release. If push rod is too short, excessive pedal travel will be required to start brake application, and full brake application may not be obtained. With push rod installed, adjust as follows:



1 Application Valve
2 Push Rod
3 Support Bracket
4 Pedal Sleeve
5 Clutch Pedal
6 Brake Pedal Pad
7 Brake Pedal

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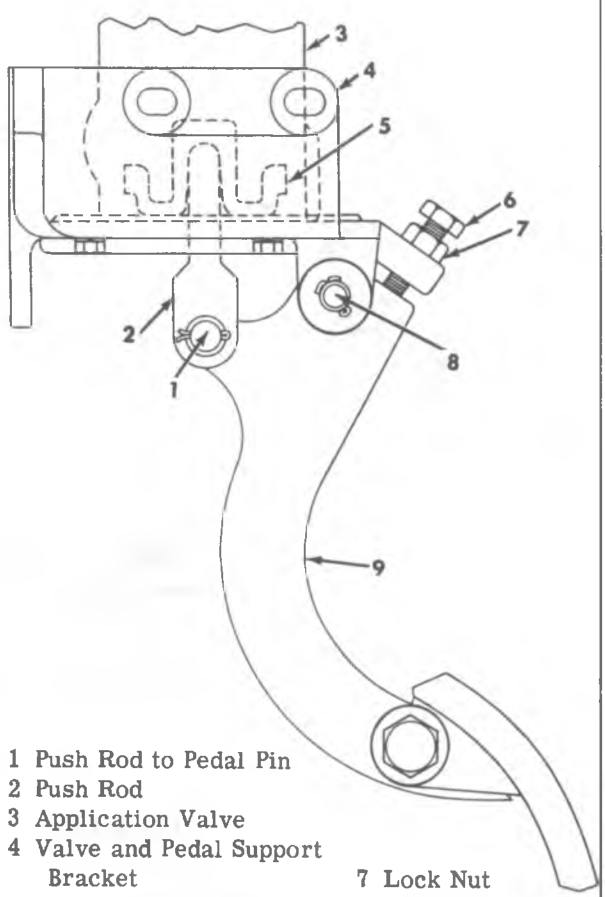
Figure 3—Brake Pedal and Linkage ("S" Models)

1. Loosen lock nut on push rod.
2. Adjust push rod to obtain 1/8" free play of brake pedal at pedal pad before push rod contacts air valve piston.
3. Hold push rod while firmly tightening lock nut.
4. Check brake operation for full application and release.

PEDAL STOP SCREW ADJUSTMENT
(TILT CAB MODELS) (Fig. 4)

Pedal stop screw adjustment controls the exhaust opening between the hollow end of the application valve piston and the exhaust valve. It also controls the pedal travel before brake application begins. If stop screw is turned down too far, it will prevent the piston from leaving the exhaust valve and brakes will not release. If it does not open far enough it can result in slow brake release. If stop screw is not turned down far enough, excessive pedal travel will be required to start the brake application, and full application may not be obtained. Adjust stop screw as follows:

1. Loosen lock nut on pedal stop screw.
2. Back stop screw out until there is free play between the push rod and the application valve piston cup.
3. Turn stop screw down until all free play is removed, then back screw out ½ turn and lock.



1 Push Rod to Pedal Pin
2 Push Rod
3 Application Valve
4 Valve and Pedal Support Bracket
5 Application Valve Piston Cup
6 Pedal Stop Screw
7 Lock Nut
8 Pedal to Bracket Pin
9 Pedal
T-1563

Figure 4—Brake Pedal and Linkage (Tilt Cab Models)

4. Hold stop screw while tightening lock nut.
5. Check brake operation for full application and release.

BRAKE LINING WEAR ADJUSTMENT
(Refer to Fig. 5)

NOTE: On vehicles equipped with "Stopmaster" brakes, brake shoe adjustment is covered under "Stopmaster Brakes" near end of this section.

Slack adjusters function as adjustable levers and provide a quick and easy method of adjusting the brakes to compensate for normal lining wear. Positive-locking type slack adjusters are used on all vehicles. Internal construction of all slack adjusters is as shown in figure 6; however, lever arm (body) may be offset to suit installation requirements. Refer to "Air Brake Specifications" at end of this section to determine slack adjuster type used.

The most efficient brake action with "S" cam brakes, will be obtained when the arm travel of the slack adjuster is held to a minimum so that the full length of the lever is utilized during brake application. Minor adjustment to compensate for normal lining wear should be confined to the slack adjusters.

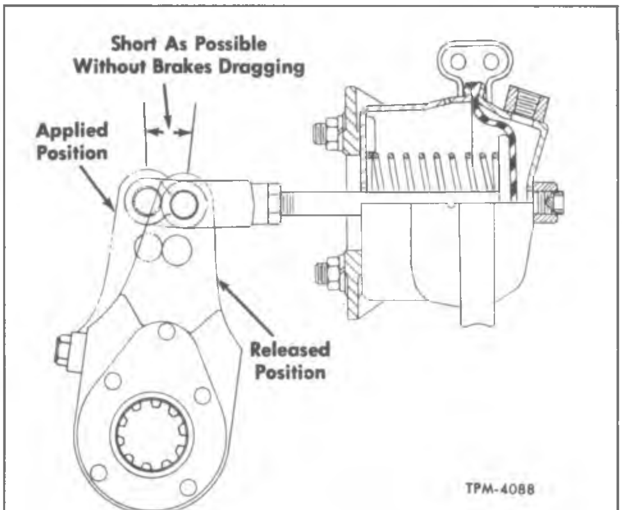
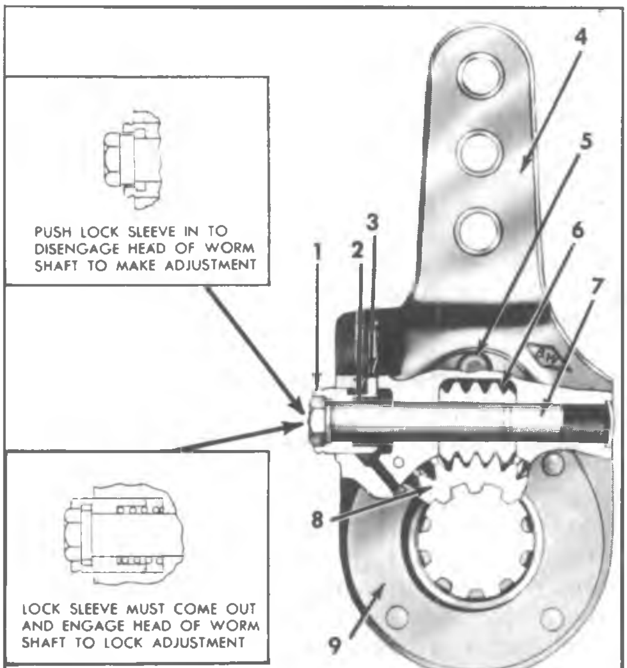


Figure 5—Typical Air Brake Adjustment

Push rod travel should be maintained as short as possible without brakes dragging (refer to fig. 5). Push rod travel should be checked after every



1 Lock Sleeve
2 Spring
3 Dowel
4 Lever
5 Rubber Plug
6 Worm
7 Worm Shaft
8 Gear
9 Cover Plate
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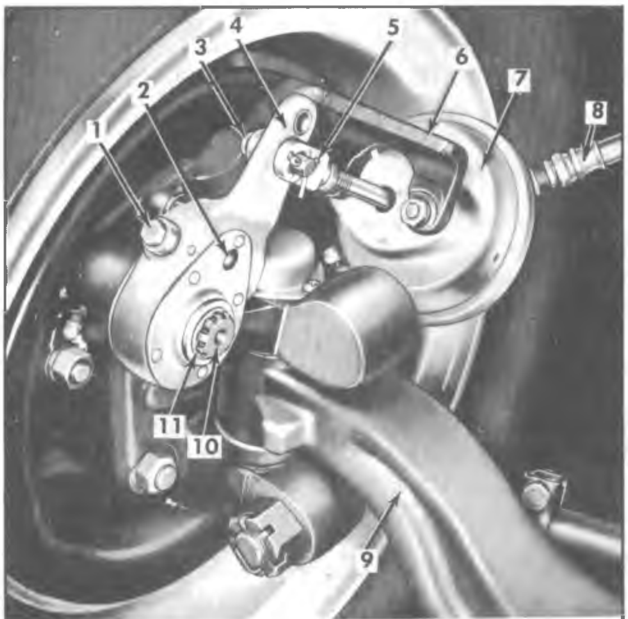
Figure 6—Slack Adjuster



1 Adjusting Worm Shaft	7 Brake Chamber
2 Lubrication Hole Plug	8 Air Brake Hose
3 Clevis Pin	9 Front Axle
4 Slack Adjuster	10 Brake Camshaft
5 Adjusting Clevis	11 Snap Ring
6 Mounting Bracket	

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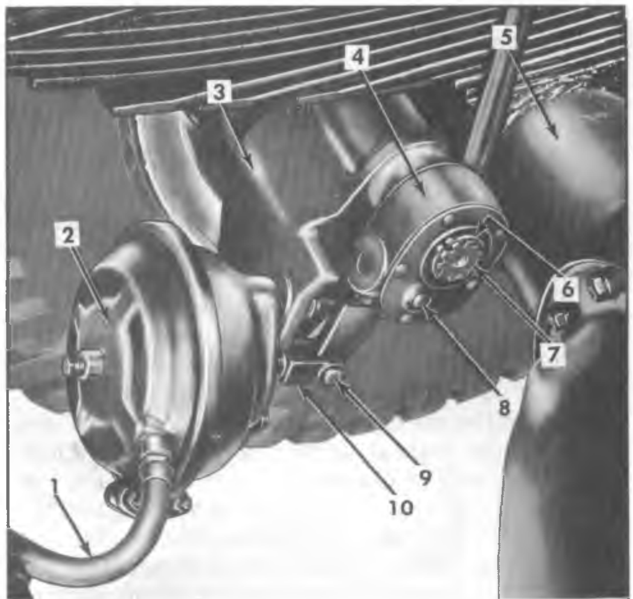
Figure 7—Brake Chamber and Slack Adjuster Installed (Front)



1 Air Brake Hose	6 Snap Ring
2 Brake Chamber	7 Brake Camshaft
3 Mounting Bracket	8 Lubrication Hole Plug
4 Slack Adjuster	9 Clevis pin
5 Rear Axle	10 Adjusting Clevis

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Figure 8—Brake Chamber and Slack Adjuster Installed (Rear)

2,000 miles of operation to determine whether adjustment is necessary. Brake linings should be replaced before wear exposes rivet heads and causes drum damage.

1. With wheel jacked up, turn slack adjuster worm shaft until brake drags, then back off until wheel turns freely.

NOTE: Lock sleeve must be pushed in before worm shaft can be turned (fig. 6). Make sure sleeve is pushed in far enough to clear hex end of worm shaft before turning shaft.

2. Be sure wheel turns freely with brakes fully released. After completing adjustment, make sure lock sleeve comes out and engages hex end of worm shaft (fig. 6). Pry sleeve out with screwdriver if necessary. Coat lock sleeve and end of worm shaft with wheel bearing grease to keep out dirt and moisture to assure free movement of sleeve at next adjustment.

SLACK ADJUSTERS

SLACK ADJUSTER OPERATING TEST

Apply brakes and make sure all slack adjusters rotate freely and without binding. Release brakes and make sure all slack adjusters return to released position freely without binding.

With brakes released, make sure the angle formed by slack adjuster arm and brake chamber push rod is greater than 90 degrees. All slack adjusters should be set at the same angle. With brakes applied, make sure the angle formed by the slack adjuster arm and brake chamber push rod is still slightly greater than 90 degrees and that all are at the same angle. If angle is less than 90 degrees with brakes applied, slack adjuster is going "over center." Adjust brakes as previously described under "Brake Adjustments."

SLACK ADJUSTER REPLACEMENT
(Refer to Figs. 7 and 8)

Removal

1. Remove clevis pin attaching brake chamber push rod yoke to slack adjuster.

2. Remove lock ring or cotter pin and spacer securing slack adjuster on camshaft. Slide slack adjuster off end of shaft.

Installation

1. If a new slack adjuster is being installed, make sure it is the same size and type as that removed. Make sure spacing washer is in place on camshaft. Slide slack adjuster onto camshaft and attach with spacer and lock ring or cotter pin.

2. Connect brake chamber push rod yoke to slack adjuster with clevis pin and cotter pin. Refer

to "Brake Chamber Installation" for adjustment of brake chamber push rod.

3. Adjust brakes as directed under "Brake Adjustments."

BRAKE CHAMBERS (STANDARD)

All service information in the following paragraph refers only to standard chambers. Standard chambers are used on front brakes on all models covered by this manual. Dependent upon rear axle model used or optional equipment ordered the chambers at rear brakes may be standard, Stopmaster, "Fail-Safe," "Super Fail-Safe" or Anchorlok. The different type chambers are covered elsewhere in the manual under appropriate headings.

An air brake chamber is used at each wheel to convert the energy of compressed air into the mechanical force and motion required to apply the brakes. The yoke on the brake chamber push rod connects to a slack adjuster which is mounted on the brake camshaft. Push rod opening and four equally spaced holes near clamping flange in non-pressure plate provide for breathing and drainage. For illustration of brake chambers installed see figure 7 (at front axle) and figure 8 (at rear axle).

Brake chambers have two different type clamp rings; (1) a two-piece ring with two bolts and (2) a one-piece clamp ring with two bolts at the clamp ring joint.

BRAKE CHAMBER OPERATION

As air pressure enters the brake chamber behind the diaphragm, the diaphragm forces push rod outward, thus applying force to the slack adjuster which rotates brake camshaft, applying brakes. When air pressure is released from the brake chamber, the brake shoe return springs and the push rod spring return brake shoes, camshaft, slack adjuster, push rod, and diaphragm to released position.

BRAKE CHAMBER SERVICEABILITY TESTS

1. Operating Test

Apply brakes and see that the brake chamber push rods move out promptly without binding. Release brakes and see that they return to released position without binding.

2. Leakage Test

a. While full brake pressure is being delivered apply soap suds to clamp ring holding the diaphragm in place between the pressure plate and non-pressure plate. No leakage is permissible. If leakage is evident, tighten clamp ring bolts.

b. With the brakes fully applied, check for leakage through the diaphragm by coating the push rod hole and drain holes in non-pressure plate with soap suds. No leakage is permissible. If leakage is evident, replace the diaphragm.

BRAKE CHAMBER REPLACEMENT

1. Removal

Disconnect the air line from brake chamber. Disconnect push rod yoke from slack adjuster. Remove nuts from brake chamber mounting studs, then remove brake chamber assembly.

2. Installation

Install the brake chamber on mounting bracket and secure with stud nuts and lock washers. Connect push rod yoke to slack adjuster. Adjust the brakes as previously directed under "Brake Adjustments." Apply brakes and make sure push rod is correct length. Angle formed by push rod and slack adjuster should be greater than 90 degrees with brakes released, and with brakes applied after being adjusted, this angle should still be greater than 90 degrees; in other words, the slack adjuster should not go "over center" during brake application. If necessary, adjust yoke on push rod to obtain this condition. Push rod must not extend through yoke far enough to interfere with slack adjuster. Test brake chamber as directed under "Serviceability Tests."

MAINTENANCE

It is recommended that all brake chambers be removed, disassembled, inspected and thoroughly cleaned at the time that brakes are relined or at one year periods, whichever occurs first (also dependent upon the type of operation and operator experience). Any parts worn, cracked, or deteriorated should be replaced.

AIR TANKS

The number of air tanks used and their mounting locations vary from model to model. On tilt cab models one tank is mounted crossways between frame side rails behind front bumper and in front of first frame crossmember. On conventional cab models the tanks are mounted along the outside of the left frame rail, under the cab in the step area. On "cowl" models the air tank is mounted on the outside of the left-hand frame side rail near the front of the vehicle.

The purpose of the air tanks is to provide a place to store compressed air so there will always be an ample supply available for immediate operation of the brakes. Tanks provide storage for sufficient compressed air for several brake applications with engine stopped.

Another purpose of the air tanks is to provide a place where the air, heated during compression, can cool and the water vapor can condense. Most of this condensation takes place in the "wet" tank; this is the tank into which the compressed air is first discharged from the compressor. Condensation should be drained from all air tanks daily. To drain tanks properly, leave drain cocks open until all air escapes and draining stops. Daily draining is not necessary on those models which have the optional moisture ejector valve.

All pressure for operation of the brakes and air compressor governor is taken from the dry tank. A one-way check valve at inlet to second tank prevents loss of air pressure from the second tank in the event of leakage in the first tank or air compressor discharge line.

Air tank U-bolts and support brackets to frame bolts should be checked for looseness at regular intervals and tightened if necessary. Air tank may be cleaned inside using steam or hot water. If corrosion or other damage has weakened the tank, it must be replaced.

AIR PRESSURE CHECK VALVE

There are several different kinds of check valves used on vehicles covered by this manual.

Check valve prevents loss of air pressure from second air tank in the event of leakage in the first tank or in the air compressor discharge line. Arrow on valve body indicates direction of air flow through valve.

The rubber valve seat should be replaced if there is any evidence of deterioration or hardening. Valve spring should be replaced if weakened by rust or corrosion. Valve disc should be perfectly smooth and free of rust or corrosion. When installing check valve, make sure it is installed to permit air flow from first tank into second tank as indicated by the arrow on valve body.

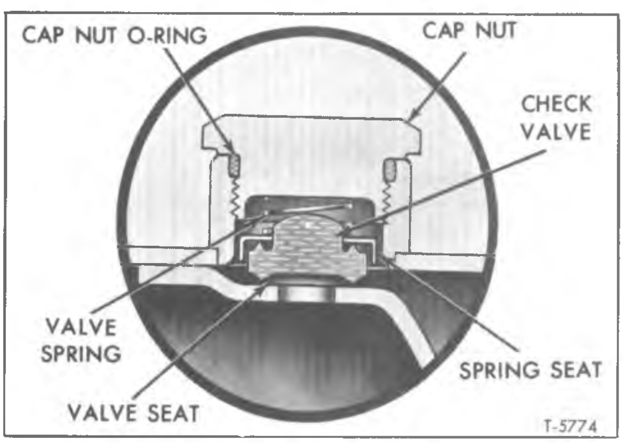


Figure 9—Air Tank Check Valve

Another type check valve, which is an integral part of the divided air tank assembly, is to be serviced and repaired as detailed in the following procedures (refer to fig. 9). This valve is built into the tank at the point where the "wet" tank portion is divided from the "dry" tank portion (refer to fig. 10).

DIVIDED TANK CHECK VALVE SERVICE
(Refer to Fig. 9)

1. Drain air from all reservoirs.
2. Remove cap nut carefully. Nut compresses both valve spring and valve seat spring and parts will "fly off" if not removed carefully.
3. Remove springs, valve, and valve seat.
4. Inspect all parts for cracking, deterioration, or swollen condition. Discard any bad parts.
5. Clean valve seat area.
6. Reassemble, using new parts as necessary. Install seat and O-ring assembly, valve, and springs.
7. Compress springs by pushing down on cap nut and thread cap nut into tank. Tighten cap nut.
8. Build up air pressure in system and determine effectiveness of check valve by opening drain cock on "wet" portion of tank and note pressure retention in "dry" portion of tank.

SAFETY VALVE

A safety valve is installed in air tank to eliminate the possibility of air pressure building up in the system beyond a safe maximum in the event of failure of the air compressor governor.

OPERATION

When pressure in the air tank is built up to exceed 145 to 155 psi, air pressure forces ball valve off seat, permitting air to escape through exhaust port to atmosphere. After pressure bleeds down, spring forces ball back onto the seat.

MAINTENANCE

Check safety valve periodically for leakage,

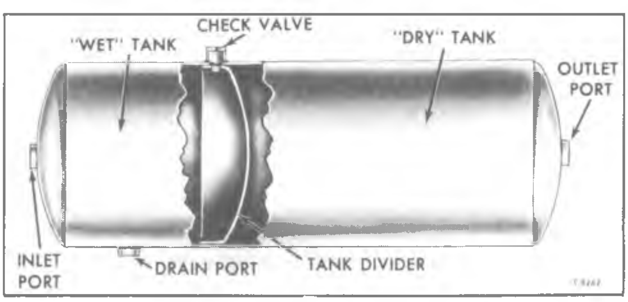


Figure 10—Divided Air Tank

using soap suds at exhaust port, with 90 pounds pressure in tank. Leakage should not exceed a 3-inch bubble in 3 seconds. Once a year, safety valve should be disassembled, cleaned with kerosene, and reset to blow off at 145 to 155 psi.

ADJUSTMENT (Fig. 11)

1. Loosen lock nut.
2. Adjust pressure by turning adjusting screw. Turn clockwise to increase pressure or counter-clockwise to decrease pressure.
3. Tighten lock nut.

PRESSURE PROTECTION VALVE

The pressure protection valve is used on some models. It is mounted in a delivery port of the application valve. On some series trucks it may be used with optional equipment (air shift, differential lock, etc.). In the optional application, it is located in the outlet air line of air tank between air tank and optional equipment.

The function of the valve is to close the air lines to horns, wipers, transmission shift, differential lock, etc., when the pressure in the main air system falls below 65 psi (± 5 lbs.). Thus, in the event of pressure loss to 65 psi, there still will be sufficient pressure left to apply service or emergency brakes and stop the vehicle.

REPLACEMENT

Removal

1. Block vehicle wheels.
2. Exhaust air pressure from system.
3. Disconnect air lines to valve.
4. Remove valve from port of application valve (or air tank line).

Installation

1. Install valve in delivery port of application valve (or air tank line).
2. Connect air lines to valve.
3. Build up air pressure in system and check for leaks.
4. Drain air pressure in system below 65 psi and check to determine if valve has shut off supply to applicable units.

QUICK RELEASE VALVE

Quick release valve is used as standard equipment at both the front and rear brakes on some models, and at front brakes only on other models. The purpose of the quick release valve is to reduce the time required to release the brakes by hastening the exhaust of air pressure from the brake chambers. The valve consists of a body cover and diaphragm so arranged as to permit air pressure to flow through the valve in one direction. When application pressure is reduced, the air pressure which has passed through the valve is permitted to escape through the exhaust port.

SERVICEABILITY TESTS

1. Operating Test

Apply brakes and observe that when brakes are released, air pressure is exhausted freely through the exhaust port of the valve. Be sure the exhaust port is not restricted in any way.

2. Leakage Test

With brakes applied, coat the exhaust port with soap suds to check leakage. Leakage is caused either by dirt on exhaust seat, by a worn diaphragm, or by a damaged exhaust seat on valve cover.

QUICK RELEASE VALVE REPLACEMENT

Removal

Disconnect air lines from valve. Remove two bolts attaching valve to crossmember or axle bracket and remove valve assembly.

Installation

Mount valve on crossmember or axle bracket and tighten mounting bolts firmly. Connect air lines to valve, referring to "Air Lines" section for torque specifications for air line fittings. Build up air pressure in system, then test valve as directed under "Serviceability Tests."

MOISTURE EJECTOR VALVE

DESCRIPTION AND OPERATION

The moisture ejector valve is mounted on a bracket attached to the cab step support close to the wet air tank. Moisture is ejected each time the brakes are released. Air pressure lifts actuator which lifts plunger, moving inlet valve off seat.

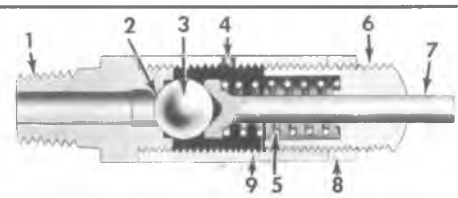


Figure 11—Safety Valve

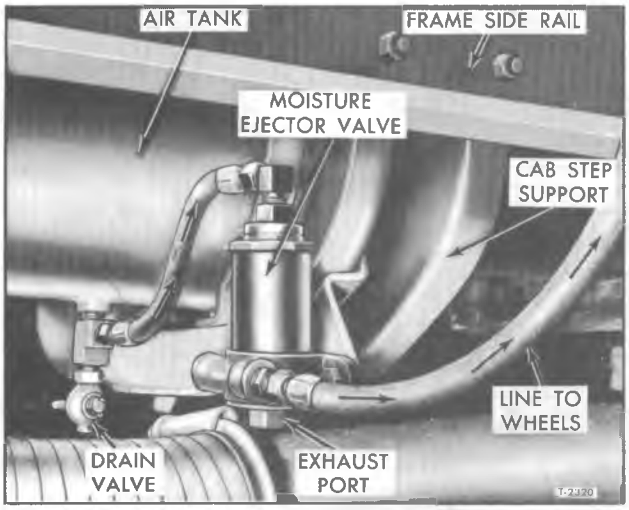


Figure 12—Moisture Ejector Valve Installed (Typical)

This permits flow of air from wet tank into column section of valve. When brakes are released, air pressure snaps actuator back in place, allowing air and moisture in column to escape past plunger seat through exhaust port of lower body to atmosphere. Spring then returns inlet seat and plunger seat to "OFF" position. This action takes place each time brakes are applied and released, thereby operating a continuous process of moisture ejection from brake air system.

The moisture ejector valve is NOT standard equipment. It is offered as optional equipment only on all models with air brakes.

REPLACEMENT (Refer to Fig. 12)

Removal

1. Exhaust air from system.
2. Disconnect air lines at valve.
3. Remove bolts which fasten valve to bracket on cab step support and remove valve.

Installation

1. Position valve on bracket on cab step support and secure with attaching bolts.
2. Connect air lines at valve.
3. Build up air pressure in system. Check operation of valve while applying and releasing brakes. Check for leaks.

BRAKE APPLICATION VALVES

GENERAL

The brake application valves used on models covered by this manual all operate on the same basic principle. The physical shape of the valves and the methods of mounting differ according to model.

Refer to page 5B-37 for information on "Modulating Emergency Application Valve."

TILT CAB MODELS

The application valve is mounted on a support bracket in an inverted position inside the cab. The actuating push rod from the brake pedal extends up through the bracket into the valve piston cup as shown in figure 4.

A breather tube is installed in the exhaust opening in place of filter screens and a hose connected to the tube carries the exhaust air down below the cab floor.

CONVENTIONAL AND "COWL" MODELS

On these models, brake application valve is mounted in a horizontal position on engine side of dash. Valve assembly is attached to a mounting bracket which is bolted to the dash panel.

Brake pedal is mounted inside the cab, with the actuating push rod extending through the dash panel into the valve piston cup as shown in figures 2 and 3.

APPLICATION VALVE REPLACEMENT

TILT CAB MODELS

Removal

1. To remove pedal only, remove cotter pin and drive out pedal to bracket pin.
2. To remove pedal, valve and bracket as an assembly or valve only, block vehicle whedls or hold by some means other than air brakes.
3. Drain air pressure from brake system.
4. Disconnect air lines from valve.
5. Disconnect exhaust hose from valve exhaust port.
6. Remove bolts which attach support bracket to cab and remove complete assembly or:
7. If valve only is to be removed, remove bolts which attach valve to support bracket and remove valve.

Installation

1. To install valve only, place valve in position on support bracket and attach with bolts or:
2. To install pedal, valve and support bracket as an assembly, position cab and attach assembly to cab with bolts.
3. Connect exhaust hose to valve exhaust port.
4. Connect air lines to valve.
5. Start engine and build up air pressure in brake system.

6. Check for leaks.
7. Test operation of brakes.

NOTE: Various items of special or optional equipment are often assembled in outlet ports of the valve, such as low air pressure switch, double check valve, stop light switch, etc. These items may be removed separately from the valve by disconnecting proper air lines, without the necessity of removing the valve from the vehicle. They may also be taken out WITH the valve as an assembly, if desired.

CONVENTIONAL AND "COWL"MODELS
(Refer to Fig. 13)

Removal

1. To remove pedal only, remove bolt attaching sleeve to support bracket. Disconnect push rod from brake pedal arm. Remove sleeve from bracket and remove brake pedal. Refer to figures 2 and 3.
2. To remove valve only, block vehicle wheels or hold by some means other than air brakes.
3. Drain air pressure from brake system.
4. Disconnect air lines from valve.
5. Remove three bolts from valve and remove valve from mounting bracket, or remove two bolts from mounting bracket and remove valve, bracket and boot from fire wall as an assembly.

Installation

1. Place valve (or valve, mounting bracket and boot) in position and secure with bolts.
2. Connect air lines to valve.
3. If brake pedal was removed, place in position in bracket and install sleeve. Attach push rod to pedal arm and adjust as necessary.
4. Start engine and build up air pressure in brake system.
5. Check for leaks.
6. Test operation of brakes.

NOTE: Various items of special or optional equipment are often assembled in outlet ports of the valve, such as low air pressure switch, double check valve, stop light switch, etc. These items may be removed separately from the valve by disconnecting proper air lines, without the necessity of removing the valve from the vehicle. They may also be taken out WITH the valve as an assembly, if desired.

SERVICEABILITY TESTS APPLICATION VALVE

OPERATION TESTS

Check the delivery pressure of the brake valve using an accurate test gauge connected into one of the air lines leading to the brake chambers. Depress the pedal to several positions between the fully released and fully applied positions and check the delivered pressure on the test gauge to see that it varies proportionately with the movement of the pedal. When the pedal is fully applied, the reading on the test gauge should be approximately that of full reservoir pressure. The reading on the test gauge should fall off to zero when application is released. Also, check pressures registered on the dash gauge. These should agree with test gauge reading within 5 pounds.

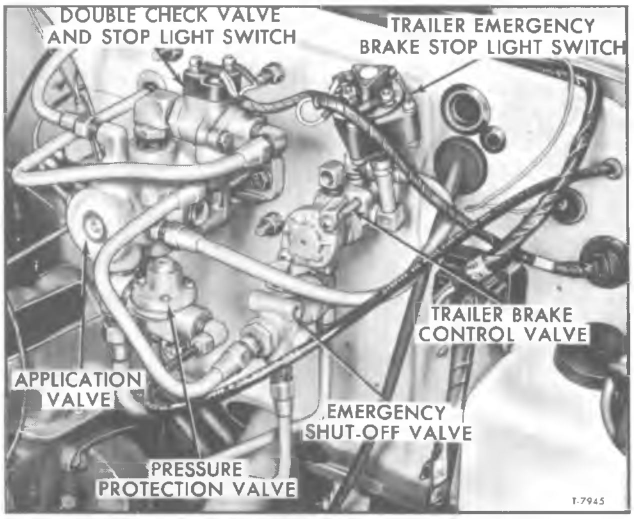


Figure 13—Application Valve Installed (Typical)

LEAKAGE TESTS

With the valve fully released, check the exhaust port or end of exhaust tube for leakage. No leakage is permissible. Leakage evidenced by this test is probably caused by worn or deteriorated inlet valve seal or by binding or corrosion between the exhaust valve disc and the valve cage, preventing the inlet valve from fully closing.

Make and hold a high pressure application. Coat the exhaust port and the top of the valve with soap suds. No leakage is permissible.

Leakage evidenced by these tests may be due to worn or deteriorated exhaust valve or leaking piston seals.

PREVENTIVE MAINTENANCE

BRAKE PEDAL

No regular, periodic maintenance is required. At the time of each chassis lubrication it is well to check pedal operation.

1. Tilt Cab Models. If the pedal does not move "free and easy," lubricate the pedal to bracket pin and the push rod to pedal pin with engine oil. Use oil sparingly. Do not drip oil on pedal pad.
2. Conventional and Cowl Models. Lubricate

nylon bushings on clutch and brake pedal shaft and sleeve sparingly with engine oil. Also oil push rod to pedal bolt. Do not drip oil on pedal pad.

BRAKE APPLICATION VALVE

It is recommended that every 3600 hours, or after 100,000 miles, whichever occurs first (and also dependent upon the type of operation and operator experience) that the application valve be removed from the vehicle, disassembled and various components inspected for wear or deterioration. Install new parts where they are found to be worn or damaged. This applies to all valves on all of the models.

AIR LINES

Metal tubing and flexible hose are used to connect the various units in the air brake system. Service instructions for both types follow:

METAL TUBING

Metal lines are of annealed copper tubing with three-piece compression type fittings. Flared type fittings should never be used in air brake systems. Connections should be tested at least every 5,000 miles and tightened or replaced, if necessary. When replacing metal tubing, tubing must be free of burrs, copper cuttings, and dirt. Blow tubing out with compressed air. Any of the above mentioned particles will destroy sealing seats in air control units. New tubing must be of the same size as the old tubing.

Always use a new sleeve when replacing tubing. When tightening tube connector nuts, tighten to torque listed below to assure an airtight connection. Overtightening will cause leakage. Apply S.A.E. #10 lube oil to ball sleeves, tubes, and male threads, then torque to minimum value and check for leaks. If leaking, back off tube nut approximately ¼-turn and retorque to higher than minimum value.

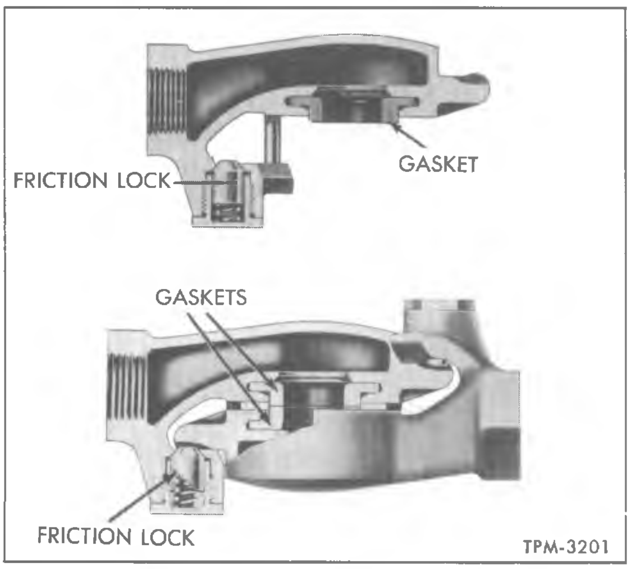


Figure 14—Trailer Hose Coupling

Tubing Size	Torque Inch-Pounds
1/4 Inch	30 to 50
3/8 Inch	30 to 50
1/2 Inch	90 to 115
5/8 Inch	100 to 125

FLEXIBLE HOSE

Flexible hose is used at each brake chamber, between cab and frame, and at trailer connections where it is impossible to use metal tubing due to constant flexing during vehicle operation. Hose connections should be tested at least every 5,000 miles and tightened or replaced if necessary. Any hose which is chafed, worn, or kinked should be replaced.

SERVICEABILITY TESTS

1. Operating Test

If any trouble symptoms, such as slow brake application or release, indicates a restricted or clogged air line, disconnect the suspected tube or hose at both ends and blow through it to make sure the passage is clear. Inspect tubing and hose for partial restriction such as would be caused by dents or kinks. If such condition is found, tubing or hose should be replaced.

2. Leakage Test

With air system fully charged and brake applied, coat all tubing and hose connections with soap suds to check for leakage. No leakage is permissible. Leakage is sometimes corrected by tightening the connection. If this fails to correct leakage, new fittings, metal tubing, or flexible hose must be installed.

TRAILER CONNECTIONS

On vehicles equipped with trailer connections, two air lines are used to connect the truck brake system to the trailer brake system. One of these lines is the "Service" line and the other is the "Emergency" line. The emergency line delivers constant air pressure to the trailer air tank and operating valve, while the service line delivers air pressure to trailer brakes only while the trailer brakes are being operated, either by means of the foot brake system or by the trailer brake hand control valve. Flexible hoses are used to make the connection between the truck and the trailer. Each hose is equipped with couplings for convenience in connecting and disconnecting the truck and trailer brake systems (fig. 14).

The emergency line is at the right side and is tagged "Emergency." The service line is at the left side and is tagged "Service." When coupling tractor and trailer make sure that air lines are properly connected. Couplings on trailer are also tagged "Service" and "Emergency." See figure 15 for illustration of trailer connections mounted on the back of a conventional cab model.

1. Couplings

Figure 14 shows a sectional view of a single hose coupling, and a view of the two couplings connected. The design of the coupling is such that when the two are connected together, pressure is placed on two rubber gaskets, making an airtight seal. The rubber gaskets should be replaced every six months, or more often under severe operating conditions.

2. Dummy Couplings

Dummy couplings are mounted on rear of cab and serve as hangers for the trailer hose when they are disconnected from the trailer. Both hoses should always be connected to the dummy couplings when not connected to the trailer.

3. Cut-Out Cocks (When Used)

Cut-out cocks are used in the trailer brake lines on vehicles not equipped with trailer breakaway valve. Purpose of cut-out cock is to provide a means of closing off these lines when they are not being used. The cut-out cock is open when the handle is at a 90-degree angle to the body and is closed when the handle is parallel with the body. Stops are provided so the handle cannot be turned beyond its normal open and closed positions.

Cut-out cocks should be tested periodically for leakage. Connect cut-out cock to source of air pressure, build up 90 pounds pressure against it, and cover opening with soap suds. If leakage exceeds a 1-inch bubble in 3 seconds, cock should be repaired or replaced. In some instances, leakage may be caused by dirt on the key. This condition can be remedied by cleaning the key and seat with gasoline, then grinding the key to its seat with grade 400 grinding compound. Thoroughly wash off all grinding compound and coat key lightly with a good grade of cup grease before assembling. If the key or body is badly scored, the complete cut-out cock should be replaced.

AIR PRESSURE GAUGE

The air pressure gauge in the instrument panel provides the driver with a means of checking sys-

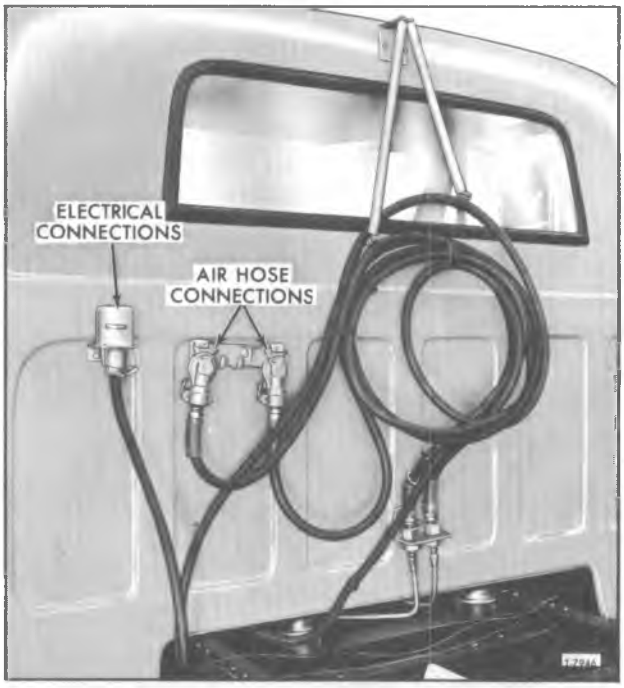


Figure 15—Trailer Brake Connections

tem air pressure. The vehicle should never be put in motion until pressure reaches 65 pounds. If pressure reading drops to less than 65 pounds while vehicle is in motion, vehicle should be stopped and the cause of air loss corrected. Dash gauge should be checked regularly with an accurate test gauge. If pressure reading varies 4 pounds or more, replace gauge with a recalibrated unit.

LOW AIR PRESSURE SWITCH

Low air pressure switch is used with a buzzer as a low air alarm. Buzzer is also used as a part of engine alarm system. The switch is installed in a delivery port of the application valve or in a fitting which is installed in a delivery port of the application valve. Switch is adjusted and sealed by the manufacturer and is not reparable. Switch has only one wire terminal, being internally grounded.

The low air pressure switch is an air-controlled switch in an electrical circuit, automatically controlling a buzzer in the cab. A tell-tale light is also used. Refer to applicable "Wiring Diagram" for electrical circuits.

The switch has a nominal pressure setting of 58 to 65 psi. If switch fails, it must be replaced. When installing switch, do not use sealing compound on threads, since the switch is grounded through its mounting and sealing compound will act as insulation.

TRAILER BRAKE CONTROLS

INDEPENDENT TRAILER BRAKE APPLICATION

On vehicles equipped with trailer brake hand control valve, trailer brakes may be applied without applying the truck brakes. When hand control valve lever is moved to applying position, air pressure passes through the hand control valve and double check valve into trailer brake service line, applying the trailer brakes. When hand control valve lever is returned to released position, air pressure in the trailer brake service line is exhausted from exhaust port of the control valve, releasing the trailer brakes. Any desired degree of trailer brake application is obtained by regulating the position of the hand control valve lever.

I. C. C. BRAKE SYSTEM EQUIPMENT

Some vehicles are equipped with special I.C.C. (Interstate Commerce Commission) brake system equipment in conjunction with the trailer brake controls. These controls are a tractor protection (breakaway) valve and a trailer emergency air supply control valve. These controls are provided for the following purposes:

1. They protect the tractor air system from complete loss of air pressure in the event of a trailer breakaway or loss of air pressure in the trailer air system.

Figure 16—Trailer Brake Hand Control Valve Installed

2. They automatically actuate the trailer brake emergency relay valve (on trailer) in case the tractor air system pressure falls below 45 psi.
3. They provide the driver with a manual means of actuating the trailer brake emergency relay valve (on trailer).

TRAILER BRAKE HAND CONTROL VALVES

Hand control valves are mounted beside the steering column with the operating handle on the right-hand side (fig. 16). The valve graduates the delivered air pressure in proportion to the degree the operating handle is moved. That is the farther the handle is moved from "OFF" to "ON," the greater the air pressure delivered to the trailer brakes. If, at any time during such an application a service brake application is also made with the foot-controlled valve, whichever valve releases the greater air pressure will control the brakes.

HAND CONTROL VALVE REPLACEMENT

Removal

1. Block vehicle wheels.
2. Drain air from brake system.
3. Disconnect air lines from valve.
4. Remove bolts attaching mounting bracket and valve to steering column.
5. Remove valve and bracket.

Installation

1. Position valve and mounting bracket on steering column. Fasten with bolts.
2. Connect air lines to valve.
3. Start engine and build up air pressure.
4. Check for leaks and operation of brakes.

TRAILER EMERGENCY AIR SUPPLY CONTROL VALVES

The trailer emergency supply control valve, working in conjunction with the tractor protection (breakaway) valve, controls the operation of the trailer brakes in EMERGENCY situations.

NOTE: THIS SYSTEM IS NOT DESIGNED TO BE USED AS A PARKING BRAKE UNDER ANY CIRCUMSTANCES.

This is a spring-loaded valve which will automatically act when pressure in the truck brake system falls below 45 psi.

Whenever the emergency air valve is actuated, either manually or automatically, truck air system pressure must be built up above 45 psi and valve knob must be manually held in to charge the trailer emergency line and release the trailer brakes.

On conventional cab models this valve is located in the engine compartment (see fig. 13). The actuating knob is connected to the valve by a push rod. The knob is connected to the valve by a push rod. The knob (fig. 17) is located below the instrument panel to the left of the steering column.

On tilt cab models this valve is mounted on a bracket at the left of the steering column.

EMERGENCY CONTROL VALVE REPLACEMENT

Removal

1. Drain air pressure from brake system.
2. Disconnect air lines.
3. Steel Tilt Cab - Remove screws from plate which holds the valve to bracket at left of steering column. Remove valve.

Conventional Cab - Disconnect knob and push rod assembly from piston stem. Remove screws which fasten valve to cowl. Remove valve from engine compartment side of cowl.

Installation

1. Position valve at mounting bracket (tilt cab) or cowl (conventional) and attach air lines.
2. Secure valve with screws. Install plate, where used.
3. On conventional cab models connect knob and push rod to valve stem.
4. Start engine and build up air pressure to operating level.
5. Check for air leaks.
6. Check the operation of trailer emergency brakes.

TRACTOR PROTECTION (BREAKAWAY) VALVE

The tractor protection valve (relay valve), used in conjunction with the trailer emergency air supply control valve, controls operation of the trailer brakes in EMERGENCY situations.

This valve is located on the inner side of the cab back panel on tilt cab models and in the engine compartment on fire wall near application valve on conventional cab models.

Both service and emergency trailer brake lines are routed through this valve, and its basic function is to protect the tractor air brake system

Figure 17—Emergency Control Valve Knob

from loss of pressure in the event of pressure loss in the trailer system.

BREAKAWAY VALVE REPLACEMENT

Removal

1. Block vehicle wheels.
2. Drain air pressure from brake system.
3. Disconnect air lines.
4. Remove mounting bolts and valve.

Installation

1. Position valve on back of cab or on mounting bracket, and install mounting bolts.
2. Connect air lines.
3. Start engine and build up air pressure to operating level.
4. Check for leaks.
5. Check operation of brakes.

SERVICEABILITY TESTS

Operating Tests

1. Pull out emergency air valve knob to exhaust air pressure from breakaway valve control line. Disconnect trailer emergency line from emergency outlet port at breakaway valve and connect an air pressure test gauge to emergency outlet port.
2. Start engine and build up air pressure in system. Low air pressure buzzer should stop operating at 58 to 65 psi. With air pressure in operating range, push emergency air valve knob in. Test gauge should show full air system pressure. Then

pull knob out, test gauge should drop to zero.

3. Again build up air pressure in system to operating range, then stop engine. Push emergency air valve knob in. Make a series of brake applications until low air buzzer sounds. Slightly open drain cock in the dry air tank to obtain a slow (approx. 10 psi per min.) pressure drop in the tractor brake system. When truck air system drops to 45 psi (approx.), the emergency air valve knob should automatically come out and pressure on test gauge should rapidly drop to zero.

Leakage Tests

1. Build up air pressure in truck brake system to operating range. Push in emergency air valve knob to charge trailer brake system. Use soap suds to coat exhaust ports of emergency air valve and breakaway valve.

2. When emergency air valve leaks excessively, install new piston O-rings. When breakaway valve leaks excessively, install new O-rings and plunger seal.

DOUBLE CHECK VALVE AND STOP LIGHT SWITCH

A combination double check valve and stop light switch is used in brake systems on all conventional models equipped with trailer brake controls. Check valve is used to connect both the foot brake application valve and the trailer brake hand control valve to the trailer brake service line. Trailer brake service line and truck stop light switch are connected to the two side outlet ports.

CHECK VALVE OPERATION

When brake application is made by the foot brake valve, air pressure from the foot brake valve forces the shuttle valve over against the inlet from the hand control valve and flows out the holes in the valve guide into the trailer brake service line. When foot brakes are released and trailer brakes are applied by means of the hand control valve, air pressure from the hand control valve forces the shuttle valve over against the inlet from the foot brake valve and flows out through the holes in the valve guide into the trailer brake service line.

CHECK VALVE SERVICEABILITY TESTS

1. Operating Tests

a. Apply truck brakes and note that brakes apply promptly on both the truck and the trailer. Release truck brakes and note that brakes on truck and trailer both release promptly.

b. Move hand control valve lever to applied position and note that brakes apply only on the trailer. Move control valve lever to released position and note that trailer brakes release promptly.

2. Leakage Tests

a. Apply truck brakes and check for leakage at hand control valve exhaust port, using soap suds.

b. Apply trailer brakes only with hand control valve and check for leakage at truck brake application valve exhaust port, using soap suds.

c. No leakage is permissible in either of these tests. If there is any leakage, replace the shuttle valve.

CHECK VALVE REPLACEMENT

Removal

1. Block vehicle wheels.
2. Drain air pressure from brake system.
3. Disconnect air lines from valve.
4. Screw valve out of brake application valve.

Installation

1. Screw valve into brake application valve.
2. Connect air lines.
3. Start engine and build up air pressure to operating level.
4. Check for leaks.
5. Check operation of brakes and stop lights.

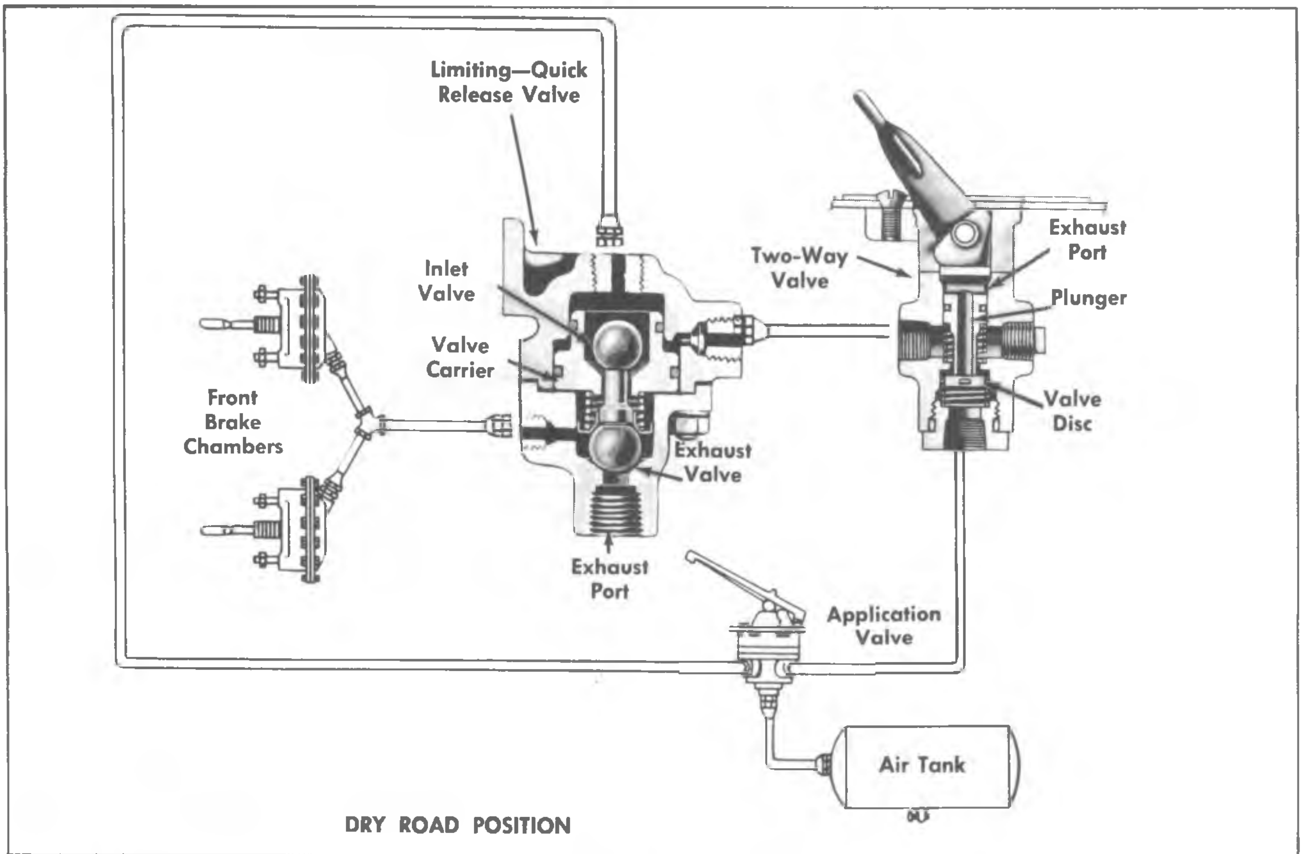
TRAILER BRAKE EMERGENCY STOP LIGHT SWITCH

A trailer brake emergency stop light switch is used on conventional models equipped with trailer brake controls. The switch is installed in a fitting in delivery port of the emergency brake control valve. The purpose of the switch is to activate trailer stop lights when trailer emergency brakes are applied. Switch is non-reparable, and must be replaced if defective. To remove switch, disconnect electrical wiring and remove switch from fitting.

FRONT BRAKE LIMITING VALVE AND TWO-WAY CONTROL VALVE

A combination limiting and quick release valve and a two-way control valve are used in combination on some vehicles as shown in figure 18. This combination permits full brake valve delivery pressure to the front brakes when on dry roads, or at the option of the driver, limits the pressure to the front brakes to 50 per cent of the brake valve delivery pressure when on slippery roads.

The two-way control valve (handle or knob) is mounted on instrument panel within easy reach of



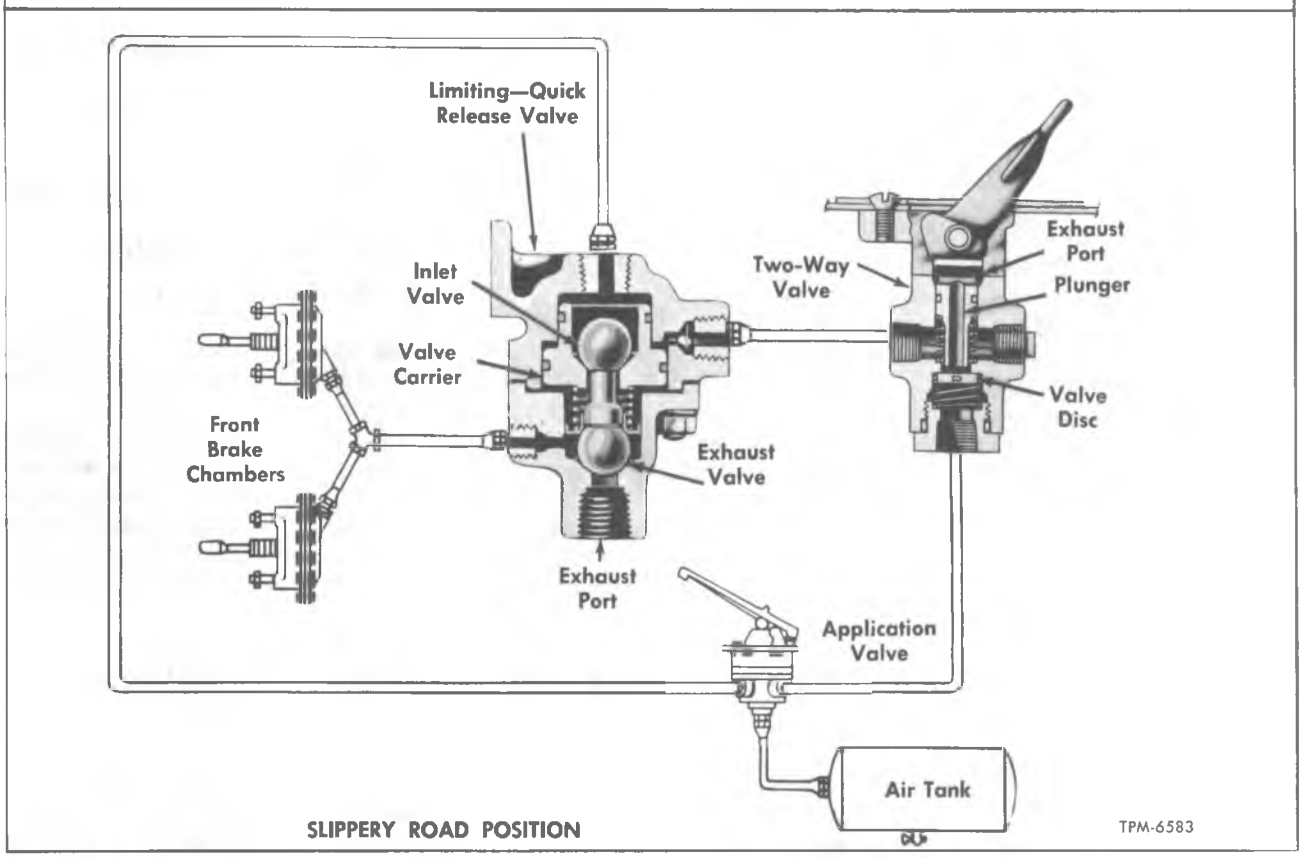


Figure 18—Front Brake Limiting and Two-Way Control Valve Operation

the driver. On tilt cab models, a plate showing "DRY ROAD" and "SLIPPERY ROAD" positions is mounted on the dash panel and a flip-type lever is used to select the desired position. On all other models, there is a knob on the dash panel marked "FRT. BRAKE LIMIT." When pushed in the valve is in "DRY ROAD" position. Pull knob out for "SLIPPERY ROAD" position. On conventional cab models the valve is located inside the cab. On "cowl" models the valve is inside the engine compartment. In both cases, the valve is mounted on a bracket fastened to the fire wall with two bolts.

The limiting quick release valve is mounted on frame crossmember near the front brake chambers. One air line from brake application valve is connected to the inlet port of the two-way valve and another connects to the brake valve port at top of limiting quick release valve (fig. 18). Another air line connects the side delivery port of the two-way valve to the port opposite the mounting pad of the limiting quick release valve. The two other side ports of the limiting quick release valve are connected to the front brake chambers.

The limiting quick release valve, besides providing for a 50 per cent reduction of front wheel brake pressure, also serves as a quick release valve when brakes are released.

SERVICEABILITY TESTS

1. Operating Tests

a. Connect an air pressure test gauge into the air line leading to the rear brake quick release or relay valve; disconnect air line at valve and connect gauge to line if no other convenient connecting point is available. Disconnect one front brake chamber line from port at side of limiting quick release valve and connect another test gauge to this port.

b. Place the handle or knob of the two-way valve in the "DRY ROAD" position and apply the truck brakes. Both test gauges should read the same. Place the handle of the two-way valve in the "SLIPPERY ROAD" position and apply the truck brakes. The test gauge at the limiting quick release valve should read approximately one-half the amount shown on the test gauge connected to the rear axle air line.

2. Leakage Tests

a. Place the handle or knob of the two-way valve in "DRY ROAD" position and with the truck brakes applied, coat the exhaust ports of the two-way valve and limiting quick release valve with soap suds. If leakage is excessive, replace valve.

b. Place handle of two-way valve in "SLIPPERY ROAD" position and with truck brakes applied, coat exhaust port of two-way valve with soap suds. If leakage is excessive, replace valve.

TWO-WAY VALVE REPLACEMENT

IMPORTANT: Before disconnecting air lines, either scribe a line or put a daub of paint on one air line and corresponding port on valve. It is possible to connect the air lines to this valve in the opposite position, with the result that the brake application pressures would be opposite to that intended; that is, with valve knob in "SLIPPERY ROAD" position, brake application would be for "DRY ROAD" conditions and vice versa.

Removal

1. Block vehicle wheels.
2. Drain air pressure from brake system.
3. Disconnect air lines.
4. On tilt cab models remove screws and remove plate and valve from instrument panel.
5. On other models, disconnect rod from lever and remove bolts and valve from bracket.

Installation

1. Position valve in instrument panel or on fire wall and connect air lines.
2. On tilt cab models fasten valve and plate to instrument panel with screws.
3. On other models, fasten valve and bracket to fire wall.
4. Start engine and build up air pressure.
5. Check for leaks.
6. Check operation of brakes.

LIMITING VALVE REPLACEMENT

Removal

1. Block vehicle wheels.
2. Drain air from brake system.
3. Disconnect air lines.
4. Remove bolts which fasten valve to vehicle. Remove valve.

Installation

1. Connect air lines.
2. Position valve and fasten with bolts.
3. Start engine and build up air pressure.
4. Check for leaks.
5. Check operation of brakes.

ANCHORLOK BRAKE CHAMBERS

"Anchorlok" brake chambers are used as optional equipment on all 50 and 60 Series trucks. Refer to figure 19.

The "Anchorlok" chamber is used as a service brake chamber, an emergency brake in case of air pressure loss and spring-applied parking brake. It consists of two separate air chambers, each having its own diaphragm and push rod. In the front chamber, air pressure enters behind the diaphragm when brake pedal is pushed, causing a service brake application, just as in any standard chamber. The rear chamber is subject to constant air pressure in front of the diaphragm, compressing the emergency parking spring. In the event of loss of air pressure in the rear chamber, or intentional exhausting of pressure by the driver, the spring will apply the brakes. Application will begin when pressure drops to approximately 45 psi and will be complete when pressure reaches approximately 25 psi.

In the event of an automatic emergency application (loss of air pressure) and it is necessary to move the vehicle before air pressure can be restored, the emergency parking spring can be compressed mechanically to release brake. A spring "caging" tool is part of the chamber assembly. Remove nut and release stud from its storage place on chamber body. Remove spring housing rubber cap and insert stud in hole. Secure stud in place (¼ turn) and "cage" spring by tightening nut with wrench. Directions are also given for this operation on the body of the chamber (see fig. 20). This same procedure is followed if the chamber is to be removed from the vehicle for service.

A manual emergency application (or parking application) may be made by the driver by pulling out the knob on the instrument panel which controls manual application. Release of a parking or emergency application can be made by pushing in this same knob, provided there is at least 45 pounds pressure in the air brake system.

BRAKE CHAMBER REPLACEMENT

REMOVAL

1. Block vehicle wheels.
2. With brakes released, remove "spring-caging" tool from its storage place. Remove spring housing rubber cap, insert stud in hole and turn ¼ turn. Run nut down on stud until finger tight, then use wrench to turn nut at least three turns. Spring is now "caged."

NOTE: If both chambers are to be removed, perform step 2 on each BEFORE proceeding further.

3. Open air tank drain valves and exhaust pressure from brake system.
4. Disconnect air lines at chamber.

NOTE: If only the emergency parking chamber needs to be removed, this may be done at this point by removing rear clamp ring and lifting rear chamber assembly off front (service) chamber.

5. Disconnect push rod clevis from slack adjuster.
6. Remove nuts and lock washers from mounting studs.
7. Remove "Anchorlok" brake chamber from mounting bracket.

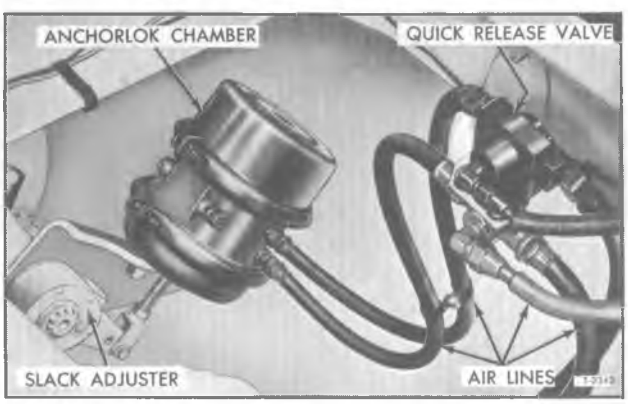


Figure 19—Anchorlok Brake Chamber Installed

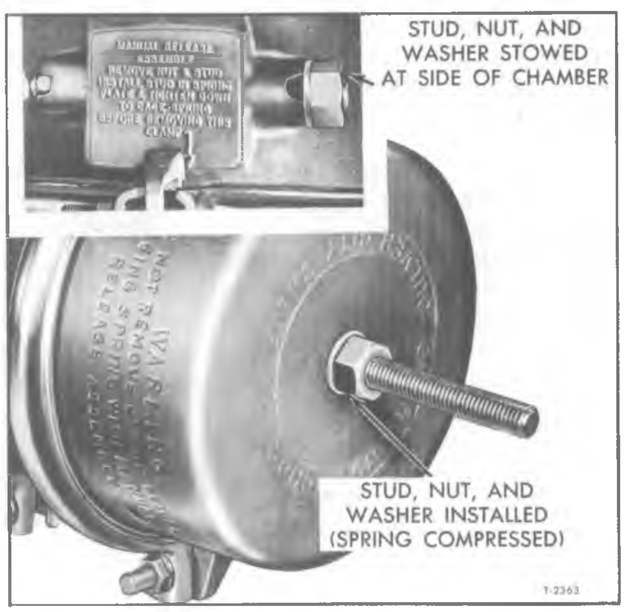


Figure 20—Spring Compressing Assembly

INSTALLATION

1. Place "Anchorlok" chamber in position on mounting bracket.

2. Install lock washers and nuts on studs.

3. Connect push rod clevis to slack adjuster.

4. Connect air lines at chamber.

5. Start engine and build up air pressure to operating level. Make sure knob is pushed in on emergency parking brake valve on instrument panel.

6. Back off nut from "caging" stud in end of chamber. Remove stud and replace in storage pocket on chamber housing. Install rubber cap over release stud hole.

7. Check operation of brakes.

8. Check for leaks.

FRONT BRAKE SHOES AND ANCHOR PINS

BRAKE SHOES

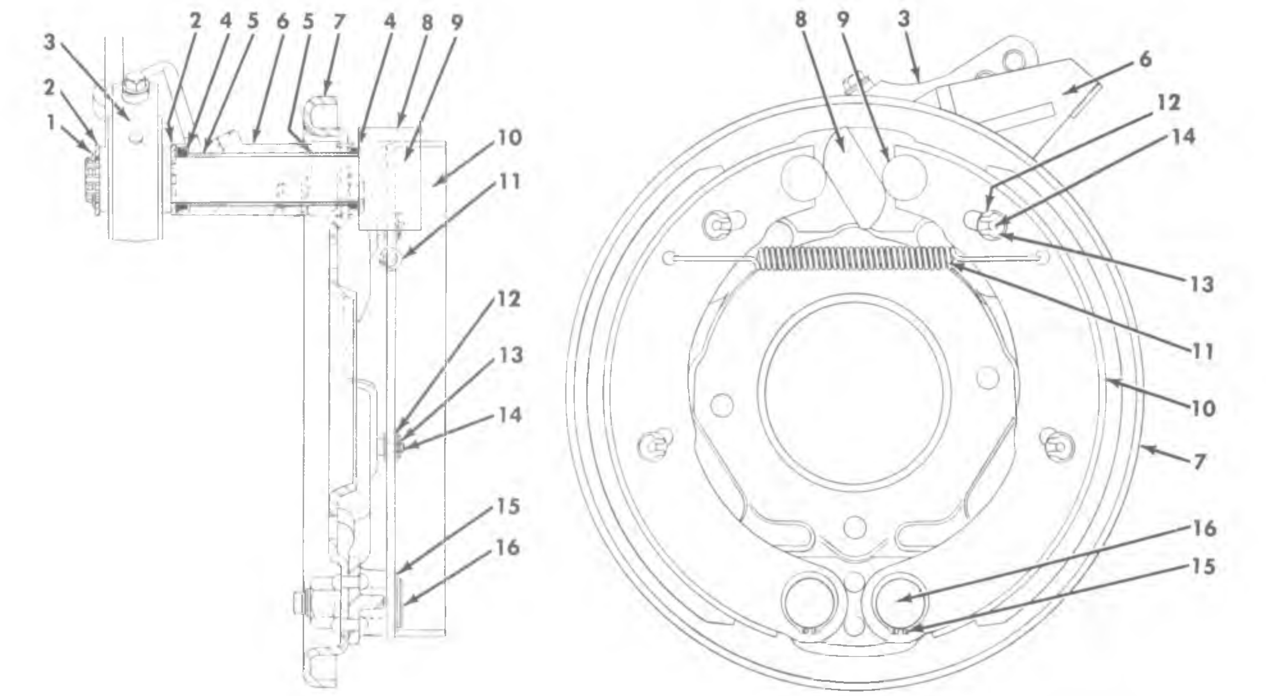
(Refer to Figure 21)

One-piece molded lining is riveted to each shoe. Lining should be replaced before it becomes worn to the extent that the rivets will damage the brake drum. Make sure new lining fits firmly against shoe and that all rivets are properly upset. When brake drums have been machined oversize, shims should be used between lining and shoe or oversize lining used to maintain proper lining-to-drum contact. Refer to "Brake Drums" in this section. Maximum braking efficiency can be obtained immediately if linings are trued-up with a conventional lining grinder so they are properly centralized in relation to center of hub.

Whenever any part of the brake assembly has been removed and replaced, adjust brakes as directed under "Brake Adjustments."

ANCHOR PINS

Anchor pin ends of shoes are secured on the anchor pins by lock rings. Shoe ends are not equipped with bushings; if shoes or anchor pins become worn, parts must be replaced. Contact between cam ends of shoes and cam is made through rollers. No lubricant should be applied at rollers or



1 Lock Ring
2 Spacer
3 Slack Adjuster
4 Camshaft Seal
5 Camshaft Bushing
6 Camshaft and Brake Chamber Bracket
7 Backing Plate
8 Cam (integral with shaft)
9 Cam Roller
10 Brake Shoe
11 Brake Shoe Return Spring
12 Guide Pin Washer
13 Guide Pin "C" Washer
14 Guide Pin
15 Lock Ring
16 Anchor Pin

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Figure 21—Front Brake Assembly

cam head; anchor pin ends should be coated with S17 Special Lubricant or equivalent at assembly. Guide pins, two for each shoe, hold shoes in alignment on backing plate.

CAMSHAFTS

Front brake camshafts have constant lift type cams forged integral with shaft. Camshafts are mounted in camshaft and brake chamber brackets which are bolted to backing plate (fig. 21). Each bracket is equipped with two bushings and a lubrication fitting. Space between bushings acts as a lubricant reservoir. Lubricant should be applied sparingly at intervals specified in LUBRICATION (SEC. 0) in this manual.

CAUTION: Do not overlubricate camshaft, as excess lubricant will be forced into brake drums.

Slack adjuster, mounted on splined end of camshaft, is held in place by a lock ring. A spacer is used on each side of slack adjuster. Whenever camshaft has been removed, coat bushing surfaces with S17 Special Lubricant or equivalent before installing. After installation, apply lubricant as directed in LUBRICATION (SEC. 0) in this manual, and adjust brake as directed under "Brake Adjustments."

Refer to FRONT SUSPENSION under "FRONT HUBS AND BEARINGS" (SEC. 3D) in this manual, for removal of wheels, hubs, and brake drums for access to brake shoes.

"S" CAM REAR BRAKES

"S" cam brake assemblies are used on rear axle of all models covered by this manual. "Stopmaster" wedge type brakes are optional on some models. Brake assembly can be removed as a complete assembly; however, the various components must be replaced individually.

The brake assembly is mounted on the backing plate, which is bolted to flange on axle housing. Brake assembly shown in figure 22 is a typical Wagner brake assembly.

BRAKE SHOES AND ANCHOR PINS

Refer to REAR SUSPENSION under "REAR HUBS AND BEARINGS" (SEC. 4C) for removal of

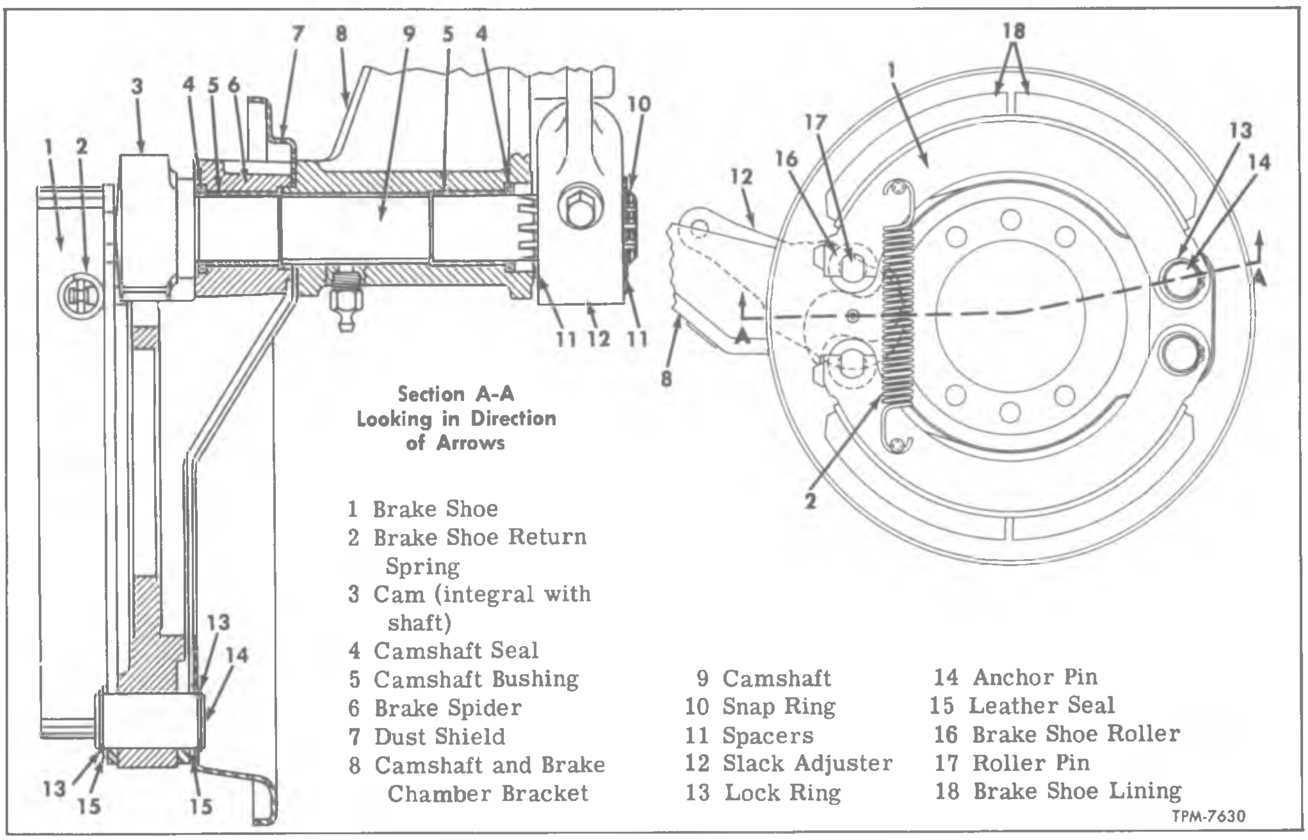


Figure 22—Rear Brake Assembly

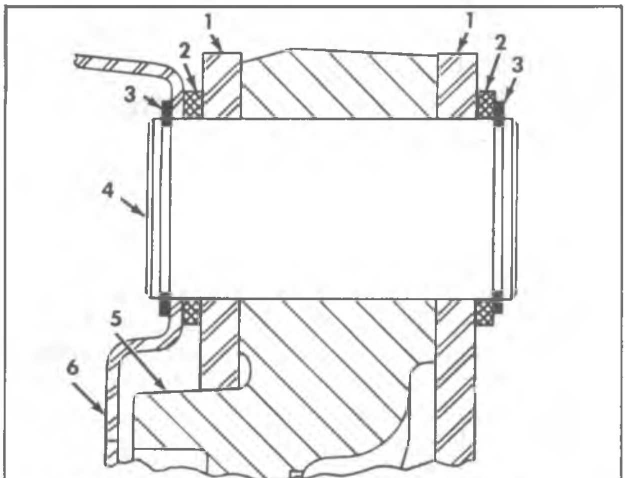


Figure 23—Rear Brake Shoe Anchor Pin Installation

wheels, hubs, and brake drums for access to brake shoes.

Each brake shoe consists of a shoe table with two shoe webs welded in place. At anchor end, shoe webs straddle the mounting flange on brake spider and pivot on anchor pins. Anchor pins are held in place by a lock ring at each end. A leather seal is used between lock ring and shoe web at outer end and between dust shield and shoe web at inner end to retain lubricant and exclude dirt. Shoe ends are not equipped with bushings; if shoes or anchor pins become worn, parts must be replaced. Refer to figure 23 for cross-sectional view.

At cam end of each shoe, a roller installed between shoe webs on a roller pin makes the contact between shoes and cam. Flats on end of roller pin fit into notches in shoe webs. Tension of brake shoe return spring holds shoe rollers firmly against cam. Return spring pins are staked in 8 places so that they will not slide out of shoe webs. No lubrication is required at rollers or roller pins; parts should be assembled clean and dry. Anchor pin ends should be coated with S17 Special Lubricant or equivalent during installation.

A two-piece molded lining is riveted to each shoe. Linings should be replaced before wear exposes the rivet heads and causes damage to brake drums. Both linings on each shoe are identical and can be installed at either end. New linings must be securely riveted to shoe with correct size rivets, and rivets must be properly upset. Maximum braking efficiency can be obtained immediately if linings are trued-up with lining grinder so they are properly centralized in relation to center of hub.

Whenever any part of the brake assembly has been removed and replaced, adjust brakes as directed under "Brake Adjustments."

CAMSHAFT

Rear brake camshafts have constant lift, S-type cams forged integral with shaft. Camshaft is carried in a bushing in brake spider at outer end, and in a bushing in camshaft and brake chamber bracket at inner end. Camshaft and brake chamber bracket is bolted to brake spider in conjunction with the brake dust shield. Lubrication fitting in bracket provides a means of lubricating both bushings; space between bushings serve as a lubricant reservoir. Seals, in outer end of camshaft bore in brake spider and in inner end of bracket, retain lubricant and exclude dirt. Apply lubricant at intervals indicated in LUBRICATION (SEC. 0) in this manual.

CAUTION: DO NOT overlubricate the camshaft, as excess lubricant may be forced by the seals into the brake drums.

Slack adjuster, mounted on splined end of camshaft, is held in place by a lock ring. A spacer is used on each side of slack adjuster. On the brake assembly shown in figure 22, the two spacers (11) are the same; on some models equipped with offset slack adjusters, the inner spacer is thicker than the outer spacer. Whenever camshaft has been removed, coat bushing surfaces with S17 Special Lubricant or equivalent before installing. After installation, apply lubricant as directed in LUBRICATION (SEC. 0) in this manual, and adjust brakes as directed under "Brake Adjustments."

BRAKE DRUMS

Brake drum installations are illustrated in REAR SUSPENSION in "REAR HUBS AND BEARINGS" (SEC. 4C), and in FRONT SUSPENSION under "FRONT HUBS AND BEARINGS" (SEC. 3D) in this manual. By referring to the illustrations in the above sections, methods of replacing brake drums are readily discernible.

Whenever brake drums are removed for servicing brakes, inspect drums. If found to be scored, rough, or out-of-round, drums should be machined.

Machining or grinding of brake drums increases the inside diameter of the drum and changes the lining to drum fit. When machining drums, it is recommended that the following maximum oversizes not be exceeded:

(a) Drums with standard diameter up to 14" can be machined up to .060" oversize.
(b) Drums with standard diameter over 14" can be machined up to .080" oversize.

When it is found that machining to these maximum limits does not provide a suitable braking surface, discard the worn drum and replace with a new standard drum.

DO NOT EXCEED THESE LIMITS. THIS IS SAFETY PRECAUTION.

STOPMASTER BRAKES

The Stopmaster type brake differs from the conventional "S" cam type brake in several respects. The air chamber push rod is connected to the brake shoes through a series of wedges, rollers, and plungers rather than through a slack adjuster and camshaft. Stopmaster brakes are used at the rear wheels only. Stopmaster brakes employ two different type air chambers; (1) a standard air chamber which is operated by air pressure and (2) a "Fail-Safe" air chamber which can be operated either by air pressure or by spring pressure. There are three basic variations of Stopmaster brakes shown in figure 24; standard, single axle "Fail-Safe," and tandem axle "Fail-Safe."

AUTOMATIC ADJUSTER

All Stopmaster brakes have automatic adjuster mechanisms. The basic part of the adjuster (refer to fig. 25) is a plunger assembly which is made up of the adjusting plunger, the actuator, and the adjusting bolt. The actuator is threaded internally to receive adjusting bolt. On the external surface, there are buttress type teeth. The plunger guide is free to slide in a drilled hole in the spider housing and has teeth to match those on the exterior surface of the actuator. A spring, gasket, and bolt are used to hold the guide in contact with the actuator.

Figure 26 is an illustration of an automatic adjuster assembly installed. When the plunger assembly is moved outward to apply the shoe against the drum, the plunger guide will slide across the sloping sides of the teeth on the actuator. If the plunger assembly moves outward and exceeds the pitch distance, the teeth on the guide will engage the next teeth on the actuator. When the plunger returns, the actuator must rotate in order to allow the assembly to return to the "in" position. This rotation is caused by the angle of the teeth. As the actuator rotates, it screws the adjusting bolt. The distance for the plunger to move before adjusting is controlled either by the angle of the teeth, and/or the number of teeth. This travel establishes the lining-drum clearance.

The plunger guide has two flat sides, which are a slip fit in a slot in the adjusting plunger. This performs two functions: (1) it prevents the guide from turning and (2) it prevents the adjusting plunger from turning in the housing.

In order to function properly the adjusting bolt must not turn. If it rotates with the actuator, no adjustment would occur.

The combination of the number of teeth on the outside of the actuator and the number of threads per inch on the adjusting bolt establishes the actual linear advance or rate of adjustment.

Procedures covering the removal and installation of automatic adjuster components are given in the following paragraphs.

Any time the adjuster assemblies are removed for service they should be lubricated as directed in the following procedures.

The adjuster system should be disassembled whenever brake shoes are relined and inspected

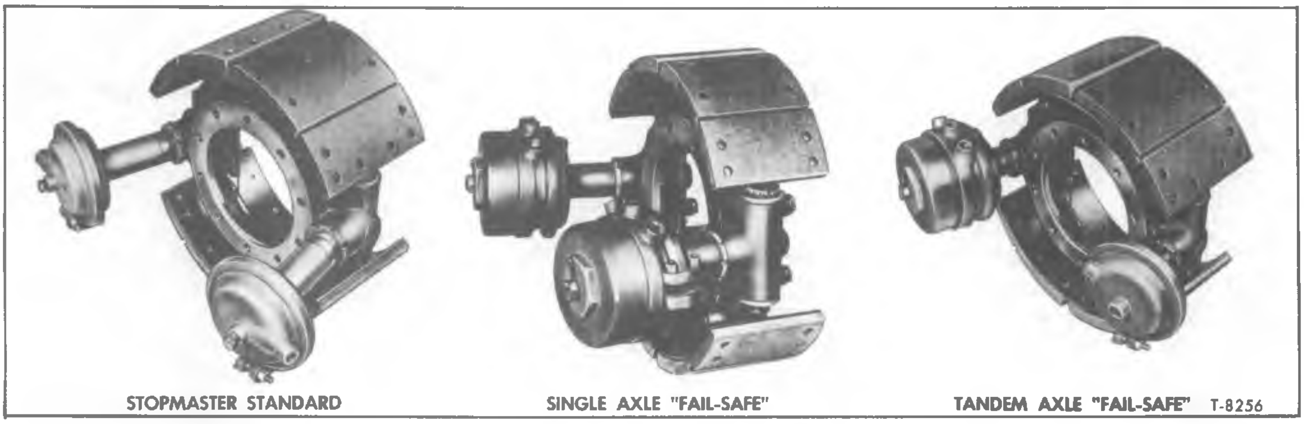


Figure 24—Stopmaster Brake Assemblies

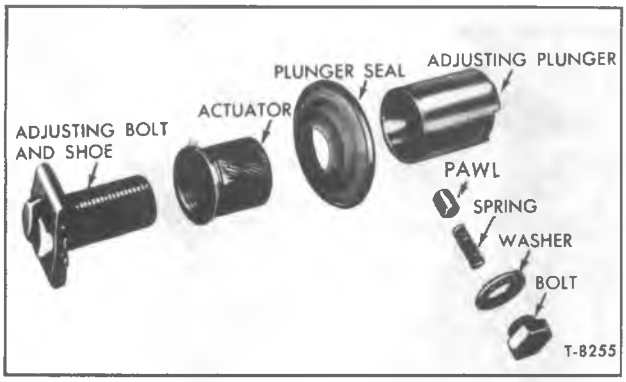
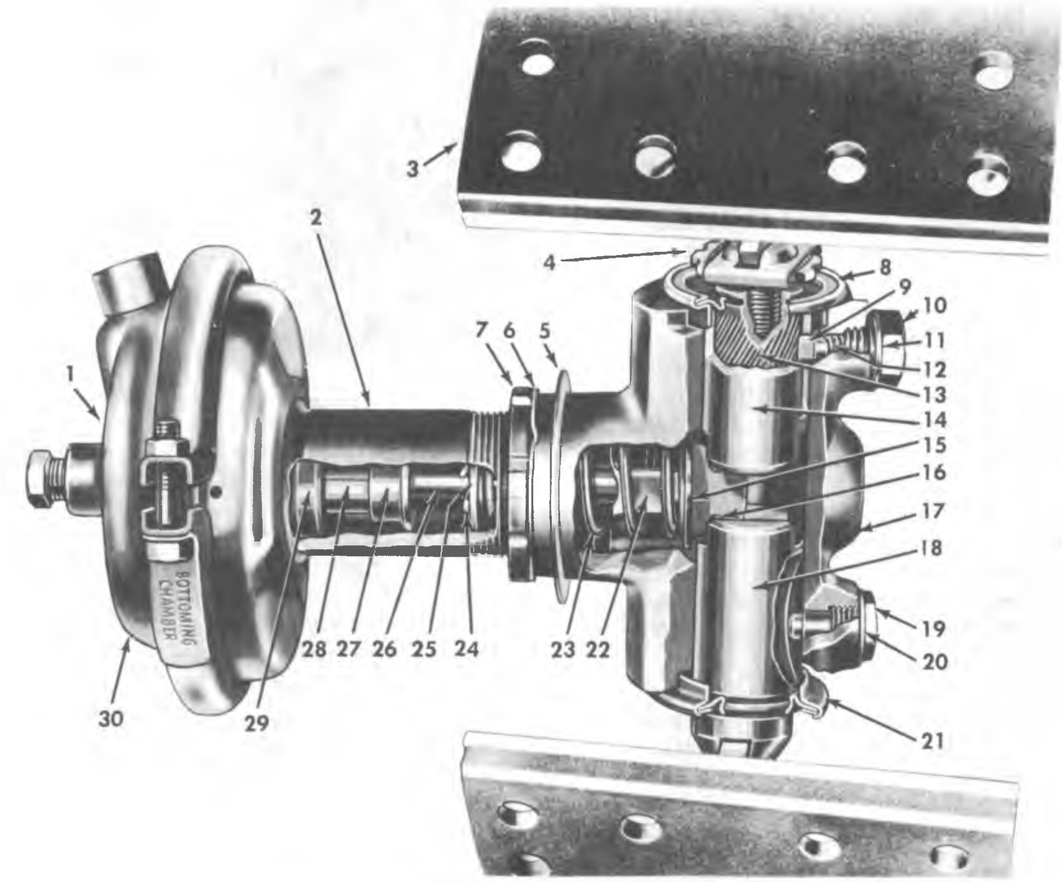


Figure 25—Automatic Adjuster Components

for the general condition of all moving parts. It is advisable to use new plunger seals and plunger guide gaskets when removing and installing these parts.

REMOVAL (Refer to Fig. 25)

1. Remove brake shoes and brake chambers as detailed under applicable procedures.
2. Remove bolt and plunger guide gasket from housing.
3. Remove spring and plunger guide.
4. Unscrew adjusting bolt from actuator.
5. Using a screwdriver, pry plunger seal out of spider housing.
6. Remove actuator and adjusting plunger.



1 Brake Air Chamber Assembly
2 Non-Pressure Half
3 Brake Shoe Assembly
4 Adjusting Bolt Assembly
5 Identification Ring
6 Spanner Nut Retainer
7 Spanner Nut
8 Plunger Seal and Retainer
9 Adjusting Pawl (Plunger Guide)
10 Hollow Cap Screw
11 Gasket
12 Spring
13 Adjusting Sleeve (Actuator)
14 Adjusting Plunger
15 Wedge Spring Retainer
16 Roller
17 Plunger Housing
18 Anchor Plunger (Solid)
19 Guide Screw
20 Gasket
21 Plunger Seal and Retainer
22 Roller Retaining Cage
23 Wedge Spring
24 Cotter Key
25 Washer
26 Wedge Shaft
27 Wedge Guide
28 Diaphragm Plate (Push Rod)
29 Rubber Boot
30 Pressure Half

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Figure 26—Automatic Adjuster Assembled

INSTALLATION (Refer to Fig. 25)

NOTE: Make sure that adjusting mechanism is installed at proper end of spider so that brake shoe ends are mounted in proper position. Also make certain that all parts are properly lubricated. All threads on all components should be coated with lubricant to assure smooth, free operation. The tip of the plunger guide and the entire plunger should also be coated. See LUBRICATION (SEC. 0) of this manual for type of lubricant to be used.

1. Install new seal on adjusting plunger and actuator.
2. Install adjusting plunger and actuator in spider housing.
3. Tap plunger seal into place in spider housing. Refer to figure 33.
4. Screw adjusting bolt into actuator to the full length of threads, then back off ¼ turn so that screw will not jam and fail to adjust when assembly is complete. Refer to figure 27.
5. Install plunger guide in spider housing. The end of the guide with teeth is installed first and the flat sides of the guide must fit into the slot in the adjusting plunger to mesh with the outer teeth of the actuator.

CAUTION: The chamfered notch on the back end of the guide must be toward the plunger seal end of the housing, otherwise the automatic adjustment feature will not function. When properly assembled, if adjusting bolt is turned in one direction, the brake will adjust and if turned in opposite direction a ratcheting effect will result. When assembled wrong, a ratcheting effect will result regardless of which direction adjusting bolt is turned.

6. Install spring, gasket, and bolt.
7. Install anchor plunger components as described under "Brake Actuation Components."

Figure 27—Installing Adjuster Bolt

8. Install brake shoes and brake chamber as detailed under applicable procedures.

INITIAL ADJUSTMENT

If a new installation has just been made as described above, start engine and build up required amount of air pressure in system. Then pump the brake pedal until the automatic adjuster system adjusts enough to provide sufficient brake for safe driving. Final adjustment is made with the vehicle in motion, by pumping the pedal.

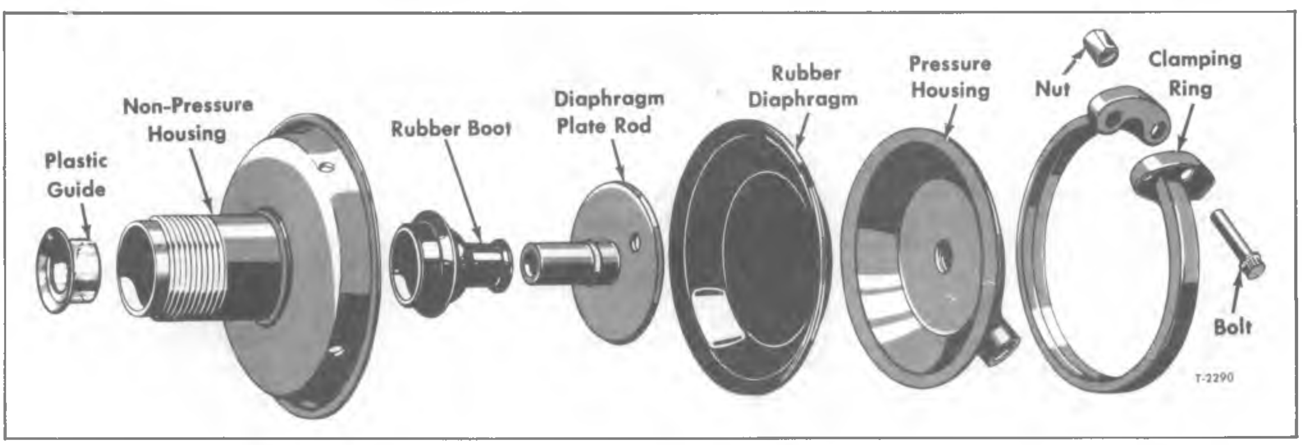


Figure 28—Standard Stopmaster Air Chamber Components

SERVICING STANDARD STOPMASTER BRAKE CHAMBERS

It is recommended that all brake chambers be removed, disassembled, inspected and thoroughly cleaned at the time that brakes are relined or at one year periods, whichever occurs first (also dependent upon type of operation and operator experience). Thorough cleaning, proper lubrication and replacement of any worn parts on a preventive maintenance basis will assure proper operation of the system at all times.

Instructions covering the removal and service of standard chambers follows (refer to fig. 28):

REMOVAL AND DISASSEMBLY

1. Disconnect air lines from chambers.
2. Using a punch, drive lock washer protrusions from notches in spanner nut and spider housing.
3. Using a spanner wrench or a punch and hammer, loosen spanner nut which secures air chamber to brake spider housing.
4. Remove air chamber assembly from brake spider housing.
5. Remove bolt and nut which secure clamping ring.
6. Scribe a mark across the pressure housing and the non-pressure housing to assure proper reassembly.
7. Remove diaphragm, rod, boot and guide from housings.

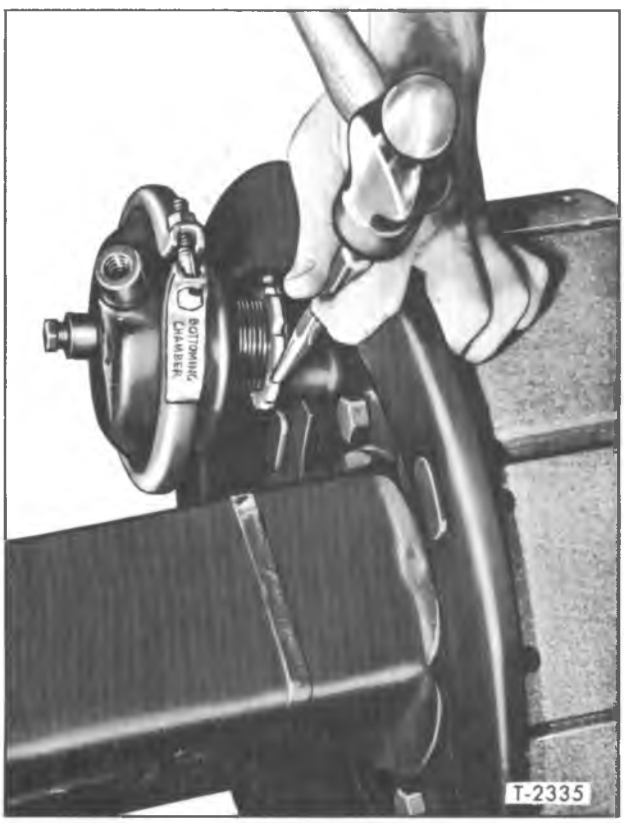


Figure 29—Staking Air Chamber Lockwasher

CLEANING AND INSPECTION

1. Clean all metal parts thoroughly, using a suitable cleaning fluid. Blow dry with air or wipe dry with cloth. (Do not use solvent on diaphragm.)
2. Examine diaphragm and replace with new part if any signs of wear or deterioration are evident.
3. Inspect pressure housing for scratches, scores, or excessive wear. Examine all parts for obstructions and remove any foreign matter.
4. Examine diaphragm plate rod boot for deterioration or cracks. If deterioration or other damage is evident, replace. In order to replace boot it is necessary to remove the plastic guide from the end of the rod. If the guide is damaged or worn, it too should be replaced. Apply a liberal amount of rubber cement to boot flange and mating surface on non-pressure housing.

BRAKE CHAMBER ASSEMBLY AND INSTALLATION

1. Install boot, rod, guide and diaphragm in non-pressure housing.
2. Position pressure housing on non-pressure housing so that scribe marks made at disassembly are aligned.
3. Install clamping ring on assembly and secure with bolt and nut.
4. Install air chamber in brake spider housing until it "bottoms" in spider. Then back off not more than one full turn to position chamber ports in line with air tubes. The plastic guide will assure proper positioning of the wedge. At this point lock the air chamber in position by tightening the spanner nut against lock washer and the spider housing. Using a punch, drive edge of lock washer into notches provided in spider housing and spanner nut (see fig. 29).

BRAKE SHOE AND LININGS

BRAKE SHOE REMOVAL
(Refer to Fig. 30)

1. Jack up rear of vehicle and remove wheels.
2. Remove hub and brake drum assembly. Refer to REAR SUSPENSION under "REAR HUBS AND BEARINGS" (SEC. 4C) of this manual.
3. Remove brake shoe return springs.
4. Lift brake shoe web out of shoe hold-down clip and out of notches in anchor and adjusting plungers.

NOTE: Mark adjusting end of brake shoes to ensure correct reassembly.

AIR BRAKES

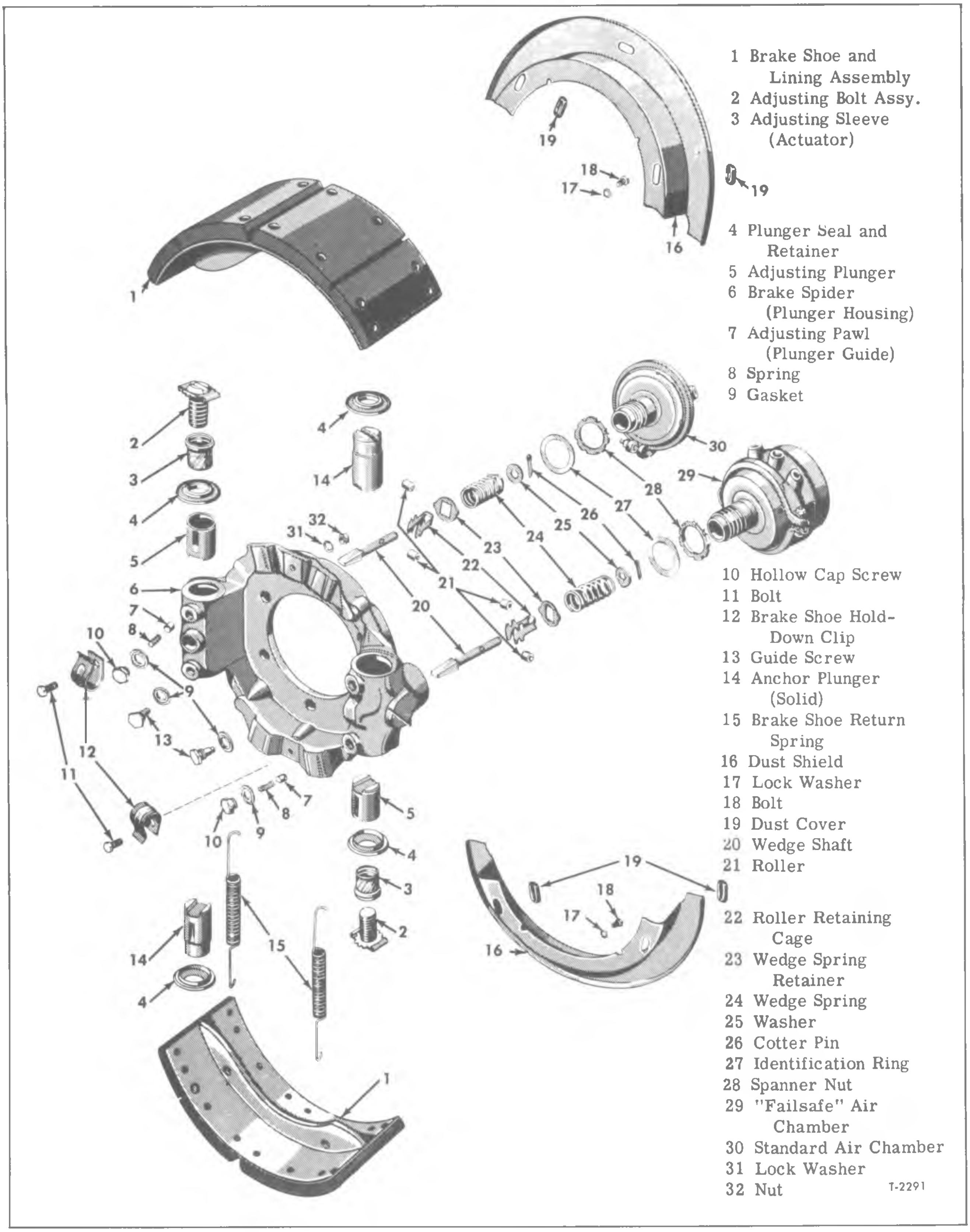


Figure 30—Stopmaster Brake Components (Automatic Adjuster with "Fail-Safe")

SHOE RELINING

Each brake shoe consists of a shoe table with a single web welded in place. A two-piece molded lining is riveted to each shoe. Lining should be replaced before wear exposes the rivet heads and causes damage to brake drums. Both linings on each shoe are identical and can be installed at either end. New linings must be securely riveted to shoe with correct size rivets, and rivets must be properly upset.

BRAKE SHOE INSTALLATION
(Refer to Fig. 30)

1. Position brake shoe webs inside hold-down clips with ends engaging slotted end of anchor plungers and slotted end of adjusting bolt.

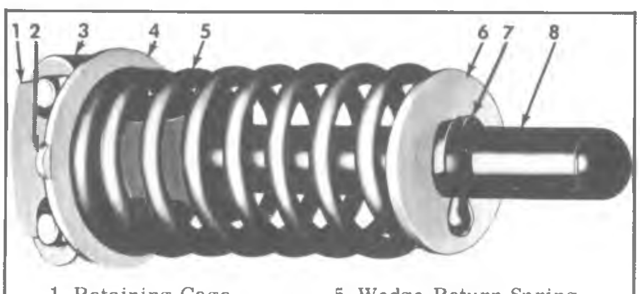
NOTE: Brake shoes are constructed with a 4-inch radius on the adjusting end and a 3-inch radius on the anchor end. When installing shoes on brake assembly, make certain the end marked as suggested in "Note" of Step 4 of "Removal" is mounted in adjusting plunger.

2. Install brake shoe return springs. Make certain hold-down clip applies pressure to shoe web to avoid cocked shoes.

BRAKE ACTUATION COMPONENTS

Actuation components can be serviced without removing spider from axle. Trouble diagnosis might indicate faulty internal parts which would not necessitate brake chamber disassembly or new brake lining. Actuation components should be inspected for faulty or unacceptable conditions.

For service of automatic adjuster components see procedures under that subject on a previous page of this section. The following procedures cover the anchor end components and other actuation components:



1 Retaining Cage
2 "Ears" on Washer
3 Roller
4 Wedge Retainer Washer
5 Wedge Return Spring
6 Return Spring Washer
7 Cotter Pin
8 Wedge

Figure 31—Wedge and Roller Assembly

REMOVAL (Refer to Fig. 30)

1. Remove brake chambers. Refer to procedures covering standard and/or "Fail-Safe" chamber service.

2. Loosen spanner nut, then unscrew non-pressure housing from brake spider. This leaves wedge, roller, and spring assembly exposed.

3. Remove wedge, roller and spring assembly from actuation housing by pulling straight out.

4. Remove brake shoes. Refer to procedure covering this operation.

5. Remove plunger guides and washers.

6. Pry plunger seal from spider housing.

7. Remove anchor plunger.

8. Remove automatic adjuster components as described in applicable procedures.

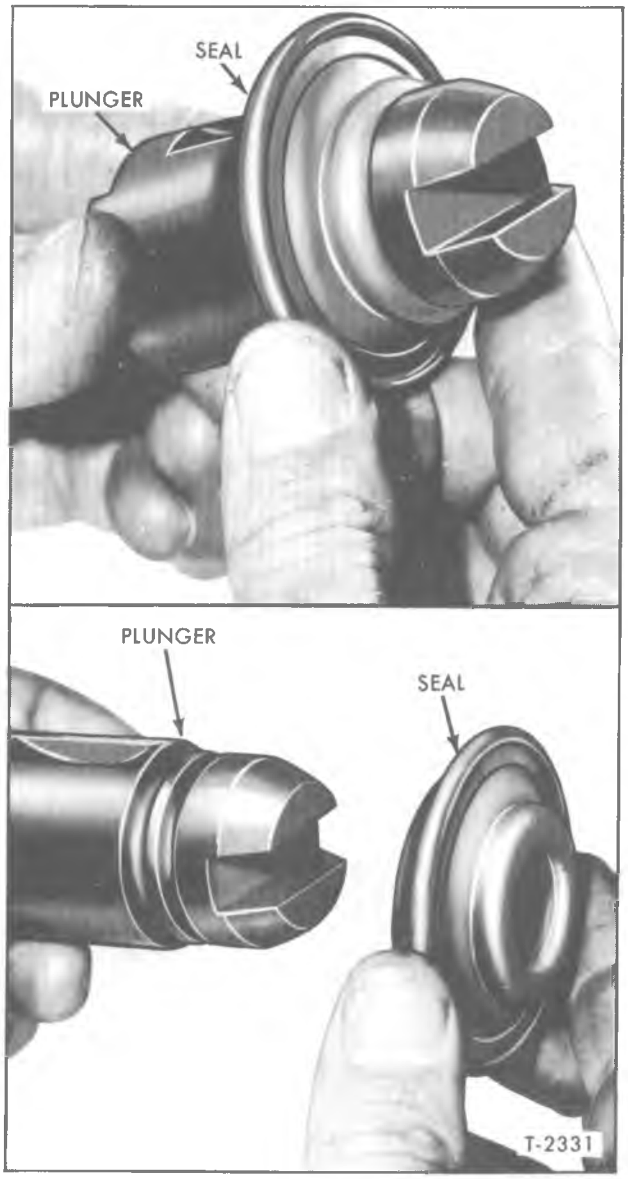


Figure 32—Installing Seal on Anchor Plunger

Figure 33—Installing Anchor Plunger and Seal

DISASSEMBLY OF WEDGE ASSEMBLY
(Refer to Figs. 30 and 31)

1. Remove cotter pin and wedge return spring washer from wedge assembly.
2. Slide wedge spring off wedge.
3. Remove wedge retainer washer and rollers from roller retaining cage.

CLEANING AND INSPECTION

All components should be thoroughly cleaned prior to inspection and reassembly.

1. Inspect wedge for bent or distorted condition. Examine bearing surfaces for scoring or wear. Replace wedge if there is evidence of wear or distortion.
2. Examine rollers for any wear or out-of-round condition. No scratches or scoring is permissible.
3. Examine wedge spring for fatigue or corrosion. Replace spring if necessary.
4. Inspect actuation housing cylinder bores for scores, scratches, or corrosion. Light scratches or slightly corroded spots may be polished out with crocus cloth. Never use emery cloth or sandpaper. If scratches or corrosion are too deep to be polished out, spider must be replaced.
5. Inspect plungers for scoring, scratches, or corrosion. Light scratches may be polished out with crocus cloth. If scratches or corrosion are too deep to be polished out, plunger must be replaced.
6. Inspect plunger seal for any cracking or deterioration. Any deterioration is unacceptable and seal should be replaced.

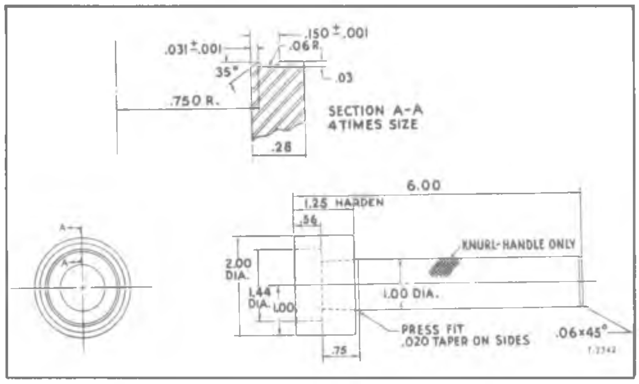


Figure 34—Plunger Seal Installing Tool Dimensions

Figure 35—Installing Wedge Assembly

ASSEMBLY OF WEDGE ASSEMBLY
(Refer to Figs. 30 and 31)

1. Install rollers in retaining cage.
2. Place washer in position on retaining cage.
3. Install wedge in retaining cage.

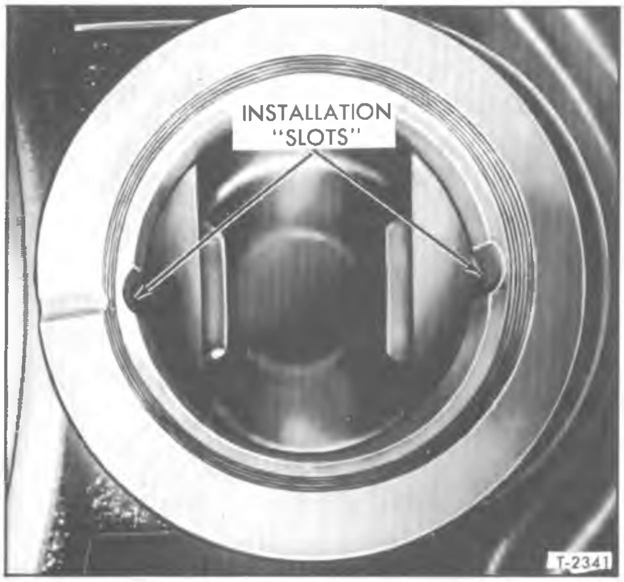


Figure 36—Wedge Cavity in Housing ("Slots" Shown)

4. Position spring on wedge against washer and compress enough to install return spring washer and cotter pin.

INSTALLATION (Refer to Fig. 30)

1. Install new seals on anchor plungers as shown in figure 32.
2. Install plungers and seals in housing as shown in figure 33.

NOTE: Installation tool shown in figure 33 can be made locally according to dimensions shown in figure 34.

3. Insert plunger guide with new washer inside slots in anchor plungers.
4. Install automatic adjuster components as detailed in applicable procedure.
5. Install wedge assembly in actuation housing (refer to fig. 35). Be sure rollers are seated correctly in retainer cage and make good contact with plungers.

NOTE: Spring retainer washer has "ears" on each side to be used as guides to assure correct installation (see fig. 31). Housing has "slots" to match "ears" on washer (see fig. 36).

6. Install brake shoes as previously described under "Brake Shoe Installation" in this section.
7. Install brake chambers as described previously.
8. Connect all air lines into both chambers.
9. Build up air pressure in system and push parking brake knob in to admit air into outer chambers (with "Fail-Safe" only).
10. With air in outer chambers, turn release bolt at each chamber (if "Fail-Safe") counterclockwise as far as it will go (approximately 18 turns - see fig. 39). Brakes are now in operating condition, either for service brakes or parking.
11. After brakes are in operating condition, adjust brakes and repeat operating and leakage tests as previously described.

"FAIL-SAFE" BRAKE CHAMBERS

GENERAL

The Stopmaster "Fail-Safe" is a mechanical actuation feature for power brakes and is two-fold in purpose. It is used as an air-released, spring-applied parking brake, as well as a safety feature in the event of air brake failure.

DESCRIPTION AND OPERATION

BRAKE CHAMBERS (Fig. 37)

Two brake chamber assemblies are used at each wheel. Type used differs by model as shown in figure 24. The "Fail-Safe" brake chamber assembly consists of an inner and outer chamber. The inner chamber, containing a diaphragm and diaphragm plate rod, serves as the service brake chamber and operates in the same manner as a conventional brake chamber. Movement of diaphragm plate rod is transmitted to the brake shoes through the mechanical actuating components as described later.

The outer chamber contains a spring-loaded piston which acts against the service brake chamber diaphragm plate rod. During normal operation, constant air pressure is applied to the outer chamber, this pressure, acting on the piston, holds the spring compressed. When air pressure is released from the outer chamber by pulling out the knob on the parking brake control valve, spring pressure forces the piston toward the service brake chamber; piston movement is transmitted through the service brake diaphragm plate rod to the brake actuating mechanism, applying the brakes.

This same action will take place in the event air pressure is lost from the system.

NOTE: The air tank supplying air pressure to the parking brake chambers is protected from the main air system by a one-way check valve; this tank will contain enough pressure for at least one parking brake release in case pressure is lost from the main air system.

In case of complete pressure loss, and pressure in the protected tank is depleted, brakes will remain applied until air pressure is restored. If necessary to move the vehicle before air pressure can be restored, brakes can be released by turning the release bolts clockwise as far as possible (approximately 18 turns) to compress the springs, as shown in figure 39. (This must be done at all "Fail-Safe" chambers at each wheel.) After air pressure has been restored, service brakes will be operative immediately; however, the parking brake will remain inoperative until the spring release bolts are backed out (counterclockwise) as far as possible to release the springs. Push parking brake valve knob in to released position to admit air pressure into the parking brake chambers to hold springs compressed while turning the release bolts.

CAUTION: Under no circumstances should any service operations be attempted on the brake chambers without first compressing the springs by means of the release bolts. Applying air pressure (at least 60 psi) to the parking brake chambers, either from the vehicle air system or from shop air supply, will hold springs compressed and facilitate turning bolts.

MECHANICAL ACTUATING COMPONENTS
(Refer to Fig. 30)

When pressure is applied to the brake chamber diaphragm plate rod, either by air pressure during a service brake application or by spring pressure from the parking brake chamber, movement is transmitted to both ends of each brake shoe through wedges, rollers, and plungers which are installed in the actuating housing in the brake spider. One plunger for each shoe incorporates an adjusting wheel to provide a means of adjusting the brakes to compensate for normal lining wear. All Stopmaster brakes have automatic adjuster mechanisms.

SERVICEABILITY TESTS

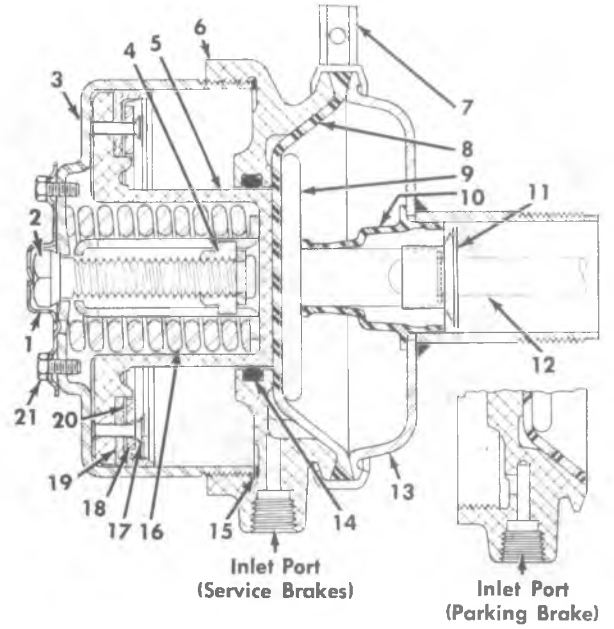
OPERATING TEST

1. Service Brakes

Make a brake application and check expansion of brake shoes against drum. Shoes should move freely and instantly when brake treadle is depressed. Release treadle. Shoes should contract and release the brakes without any lag. Visually inspect entire lining area to see if lining is bearing properly on both sides.

2. Parking Brakes

Apply parking brakes by pulling knob of control valve to release air from chamber. Brakes should apply promptly and should hold on any grade on which vehicle is expected to operate. Release the brakes by pushing knob in. The brakes should release instantly and wheels turn freely.



1 Spring Lock	12 Wedge Rod (Part of Wedge Assembly)
2 Release Bolt	13 Non-Pressure Housing
3 Spring and Cap Assembly	14 O-Ring
4 Release Bolt Nut	15 Rubber Washer
5 Piston	16 Spring
6 Pressure Housing	17 Rivet
7 Clamping Ring	18 Retainer Plate
8 Rubber Diaphragm	19 Piston Seal
9 Diaphragm Plate Rod	20 Expander
10 Rubber Boot	21 Spring Lock Capscrew
11 Wedge Rod Guide	

T-2199

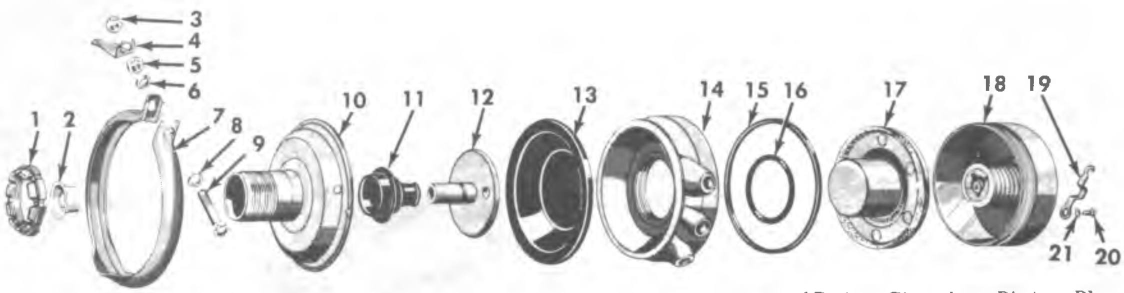
Figure 37—"Fail-Safe" Brake Chamber Assembly

LEAKAGE TEST

1. Service Brakes

With brakes applied, check air chambers for leakage at clamping ring by covering ring with soap suds. Also apply suds to drain holes on bottom of chamber. Any small air leaks should be evident. No leakage is permissible at either location. If leakage occurs at clamping ring, tighten clamping ring. If leakage still persists, diaphragm may be deteriorated or not fitting properly between pressure and non-pressure housings (see figs. 37 and 38).

If air is escaping from drain holes only, it is an indication that diaphragm is faulty and should be replaced.



1 Spanner Nut
2 Wedge Rod Guide
3 Tag Nut
4 Caution Tag
5 Nut
6 Lock Washer
7 Clamping Ring
8 Washer
9 Bolt
10 Non-Pressure Housing
11 Push Rod Boot
12 Diaphragm Plate Rod
13 Rubber Diaphragm
14 "Fail-Safe" Pressure Housing
15 Housing to Cap Rubber Washer
16 Housing to Plunger "O" Ring
17 Air Chamber Piston Plunger Assembly
18 Air Chamber Cap Assembly
19 Release Bolt Spring Lock
20 Capscrew
21 Lock Washer

T-8259

Figure 38—"Fail-Safe" Air Chamber Components

2. Parking Brakes (Fig. 37)

a. With parking brake released by air pressure, apply soap suds on cap around release bolt. Any leakage that is evident indicates a faulty piston seal. Seal should be replaced and suds applied again to be sure leakage has been corrected.

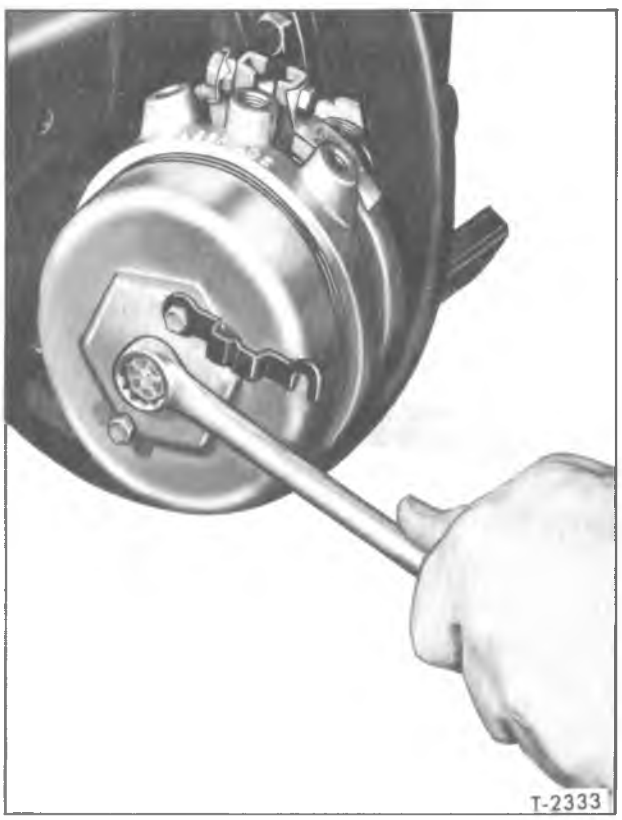


Figure 39—Compressing "Fail-Safe" Power Spring

b. Soap suds should be applied at cap to pressure housing joint. If leakage is evident, fault could be due to distorted cap caused by careless handling or deteriorated rubber washer between cap and housing.

c. Coat service brake relay valve exhaust port with soap suds. Leakage at this point indicates leakage past O-ring seal in the pressure housing. If leakage occurs, replace O-ring with new part.

SERVICING "FAIL-SAFE" BRAKE CHAMBERS

Brake chamber components can be removed from the vehicle for inspection and replacement of parts without removing the non-pressure housing and without disturbing the mechanical actuating mechanism.

REMOVAL AND DISASSEMBLY

Refer to figure 37 (also refer to figure 38 for components).

CAUTION: BEFORE ATTEMPTING BRAKE CHAMBER REMOVAL, BLOCK WHEELS SECURELY, SINCE PARKING BRAKE WILL NOT BE APPLIED.

1. With air pressure in parking brake chamber (brake released), loosen release bolt spring lock and swing to one side; then turn release bolt clockwise as far as it will go (approx. 18 turns) to compress the power spring (refer to fig. 39).

2. Exhaust air pressure from parking brake chamber by pulling parking brake knob out.

3. Disconnect air lines from both chambers.

4. Mark pressure housing and non-pressure housing so that parts can be reassembled in the same relative position. Loosen clamping ring by unscrewing bolt. Hang clamping ring on non-pressure plate tube.

5. Remove entire cap and spring assembly, pressure housing, and rubber diaphragm (see fig. 40). Diaphragm plate rod and boot will remain in the non-pressure housing.

6. Mount pressure housing in vise.

NOTE: Do not tighten vise jaws enough to distort pressure from cap assembly (see figs. 41 and 42 for illustration of this operation and dimensions to make a "strap" wrench).

7. Remove washer and O-ring from pressure housing.

8. Remove piston assembly from cap by pulling straight out. At times the spring, when fully compressed, cocks slightly. It is then necessary to loosen the release bolt a few turns so that the piston can be withdrawn easily.

9. The piston, retainer plate, seal and expander are held together by rivets. If any part of this assembly is defective the complete assembly must be replaced. Details are not serviced separately.

10. Cap and spring assembly is serviced as a unit. If any of the parts become damaged or need replacing, it is necessary to replace the complete cap and spring assembly.

CAUTION: DO NOT attempt to disassemble the cap and spring assembly. In the event any part of this assembly is defective, the complete assembly must be replaced. The component parts are not serviced separately.

Figure 40—Removing "Fail-Safe" Assembly

CLEANING AND INSPECTION
(Refer to Figs. 37 and 38)

1. It is recommended that all brake chambers be removed, disassembled, inspected and thoroughly cleaned at the time brakes are relined or at one year periods, whichever occurs first (also dependent upon type of operation and operators experience).

2. Clean all metal parts thoroughly, using a

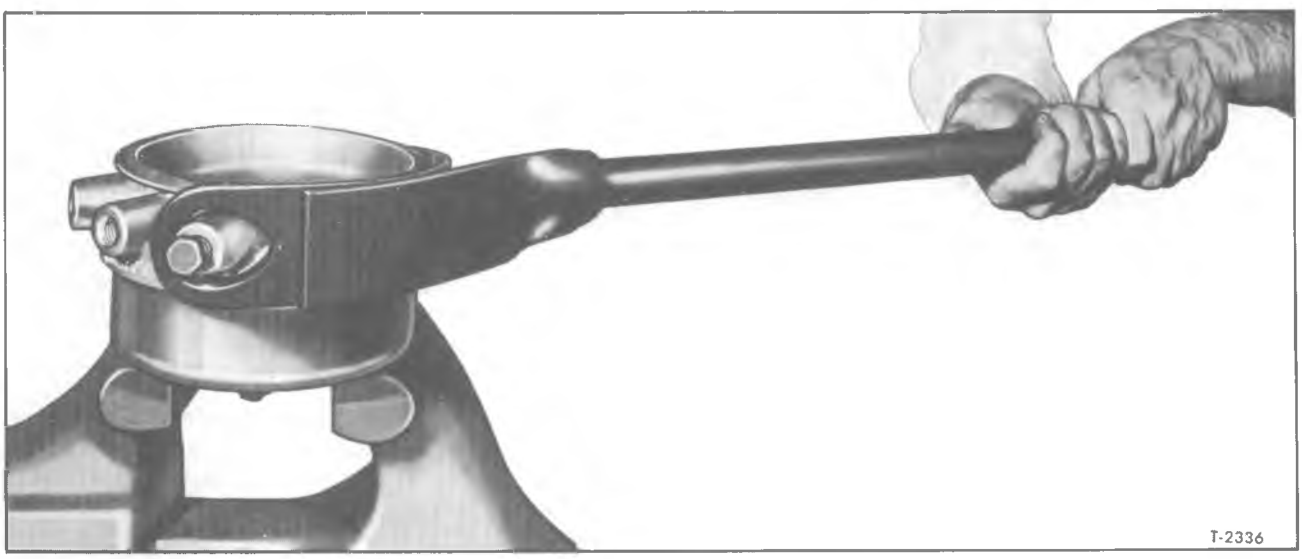


Figure 41—Removing Pressure Housing with "Strap" Wrench

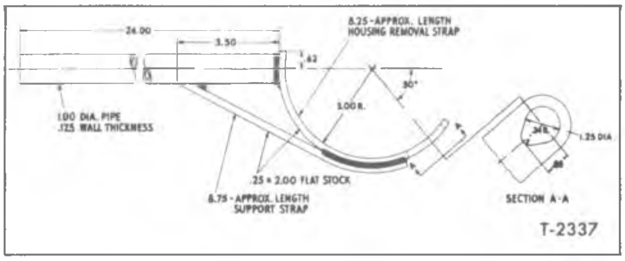


Figure 42—"Strap" Type Wrench Dimensions

suitable cleaning fluid. Blow dry with air or wipe dry with cloth.

3. Inspect piston cap for signs of damage or excessive wear. Piston should slide freely inside cap assembly. Replace piston if badly worn or damaged.

4. Inspect inside walls of cap assembly for scratches, scores, or excessive wear. Slightly worn spots may be removed with crocus cloth. Inspect external threads on cap for rust or corrosion.

5. Inspect piston seal for cracking or deterioration. Inspect expander and expander retaining plate for deterioration. Replace piston assembly, if necessary.

6. Inspect pressure housing for scratches, scores, or excessive wear. Examine all parts for obstructions and remove any foreign matter.

7. Examine spring in cap for deterioration or rust. Inspect release bolt for signs of rust on the threaded portion. Unless spring or bolt is in very bad condition, replacement should not be necessary. See "Caution" in Step 10 of "Removal and Disassembly."

8. Discard O-ring and rubber washer. Replace with new parts.

9. Examine diaphragm plate rod boot (in non-pressure housing) for deterioration or cracks. If deterioration or other damage is evident, replace as follows:

a. Pull diaphragm plate rod, wedge rod guide and boot out of wedge rod and mounting tube respectively.

b. Remove guide and boot from diaphragm plate rod and install new boot on plate rod. Replace wedge rod guide.

c. Apply a liberal amount of rubber cement to boot flange and mating surface on non-pressure housing.

d. Position plate rod on wedge rod and hold rubber boot flange tightly against housing surface. Flange should seal tight to keep any moisture or foreign matter from falling into actuation components.

NOTE: Be careful not to disturb wedge and roller mechanism inside actuation housing when repositioning plate rod on wedge rod.

BRAKE CHAMBER ASSEMBLY
AND INSTALLATION

Refer to figure 37 (also refer to figure 38 for components).

1. Install O-ring in groove in pressure housing.

2. Install piston assembly in cap assembly.

3. Position rubber washer in pressure housing at bottom of internal threads. Thread cap and spring assembly into pressure housing and tighten firmly against rubber washer. This may be done with "strap" type wrench (see figs 41 and 42), or by putting pressure housing in vise and using a wrench on hex end of cap.

4. Position diaphragm over plate rod, then install pressure housing and cap assembly.

NOTE: Diaphragm should fit evenly between pressure housing and non-pressure housing. Align marks made on housings at disassembly to ensure proper air port locations.

5. Pull clamping ring over flange of pressure and non-pressure housings. Install clamp bolt and nut and tighten firmly.

6. Connect all air lines and build up air pressure in system to normal operating pressure. Push parking brake knob in to admit air to outer brake chamber.

7. Turn release bolt counterclockwise as far as possible (approx. 18 turns) to release spring (see fig. 39). This will leave the parking brake chamber in operating condition.

NOTE: It is best to have at least 60 psi of air in chamber to hold spring tension off nut so a better "feel" is obtained when the nut does bottom.

SUPER "FAIL-SAFE" BRAKES

The Super "Fail-Safe" brake is identical to the Standard "Fail-Safe" brake in operation and principle but differs physically in size and components. Refer to figure 43 for illustration of complete Stopmaster Brake assembly with Super "Fail-Safe" chamber.

The Super "Fail-Safe" is a spring-powered brake actuator that mounts "piggy-back" on the air chamber non-pressure housing of the Stopmaster Brake (see fig. 44).

When 65 psi or more of air pressure is applied against the piston, the power spring will be held in a compressed position. When air pressure is removed, the power spring will push the piston against the diaphragm plate. The wedge head will be pushed deeper between the rollers spreading

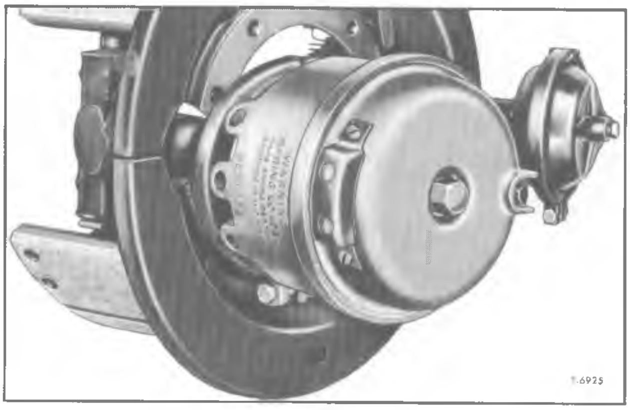


Figure 43—Brake Assembly with Super "Fail-Safe"

the plungers apart and applying the brake.

The unit is equipped with a manual release bolt to permit safe handling for service. The cap cavity is sealed by an O-ring on the release bolt.

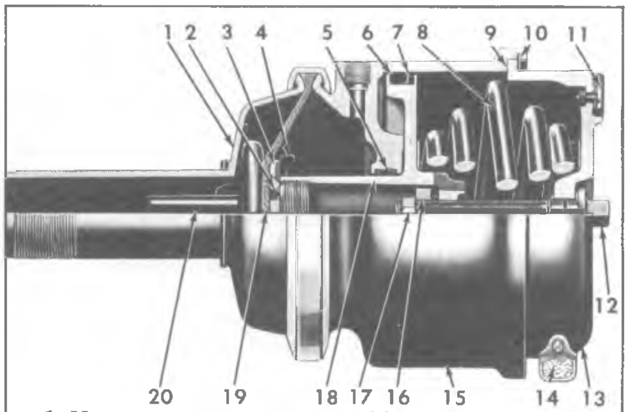
SAFETY PRECAUTIONS

When brakes are equipped with Super "Fail-Safe" units, cage the power spring before starting any disassembly or removal of wheels or drums to avoid possible injury.

When a vehicle is disabled, due to low or lost air pressure, block the wheels and cage the power spring before attempting to move the vehicle.

An internal venting system working in conjunction with a one-way breathing arrangement on the cap allows system air to fill the vacuum behind the piston when the "Fail-Safe" is actuated and keeps the unit sealed from direct atmospheric contamination.

The "Fail-Safe" is used as an air-released, spring-applied parking brake, as well as a safety feature in the event of air brake failure.



1 Non-Pressure Housing
2 Setscrew
3 Foot
4 Piston Seal
5 O-Ring
6 O-Ring
7 Back-up Ring
8 Power Spring
9 Rubber Seal
10 Lock Ring
11 Breather
12 Release Bolt
13 Cap
14 Filter
15 Housing
16 Square Nut
17 Hex Nut
18 Piston
19 Diaphragm
20 Push Rod

Figure 44—Super "Fail-Safe" Assembly

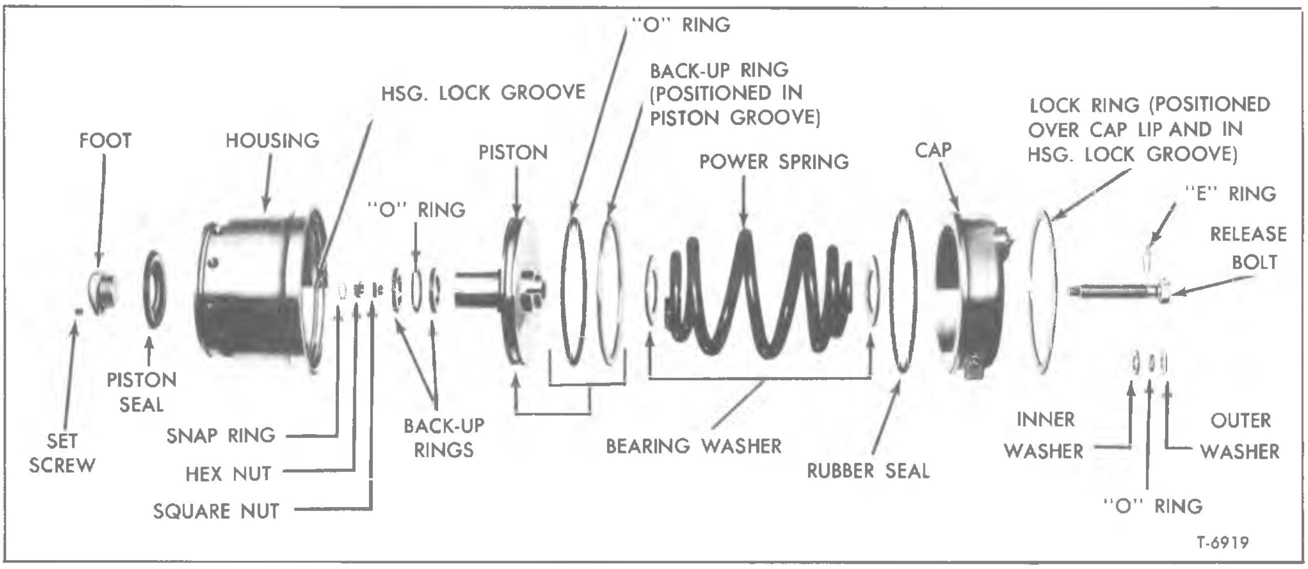


Figure 45—Super "Fail-Safe" Components

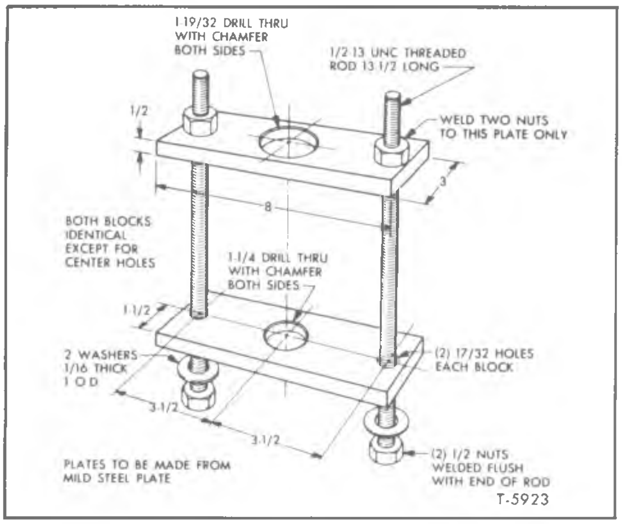


Figure 46—Power Spring Compressing Fixture

SERVICE RECOMMENDATIONS

CAGING AND UNCAGING POWER SPRING

On the Super "Fail-Safe" the head of the release bolt is exposed at all times.

The power spring is caged by rotating the release bolt 18 to 21 full turns clockwise. Do not force the bolt beyond its normal stop.

Both the caging and uncaging operation can be made easier by applying air pressure (65 psi minimum) to the "Fail-Safe." This will take the spring load off the release bolt.

DISASSEMBLY (Refer to Fig. 45)

1. Cage power spring by turning release bolt 18 to 21 turns clockwise.
2. Remove "Fail-Safe" from non-pressure housing at clamp ring.
3. Release foot setscrew.
4. Unscrew foot from piston.
5. Remove piston seal.
6. Remove sealing compound located at joint between cap and housing.
7. Remove lock ring from housing.
8. Separate cap, spring and piston assembly from housing. Remove rubber seal from housing.
9. Remove back-up rings and O-ring from groove in housing.
10. Remove snap ring and hex nut from release bolt.
11. Secure cap, spring and piston assembly in fixture.

NOTE: Refer to figure 46 for illustration of fixture. This fixture is necessary to hold the power spring in compression for disassembly. This fixture is special tool (J-23527).

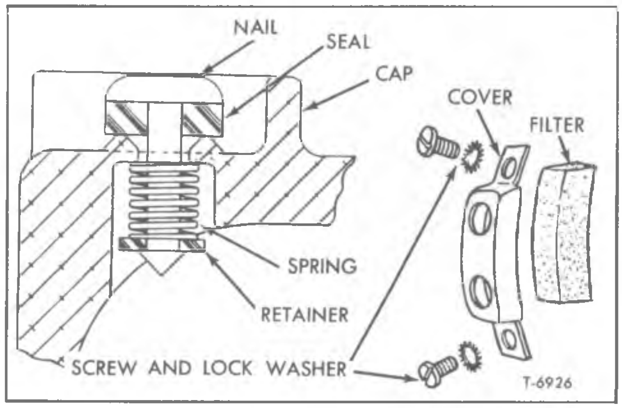


Figure 47—Breather and Filter Assembly

12. Turn release bolt until square nut falls free.
13. Release pressure on fixture until spring is unloaded.
14. Remove assembly from fixture.
15. Separate cap from spring and piston assembly.
16. Remove back-up ring and O-ring from piston.
17. Remove the two spring bearing washers.
18. Remove "E" ring from release bolt.
19. Remove flat washer from release bolt.
20. Remove release bolt from cap.
21. Remove O-ring from release bolt.
22. Remove second flat washer from release bolt.
23. Remove filler from cap.

IMPORTANT: DO NOT remove breather assembly from cap unless inspection indicates damage. It is necessary to cut the nail to remove the assembly.

ASSEMBLY

Before assembly, clean and inspect all parts. Lubricate with recommended grease. DO NOT lubricate cap in the area of the breather assembly. DO NOT use solvent on back-up or O-rings. Use hot soapy water and wipe clean.

It is necessary to use a sealer on the foot setscrew and cover the head of it with plastic tape until the sealer sets.

IMPORTANT: Replace sealing compound over cap lock ring to seal unit from outside contamination.

If breather assembly has been removed from cap, perform first four steps of following procedure. Otherwise, start assembly procedure with Step 5. Refer to figure 47.

1. Insert nail through opening in seal.
2. Insert assembly through opening in cap.

3. Insert spring over nail.
4. Force retainer over flated end of nail.
5. Install filter on cap.
6. Install outer flat washer and O-ring on release bolt.
7. Install release bolt in hole in center of cap with bolt head toward outside of cap.
8. Install inner flat washer and "E" ring on release bolt.
9. Install two spring bearing washers; one on piston and one in cap.
10. Install back-up ring and O-ring on piston.
11. Assemble cap assembly, spring, and piston Compress assembly in fixture (fig. 46).
12. Install square nut on release bolt. Remove assembly from fixture.
13. Install hex nut and snap ring on release bolt.
14. Install back-up rings and O-ring in groove in housing.
15. Assemble cap, spring, and piston assembly in housing assembly, with rubber seal between cap and housing.
16. Install lock ring in housing and seal joint between cap and housing with sealing compound.
17. Install piston seal in housing.
18. Thread foot through housing into piston.
19. Lock foot in place with setscrew. Apply sealing compound to cover head of setscrew. Cover with plastic tape until sealer sets.

MODULATING EMERGENCY APPLICATION VALVE

Some vehicles are equipped with an optional service and emergency brake application valve in conjunction with the air-operated parking brake system.

In the event of air pressure loss in service brake system, depressing the brake pedal beyond its normal travel will gradually apply the parking (emergency) brakes.

If vehicle is to be moved to a safe off-road position, parking brakes can be applied and released one or two times depending on pressure in parking brake (protected) tank. When pressure is exhausted, parking brakes will become fully applied, and can only be released mechanically.

FRONT BRAKES SPECIFICATIONS

Brake Size	15 x 3
Brake Shoe Lining	
Width	3"
Thickness	7/16"
Area (sq. in. per axle)	199
Brake Chamber	
Type	12
Diameter	5 23/32"
Adjust Travel to	Short as possible w/o brakes dragging

REAR BRAKES (EXCEPT STOPMASTER)

Brake Size	15 x 6
Brake Shoe Lining	
Width	6"
Thickness	3/4"
Area (sq. in. per axle)	377
Brake Chamber	
Type	30
Diameter	8 1/8"
Adjust Travel to	Short as possible w/o brakes dragging

STOPMASTER BRAKE SPECIFICATIONS

Brake Size	15 x 7
Brake Shoe Lining	
Width	7"
Thickness	3/4" Crescent
Area (sq. in. per axle)	440
Brake Chamber	
Standard	
Diameter (at clamp band)	5.66"
"Fail-Safe"	
Diameter (at chamber body)	5.264"

GENERAL TROUBLESHOOTING CHART

NO BRAKES

PROBABLE CAUSE	REMEDY
1. No air pressure	1. Check for leaks, broken lines, etc. Repair or replace as necessary
2. Restricted tubing or hose	2. Replace defective parts.
3. Defective brake valve	3. Repair or replace

INSUFFICIENT BRAKES

PROBABLE CAUSE	REMEDY
1. Low brake line pressure	1. Check for leaks, etc. and repair
2. Too much push rod travel	2. Adjust
3. Worn linings or drums	3. Replace as necessary
4. Leaking chamber diaphragm	4. Replace diaphragm
5. Slack adjusters out of adjustment	5. Adjust
6. Wrong size brake chambers	6. Replace according to "Specifications"

SLOW BRAKE APPLICATION

PROBABLE CAUSE	REMEDY
1. Low brake line pressure	1. Check for leaks, etc. and repair
2. Linkage binding	2. Lubricate linkage
3. Too much push rod travel	3. Adjust
4. Restriction in line	4. Remove restriction or replace line
5. Leaking brake valve	5. Repair or replace
6. Worn linings or drums	6. Replace as necessary
7. Leaking chamber diaphragm	7. Replace diaphragm
8. Brake shoe anchor pins frozen	8. Free up, replace or lubricate as necessary
9. Foot control valve linkage improperly adjusted	9. Adjust
10. Camshaft bushings binding or worn	10. Lubricate or replace

AIR BRAKES

SLOW BRAKE RELEASE	
PROBABLE CAUSE	REMEDY
1. Linkage binding	1. Lubricate linkage
2. Restriction in line	2. Remove restriction or replace line.
3. Too much push rod travel	3. Adjust
4. Improper seating of valves in application valve.	4. Repair or replace
5. Binding cam or camshafts	5. Lubricate if possible; replace if not effective.
6. Weak shoe return springs	6. Replace springs

GRABBING BRAKES	
PROBABLE CAUSE	REMEDY
1. Grease or dirt on lining	1. Clean or reline.
2. Brake drum out-of-round	2. Turn or replace
3. Defective application valve	3. Repair or replace

UNEVEN BRAKES	
PROBABLE CAUSE	REMEDY
1. Uneven slack adjuster settings	1. Adjust properly
2. Linkage binding at one or more wheels	2. Lubricate as necessary
3. Linings worn uneven	3. Adjust or replace
4. Brake shoe return spring weak or broken	4. Replace
5. Defective brake chamber	5. Repair or replace
6. Defective brake drum	6. Repair or replace
7. Unequal springs in brake chambers or between brake shoes	7. Replace in pairs.

SLOW PRESSURE BUILDUP IN RESERVOIRS	
PROBABLE CAUSE	REMEDY
1. Clogged air cleaner	1. Clean or replace
2. Air leak	2. Find and repair
3. Faulty compressor	3. Repair (see "Air Compressor" section in this manual)
4. Open or leaking reservoir drain cocks.	4. Close, repair or replace.
5. Defective compressor governor	5. Repair or replace

AIR PRESSURE ABOVE NORMAL	
PROBABLE CAUSE	REMEDY
1. Defective air gauge	1. Replace
2. Governor out of adjustment or defective	2. Adjust, repair or replace
3. Restricted line between governor and compressor	3. Clear line or replace
4. Compressor unloader inoperative	4. Repair or replace

QUICK LOSS OF PRESSURE WHEN ENGINE IS STOPPED (BRAKES NOT APPLIED)	
PROBABLE CAUSE	REMEDY
1. Leaking lines or connections	1. Repair or replace
2. Worn or leaking compressor exhaust valve or one-way check valve.	2. Repair or replace
3. Leaking governor	3. Repair or replace
4. Leaking application valve	4. Repair or replace
5. Open or leaking reservoir drain cock	5. Close, repair or replace
(BRAKES FULLY APPLIED)	
1. Leaking brake chamber	1. Repair or replace
2. Leaking application valve	2. Repair or replace
3. Leaking service line	3. Repair or replace
4. Leaking chamber hoses	4. Repair or replace
5. Dirt in two-way check valve. (If equipped with hand control valve and brakes are applied by the foot valve, dirt in the two-way check valve could cause a pressure leak at the hand valve exhaust port.)	5. Clean or replace
6. Defective quick release valve	6. Clean or replace diaphragm.

SAFETY VALVE "BLOWS OFF"	
PROBABLE CAUSE	REMEDY
1. Safety valve out of adjustment	1. Adjust
2. Pressure in system above normal	2. See chart on "Air pressure above normal"
3. Governor out of adjustment	3. Adjust

STOPMASTER TROUBLESHOOTING CHART

"FAIL-SAFE" PARKING BRAKE WILL NOT RELEASE

PROBABLE CAUSE	REMEDY
1. Air leak in "Fail-Safe" lines	1. Check air system and correct leaks
2. Loose clamp ring or cap	2. Tighten and check for air leaks
3. Leakage at release bolt	3. Replace piston and seal assembly
4. Faulty piston O-ring seal	4. Replace piston O-ring seal
5. Foreign material in "Fail-Safe" chamber	5. Clean with solvent and lubricate
6. Improper wedge adjustment	6. Make wedge adjustment
7. Corroded "Fail-Safe" spring	7. Replace cap and spring assembly

"FAIL-SAFE" PARKING BRAKE WILL NOT APPLY

PROBABLE CAUSE	REMEDY
1. "Fail-Safe" spring not fully released	1. Turn release bolt counterclockwise
2. Inoperative parking brake control valve or quick release valve	2. Check operation of valves as outlined in Maintenance Manual and replace if necessary
3. Foreign material in chambers or piston stuck in cap	3. Disassemble and clean with solvent; lubricate piston and cap
4. "Fail-Safe" spring failure	4. Replace cap and spring assembly
5. Rollers not aligned with plungers or wedge not mated with diaphragm plate rod	5. Remove non-pressure housing and check installation of wedge
6. Brakes out of adjustment	6. Adjust brakes; check operation of automatic adjusters

AUTOMATIC ADJUSTERS INOPERATIVE

PROBABLE CAUSE	REMEDY
1. Guide installed backwards	1. Remove plunger guide components and reassemble
2. Guide spring missing or weak	2. Replace guide spring
3. Plunger seal failure	3. Replace seal; clean and lubricate actuation parts
4. Adjusting bolt threaded into actuator too tight	4. Back off bolt 1/4 turn
5. Plunger guide washer omitted	5. Replace washer

SERVICE BRAKES INOPERATIVE	
PROBABLE CAUSE	REMEDY
1. Low air pressure	1. Check system for leaks
2. Faulty brake chamber diaphragm	2. Replace diaphragm
3. Improper brake shoe adjustment	3. Adjust brake shoes
4. Improper wedge adjustment	4. Make wedge adjustment
5. Plunger seal failure	5. Replace seal and clean and lubricate actuation parts
6. Grease on linings	6. Reline brakes and check seals

SECTION 5C

Parking Brakes

EXTERNAL CONTRACTING BAND TYPE BRAKE

External contracting band type parking brake is mounted at rear of transmission (fig. 1).

Brake drum is attached to the transmission output shaft flange in conjunction with the propeller shaft universal joint flange. The band and lining assembly is supported around the drum by a bracket on the adjustment side and an anchor bar on the stationary side. Both supports are attached to the transmission case. The band contracts around the drum when brake is applied.

Linkage connecting parking brake lever to brake operating cams varies on different models, however, adjustment is made at brake assembly in same manner.

BAND TYPE ADJUSTMENT (Fig. 1)

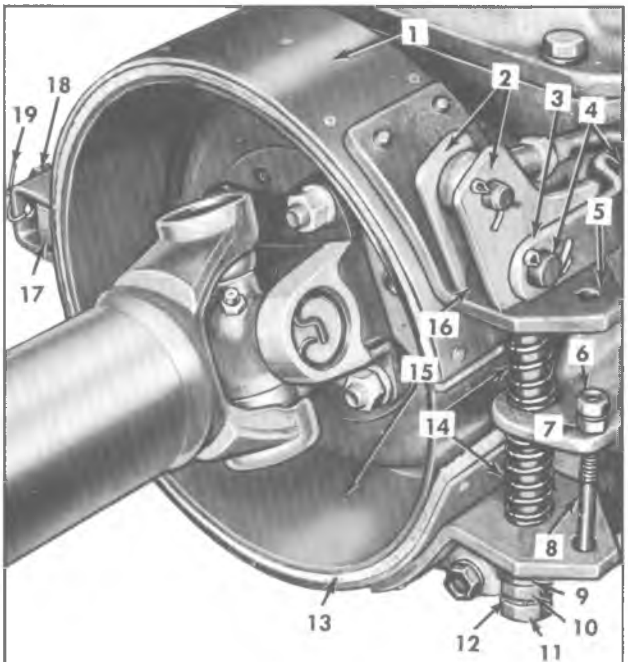
1. Place hand lever in fully released position. Disconnect brake rod or cable from operating cams by removing cotter pin and clevis pin.
2. Remove lock wire from anchor adjusting screw and turn anchor screw as necessary to obtain 0.005" to 0.015" between lining and drum. Install lock wire in anchor screw.
3. Loosen lock nut on locating bolt and tighten adjusting nut on locating bolt until there is a clearance of 0.020" to 0.040" between lower end of lining and drum. Measure clearance about 3 inches from end of lining. When correct clearance is obtained, tighten lock nut on locating bolt.
4. Loosen lock nut on adjusting bolt and tighten adjusting nut on adjusting bolt to obtain clearance of 0.020" to 0.040" between upper end of lining and drum. Measure clearance about 3 inches from end of lining. Tighten lock nut on adjusting bolt.
5. Adjust end on brake rod so that clevis pin may be freely inserted through operating cams and rod end. Install clevis pin and cotter pin, then tighten lock nut on rod end. A 0.005" shim must pass freely between drum and lining.

BRAKE BAND REMOVAL (Fig. 1)

1. Disconnect brake rod or cable from operating cams. Remove clevis pin and operating cams from upper end of adjusting bolt.
2. Remove nuts and washers from lower end of adjusting bolt. Lift adjusting bolt straight up out of brake band brackets and support, stripping release springs and cam shoe from bolt as bolt is removed.
3. Remove nuts from locating bolt, then remove bolt.
4. Remove lock wire from anchor screw, then back screw out until clear of anchor bar.
5. Slide band and lining assembly straight to rear off brake drum and anchor bar (fig. 1), removing band and lining assembly off over propeller shaft.

INSPECTION

1. Examine braking surface of drum for roughness or scoring. If drum is worn or damaged, it must be replaced.
2. Inspect brake lining. If worn down close to rivet heads, new lining must be installed.
3. Examine tension and release springs; replace if weak or broken.



1 Brake Band	11 Lock Nut
2 Cams	12 Lock Washer
3 Links	13 Brake Linings
4 Clevis Pins	14 Release Springs
5 Cam Shoe	15 Brake Drum
6 Lock Nut	16 Adjusting Bolt
7 Adjusting Nut	17 Anchor Bar
8 Locating Bolt	18 Anchor Screw
9 Washer	19 Lock Wire
10 Adjusting Nut	T-6708

Figure 1—External Contracting Band Parking Brake

BRAKE BAND INSTALLATION (Fig. 1)

1. Place band and lining assembly over propeller shaft. Place anchor screw spring in depression of anchor bar, and compress spring as band anchor bracket is placed over anchor bar.

2. Install anchor screw through bracket and spring into anchor bar. Insert locating bolt up through band lower bracket and hole in support and install nuts temporarily.

3. Place operating cams between links and install new clevis pin and cotter pin.

4. Insert threaded end of adjusting bolt down between operating cams with hook toward rear of vehicle. As bolt is lowered into place it must pass through cam shoe, band upper bracket, upper release spring, brake support, lower release spring, and band lower bracket. Install flat washer, adjusting nut, lock washer, and lock nut on adjusting bolt.

5. Adjust lining to drum clearance and connect brake rod as directed under "Band Type Adjustment."

BRAKE DRUM REMOVAL

1. Remove brake band and lining assembly.

2. Remove nuts and lock washers from bolts attaching propeller shaft U-joint flange and brake drum to transmission output shaft flange. Telescope propeller shaft at slip joint and lower end of propeller shaft to floor. Remove if necessary, nuts, lock washers, and bolts attaching propeller shaft center bearing hanger bracket to crossmember.

3. On some vehicles, brake drum is mounted on forward side of transmission mainshaft companion flange, and on other vehicles it is mounted on rear side of flange. If mounted on rear side of flange, drum may be removed without removing flange; if mounted on forward side of flange, remove retaining nut and flange from output shaft. Press serrated bolts from flange to separate drum from flange.

BRAKE DRUM INSTALLATION

1. Wipe mating surfaces of brake drum and output shaft flange clean. Position brake drum on flange and press serrated bolts into place. Replace drum assembly and retaining nut on output shaft. Refer to "Specifications" in "TRANSMISSION ON-VEHICLE SERVICE OPERATIONS" (SEC. 7B) in this manual for nut torque on various transmission models.

2. Position propeller shaft flange against the brake drum (or output shaft flange). If removed, attach propeller shaft center bearing hanger bracket to crossmember. Replace all lock washers and nuts and tighten securely.

3. Install brake band and lining assembly and adjust brake.

INTERNAL EXPANDING TYPE BRAKE

Internal expanding type parking brake is mounted at rear of transmission. Brake support plate is attached to transmission rear bearing cap or retainer with four bolts. Brake drum is mounted between universal joint flanges and is secured with eight bolts. When used as an emergency brake, at start of braking action, brake shoes are forced out against drum by a lever-operated cam. The self-energizing action of both shoes then completes brake application.

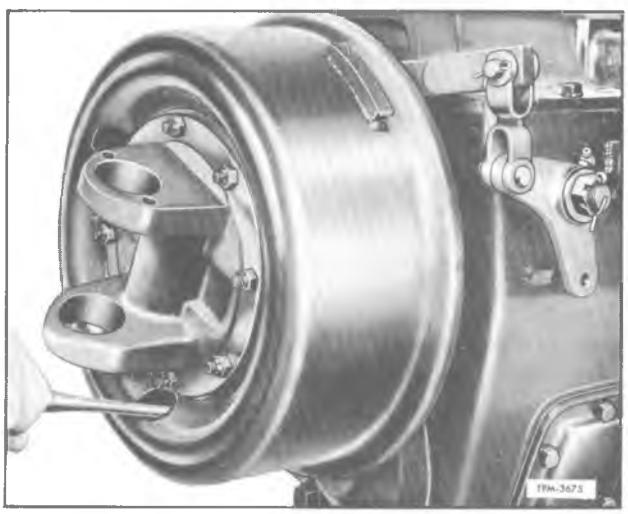


Figure 2—Internal Expanding Type Brake Adjustment

NOTE: Except in case of an emergency, set parking brake only after vehicle is brought to a complete stop. Parking brake is not designed for regular use in place of service brakes.

PARKING BRAKE ADJUSTMENT (Fig. 2)

A brake adjustment should be made before it becomes necessary to pull hand brake lever to limit of travel to obtain a full brake application.

1. Jack up at least one rear wheel. Block wheels and release hand brake.

2. Remove cotter pin and clevis pin connecting pull rod and relay lever. This will assure freedom for full shoe release.

3. Rotate brake drum to bring one of access holes into line with adjusting screw at bottom of shoes.

4. Expand shoes by rotating adjusting screw with screwdriver inserted through hole in drum. Move outer end of screwdriver away from drive shaft. Continue adjustment until shoes are tight

against drum and drum cannot be rotated by hand. Back off adjustment four (4) notches and check drum for free rotation.

5. Place parking brake lever in fully released position. Take up slack in brake linkage by pulling back on control lever just enough to overcome spring tension. Adjust clevis of pull rod to line up with hole in relay lever. Insert clevis pin and cotter pin, then tighten clevis lock nut.

6. Lower rear wheels. Remove jack and wheel blocks.

BRAKE DRUM REMOVAL

1. Jack up at least one rear wheel. Block wheels and release parking brake.

2. Disconnect universal joint at brake drum, as instructed under applicable heading in "PROPELLER SHAFTS" (SEC. 4D) in this manual.

3. Remove eight nuts and lock washers holding yoke flange and brake drum. Remove yoke flange. Lift drum carefully off mounting bolts to avoid damage to threads.

BRAKE DRUM INSTALLATION

1. Lift brake drum and install carefully over brake shoes and onto eight mounting bolts. Install yoke flange and eight nuts and lock washers. Tighten nuts alternately and evenly.

2. Adjust brake as directed under "Parking Brake Adjustment."

3. Connect propeller shaft universal joint as directed in "PROPELLER SHAFTS" (SEC. 4D) of this manual.

BRAKE SHOE REMOVAL (Fig. 3)

NOTE: Output shaft flange is removed in figure 3 for clarity of illustration; it is not necessary to remove flange to remove brake shoes.

1. Remove two return springs and anchor pin link from cam ends of brake shoes. Spread ends of brake shoes far enough to permit removal from support plate. Remove shoes, then separate by removing adjusting screw and adjusting screw spring.

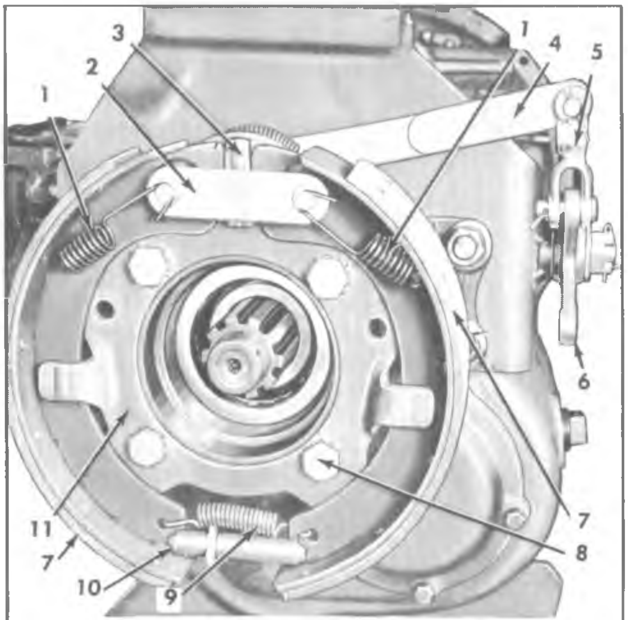
2. Replace lining if worn down close to rivet heads. Rivet new lining securely and evenly on shoes.

3. Inspect two shoe return spring, and adjusting screw spring. Parts damaged or worn should be replaced with new parts.

BRAKE SHOE INSTALLATION (Fig. 3)

1. Apply thin coat of S17 Special Lubricant on surface of support plate at points in contact with brake shoes. Apply S17 sparingly to socket end of adjusting screw and install adjusting screw socket.

2. Insert adjusting screw between adjusting ends of brake shoes. Adjusting wheel should be nearest left shoe. Install adjusting screw spring.



1 Return Springs	7 Brake Shoe
2 Anchor Pin Link	8 Plate Bolt
3 Camshaft	9 Adjusting Screw Spring
4 Control Lever	10 Adjusting Screw
5 Link	11 Support Plate
6 Relay Lever	

TPM-8399

Figure 3—Internal Expanding Type Brake Installed

3. Spread apart cam ends of brake shoes. Lift shoes vertically and push into position on support plate. Install anchor pin brace and two shoe return springs.

SUPPORT PLATE REMOVAL (Fig. 3)

1. Remove propeller shaft flange at mainshaft as directed in "TRANSMISSION ON-VEHICLE SERVICE OPERATIONS" (SEC. 7B) of this manual.

2. Remove brake shoe and lining assemblies.

3. Remove cotter pin and clevis pin attaching control lever to link.

4. Mark control lever and camshaft so that parts may be properly reassembled. Loosen clamp bolt and slide control lever off serrated camshaft. Remove camshaft from camshaft bracket.

5. Remove bolts attaching plate to transmission rear bearing cap, then remove plate.

6. Remove cotter pin, nut, washer, and relay lever. Inspect relay lever bushing. Replace damaged or badly worn bushings.

SUPPORT PLATE INSTALLATION (Fig. 3)

1. Position support plate on pilot of transmission rear bearing cap or retainer and align bolt holes. Insert four bolts and tighten securely.

2. Install camshaft in camshaft bracket. Align

PARKING BRAKES

control lever mark with mark on camshaft and install control lever. Tighten clamp nut.

3. Install brake shoe and lining assemblies.

4. Install propeller shaft flange at mainshaft as directed in "TRANSMISSION ON-VEHICLE SERVICE OPERATIONS" (SEC. 7B) of this manual.

5. Replace relay lever, washer, and nut on shaft. Tighten nut lightly, then back up to first hole and install new cotter pin. Nut should not be tight enough to restrict movement of relay lever. Insert clevis pin through holes in control lever and link and secure with new cotter pin.

OPTIONAL AIR-OPERATED PARKING BRAKE

Models in this manual using air brake systems may have installed, as optional equipment, one of the following parking-emergency brake systems: "Anchorlok," Stopmaster "Fail-Safe," or Stopmaster Super "Fail-Safe." For information concerning these features refer to "AIR BRAKES" (SEC. 5B) of this manual under appropriate heading.

SPECIFICATIONS

BRAKE TYPE	BAND	BAND	INTERNAL EXPANDING
Brake Size	9½ x 2½	9½ x 3	11 x 2
Brake Drum Diameter			
Outside	9½"	9½"	—
Inside	—	—	11"
Lining Length (approx.)	27⅝"	27⅝"	—
Internal	—	—	—
External	—	—	—
Lining Width	2½"	3"	2"
Lining Thickness	5/16"	5/16"	¼"
Total Lining Area (Sq. In.)	67.5	85.0	41.75

SECTION 5D

Air Compressors and Governors

GENERAL INFORMATION

Bendix-Westinghouse air compressors are used on all models covered by this manual.

Standard air compressors are 7¼ cubic feet per minute capacity and are air cooled. 12 cubic feet compressors are available as optional equipment. They are air or water cooled.

Removal and installation procedures are applicable to both Midland-Ross and Bendix-Westinghouse compressors.

DESCRIPTION

The air compressors covered in this manual are two-cylinder, piston type compressors. The rated capacity of an air compressor is its piston displacement in cubic feet per minute when operating at 1250 rpm. The standard air compressors used on these models are rated at 7¼ cubic feet per minute. Optional air compressors are rated at 12 cubic feet per minute. The compressor model number is shown on a name plate which is attached to the cylinder block.

All compressors are lubricated by oil from the engine lubrication system. Standard compressors are cooled by air from the fan assembly and optional compressors are cooled by coolant from the engine cooling system.

Each compressor is equipped with a governor assembly, which is attached to the cylinder head or cylinder block. This governor, in conjunction with the air compressor unloading mechanism, controls the compression of air.

COMPRESSOR MOUNTING AND DRIVE

(Refer to Figures 1 and 2)

Air compressor and drive installations vary from one model to another. Some are mounted on swivel type bases and belt tension is adjusted by means of an adjusting arm. On other types, belt tension is adjusted by adjusting an idler pulley.

The compressor belt can be tightened or loosened as necessary by moving complete assembly on swivel type or by moving idler pulley on stationary type.

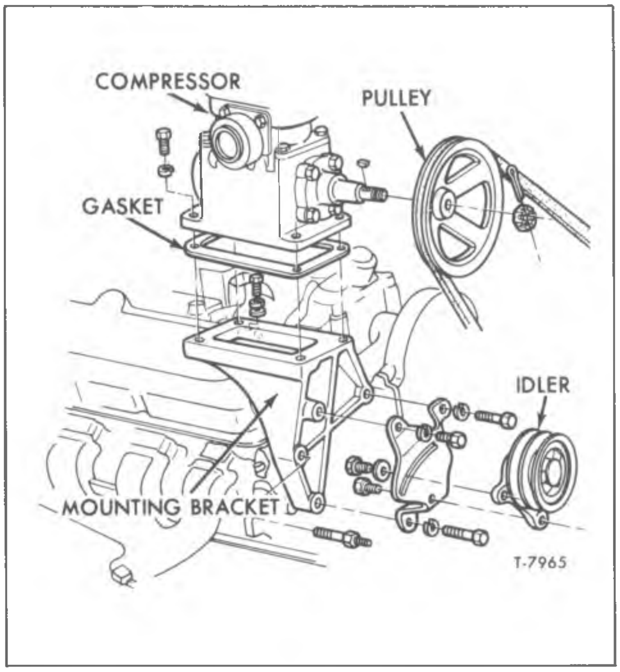


Figure 1—Air Compressor Installed (Typical Right Side Mount)

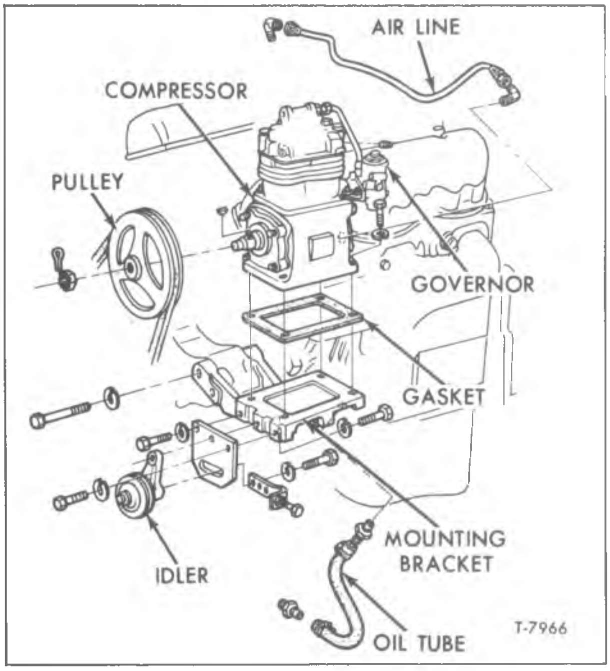


Figure 2—Air Compressor Installed (Typical Left Side Mount)

The air compressor is mounted on a base with four bolts or four bolts and nuts. This base incorporates a lubricating oil return drain hole and a boss which permits the use of one large pivot bolt or two smaller pivot bolts as a method of fastening the bottom of the air compressor. This base also provides a pivot point for drive belt tension adjustment. The pivot bolt and nut secure the air compressor assembly to a support bracket which is attached to the vehicle engine at the cylinder block or lower front engine cover (dependent on vehicle model).

The size, shape, and relative arrangement of the adjusting arm, the adjusting arm bracket, the base and the support bracket are determined by the requirements for each individual model.

All compressors used by these models are belt-driven and are equipped with a proper size pulley, to produce the rpm recommended by the manufacturer. When replacing a pulley, it is of the utmost importance that the correct one be used.

Some pulleys have a puller groove in the hub. Use this groove when removing pulley to prevent damage. Use extra care in removing a pulley without the groove.

For belt tension adjustment, refer to procedure under "Drive Belt Maintenance and Adjustment" later.

COMPRESSOR LUBRICATION

Lubricating oil, under pressure from the engine lubrication system, enters drilled crankshaft through the crankshaft bearing cap and lubricates the connecting rod bearings. Some of the oil that flows between sides of connecting rod bearings and cheeks on crankshaft is sprayed upward. This oil lubricates the piston pin bushings and the cylinder walls. The oil drains from compressor into the mounting bracket and returns directly to the engine crankcase.

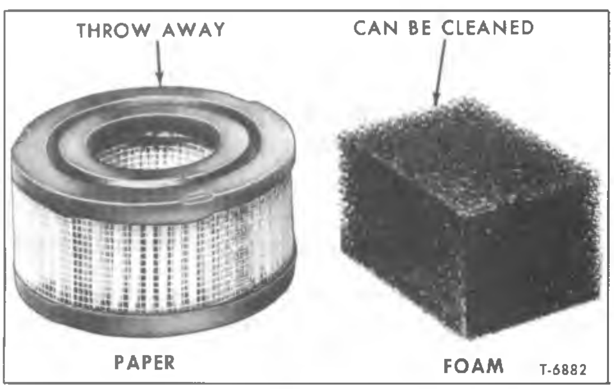


Figure 3—Compressor Air Filter

AIR COMPRESSORS AND GOVERNORS

COMPRESSOR AIR INTAKE

Air strainers (filters, fig. 3) used on any of these compressors are of the replaceable paper-type or polyurethane foam. Bendix-Westinghouse air compressors have a paper air cleaner which snaps on and off for replacement. To replace foam type, remove two screws and filter cover. The purpose of filters is to filter incoming air and to remove impurities, moisture, dirt, etc., before it is compressed into the vehicle air brake system.

The paper filter element CANNOT be cleaned and reinstalled, but must be replaced with new filter. Foam-type element is cleanable in cleaning solution by immersing and squeezing until clean. Apply oil sparingly. Filter should be checked at intervals depending on location and climate in which vehicle operates.

The compressor runs continuously while the engine is running but the actual compression of air is controlled by the governor and the unloading mechanism. During the downstroke of the piston (inlet valve open) a slight vacuum is created, drawing atmospheric air through the filter into the cylinder chamber. This air is compressed by the upward piston stroke (inlet valve closed) and is forced out through the discharge valve into the truck air brake system (reservoir).

AIR COMPRESSOR AND GOVERNOR MAINTENANCE

Service compressor air strainer at intervals recommended in LUBRICATION (SEC. 0) in this manual. Perform the following inspection and maintenance operations at intervals determined by truck operating conditions:

1. Remove cylinder head and clean carbon from inlet and discharge valves. If valves are damaged in any way, replace with new parts.

2. Make sure compressor discharge line is not choked with carbon.

3. Check governor cut-in and cut-out pressures and adjust, if necessary. Refer to "Governor Adjustment" later in this section.

4. Check compressor and bracket mounting bolts for looseness, and tighten if necessary.

5. Make sure all oil, and air line connections are tight and not leaking.

6. Check compressor drive belt tension and adjust if necessary.

AIR COMPRESSORS AND GOVERNORS

DRIVE BELT MAINTENANCE AND ADJUSTMENT

MAINTENANCE

Drive belt must be kept at proper tension. A loose belt will lower output of compressor, while a tight belt will cause eventual bearing failure. A regular, periodic inspection is recommended to check condition and tension of drive belt. Replace belt if frayed or badly worn.

ADJUSTMENT

1. Loosen bolt at adjusting arm or idler pulley. Loosen pivot bolt at mounting bracket if used.

2. Position compressor or idler pulley so that a reading of 120-130 lbs. (new belt) or 80-90 lbs. (used belt) is obtained on belt tension gauge (Tool Number J-23600).

3. Tighten bolt on adjusting arm or idler pulley securely. When used, TIGHTEN PIVOT BOLT NUT.

NOTE: A belt is considered used after 2 hours of operation or 50 to 100 miles.

COMPRESSOR REPLACEMENT

REMOVAL

1. Exhaust compressed air from air system.

2. Disconnect air and oil lines from compressor. If compressor is a water-cooled model, also disconnect water lines.

3. Loosen pivot bolt at compressor base, then loosen compressor adjusting arm bolt. Tilt compressor and remove drive belt from compressor pulley.

4. Disconnect adjusting arm from compressor by removing adjusting arm bolt.

5. Remove bolts attaching compressor crankcase to mounting bracket. Lift air compressor assembly off mounting bracket.

INSTALLATION

1. Clean oil supply line to compressor and if possible, run engine a few seconds to be sure oil supply to compressor is flowing freely.

2. Clean oil return line or passage through compressor mounting bracket to be sure oil from compressor crankcase can return to engine crankcase.

3. Lubricate compressor cylinder walls and bearings with lubricating oil before placing compressor in position.

4. Clean or replace any damaged or dirty air lines which may be corroded before connecting them to the compressor.

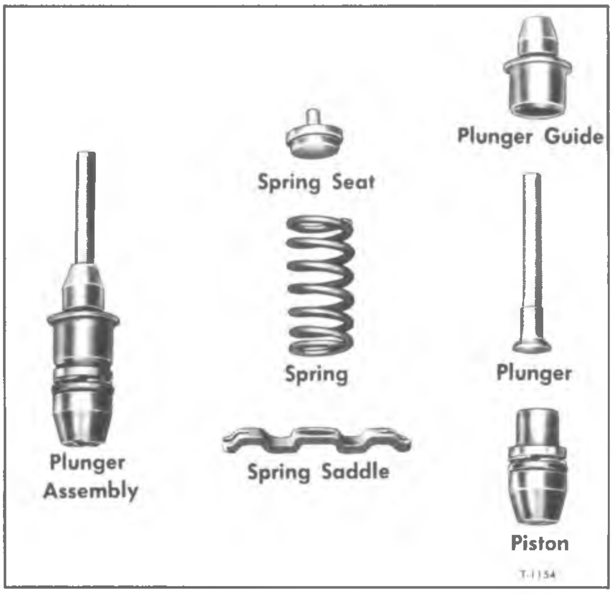


Figure 4—Unloader Assembly Components (B-W)

5. Use new gasket and make sure mating surfaces of compressor crankcase and mounting bracket are clean. Position compressor on mounting bracket and attach with bolts. Connect compressor adjusting arm to bracket on side of compressor cylinder head or block. Do not tighten.

6. Connect air and oil lines to compressor. Check all connections for tightness. Connect water lines (when used) and fill cooling system.

7. Place drive belt in compressor pulley and adjust belt tension as previously directed.

8. Adjust governor as directed later.

UNLOADER ASSEMBLY REPLACEMENT

Unloader assemblies can be replaced without removing compresssor from the vehicle.

BENDIX-WESTINGHOUSE

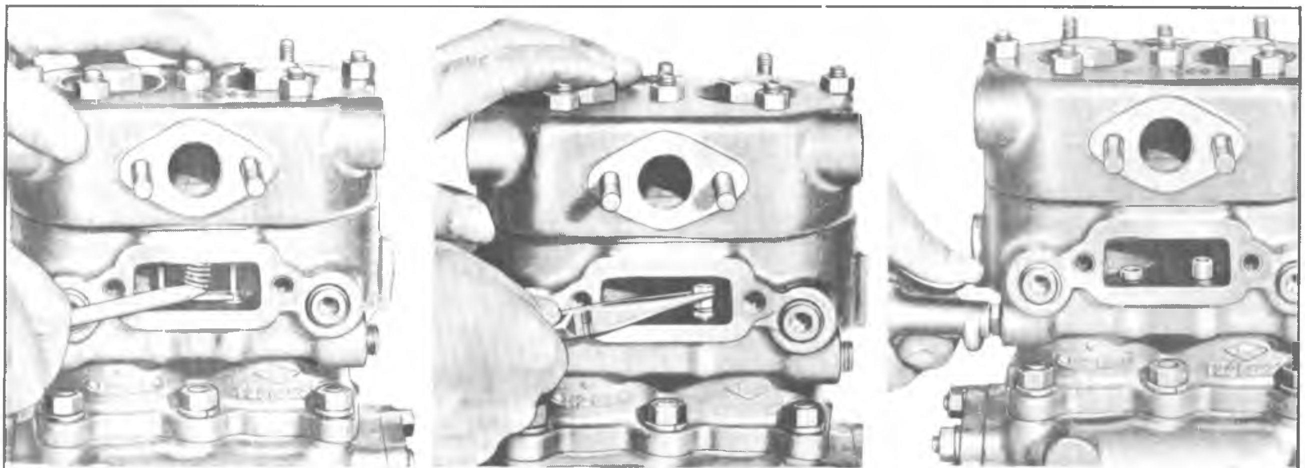
Parts are available in a kit for replacing unloader assembly. Unloader parts (fig. 4) may be changed without removing cylinder head as follows:

Removal (Fig. 5)

1. Remove air inlet elbow and discard gasket.

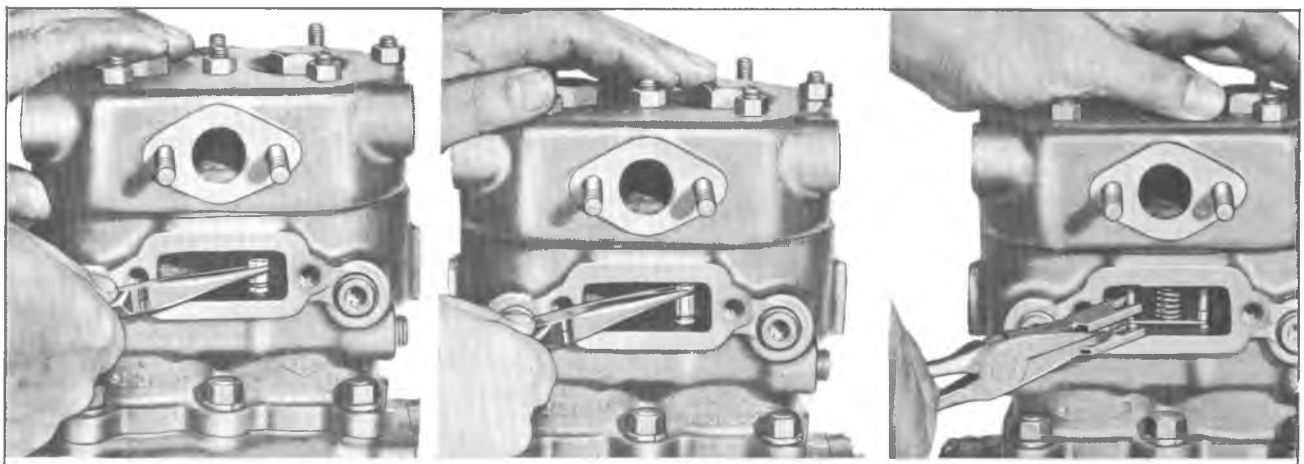
2. Insert screwdriver blade under unloader spring and raise spring off unloader spring saddle. Remove spring and spring saddle.

3. Lift each plunger guide and remove guide and plunger. Lift pistons out of bores. If piston is



REMOVING OR REPLACING UNLOADER SPRING — REMOVING UNLOADER PISTON — REMOVING UNLOADER PISTONS USING AIR PRESSURE

Figure 5—Removing Unloader Components (B-W)



INSTALLING UNLOADER PISTON — INSTALLING GUIDE AND PLUNGER ON UNLOADER PISTON — INSTALLING UNLOADER SPRING AND SADDLE

Figure 6—Installing Unloader Components (B-W)

not easily removed, build up air pressure in system until governor cuts out, raising piston. If compressor has been removed from vehicle, use air pressure as shown in figure 5.

Installation (Fig. 6)

1. Carefully insert each piston, complete with O-ring and back-up ring, in bore.
2. Slide plunger guide down over unloader plunger. Place each guide and plunger in position above unloader piston, then push guide down over top of piston.
3. Install unloader spring and spring saddle. Make sure saddle rests squarely on top of plunger guides, and make sure top of spring engages spring seat in cylinder block.
4. Install new gasket at air inlet and connect air inlet elbow.

AIR COMPRESSOR GOVERNOR

DESCRIPTION

The governor, operating in conjunction with air compressor unloading mechanism, automatically controls air pressure in the air brake or air supply system between the desired, predetermined maximum and minimum pressures. The air compressor runs continually while the engine runs, but actual compression of air is controlled by the governor which stops or starts compression when the maximum or minimum pressures are reached.

MAINTENANCE

Every 500 operating hours or after every 15,000 miles, clean or replace governor filters.

Every 3,000 operating hours or after every 100,000 miles, disassemble the governor and clean and inspect all parts. Repair governor if necessary.

GOVERNOR TESTS

OPERATING TEST

Start the engine and build up air pressure in system. Observe reading on air pressure gauge in gauge panel when governor cuts-out, stopping compression of air by the compressor. Reading on gauge when governor cuts-out should be within range shown on chart at right.

With the engine still running, slowly reduce air pressure in the system by applying and releasing brakes. Observe pressure registered by gauge when governor cuts-in and compression is resumed. Gauge reading when governor cuts-in should be within range shown on chart at right.

Before condemning or adjusting the governor, be sure the dash air gauge is registering accurately. Use an accurate test gauge to check pressure registered by the dash gauge. If the pressure settings of the governor are inaccurate or it is necessary that they be changed, adjust governor as described in the "Adjustment" procedure.

LEAKAGE TEST

Leakage checks on the governor are made at its exhaust port in both cut-in and cut-out positions. In the cut-in position, check exhaust port for inlet valve leakage by applying a soap solution at the port. Leakage could also be past the bottom piston grommet. In the cut-out position check the exhaust port to determine if leakage is present at the exhaust valve seat or stem grommet. In this position leakage could also be past the upper piston grommet.

If there is excessive leakage, replace or overhaul governor.

GOVERNOR ADJUSTMENT CHART

Governor	Cut-In Pressure	Cut-Out Pressure
All	105 psi	125 psi

GOVERNOR ADJUSTMENT

Readjustment may be necessary if the range falls below 15 psi or if the pressure settings are incorrect. Before making any adjustments, check governor filter and governor supply line (reservoir) for any restriction, then proceed as follows:

BENDIX-WESTINGHOUSE (Fig. 7)

1. Unscrew rubber cover and remove it from the governor.
2. Loosen adjusting screw lock nut.
3. Using a screwdriver, turn adjusting screw counterclockwise to raise pressure settings. Turn adjusting screw clockwise to lower the pressure settings indicated in "Governor Adjustment Chart" previously in this section.

GOVERNOR REPLACEMENT

The following procedures apply to all governors.

REMOVAL

1. Exhaust air from system.
2. Disconnect both ends of tube from governor to unloader.
3. Remove nuts and/or bolts which fasten governor to compressor or bracket.
4. Remove governor.

INSTALLATION

1. Place governor in position on compressor bracket.
2. Install nuts and/or bolts which fasten governor.
3. Connect both ends of tube to governor and unloader.
4. Build up pressure in system and check for operation and leaks.

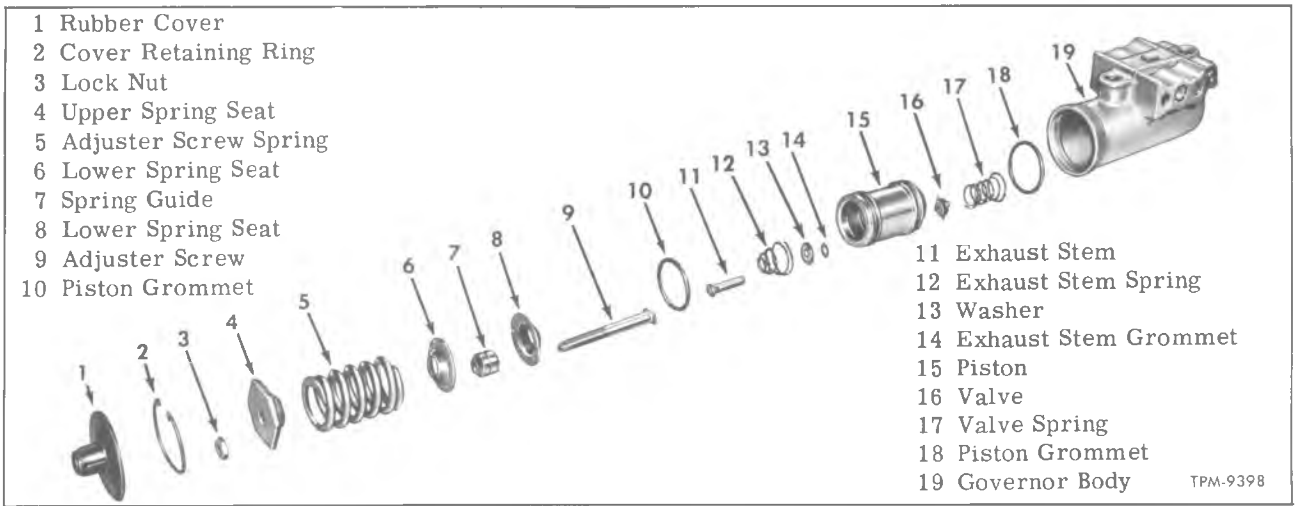


Figure 7—Air Compressor Governor (B-W)

TROUBLESHOOTING

COMPRESSOR FAILS TO MAINTAIN SUFFICIENT PRESSURE

Dirty intake strainer.

Restriction in compressor cylinder head intake or discharge cavities or in discharge line.

Leakage or broken discharge valves.

Excessive wear.

Drive belt slipping.

Inlet valves stuck open.

Worn inlet valves.

Excessive system leakage or usage.

NOISY OPERATION

Loose drive pulley.

Restrictions in cylinder head or discharge line.

Worn or burned out bearings.

Compressor not getting proper lubrication.

Excessive wear.

COMPRESSOR PASSES EXCESSIVE OIL

Excessive wear.

Dirty air strainer. (Improper air strainer maintenance.)

High inlet vacuum.

Small oil return line.

Excessive oil pressure.

Oil supply or return lines to compressor flooded.

Defective or worn oil seal rings in end cover.

Piston rings not properly installed.

Back pressure from engine crankcase.

COMPRESSOR NOT UNLOADING

Defective unloader pistons or bores.

Intake cavity restrictions.

Defective governor.

Unloader line or cavity to governor restricted.

Unloader mechanism binding or stuck.

NOTE

The air compressor is the only source of supply for the vehicle braking system. Faulty operation of the compressor will result in improper function of brakes.

SECTION 6A

Gasoline Engines

Contents of this section are listed in Index below:

GASOLINE ENGINE APPLICATION CHART

TRUCK SERIES	ENGINE STANDARD	ENGINE OPTIONAL	TRUCK SERIES	ENGINE STANDARD	ENGINE OPTIONAL
CS40	250	292	CE50	350	366
SS40	250	-	SE50	350	366
CE40	350	-	TE50	350	366
CS50	292	-	CE60	366	427
SS50	292	-	ME60	366	427
TS50	292	-	TE60	366	427

GENERAL INFORMATION

A definite, systematic maintenance program is required to assure satisfactory economical performance of engine. Included in maintenance program must be the servicing of related units and systems as well as regular tune-up of engine.

Frequency of tune-up is dependent upon the type of service in which the vehicle is used.

This section of manual provides instructions for servicing the various items and tuning the engine. Unless otherwise stated, the procedures are applicable to all gasoline engines used in vehicles covered by this manual. To adequately accomplish a satisfactory tune-up, reliable test equipment in the hands of trained personnel is necessary.

ENGINE LUBRICATION

IN-LINE ENGINES

Lubrication system for In-line engines is shown in figure 1. After passing through full-flow oil filter, oil is supplied under pressure to main oil gallery where it is distributed to main bearings, and crankshaft drillings. Hydraulic valve lifters receive oil from main gallery. Oil metered from valve lifters passes through hollow push rods to lubricate individually-mounted rocker arms.

V8 ENGINES

Figures 2 and 3 show oil diagrams for V8 engines. Oil from sump enters oil pump through screened inlet. Oil is discharged through passage leading to oil filter. From oil filter the oil is discharged into oil gallery which supplies oil to other passages which furnish lubricant to crankshaft and connecting rods, camshaft bearings, and valve operating mechanism.

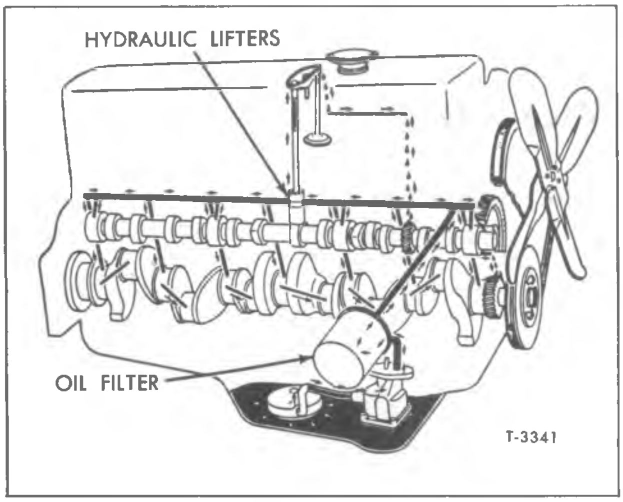


Figure 1—Lubrication Diagram for In-Line Engine

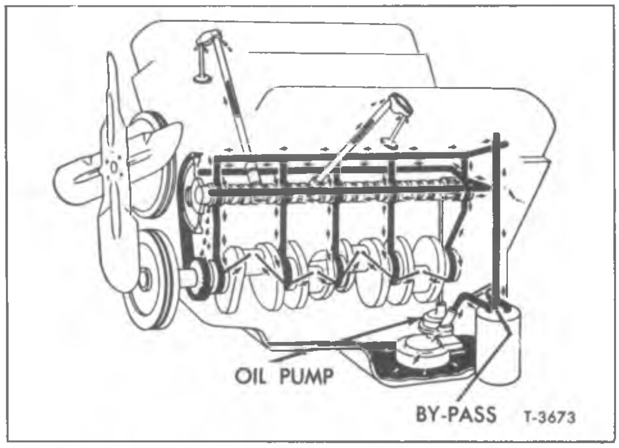


Figure 2—Lubrication Diagram for 350 V8 Engine

Cylinder walls are splash lubricated by oil thrown from connecting rods.

LUBRICATION AFTER STORAGE

If engine has not been run for some time (as when vehicle has been in storage) the lubrication system should be primed to assure immediate lubrication when engine is started. A pressurized container containing engine oil may be used to force oil through oil passages in engine.

Remove the oil pressure sending unit or plug in rear of right oil gallery and connect oil supply to the threaded port to prime the system. Pressurize the system at nominal 30 psi for minimum of 15 seconds.

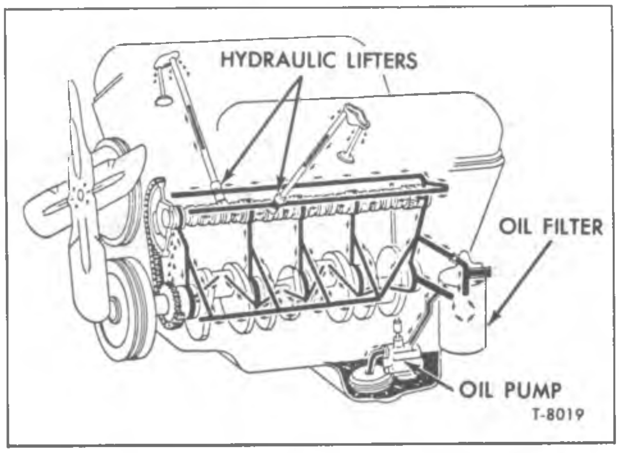


Figure 3—Lubrication Diagram for 366 and 427 V8 Engine

Engine Maintenance And Tune-up

ENGINE MAINTENANCE

SERVICING AIR CLEANERS

Carburetor air cleaners on all vehicles require occasional servicing. For type and location of air cleaners, recommended element servicing intervals, and servicing procedures, refer to ENGINE FUEL SYSTEM (SEC. 6M) of this manual.

CHECKING AND MAINTAINING CRANKCASE OIL LEVEL

Daily, or oftener if necessary, check oil level. Check when at operating temperature, and after engine has been stopped for at least five minutes. Remove dipstick, wipe clean, reinsert and remove again. The upper mark on dipstick is "FULL," the lower "ADD" or "ADD OIL." Keep level as close as possible to "FULL" mark without over-filling. Do not operate with level below "ADD" or "ADD OIL" mark. Dipstick is at the right side of engines. When replenishing oil supply in crankcase, add oil of same brand and quality as is used when changing oil.

Refer to LUBRICATION (SEC. 0) in this manual for recommendations pertaining to oil change intervals and oil filter replacement intervals.

CHECKING DRIVE BELTS

1. Inspect drive belts for excessive wear and damage. If no defects are found, check belts for proper tension.

2. When installing new drive belts or adjusting old belts, use tension gauge to provide correct tension.

CAUTION: Adjusting drive belts too tightly will impose too great a load on bearings in the driven units. Slipping will occur if drive belts are not adjusted tight enough. Belt life will be shortened if belts are not properly tightened.

ENGINE OIL FILTERS

Engine oil filters are either standard or optional equipment, and are either of two types. Filters shown in figures 1, 2, and 3 are throw-away type. Replaceable element type oil filter (fig. 12). is used as optional equipment instead of throw-away filters on some engines.

REPLACING OIL FILTER (THROW-AWAY TYPE)

1. Use filter wrench to screw the oil filter off stud on mounting bracket. Discard the filter assembly.
2. Thoroughly clean gasket area on filter bracket.
3. Fill the filter with engine oil, then apply engine oil on filter gasket (gasket is bonded to filter assembly), and thread filter onto stud until gasket contacts bracket. Tighten filter ½ turn after gasket has contacted the mating surface on filter bracket.

NOTE: When replacing the throw-away type oil filter used on some engines, a special wrench (J-22775) is available for use either with a slide-through handle, or with a socket handle, or torque wrench. Correct torque for filter installation is 20 to 25 foot-pounds.

4. Start engine and inspect for leaks at oil filter. Check crankcase oil level at dipstick. Add oil if required to raise level to "FULL" mark.

REPLACING OIL FILTER ELEMENT (REPLACEABLE ELEMENT TYPE FILTER)

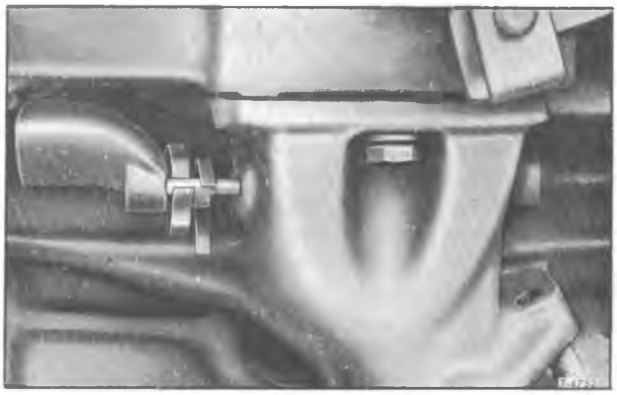


Figure 4—Manifold Heat Control Valve on In-Line Engine

1. If filter housing has drain plug, remove plug and allow oil to drain from housing. Use a wrench to loosen filter housing bolt, then remove bolt, housing, and filter element as an assembly. Remove housing gasket.
2. Remove element from housing and discard element. Clean housing thoroughly. Also clean filter bracket.
3. Install a new element in the housing, fill the housing with new oil, place housing gasket at filter bracket, and install housing and element assembly. Tighten housing retaining bolt to 45 foot-pounds torque.
4. Start engine and inspect for oil leaks. If necessary, add oil to raise oil level to "FULL" mark on dipstick.

MANIFOLD HEAT CONTROL VALVE (IN-LINE ENGINES)

Referring to figure 4, check for movement of weight on heat control valve shaft. Shaft should rotate freely in bushings. If binding is noticed, lubricate shaft with graphite in alcohol. When engine is cold, the spring should cause valve to move to closed position. Replace spring if defective.

TUNE-UP, CHECKS, AND ADJUSTMENTS

TUNE-UP SEQUENCE INDEX

GASOLINE ENGINES

INTRODUCTION

Engine tune-up consists of diagnosis, and the required preventive maintenance performed at regular intervals to provide maximum performance and economy.

A systematic procedure must be followed when tuning an engine. The operations should be performed in sequence suggested by "Tune-up Sequence Index" above.

NOTE: When performing work where electrical terminals could be accidentally grounded, disconnect the battery cables so no damage to circuits will result.

ENGINE TUNE-UP

SPARK PLUG REMOVAL

1. Clean all foreign matter away from around spark plugs and wiring using compressed air. Disconnect spark plug wires, and loosen each spark plug one turn.

2. Reconnect plug wires, start engine and accelerate to approximately 1,000 rpm. This is done to blow away loose dirt particles and carbon. Failure to do this increases the possibility of foreign material lodging under valves, with resultant false readings and possible valve damage.

3. Stop engine, disconnect plug wires and remove spark plugs.

CYLINDER COMPRESSION TEST

1. With carburetor choke and throttle in wide-open position, operate starter with remote control switch.

CAUTION: When using remote switch to operate starter, the primary wire must be disconnected from coil negative terminal and ignition switch must be turned on. Failure to do this will result in damaged grounding circuit in ignition switch.

2. Starting with compression gauge at zero, crank engine through at least four compression strokes to obtain highest possible reading.

3. Make compression check at each cylinder and record each reading.

4. If some cylinders have low compression, inject about one tablespoon of engine oil into the combustion chamber through spark plug hole. Crank engine to spread oil on cylinder walls, then recheck compression with gauge.

a. If compression is higher but does not necessarily reach normal pressure, worn piston rings are indicated.

b. If compression is not improved by adding oil to cylinder, it is probable that valves are not properly seating possibly due to sticking in guides, or burned valves or seats.

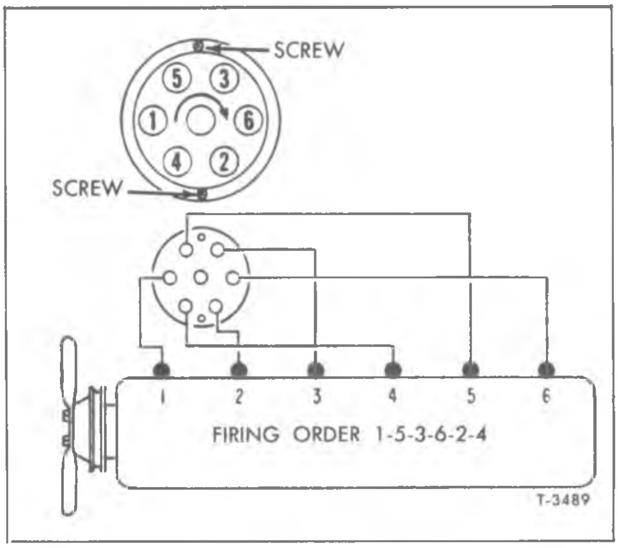


Figure 5—Cylinder Numbering and Spark Plug Wire Locations on In-Line Engine

c. If two adjacent cylinders have lower than normal compression, and injecting oil into cylinders does not increase compression, the cause may be a head gasket leak between the cylinders. This condition could be cause of coolant leaking into cylinders.

NOTE: An engine with low or uneven compression cannot be tuned to give peak performance. therefore, it is important to make necessary corrections before proceeding with tune-up operations.

SERVICE AND INSTALL SPARK PLUGS

1. Inspect all spark plugs carefully. Look for glazed, broken, or blistered porcelains and burned electrodes.

2. If spark plugs are serviceable, use an abrasive type cleaner such as sand blaster to thoroughly clean spark plugs. File end of center electrode flat.

3. Adjust spark plug gaps to specifications, and test with spark plug tester. If new plugs are required, install type and number specified in applicable Tune-up Chart.

4. When installing spark plugs, tighten to specified torque with torque wrench and special spark plug socket wrench. Correct torque is given later in applicable "Tune-up Chart."

IGNITION SYSTEM SERVICE.

1. Remove equipment as required to provide access to ignition distributor, spark plug wires and coil.

2. Check condition of wiring. If any wires are brittle, cracked, or otherwise damaged, replace as necessary.

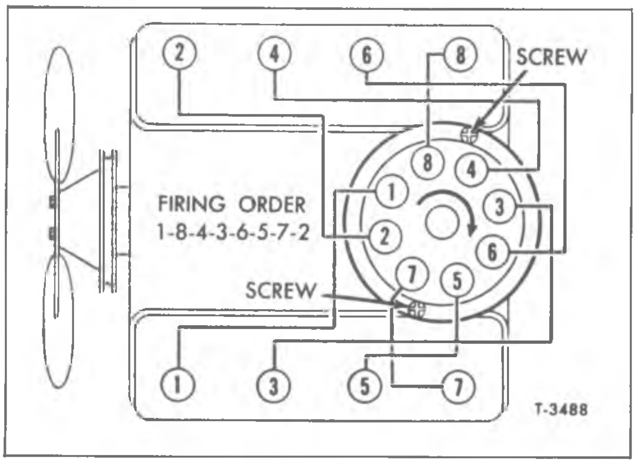
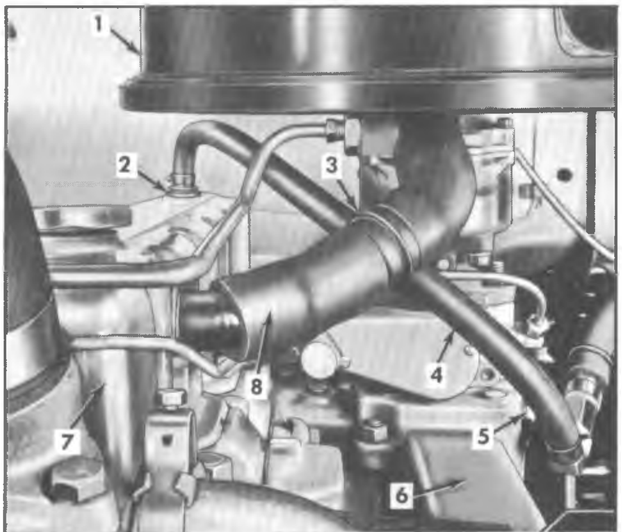


Figure 6—Cylinder Numbering and Spark Plug Wire Locations on V8 Engine

3. Inspect distributor cap for burned wire sockets, cracks, and for erosion at terminals inside cap. Replace the distributor cap if it is not in good condition. When installing spark plug wires, refer to appropriate view in figure 5 or 6, showing cylinder numbering, firing order and distributor cap wire socket numbering on each type of engine.

4. Refer to ENGINE ELECTRICAL (SEC. 6Y) of this manual and inspect ignition distributor points, rotor, and advance mechanism. Make necessary parts replacement and/or adjustments, following directions contained in the ENGINE ELECTRICAL section.



1 Air Cleaner	5 Manifold Fitting
2 Ventilation Valve	6 Intake Manifold
3 Flame Arrestor	7 Rocker Arm Cover
4 Vacuum Line	8 Hose

T-3349

Figure 7—Crankcase Ventilation System on In-Line, 6 Cylinder Engine (Typical)

BATTERY AND BATTERY CABLE SERVICE

1. Using battery hydrometer, check specific gravity of storage battery electrolyte in each cell. Gravity reading below 1.230 (corrected to 80°F.) indicates insufficient charge.

2. Use a voltmeter to check cranking voltage. Disconnect coil primary lead from negative terminal on coil to prevent engine from firing during test.

3. With voltmeter connected between coil positive terminal and ground, operate starter. Voltage of 9 volts or more when starter is cranking engine indicates that battery, and ignition circuit to coil are satisfactory. If voltage reading is less than 9 volts when engine is being cranked, or if cranking speed is low; a weak battery, defective starter switch, or excessive resistance in circuit exists.

NOTE: If, when making check of cranking voltage, it is noted that cranking speed is uneven, this is an indication of uneven cylinder compression, defective starter or starter drive.

4. In cases where loose, corroded, or otherwise defective battery cables and/or wiring are found, the defects must be corrected to ensure good engine performance.

5. If battery is weak or shows other evidence of being defective, refer to appropriate coverage in ENGINE ELECTRICAL (SEC. 6Y) in this manual for method of diagnosing battery deficiencies.

CHARGING CIRCUIT AND WIRING INSPECTION

Refer to ENGINE ELECTRICAL (SEC. 6Y) in this manual for procedure required to check performance of charging circuit units.

COOLING SYSTEM INSPECTION

Refer to ENGINE COOLING SYSTEM (SEC. 6K) in this manual for arrangement of cooling system units and for inspection and required maintenance procedures.

CARBURETOR THROTTLE AND CHOKE LINKAGE

On most vehicles it will be necessary to remove air cleaner or air intake hose adapter at carburetor to observe choke operation and action of throttle linkage. All linkage must be maintained in free working condition and should be checked as part of tune-up procedure. Oil linkage pivot points if any binding is evident. Complete information on throttle linkage is given in ENGINE FUEL SYSTEM (SEC. 6M) in this manual.

INSTRUMENT CHECK-OUT

1. Hook up test equipment for use in making final adjustments. Equipment required consists of dwell meter, tachometer, vacuum gauge and timing light.

GASOLINE ENGINES

2. With engine running at idle speed, check dwell angle and readjust if necessary.

3. With vacuum line to distributor disconnected and plugged, run engine at idle speed and check ignition timing with timing light. Loosen distributor clamp and rotate distributor body to change timing as required. Tighten distributor clamp and connect the vacuum line after checking timing.

4. While observing vacuum gauge and tachometer, set engine idle speed and adjust carburetor idle mixture screws to provide steady running engine.

NOTE: If difficulty is experienced in obtaining satisfactory engine idle performance, the cause may be due to malfunction of crankcase ventilation valve(s). Inspection and service of ventilation valves are covered later under appropriate headings

5. Refer to ENGINE ELECTRICAL (SEC. 6Y) of this manual for instructions for checking voltage regulator settings, generator output, and specifications on various electrical equipment units.

CRANKCASE VENTILATION SYSTEM (IN-LINE 6 CYLINDER ENGINE)

INSPECTION, SERVICE AND UNIT REPLACEMENT

Figure 9 shows typical closed type crankcase ventilation on In-line engine. The ventilation valve (2) is inserted in hole in rocker arm cover and flame arrestor (3) is used in air hose (8) connecting air cleaner to rocker arm cover.

TESTING CRANKCASE VENTILATION VALVE

Key numbers in text refer to figure 7.

1. Connect tachometer and vacuum gauge as when setting idle speed and mixture.

2. Start engine and adjust idle mixture and idle speed.

3. Remove ventilation valve (2) with hose (4) attached. Block the inlet opening in ventilation valve and note change in engine rpm.

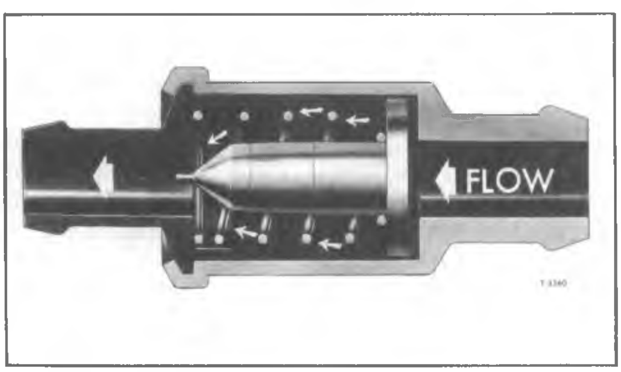


Figure 8—Crankcase Ventilation Valve for In-Line and V8 Engines (Typical)

4. If blocking the valve opening causes a change of less than 50 rpm, a clogged, or partially restricted ventilation valve is indicated.

5. Install new valve assembly, or if valve (fig. 8) is operative, reinstall in rocker arm cover.

IMPORTANT: At 24-month or 24,000 mile intervals (whichever occurs first) the crankcase ventilation valves must be replaced.

CRANKCASE VENTILATION SYSTEM (V8 ENGINE)

Figure 9 shows system components on V8 engines.

TESTING CRANKCASE VENTILATION VALVE OPERATION

At regular maintenance and/or inspection in-

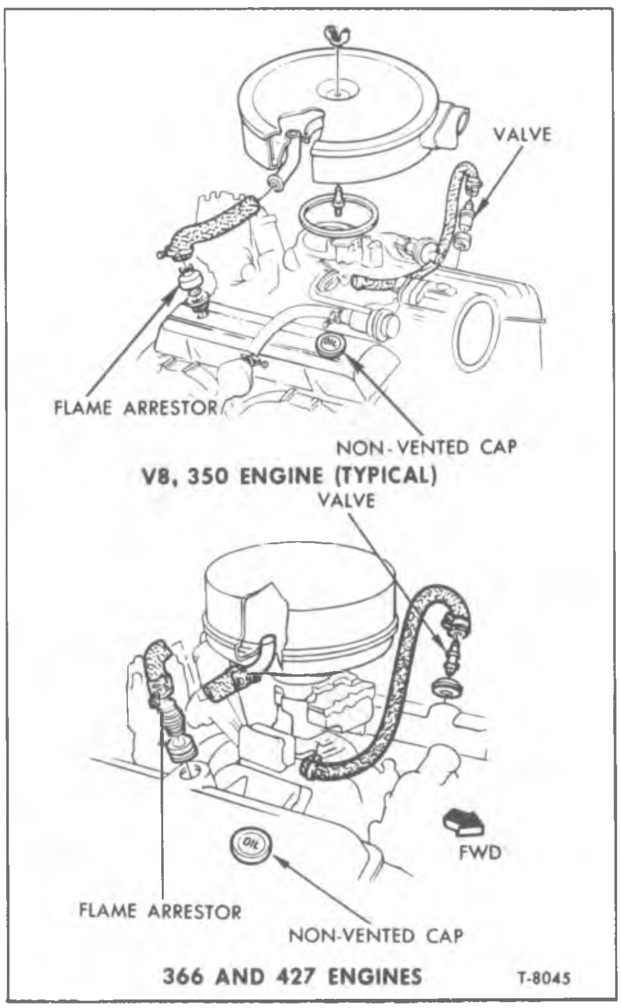


Figure 9—Arrangement of Crankcase Ventilation Units on V8 Engine

tervals service the ventilation units as directed below:

1. Test crankcase ventilation valve for proper operation as follows:

a. Connect tachometer and vacuum gauge as when setting idle speed and mixture.

b. Start engine and adjust idle mixture and idle speed.

2. Remove ventilation valve from rocker arm cover (hose attached), then block the inlet opening in valve and note the change in engine rpm. If blocking the opening causes a change of less than 50 rpm, a clogged, or partially restricted ventilation valve is indicated.

VENTILATION VALVE REPLACEMENT

1. To replace crankcase ventilation valve. Remove the valve assembly (fig. 9) from rocker arm cover with hose attached.

2. Loosen clamp and remove valve from hose.

3. Install valve assembly (fig. 8) in hose and tighten clamp. Insert valve into grommet in rocker arm cover.

IMPORTANT NOTE: At 24-month or 24,000 mile intervals (whichever occurs first) a new crankcase ventilation valve must be installed.

4. Inspect ventilation hoses, flame arrestor and grommets at service interval. Clean parts as necessary to permit free flow of clean air to rocker arm cover.

CYLINDER HEAD BOLT TORQUE AND ROCKER ARM ADJUSTMENT

IN-LINE 6, AND V8 ENGINES

Unless cylinder head gasket has recently been replaced, it is not necessary to retorque cylinder head bolts at regular tune-up on 6-cylinder In-line and V8 engines.

In cases when tune-up is being performed immediately following cylinder head gasket replacement, run engine until thoroughly warmed up, then retorque cylinder head bolts using torque wrench adapter. Figures 16, 32, and 33 show cylinder head bolt tightening sequence for 6- and 8-cylinder engines.

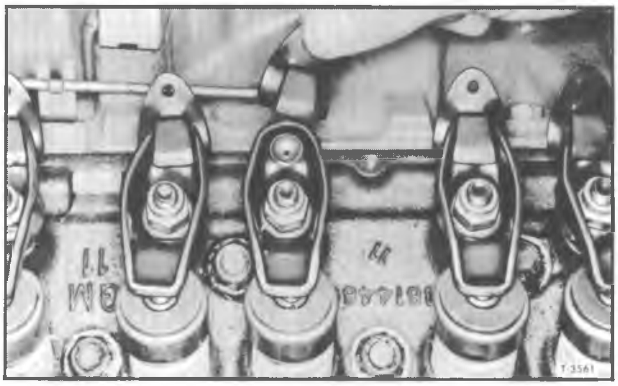


Figure 10—Use of Oil Deflector Clips on In-Line and V8 Engines

After cylinder head bolts have been tightened, adjust rocker arm stud nuts as herein directed:

1. With engine running at idle speed and rocker arm cover removed, install oil deflector clips (fig. 10) to prevent oil spatter while adjusting hydraulic lifter plunger position.

2. Back off rocker arm stud nut at one rocker arm until it begins to clatter, then turn stud nut back down slowly until the clatter just stops. This is zero lash position.

3. Turn nut down ¼ turn and pause 10 seconds until engine runs smooth. Repeat additional ¼ turns and 10-second pauses until stud nut has been turned down 1 full turn from zero lash position.

NOTE: The gradual turning down of rocker arm stud nut is necessary to allow lifter to adjust itself and allow valve to completely close each time. If valve is held open, the top of piston may strike valve and cause internal damage and/or bent push rod. Noisy valve lifters should be replaced.

NOTE: Procedure for locating noisy lifters is covered later under "IN-VEHICLE SERVICE OPERATIONS."

4. Adjust rest of valve lifters in same manner as described in preceding steps 2 and 3.

5. Remove deflector clips and install rocker arm cover using new gasket.

Refer to Next Page For "Engine Tune-Up Specifications."

TUNE-UP CHARTS

IN-LINE ENGINE TUNE-UP CHART

Except as otherwise indicated, the following specifications apply to both engine models.

ENGINE TYPE AND NUMBER OF CYLINDERS	In-Line, 6-Cyl.
COMPRESSION RATIO	
250 Engine	8.5:1
292 Engine	8.0:1
CYLINDER COMPRESSION (PSI)	
At Cranking Speed	130
Max. Variation Between Cylinders	20
SPARK PLUG MAKE AND NUMBER	
250 Engine	AC-R46TS
292 Engine	AC-CR44T
Spark Plug Gap (All)	0.035″
Plug Tightening Torque (Ft.-Lbs.)	15
IGNITION DISTRIBUTOR	
Dwell Angle (Degrees)	31-34
Point Gap (New)	0.019″
Point Gap (Used)	0.016″
Contact Lever Spring Tension (Oz.)	19-23
FIRING ORDER	1-5-3-6-2-4
IGNITION TIMING	Refer to Ign. System Specs. (Sec. 6Y)
VALVE LASH	Zero
NOTE: Valve lifters are hydraulic type. Refer to "Cylinder Head Bolt Torque and Rocker Arm Adjustment" in this section for instructions.	
ENGINE GOVERNOR SETTING	Refer to Governor Charts at end of Gasoline Engine Fuel Systems (Sec. 6M) in this manual.
ENGINE IDLE SPEED	Refer to appropriate chart in "Gasoline Engine Fuel Systems" (Sec. 6M) in this manual.
FUEL PUMP PRESSURE (PSI)	3½-4½
CYLINDER HEAD BOLT TORQUE (FT.-LBS.)	95

V-8 ENGINE TUNE-UP CHART

Except as otherwise indicated, the following specifications apply to all V8 engines.

ENGINE MODELS	350, 366, 427
NUMBER OF CYLINDERS AND ENG. TYPE	8 Cyl., V Type
COMPRESSION RATIO	8:1
CYLINDER COMPRESSION (PSI)	
At Cranking Speed	150
Max. Variation Between Cylinders	20
SPARK PLUG MAKE & NUMBER	
350 Eng. & 427	AC-R44T
366	AC-R43T
Spark Plug Gap	0.035″
Spark Plug Tightening Torque (Ft.-Lbs.)	15
IGNITION DISTRIBUTOR	
Dwell Angle (Degrees)	28-32
Point Opening	
New	0.019″
Used	0.016″
Contact Lever Spring Tension (Oz.)	19-23
FIRING ORDER	1-8-4-3-6-5-7-2
IGNITION TIMING	Refer to Ign. System Specs. (Sec. 6Y)
VALVE LASH	Zero
Note: Valve lifters are hydraulic type. Refer to "Cylinder Head Bolt Torque and Rocker Arm Adjustment" in this section for instructions.	
ENGINE IDLE SPEED	Refer to appropriate chart in "Gasoline Engine Fuel Systems" (Sec. 6M) in this manual.
FUEL PUMP PRESSURE (PSI)	5-6½
CYLINDER HEAD BOLT TORQUE (FT.-LBS.)	
350 Eng.	60-65
366 & 427	75-80

Engine Replacement

GENERAL

Two types of engines, namely "In-line" and "V8" are mounted in different manner; hence, the procedures required to remove and install each type of engine will differ. Also, the operations required to replace engines will vary between models; i.e., conventional and tilt-cab models.

IN-LINE ENGINES IN CONVENTIONAL AND SCHOOL BUS MODELS

ENGINE REMOVAL

1. Drain radiator.
2. Disconnect battery.
3. Remove hood attaching parts and remove hood.
4. Remove braces which support grille and radiator assembly.
5. Remove radiator hoses and heater hoses.
6. Remove radiator and grille assembly. Refer to SHEET METAL (SEC. 11) of this manual for necessary information when removing grille and radiator assembly.
7. Disconnect fuel line at fuel pump.
8. Remove air cleaner and cover carburetor air inlet opening to prevent entrance of dirt.
9. Disconnect choke control and accelerator linkage.

10. Disconnect exhaust pipe from manifold.

11. Disconnect wiring harness and battery cable.

12. Remove floor mat and transmission cover from cab floor, then remove hand brake lever and gearshift lever from transmission.

13. Disconnect propeller shaft from transmission flange.

14. Attach lifting equipment to take weight of power plant off mountings, then remove mounting bolts and remove rear crossmember which is bolted in place.

15. Lift engine and transmission out of chassis as an assembly.

16. Refer to TRANSMISSIONS AND CLUTCHES (SEC. 7) for necessary information to remove transmission and clutch from engine.

ENGINE INSTALLATION

1. Refer to TRANSMISSIONS AND CLUTCHES (SEC. 7) for information necessary to install clutch and transmission on engine.

2. Attach lifting equipment and lift power plant into place in chassis. Install support crossmember and install engine mountings. Refer to ENGINE MOUNTINGS (SEC. 6D) of this manual for required information regarding engine mountings.

3. Connect propeller shaft and hand brake.

4. Install hand brake lever and gearshift lever, then install cover in cab above transmission.

5. Connect exhaust pipe to manifold, make electrical wiring connections, and connect carburetor control linkage.

6. Install front end sheet metal and hood, referring to SHEET METAL (SEC. 11) for necessary information for fitting hood.

7. Install air cleaner, connect fuel line, and fill cooling system.

8. Fill crankcase with oil to proper level on dipstick, referring to LUBRICATION (SEC. 0) in this manual for recommended type and viscosity.

9. Install battery and check operation of electrical equipment.

10. Start engine and check for coolant leaks and oil leaks.

IN-LINE ENGINE REPLACEMENT FOR TILT CAB MODELS

ENGINE REMOVAL

1. Drain cooling system.

2. Disconnect battery cables.

3. Tilt the cab forward and remove radiator and shroud.

4. Disconnect shift linkage at control island.

5. Disconnect throttle and choke controls at carburetor. Also disconnect parking brake cable and housing to allow movement of control island.

6. Remove bolts which hold control island to support, then swing control island forward.

7. Disconnect hoses and remove surge tank from control island.

8. Remove right and left island supports.

9. Disconnect cab safety lock from cab rear support, then remove the cab support.

10. Disconnect electrical wiring from terminals on engine units.

11. Detach heater lines, oil lines and fuel line from engine as required.

12. Disconnect exhaust pipe from manifold. Support exhaust pipe on wire at frame.

13. Remove fan and pulley from engine.

14. Disconnect clutch control at housing.

15. Remove rocker arm cover and attach lifting brackets at cylinder head bolts. Locate brackets so that engine (without transmission) will balance when lifted.

16. Attach hoist and raise until slack is taken up, then remove engine mounting bolts. Remove bolts attaching transmission to engine, raise the engine to clear the mountings. Block transmission to provide support.

17. Move engine forward until disengaged from transmission, then lift engine out of chassis.

18. Refer to applicable portion of instructions in TRANSMISSIONS AND CLUTCHES (SEC. 7) in this manual to remove clutch parts from engine.

ENGINE INSTALLATION

Assemble clutch components and transmission to engine referring to applicable instructions in TRANSMISSIONS AND CLUTCHES (SEC. 7) in this manual.

Install power plant by reversing order of "Engine Removal" procedure taking necessary precautions to maintain cleanliness and to avoid damage to the engine components.

After engine is installed, check operation of control linkage, fill cooling system and check for leaks.

Fill crankcase with engine oil of recommended grade and viscosity. Refer to LUBRICATION (SEC. 0) in this manual.

Start engine, make adjustments at carburetor, set ignition timing and adjust valve lash.

NOTE: If engine has been run in on test stand, the foregoing adjustments will have been made previously and need not be repeated.

V8 ENGINE REPLACEMENT FOR ALL EXCEPT TILT CAB MODELS

ENGINE REMOVAL

1. Disconnect battery cables and remove battery.

2. Drain cooling system.

3. Disconnect air intake hose (if used).

4. On vehicles with power steering, drain the fluid reservoir and disconnect reservoir hose from power steering pump.

5. Disconnect wiring as necessary to permit removal of front end sheet metal.

6. Disconnect radiator and heater hoses.

7. Disconnect fuel line.

8. Referring to appropriate portion of SHEET METAL (SEC. 11) in this manual remove the front end sheet metal including hood.

> **CAUTION: If vehicle is equipped with air conditioning, removal of refrigerant lines must be done by trained personnel. Injuries can result from improper procedures.**

9. Remove fan and drive belts from front of engine, then remove power steering pump. Fluid lines may usually remain attached to pump and pump can be tied to chassis.

10. Remove air compressor (if used) and disconnect any air lines connected between engine and chassis.

11. Remove the air cleaner, then disconnect throttle, accelerator, and choke controls.

12. Disconnect the starter cables and engine wiring.

13. Disconnect exhaust pipe at each exhaust manifold. Also disconnect clutch and/or transmission controls as necessary.

14. Remove valve rocker arm covers and attach lifting brackets at head bolts, selecting locations which will give proper balance.

15. Attach hoist to engine and take weight off mountings, then disconnect engine front and rear mountings. Refer to ENGINE MOUNTINGS (SEC. 6D) for information concerning mountings.

16. Vehicles With Manual Transmission.

a. Remove bolts attaching transmission assembly to engine, then carefully separate engine from transmission.

b. Carefully pull engine forward, using care to avoid damage to clutch as disc is disengaged from mainshaft splines.

NOTE: On some vehicles it may be necessary to support transmission as engine is removed.

17. Vehicles With Automatic Transmission.

a. Refer to appropriate portion of TRANSMISSIONS AND CLUTCHES (SEC. 7) in this manual for required information and disconnect all control mechanism from transmission.

b. Disconnect propeller shaft and speedometer drive from transmission.

c. Move engine and transmission assembly forward, raising as necessary to clear crossmember. Lift power plant out of vehicle and support the assembly on engine repair stand in manner to permit removal of transmission.

18. Remove clutch mechanism from engines used with mechanical transmission, or if automatic transmission is used, remove transmission assembly.

ENGINE INSTALLATION

1. On engine equipped with manual type transmission, install clutch mechanism referring to TRANSMISSIONS AND CLUTCHES (SEC. 7) for required information.

2. If automatic transmission is used, assemble transmission to engine, referring to TRANSMISSIONS AND CLUTCHES (SEC. 7) in this manual for instructions covering automatic transmission installation.

3. Attach hoist and raise engine into position in vehicle.

4. Vehicles With Manual Transmission.

a. Inspect clutch control parts to make sure they are in good condition.

b. Carefully guide engine into alignment with transmission so transmission drive gear splines engage clutch disc without being forced.

c. Bolt clutch housing to engine, then assemble engine mountings, referring to ENGINE MOUNTINGS (SEC. 6D) in this manual for mounting information.

5. Vehicles With Automatic Transmission.

a. Assemble engine mountings according to information given in ENGINE MOUNTINGS (SEC. 6D) in this manual.

b. Connect propeller shaft and speedometer drive at rear of transmission.

c. Connect transmission control linkage.

6. Complete the engine installation by reversing the procedures previously given for removing engine.

7. Before starting engine, be sure to fill cooling system and fill crankcase with correct type of engine oil. Refer to LUBRICATION (SEC. 0) in this manual for recommended grade and viscosity of engine oil.

8. Check operation of all controls, then start engine, make adjustments at carburetor and check ignition timing. If engine has been run on a test stand before it was installed, the carburetor and ignition timing should not require re-adjusting.

9. Inspect all hoses and fittings for leaks.

V8 ENGINE REPLACEMENT FOR TILT CAB MODELS

ENGINE REMOVAL

1. Remove radiator, support and shroud, referring to ENGINE COOLING SYSTEM (SEC. 6K) in this manual for instructions.
2. Disconnect shift linkage at control island, and disconnect choke and accelerator control at carburetor.
3. Disconnect parking brake control.
4. Disconnect hoses from surge tank.
5. Remove surge tank, then remove control island to rear support. Swing control island forward.
6. Remove cab safety lock control from cab rear support and remove the cab rear support.
7. Disconnect starter and generator wiring, ignition wiring, and oil pressure and engine temperature wires.
8. Disconnect fuel line at engine.
9. Disconnect heater hoses and vacuum or air lines as required.
10. Disconnect ground straps.
11. Disconnect exhaust pipes from manifolds and wire the exhaust pipes to frame to avoid excessive stress on exhaust system supports.
12. Remove power steering pump (when used) from engine and use wire to secure pump with pressure lines attached.
13. Disconnect clutch control. The slave cylinder mounting bolts may be removed and line may remain connected to cylinder.
14. Remove fan blade assembly and pulley.
15. Remove valve rocker arm covers and install lifting eyes or brackets to provide correct balance for removing engine.
16. Attach hoist and take weight off engine mountings. Place blocking or jack under transmission, then remove bolts which secure transmission to engine. Remove engine mounting bolts. Raise engine and move forward until clutch disc is disengaged from transmission drive gear, then raise engine high enough to clear the chassis and remove engine from vehicle.
17. Set engine on stand; remove lifting device.

ENGINE INSTALLATION

1. Assemble clutch parts to engine flywheel referring to TRANSMISSIONS AND CLUTCHES (SEC. 7) in this manual for required information.
2. Hoist the engine into position in chassis and guide the clutch release bearing and disc onto transmission drive gear. Bolt transmission to engine and attach clutch release cylinder to engine.
3. Complete the engine installation by reversing the removal procedures given previously.
4. Check operation of clutch linkage and engine controls.
5. Before starting engine, be sure to fill cooling system, and fill engine crankcase with correct type of engine oil. Refer to LUBRICATION (SEC. 0) in this manual for recommended grade and viscosity for engine oil.
6. Start engine, make adjustments at carburetor; check ignition timing. If engine has been run on a test stand before it was installed, carburetor and ignition timing should not require re-adjusting.
7. Inspect all hoses and fittings for leaks.

In-Vehicle Service Operations

IN-LINE ENGINE IN-VEHICLE SERVICE OPERATIONS

MANIFOLD REPLACEMENT

REMOVAL

1. Remove air cleaner.
2. Disconnect both throttle rods at bellcrank and remove throttle return spring.
3. Disconnect fuel and vacuum lines and choke cable at carburetor.
4. Disconnect crankcase ventilation hose at rocker arm cover.
5. Disconnect exhaust pipe at manifold flange and discard packing.
6. On engines with sheet metal heat stove, remove the attaching screws, and remove stove parts (fig. 11) from exhaust manifold.
7. Remove manifold attaching bolts and clamps then remove manifold assembly and discard gaskets.
8. Check for cracks in manifold castings.
9. If necessary to replace either the intake or exhaust manifold, separate them by removing one bolt and two nuts at center of assembly. Reassemble manifolds using a new gasket. Tighten finger-tight and torque to "Specifications" after assembly to cylinder head. Transfer all necessary parts.

INSTALLATION

1. Clean gasket surfaces on cylinder head and manifolds. On engines with heat stove, assemble stove bracket at manifold attaching parts.

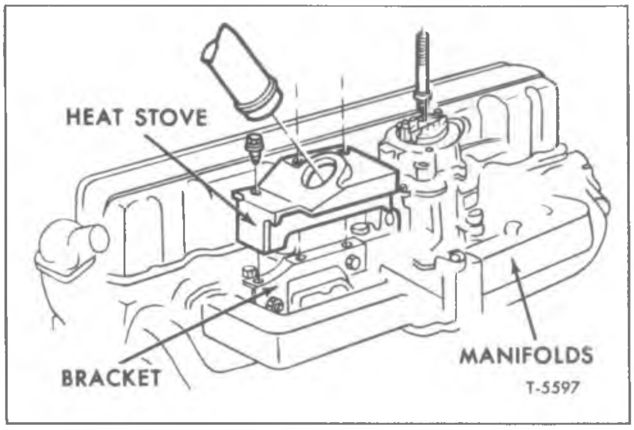
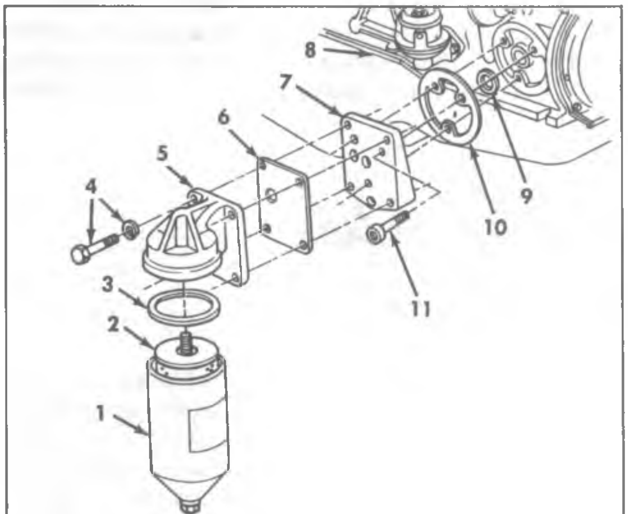


Figure 11—Manifold Heat Stove Installation (In-Line Engine)

2. Position new gasket over manifold end studs on head and carefully install the manifold in position making sure the gaskets are in place.
3. Install bolts and clamps while holding manifold in place with hand.
4. Torque bolts to "Specifications."

NOTE: Center bolt and end bolt torque differ.

5. Connect exhaust pipe to manifold using a new packing.
6. Connect crankcase ventilation hose at rocker arm cover.
7. Connect fuel and vacuum lines at carburetor.



1 Filter Shell	6 Housing Gasket
2 Filter Element	7 Adapter
3 Shell Gasket	8 Engine
4 Housing and Adapter Bolt & Lock Washer	9 Adapter-to-Block Seal
	10 Adapter Gasket
5 Housing	11 Adapter-to-Block Bolt

T-3333

Figure 12—Oil Filter and Bracket Components (Opt. 2 Qt. Type on 292 Engine)

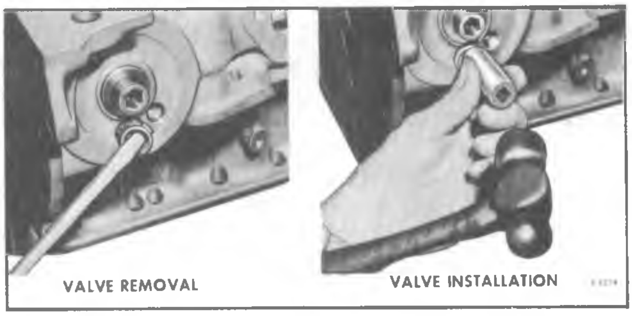


Figure 13—Replacing Oil Filter By-Pass Valve (In-Line Engine)

8. Connect choke cable and adjust as directed in ENGINE FUEL SYSTEM (SEC. 6M) of this manual.
9. Connect throttle rods at bellcrank and install throttle return spring.
10. Install air cleaner, start engine, check for leaks and adjust carburetor idle speed and mixture.

OPTIONAL OIL FILTER AND ADAPTER

Key numbers in text refer to figure 12.

When In-line engine is equipped with optional 2-quart filter, an adapter is bolted to block with special socket-head bolts.

When replacing adapter (7), use new seal and gasket (9 and 10) between adapter and cylinder block. Tighten adapter bolts (11) to 35 foot-pounds. When installing housing (5), tighten bolts (4) to 30 foot-pounds torque.

OIL FILTER BY-PASS VALVE ASSEMBLY REPLACEMENT

IN-LINE 6 ENGINE

1. Remove oil filter assembly from engine.
2. Referring to figure 13, use screwdriver as shown to pry valve out of recess in block.
3. Locate new valve assembly at block, then seat the new valve by tapping it into place with hammer and a 9/16-inch thin wall, deep socket.
4. Install engine oil filter.

ROCKER ARM COVER REPLACEMENT

REMOVAL

1. Disconnect crankcase ventilation hose at rocker arm cover.
2. Remove air cleaner.
3. Disconnect temperature wire from rocker arm cover clips.
4. Remove cover attaching screws, then remove cover.

CAUTION: DO NOT pry rocker arm cover loose. Gaskets adhering to cylinder head and rocker arm cover may be loosened by bumping end of rocker arm cover rearward with palm of hand, or a rubber mallet.

INSTALLATION

1. Clean gasket surfaces on cylinder head and rocker arm cover with degreaser, then using a new gasket, install rocker arm cover and torque screws to specifications.
2. Connect temperature wire at rocker arm cover clips.
3. Install air cleaner.
4. Connect crankcase ventilation hose.

VALVE MECHANISM REPLACEMENT

REMOVAL

1. Remove rocker arm cover as previously directed.
2. Remove rocker arm nuts, rocker arm balls, rocker arms and push rods.

NOTE: Place rocker arms, rocker arm balls and push rods in a rack so they may be reinstalled in the same location.

INSTALLATION AND ADJUSTMENT

NOTE: Whenever new rocker arms and/or rocker arm balls are being installed, coat bearing surfaces of rocker arms and rocker arm balls with Molykote or its equivalent.

1. Install push rods. Be sure push rods seat in lifter socket.
2. Install rocker arms, rocker arm balls and rocker arm nuts. Tighten rocker arm nuts until all lash is eliminated.
3. Adjust valves when lifter is on base circle of camshaft lobe as follows:

a. Mark distributor housing, with chalk, at each cylinder position (plug wire), then disconnect plug wires at spark plugs and coil and remove distributor cap and plug wire assembly (if not previously done).

b. Crank engine until distributor rotor points to No. 1 cylinder position and breaker points are open. Both valves on No. 1 cylinder may now be adjusted.

c. Back out adjusting nut until lash is felt at the push rod, then turn in adjusting nut until all lash is removed. This can be determined by checking push rod side play while turning adjusting nut (fig. 14). When play has been removed, turn adjusting nut one full additional turn (to center the lifter plunger).

Figure 14—Valve Adjustment on In-Line Engine

d. Adjust the remaining valves, one cylinder at a time, in the same manner.

4. Install distributor cap and apark plug wire assembly.
5. Install rocker arm cover as previously instructed.
6. Adjust carburetor idle speed and mixture as directed in ENGINE FUEL SYSTEM (SEC. 6M).

VALVE LIFTERS

Hydraulic valve lifters seldom require attention. The lifters are simple in design, readjustments are not necessary, and servicing of the lifters requires only that care and cleanliness be exercised in the handling of parts.

LOCATING NOISY LIFTERS

Locate a noisy valve lifter by using a piece of garden hose approximately four feet in length. Place one end of hose near the end of each intake and exhaust valve with the other end of hose to the ear. In this manner, the sound is localized making it easy to determine which lifter is at fault.

Another method is to place a finger on the face of the valve spring retainer. If the filter is not functioning properly, a distinct shock will be felt when the valve returns to its seat.

The general types of valve lifter noise are as follows:

1. Hard Rapping Noise - Usually caused by the plunger becoming tight in the bore of the lifter body to such an extent that the return spring can no longer push the plunger back up to working position. Probable causes are:

a. Excessive varnish or carbon deposit causing abnormal stickiness.

b. Galling or "pickup" between plunger and bore of lifter body, usually caused by an abrasive piece of dirt or metal wedging between plunger and lifter body.

2. Moderate Rapping Noise - Probable causes are:

a. Excessively high leakdown rate.

b. Leaky check valve seat.

c. Improper adjustment.

3. General Noise Throughout the Valve Train - This will, in almost all cases, be a definite indication of insufficient oil supply, or improper adjustment.

4. Intermittent Clicking - Probable causes are:

a. A microscopic piece of dirt momentarily caught between ball seat and check valve ball.

b. In rare cases, the ball itself may be out-of-round or have a flat spot.

c. Improper adjustment.

In most cases, where noise exists in one or more lifters all lifter units should be removed, disassembled, cleaned in a solvent, reassembled, and reinstalled in the engine.

REMOVAL

1. Remove valve mechanism as previously directed.

2. Mark distributor housing, with chalk, at each cylinder position (plug wire), then disconnect plug wires at spark plugs and coil and remove distributor cap and plug wire assembly.

3. Crank engine until distributor rotor points to number one position, then disconnect distributor primary lead at coil and remove distributor.

4. Remove push rod covers (discard gaskets).

5. Remove valve lifters.

NOTE: Place valve lifters in a rack so they may be reinstalled in the original locations.

INSTALLATION

1. Install valve lifters.

NOTE: Whenever new valve lifters are being installed, coat foot of valve lifters with Molykote or its equivalent.

2. Install push rod covers, using new gaskets, and torque screws to "Specifications."

3. Install distributor, positioning rotor to number one cylinder position, then connect primary lead at coil.

4. Install and adjust valve mechanism. Adjustment procedure is given previously under "Tune-up, Checks, and Adjustments."

5. Adjust ignition timing and carburetor idle speed and mixture.

VALVE STEM OIL SEAL AND/OR VALVE SPRING REPLACEMENT

1. Remove rocker arm cover as previously directed.

2. Remove spark plug, rocker arm, and push rod on the cylinder(s) to be serviced.

3. Apply compressed air to the spark plug hole to hold the valves in place.

NOTE: An adapter can be made from a discarded spark plug by removing electrode and cutting top of metal body as shown in figure 15. Thread the upper cavity with 3/8-inch pipe tap.

4. Using Tool (J-5892) (fig. 15) to compress the valve spring, remove the valve locks, valve cap (or rotator), valve shield and valve spring and damper.

5. Remove the valve stem oil seal.

6. To replace, set the valve spring and damper, valve shield and valve cap (or rotator) in place. The close coiled end of the spring is installed against the cylinder head. Compress the spring with Tool (J-5892) and install oil seal in the lower groove of the stem, making sure the seal is flat and not twisted.

NOTE: A light coat of oil on the seal will help prevent twisting.

7. Install the valve locks and release the compressor tool, making sure the locks seat properly in the upper groove of the valve stem.

NOTE: Grease may be used to hold the locks in place while releasing the compressor tool.

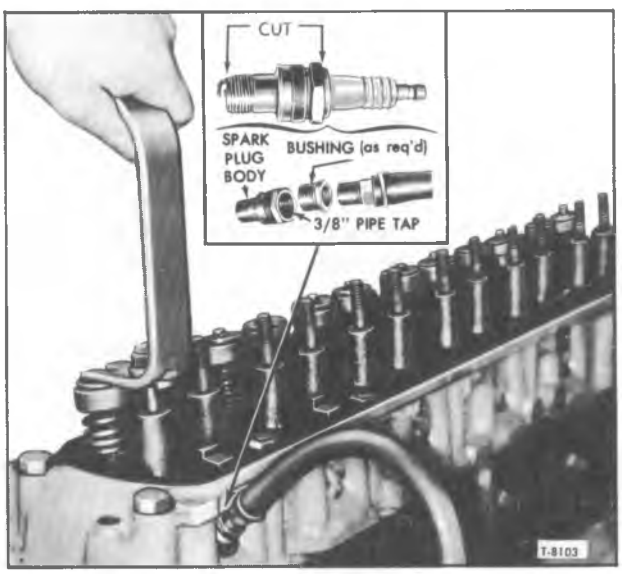


Figure 15—Using Special Tool and Compressed Air to Remove Valve Spring

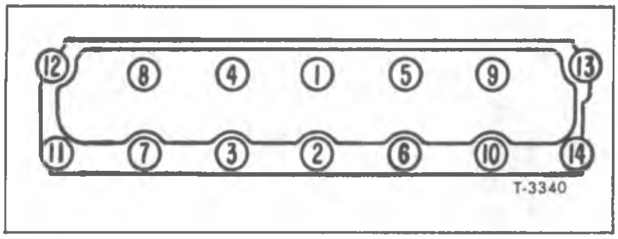


Figure 16—Cylinder Head Bolt Tightening Sequence on In-Line Engine

CYLINDER HEAD ASSEMBLY REPLACEMENT

REMOVAL

1. Remove manifold assembly.
2. Remove valve mechanism.
3. Drain cooling system.
4. Remove fuel and vacuum line from retaining clip at water outlet, then disconnect wires from temperature sending units.
5. Disconnect upper radiator hose at water outlet housing and battery ground strap at cylinder head.
6. Remove ignition coil.
7. Remove cylinder head bolts, cylinder head and gasket. Place cylinder head on two blocks of wood to prevent damage.

INSTALLATION

> **CAUTION: Gasket surfaces on both the head and the block must be clean of any foreign matter and free of nicks or heavy scratches. The cylinder head bolt threads in the block and threads on cylinder head bolt must be cleaned. (Dirt will affect bolt torque.) DO NOT use gasket sealer on composition steel-asbestos gaskets.**

1. Place the gasket in position over the dowel pins with the bead up.
2. Carefully guide cylinder head into place over dowel pins and gasket.
3. Coat threads of cylinder head bolts with sealing compound and install finger tight.
4. Tighten cylinder head bolts a little at a time in the sequence shown in figure 16, until the specified torque is reached (95 foot-pounds).
5. Install coil (if removed).
6. Connect upper radiator hose and engine ground strap.
7. Connect temperature sending unit wires and install fuel and vacuum lines in clip at water outlet.
8. Fill cooling system.
9. Install manifold assembly.
10. Install and adjust valve mechanism as previously instructed.

NOTE: DO NOT install rocker arm cover.

11. Start engine and allow to warm up, re-torque cylinder head bolts and readjust valves.

NOTE: Use of commercially available oil deflector clips (fig. 10) on rocker arms will prevent oil spatter during warm-up.

12. After making foregoing adjustment install rocker arm cover using new gasket. Install air cleaner and connect manifold heat stove pipe.

OIL PAN REPLACEMENT

OIL PAN REMOVAL

1. Clean all dirt and accumulated material from oil pan attaching bolts and drain plug.
2. Drain oil out of crankcase.
3. Remove oil pan bolts, then remove oil pan. Scrape off any portions of gaskets which adhere to oil pan flange or bolting flange on engine block and front cover. Gasket at front cover is neoprene type. Remove seal at crankshaft rear bearing cap.

INSTALLATION

1. Install seal at rear bearing cap.
2. Install front seal on timing gear cover, pressing tips into holes in cover.
3. Use grease or cement to hold side gaskets in place on cylinder block. Side gasket tabs must index with front seal on timing gear cover.
4. Install oil pan.

OIL PUMP REPLACEMENT

REMOVAL

1. Remove oil pan as previously directed under appropriate heading.
2. Remove bolt attaching oil suction pipe. Re-

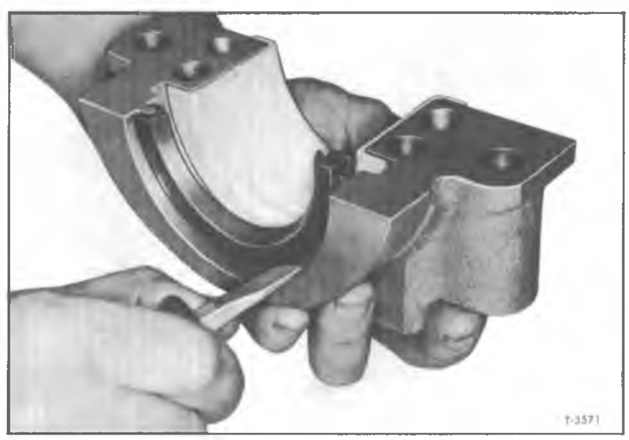


Figure 17—Removing Oil Seal from Bearing Cap

move two bolts holding pump flange to engine, then remove pump and screen as an assembly.

INSTALLATION

1. Align oil pump drive shaft to match with distributor tang, then install oil pump to block, positioning flange over distributor lower bushing. Use no gasket. Attach suction pipe support with bolt.

NOTE: Oil pump should slide easily into place, if it does not, remove and reposition shaft slot to align with distributor tang.

2. Install oil pan as instructed previously.

CRANKSHAFT REAR OIL SEAL REPLACEMENT

REMOVAL

The rear main bearing oil seal can be replaced (both halves) without removal of the crankshaft.

NOTE: Always replace the upper and lower seal as a unit. Install with the lip facing toward the front of the engine.

1. With the oil pan and oil pump removed, remove the rear main bearing cap.
2. Remove oil seal from the groove by prying from the bottom with a small screwdriver (fig. 17).
3. Use light hammer and small brass pin punch in manner shown in figure 18 to start seal upper half out of block. When end of seal protrudes far enough to be grasped with pliers, pull upper half out of block.

INSTALLATION

1. Wipe crankshaft surface with clean cloth. Apply engine oil on seal lip, but keep oil off parting line surface as this surface is treated with

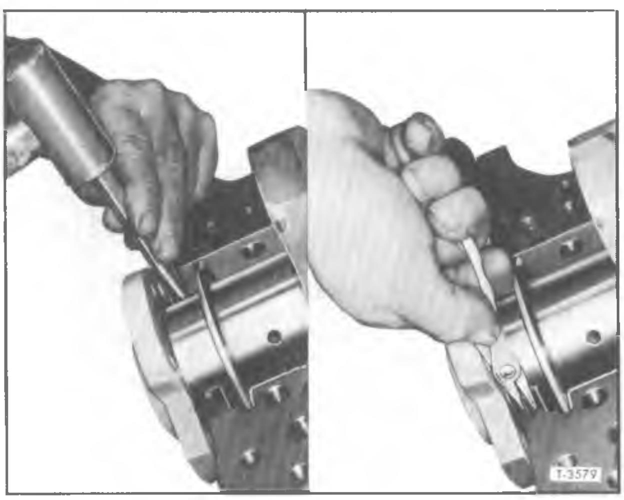


Figure 18—Removing Oil Seal Upper Half (Typical)

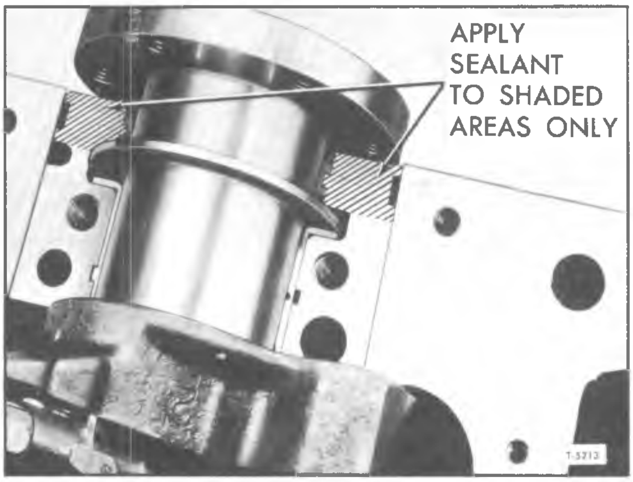


Figure 19—Sealer on Bearing Cap Area on Cylinder Block

glue. Press seal into place in bearing cap with fingers.

2. Position seal upper half on crankshaft so it can be installed in block by holding seal firmly with hammer handle while crankshaft is turned, similar to method used to install bearing.

3. Referring to figure 19, apply light coat of brush-on type oil sealing compound to block and mating surface on bearing cap. Do not apply sealer on treated ends of oil seals.

4. Install bearing cap and install cap bolts with 10 to 12 foot-pounds initial torque, then use lead hammer to tap crankshaft first rearward, then forward. This will line up rear main bearing thrust faces. Finally, tighten bearing cap bolts to 115 foot-pounds torque.

5. Install oil pump and oil pan.

CRANKSHAFT DAMPER REPLACEMENT

REMOVAL

1. Drain radiator and disconnect radiator hoses at radiator.

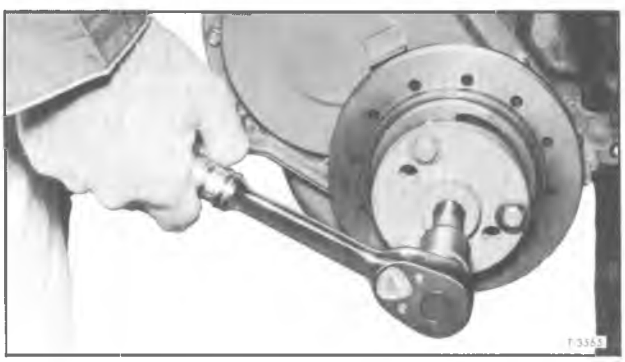


Figure 20—Removing Crankshaft Damper

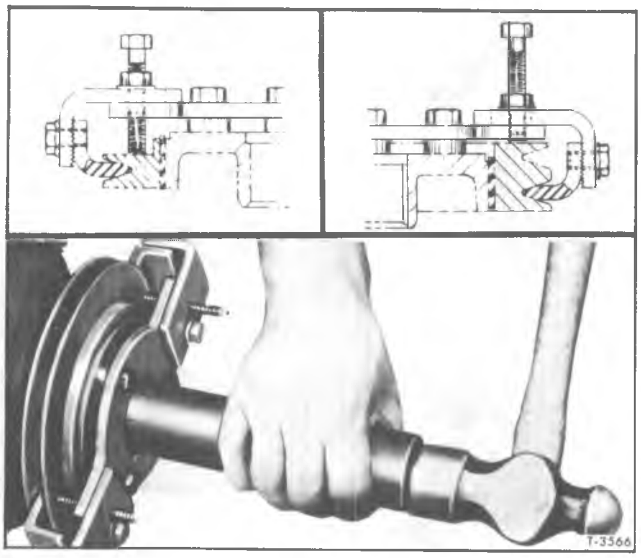


Figure 21—Installing Drive-On Type Crankshaft Damper

2. Remove radiator core, as outlined in RADIATOR AND SURGE TANK (SEC. 13) of this manual.

3. Remove fan belt and (if so equipped) accessory drive pulley and belt. If so equipped, remove retaining bolt.

4. Install Tool (J-6978-04) on damper and turn puller screw to remove damper (fig. 20). Remove tool from damper.

INSTALLATION

CAUTION: The inertia weight section of the damper is assembled to the hub with a rubber-type material. The installation procedures (with proper tool) must be followed or movement of the inertia weight section on the hub will destroy the tuning of the damper.

1. Coat front seal contact area (on damper hub) with engine oil.

2. Install damper as follows:

a. Drive On Type (250 Engine Only).

(1) Attach damper installer Tool (J-22197) to damper. Tighten fingers of tool to prevent inertia weight from moving (fig. 21).

(2) Position damper on crankshaft and drive into position until it bottoms against crankshaft gear. Remove installer tool.

b. Pull On Type (With Retaining Bolt).

(1) Use a 7/16"-20 x 4" bolt, nut, and washer or special installer (J-21058) (fig. 22) to pull torsional damper onto crankshaft. If special tool (fig. 22) is used, hold bolt with wrench, then turn threaded sleeve to force hub onto crankshaft.

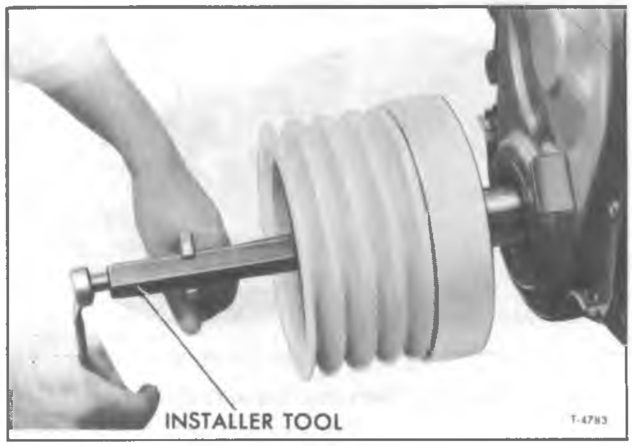


Figure 22— Installing Pull-On Type Crankshaft Damper with Special Tool

CAUTION: Install bolt in crankshaft with sufficient thread engagement (min. ½").

(2) Remove bolt, nut, and washer or tool, then install retaining bolt and torque to "Specifications."

3. Install fan belt and adjust using strand tension gauge.

4. If so equipped, install accessory drive pulley and belt.

5. Install radiator core as directed in RADIATOR AND SURGE TANK (SEC. 13) of this manual.

6. Connect radiator hoses.

7. Fill cooling system and check for leaks.

ENGINE FRONT COVER AND OIL SEAL

COVER REMOVAL

1. Remove oil pan.

2. Remove crankshaft pulley and hub or damper as directed previously.

3. Remove front cover attaching screws, remove cover and gasket.

COVER INSTALLATION

1. Clean gasket surfaces on block and front cover. If oil seal requires replacing, follow instructions given later under appropriate heading.

2. Install centering Tool (J-0966) or centering Tool (J-21742) in crankcase front cover seal (fig. 23).

3. Cement cover gasket in place on block. Attach new oil pan seal at cover lower flange.

NOTE: It is important that centering tool be used to align front cover so that crankshaft hub or damper installation will not damage seal and to position seal to seat evenly around the damper or hub surface.

4. With centering Tool (J-0966) in place (fig.

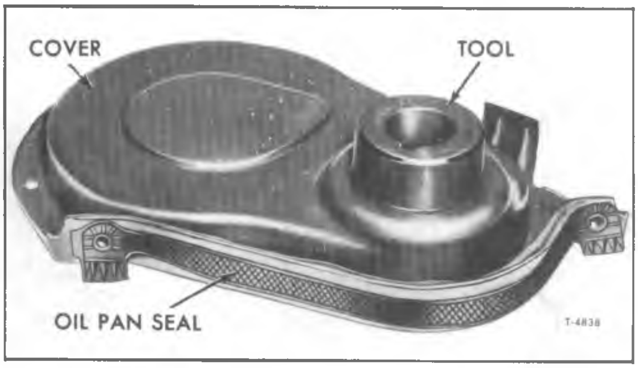


Figure 23—Centering Tool in Engine Cover

23), position cover on front of cylinder block, install attaching bolts, and tighten firmly (6½ foot-pounds torque). Install two oil pan bolts, then remove centering tool.

5. Install crankshaft damper and pulley, referring to instructions given previously.

Figure 25—Installing Front Cover Oil Seal

OIL SEAL REMOVAL

If front cover is installed, remove crankshaft damper as previously instructed, then use suitable tool to pry the seal out of cover.

If cover is removed from engine, drive oil seal out of cover with suitable tool, then clean the seal recess.

OIL SEAL INSTALLATION

If cover is installed on engine, Tool (J-8340) may be used as shown in figure 24 to drive new oil seal into cover. The seal lip must be toward inner side of cover.

When installing oil seal with cover removed, support inner side of cover with Tool (J-971), position seal with lip toward inner side of cover, then use Tool (J-995) to drive new oil seal squarely into cover as shown in figure 25.

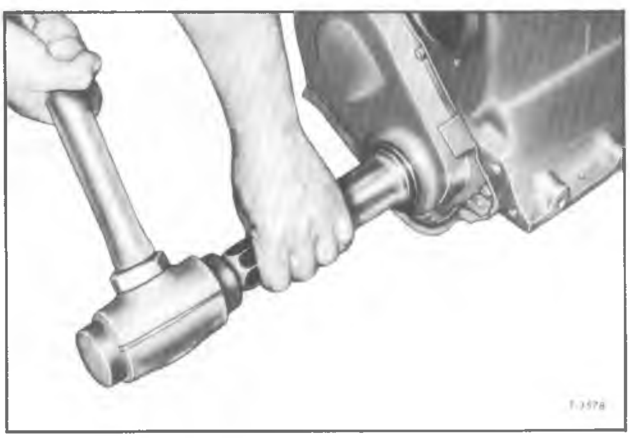


Figure 24—Installing Front Cover Oil Seal (Cover Installed)

FLYWHEEL REPLACEMENT
(250 ENGINES)

1. Remove transmission and clutch parts (as necessary), then remove the flywheel bolts, and remove flywheel from crankshaft.

2. Clean mating surfaces on flywheel and crankshaft, then place flywheel at crankshaft and install bolts. Tighten bolts to 60 foot-pounds. Figure 26 shows flywheel installation views. Install clutch parts (if used) and install transmission.

FLYWHEEL REPLACEMENT
(292 ENGINES)

1. Remove transmission and clutch mechanism from engine. Remove engine oil pan and rear main bearing cap, then use hammer and drift to drive out and remove the three flywheel-to-crankshaft dowel pins. Crankshaft must be turned each time a dowel pin is removed, so next pin can be driven out without contacting cylinder block. After removing

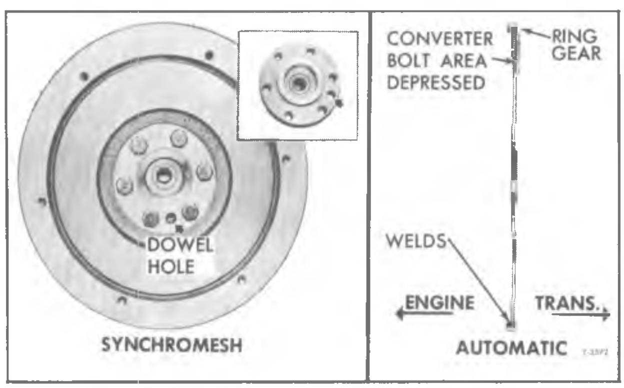


Figure 26—Flywheel Installation (Typical)

dowel pins, remove flywheel-to-crankshaft bolts, then remove flywheel.

2. Clean mating surfaces on crankshaft flange and flywheel and remove any existing burrs. Position flywheel at crankshaft flange with dowel pins aligned.

NOTE: If new flywheel is being installed it is necessary to ream the dowel pin holes to assure correct hole alignment and dowel pin fit. Dowel pins must be driven into place as they are interference fit.

3. With flywheel bolts installed and tightened to 110 foot-pounds torque, use reamer (J-22808) to size and line ream the dowel pin holes. Finish ream the holes with reamer (J-22808-1). Drive oversize dowel pins flush with flywheel rear surface. Install bearing cap and oil pan referring to instructions previously given in this section. Assemble clutch mechanism, then install transmission on engine.

CHECKING ENGINE VALVE TIMING

When it becomes necessarv to make a check of valve timing, the procedure following may be used:

1. Remove valve rocker arm cover and push rod front cover.

2. Loosen nut at #1 intake valve rocker arm, swing rocker arm away from push rod, then remove push rod and hydraulic valve lifter.

3. Temporarily install a flat face mechanical lifter in place of the hydraulic lifter.

4. Turn crankshaft until #2 exhaust valve opens and notch on pulley or damper is aligned with "O" mark on timing pointer.

5. Position dial indicator to measure lifter movement and set indicator at zero. Turn crankshaft 360 degrees and read indicator. On correctly timed engines the indicator will read as follows:

On 250 Engines . . . . 0.010 to 0.018 inch
On 292 Engines . . . . 0.012 to 0.020 inch

If reading is not as shown, reset indicator at zero and turn crankshaft 360 degrees, then read indicator again. If reading is now in accord with specifications, the engine is timed properly.

NOTE: Chart following shows indicator readings with gears properly indexed for each engine and the indicator readings resulting from improperly indexed gears:

Engine (Cu.In.)	Camshaft Part No. & Valve Lift	Gears Properly Indexed	One Tooth Adv.	One Tooth Ret.
250	3864896-.388	.014"-.004"	.0351"	.0055"
292	3848000-.405	.016"-.004"	.0379"	.0068"

6. If foregoing check indicates an out-of-time condition, remove engine front cover and check for proper indexing of timing marks on gears.

V8 ENGINE IN-VEHICLE SERVICE OPERATIONS

OIL FILTER BY-PASS VALVE REPLACEMENT

1. Remove oil filter from engine, and clean cavity in which by-pass valve is located (fig. 27).

2. Remove bolts attaching adapter and valve assembly to engine. Remove adapter and gasket.

3. Clean parts and inspect valve and spring. If defects are found, install new adapter and valve assembly as instructed below.

4. Place adapter and gasket at cylinder block and retain with two bolts as shown. Tighten adapter bolts to 6½ to 7 foot-pounds torque.

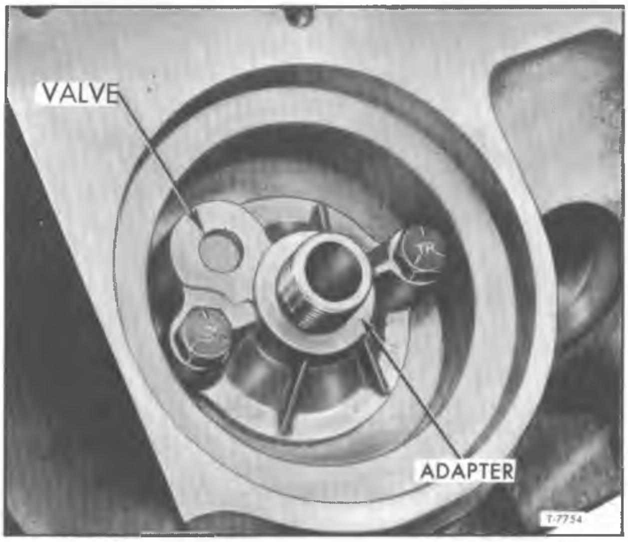


Figure 27—V8 Engine Oil Filter By-Pass Valve

INTAKE MANIFOLD REPLACEMENT

REMOVAL

NOTE: On tilt cab models, accomplish procedures previously given to detach control island and tilt it forward to provide access to top of engine.

1. Drain radiator and remove air cleaner.
2. Disconnect following items:
a. Battery cables.
b. Radiator hose, heater hose (at manifold) and water pump by-pass at pump.
c. Accelerator linkage, choke control, and fuel line at carburetor. Also disconnect governor lines (if used) at distributor and carburetor.
d. Spark advance hose and wiring at distributor.
e. Crankcase ventilation lines, as required.
3. Remove distributor cap and mark rotor position with chalk, then remove distributor.
4. Remove (as required) oil filler bracket, air cleaner bracket, air compressor and bracket, coil, accelerator return spring and bracket and accelerator bellcrank.
5. Remove manifold attaching bolts, then remove manifold and carburetor as an assembly. Discard gaskets and seals.
6. If manifold is to be replaced, transfer:
a. Carburetor and carburetor mounting studs.
b. Temperature sending unit.
c. Water outlet and thermostat (use new gasket).
d. Heater hose and water pump by-pass adapters.

INSTALLATION

1. Clean gasket and seal surfaces on manifold, block and cylinder heads.
2. Install manifold seals on block and gaskets on cylinder heads (fig. 28). Use sealer at water passages and where seals butt against gaskets.
3. Install manifold and torque bolts to "Specifications" in the sequence shown in figure 29 or 30.

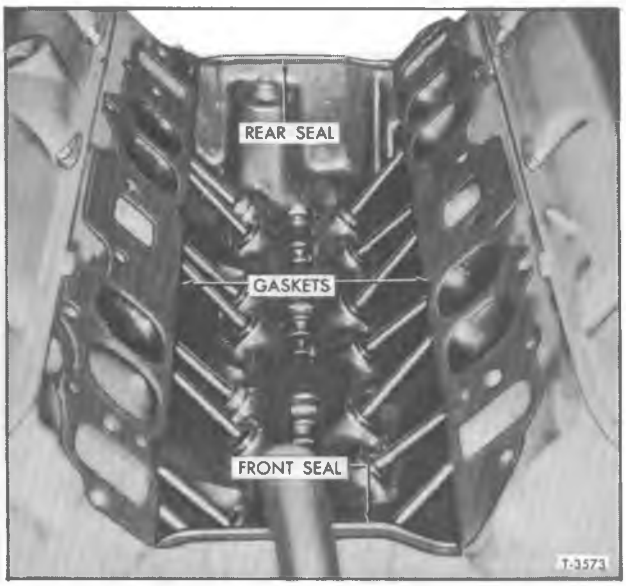


Figure 28—Intake Manifold Gaskets and Seals

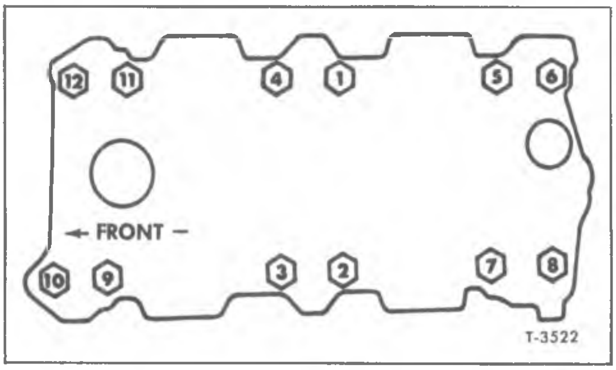


Figure 29—Intake Manifold Bolt Tightening Sequence on 350 V8 Engine

4. Install (if removed) oil filler bracket, air cleaner bracket, air compressor and bracket, coil, accelerator return spring and bracket and accelerator bellcrank.
5. Install distributor, positioning rotor at the chalk mark, then install distributor cap.
6. Connect following:
a. Spark advance hose and wiring at distributor.
b. Crankcase ventilation lines (as required).
c. Fuel line and choke cable at carburetor.
d. Accelerator linkage.
e. Water pump bypass at water pump (use new gasket).
f. Battery cables at battery.
7. Adjust choke cable and accelerator linkage.
8. Install air cleaner.

NOTE: On tilt cab models install control island by reversing the removal operations.

9. Fill cooling system and engine crankcase, then start engine and check for leaks.
10. Adjust carburetor and set ignition timing.

EXHAUST MANIFOLD REPLACEMENT

REMOVAL

1. At left exhaust manifold, disconnect and

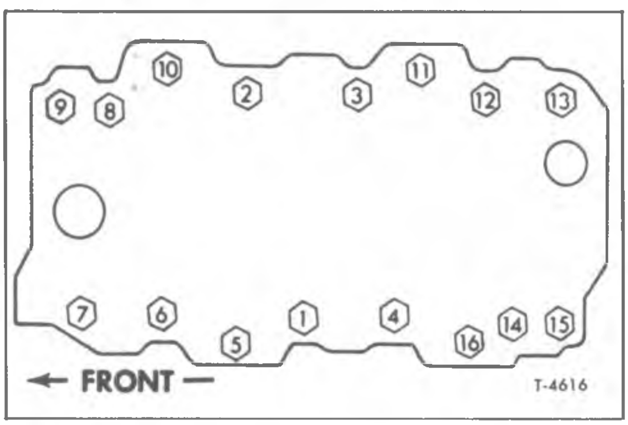


Figure 30—Intake Manifold Bolt Tightening Sequence on 366 and 427 V8 Engines

remove generator and bracket. On 366 and 427 V8 engines, remove spark plugs.

2. Disconnect exhaust pipe from manifold and hang exhaust pipe from frame with wire.

3. Bend bolt lock tabs away from end bolt heads, then remove exhaust manifold bolts.

4. Remove exhaust manifolds.

INSTALLATION

1. Clean mating surfaces on manifold and head, then install manifold in position and install center bolts (finger tight).

2. Install end bolts with locks, then torque all bolts to specifications and bend locks on end bolts.

3. Connect exhaust pipe to manifold. Use new gasket or packing.

4. On vehicles so equipped, install carburetor heater stove.

5. On left exhaust manifold, install bracket and generator and connect wiring.

6. On 366 and 427 engines install spark plugs. Start engine and check for leaks.

ROCKER ARM COVER REPLACEMENT

REMOVAL

1. Remove air cleaner and disconnect crankcase ventilation hoses.

2. Disconnect temperature wire from clips at left rocker arm cover.

3. On vehicles so equipped, remove carburetor heater from left exhaust manifold.

4. Remove rocker arm cover.

> **CAUTION: DO NOT pry rocker arm cover loose. Gaskets adhering to cylinder head and rocker arm cover may be sheared by bumping end of rocker arm cover rearward with palm of hand or a rubber mallet.**

INSTALLATION

1. Clean gasket surfaces on cylinder head and rocker arm cover with degreaser, then using a new gasket, install rocker arm cover and torque to "Specifications" at end of this section.

2. Install carburetor heater (if removed).

3. Connect crankcase ventilation hoses.

4. Install air cleaner, start engine and check for oil leaks.

VALVE MECHANISM REPLACEMENT

REMOVAL

1. Remove rocker arm covers as previously instructed.

2. Remove rocker arm nuts, rocker arm balls, rocker arms and push rods.

NOTE: Place rocker arms, rocker arm balls and push rods in a rack so they may be re-installed in the same locations.

INSTALLATION AND ADJUSTMENT

NOTE: Whenever new rocker arms and/or rocker arm balls are being installed, coat bearing surfaces of rocker arms and rocker arm balls with "Molykote" or its equivalent.

1. Install push rods. Be sure push rods seat in lifter socket.

2. Install rocker arms, rocker arm balls and rocker arm nuts. Tighten rocker arm nuts until all lash is eliminated.

3. Adjust valves when lifter is on base circle of camshaft lobe as follows:

a. Crank engine until mark on torsional damper lines up with center or "O" mark on the timing tab fastened to the crankcase front cover and the engine is in the number 1 firing position. This may be determined by placing fingers on the number 1 valve as the mark on the damper comes near the "O" mark on the crankcase front cover. If the valves are not moving, the engine is in the number 1 firing position. If the valves move as the mark comes up to the timing tab, the engine is in number 6 firing position and should be turned over one more time to reach the number 1 position.

b. With the engine in the number 1 firing position determined above, the following valves may be adjusted:

Exhaust - 1, 3, 4, 8
Intake - 1, 2, 5, 7

c. Back out adjusting nut until lash is felt at the push rod, then turn in adjusting nut until all lash is removed. This can be determined by checking push rod side play while turning adjusting nut (fig. 14). When play has been removed, turn adjusting nut in one full additional turn (to center the lifter plunger).

d. Crank the engine one revolution until the pointer "O" mark and torsional damper mark are again in alignment. This is number 6 firing position. With the engine in this position the following valves may be adjusted:

Exhaust - 2, 5, 6, 7
Intake - 3, 4, 6, 8

4. Install rocker arm covers as previously instructed.

5. Adjust carburetor idle speed and mixture.

VALVE LIFTER REPLACEMENT

GENERAL

Hydraulic valve lifters seldom require attention. The lifters are simple in design, readjustments are not necessary, and servicing of the lifters requires only that care and cleanliness be exercised in the handling of parts.

LOCATING NOISY LIFTERS

Locate a noisy valve lifter by using a piece of garden hose approximately four feet in length. Place one end of the hose near the end of each intake and exhaust valve with the other end of the hose to the ear. In this manner, the sound is localized making it easy to determine which lifter is at fault.

Another method is to place a finger on the face of the valve spring retainer. If the lifter is not functioning properly, a distinct shock will be felt when the valve returns to its seat.

The general types of valve lifter noise are as follows:

1. Hard Rapping Noise -- Usually caused by the plunger becoming tight in the bore of the lifter body to such an extent that the return spring can no longer push the plunger back up to working position. Probable causes are as follows:

a. Excessive varnish or carbon deposit causing abnormal stickiness.

b. Galling or "pick-up" between plunger and bore of lifter body, usually caused by an abrasive piece of dirt or metal wedging between plunger and lifter body.

2. Moderate Rapping Noise -- Probable causes are:

a. Excessively high leakdown rate.

b. Leaky check valve seat.

c. Improper adjustment.

3. General Noise Throughout The Valve Train -- This will, in almost all cases, be a definite indication of insufficient oil supply, or improper adjustment.

4. Intermittent Clicking -- Probable causes are:

a. A microscopic piece of dirt momentarily caught between ball seat and check valve ball.

b. In rare cases, the ball itself may be out-of-round or have a flat spot.

c. Improper adjustment.

In most cases where noise exists in one or more lifters all lifter units should be removed, disassembled, cleaned in a solvent, reassembled, and reinstalled in the engine.

REMOVAL

1. Remove intake manifold.

2. Remove valve mechanism.

3. Remove valve lifters.

NOTE: Place valve lifters in a rack so they may be reinstalled in the same locations.

INSTALLATION

1. Install valve lifters.

NOTE: Whenever new valve lifters are being installed coat foot of valve lifters with Molykote or its equivalent.

2. Install intake manifold, referring to procedure given previously.

3. Install and adjust valve mechanism.

Since valve lifters are hydraulic type, refer to the "Installation and Adjustment" procedure previously given under "Valve Mechanism Replacement" for correct method to adjust the mechanism.

VALVE STEM OIL SEAL AND/OR VALVE SPRING REPLACEMENT

1. Remove rocker arm cover as outlined.

2. Remove spark plug, rocker arm and push rod on the cylinder(s) to be serviced.

3. Apply compressed air to the spark plug hole to hold the valves in place.

NOTE: An adapter for use in connecting air supply to spark plug hole can be made from a discarded spark plug by removing electrode and cutting at the top of body as shown in figure 15. Thread the upper cavity with 3/8-inch pipe tap.

4. Using Tool (J-5892), compress the valve spring in manner shown in figure 31.

5. On 350 V8 engines, complete valve spring removal as follows:

a. Remove the valve locks, valve cap, shield, and valve spring and damper.

b. Remove valve stem oil seal from groove in valve stem.

6. On 366 and 427 engines, remove valve locks, spring cap, spring and damper. Remove umbrella-type oil seal from valve stem.

a. Set the valve spring and damper, valve shield and valve cap in place. The close coiled end of the spring is installed against the cylinder head. Compress the spring with Tool (J-5892) and install

Figure 31—Compressing Valve Spring on V8 Engine

oil seal in the lower groove of the stem, making sure the seal is flat and not twisted.

NOTE: A light coat of oil on the seal will help to prevent twisting.

b. Install the valve locks and release the compressor tool making sure the locks seat properly in the upper groove of the valve stem.

8. Assemble parts on 366 and 427 engine as follows:

a. Lubricate valve stem and install umbrella-type oil seal on stem. Push seal down below lock grooves in valve stem.

b. Place spring and damper at cylinder head, locate spring cap on spring, then use spring compressor (J-5892) and compressor valve spring.

c. Install valve locks in valve stem groove, then release valve spring meanwhile making sure locks seat properly in stem groove.

9. Install spark plug, and torque to 15 foot-pounds.

10. Install and adjust valve mechanism.

CYLINDER HEAD REPLACEMENT

REMOVAL

1. Drain cylinder block of coolant.
2. Remove intake manifold.
3. Remove exhaust manifolds.
4. Remove valve operating mechanism.
5. Remove cylinder head bolts, cylinder head and gasket. Support cylinder head on two blocks of wood to prevent damage.

INSTALLATION

CAUTION: The gasket surfaces on both the head and the block must be clean of any foreign matter and free from nicks or heavy scratches. Cylinder bolt threads in the block and threads on the cylinder head bolts must be clean.

1. On engines using a STEEL gasket, coat both sides of a new gasket with sealer. Spread the sealer thin and even. One method of applying the sealer that will assure the proper coat is with the use of a paint roller. Too much sealer may hold the gasket away from the head or block.

CAUTION: Use no sealer on engines using a composition STEEL ASBESTOS gasket.

2. Place the gasket (with bead up) in position over the dowel pins.

3. Carefully guide the cylinder head into place over the dowel pins and gasket.

4. Coat threads of cylinder head bolts with sealing compound and install bolts finger-tight.

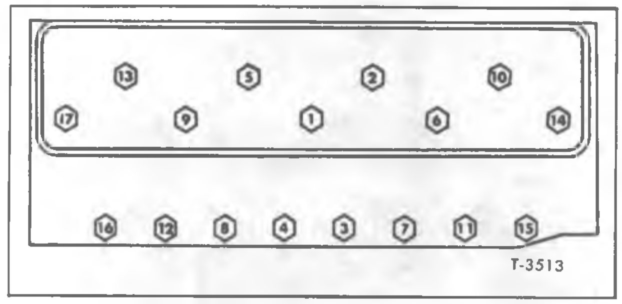


Figure 32—Cylinder Head Bolt Tightening Sequence on 350 V-8 Engine

5. Tighten each cylinder head bolt a little at a time in the sequence shown in figure 32 or 33 until the specified torque is reached.

6. Install exhaust manifolds as previously directed.

7. Install the intake manifold as previously directed.

8. Install and adjust valve mechanism as previously directed under appropriate heading.

OIL PAN REPLACEMENT

REMOVAL

1. Drain engine oil.
2. Remove oil dipstick and tube.
3. On vehicles so equipped, remove exhaust crossover pipe.
4. On vehicles equipped with automatic transmission, remove converter housing underpan.
5. Remove oil pan and discard gaskets and seals.

INSTALLATION

1. Thoroughly clean all gasket and seal surfaces on oil pan, cylinder block, crankcase front cover and rear main bearing cap.

2. Install new oil pan side gaskets on cylinder block using gasket sealer as a retainer. Install new oil pan rear seal in rear main bearing cap groove. With ends butting side gaskets. Install new oil pan

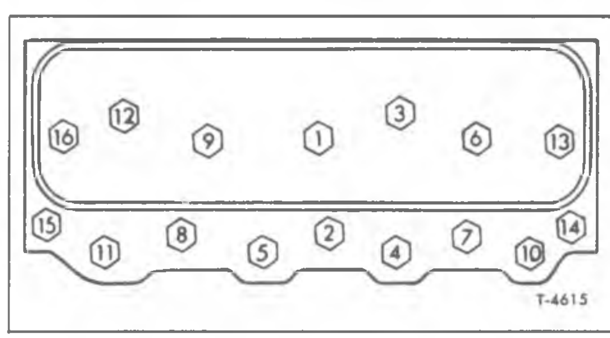


Figure 33—Cylinder Head Bolt Tightening Sequence on 366 and 427 Engine

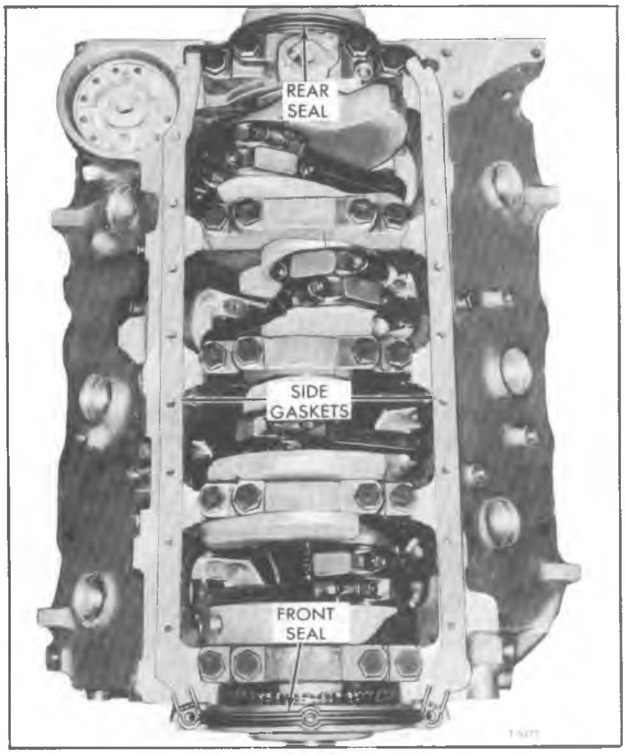


Figure 34—Oil Pan Gasket and Seal Locations

front seal in groove in crankcase front cover with ends butting side gaskets (fig. 34).

3. Install oil pan and tighten firmly.
4. Install converter housing underpan (if removed).
5. Install exhaust crossover pipe (if removed).
6. Install oil dipstick tube and dipstick.
7. Fill with oil, start engine and check for leaks.

OIL PUMP REPLACEMENT

REMOVAL

1. Remove oil pan as previously directed.
2. Remove pump to rear main bearing cap bolt and remove pump and extension shaft.

INSTALLATION

1. Assemble pump and extension shaft to rear main bearing cap, aligning slot on top end of extension shaft with drive tang on lower end of distributor drive shaft.
2. Install pump to rear bearing cap bolt and torque to 65 foot-pounds.

NOTE: Installed position of oil pump screen is with bottom edge parallel to oil pan rails.

3. Install oil pan as previously directed under appropriate heading.

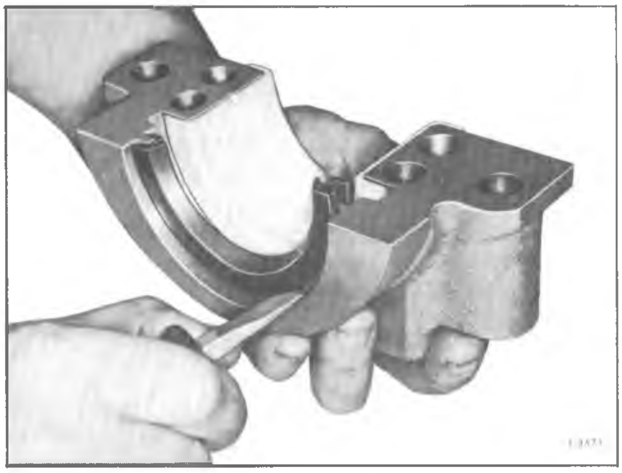


Figure 35—Removing Oil Seal from Bearing Cap

CRANKSHAFT REAR OIL SEAL REPLACEMENT

REMOVAL

The rear main bearing oil seal can be replaced (both halves) without removal of the crankshaft.

NOTE: Always replace the upper and lower seal as a unit. Install with the lip facing toward the front of the engine.

1. With the oil pan and oil pump removed, remove the rear main bearing cap.
2. Remove oil seal from the groove by prying from the bottom with a small screwdriver (fig. 35).
3. To remove the upper half of the seal, use a small hammer to tap a brass pin punch on one end of seal until it protrudes far enough to be removed with pliers (fig. 36).

INSTALLATION

NOTE: Always wipe crankshaft surface clean before installing a new seal.

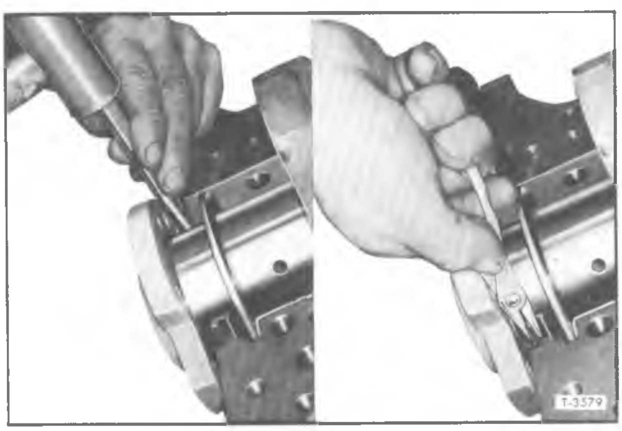


Figure 36—Removing Oil Seal Upper Half

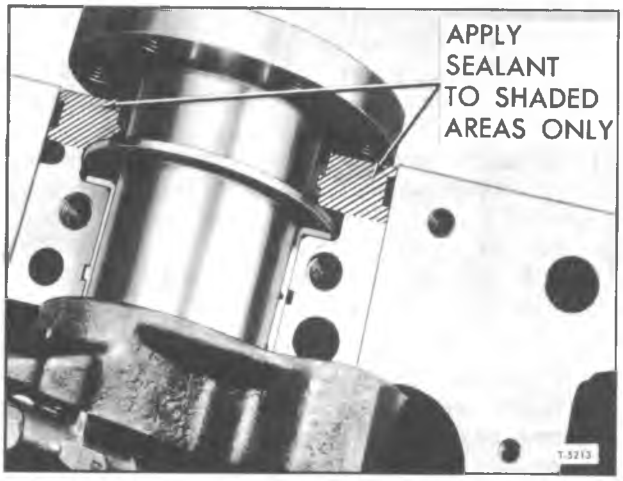


Figure 37—Sealer at Bearing Cap

1. Lubricate the lip of a new seal with engine oil. Keep oil off the parting line surface as this is treated with glue. Insert seal in cap and roll it into place with finger and thumb, using light pressure so seal tangs at parting line do not cut bead on back of seal.

2. Lubricate the lip of a new seal with engine oil. Keep oil off the parting line surface as this is treated with glue. Gradually push with a hammer handle, while turning crankshaft, until seal is rolled into place. (Similar to installing a main bearing.) Be careful that seal tangs at parting line do not cut bead on back of seal.

3. Apply sealer on cylinder block area (fig. 37).

4. Install the rear main bearing cap (with new seal) and torque cap bolts to values specified in applicable data in "V8 Engine Torque Wrench Specifications."

5. Install oil pump and oil pan, referring to applicable instructions given previously.

CRANKSHAFT DAMPER REPLACEMENT

REMOVAL

1. Remove fan belt, fan, and pulley.

2. Remove the bolt which is threaded into crankshaft and secures the damper hub.

3. Assemble special Tool (fig. 38) to damper and turn the puller screw to remove damper assembly from crankshaft.

NOTE: Tool (J-6978) has holes forming two patterns. A two-bolt and a three-bolt pattern. The holes for the two-volt pattern must be elongated for use on the 366 and 427 cu.-in. engines.

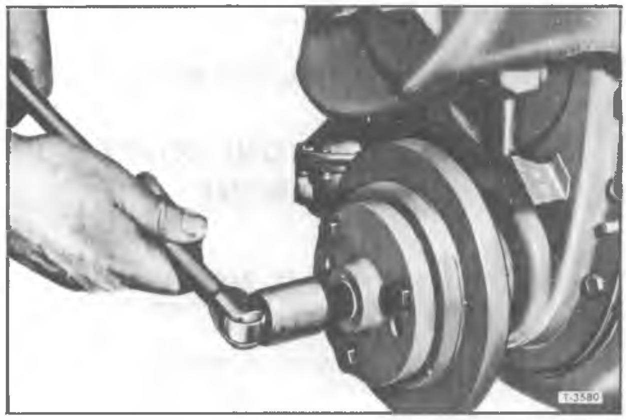


Figure 38—Removing Crankshaft Damper (Typical)

INSTALLATION

1. Coat contact surface on hub with engine oil, then position damper hub at crankshaft with keyway aligned with key.

2. Assemble damper installation tool (J-21058) (fig. 39) in crankshaft threaded hole. Hold bolt with wrench and turn hex threaded sleeve to force hub onto crankshaft.

NOTE: If radiator has not been removed from the vehicle a ½"-20 x 5" bolt and a ½"-20 nut may be used in place of bolt and nut from Tool (J-21058).

CAUTION: Install bolt in crankshaft with sufficient thread engagement (min. ½-inch).

3. Remove tool from crankshaft, then install damper retaining bolt and torque to 85 foot-pounds.

4. Install accessory drive pulley.

5. Install fan and pulley to water pump hub and tighten securely.

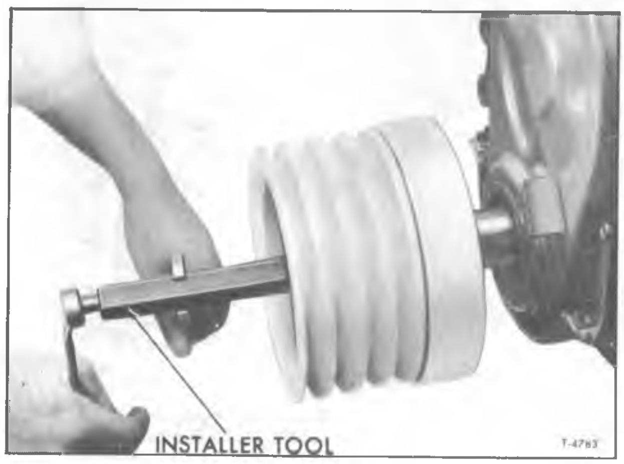


Figure 39—Installing Damper Assembly (Typical)

6. Install fan belt and adjust to "Specifications" using strand tension gauge.

7. Fill cooling system, start engine and check for leaks.

CRANKCASE FRONT COVER REPLACEMENT

REMOVAL

1. Remove oil pan as previously directed.
2. Remove crankshaft pulley and damper as previously instructed.
3. Remove water pump as outlined in ENGINE COOLING SYSTEM (SEC. 6K) of this manual.
4. Remove crankcase front cover attaching screws and remove front cover and gasket, then discard gasket.

INSTALLATION

1. Make certain that cover mounting face and cylinder block front end face are clean and flat.
2. Coat the oil seal with engine oil and using a new cover gasket, coated with gasket sealer install cover and gasket over dowel pins and cylinder block.
3. Install cover screws and tighten firmly.
4. Install water pump as outlined in ENGINE COOLING SYSTEM (SEC. 6K) of this manual.
5. Install damper as previously instructed.
6. Install oil pan and water pump assembly.

FRONT COVER OIL SEAL REPLACEMENT

NOTE: Special tools are available for replacing front cover oil seal either with cover installed or removed. Procedures for each condition are covered separately.

Figure 40—Installing Front Cover Oil Seal on 366 or 427 Engine (Cover Removed)

SEAL REPLACEMENT
(WITH COVER REMOVED)

1. With the cover removed, pry the old seal out of the cover from the front with a large screwdriver.
2. Install new seal so that open end of the seal is toward the inside of cover and drive it into position with Tool (J-23042) on 350 engines, while supporting the cover at inner side with Tool (J-971). On 366 and 427 engines, use Tool (J-22102) to drive oil seal into place (fig. 40).

> **CAUTION: When installing seal with cover removed, do not attempt to install new seal without supporting cover as indicated in Step 2 previously, as damage to cover may result.**

3. Install front cover following directions given previously under appropriate heading.

SEAL REPLACEMENT
(WITH COVER INSTALLED)

1. With torsional damper removed, pry seal out of cover from the front with a large screwdriver, being careful not to damage the surface on the crankshaft.

2. Install new seal so that open end of the seal is toward the inside of the cover and drive it into position with Tool (J-8340) for 350 engine, or with Tool (J-22102) for 366 and 427 engines (fig. 41).

3. Install damper and pulley as previously instructed.

TIMING CHAIN AND/OR SPROCKET REPLACEMENT

REMOVAL

1. Remove damper from crankshaft and re-

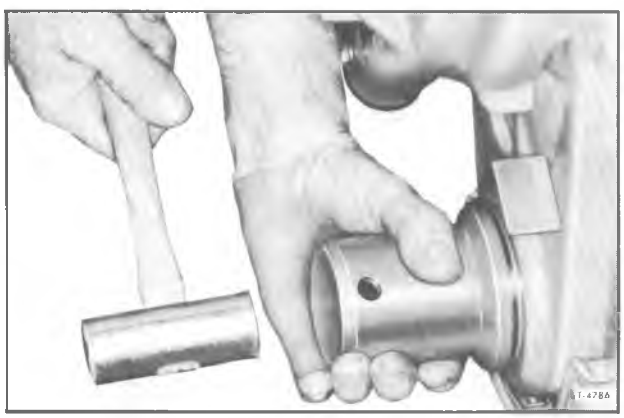


Figure 41—Installing Cover Oil Seal with Cover Installed (366 or 427 Engine Shown)

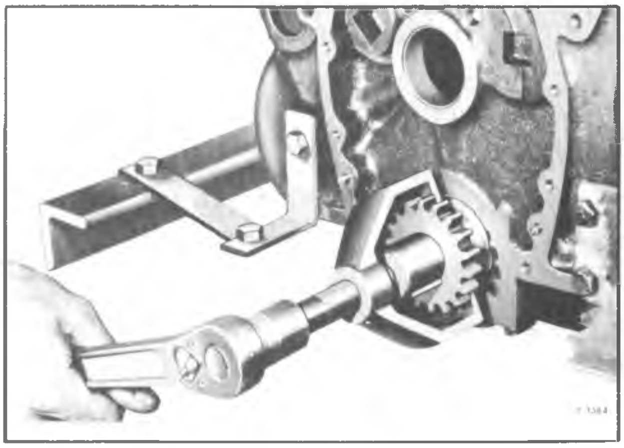


Figure 42—Removing Chain Sprocket from Crankshaft with Special Tool (Typical)

move front cover from engine. Instructions for foregoing operations are covered previously in this section.

2. Crank engine until marks on camshaft and crankshaft sprockets are in alignment (fig. 44).

3. Remove camshaft sprocket to camshaft bolts.

4. Remove camshaft sprocket and timing chain together. Sprocket is a light press fit on camshaft. If sprocket does not come off easily, a light blow on the lower edge of the sprocket (with a plastic mallet) should dislodge the sprocket.

5. If crankshaft sprocket is to be replaced, remove sprocket using Tool (J-5825) on 350 engine (fig. 42), or with Tool (J-1619) on 366 and 427 engines.

INSTALLATION

1. If crankshaft sprocket has been removed, use Tool (J-5590) as shown in figure 43 and install

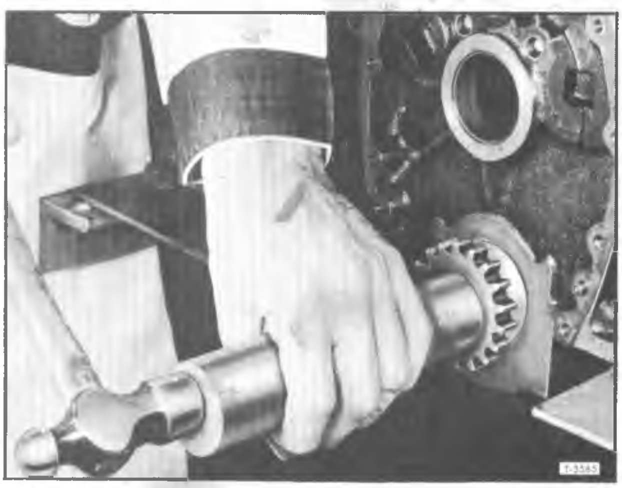


Figure 43—Installing Crankshaft Sprocket

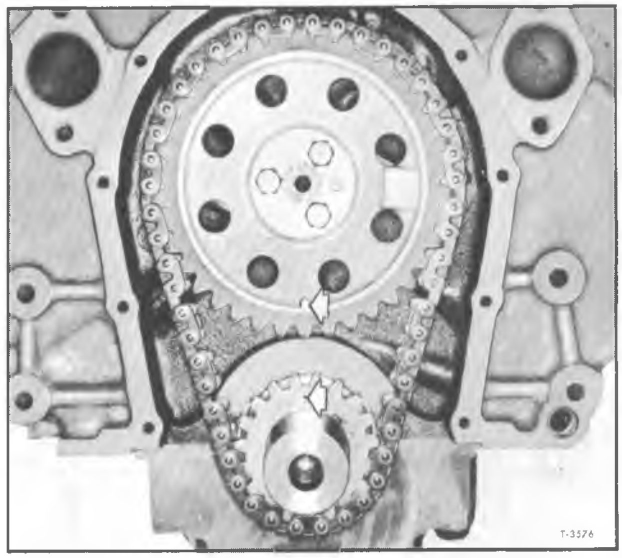


Figure 44—Marks on Timing Chain Sprockets

sprocket on 350 engine, or use Tool (J-21058) on 366 and 427 engines.

2. Install timing chain camshaft sprocket. Hold the sprocket vertical with the chain hanging down and position so alignment marks (fig. 44) are located as shown.

3. Place chain on crankshaft sprocket and push camshaft sprocket into place on camshaft, then draw the sprocket into position with three attaching bolts. Tighten sprocket bolts to 20 foot-pounds with torque wrench.

FLYWHEEL REPLACEMENT

REMOVAL

With transmission and/or clutch housing and clutch removed from engine, remove the flywheel.

INSTALLATION

1. Clean the mating surfaces on flywheel and crankshaft to make certain there are no burrs.

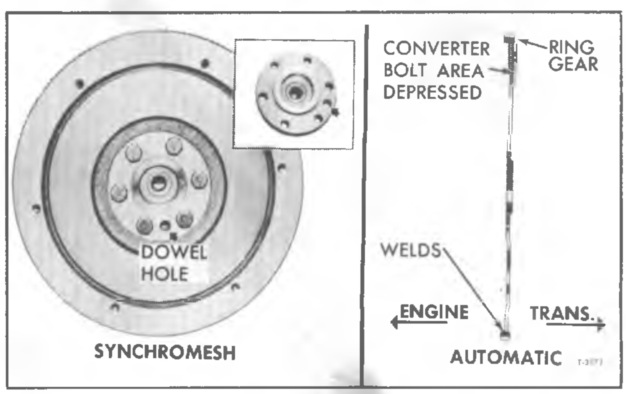


Figure 45—Flywheel Installation

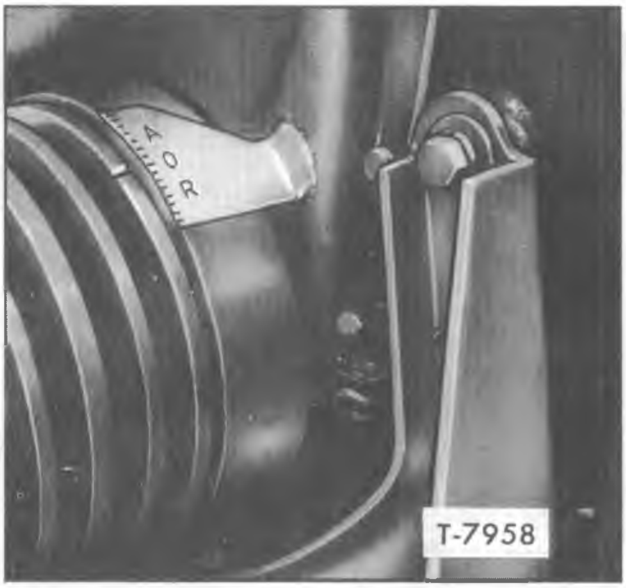


Figure 46—Ignition Timing Marks at Front of Engine (Typical)

2. Install flywheel on crankshaft and position to align dowel hole of crankshaft flange and flywheel (fig. 45).

NOTE: On Automatic Transmission equipped engines, the flywheel must be installed with the flange collar to transmission side (fig. 45).

Coat thread end of bolts with sealer, then install bolts and torque to "Specifications."

CHECKING V8 ENGINE VALVE TIMING

When it becomes necessary to make a check of valve timing, the following procedure can be used:

1. Remove valve rocker arm covers.
2. Turn crankshaft so timing mark is at the "O" mark on pointer and number 1 cylinder is ready to fire (fig. 46). At this point when moving crankshaft, the exhaust valve in number 6 cylinder will have just closed and intake valve will just begin to open. If this condition exists the valves are in time. If the exhaust valve or intake valve is open when the pointer is at the timing mark (fig. 46) the camshaft is out time.

NOTE: When the number 6 cylinder is ready to fire and the pointer is at the timing mark (fig. 46) the number 1 cylinder exhaust valve will have just closed and the intake valve will begin to open.

TORQUE WRENCH SPECIFICATIONS (IN-LINE ENGINES)

Torque wrench specifications listed below apply to clean dry threads except as otherwise indicated.

ITEM	FT.-LBS.	ITEM	FT.-LBS.
Push Rod Cover	7	Main Bearing Cap Bolts	65
Cylinder Head Bolts	95	Oil Pump Bolts	9½
Manifold Clamps (Outer)	20	Oil Filter (Throw-Away Type)	(10-15) See Text
Manifold Clamps (Except Outer)	30	Oil Filter Stud (If Used)	45
Exhaust-to-Intake Manifold	25	Crankshaft Damper	60
Thermostat Housing	30	Flywheel Bolts	
Water Outlet Housing	30	250 Engines	60
Water Pump	15	292 Engines	110
Engine Front Cover	6½	Flywheel Housing	30
Spark Plugs 13/16" Wrench Size—Gasket Type Plug	25	Oil Pan	
Spark Plugs—5/8" Wrench Size—Tapered Seat Plug	15	End Bolts	10
Connecting Rod Bolt Nuts		Bolts (Exc. Ends)	7
250 Engines	35	Oil Pan Drain Plug	20
292 Engines	40		

V8 ENGINE TORQUE WRENCH SPECIFICATIONS

ITEM	FT.-LBS.
Rocker Arm Cover	4
Rocker Arm Stud (366 and 427 Only)	50
Distributor Clamp	20
Cylinder Head	
350	65
366 and 427 Engines	80
Crankshaft Damper	85
Manifold (Inlet)	30
Manifold (Exhaust)	20
Flywheel Housing	30
Flywheel	60
Spark Plug 5/8" Wrench Size—Tapered Seat	15
Water Pump	30
Camshaft Sprocket	20
Connecting Rod Caps	
350 Engines	35
366 and 427 Engines	55
Main Bearing Caps (350 Engine)	
Inner Bolts	75
Outer Bolts	65
Main Bearing Caps (366 & 427 Engines)	
Inner Bolts	100
Outer Bolts	95
Oil Pump	65
Oil Pan	
350 Engines	5½
366 and 427 Engines	12½-15
Oil Filter	25
Oil Pan Drain Plug	20
Flywheel Housing Underpan	6-7½

Inspect engine front and rear mountings as part of regular engine maintenance program. Be sure all bracket attaching bolts are kept tight. Refer to ENGINE MOUNTINGS (SEC. 6D) for engine mounting information.

Trouble Diagnosis Chart

HARD STARTING

SYMPTOM A - SLOW CRANKING

POSSIBLE CAUSES	REMEDY
1. Heavy engine oil.	1. Change to lighter oil.
2. Partially discharged battery.	2. Charge battery.
3. Faulty or undercapacity battery.	3. Replace battery.
4. Poor battery connections.	4. Clean and tighten or replace connections.
5. Faulty starter solenoid.	5. Replace or repair solenoid.
6. Faulty starting motor or drive.	6. Overhaul starting motor.

SYMPTOM B - LOW CYLINDER COMPRESSION

POSSIBLE CAUSES	REMEDY
1. Burned or warped valves.	1. Overhaul cylinder head.
2. Improper valve lash.	2. Adjust to proper clearance.
3. Worn or broken piston rings.	3. Overhaul engine.
4. Defective cylinder head gasket.	4. Replace gasket.

SYMPTOM C - LACK OF FUEL

POSSIBLE CAUSES	REMEDY
1. Fuel lines clogged.	1. Clean fuel lines.
2. Low fuel supply.	2. Check amount of fuel in tank, fill if supply is low.
3. Clogged vent in fuel tank cap.	3. Clean or replace cap.
4. Break in fuel supply line allowing air to be drawn into fuel line.	4. Replace or repair lines.
5. Clogged fuel filter.	5. Service filter as recommended in applicable portion of ENGINE FUEL SYSTEM (SEC. 6M).
6. Water or ice in fuel system.	6. Thaw if frozen, and drain water out of tank and filters.
7. Defective fuel pump.	7. Make pressure test at pump outlet.
8. Dirty carburetor.	8. Clean carburetor.
9. Carburetor choke inoperative, or not properly adjusted.	9. Check choke operation and adjust as necessary.

SYMPTOM D - IGNITION TROUBLES

POSSIBLE CAUSES	REMEDY
1. Distributor points burned or corroded.	1. Clean or replace points.
2. Distributor points out of adjustment.	2. Adjust point gap.
3. Faulty spark plugs.	3. Clean or replace and adjust spark plug gap.
4. Defective wiring.	4. Inspect wiring and correct as required.
5. Ignition out of time.	5. Set ignition timing.

HARD STARTING (CONT.)

SYMPTOM D - IGNITION TROUBLES (Cont'd.)	
POSSIBLE CAUSES	REMEDY
6. Defective ignition coil or condenser.	6. Test coil and condenser; replace if necessary.
7. Cracked distributor cap.	7. Install new cap.

LACK OF POWER

SYMPTOM A - POOR COMPRESSION	
POSSIBLE CAUSES	REMEDY
1. Incorrect valve lash.	1. Adjust to correct clearance.
2. Leaky valves.	2. Remove cylinder head and grind valves.
3. Valves or lifters sticking.	3. Free up or replace.
4. Weak or broken valve springs.	4. Replace defective springs.
5. Valve timing incorrect.	5. Correct the valve timing.
6. Blown cylinder head gasket.	6. Replace gasket.
7. Broken or stuck piston rings.	7. Free up or replace piston rings.
8. Worn pistons, ring, and/or cylinder bores.	8. Overhaul engine.

SYMPTOM B - IGNITION SYSTEM MALFUNCTION	
POSSIBLE CAUSES	REMEDY
1. Ignition out of time.	1. Set ignition timing.
2. Defective spark plugs.	2. Clean or replace spark plugs.
3. Distributor points worn or out of adjustment.	3. Clean and adjust points or replace.

SYMPTOM C - LACK OF FUEL	
POSSIBLE CAUSES	REMEDY
1. Dirt or water in carburetor.	1. Clean carburetor.
2. Gas lines partly clogged.	2. Clean gas lines.
3. Dirt in gas tank.	3. Clean gas tank.
4. Air leaks in gas line.	4. Tighten and check gas lines.
5. Fuel pump not functioning properly.	5. Replace or repair fuel pump.
6. Governor malfunction.	6. Repair or replace governor.

SYMPTOM D - EXCESSIVE FUEL (FLOODING)	
POSSIBLE CAUSES	REMEDY
1. Choke not fully open.	1. Check choke and adjust control.
2. Air cleaner restricted.	2. Service air cleaner.
3. Carburetor float valve not seating.	3. Clean float valve and set float level.
4. Rich mixture at idle speed.	4. Adjust carburetor idle mixture.

LACK OF POWER (CONT.)

SYMPTOM D - FAULTY ACCELERATION

POSSIBLE CAUSES	REMEDY
1. Defective carburetor (accelerator pump - clogged jets).	1. Repair or replace carburetor.
2. Defective governor.	2. Repair or replace governor.
3. Air leak at intake manifold.	3. Replace gaskets and/or manifold.
4. Faulty ignition wiring.	4. Inspect for excessive resistance and defective insulation.
5. Misfiring spark plugs.	5. Clean and/or replace spark plugs.
6. Lack of cylinder compression, due to worn piston rings, burned valves, or defective head gasket.	6. Replace defective parts or overhaul engine.
7. Exhaust back pressure too high.	7. Replace or repair defective exhaust system components.

OVERHEATING

POSSIBLE CAUSES	REMEDY
1. Loose or defective fan belt.	1. Adjust or replace belt.
2. Thermostat not opening.	2. Replace thermostat.
3. Coolant loss.	3. Check for leaks and repair as necessary.
4. Partially clogged radiator.	4. Clean radiator core internal passages, and air passages.
5. Defective water pump.	5. Repair or replace pump.
6. Incorrect ignition or valve timing.	6. Retime engine.
7. Dragging brakes.	7. Adjust or repair brakes.
8. Restricted exhaust system.	8. Clean or replace exhaust system components.
9. Improper valve clearances.	9. Adjust valve clearance.
10. Ignition distributor advance inoperative.	10. Repair distributor to correct malfunction.
11. Overloaded vehicle.	11. Reduce load per vehicle rating.

NOTE: When operating vehicle in hot climate or at high altitudes, it may be necessary to check pressure cap and/or use cap with higher opening pressure to prevent boiling.

ROUGH IDLE AND/OR STALLING

SYMPTOM A - ERRATIC RUNNING OR SURGING

POSSIBLE CAUSES	REMEDY
1. Idle mixture too rich.	1. Adjust idle mixture screws.
2. Improper ignition timing.	2. Set timing.
3. Vacuum leak (air entering intake manifold).	3. Replace gasket, or tighten manifold bolts. Check and/or replace vacuum brake hose (when used).

ROUGH IDLE AND/OR STALLING (CONT.)

SYMPTOM A - ERRATIC RUNNING OR SURGING (Cont'd.)

POSSIBLE CAUSES	REMEDY
4. Inoperative crankcase ventilation valves.	4. Clean or replace valves.
5. Cylinder head gaskets leaking, or cylinder head cracked.	5. Replace cylinder head or gasket.
6. Worn valve guides.	6. Overhaul cylinder head.

SYMPTOM B - STALLING

POSSIBLE CAUSES	REMEDY
1. Engine idle speed set too slow.	1. Adjust idle speed to specifications.
2. Engine running too cool.	2. Install proper thermostat.
3. Exhaust restricted.	3. Repair exhaust system to eliminate excessive back pressure.
4. Carburetor flooding.	4. Replace defective float valve, set carburetor float level. Check fuel pump for excessive pressure.
5. Defective fuel pump.	5. Replace pump.

DETONATION (SPARK KNOCK OR PING ON ACCELERATION)

POSSIBLE CAUSES	REMEDY
1. Ignition advance too far for fuel being used.	1. Retard ignition timing.
2. Wrong type (heat range) spark plug.	2. Install correct spark plug.
3. Excessive build-up of deposits in combustion chambers.	3. Clean combustion chambers.
4. Restricted coolant passages in cylinder head causing "hot spots" in combustion chamber.	4. Remove cylinder head and clean passages.
5. Overheated engine.	5. Make corrections to lower the engine operating temperature. (Refer to "Causes" and "Remedies" previously covered under "Overheating.")
6. Lugging engine.	6. Use lower transmission gear to prevent overloading engine.

HIGH LUBRICATING OIL CONSUMPTION

POSSIBLE CAUSES	REMEDY
1. Oil lines or connections leaking.	1. Tighten or replace defective parts.
2. Leaking gaskets.	2. Replace gaskets as necessary.
3. Crankcase oil level too high.	3. Drain crankcase and refill to correct level.
4. Crankshaft oil seals worn.	4. Replace oil seals.
5. Pistons and/or rings worn, or pistons damaged; cylinder bores scored or worn.	5. Overhaul engine.

LOW ENGINE OIL PRESSURE

(When checked with engine at normal operating temperature)

POSSIBLE CAUSES	REMEDY
1. Defective oil gauge or sending unit.	1. Check pressure with master gauge. Replace oil gauge or sending unit if defective.
2. Oil viscosity too low.	2. Fill crankcase with correct oil.
3. Oil diluted with gasoline.	3. Check for indications of choke malfunction or carburetor flooding allowing gasoline to enter crankcase. Make necessary correction.
4. Suction loss.	4. Check for loose intake pipe and screen in oil pan. Also check for partially clogged inlet screen.
5. Weak or broken relief valve spring in oil pump.	5. Inspect spring and replace if necessary.

ENGINE NOISE

SYMPTOM A - VALVE MECHANISM NOISE

POSSIBLE CAUSES	REMEDY
1. Sticking valves.	1. Clean and lubricate valve stems.
2. Incorrect valve lash.	2. Adjust valve lash.
3. Bent push rod(s).	3. Determine and correct cause of push rod bending. Install new push rod.
4. Worn rocker arms and/or shaft.	4. Replace worn parts and make sure oil is reaching valve rocker arms.
5. Broken valve spring.	5. Replace spring.
6. Damaged valve lifter and/or camshaft.	6. Replace lifter and/or camshaft.

SYMPTOM B - BEARING NOISE

POSSIBLE CAUSES	REMEDY
1. Insufficient oil supply.	1. Check oil level and add oil as required.
2. Low oil pump pressure.	2. Remove and inspect oil pump and inlet screen. Make necessary corrections.
3. Thin or diluted oil.	3. Change oil. Use oil with proper viscosity.
4. Excessive bearing clearance.	4. Remove oil pan and make bearing replacement or repairs.
5. Piston pins loose fit in connecting rod or piston.	5. Install new piston pins (oversize pins if req'd.).
6. Piston to cylinder bore clearance excessive (piston slap).	6. Overhaul engine.

NOTE: When diagnosing engine noise problems, be careful that noises caused by accessories such as air compressor and power take-off are not mistaken for engine noises. Removal of accessory drive belts will eliminate any noises caused by these units.

SECTION 6D
Engine Mountings

Cushion-type mountings are used at all engine mounting points. Dual front mounts are used with all In-line engines.

The various types of mountings are illustrated in figures 1 through 6.

Engine mountings should be inspected periodically and replaced if found damaged or deteriorated.

IMPORTANT: Broken or deteriorated mounts can cause misalignment and eventual destruction of certain drive train components. Also, when a single mounting failure occurs, the remaining mounts are subjected to abnormally high stresses.

When inspecting engine mounts, check all attaching bolts and nuts for tightness. Refer to Torque Chart shown below:

> CAUTION: Raise rear of power plant only high enough to permit removal of upper cushion; and provide safety blocking to prevent tipping and possible damage to front mountings.

MOUNTING CUSHION REPLACEMENT

IMPORTANT: When supporting engine to replace a mount, raise engine only to height required to replace the mount. If raised beyond this height, possible damage to wiring, lines and control linkage could occur.

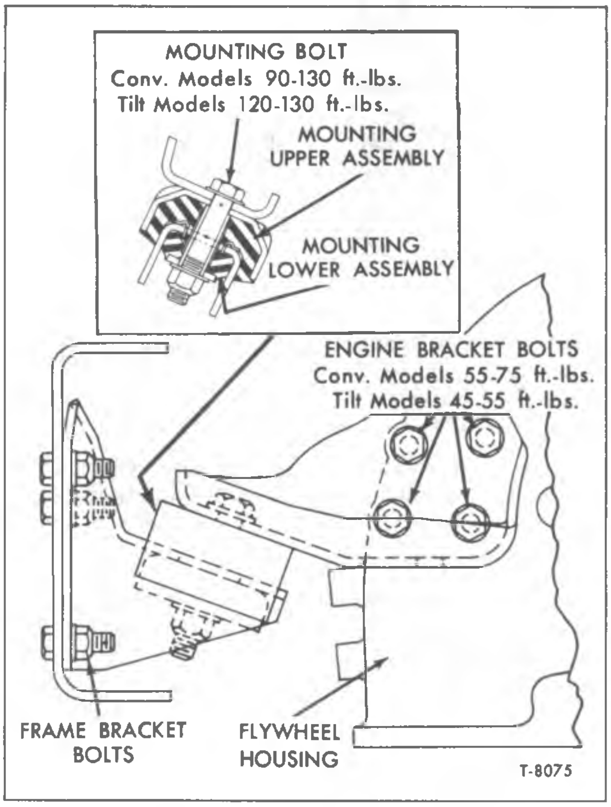


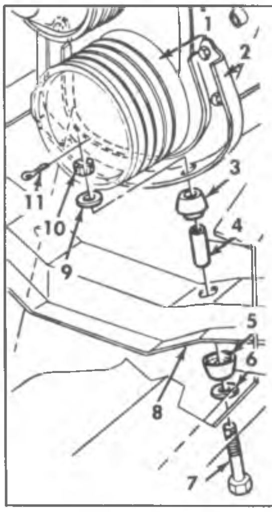
Figure 1—Engine Rear Mounting at Frame Bracket (Typical)

ENGINE MOUNTING TORQUE CHART

ENGINE FRONT MOUNTINGS			ENGINE REAR MOUNTINGS		
Models	Mounting Bracket To Engine Bolts	Mounting Bolts	Mounting Bracket To Engine Bolts	Mounting Bolts	Mounting Bracket To Frame Bolts
TE50 - 350 Eng.	35-45	70-80	-	55-75	-
- 366 Eng.	-	25-30	-	55-75	-
TE60 - 366 Eng.	-	*25-30	-	55-75	-
- 427 Eng.	-	*25-30	85-105	* 70-80	-
TS50	40-50	55-75	-	55-75	-
CE50-60; ME50					
366 Engine	30-40	*30-40	-	55-75	-
427 Engine	30-40	*30-40	80-120	*180-260	-
CS-SS-40-50	40-50	55-75	-	55-75	-
CE40; CE-ME-60	-	30-40	-	55-75	-

*Nut Torque

ENGINE MOUNTINGS



1 Crankshaft Pulley
2 Engine Support Bracket
3 Upper Cushion
4 Spacer
5 Lower Cushion
6 Washer
7 Engine Support Bolt
8 Crossmember
9 Washer
10 Nut (Conventional Models 30-40 Ft.-Lbs.) (Tilt Cab Models 25-30 Ft.-Lbs.)
11 Cotter Pin

T-8069

Figure 2—Engine Front Mounting (V8 Gasoline Engine Model)

When replacing either rear mount it is necessary to raise only that particular side of engine.

1. Before lowering engine onto new mounting cushion, make sure cushion, bolts and bolt spacers (if used) are positioned properly. Refer to applicable illustration.

NOTE: If an alignment dowel is used at mounting make certain that it engages the locating hole in mating part.

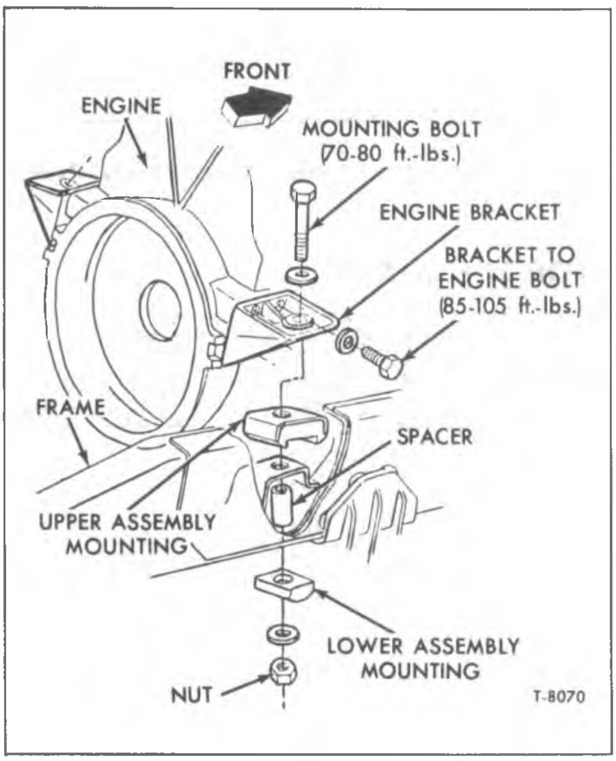


Figure 3—Engine Rear Mounting (CE, ME, and TE60)

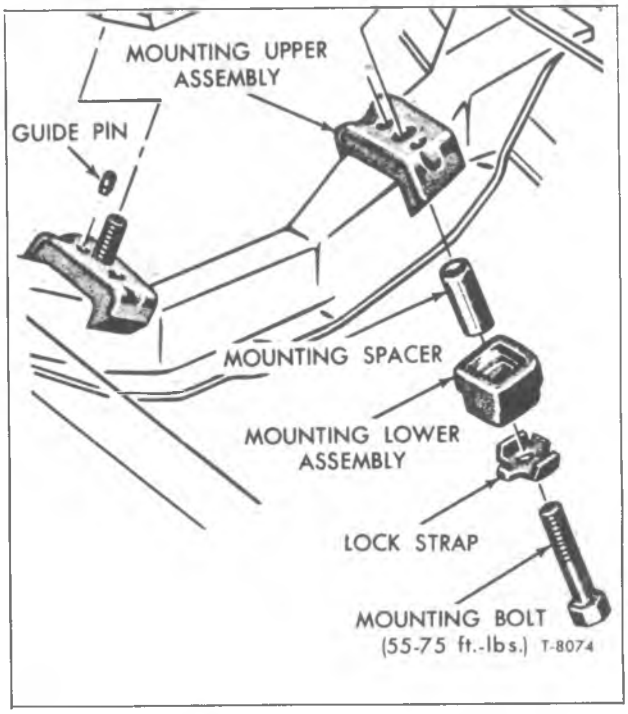


Figure 4—Engine Rear Mounting on Crossmember (CE, CS, ME50 and 60 and TE50)

2. With cushion components in place, lower engine just enough to allow starting of all attaching bolts.

3. After bolts are started, lower engine to mount, then with all components in position, tighten the attaching bolts and nuts to torque specified in Torque Chart on previous page.

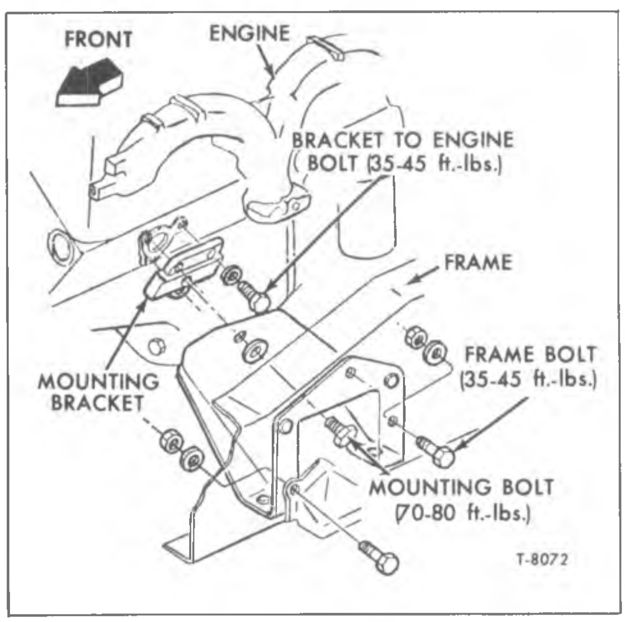


Figure 5—Engine Front Mounting (TE50)

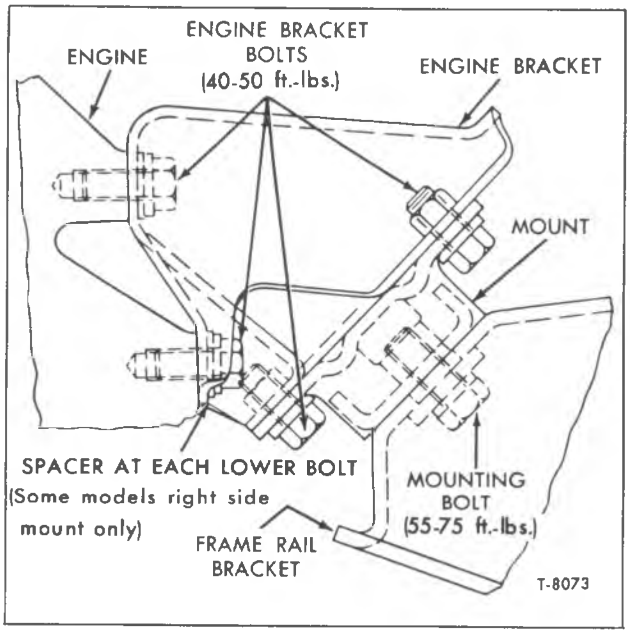


Figure 6—Front Mounting for In-Line Engine (CS40, CS, SS50; TS50) (Typical)

IMPORTANT: If a lock strap is used at mounting bolts or nuts, install the same to secure the mounting.

ENGINE FRONT MOUNT REPLACEMENT (V8 GASOLINE ENGINE MODELS)

REMOVAL (Refer to Fig. 2)

1. Remove cotter pin (11) at each mounting bolt, then loosen mounting bolt nuts.
2. Raise engine high enough to remove weight from cushions (3 and 5).
3. Remove mounting bolt nuts, bolts, spacers, and cushions.

INSTALLATION (Refer to Fig. 2)

1. Position cushions (3) on top of crossmember, and assembly spacers (4), cushions (5), washers (6), and bolts (7) through crossmember and mounting components.
2. Insert top of bolts through holes in engine mounting bracket and install castilated nuts. Torque nuts to 30-40 foot-pounds. Install cotter pins.

SECTION 6K

Engine Cooling System

GENERAL DESCRIPTION

A pressure cooling system is provided for on all models by a pressure type radiator cap (fig. 1). The pressure type radiator cap used is designed to hold a pressure above atmospheric pressure in the cooling system. Excessive pressure is relieved by a valve within the cap that opens to radiator overflow.

The water pump is a ball bearing, centrifugal vane impeller type. It requires no care other than to make certain the air vent at the top of the housing and the drain holes in the bottom do not become plugged with dirt or grease. Removal and installation of the water pump is covered in this section. Failure of the pump will necessitate pump replacement.

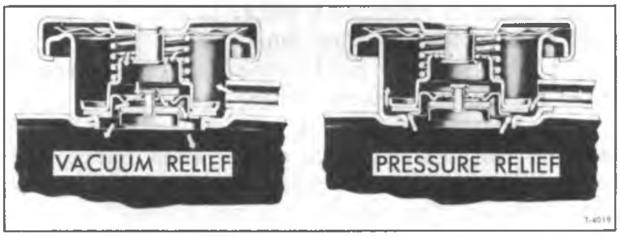


Figure 1—Pressure Type Radiator Cap

NOTE: For information covering radiator and cooling fan shrouds and also radiator cores refer to RADIATOR AND SURGE TANK (SEC. 13) of this manual.

MAINTENANCE AND ADJUSTMENTS

INSPECTION OF SYSTEM

Although action of the cooling system controls the operating temperature of the engine, improper ignition timing (gasoline engines) or improper or insufficient lubricating oil in the engine crankcase may cause the engine to overheat, even though the cooling system is functioning properly. These items should also be checked for cause of improper cooling.

CAUTION: When the engine is at normal operating temperature or above, the internal pressure built up in the cooling system will blow out scalding fluid and vapors if the radiator cap is suddenly removed. To prevent loss of coolant and to avoid the danger of being burned, the coolant level should be checked, or coolant added, only when the engine is cool. If the cap must be removed when the engine is hot, place a cloth over the cap and rotate the cap slowly counterclockwise to first stop and allow pressure to escape completely. Then turn cap again slowly counterclockwise to remove.

Cooling systems must be kept air-tight. As the pressure in the system raises the boiling point of the coolant, any air leak would lower boiling point and result in loss of coolant. Check radiator cap seal and all radiator connections. Entire cooling system can be checked for leaks in castings, connection hoses, gaskets, pressure valves, and filler cap using a conventional cooling system testing kit which can usually be obtained locally.

DRAINING COOLING SYSTEM

1. Remove radiator filler cap.
2. Remove plug or open drain cock at bottom of radiator core.
3. Remove drain plug at each side of cylinder block.
4. If tilt cab model, place heater temperature control in "HEAT" position.
5. Remove drain plug from bottom of engine oil cooler (if equipped).
6. Remove drain plug from bottom of cooling system filter assembly (if equipped).
7. If vehicle is equipped with a water-cooled air compressor, disconnect air compressor coolant hose from side of cylinder block.

FILLING COOLING SYSTEM

When cold water is poured into the radiator, the thermostats will close even though the engine is warm. This action may trap air in cylinder block and head passages. The trapped air will leak through the thermostat vents thereby lowering the water level.

Use The Following Method When Filling System:

1. If vehicle is equipped with heater, the control valve (tilt cab models) must be wide open before filling cooling system. This operation is to prevent air from being trapped in heater and lines.

2. When checking level of coolant, remove radiator cap SLOWLY (if engine is hot). No additional water is required if water is visible in filler neck or at bottom of filler tube.

3. Fill radiator until water can be seen through filler neck or to bottom of filler tube.

4. Add more water slowly until no more air bubbles can be seen. Run engine a few minutes to further expel air, then add more liquid if necessary to bring it up to proper level.

5. If vehicle is equipped with a water-cooled air compressor, vent air from compressor cooling cavities and connecting lines by loosening small hex plug at high side of compressor.

6. Do not overfill if anti-freeze solution is used.

CAUTION: DO NOT POUR COLD WATER IN RADIATOR WHILE ENGINE IS HOT. Wait until boiling ceases, then add water slowly while engine is idling. Install radiator cap firmly.

CLEANING SYSTEM

Unless water in cooling system is treated with a corrosion preventive, rust and scale may eventually clog water passages in radiator and water jackets. This condition is aggravated in some localities by the formation of insoluble salts from water used.

Cleaning solutions, commercially available, will successfully clean cooling systems of rust, scale, sludge, and grease when used as directed by the manufacturers. However, if radiator is clogged with insoluble scale formations, reliable radiator service stations in the various localities are best equipped to remove such formations.

GM Cooling System Cleaner or other commercial cleaning solutions are especially effective in removing rust, scale, and corrosion from the radiator and engine water passages. Use cleaner only as directed on label. Particularly at winter check-up, preferably before and after using anti-freeze solutions, radiator and entire system should be cleaned with a recommended cleaning solution as follows:

CLEANING

1. Drain system, then close cocks and install drain plugs.

2. Fill system with cleaning solution. Always follow manufacturer's directions.

3. With radiator covered and radiator cap on tight, run engine 15 to 20 minutes at fast idle speed. Drain system completely.

4. If cleaning solution used requires a neutralizer, use as directed by manufacturer.

FLUSHING

Before pressure flushing system, tighten cylinder head bolts to prevent possible water leaks into cylinders and crankcase and remove thermostats. When pressure flushing, apply air gradually, as radiator will stand only a limited pressure.

CORROSION PREVENTION

Use of water containing lime, alkali, and other impurities is a major cause of rust and scale formation in cooling system. Air or exhaust gas leaking into the system can also be cause of rust and corrosion. A rust preventive, inhibitor, or water filter should be used continuously.

Drain and flush cooling system every 24 months and add new anti-freeze solution.

INHIBITORS AND SEALERS

In general, inhibitors are not cleaners and will not remove scale and rust already formed. GM Cooling System Inhibitor and Sealer will retard rust and scale formation and is compatible with aluminum components. Inhibitor and sealer should be used immediately after new anti-freeze solution has been added to system and every fall thereafter.

It is important not to use too much inhibitor or to use two different types at the same time.

NOTE: USE INHIBITOR AND SEALER ONLY AS INSTRUCTED ON LABEL.

AIR SUCTION TEST

Air may be drawn into system due to low liquid level in the radiator or surge tank, leaky water pump, or loose hose connections. This action will also cause corrosion.

1. Replace radiator cap having integral pressure relief valve with a plain filler cap less the relief valve.

2. If a separate pressure relief valve is used, remove valve and install pressure valve opening cover. Make sure gasket is in good condition.

3. Make sure radiator cap seal is in good condition and will make an air-tight seal. Adjust level of cooling liquid in radiator, allowing ample room for expansion to avoid any overflow loss during test.

4. Attach a length of rubber tube to lower end of overflow tube. This connection must be air-tight. Run engine with transmission in neutral at a safe

speed until temperature gauge stops rising and remains stationary.

5. Without changing engine speed, put end of rubber tube in a bottle of water, avoiding kinks and sharp bends that might block flow of air. Watch for bubbles in bottle of water. The continuous appearance of bubbles indicates that air is being sucked into the cooling system.

6. Correct condition by tightening hose clamps and fitting connections. Also, examine all hoses carefully and if cracked, swollen, or deteriorated in any way, replace with new hose.

EXHAUST GAS LEAKAGE TEST

Exhaust gas may be blown into the cooling system past cylinder head gasket or through cracks in the cylinder head and block. This action will also cause corrosion and possible damage to engine combustion chamber components.

1. Start test with engine cold. Remove drive belt to prevent water pump operation.

2. Partially drain cooling system until cooling liquid level is at top of thermostat well. Remove thermostat(s) and add coolant until level is at top of thermostat well.

3. With transmission in neutral, start engine and accelerate it several times.

4. Watch for bubbles in water or smoke at surface of coolant while accelerating engine. Also watch when engine speed drops back to idle. The appearance of bubbles or a sudden rise of cooling liquid indicates exhaust gas leakage into cooling system. Make test quickly before boiling starts as steam bubbles will give misleading results.

5. If exhaust gas leakage is evident, replace cylinder head gasket or gaskets, then test again. Tighten cylinder head bolts to torque specified in GASOLINE ENGINES (SEC. 6A). If leaks are still evident, cylinder head or block may be cracked. Correct cause of leakage, then install thermostats and adjust drive belt. Fill cooling system.

COLD WEATHER OPERATION

Water, with an inhibitor, can be safely used as a cooling medium in climates where temperatures do not reach below 32°F. In lower temperatures, anti-freeze solutions must be used. Before installing anti-freeze solution, cooling system should be inspected and serviced for cold weather operation, as previously described under "Cleaning System."

Cylinder head bolts should be checked for tightness and gasket replaced if necessary, to avoid possibility of anti-freeze solution leaking into engine, and exhaust gases entering cooling system. After anti-freeze solution has been installed, entire system should be inspected regularly for leaks.

THAWING COOLING SYSTEM

If cooling medium in system becomes frozen solid, place vehicle in warm place until ice is completely thawed out. UNDER NO CIRCUMSTANCES SHOULD ENGINE BE RUN WHEN COOLING SYSTEM IS FROZEN SOLID.

The inhibited year-around (permanent-type) engine coolant, used to fill the cooling system at the factory is a high quality solution that meets General Motors Specification 1899-M. This factory-fill coolant solution is formulated to withstand two full calendar years of normal operation without draining or adding inhibitors, and provides freezing protection to -20°F.

It is the owner's responsibility to keep the freeze protection at a level commensurate with the area in which the vehicle will be operated. Regardless of climate, system protection should be maintained at least to 0°F., to provide adequate corrosion protection. When adding solution due to loss of coolant for any reason, or in areas where temperatures lower than -20°F., may occur, a sufficient amount of an ethylene glycol base coolant that meets GM Specification 1899-M should be used.

Every two years the cooling system should be serviced by flushing with plain water, then completely refilled with a fresh solution of water and a high-quality, inhibited (permanent type) glycol base coolant meeting GM Specification 1899-M, and providing freezing protection at least to read 0°F. At this time, also add GM Cooling System Inhibitor and Sealer or equivalent. In addition, Cooling System Inhibitor and Sealer should be added every fall thereafter. GM Cooling System Inhibitor retards the formation of rust or scale and is compatible with aluminum components.

IMPORTANT: Alcohol or methanol base coolants or plain water are not recommended for your truck at any time.

WATER TEMPERATURE INDICATOR

Electric type temperature gauge system consists of an engine thermal plug electrically connected with registering gauge mounted on instrument panel. Refer to applicable wiring diagram in "Wiring Diagram" booklet. System is activated when ignition is turned on.

In-line engines have sending unit installed at the front left side of cylinder and on all V-8's covered by this manual the sending unit is mounted on the left cylinder head.

WATER TEMPERATURE INDICATOR TEST

1. Disconnect wire at engine unit.

2. Connect a test light consisting of a 12-volt, 2-candlepower bulb and a pair of test leads in cir-

cuit by clipping one lead to battery positive terminal and other lead to body of engine gauge unit. If bulb lights, unit is properly grounded. If bulb does not light, check for presence of sealing compound around threads of unit. Remove compound and repeat test. Make sure unit is properly grounded before proceeding with next test.

3. Remove test lead from body of unit and connect lead to terminal of unit. If bulb lights, engine unit is internally short-circuited and should be replaced.

4. Remove test light and reinstall wire on unit.

5. If engine unit tests satisfactory under the previous conditions, check the following items according to nature of difficulty:

a. If gauge does not register when ignition or control switch is turned on: This may be caused by a break in the circuit between the gauge and the switch or a short between this lead and ground.

b. If gauge shows high temperature under all conditions, wire leading from gauge to engine unit is shorted to ground.

c. If gauge registers a low temperature under all conditions, wire between gauge and engine unit is broken.

Do not attempt to repair either the engine unit or the gauge. When installing new engine unit, do not use thread compound on unit threads, as this will increase electrical resistance of unit and cause faulty reading on gauge.

ENGINE OVERHEAT ALARM

An engine overheat alarm is available as optional equipment on V8 models. The alarm sending unit is located on outside of left cylinder head.

The body of the overheat switch is made of brass, while the body of the temperature gauge sending unit is zinc plated.

The alarm system is interconnected to a telltale light and, on some vehicles, to a buzzer. The purpose of this system is to signal the driver when engine temperature exceeds a safe range. Refer to appropriate wiring diagram in applicable "Wiring Diagrams" manual for alarm system circuit. Overheat temperature switch is not repairable and must be replaced as an assembly or unit.

TESTING ENGINE UNIT AND CIRCUIT

NOTE: Before testing engine unit, make the following circuit tests:

Circuit Tests

1. Disconnect wire at engine unit.

2. Connect a test light consisting of a 2-candlepower 12-volt bulb and a pair of test leads in circuit by clipping one lead to a hot terminal and other lead to body of engine unit. If bulb does not light, check for presence of sealing compound, oil or paint around threads of unit. Remove insulating substance and repeat test. Make sure unit is properly grounded before proceeding with tests.

3. Remove test lead from body of engine unit and connect lead to terminal of unit. Then providing engine water temperature is not exceeding switch setting, and the bulb lights, engine unit internally short-circuited and should be replaced. Refer to "Specifications" for switch setting.

4. Remove test light and reinstall wire on engine unit.

5. If alarm buzzer sounds and/or tell-tale lights under all conditions with engine control switch in "ON" position, wire leading from buzzer or light to engine unit is shorted to ground.

6. With engine control switch in "ON" position, and light does not come on when terminal at temperature switch is shorted to ground, a break or short in wire between engine unit and engine control switch is indicated.

7. When installing engine unit, do not use thread compound on unit threads, as this will increase electrical resistance and cause faulty reaction.

Testing Switch Contacts

NOTE: Switch unit must be removed from engine manifold in order to make this test. Before testing unit, be sure that entire unit is pre-heated to approximately engine temperature.

Insert unit tube and lower half of body threads in hydraulic oil, heated to a temperature 15°F. to 20°F., higher than unit point contact setting listed in "Specifications." Agitate oil thoroughly (and gently tap unit). If points contact readily, correct working of instrument is indicated.

ENGINE THERMOSTATS

Thermostats are installed in engine water outlet manifold on all gasoline engines.

Thermostats consist of a restriction valve controlled by a thermostatic element. Restriction valve cracks or just starts to open at predetermined temperature and continues to open as engine coolant temperature increases.

NOTE: To assure proper cooling and engine warm-up it is very important that the correct thermostat be used. Refer to "Specifications" at the end of this section for correct thermostat application.

THERMOSTAT CHECK

if it is suspected that thermostat is not functioning properly, remove thermostat assembly. If

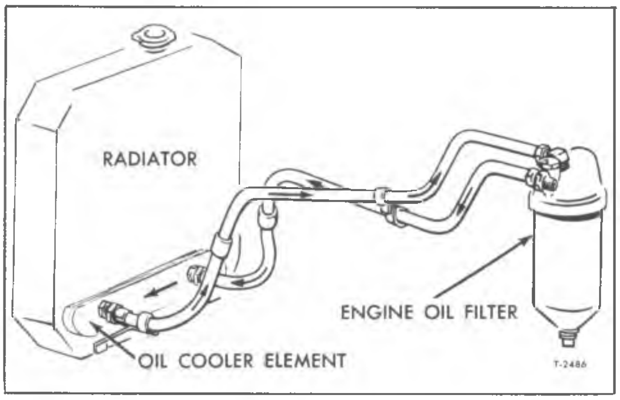


Figure 2—Oil Cooler Circuit (Typical)

the thermostat appears to be in good condition, the following test should be conducted:

Suspend thermostat and thermometer in water with thermometer located close to thermostat. Thermostat must be completely submerged and water thoroughly agitated while heating. Apply heat to the water and record both the temperature at which the thermostat begins to open and the temperature at which the thermostat is fully open.

Compare temperature readings taken in the test with those given under "Thermostats" in "Specifications" at end of this section.

Do not attempt to repair thermostat. If thermostat does not function properly, replace with new unit which has been checked as directed above.

Use new gasket when installing thermostat. Fill cooling system, then run engine until normal operating temperature is reached. Check for coolant leakage at thermostat cover gasket.

OIL COOLER

Models equipped with oil cooler use the type of oil cooling system shown in figure 2. Oil is filtered, circulated through oil cooler, and returned to engine.

If engine difficulties are encountered and there is suspicion that foreign matter has entered the oil cooler, the oil cooler and connecting lines must be flushed before engine is put back into operation.

Oil cooler, located at bottom of radiator core, should be flushed in the following manner:

1. Disconnect oil cooler lines at oil filter.
2. Back-flush oil cooler and lines using clean solvent and compressed air. DO NOT EXCEED 100 PSI AIR PRESSURE.
3. Remove all remaining cleaning solvent from the system with compressed air.
4. Flush system again with the same type of oil normally circulated through the cooler.

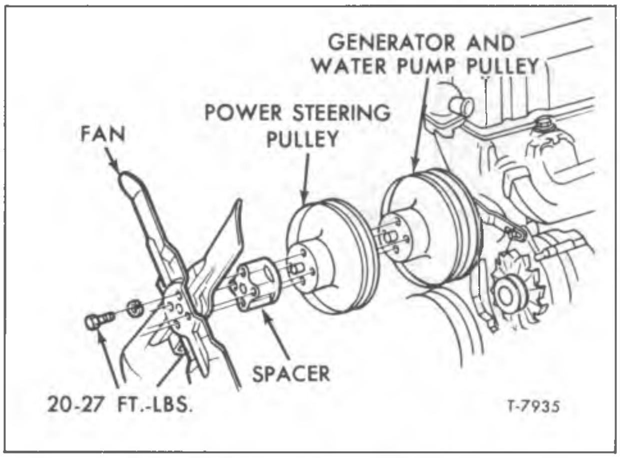


Figure 3—Fan and Drive Pulleys (CS40)

5. Test flow of oil through cooler. If flow is not restricted, reconnect oil cooler lines. If flow is restricted, have oil cooler element replaced by a radiator specialist.

FAN AND DRIVE BELTS

DRIVE BELT TENSION ADJUSTMENT

Drive belts must be kept at proper tension. A loose or broken belt will affect operation of driven accessory. A belt that is too tight will place excessive stress on the bearings within driven accessory.

V-Belt Tension

Fan belt tension on vehicles equipped with V-belts should be adjusted to 120-130 pounds on new belts, using belt tension gauge (J-23600). Used drive belts should be adjusted to 80-90 pounds. Gauge should be placed at the center of the greatest span.

NOTE: A V-belt is considered "used" after two hours of operation or approximately 50 to 100 miles.

DRIVE BELT REPLACEMENT

On some vehicles, several accessories may be driven from multiple groove crankshaft pulley, and the replacement of any one inside drive belt will make it necessary to remove all the outside belts first.

NOTE: Instructions for replacing power steering drive belt are given in "POWER STEERING" (SEC. 9B) of this manual. Refer to AIR COMPRESSOR AND GOVERNOR (SEC. 6T) of this manual for adjustment and replacement instructions for air compressor drive belts.

IMPORTANT: When replacing dual or triple drive belts, it is essential that entire set be replaced at same time. Belts are available in matched sets only.

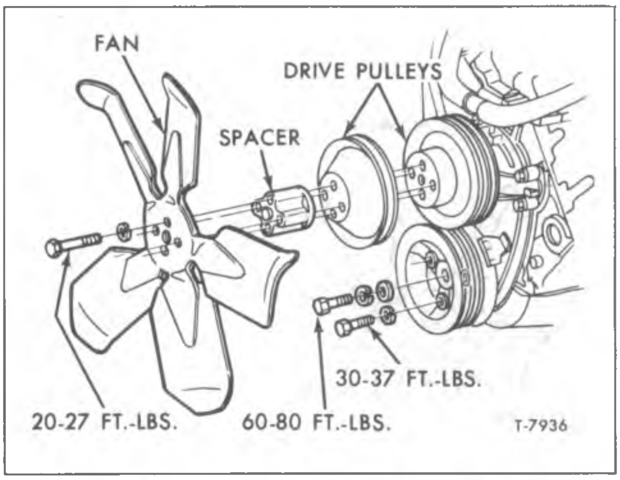


Figure 4—Fan and Drive Pulleys (CE40; CE, SE50)

1. Remove the air compressor drive belt (if equipped).
2. Loosen bolt at generator adjusting arm and loosen two pivot bolts at generator support bracket.
3. Move generator toward engine until belts can be removed from pulley.
4. To install new belts, position belts on pulleys and move accessory away from engine until a tension of 120 to 130 pounds is measured using tool (J-23600).
5. Tighten accessory adjusting arm bolt and pivot bolts.
6. Install air compressor drive belt (if equipped).

FAN AND DRIVE PULLEY REPLACEMENT

NOTE: On conventional cab models the fan is attached to the water pump pulley, while on tilt cab models the fan is driven from the crankshaft.

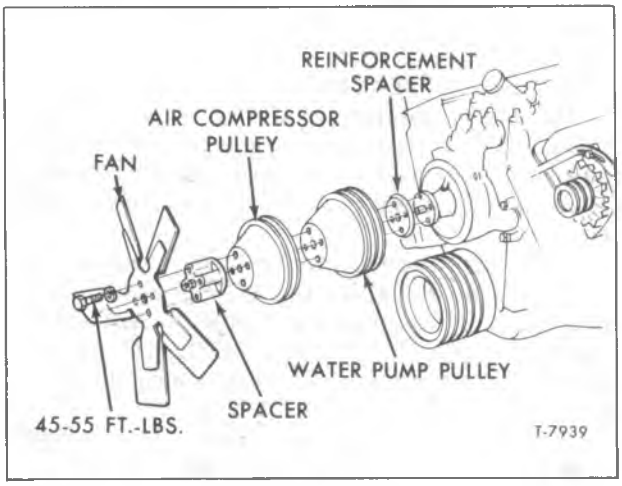


Figure 5—Fan and Drive Pulleys (CE, ME60)

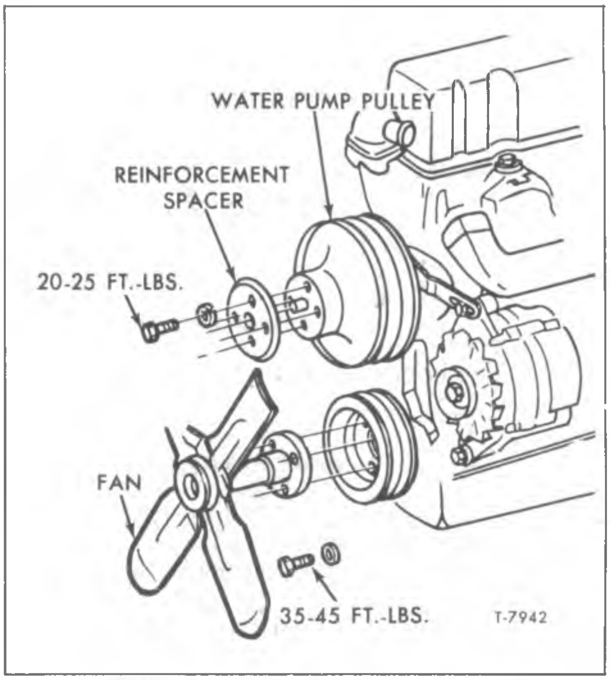


Figure 6—Fan and Drive Pulleys (TS50)

Conventional Cab Models
(Refer to Figures 3 Thru 5)

1. Loosen all belts driven by water pump drive hub.
2. Remove bolts holding fan to water pump drive hub.
3. Remove fan, spacers (when used), and pulley(s).
4. Carefully inspect fan and pulleys for cracks or distortion. Replace all damaged components.
5. Carefully install all components in sequence,

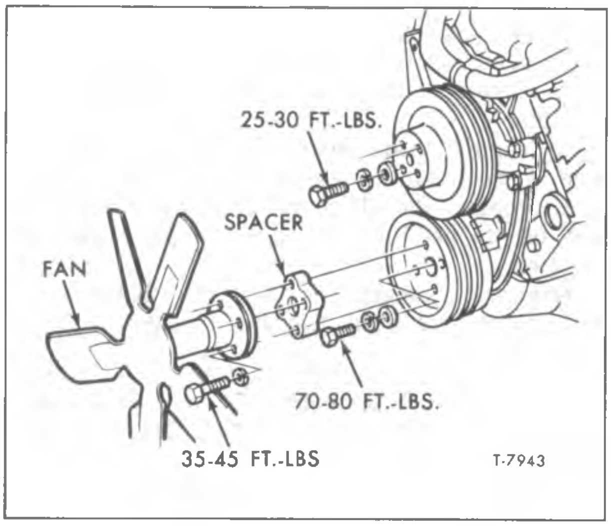


Figure 7—Fan and Drive Pulleys (TE50)

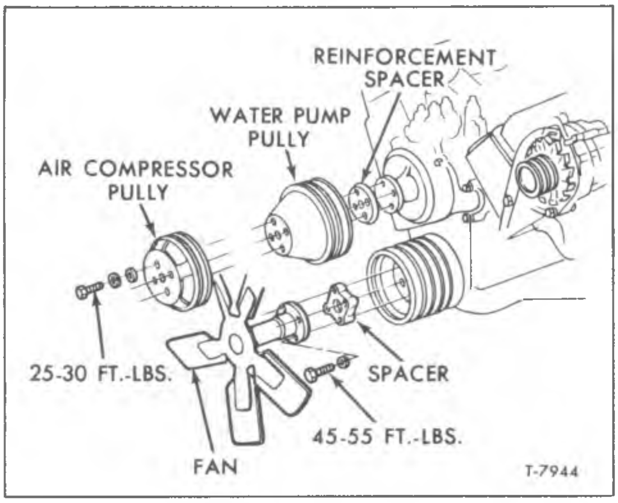


Figure 8—Fan and Drive Pulleys (TE60)

as shown. Be sure all fasteners are tightened to the proper torque value.

Tilt Cab Models - In-Line and V8 Engines (Refer to Figures 6 Thru 8)

1. Loosen all drive belts driven by crankshaft pulley.

2. Remove bolts holding fan hub to pulley hub (damper).

3. Remove fan, spacer (when used), and pulley(s).

4. Carefully inspect fan and pulleys for cracks, distortion, or other damage. Replace all defective components.

5. Carefully install all components in sequence, as shown. Be sure all fasteners are tightened to the proper torque value.

WATER PUMPS

REMOVAL (Refer to Figs. 9 and 10)

1. Drain cooling system.
2. Remove fan (Conventional Cab Models), spacers (when used), and pulley(s) from water pump drive hub as described previously in this section under "Fan and Drive Pulley Replacement."
3. Remove all hoses attached to water pump.
4. Remove bolts and washers holding pump to front of engine. Remove pump and discard gasket.

WATER PUMP OVERHAUL

For water pump overhaul information refer to applicable engine overhaul manual.

INSTALLATION (Refer to Figs. 9 and 10)

1. Position new gasket and the water pump on the front of engine. Install bolts and washers holding pump to engine. Tighten bolts to proper torque as shown.

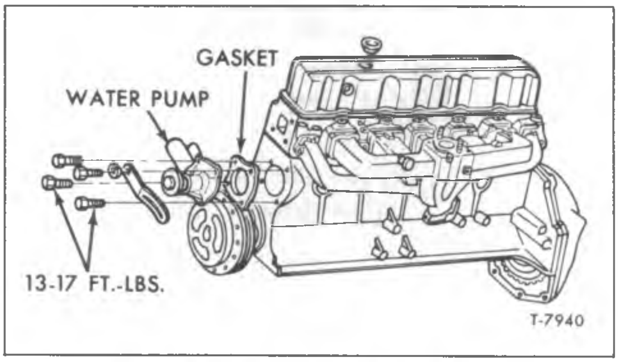


Figure 9—In-Line Engine Water Pump

2. Reconnect all hoses to water pump.
3. Install pulley(s), spacers, and fan (Conventional Cab Models) as described previously in this section under "Fan and Drive Pulley Replacement."
4. Refill cooling system.

ENGINE BLOCK HEATER

An optional engine block heater used to heat engine coolant for starting engines in cold climates is available. The unit consists of a heating coil that fits in the engine block. An attached electrical cord with a plug provides heat to warm cold engines. The unit on 250, 292, 366 and 427 engines is located on the lower front right side of the block. On the 350 engine, the unit is located on the lower rear right side of the block. If element fails to heat water in engine block, check electrical cord and connections for defects before replacing heater element.

HEATER ELEMENT REMOVAL

1. Remove plug end from element unit.
2. Remove screw by turning counterclockwise and remove carefully. Do not score machined surface of hole.

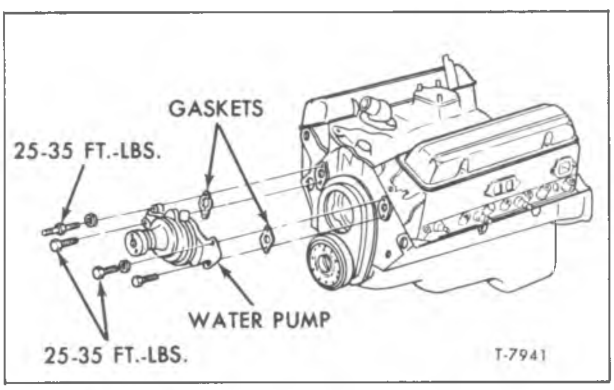


Figure 10—V8 Engine Water Pump

ENGINE COOLING SYSTEM

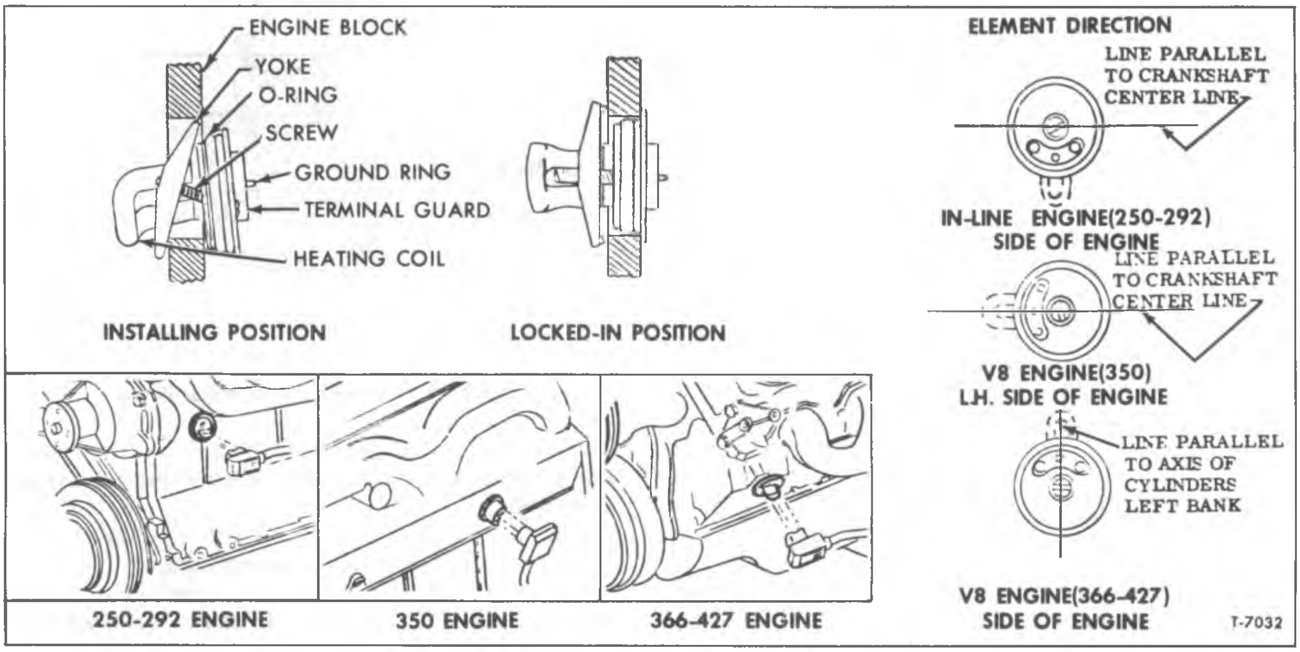


Figure 11—Engine Block Heater

HEATER ELEMENT INSTALLATION

1. Thoroughly clean plug hole.

2. Apply a coating of grease or vaseline to the O-ring and machined surface of hole (this prevents damage to the O-ring and makes installation easier).

3. Back off the #10-32 screw by turning counterclockwise to the thread limit. This allows center axis of screw carrying the yoke to take up angular positions relating to the center line axis of the heater.

4. To install into engine block, merely insert the hairpin end of the heating coil into the opening and one end of the yoke into the inside face of the block. In this displaced position it allows the other end of the yoke to be pushed beyond the inside face of the engine block (refer to fig. 11). To insert support into block, merely center the axis of the heater and the axis of the core hole and push support in as far as it will go.

5. Tighten screw in clockwise direction to 14-20 inch-pounds torque.

> CAUTION: Excessive tightening is not necessary.

6. Check cord to ensure that it does not touch engine, hot pipes, manifold, or any moving parts. Slack can be taken up between clips.

SPECIFICATIONS

The cooling system capacities listed below apply to vehicles with standard equipment only. Because of some optional equipment which may be used, air conditioning, larger engine, water filter, increased cooling, etc., the capacity of cooling system will vary. For the purpose of obtaining an accurate cooling system capacity before adding anti-freeze to an optional equipped vehicle, it is recommended that the cooling system be first replenished until visible in filler opening and then drained into a graduated container of which the contents can be measured.

COOLING SYSTEM CAPACITIES (QTS) INCL. HEATER

TRUCK MODELS	QUARTS	
	U.S.	IMPERIAL
CE40	21.0	17½
CS40	16.0	13¼
CE50	20.0	16¾
CS, SS50	17.0	14¼
TE50	28.0	23¼
TS50	24.0	20
CE, ME60	33.0	27½
CM, TE60	35.0	29¼

ENGINE THERMOSTATS

ENGINE	NUMBER USED	MEAN TEMP. (°F.)	STARTS TO OPEN (°F.)	FULLY OPEN (°F.)
250; 292	1	195	192-198	217
350	1	195	192-198	217
366; 427	2	180	177-183	202

ENGINE OVERHEAT SWITCH

SWITCH CONTACTS CLOSE AT:

V8 Gasoline Engines....................................250° F.

SECTION 6M

Engine Fuel System

Contents of this section are listed in Index below:

Gasoline Engines

NOTE: For recommended fuel refer to "Owner's and Driver's Manual."

ACCELERATOR AND THROTTLE LINKAGE ADJUSTMENT

ACCELERATOR LINKAGE ADJUSTMENT

The following procedure applies to all vehicles covered by this manual, with the exception of those models equipped with Allison Automatic Transmission. For adjustment of accelerator linkage on Allison equipped vehicles refer to "TRANSMISSION CONTROL LINKAGE" (SEC. 7A) in this manual.

1. Depress accelerator pedal against accelerator pedal stop (inside cab).
2. Hold carburetor throttle lever in wide open position.
3. Rotate swivel on accelerator control rod until it freely enters hole in throttle lever or pedal lever, depending on location of swivel.
4. Secure swivel in proper location with retaining clip.

MANUAL THROTTLE ADJUSTMENT

NOTE: Manual throttle is optional equipment on some models covered by this manual.

1. Check accelerator linkage for free movement and to be sure pull-back spring returns accelerator linkage to idle position.
2. Check to see that hand throttle wire housing is clamped securely at bracket.
3. Position hand throttle knob 1/16-inch from instrument panel, then loosen trunnion screw and move wire trunnion to make light contact with hand throttle lever. Tighten trunnion screw, then check operation of hand throttle.

If properly adjusted, initial movement of hand throttle control handle will cause increase in engine speed; and when handle is pushed in, engine will return to idle speed.

FUEL FILTERS

Rochester carburetors used on In-line and 350 cu-in. engines are equipped with a pleated paper-type filter (fig. 1) and should be replaced at 12,000-mile intervals. A frame mounted fuel filter (fig. 2) is standard equipment on CE, SE-50 and optional on CE, CS 40 and CS, SS 50. Replacement interval for both carburetor filter and frame-mounted fuel filter element is 12,000 miles.

Holley carburetors used on 366 and 427 engines are equipped with a screen located at the fuel inlet to the carburetor. This screen should be

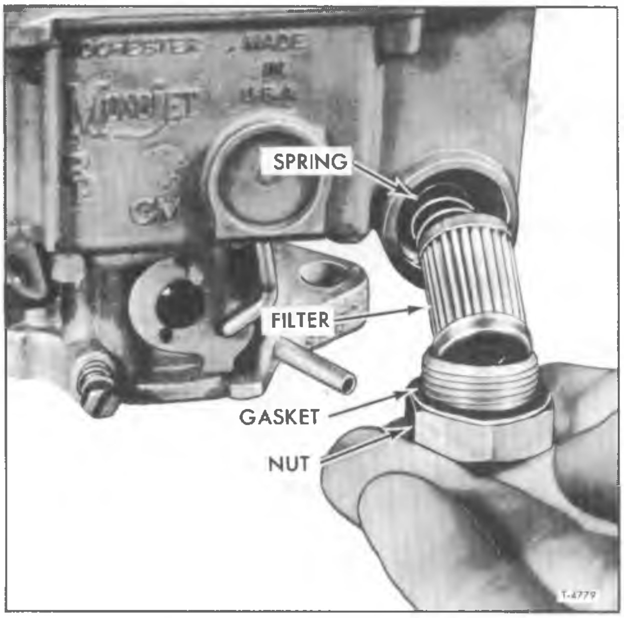


Figure 1—Pleated Paper Type Fuel Filter

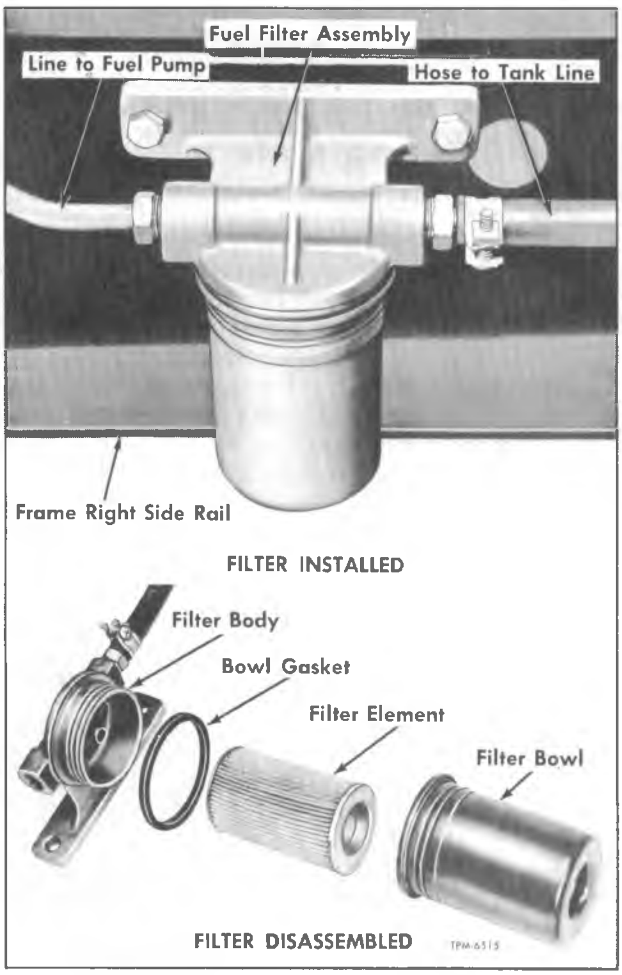


Figure 2—Frame Mounted Fuel Filter

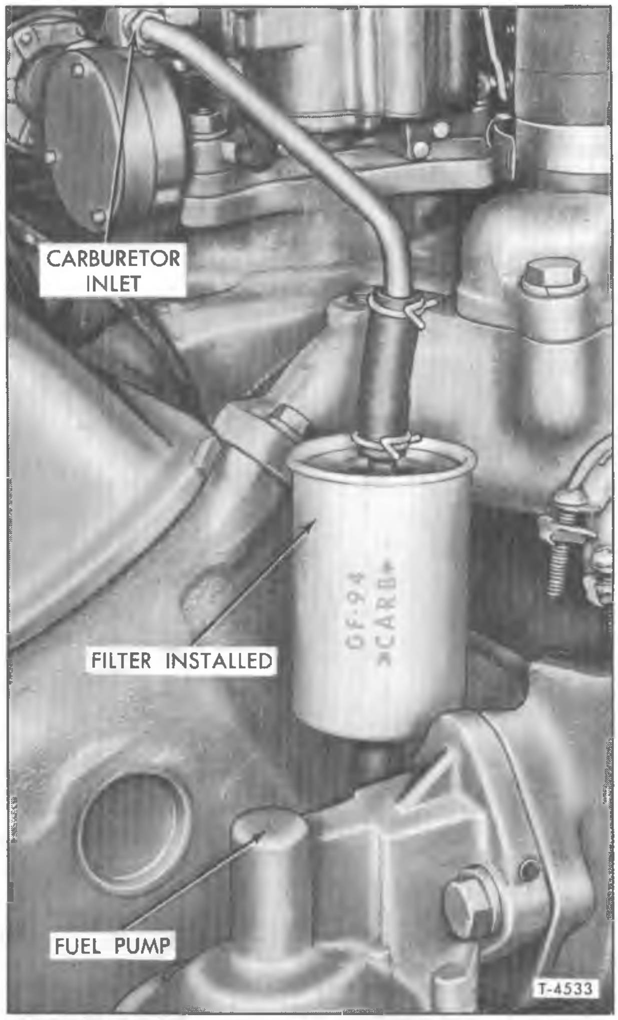


Figure 3—Disposable Line Type Filter

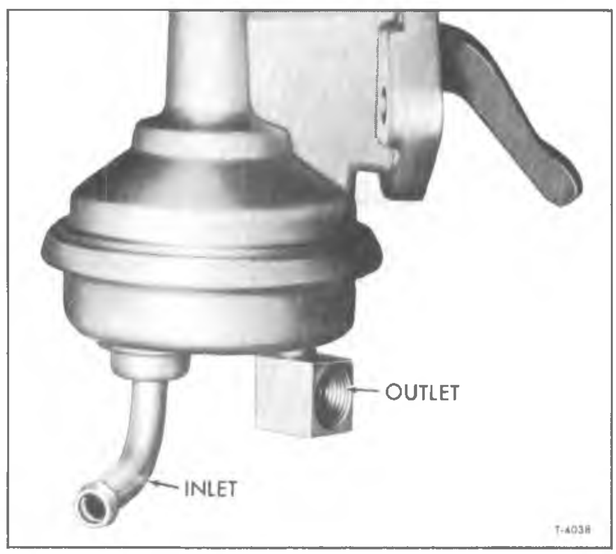


Figure 4—Fuel Pump (Typical)

cleaned at 12,000 mile intervals. A frame mounted fuel filter is standard equipment with a 366 and 427 engine and the element should be replaced at 12,000 miles.

FUEL PUMPS

CAMSHAFT DRIVEN FUEL PUMP

The camshaft driven fuel pump (fig. 4) used as standard equipment on vehicles covered by this manual cannot be overhauled. In the event of failure the entire pump must be replaced.

Pumps are diaphragm type, operated from an eccentric on the engine camshaft. The diaphragm is made from a single layer of fabric treated to make it impervious to gasoline and engine oil.

On In-line and V6 engines, the eccentric actuates the pump rocker arm. On V8 engines, a push rod (located between the camshaft eccentric and the fuel pump) actuates the rocker arm.

FUEL PUMP OPERATION

In operation, the diaphragm is pulled against pressure of spring as rocker arm is moved by engine camshaft. The partial vacuum caused in pump chamber draws fuel from tank into pump chamber through inlet valve. As camshaft rotates, pressure on rocker arm is relieved and diaphragm spring acts on diaphragm which in turn forces fuel out of pump chamber through outlet valve and through fuel line to carburetor. Each revolution of camshaft repeats this cycle, drawing fuel from tank and discharging it through line to carburetor.

When float rises in carburetor bowl and closes valve so no more fuel can enter carburetor, fuel cannot escape from fuel chamber in pump and diaphragm spring is held in compressed position. Rocker arm then idles on camshaft eccentric and diaphragm moves only a few thousandths of an inch to replace fuel which enters carburetor between pump strokes. Thus a constant pressure proportional to force of diaphragm spring is maintained on fuel in line to carburetor.

TESTING FUEL PUMP

Always check fuel pump while it is mounted on the engine and be sure there is gasoline in the tank.

The line from tank to pump is the suction side of system. The line from pump to carburetor is the pressure side of system. A leak on the pressure side of the system would be visible because of dripping fuel. A leak on the suction side would not be apparent except for its effect of reducing the volume of fuel on the pressure side.

Tighten any loose line connections and look for bends or kinks in lines which could reduce flow of fuel.

Pressure Testing

To make the pressure test, disconnect fuel line at the carburetor inlet and attach a pressure gauge between the carburetor inlet and the disconnected fuel line. Take the pressure reading with the engine running. The pressure should be within the limits given in "Specifications" for the particular engine. The pressure should remain constant and return to zero when the engine is stopped.

Capacity Test

To make the capacity test, connect a hose to the disconnected fuel line at the carburetor inlet. Place the hose in a pint measure held at carburetor level. Run the engine at 1200 rpm's and note the time it takes to fill the pint measure. Refer to "Specifications" for time required for type engine used.

FUEL PUMP REPLACEMENT

Removal

1. Disconnect fuel inlet and outlet pipes at fuel pump.

2. Remove fuel pump mounting bolts and remove pump and gasket.

3. On V8 engines, if push rod is to be removed, remove the fuel pump adapter and gasket, then remove push rod.

4. If a new fuel pump is to be installed, transfer fittings.

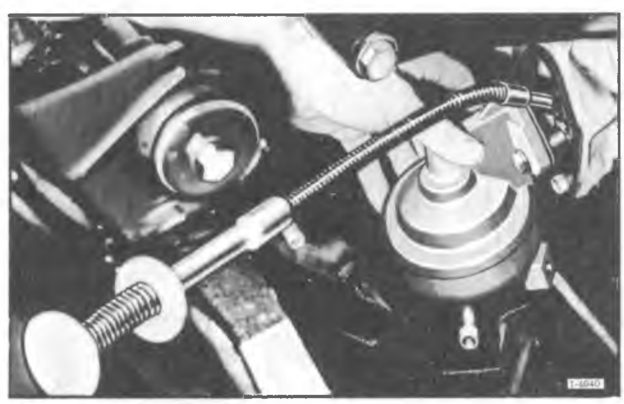


Figure 5—Installing V8 Engine Fuel Pump

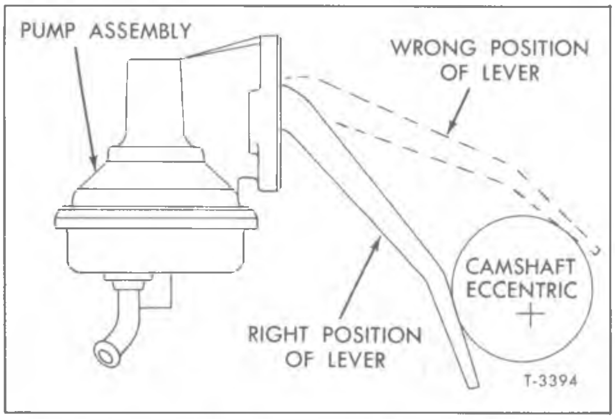


Figure 6—Positioning V6 Engine Fuel Pump for Installation

Installation

1. On V8 engines, if removed, install fuel pump push rod and fuel pump adapter. Use gasket sealer on gasket or pipe fitting.

2. Install fuel pump using a new gasket and tighten securely. Use sealer on fuel pump mounting bolt threads.

NOTE: On V8 engines, a pair of mechanical fingers may be used to hold fuel pump push rod up while installing pump (fig. 5).

IMPORTANT: When installing V6 engine fuel pump (fig. 6), be sure pump lever is positioned on bottom of camshaft eccentric otherwise pump lever will be broken when engine is started.

3. Connect fuel lines to pump.

4. Start engine and check for leaks.

ELECTRIC FUEL PUMP

GENERAL

Electric fuel pumps are available as optional equipment on Series 60 vehicles with 427 engines covered by this manual. Each fuel pump is top-mounted on the step tanks (refer to fig. 7). The pump is an electrically actuated positive displacement type unit.

Referring to figure 8, a fuel tank selector switch is located on the instrument panel so fuel may be drawn from the desired tank. Priming the fuel system is accomplished with the ignition switch "ON," and then momentarily depress the primer button.

PUMP REPLACEMENT (Fig. 7)

1. Disconnect battery ground cable.
2. Disconnect pump wiring harness from pump wiring connector.

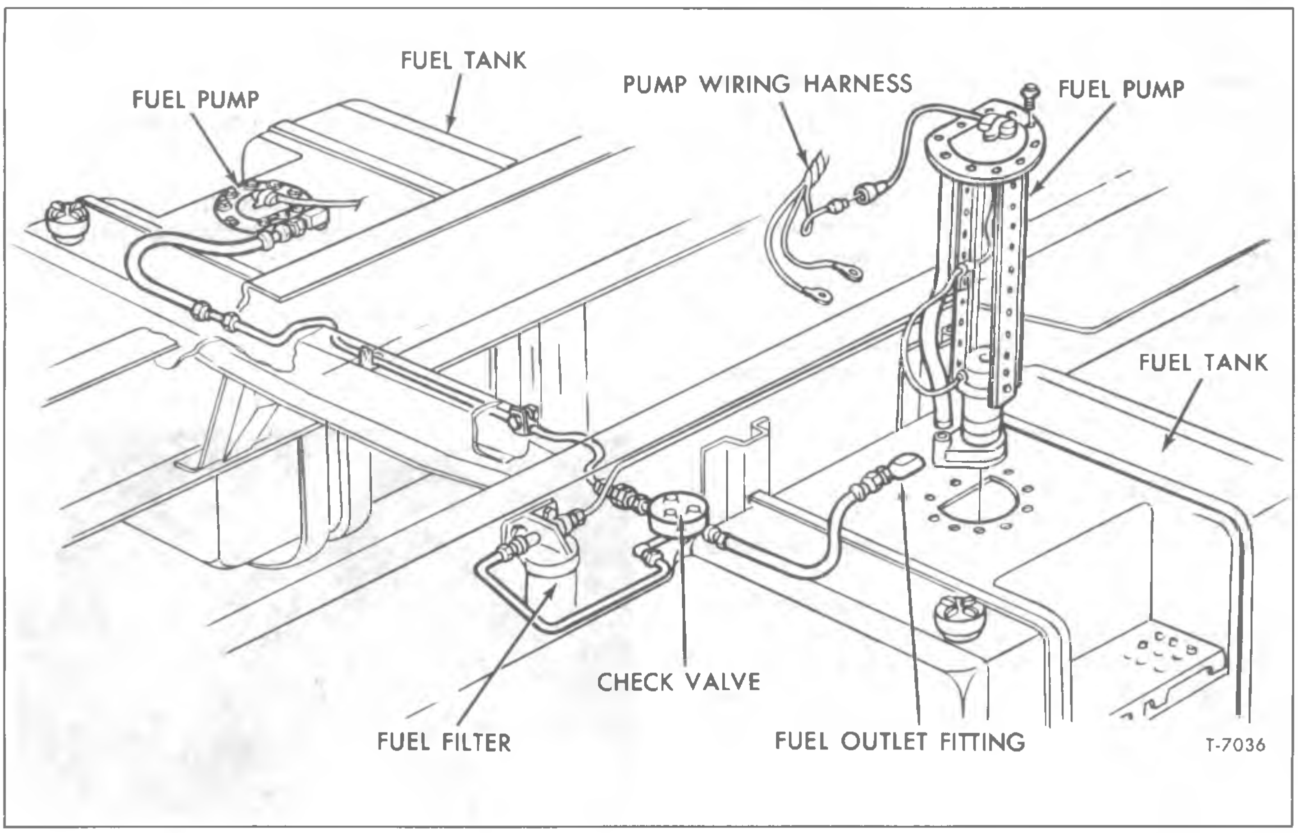


Figure 7—Electric Fuel Pump Installation

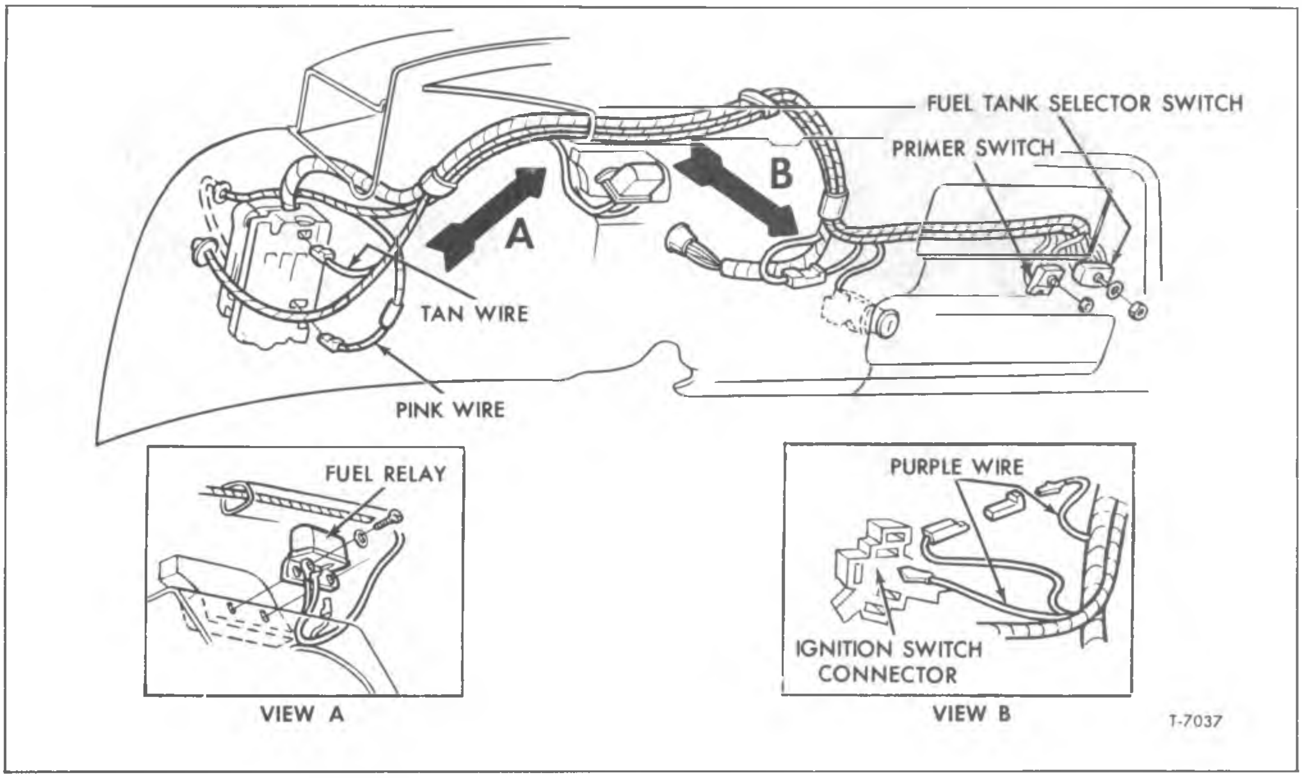


Figure 8—Electric Fuel Pump Wiring

3. Disconnect fuel outlet fitting from pump outlet hose.
4. Remove cap screws and washers retaining pump to the fuel tank.
5. Rotate pump 90 degrees counterclockwise and remove from tank.
6. Position new fuel pump assembly above tank opening.
7. Insert pump outlet line into tank. Connect outlet line to the fuel outlet fitting.
8. Carefully position pump in tank opening. Install pump-to-tank attaching cap screws and washers. Tighten cap screws to 4-6 foot-pounds.
9. Connect pump harness to pump wiring connector.
10. Connect battery ground cable.
11. Check for proper operation of both pumps by using pump selector switch.

EXHAUST EMISSION CONTROL SYSTEMS

GENERAL INFORMATION

Products of combustion in gasoline engines contain contaminants which cause atmospheric pollution. Therefore a means to reduce harmful emissions must be employed. The following systems are used on vehicles covered by this manual:

1. Positive Crankcase Ventilation System (P.C.V.).
2. Controlled Combustion System (C.C.S.).

POSITIVE CRANKCASE VENTILATION SYSTEMS

The P.C.V. system serves to prevent air pollution by re-cycling fumes from the crankcase back to the combustion chamber for burning. For detailed information on crankcase ventilation systems, refer to GASOLINE ENGINES (SEC. 6A) of this manual.

CONTROLLED COMBUSTION SYSTEM

The C.C.S. system is that system which increases combustion efficiency, and combustion efficiency reduces the hydrocarbon and carbon monoxide emissions. The complete effectiveness of this system, as well as full power and performance, is dependent upon correct ignition system and carburetor adjustments.

FUEL SYSTEM—GASOLINE ENGINES

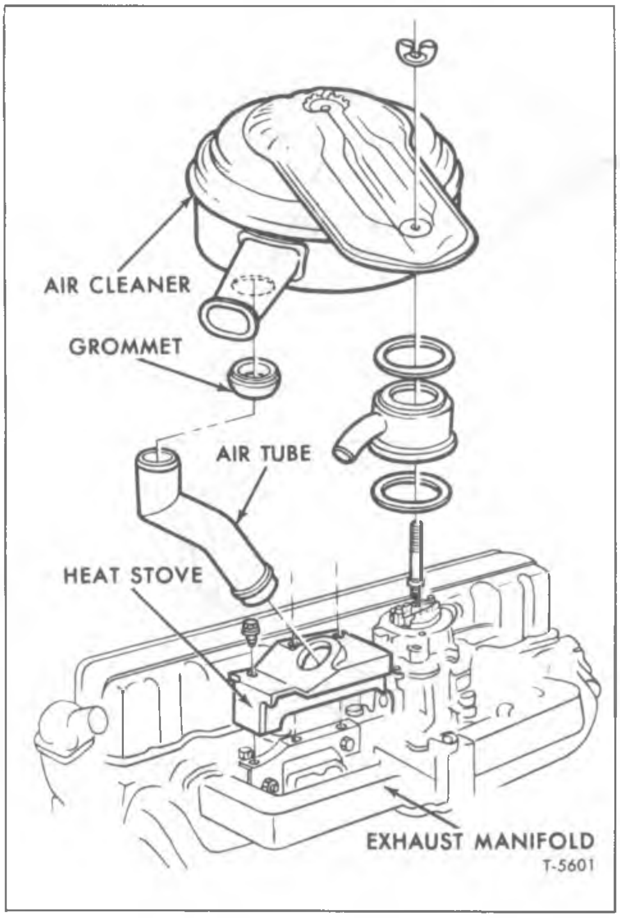


Figure 9—Heat Stove Installation (In-Line Engines)

IN-LINE AND V8 ENGINES

The C.C.S. system found on In-line and V8 engines covered by this manual consists of a heat stove (some models), specially calibrated carburetor and distributor.

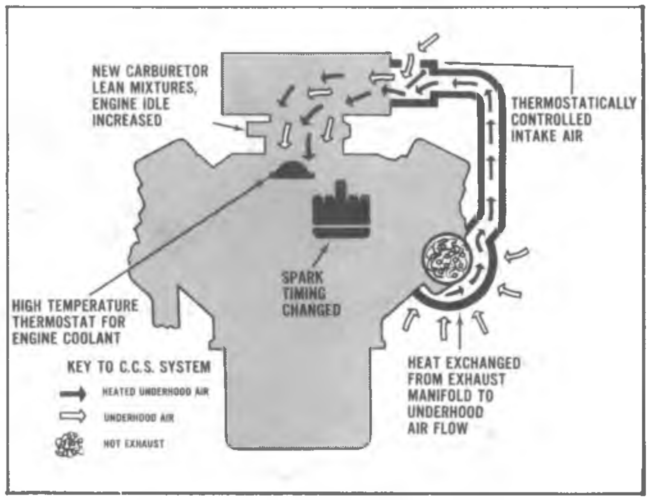


Figure 10—Controlled Combustion System

The heat stove (fig. 9) is mounted on the exhaust manifold and allows preheated air (heated by the manifold) to be drawn through the heat stove to the air cleaner where it is mixed with cool air drawn into the air cleaner opening. This warm air is then drawn into the intake manifold. No special service requirements exist for the heat stove other than periodically checking to see that it is securely mounted to the exhaust manifold and air cleaner.

Service information for carburetors is found later in this section. Note that engine idle speeds and ignition timing are given later in this section, on the "Engine Data Chart." For CCS system see fig. 10.

Servicing details pertaining to distributors are covered in ENGINE ELECTRICAL (SEC. 6Y) of this manual.

GOVERNORS

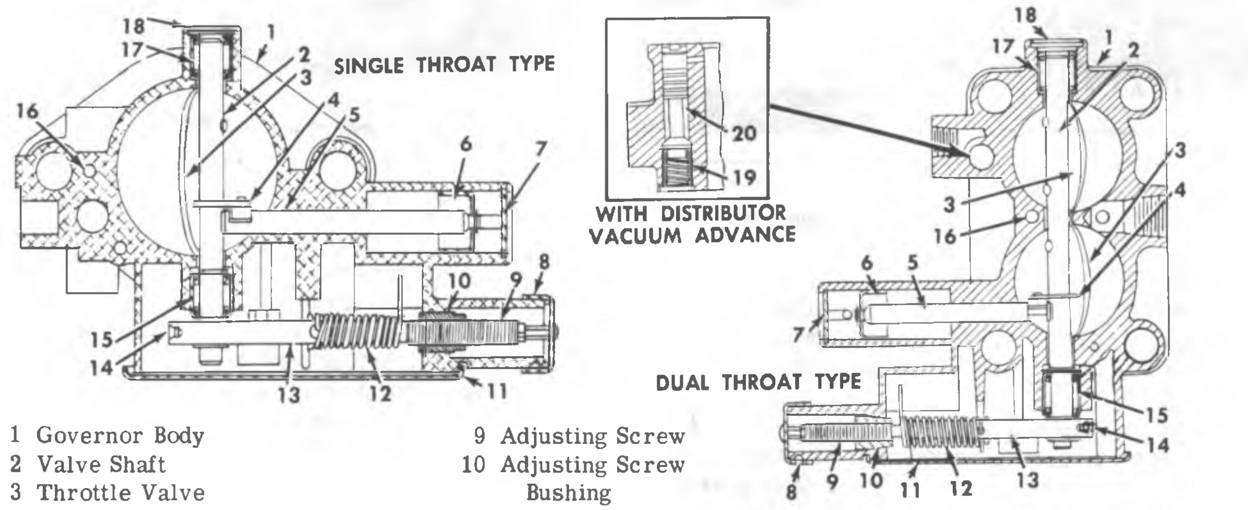
VELOCITY TYPE GOVERNORS

Velocity type governors are of two types and designated as single-throat type and dual-throat type (fig. 11). Single-throat type governor, having a single throttle valve is used on In-line engines.

Governor is mounted between carburetor and intake manifold and operates on combination of vacuum and the velocity pressure of in-going gases. Speed adjustment is by means of sealed adjusting screw.

Governor is adjusted for correct maximum engine speed and sealed at the factory.

Refer to "Governor Specifications" located at rear of this section before servicing governor.



1 Governor Body
2 Valve Shaft
3 Throttle Valve
4 Throttle Valve Arm
5 Stabilizer Piston Rod
6 Stabilizer Piston
7 Stabilizer Piston Plug
8 Adjusting Screw Cap
9 Adjusting Screw
10 Adjusting Screw Bushing
11 Governor Cover
12 Operating Spring
13 Cam Ribbon
14 Cam Ribbon Clip
15 Roller Bearing
16 Vacuum By-Pass Passage
17 Roller Bearing
18 Shaft Plug
19 Transfer Valve Spring
20 Transfer Valve

T-1875

Figure 11—Velocity Type Governor

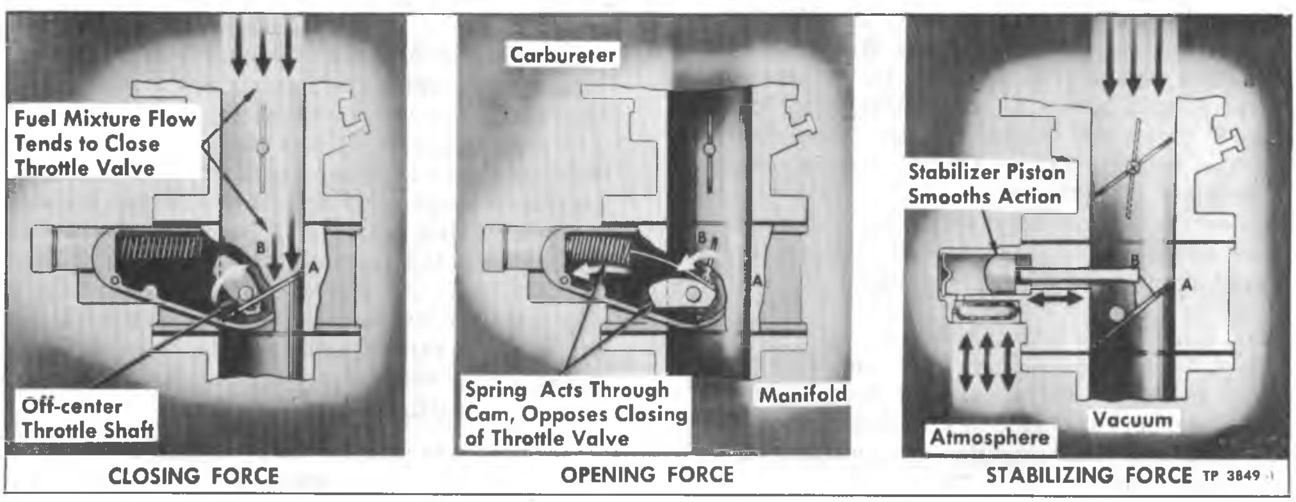


Figure 12—Major Controlling Forces of Governor Operation

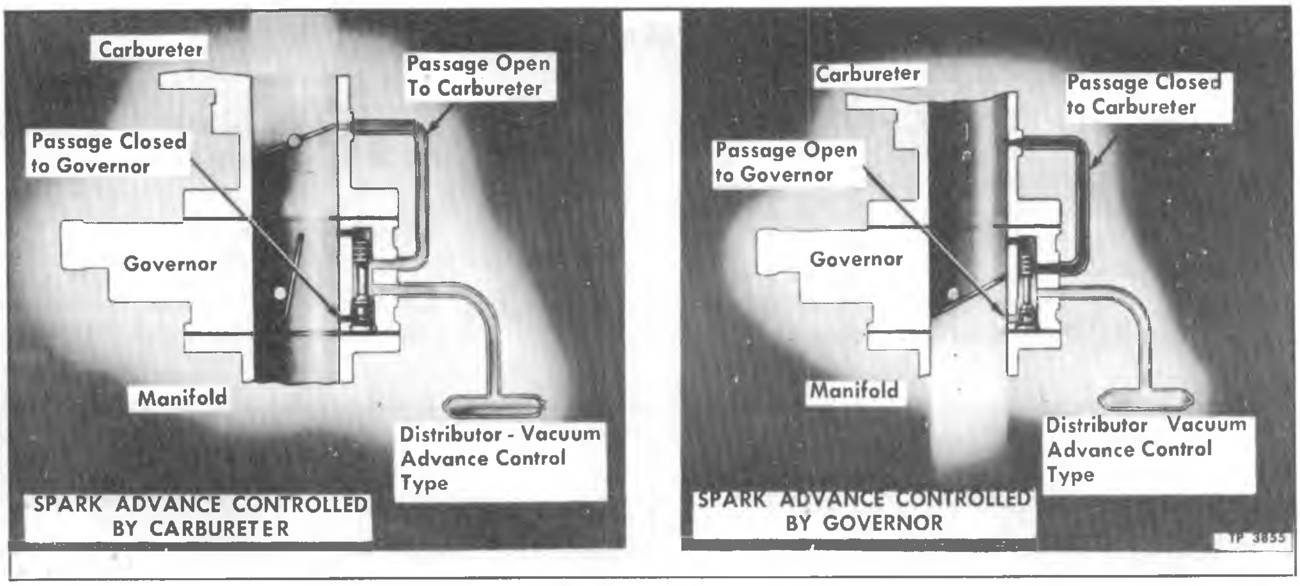


Figure 13—Vacuum Valve Operation (Typical)

GOVERNOR OPERATION

Three force systems, set up within governor, control its operation. These are shown graphically in figure 12 and are explained as follows:

Closing Force (Fig. 12)

A strong velocity pressure of air-fuel mixture against approximately 75% of the area of governor throttle valve tends to push plate into closed position. This action occurs by having the throttle shaft off-center as shown in figure 12.

Opening Force (Fig. 12)

To maintain constant control after top engine speed is reached, it is necessary to have an ever-increasing "opening force" opposing the "closing force." This is accomplished, as shown in figure 12, by the anchored coil spring, connecting ribbon and cam attached to throttle shaft. The ever-increasing spring tension plus the progressively increasing radius of the cam builds up an "opening force" to oppose and balance the "closing force" on the throttle valve. Actually, under operating conditions, throttle valve does not close but assumes a position between point "A" and "B" to give proper amount of air-fuel mixture to limit speed of engine to governor setting.

Stabilizing Force (Fig. 12)

A sudden manipulation of the throttle will often result in the opening of governor throttle valve and permit engine to exceed governed speed. To counteract this condition, a stabilizing force is set up as shown in figure 12.

Stabilizing piston is open on inside to vacuum above governor throttle valve, and is open on outside to atmospheric pressure through a felt air filter. Piston linked to throttle valve acts to close valve when a vacuum draws piston toward governor throat, thus offsetting any tendency of the increased vacuum, due to carburetor throttle valve manipulation, to open the governor valve. This action controls smoothness of governor action.

Automatic Spark Control

An automatic spark transfer valve is incorporated in all velocity type governors.

Vacuum valve (20) and valve spring (19) shown on insert of figure 11 assist in regulating the ignition timing and do not in any way control the governed speed of engine.

When vacuum transfer valve is used, the function is as follows:

As long as the carburetor throttle valve controls the engine speed, the orifice in the carburetor throat opening controls the spark advance and the engine functions the same as if it were not governor equipped. This is illustrated in left-hand view in figure 13. When the governor controls engine speed, spark control is obtained as shown in right-hand view in figure 13. Here the vacuum produced below the governor throttle valve pulls the vacuum transfer valve downward, providing an opening from below the governor throttle valve to the spark control diaphragm. At same time, the upper part of valve closes off the opening from the carburetor orifice.

When governor is equipped with this transfer valve, the automatic spark advance continues to function in a proper manner, controlling distributor advance in relation to throttle opening.

GOVERNOR MAINTENANCE

Governor requires no lubrication, adjustment or other servicing, except when engine performance indicates trouble in governor. Before attempting a diagnosis of governor difficulties, be sure engine is properly tuned and that all fuel system units are functioning properly.

The checks discussed following can be made to determine if governor requires servicing.

CHECKING GOVERNOR OPERATION

With engine idling, open throttle quickly and observe engine response. If engine is slow or sluggish, basic setting of operating spring may be wrong or governor may be dirty. If engine reaches top speed quickly, then surges erratically between high and low speed, improper spring setting or faulty stabilizer action may be the cause. In either case, cleaning and adjusting of governor is necessary.

When erratic governor action occurs, clean air filter felt. Replace filter felt if necessary.

ADJUSTMENTS

All governors are calibrated and adjusted in assembly to ensure accurate control of the maximum engine speed of the model vehicle for which they are intended. However, there will be occasions when minor adjustments are required to satisfy local conditions where the truck is operating.

To adjust a governor for higher speed, turn the adjusting cap "C" (fig. 14) counterclockwise or to the left; for lower speeds turn adjusting cap "C" clockwise or to the right. One turn on the adjusting screw will change the speed approximately 300 to 400 rpm or 4 to 5 mph.

When a more sensitive regulation is desired or if the governor is too sensitive and inclined to surge, correct the adjustment as follows by means of the calibrating nut shown at "A."

NOTE: Do not use the following adjustments unless absolutely necessary. These adjustments affect basic governor calibration and should only be used if speed adjustment does not produce satisfactory results.

Too Sensitive (Fig. 14)

1. If a governor is too sensitive or on the point of surging, remove adjusting cap and hexagonal shaft assembly and place special hollow wrench (A-24283) in position on nut "A." Insert special adjusting wrench (A-25264) through this wrench and turn main adjusting screw "B" to the right one turn.

2. With hollow wrench in slot of nut "A," turn this nut to the right about ¼ turn using the special wrench (A-25264). The main adjusting screw "B" must be kept from turning while nut "A" is adjusted.

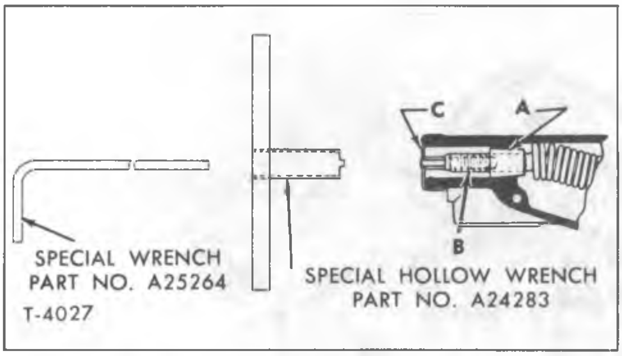


Figure 14—Governor Adjustment

Not Stable (Fig. 14)

1. If a more sensitive governor is desired, adjust main screw "B" to the left one turn and while holding this screw in new position, turn nut "A" to the left ¼ turn at a time until desired regulation is obtained.

2. When adjustment is completed, tap lightly on end of hollow wrench so that nut "A" will seat properly.

Cleaning Air Filter

Occasional cleaning of governor air filter is necessary. This element is assembled in governor body beneath a perforated cover. Clean as follows:

1. Pry out metal cover carefully with a sharp punch. Do not damage projections in governor body. Lift out filter felt and inner cover. Wash felt in cleaning solvent (gasoline, dry-cleaning solution); then allow to dry.

2. Blow out stabilizer cylinder and piston by directing air in sudden bursts through atmospheric hole in governor air cleaner chamber.

3. Install inner cover, then install felt in governor body. Install outer cover. It may be necessary to bend the cover to install; if so, flatten by tapping with hammer.

NOTE: Felt is to be installed dry; do not oil.

GOVERNOR REMOVAL

IMPORTANT: Before removing governor and associated parts, note position of governor spacers, and also note number of gaskets used. This will assure installation of parts in their original position later.

Remove air cleaner, then disconnect lines and controls from carburetor and remove carburetor and governor.

GOVERNOR INSTALLATION

1. Care should be taken to see that governor is not installed upside down. Governor is marked with an arrow indicating carburetor side.

2. A by-pass screw is installed in power jet vacuum passage in some carburetors and under no

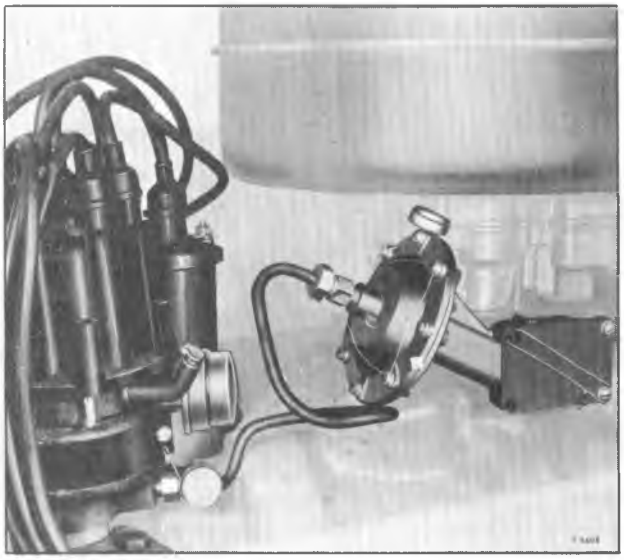


Figure 15—Distributor and Governor Mounting

circumstances should this screw be left out when installing governor.

3. On some vehicles the gasket between carburetor and governor is slotted to allow vacuum to by-pass through governor for operation of power jet piston. Make sure that this gasket is in good condition and installed so that vacuum openings are not obstructed.

4. Road test vehicle to make sure that governor is operating correctly. When this is determined seal governor as directed.

ROCHESTER 2G ENGINE GOVERNOR (VACUUM SPINNER TYPE)

The Model 2G Carburetor Governor (fig. 15) provided with some 350 V8 engines is a mechanically-driven vacuum-actuated mechanism set to govern engine speed at 4,000 rpm maximum under full load conditions. With this limit, full advantage of engine horsepower is allowed without danger of excessive wear due to overspeeding. This 4,000 rpm limit establishes an excellent pattern for shift control for automatic type transmissions.

The governor is comprised of two basic units; the centrifugal control valve housed in the distributor, and a carburetor actuator which is mounted on the carburetor throttle body (fig. 15). These two components are inter-connected by tubing.

An engine overspeed warning device is incorporated into the governor as shown in figure 16.

NOTE: For information on distributor, refer to ENGINE ELECTRICAL (SEC. 6Y) of this manual.

OPERATION (Fig. 16)

The function of the 2G Governor is to limit engine speed and yet allow a wider throttle opening

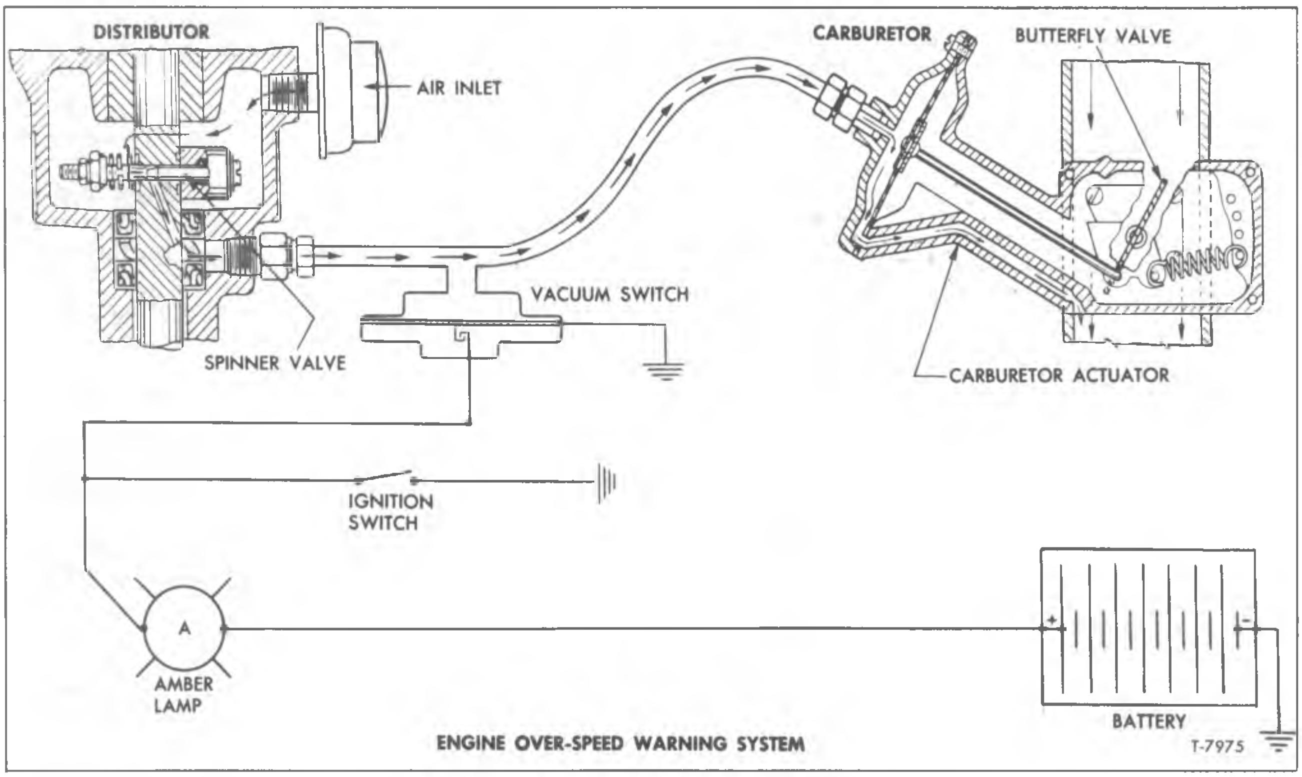


Figure 16—Governor and Overspeed Warning Light

when power is required. The throttle lever is connected to the throttle shaft in such a manner that turning the throttle lever does not actually force the throttle valves open but rather allows them to follow the throttle lever because of the governor spring tension. Thus, when the throttle lever is moved to wide open position, the position of the throttle valve will be determined by vacuum on the diaphragm and the tension of the governor or spring acting on the governor lever.

Vacuum is applied to the diaphragm through a system of vacuum passages and restrictions in the throttle body and governor housing. A speed sensitive centrifugal valve in the distributor acts as a vacuum break so that there is no vacuum applied to the diaphragm until the desired governed speed is reached. When the governed speed is reached the valve is closed and vacuum is applied to the diaphragm which acts to close the throttle valves in opposition to the governor spring tension. When power is required as load is increased, engine rpm will drop causing distributor valve to open and allow the governor spring to open the throttle valves further.

CONTROL VALVE SERVICING

Whenever the distributor is removed for overhaul, the governor control valve mechanism should be disassembled and cleaned.

GOVERNOR HOUSING SERVICING

Removal

1. Remove the four governor cover attaching screws and then the governor cover and gasket, if used.

2. Detach and remove the governor spring.

3. Remove the eight diaphragm cover attaching screws and then the diaphragm cover. Hold the throttle lever to avoid damage to the throttle valves and loosen the nut attaching the governor lever and pin assembly to the throttle shaft. Remove the governor lever from the throttle shaft, then detach it from the diaphragm rod by rotating the lever until the tang on the rod clears the slot in the lever.

4. Remove the diaphragm assembly from the housing and inspect for cracks or holes. If the diaphragm is damaged in any way, it must be replaced.

5. Remove three governor attaching screws, then remove the leather seal retainer and leather seal.

6. Detach the governor housing from the throttle body.

7. The throttle lever and bearing assembly can be removed by detaching the fast idle cam and pump rod and removing the four attaching screws. No attempt should be made to service the throttle lever bearing. If the action is sticky or binding to the point that throttle return spring cannot overcome the binding, the throttle lever assembly should be replaced.

CAUTION: Since the idle ports in the throttle body were drilled after the throttle body was assembled, the throttle valves were nicked during the drilling operation. No attempt should be made to remove the throttle valve or to further disassemble the throttle body, since any slight change in positioning of the throttle valves with relation to the idle ports would seriously disrupt carburetor operation.

Cleaning and Inspection

The throttle lever and bearing assembly should not be immersed in any carburetor cleaner, since it might cause damage to the neoprene seal protecting the ball bearings. If the throttle body itself is immersed in solvent, great care must be taken that the throttle shaft bearings are blown completely dry with compressed air. They may then be lubricated with very light machine oil. Since the calibration of vacuum versus spring tension is of extreme importance in governor operation, it can readily be seen that there should be no bind whatsoever in throttle shaft rotation. If any binding is found, the throttle body assembly must be replaced.

Installation

1. Position the gasket carefully on the throttle body and assemble the throttle lever and bearing assembly to the throttle body with the four screws provided. To be certain that the throttle lever and throttle shaft are in proper relation hold the throttle valve closed while attaching the throttle lever assembly. Position the throttle lever during assembly so that it fits easily onto the throttle body. If this procedure is followed the assembly will operate freely and correctly.

2. Place the governor housing to throttle body gasket in place, noting that the narrower edge goes toward the top of the carburetor. Then put the housing in place over the gasket.

3. Slide the leather seal and retainer over the throttle shaft, position the screw holes in correct relation and install the housing to throttle body screws loosely.

4. Check the throttle shaft for free rotation in the seal, then tighten the housing screws. The throttle valves must be held in a closed position while tightening the screws. Recheck for free rotation and repeat assembly procedure if necessary.

5. Install the diaphragm in the governor housing with the end of the diaphragm rod pointing inward. With the diaphragm in this position the hole for the vacuum passage in the diaphragm should line up with the vacuum passage in the housing.

Assemble the governor lever and pin assembly to the diaphragm rod and position the lever on the throttle shaft. Install the nut and lock washer, holding one of the throttle valves between thumb and forefinger while tightening, to avoid damage to the throttle valves.

6. Position the diaphragm carefully over the screw holes in the housing. Position the cover so that cover restriction pilots through the gasket and into the vacuum passage in the body. Install the eight screws finger-tight. Open the throttle valves wide to provide maximum travel of the diaphragm and tighten the eight cover screws to 25 to 28 inch-pounds of torque while holding the diaphragm in this position. Install lock wire on screws (fig. 15). Install the governor spring over the lever pin and the stationary post in the housing.

7. Check again for free operation of the throttle shafts, then install the governor, cover, and four attaching screws, and install lockwire (fig. 15).

8. Attach the pump rod and fast idle cam to the throttle lever assembly.

9. Install vacuum tube to diaphragm cover and distributor and install lockwire in attaching nuts (fig. 15).

TROUBLESHOOTING

1. Loss of speed control: Check for vacuum leaks and operation of bleed valve in distributor. Also for proper seal of diaphragm cover and condition of diaphragm itself. Vacuum in the governor housing can be checked by removing the connection to the distributor and attaching a vacuum line. If there is no vacuum reading, check the diaphragm for holes and be sure the vacuum passage is clear.

2. Erratic operation under load: Check for binding in throttle shaft and throttle lever.

NOTE: Vacuum and free operation are two keys to correct operation of the Rochester Governor. If all parts are free to move as intended and there are no vacuum leaks, the unit will operate correctly.

Governing systems generally malfunction in one of two ways:

1. They do not govern at all. This could result from:

a. A vacuum leak in the units or tubing.

b. "Spinner" unit stuck due to dirt, oil, or some other material depositing in the mechanism.

c. Orifices in the carburetor clogging so no vacuum could be developed in the governing system.

2. The system "over-governs": Governs when it should not, causes loss of power, etc. This could result if the vacuum passages were to become clogged with dirt, oil, or other foreign materials. Areas most likely to "clog" are the orifices in the actuator, and the area where air bleeds through the distributor "spinner" valve.

Either type of malfunctioning could be caused by: Improper spinner setting; spring post out of position in the carburetor actuator; bent or stretched spring in actuator.

SUGGESTED PROCEDURE FOR FINDING CAUSES OF IMPROPER GOVERNING

1. Localize the trouble on the vehicle. With the vacuum tube disconnected at the distributor, run the engine at about 3,000 rpm and place a finger over the end of the tube. If there is no noticeable change in engine operation, the trouble is probably in the actuator or tubing. If the engine speed is noticeably affected by this, the distributor "spinner" can be suspected.

2. If distributor trouble is indicated, perform the following operation:

a. Remove distributor from engine, remove spinner valve and clean and visually inspect the parts and passages for possible faults.

b. Check the seals. Do this by connecting the lower vacuum connector to a vacuum pump, and plugging the valve hole in the shaft either with the fingers or other suitable means. Slight "seepage" around the seals is not abnormal; however, a vacuum gauge reading within 2" hg. of the maximum that can be obtained with the vacuum hose "squeezed" should be possible if the seals are in satisfactory condition.

c. When the spinner parts are reassembled, they should be wiped with a rag saturated with light oil to provide slight, but not excessive lubrication.

3. If actuator or tubing trouble is indicated:

a. Remove the vacuum tube at the actuator, run the engine at about 3,000 rpm and place a finger over the end of the actuator. If there is no change in engine operation, probably the actuator is at fault. A change in engine rpm would indicate tube leakage and tube should be replaced.

b. If the tubing is all right, check the actuator unit for leakage. With the orifices "stopped up" with the fingers, or other means, no leakage should occur. Also check for proper seal of diaphragm cover and condition of diaphragm itself. Vacuum in the governor housing can be checked by removing the connection to the distributor and attaching a vacuum line. If there is no vacuum reading check the diaphragm for holes and be sure the vacuum passage is clear.

c. If no leakage is found, clean all parts.

d. If tampering is suspected, visually check parts with the governing parts of an engine that is governing properly.

HOLLEY INTERNAL-VACUUM TYPE GOVERNOR

(Refer to Schematic Figure 17)

GOVERNOR TEST

The following procedure should be used to help locate the cause for loss of governor control:

1. Using a tachometer, check engine governed speed.

NOTE: The governed engine rpm on 366 and 427 cu.-in. engines is 4,000 rpm no-load and 3800 rpm full-load. Refer to ENGINE ELECTRICAL (SEC. 6Y) of this manual if adjustment is necessary. Also, initial overrun means that under acceleration the engine will momentarily exceed governed speed by approximately 150-250 rpm and then settle to governed speed.

2. If there is no governor control, perform the following:

a. Disconnect the vacuum line (distributor-to-governor throttle actuating unit) from the "tee" fitting at the governor unit. Leave the secondary control valve vacuum line connected. Operate the

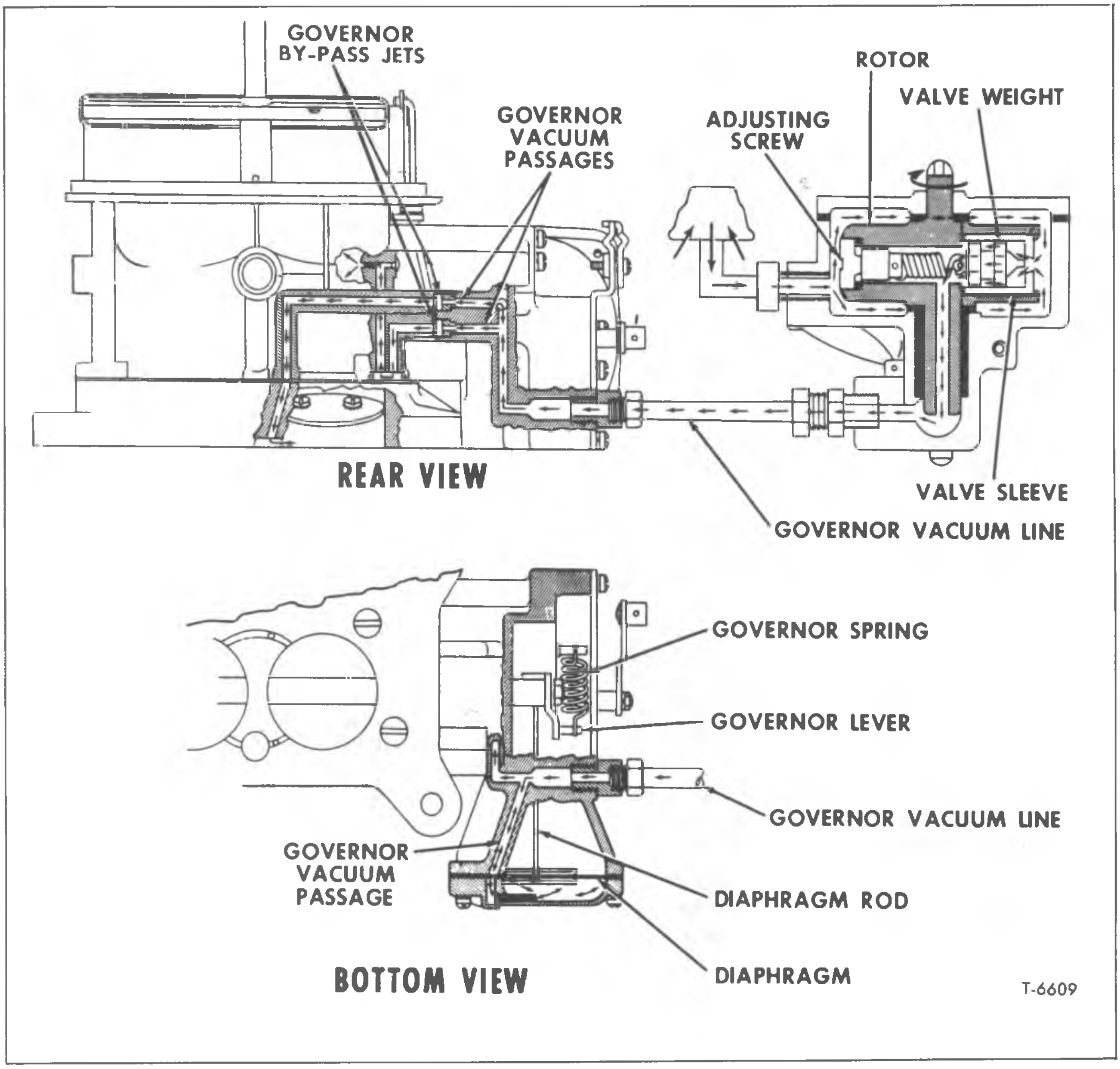


Figure 17—Holley Internal—Vacuum Type Governor

engine at 2200 rpm, then wet your finger and hold it over the opening in the "tee" fitting. If the engine speed slows to near idle, the governor trouble is in the distributor spinner valve or the lines or connections to the distributor. If the engine does not slow down proceed to Step b.

b. Disconnect the secondary control valve vacuum line from the "tee" fitting and remove the "tee" fitting. Again, operate the engine at 2200 rpm and place a wet finger over the passage to the governor throttle unit. If the engine now slows to near idle, the problem is in the secondary control valve or its vacuum line. If the engine does not slow down, the problem is in the governor throttle unit or the vacuum passages behind it.

3. If the engine governs at light load and does not govern at wide-open throttle the problem is probably in the secondary control valve. Correct operation of the secondary throttle system and the governor depends upon proper functioning of the secondary control valve. Be sure the secondary control valve air cleaner is cleaned or replaced at regular intervals depending on severity of operation, then perform the following:

When the problem is suspected to be in the secondary control valve, operate the vehicle on the highway and check governor operation. The governor should limit speed to 3800 rpm plus 150-250 rpm initial overrun. If the engine does not govern, disconnect the secondary throttle diaphragm link from the secondary throttle shaft lever. Operate the vehicle again on only the primary carburetor venturis. If the engine does not govern, remove "E" clip, disconnect the secondary throttle diaphragm link from the secondary throttle shaft lever. Operate the vehicle again on only the primary carburetor venturis. If the engine governs now, the problem is in the secondary control valve which must be replaced as an assembly.

ROCHESTER CARBURETORS

Detailed information and adjustment procedures, not found in this Service Manual, may be found in the Chevrolet 10-30 Series Truck Overhaul Manual.

ROCHESTER MODEL M CARBURETOR

The Rochester "M" carburetor (fig. 18) is used on In-line engines. The "M" model uses a manual choke with a cable control.

This is a single-barrel downdraft carburetor with a triple venturi in conjunction with a plain tube nozzle. The fuel flow in the main metering system is controlled by mechanical and vacuum means.

A conventional idle system is used in conjunction with the main metering system. A separate hot idle compensator unit is available to maintain smooth engine idle during periods of extreme hot engine operation.

The off-idle discharge port is of a vertical slot design which gives good transition between idle and main metering system operations.

An integral fuel inlet filter is mounted in the fuel bowl behind the fuel inlet nut. The paper filter provides filtration of incoming fuel entering the carburetor bowl.

The Hot Idle Compensator, used on models equipped with air conditioning, is located in a chamber on the float bowl casting on the throttle lever side of the carburetor. Its purpose is to offset the enrichening effects caused by changes in air density and fuel vapors generated during hot engine operation.

The compensator consists of a thermostatically controlled valve, a bi-metal strip which is heat sensitive, a valve holder and bracket. Under normal cooler underhood engine temperatures, the valve closes off an air channel which leads from a hole inside the air horn to a point below the throttle valve where it exits into the intake manifold through the throttle body bore. However, during periods of extreme hot engine operation, excessive fuel vapors in the carburetor can enter the intake manifold causing richer mixtures than normally required. At a pre-determined temperature, the bi-metal strip bends and unseats the compensator valve. This allows extra air to be drawn into the intake manifold to offset the richer idle mixtures and maintain engine idle speed to provide a smooth engine idle. When the engine cools and the extra air is not needed, the bi-metal strip relaxes to close, the valve and idle operation returns to normal.

To obtain proper idle adjustment speed and mixture when the engine is hot, the compensator valve must be held closed. The Hot Idle Compensator is pre-adjusted at the factory and no further adjustment is required.

Other features of the carburetor include an aluminum throttle body for decreased weight and improved heat transfer, and a thick throttle body to bowl insulator gasket to keep excessive engine

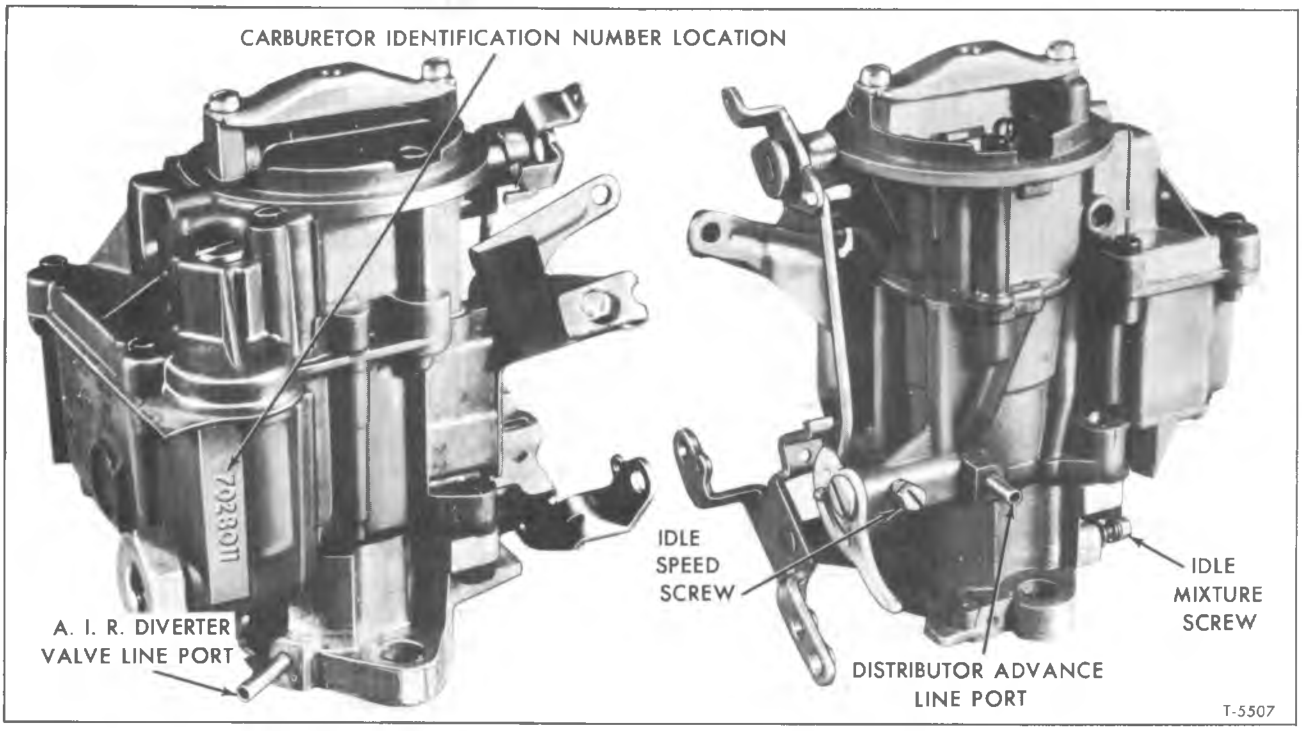


Figure 18—Rochester Model M Carburetor

heat from the float bowl. The carburetor has internally balanced venting through a vent hole in the air horn. An external idle vent valve is used to benefit hot engine idle and starting characteristics.

Carburetor has an identification part number stamped on the float bowl as shown in figure 18.

To repair or overhaul carburetor, refer to identification number and secure correct repair kit.

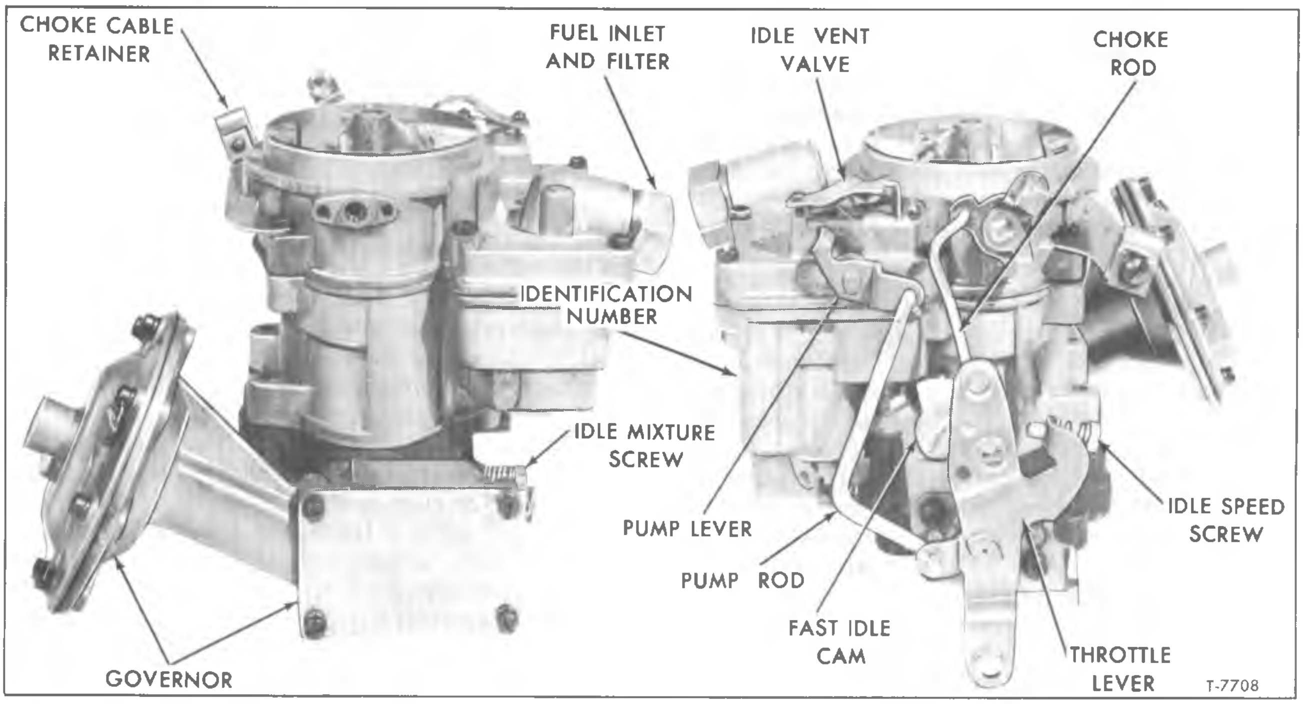


Figure 19—Rochester Model 2G Carburetor

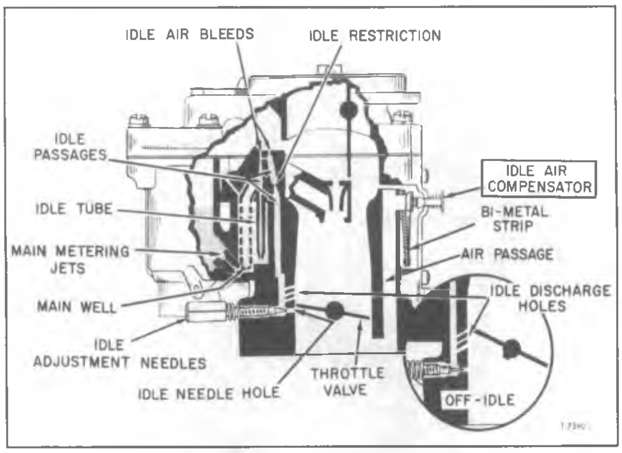


Figure 20—Idle Air Compensator (Typical)

ROCHESTER MODEL 2G CARBURETOR

The Rochester Model 2G two-barrel carburetor is used with 350 engines.

The Model 2G carburetor (fig. 19) is equipped with a manually-operated choke.

Carburetors have two venturi and a separate fuel feed for each. All fuel metering is centrally located so that each system will give instantaneous response for maximum efficiency and performance.

The Rochester two-bore carburetor has been kept basically sinple for ease in servicing the unit. The major portion of the calibrated metering parts are contained in the venturi cluster and fits on a flat portion of the carburetor float bowl at the side of the main venturi.

The removable venturi cluster contains the main nozzles, idle tubes, mixture passages, air bleeds and pump jets. The main nozzle and idle tubes are suspended in fuel in the main wells of the float bowl which helps insulate them from engine heat and minimize percolation spill-over during hot engine operation.

On models equipped with air conditioning, the carburetor also incorporates a hot idle compensator (fig. 20). The hot idle compensator consists of a bi-metal strip, a valve and a mounting bracket located between the throttle barrels. It operates as a thermostatically controlled air bleed which supplies additional air to the idle mixture during prolonged hot idle periods. There are no adjustments required on the hot idle compensator. The compensator valve must be held closed when making idle and mixture adjustments.

Carburetor has an identification part number stamped on the float bowl below the fuel filter housing (fig. 19). Before attempting to repair or overhaul carburetor, refer to identification number and secure the correct repair kit.

TROUBLE DIAGNOSIS

NOTE: The following information is included to serve as a guide in servicing carburetor. Many times a carburetor has been overhauled and replaced, yet the adverse condition still existed. Use this information which may assist in isolating the precise problem.

Before condemning the carburetor as the source of the engine running problem, always FIRST check the following:

1. Ignition System - Are the points, condenser, wires, spark plugs, and distributor operating to specifications.
2. Valve lash and spark plug gap.
3. Engine compression.
4. Crankcase ventilation system.
5. Fuel pump flow and pressure.
6. Intake manifold - cracks or gasket leakage.
7. Contaminated fuel.
8. Spark and valve timing.
9. Contaminated fuel filter.

When the carburetor is isolated to be the source of the problem (above items all checked and are to specifications), select one of the ten complaints (shown in "Troubleshooting Chart" on next page) that best describes the problem, then proceed with the action outlined.

CARBURETOR CHECKS

It is very seldom necessary to replace a complete carburetor. They can generally be repaired at a lower cost than the price of a new assembly. Repair kits are readily available.

Although there may be exceptions, carburetors should not be replaced for the following reasons:

1. Flooding - In practically all cases, flooding is caused by a dirty or sticking float needle and seat. This item is easily repaired and is not a valid reason for replacing a carburetor.

2. Carburetor Spitback - Carburetors are not to be replaced as a cure for "carburetor spitback." This condition, in most cases, is not the fault of the carburetor but results from inoperative positive crankcase ventilation, incorrect valve lash, or incorrect spark plug application and/or gap setting.

Spitback on acceleration may be caused by the accelerator pump inlet ball check valve not properly seating. However, in no case should the carburetor be replaced to cure spitback.

3. Leaking - If leaking is due to a faulty carburetor, such as one with a porous casting, the leak will show up at very early mileage (0 - 5,000 miles). Low mileage leaking due to a porous housing is a valid reason for carburetor replacement or repair, whichever is less costly. Higher mileage leaking (over 5,000 miles) in most cases is not caused by defective material in the carburetor.

Locate the complaint by reading across the top of the complaint columns, then find Step 1. If Step 1 does not remedy the complaint, move to Step 2 in that column. Take Steps 3, 4, 5, etc., in order until you have located the trouble.

★ Indicates other possible trouble points.

COMPLAINT: Flooding	Rough Idle	Economy	Hesitation	Acceleration Flatness	Surge	Low Top Speed or Power	Cold Operation	Stalling	Hard Hot Starting	CHECK POINTS	WHAT TO LOOK FOR
	1	★		★			★	1	★	IDLE ADJUSTMENT	Correct speed and mixture
2		3		★	2	3		4	★	FLOAT ADJUSTMENT	Use correct gauge
			1	★			★			PUMP ADJUSTMENT	Use correct dimension, throttle valves closed
	★	★							★	IDLE VENT ADJUSTMENT	Dirt, wear, sticking open; must be closed except at idle
		★					1	★	1	CHOKE ADJUSTMENT	Set to latest specification
							2	★		CHOKE ROD ADJUSTMENT	Use correct gauge, fast idle screw on 2nd step of cam, next to high step
							3		2	UNLOADER ADJUSTMENT (4MV)	Use correct gauge, throttle valves wide open; check to see that throttle linkage allows wide open position on vehicle
							4	★		FAST IDLE ADJUSTMENT	Set with warm engine, use tachometer, set to information specification
							5	★		SECONDARY LOCKOUT ADJ.	Proper clearance so cam is free to move with throttle valves closed
							6	2		THROTTLE RETURN CHECK	Proper clearance with throttle lever, vacuum leaks
		2a		1	3	1	★			POWER PISTON	Dirty, distorted, sticking, incorrect part
		2b		2	4	2	★			METERING ROD	Dirty, sticking, incorrect part
		4		3	1	4	★			METERING JETS	Loose, plugged, incorrect part
1	★	★						3	3	NEEDLE & SEAT	Worn, damaged, dirty, incorrect part
3		★			★			★	★	FLOAT	Bent, leaky
	3							★		IDLE NEEDLES	Worn, damaged
	4		★	★		★	★	★		THROTTLE VALVES	Sticking open or closed, damaged, not aligned properly
4	★	★	★	★	★	★	★	★	★	GASKETS	Improper seal, hard or brittle material, loose screws
	2							★	★	IDLE PASSAGES	Dirty or plugged
	★	★					7		★	CHOKE VACUUM PASSAGE	Plugged or vacuum leaks
			2				★			PUMP PLUNGER	Hard or worn seal, distorted spring, stuck vent ball check
			3				★			PUMP INLET CHECK BALL	Out-of-round, damaged seat, stuck
	★		★				★	★	★	PUMP DISCHARGE CHECK	Out-of-round, damaged seat, stuck, distorted spring
		★		★			8	★	★	CHOKE VALVE	Dirty, damaged, sticking
		1					9		4	DRIVER	Driving habits, correct procedures
	1								1	HOT IDLE COMPENSATOR	Dirty, damaged, sticking

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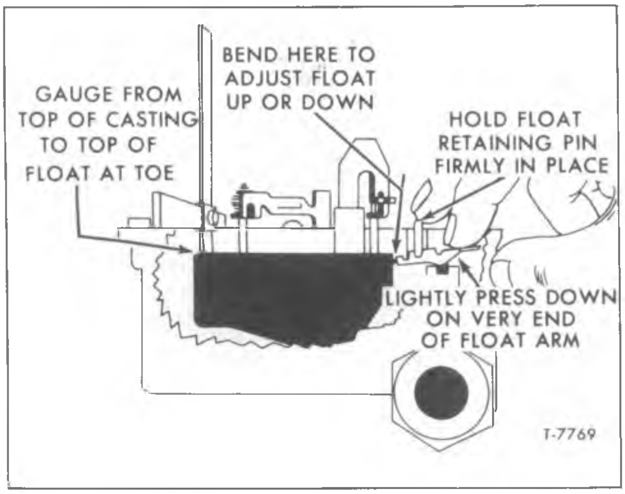


Figure 21—Float Level Adjustment (Model M)

NOTE: Fuel seepage at the bowl to air horn mating surface is normal. This usually shows up as a discolored carburetor and is caused by wicking of the gasket in the area. Correction involves a periodic tightening of the bowl to air horn assembly screws.

4. Lack of Power - Lack of engine power that is isolated to the carburetor can usually be corrected by proper carburetor calibration and adjustment. Carburetors should be repaired rather than replaced when a lack of power complaint is encountered.

ROCHESTER CARBURETOR ADJUSTMENTS

IDLE AND MIXTURE ADJUSTMENTS

Preliminary Checks (All Engines)

1. Idle and mixture adjustments should be performed with the engine at operating temperature, choke open, and air cleaner installed.
2. Air conditioning (when used) must be turned ON. In addition, the hot idle compensator (air conditioned vehicles, only) must be held closed.
3. When equipped with automatic transmission, apply parking brake and block driving wheels.
4. Check the distributor dwell reading.
   In-Line Engines 31 to 34 degrees.
   350 V8 Engine 28 to 32 degrees.

NOTE: When setting ignition timing, the term BTC means Before Top Center.

5. Adjust idle speed and mixture as follows:

In-Line Engines

1. Turn mixture screw IN until lightly contacts seat, then back mixture screw OUT four full turns.

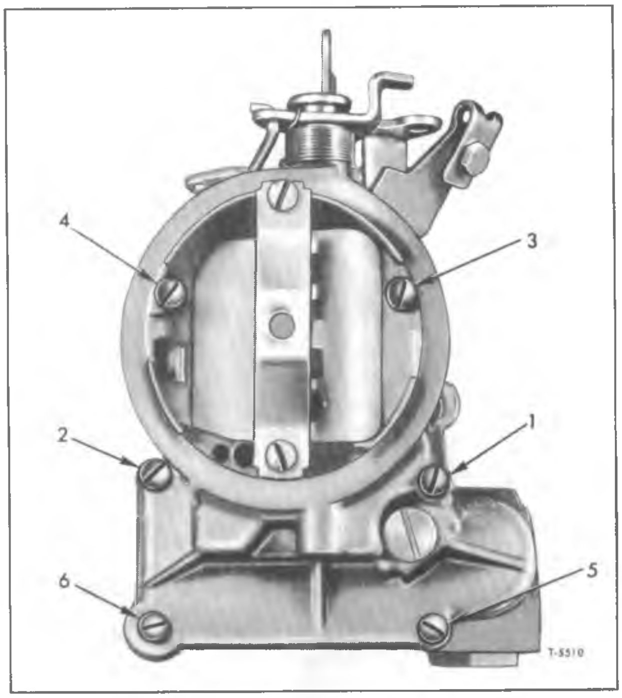


Figure 22—Air Horn Tightening Sequence

CAUTION: DO NOT TURN MIXTURE SCREW TIGHTLY AGAINST SEAT OR DAMAGE MAY RESULT.

2. Disconnect and plug distributor vacuum line - this step only. Set ignition timing as follows:

   Manual Transmission . . . . 4^{o} BTC
   Automatic Transmission . . . . 4^{o} BTC

3. Adjust idle speed screw to 600 rpm (manual transmission in neutral) or 530 rpm (automatic transmission in drive).
4. Adjust mixture screw IN to obtain 550 rpm (manual transmission in neutral), or 500 rpm (automatic transmission in drive).

350 V8 Engine

1. Adjust the mixture screws for maximum steady idle speed.
2. Disconnect and plug distributor vacuum advance line - this step only. Set ignition timing as follows:

   Manual Transmission . . . . 4^{o} BTC
   Automatic Transmission . . . . 4^{o} BTC

3. Adjust idle speed screw to obtain 500 rpm.
4. Adjust mixture screws IN to obtain a 20 rpm drop (lean roll).
5. Adjust each mixture screw out ¼ turn.
6. Check idle speed and re-adjust idle speed screw to 500 rpm, if necessary.

FLOAT LEVEL ADJUSTMENT - MODEL M
(Refer to Fig. 21)

1. Remove carburetor air cleaner.

2. Disconnect choke wire from connector on choke lever.

3. Remove fast idle cam retaining screw from main body.

4. Remove choke rod from slot in fast idle cam by rotating rod. Remove choke rod from choke lever. Note position of rod in relation to levers for ease in reassembly.

5. Remove six air horn to float bowl attaching screws. There are three long and three short screws.

6. Remove air horn by lifting straight up. Invert air horn and place on a clean bench. Remove air horn to bowl gasket.

7. Hold float bowl retaining pin firmly in place and lightly press down on very end of float arm as shown in figure 21.

8. With adjustable T-scale, measure distance from top of float at toe to float bowl gasket surface (gasket removed). Measurement should be made at point 1/16-inch from end of flat surface at float toe (not on radius). Float level should be ¼-inch.

9. Bend float pontoon up or down to adjust.

10. Install air horn gasket on float bowl by carefully sliding slit portion of gasket over metering rod holder. Then align gasket with dowels provided on top of bowl casting and press firmly in place.

NOTE: Before installing air horn, check operation of metering rod and accelerator pump to ensure free operation from closed to wide open throttle.

11. Install air horn to float bowl by lowering gently on to float bowl until seated. Install three long and three short air horn to float bowl attaching screws. Tighten screws securely using correct tightening sequence as shown in figure 22.

12. Assemble choke rod to choke shaft lever. End of rod points away from air horn when installed properly. (Lower end of rod has 45-degree bend.)

13. Install lower end of choke rod into curved slot in fast idle cam. Part number on cam should face outward.

14. Install fast idle cam to main body and tighten retaining screw securely.

15. Connect manual choke wire to choke lever.

16. Install carburetor air cleaner.

FLOAT LEVEL ADJUSTMENT - MODEL 2G

1. Remove carburetor air cleaner.

2. Disconnect choke wire from connector on choke lever.

3. Disconnect pump link from throttle lever by removing retainer. Link can be removed from pump lever.

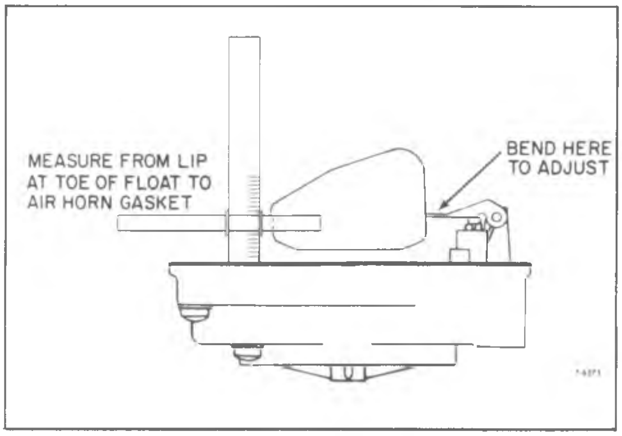


Figure 23—Float Level Adjustment (Model 2G)

5. Remove eight cover screws and choke cable bracket. Lift cover from bowl.

6. With air horn inverted, gasket in place and needle seated, measure distance from lip at toe of float to air horn gasket. Adjust float to specification (float level) by bending float arm (fig. 23).

7. With air horn right side up so that float can hang free, measure distance from lip at toe of float to air horn gasket. Adjust float to specification (float drop) by bending tang (fig. 24).

8. Place air horn on bowl making certain that accelerator pump plunger is positioned and will move freely. Raise air horn and lower straight down to ensure proper installation. Install screws and tighten securely in sequence (fig. 25).

NOTE: The longest screw is used in hole closest to boss plug in raised part of casting. The two intermediate screws are used to retain the choke cable clamp bracket.

9. Install fast idle cam retaining screw and tighten securely.

10. Insert lower end of rod in throttle lever. Install pump rod retainer.

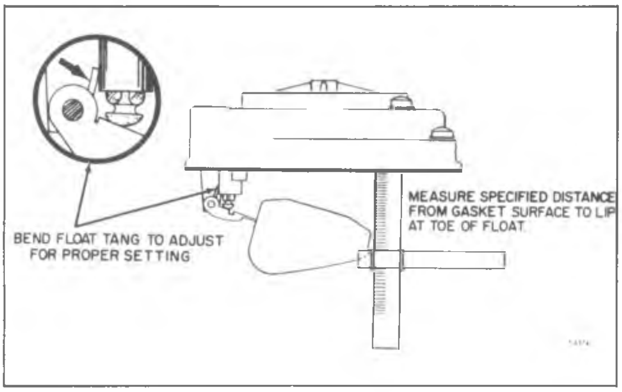


Figure 24—Float Drop Adjustment (Model 2G)

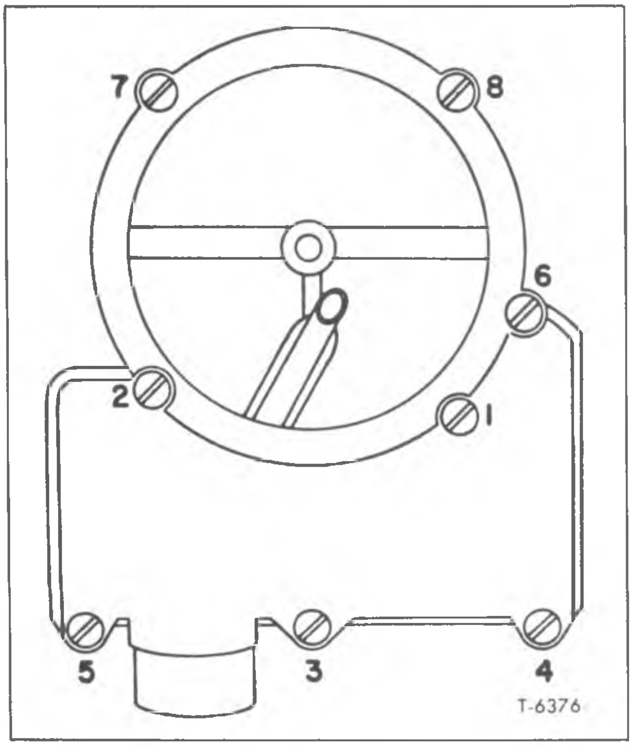


Figure 25—Air Horn Tightening Sequence (Model 2G)

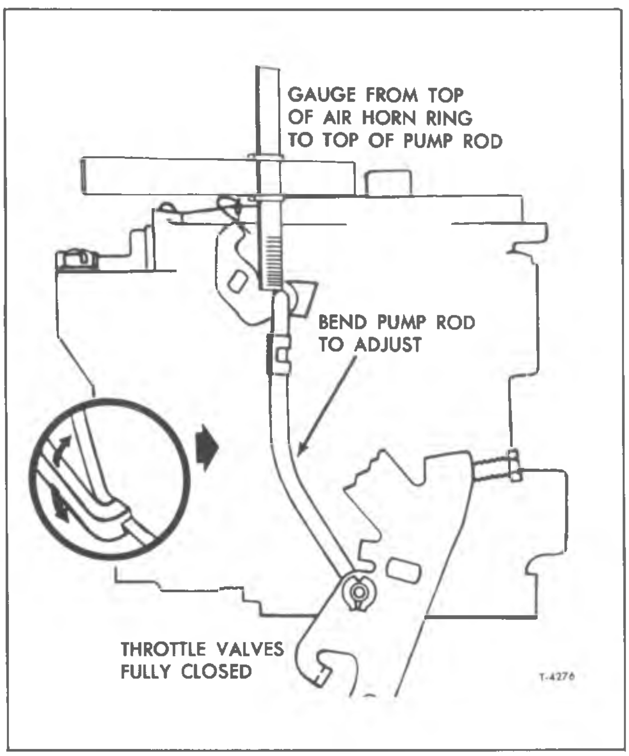


Figure 26—Accelerator Pump Rod Adjustment (Model 2G)

ACCELERATOR PUMP ROD ADJUSTMENT - MODEL 2G

Back out idle stop screw and completely close throttle valves in bore. Place gauge on top of air horn ring. Bend the pump rod at lower angle to obtain specified dimension (fig. 26).

CHOKE ADJUSTMENT (MANUAL CHOKE) - ALL MODELS

1. Remove air cleaner.
2. Push hand choke knob in to within 1/8" of instrument panel.
3. Loosen choke clamp at carburetor bracket and adjust cable through the clip until the choke valve is wide open.
4. Tighten cable clamp at carburetor bracket and check operation of choke valve to ensure full closed and wide open positions.
5. Install air cleaner.

FAST IDLE ADJUSTMENT - MODEL M
(Refer to Fig. 27)

1. Adjust idle speed as indicated under "Idle and Mixture Adjustment."
2. Rotate fast idle cam clockwise to its highest position.
3. With tang held against cam check clearance between end of slow idle screw and idle stop tang on throttle lever.
4. To adjust, insert end of screwdriver in slot provided in fast idle cam follower tang and bend inward (towards cam) or outward (away from cam) to obtain 0.100" dimension.

IMPORTANT: Support throttle lever with pliers as shown in figure 27, to prevent bending fast idle tang.

5. Check fast idle rpm, which should be as indicated in "Specifications" found at the end of this section.

CARBURETOR REPLACEMENT

REMOVAL

Flooding, stumble on acceleration and other performance complaints are, in many instances, caused by the presence of dirt, water, or other foreign matter in the carburetor. To aid in diagnosing the cause of the complaint, the carburetor should be carefully removed from the engine without draining the fuel from the bowl. The contents of the fuel bowl may then be examined for contamination as the carburetor is disassembled.

1. Remove air cleaner and gasket.
2. Disconnect fuel and vacuum lines from carburetor.
3. Disconnect choke cable or rod.
4. Disconnect accelerator linkage.
5. If equipped with Automatic transmission, disconnect TV linkage.

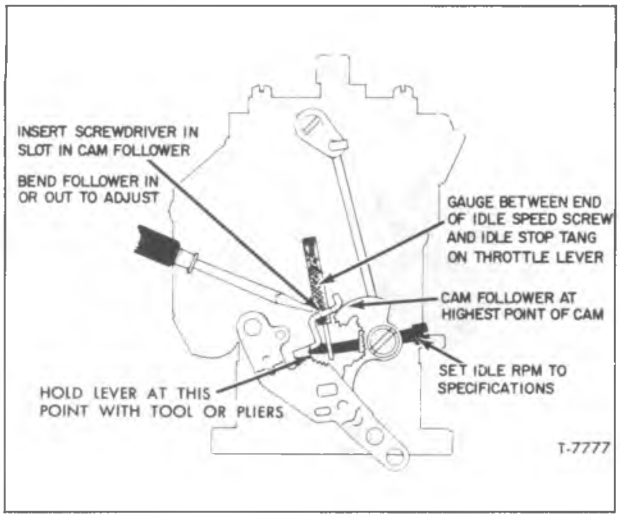


Figure 27—Fast Idle Adjustment (Model M)

6. Remove carburetor attaching nuts and remove carburetor.

TEST BEFORE INSTALLATION

It is good shop practice to fill the carburetor bowl before installing the carburetor. This reduces the strain on the starting motor and battery and reduces the possibility of backfiring while attempting to start the engine. A fuel pump clamped to the bench, a small supply of fuel and the necessary fittings enable the carburetor to be filled and the operation of the float and intake needle and seat to be checked. Operate the throttle several times and check the discharge from the pump jets before installing the carburetor.

INSTALLATION

1. Be certain throttle body and intake manifold sealing surfaces are clean.
2. Install new carburetor to manifold flange

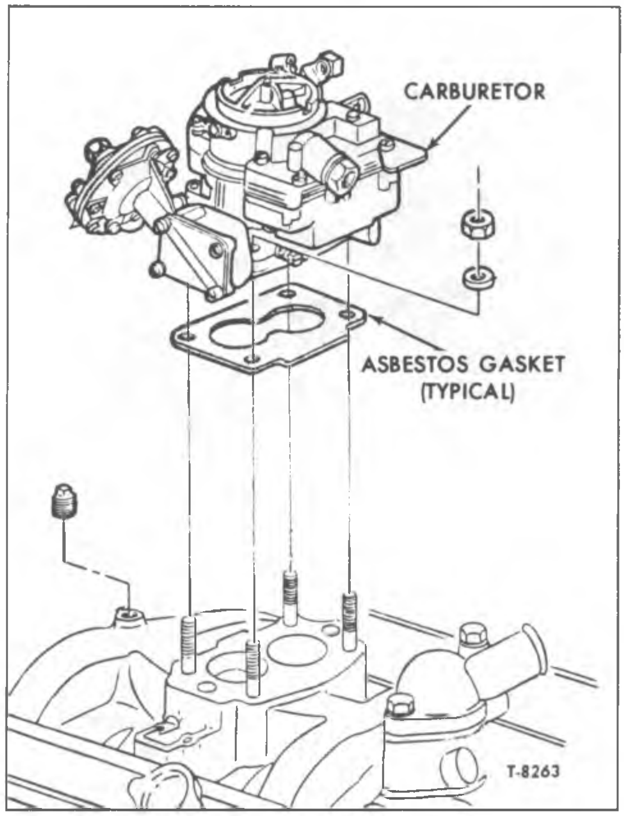


Figure 28—Rochester Model 2G Installation

gasket (see fig. 28).
3. Install carburetor over manifold studs.
4. Start vacuum and fuel lines at carburetor.
5. Install attaching nuts and tighten securely.
6. Tighten fuel and vacuum lines.
7. Connect and adjust accelerator and TV linkage (when used).
8. Connect choke cable.
9. Adjust idle speed and mixture described previously, then install air cleaner.

HOLLEY CARBURETORS

GENERAL DESCRIPTION

The Holley four-barrel carburetor Model 4150G (figs. 29, 30, and 31) is used with either 366 or 427 cu. in. engines.

This is a four-barrel two-stage carburetor consisting of eight sub-assemblies. The sub-assemblies are: The throttle body, the main body, primary and secondary fuel bowls, primary and secondary metering bodies, secondary throttle operating assembly, and the governor assembly.

The secondary throttle operating assembly (fig. 32) controls the second stage throttle plates. A vacuum signal to the spring loaded vacuum diaphragm assembly determines the position of the throttle plates. At lower speeds, the secondary throttle plates remain nearly closed, allowing the engine to maintain satisfactory fuel-air ratios and distribution. When engine speed increases to a point where additional breathing capacity is needed, the vacuum controlled secondary throttle plates begin to open.

Vacuum taken from one of the primary bores acts upon a diaphragm which controls the secondary throttle plates. The two pick-up ports are located in the primary barrel. At high speeds when engine requirements approach the capacity of the two primary bores, the increased primary venturi

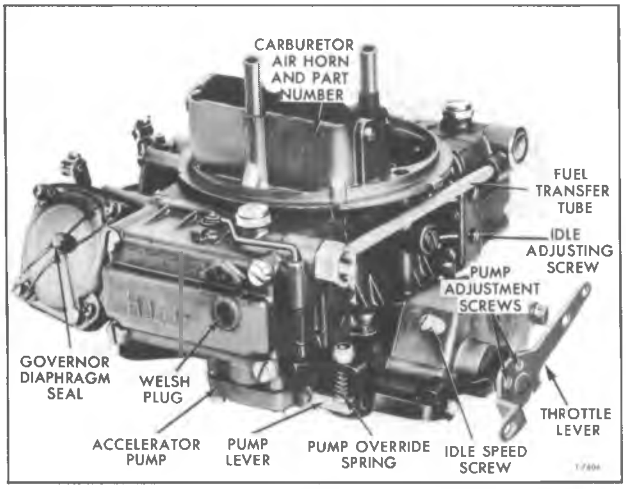


Figure 29—Holley Carburetor (Left Front View)

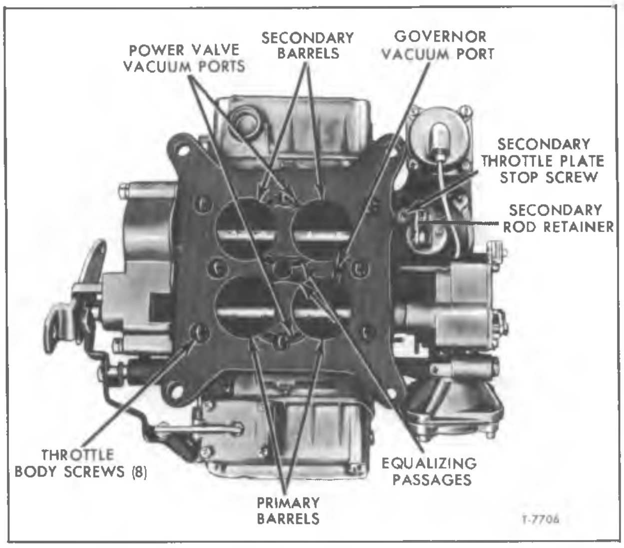


Figure 31—Holley Carburetor (Bottom View)

vacuum moves the diaphragm, compressing the diaphragm spring. The diaphragm, acting through the diaphragm link and lever, will commence to open the secondary throttle plates. The position of the secondary throttle plates depends on the strength of the vacuum. This in turn, is determined by the air-flow through the bores to the engine. As the air-flow increases, a greater secondary throttle plate opening will result and the secondary bores will supply a greater portion of the engine's requirements. As top speed is reached, the secondary throttle plates will approach wide open.

The bleed past the ball check valve in the vacuum passage of this carburetor limits the rate at which the secondary throttle plates are allowed to open. Any rapid increase in vacuum, which would tend to open the secondary throttle plates too suddenly, merely holds the ball check valve securely against its seat. The opening of the throttle plates is slowed to a rate governed by the amount of air passing through an air bleed in the check valve seat. On some units this bleed is a groove in check ball seat. On other units this is a drilled by-pass. This allows the vacuum to build up comparatively slow at the diaphragm which results in a controlled rate of opening for the secondary throttle plates. As the secondary throttle plates begin to open, a vacuum is created in the secondary bores, first at the throttle plates and then, as air flow increases, at the throat of the secondary venturi. This vacuum assists the secondary metering system during its operation.

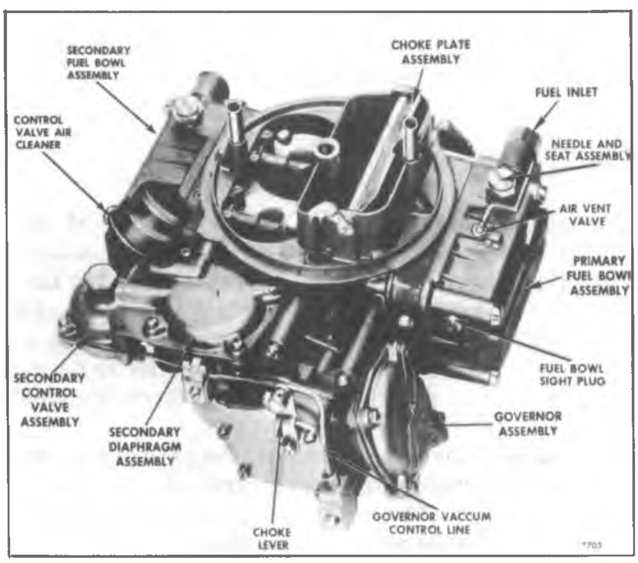


Figure 30—Holley Carburetor (Right Front View)

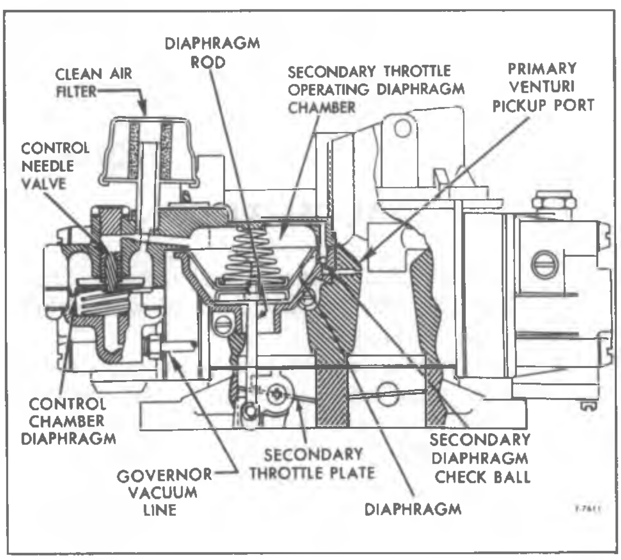


Figure 32—Secondary Throttle System

When engine speed is reduced, venturi vacuum in the bores become weaker. The momentarily stronger vacuum at the secondary throttle operating diaphragm moves the ball check valve off its seat in the vacuum passage, permitting an immediate flow of air into the diaphragm chamber. As the vacuum acting on the diaphragm is lessened, the load on the diaphragm spring will commence closing the secondary plates. The diaphragm spring is assisted by the design of the secondary plates. Each secondary plate is slightly offset. When the plates are closing, the combined force of manifold vacuum and the air stream has greater effect on the larger, upstream area of the plates, forcing the plates to a closed position. The secondary plates are retained in the closed position when the primary plates are fully closed by the secondary throttle connecting rod. This rod, which is fastened to the primary throttle lever, rides in a slot in the secondary throttle lever.

The governor incorporated on this carburetor provides a positive means of controlling engine speed. The throttle lever controls the engine until the governing speed is reached, at this time the governor assembly adjusts the throttle plates to maintain this speed under the various loadings. A clutch arrangement on the throttle body allows the manual control below governing speeds. For additional details refer to "Internal Vacuum Type Governor," covered previously in this section.

The Holley four-barrel carburetor has the identification part number and manufacturer number stamped on the air horn (fig. 29) near the choke plate. Before attempting to repair the carburetor refer to identification numbers and secure correct parts or repair kit.

HOLLEY CARBURETOR ADJUSTMENTS

PRELIMINARY CHECKS

1. Thoroughly warm up engine. If the engine is cold, allow to run for at least 15 minutes.
2. Be sure the carburetor is properly secured to the intake manifold, which will exclude the possibility of air leaks.

IDLE AND MIXTURE ADJUSTMENTS

Idle and mixture adjustments should be performed with the engine at operating temperature, choke open, air cleaner installed, air conditioning turned ON, parking brake applied, and the driving wheels blocked. Also when equipped with automatic transmission, place transmission in drive range while making carburetor idle speed adjustment.

NOTE: When setting ignition timing the term BTC means Before Top Center.

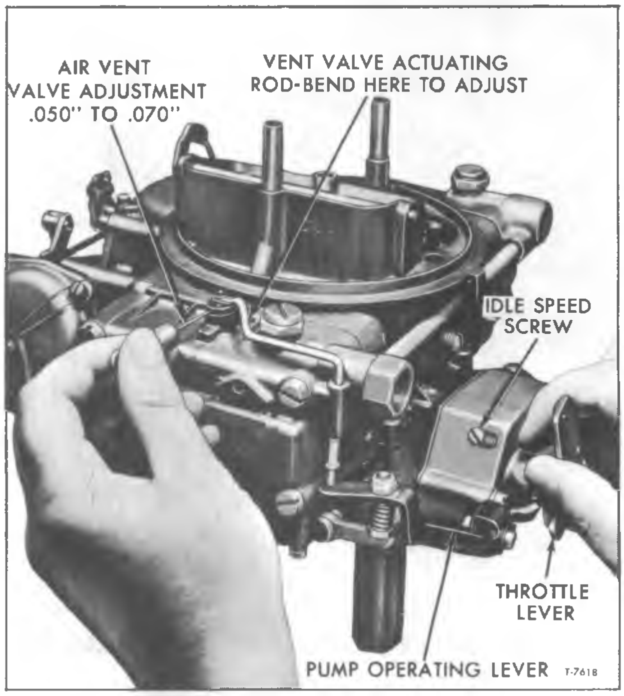


Figure 33—Air Vent Valve Adjustment

1. Check the dwell reading.

NOTE: For all engines covered by this manual, the dwell reading should be 28 to 32 degrees. Readjust dwell if necessary.

2. Set ignition timing as follows:

Manual Transmission . . . . 8^{O} BTC
Automatic Transmission . . . . 8^{O} BTC

3. Set the engine idle speed screw to provide an idle speed of 500 rpm.
4. Adjust the mixture screws for maximum steady idle speed.
5. Adjust each carburetor mixture screw in to obtain a 20 rpm drop (lean roll).
6. Adjust each mixture screw out ¼ turn.
7. Check idle speed and re-adjust to 500 rpm.

FLOAT ADJUSTMENT (HOLLEY 4150G)

1. Remove air cleaner, disconnect primary coil wire, then remove fuel level sight plugs (fig. 30).
2. With parking brake on, and transmission in neutral, crank the engine.
3. With the vehicle on a level surface, the fuel level should be on a level with the threads at the bottom of the sight plug port (plus or minus 1/32").

NOTE: No float drop adjustment is required on this carburetor.

4. If necessary to adjust (either or both bowls), loosen lock screw (fig. 30), and turn the adjusting nut clockwise to lower or counterclockwise to raise fuel level, then tighten lock screw.

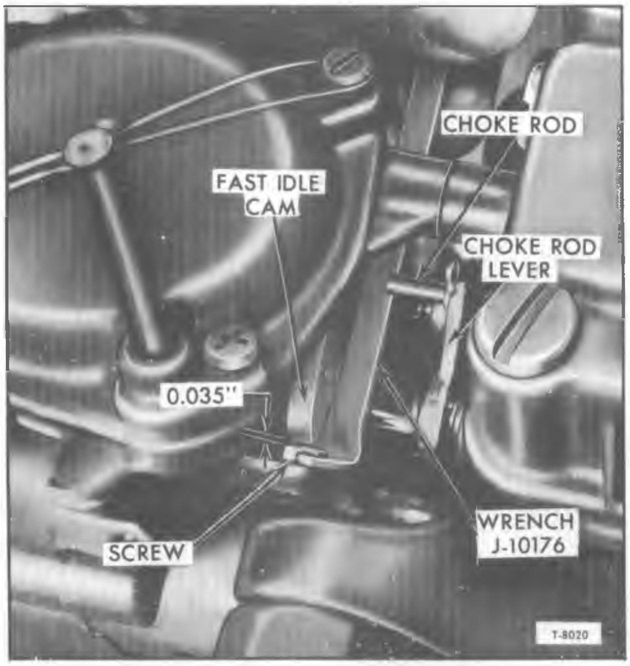


Figure 34—Fast Idle Adjustment

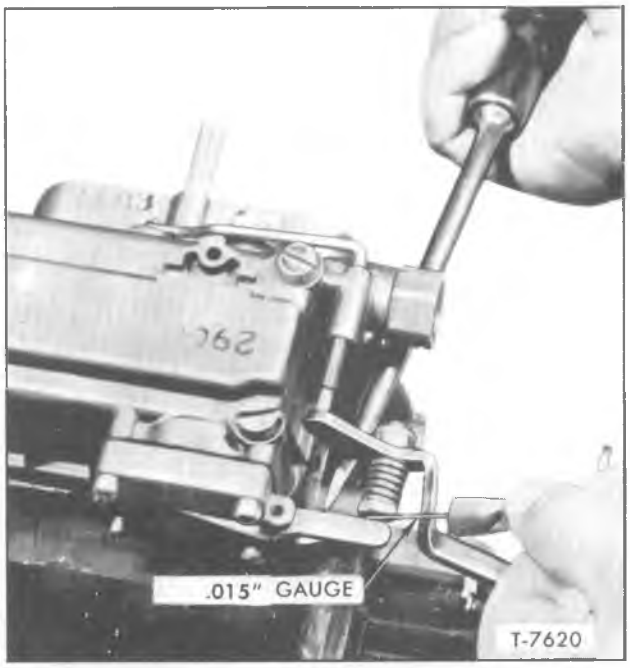


Figure 35—Accelerator Pump Adjustment

NOTE: 1/6 turn of adjusting nut equals approximately 1/16" fuel level change.

5. Allow a minute for fuel level to stabilize, then recheck the level at sight plug.

6. Re-adjust, if necessary, until proper level is obtained, then install sight plug and air cleaner.

NOTE: To assure proper secondary float level setting, it is advisable to accelerate primary throttles slightly and hand operate secondary throttle. This assures a stabilized secondary fuel level.

ADJUST AIR VENT VALVE (Fig. 33)

1. Back off idle speed screw until throttle valves are fully closed. (Choke valve open and throttle arm off idle screw.)

2. Check clearance between valve and seat. Clearance should be 0.050" to 0.070".

3. Bend air vent valve rod to adjust, if necessary.

4. Turn idle screw in until contact is made with throttle lever, then turn screw in 1½ additional turns for preliminary idle speed adjustment.

FAST IDLE ADJUSTMENT (Fig. 34)

1. With engine "OFF" and air cleaner removed, disconnect throttle return spring.

2. With throttle lever in wide open position and choke fully closed, measure gap between fast idle cam and screw. Gap should be 0.035".

3. If necessary, adjust fast idle screw to provide correct gap using wrench (J-10176).

4. Connect throttle return spring and install air cleaner.

5. Check engine rpm with choke fully closed and throttle at idle. The fast idle "Running" rpm's should be 1800-2400 rpm.

ADJUST ACCELERATOR PUMP (Fig. 35)

1. Hold throttle lever in wide open position with a rubber band and hold pump lever fully compressed (down), then measure the clearance between spring adjusting nut and arm of the pump lever.

2. Clearance should be 0.015"; adjust by turning nut or screw as required while holding opposite end. (The pump operating lever is not threaded.)

3. After adjustment is made, rotate the throttle lever to fully closed and partly open again. Any movement of the throttle lever should be noticed at operating lever spring end, indicating correct pump tip-in.

CHOKE ADJUSTMENT
(MANUAL CHOKE)

Adjustment procedure is the same as described previously for Rochester carburetors.

CARBURETOR REPLACEMENT

REMOVAL

Flooding, stumble on acceleration and other performance complaints are, in many instances, caused by the presence of dirt, water, or other foreign matter in the carburetor. To aid in diagnosing the cause of the complaint, the carburetor should be carefully removed from the engine without draining the fuel from the bowl. The contents of the fuel bowl may then be examined for contamination as the carburetor is disassembled.

1. Remove air cleaner and gasket.
2. Disconnect fuel and vacuum lines from carburetor.
3. Disconnect choke cable or rod.
4. Disconnect accelerator linkage.
5. If equipped with Automatic transmission, disconnect TV linkage.
6. Remove carburetor attaching nuts and remove carburetor.

TEST BEFORE INSTALLATION

It is good shop practice to fill the carburetor bowl before installing the carburetor. This reduces the strain on the starting motor and battery and reduces the possibility of backfiring while attempting to start the engine. A fuel pump clamped to the bench, a small supply of fuel and the necessary fittings enable the carburetor to be filled and the operation of the float and intake needle and seat to be checked. Operate the throttle several times and check the discharge from the pump jets before installing the carburetor.

INSTALLATION

1. Be certain throttle body and intake manifold sealing surfaces are clean.
2. Install new carburetor to manifold flange gasket.
3. Install carburetor over manifold studs.
4. Start vacuum and fuel lines at carburetor.
5. Install attaching nuts and tighten securely.
6. Tighten fuel and vacuum lines.
7. Connect and adjust accelerator and TV linkage (when used).
8. Connect choke cable or choke rod.
9. Adjust idle speed and mixture, then install air cleaner.

SPECIFICATIONS

ROCHESTER CARBURETOR

CARBURETOR MODEL NUMBER	"M"		"2G"	
CARBURETOR NUMBER	7040011	7040012	7041123	7041124
Engine Model	250	292	350	350
Float Level	1/4	1/4	23/32	23/32
Float Drop			1 3/4	1 3/4
Accelerator Pump			1 5/32	1 5/32
Metering Rod	0.070	0.070		
Idle Vent	—	—	.025	.025
Fast Idle (Bench)	.100	.100		
Fast Idle (Running)	2400 RPM			
Governor (Vacuum Spinner Type)				4250 RPM (No Load) 4000 RPM (Full Load)

FUEL SYSTEM—GASOLINE ENGINES

HOLLEY 4150G

PART NUMBER (MFG. NUMBER)	679344 4772-1	679345 4773-1
Engine Displacement	366	427
Transmission	ALL	
Fuel Pump Pressure	8 P.S.I.	
Throttle Bore		
Primary	1 9/16"	
Secondary	1 9/16"	

ADJUSTMENTS AND POSITIONS

Fuel Bowl Float		
Dry Float Setting (Bowl Inverted)	Adjust Float Parallel to Bowl Floor	
Wet Float Setting (Final Use Sight Plug)	With the truck on a Level Surface and engine at idle speed. Fuel should be on Line with the threads at the bottom of sight plug hole ± 1/32"	
Secondary Stop	1/2 Turn Open	
Air Vent Valve. (idle valve)	.050-.070	
Fast Idle Cam		
Mechanical	.035	
Running	1800-2400 R.P.M.	
Accelerator Pump	.015 Min.	
Cam Position (stamped)	#1 Hole	
Pump Setting	With throttle plates held wide open, and pump Lever completely depressed, there should be .015 clearance between adjusting nut and pump operating Lever. With throttle plates closed (in idle position only) be sure there is no lost movement of the pump operating Lever.	
Main Metering Jet	(stamped on Jet)	
Primary	#59	
Secondary	#70	
Power Valve	-8	
Power Valve Range		
Fully Open	-8	
Fully Closed	-10	
Governor Systems Restrictions (Stamped)	"A"—.035 "B"—.041	
Spring Post Number (Stamped)	#3	
Stained Spring	Red	Red
R.P.M.	4000 R.P.M. (No Load) 3800 R.P.M. (Full Load)	

VELOCITY TYPE GOVERNOR

KING-SEELEY MODEL (STAMPED)	NO. (STAMPED)	ENGINE MODEL	MAX. GOVERNED SPEED (RPM)* NO LOAD
651-735	3929621	250	2400
601-734	3929623	250	3900
651-739	3929625	292	2400
601-738	3929627	292	3900
651-759	3938709	292	2400
601-758	3938708	292	3900

*With Engine broken-in. Full load is approximately 300 RPM less than No Load RPM and will vary from engine to engine.

FUEL PUMP

ENGINE	PRESSURE	VOLUME
In-Line	4-5	1 pint in 35-40 seconds
350 V8	7½-9	1 pint in 20-25 seconds
366 or 427 V8	7½-9	1 pint in 10-15 seconds

Air Cleaners
(ALL ENGINES)

GASOLINE ENGINES

Air cleaners should be inspected every 6,000 miles and serviced whenever dirt becomes visible in element or oil. Under adverse conditions or extensive operation on dusty or sandy roads unit should be cleaned every day. Air cleaners on vehicles operating in dust storm areas should be cleaned immediately after such storm occurs.

> **CAUTION: In addition to its function of filtering air drawn into the engine through the carburetor, the air cleaner also acts as a flame arrester in the event the engine backfires. Because backfiring may cause fire in the engine compartment, the air cleaner should be installed at all times unless temporary removal is necessary during repair or maintenance of the vehicle.**

PAPER ELEMENT TYPE
- DRY OR PAPER WETTED

Paper element type air cleaners (figs. 1 and 2) are used on some engines covered by this manual. Inspect element assembly for damage and replace when damaged or excessively dirty.

1. Remove wing nut from stud at top of air cleaner, then lift cover and element from base. Remove base.
2. Remove all accumulated dirt from cover and base.
3. Inspect filter element for damage or excessive dirt accumulation.

a. The paper-wetted element has been impregnated with oil and cannot be cleaned. When dirt clogged, the element must be replaced.

b. Some dry elements are washable; refer to decal (fig. 3) on air cleaner for instructions. Clean element by shaking out accumulated dirt or clean by washing with water and detergent ONLY. Rinse until water runs clean. Shake off excess water and dry. DO NOT OIL THE ELEMENT. Install new element after FIVE cleanings.

IMPORTANT: DO NOT USE AIR PRESSURE TO CLEAN OR DRY ELEMENT.

c. Non-cleanable dry elements, if upon inspection, are damaged or dirt clogged, the element must be replaced.

4. Re-assemble and install in reverse order of removal procedure.

PAPER WETTED ELEMENT
WITH POLYURETHANE BAND

Some gasoline engine air cleaners are equipped with a paper wetted element having a polyurethane band (fig. 4). Inspect and clean element as follows:

1. Remove wing nut from stud at top of air cleaner, then lift cover and element from base. Remove base.
2. Remove all accumulated dirt from cover and base.
3. Being careful not to stretch polyurethane band, remove band from paper element. Inspect

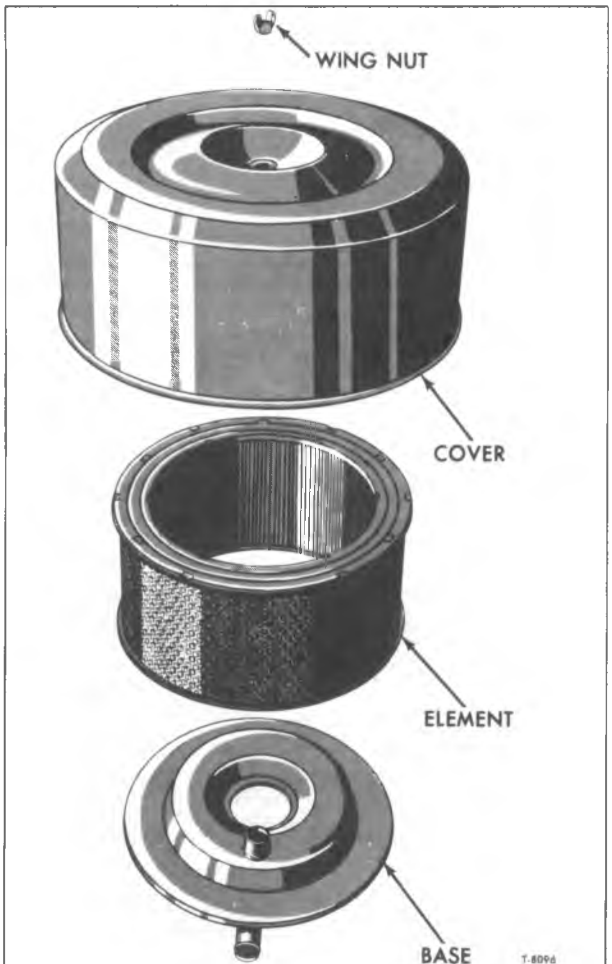


Figure 1—Air Cleaner (Gas-Dry Element) (Typical)

AIR CLEANERS

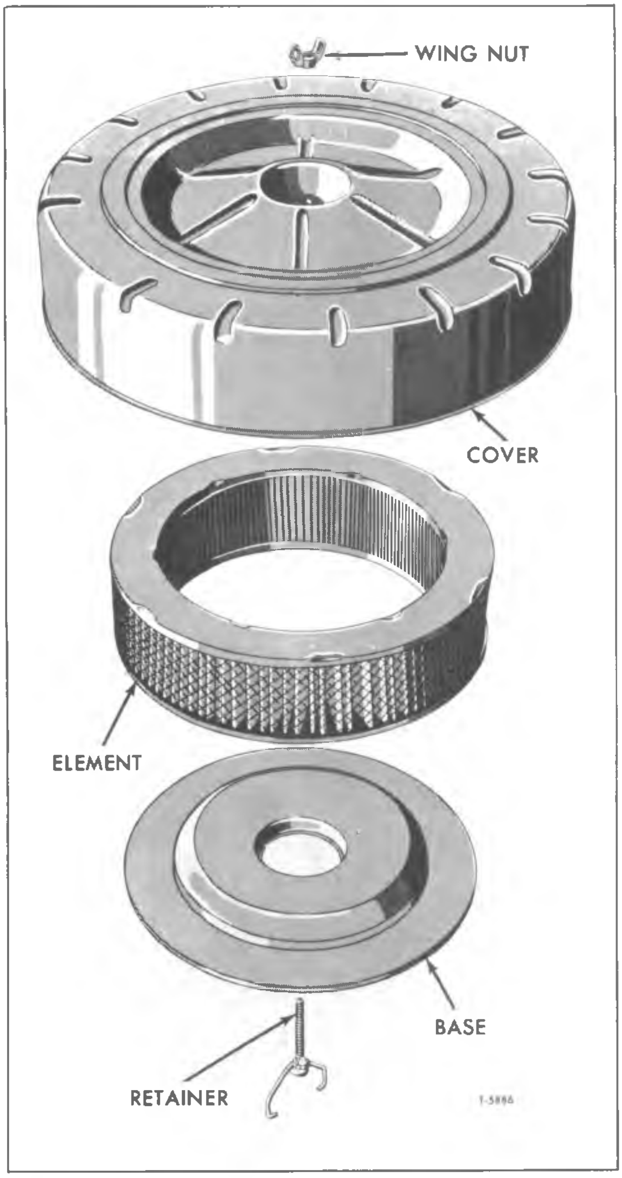


Figure 2—Air Cleaner (Gas-Paper Wetted Element) (Typical)

Figure 3—Typical Cleanable Dry Element Decal

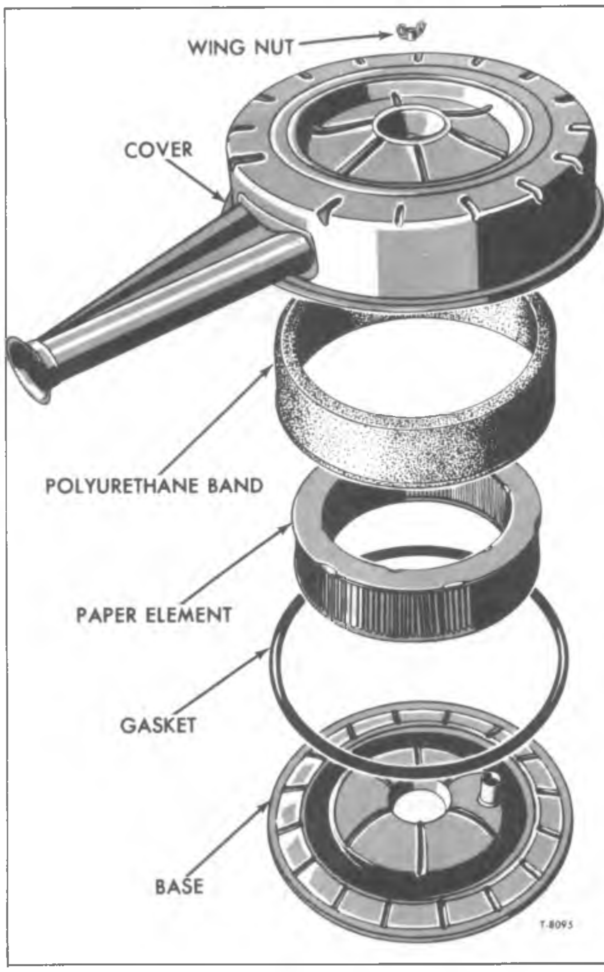


Figure 4—Air Cleaner (Paper Wetted with Polyurethane)

paper element for damage or excessive dirt condition. Replace if necessary.

4. Inspect the polyurethane band for tears or other damage, and replace if necessary.

5. If the polyurethane band is not damaged, wash in kerosene or mineral spirits; then squeeze out excess solvent.

CAUTION: NEVER USE A HOT DEGREASER OR ANY SOLVENT CONTAINING ACETONE OR SIMILAR SOLVENT FOR CLEANING POLYURETHANE BAND.

6. Dip band into S.A.E. 10 engine oil and then squeeze out excess oil.

NOTE: Never shake, stretch, swing, or wring the band to remove excess oil or solvent as this may tear the polyurethane material. Instead carefully squeeze out the excess oil.

7. Install the polyurethane band around the paper element, then reassemble and install air cleaner on the engine.

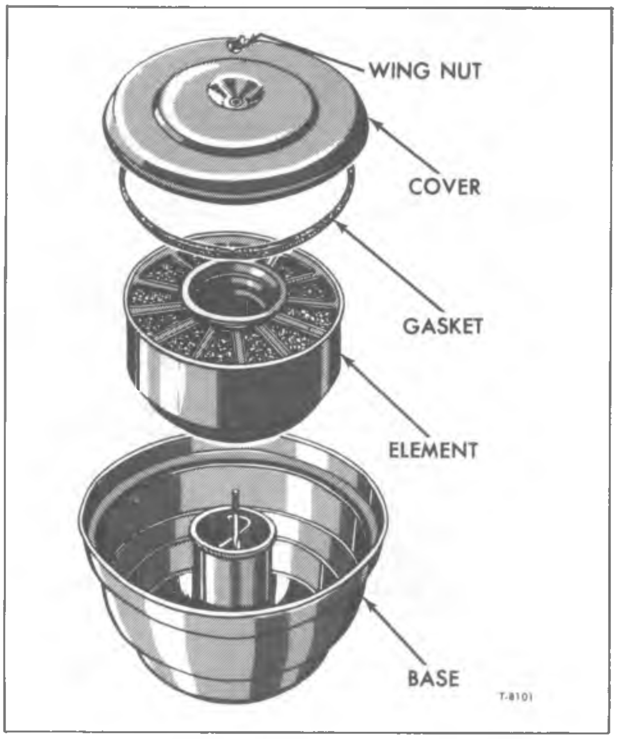


Figure 5—Air Cleaner (Oil Bath) (Typical)

OIL BATH TYPE

Oil bath air cleaners (fig. 5) used on gasoline engines covered by this manual are mounted on the carburetor.

1. Loosen wing nut and remove air cleaner assembly from vehicle.
2. Remove cover and filter element assembly.
3. Empty oil out of base or reservoir and remove all accumulated dirt by washing with cleaning solvent; then wipe dry.

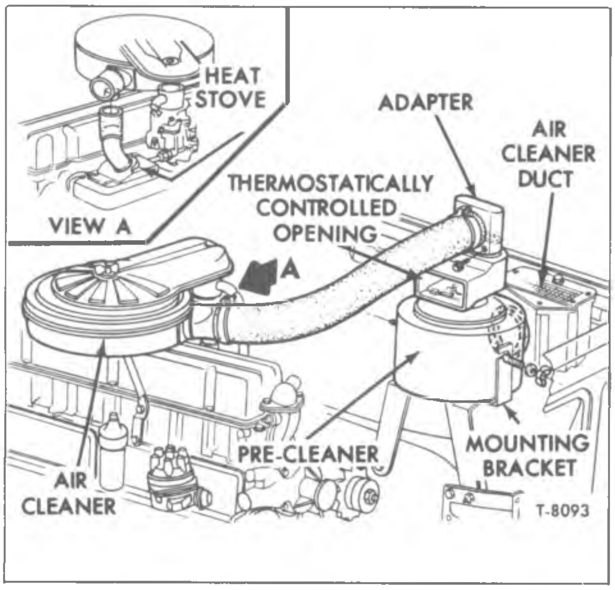


Figure 6—Oil Bath Pre-Cleaner (CS40-50)

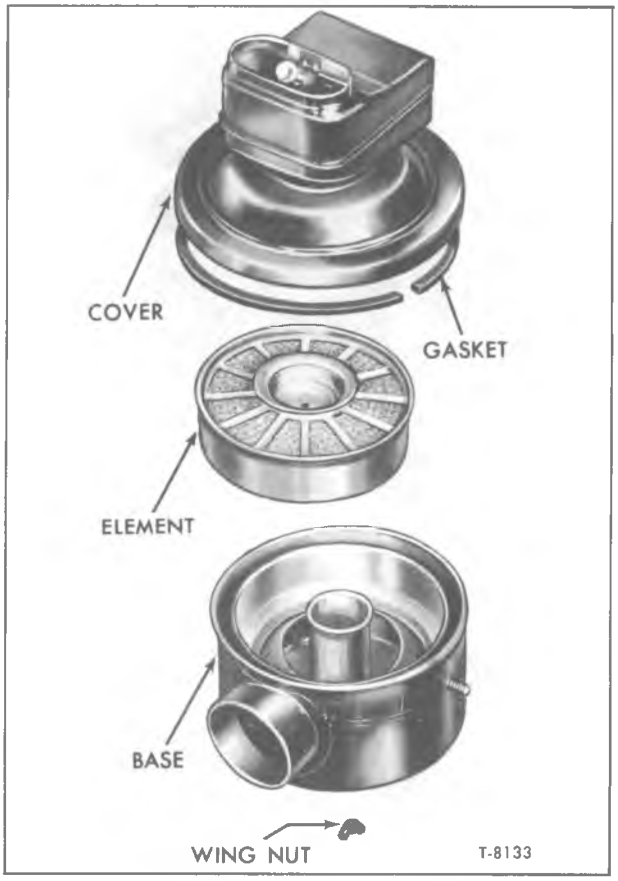


Figure 7—In-Line Engine Pre-Cleaner

4. Wash filter element by sloshing in cleaning solvent and dry thoroughly.
5. Fill reservoir with one quart of same grade oil used in engine. Install element, gasket and cover and reinstall assembly to carburetor.

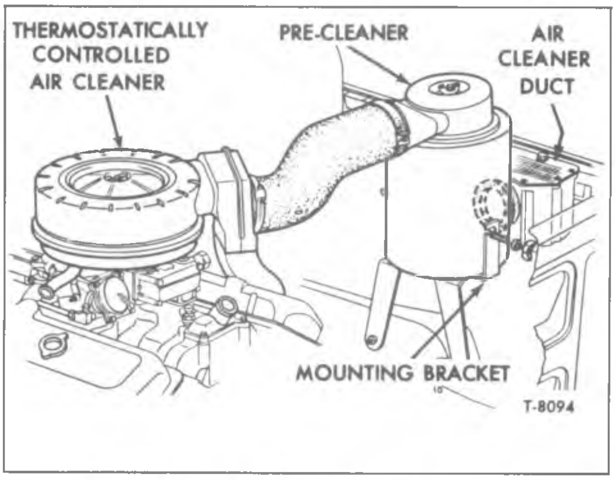


Figure 8—Oil Bath Pre-Cleaner (CE40-60)

AIR CLEANERS

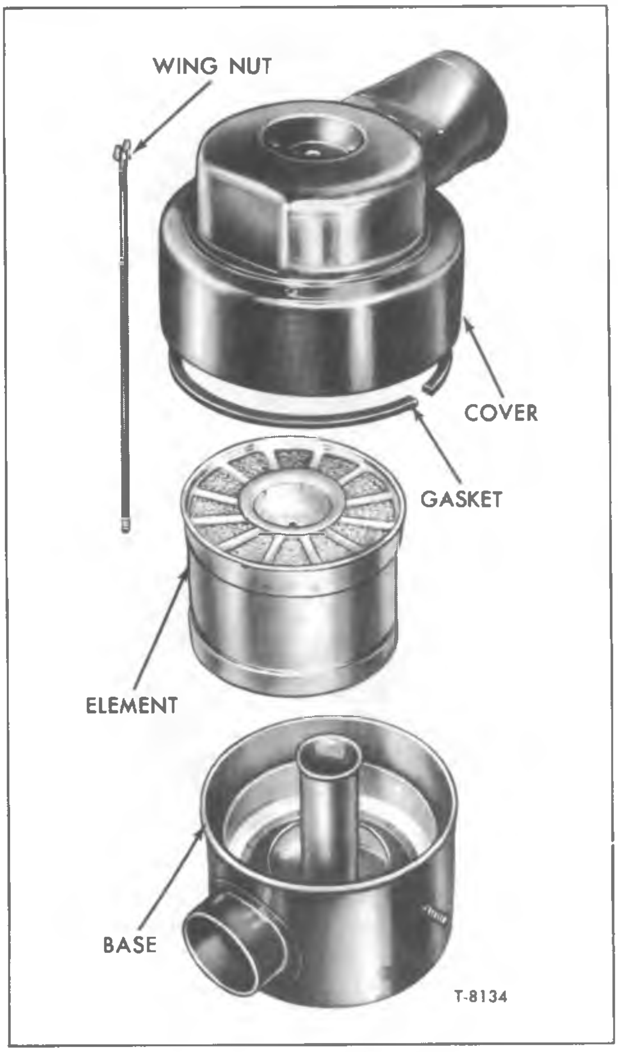


Figure 9—V8 Engine Pre-Cleaner

OIL BATH PRE-CLEANERS

Oil bath pre-cleaners (figs. 7 and 9) are available as optional equipment on In-line and V8 engines in conventional cab models. Service pre-cleaners as described in the following:

In-Line Engines (Refer to Figs. 6 and 7)

1. Loosen hose clamp retaining hose to adapter. Remove hose from adapter.
2. Loosen wing nuts holding pre-cleaner to mounting bracket.
3. Carefully remove pre-cleaner assembly from vehicle.
4. Remove wing nut from bottom of pre-cleaner assembly. Then remove cover assembly and element.
5. Empty oil out of base or reservoir and remove all accumulated dirt by washing with cleaning solvent and then wipe dry.
6. Wipe accumulated dirt from cover assembly.

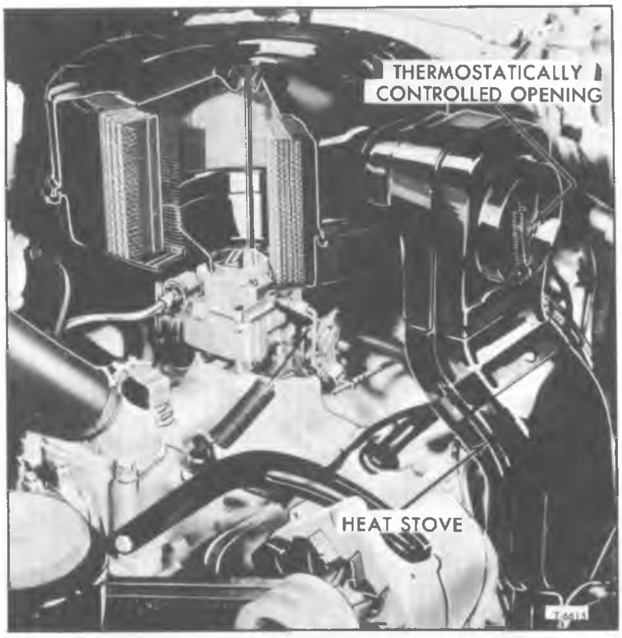


Figure 10—Thermostatically Controlled Air Cleaner

NOTE: If it is suspected that the thermostatic controlled opening is not working properly, test and replace thermostatic element, if necessary, as described later in this section under "Thermostatically Controlled Air Cleaner."

7. Wash filter element by sloshing in cleaning solvent and dry thoroughly.
8. Fill reservoir with one quart of same grade oil used in engine. Install element, gasket and cover and reinstall assembly to carburetor.

V8 Engines (Refer to Figs. 8 and 9)

1. Loosen hose clamp retaining hose to pre-cleaner. Remove hose from pre-cleaner.
2. Loosen wing nuts holding pre-cleaner to mounting bracket.
3. Carefully remove pre-cleaner assembly from vehicle.
4. Remove wing nut from top of pre-cleaner. Then remove cover assembly and element.
5. Empty oil out of base or reservoir and remove all accumulated dirt by washing with cleaning solvent and then wipe dry.
6. Wipe any accumulated dirt from cover assembly.
7. Wash filter element by sloshing up and down in cleaning solvent and dry thoroughly.
8. Fill reservoir with one quart of same grade oil used in engine. Install element, gasket and cover, and reinstall assembly to carburetor.

THERMOSTATICALLY CONTROLLED AIR CLEANER

All vehicles with a 366 or 427 engine or an

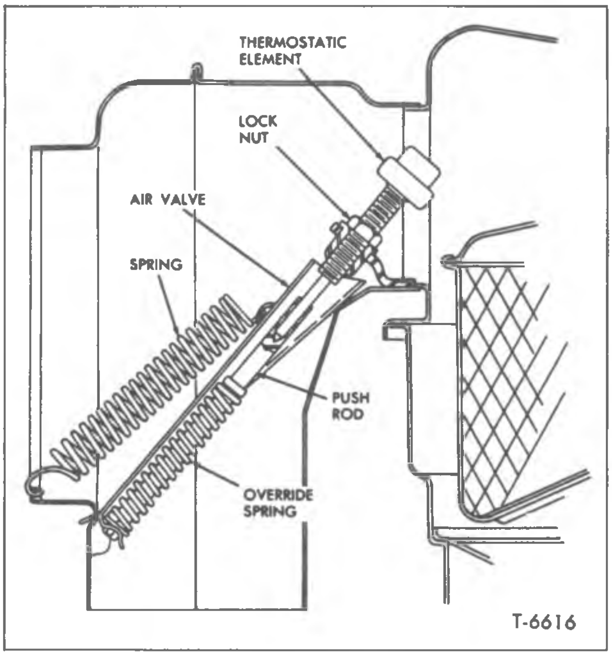


Figure 11—Air Cleaner Thermostatically Controlled Opening

optional pre-cleaner are equipped with a thermostatically controlled air cleaner (fig. 10).

NOTE: On In-line engines equipped with a pre-cleaner the thermostatic element is located in the pre-cleaner (see fig. 6).

Checking Air Valve

The thermostatically controlled air valve (fig. 11) may be easily checked for proper operation whenever the air cleaner cover assembly is removed for regularly scheduled element servicing. At this time immerse the cover (far enough to cover the thermostatic element) in water of less than 80°F. The valve should remain closed. Gradually raise temperature of water. The valve should begin to open at 83°F., and be fully open at a temperature of 102° to 105°F.

Replacing Thermostatic Element (Fig. 9)

1. Remove cover from air cleaner or pre-cleaner (In-line engines).

2. Loosen the lock nut and unthread the thermostatic element.

3. Turn in a new thermostatic element until it just bottoms on the push rod (with the air valve or door held closed by the spring). Immerse cover and thermostatic element in water at 83°F., for two to three minutes, then turn the element in further until the air valve (door) just begins to open. Tighten jam nut. Raise water temperature. Valve should be fully open at 102°F. to 105°F.

4. Re-install cover on air cleaner or pre-cleaner (In-line engines, only).

NOTE: To retain high engine efficiency and extend engine life, it is most important that air cleaner elements are serviced at recommended intervals.

SECTION 6Y

Engine Electrical

This section covering "ON-VEHICLE MAINTENANCE AND REPLACEMENT" of charging system components is divided into sections shown in the Index following:

Battery

The standard and optional type batteries used on vehicles covered by this manual are shown in the "Battery Model Application Chart" following:

BATTERY MODEL APPLICATION CHART

TRUCK SERIES	PART NO.	MODEL
STANDARD		
Series TE/TS-50; TE-60	1980030	E-5000
Series CE/CS-40; CE/CS-50	1980145	E-5000
Series CE/ME-60	1980145	E-5000
Series SE/SS-50	1980149	E-5000

BATTERY MODEL APPLICATION CHART (CONT.)

TRUCK SERIES	PART NO.	MODEL
OPTIONAL		
Series TE/TS-50; TE-60	1980038	E-3000
Series CE/CS-40; CE/CS-50	1980149	E-5000
Series CE/ME-60	1980149	E-5000

GENERAL

The battery has three major functions to perform on the vehicle:

1. It provides a source of current for starting the engine.

2. It acts as a stabilizer to the voltage in the electrical system.

3. It can, for a limited time, furnish current when electrical demands of the system exceed output of the generator.

On some vehicles, hard rubber cell covers are fitted over terminal posts of the elements. Cell connectors are welded between intermediate terminal posts of adjoining cells to establish a series circuit.

The batteries shown in figures 1 and 2 have a one-piece cell cover of hard rubber construction which reduces the tendency for corrosion to form on top of the battery. The cover is bonded to the case with sealing compound that forms an airtight seal between the cover and case. The cell connectors pass through sealed holes in cell partitions to connect elements together in the shortest practical distance (fig. 3). With the length of the electrical circuit inside the battery reduced, the internal voltage drop is decreased.

The battery shown in figure 2 has special cables with a threaded insert and bolts to thread directly into threaded receptacles molded into the side of the battery case near the top. Cables are removed or connected by loosening or tightening the bolt. A plastic covering on battery end of each cable seals the connection, thus helping to eliminate corrosion build-up and provide tighter connections.

The cells are properly filled when electrolyte level reaches the bottom of the "split vent" at bottom of the vent well. The split vent is a visual level fill feature in the cell cover. The electrolyte surface will appear distorted when it contacts the split vent.

BATTERY PRECAUTIONS

1. The electrical system is NEGATIVE ground. Installing battery with positive terminal grounded

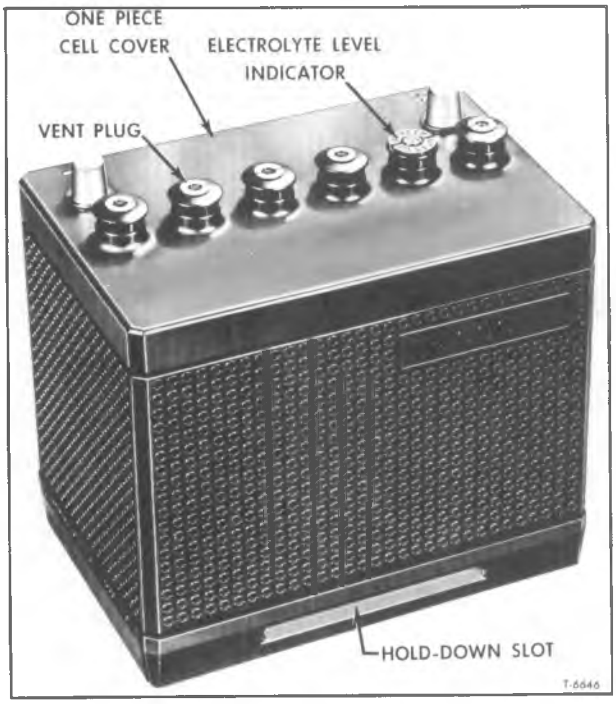


Figure 1—Battery with One-Piece Cover (Typical)

Figure 2—Side Terminal Battery (Typical)

will result in serious damage to generator, battery, and battery cables.

2. When using a booster battery or charger, connect negative battery or charger terminals together and positive battery or charger terminals together.

3. DO NOT smoke near a battery which is being charged.

COMMON CAUSES OF BATTERY FAILURE

When a battery fails, the cause of failure may lie outside the battery itself. For this reason, when a battery failure is encountered, do not be satisfied to merely recharge or replace it. Find the cause of the failure and prevent recurrence of the trouble. Listed below are some of the common causes of battery failure:

1. Defect in generating system such as high resistance, slipping generator drive belt, faulty generator or regulator.

2. Overloads caused by defective starter or excessive use of accessories.

3. Battery abuse, including failure to keep battery top clean, cable clamps clean and tight, and improper addition of water to the cells.

4. Hardened battery plates, commonly called "sulfation," due to battery being in a low state of charge over a long period of time.

5. Physical defects such as shorted cells, loss of active material from plates, etc.

6. Driving conditions or requirements under which the vehicle is used only for short drives.

7. Vehicle accessories inadvertently left on.

BATTERY MAINTENANCE

FILLING BATTERY

Batteries are equipped with "Visual Level" cell covers to facilitate checking electrolyte level and to lessen the possibility of overfilling the battery. The cell covers are molded with a long, circular, tapered vent well with two small vertical slots diametrically opposite. Viewed from above with the vent plugs removed, the lower end of the vent well appears as a ring with small portions of the circumference missing. As water is added to the cell, the surface of the rising liquid contacts the slotted lower end of the vent well, causing a distortion of the reflecting surface of the liquid which is very noticeable. Thus, the lower end of the vent well serves as a reference point in determining proper electrolyte level. The cell is properly filled when the surface of the electrolyte touches the bottom of the vent well. If some overfilling occurs, the amount can be estimated readily by the height of liquid in the vent well. It should be kept in mind that the "visual level" vent wells cannot prevent overfilling, but are rather an aid to proper servicing. Overfilling should be avoided at

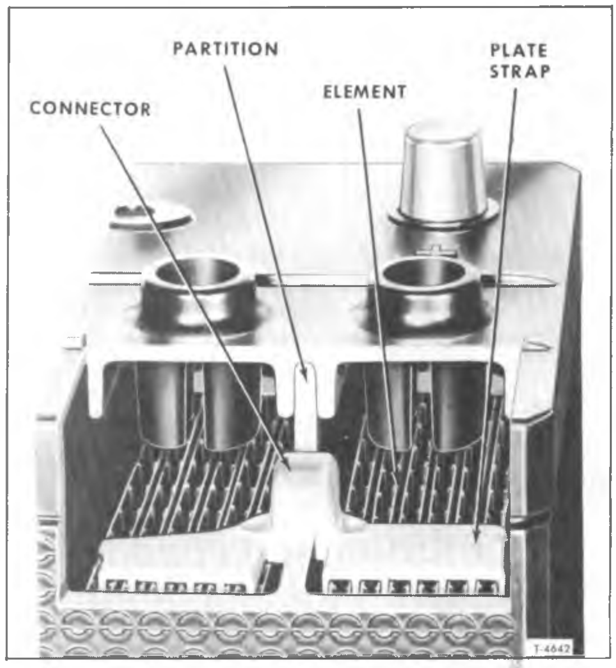


Figure 3—Internal View of Cells

all times since it contributes to premature battery failure by causing loss of electrolyte. Loss of electrolyte results in poor performance of the battery and causes excessive corrosion of cables, connections, and battery hanger.

All batteries having a one-piece cover are equipped with an electrolyte level indicator installed in the second cell cap from the positive battery post. The level indicator is a specially designed vent plug having a transparent rod extending through the center. When electrolyte is at proper level, the lower tip of the rod is immersed and the top of the rod will appear as a dark (black) spot in the center of the vent cap. When electrolyte level drops below normal, the spot will change from black to an off-white color. When the indicator shows water is needed, all cells must be checked and adjusted to their correct level using colorless, odorless, drinking water.

ELECTROLYTE LEVEL

Electrolyte level in the battery should be checked periodically. In hot weather, particularly during prolonged driving, checking should be more frequent because of more rapid loss of water. If electrolyte level is found to be low, colorless, odorless, drinking water should be added to each cell until the liquid level rises to the split vent located in the vent well. DO NOT OVERFILL because this will cause loss of electrolyte resulting in poor performance, short life, and excessive corrosion.

IMPORTANT: During service, only water should be added to the battery, not electrolyte.

BATTERY

The liquid level in the cells should never be allowed to drop below the top of the plates, as the portion of the plates exposed to air may be permanently damaged with a resultant loss of performance.

CLEANING AND INSPECTION

The external condition of the battery should be checked periodically for damage or presence of dirt and corrosion. The battery top should be kept clean to prevent the accumulation of acid film and dirt which may permit current to flow between terminals resulting in a slow discharge of the battery. For best results when cleaning the battery top, wash first with a diluted ammonia or soda solution to neutralize any acid present, then flush with clean water. Care must be taken to keep vent plugs tight so that the neutralizing solution does not enter the cells.

Cables

To ensure a good electrical contact, cables should be clean and tight on battery posts. If battery posts or cable terminals are corroded, the cables should be disconnected and the terminals and clamps cleaned separately with a soda solution and a wire brush. After cleaning and installing clamps, apply a thin coating of multi-purpose grease on posts and cable clamps to retard corrosion.

Carrier and Hold-Down

The battery carrier and hold-down should be clean and free from corrosion before installing the battery. The carrier should be in sound mechanical condition so that it will support the battery securely and keep it level.

To prevent the battery from shaking in its carrier, the hold-down bolts should be tight. However, the bolts should not be tightened to the point where the battery case or cover will be placed under a severe strain.

BATTERY CHARGING

Before charging a battery, the electrolyte level must be checked and adjusted, if needed, by adding colorless, odorless, drinking water.

When a battery is being charged, an explosive gas mixture forms in each cell. Part of this gas escapes through holes in the vent plugs and may form an explosive atmosphere around the battery if ventilation is poor. This gas may remain in or around the battery for several hours after it has been charged. Sparks or flames can ignite this gas causing an internal explosion which may shatter the battery; therefore, do not smoke near a battery which is being charged or which has been recently charged and exercise care when connecting or disconnecting booster leads or cable clamps on a charger. Poor connections are a common cause of electrical arcs which cause explosions.

Battery charging consists of applying a charge rate in amperes for a period of time in hours. Thus, a 10-ampere charge rate for seven hours would be a 70-ampere hour (A.H.) charging input to the battery.

Charging rates in the three to 50 ampere range are generally satisfactory. No particular charge rate or time can be specified for a battery due to the following factors:

1. The size, or electrical capacity in ampere-hours (A.H.) of the battery.

Example: A completely discharged 70 A.H. battery requires almost twice the recharging as a 40 A.H. battery.

2. Temperature of the battery electrolyte.

Example: About two hours longer will be needed to charge a 0^{O}F. battery than an 80^{O}F. battery.

3. Battery state-of-charge at the start of the charging period.

Example: A completely discharged battery requires twice as much charge in ampere-hours as a one-half charged battery.

4. Battery age and condition.

Example· A battery that has been subjected to severe service will require up to 50% more ampere-hour charging input than a relatively new battery.

The following basic rule applies to any battery charging situation:

"Any battery may be charged at any rate in amperes for as long as spewing of electrolyte due to violent gassing does not occur, and for as long as electrolyte temperature does not exceed 125^{O}F. If spewing of electrolyte occurs, or if electrolyte temperature exceeds 125^{O}F., the charging rate in amperes must be reduced or temporarily halted to avoid damage to the battery."

The battery is fully charged when over a two-hour period at a low charging rate in amperes all cells are gassing freely (not spewing liquid electrolyte), and no change in specific gravity occurs. The full charge specific gravity is 1.260-1.280, corrected for electrolyte temperature with the electrolyte level at the split ring, unless electrolyte loss has occurred due to age or overfilling in which case the specific gravity reading will be lower. For the most satisfactory charging, the lower charging rates in amperes are recommended.

If after prolonged charging a specific gravity of at least 1.230 on all cells cannot be reached, the battery is not in an optimum condition and will not provide optimum performance; however, it may continue to provide additional service if it has performed satisfactorily in the past.

An "emergency boost charge," consisting of a high charging rate for a short period of time, may be applied as a temporary expedient in order to crank an engine. However, this procedure usually supplies insufficient battery reserve to crank a second and third time. Therefore, the "emergency boost charge" must be followed by a subsequent charging period of sufficient duration to restore the battery to a satisfactory state of charge. Refer to the "Charging Guide" chart later in this section.

When the battery is in the vehicle, the studs provided in the wiring harness are suitable for attachment of the charger's leads.

When out of the vehicle, the sealed side terminal battery will require adapters (fig. 4) for the terminals to provide a place for attachment of the charging leads.

When the sealed terminal battery is in the vehicle, the studs provided in the wiring harness are suitable for attachment of the charger's leads.

CAUTION: Exercise care when attaching charger leads to side terminal studs to avoid contact with vehicle metal components which would result in damage to the battery.

To avoid damage, charging rate must be reduced or temporarily halted if:

1. Electrolyte temperature exceeds 125°F.
2. Violent gassing or spewing of electrolyte occurs.

Battery is fully charged when over a two-hour period at a low charging rate in amperes all cells are gassing freely and no change in specific gravity occurs. For the most satisfactory charging, the lower charging rate in amperes are recommended.

Full charge specific gravity is 1.260-1.280 corrected for temperature with electrolyte level at split ring.

The following three methods of recharging batteries are the "Slow Charge" method, the "Fast Charge" method, and "Emergency Boost Charge" method. These methods differ basically in the length of time the battery is charged and the rate at which charging current is supplied.

NOTE: Refer to "Charging Guide For Batteries" later for a suggested list of battery charging rates.

SLOW CHARGING

The "Slow Charge" method supplies the battery with a relatively low current flow for a relatively long period of time. This is the only method that will bring the battery to a full state of charge.

The "Slow Charge" method consists of charging at approximately a 4-ampere rate for 24 hours or more, if necessary, to bring the battery to full charge. A fully charged condition is reached when the cells are gassing freely and three corrected specific gravity readings taken at hourly intervals show no increase.

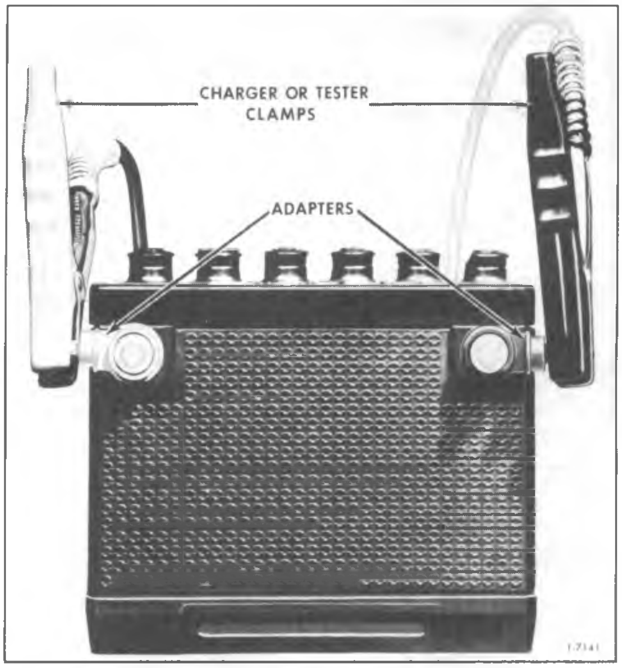


Figure 4—Charging Lead Adapters

FAST CHARGING

The "Fast Charge" method supplies current to the battery at a 40 to 50 ampere rate for a 1½-hour period of time. If the electrolyte temperature reaches 125°F., before the 1½-hour period is completed, the battery must be taken off charge temporarily, or the charging rate reduced to avoid damage to the battery.

Although a battery cannot be brought to a fully charged condition during "Fast Charge," it can be substantially recharged or "boosted." In order to bring the battery to a fully charged condition, the charging cycle must be finished by the "Slow Charge" method.

EMERGENCY BOOST CHARGING

In cases where the battery is not sufficiently charged to crank the engine, an emergency boost charge may be applied as a temporary expedient in order to crank the engine. The "Emergency Boost Charge" method consists of charging at a 40 to 50 ampere rate for a period of one-half hour.

It should be particularly noted that the "Emergency Boost Charge" will not necessarily restore the battery to a useful state of charge for continued service. After an "Emergency Boost Charge" failure to charge the battery further, either by a long uninterrupted driving period or by the "Fast Charge" or "Slow Charge" method, may result in failure to crank the engine the next time cranking is attempted. A battery should never be condemned on the basis of failure to crank the engine after an "Emergency Boost Charge." Although an emergency

CHARGING GUIDE FOR BATTERIES

Below is a suggested list of battery charging rates. Refer to applicable chart.

CHART 1: For dry charged batteries being activated with electrolyte at a temperature under 60°F., or with batteries which are expected to go into immediate operation in below freezing weather.

Amp-Hour Capacity	Dry Charge Battery Warm-up Charge
100 or Less	10 Min.
	15 Amps
Over 100	10 Min.
	30 Amps

CHART 2: For batteries which require a boost charge for the "Light Load Test" procedures.

Amp-Hour Capacity	Light Load Test Boost Charge
100 or Less	20 Min.
	50 Amps
Over 100	30 Min.
	60 Amps

CHART 3: For batteries which have become discharged and require charging. It should be recognized that slow charging is the best and only method of completely recharging batteries. However, since time is often of importance, two other methods are offered for partial battery re-charges listed in this chart.

Amp-Hour Capacity	Slow Charging	Fast Charging	Emergency Boost Charging
100 or Less	24 Hours	1-1/2 Hrs.	30 Minutes
	4 Amps	40 to 50 Amps	40 to 50 Amps
Over 100	24 Hours	3 Hours	1-1/2 Hours
	9 Amps	40 to 50 Amps	40 to 50 Amps

boost charge may put enough energy into the battery to crank the engine once, further charging usually is necessary in order to create a sufficient reserve to crank a second and third time.

BATTERY TESTS

NOTE: Refer to "Battery Test Procedure" chart following "Specifications" at end of section.

Testing procedures are used to determine whether the battery is (1) good and usable, (2) requires recharging, or (3) should be replaced. Analysis of battery conditions can be accomplished by performing a Visual Inspection, Instrument Test, Full Charge Hydrometer Test, and the Light Load Test.

IMPORTANT: DO NOT attempt to perform the Light Load Test on vehicles equipped with batteries having a one-piece cover (fig. 1 or 2).

VISUAL INSPECTION

The first step in testing the battery should be a visual inspection, which very often will save time and expense in determining battery condition.

1. Check outside of battery for a broken or cracked case or a broken or cracked cover. If damage is evident, the battery should be replaced.
2. Check the electrolyte level. Levels that are too high or too low will cause poor performance.
3. Check for loose terminal posts, cable connections, and for evidence of corrosion. Correct as required before proceeding with tests.

CAPACITY TEST

This test is one means of determining whether a battery is functioning efficiently to the degree where it can be relied upon to perform all of its duties properly in the vehicle.

A 12-volt battery that will maintain 9.0 volts or better during a capacity test should be considered a good battery. To make this test, use equipment that will take a heavy electrical load from the battery, such as a carbon pile or other suitable means. If test equipment is not available for loading the battery, the starter may be used as a load.

1. Connect positive voltmeter and ammeter leads to battery positive post and negative voltmeter and ammeter leads to battery negative post (fig. 5).

NOTE: Ammeter cable clips must contact battery posts; voltmeter cable clips must contact battery post or cable clamp.

2. Apply a load to the battery equal to three times the ampere-hour rating of the battery for 15 seconds. Refer to "Specifications" at end of this section for ampere-hour ratings of various batteries used in vehicles covered by this manual.

3. With ammeter reading specified load, read voltage which should not be less than 9.0 volts for 12-volt battery.

a. If voltmeter shows 9.0 volts or more, battery has good output capacity and will readily accept a normal charge.

(1) If specific gravity is 1.215 or more, no service is required.

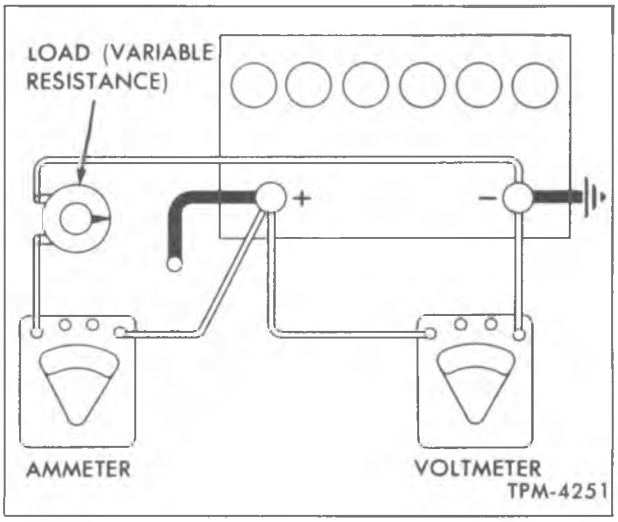


Figure 5—Battery Capacity Test

(2) If specific gravity is below 1.215, check charging circuit to determine the cause and correct as required. The battery should be slow-charged for city driving. With highway driving and a good charging system, the battery should charge satisfactorily.

b. If voltmeter shows a reading of less than 9.0 volts, perform the "Battery Instrument Test" or "Battery Light Load Test."

BATTERY INSTRUMENT TEST

NOTE: A number of suppliers have approved testing equipment available. These testers have a programmed test procedure consisting of a series of timed discharge and charge cycles that will determine the condition of the battery with a high degree of accuracy. When using these testers, follow procedures recommended by the instrument manufacturer.

Batteries should not be charged prior to testing as doing so may alter the test results.

NOTE: New batteries which have become completely discharged over a relatively long period of time, such as during vehicle storage, should be tested by the Hydrometer method. Batteries discharged to this degree cannot be accurately tested using equipment requiring load capability comparison tests.

If a tester is not available, the "Specific Gravity Cell Comparison Test" may be used as an alternate method, but with a sacrifice in testing accuracy.

1. Measure specific gravity of each cell, regardless of state of charge.

2. If specific gravity readings show a difference between the highest and lowest cell of 0.050 (50 points) or more, the battery should be replaced.

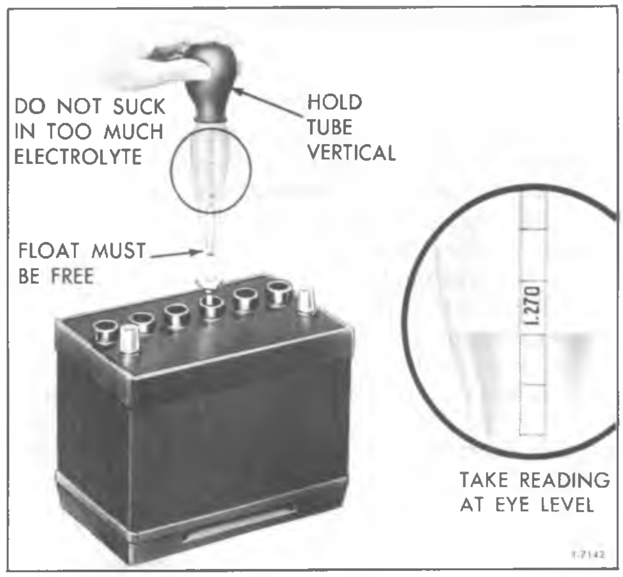


Figure 6—Testing Specific Gravity

FULL CHARGE HYDROMETER TEST

This test should be used only on batteries which test good with testing equipment or "Specific Gravity Cell Comparison Test" but which subsequently fail in service.

1. Remove the battery from the vehicle, and adjust the electrolyte level as necessary, by adding colorless, odorless, drinking water.

2. Fully charge the battery at the Slow Charging Rate as covered under "Battery Charging" previously in this section.

3. Measure the specific gravity of the electrolyte in each cell and interpret as follows:

<u>Hydrometer Reading Less Than 1.230</u> --- Full charge hydrometer readings less than 1.230 corrected for temperature indicate the battery is defective and should be replaced.

<u>Hydrometer Readings Above 1.310</u> --- Full charge hydrometer readings above 1.310 corrected for temperature indicate that the cells have been improperly filled (activation) or improperly serviced. Poor service and short battery life will result.

SPECIFIC GRAVITY READINGS

A hydrometer can be used to measure the specific gravity of the electrolyte in each cell (fig. 6).

The hydrometer measures the percentage of sulphuric acid in the battery electrolyte in terms of specific gravity. As a battery drops from a charged to a discharged condition, the acid leaves the solution and enters the plates, causing a decrease in specific gravity of electrolyte. An indication of the concentration of the electrolyte is obtained with a hydrometer.

BATTERY

When using a hydrometer, observe the following points:

1. Hydrometer must be clean, inside and out, to ensure an accurate reading.
2. Hydrometer readings must never be taken immediately after water has been added. The water must be thoroughly mixed with the electrolyte by charging for at least 15 minutes at a rate high enough to cause vigorous gassing.
3. If hydrometer has built-in thermometer, draw liquid into it several times to ensure correct temperature before taking reading.
4. Hold hydrometer vertically and draw in just enough liquid from battery cell so that float is free floating. Hold hydrometer at eye level so that float is vertical and free of outer tube, then take reading at surface of liquid. Disregard the curvature where the liquid rises against float stem due to surface tension.
5. Avoid dropping battery fluid on vehicle or clothing as it is extremely corrosive. Any fluid that drops should be washed off immediately with baking soda solution.

The specific gravity of the electrolyte varies not only with the percentage of acid in the liquid but also with temperature. As temperature increases, the electrolyte expands so that the specific gravity is reduced. As temperature drops, the electrolyte contracts so that the specific gravity increases. Unless these variations in specific gravity obtained by the hydrometer may not give a true indication of the concentration of acid in the electrolyte.

A fully charged battery will have a specific gravity reading of approximately 1.270 at an electrolyte temperature of 80°F. If the electrolyte temperature is above or below 80°F., additions or subtractions must be made in order to obtain a hydrometer reading corrected to the 80°F. standard. For every 10° above 80°F., add four specific gravity points (.004) to the hydrometer reading.

Example: A hydrometer reading of 1.260 at 110°F., would be 1.272 corrected to 80°F., indicating a fully charged battery. For every 10° below 80°F., subtract four points (.004) from the reading.

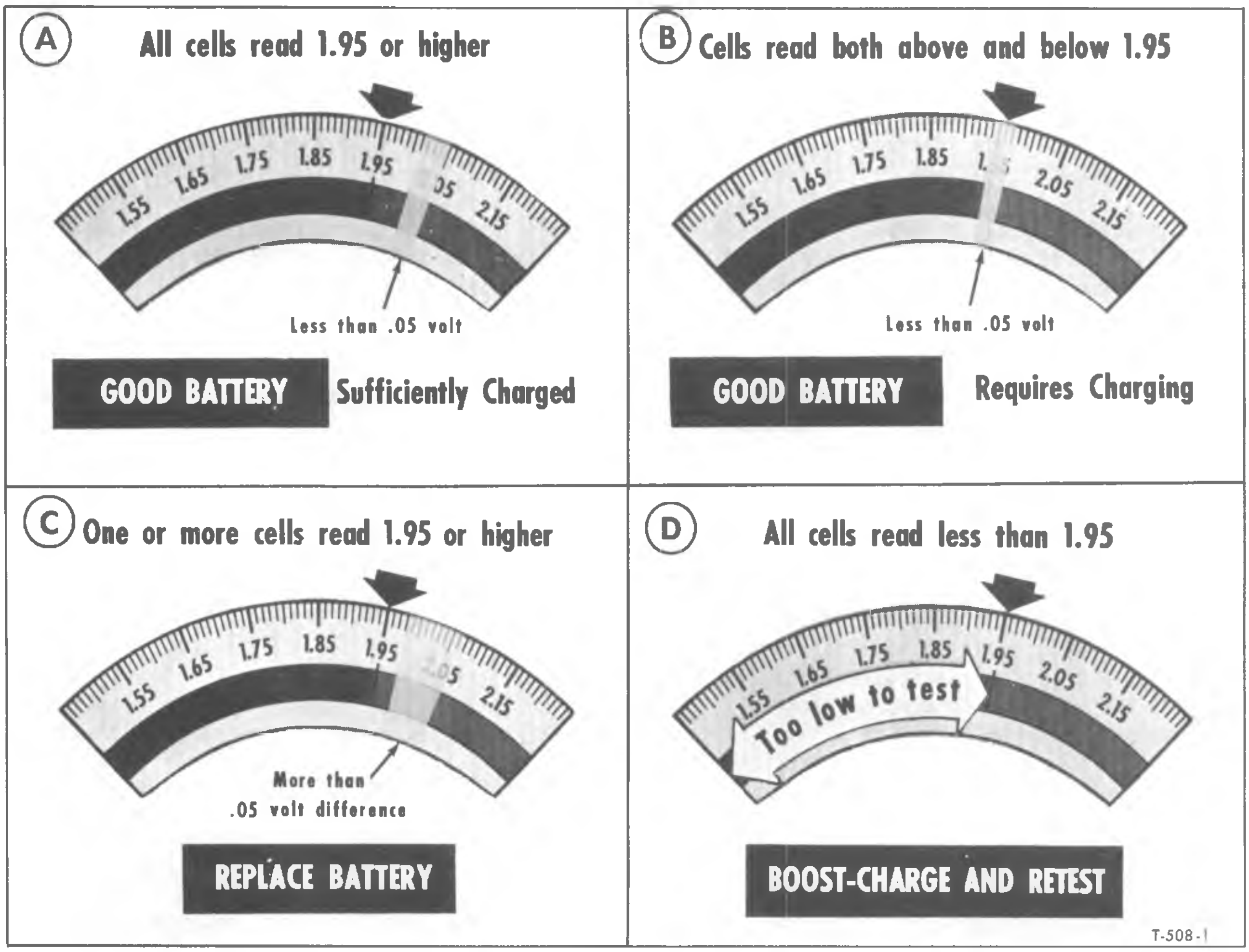


Figure 7—Battery Light Load Test

Example: A hydrometer reading of 1.272 at 0°F., would be 1.240 corrected to 80°F., indicating a partially charged battery.

BATTERY LIGHT LOAD TEST

IMPORTANT: DO NOT attempt to perform this test on vehicles equipped with batteries having a one-piece cover (fig. 1 or 2).

Check electrical condition of each cell as follows (refer to fig. 7):

1. If electrolyte level in each cell is low, adjust to proper level by adding colorless, odorless, drinking water.

2. Place load on battery by cranking engine. If engine starts, turn off ignition immediately. If engine does not start, hold starter switch "ON" for 3 seconds, then release.

3. Turn on head lights (low beam). After one minute, with lights still "ON" read voltage of each battery cell with voltmeter, compare readings with the following:

Good Battery (Fig. 7, View A)

If all cells read 1.95 volts or more and the difference between the highest and lowest cell is less than .05 volt, battery is good.

Good Battery (Fig. 7, View B)

If cells read both above and below 1.95 volts and the difference between the highest and lowest cell is less than .05 volt, battery is good but requires charging. See "Charging After Light Load Test."

Replace Battery (Fig. 7, View C)

If any cell reads 1.95 volts or more and there is a difference of .05 volt or more between the highest and lowest cell, the battery should be replaced.

Discharged Battery (Fig. 7, View D)

If all cells read less than 1.95 volts, battery is too low to test properly. FAILURE OF THE METER TO REGISTER ON ALL CELLS DOES NOT INDICATE A DEFECTIVE BATTERY. Boost charge battery and repeat "Light Load Test." (See "Boost Charging For Light Load Test.") If battery is found to be good after boosting, it should be fully recharged for good performance. If none of the cells come up to 1.95 volts after the first boost charge, the battery should be given a second boost. Batteries which do not respond after a second boost charge should be replaced.

NOTE: If any battery found to be good by the "Light Load Test" does not perform satisfactorily in subsequent service, it should again be tested by the "Light Load Test" and if it still tests "good" it should be removed from vehicle and tested as outlined under "Full Charge Hydrometer Test."

BOOST CHARGING FOR THE LIGHT LOAD TEST

Boost charge 12-volt batteries having an ampere hour capacity of 100 or less at 50 amperes for 20 minutes (50 x 20 = 1000 ampere minutes). Boost charge batteries having an ampere hour capacity of over 100 at 60 amperes for 30 minutes (60 x 30 = 1800 ampere hour minutes). If charger will not give this rate, charge for an equal number of ampere minutes at best rate available.

IMPORTANT: For purposes of this test, do not boost battery more than the amount indicated.

CHARGING AFTER THE LIGHT LOAD TEST

For best performance, a good battery should be fully charged before being returned to service.

If batteries are to be fully charged by means of a quick charger, the charge rate must be "tapered" (reduced to a safe limit) when the electrolyte temperature reaches 125°F., or when gassing becomes excessive.

NEW VEHICLES IN STOCK

1. Check electrolyte on each new vehicle received; add sufficient distilled water to bring the electrolyte up to bottom of vent wells. DO NOT OVERFILL.

2. Check electrolyte and add distilled water as necessary at weekly or semi-monthly intervals, depending upon the weather. Warm weather causes greater water loss.

3. If the specific gravity of the battery is below 1.215 (corrected to 80°F.), remove it from the vehicle and place it on a charging line. Charge the battery until the specific gravity reaches 1.260-1.280.

4. Before a new truck is placed in service, make sure the specific gravity of the battery electrolyte is at least 1.250, preferably higher. Under no circumstances should acid be added to a new battery, to increase the specific gravity of the electrolyte.

CARE OF NEW BATTERIES IN STORAGE

New batteries should be stored in accordance with instructions furnished by battery manufacturer.

PREPARING DRY-CHARGED BATTERIES FOR SERVICE

Electrolyte should be added to dry-charged batteries in accordance with instructions furnished by the battery manufacturer.

BATTERY CABLES

Excessive resistance caused by terminal connections and partial short circuits through defective cable insulation will result in abnormal voltage drop in starter cable. Low voltage at starter

BATTERY

will prevent normal starter operation and will cause hard starting. The following tests must be made with primary wire disconnected from distributor or coil to prevent engine starting:

1. Check voltage drop between grounded (-) battery terminal and vehicle frame. Place one prod of test voltmeter on grounded battery post (not on cable clamp) and the other on frame. Operate starter and note the voltage reading.

2. Check voltage drop between ungrounded (+) battery terminal and starter terminal stud with starter operating.

3. Check voltage drop between starter housing and frame with starter operating.

4. If voltage drop in any of the above tests is more than 0.5 volt on gasoline models or 1.0 volt on diesel models, there is excessive resistance in the circuit. To eliminate resistance, the cables should be disconnected and connections cleaned. If cables are frayed or the clamps excessively corroded the cables should be replaced. When selecting new cables, be sure they are at least as large as the ones being replaced.

INSTALLING BATTERIES

Battery installation varies depending on the truck model and series. To install properly, it is important to observe the following precautions:

1. Connect grounded terminal of battery last to avoid short circuits which may damage the electrical system.

2. Be sure there are not foreign objects in the carrier, so that the new battery will rest properly in the bottom of the carrier.

3. Tighten the hold-down evenly until snug (60-80 inch-pounds). Do not draw down tight enough to distort or crack the case or cover.

4. Be sure the cables are in good condition and the terminals are clean and tight. Make sure the ground cable is clean and tight at engine block or frame.

5. Check polarity to be sure the battery is not reversed with respect to the generating system.

6. When assembling bolt-type clamp terminal, loosen the bolt so the terminal will fit over the post, push the terminal on to battery post as far as possible, at least flush with or below top of post. Tighten bolt until the terminal is snug with the post.

7. On side terminal type batteries, tighten studs with wrench until adapter will not twist when force is applied with hand, then turn stud ½ turn more (70-inch pounds).

BATTERY SPECIFICATIONS

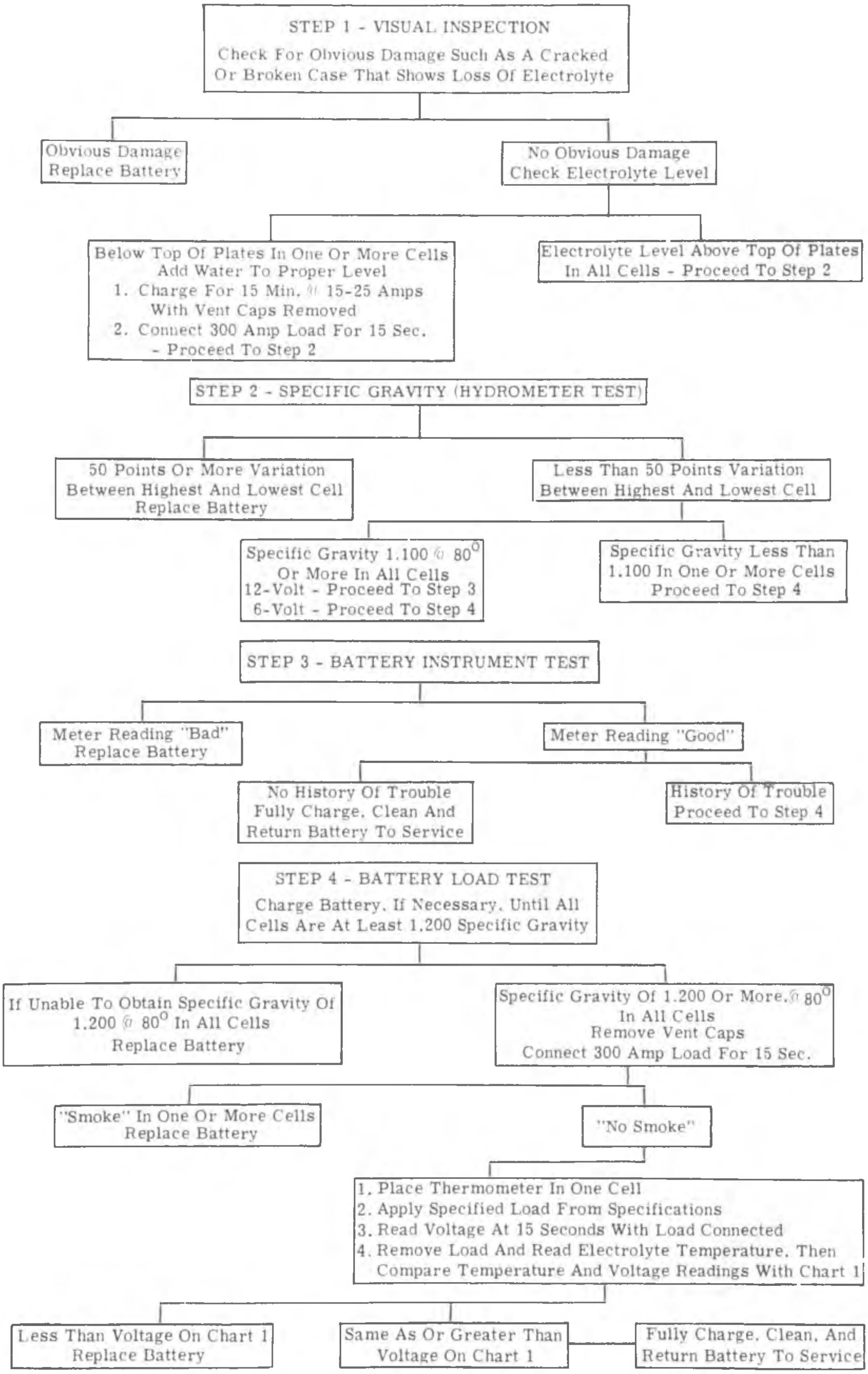
BATTERY MAKE	Delco-Remy	Delco-Remy	Delco-Remy	Delco-Remy	Delco-Remy
PART NO.	1980030	1980034	1980038	1980145	1980149
Model No.	E-5000	E-3000	E-3000	E-5000	E-5000
Catalog No.	R-58	Y-58	Y-70	R-88	R-88W
Volts	12	12	12	12	12
No. of Plates per Cell	11	9	11	11	15
Amp. Hr. Capacity at 20 Hr. Rate	61	53	70	61	80
Cranking Ability at 0°F and 300 Amps	1.6 Min.	1.1 Min.	2.0 Min.	1.6 Min.	2.6 Min.
Load Test Amp. Load	180	160	210	180	240
Voltage and Temperature Chart*	No. 1	No. 1	No. 1	No. 1	No. 1

*Voltage Must Not Drop Below Minimum Listed at Given Temperature When Battery is Subjected to Proper Load for 15 seconds and is 1.200 Specific Gravity at 80°F or more.

CHART NO. 1—VOLTAGE AND TEMPERATURE CHART

Electrolyte Temperature	80°F	70°F	60°F	50°F	40°F	30°F	20°F	10°F	0°F
Voltage (Minimum)	9.6	9.6	9.5	9.4	9.3	9.1	8.9	8.7	8.5

BATTERY TEST PROCEDURE



NOTE: Chart No. 1 is in Specifications

T 8031

Starting System

The standard and optional type starting motors used on vehicles covered by this manual are shown in the "Model Application Chart" following:

STARTING SYSTEM MODEL APPLICATION CHART

TRUCK SERIES	STANDARD PART NO.
CE-40; CS/SS/TS-50	1108360
CE/SE/TE-50	1108362
CS-40	1108368
CE/ME/TE-60	1108369

TRUCK SERIES	OPTIONAL PART NO.
CE/SE/TE-50	1108364
CE/CS-40; CE/CS/SE/SS/TS-50	1108372
CE/ME/TE-60 (with 427 Engine)	1108357

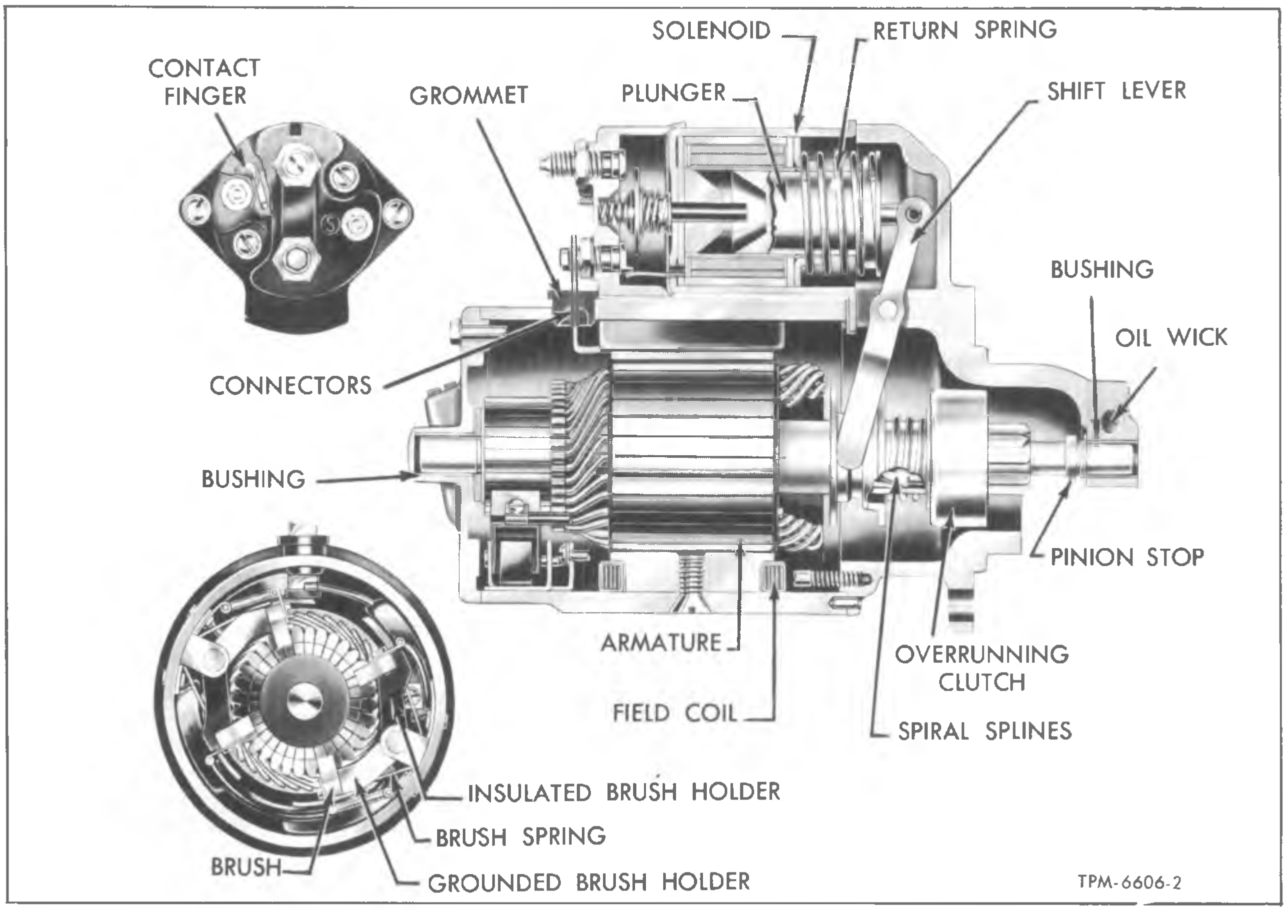


Figure 1—Overrunning Clutch Type Starting Motor (Typical)

GENERAL DESCRIPTION

A solenoid operated, overrunning clutch type starting motor (fig. 1) having an enclosed shift lever is used on all vehicles covered by this manual.

The drive end housing is extended to enclose the entire shift lever mechanism and solenoid plunger. The solenoid flange is mounted on drive end housing, with sealing compound used between flange and field frame. A compression type shift lever return spring located inside the solenoid case is used to operate the overrunning clutch. On gasoline engine models, primary circuit to ignition coil is fed from solenoid while the starter is operating.

Positive lubrication is provided to bronze bushings in commutator end frame, in the drive end frame and in the nose housing by oil saturated wicks that project through each bushing and contact the armature shaft.

STARTING SYSTEM OPERATION

The starting system consists of the battery, starting motor, including the drive assembly which engages the flywheel ring gear during cranking, the starter solenoid, mounted on the starting motor for shifting the drive assembly and closing the motor circuit and the ignition or control switch which, when in the "START" position connects a lead from the battery to the solenoid switch. During cranking, the ignition switch (gasoline engine models) also connects the battery directly to the ignition coil.

CAUTION: If a remote switch is used to operate starter, the primary wire must be disconnected from coil negative terminal and ignition switch must be turned on. Failure to do this will result in damaged grounding circuit in ignition switch.

When starter circuit is energized, the solenoid operated shift lever slides the pinion into mesh with the flywheel ring gear teeth. The rotary motion between pinion and ring gear, provided by spiral splines on clutch shaft, normally relieves tooth abutment on the first attempt to engage pinion and the engine flywheel ring gear. When the engine is started, pinion overrun protects the armature from excessive speed until the ignition or control switch is released, at which time the solenoid shift lever return spring causes the pinion to disengage. To

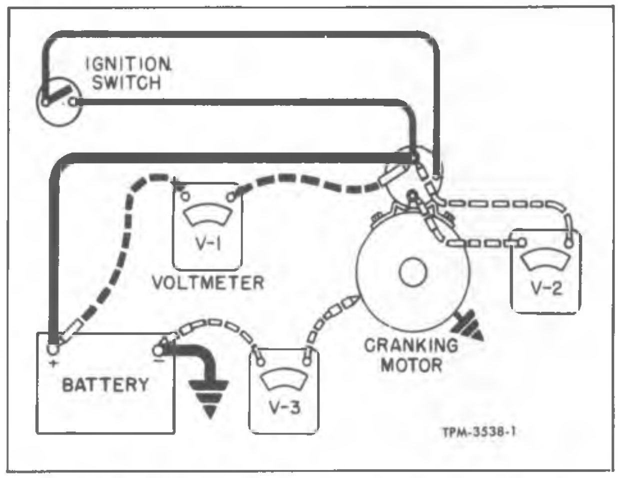


Figure 2—Voltmeter Connections for Checking Circuits

STARTING MOTOR CIRCUIT TESTS (ON VEHICLE)

Although the starter cannot be checked against specifications on the vehicle, checks can be made for excessive resistance in the starter circuit.

Referring to figure 2 and with starter cranking the engine during each check, measure resistance in various parts of the circuit as follows:

IMPORTANT

To prevent engine from starting while performing these checks, disconnect the primary lead at the distributor on gasoline engine models. On diesel models, pull stop knob on instrument panel out to set the injection pump in "NO-FUEL" (STOP) position to prevent the engine from starting.

V-1 - Check V-1 with voltmeter leads connected from battery positive post to battery terminal on the starter solenoid.

V-2 - Check V-2 with voltmeter leads connected from solenoid battery terminal to solenoid motor terminal.

V-3 - Check V-3 with voltmeter leads connected from battery negative post to starter field frame.

If voltmeter reading in any of the previous checks exceeds 0.5 volt, excessive resistance is indicated in that part of the circuit being checked. Locate and eliminate the cause of excessive voltage drop in these circuits in order to obtain maximum efficiency from the starting system. Cause of excessive resistance may be loose, corroded, or dirty connections, or frayed cables.

If starter fails to crank engine, first make sure battery is not discharged, then check solenoid operation. If the solenoid fails to operate, the trouble may be due to excessive resistance in the starter control circuit. Check all wiring and connections from ignition or control switch to solenoid for loose or corroded connections. If cause of excessive resistance is not apparent, connect a short jumper lead across the solenoid battery and switch terminals. If solenoid operates with jumper lead connected, trouble is in the control circuit. Check for defective ignition or control switch. If solenoid does not operate with jumper lead connected, solenoid is defective and must be replaced.

STARTER REPLACEMENT

REMOVAL

1. Remove ground strap from battery negative (-) post or tape end of battery cable when disconnected from starter solenoid to prevent discharge of battery by direct short.

2. Disconnect all wires from starter solenoid terminals.

3. Remove bolts, nuts, and washers which attach starter to flywheel housing, then pull starter forward to remove. Remove spacer (if used).

INSTALLATION

1. Position starter against flywheel housing and secure with bolts, nuts, and washers. Tighten starter to flywheel housing bolts to 25-35 foot-pounds torque.

2. Connect all wires to starter solenoid terminals, referring to applicable wiring diagrams to make sure of proper connections. Tighten terminal nuts firmly.

3. Connect ground strap to battery negative (-) post, then check operation of starting motor.

When the engine control switch is placed in "START" position, current from the battery is supplied through the engine control switch to energize the starter solenoid. When engine is started and reaches approximately 400-600 rpm, current from generator "R" terminal is supplied through starter control relay operating coil to break circuit to starter solenoid, thus disengaging the starter if engine control switch is not released after engine is started. This also prevents starter from being accidentally engaged by turning the control switch to "START" position while the engine is running.

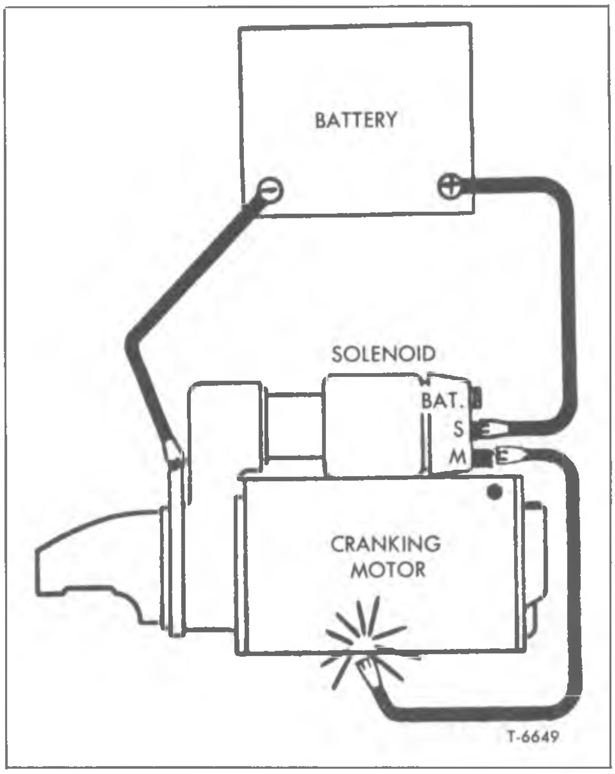


Figure 3—Circuit for Checking Pinion Clearance

PINION CLEARANCE CHECK

The drive pinion clearance should be checked whenever starter has been overhauled. There is no means of adjusting pinion clearance on light duty type starting motors. If clearance is not within specified limits, it may indicate excessive wear of solenoid linkage or shift lever yoke lugs. Clearance between end of pinion and pinion stop (retainer) with pinion in cranking position, should be 0.010"-0.140". Check clearance as follows:

1. Connect a voltage source of approximately 6 volts between the solenoid switch terminal (S) and ground.

IMPORTANT: DO NOT connect voltage source to ignition coil (R) terminal of solenoid. DO NOT use a 12-volt battery in place of the 6-volt battery specified as this will cause the starter to operate. As a further precaution to prevent motoring, connect a heavy jumper lead from solenoid motor terminal to ground (fig. 3).

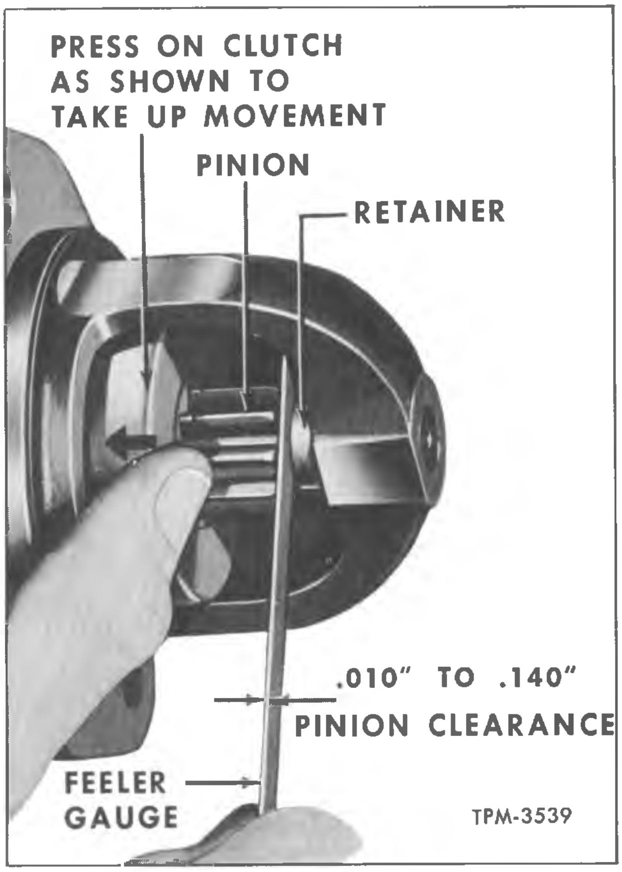


Figure 4—Measuring Pinion Clearance (Typical)

2. After energizing the solenoid with the clutch shifted forward, push the pinion back toward commutator as far as necessary to take up any possible slack, then check pinion clearance with a feeler gauge as shown in figure 4. If clearance is not within 0.010'' to 0.140'', disassemble and replace worn parts in solenoid and shift lever linkage.

STARTER FREE SPEED CHECK

The free speed check is recommended after a starting motor has been overhauled. If necessary test equipment is available, accomplish following steps to perform free speed check:

1. Connect a 12-volt battery in series with an ammeter to "battery" terminal of solenoid on starting motor.
2. Connect a lead from frame of starting motor to negative (-) post on battery.
3. Connect a voltmeter from solenoid battery terminal to ground.
4. Install a tachometer to starting motor.
5. Connect a jumper lead from "battery" terminal to switch terminal on solenoid.

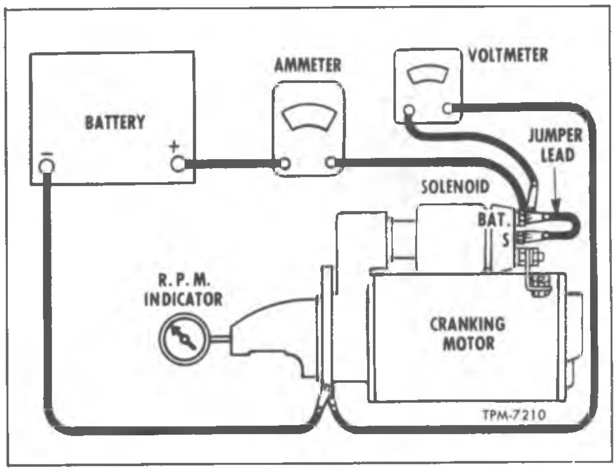


Figure 5—Circuit for Checking Motor Free Speed (Typical)

6. Observe ammeter, voltmeter and tachometer, and compare readings with "No Load Test" specifications listed in "Specifications."

STARTER SOLENOID

Starter solenoid is used to shift the starter drive pinion into engagement with flywheel teeth and to complete the circuit from battery to starter.

Solenoid has two windings, the pulling winding and the holding winding. When ignition switch is turned to "START" position both windings are energized, producing a magnetic field which pulls the plunger in. Inward movement of plunger shifts starter pinion into engagement with flywheel ring gear teeth, and closes main contacts in the solenoid switch to complete circuit from battery to starter.

The pulling winding draws comparatively heavy current for a short interval. This is required to shift the pinion into engagement. The holding winding also aids the pulling winding. As soon as plunger closes the main switch contacts, pulling winding is de-energized and only the holding winding draws current for the balance of the starting cycle.

SOLENOID MAINTENANCE

Solenoids require no periodic maintenance other than keeping the terminals clean and tight. Always check action of solenoid if it has been removed. If unit fails to function, first check wiring before condemning the solenoid. Solenoid windings can be checked for current draw, open circuit, or shorts. Refer to "Specifications" at end of this section for current values. Solenoid coil, terminals, and switch plunger can be replaced if burned or otherwise damaged. Whenever the solenoid is replaced on overrunning clutch type starting motors, pinion clearance must be checked, as previously directed under "Pinion Clearance Check."

STARTING SYSTEM SPECIFICATIONS

STARTER MODEL	1108357 1108364	1108360
Make	Delco-Remy	Delco-Remy
Series	10MT	10MT
Type	125	125
Type of Drive	Overrunning Clutch	Overrunning Clutch
Rotation (View at Drive End)	CW	CW
No Load Test		
Volts	9	9
Min. Amps*	35	55
Max. Amps*	75	80
Min. R.P.M.	6000	3500
Max. R.P.M.	9000	6000
Pinion Clearance	.010"-.140"	.010-.140"

*Includes Solenoid

STARTER SOLENOID MODEL	1114343	1114356
Rated Voltage	12	12
Current Consumption		
Pull-In Winding		
Amps	13-15.5	13-15.5
Volts	5	5
Hold-In Winding		
Amps	14.5-16.5	14.5-16.5
Volts	10	10

STARTER MODEL	1108362	1108369 1108372	1113686
Make	Delco-Remy	Delco-Remy	Delco-Remy
Series	10MT	10MT	35MT
Type	125	125	185
Type of Drive	Overrunning Clutch	Overrunning Clutch	Overrunning Clutch
Rotation (Viewed at Drive End)	CW	CW	CW
No Load Test			
Volts	9	9	9
Min. Amps*	55	35	130
Max. Amps*	80	75	160
Min. R.P.M.	3500	6000	5000
Max. R.P.M.	6000	9000	7000
Pinion Clearance	.010"-.140"	.010"-.140"	.010"-.140"

*Includes Solenoid

STARTER SOLENOID MODEL	1114344	1114356	1115518
Rated Voltage	12	12	12
Current Consumption			
Pull-In Winding			
Amps	13-15.5	13-15.5	26-29
Volts	5	5	5
Hold-In Winding			
Amps	14.5-16.5	14.5-16.5	18-20
Volts	10	10	10

Ignition System

GENERAL

The ignition system consists of the source of power (battery or generator) ignition switch, ignition coil, distributor, condenser, spark plugs, and high and low tension wires.

A special resistance wire is used in the body wiring harness connecting the ignition terminal on the ignition switch to the ignition coil on all gasoline engine equipped vehicles. Resistance value of the wire used on In-line gasoline engine models is 1.80 ± .05 ohms. Resistance value of the wire used on V8 gasoline engine models is 1.35 ± .05 ohms. The resistance wire is identified on applicable Wiring Diagrams as 20-BLK; or 20 WHT.-ORN. & PPL. CR. TR.

Resistance value of the wire can be checked as explained later.

The resistance wire is used to increase ignition coil efficiency and lengthen distributor point life. If resistance wire becomes damaged, replace with wire of same gauge and length.

IMPORTANT: DO NOT use regular copper wire in place of the resistance wire. When using a remote switch to operate the starter, disconnect primary wire from ignition coil negative terminal and turn ignition switch "ON" to prevent damaging the grounding circuit in the ignition switch.

CAUTION

Since the ignition coil is fed through the starter solenoid during cranking, the engine will have a tendency to start whenever it is cranked, even through the ignition switch is in the "OFF" position. To prevent this from happening and possibly causing serious injury, always disconnect the primary wire from the ignition coil before performing tests which require cranking the engine.

RESISTANCE WIRE CHECK

1. Make sure ignition switch is in "OFF" position.

NOTE: If ignition switch is not in "OFF" position, ohmmeter will be damaged.

2. Connect an ohmmeter lead to each end of the resistance wire and note the reading.

3. Replace resistance wire if ohmmeter reading is not within 1.75-1.85 ohms on In-line gasoline engine models, or 1.30-1.40 ohms on V8 gasoline engine models.

IGNITION MAINTENANCE

Inspecting and adjusting the ignition system at regular intervals will aid in locating and correcting conditions which result in lowered performance before engine performance is affected.

1. Check condition of battery and cables as directed previously in "BATTERY" section.

2. Check operation of centrifugal advance mechanism by removing distributor cap and turning the rotor in clockwise direction. The cam should rotate freely and when released, it should return to its original position without sticking or binding.

3. Wipe out distributor cap with a soft cloth and clean wire sockets with a small round brush. Inspect cap and rotor for chips, cracks, and carbonized short paths; look for burned metal inserts in cap and for burned metal segment on rotor.

4. Inspect breaker points. Slight discoloration and roughness is normal. Slight roughness can be removed with a few strokes of a clean, fine-cut contact file. If points are badly pitted or burned, replace points as directed later under "Distributor."

5. Check cam dwell angle with a dwell meter. If dwell meter is not available, point opening can be checked with a dial indicator. Never check opening of used points with a feeler gauge. If dwell angle (or point opening) requires adjustment, adjust as directed later under "Distributor."

6. Check ignition timing with timing light as directed later under "Ignition Timing."

IGNITION SYSTEM

7. Inspect all ignition wiring for brittle, cracked, or oil soaked insulation. Check all connections, making sure they are clean and tight.

8. Distributor must be kept properly lubricated. Refer to LUBRICATION (SEC. 0) for intervals and instructions.

9. Remove spark plugs and clean, inspect, and adjust point gap as directed later under "Spark Plugs."

IGNITION SWITCH REPLACEMENT

The ignition or control switch and harness-to-switch connector features a three-tang lock to secure a firm connection (fig. 1). The switch lock cylinder and cylinder housing can be removed as follows:

REMOVAL

1. Disconnect negative (-) cable from battery post.

2. Remove lock cylinder by positioning switch in "OFF" position and inserting wire in small hole in cylinder face. Push in on wire to depress plunger and continue to turn key counterclockwise until lock cylinder can be pulled from cylinder housing.

3. Remove the metal ignition switch retaining nut from the passenger side of the dash.

4. Pull ignition switch out from under dash and separate wiring connectors by inserting thin blade of small screwdriver under each tang of wiring connector as shown in figure 1. Pull connector from switch.

INSTALLATION

1. Engage lock tangs of wiring connector to switch. Make sure lock tangs are fully engaged by trying to separate.

2. Place the switch with wiring into position from underside of dash and install switch retaining nut firmly.

3. Insert switch lock cylinder in switch housing and rotate clockwise to secure in "LOCK" position.

4. Connect battery negative cable to post and check operation of switch.

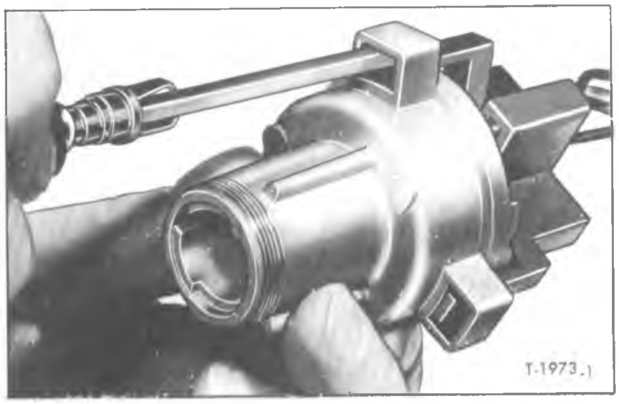


Figure 1—Disengaging Ignition Switch Connector

IGNITION TIMING

Timing the ignition system comprises:

(1) Initial Timing -- Setting distributor to permit opening of points at correct firing intervals - and -

(2) Manual Advance Adjustment -- Retarding or advancing the point opening to compensate for various grades of fuel which may be used. These timing factors require checking and adjusting at regular intervals, or whenever performance of engine necessitates such action.

IMPORTANT: Before attempting to adjust ignition timing, make sure carburetor is properly adjusted. Disconnect vacuum line from distributor vacuum advance unit and plug the open end of line.

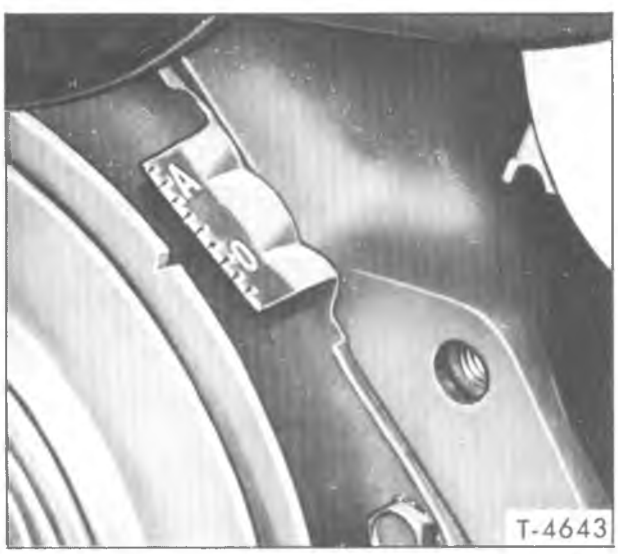


Figure 2—Timing Marks (In-Line Engine) (Typical)

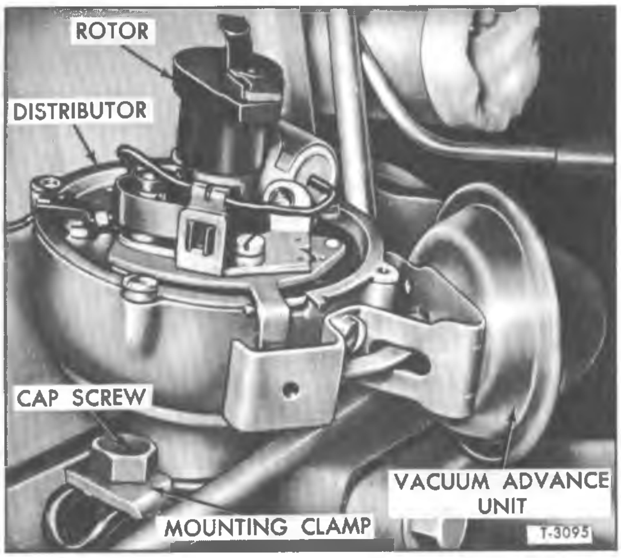


Figure 3—Distributor Installed with Cap Removed (In-Line Engine) (Typical)

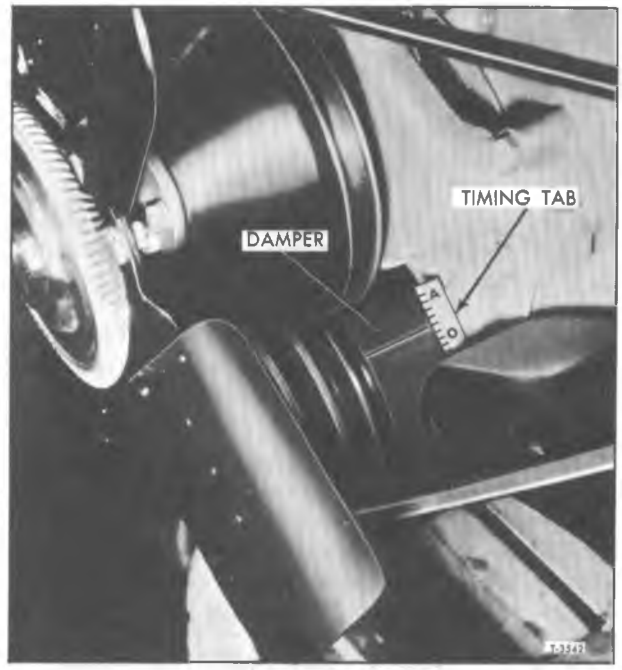


Figure 4—Timing Marks (V8 Engine) (Typical)

NOTE: The timing settings, listed in "Specifications" at end of this section, are recommended settings for average nation-wide regular gasoline. Timing must be retarded as required when lower octane gasoline is used.

IN-LINE ENGINES
(WITH ENGINE RUNNING) (Fig. 2)

On vehicles equipped with the In-line engine, the timing tab is installed at front of engine above crankshaft pulley at left side. Markings on the timing tab are in 2-degree increments with the "O" mark being upper-dead-center. Timing is set on No. 1 cylinder.

NOTE: Refer to "Ignition Timing" in "Specifications" at end of this section for correct timing of each engine.

With timing light connected to No. 1 spark plug and with engine idling (500 rpm max.) loosen mounting clamp cap screw at base of distributor (fig. 3) and rotate distributor as necessary, to synchronize flashes with timing mark when mark is aligned with pointer. After completing adjustment, tighten cap screw and connect vacuum line.

V8 ENGINES
(WITH ENGINE RUNNING) (Fig. 4)

NOTE: Make sure distributor is in good condition and dwell angle is properly adjusted before checking ignition timing. If dwell angle requires adjustment, adjust as directed later under "Distributor."

1. Disconnect distributor spark advance hose and plug vacuum source opening.

2. Connect one lead of timing light to No. 1 spark plug terminal and connect the other lead in accordance with instructions furnished with the instrument.

NOTE: Markings on timing tab are in 2-degree increments (the greatest number of markings are on the "A" side of the "O"). The "O" mark is TDC and all BTDC settings fall on the "A" (advance) side of "O."

3. Start engine and run at idle. Set timing to limit listed under "Ignition Timing" in "Specifications" at end of this section. If timing mark does not align with pointer, loosen distributor mounting clamp cap screw and rotate distributor body as required to synchronize timing light flashes with timing mark on timing tab.

4. Tighten the distributor mounting clamp cap screw; then, stop engine, remove timing light, and connect the spark advance hose.

IN-LINE V8 ENGINES
(WITH ENGINE NOT RUNNING)

1. Locate No. 1 cylinder spark plug wire on distributor cap; mark distributor body adjacent to No. 1 wire socket in cap, then remove cap.

2. Intermittently operate starter until proper timing mark on crankshaft pulley is aligned with timing tab or pointer (fig. 2 or 4).

With timing mark aligned with timing tab, or pointer, rotor segment should point toward mark made on distributor body in Step 1 previously. Instead, rotor segment may point 180 degrees away from mark; in this case engine must be rotated one complete revolution and timing mark realigned.

3. With timing mark aligned with timing tab or pointer and with rotor segment pointing to No. 1 spark plug wire, points should just begin to open.

Loosen distributor mounting clamp cap screw and turn distributor housing clockwise until points close. Remove high tension wire from center socket in distributor cap. Turn on ignition switch and hold end of high tension wire (still connected to coil) ¼-inch from a ground; then turn distributor housing counterclockwise until a spark jumps the gap between high tension wire and ground. When spark occurs, points are open. Hold distributor in this position and tighten mounting clamp cap screw.

Turn ignition switch off and install distributor cap. Install high tension wire in cap.

MANUAL ADVANCE ADJUSTMENT

1. After engine has been thoroughly warmed up, drive vehicle using grade of fuel expected to be used in service. Engine should not ping or knock excessively under load and full throttle.

2. If knock is evident, loosen the distributor mounting clamp cap screw and turn distributor housing clockwise to retard spark until knock is eliminated.

NOTE: Manual advance should be set to obtain the best possible engine performance with the particular grade of gasoline being used.

DISTRIBUTOR

Distributor used on In-line engines is mounted on right side of engine and is driven by the engine camshaft by spiral cut gears. A gasket is used between flange on distributor housing and cylinder block. The distributor is held in place by a mounting clamp and cap screw (fig. 3). Lower end of distributor shaft is tongued and engages a slot in upper end of oil pump drive shaft to drive the oil pump.

The distributor used on V8 engines is mounted on top center of cylinder block at rear end and is driven from the engine camshaft by spiral cut gears. A gasket is used between flange on distributor housing and cylinder block. The distributor is held in place by a mounting clamp and cap screw. The drive gear, secured on lower end of distributor shaft, by a rivet or roll pin, has a hexagonal opening in lower end which engages end of oil pump shaft to drive the oil pump. Model number is stamped on the distributor housing.

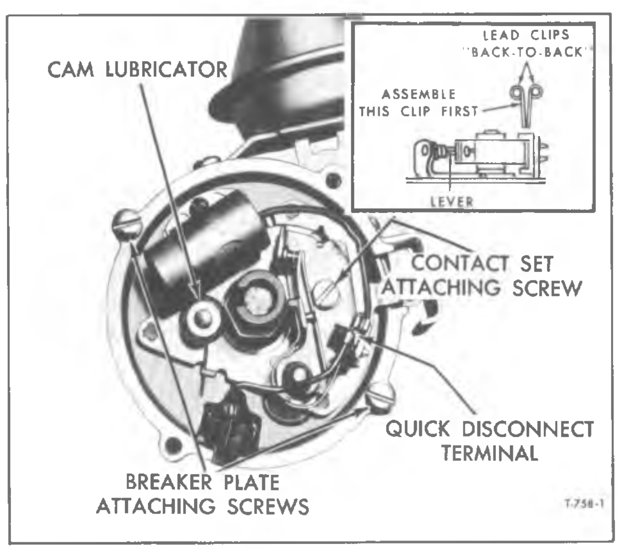


Figure 5—Breaker Plate Attaching Parts

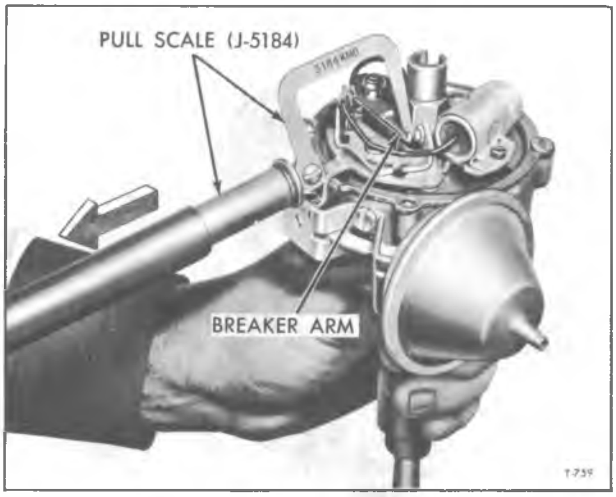


Figure 6—Checking Breaker Arm Spring Tension

DISTRIBUTOR CONTACT POINTS

CLEANING

Dirty contact points should be dressed with a few strokes of a clean, fine-cut contact file. The file should not be used on other metals and should be kept free of grease and dirt. Never use emery cloth to clean contact points. Do not attempt to remove all roughness or dress point surfaces down smooth, merely remove scale or dirt.

Replace contact points which are badly pitted or burned. High resistance or loose connection in the condenser circuit, oil or foreign materials on contact surfaces, improper point adjustment or excessively high voltage may cause oxidized contact points. If excessive point pitting is encountered, check for an out-of-balance condition in the ignition system, often caused by improper condenser capacity.

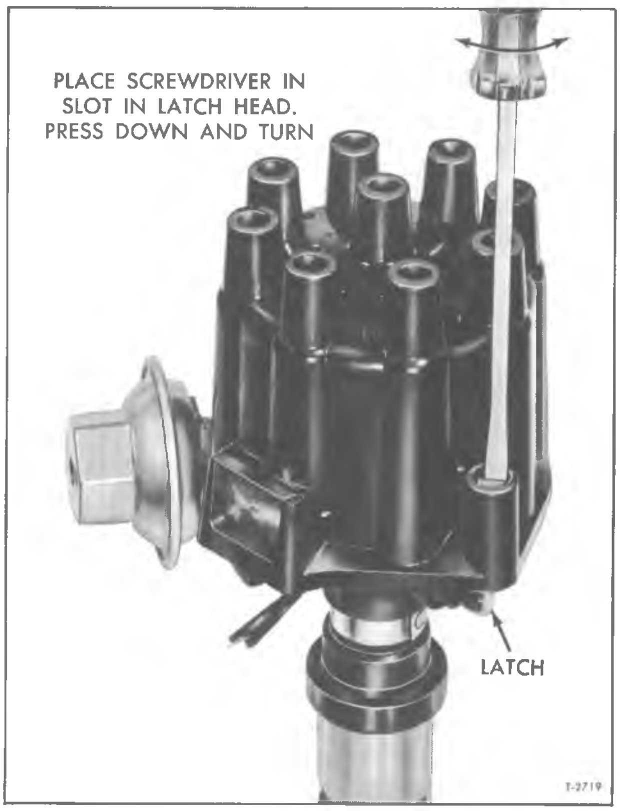


Figure 7—Disengaging Distributor Cap Latches (V8 Engine) (Typical)

CONTACT POINT REPLACEMENT
(IN-LINE ENGINES)

Removal

1. Release distributor cap hold-down screws, remove cap and place it out of work area.
2. Remove rotor.
3. Pull primary and condenser lead wires from contact point quick-disconnect terminal (fig. 5).
4. Remove contact set attaching screw, lift contact point set from breaker plate.
5. Clean breaker plate of oil, smudge and dirt.

Installation

1. Carefully wipe protective film from contact set, then place new contact set assembly on breaker plate and install attaching screw.

NOTE: Pilot on contact set must engage matching hole in breaker plate.

2. Connect primary lead and condenser lead to terminals (fig. 5). Lead clips must be assembled "back-to-back." Push clip nearest the contact lever down between the spring and locator; then push the remaining clip down between the first clip and locator. Do not push on the spring.
3. Apply a slight trace of petroleum jelly to the breaker cam and a few drops of S.A.E. #20 oil on top of the shaft.
4. Check and adjust points for proper alignment and breaker arm spring for proper tension (fig. 8). Use an alignment tool to bend stationary contact support if points need alignment.

NOTE: The contact point pressure must fall within specified limits. Weak tension will cause chatter resulting in arcing and burning of the points and an ignition miss at high speed, while excessive tension will cause undue wear of the contact points, cam and rubbing block. Breaker arm spring tension should be 19-23 ounces. The contact point pressure should be checked with a spring gauge. The scale should be hooked to the breaker lever and the pull exerted at 90 degrees to the breaker lever as shown in figure 6. The reading should be taken just as the points separate. The pressure can be adjusted by bending the breaker lever spring.

Figure 8—Distributor Contact Set Replacement

If pressure is excessive, it can be decreased by pinching the spring carefully. To increase pressure, the lever must be removed from the distributor so the spring can be bent away from the lever. Avoid excessive spring distortion.

5. Set point opening to dimension listed in "Specifications" at end of this section.
6. Install rotor, then position and secure distributor cap to housing.
7. Start engine and check dwell angle and ignition timing.

CONTACT POINT REPLACEMENT
(V8 ENGINES)

Removal

1. Place a screwdriver in the slot head of each distributor cap latch, then press down and turn ¼ turn in either direction to release cap (fig. 7). Remove cap and place it out of work area.
2. Remove two screws which attach the rotor to the weight base assembly, then pull the primary lead and condenser lead wires from the contact point quick-disconnect terminal (fig. 8).
3. Remove two screws which attach the base of the contact set to the distributor housing.
4. Lift the contact point set from housing, and clean housing of oil, smudge and dirt.

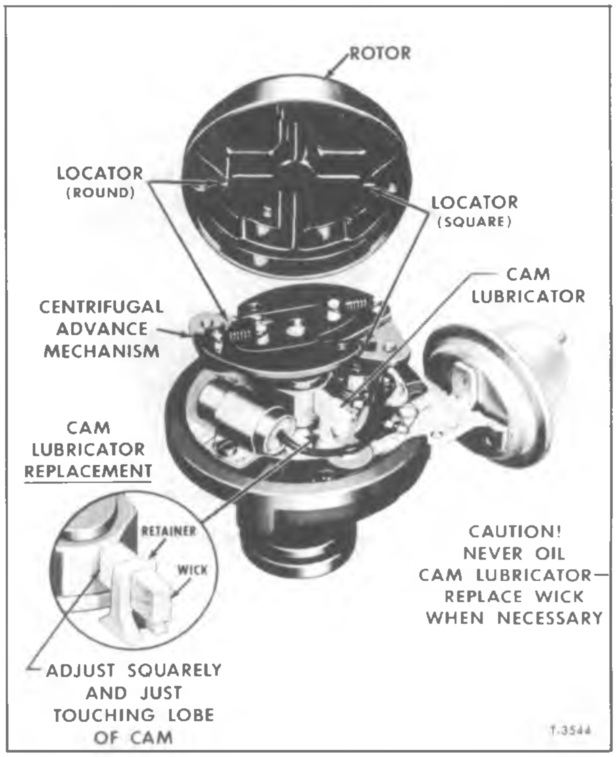


Figure 9 —View of Distributor (V8 Engine) (Typical)

5. If distributor is equipped with a cam lubricator wick (fig. 9), use long nose pliers to squeeze the assembly together at base and lift out. Remove all old lubricant from cam surface.

Installation

NOTE: The contact point set is replaced as a complete assembly. The service replacement set has the breaker lever spring and point alignment pre-adjusted.

1. If distributor was equipped with a cam lubricator, adjust wick to just touch lobe of cam.

NOTE: End of cam lubricant wick should be adjusted to just touch cam lobes. Over-lubrication of cam resulting in grease on contact points can be caused by cam lubrication wick bearing too hard against cam surface. A correctly adjusted cam lubricator wick will provide adequate lubrication for cam. Do not apply additional grease to cam surface.

2. Place new contact set assembly on distributor housing and attach with two screws (fig. 8).
3. Position condenser lead and primary lead clips back-to-back as shown in figure 8, then press lead clips into quick disconnect terminal.
4. Position rotor over weight assembly and attach with two screws and washers.
5. Position distributor cap over rotor, then place a screwdriver in the slot head of each latch.

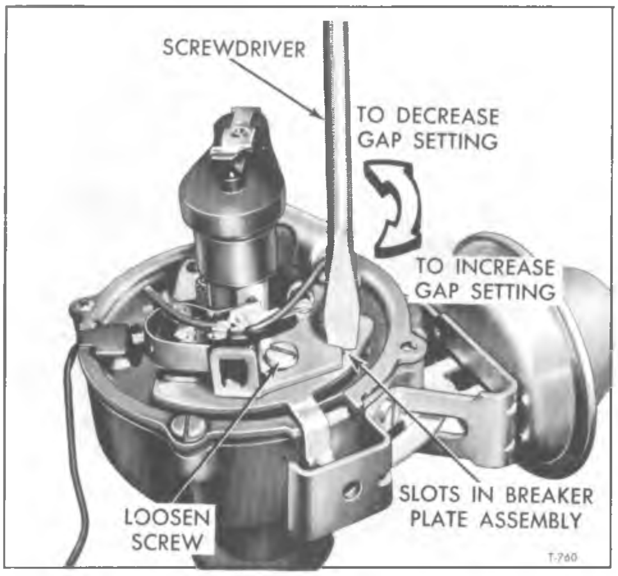


Figure 10—Setting Point Opening (In-Line and V6 Engines) (Typical)

Press down and turn to lock cap in position.

6. Start engine and check point dwell and ignition timing.

SETTING DWELL ANGLE

The point opening of new points can be checked with a feeler gauge, but the use of a feeler gauge on rough or uncleaned used points is not recommended since accurate mechanical gauging cannot be done on such points.

Contact points must be set to the proper opening. Points set too close may tend to burn and pit rapidly. Points with excessive separation tend to cause a weak spark at high speed. Proper point setting for these engines are listed in "Specifications" at end of this section.

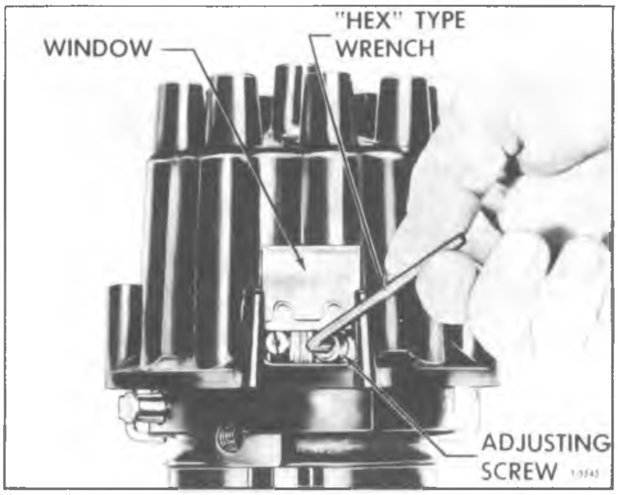


Figure 11—Setting Dwell Angle (V8 Engine) (Typical)

New points should be set to the larger opening as the rubbing block will wear down slightly while seating to the cam. Contact points should be cleaned before adjusting if they have been in service.

CONTACT POINT OPENING ADJUSTMENT (IN-LINE ENGINES)

1. Release distributor cap hold-down screws, remove cap and place it out of work area.
2. If necessary, align points by bending the fixed contact support. Do not bend the breaker lever. Do not attempt to align used points; replace them where serious misalignment is observed. Use an aligning tool if available.
3. Turn the distributor shaft until the breaker arm rubbing block is on the high point of the cam lobe. This will provide maximum point opening.
4. Loosen the contact support lock screw.
5. Use a screwdriver to move point support to obtain a 0.019" opening for new points (or 0.016" opening for used points) (fig. 10).
6. Tighten the contact support lock screw and recheck the point opening.
7. After checking and adjusting the contact point opening to specifications, the cam angle or dwell should be checked with a dwell meter, if such equipment is available (see "Specifications" at end of section for proper dwell angle).

NOTE: DISCONNECT AND PLUG VACUUM LINE WHEN CHECKING. If the cam angle is less than the specified minimum, check for defective or misaligned contact points or worn distributor cam lobes. The variation in cam angle readings between idle speed and 1750 engine rpm should not exceed 3 degrees. Excessive variation in this speed range indicates wear in the distributor.

NOTE: Cam angle readings taken at speeds above 1750 engine rpm may prove unreliable on some cam angle meters.

DWELL ANGLE ADJUSTMENT (ON VEHICLE)

1. With engine running at idle and operating temperature normalized, raise window in distributor cap and insert a "hex" type wrench into head of adjusting screw as shown in figure 11.
2. Connect a dwell meter to the distributor; then turn adjusting tool until the specified dwell angle is obtained. Refer to "Specifications" at end of this section for correct dwell angle.

NOTE: If a dwell meter is not available, turn the adjusting screw in (clockwise) until the engine begins to misfire, then back out one-half turn. This provides the approximate dwell angle required.

DWELL ANGLE ADJUSTMENT
(OFF VEHICLE)

1. Distributor Test Method

a. With distributor mounted on a distributor testing machine, connect dwell meter to distributor primary lead.

b. Turn adjusting screw (fig. 11) to set dwell angle to 30 degrees.

2. Test Light Method

a. With distributor mounted in a vise, connect a test lamp to the primary lead.

b. Rotate shaft until one of the circuit breaker cam lobes is under the center of breaker lever rubbing block.

c. Turn adjusting screw (fig. 11) clockwise until lamp lights, then give wrench ½ turn in opposite direction (counterclockwise) to obtain proper dwell angle.

CENTRIFUGAL ADVANCE

IN-LINE ENGINES

Distributor is equipped with a centrifugal spark advance mechanism located under the breaker plate assembly. The advance mechanism is part of main shaft assembly and consists of an automatic cam actuated by two centrifugal weights controlled by springs.

Where speed variations are encountered, spark advance, based on engine speed, is necessary to develop maximum power. As engine speed increases, the weights are gradually thrown out against the springs and rotate the cam to provide the desired spark advance for speed at which engine is running.

The correct weights, cam contour, and spring calibration have been selected to provide spark advance which will give the best performance of engine throughout its entire speed range. The centrifugal advance mechanism can be checked for freeness of operation as previously directed under "Ignition Maintenance." A distributor tester must be used to check advance action under various speed conditions.

V8 ENGINES

On V8 engines, the distributor is equipped with a centrifugal advance mechanism mounted above the contact set assembly and covered by a molded rotor.

The centrifugal advance mechanism consists of an automatic cam actuated by two centrifugal weights controlled by springs. As speed of the distributor shaft increases with engine speed, the weights are thrown outward against the pull of the springs. This advances the cam, causing the contact points to open earlier, thus advancing the spark.

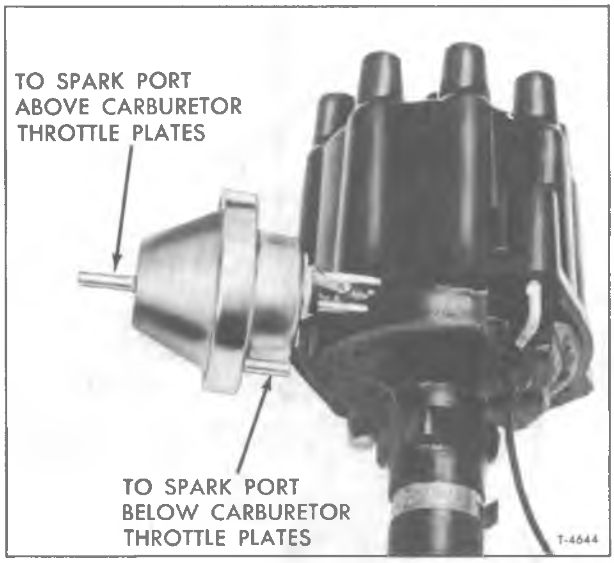


Figure 12—Position of Vacuum Hoses (With C.C.S.) (Typical)

VACUUM ADVANCE

The vacuum advance control unit is mounted to the base of the distributor housing. The vacuum control unit consists of an enclosed, calibrated, spring-loaded diaphragm and is linked to the movable breaker plate. Under part throttle operation, the intake manifold vacuum is sufficient to actuate the vacuum control diaphragm and cause the breaker plate to move, advancing the spark and increasing fuel economy. During acceleration or when engine is under heavy load, the vacuum is not sufficient to actuate the diaphragm and the breaker plate is held in the retarded position by a calibrated return spring which bears against the vacuum diaphragm.

On vehicles equipped with the controlled combustion system, a double-acting diaphragm is used in the distributor vacuum control unit. The vacuum

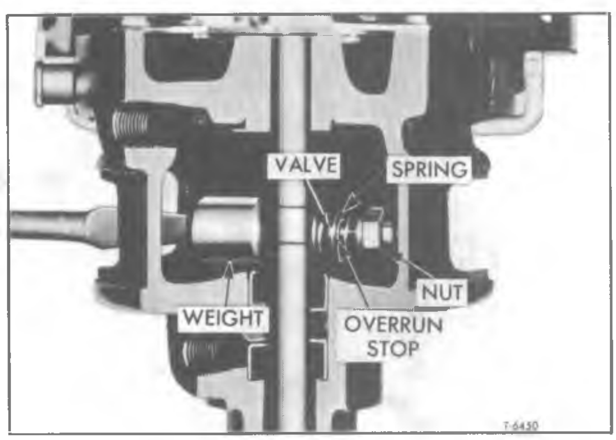


Figure 13—Adjusting Spinner Governor

retard side of the diaphragm is connected to manifold vacuum through ports on carburetor. At idle speed, with carburetor throttle valves closed, vacuum on this diaphragm will retard the spark 10 degrees. The opposite side of the diaphragm is connected to a port above the throttle valves (fig. 12). When carburetor throttle valves are open, vacuum on this side of the diaphragm immediately advances the spark to the initial setting. When throttle valves are open, the double-acting vacuum advance unit functions exactly the same as the single diaphragm vacuum advance unit.

VACUUM OPERATED GOVERNOR (WHEN USED)

Since governing speed is a function of both the distributor spinner and the carburetor actuator, the only positive method of accurately setting speed is to adjust the spinner on the vehicle. For extremely accurate full throttle governing, road testing is necessary; however, for practical purposes it can be assumed full throttle governed speed will be about 200 rpm below no-load governed speed. The adjustment can be made by "revving" up the engine against the governor with the transmission in neutral.

The spinner mechanism can be adjusted by holding the slotted end of the valve with a screwdriver (fig. 13) and turning the adjusting nut on the other end. Increase the governing speed by turning the adjusting nut clockwise, decrease the speed by turning the nut counterclockwise.

The governing system will operate satisfactorily for long periods if:

1. The vacuum passages are kept free from dirt.
2. The governor air cleaner should be cleaned often enough to prevent restrictions to the supply of clean air necessary in operating the governing system.
3. Maintain tight cover bands or plugs on the distributor "spinner" compartment. Since a partial vacuum exists in this chamber, dirt could be drawn through a leaking cover band and upset the operation of the spinner valve.

If an approximate bench setting of the spinner is desired, the following procedure can be followed:

1. With "spinner" valve adjusted so that at least two threads on the valve are showing behind the nut, mount the distributor in a tester.
2. Screw vacuum adapter into lower vacuum opening on the distributor housing.
3. With vacuum hose pinched or bent double to prevent leakage through the hose, adjust vacuum so that gauge reads 5.0 inches. Replace hose, then repeat adjustment until reading returns to 5.0 inches each time the hose is pinched.
4. Attach vacuum hose to the adapter on the distributor and start the tester. Increase speed until the vacuum reading reaches a maximum value. The maximum value will vary depending on the type "spinner" parts used but will probably be above 3.8" hg.
5. After the maximum reading has been reached, slowly decrease distributor speed until vacuum gauge hand falls back to .1" hg. The speed at which the .1" hg. drop occurs will be the approximate no-load governed speed. (Remember that distributor rpm is one-half engine rpm when making this adjustment.)

DISTRIBUTOR REMOVAL

1. Locate No. 1 cylinder spark plug wire on distributor cap, mark this position on cap and mark distributor housing adjacent to No. 1 wire in cap.
2. Release distributor cap hold-down screws, then remove cap and place clear of work area.
3. Disconnect distributor primary wire from terminal on ignition coil.
4. Intermittently operate starter until crankshaft pulley comes to rest with the correct timing mark aligned with pointer or timing tab (fig. 2 or 4).

NOTE: Refer to "Ignition Timing" in this section for ignition timing point on each engine.

With pointer and timing mark aligned, rotor segment should point toward mark made on distributor body in Step 1 previously; instead, rotor segment may point 180 degrees away from mark; in this case, rotate engine one complete revolution and re-align timing mark with pointer.

Distributor can be removed and readily reinstalled if engine remains in this position.

5. Disconnect external connections (vacuum line, drive cables, etc.), then remove cap screw and mounting clamp. Lift distributor straight up until spiral gear disengages camshaft gear. Rotor will rotate a few degrees clockwise as gears disengage. Mark this position of rotor on distributor housing, also note position of vacuum advance mechanism relative to engine. Lift distributor straight up to complete removal. Remove distributor flange to cylinder block gasket.

NOTE: Always set distributor in upright position so oil from distributor shaft will not run out onto breaker plate and points.

DISTRIBUTOR INSTALLATION

IF ENGINE HAS NOT BEEN CRANKED
(IN-LINE ENGINE MODELS)

1. Turn the rotor approximately 1/8 turn in a clockwise direction past the mark previously placed

on the distributor housing to locate the rotor.

2. Place new distributor to cylinder block gasket on block and lubricate distributor drive gear with engine oil.

3. Push the distributor down into position in the cylinder block with the distributor housing in a normal "installed" position.

NOTE: It may be necessary to move rotor slightly to start gear into mesh with camshaft gear, but rotor should line up with the mark on distributor housing when distributor is in place.

4. Install distributor hold-down clamp and cap screw. Tighten the clamp bolt firmly, then connect vacuum line. Connect primary wire to coil terminal and install cap. Install spark plug wires in cap in correct firing sequence -- 1-5-3-6-2-4 -- starting with No. 1 wire in socket adjacent to No. 1 firing position mark on distributor housing, then proceeding clockwise around the cap.

5. Check and adjust ignition timing as previously directed under "Ignition Timing."

IF ENGINE HAS NOT BEEN CRANKED (V8 ENGINE MODELS)

1. If distributor is new, No. 1 firing position can be determined by the mark made on the old distributor housing prior to removal. Also locate mark made on housing after gears were disengaged.

2. Place new distributor to cylinder block gasket on cylinder block and lubricate distributor drive gear with engine oil.

3. Turn rotor so segment points to the mark made after disengaging gears. As distributor is inserted into place, spiral gear will cause rotor to turn counterclockwise. It may be necessary to insert the assembly several times to find the correct position to bring rotor segment to No. 1 firing position.

4. Install distributor hold-down clamp and cap screw. Tighten the clamp bolt firmly, then install distributor cap. Install spark plug wires in cap in correct firing sequence -- 1-8-4-3-6-5-7-2 -- on V8 engines -- beginning with No. 1 wire in socket adjacent to No. 1 firing position mark on distributor housing, then proceeding clockwise around the cap. Install secondary wire from ignition coil in center socket in distributor cap. Connect distributor primary wire to negative (-) terminal on ignition coil. Connect vacuum line(s).

5. Check ignition timing as explained previously under "Ignition Timing."

IF ENGINE HAS BEEN CRANKED (IN-LINE ENGINES)

1. Locate No. 1 piston in firing position by either of two methods described below:

a. Remove No. 1 spark plug and with finger on plug hole, crank engine until compression is felt in No. 1 cylinder. Continue cranking until timing mark on crankchast pulley is aligned with mark on timing tab.

NOTE: Refer to "Ignition Timing" earlier for correct timing on each engine.

b. Remove rocker arm cover and crank engine until No. 1 intake valve closes. Continue to crank slowly about 1/3 turn until timing mark on pulley is aligned with mark on timing tab.

2. Place a new gasket on cylinder block, then position distributor to opening in cylinder block in normal installed attitude, noting position of vacuum control unit.

3. Position rotor to point toward front of engine (with distributor held in installed attitude), then turn rotor counterclockwise approximately 1/8 turn and push distributor down to engine camshaft. It may be necessary to rotate rotor slightly until engagement is felt.

4. While pressing down on distributor, engage starter several times to make sure oil pump shaft is engaged. Install distributor hold-down clamp and bolt and snug up bolt.

5. Turn distributor body slightly until points just begin to open and tighten clamp bolt.

6. Place distributor cap in position and check to see that rotor lines up with terminal for No. 1 spark plug.

7. Install distributor cap. Install spark plug wires in cap in correct firing sequence -- 1-5-3-6-2-4 -- starting with No. 1 wire in socket adjacent to No. 1 firing position mark on distributor housing, then proceeding clockwise around the cap. Install Hi-tension wire from ignition coil in center socket in distributor cap. Connect distributor primary wire to negative (-) terminal on ignition coil.

8. Connect vacuum line to vacuum advance unit on distributor.

9. Start engine and adjust timing as explained under "Ignition Timing" previously.

IF ENGINE HAS BEEN CRANKED (V8 ENGINE MODELS)

1. Remove left-hand valve rocker arm cover. Turn engine over by intermittently operating starter and observe movement of the No. 1 intake valve (second valve from front). When intake valve starts to close (move upward), continue to turn engine slowly until pointer on timing gear cover is at proper timing mark on crankshaft pulley or damper (fig. 4). Engine is then in No. 1 firing position.

2. Install distributor as described previously. It may be necessary to turn the oil pump drive shaft to permit engagement of drive shaft with distributor drive gear.

3. Install distributor hold-down clamp and cap screw.

4. Install distributor cap. Install spark plug wires in cap in correct firing sequence 1-8-4-3-6-5-7-2 on V8 engines -- starting with No. 1 wire in socket adjacent to No. 1 firing position mark on distributor housing, then proceeding clockwise around the cap. Install secondary wire from ignition coil in center socket in distributor cap. Connect distributor primary wire to negative (-) terminal on ignition coil.

5. Check and adjust ignition timing as previously directed under "Ignition Timing."

DISTRIBUTOR CONDENSER

Condenser, mounted on breaker plate and connected across the points, reduces point arc by its ability to store up electrical energy.

REMOVAL AND INSTALLATION

1. Release distributor cap hold-down screws, remove cap, and place it out of the work area.

2. Remove rotor.

3. Disconnect condenser lead wire from contact point quick-disconnect terminal.

4. Remove condenser attaching screw, lift condenser from breaker plate, and wipe breaker plate clean.

5. Install new condenser, using reverse of procedure outlined above.

TEST

Four factors affect condenser operation, and each must be considered in making tests:

Breakdown. Breakdown is a failure of insulating material, causing direct short between metallic elements of condenser. This condition prevents any condenser action.

Low Insulation Resistance. This condition permits leakage which prevents condenser from holding its charge. A condenser with low insulation resistance is said to be weak.

High Series Resistance. This is excessive resistance in condenser circuit due to broken strands in condenser lead or to defective connections. This will cause burned contact points and ignition failure upon initial start and at high speeds.

Capacity. Capacity is built into a condenser and is determined by the area of the metallic elements, and the insulating and impregnating materials. A condenser of incorrect capacity will result in point pitting.

IGNITION COIL

On In-line engine models, the ignition coil is mounted on side of cylinder block and on V8 engine models, the coil is mounted on top of block near front of distributor. Ignition coil primary terminals are marked positive (+) and negative (-).

Wire from distributor primary wire (black) must be connected to negative (-) terminal of coil. The light green feed wire from starter solenoid and the special resistance wire must be connected to positive (+) terminal of coil.

IGNITION COIL TEST

If there is any doubt as to the condition of the coil, it should be tested with a conventional coil tester, following instructions furnished by the manufacturer of the testing equipment. Defects indicated by the test are:

1. Weak coil.
2. Open primary circuit.
3. Open secondary circuit.
4. High voltage breakdown in secondary circuit.
5. Shorted turns in primary or secondary.
6. High resistance in primary connections.

If any of the above conditions are evident, coil must be replaced.

Before using a coil test instrument, connect test points of a 110-volt test lamp to both primary terminals of coil. If test lamp does not light, the primary circuit is open.

Apply one test point of the test lamp to the high tension terminal and the other test point to one of the primary terminals. If secondary circuit is not open, the lamp will not light but tiny sparks will appear at test points when they are rubbed over terminals. If secondary circuit is open, no sparks will occur.

Apply one test point of test lamp to coil case and touch the other point to the primary and high tension terminals. If the lamp lights, or if tiny sparks appear at point of contact, the coil windings are grounded.

A coil with open or grounded windings must be replaced. It is unnecessary to test such a coil with a coil test instrument.

If coil windings are not open or grounded, a test for short circuits and other internal defects should be made using a reliable coil test instrument, following instructions furnished with instrument. The instrument must be frequently checked to make certain that it is accurately calibrated.

NOTE: When using a coil test instrument, coil must be at normal operating temperature since internal defects often fail to show up on a cold coil test.

SPARK PLUGS

GENERAL INFORMATION

Resistor-type spark plugs and resistor-type tapered seat plugs with extra long reach are used in engines covered by this manual. Refer to "Specifications" at end of this section for proper spark plug application.

Spark plugs are protected by an insulating nipple made of special heat-resistant material which covers the spark plug terminal and extends downward over a portion of the plug insulator. These nipples prevent flash-over with resultant missing of the engine, even though a film is allowed to accumulate on exposed portion of plug porcelains.

All AC spark plugs have a type number on the insulator which designates thread size as well as relative position of the plug in the Heat Range. Type numbers starting with 4 are 14 MM thread size.

The last digit of the type number indicates the Heat Range position of the plug in the AC Heat Range System. These numbers are read the same as a thermometer - the higher the last digit, the hotter the plug will operate in the engine; the lower the last digit, the cooler the plug will operate.

Spark plug life is governed to a large extent by operating conditions, and plug life varies accordingly. To ensure peak performance, spark plugs should be checked, cleaned, and regapped every 6,000 miles.

Worn and dirty plugs may give satisfactory operation at idling speed, but under operating conditions they frequently fail. Faulty plugs are evident in a number of ways such as wasting gas, power loss, loss of speed, hard starting, and general poor engine performance.

Spark plug failure, in addition to normal wear, may be due to dirty or leaded plugs, excessive gap, or broken insulator.

Dirty or leaded plugs may be evident by black carbon deposits, or red, brown, yellow, or blistered oxide deposits on the plugs. The black deposits are usually the result of slow speed driving and short runs where sufficient engine operating temerature is seldom reached. Worn piston rings, faulty ignition, over-rich fuel mixture and spark plugs which are too "cold" will also result in carbon deposits. Red, brown, or yellow oxide deposits, a consequence of the combustion of leaded fuel, usually result in spark plug failure under severe operating conditions.

The oxides have no adverse affect on plug operation as long as they remain in a powdery state. But, under high speed or hard pull, the powder oxide deposits melt and form a heavy glaze coating on the insulator which, when hot, acts as a good electrical conductor, allowing current to follow the deposits and short out the plug.

Excessive gap wear on plugs of low mileage usually indicates the engine is operating at speeds or loads that are consistently greater than normal or that a plug which is too "hot" is being used. In addition, electrode wear may be the result of plug overheating, caused by combustion gases leaking past the threads and gaskets, due to insufficient compression of the spark plug gasket (V6 engine only), dirt under gasket, or use of old gaskets. Too lean a fuel mixture will also result in excessive electrode wear.

Spark plug life will also be affected by incorrect timing of the engine which results in excessively high operating temperature.

Broken insulators are usually the result of improper installation or carelessness. Broken upper insulators usually result from a poor fitting wrench or an outside blow. The cracked insulator may not make itself evident immediately, but will as soon as oil or moisture penetrates the fracture. The fracture is usually just below the crimped part of the shell and may not be visible.

Broken lower insulators usually result from carelessness when regapping and generally are visible. This type of a break may result from the plug operating too "Hot" such as encountered in sustained periods of high speed operation or under extremely heavy loads, especially if not installed correctly. When regapping a spark plug, to avoid lower insulator breakage, always make the gap adjustment by bending the ground (side) electrode. Spark plugs with broken insulators should always be replaced.

Spark plugs, to give good performance in a particular engine, must operate within a certain temperature range (neither too hot nor too cool). If the spark plug remains too "cool," oil, soot, carbon, and lead components will deposit on the insulator, causing FOULING and MISSING. If the plug runs too "hot," the deposits accumulated on the insulator surface during continuous slow or stop-and-go driving may become blistered, electrodes will wear rapidly, and under extreme conditions, premature ignition (preignition) of the fuel mixture result. EITHER CONDITION WILL SERIOUSLY AFFECT THE PERFORMANCE OF THE ENGINE.

Refer to "Specifications" at end of this section, as the use of spark plugs in the proper Heat Range is of vital importance to good engine performance. Frequently, the wrong type of spark plug, one with an improper Heat Range for the engine, may have been installed when replacing spark plugs originally fitted by the engine manufacturer and such misapplication may lead to poor performance.

ABNORMAL OPERATION

Where abnormal operating condition causes chronic carbon or oil fouling of the plugs, the use of a type with one or two numbers higher (a "hotter" type) than recommended in "Specifications," will generally remedy the trouble; and by the same formula, where chronic preignition or rapid electrode wear is experienced, a type with one or two numbers lower (a "cooler" type) will generally be found satisfactory.

SPARK PLUG REMOVAL

IMPORTANT: Before removing any spark plug, blow all dirt and any foreign matter out of plug sockets in cylinder head.

1. Pull wires off spark plug terminals, using caution to avoid damaging wire terminals. Remove wires by firmly grasping large end of boot.

2. Using a suitable spark plug wrench socket, remove the spark plugs (fig. 14).

NOTE: Ordinary wrenches may damage porcelain on plugs. If gaskets do not remain on plugs (V6 engines only), remove from cylinder head.

INSPECTION AND CLEANING

Inspect plugs for cracked porcelain and burned points, and check point gap. Also check for loose terminals. Replace plugs which have excessively burned electrodes or cracked porcelain. Plugs should be cleaned with an abrasive type cleaner. If porcelain is badly glazed or blistered, the spark plugs should be replaced. All spark plugs must be of the same make and number of heat range. Use a wire feeler gauge when checking spark plug gap.

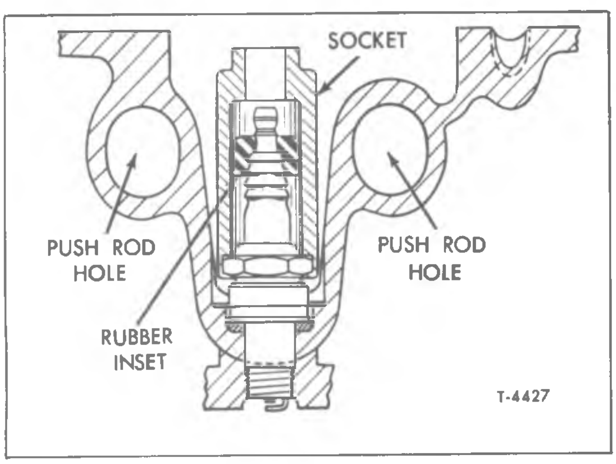


Figure 14—Wrench Socket Installed on Plug (Typical)

POINT GAP ADJUSTMENT

Setting spark plug gap is a precision operation and should be treated as such. Refer to "Specifications," at end of this section for proper gap dimensions. All plugs must be set to the same dimension, using a standard round feeler gauge.

CAUTION: Before adjusting gap, file center electrode flat. In adjusting the spark plug gap, never bend the center electrode which extends through the porcelain center as this may break the lower insulator. Always make adjustment by bending the ground or side electrode.

SPARK PLUG INSTALLATION

NOTE: Improper installation is one of the greatest single causes of unsatisfactory spark plug performance, and is the result of one or more of the following practices:

1. Installation of plugs with insufficient torque to fully seat the gasket.

2. Installation of the plugs using excessive torque which changes the gap setting.

3. Installation of plugs on dirty gasket seat.

4. Installation of plugs to corroded spark plug hole threads.

Failure to install plugs properly will cause them to operate at excessively high temperatures and result in reduced operating life under mild operation or complete destruction under severe operation where the intense heat cannot be dissipated rapidly enough.

Be certain that the old gasket is removed before installation of plug and that the gasket seat is clean and smooth.

Also, check to be sure that spark plug threads and cylinder head threads are not dirty or damaged. Dirty or damaged threads cause a faulty torque reading, resulting in incorrect installation and consequent poor spark plug life and faulty operation.

On engines equipped with tapered seat plugs, install spark plugs in the engine and tighten finger tight. Using a suitable spark plug wrench socket and a torque wrench, tighten plugs to 15 foot-pounds torque.

CAUTION: If tapered seat plugs are over-tightened, they will be very difficult to remove.

IGNITION SYSTEM

Spark plugs which are not tightened correctly will result in too high an operating temperature if too loose, or distortion of the spark plug body and change in gap setting, or damage to the gasket if too tight.

HIGH AND LOW TENSION WIRES

High tension wires include the wires connecting the distributor cap to the spark plugs, and the wire connecting the center electrode of the distributor cap to the center terminal of the ignition coil. Low tension wires are the small wires connected to the primary terminals on the coil, and to the primary terminal at the distributor.

High tension wires have a built-in resistance of approximately 4,000 ohms per foot except coil wire which is 8,000 ohms per foot.

At regular intervals wires should be inspected for damage. If insulation is cracked or swollen, wires should be replaced.

OVERSPEED WARNING SYSTEM

The purpose of the overspeed warning system used on some vehicles to warn the driver of excessive engine speed in an overrun condition (such as during down-hill operation when the wheels may begin to drive the engine) and thus enable steps to be taken to correct the condition.

The system (fig. 15) consists of an amber jeweled warning lamp mounted in the cab, a vacuum sensing switch in the spinner governor vacuum line, and a warning lamp burn-out checking circuit. These components operate in conjunction with the "2GC Engine Governor".

In operation, when the engine reaches its governed speed (4,000 rpm with standard transmission or with Allison Automatic Transmission - maximum under full load conditions), the centrifugally operated spinner valve will close, thus applying a vacuum on the carburetor actuator diaphragm which in turn acts to close the throttle valves. The overspeed warning system vacuum switch, being in the spinner governor vacuum line, also senses the vacuum applied when governed speed is reached and acts to close the circuit to the battery thus lighting the amber warning lamp.

When ignition switch is placed in "START" position, current from the battery is supplied through the amber jeweled warning lamp to ground through the ignition switch causing the lamp to light. Where the ignition key is released from "START" position, the ignition switch ground circuit is broken and the lamp will go out and remain out until such time as the engine reaches its predetermined governed speed.

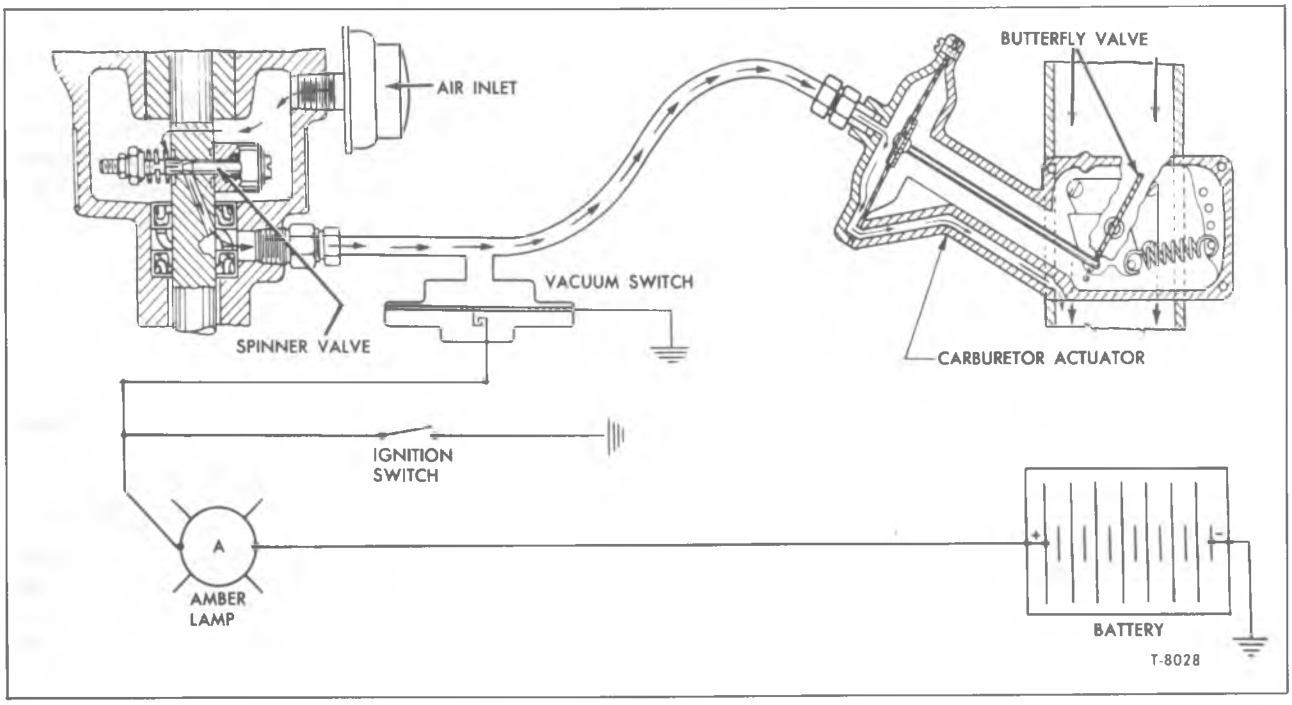


Figure 15—Engine Overspeed Warning System

IGNITION SYSTEM SPECIFICATIONS

ENGINE	250	292	366	427	350	350
DISTRIBUTOR						
Make	Delco-Remy	Delco-Remy	Delco-Remy	Delco-Remy	Delco-Remy	Delco-Remy
Model No.	1110489	1110491	1111365	1111365	1111364	1112048
Rotation (Viewed at Rotor)	Clockwise	Clockwise	Clockwise	Clockwise	Clockwise	Clockwise
Point Opening						
New	0.019	0.019	—	—	—	—
Used	0.016	0.016	—	—	—	—
Cam Angle (Degrees)	31-34 (1)	31-34 (1)	28-32 (2)	28-32 (2)	28-32 (2)	28-32 (2)
Centrifugal Advance						
Start						
Distributor Degrees	0-3	0-3	1.3-3.3	1.3-3.3	0.9-2.9	0.9-2.9
RPM	500	500	600	600	600	600
Intermediate						
Distributor Degrees	2.2-5.2	2.2-5.2	—	—	—	—
RPM	580	580	—	—	—	—
Intermediate						
Distributor Degrees	9.5-11.5	4.2-6.2	13.5-15.5	13.5-15.5	6-8	6-8
RPM	975	640	1400	1400	1000	1000
Intermediate						
Distributor Degrees	—	10.5-12.5	—	—	—	—
RPM	—	1000	—	—	—	—
Maximum Advance						
Distributor Degrees	15-17	15-17	16-18	16-18	13-15	13-15
RPM	2100	2100	2200	2200	2050	2050
Firing Order	1-5-3-6-2-4	1-5-3-6-2-4	1-8-4-3-6-5-7-2	1-8-4-3-6-5-7-2	1-8-4-3-6-5-7-2	1-8-4-3-6-5-7-2

(1) With vacuum advance line disconnected and plugged.

(2) Satisfactory range. When adjusting, set to 30 degrees (Gives .016″ point opening).

IGNITION TIMING						
With CCS-M						
Manual Transmission						
Idle RPM	550	550	500	500	500	500
Ignition Timing (1)	4° BTC	4° BTC	8° BTC	8° BTC	4° BTC	4° BTC
Automatic Transmission						
Idle RPM	500	500	500	500	500	500
Ignition Timing (1)	4° BTC	4° BTC	8° BTC	8° BTC	4° BTC	4° BTC

(1) With vacuum advance line disconnected and plugged.

BTC—Before Top Center BTDC—Before Top Dead Center

ENGINE	250	292	366	427	350	350
DISTRIBUTOR VACUUM CONTROL						
MODEL NO.	**1116217**	**1116217**	—	—	—	**1116201**
Inches of Mercury to Start Advance	6-8	6-8	—	—	—	7-9
Inches of Mercury for Maximum Advance	15.5-17	15.5-17	—	—	—	15-15.75
Maximum Advance (Distributor Degrees)*	11.5	11.5	—	—	—	8
*Plus or minus one degree.						
IGNITION COIL						
Model No.	1115208	1115208	1115293	1115293	1115293	1115293
SPARK PLUGS						
Make	AC	AC	AC	AC	AC	AC
Type	R-46TS	R-44T	R-43T	R-44T	R-44T	R-44T
Size	14MM	14MM	14MM	14MM	14MM	14MM
Hex. Size	⅝″	⅝″	⅝″	⅝″	⅝″	⅝″
Point Gap	.035	.035	.030	.035	.035	.035
Torque (Ft. Lbs.)	15	15	15	15	15	15

Alternating Current Generating System

(NON-INTEGRAL TYPE)

A non-integral (generator and separate regulator) or an integral (generator with solid state regulator built in) type generating system is used on vehicles covered by this manual.

NOTE: Refer to "Model Application Chart" below and "Specifications" at end of this section. This section is divided into sub-sections listed in the Index below:

NOTE: The integral-type alternating current generating system is covered later in this manual.

MODEL APPLICATION CHART

AMPERAGE	GENERATOR	USE WITH REGULATOR
STANDARD		
37-Amp. - CE/CS-40; CE/CS/SE/SS-50(02)	1100838	1119515
42-Amp. - CE/CS-40; CE/CM/CS-50(03)	1100842	1119515
42-Amp. - TE/TS-50	1100842	1119515
42-Amp. - TE-60	1100842	1119515
42-Amp. - CE/ME-60	1100547	Integral
OPTIONAL		
42-Amp. - CE/CS-40(02); CE/CS/SE/SS-50(02)		
42-Amp. - CE-50(02-03)	1100842	1119515
61-Amp. - CE/CS-40; CE/CS-50	1100547	Integral
61-Amp. - TE/TS-50; TE-60	1100849	1119515
61-Amp. - SE/SS-50	1100849	1119515
61-Amp. - CE-50; CE-60	1100849	1119515
62-Amp. - CE/CS-40; CE/CS/SE/SS-50; CE/ME-60	1100548	Integral
62-Emp. - TE/TS-50; TE-60	1117782	1116378
100-Amp. - SE/SS-50	1117754	1116378
130-Amp. - SE/SS-50	1117141	Integral
	1117128	9000590*

*Requires Relay 1116972.

A. C. GENERATING SYSTEM (NON-INTEGRAL TYPE)

GENERATING SYSTEM GENERAL DESCRIPTION (NON-INTEGRAL TYPE SYSTEM)

The basic charging system components include the battery, the self-rectifying, alternating current type generator, the voltage regulator, and interconnecting wiring.

An indicator lamp (tell-tale) which indicates only whether or not the generator is charging, or an ammeter or voltmeter type charge indicator is used on vehicles covered by this manual.

A typical generating system used on vehicles equipped with the two-unit type regulator is schematically illustrated in figure 1. A typical generating system used on vehicles equipped with the transistor type regulator is schematically illustrated in figure 2, and a typical generating system used on vehicles equipped with the 9000590 type regulator and separate field relay is illustrated in figure 3.

NOTE: Schematic diagrams of generating systems used on vehicles equipped with integral type generating systems (generator with solid state regulator built-in) are covered later in this section.

The alternating current type generator is used as standard and optional equipment on all vehicles covered by this manual. All units are self-rectifying, alternating current (A.C.) type with direct current (D.C.) output.

The generator is air-cooled by a single fan attached to the drive pulley or by blades attached to both ends of the rotor assembly.

The alternating current generator consists of two major parts, a stator and a rotor. The stator is composed of a large number of windings assem-

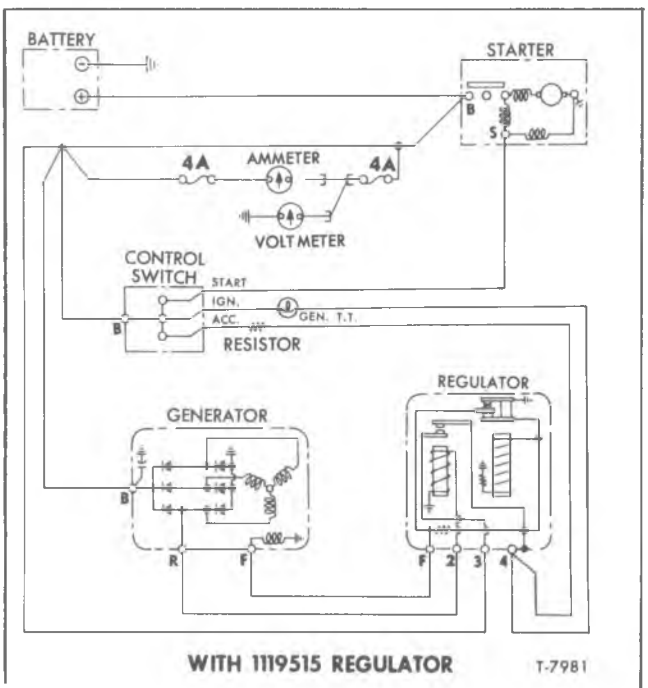


Figure 1—Schematic Diagram of A.C. Charging Circuit with Two-Unit Type Regulator (Typical)

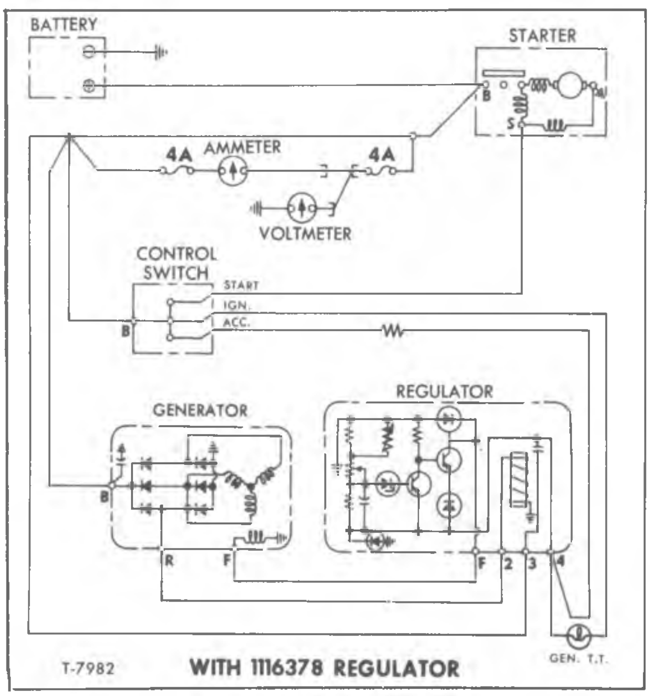


Figure 2—Schematic Diagram of A.C. Charging Circuit with Transistor Type Regulator (Typical)

A. C. GENERATING SYSTEM (NON-INTEGRAL TYPE)

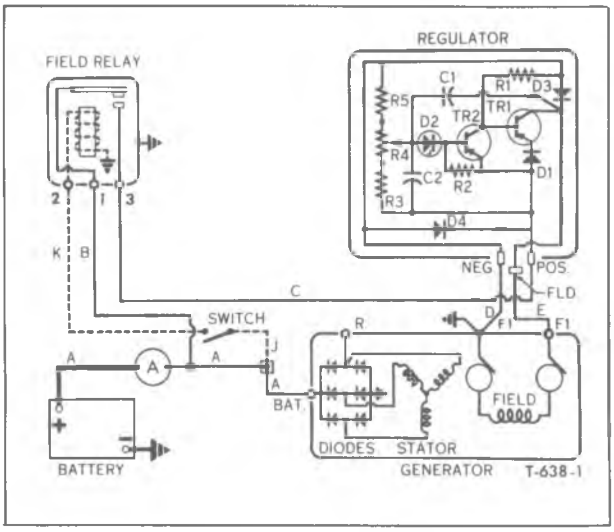


Figure 3—Schematic Diagram of A.C. Charging Circuit with 9000590 Regulator and 1116972 Relay

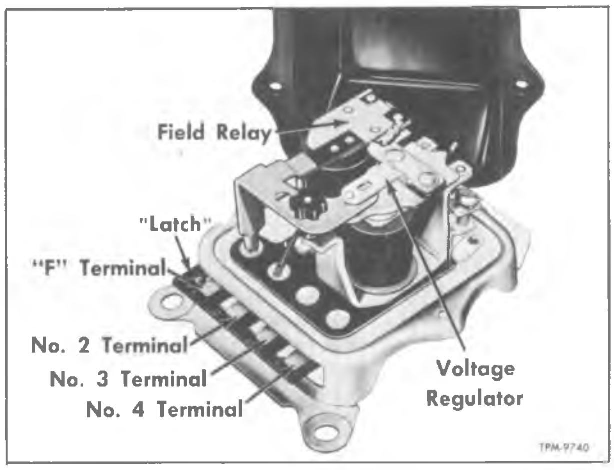


Figure 4—Vibrating Point Type Regulator with Cover Removed (Typical)

bled on the inside of a laminated core which is attached to the generator frame. The rotor revolves within the stator on bearings in each end frame. Two brushes are required to carry current through the two slip rings to the field coils wound concentric with the rotor shaft.

Although generators vary with respect to current output and type of voltage regulation, the operating principles are similar.

The generator is driven from the engine and converts mechanical energy to electrical power. The alternating current produced within the generator is rectified by six diodes installed in the generator end frame and heat sink assembly. Direct current is produced at output (BAT.) terminal on generator.

The regulator controls generator voltage output by varying current flow in field windings in generator rotor assembly. No current regulating device is required in regulator used with the A.C. generator since the generator has inherent current regulation as long as the voltage is controlled. A cut-out relay is not required with the A.C. generating system as the diodes will not conduct an electrical current in reverse direction; i.e., from battery to ground through the generator.

On all generating systems, except those equipped with the 62-amp. or 130-amp. generator, voltage is controlled by a vibrating point type regulator (fig. 4). Voltage on 62-amp. generating systems is controlled by a full transistor type regulator (fig. 5), and on the 130-amp generating system, voltage is controlled by a full transistor type regulator (fig. 6).

The full transistor type regulator used on models equipped with the 62-amp. or 130-amp. generator is composed of transistors, diodes, capacitors, and resistors which form a completely static electrical unit containing no moving parts.

The regulator limits generator voltage to a preset value by controlling generator field current. Regulator voltage setting can be adjusted externally by removing a pipe plug in cover, then rotating the adjusting screw within regulator as explained later in this section.

PRECAUTIONS

Observe the following precautions when performing service operations on the alternating current generating system. Failure to observe these precautions may result in serious damage to the charging system.

1. THE ELECTRICAL SYSTEM IS NEGATIVE GROUND. Connecting the battery or a battery charger with the positive terminal grounded will endanger generator diodes and vehicle wiring by high current flow. Burned wiring harnesses and burned "Open" diodes will result.

2. Never operate the generator on an open circuit (field terminal connected and output terminal disconnected). With no battery or electrical load in the circuit (open circuit) the generator can build up excessively high voltage. Be sure all connections in the charging circuit are secure.

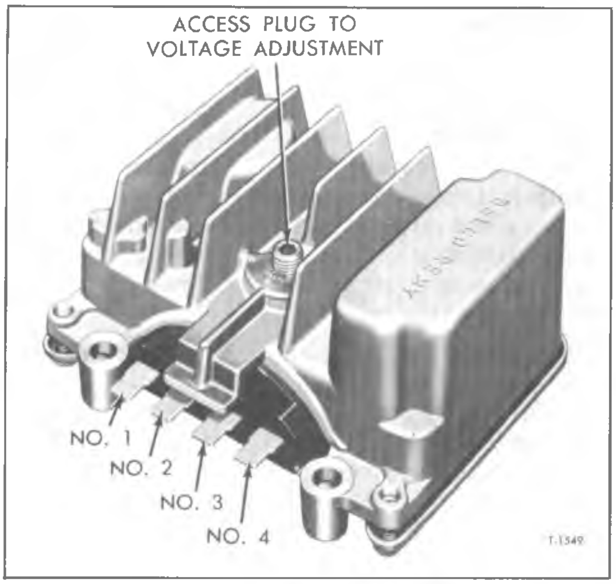


Figure 5—Full Transistor Regulator (Model 1116378) (Typical)

3. When working near the generator or regulator and before replacing electrical system components, disconnect negative lead from battery to prevent accidental shorting at generator and regulator terminals where battery voltage is available.

NOTE: Replace voltage regulator with same type and model.

4. The generator cannot be polarized. Any attempt to polarize the generator may result in serious damage to charging system components.

5. Do not short across or ground terminals on generator or regulator.

6. When using a booster battery, be sure to connect negative battery terminals together and positive terminals together.

7. Disconnect battery leads while charging batteries. Do not use a fast charger as a booster for starting the engine. When attaching battery charger leads to the battery, connect charger positive lead to battery positive terminal and connect charger negative lead to battery negative terminal.

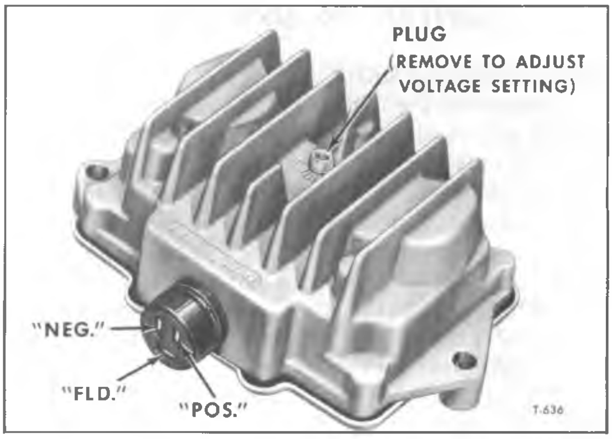


Figure 6—Full Transistor Type Regulator (Model 9000590)

8. Disconnect battery negative terminal before welding on vehicle since a reverse current flow from the welder may damage generator diodes as well as other electrical components.

9. Never replace the brown and white stripe special resistance wire in harness connected to ignition control switch unless it is of the same material and of same length (approx. 60 inches long). Generating system will not function without this wire. Wire is identified on wiring diagrams as 24-BN.-WS. Resistance value of wire is approximately 10 ± 1.0 ohms, 6.25 watts.

NOTE: Refer to "Charging System Trouble Analysis Chart" later in this section to aid in locating source of charging system malfunctions before replacing components.

IMPORTANT: Always locate and correct the cause of a malfunction to prevent reoccurrence.

ON VEHICLE MAINTENANCE, TESTS, AND ADJUSTMENTS

GENERATING SYSTEM MAINTENANCE

At regular intervals, inspect generating system to locate and correct potential causes of trouble before generating system performance is affected.

1. Check generator drive belt tension and adjust if necessary. See procedure later under "Generator Drive Belt Tension Adjustment."

2. Check generator pulley nut, mounting and adjusting arm bolts and tighten as necessary.

3. Check all electrical connections for tightness and corrosion. Clean and tighten connections as necessary. Be sure wiring insulation is in good condition, and that all wiring is securely clipped to prevent chafing the insulation.

4. With engine running, listen for noise and check generator for vibration. If generator is noisy or vibrates excessively, it should be removed for inspection and repair.

5. Check battery electrolyte level and specific gravity. Replenish electrolyte level, as necessary.

GENERATOR DRIVE BELT

TENSION ADJUSTMENT

Because of the higher inertia and load capacity of rotor used with A.C. generators, PROPER BELT TENSION must be maintained.

All generators are pivot-base mounted with the belt tension adjustment arm at the top. Use a belt tension dial gauge to check tension on each individual belt. If tension is not within 80-90 lbs. (used belts) or 100-110 lbs. (new belts), loosen the adjustment arm clamp bolt and move generator to obtain recommended tension.

IMPORTANT: When adjusting belt tension, apply pressure at center of generator, never against either end frame.

NOTE: On a new vehicle, or after having installed new belts, check tension of belt(s) twice in first 200 miles of operation. When making adjustment, examine belt(s) and replace if necessary.

A loose or broken drive belt will affect operation of generator. A drive belt that is too tight will place excessive strain on bearings.

IMPORTANT: When replacing dual drive belts, it is essential that entire set be replaced at same time. Belts are available in matched sets only.

GENERATING SYSTEM TROUBLE SYMPTOMS

Abnormal operation of the generating system is usually indicated by one or more of the following symptoms:

1. Battery undercharged (low specific gravity of electrolyte).
2. Battery using an excessive amount of water, indicating an extremely high charging rate.
3. Excessive generator noise or vibration.
4. Failure of indicator lamp to illuminate when ignition switch is on (engine not running).
5. Indicator lamp continues to glow with engine running.
6. Indicator lamp fails to go out when ignition or control switch is turned off.
7. Ammeter shows high charging rate with a fully charged battery.
8. Ammeter shows low or no charge with a partially discharged battery.

GENERATOR ON-VEHICLE TESTS

The following is a list of the most common generator defects encountered:

1. Open or shorted generator diodes.
2. Open, shorted, or grounded stator winding.
3. Open, shorted, or grounded field winding.
4. Worn generator brushes.
5. Excessive generator noise.

Generator diodes and stator windings should be checked as explained under "Generator Output Test" later in this section. If a defect is indicated by this test, remove generator and repair.

Generator field windings and brushes should be checked as outlined under "Charging System Trouble Analysis Chart" later in this section. If this check indicates a defect in the field winding, remove generator and repair. Replace worn brushes as explained under "Generator Brush Replacement" later in this section.

Excessive generator noise is usually the result of one or more of the following:

1. Brush "Squeal" caused by a hard spot on one of the brushes or rough or dirty slip rings. To check for brush "Squeal," remove generator drive belt and spin generator drive pulley by hand. Lift brushes off slip rings and spin drive pulley again. If noise disappears, clean and inspect slip rings and replace brushes if worn.

2. Dry or rough bearings in end frame.

IMPORTANT: Dry or rough bearings may be the result of over-tightening generator drive belt(s), loose generator mountings, or an unbalanced generator fan or pulley. Remove generator and repair.

3. A defective diode or stator resulting in an electrical unbalance.

To check for a defective diode or stator, perform "Generator Output Test" explained later in this section. If a defect is indicated by this test, remove generator and repair.

GENERATOR CHARGE INDICATOR LAMP CIRCUIT TEST

NOTE: Refer to procedure outlined in "Charging System Trouble Analysis Chart" later in this section to determine whether something other than a generator or regulator defect is indicated before proceeding with this test which applies to vehicles equipped with a charge indicator lamp.

1. Check the indicator lamp bulb which may be burned out. Make sure socket is fully engaged.
2. Check wiring connections at junction.
3. Lift the regulator terminal latch slightly, then pull connector from regulator terminals.

CAUTION: DO NOT allow any leads to contact a ground or "live" wire or terminal except as directed. A heavy cloth, taped in position below regulator terminals, will assist in preventing contact.

4. Referring to figure 7, insert jumper lead into #4 terminal socket in harness connector and ground the other end to regulator base as illus-

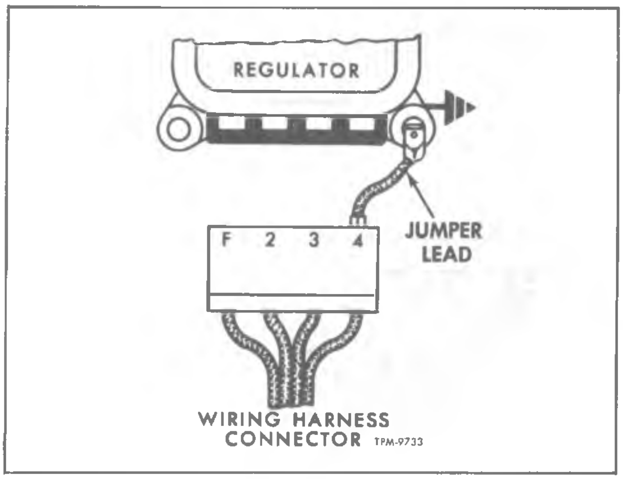


Figure 7—Jumper Lead Connections for Testing Indicator Lamp Circuit (Typical)

trated. Momentarily (not more than 10 seconds) turn on ignition or control switch. Indicator lamp should light. If not, check for open circuit in wiring between the jumper lead and switch, switch and horn relay, and to the battery.

5. If indicator lamp comes on when #4 socket in wiring harness connector is grounded (fig. 7), connect jumper lead between wiring harness connector terminals "F" and #4 as shown in figure 8. Turn ignition or control switch on momentarily.

a. If light comes on, an open circuit exists within the regulator. Refer to regulator tests later.

b. If light does not come on, an open circuit exists between the connector and generator or in the field circuit within generator.

c. Use a long jumper lead between the #4 socket in harness connector and the "F" (field) terminal at generator. If light then comes on, the generator field circuit is good and an open circuit exists in wiring between "F" terminal on regulator and "F" terminal on generator. If light does not

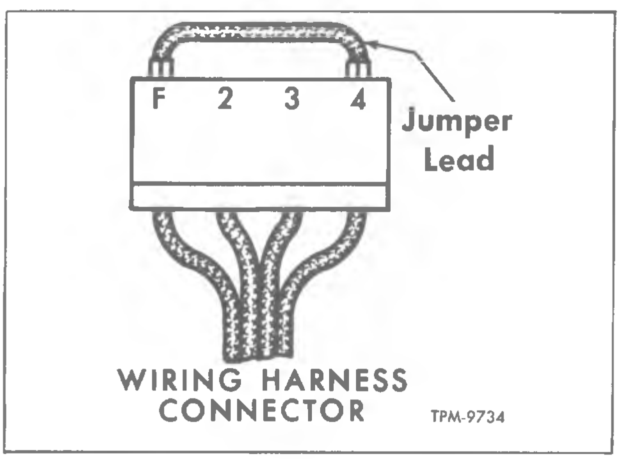


Figure 8—Checking Indicator Lamp Wiring

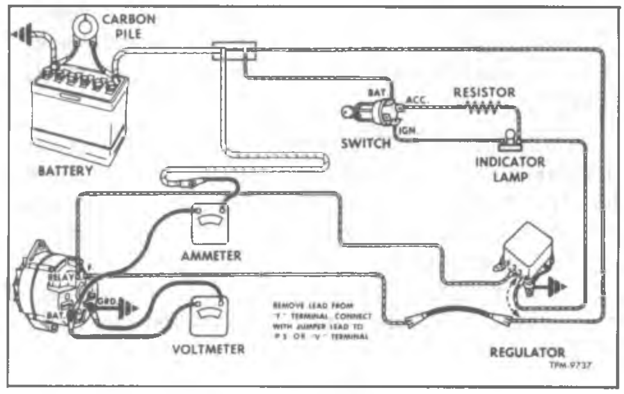


Figure 9—Connections for Testing Generator Output (Except 9000590 Regulator) (Typical)

come on, an open circuit exists in the generator field circuit.

6. If, with all wiring connected normally, and the indicator lamp comes on when ignition or control switch is off, a defective diode is indicated.

GENERATOR OUTPUT TEST ON VEHICLE

Refer to procedures outlined in "Charging System Trouble Analysis Chart" later in this section to determine whether something other than a generator defect is indicated before proceeding with this test.

QUICK TEST FOR OUTPUT

1. Connect voltmeter "POS" lead to generator output terminal and "NEG" voltmeter lead to ground on chassis.

2. Start engine and turn heater motor to medium speed position.

3. Increase engine speed until voltmeter reading does not increase and record the reading.

CAUTION: DO NOT exceed 2000 rpm.

4. Disconnect ground (NEG.) cable from battery.

5. If voltmeter reading is lower than in Step 3 above, a defective generator is indicated. Remove generator and repair.

GENERATOR OUTPUT TEST (EXCEPT 9000590 REGULATOR)

1. Disconnect positive cable from battery.

2. Remove wire from "BAT" terminal on generator, and connect an ammeter between wire and "BAT" terminal on generator (fig. 9).

3. Install a voltmeter between the generator "BAT" terminal and "GRD" terminal.

4. Pull latch on regulator upward to disengage

A. C. GENERATING SYSTEM (NON-INTEGRAL TYPE)

from connector, then pull wiring harness connector from regulator. Connect a jumper lead between "F" terminal socket and #3 socket as shown in figure 10.

IMPORTANT: With wiring connected as shown in figure 9, the voltage regulator is taken out of the circuit, and causes field to be energized by full battery voltage. Generator output voltage must be controlled by loading the battery with a carbon pile or turning on vehicle accessories. Do not permit voltage to exceed setting specified for regulator as listed in "Specifications."

5. Connect a tachometer to engine, then connect positive cable to battery and start engine. Adjust engine speed and carbon pile (if used) or with vehicle accessories to provide rated voltage. Ratings for each generator are given in "Specifications" at end of this section. If generator does not produce current within its rated capacity, it can be considered defective and in need of repair.

6. Remove instruments and jumper lead and connect wiring harness connector to regulator.

7. If no defects were discovered by the foregoing tests, yet the battery remains undercharged, adjust voltage regulator setting as explained under applicable regulator later in this section.

GENERATOR OUTPUT TEST
(WITH 9000590 REGULATOR)

1. Connect voltmeter to a test adapter as shown in View A, figure 11.

2. Turn on the ignition or control switch.

3. Operate the generator at specified speed and check for rated output as listed in "Specifications" at end of this section. Load the battery with a carbon pile or vehicle accessories (if needed) to obtain rated output. If generator does not produce rated output, repair or replace the generator.

GENERATOR FIELD CIRCUIT CHECK (WITH 9000590 REGULATOR)

1. Connect a voltmeter to the test adapter as shown in View B, figure 11.

2. Turn the ignition or control switch on.

3. If the voltmeter registers zero volts, check the generator field as follows:

a. Turn the ignition or control switch off and disconnect the battery ground strap.

b. Disconnect the adapter from the regulator.

c. Connect an ohmmeter to the adapter as shown in View C, figure 11.

d. If the ohmmeter indicates high, there is an open, or excessive resistance in the field winding, or in wiring between regulator positive terminal and generator F1 terminal (Lead E, fig. 3).

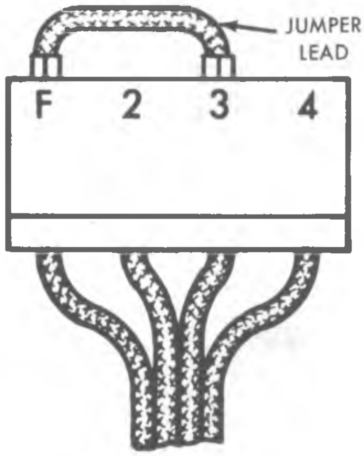


Figure 10—Generator Output Test (Jumper Lead Connections at Regulator) (Except 9000590 Regulator) (Typical)

e. If the ohmmeter indicates low, the winding is shorted or grounded.

NOTE: Since the reading is taken through the adapter, leads, brushes and slip rings, the ohmmeter reading on a good field winding will be slightly higher than the specified value. This is because the specified value is for an ohmmeter reading directly across the slip rings.

f. Disconnect ohmmeter and reconnect the battery ground strap.

4. If the voltmeter indicates battery voltage, the regulator is shorted and must be replaced, or the generator field winding is open or grounded. Check as follows:

a. To check the generator field, turn the ignition or control switch off and disconnect battery ground strap.

b. Disconnect test adapter from the regulator.

c. Connect an ohmmeter to the adapter as shown in View C, figure 11.

d. If the ohmmeter indicates high, there is an open, or excessive resistance in the field winding, or in the wiring between regulator positive terminal and generator F1 terminal (Lead E, fig. 3).

e. If the ohmmeter indicates low, the winding is shorted or grounded.

f. Disconnect ohmmeter and reconnect the battery ground strap.

g. To check the regulator, connect a voltmeter as shown in View A, figure 11, and operate the engine at moderate speed. If the voltage is uncontrolled and increases with speed to values above the specified setting range, repair or replace the regulator.

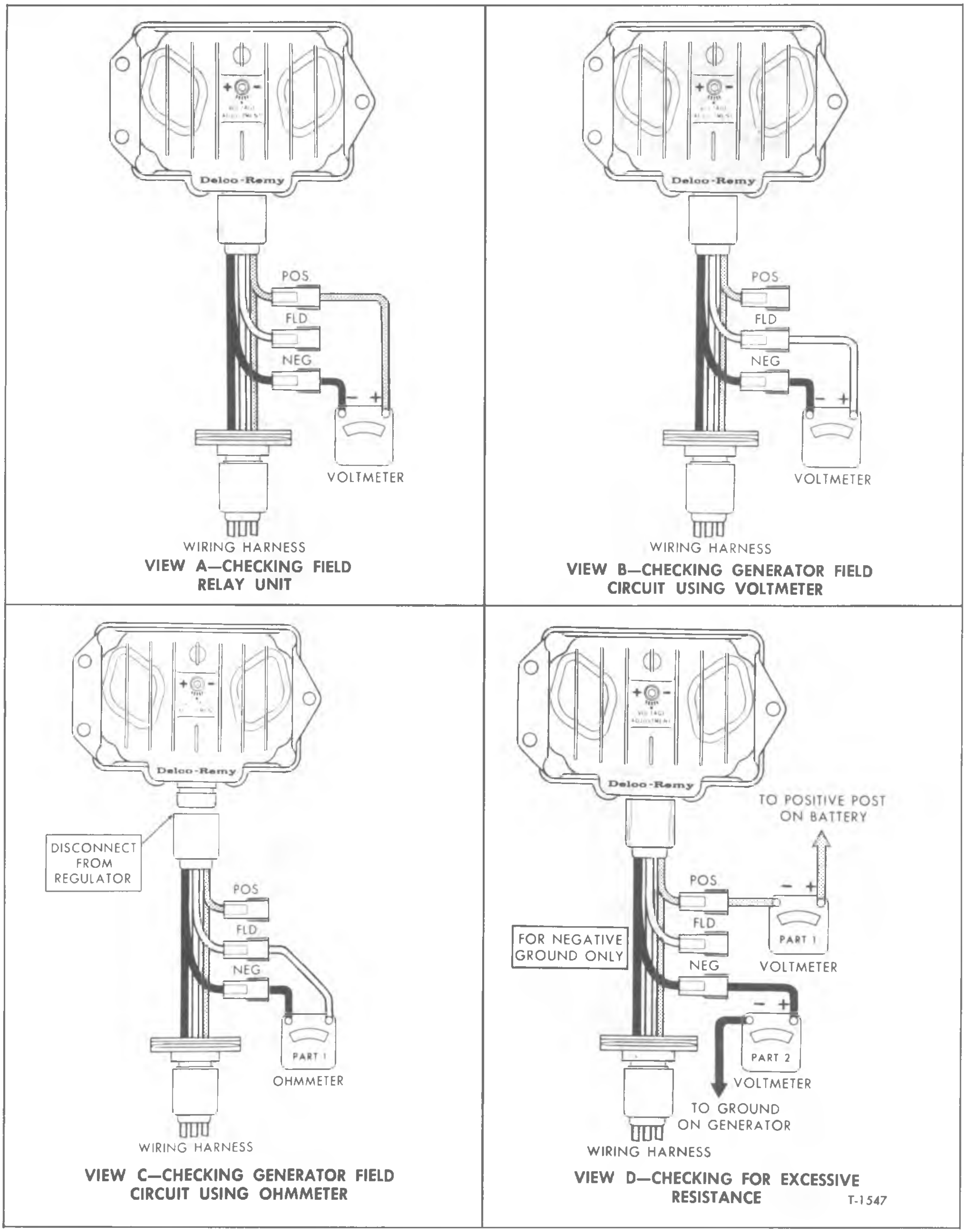


Figure 11—Using Adapter (J-21600) To Check Generator Output (9000590 Type Regulator)

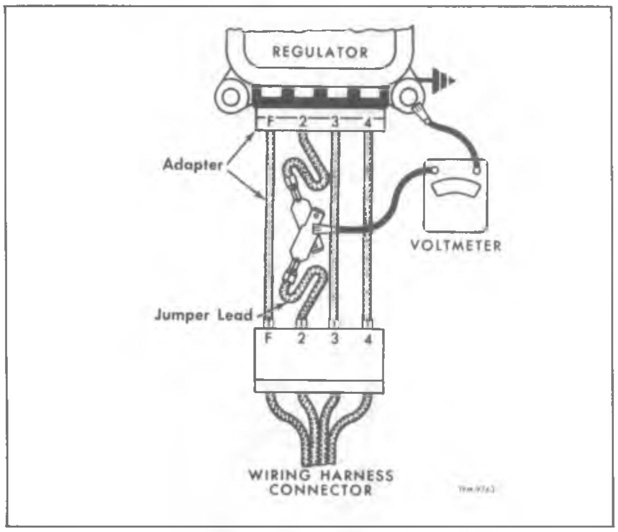


Figure 12—Testing Regulator Field Relay (Two-Unit Type Regulator)

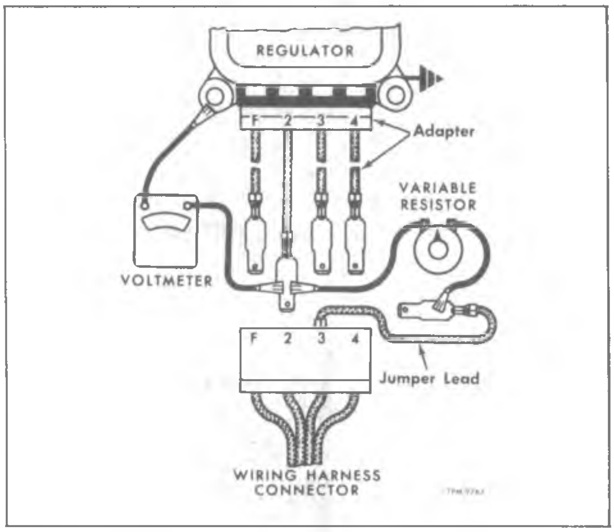


Figure 13—Testing Field Relay Closing Voltage (Two-Unit Type Regulator) (Typical)

EXCESSIVE RESISTANCE CHECK (GENERATING SYSTEMS WITH 9000590 REGULATOR)

NOTE: Excessive resistance in the sensing circuit, consisting of wiring and the regulator, can cause an overcharged battery.

1. Connect a voltmeter as shown in Part 1 and Part 2, View D, figure 11.

2. Turn the ignition or control switch on, but do not start the engine.

3. If both voltmeter readings total more than .3 volt, check for excessive resistance in leads (B, C, and D, fig. 3), which can cause an overcharged battery. If these leads are satisfactory, the field relay contacts may have excessive resistance. In this event, replace the field relay unit.

REGULATOR UNIT FIELD RELAY TEST ON VEHICLE

If the generator charge indicator shows no charge, the regulator field relay or possibly the generator is at fault. To determine which is at fault, proceed as follows:

1. Make connections to the regulator and connector terminals as shown in figure 12.

2. Start engine and operate at fast idle speed. Observe the voltmeter reading. If reading is 5 volts or over and indicator shows no charge, the field relay is defective and must be checked.

3. If voltmeter reading is below 5 volts on regulator 1119515 trouble is in generator. Refer to applicable "Generator" section explained later.

4. The field relay closing voltage can be checked on the vehicle as follows:

NOTE: Refer to figure 13 for test connections.

a. Connect a 100-150 ohm variable resistor and a voltmeter to adapter as shown in figure 13.

NOTE: If the 0-50 ohms variable resistor unit (J-21260) is used, it will be necessary to add a 15 and a 115 ohm resistor in same series to provide required resistance.

b. Turn resistor to the open or "full resistance" position. Leave ignition or control switch off.

c. Slowly decrease resistance and note the closing voltage. Voltage should be 1.5 to 3.2 volts on the 1119515 regulator. If necessary, adjust voltage by bending the armature support heel iron.

REGULATOR VOLTAGE TEST (ON VEHICLE)

The voltage at which the regulator operates varies with changes in regulator ambient temperature which is the temperature of air at a distance of ¼-inch from the regulator.

NOTE: The 9000590 type regulator is not noticeably affected by changes in temperature.

GENERATING SYSTEM WITH TWO-UNIT TYPE REGULATOR

NOTE: On some generating systems, No. 2 terminal on regulator is energized by system voltage rather than by voltage at "R" terminal of generator.

1. Refer to figure 14 which shows all test equipment connected into system. Figure 15 shows use of special adapter and jumper lead at regulator.

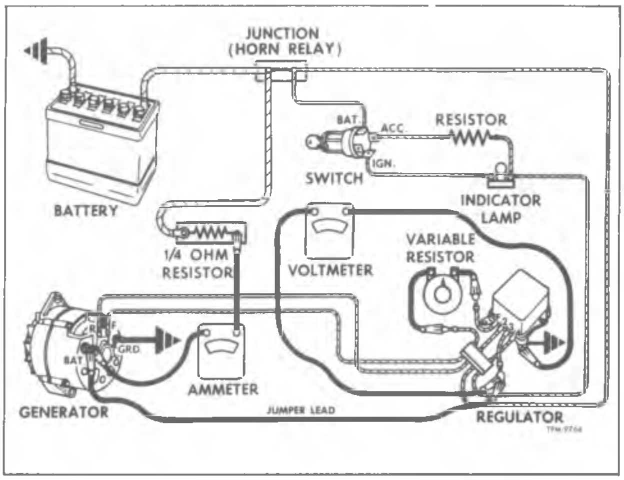


Figure 14—Connections for Testing Regulator Voltage Setting (Two-Unit Type Regulator)

2. Connect an ammeter and a ¼-ohm resistor with a rating of 25 watts or more in series in the circuit at the "BAT" terminal on the generator (fig. 14). In the event the battery is discharged, the ¼-ohm resistor will limit the generator output to 10 amperes or less which is required, when checking and adjusting the voltage setting.

3. Install special adapter as shown in figure 14. Use a 25 ohm 25 watt variable resistor in series with the generator field windings at the regulator "F" terminal, and connect a jumper lead from the #3 adapter lead to the generator "BAT"

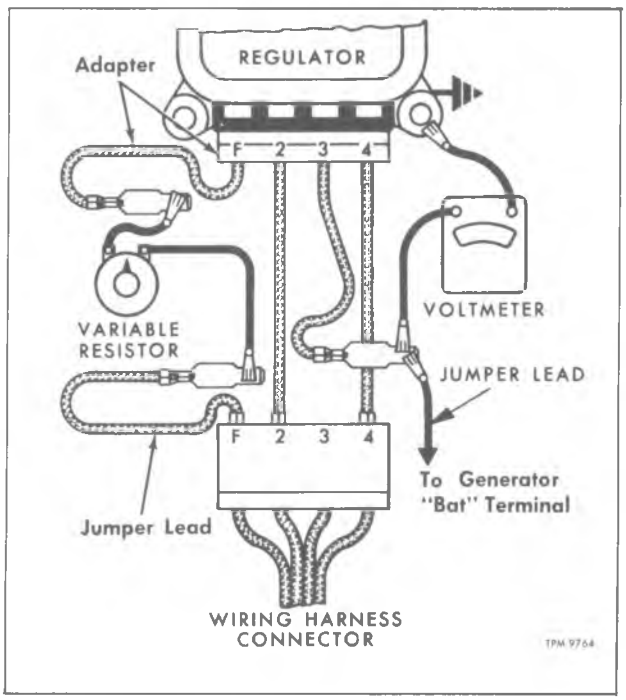


Figure 15—Testing Voltage Setting (Two-Unit Regulator)

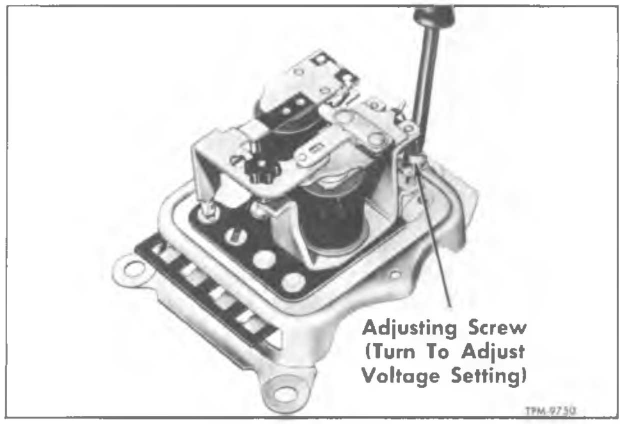


Figure 16—Adjusting Voltage Setting (Two-Unit Type Regulator) (Typical)

terminal as shown. Connect a voltmeter from the #3 adapter lead to ground as shown. Turn the resistor to the closed or "no resistance" position.

4. Secure a thermometer close to regulator to establish operating temperature. With all accessories and lights off, start and operate engine for 15 minutes at 1500 engine rpm.

5. After warm-up, cycle generator as follows:

a. Turn variable resistor to "OFF" or "FULL RESISTANCE" position.

b. Disconnect lead at #4 terminal of harness connector momentarily, then reconnect lead.

c. Return variable resistor to the closed or "no resistance" position.

d. Bring engine speed up to approximately 2500 rpm and note the voltage setting. Refer to applicable "Temperature Voltage Chart" in "Specifications" at end of this section.

NOTE: The regulator unit should be operating on the upper or shorting contacts. If it will not operate on the upper contacts, the battery is in extreme state of discharge, and must be at least partially recharged before proceeding with test.

6. To prevent accidental grounding and consequent damage to internal regulator parts when removing or installing regulator cover, perform the following steps in order listed:

a. Disconnect #4 lead at harness connector.

b. Disconnect jumper lead at generator "BAT" terminal.

c. Remove regulator cover.

d. Reconnect jumper lead to generator "BAT" terminal.

e. Connect #4 lead to harness connector.

7. To adjust the voltage setting, turn adjusting screw as shown in figure 16.

IMPORTANT: Always turn screw clockwise to make final setting to ensure spring-holder being against head of adjusting screw. If necessary, pry holder up against screw head before turning screw clockwise.

A. C. GENERATING SYSTEM (NON-INTEGRAL TYPE)

8. After making the setting, cycle the generator again as directed previously in Step 5.

9. Operate engine at approximately 2500 rpm and note voltage setting. Readjust if necessary.

10. Check the voltage setting while operating on the lower set of contacts as follows:

11. Slowly increase the resistance of the variable resistor with the engine operating at 2500 rpm until the regulator begins to operate on lower set of contacts. Then, note the change in voltage reading. The upper set voltage should be 0.1 to 0.4 volts higher than on lower contacts.

NOTE: The most desirable method for determining that the regulator is operating on the lower set of contacts when the cover is installed is to use earphones (if available) connected across the regulator "F" terminal to ground. As the variable resistor is turned, and operation changes from the upper set of contacts to the lower set, the earphones sound will fade away and stop completely and then return when the lower set of contacts begin to operate.

The alternate method is visual observation, but this is less desirable because the cover must be removed which affects temperature stabilization.

If turning the variable resistor does not cause the regulator to operate on the lower set of contacts, return the variable resistor to the "no resistance" position, turn the carbon pile to slightly load the battery, and then adjust the variable resistor to cause the regulator to operate on the lower set of contacts. Usually, turning on the vehicle head lights can substitute for the carbon pile.

The difference in voltage between the operation of the upper set of contacts and the lower set is increased by slightly increasing the air gap between the armature and center of core and decreased by slightly decreasing the air gap using nylon adjusting nut. This adjustment can be made while the regulator is operating. If necessary to make this air gap adjustment, recheck the voltage setting of both sets of contacts.

12. Always make final voltage test after the regulator cover is installed.

IMPORTANT: Observe special procedure in Step 6 previously when installing and removing regulator cover.

13. The regulator can be removed and checked as directed later under applicable "Voltage Regulator."

SYSTEM WITH 1116378 REGULATOR

1. Make connections as shown in View A, figure 17.

CAUTION: DO NOT leave jumper lead connected longer than five minutes.

2. If voltage in Step 1 is less than 0.9 volt or greater than 2.0 volts, repair or replace regulator.

3. If voltage in Step 1 was between 0.9 and 2.0 volts, proceed as follows:

a. Make connections as shown in View B, Part 1, figure 17, and record the voltage drop.

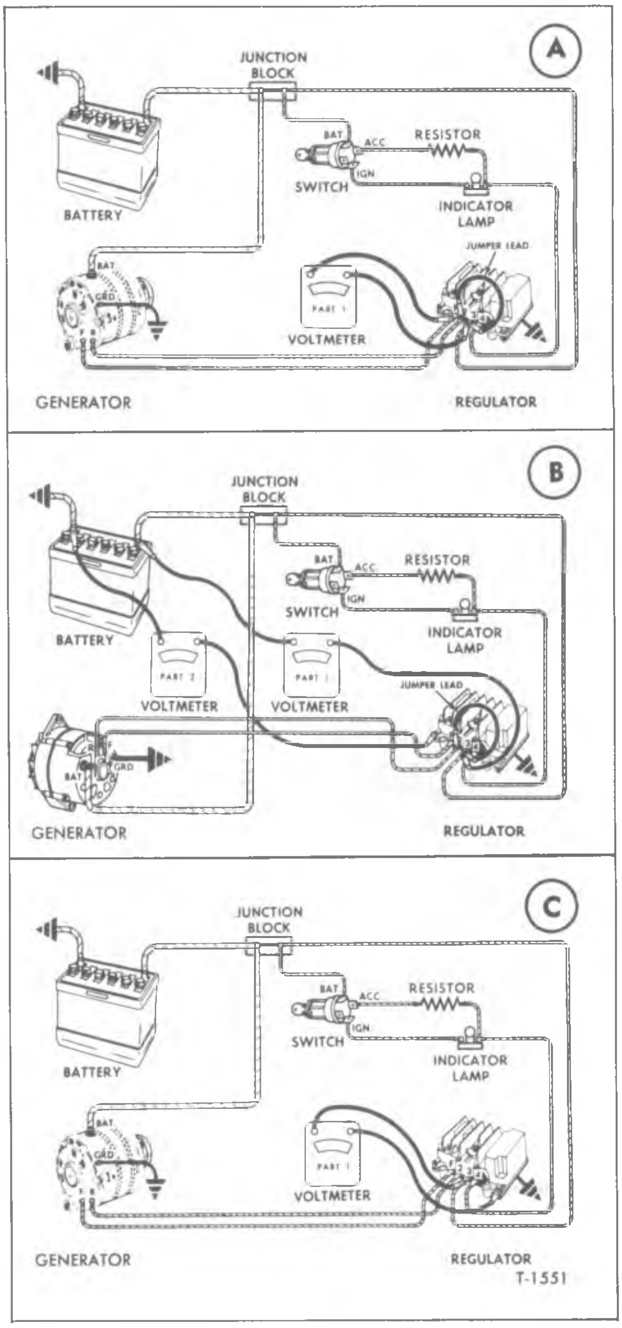


Figure 17—Connections for Testing 1116378 Regulator Voltage Setting (Typical)

Figure 18—Adjusting Voltage Setting (Typical)

NOTE: Voltmeter is connected between battery positive terminal and regulator No. 3 terminal, and jumper lead is connected between regulator No. 2 and No. 3 terminals.

b. Connect a voltmeter between battery ground terminal and ground on regulator base as shown in View B, Part 2, figure 17, and record the voltage drop.

c. Add voltage in Step a. to voltage in Step b. above. If total voltage (a. + b.) is above 0.25 volt, check system wiring for high resistance and check regulator for proper ground.

d. If total voltage in Step c. is below 0.25 volt, connect a voltmeter between regulator No. 3 terminal and ground on regulator base as shown in View C, figure 17; then with switch on, operate engine at 1275 rpm for 15 minutes. Leave cover on regulator. Place a thermometer ¼-inch from regulator cover and compare voltage with "Specifications" given in "Temperature Chart" at end of this section.

4. If actual regulating voltage, as checked is not within the voltage range specified for the measured ambient temperature, repair or replace the regulator.

5. If voltage is within specified range for the measured ambient temperature, the charging system operation is satisfactory. However, the regulator setting may need to be changed to meet battery charging requirement for a particular type of operation. Remove plug from regulator cover, then use a thin, flat-bladed instrument to turn the slotted adjuster inside the regulator (fig. 18).

6. To raise the voltage setting, turn slotted adjusting plug one notch (clockwise), then check for an improved battery condition.

NOTE: After two notches in each direction there is a positive stop.

7. To lower the voltage setting, turn slotted adjusting plug one notch (counterclockwise), then check for an improved battery condition after a service period of reasonable length.

8. If regulator cannot be adjusted to a value within the specified range, repair or replace the regulator.

NOTE: If repeated regulator failures are experienced on the vehicle, but no defects are found, a shorted, grounded, or open generator field winding, or grounded leads of an intermittent nature should be suspected.

GENERATING SYSTEM WITH
9000590 REGULATOR

1. Connect a voltmeter to the adapter as shown in View A, figure 11.

2. Turn all accessories off.

3. Operate generator at approximately 3,000 rpm (approx. 1200 engine rpm).

4. The generator output should be at least 10 amperes below the rated generator output for this check.

5. To adjust voltage setting, remove plug and turn slotted adjusting button inside regulator (fig. 18). Use thin flat-bladed instrument.

6. For an undercharged battery, raise voltage setting by turning one notch (clockwise) and then check for an improved battery condition after a service period of reasonable length.

NOTE: After two notches in each direction, there is a positive stop.

7. For an overcharged battery, lower voltage setting by turning one notch (counterclockwise) and then check for an improved battery condition after a service period of reasonable length.

8. If the regulator cannot be adjusted to a value within the specified range, replace or repair the regulator.

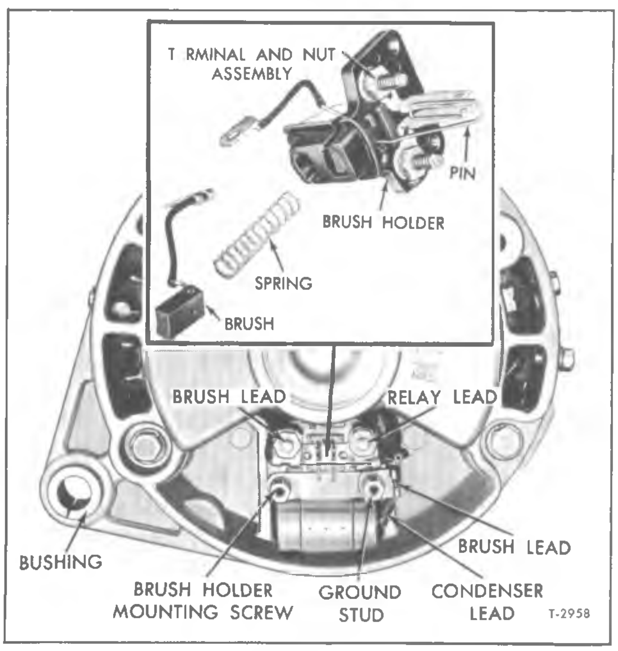


Figure 19—Generator Brush Replacement (Model 1117754) (Typical)

A. C. GENERATING SYSTEM (NON-INTEGRAL TYPE)

NOTE: If repeated regulator failures are experienced on the vehicle, but no defects are found, a shorted, grounded, or open generator field winding, or grounded leads, of an intermittent nature should be suspected.

TAILORING THE VOLTAGE SETTING

The proper setting is obtained when the battery remains fully charged with a minimum use of water.

If no circuit defects are found, yet the battery remains undercharged, raise the setting by 0.3 volt, then check the battery over a period of time to see if improvements were achieved; reset regulator if necessary. If the system is overcharging, lower the setting by 0.3 volt, then check battery over a period of time.

GENERATOR REPLACEMENT

Due to variations in design and equipment on vehicles using A.C. generators, the replacement procedures will vary accordingly. The removal and installation instructions given following are intended only as a guide. Additional operations will be required on some vehicles to remove other equipment to permit access to generator, belts, and/or brackets.

GENERATOR REMOVAL

1. Disconnect negative battery cable from the battery.

> **CAUTION: It is important that battery negative terminal be disconnected, since generator will be damaged if wiring or terminals are accidentally shorted or grounded while being disconnected.**

2. On 37-, 42-, 61-, and 62-amp generators, depress lock on connector and pull connector out of socket on generator. Pull rubber boot off "BAT" terminal and remove terminal nut. Disconnect wire from "GRD" terminal and remove the wiring clip.

On 130-amp generator, remove nuts and washers from harness leads at generator terminals. Remove harness clip from generator, then pull leads from terminals.

3. Loosen adjusting arm pivot bolt and generator to mounting bracket bolts; then move generator to loosen the drive belt or belts. Remove generator drive belt or belts.

4. Remove adjusting arm pivot bolt and generator to mounting bracket bolts; then remove generator.

GENERATOR BRUSH REPLACEMENT (MODEL 1117754)

NOTE: Brush replacement on 37-, 42-, 61-, and 130-amp generator models requires partial disassembly of the generator and is considered a part of the unit overhaul procedure.

Removal (Fig. 19)

1. Remove screws from brush holder cover and remove cover.

2. Remove nut retaining indicator light wire to blade connector post and disconnect lead from post.

3. Remove two screws which attach condenser and brush holder to rear end frame.

NOTE: Condenser lead is connected inside the generator. Leave condenser with generator to avoid excessive strain on lead wire.

4. Remove brush holder, brushes, and brush springs from generator end frame.

Installation (Fig. 19)

1. Position brush springs and brushes in brush holder and insert a pin through hole in brush holder and brushes to retain in position.

2. Position brush holder and brushes in end frame, then secure brush and condenser leads to terminals as shown in figure 19.

3. Install brush holder mounting screws and tighten firmly.

4. Remove pin from brush holder and check to be sure all leads are properly connected. Install cover over brush holder.

GENERATOR INSTALLATION

IMPORTANT: Be sure negative battery cable is disconnected from battery. Failure to disconnect the negative battery cable may result in damage to generator.

1. Attach generator to mounting bracket and install adjusting arm. Tighten flange-type lock nuts securely.

2. Place drive belt(s) over generator drive pulley and adjust belt tension as explained under "Drive Belt Tension Adjustment" previously. Tighten flange type lock nuts and mounting bolts to torque recommended in "Specifications."

3. On 37-, 42-, 61-, or 62-amp generators, push the wiring harness connector into socket, making sure lock on connector engages end frame. Place harness clip on ground terminal marked "GRD" and connect ground wire to terminal.

On 130-amp generator, connect harness leads to respective generator terminals, then install attaching nuts and washers. Install harness clip.

4. Attach red wire to "BAT" terminal on generator and fit boot on terminal.

5. Perform "Generator Output Test" described previously to determine if generator is operating properly and regulator is correctly adjusted.

A. C. GENERATING SYSTEM (NON-INTEGRAL TYPE)

TWO-UNIT TYPE REGULATOR (MODEL 1119507 OR 1119515)

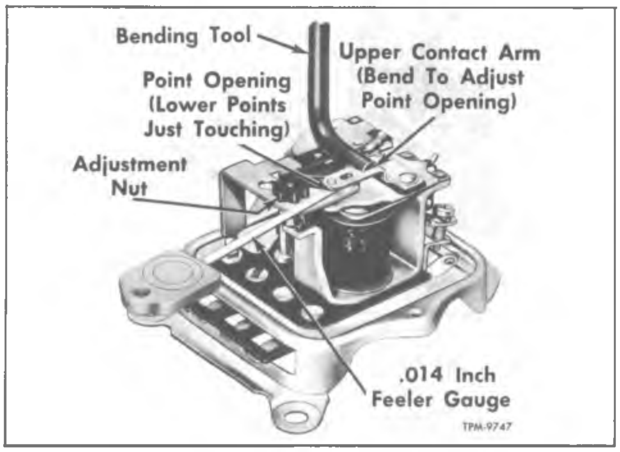


Figure 20—Adjusting Point Opening

GENERAL

The two-unit type voltage regulator is used on all models equipped with the 37-, 42-, or 61-amp generating system. Operation of regulator and other affiliated generator system units is explained previously under "Generating System General Description."

REGULATOR REPLACEMENT

REMOVAL

1. Disconnect the negative cable from battery.
2. Carefully lift up on regulator wiring harness connector with one hand and with the other, pull harness connector from regulator.
3. Remove regulator mounting screws, then remove regulator assembly.

INSTALLATION

IMPORTANT: Make sure one battery cable is disconnected from battery.

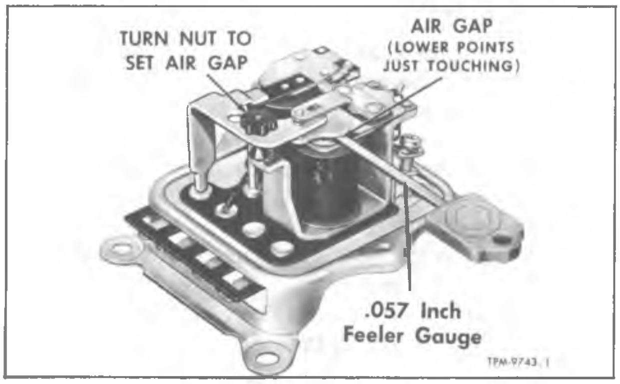


Figure 21—Adjusting Air Gap

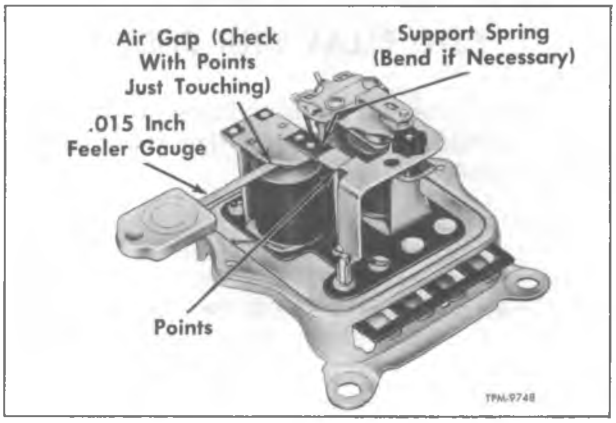


Figure 22—Adjusting Field Relay Air Gap

1. Place regulator-to-generator ground wire (if used) on regulator mounting and install regulator attaching screws.
2. Lift up on regulator terminal latch and insert wiring harness connector over regulator terminals.

IMPORTANT: Make sure connector is fully engaged over terminals and locked in position. Check by attempting to pull connector apart.

3. Connect battery cable to battery terminal.

GENERAL INSPECTION

With regulator assembly on work bench, remove the cover (fig. 4) and inspect various components, connections, and contact points for signs of damage.

VOLTAGE REGULATOR UNIT CHECK

CHECKING AND ADJUSTING CONTACT POINT OPENING

With the lower contacts touching, measure the point opening between the upper contacts as shown in figure 20. Point opening should measure 0.014". Adjust by bending the upper contact arm as shown.

CHECKING AND ADJUSTING AIR GAP

Measure air gap with a 0.057-inch feeler gauge between the armature and the core when lower contacts are just touching as shown in figure 21. To adjust the air gap, turn the adjustment nut located on the contact support.

NOTE: Only an approximate air gap setting should be made by the feeler gauge method above. The final setting must be whatever is required to obtain the specified difference in voltage between the upper and lower contacts. Instructions for making final setting are explained previously. See "Regulator Voltage Test (On Vehicle)."

FIELD RELAY UNIT CHECK

NOTE: Check closing voltage as explained under "Regulator Unit Field Relay Test - On Vehicle" previously.

CHECKING AND ADJUSTING AIR GAP

Referring to figure 22, insert a 0.030-inch feeler gauge between the armature and core and exert just enough pressure on the armature to allow it to touch the gauge. The contact set should just close at this time, adjust by bending the flat contact support spring.

CHECKING AND ADJUSTING
CONTACT POINT GAP

Referring to figure 23, insert an 0.030-inch feeler gauge between the contact points with the armature in its normal rest position.

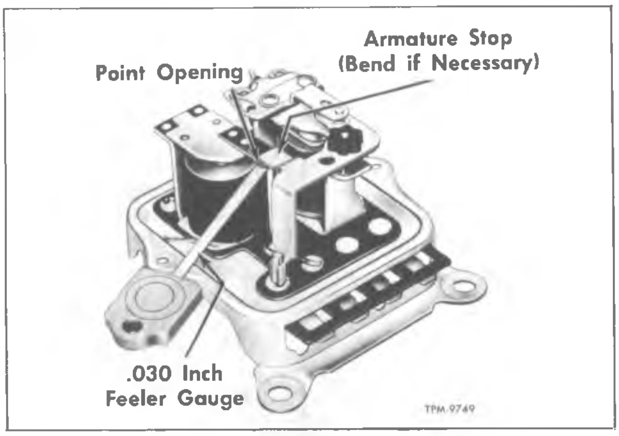


Figure 23—Adjusting Field Relay Contact Points

The point opening can be adjusted, if necessary, by bending the relay heel iron.

FULL-TRANSISTORIZED TYPE REGULATOR (MODEL 1116378)

GENERAL

The full transistor regulator is used on models equipped with the 62-amp generator as shown in "Model Application Chart" previously.

The regulator is composed of transistors, diodes, capacitors, and resistors which form a completely static electrical unit containing no moving parts.

The function of the regulator is to limit voltage to a given value. The voltage at which the generator is limited is determined by the regulator adjustment which, when adjusted, remains practically unchanged. Refer to "Regulator Adjustment" later in this section.

IMPORTANT: The field wire terminal must not be grounded or flashed when regulator is connected into circuit as instant damage to transistors will result.

OPERATING PRINCIPLES

In the circuit illustrated in figure 2 in "Generating System General Description" section, when ignition switch is closed and engine is not running, the ammeter will show a discharged condition or the indicator lamp will "light," to indicate the generator is not charging. The current flow can be traced from the battery to the "BAT" terminal on the ignition switch, through the indicator lamp and resistor, then to No. 2 or 4 terminal on the regulator. From here it continues to flow through transistor TR-1 to "F" terminal on the regulator and on through the generator field winding to ground, completing the circuit back to the battery.

When the engine is started and generator begins to operate, A.C. voltages are induced in the generator stator windings. These voltages are changed or rectified to D.C. voltage which appears at the output, or "BAT" terminal on the generator. The generator then supplies current to charge the battery and operate vehicle accessories.

On 62-amp generating systems equipped with the 1116378 transistorized regulator, voltage from "R" terminal on generator is impressed through regulator #2 terminal and through field relay winding causing the relay contacts to close. This connects the regulator #4 terminal directly to battery through the field relay contacts, causing the indicator lamp to go "OUT." Generator field current then flows from generator or battery to regulator #3 terminal, then through the field relay contacts and transistor TR-1 to the generator field winding.

As generator speed increases, the voltage reaches the pre-set value and components in the regulator cause transistor TR-1 to alternately "turn-off" and "turn-on" the generator field voltage. The regulator thus operates to limit the generator output voltage to the pre-set value.

ANALYZING CHARGING SYSTEM TROUBLES

NOTE: Procedures for analyzing or checking charging system trouble are explained previously.

If trouble is located in the generator during the test procedures, refer to the applicable generator section for corrective procedures.

When analyzing the system, make sure all connections between the battery, junction block, and generator are clean and tight, then remove the wiring harness connector from the regulator and connect the adapter between the wiring harness connector and the regulator.

When the trouble is found, it is not necessary to make further checks; however, it is often advisable to complete all checks to ensure that no other troubles exist.

REGULATOR ADJUSTMENT

NOTE: Refer to "Charging System Trouble Analysis Chart" later in this section for procedure on analyzing and checking charging system malfunctions.

1. Connect (POS) voltmeter lead to battery (POS) terminal on regulator and (NEG) voltmeter lead to ground on regulator.

2. Adjust engine speed to approximately 1500 rpm, then turn heater to medium speed and turn all other electrical load "OFF." Disconnect negative cable from the battery.

3. Place a thermometer approximately 1/4" from regulator cover and operate for approxmately 15 minutes.

4. Compare voltmeter reading with those given under applicable regulator in "Specifications" at end of this section.

5. If voltmeter is not within limits listed in "Specifications," remove plug from the regulator cover and insert a thin-bladed screwdriver into adjustment screw.

NOTE: After two notches in either direction there is a positive stop.

IMPORTANT: DO NOT force adjusting screw beyond normal stop. Forcing the screw beyond the normal stop will destroy the regulator.

6. For an undercharged battery, raise voltage setting by turning adjusting screw one notch (clockwise), then check for an improved battery condition after a service period of reasonable length.

7. For an overcharged battery, lower voltage setting by turning adjusting screw one notch (counterclockwise), then check for an improved battery condition after a service period of reasonable length.

8. If regulator cannot be adjusted to within limits listed in "Specifications," at end of this section, repair or replace the regulator.

REGULATOR REPLACEMENT AND REPAIR

REGULATOR REMOVAL

1. Disconnect the negative cable from battery.
2. Carefully lift up on regulator wiring harness connector with one hand and with the other, pull harness connector from regulator.
3. Remove regulator mounting screws, then remove regulator assembly.

REGULATOR REPAIR

With the regulator on work bench remove the cover and inspect various components, connections, and field relay contact points for signs of damage.

If field relay contact points are dirty or oxidized, they should be cleaned. The contact surfaces may oxidize and develop a slight cavity. These surfaces should be cleaned to bare metal using a riffler file.

IMPORTANT: DO NOT file excessively.

If the voltage regulator cannot be adjusted to within limits listed in "Specifications" at end of this section, replace the regulator assembly.

REGULATOR INSTALLATION

IMPORTANT: Make sure one battery cable is disconnected from battery.

1. Place regulator-to-generator ground wire on regulator mounting and install regulator attaching screws.
2. Lift up on regulator terminal latch and insert wiring harness connector over regulator terminals.

IMPORTANT: Make sure connector is fully engaged over terminals and locked in position. Check by attempting to pull connector apart.

3. Connect battery cable to battery terminal.

A. C. GENERATING SYSTEM (NON-INTEGRAL TYPE)

FULL-TRANSISTORIZED TYPE REGULATOR (MODEL 9000590)

GENERAL

The full transistor regulator illustrated in figure 6, is used on vehicles equipped with the 130-amp generator and separate field relay unit.

The separate field relay is used to disconnect regulator feed (POS) terminal from battery circuit when ignition or control switch in "OFF" position.

NOTE: The field relay units are non-adjustable or repairable. If the relay becomes inoperative replace with a unit of the same type.

CAUTION: The field wire terminal must not be grounded or flashed when the regulator is connected into the circuit as transistors will be instantly damaged.

OPERATING PRINCIPLES

NOTE: A generator, battery, separate field relay unit, voltage regulator, and an ammeter, voltmeter, or charge indicator tell-tale are used in the system. A schematic wiring diagram of the charging circuit is shown in figure 3 in "Generating System General Description" section previously.

When ignition switch is closed and engine is not running, the field relay winding is energized causing field relay contacts to close.

With the contacts closed, generator field current can be traced from the battery through the relay contacts to the regulator "POS" terminal. Current then continues through diode D1 and transistor TR-1 to the regulator "FLD" terminal, and then through the generator field winding to ground completing the circuit back to the battery.

When the engine is started and generator begins to operate A.C. voltages are induced in the stator windings. These voltages are changed, or rectified, to a D.C. voltage which appears at the output, or "BAT" terminal on the generator. The generator then supplies current to charge the battery and operate vehicle accessories.

As generator speed increases, the voltage reaches the pre-set value and the components in the regulator cause transistor TR-1 to alternately "turn-off" and "turn-on" the generator field voltage. The regulator thus operates to limit the generator output voltage to the pre-set value.

ANALYZING CHARGING SYSTEM TROUBLES

NOTE: Procedures for analyzing or checking charging system trouble are explained previously under "On-Vehicle Maintenance, Tests, and Adjustments."

To check circuits it is necessary to use an adapter (J-21600) at regulator.

If the trouble is located in the generator during the test procedures, refer to applicable generator section for corrective procedures.

When analyzing the system, make sure all connections between the battery, junction block, and generator, are clean and tight. Then remove the wiring harness connector from the regulator, and connect the adapter between the wiring harness connector and the regulator.

When the trouble is found, it is not necessary to make further checks; however, it is often advisable to complete all checks to ensure that no other trouble exists.

The "Trouble Analysis Chart" on following page, provides a quick method of analyzing the failure, effect, and probable cause or causes.

REGULATOR REPLACEMENT

REMOVAL

1. Disconnect the negative battery cable from the battery.
2. Carefully pull wiring harness connector from regulator.
3. Remove regulator mounting screws, then remove regulator assembly.

INSTALLATION

IMPORTANT: Make sure the negative battery cable is disconnected from the battery.

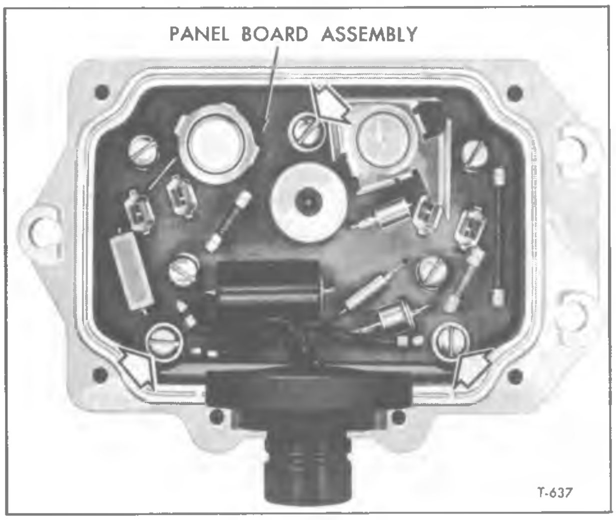


Figure 24—Regulator with Bottom Plate Removed

A. C. GENERATING SYSTEM (NON-INTEGRAL TYPE)
TROUBLE ANALYSIS CHART

Component Failure	System Effect	Probable Cause
Output Transistor Shorted	High system voltage, Battery overcharge, Lights burning out.	1. F terminal of generator has been grounded. 2. Poor ground in system or poor connection at generator or regulator. 3. Regulator too hot. 4. Ground in wiring between F of generator and regulator. 5. Defective transistor. 6. Shorted field in generator.
Output Transistor open emitter	No Charge	1. Severe ground at F terminal of generator. 2. Severe ground in wiring between F of generator and regulator. 3. Generator field completely shorted.
Driver Transistor Shorted	No Charge	1. Reverse battery polarity. 2. High positive transient from an external source. 3. Defective transistor.
Driver Transistor Open	High system voltage.	1. Defective transistor.
Zener Diode Shorted	No Charge	1. Reverse battery polarity. 2. High system voltage. 3. Defective zener.
Zener Diode Open	High system voltage	1. Defective zener.
Field discharge Diode open	Shorted output transistor and high system voltage.	1. Reverse battery polarity. 2. Defective diode.
Back bias Diode open	No Charge	1. Severe ground at F terminal of generator. 2. Severe ground in wiring between F of generator and regulator. 3. Generator field completely shorted. 4. Defective diode.
Back bias Diode shorted	Poor switching which would cause shorted output transistor.	1. F terminal of generator has been grounded. 2. Poor ground in system or poor connection at generator 3. Regulator too hot. 4. Ground in wiring between F of generator and regulator. 5. Defective transistor. 6. Shorted field in generator. 7. Defective diode.
Transient Suppression Diode open	Output transistor may short from transients - depends on application.	1. Reverse battery polarity. 2. High positive transient from external source.
Filter capacitor Open	Poor switching may or may not fail output transistor.	1. Defective connection. 2. Defective capacitor.
Feedback capacitor Shorted	High system voltage.	Defective capacitor.
Feedback capacitor Open	Poor switching which could cause shorted output transistor.	1. Poor connection. 2. Defective capacitor.
Open resistor in negative side of voltage divider. Open negative side of potentiometer.	High system voltage.	Defective resistor or potentiometer.
Open resistor in positive side of voltage divider. Open positive side of potentiometer.	No Charge	Defective resistor or potentiometer.
Open collector load resistor	No Charge	Defective resistor.
Open driver emitter - base resistor	Poor switching which will short output transistor. High system voltage.	Defective resistor.

A. C. GENERATING SYSTEM (NON-INTEGRAL TYPE)

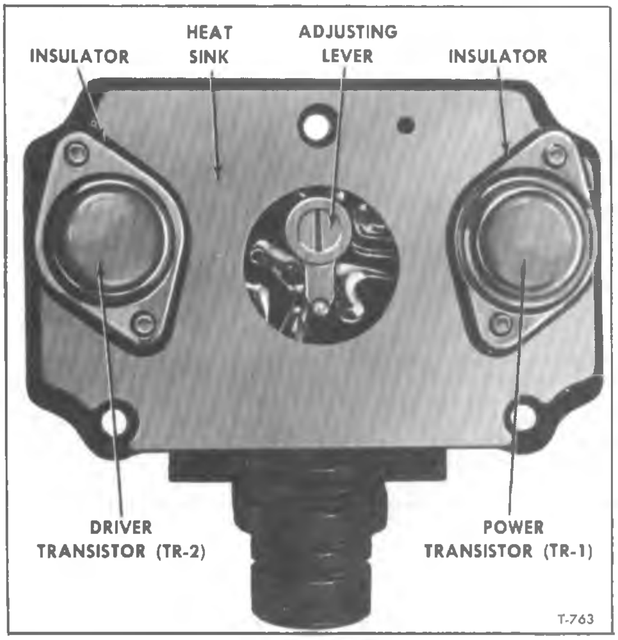


Figure 25—Top Side of Panel Board Assembly

1. Place regulator-to-generator ground wire on regulator mounting and install regulator attaching screws.
2. Insert wiring harness connector into regulator receptacle.
3. Connect battery cable to battery terminal.

REGULATOR REPAIR

To check the regulator for defective components, proceed as follows:

1. Remove the bottom plate from the regulator (fig. 24).
2. Remove the three panel board attaching screws identified by arrows (fig. 24), and lift the assembly from the housing.
3. To aid in reassembly, note or make any identifying markings on the two transistors and their respective locations on the panel board and heat sink assembly (fig. 26).
4. Note the insulators between the transistors and the heat sink, and the insulators separating the heat sink from the panel board (fig. 26).
5. Remove the transistor attaching screws, and separate the transistors and heat sink from the panel board.

With the transistors separated from the assembly, an ohmmeter may be used to check the transistors and components on the panel board for defects. An ohmmeter having a 1½-volt cell, which is the type usually found in service stations, is recommended. The low range scale on the ohmmeter should be used.

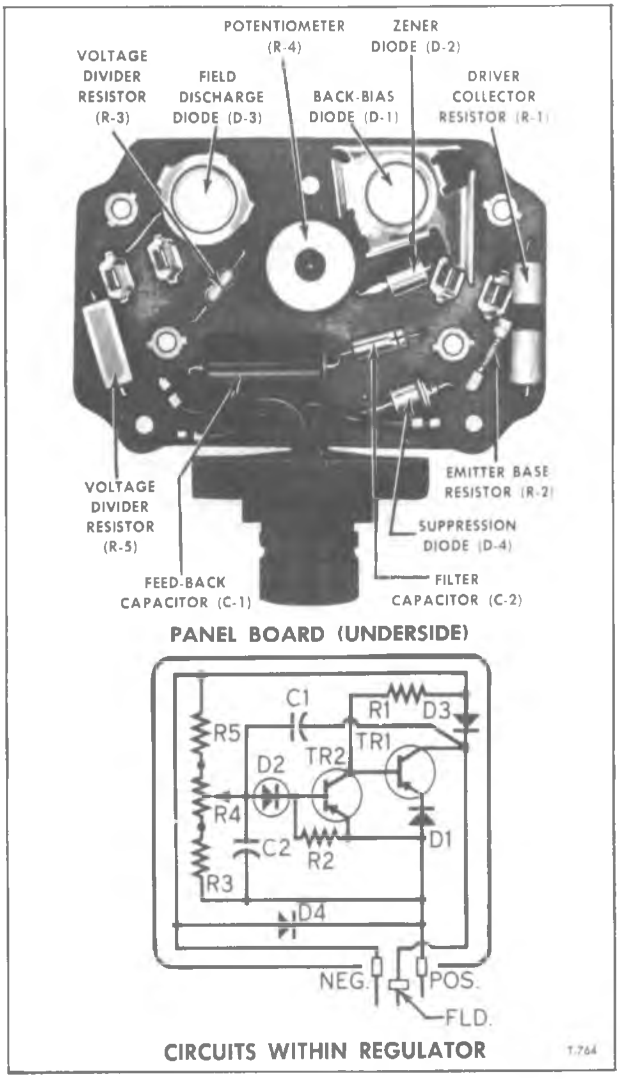


Figure 26—Under Side of Panel Board Assembly

If a component part of the panel board is found to be faulty, it should be replaced before proceeding with the remaining checks. A 25 watt soldering gun is recommended, and a 60% tin 40% lead solder should be used when re-soldering. Avoid excessive heat which may damage the panel board. Chip away any epoxy involved, and apply new epoxy which is commercially available. The component parts are identified in figures 25 and 26.

In order to check the panel board assembly, it is necessary to unsolder the emitter-base resistor at location shown in figure 27.

In all of the following checks, connect the ohmmeter as shown, then reverse ohmmeter leads to obtain two readings.

NOTE: Refer to figures 25 and 26 for identification and location of following components:

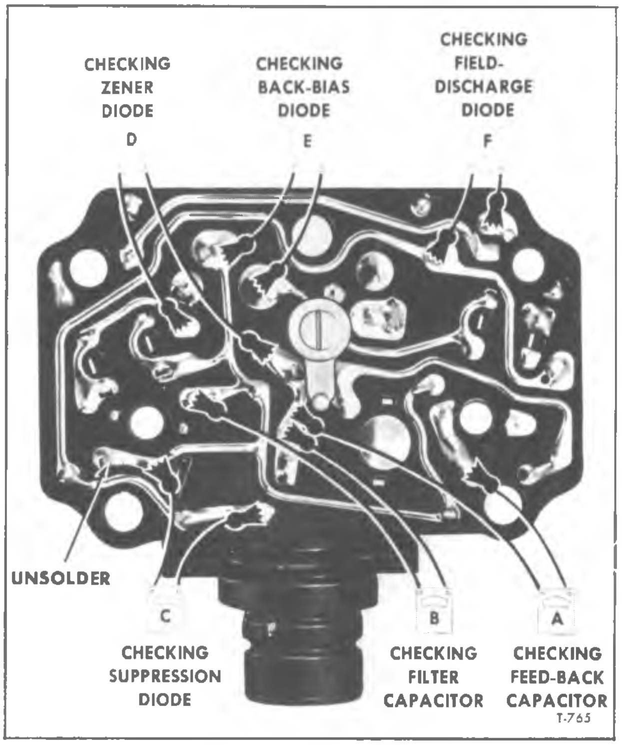


Figure 27—Checking Regulator Circuits

FEED-BACK CAPACITOR (C1),
(Part A, Fig. 27)

If both readings are zero, the capacitor is defective. Visually inspect for open soldered connections and broken leads.

FILTER CAPACITOR (C2),
(Part B, Fig. 27)

If both readings are zero, the capacitor is defective. Visually inspect for open soldered connections and broken leads. To assemble a new capacitor properly, note location of the "+" identifying mark in figure 26.

SUPPRESSION DIODE (D4),
(Part C, Fig. 27)

If the two readings are identical, the diode is faulty.

ZENER DIODE (D2),
(Part D, Fig. 27)

Replace the diode if both readings are zero, or if both readings are infinite.

BACK-BIAS DIODE (D1),
(Part E, Fig. 27)

Replace the diode if both readings are zero, if both readings are infinite, or identical.

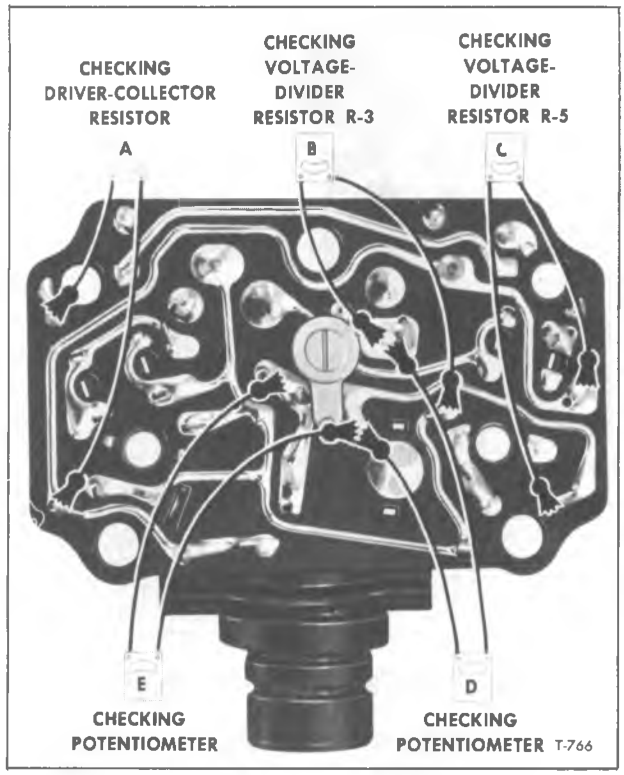


Figure 28—Checking Regulator Circuits

FIELD-DISCHARGE DIODE (D3),
(Part F, Fig. 27)

Replace the diode if both readings are zero, if both readings are infinite, or if both are identical.

DRIVER-COLLECTOR RESISTOR,
(Part A, Fig. 28)

If both readings are infinite, the resistor is open.

VOLTAGE-DIVIDER RESISTOR (R3),
(Part B, Fig. 28)

If one reading is infinite or nearly infinite, or if both readings are infinite or nearly infinite, the resistor is open.

VOLTAGE DIVIDER RESISTOR (R5),
(Part C, Fig. 28)

If one reading is infinite or nearly infinite, or if both readings are infinite or nearly infinite, the resistor is open.

POTENTIOMETER,
(Parts D and E, Fig. 28)

If one reading is infinite or nearly infinite in Part D, the potentiometer is open. If both readings are infinite in Part E, the potentiometer is open.

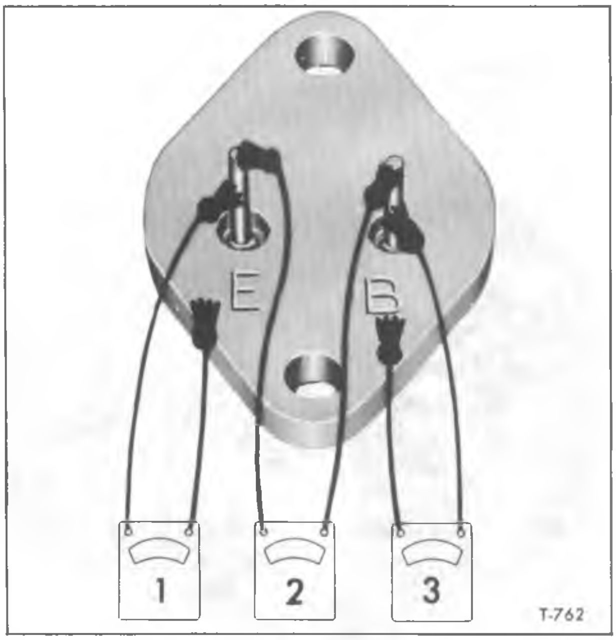


Figure 29—Checking Transistors for Shorts

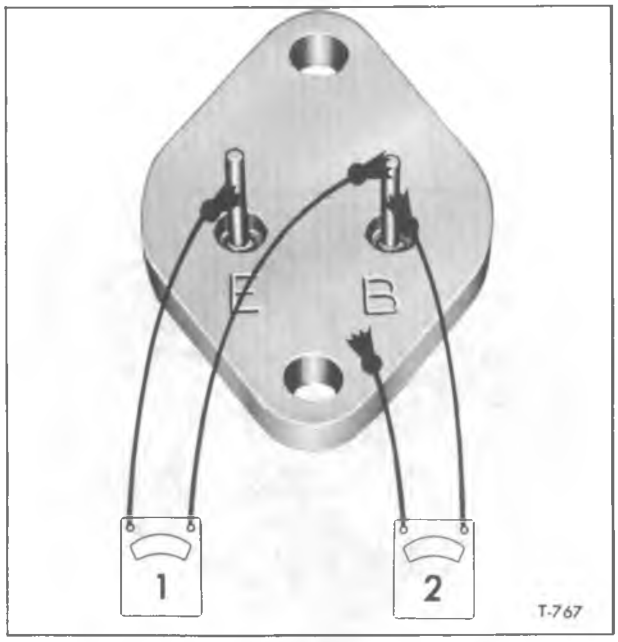


Figure 30—Checking Transistors for Opens

NOTE: When installing a new potentiometer, locate the adjusting lever in a vertical position (fig. 26), turn the potentiometer resistance adjustment to the middle position, then use a soldering iron to melt the lever into potentiometer.

EMITTER-BASE RESISTOR
(OHMMETER CHECK NOT ILLUSTRATED)

Since this resistor has been unsoldered from the panel board at one end, merely connect an ohmmeter across the resistor - an infinite reading indicates an open. Replace if defective.

DRIVER AND POWER TRANSISTORS
(Refer to Fig. 29)

If both readings in Step 1 are zero, or if both readings are very low and identical, the transistor is shorted. Similarly, if both readings in Step 2, or in Step 3, are zero or very low and identical, the transistor is shorted.

DRIVER AND POWER TRANSISTORS
(TR-1 AND TR-2), (Refer to Fig. 30)

If both readings in Step 1 are infinite, or if both readings are very high and identical, the transistor is open. Similarly, if both readings in Step 2 are infinite or very high and identical, the transistor is open.

REASSEMBLY AND FINAL CHECK

During assembly, coat with silicon grease both sides of the flat insulators used between the transistors and heat sink, and also the heat sink on the side on which the transistors are mounted. The silicon grease increases heat conduction.

A. C. GENERATING SYSTEM (NON-INTEGRAL TYPE)

CHARGING SYSTEM TROUBLE ANALYSIS CHART

BATTERY UNDERCHARGED OR DEAD
1. Faulty drive belt tension adjustment.
2. Faulty wiring, connector, or connection.
3. Faulty generator.
4. Faulty voltage regulator.
5. Faulty battery.
6. Incorrect generator application.
7. Accessories left on with engine off.

BATTERY OVERCHARGED

Check for:
1. High voltage regulator setting.
2. Excessive voltage drop in sensing circuit.

VISUAL INSPECTION

1. Check for loose generator mounting.
2. Check generator drive belt tension.
3. Check wiring and clean connectors and connections at generator, regulator, and battery.
4. Check for accessories left on or shorted wiring.

PRELIMINARY TEST

With ignition switch "OFF" connect voltmeter between "BAT" terminal on generator and chassis ground.

Disconnect "NEG" battery cable and connect test light from cable to "BAT" terminal. If light is "ON" wiring is shorted or an accessory is on.

If a voltmeter reading is obtained, record reading and proceed as follows:
Start engine (accessories "OFF") and operate at approximately 1500 RPM.

If voltmeter DOES NOT register, circuit is open between battery and generator.
NOTE: Refer to Wiring Diagram Manual for wiring circuits.

Check generator (on vehicle) since an open circuit could result in damage to generator diodes.

If voltage reading was the same or lower, failure of the following is indicated:

1. Worn or sticking generator brushes.
2. Open circuit to generator field.
3. Open or shorted generator field.

To determine fault - Proceed as directed under applicable regulator chart following.

If voltmeter reading was higher than previous, regulator circuit is satisfactory. FAULT IS:
1. Low regulator setting.
2. Faulty battery.
3. Faulty generator.
4. Incorrect generator application.

1. Charge and check the battery.
2. Check for low regulator or setting.
3. Check generator (on vehicle) for defective diode or stator.
4. Check for incorrect generator application. Consider type of driving or accessories added.

CHARGING SYSTEM TROUBLE ANALYSIS CHART WITH 1119515, OR 1116378 REGULATOR

Load battery with a carbon pile or with heater and head lamps on. Disconnect wire from field terminal at generator. Momentarily (not more than 10 seconds) connect a jumper from generator "BAT" terminal to field "F" terminal.

If voltage reading increased:
Defective regulator or wiring is indicated.
Proceed as follows:
Remove jumper lead and reconnect wire to generator field terminal. Connect voltmeter "POS" lead to No. 3 regulator terminal and "NEG" voltmeter lead to "F" terminal on regulator.

If voltage remains low -
FAULT IS:
1. Worn or dirty brushes.
2. Open or shorted generator field.

If voltmeter reads "O" or low, connect voltmeter between No. 3 regulator terminal and chassis ground.

If high voltmeter reading was obtained, regulator is open. Repair or replace regulator.

If a voltmeter reading was obtained, connect voltmeter leads between No. 2 regulator terminal and chassis ground.

If voltmeter reading is "O" wiring is open between battery and No. 3 regulator terminal.

If voltmeter reading was obtained, generator field relay is defective. Rep r or replace regulator.

If voltmeter reading was "O" wiring is open to No. 2 regulator terminal.

A. C. GENERATING SYSTEM (NON-INTEGRAL TYPE)

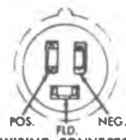
TROUBLE ANALYSIS CHART (CONT.)

CHARGING SYSTEM TROUBLE ANALYSIS CHART WITH 9000590 REGULATOR

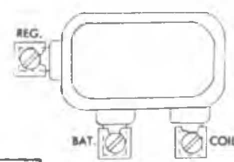
Load battery with a carbon pile or with heater and head lamps on. Disconnect wire from field terminal at generator. Momentarily (not more than 10 seconds) connect a jumper from generator "BAT" terminal to field terminal

If voltage reading increased:
Defective regulator, wiring or field relay is indicated.
Proceed as follows:
Remove jumper lead, then remove wiring connector from regulator and connect voltmeter "POS" lead to "POS" terminal in wiring connector and "NEG" voltmeter lead to field terminal in connector.

If voltage reading remains low:
FAULT IS:
1. Worn or dirty brushes.
2. Open or shorted generator field.



WIRING CONNECTOR



1115841 RELAY

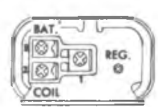
If voltmeter reading is "O" wiring or field relay is open.
1. Between field terminal of regulator and generator field.
2. Circuit is open between "POS" terminal of wiring connector and field relay.
3. Field relay is defective.
Proceed as follows:
Locate field relay unit and note Part Number. Connect voltmeter "POS" lead to relay "BAT" terminal and "NEG" lead to ground.

If voltmeter reading is obtained, voltage regulator is open or ground circuit is defective.
Proceed as follows:

Remove "NEG" voltmeter lead from regulator wiring connector and connect to "NEG" terminal of wiring connector.

If reading is "O," ground wire to regulator is open.

If voltmeter reading is obtained, a defective regulator is indicated. Remove regulator and repair.



1115827 RELAY

If voltmeter reading is obtained, connect "POS" voltmeter lead to regulator terminal of field relay.

If voltmeter reading is "O," wiring is open between relay terminal and battery.

If voltmeter reading is obtained, connect voltmeter "POS" lead to coil terminal of field relay.

If voltmeter reading is "O," wire from relay terminal to regulator terminal is open.

If voltmeter reading is "O" wiring is open between field relay terminal and ignition switch on vehicles equipped with the 1115841 field relay or to "R" terminal of generator on vehicles equipped with the 1115827 field relay.

If voltmeter reading was obtained, field relay is defective. Remove relay and replace.

A. C. GENERATING SYSTEM (NON-INTEGRAL TYPE)

NON-INTEGRAL TYPE GENERATOR SPECIFICATIONS

GENERATOR MODEL	1100838	1100842	1100849	1117754 1117782	1117128
Make	Delco-Remy	Delco-Remy	Delco-Remy	Delco-Remy	Delco-Remy
Series	10DN	10DN	10DN	20DN	40DN
Type	100	100	100	150	125
Rotation (Viewing Drive End)	Clockwise	Clockwise	Clockwise	Clockwise	Clockwise
Brush Spring Tension (Oz.)	—	—	—	—	10
Field Current at 80° F.					
Amps	2.2-2.6	2.2-2.6	2.2-2.6	4.1-4.6	2.2-2.4
Volts	12	12	12	12	12
Cold Output					
Specified Volts	14.0	14.0	14.0	14.0	14.0
Amps	25	28	33	20 (b)	40 (b)
Generator RPM (Approx.)	2000	2000	2000	1100	1100
Amps	35	40	58	55 (b)	126 (b)
Generator RPM (Approx.)	5000	5000	5000	2500	2500
Rated Hot Output (Amps) (a)	37	42	61	62	130

(a) Rated Hot Output at Maximum Operating Speed.
(b) If Generator Output is checked without a Regulator, the Output should be 5-10% higher than the value given.

TWO-UNIT TYPE REGULATOR (MODEL 1119515)

MAKE MODEL	DELCO-REMY 1119515
Field Relay	
Air Gap (In.) (a)	0.015
Point Opening (In.)	0.030
Closing Voltage Range	1.5-3.2
Voltage Regulator	
Air Gap (In.) (Approx.) (b)	0.067
Point Opening (In.)	0.014
Voltage Chart	No. 1

(a) Tolerance Plus or Minus 20%
(b) Make Field Adjustment as Per Text.

TEMPERATURE VOLTAGE CHART NO. 1

Degree F.	65	85	105	125	145	165	185
Voltage Setting	13.9-15.0	13.8-14.8	13.7-14.6	13.5-14.4	13.4-14.2	13.2-14.0	13.1-13.9

*Operation on Lower Contacts Must be 0.1-0.4 Volt Lower Than on Upper Contacts.

FULL TRANSISTOR TYPE REGULATOR (MODEL 1116378)

MAKE MODEL	DELCO-REMY 1116378
Field Relay	
Closing Voltage Range	2.0-3.0
Voltage Chart (a)	No. 2

(a) Allowable Range at "0" Position of Adjusting Screw.

TEMPERATURE—VOLTAGE CHART NO. 2

Regulator Ambient Temp. (Deg. F.)	65	85	105	125	145	165	185
Voltage Setting Range	14.1-14.8	13.9-14.7	13.7-14.5	13.6-14.3	13.4-14.2	13.2-14.0	13.1-13.8

SPECIFICATIONS (CONT.)

FULL TRANSISTOR TYPE REGULATOR SPECIFICATIONS

Make	Delco-Remy
Model	9000590
Voltage Setting (a)	13.7-14.3

(a) Allowable Range at "0" Position of Adjusting Screw.

FIELD RELAY UNIT SPECIFICATIONS

Relay Model	1116972
Make	Delco-Remy
Air Gap at Core	
Points Closed (In.)	0.010 (Min.)
Point Opening (In.)	0.015-0.025
Closing Voltage Range	7-9
Sealing Voltage	11.0 Max.

GENERATOR TORQUE SPECIFICATIONS

ITEM	TYPE OF PART	TORQUE (FT. LBS.)
Generator Pulley Nut	Nut	55-65
Generator Adjusting Arm Pivot Bolt		
With 37-, or 42-Amp. Generator	Bolt	15-20
With 61-Amp. Generator	Bolt	20-25
With 62-Amp. Generator	Bolt	25-30
With 130-Amp. Generator	Bolt	30-35
Generator to Mounting Bracket Pivot Bolt*		
With 37-, or 42-Amp. Generator*	Nut	15-20
	Bolt	25-30
With 61-Amp. Generator	Nut	15-20
	Bolt	30-35
With 62-Amp. Generator	Nut	35-45
	Bolt	40-50
With 130-Amp. Generator	Nut	25-30
Generator Support Bracket-To-Mounting Bracket	Bolt	40-50
Generator Mounting Bracket-To-Engine		
With 37-, or 42-Amp. Generator	Nut	25-30
	Bolt	45-55
With 61-Amp. Generator	Nut	25-35
	Bolt	45-55
With 62-Amp. Generator	Bolt	40-50
With 130-Amp. Generator	Bolt	40-50

*Tighten Pivot Bolts prior to tightening other mounting bolts.

Alternating Current Generating System

(INTEGRAL TYPE)

The integral (generator with solid state regulator built in) type alternating current generator is used as standard and optional equipment on vehicles shown in the Model Application Chart below:

Refer to "Model Application Chart" below and "Specifications" at end of this section. This section is divided into sub-sections shown in the Index following:

MODEL APPLICATION CHART

AMPERAGE	TRUCK SERIES	GENERATOR
STANDARD		
42-Amp.	- CE/ME-60	1100547
OPTIONAL		
42-Amp.	- CE-50(02-03)	1100547
61-Amp.	- CE-50; CE/ME-60	1100548
100-Amp.	- SE/SS-50	1117141

42- AND 61-AMP. GENERATING SYSTEM

GENERAL DESCRIPTION

The generator illustrated in figure 1, features a solid state regulator mounted inside the generator slip ring end frame. All regulator components are enclosed in a solid mold. This unit, along with the brush holder assembly, is attached to the slip ring end frame. The regulator voltage setting is not adjustable.

The generator rotor bearings contain a supply of lubricant sufficiently adequate to eliminate the need for periodic lubrication. Two brushes carry current through two slip rings to the field coil.

The stator windings are assembled on the inside of a laminated core that forms part of the generator frame. A rectifier bridge connected to the stator windings contains six diodes, and electrically changes the stator A.C. voltages to a D.C. voltage which appears at the generator output terminal. Generator field current is supplied through a diode trio connected to the stator windings. A capacitor, or condenser, mounted in the end frame protects the rectifier bridge and diode trio from high voltages, and suppresses radio noise.

OPERATING PRINCIPLES

A typical wiring diagram is illustrated in figure 2. The basic operating principles are explained as follows:

When ignition switch is closed, current from the battery flows through the resistor to generator No. 1 terminal, through resistor R1, diode D1, and the base-emitter of transistor TR1 to ground, then back to the battery. This turns on transistor TR1, and current flows through the generator field coil and TR1 back to the battery. The ignition resistor reduces total circuit resistance to provide higher field current for initial voltage build-up when the engine starts.

With generator operating, A.C. voltages are generated in the stator windings, and the stator supplies D.C. field current through the diode trio, the field, TR1, and then through the grounded diodes in the rectifier bridge back to the stator. The six diodes in the rectifier bridge change the stator A.C. voltages to a D.C. voltage which appears between ground and generator "BAT" terminal. As

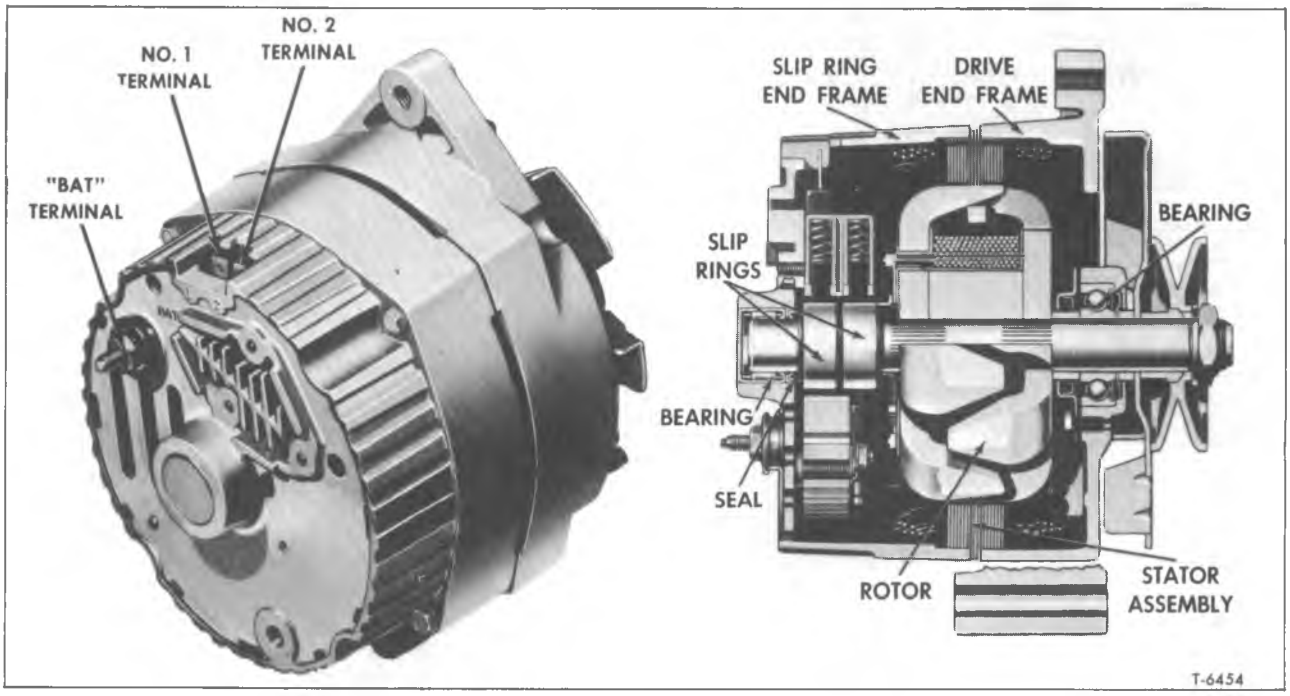


Figure 1—42- or 61-Amp. Integral Type Alternating Current Generator (Typical)

generator speed increases, current is provided for charging the battery and operating electrical accessories.

The No. 2 terminal on the generator is always connected to the battery, but the discharge current is limited to a negligible value by the high resistances of R2 and R3. As generator speed and voltage increase, the voltage between resistors R2 and R3 increases to the point where zener diode D2 conducts. Transistor TR2 then turns on and TR1 turns off. With TR1 off, field current and system voltage decrease, and D2 blocks current flow, causing TR1 to turn back on. The field current and system voltage increase. This cycle repeats many times per second to limit generator voltage to a pre-set value.

Capacitor C1 smooths out the voltage across R3, resistor R4 prevents excessive current through TR1 at high temperatures, and diode D3 prevents high induced voltages in the field windings when TR1 turns off.

GENERATING SYSTEM MAINTENANCE

Most charging system troubles show up as an undercharged or overcharged battery. Since the battery itself may be defective, it should be checked first to determine its condition. In the case of an undercharged battery, check for battery drain caused by ground or by accessories being left on.

At regular intervals, inspect generating system to locate and correct potential causes of trouble before generating system performance is affected.

1. Check generator drive belt tension and adjust if necessary. See procedure later under "Generator Drive Belt Tension Adjustment."
2. Check generator mounting and adjusting arm bolts and tighten as necessary.
3. Check all electrical connections for tightness and corrosion. Clean and tighten connections as necessary. Be sure wiring insulation is in good condition, and that all wiring is securely clipped to prevent chafing the insulation.
4. With engine running, listen for noise and check generator for vibration. If generator is noisy or vibrates excessively, it should be removed for inspection and repair.
5. Check battery electrolyte level and specific gravity. Replenish electrolyte level, as necessary.

PRECAUTIONS

Observe the following precautions when performing service operations on the alternating current generating system. Failure to observe these precautions may result in serious damage to the charging system.

NOTE: A basic wiring diagram showing lead connections is shown in figure 3.

1. Electrical system is NEGATIVE GROUND. Connecting the battery with positive terminal

A. C. GENERATING SYSTEM (INTEGRAL TYPE)

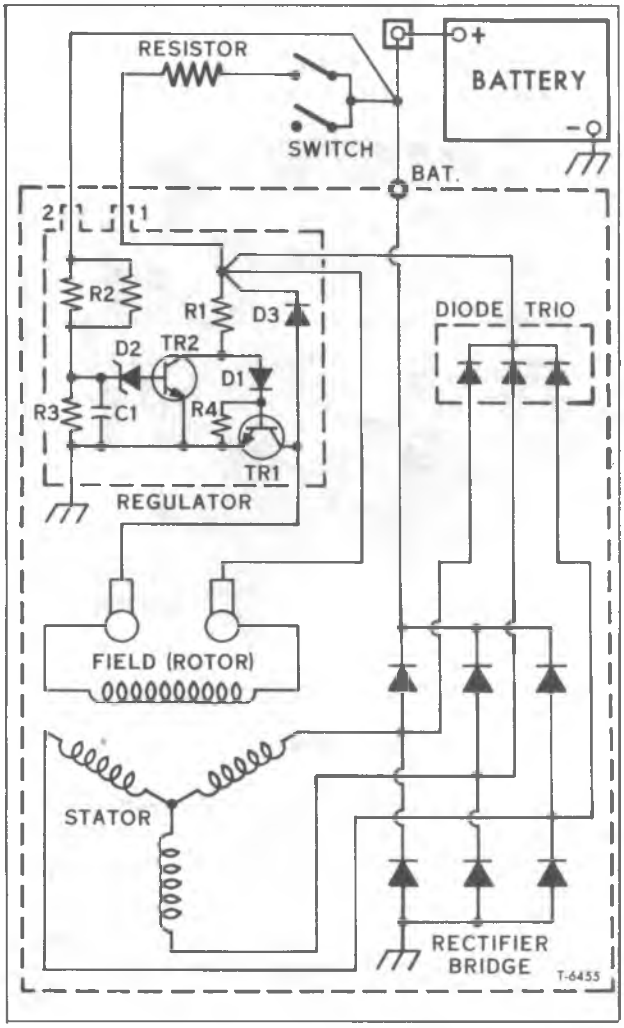


Figure 2—Schematic Diagram of 42- or 61-Amp. Integral Type Charging System (Typical)

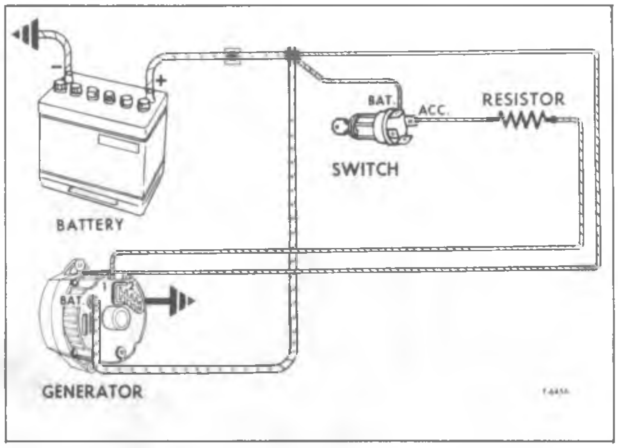


Figure 3—Typical Lead Connections (42- or 61-Amp. Integral Type Generator)

grounded will result in severe damage to generator, battery and battery cables.

2. DO NOT ground the field circuit at generator.

3. Never operate generator with open circuit, that is, with output wire disconnected from terminal and with field circuit externally energized. Be absolutely sure all connections in circuit are secure.

4. When using a booster battery, be sure to connect negative battery terminals together and positive terminals together.

5. Disconnect battery leads while charging batteries. Do not use a fast charger as a booster for starting the engine. When attaching battery charger leads to battery, connect charger positive lead to battery positive terminal and connect charger negative lead to battery negative terminal.

6. Do not short across or ground any of the terminals in the charging circuit.

7. Do not attempt to polarize the generator.

8. When working near generator or regulator, disconnect battery cable to prevent accidental grounding at generator terminals.

9. Always disconnect battery negative lead when replacing electrical system components. This eliminates accidental shorting at generator terminals where battery voltage is available.

10. Disconnect battery negative terminal before welding on vehicle, since a reverse current from the welder may damage generator diodes as well as other electrical components.

11. Never replace the special resistance wire in harness connected to the ignition switch unless it is of same material and of same length (approx. 60 inches long). Generating system will not function without this wire.

GENERATOR DRIVE BELT

TENSION ADJUSTMENT

Because of the higher inertia and load capacity of rotor used with A.C. generators, PROPER BELT TENSION MUST BE MAINTAINED.

All generators are pivot-base mounted with the belt tension adjustment arm at the top. Use a belt tension dial gauge to check tension on each individual belt. If tension is not within 80-90 lbs. (used belts) or 100-110 lbs. (new belts), loosen adjustment arm clamp bolt and move generator to obtain recommended tension.

> **CAUTION: When adjusting belt tension, apply pressure at center of generator, never against either end frame.**

NOTE: On a new vehicle, or after having installed new belts, check tension of belt(s) twice in first 200 miles of operation. When making adjustment, examine belt(s) and replace if necessary.

A loose or broken drive belt will affect operation of generator. A drive belt that is too tight will place too much strain on bearings.

IMPORTANT: When replacing dual drive belts, it is essential that entire set be replaced at same time. Belts are available in matched sets only.

GENERATING SYSTEM TROUBLE SYMPTOMS

Abnormal operation of the generating system is usually indicated by one or more of the following symptoms:

1. Battery undercharged (low specific gravity of electrolyte).
2. Battery using an excessive amount of water, indicating an extremely high charging rate.
3. Excessive generator noise or vibration.
4. Failure of indicator lamp to illuminate when ignition switch is turned on (engine not running).
5. Indicator lamp continues to glow with engine running.
6. Indicator lamp fails to go out when ignition or control switch is turned off.
7. Ammeter shows high charging rate with a fully charged battery.

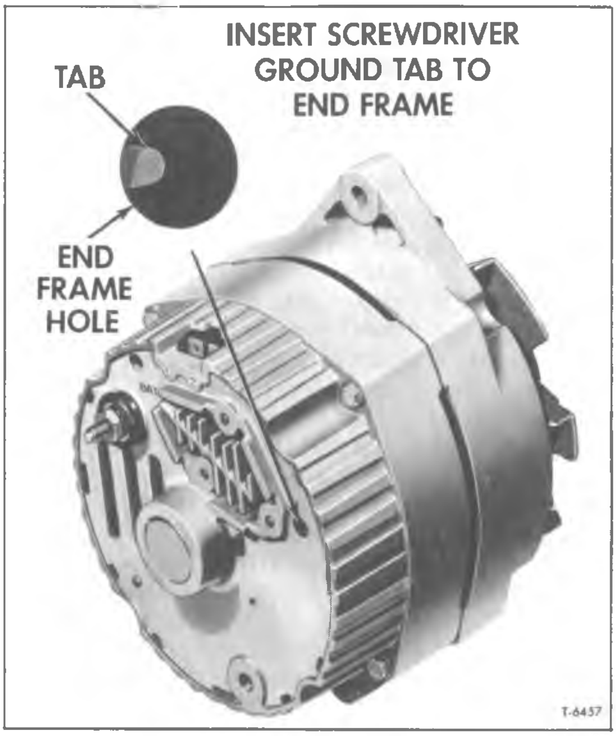


Figure 4—End View of 42- or 61-Amp. Integral Type Generator (Typical)

8. Ammeter shows low or no charge with a partially discharged battery.

GENERATOR ON-VEHICLE TESTS

The following is a list of the most common generator defects encountered:

1. Open or shorted generator diodes.
2. Open, shorted, or grounded stator winding.
3. Open, shorted, or grounded field winding.
4. Worn generator brushes.
5. Excessive generator noise.

Generator diodes and stator windings should be checked as explained under "Generator Output Test" later in this section. If a defect is indicated by this test, remove generator and repair.

Excessive generator noise is usually the result of one or more of the following:

1. Brush "squeal" caused by a hard spot on one of the brushes of rough or dirty slip rings. To check for brush "squeal," remove generator drive belt and spin generator drive pulley by hand. Lift brushes off slip rings and spin drive pulley again. If noise disappears, clean and inspect slip rings and replace brushes if worn.
2. Dry or rough bearings in end frame.

> **CAUTION: Dry or rough bearings may be the result of over-tightening generator drive belt(s), loose generator mountings, or an unbalanced generator fan or pulley.**

3. A defective diode or stator resulting in an electrical unbalance.

To check for a defective diode or stator, perform "Generator Output Test" explained later in this section. If a defect is indicated by this test, remove generator and repair.

STATIC CHECK

Before making any electrical checks, visually inspect all connections, including slip-on connectors, to make sure they are clean and tight. Inspect all wiring for cracked, frayed, or broken insulation. Be sure generator mounting bolts are tight and unit is properly grounded. Check for loose fan belt.

UNDERCHARGED BATTERY CONDITION CHECK

This condition, as evidenced by slow cranking and low specific gravity readings, can be caused by one or more of the following conditions even though the ammeter may be operating normally:

1. Insure that the undercharged condition has not been caused by accessories having been left on for extended periods.

A. C. GENERATING SYSTEM (INTEGRAL TYPE)

2. Check the drive belt for proper tension.
3. Check battery. Test is not valid unless battery is good and fully charged.
4. Inspect the wiring for defects. Check all connections for tightness and cleanliness, including the slip connectors at the generator and fire wall, and the cable clamps and battery posts.
5. With ignition switch on connect a voltmeter from generator "BAT" terminal to ground. A zero reading indicates an open between voltmeter connection and battery. Also, disconnect wiring har ness at generator No. 1 and No. 2 terminals, and connect voltmeter from No. 1 harness terminal to ground. A zero reading indicates an open between voltmeter connection and battery. Reconnect harness to No. 1 and No. 2 terminals.

NOTE: If previous Steps 1 through 5 check satisfactorily, check generator as follows:

6. Connect a voltmeter in the circuit at the "BAT" terminal of the generator.
7. Operate engine at moderate speed (approximately 1500-2000 rpm) and turn on electrical loads (high beam headlights, windshield wiper, heater or A/C blower, radio, etc.).

NOTE: Without sufficient electrical load to demand maximum generator output the following voltage check is invalid.

8. Observe voltmeter reading:

a. If reading is 12.8 volts or more, generator is not defective. Turn off electrical loads, stop engine and disconnect test equipment. Recheck Steps 1 through 5.

b. If reading is less than 12.8 volts, ground field winding by inserting a screwdriver into the test hole in the end frame (fig. 4).

CAUTION: TAB IS WITHIN ¾-INCH OF CASTING SURFACE. DO NOT FORCE SCREWDRIVER DEEPER THAN 1-INCH INTO END FRAME.

(1) If voltage increases (13 volts and above) regulator is defective and must be replaced. Repeat Steps 7 and 8 after new regulator unit has been installed.

(2) If voltage does not increase significantly, remove generator and repair.

9. Turn off electrical loads, shut off engine and disconnect all test equipment.

OVERCHARGED BATTERY CONDITION CHECK

1. Determine condition of battery. Test is not valid if battery is not good and fully charged.
2. Connect a voltmeter from generator No. 2 terminal to ground. If reading is zero, No. 2 lead circuit is open, which will cause an overcharged condition.

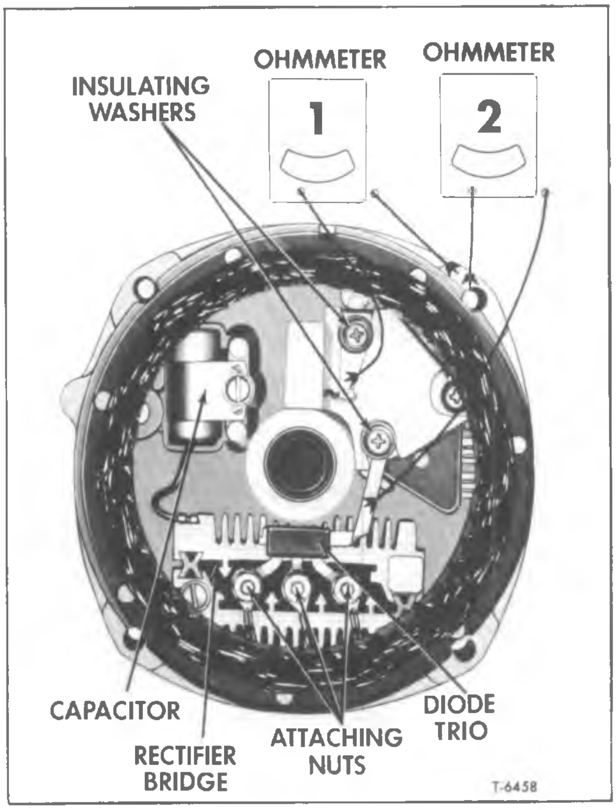


Figure 5—Slip Ring End Frame (42- or 61-Amp. Integral Type Generator)

3. If battery and No. 2 lead circuit check good, but an obvious overcharge condition exists as evidenced by excessive battery water usage, proceed as follows:

a. Remove the generator, then remove four through-bolts, and separate the drive end frame and rotor assembly from the stator assembly by prying apart with a screwdriver at the stator slot.

b. Connect ohmmeter using lowest range scale from brush lead clip to end frame as shown in Step 1 in figure 5, then reverse lead connections.

c. If both readings are zero, either the brush lead clip is grounded or regulator is defective.

d. A grounded brush lead clip can result from omission of insulating washer (fig. 5), omission of insulating sleeve over screw, or damaged insulating sleeve. Remove screw to inspect sleeve. If satisfactory, replace regulator.

e. Assemble generator, then check for rated output as explained later in this section.

GENERATOR OUTPUT TEST

To check the generator in a test stand, proceed as follows:

1. Make connections as shown in figure 6, except leave the carbon pile disconnected. Use a fully charged battery and a 10 ohm resistor rated

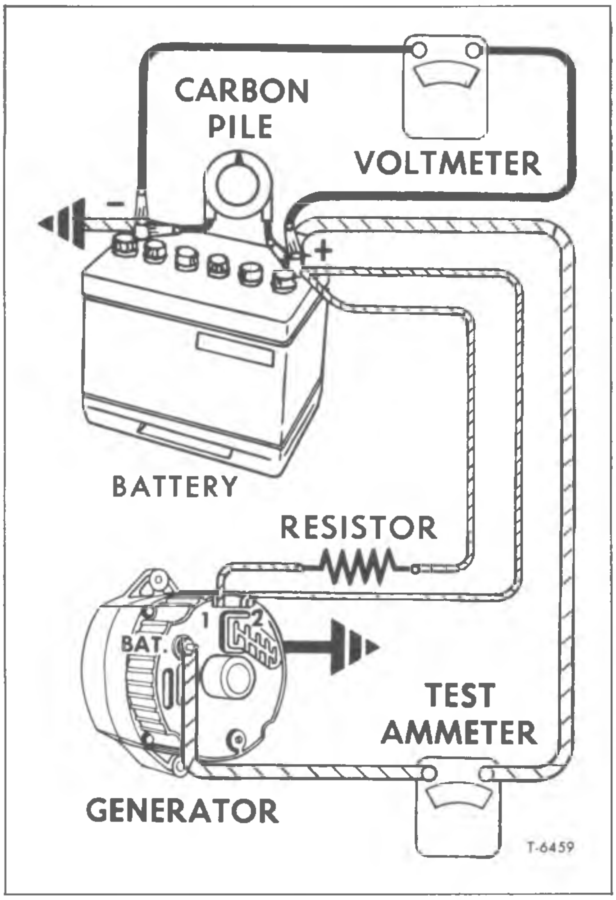


Figure 6—Connections for Testing Generator Output (42- and 61-Amp. Integral Type Generator)

at 6 watts or more between the generator No. 1 terminal and the battery.

NOTE: Battery must be fully charged when making this check. An undercharged battery would be charged during the test procedure, thus producing varied ammeter and voltmeter readings.

2. Slowly increase generator speed and observe the voltage.
3. If voltage is uncontrolled with speed and increases above 16 volts, check for a grounded brush lead clip as explained previously under "Overcharged Battery," Step 3. If not grounded, replace the regulator.
4. Connect the carbon pile as shown in figure 6.

5. Operate the generator at moderate speed as required and adjust carbon pile as required to obtain maximum current output.

6. If output is within ten per cent of rated output, as listed in "Specifications" at end of this section, generator is good.
7. If output is not within ten per cent of rated output, ground the generator field (fig. 4).

CAUTION: TAB IS WITHIN ¾-INCH OF CASTING SURFACE. DO NOT FORCE SCREWDRIVER DEEPER THAN 1-INCH INTO END FRAME.

8. Operate generator at moderate speed and adjust carbon pile as required to obtain maximum output.
9. If output is within ten per cent of rated output, replace the regulator (fig. 5).
10. If output is not within ten per cent of rated output, check the field winding, diode trio, rectifier bridge and stator as previously covered.

GENERATOR REPLACEMENT

Due to variations in design and equipment on vehicles using A.C. generators, the replacement procedures will vary accordingly. The removal and installation instructions following are intended only as a guide. Additional operations will be required on some vehicles to remove other equipment to permit access to generator, belts, and/or brackets.

REMOVAL

1. Disconnect negative cable from battery.
2. Depress lock on connector and pull connector out of socket on generator. Pull rubber boot off "BAT" terminal and remove terminal nut. Disconnect ground (GRD) terminal and remove wiring clip.
3. Loosen bolt in adjusting arm and mounting bracket. Move generator to loosen drive belt (or belts); remove belt(s) from generator pulley.
4. Remove the bolt attaching the generator to mounting bracket, remove adjusting arm bolt, then remove generator from engine.

INSTALLATION

1. Attach generator to mounting bracket and install adjusting arm. Tighten flange-type lock nuts securely.
2. Place drive belt(s) over generator drive pulley and adjust belt tension. Tighten mounting bolts and adjusting arm bolt when belt tension adjustment has been made. Refer to "Drive Belt Tension Adjustment" earlier in this section.
3. Push the wiring harness connector into the socket making sure the lock on the connector engages the end frame. Place harness clip on ground terminal marked "GRD" and connect the ground wire to terminal.
4. Attach red wire to "BAT" terminal on generator and fit boot on terminal.
5. Perform "Generator Output Test" described earlier in this section to determine if generator is operating properly and regulator is correctly adjusted.

A. C. GENERATING SYSTEM (INTEGRAL TYPE)

100-AMP. GENERATING SYSTEM

GENERAL DESCRIPTION

The basic charging system components include the battery, the self-rectifying, integral type alternating current generator having a built-in regulator, and interconnecting wiring. An ammeter or voltmeter type charge indicator is used on vehicles equipped with the integral type generating system.

The generator illustrated in figure 7, features a solid state regulator mounted inside the generator slip ring end frame. All regulator components are enclosed in a solid mold. This unit, along with the brush holder assembly, is attached to the slip ring end frame. The regulator voltage setting can be adjusted as explained later in this section.

Only one wire is required to connect generator to battery, along with an adequate ground return. An "R" terminal is provided to operate auxiliary equipment in some circuits.

The generator is air cooled by a fan attached to the drive end. The rotor bearings contain a supply of lubricant sufficiently adequate to eliminate the need for periodic lubrication.

The drive end frame bearing is sealed on both sides. Two brushes carry current through the two slip rings to the field coil mounted on the rotor shaft.

The stator is composed of a large number of windings assembled on the inside of a laminated core that forms a part of the generator frame. Two rectifier bridges connected to the stator windings each contain six diodes, and electrically change the stator A.C. voltages to a D.C. voltage which appears at the generator output terminal. Generator field current is supplied through a diode trio connected to the stator windings. A capacitor, or condenser, mounted in the end frame, protects the rectifier bridges and diode trio from high voltages and suppresses radio noise.

The output terminal is connected directly to the battery positive terminal.

A typical generating system used on vehicles equipped with the 100-amp, integral type alternating current generator is schematically illustrated in figure 8.

OPERATING PRINCIPLES

A typical diagram showing generator and regulator internal circuitry is shown in figure 8. As the rotor begins to turn, the residual magnetism therein induces voltages in the stator windings. Current then flows through the diode trio, resistor R1, and resistor R4, to turn transistor TR1 on. The stator then supplies D.C. field current through the diode trio, the field, TR1, and then through the grounded diodes in the rectifier bridges back to the stator. Diodes in the rectifier bridges change the stator A.C. voltages to a D.C. voltage which appears between the ground and battery "BAT" terminal. As speed increases, current is provided for charging the battery and operating electrical accessories.

As the speed and voltage increase, the voltage between R2 and R3 increases to the value where zener diode D1 conducts. Transistor TR2 then

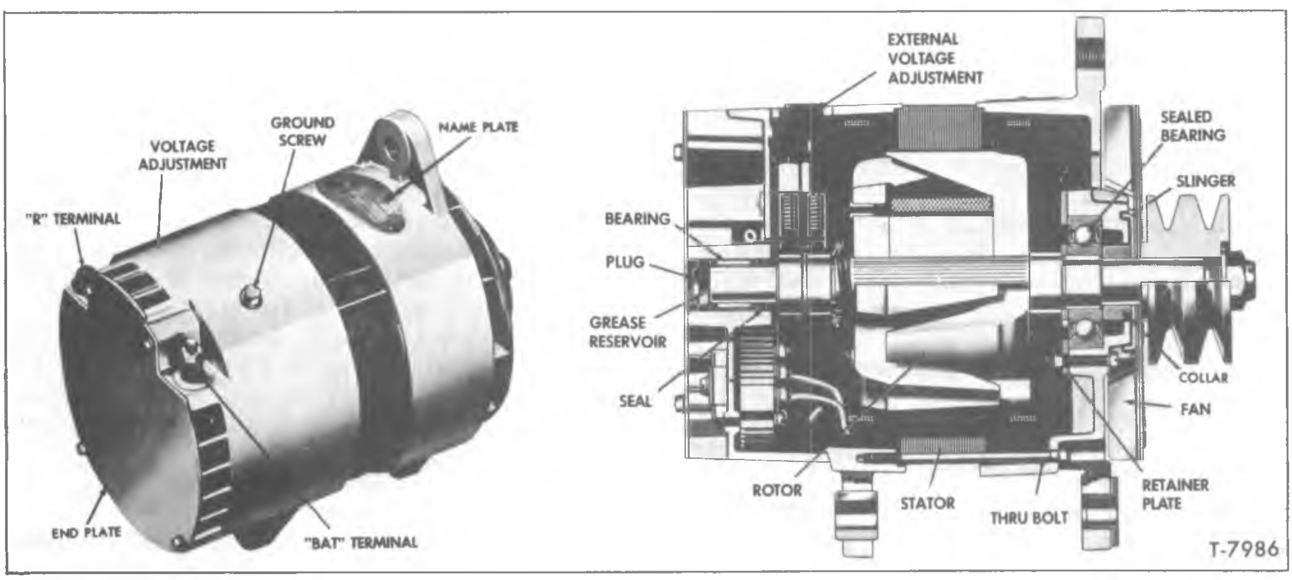


Figure 7—100-Amp. Integral Type Alternating Current Generator (Typical)

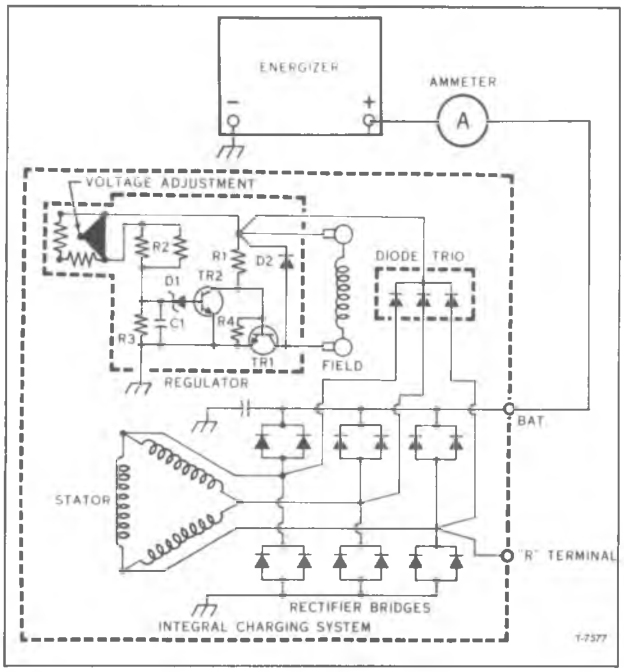


Figure 8—Schematic Diagram of 100-Amp. Integral Type Charging Circuit (Typical)

turns on and TR1 turns off. With TR1 off, the field current and system voltage decrease, and D1 then blocks current flow causing TR1 to turn back on. The field current and system voltage increase, and this cycle then repeats many times per second to limit voltage to the adjusted value.

Capacitor C1 smoothes out voltage across R3. Resistor R4 prevents excessive current through TR1 at high temperatures, and diode D2 prevents high-induced voltages in the field windings when TR1 turns off.

GENERATING SYSTEM MAINTENANCE

Most charging system troubles show up as an undercharged or overcharged battery. Since the battery may be defective, it should be checked first to determine its condition. In the case of an undercharged battery, check for battery drain caused by grounds or by accessories being left on.

IMPORTANT: Keep generator terminals and all other terminals in the electrical system clean and tight. A loose or corroded terminal will cause excessive resistance in system which will result in hard starting, dim lights, etc.

At regular intervals, inspect generating system to locate and correct potential causes of trouble before generating system performance is affected.

1. Check generator drive belt tension and adjust if necessary. Refer to procedure under "Generator Drive Belt Tension Adjustment," later.
2. Check generator mounting and adjusting arm bolts and tighten as necessary.
3. Check all electrical connections for tightness and corrosion. Clean and tighten connections as necessary. Be sure wiring insulation is in good condition and that all wiring is securely clipped to prevent chafing the insulation.
4. With engine running, listen for noise and check generator for vibration. If generator is noisy or vibrates excessively, it should be removed for inspection and repair.
5. Check battery electrolyte level and specific gravity. Replenish electrolyte level as necessary.

PRECAUTIONS

Observe the following precautions when performing service operations on the integral type alternating current generating system. Failure to observe these precautions may result in serious damage to the charging system.

1. Electrical system is negative ground. Connecting the battery or battery charger with positive terminal grounded will endanger generator diodes and vehicle wiring by high current flow. Burned wiring harnesses and burned "Open" diodes will result.
2. Never operate the generator on an open circuit (field terminal connected and output "BAT" terminal disconnected). With no battery or electrical load in the circuit (open circuit) the generator can build up excessively high voltage. Be sure all connections in the charging circuit are secure.
3. The generator cannot be polarized. Any attempt to polarize the generator may result in serious damage to charging system components.
4. Before replacing electrical system components, disconnect negative battery cable from the battery to prevent accidental shorting at generator terminals where battery voltage is available.
5. Do not short across or ground terminals on the generator.
6. When using a booster battery, be sure to connect negative battery terminals together and positive terminals together.
7. Disconnect battery leads while charging batteries. Do not use a fast charger as a booster for starting the engine. When attaching battery charger leads to the battery, connect charger positive leads to battery positive terminal and charger negative leads to battery negative terminal.

GENERATOR DRIVE BELT

Because of the higher inertia and load capacity of the rotor used with the A.C. generator, proper belt tension must be maintained.

A loose or broken drive belt will affect operation of the generator. A belt that is too tight will place excessive strain on bearings.

A. C. GENERATING SYSTEM (INTEGRAL TYPE)

IMPORTANT

When adjusting drive belt tension, apply pressure against center of generator, never against either end frame.

NOTE: On a new vehicle, or after having installed a new belt, check tension of belt twice in first 200 miles of operation. Before adjusting the drive belt, examine the belt and replace if frayed or worn.

The generator is pivot-base mounted with the belt tension adjustment arm at the top. Use a suitable belt tension dial gauge to check tension on each individual belt. If tension is not within 80-90 lbs. (used belts) or 100-110 lbs. (new belts), loosen adjustment arm clamp bolt and generator pivot bolts, then move generator to obtain recommended tension. Tighten clamp bolt and pivot bolts firmly.

GENERATING SYSTEM TROUBLE SYMPTOMS

Abnormal operation of the generating system is usually indicated by one or more of the following symptoms.

1. Battery undercharged (low specific gravity of electrolyte).
2. Battery using an excessive amount of water, indicating an extremely high charging rate.
3. Excessive generator noise or vibration.
4. Failure of indicator lamp to illuminate when ignition switch is turned on (engine not running).
5. Indicator lamp continues to glow with engine running.
6. Indicator lamp fails to go out when ignition or control switch is turned off.
7. Ammeter shows high charging rate with a fully charged battery.
8. Ammeter shows low or no charge with a partially discharged battery.

GENERATOR ON-VEHICLE TESTS

STATIC CHECK

Before performing any electrical checks, visually inspect all connections, including slip-on connectors, to make sure they are clean and tight. Inspect all wiring for cracked, frayed, or deteriorated insulation. Be sure generator mounting bolts are tight and that unit is properly grounded. Check generator drive belt for proper tension.

UNDERCHARGED BATTERY CONDITION CHECK

This condition, as evidenced by slow cranking and low specific gravity readings, can be covered by one or more of the following conditions even though the ammeter may be operating normally.

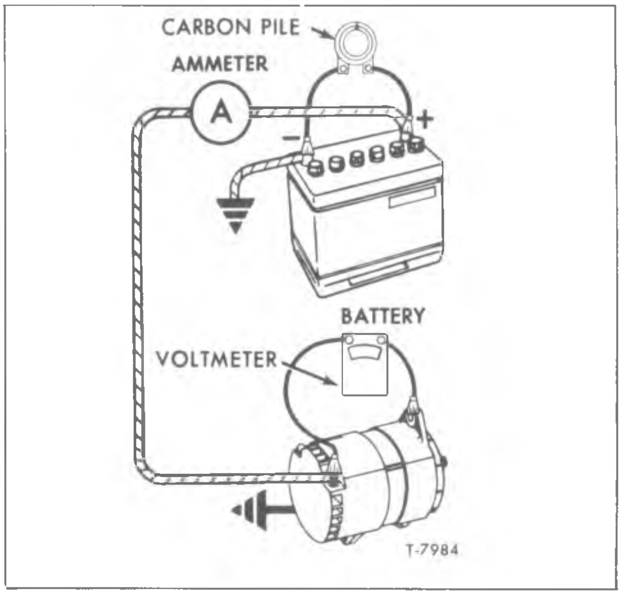


Figure 9—Connections for Testing 100-Amp. Integral Type Generator (Typical)

1. Insure that the undercharged condition has not been caused by accessories having been left on for extended periods.
2. Check the drive belt for proper tension.
3. Check battery. Test is not valid unless battery is good and fully charged.
4. Inspect wiring for defects. Check all connections for tightness and cleanliness, including cable clamps and battery posts.
5. Referring to figure 9, connect a voltmeter from generator "BAT" terminal to ground on generator. A zero reading indicates an open between voltmeter connection and battery.

NOTE: If previous Steps 1 through 5 check satisfactorily, check generator as follows:

6. Disconnect negative battery cable from the battery.
7. Connect an ammeter in circuit between battery positive (+) terminal and generator "BAT" terminal, then connect negative battery cable to battery.
8. Connect a carbon pile across the battery, then operate engine at moderate speed (approximately 1500-2000 rpm). Turn on vehicle accessories and adjust carbon pile as required to obtain maximum current output.

IMPORTANT: Initial voltage build-up is by residual magnetism in the rotor. Without sufficient electrical load to demand maximum generator output, the following check is invalid:

9. Observe ammeter reading:

a. If ampere output is within 10 per cent of rated output as listed in "Specifications" at end of

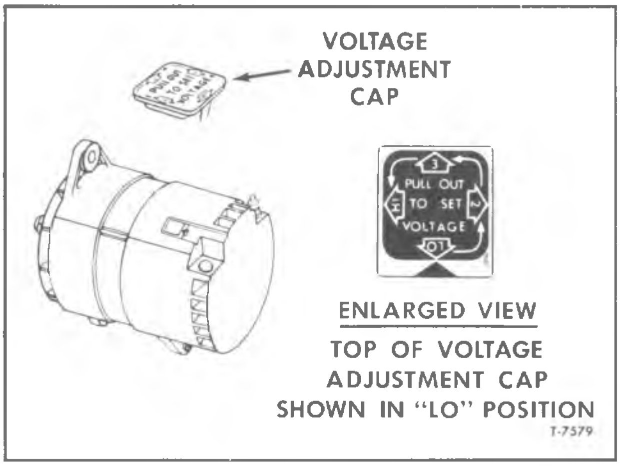


Figure 10—Voltage Adjustment Cap

this section, generator is not defective. Remove voltage adjustment cap from generator and raise the setting by rotating in increments of 90^{O}, and then insert the cap in the connector body. As illustrated in figure 10, the cap is set for low voltage. With position 2 aligned with arrow, the setting is increased to medium low, position 3 is medium high, and position "HI" is the highest regulator setting. After adjusting the setting, check for an improved battery condition after a service period of reasonable length.

b. If ampere output is not within 10 per cent of rated output as listed in "Specifications" at end of this section, record the maximum amperes that can be obtained for future reference, then remove generator and repair.

10. Turn off electrical loads, shut off engine and disconnect all test equipment.

OVERCHARGED BATTERY
CONDITION CHECK

1. Determine condition of battery. Test is not valid if battery is not good and fully charged.

NOTE: An overheated battery will be overcharged even though no charging circuit defects are present.

2. Connect a voltmeter between generator "BAT" terminal and ground.

3. With all accessories turned off, start engine and increase speed, as required, to obtain maximum voltage reading.

4. If voltage exceeds 15 volts, remove generator and repair.

5. If voltage does not exceed 15 volts, adjust voltage to a lower value by removing voltage adjusting cap, rotating in increments of 90^{O}, and then inserting the cap into the connector body. Check battery condition after a service period of reasonable length. The lowest setting is with "LO" aligned with the arrow, position 2 is medium low, position 3 is medium high, and "HI" is the highest setting.

NOTE· If an obvious overcharge condition exists as evidenced by excessive water usage, and if the battery is not overheated and not defective, remove the generator and repair.

GENERATOR OUTPUT TEST

To check generator in a test stand, proceed as follows:

1. Make connections as shown in figure 9.

NOTE: Leave carbon pile in "OFF" position or disconnected. Also, use a fully charged battery. An undercharged battery would become charged during the test procedure, resulting in varied ammeter and voltmeter readings until battery reaches a fully charged condition.

2. Operate generator at 4000 rpm or more, then adjust carbon pile as required to obtain maximum current output.

IMPORTANT: Initial voltage build-up is by residual magnetism in the rotor. Increase speed as required to obtain maximum current output.

3. If ampere output is within 10 per cent of limits listed in "Specifications" at end of this section, generator is not defective.

4. If ampere output is not within 10 per cent of limits listed in "Specifications," increase generator speed as required to obtain maximum voltage reading. Note position of voltage adjustment cap (fig. 10).

5. If voltage exceeds 15 volts with voltage adjusting cap in "LO" or any other position, generator must be disassembled and repaired.

6. If voltage does not exceed 15 volts, adjust voltage by removing the voltage adjustment cap, then repositioning cap (after rotating ¼-turn) in desired direction.

GENERATOR REPLACEMENT

Due to variations in design and equipment used, the replacement procedure will vary accordingly. The removal and installation instructions following are intended only as a guide. Additional operations may be required on some vehicles to remove additional equipment to gain access to generator, drive belt, and/or brackets.

GENERATOR REMOVAL

1. Disconnect negative battery cable from battery.

IMPORTANT: It is important that battery negative terminal be disconnected since generator will be damaged if wiring or terminals are accidentally shorted or grounded while being disconnected.

A. C. GENERATING SYSTEM (INTEGRAL TYPE)

2. Remove shield from generator drive pulley.
3. Remove nuts and washers from harness leads at generator terminals. Tag each wire to aid in identification, then remove leads from terminals.
4. Loosen adjusting arm clamp bolt and generator to mounting bracket pivot bolts. Move generator to loosen the drive belt, then remove belt from generator pulley.
5. Remove adjusting arm clamp bolt and generator to mounting bracket bolts, then remove generator from vehicle.

GENERATOR INSTALLATION

IMPORTANT: Be sure negative battery cable is disconnected from the battery. Failure to disconnect the battery cable may result in damage to the generator.

1. Position generator on mounting bracket and install generator to mounting bracket bolts and adjusting arm to generator clamp bolt and washers.
2. Place drive belt over generator drive pulley and adjust belt tension as explained under "Generator Drive Belt" previously. Tighten mounting bracket pivot bolts and adjustment arm clamp bolt securely.
3. Connect harness leads to respective terminals on generator. Install attaching nuts and washers.
4. Install protective shield over generator drive pulley, if removed.
5. Connect negative battery cable to battery, then perform "Generator Output Test" described previously to determine if generator is operating within specified limits.

INTEGRAL-TYPE ALTERNATING CURRENT GENERATING SYSTEM SPECIFICATIONS

GENERATOR MODEL	1100547	1100548	1117141
Make	Delco-Remy	Delco-Remy	Delco-Remy
Series	10SI	10SI	40SI
Type	100	100	150
Rotation (Viewing Drive End)	Clockwise	Clockwise	Clockwise
Field Current at 80° F.			
Amps	4.0-4.5	4.0-4.5	4.0-4.5
Volts	12	12	12
Cold Output			
Specified Volts	(b)	(b)	(b)
Amps	—	—	—
Generator RPM (Approx.)	—	—	—
Amps	37	55	110
Generator RPM (Approx.)	5000	5000	5000
Rated Hot Output (Amps) (a)	42	61	100

(a) Rated Hot Output at Maximum Operating Speed.
(b) Voltmeter not needed for Cold Output Check. Load Battery with a Carbon Pile to obtain Maximum Output.

SECTION 7

Transmissions and Clutches

Contents of this section are listed in Index below:

SECTION 7A

Transmission Control Linkage

Contents of this section are listed in Index below:

TILT CAB MODELS WITH MANUAL TRANSMISSION

LINKAGE ADJUSTMENT

NOTE: Key numbers in text refer to figure 1.

1. Place transmission selector and shift levers (9) in "NEUTRAL" position.

2. Adjust selector and shift rods (8) to provide 90-degree angularity at the lower end of the gearshift lever (1) to the control island panel (2) as shown.

NOTE: Adjustment of the selector and shift rods is accomplished by disconnecting the rods at the control island or transmission, depending on the location of the adjustable clevis (see Inset, fig. 1). Rotate the adjustable clevis on each rod to the desired position, then reconnect the rods to the control island or transmission. Tighten lock nuts firmly.

3. Check adjustment by moving gearshift lever through the shift pattern. There must be no binding in the linkage.

NOTE: At the extreme selector and shift movements, clevis pins should rotate freely. Readjust linkage, if necessary, to obtain these conditions.

4. Replace any worn or damaged cotter pins.

5. Lubricate control linkage as described in LUBRICATION (SEC. 0) of this manual.

CONTROL ISLAND SHIFT MECHANISM

On tilt cab models with manual transmission, if shift controls on control island become worn or damaged, make repairs as described in the following text:

REMOVAL

NOTE: Key numbers in following text refer to figure 2.

1. At the control island panel, disconnect shift rod (6) from shift finger (10). Also, disconnect selector rod (7) from selector finger (9).

2. Remove shift mechanism assembly-to-control island panel attaching parts and then remove assembly from vehicle.

3. Remove gearshift knob, boot retainer (1) and boot (2).

TRANSMISSON CONTROL LINKAGE

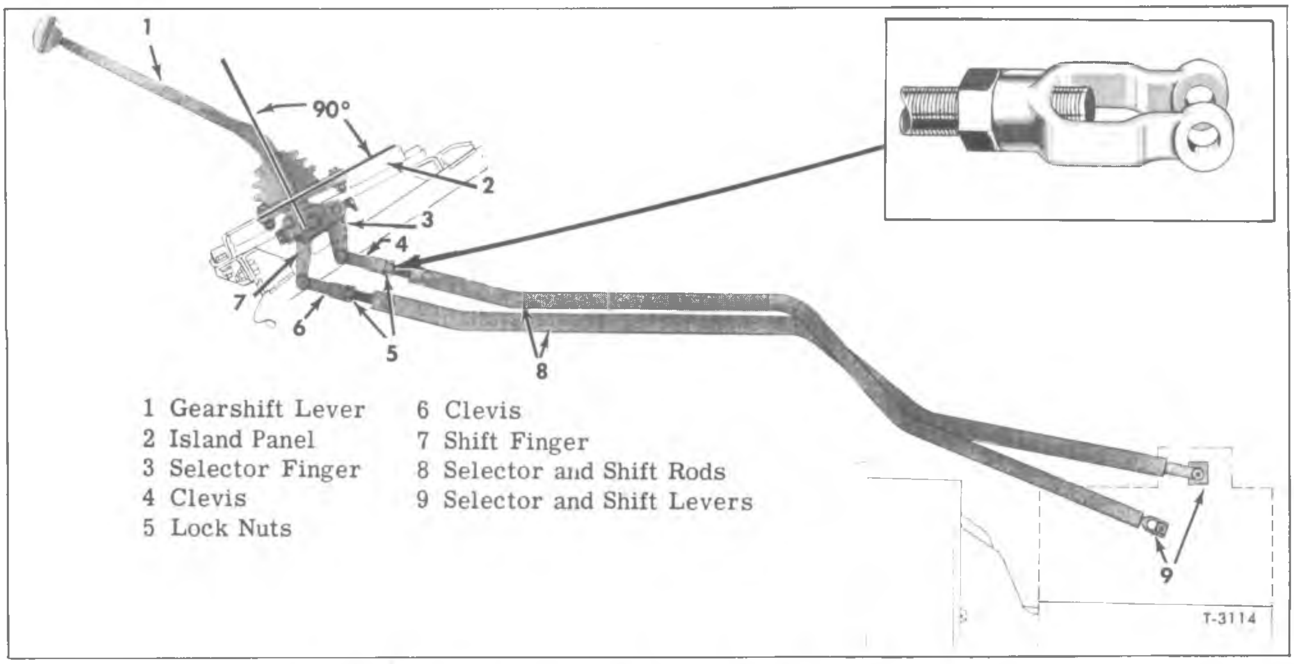


Figure 1—Manual Transmission Control Linkage (Tilt Cab) (Typical)

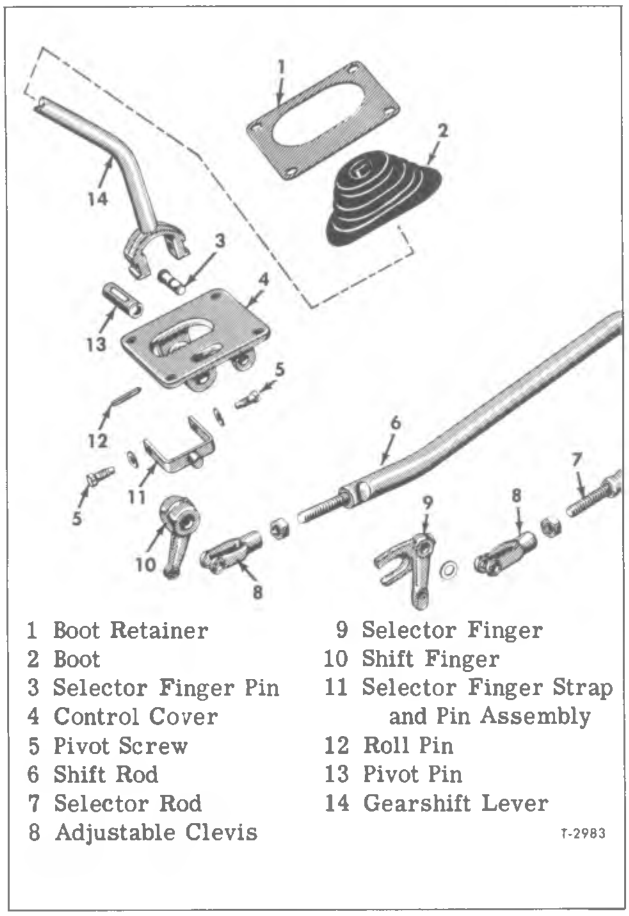


Figure 2—Control Island Shift Mechanism

DISASSEMBLY

NOTE: Key numbers in following text refer to figure 2.

1. Remove cotter pin and washer from selector finger pin (3), then remove selector finger (9).
2. Remove lockwires from pivot screws (5), then remove pivot screws, washers, and selector finger strap and pin assembly (11).
3. Remove gearshift lever (14).
4. Using hammer and punch, remove roll pin (12), pivot pin (13), and then remove shift finger (10) from control cover (4).

CLEANING AND INSPECTION

1. Clean all parts thoroughly in cleaning solvent. Wipe or blow parts dry.
2. Check all parts for wear, distortion, cracks, or other damage.
3. Replace all parts that would affect proper selection of transmission gears.

ASSEMBLY

NOTE: Key numbers in following text refer to figure 2.

1. Place gearshift lever on shift lever finger (10) and position in control cover. Install pivot pin (13) and roll pin (12).
2. Install selector finger strap and pin assembly (11), washers and two pivot screws (5). Torque screws to 60-65 foot-pounds and install new lockwires to pivot screws.
3. Install selector finger pin (3), selector finger (9), washer and new cotter pin.

INSTALLATION

NOTE: Key numbers in text refer to figure 2.

1. Install boot (2), boot retainer (1) and gearshift knob to shift mechanism assembly.

2. Place shift assembly in proper position on control island and install attaching parts.

3. Connect shift control linkage to selector finger (9) and shift finger (10), then adjust control linkage as covered previously under "Linkage Adjustment" procedures.

REMOTE CONTROL ASSEMBLY (AT TRANSMISSION)

Tilt cab vehicles with manual transmissions have remote control assemblies as shown in figures 4, 5, 6, and 8. Should parts become worn or defective make repairs as described in the following text:

REMOVAL

1. Position transmission gearshift lever in "NEUTRAL" and disconnect shift control rods from shift levers at transmission.

2. Disconnect electrical connector from back-up light switch.

NOTE: On models equipped with New Process transmission, remove selector lever bellcrank snap ring.

IMPORTANT: On models equipped with Spicer transmission, remove the retainer, plunger pin spring, and plunger pin as shown in figure 3. Keep the remote control assembly slightly tilted to the left, as shown, to prevent the plunger from falling into the transmission during removal.

3. Remove remote control assembly-to-transmission attaching parts, then carefully remove assembly and gasket from vehicle.

4. Place a clean lint-free cloth over the transmission opening to prevent entry of dirt or other foreign material.

INSTALLATION

1. Position a new gasket on transmission cover.

IMPORTANT: On models equipped with Spicer transmissions, keep the remote control assembly slightly tilted to the left during installation as shown in figure 3, to prevent the plunger from falling into the transmission.

2. With all parts in neutral position, carefully place the remote control assembly on the transmission cover.

3. Install remote control assembly-to-transmission attaching parts. Tighten bolts securely.

NOTE: On models equipped with New Process transmissions, install selector lever bellcrank snap ring which retains bellcrank to transmission cover.

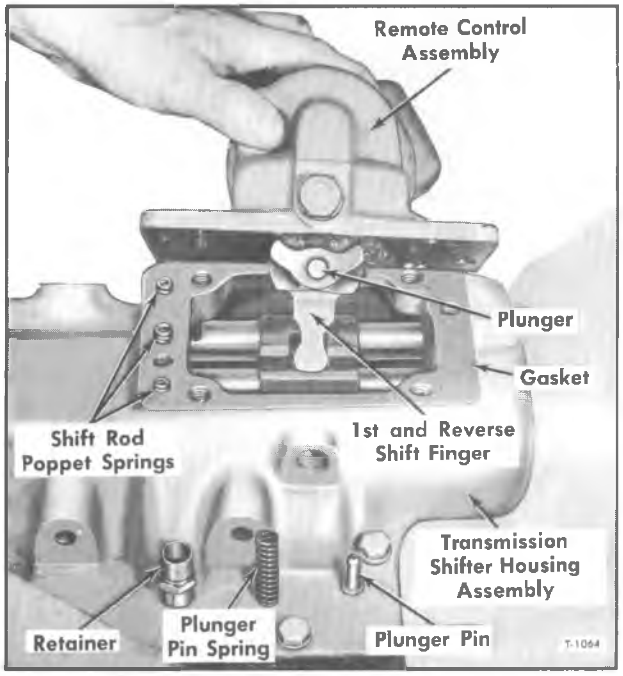


Figure 3—Removing Spicer Remote Control Assembly

4. Reconnect shift control rods to the shift levers on the transmission remote control assembly.

5. Adjust transmission shift control linkage as described previously under "Linkage Adjustment."

NEW PROCESS 435 - REMOTE CONTROL ASSEMBLY

Disassembly

NOTE: Key numbers in text refer to figure 4.

1. Using a hammer and punch, remove roll pin (14) from remote control shift rail (2). Remove shift rail yoke (9) and rail selector (12) from shift rail (2).

2. Remove rubber shift rail boot (8).

3. Using snap ring pliers, remove snap ring (19) from shift rail (2).

4. Loosen lock nut (6), then remove shift yoke guide (7) from remote control cover (5).

5. Using hammer and punch, remove roll pin (22) which retains shift finger (21) to shift rail (2).

6. Drive shift rail (2) forward out of cover (5) forcing out expansion plug (1).

7. Remove all attaching parts retaining rail selector (12) and bellcrank (17) to ball joint assembly (13). Remove rail selector and bellcrank from ball joint assembly.

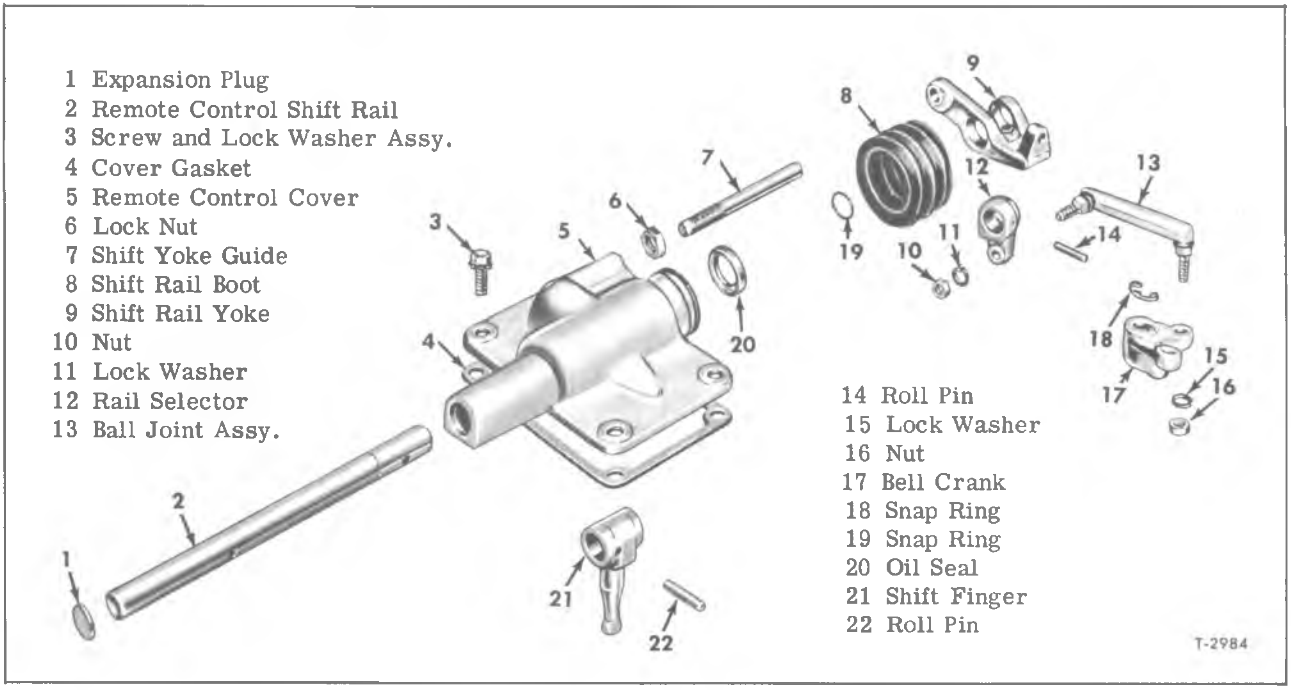


Figure 4—Remote Control Assembly (New Process 435)

Cleaning and Inspection

1. Clean all metal parts thoroughly in cleaning solvent. Wipe or blow parts dry.
2. Check all parts for wear, distortion, cracks or other damage.
3. Replace all parts that would affect proper selection of transmission gears.

Bushing Replacement

1. Press or drive shift rail yoke housing out of bore in shift rail yoke (9, fig. 4).
2. Using a suitable sleeve, press or drive new bushing into bore of shift yoke.

Oil Seal Replacement

1. Press or drive oil seal (20, fig. 4) out of remote control cover.
2. With a suitable sleeve, press or drive new oil seal into bore of cover.

NOTE: Coat outer diameter of oil seal with a light coat of sealing cement prior to installation.

Assembly

NOTE: Key numbers in text refer to figure 4.

1. Insert shift rail (2) part way into remote control cover (5), with flat on rail toward gasket face.
2. Position shift finger (21) on shift rail (2) with off-center hole to the front. Push shift rail the remaining distance into cover.
3. Install roll pin (22) to retain shift finger (21) on shift rail (2).
4. With lock nut (6) installed on shift yoke guide (7), install guide in cover (5). Tighten lock nut firmly.
5. Install snap ring (19) in groove of rail (2).
6. Install shift rail boot (8) on shift rail (2).
7. Position shift rail yoke (9) and rail selector (12), with offset toward front, on yoke guide (7) and shift rail.
8. Install roll pin (14) into holes in rail selector (12) and shift rail (2).
9. Install ball joint assembly (13) on rail selector (12), then install bellcrank (17) on ball joint assembly (13).
10. Install expansion plug (1) in shift rail opening in remote control cover (5).

NEW PROCESS 540 OR 542
- REMOTE CONTROL ASSEMBLY

Disassembly

NOTE: Key numbers in text refer to figure 5.

1. Remove attaching parts retaining selector lever (15) and selector lever bellcrank (6) to selector lever link assembly (16), then remove bellcrank and link assembly.
2. Using a hammer and punch, remove roll pin (12) attaching selector lever (15) to shift rail (2). Remove shift rail yoke (10) and selector lever (15) from shift rail.
3. Using an Easy-Out, remove roll pin (19), attaching shift finger (18) to shift rail.

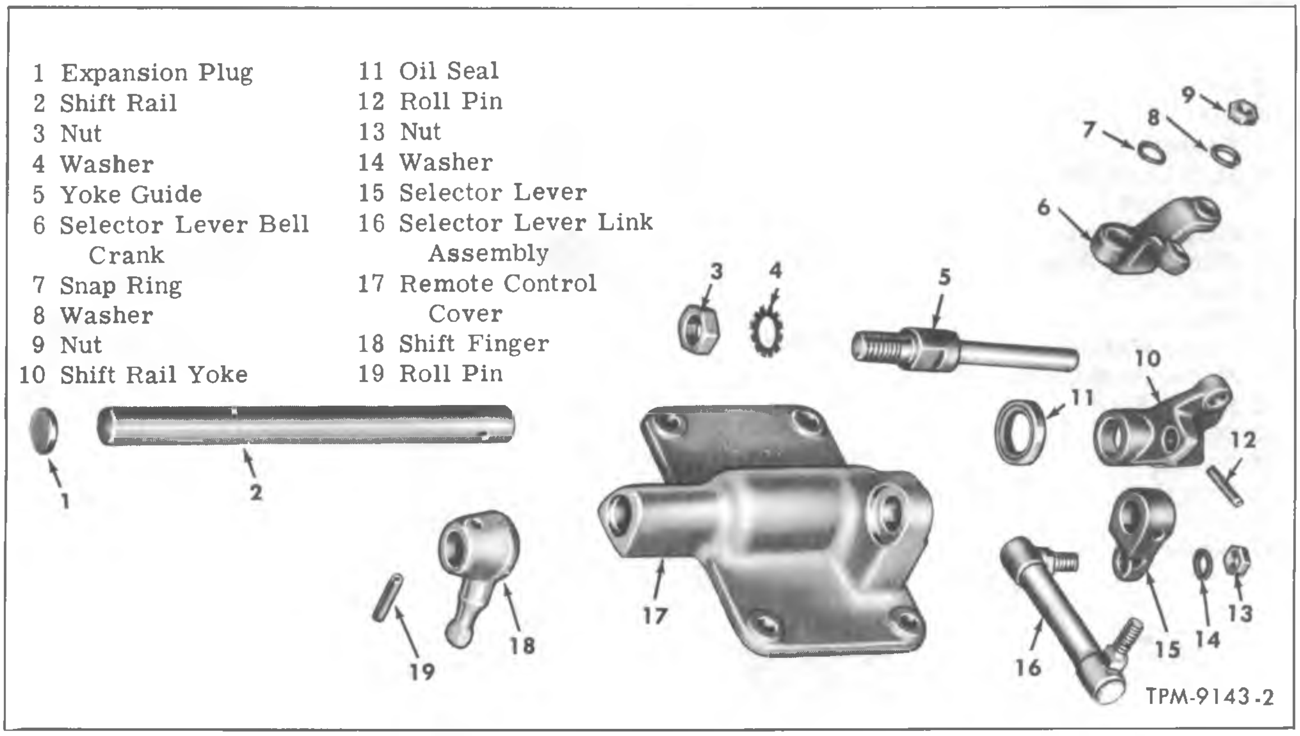


Figure 5—Remote Control Assembly (New Process 540 or 542)

4. Remove shift rail (2) from remote control cover (17).

5. Remove yoke guide (5) from cover (17).

Cleaning and Inspection

1. Clean all metal parts thoroughly in cleaning solvent. Wipe or blow parts dry.

2. Check all parts for wear, cracks, distortion, or other damage.

3. Replace all parts that would affect proper selection of transmission gears.

Bushing Replacement

1. Press or drive shift rail yoke bushing out of bore in shift rail yoke (10, fig. 5).

2. Using a suitable sleeve, press or drive new bushing into bore of shift yoke.

Oil Seal Replacement

1. Press or pry oil seal (11, fig. 5) out of remote control cover.

2. Using a suitable sleeve, press or drive new oil seal into bore of cover.

NOTE: Coat outer diameter of oil seal with a coat of sealing cement prior to installation.

Assembly

NOTE: Key numbers in text refer to figure 5.

1. Insert shift rail (2) part way into remote control cover (17).

2. Position shift finger (18) on shift rail with offset to the front. Push shift rail the remaining distance into cover.

3. Install roll pin (19) to retain shift finger in proper position on shift rail.

4. Position yoke guide (5) in offset of remote control cover (17). Install washer (4) and nut (3) on shift yoke guide.

5. Position shift rail yoke (10) and selector lever (15), with offset toward front, on shift rail (2).

NOTE: Be sure shift rail yoke engages both the shift rail and yoke guide (5). With parts properly aligned install roll pin (12) through selector lever (15) and shift rail (2).

6. Install washer (14) and nut (13) retaining selector lever link assembly (16) to selector lever (15).

7. Install washer (8) and nut (9) retaining selector lever bellcrank (6) to selector lever link assembly (16).

8. Install expansion plug (1), if removed in shift rail opening in remote control cover (17).

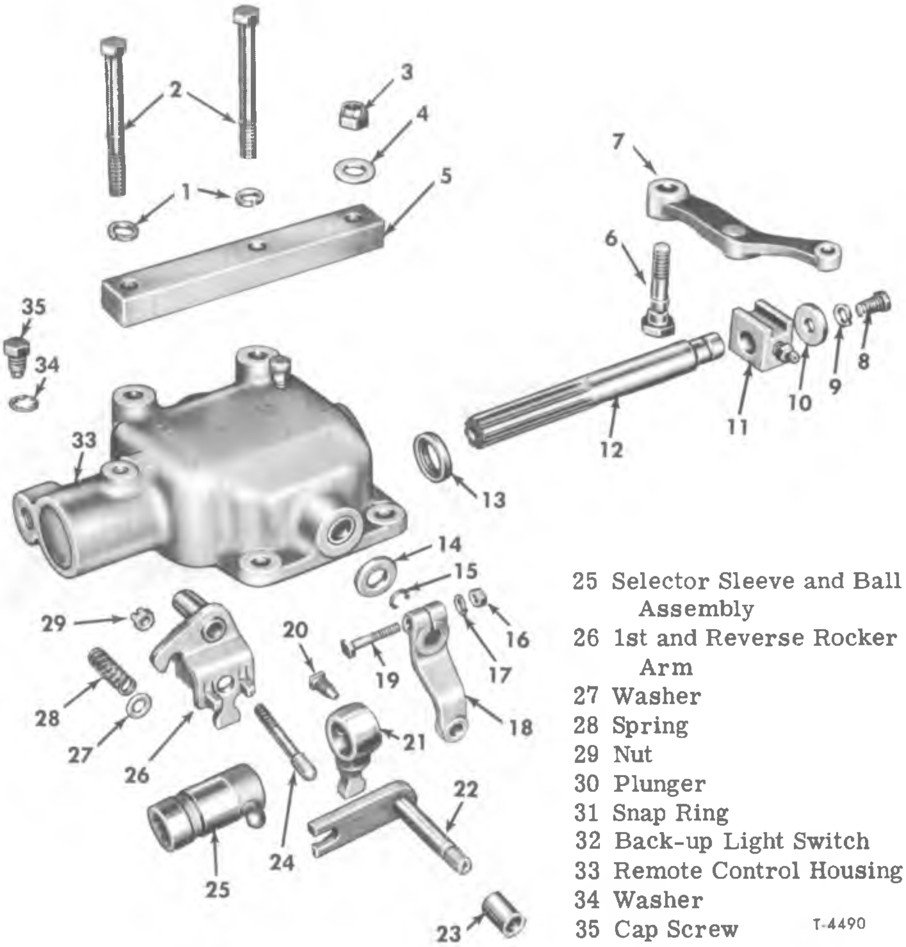
CLARK 282V AND 285V -
REMOTE CONTROL ASSEMBLY

Disassembly

NOTE: Key numbers in text refer to figure 6.

1. Remove lock wire and shift finger screw

1 Washers
2 Bolts
3 Nut
4 Washer
5 Shift Lever Mounting Bracket
6 Shift Lever Pivot Bolt
7 Shift Lever Assembly
8 Bolt
9 Washer
10 Collar Washer
11 Shifter Shaft Collar
12 Shifter Shaft
13 Oil Seal
14 Washer
15 Snap Ring
16 Nut
17 Washer
18 Selector Lever
19 Bolt
20 Shift Finger Screws
21 Shift Finger
22 Selector Arm and Shaft Assembly
23 Spacer
24 Reverse Latch Plunger



25 Selector Sleeve and Ball Assembly
26 1st and Reverse Rocker Arm
27 Washer
28 Spring
29 Nut
30 Plunger
31 Snap Ring
32 Back-up Light Switch
33 Remote Control Housing
34 Washer
35 Cap Screw

Figure 6—Remote Control Assembly (Clark 282V or 285V)

(20), then remove shifter shaft (12) and shift finger (21) from remote control housing (33).

2. Remove attaching parts holding shifter shaft collar (11) to shifter shaft (12), then remove shifter shaft collar.

3. Remove 1st and reverse rocker arm (26) from housing. Remove cotter pin from nut (29), then remove nut (29) from reverse latch plunger (24) releasing spring (28), washer (27) and plunger (24).

4. Loosen nut (16) and remove selector lever (18).

5. Remove snap ring (15) and washer (14) from selector arm and shaft assembly (22).

6. Remove cap screw (35) and washer (34) from housing.

7. Rotate selector sleeve and ball assembly (25) away from selector arm and shaft assembly (22), then remove selector sleeve and ball assembly from housing.

8. Remove selector arm and shaft assembly (22) and spacer (23) from housing.

9. Remove attaching parts that retain shift lever assembly (7) to shift lever mounting bracket (5), then remove shift lever assembly.

10. Remove attaching parts that retain shift lever mounting bracket (5) to housing, then remove shift lever mounting bracket.

Cleaning and Inspection

1. Clean all metal parts thoroughly in cleaning solvent.

2. Check all parts for wear, distortion, cracks or other damage.

3. Replace all parts that would affect proper selection of transmission gears.

Oil Seal Replacement

1. Press or pry oil seals out of remote control housing.

2. Using a suitable sleeve, press or drive new oil seal into bore of housing.

NOTE: Coat the outer diameter of the oil seal with a light coat of sealing cement prior to installation.

Assembly

NOTE: Key numbers in text refer to figure 6.

1. Position selector sleeve and ball assembly (25) in remote control housing (33), then install washer (34) and cap screw (35). Tighten screw firmly.

2. Position selector arm and shaft assembly (22) and spacer (23) in housing, then install washer (14) and snap ring (15).

3. Assemble reverse latch plunger (24), washer (27), spring (28), and nut (29) to 1st and reverse rocker arm (26).

4. Adjust reverse latch plunger so rounded end is flush or slightly below the two flat ends of the 1st and reverse rocker arm as shown in figure 7. Secure adjusting nut in proper position with a cotter pin.

5. Position shift finger (21) in housing (33); then install shifter shaft (12) in housing, aligning splines of shifter shaft with splines of selector sleeve and ball assembly (25), and hole in shifter shaft with hole in shift finger (21).

6. Install shift finger screw (20). Tighten screw to 25 foot-pounds torque and secure with lock wire.

7. Install attaching parts that retain shifter shaft collar (11) to shifter shaft (12).

8. Install attaching parts that hold shift lever assembly (7) to shift lever mounting bracket (5). Tighten nut to 25-31 foot-pounds torque.

9. Install attaching parts that hold shift lever mounting bracket (5) to housing (33). Be sure shift lever assembly (7) is properly seated in slot of shifter shaft collar (11).

10. Position selector lever (18) on selector arm and shaft assembly (22), so that the selector lever is perpendicular to the gasket side of the housing (33). Tighten nut (16) firmly.

SPICER REMOTE CONTROL ASSEMBLY (USED ON SPICER 5752C)

Disassembly

NOTE: Key numbers in text refer to figure 8.

1. It is important to mark location of shift lever (16) in relation to shift finger shaft (15) to facilitate assembly. Loosen clamp bolt on shift lever, then remove shift lever and thrust washer (14).

2. Remove selection lever (11) from selection cam and stud assembly (6).

3. Through opening in bottom of control housing (3), remove lock wire and shift finger screw (21) from shift finger (4).

4. Remove attaching parts that hold end cover (19) to control housing (3).

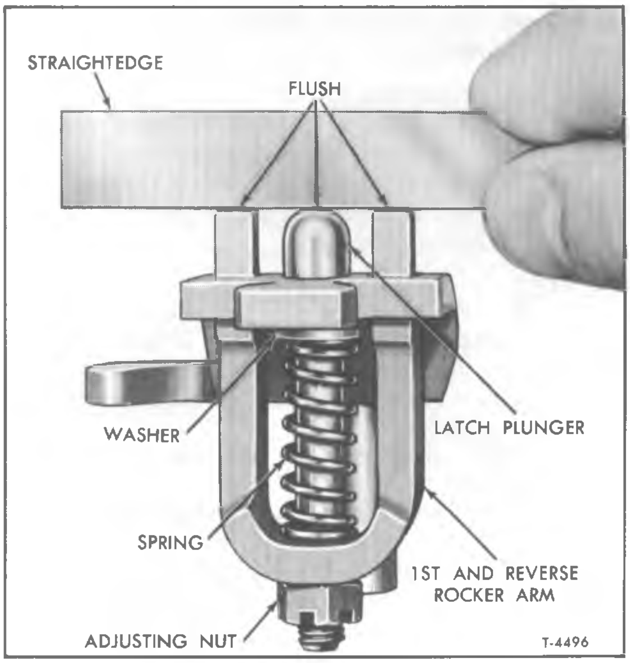


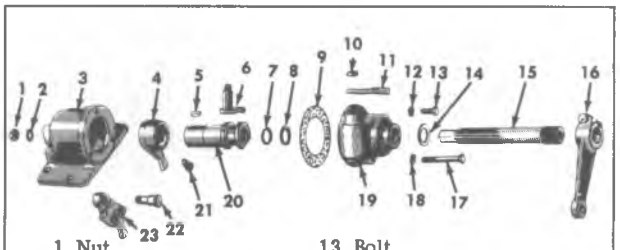
Figure 7—Reverse Latch Plunger Adjustment

5. Remove shift finger shaft (15) and end cover (19) from control housing (3). Remove shift finger (4) from control housing.

6. Rotate selection lever shaft (20) 180 degrees, then remove selection lever shaft from shift finger shaft (15).

7. Remove shift finger shaft (15) and selection cam and stud assembly (6) from end cover (19).

8. Remove attaching parts holding reverse



1 Nut
2 Lock Washer
3 Control Housing
4 Shift Finger
5 Shift Finger Key
6 Selection Cam and Stud Assembly
7 Snap Ring
8 Thrust Washer
9 Gasket
10 Nut
11 Selection Lever
12 Washer
13 Bolt
14 Thrust Washer
15 Shift Finger Shaft
16 Shift Lever
17 Bolt
18 Washer
19 End Cover
20 Selection Lever Shaft
21 Shift Finger Screw
22 Reverse Shift Finger Stud
23 Reverse Shift Finger

T-2985

Figure 8—Remote Control Assembly (Spicer Transmission)

TRANSMISSON CONTROL LINKAGE

shift finger (23) to control housing (3), then remove reverse shift finger.

Cleaning and Inspection

1. Clean all parts thoroughly with suitable cleaning solvent. Wipe or blow parts dry.

2. Examine all parts for scoring, cracks, or other damage. Discard all parts that are not in good condition.

Assembly

NOTE: Key numbers in text refer to figure 8.

1. Install reverse shift (23) in control housing (3). Tighten attaching nut firmly.

2. Install selection cam and stud assembly (6) into end cover (19).

3. Install snap ring (7) and thrust washer (8) on shift finger shaft into end cover.

4. Install shift finger key (5) on selection lever shaft (20).

5. Slide selection lever shaft (20) onto shift finger shaft (15). Rotate selection lever shaft until selection cam and stud assembly (6) properly engages selection lever shaft. Then rotate selection lever shaft 180 degrees so that the shift finger key (5) is pointing upward as shown.

6. Position new gasket (9) on control housing (3).

7. Position shift finger (4) in control housing (3), then while inserting the end cover (19) with shafts into control housing, install shift finger (4) on selection lever shaft (20).

NOTE: Be sure the shift finger (4) is installed on the shaft with the longer boss facing the end cover as shown.

8. Install end cover (19) to control housing (3). Tighten attaching bolts firmly.

9. Install shift finger screw (21) and new lock wire to shift finger (4).

10. Position selection lever (11) on selection cam and stud assembly (6), so that selection lever is parallel to the shift finger shaft (15). Tighten attaching nut firmly.

11. Align marks on shift lever (16) and shift finger shaft (15). Tighten clamp bolt firmly.

TRUCK MODELS WITH ALLISON MT40 AUTOMATIC TRANSMISSIONS

LINKAGE ADJUSTMENTS

Prior to making any checks or adjustments of transmission manual and throttle control linkage, check performance of the engine. The transmission is often blamed for poor operation of the vehicle when the engine is not tuned to deliver peak power. Refer to GASOLINE ENGINES (SEC. 6A) or GMC DIESEL ENGINE (SEC. 6B) in this manual for recommended tune-up procedures. It should be kept

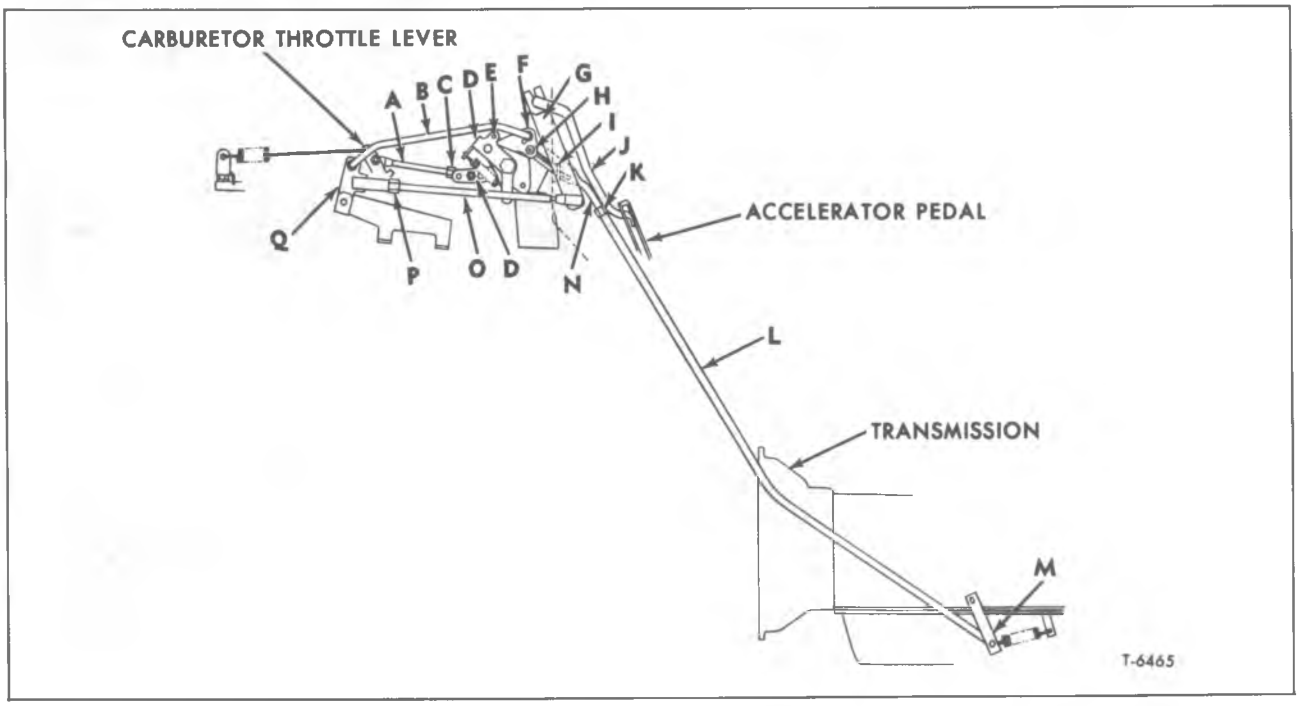


Figure 9—Accelerator and TV Linkage

in mind, that to assure efficient performance of power plant, the transmission should be as carefully balanced with the engine as are fuel and ignition systems.

The transmission control linkage must be checked and properly adjusted whenever any of the following events occur:

1. At time of "New Vehicle Inspection," after final engine idle adjustments have been made.
2. After any transmission control linkage has been removed or replaced.
3. After transmission has been removed and reinstalled in vehicle.
4. When the transmission is not performing properly.

WARNING

DO NOT START ENGINE WITH SHIFT LINKAGE DISCONNECTED, AS SERIOUS INJURY COULD RESULT TO VEHICLE OR PERSONNEL.

ACCELERATOR AND TV LINKAGE

The TV (throttle valve) linkage must be properly adjusted so that engine and transmission, as a matched pair, can give maximum performance. If transmission TV linkage is incorrectly adjusted, the engine may not operate at full governed rpm, or the transmission upshift and downshift points may be incorrect.

The TV linkage should be adjusted so that transmission upshift occurs at approximately 50 rpm below engine governed speed during full load operation.

A detent position is incorporated in the TV linkage to provide additional control of transmission shifts. DETENT, referred to as "full throttle" is the point of full fuel control opening where accelerator pedal resistance is felt. THRU-DETENT is accomplished by depressing pedal through pedal resistance until it bottoms. If the DETENT shift points are correct, but the THRU-DETENT shift points are not correct, the TV mechanism in the transmission may be sticking. The THRU-DETENT position should not allow transmission to upshift and should allow downshifts at the highest rpm possible.

CAUTION: TRANSMISSION SHOULD NOT BE OPERATED IF THROTTLE LINKAGE IS NOT ADJUSTED CORRECTLY BECAUSE INSUFFICIENT TV PRESSURE COULD CAUSE REDUCTION OF MAIN PRESSURE, WHICH IN TURN, MIGHT RESULT IN CLUTCH SLIPPAGE AND TRANSMISSION FAILURE.

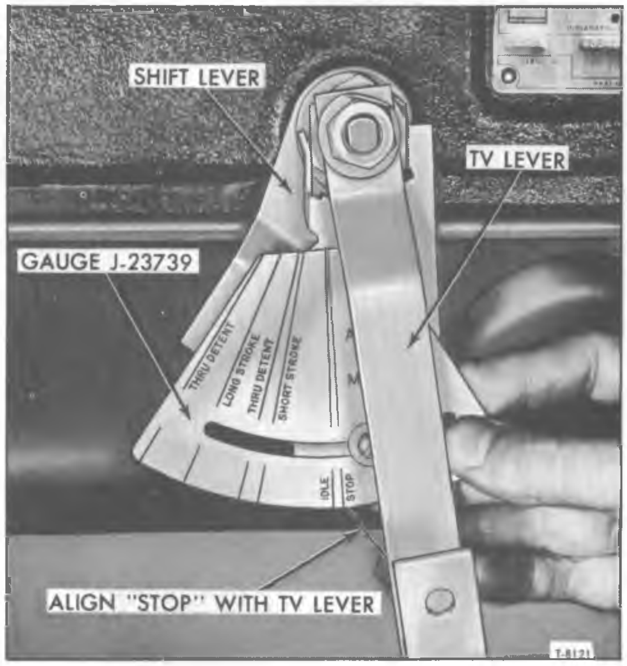


Figure 10—Installing TV Linkage Adjustment Gauge

TV Linkage Adjustment - ME60

IMPORTANT: Be sure engine idle and governed speed are properly adjusted before proceeding. Refer to ENGINE FUEL SYSTEM (SEC. 6M) for adjustments.

1. Apply parking brake and block vehicle's driving wheels.
2. To facilitate installation of TV Linkage Adjustment Gauge (J-23739), disconnect manual selector linkage at transmission by removing clevis pin from shift lever (F, fig. 15).
3. Disconnect TV rod (L, fig. 9) from transmission TV lever. Also disconnect TV lever return spring from TV lever.
4. Referring to figure 9, perform the following:

a. Insert a ¼-inch diameter pin through hole (E) and into alignment slot of lever (F). With carburetor throttle lever held in "IDLE" position by the throttle return spring, adjust length of rod assembly (A) to provide free-entry into lever (D). Secure length of rod (A) by tightening nut (C).

b. Remove ¼" diameter pin from hole (E).

c. Disconnect rod assembly (O) from lever (Q).

d. Rotate lever (F) counterclockwise to downshift position (THRU-DETENT) and hold.

e. Have assistant depress accelerator pedal until pedal rod (J) contacts bumper (I).

f. Adjust length of rod assembly (O) to provide free-entry into lever (Q). Secure length of rod (O) by tightening nut (P).

5. Install gauge (J-23739) as shown in figure 10. Note that gauge is installed on manual selector nut.

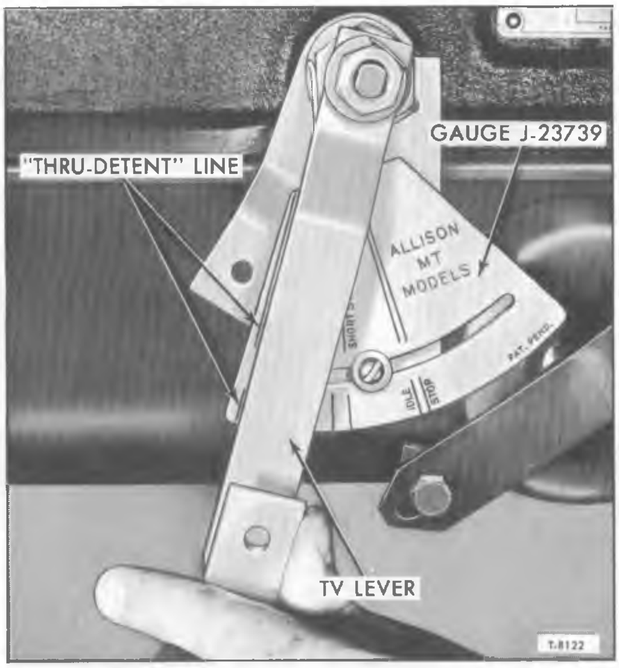


Figure 11—Checking for Proper TV Lever Travel

6. Hold TV lever full counterclockwise against transmission internal stop. Align the "STOP" line on gauge with the forward edge of TV lever. If necessary reposition gauge on manual selector nut to obtain alignment. Use a mirror if unable to view directly.

7. Move TV lever full clockwise as shown in figure 11. TV lever should be aligned with "THRU-DETENT" line. This step is a check to be sure no internal condition exists in the transmission that would prevent full movement of the TV lever.

NOTE: All MT Series transmissions covered by this manual are of the Long Stroke design, and TV lever travel must be the same as shown in figure 11. Correct any internal transmission condition, if necessary, before proceeding.

8. Reconnect TV rod (L, fig. 9) to transmission TV lever (M).

9. With engine "OFF" and accelerator pedal at "IDLE" position, the forward edge of TV lever should be aligned with the "IDLE" line on gauge, as shown in figure 12. If necessary, shorten or lengthen TV rod to obtain alignment with gauge by performing the following:

a. Have assistant loosen retaining nut (K, fig. 9) holding slotted-rod (N) in position on TV rod (L).

b. Referring to figure 12, align TV lever with "IDLE" line on gauge and hold.

c. With accelerator linkage at "IDLE" position, have assistant position slotted-rod (N, fig. 9) so upper portion of slot contacts stud (H). Secure slotted-rod (N) to TV rod (L) by tightening nut (K). Recheck TV lever on transmission to be sure it is aligned with "IDLE" line on gauge (fig. 12).

10. Have assistant depress accelerator pedal to full throttle (DETENT). Referring to figure 13, TV lever should be aligned with "LONG STROKE" line on gauge.

NOTE: Any under- or over-travel in Step 10 indicates faulty or improper linkage components.

11. Remove gauge from transmission and connect clevis (E, fig. 15) to shift lever (F).

NOTE: Check for proper linkage adjustment as described later in this section under "Manual Range Selector Linkage."

12. Check TV linkage by having assistant depress accelerator pedal to pedal bumper (THRU-DETENT). Hold TV lever (M, fig. 9) in this position. When assistant releases the accelerator pedal, carburetor throttle lever and accelerator pedal must return freely to "IDLE" position. Connect TV lever return spring.

13. Using a tachometer to accurately check engine rpm, with selector lever in "N" (Neutral), check engine idle speed (500 rpm). Road test or dynamometer test vehicle to check for full load upshift (5th to 6th). Upshift should occur at approximately 50 rpm below the engine governed speed (4000 rpm). If upshifts do not occur at specified rpm adjust as follows:

a. To raise shift point, shorten TV rod (L, fig. 9) by loosening nut (K), then reposition slotted-rod (N) as required. Tighten nut (K) against shoulder of rod (L).

b. To lower shift point, lengthen rod (L) in the same manner as preceding step.

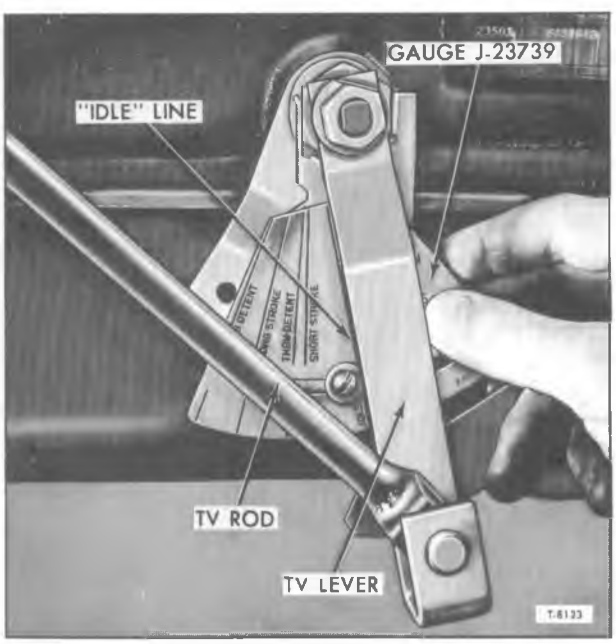


Figure 12—Position of TV Lever at Idle

TV Linkage Adjustment - TG50

IMPORTANT: Be sure engine idle (700 rpm with MT Series transmission) and governed speed are properly adjusted, before proceeding. Refer to ENGINE FUEL SYSTEM (SEC. 6M) for adjustments.

1. Apply parking brake and block vehicle's driving wheels.

2. To facilitate installation of TV Linkage Adjustment Gauge (J-23739) disconnect manual range selector linkage at transmission by removing clevis pin from shift lever (H, fig. 16).

3. Disconnect TV rod (H, fig. 14) from TV lever (J). Also disconnect TV lever return spring from TV lever.

4. Referring to figure 14, perform the following:

a. With cab tilted, position lever (E) 0.060-inch, using feeler gauge, from stop (F) and adjust swivel on link assembly (D) to provide free-entry of link assembly (D) into levers (E) and (M).

b. Adjustment of the detent button (A) is accomplished by relocating the two jam nuts (located on detent button assembly. Return cab to normal ride height. With the accelerator pedal (B) depressed to THRU-DETENT (detent button - compressed), ample clearance must exist between the pedal and cab floor to assure complete movement of the TV linkage to the THRU-DETENT position.

c. With accelerator pedal just touching detent button (A) the injection pump control lever (M) should be in the full throttle position. If adjustment is required shorten or lengthen rod (C) as necessary. Note link assembly (D) must not be extended when performing this step.

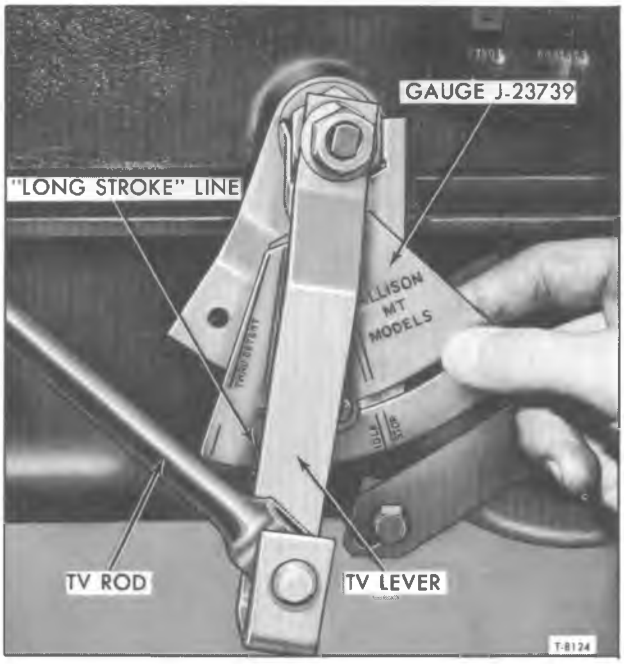


Figure 13—Checking for Proper TV Linkage Adjustment at Full Throttle

5. Install gauge (J-23739) as shown in figure 10. Note gauge is installed on manual selector nut.

6. Hold TV lever full counterclockwise against transmission internal stop. Align the "STOP" line on gauge with forward edge of TV lever. If necessary, reposition gauge on manual selector nut to obtain alignment. Use a mirror if unable to view directly.

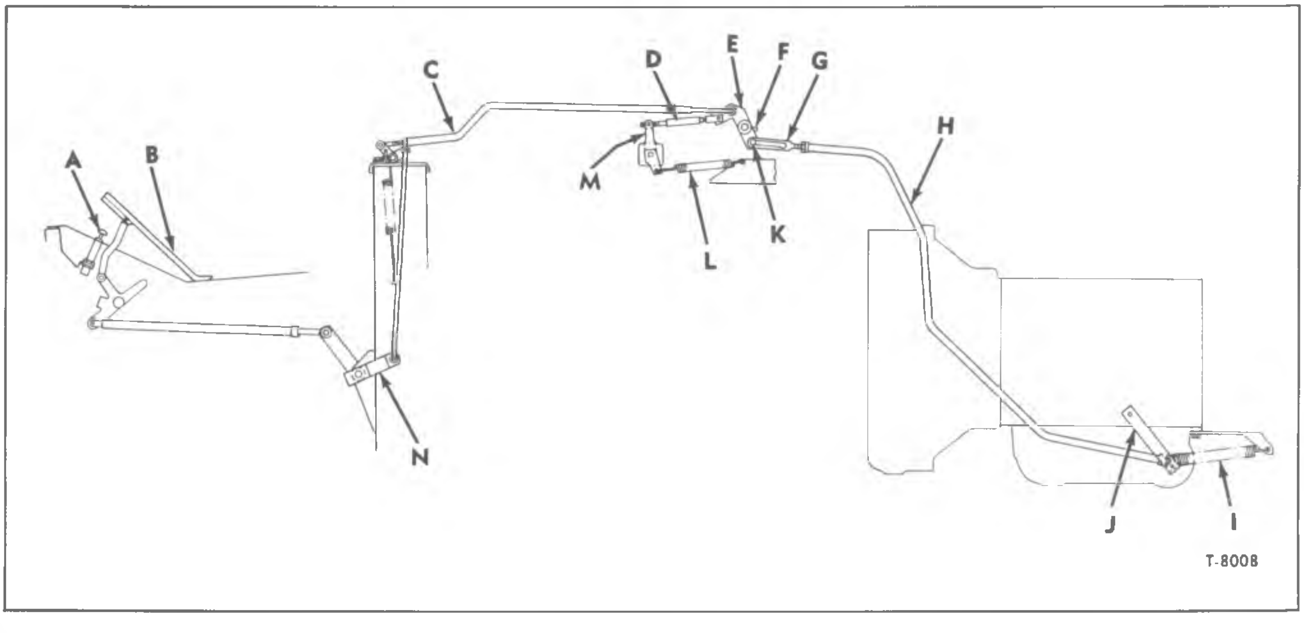


Figure 14—Accelerator and TV Linkage (TG50)

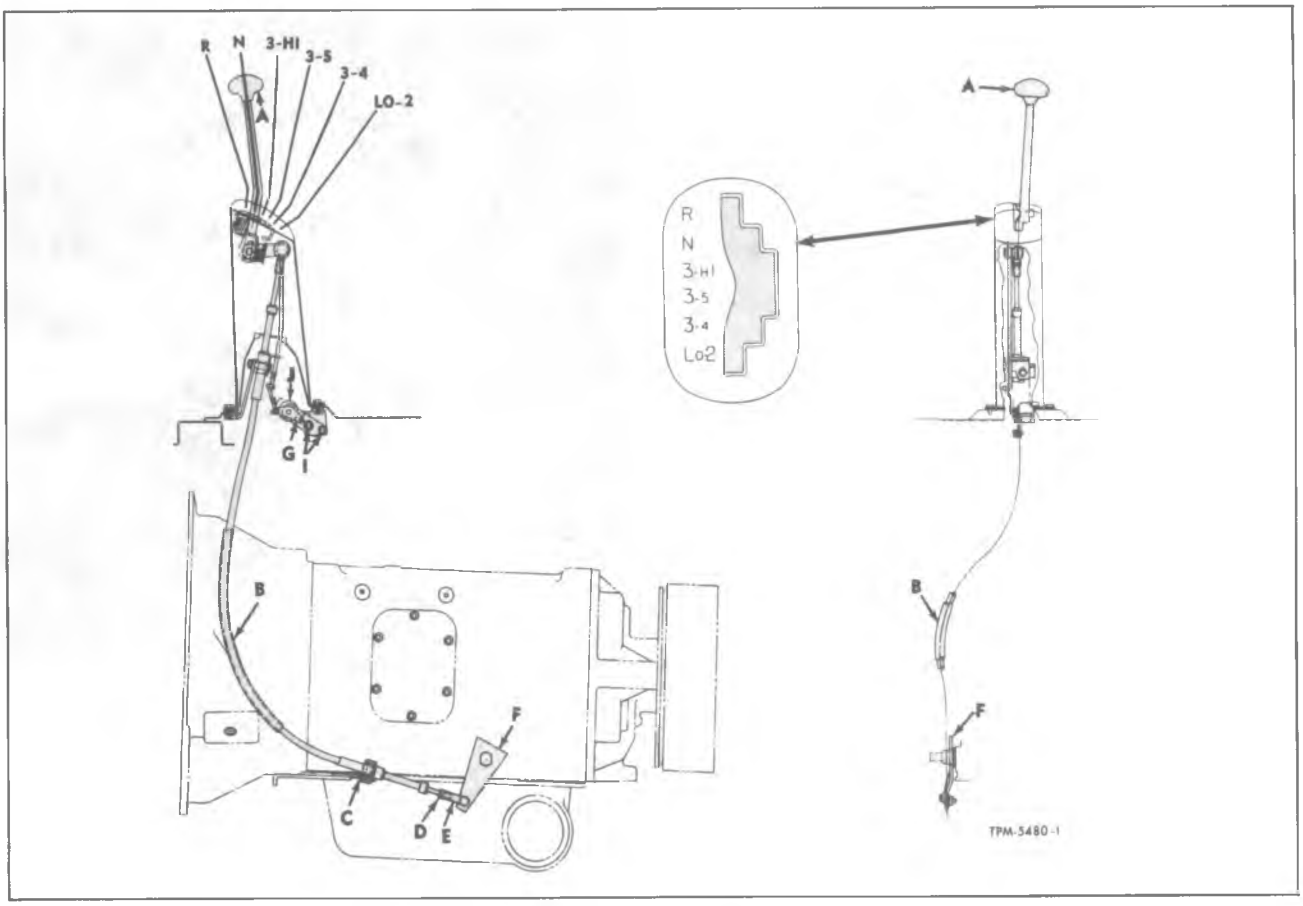


Figure 15—Manual Range Selector Linkage (ME60)

7. Move TV lever full clockwise as shown in figure 11. TV lever should be aligned with "THRU-DETENT" line. This step is a check to be sure no internal condition exists in the transmission that would prevent full movement of the TV lever.

NOTE: All MT Series transmissions covered by this manual are of the Long Stroke design, and TV lever travel must be the same as shown in figure 11. Correct any internal transmission condition, if necessary, before proceeding.

8. Reconnect TV rod (H, fig. 14) to transmission TV lever (J).

9. With engine "OFF" and accelerator pedal at "IDLE" position, the forward edge of TV lever should be aligned with the "IDLE" line on gauge, as shown in figure 12. If necessary, shorten or lengthen TV rod to obtain alignment with gauge by performing the following:

a. With cab tilted, have assistant loosen retaining nut holding slotted-rod (G) in position on TV rod (H).

b. Referring to figure 12, align TV lever with "IDLE" line on gauge and hold.

c. With accelerator linkage at "IDLE" position, have assistant position slotted-rod (G, fig. 14) so upper portion of slot contacts stud (K). Secure slotted-rod (G) to TV rod (H) by tightening retaining nut. Recheck TV lever on transmission to be sure it is aligned with "IDLE" line on gauge (fig. 12).

10. Return cab to normal ride height. Have assistant depress accelerator pedal to full throttle (DETENT). Referring to figure 13, TV lever should be aligned with "LONG STROKE" line on gauge.

NOTE: Any under- or over-travel in Step 10 indicates faulty or improper linkage components.

11. Remove gauge from transmission and connect clevis (G, fig. 16) to shift lever (H).

NOTE: Check for proper linkage adjustment as described later in this section under "Manual Range Selector Linkage."

12. Check TV linkage by having assistant depress accelerator pedal until detent button (A, fig. 14) is compressed (THRU-DETENT position). Hold TV lever (J) in this position. When assistant releases accelerator pedal, injection pump control lever (M) and accelerator pedal must return freely

to "IDLE" position. Connect TV lever return spring (I).

13. Using a tachometer to accurately check engine rpm, with selector lever in "N" (Neutral), check engine idle speed (700 rpm). Road test or dynamometer test vehicle to check for full-load upshift (5th to 6th). Upshift should occur at approximately 50 rpm below the engine governed speed (2800 rpm - full load). If upshifts do not occur at specified rpm adjust as follows:

a. To raise shift point, shorten TV rod (H, fig. 14) by loosening retaining nut holding slotted-rod (G) to TV rod (H). Reposition slotted-rod as required. Tighten retaining nut against shoulder for rod (H).

b. To lower shift point, lengthen rod (H) in the same manner as preceding step.

MANUAL RANGE SELECTOR LINKAGE
(Refer to Figs. 15 and 16)

The manual selector linkage should fully engage all transmission range positions just before the lever hits the "stops" incorporated in the shift control tower. Shift the selector lever through each position while feeling for full engagement in the transmission. Note the position of the selector lever after each shift. Transmission should not engage "3 - HI" or "R" (ME60), or "3 - 6" or "R" (TG50), until the selector lever on control tower is completely out of the neutral notch. If lever is not properly located or operating, the linkage should be adjusted as follows:

WARNING

DO NOT START ENGINE WITH MANUAL SELECTOR LINKAGE DISCONNECTED, AS SERIOUS INJURY COULD RESULT TO VEHICLE OR PERSONNEL.

Manual Selector Linkage Adjustment
-ME60 (Refer to Fig. 15)

1. Back nut (D) away from clevis (E) and remove cotter pin and clevis pin from outer shifter lever (F).

2. Place transmission selector lever (A) in the "LO-2" position and while holding transmission outer shift lever in "LO-2" position (counterclockwise to rearmost position). Adjust clevis (E) to proper length to insert clevis pin freely through holes in clevis (E) and shifter lever (F).

3. Install new cotter pin in clevis pin and tighten nut (D) firmly against clevis (E). Check to see that bolts holding cable bracket (C) are tight to cable cover and housing.

4. After completing adjustment, operate vehicle and check operation of selector lever through all shift ranges. Readjust if necessary.

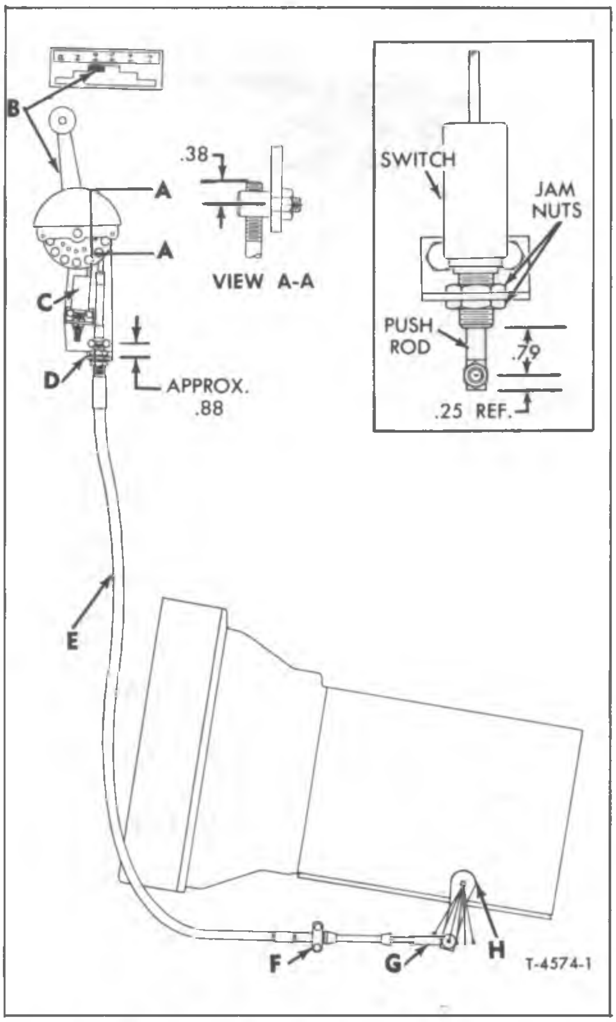


Figure 16—Manual Range Selector Linkage (TG50)

Manual Selector Linkage Adjustment
- TG50 (Refer to Fig. 16)

1. Locate transmission selector lever (B) against stop in "3-6" position.

2. Check cable for dimension shown in View A-A, figure 16, and adjust if necessary. Anchor cable to bracket at point (D).

NOTE: Threaded portion of shift cable extends 0.88-inch above top-side of bracket, as shown at point (D).

3. Disconnect clevis (G) from manual shift lever (H). Anchor cable (E) securely at point (F).

4. Locate manual shift lever (H) in "3-6" position (3rd notch from the rear). Adjust clevis (G) for free-entry of clevis pin through clevis and manual shift lever (H). Then lengthen clevis (G) by 1½ turns, install clevis pin, tighten jam nut, and secure with cotter pin.

5. After completing all adjustments, operate vehicle and check operation of selector lever through all shift ranges. Readjust if necessary.

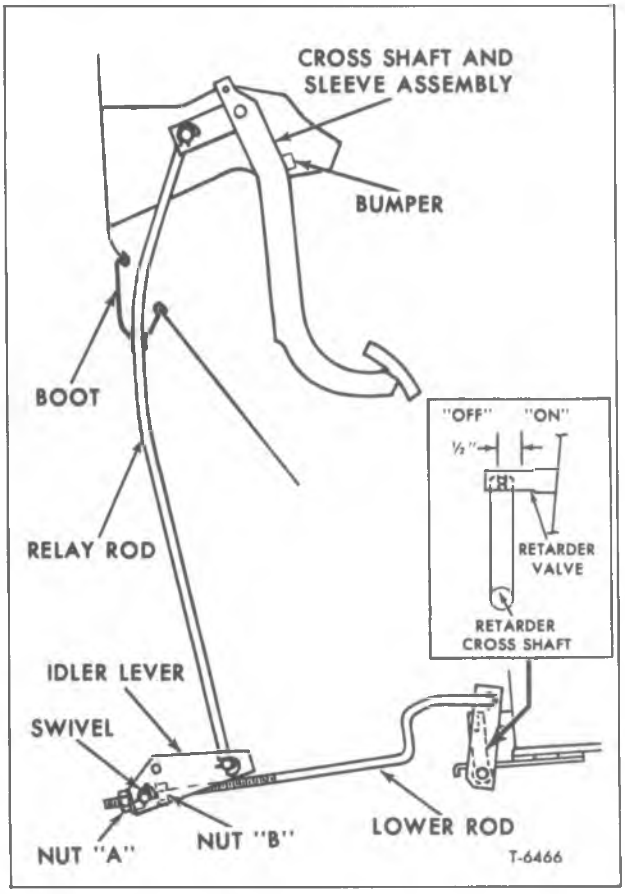


Figure 17—Retarder Linkage (ME60)

NEUTRAL SAFETY AND BACK-UP SWITCH ADJUSTMENT

"Manual Selector Linkage Adjustment" should be performed as described previously, prior to adjustment of the neutral safety switch.

Adjustment Procedure - ME60
(Refer to Fig. 15)

Access to the neutral safety switch (J) can be gained from underneath vehicle or by removing bolts holding control tower to floor.

1. Block driving wheels, apply parking brake, then pull secondary wire out of center socket in distributor cap and ground wire to prevent possible damage to coil.
2. Loosen switch mounting screws (I).
3. Move control tower selector lever to "N" (Neutral) position.
4. While holding safety switch lever in same position, as shown, insert a 3/32-inch diameter pin in hole (G) of switch arm and bracket. Tighten switch mounting screws (I) and remove the pin placed temporarily in hole (G).
5. Check each range position on control tower to make sure the starter will not operate with the selector lever in any position other than "N" (Neutral). If necessary, readjust the switch to obtain this condition.
6. Install coil wire in center socket of distributor cap.

Adjustment Procedure - TG 50
(Refer to Fig. 16)

1. Block driving wheels, apply parking brake, and perform the following to prevent the vehicle from accidentally starting while performing adjustment:
2. Place fuel shut-off lever in "SHUT-OFF" position.
3. Move lever (B) to "N" (Neutral) position, then referring to Inset, figure 16, loosen jam nuts and adjust length of push rod to dimension shown.
4. With switch push rod properly adjusted. tighten jam nuts securely.
5. Check each range position of shift linkage to make sure the starter does not operate with the selector lever in any position other than "N." Have assistant check for proper operation of back-up lights with selector lever in "R." If necessary, readjust switch.

RETARDER ADJUSTMENT
(Refer to Fig. 17)

NOTE: The ME60 is the only truck model covered by this manual that is equipped with a hydraulic retarder.

1. Loosen nuts (A and B).

2. Remove clip retaining swivel to idler lever, then remove swivel from retarder lever.

3. With retarder pedal against stop bumper (in cab), adjust swivel on push rod for free-entry into idler lever.

4. Tighten nuts (A and B) to retain swivel in position. Install clip to retain swivel to retarder lever.

NOTE: Referring to Inset, of figure 17, the retarder valve is shown in the "OFF" position. Full travel of valve from "OFF" to "ON" position is ½-inch.

5. Have an assistant depress retarder pedal (in cab), while checking for proper movement of retarder valve. Use a scale to be sure movement of valve from "OFF" to "ON" position is ½-inch.

6. Have assistant release retarder pedal. The retarder valve must return to the "OFF" position (retarder valve fully closed) when the pedal is released. The pedal must return positively and immediately to released position (pedal against the bumper stop) when foot pressure is released.

7. Readjust linkage, if necessary.

TRUCK MODELS WITH ALLISON AT540 AUTOMATIC TRANSMISSION

LINKAGE ADJUSTMENTS

MANUAL RANGE SELECTOR LINKAGE ADJUSTMENT (Refer to Fig. 18)

The manual selector linkage should fully engage all transmission range positions just before the lever hits the "stops" incorporated in the shift control tower. Shift the selector lever through each position while feeling for full engagement in the transmission. Note the position of the selector lever after each shift. Transmission should not engage "D" (Drive) or "R" (Reverse) until the selector lever on control tower is completely out of the "N" (Neutral) notch. If lever is not properly located or operating, the linkage should be adjusted as follows:

1. Locate transmission selector lever (B) against stop in "N" position.

2. Check cable for dimension shown in View A-A, and adjust if necessary. Anchor cable to bracket at point (D).

3. Disconnect clevis (G) from manual shift lever (H). Anchor cable (E) securely at point (F).

4. Locate manual shift lever (H) in "N."

NOTE: Neutral position of manual shift lever is obtained by rotating lever completely forward, then back one notch.

5. Adjust clevis (G) for free-entry of clevis pin through clevis and manual shift lever (H). Then shorten cable by rotating clevis 2 turns clockwise. Tighten jam nut against clevis; install clevis pin and secure with cotter pin.

6. After completing all adjustments, operate vehicle and check operation of the selector lever through all shift ranges. Readjust if necessary.

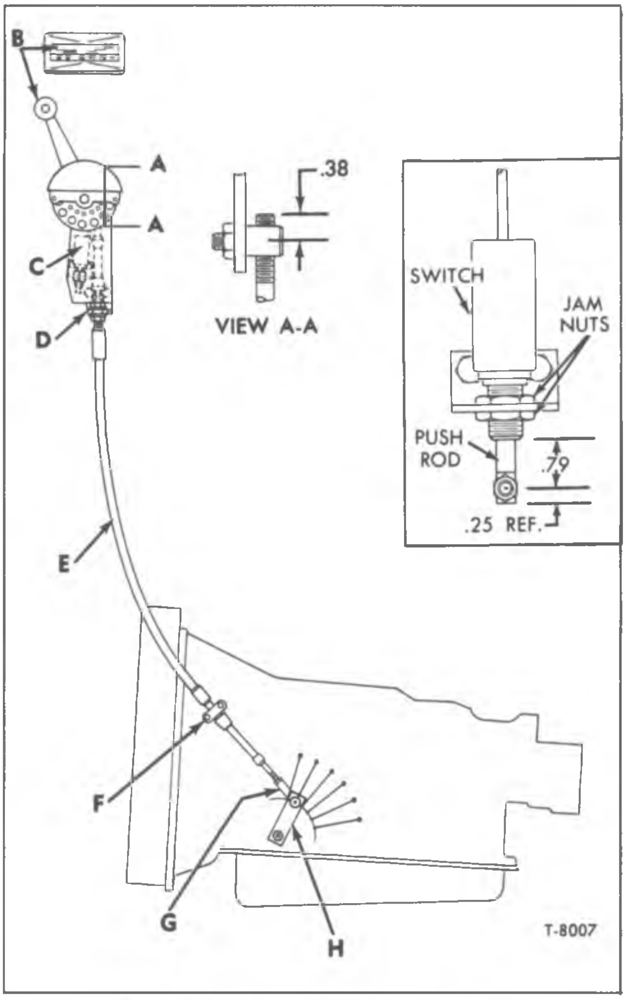


Figure 18—Manual Shift Linkage (AT540)

NEUTRAL SAFETY AND BACK-UP LIGHT SWITCH ADJUSTMENT (Refer to Inset, Fig. 18)

NOTE: "Manual Range Selector Linkage Adjustment" should be performed as described previously, prior to adjustment of the neutral safety switch.

1. Block driving wheels, apply parking brake, and perform the following to prevent the vehicle from accidentally starting while performing adjustment:

1. Pull secondary wire out of center socket in distributor cap and ground wire to prevent possible damage to coil.

2. Move lever (B) to "N" (Neutral) position, then referring to Inset, figure 18, loosen jam nuts and adjust length of push rod to dimension shown.

3. With switch push rod properly adjusted, tighten jam nuts securely.

4. Check each range position of shift linkage to make sure the starter does not operate with the selector lever in any position other than "N." Have assistant check for proper operation of back-up lights with selector lever in "R." If necessary, readjust switch.

5. Reconnect secondary wire to distributor cap.

SECTION 7B

Transmission On-Vehicle Service Operations

MANUAL TRANSMISSION SERVICING

MANUAL TRANSMISSION TROUBLE DIAGNOSIS

The following trouble diagnosis information will assist in locating transmission troubles, but in addition will serve as a guide to find the "cause" to prevent reoccurence.

Whenever possible, road test the vehicle prior to overhaul. Mechanics usually get second or third hand reports of trouble experienced with the unit and these reports do not always accurately describe the actual conditions. Sometimes symptoms seem to indicate trouble in the transmission; while actually the trouble may be caused by the axle, propeller shaft, universal joint, engine or clutch. Therefore, before removing transmission or related components to locate trouble, always road test to check possibility that trouble may exist in other closely associated units. If the mechanic can drive, road testing will be more effective; however, just riding with the driver can be very informative.

Many times the answer to the trouble is apparent when the unit is inspected prior to disassembly, but this evidence is often lost when the parts are separated. If possible, check the unit prior to disassembly. Bear in mind that a careful inspection of the unit should be made as each disassembly step is performed.

It is poor practice to disassemble a unit or complete transmission as quickly as possible without bothering to examine the parts as they come down. It happens many times that a mechanic has completely disassembled a unit and failed to find the cause of the trouble because he did not bother to examine the parts as they came apart. After the transmission is disassembled, check the lubricant for foreign particles which often reveal sources of trouble that are overlooked during the disassembly.

NOISY OPERATION

Noise is very elusive and generally not the fault of transmission; therefore, mechanics should road test to determine if the driver's complaint of noise is actually in the transmission.

Noise Arising Outside Transmission

In numerous instances, drivers have insisted that the noise was in the transmission, however, investigations revealed the noise to be caused by one of the following conditions:

1. Fan out-of-balance or blades were bent.
2. Defective vibration damper.
3. Crankshaft out-of-balance.
4. Flywheel out-of-balance.
5. Flywheel mounting bolts loose.
6. Engine rough at idle producing rattle in gear train.
7. Clutch assembly out-of-balance.
8. Engine mounts loose or broken.
9. Power take-off engaged.
10. Universal joints worn out.
11. Propeller shafts out-of-balance.
12. Universal joint angles out of plane or at excessive angle.
13. Center bearings in drive line dry - not mounted properly, etc.
14. Wheels out-of-balance.
15. Tires treads humming or vibrating at certain speeds.
16. Air leaks on suction side of induction system - especially with turbo-chargers (if used).

Noise Arising In Transmission

Mechanics should try to locate and eliminate noise by means other than transmission removal, or overhaul. However, if noise appears to be in the transmission try to break it down into the following classifications. If possible, determine what position gearshift lever is in when noise occurs. If noise is evident in only one gear position, cause of noise is generally traceable to gears in operation.

TRANSMISSION ON-VEHICLE SERVICE

1. Growl and Humming, or more serious, a grinding noise. These noises are caused by worn, chipped, rough, or cracked gears. As gears continue to wear, the grinding noise will be noticeable, particularly in the gear position that throws the greatest load on the worn gear.

2. Hissing, or more serious, a thumping or bumping-type noise. Hissing noises could be caused by bad bearings. As bearings wear and retainers start to break up, etc., the noise could change to a thumping or bumping.

3. Metallic Rattles within the transmission usually result from a variety of conditions. Engine torsional vibrations are transmitted to the transmission through the clutch. A characteristic of the two-plate clutch is a rattling noise, due to oscillation of the intermediate plate drive lugs within the flywheel openings when the clutch is released. In general, engine speeds could be 600 rpm or above, to eliminate objectionable rattles and vibration during the idle. A defective or faulty injector would cause a rough or lower idle speed and a rattle in the transmission. Rattle could also be caused by excessive backlash in power take-off unit mounting.

4. Improper Lubricants, or lack of lubricant can produce noises. Transmissions with low oil levels sometimes run hotter than normal, as there is insufficient lubricant to cool and cover the gears.

5. Squealing, particularly when the transmission is operating at higher speeds, could be caused by one of the free-running gears seizing on the thrust face or fluted diameter temporarily and then letting go. In general, a mild seizure will clear itself up and the transmission will continue to operate very satisfactorily without this defect being known. Refer to Step 7 following:

6. Gear Seizure at high speed, usually accompanied with loud squealing noise. This type of seizure is readily apparent to the driver since the truck will suddenly slow down as if the brakes were being applied. If the truck continues to move ahead, even though the gearshift lever is placed in neutral, it would indicate the floating gear on the mainshaft had seized. Depressing the clutch should interrupt the driving torque. The seized gear could be checked quite readily by depressing clutch and checking the action with the gearshift lever progressively in all shift positions. If releasing the clutch tends to kill the engine, then this gear position has not seized. In other words, the transmission would be in two gears at the same time. By a process of elimination, the gear at fault can be readily identified. Refer to Step 7 following:

7. Vibration: Gear seizures on thrust faces or fluted diameters are usually caused by vibrations in the power train; this could be engine, propeller shafts, joint angle, rear axle, differentials, etc.

a. Improved highways permit sustained high speeds. The fact that engines and entire power trains can now cruise at a high rpm can introduce vibration frequencies, that were not critical in the past. At slower speeds these items would get by or only pass through critical periods while accelerating or decelerating through the gears.

b. In the past, drive line vibrations such as bent tubes, joints out of phase or alignment, bad angles due to short couples, clutches out of balance, gears and shafts in transmission out of balance, were fairly obvious. These items will become more critical in vehicles running at sustained high speeds.

c. Critical vibrations associated with higher speeds are not the old thumping or bumping type, but are high frequency vibrations. This type of vibration will cause gear seizures, damaged synchronizers, bearing failure due to retainer bolt failures, promote brinelling, fretting corrosion, etc.

8. Gear Whine is usually caused by lack of backlash between mating gears or improper shimming of power take-off units.

Noise In Neutral

1. Misalignment of transmission.
2. Worn or scored main drive gear and/or countershaft bearings.
3. Scuffed gear tooth contact surfaces on gears.
4. Unmatched constant mesh gears.
5. Worn, rough reverse idler gear.
6. Eccentric countershaft gear assembly.
7. Sprung or worn countershaft.
8. Excessive backlash in constant mesh gear.
9. Excessive end play in countershaft, or reverse idler pinion.
10. Worn mainshaft pilot bearing.
11. Scuffed gear tooth contact surface insufficient lubrication.
12. Incorrect grade of lubricant.
13. Incorrect clutch linkage adjustment.

Noise In Gear

1. Worn, or rough mainshaft rear bearing.
2. Rough, chipped or tapered sliding gear teeth.
3. Noisy speedometer gears.
4. Excessive end play of mainshaft gears.
5. Refer to conditions listed under "Noise in Neutral."

WALKING OR SLIPPING OUT OF GEAR

1. If the units are walking out of gear it could be caused by:

a. Interference or resistance in the shift mechanism preventing full engagement of the sliding clutch gear, or -

b. If the gear has been shifted completely into position some other malfunction which could move the gear out of its proper location.

2. A number of items which would prevent full engagement of gears are:

a. Shift fork pads or groove in sliding gear or collar worn excessively.

b. Worn taper on gear clutch teeth.

c. Transmission and engine out of alignment either vertically or horizontally.

3. A few items which could move the gear or shaft out of proper position, particularly on rough roads are:

a. Use of heavy shift lever extensions.

b. Shift rod poppet springs broken.

c. Shift rod poppet notches worn.

NOTE: When gearshift lever can be held in to prevent jump-out, detent modifications will often correct it. When a gear has been allowed to jump out for a long period generally the cause must be corrected plus replacement of the affected gears.

d. Shift rod bent or sprung out of line.

e. Shift fork pads not square with shift rod bore.

f. Excessive end-play in drive gear, mainshaft or countershaft, caused by worn bearings, retainers, etc.

g. Thrust washers or faces worn excessively, missing, etc.

HARD SHIFTING

1. Sliding gear tight on shaft splines.
2. Insufficient chamfer of sliding gear teeth.
3. Burred mainshaft or sliding gear splines.
4. Misaligned mainshaft.
5. Damaged synchronizing unit.
6. Improper adjustment of shifting linkage or excessively worn.
7. Worn shift rods.
8. Worn, sprung shifter fork.
9. Wrong lubricant especially if extreme pressure type lubricants are added.
10. Free-running gears, seized or galled on either the thrust face or diameters.

STICKING IN GEAR

1. Insufficient chamfer on detent ball notches.
2. Chips wedged between or under splines of shaft and gear.
3. Misaligned mainshaft and/or countershaft.

CRASH SHIFTING OR RAKING OF GEARS

Raking of gears during the manual shift is usually caused by a defective synchronizer or improper shifting technique for synchronized transmission.

When the shift lever moves directly into the manual shift position without resistance, the raking of teeth will be audible and felt through the gearshift lever. This condition does not always mean the synchronizer is worn out. The following may cause this condition:

1. Quite often, small chips may lodge in the synchronizer temporarily, which prevents proper synchronization and causes raking shifts. Continued operation of the transmission may either embed the chip below the surface of the bronze or reject it and the synchronizer will return to normal functioning.

2. Use of improper oils often causes raking of synchronizer. Heavy oil prevents the synchronizer from breaking through the oil film and doing the job properly. The above condition usually occurs with cold, heavy oil, but the synchronizer begins to work properly when the transmission oil reaches normal operating temperature.

The use of extreme pressure type lubricants is not recommended. Glazing of the synchronizer cone due to breakdown of oil is especially common with extreme pressure additives found in multi-purpose or rear axle type lubricants.

Broken synchronizer components sometimes jam under poppet preventing proper movement of synchronizer cone, resulting in crash shifts.

Worn synchronizer components with the loss of clutching action are usually caused by poor driver technique, or failure to control engine speed drop-off during upshift, or failure to bring engine speed nearly up to governor speed when downshifting, causes overwork of synchronizer and failure to shift. Also, drivers who try to shift without using the clutch will burn or wear out manual synchronizers at relatively low mileage.

OIL LEAKS

1. Oil level too high.
2. Wrong lubricant in unit.
3. Non-shielded bearing used at front or rear bearing cap. (Where applicable.)
4. Seals (if used) defective or omitted from bearing cap, wrong type seal used, etc.
5. Transmission breather omitted, plugged internally, etc.
6. Cap screws loose, omitted or missing from remote control, shifter housing, bearing caps, power take-off, or covers, etc.
7. Welch "seal" plugs loose or missing entirely from machine openings in case.
8. Oil drain-back openings in bearing caps or case plugged with varnish, dirt, covered with gasket material, etc.
9. Broken gaskets, gaskets shifted or

squeezed out of position, pieces still under bearing caps, clutch housing, power take-off, and covers, etc.

10. Cracks or holes in castings.
11. Drain plug loose.

BEARING FAILURES

More than 90 per cent of all bearing failures are caused by dirt which is always abrasive.

Dirt may enter the bearings during assembly of the units or be carried into the bearing by the lubricant while in service. Dirt may enter through seals, breather or even dirty containers used for addition or change of lubricant.

Softer material such as dirt, dust, etc., usually form abrasive paste or lapping compounds within the bearings themselves since the unit pressure between the balls and raceways makes a perfect pulverizer. The rolling motion tends to entrap and hold the abrasives. As the balls and raceways wear, the bearings become noisy. The lapping action tends to increase rapidly as the fine steel from the balls and rollway adds to the lapping material.

Hard coarse material such as chips, etc., may enter the bearings during assembly from hammers, drifts, power chisels, etc., or be manufactured within the unit during service from raking teeth, etc. These chips produce small indentation in balls and races. Jamming of these hard particles between balls and races may cause the inner race to turn on shaft, or the outer race to turn in the housing.

Corrosion

Water, acid, and corrosive materials formed by deterioration of lubricant will produce reddish-brown coating and small etched holes over outer and exposed surfaces of race. Corrosive oxides also act as lapping agent.

Fatigue

All bearings are subject to fatigue and must be replaced eventually. Your own operating experience will dictate mileage replacement of bearings showing only normal wear.

Shaft Fits

Excessive looseness under load is very objectionable because it produces a creeping or slipping of the inner ring on the rotating shaft. This causes the surface metal of shaft to scrub or wear off.

Bearing fits on rotating shafts are usually specified as tight. When play or looseness, even 0.001", exists between the bearing and shaft, there is a very powerful force tending to rotate the inner race on the shaft. This force is caused by the looseness or lost motion between the parts and disappears when no looseness exists.

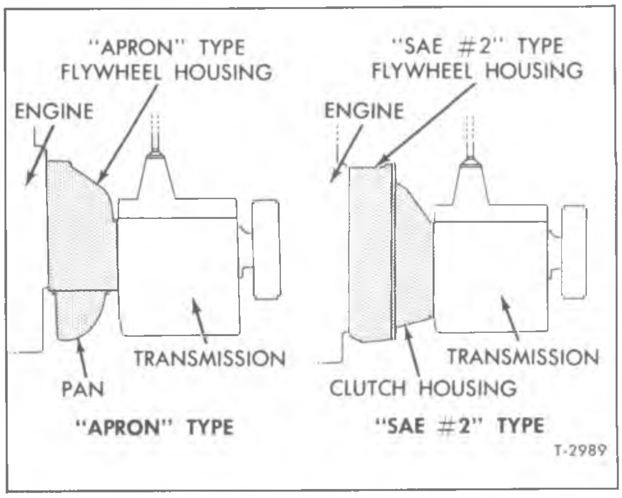


Figure 1—Flywheel Housing Identification

BEARING REPLACEMENT

It is far more difficult to remove bearings from a shaft than to put them on. In most cases it is necessary to remove the bearing by pulling on the outer race which can damage the balls or races. Since such damage is seldom visible, it does not become known until after complete reassembly. If a bearing is not going to be replaced, avoid removal during low mileage rebuild.

Brinelling caused by improper assembly or removal -- usually hammering with off-center blows. Use drivers, preferably under an arbor, or pullers.

MANUAL TRANSMISSION REPLACEMENT

The procedures required to remove the manual transmission from trucks covered in this manual are dependent generally upon the type of lifting equipment available in the repair shop. Operations other than those included in this section may be necessary if vehicle has special equipment, such as a power take-off unit and controls, etc.

The required operations will be obvious upon visual inspection of the vehicle. The instructions contained herein under "Removal" and "Installation" will serve as a guide in accomplishing transmission replacement.

It is important to note that vehicles covered by this manual will have either an "Apron" or "S.A.E. #2" type flywheel housing as shown in figure 1. The "apron" type flywheel housing is easily identified by the sheet metal pan which covers the entire lower portion of the clutch housing. Note lack of a separate clutch housing.

The "S.A.E. #2" type flywheel housing completely surrounds the flywheel. A separate clutch housing is used in addition to the flywheel housing.

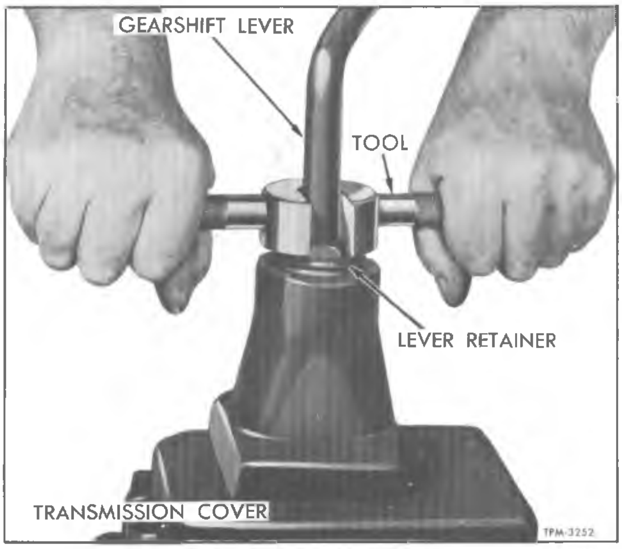


Figure 2—Replacing Gearshift Lever (SM465 and New Process Transmissions)

Transmission replacement procedures are different for each type flywheel housing used.

REMOVAL

1. Remove floor mat and transmission floor pan cover, then place gearshift lever in "N" (Neutral) position. Remove gearshift lever and control tower assembly, except when equipped as follows:

NOTE: On vehicles equipped with SM465 or New Process transmission, remove gearshift lever (only) using Tool (J-8109) as shown in figure 2. Press down firmly on tool and rotate counterclockwise.

2. Place clean lint-free cloth or other suitable covering over opening at top of transmission to prevent entry of dirt or other foreign material.
3. Disconnect electrical wiring from back-up light switch mounted on transmission.
4. Drain lubricant from transmission.
5. Disconnect speedometer cable from transmission adapter.
6. Disconnect clutch control linkage.
7. Disconnect and remove parking brake lever and controls (when used).
8. Disconnect propeller shaft from transmission as described in "PROPELLER SHAFTS" (SEC. 4D) of this manual.
9. If vehicle is equipped with power take-off, remove unit and controls from transmission. Place protective covering over opening.
10. Position a suitable dolly or jack under vehicle and adjust to carry weight of transmission.
11. Visually inspect to determine if other equipment, lines, or brackets must be removed to permit removal of the transmission.

NOTE: On vehicles which have the engine rear mountings attached to the clutch housing, it will be necessary to support the engine using a suitable dolly or jack at the flywheel housing. Then, remove engine rear mountings as described in ENGINE MOUNTINGS (SEC. 6D) of this manual.

12. Remove bolts which attach transmission to engine as follows:

a. Apron Type Flywheel Housing - Remove bolts retaining transmission to "Apron" type flywheel housing (refer to fig. 1).

b. S.A.E. #2 Type Flywheel Housing - Remove clutch housing-to-flywheel housing mounting bolts.

13. Move the transmission assembly straight away from the engine, using care to keep the transmission main drive gear shaft in alignment with the clutch disc hub.

CAUTION: When removing the transmission, do not allow weight of the transmission to hang on clutch disc hub, as disc will become distorted, seriously affecting clutch operation.

14. When transmission is free from engine, lower the transmission and move from under the vehicle.
15. If desired, a careful check of clutch components should be made after the transmission has been removed. If the clutch requires repair, refer to "CLUTCHES" (SEC. 7E) of this manual.

INSTALLATION

1. Apply a light coat of high temperature grease, to the main drive gear bearing retainer and splined portion of transmission main drive gear shaft to assure free movement of clutch and transmission components during assembly. Refer to LUBRICATION (SEC. 0) of this manual for explanation of high temperature grease.

CAUTION: DO NOT apply an excessive amount of grease in the above areas, as under normal operation this grease would be thrown onto clutch facings resulting in clutch failure.

2. Shift the transmission into high gear.
3. Mount the transmission on dolly or jack and move into position under the vehicle.

NOTE: On models equipped with "Apron" type flywheel housing, position the clutch release bearing and support assembly inside the flywheel housing. Be sure the clutch fork properly engages the clutch release bearing.

4. Align the transmission main drive gear shaft with the clutch disc hub by rotating the transmission output flange or yoke. Move the transmission forward, guiding the main drive gear shaft into the clutch disc splines.

IMPORTANT: Avoid springing the clutch when the transmission is being installed. Do not force the transmission into clutch disc splines. Do not let transmission drop or hang unsupported in the splined hub of the clutch disc.

5. Install clutch housing-to-engine flywheel housing mounting bolts and washers (except on vehicles equipped with "Apron" type flywheel housing). Tighten bolts to 25 to 30 foot-pounds torque.

NOTE: On vehicles equipped with "Apron" type flywheel housing, install transmission-to-flywheel housing mounting bolts and lock washers. Tighten bolts as indicated following:

	Bolt Torque (Ft.-Lbs.)
a. Conv. Cab Models	60 - 90
b. Tilt Cab Models	55 - 65

6. If the engine rear mountings were removed, reinstall the mounts as covered in ENGINE MOUNTINGS (SEC. 6D) of this manual. Be sure all mounting bolts are properly torqued.

7. If vehicle is equipped with power take-off reinstall unit and controls.

8. Connect propeller shaft to transmission as described in "PROPELLER SHAFTS" (SEC. 4D) of this manual.

NOTE: Proper torque values for the mainshaft flange or yoke retaining nut is given under "Rear Oil Seal Replacement" later in this section.

9. Connect mechanical parking brake lever and controls (when used). Adjust brake, if necessary, as outlined in "PARKING BRAKE" (SEC. 5C) of this manual.

10. Reconnect clutch control linkage.

11. Connect speedometer cable to adapter at transmission.

12. If other equipment (exhaust pipe, support brackets, etc.) was removed, reinstall these parts.

13. Shift the transmission into "N" (Neutral) and reinstall gearshift lever and control tower assembly.

NOTE: On vehicles equipped with SM465 or New Process transmission, install gearshift lever using Tool (J-8109) as shown in figure 2.

14. Connect electrical wiring to back-up light switch mounted on transmission.

15. Fill transmission with lubricant recommended in LUBRICATION (SEC. 0) of this manual.

16. If necessary, adjust clutch control linkage as described in "CLUTCH CONTROLS" (SEC. 7D).

REAR OIL SEAL REPLACEMENT

REMOVAL

1. Drain lubricant from transmission.

2. Disconnect propeller shaft from transmission as described in "PROPELLER SHAFTS" (SEC. 4D) of this manual.

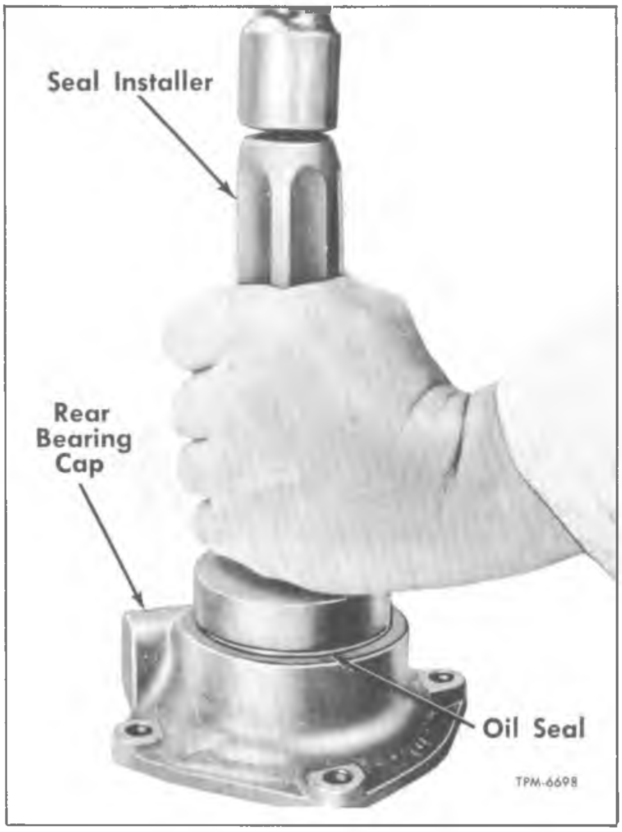


Figure 3—Installing Mainshaft Rear Oil Seal

3. Remove parking brake (when used) from rear of transmission as described in "PARKING BRAKE" (SEC. 5C) of this manual.

4. Disconnect speedometer cable and remove speedometer driven gear from mainshaft rear bearing cap.

5. Using flange or yoke holding tool, remove the output yoke or companion flange nut. Pull output yoke or companion flange off mainshaft.

6. Remove mainshaft rear bearing cap and gasket. Discard gasket.

7. Using a suitable puller, remove oil seal from rear bearing cap. Discard oil seal.

INSTALLATION

1. Install new oil seal in mainshaft rear bearing cap using a suitable seal installer as shown in figure 3, with lip of seal pointing toward transmission case.

NOTE: Sealing cement should be used at the outer diameter of oil seal to prevent leakage. Wipe off excess cement.

2. Clean all gasket surfaces, then install rear bearing cap and oil seal assembly with a new gasket to transmission case. Tighten cap screws firmly.

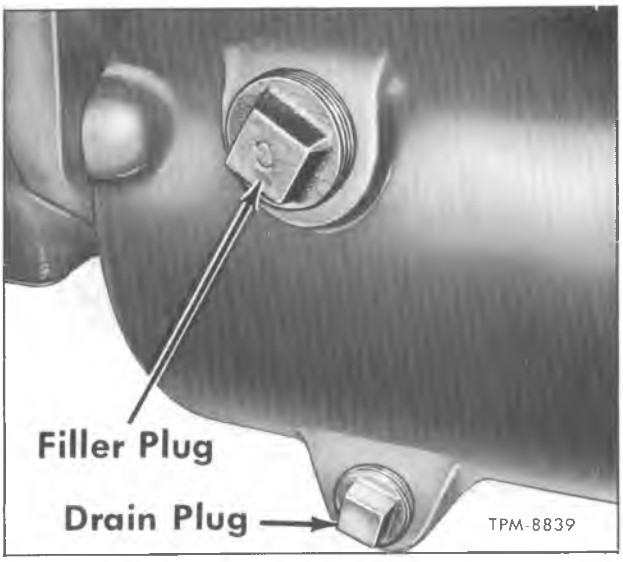


Figure 4—Transmission Filler and Drain Plugs (Typical)

NOTE: Oil return passage in rear bearing cap must line up with oil passage in transmission case.

3. Install output yoke or companion flange on mainshaft. Using flange or yoke holding tool, install retaining nut. Refer to "Torque Specifications" for proper torque.

4. Install speedometer driven gear, then connect speedometer cable.

5. Install parking brake (when used) to transmission as described in "PARKING BRAKE" (SEC. 5C) of this manual. Adjust brake if necessary.

6. Connect propeller shaft to transmission as described in "PROPELLER SHAFTS" (SEC. 4D) of this manual.

7. Refill transmission with lubricant as described in LUBRICATION (SEC. 0) of this manual.

TORQUE SPECIFICATIONS

Companion Flange or Output Yoke Retaining Nut

Transmission Model	Nut Torque (Ft.-Lbs.)
Corporation SM465	95 - 120
New Process 435	125 - 150
New Process 540, 542	125 - 150
Clark 282 or 285	400 - 450
Clark 325 or 327	400 - 450
Spicer 5652, 5752 or 5756 ...	500 - 550

MANUAL TRANSMISSION LUBRICATION DETAILS

IMPORTANT: For information on lubrication intervals, type of lubricant, and lubricant capacity for manual transmissions, refer to LUBRICATION (SEC. 0) of this manual.

CHECKING LEVEL (Fig. 4)

At specified interval remove filler plug at side of case and, if necessary, add sufficient recommended lubricant to bring lubricant level up to level of opening. Install and tighten filler plug.

DRAINING AND FILLING (Fig. 4)

When transmission is new or after overhaul, it is recommended that lubricant be drained after the first 3,000 miles of operation, and thereafter at recommended intervals. Draining at early mileage removes fine metallic particles or other foreign material.

At specified intervals, preferably immediately after operation while unit is hot, remove drain plug to drain lubricant. Clean drain plug, then reinstall and tighten securely. Refill to level of filler plug with lubricant recommended in LUBRICATION (SEC. 0) of this manual.

ALLISON AUTOMATIC TRANSMISSION SERVICING

MT40 TRANSMISSION REPLACEMENT

The following procedures apply to all vehicles covered by this manual. However, it may be necessary to remove air tanks, fuel tanks, special equipment, etc., on some vehicles to provide clearance before the transmission is removed.

IMPORTANT: The torque converter and transmission must be removed from, or installed into the vehicle as a unit. The transmission cannot be removed from or installed on the converter in the vehicle.

Overhaul information for MT Series transmissions is contained in Allison Manual SA1126.

REMOVAL

1. Block vehicle so that it cannot move. Disconnect ground strap from battery negative (-) post. Remove the spark plugs (gasoline engines) so the engine can be turned over manually. On models equipped with diesel engines, place fuel shut-off lever in "SHUT-OFF" position.

2. Loosen the transmission oil filter cover by loosening cover strap retaining bolt and nut to allow transmission oil to drain. Do not remove the filter cover from the oil pan as oil will gush out too quickly. When oil stops flowing, tighten the cover strap.

3. Disconnect the range selector cable from shift lever at left-side of transmission.

4. Disconnect TV (throttle valve) rod from TV lever at left side of transmission.

5. Disconnect retarder linkage on left side of transmission (when used).

6. Remove the oil level gauge (dipstick). Disconnect oil filler tube at right side of transmission oil pan and remove the clamp. Remove vent hose clamps and lift out filler tube and vent hose assembly. Replace dipstick in tube and cover the vent hose and oil pan openings to prevent entry of foreign material.

7. Disconnect oil cooler lines from fittings on the retarder valve body. Plug line ends and valve body openings with clean lint-free material. Disconnect wiring from hot oil switch.

8. Disconnect the speedometer shaft fitting from adapter at rear of the transmission.

9. Disconnect the propeller shaft from transmission as described in "PROPELLER SHAFTS" (SEC. 4D) of this manual.

10. Disconnect the mechanical parking brake linkage at right side of transmission (if used).

11. Through the opening in the flywheel housing, use a pry-bar as necessary to manually turn the flywheel. As the flywheel is rotated, remove the six nuts retaining flywheel flex plate assembly to converter pump cover.

> **CAUTION: DO NOT rotate flywheel by using wrench on the nuts or prying against studs on converter cover.**

12. Support the transmission with a 1,000-pound (minimum) transmission floor jack (see fig. 5). The jack must be positioned so transmission oil pan will not support the weight of the transmission. Fasten a safety chain over top of transmission and to both sides of the jack.

13. Place a support under rear of engine and remove converter housing-to-frame support bolts. Raise the engine to remove weight from the engine rear mounts.

14. Remove the converter housing-to-flywheel housing attaching bolts and washers.

15. Remove transmission rear mounting bolts and then remove transmission rear support on ME6500.

16. Move transmission from the engine, lower the assembly carefully and move it out from the vehicle.

INSTALLATION

1. Raise vehicle sufficiently to allow installation of transmission. With transmission assembly properly mounted on transmission jack as shown in figure 5, move transmission into position aligning converter housing with flywheel housing. Check for and clean away any foreign material in flywheel

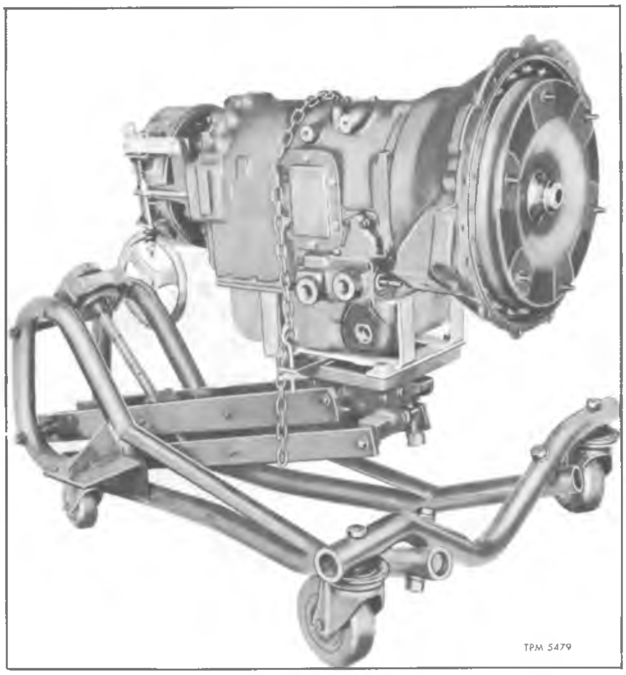


Figure 5—Transmission Mounted on Adjustable Dolly

pilot hole and on flywheel flex plate assembly and converter housing face. Rotate flywheel as necessary so that the six studs on the converter cover can freely enter holes in engine flywheel flex plate assembly. Carefully move transmission assembly toward engine so studs can enter holes in flex plate and so that pilot on transmission enters pilot hole in center of flywheel.

2. Install bolts and washers that attach converter housing to engine flywheel housing. Tighten bolts to 25-30 foot-pounds torque.

3. Loosely, install six nuts that hold converter cover to flywheel flex plate. On next hand rotation of engine, tighten nuts as follows:

ME60	20-25 Ft.-Lbs.
TG50	15-20 Ft.-Lbs.

4. Install transmission rear support on ME-60. Tighten frame rail-to-support nuts at left frame rail to 35-55 foot-pounds and at the right frame rail tighten the single nut to 80-120 foot-pounds torque. Tighten two rear support bracket-to-transmission bolts to 55-75 foot-pounds torque.

5. Carefully lower engine and transmission assembly onto engine rear mounts. Tighten engine rear mounting bolts to 55-75 foot-pounds torque. Then bend lock tabs down over head of each bolt. Remove lifting equipment from beneath vehicle.

6. Remove plugs from oil cooler lines and transmission valve body openings. Be sure fittings are clean and lint-free, then connect oil cooler lines to transmission. Connect wiring to oil temperature warning switch on transmission.

NOTE: Oil temperature warning switch is located in the oil cooler line fitting in the forward opening in retarder valve body.

7. Install the oil filler tube and clamp at right side of transmission oil pan. Check for serviceable condition of transmission vent tube and clamps, then install these parts. Install oil level gauge.

NOTE: Cover oil filler tube upper opening to keep out foreign material while being pushed up into engine compartment during installation.

8. Connect speedometer shaft fitting to adapter at rear of transmission.

9. Connect propeller shaft to transmission as described in "PROPELLER SHAFTS" (SEC. 4D) of this manual.

10. Connect parking brake linkage (if used) at side of transmission.

11. Connect retarder (when used) and TV linkage on left side of transmission.

12. Connect the range selector cable to shift lever at left side of transmission.

13. Install new oil filter element in auxiliary oil filter (if used) and add transmission oil as described later in this section.

WARNING: TO PREVENT ACCIDENTAL STARTING OF VEHICLE, WHILE IN A DRIVE RANGE, BE SURE THE IGNITION SWITCH IS IN THE "OFF" POSITION BEFORE PROCEEDING TO NEXT STEP.

14. Install spark plugs (gasoline engines) and connect battery ground strap, previously disconnected (for safety).

15. Refer to "TRANSMISSION CONTROL LINK AGE (SEC. 7A) of this manual for adjustment of manual shift linkage, accelerator and TV linkage, and the retarder linkage (when used).

AT540 TRANSMISSION REPLACEMENT

The following procedures apply to all vehicles covered by this manual. However, it may be necessary to remove air tanks, fuel tanks, special equipment, etc., on some vehicles to provide clearance before the transmission is removed.

Troubleshooting, maintenance, and overhaul information for the AT540 transmission is contained in Allison Manual SA-1241.

REMOVAL

1. Block vehicle so that it cannot move. Disconnect ground strap from battery negative (-) post. Remove the spark plugs so the engine can be turned over manually.

2. Remove the oil level gauge (dipstick). Drain transmission by disconnecting oil filler tube at right side of transmission oil pan. Remove bracket holding oil filler tube to transmission and remove filler tube from vehicle. Replace dipstick in tube and cover the oil pan opening to prevent entry of foreign material.

3. Disconnect oil cooler lines from fittings on right side of transmission case. Plug line ends and case openings with lint-free material.

4. Disconnect the range selector cable from shift lever at left-side of transmission.

5. Disconnect vacuum modulator line from modulator.

6. Disconnect the speedometer shaft fitting from adapter at rear of transmission.

7. Disconnect the propeller shaft from transmission as described in "PROPELLER SHAFTS" (SEC. 4D) of this manual.

8. Disconnect the mechanical parking brake linkage at the right side of the transmission (if used).

9. Through the opening in the flywheel housing, use a pry-bar, as necessary to manually turn the flywheel. As the flywheel is rotated, remove the six bolts retaining flywheel flex plate assembly to converter cover.

10. Support the transmission with a 500-pound (minimum) transmission floor jack. The jack must be positioned so transmission oil pan will not support the weight of transmission. Fasten a safety chain over top of transmission and to both sides of jack.

11. Place a support under rear of engine and remove transmission case-to-crossmember support bolts. Raise the engine to remove weight from the engine rear mounts.

12. Remove the transmission case-to-flywheel housing bolts and washers.

13. Carefully inspect transmission and surrounding area to be sure no lines, hoses, or wires will interfere with transmission removal.

IMPORTANT: When removing transmission, keep rear of transmission lower than the front so as not to lose converter.

14. Move transmission assembly from the engine, lower the assembly carefully and move it out from the vehicle.

INSTALLATION

1. Raise vehicle sufficiently to allow installation of transmission. With transmission assembly mounted on transmission jack move transmission into position aligning converter with flywheel. Check for and clean away any foreign material in flywheel pilot hole, flywheel flex plate assembly, and front face of transmission case. Rotate flywheel as necessary so that the six bolt holes in flex plate are aligned with bolt holes in converter cover. Carefully move transmission assembly toward engine so flex plate-to-converter cover bolts

can be loosely installed and so that pilot on transmission converter enters pilot hole in center of flywheel.

2. Install bolts and washers that attach transmission case to flywheel housing. Tighten bolts to 25-30 foot-pounds torque.

3. Tighten the six flex plate-to-converter cover bolts to 35-40 foot-pounds torque.

4. Carefully lower engine and transmission assembly onto engine rear mounts. Tighten engine rear mounting bolts to 60-70 foot-pounds torque. Then bend lock tabs down over head of each bolt. Remove lifting equipment from beneath vehicle.

5. Remove plugs from oil cooler lines and transmission case fittings. Be sure fittings are clean and lint-free, then connect oil cooler lines to transmission.

6. Install oil filler tube and bracket on right side of transmission. Install oil level gauge (dipstick).

7. Connect the speedometer shaft fitting to adapter at rear of transmission.

8. Connect propeller shaft to transmission as described in "PROPELLER SHAFTS" (SEC. 4D).

9. Connect parking brake linkage (if used) at side of transmission.

10. Connect the range selector cable to shift lever at left side of transmission.

11. Connect the vacuum modulator line to modulator.

> WARNING: TO PREVENT ACCIDENTAL STARTING OF VEHICLE, WHILE IN A DRIVE RANGE, BE SURE THE IGNITION SWITCH IS IN THE "OFF" POSITION BEFORE PROCEEDING TO NEXT STEP.

12. Install spark plugs and connect battery ground strap, previously disconnected (for safety).

13. Connect any other lines, hoses, or wires which were disconnected to aid in transmission removal.

14. Refer to "TRANSMISSION CONTROL LINKAGE" (SEC. 7A) of this manual for adjustment of manual shift linkage.

ALLISON AUTOMATIC TRANSMISSION LUBRICATION DETAILS

IMPORTANT: For information on lubrication intervals and type of lubricant, for Allison Automatic transmissions, refer to LUBRICATION (SEC. 0) of this manual.

CHECKING FLUID LEVEL

If oil level is too high or too low, foaming of oil will occur. This will affect lubrication, cooling, and pressure build-up.

The dipstick and filler tube are located on the right side of transmission.

1. Apply parking brake firmly and block driving wheels. Start engine and warm fluid to operating temperature.

IMPORTANT: DO NOT operate retarder (if so equipped) while warming fluid. Move selector lever through all speed ranges.

2. Run engine at idle rpm with lever in "N" (Neutral).

3. Clean dipstick and adjacent area, then remove dipstick, clean, reinsert, again remove and note fluid level.

4. Add one quart of fluid when level reaches "ADD" mark.

DRAINING AND FILLING

Drain while transmission fluid is at operating temperature (160°F. minimum).

NOTE: This procedure includes replacement of the oil filter element.

MT Series Transmission

1. Remove bolt, nut, and strap which secures filter cover to oil pan.

2. Carefully remove filter cover to prevent oil "gushing" out. When drainage is complete, remove cover and filter element.

3. Install new element, retainer seal ring, and cover seal ring. Secure cover-to-oil pan with strap. Tighten strap retaining bolt to 11 - 14 foot-pounds torque.

4. Pour specified type and quantity of oil into transmission filler tube.

5. Check fluid level as described previously. DO NOT OVERFILL.

IMPORTANT: Transmission refill fluid capacity, after various service operations have been performed, is as follows:

a. Removal of filter cover only - approximately 9 quarts.

b. Removal of oil pan only - approximately 10 quarts.

c. Removal of oil pan and control valve assembly - approximately 13 quarts.

d. If transmission (including converter) and oil cooling system have been completely drained - approximately 19 quarts.

AT540 Transmission

1. Remove transmission dipstick and carefully remove oil filler tube to prevent oil "gushing" out. When drainage is complete, remove transmission oil pan and gasket.

2. Remove bolt holding oil filter to control valve body, then pull out oil filter and oil intake pipe.

3. Install a new seal ring onto the top of the oil intake pipe, and lubricate the seal ring with the same oil as used to refill the transmission.

4. Insert the intake pipe and sealring into the hole at the bottom of the transmission. Install new oil filter assembly (includes grommet) onto the intake pipe. Tighten retaining bolt to 10-13 foot-pounds torque.

5. Install the oil pan gasket on the oil pan (using oil-soluble grease to hold the gasket in place on the pan, if necessary).

CAUTION: DO NOT use gasket-type sealing compounds any place either inside the transmission or where they might get washed into the transmission. Also, only oil soluble greases may be used for temporarily retaining parts during assembly.

6. Install oil pan and gasket. Tighten oil pan retaining bolts to 10-13 foot-pounds torque.

7. Install the filler tube at the side of the pan.

8. Refill transmission with approximately 9 quarts of recommended transmission lubricant. Check level using dipstick and correct as necessary.

OIL COOLER, LINES. AND BY-PASS SYSTEM

IMPORTANT: The vehicle's radiator not only cools the engine coolant, but also cools the transmission oil. It is imperative that the coolant be at the proper level at all times, otherwise insufficient heat dissipation from transmission oil will result.

An oil cooler located in the bottom of the radiator, through which transmission oil is circulated before returning to the oil pan, dissipates heat created by normal operation of the torque converter and transmission. If a transmission failure occurs which causes foreign matter to be carried into the oil cooler, the cooler and all connecting lines should be thoroughly cleaned by flushing before transmission is put back into operation.

FLUSHING OIL COOLER AND LINES

It is important that following transmission malfunctions, the transmission oil cooler be properly flushed since foreign particles lodged in the cooler eventually become free and can cause a repeated transmission failure. If the oil cooler and lines are properly flushed, the possibility of these troubles reoccurring after the transmission has been repaired is eliminated or substantially reduced.

Whenever an internal difficulty occurs in the transmission which would result in clutch plate material or metal particles being distributed throughout the oil system, the oil cooler should be thoroughly flushed as outlined in the following text, then an auxiliary filter installed in the cooler return line before the vehicle is returned to service:

1. Disconnect both oil cooler lines at the fittings at side of transmission case, or if an auxiliary filter has been previously installed, disconnect cooler return line at filter instead of at the transmission. (Change auxiliary filter element.)

2. Back-flush the oil cooler and lines using clean solvent and compressed air.

CAUTION: DO NOT exceed 100 psi air pressure.

3. Remove all remaining cleaning solvent from the system with compressed air.

4. Flush the cooling system again with DEXRON ® transmission fluid. After the final flush, test the oil cooler for free flow of oil, and if the flow is restricted, the radiator bottom tank and cooler assembly must be replaced.

SECTION 7C

Auxiliary Transmissions

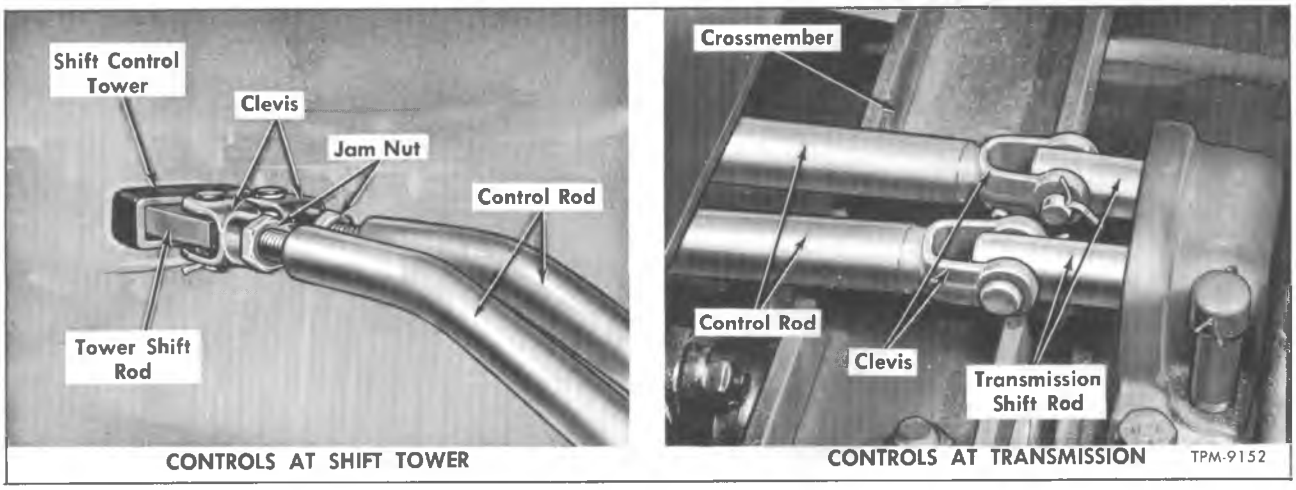


Figure 1—Auxiliary Transmission Linkage (Typical)

This section covers on-vehicle service information on Spicer Auxiliary Transmissions. Gear shifting is accomplished by use of the shift lever in the cab, which is interconnected to the auxiliary transmission with control rods. The auxiliary transmission is supported at the front by a support bracket attached to frame side rails and at the rear by a support beam attached to frame brackets. Hand brake (when used) and speedometer drive are at rear of transmission.

LINKAGE ADJUSTMENTS

(Refer to Figure 1)

1. Disconnect control rods from shift control tower under cab.
2. Place the auxiliary transmission gearshift lever and shift rods on transmission in "NEUTRAL.
3. Adjust the length of each control rod by rotating its adjustable clevis to provide a free clevis pin fit.
4. Reconnect control rods to the control tower and shift transmission through entire shift pattern.

NOTE: At the extreme control rod movements, clevis pins should rotate freely. Readjust linkage if necessary to obtain these conditions. Replace any worn or damaged cotter pins. Tighten lock nuts firmly.

5. Lubricate control linkage with same grade of oil used in engine.

AUXILIARY TRANSMISSION REPLACEMENT

REMOVAL

1. Drain lubricant from auxiliary transmission.

2. Disconnect propeller shafts from input and output ends of transmission. Refer to "PROPELLER SHAFTS" (SEC. 4D) in this manual.

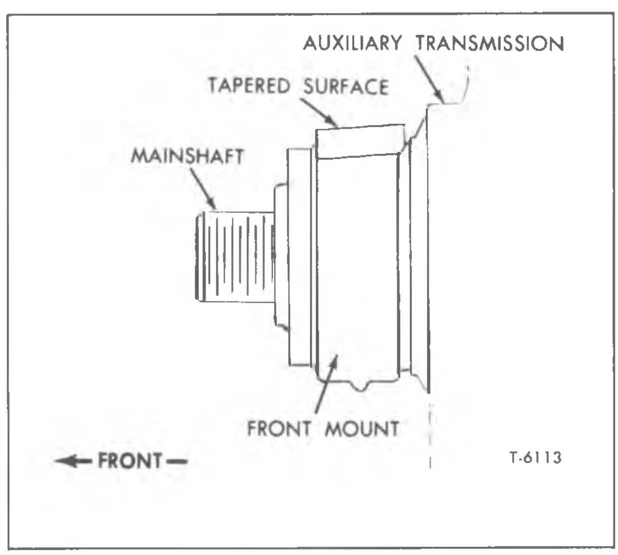


Figure 2—Front Mount Installed

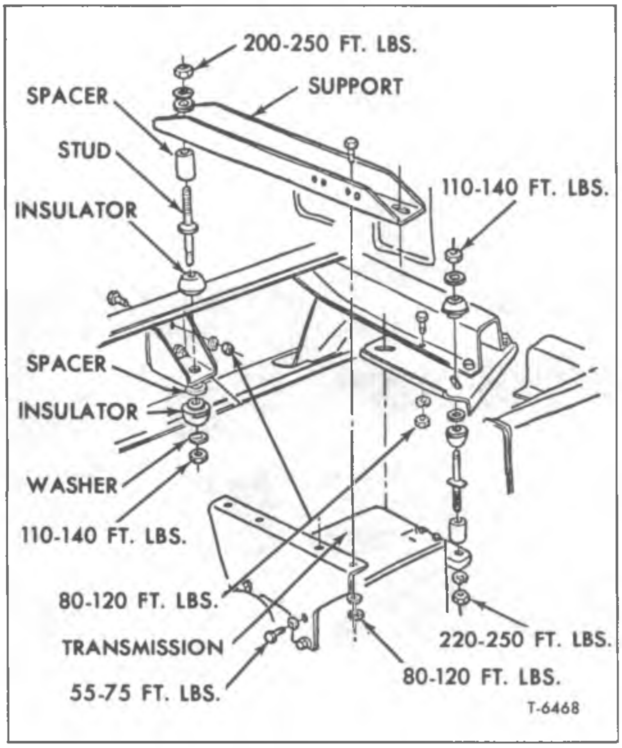


Figure 3—Auxiliary Transmission Mounting (Spicer 6041)

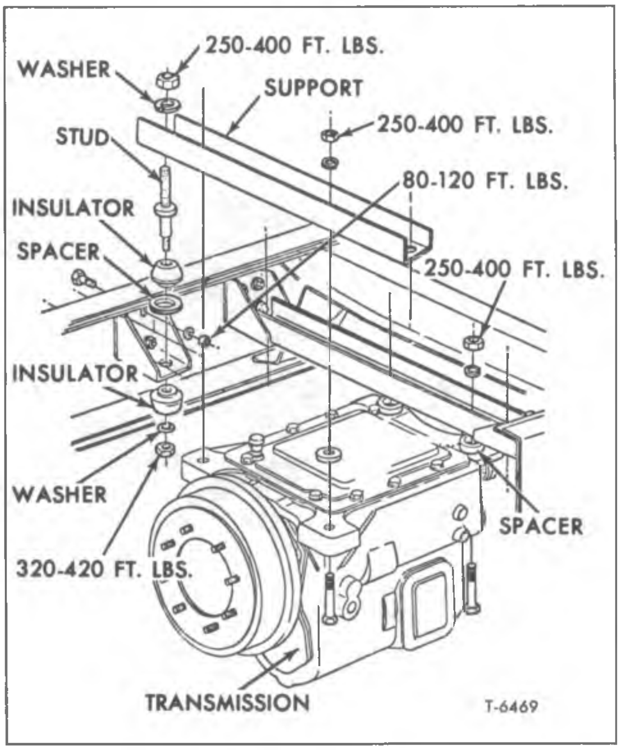


Figure 4—Auxiliary Transmission Mounting (Spicer 7041)

NOTE: Support propeller shafts securely to prevent damage from dropping.

3. Disconnect shift control rods from the front of the transmission.

4. Disconnect speedometer cable from adapter at rear of the transmission.

5. Disconnect parking brake linkage (when used).

6. Remove all connections to the auxiliary transmission power take-off (when used).

7. Position a suitable dolly or jack under the transmission and adjust to safely carry the weight of the transmission.

8. Remove attaching parts from auxiliary transmission front and rear mountings. Lower the transmission away from the chassis.

INSTALLATION

The procedures required to install auxiliary transmission are dependent on the type of transmission mountings which vary due to different vehicle drive-line configurations.

1. Be sure the tapered surface of the auxiliary transmission front mount faces the front of the vehicle as shown in figure 2.

2. With transmission mounted on a suitable dolly or jack move into position under the vehicle.

3. Torque attaching parts to proper specifications as shown in figures 3 and 4.

4. Reconnect propeller shafts to the input and output ends of the transmission as described in "PROPELLER SHAFTS" (SEC. 4D) in this manual.

IMPORTANT: The preceding steps, serve to locate the auxiliary transmission in relation to the vehicle's frame. Also, it is essential that the auxiliary transmission be checked for proper drive-line angle adjustment as described under "PROPELLER SHAFTS" (SEC. 4D) in this manual, and if necessary, spacers added or removed from rear mounts.

5. Reconnect power take-off (when used).

6. Reconnect parking brake linkage (when used).

7. Connect speedometer cable to adapter at the rear of the transmission.

8. Reconnect shift control rods to the front of the transmission and adjust linkage if necessary.

9. Refill transmission with lubricant recommended in LUBRICATION (SEC. 0) of this manual.

SECTION 7D
Clutch Controls

MECHANICAL CLUTCH LINKAGE (CONVENTIONAL CAB MODELS)

All conventional cab and cowl models covered by this manual are equipped with mechanical clutch control linkages, as shown in figures 1, 2, 3, 6 and 7.

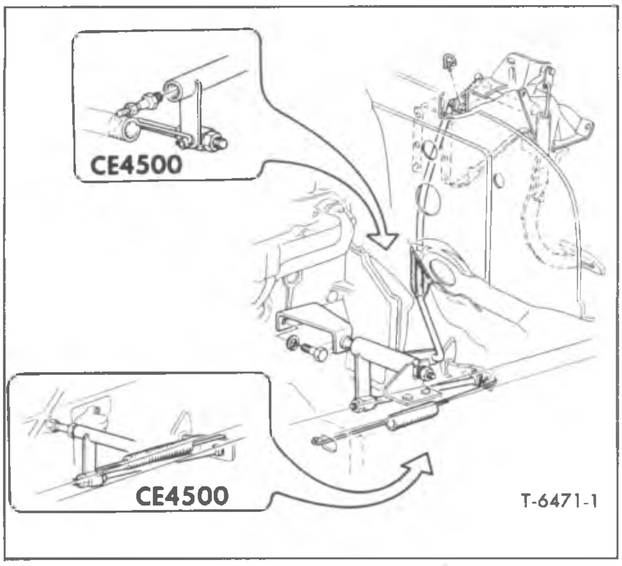


Figure 1—Clutch Linkage (CE, CS40; CS, SS50)

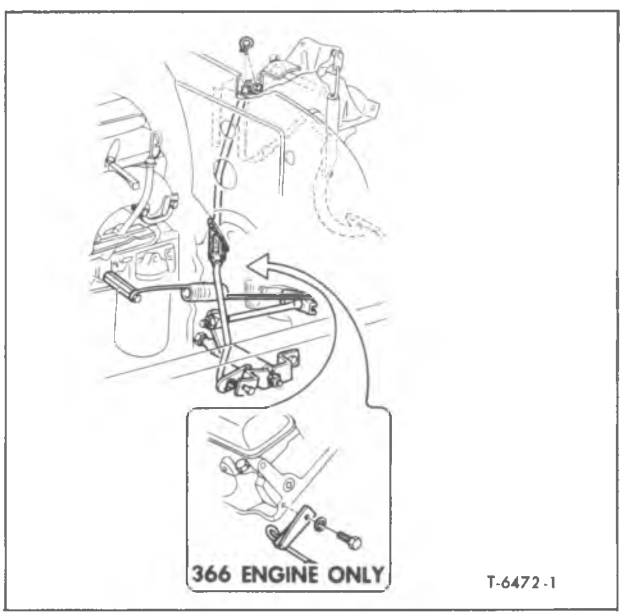


Figure 2—Clutch Linkage (CE, SE50; CE, ME60)

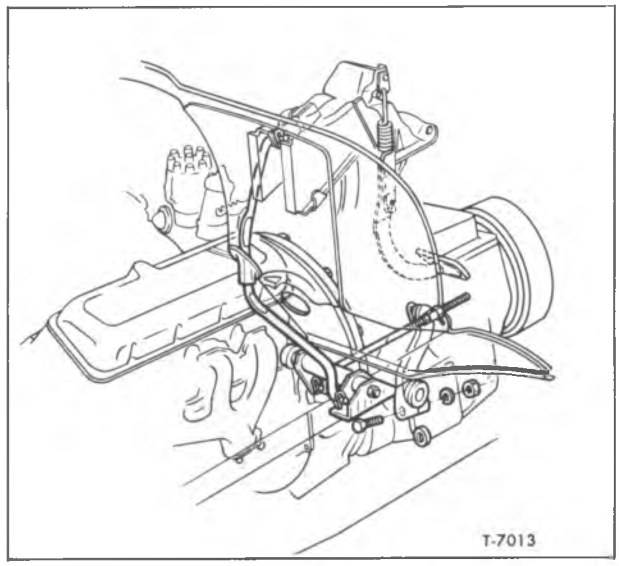


Figure 3—Clutch Linkage (CE, ME60 with 427 Engine)

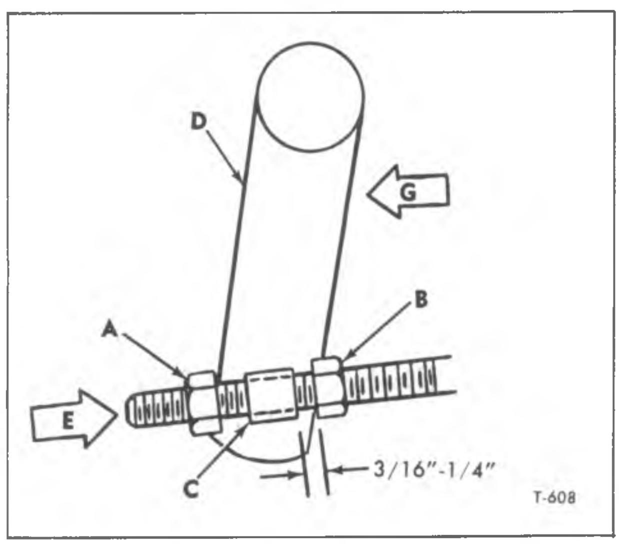


Figure 4—Linkage Adjustment (All Models, Except Those Equipped with 427 Engines)

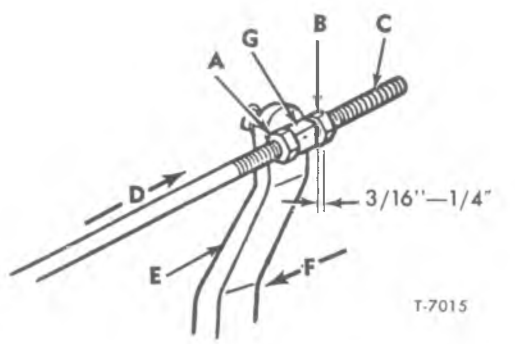
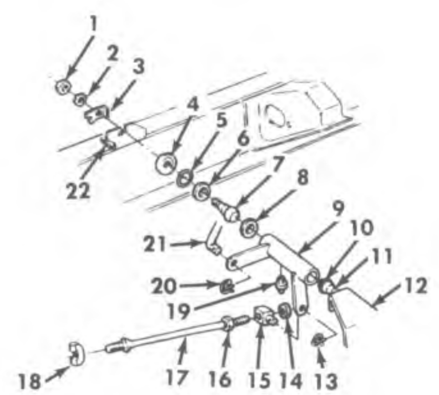


Figure 5—Linkage Adjustment (CE, ME60 with 427 Engine)



1 Nut
2 Washer
3 Special Washer
4 Felt Seal
5 Seat Spring Retainer
6 Nylon Seat
7 Ball Stud
8 Nylon Seat
9 Clutch Lever and Shaft
10 O-Ring (Except CE40)
11 Ball Stud
12 Engine Bracket
13 Clip
14 Nut
15 Swivel
16 Nut
17 Push Rod
18 Wedge
19 Grease Fitting
20 Clip
21 Pull Rod
22 Frame Bracket

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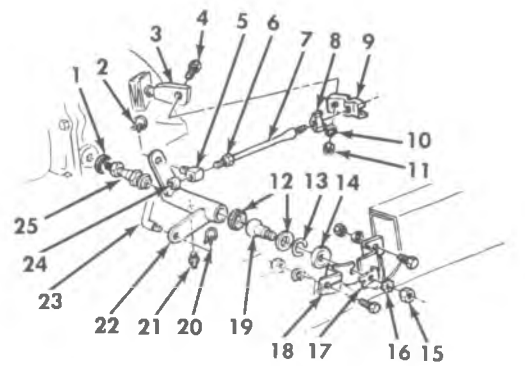
Figure 6—Clutch Lever and Shaft Components (In-Line Engines and CE40)

MECHANICAL LINKAGE ADJUSTMENTS

As clutch facings wear, the amount of pedal free-travel is reduced and in time this will result in clutch slippage. Therefore, it is necessary to adjust the free-travel at periodic intervals to permit full engagement of the clutch.



1 Seal
2 Clip
3 Clutch Fork
4 Bolt
5 Swivel
6 Nut
7 Push Rod
8 Wedge
9 Clutch Fork Extension
10 Washer
11 Nut
12 Nylon Seat
13 Seat Spring Retainer
14 Seal and Retainer
15 Nut
16 Washer
17 Special Washer
18 Frame Bracket
19 Ball Stud
20 Clip
21 Grease Fitting
22 Clutch Lever and Shaft
23 Pull Rod
24 Nut
25 Ball Stud

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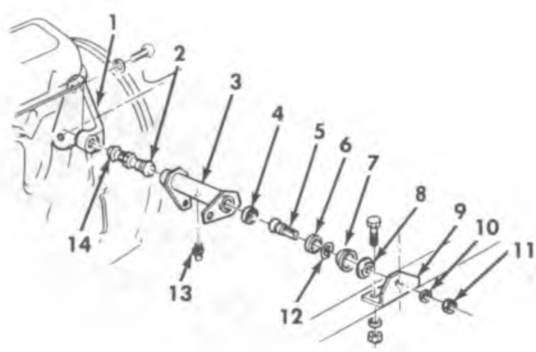
Figure 7—Clutch Lever and Shaft Components (CE, SE50; CE, ME60)

NOTE: Adjustment is necessary when pedal free-travel is reduced to less than $\frac{3}{4}$-inch. Proper free-travel is $\frac{3}{4}$ to 1 inch. Adjustment is made by shortening or lengthing the push rod at the idler shaft lever or clutch release lever (refer to figs. 1, 2, 3, 6, and 7).

ALL MODELS, EXCEPT THOSE EQUIPPED WITH 427 V8 ENGINES

NOTE: Key letters in text refer to figure 4.

1. Disconnect return spring and loosen nuts (A and B).
2. Apply approximately 5 pounds force to the push rod in direction of arrow (E) to eliminate clearance between release bearing and internal release levers.
3. Move lever (D) in direction of arrow (G) until pedal makes contact with stop.
4. Turn nut (B) as necessary to obtain a clearance of 3/16 to $\frac{1}{4}$ inch between nut and swivel (C). This will provide approximately $\frac{3}{4}$ to 1 inch free-travel at pedal pad.
5. Tighten nut (A) to lock sleeve against nut (B). Connect return spring. Check operation of clutch linkage.



1 Engine Bracket	8 Seal Retainer
2 Ball Stud	9 Frame Bracket
3 Clutch Lever and Shaft	10 Washer
4 Nylon Seat	11 Nut
5 Ball Stud	12 Seat Spring Retainer
6 Nylon Seat	13 Grease Fitting
7 Seal	14 Seal

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Figure 8—Clutch Lever and Shaft Components (CE, ME60 with 427 Engine)

CE, ME60 WITH 427 ENGINE

NOTE: Key letters in text refer to figure 5.

1. Loosen nuts (A and B).

2. Apply approximately 5 pounds force to the push rod (C) in direction of arrow (D) to remove linkage clearances.

3. Apply approximately 5 pounds force to clutch lever (E) in direction of arrow (F) to eliminate clearance between release bearing and internal release fingers.

4. Turn nut (B) as necessary to obtain a clearance of 3/16 to ¼ inch between nut and swivel (G). This will provide approximately ¾ to 1 inch free-travel at pedal pad.

5. Holding nut (B), release clutch lever (E) and tighten nut (A) to retain swivel against nut (B). Check operation of clutch linkage.

CLUTCH LEVER AND SHAFT REPLACEMENT

If necessary, to replace clutch lever and shaft components, refer to figures 6 through 8. Check all parts for wear, cracks, distortion, or other damage. Replace all components that would affect proper operation of the clutch lever and shaft assembly. Be sure spherical surface of nylon seats face ball studs when assembled. Ball studs should be lubricated with Multi-Purpose Grease during assembly. For explanation of grease, refer to LUBRICATION (SEC. 0) of this manual.

CLUTCH PEDAL AND SHAFT REPLACEMENT

Procedures for replacing clutch pedal on models equipped with mechanical clutch linkage are given in "HYDRAULIC BRAKES" (SEC. 5A) of this manual.

Always Be Sure To Adjust The Clutch Linkage After Performing Clutch Maintenance Operations.

HYDRAULIC TYPE CONTROLS (TILT CAB MODELS)

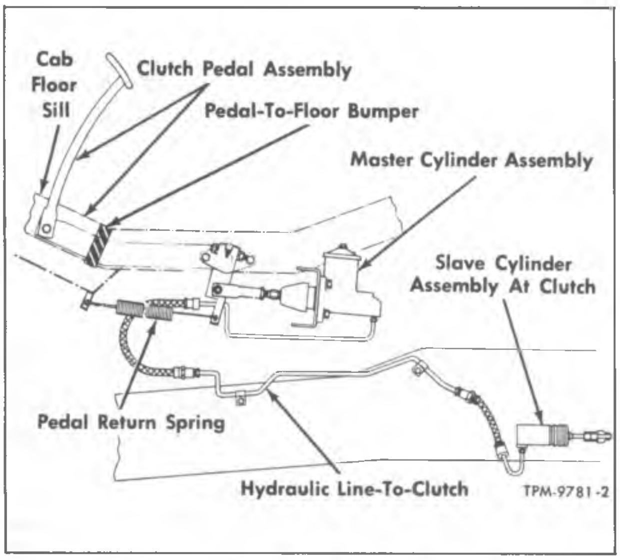


Figure 9—Clutch Hydraulic System (Tilt Cab Models)

DESCRIPTION AND OPERATION

The clutch hydraulic control system is typically illustrated in figure 9. This system utilizes hydraulic pressure as a means of transmitting clutch pedal movement to the clutch release mechanism. The system consists of a pedal-operated master cylinder and a slave cylinder, interconnected with hydraulic lines. Clutch pedal is connected to the master cylinder push rod, and the slave cylinder push rod is connected to the clutch release fork.

When clutch pedal is depressed, hydraulic fluid is displaced from the master cylinder into the slave cylinder, forcing the slave cylinder piston outward. Movement of piston is transmitted through slave cylinder push rod, and clutch release fork to disengage the clutch.

When pedal is released, pedal return spring returns pedal to released (clutch engaged) position. With pressure removed from hydraulic fluid, clutch engages. Slave cylinder push rod return spring forces push rod and piston rearward in slave cylinder, displacing hydraulic fluid back into the master cylinder. The above events occur with each clutch disengagement.

The system should be checked and serviced periodically as stated below:

1. Maintain proper level of hydraulic fluid in master cylinder. Refer to LUBRICATION (SEC. 0) for recommended fluid and checking intervals. At least once a year, drain and flush entire clutch system and refill with new fluid.

Figure 10—Access to Master Cylinder

2. Inspect the entire clutch system regularly for fluid leakage. Leakage must be corrected immediately.
3. Make sure return spring at release fork is not weak or broken.
4. Check, and if necessary, adjust clutch linkage.
5. If clutch pedal action is springy or spongy, it is an indication that air needs to be bled from hydraulic system.

A specified clearance at two points in the hydraulic control linkage is necessary for proper operation. One adjustment is made between the master cylinder piston and the end of foot pedal push rod. This adjustment is referred to as the "Master Cylinder Push Rod Check and Adjustment."

The other adjustment is made by obtaining the proper operating length of the slave cylinder push rod down at the clutch. This adjustment is referred to as the "Slave Cylinder Push Rod Check and Adjustment."

IMPORTANT: The master cylinder check and adjustment must be performed before the slave cylinder check and adjustment. Also, before making either adjustment, make sure that level of

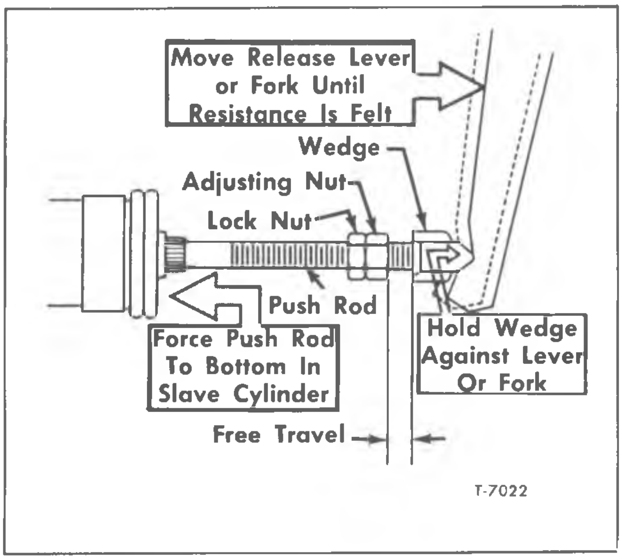


Figure 11—Clutch Slave Cylinder Adjustment

fluid in master cylinder is ½ inch below the top of reservoir. The fluid system must be free of air.

Access to master cylinder filler cap on Steel Tilt Models is gained after removing small access door located at front of driver's seat riser as shown in figure 10.

The master cylinder on Steel Tilt Models is bracket-mounted below cab flooring as shown in figure 12. Acess to pedal linkage for checking and adjusting purposes is made when cab is tilted completely forward. However, when checking and replenishing fluid in master cylinder, the cab must be in its lowered or operating position.

After servicing fluid system on Steel Tilt Models, examine door opening or cover seal. Apply new caulking if necessary before installing door, otherwise dust may enter the cab later at this point.

BLEEDING HYDRAULIC SYSTEM

Use only Hydraulic Brake Fluid recommended in LUBRICATION (SEC. 0). When other than recommended fluid has been used, drain and flush the entire hydraulic system, using clean alcohol or a hydraulic brake system cleaning fluid. Disassemble, clean, and inspect hydraulic units. Replace all rubber parts. Refill with RECOMMENDED fluid.

The need for bleeding air from the system is generally indicated by a springy, spongy pedal action. The presence of air in system is a result of low fluid level in master cylinder, or if some part of system has been opened. Bleeder valve is provided at the slave cylinder alongside of clutch (fig. 15).

Plain end of bleeder hose can be slipped over end of bleeder valve.

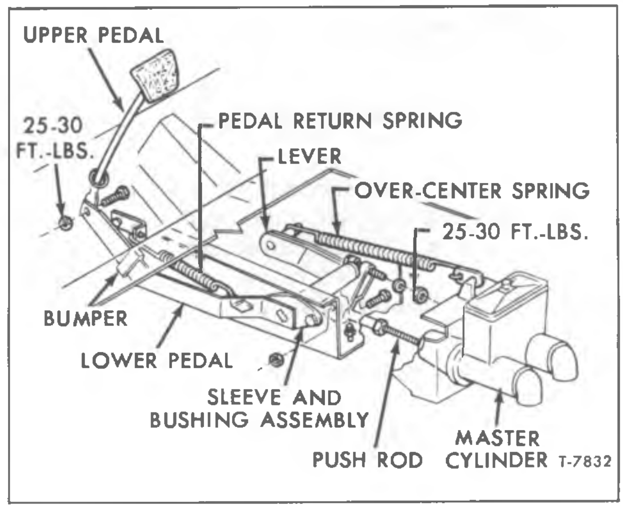


Figure 12—Clutch Pedal and Linkage ("TE" and "TS" Models)

Clutch system may be bled either manually or with pressure bleeding equipment.

PRESSURE BLEEDING

1. Make sure fluid level in fluid supply pressure tank is up to petcock above outlet and that tank is charged with 40 to 50 psi air pressure.
2. Clean dirt from around master cylinder cover. Remove standard cover and install bleeder cover. Connect pressure tank hose to bleeder cover opening. Bleed air from hose before tightening connection. Open valves at both ends of hose.
3. Slip end of bleeder drain hose over bleed valve at slave cylinder (8, fig. 15) and place the other end in a glass jar containing enough hydraulic fluid to cover end of hose. Open bleeder valve with wrench and observe flow of fluid from hose. Close bleeder valve as soon as bubbles stop and fluid flows in a solid stream.

MANUAL BLEEDING

Manual bleeding is the same as pressure bleeding, except that the hydraulic fluid is forced through the line by pumping the clutch pedal. Fluid in master cylinder must be replenished after bleeding. Clutch pedal should be pumped up and down slowly, and should be on downstroke as bleeder valve is closed.

MASTER CYLINDER PUSH ROD ADJUSTMENT

(Refer to Figure 12)

IMPORTANT: If any doubt exists relative to push rod adjustment, always remember it is better to have push rod adjusted too short than for it to be too long.

1. With engine "OFF," transmission in "Neutral," apply parking brake.

2. Tilt cab (see instructions in Section 1).

3. Loosen adjusting nut on push rod. Using pliers, turn rod in or out of rod end as necessary. Adjust so that a 1/8-inch movement of clutch pedal at pad is necessary before end of push rod contacts piston in master cylinder.

4. Tighten adjusting nut.

5. Check operation of clutch.

SLAVE CYLINDER PUSH ROD CHECK AND ADJUSTMENT

(Refer to Figure 11)

This procedure is required periodically to compensate for clutch facing wear. Purpose of adjustment is to maintain a clearance between the release bearing and the clutch release fingers with clutch engaged.

IMPORTANT: The clearance between the wedge and adjusting nut on models equipped with In-line and V8 engines should be 3/16-inch. On models equipped with V6 engine the clearance should be ½-inch. A short ruler may be used for checking the clearance.

1. Disconnect the slave cylinder return spring from clutch fork.

2. Force the slave cylinder push rod into the slave cylinder until it bottoms, by pushing on the vee nut.

3. Move the clutch fork away from the slave cylinder, until the release bearing contacts the clutch release fingers.

4. Check the clearance between the wedge and adjusting nut which should be as follows:

In-Line and V8 Engines . . . . 3/16"

5. If necessary, adjust the clearance by loosening the lock nut and adjusting nut. Reposition adjusting nut to provide proper clearance, then tighten lock nut against adjusting nut.

6. Connect slave cylinder return spring. Check operation of clutch.

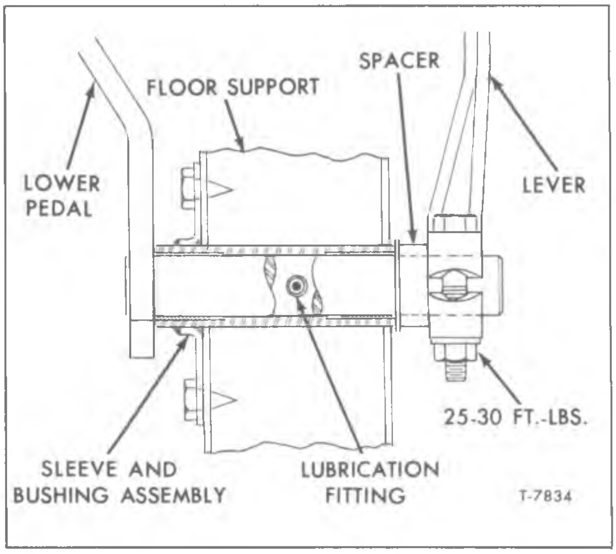


Figure 13 —Pedal Sleeve and Bushing Assembly

CLUTCH PEDAL AND BUSHING ASSEMBLY REPLACEMENT

REMOVAL (Refer to Figs. 12 and 13)

1. Tilt cab (see instructions in Section 1).

2. Disconnect pedal return spring, and also overcenter spring (used on "TE and TS" Models only).

3. Separate upper pedal from lower pedal after removing attaching bolt.

4. Remove bolt attaching pedal shaft lever to master cylinder push rod. Remove push rod.

5. Loosen bolt which clamps pedal shaft lever to lower pedal shaft. Slide lower pedal and shaft assembly from cab sill and then remove pedal shaft lever and spacer.

6. Through small access hole at base of cab sill, remove pedal shaft lubrication fitting.

7. Remove two retaining screws which attach the flange of pedal sleeve and bushing assembly from cab sill.

8. Remove pedal sleeve and bushing assembly from cab sill.

INSPECTION

1. Temporarily install lower pedal shaft into the pedal sleeve and bushing assembly and check for excessive wear. If necessary, replace bushings or entire pedal sleeve and bushing assembly.

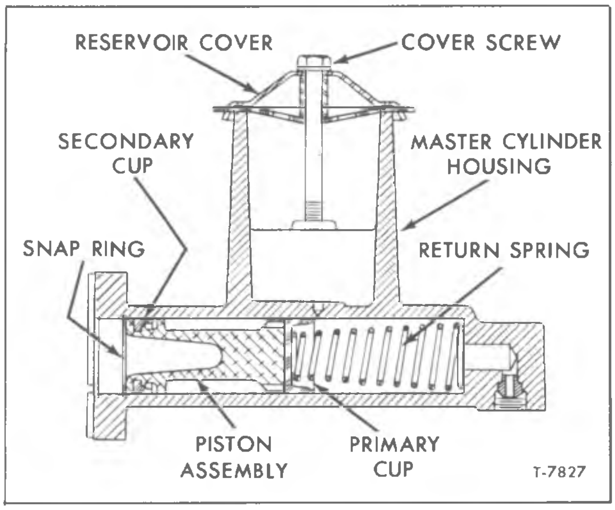


Figure 14—Clutch Master Cylinder

2. Check lower clutch pedal shaft for alignment and, if bent, straighten or replace.

3. Make sure pedal bumper is in good condition and located on lower pedal as shown.

INSTALLATION (Refer to Figs. 12 and 13)

1. Insert pedal sleeve and bushing assembly into cab sill, making sure that lubrication fitting hole faces the bottom of cab sill. Secure with two retaining screws.

2. Install lubrication fitting into tapped hole at bottom of sleeve.

3. Slide the lower pedal and shaft assembly through the sleeve, through the spacer, and into the partly serrated hole of the pedal shaft lever. Make sure pedal shaft lever is positioned as shown in figure 12.

4. Remove all shaft end play, then clamp pedal shaft lever to lower pedal shaft by tightening clamp bolt nut. Tighten nut to 25-30 foot-pounds torque.

5. Insert upper pedal through floor seal and attach to lower pedal with bolt, nut and washer.

IMPORTANT: Be sure bolt is inserted in direction shown in figure 12. Tighten nut to 25-30 foot-pounds torque.

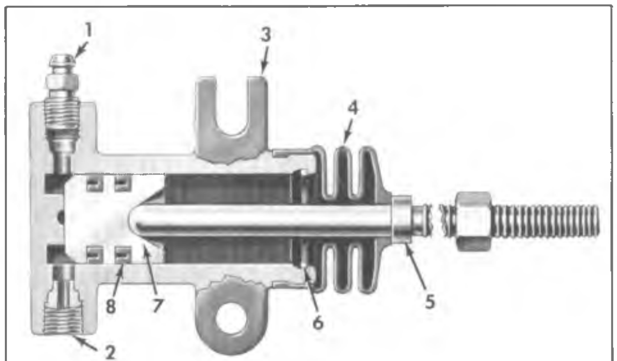
6. Install clutch pedal return spring and also overcenter spring (used on "TE and TS" models only).

IMPORTANT: Exercise caution when installing springs.

7. Install master cylinder push rod and adjust as described earlier in this section.

CLUTCH MASTER CYLINDER

A double-barrel master cylinder (fig. 14) is used on steel tilt models covered by this manual. The unit consists of two cylinders with an integral reservoir.



1 Bleeder Valve
2 Fluid Entry Port
3 Cylinder Body
4 Push Rod Boot
5 Push Rod
6 Piston Retaining Ring
7 Piston
8 Piston Seals
T-1006

Figure 15—Clutch Slave Cylinder (Typical)

MAINTENANCE (ALL TYPES)

Filler cap or cover on all clutch master cylinders are designed to vent the fluid reservoir without permitting loss of fluid. Bypass port between cylinder bore and reservoir and vent hole in filler cap must be kept open to assure proper clutch control. An obstructed bypass port will prevent return of fluid to reservoir, preventing full engagement of clutch. Bypass ports may be obstructed by one of the following causes:

1. Clogged With Dirt -- Remove master cylinder and disassemble and clean all parts.

2. Swollen Primary Cup Due to the Use of Wrong Fluid -- Overhaul master cylinder, drain and flush entire clutch control system, and refill with proper fluid.

3. Pedal Binding on Shaft, Preventing Full Return of Piston -- Free up and lubricate pedal.

4. Improper Push Rod Adjustment -- Adjust push rod.

MASTER CYLINDER REPLACEMENT

Instructions for replacing clutch master cylinders are the same as for brake master cylinders as described in "HYDRAULIC BRAKES" (SEC. 5A).

After installing clutch master cylinder, bleed system and adjust push rod as described previously under "Bleeding Hydraulic System" and "Master Cylinder Push Rod Adjustment."

CLUTCH SLAVE CYLINDER

The clutch slave cylinder (fig. 15) mounted at side of clutch assembly (fig. 16) activates the mechanical clutch release fork or lever to disengage clutch when cylinder is pressurized.

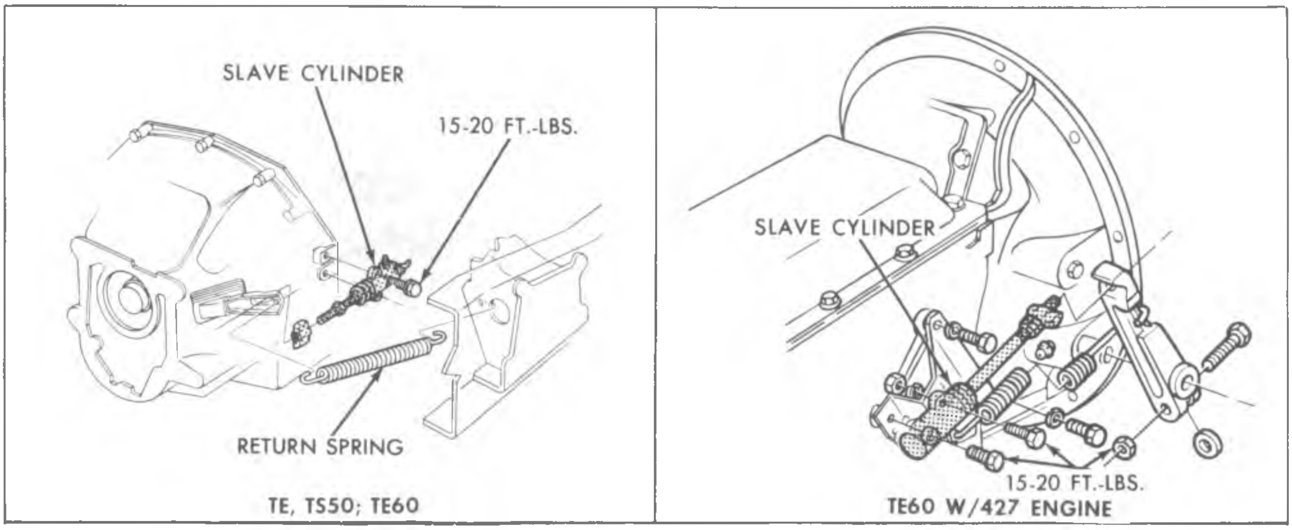


Figure 16—Clutch Slave Cylinder Installation

REMOVAL (Refer to Fig. 16)

1. Remove return spring from clutch release fork.

2. Disconnect fluid line at slave cylinder.

3. Remove bolts retaining slave cylinder, then remove cylinder assembly.

DISASSEMBLY (Refer to Fig. 15)

1. Remove cylinder push rod (5) and push rod boot (4) from cylinder.

2. Remove piston retaining ring (6) from slave cylinder.

> **CAUTION: Use extreme care while removing retaining ring to prevent damage to the bore of the cylinder body (3).**

3. Remove piston assembly (7) with seals (8) from cylinder body (3).

NOTE: Piston can be jarred from body or small amount of air pressure at line fitting will force piston from bore. Use caution to prevent damage to the piston.

4. If seals are found in good shape, they need not be removed.

INSPECTION (Refer to Fig. 15)

1. Inspect slave cylinder bore, making sure that it is smooth. A scored or damaged cylinder body (3) must be replaced.

NOTE: Burrs at the bore side of inlet port can be removed by honing or by use of crocus cloth.

2. Check piston seals (8) if removed. Swelling of seals could be due to use of improper brake fluid.

3. Check fit of the piston in the cylinder bore, using a feeler gauge. This clearance should be from 0.002" to 0.004".

ASSEMBLY (Refer to Fig. 15)

1. Install seals (8) into grooves of piston (7) with lips of seals positioned to fluid end of piston.

2. Dip piston and seals into clean brake fluid then carefully install piston assembly into bore of cylinder. Refer to figure 20 for proper position of piston in cylinder.

3. Install retaining ring (6) into groove at open end of cylinder.

4. Install boot (4) over push rod (5) and install rod and boot to slave cylinder.

INSTALLATION

1. Bolt slave cylinder assembly to engine (fig. 16).

2. Adjust slave cylinder push rod clearance as outlined in this section under "Slave Cylinder Push Rod Adjustment."

3. Attach hydraulic line to slave cylinder and bleed air from system at slave cylinder bleed fitting. See "Bleeding Hydraulic System" as described previously.

SECTION 7E

Clutches

CLUTCH APPLICATION CHART

Clutch Type	Engine Application
GM (11-Inch Single Disc)	250
Borg & Beck (12-Inch Single Disc)	292, 350
Borg & Beck (12-Inch Dual Disc)	427
Borg & Beck (13-Inch Single Disc)	350, 366

CLUTCH REPLACEMENT

IMPORTANT: Whenever clutch components require replacement, use only genuine General Motors Parts or equivalent to assure maximum clutch performance and life.

CLUTCH REMOVAL

1. Remove transmission assembly from vehicle as directed in "TRANSMISSION ON-VEHICLE SERVICE OPERATIONS" (SEC. 7B) of this manual.

NOTE: On vehicles equipped with a clutch release fork, remove release bearing and support assembly from release fork. Disengage clutch fork return spring from end of fork.

2. Remove clutch release fork (when used) from ball stud by prying it away from the ball with a screwdriver until it snaps loose from the ball.

3. Install aligning tool or an old transmission main drive gear into the hub of the clutch driven disc(s) to support the clutch components during removal.

IMPORTANT: To facilitate removal of the Long or Borg and Beck clutch cover assemblies, install hardwood wedges between the release levers and cover as shown in figures 1 and 3.

4. Mark clutch cover in relation to engine flywheel to assure original position when reassembled later if either part is to be reused.

5. Loosen the cover bolts alternately one turn at a time to avoid creating undue stresses in the clutch cover.

NOTE: It is most important that the cover bolts be loosened one turn at a time on the 11-inch clutch (used on vehicles equipped with In-Line engine).

6. With the aid of aligning tool or old transmission main drive gear remove complete clutch assembly from flywheel.

INSPECTION AND REPAIR

The following procedures apply to all clutch components with exceptions as indicated.

CLUTCH RELEASE MECHANISM (FORK-TYPE)

1. Check release fork and ball stud for wear, distortion, cracks, or other damage.

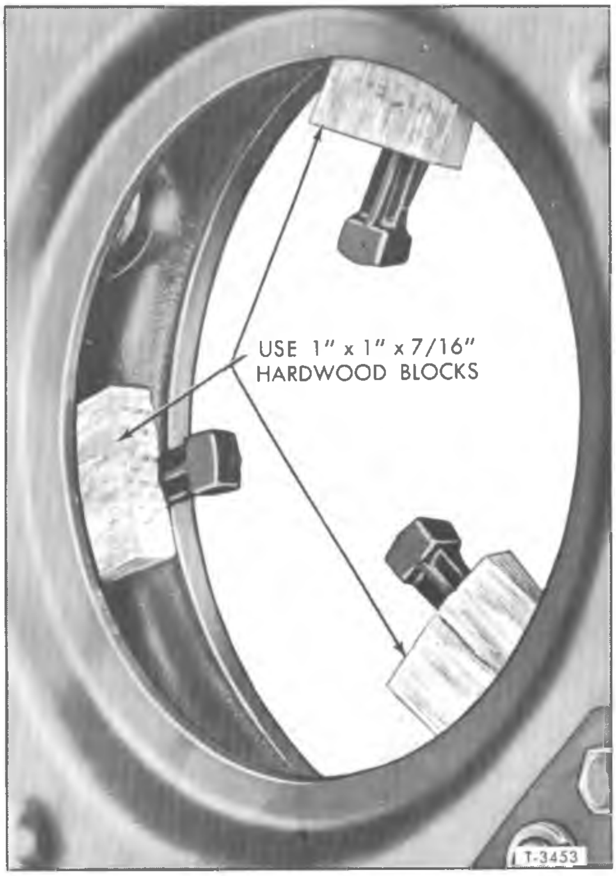


Figure 1—Use of Blocks Between Release Levers and Cover (Long or Borg and Beck)

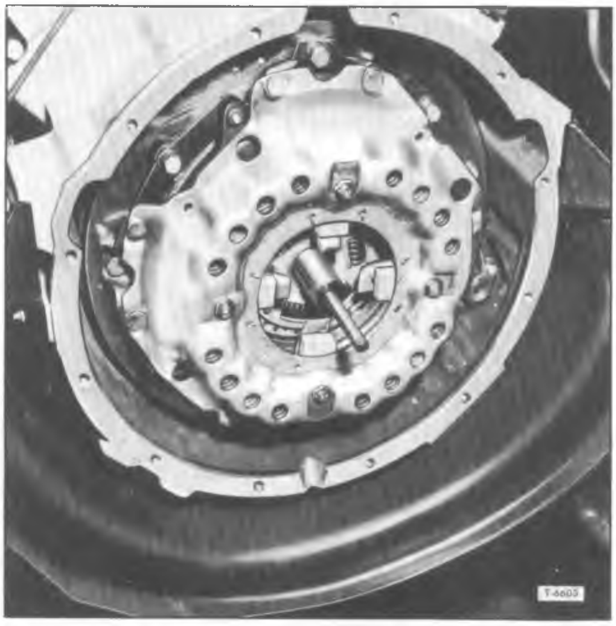


Figure 2—Borg and Beck 12-Inch Dual Disc Clutch

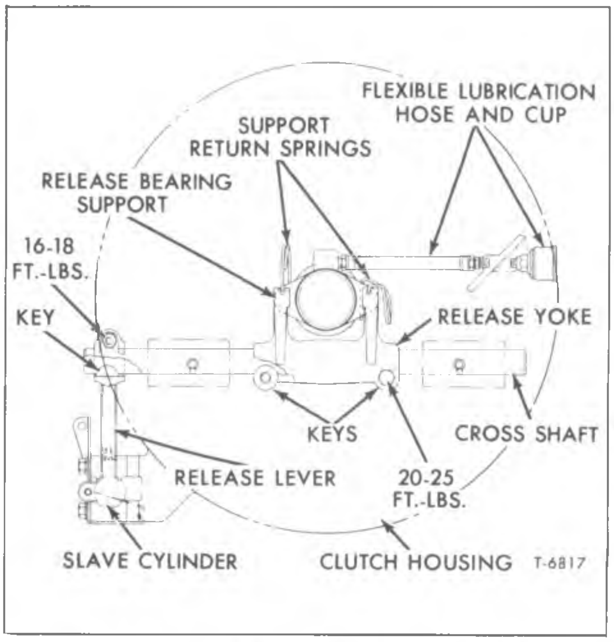


Figure 4—Clutch Release Mechanism (Yoke Type)

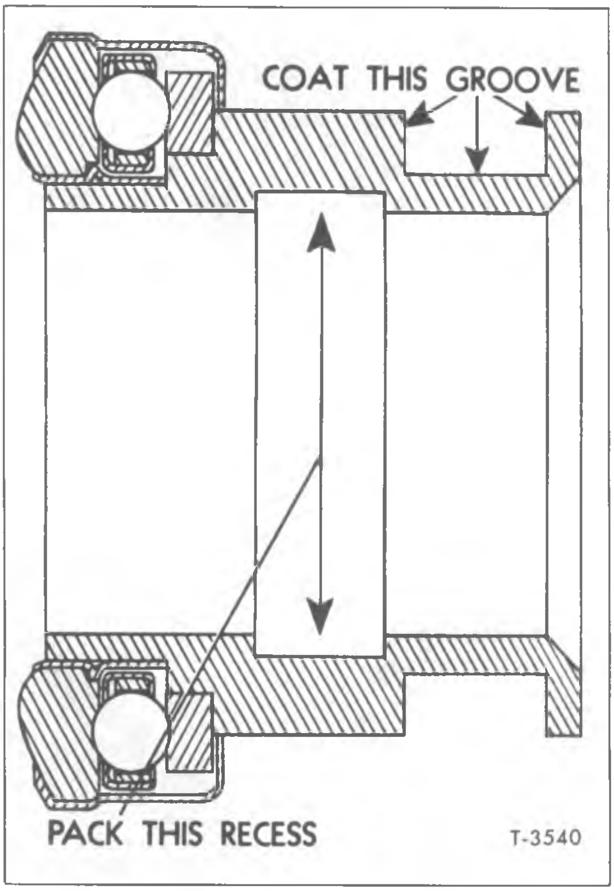


Figure 3—Release Bearing and Support Assembly (Typical)

2. Check release bearing for roughness or noise by rotating bearing race while applying light pressure.

3. Replace all components that would affect proper operation of the clutch release mechanism.

4. Prior to installation of clutch release bearing and support assembly (fig. 3), fill the inside groove and coat the outside groove with a small quantity of high temperature grease "S27." For an explanation of lubricant "S27" refer to LUBRICATION (SEC. 0) of this manual.

IMPORTANT: An excessive amount of lubricant applied to release bearing could spin off the bearing and damage other clutch components.

CLUTCH RELEASE MECHANISM (YOKE-TYPE)

Check bearing for roughness or noise by rotating bearing race while applying light pressure. Replace the bearing if it is rough, noisy, or when damaged.

Removal (Refer to Fig. 4)

1. Remove release lever from clutch release cross shaft.

2. Disconnect flexible lubrication tube from top of release bearing support. Remove two retaining springs from top of bearing support. Slide release bearing and support assembly off end of transmission bearing cap.

3. Remove two cap screws which attach release yoke to cross shaft, then drive the yoke to one side to expose two drive keys. Remove keys, then drive shaft out of yoke and remove from the housing.

Installation (Refer to Fig. 4)

1. Hold clutch release yoke in position in the clutch housing, then insert release cross shaft through one side of clutch housing, through release yoke and out through opposite side of housing.
2. Install two keys in cross shaft, then move yoke into place with keys engaging keyway in yoke. Do not tighten bolts until after release bearing and support assembly is assembled to bearing cap.
3. Examine contact buttons on ears of bearing support for worn condition. Buttons can be pressed out or into support if necessary.
4. Slide release bearing and support assembly on bearing cap to contact fingers of release yoke.
5. Install retaining springs, then connect lubrication tube to top of support.
6. Check cross shaft and yoke to make sure they are properly centered then tighten yoke clamp bolts.
7. Install release lever on yoke cross shaft with drive key in slot of shaft. Lever should be positioned on shaft so that it is directly in line with center of slave cylinder push rod. Tighten lever clamp bolt firmly.
8. Fill grease cup with lubricant as specified in LUBRICATION (SEC. 0) of this manual, and turn down cup to provide initial lubrication to support. Also, lubricate clutch cross shaft bushings, using fitting at each side of clutch housing.

PILOT BUSHING (IN-LINE ENGINES)

The pilot bushing, which is pressed into crankshaft is an oil impregnated type bronze bearing. This bushing requires attention only when the clutch is removed from the vehicle, at which time it should be cleaned and inspected for excessive wear or damage and should be replaced if necessary.

Removal

Install Tool (J-1448), and pull bushing from crankshaft bore (fig. 5).

Installation

In replacing this bearing, use Tool (J-1522). Place bearing on pilot of tool with radius in bore of bearing next to shoulder of tool and drive into crankshaft.

PILOT BEARING

Corrosion or roughness on either the race or balls can be detected by rotating bearing inner race with finger.

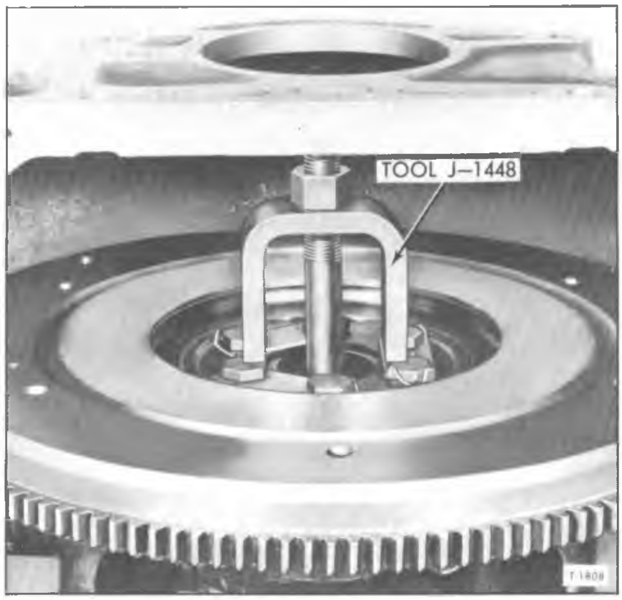


Figure 5—Pilot Bushing Removal

Removal

Remove clutch pilot bearing assembly from engine, using pilot bearing remover (J-5901-2) with slide hammer (J-2619). With fingers on puller closed, insert fingers through bearing inner race as far as they will go, then tighten thumb screw to spread fingers. Slide weight sharply against stop on puller shaft to remove bearing.

Installation

1. Pack clutch pilot bearing with small quantity of high temperature lubricant specified in LUBRICATION (SEC. 0) of this manual.
2. With shielded side of bearing toward the rear, drive pilot bearing into position using a suitable driver. Bearing should be seated firmly.

FLYWHEEL, INTERMEDIATE DRIVE PLATE, AND PRESSURE PLATE

If either the flywheel, intermediate drive plate, or clutch pressure plate is found to be scored, burned, warped, or worn, these components are to be replaced. All recommendations for machining of the flywheel, intermediate drive plate, and/or pressure plate to eliminate these conditions are to be voided.

DRIVEN DISCS

Inspect driven disc assembly for worn, loose, and grease or oil-soaked facings. Check for broken springs, loose rivets (when used), or cracks in the driven disc hub. Examine splines in hub for wear and make sure they slide freely on splines of the main drive gear. If any wear or damage is evident, replace with a new driven disc assembly.

PRESSURE PLATE AND COVER ASSEMBLY

Detailed inspection and repair procedures for the pressure plate and cover assembly are not covered in this manual.

CLUTCH INSTALLATION

1. Be sure the wood blocks (figs. 1 and 3) or hold-down bolts and washers (fig. 2) are installed in the clutch cover assembly.

2. Place front driven disc against flywheel. Place intermediate drive plate against the front driven disc. Then place rear driven disc against intermediate drive plate.

NOTE: Be sure the larger exposed portion of disc damper springs face the pressure plate.

3. Move clutch cover assembly into position against dual disc assembly. Insert alignment tool or old transmission main drive gear into pilot bearing.

4. If alignment marks were made on clutch cover and engine flywheel prior to removal, align these marks.

5. Install cover-to-flywheel bolts and washers. Tighten bolts alternately one turn at a time to compress clutch pressure springs evenly and prevent possible distortion of cover.

NOTE: Tighten clutch cover-to-flywheel bolts to 35-45 foot-pounds torque. Remove aligning tool.

IMPORTANT: After installing clutch cover assembly be sure to remove wood blocks (refer to fig. 1).

6. Clutch release mechanism (fork-type):

a. Be sure clutch release bearing and support assembly (fig. 4) is lubricated as described previously under "Inspection and Repair."

b. Install release fork ball stud to the clutch housing. Tighten ball stud to 30-40 foot-pounds torque.

c. Apply a small amount of high temperature grease to ball stud recess in release fork, then install ball stud retainer spring in fork. Force ball stud into fork recess until engaged by spring.

d. Position release bearing in yoke portion of release fork.

7. Clutch release mechanism (yoke-type):

a. Be sure clutch release bearing and support assembly is lubricated as described previously under "Clutch Release Mechanism."

8. Install transmission assembly as described in "TRANSMISSION ON-VEHICLE SERVICE OPERATIONS" (SEC. 7B) in this manual.

CLUTCH TROUBLESHOOTING

SYMPTOMS AND PROBABLE CAUSE	PROBABLE REMEDY
SLIPPING	
1. Improper adjustment.	1. Adjust slave cylinder travel clearance or if control is of link type, make adjustment at release fork or lever adjustment rod.
2. Oil soaked clutch disc.	2. Install new disc.
3. Worn splines on transmission drive gear.	3. Replace drive gear.
4. Lining loose on clutch disc.	4. Install new disc.
5. Warped pressure plate or engine flywheel.	5. Replace pressure plate or flywheel.
GRABBING	
1. Oil on disc lining.	1. Install new disc.
2. Worn splines on transmission drive gear.	2. Replace drive gear.
3. Loose engine mountings.	3. Tighten or replace engine mountings.
4. Warped pressure plate or engine flywheel.	4. Replace pressure plate or flywheel.
RATTLING	
1. Weak retracting springs.	1. Replace springs.
2. Release fork loose on ball pivot stud.	2. Check stud and retaining spring and if necessary, replace.
NOISY	
1. Worn clutch release bearing.	1. Replace release bearing.

HYDRAULIC CONTROLS

PEDAL SPONGY	
1. Air in clutch hydraulic line.	1. Bleed clutch slave cylinder.
EXCESSIVE PEDAL TRAVEL	
1. Leaking slave cylinder line.	1. Tighten or replace line.
2. Fluid low in hydraulic master cylinder.	2. Fill cylinder to 1/2" below top of reservoir.
3. Clutch master cylinder push rod lever loose or not properly adjusted.	3. Adjust length of clutch push rod under dash.
CLUTCH PEDAL RELEASES CLUTCH BUT PEDAL GRADUALLY TRAVELS DOWNWARD	
1. Clutch master cylinder leaks past primary cup.	1. Overhaul master cylinder.
2. External leaks.	2. Tighten all line fittings and check for leaks in line.

T-6847

SECTION 8

Fuel Tank and Exhaust

NOTE: Refer to ENGINE FUEL SYSTEM (SEC. 6M) for information pertaining to fuel filters and fuel pumps.

SECTION 8A

Fuel Tank, Lines, and Gauge System

GENERAL DESCRIPTION

TANK MOUNTINGS AND LOCATIONS

The standard 21-gallon (17.5 Imperial Measure) fuel tank with cover, is mounted behind the seat within the cab. The filler neck extends through the left side of the cab (fig. 1A).

In general, fuel tanks are located on side of chassis (fig. 1, B thru F), and lay lengthwise to frame side rail. A mounting of two metal straps anchor tanks to mounting brackets which are bolted to frame side member. Metal-to-metal contact between tank and brackets and straps is prevented by use of anti-squeak material.

FUEL TANK CONSTRUCTION

Types A, B, and C fuel tanks (fig. 1) consist of two steel sections, each with a wide flange and baffles which are pressed into the tank halves. The two tank sections are seam-welded at the flange around the entire tank to assure leakproof construction. Exceptional stiffness is secured by the combination of the welded flanges and depressed ribs in both tank sections. Baffle plates are incorporated to provide additional stiffness and to prevent the surging of gasoline within the tank.

Types D, E, and F (fig. 1) fuel tanks are seam welded around the entire tank.

FILLER CAPS AND NECKS

Types A, B, and C (fig. 1) fuel tanks are equipped with a vented filler neck cap, which incorporates a pressure relief valve. The pressure relief valve is required by I.C.C. regulations and is designed to prevent excessive spillage if tank should ever become inverted. When necessary, replace with original type cap.

Fuel tank filler caps and neck assemblies also conform to the latest S.A.E. Standards for filler caps and related filler neck cams. Upper and lower filler necks vary as to size, length, and shape, depending on model requirements. Filler necks are treated so that rust will not form and get into the fuel system. In general, lower filler necks are first bolted or riveted to the tank and then sweat soldered in place to eliminate any possibility of leakage. All tanks are equipped with a vented filler neck cap.

Types D, E, and F (fig. 1) fuel tank filler caps and vent check valves conform to the latest S.A.E. and I.C.C. regulations. The typical cap as shown in figure 2 is designed so that the four holes are filled with a special fusible alloy. This will melt out at approximately 160° to 170°F., to preclude explosion.

FUEL PICKUP PIPE

The fuel pickup pipe is built integrally with the tank gauge unit, located at the top of the tank in line with safety recommendations. A large area, fine-mesh screen is located on the bottom of the fuel pickup pipe. This screen is designed to prevent the entrance of dirt or water into the fuel system. See "Fuel Gauge System" later in this section for complete description of tank sending unit.

IMPORTANT

When working on fuel system, fire fighting and appropriate safety equipment should be provided in accordance with local fire and safety regulations.

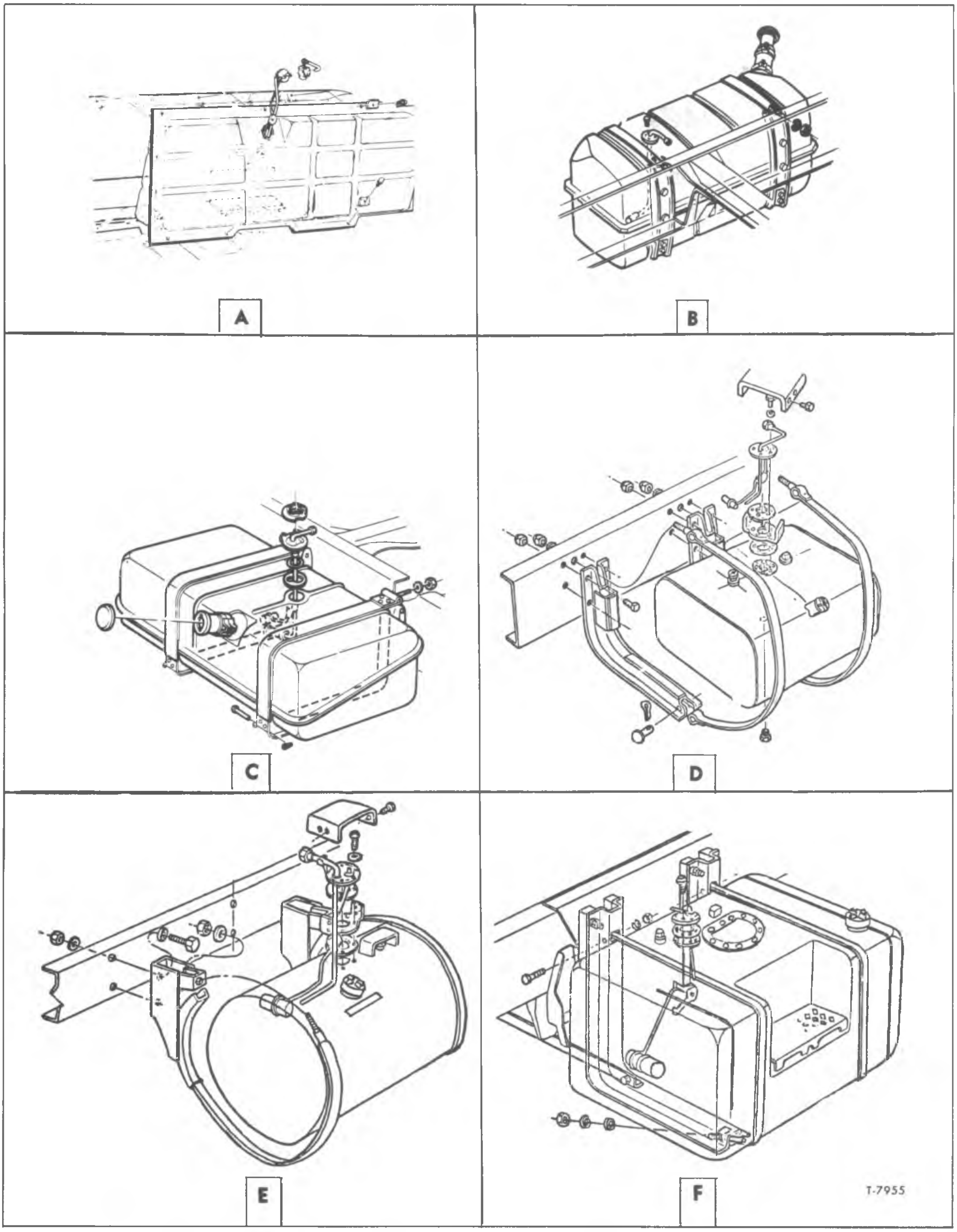


Figure 1—Cab and Frame Mounted Fuel Tanks (Typical)

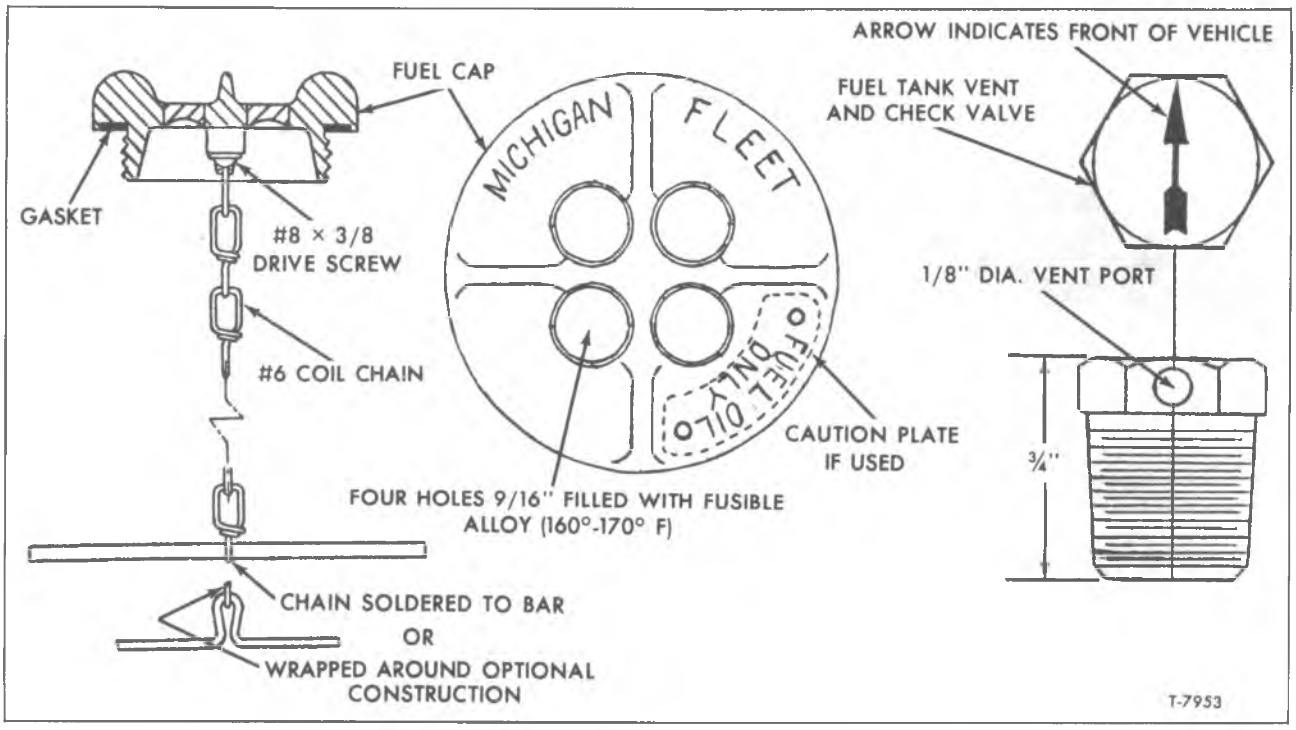


Figure 2—Safety Cap and Vent Check Valve Plug (Typical)

SAFETY CAP DESCRIPTION AND REPLACEMENT

Care should be taken during sheet metal, or other repairs in the areas around the fuel tank. The cap should be covered with a protective cover if the vehicle is put into a paint oven or if a heat lamp is used near the tank. If the alloy should melt for any reason, no attempt should be made to replace it. The cap assembly should be replaced. It can be replaced by working the safety chain out of the neck of the tank. A new cap and chain should be installed so that chain is hooked inside the neck and will not allow cap to fall during normal use.

A check valve vent (fig. 2) is used in conjunction with the safety cap as a vent for the tank and a check valve in case the tank becomes inverted. The vent port should be kept open and clear at all times. Any dirt should be removed from the port, the fuel cap removed and air forced into the vent port to clean it.

REPLACEMENT OF GAUGE UNIT OR STRAINER

NOTE: Ignition switch must be in "OFF" position.

1. Move seat forward and remove tank cover.
2. If necessary, drain tank to a level below gauge unit mounting.
3. Disconnect fuel feed line and wiring from gauge unit.
4. Unlock gauge cam ring using special tool as shown on page 8A-7; remove gauge unit from tank.
5. Replace or clean strainer with compressed air as required.
6. Using new gasket, install gauge unit using reverse of removal procedure.

FUEL TANK REPLACEMENT

DRAINING FUEL TANK

If fuel tank does not incorporate a drain plug, it will be necessary to siphon fuel from tank. The following procedure is recommended:

1. Obtain an 8 to 10 foot length of 3/8", or slightly less, I.D. hose and cut a flap type slit 18" from one end (refer to fig. 3).

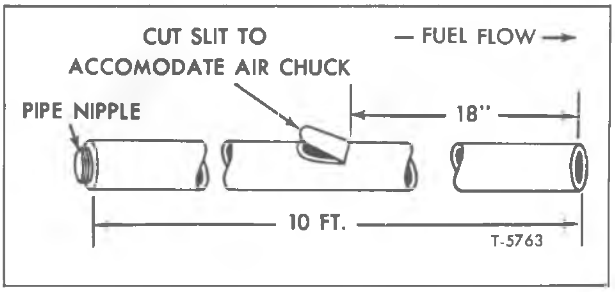


Figure 3—Tank Siphon Construction

Figure 4—Tube Flaring Tool J-8051

NOTE: Hose with larger than 3/8" I.D. is not recommended as it is difficult to erect and maintain a siphon using this method with a larger hose.

2. Insert a small nipple (at least 1/8" larger O.D. than the hose I.D.) into opposite end of hose from slit.

3. Insert nipple end of hose into tank until it strikes bottom.

4. With the opposite end of the hose in a suitable container which is positioned below bottom of fuel tank, insert an air pressure hose nozzle into flap-type slit and trigger flow of fuel by forcing air pressure through siphon towards container.

TANK REMOVAL

The following procedure is intended as a general guide only and will vary according to truck series and model.

1. Drain tank by removing drain plug (if equipped) or using siphon as described previously.

2. Disconnect filler neck hose at lower clamp as required to provide clearance for tank removal.

3. Disconnect fuel line(s) and wiring from tank unit. Ignition switch must be in "OFF" position.

NOTE: On models when top of tank is not readily accessible, loosen tank support straps enough to disconnect tank unit wire.

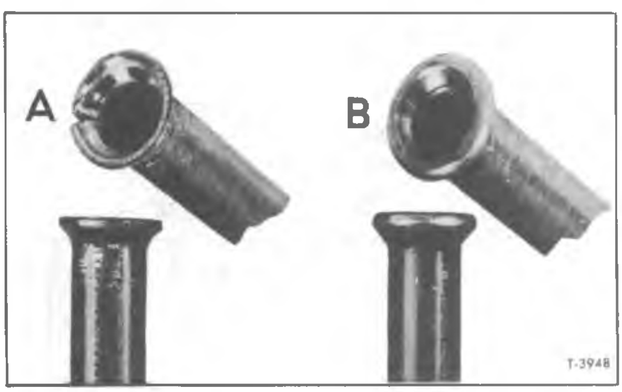


Figure 5—Single and Double Lap Flare

4. Remove tank support straps and lower tank from vehicle. To remove fuel tank sending unit, refer to procedure under "Tank Unit Replacement" described later in this section.

5. To install, reverse the "Removal" procedure. Replace all anti-squeak material and be sure tank straps are positioned properly and tightened evenly.

FUEL TANK REPAIR

Remove all lines, wires, and gauge unit from tank assembly. Remove tank for major repairs as previously covered under "Fuel Tank Replacement." In event of repairs that involve soldering or welding, even though the tank has been drained, it must be purged or cleansed to be made safe.

The purging process removes the fuel molecules that remain in the metal walls of the tank forming the dangerous fumes. Flush the tank out with clean water for 5 minutes. Next, pour in a specified amount of purging material per manufacturer's specification. Insert an air hose to the bottom of the tank and agitate with air 7 to 10 minutes on smaller tanks. Empty the tank and make necessary repairs. Reinstall gauge unit and install tank to vehicle. Connect lines and wire and when repair area is cold refill tank with fuel to prevent rust formation.

If tank is to be stored after repair, insert a small quantity of Kerosene and #10 engine oil mixed 50/50 and agitate tank. Pour off excess and seal openings to prevent rust formation.

FUEL LINE INSTALLATION

In making up fuel lines, it is important that the ends of the tubing be flared properly for the compression couplings. Unless the tubing is properly flared, the couplings will leak.

NOTE: Only seamless steel tubing is to be used.

The tubing must be double-lap flared at the ends in order to produce a strong leak-proof joint.

The Tool (J-8051) (fig. 4) must be equipped with the proper size die block and upset flare punch for each size tubing to form the double-lap flare.

The proper size die blocks and upset flare punches are as follows:

Tubing Size	Die Block	Upset Flare Punch	Finish Flare Punch
3/16"	J-2185-27	J-2185-3	J-2185-26
1/4"	J-2185-28	J-2185-37	J-2185-26
5/16"	J-2185-29	J-2185-4	J-2185-26

NOTE: These special tools are also part of Kit J-8051.

Figure 5 shows two pieces of tubing - one with a single-lap flare "A" and the other with a double-lap flare "B." It will be noted that the single-lap flare splits the tubing while the double-lap flare shown in "B" is a heavy, well-formed joint.

The following procedure should be followed in making up fuel pipes:

1. Cut tubing to the desired length, using Tool (J-8000). Square off ends of tube and ream sharp edges with reamer tool provided on the tube cutter.
2. Install compression couplings on tubing and dip end of tubing to be flared in hydraulic brake fluid. This lubrication results in better formation of the flare.
3. Select the correct size upset flare punch. One end of this punch is hollowed out to gauge the amount of tubing necessary to form a double-lap flare.
4. Slip the punch into the tool body with gauge end toward the die blocks, install ram and tap lightly until punch meets the die blocks and they are forced securely against the stop plate (fig. 6).
5. Draw latch plate nuts down tight to prevent tube from slipping. Draw nuts down alternately beginning with nut on closed side to prevent distortion of plate.
6. Remove punch and ram. Reverse punch and place back in tool body. Install ram and tap lightly until face of punch contacts face of die blocks to complete first flare operation (fig. 7).
7. Remove ram and punch.
8. Insert finish flare and ram in tool body and tap ram until a good seat is formed (fig. 8).
9. Blow tubing out with compressed air.

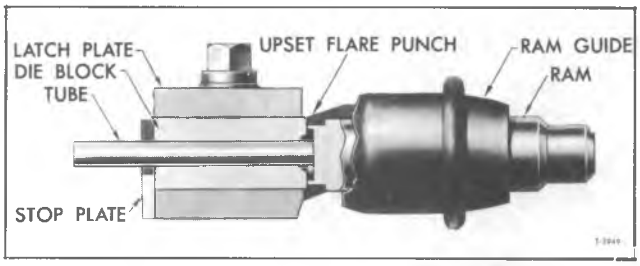


Figure 6—Flaring Operation (Positioning Tubing)

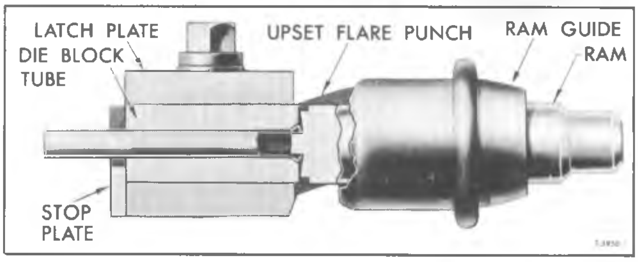


Figure 7—Flaring Operation (First Flare)

FUEL LINE MAINTENANCE

The fuel lines should be inspected occasionally for leaks, kinks, or dents. If evidence of dirt is found in the carburetor, fuel pump, or fuel filter on disassembly, the lines should be disconnected and blown out. Check the fuel strainer in the tank for damage or omission. A leaking fuel tank should be repaired or replaced immediately (see "Fuel Tank Repair"). Crimped, kinked, or leaking fuel lines should be replaced.

When installing fuel lines, tighten tubing nuts only enough to prevent leakage and provide a secure connection. Where possible, a back-up wrench should be used to prevent twisting or excess stress on tubing.

When replacing a flexible fuel line, be sure hoses are properly located to prevent chafing against frame members, or twisting. Fuel line retainers should be positioned properly on fuel lines to assure secure support, yet not result in line constriction. Cracked, corroded, or bent retainers should be replaced. On models where the fuel line passes through the frame there should be a rubber grommet in the frame hole or a section of rubber hose around the line.

NOTE: Refer to FUEL SYSTEM (SEC. 6M) of this manual for information pertaining to maintenance and replacement intervals for In-line and frame mounted fuel filters.

FUEL LINE RETAINER CLIP (Fig. 9)

A periodic inspection should be made to be sure lines are securely mounted. If fuel pipes and retainer clips are removed. Tool (J-7777) should be used to install new retainer clips (fig. 9). After removal of the old clip from the frame, position the new clip in the location of the old clip. Index the "blind rivet" and press hard (hand pressure should do) to expand rivet.

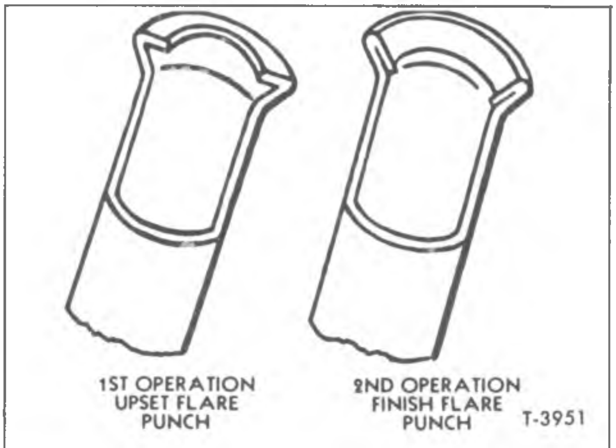


Figure 8—Flaring Operation (First and Second Flare)

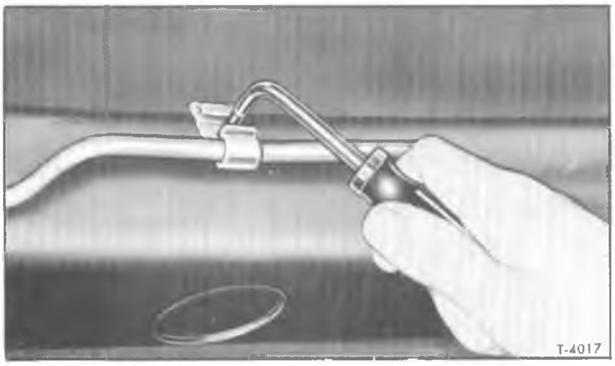


Figure 9—Installing Fuel Line Retainer

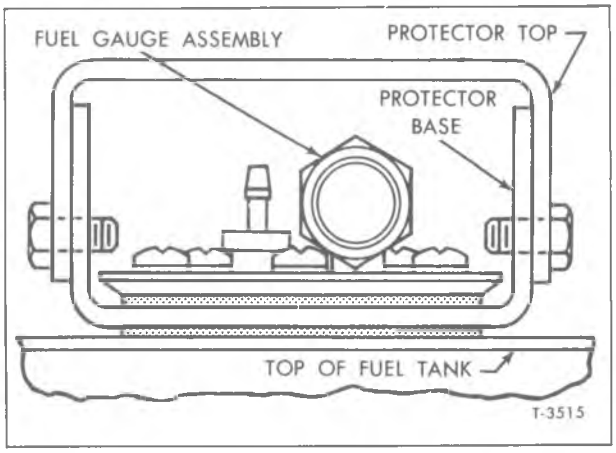


Figure 11—Tank Unit Protector

FUEL GAUGE SYSTEM

TANK UNIT (Fig. 10)

The fuel tank strainer, fuel pickup pipe, and tank gauge unit are one assembly. The sock-type strainer, located on bottom of fuel pickup pipe, is of plastic wrap construction with a heat sealed end and is replaceable. The large area fuel strainer is of sufficiently fine mesh to prevent entrance of contaminants into fuel system and operates with a self-cleaning action. Inspect condition of strainer if tank unit is removed and replace or clean as required.

The tank unit houses a variable resistor (rheostat) which controls current through the dash gauge according to position of float. The tank unit rheostat may be checked with an ohmmeter. With float on "EMPTY" position, ohmmeter connected across rheostat should indicate .00 to 1.0 ohms resistance.

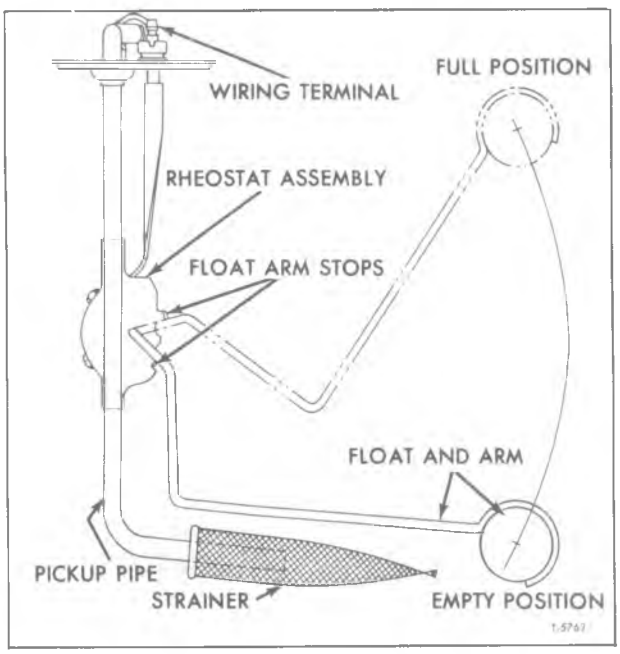


Figure 10—Gasoline Tank Sending Unit

With float on "FULL" position, resistance should measure about 90 ohms for conventional cab models and 30 ohms for steel tilt models.

TANK UNIT REPLACEMENT

NOTE: Tank may incorporate a protective top (fig. 11) to shield tank unit electrical connections and fuel line(s). To remove the protector top, a bolt at each side must be removed. The lower portion of the gauge protector is sandwiched between two gaskets beneath the top of the fuel gauge and can be removed only after removal of gauge unit from fuel tank.

Tilt Cab Models

1. Turn ignition switch or engine control switch to "OFF" position.
2. Disconnect electrical wire from terminal on tank unit.
3. Disconnect fuel line(s) at tank unit.
4. Remove screws or bolts attaching tank unit flange to tank. Then lift tank unit out of tank.
5. Carefully install new gasket and tank unit in tank and align flange bolt holes.
6. Install screws holding flange to tank.
7. Connect fuel line(s) at tank unit. Connect electrical wire to terminal on tank unit.

Conventional Cab Models

A special tool can be devised to facilitate removal and installation of tank unit. Tool can be made from a common spanner wrench as follows:

Saw one slot in each dowel at end of each spanner arm (see Inset on fig. 12). Each slot should be parallel to spanner arm as shown. The saw slots should measure approximately 1/8 inch deep and 1/16 inch wide (width of two hack-saw blades). File a flat surface perpendicular to slot at each end of slots. Grind end of spanner arms if additional clearance is needed.

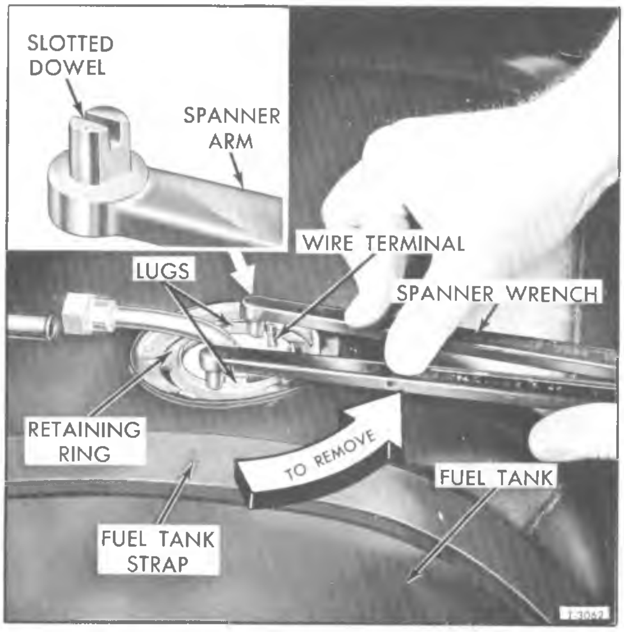


Figure 12—Removing Retainer Ring

DASH GAUGE

Refer to wiring diagram shown on "Fuel Gauge System Trouble Diagnosis Chart."

The dash fuel gauge is an electromagnetic instrument which visually indicates quantity of fuel in tank when the ignition switch is turned to the "ON" or "ACCESSORY" position.

The dash gauge consists of a permanent magnetic armature and spindle assembly to which a pointer is attached. Surrounding the magnetic armature are two coils wound perpendicular to each other. These coils provide the magnetic field which deflects the armature and pointer. The intensity and direction of the resultant magnetic field of the coils is dependent on current flow controlled by resistance of the tank unit rheostat. When the position of the slider arm varies, a change in rheostat resistance occurs which results in a proportional current change in the dash gauge coils. This allows the armature (and pointer) to align itself according to the resultant magnetic field produced by the coils. The total angular travel of armature and pointer from "EMPTY" to "FULL" is 90 degrees.

As mentioned previously, the tank unit rheostat resistance is approximately zero ohms when the fuel tank is empty (float arm is at its lowest position). As the tank is filled, the tank unit float arm will rise to increase rheostat resistance which in turn, will result in the pointer in the dash gauge to deflect towards the "FULL" position.

The dash gauge is not reparable and is replaced as an assembly. The dash gauge fixed calibration resistor shown on the "Fuel Gauge Wiring Diaphragm" is connected across the two external wiring terminals of the gauge. Refer to CHASSIS ELECTRICAL AND INSTRUMENTS (SEC. 12) of this manual for illustrations of dash gauge as positioned on various types of instrument clusters.

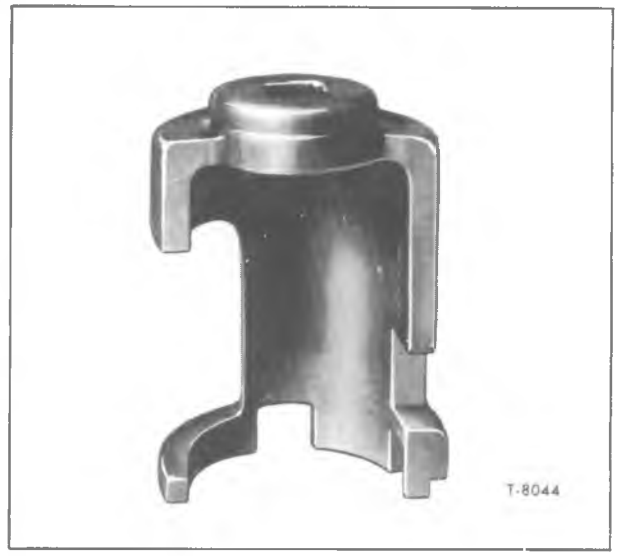


Figure 13—Special Tool

WARNING: Conventional cab models have a 90 ohm dash gauge and a 90 ohm tank sending unit. All steel tilt models have a 30 ohm dash unit and a 30 ohm tank sending unit. It is important that dash gauge and sending units not be interchanged between conventional and tilt cab models if wrong fuel gauge components are installed, inaccurate fuel quantity readings will result. To be certain that mating resistances between dash gauge and tank unit are maintained, be sure to install correct parts.

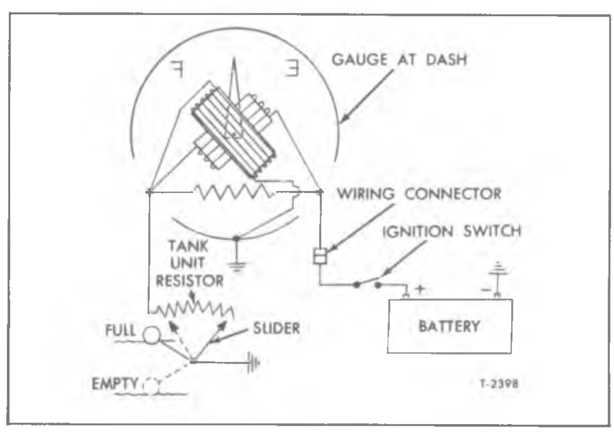


Figure 14—Fuel Gauge System Wiring Diagram

FUEL GAUGE SYSTEM TROUBLE DIAGNOSIS CHART

PROBABLE CAUSE	Reads 1/4 when empty or won't read empty	Reads accurately between "E" and 1/4; above 1/4 reads "F"	Needle does not move	Reads "E" all the time	Reads "F" all the time	Reads 3/4 when full or won't read full	Reads 1/4 when full	Reads too high for amount in tank	Erratic reading	SUGGESTED REMEDIES
1. Loose connection anywhere in circuit									x	Inspect and, if necessary, clean and tighten all connections in circuit
2. Poor dash fuel gauge calibration								x		Install new dash fuel gauge
3. Poor tank unit calibration								x		Install new tank unit*
4. Circuit grounded in resistor of tank unit						x	x			Install new tank unit*
5. Circuit grounded between tank unit resistor and dash gauge				x						Insulate grounded circuit
6. Circuit within dash gauge grounded.								x		Install new dash fuel gauge
7. Circuit grounded between battery and dash gauge.			x							Insulate grounded circuit
8. Open circuit between ignition switch and dash gauge			x							Clean and tighten appropriate terminals or repair broken wire
9. Open circuit between ground terminal on gauge and ground				x						Clean and tighten mounting bracket where contact is made between dash gauge and ground
10. Open circuit between sending unit terminal on dash gauge and resistor terminal on tank unit					x					Clean and tighten appropriate terminals or repair broken wire
11. Open circuit in resistor of tank unit at 1/4 full position		x								Install new tank unit*
12. Open circuit between tank unit slider resistor and ground					x					Install new tank unit*
13. Needle rubbing on face of gauge			x	x	x	x	x			Position needle to prevent contact with face or install new gauge
14. Fuel tank float hang-up	x		x	x	x	x	x			Free binding float or install new tank unit*
15. Top of fuel tank deformed						x				Straighten tank top or replace tank
16. Bottom of fuel tank deformed	x									Straighten bottom of tank or replace tank
17. Tank unit mounting flange bent	x					x	x			Straighten mounting flange or replace tank unit*

* Ignition switch must be "OFF" before removing tank sending unit, otherwise full battery voltage may destroy unit or ignite fuel vapors. For maximum safety, remove cable from negative battery terminal.

SECTION 8B

Exhaust System

GENERAL INFORMATION

Exhaust system designs vary according to engine type and model designation (figs. 15, 16, and 17). In general, all exhaust system connections are of split-joint coupled design, secured with clamp U-bolts. Flexible hangers are used to reduce noise transfer to body and to relieve concentrated loads on exhaust system components.

In general, mufflers are of heavy duty construction designed for optimum quieting efficiency, reduced exhaust back pressure, and long life due to use of aluminized tubes and baffles.

MAINTENANCE

EXHAUST RESTRICTION AND LEAKS

Exhaust system should be inspected periodically for restrictions and leaks. Restrictions such as kinked or crimped pipes result in excessive back pressure which can lead to increased fuel consumption, power loss, and possible damage to engine combustion chamber components. Exhaust leaks are commonly the result of loose clamp assemblies, defective exhaust pipe to manifold packing, corroded pipes, or a punctured muffler. In addition to objectionable noise, a leaking exhaust system could allow toxic gases to enter cab.

Damaged or corroded exhaust system components should be replaced without delay. If it is absolutely necessary to operate vehicle when an exhaust leak exists, use extreme caution and keep cab well ventilated.

CAUTION

If a gasoline engine is operated with a faulty exhaust system, poisonous (carbon monoxide) gas may enter cab and cause serious or fatal injury to personnel. Carbon monoxide may or may not have a detectable odor, and is tasteless and colorless. In the presence of carbon monoxide, physical symptoms such as headache, eye smarting and/or drowsiness may be experienced.

EXHAUST SYSTEM ALIGNMENT

During installation of a new exhaust pipe, muffler or tail pipe, care should be taken to properly position components in relation to each other. Particular care should be given to the installation

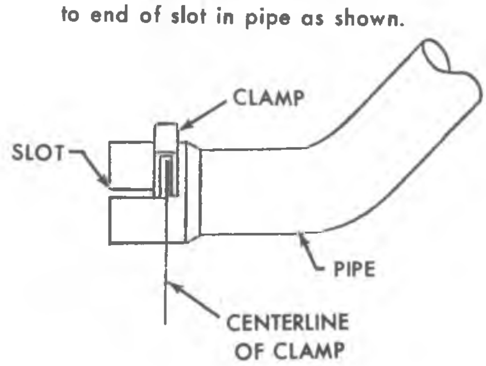


Figure 15—Exhaust Pipe Clamp Installation

of the exhaust pipe and crossover pipe assembly on "V" engines equipped with single exhaust system.

On all joints except exhaust manifold, apply sealer (GM 9985020) or equivalent, to prevent possible leaks.

Incorrectly assembled parts of exhaust system are frequently the cause of annoying noises and rattles due to improper clearances. Exhaust components must have ¾" clearance from cab to avoid possible overheating cab panelling. Therefore, leave all clamp assemblies and muffler strap bolts loose temporarily until the entire system has been inspected to determine if there is adequate clearance between exhaust components and frame members. The weight of the exhaust system should be properly distributed on all supporting brackets and hangers. If the load is not properly balanced, reposition pipes at connecting joints to relieve any concentrated loads. After adjusting hangers, aligning pipes, and repositioning muffler, check entire system for adequate clearance and then tighten all clamps, working from front to rear. Start engine and inspect all connections for leakage.

NOTE: When installing exhaust pipe to manifold, always use new packing and nuts. Be sure to clean manifold stud threads with a wire brush before installing new nuts.

WARNING-CARBON MONOXIDE

KEEP COWL VENT AND HEATER INTAKES CLOSED WHEN OPERATING IN CONGESTED TRAFFIC TO PREVENT DEADLY EXHAUST GASES FROM ENTERING CAB.

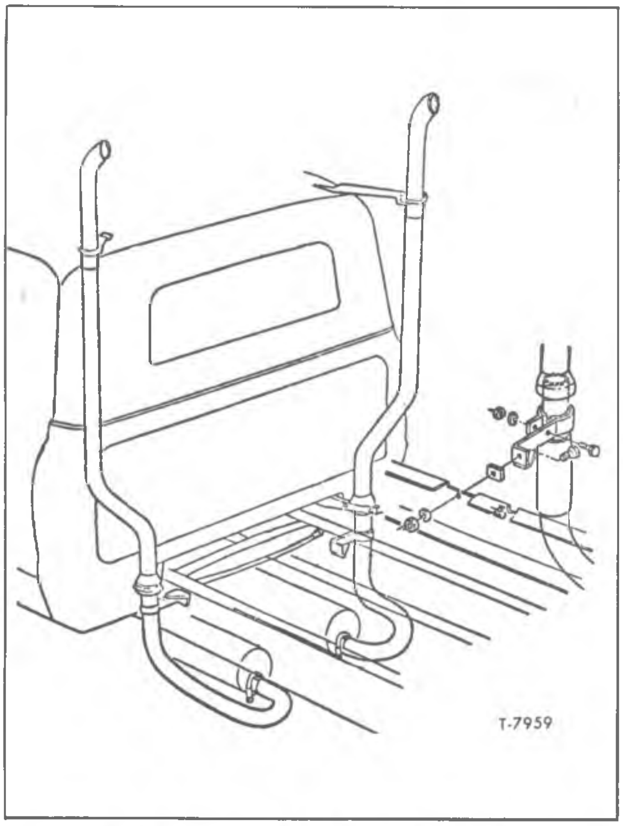


Figure 16—Conventional Cab Vertical Exhaust (Typical)

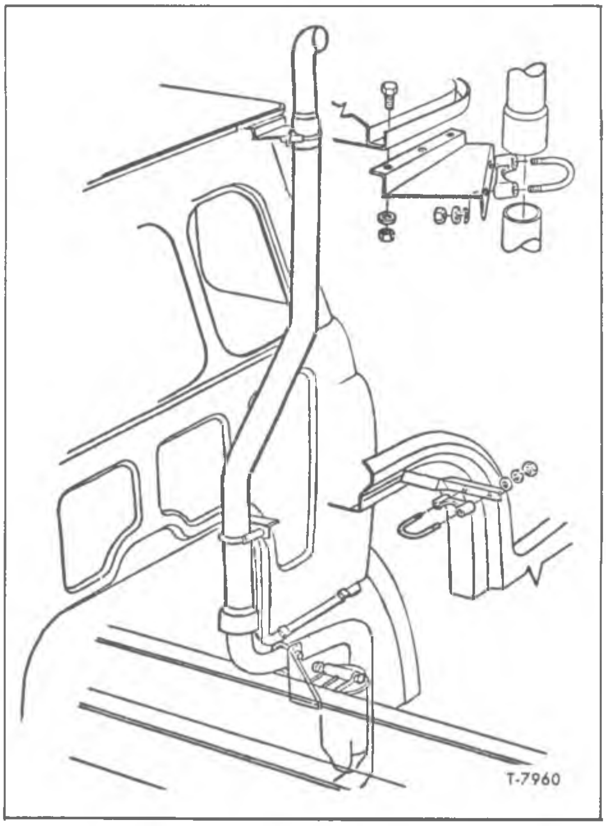


Figure 17—Tilt Cab Vertical Exhaust (Typical)

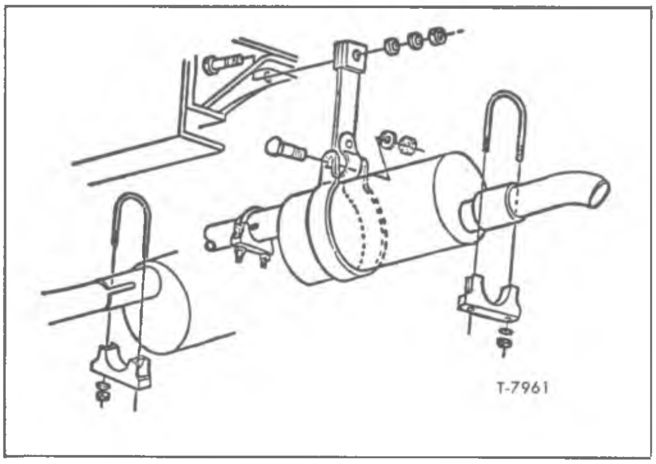


Figure 18—Standard Mufflers and Clamps

> WARNING - CARBON MONOXIDE
>
> Keep cowl vent and heater intakes closed when operating in congested traffic to prevent deadly exhaust gases from entering cab.

SECTION 9

Steering System

Contents of this section are listed in Index below:

SECTION 9A

Mechanical Steering

Contents of this section are listed in Index below:

DESCRIPTION

Rotation of the steering wheel is transmitted to the front axle right and left steering arms from the steering gear pitman arm by linkage consisting of a drag link and tie rod. Toe-in is also adjusted and maintained through use of the tie rod.

Steering shaft on conventional cab models is of one-piece construction and uses a rag-type flexible coupling to connect shaft to steering gear worm shaft. Tilt cab and cowl models use a two-piece shaft arrangement comprised of two universal yoke-type joints and a splined shaft and sleeve which is essential to permit movement of shaft while revolving. Ball bearings are provided at upper and lower ends of steering column, to center steering shaft in column, and to ensure smooth operation of steering system. Components of column and shaft(s) which are subject to wear are replaceable, and methods used for repair are described in detail later.

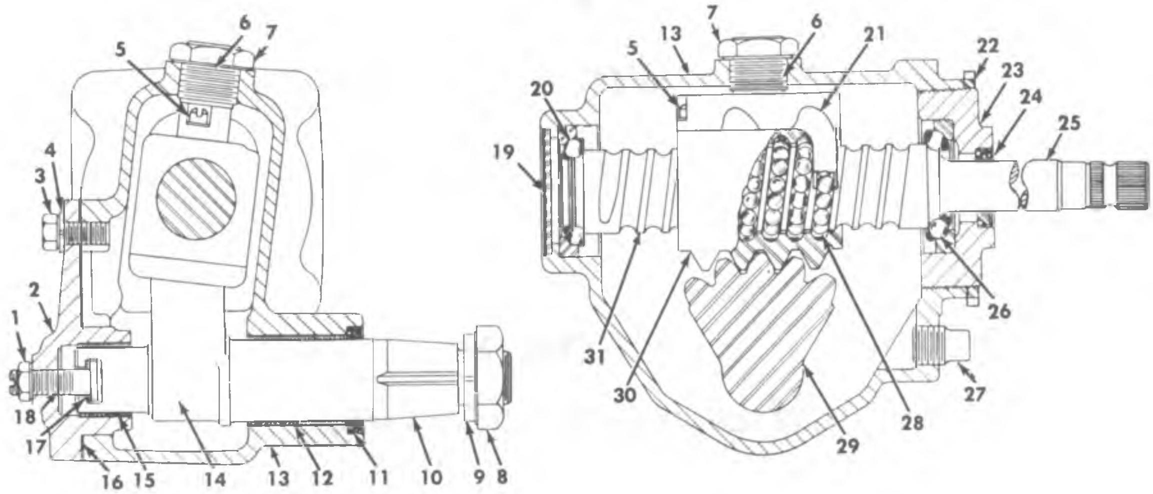
A recirculating ball bearing and sector nut type steering gear, mounted on left frame side rail forward of front wheels, is used on all vehicles covered by this manual. This unit is adjustable for normal wear.

Steering gear assemblies, while similar in construction, vary in size and mounting, depending on truck model application. Refer to "Model Application Chart" at end of this section for proper steering gear application on each truck series.

The major differences in the steering gear assemblies are described in the following text:

NOTE: Refer to "Steering Gear Adjustments" later in this section for adjustment of Pitman Shaft lash, back-up adjuster, and worm thrust bearings.

The type 549-D and 553-D steering gear assemblies shown in figure 1 have an adjuster assembly at shaft end of gear housing for adjustment



1 Lash Adjuster Lock Nut
2 Side Cover
3 Side Cover Bolt
4 Lock Washer
5 Clamp Retainer Screw
6 Back-up Adjuster (Type 553-D-17 Only)
7 Back-up Adjuster Lock Nut (Type 553-D-17 Only)
8 Pitman Arm Nut
9 Lock Washer
10 Pitman Shaft
11 Pitman Shaft Oil Seal
12 Housing Bushing
13 Steering Gear Housing
14 Pitman Shaft Sector Gear
15 Side Cover Bushing
16 Side Cover Gasket
17 Lash Adjuster Shim
18 Lash Adjuster
19 Expansion Plug
20 Worm Thrust Bearing
21 Ball Guide
22 Adjuster Lock Nut
23 Cup and Adjuster Assembly
24 Adjuster Worm Thrust Bearing Oil Seal
25 Steering Shaft
26 Upper Worm Thrust Bearing
27 Filler Plug
28 Worm Balls
29 Pitman Shaft Sector Gear
30 Ball Nut
31 Worm Shaft

T-3332

Figure 1—Type 549-D and 553-D Steering Gear (Typical)

of worm thrust bearing; lip-type oil seals at steering worm and pitman shaft; shims for adjustment of pitman shaft lash, and bushings in gear housing and side cover. A back-up adjuster is used on the 553-D-17 type steering gear as used on tilt cab models, to prevent the worm shaft from flexing up and down. Figure 6 shows tilt cab steering gear and linkage components.

STEERING SYSTEM MAINTENANCE

The following maintenance operations may be accomplished with the steering gear assembly installed in the vehicle.

1. At regular intervals, check and if necessary tighten all steering gear mounting bolts, pitman arm nut, and gear housing upper cover and side cover attaching bolts.

2. Lubricate the steering gear and related linkage as described in LUBRICATION (SEC. 0) of this manual.

NOTE: If excess looseness is evident in steering system, all components of steering column should be inspected for wear. Drag link, connecting rod, and tie rod end ball sockets should be checked and repaired if worn. These checks should be made before attempting to inspect or adjust steering gear. If the above checks indicate components to be in good condition, gear assembly may be adjusted.

4. To adjust steering gear assembly, refer to "Steering Gear Adjustments" later in this section.

5. Periodically check steering column mounting bolts and check torque on stop clamp, and worm shaft clamp bolt nuts.

NOTE: ALL STEERING ATTACHMENTS ARE IMPORTANT ATTACHING PARTS IN THAT THEY COULD AFFECT THE PERFORMANCE OF VITAL COMPONENTS AND SYSTEMS, AND/OR COULD RESULT IN MAJOR REPAIR EXPENSE. THEY MUST BE REPLACED WITH PARTS OF THE SAME PART NUMBERS OR WITH EQUIVALENT PARTS IF REPLACEMENT BECOMES NECESSARY. DO NOT USE REPLACEMENT PARTS OF LESSER QUALITY OR SUBSTITUTE DESIGN. TORQUE VALUES MUST BE USED AS SPECIFIED DURING REASSEMBLY TO ASSURE PROPER RETENTION OF THESE PARTS.

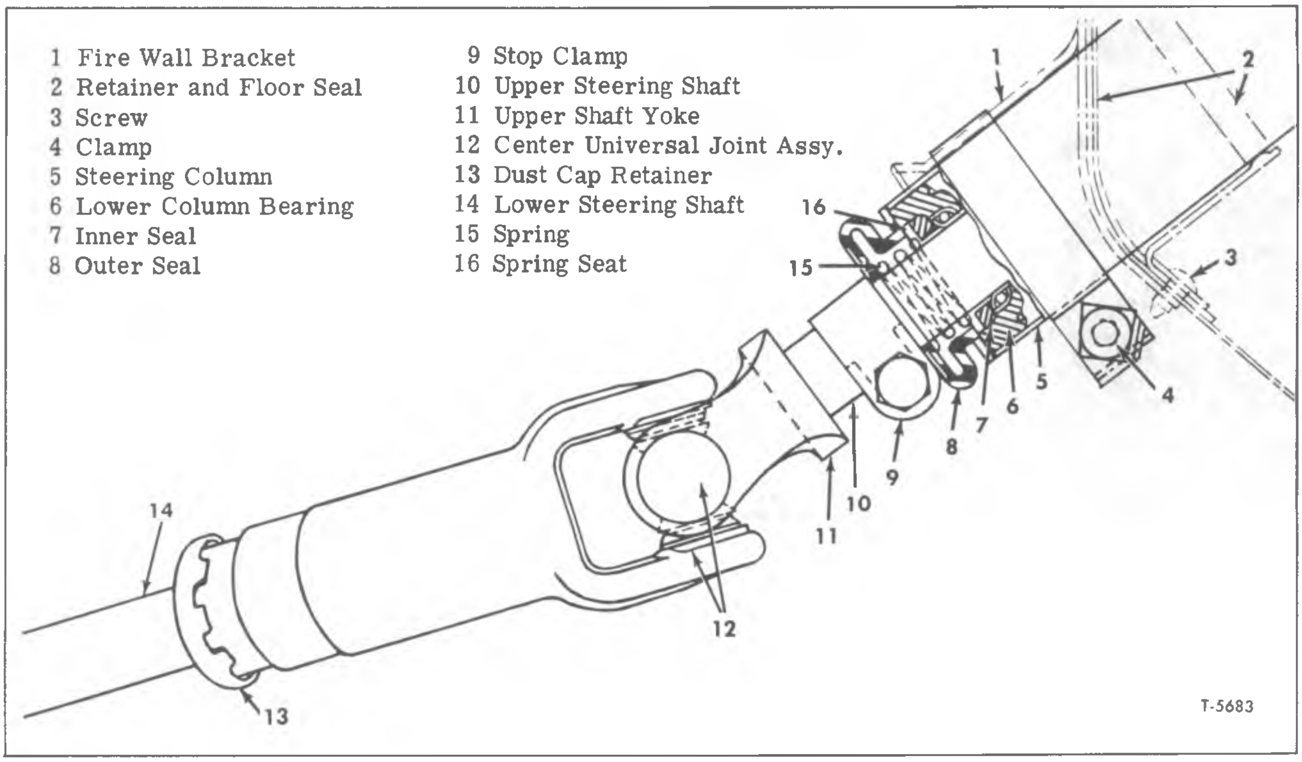


Figure 2—Steering Column Stop Clamp Components (Cowl Model Shown)

STEERING WHEEL CHUCKING
OR CLUNKING NOISE

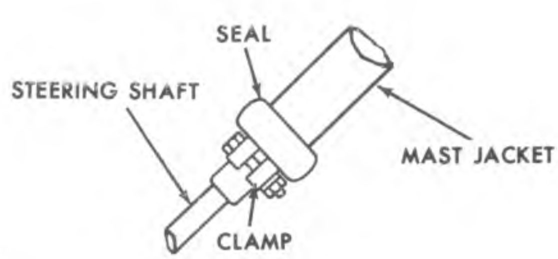
When steering wheel clunking noise is noted, or an up-and-down chucking movement of steering wheel is encountered, it is possible that mast jacket upper and lower clamps have loosened and should be re-torqued. To tighten and adjust steering column clamps, observe the following:

1. Loosen mast jacket clamps at dash and fire wall.

2. Push steering wheel down until all up-and-down movement has been removed.

3. Tighten clamp at dash, then tighten clamp at fire wall (if used).

4. Adjust "stop" clamp at bottom of steering shaft to allow 0.005" to 0.030" up and down movement of the upper shaft assembly (refer to figs. 2 and 3).



Adjust clamp to allow 0.005" min. to 0.030" max. axial movement of shaft assembly and torque clamp bolt to 8 to 11 foot-pounds. This clearance must be maintained to prevent excessive axial chucking of the upper steering shaft or binding of the upper steering shaft bearing. T-6470

Figure 3—Steering Column Stop Clamp Adjustment (Conventional Cab) (Typical)

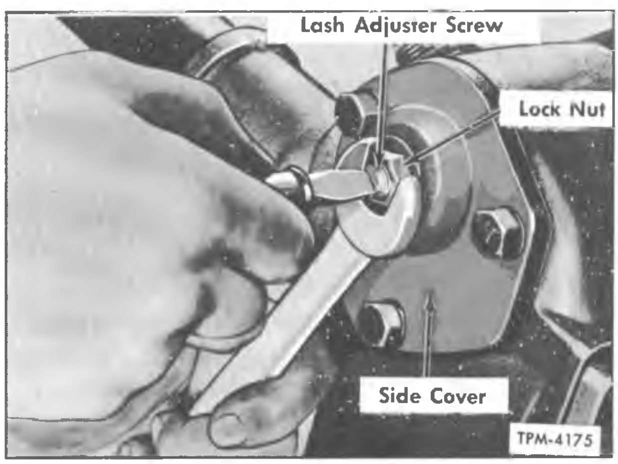


Figure 4—Adjusting Sector Gear Lash

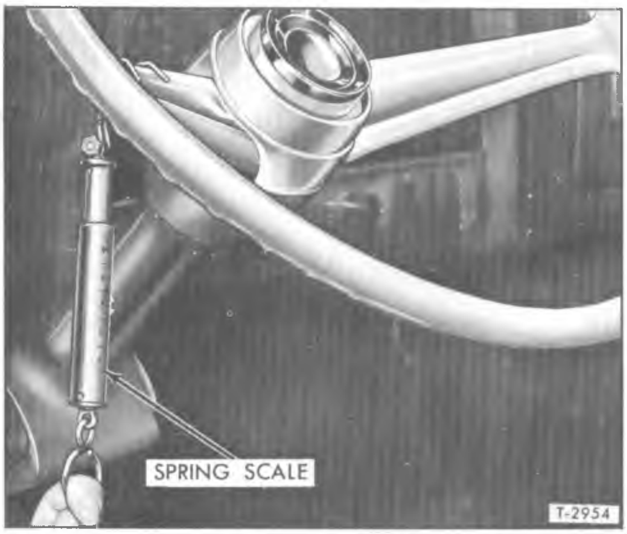


Figure 5—Checking Steering Wheel Rim Pull

NOTE: If "clunking" still exists, the yoke and sleeve assemblies should be disconnected, inspected for wear, and replaced if necessary. This is an important safety procedure which will prevent internal steering shaft joint interference.

Other factors should be considered when attempting to determine source of clunking movement in system. Loose linkage, or worn ball joints can produce a telescoping effect through steering gear and column to the steering wheel, and it may be difficult to determine whether trouble is in the steering column, gear assembly, or linkage components. Some of the most common causes of steering clunk, or chucking movement are as follows:

a. Insufficient lubricant in steering gear assembly.
b. Pitman arm loose on pitman shaft.
c. Steering gear loose on chassis frame.
d. Steering gear incorrectly adjusted.
e. Air pressure in tires too high.
f. Shock absorbers defective.
g. Worn king pins and bushings.

STEERING GEAR ADJUSTMENTS

(Refer to Figures 1 and 4)

The steering gear assembly is designed to provide adjustment to compensate for normal wear at worm bearings, pitman shaft, and mating parts.

Before adjustments are made to the steering gear in an attempt to correct such conditions as shimmy, loose or hard steering and road shocks, a careful check should be made of front end alignment, shock absorbers, wheel balance, and tire pressure for possible causes.

NOTE: Before making any steering gear adjustment, check lubricant in gear housing and fill to proper level, if necessary, as directed in LUBRICATION (SEC. 0) of this manual. Tighten all mounting bolts to torque recommended in "Specifications" at end of this section.

Procedures for checking and adjusting the steering gear must be performed in sequence given in the following paragraphs:

Always check worm bearing adjustment first, and adjust if necessary, before making pitman shaft lash adjustment.

NOTE: Before making any adjustments on the steering gear, loosen back-up adjuster lock nut (as used on tilt cab models); then loosen back-up adjuster.

CHECKING WORM BEARING ADJUSTMENT

1. Disconnect drag link or connecting rod from pitman arm. Note relative position of linkage and pitman arm so parts may be reassembled in same relative position. Refer to "Steering Linkage" later in this section for correct procedures.
2. Loosen lock nut and turn lash adjuster (fig. 4) a few turns counterclockwise to relieve load from worm bearings and to provide clearance between the sector gear and worm ball nut.
3. Turn steering wheel GENTLY in one direction to end of travel, then back away one full turn.

> **CAUTION: DO NOT turn steering wheel hard against "stops" when linkage is disconnected from pitman arm as damage to ball guides will result.**

4. Attach spring scale (J-544-01) at rim of wheel as shown in figure 5. Pull on scale in a line at right angle to wheel spoke and measure the amount of pull required to keep the wheel moving. If worm bearings are properly adjusted, reading on spring scale should be between 1½ and 2 pounds.

NOTE: If pull is not within 1½ to 2 pounds, worm bearings require adjustment. If "rough" or "lumpy" action is noted during check, worm bearings are probably damaged. Steering gear should then be removed, disassembled, and bearings examined. If worm bearings do not require adjustment, adjust pitman shaft lash as described later in this section. Adjust worm bearings as follows:

WORM BEARING ADJUSTMENT

1. Loosen adjuster lock nut (22) (fig. 1) at shaft end of steering gear and turn worm bearing adjuster screw (23) clockwise until there is no perceptible end play in the worm.
2. Using spring scale (J-544-01), check the steering wheel rim pull as outlined previously. Turn adjuster screw until a pull of 1½ to 2 pounds

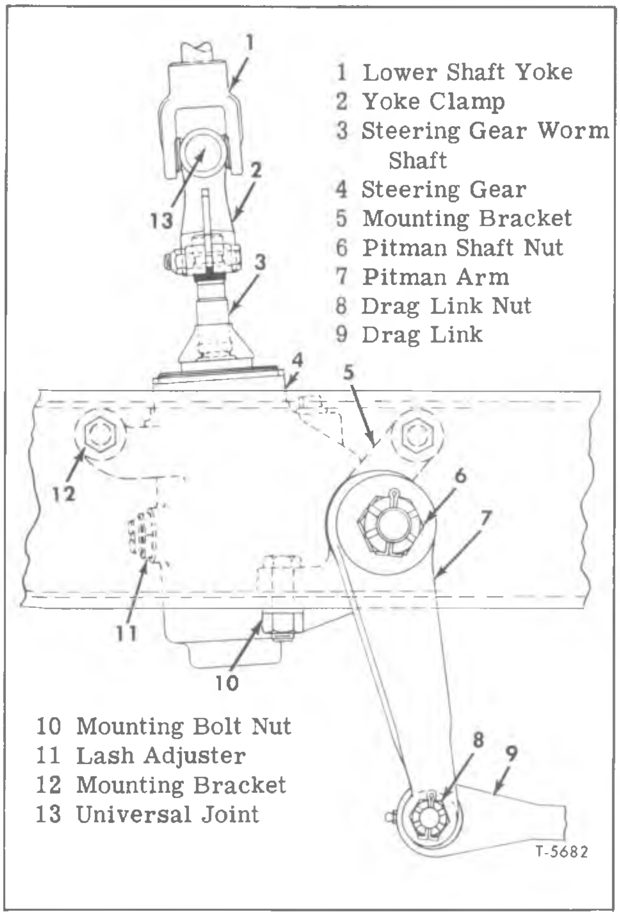


Figure 6—Steering Gear and Connections (Tilt Cab Model)

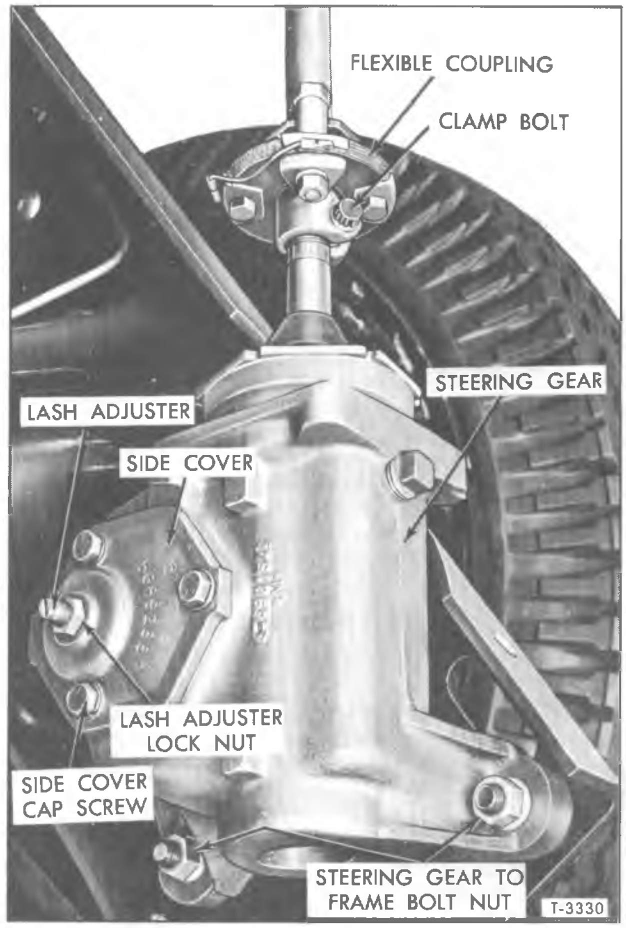


Figure 7—Steering Gear and Shaft (with Rag-Type Flexible Coupling)

is obtained on spring scale at steering wheel.

3. Tighten adjuster lock nut to 70 to 100 foot-pounds torque.

PITMAN SHAFT LASH ADJUSTMENT

1. Center steering gear by turning steering wheel from extreme right to extreme left positions, counting the exact number of turns. Turn wheel back exactly half-way, to center position. Mark wheel at top or bottom center with a piece of tape.

2. Loosen lash adjuster lock nut and turn adjuster screw (fig. 4) clockwise to remove all back lash between gear teeth. Tighten lock nut to 25-35 foot-pounds torque, then check steering wheel rim pull as outlined previously. Measure greatest pull as wheel is pulled through center position. Rim pull should be 2¾ to 3¼ pounds.

3. If rim pull is not within specified limits, loosen lock nut and turn lash adjuster to obtain proper wheel rim pull.

IMPORTANT: Always check wheel rim pull after lock nut has been tightened.

4. On vehicles equipped with the 553-D-17 type steering gear, turn back-up adjuster in (with worm shaft on center position) until it bottoms, then back off 1/8 to 1/4 turn. Tighten jam nut to torque listed in "Specifications" at end of this section.

5. After all adjustments have been completed, reconnect drag link or connecting rod to pitman arm as described under "Steering Linkage" later in this section.

STEERING GEAR REPLACEMENT

(Refer to Figures 6 and 8)

If the steering gear cannot be properly adjusted, or if during adjustment procedures "rough" operation is noticed, the steering gear must be removed from the vehicle and overhauled. The steering gear must be removed from the vehicle for all overhaul or repair procedures.

STEERING GEAR REMOVAL

1. Disconnect steering linkage from pitman arm.

2. Scribe an alignment mark on steering gear worm shaft and clamp yoke or coupling on steering gear lower or intermediate shaft (fig. 15).

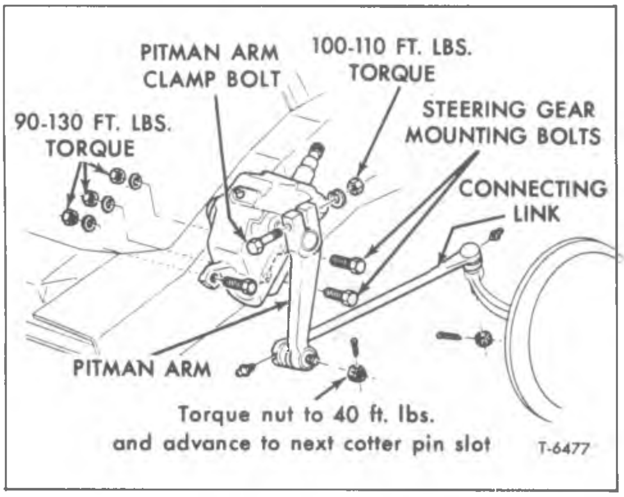


Figure 8—Steering Gear and Linkage (Cowl and Conventional Cab) (Typical)

3. Remove bolt attaching lower or intermediate shaft clamp yoke or coupling to steering gear worm shaft (3) (fig. 6).

NOTE: When removing flexible coupling-type joint (fig. 7), remove the two bolts and nuts which secure lower clamp plate to balance of rag joint assembly.

4. Remove pitman arm nut (6, fig. 6) and lock washer; then using puller (J-3186) remove pitman arm (7) (fig. 6).

5. Remove bolts, nuts, and washers which attach steering gear (4) to frame and remove steering gear.

PITMAN ARM

A clamp bolt retained pitman arm is used on some models and can be replaced as follows:

REMOVAL (Fig. 8)

1. Remove cotter pin from connecting link nut at pitman arm. Remove nut.

2. Extract connecting link ball from pitman arm by striking pitman arm at the connecting link ball and backing up the pitman arm with a large heavy hammer of equivalent tool.

3. Remove nut from pitman arm clamp bolt, then remove bolt and flat washer.

4. Tap the pitman arm on the backside and if necessary, insert a wedge shaped tool into the open slot of pitman arm to facilitate removal.

INSTALLATION

NOTE: When positioning the pitman arm on the steering gear sector shaft, exercise caution to ensure that the blind serration is properly aligned between the pitman arm and the steering gear sector shaft and that the connecting link tapered hole small section is to the outside of the vehicle.

1. Position the pitman arm on the sector shaft and carefully force the arm onto the shaft. If necessary, drive a wedge-shaped tool into the clamp bolt slot of the pitman arm to lightly spread the clamp bosses.

2. Install the clamp bolt, flat washer, and nut. Torque nut to 100 to 110 foot-pounds.

3. Insert connecting link ball stud into pitman arm and seat the taper (to prevent ball stud turning when tightening nut) by tapping lightly with a hammer.

4. Install the connecting link ball stud nut. Torque nut to 40 foot-pounds and then continue to tighten until cotter pin hole is aligned.

5. Install new cotter pin.

STEERING GEAR INSTALLATION
(Refer to Fig. 6)

1. Position steering wheel in straight-ahead position and steering gear in center position. Mark on worm shaft should be in 12 o'clock position on vehicles equipped with the 549-D type steering gear and in 6 o'clock position on vehicles equipped with the 553-D type steering gear.

2. Position steering gear on frame side member, and at the same time slide the worm shaft (3) into the clamp yoke (2) or coupling on steering lower or intermediate shaft.

IMPORTANT: Check to make sure match marks on lower or intermediate shaft clamp yoke or coupling and steering gear worm shaft are aligned.

3. Install bolts, nuts, and washers which attach steering gear to frame. Tighten bolts to torque listed in "Specifications" at end of this section.

4. On all tilt cab models, install spacer washer (2) between steering gear and frame at rear bolt location as shown in figure 9.

5. Attach lower or intermediate shaft clamp yoke or coupling to steering gear worm shaft with bolt; or bolt, nut, and washer. On vehicles with rag-type coupling (joint) adjust coupling to maintain dimension 0.250" to 0.375" as shown in figure 22 before tightening clamp bolt. Tighten bolt or nut to torque listed in "Specifications" at end of this section.

6. On all vehicles pitman arm and pitman shaft have matching blank serrations which must be aligned. With pitman arm and shaft aligned, press pitman arm onto shaft and install washer and pitman shaft nut. Tighten nut to torque listed in "Specifications" at end of this section.

STEERING LINKAGE
(Refer to Figure 9)

DESCRIPTION

Turning motion of steering wheel is transmitted through the steering gear (1) and pitman shaft

(3) to the pitman arm (5), which is connected to the drag link (7). Drag link is designed with a ball joint at each end, and is connected to left front steering arm (8). Steering control of right wheel is accomplished through use of the tie rod which is located at rear of axle. This tie rod is connected by means of ball sockets to left rear steering arm and it extends to opposite side of axle and fastens to right wheel steering arm. Steering linkage although similar, is not the same for all series vehicles covered in this manual.

Steering linkage between steering gear and front wheels affects steering action. If parts are out-of-adjustment, bent, damaged, worn, or twisted, poor steering will result. Steering linkage should be properly adjusted at all times.

NOTE: Whenever any steering linkage components have been repaired or replaced, check steering geometry and front end alignment as described in FRONT SUSPENSION (SEC. 3) of this manual.

STEERING DRAG LINK OR CONNECTING ROD

(Refer to Figures 8, 9, and 11)

A non-adjustable drag link or connecting rod (fig. 9, Item 7) is used to connect the pitman arm to the left steering arm. No periodic maintenance is required other than lubrication and keeping stud nuts properly torqued. If the drag link or connecting rod becomes worn or damaged, replace the complete assembly as follows:

REMOVAL

1. Remove cotter pin at each end of drag link or connecting rod. Discard cotter pins, and remove nut (10) from ball socket stud.
2. Using a soft hammer, tap each ball stud until drag link or connecting rod is loose. Remove drag link or connecting rod from vehicle.

INSTALLATION

1. Position drag link or connecting rod to pitman arm (5) and steering arm (8), then install ball stud nut (10) at each end. Tighten nuts firmly to fit tapered studs snugly and prevent movement when nuts are torqued.
2. Using a torque wrench, tighten ball stud nuts to 125 to 150 foot-pounds torque, then advance to next cotter pin hole and install cotter pin to secure stud nut.

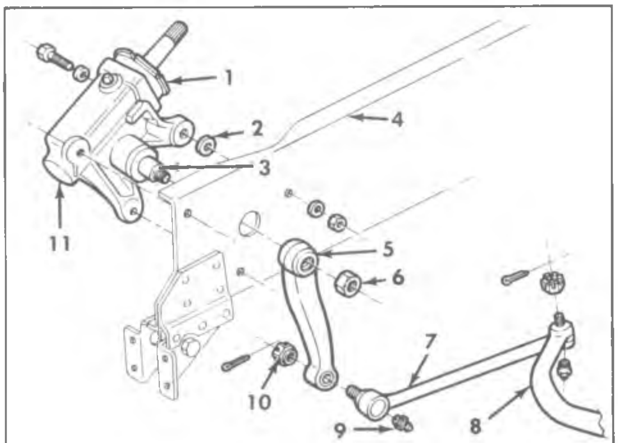
STEERING TIE ROD

(Refer to Figure 10)

DESCRIPTION

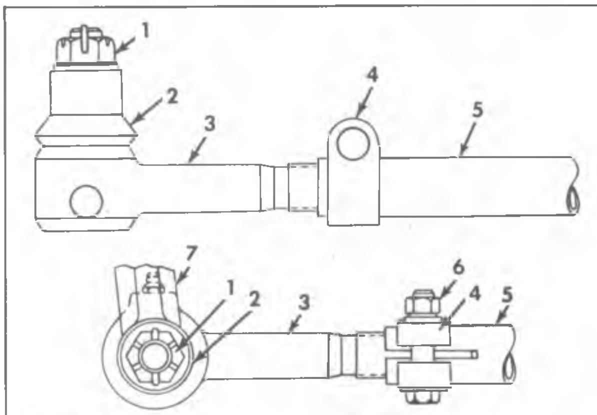
Vehicles covered in this manual have a three-piece tie rod connecting left and right steering arms. The tie rod assembly consists of a tube and two socket end assemblies. Socket end assemblies are threaded into tube and locked in place with clamps. Right- and left-hand threads are provided to facilitate toe-in adjustment and steering wheel centering.

The tie rod ends are self-adjusting and require no attention in service other than periodic



1 Worm Shaft Adjuster Lock Nut
2 Spacer Washer
3 Pitman Shaft
4 Frame
5 Pitman Arm
6 Pitman Shaft Nut
7 Drag Link
8 Steering Arm
9 Lubrication Fitting
10 Drag Link Stud Nut
11 Steering Gear T-5684

Figure 9—Steering Linkage ("T" Models)



1 Nut
2 Seal
3 Tie Rod End
4 End Clamp
5 Tie Rod
6 Clamp Bolt Nut
7 Steering Arm
T-5685

Figure 10—Steering Tie Rod

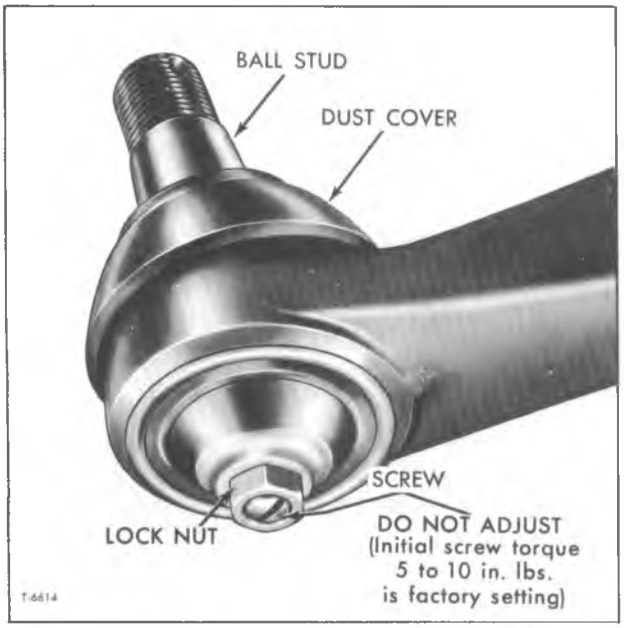


Figure 11—Steering Connecting Link Assembly

lubrication and inspection to see that ball studs are tight. Socket ends should be replaced when excessive up and down motion or any lost motion or end play at ball end of stud exists.

MAINTENANCE

1. Clamp bolt nuts should be periodically checked for tightness.
2. Inspect tie rod for bent condition. If tie rod is bent more than 5 degrees, replace assembly. If tie rod is bent less than 5 degrees, tie rod may be straightened using cold straightening method.
3. Lubricate tie rod ends. Refer to LUBRICATION (SEC. 0) of this manual.

TIE ROD REPLACEMENT

Removal

1. Remove cotter pins and stud nuts attaching tie rod to right or left steering arm.
2. Remove ball stud from steering arm by positioning a jack under arm and applying light lifting force, while tapping on socket end with a hammer. A heavy hammer as a backing at the steering arm may be used as an alternate method, if desired. Push downward, on tie rod to remove from steering arm.

NOTE: If tie rod end assemblies are damaged in any way, they must be replaced.

Installation

1. If tie rod was dismantled, position clamps on ends of rod.

NOTE: Threads on socket end, and in tie rod tube must be clean and free from rust or difficulty in adjusting toe-in will be experienced.

2. Thread socket ends into tie rod tube and make certain ends are threaded in an equal distance.

3. Position socket end studs into steering arm holes, and install stud nuts, tighten nuts to torque specified in "Specifications" at end of this section. Install new cotter pins, and spread ends. Lubricate socket ends. Refer to LUBRICATION (SEC. 0) of this manual.

4. Adjust toe-in as described in "FRONT END ALIGNMENT" (SEC. 3A) of this manual for correct dimension.

5. Before tightening tie rod clamp bolts, make sure tie rod ends are in alignment with each other. Position clamps so that clamp bolt opening is in line with slot in tie rod tube. Clamp will be difficult to tighten sufficiently to lock socket end in place, if not properly positioned on tie rod.

NOTE: ALL STEERING COMPONENT ATTACHMENTS ARE IMPORTANT ATTACHING PARTS IN THAT THEY COULD AFFECT THE PERFORMANCE OF VITAL COMPONENTS AND SYSTEMS, AND/OR COULD RESULT IN MAJOR REPAIR EXPENSE. THEY MUST BE REPLACED WITH PARTS OF THE SAME PART NUMBERS OR WITH EQUIVALENT PARTS IF REPLACEMENT BECOMES NECESSARY. DO NOT USE REPLACEMENT PARTS OF LESSER QUALITY OR SUBSTITUTE DESIGN. TORQUE VALUES MUST BE USED AS SPECIFIED DURING REASSEMBLY TO ASSURE PROPER RETENTION OF THESE PARTS.

PITMAN SHAFT SEAL REPLACEMENT (GEAR IN VEHICLE)

(Refer to Figure 12)

If, upon inspection of the gear, it is found that oil leakage exists at the pitman shaft seals, the seals may often be replaced without removing the gear assembly from the vehicle as follows:

1. Remove pitman nut and disconnect pitman arm from pitman shaft using Puller (J-6632).

CAUTION: DO NOT hammer on the end of Puller Tool (J-6632).

2. Thoroughly clean end of pitman shaft and gear housing, then tape splines on end of pitman to ensure that seals will not be cut by splines during assembly.

NOTE: Only one layer of tape should be used; an excessive amount of tape will not allow the seals to pass over it, due to the close tolerance between the seals and the pitman shaft.

3. Remove pitman shaft seal retaining ring with Snap Ring Pliers (J-4245).

4. Start engine and turn steering wheel fully to the left so that oil pressure in the housing can force out pitman shaft seals. Stop engine immediately.

NOTE: Use suitable container to catch oil forced out of gear. This method of removing the pitman shaft seals is recommended, as it eliminates the possibility of scoring the housing while attempting to pry seals out. If pressure of oil does not remove seals, it will be necessary to remove the gear assembly from vehicle and remove the seals as explained previously.

5. Inspect seals for damage to rubber covering on O.D. If O.D. appears scored, inspect housing for burrs and remove before attempting new seal installation.

6. Clean the end of housing thoroughly so that dirt will not enter housing with the installation of the new seals.

7. Lubricate the seals thoroughly with Steering Fluid to install seals with Installer (J-6219). Install the inner single lip seal first, then a back-up washer. Drive seal in far enough to provide clearance for the outer seal, back-up washer and retaining ring. Make sure that the inner seal does not bottom on the counterbore. Install the outer double lip seal and the second back-up washer in only far enough to provide clearance for the retaining ring. Install retaining ring.

8. Fill pump reservoir to proper level. Start engine and allow engine to idle for at least three minutes without turning steering wheel. Turn wheel to left and check for leaks.

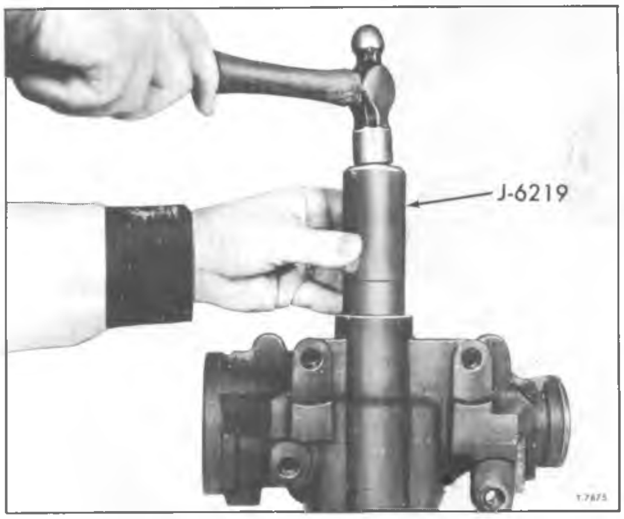


Figure 12—Installing Pitman Shaft Seals Using Tool J-6219

9. Remove tape and reconnect pitman arm.

NOTE: THE PITMAN ARM TO STEERING GEAR NUT IS AN IMPORTANT ATTACHING PART IN THAT IT COULD AFFECT THE PERFORMANCE OF VITAL COMPONENTS AND SYSTEMS, AND/OR COULD RESULT IN MAJOR REPAIR EXPENSE. IT MUST BE REPLACED WITH ONE OF THE SAME PART NUMBER OR WITH AN EQUIVALENT PART IF REPLACEMENT BECOMES NECESSARY. DO NOT USE A REPLACEMENT PART OF LESSER QUALITY OR SUBSTITUTE DESIGN. TORQUE VALUES MUST BE USED AS SPECIFIED DURING REASSEMBLY TO ASSURE PROPER RETENTION OF THIS PART.

STEERING WHEEL AND STEERING COLUMN

DESCRIPTION

(Refer to Figures 14, 17, 18, 19, and 24)

Steering column on models covered in this manual may be either one-piece or two-piece construction depending upon type of model it is used on. Universal type joints are used on models where straight steering shafts are not suitable (fig. 24). Shafts are clamp fastened to steering worm shaft at steering gear assembly. Column is secured to dash and cowl by brackets and fastened with bolts and nuts. Ball-type bearings are used in steering column upper and lower ends. Steering wheel used on conventional and tilt cab series is a three-spoke type, while the two-spoke type is used on cowl models. Steering wheel is a tapered splined fit on steering shaft, and it houses the horn switch assembly. It is retained by a washer and lock nut. Steering shaft has an alignment mark stamped on its end, and wheel should be installed with the cut-out portion of horn contact centered with mark on shaft as shown in figure 20.

Turn signals and hazard warning switch are located in upper steering column housing.

MULTIPLE WIRE CONNECTORS

DISASSEMBLY

On all models, to remove harness from steering column it will be necessary to remove multiple connector at end of harness. Tool (J-21091) may be used on twin- lock-type connector. If not available, two small thin screwdrivers may be inserted at each side of connector to relieve tension on lock tabs. Thin screwdriver may also be used on blade-type connector to accomplish removal of terminal.

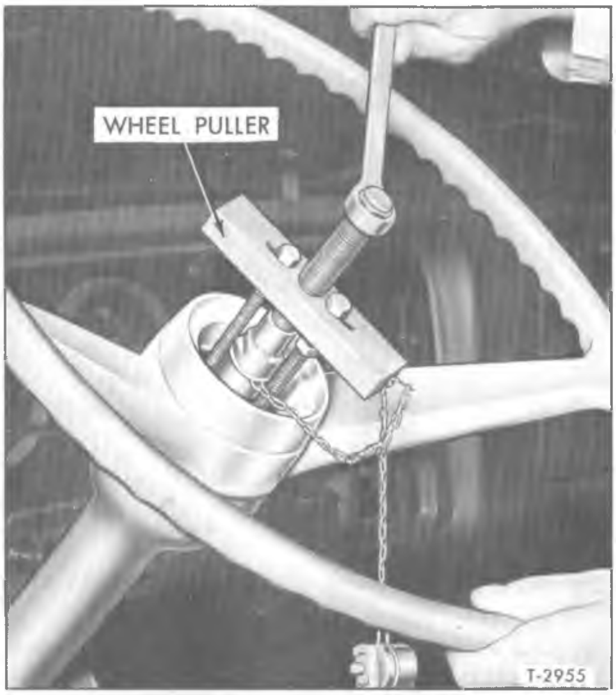


Figure 13—Steering Wheel Removal (Typical)

NOTE: Before removing wires from connector, wires should be tagged, and numbered in relation to the holes in which they are to be re-inserted in connector. If doubt exists as to proper location of wires in connector, see appropriate Wiring Diagrams booklet.

STEERING WHEEL REPLACEMENT

(Refer to Figure 14)

REMOVAL

1. Disconnect directional signal switch harness from chassis wiring harness connector.
2. Set front wheels in straight-ahead position; then pry horn button cap (14) and retainer (15) from steering wheel.
3. Remove steering wheel locking nut (13) and washer (12).
4. Remove three screws which attach the horn receiver cup to allow access to puller holes in steering wheel (refer to fig. 20).
5. Using Puller (J-2927-01), remove steering wheel (fig. 13). It may be necessary to tap on bolt head of tool with a hammer as it is turned down to loosen a tight steering wheel.

INSTALLATION

NOTE: Front wheels must be in straight-ahead position and directional signal control assembly must be in neutral position when installing steering wheel.

1. Install three screws which attach horn receiver cup.
2. On vehicles equipped with a two-spoke steering wheel, position wheel on steering shaft with spokes of wheel in a horizontal position.
3. On vehicles equipped with a three-spoke wheel, position wheel on shaft with lower spoke of steering wheel in vertical position.
4. Line up cut-out portion of horn receiver cup with mark on steering shaft as shown in figure 20.
5. Tap steering wheel gently into place.
6. Install special flat washer and locking nut on steering shaft. Tighten nut to torque listed in "Specifications" at end of this section.
7. Install retainer and horn button cap and connect directional signal wiring harness to chassis wiring harness connector.

STEERING COLUMN AND SHAFT (CAB AND COWL MODELS)

REMOVAL (Refer to Figs. 18 and 19)

NOTE: A one-piece steering shaft is used on all cab models (fig. 18) and a two-piece shaft is used on all cowl models (fig. 19).

1. Disconnect directional signal, horn, and hazard warning flasher lighting connector.
2. Remove steering wheel as described under "Steering Wheel Replacement" previously.
3. Mark clamp yoke (19, fig. 19) or coupling and steering gear worm shaft (20) to ensure installation in the same relative position (fig. 15).
4. Remove bolt attaching clamp yoke or coupling on steering shaft to steering gear worm shaft.
5. If used, remove cap screws which attach trailer brake hand control to steering column and remove attaching clamp.
6. Remove screws which attach steering column seal retainer and seal (2) to cab floor.
7. Remove bolts which attach U-clamp to under edge of dash support (fig. 21), then pull flexible coupling free of steering gear worm shaft. Remove column and shaft assembly from inside the cab.

NOTE: On vehicles equipped with the one-piece steering shaft, the dash support brace (4) must be removed to gain sufficient clearance to remove steering shaft and coupling.

8. Lift clamp yoke or coupling off steering gear worm shaft, then twist and turn shaft assembly as required to remove from vehicle.

DISASSEMBLY OF STEERING COLUMN AND SHAFT

1. Remove screws attaching directional signal control lever to control switch assembly and remove lever (1, fig. 16).

NOTE: It is necessary to remove multiple wire connector at end of harness before directional switch can be removed. See "Multiple Wire Connectors" as described previously in this section.

2. Remove three screws (7, fig. 16) which attach directional signal control switch assembly (2) to control housing (8). Remove switch and harness (3) from housing.

3. Twist directional control housing (8, fig. 16) counterclockwise and remove from steering column

4. Pull steering shaft (fig. 19) (7) from steering column (5), and pry lower bearing (11) from tube, if bearing is worn or defective. Refer to figure 18 for conventional cab models.

5. Remove bearing inner seal (12), spring seat (13), spring (14) and outer seal assembly (15). Remove stop clamp (16) and bolt, if desired.

6. Referring to figure 17, on vehicles with two-piece shaft, remove snap rings (2) from inside of universal joint. Tap yoke sideways to dislodge bushing (1) of adjoining yoke, repeat operation until all bushings are removed. Remove cork seals (3) from journal and discard.

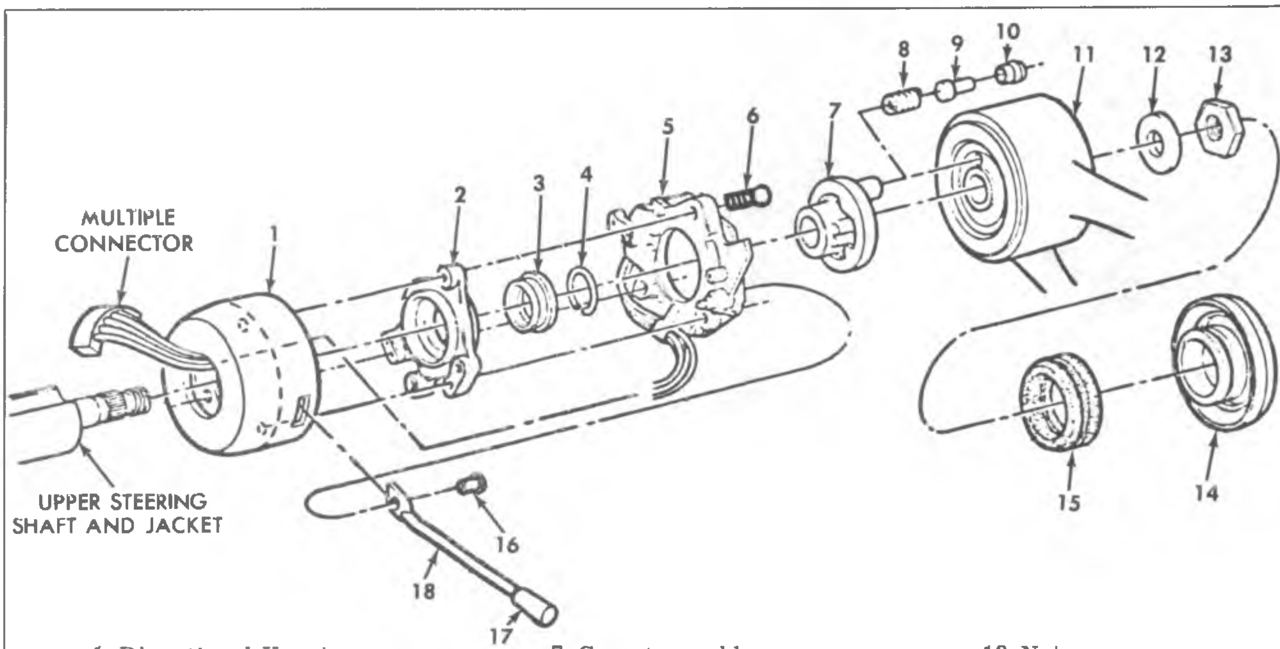
7. Referring to figure 17, to remove slip yoke (6) from lower shaft assembly (9), bend tabs of dust cap (8) away from retainer groove. Pull shaft (9), felt seal (7), and washer (5) from yoke sleeve (6).

CLEANING, INSPECTION, AND REPAIR OF COLUMN AND SHAFT (ALL MODELS)

Inspect steering column bearings for rough spots or loose worn condition, if bearing shows slightest indication of deterioration, it should be replaced. Inspect all wiring, connections, and directional control switch assembly for bare spots, loose connections, or general deterioration. Directional switch is serviced as an assembly, complete with wiring harness. Switch should operate smoothly and be free from binding condition. Check horn contact brush surface, and inspect contact plunger for freedom of action and binding condition. Upper column bearing horn contact surface should not be worn excessively or have deep grooves cut in it.

Clean all universal joint parts in a suitable solvent. Inspect bearing bushings for galling, which is evidenced by pitting or deep ridges in bores. Inspect journal bearing surfaces for galled spots. Check amount of journal and bushing clearance, if it is excessive, replace joint or correct steering adjustment will be difficult to obtain. If any of the above conditions exist, parts should be replaced. Journal and bushing assembly should be replaced as a complete unit only. If only badly worn parts of a unit are replaced, premature replacement of remaining parts will be necessary later.

All mounting brackets and components should



1 Directional Housing	7 Cam Assembly	13 Nut
2 Switch Support	8 Spring	14 Horn Button
3 Upper Bearing	9 Eyelet	15 Retainer Ring
4 Snap Ring	10 Insulator	16 Screw
5 Direction and Hazard Switch	11 Wheel Assembly	17 Knob
6 Screw	12 Washer	18 Lever

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Figure 14—Steering Wheel, Hazard Warning, and Directional Signal Components

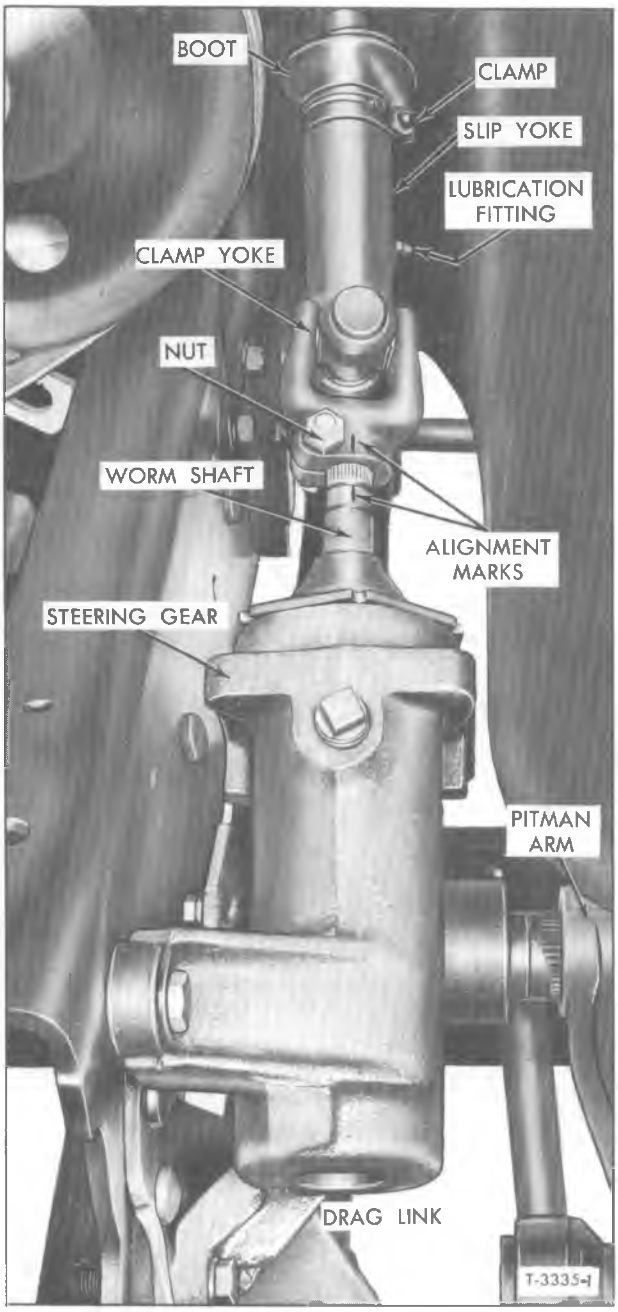
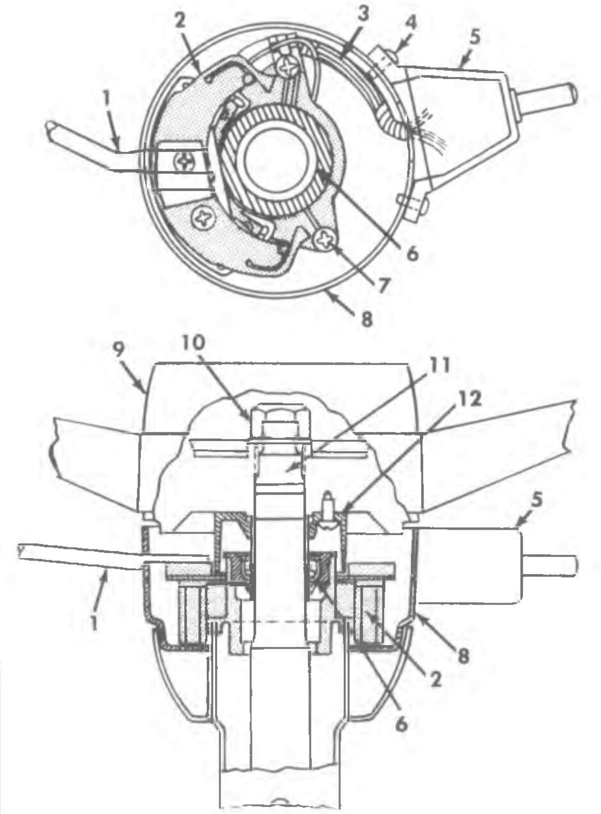


Figure 15—Steering Gear and Lower Shaft Installed



1 Directional Lever	8 Directional Housing
2 Directional Switch	9 Steering Wheel
3 Harness	10 Steering Shaft Lock Nut
4 Screw	
5 Hazard Warning Switch	11 Upper Steering Shaft
6 Upper Bearing	12 Canceling Cam
7 Switch Retainer Screw	

T-5686

Figure 16—Upper Steering Column (Cowl and Conventional Cab) (Typical)

be checked for cracks and breaks, repair or secure new parts as necessary. All dust caps of rubber or similar construction should be replaced with new, if slightest evidence of damage is present. Install all new seals when assembling steering system.

ASSEMBLY OF COLUMN AND SHAFT

Key numbers in text refer to figure 19, except where otherwise noted.

1. Press bearing (11) into lower end of steering column tube (5). Install directional signal housing (6) at upper end of column by turning unit clockwise to lock it in place in upper jacket.

NOTE: It is necessary to insert wiring harness through opening in base of upper column jacket before locking switch and directional housing, to column with the three attaching screws. See "Multiple Wire Connectors" of this section for connector installation.

2. Referring to figure 16, install directional and hazard warning control switch and harness (2 and 3) in housing (8) using the three retainer screws (7). Tighten screws securely. Install hazard warning switch (5) to housing. Inspect wiring harness (3) and make certain it is not pinched and is properly positioned. Install directional control lever (1)

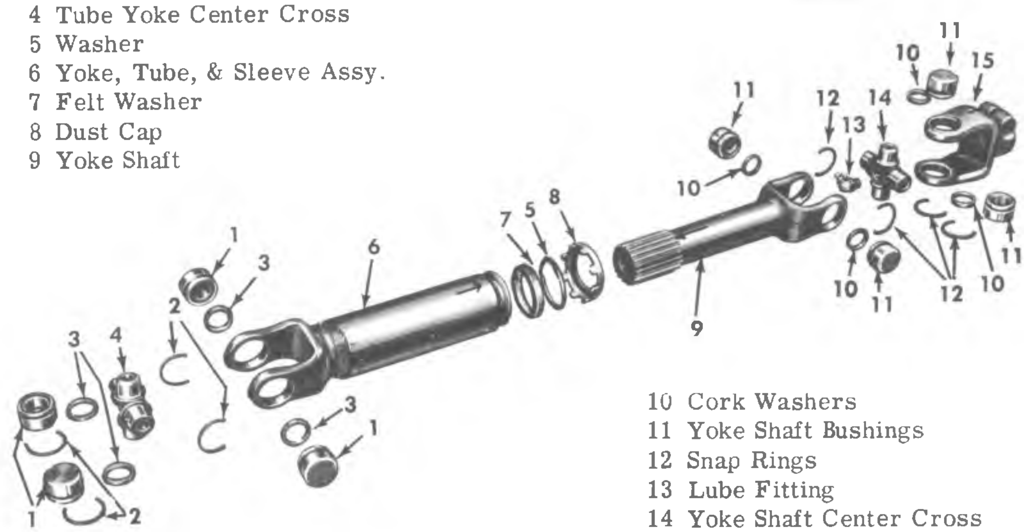


Figure 17—Intermediate Shaft (Typical)

to bracket on control switch. On columns using clips, secure harness to clips.

3. On vehicles using two-piece steering column, assemble center universal joint (17), bushings, and seals to yokes, and journal using new repair kit. Lubricate joint when assembled.

4. If lower universal joint was disassembled, assemble joint as described in Step 3 above.

5. Referring to figure 17, install tabbed dust cap (8), washer (5), and felt seal (7) on lower splined shaft, and joint assembly. Lubricate and insert splined end of shaft (9) into intermediate slip yoke assembly (6). Crimp ends of dust cap tabs into groove at end of slip yoke.

6. Slide stop clamp and bolt (16, fig. 19), outer seal (15), spring (14), spring seat (13), and inner seal (12) on upper steering shaft, and in that order. Install floor column seal (2) on steering shaft or column before assembling shaft to steering column.

7. Insert single or two-piece shaft through lower bearing (11), and push upward through upper bearing until shaft (7) extends past top of mast jacket.

8. Referring to figure 20, insert horn contact cartridge assembly (7) into hole in steering wheel hub. Insulator and brush should extend past the underside of hub when fully positioned as shown.

9. Referring to figure 20, install diaphragm type spring (9) receiver cup (4) and plastic bushing spacer (3) into opening at top side of steering wheel hub. Secure all parts with three screws (2) and torque to 20-30 inch-pounds. At under-side of hub, check movement of horn contact brush (8); it should be under spring tension and be free from binding condition. Place canceling cam over brush, and align holes in cam with two tapped holes in hub. Secure cam to hub with two screws and tighten securely.

INSTALLATION

1. Position steering shaft and coupling, or upper and lower column assembly of two section units in vehicle. Place yoke clamp (19, fig. 19), or coupling clamp, on steering gear worm shaft (20), with match marks aligned.

2. Install coupling bolt and torque to 25-35 foot-pounds on "C" Models, and 30-40 foot-pounds on cowl models.

3. Loosely, install mast jacket U-clamp at under-edge of dash support, being careful to insert tang on U-clamp into elongated slot of mast jacket (refer to fig. 21).

4. Adjust lower flexible coupling (fig. 22) to maintain dimension of 0.250" to 0.375". While holding this dimension, torque U-clamp bolts to 15 to 20 foot-pounds.

5. Raise column into position and loosely install all brackets, and bolts or clamps (4, fig. 19) as they were previous to removal. Position floor seal (2) in place at cowl or floor.

IMPORTANT: To prevent axial bind, all steering column attaching brackets, or supports should

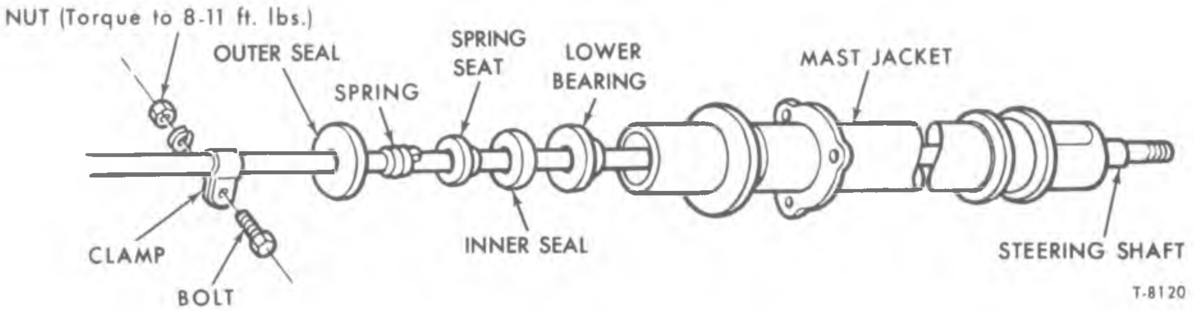


Figure 18—Steering Column Mast Jacket Components (Conventional Cab)

be tightened first where they fasten to cab. Tighten steering shaft coupling, or yoke clamp at steering gear worm shaft, before tightening clamps which actually secure the column to mounting brackets.

6. Install screws which attach steering column floor seal and retainer to floor or cowl (fig. 21).

7. Tighten all the steering column attaching clamps, bolts, and nuts in the secuence just described. Tighten all clamps to the torque listed in "Specifications" at end of this section.

8. Install steering wheel to steering shaft (7, fig. 19) using care to align mark on shaft end, with center of cutout portion of horn receiver cup as shown in figure 20. Tap wheel on shaft and install washer and lock nut (8). Torque nut to 35-45 foot-pounds. Press horn button into place in wheel hub.

9. At lower end of steering column (fig. 19) position inner seal (12), spring seat (13), spring (14), outer column seal (15), and stop clamp bolt and nut (16) against lower column bearing (11). Install with inner seal inserted in lower bearing recess. Adjust stop clamp so that 0.005" minimum to 0.030" maximum axial shaft end play movement exists. This clearance must be maintained to prevent binding of bearings or steering wheel chucking condition (fig. 3).

10. Connect the directional signal and hazard warning wiring connector to multiple connection under dash.

11. Secure trailer hand brake control to column if previously removed.

12. Test action of steering wheel for bind, looseness, or chucking, and make adjustments, if necessary. Check turn lights, hazard warning, and horn operation. Inspect all components for loose bolts and tighten if necessary.

IMPORTANT: On occasion, a scraping or rubbing noise in the steering wheel (Conv. Cab Models) may be incorrectly diagnosed as rough mast jacket bearings. Lubrication of the rubber seal at lower end of the steering column mast jacket will usually correct this condition.

STEERING COLUMN AND SHAFT ASSEMBLY (TILT CAB MODEL)

A new upper steering column cross section (fig. 23) is incorporated for tilt cab models and houses the hazard warning switch instead of being dash mounted. The upper shaft and column assembly can be serviced as follows:

REMOVAL OF COLUMN AND SHAFT

NOTE: Key numbers in following text refer to figure 24, except as otherwise noted:

1. Remove steering wheel as described previously in this section under "Steering Wheel Replacement."

2. Disconnect all wiring from steering column under dash.

3. Mark clamp yoke (22) and steering gear worm shaft (23) so they can be installed (fig. 15) in same relative position, loosen, and remove clamp bolt and nut.

4. Remove trailer hand brake control valve (if used), from steering column.

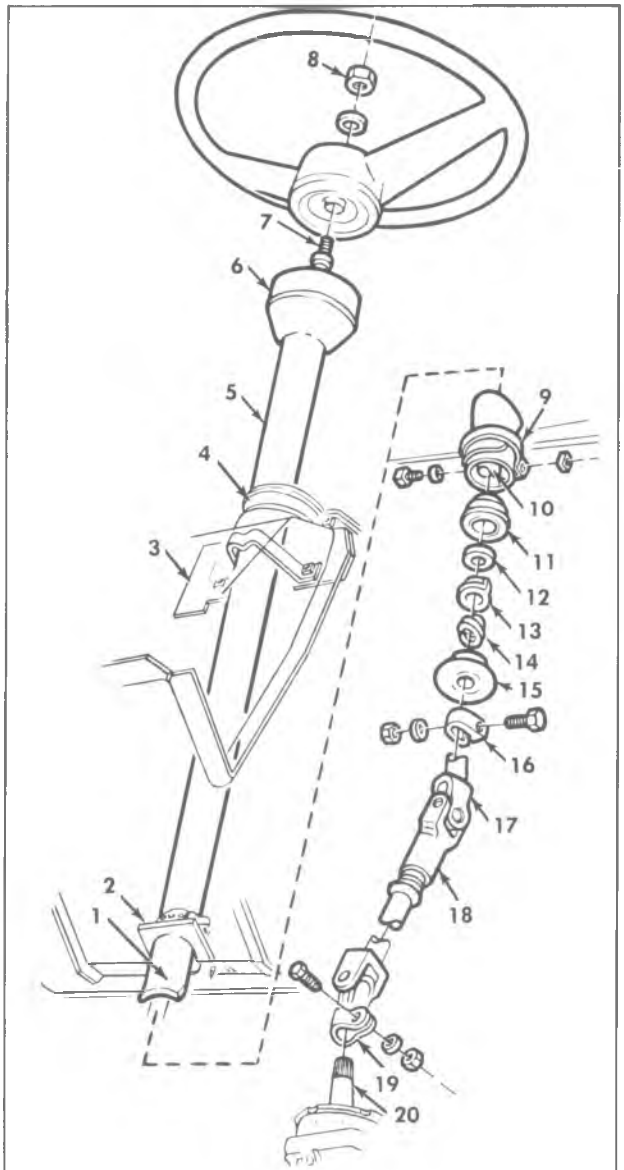
5. Remove steering column seal (19) and retainer (20) from cab floor.

6. Remove all bolts attaching steering column clamps (7) to supports and braces. Remove steering column and shaft assembly.

DISASSEMBLY OF COLUMN AND SHAFT

NOTE: Key numbers in text refer to figure 24, except as otherwise noted.

1. Pull upper steering shaft (1) from steering column (6).



1 Cowl Bracket	11 Lower Bearing
2 Floor Seal	12 Inner Seal
3 Dash Bracket	13 Spring Seat
4 Column Clamp	14 Spring
5 Steering Column	15 Outer Seal
6 Directional Switch Housing	16 Stop Clamp
7 Upper Steering Shaft	17 Center Universal Joint
8 Steering Wheel Lock Nut	18 Slip Yoke
9 Lower Column Clamp	19 Lower Shaft Clamp
10 Steering Shaft	20 Worm Shaft

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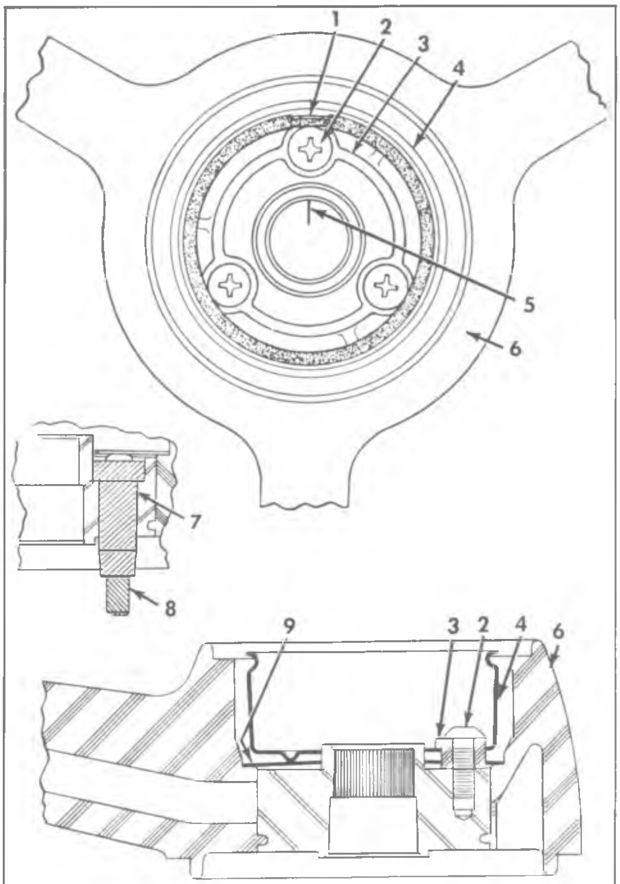
Figure 19—Steering Column and Shaft (Cowl Model)

2. Referring to figure 16, remove directional control lever from control switch.

NOTE: It is necessary to remove multiple wire connector at end of harness before directional switch can be removed. See "Multiple Wire Connectors" as described previously in this section.



1 Notch in Receiver Cup	6 Steering Wheel Hub
2 Retainer Screw	7 Horn Contact Cartridge
3 Bushing Spacer	8 Contact Brush
4 Receiver Cup	9 Bellville Spring
5 Alignment Mark	

T-5799

Figure 20—Horn Assembly Components (Cowl and Conventional Cab)

3. Remove three screws which retain directional signal switch to housing. Remove directional switch, hazard warning, and harness.

4. Remove directional switch housing (4) from column by turning counterclockwise to unlock from tabs.

5. Pull, or pry lower bearing (8) from steering column, if damaged or defective.

6. Remove inner seal (10), spring seat (11), spring (12), outer seal assembly (13), and stop clamp (14) from upper steering shaft.

7. Refer to figure 17 to separate upper and lower steering shafts at joint (15) (fig. 24). Remove two snap rings (2) (fig. 17), and tap yoke sideways to dislodge bushings (1) of adjoining yoke; repeat

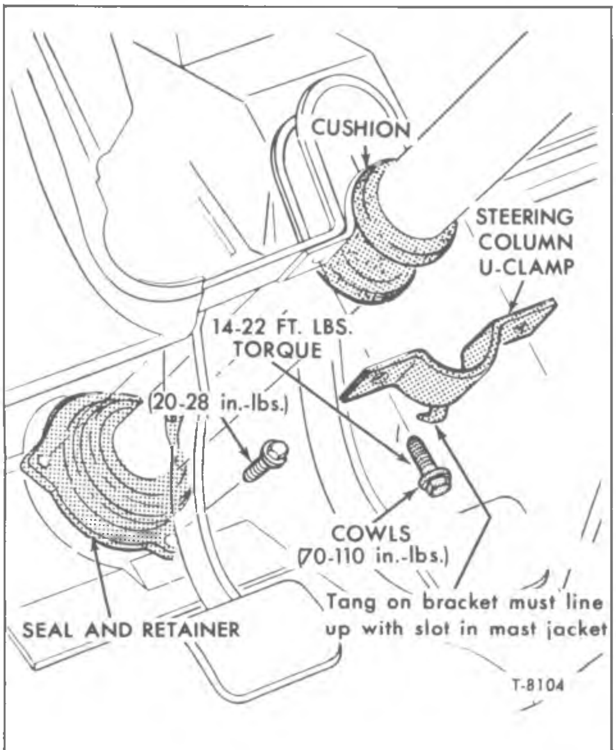


Figure 21—Steering Column Mounting (Cowl and Conventional Cab) (Typical)

operation until all bushings are removed. Remove cork seals (3) from journal (4) and discard.

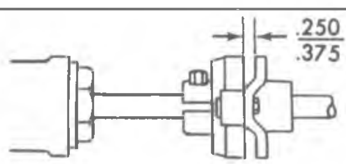
8. To remove slip yoke (16) (fig. 24) from lower shaft assembly (18), bend tabs of dust cap (17) away from retainer groove. Pull shaft, felt seal, and washer, from yoke sleeve. Slide components from shaft, and discard seal.

9. If disassembly of lower clamp yoke to shaft is desired, proceed as described in Step 7 above.

INSPECTION OF COLUMN AND SHAFT

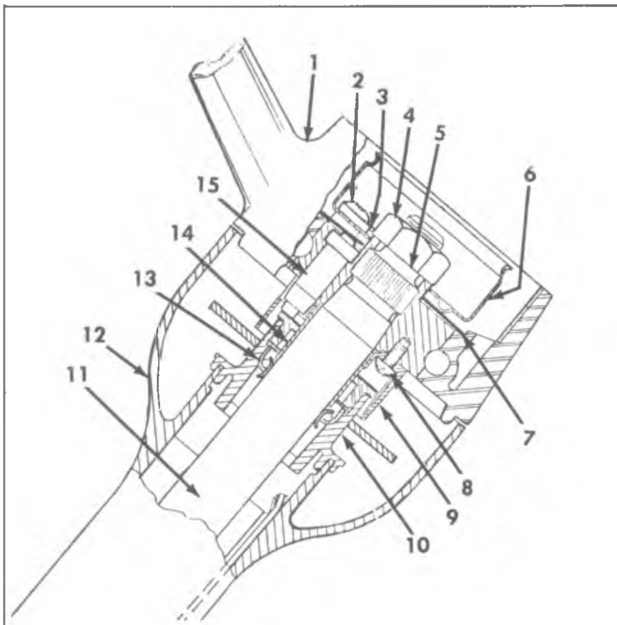
Inspect steering column components and replace, or repair, as described previously in "Inspection" of this section.

NOTE: ALL STEERING ATTACHMENTS, ARE IMPORTANT ATTACHING PARTS IN THAT THEY COULD AFFECT THE PERFORMANCE OF VITAL COMPONENTS AND SYSTEMS, AND/OR COULD RESULT IN MAJOR REPAIR EXPENSE. THEY MUST BE REPLACED WITH PARTS OF THE SAME PART NUMBERS OR WITH EQUIVALENT PARTS IF REPLACEMENT BECOMES NECESSARY. DO NOT USE REPLACEMENT PARTS OF LESSER QUALITY OR SUBSTITUTE DESIGN. TORQUE VALUES MUST BE USED AS SPECIFIED DURING REASSEMBLY TO ASSURE PROPER RETENTION OF THESE PARTS.



This dimension must be held to prevent distortion of flexible coupling with resultant bind and harshness. T-6476

Figure 22—Rag-Type Flexible Coupling Adjustment (Conventional Cab)



1 Steering Wheel
2 Screw
3 Screw Insulator
4 Nut
5 Washer
6 Horn Button Retainer Cup
7 Belleville Spring
8 Canceling Cam Screw
9 Canceling Cam
10 Directional & Hazard Warning Switch Assembly
11 Steering Shaft
12 Directional Switch Housing
13 Upper Bearing
14 Spacer
15 Horn Contact

T-7082

Figure 23—Upper Steering Column Cross Section (Tilt Cab) (Typical)

ASSEMBLY OF COLUMN AND SHAFT

NOTE: Refer to figure 24 for key numbers unless otherwise indicated.

1. Press bearing (8) into lower end of upper steering column tube (6).

2. Install directional signal housing (4) at upper end of column by turning it clockwise to lock it in place in upper jacket.

NOTE: It is necessary to insert wiring harness through opening in base of upper column before locking directional and hazard warning switch harness to column with the three attaching screws. See "Multiple Wiring Connectors" of this section for connector installation.

3. Install directional signal and hazard warning switch in housing with three attaching screws. Tighten screws securely. Inspect wiring harness to make certain it is properly positioned and clipped on outside of steering jacket.

4. At lower steering shaft (18), position floor seal (19), tabbed dust cap (17), metal washer, and new felt seal on splined yoke shaft (18). Lubricate splines lightly. Align arrows on yoke shaft and slip joint tube. Slide shaft into tube and crimp tabs of dust cap into groove in yoke tube.

5. Referring to figure 17, if lower shaft yoke clamp (15) was previously disassembled, assemble, installing new cork seals (10) to cross journal (14), install new bushings (11) and snap ring (12). Press or tap bushings in yoke over cross journals until snap rings can be installed in bushings.

6. Refer to figure 17, position center cross (4), and lower shaft (6) upper yoke in upper shaft yoke. Install all new cork washers (3), on journals (4), install new bushings (1) and snap rings (2). Press or tap bushings in yoke over cross journals until snap rings can be installed in bushings.

7. Slide stop clamp (14), outer seal (13), spring (12), spring seat (11) and inner seal (10) on upper shaft. Insert upper shaft into lower steering column bearing (8), and push upward through upper bearing until shaft extends past top of mast jacket.

INSTALLATION OF COLUMN AND SHAFT

NOTE: ALL STEERING COLUMN ATTACHMENTS ARE IMPORTANT ATTACHING PARTS IN THAT THEY COULD AFFECT THE PERFORMANCE OF VITAL COMPONENTS AND SYSTEMS. AND/OR COULD RESULT IN MAJOR REPAIR EXPENSE. THEY MUST BE REPLACED WITH PARTS OF THE SAME PART NUMBERS OR WITH EQUIVALENT PARTS IF REPLACEMENT BECOMES NECESSARY. DO NOT USE REPLACEMENT PARTS OF LESSER QUALITY OR SUBSTITUTE DESIGN. TORQUE VALUES MUST BE USED AS SPECIFIED DURING REASSEMBLY TO ASSURE PROPER RETENTION OF THESE PARTS.

INSTALLATION OF COLUMN AND SHAFT
(Refer to Fig. 24)

1. Position steering shaft assembly in vehicle. Align match marks and place lower yoke clamp (22) on steering gear worm shaft (23). Tighten clamp bolt nuts to 40-50 foot-pounds torque.

2. Raise column to position and loosely install all brackets, bolts, and clamps. Position floor seal at floor.

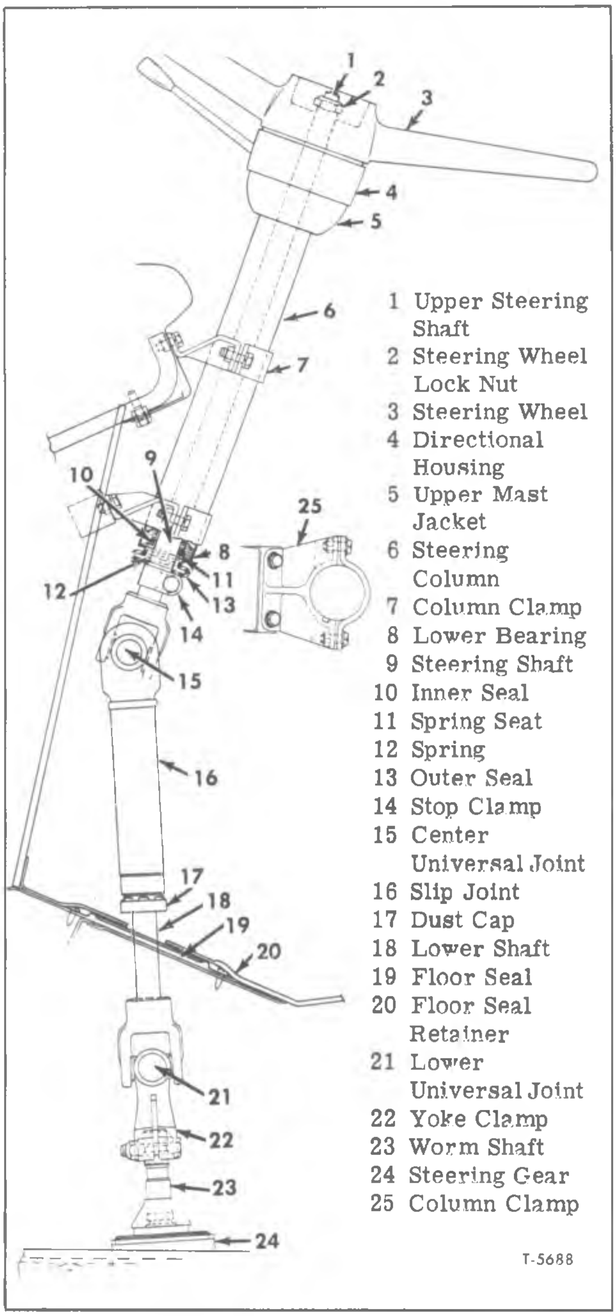


Figure 24—Steering Column and Shaft (Tilt Cab)

IMPORTANT: To prevent axial bind, all steering column attaching brackets or supports should be tightened first that fasten to cab. Tighten steering shaft yoke clamp at steering gear worm shaft before tightening clamps which secure the column to mounting brackets.

3. Install screws which attach steering column seal and retainer to floor.

4. Tighten all the steering column attaching clamps, bolts, and nuts in sequence described previously. Tighten all column clamps to torque listed

in "Specifications" at end of this section.

5. Install steering wheel to steering shaft as outlined under "Steering Wheel Replacement."

6. At lower end of steering column, position inner seal (10), spring seat (11), spring (12), outer column seal (13), and stop clamp (14), bolt and nut, against lower column bearing (8).

7. Install with inner seal (10) inserted in bearing recess. Adjust stop clamp so that 0.005" minimum to 0.030" maximum axial shaft end play movement exists. This clearance must be maintained to prevent binding of bearings, or steering wheel chucking condition (fig. 3).

8. Connect directional signal wiring connector to multiple connector under dash.

9. Secure trailer hand brake control to column if previously removed.

10. Test action of steering wheel for bind, looseness, or chucking and make adjustments, if necessary. Check turn lights and horn operation.

MECHANICAL STEERING TROUBLE DIAGNOSIS CHART

PROBLEM - STEERING WANDERS

CAUSE
1. Toe-in out of adjustment, or tie rod ends worn. Toe-out causes steering to wander.
2. Steering system out of alignment.
3. Tires badly worn, edge of tires are rounded off.
4. All steering components worn and loose.
5. Lack of lubrication in linkage and king pins.

REPAIR
1. Replace tie rod ends if worn, adjust to correct toe-in, and inspect steering arm and tie rod for bent condition.
2. Align steering complete, caster, camber, and toe-in. Inspect spring components for condition and wear.
3. Install new tires, and check alignment; abnormal tire wear indicates improper alignment.
4. Replace or adjust loose or worn parts as necessary.
5. Lubricate as described in LUBRICATION (SEC. 0) of this manual. Free up any components which are frozen and will not take lubrication.

PROBLEM - STEERING PULLS TO LEFT OR RIGHT

CAUSE
1. Camber incorrectly adjusted. Steering will generally pull to side of axle having greatest positive camber.
2. Low air pressure in right or left tire. Steering will pull to side having low air pressure.
3. Axle loose and shifted at spring U-bolts.
4. Rear axle loose at spring U-bolts if shifted at one side will cause steering to pull.

REPAIR
1. Adjust camber to correct specifications.
2. Inflate tire to correct pressure, check for air leak.
3. Align axle, and tighten U-bolt nuts to proper torque. Inspect for damaged parts.
4. Align rear axle and replace defective parts, if any. Tighten U-bolts to proper torque.

PROBLEM - HARD STEERING

CAUSE
1. Lack of lubrication - frozen king pins or ball joints.
2. Tire pressure too low.
3. Improper or excessive positive caster.
4. Steering gear adjusted too tight, or binding condition in steering column.

REPAIR
1. Lubricate, and free up king pins. Make certain all fittings take lubricant properly.
2. Inflate tires to proper pressure.
3. Adjust caster to correct specification as described in "FRONT END ALIGNMENT" (SEC. 3A) of this manual.
4. Adjust steering gear as described previously in this section. Adjust steering column mounting clamps, and stop clamp as previously described in this section.

PROBLEM - VIBRATION OR SHIMMY

CAUSE
1. Tires, wheels, or brake drums out of balance.
2. Bent wheel or out of round tire.
3. Loose steering linkage components.
4. Wheel loose on hub.
5. Drive line universal joints rough, or defective. This condition may be confused with steering vibration.
6. Engine misses or is out of balance, this may also be confused with steering shimmy.
7. Defective shock absorbers.

REPAIR
1. Balance tires and wheels, preferably with on-vehicle type balancer, as this method balances entire wheel and drum assembly.
2. Replace wheel, and remount tire, or replace.
3. Adjust, tighten, and repair linkage as necessary.
4. Inspect wheel bolt holes for damage, and tighten to proper torque if OK.
5. Repair drive line as described in "PROPELLER SHAFTS" (SEC. 4D) of this manual.
6. Correct miss in engine, or repair out of balance condition, clutch, pressure plate, or harmonic balancer etc.
7. Replace shock absorbers.

PROBLEM - EXCESSIVE ROAD SHOCK

CAUSE
1. Tire air pressure too high.
2. Wheel bearings adjusted too loose.
3. Camber adjustment incorrect - (negative camber contributes to road shock).
4. Weak or broken front spring.
5. Defective shock absorbers.
6. Loose suspension components.

REPAIR
1. Deflate to correct pressure.
2. Adjust bearings as described in "FRONT HUBS AND BEARINGS" (SEC. 3D).
3. Adjust camber to correct specification as described in "FRONT END ALIGNMENT" (SEC. 3A) of this manual.
4. Repair or replace spring.
5. Replace shock, or shock absorbers.
6. Inspect, adjust or repair, and replace parts as necessary.

PROBLEM - SNAPPING OR CHUCKING IN STEERING COLUMN OR WHEEL

CAUSE
1. Steering shaft stop clamp loose, this permits excessive up and down movement of steering shaft and wheel in column.
2. Loose steering gear at frame.
3. Worn steering shaft universal joints.
4. Worn steering linkage components. The effect of these components will telescope through steering system and be felt in steering wheel.
5. Steering gear incorrectly adjusted.

REPAIR
1. Adjust steering shaft stop clamp as described previously in this section.
2. Tighten mounting bolts to proper torque listed in "Specifications" at end of this section.
3. Replace and repair joints as necessary.
4. Adjust, tighten and repair components as described previously in this section.
5. Adjust steering gear as previously described in this section.

MECHANICAL STEERING SPECIFICATIONS

STEERING GEAR APPLICATION CHART

TRUCK MODELS	GEAR MODEL	GEAR RATIO
C40, 50	549-D-176	28.14 to 1
S50	553-D-78	28.14 to 1
C60	553-D-72	28.14 to 1
T50, 60	553-D-17	28.14 to 1

STEERING GEAR ADJUSTMENTS

WORM BEARINGS	
Pull to keep wheel moving	1½ to 2 lbs.
SECTOR GEAR LASH:	
Pull over center	2¾ to 3¼ lbs.
Lash Adjuster Shim Thickness	0.063", 0.065", 0.067", 0.069"

TORQUE SPECIFICATIONS

LOCATION	TYPE OF PART	TORQUE (1) FT. LBS.
STEERING GEAR		
Lash Adjuster Screw	Nut	25-35
Side Cover to Housing	Bolt	25-35
Worm Bearing Adjuster Screw	Nut	70-100
Back Up Adjuster Jam Nut (if used) (553-D-17 only)	Nut	30-50
STEERING WHEEL-TO-STEERING SHAFT	Nut	
Except "T" Models		35-45
"T" Models		45-50
STEERING COLUMN CLAMP BOLT		
All Models	Bolt	15-20
STEERING SHAFT "STOP" CLAMP BOLT		
All Models	Nut	8-12
STEERING SHAFT-TO-WORM SHAFT CLAMP BOLT		
"T" Models	Nut	40-50
"S" Models	Nut	30-40
"C" Models	Bolt	25-35
STEERING GEAR-TO-FRAME BOLT		
All Except "T" Models	Nut	90-130
"T" Models	Nut	90-110
PITMAN ARM TO PITMAN SHAFT		
"T" Models	Nut	220-250
All Others (Pitman Arm Clamp Bolt)	Nut	100-110
CONNECTING ROD STUD-TO-PITMAN ARM AND STEERING ARM		
Except "T" Models	Nut	40 (2)
"T" Models	Nut	125-150 (2)
STEERING ARM-TO-TIE ROD STUD		
F050, F055	Nut	150-160 (2)
F070	Nut	150-180 (2)
F090, F110, F120	Nut	125-150 (2)
STEERING TIE ROD CLAMP BOLT		
F050, F055	Nut	45-55
F070	Nut	80-100
F090, F110, F120	Nut	65-75
STEERING ARM-TO-STEERING KNUCKLE STUD		
F050, F055	Nut	115-165 (2)
F070	Nut	180-240 (2)
F090, F110, F120	Nut	400 (2)

(1) NOTE: All tapered ball studs must be clean and dry.
(2) Tighten as indicated, then tighten to next notch to insert cotter pin.

SECTION 9B

Power Steering

Contents of this section are listed in Index below:

NOTE: All power steering attachments, are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with parts of the same part numbers or with equivalent parts if replacement becomes necessary. Do not use replacement parts of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.

POWER STEERING SYSTEM

DESCRIPTION

The power steering system provides automatic hydraulic assistance to the turning effort applied to the mechanical steering system.

The power steering system consists of a control valve, power cylinder, and a hydraulic pump used in conjunction with the steering gear. An oil cooler is attached to front of radiator on all vehicles except those equipped with air conditioning.

The power steering system is a complete Inline unit. The steering shaft, hydraulic valve, worm, and ball nut are in a line, making a compact, space-saving steering gear. The recirculating ball-type mechanical steering gear is used in conjunction with the control valve.

The power steering will not operate without driver guidance; therefore, when turning effort is relieved, the front wheels return to neutral or straight-ahead position.

The power cylinder is actuated by operation of the control valve which supplies hydraulic fluid to either side of the power cylinder piston as required, depending on the position of the valve. The pressure used to operate this system is supplied by either a vane-type or slipper type oil pump.

If, for any reason, the power steering system should fail, the control valve "locks up" and the steering gear operates manually, giving the driver full control of the vehicle; however, greater manual effort will be required to operate the steering mechanism.

A fluid reservoir either encases the pump or is mounted on top of the pump. An additional reservoir is mounted on a bracket attached to the radiator support on conventional cab models or to the transmission control island panel front support on tilt cab models.

MAINTENANCE

The power steering system requires little maintenance. However, the hydraulic system should be kept clean to ensure maximum operating performance and trouble-free service. Periodic inspection to check for leaks should also be made.

At regular intervals the pump hydraulic fluid level in the reservoir should be checked and fluid added when required. Refer to LUBRICATION (SEC. 0) for type of fluid to be used, and intervals for filling.

When the slightest evidence of dirt, sludge, or water is discovered in the system, drain and refill with clean hydraulic fluid recommended in LUBRICATION (SEC. 0) earlier. To drain system, disconnect fluid lines at power cylinder. Air in the fluid system will cause spongy action and noisy operation. When any hose has been disconnected or when fluid has been lost for any reason, the system must be bled after adding fluid. Bleed system as directed later in this section under "Bleeding Hydraulic System."

Should the power steering system become inoperative due to loss of hydraulic fluid, pump pressure line should be re-routed from pump outlet directly back to pump reservoir.

IMPORTANT: DO NOT operate pump without fluid in pump reservoir.

The hydraulic pump, control valve, and power cylinder do not require adjustment on the vehicle. The only adjustments are on the steering linkage. Adjustment of these parts are normally required only when the units have been removed or disconnected.

NOTE: These adjustments, with the exception of the power cylinder piston rod end, are the same as previously described in "MECHANICAL STEERING" previously in this group.

Wheel alignment must be maintained to proper specifications. Refer to FRONT SUSPENSION (SEC. 3) in this manual for proper procedures for checking front end alignment. Improper tire inflation will also affect operation of the power steering. The tires should be checked at regular intervals.

Because of the power assist from the power steering system it is more difficult to detect defects in the steering system. Therefore, periodic maintenance is very important on a vehicle having power steering.

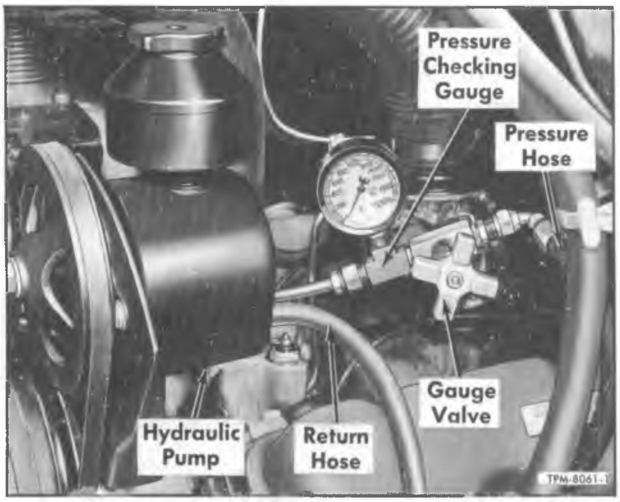


Figure 1—Checking Pump Hydraulic Pressure (Vane Type Pump) (Typical)

BLEEDING HYDRAULIC SYSTEM

When a power steering pump or power cylinder has been installed or a disconnected oil line has been reconnected, the air that has entered the system must be bled out before the vehicle is again operated. If air is allowed to remain in the hydraulic fluid system, noisy and unsatisfactory operation of the steering system will result. Bleed air from the hydraulic system as follows:

NOTE: When hydraulic fluid is added to power steering system, fluid should be poured through a 200 mesh wire screen. Use only the hydraulic fluid recommended in LUBRICATION (SEC. 0) in this manual.

Power steering system reservoir is located on power steering hydraulic pump. Reservoir is marked with an "OIL LEVEL" mark. Use only "Automatic Transmission Fluid GM DEXRON ® . DO NOT USE HYDRAULIC BRAKE FLUID, SHOCK ABSORBER FLUID, OR SIMILAR OIL.

Fluid level should be kept at "OIL LEVEL" mark on reservoir. After cleaning reservoir and cover, loosen cover bolt and remove. Using a clean receptacle, pour fluid through a 200 mesh screen. Keep fluid clean and free from water.

1. Fill pump fluid reservoir to proper level and let fluid remain undisturbed for about two minutes.
2. Raise front end of the vehicle so that front wheels are off the ground.
3. Turn wheels to right and left to wheel "stops" to eliminate air pockets in the power cylinder. Continue this operation until fluid in reservoir stops bubbling. Maintain fluid level during this operation.
4. Start the engine and run at idle for two minutes, turn wheels to right and left as before. DO NOT HIT THE WHEEL STOPS. Recheck fluid level and hose connections for leaks. Continue this operation until fluid in reservoir is clear.
5. Increase engine speed to approximately 1500 rpm and continue running at this speed until all signs of air bubbles cease to appear in reservoir. Turn wheels (off the ground) to right and left. DO NOT HIT THE WHEEL STOPS.
6. Lower the vehicle and turn wheels on the ground. Recheck for leaks.
7. Check fluid level in reservoir and refill as required.

HYDRAULIC PRESSURE TEST

VANE-TYPE HYDRAULIC PUMPS

1. Disconnect pressure hose from fitting at the hydraulic pump. Connect a 0 to 2000 psi pressure gauge (J-22181) between the pressure hose and the pump pressure port. Leave valve in pressure gauge line open (fig. 1).

2. Bleed steering hydraulic system to remove all air from pressure line as directed previously under "Bleeding Hydraulic System."

3. Start engine and run at idle speed. Turn wheels through normal operating range several times until the hydraulic fluid temperature reaches 170°F. When fluid temperature reaches 170°F., close valve in pressure gauge line and observe reading on pressure gauge. Pressure reading should be within 900-1000 psi.

4. Open valve in pressure gauge line. Turn wheels to extreme right and left against "stops" (with wheels on ground). At extreme right or left position the maximum pressure reading should be within the amount specified in procedure 3 above.

SLIPPER-TYPE HYDRAULIC PUMP

1. Disconnect hydraulic pump to steering gear pressure line at pump. Connect a 0 to 2000 psi pressure gauge (J-22181) to the pump outlet; then connect a shut-off valve between the pressure gauge and pressure line (fig. 2). Make sure all connections are tight and that shut-off valve is fully open.

NOTE: The pressure gauge must be installed between the pump and the shut-off valve.

2. Start the engine and run for several minutes at idle speed. Turn wheels from right to left several times to expel all air from system and to bring fluid temperature to approximately 170°F.

3. Close shut-off valve and observe pressure gauge. Pressure should be 1000 to 1100 psi.

NOTE: DO NOT close valve for more than a few seconds, as this would increase fluid temperature and cause excessive pump wear.

4. Open shut-off valve; then turn wheels to extreme right and left with wheels on ground. At extreme positions, the maximum pressure reading should be within above limits.

5. If pressure is greater than 1100 psi or less than 1000 psi, replace the pressure relief valve and repeat the test. If pressure is still not within limits specified, remove pump and disassemble.

PUMP DRIVE BELT

MAINTENANCE

The drive belt must be kept at proper tension. A loose belt will reduce output of the hydraulic pump, while a tight belt will cause eventual bearing failure. A regular, periodic inspection is recommended to check condition of drive belt. Replace belt if frayed or badly worn.

NOTE: On a new vehicle or after having installed a new drive belt, check belt tension twice in first 200 miles of operation.

ADJUSTMENT

NOTE: Gauge (J-23600) must be placed at center of the greatest span of the belt.

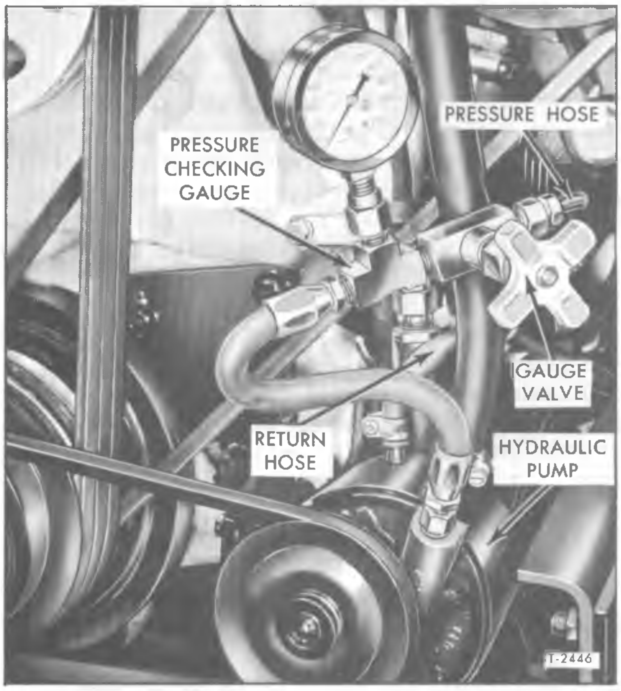


Figure 2—Checking Pump Hydraulic Pressure (Slipper Type Pump) (Typical)

1. Loosen hydraulic pump to mounting bracket attaching bolts.

2. Position pump so that a reading of 120-130 pounds (new belt) or 90-100 pounds (used belt) is obtained on a strand tension gauge.

3. Tighten pump to mounting bracket bolts firmly.

NOTE: Mounting brackets and bolt holes should be inspected for cracks or elongated condition. If defective, they should be repaired or replaced.

TUBES, HOSES, AND FITTINGS

Stationary tubes and flexible hoses are used to carry hydraulic fluid through the power steering system. These tubes and hoses connect the steering gear to the power cylinder and hydraulic pump.

All tubes, hoses, and fittings should be inspected for leakage at regular intervals. Fittings must be tightened to torque listed in "Specifications" at end of this section. Make sure clips, clamps, and unions supporting tubes and hoses are in place and properly secured.

When servicing power steering hoses, avoid twisting the hoses unnecessarily. Install hoses with the wheels in the straight-ahead position, then turn the wheels fully to the left and right, while observing movement of the hoses. Correct any hose contact with other parts of the vehicle that could cause chafing or wear.

POWER STEERING GEAR AND CONTROL VALVE

NOTE: Control valve and Power Steering Gear fasteners are important attaching parts in that they could affect the performance of vital components and systems and/or could result in major repair expense. They must be replaced with parts of the same part numbers or with equivalent parts if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of parts.

The 553-DV-54, 553-DV-73 and 553-DV-79 type power steering gear assemblies are used on vehicles covered by this manual. The power steering gear assemblies are basically the same except for size and mounting. Refer to "Model Application Chart" at end of this section.

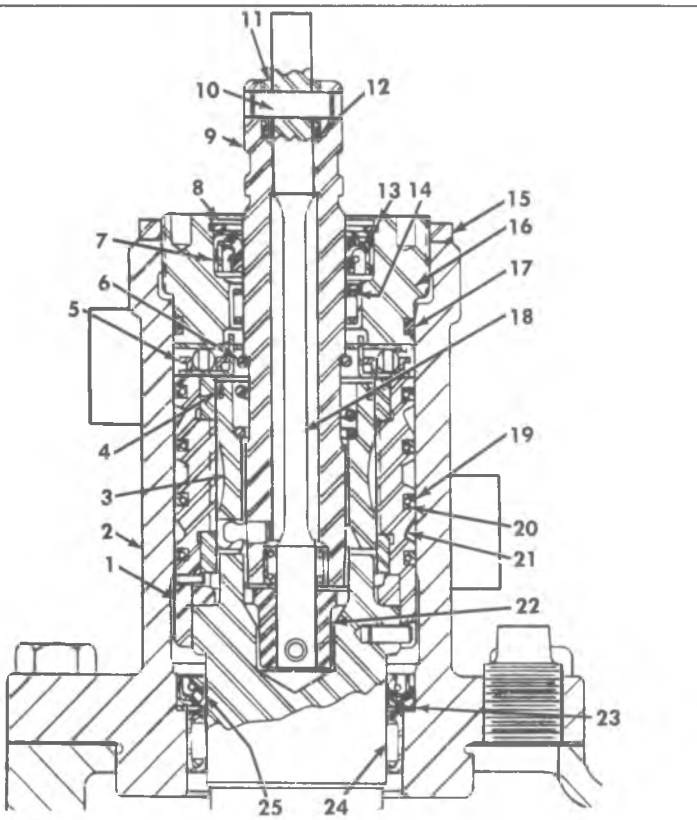
CONTROL VALVE

The power steering system control valve is mounted on top of the steering gear housing and is activated by a torsion bar that tends to keep the valve in neutral position. Should the torsion bar break, the spool and valve body "lock up" into a complete unit, and steering gear then operates as a mechanical unit.

The valve shown in figure 3 is an open-centered, rotary-type, three-way valve. The spool is held in the neutral position by means of the torsion bar. The spool is attached by means of a stud fastened to one end of the torsion bar and the valve body to the other end. Twisting of the torsion bar allows the spool to displace in relation to the valve body, thereby operating the valve.

CONTROL VALVE OPERATION

When the valve is in neutral or straight-ahead position, the fluid flows from pump through the open-center valve, and back to pump reservoir without traveling through the power cylinder. This



1 Valve Body
2 Top Cover
3 Valve Spool
4 Valve Spool Dampener
5 Upper Thrust Bearing
6 Spool Spring
7 Stub Shaft Seal
8 Seal Retaining Ring
9 Stub Shaft
10 Torsion Bar Pin
11 Torsion Bar Sleeve
12 Torsion Bar Seal
13 Seal Back-up Washer
14 Needle Bearing
15 Adjuster Plug Lock Nut
16 Adjuster Plug
17 O-ring Seal
18 Torsion Bar
19 Valve Body Ring
20 Back-up Seal
21 Valve Assembly
22 Torsion Bar Cap
23 Back-up Washer
24 Worm Bearing
25 Worm Oil Seal

TPM-9060

Figure 3—Power Steering Control Valve (Typical)

open-center position of the valve reduces pump losses to a minimum. Valve is in open-center position at all times except when turning. The power cylinder is always full of fluid, which acts as a cushion to absorb shocks so that they are not transferred to the driver. This fluid lubricates all internal components of valve, making it unnecessary to lubricate the valve.

With the steering wheel turned to the right, the torsion bar is deflected, changing the relationship of the spool grooves and valve body grooves with each other. The right-turn grooves of the spool are closed off from the return grooves and opened to the pressure grooves. The left-turn grooves of the spool are closed off from the pressure grooves and opened to the return grooves. This causes the fluid to flow into the appropriate half ot the power cylinder, overcoming the tire friction in that direction. The fluid in the opposite end of the cylinder is simultaneously forced out through the valve and back to the pump reservoir.

The greater the resistance to turning between road bed and front wheels, the more the valve spool is displaced and the higher the fluid pressure is on the resisting side of the piston. Since the amount of valve displacement and consequently the amount of hydraulic pressure built in the cylinder is dependent upon the resistance to turning, the operator is assured of the proper amount of smooth hydraulic assist at all times. The instant the operator stops applying steering effort to the steering wheel, the valve is returned to its neutral position by the torsion bar. The fluid pressure is equalized on both sides of the piston when the torsion bar returns to neutral position. The wheels return to a straight-ahead position due to the steering geometry of the vehicle.

When the steering wheel is turned to the left, the fluid flow in the valve is the same as when making a right-turn but takes place in the opposite direction. Parking pressure, the most difficult of turning conditions, should range from 900 to 1000 psi on vane-type hydraulic pump models and from 1000 to 1100 psi on the slipper type hydraulic pump, depending upon road bed conditions, weight of vehicle, and pressure relief setting in the pump.

During normal straight-ahead driving, steering wheel effort will be approximately the same as manual effort under the same conditions. The control valve will give the driver a smooth transition through the driving range of wheel effort and retain the "road-feel" necessary for effortless driving.

NOTE: Trouble Diagnosis Chart to aid in diagnosing noise, and steering problems can be found at rear of this section. It is intended as a quick reference and covers most problems encountered.

POWER STEERING GEAR REPLACEMENT

REMOVAL

NOTE: Refer to "MECHANICAL STEERING" (SEC. 9A) for Pitman shaft seal replacement.

1. Mark steering gear worm shaft and coupling or clamp yoke on steering shaft or intermediate shaft to assure installation in same position when steering gear is reinstalled.
2. Remove cotter pin and nut attaching connecting rod to Pitman arm. Use a soft hammer to tap connecting rod loose from Pitman arm.
3. On models equipped with a side mounted power cylinder, disconnect power cylinder socket end from Pitman arm.
4. Remove steering shaft to steering gear worm shaft clamp bolt and nut. Bend tangs on dust cap away from the yoke tube, then raise shaft and yoke off steering gear worm shaft.
5. Remove Pitman arm pinch bolt, nut, and special washer; or the Pitman arm to shaft nut and washer. Use puller (J-21143) to remove Pitman arm from shaft.
6. Drain as much fluid as possible from the steering gear.
7. Disconnect control valve to pump return tube, pump to control valve pressure tube, and control valve to power cylinder right and left turn tubes from control valve ports.

IMPORTANT: Cover or plug exposed tubes and ports to prevent dirt from entering system.

8. Remove bolts, nuts, and washers which attach steering gear assembly to frame left side member. Remove steering gear and control valve assembly.

INSTALLATION

1. Position steering wheel in straight-ahead position and steering gear in center position with mark on worm shaft located as described in "Specifications" at end of this section.
2. Position steering gear on frame left side member and at the same time, slide worm shaft into steering shaft clamp yoke or coupling. Check to make sure alignment marks are aligned.
3. Install bolts, nuts, and washers to attach steering gear to frame side member. Tighten bolts to torque listed in "Specifications."
4. Attach intermediate shaft clamp yoke or coupling to steering gear wormshaft with bolt, nut, and washer. Tighten bolt to torque listed in "Specifications" at end of this section.
5. Move dust cap down on yoke tube and bend tangs down to secure in position.
6. Position Pitman arm on Pitman shaft. Pitman arm and shaft have matching blank serrations which must be aligned. Align scribe marks, then install Pitman arm on shaft.

On Conventional Cab and "S" Models, install pinch bolt, special hardened washer, and nut to secure Pitman arm to shaft. Tighten pinch bolt nut to 100-110 foot-pounds torque.

On Tilt Cab Models, install washer and nut to attach Pitman arm to shaft. Tighten nut to 220-250 foot-pounds torque.

7. Connect connecting rod to Pitman arm and attach with nut. Tighten nut to torque listed in "Specifications" at end of this section; then advance to next aligning slot and install a new cotter pin.

8. On vehicles equipped with a side mounted power steering cylinder, connect power cylinder end socket assembly to Pitman arm and attach with nut. Tighten nut to torque listed in "Specifications" at end of this section, then advance to next aligning slot and install a new cotter pin.

9. Connect control valve to pump return tube, pump-to-control valve pressure tube, and right- and left-turn tubes from power cylinder to control valve ports. Tighten fittings to torque specified in "Specifications" at end of this section.

10. Bleed the system and fill reservoir to proper level as described under "Bleeding Hydraulic System" previously in this section.

TROUBLESHOOTING THE POWER STEERING GEAR

NOISE

Several different types of noise may be heard with the control valve steering gear. Troubleshoot noises as follows:

RATTLE OR CHUCKLE

1. Cause could be loose adjustment. Adjust thrust bearing preload.

2. Noise could be caused by steering gear being loose on frame.

a. Check steering gear installation as described previously in this section under "Steering Gear Replacement."

b. Torque steering gear mounting bolts to torque specified under "Specifications" later in this section.

3. Coupling pin stops hitting against the upper flange could also cause this type of noise. Re-alignment of the shaft with the gear or an endwise adjustment of shaft should correct this condition.

NOTE: A slight rattle may occur on turns because of the increased lash off the high point. This is normal.

HISS

There is some noise in all power steering gears which cannot be eliminated. One of the most common is the "hissing" sound most evident at standstill parking with wheels at end of travel. The "hissing" noise is usually caused by a faulty valve.

Do not replace the valve unless the "hiss" is extremely objectionable, since the replacement valve will also have a slight "hissing" noise. Be sure, however, that the steering shaft and gear are properly aligned as the shaft rotates, since misalignment will transmit the "hissing" noise into the cab.

VALVE SQUAWK

Valve squawk when turning or when recovering from a turn may be caused by a worn dampener ring on the valve spool or by a loose or worn valve body. In both cases replace faulty parts.

STEERING GEAR LEAKS

INTERNAL LEAKS

High internal leakage will cause a momentary increase in the steering effort when turning the wheel fast. If this situation should occur, replace the control valve.

EXTERNAL LEAKS

To determine the source of external leaks, thoroughly clean the steering gear and inspect. External leakage may be due to loose hose connections or damaged hose, adjuster plug seals or torsion bar seals. Correct external leaks as follows:

CAUSE	REMEDY
1. Loose hose connections .	Tighten Connections
2. Damaged hose	Replace Hose
3. Damaged adjuster plug seals .	Replace Seals
4. Damaged torsion bar seal . .	Replace Seal

STEERING GEAR MALFUNCTIONS

Each of the malfunctions listed here have a number of causes and each cause has a remedy. These causes and remedies are given in the "Troubleshooting Quick Reference Chart" later in this section.

1. Hard steering while driving.
2. Poor return of steering.
3. Leads to one side or the other.
4. Momentary increased effort on fast turn.
5. Excessive wheel kickback.
6. Steering wheel jerks.
7. Hard steering when parking.
8. Effortless turn.

POWER STEERING HYDRAULIC PUMP

NOTE: These Power Steering Hydraulic Pump fasteners are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with parts of the same part numbers or with equivalent parts if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of parts.

A positive displacement vane-type or slipper-type hydraulic pump is used on vehicles covered by this manual. Refer to "Model Application Chart" and "Specifications" at end of this section for model application and capacity of each pump model.

The vane-type hydraulic pump is mounted at front of engine (fig. 4) or on top of engine and is belt-driven from the engine crankshaft or water pump pulley in conjunction with other accessories.

The oil reservoir encases the pump and on some vehicles, an additional reservoir is remotely mounted on the radiator front support or on the transmission control island support.

On some pump models, the drive shaft is supported by a bushing in the pump housing. On others, the drive shaft is supported by one ball bearing and one needle bearing in the pump housing.

The pump rotary group is the heart of the pump and consists of the drive shaft, rotor, vanes, pump ring, thrust plate, and pressure plate. Flow control valve is the nerve center of the pump and includes flow control plunger, flow control spring, and the pressure relief ball and spring. This assembly controls flow and pressure in the system.

PUMP OPERATION

NOTE: Refer to figures 5 and 6.

As the drive shaft rotates the rotor, the vanes follow the cam surface in the pump ring. This cam consists of two rising and falling areas which cause a complete pumping cycle to occur every 180 degrees of rotation (fig. 5).

The spaces between rotor vanes pick up oil on the rising portions of the cam from two openings between thrust plate and pump ring and from opening between the pressure plate and pump ring. This oil is discharged on the falling portion of the cam through two openings in the pressure plate and two openings in the thrust plate which are connected to openings in the pressure plate by cross-over holes in the pump ring (fig. 5). The oil passes through the pressure plate into cavity (1) behind it. A portion of this oil is directed back through other passages in the pressure plate so that it may enter behind the vanes forcing them to follow the cam surface of the pump ring (fig. 8, View B).

From cavity (1) the oil flows into passage (2) which is controlled in size to provide definitely known oil velocities. From passage (2) a certain quantity of oil passes through orifice (3) into passage (8) and then to the steering gear. Notice that passage (8) is connected to cavity (10) by passage (9). When the quantity of oil exceeds the predetermined system requirements, the pressure drop through orifice (3) exceeds force of spring (12), flow control plunger (11) starts to move back, thereby providing flow control through passages (4), (6) and (7), with (7) being the suction or intake part of the pump. Supercharging occurs as a result of pressure oil in passage (4) discharging into passage (6) at high velocity, picking up the make-up oil from reservoir through passage (5) on the jet-jump principle. Then by a reduction of velocity in passage (6) and (7), velocity energy is converted into supercharge pressure (fig. 6, View B).

The pressure relief valve is contained inside flow control plunger (11). If pump pressure exceeds a certain predetermined pressure, the pressure relief ball will open, allowing a small amount of oil to flow through passages (8) and (9), hole (13), through flow control plunger (11) and into passage (6). This flow of oil causes a pressure drop across hole (13), thus creating a pressure

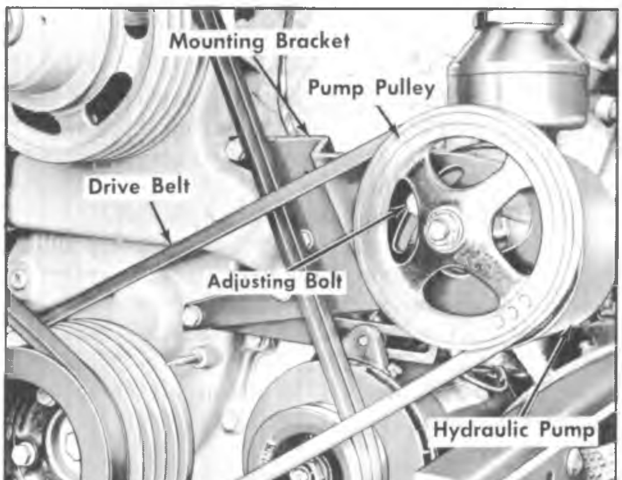


Figure 4—Power Steering Hydraulic Pump Installed (Typical)

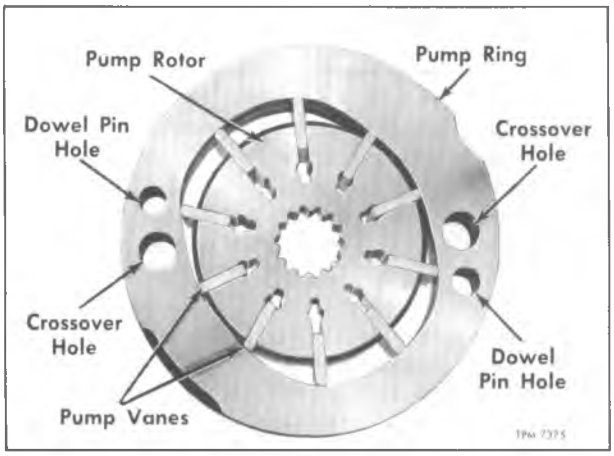


Figure 5—Cross Section of Rotor and Vanes in Pump

unbalance which moves the flow control plunger back against spring pressure, allowing the major portion of oil to bypass through passages (2), (4), and (6) in the same manner as is accomplished by flow control (View B, fig. 6).

Figure 6, View "A" is typical of pump operation when the vehicle is driven at low speed during a partial turn. The oil pressure cannot build up high enough to cause the pressure relief valve to open as the external circuit still allows some oil to flow through the system.

Figure 6, View "B" is typical of pump operation when vehicle is driven at high speeds. In this case, the flow control valve has opened to allow oil flow in excess of system requirements to bypass into intake chamber of the pump.

PUMP REPLACEMENT

Removal

1. Disconnect hoses at pump and secure ends in raised position to prevent drainage of oil.
2. Install caps at pump fittings to prevent drainage of oil from pump.
3. Remove drive pulley attaching nut.
4. Loosen mounting bracket to pump bolts.
5. Remove pump drive belt.
6. Slide pulley from pump drive shaft. DO NOT HAMMER PULLEY OFF SHAFT AS THIS WILL DAMAGE THE PUMP.
7. Remove bracket to pump attaching bolts and remove pump.

Installation

1. Position pump assembly on mounting bracket with holes aligned and install attaching bolts loosely.
2. Slide pulley on drive shaft. DO NOT HAMMER PULLEY ON SHAFT.
3. Install pulley nut (finger-tight) against the pulley.
4. Connect and tighten hose fittings.
5. Fill pump reservoir with fluid recommended in LUBRICATION (SEC. 0) of this manual.
6. Bleed pump by turning pulley backward (counterclockwise as viewed from the front) until all air bubbles cease to appear.
7. Install pump drive belt over drive pulley.
8. Adjust belt tension as previously described, then tighten attaching bolts securely.
9. Tighten drive pulley attaching nut to 25-35 foot-pounds torque.

SLIPPER TYPE HYDRAULIC PUMP

The slipper-type hydraulic pump is a constant displacement type pump with a minimum output of 1.45 gallons per minute with pump idling at a speed of 450 rpm against 665-735 psi pressure. The pump has a maximum flow control range of 3.4 to 4.1 gallons per minute with a 1000 to 1100 psi pressure relief valve. The pump is mounted at front of engine and is belt-driven from crankshaft.

PUMP OPERATION

As the drive shaft rotates the rotor, spring loaded slippers, which contact the eccentric diameter inside the pump housing, force oil from the inlet side of the pump to the flow control valve (fig. 7). Pressure inside the pump is controlled by a valve which permits fluid to be recirculated within the pump. Maximum pressure in the system is limited by a pressure relief valve which opens into the reservoir when pressure exceeds specified maximum of 1000-1100 psi.

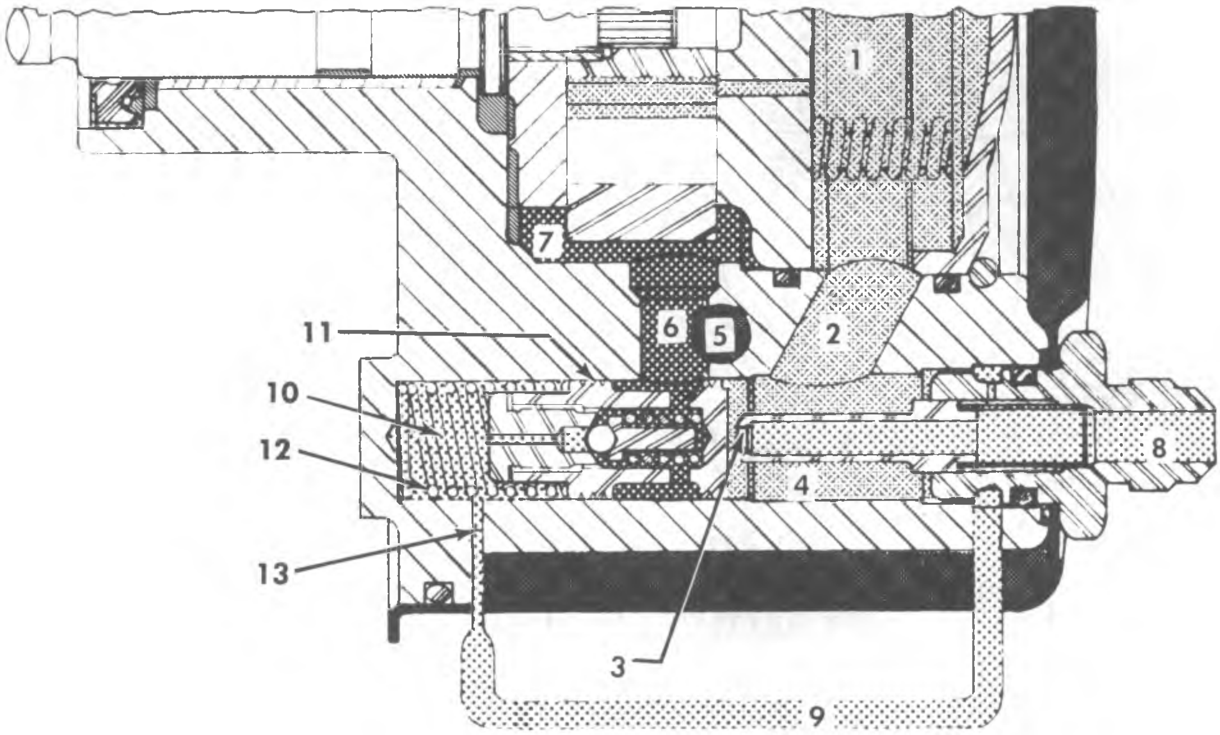
NOTE: At regular intervals, the fluid level in the reservoir should be checked and fluid added when level is more than two inches below filler cap. Refer to LUBRICATION (SEC. 0) of this manual for type of fluid to be used.

IMPORTANT: Before checking fluid level, start the engine and turn steering wheel to the left and right several times to expel air from system, then shut off the engine.

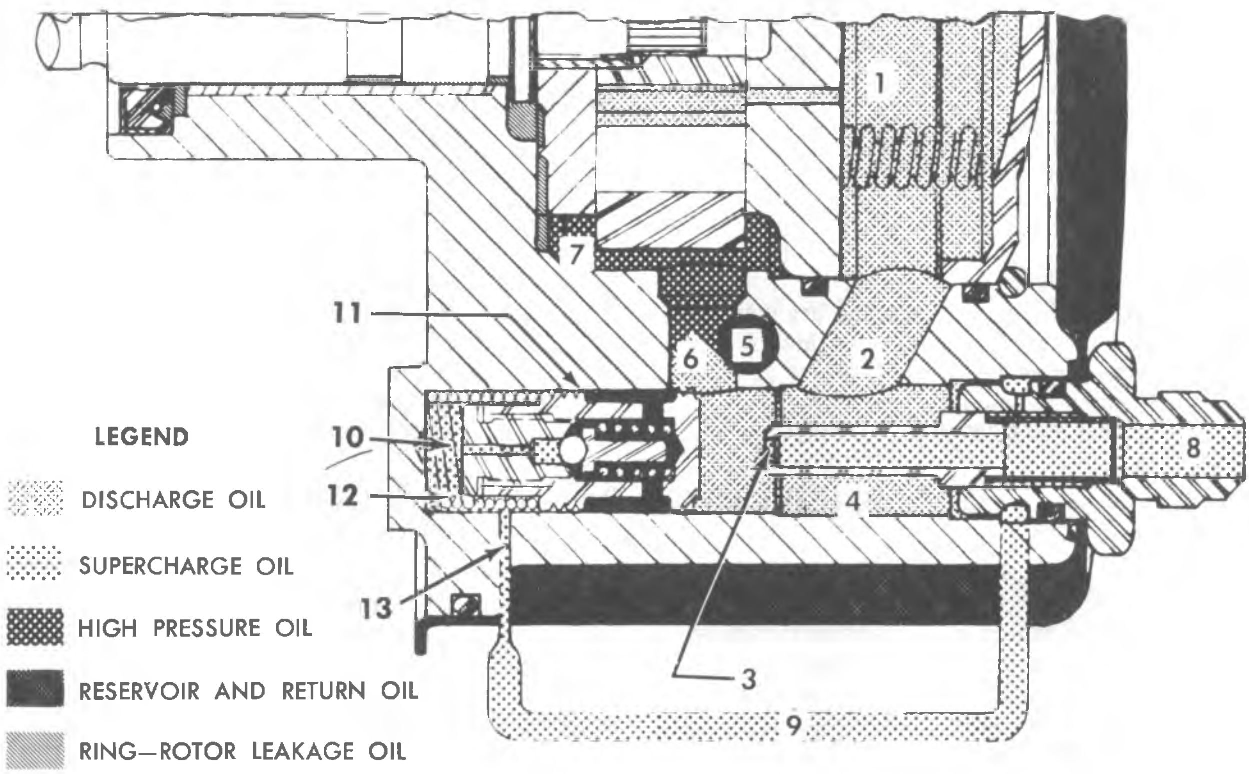
PUMP REPLACEMENT

Removal

1. Loosen two cap screws which attach pump mounting bracket to engine, then move pump inward and remove drive belt.
2. Disconnect hoses at pump. When hoses are disconnected, secure ends in raised position to prevent drainage of oil. Install caps at pump fittings to prevent loss of fluid from pump.
3. Remove two cap screws and lock washers which attach pump and mounting bracket to engine.



VIEW A—PUMP OPERATION—LOW SPEED



VIEW B—PUMP OPERATION—HIGH SPEED

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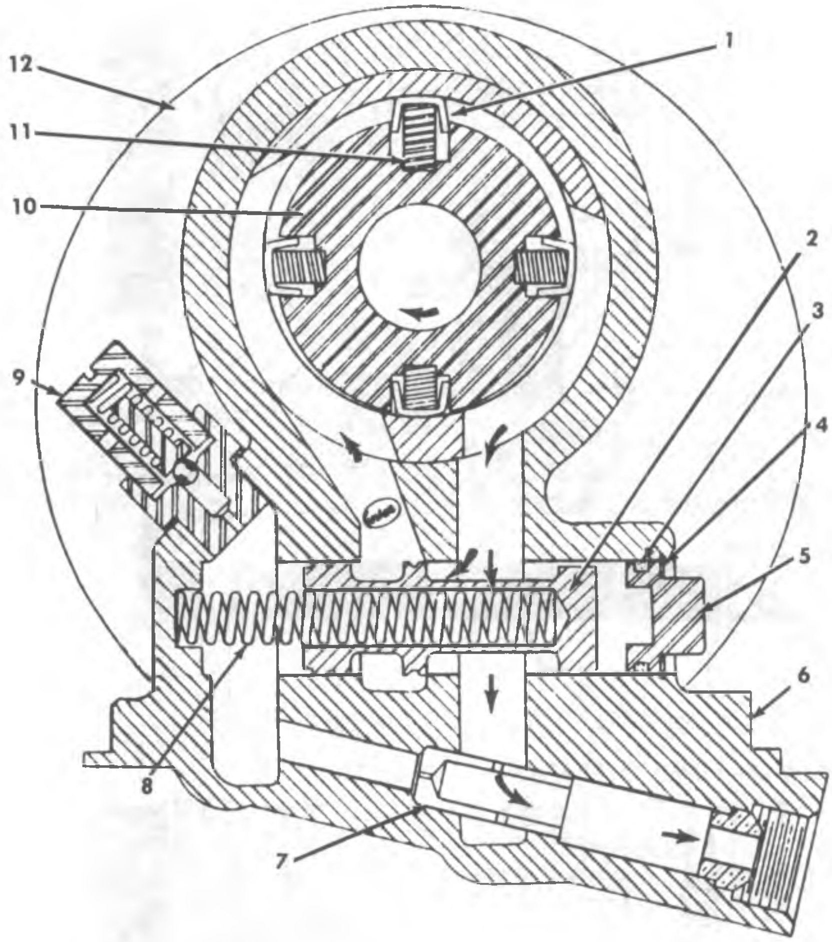
Figure 6—Power Steering Hydraulic Pump Operation



1 Rotor Slipper
2 Flow Control Valve
3 O-Ring Seal
4 Snap Ring
5 Control Valve Plug
6 Pump Body
7 Metering Insert
8 Control Valve Spring
9 Relief Valve Assembly
10 Rotor
11 Slipper Spring
12 Reservoir

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Figure 7—Slipper Type Hydraulic Pump

Installation

1. Position pump and mounting bracket on engine and attach with cap screws and washers.
2. Install drive belt and adjust as previously described under "Pump Drive Belt."
3. Connect and tighten hose fittings.
4. Fill pump reservoir with fluid recommended in LUBRICATION (SEC. 0) of this manual.
5. Start engine and run for several minutes at idle speed. Turn wheels from right to left several times to expel all air from system. Recheck fluid level in reservoir and fill to proper level.

TROUBLESHOOTING THE HYDRAULIC PUMP

PUMP NOISE

The power steering pump is not completely noiseless. Some noise will be present whenever the wheels are against the wheel stops. The noise usually becomes greater as the engine speed is increased as when making a full cramped U-turn. The noise is caused by the relief valve and is normal. Momentary aeration of the oil is sometimes noticeable under these conditions. Some noise may also be present under standstill parking condition, particularly when the wheel stops are contacted. Power steering pump noise can be confused with many other things such as transmission, rear axle, generator, etc. If excessive noise is present, remove the pump drive belt to make sure the pump is at fault. If it is determined that the pump is at fault proceed as follows:

1. Check Drive Belt Tightness. Adjust belt tension, if necessary, as described previously under "Pump Belt Tension Adjustment."
2. Check Oil Level. Refill, if necessary, as described previously under "Bleeding Hydraulic System."

3. Check Hose. Make sure hose is not touching any other parts of the vehicle.

4. Check For Presence of Air in The Oil. Air will show up as bubbles or will appear milky. Small amounts of air cause extremely noisy operation. If air is present, accomplish the following:

a. Tighten all fittings and bolts.

b. Check the entire system for source of air leak. Air can leak into the system at many places. Air leaks usually occur at joints in the system where oil passes through at high velocity - such as hose connections or at the drive shaft seal.

NOTE: After each step in attempting to eliminate air, the pump should be operated for a few minutes at idle speed while occasionally turning the steering wheel between extreme turns to allow air to bleed out of oil.

5. After Eliminating Air From The Oil. Install a pressure gauge in the pressure line between the pump and steering gear. If, when racing the engine to about 1000 rpm and without turning the wheels, pressure exceeds 125 psi, the hose and/or the steering gear are restricting the oil flow. These parts should be examined to determine cause of restriction.

6. If The Pressure is Less Than 125 Psi in Step 5 Above, remove the pump and repair.

PUMP LEAKS

Whenever oil leakage occurs in the hydraulic pump, all fittings and bolts should be cleaned and tightened. If this does not stop leakage, wipe pump assembly clean to determine where it is leaking. Following are some of the possible causes of pump leakage (see Table below):

POOR, OR NO ASSIST, OR PUMP INOPERATIVE

When the pump is inoperative, providing little or no assist in turning, first check the belt tension and adjust it as necessary, as previously described. If this does not correct problem, check oil level, fill and bleed the system as described previously.

If there is no improvement, it must be established whether the pump, steering gear, or hose is the source of trouble. This may be determined by two tests after placing a pressure gauge in the pressure line between pump and steering gear.

Test #1 is Performed With the Oil Circuit Open. Raise the temperature of oil to operating range of 150 to 170 degrees measured with a thermometer. This may be accomplished by turning the wheels from wheel stop to wheel stop several times. Do not hold steering wheel against wheel stop for any extended period as this will overheat the oil. As previously mentioned, the pressure relief valve in the pump will not be able to handle the excessive pressure created by contacting the wheel stop for an extended period of time, therefore, the oil will overheat.

After heating the oil to at least 150°F., set engine idle to 450 rpm, then turn the steering wheel from one end to the other and read pressure on gauge while holding wheel momentarily against stops. Reading should be the maximum with engine idling at 450 rpm. If it is not, trouble is in the hydraulic circuit, but it does not indicate whether the pump or steering gear or both are at fault.

This can be determined by performing Test #2 and comparing it with test #1.

Test #2 is Performed With the Oil Circuit Closed. Set engine idle at 450 rpm and turn the shut-off valve of gauge to the closed position.

NOTE: Shut-off valve must be located between the gauge and steering gear. Observe pump pressure on gauge at idle and compare it with Test #1.

Diagnosis of the Two Tests. If the first test is below specifications and the second test is equal to specifications, or greater, the steering gear is at fault. When the first test is below specifications and the second test is not more than 50 psi greater, the pump is at fault.

NOTE: If steering gear is found to be at fault, use the troubleshooting procedures for the steering gear described under "Troubleshooting The Power Steering Gear" previously in this manual.

NOTE: For additional troubleshooting information, refer to "Quick Reference Troubleshooting Chart" later in this section.

SOURCE OF LEAK	CAUSE	REMEDY
Top of reservoir	Reservoir too full	Fill to proper level.
	Air in the oil	Eliminate air as previously described under "Pump Noise."
At the pressure fitting or studs	Not tightened sufficiently	Torque to 25-40 foot-pounds.
	Cross threaded or defective seat on fittings or hose end. Damaged seals.	Correct as necessary.
At shaft seal	Defective seal or damaged shaft	Replace damaged parts.
Leaks in metal parts	Damaged castings	Replace damaged parts.

POWER STEERING POWER CYLINDER

> NOTE: These power steering power cylinder fasteners are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with parts of the same part number or equivalent parts if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of parts.

There are three power cylinders covered in this section. The power cylinder acts as a power assist to the mechanical steering. Refer to "Specifications" at end of this section for power cylinder application on each series vehicle.

The power cylinder is either side mounted or axle mounted. On vehicles equipped with the side mounted power cylinder, the cylinder is bracketed to the frame side rail at one end and to the Pitman arm at the other end. On vehicles equipped with the axle mounted power cylinder, the cylinder is bracketed to the front axle at one end and to the steering tie rod at the other end.

Stationary metal tubes and flexible hose assemblies carry hydraulic fluid to operate the power cylinder piston for right and left turns.

When steering wheel is turned, the control valve on steering gear housing directs hydraulic fluid, under pressure from the hydraulic pump, to either side (depending on whether a right or left turn is being made) of a piston in the power cylinder (fig. 8). This produces movement of the piston and attached steering linkage. The force applied by the power cylinder is the amount of thrust necessary for all steering requirements.

When turn is completed, reduced effort in steering wheel allows steering geometry of the vehicle to return wheel to a neutral or straight-ahead position. When returning to a neutral position, oil on one side of the cylinder piston is forced back to the hydraulic pump reservoir by oil on other side of the piston, thus equalizing the oil pressure. This constant amount of oil in the cylinder acts as a shock absorber or cushion to dissipate road shocks to the operator.

The power cylinders used on these vehicles are of the same basic design for all models. The only difference is in the stroke length which for all models is dependent upon the axle capacity. On conventional cab models, the power cylinder piston rod is threaded directly onto the piston.

POWER CYLINDER REPLACEMENT

SIDE MOUNTED CYLINDER

Removal (Fig. 9)

1. Clean dirt from around hose connections at the power cylinder.

2. Disconnect the two hydraulic lines connected to the power cylinder and drain fluid into a container. DO NOT RE-USE FLUID. Cover line fittings and ports in cylinder. Remove clip attaching line to bracket on cylinder.

3. Remove cotter pin and loosen (back out) adjuster screw securing end of the power cylinder to the frame mounted support bracket mounting ball stud enough that the cylinder can be removed from the mounting ball stud.

4. Remove cotter pin and ball stud nut at Pitman arm; then remove ball stud from Pitman arm by tapping on end of the ball stud with a soft hammer. Remove the power cylinder.

Installation (Figs. 9 and 10)

NOTE: When installing a power cylinder housing and adjusting screw at the ball stud attachment, tighten the screw with the ball stud in place until it bottoms, then back the adjustment screw out to the nearest aligning slot and install a new cotter pin to secure.

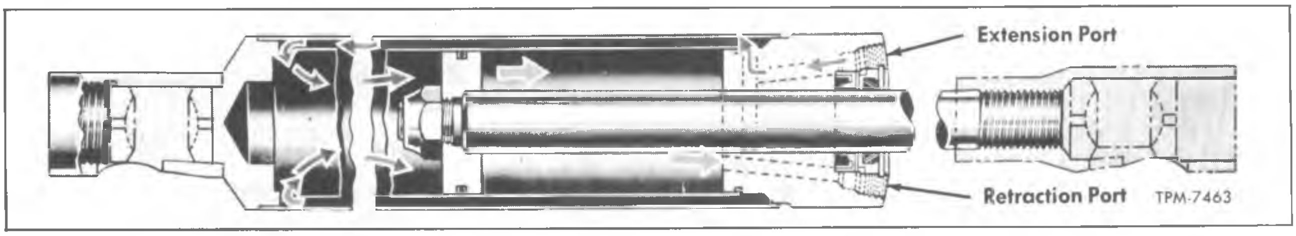


Figure 8—Power Cylinder Oil Flow (Typical)

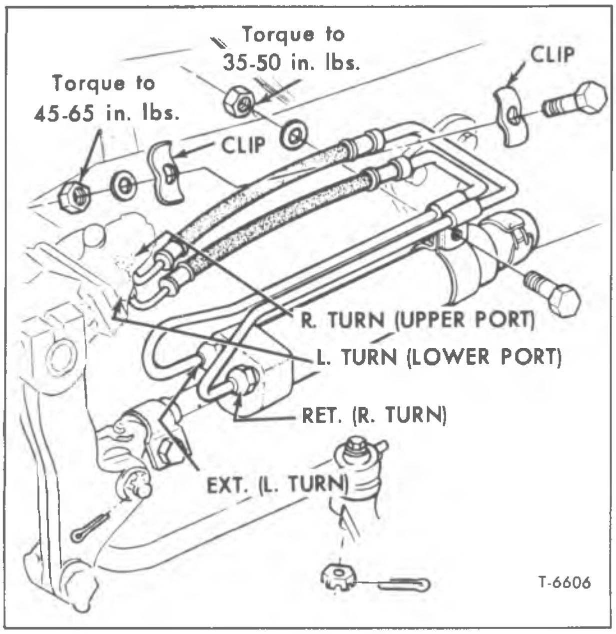


Figure 9—Side Mounted Power Steering Cylinder

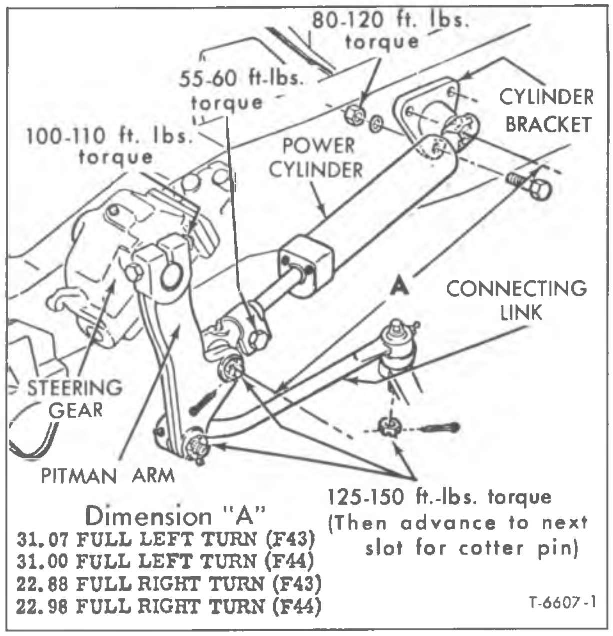


Figure 10—Side Mounted Cylinder Adjustment

1. Position dust cover over the frame mounting bracket ball stud, then position the cylinder onto the stud.
2. Install adjusting screw and tighten until it bottoms; then back screw out to nearest aligning slot and insert a new cotter pin to secure.
3. Insert ball stud at Pitman arm and seat the tapered stud into the Pitman arm by tapping lightly with a hammer.
4. Install ball stud nut and torque to limits listed in "Specifications" at end of this section, then tighten to next aligning slot and secure with a new cotter pin.
5. Position dust cover tangs through holes provided and bend to secure.
6. Connect the two hydraulic lines being careful to connect the lines to the proper ports (fig. 9).

> CAUTION: Severe manipulations of the steering mechanism can result from crossing hydraulic steering lines, with possible injury to personnel involved; especially if hand engages spoke of steering wheel.

7. Clip hydraulic lines to power cylinder and

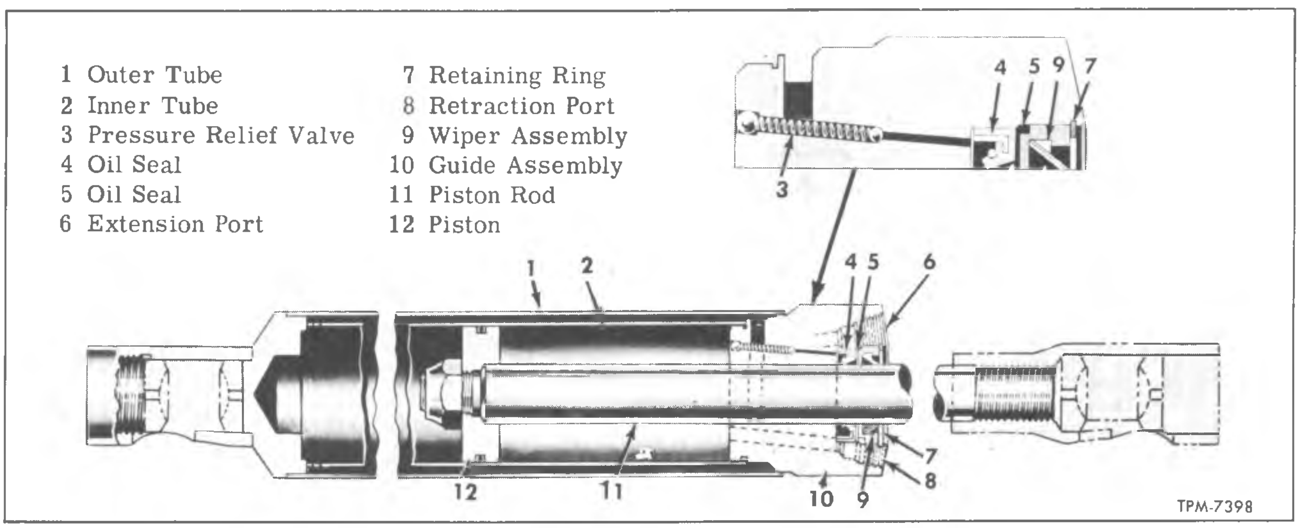


Figure 11—Power Cylinder (Typical)

bleed the hydraulic system as explained previously under "Bleeding Hydraulic System."

AXLE MOUNTED CYLINDER

Removal

1. Clean dirt from around hose connections at power cylinder ports.

2. Disconnect hoses from power cylinder, catching hydraulic fluid in a clean container. Cover hose fittings and ports in cylinder to keep dirt out.

3. Remove cotter pin and loosen adjuster screw securing end of power cylinder to support bracket mounting, then remove cylinder from mounting ball.

4. Repeat procedures in Step 3 previously, and remove opposite end of cylinder from tie rod ball stud.

Installation

1. Position power cylinder on tie rod ball stud and on support bracket mounting ball.

2. Turn adjuster screw at each end of power cylinder in tight; then back off to nearest cotter pin hole and install new cotter pin.

3. Turn front wheels from extreme right to extreme left and check to see that power cylinder does not bottom, preventing stops from hitting the axle.

4. Connect hydraulic hoses to power cylinder ports. Tighten hose fittings to 25-40 foot-pounds torque.

NOTE: Make certain hoses are not kinked and do not bind when wheels are turned.

5. Bleed the hydraulic system and bring fluid to proper level as previously directed.

POWER CYLINDER SEAL REPLACEMENT

REMOVAL (Fig. 11)

NOTE: The piston rod seal, wiper ring and retainer, socket end ball stud seats, and adjuster screws are the only parts of the power cylinder that can be replaced.

1. If not previously removed, remove cotter pin, adjuster screw, and ball seats from one end of the power cylinder. Use a wide blade screwdriver to turn adjuster screw out. Repeat these

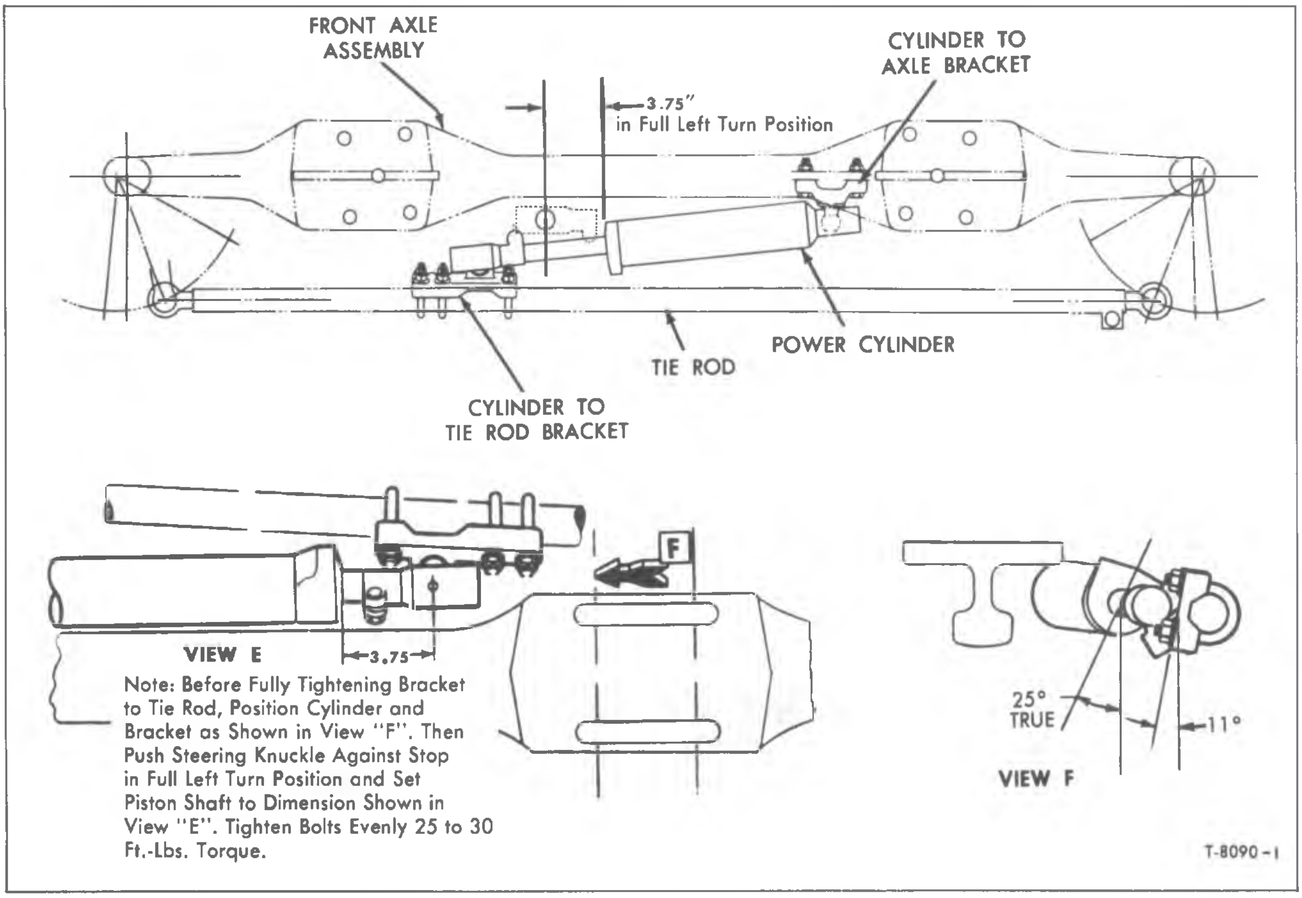


Figure 12—Axle Mounted Power Cylinder Adjustment

procedures at opposite end of the cylinder.

2. Loosen clamp bolt on the outside of the socket.

3. Using a wide blade screwdriver to keep the piston from turning, unthread socket end from piston rod.

4. Force piston rod in and out of power cylinder to drain remaining fluid.

5. Using Tru-Arc snap ring pliers, remove the scraper retainer snap ring from groove in piston rod guide assembly.

6. Apply air pressure to the retraction port in the guide assembly while at the same time holding a finger over the extension port (fig. 11). This will dislodge wiper ring assembly, scraper retainer, scraper retainer O-ring seal, and piston rod seal from the guide assembly.

CLEANING AND INSPECTION

Clean and inspect the components using cleaning solvent and compressed air. Replace all parts that are not in first class condition.

ASSEMBLY (Refer to Fig. 11)

1. Lubricate lip of the piston rod seal with a thin layer of Lubriplate or equivalent, and insert it into the guide assembly with the "U" of the cup toward the bottom of opening in guide.

2. Install scraper retainer O-ring seal.

3. Install the scraper retainer in guide with "U" side pointing out.

4. Insert the wiper ring assembly, then using Tru-Arc snap ring pliers, install the retaining snap ring. Make sure retaining ring is well seated in groove of the guide assembly.

5. Thread the socket end assembly on piston rod until it shoulders against the rod.

6. Tighten the clamp bolt securely.

7. At both ends of the power cylinder, install ball seats; then thread the adjuster screws into the sockets loosely.

POWER CYLINDER ADJUSTMENT

AXLE MOUNTED CYLINDER

Adjustment dimensions for all axle mounted cylinders are shown in figure 12.

1. Attach power cylinder to axle.

2. Position wheels in full right-hand turn, against wheel stop.

3. Depress power cylinder piston rod into cylinder housing, until it bottoms. Using a grease pencil or other suitable marking device, place mark on piston rod at cylinder housing.

4. Loosely attach cylinder tie rod bracket, to tie rod so that it is free to slide on rod.

5. Extend power cylinder piston rod out of cylinder housing to its full length of travel (bottomed) and mark piston rod.

6. Depress piston rod 1/8-inch and tighten to tie rod. It is important the piston rod be depressed 1/8-inch from the fully extended position while the piston rod is secured to the tie rod.

NOTE: For proper torque on power steering components, refer to "Power Steering Specifications" later.

7. Position wheels in a full left-hand turn, against wheel stop.

8. Check that first marking piston rod (piston rod depressed) is still visible.

NOTE: Proper adjustment of power cylinder is achieved when cycled from a full left-hand to right-hand turn without the cylinder bottoming.

9. Check for clearance of cylinder at both axle and tie rod while wheels are being turned. Repeat adjustment procedure, if necessary.

SIDE-MOUNTED CYLINDER

No adjustment is required on side-mounted cylinders since the distance between ball stud connections is not subject to adjustment or change.

TROUBLESHOOTING THE POWER CYLINDER

POWER CYLINDER LEAKAGE

INTERNAL LEAKS

Internal leakage in the power cylinder will show up in a momentary increase in driver effort when turning the wheel fast. If this occurs, replace complete cylinder assembly.

EXTERNAL LEAKS

If the power cylinder is leaking externally, wipe it clean to determine where it is leaking. Leakage around the piston rod seals may be corrected by replacing the seals. If the power cylinder still leaks after replacing the seals, the pressure relief valve is not operating properly and the complete power cylinder will have to be replaced. Any leakage around the welds on the cylinder will necessitate replacing the complete power cylinder assembly. Tighten the hose connections at the extension and retraction ports if this is a source of leakage. If tightening the connection does not stop leakage, replace complete cylinder assembly.

NOTE: Any damage to the cylinder which will hamper its operation necessitates replacement of the complete power cylinder assembly. The cylinder is not serviced except for the piston rod seals.

NOTE: Refer to "Quick Reference Troubleshooting Chart" later for additional information.

TIE ROD ANTI-ROTATION BUSHING

NOTE: These tie rod anti-rotation bushing fasteners are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with parts of the same part numbers or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of parts.

On some vehicles covered by this manual equipped with power steering, anti-rotation bushings are installed over tie rod end studs between tie rod ends and steering arms (fig. 13). Each bushing consists of two cupped washers and a rubber washer. Purpose of the anti-rotation bushings is to prevent weight of the power cylinder which is clamped to the tie rod, from rotating the tie rod and causing tie rod ends to bind against the ball studs. Bushings should be replaced if they become worn enough to permit rotation of the tie rod.

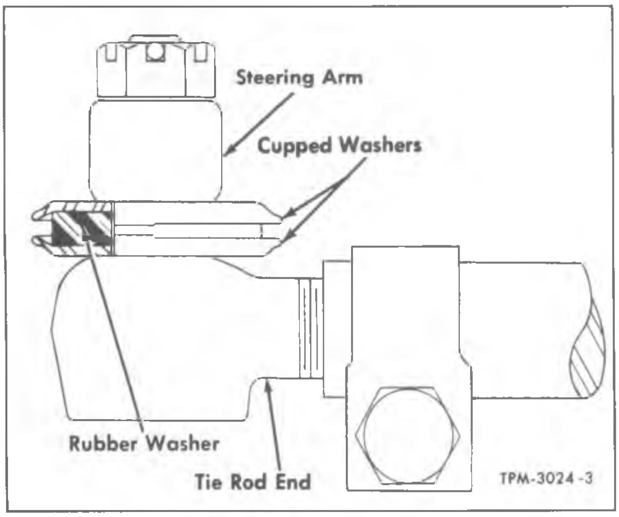


Figure 13—Tie Rod Anti-Rotation Bushing (Typical)

BUSHING REPLACEMENT

REMOVAL

1. At each end of the tie rod, remove cotter pin and stud nut. Discard cotter pin.
2. Tap tie rod loose from steering arms.
3. Remove two cupped metal washers and rubber washer from each tie rod end stud. Discard these parts.

INSTALLATION

1. Position two new cupped washers and new rubber washer on each tie rod end stud.
2. Loosen both socket end clamp bolts; then install tie rod on steering arms, rotating socket ends as necessary to align parts. The upper and lower cupped washers must be parallel when no power or pressure is applied to the tie rod. Install stud nuts and new cotter pins.
3. With parts properly aligned (fig. 13), tighten socket end clamp bolts to torque listed in "Specifications" at end of this section.
4. Install tie rod ball studs to steering arms and torque to limits listed in "Specifications" at end of this section.

OIL COOLER

An oil cooler is attached to the radiator front support on all vehicles with power steering except with air conditioning.

The oil cooler may be removed for repair or replacement by disconnecting hoses and removing screws which attach it to support braces.

OIL COOLER MAINTENANCE

At regular intervals, or when operating conditions warrant, examine the cooler for leaks and bent fins. A damaged or leaking cooler should be serviced by a radiator specialist or replaced with a new assembly. Proper repair requires the use of special tools and equipment as well as provisions for making proper tests.

If the cooler assembly requires painting, spray with special radiator paint; do not use paint mixed with oil, as oil mixed paint will form an insulation and prevent efficient dissipation of heat.

Occasional external flushing with water, using an ordinary hose, will help remove dirt, bugs and other foreign matter from between fins of cooler. Water under pressure should be directed from behind the cooler to force dirt out in opposite direction of its entrance. Direct the water stream against edges of fins (not sideways) to eliminate danger of bending fins.

QUICK REFERENCE TROUBLE SHOOTING CHART

NOTE: Some of the remedial procedures suggested for conditions outlined in this chart constitute overhaul of components which is not within the scope of this manual. Refer to "Overhaul" section of applicable manual for proper method of accomplishing these corrections.

(Type 553-DV Power Steering)
HYDRAULIC PUMP

CONDITION	CAUSE	REMEDY
1. Pump Noise.	Loose belt.	Tighten belt.
	Hoses touching other parts of truck.	Adjust hose position.
	Low oil level.	Fill reservoir.
	Air in the oil.	Locate source of air leak and correct.
	Excessive back pressure caused by hoses or steering gear.	Locate restriction and correct. Bleed system.
	Scored pressure plate.	Lap away light scoring. Replace heavily scored part.
	Vanes not installed properly.	Install properly.
	Extreme wear of pump ring.	Replace ring.
	Vanes sticking in rotor slots.	Free up by removing burrs or dirt.
	Face of thrust plate scored.	Lap away light scoring. Replace heavily scored part.
	Scored rotor.	Lap away light scoring. Replace heavily scored part.
	Defective flow control plunger.	Replace assembly.
2. Leaks at top of of reservoir.	Reservoir too full.	Fill to proper level.
	Air in the oil.	Locate source of air leak and correct.
3. Leaks at the reservoir.	O-Ring seal cut.	Replace O-Ring seal.
	O-Ring improperly installed.	Install seal properly.
4. Leaks at the pressure fitting or mounting stud.	Not tightened sufficiently.	Torque to 30-40 ft.-lbs.
	Cross threaded or damaged seat.	Replace damaged part.
	Defective seat on hose end.	Replace hose.
	Damaged seals.	Replace seals.
5. Leaks at the shaft seal.	Defective seal.	Replace seal.
	Damaged shaft.	Replace shaft.
6. Leaks in metal parts.	Poor casting.	Replace defective parts.
7. Pump inoperative, poor, or no assist.	Loose drive belt.	Tighten belt.
	Low oil level.	Fill reservoir to proper level.
	Air in the oil.	Locate source of air leak and correct.
	Defective hoses or steering gear as determined by test outlined under gear section later in this chart.	Correct.
	Flow control valve stuck.	Remove burrs or dirt.
	Loose nut in end of flow control valve.	Tighten nut.
	Pressure plate not flat against ring.	Correct condition.
	Extreme wear of pump ring.	Replace pump ring.
	Scored pressure plate, thrust plate, and or rotor.	Lap away light scoring. Replace heavily scored parts.

8. **Pump inoperative, poor, or no assist.**	Vanes not installed properly. Vanes sticking in rotor slots. Faulty flow control valve assembly.	Install vanes properly. Free up by removing burrs or dirt. Replace assembly.

CONTROL VALVE AND POWER STEERING GEAR

CONDITION	CAUSE	REMEDY
1. **Gear noise (rattle or chuckle).**	Loose over-center adjustment. Coupling pin stops, hitting against upper flange. **NOTE:** A slight rattle may occur on turns because of the increased lash off the high point. This is normal. Gear loose on frame.	Adjust to specification. Re-align shaft with gear. Adjust endwise if necessary. Check gear to frame mounting bolts. Tighten bolts to specifications.
2. **Gear noise (hissing sound).**	There is some noise in all power steering systems. One of the most common is a hissing sound most evident at standstill parking.	Do not replace valve unless "hiss" is extremely objectionable. Be sure steering shaft and gear are aligned so the flexible coupling is not distorted as shaft rotates. Any metal to metal contact through the flexible coupling will transmit the valve hiss into the truck.
3. **Valve squawk when turning or when recovering from a turn.**	Cut or worn dampener O-Ring on spool Loose or worn valve.	Replace dampener O-Ring, being careful not to cut the new ring at installation. Replace valve.
4. **Internal leaks.**	Momentary increased effort on fast turn.	Replace valve.
5. **External oil leaks (wipe gear thoroughly and make sure source of leakage is determined).**	Loose hose connections. Damaged hose. Adjuster plug seals Torsion bar seal	Tighten. Replace. Replace seal. Replace torsion bar and stub shaft assembly.
6. **Hard steering while driving.**	Frozen steering shaft bearings. Lower coupling flange rubbing against adjuster. Steering wheel rubbing against gearshift bowl. Steering adjustment tight.	Replace bearings. Loosen bolt and assemble properly. Adjust jacket endwise. Check adjustment by dropping pitman arm from gear or disconnecting linkage from pitman arm ball. Readjust if necessary.
7. **Poor return of steering.**	Frozen steering shaft bearings. Lower coupling flange rubbing against adjuster. Steering wheel rubbing against gearshift bowl. Tires not properly inflated. Incorrect caster or toe-in front wheels. Tight steering linkage. Steering gear misalignment. Tightness of suspension joints. Steering adjustment tight. Tight sector to ball nut adjustment. Thrust bearing adjustment too tight. Sticky valve spool.	Replace bearings. Loosen bolt and assemble properly. Adjust jacket endwise. Inflate to specification. Adjust as described in front axle (Sec. 3) of this manual. Lubricate linkage as described in lubrication (Sec. 0) of this manual. Re-shim at frame. Lubricate or otherwise free up. Check adjustment by dropping pitman arm from gear or disconnecting linkage from pitman arm ball. Readjust if necessary. Adjust in truck to specification. Remove gear and adjust to specifications. Remove and clean valve or replace valve.

CONTROL VALVE AND POWER STEERING GEAR (Cont.)

CONDITION	CAUSE	REMEDY
8. Truck leads to one side or to the other.	Due to front end misalignment.	Adjust to specification.
	Unbalanced or badly worn valve. **NOTE:** If this is the cause, steering effort will be very light in direction of lead and heavy in opposite direction.	Replace valve.
9. Momentary increase in effort when turning wheel fast.	Low oil level in pump.	Check oil level in pump reservoir and bring to proper level.
	Pump belt slipping.	Tighten or replace belt.
10. Excessive wheel kick-back or loose steering.	Lash in steering linkage.	Adjust parts affected.
	Air in the system.	Add oil to pump reservoir.
	Excessive lash between pitman shaft sector and ball nut.	Adjust to specification.
	Loose thrust bearing adjustment.	Remove steering gear and adjust to specification.
11. Steering wheel surges or jerks when turning with engine running—especially during parking.	Loose pump belt.	Adjust to specification.
12. Hard steering when parking.	Loose pump belt.	Adjust to specification.
	Low oil level in reservoir.	Fill to proper level. If excessively low, check all lines and joints for evidence of external leakage.
	Lack of lubrication in linkage for front suspension.	Add lubricant where needed as described in lubrication (Sec. 0) of this manual.
	Tires not properly inflated.	Inflate to recommended pressure.
	Insufficient oil pressure.	If all of the above checks do not reveal the cause of hard steering, make the following tests of oil pressure: a. Disconnect the pressure line at oil pump. Attach gauge to pump. Connect the hose to end of gauge where the valve is located. b. With the engine at warm idle and gauge valve open, note the oil pressure on the gauge while turning steering wheel from one extreme position to the other. Especially note the maximum pressure which can be built up with the wheel held in either right or left extreme position. **CAUTION:** Do not hold wheel in extreme position for an extended period of time because it will drastically increase the oil temperature and will cause undue wear on the oil pump. c. With oil temperature between 150 degrees F and 170 degrees F, as measured with a thermometer in the reservoir, the maximum oil pressure should not be less than 600 PSI for satisfactory power steering operation. d. If the maximum oil pressure is less than 600 PSI, it indicates trouble in the pump, steering gear, cylinder, or a combination of these parts. To eliminate the gear, close the gauge valve and quickly test pressure of the pump only with the engine at warm idle; then open the valve to avoid increasing oil temperature.

CONTROL VALVE AND POWER STEERING GEAR (Cont.)

CONDITION	CAUSE	REMEDY
Hard steering when parking. (Cont'd)		Comparing the maximum pressures obtained in these two tests will indicate source of trouble as follows: (a) First test pressure low and second test pressure normal—indicates faulty external oil lines, or steering gear. (b) First test and second test pressures equally low—indicates faulty oil pump. If the above test shows trouble to be in pump, see hydraulic pump procedures described previously. If trouble is shown to be in steering gear or hoses, examine for external oil leaks as described under LEAKS—ITEM 5.
	Low oil pressure due to restriction in hoses:	
	a. Check for kinks in hoses.	Remove kinks.
	b. Foreign object stuck in hose.	Remove hoses and remove restricting object or replace hose.
	Low oil pressure due to steering gear	
	a. Leakage at valve rings, valve body to worm seal.	Remove gear from truck for disassembly and replace seals.
	b. Loose fit of spool in valve body or leaky valve body.	Replace valve.
13. Excessive effort to turn.	Broken torsion bar	Replace torsion bar and stub shaft assembly.

POWER CYLINDER

1. Internal leaks.	Momentary increased effort when turning wheel.	Replace cylinder assembly.
2. External leaks.	Around piston rod seals.	1. Replace seals.
	At hose connections.	2. Cylinder relief valve not working—replace cylinder assembly. Tighten or replace cylinder if tightening does not remedy condition.
	Around welded joints.	Replace cylinder assembly.
3. Excessive ball socket movement.	End play present. Worn ball seats.	Adjust to specifications. Replace seats.
4. Piston rod end clamp movement.	Loose bolts.	Torque to specifications after proper positioning to specifications.

SPECIFICATIONS

POWER STEERING GEAR APPLICATION CHART

TRUCK SERIES	GEAR MODEL	RATIO	CENTER POSITION
CE/CS-40; CE/CG/CS-50	553-DV-73	28.14 to 1	12 O'Clock
CE/ME-60	553-DV-73	28.14 to 1	12 O'Clock
SE/SS-50	553-DV-79	28.14 to 1	12 O'Clock
TE/TS-50; TE-60	553-DV-54	28.14 to 1	6 O'Clock

STEERING GEAR ADJUSTMENT

Thrust Bearing Preload .... 1 to 3 Inch Pounds in Excess of Valve Assembly Drag
Thrust Bearing Adjustment Plus Seal Drag .... 8 to 10 Inch-Pounds Maximum
Pitman Shaft Preload* .... 4 to 8 Inch-Pounds in Excess of Total Preload and Drag
Final Over-Center Reading—(Total of Valve and Seal Drag, Worm Bearing
Preload and Lash Adjuster Preload) .... 20 Inch Pounds Maximum

*Readings are to be made through an Arc NOT Exceeding 20° with Gear on Center and Pitman Shaft Backed off.

POWER STEERING HYDRAULIC PUMP MODEL APPLICATION CHART

TRUCK SERIES	PUMP MODEL	TYPE
CS-40; CS/SS-50	235-P-129	Vane
CE-40-50; SE-50; CE/ME-60	235-P-118	Vane
CG-50	235-P-107	Vane
TS-50	235-P-19	Vane
TE-50-60	235-P-20	Vane

HYDRAULIC PUMP SPECIFICATIONS

VANE TYPE PUMP

Make .... Saginaw Steering Gear Division
Type .... Vane
Models 235-P-19; 235-P-20; 235-P-36
Capacity Per Minute
Maximum .... 3.5 G.P.M. of Power Steering Fluid (Specified in LUBRICATION-SEC. 0) at 170°F. Temperature When Operating Pump at 1500 R.P.M. Against 50 P.S.I. Pressure.
Minimum .... 2.35 G.P.M. of Power Steering Fluid (Specified in LUBRICATION-SEC. 0) at 170°F. Temperature When Operating Pump at Idle Speed Against 665/735 P.S.I. Pressure.
Pressure Relief Valve
Minimum P.S.I. 900
Maximum P.S.I. 1000

VANE TYPE PUMP

Make .... Saginaw Steering Gear Division
Type .... Vane
Models 235-P-107; 235-P-118; 235-P-129
Capacity Per Minute
Maximum .... 4.25 G.P.M. of Power Steering Fluid (Specified in LUBRICATION-SEC. 0) at 170°F. When Operating Pump at 1500 R.P.M. Against 50 P.S.I. Pressure.
Minimum .... 2.35 G.P.M. of Power Steering Fluid (Specified in LUBRICATION-Sec. 0) at 170°F. When Operating Pump at Idle Speed Against 665/735 P.S.I. Pressure.
Pressure Relief Valve
Minimum P.S.I. 900
Maximum P.S.I. 1000

POWER STEERING POWER CYLINDER SPECIFICATIONS

Make....Saginaw Steering Gear Division
Type....Hydraulic
Model....See Chart Below

TRUCK SERIES	MODEL	RETRACTED LENGTH	EXTENDED LENGTH	STROKE
CE/CS-40(03)	5690726	15.735″	24.795″	9.06″
CE/CG/CS-50(03)	5690726	15.735″	24.795″	9.06″
CE/ME-60(03-13)	5690726	15.735″	24.795″	9.06″
CE/CS-40(02)	7802292	16.87″	27.07″	10.20″
CE/CS/SE/SS-50(02)	7802292	16.87″	27.07″	10.20″
CE-60(02)	7802292	16.87″	27.07″	10.20″
TE/TS-50; TE-60 (Except F-090; F-120 front axle)	5690726	15.735″	24.795″	9.06″
TE/TS-50; TE-60 (with F-090 or F-120 front axle)	5688931	18.915″	29.975″	11.06″

POWER STEERING TORQUE SPECIFICATIONS

LOCATION	TYPE OF PART	TORQUE (1) (FT. LBS.)
Steering Gear to Frame Bolt		
Conventional Cab and "S" Models	Nut	90-130
Tilt Cab Models	Nut	90-110
Pitman Arm to Pitman Shaft		
Conventional Cab and "S" Models (Pinch Bolt)	Nut	100-110
Steel Tilt Cab Models	Nut	220-250
Steering Gear Adjustments		
Lash Adjuster Screw	Nut	25-35
Side Cover to Housing	Bolt	25-35
Worm Bearing Adjuster Screw	Nut	50-110
Control Valve to Steering Gear	Bolt	35-45
Hose Fittings to Ports	—	20-30
Steering Column Clamp Bolt	Bolt	15-20
Steering Shaft "Stop" Clamp Bolt	Nut	8-12
Steering Shaft to Worm Shaft Clamp Bolt		
All Except "S" Models	Nut	40-50
"S" Models	Nut	30-40
Steering Connecting Rod Stud to Pitman Arm and Steering Arm		
Conventional Cab and "S" Models (2)	Nut	40 (2)
Tilt Cab Models (2)	Nut	125-150 (2)
Tie Rod to Steering Arm Stud		
F-050; F-055 Front Axle	Nut	150-160 (2)
F-070 Front Axle	Nut	150-180 (2)
F-090; F-110; F-120 Front Axle	Nut	125-150 (2)

POWER STEERING TORQUE SPECIFICATIONS (CONT.)

LOCATION	TYPE OF PART	TORQUE (1) (FT. LBS.)
Steering Tie Rod End Clamp Bolt		
F-050, F-055 Front Axle	Nut	45-55
F-070 Front Axle	Nut	80-100
F-090, F-110 Front Axle	Nut	65-75
F-120 Front Axle	Nut	60-80
Power Steering Cylinder Anchor Bracket to Frame Bolt	Nut	80-120
Power Steering Cylinder Anchor Bracket to Axle Bolt	Nut	50-60
Power Steering Cylinder to Pitman Arm Stud	Nut	125-150 (2)
Power Steering Cylinder Anchor Bracket to Tie Rod U-Bolt		
Except Tilt Cab Models	Nut	30-40
Tilt Cab Models	Nut	35-45
Power Steering Cylinder Anchor Stud to Axle	Nut	125-150
Power Steering Cylinder Ball Stud Socket Clamp Bolt		
With Frame Mounted Cylinder	Nut	55-65
Except Tilt Cab Models	Bolt	55-65
Tilt Cab Models	Bolt	40-50
Power Steering Pump Pulley		
CE/CS-40; CE/CS/SE/SS-50	Nut	65-95
CG-50	Nut	25-30
TE-50; CE/ME/TE-60	Nut	40-55
TS50	Nut	55-65
Power Steering Pump Mounting Bracket to Engine	Bolt	25-30
Power Steering Pump Support Bracket to Mounting Bracket	Bolt	20-30
Power Steering Pump to Mounting Bracket	Bolt	25-30
Power Steering Pump to Support Bracket Bolt	Nut	20-30
Power Steering Pump Stud to Mounting Bracket	Nut	25-30
Reservoir Mounting Bracket to Support	Bolt	20-25
Reservoir to Mounting Bracket	Bolt	20-25
Oil Cooler to Support Bracket	Bolt	10-15
Vane Type Hydraulic Pump		
Mounting Bolt or Stud	—	25-40
Port Fitting	—	25-40
Slipper Type Hydraulic Pump		
Reservoir Cap Screw	—	15-20
Pressure Relief Valve	—	30
Front Insert Nut	Nut	95-105

(1) NOTE: All Tapered Ball Studs must be Clean and Dry.
(2) Tighten Nut to Specified Torque, then Advance to Next Aligning Slot and Install a New Cotter Pin.

A satisfactory steering system depends upon maintaining components in good condition, with a minimum amount of wear permitted. Proper alignment, and lubrication will pay dividends in driver satisfaction, and in tire economy.

SECTION 10

Wheels and Tires

Contents of this section are listed in Index below:

GENERAL DESCRIPTION

Wheels used on vehicles covered in this manual are Disc, Cast, or Budd type (fig. 1). Disc wheels are secured on hub studs with nuts. Budd type front wheels have a single nut, while rear wheels have inner and outer nuts. On cast steel wheels, tires are mounted on rims which are secured on wheel with rim clamps, studs, and nuts.

WHEEL NUT TIGHTENING SEQUENCE

On a new vehicle, or after a wheel has been changed, the wheel nut torque must be checked at intervals of 100, 500, 1,000, and every 1,000 miles thereafter.

NOTE: Wheel hub flanges, wheels, studs, and stud nuts should be free of rust, lubricants, dirt, and finish color paint on all "faying" surfaces to ensure proper torque retention.

CAST SPOKE WHEEL (Fig. 2)

1. Install tire and rim assembly to axle hub.
   a. Install rim spacer (rear only).
   b. Install outer rear tire and rim assembly with valve stem opposite valve stem on inner tire and rim assembly.
2. Install rim clamps and nuts. Position and finger tighten.
3. Starting at bottom, tighten No. 1 nut to 15 to 20 foot-pounds torque.
4. Torque nuts 2, 3, 4, 5, and 6 (if used) using indicated sequence to 190 to 210 foot-pounds.
5. Retorque nut No. 1 to 190-210 foot-pounds.
6. Wheel clamps must be seated following wheel circumference.

CAUTION: DO NOT TIGHTEN NUT WITH CLAMP IN COCKED POSITION.

7. Wheel runout measured at the tire sidewall should not exceed 1/8-inch on front wheels and 3/16-inch on rear wheels.

DISC-TYPE WHEELS (Fig. 3)

1. Install tire and wheel assembly to axle hub.
2. Install all nuts loosely. Finger tighten inner wheel nuts (rear) or wheel nuts (front) marked by arrows.
3. Then, tighten nuts to specified torque in sequence illustrated.
4. Install outer rear tire and wheel assembly with valve stem opposite valve stem on inner tire and wheel assembly.
   a. Install and finger tighten outer nuts marked by arrows.
   b. Then, tighten to specified torque in sequence illustrated.
5. Torque requirements:
   Disc (Except Budd Type) - 300-400 ft.-lbs.
   Disc (Budd - Steel) - 500-550 ft.-lbs.
   Disc (Budd - Aluminum Hubs or Wheels) - 450-500 ft. lbs.

NOTE: All Budd-type inner and outer nuts used on the right side of the vehicle have right-hand threads. All inner and outer nuts used on left side have left-hand threads. Both inner, and outer nuts

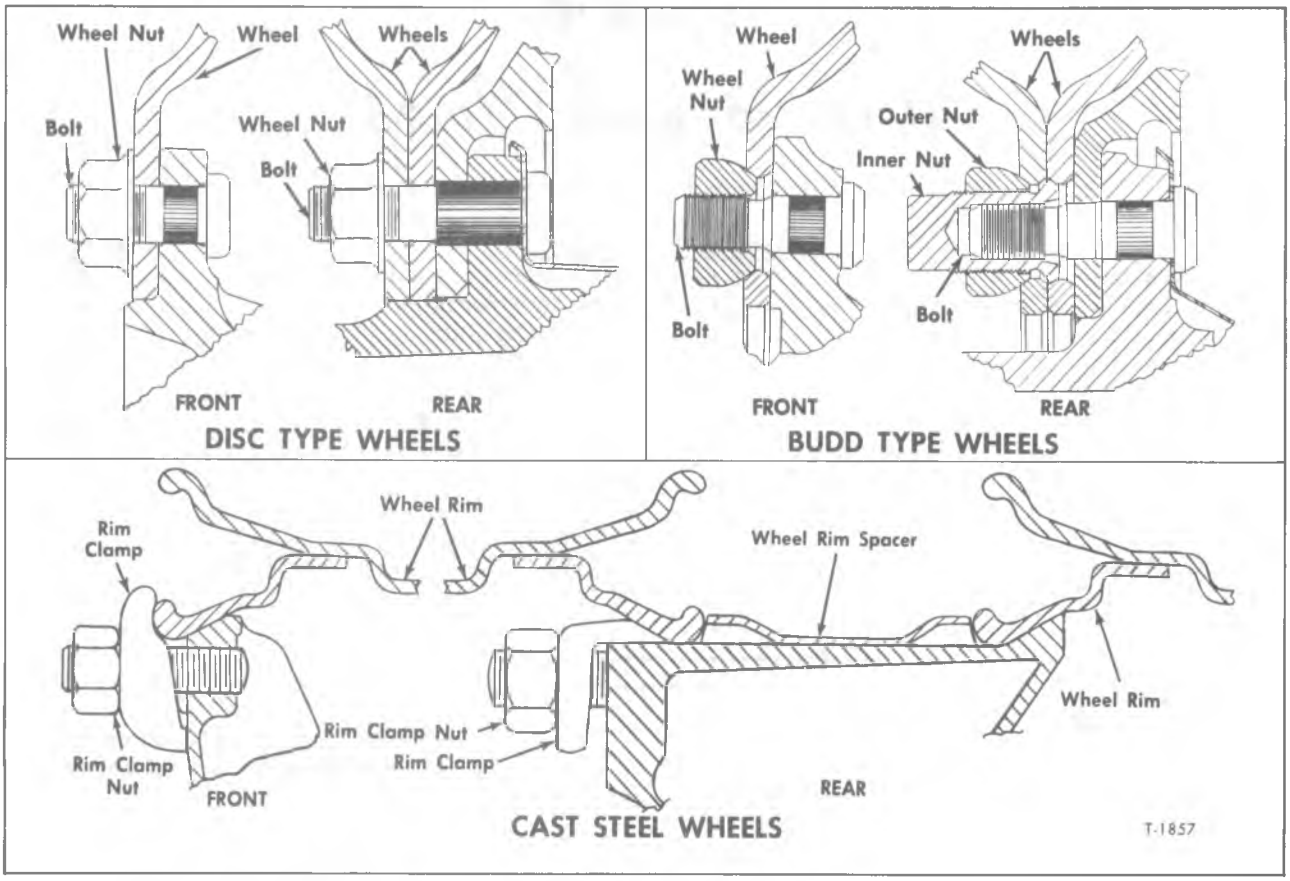


Figure 1—Typical Disc, Budd, and Cast Wheels

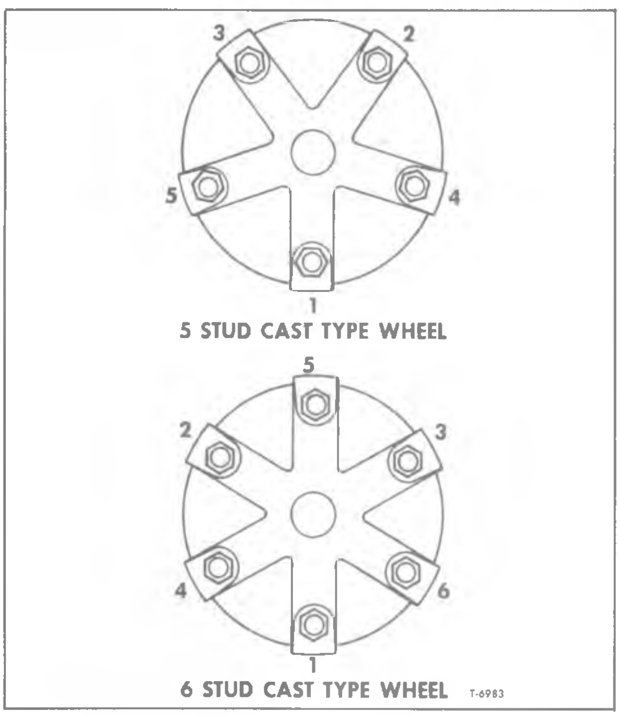


Figure 2—Wheel Nut Tightening Sequence (Cast Type Wheels)

are appropriately stamped with the letter "L" to signify left-hand or "R" to signify right-hand. Care should be exercised to prevent trying to use the wrong thread nut for the respective side, as damage to the stud threads could occur.

DUAL WHEELS

When installing dual wheels, position valve stems 180 degrees apart (Disc-Type) or as close to 180 degrees as possible (Cast-Type).

On Budd-type dual wheels, loosen outer nuts before attempting to torque inside nuts, then torque outside nuts.

> CAUTION: When removing dual cast spoke type wheels, loosen all nuts approximately flush with end of stud, then tap clamps to loosen wheel. Refer to figure 4. Do not remove nuts until clamps are free as clamps may fly off studs.

WHEEL STUDS OR BOLTS AND NUTS

If any wheel experiences a single stud failure caused by a loose-running wheel, all studs should be replaced. A loose-running wheel may cause only one stud to break, but more studs could be fatigued to the point of failure, but not easily noticeable. Replacing only the one broken stud and remounting the wheel could then promote further and possibly serious failure. If stud holes in wheels have become elongated or distorted, replace the wheel.

NOTE: These wheel to hub stud and nut fasteners are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.

WHEEL INSPECTION

Do not use wheels with bent rims. The continued use of such wheels will result in excessive tire wear and, if wheel is mounted on front of vehicle, difficulty in steering will be experienced. Wheels that are thought to be distorted may be checked as follows, referring to figure 5 for checking points:

1. Raise axle at side to be checked and safely support underneath.
2. Tool for checking run-out may be readily improvised as follows:

   Secure block of wood approximately 6" x 6" x 14" or material with suitable base so it will remain positioned. Secure thin piece of wood or suitable material 10 inches long, such as ruler or yardstick, and fasten to wood block to a height in relation to rim surfaces as shown in figure 5. Tighten screw sufficiently so pointer will hold its position when adjusted.
3. Position pointer at crown of rim (A, fig. 5). Slowly revolve wheel and move pointer toward wheel until it contacts wheel at nearest point.
4. Continue to revolve wheel and check amount of lateral run-out (amount of wheel side wobble). This should not exceed 3/32-inch.
5. Place point of marker at inside of wheel at point "B," in figure 5. Follow the previous procedure to check radial run-out (out-of-round condition); this should not exceed 3/32-inch. If wheel is distorted beyone these dimensions it should be replaced.
6. If doubt exists whether the wheel or hub is distorted, hub may be checked as follows: Replace the existing wheel with a wheel known to be true. Revolve the wheel and make the previously mentioned tests. If tests are within limits, the hub is satisfactory, but wheel is sprung.
7. A dismounted wheel may be checked for

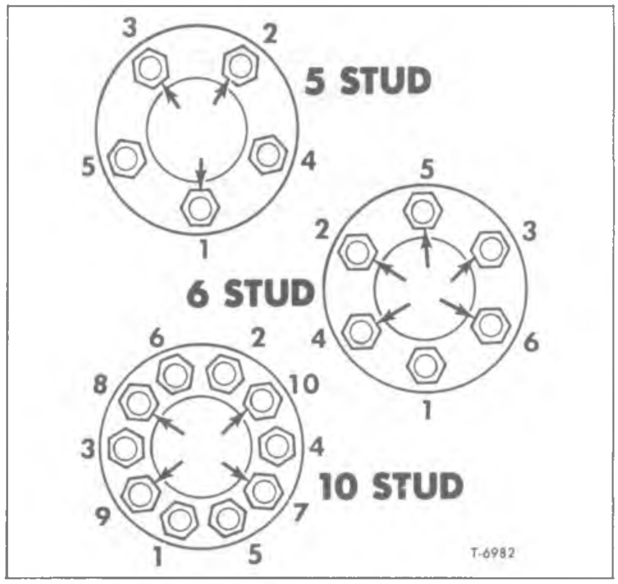


Figure 3—Wheel Nut Tightening Sequence (Disc Type Wheels)

Figure 4—Clamp Removal (Dual Spoke Wheel)

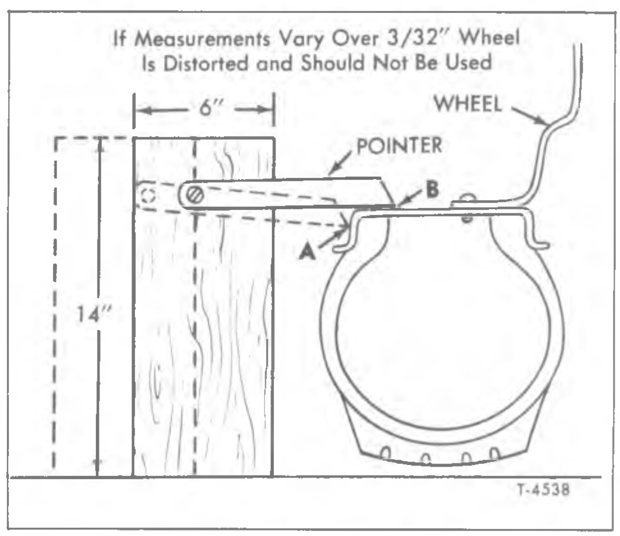


Figure 5—Method of Checking Distorted Wheels

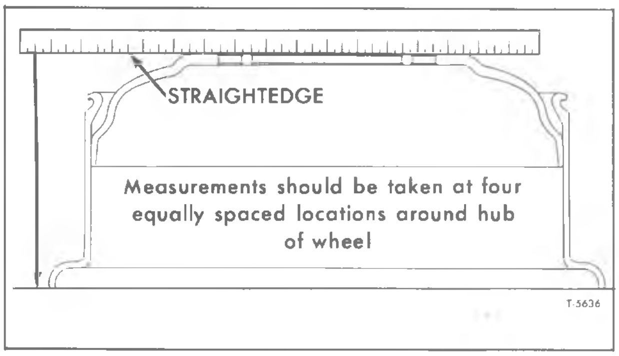


Figure 6—Typical Wheel Checking Diagram

side wobble by placing a straight-edge on face or hub of wheel. Measure distance from straight-edge to edge of wheel rim, this should be checked at four equally spaced locations. If distance is the same at all positions wheel is not distorted (see fig. 6). A dismounted wheel may also be checked for radial, and lateral run-out if desired, by temporarily mounting it to a hub on vehicle. Follow the previous Steps 2, 3, 4, and 5.

TIRES

Tube-type tires are standard and optional on all vehicles covered in this manual.

One of the most important factors of economical and safe truck operation is systematic and correct tire maintenance. The tires must not only support the weight of the loaded vehicle, but they also serve to transmit driving and braking forces to road surface. Therefore, the tires used on all trucks should receive the same amount of careful systematic, and regular maintenance as do other operating units. The three major causes of tire troubles are (1) underinflation (2) bruises and (3) misalignment. Tires should be checked periodically to prevent excessive damage caused by these conditions.

Periodically check the valve stem cores and caps for leakage. Also, check around tires for embedded steel, rock, or glass. If any of these objects are allowed to remain in tread, they may eventually reach the tube.

NOTE: In some instances the tube of an inflated tire may already be punctured and pressure will be lost only when object is removed.

INFLATION OF TIRES

Under-inflation is the greatest cause for loss of tire life expectancy. Tires should be checked frequently for this condition. The fabric, rubber, bead, contour, and size of tires used on these vehicles are designed to obtain maximum length of service under all operating conditions to which vehicles may be subjected. TIRES ARE DESIGNED TO OPERATE EFFICIENTLY ONLY ON A PRESCRIBED AMOUNT OF AIR. Unless the correct air pressure is consistently maintained, the tires will not function as they should; consequently, safe economical operation of vehicle will be materially affected.

An under-inflated tire runs sluggishly, heats up quickly because of the greater flexing, and is subjected to more frequent bruising. In the situation of duals, loss of pressure in one tire could cause slippage of rim on wheel with the result of tire, tube, rim, and spacer loss. On the other hand, over-inflation may weaken the tire, causing a blowout. In addition to the deteriorating effect improperly inflated tires may have on the tire life, this condition will affect steering, riding comfort, and safe driving. FOLLOW THE TIRE PRESSURE RECOMMENDATIONS OF THE TIRE MANUFACTURER.

For greater riding comfort, prolonged tire life, and to reduce wear and tear on the truck chassis, tires should be inflated for loads carried on tires as indicated in "Tire Load and Inflation Table" in "Specifications" at end of this section. In no case should this combined front and rear tire load exceed the maximum recommended load shown in "Load Capacity Chart" in the current Owner's and Driver's Manual.

Many components of trucks are designed for definite load-carrying capacities. For example, the strength of the springs is related to the specified load limit; if this limit is exceeded, a spring could break, creating a potential safety hazard. Overloading the truck might produce a similar problem with respect to the frame, axles, tires, or wheels.

The weight capacity of a truck is contained on the metal GVW plate. This plate specifies the maximum gross vehicle weight rating of truck and refers to the Truck Owner's Guide for additional load capacity information regarding tire and spring options. "Gross vehicle weight" means the total weight of the vehicle including the load being carried. It is important not exceed the maximum gross vehicle weight rating of a truck, and that proper distribution of the load between the front and rear axles be maintained in order not to exceed the tire and spring capacity. The best method to check this weight distribution is to weigh the truck at a highway weigh station or at a local company having scales to weigh vehicles. (The weight on the rear wheels and front wheels should be determined separately.)

BALANCED INFLATION

The whole efficiency of the vehicle will be upset if air pressure in the tires are out-of-balance.

Balanced inflation may be expressed as: All tires on the same axle should always carry the same air pressure. A difference in air pressure of the rear tires and the front tires may be permissible within certain limitations; however, there should not be a difference in pressures between the right and left tires on the same axle. A 5-pound under-inflation in one front tire not only can destroy ease of steering, but creates steering hazards which generally point to a potential accident. An under-inflated rear tire can destroy the value of the most efficient brakes. Balance tires for ease of steering, comfort in riding, safety in driving, as well as for minimum fuel consumption and maximum tire mileage.

PRESSURE LOSS

At periodic intervals, each tire should be gauged for pressure loss with an accurate gauge before tires are brought to correct operating pressure. The purpose of this check is to determine the exact pressure loss in each tire. In other words, if at the time this check is made, a definite pressure loss is noted in any one of the tires, an inspection should be made of the tire showing the loss and the cause of loss corrected. This method should definitely establish a "danger signal" on the condition of the tires. The pressure loss check should be made consistently with the same gauge, so that any element of inaccuracy in the gauge will be the same for all tires.

VALVE CORE AND CAP

The valve core is a spring-loaded check valve in the valve stem, permitting inflation or deflation of the tube or tire. This check valve, or core, is not intended to hold the air during operation. The valve cap is provided to seal the air in the tube and tire. When valve cap is tightened down on stem, the sealing washer inside cap is pressed tightly against top of stem, preventing air leakage. It is important, therefore, that valve caps be used at all times.

TIRE ROTATION

Tires should be interchanged at regular intervals to obtain maximum tire life. Refer to figure 7. If there is uneven tread wear on front tires. rotate tires immediately and check vehicle for mechanical irregularities. Since there are three tires on each side of the vehicle, the front tires should be moved to the rear when 1/3 of the tread life has been used. When tires are moved to rear, follow recommendations as described later under "Selection of Tires" in matching them with other tires. Mount new tires on front.

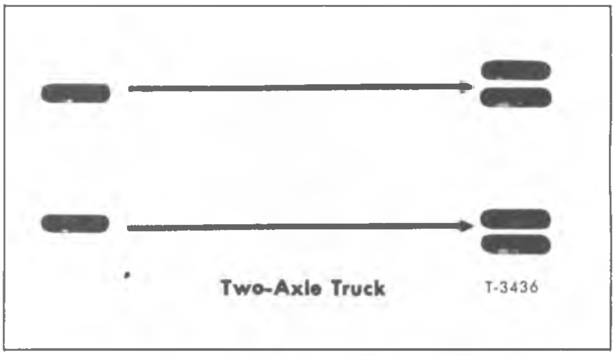


Figure 7—Tire Rotation Diagram

TIRE REMOVAL AND INSTALLATION

SAFETY PRECAUTIONS

UNLESS EXPERIENCED, DO NOT ATTEMPT TO REPAIR TIRE. HAVE REPAIRS MADE BY A RELIABLE TIRE REPAIR SHOP.

Most truck "rim accidents" are caused by carelessness, thoughtlessness, or lack of experience, when inflating the tire after mounting. Such accidents are always serious and sometimes fatal. Be on the safe side -- always follow the precautions explained following:

On all rims, the lock ring must be fully seated in the rim gutter before inflating tire. This is important for the safety of the person inflating the tire. As a safety measure, observe the following precautions:

On Budd or Disc Type wheels, wrap three lengths of chain evenly spaced around tire and rim through hand holes. Leave chain loose enough to permit expansion of tire during inflation. Leave chains in place until tire is fully inflated, examine lock ring to see that it is fully seated, then remove safety chains.

On cast wheels, wrap tire and rim with a chain at opposite sides of rim and secure ends of chain. Leave chain loose enough to permit expansion of tire during inflation. After inflating, examine lock ring to see that it is fully seated, then remove chain.

When tires are mounted on dirty or corroded rims, or when they are not properly centered on rims, the tire bead may "bind" on the rim, and refuse to seat. Allowing pressure to continue to build up within the assembly in an attempt to seat the tire bead is a DANGEROUS PRACTICE which can result in a broken tire bead, and serious injury to the serviceman. All of the following safety precautions should be observed.

1. Make sure that rim flanges and bead ledge (especially hump and radius) areas are smooth and clean. Remove any oxidized rubber, dried soap solution, rust, heavy paint, etc., with a wire brush, or in extreme cases, a file.

NOTE: Repaint bare metal with a good grade of aluminum paint or equivalent, to prevent rust.

2. Lubricate tire beads, rim flanges, and bead ledge areas with a liberal amount of thin vegetable oil soap solution, or approved rubber lubricant.

3. Insure that air pressure build-up during the bead seating process is not allowed to exceed 40 pounds pressure.

IMPORTANT: If beads have not seated by the time pressure reaches 40 pounds, assembly should be deflated, repositioned on rim, relubricated, and re-inflated.

4. Make sure valve core is inserted in valve stem prior to inflating.

5. Use an extension gauge with clip on chuck so air pressure build-up can be closely watched and so that you can stand well back from the assembly during the bead seating process to avoid possibility of personal injury.

MATCHING SIDE AND LOCK RINGS

Side and lock rings of different rim types are not interchangeable. Some may appear to be, but they do not fit properly on the rim base. Serious accidents have resulted from the use of mismatched rimgs. Rim base and rings must be matched according to manufacturer, size and type. This information is stamped on each part.

TUBE-TYPE WHEELS AND TIRES

Installing Synthetic Tubes

1. Before installing tube in tire, clean inside of casing thoroughly.

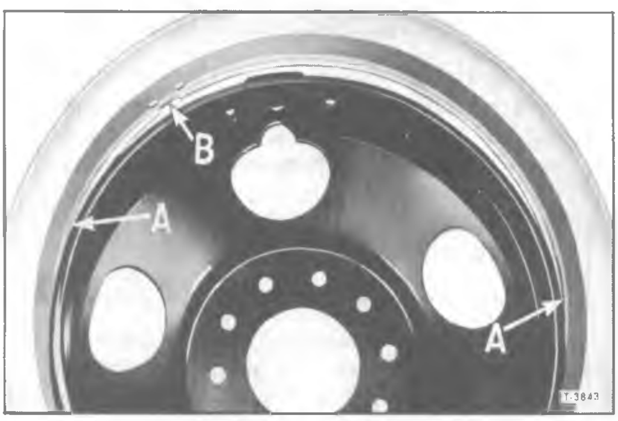


Figure 8—Slide Ring Assembly Points

2. Insert tube in tire and inflate until it is nearly rounded out.

3. Inspect rim for rust scale and bent flanges -- clean rust scale and straighten flanges where necessary.

4. Using a brush or cloth swab, apply a solution of neutral vegetable oil soap to the inside and outside of tire beads and also to the tim side of the tube. Do not allow soap solution to run down into tire. Insert flap in tire if used.

5. Center valve and pull it firmly against the rim. Hold in this position and inflate until tire beads are firmly seated on rim against flanges.

6. Completely deflate tire by removing valve core. Re-inflate to correct pressure.

NOTE: When tube and flap are not properly lubricated and mounted, they will stretch thin in the tire bead and rim region. This will cause premature failure.

TWO SECTION RIMS

To facilitate assembly and removal, two cutaway sections "A" (fig. 8), and an operating notch "B" are incorporated in the locking flange of the side ring.

In separating the side ring from the wheel rim of the spare or new wheel for tire installation, stand the wheel up with the operating notch in the side ring at the top. The straight end of a tire iron is inserted and driven into the operating notch (fig. 9). The tool is moved as a lever to lift the side ring away from the rim. After the side ring has passed over the rim gutter at the operating notch, work progressively around entire rim until side ring is separated from wheel rim.

Demounting Tire

1. Completely deflate tire by removing the valve core.

2. Loosen the tire bead from its seat in the side ring by driving the tire iron between the tire bead and the side ring (fig. 10). Repeat this operation progressively around the side ring prying until bead is loose.

3. Insert straight end of tire iron into operating notch located at double pimples "B" (fig. 12).

4. Push side ring down at point opposite operating notch and force tire iron handle down causing side ring to disengage from rim gutter. Repeat progressively around the side ring, prying ring from rim gutter until free.

5. To free opposite tire bead from wheel rim, turn tire over and repeat bead loosening operation (fig. 11).

NOTE: It is not necessary to remove side ring from tire bead if tire is to be removed for tube repair only. Simply loosen tire bead from wheel rim as shown in figures 10 and 11 and remove tube.

Figure 9—Tire Iron in Operating Notch

Two Section Rims - Mounting Tire

1. Remove all rust scale from wheel rim and side ring.

2. Insert tube in tire and inflate until tube is nearly rounded out.

3. Lubricate tire beads, rim sides of tube and both sides of flap with a solution of neutral vegetable soap or equivalent rubber lubricant. Insert flap in tire.

4. Place disc portion of wheel on floor with rim gutter up and install tire and tube assembly indexing tube stem with stem support in wheel rim and with valve stem pointing in desired direction.

5. Place side ring in position with operating notch "B" (fig. 13) approximately three inches from valve on either side.

6. The two cut-away sections opposite each other "A" (fig. 14) on inner diameter of side ring are positioned so as to span the rim gutter.

7. At point "C" opposite valve, force ring into rim gutter as far as possible.

8. Insert straight end of tire iron into operating notch "B" (fig. 15). Then pull in the direction indicated.

9. Retain pressure with tool and strike side ring downward at a point between operating notch and cut-away section, thereby engaging side ring over rim gutter at these points.

10. Remove tool and strike additional blows progressively toward other cut-away section until toe of side ring has passed over the rim gutter.

Figure 10—Loosening Tire Bead

Figure 11—Loosening Tire Bead

Figure 12—Disengaging Side Ring From Rim Gutter

11. While the side ring is being applied to the wheel rim, it is tight and requires force or

Figure 13—Position Side Ring

Figure 14—Positioning Ring in Rim Gutter

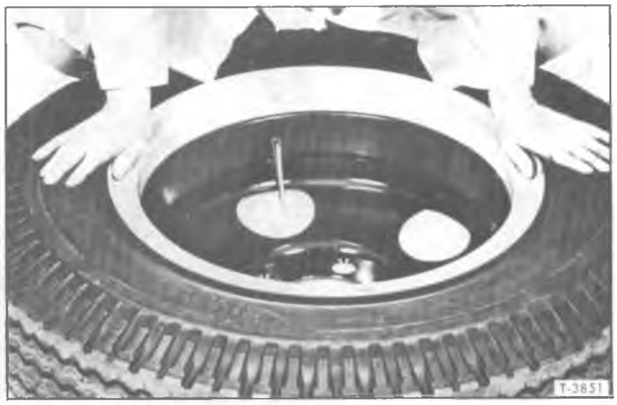


Figure 16—Checking Side Ring for Bind on Rim

hammer blows to complete the application. When side ring is completely installed on the rim, it is no longer tight and can be depressed or will yield to a light hammer blow. Precaution should be taken to see that side ring is not binding on the rim and can be freely depressed (fig. 16) before inflating tire.

THREE SECTION RIMS

Demounting Tire

1. Completely deflate tire by removing the valve core.

2. Using a hammer, tap around the side ring progressively to move it in toward the center of the rim until it clears the clamp ring (fig. 17).

3. Starting at the split in the clamp ring, raise its end out of the rim gutter, using a screwdriver and the tire iron (fig. 18). Then remove the clamp ring by prying it out of the gutter with the tire iron, moving progressively around the rim.

4. Drive the curved end of the tire iron in between the side ring and the tire bead (fig. 19). Then pry down on the opposite end of tire iron to move the tire bead away from the side ring flange.

5. Continue the foregoing operation progressively around the tire until side ring is removed.

NOTE: The tire bead seat on the side ring is slightly tapered; this design makes removal of ring much easier.

6. Push the valve stem up inside the tire to prevent damage while removing the tire. The tire may be removed from the rim by turning it over and following the procedure in Step 4.

Mounting Tire

1. Remove all rust scale from the rim, side ring and clamp ring.

2. Insert tube in tire and inflate until tube is nearly rounded out.

3. Lubricate tire beads, rim sides of tube, and both sides of flap with a solution of neutral vegetable oil soap or equivalent rubber lubricant. Insert flap in tire, if used.

4. Place tire on rim with valve in line with the valve hole in rim. Insert valve through hole, then work tire onto rim.

5. Place side ring into position on tire and rim. Then press the side ring into tire and onto the rim using the tapered end of tire iron until the

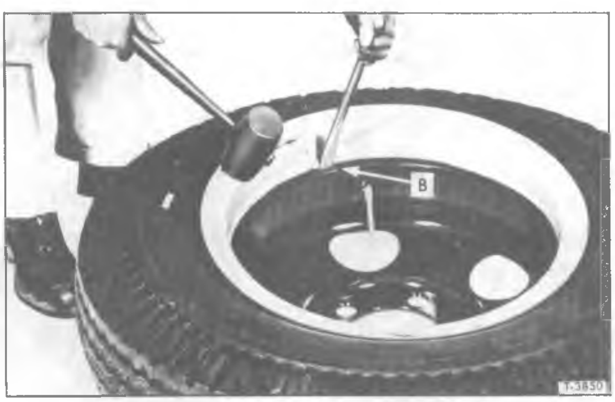


Figure 15—Engaging Side Ring Over Rim Gutter

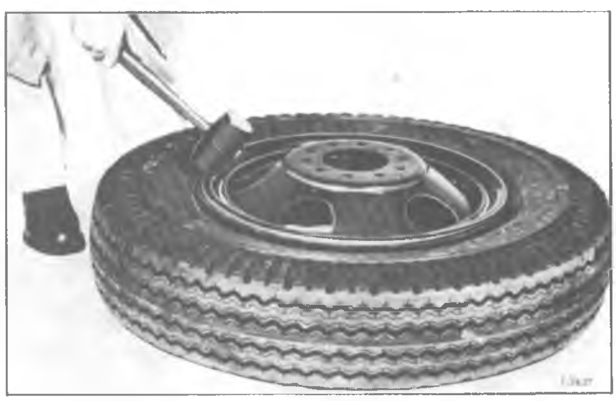


Figure 17—Releasing Tire Rim Clamp

Figure 18—Raising End of Clamp Ring

clamp ring gutter is exposed. Insert end of clamp ring in gutter and work progressively around the tire until the clamp ring is seated in the gutter.

CAUTION: DO NOT stand unprotected in front of clamp ring when inflating tire. If a protective inflation cage is not available, wrap three lengths of chain, evenly spaced around tire and rim. Secure chains but leave loose enough to permit expansion of tire during inflation. Use an extension gauge with clip on chuck to inflate tire.

6. Inflate tire in safety cage or with safety chains. Stand well back from assembly during bead seating process to avoid possibility of personal injury. Inflate tire until tire beads are firmly seated against rim flanges.

7. Completely deflate tire by removing valve core. Then re-inflate to recommended pressure.

IMPORTANT: When servicing wheels, care should be taken to prevent wheel discs, and rims from becoming mixed. Rims should be tagged or marked to assure assembly to correct disc. The following chart is provided (fig. 20) to aid in assembling the correct rim to disc if they should become mixed.

On vehicles with tires that are secured on rim by a one-piece split lock ring, or by a continuous side ring held in place by a split ring, conventional methods are used to mount and dismount tires.

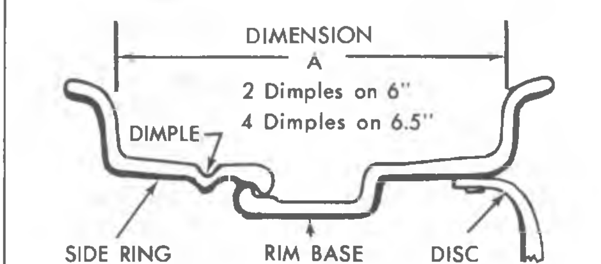
SELECTION OF TIRES

All tires on an axle should, whenever possible, be of the same make, since difference in design and tread in some instances result in unequal tire rolling radii. When installing tires, all tires on each axle should have the same outside diameter within ¼-inch on tires up to and including size 9.00-20, or within ½-inch on sizes 10.00-20. If tires do not have the same outside diameter (within the above limitations), excessive tread scuffing and hard steering will result. In highway service, the smaller of the two tires on a dual assembly should be installed on the inside position, provided its diameter is within the tolerance described previously.

Figure 19—Starting Side Ring Removal

WHEEL AND TIRE BALANCING

It is desirable from the standpoints of tire wear and vehicle handling ease to maintain proper balance of front wheel and tire assemblies on all models. All wheels intended for use on front of vehicle, such as those switched during periodic tire rotation and those installed as new or repaired replacement equipment should be accurately balanced. This may be accomplished by either of two types of balancing systems in current use which balance wheels either on the vehicle or off. The



Wheel Size	Dimension A	Tire Size
20 x 6.0	6.0″	7.00-20
		7.50-20
		8.25-20
20 x 6.5	6.5″	8.25-20
		9.00-20

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Figure 20—Rim Cross Section Chart

"on-the-vehicle" type, however, is the more desirable in that all rolling components (brake drums, bearings, seals, etc.), are included in the balancing procedure and thereby have any existing unbalance corrected.

Wheel balance is the equal distribution of the weight of the wheel and tire assembly around the axis of rotation. There are two ways in which wheels can be balanced -- statically and dynamically. Wheels must be statically balanced before they can be balanced dynamically.

STATIC BALANCE

Static balance (sometimes called still balance) is the equal distribution of weight of the wheel and tire assembly about the axis of rotation in such a manner that the assembly has no tendency to rotate by itself, regardless of its position. For example: A wheel with a chunk of dirt on the rim will always rotate by itself until the heavy side is at the bottom. Any wheel with a heavy side like this is statically out-of-balance. Static unbalance of a wheel causes a hopping or pounding action (up and down) which frequently leads to wheel "flutter" and quite often to wheel "tramp."

DYNAMIC BALANCE

Dynamic balance (sometimes called running balance) means that the wheel must be in static balance, and also run smoothly at all speeds on an axis which runs through the center line of the wheel and tire and is perpendicular to the axis of rotation.

To ensure successful, accurate balancing, the following precautions must be observed:

Wheel and tire must be clean and free from all foreign matter. The tires should be in good condition and properly mounted with the balance mark on the tire, if any, lined up with the valve.

Bent wheels that have run-out over 3/32" should either be replaced or straightened before being balanced.

Inspect tire and wheel assembly to determine if an eccentric or out-of-round condition exists. Note that this condition, if severe, cannot be "balanced out." An assembly which has an out-of-round condition exceeding 5/16" is not suitable for use on the front of the vehicle. Its use on the rear should be governed by its general condition and whether the roundness defect seriously detracts from overall ride quality.

When balancing wheels and tires, it is recommended that the instructions covering the operation of the wheel balancer being used be closely followed.

CORRECTING IRREGULAR TIRE WEAR

Heel and Toe Wear -- This is a saw-toothed effect where one end of each tread block is worn more than the other. The end that wears is the one that first grips the road when the brakes are applied.

Heel and toe wear is less noticeable on rear tires than on front tires, because the propelling action of the rear wheels creates a force which tends to wear the opposite end of the tread blocks. The two forces, propelling and braking, make for more even wear of the rear tires, whereas only the braking forces act on the front wheels, and the saw-toothed effect is more noticeable.

A certain amount of heel and toe wear is normal. Excessive wear is usually due to high speed driving and excessive use of brakes. The best remedy, in addition to cautioning the owner on his driving habits, is to interchange tires regularly.

Side Wear -- This may be caused by incorrect wheel camber, underinflation, high cambered roads or by taking corners at too high a rate of speed.

The first two causes are the most common. Camber wear can be readily identified because it occurs only on one side of the treads, whereas underinflation causes wear on both sides. Camber wear requires correction of the camber first and then interchanging tires.

There is, of course, no correction for high cambered roads. Cornering wear is discussed further on.

Misalignment Wear -- This is wear due to excessive toe-in or toe-out. In either case, tires will revolve with a side motion and scrape the tread rubber off. If misalignment is severe, the rubber will be scraped off of both tires; if slight, only one will be affected.

The scraping action against the face of the tire causes a small feather edge of rubber to appear on one side of the tread and this feather edge is certain indication of misalignment. The remedy is readjusting toe-in, or rechecking the entire front end alignment if necessary.

Uneven Wear -- Uneven or spotty wear is due to such irregularities as unequal caster or camber, bent front suspension parts, out-of-balance wheels, brake drums out-of-round, brakes out of adjustment or other mechanical conditions. The remedy in each case consists of locating the mechanical defect and correcting it.

Cornering Wear -- When a truck makes an extremely fast turn, the weight is shifted from an even loading on all wheels to an abnormal load on the tires on the outside of the curve and very light load on the inside tires, due to centrifugal force. This unequal loading may have two unfavorable results.

First, the rear tire on the inside of the curve may be relieved of so much load that it is no longer geared to the road and it slips, grinding off the tread on the inside half of the tire at the excessive rate. This type of tire shows much the same appearance of tread wear as tire wear caused by negative camber.

Second, the transfer of weight may also overload the outside tires so much that they are laterally distorted resulting in excessive wear on the outside half of the tire, producing a type of wear like that caused by excessive positive camber.

Cornering wear can be most easily distinguished from abnormal camber wear by the rounding of the outside shoulder or edge of the tire and by the roughening of the tread surface which denotes abrasion.

Cornering wear often produces a fin or raised portion along the inside edge of each row in the tread pattern. In some cases this fin is almost as pronounced as a toe-in fin, and in others, it tapers into a row of tread blocks to such an extent that the tire has a definite "step wear" appearance.

The only remedy for cornering wear is proper instruction of operators. Driving more slowly on curves and turns will avoid grinding rubber off tires. To offset normal cornering wear as much as possible, tires should be interchanged at regular intervals.

SPECIFICATIONS

WHEEL NUT TORQUE

CAST TYPE WHEELS	
Tighten nuts as directed in text to:	
Front	190-210 foot-pounds
Rear	190-210 foot-pounds
BUDD TYPE (DISC) WHEELS	
Tighten nuts as directed in text to:	
Front	500-550 foot-pounds
Rear (Inner and Outer Nuts)	500-550 foot-pounds*
Aluminum Wheels and/or Hubs	450-500 foot-pounds*
CORPORATION TYPE (DISC) WHEELS	
Tighten nuts as directed in text to:	
Front	300-400 foot-pounds
Rear	300-400 foot-pounds

* Loosen outer nuts, tighten inner nuts, then tighten outer nuts.

All wheels equipped with a tubular side ring (rolled flange rim) on the outboard side of the wheel rims require special design weights to fit. Dynamic balancing can be accomplished through use of these special balance weights which are designed only for installations on the outboard side of these wheels. Conventional weights fit only the inboard side of these wheels.

CAUTION: DO NOT stand unprotected in front of clamp ring when inflating tire. If a protective inflation cage is not available, wrap three lengths of chain, evenly spaced around tire and rim. Secure chains but leave loose enough to permit expansion of tire during inflation. Use an extension gauge with clip on chuck so air pressure build-up can be closely watched and so that you can stand well back from the assembly during the bead seating process to avoid possibility of personal injury.

TIRE LOAD AND INFLATION TABLES

Tire and Rim Association Standard Tire Loads At Various Inflation Pressures.

Load Range Letters and Corresponding Ply Rating
(**D** = 8 ply, **E** = 10 ply, **F** = 12 ply and **G** = 14 ply)

SINGLE TIRES FOR TRUCKS IN HIGHWAY SERVICE

TIRE SIZE	LOAD RANGE	TIRE LOAD LIMITS AT VARIOUS INFLATION PRESSURES										
		50	55	60	65	70	75	80	85	90	95	100
7.00-20	D	2100	2260	2390	2530	2670	**2790**					
7.00-20	E	2100	2260	2390	2530	2670	2790	2920	3030	**3150**		
7.50-20	D	2360	2530	2680	2840	2990	**3140**					
7.50-20	E	2360	2530	2680	2840	2990	3140	3270	3410	**3530**		
8.25-20	E	2800	3010	3190	3370	3560	3730	3890	**4050**			
8.25-20	F	2800	3010	3190	3370	3560	3730	3890	4050	4210	4350	**4500**
9.00-20	E		3560	3770	4000	4210	4410	**4610**				
9.00-20	F		3560	3770	4000	4210	4410	4610	4790	4970	**5150**	
10.00-20	F			4290	4530	4770	4990	5220	**5430**			
10.00-20	G			4290	4530	4770	4990	5220	5430	5640	5840	**6040**
11.00-20	F			4670	4940	5200	5450	5690	**5920**			
11.00-22	F			4960	5240	5520	5790	6040	**6290**			

DUAL TIRES FOR TRUCKS IN HIGHWAY SERVICE

TIRE SIZE	LOAD RANGE	TIRE LOAD LIMITS AT VARIOUS INFLATION PRESSURES										
		40	45	50	55	60	65	70	75	80	85	90
7.00-20	D	1840	1980	2100	2220	2340	**2450**					
7.00-20	E	1840	1980	2100	2220	2340	2450	2560	2660	**2760**		
7.50-20	D	2070	2220	2350	2490	2620	**2750**					
7.50-20	E	2070	2220	2350	2490	2620	2750	2870	2990	**3100**		
8.25-20	E	2460	2640	2800	2960	3120	3270	3410	**3550**			
8.25-20	F	2460	2640	2800	2960	3120	3270	3410	3550	3690	3820	**3950**
9.00-20	E		3120	3310	3510	3690	3870	**4040**				
9.00-20	F		3120	3310	3510	3690	3870	4040	4200	4360	**4520**	
10.00-20	F			3760	3970	4180	4380	4580	**4760**			
10.00-20	G			3760	3970	4180	4380	4580	4760	4950	5120	**5300**
11.00-20	F			4100	4330	4560	4780	4990	**5190**			
11.00-22	F			4350	4600	4840	5080	5300	**5520**			

NOTE: Bold face figures indicate maximum recommended load.

SECTION 11

Sheet Metal

Contents of this section are listed in Index below:

The SHEET METAL information on models covered in this manual is complete. Figure 1 shows typical Front Sheet Metal Components.

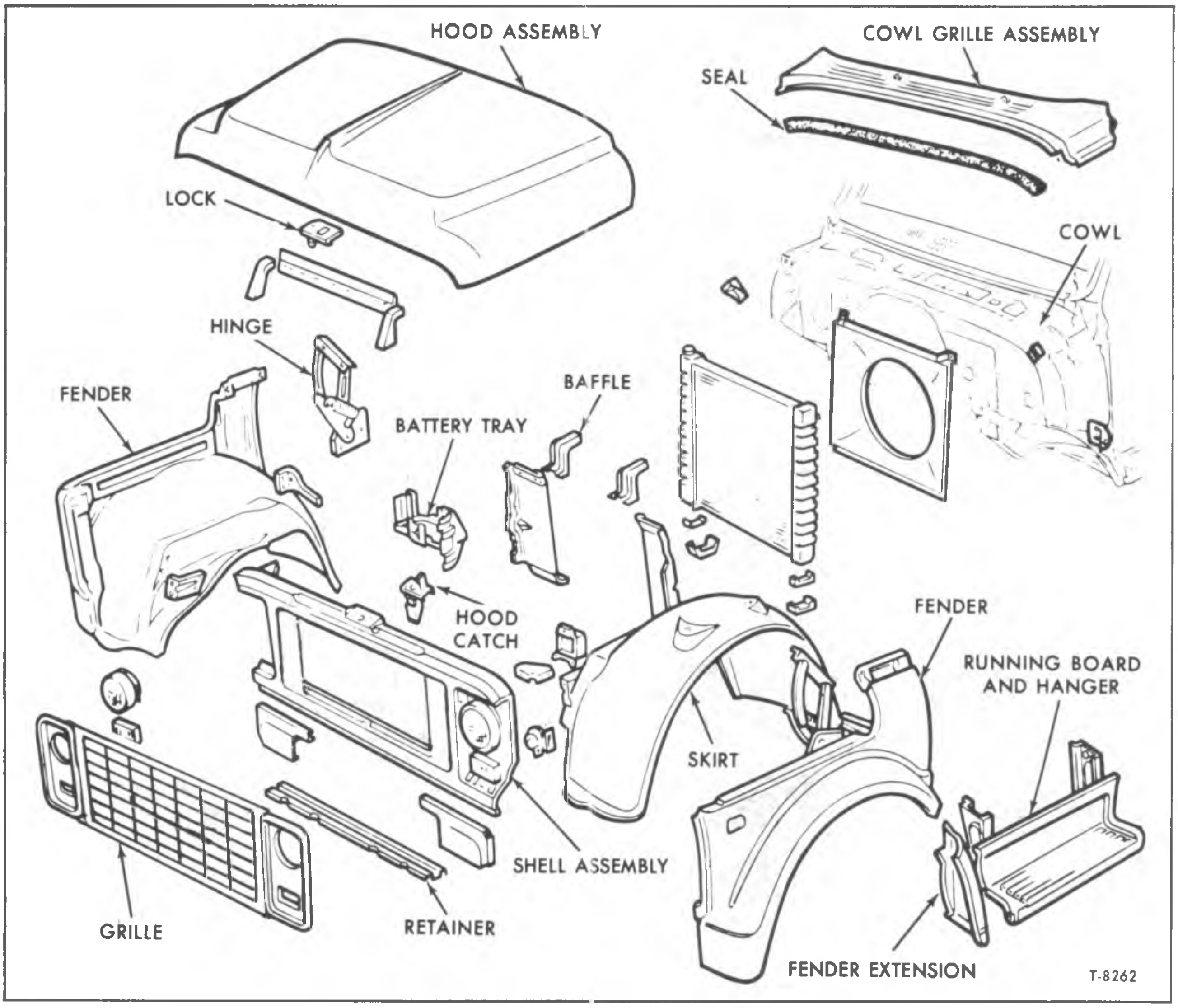


Figure 1—Typical Front End Sheet Metal Components

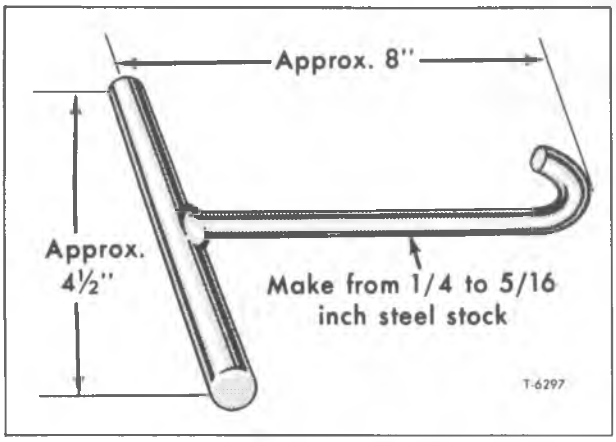


Figure 2—Improvised Tool

HOOD HINGE SPRING REPLACEMENT

NOTE: To facilitate hinge spring replacement a tool can be improvised to dimensions shown in figure 2.

1. Raise and safely support the hood in "Full-Open" position.
2. As shown in figure 3, engage hooked end of tool to spring, then carefully pull forward to engage or disengage spring from hinge assembly.

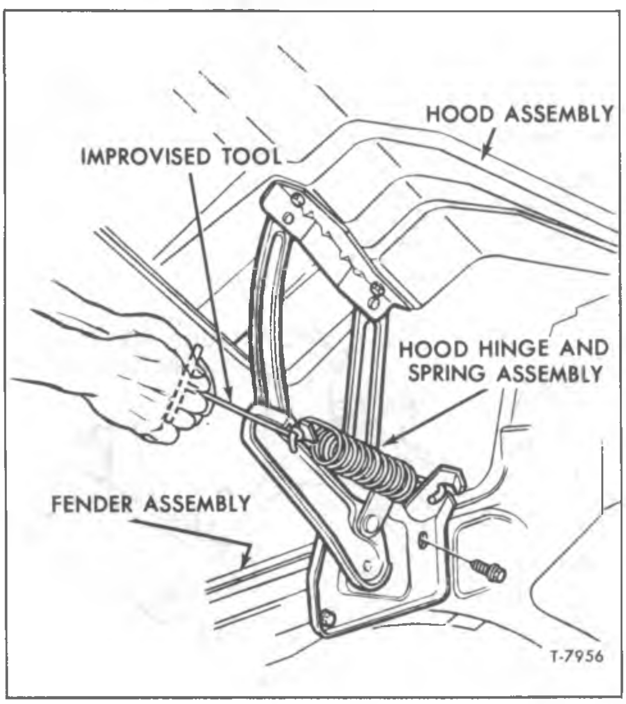


Figure 3—Removing Hood Spring

NOTE: Install painted end of spring toward the rear.

HOOD HINGE REPLACEMENT

(Refer to Figure 3)

REMOVAL

1. Prop the hood in the extreme open position and place protective covering over the cowl and fenders.
2. Scribe position of hinge attachment on hood rear reinforcement and remove two bolts.
3. Remove hood hinge spring as explained above.
4. Scribe position of hinge attachment on fender assembly, remove bolts and hinge.

INSTALLATION

1. Install hinge assembly to fender and align within scribe marks. Install bolts.
2. Install hood hinge springs.
3. Install bolts and align hood. See "Hood Replacement and Alignment" in this section.

HOOD LOCK ASSEMBLY

A bolt-type hood lock is used as shown in figure 4. The lock bolts, located on the hood dovetails with the mounted striker plate, preventing upward or downward movement of the hood while the vehicle is in motion. Integral with the striker plate is the combination lock release lever and safety catch.

MAINTENANCE

Every 4 months or 6,000 miles, whichever occurs first, lubricate hood assembly and hood hinge assembly as follows:

1. Wipe off any accumulation of dirt or contamination on latch parts.
2. Apply Lubriplate or equivalent to latch pilot bolts and latch locking plate.
3. Apply light engine oil to all pivot points in release mechanism, as well as primary and secondary latch mechanisms.
4. Lubricate hood hinges.
5. Make hood hinge and latch mechanism functional; check to assure the assembly is working correctly.

REPLACEMENT

1. Open hood and remove the four bolts holding the combination lock catch and lock bolt.

NOTE: If original hood lock assembly is to be replaced, scribe a line around lock for alignment on installation.

2. Place hood lock assembly in position.
3. Adjust as outlined later under "Adjustment."

ADJUSTMENT

1. Open hood and adjust tightness of lock bolt support so that they are just "snug" enough to hold lock bolt in position.
2. Close hood in a normal manner.
3. Raise hood again; lock bolt assembly will have shifted to operating position. Tighten bolts fully. Further adjustment may be made at lock bolt support, if necessary.
4. Adjust lock bolt to obtain a secure hood closure and reasonable lock release effort.

HOOD AND RADIATOR SEALS
(Refer to Figure 5)

1. Inspect seals for damage or wear.
2. Remove staples and replace seals (if necessary), using sheet metal screws and flat washers.

HOOD PADS (Fig. 6)

Eight hood pads are installed between hood reinforcements and hood sheet metal for noise insulation. If any apparent noise is from hood area, lift hood and visually inspect pads. If pads are out of position or worn, insert wide thin piece of metal between support and sheet metal. Pry down enough to remove pressure from pads. Reposition or replace pads as required.

HOOD REPLACEMENT AND ALIGNMENT

REMOVAL

1. Lay a fender cover along cowl top to prevent hood from scratching cowl top.
2. Open hood and prop in full open position.

NOTE: If hood is to be reinstalled and present alignment is satisfactory, mark each hinge in relation to hood, to assure original alignment.

3. Remove two cap screws which attach each hinge to hood; then with a helper remover hood from vehicle.

INSTALLATION

1. If original hood is to be installed, position hood to hinges and install four cap screws snug which attach hinges to hood.

NOTE: If a new hood is to be installed, perform procedures as outlined later under "Alignment."

2. Shift hood on hinges to location marks made before removal of hood, then tighten attaching cap screws at hinges firmly. Close hood and check fit. If necessary to align hood perform procedure as outlined under "Alignment" which follows:

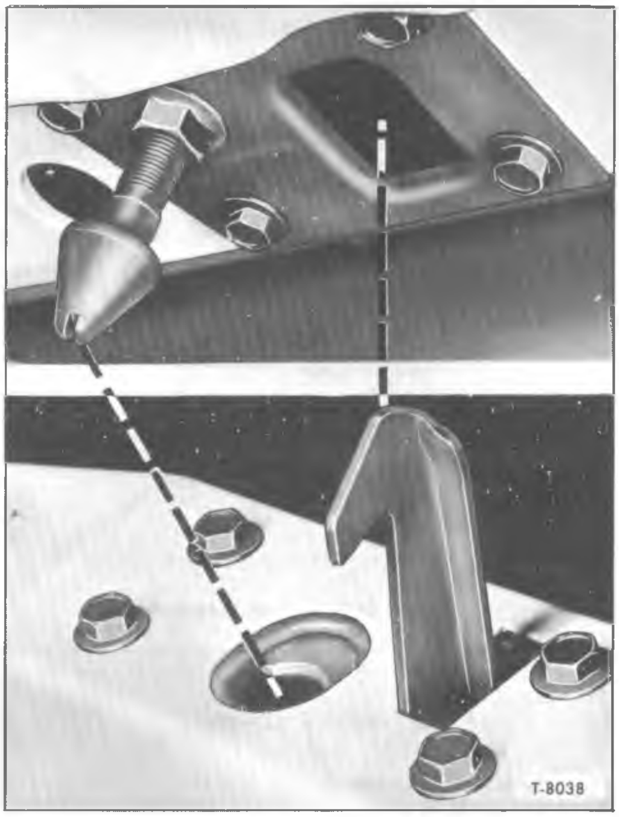


Figure 4—Hood Lock Assembly

ALIGNMENT (Fig. 7)

1. Loosen hood hinge bolts. Note that rearmost bolt hole in hinge is slotted to allow hood trailing edge to move up and down.
2. Adjust hood rear bumper so that hood and

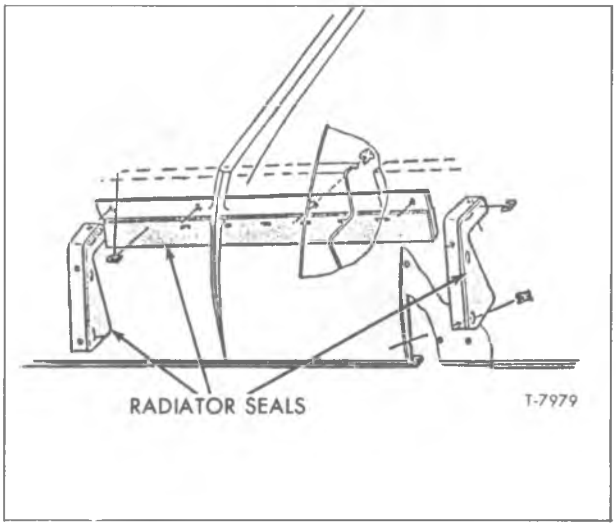


Figure 5—Hood and Radiator Seals

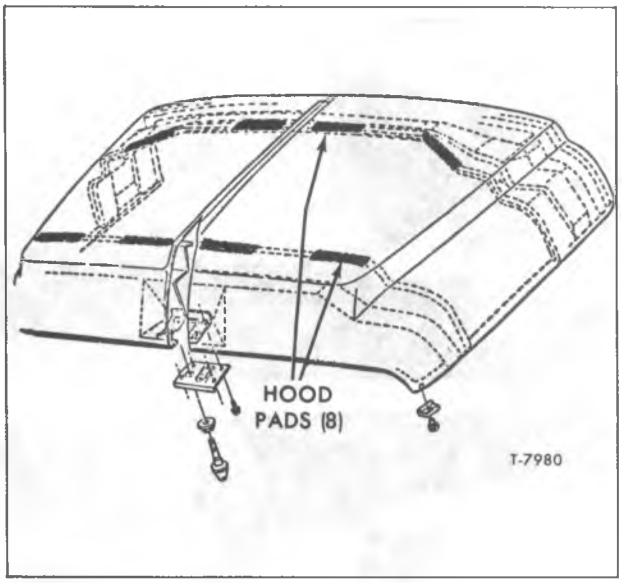


Figure 6—Hood Pads and Lock

cowl surfaces are flush.

3. Perform hood lock adjustment as outlined previously in this section, if necessary.

NOTE: Hood lock assembly (fig. 8) to be adjusted fore and aft until nubbin (part of hood lock bolt support assembly) enters center of elongated guide (socket). Bending nubbin to accomplish this adjustment may seriously affect lock operation and safety catch engagement and is, therefore, NOT RECOMMENDED.

FRONT END SHEET METAL UNIT REPLACEMENT

Removal of entire front sheet metal unit including radiator is a relatively simple operation involving, basically disassembly of mounts, disconnecting radiator hoses and removal of front bumper. Vehicles equipped with air conditioning and/or power steering will require special handling.

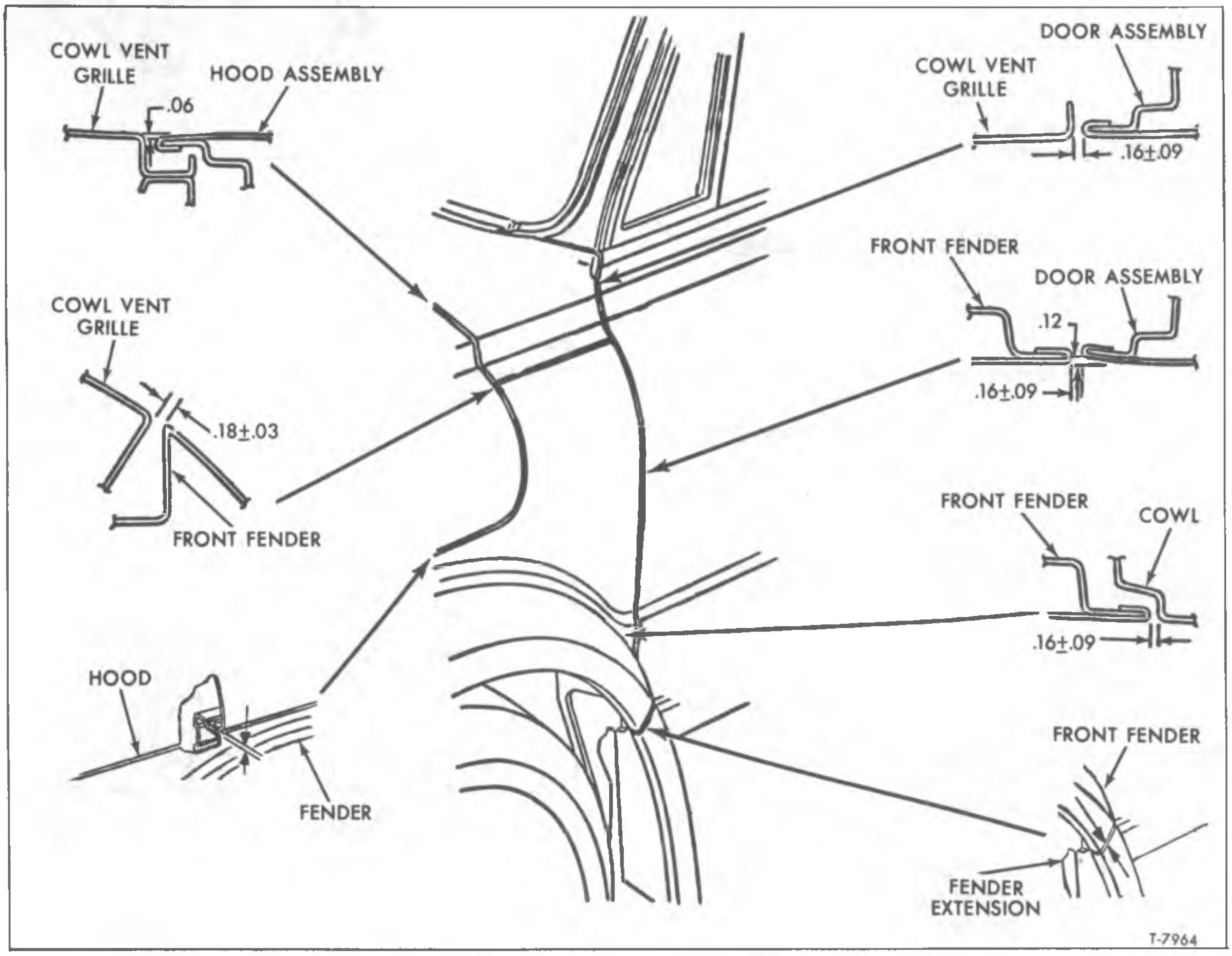


Figure 7—Front Sheet Metal Alignment Dimensions

NOTE: Shims which are found at various locations should be recorded to ease installation of sheet metal assembly. Proceed as follows:

REMOVAL

1. Remove windshield wiper arms and cowl grille (except cowl models).
2. Drain radiator and remove radiator hoses.
3. Disconnect transmission cooler lines, and disconnect air cleaner intake hose at fender skirt, if so equipped.
4. Disconnect wire connectors at dash and toe panel. Disconnect the battery, generator and regulator wire leads. Remove battery.
5. Disconnect power steering fluid reservoir from inside grille.
6. Remove front bumper bolts and remove bumper.
7. Remove two bolts from underneath front frame crossmember and attachments securing sheet metal (see fig. 9).
8. Remove one screw, each side attaching cowl bracket to fender (plastic plug covers) access from inside cab, on cowl (fig. 10). DO NOT remove cowl bracket.
9. Remove two bolts attaching fender upper edge to plenum and hinge pillar (fig. 10).
10. Tape shims in their respective positions for reassembly ease.
11. Remove two screws (each side) attaching fender gusset to cowl (fig. 11).
12. Working from underneath rear of fender, remove bolts which attach each fender skirt to the fender extension flange.
13. Remove two bolts from radiator support mount.
14. Remove bolt attaching each fender skirt to cab sill extension.
15. With the aid of a helper, remove front sheet metal unit with radiator, battery carrier, horn and voltage regulator.

INSTALLATION

1. Tape washers and cushions to frame and fender brackets with masking tape.

NOTE: If sheet metal mounting cushions on frame brackets are worn or deteriorated, replace before installing front sheet metal.

2. With helper's aid, place sheet metal assembly in position.

NOTE: Install all bolts loosely to facilitate alignment after complete installation.

CAUTION: Use care to prevent stripping threads when installing two bolts from underneath front frame crossmember (fig. 9). This could cause retaining nuts to loosen, and it would be necessary to remove the radiator.

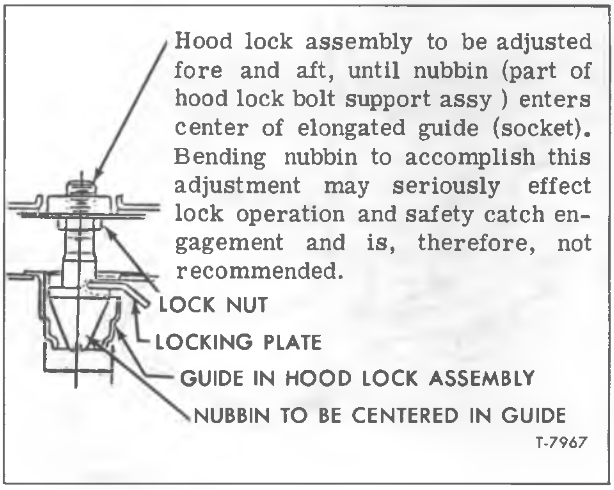


Figure 8—Hood Lock Alignment

3. Install two bolts and shims required at each fender rear upper edge.
4. Install combination bolt and flat washer assembly into each cowl bracket to fender.
5. Tighten the sheet metal mounting bolt 35 to 55 foot-pounds torque (fig. 9).
6. Install spacer, washer, and bolt in each fender skirt to cab sill extension.
7. Install skirt attaching bolts to fender extension.
8. Tighten all bolts. Install bolt access plugs on cowl models.
9. Install front bumper.

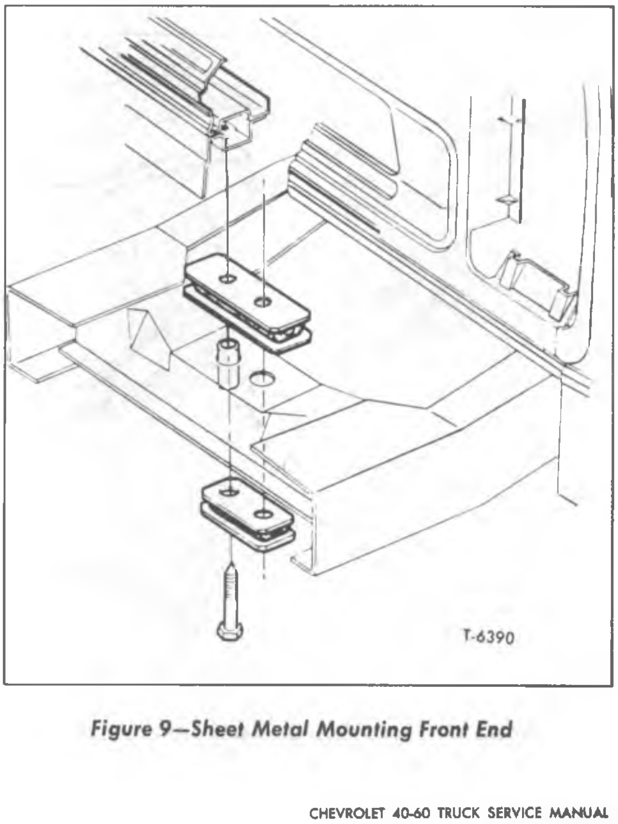


Figure 9—Sheet Metal Mounting Front End

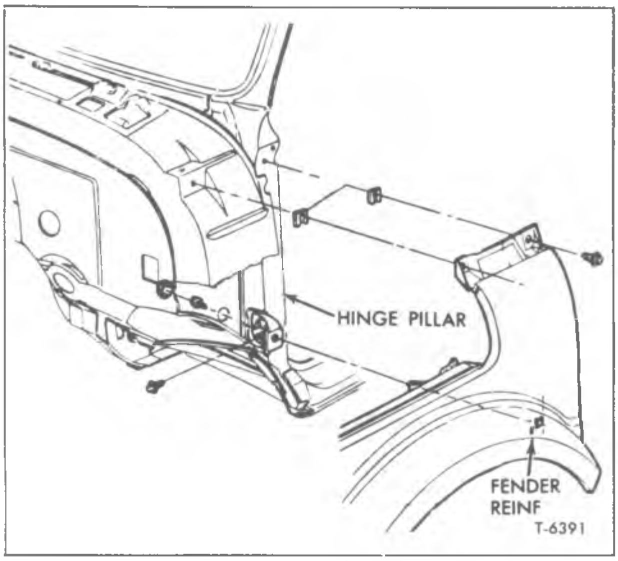


Figure 10—Fender Gusset-To-Cowl Attachment

10. Connect upper and lower radiator hoses.
11. Install transmission cooler lines (if used).
12. Connect power steering fluid reservoir hose to pump (if used).
13. Connect air cleaner intake hose to fender skirt (if used).
14. Connect wire connectors at dash and toe panel. Connect generator and regulator leads. Install and connect battery.
15. Fill radiator, start engine and check for leaks.

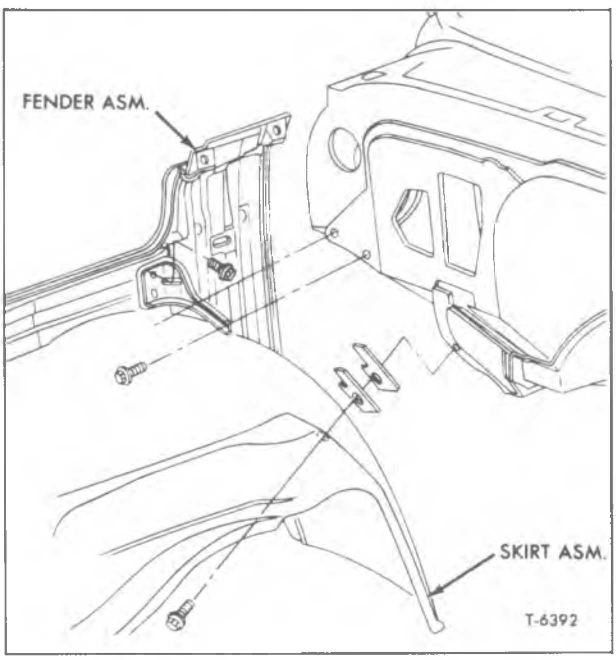


Figure 11—Fender Gusset-To-Cowl Attachment

FRONT FENDER REPLACEMENT (LESS SKIRT)

(Refer to Figures 10, 11, 12, and 13)

REMOVAL

1. Remove windshield wiper arms (except cowl models).
2. Remove cowl grille, disconnecting radio antenna lead (except cowl models).
3. Remove hood, outlining hinge bolts at fender before removing.
4. Lift hood off.
5. Remove two bolts and shims attaching fender to cowl.

NOTE: On cowl models, remove bolt access plugs inside of cowl to remove bolts (fig. 10).

6. Remove screw from inside cab (plastic plug covers access mounting). Do not remove cowl bracket.
7. Remove screws connecting skirt edge to fender flange.
8. Right fender removal necessitates removal of battery cables, battery and three screws attaching battery tray to fender.
9. Remove one bolt hidden from view connecting grille lower panel to front inboard edge of fender (access hole provided).
10. Remove bolts connecting grille to front fender from inside of engine compartment.
11. Remove three bolts fastening gusset to fender and grille (fig. 12).
12. Remove the two bolts fastening gusset to fender.
13. Disconnect electrical wiring.

INSTALLATION

To install, reverse the "Removal" procedure, using sealing tape between filler panel and fender to assure complete seal (fig. 12). Check sheet metal alignment.

FENDER SKIRT REPLACEMENT

(Refer to Figures 11 and 12)

REMOVAL

1. Turn steering wheel so front of tire is inboard.
2. Underneath the skirt remove two screws at top attached to fender.
3. Remove three screws attaching skirt to lower fender extension.
4. Remove three screws at front of skirt attached to fender.
5. Remove six screws holding skirt to fender opening flange.
6. Remove screw attaching skirt to radiator grille.

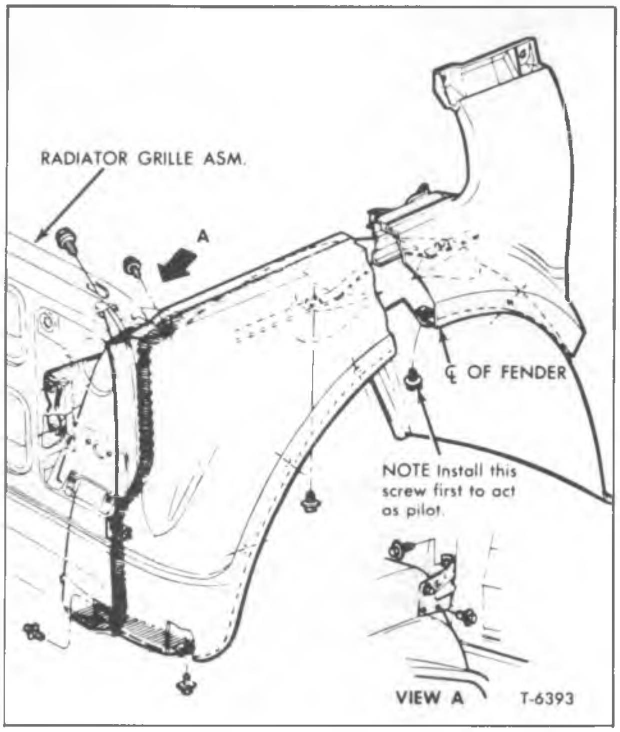


Figure 12—Fender to Grille Attachment

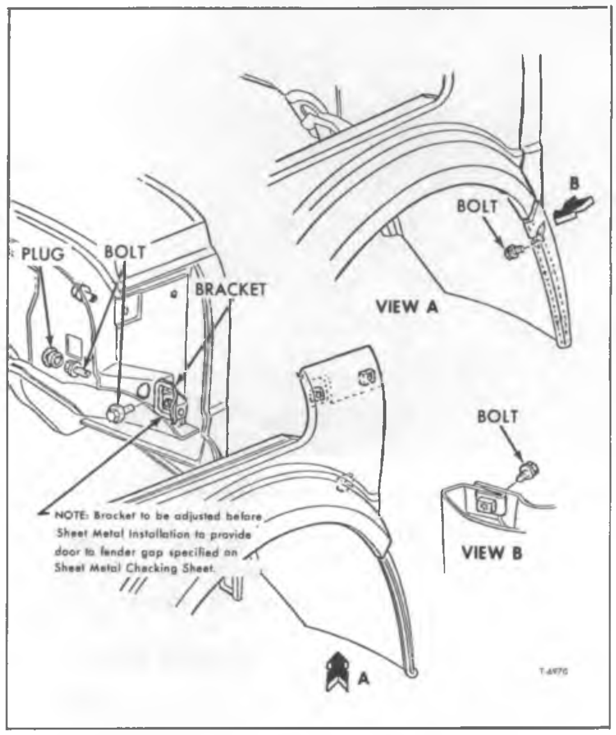


Figure 13—Fender-To-Cowl Attachment on Cowl Models

7. Underneath the skirt, inboard, remove a large bolt fastened through the fender skirt to the cowl extension. Note shim and record.

8. Under the hood remove two screws attaching skirt reinforcement to skirt.

9. Rotate skirt outward over tire, then remove rearward.

INSTALLATION

Reinstall in reverse order of "Removal" procedure. Note condition of tape sealing of fender skirt flange. Replace if necessary. Refer to "Note" on figure 12 to install pilot screw.

RUNNING BOARD AND FENDER EXTENSION REPLACEMENT

REMOVAL (Fig. 14)

1. Remove bolt from inside door opening attached to lower extension.

2. Remove bolts from under front of running board to extension bottom.

3. Remove bolts fastening skirt to flange of lower extension.

4. Pull lower fender extension downward, then out.

INSTALLATION (Fig. 14)

Reinstall in reverse order of "Removal" procedure.

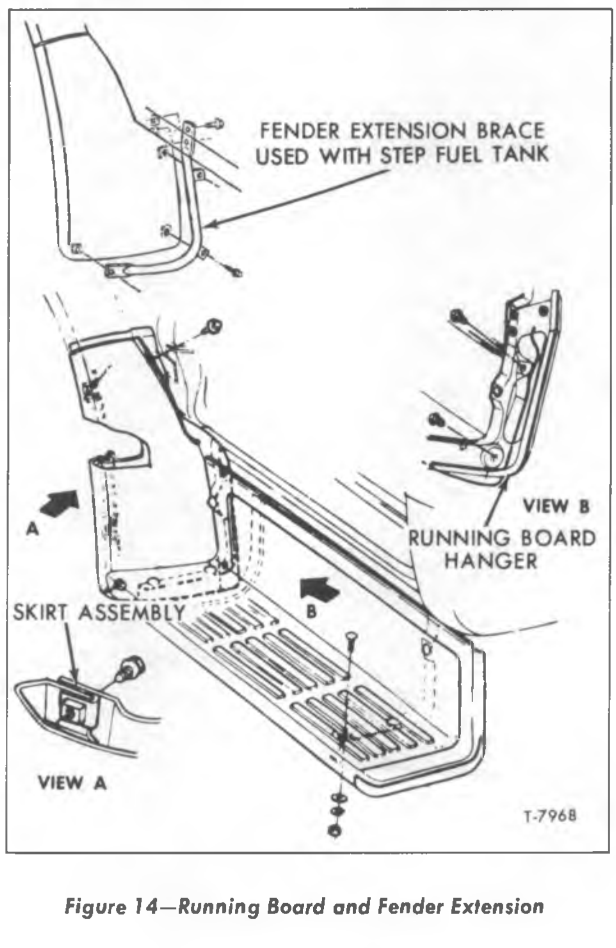


Figure 14—Running Board and Fender Extension

Proper protection and maintenance of finish will add to its luster. Road elements are injurious to painted surfaces of vehicle. These can be removed by regular washings. As an additional protection, polish vehicle, using a good grade of wax, 30 days after delivery. Apply a coat of polish thereafter at least once a year.

SECTION 12

Chassis Electrical and Instruments

This section, covering maintenance and replacement of chassis electrical system units, is divided into sub-sections shown in index below:

MISCELLANEOUS ELECTRICAL

NOTE: Certain electrical units, when closely associated with other systems or units, are covered in other sections of this manual as listed below:

Unit	Section
Gauge, Engine Oil Temperature	6K
Gauge, Fuel Tank Unit	8
Indicator, Water Temperature	6K
Motor, Air Conditioning Blower	1
Motor, Electric W/S Wiper and Washer	1
Motor, Heater Blower	1
Motor, 2-Speed Axle Shift	4A
Relay, Air Cond. Blower Control	1
Relay, Starter Control	6Y
Resistor, Heater Blower Control	1
Sender Unit, Engine Temperature	6K
Sender, Fuel Gauge Tank Unit	8
Speedometer Adapter, 2-Speed Axle	4A
Switch, Air Conditioning Control	1
Switch, Air Cond. Blower Control	1
Switch, Axle Shift Motor	4A
Switch, 2-Speed Axle Shift	4A
Switch, Differential Lock	4A
Switch, Engine Overheat	6K
Switch, Engine Overspeed	1
Switch, Heater Control	1
Switch, Heater Blower Control	5B
Switch, Low Air	6Y
Switch, Starter Magnetic	6Y
Switch, W/S Wiper and Washer	1
Tachometer Drive	6A

WIRING DIAGRAMS

Wiring diagrams indicate electrical circuits and connections for standard and optional equipment used on vehicles covered by this manual. Standard equipment is shown in solid lines on diagrams and optional equipment is shown in broken lines. Truck series to which each diagram applies is shown on each diagram.

WIRING HARNESSES AND WIRES

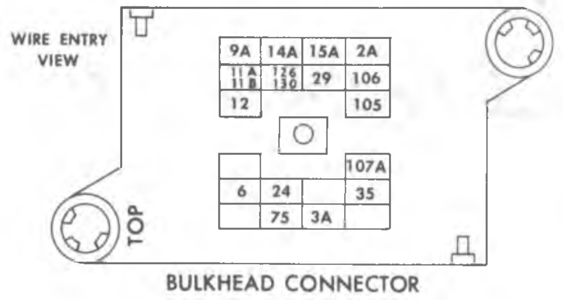
Connections between chassis wiring harness and the engine, body, and lighting wiring harness are made through a multiple plug and receptacle type connector. Connections at instrument cluster, gauges, and units are made through a multiple plug and receptacle type connector and through plastic insulated blade-type connectors and screw-type terminals.

A typical bulkhead connector used on all except tilt cab models is shown in figure 1, and a typical instrument cluster connector used on conventional cab models is shown in figure 2.

Some wires are grouped and taped together with a moisture and heat-resistant black, plastic-type tape to form a wiring harness; in other instances, it is more practical to use a single wire or cable. Every wire is of a specific size with plain colored or striped insulation as indicated on the wiring diagram. Insulation colors assist in tracing circuits and in making proper connections.

The In-line and V8 gasoline engine models have a special resistance wire in the engine wiring harness to connect the "IGN" terminal of the ignition switch to the positive (+) terminal of the ignition coil. The proper length wire is used to provide correct resistance. This wire is identified on applicable wiring diagrams as: (20-WHT.-ORN.-& PPL.-CR.-TR.) or (20-BLK.).

On In-line engine models, resistance value of the wire is 1.80 ± .05 ohms. On tilt cab models with V8 engine, resistance value of the wire is 1.35 ± .05 ohms.



WIRE	GA.	COLOR	
9A	18	BRN.	
14A	20	BLU. LT.	
15A	20	BLU. DK.	
2A		RED	
130	24	BRN.—SGL. WHT. STR.	* 126 | 20 | BRN.
29		GRN. DK.	
106	20	BLK.—SGL. WHT. STR.	
12	18	TAN	
105	20	BLK.	
107A	20	BLU. DK.	
6	12	PPL.	
24	18	GRN. LT.	
35	20	GRN. DK.	
75	18	GRN. DK.	
3A	12	PNK.	

T-8001

Figure 1—Bulkhead Connector (Except Tilt Cab Models) (Typical)

During cranking, a full 12-volts is supplied to the coil by a shunt wire connected between "R" terminal on starter solenoid and "+" terminal on ignition coil.

MAINTENANCE AND REPAIR

All electrical connections must be kept clean and tight. Loose or corroded connections may cause a discharged battery, difficult starting, dim lights, and possible damage to generator and regulator. Wires must be replaced if insulation becomes burned, cracked, or deteriorated.

Whenever it is necessary to splice a wire or repair one that is broken, always use rosin flux solder to bond the splice and insulating tape to cover all splices or bare wires.

When replacing wires, it is important that the correct size wire as shown on applicable wiring diagram be used. Each harness or wire must be held securely in place by clips or other holding devices to prevent chafing or wearing away insulation due to vibration.

CAUTION: Never replace a wire with one of a smaller size. DO NOT replace a fusible link with a wire of a larger size.

By referring to the wiring diagrams, circuits may be tested for continuous circuits or shorts with a conventional test lamp or low reading voltmeter.

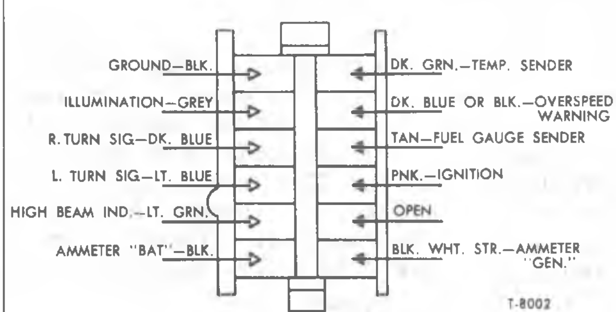


Figure 2—Laminated Circuit Connector (Conventional Cab Models) (Typical)

REPLACING WIRING CONNECTOR TERMINALS

Either blade-type or twin lock type terminals are used in the wiring harness connectors. Mating ends of the connectors are secured by tang locks which must be disengaged at the same time to separate the connector.

Terminal Removal

1. To remove a blade-type terminal from the connector, disengage lock tangs and separate connector. Insert a thin bladed instrument under mating end of connector terminal and pry up on terminal being careful not to damage connector. Pull wire and terminal from connector as shown in figure 3.
2. To remove a twin lock type terminal from connector, disengage the lock tangs and separate connector. Insert terminal remover (J-22727) or equivalent, as shown in figure 4 to disengage terminal locks from the connector. Pull wire and terminal from cable connector.

Terminal Installation

NOTE: If original terminals are to be used, pry lock on terminal clips down to assure a firm connection when terminals are inserted.

1. Press terminals into mating end of connector, then check to make sure terminals are firmly engaged in connector by attempting to pull apart.
2. Connect mating ends of connector and check to be sure all lock tangs are firmly engaged by attempting to separate.

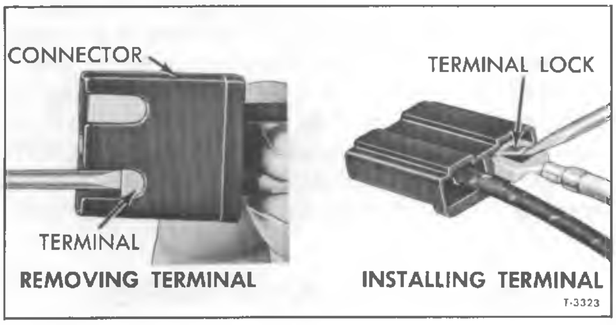


Figure 3—Replacing Blade Type Connector Terminals

CHASSIS JUNCTIONS

Terminal posts on junction blocks are numbered to correspond with numbers shown in symbols on applicable wiring diagrams.

TILT CAB MODELS

Chassis junction block (fig. 5) is located under left-hand step riser panel and is accessible when door is open and cover is removed. On vehicles equipped with the electric two-speed axle, an axle shift switch circuit breaker is mounted between two 12-terminal junction blocks.

The junction block is used to complete electrical circuit to the instrument panel harness, the engine wiring harness, the dome lamp and the trailer wiring harness assembly.

CIRCUIT BREAKERS

The headlight circuit is protected by a 25-amp automatic reset type circuit breaker built into the main light switch. Any condition which causes an overload on this circuit causes the bimetallic element to open the circuit. When element cools, the circuit breaker will close the circuit. This off-and-on cycle will repeat until light switch is turned off or until cause of overload has been located and corrected. Circuit breaker is shown in main light switch wiring diagram (fig. 19 or 20). If circuit breaker becomes defective, the complete light switch assembly must be replaced.

A 15- or 20-amp automatic reset type circuit breaker is used in the two-speed axle shift switch circuit on vehicles equipped with the two-speed axle.

Circuit to the two-speed axle electric shift motor is protected by an automatic reset type circuit breaker. Any condition which causes an overload on a circuit, such as a short, will cause circuit breaker bimetallic element to open the circuit; when element cools, the circuit breaker will again close circuit. This off-and-on cycle will repeat until the switch controlling the defective circuit is turned off, or until the cause of overload has been located and corrected. In the event a circuit breaker becomes defective (burns open), the defective circuit breaker must be replaced. Install circuit breakers so the feed or battery wire is connected to the "BAT" or short terminal and the wires carrying the circuit to the electrical units is connected to the "AUX." or long terminal.

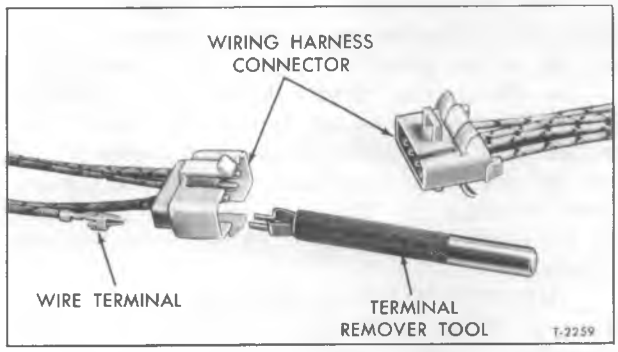


Figure 4—Removing Twin Lock Connector Terminals

FUSE BLOCK AND FUSES

A bulkhead fuse panel (fig. 6) provides power take-offs and fuse clips for appropriate circuits. The engine wiring harness connectors are bolted to the fust panel. The fuse block is located inside cab on left-hand side cowl panel and is accessible from under left end of dash panel.

A fusible link is installed between the positive (+) terminal on the battery and a junction block. On series SS50, a fusible link is also installed in the feed circuit to the ignition switch, fuse panel, light switch, and the horn relay.

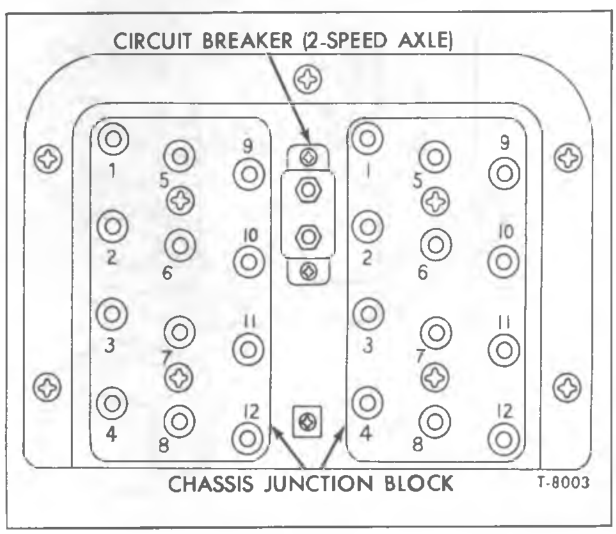


Figure 5—Chassis Junction Block (Tilt Cab Models) (Typical)

Two 4-ampere or 10-ampere fuses, used to protect the ammeter, are installed between a junction block fed from the battery and the ammeter.

A directional signal flasher and a traffic hazard flasher are installed on the fuse panel. The traffic hazard signals are wired independently and can be energized regardless of ignition switch position. Refer to "Flasher" later in this section for information pertaining to flasher operation and circuitry.

IMPORTANT: When replacing fuses, fusible links, or flashers, be certain replacement is the same part number as the defective component.

FUSIBLE LINKS

A fusible link is installed between the positive (+) terminal of the battery and a junction block. On Series SS50, a fusible link is also installed in the main feed circuit to the ignition switch, light switch, fuse panel, and the horn relay. The fusible link is incorporated as part of the wiring system to provide increased overload protection to electrical circuits, except the starting motor circuit, which are not otherwise protected by fuses.

The fusible link is a wire of four gauge sizes smaller than the smallest feed wire; for example; a fusible link of 16-gauge wire must have 12-gauge wire or larger in all unprotected circuits of the link system. To aid in identification, the gauge size of the wire is labeled on the side of the link.

IMPORTANT: If an overload or some other condition destroys a link, locate and correct the cause of the failure, then replace the link with a wire of the same gauge size and length. DO NOT replace a fusible link with a wire of larger size. Refer to Parts Book for correct replacement part number.

MECHANICAL SPEEDOMETER

Speedometer is mechanically driven from the speedometer adapter by a flexible cable. The miles-per-hour hand is magnetic cup actuated, while the odometer is direct gear actuated. If speedometer becomes inoperative, disconnect the cable at rear of speedometer head and adapter and check to make sure cable and drive gear on transmission are operating properly. This can be done by driving the vehicle forward while an assistant checks movement of the drive cable inside the flexible cable. If cable and drive gear operates properly, replace speedometer head. If not, determine whether the cable or drive gear is defective and replace the defective component.

To check the speedometer for accuracy, use a test machine that is equipped with a drive. Connect speedometer head to drive and operate at a known 1,000 rpm. The miles-per-hour hand should

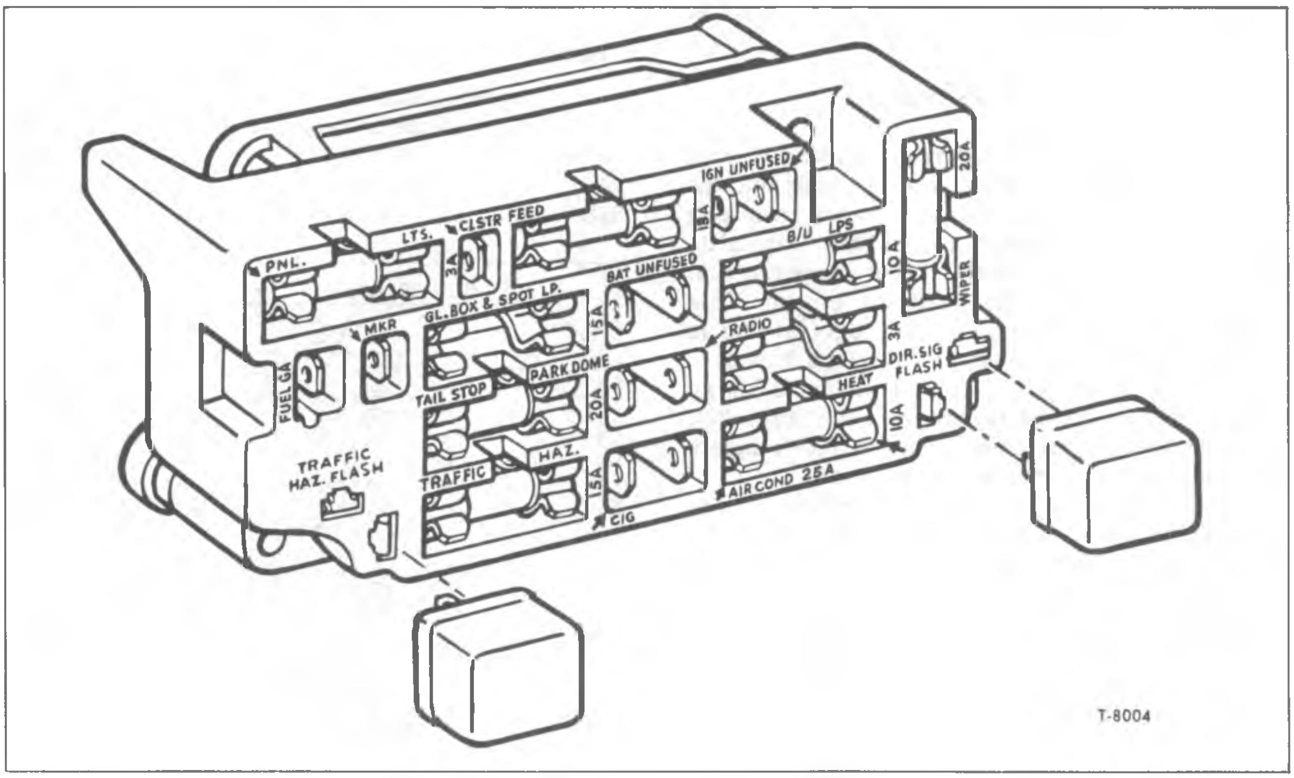


Figure 6—Typical Fuse Block

register 60 mph, and the odometer should register one-mile-per-minute. If not, speedometer head is defective and should be replaced.

NOTE: A speed warning device is used as optional equipment on some vehicles to audibly alert the driver when a predetermined speed has been obtained.

A knob on instrument panel to left of speedometer controls an indicator hand on the speedometer. When indicator is set to a desired speed, a buzzer, connected in series with the speedometer will audibly alert the driver when the predetermined speed is obtained.

The buzzer is not adjustable or repairable, therefore, if it becomes inoperative, replace.

SPEEDOMETER CABLE
REPLACEMENT OR LUBRICATION

1. Disconnect speedometer cable from speedometer head.

2. Remove cable by pulling it out from speedometer end of conduit.

NOTE: If cable is broken, it will be necessary to remove lower portion of cable from transmission end of conduit.

3. Lubricate lower ¾ portion of cable with lubricant specified in LUBRICATION (SEC. 0) of this manual, then push cable into conduit.

IMPORTANT: DO NOT kink cable or cable housing. Connect upper end of cable to speedometer head, then road test vehicle for proper speedometer operation.

CAUTION: DO NOT over-lubricate the flexible cable or adapter. Excessive lubrication will seriously affect speedometer operation.

ELECTRIC HORN

The electric air-tone "S" type horn is carefully adjusted and inspected during manufacture and should operate indefinitely without attention. The horn assembly should not be adjusted or repaired.

If the horn fails to operate, use a jumper lead to check the external horn circuit as follows:

1. Connect jumper lead from No. 2 terminal on horn relay to ground. If horn then operates, trouble is in the horn control circuit. If horn does not operate, remove jumper lead and proceed with Step 2.

2. Momentarily connect jumper lead between No. 3 and No. 1 terminals on horn relay. If horn operates, the relay is defective.

3. Horn circuit is internally grounded through the horn mounting. Therefore, it is necessary that a good ground connection be maintained between the horn mounting bracket and its mating part. Check for a good ground by connecting a jumper lead from the horn mounting bracket to the vehicle frame. Be sure contact is made through paint on horn bracket and frame.

If trouble was not corrected by the above checks, a foreign particle may be holding the horn contacts open. This condition can sometimes be corrected by energizing the horn, then lightly tapping the horn power plant to dislodge the particle. If this fails to correct the problem, replace the horn assembly.

AIR HORN

Air horns (when used) are mounted on pedestals attached to the cab roof panel. Air pressure to horns is controlled by a control valve mounted on the inner hinge pillar panel at left side of cab. A signal cord is used to manually activate the control valve.

Air pressure is supplied by the pressure protection valve. Refer to "AIR BRAKES" (SEC. 5B) in this manual for information on the pressure protection valve.

If the air horn control valve becomes inoperative, a service kit consisting of a spring, rubber seat, and plunger may be installed after disconnecting the air inlet line and removing end plug from valve.

RELAYS

Relays are used in some instances to automatically open or close a circuit as operating conditions may require; in other cases, they are used to provide a direct connection between the battery and an electrically operated device, with only a small amount of current required to energize the relay operating coil. The latter use eliminates the use of great lengths of heavy wire, thereby providing higher voltage to the electrical device.

NOTE: Information pertaining to the Starter Interlock Relay is covered under "STARTING SYSTEM" in ENGINE ELECTRICAL (SEC. 6Y) in this manual.

HORN RELAY

NOTE: Refer to applicable wiring diagram for wiring connections at horn relay.

The horn button in center of steering wheel is connected in series with relay operating coil at relay terminal No. 2. When circuit through relay operating coil is completed at the horn button, a small amount of current flows from the battery through the coil winding. With winding energized, armature is attracted to core and points close. Current from the battery (No. 1 terminal), then flows directly through relay contacts and out No. 3 terminal to the horn. The relay thus provides a higher voltage to the horn by avoiding voltage drop through the long circuit through the horn button. Relay is non-adjustable, therefore, if it becomes inoperative, replace.

TRAILER I.C.C. MARKER
LAMP RELAY (WHEN USED)

NOTE: Refer to applicable wiring diagram for wiring connections at relay.

The marker lamp switch on instrument panel is connected in series with main light switch and operating coil of I.C.C. marker lamp relay operating coil at terminal No. 3.

When the main light switch and the marker lamp switch are placed in "ON" position, a small amount of current will flow through the relay coil winding. With winding energized, armature is attracted to core and points close. Current from the battery (No. 1 terminal), then flows directly through relay contacts and out terminal No. 2 to complete circuit to rear I.C.C. marker lamps.

If opening voltage is not within limits listed in "Specifications" at end of this section, replace the relay.

IGNITION AND STARTER SWITCH

The ignition switch is mounted on the dash panel. The starting circuit is energized by placing the switch in "START" position.

The switch and harness-to-switch connector features a three tang lock to secure a firm connection. The switch lock cylinder and cylinder housing can be replaced as follows:

REMOVAL

1. Disconnect negative battery cable from battery.
2. Position switch in "OFF" position, then insert a wire into small hole in cylinder face. Push in on wire to depress plunger and turn key counterclockwise until lock cylinder can be pulled from cylinder housing.
3. Using a suitable tool, remove ignition switch retaining nut from dash panel.
4. Reach up under dash panel and pull switch from panel opening. Insert a thin bladed screwdriver under each tang of the wiring connector and release wiring connector lugs from switch. Pull connector from switch.

INSTALLATION

1. Position wiring connector on switch and engage lock tangs of wiring connector on switch housing. Make sure lock tangs are firmly engaged by attempting to separate.
2. Insert switch into panel opening, then install switch retaining nut and tighten firmly.
3. Insert switch lock cylinder into switch housing and rotate clockwise to secure in lock position.
4. Connect negative battery cable to battery, and check operation of switch.

TRAILER EMERGENCY STOP LIGHT SWITCH (WHEN USED)

The air-operated emergency stop light switch is used as optional equipment on some vehicles covered by this manual. Refer to applicable wiring diagram for electrical connections at the switch. Refer to "AIR BRAKES" (SEC. 5B) of this manual for information relative to testing and replacing the switch.

INTER-AXLE DIFFERENTIAL LOCK SWITCH

The inter-axle differential lock switch is located on the dash panel on vehicles equipped with the tandem rear axle. When switch lever is positioned in "LOCK" position, the "DIFF. LOCK" tell-tale lamp illuminates. Refer to "REAR AXLE AND CONTROLS" (SEC. 4A) of this manual for information relative to this unit.

ALARM SYSTEM

Various alarm systems are used on vehicles covered by this manual. Tell-tale lights located on the gauge and tell-tale panel in front of driver are illuminated only when the bulb behind the lettering is illuminated.

A low vacuum, low air pressure, and/or engine alarm buzzer is used to audibly alert the driver of low vacuum, low air pressure, low oil pressure, or an overheated engine.

LOW VACUUM ALARM SYSTEM

The low vacuum alarm system, on vehicles so equipped, consists of a low vacuum switch, a buzzer, and a gauge to audibly and visually warn the driver when vacuum is below a safe limit.

The low vacuum alarm buzzer is mounted on left side of dash panel inside the cab. When circuit through buzzer is completed at low vacuum switch, action of the vibrating armature striking the core produces a buzzing sound.

Low vacuum alarm system wiring connections are shown on applicable wiring diagrams. The alarm buzzer and switch are not reparable units; therefore, if unit becomes inoperative, replace.

LOW AIR PRESSURE ALARM SYSTEM

The low air pressure alarm system, on vehicles so equipped, consists of a low air pressure switch, a buzzer, and a tell-tale and/or gauge to audibly and visually warn the driver when air pressure in the system is below a safe limit for brake operation. Refer to "AIR BRAKES" (SEC. 5B) for information on low air pressure switch.

The low air pressure alarm buzzer is mounted on left side of dash panel inside the cab on conventional cab models; or on instrument panel to steering column support bracket on tilt cab models. When circuit through buzzer is completed at low air pressure switch, action of the vibrating armature striking the core produces a buzzing sound.

Low air pressure alarm system wiring connections are shown on applicable wiring diagrams. In the event of failure, the buzzer must be replaced.

NOTE: This system is part of the "Engine Alarm System" when vehicle is so equipped.

ENGINE ALARM SYSTEM

This system, used as optional equipment on some vehicles, audibly and visually warns the driver of low air pressure, low oil pressure, or an overheated engine. The alarm system consists of a low air pressure switch, low oil pressure switch, hot engine switch, alarm buzzer and rectifier assembly, and a separate tell-tale light for each condition. The buzzer and rectifier is mounted on left side of dash panel inside the cab on conventional cab models and on steel-tilt cab models, it is mounted on instrument panel to steering column support bracket. Wiring connections are shown on applicable wiring diagrams.

Buzzer and rectifier assembly consists of a vibrating armature type relay which produces a buzzing sound when the circuit through relay coil is completed by either of three controlling switches and a three circuit rectifier. The rectifier permits current flow in one direction only, preventing a back flow of current from one alarm circuit from illuminating the other tell-tale lights. Thus, when only one abnormal condition exists, the buzzer will sound but only the tell-tale light connected to that circuit will illuminate.

If alarm buzzer or rectifier assembly does not operate properly, replace the complete unit.

INSTRUMENTS AND GAUGES

GENERAL MAINTENANCE

All instruments and gauges are installed in the instrument cluster or dash panel. The entire cluster may be removed from the vehicle for servicing instruments and gauges. Illumination and indicator lamps may be replaced without removing the cluster from the vehicle. On conventional cab models having a laminated die cut circuit, the bulbs are installed in plastic holders which lock into the cluster housing. On all other models, the lamp sockets are clip retained and can be quickly snapped in or out of position.

Regular maintenance is not required on the instrument cluster or its components other than maintaining clean, tight electrical connections, replacing defective components and keeping speedometer cable properly lubricated.

CONVENTIONAL CAB MODELS

A typical instrument cluster used on these vehicles is shown in figure 7. Cluster contains instrument lights, indicator lights, gauges, speedometer, and tachometer.

NOTE: The instruments, gauges, and tell-tale lights will vary with truck models, depending upon the size of vehicle and equipment used.

INSTRUMENT CLUSTER REMOVAL
(Refer to Figs. 7 and 9)

1. Disconnect negative battery cable from battery to prevent accidental grounding at the ammeter when removing cluster.
2. Disconnect speedometer drive cable and wiring harness connector at rear of instrument panel (fig. 9).

3. Remove choke control knob from choke rod.

4. Remove setscrew from windshield wiper knob, then remove knob.

5. Pull light switch knob out to extreme position, then press on spring-loaded release button on switch assembly and pull switch knob and rod out of instrument panel.

6. Using a suitable tool, remove choke control, windshield wiper, and light switch bezels from instrument panel.

7. Disconnect air pressure and oil pressure gauge pipes.

NOTE: Wrap oil pressure gauge line with a cloth to prevent loss of oil when connection is opened.

8. Loosen mast jacket upper support clamp bolts and lower mast jacket to prevent interference with lower edge of instrument cluster.

9. Remove cluster retaining screws from face of assembly and remove instrument cluster from instrument panel.

LAMINATED DIE-CUT CIRCUIT REPLACEMENT

1. With instrument cluster removed from vehicle, remove all lamp assemblies from the cluster (fig. 8).

2. Remove laminated circuit retaining screws and washers.

IMPORTANT: These screws serve as a ground for the circuit and must be reinstalled to provide proper ground connections for the laminated circuit.

3. Remove fuel, temperature, and ammeter terminal nuts which retain laminated circuit to cluster cover.

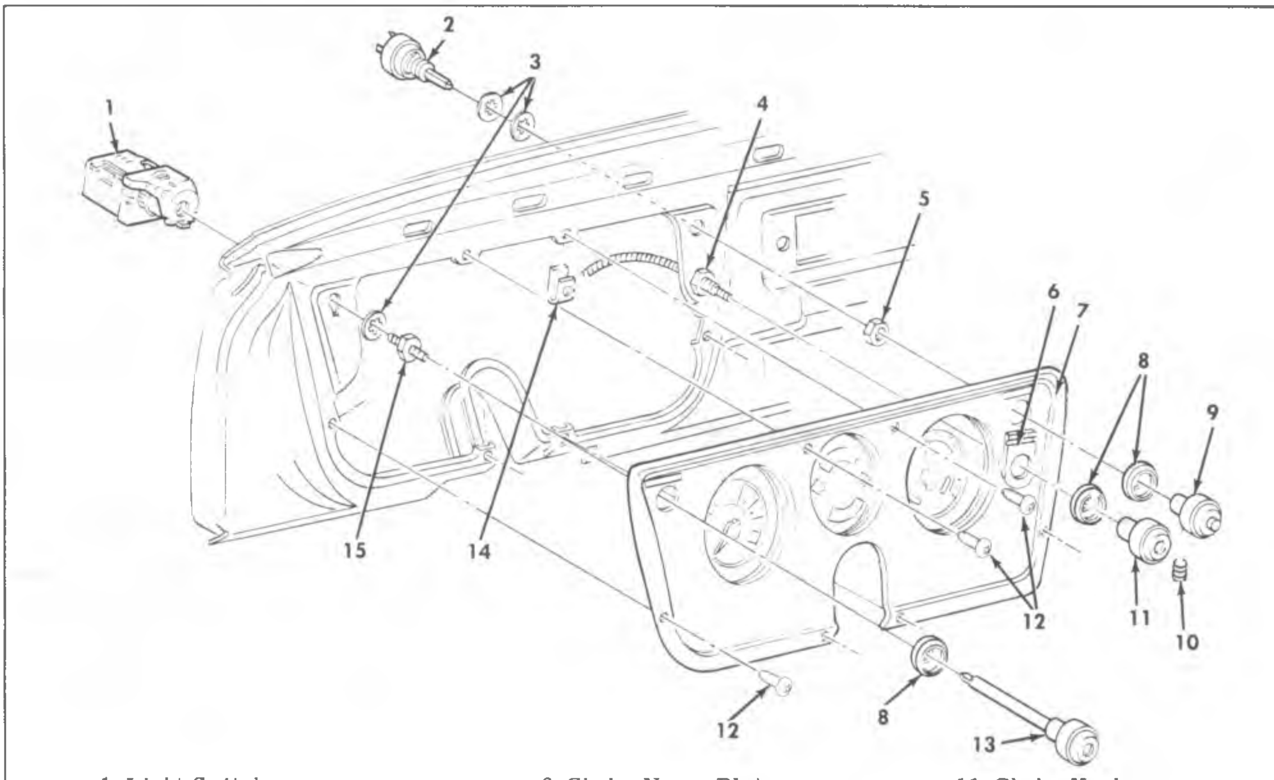
4. Remove laminated circuit from rear of instrument cluster.

5. Install laminated circuit in reverse order of removal and check operation of unit.

INSTRUMENT CLUSTER INSTALLATION

1. With instrument cluster completely assembled, position cluster in instrument panel and attach with screws.

2. Install light switch, windshield wiper switch,



1 Light Switch
2 W/S Wiper and Washer Switch Assembly
3 Washer
4 Choke Rod and Tube
5 Nut
6 Choke Name Plate
7 Instrument Cluster Assembly
8 Bezel
9 Knob - W/S Wiper
10 Setscrew
11 Choke Knob
12 Screw
13 Light Switch Rod
14 "J" Nut
15 Nut Assembly

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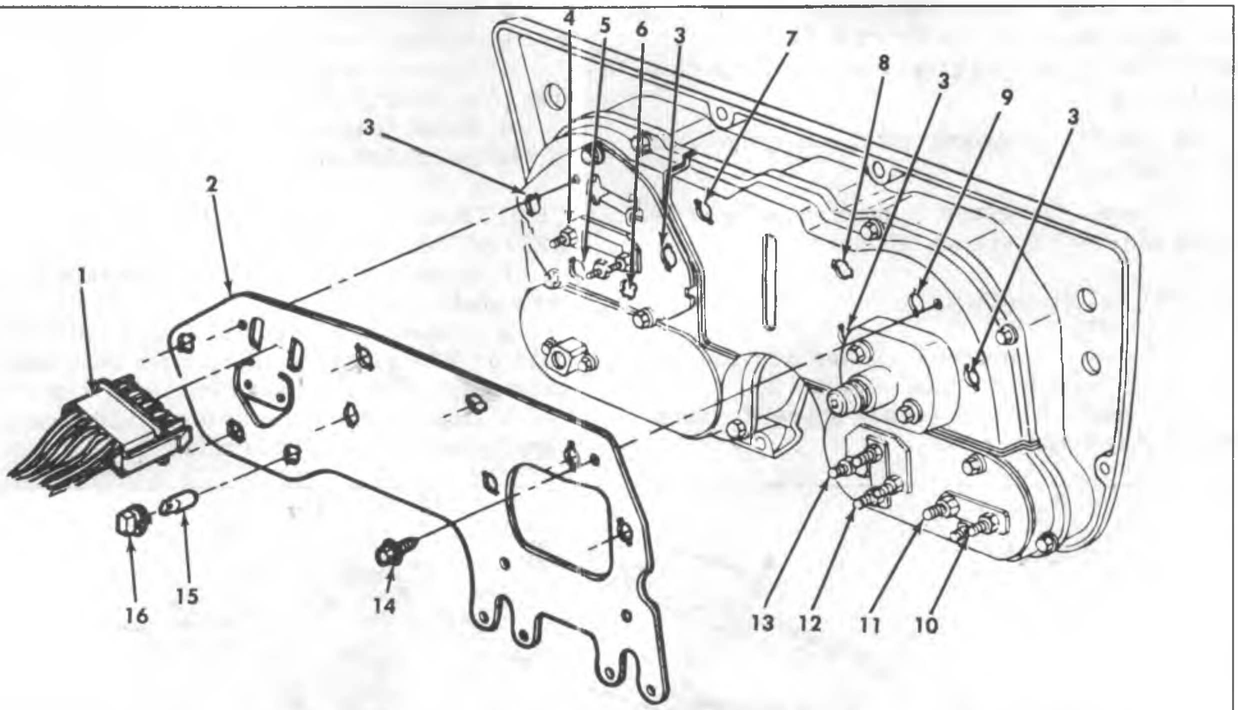
Figure 7—Instrument Cluster (Conventional Cab Models) (Typical)



1 Instrument Cluster Connector
2 Laminated Circuit
3 Instrument Cluster Lamp
4 Fuel Gauge
5 Overspeed Warning/Low Vacuum
6 Brake Warning Indicator
7 R.H. Directional Tell-tale
8 L.H. Directional Tell-tale
9 High-Beam Indicator
10 Generator (Ammeter)
11 Battery (Ammeter)
12 Ignition Terminal
13 Temperature Gauge
14 Laminated Circuit to Panel Screw
15 Lamp Bulb
16 Bulb Holder

T-6598

Figure 8—Instrument Cluster Connections (Conventional Cab Models) (Typical)

and choke control bezels in instrument panel and tighten firmly.

3. Insert light switch rod through ferrule and push in until spring-loaded latch engages groove near end of rod.

4. Position windshield wiper knob on switch assembly and secure with setscrew.

5. Thread choke control knob onto choke rod.

6. Referring to figure 9 for proper connections, connect speedometer drive cable and wiring harness connector at rear of instrument panel.

7. Connect air pressure and oil pressure gauge pipes to respective units.

8. Connect negative battery cable to battery and check operation of indicator and illumination lights and gauges.

INDICATOR AND ILLUMINATION BULB REPLACEMENT

1. Turn bulb holder counterclockwise to remove from cluster housing.

2. Pull bulb straight out to remove from the holder.

3. Install replacement bulb in holder and press inward to lock in place.

4. Insert holder into housing with lugs on holder entering notch in case and turn clockwise to lock in place.

SPEEDOMETER REPLACEMENT

NOTE: Refer to "Mechanical Speedometer" previously in this section for information pertaining to mechanical speedometer operation and speedometer cable replacement or lubrication.

1. Remove instrument cluster assembly and laminated circuit as previously described.

2. Remove screws and cluster rear cover.

3. Remove front cover from face of cluster.

4. Remove two retaining screws, then remove speedometer from cluster.

5. Install speedometer in reverse order of removal and check operation of unit.

FUEL GAUGE REPLACEMENT

(Refer to Figs. 7 and 9)

1. Remove instrument cluster assembly as previously described.

2. Remove instrument lamps, ground screws, and terminal nuts which retain the laminated circuit to fuel gauge section of the cluster assembly.

3. Carefully remove the laminated circuit from fuel gauge area of the cluster, then remove retaining screws, cover, and gauge assembly from cluster housing.

4. Remove attaching nuts and gauge from cover plate.

5. Install fuel gauge in reverse order of removal and check operation of unit.

TEMPERATURE GAUGE REPLACEMENT (Fig. 8)

1. Remove instrument cluster assembly as previously described in this section.

2. Remove terminal nuts which retain laminated circuit to gauge unit.

3. Remove three attaching screws, cover, and gauge assembly from cluster housing.

4. Remove terminal attaching nuts and gauge unit from cover plate.

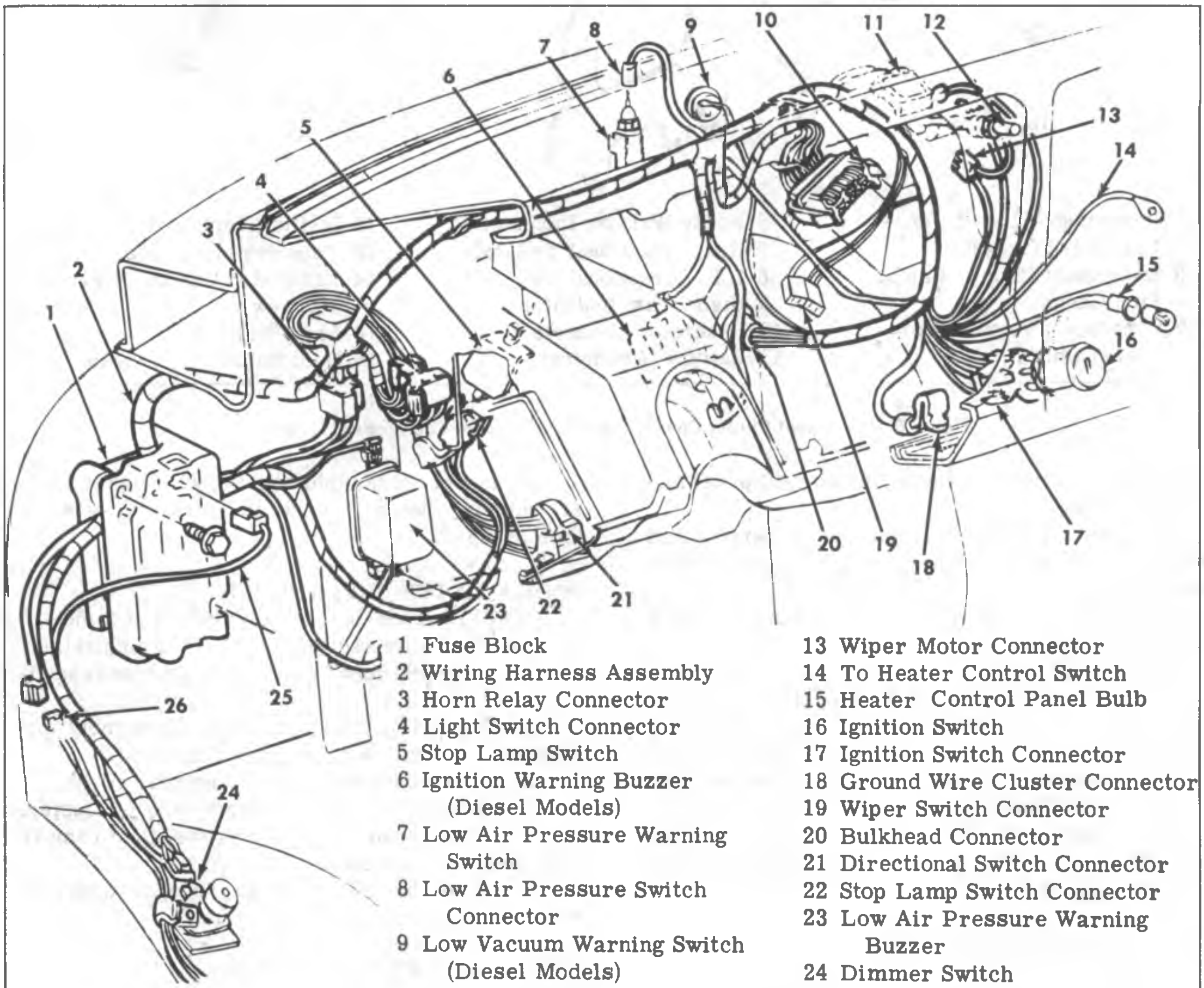
5. Install temperature gauge in reverse order of removal and check operation of unit.

TEMPERATURE SENDER UNIT REPLACEMENT

1. Relieve coolant system pressure by loosening radiator cap.

2. Remove sender unit located in left cylinder head on V8 engines, and in cylinder head rear exhaust port on L-6 engines. Replace with new unit.

3. Check coolant system level, tighten radiator cap, and check operation of unit.



1 Fuel Block
2 Wiring Harness Assembly
3 Horn Relay Connector
4 Light Switch Connector
5 Stop Lamp Switch
6 Ignition Warning Buzzer (Diesel Models)
7 Low Air Pressure Warning Switch
8 Low Air Pressure Switch Connector
9 Low Vacuum Warning Switch (Diesel Models)
10 Cluster Connector
11 Windshield Wiper Motor
12 Choke Rod
13 Wiper Motor Connector
14 To Heater Control Switch
15 Heater Control Panel Bulb
16 Ignition Switch
17 Ignition Switch Connector
18 Ground Wire Cluster Connector
19 Wiper Switch Connector
20 Bulkhead Connector
21 Directional Switch Connector
22 Stop Lamp Switch Connector
23 Low Air Pressure Warning Buzzer
24 Dimmer Switch
25 Fuel Tank Meter Wire
26 Dome Lamp Connector

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Figure 9—Instrument Panel Wiring (Conventional Cab Models) (Typical)

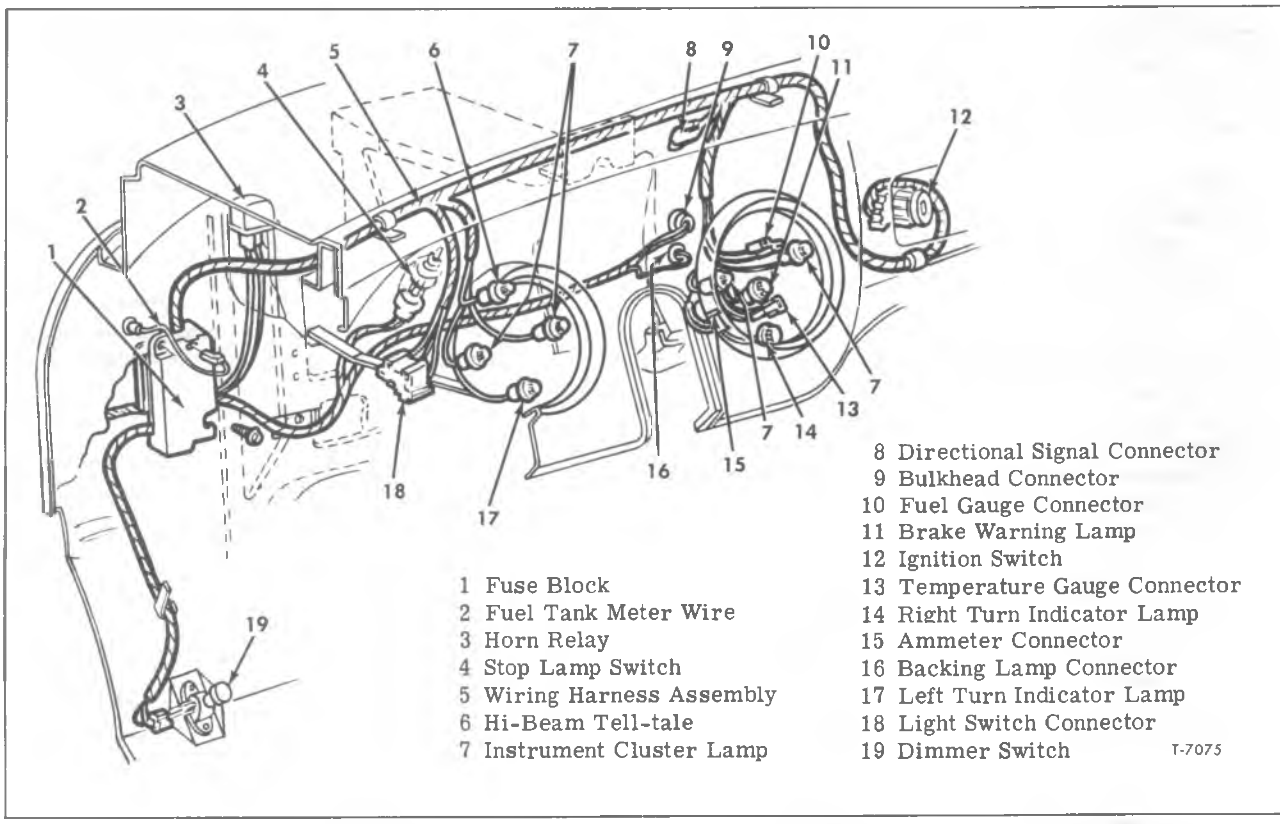


Figure 10—Instrument Panel Wiring (Cowl and "S" Models) (Typical)

OIL AND/OR AIR PRESSURE GAUGE REPLACEMENT (Fig. 8 or 9)

Removal

1. Disconnect negative battery cable from battery.
2. Disconnect oil pressure and air pressure (if so equipped) gauge feed pipes.

NOTE: Oil pressure line connection may leak oil when opened; wrap with cloth.

3. Remove three rear cover retaining screws. Tip cover and gauge assembly and remove from instrument cluster housing.
4. Remove pipe fitting and retaining nut from gauge being replaced and remove gauge from cover.

Installation

1. Install gauge to cover with retaining nut and pipe fitting.
2. Install gauge in instrument cluster housing and attach with retaining screws.

NOTE: Check to be sure printed circuit edge is not pinched between cover and cluster housing.

3. Connect feed lines to gauge(s). Connect negative battery cable to battery and check operation of units.

OIL PRESSURE SENDER UNIT REPLACEMENT

1. Disconnect wiring harness connector from sender unit terminal located in block above starter on L-6 engines and at left front of distributor on V8 engines.
2. Remove sender unit using Tool (J-21757). Replace with new unit and check operation.

AMMETER GAUGE REPLACEMENT (Refer to Figs. 7 and 8)

1. Remove instrument cluster assembly and laminated circuit as described previously.
2. Remove terminal nuts which attach printed circuit to gauge unit.
3. Remove three attaching screws, cover and gauge assembly from cluster housing.
4. Remove terminal attaching nuts and gauge unit from cover plate.
5. Replace ammeter gauge unit by reversing removal procedure and check operation of unit.

COWL AND "S" MODELS

The cluster contains a generator ammeter, engine temperature gauge, oil pressure gauge, and a fuel gauge. A matching round speedometer is also used on these models and an air pressure gauge or vacuum gauge is mounted on the instrument panel.

Electrical connections to gauges are made through blade-type connectors (fig. 10). The instrument and tell-tale light bulbs are installed in sockets which snap into holes in back of cluster.

INSTRUMENT CLUSTER REMOVAL

1. Disconnect negative battery cable from battery to prevent accidental grounding at ammeter when removing cluster.
2. Remove indicator and illumination lamp bulbs and disconnect electrical terminal connectors from instrument panel wiring harness.
3. Disconnect oil pressure gauge line and wrap line with a cloth to prevent loss of oil when connection is opened.
4. Remove three screws which attach cluster housing to dash panel, then remove cluster from under dash panel.

INSTRUMENT CLUSTER INSTALLATION

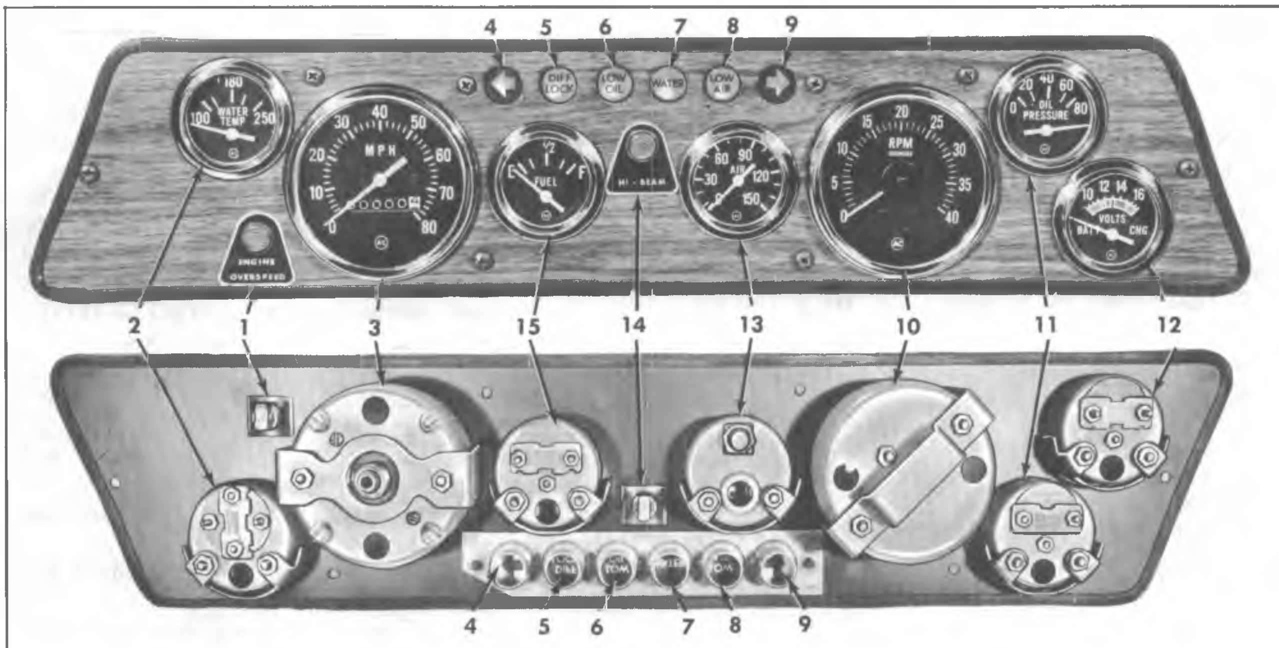
1. With instrument cluster completely assembled, position instrument cluster in dash panel opening and install three screws to attach. Tighten screws firmly.
2. Connect oil pressure gauge line to oil pressure gauge and tighten connections firmly.
3. Connect electrical terminal connectors to respective terminals on instrument cluster and install indicator and illumination lamp bulbs in respective openings in instrument cluster (fig. 10).
4. Connect negative battery cable to battery and check operation of indicator and illumination lights and gauges.

SPEEDOMETER REPLACEMENT

NOTE: Refer to "Mechanical Speedometer" previously in this section for information pertaining to mechanical operation and speedometer cable replacement and lubrication.

1. Disconnect negative battery cable from battery.
2. Disconnect speedometer cable and all indicator and illumination sockets from rear of speedometer.
3. Remove three screws which attach speedometer housing to dash panel, then remove speedometer.
4. Install speedometer in reverse order of removal and check operation of unit.

NOTE: DO NOT KINK CABLE HOUSING when connecting speedometer cable.



1 Engine Overspeed Warning Tell-tale
2 Temperature Gauge
3 Speedometer
4 L.H. Turn Signal Tell-tale
5 Differential Lock Tell-tale
6 Low Oil Tell-tale
7 Water Temperature Tell-tale
8 Low Air Tell-tale
9 R.H. Turn Signal Tell-tale
10 Tachometer
11 Engine Oil Pressure Gauge
12 Voltmeter
13 Air Pressure Gauge
14 Hi-Beam Tell-tale
15 Fuel Gauge

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Figure 11—Instrument Cluster (Tilt Cab Models) (Typical)

FUEL GAUGE REPLACEMENT

1. Remove instrument cluster assembly as previously described.

2. Uncrimp bezel (7 places) and remove bezel.

3. Remove nuts which attach fuel gauge to cluster case and remove gauge.

4. Install fuel gauge in reverse order of removal and check operation of unit.

TEMPERATURE GAUGE REPLACEMENT

1. Remove instrument cluster assembly as previously described.

2. Uncrimp bezel (7 places) and remove bezel.

3. Remove two nuts which attach temperature gauge to cluster case and remove gauge.

4. Install temperature gauge in reverse order of removal and check operation of unit.

TEMPERATURE SENDER UNIT REPLACEMENT

1. Loosen radiator cap to relieve coolant system pressure.

2. Remove sender unit located in left cylinder head port or in cylinder head rear exhaust port. Replace with new unit.

3. Check coolant system level, tighten radiator cap, and check operation of unit.

OIL PRESSURE GAUGE REPLACEMENT

1. Remove instrument cluster assembly as previously described.

2. Uncrimp bezel (7 places) and remove bezel.

3. Remove nuts which attach oil pressure gauge to cluster case and remove gauge.

4. Install oil pressure gauge in reverse order of removal and check operation of unit.

OIL PRESSURE SENDER UNIT REPLACEMENT

1. Disconnect wiring harness connector from sender unit terminal located in block above starter or at left front of distributor.

2. Remove sender unit using Tool (J-21757), replace with new unit and check operation.

AIR PRESSURE GAUGE REPLACEMENT

1. Unsnap socket and bulb from top of gauge housing.

2. Disconnect air supply line from rear of gauge.

3. Remove two nuts, washers, and mounting clamp which attach air pressure gauge to instrument panel, then remove the air pressure gauge.

4. Install air pressure gauge in reverse order of removal and check operation of unit.

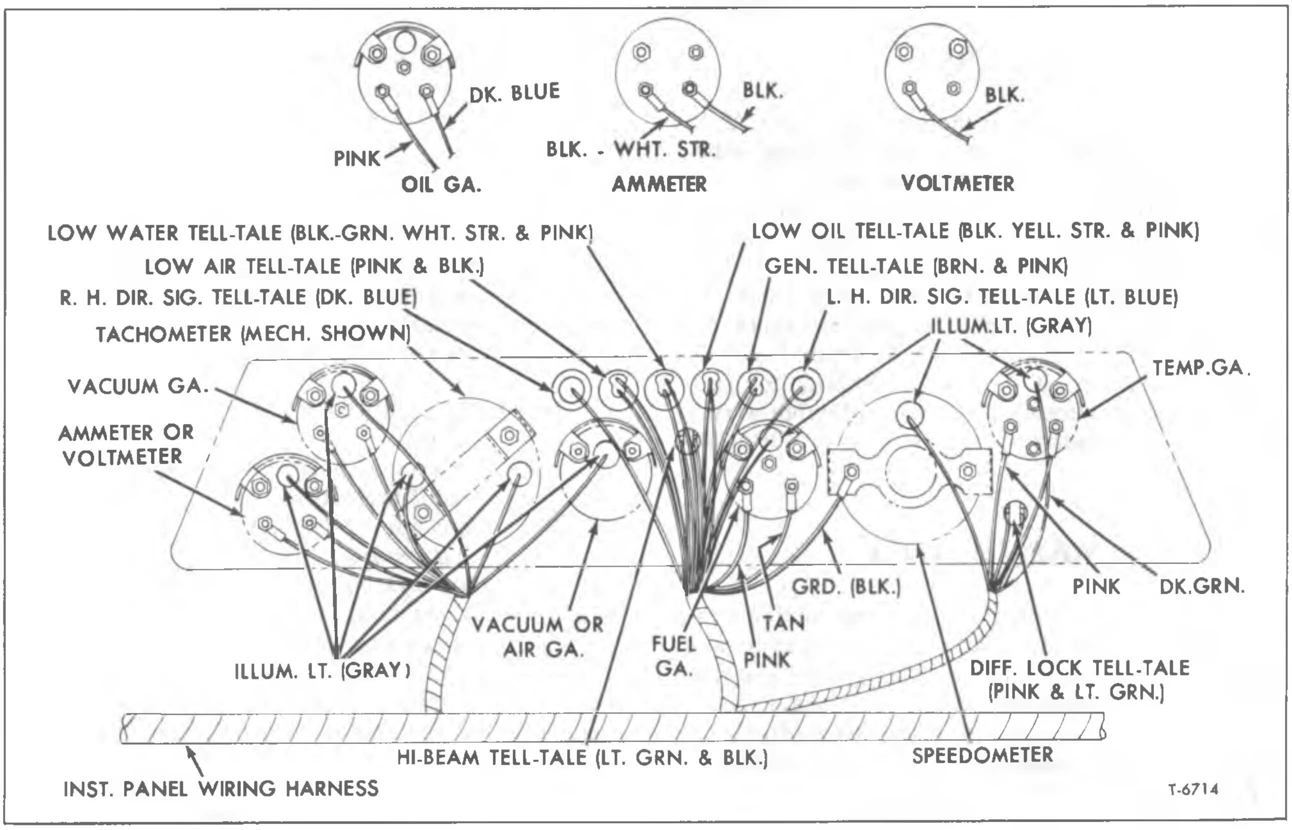


Figure 12—Connections at Rear of Instrument Cluster (Tilt Cab Models) (Typical)

STEEL TILT CAB MODELS

A typical instrument cluster used on tilt cab models is shown in figure 11. Each cluster contains gauge and tell-tale lights, gauges, speedometer and tachometer. Lettering on each tell-tale window is visible only when the light behind the tell-tale is illuminated.

The switches and controls, located on dash panel below the cluster are identified by decals.

INSTRUMENT CLUSTER REMOVAL

IMPORTANT: To prevent accidental grounding, disconnect negative battery cable from battery before removing the instrument cluster.

1. Disconnect negative battery cable from the battery, then disconnect wiring harness connectors from under dash panel. Refer to figure 12 for wiring connections at rear of cluster.

2. Remove screws which attach instrument cluster to dash panel, then tilt cluster outward far enough to reach connections at rear of cluster.

NOTE: It may be necessary to disconnect oil and/or air pressure gauge lines before tilting the cluster outward.

3. Disconnect drive cables, lines, wiring connected to terminals, and illumination and tell-tale lamp bulbs from each gauge and unit.

4. Each gauge or unit is retained in the cluster with two mounting brackets. Remove wiring from connector or terminals at rear of gauge or unit, then remove nuts and washers from mounting bracket and remove gauge or unit from rear of cluster.

INSTRUMENT CLUSTER INSTALLATION

NOTE: Refer to figure 12 for wiring connections at rear of cluster.

1. Position each gauge or unit in cluster and install nuts and washers to attach to brackets.

2. Position instrument cluster in dash panel far enough to reach through panel opening and reach the rear of each gauge and unit.

3. Connect drive cables, lines, and wiring to each gauge and unit. Insert illumination and tell-tale lamp bulbs in sockets.

4. Move instrument cluster into position in panel opening and attach to instrument panel with retaining screws. Connect wiring harness connectors under dash, then connect negative battery cable to battery.

5. Check operation of each gauge and unit.

LIGHTING SYSTEM

GENERAL

The lighting system includes the main light switch, stop light, dimmer and backing lamp switches, head and parking lamps, stop tail, side marker, clearance and identification lamps, instrument illumination, directional signal and indicator lamps and necessary wiring.

All vehicles covered by this manual use the 7-inch single sealed-beam unit type headlights; all other lights are replaceable bulb type. Refer to "Light Bulb Data" at end of this section for bulb size and trade number. Refer to applicable wiring diagram for lighting system wiring circuits and wire identification.

MAINTENANCE

Periodically check to see that all wiring connections are clean and tight, that lighting units are tightly mounted to provide a good ground and that headlamps are properly adjusted. Loose or corroded connections may cause a discharged battery, difficult starting, dim lights and possible damage to generator and regulator.

By referring to applicable wiring diagrams, circuits may be tested for a continuous circuit or shorts, with a low reading voltmeter or a conventional test lamp. Headlights and parking lights are protected by a circuit breaker built into the main light switch.

HEADLIGHTS

All vehicles covered by this manual use two 7-inch single "T-3" sealed-beam unit type headlights incorporating three projecting guide points which are optically ground to provide flat surfaces at right angles to the light beam.

HEADLAMP BEAM ADJUSTMENT
(Refer to Fig. 13)

Headlamps must be properly aimed to obtain maximum road illumination.

With the Guide "T-3" type sealed-beam units, proper aiming must be maintained since the increased range and power of this lamp make even slight variations from recommended aiming hazardous to approaching motorists.

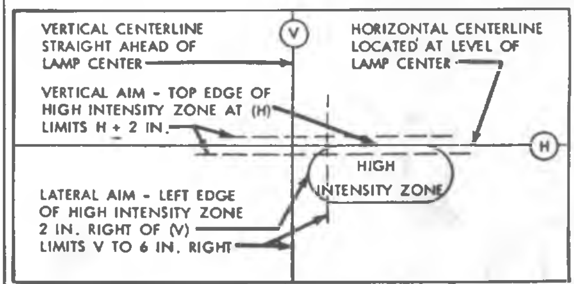
IMPORTANT: Whenever a sealed-beam unit has been replaced or after making repairs to front end sheet metal, the headlamps must be checked for proper aim.

In addition to providing superior lighting, the "T-3" type sealed-beam unit permits adjustment of the light without the use of an aiming screen and without requiring a large work area. Aiming is accomplished with the use of a safety aimer (J-6878-01). Instructions for using the Safety Aimer are supplied by the instrument manufacturer.

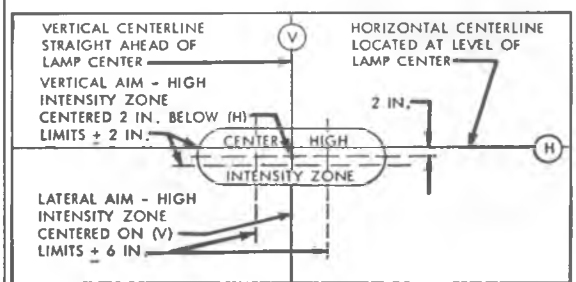
Horizontal and vertical aiming of each sealed-beam unit is provided by two adjusting screws, visible through the bezel, which move the mounting ring against tension of the coil spring.

Headlight beam adjustment requirements will vary on different vehicles due to size and distribution of load, type of standard or optional suspension, size of tires, tire pressures, and other factors. Average requirements are for the high intensity zone of the high beams to be straight ahead and two inches below the headlight level at 25 feet. Low beam of all 7-inch units should be adjusted so the high intensity zone of the light beam is just to the right of the headlight center and just below the headlight level at 25 feet. To obtain correct adjustment, beam adjustment should be made with the vehicle loaded with the normal average load it will be carrying during the majority of its operation. Tires should be uniformly inflated to recommended pressure when adjusting headlight beams. Beam adjusting screws are identified in figure 14.

In all cases, it must be remembered that state or local legislation and specific vehicle conditions will govern the final aim for the best and safest lighting. Especially in the case of vehicles carrying widely varying loads during night-time operation, the final decision as to safe operation must still be made on the basis of "the most light on the road with the least annoyance to oncoming traffic."



AIM INSPECTION LIMITS FOR LOWER BEAM OF:
7 in. Type 2 Sealed Beam
Caution—Do not aim or inspect these lamps on the upper beam



AIM INSPECTION LIMITS FOR UPPER BEAM OF:
7 in. Sealed Beam, except Type 2 T-3491

Figure 13—Headlight Beam Adjustment (Typical)

SINGLE SEALED-BEAM UNIT REPLACEMENT

Removal (Fig. 15)

1. Remove screws which attach headlamp bezel to mounting ring, then remove bezel.
2. Remove screws which attach retaining ring to mounting ring, then use a hooked tool to release retaining spring from slot in retaining ring (inset, fig. 14).
3. Rotate headlamp unit to disengage assembly from headlamp adjusting screws.

NOTE: DO NOT disturb the adjusting screw settings.

4. Remove retaining ring and headlamp from mounting ring.
5. Pull wiring connector plug off back of unit, then remove sealed-beam unit from mounting ring.

Installation (Fig. 15)

1. Position new sealed-beam unit with number molded into lens face at the top, then push wiring connector plug over blade-type terminals on back of sealed-beam unit.
2. Install headlamp assembly in panel opening and rotate to engage mounting ring tabs with adjusting screws.
3. Using a hooked tool, pull out on retaining spring and engage in slot near bottom of retaining ring (inset, fig. 14).
4. Check headlamp beam adjustment as described previously, then install bezel.

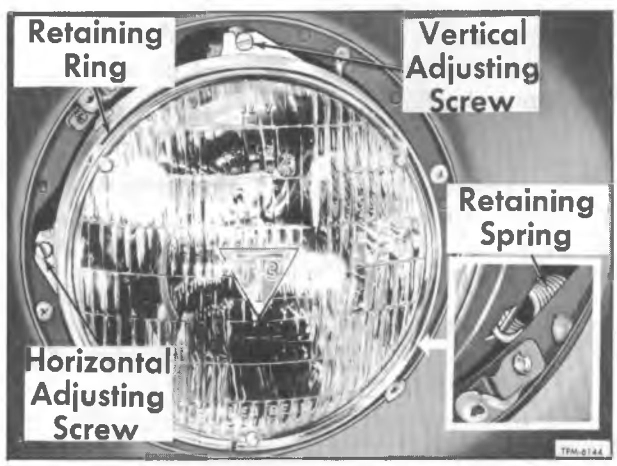
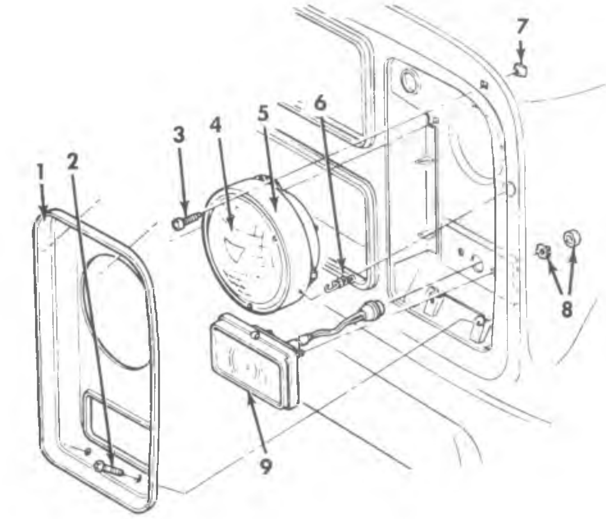


Figure 14—Single Sealed-Beam Unit Adjustment Points (Typical)



1 Bezel	6 Retaining Spring
2 Bezel to Panel Screw	7 Nut
3 Headlamp Mounting Screw	8 Parking Lamp Mounting Nut and Washer
4 Headlamp Assy.	9 Parking Lamp Assy.
5 Headlamp Retaining Ring	

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Figure 15—Single Sealed-Beam Unit Replacement

PARKING LIGHTS

Parking lights are illuminated with main light switch pulled out to the first detent position. The parking light circuit is protected by an automatic reset type circuit breaker built into the main light switch.

NOTE: On tilt cab models, the parking lights are incorporated within the directional light assembly.

BULB REPLACEMENT (CONVENTIONAL CAB MODELS) (Fig. 15)

1. Remove screws which attach bezel to panel and remove bezel.
2. Remove retaining screws and lens from housing.
3. Press in on bulb and turn counterclockwise to remove from holder.
4. Install lens retaining screws, then install bezel and bezel to panel screws.

LAMP HOUSING REPLACEMENT (CONVENTIONAL CAB MODELS)

1. Remove headlamp bezel.
2. Remove lamp housing retaining nuts, then disengage assembly from panel opening.
3. Disconnect parking lamp harness connector from forward wiring harness.
4. Connect wiring of new unit to vehicle harness.
5. Position lamp housing in panel opening and install retaining nuts.
6. Install bulb, lens, and bezel.

SIDE MARKER LIGHTS

1. Remove screws which attach marker lamp assembly to housing.
2. Rotate marker lamp assembly over and turn plug connector ¼ turn counterclockwise to remove.
3. Replace bulb in connector, then position marker lamp assembly on housing and attach with screws.

REAR LIGHTING

Various rear lighting arrangements are used on vehicles covered by this manual. Rear lamp bulbs may be replaced by removing the lamp lens attaching screws and lamp lens. The lamp housing may be replaced by removing the housing attaching nuts or screws, or by removing nuts and bolts from the mounting bracket.

NOTE: Refer to "Light Bulb Data" at end of this section for bulb size and type.

STOP AND TAILLIGHT

The stop and taillight is a combination type lamp, having a double-filament bulb. The taillight filament is 3 candlepower, and the stop light filament is 32 candlepower.

BULB REPLACEMENT

Removal

Remove lens retaining screws, then remove lens and gasket from housing. Press bulb inward and turn counterclockwise to remove.

Installation

NOTE: Refer to "Light Bulb Data" at end of this section for bulb size and type.

Note that J-slots in bulb sockets are of different depths and lugs on bulb base are located at different distances from end of base. Lugs and slots must be matched to permit installation of bulb. Insert bulb in socket, press inward on bulb and turn clockwise to lock in place. Position lens and gasket on body and attach with screws.

BACK-UP LIGHTS

The back-up light circuit is fed from the ignition switch control circuit. The back-up lamp switch, mounted on the transmission, is activated by the reverse shift rail (mechanical transmission), when the ignition switch is placed in "ON" position and transmission shift lever is in reverse. Switch adjustment on vehicles equipped with the Allison transmission is covered under "TRANSMISSION CONTROL LINKAGE" (SEC. 7A).

If back-up lights become inoperative, disconnect wiring harness connector plug from the switch. Connect both terminals in the connector with a jumper, then place ignition switch in "ON" position. If back-up lights operate, thread switch out of transmission cover and replace.

BULB REPLACEMENT

NOTE: Refer to "Light Bulb Data" at end of this section for bulb size and type.

Remove screws which attach lens to lamp housing and remove the lens. Press bulb inward and turn counterclockwise to remove from socket.

Press new bulb into socket and turn clockwise to lock in place. Position lens and gasket on housing and attach with screws.

INSTRUMENT AND TELL-TALE LIGHTS

The instrument and tell-tale light bulbs are installed in bulb holders or pronged bulb sockets which snap into openings in instrument cluster gauges, speedometer, and tachometer case. The instrument panel lamp circuit is protected by a 3-ampere fuse located on the fuse panel.

BULB REPLACEMENT
(CONVENTIONAL CAB MODELS)

1. Turn bulb holder counterclockwise to remove from cluster housing.
2. Pull bulb straight out to remove from holder.
3. Position replacement bulb in holder, then insert holder into housing with lugs on holder entering notches in case. Turn bulb holder clockwise to lock in place.

BULB REPLACEMENT (EXCEPT
CONVENTIONAL CAB MODELS)

Pull bulb socket out of instrument cluster, gauge unit, speedometer, or tachometer case. Press bulb in and turn counterclockwise to remove from socket. Press new bulb into socket and turn clockwise to secure in place. After replacing bulb, press socket firmly into place in opening in cluster, gauge unit, speedometer, or tachometer case.

NOTE: On tilt cab models, the "Hi-Beam" tell-tale and engine overspeed warning tell-tale, or differential lock tell-tale (when used) are retained in the instrument cluster panel with a spring retainer. To replace the tell-tale lamp, disconnect wiring connector from back of tell-tale lamp, then

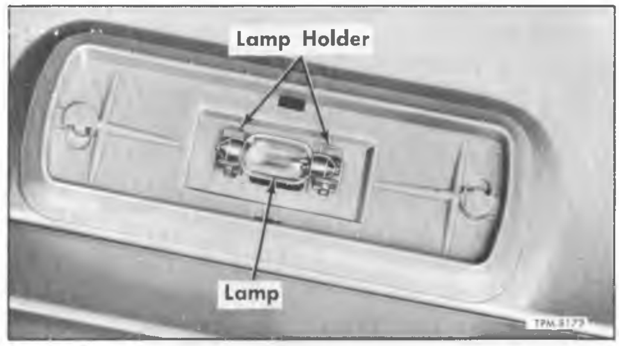


Figure 16—Dome Light (Typical)

remove spring retainer from lamp assembly. Press lamp assembly out of panel and replace with a new unit.

DOME LIGHT

On conventional cab and tilt cab models, dome lamp is mounted at rear of cab above rear window, and is operated by rotating main light switch knob to extreme counterclockwise position.

BULB REPLACEMENT (Fig. 16)

Dome lamp lens is of molded plastic with a lug molded on edge of lens at center top and bottom. To remove lens, grasp lens between thumb and finger at center, and squeeze sides together to disengage lugs from assembly. The tubular type bulb is held in position by two spring-loaded clips. To remove bulb, pull forward until bulb releases from clips. Replace bulb, position lens in assembly, and press in until lugs snap into place.

CAB FRONT MARKER AND IDENTIFICATION LIGHTS

The front marker and identification lights (when used) are mounted across front top of cab. Marker light circuits are energized with main

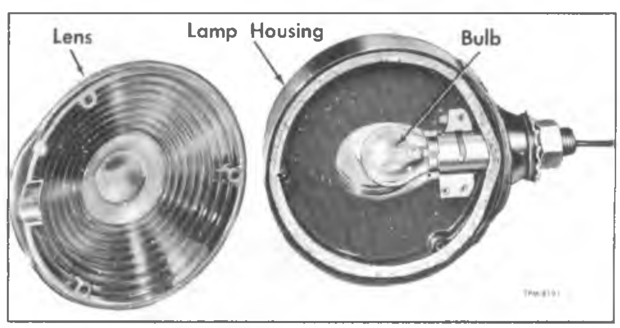


Figure 17—Directional and Parking Light (Tilt Cab Models) (Typical)

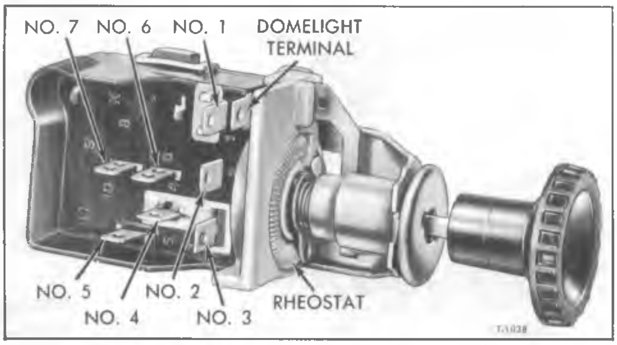


Figure 18—Main Light Switch (Typical)

light switch in "ON" position, or with marker blink switch in "ON" position.

To replace the bulb, remove screws, which attach lens to lamp housing. Replace bulb and check operation of unit, then install lens and attach with screws.

DIRECTIONAL SIGNAL LIGHTS

Directional signal lights are either an integral part of the parking light assembly and the stop and taillight assembly or are mounted on each side of cab, or in combination.

When ignition or control switch is placed in "ON" position, 12 volts is supplied through a fuse to the flasher unit. Placing directional signal lever in a right or left turn position supplies 12 volts from flasher unit through switch, then to right or left signal.

A light at either side of the instrument cluster flashes when either the left or right signal lamp is

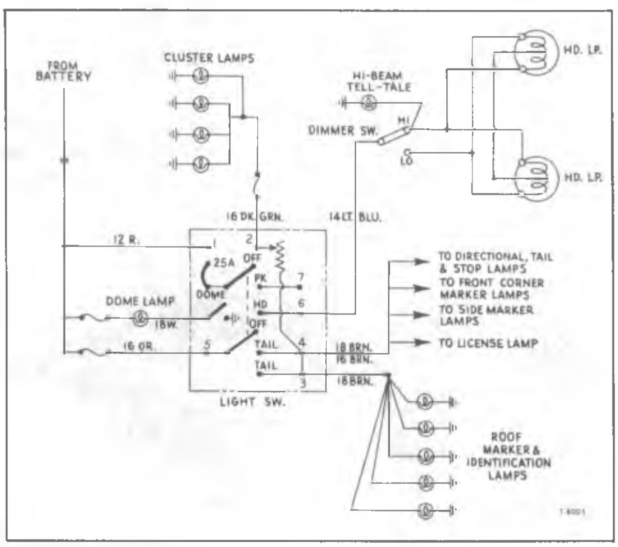


Figure 19—Main Light Switch Circuit Diagram (Conventional Cab Models) (Typical)

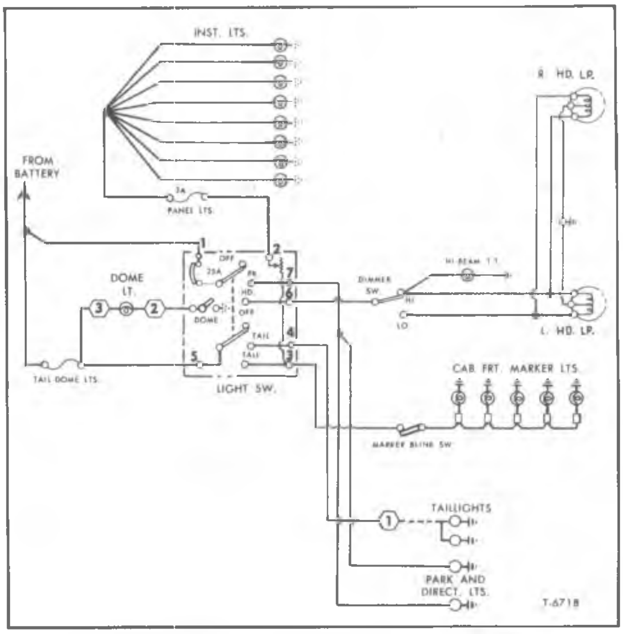


Figure 20—Main Light Switch Circuit Diagram (Tilt Cab Models) (Typical)

illuminated. When turn is completed, lever returns to "OFF" position by a cancelling cam.

When hazard warning switch is energized, both directional signal and tell-tale lights will flash. To cancel or turn off the lights, pull the plunger out.

If directional tell-tale on instrument panel flashes in one position but not the other, check for the following:

1. Directional lamp bulb burned out.
2. Directional tell-tale lamp bulb on instrument panel burned out.
3. Incorrect directional lamp bulb installed.
4. Defective ground between bulb socket and mounting.
5. Defective directional control switch assembly.

If directional tell-tale lamps on instrument panel do not flash in either position, check for the following:

1. Burned out fuse on fuse block.
2. Flasher terminals not properly engaged in junction block or defective flasher.
3. Short or open circuit. Check indicator lamp circuit referring to applicable wiring diagram.
4. Defective directional control switch.

If directional tell-tale light does not cancel after completing a turn, remove the steering wheel as explained in "MECHANICAL STEERING" (SEC. 9A) of this manual and check for a worn or damaged cancelling cam.

DIRECTIONAL SIGNAL BULB REPLACEMENT (Fig. 17)

NOTE: Since directional lights are a part of the parking and taillight assemblies on conventional cab models, refer to applicable light assembly for bulb replacement.

To replace a directional signal bulb on a tilt cab models, remove three screws which attach directional lamp lens to housing, then remove the lens. Press inward on bulb and turn counterclockwise to release from socket. Press new bulb into socket and turn clockwise to secure. Replace gasket if damaged, then position lens on lamp housing and attach with three screws.

HAZARD WARNING SYSTEM

All vehicles are equipped with a hazard warning lighting system to be operated when on-the-road disability occurs. This system is fed from the battery and can be operated regardless of ignition or control switch position.

NOTE: Refer to applicable wiring diagram.

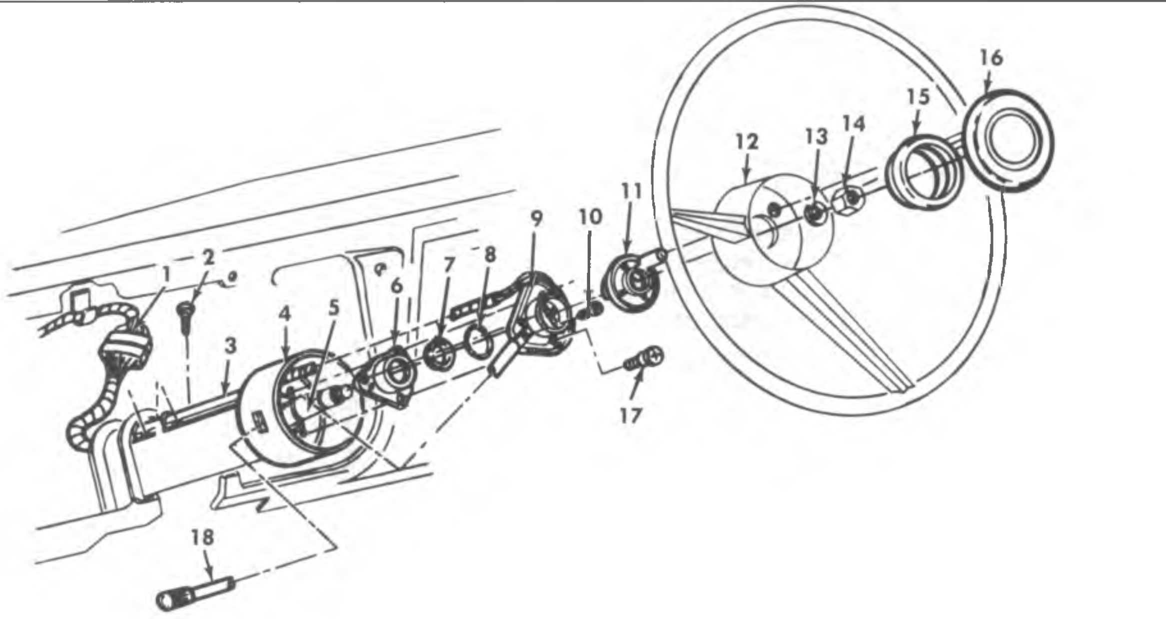
A switch mounted on side of the directional signal control housing operates front and rear directional signal lights simultaneously. When hazard warning lights are operating, both directional telltale lights will flash. To cancel or "turn off" the lights, pull hazard warning switch plunger out.

If switch becomes inoperative, check for a blown fuse or a defective flasher. If this fails to correct the condition, replace the hazard warning switch. The hazard warning switch shown in figure 21 or 22 may be replaced as explained under "Directional Signal Control Assembly" later in this section.

MAIN LIGHT SWITCH

The main light switch, mounted on the instrument panel, is shown in figure 18. A circuit diagram for conventional cab models is shown in figure 19 and a circuit diagram for tilt cab models is shown in figure 20.

A multiple connector, attached to the wiring harness, engages the blade-type terminals on the switch. The connector can be installed in only one position. A rheostat is incorporated in the instrument panel light circuit to dim these lights if desired.



1 Wiring Connector
2 Mast Jacket Cover Screw
3 Mast Jacket Cover
4 Directional Switch Housing
5 Steering Shaft
6 Bearing Support
7 Upper Bearing Assembly
8 Bearing Retainer
9 Directional and Hazard Warning Switch
10 Directional Switch Lever Retaining Screw
11 Cancelling Cam
12 Steering Wheel
13 Washer
14 Nut
15 Retainer
16 Horn Button Cap
17 Switch Mounting Screw
18 Directional Lever

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Figure 21—Directional Signal Assembly (Except Tilt Cab Models) (Typical)

An automatic reset type circuit breaker built into the main light switch assembly protects the headlight and parking light circuits. Before replacing the light switch, make sure trouble is in the switch and not elsewhere in the lighting system by checking circuits with suitable equipment.

REMOVAL

1. Disconnect negative battery cable from the battery.
2. Pull the switch knob out to full on position, then reaching up behind instrument panel press on spring loaded release button on top of switch assembly and remove switch knob and rod.
3. Remove bezel and retaining nut, then push switch from panel opening and remove from behind instrument panel.
4. Disconnect multiple wiring connector from switch terminals.

INSTALLATION

1. Connect multiple wiring connector plug to switch terminals.
2. Position switch under instrument panel with locating lug on switch frame engaging hole in instrument panel. Thread ferrule into switch and tighten firmly using a wide blade screwdriver.
3. Install bezel, then insert switch rod through ferrule and push in until spring-loaded latch engages groove near end of rod.
4. Connect negative battery cable to battery and check operation of all lights.

DIMMER SWITCH

The foot-operated dimmer switch is used to select headlight high or low beam. Switch is mounted on left side of cab floor panel and is operative when headlights are illuminated. Switch terminals are blade-type with connector plug attached to harness.

SWITCH REPLACEMENT

1. Fold back the floor mat and remove two screws which attach switch to floor panel or toeboard riser.
2. Disconnect wiring harness connector plug from switch.
3. Push wiring harness connector plug onto replacement switch and check operation.
4. Position switch on floor panel or toeboard riser and attach with two screws. Position floor mat over switch and wiring connector.

STOP LIGHT SWITCH

Either a mechanically-operated or air-operated stop light switch is used on vehicles covered by this manual.

MECHANICALLY OPERATED TYPE

The mechanically operated type switch used on models equipped with vacuum-hydraulic brakes, is a plunger or lever type switch. With brake pedal released, edge of pedal lever holds switch plunger in, breaking circuit to the stop light. When brake is applied and pedal lever moves away from switch plunger, a spring within the switch moves the plunger out to complete the stop light circuit. Switch terminals are blade type with wiring connections made through a connector plug on wiring harness. Switch cannot be disassembled; therefore, if switch becomes inoperative, it must be replaced.

When installing a lever type switch, make sure lever on switch is located above brake pedal lug, otherwise switch will not be operative. Also, make sure wiring connections at switch are fully engaged.

After installing switch, it must be adjusted so that initial movement of brake pedal, measured at the pedal pad, will permit switch to close and complete stop light circuit. After adjusting and tightening switch mounting nuts or bolts, visually check operation of stop light to make sure stop light comes on when brakes are applied and goes out when brake pedal is released.

AIR OPERATED TYPE

The air operated type stop light switch is used on vehicles equipped with air brakes or I.C.C. trailer brake controls. Refer to "AIR BRAKES" (SEC. 5B) for information pertaining to this switch.

SWITCH REPLACEMENT

1. Disconnect wiring harness connector from switch and remove switch retaining nut, then thread switch out of mounting bracket.
2. Depress brake pedal and thread new switch into bracket until switch shoulder bottoms against bracket. Install retaining nut on switch.
3. Check switch for proper operation. Electrical contact should be made when pedal is depressed 3/8" to 5/8" from fully released position.

WIPER SWITCH REPLACEMENT

1. Disconnect battery ground cable.
2. Loosen setscrew and remove wiper knob.
3. Remove bezel and retaining nut.
4. Push switch from panel opening and remove from behind instrument cluster.
5. Disconnect wiring at switch terminals.
6. To install, reverse the removal procedure and check operation of unit.

NEUTRAL START SWITCH

NOTE: Information applicable to the neutral start switch is covered in "TRANSMISSION ON-VEHICLE SERVICE" (SEC. 7B) in this manual.

DIRECTIONAL SIGNAL CONTROL ASSEMBLY (EXCEPT TILT CAB MODELS)

The directional signal switch is an electrically operated self-contained unit which incorporates the cancelling mechanism, the hazard warning switch and the lane changing signal. The switch is one complete plastic assembly and is serviced as a unit except for the spring detent, yoke assembly and cancelling springs.

The hazard warning circuit is activated by a push-pull switch located on the right side of the mast jacket, opposite the directional switch lever. The switch knob must be pulled out to cancel the circuit.

The lane changing circuit is energized by holding the directional signal lever toward the first detent position. There is no lock-in device in this position.

REMOVAL (Fig. 21)

1. Disconnect directional signal switch wiring from multiple connector and disconnect wiring connector from horn relay.
2. Remove horn button cap and retainer, then remove three screws which attach insulator to steering wheel. Remove insulator, retainer cup, and Belleville spring.
3. Remove steering wheel as explained under "Steering Wheel Replacement" in "MECHANICAL STEERING" (SEC. 9A).
4. Remove cancelling cam from steering shaft.
5. Remove mast jacket upper bracket, then remove screws which attach switch wiring cover to mast jacket. Remove cover.
6. Remove directional signal control lever retaining screw, then remove control lever.
7. Push hazard warning switch knob in to prevent damage to switch when removing.
8. Remove screws which attach directional signal control switch to housing, then remove switch with wiring from mast jacket.
9. Remove bearing retainer, then remove steering shaft upper bearing and switch support from directional signal housing.

INSTALLATION (Fig. 21)

1. Position directional signal control housing on mast jacket and turn to lock in position.
2. Position switch support in housing, then install steering shaft upper bearing and bearing retainer.
3. Position control switch in housing and thread switch wiring through mast jacket.
4. Align switch mounting holes with holes in support and housing, then install retaining screws and tighten firmly.
5. Position switch lever through housing and attach to control switch with screw.
6. Place cancelling cam over steering shaft.
7. Place directional switch in neutral position then install steering wheel as explained under "Steering Wheel Replacement" in "MECHANICAL STEERING" (SEC. 9A).
8. Position Belleville spring in steering wheel hub with concave side down, then install retainer cup with notch in 12 o'clock position. Install insulator and attach to hub with three screws. Tighten screws evenly and firmly.
9. Connect directional switch multiple connector to chassis wiring harness connector and connect wiring harness connector to horn relay.

NOTE: Insert terminals into connector cavities per designated wire colors as shown in figure 23.

10. Install horn button cap and retainer, then check operation of directional signal switch, hazard warning switch, and horn.

DIRECTIONAL SIGNAL CONTROL ASSEMBLY (TILT CAB MODELS)

The control assembly consists of a switch, contact, wiring and bearing assembly and a cancelling cam (fig. 22). The control assembly is installed over the steering shaft, inside the housing and the cancelling cam is attached to the steering wheel hub. The hazard warning switch is mounted on side of the directional signal control housing.

REMOVAL (Fig. 22)

1. Remove the steering wheel as directed in "Steering Wheel Replacement" in "MECHANICAL STEERING" (SEC. 9A).

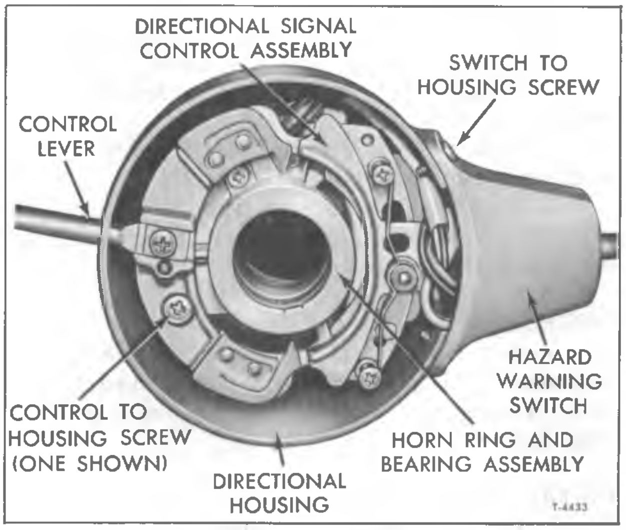


Figure 22—Directional and Hazard Warning Switch (Tilt Cab Models) (Typical)

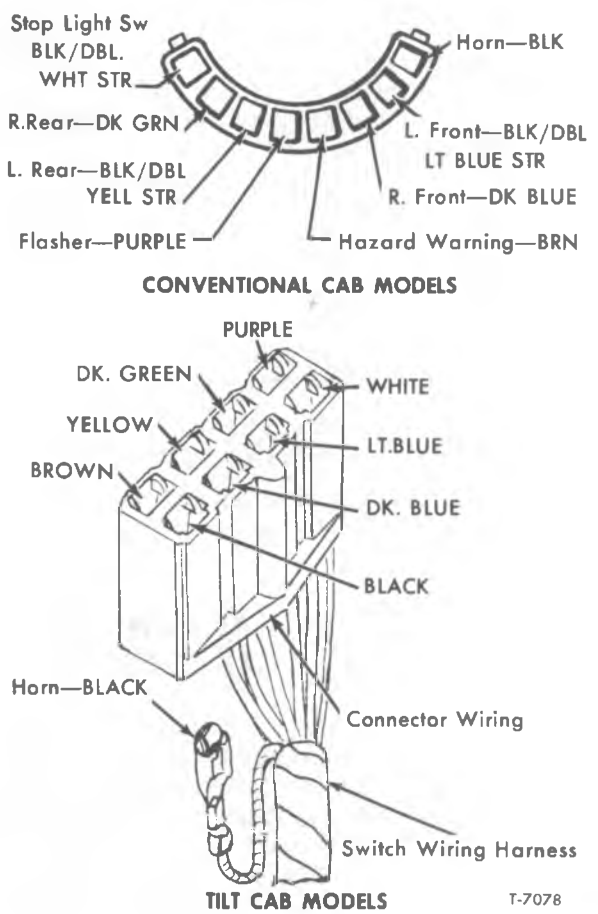


Figure 23—Directional Signal Wiring Connector

2. Remove steering shaft upper bearing sleeve.

3. Disconnect wiring harness at instrument panel harness connector.

NOTE: It may be necessary to remove control assembly wiring from wiring harness connector.

4. Remove screw attaching control lever to switch and remove lever.

5. Remove two screws which attach hazard warning switch to housing.

6. Remove three screws which attach control assembly to housing, then remove control assembly with wiring from housing.

INSPECTION

Inspect control switch, hazard switch, wiring and bearing. Replace worn or damaged parts. Inspect cancelling cam on steering wheel hub and replace if worn or damaged.

INSTALLATION (Fig. 22)

1. Position control assembly in housing and attach to housing with three screws. Tighten screws firmly; however, do not exceed 30 in.-lbs. torque.

2. Position control lever on control assembly and attach with screw. Tighten screw firmly.

3. Position hazard warning switch on housing and attach with two screws. Route switch wires on outside of control assembly.

4. Connect wires at harness connector.

NOTE: Insert terminals into connector cavities per designated wire colors as shown in figure 23.

5. Install steering shaft upper bearing sleeve, then install steering wheel as directed under "Steering Wheel Replacement" in "MECHANICAL STEERING" (SEC. 9A) of this manual.

FLASHERS

Two prong specific load or variable load flashers are used in the directional and hazard warning system on vehicles covered by this manual. Refer to "Specifications" at end of this section for type of flasher and trade number.

On vehicles equipped with the specific load flasher, the tell-tale will not operate if one directional lamp bulb is taken out of the circuit.

On vehicles equipped with the variable load flasher, the directional tell-tale will operate even though one or more of the indicator bulbs are taken out of the circuit.

IMPORTANT: On vehicles equipped with the variable load flasher each lamp bulb should be checked daily for proper operation.

If directional tell-tale on instrument panel flashes in one position but not the other, check for the following:

1. Directional lamp bulb burned out.
2. Incorrect directional lamp bulb installed.
3. Defective ground between bulb socket and mounting.
4. Defective directional control switch assembly.

If directional tell-tale on instrument panel does not flash in either direction, check for the following:

1. Burned out fuse on fuse block.
2. Defective flasher or flasher terminals not properly engaged in junction block.
3. Directional tell-tale bulb on instrument panel burned out.
4. Short or open circuit. Check indicator lamp circuit referring to applicable wiring diagram.
5. Defective directional control switch assembly.

If directional tell-tale light does not cancel after completing a turn, remove the steering wheel as explained in "MECHANICAL STEERING" (SEC. 9A) and check for a worn or damaged cancelling cam.

LIGHT BULB DATA

	BULB NO.	CANDLE-POWER
Headlamp		
Single Sealed Beam Unit	6014	60-50 Watts
Directional Signal Lights	1156	32
Parking and Directional Signal Lights	1157	32-3
Tail and Stop Lights	1157	32-3
Tail, Stop, and Rear Directional Light	1157	32-3
Side Marker Lights	194	2
Clearance and Identification Lights	67	4
Marker Lights	1445 or 1895	1 or 2
Back-up Light	1156	32
License Light	67	4
Instrument and Tell-Tale Lights		
Conv. Cab, Cowl, and "S" Models (02)	1895	2
Conventional Cab (03-13)	194	2
Tilt Cab Models	57	2
Dome Light	211	12
Headlamp Hi-Beam Indicator		
Except Tilt Cab Models	1445	1
Tilt Cab Models	1090D18	667582
Overspeed Warning Lamp (When Used)		
Except Tilt Cab Models	67	4
Tilt Cab Models	1090D18	667582
Directional Signal Indicator Light		
Conv. Cab, Cowl and "S" Models (02)	1445	1
Conventional Cab Models (03-13)	168	3
Tilt Cab Models	57	2
Heater Control Light		
Conventional Cab Models (03-13)	1445	1
Tilt Cab Models	57	2
Speedometer Lamp		
Conv. Cab, Cowl, and "S" Models (02)	1895	2
Conventional Cab Models (03-13)	194	2
Tilt Cab Models	53	1
Low Vacuum Gauge Warning Lamp		
Conv. Cab, Cowl, and "S" Models (02)	1895	2
Conventional Cab Models (03-13)	194	2
Tilt Cab Models	53	1
Brake Warning Light	1895	2
Temperature Gauge Light (Tilt Cab Models)	53	1
Fuel Gauge Light (Tilt Cab Models)	53	1
Air Pressure Gauge Light	53	1
Voltmeter Light	53	1
Tachometer Gauge Light	53	1
Ammeter Gauge Light	53	1
Oil Pressure Gauge Light	53	1

SPECIFICATIONS

AIR BRAKE WARNING BUZZER

Make .... Delco-Remy
Model 1116882
Point Opening (In.) 0.017
Closing Voltage .... Adjust to Buzz at .25-.35 Amperes at 13.5-14.5 Volts

ENGINE ALARM BUZZER

Make .... Delco-Remy
Model 1116914
Point Opening (In.) 0.015
Closing Voltage .... Adjust to Buzz at .30-.35 Amperes at 13.5-14.5 Volts

FLASHER UNIT

Specific Load—2 Prong .... SIG. STAT 144
Variable Load—2 Prong .... SIG. STAT 175

HORN RELAY

Model 2480982
Voltage 12

HORN RELAY

Make .... Delco-Remy
Model 1115811
Air Gap at Core
Points Closed (In.) 0.020
Point Opening (In.) 0.018
Closing Voltage (Range) 1.5-9.5

ELECTRIC HORN

Make .... Delco-Remy
Model 9000235
Frequency .... 357 C.P.S.

ELECTRIC HORN

Make .... Delco-Remy
Model 9000485
Frequency .... 360 C.P.S.

TRAILER I.C.C. MARKER LAMP RELAY

Make .... Delco-Remy
Model 1115841
Air Gap at Core
Points Closed (In.)* .... 0.012 (Min.)
Point Opening (In.) 0.015-0.025
Closing Voltage (Range) 7-8
Sealing Voltage .... 10 (Max.)
*Tolerance Plus or Minus 10%

LOW AIR PRESSURE OR LOW VACUUM ALARM BUZZER

Make .... Delco-Remy
Model 1116882
Point Opening (In.) 0.017
Closing Voltage .... Adjust to Buzz at .25-.35 Amperes at 13.5-15.4 Volts

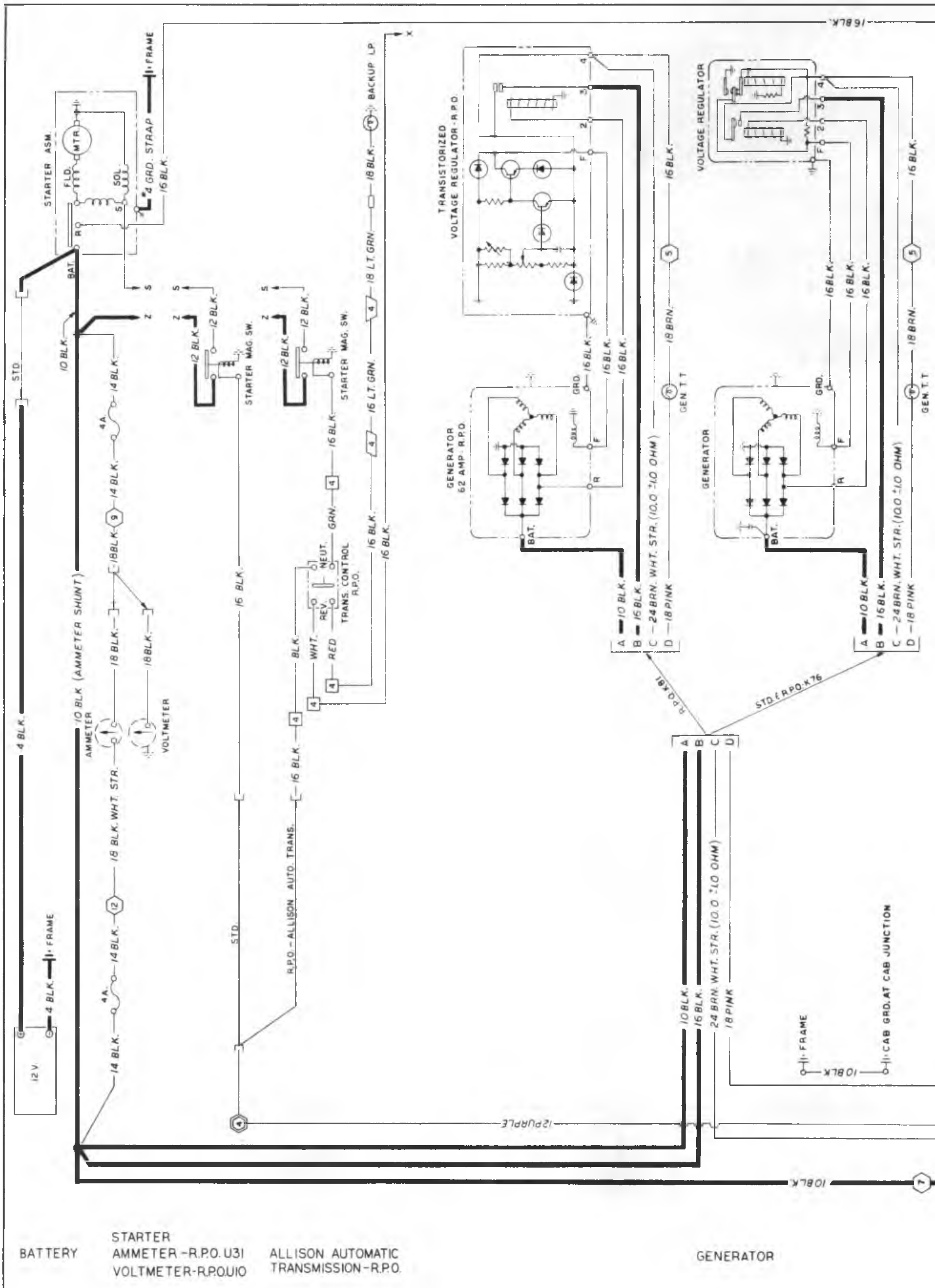


Figure 24—Engine Compartment—TE-TS50, TE60

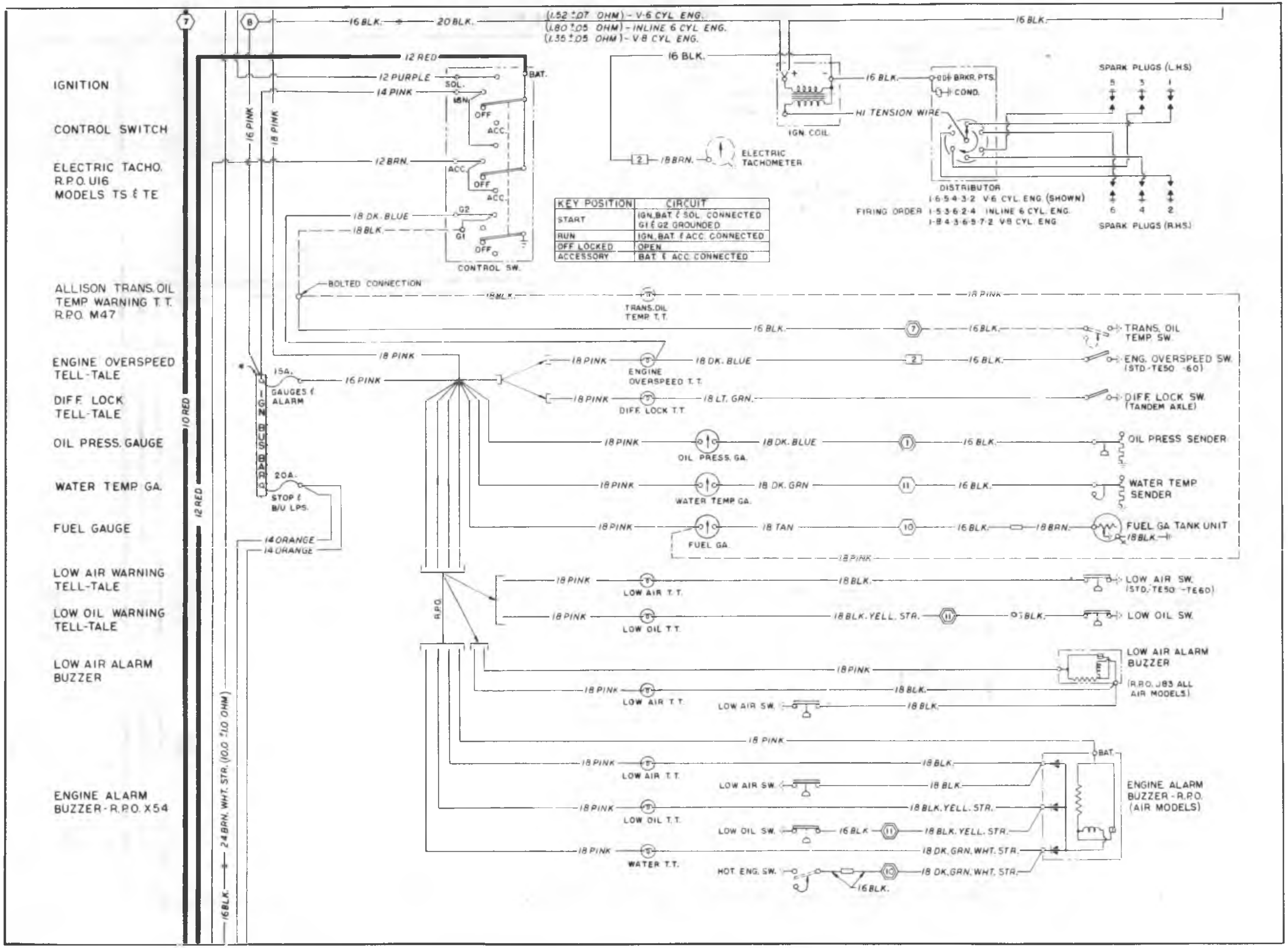


Figure 25—Instrument Panel—TE-TS50, TE60

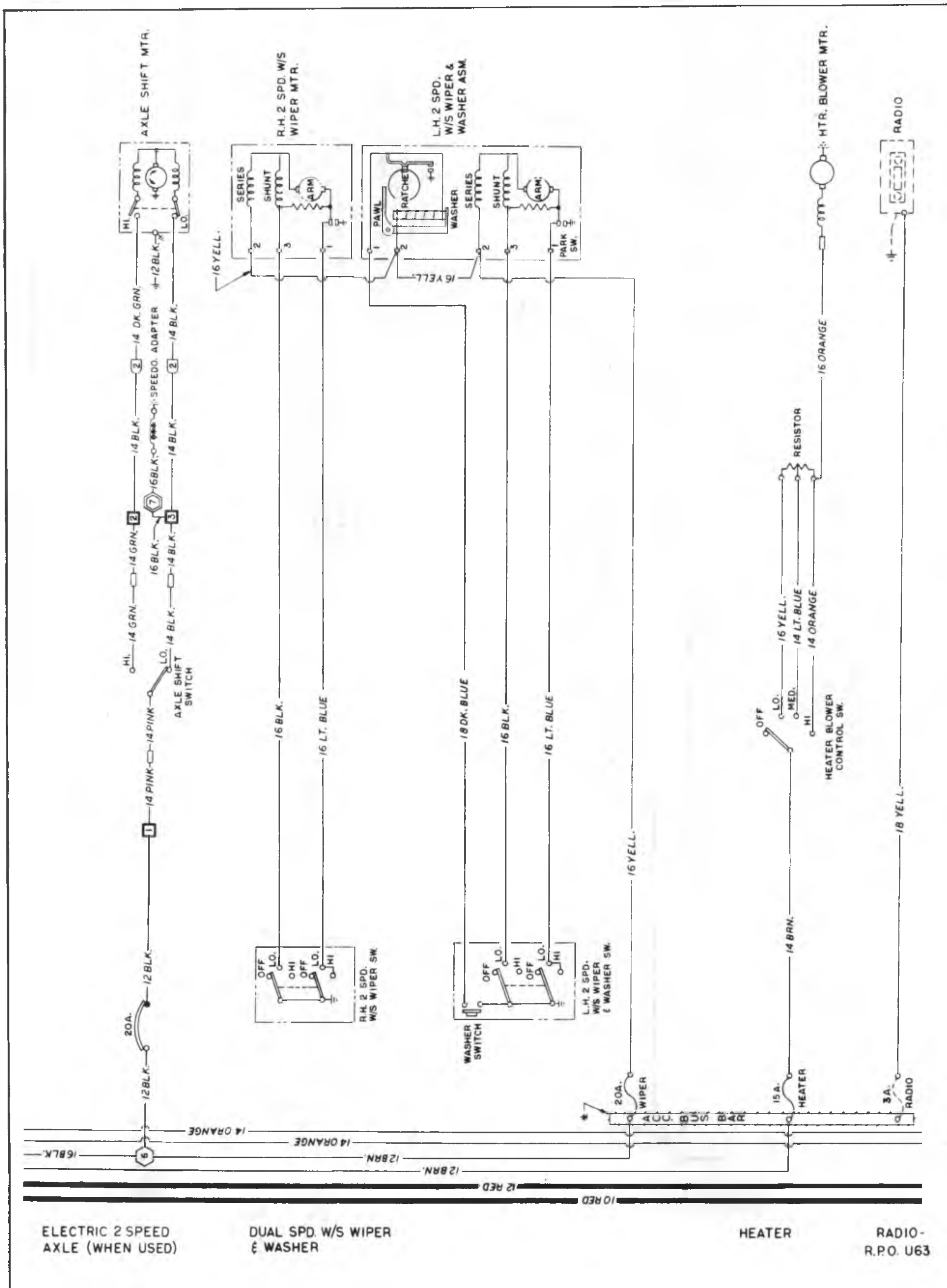


Figure 26—Cab Wiring—TE-TS50, TE60

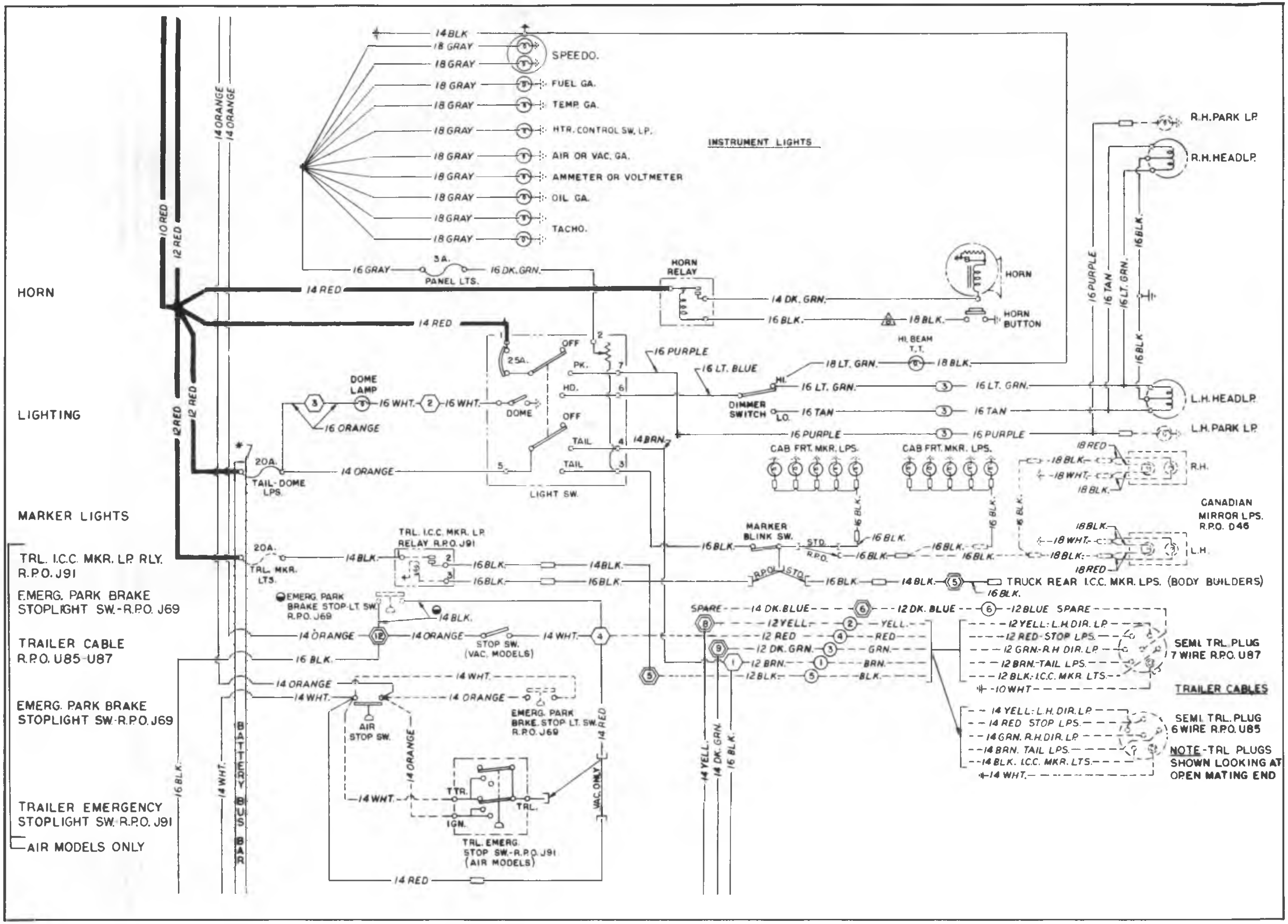


Figure 27—Cab Wiring—TE-TS50, TE60

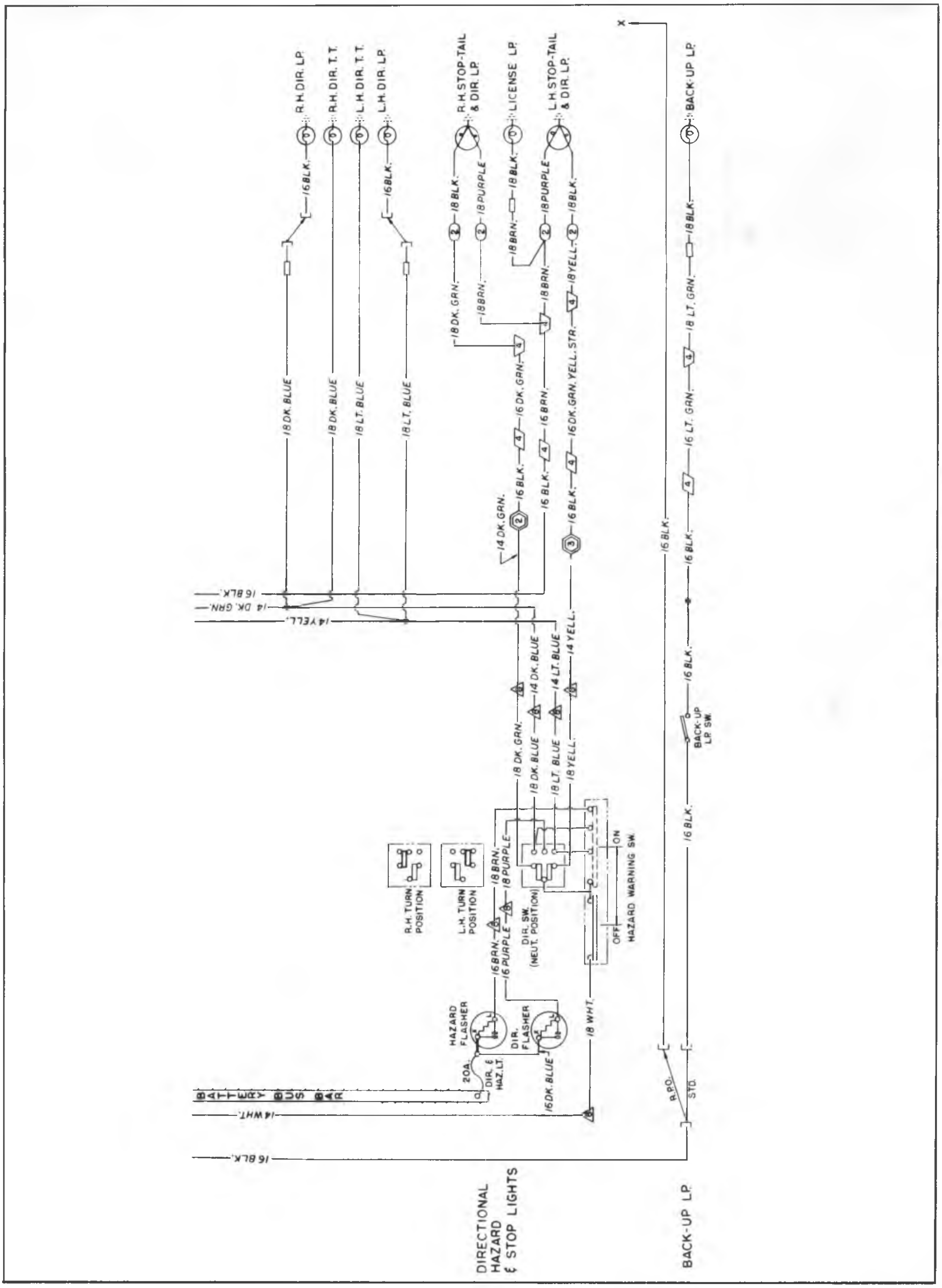


Figure 28—Chassis Wiring—TE-TS50, TE60

CIRCUIT IDENTIFICATION

LEGEND

SYMBOL	JUNCTION	FUNCTION	LOCATION
	3 POST JCT. BLOCK (*1 THRU *3)	ENG. HARN. TO SHIFT SW. JCT. CABLE TO AXLE SHIFT SW.	ON CONTROL ISLAND PNL SUPT FRT SILL BRKT
	12 POST JCT. BLOCK (*1 THRU *12) L.H.	INSTR. PANEL HARN. TO ENG. HARN. DOME LP. WIRE ASM. & TRL. WRG. HARN.	CAB JCT. BELOW FLOOR AT L.H. FRT. STEP RISER
	12 POST JCT. BLOCK (*1 THRU *12) R.H.-WIRES WITH RED SLEEVE		
	6 POST JCT. BLOCK (*1 THRU *6)	TRL. WRG. HARN. TO TRL. CABLE ASM.	UNDER CAB AT CAB REAR
8	8 WAY MULTIPLE CONNECTOR	DIRECT SW. ASM. TO INSTR. PNL. HARN	UNDER INSTR. PANEL AT STEERING COLUMN
3	3 WAY MULTIPLE CONNECTOR	INSTR. PANEL HARN. TO HDLP & PARK LP. HARN.	BELOW FLOOR AT L.H. HDLP. ASM.
4	4 WAY MULTIPLE CONNECTOR	ENG. HARN. TO STOP-TAIL LP. FRT. EXT. HARN.	L.H. FRAME RAIL AT BACK OF CAB
4	4 WAY MULTIPLE CONNECTOR	STOP-TAIL LP FRT. EXT. HARN. TO REAR STOP-TAIL LP. HARN	L.H. FRAME RAIL AT REAR AXLE
2	2 WAY MULTIPLE CONNECTOR	REAR STOP-TAIL LP HARN. TO STOP-TAIL LP. ASM.	AT STOP-TAIL LP. ASM.
2	2 WAY MULTIPLE CONNECTOR	INSTR. PANEL HARN. TO ENG. HARN.	CAB JCT. BELOW FLOOR AT L.H. FRT. STEP RISER (TS & TE MODELS ONLY)
2	2 WAY MULTIPLE CONNECTOR	ENG. HARN. TO AXLE SHIFT MTR. CABLE	L.H. FRAME AT BACK OF CAB
	FUSE		FUSE BLOCK-INSIDE CAB L.H. SIDE COWL PANEL
BAT. AUX.	CIRCUIT BREAKER		CAB. JCT. BELOW FLOOR AT L.H. FRT. STEP RISER
	SINGLE LINE CONNECTOR		RELATED CIRCUITS
	TERMINAL OR CONNECTOR TERMINATION		RELATED CIRCUITS
	SPLICE		RELATED CIRCUITS
	LINE FUSE		RELATED CIRCUITS
----	BROKEN LINES & SPECIFIED R.P.O. DENOTE WRG. & PARTS OTHER THAN STD. & NOT IN STD. WRG. HARN. ASM.		
*	BUS BAR PART OF FUSE BLOCK-FUSE BLOCK PART OF INSTR PANEL HARN ASM		
4	4 WAY MULTPLE CONNECTOR	ENG. HARN. TO TRANSMISSION CONTROL ASM.	ON CONTROL ISLAND PNL.

Figure 29—Legend For Wiring—TE-TS50, TE60

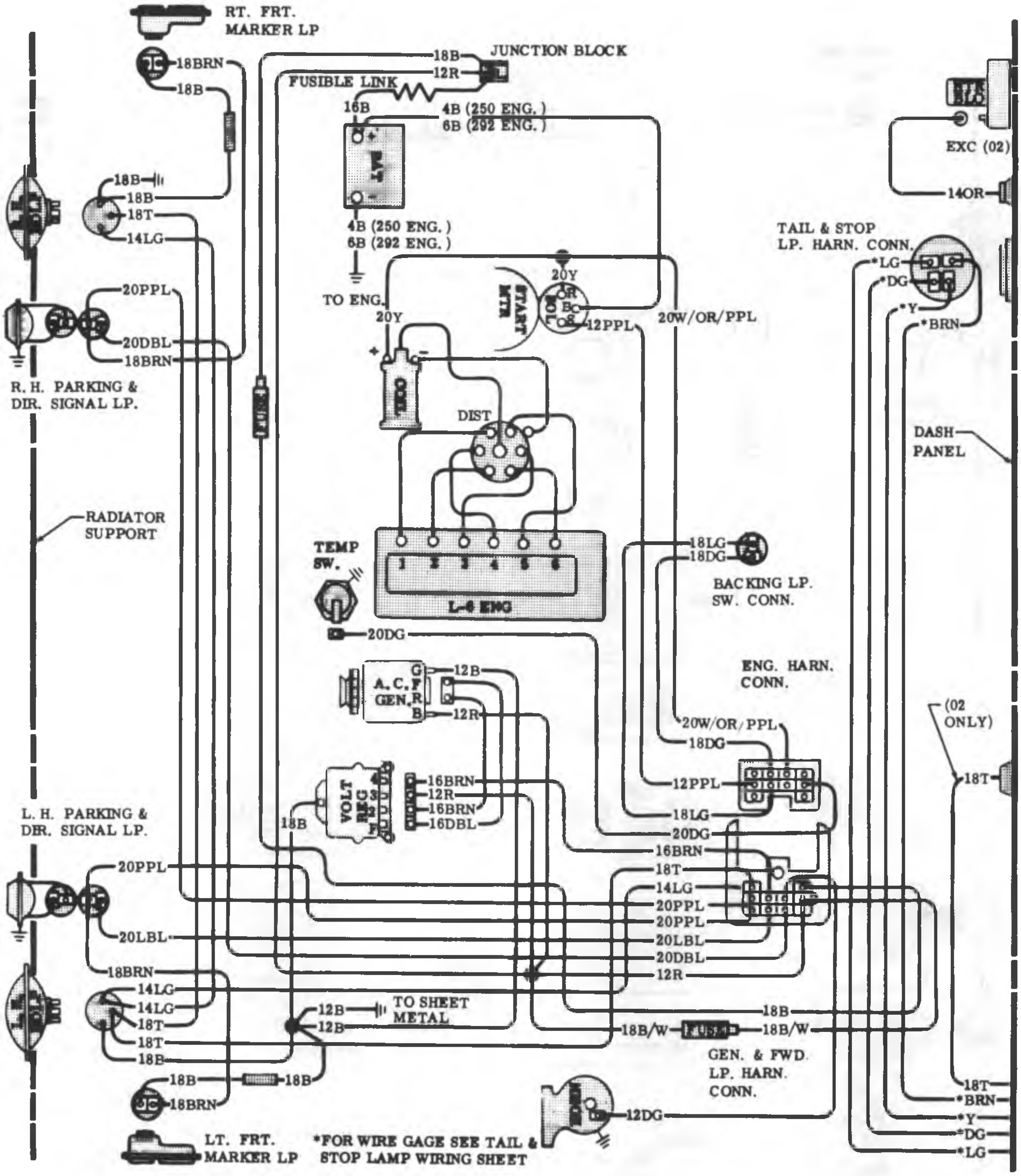


Figure 30—Engine Compartment—CS40-50

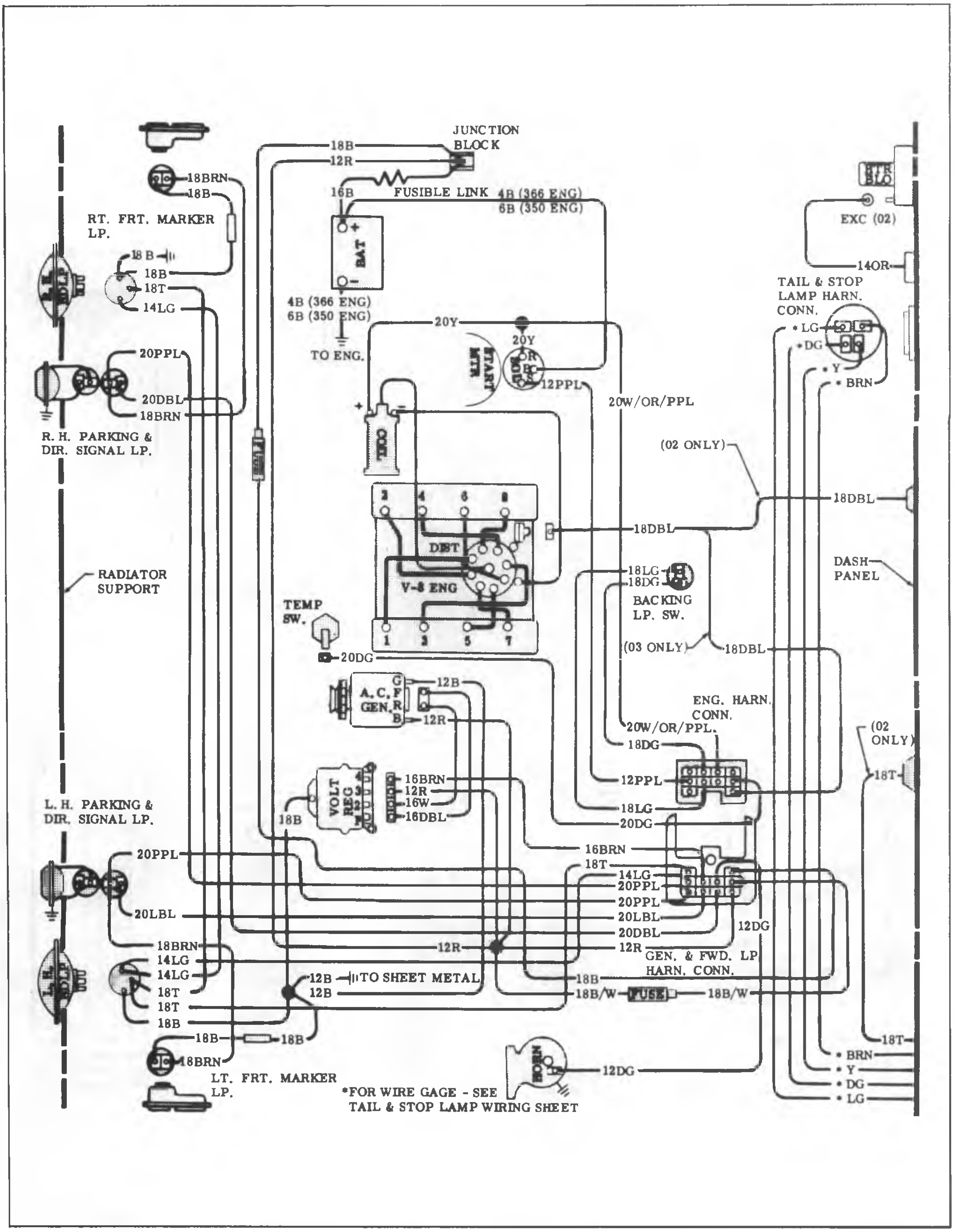


Figure 31—Engine Compartment—CE40-50

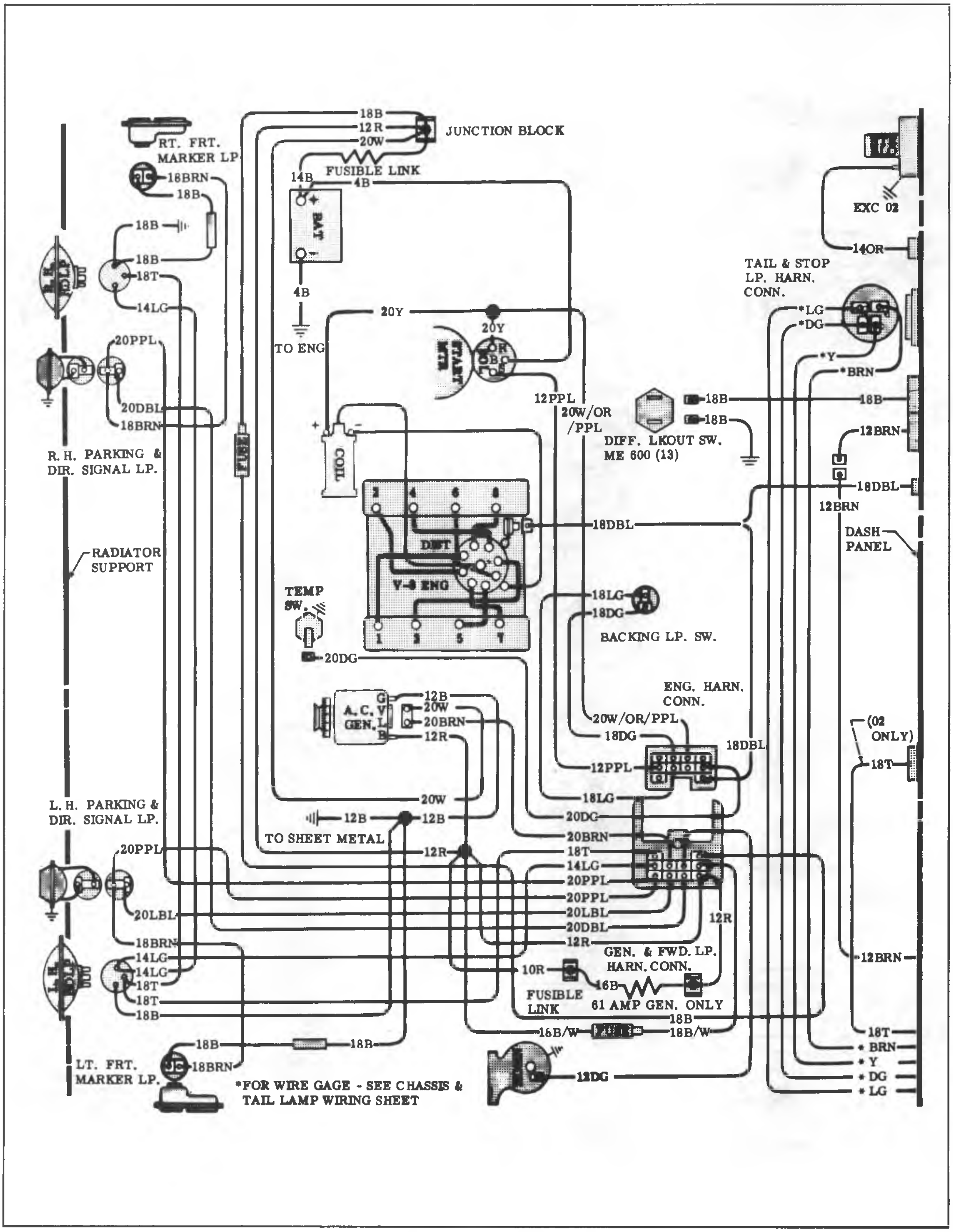


Figure 32—Engine Compartment—CE-ME60

CHASSIS ELECTRICAL AND INSTRUMENTS

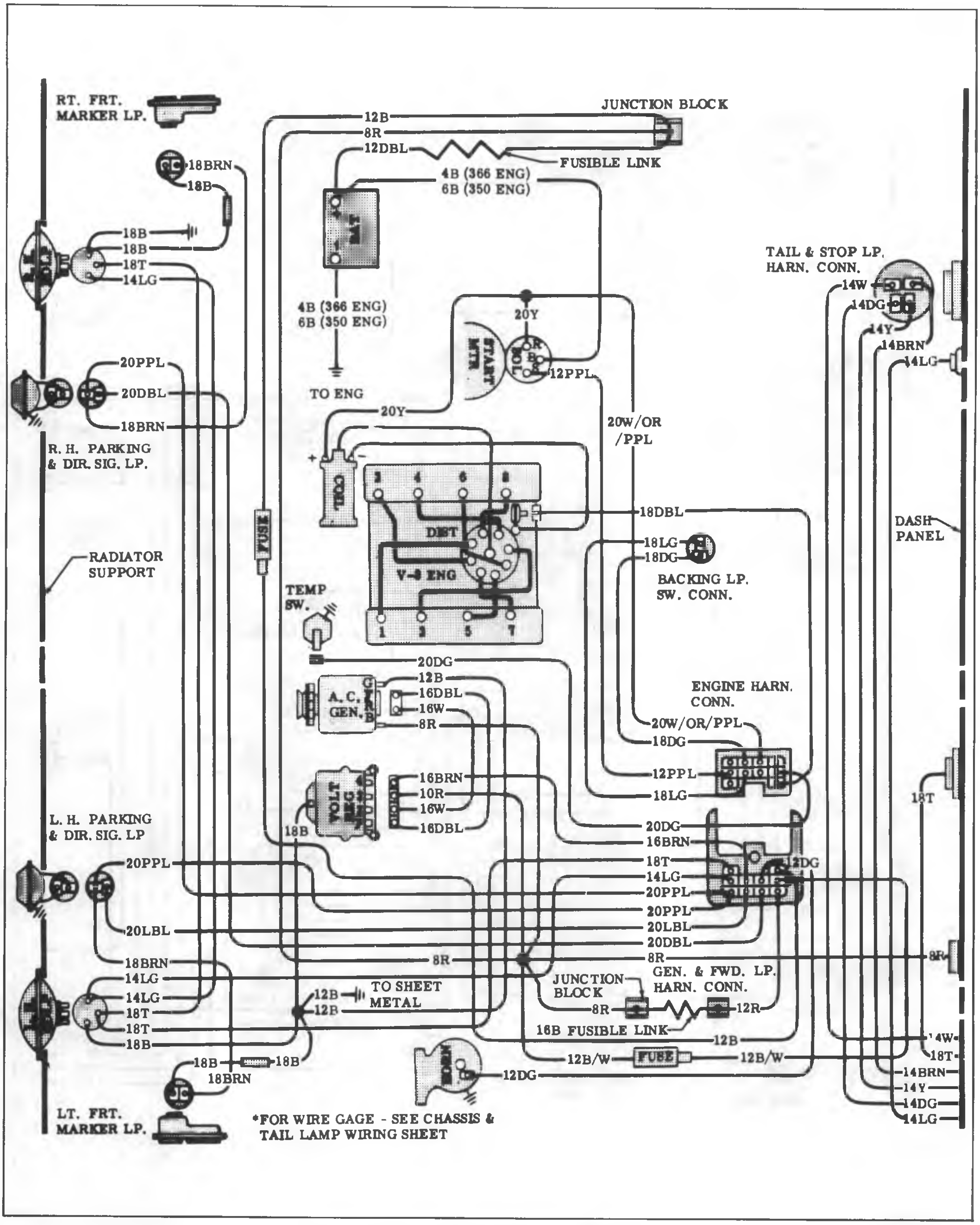


Figure 33—Engine Compartment—SE50

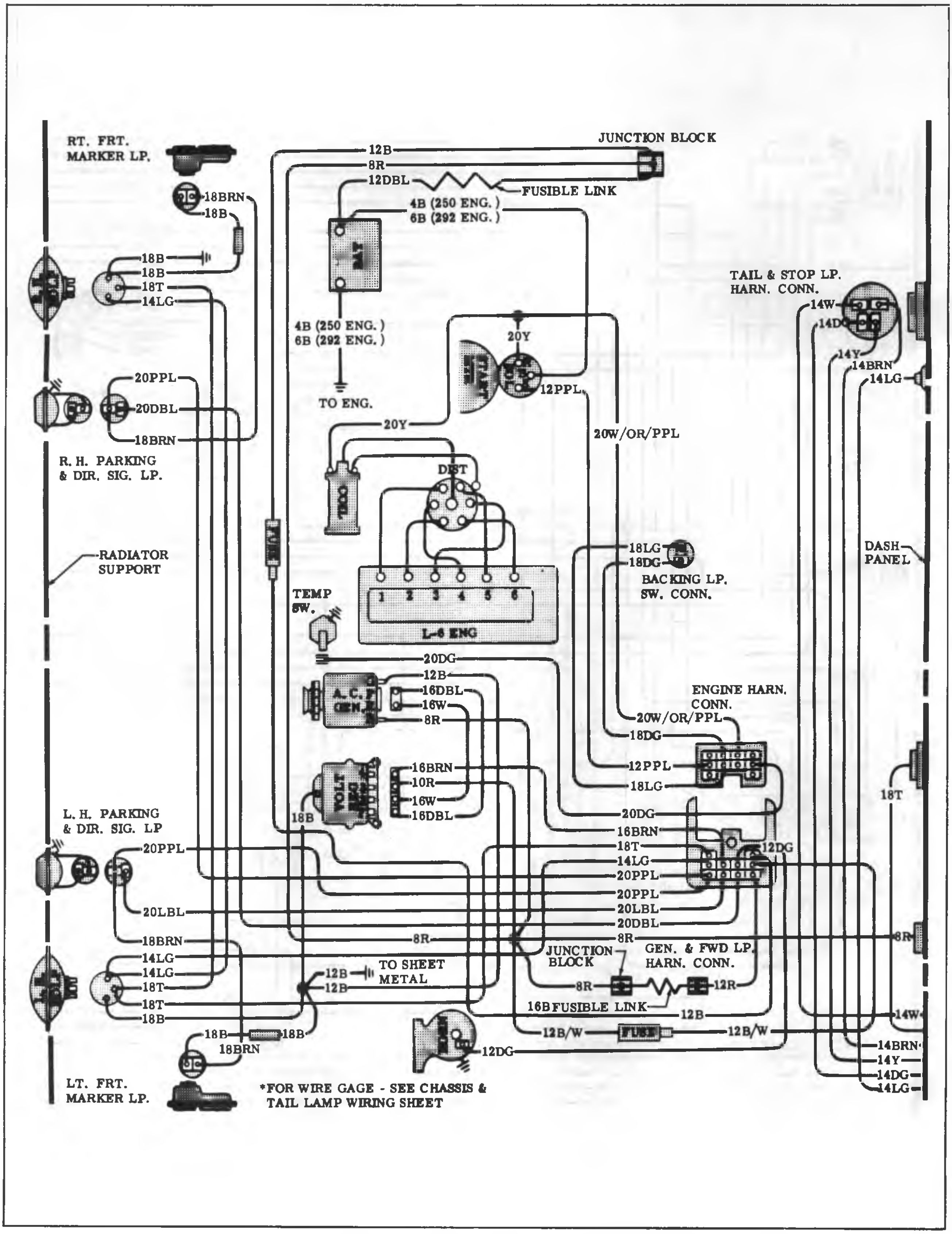


Figure 34—Engine Compartment—SS50

CHASSIS ELECTRICAL AND INSTRUMENTS

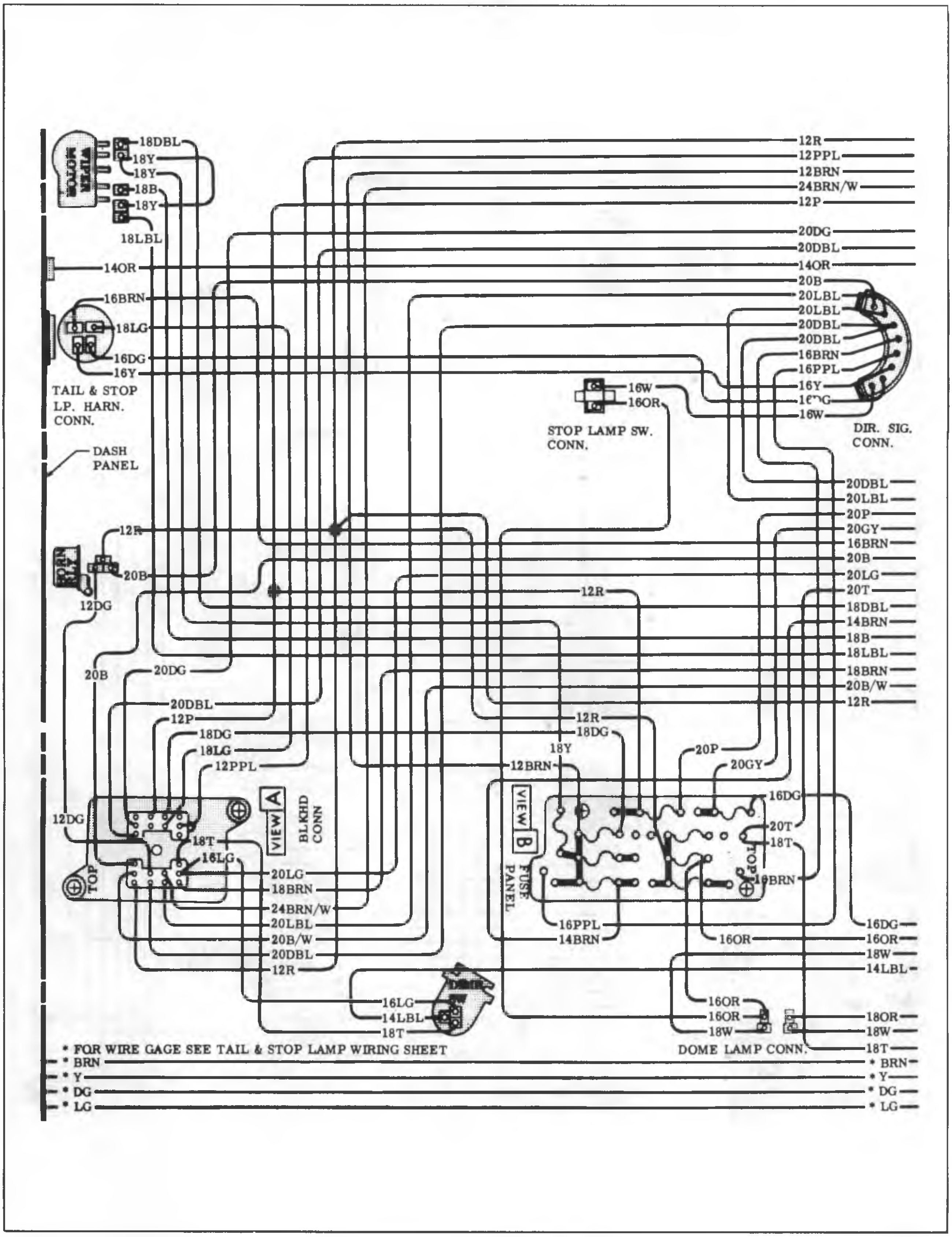


Figure 35—Instrument Panel—CE-CS40-50 (03)

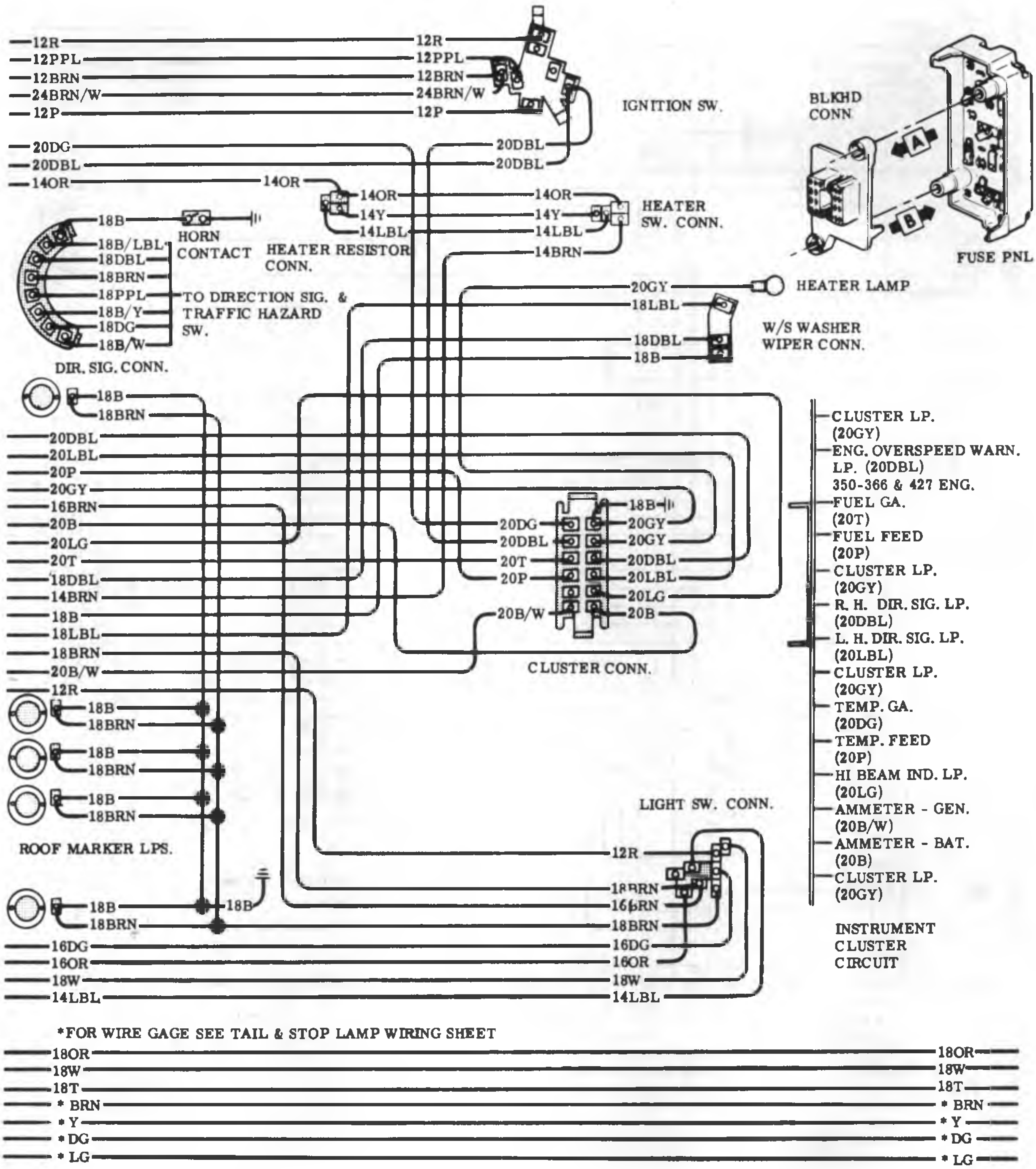


Figure 36—Instrument Panel—CE-CS40-50 (03)

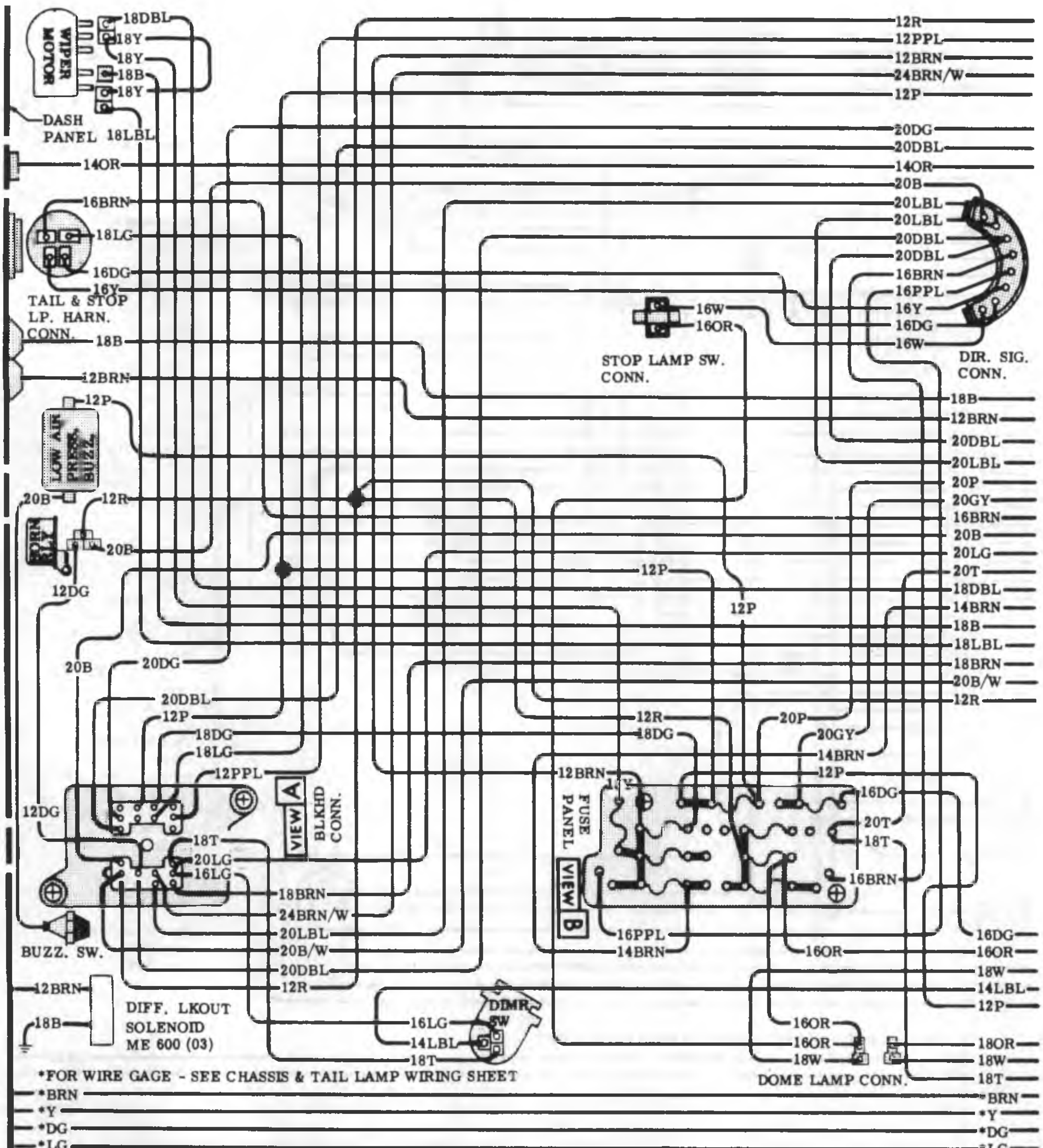


Figure 37—Instrument Panel—CE-ME60 (03-13)

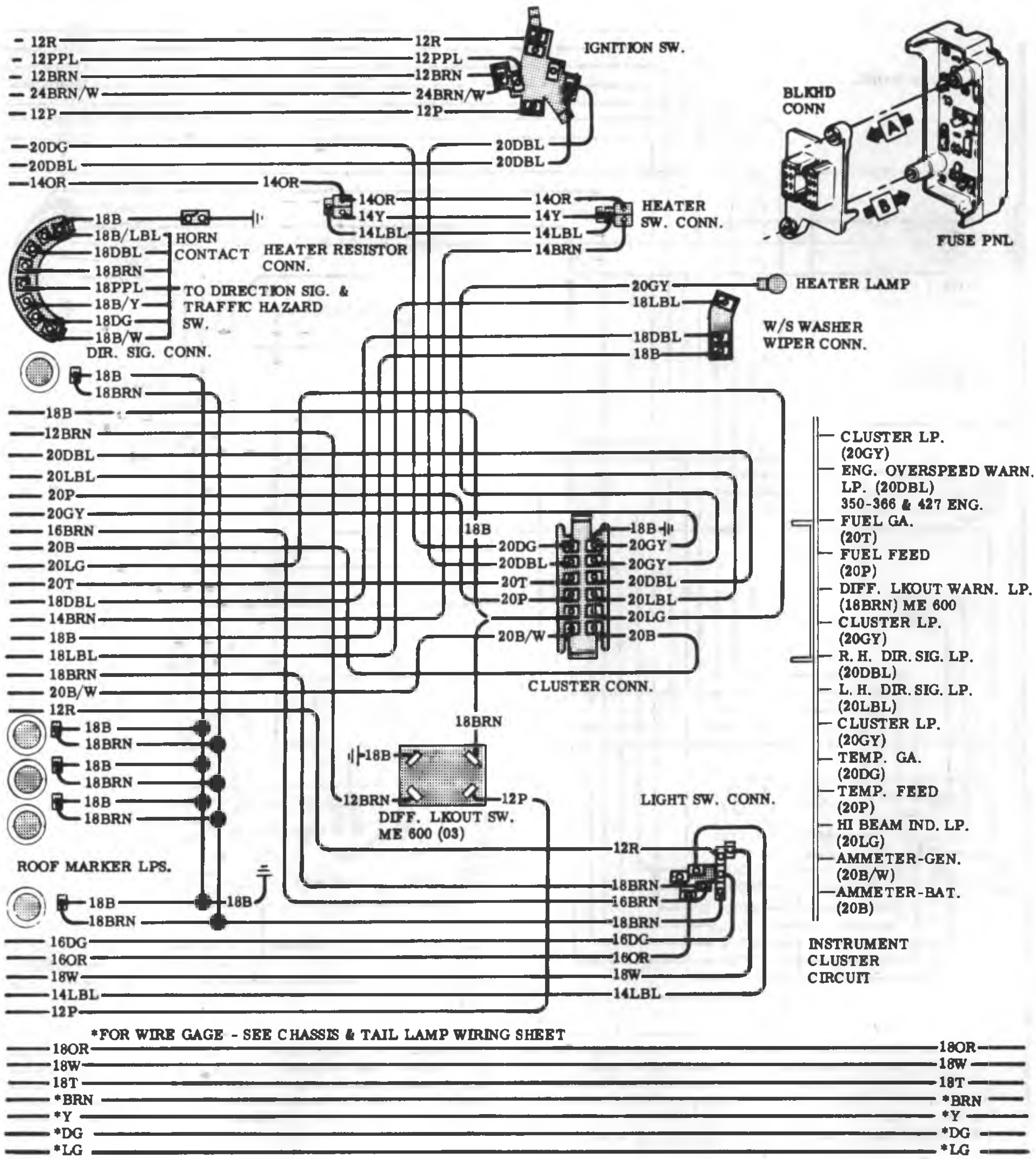


Figure 38—Instrument Panel—CE-ME60 (03-13)

CHASSIS ELECTRICAL AND INSTRUMENTS

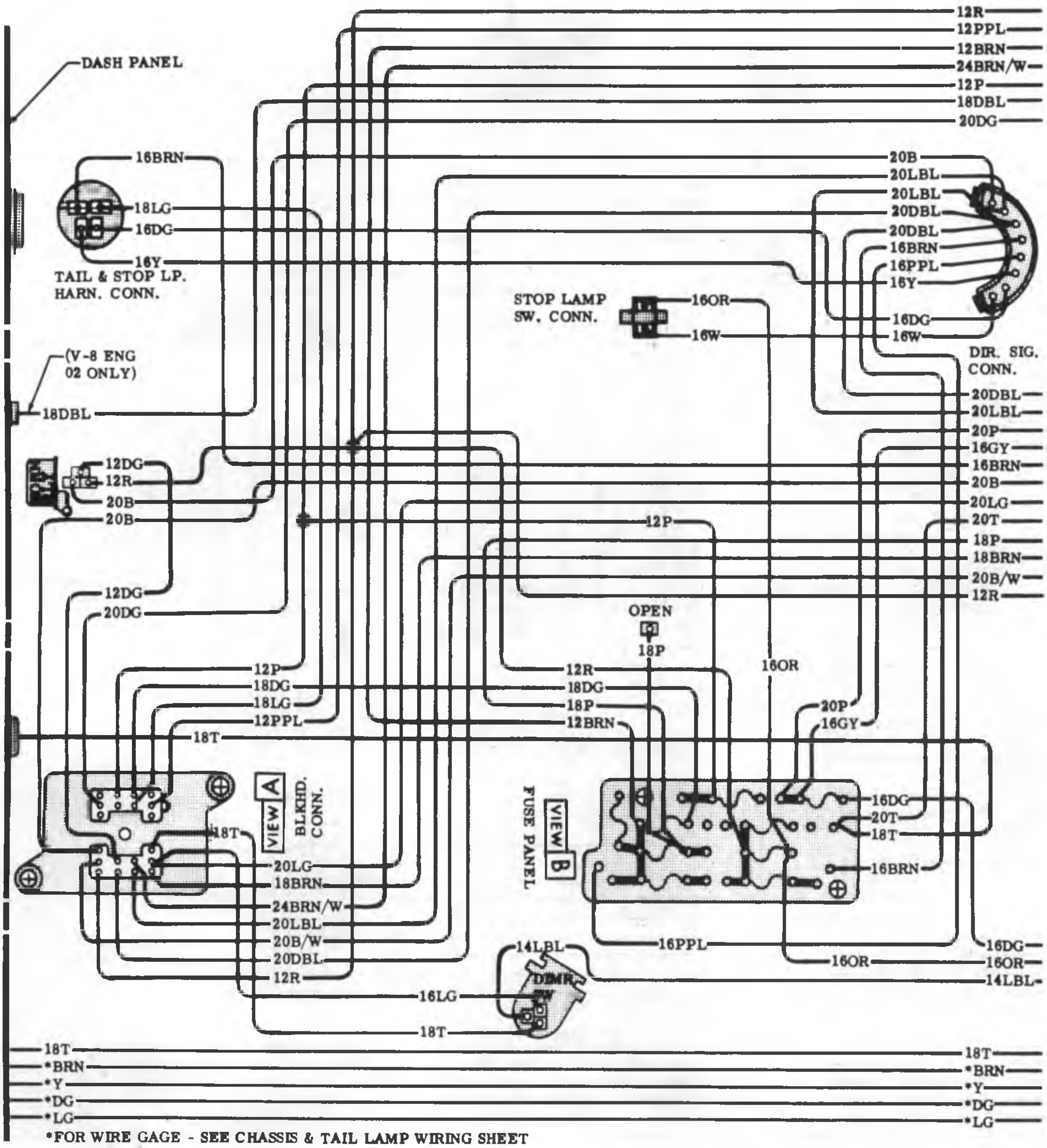


Figure 39—Instrument Panel—CA40-50 (02)

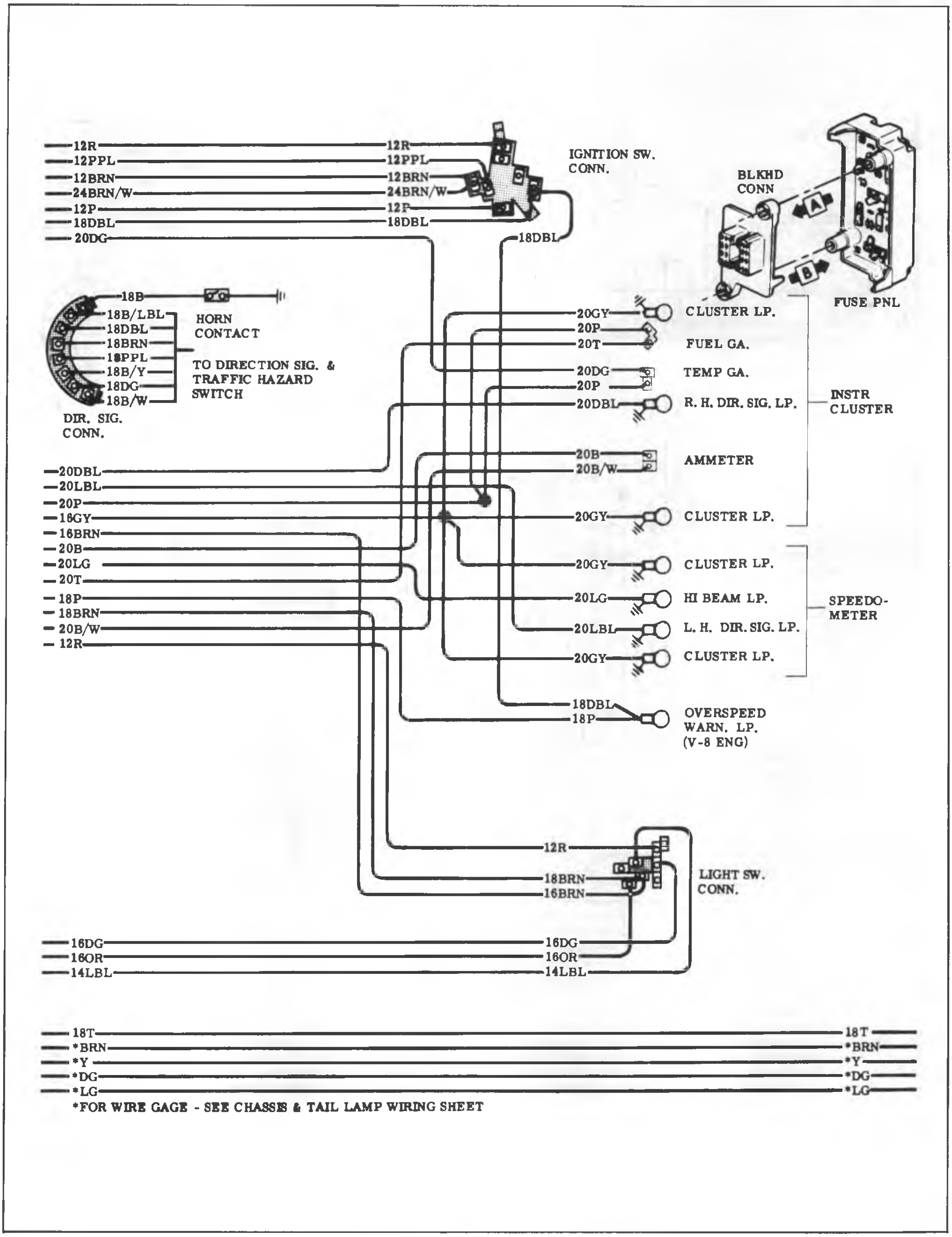


Figure 40—Instrument Panel—CA40-50 (02)

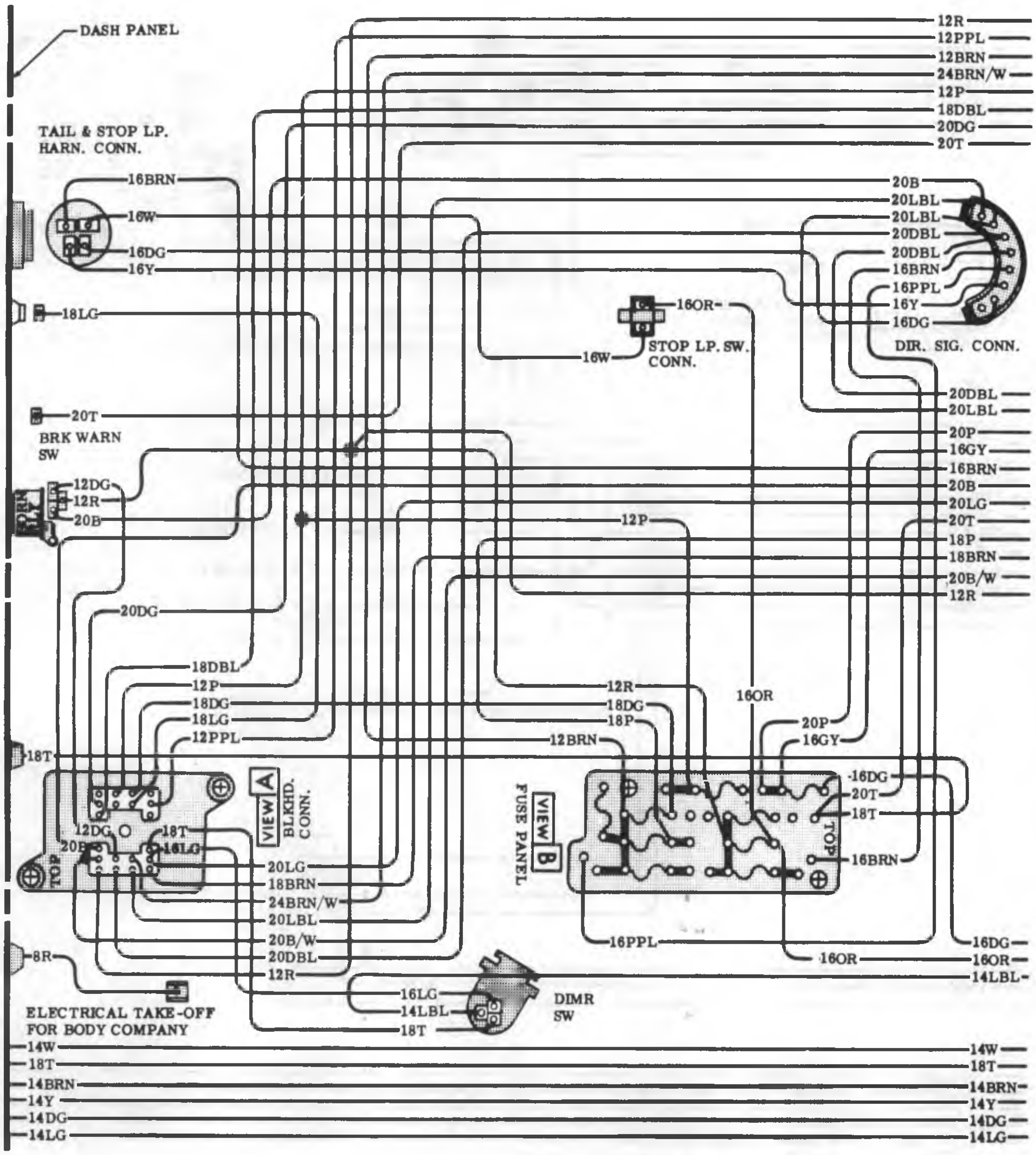


Figure 41—Instrument Panel—SA50 (02)

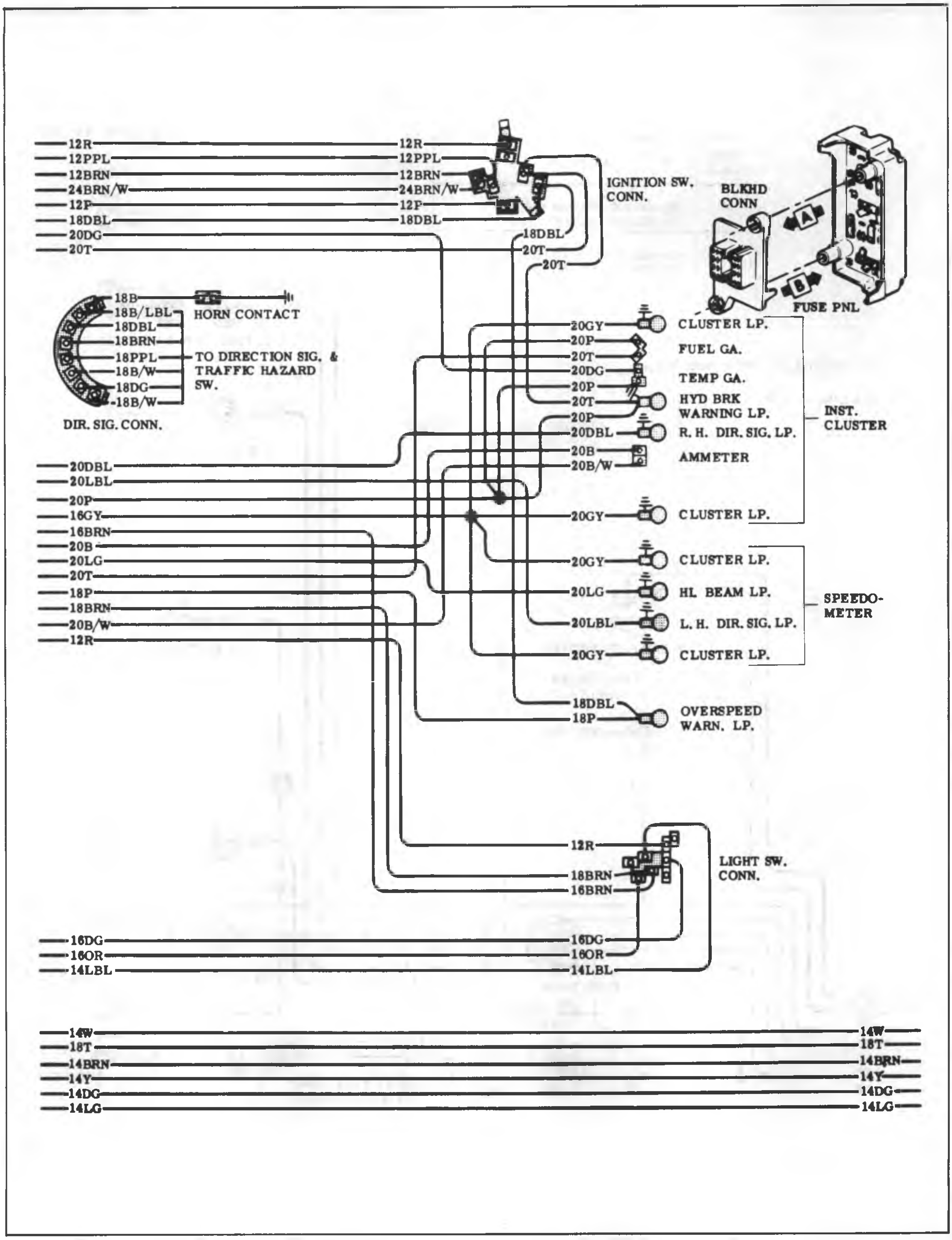
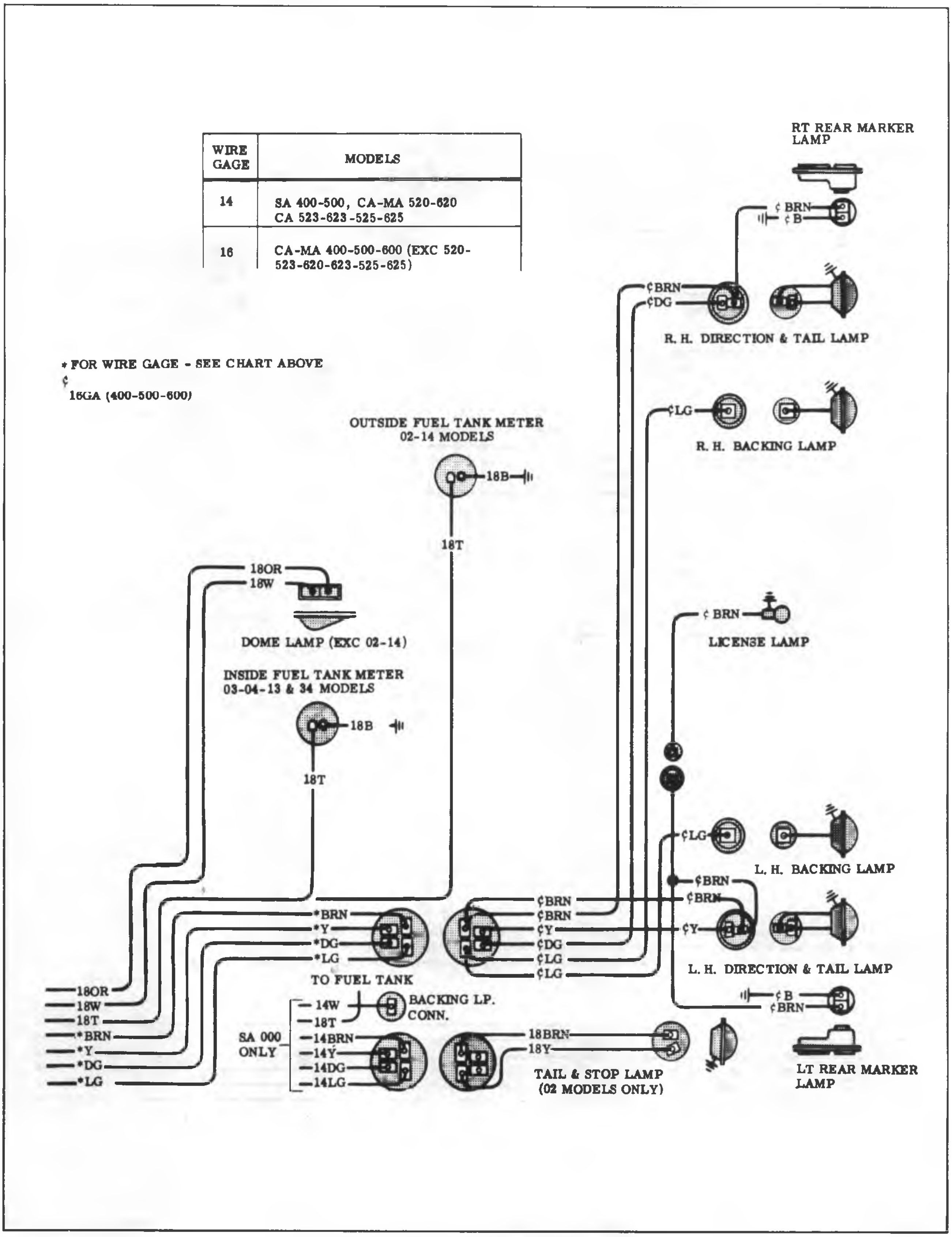


Figure 42—Instrument Panel—SA50 (02)

CHASSIS ELECTRICAL AND INSTRUMENTS



WIRE GAGE	MODELS
14	SA 400-500, CA-MA 520-620 CA 523-623-525-625
16	CA-MA 400-500-600 (EXC 520-523-620-623-525-625)

Figure 43—Tail and Stop Lamp—SA50 (02) ME60

WIRE GAGE	MODELS
16	CA 40 -50 -60

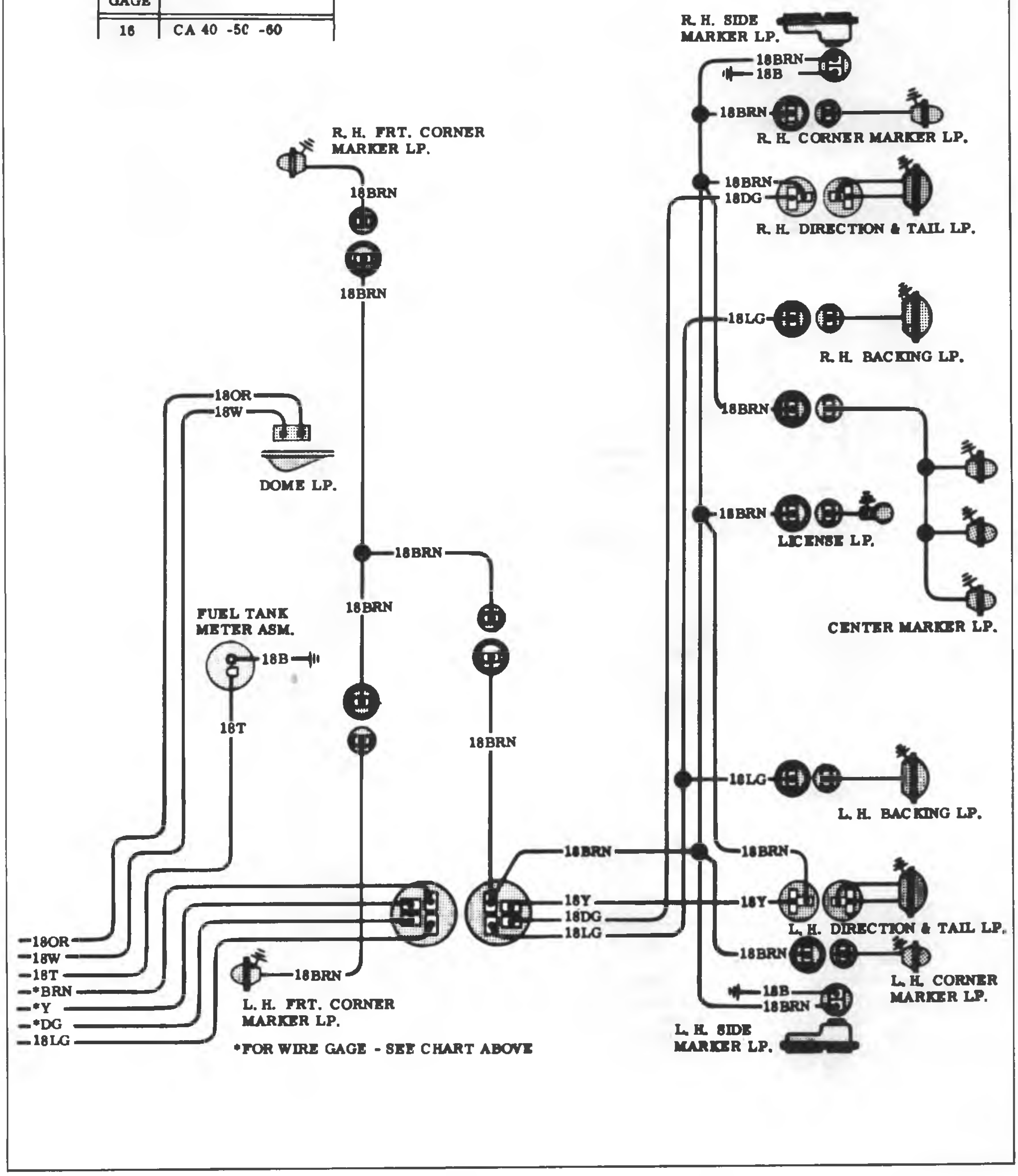
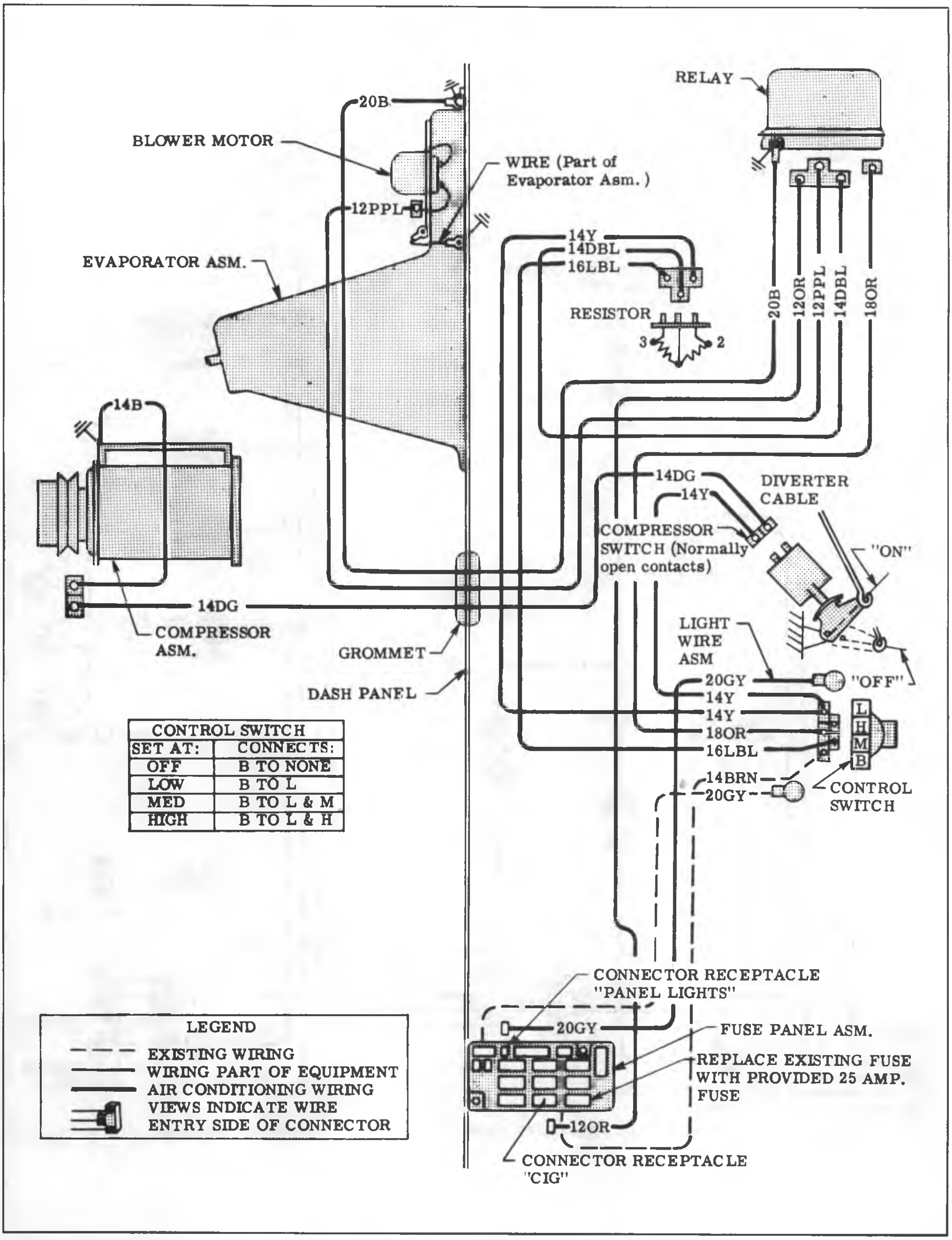


Figure 44—Tail and Stop Lamp—CA40-50, CE60



CONTROL SWITCH	
SET AT:	CONNECTS:
OFF	B TO NONE
LOW	B TO L
MED	B TO L & M
HIGH	B TO L & H

Figure 45—Air Conditioning

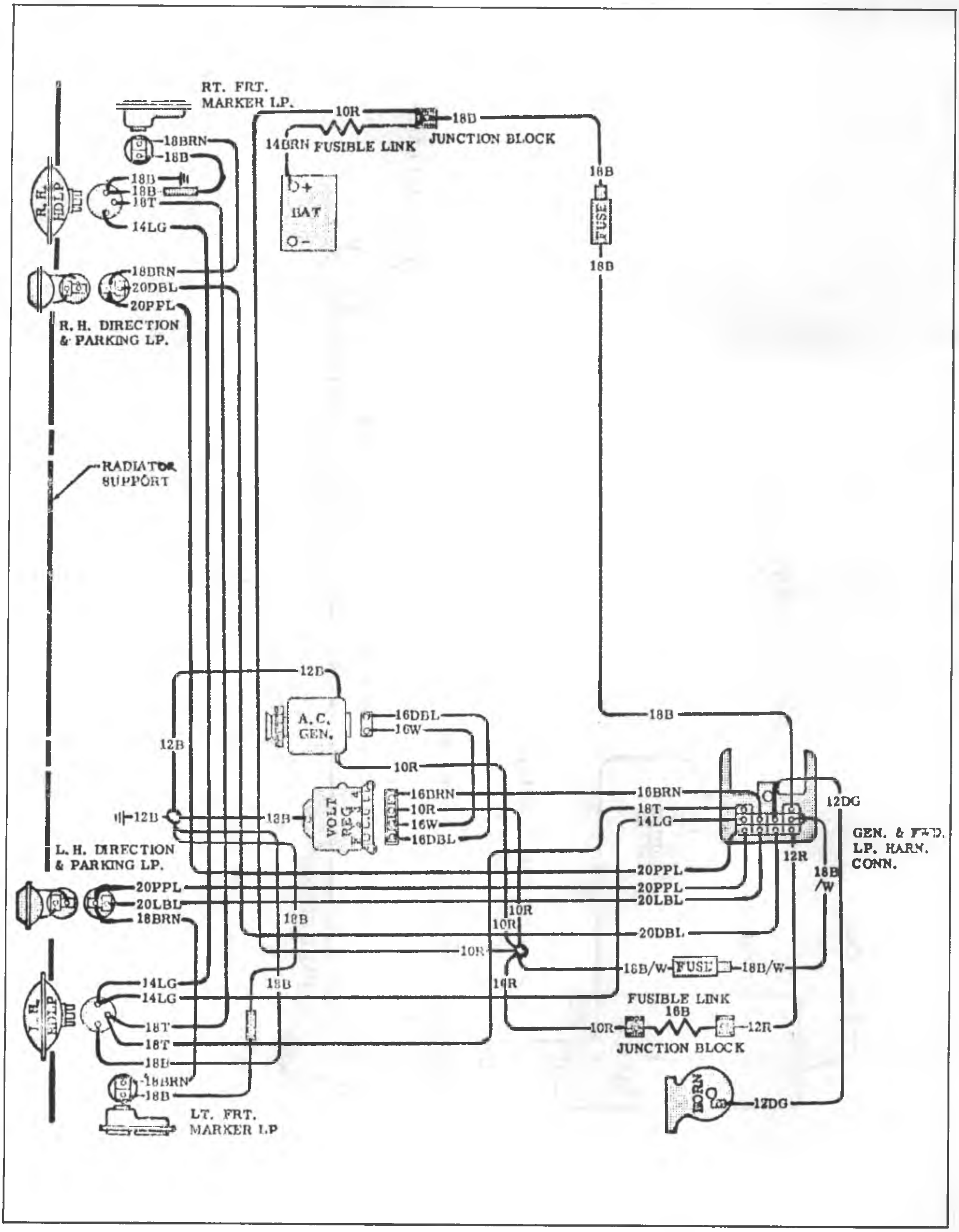


Figure 46—Generator—62 Amp-CA40, CA-SA50, CE-ME60

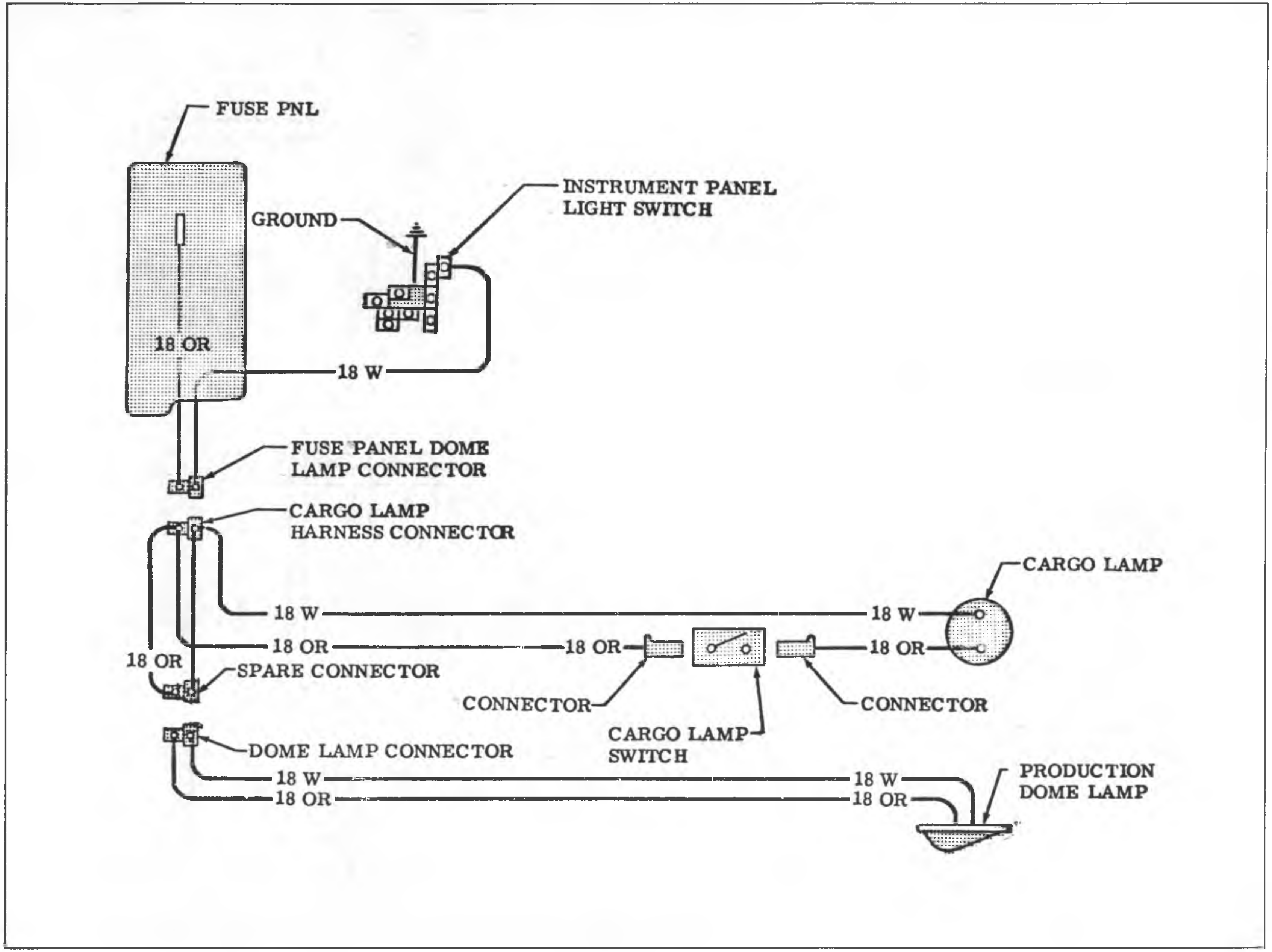


Figure 47—Cargo Lamp

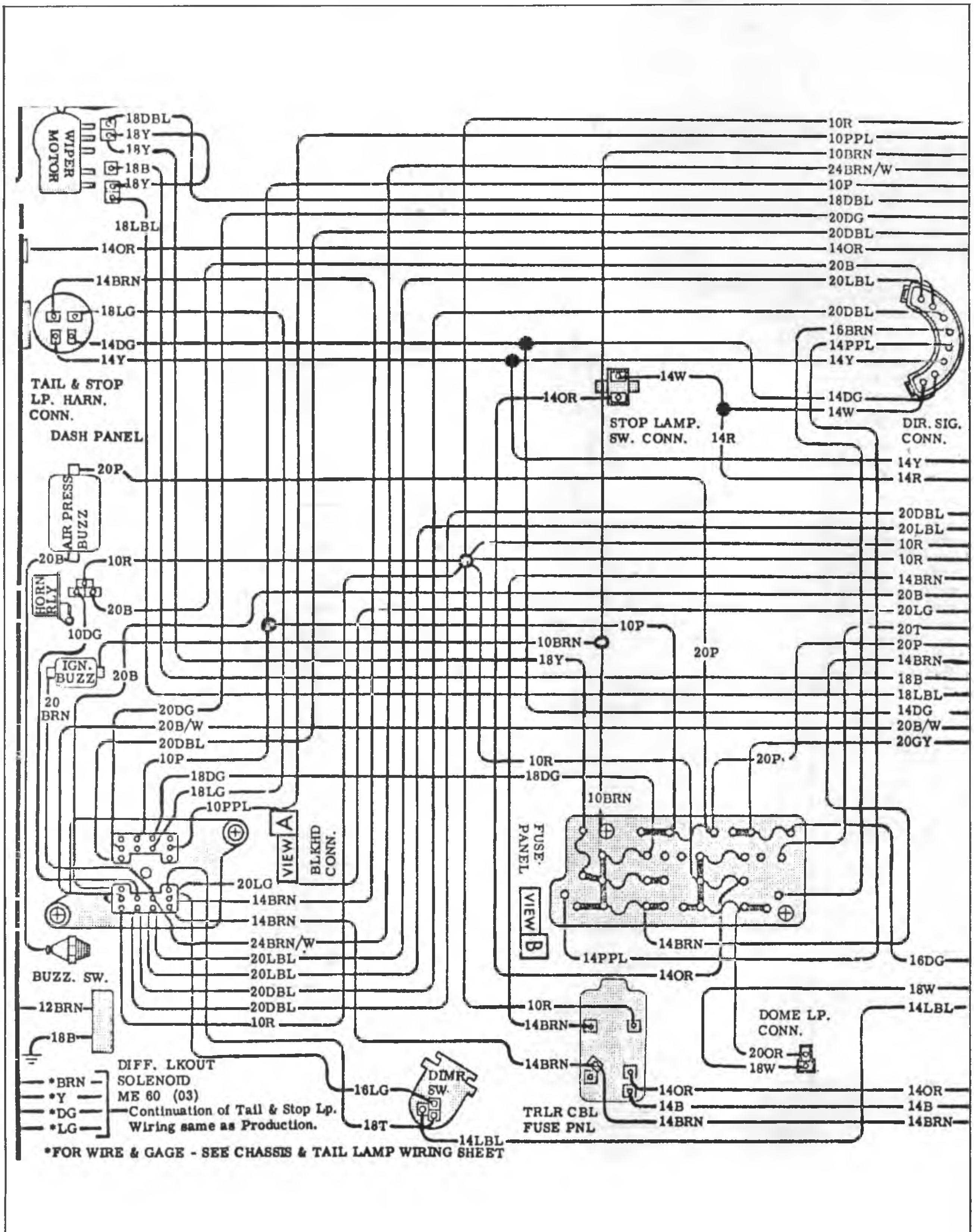


Figure 48—Trailer Jumper Cable—CE50, CE-ME60

CHASSIS ELECTRICAL AND INSTRUMENTS

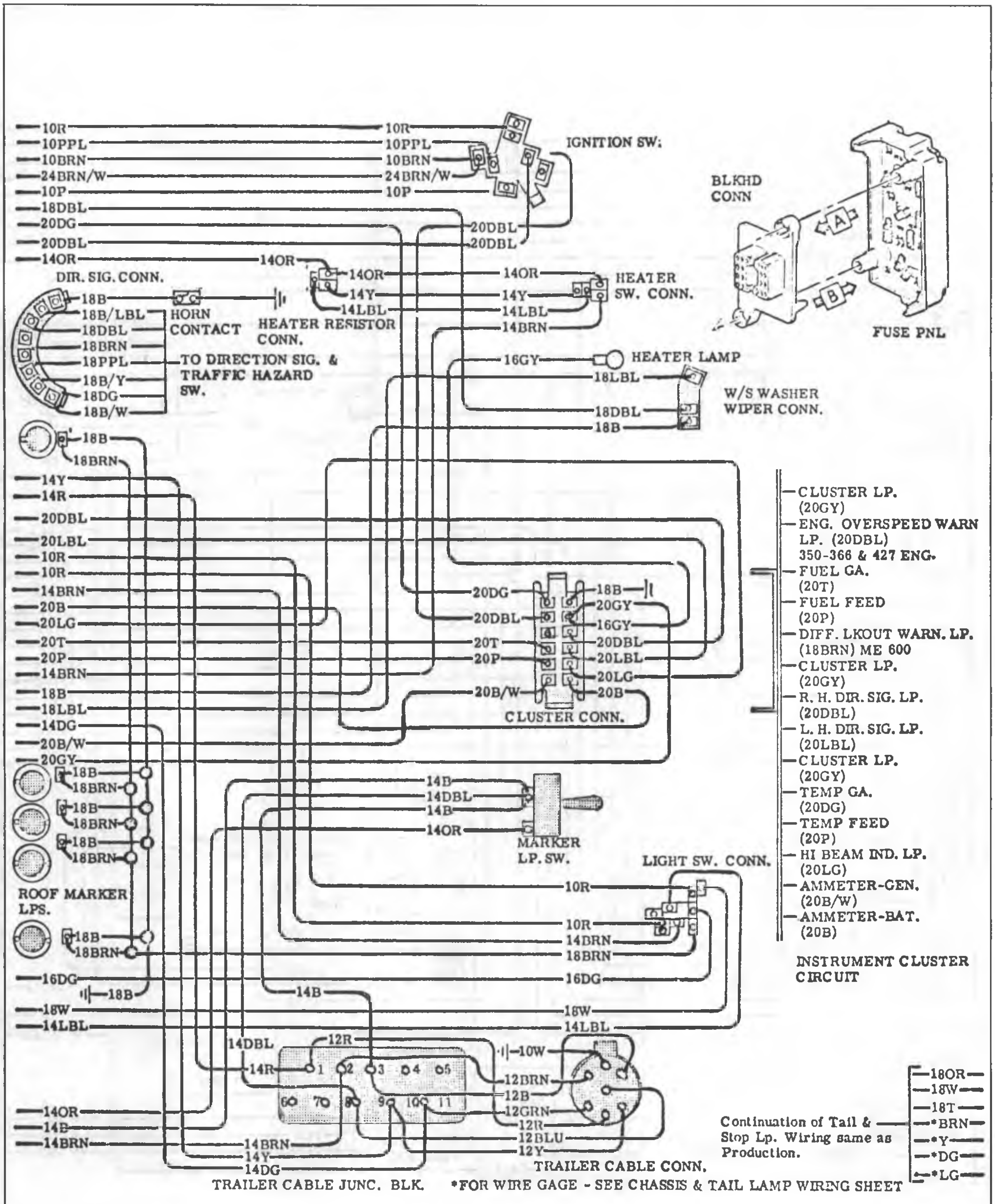


Figure 49—Trailer Jumper Cable—CE50, CE-ME60

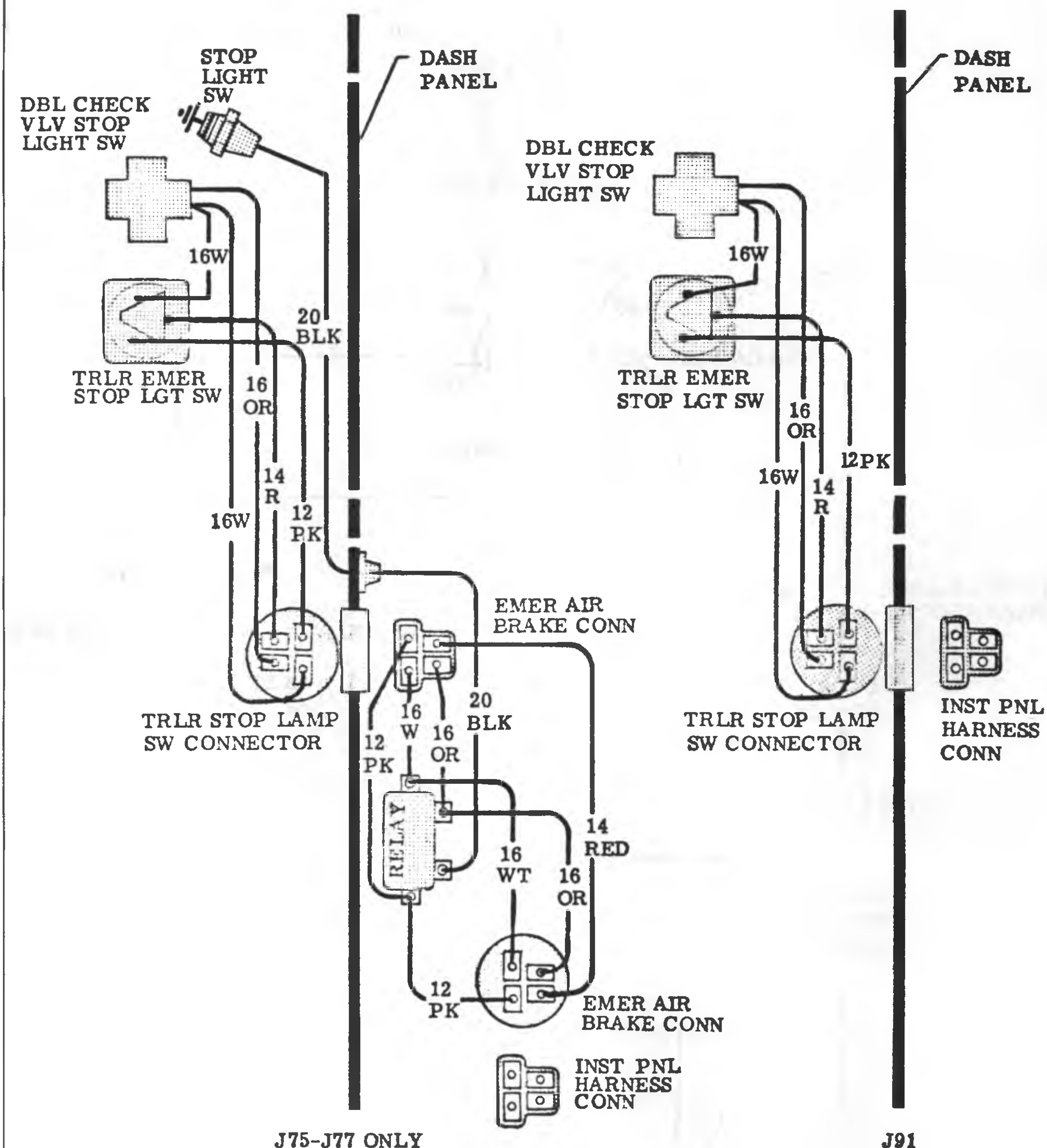


Figure 50—Trailer Jumper Cable—CE50, CE-ME60

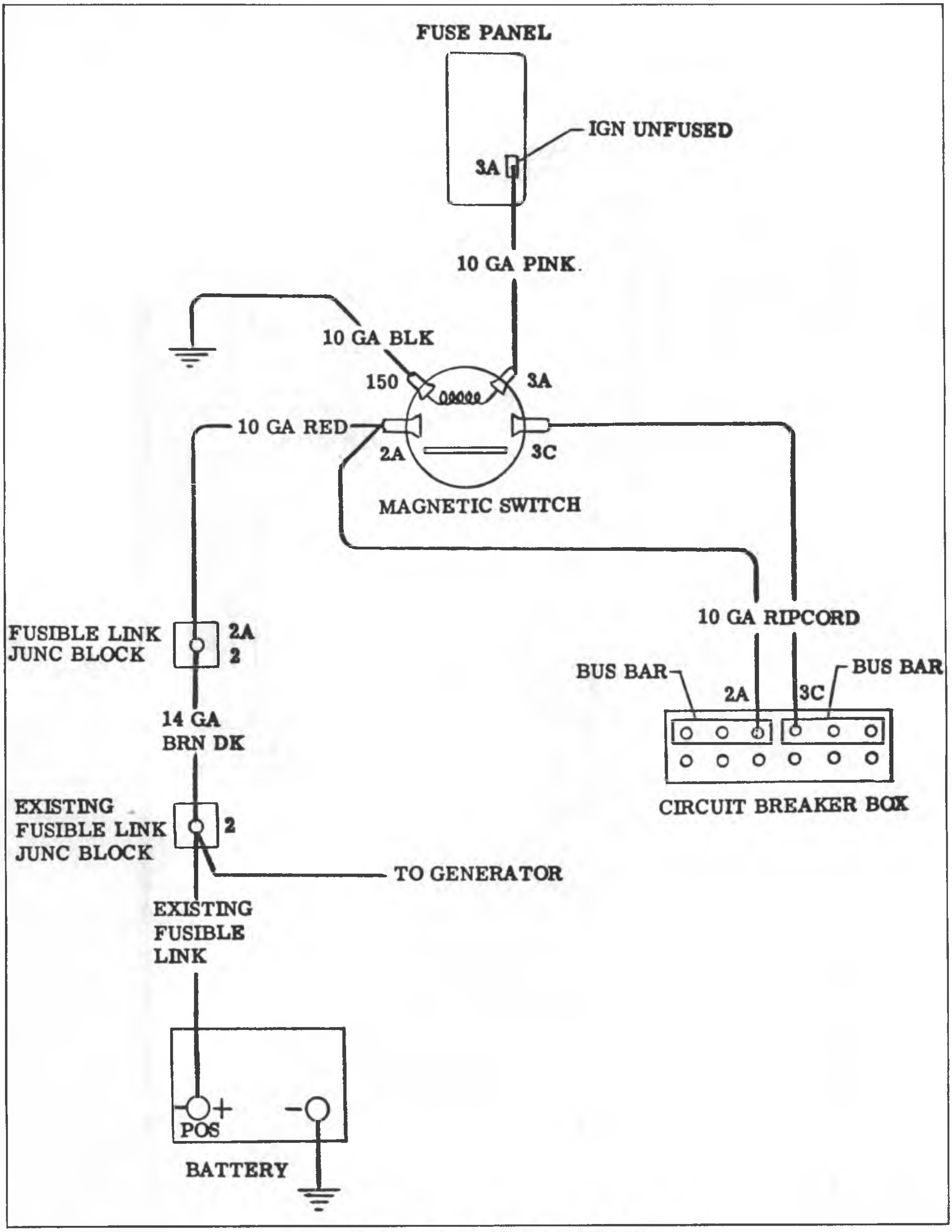


Figure 51—Power Outlet Box—CA40-50, CA-ME60

SECTION 13

Radiator and Surge Tank

NOTE: Refer to ENGINE COOLING (SEC. 6K) of this manual for information relative to engine coolant circulation, system capacities, temperature indicators, thermostats, water filters, and fan belts. Information on replacement of radiator shell and front end sheet metal is provided in SHEET METAL (SEC. 11) of this manual.

DESCRIPTION

Pressurized cooling with regulated coolant flow is standard on all models. Use of pressurized system allows increased coolant operating temperatures for improved efficiency, extended engine life, and minimum coolant loss. Pressure valve in radiator filler cap is used to maintain specified pressure within cooling system. Temperature of coolant is regulated by thermostat control in engine.

Radiator assemblies are engineered with optimum frontal core area and maximum heat transfer characteristics. All radiator assemblies are fitted with a shroud designed to assist fan in directing air flow through radiator core and also serve as a fan guard. For continuous heavy-duty applications, radiator assemblies with increased cooling capacity are available as optional equipment.

Provision for coolant expansion is achieved by maintaining an air reservoir in upper radiator tank or surge tank. This retards coolant overflow reducing necessity of frequent refills.

Surplus coolant is released through filler cap pressure valve and neck vent to which is connected an overflow tube. Purpose of overflow tube is to allow excess coolant to be released beneath vehicle.

Pressure in cooling system is maintained by use of radiator cap equipped with two valves; one which relieves excessive pressure in system and another which admits outside air to compensate for coolant contraction after engine is stopped. Radiator caps are provided with pressure ratings of 9 pounds per square inch. Coolant boiling point increases approximately 3 degrees for each additional pound of pressure. Refer to "Specifications" at end of this section for correct replacement radiator filler cap.

MAINTENANCE

At regular intervals, cooling system components should be inspected to determine if service is required. Regular systematic checks will reveal faulty condition of various units and indicate necessity of servicing or replacement of such components before failure occurs. Suggested checks are:

1. Frequently check coolant level. If low, add recommended coolant as required.

2. Check hose connections and tighten clamps if seeping is evident. Cracked, stripped, or corroded clamps should be replaced.

3. Inspect radiator hoses for spongy or checked appearance. Deteriorated hoses should be replaced before bursting occurs which would result in coolant loss and could cause extensive engine damage due to overheating.

3. Check radiator core for leaks and for accumulation of dirt which obstructs air passage and reduces effective heat transfer.

4. Inspect resilient radiator mountings for deterioration and replace as required. Keep mounting bolts tight to prevent core damage due to road shocks and vibration. Check side flanges and support braces for evidence of metal damage if mounting bolts are missing, loose, or stripped.

5. Inspect for proper clearance between fan blades, radiator core, and shroud (if equipped). Check fan attaching bolts for tightness and observe alignment of fan blades in relation to each other. Replace fan if any blade is bent. Distance between blades and shroud should be equal around entire perimeter of shroud. If adjustment is required, shroud attaching bolts may be loosened and shroud shifted as necessary to provide proper clearance.

6. Check filler cap seals for evidence of cracking or separation. Replace as required.

7. To assist in maintaining efficient heat dissipation, an occasional external flushing with water will remove majority of dirt accumulation and foreign matter from between core fins. Water under moderate pressure should be directed from behind core to force debris out in opposite direction of its entrance. Water should be directed in line with fins, not sideways, to reduce possibility of bending fins.

8. When coolant loss is evident or engine overheating occurs, the damaged or clogged radiator should be serviced by a radiator specialist or replaced with a new one. Efficient repair of radiators requires the use of special tools and equipment as well as provisions for making proper tests. If radiator core requires painting, spray with special radiator paint; do not use paint mixed with oil, as oil mixed paint will form an insulation and prevent efficient dissipation of heat.

RADIATOR MOUNTINGS

All radiator core mountings on "C" and "S" Models consist of three major components: radiator upper retainers, radiator core, and radiator lower mounts. All "T" Models employ a separate bracket mounted surge tank which serves as a coolant reservoir for the radiator core.

Type of radiator core mounting varies according to model and engine type.

RADIATOR REPLACEMENT

Due to various types of radiator mountings, the following general information applies to all

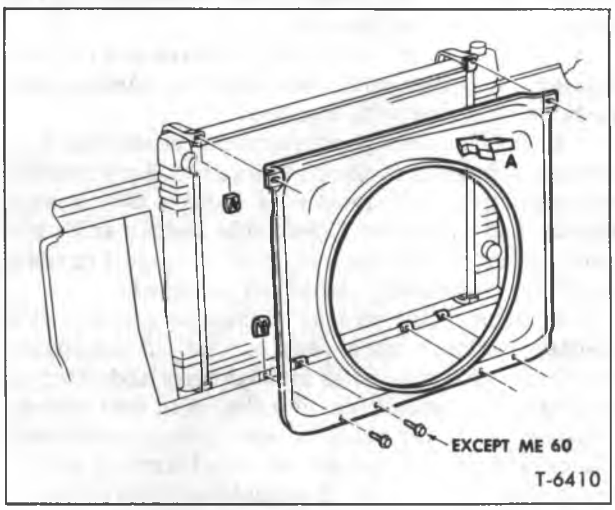


Figure 1—Radiator Fan Shroud Installation

models. The radiator assembly may include a fan shroud and an oil cooler at base of radiator core. If equipped with a fan shroud, remove attaching bolts and then lay shroud back over fan blade. When oil lines are removed, make provisions for catching oil drainage from cooler tank and lines. Do not re-use this oil. Replenish transmission to recommended level with fresh fluid after installing radiator.

Some models may be equipped with a separate power steering oil cooler which is attached in front of radiator core by means of cooler support braces. On models so equipped, it may be necessary to remove power steering oil cooler in order to replace radiator core. For information relative to removal and installation of oil cooler, see "POWER STEERING" (SEC. 9B) of this manual.

"C" AND "S" MODELS

For illustration of radiator fan shroud installation (when used) refer to figure 1. Radiator installation for conventional and cowl models 40 and 50 is illustrated in figure 2 and radiator installation for conventional cab models 60 in figure 3.

Removal

1. Drain radiator and disconnect water hoses and transmission coolant line if so equipped.

2. If vehicle is equipped with a fan shroud, remove shroud attaching screws (fig. 1) and carefully hang shroud over engine fan assembly to provide clearance for radiator removal.

3. Remove screws securing radiator retainers to radiator support and remove retainers and bumpers.

4. Lift radiator up out of lower mounts. Lift shroud out of vehicle.

5. Inspect lower pads and retainers and replace if necessary.

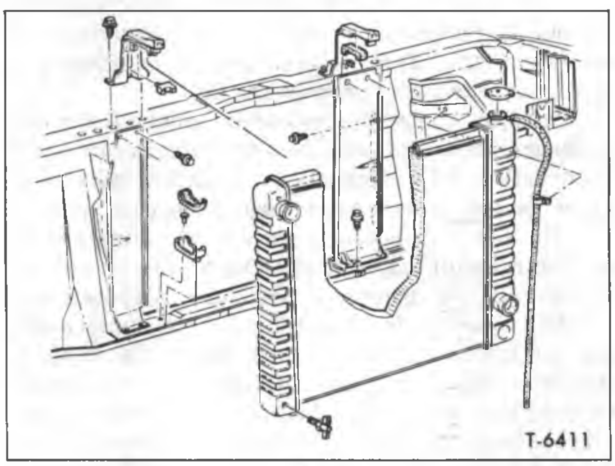


Figure 2—Radiator Installation (All Conv. and Cowl Models 40, 50) (Typical)

Installation

1. Lower shroud and radiator into position and secure shroud with bottom attaching screws.
2. Install two retainers at top of radiator and shroud with four screws.
3. Complete installation of shroud with two screws to radiator retainer.
4. Connect radiator hoses and transmission coolant line, fill cooling system, and check for leaks.
5. Refer to "Torque Specifications" for correct torque values.

"T" MODELS (Fig. 4)

Removal

1. Drain radiator.
2. Disconnect throttle linkage at linkage bracket on radiator support.
3. Remove electrical components from radiator support assembly.
4. Disconnect upper and lower coolant hoses from radiator.
5. If vehicle is equipped with air conditioning or power steering cooling coils, remove coils if necessary.
6. Remove nuts, washers, and springs from U-bolt.
7. Remove upper mounting bolts and rubber bushings.
8. To remove radiator and support assembly, tilt assembly forward and lift assembly out of vehicle.
9. To remove radiator core assembly from support assembly, remove cap screws from fan shroud and remove fan shroud. Remove cap screws attaching radiator core assembly to support assembly and remove core assembly.

Installation

1. Position radiator core assembly in support assembly and secure with cap screws.
2. Install fan shroud and retain with cap screws.

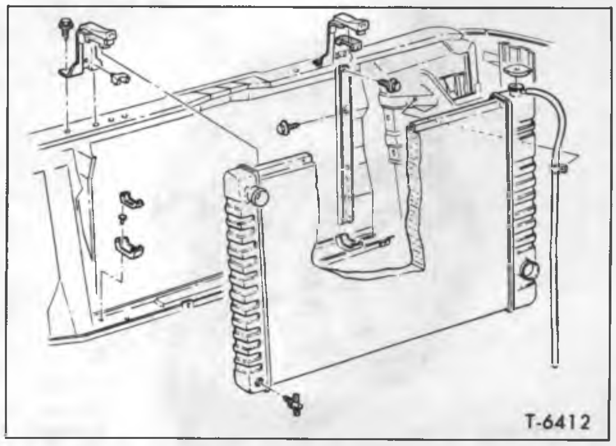


Figure 3—Radiator Installation (Conv. Cab Models—60)

3. Carefully place radiator and support assembly in vehicle. Be sure components of lower mount are properly positioned.
4. Assemble radiator upper mounts and complete assembly of lower mounts. When installing lower mount be sure to position shims and cushions as shown and to compress the mounting springs to dimension shown in figure 4.
5. Connect upper and lower coolant hoses to radiator.
6. Install air conditioning or power steering cooling coils (if removed).
7. Install electrical components on radiator and connect throttle linkage to radiator support.
8. Fill cooling system and inspect system for leaks.

TORQUE SPECIFICATIONS (ALL MODELS)

Retainer to Radiator Support Screws	150 in. lbs.
Radiator Drain Cock	118 in. lbs.
Shroud Attaching Screws	43 in. lbs.

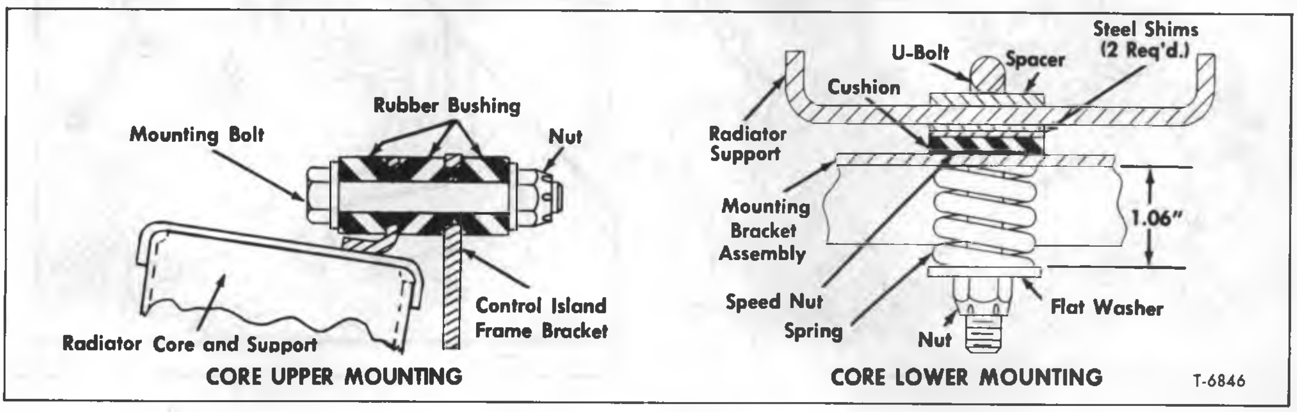


Figure 4—Radiator Mountings ("T" Models)

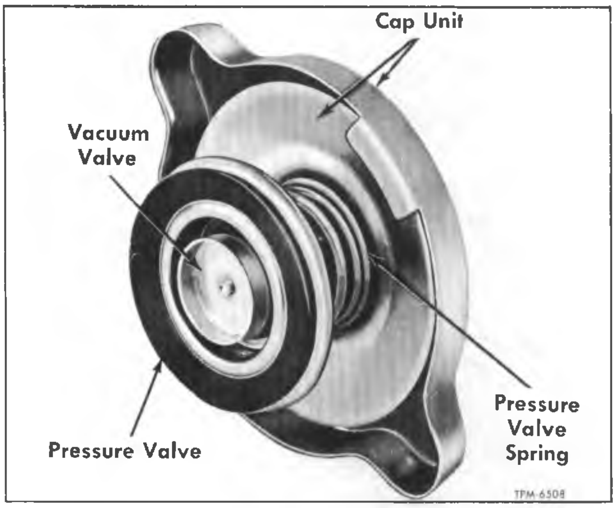


Figure 5—Pressure Relief Valve and Filler Cap

PRESSURE RELIEF VALVE AND FILLER CAP

Pressure relief valve assembly, integral with radiator filler cap, incorporates a pressure valve and a vacuum valve (fig. 5). When pressure in system reaches valve setting (see "Specifications" at end of this section), pressure valve opens and vapor is allowed to escape. As liquid in system cools it contracts; this allows pressure valve to close and also creates a partial vacuum in system. Atmospheric pressure acting through overflow tube unseats vacuum valve and allows air to enter system. The overflow pipe connects to valve outside the valve seal; thus no liquid or air can escape from the system when both valves are in the closed position.

Radiator filler cap is constructed with a spring-loaded rubber seal which is pressed firmly against surface of filler neck seat when cap is installed. Rubber seal must be in good condition and top of radiator filler neck must be clean and smooth in order to form an air-tight seal. Seal of filler cap and operation of pressure relief valve can be checked using a conventional cooling system testing kit.

NOTE: When engine is at normal operating temperature or above, the internal pressure built up in the cooling system will blow out scalding fluid and vapors if the radiator cap is suddenly removed. To prevent loss of coolant and to avoid the danger of being burned, the coolant level should be checked or coolant added only when the engine is cool. If the cap must be removed when the engine is hot, place a cloth over the cap and rotate the cap slowly counterclockwise to first stop and allow pressure to escape completely. Then turn cap again slowly counterclockwise to remove.

RADIATOR SURGE TANK

A separate radiator surge tank on all "T" Models, is mounted to rear of control island framing. A surge tank is also available on other models as optional equipment (see fig. 6). Tank serves as a coolant reservoir for the radiator core which is mounted at front of engine. Hoses and pipes connect tank to radiator and water pump. Surge tank incorporates the cooling system filler cap which is accessible from inside cab ("T" Models) through door at top of seat riser. Tilt cab forward to gain

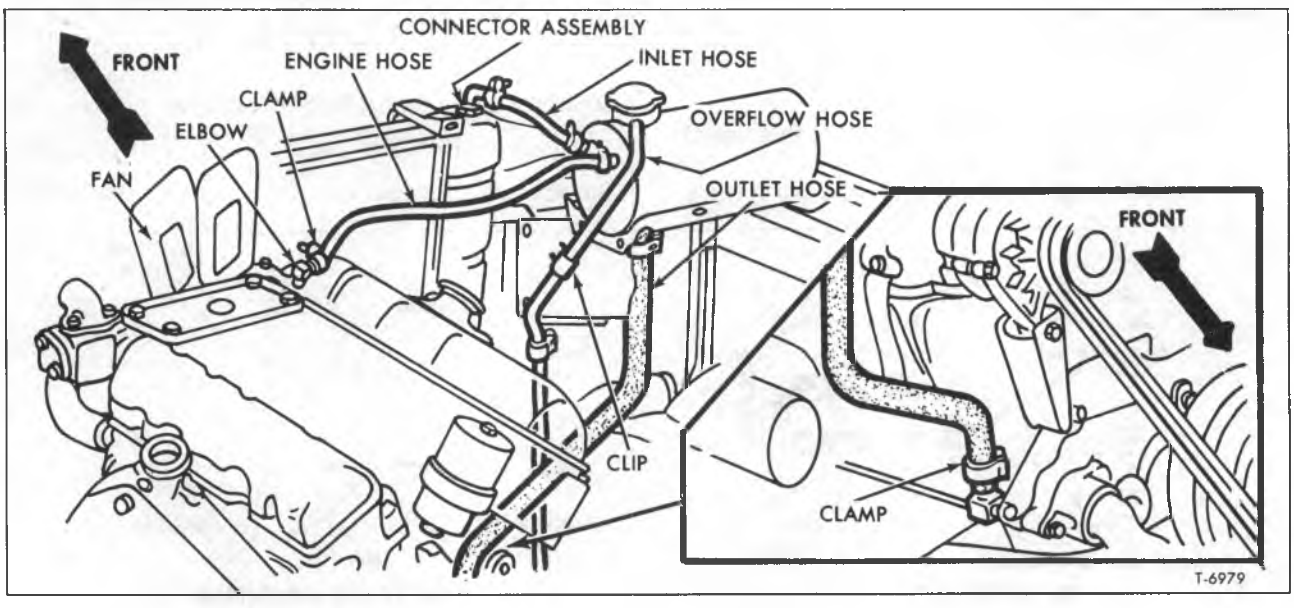


Figure 6—Surge Tank Mounting (Typical)

access to surge tank. Tank is in engine compartment on other models.

At regular intervals check tank and connecting hoses for leaks. Keep hose clamps and mounting bolts tightened securely.

ENGINE COOLANT

COOLANT RECOMMENDATIONS

The year-around engine coolant used to fill the cooling system at the factory is a high quality solution that meets General Motors Specification 1899-M. This factory-fill coolant solution is formulated to withstand two full calendar years of normal operation without draining or adding inhibitors, provided the same concentration of coolant is added if the system needs additional fluid between drain periods. The original factory fill coolant provides freezing protection to -20°F.

Every two years, the cooling system should be serviced as described in ENGINE COOLING (SEC. 6K) of this manual. A thorough description of inspection, draining, and cleaning of the cooling system is given.

IMPORTANT: Alcohol, methanol base coolants, or plain water are not recommended. Only a sufficient amount of Ethylene Glycol base coolant meeting GM Specification 1899-M should be used. DO NOT use glycol ether (methoxy propanol type) base permanent type anti-freeze coolants in DH478 diesel engine as damage to cylinder head gasket seals will occur.

COOLANT TESTING

Always test solution before adding water or anti-freeze. Engine should be warmed up to operating temperature. Fill and empty tester several times to warm tester before using. Keep tester clean inside and out.

Some testers will indicate correct freezing point only when test is made at a specific temperature. Other testers are provided with thermometers and tables and indicate freezing points corresponding to readings made at various temperatures. Disregarding temperatures of solution may cause an error as large as 30°F. Read and be guided by instructions furnished by tester manufacturer.

In the event coolant freezes solid in extreme cold weather, place vehicle in warm building or improvise some means of thawing coolant before starting engine. Under no circumstances should engine be operated when coolant is frozen solid. After thawing, refill system with a higher concentration of anti-freeze solution and start engine. Inspect entire system for leakage and then test coolant with hydrometer to determine if adequate anti-freeze protection is provided.

COOLANT PRECAUTIONS

1. Overheating is not always caused by a defective cooling system; incorrect ignition timing, dragging brakes, under-inflated tires, and improper use of transmission gears can cause overheating.
2. Keep water pump and fan drive belts at proper tension. Refer to ENGINE COOLING SYSTEM (SEC. 6K) of this manual.
3. Do not over-fill cooling system. Expansion of coolant when hot will cause loss of coolant through overflow tube.
4. Do not remove radiator filler cap when engine is hot. Wait until system cools off.
5. Do not pour cold water into cooling system when the engine is hot. Wait until system cools off.
6. If cooling system requires frequent refilling, check for leaks.
7. Keep all connections tight, and make sure gasket on radiator filler cap is in good condition.
8. When filling system with anti-freeze solution ALWAYS FOLLOW RECOMMENDATIONS of anti-freeze manufacturer.
9. Use only Ethylene Glycol base coolant meeting GM Specification 1899-M. DO NOT use Glycol Ether (Methoxy Propanol Type) in GMC Diesel engines.
10. Drain and flush cooling system every other year, preferably at start or end of winter operation.

SPECIFICATIONS

COOLING SYSTEM PRESSURE RELIEF VALVE		
MODELS	VALVE STAMPED	OPENING PRESSURE
All Models	RC-12-9#	9 psi

RADIATOR AND SURGE TANK

Always use coolant containing rust and corrosion inhibitor compounds.

When vehicle is operated in freezing weather, protect cooling system by use of permanent-type antifreeze.

Special Tools

References are made to special tools in the various sections of this manual. These tools, or their equivalent, are necessary and are recommended to readily and efficiently accomplish certain service operations.

SECTION 1 — CAB AND BODY

Tool No.	Tool Name
J-2189	Weatherstrip Tool Set
J-9316	Windshield Alignment Blocks (Tilt Cab)
J-5742-01 & J-9886	Door Inside Handle Clip Remover
J-22577	Windshield Checking Blocks
J-22585	Door Hinge Bolt Wrench
AIR CONDITIONING	
J-5725-04	Gauge Set
J-5420	Valve Adapter
J-9459	Valve Adapter
J-5428 or J-5428-02	Vacuum Pump
J-5428-03	Vacuum Pump
J-8695-18	Hose-to-Drum Adapter
J-6084	Leak Detector
J-6272-01	Multi-Opener
J-6271	Fits-All Valve (1 Can Opener)
J-8393	Deluxe Portable A/C Service Station
J-22132-01	Schrader Valve Core Remover and Installer
J-22974	Seal Installation Tool
J-23573	Belt Tension Gauge
J-23586	Belt Tension Gauge

SECTION 3C — FRONT SPRINGS

J-8806	Ball Joint Stud Remover
*J-21058	Bushing Remover and Replacer Set (Plain Spring Eye Bushing)
J-21978-1 & 2	Bushing Remover and Replacer Set
J-21979	Bushing Remover and Replacer (Oval Adapter)
J-21830-4	Spring Bushing Receiver
J-21830-7	Spring Bushing Receiver Bridge
J-22620-1	Spring Bushing Remover and Installer

SECTION 4A — REAR AXLE

J-8107	Power Shift Cylinder Piston Replacer
J-3453	Pinion Yoke Holding Bar
J-22281	Pinion Oil Seal Installer - H135, H110, and H150
J-22283	Pinion Oil Seal Installer - T150

SECTION 4B — REAR SPRINGS

*J-21058	Remover and Replacer (Plain Spring Eye Bushing)

*Listed in more than one section.

SECTION 4C — REAR HUBS AND BEARINGS

Tool No.	Tool Name
J-870	Wheel Bearing Nut Wrench H110 & H135
J-5955	Wheel Bearing Nut Wrench H150 & T150
	Tru-Arc Snap Ring Pliers
J-7757	Wheel Bearing Wrench Set
Consists of next 7 items:	
J-7757-1	3¼" Octagon
J-7757-2	3-13/16" Octagon
J-7757-3	4" Hexagon
J-7757-4	4-3/8" Octagon
J-7757-5	4-7/8" Octagon
J-7757-6	Extension Bar ¾" Drive
J-7341	3½" Octagon

SECTION 5A — HYDRAULIC BRAKES

J-23449 J-23449-2)	Switch Adjusting Tool
J-22348	Brake Spring Replacer (Twin Action)
J-23573	Strand Tension Gauge

SECTION 5B — AIR BRAKES

J-23527	Spring Compressor

SECTION 6A — GASOLINE ENGINES

IN-LINE ENGINES

J-6978	Crankshaft Damper Puller
J-22197	Crankshaft Damper Installer
J-5892	Valve Spring Compressor (Head Installed)
J-8062	Valve Spring Compressor (Head Removed)
J-0995	Front Cover Oil Seal Installer (Cover Removed)
J-8340	Front Cover Oil Seal Installer (Cover Installed)
J-0966	Front Cover Centering Gauge
J-21742	Front Cover Centering Gauge
J-6978	Crankshaft Damper Remover
J-22197	Crankshaft Damper Installer (Drive-On Type)
J-21058	Crankshaft Damper Installer (Pull-On Type)
J-22808	Flywheel Dowel Pin Hole Reamer
J-0971	Front Cover Support Tool

SPECIAL TOOLS

V8 ENGINES

J-5892	Valve Spring Compressor (Head Installed)
J-6978	Crankshaft Damper Remover
J-21058	Crankshaft Damper and Sprocket Installer
J-1619	Crankshaft Sprocket Remover (366 and 427 Engines)
J-5825	Crankshaft Sprocket Remover (350 Engine)
J-23042	Cover Oil Seal Installer (350 Engine w/Cover Removed)
J-0971	Cover Support Tool
J-22102	Cover Oil Seal Installer (366 and 427 Engines)
J-8340	Cover Oil Seal Installer (350 Engine)
J-5590	Crankshaft Sprocket Installer (350 Engine)

SECTION 6K – ENGINE COOLING

* J-23600	Belt Tension Gauge

SECTION 6M – GASOLINE ENGINE FUEL SYSTEM

J-8824	Float Gauge (Bendix Stromberg)
J-4395	Float Lever Bending Tool (Bendix-Stromberg)
J-10176	Idle Adjust Wrench

*Listed in more than one section.

SECTION 6T – AIR COMPRESSOR

* J-23600	Belt Tension Gauge

SECTION 6Y – ENGINE ELECTRICAL

BATTERY

J-22552	Battery Tester - Charger (421 Test)

IGNITION SYSTEM

S-9704B	Spark Plug Wrench Socket (13/16" Plugs)
J-22694	Spark Plug Wrench Socket (5/8" Tapered Seat Plugs)
J-6296-01	Distributor Adjusting Wrench

A.C. GENERATING SYSTEM
(NON-INTEGRAL TYPE)

J-9782-1	Test Adapter Jumper Wire
J-9782-3	Regulator Test Adapter
J-21600	Test Adapter
J-544	Brush Spring Scale
J-22973	Thermometer
J-23586	Poly-V Belt Tension Gauge

SECTION 7A – TRANSMISSION CONTROL

J-23739	TV Linkage Adjustment Gauge

SECTION 7B – TRANSMISSION ON–VEHICLE SERVICE

J-8109	Gearshift Lever Remover

WEIGHTS AND MEASURES

LINEAR MEASURE

1/12 foot (ft.)	=1 inch (in.)
12 inches	=1 foot
3 feet	=1 yard (1 yd.)

AREA MEASURE

1/144 square foot (sq. ft.)	=1 square inch (sq. in.)
144 square inches	=1 square foot
9 square feet	=1 square yard (sq. yd.)

LIQUID MEASURE

1/16 pint (pt.)	=1 ounce (oz.)
1 pint	=16 ounces
2 pints	=1 quart (qt.) = 32 ounces
4 quarts	=1 gallon (gal.)
31 1/2 gallons	=1 barrel (bbl.)

DRY MEASURE

1/2 quart (qt.)	=1 pint (pt.)
2 pints	=1 quart (qt.)
8 quarts	=1 peck (pk.)
4 pecks	=1 bushel (bu.)
105 quarts	=1 barrel

CUBIC MEASURE

1,728 cubic inches	=1 cubic foot
27 cubic feet	=1 cubic yard

COMMON WEIGHT

16 ounces	=1 pound
100 pounds	=1 hundred weight (cwt.)
2000 pounds	=1 ton

COMMON U.S.A. EQUIVALENTS

LENGTH

1 inch	=25.4001 millimeters
1 millimeter	=0.03937 inches
1 foot	=0.304801 meters
1 meter	=3.28083 feet
1 yard	=9.914402 meters
1 meter	=1.093611 yards
1 mile	=1.609347 kilometers
1 kilometer	=0.621370 miles

LIQUID CAPACITY

1 quart	=0.94633 liters
1 liter	=1.05671 quarts
1 gallon	=3.78533 liters
1 liter	=0.26418 gallons

DRY CAPACITY

1 quart	=1.1012 liters
1 liter	=0.9081 quarts
1 peck	=8.810 liters
1 liter	=0.11351 pecks

DECIMAL EQUIVALENTS

1/64	.015625	33/64	.515625
1/32	.03125	17/32	.53125
3/64	.046875	35/64	.546875
1/16	.0625	9/16	.5625
5/64	.078125	37/64	.578125
3/32	.09375	19/32	.59375
7/64	.109375	39/64	.609375
1/8	.125	5/8	.625
9/64	.140625	41/64	.640625
5/32	.15625	21/32	.65625
11/64	.171875	43/64	.671875
3/16	.1875	11/16	.6875
13/64	.203125	45/64	.703125
7/32	.21875	23/32	.71875
15/64	.234375	47/64	.734375
1/4	.25	3/4	.75
17/64	.265625	49/64	.765625
9/32	.28125	25/32	.78125
19/64	.296875	51/64	.796875
5/16	.3125	13/16	.8125
21/64	.328125	53/64	.828125
11/32	.34375	27/32	.84375
23/64	.359375	55/64	.859375
3/8	.375	7/8	.875
25/64	.390625	57/64	.890625
23/32	.40625	29/32	.90625
27/64	.421875	59/64	.921875
7/16	.4375	15/16	.9375
29/64	.453125	61/64	.953125
15/32	.46875	31/32	.96875
31/64	.484375	63/64	.984375
1/2	.5	1	

GAGES

GAGE NO.	U. S. STANDARD GAGE* Approx. Thickness—Inches	AMERICAN WIRE or B & S GAGE Thickness—Inches
0000000	0.490	
000000	.460	0.5800
00000	.429	.5165
0000	.398	.4600
000	.368	.4096
00	.337	.3648
0	.306	.3248
1	.2757	.2893
2	.2604	.2576
3	.2451	.2294
4	.2298	.2043
5	.2145	.1819
6	.1991	.1620
7	.1838	.1443
8	.1685	.1285
9	.1532	.1144
10	.1379	.1019
11	.1225	.0907
12	.1072	.0808
13	.0919	.0720
14	.0766	.0641
15	.0689	.0571
16	.0613	.0508
17	.0551	.0453
18	.0490	.0403
19	.0429	.0359
20	.0368	.0320
21	.0337	.0285
22	.0306	.0253
23	.0276	.0226
24	.0245	.0201
25	.0214	.0179
26	.0184	.0159
27	.0169	.0142
28	.0153	.0126
29	.0138	.0113
30	.0123	.0100
31	.0107	.00893
32	.0100	.00795
33	.0092	.00708
34	.0084	.00630
35	.0077	.00561
36	.0069	.00500
37	.0065	.00445
38	.0061	.00397
39	.0057	.00353
40	.0054	.00314
41	.0052	
42	.0050	
43	.0048	
44	.0046	

DRILL SIZES

Letter Sizes	Drill Diam. Inches	Wire Gage Sizes	Drill Diam. Inches	Wire Gage Sizes	Drill Diam. Inches	Wire Gage Sizes	Drill Diam. Inches
Z	0.413	1	0.2280	28	0.1405	55	0.0520
Y	0.404	2	0.2210	29	0.1360	56	0.0465
X	0.397	3	0.2130	30	0.1285	57	0.0430
W	0.386	4	0.2090	31	0.1200	58	0.0420
V	0.377	5	0.2055	32	0.1160	59	0.0410
U	0.368	6	0.2040	33	0.1130	60	0.0400
T	0.358	7	0.2010	34	0.1110	61	0.0390
S	0.348	8	0.1990	35	0.1100	62	0.0380
R	0.339	9	0.1960	36	0.1065	63	0.0370
Q	0.332	10	0.1935	37	0.1040	64	0.0360
P	0.323	11	0.1910	38	0.1015	65	0.0350
O	0.316	12	0.1890	39	0.0995	66	0.0330
N	0.302	13	0.1850	40	0.0980	67	0.0320
M	0.295	14	0.1820	41	0.0960	68	0.0310
L	0.290	15	0.1800	42	0.0935	69	0.0292
K	0.281	16	0.1770	43	0.0890	70	0.0280
J	0.277	17	0.1730	44	0.0860	71	0.0260
I	0.272	18	0.1695	45	0.0820	72	0.0250
H	0.266	19	0.1660	46	0.0810	73	0.0240
G	0.261	20	0.1610	47	0.0785	74	0.0225
F	0.257	21	0.1590	48	0.0760	75	0.0210
E	0.250	22	0.1570	49	0.0730	76	0.0200
D	0.246	23	0.1540	50	0.0700	77	0.0180
C	0.242	24	0.1520	51	0.0670	78	0.0160
B	0.238	25	0.1495	52	0.0635	79	0.0145
A	0.234	26	0.1470	53	0.0595	80	0.0135
		27	0.1440	54	0.0550		

PROMPT DEPENDABLE QUALITY

SUPER

CHEVROLET

SERVICE