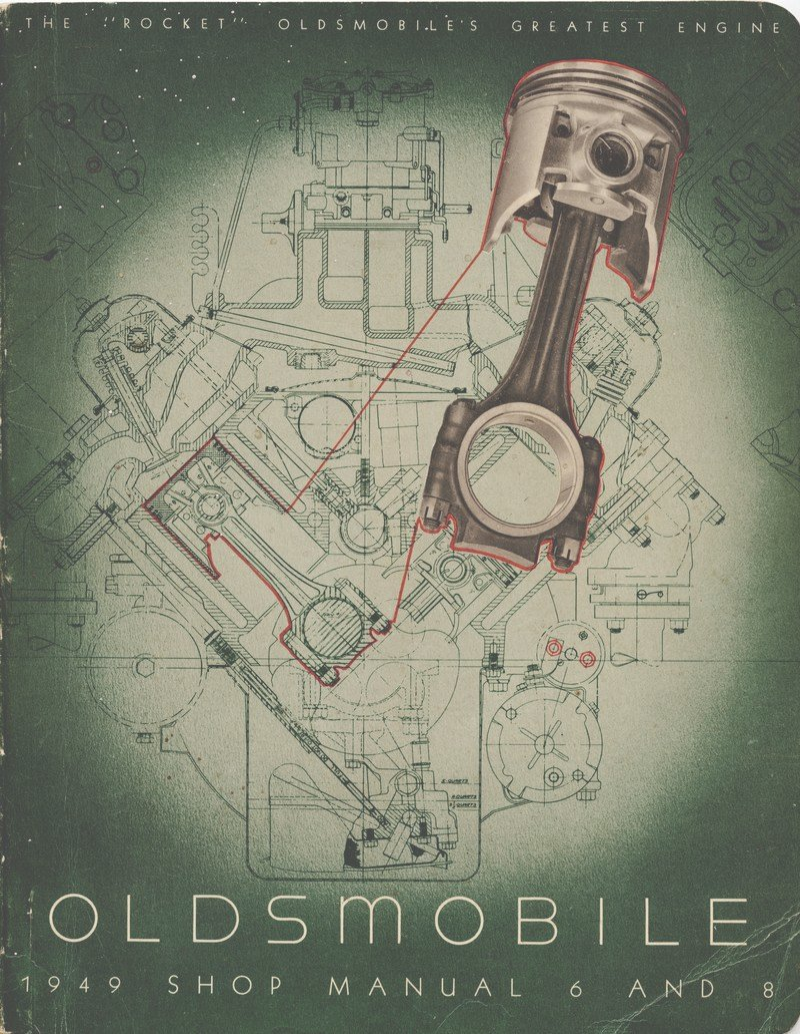
THE "ROCKET" OLDSMOBILE'S GREATEST ENGINE



OLDSMOBILE

1949 SHOP MANUAL 6 AND 8

1949 OLDSMOBILE SHOP MANUAL

■

Price

One Dollar and Fifty Cents

■

FOREWORD

This manual is compiled to provide Oldsmobile service men with proper adjustment and repair procedure for the 1949 models.

An understanding of this manual and the supplementary product bulletins, which are issued when necessary, will help to maintain Oldsmobile's product reputation which is the highest in the industry.

■

Service Department

OLDSMOBILE DIVISION

General Motors Corporation

LANSING, MICHIGAN

PRINTED IN U.S.A.

GENERAL INFORMATION

1949 MODEL DESIGNATION

Series	Fisher Body Style Number	Car Orders	Body Style
76 and 88 Series, 119½" Wheelbase	3507	CS	Club Sedan
	3508	TS	Town Sedan
	3527	CC	Club Coupe
	3569	S	Sedan (4 Dr.)
	3567X	CR	Convertible Coupe
	3507D	DCS	Deluxe Club Sedan
	3508D	DTS	Deluxe Town Sedan
	3527D	DCC	Deluxe Club Coupe
	3561D	DSW	Deluxe Station Wagon
	3569D	DS	Deluxe Sedan (4 Dr.)
98 Series, 125" Wheelbase	3807	CS	Club Sedan
	3869	S	Sedan
	3807D	DCS	Deluxe Club Sedan
	3869D	DS	Deluxe Sedan
	3867X	DCR	Deluxe Convertible Coupe

ENGINE STARTING NUMBERS FOR 1949

The eight cylinder engine number is stamped below the left hand cylinder head on the front surface of the left hand bank cylinder block as shown in Fig. 2. The number is stamped upside down so it can be read with a mirror.

The six cylinder engine number is located at the left front top corner of the cylinder block.

Each engine number is prefixed by a digit and a letter; the digit indicating number of cylinders, and the letter indicating compression ratio. The six cylinder Hydra-Matic equipped engines are suffixed with the letter "H"; inasmuch as all eight cylinder models are Hydra-Matic equipped, however, no engine suffix letter is used for these cars.

The starting engine numbers for 1949 cars are:

6A1001 for six cylinder engines.

8A1001 for eight cylinder engines.

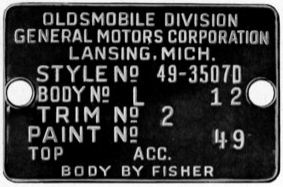


Fig. 1. Body Number Plate

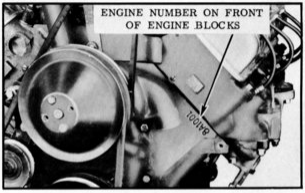


Fig. 2. Rocket Engine Number Location

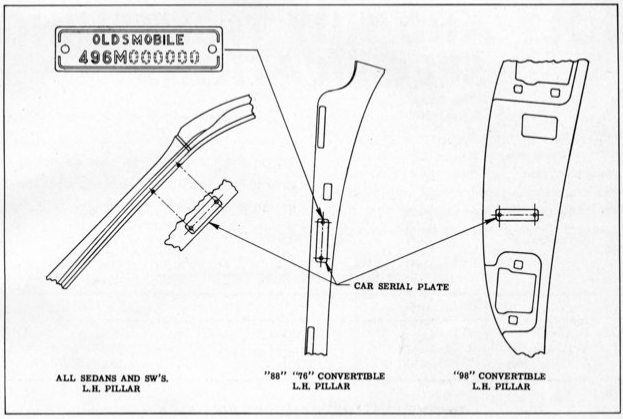


Fig. 3. Serial Number Location

STARTING SERIAL NUMBERS FOR 1949

Built At:	*76 Series*	*88 Series*	*98 Series*
Lansing, Michigan	496M1001	498M1001	499M1001
Atlanta, Georgia	496A1001	498A1001	499A1001
Framingham, Massachusetts	496B1001	498B1001	499B1001
Kansas City, Kansas	496K1001	498K1001	499K1001
Linden, New Jersey	496L1001	498L1001	499L1001
South Gate, California	496C1001	498C1001	499C1001
Wilmington, Delaware	496W1001	498W1001	499W1001

The 1949 car serial number plates are located on the left hand body pillar posts as illustrated in Fig. 3.

Each serial number is prefixed by three numbers and a letter; the first two numbers (49) indicate the year, 1949. The third prefix number designates the model, "6" indicating 76 series, "8" indicating 88 series, and "9" indicating 98 series. The letter used in each prefix identifies the assembly plant at which the car was built, the letter "M" indicating a Lansing-built car; "A", an Atlanta-built car, etc. ALWAYS SHOW COMPLETE ENGINE AND SERIAL NUMBERS IN REPORTS AND CORRESPONDENCE.

BOLT AND NUT TIGHTENING SPECIFICATIONS

Proper tightening of bolts and nuts is frequently the difference between a permanent satisfactorily operating automobile and an unsatisfactory one. In order that Oldsmobile service men can tighten bolts and nuts to recommended engineering specifications, tightening charts are shown below and on the following pages.

These torque wrench specifications are based on use of new (clean) bolts and nuts. Due to increased friction build-up, they do not apply to rusty bolts and nuts. Therefore, when installing previously used bolts and nuts, make sure threads are CLEAN.

6 Cylinder Engine

	APPLICATION	FT. LBS.
1.	Clutch to Flywheel Bolts	22-26
2.	Clutch Housing to Block Bolts	50-55
3.	Clutch Pan Bolts	11-14
4.	Clutch Release Ball Stud	70-80
5.	Connecting Rod Bolt & Nuts	45-50
6.	Crankshaft Front End Bolt	130-140
7.	Cylinder Head Bolts	60-70
8.	Exhaust to Intake Manifold Bolts	22-26
9.	Flywheel Cover to Flywheel—(H-T)	30-35
10.	Front Engine Plate to Block Bolts	22-26
11.	Front Mounting to Cover Nuts	30-35
12.	Flywheel to Crankshaft Bolts	55-60
13.	Generator Link & Timing Cover to Block	14-18
14.	Ignition Coil to Block Nut	9-11
15.	Main Bearing Bolts No. 1, 2, & 3	100
16.	Main Bearing Bolts—(Rear)	140
17.	Manifold to Block Nuts	11-14
18.	Oil Pan Bolts	9-11
19.	Oil Pan Drain Plug	22-26
20.	Oil Pump to Block	30-35
21.	Oil Pump Cover Bolts	2-4
22.	Oil Screen Body Bracket Bolt	9-11
23.	Piston Pin Lock Screws	9-11
24.	Spark Plugs	28-35
25.	Timing Chain Cover Bolts & Nuts	11-14
26.	Timing Chain Cover to Block Bolts 5/16"	11-14
27.	Timing Chain Cover to Block Bolts ⅜"	35-40
28.	Timing Chain Sprocket to Camshaft Bolts	11-14
29.	Transmission to Housing Bolt & Nuts	60-70
30.	Water Outlet to Head Bolts	22-26
31.	Water Pump to Block Bolts	22-26
32.	Water Pump Cover Bolts	2-4

8 Cylinder Engine

	APPLICATION	FT. LBS.
1.	Air Circulating Baffle Bolt	2-4
2.	Bearing Housing to Front Cover	11-14
3.	Camshaft Thrust Plate to Cyl. Block Bolt	2-4
4.	Carburetor to Intake Manifold Nut	11-14
5.	Connecting Rod Nut	45-50
6.	Crankcase Ventilator Baffle Bolts	9-11
7.	Crankshaft Bearing Cap Bolt No. 1, 2, 3 & 4	100
8.	Crankshaft Bearing Cap Bolt (Rear)	140
9.	Cylinder Block Top Cover Bolt	3-4
10.	Cylinder Head to Block Bolt	60-70
11.	Exhaust Manifolds to Cylinder Head Nut	22-26
12.	Filter Assembly to Cyl. Block	30-35
13.	Filter Housing to Base Bolt	40-45
14.	Flywheel to Crankshaft Bolt	65-70
15.	Flywheel Cover Housing to Block & Flywheel Hsg.	50-55
16.	Flywheel Lower Housing Cover Bolt	2-4
17.	Flywheel Lower Housing to Cyl. Block Bolt	50-55
18.	Front Cover to Cylinder Block Bolts	30-35
19.	Front Mounting Brkt. to Front Cover Bolts	22-26
20.	Fuel and Vac. Pump to Cyl. Block Bolt	35-40
21.	Gear & Eccentric to Camshaft Bolt	16-20
22.	Generator Bracket to Int. Manifold Bolt	22-26
23.	Harmonic Balancer to Crankshaft Bolt	130-140
24.	Idler Pulley to Adjusting Arm Nut	30-35
25.	Idler Pulley Arm & Cover to Block	45-50
26.	Ignition Coil to Intake Manifold Bolt	9-11
27.	Intake Manifold to Cylinder Head Bolt	22-26
28.	Intake Manifold to Cylinder Head Nut	22-26
29.	Oil Filter Pad Cover Bolts	30-35
30.	Oil Level Indicator Outer Guide	15-20
31.	Oil Pan Bolts	9-11
32.	Oil Pan Drain Plug	22-26
33.	Oil Pump Cover to Pump Body Bolt	2-4
34.	Oil Pump Relief Valve Plug	35-40
35.	Pan to Flywheel Cover Housing	9-14
36.	Pan to Flywheel Lower Housing	50-55
37.	Pump Assembly to Bearing Cap	11-14
38.	Rear Mounting Support Bolt	45-50
39.	Rocker Shaft Bracket to Cyl. Head Bolt	18-22
40.	Screen Cover to Oil Pump Body	2-4
41.	Spark Plugs	28-35
42.	Starter Motor to Flywheel Lower Hsg. Nut & Bolt	45-50
43.	Torus Cover to Flywheel Bolt	30-35
44.	Transmission to Housing Bolt	60-70
45.	Valve Cover Bolts	2-3
46.	Water Outlet Hole Cover Nuts	22-26
47.	Water Outlet to Manifold	22-26

Chassis

APPLICATION	FT. LBS.
1. Battery Box Cover Nut	1.5-2.5
2. Body Bolt 7/16"	25-30
3. Body Bolt ½"	45-50
4. Bolt Used in Conjunction with Spring Nut	4-6
5. Clutch & Brake Pedal Shank Nut	20-25
6. Cross Shaft Inner Lever to Shaft	10-12
7. Differential to Axle Housing Bolt	40-45
8. Differential Pedestal Cap Bolt	70-75
9. Front Brake to Steering Knuckle Bolt & Nut	35-40
10. Front Motor Mounting to Frame Bolt	25-30
11. Front Shock to Frame Bolt & Nut	55-60
12. Front Stabilizer Shaft Bracket to Frame Bolt & Nut	25-30
13. Front Wheel Spindle Nut	25-30
14. Idler Arm Bushing	100 Min.
15. Knuckle Support Bushing in Support	145-155
16. Knuckle Support Clamp Bolt	30-35
17. Knuckle Support Upper Arm Pivot Bushing Lock Bolt & Nut	22-26
18. Lower Arm Outer Shaft Pivot Pin & Nut	50-60
19. Lower Control Arm Shaft to Frame Bolt & Nut	55-60
20. Lower Shift Control Bracket U-Bolt	3-4
21. Master Cylinder Filler Cap	20-35
22. Master Cylinder to Plate & Bracket Bolt & Nut	55-60
23. Pitman Arm Nut	100-110
24. Propeller Shaft Flange Bolt	18-22
25. Radiator Center Mounting Nut	25-30
26. Rear Axle Insulator Bolt	110-120
27. Rear Brake to Axle Housing Nut	50-55
28. Rear Brake Cable Anchor to Backing Plate Bolt	10-12
29. Rear Brake Cable Support–Clamps to Frame Bolt & Nut	11-14
30. Rear Engine Support to Frame Bolt & Nut	25-30
31. Rear Shock to Backing Plate Bolt	120-130
32. Rear Shock Link to Arm Nut	18-22
33. Rear Spring Clamp Bolt–Upper	30-35
34. Rear Stabilizer Shaft Bracket to Support Arm Bolt	25-30
35. Rear Support Arm Pivot Bolt & Nut	100-110
36. Ring Gear	35-40
37. Secondary to Primary Bumper Bar Nut	30-35
38. Shift Control Lower Lever to Shaft	14-18
39. Starter to Housing Bolt & Nut	45-50
40. Steering Gear to Frame Bolt	25-30
41. Steering Idler Support Arm to Frame Bolt	25-30
42. Steering Wheel Nut	15 Min. end Stake
43. Support Arm Brackets to Frame Bolt & Nut	11-14
44. Tie Rod Clamp Bolt	11-14
45. Tie Rod to Steering Arm Nut	40-45
46. Track Bar Nut–(Frame End)	135-140
47. Track Bar Nut–(Housing End)	135-140
48. Track Bar Pin Plate to Bracket & Strut Bolt & Nut	55-60
49. Track Bar Support Bracket to Frame Bolt & Nut	55-60
50. Track Bar Support Bracket Strut to Frame Bolt & Nut	25-30
51. Upper Pivot Bushing in Front Shock	85-95
52. Wheel Nut–(Right & Left)	65-70

LUBRICATION

Very often one of the most important service operations, lubrication, is neglected, with subsequent reduced car life.

Suitable provision has been made in the design of Oldsmobile cars whereby lubricant is supplied to the various moving parts; the information contained in this chapter shows how and when best to apply the lubricant to the various units of the automobile.

Lubricants are much cheaper than repair bills and should be applied regularly if the maximum useful service is to be expected from the car. To this end, therefore, it is important that the proper grades of lubricants be used in accordance with a definite schedule.

Engine Lubrication

All of the vital working parts of the engine proper are lubricated by the oil in the crankcase which is constantly circulated through the engine by the oiling system. As the power and speed of engines have increased, better lubrication systems have been developed to positively protect the hundreds of close-fitting and fast-moving engine parts.

ENGINE OIL RECOMMENDATIONS

Engine lubricants are classified according to a system, known as the S.A.E. Viscosity Number System which classifies lubricants in terms of viscosity or fluidity. (S.A.E. is the abbreviation for *Society of Automotive Engineers.*) Lubricants of low number designation, such as S.A.E. 10, flow more readily than lubricants designated as S.A.E. 20 or 30. The S.A.E. numbers refer to viscosity alone and in no way, refer to the quality or other characteristics of lubricants.

Because of the close relationship of engine lubricants to easy starting at all temperatures, minimum engine wear and economy, it is important that the recommendations made in this chapter on lubrication and on the lubrication chart included with this manual be followed.

The oil refiners or marketers supplying the lubricant are responsible for the quality of their product. Their reputation is the car owners' best assurance of receiving quality products from them.

Break-In Oils

"Break-in" oils or compounds are entirely unnecessary, and they should not be used under any circumstances unless the supplier can furnish satisfactory proof that the compound contains no harmful ingredients.

Lubrication

The engine oil in crankcase at time of delivery should be used for the first 500 miles of operation. If it should be necessary to add oil during this period, nothing heavier than 10-W should be used during the winter and 20-W during the summer.

At the end of the first 500 miles, oil should be drained when hot and crankcase refilled with the type of oil best suited to the climatic and driving conditions in which the car will be operated.

Summer

S.A.E. 20 or 20-W engine oil should be used for average summer temperatures. For temperatures above 90° F. for protracted periods, S.A.E. 30 engine oil should be used.

Fall—Winter—Spring

During the colder months of the year, engine oil which will permit easy starting at the lowest

atmospheric temperature likely to be encountered, should be used.

When the crankcase is drained and refilled, oil should be selected on the basis of the anticipated minimum temperature for the period during which the oil is to be used. Unless the crankcase oil is selected on this basis, difficulty in starting is likely to be experienced at each drop in temperature and the efficiency and economy of the engine will be impaired. The grades best suited for use at the various temperatures are as follows:

Anticipated Minimum Temperature Condition		Use the S.A.E. Grade Indicated
Not lower than	32° F.	20 or 20-W
As low as	10° F.	20-W
As low as	–10° F.	10-W
Lower than	–10° F.	10-W plus 10% kerosene

NOTE: 10-W oil, plus 10% kerosene, is recommended only for those territories where the temperature falls below minus (—) 10° F. for protracted periods.

MAINTAINING OIL LEVEL

The oil gauge rod, Fig. 4, is marked "Full" and "Add".

The oil level should be maintained between these two lines, neither going above the "Full" line nor under the "Add" line. The oil level should be checked frequently and oil added when necessary to maintain level between these two lines. It is important that the crankcase is always full before a long drive is started.

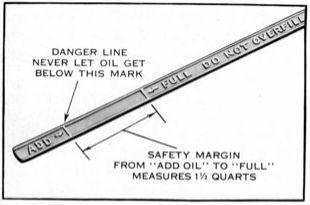


Fig. 4. Oil Level Gauge

Crankcase capacity of both the six and the eight cylinder engines is 5 quarts.

When to Change Crankcase Oil

Improved oils, changed driving conditions, and improvements in engines, such as the crankcase ventilating system, have greatly lengthened the life of good lubricating oils. However, to insure continuation of best performance, low maintenance cost and long engine life, it is necessary that the crankcase oil be changed whenever it becomes contaminated with harmful foreign materials. Under normal driving conditions draining the crankcase and replacing with fresh oil every 2,000 miles should be satisfactory. Under adverse conditions, it may become necessary to drain the crankcase oil more frequently.

Although air cleaners substantially decrease the amount of dust which enters the crankcase, driving over dusty roads or through dust storms introduces a certain amount of abrasive material into the engine, and when oil becomes contaminated, it should promptly be drained and refilled to prevent undue engine wear. The frequency of draining depends upon conditions, and no definite draining periods can be recommended.

Short runs in cold weather, such as are encountered in city driving, do not permit thorough warming of engine, and water may accumulate in crankcase from condensation of moisture produced by burning of fuel. Water in the crankcase will promote rusting and may cause clogging of oil screens and passages interfering with proper oil circulation. Under normal driving conditions, this water vaporizes and is removed by crankcase ventilation. If water accumulates, it should be removed by draining crankcase as frequently as required.

During the cold months, free-flowing oils are required for easy starting; therefore, at beginning of winter season, crankcase should be drained and refilled with oil of proper viscosity for low temperature operation.

On continuous hard driving, these light oils may thicken, and under such severe conditions, more frequent draining may be required to prevent hard starting.

It is always best to drain crankcase after engine has reached normal operating temperature. The benefit of draining is, to some extent, lost if crankcase is drained when engine is cold, as some of the suspended foreign material will cling to the sides of oil pan and will not drain out readily with the slower moving cold oil.

CRANKCASE VENTILATOR

The crankcase in all models is provided with a ventilating system to prevent harmful dilution of the engine oil by water and fuel under normal driving conditions. This system utilizes the crankshaft with its counter-weights as a blower to force the vapors consisting of fuel and water from the crankcase.

Chassis Lubrication

The lubrication chart which follows indicates the points requiring lubrication, the recommended intervals and the kind of lubricant to be used. It should be realized that oily surfaces quickly collect dirt, which, if allowed to reach the various moving parts, will cause premature wear. It is advisable to keep all points of lubrication as free from dirt as possible.

In addition to the regular chassis lubrication every 1,000 miles, the following units should be lubricated at specified intervals as shown on the lubrication chart:

Synchro-Mesh Transmission

Remove the filler cap in the transmission case and fill to the level of the opening with an oil conforming in viscosity with S.A.E. No. 80 or S.A.E. No. 90 Mild E.P. Check the level.

Hydra-Matic Drive

For Hydra-Matic lubrication, see HYDRA-MATIC section.

Rear Axle Lubrication

The rear axle of all models is equipped with a Hypoid gear and pinion. It must be filled to the filler plug with 3¾ pounds of S.A.E. 90 All-Purpose Hypoid Gear Lubricant.

The lubricant level should be checked and, if necessary, replenished at 1,000 mile intervals. Periodic or seasonal changes of lubricant, however, are not recommended.

Care must be exercised to assure that all dirt is cleaned from around the filler cap before the cap is removed in order to avoid the introduction of foreign material into the lubricant.

In localities where the temperature does not fall below −10° F., S.A.E. 90 All-Purpose Hypoid Lubricant is recommended for use both in winter and summer. S.A.E. 80 All-Purpose Hypoid is recommended for use during the winter months in localities where the temperature drops below −10° F.

It is extremely important that only *Hypoid* lubricants having the properties and characteristics necessary for the satisfactory lubrication of hypoid gears be used in the rear axle.

Rear wheel bearings are of the sealed type, filled with lubricant when assembled, and need no further lubrication.

Steering Gear

Remove plug in housing and replenish, if necessary, with Saginaw All-Season Steering Gear Lubricant, G.M. Specification 4673M-UMS 270664, each 5,000 miles. This unit need not be drained except when it is overhauled.

Universal Joint Lubrication

The needle bearings at the transmission and the rear axle end of the propeller shafts are prepacked with lubricant at the time of their manufacture; no attention need be given these bearings so far as lubrication is concerned for 20,000 to 30,000 miles. (See PROPELLER SHAFT)

Front Wheel Bearing Lubrication

The front wheel bearings should be lubricated every 5,000 miles. About a tablespoonful of high melting point wheel bearing grease should be spread throughout the ball bearings when they are reinstalled. An excessive amount of grease should not be used, due to the possibilities of lubricant getting into brake drums.

Rubber Bushings Lubrication

All load carrying rubber parts (bushings) are designed to function without slippage. After a very short period of service they partially bond themselves to adjacent metal parts. This bonding action further reduces slippage.

Lubrication of rubber parts should be avoided, as lubrication defeats the purpose of the design and causes slippage.

If, under certain unusual operating conditions, a squeak in rubber bushings should develop, it can be eliminated by the application of a very small amount of soapy water.

General Body Lubrication

Door Lock

The door locks are lubricated when installed at the factory and usually need no attention for the first two years except at the lock bolt oil reservoir felt which should be dampened with machine oil every two months or so.

Door Ease may be applied to the lock bolt or striker plate instead of the oil. Both should not be used at the same time.

Front Seat Mechanism

Cup grease should be used twice a year to lubricate the front seat adjusting mechanism.

Door Lock Cylinders

A small quantity of powdered graphite occasionally applied to the door lock cylinders will prevent sticking at this point.

Door Check Link

The door check link should be lubricated with oil at pivot joint and dry graphite on door rubber bumper.

Door Wedge Plate and Dovetail Bumper Assembly

An application of *Door Ease* is the cleanest and most efficient method of lubricating these parts. All old grease should be removed before a new application of *Door Ease* is made. Parts should be given a light coating only, as a heavy coating is wasteful and collects grime that may rub off on clothing.

Hood Hinges

A light engine oil should be used to lubricate the hood hinges, care being taken not to allow the oil to drop on fenders or other exposed painted surfaces.

SPEEDOMETER CABLE LUBRICATION

The speedometer cable is lubricated when installed at the factory and under normal driving conditions should require no further lubrication.

NOTE: See SPEEDOMETER CABLE LUBRICATION in SYNCRO-MESH section when a new cable is to be installed.

LUBRICA

1949 OLDSM

SHOCK ABSORBERS AND SPEEDOMETER CABLE
CONSULT DEALER FOR PROPER LUBRICATION

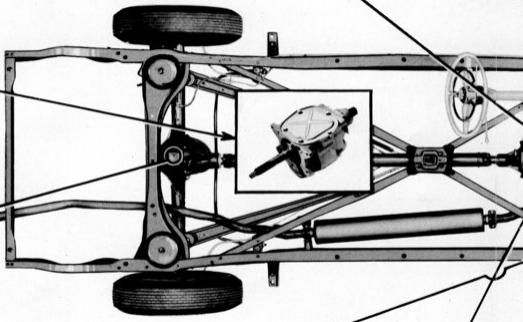
1,000 MILES
CLUTCH AND BRAKE PEDAL BUSHING
CLUTCH LINKAGE AND FELTS — ENGINE OIL

1,000 MILES
8 CYLINDER DISTRIBUTOR
A DROP OF ENGINE OIL ON FELT UNDER ROTOR

5,000 MILE
STEERING GEAR
SPECIAL YEAR AROUND STEERING GEAR LUBRICANT

SYNCRO-MESH TRANSMISSION
CAPACITY—2 LBS.
S.A.E. 80 OR 90 MULTI-PURPOSE LUBRICANT

DIFFERENTIAL
Replenish every 1,000 miles with S.A.E. 90 Multi-Purpose Gear Lubricant. Periodic or seasonal changes not recommended.



ENGINE OIL — REFILL CAPACITY — 8 CYLINDER — 5 QTS., — 6 CYLINDER — 5 QTS.

SUMMER	WINTER
USE S.A.E. 20 or 20-W	If min. anticipated temps will be Not lower than 32 F. Use Grade 20-W or S.A.E. 20
ABOVE 90 USE S.A.E. 30	If min. anticipated temps will be As low as . . 10 F. Use Grade 20-W
	If min. anticipated temps will be As low as . . —10 F. Use Grade 10-W
	If min. anticipated temps will be Below . . . —10 F. Use Grade 10-W plus 10% kerosene

HYDRA-MATIC DRIVE
USE GM HYDRA-MATIC DRIVE FLUID, AVAILABLE AT YOUR OLDSMOBILE DEALER.

B O

TION SIX EIGHT

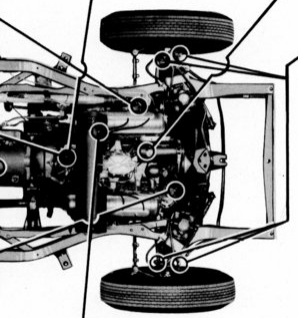
OBILE

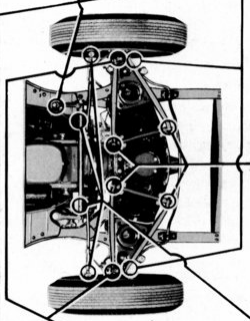
1,000 MILES
6 CYL. DISTRIBUTOR
IN GREASE CUP USE NO. 2½ CUP GREASE. FELT UNDER ROTOR A DROP OF ENGINE OIL.

1,000 MILES
GENERATOR OIL CUPS
(FRONT AND REAR ENDS)
ENGINE OIL

1,000 MILES
STEERING IDLER ARM BUSHING
CHASSIS LUBRICANT

1,000 MILES
UPPER AND LOWER CONTROL ARM PIVOT PIN
CHASSIS LUBRICANT





1,000 MILES
LOWER CONTROL ARM PIVOT SHAFTS
CHASSIS LUBRICANT

HEAVY DUTY (OIL BATH) AIR CLEANER
CAPACITY—1 PINT
CLEAN AND REPLENISH OIL COMPARTMENT WITH S.A.E. 50 OIL EVERY 5,000 MILES. OFTENER UNDER DUSTY OPERATING CONDITIONS OR IF SEVERE DUST STORMS PREVAIL.

FRONT WHEEL BEARINGS
CLEAN AND PACK WITH WHEEL BEARING GREASE OF HIGH MELTING POINT EVERY 5,000 MILES.

1,000 MILES
KING PINS
UPPER AND LOWER BUSHINGS
CHASSIS LUBRICANT

1,000 MILES
TIE ROD—INNER
TIE ROD—OUTER
CHASSIS LUBRICANT

DY LUBRICATION

DOOR LOCK BOLT AND WEDGE PLATE
Lubricate with Door Ease

HOOD — DOOR CHECK LINKAGE
(Lubricate as necessary)
- *Hinges with Engine Oil*
- *Latch with Lubriplate*

LUBRICATION SIX EIGHT

1949 OLDSMOBILE

SHOCK ABSORBERS AND SPEEDOMETER CABLE
CONSULT DEALER FOR PROPER LUBRICATION

1,000 MILES
CLUTCH AND BRAKE PEDAL BUSHING
CLUTCH LINKAGE AND FELTS — ENGINE OIL

1,000 MILES
8 CYLINDER DISTRIBUTOR
A DROP OF ENGINE OIL ON FELT UNDER ROTOR

5,000 MILES
STEERING GEAR
SPECIAL YEAR AROUND STEERING GEAR LUBRICANT

1,000 MILES
6 CYL. DISTRIBUTOR
IN GREASE CUP USE NO. 2½ CUP GREASE. FELT UNDER ROTOR A DROP OF ENGINE OIL.

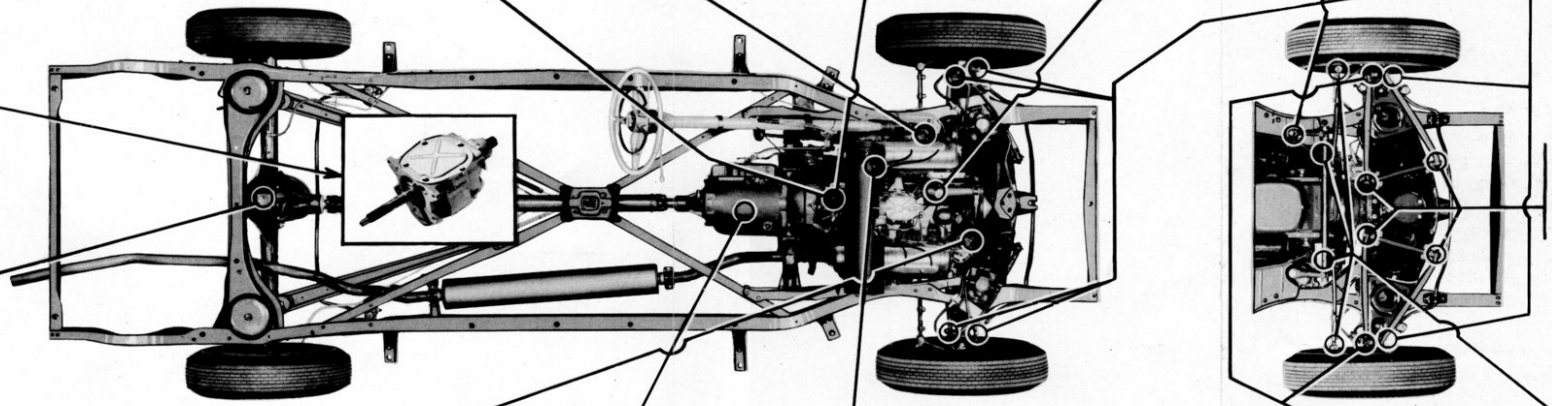
1,000 MILES
GENERATOR OIL CUPS
(FRONT AND REAR ENDS) ENGINE OIL

1,000 MILES
STEERING IDLER ARM BUSHING
CHASSIS LUBRICANT

1,000 MILES
UPPER AND LOWER CONTROL ARM PIVOT PIN
CHASSIS LUBRICANT

SYNCRO-MESH TRANSMISSION
CAPACITY—2 LBS.
S.A.E. 80 OR 90 MULTI-PURPOSE LUBRICANT

DIFFERENTIAL
Replenish every 1,000 miles with S.A.E. 90 Multi-Purpose Gear Lubricant. Periodic or seasonal changes not recommended.



1,000 MILES
LOWER CONTROL ARM PIVOT SHAFTS
CHASSIS LUBRICANT

ENGINE OIL — REFILL CAPACITY — 8 CYLINDER — 5 QTS., — 6 CYLINDER — 5 QTS.

SUMMER	WINTER	
USE S.A.E. 20 or 20-W	If min. anticipated temps will be Not lower than	32 F. Use Grade 20-W or S.A.E. 20
ABOVE 90 USE S.A.E. 30	If min. anticipated temps will be As low as . .	10 F. Use Grade 20-W
	If min. anticipated temps will be As low as . .	—10 F. Use Grade 10-W
	If min. anticipated temps will be Below . . .	—10 F Use Grade 10-W plus 10% kerosene

HYDRA-MATIC DRIVE
USE GM HYDRA-MATIC DRIVE FLUID, AVAILABLE AT YOUR OLDSMOBILE DEALER.

HEAVY DUTY (OIL BATH) AIR CLEANER
CAPACITY—1 PINT
CLEAN AND REPLENISH OIL COMPARTMENT WITH S.A.E. 50 OIL EVERY 5,000 MILES. OFTENER UNDER DUSTY OPERATING CONDITIONS OR IF SEVERE DUST STORMS PREVAIL.

FRONT WHEEL BEARINGS
CLEAN AND PACK WITH WHEEL BEARING GREASE OF HIGH MELTING POINT EVERY 5,000 MILES.

1,000 MILES
KING PINS
UPPER AND LOWER BUSHINGS
CHASSIS LUBRICANT

1,000 MILES
TIE ROD—INNER
TIE ROD—OUTER
CHASSIS LUBRICANT

BODY LUBRICATION

DOOR LOCK BOLT AND WEDGE PLATE
- *Lubricate with Door Ease*

HOOD — DOOR CHECK LINKAGE
(Lubricate as necessary)
- *Hinges with Engine Oil*
- *Latch with Lubriplate*

BODY

All 1949 Oldsmobile Unisteel bodies are built entirely of steel. Floor pans, pillars, rear quarter panels, back panels, cowl, dash and roof, are reinforced by steel channels and braces at points of stress and are welded together into one solid unit.

The entire inside of the body is first bonderized and then insulated against sound and extremes of temperature with sound silencing felt. The joints of all welded panels in the floor and lower side panel construction are sealed against entrances of dust, water, and air drafts. The dash panel is heavily insulated against heat and sound.

Steel-hooked supports and twisted fiber tacking strips are used at certain sections of the body for attachments of various trim assemblies.

Numerous adjustable parts such as striker plates, hinges, trunk lids, etc., are used, the adjustments of which facilitate easier service and maintenance.

Four-door sedans, due to the length of the ventilator equipped rear door windows, do not have rear quarter windows. The cowl side panels are of concave design and are completely hidden by the car hood. The cowl upper panel is of very narrow design and is not equipped with the cowl ventilator or lid. Cowl ventilation is accomplished, however, by means of tubing attached to air intake grilles at the front of each fender directly under the head lights.

A wire mesh screen prevents entry of bugs into the body through the ventilator when in the open position.

The rear compartment floor pans of most body styles are equipped with spare tire wells for carrying the spare tire in a vertical position. Due to the width of the 98 series rear compartment lids, double cam locking devices are used on those models. The two locks, which are controlled by a single handle, are located at the bottom of the lid and are operated by eccentric locking arms. All 76 and 88 series rear compartment lids are equipped with single center snap locks. The compartment lids on all body styles, except 98 series convertibles, use counterbalanced and hold-open type hinges, eliminating the need for lid supports. The 98 series convertibles, however, use conventional telescopic type lid supports.

BODY MOUNTING

The body is securely mounted on the chassis, tire carcass shims separating the body from the frame. Sixteen body bolts and two studs secure the body to the chassis frame of all closed models. Twenty-two body bolts and two studs secure the 76 and 88 series convertible bodies to frames, while twenty bolts and two studs are used to secure the 98 series convertible body to frame.

WINDSHIELD REMOVAL AND REPLACEMENT

All 1949 model Oldsmobiles incorporate the use of two piece curved windshields which are removed and replaced from *outside* the body as follows:

98 Series

1. Protect the upper cowl and hood with suitable covering.
2. Remove windshield wiper transmission "burr" as follows:
   a. Remove wiper blades and arms.
   b. Unscrew the small set screw from handle of Windshield Wiper Transmission Burr Removing and Replacing

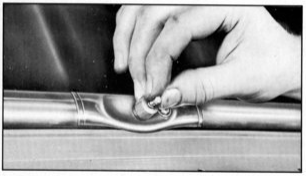


Fig. 6. Threading Set Screw Into Transmission Shaft

Tool No. J-2682 and thread into end of transmission shaft as shown in Fig. 6.

c. Place Tool No. J-2682 in position shown in Fig. 7, and, holding hex barrel of tool stationary, turn handle of tool counter-clockwise until "burr" is removed.

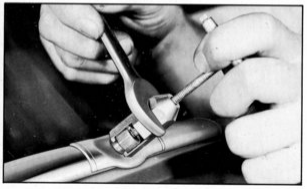


Fig. 7. Removing "Burr" with Tool J-2682

d. Remove small set screw from transmission shaft and replace in tool handle.

3. Remove center division molding by carefully prying loose at top and following down the molding until removed.
4. Remove screws at "A" and "B", Fig. 8, lift center division reveal molding retainer out of position and remove.
5. Remove upper windshield reveal molding as shown in Fig. 9 by prying DOWNWARD toward glass until released from its retainer.

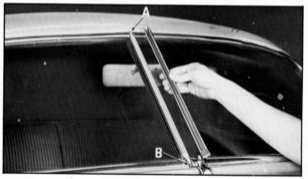


Fig. 8. Removing Center Division Reveal Molding

6. Remove windshield lower reveal molding by inserting blade of putty knife or other suitable tool under lower lip of molding and carefully prying UPWARD toward glass until released from its retainer (See Fig. 10).

Fig. 9. Removing Windshield Upper Reveal Molding

7. At the lower outside corner of each windshield, locate the ends of the windshield rubber channel filler and pull out of position around the opening as shown in Fig. 11.

Fig. 10. Removing Windshield Lower Reveal Molding

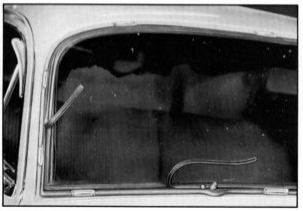


Fig. 11. Removing Channel Filler Strip

8. Loosen glass from windshield rubber channel and carefully lift from opening.
9. To remove the windshield glass rubber channel, loosen sealing compound at base of rubber channel with a putty knife, then lift up and disengage it from the pinch-weld flange around the opening.
10. Remove reveal molding retainers which straddle the pinch-weld flange by disengaging and lifting them out of position. Before removal, chalk mark exact location of retainers for re-installation.
11. Fill the pinch-weld portion of each reveal molding clip with Weatherstrip Cement as indicated by shaded area in sketch "A", Fig. 12.
12. Install reveal molding clips on pinch weld flange in their original positions and apply a bead of Weatherstrip Cement to the edge of the pinch-weld completely around the opening and also in the "valley" of the clip as indicated in sketch "B", Fig. 12.
13. Clean and re-install windshield rubber channel over pinch-weld, pressing firmly and evenly in place.
14. Install windshield glass, holding as shown in Fig. 13. Insert straight edge of glass into groove of windshield rubber channel at the center division area, lower glass flat against balance of rubber channel and,

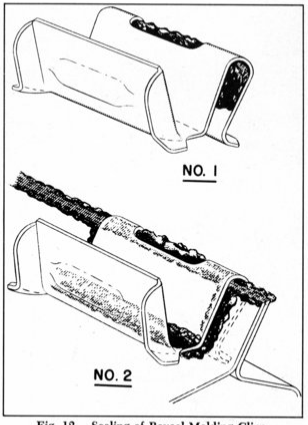


Fig. 12. Sealing of Reveal Molding Clips

with a putty knife, carefully work lip of rubber channel over edge of glass starting at bottom as shown in Fig. 14, and working toward side, up the side and across the top.

NOTE: An application of mild liquid soap in the groove of the rubber channel simplifies the installation.

15. Using a sealing gun and "3M Weatherstrip Cement", seal under the extended upper lip of the rubber channel ONLY in the area directly below the wiper shaft and windshield washer tube. Also, apply a ribbon of sealer to the rubber channel around the circumference of the wiper shaft and washer tube.
16. Install the windshield rubber channel filler strip in the groove of the rubber channel. Filler strip may be lubricated with mild liquid soap. Starting at the windshield

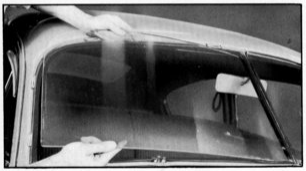


Fig. 13. Inserting Windshield Glass Into Channel

Fig. 15. Installing Rubber Channel Filler Strip

lower center division, the rubber filler is inserted through the eye of the special tool No. J-2767 as shown in Fig. 15. The spreader end of tool is inserted into the groove of the glass channel and pushed along to "zipper" the rubber filler into place. Prior to reveal molding installation, apply with a sealing gun a ⅛" bead of "3M Weatherstrip Cement" along the edge of the rubber glass channel and reveal molding retainers where they contact the cowl.

17. Replace windshield reveal moldings in reverse order of their removal.
18. Replace windshield wiper transmission "burr" as follows:
    a. Place a NEW burr in position on shaft of transmission and align properly.
    b. Adjust tool No. J-2682 so that pointed end of barrel is at bottom as shown in Fig. 16; screw threaded pilot into transmission shaft and, holding "T" handle stationary, carefully turn barrel of tool with a wrench until burr has been pushed to its proper position.
19. Replace wiper blades and arms.

76 and 88 Series

1. Protect instrument panel, upper cowl and hood with suitable covering.
2. Remove upper and lower escutcheon and rear view mirror at the center division.
3. Remove garnish moldings and spacers.
4. From inside the body, remove the lower reveal molding retaining screws and cup washers located directly under the reveal molding.
5. Remove windshield wiper arm and blade.
6. Remove center division reveal molding and lower escutcheon.

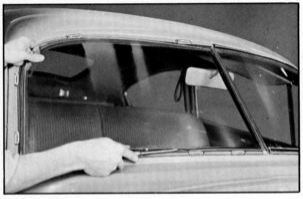


Fig. 14. Working Lip of Rubber Channel over Glass

Fig. 16. Replacing Wiper Transmission "Burr"

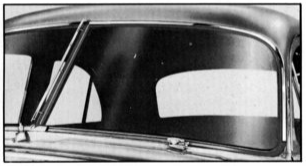


Fig. 17. Lower Reveal Molding Removal

7. Loosen lower reveal molding retainer at center division.

   NOTE: Loosen, but do not remove the screw.

8. Remove lower reveal molding outer retaining screw on front body pillars.
9. Remove lower reveal molding by raising molding to clear transmission and sliding it off the center retainer. (Fig. 17)
10. Remove corner reveal molding (where used) by unscrewing the single retaining screw.

    NOTE: The upper reveal molding is not removed at this time.

11. Applying pressure with the palm of the hand against the inside surface of the glass at the outer end of the windshield opening, carefully force the channel off the pinch-weld. The force may be applied alternately

Fig. 18. Windshield Glass Removal

Fig. 19. Upper Reveal Molding Removal

at the upper and lower outer corners. The separation will usually start at one of these two points. (Fig. 18)

12. Move the outer end of the glass and channel to disengage from all the pinch-weld, but not from the center division bar. The rubber channel stays on the glass during this operation.
13. Curl lip of channel to release outer section of upper reveal molding; lift balance of molding from channel. (Fig. 19)
14. Break seal of weatherstrip cement between channel and glass, and remove channel from glass.
15. Check alignment of windshield opening and inspect pinch-weld for irregularities.
16. Remove the old cement with oleum spirits and a scraper; dry thoroughly.
17. Insert a strong string in pinch-weld cavity around entire exposed length of channel.
18. Apply a ⅛" bead of weatherstrip cement at the base of the pinch-weld around the entire exposed length of the windshield opening and across the windshield center bar at the top and bottom. (Fig. 20)
19. Work rubber channel onto windshield glass all around except at the center division.

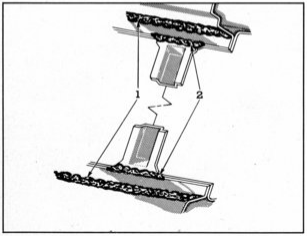


Fig. 20. Sealing Windshield Opening

20. Apply a small amount of mild soap solution in the upper reveal molding cavity, in the center division glass cavity, and on the back side of the channel along its entire exposed length.
21. Insert the inner end of the reveal molding into channel cavity about six inches from the center division and slide toward the center division until the outer side section comes into alignment with the rubber channel; complete the installation of reveal molding. (Fig. 21)
22. Set glass into center division glass cavity, and position in windshield opening, holding it in place with moderate pressure from outside the body.

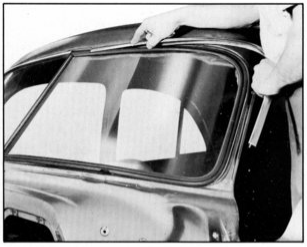


Fig. 21. Installing Upper Reveal Molding

Fig. 22. Pulling Inner Lip of Rubber Channel Over Pinch Weld

23. Use the string to pull the inner lip of the rubber channel over the pinch-weld as follows:
    (a) From inside the body, pull the string about three-quarters across the bottom of the windshield opening, starting from the lower inner corner of the opening. (See Fig. 22)
    (b) Starting at the center division, pull the top string a little more than half way across the top.
    (c) Pull the bottom string the rest of the way along the bottom, and around the lower outer corner.
    (d) Grasp both strings and, pulling simultaneously, bring the lip over the pinch-weld at the upper outer corner.

    NOTE: The string should be pulled approximately parallel to the glass surface and perpendicular to the rubber channel.
24. Settle the glass and channel into normal position by using a moderate hand pressure around the windshield.
25. Apply weatherstrip cement between glass and outer wall of channel completely around the glass, around hole in lower reveal molding retainer at center division, and around hole in rubber channel. (Fig. 23)
26. Slide corner reveal molding on end of upper molding, and secure in place with screw.

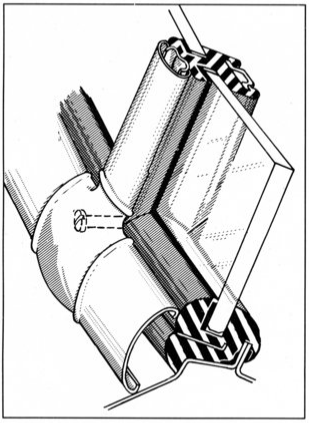


Fig. 23. Windshield Sealing

27. Install lower reveal molding by sliding onto retainer at center division and installing screw at outer end of molding.
28. Place center division reveal molding in position after sealing around the holes and secure the molding temporarily with two ten inch lengths of masking tape horizontally across the molding.

    NOTE: This is to permit a one man operation. Otherwise it would be necessary for a second person to hold pressure against the reveal molding when the garnish molding barrel nuts are being installed.
29. Install windshield wiper arm and blade.
30. Seal and install lower reveal molding retaining screws and cup washers inside body.
31. Install garnish moldings, escutcheons and rear view mirror.

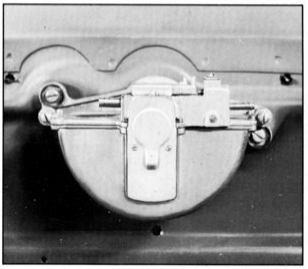


Fig. 24. 98 Series Windshield Wiper Motor

WINDSHIELD WIPER—98 Series

The windshield wiper motor, attached to the front upper center of the dash panel underneath the hood, drives the wipers through a cable and pulley system which operates from the motor through a tensioner assembly and to the wiper transmission.

The ends of the drive cables, with clenched sleeves, are seated into the grooves of the motor shaft linkage protruding through the dash to inside the car as shown at "B". Fig. 25.

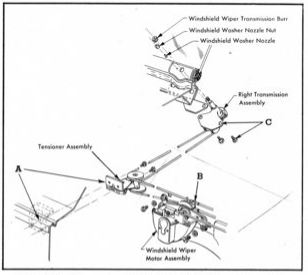


Fig. 25. Layout of Windshield Wiper Operating Mechanism

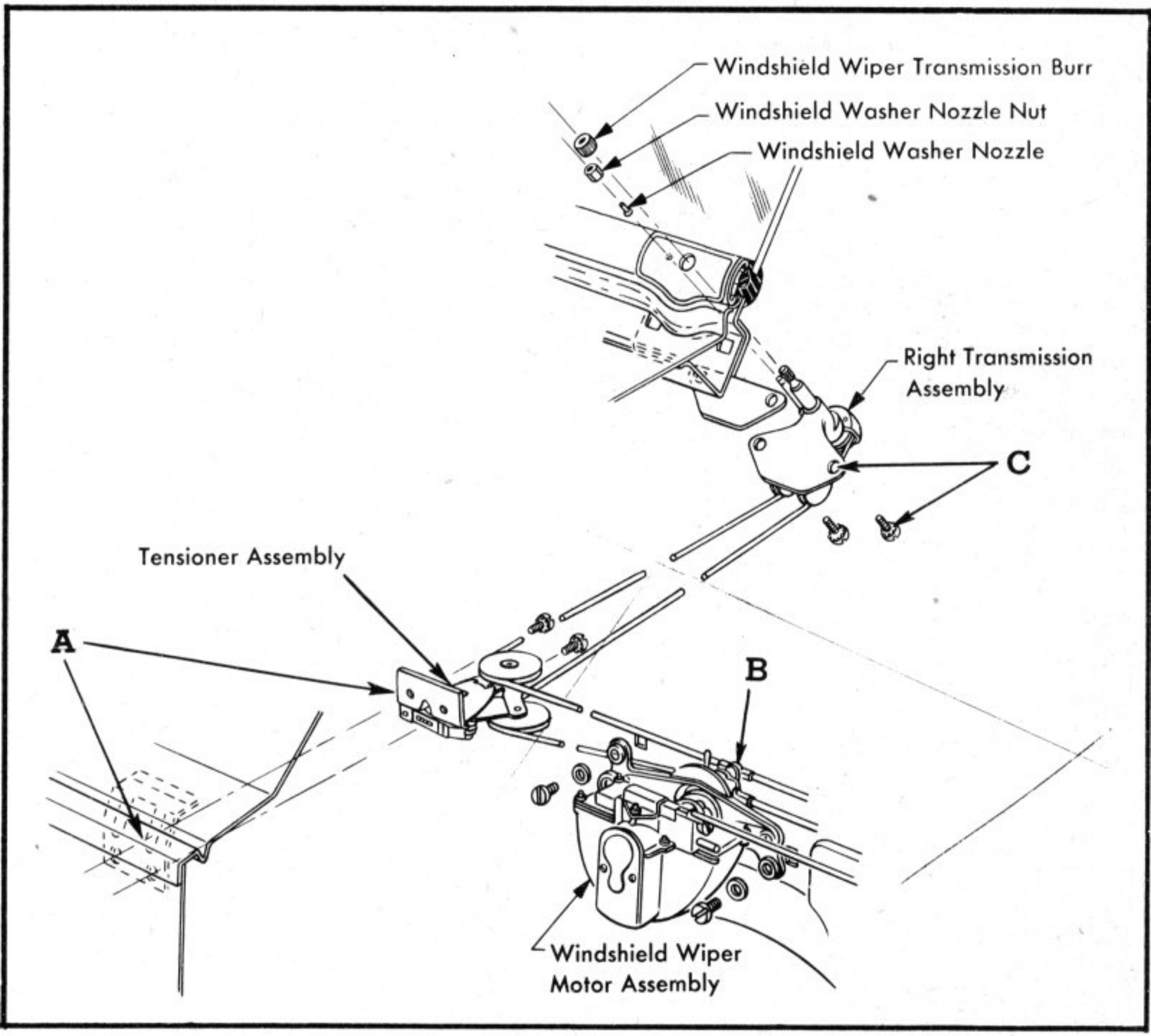


Fig. 25. Layout of Windshield Wiper Operating Mechanism

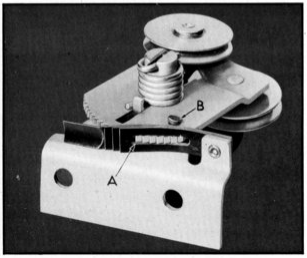


Fig. 26. Windshield Wiper Tension

The windshield wiper tensioner assemblies are attached to the upper right and left sides of the inner dash at "A" adjacent to the wiper transmissions which are mounted to the windshield lower inner frame inside the dash as shown at "C", Fig. 25. The self-adjusting tensioners, with pulleys, are spring-loaded to maintain a constant tension through a ratchet and spring arrangement (shown at "A", Fig. 26), preventing slippage and wear of the cables.

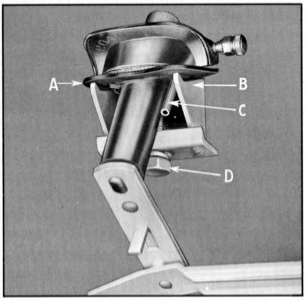


Fig 27. Windshield Wiper Transmission Details, 76 and 88 Series

The windshield wiper transmission shaft protrudes through the windshield rubber glass channel and windshield reveal molding.

WINDSHIELD WIPER—76 and 88 Series

The windshield wiper transmission, installed over a cut-out in the top of the cowl upper panel, as illustrated in Fig. 27. "A" indicates the transmission rubber gasket, "B" the attaching retainer, "C" the windshield washer hose attachment and "D" transmission attaching retainer bolt.

The wiper motor is attached to a bracket underneath the cowl, and the wiper is operated by means of wiper links which are attached to the motor end, only, through a spring retainer arrangement. The motor assembly itself has been increased in power over previous models.

Windshield Wiper Transmission Removal and Replacement—98 Series

1. Protect the upper cowl with suitable covering and remove windshield wiper transmission "burr" as follows:
   a. Remove wiper blades and arms.
   b. Unscrew the small set screw from handle of Windshield Wiper Transmission Burr Removing and Replacing Tool No. J-2682 and thread into end of transmission shaft as shown in Fig. 6.
   c. Place tool No. J-2682 in position shown in Fig. 7, and, holding hex barrel of tool stationary, turn handle of tool counter-clockwise until "burr" is removed.
   d. Remove small set screw from transmission shaft and replace in tool handle.
2. Remove windshield washer nut, nozzle, and rubber tubing from transmission.
3. Remove glove compartment for right transmission removal.
4. Underneath the instrument panel, loosen tension on cables at tensioner as follows:

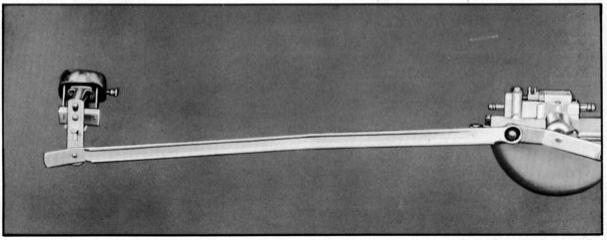


Fig. 28. Windshield Wiper Transmission and Motor Layout.–76 and 88 Series

a. Apply slight pressure to tensioner ratchet spring. See "A", Fig. 26.
b. Rotate upper section holding pulleys until locking pin hole is in line with similar hole in lower section.
c. Insert ⅛" locking pin or drift in hole as shown at "B", Fig. 26.
d. Unhook cables, remove two screws holding tensioner, and remove.

5. Remove ends of cables from motor drive as shown at "B", Fig. 25.
6. Remove the two hex head bolts attaching wiper transmission to underside of cowl shown at "C", Fig. 25.
7. Lower transmission from position and remove.
8. To replace, reverse sequence of operations, fitting cables to tensioner and releasing pin to put tension in system.

NOTE: For ease of transmission replacement, use mild liquid soap around shaft when inserting through rubber glass channel.

Check operation of wiper after replacement.

Windshield Wiper Transmission Removal and Replacement–76 and 88 Series

1. Remove link from motor. (See Fig. 28)
2. Remove glove compartment for right transmission removal.
3. Disconnect windshield washer hose.
4. Remove transmission retaining bolt and retainer.
5. Break seal, and remove transmission assembly and gasket.

NOTE: Transmission assembly is composed of transmission and link which are serviced together as one part.

6. To replace, reverse sequence of operations sealing transmission and adjusting at motor end of link.

Back Window Glass Removal and Replacement–98 Series

The removal of a back window glass is basically the same as windshield glass removal.

1. On the club sedans, remove back window reveal moldings by inserting a flat-bladed tool under outer edge of molding and prying towards the glass. Remove right hand reveal molding first.

On the 4-door sedan styles, the lower reveal molding is formed by a two-piece (right and left) rear quarter belt molding. This belt molding must be removed before attempting to remove the upper sections.

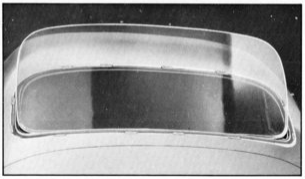


Fig. 29. Installing Back Window Glass

Pry loose each section from the snap-on retainers at the lower window opening. Then slide the curved end of each molding off the molding retainers at the rear quarter panel.

2. Pull up and remove the glass channel rubber filler strip (similar to windshields).
3. Carefully loosen glass from the rubber glass channel and remove.

   NOTE: If rubber glass channel is removed from the back window opening pinch-weld, seal and re-install the channel over pinch-weld using the same procedure as outlined in WINDSHIELD REMOVAL AND REPLACEMENT.
4. In replacing, lubricate the rubber glass channel and filler strip with a light application of mild soap.

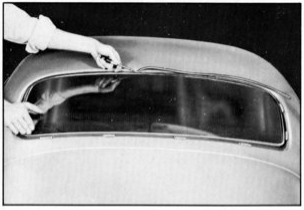


Fig. 30. Inserting Rubber Filler Strip With Tool J-2767

Fig. 31. Molding Arrangement for 76 and 88 Series Back Windows

5. Insert the lower end of glass in the groove of the rubber channel (See Fig. 29). Lower glass and with a flat-bladed tool carefully work the lip of the rubber over the edge of glass around the entire opening.
6. Using tool No. J-2767 as illustrated, thread the rubber filler strip through the eye of the tool and "zipper" the filler strip into the groove of the back glass rubber channel. (Fig. 30)

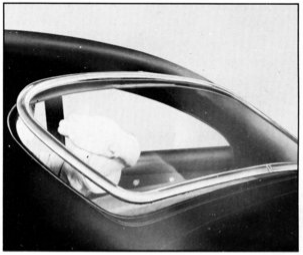


Fig. 32. Removing Back Window Glass and Channel

Fig. 33. Removing Back Window Reveal Molding

7. To make a permanent waterproof seal, lay an even ⅛" bead of "3M Weatherstrip Cement" along the outer edge of the rubber glass channel completely around back window, so as to bridge the edge of the rubber to the opening.
8. Re-install the back window reveal moldings.

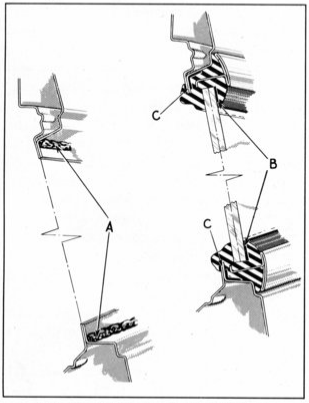


Fig. 34. Sealing of Back Window Glass

Back Window Glass Removal and Replacement—76 and 88 Series

The removal of the back window glass is basically the same as the windshield glass removal. This operation outlines the back window glass removal on club sedan and town sedan bodies; however, the procedure outlined also applies to other styles, with the exception that the rear quarter crease moldings and "snap-on" retainer, and the corner reveal moldings at each lower corner of the back window opening, must also be removed before proceeding with the steps as outlined. The rear quarter crease molding is attached with "snap-on" retainers and with nut and bolt assemblies which are accessible through the upper rear compartment opening.

1. Remove back window garnish molding.
2. With a flat bladed tool, loosen the rubber channel from its cemented base at pinch-weld flange around interior of back window opening.
3. Apply moderate hand pressure against the glass from inside the body and carefully force the glass and its channel to release from the pinch-weld. (Fig. 32)
4. From outside the body, remove the glass and rubber channel assembly from the opening.

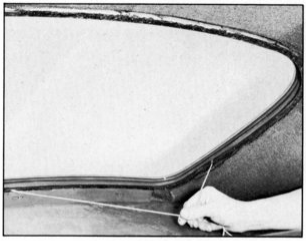


Fig. 35. Pulling Inner Lip of Rubber Channel Over Pinch Weld

NOTE: The glass remains in the channel during removal.

5. Remove the reveal molding by first curling the rubber channel off the side of the molding, then sliding the molding out of the rubber channel. The escutcheons at the center of the back window opening will slide off the molding during its removal.
6. Remove glass from channel.
7. Remove old cement, dirt, etc., from window opening and apply "3M Weatherstrip Cement" around outside base of pinch-weld continuously around back window opening as shown at "A", Fig. 34.
8. Install glass to channel, applying weatherstrip cement between glass and outer wall of channel at "B", Fig. 34.
9. With liquid hand soap, lubricate reveal molding cavity of channel and install reveal molding and escutcheon to channel.
10. Insert a strong cord into rubber pinch-weld cavity at "C", Fig. 34. Allow a loop to extend out of the channel at one side while the two ends of the string extend out of the channel at the opposite side. Be sure the strings at the base of the loop overlap within the pinch-weld cavity. Using a mild soap solution, lubricate rubber channel inside lip.

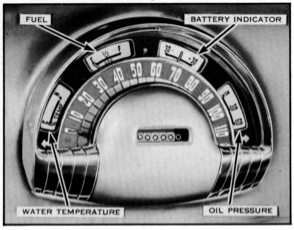


Fig. 36. Instrument Cluster

11. Position glass and rubber channel in opening, with string accessible from inside body.

    NOTE: Securing glass in opening with masking tape applied from outside may be of assistance for a one-man operation.
12. Use the string from inside body to pull the inner lip of rubber channel over the pinch-weld. (Fig. 35)
13. After assembly is in position, apply "3M Weatherstrip Cement" under inner lip of rubber channel and install back window garnish molding.

Instrument Panels

All instrument panels, which are two-tone in color to harmonize with the various interior color combinations, are reinforced along their lower edge by a channel type reinforcement which runs crosswise of the body.

The instruments are grouped in a cluster immediately ahead of the steering wheel so as to be most convenient to the driver. The speedometer is in the form of a half circle dial surrounded by temperature, gasoline, ammeter, and oil pressure gauges each of which is independently removable. (See Fig. 36)

Between the figures 50 and 60 on the speedometer dial is provided a small opening which shows red any time the headlights are in the upper beam position. At both extremes of the dial is a small arrow, one pointing to the right and the other to the left, which flashes simultaneously with the parking and tail lights while the turn signal is operating. At the lower center of the instrument cluster is located an odometer to register mileage.

All wire connections at the instrument gauges are of the "push-on" type to facilitate assembly.

On each side of the instrument cluster is a row of four knobs. At the left side are, from top to bottom, the light switch, windshield wiper-

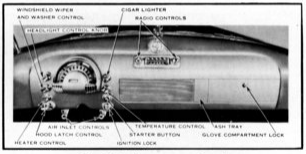


Fig. 37. Instrument Panel

washer knob, heater-defroster switch, and hood latch control pull. On the right side of the instrument cluster are, from top to bottom, the cigar lighter, heater thermostatic control knob, solenoid starter button, and ignition switch.

The light switch is of the push-pull type having three positions, "Off", "Parking", and "Bright". The instrument panel lights are controlled through the main light switch knob, any degree of light intensity being available through the rotation of this knob while the switch is in either of the "on" positions.

Immediately below the instrument panel at each side of the steering column is an air inlet knob which controls the flow of air into the driving compartment from outside through the air ducts along the front fenders. The knob to the left is for warm weather use only when ventilating without the heater. The knob on the right controls the flow of air to the heater and the defroster and can be used for both warm and cold weather operation.

Centered in the instrument panel is a wide stamped grille with horizontal openings behind which the radio mounts. Radio tuning controls are placed high on the panel directly over the speaker grille, and space is provided above the radio panel for a clock which is easily visable to all passengers.

GLOVE COMPARTMENT

The glove compartment is similar in construction to that used in previous models and is held in the instrument panel opening by cross recess head screws. The glove compartment lid is suspended on two "goose neck" type hinges which are flanged and fastened to the inner surface of the lid.

The glove compartment latch and lock assembly, operated with the same oval head key used to unlock the trunk compartment (lift gate on station wagons), is located on the glove compartment lid.

The lock may be released by removing one screw and washer on the lock retainer cap as shown at "A", Fig. 38.

Ash Receiver

A large "tilt" type ash receiver is located on the instrument panel between the radio grille and the glove compartment lid. The ash receiver can be removed for cleaning by opening it part way, then pushing down on ash deflector and pulling receiver assembly out of instrument panel.

Doors

The doors of all models are designed to perfectly match the general outside body and fender contours and, due to the new trend, fender extension panels are no longer used.

Fig. 38. Glove Compartment Lock

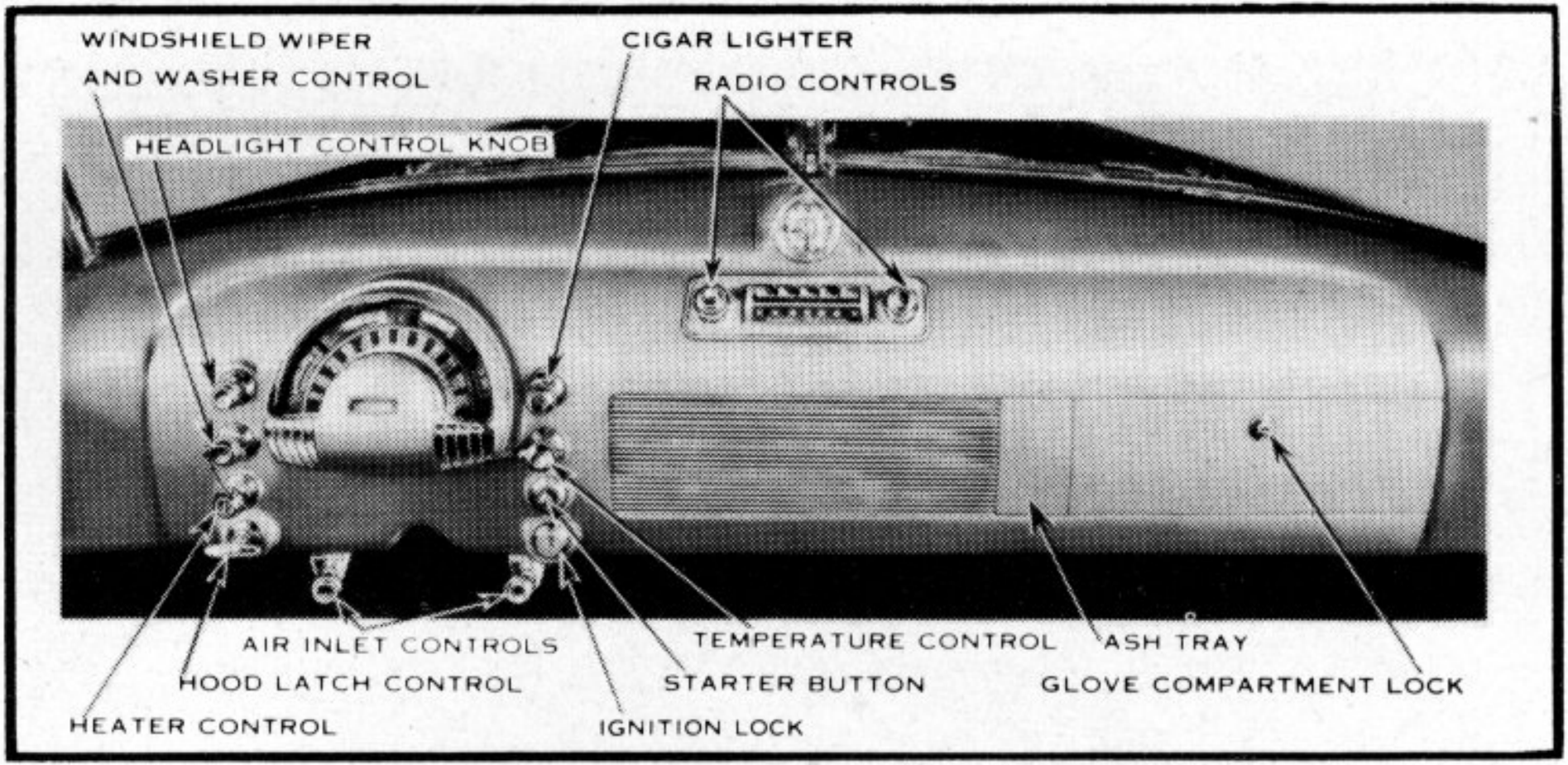


Fig. 37. Instrument Panel

The front doors consist of outer and inner panel assemblies which are welded together along their flanged edges. The inner panel of doors is deep drawn to conform with body styling and is provided with a large loading hole for installation of hardware parts.

The construction of sedan rear doors also consists primarily of inner and outer panel assemblies and is similar in many respects to the front door. The wide lock pillar face of the rear door inner panel, however, is formed as a separate part called a rear door inner panel extension. This deep drawn section covers the forward portion of the rear body lock pillar when the door is closed.

Front doors of 98 series cars are hung to the front body pillars with box-type hinges. The strap portion of the hinge is recessed into the door inner panel and is held with hex head bolts.

All 76 and 88 series doors and 98 series 4-door sedan rear doors are equipped with butt-tvpe hinges which fit into recesses in the door inner panels. These are secured with cross head screws. To aid in sealing, cover plates are attached with screws over portions of butt-type hinges where they fasten to the door inner panels and center pillars.

All doors are, for the convenience of passengers, equipped with check links to hold doors in the open position.

Inside Safety Lock

The door inside safety lock, similar to that used in previous years, is of the button type through the garnish molding. On front doors, this lock button is located directly above the lock. The safety lock button on rear doors is located at the front part of the window opening and operates the lock through a remote control rod.

Remote Control Mechanism

All series use a new three-point attaching remote control assembly, the link of which is attached directly to the lock bolt on all door locks. This remote control mechanism, where attached to the door inner panel, is adjustable fore and aft to take up any play in the link.

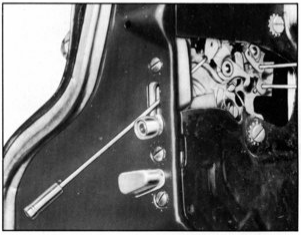


Fig. 39. Engaging "Free Wheeling" Device (76 and 88 Series)

DOOR LOCKS

Door locks on 98 series cars are similar to those used in 1948. The 76 and 88 models, however, are equipped with a new push-button type latching mechanism.

All 1949 Oldsmobile rear door locks are equipped with a free-wheeling feature. These locks are so designed that the free-wheeling feature may be brought into play by inserting a tool

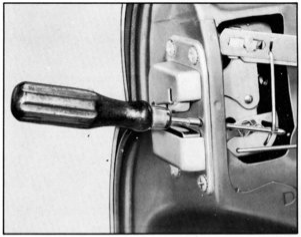


Fig. 40. Engaging "Free Wheeling" Device (98 Series)

Fig. 41. Disengaging "Free Wheeling" Device (76 and 88 Series)

through the clearance hole in the pillar and lock to trip the remote control link lever. (Figs. 39 & 40)

To change the remote control handle from a positive to a "free-wheeling" action, insert a small hooked tool through clearance hole in the door facing as shown in Figs. 41 & 42. Operate the tool so as to trip the little tab upward to engage the intermittent lever of the lock. To change the lock back to a positive action, reverse this procedure. The lock is in a positive position when installed at the factory.

Door Removal and Replacement—98 Series

1. Disconnect the door check link at body pillar by removing screw from check link support. (See Fig. 43)

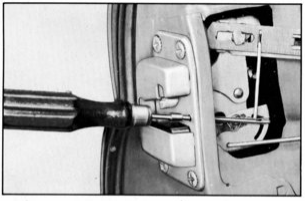


Fig. 42. Disengaging "Free Wheeling" Device (98 Series)

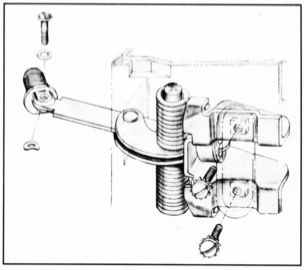


Fig. 43. Door Check Link Mechanism

2. On front doors, with a helper holding door, remove the cross-head screws securing each hinge box assembly to the front body pillar. Some of these hinge screws are accessible inside the hinge box. (Fig. 44)
3. On the rear doors, remove the hinge cover plate from the inner edge of each hinge strap and center pillar; then, with a helper holding the door, remove the cross-head screws from upper and lower hinge straps where attached to center pillar.
4. To install, reverse sequence of operations applying a ribbon of "3M Auto Body Sealer" along the inner edge of each rear door hinge strap and body pillar before reinstalling hinge cover plates.

Door Removal and Replacement—76 and 88 Series

1. Loosen door front weatherstrip retainer (front door only).
2. Remove hinge cover plates.
3. Scribe hinge locations.
4. Remove hinge from door pillar on front doors from body pillar; on rear doors remove door, taking care not to damage check link.

   NOTE: The check link support and link do not have to be disturbed to remove the

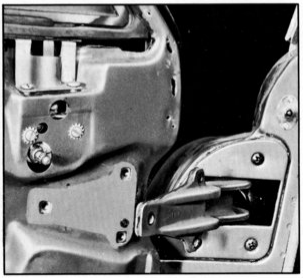


Fig. 44. Front Door Hinge (98 Series)

door. Care must be used when removing the door to disengage the curved end of the link from the support roller. Swing the door toward the closed position to disengage link. (Fig. 45)

5. To install, reverse sequence of operations, carefully sealing front door hinges with "3M Auto Body Sealer" at hinge, bolt heads, and hinge cover plates.

Fig. 45. '76 and 88 Series Door Check Link

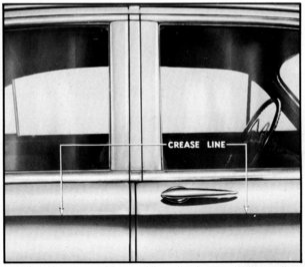


Fig. 46. Door Crease Lines in Proper Alignment

Adjustment and Servicing of Doors—98 Series

Body doors can ordinarily be fitted to body openings by the simple method of adjusting hinges and striker plates, except in cases where the body shell or door has been damaged by collision.

In checking for door misalignment, the door lock striker plate should be removed from the body pillar allowing the door to hang free on its hinges. Spacing at sides and top of door should then be checked; the crease line or molding on the doors and adjacent body panels should be in continuous horizontal alignment as shown in Fig. 46.

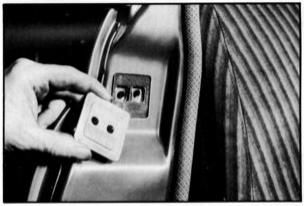


Fig. 47. Door Lock Striker Plate

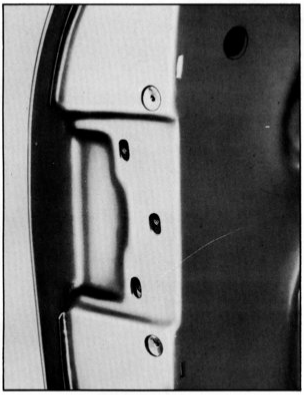


Fig. 48. Rear Door Hinge Pillar

The door lock striker plate can be adjusted up and down or in and out to provide proper door fit at lock side and to take up excess play due to normal wear of lock bolt.

Fig. 49. Center Hinge Pillar

Serrations on back of plate and body pillar, coupled with movable cage nuts in the pillar, allow for this adjustment. (See Fig. 47)

Front doors can be adjusted "up and down" and "fore and aft" by shifting the position of the hinge straps on the door inner panel. (See Fig. 44) A small "in and out" adjustment is possible on the body pillar hinge box mountings or by shimming the hinge straps at door panel.

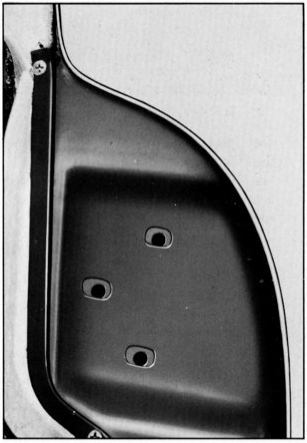


Fig. 50. Front Door Hinge Pillar

Rear door "up and down" adjustment is provided by changing the position of the butt-type hinges on the door pillar. (See Fig. 48) "In and out" adjustment is made on the center pillar, and shims can be used to accomplish "fore and aft" adjustment.

A ⅜" up and down adjustment is provided for the positioning of the door check on the door inner panel.

Adjustment and Servicing of Doors—76 and 88 Series

Front

1. Remove the door lock striker, and check door alignment.
2. Remove hinge cover plates and scribe hinge location.
3. In and out adjustment is provided at door pillar, and requires corresponding check link support adjustment to maintain normal hold-open operation. (Fig. 50)
4. The hinge bolt holes in the body hinge pillar are 9/16" diameter providing for up and down, or forward and rearward adjustment at this point. Further rearward adjustment of the door can be made by adding full shims to the door half of hinge straps. Due to the inaccessibility of the bolts at the body half of the hinge strap it will be necessary to remove the door for an up, down, forward and rearward adjustment.

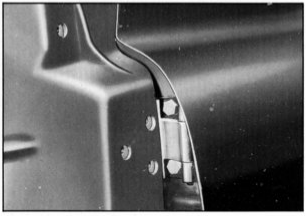


Fig. 51. Front Body Hinge Pillar

5. Determine the amount the door is to be moved and remove door.
6. With the door removed, and prior to moving the hinges on the body, a flat bar can be held to the door half of the hinge straps with "C" clamps. This bar between the two hinges will hold the hinge pins in line during adjustment.
7. Using the scribe line as a reference, loosen and carefully move each hinge up, down, forward or rearward the required amount, then tighten the hinge bolts and seal as required.
8. Install the door and check alignment.
9. Complete the sealing operations at the hinges and water test. This operation is recommended after each hinge adjustment.

Rear

1. Remove door lock striker and check door alignment.
2. Scribe position of hinges.
3. In and out adjustment is provided at the body pillar. (Fig. 49)

   NOTE: After in or out adjustment of the door, check the door check link for hold open operation and adjust if necessary.
4. Up and down adjustment is provided at door pillar.
5. Shim body half of hinge straps for forward and rearward adjustment as follows:
   (a) For forward adjustment, add shims to the inside half of body hinge pillar straps, upper and lower hinges.
   (b) For rearward adjustment, add shims to the outside half of body hinge pillar straps, upper and lower hinges.

   NOTE: To gain additional "rearward" adjustment, add full shims to door half of hinge straps, upper and lower hinges.

Door Rubber Weatherstrips

The rubber weatherstrips of all doors are cemented with "3-M Weatherstrip Cement," and front door weatherstrips are held in position on the hinge pillar side from the creaseline down, by a metal retainer strip.

Door bottom weatherstrips are held in position by a metal retainer with a scalloped flange

crimped over the weatherstrip after it is cemented.

Door Rubber Weatherstrip Removal and Installation

1. Remove front weatherstrip retainer screws.
2. Bend down retainers along bottom of door and, using a putty knife, break the seal between weatherstrip and door flange, remove weatherstrip.
3. Remove all dirt and dried cement from weatherstrip and door flange.
4. Apply a thin coat of weatherstrip cement to door flange and to weatherstrip; allow cement to dry until tacky and install weatherstrip. Replace torn or otherwise damaged sections of weatherstrip with new sections.
5. Press weatherstrip firmly in place, bend bottom retainers, and install front retainer; clean off excess cement.

   NOTE: Allow not less than one hour drying time before closing door.

Door Window Garnish Moldings

Door inside moldings consist of an upper inverted "U" shaped garnish molding and a door belt finishing molding on 98 series cars. The upper garnish molding is attached with screws to the window opening. The belt finish molding is assembled by placing in position and sliding upward to engage the key hole shaped slots on the molding back side with screw heads. protruding from the door inner panel. It is also held with screws at each end. (Fig. 52)

The garnish molding arrangement of 76 and 88 series cars is similar to that of 98 series cars except that a one-piece stamping is used at each opening, rather than the two-piece molding used on the 98 series. (See Fig. 53)

In removing the 76 and 88 series moldings, it is necessary, after removing screws, to pull upward and outward freeing molding from holding clips. It is also necessary to remove the wind deflector attached to the ventilator division channel before attempting to remove molding from rear doors of 76 and 88 series cars.

Door Inside Handle Removal

1. Depress the trim pad and insert special pliers behind escutcheon plate to grip handle retaining spring.
2. Carefully remove retaining spring, then remove handle. (Fig. 54)
3. To replace, first insert retaining spring in handle, then install handle on splined shaft of regulator.

Door Arm Rest Removal

1. From the underside of arm rest, remove two

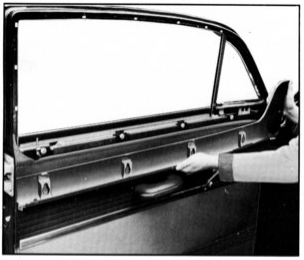


Fig. 52. Removing Door Belt Finish Molding

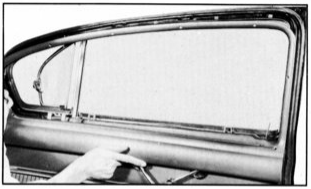


Fig. 53. Removing Door Garnish Molding

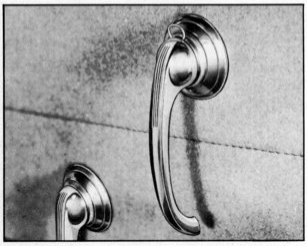


Fig. 54. Door Inside Handle Removal

long screws which hold the assembly to the door panel. (See Fig. 55)

NOTE: On 76 and 88 series cars, it will be necessary to remove a small trim plate fastened by two cross-head screws in order to gain access to the arm rest attaching screws.

2. To replace, reverse the procedure.

Door Trim Pad Removal

The nail-on door trim pad used on all models is removed as follows:

1. Remove the door inside handles, also Hydro-Lectric switch where used.

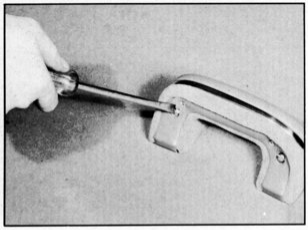


Fig. 55. Door Arm Rest Removal

2. Remove the door belt finishing molding (complete garnish molding in 76 and 88 series cars.
3. Remove door arm rest.
4. Remove screws at lower corners of trim pad.
5. With a suitable flat tool, pry loose the trim pad at both sides, then, raise it from the retaining hooks at center of door and the retainer channel at the bottom.
6. To replace, reverse this procedure.

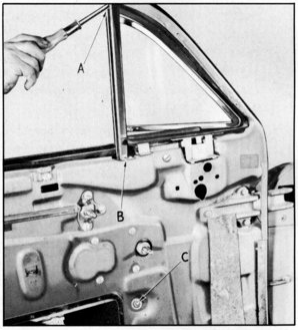


Fig. 56. Removing Door Division Channel

Door Division Channel Removal

1. Lower glass, and remove the door trim pad.
2. Pry the glass run channel to release clips from pinch-weld at door header.
3. Remove the single cross-head screw located inside division channel as shown at "A", Fig. 56.
4. Remove the screws holding the division channel bracket to edge of door inner panel at window opening. (See "B", Fig. 56)
5. Remove nut and adjusting screw at bottom of channel as shown at "C", noting before

removal the amount screw projects through hole.

6. With door ventilator open, swing division channel out of position, pull up, and remove through window opening of door.
7. To replace, reverse sequence of operations, adjusting lower end of channel forward or backward by loosening nut at "C", Fig. 56, and moving stud in slotted hole in inner panel the desired amount. To move lower end of channel in or out, adjust the internal stud nut on the opposite side of inner panel, accessible through the loading hole.

Door Window Glass Removal

1. Remove door trim pad.
2. Remove ventilator division channel.
3. Lower window and remove the two screws from each end of the sash channel to disengage the sash channel from the cam. (See "A", Fig. 57) These screws are accessible through the loading hole in door inner panel with window in lowered position.
4. Carefully raise the glass to an almost closed position and tilt inward using care to work out one lower corner at a time so as not to cause damage.
5. To replace, reverse this procedure.

Door Ventilator Removal

1. Remove door division channel.
2. Remove ventilator regulator (front door 98 series, only) as follows:
   (a) Remove loading hole cover.
   (b) Remove hex bolt at "A", Fig. 58, to disconnect lower pivot shaft from regulator mechanism.
   (c) Remove four screws at "C", Fig. 58, holding regulator to door inner panel, and remove mechanism through loading hole.
   NOTE: The set screw designated at "B", Fig. 58, controls the ventilator "Friction Clamp" and may be adjusted to take up any excess play in the ventilator shaft.
3. Remove ventilator lower mounting bracket screws from door inner panel.
4. Remove screws along door pillar facing and remove ventilator assembly.
5. To replace, reverse sequence of operations.

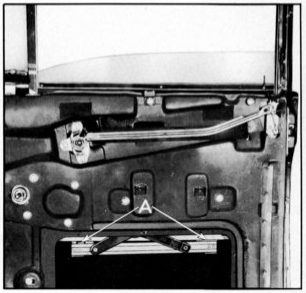


Fig. 57. Disengaging Sash Channel from Cam

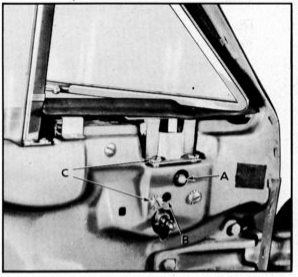


Fig. 58. Door Ventilator Removal

Fig. 59. Removal of Screws from Regulator Cam

Rear Quarter Window Removal (Club Sedans)

1. Remove rear quarter window garnish molding.
2. Remove the window regulator handle.
3. Remove finishing panel below window opening (98 series) by lifting panel off its retaining clip and pulling down and out to free from retaining bolts.
4. Release and turn back quarter trim pad sufficiently to expose rear quarter inner panel.
5. Raise window and through the cut-outs in inner quarter panel, remove the four screws from regulator cam. (Fig. 59)
6. Grasping top edge of glass, lift and tilt glass inward to free it from its channel and remove from inside body.
7. To install, reverse sequence of operations.

Rear Quarter Window Removal (76 and 88 Series Club Coupe)

The sliding type rear quarter window used on 76 and 88 series club coupes is removed as follows:

1. Remove the garnish molding.
2. In the window opening, remove the screws holding the ventilator frame and garnish molding front support clip.
3. Tip ventilator assembly inward at top and lift the assembly up and out.

Front Seat Disassembly—98 Series

1. Remove front seat cushion by lifting from frame.
2. Bend out the metal tabs holding the bottom of the front seat back cushion to the frame.
3. Pull bottom of back cushion forward, lift up to disengage it from the toggle fasteners at the top of seat frame, and remove cushion.
4. Disconnect connecting rod and clip from remote control assembly of seat adjuster mechanism on inside of left hand seat side panel.
5. Remove bolts attaching seat bottom to seat adjuster mechanism (3 bolts each side); see "A", Fig. 60. Do not remove equalizer rod bolts attaching equalizer rod assembly to seat frame.
6. Remove seat, disengaging equalizing rod from adjuster mechanism and clips on

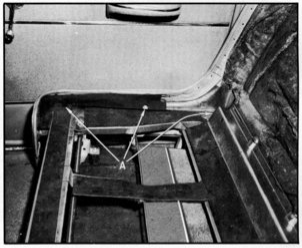


Fig. 60. Removal of Seat Attaching Bolts

cushion supports from auxiliary locking rod.

Seat adjuster handle and its attachments are removed with seat.

7. To reassemble, reverse sequence of operations.

Front Seat Disassembly—76 and 88 Series

NOTE: Front seat cushion cannot be removed from seat frame in conventional manner.

1. Loosen Allen set screw and remove seat adjuster control knob from left side of seat.
2. Remove seat side panels.
3. Remove seat adjuster to floor pan bolts and remove seat assembly. (Fig. 61)
4. Remove back trim panel by removing screws at bottom and sliding panel down to disengage the slide-on tabs at top.
5. Remove seat adjuster cover assemblies from seat cushion frame.
6. Disassemble the seat back from the seat cushion.
7. To reassemble, reverse sequence of operations.

Robe Rail Cord Removal

1. Remove outer cross-head screw from escutcheon on each end of robe rail cord, and remove cord as illustrated. (Fig. 62) The escutcheons may be removed if desired by removing the remaining inner screws.
2. To replace, reverse this procedure.

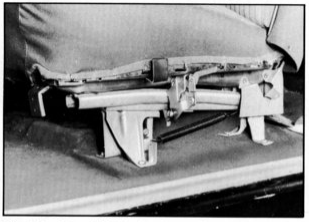


Fig. 61. 76 and 88 Series Seat Adjuster Attachment

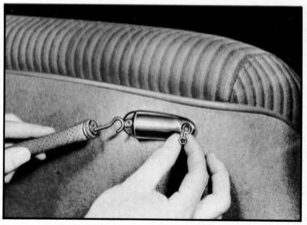


Fig. 62. Robe Cord Removal

FRONT SEAT ADJUSTER

The front seat adjuster mechanism is designed with ball and roller assemblies between the upper and lower channels for added ease of operation. The complete assembly, bolted to the seat frame and to the floor pan, is controlled by a seat adjuster handle on the left side of the seat, and parallel travel is maintained by an equalizer bar.

Seat Adjuster Removal and Replacement—98 Series

1. Remove seat cushion.
2. Disconnect connecting rod and clip from remote control assembly of seat adjuster mechanism on inside of left hand seat side panel.
3. Remove 3 bolts each side attaching seat bottom to seat adjuster mechanism. (See "A", Fig. 60)

   Do not remove equalizer rod bolts attaching equalizer rod assembly to seat frame.
4. Remove seat, disengaging equalizing rod from adjuster mechanism and clips on cushion supports from the auxiliary locking rod.

5. The seat adjuster handle and its attachments are removed with the seat.
6. Remove 4 bolts each side retaining seat adjuster assembly to floor board.
7. Remove auxiliary locking rod and remove seat adjuster assembly.
8. To replace, sequence of operations should be reversed.

Seat Adjuster Removal and Replacement —76 and 88 Series

1. Loosen Allen set screw, and remove seat adjuster control knob from left side of seat.
2. Remove seat side panels.
3. Remove seat adjuster to floor pan bolts, and remove seat assembly.
4. Remove seat adjuster from seat. With adjuster removed, the lock control rod and equalizer bar can be removed.

   NOTE: In order to remove from seat, adjuster must be pushed to extreme back postion to remove front bolts and to extreme forward position to remove back bolts.

To replace adjuster:

1. Install equalizer rod to seat frame.
2. Install right hand seat adjuster with rear and side bolts making sure the equalizer rod is engaged in slot.
3. Install seat adjuster locking rod to right hand seat adjuster.
4. Install locking rod in center support anti-rattle clip.
5. Position left hand seat adjuster on seat frame and attach into place with rear and side bolts, making sure equalizer rod engages in slot.
6. Shift seat adjuster backward and install front bolts.
7. Install seat assembly with bolts to floor pan and check operation.
8. Install seat side panels and control knob, and recheck operation of seat adjuster.

Rear Seat Back Cushion Removal—(Plain Back)

1. Lift up and remove rear seat cushion.
2. From inside the body, straighten out the metal tabs anchoring cushions at bottom of seat back. (If anchored at this location with screws instead of tabs, remove screws.)
3. Raise read compartment lid, remove lining board directly behind seat back and, from the rear compartment, bend down the metal retaining tabs holding upper portion of seat.
4. From inside body, pull out seat back at the bottom, lift, and remove.
5. To replace, reverse this procedure.

Rear Seat Back and Center Arm Rest

1. Lift up and remove hear seat cushion.
2. Raise rear compartment lid and remove the rear compartment lining board directly behind the seat back.
3. From the rear compartment, bend down the metal retaining tabs holding upper portion of seat back at this area.

Fig. 63. Attachment of Rear Seat Center Arm Rest

4. On inside of body, lift up seat back to clear retainer at the top and remove.
5. To remove center arm rest, remove two screws holding arm rest extension strap retainer at upper seatback structure, shown at "A", Fig. 63.
6. Lift up arm rest to uncover the two bracket screws "B" on each side of arm rest. Remove screws and arm rest.
7. To replace, reverse sequence of operations.

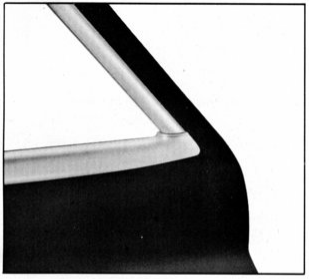


Fig. 64. 98 Series Front Door Reveal Molding Junction

REVEAL MOLDINGS

Closed body door and quarter windows have a two-piece door outside window molding consisting of an upper and a lower window reveal molding assembly. Figure 64 shows the junction of the upper and lower moldings at the lower corner of the door window on the 98 series. The upper molding is retained by clips, while the lower molding which laps over the end of the upper molding, is attached with screws. No reveal molding covers the front door lock pillar or the rear door hinge pillar portions of the window opening. On sedans, the center pillar has short upper and lower reveal moldings which are installed over bolts placed through the center pillar assembly and retained by nuts on the center pillar inner panel. Convertible styles have only single lower door and quarter window reveal moldings similar to those on closed bodies.

Door Window Reveal Molding Removal —98 Series

1. Remove door trim pad.
2. Remove header section of door window glass run channel.
3. Loosen door ventilator division channel at top of opening.
4. Remove door ventilator assembly and rain deflector.
5. Lower glass and remove the retaining screws from the lower reveal molding indicated at "A", Fig. 65. Remove molding.
6. Remove the clips from the upper reveal molding indicated at "B", Fig. 65, and remove molding.
7. To install, reverse this procedure. Check alignment of upper and lower reveal moldings and of window ventilator assembly and division channels immediately after their respective installations.

   NOTE: The rear quarter reveal moldings on two door styles may be removed by fol-

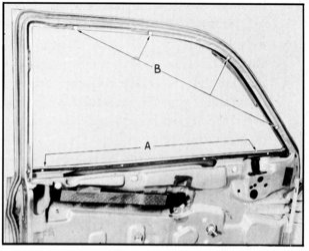


Fig. 65. Reveal Molding Retainer Clips and Screws

lowing the basic principle of door window reveal molding removal as outlined.

Reveal Molding Removal and Installation—76 and 88 Series

The reveal moldings on 76 and 88 series cars are attached to the body by means of spring clips over which the moldings snap. The center pillar reveal molding is bolted to the center pillar with a nut under the inside center pillar trim. Remove reveal molding as follows:

1. Protect outside finish with masking tape and, using a suitable flat tool, disengage door reveal molding from clips and remove.
2. Loosen center pillar trim and wind hose foundation at upper end.
3. Remove nut inside center pillar and remove center pillar reveal molding.
4. To install, reverse sequence of operations sealing all holes and clips.

DOOR OUTSIDE HANDLE REMOVAL—98 Series

1. Loosen door rubber weatherstrip on door lock pillar adjacent to the lock to expose the access hole in door facing for insertion of removing tool. (Closed styles only). On Convertibles this hole is already exposed.
2. Turn door handle down slightly and insert a ¼" socket wrench with shank length 3½ inches or longer through this access hole.
3. Enter end of tool into socket or tumbler on lock mechanism as shown in door cut-away illustration, Fig. 66, and loosen hex-head ¼" retaining screw sufficiently to remove door handle.

   CAUTION: Do not completely remove this screw.
4. To replace, reverse sequence of operations and re-cement loosened portion of weatherstrip.

   NOTE: If the upper mounting screw of the door lock adjacent to the door flange is removed before this operation, the end of the outside door handle retaining screw can be readily noted.

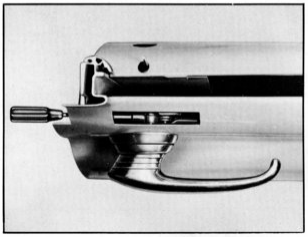


Fig. 66. 98 Series Outside Door Handle Removal

DOOR OUTSIDE HANDLE REMOVAL—76 and 88 Series

The stationary outside door handle, which is equipped with a push-button type latch release, is held to the door by means of a flat spring retainer on the back side of the door outer panel. It is removed in exactly the same manner as the 98 series outside *safety lock* which is described immediately following, except that it is necessary to remove a screw holding the retainer to the door pillar before retainer can be moved.

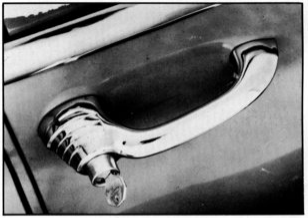


Fig. 67. 76 and 88 Series Outside Door Handle

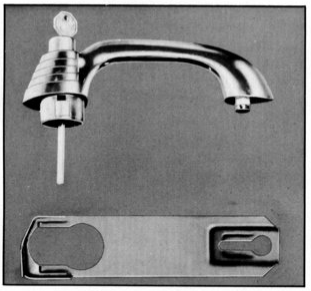


Fig. 68. Outside Door Handle and Spring Retainer

Door Outside Safety Lock Removal—98 Series

1. Release the door weatherstrip at the lock face to expose flat spring retainer.
2. Insert a suitable tool between the door flange and retainer spring and pry the retainer out about 1½". The safety lock may now be disengaged and removed from its opening in the door panel.
3. To replace, reverse this procedure, cementing door rubber weatherstrip back into position with "3-M Weatherstrip Cement."

Door Outside Safety Lock Removal—76 and 88 Series

1. Remove door handle.
2. Remove retaining snap ring.
3. Remove stop washer, spring, and detent washer.
4. Remove lock cylinder and push button shaft assembly. (See Fig. 68)
5. To replace, reverse sequence of operations and check operation of lock and push button latch release.

Door Lock Remote Control Removal

1. Remove door trim pad.
2. Remove remote control assembly attaching screws on door inner panel.
3. Disengage the remote control from linkage and remove.
4. To replace, reverse sequence of operations.

DOOR LOCK ASSEMBLY REMOVAL

1. Remove door outside handle and outside safety lock.

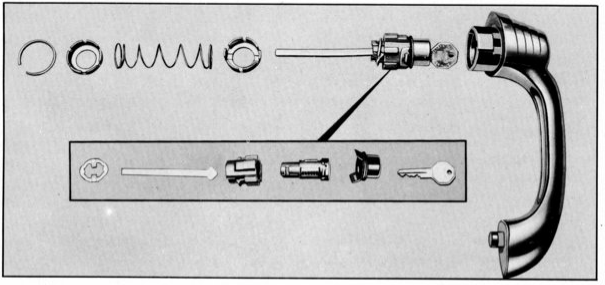


Fig. 69. Door Lock Assembly Details, 76 and 88 Series

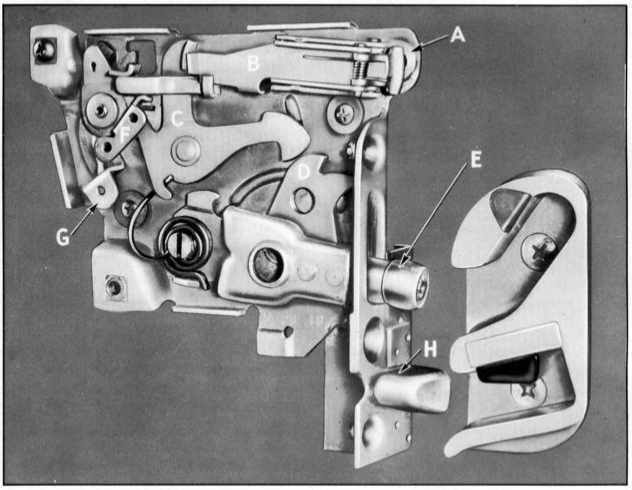


Fig. 70. Details of 76 and 88 Series Lock Mechanism

2. Remove door trim pad.
3. Disconnect inside locking rod and remote control link.
4. Remove screws at inner panel (76 and 88 series, only) and at pillar face holding door lock.
5. Remove door lock through opening in lock pillar face by turning lock at a slight angle toward the in side of car, then tilt the front of the lock down to clear opening.
6. To install, reverse sequence of operations. NOTE: On 76 and 88 series front doors, it will be necessary to loosen the glass run channel at the bottom and pull out slightly to replace the lock in its proper position.

Latch of 76 and 88 series cars should always be in "DOWN" position when door is closed.

Rear Compartment Lid

Rear compartment lids consist of an outer and inner panel which are spotwelded together along their flanged edges to form a complete unit. On 4-door sedans and convertibles, the lid paneling is deep drawn to provide ample rear compartment storage space. All lids are hinged at the top to the compartment opening and are locked at the bottom.

The lids of all 98 models are equipped with dual locks of simplified design. These locks are

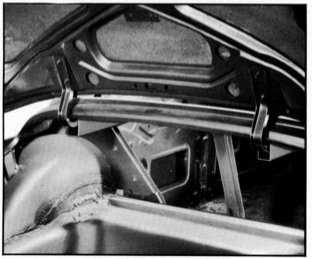


Fig. 71. Rear Compartment Lid Hinges

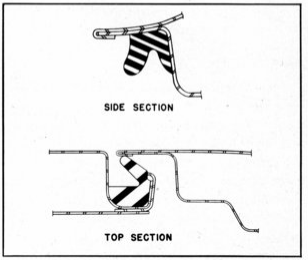


Fig. 72. Rear Compartment Weatherstrip Arrangement

so designed that the rotary action is parallel to the inner panel, and the cam part of the lock is protected by a metal baffle to prevent luggage from jamming the mechanism. The lid lock striker plates of all series are adjustable.

On 98 series closed bodies and all 76 and 88 series bodies, rear compartment lid hinges are contained in hinge boxes which are welded to the upper side of the gutter and the seat back compartment panel. Floating cage nuts located in the lid inner panel, allow up and down or side adjustment of the lid. All rear compartment lid hinges, except those on 98 convertibles, are the counterbalanced and hold-open type, no compartment lid support being used. Due to the construction of the folding top compartment of 98 series convertible coupes, a single telescopic lid support is used on this model.

A single *Automatic* type lock is used on 76 and 88 series cars. When the lid is lowered and the lock tongue engages the striker, the lid is automatically locked. The key releases the lock and it is not necessary to turn the handle to unlatch the lid on these models.

REAR COMPARTMENT LID REMOVAL

1. Disconnect the light wire and remove from lid.
2. On 98 series convertibles, disconnect the lid support where it is attached to lid inner panel.
3. Scribe the exact position of each hinge strap on the lid inner panel and remove the retaining bolts from the hinges.
4. Carefully lift the lid out of its opening using care to prevent dropping or slipping against the body finish.

Although it is possible to remove the lid by driving out the lid hinge pins, the operation as here outlined is much simpler.

5. To replace, with the aid of a helper, carefully place lid into position over the hinge straps within the scribed marks, and install the hinge bolts.
6. If necessary, adjust the lid by loosening the hinge bolts and moving the lid either up or down or sideways the desired amount; then, tighten the bolts. Movable cage nuts on the inner lid panel permit this floating adjustment. The position of the lid in the opening may be raised by inserting shims between upper half of hinge straps and lid, and may be lowered by inserting shims between the lower half of hinge straps and

lid. The lid lock strikers at bottom of lid and side bumpers are also adjustable.

HEADLINING

The headlining which comprises the complete roof upper structure trim, extends from the front of the roof at the windshield, to the back, and down to the belt line of the body. Across the upper side of the headlining, at spaced intervals, strips of muslin called *listings* are sewed. Through the hem of these listings during installation, insulated wires called *listing wires* are inserted for attachment of the headlining to the roof bows.

At the underside of the roof are located steel cross bows to which the headlining listings are attached.

In addition to the fastenings at roof bows, adjustable wire supports are inserted through some of the headlining listings and secured to the side rails to form the lining to the roof contour. (Wire listing supports, only, are used on 76 and 88 series bodies). The skirt of the headlining, during installation, is tucked under metal toothed retainers along the side roof rails with a special tool.

Headlining Removal and Installation

1. Remove windshield, rear quarter window, and back window garnish moldings.
2. Remove sun visors and brackets.
3. Remove dome lamp assembly.
4. Remove rear seat cushion and rear seat back.
5. Remove rear parcel shelf trim panel.
6. Remove tacks and loosen trim around windshield, rear quarter window and back window.

   NOTE: Proceed very carefully as material is retained by pointed metal tabs and, on 76 and 88 series cars, it is also cemented.
7. Starting at the front corners, carefully disengage the headlining from its retainers at the roof side rail and on the right side rail, remove the screws holding the headlining wire support ends to the side rails.

   NOTE: On 76 and 88 models, loosening the retainer screws progressively as headlining is loosened facilitates the disengagement of headlining from retainers.
8. Starting at the front roof bow and proceeding toward the rear, bend down the metal tabs on each roof bow and remove headlining from roof bows. (98 series, only). Also disconnect the headlining listing wires from their attachment on the left side roof rail and remove lining.
9. To replace, center and hang the headlining on the rear roof bow and, work toward the front, attaching the headlining to the roof bows and the curved listing wires to the roof side rails.
10. Attach listing support wires above rear quarter windows.
11. Fasten headlining at back window opening and at rear parcel shelf, cementing lining to window opening on 76 and 88 models.
12. Stretch headlining to the front and fasten at windshield opening. All fullness must be removed from front to rear before installing side section of lining.
13. Using headlining inserter, tool No. J-2772, as shown in Fig. 73, carefully tuck the edges of the headlining up under toothed retainer along the side roof rails. Before performing the operation, make sure the retainers are fastened firmly in place.
14. Retack headlining around rear quarter windows (98 series only).
15. Install dome light, garnish moldings, sun visors and rear seat cushions.

LOCKS AND KEYS

Each car is equipped with two sets of matched tumbler locks and two sets of keys. The hexagon head key is coded to the door handle lock, and also fits the ignition lock. The oval head

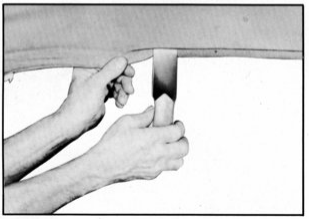


Fig. 73. Inserting Headlining with Tool J-2772

key is coded to the rear compartment lock and fits the rear compartment (lift gate on station wagons) and glove compartment locks.

Door lock key numbers are stamped on the shank of the locking handles and it is necessary to remove them to locate the numbers.

The glove compartment lock is not stamped. However, the code of either the key or locking cylinder can be duplicated by using the combination of the rear compartment handle lock. This also applies to the ignition lock; however, in duplicating the ignition lock or key the code should be taken from the door locking handle.

All key numbers are stamped on an identification tab which is part of the key head. The number should be recorded, and then the tab should be knocked out and kept by owner for future reference, eliminating the possibility of unauthorized duplication of keys.

Coding Cylinder Locks and Keys

The ignition lock in production is assembled with tumblers cut to fit the combination of door locking handle key.

Parts for duplicating this lock are available with the locking cylinder and the locking bar staked in place, less tumblers, requiring the proper combination of tumblers to be used in building up the lock combination to code with the door lock number. Lock codes are recorded in the Briggs & Stratton Corp. code list, furnished only to authorized dealers servicing locks.

Four types of tumblers are used to make all the various lock tumbler combinations, and each type is coded according to its color as follows:

C—Copper
N—Nickel
B—Black
Y—Yellow

All tumblers are shaped exactly alike except for the position of a notch on one side; as the proper key is inserted into the lock cylinder each tumbler is raised the proper amount so that the notches on all six tumblers are brought to the same level. As soon as the tumblers all "line-up", the locking bar is pushed toward the centerline of the cylinder (into the notches) by two small springs, leaving the cylinder free to be turned in its bore to unlock.

Assembling Lock Cylinder

After the tumbler code has been determined, either from the Briggs & Stratton Code list or with the use of a key decoder, the lock can be assembled. Every code is composed of six letters which refer respectively to the six tumblers to be inserted in the cylinder. (See Fig. 74)

Starting at the key end and proceeding toward the inner end, drop the tumblers, each stamped with the letter corresponding to the code, into their respective tumbler slots with notches to the right as viewed from key end of cylinder. (A

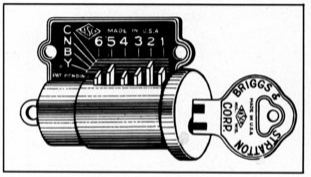


Fig. 74. Key Decoder

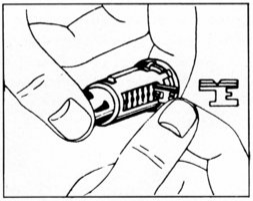


Fig. 75. Inserting tumblers into Cylinder

tumbler cannot be installed other than in its proper position.) (See Fig. 75)

After the tumblers have been installed, insert

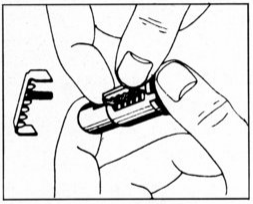


Fig. 76. Installing Spring Retainer in Cylinder

a small coil spring over the tip at the upper end of each tumbler, place the coil spring retainer in position, and press retainer tabs into the cylinder barrel. Next, place the cylinder assembly

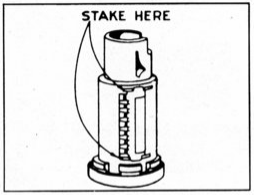


Fig. 77. Location for Staking Spring Retainer

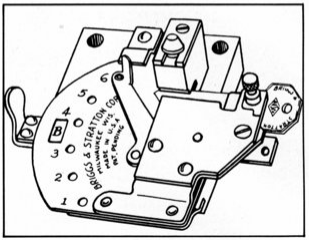


Fig. 78. Key Cutting Machine

in the lock staking tool and, with a prick punch, peen the cylinder at each end of the spring retainer slot to hold retainer in place. (Figs 76 & 77)

Cutting Keys

To cut a key to a special code number proceed as follows: Place the blank key in the key cutting machine and tighten the clamp thumb screw. (See Fig. 78)

Place the machine lever on number "one" and pull the slide handle out until the first letter in the code appears in the opening. Then with a hammer, strike a sharp blow on the cutting tool. Continue operation of cutting to complete combination of code.

After key cutting operation is completed, check with the key decoder. (See Fig. 74) The new key should lift the tumblers in the decoder in line with the combination of color and numbers on the decoder as represented in the original Briggs & Stratton code book.

BODY AND STYLE NUMBER PLATE

The body and style number plate shows:

1. Style (The year and style number of body).
2. Body number.
3. Trim number. (Combination code number of trim.)

4. Paint number (Color specification number).

When ordering body parts, or writing shop orders and reports, it is necessary that all letters and numbers are included for correct body identification. (See Fig. 1)

AUTOMOBILE "HOUSECLEANING"—Cleaning Upholstery

There are basically three different types of cleaning agents: 1st, volatile cleaners such as naphtha or gasoline, carbon tetrachloride and many other colorless liquids having great solvent powers for grease and oil; 2nd, alkaline soaps and soap and water mixtures; 3rd, soapless detergents.

It is definitely recommended that a "volatile type cleaner", preferably a mixture of carbon tetrachloride and cleaner's naphtha be used. The following method for cleaning upholstery fabrics is generally considered the most successful in removing spots caused by ordinary soil:

VERY IMPORTANT: Be sure area where volatile cleaners are used is WELL VENTILATED and that no fire or flame is exposed in immediate vicinity.

1. Several small swatches of folded cheesecloth or other suitable cloth are required.

2. Carefully brush away all loose, dry particles of dirt and soil.

3. Immerse small cloth swatch in cleaning solution, wring out thoroughly, open cloth and allow medium evaporation.

4. Place cloth on soiled spot, using no friction and only slight tapping pressure, several times. This will pick up loose particles which are too embedded to be removed in the brushing operation. This operation should be repeated several times—in each instance using a clean area of the cloth.

5. Immerse a new cloth in cleaner, wring out thoroughly, open and allow to evaporate until barely damp. Apply increased pressure and rub soiled area in a backward and forward motion. The cleaning cloth should be reversed several times in this operation.

6. Immerse third cloth, wring out, allow evaporation and apply to both the spot and the area surrounding same, using a light, brisk motion.

7. Repeat brushing operation.

Careful application of these methods is the prime factor in obtaining satisfactory results and if followed closely the various degrees of operation will prevent the appearance of unsightly rings. The evident slowness of the completed operation is compensated for by the results obtained.

CAUTION – While "volatile type" spot cleaners only are recommended for use on upholstery fabric, care must always be exercised not to apply it in sufficient quantity to soak the padding on the cushions, arm rests or trim pads when cleaning them.

Some cushions and arm rests are padded with foam type rubber and if soaked with hydrocarbon cleaners the rubber padding will absorb it and may be destroyed.

On door trim pads, the solvent may dissolve the black waterproofing with which the board backing is impregnated and bleed it out through the sewing thread onto the trim pad cover.

Cleaning Methods for Convertible Tops

Convertible top materials are made from two thicknesses of durable, high-count, all-cotton or cotton and rayon fabrics combined with an inner layer of rubber. In addition, the material is sufficiently pre-shrunk, to avoid shrinkage under normal conditions of service, and it is also treated to resist and shed water. Because of the exposure of convertible tops to direct sunlight, rain and snow, the fabrics used, like all other textiles, will fade to some extent. A further effect of weather on convertible cabriolet tops may be a condensation of moisture from the air appearing on the inside lining. When windows

and other openings are closed, certain outside atmospheric conditions may cause condensation; this is not to be confused with actual leakage of water through the fabric.

These top materials are easily cleaned and kept attractive if the following instructions, as to proper methods of cleaning and care, are exercised. Generally, soilage can be removed with art gum or crude rubber. If dirt is heavily embedded in the fabric, however, the top should be thoroughly brushed with a whisk broom. In this brushing, a minimum of pressure should be applied to those areas of the assembly which cover the metal bows of the top structure, since heavy abrasion will disturb the surface of the material appreciably, causing an unsightly appearance. After brushing, the top should be washed thoroughly with a neutral soap suds and lukewarm water. A cloth or brush with soft bristles should be used. Generous quantities of clear water should then be applied over the surface to remove any particles of soap which might remain. *Volatile and other clear cleaners, naphtha, gasoline or household cleansing and bleaching agents should never be used.*

It is very important, that the top is always thoroughly dry before collapsing and folding it down, as folding the top while wet or damp might cause mildew, shrinkage, or unsightly wrinkles.

Cleaning Genuine and Imitation Leather

Some closed models and all convertible cabriolet styles use either genuine or imitation leather on certain sections of body trim in order to provide the beauty and extra serviceability which these afford.

The genuine leathers used in Oldsmobiles are selected from fine quality steerhides, properly split, tanned and color coated. Imitation leather coated fabrics are made from cotton bases, of various weights and textures consistent with their use in the car, with coatings of colored rubber or pyroxylin being applied.

Genuine leathers have a natural tendency to wrinkle and such wrinkles or creases occurring in service do not detract from the quality of the leather, but serve to preserve and keep active the oils incorporated in the leather when it was tanned. A cushion in this condition is simply described as having "comfort wrinkles."

The best cuts of leather have certain scars, and briar scratches which likewise do not detract from the quality or durability but indicate that the hide carrying these "blemishes" is of the top cut grade and the markings are entirely natural.

Care of genuine leather is a relatively simple but important matter. If dirt accumulates on the surface, this generates into a hard grit which, under pressure, will cut the finish and cause the leather to crack or bleed color. The surface should be gone over occasionally with a dry cloth and if dirt should accumulate, the following cleaning instructions should be used:

1. Lukewarm water and a neutral soap should be used and a thin suds worked up on a piece of cheesecloth and applied to the surface.

2. The operation should be repeated, using only a damp cloth and no soap.

3. The leather should then be wiped dry with a soft cloth.

FURNITURE POLISHES, OILS OR VARNISHES SHOULD NEVER BE USED.

The genuine leather cleaning instructions can also be successfully used for cleaning imitation leather coated fabrics.

PAINT SPECIFICATIONS

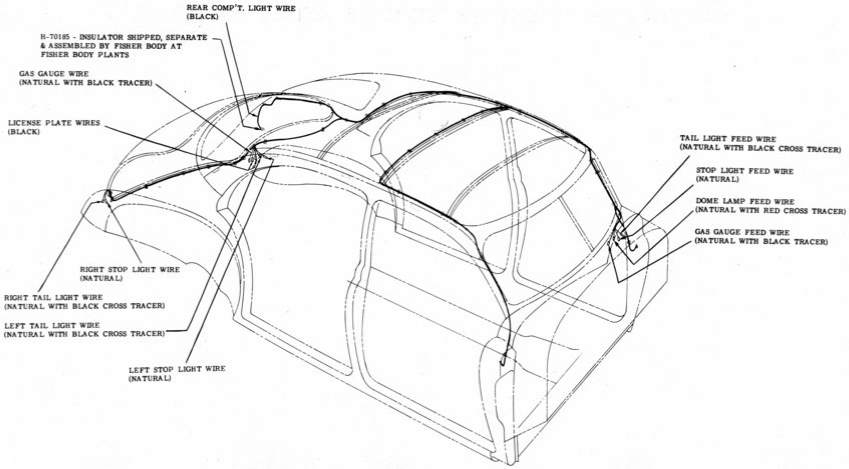
COMB. No.	Models On Which Available: All Club Coupes and 4-Door Sedans	All Club Sedans, Town Sedans and Convertibles	76 and 88 Series Deluxe Station Wagons	Colors: Lower Body and Sheet Metal	Upper Body	Wheels Note: Back side of all wheels and insides of rims painted black as follows: Lansing Plant Rinshed—Mason Black—10402 All Assembly Plants Dupont Black—94-21090
				For Lansing Plant—Rinshed—Mason		
40	X	X	X	Black—20498	Same	Canton Red—10522
41-C	X	X		Almond Green—023443	Same	Cream—10732
42	X	X	X	Garnet Maroon—PS-646	Same	Black—10402
42-C	X	X		Chariot Red—25520	Same	Chariot Red—10521
43	X	X	X	Tawnee Buff—028828	Same	Buff—10734
43-A	X			Tawnee Buff—028828	Praline Brown—PS-841	Buff—10734
43-C	X	X		Nankeen Cream—27782	Same	Cream—10732
44	X	X		Crest Blue—022295	Same	Blue—10243
44-A	X			Crest Blue—022295	Serge Blue—PS-0202	Blue—10243
45	X	X		Serge Blue—PS-0202	Serge Blue—PS-0202	Blue—10243
46	X	X		Praline Brown—PS-841	Same	Buff—10734
47	X	X		Silver Gray—021137	Same	Canton Red—10522
47-A	X			Silver Gray—021137	Metal Gray—PS-0104	Canton Red—10522
48	X	X		Metal Gray—PS-0104	Same	Canton Red—10522
49	X	X	X	Ivy Green—PS-3350-D	Same	Cream—10732
49-B	X			Seafoam Green—PS-3321-A	Ivy Green—PS-3350-D	Cream—10732
49-C	X	X		Seafoam Green—PS-3321-A	Same	Cream—10732
				For Assembly Plants (Except Southgate)—Dupont		
40	X	X	X	Black—253-2228	Same	Canton Red—44-3618
41-C	X	X		Almond Green—253-39805	Same	Cream—94-20430
42	X	X	X	Garnet Maroon—207-55104	Same	Black—94-21090
42-C	X	X		Chariot Red—253-54869-M	Same	Chariot Red—94-54869
43	X	X	X	Tawnee Buff—253-39865	Same	Buff—94-39865
43-A	X			Tawnee Buff—253-39865	Praline Brown—207-51572	Buff—94-39865
43-C	X	X		Nankeen Cream—253-5265	Same	Cream—94-20430
44	X	X		Crest Blue—253-39843	Same	Blue—94-39843
44-A	X			Crest Blue—253-39843	Serge Blue—207-39258	Blue—94-39843
45	X	X		Serge Blue—207-39258	Same	Blue—94-39843
46	X	X		Praline Brown—207-51572	Same	Buff—94-39865
47	X	X		Silver Gray—253-55277	Same	Canton Red—94-3618
47-A	X			Silver Gray—253-55277	Metal Gray—207-55324	Canton Red—94-3618
48	X	X		Metal Gray—207-55324	Same	Canton Red—94-3618
49	X	X	X	Ivy Green—207-34851-L	Same	Cream—94-20430
49-B	X			Seafoam Green—207-31680	Ivy Green—207-34851-L	Cream—94-20430
49-C	X	X		Seafoam Green—207-31680	Same	Cream—94-20430

PAINT SPECIFICATIONS

COMB. No.	Models On Which Available: All Club Coupes and 4-Door Sedans	All Club Sedans, Town Sedans and Convertibles	76 and 88 Series Deluxe Station Wagons	Colors: Lower Body and Sheet Metal	Upper Body	Wheels Note: Back side of all wheels and insides of rims painted black as follows: Lansing Plant Rinshed—Mason Black—10402 All Assembly Plants Dupont Black—94-21090
				For Southgate Plant—Dupont		
40	X	X	X	Black—253-2228	Same	Canton Red—94-3618
41-C	X	X		Almond Green—253-39805	Same	Almond Green—94-39802
42	X	X	X	Garnet Maroon—207-55104	Same	Garnet Maroon—182-10224
42-C	X	X		Chariot Red—253-54869-M	Same	Chariot Red—94-54869
43	X	X	X	Tawnee Buff—253-39865	Same	Buff—94-39865
43-A	X			Tawnee Buff—253-39865	Praline Brown—207-51572	Buff—94-39865
43-C	X	X		Nankeen Cream—253-5265	Same	Cream—94-20430
44	X	X		Crest Blue—253-39843	Same	Blue—94-39843
44-A	X			Crest Blue—253-39843	Serge Blue—207-39258	Blue—94-39843
45	X	X		Serge Blue—207-39258	Same	Serge Blue—182-10254
46	X	X		Praline Brown—207-51572	Same	Praline Brown—182-10210
47	X	X		Silver Gray—253-55277	Same	Silver Gray—94-5277
47-A	X			Silver Gray—253-55277	Metal Gray—207-55324	Silver Gray—94-5277
48	X	X		Metal Gray—207-55324	Same	Metal Gray—182-10310
49	X	X	X	Ivy Green—207-34851-L	Same	Ivy Green—182-22161
49-B	X			Seafoam Green—207-31680	Ivy Green—207-34851-L	Seafoam Green—182-21767
49-C	X	X		Seafoam Green—207-31680	Same	Seafoam Green—182-21767

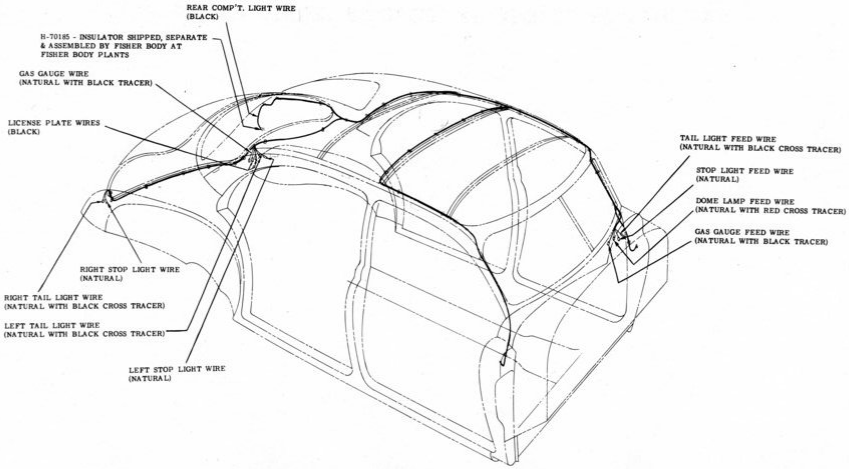
Trim and Instrument Panel Paint Specifications

COMB. #	UPHOLSTERY MATERIAL	INSTRUMENT PANEL COLORS						MODELS ON WHICH USED			
		UPPER PORTION			LOWER PORTION			Standard Closed Models	Deluxe Closed Models Except Station Wagons	Station Wagons	Convertibles
		COLOR	RINSHED-MASON	DUPONT	COLOR	RINSHED-MASON	DUPONT				
1	Gray Striped Bedford Cord	Gray Met. Chr.	TS-1197	207-39111	Pearl Beige	PS-8887	272-54678	X			
2	Two Tone Gray Broadcloth	Gray Met. Chr.	TS-1197	207-39111	Pearl Beige	PS-8887	272-54678		X		
4	Tan Leather and Tan Cloth	Dark Chamois	028832	253-6936	Pearl Beige	PS-8887	272-54678				X
5	Red Leather and Tan Cloth	Chariot Red	25520	253-54869M	Pearl Beige	PS-8887	272-54678				X
6	Green Leather and Green Cloth	Riverhead Green	020310	253-5942	Pearl Beige	PS-8887	272-54678				X
7	Blue Leather and Blue Cloth	Blue	022298	253-50632	Pearl Beige	PS-8887	272-54678				X
14	Tan Leather	Dark Chamois	028832	253-6936	Pearl Beige	PS-8887	272-54678			X	X
15	Red Leather	Chariot Red	25520	253-54869M	Pearl Beige	PS-8887	272-54678			X	X
16	Green Leather	Riverhead Green	020310	253-5942	Pearl Beige	PS-8887	272-54678				X
17	Blue Leather	Blue	022298	253-50632	Pearl Beige	PS-8887	272-54678				X
24	Light Tan Leather Tan Cloth	Tan	028833	253-50921	Pearl Beige	PS-8887	272-54678				X
25	Light Red Leather Tan Cloth	Chariot Red	25520	253-54869M	Pearl Beige	PS-8887	272-54678				X
26	Light Green Leather Green Cloth	Stone Green	023444	253-50789	Pearl Beige	PS-8887	272-54678				X
27	Light Blue Leather Blue Cloth	Cameron Blue	PS-0204	202-36626	Pearl Beige	PS-8887	272-54678				X
28	Light Yellow Leather Gray Cloth	Black	20498	253-2228	Pearl Beige	PS-8887	272-54678				X
29	Black Leather and Tan Cloth	Black	20498	253-2228	Pearl Beige	PS-8887	272-54678				X
34	Light Tan Leather	Tan	028833	253-50921	Pearl Beige	PS-8887	272-54678				X
35	Light Red Leather	Chariot Red	25520	253-54869M	Pearl Beige	PS-8887	272-54678				X
36	Light Green Leather	Stone Green	023444	253-50789	Pearl Beige	PS-8887	272-54678				X
37	Light Blue Leather	Cameron Blue	PS-0204	202-36626	Pearl Beige	PS-8887	272-54678				X
38	Light Yellow Leather	Black	20498	253-2228	Pearl Beige	PS-8887	272-54678				X
39	Black Leather	Black	20498	253-2228	Pearl Beige	PS-8887	272-54678				X



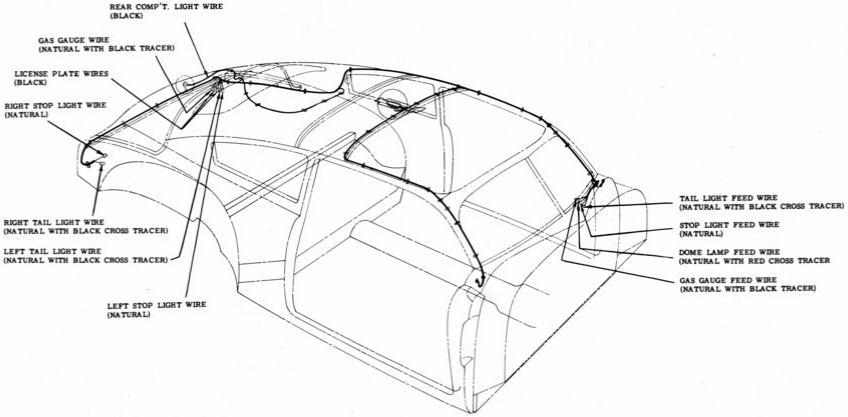
4-DOOR STYLES 49-3869, 49-3869D, 49-3869DX

Fig. 79. 98 Series Wiring Diagram



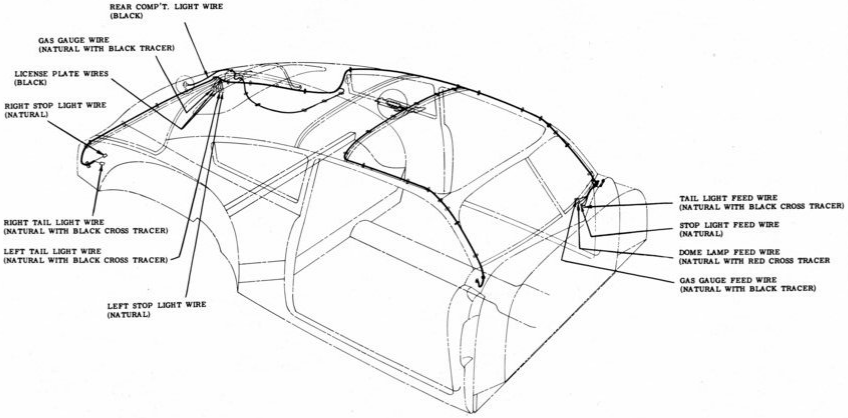
4-DOOR STYLES 49-3869, 49-3869D, 49-3869DX

Fig. 79. 98 Series Wiring Diagram



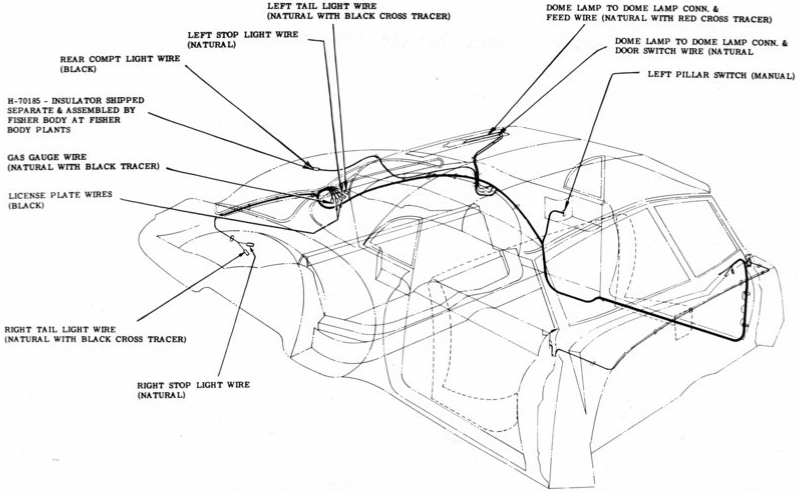
CLUB SEDAN STYLES 49-3807, 49-3807D, 49-3807DX

Fig. 80. 98 Series Wiring Diagram



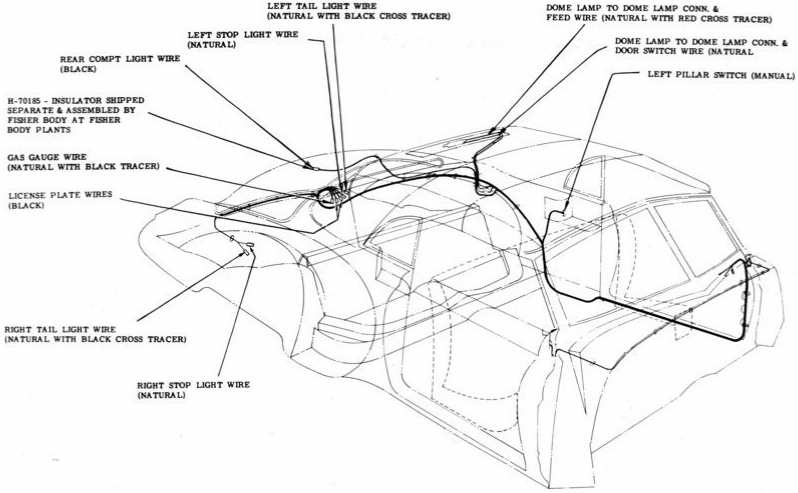
CLUB SEDAN STYLES 49-3807, 49-3807D, 49-3807DX

Fig. 80. 98 Series Wiring Diagram



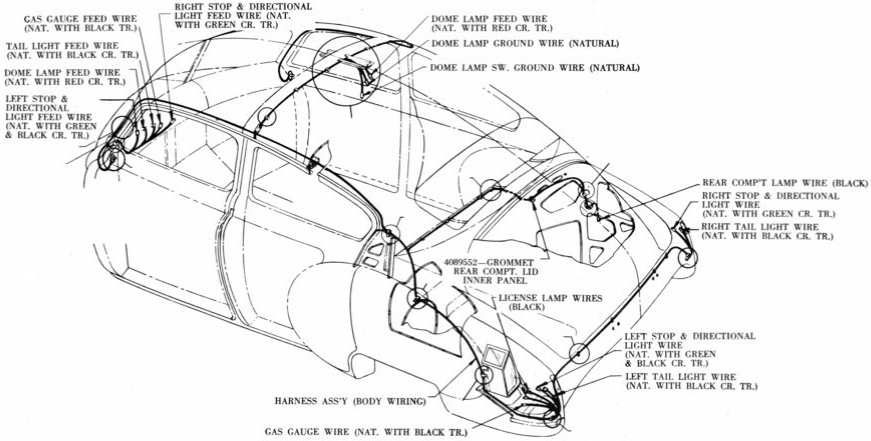
CONVERTIBLE STYLE 49-3867X

Fig. 81. 98 Series Wiring Diagram



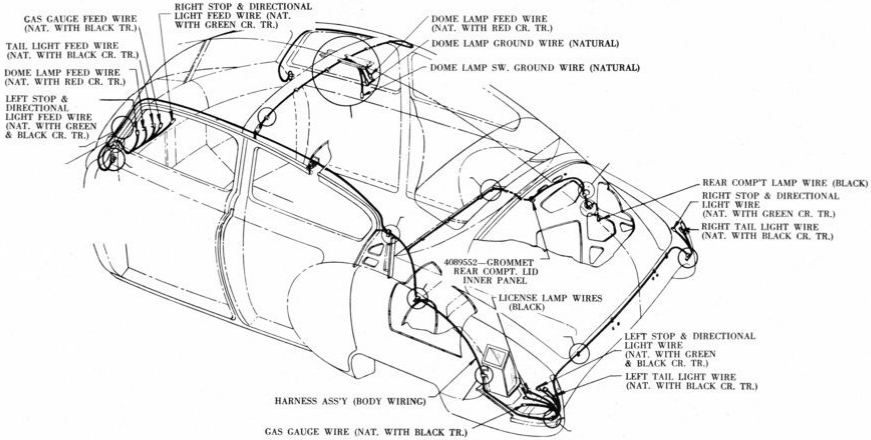
CONVERTIBLE STYLE 49-3867X

Fig. 81. 98 Series Wiring Diagram



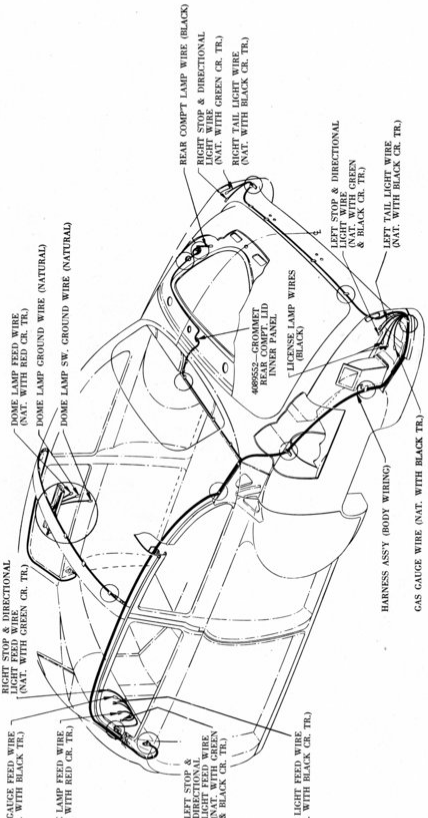
TOWN SEDAN STYLES 3508, 3508D

Fig. 82. 76 and 88 Series Wiring Diagram



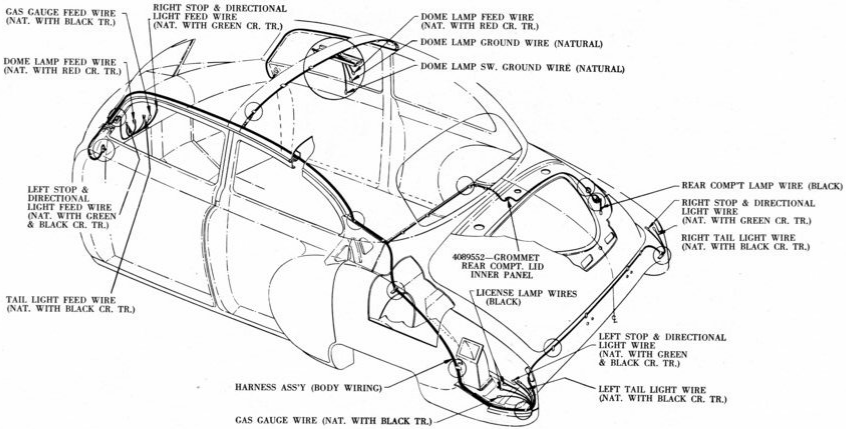
TOWN SEDAN STYLES 3508, 3508D

Fig. 82. 76 and 88 Series Wiring Diagram



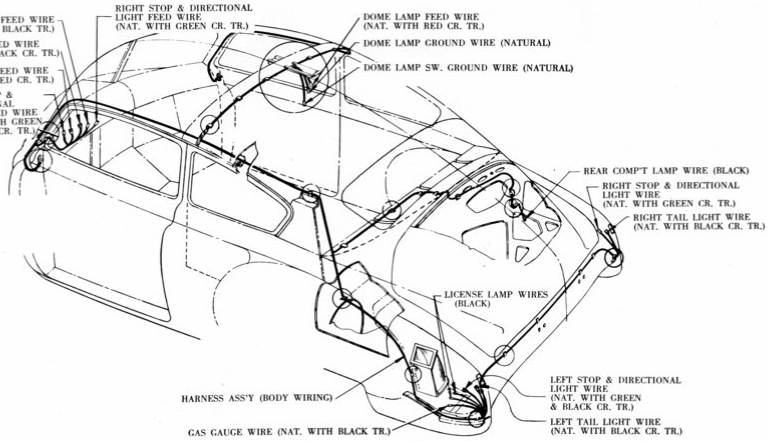
4-DOOR SEDAN STYLES 3569, 3569D

Fig. 83. 76 and 88 Series Wiring Diagram



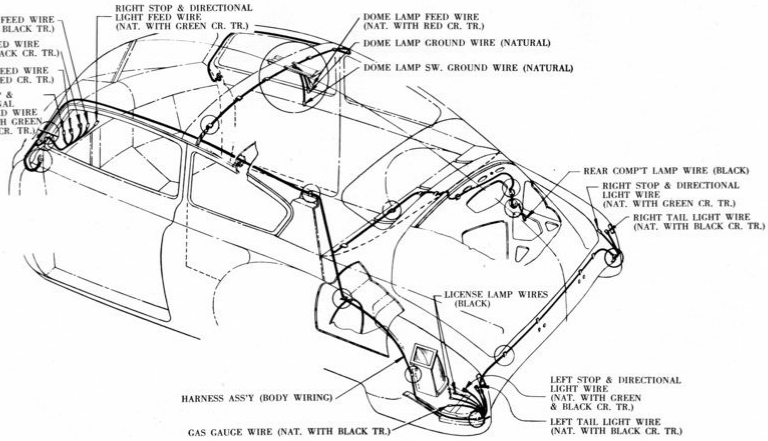
4-DOOR SEDAN STYLES 3569, 3569D

Fig. 83. 76 and 88 Series Wiring Diagram



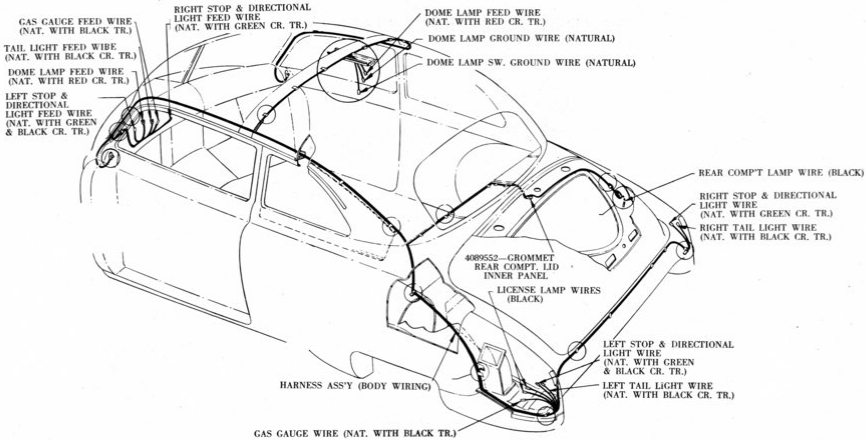
CLUB SEDAN STYLES 3507, 3507D

Fig. 84. 76 and 88 Series Wiring Diagram



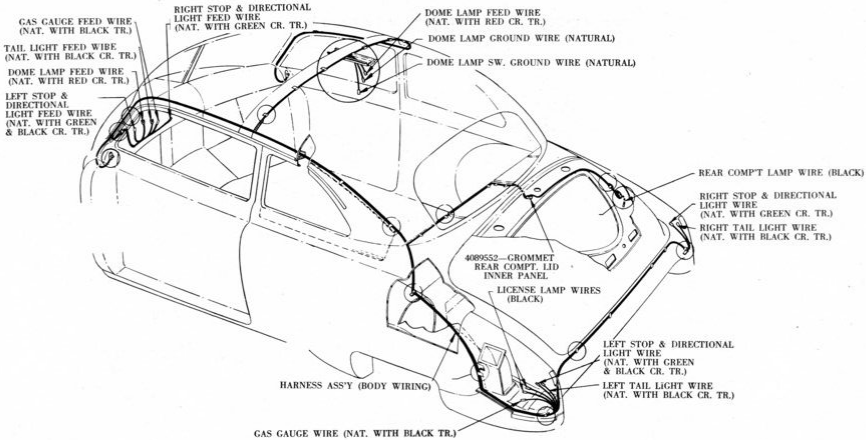
CLUB SEDAN STYLES 3507, 3507D

Fig. 84. 76 and 88 Series Wiring Diagram



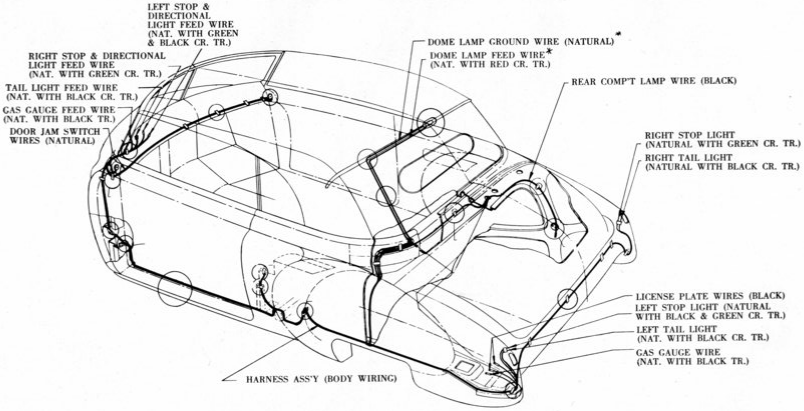
CLUB COUPE STYLES 3527, 3527D

Fig. 85. 76 and 88 Series Wiring Diagram



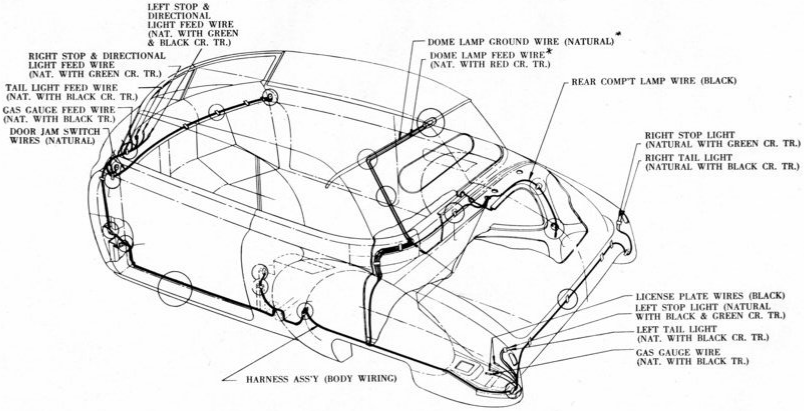
CLUB COUPE STYLES 3527, 3527D

Fig. 85. 76 and 88 Series Wiring Diagram



CONVERTIBLE STYLE 3567DX

Fig. 86. 76 and 88 Series Wiring Diagram



CONVERTIBLE STYLE 3567DX

Fig. 86. 76 and 88 Series Wiring Diagram

FRAMES

The frames on the 1949–76 and 88 models are similar to those used on 1948–60 and 70 series cars except for certain changes which improve strength characteristics. The 1949 models have redesigned side bars to improve beam and fatigue strength ahead of the dash and over the rear axle, and redesigned front cross bars eliminate the need for auxiliary engine mounting brackets. Rivets have replaced welds at certain points on the frame in order that fatigue life might be improved.

The 98 series frames remain essentially the same as those used on 1948–98 models except for modifications necessary to accommodate the new engine.

Frames consist of deep, channel section side rails and sub-bars, channel "X" members and five cross members.

The frame side rails are deep formed channel sections designed with suitable kickup at the rear axle to provide for axle clearance and low center of gravity.

The "X" member is made from channel section and extends from the rear engine mounting cross member to the kickup over the rear axle. Riveted gusset plates join the "X" member bars at the center.

Inner sub-bars are added at the front end of the "X" member to form a box section at the narrow portion of the frame adjacent to the engine.

The front suspension cross member is a complete box section riveted to the frame side rails and further supported by the forward end of the front inner sub-bars.

Since the inherent rigidity of the closed body does not exist in the convertible body, a special frame is used for convertible models. While the convertible frame is the same general design as that used for other body styles, the side rails and the "X" member are made of extra heavy gauge stock and the "X" member is of I-beam construction.

CHECKING FRAME ALIGNMENT

The diagram shown in Fig. 87 will greatly assist in checking the alignment of a car frame that has been distorted by collision or otherwise.

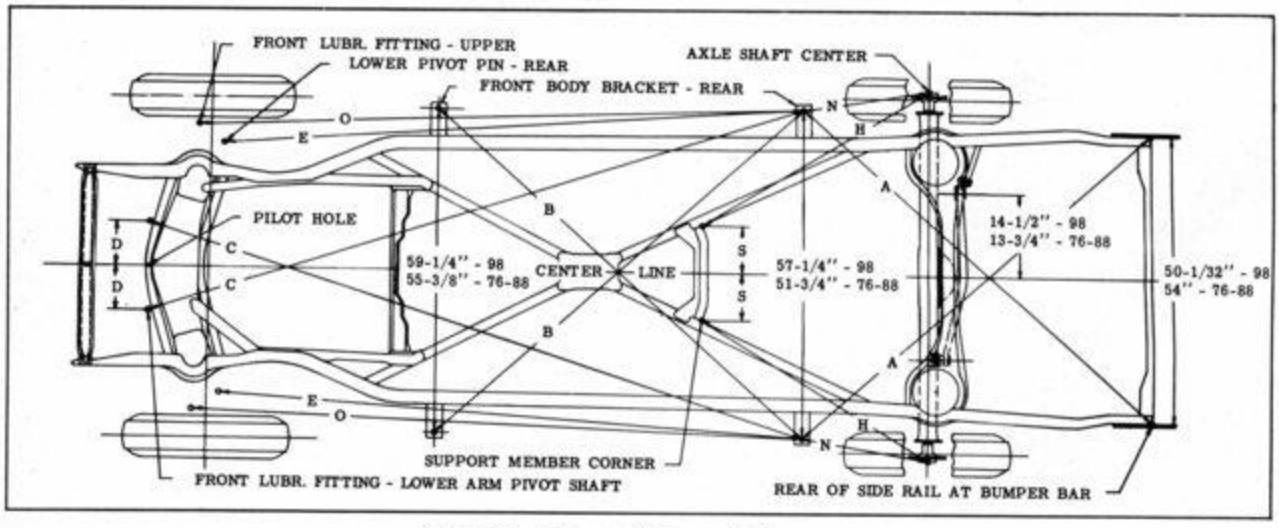


Fig. 87. Frame Alignment Diagram

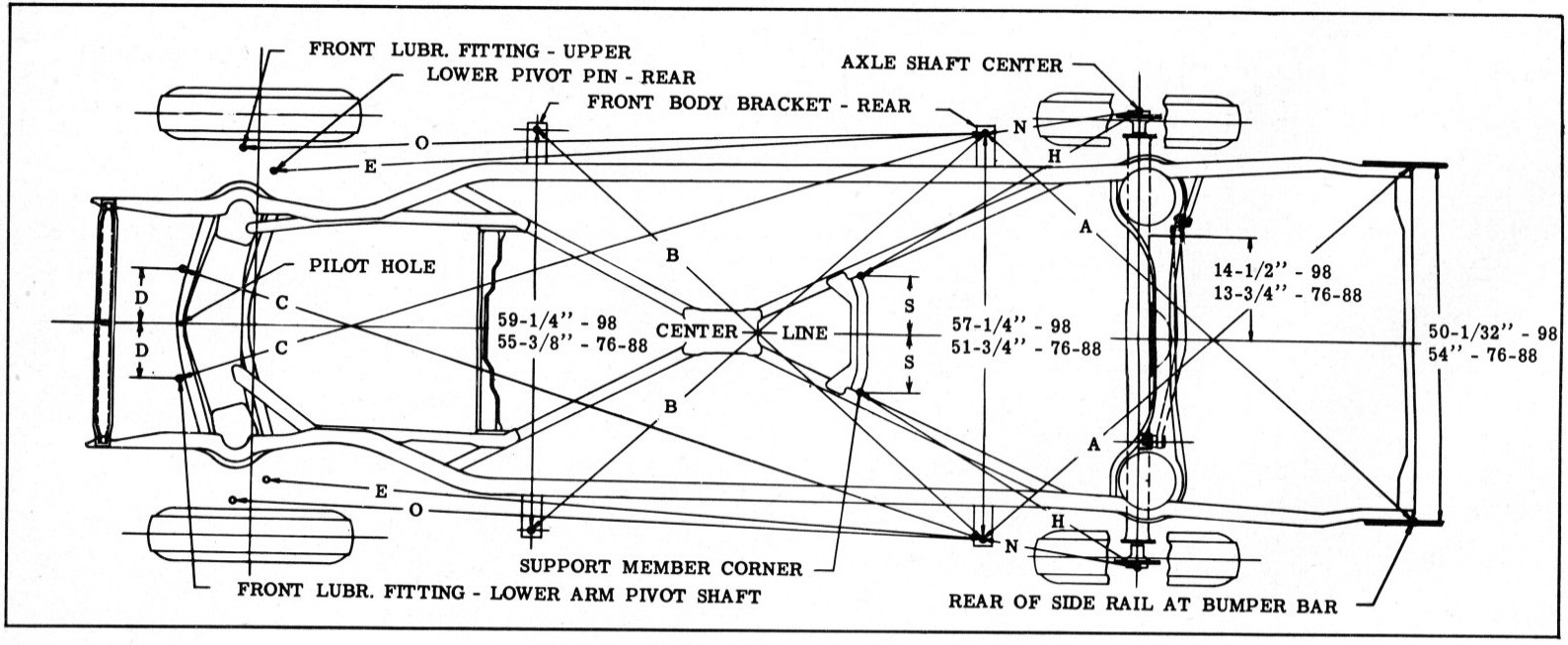


Fig. 87. Frame Alignment Diagram

The reference points indicated in the figure are transferred to a level floor or surface plate by means of a plumb bob. The dimensions between the various reference points shown in the figure compared with similar points on the frame to be checked, will show where straightening operations are necessary.

To check for frame misalignment at any point in the frame, proceed as follows:

1. Place car on clean, level floor and set brakes.
2. Drop plumb bob and mark floor from corresponding points, as indicated, on each side of the frame.
3. Move car and make all checks by means of the marks placed on the floor.

   NOTE: Measurements must be equal within ¼".

4. Measure A-A. If not equal, rear end of frame is misaligned. If A-A are equal, mark point on floor where lines cross.
5. Measure B-B. If not equal, center portion of frame is misaligned. If B-B are equal, mark point on floor where lines cross.
6. If A-A are equal and B-B are equal, draw center line through the points where A-A and B-B cross.

If the center line passes over the pilot hole mark, then frame alignment is correct. If the center line does not pass through the pilot hole mark, then the forward part of frame is misaligned.

In the event that collision had occurred from the rear end of the automobile, center line could be produced by starting from the pilot hole mark on the floor and producing line through the points where B-B cross.

If collision had occurred in the middle portion of the frame, then center line could be produced by means of the pilot hole mark and the intersection of A-A.

NOTE: The dimensions at the rear end of the frame and at the body brackets are specified to provide measurements, by means of which the center line of the frame may be established, if frame is damaged to such an extent as to make the methods previously listed impossible. Take measurement as indicated and half the distance equals center point at that part of the frame.

THE FOLLOWING CHECKS CANNOT BE MADE UNTIL IT IS DEFINITELY DETERMINED THAT THE FRAME IS PROPERLY ALIGNED.

7. C-C not equal, then front suspension cross member has shifted.
8. If C-C is equal, then position of front suspension cross member MAY be correct. Measure D-D. If not equal, front suspension cross member has shifted.
9. E-E not equal, then lower control arm is bent.
10. O-O not equal, then upper control arm is bent.
11. N-N, H-H and S-S not equal, then the rear axle housing, rear support arms or track bar are bent or shifted. A visual inspection of these units will determine the parts affected. Dimensional drawings of the track bar and rear support arm are furnished in the rear suspension section.

STRAIGHTENING FRAME

In case of collision, frame members can often be satisfactorily straightened to the required limits. Since the front suspension cross member is made to unusually close limits, necessary for proper front wheel alignment, straightening of this unit may not be successful.

It is possible that the ordinary straightening methods will suffice for minor damage, however, in case of serious damage or fracture, the entire front suspension cross member must be replaced.

Before the member is replaced, it is essential that the frame alignment be checked, and corrected if necessary.

Whenever possible, the parts should be securely fastened with hot rivets. In case no riveting equipment is available, however, finished bolts snugly fitted in reamed holes may be used. The nuts should be securely tightened and lockwashers used, care being taken that washers do not spread. (Cold driven rivets are not recommended unless the heavy power press equipment necessary to make secure fastening is available.)

When the frame repair is completed and inspected, the various parts of the front suspension may be assembled.

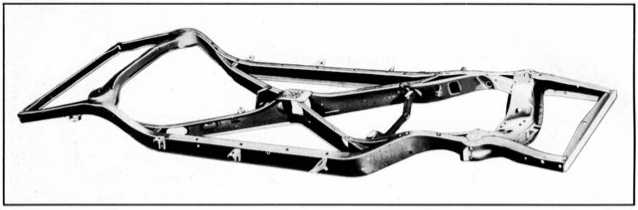


Fig. 88. 1949–76 and 88 Series Frame

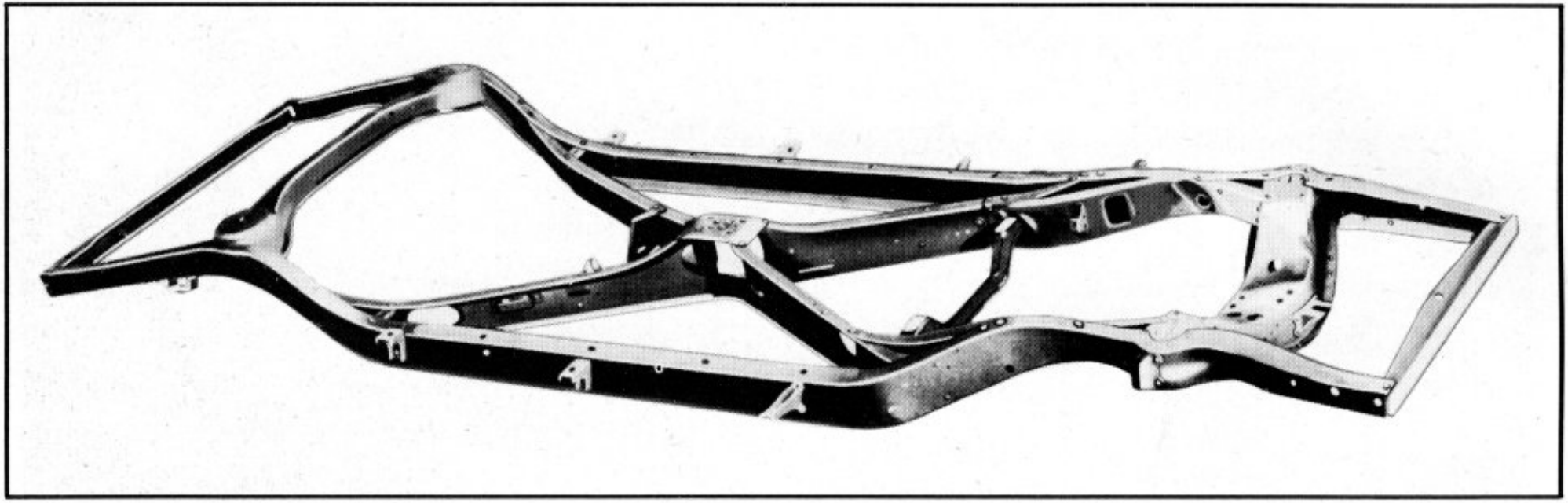


Fig. 88. 1949–76 and 88 Series Frame

FRONT END SUSPENSION

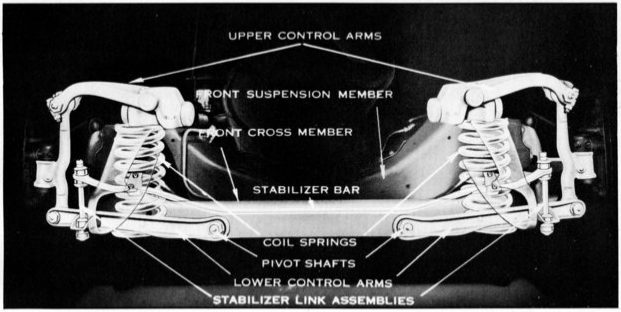


Fig. 89. Front Suspension System

The basic front end suspension design used on 1948 models has been carried over to 1949 models; however, certain modifications have been made to adapt the system to the narrower front tread on "76" and "88" series cars:

1. Front shock absorber arms (upper suspension arms) have been shortened 7/16" on "76" and "88" series cars.

2. Steering arms are new for "76" and "88" series cars, making them non-interchangeable with "98" series arms.

The independent front wheel construction is used on all models. This suspension allows either front wheel to react to change in the road surface level without appreciably affecting the opposite wheel, thus preventing a synchronous action of front wheels and eliminating a principal source of energy which brings about wheel tramp and shimmy, undesirable riding qualities, and disagreeable steering characteristics. This design of suspension employs coil type chassis springs, which are not subject to the varying factors of interleaf friction, as is the case with conventional leaf type chassis springs.

The wheel knuckle is the reverse Elliott type and is attached to the knuckle support by means of a hardened steel king pin, which moves on bronze bushings.

The knuckle support is pivoted at both upper and lower ends to "V" shaped control arms. Each upper control arm assembly is attached at its inner end to the shock absorber camshaft. Each lower control arm assembly is pivoted at its inner end on a solid shaft, which is attached to the underside of the frame front cross member. Each end of the pivoted inner shaft for the lower control arms carries a hardened steel bushing. There is an oil reservoir at the outer end of each bushing to furnish lubrication to the threaded bearings at any time lubricant is present in the oil reservoir.

At each end of the lower control arm inner

shaft and at the inside of the arms, a rubber seal covers the inner end of the bushings and the threads on the shaft. This seal prevents dirt and water from creeping into the bearing, prolongs the life of the bearing and reduces squeaks at these points.

Rubber seals are also carried at the outer end of the upper and lower control arms over the exposed portion of the threaded bearings where the arms are attached to the knuckle support.

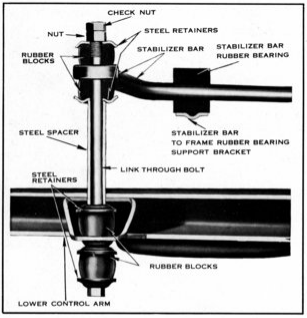


Fig. 90. Ride Stabilizer—Front

The control arms allow the knuckle support, spindle and wheel to move through a vertical plane only. The lower control arm is longer than the upper one which provides for a change in the camber of the front wheel to mathematically compensate for front tread width variation occurring as the coil chassis springs rebound or compress.

The chassis coil springs are supported at their lower ends in sheet metal seats which are riveted and welded to the lower control arms, and the upper ends seat in the frame front cross member.

Rubber bumpers are provided to limit the travel of the upper and lower control arms.

The front shock absorbers with upper control arms are accurately located by close fitting bolts and are mounted on top of the front cross member.

To provide more control of body roll, a front end stabilizer is used.

The front stabilizer is mounted in rubber attached to the frame ahead of the front springs with Wahl type connecting links from the stabilizer bar to the bracket riveted to the lower control arm. This linkage provides complete rubber insulation between the metal parts.

LUBRICATION OF FRONT SUSPENSION

The threaded bushings used in the front end suspension system require thorough lubrication at 1,000 mile intervals, with the weight of the car off the bearings, to assure against squeaks. When these parts are lubricated, therefore, the front end of the car must be lifted with a jack placed under the center of the front cross member, so that the car is supported at the frame, and the front suspension system entirely relieved of weight.

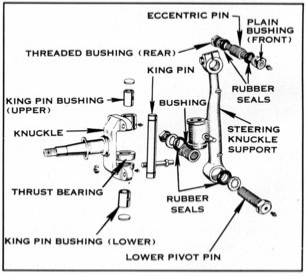


Fig. 91. Upper and Lower Pivot Pin Details

PIVOT PINS—FRONT END SUSPENSION

A clearance of from .011″ to .025″ is provided between the threaded pins and bushings

on the front end construction. The threaded surface automatically provides perfect side adjustment and where the roll is always in the same direction, the two members of the bearing are virtually tied together even when one fits loosely within the other. This permits ample space for lubrication, rolling friction, and free action for oscillation. The rolling action minimizes wear and accounts for the long life of the pin and bushing. If the bushings are properly lubricated and the tolerances are within the specified clearances, they will not be noisy when properly adjusted and should not be changed because of noise. UNDER NO CONDITIONS SHOULD ANY CHANGES BE MADE TO REDUCE THE SPECIFIED THREAD CLEARANCES GIVEN ABOVE.

Remove Upper Pivot Pin

1. Place jack under lower control arm, raising car off floor, and remove wheel and tire assembly.
2. Remove upper control arm clamp bolt.
3. Remove both front and rear bushings and rubber seals from control arm.
4. Loosen clamp bolt in knuckle support. NOTE—To prevent damage to brake hose, fasten steering knuckle support to upper control arm with a short piece of light wire.
5. Using tool No. J-720, remove pivot pin from knuckle support.

Replace Upper Pivot Pin

1. Holding knuckle support in line with hole through control arm, screw pivot pin into knuckle support with hole for Allen wrench in pin toward front of car.
2. With tool J-720, turn pivot pin until largest diameter section is centralized in support. (See Fig. 92)
3. Tighten clamp bolt in knuckle support arm. Assemble rubber seals over eccentric pin.
4. Centralize support arm as near as possible in control arm yoke and start rear bushing on threads of pin and in threads of control arm.
5. Start front bushing on thread of pin before locking rear bushing up tight.
6. Thread rear bushing in until tight.
7. Screw front bushing up to leave 1/32" clearance between hex portion of bushing and front face of upper control arm.
8. Replace and lock clamp bolt in control arm.
9. Remove lubrication fitting from front pivot pin bushing and set caster, camber and toe-in.

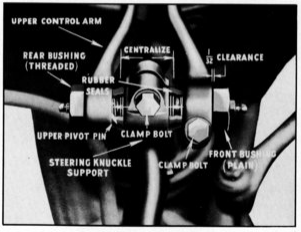


Fig. 92. Upper Pivot Assembly

Remove Lower Pivot Pin

1. Place jack under lower control arm, raise car off floor and remove wheel and tire assembly.
2. Remove lock nut and washer at rear of pin.
3. Remove lower pivot pin.

Replace Lower Pivot Pin

1. Centralize knuckle support arm, as near as possible, between front and rear control arms and screw pivot pin through front control arm and into bushing of support arm.

NOTE—When the support arm is properly spaced between front and rear control arms, there will be approximately 1/8" between the inner face of the front control arm and the end of the bushing. (See Fig. 93)

The assembly of the lower pivot pin rubber seals can be more easily accomplished if, before the lower pivot pin is assembled through the lower control arm assembly and vertical support, the seals are slipped over the outer ends of the lower control arms approximately 1". After the bolt has been threaded into position, the seals can be quickly and easily snapped around it.

2. Screw pivot pin into rear control arm.
3. Install lock nut and washer and snap seals into position.
4. Set caster, camber and toe-in.

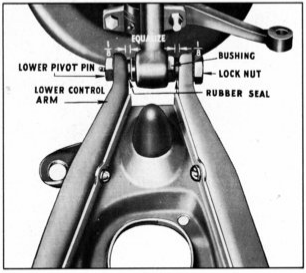


Fig. 93. Lower Pivot Assembly

FRONT COIL SRING IDENTIFICATION

Coil springs may be identified by a daub of paint or the part number, which is stamped on the outside of one of the end coils. They may be identified without removing, by the diameter of the wire. See Specifications.

Remove and Replace Front Coil Spring

1. Disconnect outer end of tie rod from steering arm.
2. Remove lower pivot pin.
3. Disconnect stabilizer link.
4. Support car frame by another jack.
5. Lower jack from under lower control arm, which allows lower control arm assembly to drop out of position.
6. Remove spring.
7. To assemble, reverse operations. Check caster, camber and toe-in.

NOTE—There is a top and bottom to the front coil spring. The top may be identified since the top coil is flattened at the end; the bottom is not. When assembling the front coil spring, be sure the flattened end of the spring is to the top and centralized by the four lugs on the cross member. The end of the coil at the bottom indexes with the hole provided in the spring seat.

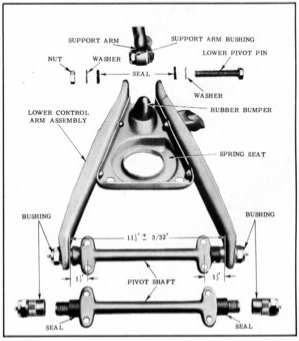


Fig. 94. Lower Control Arm Details

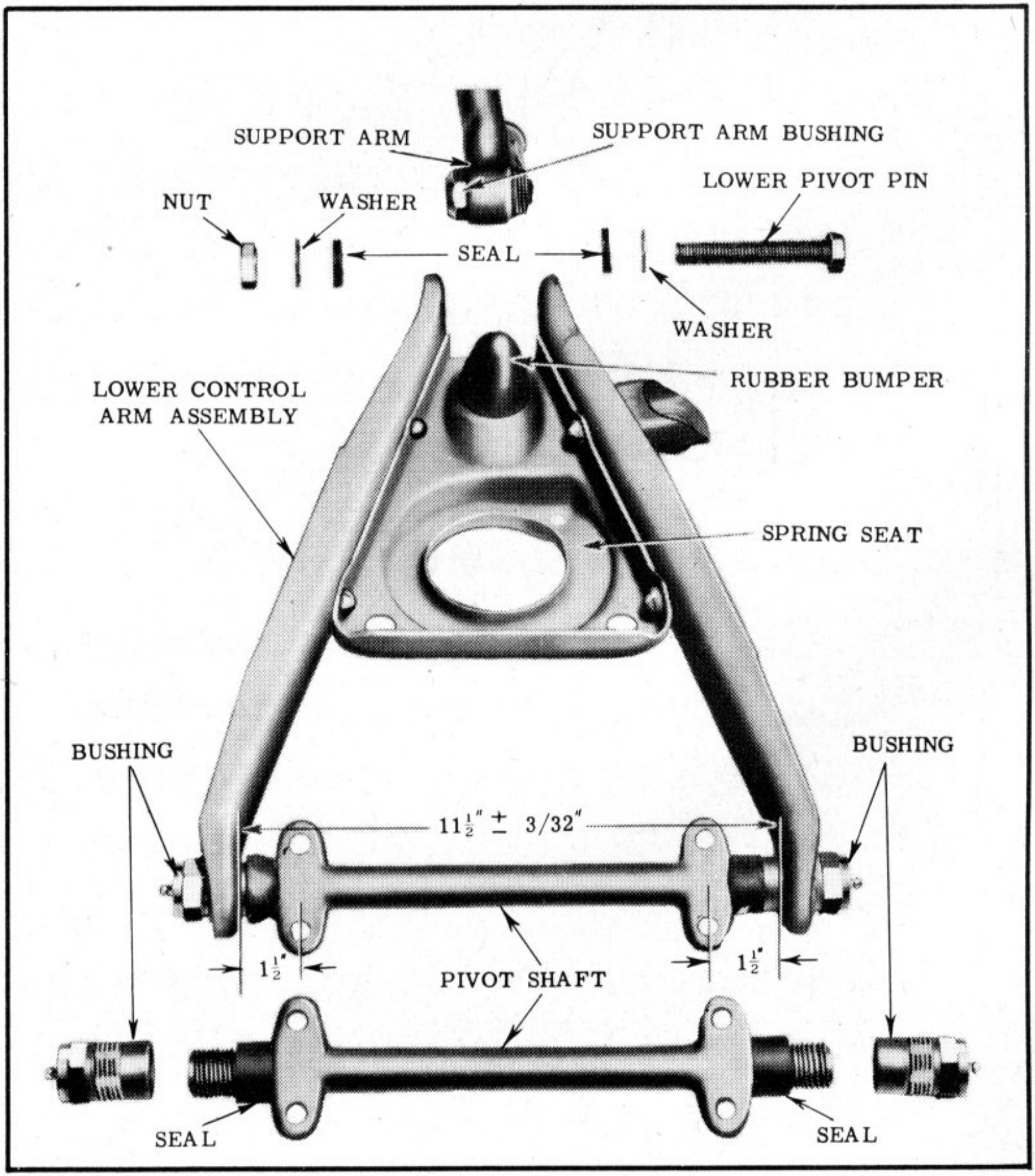


Fig. 94. Lower Control Arm Details

REMOVE LOWER CONTROL ARM ASSEMBLY OR PIVOT SHAFT

The front and rear lower control arms and spring seat are serviced as an assembly. They are not interchangeable, right and left. (See Fig. 94)

1. Proceed as outlined under REMOVE FRONT COIL SPRING.
2. Remove lower control arm assembly and pivot shaft from frame front cross member.
3. Unscrew pivot shaft bushings and remove shaft from lower control arm assembly.

REPLACE LOWER CONTROL ARM ASSEMBLY OR PIVOT SHAFT

The lower control arm pivot shaft bushings have threads on the inside and outside of the bushing. The inside of the bushing threads onto the pivot shaft, but the bushing cuts its own thread in the lower control arm.

Since the distance between the inside face of the inner ends of the lower control arm must be 11½±3/32" when assembled, it is necessary to use special tool No. J-1052 to prevent the arms from moving inward while the bushing is cutting a thread during installation.

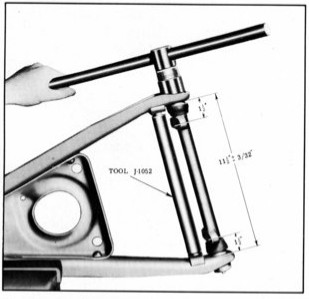


Fig. 95. Insalling Pivot Shaft in Lower Control Arm Assembly

To install pivot shaft and lower control arm assembly, proceed as follows:

1. Place tool J-1052 in position and expand until the distance between the inside face of the arms at inner end is 11½". (See Figs. 94 & 95)
2. Place pivot shaft in assembly.
3. Start bushing on pivot shaft and into arm at same time. Tighten bushing in place.
4. Center pivot shaft between control arms and install the other bushing as above, being sure threads index so there is no bind. Remove tool.
5. The distance between the center of the pivot shaft bolt holes and the inside face of the arm should be 1½" at each end. (See Figs. 94 & 95) Turn pivot shaft as necessary to centralize.
6. Install lower control arm assembly and replace front coil spring.
7. Replace lower pivot pin.
8. Set caster, camber and toe-in.

REBUSH KING PINS

1. Remove front wheel hub and drum assembly.
2. Remove tie rod outer end from steering arm (plain arm).
3. Remove backing plate without disconnecting brake hose and place out of way, avoiding any strain on brake hose.
4. Remove king pin lock pin.
5. Remove upper and lower welch plugs from knuckle. (A simple way to remove stubborn or tightly pressed welch plugs is to drill small hole in plug and pry out with suitable drift punch inserted in the drilled hole.)
6. Drive out king pin using soft (copper or brass) drift.
7. Press bushing from steering knuckle, using tool No. J-725-1.

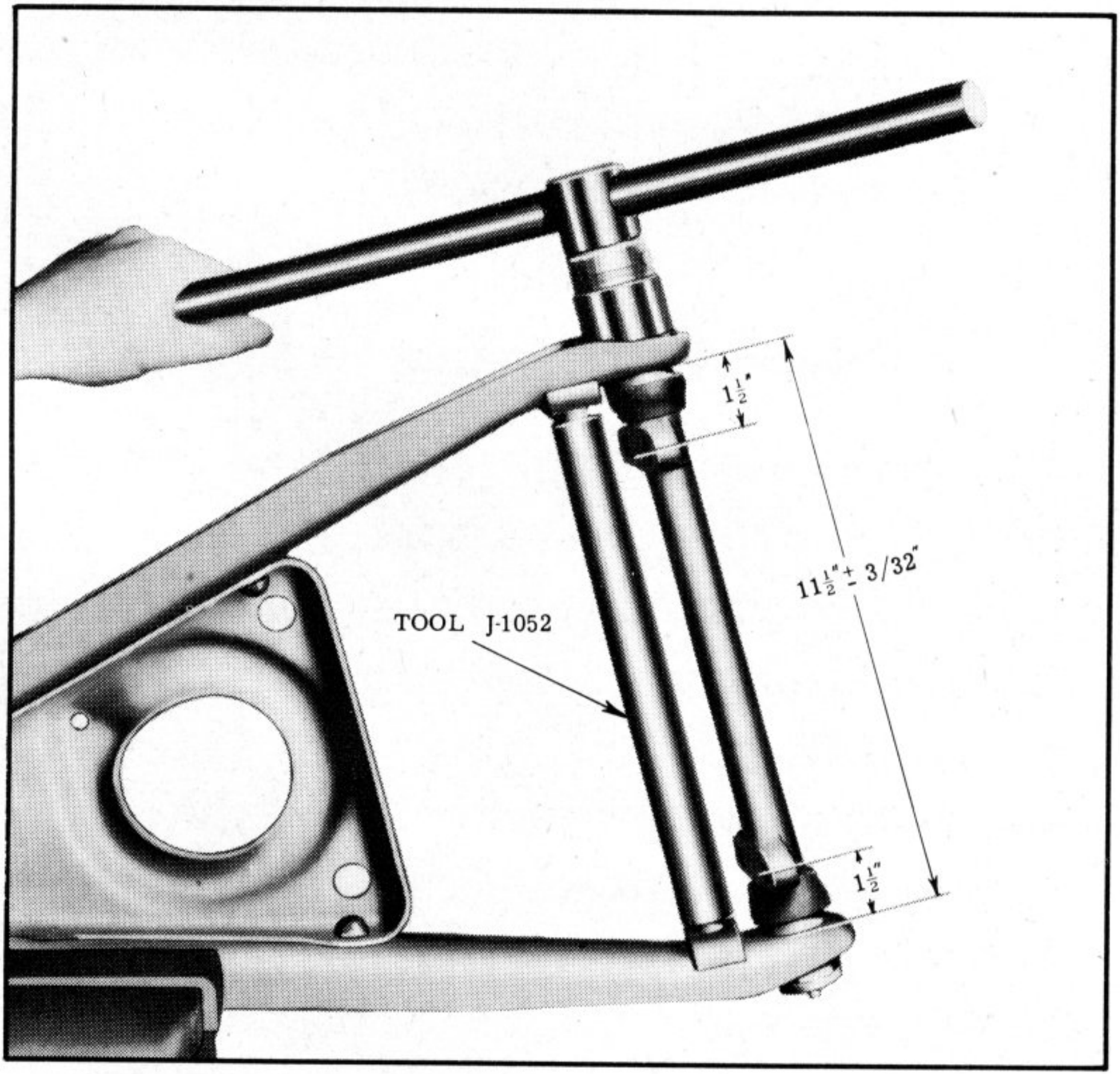


Fig. 95. Insalling Pivot Shaft in Lower Control Arm Assembly

Note that the king pin bushings have two grooves on the inside diameter—one short groove leading from the oil hole to one end of the bushing and a long groove opposite the oil hole extending the entire length of the bushing. The short groove leads to the top on the upper bushing and to the bottom on the lower bushing. In other words, the short groove always leads to the expansion plug. (See Fig. 97)

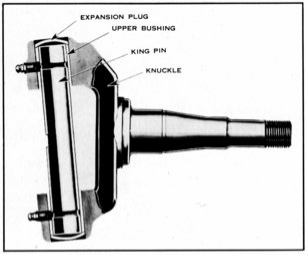


Fig. 96. King Pin Mounting

8. With oil hole in bushing in line with hole for oil fitting, press bushing into knuckle, using tool No. J-725-1.
9. Burnish bushing in place, using tool No. J-722-1.
10. Line ream bushing to size, using tool No. HM-592.
11. To assemble, reverse operations 1, 2, 3, 4, 5 and 6. Check caster, camber and toe-in.

REMOVE AND REPLACE FRONT STABILIZER

The front stabilizer on all models may be removed as follows:

1. Disconnect link from stabilizer bar by removing nuts from top of link; pull out bolt from bottom of link. (See Fig. 90)

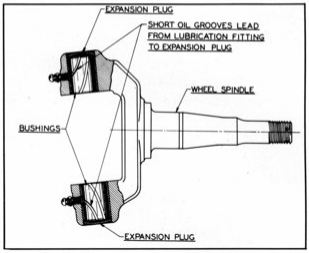


Fig. 97. Steering Knuckle Bushings

2. Remove the bracket bolts supporting stabilizer bar to frame and remove stabilizer.
3. To replace, reverse sequence of above operations and note:
   (a) The rubber bearings on the stabilizer bar at the frame support are serviced separately from the stabilizer bar assembly.
   (b) When attaching the link, place one rubber and one steel retainer at the top and bottom of both the control arm support and stabilizer bar, as shown in Fig. 90, and draw the nut down to the limit of the thread. (Install second nut to lock link in place.)

Shock Absorber—Front

Delco, double acting, piston type shock absorbers are used on all models.

The shock absorber unit comprises one rebound and one compression piston—one fitted with a spring loaded compression valve, the other with a spring loaded rebound valve—with suitable cam motion connected through a shaft to an outside arm for operating the pistons. The rebound and compression valves operate as main control valves and also as inlet valves for the return of fluid to each cylinder. (Figs. 98 & 99)

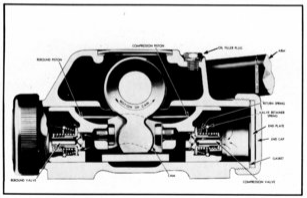


Fig. 98. Front Shock Absorber Arm Moving Up—On Compression

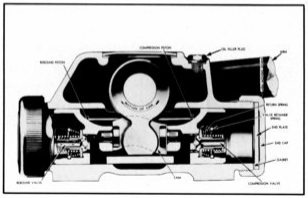


Fig. 99. Front Shock Absorber Arm Moving Down—On Rebound

Each valve has a bleeder hole in the valve stem. Under normal car operation, when the fluid pressure is applied by the piston, transfer of fluid takes place through the bleeder hole, but for violent road shocks, the valve opens, allowing a more rapid transfer of fluid past the valve seat as well as the bleed hole.

As the shock absorber arm moves downward, due to car spring rebound movement, pressure set up in the rebound cylinder forces fluid through the bleeder hole or opens the rebound valve by compressing the valve spring; at the same time, the compression intake valve opens, due to the partial vacuum created in the compression cylinder, filling the compression cylinder with fluid. As the shock absorber arm moves up, pressure set up in the compression cylinder forces fluid through the bleeder hole or opens the compression valve by compressing the valve spring; at the same time, the rebound intake valve opens, due to the partial vacuum created in the rebound cylinder, filling the rebound cylinder with fluid. Thus the action of the fluid is the same in both the rebound and compression cylinders, but the rate of movement of the arm up and down is controlled by the size of the bleeder hole and weight of the rebound and compression valve springs.

Identification of the rebound or compression valve assembly is possible by the number stamped on the valve. The compression end of the front shock absorber is under the shock absorber arm.

SERVICING OF FRONT SHOCK ABSORBERS

An unsatisfactory ride condition, not due to lack of lubrication, can ordinarily be corrected by putting the shock absorbers in good operating condition. To test shock absorber action without removing from the car, proceed as follows:

1. Make sure the shock absorber is securely mounted, then disconnect shock absorber arm at outer end.
2. Move shock absorber arm through complete travel. There should be no free movement in the shock absorber arm and the amount of force required to move the arm up and down should be almost equal.
3. Lack of resistance in the arm usually signifies air in the shock absorber, a valve sticking open, or low fluid level.
4. Too much resistance in the arm usually signifies a plugged valve orifice.
5. If control of shock absorber is defective, the fluid level should be checked and shock absorber filled if level is found to be low. (Should the fluid be found at the proper level, the shock absorber will need to be removed in order for cause of defective action to be found.)

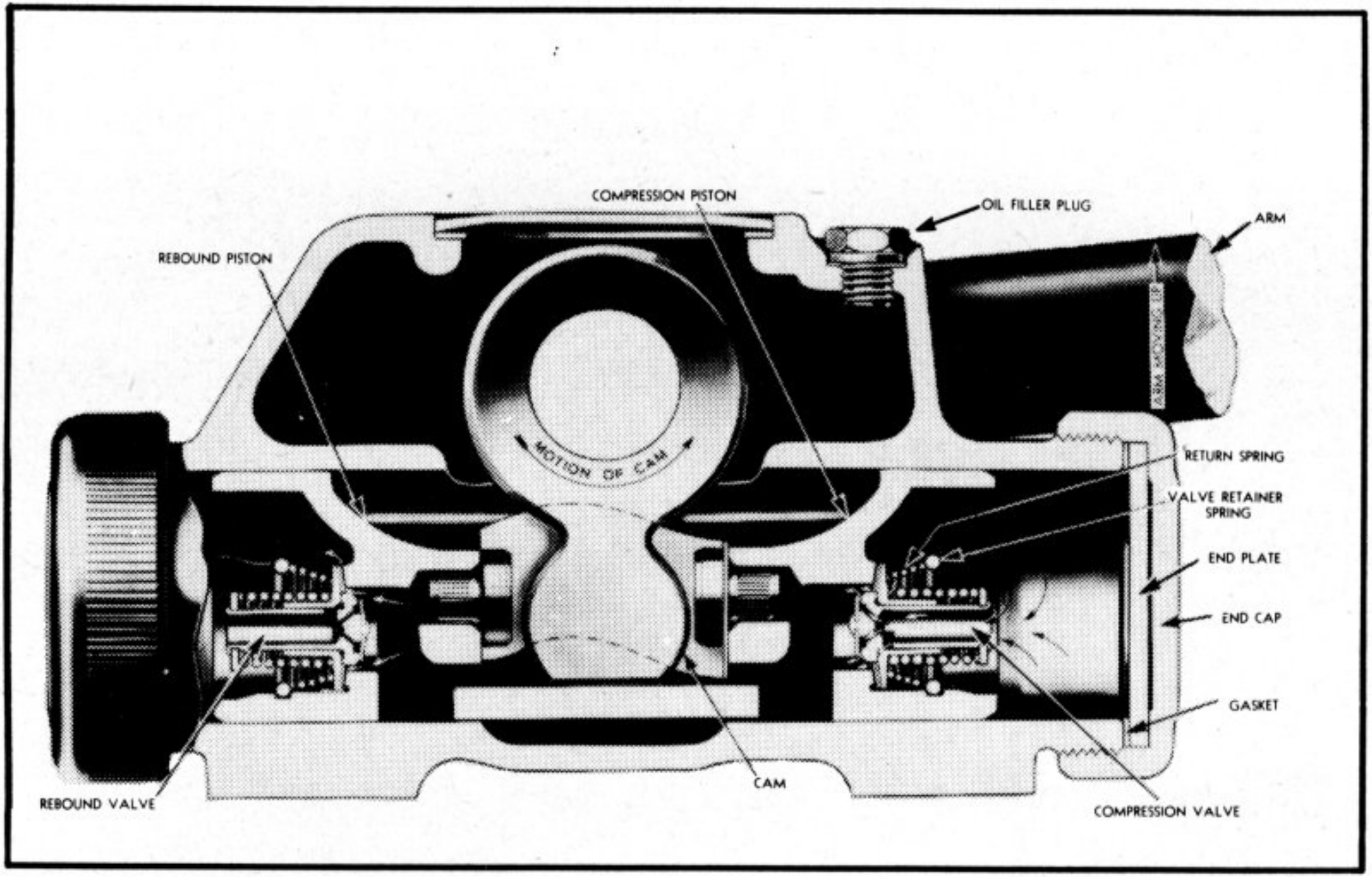


Fig. 98. Front Shock Absorber Arm Moving Up—On Compression

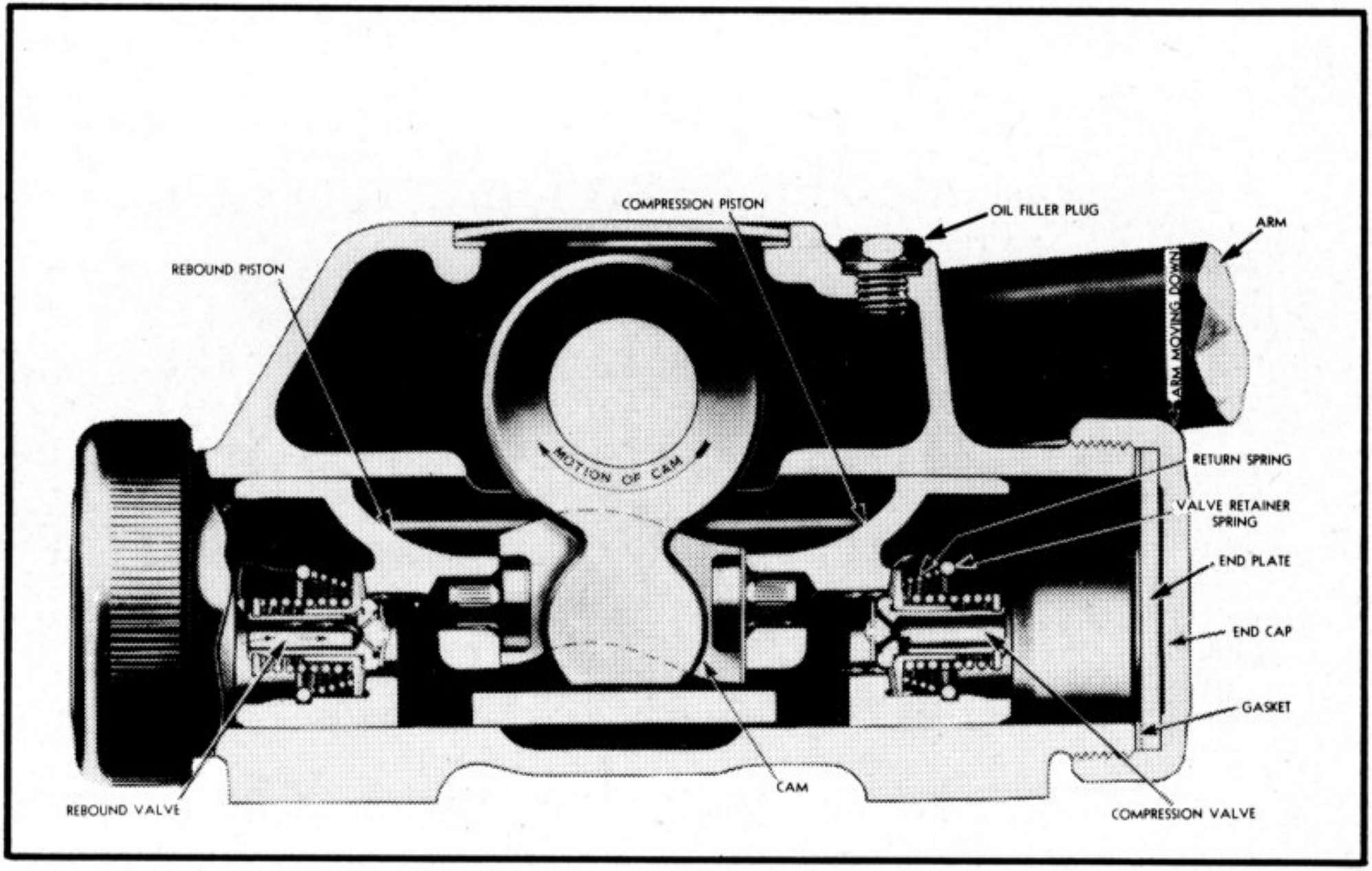


Fig. 99. Front Shock Absorber Arm Moving Down—On Rebound

NOTE: The presence of an appreciable amount of oil under the shaft bearings on the outside of the shock absorber usually indicates the shaft bushings are worn or the oil seal has failed. In either case, the shock absorber unit should be replaced without further examination. This type of failure occurs only rarely, however, except at high mileage (over 50,000 miles).

6. Never install other than same code number valve unless instructed to do so by the factory.

Fig. 100. Removing Front Shock Absorber End Cap

Remove and Replace Front Shock Absorber

1. Remove upper pivot pin.

   NOTE: To prevent damage to brake hose, fasten steering knuckle support to front coil spring with a piece of light wire.

2. Remove the four front shock absorber attacking bolts.

   NOTE: The front spring can be removed at this time as follows:

   (a) Disconnect stabilizer link.
   (b) Disconnect brake hose at frame.
   (c) Disconnect tie rod from steering arm.
   (d) Swing backing plate and knuckle assembly down and remove spring.

   NOTE—It will be necessary to bleed the brakes if brake hose has been disconnected. If front spring is removed, see REMOVE AND REPLACE FRONT COIL SPRING to properly assemble spring at frame cross member.

3. To assemble, reverse operations and set caster, camber and toe-in.

Disassemble Front Shock Absorber

1. Thoroughly clean outside of shock absorber.
2. Install on mounting block, using tool J-895. (See Fig. 100)
3. Remove end cap, using tool J-766.
4. Remove fluid.
5. With screwdriver, remove retainer ring which holds valve in place. This will allow removal of valve assembly, return spring and the two thin steel discs under the valve seat.

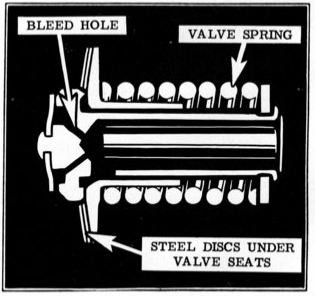


Fig. 101. Front Shock Absorber Valve Assembly

6. Inspect valve. If air cannot be blown through bleed hole, valve is plugged and new valve should be installed.

7. Repeat above operations at opposite end of shock absorber.
8. Thoroughly clean inside of shock absorber with gasoline or kerosene, working shock absorber arm through complete travel while cleaning.
9. Drain cleaning solution from shock absorber and blow out with air.

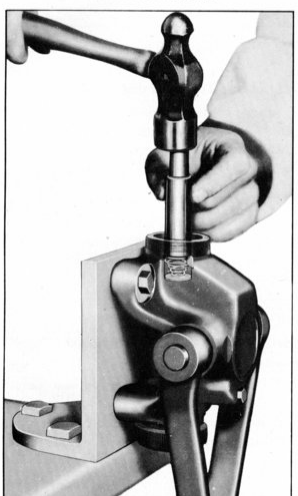


Fig. 102. Installing Front Shock Absorber Valve Retainer

Assemble Front Shock Absorber

1. Install compression and rebound valve discs, valves and retainers, using tool J-896 to hold return spring down. (See Fig. 102)
2. Install one end cap, using new end cap gasket. Tighten securely with tool J-766.

   CAUTION—A small amount of Lubriplate or soft soap should be placed between the end cap and the end plate, and between the end plate and gasket before installing to prevent the gasket tearing when tightening end cap. Tap end cap with hammer after tightening and then retighten.
3. Place shock absorber on mounting block with open end up and fill with fluid, holding the valve off its seat while filling. Move shock absorber arm through complete travel while filling to remove any air trapped in closed end.
4. When completely filled, install end cap securely, using new gasket and being careful not to tear gasket, as mentioned in (2) above.
5. Place shock absorber on mounting block with filler plug and tilted upwards approximately 15° from horizontal position. Remove filler plug and make sure shock absorber is completely full of fluid.

   CAUTION—It is important that the front shock absorber be filled through the filler plug with shock absorber in above position, otherwise, air may be locked in shock absorber.

Front Wheel Alignment

Front wheel alignment is the mechanics of adjusting all the inter-related factors affecting the running and steering of the front wheels of the automobile. Incorrect alignment of front wheels will result in hard steering and abnormal tire wear.

Wheel Alignment Factors

The front wheel alignment factors are:

1. CASTER.
2. CAMBER.
3. TOE-IN.
4. KING PIN INCLINATION.
5. TOE-OUT (STEERING GEOMETRY).

Inspection Before Checking Front Wheel Alignment

Before any attempt is made to check for or make any adjustment for Caster, Camber, Toe-In, King Pin Inclination or Toe-Out, some preliminary checks should be made on those parts which influence the steering of the car, such as:

1. Inflate tires to recommended pressures.
2. Check front wheel bearings for looseness.
3. Check front wheels for radial and lateral run-out, which should not exceed 1/8".
4. Check balance of front wheels.
5. Grasp front bumper in center and raise and lower front end several times to allow frame to come to its normal level. If spotty tire wear is in evidence, observe especially for uneven action between right and left sides of car when car is raised and lowered.
6. Check shock absorber action.
7. Set front wheels in straight-ahead position.
8. Check front wheel alignment without passengers or load in or on car.

Wheel Bearings

The proper functioning of the front wheel suspension cannot be maintained unless the front wheel bearings are correctly adjusted. See FRONT WHEEL BEARING ADJUSTMENT.

Wheel Run-Out

Wheels and tires should run as nearly concentric as possible with the steering knuckle spindle. Run-out of wheels or tires may be checked by holding a piece of chalk against the wheel at rim or tire side wall and spin wheel.

Chalk will make a wide mark where wheel or tire runs out, and will miss where it runs in.

When checking camber, any run-out (the place where the chalk mark is heaviest) should be placed half way up and down at the side. When checking toe-in, any run-out should be placed at the top. (See Fig. 103)

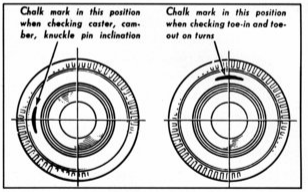


Fig. 103. Location of Point of Greatest Run-Out of Front Wheels

Wheel and Tire Balance

Wheel, tire and brake drum balance must be maintained within certain limits, otherwise wheel tramp and high speed shimmy will result. See FRONT WHEEL BALANCE.

Shock Absorbers

Good steering requires properly performing shock absorbers. Most shock absorber troubles which interfere with steering can be traced to insufficient fluid due to leaking or worn-out shocks, improper operation of valves, or damaged parts.

Setting Front Wheels in Straight-Ahead Position

1. Disconnect steering relay rod from pitman arm. Check all three steering gear adjustments, and adjust if necessary. Set gear on high point. (See STEERING section.)
2. Without changing position of pitman shaft, reassemble steering relay rod to pitman arm. It may be necessary to turn WHEELS slightly to assemble steering relay rod assembly to pitman arm.
3. Place center gauge J-1447 in place on lower side of front cross member, and adjust each tie rod to obtain the length shown in Fig. 104, between the center line on the gauge and the inner side of each backing plate, without disturbing steering gear high point position. Wheels are now nearly in straight-

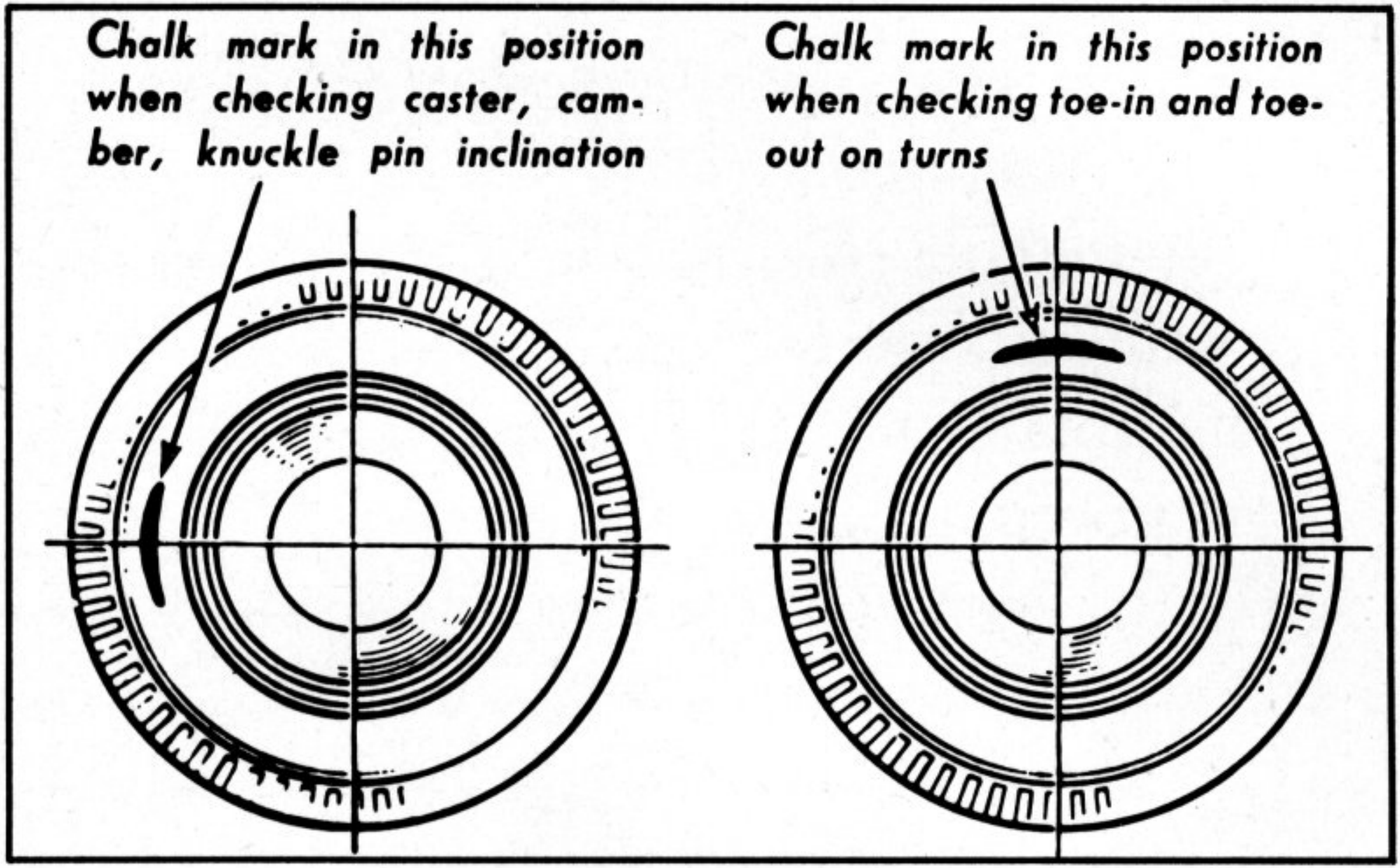


Fig. 103. Location of Point of Greatest Run-Out of Front Wheels

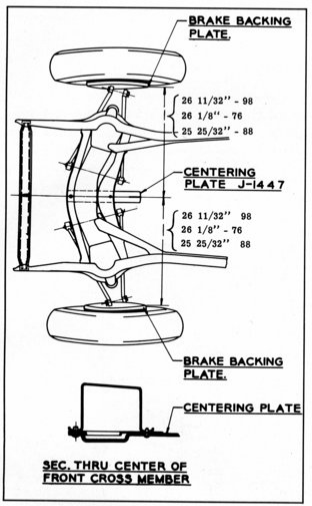


Fig. 104. Setting Front Wheels Straight Ahead

ahead position and steering gear is on center.

4. Check toe-in and set if necessary. If toe-in adjustment is necessary to bring within limits, adjust tie rod which will make car run more nearly straight ahead when holding steering gear on center.

   NOTE—When using gauge J-1447, be sure to set the adjustable pin at one end in the correct position for model of car being checked.

CASTER ANGLE

Caster is the angle of inclination between the king pin and the vertical.

Check for Caster Angle

CASTER ADJUSTMENT SHOULD ALWAYS BE MADE BEFORE CAMBER ADJUSTMENT.

NOTE—When checking the caster angle, it is important to take the readings with the weight of the car on the front wheels and to position the wheels as shown in Fig. 104. Always select level place on floor when checking for caster.

Having performed the preliminary checks, as outlined under 1, 2, 3, 4, 5, 6, 7 and 8, INSPECTION BEFORE CHECKING FRONT WHEEL ALIGNMENT, the caster angle should be checked with reputable front end aligning equipment.

Setting Caster Angle

1. Loosen clamp bolt at upper end of steering knuckle support.
2. Remove lubrication fitting from front bushing of eccentric pin at outer end of upper control arms.
3. Insert Allen Wrench, Tool J-720, through the hole from which the lubrication fitting was removed and adjust the caster by

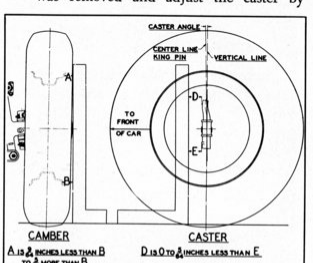


Fig. 105. Checking Caster and Camber

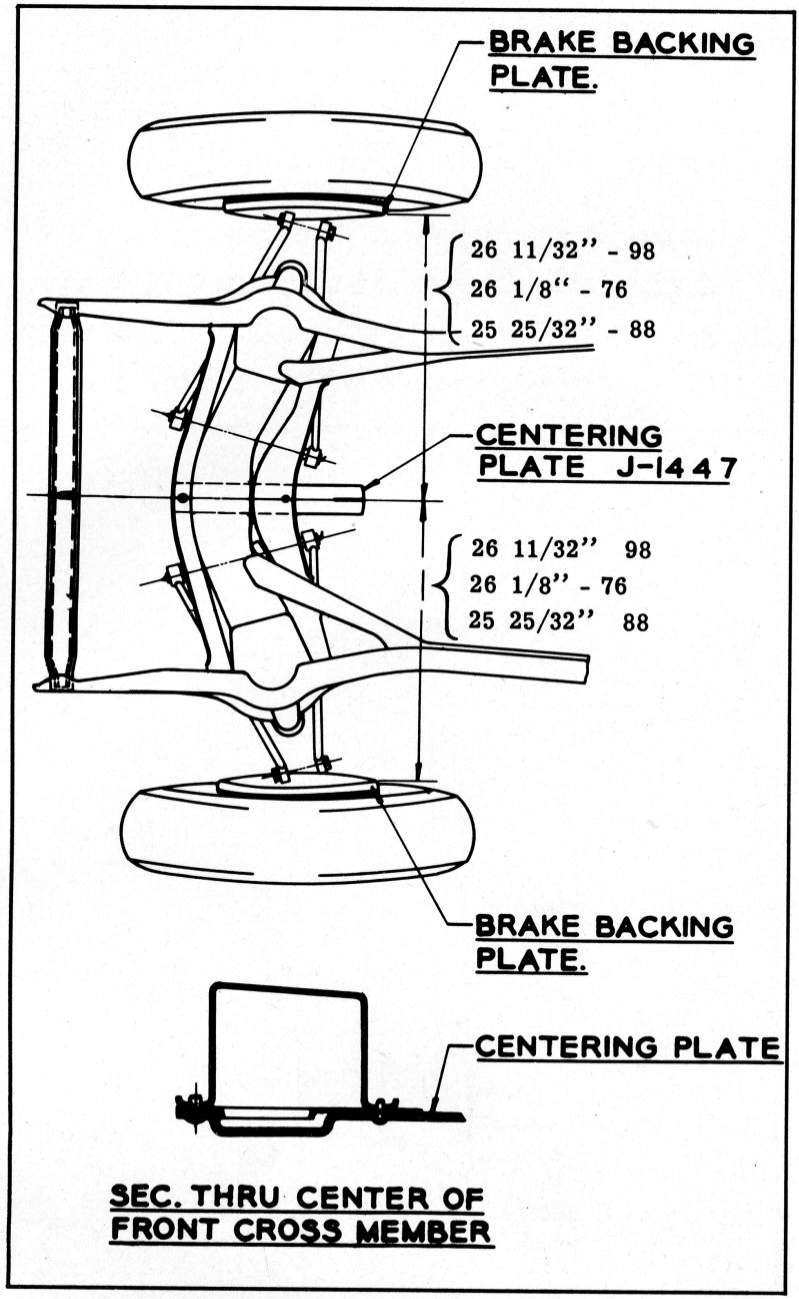


Fig. 104. Setting Front Wheels Straight Ahead

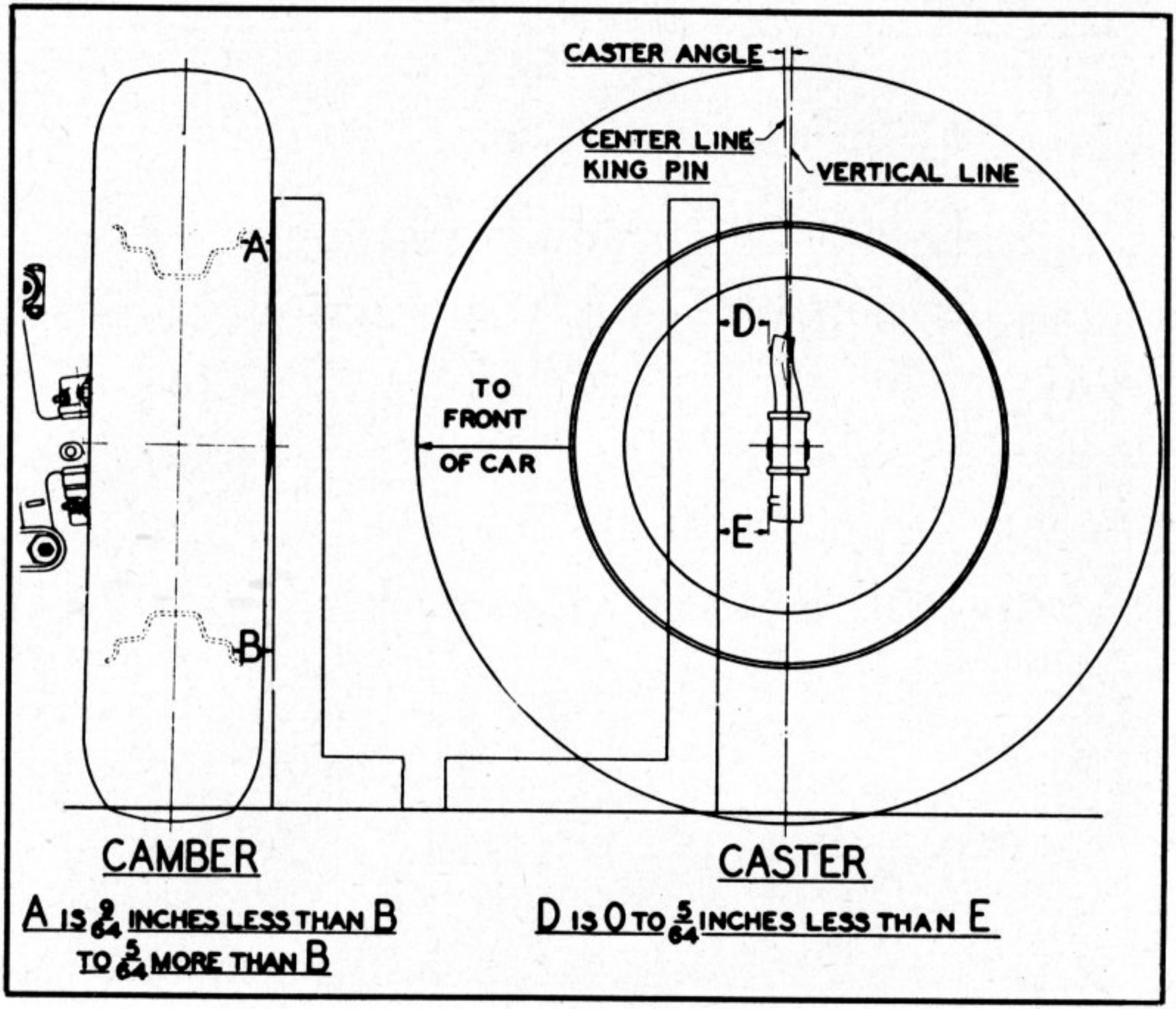


Fig. 105. Checking Caster and Camber

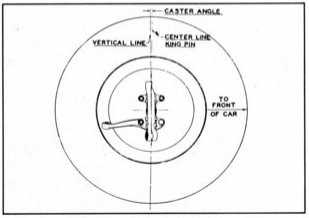


Fig. 106. Front Wheel Caster

turning the eccentric pin until the desired adjustment is obtained.

(a) Turn threaded pin on both sides of the car in a clockwise direction to increase caster and in a counter-clockwise direction to decrease caster.

NOTE—ALWAYS TURN THE ECCENTRIC PIN IN MULTIPLES OF ONE TURN so as not to disturb the camber setting.

4. After completing the adjustment to recommended specifications, tighten the knuckle support clamp bolts and install lubrication fittings.

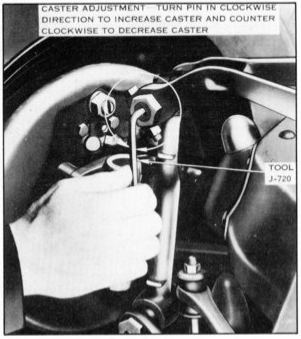


Fig. 107. Caster Adjustment

CAMBER

Camber is the outward tilt of the front wheels at the top. The purpose of camber is to support the greater part of the car weight on the inner wheel bearings, to reduce side thrust on the king pins, to compensate for looseness and wear in the steering knuckle and wheel bearings, and to bring the point of pivot near the center of the tire tread.

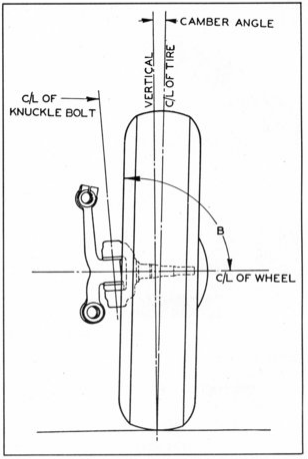


Fig. 108. Front Wheel Camber

Too much camber is undesirable because of the effect it has on tire squeal and wear due to improper contact with the road. In order to secure the effect of camber required for easy steering and minimum wear of parts, the king

pins are inclined at the top (toward center of car) to reduce the amount of camber which would otherwise be necessary. It is obvious, therefore, that the angle of inclination of the king pin is closely associated with the wheel camber in its effect on steering.

Check for Camber

NOTE—When checking the camber, the front wheels should be turned so that the high spot in the tires is in a horizontal plane, as shown in Fig. 103. Always select level place on floor when checking for camber.

Having performed the preliminary checks as outlined under 1, 2, 3, 4, 5, 6, 7 and 8, INSPECTION BEFORE CHECKING FRONT WHEEL ALIGNMENT, the camber should be checked with reputable front end aligning equipment. If such equipment is not available, however, a check can be made with an ordinary carpenter's square and level as follows:

1. Place a square on the floor at right angles to the wheel as illustrated in Fig. 105. The distance between the square and the felloe of the wheel at the top should be 9/64" less to 5/64" more than the distance between the felloe and square at the bottom of the wheel. The total variation between the two sides of the car should not be more than 9/64".

Adjustment for Camber

1. Loosen clamp bolt at upper end of steering knuckle support.
2. Remove lubrication fitting from front bushing of eccentric pin at outer end of upper control arms.
3. Insert Allen Wrench, tool J-720, through the hole from which the lubrication fitting was removed and adjust the camber by turning the eccentric pin until desired adjustment is secured.

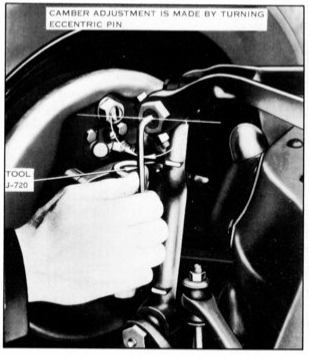


Fig. 109. Camber Adjustment

NOTE—Since the camber adjustment is controlled by the eccentric action of the threaded pin, ½ turn gives the maximum adjustment and is all that should be required. Furthermore, changing camber will change caster angle slightly. Caster angle, however, usually will still be within limits.

4. After completing adjustment to the recommended specifications, tighten the knuckle

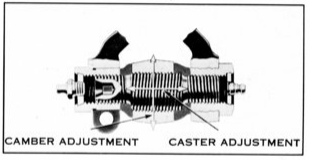


Fig. 110. Eccentric Pin

support clamp bolts and install lubrication fittings.

TOE-IN

Toe-in is the setting or adjustment of the front wheels so that the distance between them is less at the front than at the rear. (See Fig. 111)

The purpose of toe-in is to make the wheels roll straight ahead and compensate for the tendency of cambered wheels to roll outward. Toe-in is also necessary to prevent abnormal tire wear.

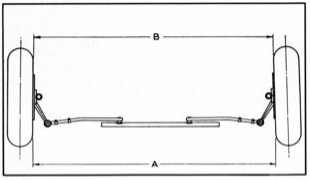


Fig. 111. Front Wheel Toe-In

Checking for Toe-In

Having performed the preliminary checks as outlined under INSPECTION BEFORE CHECKING FRONT WHEEL ALIGNMENT, the toe-in may be checked to specifications.

When checking toe-in, the high spot on the side of the tires should be in a vertical plane as shown in Fig. 103 if check is made on front end aligning equipment. The preferred method of setting toe-in, however, is with the use of a "tram bar" as follows:

1. Move car forward slowly on a level floor allowing wheels to turn one revolution or more.
2. With tram bar approximately 10" from the floor, place it between front tires at point "A" as shown in Fig. 111. Set bar on zero.
3. Mark point of contact of tram bar on tire, then roll car forward until the mark coincides with tram bar when placed between tires at point "B".
4. Read the indicated toe-in (or toe-out) on tram bar, and adjust if necessary to place within limits given below.

   NOTE—Since the toe-in readings are taken at same point on tire for position "A" and "B", any run out of the wheel and tires is cancelled and the true toe-in is read.

Toe-in is highly important to the proper functioning of the automobile and should be set as accurately as possible.

The distance "B" between the front of the front tires should be 1/16" to 1/8" less than the distance "A" between the rear of the front tires, as shown in Fig. 111.

Setting Toe-In

1. Loosen the clamp screws at each end of the steering tie rod adjustable tubes.
2. Turn both tie rod tubes an equal amount until the desired toe-in setting is obtained if steering wheel "down" spoke is in proper position when car is rolled forward on level floor. If car tends to lead when steering wheel is centered, adjust the tie rod that will cause the car to go more nearly straight ahead.

   NOTE—Turning the tie rod tubes in the direction the wheels revolve when the car moves forward decreases the toe-in.
3. When adjustment has been completed, according to the recommended specifications, make sure outer tie rod end is horizontal (that is, ball stud riding squarely in seat), tighten all clamp screws.

TOE-OUT (Steering Geometry)

Toe-out is the mechanics of keeping the front wheels in proper relative alignment as the

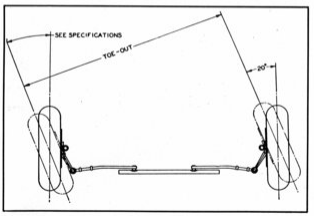


Fig. 112. Front Wheel Toe-Out

wheels are turned right and left. When driving on a curve, the wheels go into a toe-out position, further apart at the front of the tire than they are at the back. This condition increases with the increase of the turn.

Toe-out is provided for in the design by certain definite relations which must exist between the steering arms, the turning radius, the wheelbase and the distance between the king pins.

Toe-out is checked by turning the wheels to the right or left, locating the outside wheel in a definite position and determining the position of the inside wheel. With the outside wheel set at 20°, the setting of the inside wheel should be 23° ± ½° on all models. Errors found when checking the inside wheel are usually due to bent steering arms or incorrect caster, camber and toe-in. If error is due to bent steering arm, replacement with new arm should be made. When replacements of this kind are made, it is important that other front end parts are checked and front wheels realigned.

DIAGNOSIS CHART

EFFECT	CAUSE	REMEDY
Hard steering (indicated by tightness in steering system).	Low or uneven tire pressure.	Inflate tires to proper pressure.
	Steering gear or connections adjusted too tight.	Test steering system for binding with front wheels off floor. Adjust as necessary and lubricate.
	Insufficient or incorrect lubricant used.	Check lubricant in steering gear and lubricate steering system as required.
	Improper caster.	Check caster and adjust as necessary.
	Suspension arms bent or twisted.	Check wheel alignment by checking the caster, camber, and king pin inclination. If arms are removed from car, check against specifications. Replace arms with new ones.
	Frame bent or broken.	Check frame for proper alignment and breakage. Repair or replace frame as necessary.
	Steering knuckle bent.	Replace with new knuckle.
Excessive play or looseness in steering system.	Steering gear or connections adjusted too loosely or worn.	Adjust or install new parts as necessary.

DIAGNOSIS CHART—Continued

EFFECT	CAUSE	REMEDY
	Steering knuckle bearings worn.	Install new bearings.
	Front wheel bearings incorrectly adjusted or worn.	Adjust bearings or replace with new parts as necessary.
Erratic steering on application of brakes.	Low or uneven tire pressure.	Inflate tires to proper pressure.
	Brakes incorrectly or unevenly adjusted. Dirt or grease on lining.	Adjust brakes. Clean linings or replace.
	Incorrect or uneven caster.	Check caster and adjust as necessary.
	Steering knuckle bent.	Replace with new knuckle.
Car pulls to one side.	Low or uneven tire pressure.	Inflate tires to proper pressure.
	Rear wheels not tracking with front wheels.	Check alignment of rear wheels and correct as necessary.
	Brakes incorrectly or unevenly adjusted, or dragging.	Adjust brakes.
	Shock absorbers worn or inoperative.	Check and correct as necessary.
	Toe-in incorrect.	Adjust tie rods to make front wheels toe-in proper amount.
	Incorrect or uneven caster.	Check caster and adjust as necessary.
	Incorrect or uneven camber.	Check camber and correct by adjustment or by replacing parts.
	Rear axle shifted.	Check frame and axle for alignment. Repair or replace as necessary.
	Frame or frame "X" cross member bent or broken.	Check frame for proper alignment and breakage. Repair or replace frame as necessary.
Worn tire tread edges.	Improper front end alignment.	Check and correct front end alignment. Tighten idler arm support and bushings.
	High speed driving on curves.	Keep speed down on curves and tires properly inflated.
	Steering knuckle bent.	Replace with new knuckle.
	Steering knuckle arm bent.	Check by testing toe-out. Replace with new arm.
Scuffed tires.	Tires improperly inflated.	Inflate tires to proper pressure.
	Wheels or tires out of true.	Check for wheel and tire wobble. See that wheels and tires are properly mounted.

DIAGNOSIS CHART—Continued

EFFECT	CAUSE	REMEDY
	Steering knuckle bearings worn.	Install new bearings.
	Toe-in incorrect.	Adjust tie rods to make front wheels toe-in proper amount.
	Uneven caster.	Check caster and adjust as necessary.
	Incorrect toe-out on turns.	Replace steering knuckle arms.
	Steering gear incorrectly adjusted.	Adjust steering gear.
	Eccentric or bulged tires.	Replace with new ones.
Front or rear wheel tramp.	Wheels, tires or brake drums out of balance.	Balance wheels and tires. Also check for out of balance brake drums and for eccentric or bulged tires and replace as necessary.
	Motor mountings failed or torn loose.	Check motor mountings and replace if necessary.
	Shock absorbers inoperative.	Refill or replace.
	Loose or worn front wheel bearings.	Adjust or replace front wheel bearings.
Car wanders.	Low or uneven tire pressure.	Inflate tires to proper pressure.
	Steering gear or connections adjusted too loosely or worn.	Adjust or install new parts as necessary.
	Steering gear or connections adjusted too tightly.	Test steering system for binding with front wheels off floor. Adjust as necessary and lubricate.
	Steering knuckle bearings worn.	Install new bearings.
	Wheels toe-out in straight ahead position.	Adjust tie rods to make front wheels toe-in proper amount.
	Incorrect or uneven caster.	Check caster and adjust as necessary.
	Steering knuckle bent.	Replace with new knuckle.
	Rear axle shifted.	Check frame or axle for alignment. Repair or replace as necessary.
Road Shocks	Low or high tire pressure.	Inflate tires to proper pressure.
	Steering gear or connections incorrectly adjusted.	Adjust steering gear and connections.
	Improper caster.	Check caster and adjust as necessary.
	Shock absorbers inoperative or leaking. Wrong valving.	Repair or replace.

DIAGNOSIS CHART—Continued

EFFECT	CAUSE	REMEDY
	Wrong type or size of tires used.	Install new tires of correct type and size.
	Steering knuckle bent.	Replace with new knuckle.
	Suspension arms bent or twisted.	Check wheel alignment by checking caster, camber, and king pin inclination. If arms are removed from car, check against specifications. Replace arms with new ones.
	Steering knuckle bent.	Replace with new knuckle.
Cupped tires.	Tires improperly inflated.	Inflate tires to proper pressure.
	Uneven suspension or shock absorber action.	Check shock absorbers and suspensions for cause, and correct as necessary.
	Wheels, tires or brake drums out of balance.	Balance wheels and tires. Also check for eccentric or bulged tires and replace as necessary.
	Dragging brakes. (Incorrectly adjusted.)	Adjust brakes.
	Worn steering knuckle bearings or wheel bearings incorrectly adjusted or worn.	Adjust or replace parts as necessary.
	Steering knuckle bent.	Replace with new knuckle.
Front wheel shimmy.	Uneven tire pressure.	Inflate tires to proper pressure.
	Steering connections incorrectly adjusted or worn.	Adjust or install new parts as necessary.
	Front wheel bearings incorrectly adjusted or worn.	Adjust bearings or replace with new parts as necessary.
	Shock absorbers inoperative or leaking.	Refill or replace.
	Steering knuckle bearings worn.	Install new bearings.
	Toe-in incorrect.	Adjust tie rods to make front wheels toe-in proper amount.
	Incorrect or uneven caster.	Check caster and adjust as necessary.
	Steering knuckle bent.	Replace with new knuckle.
	Wheels, tires or brake drums out of balance.	Balance wheels and tires. Also check for out of balance brake drums and for eccentric or bulged tires and replace as necessary.
	Wheels or tires out of true.	Check for wheel and tire wobble. See that wheels and tires are properly mounted and balanced.

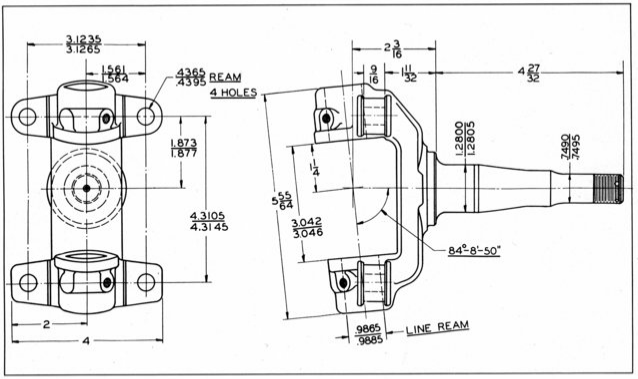


Fig. 113. Steering Knuckle Detail

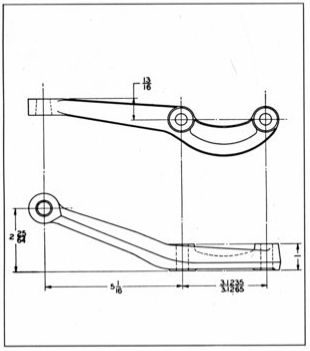


Fig. 114. Steering Arm Detail—76 and 88 Series

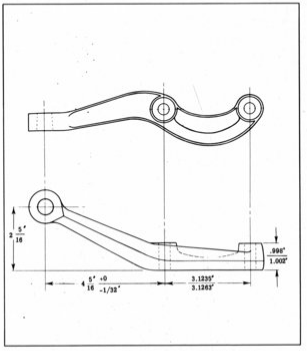


Fig. 115. Steering Arm Detail—98 Series

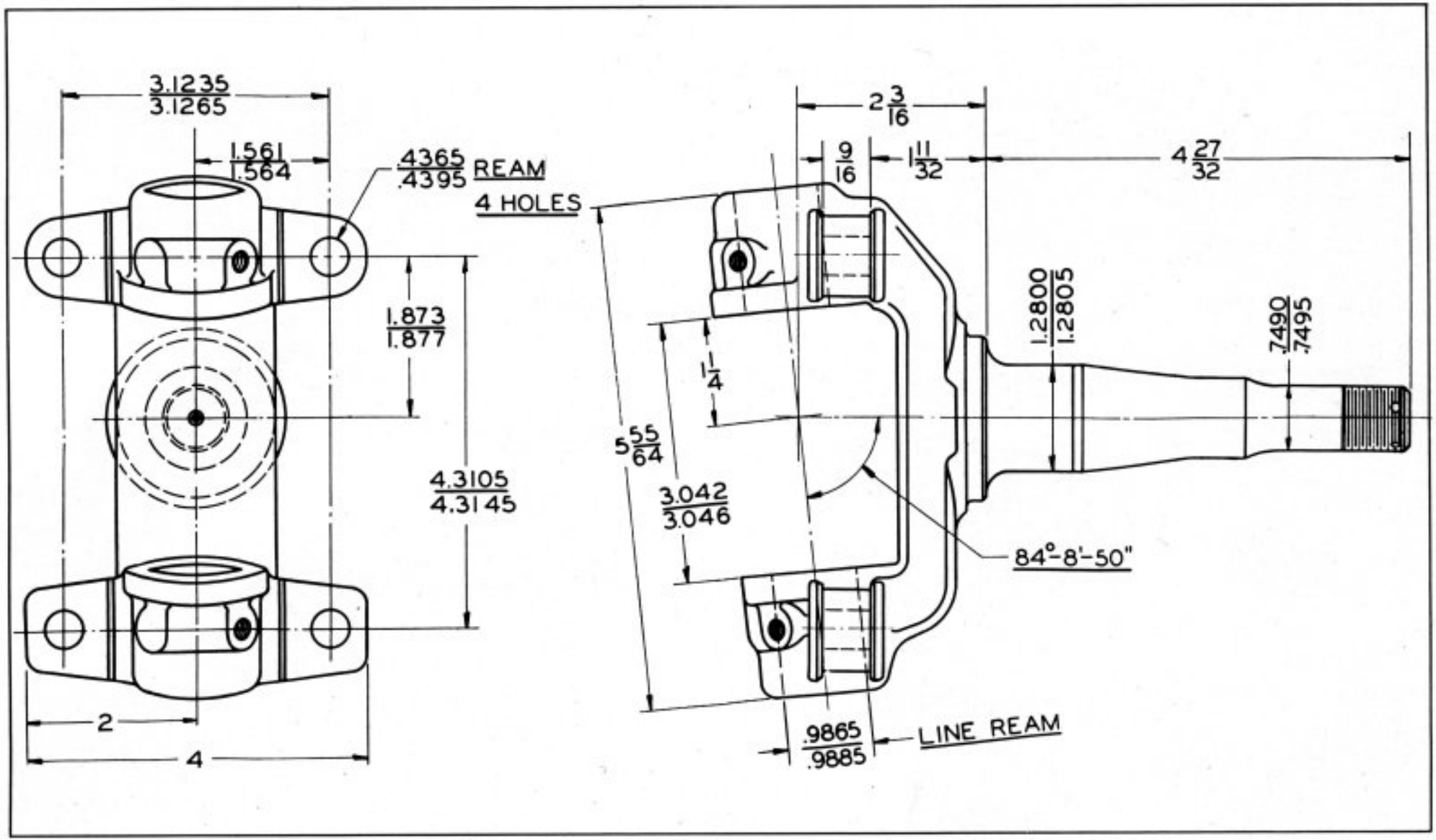


Fig. 113. Steering Knuckle Detail

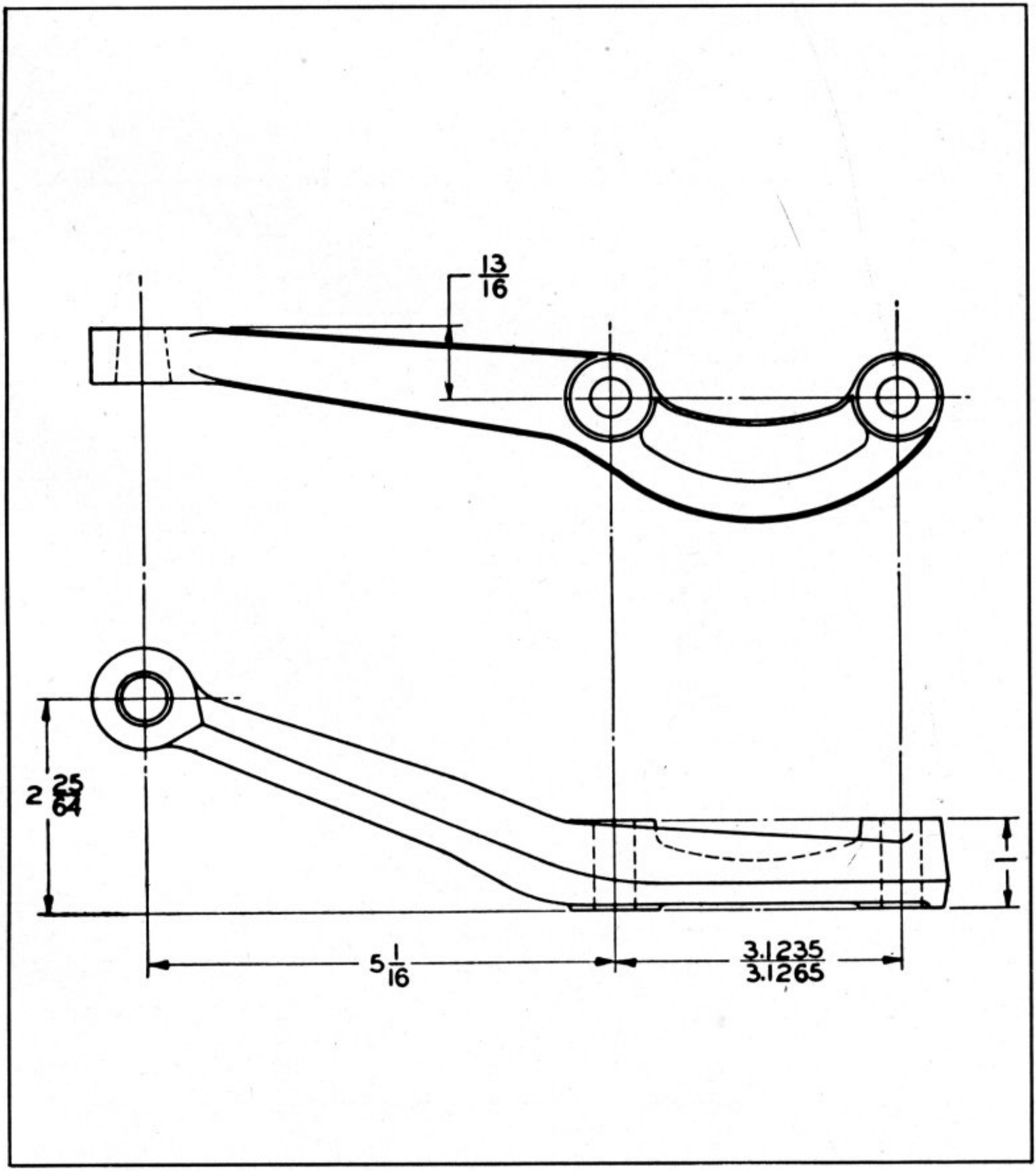


Fig. 114. Steering Arm Detail—76 and 88 Series

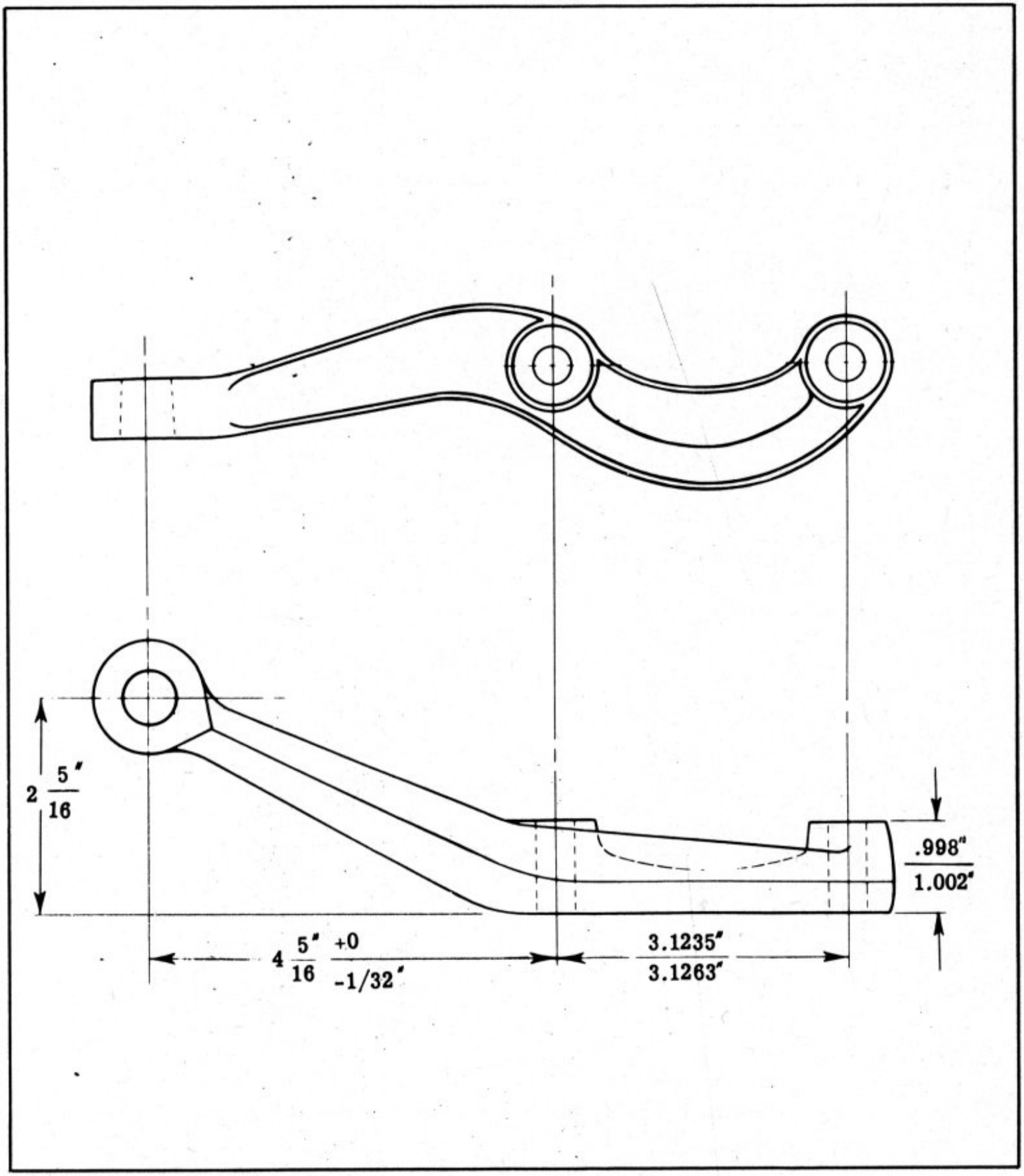


Fig. 115. Steering Arm Detail—98 Series

SPECIFICATIONS—1949 MODEL

SUBJECT AND REMARKS	119½″ Wheelbase	125″ Wheelbase
1. CASTER ANGLE—DEGREES	0° to −¾° (Neg.)	0° to −¾° (Neg.)
2. CAMBER—DEGREES	*−¾° to +¼°	*−¾° to +¼°
3. TOE-IN	1/16″ to ⅛″	1/16″ to ⅛″
4. KING PIN INCLINATION	4° 29′ 47″	4° 29′ 47″
5. TOE-OUT	23° ±½°	23° ±½°
6. TREAD	57″	58″

* Service limit. New Car Specification −¼° to +¾°.

FRONT COIL SPRING CHART

MODEL	509040	511138		419540	41953		554995
	76 ex. DSW & CR	76 DSW & CR	88 ex. DSW & CR	88 DSW	88 CR	98 ex. DCR	98 DCR
Inside Diameter	3 11/16″	3 11/16″		3 11/16″	3 11/16″		3 11/16″
Identification Color	Red (2 daubs)	Grey & Yellow		Red & Blue	Green (2 daubs)		Yellow & Brown
Diameter of Wire	.625″	.635″		.660″	.660″		.660″

FRONT SHOCK ABSORBER CHART

MODEL	76 ex. CR	76 CR	88	98
Model—R.H.	1947 J	1947 J	1947 J	1947 C
L.H.	1947 K	1947 K	1947 K	1947 D
Rebound Valve	3.5 F	4 H	3.5 F	3 H
Compression Valve	3.5 B	3 B	3.5 B	3 B

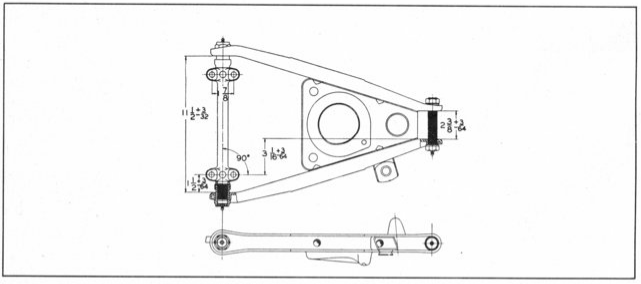


Fig. 116—Lower Control Arm Detail

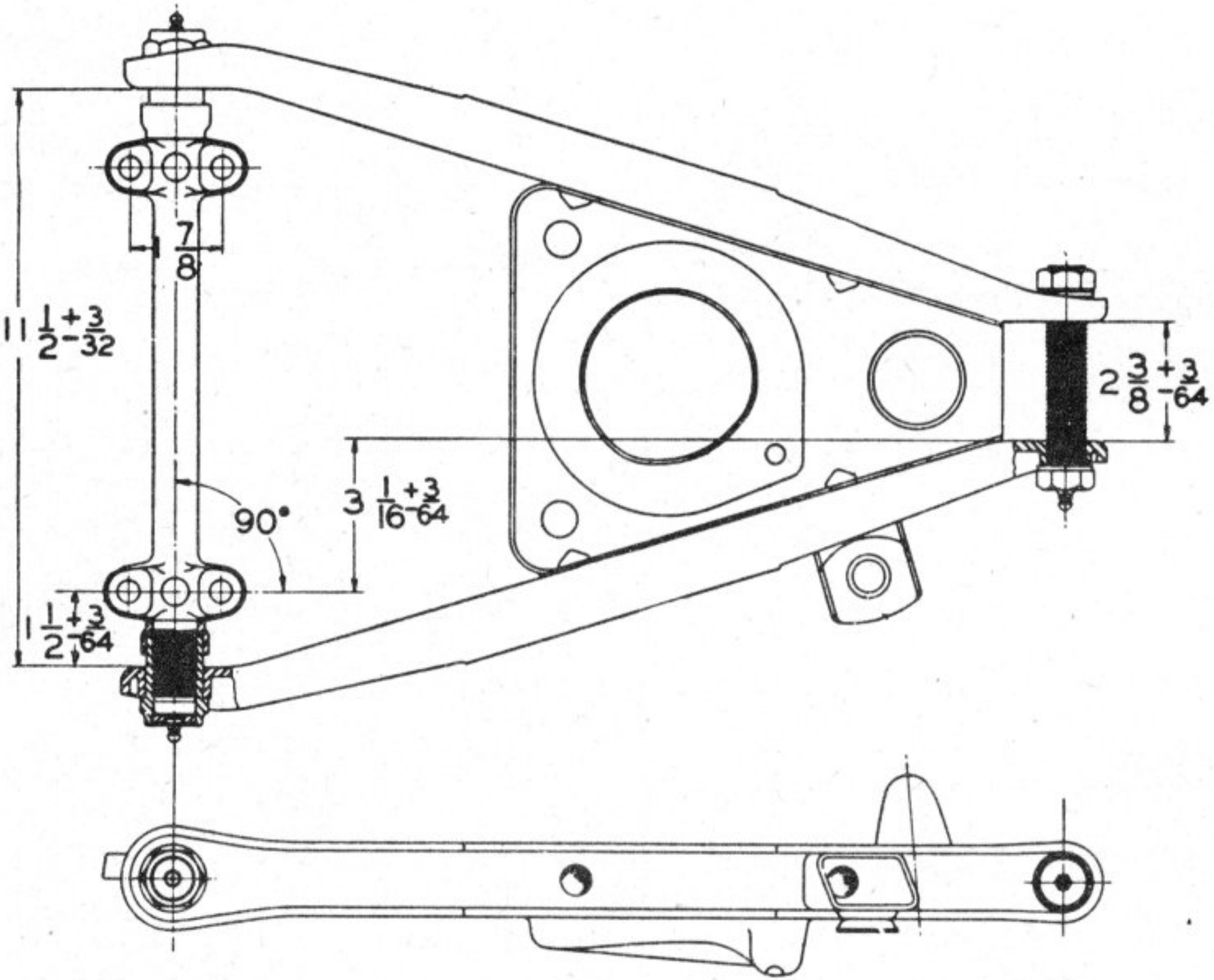


Fig. 116—Lower Control Arm Detail

REAR END SUSPENSION

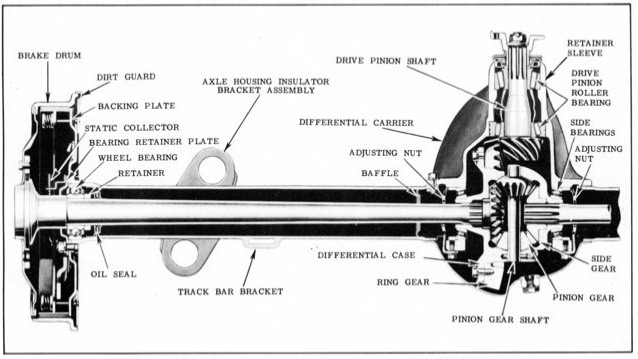


Fig. 117. Rear Axle and Wheel Bearings

The 1949 rear axle and differential assembly is similar in design to that used on 1948 models.

The rear axle for all models, is the semi-floating type and has hypoid gears. The banjo type axle housing is mounted with rubber insulators between the rear support arms and the housing.

The rear cover for the differential is welded to the banjo housing and, because of the liability of damage to drain plug on the under side of the banjo housing, no drain plug is provided. The oil, however, may be drained from the housing by removing the lower attaching cap screw in the differential carrier.

Baffles and oil seals are provided in the axle housing between the differential side bearings and wheel bearings to prevent oil from flushing out the sealed wheel bearings as well as to protect the brakes.

Both 1949 eight cylinder model axle housings are provided with supports into which the differential carrier pedestal caps pilot, eliminating any tendency of the caps to spread due to the increased torque of the new larger eight cylinder engine.

Except for the machined pilot surfaces on eight cylinder pedestal caps, differential carrier assemblies are alike, and the eight cylinder carriers will fit into six cylinder housings, although six cylinder carriers cannot be installed in eight cylinder housings because of the interference between the housing supports and the non-machined pedestal caps.

It is important that only housings with welded supports and carriers with machined pedestal caps be used on eight cylinder models.

Three and three-quarters (3¾) pounds of SAE 90 Multi-Purpose Hypoid lubricant are

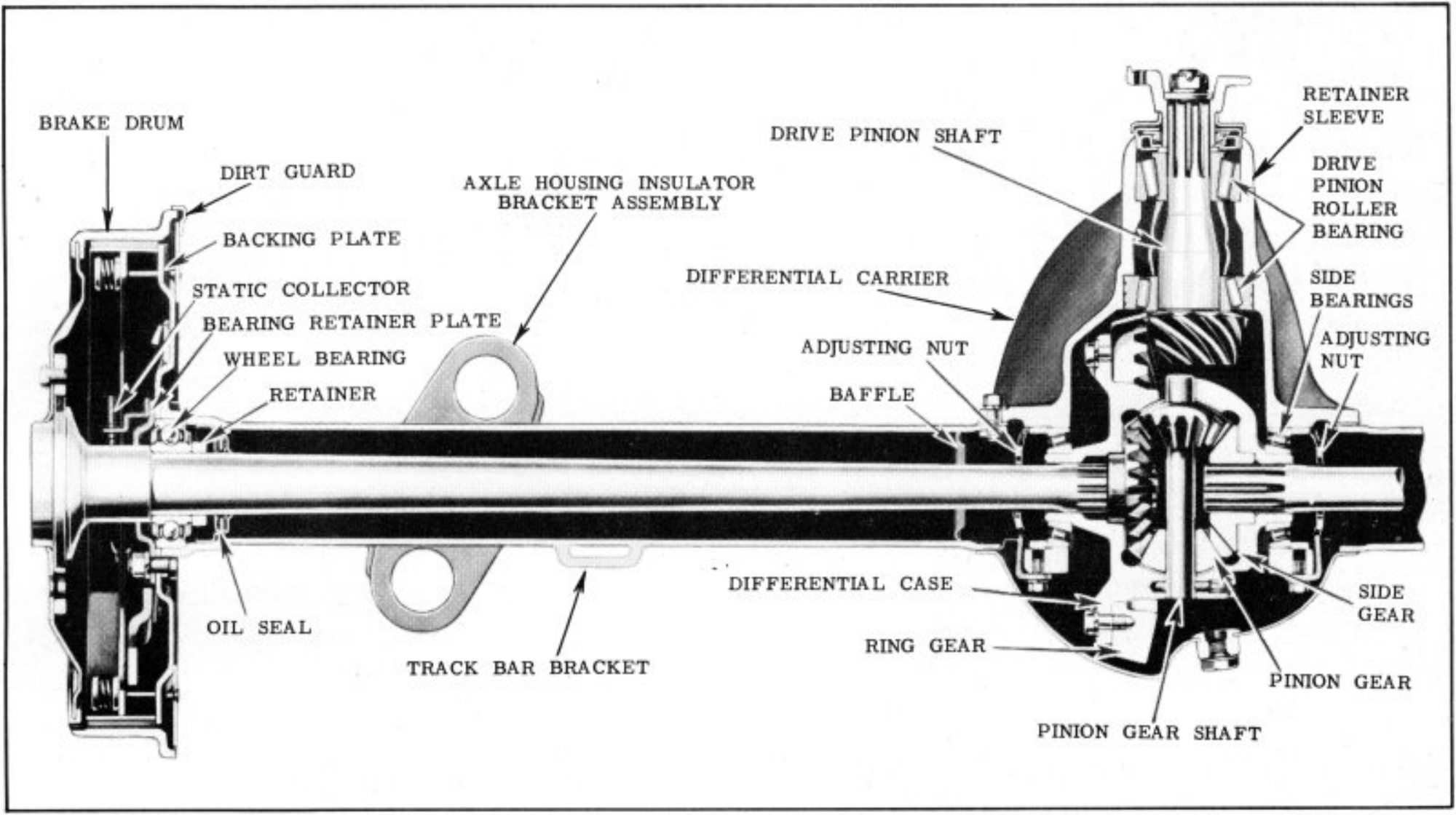


Fig. 117. Rear Axle and Wheel Bearings

used in the rear axle. Differentials should be filled to oil plug level. See Lubrication Chart for further instructions.

The drive pinion shaft, which is integral with the pinion, is mounted at both front and rear on preloaded taper roller bearings. Adjustment of the pinion along its axis is obtained by shims placed between the rear bearing outer race and a shoulder in the carrier. Adjustment of the pre-load of the two bearings is obtained by tightening the companion flange nut which compresses a sleeve over the pinion stem between the bearings. Both outer races are pressed into the carrier, the rear race against the pinion adjusting shims, the front race against a shoulder in the carrier. The rear bearing inner race is pressed over the pinion stem to a shoulder at the pinion end. The front bearing is a close sliding fit on the pinion stem.

The malleable iron differential case is mounted in the alloy cast iron differential carrier on two taper roller differential side bearings.

The axle shafts have involute splines on the inner ends and engage the differential side gears. The outer ends are upset into flanges to which are bolted the brake drums and rear wheels. The wheel bearings, on the outer end of the axle shafts, are the sealed type ball bearings, which are lubricated when assembled and need no further lubrication.

AXLE TESTING

The necessity for overhauling a differential may be from broken parts or normal wear causing gear noise. A so-called gear noise may not be gear noise, but may result from tires on certain kinds of road surfaces, body drumming, muffler roar, etc. Therefore, before a differential is torn down or adjusted for gear noise, a systematic check should be conducted under standard conditions as follows:

1. Select a level tarvia or asphalt road, as this type road surface practically eliminates tire noise.
2. Drive car far enough to thoroughly warm rear axle lubricant.
3. If any noise is present, note speed at which it occurs, and with car standing, accelerate the engine to approximate speed where noise was noticed to definitely determine

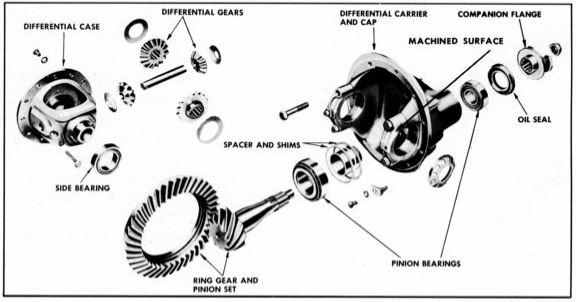


Fig. 118. Differential Assembly Detail—88 and 98 Series

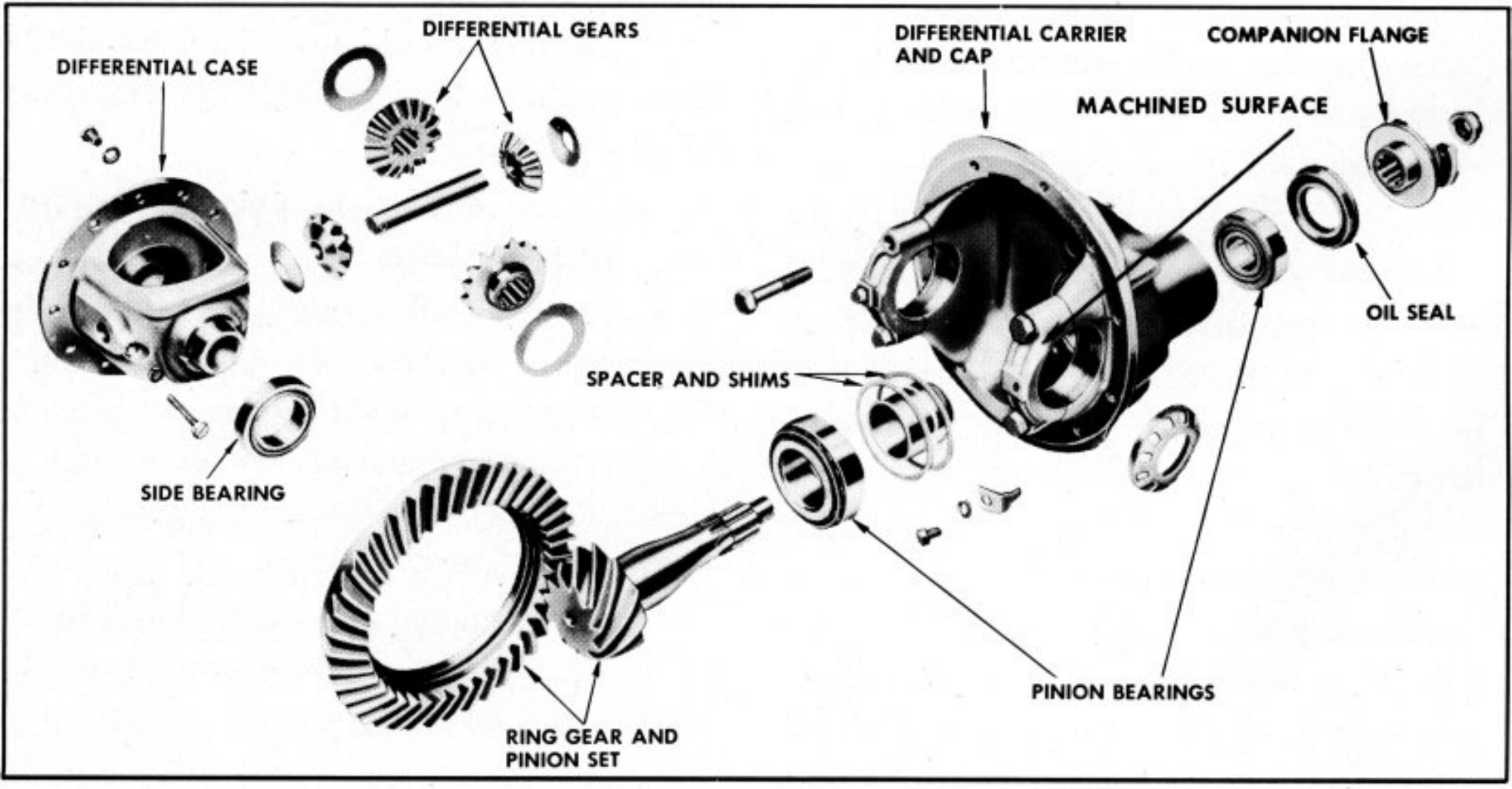


Fig. 118. Differential Assembly Detail—88 and 98 Series

that noise was not caused by exhaust or muffler roar.

4. Accelerate car to 45 miles per hour, and with gear shift lever in neutral and engine shut off, coast from 45 down to 15 miles per hour to make sure condition is not tire noise.

NOTE—Hydra-Matic Transmission oil pumps may be heard as a high pitched whine much like light axle noise. To check pumps, make the following tests:

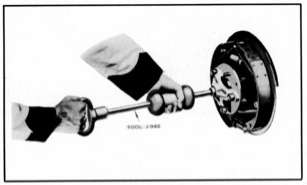


Fig. 119. Removing Axle Shaft with Tool J-942

Test Front Oil Pump

1. With engine idling, transmission in neutral, listen for whine.
2. Raise engine speed gradually. If front pump whine is very pronounced, it will follow engine speed.

   NOTE—It can be easily heard with the transmission dip stick removed.
3. Start the car in motion and increase car speed. The front pump (if noisy) will again be heard while driving or coasting the car.
4. Drive the car to approximately twenty (20) MPH above speed where whine is most pronounced.
5. Turn ignition key off and move control lever to neutral.

   NOTE—Front pump is now NOT working, and if whine can not be heard while coasting, the front pump is at fault and will need to be corrected.
6. Examine the pump gears, gear pockets and crescent for excessive wear. Also the babbitt bushing in the pump body. If any of the above mentioned causes are apparent, a new pump must be installed as these parts are not serviced separately.

Test Rear Pump

1. Drive the car to determine at what speeds whine is heard.
2. If whine can be heard on drive or coast with engine running, and on coast with engine shut off (shift lever in neutral), it is a good indication that the rear oil pump is at fault.

To further check this whine make a second test as follows:

1. Remove the propeller shaft.
2. Remove oil dip stick from transmission.
3. Place control lever in "Hi" range position, run engine until speedometer registers the same as when whine was heard.
4. If whine is heard under this test, the rear oil pump is at fault. (Whine may not be as loud as when the propeller shaft is attached).
5. Examine rear oil pump gears for wear, nicks or burrs.
6. Examine oil pump gears for clearance in pump pockets. If gears show excessive wear or scrape the pump pockets, a new rear pump will need to be installed.
7. Examine the bronze drive gear for excessive wear on the drive side of tooth contact. If the bronze drive gear shows heavy deep lapping groove, the bronze drive gear will need to be replaced.

If the above checks indicate that the noise is in the rear axle drive gears, it may be caused

from drive noise, coast noise, float noise or bad bearings. These respective conditions may be identified as follows:

(a) Drive noise is most pronounced on constant acceleration through the speed range of 15 to 45 miles per hour, either part or full throttle.

(b) Coast noise will be most pronounced by allowing car to coast from 45 miles per hour through the speed range to 15 miles per hour—throttle closed and clutch engaged.

(c) Float noise is most pronounced while holding the speed constant at three-mile intervals between 15 to 45 miles per hour.

(d) Bad bearings, if worn, rough or loose, will aggravate drive, float or coast noise. If the bearings have these characteristics, any of the differential noises will be noticed by a heavy irregular drive noise on constant acceleration and float, and a very rough and irregular coast noise on deceleration.

CAUTION: To a considerable extent the rear axle housing acts as a "speaking tube" and, for this reason, a faulty carrier bearing may be mistaken as a defective wheel bearing.

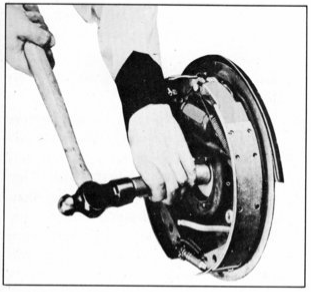


Fig. 120. Installing Axle Shaft Bearing Oil Seal with Tool J-1049

REMOVE AXLE SHAFT

1. Remove wheel.

   NOTE—Wheel nuts on left side of car, front and rear, have left hand threads.

2. Remove the two Tinnerman nuts from wheel studs which hold the brake drum in place and remove the drum.

   NOTE—If Tinnerman nuts are removed by turning off threads, they can be used again; however, if nuts are damaged in any way they should be replaced.

3. Remove nuts from the four bolts attaching brake backing plate to axle housing.
4. Pull axle shaft bearing retainer plate away from backing plate, taking care not to dislodge backing plate as brake line may be damaged.
5. Withdraw axle shaft and bearing assembly, using tool No. J-942. (Fig. 119)

   NOTE—Extreme care must be exercised to prevent the axle shafts from dragging on oil seal. Bearings should be covered with a clean rag to prevent dirt getting into bearings.

6. Replace one backing plate attaching nut to hold backing plate in position.

REPLACE AXLE SHAFT

NOTE—Before replacing axle shafts, examine oil seals. The oil seal carries two leather washers with feather edges which form a tight seal around the axle shaft. If these feather edges are damaged in any way, oil will leak past the seal. Furthermore, if the seal is not properly installed in the axle housing, a leak is likely to occur around outside diameter of the oil seal assembly. When it is necessary to install an oil seal, the seal should be driven into the axle housing true with the axis of the shaft and sealed with Permatex or white lead around the outside diameter. The seal can be properly installed by using tool J-1049 as shown in Fig. 120.

Before installing axle shaft, examine the surface of the shaft on which the seal wipes to make sure that it is smooth and free from tool marks. If necessary, dress down outside diameter of shaft with fine emery cloth to make a smooth bearing for the oil seal.

If roughness or excessive play is manifest in wheel bearing, replace. (See SEALED WHEEL BEARINGS—REAR)

Axle shafts are serviced with wheel studs pressed into the flange of the shaft. The threads of these studs are left hand for the left hand side of the car and right hand for the right hand side of the car, thereby making the right and left hand shaft assemblies different for service. Axle shafts are not interchangeable between 98 series and 76 and 88 series cars.

1. Remove temporary nut holding backing plate to axle housing.

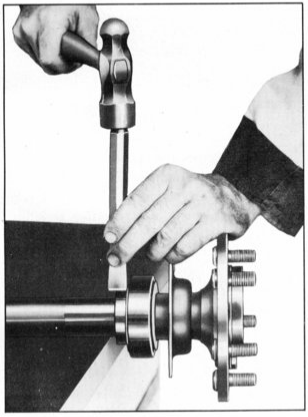


Fig. 121. Removing Wheel Bearing Retainer

2. Slide axle shaft and bearing assembly into place. EXTREME CARE MUST BE EXERCISED WHEN SLIDING THE AXLE SHAFT THROUGH THE WHEEL BEARING OIL SEAL TO AVOID DAMAGING THE SEAL. The inner diameter of the oil seal has a feather edge to hug shaft closely and prevent oil leaks. If this feather edge is damaged, the efficiency of the oil seal is impaired.
3. Clean surfaces at center of backing plate and retainer plate. Install new gasket between retainer plate and backing plate, and bolt in place. Tighten bearing retainer bolt nuts, replacing lockwashers if these are damaged.
4. Replace brake drum.
5. Replace rear wheel.
6. Adjust brakes.

REMOVE AND REPLACE AXLE SHAFT BEARING

1. Remove rear axle shaft.
2. Remove bearing retainer collar after splitting wth cold chisel as shown in Fig. 121. Do not damage axle shaft.
3. Engaging outer race of bearing with tool J-947-2, used in conjunction with J-947-1, press off bearing in arbor press. Remove bearing only when a new bearing is to be installed. (Fig. 122)
4. Using tool No. J-947-3, in conjunction with plate J-947-1, press bearing over axle shaft, being sure that pressure is applied to inner race of bearing. After bearing has been pressed firmly against axle shaft shoulder, press new bearing retainer collar in place firmly against bearing with chamfered end of collar toward bearing. Do not burr chamfered end of retainer collar or damage shaft surface on which oil seal will run. (Fig. 123)

Replacement of Pinion Bearing Oil Seal

1. Disconnect rear universal joint from companion flange.
2. Mark the position of the companion flange and nut so that they can be reinstalled in the same positions.
3. Remove companion flange nut using tool J-2933 to hold flange.
4. Remove companion flange using J-962 Companion Flange Puller.
5. Remove oil seal by prying it out of carrier with a blunt tool.
6. Examine surface of companion flange for tool marks, nicks, or damaged surfaces. If damaged, replace flange as per instructions under REPLACEMENT OF COMPANION FLANGE.

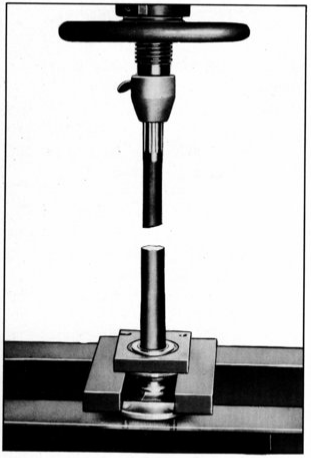


Fig. 122. Removing Axle Shaft Bearing with Tool J-947

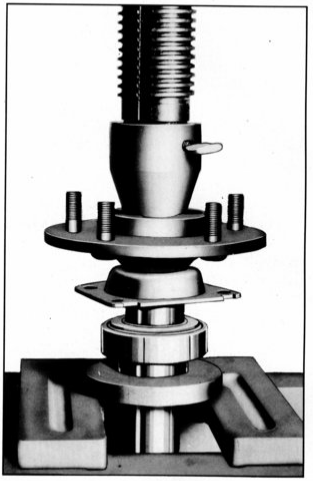


Fig. 123. Installing Axle Shaft Bearing Retainer with Tool J-947

7. Oil the leather and coat the outer diameter of the new oil seal with Permatex No. 3 or similar compound and install the seal. (J-2935 Rear Pinion Bearing Installing Plate can be used against the face of the seal while tapping seal into place.) Take care not to use an excessive amount of Permatex sealer as it will damage the front pinion bearing.
8. Try the companion flange nut on the pinion threads. If necessary, clean up threads with a file where upset by staking.
9. Install the companion flange and tighten the companion flange nut to the same position as marked in step 2.

Replacement of Companion Flange

1. Remove both axle shafts. Disconnect rear universal joint.
2. Remove companion flange nut using Tool J-2933 to hold flange.
3. Remove companion flange using J-962 Companion Flange Puller.
4. Try the companion flange nut on pinion threads for freeness. If necessary, clean the threads with a file.
5. Install new companion flange and replace flange nut.
6. With a 1″ socket wrench, tighten the nut a little at a time and turn the pinion several revolutions after each tightening to seat the rollers, checking the preload friction of bearings each time with an inch-pound torque wrench until preload friction is 15 to 20 pounds.

   NOTE—In no case should the friction exceed 25 inch pounds if the axle has been in use.
7. Stake end of pinion gear into the recess in nut.
8. Connect rear universal joint and install axle shafts and wheels.

DIFFERENTIAL GEAR NOISE

Improper gear tooth contact will result in gear noise due to:

(a) Incorrect number of pinion-locating shims.
(b) Incorrect backlash between pinion and ring gear.
(c) Incorrect tension on side bearings, due to improper adjustment, or on high mileage cars, due to wear in side bearings.
(d) Excessive wear in pinion bearings allowing the pinion gear to float.
(e) Scored, worn due to improper contact, or otherwise damaged gears.

The above mentioned should be examined carefully and parts replaced as required.

GEAR INSPECTION AND TOOTH CONTACT

Before gears are replaced in differential assembly, they should be carefully examined for scoring and proper tooth contact. A scoring condition may be the result of insufficient lubrication, improper lubricant for the load required of the gears, dirty lubricant, or improper tooth contact. The gears in a differential, which usually cause trouble (noisy gears) from these conditions, are the ring gear and pinion. The two side gears and two pinions inside the differential case rarely give trouble; in fact can be rather badly worn without affecting the operation of the differential, inasmuch as they are used only when one rear wheel travels faster than the opposite rear wheel.

Scoring marks on the contact face of the gear teeth are light colored areas caused by instantaneous fusing with the mating gear teeth. These marks usually run from the bottom to the top of the tooth.

After gear teeth have started to score, gears should be replaced. GEAR AND PINION SHOULD ALWAYS BE REPLACED IN PAIRS, and may be so identified by similar etched markings on the O.D. of the ring gear and inner end of the pinion. Always use new bolts, furnished with the ring gear and pinion set, when installing ring gear.

Improper gear tooth contact will result in noise. Gear tooth contact on gears that have been used under load will be distributed over a greater portion of the tooth than on gears that are rotated by hand. Figs. 124 & 125 show the comparison on the same gear tooth under load and when rotated by hand.

Gears that have been used and were noisy should be inspected for tooth contact before they are replaced and a new ring gear and pinion set should be checked for tooth contact after they have been assembled and before they are used in the car.

If the tooth contact is distributed over the

Fig. 124. Tooth Contact Under Load

full length of tooth as shown in Fig. 124, for a gear that has been used, or as shown in Fig. 125 on new gears rotated by hand, the gears are satisfactory for use. If, however, the tooth contact is short or distributed over only a portion of the tooth under load, the gears will probably run noisy. Even if the gears are not scored but have run long enough in this position to wear the teeth appreciably, the noise usually CANNOT be adjusted out. If, however, noise comes in on a comparatively new differential assembly, an adjustment is sometimes effective and can be brought about as follows for either drive noise, float noise or coast noise:

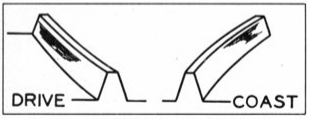


Fig. 125. Tooth Contact Under Hand Load

1. Adjustment for Drive Noise

Tooth contact should be moved to the toe and flank of tooth by moving pinion in (to rear of car) one shim at a time (.002″). To go too far may bring in float noise. It is sometimes necessary to increase the backlash one notch if the pinion has been moved in three shims (.006″). In this case, the proper tension must be maintained on the differential side bearings regardless of the markings previously placed on the adjusting nuts.

Shims for adjusting the pinion bearing are available in .002″, .003″, .004″, 005″,

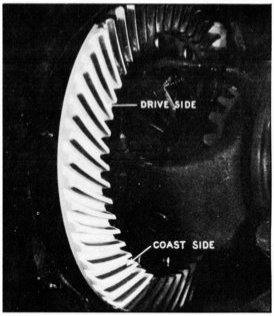


Fig. 126. Correct Tooth Contact

and .010″ thickness. If it is desired, therefore, to decrease the total thickness of shims by .003″, this may be accomplished by substituting .002″ for .005″. The same reasoning may be used to *increase* the total thickness of shims by .003″.

Fig. 127. Improper Tooth Contact

2. Adjustment for Float Noise

Move tooth contact to the heel and face of tooth by moving the pinion out (to front of car) one shim at a time (.002″). To go too far will bring in heavy drive noise. At times, one notch in adjustment of side bearings will change the backlash and may improve float condition. However, this is not advisable unless the pinion can be moved three or more shims (.006″) without changing the type of noise. In this case, the pinion should be replaced to its original position and a little more or less lash may be attempted. In changing the ring gear position, the contact is moved to the face or flank of the tooth. This may give some improvement as to float noise. It must be remembered that the proper tension on the differential side bearings must be maintained. Therefore, the markings that were placed on the side bearing adjusting nuts do not mean anything at this time as there is now a different ring gear position, and it is necessary to have three to four notches of tension regardless of the markings.

3. Adjustment for Coast Noise

Tooth contact should be moved to the heel and face, as in the light drive and float conditions. To go too far may bring in heavy drive noise. It may be necessary to take up one notch of backlash if pinion had to be moved three shims (.006″) to obtain results. In this case, three to four notches of tension on differential side bearings should be maintained regardless of the markings on the side bearing adjusting nuts.

CHECKING REAR AXLE HOUSING FOR MISALIGNMENT

NOTE—In rare cases, a rear axle housing may become damaged and bent. If this condition is found, the banjo housing should be removed from the car and checked both horizontally and vertically as described below.

Check for vertical alignment by laying housing on surface plate with each end flange resting on plate and carrier down. The distance between the finished face and surface plate must be between 45/64″ and 49/64″.

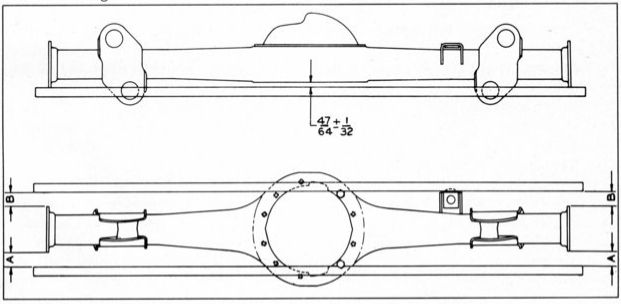


Fig. 128. Checking Horizontal and Vertical Alignment of Axle Housing

Check for horizontal alignment by laying housing flat on table and screw two bolts in place as shown at center of housing, Fig. 128. Then clamp a straight edge against bolt so that "A" at each end will be equal and make note of distance "A". Repeat this same procedure on other side to get distance "B". The difference between "A" and "B" should not be more than 1/16".

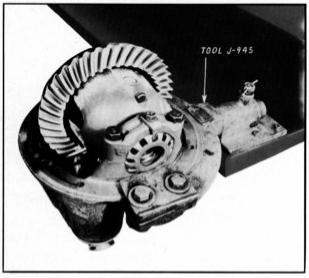


Fig. 129.—Differential Assembly—Tool J-945

BEARING FAILURE

All bearings in the 1949 differential are of the roller type.

Before any attempt is made to inspect these bearings, they should be cleaned as follows:

1. Rotate bearing by hand in clean kerosene or gasoline until free from grease and oil.
2. Blow out with air hose by directing air through the bearing at the same time rotating the bearing by hand. Do not spin the bearing with air pressure.

   CAUTION—Due to the presence of water in the air line, be sure all water is removed.
3. If necessary, repeat cleaning operation to be sure all foreign substance has been removed.
4. After cleaning thoroughly, lubricate with clean engine oil and rotate by hand and inspect for rough spots.

Bearings fail due to "lapping", "loading", or "locking".

Lapping is caused by fine particles of abrasive material, such as scale, sand, or emery, circulated within the differential by the oil, wearing away the surface of the rollers and races. Bearings which are "worn" loose, but remain smooth without flaking or pitting, are clear evidence of dirty oil. When the bearing condition indicates that abrasives are present in the oil, all interior surfaces must be thoroughly cleaned, bearings adjusted or replaced, and the axle filled with new, clean oil.

Loading of bearings is caused by overload, faulty assembly such as misalignment, or too tight adjustment. Bearings which have failed by loading have either flaked rollers, pitted races, or both.

A locked bearing condition is usually the result of a damaged roller cage or particles of foreign material in the lubricating oil wedging between the rollers and races and causing one of the races to turn on the shaft, or in the housing. Preloading of bearings higher than specified, is also sometimes the cause of locked bearings which results as undue friction between the large ends of rollers and the shoulder of the inner race.

It is important that the cause of bearing failure is corrected before new bearings are installed, or the failure is certain to recur.

Sealed Wheel Bearings—Rear

The sealed rear wheel bearings are built with .012" to .015" end-play between balls and races and should not be rejected unless end-play is greater than .020" or definite roughness between ball and race can be felt when bearing is rotated by hand. The bearing should be checked for end-play and roughness before it is removed

from the axle shaft. If bearing has been removed from the axle shaft, it should not be used again.

NOTE—It is extremely important that the centerlines of the two races be together when end-play is measured, as tipping of either race can cause a large error in end-play reading.

CAUTION—To a considerable extent, the rear axle housing acts as a "speaking tube" and, for this reason, a faulty carrier bearing may be mistaken as a defective wheel bearing.

COMPLETE REAR AXLE OVERHAUL

1. Remove the axle shafts (See REMOVE AXLE SHAFT).
2. Clean the differential carrier and the axle housing around carrier to prevent dirt entering the housing or falling on the gears.
3. Disconnect the propeller shaft at the rear universal joint after having wired the trunnion blocks together to avoid the loss of rollers. Mark the joint so that it can be replaced in the same position.
4. Drain the oil by removal of the bottom differential carrier to housing screws and remove the differential carrier assembly from the housing.

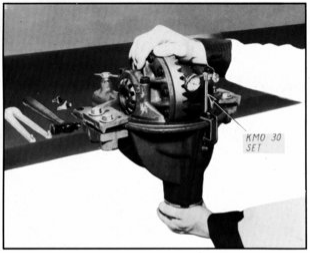


Fig. 130. Checking Backlash

CAUTION—Do not wash the exterior of the carrier until differential has been disassembled. This will avoid washing dirt into the bearings.

5. Place differential assembly into holding fixture J-945. (Fig. 129)

Inspection of Differential Before Disassembly

1. Make sure that companion flange nut is tight and has not been moved from staked position.
2. Check tightness of the ring gear to differential case cap screws and tighten if necessary.
3. Check the backlash between the ring gear and pinion gear. (See Fig. 130) (Backlash should be not less than .004″ nor more than .008″.)
4. Check the side bearing adjusting nuts for proper tension of the side bearings as follows:
   (a) With a center punch, mark the bearing cap and carrier with two marks. Also mark the adjusting nut with two marks in line with marks on bearing cap and carrier. Mark the left side with one mark in the same manner. These marks will serve for location and identification purposes. (Fig. 131)

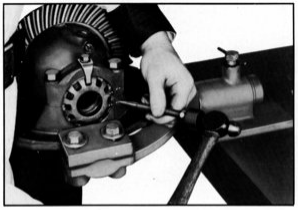


Fig. 131. Marking Side Bearing Adjusting Nut

(b) Remove bearing cap locks.

(c) Loosen each bearing cap attaching bolt (¼ to ½ turn) just enough to turn adjusting nut. (Tap lightly on bearing cap to assure freeness of nut in threads.)

(d) Back off the right hand adjusting nut (one opposite the ring gear) and watch the edge of the outer race to see if it turns along with the adjusting nut.

NOTE—The outside bearing race should start to turn the instant the adjusting nut is loosened. It should continue to turn until adjusting nut is loosened three to four notches. Count notches in bearing adjusting nut from the original center punch marks to the point where bearing stops turning.

Careful inspection of the side bearing tension as outlined above will assist in determining cause of noisy axle, as in many instances improper side bearing tension and improper backlash are the basic causes of noise.

(e) Inspect the surfaces of the ring gear and pinion teeth for nicks, burrs, scoring, or other damage. (Ring gears and pinions are replaced in sets only.)

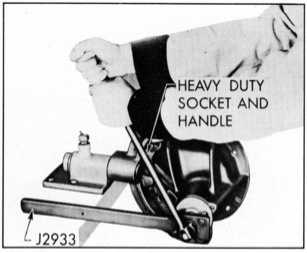


Fig. 132. Removing Companion Flange Nut

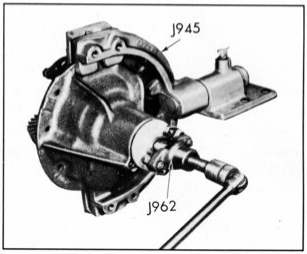


Fig. 133. Removing Companion Flange

Complete Disassembly of Differential

1. Remove the bearing caps and adjusting nuts.
2. Lift the differential case and ring gear from carrier, being careful not to drop the side bearing outer races.

   NOTE—Keep the side bearing outer races separated (right and left side) so they may be replaced on their respective bearings.
3. Remove the companion flange nut. (See Fig. 132)

   CAUTION—Leave the assembly in a horizontal position to avoid pinion dropping out on floor should the front bearing have a sliding fit on the pinion stem.
4. Remove companion flange. (Fig. 133)
5. Remove the pinion from the carrier, taking care not to damage pinion stem threads or oil seal.

   (a) If front pinion bearing has a sliding fit, remove pinion by hand.

   (b) If front pinion bearing has a light press fit, temporarily replace companion flange nut, then lightly tap the pinion loose from the bearing with a soft hammer. (See Fig. 134)

   (c) If the front pinion bearing is a tight

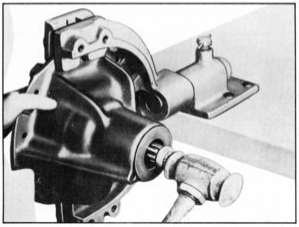


Fig. 134. Tapping Pinion from Front Bearing

press fit, use an arbor press to press the pinion through the bearing. (See Fig. 135)

6. Remove nut.
7. Remove the pinion shaft and rear bearing roller assembly as one unit from the rear of the carrier.

   The compressible spacer can be lifted from the pinion stem or carrier. In some cases, a shim .037" to .045" thick will be found between the spacer and the front inner race and roller assembly. If the same spacer is to be replaced when reassembling, use the shim in the same position.
8. Remove the oil seal by prying it out of the carrier with a blunt tool applied to the rim of the retainer. (See Fig. 136)

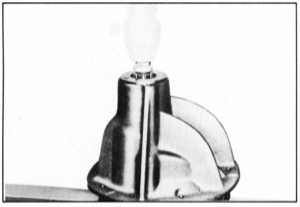


Fig. 135. Pressing Pinion from Front Bearing

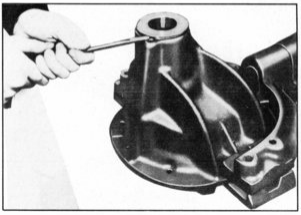


Fig. 136. Removing Oil Seal

9. Remove the front inner race and roller assembly.
10. Press the front bearing outer race out of the carrier. (See Fig. 137)
11. Press the rear bearing outer race out of the carrier. (See Fig. 138)
12. Remove pinion adjusting shims from carrier case.
13. Press rear bearing inner race and roller assembly off the pinion stem. (See Fig. 139)
14. Remove the differential pinion cross shaft, pinions, side gears, and thrust washers from the differential case.

    NOTE—Do not remove the side bearing inner roller assembly from the differential case hubs unless side bearings are to be replaced.

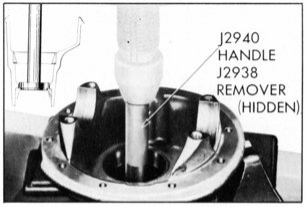


Fig. 137. Removing Front Bearing Outer Race

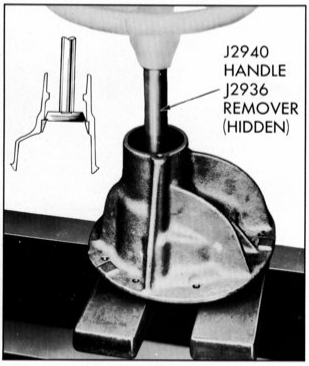


Fig. 138. Removing Rear Bearing Outer Race

Inspection of Parts

1. Wash the drive pinion bearings thoroughly in clean gasoline or kerosene (do not use brush), lubricate them with clean engine oil and examine for roughness. Both bearings should feel smooth when inner race and roller assembly are placed in their outer races and rotated with hand pressure.
2. Examine the pinion oil seal for damage to the retainer, wear or charring of leather, an indication of previous leakage. When necessary to install a new seal, oil the leather with engine oil and coat the outside diameter of the shell with Permatex or other similar compound before pressing into place in the carrier. Examine surface of companion flange for tool marks, nicks, or rough surface which would cause damage to the seal. Replace if damaged.
3. Examine the differential gear teeth, bores of differential pinions, spherical backs of pinions, pinion (cross) shaft, thrust washers and thrust surfaces inside the differential case for wear or damage. If any of the above mentioned parts are worn to a degree where they will affect the operation of the differential, they should be replaced.

   NOTE—Black surfaces on thrust washers and black spots on copper plated differential pinion (cross) shaft may be caused by certain types of lubricating oils, but is not reason for replacement unless surfaces are deeply pitted or corroded.
4. Inspect the fit of the differential side bearings on the case hubs by prying against the shoulder at the puller recesses in the case. Side bearings must be tight on the hubs. Examine the surfaces of the differential side bearing rollers and the outer races for damage or failure; oil the rollers with clean engine oil and press the outer races to the rollers, one side at a time, rotating with a steady hand pressure. If a

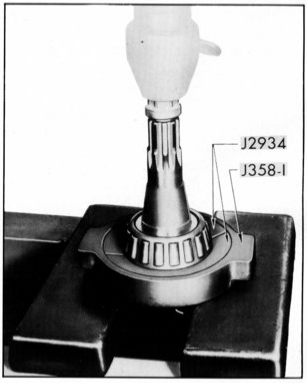


Fig. 139. Removing Rear Bearing Inner Race from Pinion

Fig. 140. Removing Differential Side Bearing with Tool HM 843-B

bearing feels rough, install a complete new bearing assembly. (See Figs. 140 & 141) Press only on the end of the inner race when installing a new side bearing. The inner race must be a heavy press fit on the case hub.

5. Make sure that the oil passages in the differential carrier are clean and unobstructed.

NOTE—Whenever a differential is rebuilt due to bearing failure, care must be used to see that all foreign matter such as grit, dirt, metal particles, etc. is removed from the carrier. This should include removing the small welch plug at the front of carrier and with a small rod pass a clean piece of cloth through the oil return passage hole in carrier. Be sure to install a new welch plug. A thin coat of Permatex Sealer No. 3 or equivalent should be applied to the welch plug before it is pressed into the carrier.

6. Try the companion flange nut on the pinion threads and, if necessary, clean up threads with a file where upset by staking.

Fig. 141. Installing Differential Side Bearing with Tool J-941

Before assembling a differential, the correct number of shims to locate the drive pinion properly must be determined from markings on the differential carrier and end of pinion gear. Pinions seldom require marking.

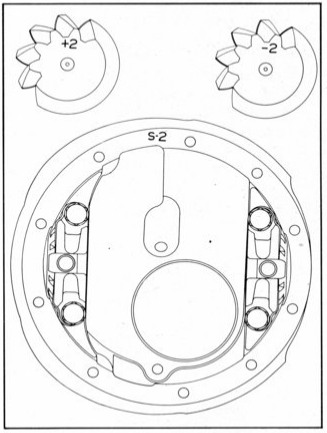


Fig. 142. Pinion and Carrier Markings

SHIM THICKNESS		
509263-SHIM (.002)-PLAIN 509264-SHIM (.003)-BLUE 509265-SHIM (.004)-COPPER 509266-SHIM (.005)-PLAIN 509267-SHIM (.010)-PLAIN	USE THESE SHIMS IN COMBINATIONS AS SHOWN BELOW TO GET REQ'D. TOTAL THICKNESS	
.002 = .002	.011 = .004 + .004 + .003	
.003 = .003	.012 = .004 + .004 + .004	
.004 = .004	.013 = .005 + .004 + .004	
.005 = .005	.014 = .010 + .004	
.006 = .003 + .003	.015 = .010 + .005	
.007 = .004 + .003	.016 = .010 + .003 + .003	
.008 = .004 + .004	.017 = .010 + .004 + .003	
.009 = .005 + .004	.018 = .010 + .004 + .004	
.010 = .010	.019 = .010 + .005 + .004	

CARRIER DEPTH MARKING		PINION MARKING MINUS					PLUS				
		-4	-3	-2	-1	0	+1	+2	+3	+4
5.570	S-5		.002	.003	.004	.005	.006	.007	.008	.009
5.571	S-4	.002	.003	.004	.005	.006	.007	.008	.009	.010
5.572	S-3	.003	.004	.005	.006	.007	.008	.009	.010	.011
5.573	S-2	.004	.005	.006	.007	.008	.009	.010	.011	.012
5.574	S-1	.005	.006	.007	.008	.009	.010	.011	.012	.013
5.575	0	.006	.007	.008	.009	.010	.011	.012	.013	.014
5.576	D-1	.007	.008	.009	.010	.011	.012	.013	.014	.015
5.577	D-2	.008	.009	.010	.011	.012	.013	.014	.015	.016
5.578	D-3	.009	.010	.011	.012	.013	.014	.015	.016	.017
5.579	D-4	.010	.011	.012	.013	.014	.015	.016	.017	.018
5.580	D-5	.011	.012	.013	.014	.015	.016	.017	.018	.019

Fig. 143. Rear Axle Pinion Shim Chart

MARKING ON DIFFERENTIAL CARRIER AND PINION

Differential carrier housings are marked on the face of the flange. (See Fig. 142) "D" means "deep", and "S" means "shallow" depth of bore to the shoulder for the rear bearing. The digit following the letter designates the number of thousandths "deep" or "shallow". Carriers marked "D" require more shim thickness than carriers marked "S". The pinion, if not standard, will be marked on the end for the number in thousandths inch shims required to set pinion in correct position in the carrier, as – plus 2 requires .002" added shim thickness. Pinions not marked are standard. Therefore, a pinion not marked in a carrier marked "O" will require only the .010" in shims which is standard.

How to Use Shim Chart

Read the marking on the carrier and pinion. (See Fig. 143) In the table, read to the right from the "Carrier" marking corresponding with the mark on the carrier flange and down from the "Pinion" marking corresponding with the mark on the pinion. The intersection of the vertical (Pinion) column with the horizontal (Carrier) column shows the correct total shim thickness for this carrier and pinion. Example—A carrier which is marked "D-3" with a pinion marked "-2" requires total shim thickness of .011" with average bearing. Always measure total shim thickness with micrometer after cleaning lint, etc., from shim surfaces and before installing in carrier.

Assembly of Differential Carrier

With all parts thoroughly cleaned and all bearings oiled, proceed to reassemble as follows:

1. Install correct number of pinion adjusting shims against shoulder of rear bore of carrier and press outer race of rear bearing firmly in place against shims and shoulder in the carrier. (See Fig. 144)
2. Press outer race of front pinion bearing firmly in place against shoulder in the carrier. (See Fig. 145)
3. Press rear bearing inner race and roller assembly firmly in place to shoulder on the pinion stem. (See Fig. 146)
4. Place compressible spacer over the pinion stem and place pinion in position in the carrier, then install front bearing inner race and roller assembly.

   NOTE—If a production shim .037" to .045" thick was found between the spacer and front race and roller assembly, and the same spacer is reinstalled, use the shim. If a new spacer is used, discard the shim.

   (a) If the front pinion bearing is a sliding fit, turn the carrier so the pinion is

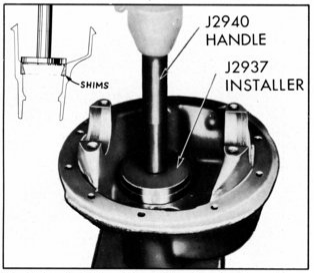


Fig. 144. Installing Rear Pinion Bearing Outer Race

horizontal, then slide bearing into place.

(b) If the front pinion bearing is a press fit, use an arbor press to install the bearing. Use the small end of an old spacer as a tool to press the bearing onto pinion stem. (See Fig. 147)

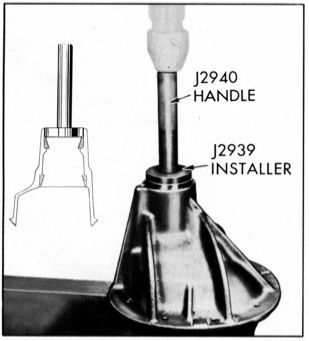


Fig. 145. Installing Front Pinion Bearing Outer Race

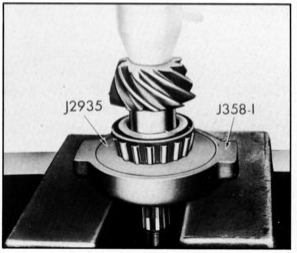


Fig. 146. Installing Rear Bearing Inner Race and Roller Assembly

When to Use a New Compressible Spacer

A new spacer is required between the pinion bearings under any of the following conditions:

1. When a new ring gear and pinion set is installed.
2. When either front or rear pinion bearing is changed.
3. When a new carrier is used.
4. When pinion adjusting shim thickness is increased.

Fig. 147. Pressing Front Bearing in Place Using Old Spacer as a Press Tool

Pinion Bearing Preload

1. Oil the leather and coat the outer diameter of the oil seal with Permatex No. 3 or similar compound and install the seal (J-2935 Rear Pinion Bearing Installing Plate can be used against the face of the seal while tapping it into place.) Press on

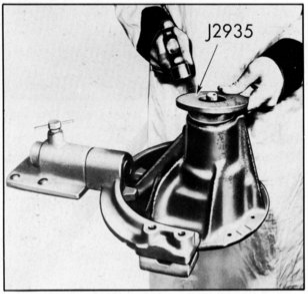


Fig. 148. Tapping Pinion Bearing Oil Seal into Place

the companion flange and install nut after oiling thread and washer-face of nut. Take care not to use an excess of Permatex Sealer, as it will damage the front pinion bearing. (Fig. 148)

CAUTION – Extreme care must be used while tightening companion flange nut to preload the bearing after companion flange contacts the spacer. If specified maximum preload is exceeded, it will be necessary to install a new spacer. It is also important to rotate the pinion several revolutions during preloading operation. Normally, ½ to 1¼ turns of the nut will be required to compress a new spacer and preload bearings. Spacers once compressed will require less tightening.

2. Tighten the companion flange nut until

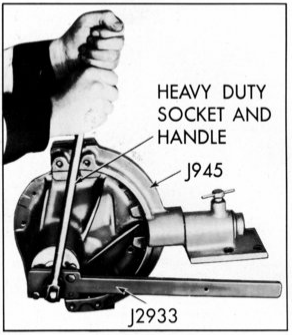


Fig. 149. Tightening Companion Flange Nut

flange is felt to contact spacer. This will take up most of the end play in the bearings. (See Fig. 149)

3. Continue to tighten nut carefully, not more than 1/6 turn at a time, then remove 1" socket, turn pinion several revolutions to seat rollers, and check friction with an inch pound torque wrench or spring scale J-544-A. Repeat tightening and checking, until preload friction to turn the pinion in the bearings and oil seal is 27 to 37 inch

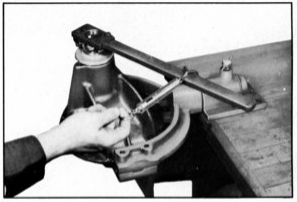


Fig. 150. Measuring Preload with Spring Scale

pounds for new bearings, or 15 to 20 inch pounds for bearings that have several thousand miles or more use. (Figs. 151 & 152)

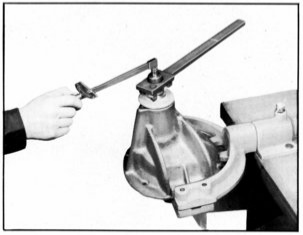


Fig. 151. Measuring Preload with Torque Wrench

4. Stake the end of the pinion gear into the recesses on the head of the nut after the desired preload has been obtained. (See Fig. 152)

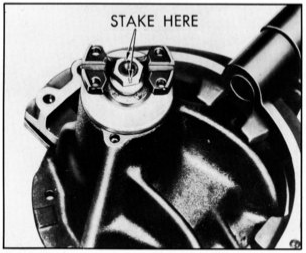


Fig. 152. Staking Pinion Shaft Nut

Use of Spring Scale J-544-A

Torque measurements can be taken with the steering gear adjustment spring scale. With the scale hooked onto the Companion Flange holding tool (J-2933) at a point ten inches (10") from the pinion shaft center, readings in pounds times ten (10) will give inch pounds. For instance, three (3) pounds on the spring scale will indicate 30 inch pounds. Readings between the pound graduations must be interpreted in tenths of a pound, i.e., 3 pounds, 8 ounces, equals 3.5 pounds and such a reading indicates 35 inch pounds. Spring scale readings for new bearings should be 2.7 to 3.7 pounds. Properly preloading bearings with several thousand miles or more should give a spring scale reading of 1.5 to 2 pounds.

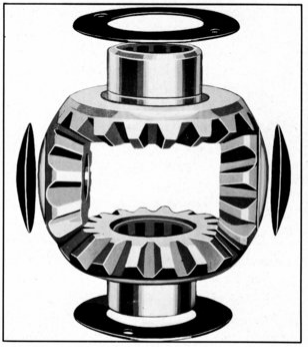


Fig. 153. Side Gears, Pinions, and Thrust Washers

NOTE—Hypoid ring gears and pinions are matched in sets at the factory and serviced only in sets. Do not attempt to replace either the gear or pinion without its mating member.

Cap screws used in attaching the ring gear to the differential case are made of special alloy steel and heat treated for the particular use. Do not use common screws as substitutes. Always use new heavy type lock washers under these screws when occasion requires removal of the screws.

Installing Assembly into Carrier Case

1. Install the differential side gears and pinions after thoroughly oiling all the surfaces, including the thrust washers. Tighten the differential pinion (cross) shaft lock screw securely.
2. With the differential bearing outer races held squarely over the bearing rollers, lower the differential case and ring gear assembly into the carrier cross bore, engaging with the pinion teeth. Move the ring gear toward the pinion until the backlash is just taken up, and place the adjusting nuts (right hand part on right hand side as previously marked) squarely against the bearing outer races and into the threads of carrier pedestals. Rotate the adjuster nuts until they are snug against the bearing, and install the bearing caps as marked. They will seat neatly against the carrier pedestals if the adjusting nuts are properly seated, threads not crossed, or caps interchanged. Draw down the cap screws only sufficiently to lightly hold the caps in place while adjusting the bearing nuts.

NOTE—Unless a change of ring gear and pinion adjustments has been required, new parts installed, or differential bearing adjustments altered, the adjusting nuts will be in the original position as marked and the backlash will agree with the measurements taken at disassembly.

Adjusting Side Bearing Tension

With the caps tightened down, check the adjusting nuts to be certain that they are not clamped too tight to be turned. If the adjusting nuts cannot be turned, the threads are crossed or caps are adjusted too tight. Make the necessary correction, and recheck.

NOTE—Whenever new parts, i.e., gear set, bearings, etc., are installed, the markings to indicate the original positions of gears and bearings must be disregarded.

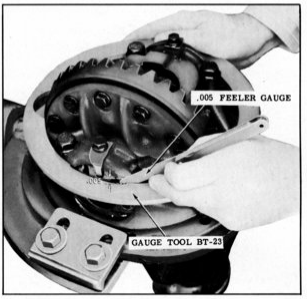


Fig. 154. Adjusting Pedestal Spread—88 and 98 Series

To adjust differential side bearing tension and gear backlash, proceed as follows:

1. Back off right hand adjusting nut (one opposite ring gear) four turns.
2. Tighten the left hand adjusting nut against the bearing race, removing all lash between

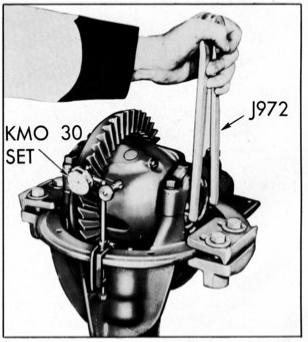


Fig. 155. Adjusting Differential Side Bearing Caps and Checking Backlash

ring gear and pinion. Then back off four notches, leaving slot in adjusting nut in line with lock cap screw hole in bearing cap.

3. Tighten right hand adjusting nut, watching race of bearing. When bearing race starts to turn, indicating tension on bearing, continue to tighten two to four notches, align slot in nut with hole in bearing cap.
4. Tighten bearing cap bolts 70 to 75 ft. lbs.
5. Clamp indicator to differential carrier and check backlash. (See Fig. 155) Backlash should be not less than .004" nor more than .008".
6. If necessary, loosen bearing cap bolts and adjust bearing nuts by turning nuts right or left to obtain correct lash; always moving right and left adjusting nuts an equal number of notches.
7. Again tighten pedestal caps 70 to 75 ft. lbs. and check lash.

   NOTE—The above procedure, steps 1 through 7, completes the side bearing tension adjustment on 76 series cars (non-piloted differentials). The following steps, 8 through 10, will be necessary in addition to the first seven steps in order to complete the bearing tension adjustment on 88 and 98 series cars (piloted differentials) in order to provide proper pedestal spread.

8. Position gauge tool No. BT-23 over pedestal caps as shown in Fig. 154.
9. Clearance must be .005", between gauge tool No. BT-23 and machined surface of pedestal cap.

NOTE—If clearance is not .005", loosen the right hand side bearing cap bolts (opposite ring gear) and adjust nut (loose or tight) one notch at a time and check each time to obtain .005" clearance.

Be sure bearing cap bolts are tight each time clearance is checked.

DO NOT TIGHTEN ADJUSTING NUT MORE THAN FOUR (4) NOTCHES NOR LESS THAN TWO (2) NOTCHES.

If it is impossible to obtain proper clearance (.005") within the 2 to 4 notch adjustment range, the position of pedestal caps may be varied a small amount by loosening the pedestal bolts slightly and tapping the caps lightly in the desired direction with a soft hammer.

The adjustment of the pedestal supported differential is correct when:

(a) Pinion shaft has been set to proper position and has the required 27 to 37 inch pounds torque with pinion shaft nuts staked.

(b) Bearing cap bolts are tightened 70 to 75 ft. lbs.

(c) Backlash between pinion and ring gear is .004" to .008".

(d) Tension on side bearings is 2 to 4 notches tight.

(e) Clearance between gauge tool BT-23 and pedestal cap is .005".

Installation of Differential Carrier Assembly into Housing

1. Thoroughly wash the interior of the rear axle housing with clean gasoline or kerosene and wipe dry to remove all metal particles. The surfaces of the carrier and housing should be cleaned and a new gasket installed.
2. Assemble the carrier to the housing, pulling up the screws evenly and securely.

   NOTE—On eight cylinder cars, it will be necessary to install three pilot studs (Tool BT-24) as shown in Fig. 156, install 4 temporary bolts and remove the pilot studs; after which the remaining bolts can be installed and tightened to specified torque.

3. Assemble the rear axle shafts.

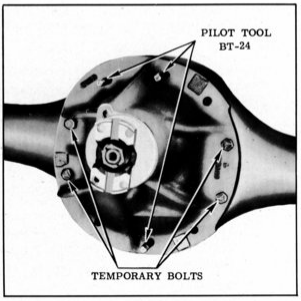


Fig. 156. Installing Machined Carrier into Axle Housing

4. With car setting level, fill the rear axle housing to filler plug level with new SAE 90 Multi-Purpose Hypoid Lubricant suitable for passenger car duty. All lubricants should be stored in a clean and closed container.

   NOTE—If new gears or a new carrier assembly is installed, the factory extreme pressure lubricant, furnished, must be used.

5. Connect the propeller shaft at the rear universal joint flange.

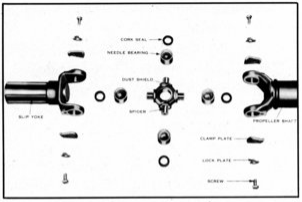


Fig. 157. Universal Joint Details (Screw and Clamp Plate Type)

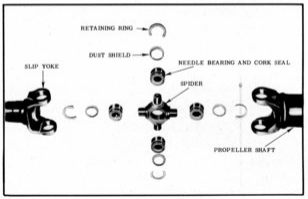


Fig. 158. Universal Joint Details (Lock Ring Trunion Retainer Type)

6. Road test, observing for rear axle noise.

If rear axle noise is present and is not within the standards as outlined under DIFFERENTIAL GEAR NOISE, make corrections as instructed under DRIVE NOISE, COAST NOISE, or FLOAT NOISE, depending upon the nature of the noise.

If gear noise can not be adjusted out with the use of shims, it will be necessary to install a new set of gears.

Propeller Shaft

Two types of propeller shafts are used in the 1949 models. One type differs from the other in the method of holding the needle bearing assembly in place. These two type propeller shafts are as follows:

1. The screw and clamp plate type (See Fig. 157)
2. The lock ring trunnion retainer type (See Fig. 158) With this type propeller shaft the needle bearing assemblies are held in place by a lock ring which snaps into a machined groove in the needle bearing assembly.

These two type propeller shafts are interchangeable; that is, the screw and clamp plate type propeller shaft may be installed in a model that has a lock ring trunnion retainer type as follows:

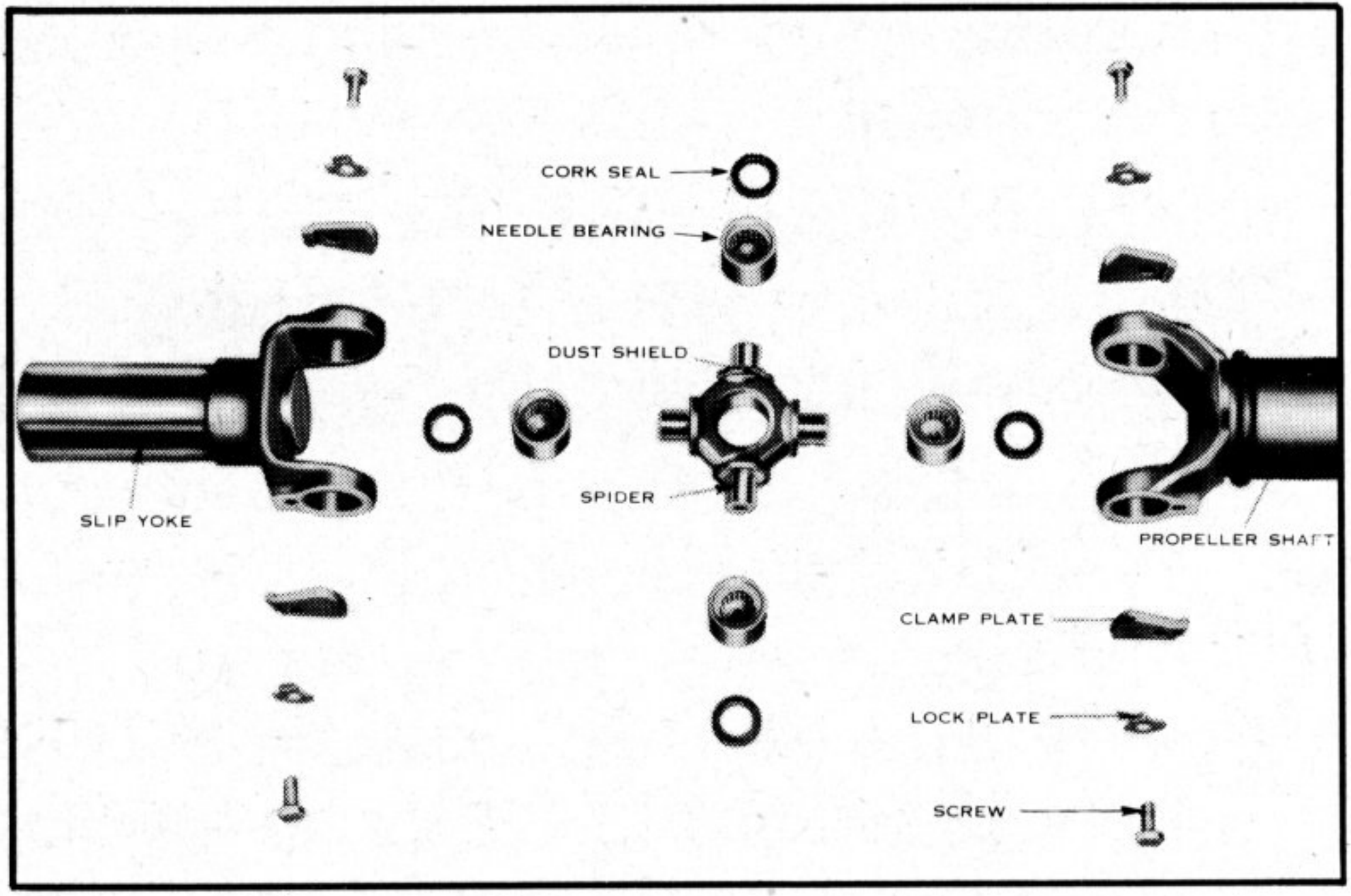


Fig. 157. Universal Joint Details (Screw and Clamp Plate Type)

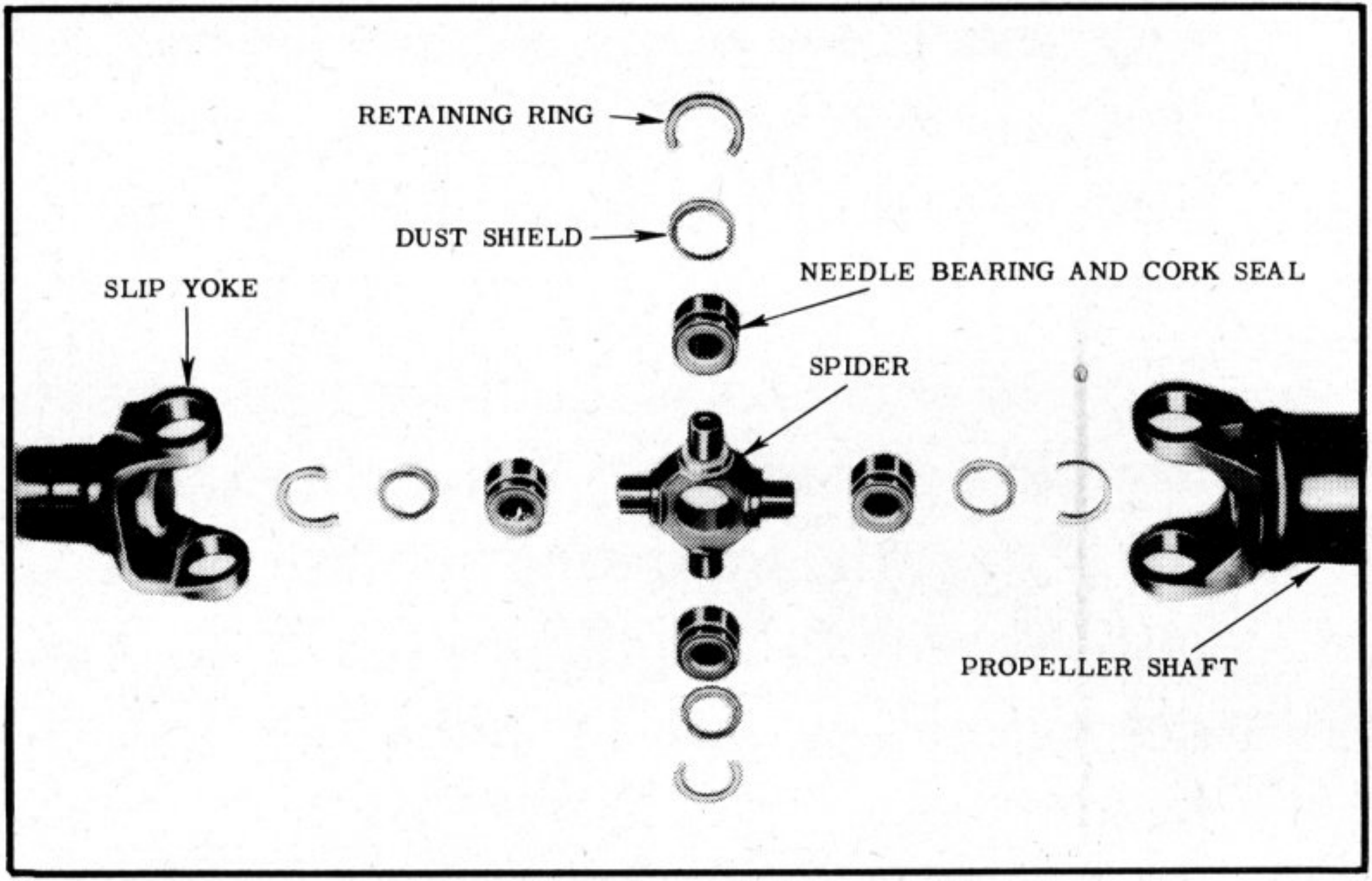


Fig. 158. Universal Joint Details (Lock Ring Trunion Retainer Type)

1. As a propeller shaft assembly complete with slip yoke.
2. A slip yoke of the lock ring trunnion retainer type may be installed on a propeller shaft with a screw and clamp plate trunnion or vice versa, providing the complete slip yoke—that is, complete with needle bearing—is installed. Where an interchange of this kind is made, two of the needle bearings will then be retained by means of the lock rings and two by means of the clamp plates.

In addition to the two types of shafts, three different size propeller shaft assemblies of either type are used as follows:

1. 2-¾" diameter, 56-7/8" length, used on all 76 series cars.
2. 3" diameter, 58-½" length, used on all 88 series cars.
3. 3" diameter, 59-15/16" length, used on all 98 series cars.

The slip yoke is at the transmission end ahead of the universal joint on all models, regardless of the type of propeller shaft or transmission.

Since the slip yoke is ahead of the front universal joint, it can be assembled to the transmission in any position.

UNIVERSAL JOINT

The joint construction consists of a splined flange and slip yoke assembled into a rigid unit consisting of a steel forged spider and four needle bearing assemblies.

Each journal of the spider is drilled to provide an oil reservoir which is filled with G.M. 4618-M when assembled at the factory. Additional lubrication should not be required for 20,000 to 30,000 miles.

Each needle bearing assembly consists of bearing rollers, which are held in place by a metal retainer and cork gasket providing an efficient seal against leakage of the lubricant or dirt getting into the bearing. The retainer also prevents the rollers falling out when the joint is disassembled.

Two of the needle bearing assemblies at the differential end of the propeller shaft also have integral driving keys which link with driving key slots in the differential companion flange. The two needle bearing assemblies are held in place by two cap screws and a lock plate. The other needle bearing assemblies at both ends of the shaft are assembled directly into the yoke and held in place by means of a clamp plate lock-washer and cap screw on one type of shaft, and by a lock ring which snaps into a machine groove in the needle bearing assembly on the other type of shaft.

Since the slip yoke is at the transmission end and receives its lubrication from the transmission, a lubrication fitting is not necessary.

Propeller shafts are dynamically balanced with joints assembled.

Disassemble Universal Joint

It will seldom be necessary to disassemble the universal joint. However, when joint is disassembled, all parts should be thoroughly washed and the reservoir in each journal of the spider filled with Universal Joint Fibrous Grease G.M. 4618-M before the joint is reassembled. New cork packing should be used at each bearing assembly when reassembling the joint.

To remove propeller shaft assembly, disconnect the propeller shaft at the axle end and slide the slip yoke and propeller shaft backwards.

Before disassembling universal joint, mark needle bearings, propeller shaft, and slip yoke so that all parts, even though some may be new parts, may be reassembled in their respective positions.

1. To remove the roller bearing assemblies that are assembled directly into the yoke:
   a. Remove locking plates and clamp plates or lock ring.

b. Push one roller bearing assembly toward spider, thus forcing out opposite bearing assembly.
c. Reverse, pushing on spider to remove other roller bearing assembly.
d. It may be necessary to remove one dust shield from spider to remove spider from yoke.

Assemble Universal Joint

Reverse above procedure.

CAUTION—When reassembling:

1. Use new lock plates and be sure the ears on plates are turned up against head of bearing assembly cap screws.
2. When installing slip yoke to transmission main shaft, apply a small amount of chassis lubricant (tablespoonful), to the splines to provide initial lubrication. Also see that the surface of yoke where transmission oil seal contacts is smooth—always use new seal.

Chassis Rear Suspension

Coil spring suspension is used on the rear of all models. The design of the rear suspension which is essentially the same as was used in 1948, consists of two coil springs, two rear axle support arms, a track bar and suitable attaching parts.

The coil springs act in a carrying capactiy only, and the rear axle support arms take all of the driving and braking torque. Stabilization is provided by mounting the arms several inches apart at their front end and by a rear stabilizer bar.

CAUTION—When servicing rear suspension, it is sometimes necessary to take weight off springs by means of a jack under car frame and to disconnect shock absorbers. Whenever either springs or shock absorbers, or both, are disconnected, the brake hose should be disconnected at the rear axle and the propeller shaft should be removed. It will be necessary to bleed both rear wheels when hose is connected.

This is important since in the one case the flexible brake hose connection may be strained resulting in a leak, and in the other, the propeller shaft will strike the support arm bracket at the frame cross member, denting the propeller shaft and causing it to be out of balance.

CHASSIS REAR SPRINGS

The rear coil springs are attached at their upper end to the frame cross member and at their lower end to the rear axle insulator assembly and rear axle support arms behind the axle by means of a clamp and bolt at each end of the spring. A composition washer is used to insulate the spring from the frame at its upper end.

NOTE—The rear coil springs are not interchangeable with the front coil springs, nor between the various models due to different loads and rates.

Spring Identification

Springs may be identified by a daub of paint, or the part number which is stamped on the outside of one of the end coils. Since either end of the rear spring may be installed to the top, (see item 1, REPLACE REAR COIL SPRING) the part number may be either top or bottom and it will usually be necessary to remove the spring to see the part number. Car models with their corresponding paint color identification are listed in the specifications.

Remove and Replace Rear Coil Spring

1. Disconnect the brake hose at the axle.
2. Disconnect propeller shaft at differential and remove.
3. Disconnect both shock absorber arms from links.

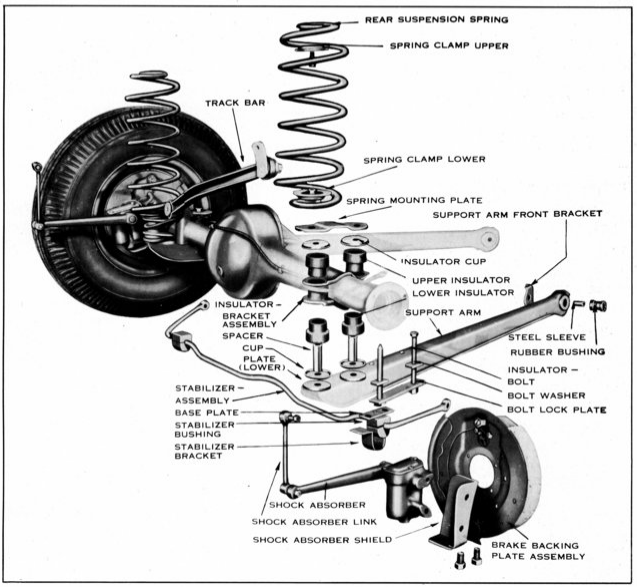


Fig. 159. Rear Suspension Details

4. Remove spring bolt (upper) and axle housing insulator bolt (rear).
5. Take car weight off springs and remove spring.

To replace or install new springs, reverse sequence of above operations and note:

1. The ends of both end coils of the rear coil springs are curled, but due to manufacturing variation, the end of one of the end coils may have a straight portion, the opposite end being curled. The coil with the straight portion should be assembled to the top. If both ends are curled, either end may be installed to the top. In either case, the spring must be mounted on the mounting plate so that the curled end of the coil is to the rear and 1/16″ to the right of a center line through the rear axle support arm. (See Fig. 160)
2. The spring lower clamp contains a grom-

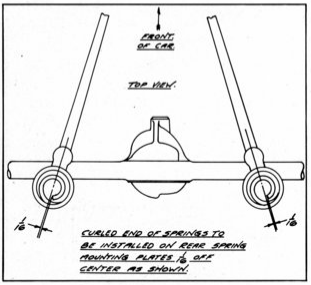


Fig. 160. Positioning Rear Coil Spring.

met nut, the upper clamp does not, the grommet nut being in the frame side rail.

3. The spring upper clamp and composition washer may be more easily installed if these parts are temporarily taped to the spring, then place the spring in position and line up the holes in the clamp and frame. Let weight of car down slightly to hold spring in line while installing upper spring bolt.

   CAUTION – Both upper and lower clamps act as a clamp due to their cam shape. (See Fig. 161) Be sure that they seat snugly in the spring coil, top and bottom. Be sure coil spring is not riding on raised portion of mounting plate, appearing to be tight when it is actually binding.

   Upper rear spring clamps are new for 76 and 88 series cars and are not interchangeable with 98 series clamps.

4. Be sure that brakes are bled after brake hose is connected.

REAR AXLE SUPPORT ARMS

Two rear axle support arms extend from behind the rear axle to the frame X member section, and are attached at their rear end to the outer end of the axle housing by two axle housing insulator bolts. The support arms are insulated from the axle, by rubber insulators, to prevent road noises from being transmitted to the car. They are attached at their front end to a section of the frame back of the frame X member center by means of suitable brackets and rubber bushings. The arms are permitted movement up and down by a rubber pivot bushing which is secured to the frame by means of a bolt and mounting brackets.

Rear axle support arms are not interchangeable, right and left; however, the same support arms are used on all models.

Axle Housing Insulators and Bolts

The same axle housing rubber insulators are used on each side and on all models. The upper half of the insulator, however, is different from the lower half and may be identified by the visible difference in size (the over-all length of the upper is greater than the lower) and the words "upper" and "lower" molded in the rubber. Upper and lower insulators should never be interchanged.

The axle housing front insulator bolt is 5¾" long and has a right hand thread. The axle housing rear insulator bolt is 6" long and has a left hand thread. The same bolts are used on

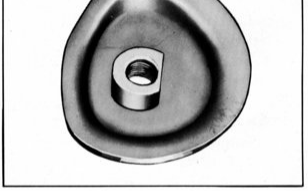


Fig. 161. Spring Lower Clamp

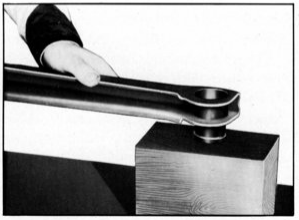


Fig. 162. Installing Support Arm Rubber Bushing

each side on all models. The hexagon head of the rear bolt is to the bottom while the hexagon head on the front bolt is to the top.

NOTE—Always pull insulator bolts down evenly and tightly. Never completely tighten the front bolt before tightening the back or vice versa. (See Torque Specifications).

Remove and Replace Rear Axle Support Arm, Axle Housing Insulators, Plates, and Spacers

Either rear axle support arm may be removed by removing the insulator bolts, both front and rear, and disconnecting the support arm where it is attached to the frame at the front end of the arm.

The various parts of the insulator assembly may be removed as follows:

1. Disconnect brake hose at axle.
2. Disconnect propeller shaft at differential and remove.
3. Disconnect shock absorber arms from links.
4. Raise car weight off springs.
5. Remove both front and rear insulator bolts.
6. Push lower end of coil spring out of way, as necessary, permitting removal of insulators, insulator plates, cups or spacer.

To replace, reverse sequence of above operation and note:

1. The insulator mounting plate is smaller at one end that at the other. The big end of the plate is the spring end.
2. Place insulators, mounting plate, spacers, bolts, cups and lower end of coil spring in position. Let car weight down (partially) and use jack under the support arm, if necessary, to help compress the rubber insulator and make installation of insulator bolts easy.
3. Always position rear coil spring correctly as shown in REMOVE AND REPLACE REAR COIL SPRING. (Fig. 160)
4. Be sure coil spring is not riding on raised portion of mounting plate, making it appear securely clamped down when it is actually binding.
5. Be sure that brakes are bled after brake hose is connected.

TRACK BAR

The track bar is mounted on rubber bushings, which do not require lubrication, and is anchored at one end to the axle and at the other end to the rear intermediate frame cross member and frame side rail by means of two separate brackets and an integral anchor pin and self locking nut. (Fig. 163)

The track bar used on 98 series cars is of different length from that used on the 76 and 88 series cars and they cannot be interchanged.

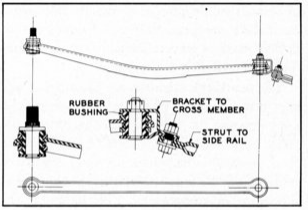


Fig. 163. Track Bar Detail

Remove and Replace Track Bar

1. Disconnect bar at axle end by removing nut and, by suitable means, prying forward to loosen serrated bolt.
2. Disconnect track bar from frame cross member bracket and frame side rail bracket.
3. Rotate plate on frame end of track bar as required and remove.
4. To replace, reverse sequence of operations, tightening nuts to required specifications.

STABILIZER

Interconnected between the frame side rails ahead of the axle on all models is a special heat-treated spring steel stabilizer, which, through torque reaction, tends to decrease the rolling action of the car on turns and irregular road surfaces.

The stabilizer is mounted in rubber bushings to the under side of each rear axle support arm and attached to the frame side rail by Wahl type connecting links. This mounting and linkage provides complete rubber insulation between the metal parts.

Shock Absorbers—Rear

Delco, double-acting (cylinder to cylinder discharge), parallel cylinder type shock absorbers are used at the rear of all models.

The rear shock absorbers are similar in design to those used in the front except the valves controlling compression and rebound are in drilled passages which interconnect the cylinders to give slightly faster action.

The rear shock absorbers are mounted on the rear brake backing plates by cap screws, the arms extending to the rear and attaching to the frame by means of non-adjustable links. In the front shock absorber, the arm moves downward on rebound; whereas on the rear, the arm moves downward on compression. This is due to the difference in mounting.

Shock Absorber Valving

Under no circumstances should the valving be changed from factory recommended specifications unless authorized to do so by factory technical bulletins.

Shock absorber valve specifications always list the rebound valve first, followed by the compression valve specification. For example, in the specification reading .80M—.40Cd2, the .80M is the rebound valve calibration and .40Cd2 is the compression valve.

The rebound valve assembly is at the bottom of the shock absorber. The compression valve assembly is at the front side.

In addition to the difference in number and location, identification of the rebound or compression valve assembly is possible due to the difference in appearance. (See Fig. 164) The hex of one of the shock absorber valve nuts is shorter than the other. The short valve nut goes with the rebound valve.

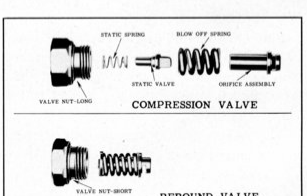


Fig. 164. Rear Shock Absorber Valves

Rear Shock Absorber Service

The rear shock absorber should not be disassembled as the internal parts, the pistons, piston springs, cam, and intake valves are not removable and, therefore, cannot be serviced. The only serviceable parts of the rear shock absorber are as follows:

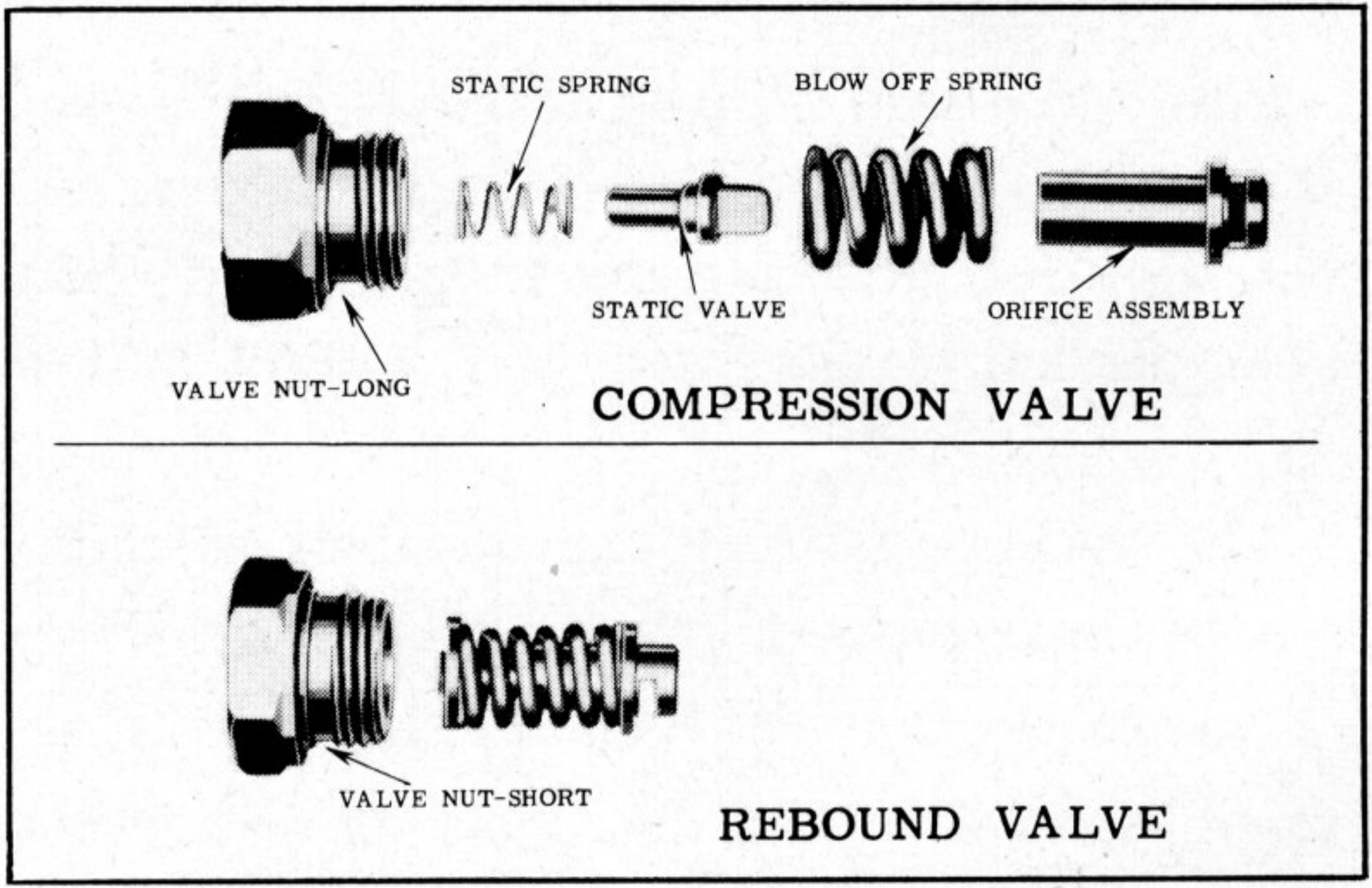


Fig. 164. Rear Shock Absorber Valves

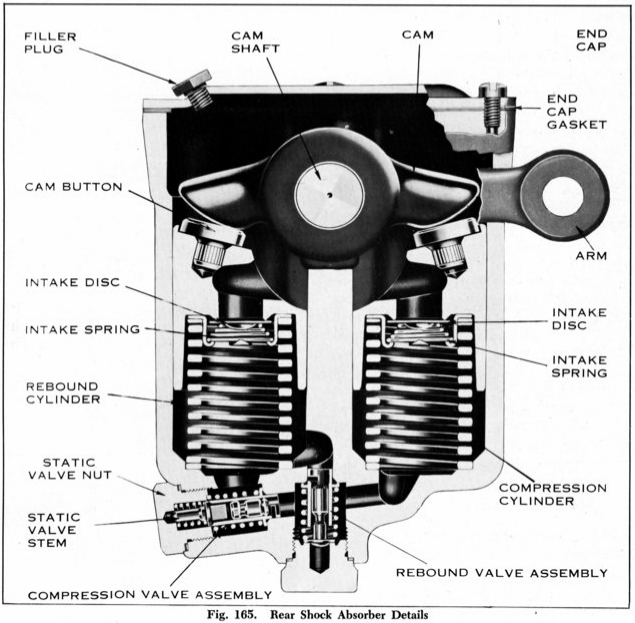


Fig. 165. Rear Shock Absorber Details

Cover
Cover Gasket
Cover Screws
Rebound Valves
Compression Valves
Valve Nuts and Gaskets
Filler Plug

If replacement of a piston, intake valve, etc., becomes necessary, or if outside of shock body shows evidence of appreciable leakage of oil at shaft bearing, complete shock absorber replacement will be necessary.

Filling Rear Shock Absorber

The practice of filling rear shock absorbers at periodic mileages is *not* recommended. These units are filled at the factory to the proper level and should ordinarily operate for the normal life of the car without further attention.

If mechanical replacement of parts, such as

valves or gaskets, is necessary, the unit should be filled with Delco Shock Absorber Fluid after the shock absorber is serviced.

The filler plug hole is to the front and, since the shock absorber is set at an angle, the front of the shock absorber is the highest point. Filling the shock absorber (completely) to the filler plug hole may result in a blown cover gasket, as the fluid will expand due to temperature change.

To provide room for fluid expansion, the shock absorber must not be filled completely; but to within 23/32" of the filler plug opening when the shock absorber sets at a 15 degree angle, filler plug opening at the top.

Correct fluid level of the rear shock absorber (when mounted on backing plate) is obtained by the use of shock absorber gun K.M.O.-1026 and Adapter J-1611 as follows:

1. Fill the shock absorber completely until fluid is level with filler plug hole.
2. Using Adapter J-1611 on shock absorber gun, draw off as much fluid as possible. The fluid level is now correct.

   NOTE—If shock absorber is removed for servicing check fluid level as above after reinstalling.

Remove and Replace Rear Shock Absorber

1. Jack up rear end.
2. Remove the wheel and brake drum.
3. Disconnect brake hose at rear axle and disconnect shock absorber arm.
4. Remove shock absorber and shield.

To replace, reverse sequence of operation and:

1. Use torque wrench when installing shock absorber (See Torque Specifications.)
2. Due to variation, it may be necessary to spread shoes slightly to get "socket" on bolt head.
3. Bleed brake.

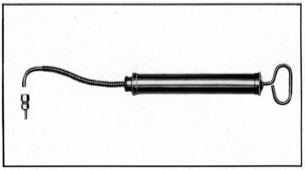


Fig. 166. Shock Absorber Gun and Adapter

SHOCK ABSORBER LINK

The link connecting the rear shock absorber arm to the frame is the non-adjustable type. The pin at the bottom of the link has a tapered S.A.E. connection to the shock absorber arm and a non-adjustable rubber bushing between pin and the link. Torsional movement between the link and the arm is taken up by the tightening of this rubber bushing. The upper end of the link uses rubber (Wahl) blocks with the nuts at the upper end of the link tightened to the limit of the threads.

Remove and Replace Shock Absorber Link

1. Disconnect brake hose at rear axle.
2. Disconnect shock link at bottom.
3. Holding nut on top of link, turn link to remove.
4. When replacing link, take up nut the limit of the threads.
5. Bleed brake.

REAR END SUSPENSION SPECIFICATIONS—1949 MODEL

	76	88	98
1. REAR AXLE			
a. Tread	59″	59″	61½″
b. Road Clearance (at Differential)	8⅛″	8 9/32″	8 9/32″
c. Allowable Out of True of Housing on the Vertical	1/32″	1/32″	1/32″
Allowable Out of True of Housing on the Horizontal	1/16″	1/16″	1/16″
d. Pinion Bearings (Front & Rear) Type	Taper Roller	Taper Roller	Taper Roller
e. Differential Side Bearing—Type	Taper Roller	Taper Roller	Taper Roller
f. Rear Wheel Bearings—Type	Shielded Ball	Shielded Ball	Shielded Ball
g. Oil Capacity	3¾ lbs.	3¾ lbs.	3¾ lbs.
2. PROPELLOR SHAFT			
a. Length: Between Center Line of Joints—Syncro-Mesh	56⅞″	.....	.....
b. Outside Diameter—Syncro-Mesh	2¾″	.....	.....
c. Length—Hydra-Matic	56⅞″	58½″	59 15/16″
d. Outside Diameter—Hydra-Matic	2¾″	3″	3″

REAR COIL SPRING CHART

	417865	557585	1310399	415472	416401
MODEL	76 & 88 Club Coupe and Club Sedan	76 & 88 Conv., Sed., and Town Sedan	76 & 88 Station Wagon	98 Club Sed.	98 Sed. and Convertible
INSIDE DIA.	5½″	5½″	5½″	5½″	5½″
IDENTIFICATION COLOR	Green-Orange	Yellow-Brown	Red	Green-Yellow	Green-Gray
DIA. OF WIRE	.540″	.540″	.619″	.587″	.587″

REAR SHOCK ABSORBER CHART

MODEL	76	88 ex. DSW	88 DSW	98
Model—R. H.	2105-N	2105-N	2105-N	2105-E
L. H.	2105-P	2105-P	2105-P	2105-F
Rebound Valve	.80M	.90J	.80M	.80M
Compression Valve	.40 Cd2	1.5 Cd2	.40 Cd2	.40 Cd2

BRAKES

All 1949 model Oldsmobiles are equipped with Duo-Servo, single anchor hydraulically actuated brakes which are fundamentally the same as those used on previous models.

The master brake cylinder is located underneath the hood and on the left chassis frame front extension.

The 76 series cars use 11″ x 2″ brakes on the front and 11″ x 1¾″ brakes on the rear. The 88 and 98 series cars both use 11″ x 2½″ brakes on the front and 11″ x 2″ brakes on the rear.

The brake adjustment is the same on all models. See BRAKE ADJUSTMENT.

The brake system comprises, (1) a self-contained brake assembly for each wheel with the necessary brake shoe anchors, retaining springs, adjusters and wheel cylinders for applying pressure to the two brake shoes. (2) The Hydraulic system, which consists of the master cylinder, wheel cylinders and necessary pipes and conduits for transmitting the liquid from the master to the wheel cylinders. (3) A parking brake on the rear wheels with suitable cable connections from the hand brake lever to the brake shoes. (4) A brake pedal for applying necessary pressure to the Hydraulic system to stop the car.

Two brake shoes are used in the brake assembly of each wheel. The forward shoe is known as the "primary" and the rear shoe as the "secondary." These shoes are drawn at the upper end against the anchor pin by tension springs, but are free to float at the lower end and are held in definite relationship to each other by an adjusting screw and its tension spring. The parking brake is applied through the same rear wheel primary and secondary shoes which are actuated hydraulically for the service brake. The parking brake, however, is separate and distinct from the service brake in that it is mechanically controlled through the hand brake lever under the instrument panel, and has its own levers within the rear brake assemblies.

Fig. 167. Rear Brake Seal

When pressure is applied to the brake pedal of a forward moving car equipped with Duo-Servo brakes, the primary shoes first depart from the anchor pins, picking up rotative energy from the brake drums, which they transmit to the secondary shoes through the adjusting screws. The force originally applied by the driver is thus substantially increased by this self-energizing action.

It is therefore evident that a car equipped with Duo-Servo brakes requires far less effort on the part of the driver to make a given stop than that required to make the same stop with a car not so equipped.

When the car is braked while traveling in a backward direction, the same action takes place except that the secondary shoes function as primaries, and the primaries as secondaries.

When a car is being slowed down by the brakes, a transfer of weight takes place from the rear to the front wheels, and the quicker the stop, the greater the transfer of weight. In order to equalize as nearly as possible the braking effort on the front and rear wheels, larger hydraulic wheel brake cylinders are used for the front than for the rear wheels.

The brake drums are of cast iron which not only increases brake lining life, but also furnishes an ideal braking surface.

A double dirt seal is used on all brakes between the brake backing plate and the drum. The outer section of the backing plate is depressed, and a flat flange, fitting very close to the drum, is welded to the backing plate. Thus, any water or dirt thrown off the drum, due to centrifugal force, falls into the depression between the backing plate and the flange and out of the brake assembly.

The dirt seal on the front wheel brakes of the 88 and 98 series cars is a circular flange which is an integral part of the front wheel backing plate.

An additional semi-circular flanged dirt guard is welded to the rear backing plates.

The possibility of any oil dripping onto the braking surfaces is prevented by a sump in the stamped rear wheel bearing retainer which catches any small amount of oil which might leak past the bearing.

The brake pedal is attached to the master cylinder push rod clevis by means of a clevis pin with a cotter pin. The engagement between the pedal and clevis would be maintained, however, even though the clevis pin might be lost. This extra safety factor is provided by means of the "duck bill" shape of the brake pedal end and the special shape of the opening in the master cylinder clevis. (See Fig. 174)

PARKING BRAKE

The mechanically controlled parking brake operates on rear wheels only. The hand brake lever is mounted to a bracket on the inside of the cowl.

A flexible cable enclosed in a metal conduit connects the hand lever to an intermediate lever located at the rear of the center point of the frame "X" cross member.

Two flexible cables enclosed through part of their length in conduits, and an equalizer link connect the intermediate lever to the right and left rear brakes. (See Fig. 168)

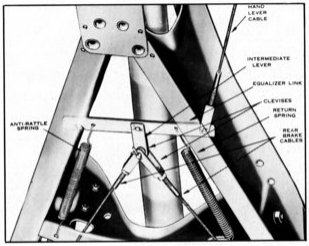


Fig. 168. Parking Brake Linkage

The equalizer link pivots at one end on the intermediate lever, the operating cables being attached to the other end. The link is free to swing about its pivot, thus providing equal braking effort on both rear wheels.

Adjustment of the cable between the parking brake lever and the intermediate lever will seldom be necessary. A clevis, however, is provided at the intermediate lever end for making adjustment in production. "Slack" which in some cases may develop in this cable, can be removed by adjusting the clevis so that the pin will just enter clevis and intermediate lever freely.

For parking brake adjustment, see "Brake Adjustment".

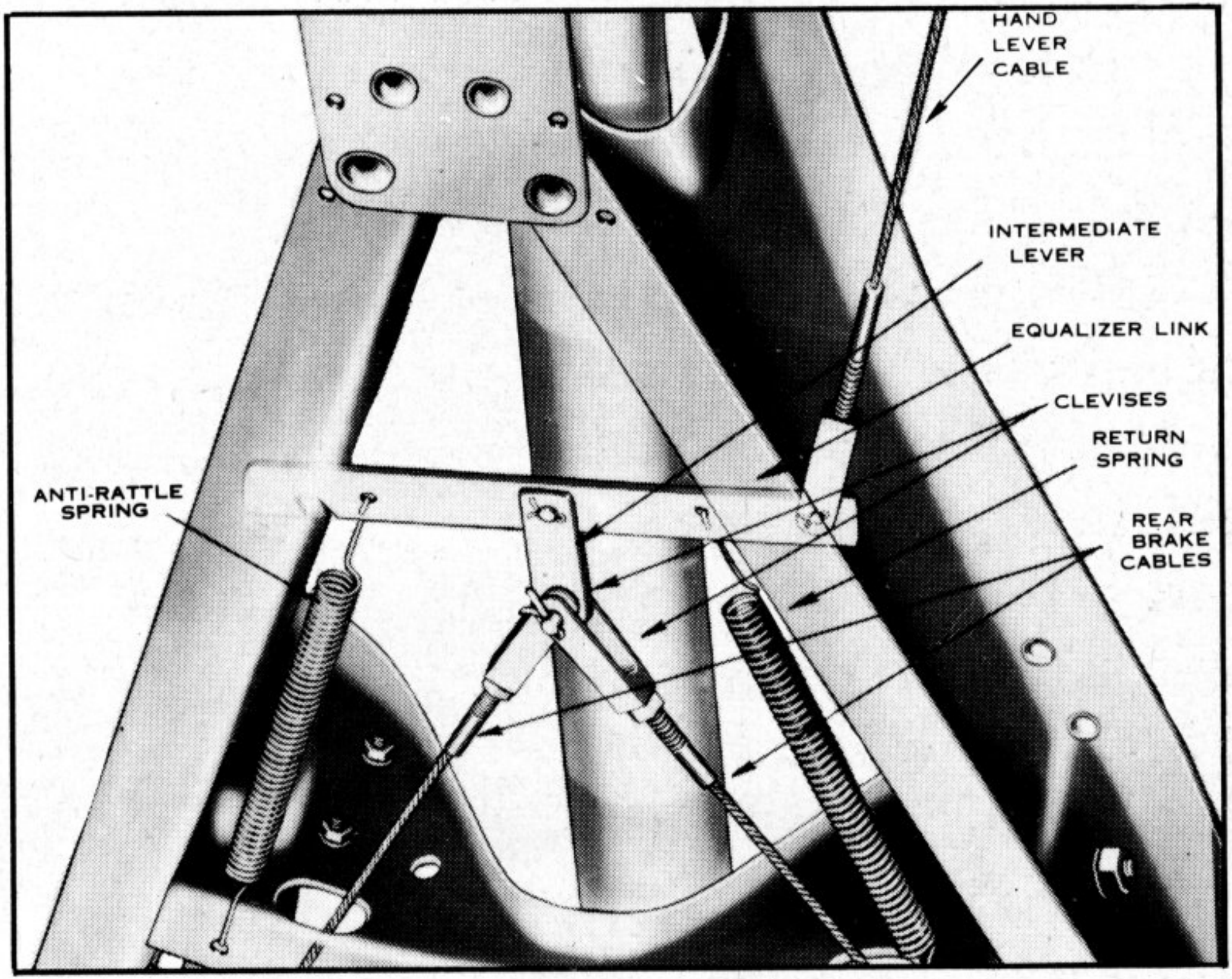


Fig. 168. Parking Brake Linkage

HYDRAULIC SYSTEM

The hydraulic system consists of: (1) a master cylinder in which hydraulic pressure is originated; (2) a reservoir integral with the master cylinder which stores a supply of fluid for keeping the operating fluid at a constant volume; (3) a wheel cylinder in each brake to receive the pressure from the master cylinder and transmit the force to the shoes; (4) The "lines" consisting of tubing, flexible hose, brackets and unions, interconnecting the master cylinder and the wheel cylinders.

The master cylinder is fitted with a piston and each wheel cylinder with two pistons. All these pistons are provided with rubber cups to seal against loss of brake fluid pressure.

HYDRAULIC BRAKE OPERATION

When the brake pedal is depressed, fluid is forced from the master cylinder through the lines to the wheel cylinders to cause their pistons to move apart bringing the shoes into contact with the brake drums. The instant all shoes contact the drums, pressure build-up begins.

Due to the fact that the same pressure exists at all points of any hydraulic system, the unit pressure on the master cylinder piston also exists on all wheel cylinder pistons; the brake system is thus self-equalizing.

Because brake fluid is incompressible, pressure may be held as long as required without additional pedal travel.

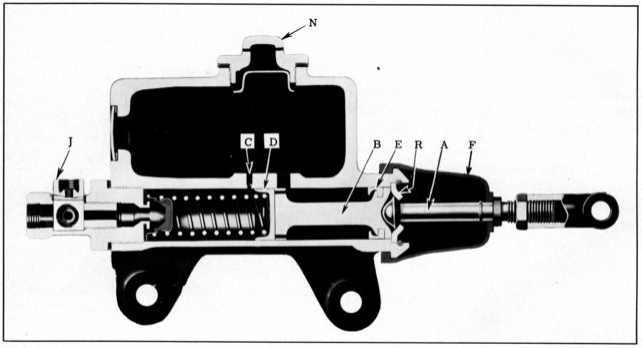


Fig. 169. Master Cylinder Details

When the pressure on foot pedal is released, the return springs on brake shoes retract and return wheel cylinder pistons to their normal or "off" position, forcing the brake fluid back through the flexible hoses and tubing into the master cylinder and its supply tank.

MASTER CYLINDER

The master cylinder, located on a bracket on the main frame underneath the hood on the left side of the engine has, as was mentioned pre-

viously, a supply tank cast integral over the master cylinder proper.

The function of the supply tank is to maintain a constant volume of fluid in the system at all times, regardless of expansion from heat or contraction from cold. When the brake system is refilled after bleeding, the supply tank stores fluid which is pumped into the lines by stroking the master cylinder.

The return to "off" position of piston "B" and cup "D", (Fig. 169), is much faster than the return of the fluid through fitting "J" into the master cylinder. A momentary vacuum is created in the cylinder barrel and additional fluid is drawn into the system through the drilled holes in piston "B" and past the lip of cup "D". Any excess is by-passed by port "C" into the reservoir, thus the cylinder is full of fluid for the next brake application.

IT IS IMPERATIVE THAT THE PEDAL STOPS BY MEANS OF THE ADJUSTING ROD "A" CONTACTING STOP "R" IN THE MASTER CYLINDER (SEE FIG. 169) RATHER THAN BY THE PEDAL CONTACTING THE TOE BOARD. (SEE BRAKE PEDAL ADJUSTMENT).

Cup "D", Fig. 169, must be clear of port "C" when piston "B" is in its "off" or returned position, otherwise the compensating action of the master cylinder will be destroyed and the brakes will drag. This can be determined by making sure that there is a slight amount of free movement of the brake pedal before the piston starts to move. Secondary cup "E" prevents fluid from leaking out of master cylinder into boot "F". Supply tank filler cap "N" is conveniently located for checking fluid level; tank should be kept at least half full of fluid.

CAUTION—In removing supply tank filler cap, extreme care mst be exercised to prevent dirt from entering master cylinder.

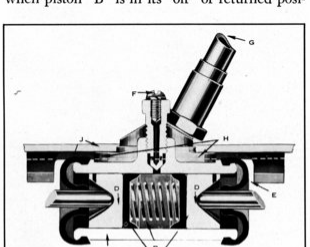


Fig. 170. Front Wheel Cylinder Details

WHEEL CYLINDER

The wheel cylinder, Fig. 170, composed of casting "A", return spring and cups "C", pistons "D", boots "E", and bleeder screw "F", is of the double piston type. Fluid enters the cylinder through the inlet "G". Casting "A" is anchored at "H" to the brake backing plate. Pistons "D" are connected to the brake shoes by means of links. Introduction of fluid into the cylinder causes the pistons to move in opposite directions, thus forcing the shoes into contact with the brake drum. Pressure cannot be built in the system until all shoes are in contact with their drums.

Both front and rear wheel cylinders have a wheel cylinder piston stop "J". The stop which is part of the backing plate assembly, bears against the rubber end boots of the wheel cylinder, thus preventing the piston from leaving the cylinders under any operating conditions.

NOTE—The diameter of wheel cylinder pistons (and rubber cups) is 1⅛" for the front brakes and 1" for the rear brakes on the "76" and "98" models. The "88" series cars use 1-3/32" pistons for the front and 15/16" pistons for the rear brakes. When new cups or pistons are installed the correct size must always be used.

BRAKE LUBRICATION

All the mechanical parts of the brake control should be lubricated periodically in order to assure long life and proper operation.

The brake (and clutch) pedals have drilled lubrication fittings and the pedal cross shaft is copper plated to prevent rusting, scoring, and hard pedal operation.

All the clevis pins, links, and moving parts of the hand brake system should be lubricated with engine oil at each chassis lubrication.

The parking brake cables leading to the rear wheels operate inside metal conduits through a portion of their length. These cables should be lubricated every 10,000 miles by pulling the cables rearward through the metal conduits and applying a liberal amount of brake cable lubricant.

At each major brake adjustment, all rust should be cleaned from brake shoes, the inner surfaces of the brake backing plates, and all metal contact points at the brake shoe assembly; then a thin film of "Lubriplate," or its equivalent applied to the surfaces against which the shoes operate or adjacent brake parts contact. Care must be exercised to prevent any lubricant from getting onto the braking surfaces of shoes or drums.

NOTE—"Lubriplate," or its equivalent (Bendix Brake Lubricant) is obtainable from the Bendix Products Div., South Bend, Indiana, or from any Bendix Brake service station.

Delco Brake Lubricant, Brake Cable Lubricant, or a similar product, is obtainable at United Motors Service dealers and distributors.

BLEEDING OF LINE

Whenever a main pipe line is removed from the master cylinder, the brake system must be bled at all four wheels. Whenever a line is disconnected from any individual wheel, it is necessary that wheel cylinder *only* be bled.

Before the brakes are bled, the supply tank should be filled with genuine G.M. Brake Fluid No. 9 and kept at least half full of fluid during bleeding operation. Brake Master Cylinder Filler Tool No. J-713, will help in brake bleeding operation.

1. Remove screw "F" from end of bleeder connection, Fig. 170, and attach bleeder drain, Fig. 171. Allow tube to hang into clean container, such as a pint mason jar.
2. Unscrew bleeder connection three-quarters of a turn.
3. Depress foot pedal by hand, allowing pedal

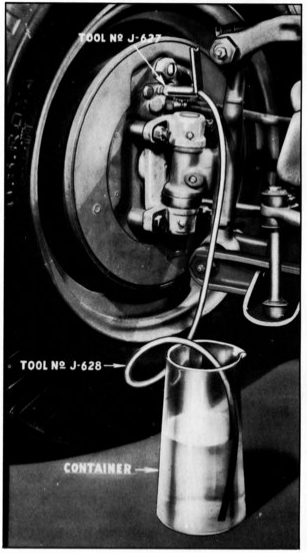


Fig. 171. Brake Bleeding Operation

to return to "off" position slowly. This gives a pumping action which forces fluid through tubing and out at wheel cylinders, carrying with it any air that may be present. CAUTION—After brake pedal is depressed, it must be allowed to return slowly, otherwise air may be drawn into system.

4. Watch flow of fluid from hose, the end of which should be kept below surface of fluid, and when all air bubbles cease to appear, close bleeder connection.

   NOTE—Fluid withdrawn in "bleeding" operation should not be used again.

5. Fluid should be replenished in supply tank after each cylinder is bled. Should supply tank be drained during bleeding operation, air will enter the system and "re-bleeding" will then be necessary. When bleeding operation is completed, supply tank must be refilled.

   NOTE—Always use G. M. Brake Fluid No. 9.

BRAKE ADJUSTMENT

Minor Operation (Shoe Adjustment for Loss of Pedal Due to Lining Wear)

1. Jack all wheels clear of the floor.
2. Disconnect parking brake cables at equalizer link (if the cables have been adjusted too short, the rear brake shoes will be forced away from the anchor pins in brake release position, making correct shoe adjustment impossible).
3. Remove adjusting hole covers on all four wheels. Expand brake shoes by turning adjusting screw, using tool HM-13985 (moving outer end of tool toward center of wheel expands shoes) until heavy drag is felt on brake drum.
4. Turn adjusting screw in opposite direction on all four wheels approximately sixteen notches until brake drum is free of brake drag.
5. Replace adjusting screw hole covers.
6. Pull parking brake cables toward equalizer link. Remove all "slack" and adjust clevises so that pin will just enter both clevises and equalizer link freely when equalizer link is parallel with propeller shaft. Lock clevis jam nuts and insert clevis pin cotters. ALWAYS INSTALL CLEVIS PINS WITH THE HEAD TO TOP.

   NOTE—To assure proper position of equalizer, hold equalizer link parallel with propeller shaft while the length of each cable is being adjusted.

7. Lower car and test brakes.

   NOTE—If it is necessary to take up adjusting screw (see 4 above), more than 50 notches, or car mileage indicates linings may be worn to rivets, then wheels and drums should be removed and linings inspected as outlined under MAJOR BRAKE ADJUSTMENT. In fact, it is well to check condition of brake lining approximately

Fig. 172. Front Brake Details

every 5,000 miles by removing one front wheel and drum assembly.

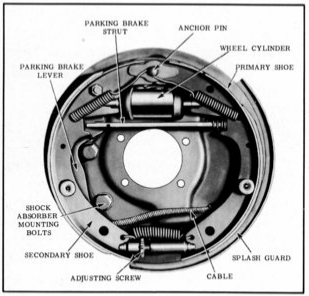


Fig. 173. Rear Brake Details

BRAKE PEDAL ADJUSTMENT

Before attempting to adjust pedal, be certain that pedal freely returns to stop, not binding on the pedal shaft, and that the pedal retracting spring has not lost its tension.

The brake pedal must be adjusted to insure full pedal travel. Pedal adjusting rod "A" must rest against stop "R" (See Fig. 169) in master cylinder. Rod should be against stop when sponge rubber pedal bumper is compressed not more than 3/16" by the shoulder on the pedal.

To adjust pedal, loosen check nut and adjust master cylinder adjusting rod to give approximately 3/16" compression of sponge rubber pedal bumper with master cylinder stop engaged. (See Fig. 174) This provides correct pedal adjustment and pedal lash.

BRAKE PEDAL REMOVAL

1. Disconnect pedal rod from brake pedal.
2. Disconnect pedal return spring.
3. Remove horseshoe retainer from end of pedal cross shaft.

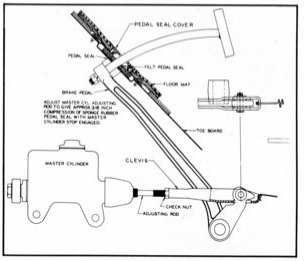


Fig. 174. Brake Pedal Adjustment

4. Remove pedal cross shaft bolt.
5. Push shaft through pedal.
6. Just loosen brake pedal adjusting rod check nut. If check nut is just loosened, it will facilitate reassembly.
7. Turn master cylinder adjusting rod out of master cylinder clevis.
8. Disassemble clevis from brake pedal. To assemble, reverse sequence of operations and adjust pedal.

MAJOR BRAKE ADJUSTMENT

NOTE—When brake lining replacement is necessary, normally all shoes and linings are replaced. In no case should a single shoe and lining be replaced. In exceptional cases it may be satisfactory to replace the shoes and linings on both front wheels or both rear wheels.

It is recommended that the entire hydraulic system be thoroughly cleansed and flushed with Declene Flushing Fluid any time a major brake adjustment is made or every 15,000 miles. Declene is available through General Motors Parts Division Warehouses.

For brake lining inspection and lubrication of brake parts—or replacement of linings and shoes—proceed as follows:

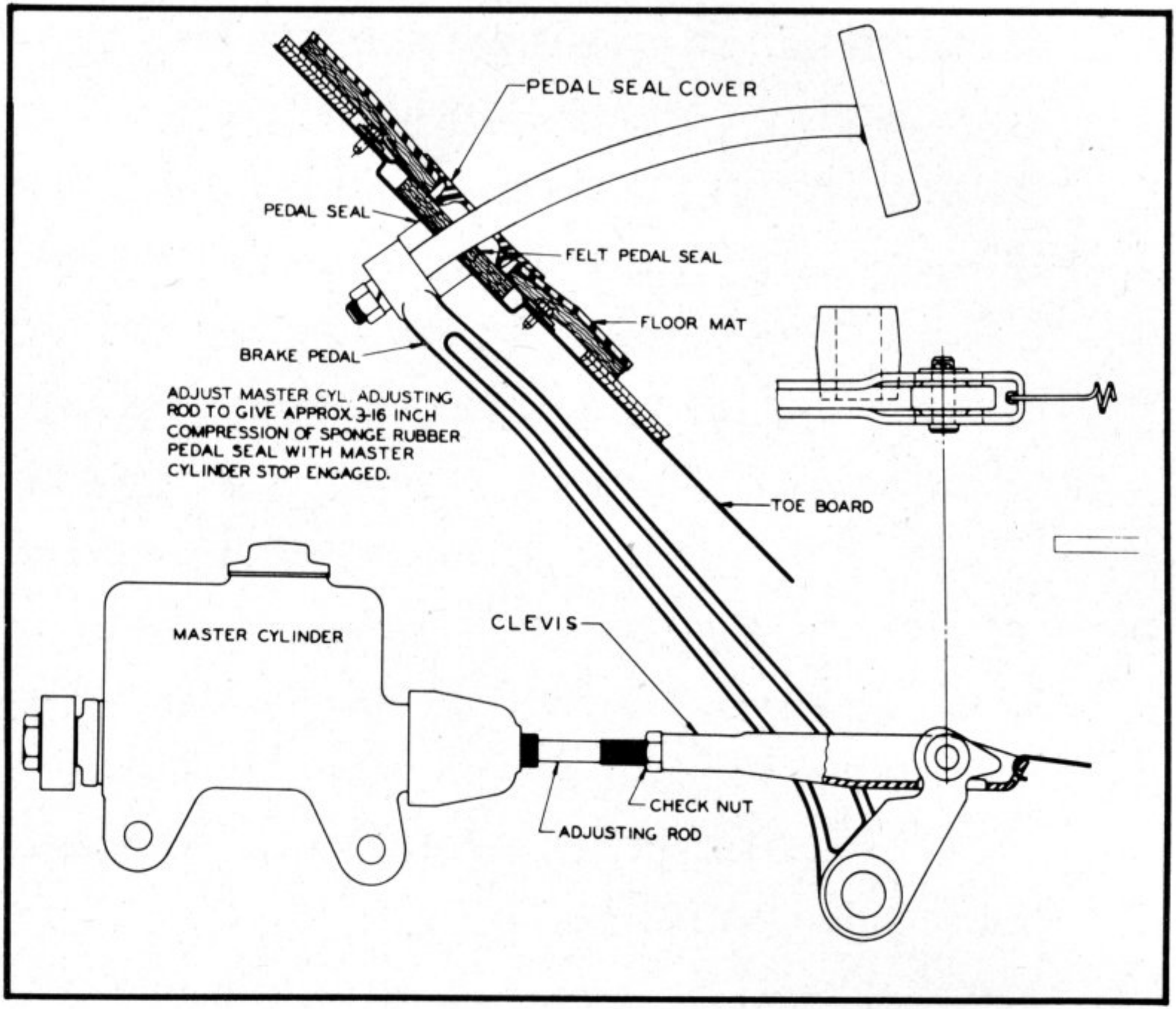


Fig. 174. Brake Pedal Adjustment

1. Jack up car and remove wheels.
2. Remove wheel hub and brake drum assemblies from the front wheel spindles and rear wheel axle shafts.
3. Check linings for wear. (If linings are worn nearly flush with rivets, new genuine Oldsmobile Linings should be installed.)
4. Examine brake drum lining bearing surfaces for smoothness. It is often possible to remove a slightly scored or scratched condition by the use of emery cloth.

If, after this has been done, the surfaces are not smooth, the drums should be rebored to .060 inches greater than the original nominal inside diameter—that is, after reboring the diameter for all models should be 11.060 inches. Oversize brake linings should be used with rebored drums.

NOTE: The smoothness for the surfaces of the drum mentioned above does not mean that the surfaces must be entirely free from grooves. The surfaces of the grooves, however, must be smooth.

NOTE—Whether new linings are required or cleaning and lubrication of brake parts only are necessary, proceed as follows:

5. Remove shoes and disconnect hand brake cables from operating levers.

   NOTE—Should it be necessary to remove any wheel cylinder internal parts, wheel cylinder will have to be removed from backing plate.
6. Disconnect parking brake cable clevises at equalizer link.
7. Remove brake shoe hold-down cups and springs.
8. Disconnect brake shoe return springs and shoe connecting springs.
9. Check king pin bushings for looseness.
10. Clean all rust from shoes, from inner surfaces of brake backing plates and all metal contacting points. Apply a thin coat of "Lubriplate" or its equivalent to the backing plate ledges, against which the shoes operate, and all metal contacting points, being careful not to get any on face of lining.
11. Clean exposed portions of hand brake cables. Pull cables rearward through conduits, lubricate freely with Brake Cable Lubricant and return to normal position. Remove any excess lubricant.

    NOTE—Delco Brake Cable Lubricant, or a similar product, is obtainable at United Motor Service dealers and distributors.
12. Tighten bolts that hold brake backing plates to axles.
13. Reassemble brakes, connecting parking brake cables to rear brake operating levers.
14. Install wheel hub and brake drum assemblies.

    NOTE—When newly lined shoes are installed, adjustment of the notched adjusting screw is necessary to allow the hubs and drums to be assembled in place.
15. Adjust front wheel bearings.
16. Expand brake shoes by turning notched adjusting wheel, using tool HM-13985 (moving outer end of tool toward center of drum expands shoes) until heavy drag is felt on brake drum.
17. Release adjusting screw on all four brakes approximately sixteen notches, until brakes are free of drag and replace adjusting screw hole covers.
18. With primary shoe against the drum, check to see that clearance at anchor and adjusting end of secondary shoe is equal, using a .015" feeler. If clearance is not equal, adjust anchor and adjusting screw as required. The head of the anchor pin has, for adjustment, a square shank the top of which is beveled on one side. The side without the bevel designates the high side of the cam.

The clearance at each end of secondary shoe should not vary more than plus or minus .002".

NOTE—If the clearance at the anchor pin end of the secondary shoe is too great, turn the anchor pin in the direction that the wheel turns as the car moves forward; if too little, turn the anchor in the opposite direction. Hold anchor pin and tighten anchor pin lock nut as tightly as possible with special wrench J-618. (Fig. 175)

19. Pull parking brake cable toward equalizer link. Remove all "slack" and adjust clevises so that pin will just enter both clevises freely at equalizer link when equalizer link is parallel with propeller shaft. Lock clevis pin jam nuts and insert clevis pin cotters. ALWAYS INSTALL CLEVIS PINS WITH HEAD TO TOP.

NOTE: To assure proper position of equalizer, hold equalizer parallel with propeller shaft while the link of each cable is being adjusted.

20. Replace wheels and test.

Parking Brake Adjustment

NOTE: Although the parking brake engages only the rear wheel brake shoes, it is recommended that for satisfactory results, brake shoe adjustment be made on all four wheels.

1. Drop parking brake cables.
2. Remove adjusting screw hole covers and expand brake shoes on all four wheels by turning adjusting screw, using tool HM-13985 (moving outer end of tool toward center of drum expands shoes) until heavy drag is felt on each brake drum.
3. Pull parking brake cables toward equalizer link, remove all slack and adjust clevises so that pin will just enter both clevises and equalizer link freely when equalizer link is parallel with propeller shaft.

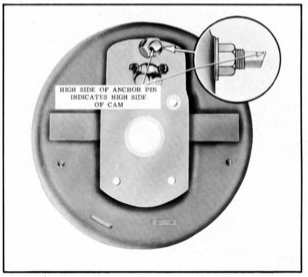


Fig. 175. Anchor Pin Adjustment

4. Lock clevis jam nuts and insert clevis pin cotters. ALWAYS INSTALL CLEVIS PINS WITH THE HEAD AT TOP.
5. Release adjusting screw on all four wheels approximately sixteen notches, until brakes are free of drag, and replace adjusting screw hole covers. (All four adjusting screws must be released the *same number of notches.*)

NOTE: To assure proper position of equalizer, hold equalizer link parallel with propeller shaft while the length of each cable is being adjusted.

Complete Removal of Brake Assembly

1. Disconnect flexible hose at frame end on front brakes. On rear brakes disconnect metal fluid link at brake backing plate.
2. Remove four bolts which hold brake backing plate to steering knuckle, or backing plate to axle housing which allows removal of complete brake assembly.
3. Remove parking brake cables at brake operating levers.
4. To replace, reverse operations.
5. Perform bleeding operation at all four wheels.

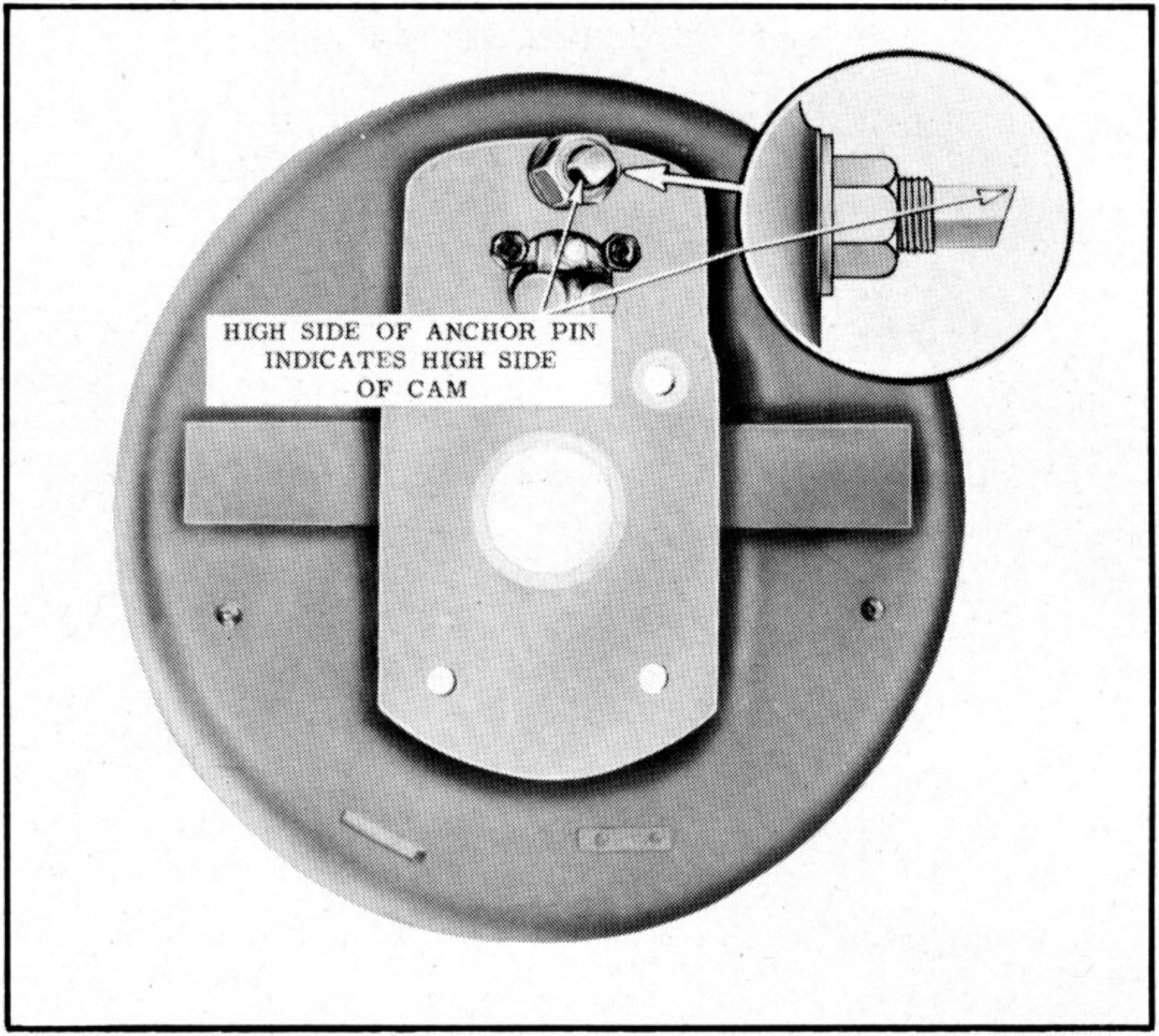


Fig. 175. Anchor Pin Adjustment

BRAKE MAINTENANCE HINTS

Reconditioning Master and Wheel Hydraulic Cylinders

CAUTION:—It is important that no attempt ever be made to in any way recondition a brake master or wheel cylinder bore, as a means of salvaging the cylinders.

Reconditioning of the bores leaves the walls sufficiently rough to cause premature destruction of the rubber cups. It also enlarges the bore to the extent that the standard size pistons will no longer fit properly. OVERSIZE PISTONS AND CUPS ARE NOT AVAILABLE. Master cylinder and wheel cylinder repair kits are available at all G.M.P.D. depots. These kits contain a complete set of standard parts to repair one cylinder. They do not contain a cylinder.

1. Pedal Goes to Floorboard

Causes:

(a) Normal wear of lining.

(b) Leak in system.

(c) Air in system.

(d) No fluid in supply tank.

NOTE:—Under any of these conditions the user of the car may have met critical situations by pumping the pedal several times at each application.

Remedy:

(a) Adjust brakes outlined under "MINOR BRAKE ADJUSTMENTS."

(b) A connection leak in the system will allow the pedal, under pressure to go to the toe board gradually. A cup leak does not necessarily result in loss of pedal travel but will be indicated by a loss of fluid in the supply tank. If no leaks are found at wheels or connections, remove master cylinder and check bore of barrel for score or scratches.

(c) Air in the system will cause a springy, rubbery action of the pedal. Should a sufficient quantity be introduced into the system, the pedal will go to toe board under normal pressure. System should be bled.

(d) The supply tank should be at least one-half full of fluid. Should the tank become empty, air will be introduced into the system, necessitating bleeding.

2. All Brakes Drag

Cause:

(a) Mineral oil in system.

(b) Port hole closed in master cylinder.

Remedy:

(a) The introduction into the system of any oil of a mineral base, such as engine oil, kerosene, or the like, will cause the cups to swell and distort, making it necessary to replace all rubber parts. Flush system with Declene or a good grade of clean alcohol, replace necessary parts, and refill with G. M. Brake Fluid No. 9.

(b) Port C—Fig. — must be opened when brakes are in released position. Should this port be blocked by piston cup not returning to its proper released position, then the pressure in the system will gradually build up and brakes will drag. Check brake pedal adjustment. Inspect Port C in master cylinder to see that it is not plugged. Check master cylinder piston cups to see that they are not distorted, due to the use of other than recommended fluid.

3. One Wheel Drags

Cause:

(a) Distorted (stretched out) brake shoe return spring.

(b) Brake shoe set too close to drum.

(c) Cups distorted.

(d) Loose front wheel bearings.

Remedy:

(a) Springs sometimes lose their contracting power and take a set. Replace spring.

(b) Re-adjust shoes to proper clearance.

(c) If in checking wheel cylinders, kerosene, gasoline and other fluids are used as a cleaner instead of alcohol or Declene, the cups will swell and distort. The return action of the shoes will be retarded and brake drum will heat. Replace cups and wash unit in Declene or a good alcohol and dip all parts in G. M. Brake Fluid before reassembling.

(d) Adjust bearings. Replace if necessary.

4. Car Pulls to One Side

Cause:

(a) Grease, oil, paint or other foreign substances on lining or drums.

(b) Shoes improperly set.

(c) Backing plate loose on axle.

(d) Different makes of lining.

(e) Tires not properly inflated.

(f) Out-of-round drums.

Remedy:

(a) Clean drums and replace with genuine Oldsmobile linings.

(b) Re-adjust shoes to proper clearance.

(c) Loose backing plate permits the brake assembly to shift on the locating bolts. This shifting changes the pre-determined centers and causes unequal efficiency. Tighten backing plates and re-adjust brakes to proper clearance.

(d) Always use genuine Oldsmobile linings.

(e) Inflate to correct pressures.

(f) True drums—rebore to .060″ greater than original nominal inside diameter. If drum has already been rebored .060″, new drum must be used.

5. Springy, Spongy Pedal

Cause:

(a) Brake shoes not properly adjusted.

(b) Air in system.

Remedy:

(a) Re-adjust shoes to proper clearance.

(b) Consult remedies C and D under No. 1.

6. Excessive Pressure on Pedal, Poor Stop

Cause:

(a) Brake shoes not properly adjusted.

(b) Improper lining.

(c) Grease, oil, paint or other foreign substances on lining or drum surfaces.

Remedy:

(a) Re-adjust shoes to proper clearance.

(b) Clean drums and replace with genuine Oldsmobile linings.

Always use genuine Oldsmobile Linings. Improper grades of brake linings lose their gripping qualities after a few thousand miles. As the frictional quality decreases, the pressure on the brake pedal is naturally increased to get the equivalent stop.

(c) Consult remedy A under No. 4.

7. Light Pressure on Pedal, Severe Brakes

Cause:

(a) Brake shoes not properly adjusted.

(b) Loose backing plate on axles.

(c) Grease-soaked lining.

Remedy:

(a) Re-adjust shoes to proper clearance.

(b) Consult Remedy C under No. 4.

(c) Consult Remedy A under No. 4.

Caution:

DON'T use a substitute for G. M. Brake Fluid No. 9. Substitutes are not suitable for this system.

DON'T allow grease, paint, oil or brake fluid to come in contact with brake lining.

DON'T clean rubber part or inside of cylinders with anything but a good grade of clean *alcohol*.

DON'T use kerosene or gasoline.

DON'T reline shoes with other than Genuine *OLDSMOBILE* linings.

DON'T allow the supply tank to become less than one-half full of brake fluid.

DON'T attempt to salvage used brake fluid.

BRAKE FLUID

It is important to use genuine G. M. Brake Fluid No. 9, which has wide temperature range.

G. M. Brake Fluid No. 9 is sold in convenient containers through zone warehouses. The name G. M. on the container is your guarantee against substitution.

BRAKE SPECIFICATIONS—1949 MODEL

SUBJECT AND REMARKS	"76"	"88"	"98"
1. BRAKING AREA (FOOT BRAKES)	159.8 sq. in.	191.7 sq. in	191.7 sq. in
2. DRUMS			
a. Material—Braking Surface	Cast Iron	Cast Iron	Cast Iron
b. Inside Diameter	11"	11"	11"
c. Maximum Out of Round	.005"	.005"	.005"
d. Clearance between Brake Lining and Drum (when new or newly adjusted)	.015"	.015"	.015"
3. FLUID	GM No. 9	GM No. 9	GM No. 9
4. LINING			
a. Length			
1. Front Primary (Forward Shoe)	9 11/32"	9 11/32"	9 11/32"
2. Front Secondary (Rear Shoe)	11 31/32"	11 31/32"	11 31/32"
3. Rear Primary (Forward Shoe)	12"	9 11/32"	9 11/32"
4. Rear Secondary (Rear Shoe)	12"	11 31/32"	11 31/32"
b. Width			
1. Front	2"	2½"	2½"
2. Rear	1¾"	2"	2"
c. Thickness			
1. Front	3/16"	3/16"	3/16"
2. Rear	3/16"	3/16"	3/16"
5. RATIO (PERCENTAGE OF BRAKING EFFECT)			
a. Front Brakes	56%	58%	56%
b. Rear Brakes	44%	42%	44%
6. WHEEL CYLINDER BORE			
a. Front Wheel Cylinder	1⅛"	1 5/32"	1⅛"
b. Rear Wheel Cylinder	1"	15/16"	1"
7. MASTER CYLINDER BORE	1"	1"	1"

6-CYLINDER ENGINE

The 1949 "Big Six" is similar in design to the 1948 six cylinder engine with innovations including larger bore and stroke which have increased the displacement to 257 cubic inches.

The 6.5:1 compression ratio, L-head engine develops 105 horsepower.

CYLINDER BLOCK

The six cylinder block is designed such that maximum rigidity with minimum distortion characteristics are accomplished in a relatively light weight iron alloy casting.

Cooling of the block is accomplished through water jackets which completely surround the cylinder barrels.

The angular positioned distributor and oil pump drive locates the oil pump on the right side and the distributor on the left side of the engine.

The angles of the intake and exhaust valve seats are 30° and 45° respectively.

CAUTION—Never add water to cylinder block while block is hot, nor operate engine with low water level. Always run engine while adding water.

OIL PAN REMOVAL

1. Drop the steering relay rod assembly on one side by disconnecting the idler arm from the frame.
2. Drain radiator and disconnect radiator hoses.
3. Remove two engine mounting bolts from frame front cross member and raise engine approximately ¾" to permit removal of oil pan.
4. The bolts around the front end of the oil pan, where not accessible directly, are accessible through openings provided in the front cross member and by unhooking the fasteners of the splash guard between the front cross member and the radiator lower baffle. The No. 1 bolts (from the front) on each side of pan must be removed with an end wrench due to interference by the front frame cross member.
5. Rotate crankshaft (either by flywheel or starter) so that counterweights are up out of way. Use tool No. J-1786.
6. When installing pan, always use new gaskets and allow cement to dry thoroughly before making installation. This will help prevent gasket getting out of place due to contacting the cylinder block when placing pan in position.

CYLINDER HEAD REMOVAL

The cylinder head is attached to the block by alloy steel bolts. Whenever cylinder head is removed, a new gasket coated lightly on both sides with POB Perfect Gasket Seal should be used in replacement.

NOTE—Never attempt to use gasket more than once.

The sealer should be applied at 70° (room temperature) and the edge around combustion space should be wiped to prevent any possibility of sealer getting into combustion chamber.

The gasket flange around the combustion chamber is considerably wider on one side than on the opposite side and this wider flange (3/16") should be installed down, next to the block.

Bolts should be torque tightened in the order shown in Fig. 176 to the specifications indicated on Torque Wrench Chart.

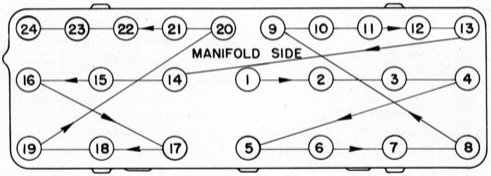


Fig. 176. Order of Tightening Cylinder Head Bolts

CRANKSHAFT

The six cylinder, drop forged crankshaft has four main bearings. Crankshafts, made of high carbon heat treated steel with counterweights forged integral, are dynamically balanced. Oil is distributed to connecting rods and piston pins through holes drilled in the crankshaft.

The crankshaft front oil seal consists of a felt packing in the timing chain cover which is held in place by means of a retainer ring spot welded to the cover. This packing provides effective sealing at the machine hub surface of the fan drive pulley.

A torsional vibration balancer similar in design to that used on the 8 cylinder engine is also used on 6 cylinder engines.

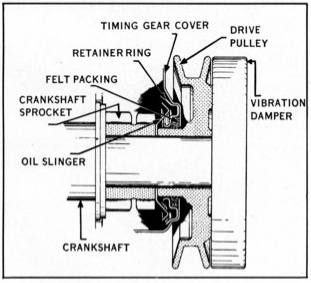


Fig. 177. Crankshaft Front Oil Seal

FLYWHEEL

The flywheel on Syncro-Mesh transmission equipped cars is made of cast iron, while the flywheel on the Hydra-Matic transmission equipped cars is made of pressed steel. A hardened steel ring gear is shrunk on the outside diameter of both flywheels. The starter pinion has 9 teeth. The flywheel is balanced both statically and dynamically separate from the crankshaft, then assembled to crankshaft along with a separately balanced clutch assembly (Syncro-Mesh only); after which, the complete assembly is balanced dynamically.

Servicing Flywheel

When the flywheel is installed, the flywheel nuts should be tightened evenly with a torque wrench. See Torque Wrench Chart.

Only two of the six 7/16″ holes in the flywheel for attaching it to the crankshaft flange are reamed. Therefore, after assembling a new flywheel to crankshaft having two reamed holes,

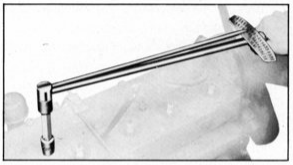


Fig. 178. Tightening Cylinder Head with Tool J-1264

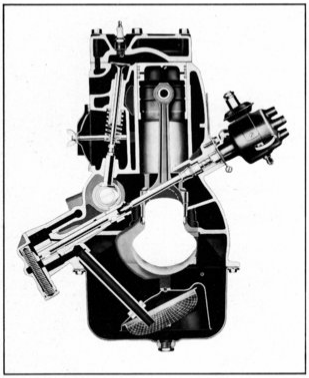


Fig. 179. Transverse View of Engine

the remaining four holes should be reamed to 7/16". Attaching bolts will then fit satisfactorily.

Six threaded holes are provided in the flywheel for mounting the clutch assembly. The second threaded hole in the flywheel on each side of the clutch locating dowel has a deeper counterbore than the other threaded holes. (See Fig. 180) Two of the cap screws have a longer shank under their head and must be used in the holes with deeper counterbores. Otherwise, it is impossible to securely fasten the clutch assembly to the flywheel. The purpose of the longer shank cap screw is to provide locating dowels between clutch assembly and flywheel.

Timing mark is placed on the 6 cylinder flywheel.

Flywheel Housing

The upper section of the flywheel and clutch housing is made of cast iron and the lower section of the clutch housing is bolted to the crankcase; alignment is maintained by two ½" dowels. The pilot hole for the transmission is bored after assembly to crankcase in order to maintain proper alignment of crankshaft, clutch and transmission, and the two lower holes in the flywheel housing for mounting the transmission are tapped. The transmission, mounted by four cap screws, may be removed without removing the flywheel housing lower pan.

The flywheel housing on the Syncro-Mesh transmission equipped cars is of one piece construction while the flywheel housing on the Hydra-Matic transmission equipped cars is of two piece construction bolted together. Both halves are stamped with a number on their bottom face. The numbers on both halves of the flywheel housing must match and in no case should only one half of the housing be changed. If a change is necessary for any reason, it will be necessary to change both halves of the housing.

Any oil which may be drawn into the clutch housing through the rear main bearing is prevented from getting on the clutch driven plate by means of a baffle which is a part of the clutch pressure plate assembly.

NOTE—The clutch assembly can be removed or installed without disturbing the upper section of the flywheel housing.

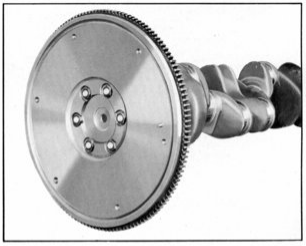


Fig. 180. Flywheel

MAIN BEARINGS

Six cylinder engines have four shell type main bearings lined with special babbitt. They are held in place with small extensions on the edge of the bearing shell, which are located in machined notches in the block and cap.

The front main bearing shell has a short groove leading forward from the center oil groove to the crankshaft bronze thrust plate. (See Fig. 181)

End thrust on crankshafts is taken through the front main bearing by means of a steel thrust collar and two bronze thrust plates. The steel thrust collar is used between one bronze thrust plate and the crankshaft sprocket. (See Fig. 182) The rear bronze plate is .124" thick. The thickness of the front plate, however, is selective; i.e. the .124" plate or either of two other plates is used to maintain proper clearances.

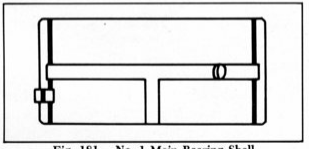


Fig. 181. No. 1 Main Bearing Shell

Rear Bearing Oil Seal

The rear main bearing oil seal, is designed with a positive special asbestos covered wiper seal contacting the machined surface of the crankshaft. In conjunction with the wiper, a slinger on the crankshaft ahead of the seal deflects oil into the oil drain, from which it is returned to the oil pan. (See Fig. 183)

The vertical joints between the bearing cap and the cylinder block are sealed with cork strips.

Servicing Main Bearings

When main bearing cap bolts are removed, they should be marked and designated so that they may be reassembled in their respective positions in the cylinder block. Always install to proper torque specification.

NOTE—The rear main bearing cap bolts are 9/16". The rest of the main bearing cap bolts are ½". The size of the hex is the same on the ½" and 9/16" bolts.

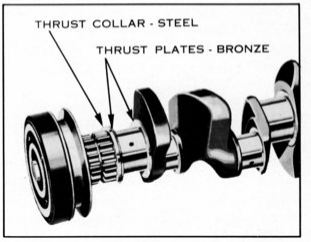


Fig. 182. Crankshaft Showing Thrust Plates

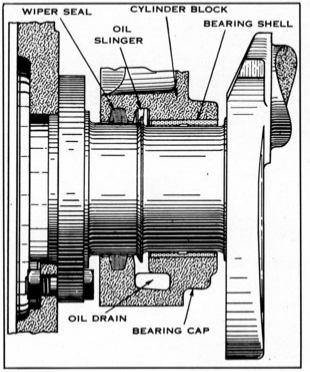


Fig. 183. Rear Main Bearing Details

Bearing shells, which should never be shimmed or otherwise adjusted, are installed in caps so that positive contact is made at the joints. The bearings can be removed and replaced without removing the crankshaft.

After the bearing cap has been removed, a small specially designed pin (HM-J-173 Crankshaft Upper Bearing Removing Pin) may be inserted in the oil hole of the shaft, as shown in Fig. 184. The head of this pin will not protrude from the hole quite as far as the thickness of the bearing. When the crankshaft is turned in the usual direction of rotation, the head of the pin will engage the upper half of the bearing and turn it out with the rotating crankshaft The bearing may be replaced by inserting the plain edge of the bearing at the indented side of the upper bearing support and gently rotating it into place, with the crankshaft.

Before installing the upper bearing into place remove the sharp edge from the plain edge of the bearing.

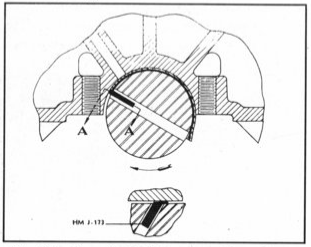


Fig. 184. Removing Main Bearings with Tool J-173

Install Rear Main Bearing Oil Seal

The same instructions for installing the rear main bearing oil seal apply to both 6 and 8 cylinder engines (see 8 cylinder section) except that Rear Main Bearing Oil Seal Compressor Tool No. J-955 should be used on 6 cylinder engines.

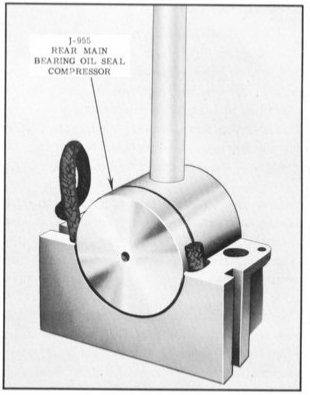


Fig. 185. Installing Rear Main Bearing Oil Seal in Block Bearing Cap

PISTONS

Six cylinder pistons, similar in design to those used in former years have four rings (two compression and two oil rings) and a balancing rib on the inside bottom of the skirt.

To minimize distortion, the skirt is amply thick, and the piston has reinforcing ribs on the inside wall.

Oil return holes are drilled in the two lower grooves of pistons in order to allow drainage back into oil pan.

A chemical process which deposits a coating on the pistons improves the surface of the piston and aids break-in. Pistons removed from an engine with mileage will show this coating worn through on both thrust sides. This is a normal condition.

Adequate cylinder wall lubrication during the warm-up period and at lower speeds, when there is insufficient throw-off from the bearings, is

provided by an oil spit hole in the upper half of the connecting rod bearing. This oil spit hole indexes with the oil hole in the crankshaft as the piston approaches top dead center on each piston stroke thereby spraying the exposed cylinder wall with an additional supply of oil.

Cylinder wall lubrication is accomplished during warm up and low speed driving in the same manner on the "Big Six" as on the 8 cylinder by means of a connecting rod spit hole.

The six cylinder piston pin is locked in the piston and floats on the connecting rod.

Always install pistons with mark "V-S" on top of piston, toward valve side of engine.

NOTE—Pistons must always be removed from the top of the block.

Fig. 186. Measuring Pistons

Measuring Pistons

When measuring pistons for size, measurements must be taken with piston pin removed and at two places opposite piston pin boss as follows:

1. ⅜″ from lower ring groove.
2. ⅜″ from bottom of skirt.

Allowable taper limit is .0004″. The largest diameter must be at the bottom.

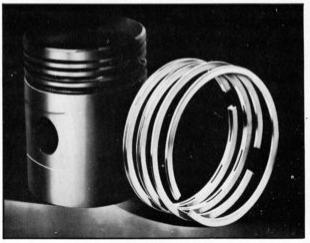


Fig. 187. Piston and Rings

Fitting Pistons

Instructions for fitting pistons in 8 cylinder section will apply to 6 cylinder with the exception that 6 cylinder piston fit is .00125″ to .00175″ and that scale HM-593 with ½″ x 12″ x .0015″ tape should read between the limits of seven to twenty pounds when withdrawn from between piston and cylinder wall.

NOTE—Piston Pin Bushing Remover Tool No. J-1674 will be used for 6 cylinder pistons.

Fig. 188. Determining Piston Clearance with Tool HM-593

Reconditioning Cylinder Bores

Instructions for reconditioning cylinder bores in 8 cylinder section will apply to 6 cylinder engine except that the order of reconditioning cylinders is 1, 3, 5, 2, 4, 6 on 6 cylinder engines and allowable out of round on reconditioned bores should be held to .0005".

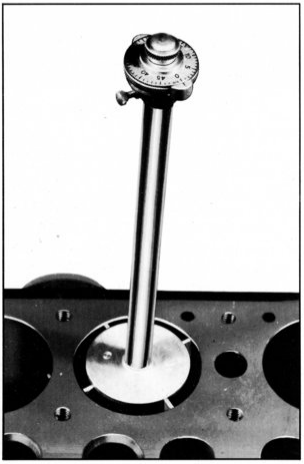


Fig. 189. Determining Cylinder Size with Tool HM 51

PISTON PINS

The hardened, ground and lap-finished hollow piston pin is held in piston boss by a press fit and a lock screw located in a drilled hole in piston pin and boss. The free end of the piston pin is slotted to permit the piston boss to slip on the pin during expansion and contraction of the piston, thus preventing distortion.

Fitting Piston Pins in Piston

Piston pins are available in three sizes—standard, .001" and .003" oversize. The standard pins are all to the high limit. Reaming and if necessary, honing of the piston pin hole for installation of oversize pins is satisfactory.

The piston pin fit is satisfactory when it is a "very tight wring fit" in each hole. A "very tight wring fit" is one in which the pin can just be twisted in each pin hole with the aid of a 6" drift in the piston pin lock screw hole. The piston pin and hole must be completely free of oil. Since this is a dry, metal to metal fit, some "squeak" will undoubtedly be apparent as the pin is twisted in the piston. This fit must be made with a solid part of the pin in the boss. The split part must be entirely through the boss.

Piston pins may be removed from the piston without destroying the out of round of the piston by holding the piston in the hand and removing with tool HM-535 and tapping the pin from the split end out of the piston. Do not support the piston rigidly on a bench during removal.

Fit and Install Piston Pin as follows:

Whenever installation of the pin becomes necessary, the size pin required should be determined by trying a standard, .001", or .003". Since all pins available through the Parts Department are to the high limit, there may be cases where the standard size pin will provide satisfactory fit. If a careful reaming job is done, ordinarily finish honing of the piston pin hole should not be necessary.

1. Using reamer HM-536, line ream (and if necessary, hone) piston pin hole for installation of the size pin required.
2. With piston pin hole and pin completely free of oil, insert pin in piston pin hole.
3. Using 6" drift in the piston pin lock screw hole, twist pin in the piston. The split section of the pin will fit the hole easily. The fit is satisfactory when the pin, after

it has passed the split section, can just be twisted.

4. Repeat 2 and 3 above in opposite pin hole.
5. After making sure that pin is a "very tight wring fit," assemble pin as follows:
   a. Heat the piston in boiling water. Do not heat the pin.
   b. Coat the inside of the piston pin boss with graphite grease.
   c. Assemble the cold pin in the hot piston. Due to the expansion characteristics of the cold pin and hot piston, start the split end of the piston pin into the piston and rod assembly by hand as far as possible. Using HM-535, lightly tap piston pin in place. Oil spit hole in connecting rod should be toward valve side of engine.
   d. Install piston pin lock screw.
   e. After completing assembly of piston pin, connecting rod and rings, the assembly should be checked for alignment before installation in the engine.

      NOTE—To fit piston pin to connecting rod pin bushing, see SERVICING CONNECTING RODS.

PISTON RINGS

Six cylinder piston rings are very similar in design to those used in the 8 cylinder engines except that there is an additional ring on 6 cylinder pistons.

Fitting Piston Rings

1. Piston ring gap must be measured with the ring down in the ring-traveled part of the cylinder bore to which it is fitted. Be sure ring is square in cylinder bore. When filing ring for gap clearance, make sure that gap is square. Measure vertical clearance as shown in Fig. 190.
2. When rings are installed on piston, they should be staggered so that the gap of one ring is not in line with the gap of any other ring on the piston.

   CAUTION—There is a top and bottom to the compression ring. One side of the ring is stamped "Top" and this identification should always be placed toward the top of the piston when ring is installed.
3. The piston and ring assemblies can be easily installed in the piston bore without the liability of breaking piston rings if tool J-1002-6 is used when assembling.

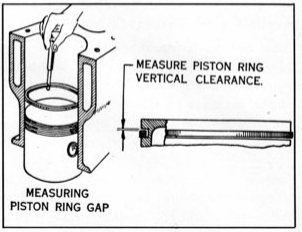


Fig. 190. Fitting Piston Rings

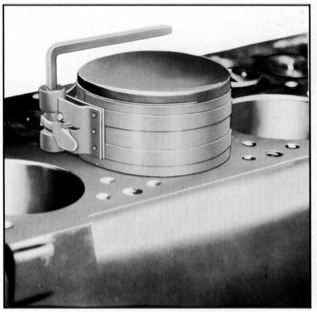


Fig. 191. Installing Piston and Ring Assembly

CONNECTING RODS

Six cylinder connecting rods are of the same general design as 8 cylinder rods, and service instructions are the same except that 6 cylinder piston pins should be replaced with the use of tool J-1674, Remover and Replacer, and tool J-1649, Support Block. Reaming should be done with reamer HM-536 to accomplish a "suck fit" between piston pin and bushing. This means that pin should not drop through bushing by its own weight but should be easily pushed through with slight pressure.

Servicing Connecting Rods

1. When installing connecting rods, oil spit hole in upper half of connecting rod bearing must be toward valve side of engine.
2. The small grooves forged in the rod and cap bolt boss on the same side as the part number must be matched when assembled.
3. Two ground bolts are used to insure accurate lineup of cap and rod. Under no circumstances should other than G.M. bolts be used.

   Connecting rod bolt nuts should be tightened evenly and with a torque wrench.
4. When replacing connecting rod bearings, adjustment either by shim or filing of rod or cap should not be attempted as results would be unsatisfactory.
5. Piston pin bushing replacement should be made by pressing new bushing in connecting rod with tool J-1674 Remover and Replacer and tool J-1649 Support Block. Line ream bushing to size with reamer HM-536. The fit of the piston pin in the connecting rod bushing should be a "suck fit". A "suck fit" is one where the piston pin will not drop through the connecting rod pin bushing of its own accord, but will need to be pushed through with a slight pressure of the thumb.

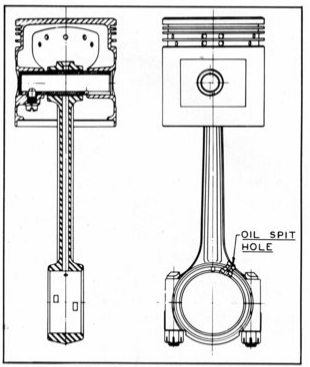


Fig. 192. Rod and Piston Assembly

CAMSHAFT

A heat treated, cast, taper ground camshaft supported by four steel backed copper lead bronze bushings is used in 6 cylinder engines.

A semi-circular flange is provided around the camshaft opening in the front engine support plate to take the forward thrust of the camshaft. The backward thrust is taken at the front of the cylinder block. (See Fig. 193)

A silent anti-whip chain which requires no adjustment drives the camshaft.

Pressure lubrication is supplied to the timing chain and sprockets from the front main bearing to camshaft bearing passage. Four holes are drilled in the front camshaft thrust surface and each time these holes register with the hole in the cylinder block from the oil passage, a spray of oil gushes on the timing chain and sprockets.

VALVES

Alloy steel intake and exhaust valves are used in 6 cylinder Oldsmobile engines. The angle of the seat on the intake valve is 30° and on the exhaust is 45°.

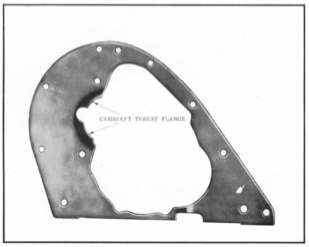


Fig. 193. Front Engine Support Plate

Servicing Valve Mechanism

In order to obtain the correct valve lash, valves should be lashed with the engine warm and running.

NOTE—Whenever valve cover plates are removed, new valve cover plate gaskets should be used, if old gaskets are damaged in any way.

Correct valve lash may be obtained, though less satisfactorily, with the engine warm and not running, providing valves are on the low point of the cam when lash is adjusted.

The valves of each cylinder are on the low point of the cam when the cylinder fires.

To obtain correct lash, proceed as follows:

1. Allow engine to run until warm. Turn off.
2. Install timing light K-352 and turn on ignition.
3. Bring No. 1 cylinder up on firing stroke until light just lights.

   NOTE—Both valves in No. 1 cylinder are now on low point of cam (closed).
4. Adjust valve lash in No. 1 cylinder to .008" intake and .011" exhaust.
5. Proceed as above for each cylinder in firing order:

   Six cylinder firing order is: 1, 5, 3, 6, 2, 4.

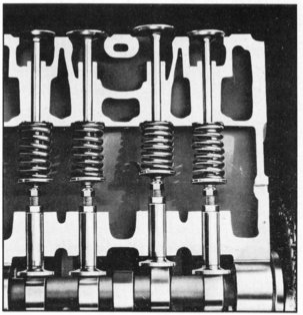


Fig. 194. Valve Mechanism

VALVE SPRINGS AND DAMPERS

Valve springs and dampers on six cylinder engines are similar in design to those used on eight cylinder models described in that section.

Remove and Replace Valve Springs and Dampers

1. Remove cylinder head to allow removal of valves.
2. Remove valve compartment covers.
3. With valve lifter tool J-498-0, compress valve spring and remove valve spring lock cones.

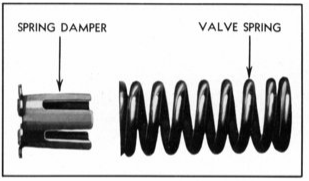


Fig. 195. Valve Spring and Damper

4. Remove valve spring retainer and damper.
5. To replace valve spring, reverse above sequence of operations, being sure that the valve spring damper is in place at upper end of spring before spring is installed.

VALVE LIFTERS

Mechanical valve lifters, equipped with self-locking screws which eliminate the check nut, are incorporated in the 1949-6 cylinder engine design.

NOTE—In cases of lifter replacement, always replace lifter assembly complete with self locking screw.

The lifters are all steel construction of the mushroom type, with a spherical face, and operate in bosses machined in the cylinder block. The bosses for the valve lifters are within the valve compartment, which opens into the crankcase, so the lifters are amply lubricated at all times.

Valve lifter holes in cylinder block are finished by an advanced process known as Bearing-izing, which permits greater accuracy and provides a mirror-like burnished surface.

Due to this improved bearing surface, it is well, when necessary to replace valve lifters to use oversize lifter without reaming out the lifter hole, which destroys Bearing-ized surface.

Remove and Replace Valve Lifters

When valve lifters are removed and replaced:

1. The front end sheet metal does not have to be removed to remove the camshaft. Remove radiator core and radiator grille.
2. It is necessary to remove fuel pump, cylinder head, oil pump and camshaft.
3. Use "U" clips under valve heads to hold valves in open position. The "U" clips should be made of soft material so as not to damage the valves or cylinder block; ½" copper tubing 2" long, after bending is satisfactory.
4. Tie up all valve lifters using a soft wire to hold the lifters in the raised position to clear cams and camshaft bearing journals.
5. Mark lifters so they may be reassembled in their respective positions in the cylinder block. Otherwise, lifter noise or binding may result.
6. Remove distributor and oil pump.
7. If new lifters are installed, replace lifter assembly complete with lock screw.
8. Use tool HM-408-0 and time sprockets as shown in Fig. 196.
9. Set number one cylinder on firing center. Set distributor on number one cam. Slide oil pump tentatively into position to determine oil pump gear position. Turn gear, as necessary, and assemble to distributor shaft without revolving distributor shaft.

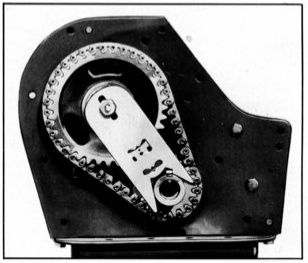


Fig. 196. Timing Crankshaft and Camshaft Sprockets with Tool HM 408-O

Checking Valve Timing

Valve timing is for .008" lash on intake and .011" lash on exhaust valves.

The correct valve timing when replacing camshaft or sprocket gears can be obtained by using tool as shown in Fig. 196.

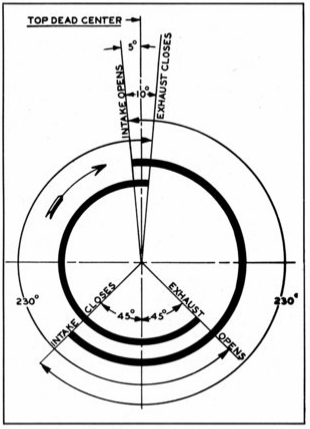


Fig. 197. Six Cylinder Valve Timing Diagram

VALVE GUIDES

The 6 cylinder engine uses cast iron lubrited guides which furnish ample bearing surface and insure proper valve seating.

Replace Valve Guides

The same valve guides are used for both intake and exhaust valves. The upper end of both intake and exhaust valve guides is ⅞" from the top of the cylinder block. It is important when installing guides that the distance from the top of the block to the tops of the guides be held according to specifications. Therefore, tool J-952 shown in Fig. 198, should be used when installing either intake or exhaust valve guides.

LUBRICATING SYSTEM

The engine lubrication system, as indicated by the phantom view of the oil lines (Fig. 199) provides full pressure lubrication to all the important rotating and reciprocating parts of the engine. The heavy lines show the paths of oil travel from the crankcase, up through the various parts of the engine, and back again to the pump.

The gear pump delivers oil directly to the main bearings, and oil continues under pressure through drilled holes in the crank cheeks to the adjacent connecting rod bearings; and from these, oil is forced, still under pressure, out of the oil spit hole in the upper half of the connecting rod bearings to the cylinder walls and up through the rifle-drilled passages of the rods

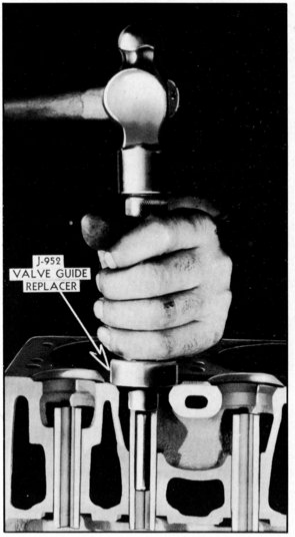


Fig. 198. Replacing Valve Guides

to the piston pins. Drilled passages in the crankcase webs also deliver oil under pressure from the main bearings to the camshaft bearings and camshaft thrust bearings. A jet of oil directs a small stream upon the timing chain sprocket and the spray therefrom is thrown around the chain compartment. Other parts of the engine are lubricated by a continuous spray thrown from the crankshaft.

OIL PUMP

The 1949 six cylinder engine oil pump, which can be removed from the engine without disturbing any of the drive mechanism, is of the positive gear type similar to that used in 1948.

The intake or suction port of the pump, through which oil is drawn from the crankcase, connects with a passage inside a large circular screen which is inclined with respect to the bottom of the pan to prevent loss of oil pressure from possible formation of sludge or emulsified particles which might clog the screen during winter operation. Oil operating pressure is 28 to 33 pounds.

The oil pump is located at the right side of the engine on the outside of the crankcase. The drive gear for the oil pump and distributor shaft is keyed to the pump shaft and driven from the camshaft by spiral gears. The lower end of the distributor drive shaft is flattened and is engaged between two flat springs in the pump drive gear.

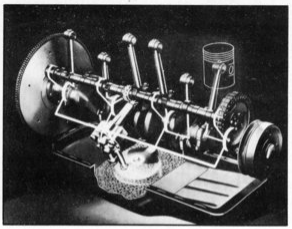


Fig. 199. Engine Lubrication System

Disassemble Oil Pump

To disassemble the oil pump, proceed as follows:

1. With an arbor press and using tool J-959 as shown in Fig. 201 press the drive gear from upper end of pump shaft. Remove Woodruff key from upper end of shaft.
2. Remove pump housing cover, oil pump gears and shaft.

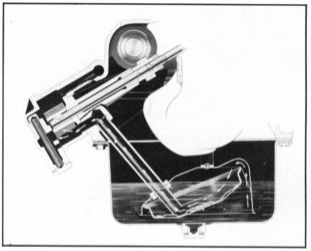


Fig. 200. Oil Pump and Screen Assembly

Assemble Oil Pump

The pump shaft is pressed into pump gear flush with outer end of gear on the six cylinder engines.

To completely assemble the oil pump:

1. Place pump gear on flat surface and, with Woodruff key in pump shaft, press shaft through gear, flush with outer end of gear. (Fig. 202)
2. Place idler gear on stub shaft in pump body and slide pump shaft and gear assembly into place in pump housing.
3. Put Woodruff key in place on upper end of pump shaft and press pump drive gear onto shaft, using tool J-954-1 between

inner face of gear hub and pump body. Tool J-954-1 must be used when assembling pump drive gear, otherwise, proper end clearance of pump shaft assembly will not be maintained. (See Fig. 203)

4. Assemble piston, relief spring and nut into place in pump cover and bolt cover to pump body. Use new gasket between pump cover and body.

   NOTE—Always use new gasket between pump body and cylinder block when assembling pump to cylinder block.

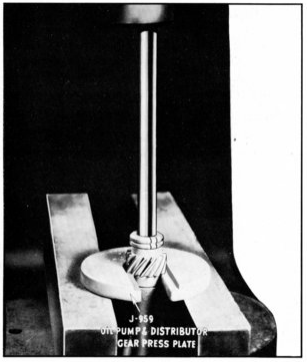


Fig. 201. Removing Oil Pump Drive Gear with Tool J-959—Pump Removed from Engine

CRANKCASE VENTILATION

The six cylinder crankcase ventilating system operates in the same manner as that of the eight cylinder engine, the description of which may be found in the eight cylinder section of this manual.

MANIFOLDS

The intake and exhaust manifolds are cast

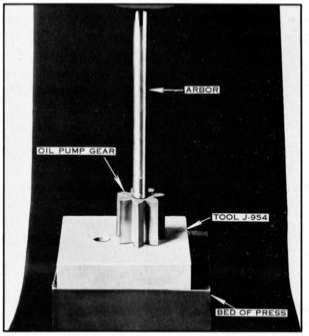


Fig. 202. Pressing Pump Shaft into Pump Gear

so as to form a heater body around the portion of the intake manifold through which the mixture from the carburetor flows.

The intake manifold is mounted on top of the exhaust manifold, this construction decreasing the amount of heat transferred to the carburetor.

Fig. 203. Pressing Pump Drive Gear onto Pump Shaft

Assembled in the heater body is an automatic valve which regulates the amount of heat by-passed through the heater body so that a sufficient amount of heat is transferred to the intake manifold at both low and high speeds, to insure a more uniform vaporization condition.

The automatic valve is mounted on a shaft, attached to which is a thermostatic spring which holds the valve closed under pressure when the manifold is cold, thus insuring a rapid warm-up by diverting the entire volume of exhaust gases to heating the intake manifold. This action continues until the thermostatic spring absorbs enough heat to gradually lose its tension. This allows the amount of heat being transferred to the intake manifold to be regulated in accordance with the heater-valve position which is automatically determined by the pressure applied to it by the velocity of the exhaust gases.

An anti-rattle spring is attached to the heater valve shaft, preventing heater valve noise during the engine warm-up. The spring should be adjusted so that it strikes the stop before the heater valve contacts the exhaust manifold when valve is in closed position. (See Fig. 204)

The counterweighted lever on the end of the heater valve shaft assures positive opening of the heater valve while the thermostatic spring is hot and off its anchorage. The thermostatic spring is to the rear of the manifold where it is less affected by cold blasts of air through the radiator core.

The heater valve, shaft, and shaft bushings are made of special heat resisting, non-corrosive metal in order to limit the possibility of sticking.

ADJUSTMENT OF THERMOSTAT ON MANIFOLD HEAT CONTROL VALVE

The proper tension on the manifold heater valve thermostatic spring at room temperature is 125° wind-up (⅓ of a revolution approximately) on the six cylinder engine.

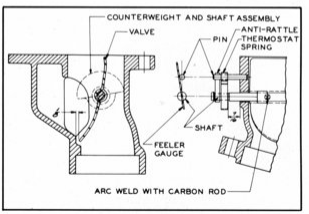


Fig. 204. Manifold Heat Control Valve

SERVICING EXHAUST MANIFOLD

It is extremely important that the thermostatically controlled manifold valve is properly positioned on the shaft. With the valve in the closed position, the slot in the rear end of the manifold valve shaft should be six degrees to the left (toward engine) of straight up and down. The valve is in this position when gauge (feeler stock) laying in slot in end of shaft contacts stop pin. (See Fig. 204) To assure proper position of valve:

1. Install shaft and counterweight assembly in manifold with counterweight to the top. Slot in end of valve shaft will be in nearly straight up and down position.
2. Rotate shaft slightly toward engine.
3. Place feeler gauge in slot in end of shaft and rotate away from engine until feeler contacts anti-rattle spring stop pin.
4. With counterweight toward top and gauge laying in shaft slot and touching stop pin, valve in closed position within ⅛", arc weld valve to shaft. (See Fig. 204)

   NOTE—Clamping valve to shaft will help hold it in position to weld.

ENGINE MOUNTING

Six cylinder engine mountings are similar to those used on 1948 98 models. Three mountings, one at the front and two at the rear, control

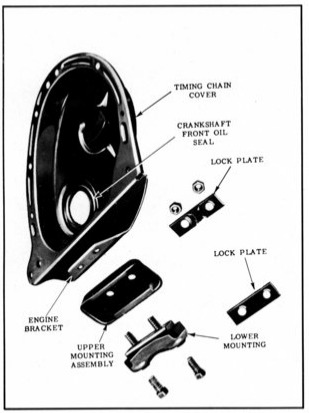


Fig. 205. Front Engine Mounting Detail

vertical, lateral, fore and aft movement of the engine caused by engine torque and periodic vibration. (Figs. 205, 206 & 207)

CAUTION—When installation of a front engine mounting becomes necessary, the cap screws which fasten the mounting to the frame, should first be screwed finger tight. Then take one turn on one cap screw, and one turn on the other, and so on, to tighten evenly in place. DO NOT TIGHTEN ONE CAP SCREW IN POSITION INDEPENDENTLY OF THE OTHER. This is extremely important, since if either cap screw is tightened in place independently of the other, the lower portion of the assembly will not seat evenly in the upper portion. The front mounting must be properly positioned and tightened otherwise severe engine roughness will be present. Make certain that the short pilots (in which the holes are tapped) actually enter the cross member.

COOLING SYSTEM

The 1949 six cylinder engine cooling system is composed of a radiator core, thermostatic water flow control, water by-pass, water pump and fan.

Water is discharged into a manifold tube lying along the block in the water jacket by a water pump mounted at the front of the cylinder block. (Fig. 208)

The water distribution manifold tube is on the right side of the cylinder block, between the valves and cylinder barrels. Holes in the side of the manifold and slots along the top distribute water around the valves for ample cooling.

If the engine portion of the cooling system should become clogged, the condition should be corrected by use of a reputable solvent rather than by reverse flushing.

In the event the radiator portion of the cooling system becomes clogged, the condition should be corrected by the use of a reputable solvent, or reverse flushing of the radiator core and tank assembly only.

RADIATOR CORES

The Harrison Cellular round "V" type radiator core, used on six cylinder engines, is bound to an upper and a lower tank by a steel harness forming the radiator unit. This assembly is bolted to a rigid steel support extending along the bottom and on the sides of the core.

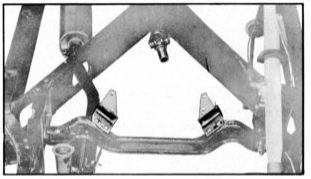


Fig. 206. Rear Engine Mounting

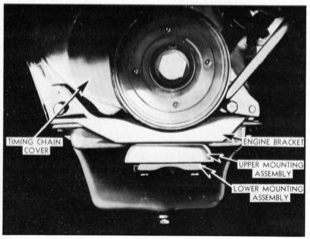


Fig. 207. Front Engine Mounting

The upright supports on each side are connected by a bar in front of the core. This entire unit is mounted, as a single assembly, on the front cross member with one stud in the bottom of the center and insulated from the frame with rubber impregnated canvas 5/16" thick.

Also attached to the radiator support are the front fenders, making a single unit of the radiator core, baffle, fenders, and grille.

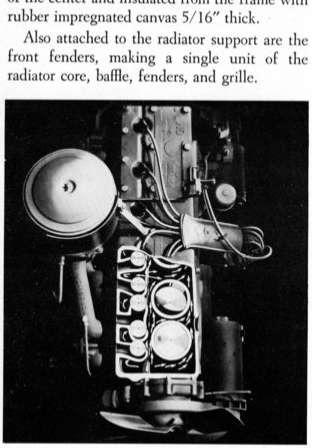


Fig. 208. Cooling System

Remove and Replace Radiator Core

When removing and replacing the 6 cylinder engine radiator core:

1. Drain cooling system.
2. Disconnect upper and lower hose connections.
3. Disconnect hood latch cable.
4. Remove upper radiator baffle.
5. Remove one self-tapping screw (each side) shroud to radiator core.
6. Remove the four self-tapping screws (each side) attaching the core to the core support.
7. Turn fan as necessary and remove core.
8. To replace, reverse sequence of operations.

TEMPERATURE CONTROL

The thermostatic valve used in the 6 cylinder engine cooling system is similar in design and description to that used on 8 cylinder engines, described in that section, except for its location which is in the cylinder head water outlet.

FAN AND BELT

Four unequally spaced fan blades riveted to a pressed steel pulley forms the radiator fan which is attached to the water pump impeller shaft hub with four cap screws. Proper tension of the "V" belt driving the fan is maintained by adjusting the position of the generator which is driven by the crankshaft pulley through the same belt.

Lateral run-out of fans must not exceed ⅛" and out-of-balance must be held within one quarter inch ounce in order to avoid rough engine and short water pump bearing life.

Remove and Replace Fan Blades

The fan blades may be removed and replaced without removing the water pump or front end sheet metal and radiator.

If the fan blades and pulley are removed, they may be attached to the water pump shaft flange more easily as follows:

1. Screw a 5/16"-24 x ⅝" stud into the water pump shaft flange on the radiator side of the flange.
2. Put the fan pulley and fan blades in place with the stud in one of the bolt holes of pulley and fan blades. The stud will align the three remaining holes so cap screws can be screwed in place.
3. Install the three remaining cap screws and turn finger tight, then remove stud and install fourth cap screw and tighten all screws tight.

If fan blades only are removed and replaced, the above steps are not necessary, since the tension on the fan belt will maintain the holes in the fan drive pulley and water pump shaft flange in alignment.

Adjust Fan Belt

The fan belt tension is adjusted by the movement of the generator on two supporting pivot bolts, and is held in position by a slotted adjustment link clamped to the generator with a cap screw.

Too tight a fan belt will cause excessive wear on the bearings and eventual leaks.

The fan belt should be adjusted so that ¾" deflection will be obtained when measured by means of a scale midway between the fan and generator pulleys, and at right angles to a straight edge laid across the two pulleys, as shown in Fig. 209. Push in on scale lightly.

CAUTION—After completing fan belt adjustment, be sure that all generator attaching bolts are securely tightened. (See Torque Chart)

Remove Lower Fan Pulley

The drive pulley on the crankshaft is of pressed steel; therefore, if removal becomes necessary, care must be exercised to prevent damage to pulley rim. The pulley can be started off the crankshaft by using two screwdrivers, one on each side of the pulley, between rim of pulley and chain cover and prying out on the pulley.

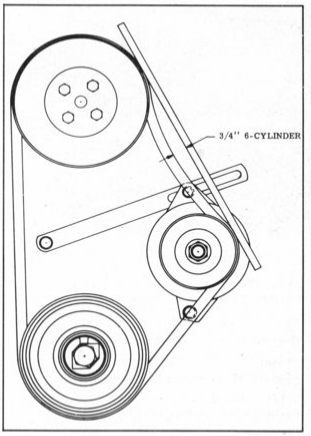


Fig. 209. Fan Belt Adjustment

WATER PUMP

A centrifugal type water pump mounted at the front of the cylinder block is driven at .95 times crankshaft speed by the crankshaft through a "V" belt which also drives the generator. The design and description of the 6 cylinder water pump are similar to those of the 8 cylinder engine except for the above mentioned mounting and drive, and that section should be referred to for further information.

Water Pump By-Pass

A water by-pass which consists of a drilled passage from the cylinder head water jacket through the cylinder block to an opening in the water pump cover is incorporated in the design

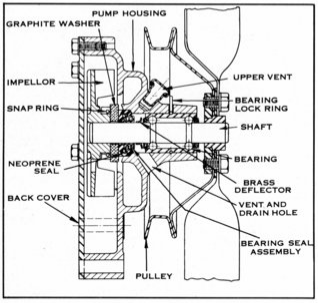


Fig. 210. Water Pump Assembly

of the engine in order to prevent excessive pressure build-up within the system while the thermostatically controlled valve is closed.

Remove and Replace Water Pump

1. Remove fan belt from crankshaft pulley by first relieving tension on belt at generator pulley.
2. Loosen and remove the three cap screws which attach the pump to cylinder block.
3. Loosen lower radiator hose.
4. Remove water pump assembly.
5. To install, use new gasket and reverse sequence of operations.

Disassemble Water Pump

Whenever it becomes necessary to disassemble the water pump, the operation should be performed in the following sequence:

1. Remove cover plate from back of pump body.
2. Remove pulley from pump shaft flange.
3. Remove bearing lock ring from outside of pump housing at bearing. (See Fig. 210)
4. Support outer end of pump body in arbor press and and press shaft and bearing assembly through the impeller. (See Fig. 211)

If bearing only is to be replaced, no further disassembly is necessary. The bearing and pump shaft will be serviced as an assembly since the shaft serves as the inner race for the ball bearing. See note under ASSEMBLE WATER PUMP.

Assemble Water Pump

1. Install bearing seal assembly into rear of pump housing with the four parts in their relative positions, as shown in Fig. 210. Install graphite washer either side toward impeller.

   The water pump shaft deflector is serviced separate from the bearing and shaft. When a new bearing is installed, or the water pump is overhauled and the original bearing continued in service, use a new slinger.

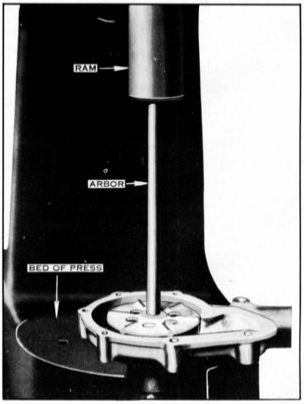


Fig. 211. Removing Water Pump Shaft

Assemble brass deflector to water pump bearing shaft as follows: (See Fig. 212)

(a) Stand bearing and shaft assembly in an upright position in a small press.

(b) Carefully start brass slinger onto end of shaft with the fingers. Flared end of slinger should be toward ball bearing. (See Fig. 210)

(c) Lay a .025" thick feeler gauge on top side of bearing.

(d) Place tool J-1446 over slinger and then, by use of press, push slinger down on shaft until a slight drag is felt on gauge. Clearance between slinger and end of bearing must be .025" in order to secure proper protection of bearing and yet not have slinger touch bearing and produce noise.

(e) Remove tool J-1446 and water pump bearing and shaft assembly from press.

IMPORTANT NOTE—In the reassembly of water pumps it is important to make sure that:

(a) Machined chamfered seat within water pump body casting for rubber seal is not scored, or that rubber or dirt is on the seat to keep seal from seating properly. Seat should be thoroughly cleaned with thinner and wiped dry and clean before seal assembly is installed. Use water pump body cleaning reamer Tool J-1455.

(b) When installing seal assembly in body casting, make sure that it positively seats and does not hang up on sides of casting. Wetting the hole in casting with soap solution will aid in the easy assembly of the rubber seal assembly. Use Water Pump Seal Installing Tool No. J-1456.

2. Install snap ring in groove inside housing and behind graphite washer.
3. With water pump impeller supported in arbor press, press shaft and bearing assembly into pump body until bearing lock ring snaps into position in the bearing outer race. After impeller has been pressed into place and with bearing lock ring in place, there should be 1/32" clearance between pump impeller rear finished face and the end of pump housing.
4. Install pump body rear cover plate, using a new gasket.
5. Install pulley.

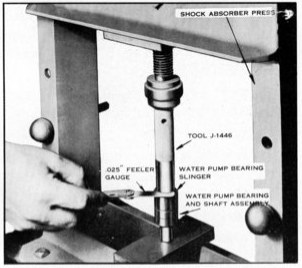


Fig. 212. Installation of Water Pump Shaft Slinger

METHOD OF DETECTING EXHAUST GAS LEAKAGE

Start test with engine cold and fan belt disconnected so the water pump will not operate. Disconnect the upper hose at the radiator. Drain system until water is level with the top of the block but no lower. Take out the hose line or block thermostat. Replace the thermostat housing, if removed, and for convenience bend the hose back into a vertical position. Fill the hose with water nearly to the top. "Gun" engine several times, watching for bubbles while "gunning," and also when engine drops to "idling." Appearance of bubbles or a sudden rise of water level in the hose indicates exhaust

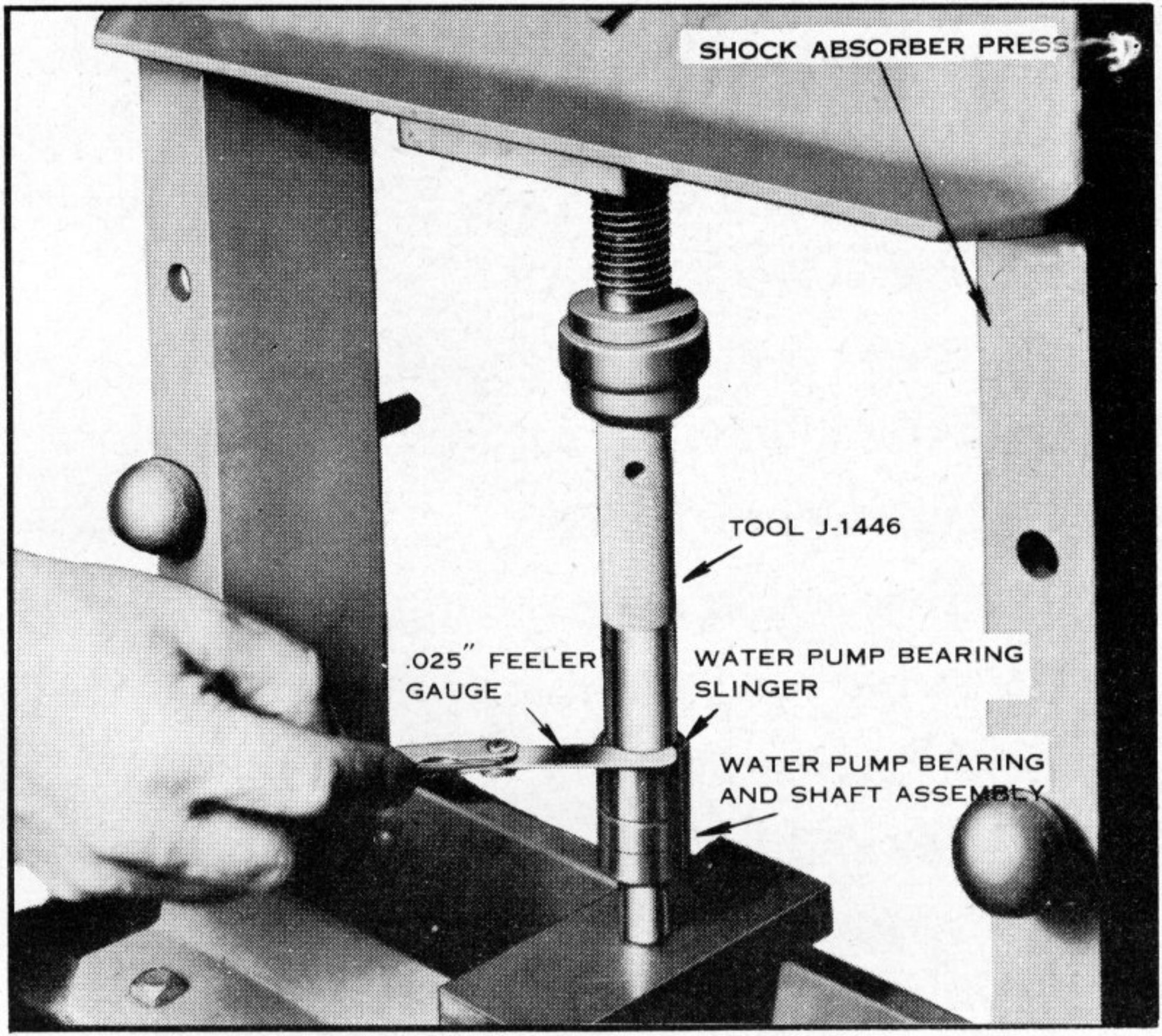


Fig. 212. Installation of Water Pump Shaft Slinger

gas leakage. The test should be made quickly before boiling starts, since steam would also appear as bubbles and give misleading results.

Fig. 213. Heavy Duty (Oil Bath) Air Cleaner

INTAKE SILENCER AND AIR CLEANER

The 6 cylinder engine is equipped with a combination air cleaner and intake silencer similar to that used on 8 cylinder models and the heavy duty cleaner is furnished as optional equipment.

Air cleaner servicing instructions included in the 8 cylinder section of this manual are applicable to the 6 cylinder cleaners and may be referred to for information.

Carburetion

The 1949-76 series Hydra-Matic Oldsmobiles are equipped with Carter Carburetor, model 709-S, and the Syncro-mesh cars are equipped with Carter Carburetor, model 710-S.

The two carburetors are both down-draft, triple venturi models, and are similar in construction except as follows:

1. The 710-S carburetor has a distribution baffle in the riser. This baffle is not used in the 709-S carburetor as the wide-open stop position of the throttle is 9° past the centerline of the bore.
2. A spring is used to aid in the return of the accelerating pump linkage in the 709-S carburetor and to insure against sticking at wide open throttle.

Line drawings of the carburetors are shown in Figs. 215, 225, 226 & 227.

The specifications and calibration which are slightly different between the two models are as follows:

1. The thermostatic coil housing assembly used on the 710-S is of different calibration (F Coil) from that used on the 709-S (M Coil). Both are set at index.
2. The dechoker setting on the 710-S is different from that on the 709-S. The method of adjustment is the same.
3. The correct throttle adjustment for the 710-S is six miles per hour in high gear on level road. The correct throttle setting (using an accurate tachometer) is 425 engine r.p.m. for 710-S and 375 engine r.p.m. for the 709-S.

Both 1949 - 6 cylinder engine carburetors incorporate the following features:

1. A triple venturi.
2. Positive action accelerating pump.
3. Metering rod (variable orifice).
4. Anti-Percolating unit.
5. A slow and fast idle device, which operates in conjunction with the automatic throttle opening mechanism (throttle cracker).
6. Dechoker.

7. Lockout.
8. Climatic Control (Automatic Choke).

The metering rods are throttle and vacuum controlled.

Servicing and parts for the Carter carburetor and automatic choke are available through the Carter Carburetor Company and their authorized distributors.

Each carburetor is calibrated to provide maximum power and mileage on standard gasoline in normal altitudes, and flow tested to determine accurately the weight of air and fuel comprising the mixture.

Wear will, in time, impair the efficiency of the carburetor. Bringing the unit back to normal specifications through proper servicing will maintain the good performance and economy originally built into the unit.

Due to the close relationship between the various carburetor adjustments, it is important when adjustments become necessary to make them in the following sequence:

1. Float adjustment.
2. Accelerator pump adjustment.
3. Metering rod adjustment.
4. Anti-percolator adjustment.
5. Fast idle adjustment.
6. Dechoker adjustment.
7. Lockout adjustment.
8. Idle adjustment.
9. Automatic throttle opening adjustment.

MAKE EACH ADJUSTMENT CAREFULLY TO AVOID DISTURBING ONE ADJUSTMENT WHILE MAKING ANOTHER.

TRIPLE VENTURI

The fuel atomized in the primary venturi is kept centrally located in the air stream by the surrounding blanket of air passing into the second and again into the main venturi. This provides a triple protection against liquid fuel coming in contact with the walls of the carburetor and, since the fuel is better atomized, there is a noticeable increase in smoothness, greater power output, and economy at both high and low speeds.

FLOAT LEVEL ADJUSTMENT

The float level adjustment is ½" on both carburetors.

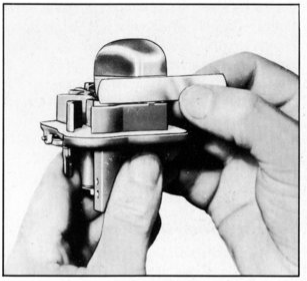


Fig. 214. Measuring Float Level

To check float level:

1. Invert the bowl cover and, with inlet needle seated, gauge vertical distance from top of projection on bowl cover to top of soldered seam at front end of float with tool J-818-1. (See Fig. 214)
2. Adjustment is obtained by bending the lip on the float which contacts needle. Do not bend on front of float when adjusting.
3. If intake needle or seat shows wear or damage, replace both as these come in matched sets.
4. If holes in float for float pin are worn or out of round, or float is loaded with gas, replace float. Float pin should be replaced if it shows wear.

NOTE: When holding bowl cover in

normal position, free end of float should have minimum drop of ½". Adjustment can be made by bending two small float-stop lips at anchored end of float.

ACCELERATING PUMP

For smooth, rapid acceleration and flexibility, it is necessary to supply momentarily an extra amount of gas when the throttle is opened. On the up stroke of the pump piston, gas is drawn through the inlet check valve into the pump cylinder. On the down stroke, the compression closes the inlet check valve and opens the discharge check valve, forcing a spray of fuel through the pump discharge jet against the secondary venturi.

CAUTION—PUMP ADJUSTMENT SHOULD BE MADE BEFORE ANY OTHER CARBURETOR ADJUSTMENT EXCEPT FLOAT LEVEL ADJUSTMENT.

Pump Adjustment

Full pump stroke is obtained by moving the throttle from closed to wide open position. The stroke can be checked by marking the pump shaft at wide open position and fully closed position and then gauging the distance between the marks. Adjustment is obtained by bending throttle connecting rod at lower angle.

Full pump stroke is ¼" ± 1/64" on both carburetors.

METERING ROD—FUEL SYSTEM

The main metering rod controls the flow of gas from the float chamber to the main discharge nozzle and provides maximum power without sacrificing economy or vice versa, since it varies the size of the fuel orifice (metering rod jet) depending on the amount of throttle opening. The metering rod works within the metering rod jet.

Three steps of different diameters on the rod provide the means of varying the fuel orifice (metering rod jet). The larger diameter step (economy step) controls the fuel flow to approximately 50 M.P.H., after which the next step becomes effective up to approximately 70 M.P.H. For maximum speed or for full power at any speed, the small step becomes effective.

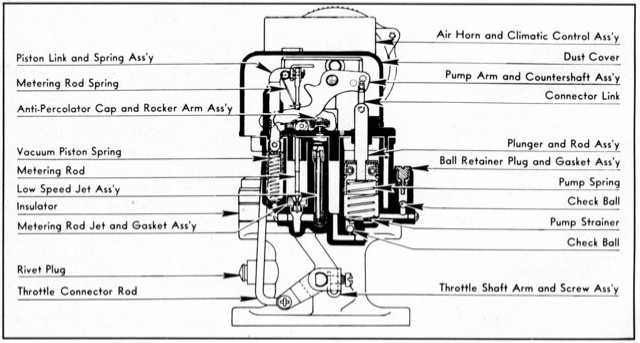


Fig. 215. Carburetor Details

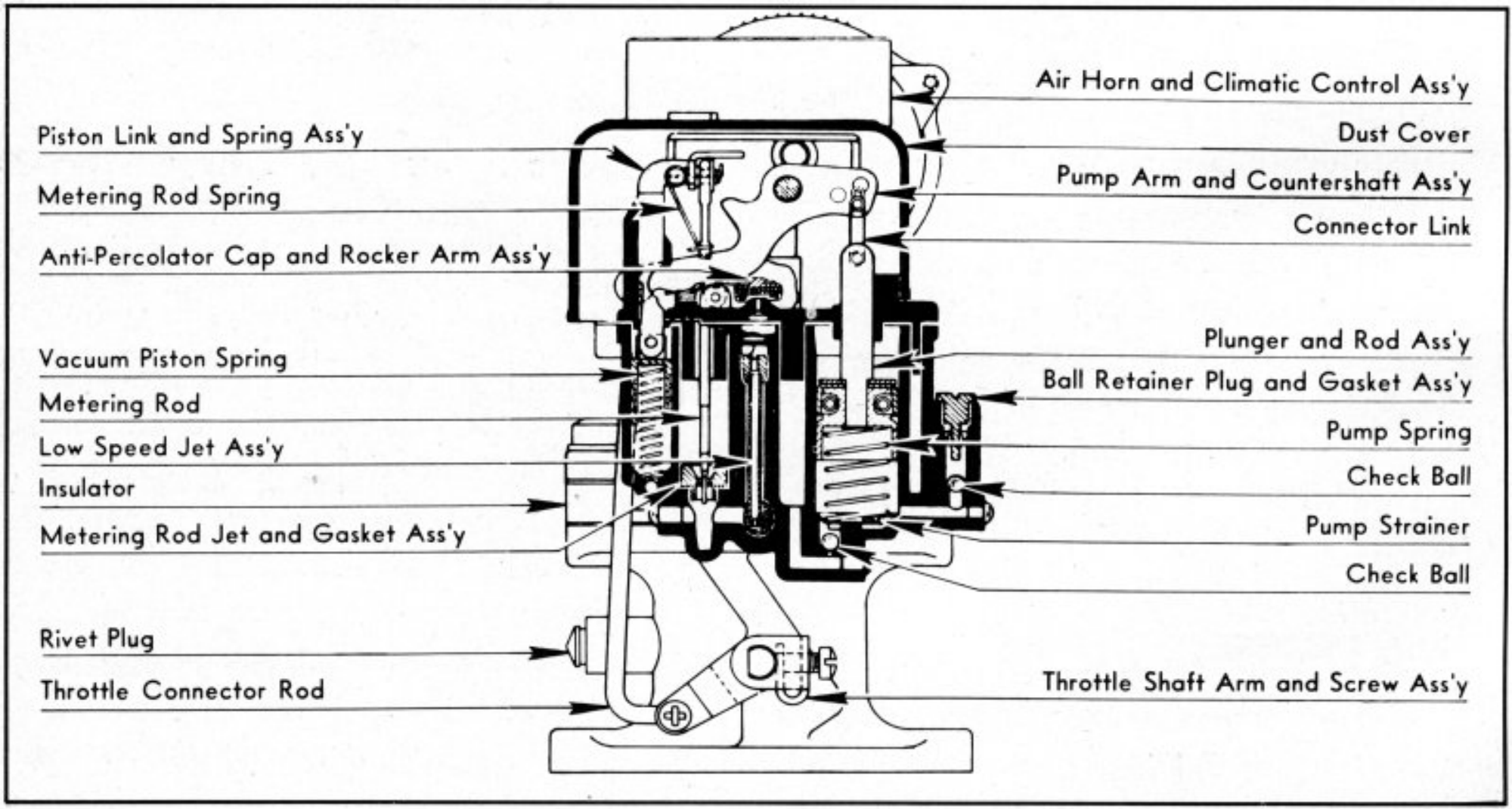


Fig. 215. Carburetor Details

Fuel enters the carburetor at the float chamber inlet, flowing through the needle valve and seat into the float bowl. It is maintained at constant level by the float.

Air enters the carburetor air horn, placing a suction on the main discharge opening, depending on the amount of throttle opening. The main metering rod controls the flow of gas from the float chamber to the main discharge nozzle. At all speeds, the fuel passes from the metering rod jet into the main passage, idle jet and nozzle, from which it enters the air stream, either through the idle discharge opening or the main discharge nozzle. The main nozzle discharges the fuel at an upward angle into the primary venturi against the downward air stream.

METERING ROD ADJUSTMENT SHOULD BE MADE WHENEVER IT HAS BEEN CHANGED OR WHEN LEANER THAN STANDARD RODS ARE INSTALLED AND MUST BE MADE AFTER THE PUMP ADJUSTMENT.

Metering Rod Adjustment

1. Insert gauge tool No. J-1265 in place of metering rod, seating tapered end in metering rod jet. Hold gauge vertical to insure seating.
2. With throttle valve fully closed, (throttle screw backed out) press down lightly as far as possible on piston link directly over piston. There should be less than .005" clearance between metering rod pin and shoulder in notch of gauge. (See Fig. 216) (Gauge must not drag on pin.)
3. Adjustment can be made by bending lip on piston link so that it contacts pump arm.

ANTI-PERCOLATOR

The anti-percolating device vents the main nozzle and prevents percolation when the motor is at rest after hard or high speed driving. Percolation is caused by the heat of the motor causing the fuel in the float chamber to boil, forcing fuel through the nozzle and into the intake manifold. The excess gasoline in the manifold causes hard starting with a hot motor.

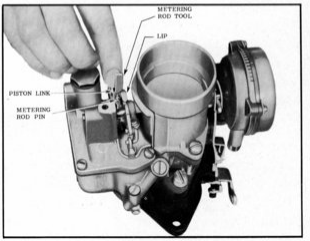


Fig. 216. Adjusting Metering Rod

Anti-Percolator Adjustment

With the throttle valve opened .020", which is accomplished by placing tool J-1136 between valve and bore of carburetor (side opposite port), there should be a clearance of .005" to .015" between anti-percolator cap rocker arm and pump arm. Adjustment is obtained by bending anti-percolator rocker arm as necessary. (See Fig. 217)

SLOW AND FAST IDLE AND AUTOMATIC THROTTLE OPENING

Both carburetors incorporate a slow and fast idle mechanism which operates in conjunction with an automatic throttle opening device and automatic choke.

This mechanism consists of a fast idle link assembly, fast idle cam and pin assembly and throttle adjusting screw and lever assembly. (See Fig. 218)

Fig. 218 shows the carburetor with the fast idle cam in the wide open choke position. The cam will be in this position when the hot engine is stopped and the throttle valve allowed to close. As the engine becomes cold, the thermostatic spring on the automatic choke gradually gains

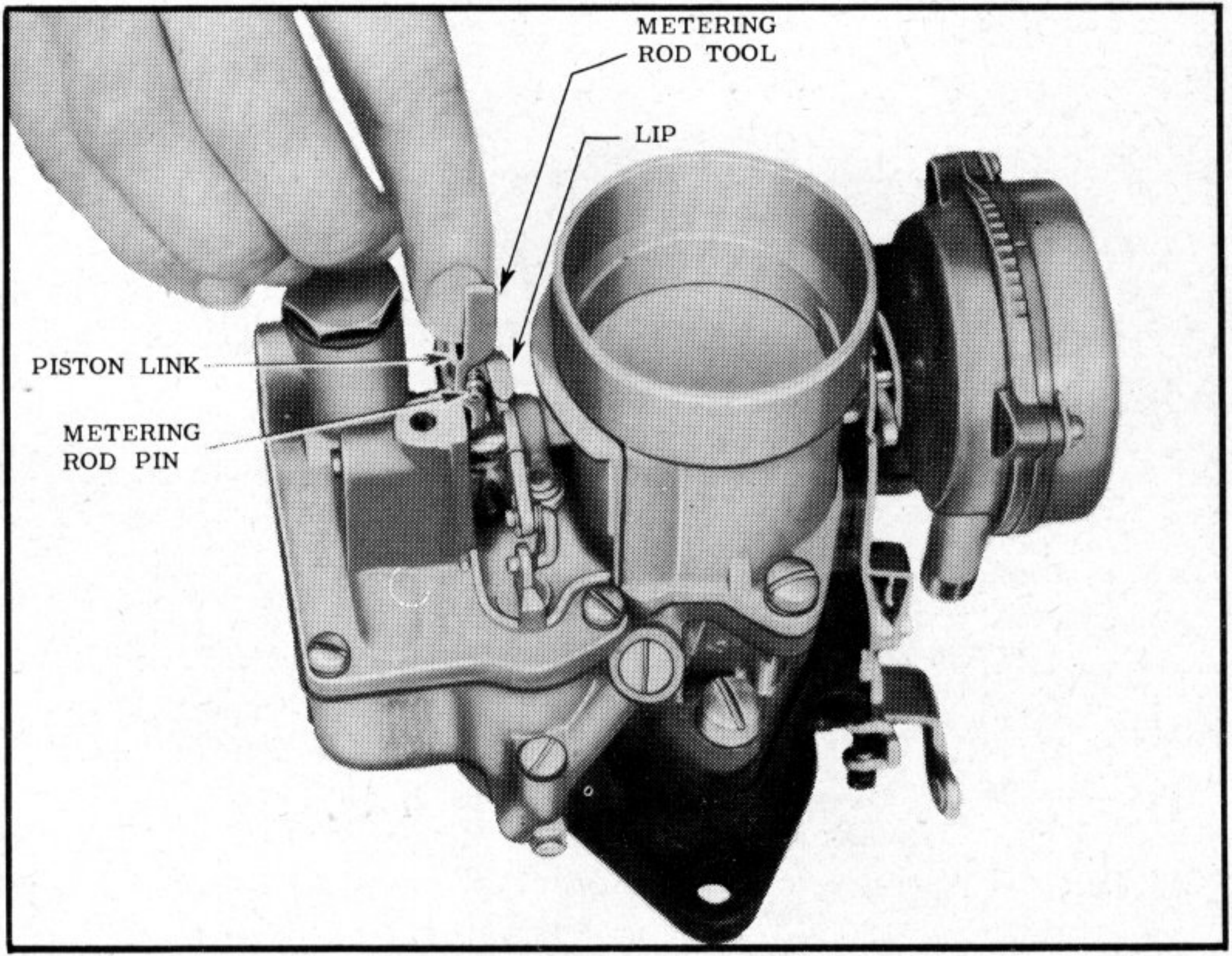


Fig. 216. Adjusting Metering Rod

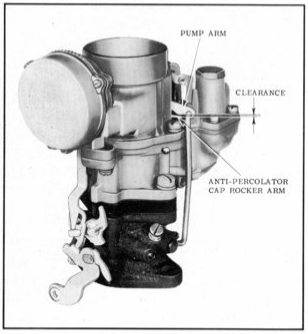


Fig. 217. Adjusting Anti-Percolator

tension and tends to close the choke valve. It is prevented from doing so by the throttle adjusting screw coming in contact with the first step on the fast idle cam.

As soon as the starter is engaged, the throttle is partially opened by the automatic throttle opening device.

This causes the throttle adjusting screw (idling screw) to be lifted away, allowing the fast idle cam to raise and close the choke valve by means of the tension of the thermostatic spring. As soon as the engine fires, the throttle adjusting screw comes to rest on the high portion of the fast idle cam, providing the proper throttle opening for a cold engine. (See Fig. 219)

As the engine warms up, the thermostatic spring loses its tension, allowing the choke lever link to drop, which opens choke valve, the fast idle cam to revolve, and the throttle to close to slow idle. The idle adjusting screw comes to rest on the first step of the cam.

Fast Idle Adjustment

With the fast idle cam held in slow idle position, tighten throttle lever adjusting screw until it just seats against cam. Hold throttle lever closed and pull cam back until first (or lower) step on cam is against (not on) set screw. (See Fig. 218)

With the fast idle cam and throttle lever adjusting screw in this position, there should be ⅝″ clearance between inside wall of air horn and lower edge of choke valve. Adjustment is obtained by bending the offset portion of the fast idle link. Tool J-1137.

DECHOKER

Should the engine become flooded, the choke valve can be opened by pressing the foot accelerator to the wide open position. This brings the cam on the throttle lever in contact with the pin on the fast idle cam, which opens choke valve. (See Fig. 220)

To deflood engine hold the accelerator in the

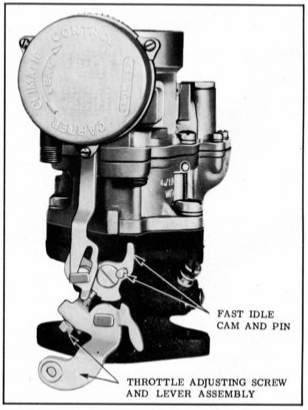


Fig. 218. Slow and Fast Idle—Engine Hot or Cold—Choke Open

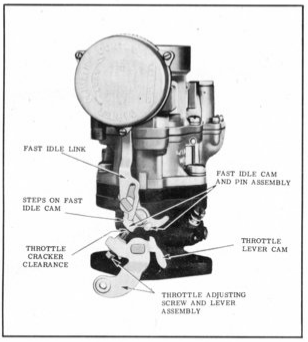


Fig. 219. Slow and Fast Idle–Engine Cold and Running

wide open position while the engine is turned over several times by means of the starter.

Dechoker Adjustment

Move throttle to wide open position.

On the 710-S carburetor, the dechoker mechanism should open the choke valve so there is a distance of 7/16″ between the lower edge of the choke valve and inner wall of air horn. On the 709-S carburetor, the distance should be ⅜″. On both carburetors, adjustment is obtained by bending the cam on the throttle lever that contacts the pin on the fast idle cam. Use tool No. J-1137.

LOCKOUT

Carburetors have an automatic lockout device which prevents the choke closing under certain wide open throttle conditions. For example—with choke and throttle wide open, on a hard, long pull, the choke tends to close because of the lowered vacuum and slow heat transfer. It is prevented from doing so by the lip on the lower end of the fast idle connector link coming in contact with the cam on the throttle lever. (See Fig. 221)

Lockout Adjustment

With the throttle and choke valves wide open, choke should lock in the wide open position.

Adjustment is made by bending the lip of the lower end of the fast idle link to give 1/32″ clearance between the lip and the throttle lever lock when the throttle and choke valves are held wide open. (See Fig. 221) Use tool J-787.

IDLE ADJUSTMENT

With motor warm, choke valve wide open, set throttle lever adjusting screw to correct idle, then set idle adjustment screw so that motor fires evenly without loping or stalling.

If good idle is not obtained, remove adjusting screw and speed up motor, which will remove any dirt that may have accumulated around the adjusting screw seat. If idle is still unsatisfac-

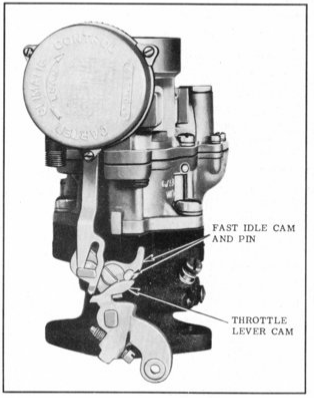


Fig. 220. Adjusting Dechoker

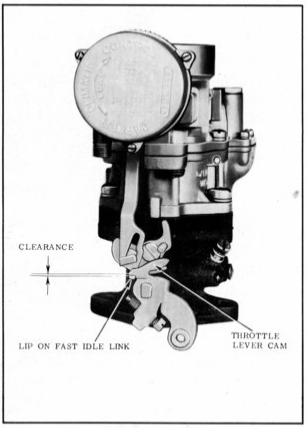


Fig. 221. Adjusting Lockout

tory, remove the low speed jet tube and clean thoroughly with compressed air. Examine to see that tube seats air tight in casting, top and bottom. If they do not, replace with new tubes of identical specifications.

THROTTLE CONTROLS—ADJUSTMENT

Synchro-Mesh Transmission Equipped Cars Only

The throttle control mechanism, which is mounted on the engine, is comprised of the following parts:

a. Four separate control rods between the accelerator pedal and carburetor.
b. The throttle control bellcrank and throttle cracking lever and throttle cracking adjusting screw.

If the engine throttle control rods are disassembled or new rods installed, then, in addition to the normal carburetor and automatic throttle opening adjustment, proper throttle control rod adjustments must be made as follows:

1. Set carburetor at correct idle.
2. Disconnect carburetor rod at trunnion end.
3. Insert tool BT-25 through holes in bell crank and bracket.
4. With tool BT-25 in place and carburetor held on slow idle, adjust length of throttle rod so that rod slips freely through hole in carburetor arm. Insert cotter key.
5. Remove tool BT-25 and with carburetor still held on slow idle, remove cotter key from bellcrank to idler lever rod. Loosen lock nut at clevis.
6. Adjust bellcrank to idler lever rod so that with rod inserted in hole in bellcrank a clearance of 3/32" to 5/32" will be maintained between idler lever and bead on toe pan.
7. Insert cotter key and tighten lock nut.

   NOTE: See Hydra-Matic section for throttle control adjustment on Hydra-Matic equipped cars.

AUTOMATIC THROTTLE OPENING DEVICE

(Throttle Cracker)

The automatic throttle opening device which is a part of the throttle control mechanism consists primarily of the throttle cracking lever, the throttle cracking rod by means of which the cracking lever is operated, and the throttle mechanism which connects the accelerator to the carburetor.

As previously described under SLOW AND FAST IDLE, after a warm engine has cooled, the throttle adjusting screw will be in the slow idle position with the choke valve held open. (See Fig. 218) As soon as the starter is engaged the throttle is partially opened, at which time, the throttle adjusting screw is lifted from its seat in the slow idle position and comes to rest in the fast idle position, allowing the tension of the

thermostatic spring to close the choke valve. This operation is performed by means of the throttle cracking rod moving the throttle cracking lever against throttle adjusting screw on bellcrank when starter is engaged. The engine will not start properly if the automatic throttle opening is not correctly adjusted.

AUTOMATIC THROTTLE OPENING ADJUSTMENT

The correct automatic throttle opening for both carburetors is a clearance of .0625" to .0825" (1/16") between the throttle adjusting screw (idling screw) and highest portion of fast idle cam when the starter button is fully depressed. (See Fig. 219)

To make adjustment, proceed as follows:

1. Depress starter button to full down position.
2. Loosen throttle cracker adjusting screw lock nut on bellcrank. (Fig. 219)
3. Set the adjusting screw to obtain .0625" to .0825" (1/16") between the throttle adjusting screw (idling screw) and the fast idle came with the throttle adjusting screw about to seat on highest portion of cam and the starter button depressed.

OTHER CARBURETOR ADJUSTMENTS

1. *If Carburetor Loads Up* after considerable service, float level should be checked. Wear on lip of float lever will raise float level. Float level may be reset by bending lip of float lever down to raise float level or bending lever up to lower float level. Only a very slight bend is needed.

   NOTE: Always recheck float drop.
2. *If Motor Stalls* while idling, reset throttle adjusting screw and idle adjustment screw to specifications. If these adjustments do not correct stalling, remove low speed jet and clean thoroughly with compressed air. Examine and see that jet seats gasoline-tight at shoulder. If not, replace with new jet of identical specifications. *Never change a low speed jet from one carburetor to another or from one carburetor barrel to another.*
3. *A Clogged Pump Jet* is indicated by increasing resistance on foot throttle. Pump jet should be removed and cleaned with compressed air, which, in many cases, will remove the dirt or lint. However, it is usually advisable to replace the pump jet, as its cost is nominal. All jets must be seated gasoline tight.
4. *Poor Acceleration* may be due to damaged or worn plunger leather in accelerating pump, loose plunger, corrosion or sediment in pump cylinder, bent pump arm parts (which may be replaced at small cost), or incorrect adjustment.

Pump needle passage inside air horn should be cleaned with compressed air. Be sure that retaining ring at bottom of pump cylinder retains check ball in place.

DISASSEMBLE CARBURETOR

Use Carburetor Service Kit. (See Figs. 225 to 227)

1. Remove dust cover, lock washer and attaching screw. Examine inside of dust cover for marks which indicate metering rod assembly has been dragging. This condition can be corrected by the proper installation of dust cover.
2. Remove fast idle cam attaching screw and fast idle cam.
3. Remove air horn attaching screws, air horn and gasket. (Two screws on top and one beneath climatic control housing.)
   (a) Remove retainer screws, retainers and thermostatic coil and housing assembly.
   (b) Remove piston housing strainer.
   (c) Remove choke valve screws and choke valve.
   (d) Loosen screw on choker lever, screw and link assembly four full turns. Pry

lip on lever away from shaft with screwdriver or pliers.

(e) Revolve choke shaft counter-clockwise until piston is free from cylinder and remove assembly intact.

NOTE: Do not remove pin holding piston housing and air horn castings together. These are line-reamed at factory and should not be disassembled.

4. Remove pin spring, spring retainer and retainer spring from throttle connector rod to remove rod.
5. Remove pin spring and connector link from pump arm.
6. Remove low speed passage plug and gasket assembly. (Located next to anti-percolator cap.)
7. Remove bowl cover attaching screws and lock washers, lift off bowl cover assembly intact and remove vacuum piston spring from vacuum cylinder in casting. Remove piston from link by revolving one-quarter turn. Then remove piston link and metering rod from bowl cover assembly and disassemble rod and link. Do not lose small metering rod disk. Next remove bowl cover gasket, pump arm and countershaft assembly, float and lever assembly, needle and seat assembly, strainer nut and gasket assembly and strainer.
8. Remove anti-percolator cap and rocker arm assembly, and spring by removing anti-percolator pin.
9. Remove pump plunger and rod assembly and pump spring. Then remove pump strainer and check ball from bottom of pump cylinder.
10. Remove low speed jet assembly. Remove nozzle passage plug and gasket assembly, nozzle retainer plug and nozzle. Be sure to remove small nozzle gasket from nozzle passage.
11. Remove metering rod jet and gasket assembly.
12. Remove pump jet passage plug and gasket assembly, and pump jet.
13. Remove pump discharge ball retainer and gasket assembly, and check ball.
14. Remove body flange assembly gaskets and insulator.
15. Remove idle adjusting screw, spring and idle port rivet plug.
16. Remove throttle shaft arm and screw assembly.
17. Remove throttle valve screws, throttle, throttle shaft and lever assembly.

ASSEMBLE CARBURETOR

Before reassembling carburetor, clean casting and all parts with clean gasoline, using a small brush and a clean pan. Do not immerse cork parts in gasoline. Then blow through all passages in casting with compressed air. Blow off each part before installing it in carburetor. Use all new gaskets. Check all parts to carburetor specifications. Replace all worn parts with new. If any carbon is in the bore of the carburetor, remove it by scraping or with sandpaper before installing parts. (DO NOT USE EMERY CLOTH.) Install all parts tightly.

1. Group all float circuit parts removed in operation 7.
2. Group all low speed circuit parts removed in operations 6, 10, 15, 16 and 17.
3. Group all high speed circuit parts removed in operations 8, 10, 11 and vacuum piston spring, vacuum piston link, piston, metering rod and disc removed in operation 7.
4. Group all pump circuit parts removed in operations 4, 5, 9, 12, 13 and pump arm and countershaft assembly removed in operation 7.
5. Group all choke circuit parts removed in operation 3.
6. Install needle seat assembly, strainer, and nut and gasket assembly in bowl cover.

7. Hang needle by clip on float lip and lower into place. Then install float lever pin; set float level.

   Invert bowl cover as assembled and gauge vertical distance from top of projection on bowl cover to top of soldered seam at front end of float. Correct setting is ½" with needle seated. (Use Tool J-818-1.) Adjustment is obtained by bending the lip on float which contacts needle. Do not bend on front of float in adjusting, as damage will result. If intake needle or seat shows wear or damage, replace both, as these come in matched sets. If holes in float for float pin are worn or out of round, or float is loaded with gas, replace float. Float pin should be replaced if it shows wear.

   When holding bowl cover in normal position, free end of float should have minimum drop of ½". Adjustment can be made by bending two small float-stop lips at anchored end of float.
8. With manifold side of carburetor flange casting facing up, install throttle shaft and lever assembly. Then back out throttle lever adjusting screw. If throttle shaft is worn or lever is loose on shaft, replace it.
9. Install throttle valve, using new valve screws. The trademark on the throttle valve should be facing up (toward manifold) and to the idle port side. With the valve screws loose, tap throttle valve lightly to centralize it in the bore of carburetor. Hold valve in place with fingers. Then securely tighten screws. Be sure throttle lever adjusting screw is backed off so valve will seat.
10. Install throttle shaft arm and screw assembly. Set arm and tighten screw so throttle will move freely. If holes in arm are worn, replace.
11. Install new idle port plug, idle adjusting screw and spring. No copper washer is used on plug. If idle adjusting screw is burred, replace it. Adjust idle screw to specifications. (Make final adjustment with engine running.)
12. Install body flange assembly, using new gaskets and insulator.
13. Install nozzle assembly with new gasket. Flat side of nozzle must be facing upward. Then install nozzle retainer plug, and nozzle passage plug and gasket assembly.
14. Install low speed jet. Be sure hole at lower end is open. Work jet well into seat by moving back and forth; then remove and examine to make sure jet seats in casting at shoulder; then reinstall.
15. Install pump jet and pump jet passage plug and gasket assembly. Be sure small hole in casting from pump jet passage to outside is open.
16. Install discharge check ball, and pump discharge ball retainer and gasket assembly.
17. Install intake check ball in bottom of pump cylinder, then pump strainer, pump spring and plunger and rod assembly.
18. Install metering rod jet assembly. If metering rod shows wear, replace metering rod jet and metering rod. Always replace both rod and jet. Never use one new rod with old jet or vice versa.
19. Assemble new gasket on bowl cover. Install anti-percolator cap and rocker assembly, and pump arm and countershaft assembly in bowl cover. Then install piston link assembly in bowl cover and attach piston. Invert bowl cover as assembled and place vacuum piston spring in piston. Invert carburetor casting as assembled onto bowl cover, then install screws and lock washers.
20. Install low speed passage plug and gasket assembly located next to anti-percolator cap in bowl cover.
21. Install connector link in medium hole in pump arm, and pump shaft with pin spring at top, and ends of link away from bore. Then install throttle connector rod.

22. Make accelerator pump adjustment.
23. Make metering rod adjustment.
24. Make anti-percolator adjustment.
25. Install new air horn gasket, and air horn and piston housing assembly. Be sure to install screw under piston housing.
26. Install choke shaft assembly and piston. At the same time install choker lever, screw and link assembly behind piston housing.
27. Install choker valve and use new choker valve screws. With the choker valve screws loose, tap choker valve lightly to centralize it in the air horn, then securely tighten screws. Choker valve should move freely in air horn. Then tighten screw in choker lever. Choke should fall open of its own weight.
28. Install strainer in piston housing. If strainer is dirty or clogged, replace.
29. Install thermostat housing and coil assembly with word "Climatic" at bottom and turn counter-clockwise to specifications. Install housing retainers and attaching screws and tighten securely.
30. Install fast idle cam with attaching screws.
31. Make fast idle adjustment.
32. Make dechoker adjustment.
33. Make lockout adjustment.
34. Pack dust cover attaching screw hole in bowl cover with graphite grease and install dust cover and attaching screw and lock washer. Never use oil or grease elsewhere on carburetor or linkage. Carburetor is now ready for installation on manifold.

AUTOMATIC CHOKE

The automatic choke on both carburetors is an integral part of the carburetor and consists primarily of two major assemblies—the thermostatic coil spring and housing assembly and the assembly consisting of piston housing, choke, shaft, lever, screen and piston. The automatic choke operates in conjunction with the automatic throttle opening device and the slow and fast idle mechanism. It is provided with a dechoker which is operated manually, should the engine become flooded.

Operation—Automatic Choke

(See Figs. 222 to 224.)

The operation of the automatic choke is governed by intake manifold vacuum and exhaust manifold temperature.

On initial starting, as the engine fires, the vacuum created in the manifold, pulls the piston down, exerting tension on the thermostatic spring and opening the choke valve far enough for initial running. Hot air is drawn from the stove on the exhaust manifold through the connecting pipe, and screen, to the automatic choke housing, and around the piston to the carburetor and intake manifold. As the heat increases around the thermostatic spring, the spring loses its tension allowing the choke to open gradually.

After it reaches the full open position, it will remain open of its own weight. When the engine is stopped, the thermostatic spring gains tension and tends to close the choke. (See SLOW AND FAST IDLE.) The automatic choke is protected by a screen in the hot air line to keep dirt and soot from entering the thermostatic housing. If the screen clogs, it will restrict the flow of hot air to the thermostatic housing and cause loading.

Automatic Choke Adjustment

Except for a check of the moving parts to see that they operate freely and an occasional cleaning of the hot air line screen, adjustment of the unit itself in the field should seldom be necessary, as the choke is properly calibrated at the factory.

Directions for adjusting (lean or rich) are clearly marked on the housing. For average driving and climatic conditions, coil housing should be set at index.

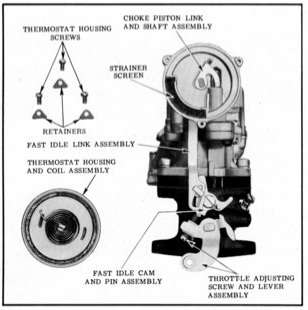


Fig. 222. Automatic Choke

Action of climatic control during warm-up period is affected by grade of fuel used.

MAKE NO ADJUSTMENT UNTIL MOTOR IS COLD. If cold motor shows a tendency to run lean during the warm-up period, turn housing counter-clockwise one mark at a time to richen it until desired results are obtained.

Do not richen choke more than two notches from index.

If cold engine has a tendency to load or run rich during the warm-up period, revolve choke housing clockwise one mark at a time to lean it out, until desired results are secured.

These adjustments should be made with care and *motor must be thoroughly cooled off* between adjustments. At least *four hours* should be allowed to cool motor.

AUTOMATIC CHOKE SERVICE SUGGESTIONS

If "hard starting" exists and is due to choke and carburetor, check as follows:

1. Examine choke valve and shaft to see that it is free of dirt and does not bind in air horn.
2. See that dechoker is adjusted properly.
3. If choke linkage does not operate freely because of grease and dirt on carburetor body, wash with brush using clean gasoline.
4. To check thermostatic coil spring, temporarily set choke at index. Choke valve should now close lightly on its seat at a temperature of 79° F. All parts of the carburetor and choke must be at this temperature when this check is made. If choke valve does not close at the proper temperature, install new thermostatic housing and coil assembly.
5. Make certain hot air line from manifold to choke is properly connected. An air leak will prevent proper operation.
6. See that automatic throttle opening device is properly adjusted.
7. See that slow and fast idle adjustment, dechoker adjustment, is correct.

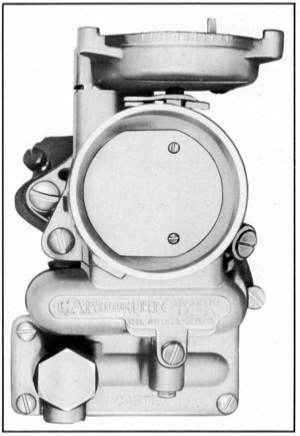


Fig. 223. Automatic Choke Valve

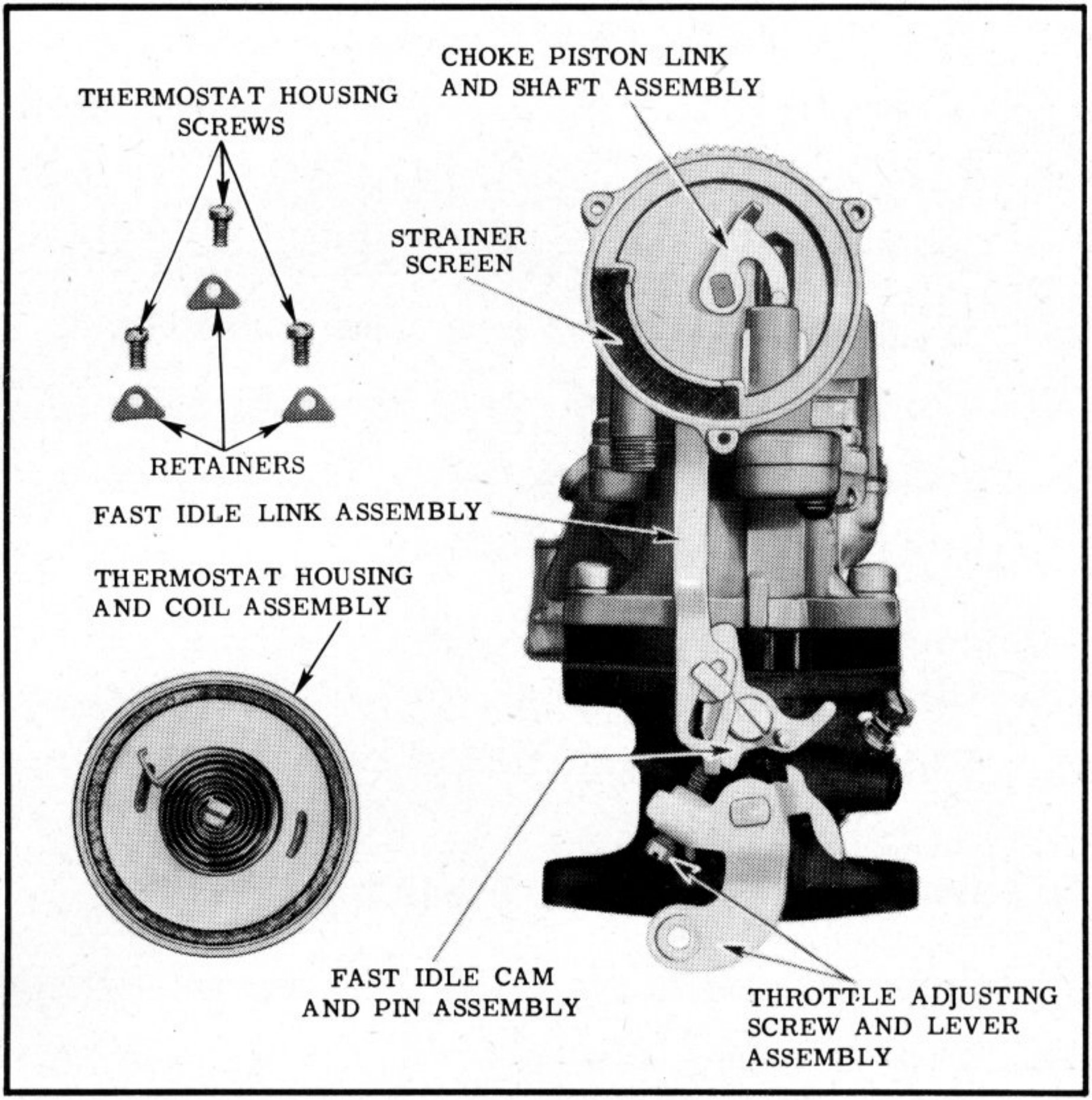


Fig. 222. Automatic Choke

Disassemble Automatic Choke

Do not attempt to service air horn and climatic control assembly on the carburetor. Remove from carburetor as instructed under ASSEMBLE AND DISASSEMBLE CARBURETOR.

To disassemble automatic choke, proceed as follows: (See Figs. 222, 224)

1. Remove attaching screws housing retainers and remove thermostatic coil and housing assembly.
2. Remove strainer screen.
3. Remove choker valve screws and choker valve.
4. Loosen clamp screw on fast idle lever, screw and link assembly, bend lip under screw with screwdriver, so it will pass over the portion of choke shaft which is not milled flat. Fast idle lever assembly can easily be removed if this lip is properly compressed.
5. Remove choker piston lever, link and shaft assembly by revolving shaft counter-clockwise until piston is free from cylinder.
6. Do not remove rivet that holds air horn and piston housing together. These parts are line-reamed at the factory.

   If it has been removed, line up the three choker shaft bearings with shaft and valve, so valve, shaft and piston work freely.

Assemble Automatic Choke

Before reassembling, wash all parts, *except coil and housing assembly* in clean gasoline. Then blow through all passages with compressed air. Remove all foreign substances from air passages and parts to allow all parts to work freely.

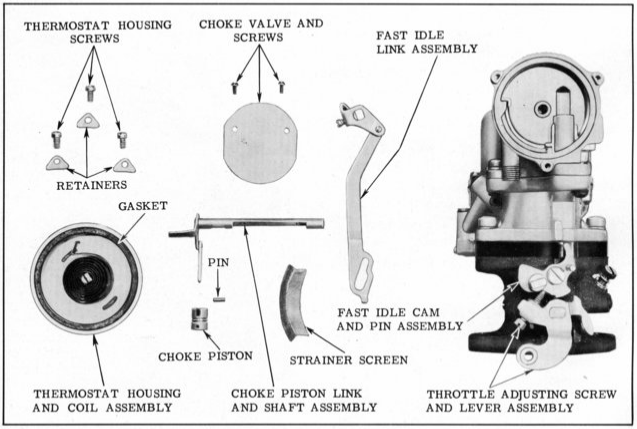


Fig. 224. Automatic Choke Details

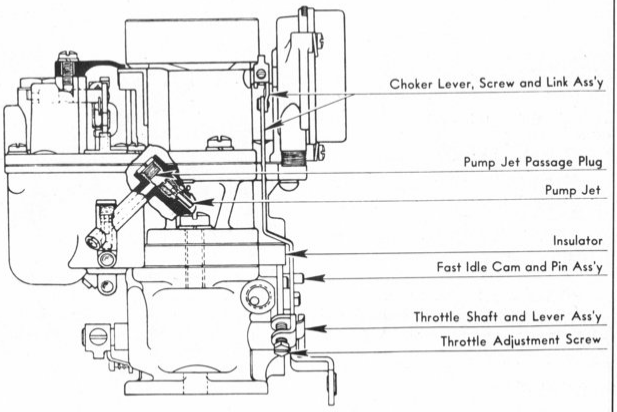


Fig. 225. Carburetor Details

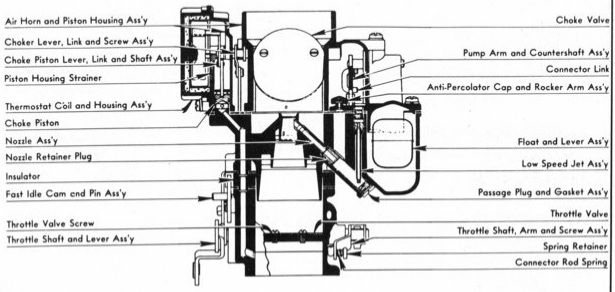


Fig. 226. Carburetor Details

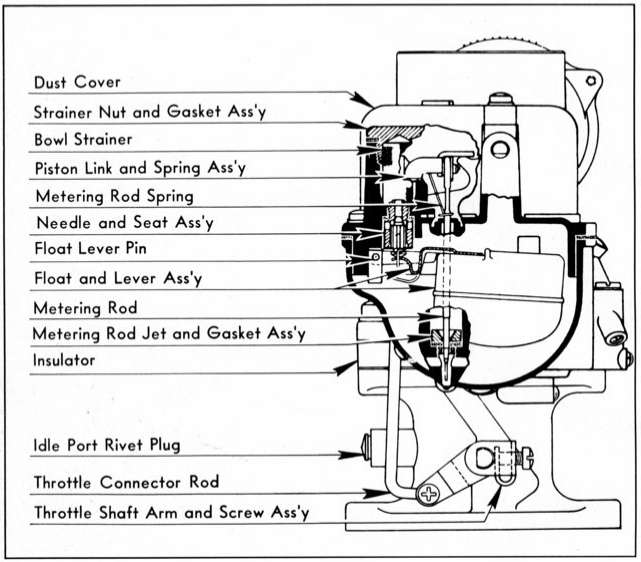


Fig. 227. Carburetor Details

Use all new gaskets. Replace all worn or damaged parts with new. Then proceed as follows:

1. Install choke piston lever, link and shaft assembly in air horn and climatic control assembly, install the choke lever, link, and screw assembly.
2. Install choker valve with "C" up and use new choker valve screws. With the choker valve screws loose, tap choker valve lightly to centralize it in the air horn, then securely tighten screws. Choker valve should move freely in air horn. Then tighten screw in choker lever.
3. Install strainer in piston housing. If strainer is dirty or clogged, clean and replace if necessary.
4. Install air horn assembly, using new gasket. Tighten air horn attaching screws and lockwashers. (Be sure attaching screw beneath piston housing is tightened.)
5. Check thermostatic housing and coil assembly. If end of coil drags on housing, entire unit must be replaced.

6. Install thermostatic housing and coil assembly with word "Climatic" at bottom and turn counterclockwise to specifications.
7. Install housing retainers and attaching screws and tighten securely. Set fast idle, dechoker and lockout.

   CAUTION: When reassembling choke valve, make certain it is in perfect alignment with air horn bore. If it is not, choke will stick in its closed position and will have a tendency to drag on air horn throughout its range.

   When reassembling carburetor to motor, make certain hot air tubing is properly connected. An air leak at this point will prevent climatic control from functioning properly.

VACUUM GAUGE

The J-89 vacuum gauge may be used to check ignition, carburetion and compression. Readings should be taken with the engine running at the recommended idling speed.

Engines are designed to draw at least 17 inches of steady vacuum at the correct idling speed.

On a properly tuned engine, the vacuum indicator needle should always be steady. If the needle flickers and will not hold a steady reading, it indicates that there is something wrong with the engine.

READY REFERENCE TABLE

Gauge Indication	What to Look For
Needle drops back at regular intervals	Valve stuck open Chipped valve head Warped valve seat Tight valves
Needle drops back at irregular intervals	Gummy valve stems Mixture too rich Mixture too lean Occasional plug miss
Low vacuum	Intake manifold leak
Very heavy irregular drop	Head gasket leak
Needle flickers getting worse with speed	Weak valve springs

Fuel Pump

To insure cool operation of the fuel pump the pump is placed very low at the front right side of the engine cylinder block, with the fuel bowl inverted. With this location of the pump, the fuel bowl is in the path of the outside air stream; as a result, the fuel is kept much cooler and the tendency toward vapor lock reduced. An insulating shield is also provided over the pump. (See Fig. 228)

The sealing of the pump against possible loss of oil through either the gas or vacuum sections has been adequately provided for by seals at both diaphragm stems and by the inverted position of

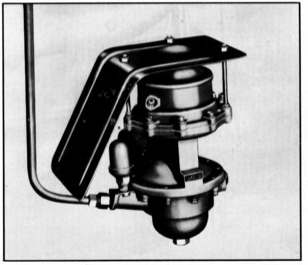


Fig. 228. Fuel Pump Shield

the vacuum section. With these seals, oil is allowed to lubricate the pump mechanism and is prevented from entering either the fuel or vacuum sections of the pump.

The series "AJ" AC Fuel Pump is used on all six cylinder engines.

NOTE: Sediment and water sometimes become trapped within the fuel pump filtering bowl causing difficult and sometimes impossible engine operation. Difficulty because of moisture is more likely to occur at low winter temperatures. To avoid difficulty, remove and clean the filtering

bowl and strainer at least twice a year, i. e. in spring and fall.

Operation of Fuel Pump and Fuel Section of Combination Fuel and Vacuum Pump

The rotation of camshaft eccentric actuates rocker arm (A), pivoted at (B), which pulls link (C) and diaphragm (D) upward against pressure (E), which creates a vacuum in pump chamber (F).

On the suction stroke of the pump, fuel from the rear tank enters through inlet (G) into sediment bowl (H) and passes through strainer (I) and then through inlet valve into pump chamber (F). (See Fig. 229)

On the return stroke, spring pressure (E) pushes diaphragm (D) downward, forcing fuel from chamber (F) through outlet valve (J) and out through (K) to the carburetor.

When the carburetor bowl is filled, the float in the carburetor will shut off the needle valve, thus creating a pressure in the pump chamber (F). This pressure will hold diaphragm (D) upward against spring pressure (E), where it will remain inoperative in the upward position until the carburetor requires further fuel and the needle valve opens. Spring (L) is merely for the purpose of keeping the rocker arm in constant contact with eccentric.

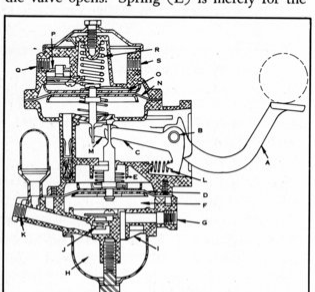


Fig. 229. Combination Fuel Pump and Vacuum Pump

Operation of Vacuum Section of Fuel Pump

The rotation of camshaft eccentric actuates rocker arm (A), pivoted at "B", which pushes link (M) and in turn diaphragm (N) upward, expelling the air in chamber (O) through exhaust valve (P) and out opening (Q) to the intake manifold. (See Fig. 229)

On the return stroke of rocker arm (A), spring (R) moves the diaphragm (N) downward, creating a suction in chamber (O), opening intake valve, drawing air through the inlet passage (S) from the windshield wiper.

When the windshield wiper is not being used, the manifold vacuum holds diaphragm (N) upward against spring pressure (R), so that the diaphragm does not make a complete stroke for every stroke of the rocker arm (A).

When the manifold vacuum is greater than the vacuum created by the pump, the air will flow from the windshield wiper through both valves of the pump, and the operation of the wiper will be the same as if the pump were not installed. However, when the intake manifold vacuum is low—that is, when the car is accelerating or operating at high speed—the vacuum created by the pump will be greater and will operate the wiper.

Gasoline Feed Lines

Considerable attention has been given to reducing the temperature of the gasoline entering the fuel pump and carburetor, to eliminate the troublesome effects of vapor lock caused by the highly volatile fuels. The main fuel line is located on the outside of the left hand frame side rail—the opposite side from the exhaust system, and passes over to the fuel pump side of the engine, along the front side of the frame front cross member, where it is cooled by air passing over it.

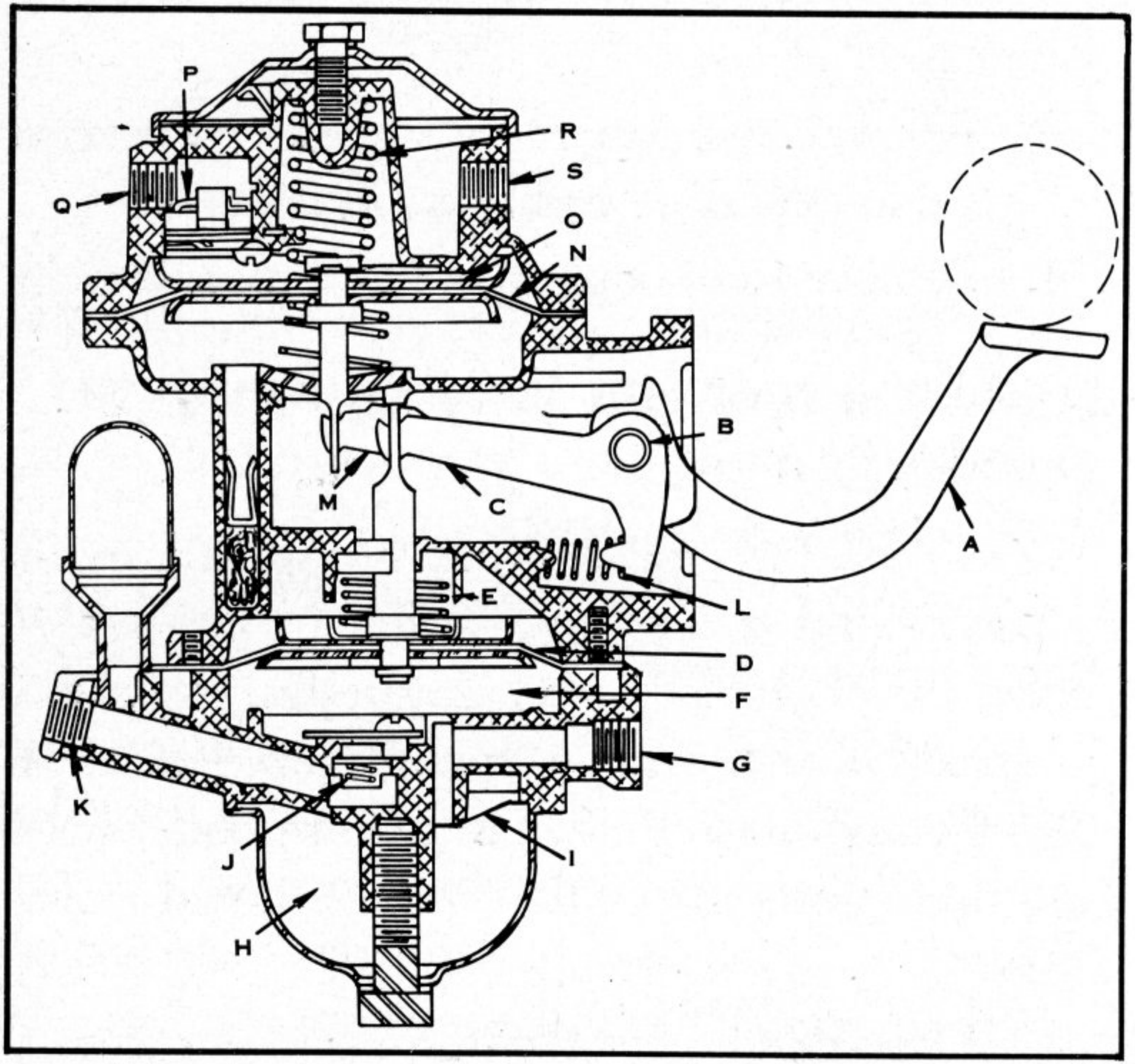


Fig. 229. Combination Fuel Pump and Vacuum Pump

SERVICE AND ADJUSTMENTS—AC FUEL PUMP

Parts for the AC Fuel Pump are available through United Motors Service Branches and Authorized AC Service Stations. Available from Hinckley-Myers is the fuel pump analyzer Tool HMO144, which permits a complete check of the fuel pump without removing it from the engine.

Fuel pump repairs are divided into two classifications:

1. Repairs made without disturbing pump installation.
2. Repairs which necessitate removal and disassembly of the fuel pump.

Repairs Made Without Disturbing Fuel Pump Installation

First check the fuel pump on the engine, using Fuel Pump Analyzer HMO144. If capacity test and pressure are correct (4 to 5 lbs. on fuel section), the trouble must be elsewhere. Check carburetor float and needle for proper functioning. If lack of fuel is evidenced, also check fuel line for leaks, split seams, kinks or other obstructions. If pump shows high pressure, a quick remedy sometimes is to add another gasket or two between the pump mounting flange and crankcase.

Loose pipe fittings: Tighten all pipe connections at gasoline tank and at the pump.

Dirty screen: Remove and clean screen.

Leaks at diaphragm flange: Tighten the cover screws alternately and securely.

NOTE: Check to see if leaks occur at pipe fittings allowing fuel to run down pump to flange, appearing to originate there. Do not use shellac or any other adhesive on diaphragm.

Disassemble Fuel and Vacuum Pump

To disassemble the vacuum section of pump:

1. Remove fuel pump from engine.
2. Mark both vacuum section cover and fuel section cover so parts may be reassembled in correct position.
3. Holding pump in vise, remove two cap screws from opposite sides in fuel section cover and insert two guide pins in place from which cap screws were removed. These two guides will pilot cover while remaining eight screws are being removed. Guide pins can be made from 3/16″ cold roll 2″ long, threaded ¼″ on one end with 10-32 thread.
4. Remove balance of cap screws and remove vacuum section cover.
5. Press down on pump operating lever, and unhook diaphragm link assembly from inner pump arm.

The above five steps are all that are necessary to remove the vacuum pump diaphragm assembly.

To disassemble the fuel section of Series "AJ" Combination Fuel and Vacuum Pump:

1. Counterbore small end of pump arm pin with ⅜″ drill and drive pin from pump body and arm with special tool No. J-1521581, which can be purchased either from United Motors Service or AC Spark Plug Division, Flint, Michigan.
2. Support pump in holding fixture with fuel section pointing up and remove fuel bowl and screen by removing one cap screw at center of bowl.
3. Remove ten cap screws and remove fuel section cover assembly.
4. Remove fuel diaphragm and link assembly.

Assemble Fuel and Vacuum Pump Fuel Section

Assemble link, rocker arm bushing, link spacer washers, and rocker arm spring in position in body. In place of the rocker arm pin, insert end of special rocker arm assembling pin No. 1521-581 through rocker arm pin hole in body, holding these parts in position; then proceed as follows:

1. Place diaphragm spring in position and assemble pull rod and diaphragm assembly

through boss in body, hooking pull rod over end of link.

2. Force small end of special assembling pin through holes in body, link and rocker arm until the large end of pin is holding assembly together.
3. Using regular rocker arm pin, drive special assembling pin on through assembly. This leaves rocker arm pin properly assembled.
4. Assemble steel washer over counter bored end of rocker arm pin.
5. Use a center punch or some similar tool to swedge out the counter bored end of the pin against the washer.

NOTE: To remove the pin it is necessary to use a ⅜″ or larger drill to drill out the counter bored end of pin.

Valve and Cover Assembly

1. Place gasket in position in inlet and outlet cage seats in fuel cover.
2. Place valve and cage assemblies in position in inlet and outlet cage seats in cover, making sure that the large diameter is placed against the gasket on the inlet side and that the small diameter is assembled into the outlet hole in the cover, permitting the shoulder of the cage to fit properly against the gasket.
3. Place valve cage retainer in position with the curved end of two lugs fitting snugly against each valve cage. Insert screw and tighten securely, making sure that retainer lugs are in proper position when finally tightened.
4. Place cork bowl gasket in seat in cover, making sure that it fits properly in seat.
5. Assemble metal bowl in position on gasket; place small gasket around cap screw hole in bottom of bowl. Assemble cap screw through hole in bowl and tighten securely.

Cover Assembly

1. Push upward on rocker arm until diaphragm is level with the top surface of body flange.
2. Place cover assembly in proper position designated by mark on flanges, made before disassembling the pump.
3. Install cover screws and lockwashers, tightening only until flanges are ⅛″ apart.
4. Release rocker arm, which will place the diaphragm in its highest position.
5. Tighten cover screws alternately and securely.

Vacuum Pump Assembly

1. Place gasket in position in inlet and outlet cage seats in body.
2. Place valve and cage assemblies in position in inlet and outlet cage seats in body, making sure that the large diameter is placed against the gasket on inlet side and that the small diameter fits into the outlet hole, permitting the shoulder of the cage to fit properly against the gasket.
3. Place valve cage retainer in position with the curved end of two lugs fitting snugly against each valve cage. Insert screw and tighten securely, making sure that the retainer lugs are in proper position when finally tightened.
4. Place screen, cover plate gasket, cover plate and cap screw gasket in proper position, then insert cover plate cap screw and tighten securely.

Assembly of Vacuum Pump Unit to Fuel Pump

The vacuum diaphragm may be properly assembled in the fuel pump by the use of a small tool, shown in Fig. 230, and by using the following procedure as a guide:

1. With the pump inverted and the diaphragm assembly connected to the linkage, operate the rocker arm until the diaphragm is exactly level with the surface of the body flange. Insert bent end of tool between the rocker

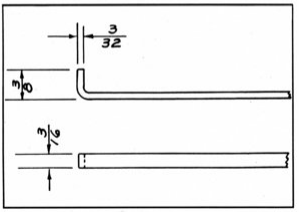


Fig. 230. Details of Tool for Assembling Vacuum Diaphragm Assembly

arm and the die cast body so that the diaphragm cannot move from this level position when the vacuum spring is assembled.

2. Place vacuum diaphragm spring and cover assembly in position, compressing the spring sufficiently to permit engagement of cover screws.
3. Install ALL of the cover screws and lock washers, but tighten these screws by hand *only enough to place a slight tension on the lock washers.* (See Fig. 231)

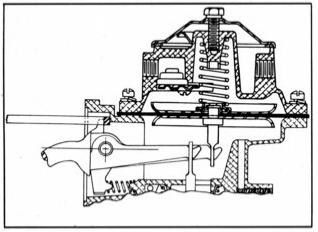


Fig. 231. Holding Diaphragm in Position with Tool while Assembling Diaphragm Cover

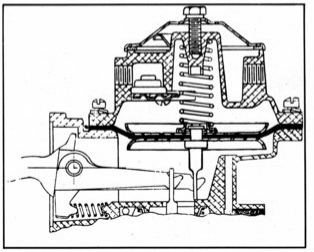


Fig. 232. Diaphragm Flexed to Correct Position for Proper Pump Operation

4. Remove the tool which locked the rocker arm in position. The vacuum diaphragm spring will then push the diaphragm downward and this movement will automatically flex the correct amount of diaphragm cloth required for proper pump operation. When properly flexed, the outer edge of the diaphragm cloth should project evenly and be flush with (or slightly overhang) the edge of the body casting. (See Fig. 232)
5. Tighten all cover screws alternately and securely.

FUEL PUMP SERVICE HINTS—

Valve Springs

Never stretch or in any way change the tension of the valve springs as this will change the pressure of the spring against the valve and reduce the capacity of the pump. Always use new valve springs if the old springs are at all questionable.

Fuel Pump Trouble Chart

Trouble	*Evidenced by*	*Remedy*
Broken rocker arm.	Visible.	Replace rocker arm.
Broken rocker arm spring.	Visible.	Replace rocker arm spring.
Defective or worn links.	Pump does not supply sufficient fuel.	Replace links. Also check for air leaks.
Broken diaphragm return spring—also valve retainer.	Does not supply fuel to carburetor.	Replace spring.
Punctured or worn-out fuel pump diaphragm	Fuel leaking through vent hole in body.	Replace complete diaphragm.
Leakage at diaphragm flange.	Visible.	Tighten cover screws evenly and securely.

IMPORTANT: Mark the top cover and body before disassembling so that in reassembling they are replaced in the same relative position.

Vacuum Pump Trouble Chart

Trouble	*Evidenced by*	*Remedy*
Vacuum pump unit not operating.	Slow action of windshield wiper at high speed or when accelerating.	Check wiper valve lines and fittings. If trouble is not located disassemble vacuum pump unit and check valves and diaphragm.
Punctured vacuum pump diaphragm.	Possible missing of engine at low speed due to excess air in intake—also evidenced by irregular performance of windshield wiper when accelerating.	Replace vacuum pump diaphragm.

ENGINE SPECIFICATIONS—6 AND 8 CYLINDER—1949 MODEL

Subject and Remarks	6 Cylinder	8 Cylinder
1. CYLINDER BLOCK		
a. Engine Type	L-type	90° V-type
b. Number of Cylinders	6	8
c. Bore and Stroke	3 11/32" x 4 3/8"	3 3/4" x 3 7/16"
d. Piston Displacement	257 cu. in.	303 cu. in.
e. Maximum Horsepower	105	135
SAE Rated HP	29.9	45
f. Engine Torque	202 ft. lbs.	263 ft. lbs.
g. Compression Ratio	6.5:1	7.25:1
h. Firing Order	1-5-3-6-2-4	1-8-7-3-6-5-4-2
2. CRANKSHAFT		
a. Diameter—Main Bearing Journal		
No. 1	2.478" - 2.479"	2.498" - 2.499"
No. 2	2.5405" - 2.5415"	2.498" - 2.499"
No. 3	2.6655" - 2.6665"	2.498" - 2.499"
No. 4	2.6855" - 2.6865"	2.498" - 2.499"
No. 5		2.623" - 2.624"
b. Width—Main Bearing Journal, Including Fillets		
No. 1	1 15/32"	1 3/32"
No. 2	1 1/4"	1 1/8"
No. 3	1 1/4"	1 1/8"
No. 4	1 1/2"	1 1/8"
No. 5		1 7/8"
c. Diameter—Connecting Rod Bearing Journal	2.353" - 2.354"	2.2488" - 2.2498"
d. Width—Connecting Rod Bearing, Including Fillets	1.1265" - 1.1295"	1.997" - 2.000"
e. Length—Overall Crankshaft	33 1/8"	26 1/8"
f. Weight—Crankshaft	100 lbs.	60 lbs.
g. Diameter of Oil Holes in Crankshaft	1/4"	1/4"
h. Number of Counterweights	7	6
i. Clearance—Crankshaft End Thrust	.004" - .008"	.004" - .008"
3. CRANKSHAFT SPROCKETS		
a. Width	1.200" - 1.206"	.795" - .799"
b. Pitch	.500"	.500"
c. Number of Teeth	18	18
4. FLYWHEEL		
a. No. of Teeth on Starter Gear	145	145
b. No. of Teeth on Starter Pinion	9	9
5. MAIN BEARINGS		
a. Clearance—Crankshaft Radial in Rear Bearing	.0005"-.002"	.002" - .0035"
b. Clearance—Crankshaft Radial in Bearing	.001" - .003"	.0005" - .003"
c. Length—Bearing Shell, Including Chamfers		
No. 1	1 9/32"	15/16"
No. 2	1"	15/16"
No. 3	1"	15/16"
No. 4	1 7/32"	15/16"
No. 5		1 7/8"
d. Bronze Thrust Plates		
(1) Thickness (Selective) 3 Plates	.1175" - .1245"	
(2) Diameter	2.482" - 2.487"	
(3) Diameter—Outside	3 9/16"	

ENGINE SPECIFICATIONS—6 AND 8 CYLINDER—1949 MODEL—Continued

Subject and Remarks	6 Cylinder	8 Cylinder
6. PISTONS		
a. Length Overall	4 1/32"	4"
b. Length from Top of Piston to Pin Center	2.112" - 2.117"	1.875" - 1.878"
c. Clearance (at Thrust Surface) Selective	.0005" - .0010"	.0005" - .0010"
d. Diameter—Nominal Outside	3 17/32"	3¾"
e. Weight—Less Pins and Rings	18.24 oz.	19.88 oz.
7. PISTON PINS		
a. Diameter (Selective)	.8554" - .8557"	.9803" - .9807"
b. Length	3 5/32"	3"
c. Radial Clearance (Selective) Lock Screw Boss	{.0003" .0006"} Tight	
d. Radial Clearance (Selective) Plain Boss	.0002" Loose .0001" Tight	.0002" Loose .0000"
8. PISTON RINGS		
a. Material	C. I.	C. I.
b. Number Compression Rings	2	2
c. Width, Compression Rings	.0925" - .0935"	.077" - .078"
d. Thickness, Compression Rings (Maximum)	.170" - .175"	.187"
e. Gap Clearance, Compression Rings	.007" - .017"	.008" - .020"
f. Clearance in Groove, Compression Rings	.001" - .003"	.001" - .003"
g. Number Oil Rings	2	1
h. Width Oil Rings	.1860" - .1865"	.1860" - .1865"
i. Thickness, Oil Rings (Maximum)	.157"	.163"
k. Gap Clearance, Oil Rings	.007" - .016"	.008" - .020"
l. Clearance in Groove, Oil Rings	.001" - .0025"	.0018" - .0033"
9. CONNECTING RODS		
a. Length—Center to Center	7 13/16"	7⅝"
b. Length—Lower Bearing Shell	1"	.9945" - .9955"
c. Length—Upper Bearing	1¼"	1.249" - 1.251"
d. Diameter—Lower Bearing	2.3570" - 2.3575"	2.3745" - 2.3750"
e. Diameter—Upper Bearing (Selective)	.8558" - .8562"	.9807" - .9811"
f. Clearance—On Crankshaft (Vertical)	.0005" - .0025"	.0009" - .0029"
g. Clearance—On Crankshaft (Horizontal)	.0025" - .0045"	.0019" - .0039"
h. Clearance—Radial—On Piston Pin	.0003" - .0006"	.0003" - .0005"
i. Clearance—End—On Crankshaft	.0055" - .0105"	.002" - .011"
k. Diameter—Connecting Rod Bolt	.389" - .390"	.389" - .390"
10. CAMSHAFT		
a. Bearing Journal Diameters		
No. 1	1.9974" - 1.9981"	1.8724" - 1.8731"
No. 2	1.9349" - 1.9351"	1.8724" - 1.8731"
No. 3	1.8724" - 1.8731"	1.8724" - 1.8731"
No. 4	1.8099" - 1.8106"	1.8724" - 1.8731"
No. 5		1.8724" - 1.8731"
b. Width Including Chamfers		
No. 1	1 3/16"	25/32"
No. 2	1⅛"	25/32"
No. 3	1⅛"	25/32"
No. 4	1"	25/32"
No. 5		25/32"
c. Journal Clearance in Bushing	.0014" - .0036"	.0014" - .0036"
d. Diameter—Reamed Bushing		
No. 1	1.9995" - 2.001"	1.8745" - 1.8760"
No. 2	1.937" - 1.9385"	1.8745" - 1.8760"

ENGINE SPECIFICATIONS—6 AND 8 CYLINDER—1949 MODEL—Continued

Subject and Remarks	6 Cylinder	8 Cylinder
d. Diameter—Reamed Bushing—Continued		
No. 3	1.8745″ - 1.876″	1.8745″ - 1.8760″
No. 4	1.812″ - 1.8135″	1.8745″ - 1.8760″
No. 5		1.8745″ - 1.8760″
e. Length—Bushing		
No. 1	1 3/32″	11/16″
No. 2	1″	11/16″
No. 3	1″	11/16″
No. 4	7/8″	11/16″
No. 5		11/16″
f. End Thrust	Engine Front Plate	Block and Engine Thrust Plate
11. CAMSHAFT SPROCKET		
a. Width	.644″	.401″ - .411″
b. Pitch	.500″	.500″
c. Number of Teeth	36	36
12. TIMING CHAIN		
a. Width	15/16″	11/16″
b. Length	23½″	24″
c. Number of Links	47	48
d. Pitch	.500″	.500″
13. VALVES—INTAKE		
a. Diameter—Head	1.745″ - 1.755″	1¾″
b. Diameter—Stem	.3415″ - .3425″	.3417″ - .3425″
c. Angle—Valve Seat	30°	45°
d. Width—Seat	.042″ - .052″	.042″ - .071″
e. Length—Overall	5.7695″ - 5.8095″	4.907″ - 4.927″
f. Lift	.310″	.330″
g. Clearance in Guide	.00175″ - .00375″	.00175″ - .00355″
h. Lash—Engine Warm	.008″	
14. VALVES—EXHAUST		
a. Diameter—Head	1 27/64″	1.432″ - 1.442″
b. Diameter—Stem	.3410″ - .3418″	.3930″ - .3938″
c. Angle—Valve Seat	45°	45°
d. Width—Seat	.070″ - .085″	.070″ - .098″
e. Length—Overall	5 51/64″	4.931″ - 4.951″
f. Lift	.308″	.330″
g. Clearance in Guide	.00245″ - .00425″	.00225″ - .00405″
h. Lash—Engine Warm	.011″	
15. VALVE SPRINGS		
a. Number of Coils	9½	7½
b. Number of Active Coils	7½	5½
c. Length—Free	2⅝″	2 9/32″
d. Diameter—Wire	.162″	.169″
e. Diameter—Inside	.820″	.828″
f. Diameter—Outside	1.156″	1.168″
g. Pressure and Length		
(1) Valve Open	1 15/16″ at 100 lbs.	1.777″ at 62 - 68 lbs.
(2) Valve Closed	2¼″ at 55 lbs.	1.447″ at 136 - 146 lbs.
16. VALVE LIFTERS		
a. Diameter—Head	1.125″ - 1.140″	
b. Diameter—Body	.6235″ - .6240″	.8424″ - .8427″
c. Length—Overall	3.090″ - 3.100″	2″

ENGINE SPECIFICATIONS–6 AND 8 CYLINDER–1949 MODEL–Concluded

Subject and Remarks	6 Cylinder	8 Cylinder
16. VALVE LIFTERS–Continued		
d. Clearance in Boss (Selective)	.0005″ - .0008″	.0005″ - .0018″
e. Runout of Face with Axis		
(1) Cam End	.001″ on 1″ Dia.	
(2) Adjusting Screw End	.015″ on 1″ Dia.	
17. VALVE GUIDES		
a. Height from Top of Block	15/16″	
Height from Top of Head		27/32″
b. Diameter–Inside Ream Int.	.34425″ - .34525″	.34425″ - .34525″
c. Diameter–Inside Ream Exh.	.34425″ - .34525″	.39605″ - .39705″
d. Length–Overall	3 7/32″	2 11/16″
18. LUBRICATION SYSTEM		
a. Capacity–Engine Oil–Qts.	5	5
b. Width–Pump Gears	1½″	1½″
19. COOLING SYSTEM		
a. Radiator–Make	Harrison	Harrison
b. Capacity–Qts.	18½	21½
c. Thickness–Radiator Core	2 15/32″	2 15/32″
d. Area–Frontal	285.36 Sq. In.	483.99 Sq. In.
e. Diameter–Fan Blades	17¾″	19¼″
f. Fan Belt–Width	13/16″	¾″
g. Generator Belt–Width		⅜″

ROCKET ENGINE

The 1949 Oldsmobile Rocket engine is of entirely new design having two banks of cylinders at a 90° angle. Overhead valves are used to accommodate the smaller combustion chambers necessary for high compression operation. Self adjusting hydraulic valve lifters keep the valve mechanism quiet under all operating conditions.

The new Rocket engine which is designed to withstand a compression ratio as high as 12.5 to 1 operates on an actual compression ratio of 7.25 to 1 which matches the octane ratings of the premium gasoline now on the market. The bore and stroke are 3¾″ and 3-7/16″ respectively.

Cylinder Block

The cylinder block and upper crankcase are cast integral to provide maximum rigidity with minimum size and weight. The upper flywheel housing is also integral with the block to facilitate better alignment and for greater rigidity.

The water jackets extend the entire length of the cylinders except for a small portion around the oil galley holes and the cooling liquid completely surrounds the cylinder barrels of both banks of cylinders.

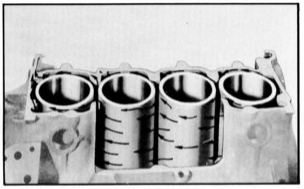


Fig. 233. Cooling Cylinder Walls

Two main galleys and fifteen oil passages are drilled in the block to provide efficient distribution of oil to all moving parts.

The left hand bank of cylinders is numbered 1, 3, 5 and 7 starting from the front; the right hand bank of cylinders is numbered 2, 4, 6 and 8 starting from the front. Number 1 cylinder can be remembered to be on the left side as this bank of cylinders is slightly forward of the right hand bank. The connecting rods are positioned on the crankshaft 1 to 8 consecutively from front to rear. The Rocket engine number is stamped on the front surface of the left hand bank. This permanent engine number is stamped upside down to facilitate easy reading. Whenever a cylinder block is replaced, the original engine number must be transferred to the replacement block according to the particular state law.

OIL PAN

The lower crankcase oil pan is made of pressed steel and is shallow at the forward end to provide clearance for the steering relay rod and the exhaust crossover pipe.

Oil Pan Removal

1. Remove starting motor.
2. Remove exhaust crossover pipe.
3. Drop steering relay rod by disconnecting idler arm from frame.
4. Remove oil pan.

When replacing the oil pan, always use new cork gaskets and new front and rear synthetic rubber seals. The cork gaskets should be cemented to the pan and the circular seal surfaces of the front cover and rear main bearing cap should be coated with lubriplate to insure that the seals maintain their proper position during oil pan installation. Oil pan bolts should be

tightened evenly and to the proper torque as indicated in the Torque Wrench Chart.

Cylinder Heads

The cylinder heads are single castings of alloy iron machined to maintain very close limits of combustion chamber volume. Water passages are provided in the cylinder heads to allow for proper circulation of water around the valve seats and valve guides.

With the exception of the intake manifold stud positions, the right and left cylinder heads are identical.

There are two oil return holes located in each head, one located at each outside corner, which allow the oil which lubricates the rocker arm shafts and rocker arms to return to the crankcase.

Remove Cylinder Head

1. Drain cooling system and disconnect upper radiator hose from water outlet.
2. Remove air cleaner and generator.
3. Remove spark plug wire retainers (nameplates) and disconnect wires from spark plugs.
4. Disconnect throttle linkage.
5. Disconnect spark plug wire and air cleaner supports from cylinder heads.

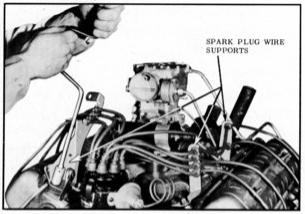


Fig. 234. Removing Spark Plug Wire Supports

6. Remove distributor cap and lift cap and high tension wire assembly (with supports) from engine.
7. Remove fuel pump to carburetor fuel line and two vacuum lines from carburetor to fuel pump and distributor.
8. Remove external water by-pass tube.
9. Remove valve covers.
10. Remove intake manifold with coil and carburetor attached.
11. Disconnect exhaust pipe from exhaust manifold.
12. Remove rocker arm shaft assembly with rocker arms and brackets.
13. Remove push rods.
14. Remove cylinder head with exhaust manifold attached by removing the 14 remaining cylinder head bolts.

Install Cylinder Heads

Installation of cylinder heads and gaskets is the reverse of the removal procedure, with attention being given to the following instructions:

When replacement of a cylinder head is made, a new gasket, coated on both sides with POB No. 3 Gasket Sealer, must be installed with the crimped side up.

After cylinder heads have been placed in position, the push rods and rocker arm assemblies should be installed and care taken to assure that the push rods are properly seated in the rocker arms and valve lifters; cylinder head bolts should be tightened in the sequence shown in Fig. 236 and to 65 to 70 ft. lbs. torque.

Valve cover gaskets should be cemented to the valve cover by coating gasket on one side with high compression gasket cement, or gasket shellac.

A new exhaust pipe gasket should be used when reinstalling pipe to exhaust manifold.

New intake manifold gaskets coated on both sides with POB No. 3 sealer, must always be used when intake manifold is replaced. Threads

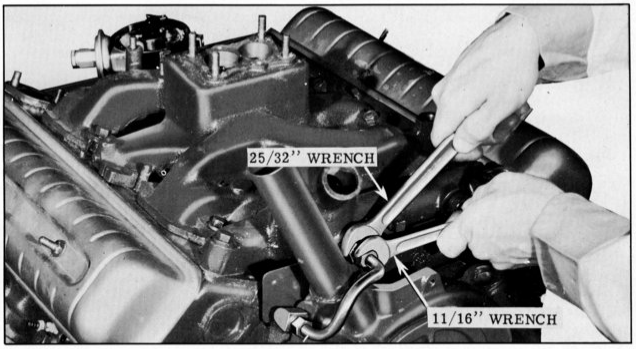


Fig. 235. Removing Water By-Pass Tube

of six intake manifold bolts should be dipped in POB No. 3 sealer before installing. Manifold attaching bolts and nuts should then be tightened in the sequence shown in Fig. 237 and to 22 to 26 ft. lbs. torque.

NOTE—It is very important that intake manifold be properly centered between cylinder heads before bolts are tightened.

After cylinder head and intake manifold installation has been completed, throttle linkage should be adjusted as outlined in the HYDRA-MATIC DRIVE section.

Crankshaft

The crankshaft, supported by five main bearings, is made of drop forged, heat treated, high carbon steel with counterweights forged integral

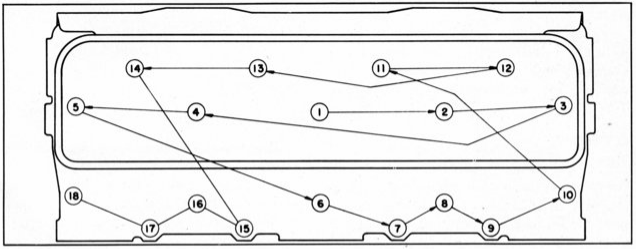


Fig. 236. Order of Tightening Cylinder Head Bolts

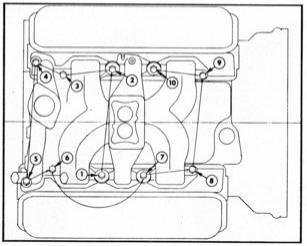


Fig. 237. Order of Tightening Manifold Attaching Bolts

and is balanced dynamically. Oil distribution holes are drilled for connecting rod and piston pin bearing lubrication.

The crankshaft front oil seal is located in the engine front cover. In addition, an oil slinger between the crankshaft sprocket gear and the oil seal prevents the major portion of the oil from reaching the seal proper.

A torsional vibration balancer is attached to the front end of the crankshaft to neutralize periodic vibrations. It is a self-contained, non-adjustable unit and forms a part of the fan and generator drive pulley. The hub of the balancer is keyed to the crankshaft and retained by a clamp bolt threaded into the end of the crankshaft.

Two plated pins are located on the outer surface of the balancer for timing purposes. The distance between the two pins represents a 5° change in ignition timing—from 0° to 5° before T.D.C.

FLYWHEEL

The eight cylinder flywheel is of pressed steel, one piece construction with an integral ring gear for cranking the engine. The flywheel, crankshaft and Hydra-Matic torus cover are balanced separately and as an assembly. The two dowel pins for locating the torus cover are of different size; therefore, the torus cover can be installed in only one position, insuring proper alignment and balance whenever the cover is removed and replaced.

The flywheel mounting bolts, which are self locking, thread into the crankshaft rear flange. It is unnecessary to ream any of the bolt holes when assembling a new flywheel to the crankshaft.

It is important that the flywheel to crankshaft bolts be tightened to the proper torque as indicated in the Torque Wrench Chart. A new gasket should always be used.

FLYWHEEL HOUSING

The flywheel housing actually consists of four parts; the upper housing, lower housing, cover housing and housing pan. The upper housing, however, is cast integral with the cylinder block and is therefore referred to as the block. The lower flywheel housing which is located and aligned with the block by means of two dowel pins, is attached with four bolts. A plate provided at the bottom of the lower housing can be removed to drain the Hydra-Matic fluid from the torus cover and to check torus cover to flywheel bolt tightness. The starting motor is attached to the left side of the lower flywheel housing.

The flywheel cover housing is bolted to the crankcase and alignment is maintained by two ½" dowels. The housing pan is attached to both the cover housing and the lower housing, no gasket being used.

MAIN BEARINGS

There are five replaceable type main bearings supporting the crankshaft. These steel backed babbitt inserts are located by small locating tabs on the edge of the bearing shells which fit in machined notches in the block and bearing caps.

The front four main bearings are alike. The fifth, or rear bearing is flanged with integral

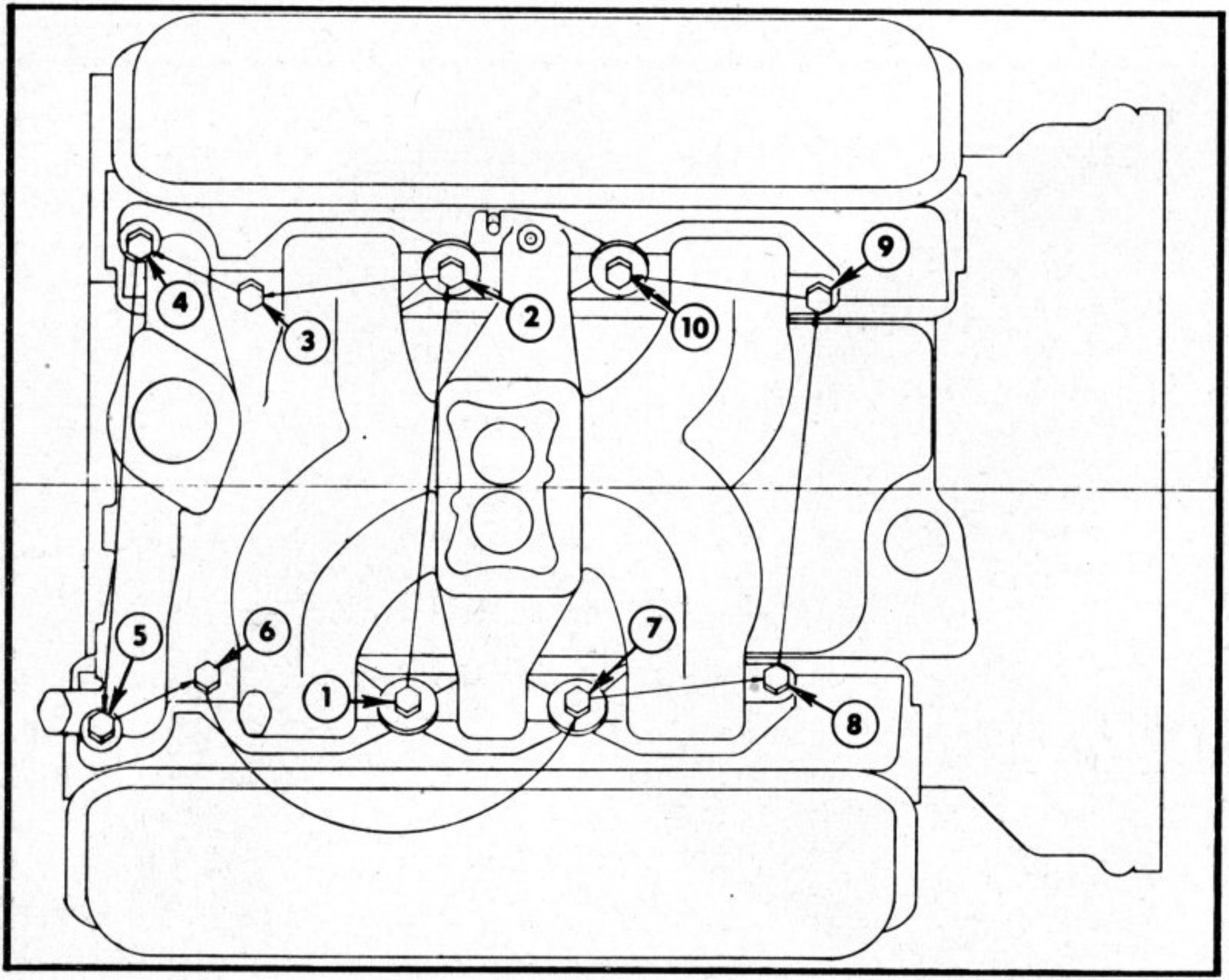


Fig. 237. Order of Tightening Manifold Attaching Bolts

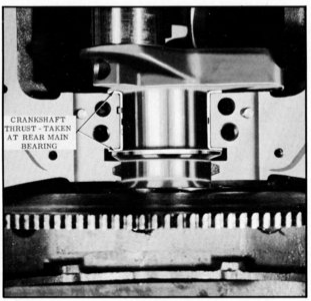


Fig. 238. Rear Main Bearing With Integral Thrust Faces

thrust faces which fit between the oil slinger and the machined surface of the rear crankshaft counterweight eliminating the need for thrust plates or washers.

Main Bearing Caps

The main bearing caps are located by means of an offset broached channel in the cylinder block, making improper installation impossible. The bearing caps, except the rear cap, are numbered consecutively, one through four, with number one at the front. These numbers are located on the bottom of the cap, to one side, and should always be toward the right bank of cylinders.

The main bearing locating notches in the caps are machined on the same side as the corresponding notches in the block.

Servicing Main Bearings

Bearing adjustments are not recommended and shims are not to be used. Whenever a bearing failure occurs, a new bearing insert should be installed. Bearing insert numbers 1, 2, 3 and 4 are furnished in one size only. The diameter clearance of journal 1, 2, 3 and 4 is .0005″-.003″.

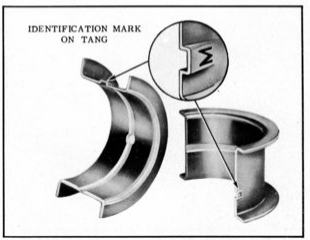


Fig. 239. Rear Main Bearing Size Identification

The rear main bearing diameter clearance is .0020″-.0035″ and is a selective fit. Bearing inserts are furnished in three sizes, "M" Medium, "T" Thin, and "H" Heavy.

The tang of the rear main bearing is marked with a letter "M", "T", or "H". When replacing rear main bearing inserts, the same size insert (determined by checking the tang marking) should be installed.

The lower flywheel housing and pan must be removed in order to remove the rear main bearing cap; however, bearing inserts can be replaced without removing the crankshaft.

Servicing Rear Main Bearing Oil Seal

The rear main bearing is positively sealed against oil leaks by a special asbestos covered wiper seal; special care must be exercised when installing this seal.

Whenever the crankshaft is removed, a new seal coated with graphite grease should be installed. The seal, to be properly installed, should be crowded into the groove in the upper and lower half of the bearing by hand, then driven tightly into the groove by tapping tool BT-12 with a hammer. (See Fig. 240)

After the seal has been seated in the bearing and while the tool is still resting in the bearing, the seal should be cut flush with the parting line

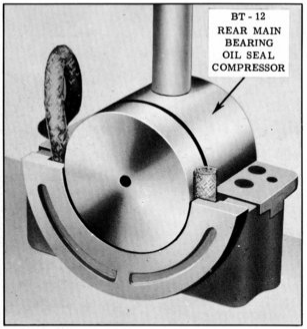


Fig. 240. Installing Rear Main Bearing Oil Seal

between upper and lower bearing, using a very sharp knife. The ends of the seal must be cut clean so no frayed ends will be clamped between the block and cap, and the seal must entirely fill the groove; i.e., not cut too short, otherwise a leak will occur. (See Fig. 240)

Pistons

The aluminum alloy "auto thermic" steel strut pistons have three rings; two compression rings and one oil ring. The oil ring is of the slotted type. The pistons are so constructed that the clearance between the piston and the cylinder wall is automatically controlled over the entire range of temperatures encountered from extreme cold to extreme heat. The cutaway piston skirt allows a lower engine height. Pistons are tin plated to insure against scoring during the break-in period.

Servicing Pistons

All pistons must be removed from the top of the cylinder block.

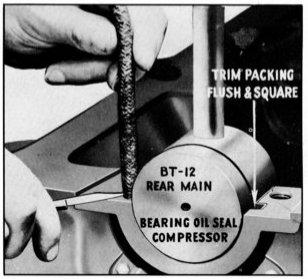


Fig. 241. Cutting Rear Main Bearing Oil Seal

IMPORTANT—If more than one piston assembly is to be removed, stamp the corresponding cylinder number on each piston, connecting rod, and cap pads while the connecting rod is still attached to the crankshaft. This will eliminate any bent or sprung rods which might result if the stamping operation were done on the bench. The machined pads on the connecting rod and cap will always be toward the bottom of the engine, and in a more exposed position than the opposite side, in which is located the oil spit hole. The side to be stamped is also the same side on which the forged notch is located in the rod and cap.

All pistons will have an "F" cast on the front side. When installing the piston assemblies in the cylinders, the "F" should always be toward the front of the engine.

The left hand or odd numbered piston assemblies will always be installed in the left hand bank of cylinders, while the even numbered piston assemblies will always be installed in the right hand bank of cylinders.

One side of the connecting rod and cap bearing surface will have two machined bosses. (See Fig. 242) This side of the connecting rod and

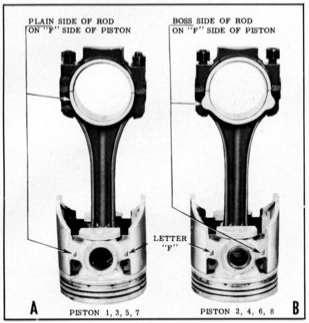


Fig. 242. Assembly of Connecting Rod to Piston Pin

cap of the two adjacent rods on each crankpin will always be facing each other.

This means that the machined bosses on the rod and cap assemblies of the odd numbered piston assemblies will always be facing the rear of the engine, while the machined bosses of the even numbered piston assemblies will be facing

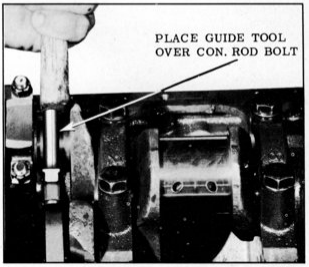


Fig. 244. Removing Piston and Connecting Rod Assembly

the front of the engine. When installing piston and connecting rod assemblies in the engine, connecting rod bolt guides, Tool BT-22, should be placed over connecting rod bolt threads to protect the crankshaft bearing surfaces. It is very important that the connecting rod caps are properly installed, i.e., with the forged locating notches on rod and cap adjacent to each other.

After the four piston assemblies and rod bearing caps of one bank of cylinders have been in-

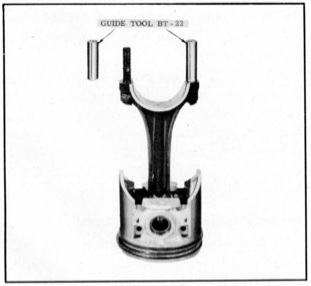


Fig. 243. Connecting Rod Bolt Guide

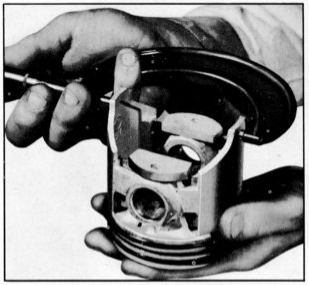


Fig. 245 Measuring Piston

stalled, the connecting rod cap attaching nuts should be snugged up only enough to keep each rod in position. This will facilitate ease of assembly of the remaining four piston assemblies in the opposite cylinder bank.

The clearance between the adjacent rods on each crankpin should be from .002" to .011" when checked with a feeler gauge.

When measuring pistons for size, measurements must be taken ⅛" from bottom of skirt and with piston pin removed.

Allowable taper is .0000"-.0003". The largest diameter must be at the bottom.

Fitting Pistons

The cylinder piston clearance, measured (90°) opposite piston pin hole between largest diameter (bottom) of piston skirt and cylinder wall, should be .0005"-.001".

Fitting pistons should not be attempted unless the proper tools, as follows, are available:

Cylinder Gauge	HM-51
Cylinder Hone	HMO-1000A
Vacuum for removing honing dust	HMO-1000B
Micrometer (Outside)	3" - 4"
Piston Feeler Scale	HM593
½" x 12" x .0015" Feeler Ribbon	
Piston Pin Bushing Reamer	HM-586
Connecting Rod and Piston Alignment Checking Tool	J-874-O
Support Block	J-1649

Pistons must be fitted as follows:

1. With piston and cylinder block at the same temperature.
2. With piston pin removed.
3. With the pin removed, fit piston so that the clearance (measured 90° opposite the piston pin hole) between the largest diameter (bottom) of piston and cylinder wall is .0005"-.001".

This clearance can be measured by using ½" x 12" x .0015" ribbon attached to scale HM-593

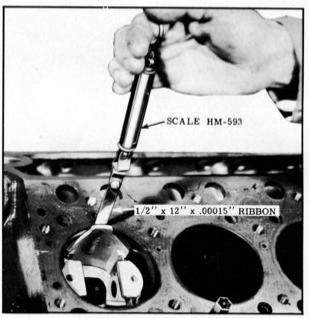


Fig. 246. Determining Piston Clearance

which, when withdrawn from between the piston and cylinder wall, will read within the limits of 10 to 18 pounds on the scale. (See Fig. 246)

The feeler ribbon should be exactly 90° (opposite) from piston pin hole.

Each piston should be fit to its individual cylinder and marked for that cylinder.

After assembly of piston, pin, connecting rod and rings is completed, the assembly should be checked for alignment before it is installed in the engine.

CAUTION—When pistons are fitted to reconditioned bores, the cylinder block should set long enough to cool to normal room temperature and the piston fit rechecked before installation of piston and rod assembly. Placing the piston in the block and allowing piston and block to cool together will assure uniform temperature.

Reconditioning Cylinder Bore

Determine size of cylinder bore by placing gauge (HM-51) in cylinder and expanding blades until they drag slightly on wall. (See Fig. 247)

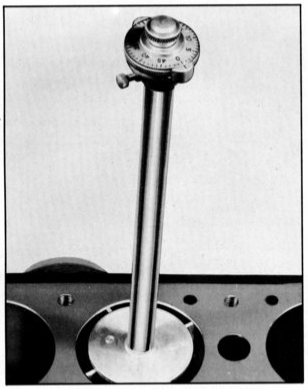


Fig. 247. Determining Cylinder Size

Set indicator to zero and release blade enough to remove gauge. Turn indicator to zero and, with micrometer, measure across blades to determine size of cylinder.

Reconditioned cylinder bores should be held to not more than .001″ out of round and .0005″ taper.

It is important that reconditioned cylinder bores are thoroughly washed to remove all traces of abrasive material. Otherwise very rapid wear of the new bore will result.

PISTON PINS

The piston pins are of the full floating type, held in position by two lock rings, one at each end of the pin.

Fitting Piston Pins in Piston

Piston pins are available in three sizes—standard, .001″, and .003″, oversize. Honing of the piston pin hole for installation of oversize pins is the most satisfactory method of sizing.

The piston pin fit in the piston is .0000″-.0002″ loose. If the clearance is to the high limit (.0002″), the pin can be inserted in the piston with very little hand pressure. The pin will not fall through the piston by its own weight. If the clearance is to the low limit (.0000″), considerable hand pressure will be required to insert the pin in the piston. By using a brass drift, the pin can be tapped into the piston using very little pressure. It is very important that both the pin and piston pin hole be clean and free from oil and that the piston pin hole is not more than .0005″ out of round.

Whenever the replacement of a piston pin is necessary, the size pin required should be determined by trying a standard, .001″ or .003″ oversize pin.

After the pin has been fitted to the piston, assemble the rod, piston, pin and two new lock rings, and check the assembly for alignment before installation in the engine.

CAUTION—In the Rocket engine, if connecting rod is not in alignment, a new rod must be used. NO ATTEMPT SHOULD BE MADE TO STRAIGHTEN THE ROD.

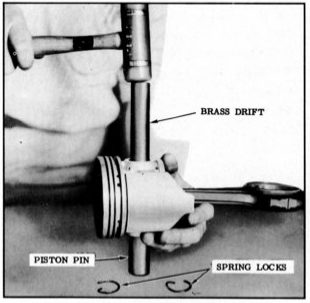


Fig. 248. Removing Piston Pin

NOTE—To fit piston pin to connecting rod bushing, see SERVICING CONNECTING RODS.

NOTE—When piston pins are removed, old lock rings should be discarded and new service type lock rings used in replacement.

PISTON RINGS

All pistons have three rings (two compression and one oil ring) located above the piston pin.

Chemical treatment of the compression rings deposits a black surface coating which materially improves their break-in characteristics. Oil rings are designed for rapid break-in and maximum oil economy.

CAUTION—Compression rings have a step or chamfer cut on one face, located on the inside; this chamfered face should always be installed towards the top of the piston. Oil rings bearing the word "Top" on one side should be installed with this side toward top of piston. Oil rings that do not have the word "Top" located on one side have symmetrical sections and can be installed with either side up.

1. Piston ring gap must be measured with the ring square with the bore and down in the ring-traveled part of the cylinder bore in which it is fitted.
2. When filing ring for gap clearance, make sure that gap is square.
3. Measure vertical clearance as shown in Fig. 249.

   Ring gap:

Oil ring	.008″ - .016″
Compression ring	.008″ - .016″

   Vertical clearance in groove:

Oil ring in groove	.0015″ - .003″
Compression rings in groove	.002″ - .004″

4. When rings are installed on piston, the gaps should be staggered 120° apart.

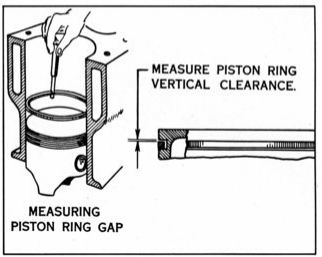


Fig. 249. Fitting Piston Rings

The piston and ring assemblies can be easily installed in the piston bore without the liability of breaking the piston rings if tool J-1002-6 is used when assembling.

Connecting Rods

Connecting rods are heat treated, drop-forged steel, with I-beam section drilled for pressure oil feed to piston pins.

An oil spit hole is provided in the upper half of the connecting rod, immediately above the rod and cap joint, to provide additional cylinder wall lubrication. This oil spit hole indexes with the oil hole in the crankshaft as the piston approaches top dead center on each piston stroke, thereby spraying the exposed cylinder wall on the opposite bank with an additional supply of oil.

Connecting rods have steel backed babbitt lined bearing inserts held in place by tangs stamped in edge of the bearing shells which locate in machined notches in cap and rod.

Piston pin bushings are thin walled bronze.

Self locking nuts (no cotter pins) are used on all connecting rods and caps. Connecting rod nuts should be tightened with a torque wrench to specifications listed on the torque chart.

Servicing Connecting Rod Bearings

The removable, insert type connecting rod bearing shells are assembled with a slight projection above the rod and cap faces to insure a positive contact. Therefore, adjustment for wear is not recommended except by installation of new bearing shells. If metal is removed from either cap or rod face, it will be impossible to use the rod again with a new bearing shell.

Under no circumstances should shims be used to obtain proper clearance, as their use may cause excessive oil consumption.

A small groove forged in the rod and another forged in the cap at one attaching bolt boss should, when rod and cap are assembled, be on the same side. The rod and cap pads used for stamping the cylinder number are on the same side as the grooves.

In the event that piston pin bushing replacement should become necessary, the bushing, after having been pressed into the rod, must be finished to size with Piston Pin Bushing Honing Tool, Number KMO-754.

The fit of the piston pin in the connecting rod bushing is .0003" - .0005" loose.

Camshaft

A chemical process which deposits a black coating on the cam bearings and cams improves initial wearing characteristics.

The cams are specially heat treated to produce a hard wearing surface on the working portion of the cams and are ground with a slight taper to insure positive rotation of the valve lifters. The camshaft is supported in the crankcase in five bearings.

A camshaft thrust plate, which takes the forward thrust of the camshaft, is provided around the camshaft opening at the front of the block. The backward thrust is taken at the front of the cylinder block.

One side of the thrust plate is machined to seat against the block, and the four attaching screw holes are offset allowing the plate to be installed only one way. Located in the right side of the camshaft thrust plate is a small hole which indexes with the right side oil galley hole in the block, providing a continuous pressure lubrication to the timing chain sprockets, fuel pump eccentric and lever.

NOTE—The camshaft thrust plate must be flat to properly seal off the forward end of the two oil galleys and insure against low oil pressure at idling speeds.

The camshaft is driven by a silent anti-whip chain which requires no adjustment.

The fuel pump eccentric is attached to the front end of the camshaft by three cap screws so located that it is difficult to install the eccentric backwards (with the wrong face outward) causing the eccentric to be incorrectly located. In order to facilitate proper installation, an "O", which should be placed toward the front, has been stamped on one side of the eccentric. (The

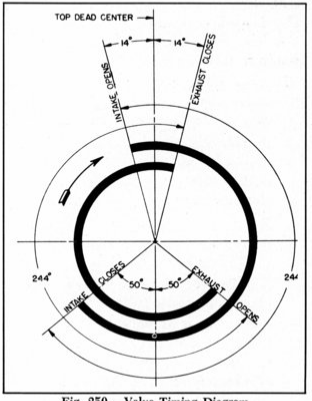


Fig. 250. Valve Timing Diagram

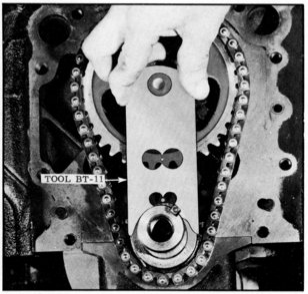


Fig. 251. Timing Crankshaft and Camshaft Sprockets

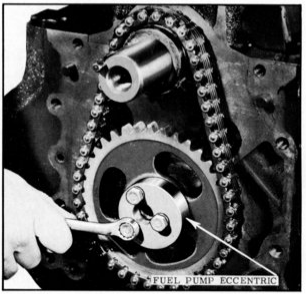


Fig 252. Removing Fuel Pump Eccentric

"O" on the eccentric will nearly line up with the timing mark on the camshaft sprocket).

When camshaft gear, timing chain, or sprocket gear is replaced, the correct valve timing can be obtained by using tool BT-11 as shown in Fig. 251. Crankshaft must be rotated 360° when distributor is installed.

Remove Camshaft

1. Drain radiator and remove radiator and heater hoses.
2. Remove air cleaner.
3. Remove fuel and vacuum lines.
4. Remove distributor.
5. Remove throttle linkage from carburetor.
6. Remove radiator fan, pulleys, and belts.
7. Remove generator, belt, and brackets.
8. Remove spark plug wire support.
9. Remove external water by-pass tube.
10. Remove push rod covers, rocker arm assembly, and push rods.
11. Remove intake manifold.
12. Remove cylinder block cover.
13. Remove valve lifters and place in rack. This is to keep lifters clean and so they can be replaced in the same order as removed.
14. Remove upper radiator baffle support.
15. Remove radiator core.
16. Remove harmonic balancer and pulley assembly.
17. Remove fuel pump.
18. Remove exhaust cross-over pipe.
19. Remove steering idler arm.
20. Remove oil pan.
21. Remove front engine mounting, holding engine with special tool set BT-29.
22. Remove engine front cover.
23. Remove fuel pump eccentric, timing chain and sprocket.

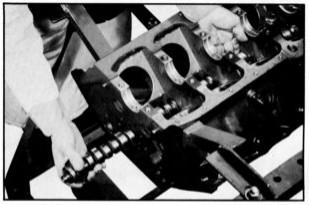


Fig. 253. Removing Camshaft

24. Remove camshaft thrust plate, and camshaft.

To replace, reverse sequence of operations, set valve timing, and adjust carburetor idle.

Valve Lifters

The new type hydraulic valve lifters maintain zero valve lash or tappet clearance. Any lash which results in the system, is instantaneously taken up by the hydraulic action.

The hydraulic valve lifter consists of the heat treated alloy cast iron valve lifter body, plunger, plunger spring, ball check valve, ball check valve retainer, push rod seat, and push rod seat retainer ring.

A direct oil feed from the main oil galley line to the valve lifters is maintained at all times. This oil feed indexes with a groove and oil hole in the lifter body and an oil hole in the plunger.

Whenever lash tends to be present, the plunger spring expands pushing the plunger until solid contact is made with the push rod and linkage. This creates a difference in oil pressure on either side of the ball check valve, the lower oil pressure being below the plunger. The higher pressure above, forces the ball check valve away from the seat and allows the oil to flow, below the plunger to fill the lower cavity with oil until the pressure is equalized.

When the lifter is raised by the cam, the increased oil pressure below the plunger forces the ball check valve in its seat, and the oil then becomes a solid connecting link.

There is a certain amount of oil leakage between the plunger and valve lifter body while the engine valve is open to eliminate the possibility of a "negative valve lash clearance" condition.

NOTE—After the engine has been standing for a considerable length of time, a certain amount of valve lifter noise will occur when the engine is first started due to the fact that oil escapes from those lifters which are holding valves open against spring pressure at the time the engine was stopped. Oil pressure will refill these lifters after a few seconds of engine operation, at which time the noise will disappear. Such starting noise should not be considered as excessive valve noise.

Remove Valve Lifters

1. Remove intake manifold.
2. Remove engine push rod cover.
3. Remove valve cover.
4. Remove rocker arm shaft assembly.
5. Remove push rods.
6. Remove valve lifters.

   IMPORTANT—Valve lifters and push rods should be placed in a rack in their proper sequence so they can be reinstalled in their same position in the cylinder block.

Reverse removal procedure for installation.

Disassemble and Assemble Valve Lifter

1. Hold plunger down with a push rod, and remove plunger retainer with a screw driver.

   CAUTION—Hold hand over opening when removing spring to prevent loss of spring.

2. Remove push rod seat, plunger, ball check valve, ball retainer, and spring.

   CAUTION—It is very important when disassembling a hydraulic valve lifter that it is thoroughly cleaned and inspected before reassembly. The slightest particle of foreign material under the ball check valve will cause malfunctioning of the lifter. Close inspection should also be made for nicks, burrs, or scoring of parts. If any parts are so damaged, the entire lifter assemblies should be replaced.

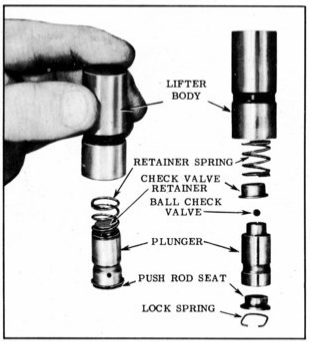


Fig. 254. Detail of Hydraulic Valve Lifter

3. Place plunger over push rod seat.
4. Install ball into hole in plunger.
5. Place ball check valve retainer over ball in plunger.
6. Place check valve retainer spring over retainer.
7. Carefully assemble valve lifter body over the complete assembly.
8. Turn assembly over and while holding push rod seat down, install retaining lock spring.
9. Fill lifters with oil before reinstalling in engine by submerging in engine oil and pumping the plunger with a push rod until lifter is full. (Lifter is full when it becomes impossible to pump the plunger with hand pressure).

Valve lifters in production engines may be one of four sizes: standard, .001", .002" or .003" oversize. It is important when replacing valve lifter assemblies that the proper size lifter be ordered. An identification numeral is etched on all lifter bodies except standard. The cylinder block is marked for lifter size on the rail under the push rod cover. Valve lifters which are .005" oversize, are available for service replacements.

Valve Linkage

PUSH RODS

The steel push rods for all valves are identical; however, longer push rods will be used for export due to the thicker cylinder head gaskets used on those engines. The longer rods will not operate properly in engines manufactured for domestic use, and under no circumstances should they be installed.

The push rods used in export engines will have a copper finish which will distinguish them from the plain finished regular push rods.

ROCKER ARMS

The Pearlitic malleable iron rocker arms are positioned on the valve rocker shaft by means of springs and valve rocker shaft brackets.

Rocker arms are identical except that the intake arms may be identified by a brass pin which blocks the upper end of the drilled passage leading to the push rod oil hole. This oil passage provides lubrication between the push rod and its seat in the rocker arm.

VALVE ROCKER SHAFT BRACKETS

The rocker arm shafts are supported by four brackets on each cylinder head, three of which are identical. The remaining bracket on each head has an oil hole drilled through the bottom which indexes with the oil line in the cylinder head originating at the No. 2 camshaft bearing for the left side and at the No. 4 camshaft bearing on the right side. These two brackets can be identified by their dowel pins which position the rocker arm shaft with respect to the oil passages.

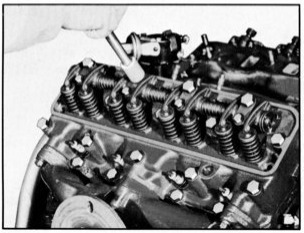


Fig. 255. Removing Valve Rocker Shaft Brackets

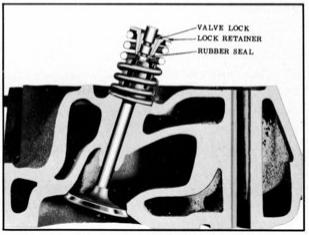


Fig. 257. Detail of Intake Valve

Three rocker shaft springs are used to keep the center rocker arms in proper position against the brackets, whereas both end rocker arms are positioned by a flat washer, a wave washer and a cotter pin.

The rocker arm shafts, which are identical for both sides, are made of alloy steel tubing with the ends plugged. The hollow shaft fills with oil from the pressure system and provides lubrication for the rocker arms, push rods and push rod seats.

Disassembly of Rocker Arm Shaft

If, for any reason, it should become necessary to disassemble the rocker arm shaft assembly, proceed as follows:

1. Remove cotter key, flat washer and wave washer.
2. Remove rocker arms, supports and springs from shaft.

   NOTE—One support is doweled to each shaft and should not be removed when disassembling the shaft assembly.

When assembling rocker arms and supports to shaft, be sure the supports are installed correctly on the shaft in relation to the doweled support and that the rocker arm (push rod end) is in the same side as the large cylinder head bolt hole in each support.

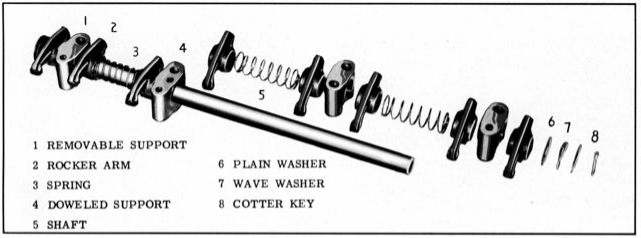


Fig. 256. Rocker Arm Shaft Assembly

VALVES

The intake valves are made of alloy steel, and the exhaust valves are made of a special high grade heat resisting alloy steel. The angle of the seat is 45°. The exhaust valve stem is 1/16" larger in diameter than that of the intake valve to provide better cooling of the valve head. Rubber seals are installed on the second groove from the end on intake valves as shown in Fig. 257; seals must be carefully positioned when they are reinstalled in order to prevent their being damaged.

Valve Springs and Dampers

The intake and exhaust valve springs are identical. To eliminate the inherent vibration in the valve springs at certain engine speeds and to increase life of the spring, a damper is used inside the bottom coils seating against the cylinder head.

Remove Valve Springs and Dampers

1. Remove cylinder head.
2. Using tool BT-14, compress valve springs until valve stem locks can be removed.

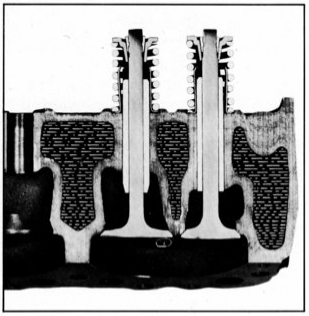


Fig. 258. Cylinder Head Cut Away View

3. Remove valve spring retainers, springs and dampers.

Reverse removal procedure for installation, taking care to see that rubber seals on intake valve stems are in proper position. (See Fig. 257)

Valve Guides

The cast iron valve guides furnish ample bearing surface for the valve stem to insure proper seating of valves in the head and ample dissipation of heat. The over-all length of the intake and exhaust valve guides is the same. The intake guide has a smaller bore than the exhaust guide and is also beveled at the bottom.

Replace Valve Guides

Both intake and exhaust valve guides extend

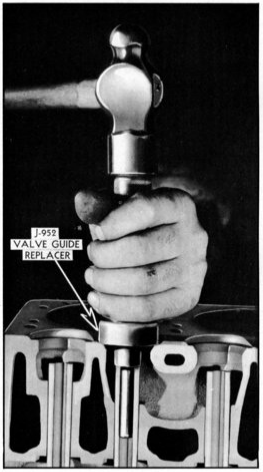


Fig. 259. Replacing Valve Guides

53/64" - 27/32" above the face of the valve spring seat.

It is important when installing a valve guide that the distance from the top of the guide to the cylinder head be held according to specifications. Therefore, tool BT-13 shown in Fig. 259 should be used when installing either intake or exhaust valve guides. Both guides are undercut to a smaller outside diameter at the top.

Drive the new guide in from the top of the cylinder head until the tool seats on the valve spring seat.

Lubricating System

The engine lubricating system, as indicated by the phantom view of the oil lines (Fig. 260) provides full pressure lubrication to all important rotating and reciprocating parts of the engine.

Oil is delivered by the oil pump to the oil filter which filters all of the oil coming from the pump. When a filter is not used, the oil flows through the same lines and a direct connection is made between the intake and exhaust lines at the filter mounting pad.

Oil then flows to the main oil galley on the right side of the engine adjacent to the camshaft and also to a line between the rear main and rear camshaft bearings. The main oil galley, which extends the full length of the block, pro vides lubrication to the front four main bearings and all the valve lifters on the right side.

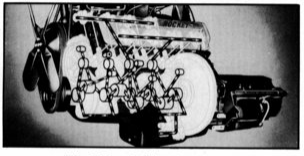


Fig. 260. Lubricating System

Oil lines are drilled from the front four bearings to their respective camshaft bearings. In addition, an oil line is drilled from the front main bearing to the left side galley which provides lubricant to the valve lifters in the left bank of cylinders. From number "two" camshaft bearing is an oil line indexing with the left cylinder head which, in turn, indexes with the oil hole in one of the rocker arm supports. From number "four" camshaft bearing is a similar oil line which indexes through the cylinder head to a rocker arm support on the right cylinder head. The holes in No. 2 and No. 4 camshaft bearings meter and reduce the oil pressure to the rocker shafts.

From the rocker arm shaft, the oil is forced to the rocker arm bearing surfaces and also to the push rod seats in the rocker arms. Oil drainback from the rocker arm assembly is attained by two oil drain holes in each head, one located at each outer corner of the cylinder head.

The camshaft thrust plate covers the oil galley holes at the front of the block. However, there is a 1/16" hole in the plate which indexes with the right hand oil galley to provide lubrication for the timing chain, sprockets, fuel pump lever and eccentric.

The oil plug at the rear of the left side oil galley has a 1/16" hole which provides lubrication for the distributor drive gear.

Oil is also forced from the main bearings through drilled passages in the crankshaft to the connecting rod bearings and through rifle drilled connecting rods to the piston pins.

Cylinder wall lubrication is achieved by an oil spit hole in each connecting rod which sprays oil onto the cylinder wall on the opposite bank.

The camshaft cam contours and lifter faces are lubricated by continuous spray thrown from the connecting rod bearings.

OIL PUMP

The positive gear type oil pump is located in the lower crankcase and oil pan. It is attached

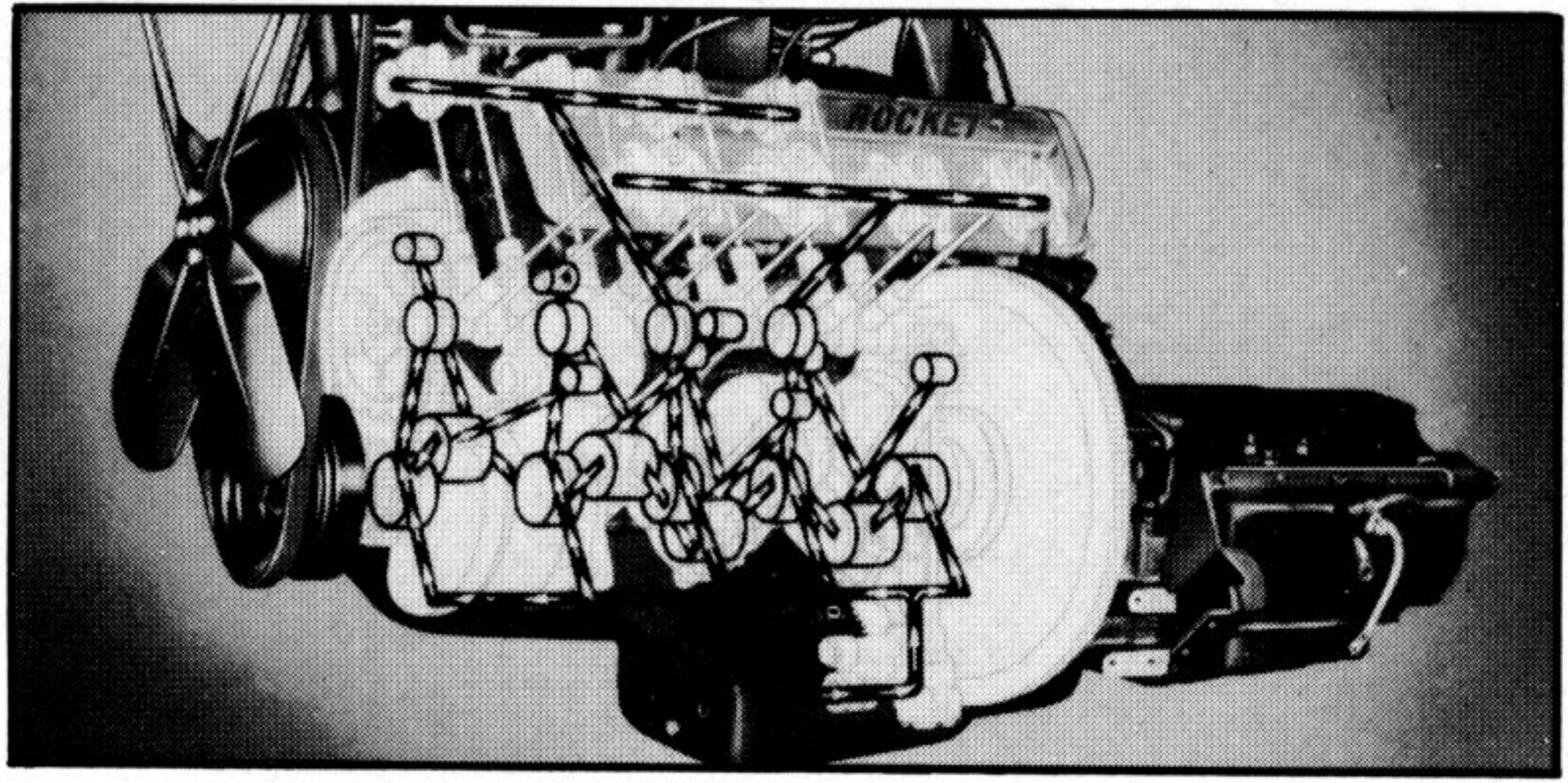


Fig. 260. Lubricating System

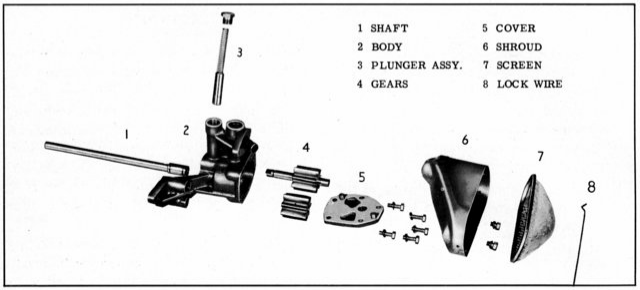


Fig. 261. Oil Pump Assembly Detail

to the rear main bearing cap with three attaching bolts and can be removed without disturbing any of the drive mechanism. The drive for the oil pump is taken through a jointed extension shaft which engages the lower end of the distributor drive gear. The distributor drive gear is a spiral gear driven by the camshaft.

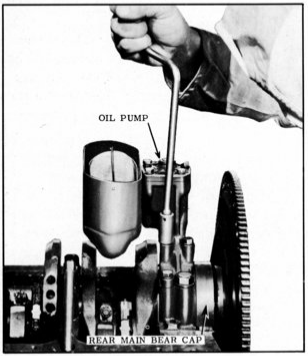


Fig. 262. Removing Oil Pump

The oil operating pressure has been increased to approximately 40 pounds per square inch.

Disassemble and Assemble Oil Pump

1. Remove oil screen lock wire and screen.
2. Remove oil screen shroud.
3. Remove lower snap ring from extension shaft coupling.
4. Remove oil pump cover.
5. Remove oil pump gears.
6. Remove oil pump pressure regulator nut, spring and valve.

To assemble oil pump, reverse disassembly procedure.

CRANKCASE VENTILATION

The crankcase ventilating system prevents the harmful dilution of engine oil. The evacuation of air is through a crankcase ventilator baffle assembly at the rear of the crankcase to the crankcase ventilator tube. The end of the ventilator tube is beveled and projects into the air stream caused by the motion of the car. The air

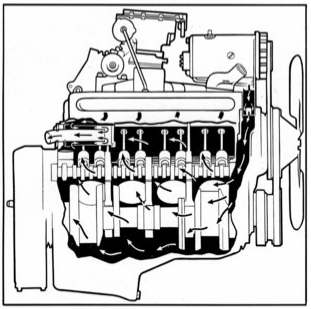


Fig. 263. Crankcase Ventilation System

passing the end of the tube creates a vacuum which draws air out of the crankcase; together with its contents of gasoline and water vapors. The fan blast forces fresh air through the breather cap and oil filler tube into the crankcase. The breather cap contains a small air cleaner to prevent the entrance of dust and other foreign matter.

The ventilator outlet tube is a push fit on the ventilator tube flange, and can be removed without disassembly of the flange bolts which secure the flange and inner crankcase ventilator baffle to the cylinder block.

In removing the ventilator outlet tube the tube to lower flywheel housing bracket should be disconnected from the flywheel housing, leaving the bracket attached to the pipe.

OIL FILTER OR PAD COVER

If, for any reason, the oil filter or pad cover is replaced, the attaching bolts should be torqued to 35-40 ft. lbs.

A new gasket, coated on both sides with POB No. 5 Sealer, should always be used whenever the oil filter or pad cover has been removed.

Manifolds

The intake manifolding for both banks of cylinders is of one casting, while each bank has a separate exhaust manifold.

The intake manifold consists of two different sets of feeding passages; the left side of the carburetor supplies fuel to cylinders 3, 5, 2 and 8 through one set of passages, while the right side of the carburetor supplies fuel to cylinders 1, 7, 4, and 6 through the other set of passages. (See Fig. 264)

Preheating of the gasoline mixture is obtained by the center exhaust gas passage which directly connects the two exhaust manifolds, allowing the hot exhaust gases to circulate around the intake manifold heater body.

Cast integral with the intake manifold at the front is a passage which returns the water from the two heads to the water outlet and the radiator core.

The intake manifold is located fore and aft by a dowel on the right hand cylinder head and laterally by the angular mounting faces on the heads which form a cradle.

There is a right and a left side exhaust manifold, and the two cannot be interchanged. The manifold opening to the exhaust pipe is more centrally located on the right side exhaust mani-

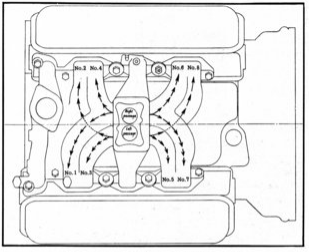


Fig. 264. Fuel Supply Passages

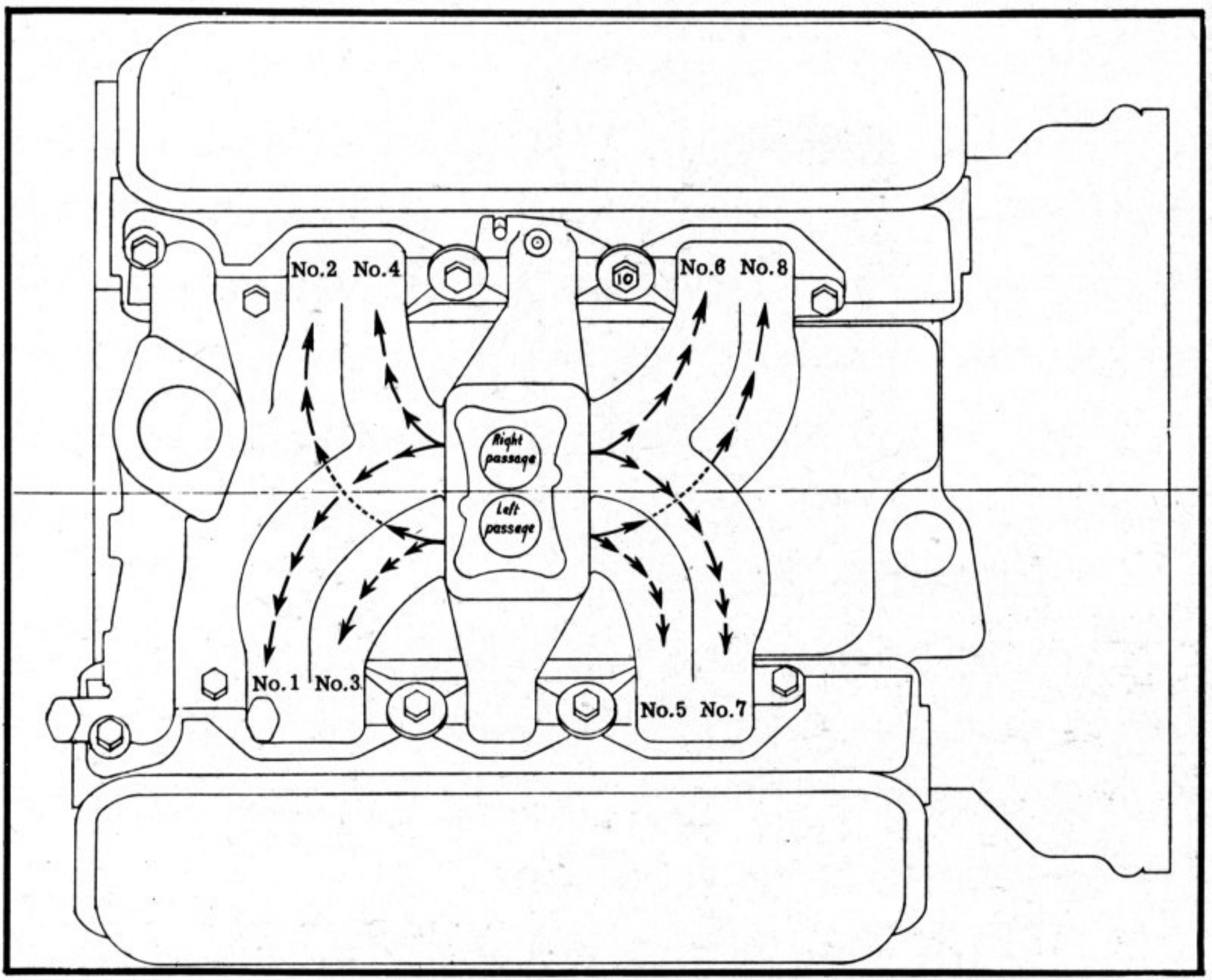


Fig. 264. Fuel Supply Passages

fold than on the left. For easy identification, the letters "LH" or "RH" are cast on the manifolds.

The manifold heat control valve assembly is mounted on the left side between the exhaust manifold and the exhaust pipe. This automatically controlled valve regulates the amount of heat by-passed through the intake manifold heater body so that a sufficient amount of heat is transferred to insure a uniform vaporization of the intake mixture under all operating conditions.

The thermostatic spring tends to close the heater valve when cold. Exhaust gas pressure, which increases with speed and throttle opening, tends to open the offset valve. The counterweight attached to the valve shaft holds the valve open at low speeds when the thermostat is hot. The valve offset, counterweight, and thermostat are calibrated to give proper intake manifold heat under all driving conditions.

A stop spring attached to the heater valve shaft should be adjusted so that it strikes the stop before the counter-weight contacts the thermostat pin to prevent rattle when valve is in closed position.

The heater valve, shaft, and shaft bushings are made of special heat resisting, stainless steel to prevent the possibility of sticking.

ENGINE MOUNTINGS

The engine is supported in the frame at three points, on non-adjustable wear-proof, rubber mountings which are so constructed and located, that they control and absorb engine torque reaction and insulate the engine from the frame.

The front mounting is bolted between a bracket on the front engine cover and the frame front cross member.

The rear mountings which are different from those used on previous models, are attached to the rear of the flywheel cover housing and the frame second cross member.

CAUTION—When installation of a front engine mounting becomes necessary, the cap screws fastening the mounting to the frame or bracket should first be screwed finger tight, then tightened alternately, one turn at a time. DO NOT TIGHTEN ONE CAP SCREW IN POSITION INDEPENDENTLY OF THE OTHER. This is extremely important, since the lower portion of the assembly would not seat evenly in the upper portion. The front mounting must be properly positioned and tightened, otherwise the mounting will not properly function as an insulator.

Cooling System

The cooling system consists of a Harrison cellular type round "V" radiator core, thermostatic water flow control, water by-pass, water pump attached to the front engine cover, and a four-blade fan.

The water pump discharges water through the front engine cover into both banks of the block. The water then flows through the block, up into the two cylinder heads, and through the heads to the front. It then flows from the front of each cylinder head through the intake manifold water passage to the water outlet and finally to the radiator.

When the thermostat is closed, all the water flows through both the internal and external by-pass passages to the inlet side of the water pump and back to the engine block.

No water distributor tube is used in the block, since the size and location of the water distributor holes in the cylinder block and heads are designed for uniform coolant distribution.

RADIATOR

The radiator core is the Harrison Cellular round "V" type, which permits a maximum heat dissipation with minimum size of core. The radiator core, upper tank and lower tank are bound together by a steel harness, which completely encircles the three units. This assembly

is then bolted to a very rigid steel radiator support which extends along the bottom and up the sides of the radiator core.

The front fender also attaches to the radiator support making one unit of the radiator core, baffle, grille, headlamps, and front fenders.

Attached to the rear of the radiator core and completely encasing the fan, is a shroud which facilitates more efficient cooling of the engine.

A seven pound pressure radiator cap is used as compared to the four pound cap used on previous models. As a result of the increase in pressure, the boiling point of the water has been raised to approximately 230° F. reducing the tendency to boil under extremely hot operating conditions and at high altitudes.

Remove Radiator Core and Shroud

1. Drain cooling system.
2. Disconnect upper and lower radiator hose connections.
3. Remove radiator upper baffle.
4. Remove radiator shroud.

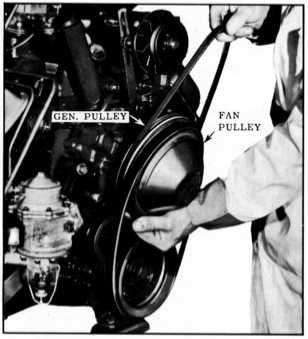


Fig. 265. Removing Fan Blades and Pulley

5. Remove core.

To install radiator core and shroud, reverse the removal procedure.

TEMPERATURE CONTROL

Water temperature is automatically controlled by a bellows type thermostatic valve located in the intake manifold water outlet passage.

The thermostatic valve when cold, closes the passage between the water outlet casting and the radiator permitting the engine to quickly reach an efficient and economical operating temperature. When the water temperature reaches 151° F. the thermostat gradually opens allowing water to flow through the radiator thus regulating the temperature under all operating conditions.

FAN AND BELT

The fan has four unequally spaced blades and, together with a fan pulley and a generator drive pulley, is attached to the water pump impeller shaft hub by four cap screws. The crankshaft pulley and a "V" belt drive the fan, which is larger than the one used on previous models.

The second or rear pulley which is attached to the water pump impeller shaft hub, and a "V" belt, drive the generator, which is located directly above the water pump. (See Fig. 265)

Fans on all models are checked for lateral runout which must not exceed ⅛", and for balance which must not exceed one quarter inch ounce. A fan which does not meet these specifications will cause a rough engine and shorten the life of the water pump.

Remove and Replace Fan Blades and Pulleys

The fan blades and two pulleys can be removed without disturbing the water pump as follows:

1. Loosen idler pulley adjusting bolt.
2. Loosen generator link adjusting bolt.
3. Remove four fan and pulley attaching bolts.

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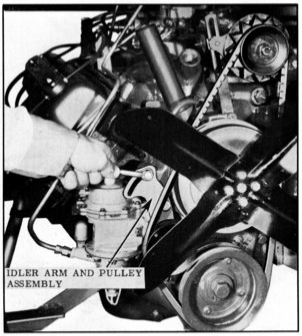


Fig. 266. Loosening Idler Pulley Adjusting Bolt

4. Remove fan and two pulleys.

Reverse the above procedure for installing fan and pulleys, and adjust belts to proper tension.

If tension on belts is not released, the fan can be removed without disturbing the pulleys by removing four attaching bolts. The tension of the two belts will keep the pulleys in position.

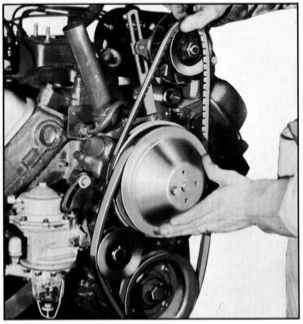


Fig. 267. Assembling Fan Pulleys

Adjust Fan and Generator Belts

The fan belt is adjusted by means of an idler pulley attached to a slotted adjusting arm which, in turn, is attached to the front cover. A force of 25 lbs., applied midway between the idler and fan pulleys and perpendicular to the belt, should deflect the belt ½". (See Fig. 268)

The generator belt is adjusted by means of a slotted adjusting link to which the generator is attached. A force of 25 lbs., applied midway between the fan and generator pulley and perpendicular to the belt, should deflect the belt ¾".

Remove Lower Fan Pulley and Harmonic Balancer (With Radiator Removal)

1. Remove crankshaft front end bolt and washers.

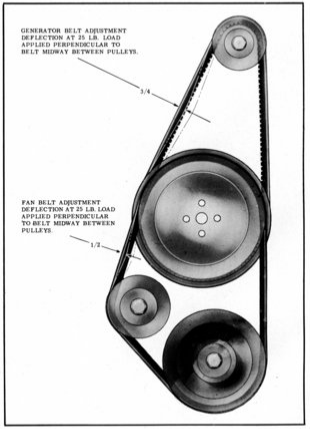


Fig. 268. Adjusting Fan and Generator Bolts

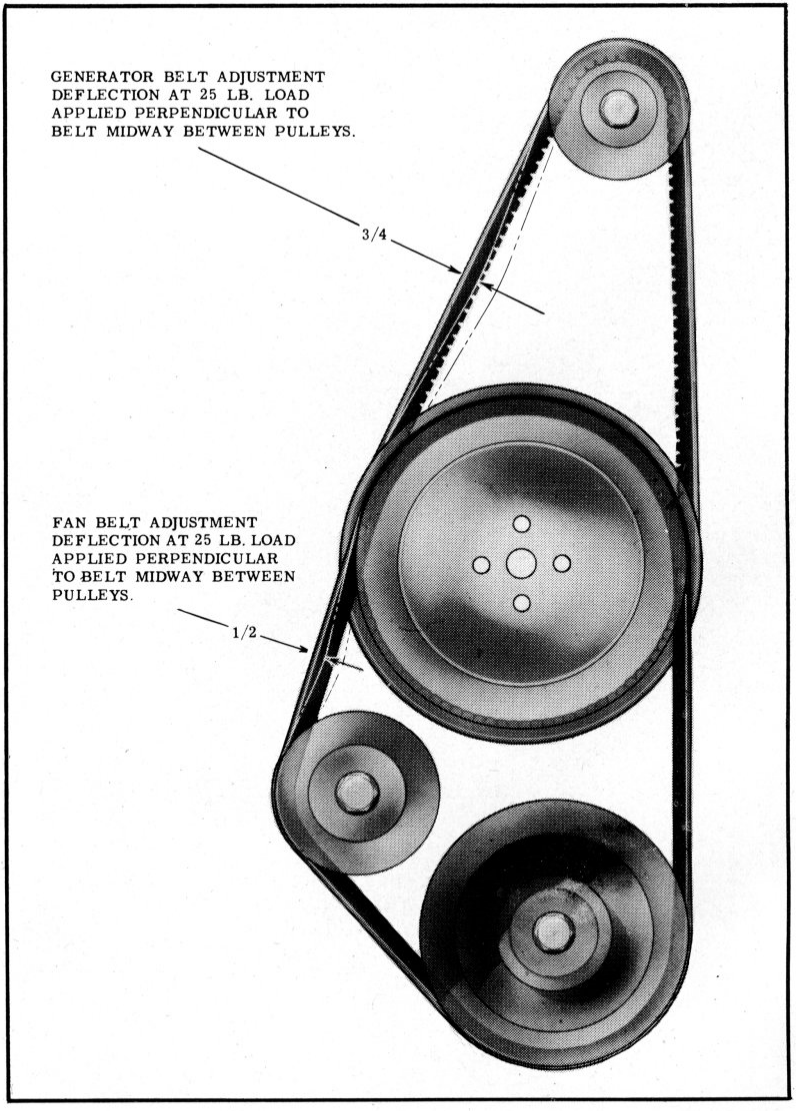


Fig. 268. Adjusting Fan and Generator Bolts

2. Carefully pry pulley and balancer from crankshaft.

When installing pulley and harmonic balancer, always use a new lock washer.

WATER PUMP

The centrifugal type water pump, mounted in the front engine cover casting, is driven by the crankshaft through the use of pulleys and a belt at .8 crankshaft speed.

The water pump features a permanently lubricated double row ball bearing and a non-adjustable seal assembly for the pump shaft. The permanent seal, which makes repacking unnecessary, consists of a graphite washer adjacent to the impeller, backed with a neoprene seal and a spring assembled in a seal housing which is pressed into the water pump housing. The graphite washer prohibits water passage between the impeller and seal. The neoprene seal acts as a further check on any fluid which might pass between the graphite washer and the housing. This seal cannot be disassembled, and if a leak appears, the complete seal assembly should be replaced as a unit.

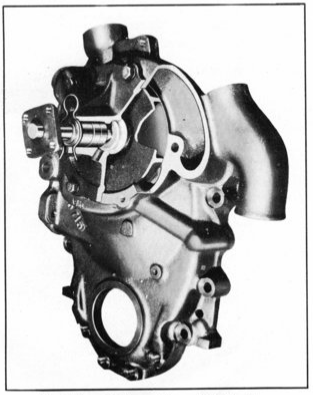


Fig. 269. Cut Away View of Water Pump Assembly and Front Cover

A brass slinger is pressed onto the shaft between the seal and the bearing so that any moisture in front of the seal will be deflected away from the bearing and out the drain hole.

The large vent and drain hole, located at the bottom side of the pump housing, minimizes moisture formation in the pump assembly and provides a drain which is in a direct line with the brass slinger.

The pump shaft is part of a permanently lubricated double row ball bearing. Grooves in the shaft act as the inner races for the bearings and provide a means of taking end thrust of the fan and pump.

To avoid unnecessary water pump bearing replacement, a check should always be made to assure that the noise is actually caused by the pump and is not the result of noisy generator, fan belt, idler pulley bearing, or harmonic balancer.

IMPORTANT—When water pump bearing housing assembly is dis-assembled for any reason, a new seal assembly must be installed because of the possibility of the seal assembly housing being distorted.

WATER-PUMP BY-PASS

To provide water circulation and prevent excessive build-up of pressure within the cylinder block and cylinder head during the time the thermostatic valve is closed, an internal and external water by-pass is provided between the cylinder heads and the inlet side of the water pump.

Water flows in the internal by-pass directly from the cylinder head through the block and to the inlet side of the water pump, while the water in the external by-pass flows from the

water passage of the intake manifold to the inlet side of the pump (by-passing the thermostat).

The external water by-pass provides additional water flow and facilitates the flow of water to the thermostat when it is closed.

Remove and Replace Water Pump

1. Remove fan and two fan pulleys.
2. Remove six water pump attaching bolts (four pump housing to front engine cover attaching bolts and two pump housing to block attaching bolts).
3. Remove water pump.

Reverse the above procedure using new gasket for installation.

One side of the water pump bearing housing gasket should be coated with gasket cement. The four water pump bearing housing bolt threads should be dipped in CP No. 9 Sealer.

Disassemble Water Pump

1. Remove bearing retainer from front of housing.
2. Support outside surface of pump housing in arbor press, and press shaft through impeller and housing, pressing on impeller end of shaft toward front of housing. (Fig. 270)
3. Remove seal assembly from housing by driving against inside face of seal with a drift.
4. Remove pulley drive flange, if a new bearing is to be installed.
5. Clean all sealer material from pump housing and seal seat.

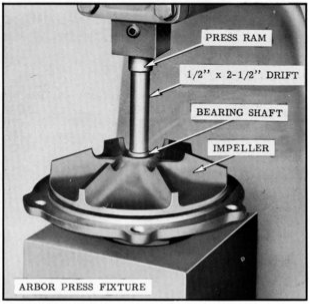


Fig. 270. Removing Impeller from Shaft

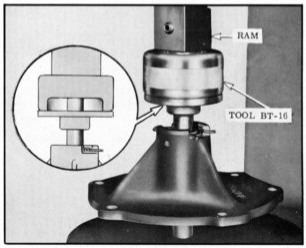


Fig. 271. Installing Fan Hub

Assemble Water Pump

The water pump double row ball bearing has one large circumferential groove in the center, and two smaller circumferential grooves toward

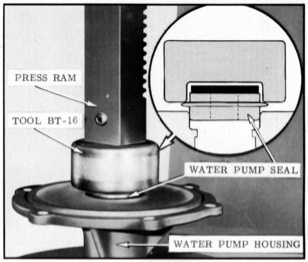


Fig. 272. Installing Seal in Pump Housing

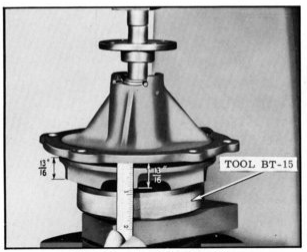


Fig. 273. Installing Impeller

one end. The end with the two smaller grooves must always be assembled into the pump housing first. This end of the bearing shaft is the rear or impeller end.

1. Assemble bearing, slinger and hub assembly to housing, using tool BT-16 (See Fig. 271)

   NOTE—In event that new bearing is used, it will be necessary to assemble slinger and hub to bearing before assembling into housing.

2. Assemble seal in housing using tool BT-16 as shown in Figure 272.
3. Using tool BT-15 to support impeller as shown in Figure 273, press bearing shaft through impeller until bottom edges of vanes are 13/16" from machined face at edge of housing.

WATER TEMPERATURE GAUGE

An electrically operated water temperature gauge is mounted in the instrument panel to indicate the temperature of the cooling liquid in the engine.

INTAKE SILENCER AND AIR CLEANER

The AC combination intake silencer and air cleaner is standard equipment. An AC combination intake silencer and heavy duty (oil bath) air cleaner is furnished as optional equipment.

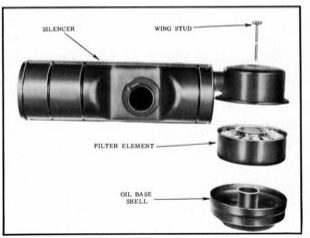


Fig. 274. Intake Silencer and Air Cleaner

Servicing Air Cleaner

The standard air cleaner should be serviced every 2,000 miles when car is operated on paved roads and every 500 to 1,000 miles when car is operated on dirt roads or under dusty conditions.

The heavy duty oil bath cleaner should be serviced every 5,000 miles when car is operated on paved roads, and every 2,500 miles when car is operated on dirt roads under average dusty conditions. Under extreme conditions in territories subject to dust storms or where industrial abrasives are prevalent, cleaners may require more frequent service.

The cleaner can be removed after loosening the cleaner at the carburetor and at the air cleaner support bracket.

To service heavy duty (oil bath) air cleaner, proceed as follows:

1. Remove wing-nut from top of cover while holding oil reservoir.
2. Remove cleaner unit and oil reservoir.
3. Wash accumulated dirt from the cleaner unit by plunging it up and down several times in can of clean gasoline or kerosene.

   CAUTION—Do not oil cleaner as it is automatically oiled in operation. Do not

wet felt in cover. If felt becomes wet, clean with clear gasoline.

4. Clean accumulated dirt from the oil reservoir and refill to indicated level with one pint of S.A.E. 50 oil, (S.A.E. 40 oil for winter temperatures).

Remove and Install Engine Front Cover

1. Drain cooling system.
2. Disconnect lower radiator hose and heater hose from front cover.
3. Disconnect external water by-pass at intake manifold.
4. Disconnect generator link at generator.
5. Remove oil pan.
6. Remove two bolts attaching front motor mount to frame.
7. Support engine with special tool set BT-29. (Motor mount must clear frame front cross member).
8. Remove radiator core assembly and shroud.
9. Remove fan blades and pulleys.
10. Remove lower pulley and harmonic balancer.
11. Remove fuel and vacuum pump assembly.

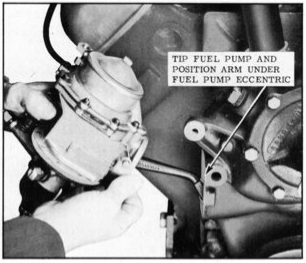


Fig. 275. Installing Fuel and Vacuum Pump Assembly

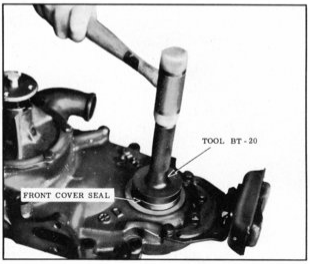


Fig. 276. Installing Front Cover Seal

12. Remove front cover attaching bolts.

To install, reverse sequence of operations.

NOTE—Always install a new front cover gasket coated on one side with gasket cement.

The sealing surface of the front oil seal and the fuel pump operating arm pad should be coated with Fiske lubriplate.

The front cover attaching bolts and the threads on the by-pass elbow fitting should be dipped in POB No. 3 Sealer.

One side of the fuel and vacuum pump gasket should be coated with a gasket cement.

Replace Crankshaft Front Oil Seal

The engine front cover must be removed to replace the front oil seal, since the seal is located in the cover housing.

Before installing a new seal, wipe POB No. 3 Sealer on the outside diameter of the seal.

Tool BT-20 can be used to properly install seal in front cover without damaging seal. (Fig 276)

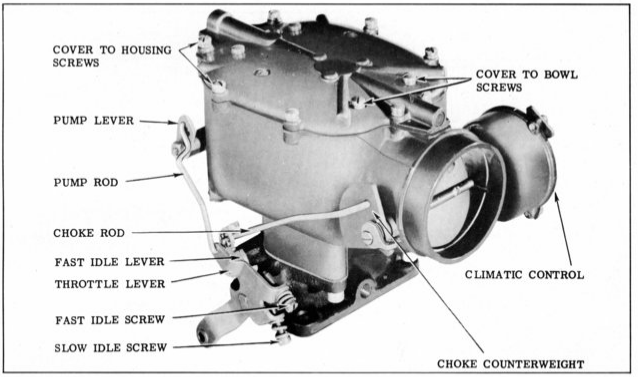


Fig. 277. Rochester GM Carburetor

CARBURETION

All 1949-8 cylinder Oldsmobiles are equipped with either the Rochester Products GM Carburetor, Model 7001570 or the Carter Carburetor, Model WGD. Although both carburetors are dissimilar to any used on previous models, their designs are entirely different and, therefore, are covered separately in this manual.

Rochester GM Carburetor

The Rochester GM Carburetor is an entirely new design which differs from previous types used on the Oldsmobile 8 cylinder engines in that the air entrance is of the horizontal type.

Foremost of the major advantages of the carburetor is the comparatively low gasoline bowl temperatures under all driving conditions, minimizing the difficulty of hot starting. Most service operations can be done after removing the carburetor bowl cover without disturbing or removing the air cleaner or carburetor throttle body. The removal of the eight cover screws permits complete service of the cover and float bowl assembly which contains all the important fuel-air calibrations and the accelerating pump; thus, the ease of removal of this important unit facilitates servicing the carburetor.

The Rochester GM Carburetor accelerating pump is a positive displacement type providing at all times a smooth acceleration due to instantaneous pump action. The pump jets are so "targeted" that the fuel is evenly atomized and mixed with air prior to entering the manifold, insuring more equal distribution to all cylinders and the accompanying smooth, powerful acceleration.

In addition to the fuel delivered by the carburetor pump, fuel is also metered to the engine by the power system whenever the manifold vacuum is suddenly decreased.

Whenever the Rochester GM Carburetor is

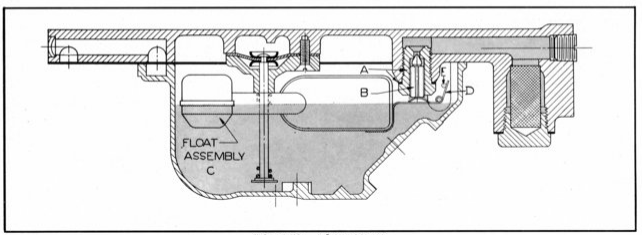


Fig. 278. Float Circuit

disassembled and rebuilt, the following adjustments are required in the sequence listed:

FLOAT ADJUSTMENT

PUMP ACTUATING LEVER ADJUSTMENT (GASOLINE DISCHARGE)

CHOKE ROD ADJUSTMENT

UNLOADER ADJUSTMENT

FAST IDLE CAM ADJUSTMENT

Each adjustment must be made accurately and without changing other adjustments if proper operation of the carburetor is to be expected.

The basically simple fuel systems and carburetor adjustments are discussed individually as follows:

FLOAT SYSTEM

The float system of the Rochester GM Carburetor has been designed in line with the carburetor itself to give maximum efficiency and performance under all driving conditions. The increased carburetor performance of the float system is due primarily to the central location of the main metering jets, the discharge nozzles and the concentricity of the float and bowl.

This construction insures a constant fuel feed to the engine at all times regardless of the road angle, acceleration, deceleration, or sudden stoppage, and the corresponding shift of the fuel level angle within the bowl. Although the car may be subjected to various road angles, such as hill climbing and the consequent change of fuel level angle within the bowl, the main metering jets, due to their central location in the bottom of the bowl, cannot become uncovered of fuel, thereby momentarily starving the engine and stalling. The discharge nozzles are also centrally located so that they are never below the fuel level in the bowl at any angle the car may assume, preventing any fuel spilling from the nozzles.

To further aid and maintain the proper fuel level in the carburetor bowl under all road and driving conditions, the float tang (D) is always in control with a calibrated balance spring (E) as illustrated in Fig. 278. This float balance spring serves a twofold purpose: First, it acts as an effective float vibration dampener to prevent needle wear. Secondly, it permits the use of a smaller and more efficient float without sacrificing actual bowl fuel capacity.

Float Level Adjustment

The Float level of the Rochester GM Carburetor is 23/32″ and is checked as follows:

1. Invert bowl cover and, with steel float needle seated, gauge vertical distance

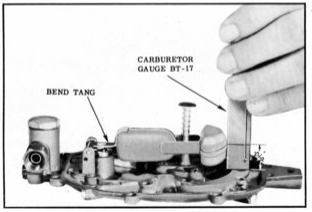


Fig. 279. Float Adjustment

from face of cover to soldered seam of float. The dimension, which should be 23/32" as shown in Fig. 279, is measured with a scale or tool number BT-17. (Bowl gasket should be removed when adjustment is measured.)

2. Adjustment is obtained by bending float tang which contacts float needle.

   NOTE: *Do Not Bend Front of Float.*

3. If needle or seat shows wear or damage, both should be replaced with a matched seat and needle set.

PUMP SYSTEM

To insure smooth, quick acceleration, the Rochester GM Carburetor has a diaphragm type accelerating pump. It is positive displacement in action so that an immediate pump delivery is guaranteed by the slightest movement of the accelerator foot pedal with no loss or leak of fuel.

The pump housing, diaphragm, jets and actuating lever and spring are attached to the bottom side of the float bowl. The pump diaphragm actuating lever is connected by a yoke within the carburetor housing to a pump lever and rod outside the housing. This pump rod is in direct linkage to the throttle lever.

The source of fuel for the pump system originates in the carburetor float bowl. To exclude dirt, the fuel must first pass through a finely meshed screen (A) in the bottom of the bowl. (See Fig. 280) The fuel then passes up through the bowl past the intake ball check (B) and into the cavity in the back of the float bowl created by the attaching of the pump diaphragm (C). Upon acceleration, the pump actuating spring moves the diaphragm against the cavity; thereby displacing fuel. This fuel passes vertically up the passage (D) in the float bowl, past the outlet pump needle (E) and down the passageway to be sprayed by the pump jets (F) into the engine manifold. One of the more outstanding features of this type pump system is that the conical-shaped pump return spring (G) has been calibrated to the degree that there is no loss of motion or "play" in the diaphragm or actuating levers. Any degree of throttle lever movement instantly causes the accelerating pump to deliver a corresponding amount of fuel for smooth, quick acceleration.

Pump Actuating Lever Adjustment

1. With carburetor completely assembled, insert pump rod in outside hole.
2. Back off idle stop screw and fast idle screw so that throttle lever and valves will freely close.
3. Remove cotter key from pump rod and remove rod from throttle lever.
4. Hold throttle lever in full closed position.
5. Pull pump rod down to full cocked dia-

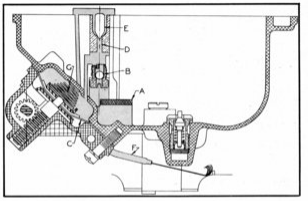


Fig. 280. Pump Circuit

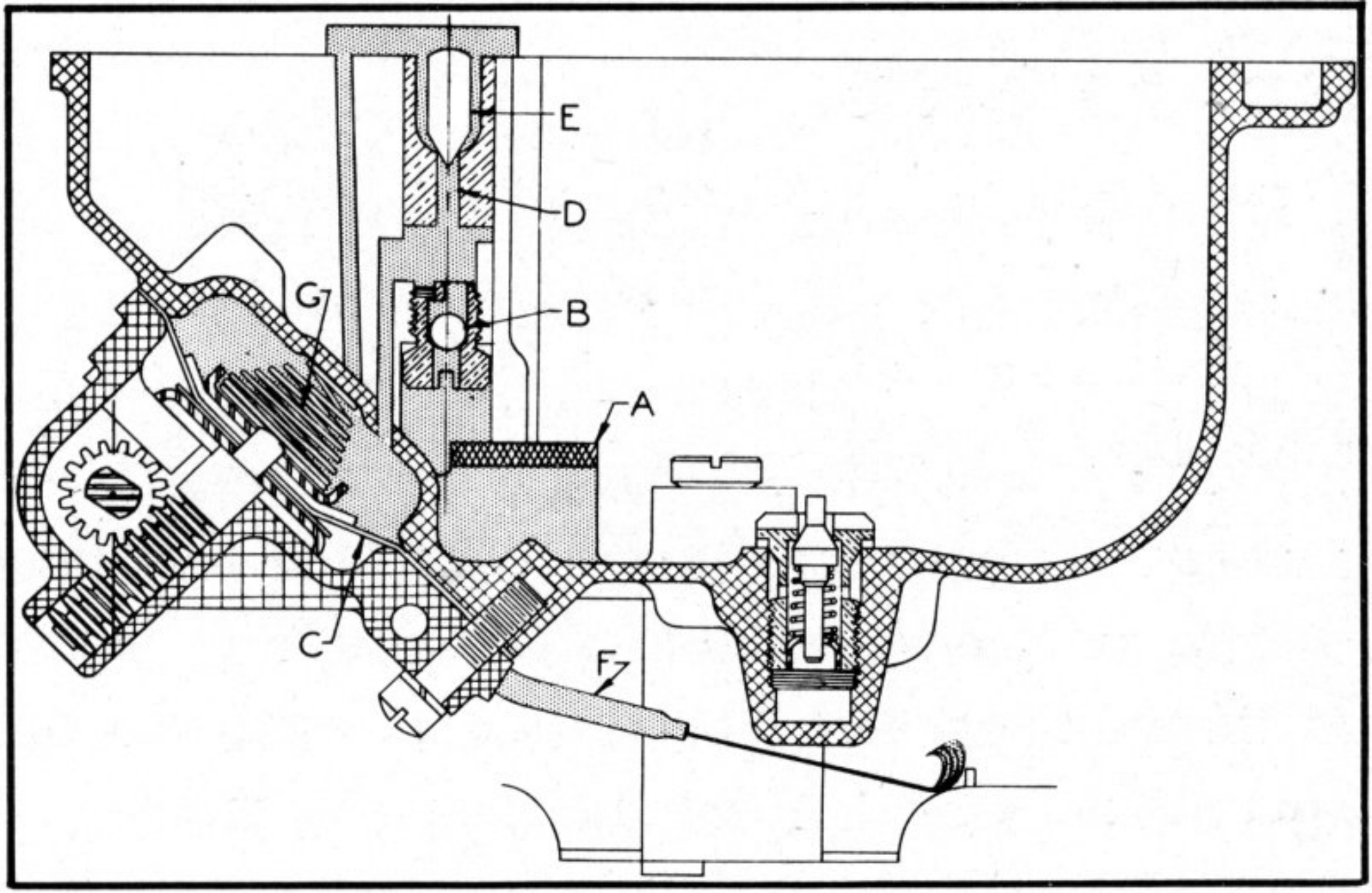


Fig. 280. Pump Circuit

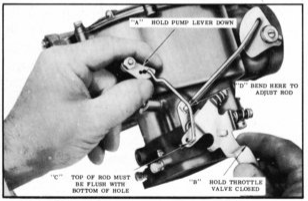


Fig. 281. Pump Actuating Lever Adjustment

phragm position, so rod is directly below hole in throttle lever. (See Fig. 281)

6. To obtain correct pump actuating lever adjustment, carefully bend pump rod so that the *TOP* edge of pump rod is flush with *BOTTOM* edge of hole in throttle lever.
7. Reassemble rod to throttle lever.

Pump Jet Targeting (Directing Stream of Gasoline)

The stream of gasoline from each of the two carburetor pump jets (A) must be directed to its proper section of the dual venturi system in order to obtain good acceleration performance; although the actual point at which the stream strikes the housing venturi cannot be seen, it can be checked by observing the discharge from the air horn.

The pump discharge when the throttle lever is slowly actuated, should appear as a fan shaped spray and *should not come out air horn.* Only a very slight bend is required to properly target pump jets. (See Fig. 280)

CHOKE SYSTEM

The Rochester GM Carburetor employs a thermostatically operated choker valve to insure proper starting and driving during cold weather operation. As shown in Fig. 282, this choke system is composed of the thermostatic coil (A), choke piston (B), valve (C) and choker valve shaft (D). It is operated by intake manifold vacuum, exhaust manifold heat, and the offset weight of the choker valve itself.

When the engine is cold, the thermostatic coil (A) is so calibrated as to hold the choke valve closed in the air horn to give proper starting fuel-air mixture. As the engine is started, air flow into the carburetor air horn aids in opening the offset choker valve. As the engine intake vacuum builds up, suction is applied to the bottom side of the choke piston (B) which tends to pull the choke valve open against the torque of the thermostatic coil. Thus, a reduced amount of air is allowed to enter the carburetor to mix with the constant amount of fuel, thereby reducing the air of the fuel-air ratios to give a richer mixture required during cold weather operation. As the engine warms up, however, heat piped from the exhaust manifold to the thermostatic coil cover causes the coil to relax, allowing the choker valve to move to its open position, and admitting ample air to reduce the fuel-air ratio to a more efficient and economical mixture.

Choke Rod Adjustment

With thermostat cover set at index (at 75° room temperature) choke valve should be closed.

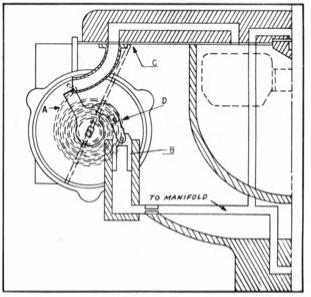


Fig. 282. Choke Circuit

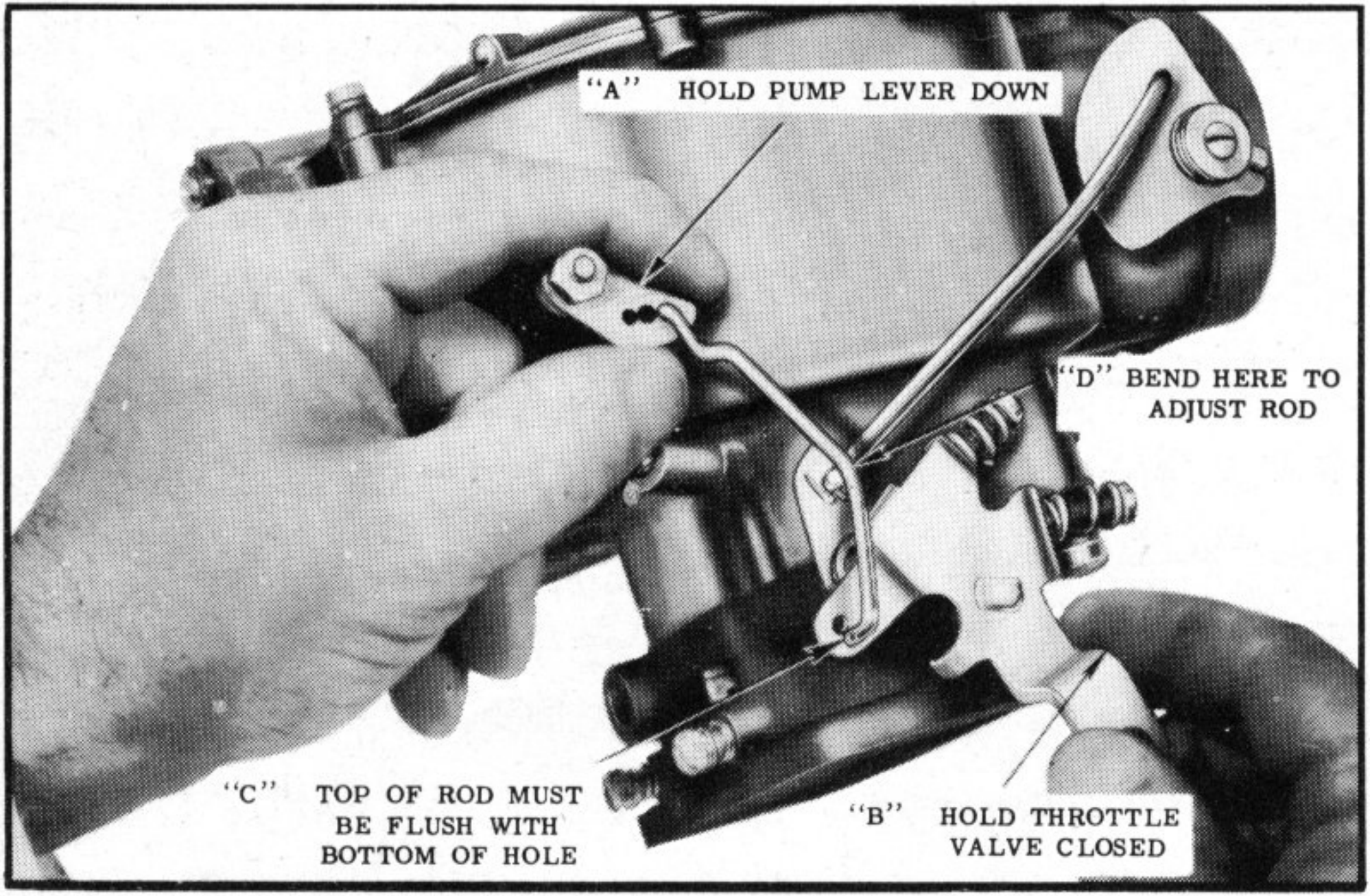


Fig. 281. Pump Actuating Lever Adjustment

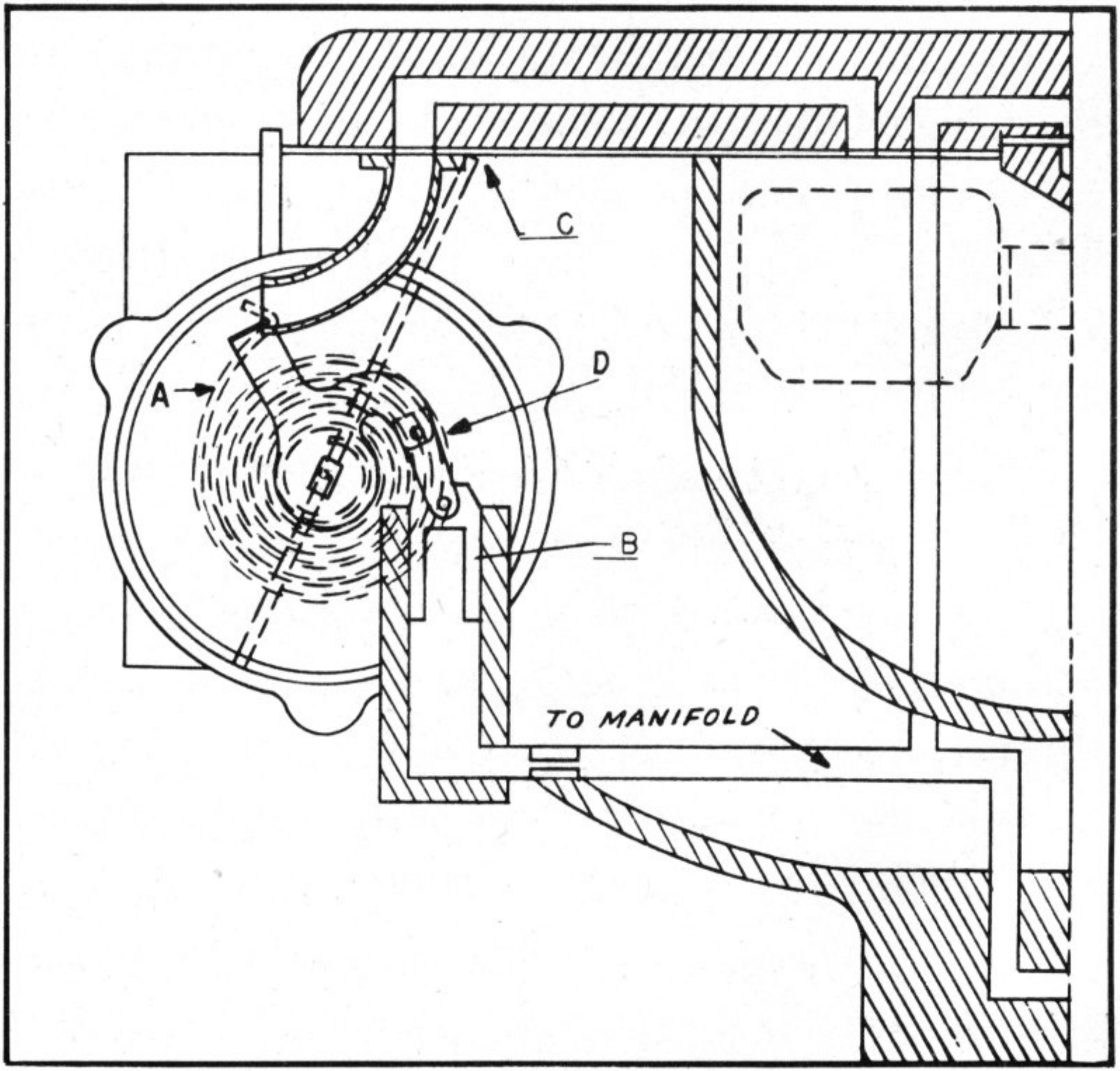


Fig. 282. Choke Circuit

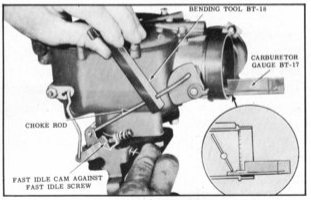


Fig. 283. Choke Rod Adjustment

1. Turn fast idle screw in relation to fast idle cam until compression spring is slightly compressed.
2. Hold throttle in closed position and move fast idle cam so that the first step of cam is resting against fast idle screw.
3. Be sure choke trip lever is in contact with choke counter-weight. Choke valve will now be opened slightly.

   NOTE—With fast idle screw and fast idle cam held in this position, clearance between the bottom of choke valve and bottom of air horn (small inside diameter) should be (.147") and can readily be checked with section "C" of carburetor gauge tool No. BT-17. (See Fig. 283)
4. Bend choke rod slightly to obtain correct clearance, (use tool BT-18).
5. Be sure choke rod does not rub on housing at any choke valve position.

IDLE SYSTEM

The carburetor idle system controls the fuel-air mixtures from the car idle setting up to approximately 25 to 30 miles per hour. As shown in Fig. 284, the fuel in the float bowl passes through the calibrated main metering jets (A) horizontally to the brass idle tubes (B). In the bottom of each of these idle tubes is a .026" drilled orifice which governs the actual amount of liquid fuel to be metered. The gasoline continues to follow the path of suction up these tubes; at this junction of the cover and bowl, air mixes with the idle system fuel through a calibrated hole, termed the idle air bleed (C), forming a mixture of fuel and air. This mixture passes horizontally through the idle channel passage of the cover; additional air is then metered by the idle channel bleed (D). The idle fuel-air mixture then passes downward through the idle passage in the carburetor housing to the throttle body where it is delivered to the engine manifold by the idle adjusting screw hole. The secondary hole and the top idle hole (E) as they are exposed to manifold suction by the opening of the throttle valves (F), deliver additional fuel for the low speed driving range.

PARTIAL THROTTLE SYSTEM

At a point of sufficient throttle opening, manifold vacuum is applied to the nozzles which then take over the economical delivery of fuel to the engine. This point is termed the "Transfer Point" inasmuch as the fuel delivery is transferred from the idle system to the main metering system. To a large degree, the calibrated main metering jets govern the fuel mixtures through-

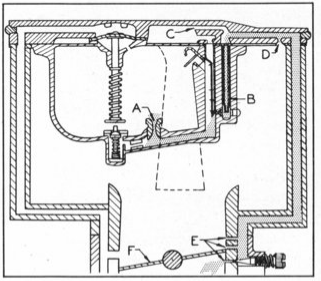


Fig. 284. Idle and Low Speed System

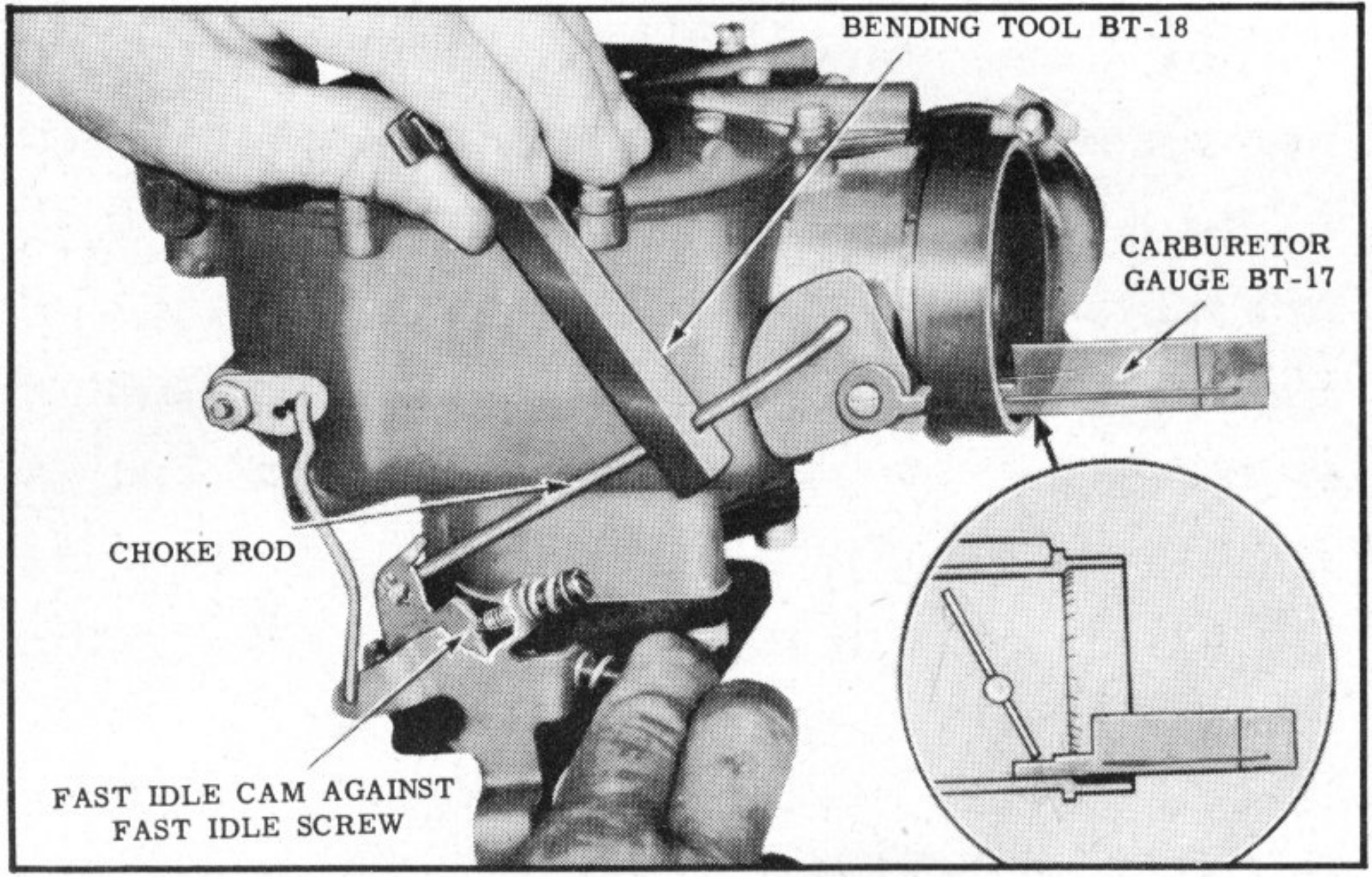


Fig. 283. Choke Rod Adjustment

out this range of 30 to 60 miles per hour, assisted by the air bleeds in the main well tubes being exposed or covered by the rise or fall of fuel level.

As shown in Fig. 285, the throttle valves (F) are opened sufficiently that the manifold suction on the nozzles (G) is greater than at the idle discharge holes (E) in the throttle body; consequently, fuel continues to pass through the calibrated main metering jets (A) horizontally through the passage in the float bowl. However, the suction being greater on the nozzles, the fuel passes upward through the main wells, rather than the idle tubes, and out the discharge nozzles (G) to the manifold. The brass main well tubes (H) have four drilled calibrated holes. The small top hole (.022") is located 7/16" from the top of the bowl; it is, therefore, above the 9/16" fuel level at all times and admits air from the main well bleed (C) in the cover to join with the fuel coming up the main wells, so that a mixture of fuel and air is passed by the nozzles.

As the throttle valves are opened to a greater degree, the suction on the nozzles is increased, the delivery of more fuel to meet the increased engine demand, which results in a lowered fuel level within the bowl.

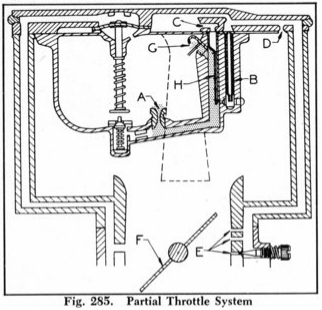


Fig. 285. Partial Throttle System

The three other calibrated holes in the kidney-shaped main well tubes are then exposed, in turn, by the lowering of the fuel level to admit more air to join with the fuel passing from the nozzles. Thus, although the nozzle suction is increased by throttle opening, the fuel-air ratio to the engine remains a constant economical mixture at all times throughout the partial throttle range.

POWER SYSTEM

The Rochester GM Carburetor employs a vacuum operated diaphragm, stem, calibrated spring and valve to deliver the wide open throttle (power) mixtures. This system known as the power system, provides fuel readily for acceleration or hill climbing according to the engine demand.

The carburetor power system is built upon the principle of low speed or sudden acceleration being always accompanied by an immediate corresponding decrease in intake manifold vacuum. A direct vacuum passage through the carburetor to the intake manifold insures instantaneous diaphragm action in this carburetor.

Attached to the cover of the carburetor is the vacuum operated diaphragm, stem and calibrated spring (J) (See Fig. 286). Located in the bowl of the carburetor is the power valve (K); pressed into the connecting passages between the power valve and main metering jets are the calibrated power restrictions (L). Engine intake vacuum or suction passes through passage (M) from the throttle body up through the housing and joins the horizontal cover passage to act upon the power diaphragm. At any manifold vacuum greater than 8 inches of mercury, the suction on the diaphragm is sufficient to hold the power stem in the "UP" position. Opposing this suction is the force of the power spring surrounding the stem. This calibrated spring at any manifold vacuum lower than 8 inches of mercury, forces the stem "DOWN" which unseats the spring loaded plunger (K)

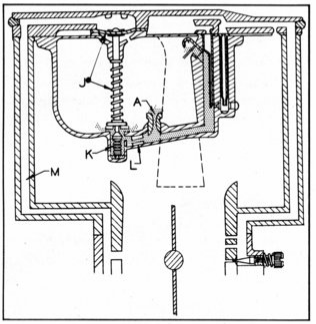


Fig. 286. Power System

in the power valve, allowing fuel in the bowl to pass through the valve to be metered by the power restrictions (L). This metered fuel joins with fuel already passing through the main metering jets (A) to be delivered to the engine.

Perhaps the greatest advantage of the vacuum operated power system to provide the power mixtures is the instantaneous positive action, for the moment the engine intake manifold vacuum is decreased below 8 inches of mercury, additional fuel is metered to the engine; conversely, as the throttle is closed, the accompanying higher manifold vacuum immediately stops the flow of fuel through this system, and the carburetor fuel delivery returns to the economical partial throttle mixtures.

Unloader Adjustment

With thermostat cover at *index,* proceed as follows:

1. Open carburetor throttle lever to full wide open position making sure choke trip lever is in contact with choke counterweight tang.
2. Check clearance between bottom of choke valve and bore of carburetor air horn (small inside diameter) with throttle lever fully open, clearance should be .238" and can readily be checked with section "D" of carburetor gauge tool No. BT-17. (See Fig. 287)
3. Bend throttle lever tang slightly (if necessary) with tool BT-18 to move fast idle cam so that choke valve opens to .238".

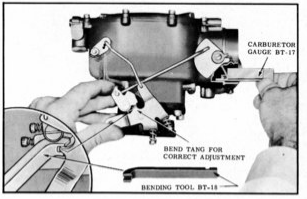


Fig. 287. Unloader Adjustment

Fast Idle Cam Adjustment

1. With the carburetor installed on the engine, hold the throttle partially open and rotate the fast idle cam so that the fast idle adjusting screw is in line with the lowest point (low step) of the fast idle cam. (See Fig. 288)
2. Adjust fast idle screw in this position (on the low step of the cam) to give an engine speed of 500 RPM with engine and transmission warm.

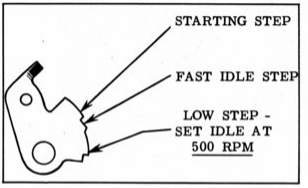


Fig. 288. Fast Idle Cam Adjustment

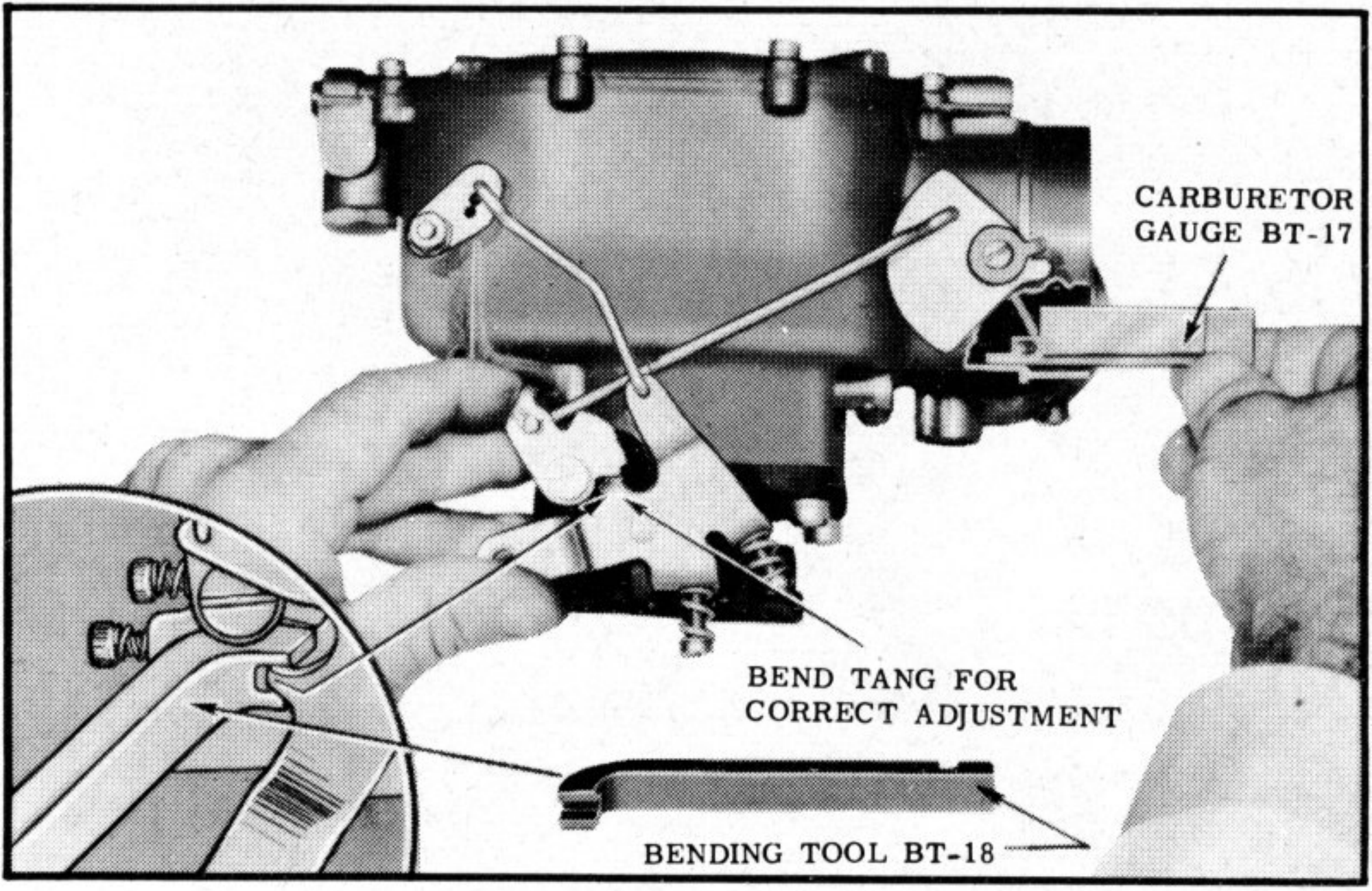


Fig. 287. Unloader Adjustment

Fig. 289. Disassembly of Cover and Bowl

DISASSEMBLY OF THE ROCHESTER GM CARBURETOR

1. Remove the 8 outside cover screws, move throttle lever to full *open* position in order to free pump actuating lever from pump yoke which is inside housing. Lift cover and bowl assembly from outer housing. (See Fig. 289)
2. Place bowl and cover assembly on flat surface, remove 6 attaching screws and lift cover straight up to prevent damaging float.

   NOTE—Float should be suspended freely from cover so that bottom of float is flush with power stem.
3. Remove power valve, fiber gasket, and two main metering jets from bottom of bowl. (See Fig. 290)
4. With the use of a small pointed object or thin screw driver blade, remove retaining ring and screen in bottom of bowl.
5. Turn bowl upside down and two kidney-shaped main well tubes, two idle tubes, and brass needle pump outlet check should drop from bowl. (See Fig. 291)

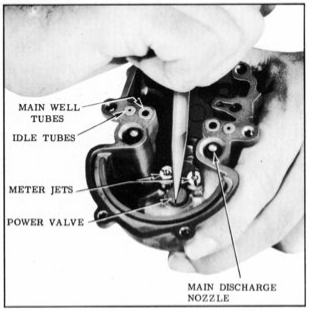


Fig. 290. Disassembly of Bowl

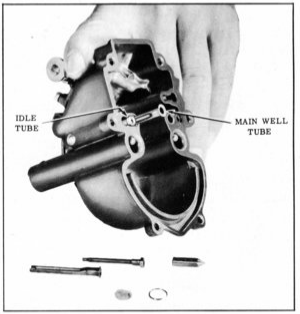


Fig. 291. Removing Main Well Tubes

NOTE—A small wooden wedge, such as a round toothpick, may be used to facilitate lifting main well tubes and idle tubes from bowl. DO NOT PRY WITH DRILL OR OTHER SHARP INSTRUMENT.

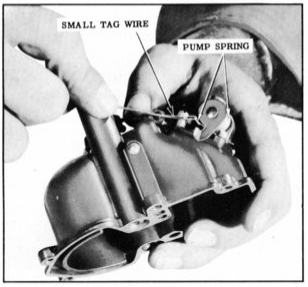


Fig. 292. Unwinding Pump Spring

6. With a small tag wire positioned into outside of pump actuating spring, unwind spring three turns to full relaxed position. (See Fig. 292) DO NOT DISTORT OR STRETCH PUMP ACTUATING SPRING.
7. Remove five pump housing attaching screws. Care should be taken so as not to disturb the position of two pump jets, as they are factory targeted for proper acceleration. Remove the conical shaped pump return spring inside pump diaphragm making sure it does not spring out or become distorted. DO NOT REMOVE NOZZLES FROM BOWL.
8. Remove pump plug and pump intake ball check valve. (See Fig. 293)

   NOTE—Use a screw driver of ¼" width to prevent damage to internal threads of pump well.

The bowl should now be cleaned in solvent, such as carbon tetrachloride, and dried with compressed air. Passage plugs may be removed to ascertain that all passages are free and clean of carbon or dirt.

Disassembly of the carburetor to this point permits servicing one or all the individual units.

Disassemble Cover Assembly

1. Remove float lever hinge pin and carefully lift float from cover.
2. Remove steel float needle from float needle seat.
3. Remove 3 power diaphragm assembly attaching screws. Remove assembly.
4. Using a ½" width screw driver, remove float needle seat and fiber gasket.
5. Grip cover in vice by fuel inlet boss and, using a ¾" wrench, remove fuel inlet nut and screen. Blow all passages with compressed air. DO NOT PASS DRILLS OR WIRE THROUGH CALIBRATED HOLES.

Disassemble Housing from Throttle Body

1. Remove balance tube from air horn.
2. Remove three attaching screws with lugs from choke housing cover. Remove cover and thermostat coil as an assembly. DO NOT DISTORT COIL IN REMOVAL.
3. Remove choke valve screws and valve. (See Fig. 294)

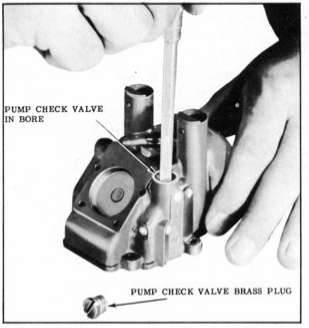


Fig. 293. Removal of Pump Check Valve

Fig. 294. Housing and Throttle Body

4. Remove cotter pin from pump rod, remove rod. DO NOT BEND PUMP ROD IN REMOVAL.
5. Remove cotter pin from either end of choke rod and carefully remove rod.
6. Remove choke counterweight, collar, and washer.
7. Remove choke vacuum piston and shaft by revolving choke shaft until piston is free from cylinder.
8. Remove 3 housing to throttle body attaching screws.
9. Remove nut, lock washer and felt packing from pump yoke; remove pump yoke from inside housing.

   NOTE: When removing nut or yoke, use care so as not to lose the felt packing washer in counterbore of housing (outside).

Disassemble Throttle Body

1. Remove fast idle cam attaching screws and cam.
2. Remove 2 idle adjusting screws and springs.

   NOTE: The carburetor throttle valves and throttle shaft are not removed from the throttle unless service for these particular parts is required.

   Holding a light to passage holes in throttle body, will assist to readily determine if all passages are free and clean.

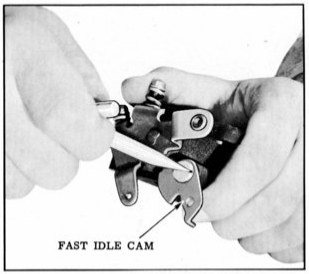


Fig. 295. Disassembly of Throttle Body

Disassemble Pump

1. Remove conical spring and lift rack and diaphragm from pump housing, allowing pump lever to rotate.
2. Remove cotter pin from end of pump lever shaft.
3. Remove small metal and felt washers, and tap pump shaft from pinion gear.
4. Small pinion gear will now drop from depression of pump housing.

CLEANING AND INSPECTION OF CARBURETOR PARTS

1. Place all parts *except the pump and diaphragm assembly and the vacuum power diaphragm assembly* in a carburetor cleaning container.
2. Clean parts in carburetor cleaning solvent.
3. Dry parts and clean passages with compressed air.

Fig. 296. Assembly of Throttle Body

NOTE: Passage plugs may be removed when it is necessary to ascertain that all passages are free and clean of carbon, gum or dirt.

4. Check float for dents, and pin or pin hole for wear.
5. Examine float needle and seat; if grooved, replace both needle and seat assembly.
6. Inspect throttle shaft and choke shaft for wear in their bores. Replace if worn excessively.
7. Inspect pump diaphragm and, if damaged, replace rack and diaphragm assembly.
8. Inspect pump intake check valve by blowing ball against seat.
9. Inspect rods and holes in levers; if worn out-of-round, they should be replaced.

IMPORTANT: All fiber gaskets should be stored in a dry place and heated prior to installation to remove all moisture.

Assembly of Carburetor

1. With housing upside down on flat surface, attach throttle body with 3 attaching screws, and, using a new gasket between housing and throttle body, tighten evenly.
2. Install 2 idle adjusting screws and springs.

   NOTE: Temporary idle adjustment should be made by turning idle screws into throttle body finger tight and back each screw out 1 turn. Final adjustment is made after the carburetor is installed on the engine.
3. Securely install fast idle cam to throttle body, making sure it operates freely.
4. Install choke valve shaft and vacuum piston assembly.
5. Install choke valve with the letters "RP" facing up, centering valve in air horn and installing new screws. Offset weight of choke valve should cause valve to freely fall to open position.
6. Install choke counterweight, washer and collar to choke shaft.

   NOTE: Tang on collar must be over tang on counterweight.
7. Install choke rod with offset end in counterweight hole. Install cotter pin, and bend 180° to prevent binding.
8. Install felt washer in pump yoke counter-

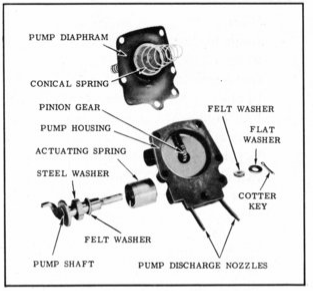


Fig. 297. Detail Assembly of Pump

bore and, holding washer in place, slide pump yoke in place from inside housing.

9. Assemble the pump actuating lever onto the pump shaft, with the letters "RP" facing out and the (3) position holes facing air horn.
10. Install pump rod into outside hole of actuating lever, and cotter pin end in throttle lever. Install cotter pin, spread ends of cotter pin 180° to insure against binding.

    NOTE: The OUTSIDE hole in pump lever is factory setting for minimum or standard adjustment. The CENTER hole is medium and the INSIDE hole is maximum, pump stroke.
11. Install thermostatic cover and coil assemsembly with new gasket. Slowly rotate cover until index marks on cover and housing are aligned; tighten securely. Be sure to use lock lug on one screw.

    NOTE: Choke valve should close lightly in air horn at 75° Fahrenheit or room temperature with *index* marks aligned.
12. Install balance tube, making sure flat on tube is in place in air horn.

Assemble Carburetor Cover

1. With a screw driver having at least a 1/2" width blade, install the float needle seat, using a new red fiber gasket; place steel float needle in float needle seat.

   FLOAT AND NEEDLE SEAT ARE FACTORY MATCHED and if replacement is required, they should be replaced in pairs.

   IMPORTANT: The float needle seat must be tightened securely to prevent gasoline leakage. (A 1/2" width screw driver must be used to tighten seat securely without damaging the cross slot.) Care should be exercised so as not to damage float balance spring. If spring measures more than 9/16" free length, it must be replaced.

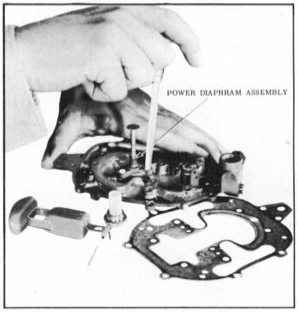


Fig. 298. Assembly of Power Diaphragm

2. Install power diaphragm assembly with 3 attaching screws.

   CAUTION: The power diaphragm must be replaced if torn or distorted, as poor performance and high gasoline consumption will result from malfunctioning diaphragm action.
3. Place float carefully over diaphragm stem, assemble in place with the small tang on the outside of balance spring, and install float hinge pin.
4. With cover gasket removed, hold the cover upside down, and check float level height from face of cover to top of soldered seam. Dimensions should be 23/32" and should be checked with a scale or carb. gauge, No. BT-17. Bend float tang which contacts top of float needle to obtain the 23/32" adjustment. (See Fig. 299) DO NOT BEND AT FRONT OF FLOAT. Float should appear in close parallel with cover face.
5. IMPORTANT: The float tension adjustment is always made after adjustment of the float level height to insure proper float level drop and resultant fuel entry into

bowl in sufficient quantities under high speed operation.

Bend float tang *against* spring to decrease amount of drop; bend *away* from spring to increase drop. Tension is correct when float drop is such that outside edge of float (bottom) is level with power diaphragm stem when suspended freely from cover. (See Fig. 302)

6. Replace strainer screen, install new gasket and strainer nut.

Assemble Pump

Careful and proper assembly and installation of the pump and bowl are of the utmost importance to insure smooth acceleration and performance. To properly assemble the pump, proceed as follows:

1. Place felt washer and pump actuating spring over pump shaft with the small hooked end of spring against the actuating lever.
2. Place the pinion gear in pump housing cavity, and insert pump shaft through housing and pinion gear, until the knurled portion on shaft contacts pinion gear. Lightly tap pump shaft through pinion gear, but *do not force pump shaft.*
3. Assemble small felt washer then flat washer over end of shaft and install cotter key. Pump shaft should be free to rotate.

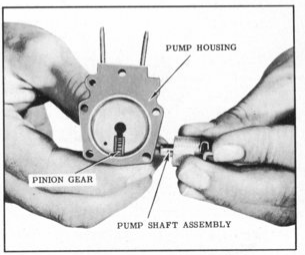


Fig. 300. Assembly of Pump Shaft

4. Start the pump rack assembly in contact with pinion gear, so that in the "pump refill" or "cocked" position, the pump lever arm will be parallel with the pump housing face. (See Fig. 301) This will require lifting of rack and rotating pump shaft, checking each time until proper position is accomplished.
5. Place conical pump return spring in retaining cup of diaphragm assembly, opening the last coil of spring slightly to make spring stick into retaining cup.
6. Place top of conical spring in pump cavity counterbore, and insert the five pump to housing attaching screws with lock washers through the housing and diaphragm.

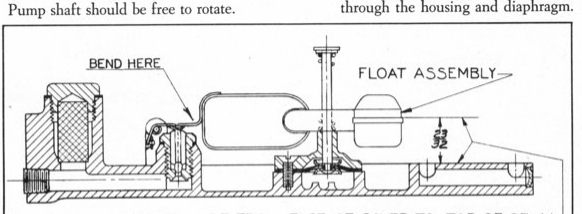


Fig. 299. Detail of Float Adjustment

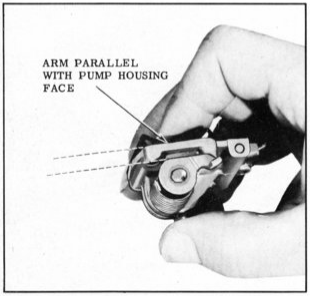


Fig. 301. Position of Pump Lever in "Cocked" Position

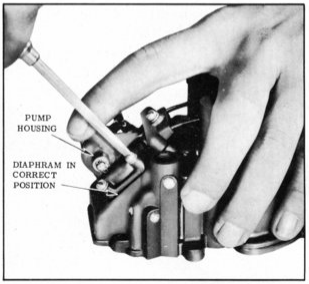


Fig. 303. Attaching Pump to Bowl

7. While holding housing in place, partially install screws, inspect diaphragm to see that edges are not pinched or distorted, and finish tightening screws evenly and securely. (See Fig. 303)

   IMPORTANT: Test pump shaft for binding. The arm should return from the "discharge" to the "cocked" position by the force of the internal conical spring. It may be necessary to tap either end of shaft lightly to obtain free movement.

8. With straight end of pump actuating spring against pump housing, use a small wire to wind up the spring past the pump lever 2½ times before hooking end of spring over lever. *Do not distort or stretch pump spring.* Pump actuating spring coils should be flush with hub of pump lever.

9. Again test pump for proper operation by operating lever against spring tension. Pump should work freely when lever is actuated by hand.

Assemble Carburetor Bowl

1. Install two main metering jets.

   CAUTION: Do not pass drills or wires through jets as these are flow-tested when manufactured for proper calibration.

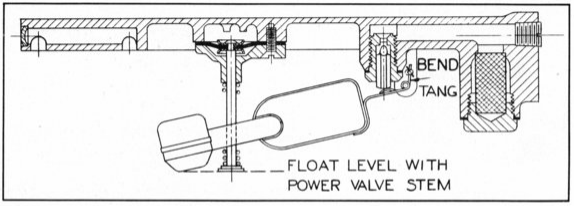


Fig. 302. Detail of Float Tension Adjustment

2. Using a screw driver of 5/16" width, install power valve with new red fibre washer.
3. Install pump intake check valve and brass plug into pump well; tighten plug securely.
4. Install pump screen and small retaining ring.
5. Drop brass pump outlet needle into well and tap lightly to obtain a good seat.
6. Place idle tubes and main well tubes in their respective cavities.

   CAUTION: Be sure the "flat" on each main well tube is positioned with the "flat" in bowl. *THIS IS VERY IMPORTANT FOR PROPER FUNCTION OF CARBURETOR.*

Assemble Cover and Housing

1. Install new gasket on bowl cover and place cover over bowl, carefully aligning gasket.
2. Insert and start six cover to bowl attaching screws.
3. Hold throttle lever in full wide open position to insure that pump actuating lever will rest within yoke in housing.

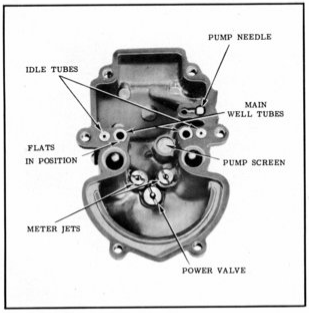


Fig. 304. Assembly of Carburetor Bowl

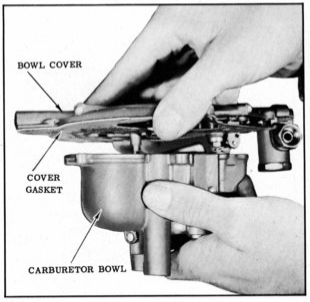


Fig. 305. Assembly of Bowl Cover

NOTE: *Check to see that balance tube is facing air horn.*

4. Assemble cover on housing, making sure pump actuating lever rests in yoke inside the housing.
5. Install and tighten evenly and securely eight cover to housing attaching screws; also finish tightening cover to bowl screws. Test the operation of throttle lever for free movement from closed to wide open position; note that when in closed position the pump spring will partially open throttle valves.

Carter WGD Carburetor

The Carter Model WGD Carburetor has five conventional circuits, as follows:

FLOAT CIRCUIT
LOW SPEED CIRCUIT
HIGH SPEED CIRCUIT
PUMP CIRCUIT
CLIMATIC CONTROL (CHOKE) CIRCUIT

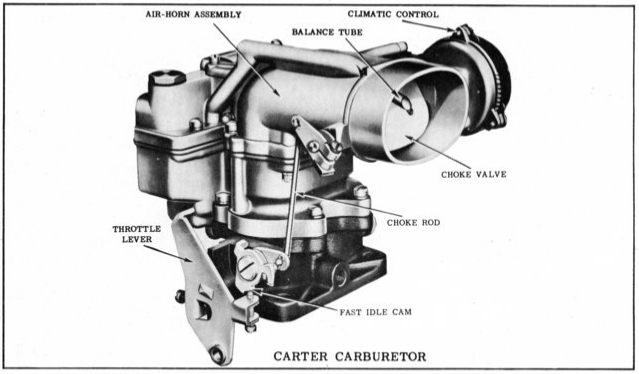


Fig. 306. Carter WGD Carburetor

FLOAT CIRCUIT

The float circuit is completely balanced, using an inside vent, the tube of which extends into the airhorn on the air cleaner side of the choke valve. The bowl is completely sealed from the atmosphere by the bowl cover gasket and dust cover gasket.

Float Level Adjustment

With the bowl cover inverted and needle seated, adjust the float lip so clearance between top of float, and bowl cover is ¼". (See Fig. 307) Adjust by bending lip of float, not float arm.

PUMP CIRCUIT

The pump circuit contains the later type double spring plunger, one spring on top of the plunger and the other below the plunger. Delayed action is controlled not only on the decompression of the upper spring but also by the rate of compression of the lower spring.

A pump relief valve is installed in the pump discharge passage, allowing the pump to discharge excess fuel back to the bowl during fast acceleration.

Fig. 307. Float Adjustment

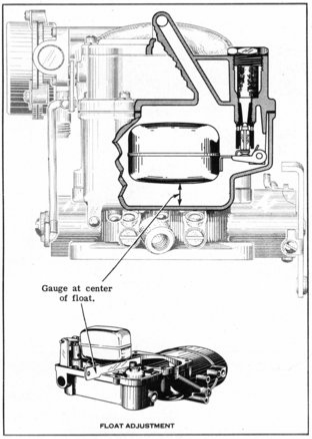


Fig. 308. Float Circuit

It also acts in the nature of a safety valve in the event of a restriction in the discharge passage.

The pump discharge is fed into a small pocket at the pump jet cluster and feeds from there into each of the two discharge jets. This small pocket is vented to atmosphere to prevent pump pull-over at constant throttle operation. Repeated pressing of the foot throttle with engine not in operation will result in fuel being forced out this vent to the outside of the body casting.

Pump adjustment as follows must be made before metering rod adjustment.

Pump Adjustment

Back out throttle lever set screw until throttle valves seat in bores of carburetor. Hold straight edge across top of dust cover boss at pump arm. (See Fig. 311) Bend throttle connector rod at upper angle until upper flat of pump arm is parallel with straight edge while throttle valves are seated.

LOW SPEED CIRCUIT

The low speed circuit is the conventional Carter five-point system and picks up its fuel from the high speed passage. A small bleed leading from the top of the idle well through a restricted passage into the anti-percolator well prevents the accumulation of fuel vapors in the idle well which might tend to produce an irregular idle with engine at higher than normal operating temperatures.

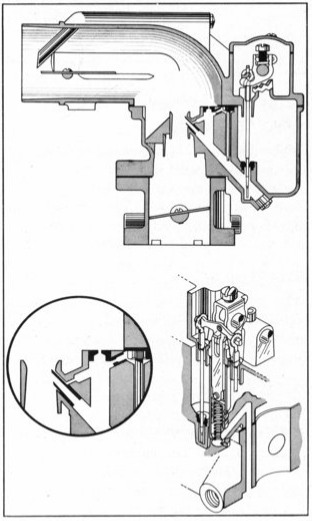


Fig. 309. High Speed Circuit

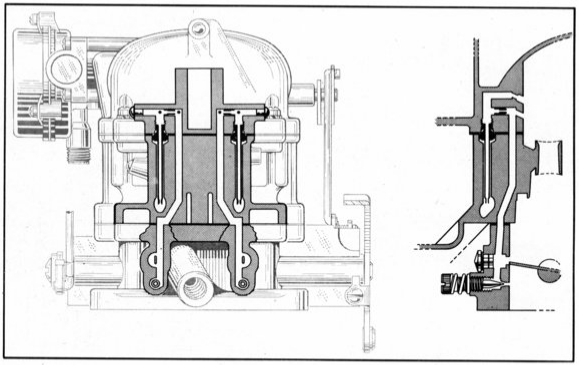


Fig. 310. Low Speed Circuit

HIGH SPEED CIRCUIT

The high speed circuit incorporates the vacumeter system of controlling the metering rods. The nozzle is pressed into place and must never be removed. The vent from the anti-percolator well leads into the pocket formed between the flat of the nozzle and the high speed passage at the inner wall of the primary venturi.

There is also a small vent from the anti-percolator well to the bore of the carburetor. This vents the well to atmosphere during idle operation but effects a balance between the anti-percolator well and the high speed passage during high speed operation, practically eliminating any back bleeding of air into the high speed circuit during high speed operation.

Metering Rod Adjustment

Metering rod adjustment is important and must be done *after* pump adjustment. No metering rod gauges are necessary. Back out throttle lever set screw to seat throttle valves, press down on vacumeter link until metering rods bottom in bowl casting. With rods held in this position, revolve metering rod arm until lip contacts vacumeter link and carefully tighten metering

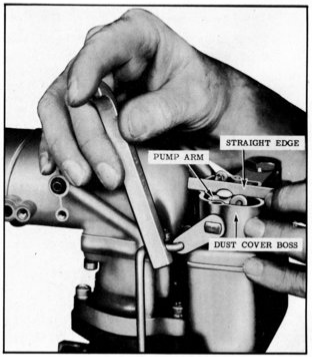


Fig. 311. Pump Adjustment

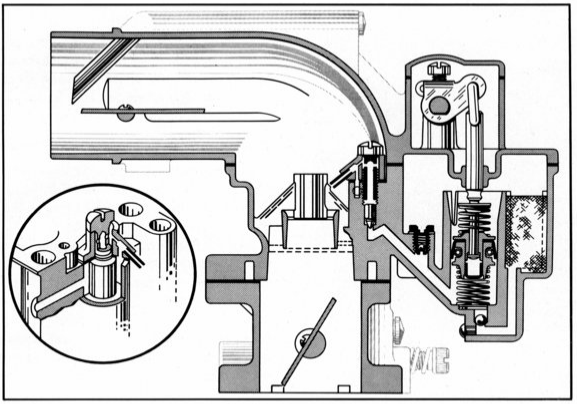


Fig. 312. Pump Circuit

rod arm set screw. (See Fig. 313) Lubricate countershaft through hole in center post sup-

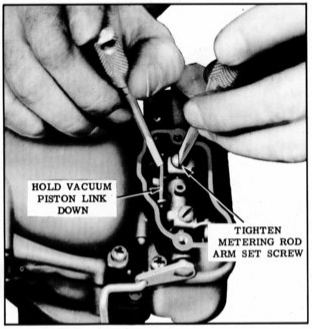


Fig. 313. Metering Rod Adjustment

port and outer dust cover screw hole with light graphite grease or equivalent. Install dust cover and gasket.

Fast Idle Adjustment

1. Back out fast idle set screw until cam revolves freely with throttle valves seated. Loosen choke lever clamp screw. Insert a .015″ round feeler gauge between lip of fast idle cam and boss on flange casting. Hold choke valve tightly closed and take all slack out of linkage by pressing choke lever toward closed position—hold in place and tighten clamp screw.
2. With choke valve tightly closed, insert a .015″ round feeler gauge between throttle valve and bore of carburetor, (side opposite idle port).

   Place carburetor upright on bench so gauge extends over edge of bench. (See Fig. 314)

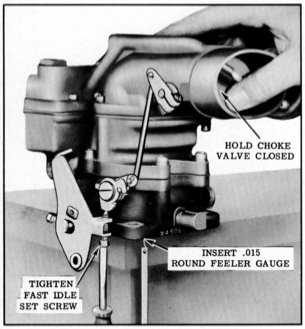


Fig. 314. Fast Idle Adjustment

3. Hold choke valve tightly closed and tighten fast idle set screw against high step of cam until gauge just falls free.

Unloader Adjustment

With throttle valve held in wide open position there should be 1/8″ to 3/16″ clearance between lower edge of choke valve and inner wall of airhorn. Adjust by bending lip on throttle lever using Tool T109-41. (See Fig. 316)

CLIMATIC CONTROL (CHOKE) CIRCUIT

The climatic control circuit does not incorporate a strainer but uses a metal baffle plate to prevent particles from accumulating in the slots of the vacuum cylinder.

A small synthetic rubber washer seals the vacuum passage between the piston housing and the air horn and must be changed each time the climatic control is disassembled for cleaning. Three self-tapping screws hold the piston housing to the airhorn and, when assembling, extreme caution must be used to insure that piston housing is tightly secured to the airhorn. However, DO NOT STRIP SCREW THREADS.

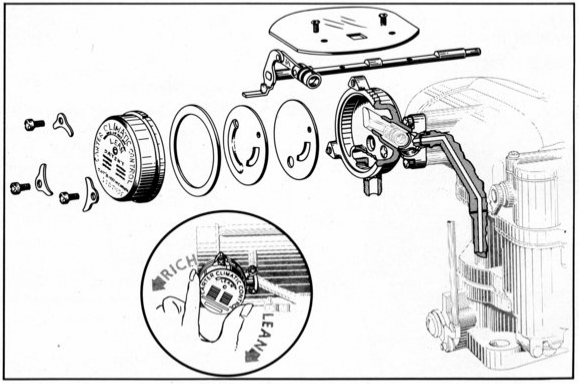


Fig. 315. Climatic Control (Choke) Circuit

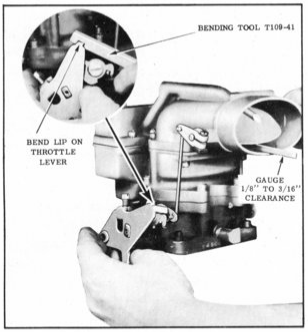


Fig. 316. Unloader Adjustment

Choke Adjustment

Revolve thermostatic coil housing counterclockwise until notch in housing is set on *index*.

DISASSEMBLE CARBURETOR

1. Remove dust cover and gasket and remove strainer nut assembly.
2. Remove fast idle connector rod and throttle connector rod at both ends, then remove bowl cover and air horn attaching screws.
3. Remove air horn assembly with all parts attached. (See Fig. 317)
4. Remove float, needle, and seat assembly. Loosen set screws on metering rod arm and pump arm, and slide countershaft out of casting. Remove metering rod arm, pump arm, plunger assembly, vacumeter piston and link, and metering rods. Remove air-horn bowl cover gasket and both low speed jets.
5. Remove choke lever and screw assembly, choke valve screws and valve, thermostatic coil housing screws and retainers, gasket and metal baffle plate. Revolve choke shaft until piston is clear of vacuum cylinder and remove shaft assembly. Remove the three self-tapping screws to remove piston housing assembly from air horn casting. Then remove small piston housing gasket. All parts have now been removed from air horn casting.
6. Remove pump jet cluster and gasket, and invert casting to remove vacumeter spring, pump discharge needle and lower pump spring. Remove metering rod jets, pump relief plug assembly and pump intake screw. Using tool T109-56, remove ring retainer and intake check ball from pump cylinder. NEVER ATTEMPT TO REMOVE NOZZLES FROM BODY CASTING.
7. Loosen throttle shaft arm attaching screw, washer and throttle shaft arm. Remove throttle shaft retaining ring, valve attaching screws and valves. Slide throttle shaft assembly from flange casting. (See Fig. 318) Remove fast idle cam assembly, idle adjusting screws, springs and idle port rivet plugs.

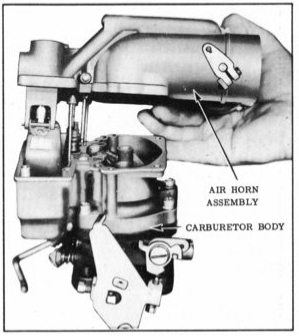


Fig. 317. Removal of Air Horn

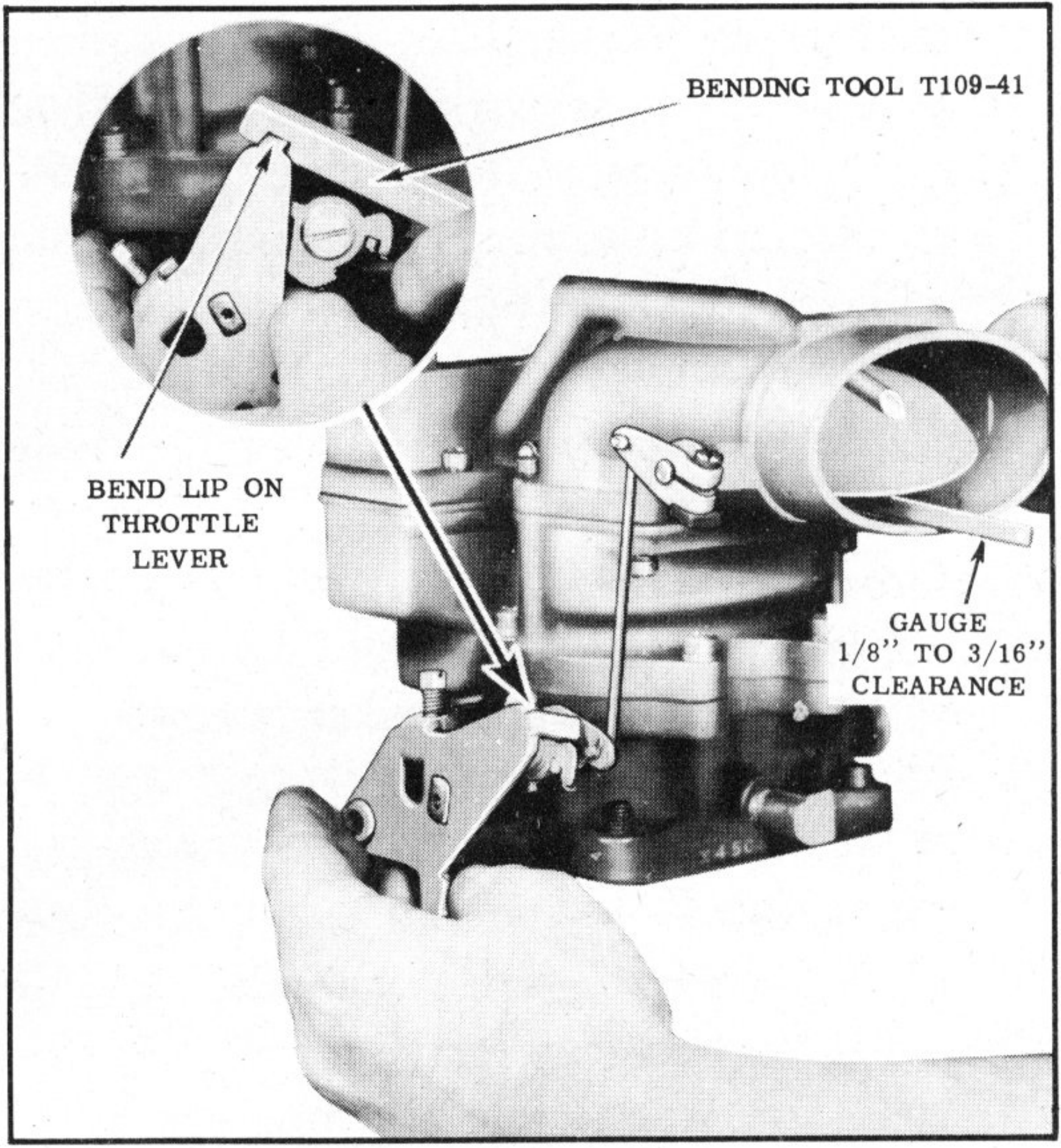


Fig. 316. Unloader Adjustment

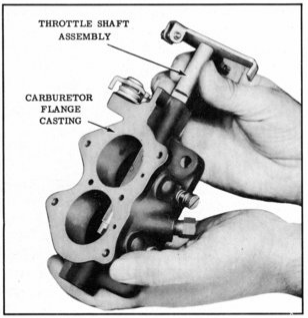


Fig. 318. Removing Throttle Shaft

CLEANING, INSPECTING AND GROUPING OF PARTS

1. The welch plug in the bottom of the climatic control housing may be removed by drilling small hole in center of plug and using nozzle puller T109-178. (See Fig. 319)

   Carefully clean welch plug seat in casting before installing new plug. Use flat end tool to seal new plug securely in casting.

   Using a small soft bristle brush, carefully clean small opening between flat tip of nozzles and inner primary venturi walls. Extreme caution must be used to prevent damage to nozzle tips.
2. Place all parts in carburetor container.
3. Wash all parts in solvent or approved carburetor cleaner.
4. Dry parts and clean passages with compressed air.
5. Remove carbon from bores of flange with sand paper—never use emery cloth.
6. Examine vacuum cylinder in climatic control piston housing for dirt and carbon accumulation. If excessive dirt and carbon are found, remove welch plug from base of vacuum cylinder as illustrated in Figure 319, in order to facilitate removal of carbon from slots in cylinder.
7. Replace all worn or damaged parts using new gaskets.
8. Group all *FUEL LEVEL* controlling parts, i.e.: Float, needle and seat assembly, float pin, strainer, nut and gasket assembly.
9. Group all parts controlling *IDLE OPERATION,* consisting of: Low speed jets, idle adjusting screws and spring, idle port plugs, throttle shaft assembly, throttle valves and screws, retaining ring, throttle shaft arm, washer and attaching screws.
10. Group all *HIGH SPEED OPERATION* parts, consisting of: Metering rods and jets, vacuum piston, spring, link, metering rod arm, countershaft assembly and connector rod.
11. Group all parts controlling *PUMP OPERATION,* i.e.: Pump intake screen, pump plunger assembly, pump arm and link, lower pump spring, intake check ball and

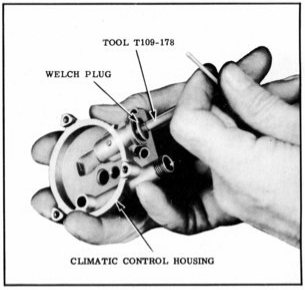


Fig. 319. Removing Welch Plug

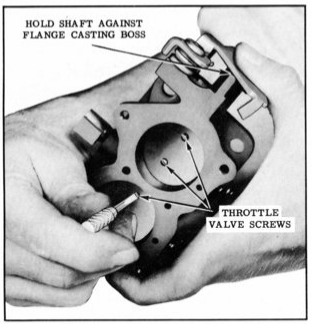


Fig. 320. Tightening Throttle Shaft Screws

retainer, pump relief plug assembly, discharge needle, pump jet cluster, gasket and retainer screw.

12. Group all parts controlling *CHOKE OPERATION,* which are: Piston housing assembly, hot air passage gasket, piston housing attaching screws, shaft and piston assembly, choke valve and screws, baffle plate, gasket, thermostatic coil housing assembly with screws and retainers, choke shaft arm, choke connector rod and fast idle cam assembly with attaching screw.

ASSEMBLE CARBURETOR

1. Install all parts controlling *IDLE OPERATION.* Install throttle shaft and lever assembly.
2. Back out throttle lever set screw and install throttle valves with "C" toward idle ports when viewed from manifold side of flange.
3. Hold valves firmly in place with fingers and tap lightly with screw-driver to center valves before tightening screws.
4. Tighten screws while holding lever end of shaft against flange casting boss, (See Fig. 320) With throttle valve seated, install *new* throttle shaft retaining ring.
5. Install *new* idle port plugs, idle adjusting screws and springs.

   NOTE: Temporary idle adjustment should be made by turning idle screws into throttle body finger tight and backing out each screw ¾ to 1½ turns.
6. Install throttle retainer ring on shaft, then install throttle arm on shaft.
7. Install washer and retaining screw.
8. Install low speed jets in air horn. Tighten securely. (See Fig. 321)
9. Assemble body casting to flange using new gasket. Tighten screws evenly and securely.
10. Install all parts controlling *PUMP OPERATION.* Install pump discharge needle (point downward), pump jet cluster with new gasket, and tighten screw securely. Install pump relief plug assembly and strainer. Drop pump intake ball into place in bottom of pump cylinder and install retaining ring using tool T109-122U. Install lower pump spring. Assemble pump

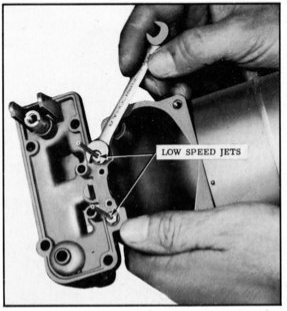


Fig. 321. Installing Low Speed Jets

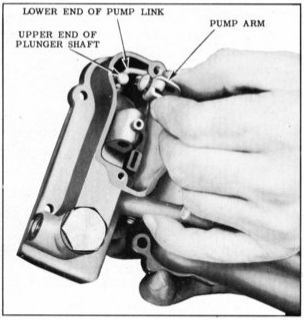


Fig. 322. Installing Pump Link

link in pump arm with pin spring retainer. Push pump plunger into place in bowl cover, then slide lower end of pump link through hole in upper end of plunger shaft and revolve ½ turn. (See Fig. 322)

11. Install all parts controlling *FUEL LEVEL*. Press strainer into recessed portion of strainer plug and gasket assembly, then install as assembled in bowl cover. Install needle seat and gasket assembly, attach needle pull clip and needle to float, then install float assembly and float pin.
12. Set float level as outlined under FLOAT LEVEL ADJUSTMENT.
13. Install all parts controlling *HIGH SPEED OPERATION*. Install metering rod jets—tighten securely.

    NOTE: No gaskets are used under metering rod jets.
14. Install metering rod spring in vacuum piston link, then install vacuum piston spring in cylinder in body casting.
15. Install vacuum piston link through slot in bowl cover with protruding lip extending toward airhorn. (See Fig. 323) Hold in place and invert bowl cover to install bowl cover gasket.
16. Install vacumeter piston with pin extending toward air horn.
17. Carefully assemble airhorn on body casting and tighten in place evenly and securely with eight attaching screws. Be sure strainer nut is tight.

    CAUTION: TIGHTEN FOUR CENTER SCREWS FIRST.

    NOTE: Hold pump arm (as assembled to plunger) in position and slide countershaft into place until end of shaft just extends through center post. Hold metering rod arm in position (with lip extending through slot in vacumeter link) and slide shaft into place. Tighten pump arm screw, then install throttle connector rod, and retainers. Install both metering rods, making sure rods are in jets.

    Connect metering rod spring. Press downward on vacumeter link to be sure link and rods do not bind in any position.

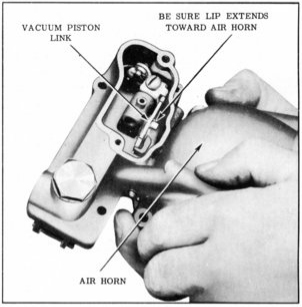


Fig. 323. Installing Vacuum Piston Link

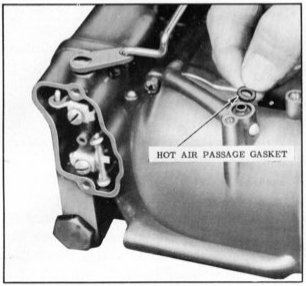


Fig. 324. Installing Gasket in Air Horn

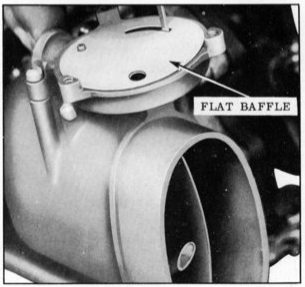


Fig. 325. Installing Baffle Plates

18. Adjust accelerator pump as outlined under PUMP ADJUSTMENT.
19. Adjust metering rods as outlined under METERING ROD ADJUSTMENT.
20. Install all parts controlling *CHOKE OPERATION*; Install new hot air passage gasket in air horn. (See Fig. 324)
21. Assemble piston housing assembly to airhorn. Carefully tighten screws as they are of the self-tapping type and must be pulled down securely.
22. Install choke shaft and piston assembly in position and carefully feed piston into cylinder.
23. Install choke valve, making sure tapered edges of valve seat in airhorn. Hold securely in place with finger and tap with screwdriver before tightening screws. Choke valve should fall free by its own weight.
24. Install choke shaft arm, fast idle cam assembly, and choke connector rod. Install flat baffle plate, extruded baffle plate, (See Fig. 325) gasket, and thermostatic coil and housing assembly. Install retainers and screws but do not tighten.
25. Adjust automatic choke as outlined under CHOKE ADJUSTMENT, and tighten retainer screws.
26. Make fast idle and unloader adjustments as indicated under FAST IDLE ADJUSTMENT and UNLOADER ADJUSTMENT, respectively.

Anti-Freeze Solutions

In selecting anti-freezing solutions for winter operation, the local conditions and the type of service must be considered. The following information is given to enable the car owner to more intelligently select the anti-freezing solution best suited to meet his own individual driving conditions.

The available commercial materials for preparing anti-freezing solutions for automobile radiators are denatured alcohol, methanol (synthetic wood or methyl alcohol), distilled glycerine and ethylene glycol.

NOTE—Regardless of the type of anti-freeze being used, be sure that cylinder head, all hose connections, etc., are tight and leakproof.

ALCOHOL

Denatured alcohol and methanol are extensively used for anti-freezing solutions. The various types of alcohol anti-freezes are widely distributed, afford protection against freezing, and are not injurious to the materials used in the cooling system.

All the alcohol solutions are subject to loss by evaporation, especially on heavy runs, and unless solution is tested periodically and sufficient anti-freeze added to replace the loss by evaporation, the engine or radiator, or both, are likely to be damaged by freezing. The car finish is damaged by contact with alcohol solutions or vapors, and any material accidentally spilled on the finish should be flushed off immediately with a large quantity of clean cold water.

ETHYLENE GLYCOL

Ethylene glycol is, in first cost, more expensive than alcohol. Ethylene glycol anti-freezing solutions have the distinct advantage of possessing a somewhat higher boiling point than alcohol anti-freezing solutions, and consequently, may be operated at a higher temperature, resulting in a more effective performance of the car heater.

Ethylene glycol has the further advantage that in a tight system only water is required to replace evaporation losses. However, any solution lost mechanically through leakage or foaming must be replaced by additional new solution. Under ordinary conditions ethylene glycol solutions are not injurious to the car finish.

"GM Ethylene Glycol" is especially treated and compounded for use in the cooling system. Other ethylene glycol preparations are available, but only those containing suitable corrosion inhibitors and compounded for use in automobile cooling systems should be used.

The following table shows the quantity of General Motors Anti-Freeze required to protect to indicated temperatures:

Freezing Temp.	G. M. Anti-Freeze		G. M. Ethylene Glycol Anti-Freeze	
	6 Cyl.	8 Cyl.	6 Cyl.	8 Cyl.
+10° F.	4.5 qts.	6.0 qts.	5.0 qts.	6.5 qts.
0° F.	6.0 qts.	7.5 qts.	6.5 qts.	8.0 qts.
−10° F.	7.0 qts.	8.5 qts.	7.5 qts.	9.0 qts.
−20° F.	8.0 qts.	9.5 qts.	8.5 qts.	10.0 qts.
−30° F.	9.0 qts.	10.5 qts.	9.0 qts.	11.0 qts.

The above capacity chart is for cars without heater equipment. If car is equipped with heater, slightly more anti-freeze will be required to secure the indicated protection, since the addition of the heater increases the total cooling system capacity (approximately 1¼ qts.). To assure adequate protection, check with accurate reading hydrometer.

OTHER ANTI-FREEZING SOLUTIONS

Salt solutions, such as calcium or magnesium chloride, sodium silicate, etc., honey, glucose, and sugar solutions, and oils are not satisfactory for use in automobile radiators.

SERVICING THE COOLING SYSTEM

Before installing anti-freezing solution, the cooling system should be inspected and serviced for winter operation. The system should be thoroughly cleaned and any loose scale and iron rust removed.

If the engine portion of the cooling system becomes clogged, the condition should be corrected by the use of a reputable solvent, rather than by reverse flushing.

In the event the radiator portion of the cooling system becomes clogged, the condition should be corrected by the use of a reputable solvent or reverse flushing of the radiator core and tank assembly only.

Cylinder head gaskets should be tightened, or replaced if necessary, to avoid the possibility of anti-freezing solutions leaking into the engine or exhaust gas blowing into the cooling system. Anti-freeze, or water, mixed with engine oil may form sludge, which will interfere with lubrication and, in some cases, may form varnish-like deposits which will cause gumming and sticking of the moving parts.

The water pump seal must be leak tight, not only to avoid loss of liquid, but to prevent air from being drawn into the cooling system. Aeration of the cooling liquid causes foaming and promotes oxidation which may result in serious corrosion.

After the anti-freezing solution has been installed, the entire system, including the hose connections, cylinder head gasket and pump, should be inspected regularly to insure that no leaks have developed.

The use of additional rust preventatives or inhibitors, is not recommended with "GM Anti-Freeze," "GM Ethylene Glycol," or with other anti-freeze preparations that have been chemically treated or compounded for use in automotive cooling systems.

Loss of Anti-Freezing Solutions

Anti-freeze, or water, or both may be lost from the cooling system through leaks, evaporation, boiling, foaming, or expansion. Loss through excessive evaporation or boiling may be caused by impaired circulation or through the use of a high temperature thermostat.

Loss by expansion is sometimes a result of over-filling. In the average cooling system, the anti-freezing solution expands approximately 2 pints on heating from 30 to 160°F., and a corresponding space should be left when adding liquid to the radiator.

A hydrometer test will indicate whether anti-freeze or water or both should be added to bring the solution to the proper level and to maintain the desired freezing point.

Testing

Some devices, used for testing anti-freezing solutions, will indicate the correct freezing point only when the test is made at a specific temperature. Other testers, provided with thermometers and tables, indicate the freezing points corresponding to readings made at various temperatures. Disregarding the temperature of the solution, when tested, may cause an error as great as 30 degrees.

Some testing devices are made to test only one kind of anti-freezing solution. Others have several scales and may be used for the corresponding kinds of anti-freeze.

The freezing point of a solution containing both alcohol and ethylene glycol cannot be determined accurately by means of a hydrometer.

CLUTCH

The 1949 six cylinder clutch assembly and hook-up are essentially the same as those used on 1948 8-cylinder syncro-mesh models. Since all the 1949 eight cylinder cars (88 and 98 series) are Hydra-Matic equipped, there is, of course, no clutch mechanism for these models.

The clutch is a Borg & Beck, single plate, dry disk type, with knife edge lever and strut construction, which requires no adjustment.

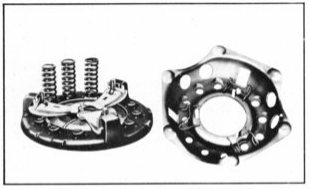


Fig. 326. Clutch Assembly Detail

The pressure plate assembly does not include a clutch release bearing plate. The clutch release fingers, the ends of which bear directly on the clutch throwout bearing, are of the case hardened "Duck Bill" type. The carbon clutch release bearing is impregnated with petrolatum and, under normal driving conditions, it should not require additional lubricant throughout the life of the car. For the benefit of those owners who use the clutch considerably more than average, such as rural mail carriers, a lubrication fitting is provided on the clutch throwout bearing. The bearing may require lubrication at 5,000 mile intervals under such conditions. Petrolatum should be used to lubricate the bearing. However, if petrolatum is not available, ordinary white or amber colored vaseline may be substituted. If neither petrolatum nor vaseline is available, no other lubricant should be used since the use of a substitute might be detrimental to the bearing. A small, high pressure hand gun should be used to lubricate the bearing which is full when the petrolatum just starts to come out the vent hole at the top of the bearing.

A circular baffle which fits around the hub of the clutch driven plate and extends outward to the inside diameter of the clutch pressure plate, prevents oil from getting into the clutch assembly.

AN INDIVIDUAL ADJUSTMENT IS PROVIDED FOR LOCATING EACH RELEASE LEVER IN MANUFACTURING, AND THEY ARE LOCKED IN PLACE AND SHOULD NOT BE DISTURBED UNLESS THE INSTRUCTIONS FOR SERVICING CLUTCH ARE FOLLOWED IN DETAIL.

Each release lever is pivoted on a floating pin which remains stationary in the lever and rolls across a short, flat portion of the enlarged hole in the eyebolt.

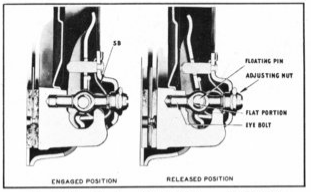


Fig. 327. Strut and Eyebolt Assembly Detail

The outer ends of the eyebolts extend through holes in the clutch cover and are fitted with adjusting nuts by which each lever is located in correct position. The outer ends of the release

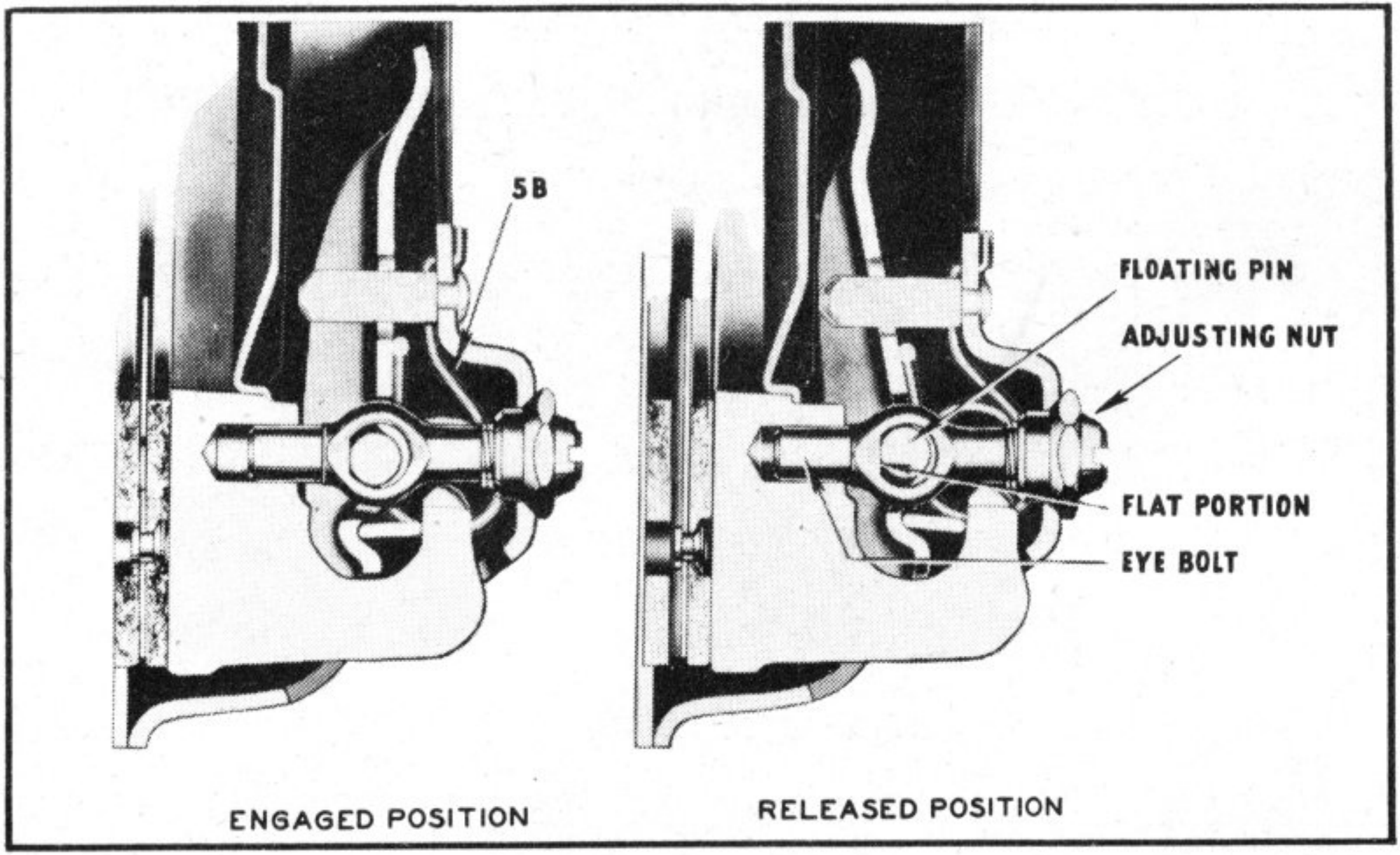


Fig. 327. Strut and Eyebolt Assembly Detail

levers engage the pressure plate lugs by means of struts which provide knife edge contact between the outer ends of the levers and the pressure plate lugs eliminating friction at this point.

Nine pressure springs are used in the clutch cover for maintaining the proper pressure between the clutch driven plate, flywheel and pressure plate.

Clutch Driven Plate

The clutch driven plate is of cushioned spring construction with grooved facing on both sides. Cushioning is obtained by means of separate cushioning segments which are riveted to the clutch hub assembly and extend between the facings. Each facing is made in the form of an endless ring and is treated by a process whereby the original characteristics of the material are maintained.

Balance is obtained by means of special steel rivets inserted in holes provided in the driving disc, and grinding of the edges for balance should be avoided in order to prevent damage to the cushions.

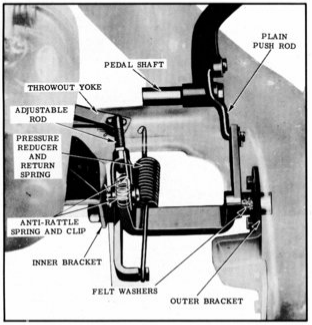


Fig. 328. Clutch Throwout Auxiliary Shaft Assembly

Clutch Throwout Auxiliary Shaft Assembly and Pedal Adjustment

The clutch throwout auxiliary shaft assembly is provided to allow clutch engagement and disengagement independent of engine movement permitted by rubber engine mountings.

The assembly consists of a stamped steel auxiliary shaft with a hardened plated pin at each end, three integral arms, a combination clutch pedal pressure reducer and return spring, and an anti-rattle spring. Two clutch auxiliary shaft felt washers impregnated with oil are used, one around each plated pin.

The auxiliary shaft is supported by two brackets, one on the cylinder block, the other on the frame. The auxiliary shaft floats in both brackets which prevents the transverse engine movement being transmitted to the clutch pedal. (See Fig. 329) Endwise shaft movement is kept within reasonable bounds by the felt washers.

A rubber sleeve between the inner bracket and bushing gives additional flexibility and insures against noise and vibration being carried from the engine to the clutch control.

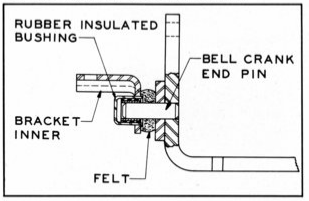


Fig. 329. Detail of Clutch Auxiliary Shaft Insulation

The plain push rod furnishes a connection between the clutch pedal and one arm on the auxiliary shaft. The adjustable link furnishes a connection between one arm of the auxiliary shaft and the clutch release yoke. The adjustment for clutch pedal lash is made on this link, which is the only clutch adjustment.

The third auxiliary shaft arm furnishes a connection for the combination pressure reducer and return spring, the anchored end of which is attached to the second frame cross member. The return spring not only takes up the slack in the clutch pedal during the time the clutch is engaged but, by virtue of the geometric relationship designed into the shaft and spring set-up, the spring begins to add to the force provided by the driver after the pedal has been depressed a very small amount.

Lubrication of the auxiliary shaft assembly is provided by means of the felt washers at each end of the shaft. Engine oil should be applied to the felt washers at regular lubrication intervals.

A high pressure lubrication fitting is provided on the underside of both the clutch and brake pedals for their lubrication. Two bronze bushings are pressed into the lower ends of both pedals.

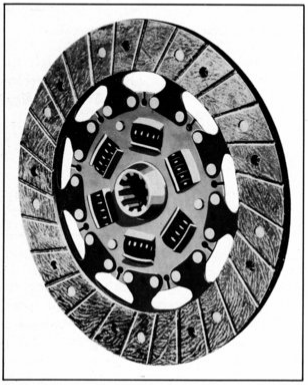


Fig. 330. Clutch Driven Plate Assembly

Disassembly and Inspection

1. Remove clutch from engine.

   NOTE—Clutch can be removed from the bottom without removing flywheel housing from engine block.

2. If the same cover and pressure plate are to be reinstalled, mark the cover and pressure plate with a punch so that the two parts may be reassembled in the same relative position.
3. Place the cover on the bed of an arbor press with a block under the pressure plate so arranged that cover is left free to move down. Place a block or bar across the top of the cover, resting on the spring bosses.
4. Compress the cover with the spindle of the press and, holding it under compression, remove the adjusting nuts and then slowly release the pressure to prevent the springs from flying out.
5. The cover can then be lifted off and all parts will be available for inspection.

   To remove release levers, grasp the lever and eyebolt between the thumb and fingers as shown in Fig. 331, so that the inner end of lever and upper end of eyebolt are as near together as possible, keeping the eyebolt pin seated in its socket in the lever. The strut can then be lifted over the ridge on the end of the lever, making it possible to lift the lever and eyebolt off the pressure plate.

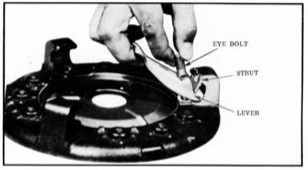


Fig. 331. Disassembling Release Levers

6. Inspect the pressure plate springs and replace if they show signs of overheating due to clutch slipping. If the springs have been overheated, the paint will be burned off, or they will show a pronounced blue color, indicating the temper has been drawn.
7. Inspect the driven plate (Fig. 330) and replace if the facings are worn nearly to the rivet heads.
8. Inspect cushion springs in clutch driven plate for cracks or fatigue failures and replace plate assembly where failure is noted.

   NOTE—Installation of clutch driven plate facings is not recommended as it is difficult to obtain balance and flat parallel faces. A new clutch driven plate assembly should be installed instead, to insure the accuracy built into the unit. However, in an emergency case if it is necessary to reline the plate, only factory recommended facings should be used.

Assemble Clutch

1. When assembling the struts and release levers, apply a small amount of "Lubriplate" to working edges of struts and on each side of the ears on the pressure plate where they extend through the clutch cover.

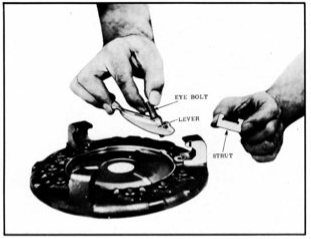


Fig. 332. Assembling Release Levers

2. Assemble baffle plate to pressure plate. The three ears on the edge of the baffle plate must rest on the spring seat ribs which are adjacent to the lugs on the pressure plate. (See Fig. 335) The pressure plate springs seat on these ears and hold the baffle plate in place. If the baffle plate ears have been bent in handling, straighten so that they will lie flat on the spring seat ribs. The baffle plate must seat fully into the recess in the pressure plate.

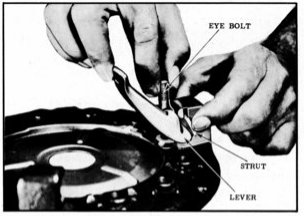


Fig. 333. Assembling Release Levers

3. Assemble a lever, eyebolt and eyebolt pin, holding the threaded end of the eyebolt between the thumb and index finger, allowing the end of the lever to rest on the second finger. Hold the end of the lever and the end of the eyebolt as close together as possible as in Fig. 332. With the other hand grasp strut between the thumb and first finger, and insert strut in the slots of the pressure plate lug. Then drop strut slightly and tilt the edge until it touches the vertically milled surface of the lug. Insert the lower end of the eyebolt in the hole in the pressure plate. (Fig. 333) The short end of the lever will then be under the hook of the pressure plate and near the strut. Slide the strut upward in the slots of the lug, lift it over the ridge on the short end of the lever and drop it into its groove in the lever.

Then place the springs on the pressure plate in a vertical position, seating them in the small bosses on the pressure plate, as shown in Fig. 334.

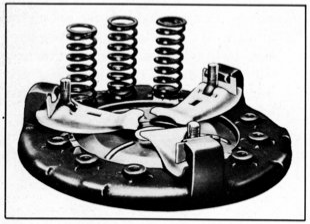


Fig. 334. Clutch Assembly Detail

4. Assemble anti-rattle spring to cover and lay the cover on top of the assembled parts, taking care that the anti-rattle springs are in position and the tops of the springs are directly under the embossed seats on the cover. Also, be sure that any marks previously placed on the cover and pressure plate are in correct location.
5. The bar can then be laid across the cover and the assembly slowly compressed. Be sure that the eyebolts and pressure plate lugs are guided through the proper holes in the cover. Care must be taken that the springs remain in their seats.
6. Holding the clutch under compression the adjusting nuts can then be screwed down on the eyebolts until their tops are flush with the tops of the eyebolts.
7. The spindle of the press can then be released.
8. The clutch should then be released several times so that all moving parts will settle into their working positions. This can be done with the press by applying spindle to inner ends of levers.

Adjust Clutch Levers

If a new clutch pressure plate assembly is installed and the clutch levers are all in the same plane within .015" variation, it is not necessary to adjust the levers before installation.

If the clutch pressure plate assembly has been removed from the car (for example- to remove and replace clutch driven plate or a similar reason) and has not been disassembled and the levers are all in the same plane within .015" variation, it is not necessary to adjust the levers.

If the clutch pressure plate assembly has been disassembled, then adjust levers so they are all in the same plane within .005" as follows:

1. Using an extra flywheel as a dummy, place the gauge plate Tool No. J-1048 in the flywheel in the position normally occupied by the driven plate and mount the cover on the flywheel, turning the holding screws only a turn or two at a time when pulling against the spring pressure, otherwise the cover may be sprung. Before the cover is tightened down, be sure the gauge plate is centered and the three flat machined lugs are directly under the levers.

   NOTE–If an extra flywheel is not available, the flywheel from the engine may be removed for use, but this practice is to be avoided if possible.

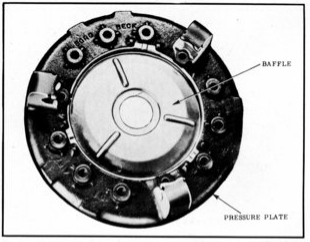


Fig. 335. Clutch Pressure Plate and Baffle

2. After the cover has been mounted, a short straight edge or scale (approximately three inches long) can be laid across the center boss and the bearing surface of one lever. Then turn adjusting nut on each lever until all levers are in the same plane within .005". (See Fig. 337)
NOTE—Engage and disengage assembly several times to be sure all working parts are properly seated, and recheck.
After adjustment is completed, lock the nuts with a small chisel, peening portions of the nut into the slot in eyebolt.

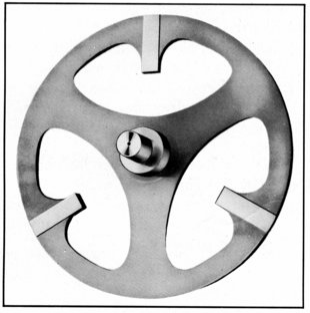


Fig. 336. Gauge Plate Tool J-1048

3. Loosen holding screws a turn or two at a time until spring pressure is relieved, which will allow clutch and gauge plate to be removed.
4. If the flywheel was removed from the crankshaft, replace same, using new cap screws and nuts.
5. ASSEMBLE DRIVEN PLATE AND CLUTCH TO FLYWHEEL. ONE SIDE OF THE CLUTCH HUB HAS A MACHINED SURFACE. THE MACHINED HUB END IS ON THE PRESSURE PLATE SIDE OF THE CLUTCH DRIVEN PLATE.
NOTE—Six threaded holes are provided in the flywheel for mounting the clutch assembly. The second threaded hole in the flywheel on each side of the clutch locating dowel (See A, Fig. 338) has a deeper counterbore than the other threaded holes.

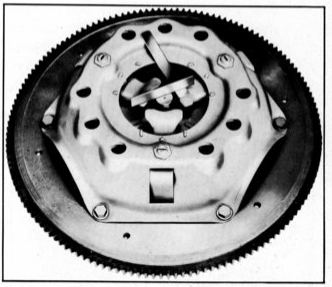


Fig. 337. Setting Levers with Gauge Plate Tool J-1048

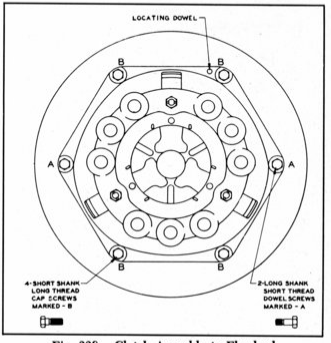


Fig. 338. Clutch Assembly to Flywheel

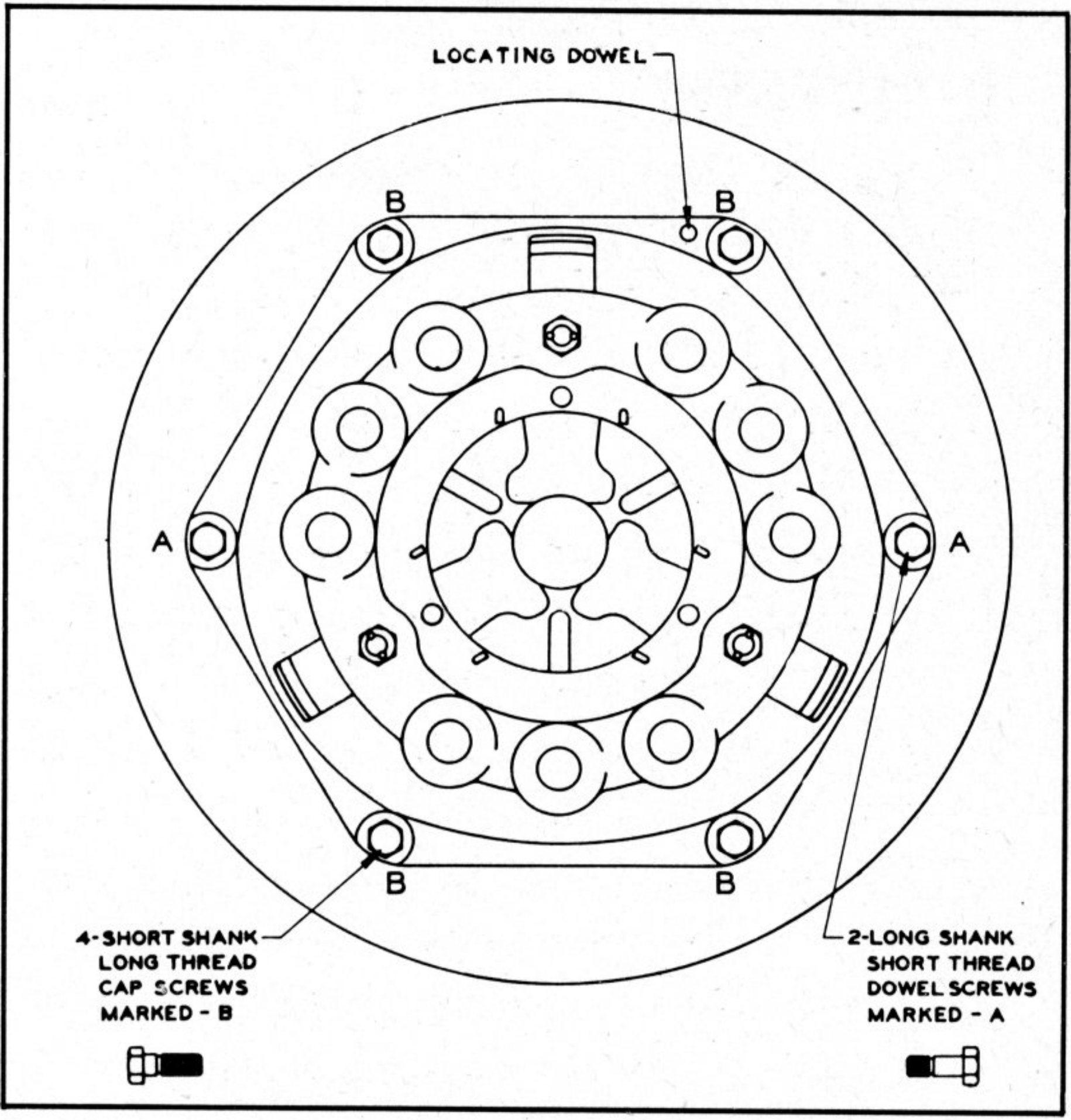


Fig. 338. Clutch Assembly to Flywheel

Two of the cap screws which have a longer shank under their head must be used in these holes with the deeper counterbores. Otherwise, it is impossible to securely fasten the clutch assembly to the flywheel. The purpose of the longer shank cap screws is to provide additional locating dowels between clutch assembly and flywheel.

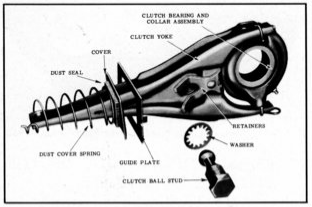


Fig. 339. Clutch Yoke Assembly

Remove and Replace Clutch Throwout Yoke

To remove the clutch throwout yoke, proceed as follows: (See Fig. 339)

1. Remove transmission.
2. Remove the flywheel housing pan and auxiliary shaft bracket.
3. Disconnect adjusting link from yoke.
4. Remove anti-rattle spring, seal and guide plate from outer end of yoke. Snap yoke off ball stud by pushing in on end of yoke.
5. Remove ball stud.
6. Remove yoke.
7. To replace, reverse sequence of operations for removal.

Remove and Replace Clutch Auxiliary Shaft

To remove the clutch auxiliary shaft, proceed as follows:

1. Disconnect adjustable link and then plain link from clutch auxiliary shaft.
2. Disconnect pressure reducer spring by revolving auxiliary shaft backwards, holding the auxiliary shaft firmly while revolving.
3. Remove the inner auxiliary shaft bracket.
4. Slide shaft out of frame bracket.
5. To replace, reverse sequence of operations, lubricating each end of shaft and making sure that all parts are free.

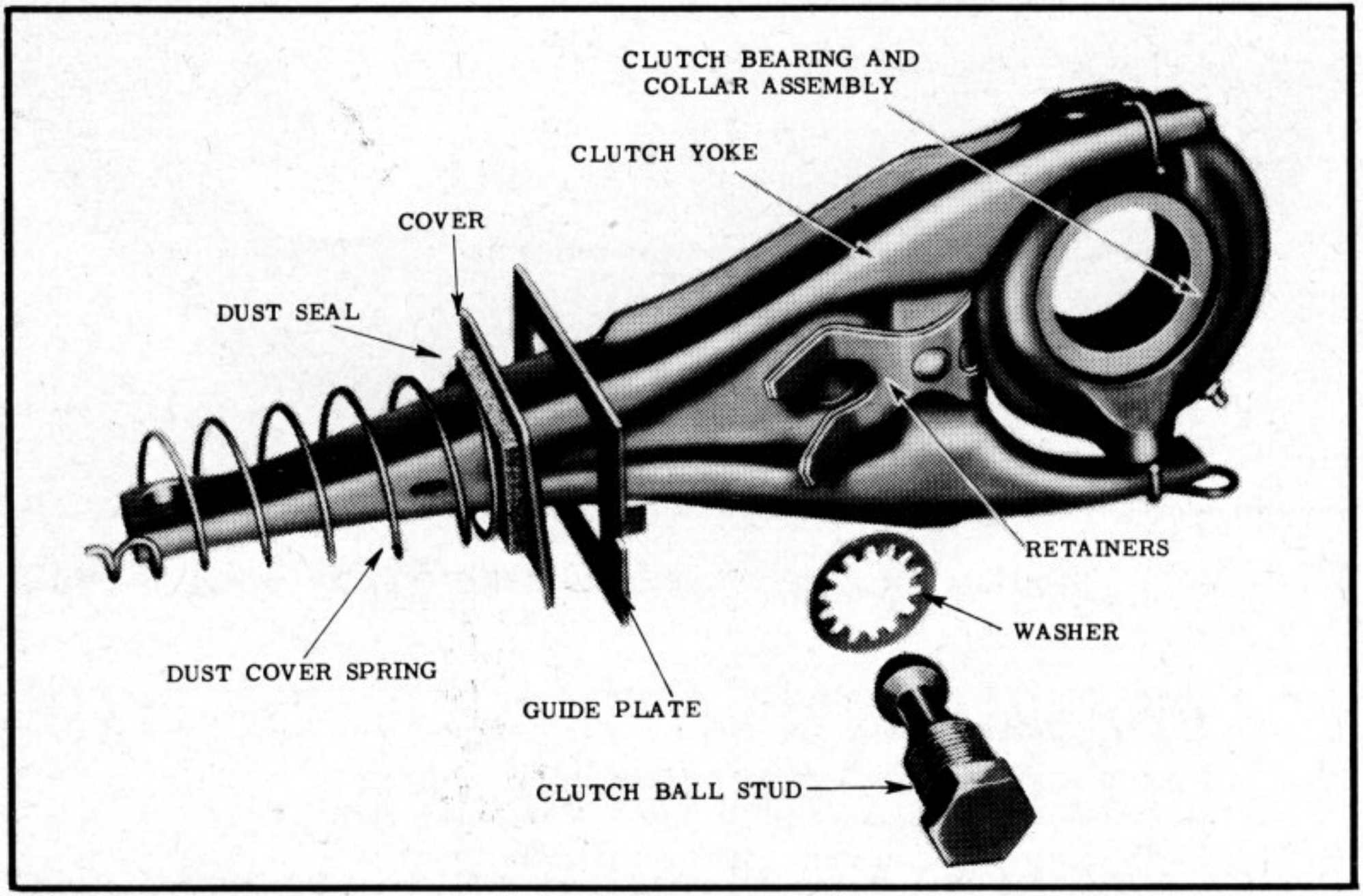


Fig. 339. Clutch Yoke Assembly

CLUTCH SPECIFICATIONS—1949 6 Cyl.

SUBJECT AND REMARKS	6 CYLINDER CLUTCH
1. TYPE	10A7
2. CLEARANCE BETWEEN	
Hub and Splines on Clutch Shaft	.0005"-.0035"
3. DISC FACINGS	
a. Area—Total Square Inches	40.04
b. Diameter Inside	7"
c. Diameter Outside	10"
d. Number Used	2
e. Thickness	.125"
4. DRIVEN DISC ASSEMBLY	
a. Number Used	1
b. Thickness (Over all)	.320"-.340"
5. PEDAL FREE MOVEMENT	⅞" to 1¼"
6. PRESSURE SPRINGS	
a. Number Used	9
b. Compression Pressure—lbs.	175 at 1 11/16"
7. RELEASE BEARING	
a. Thickness	1 1/32"
b. Type	Graphite

SYNCRO-MESH TRANSMISSION

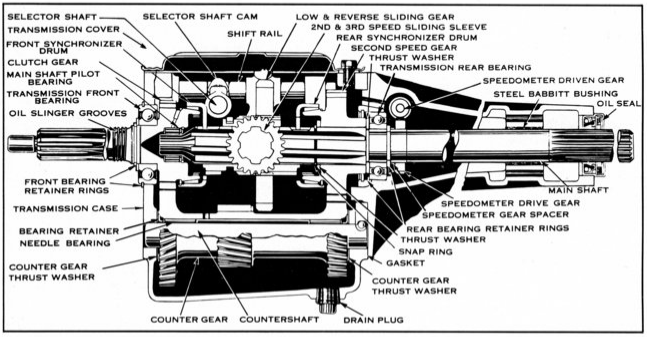


Fig. 340. Syncro-Mesh Transmission Assembly

The 1949 six cylinder model standard equipment includes a Syncro-Mesh transmission of the same design as that used in 1948, which is operated by a handi-shift control lever mounted on the steering column.

The shifting mechanism inside the transmission is located in the top of the case and consists of a transverse selector shaft, vertical selector shaft, high and low shifter rails, shifter cams and forks.

An opening is provided in the transmission rear bearing housing which provides for lubrication of the speedometer drive and driven gears by means of the transmission lubricant raised by the gears.

The Syncro-Mesh transmission has synchronizers for second and third gears. All gears, including reverse, are helically cut to provide quiet operation.

The transmission is mounted to the clutch housing with four support bolts, and the main drive gear and integral clutch shaft is piloted in the crankshaft on a Durex bushing. This arrangement assures positive alignment and eliminates pilot bearing wear and noise. The main drive gear bearing incorporates a snap ring in its outer race, which provides positive position of the bearing and gear.

The main shaft pilot bearing is the short, solid roller type in which the hardened main shaft is used as the inner race and the recess inside the main drive gear is used as the outer race.

Involute splines are used throughout the transmission, thereby increasing accuracy be-

tween the mating members, reducing the tendency toward noisy operation and increasing the bearing surfaces and life of parts. No detent springs are used under sliding sleeve.

Synchronization is accomplished by the beveled face of the two slots on the sliding sleeve coming into contact with the cam on the two fingers of the synchronizing drum. The slots sliding over these fingers produce the pressure on the drum required to synchronize the speed of the main shaft with that of the main drive gear in high or second speed gear so that engagement of the main shaft can be made with both members running at the same speed, quietly and with little effort.

Needle bearings are used at both ends of the countershaft, providing high efficiency and long life of countershaft parts.

HANDI-SHIFT CONTROL

The Syncro-Mesh transmission is shifted by a mechanism known as the Handi-Shift control mounted below the steering wheel and pivoted to a tube, inside the steering column, which is concentric with both the steering shaft and column.

The position of the handi-shift control lever determines the position of the gear shift tube both rotatively and axially, and movement of the tube actuates two shifter levers below the floor board. These two shifter levers, in turn, are connected by rods to shafts inside the transmission case which slide the various gears into position making possible the selection of the desired gear ratio.

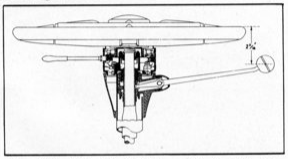


Fig. 341. Adjusting Shift Lever Vertical Position

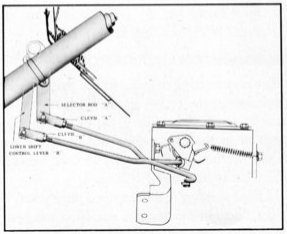


Fig. 342. Shift Control Rod Adjustment

The shifting positions follow the conventional "H" pattern as shown in Fig. 343.

GEARSHIFT LEVER POSITION

Two adjustments are provided to maintain the proper position of the gear shift lever in relation to the steering wheel.

These two adjustments are made as follows:

1. Place the shift lever and transmission in neutral.
2. Remove selector rod clevis pin at "A", Fig. 342, and adjust clevis to obtain a vertical distance of 2 11/16" between the top of steering wheel rim and top of shift lever knob, when clevis pin just slides freely through hole. (See Fig. 341)

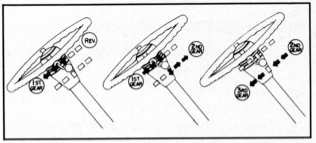


Fig. 343. Diagram of Gear Shift Lever Movement

3. With the shift lever still in neutral, remove the shift control rod clevis pin at "B", Fig. 342, and adjust clevis to obtain a dimension of 1 3/16" (horizontal) from center line of steering wheel to center of shift control

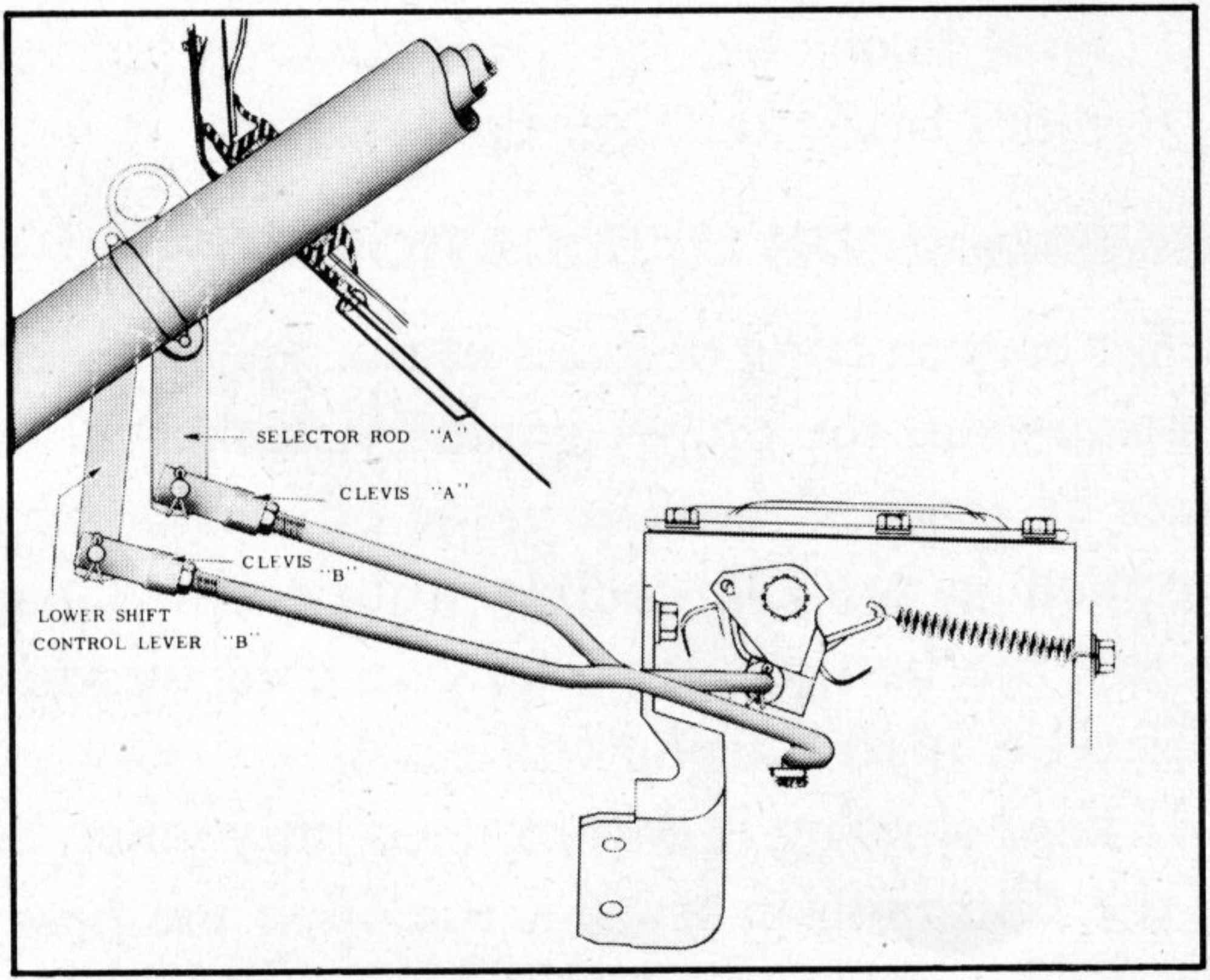


Fig. 342. Shift Control Rod Adjustment

lever knob, Fig. 345, when clevis pin just slides freely through hole.

TRANSMISSION LUBRICATION

For easy shifting of gears in the Syncro-Mesh transmission, the proper grade (viscosity) of oil must be used. A heavier grade of oil than that specified in the Oldsmobile Lubrication Chart should not be used, especially in cold weather, otherwise, hard shifting will result.

If hard shifting is encountered only when oil in the transmission is cold, the oil is too heavy for the temperature at which the car is being driven. A transmission should not be overhauled for hard shifting unless the grade of oil being used is checked and found to be of the specified viscosity.

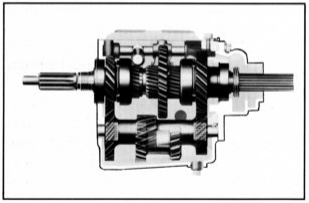


Fig. 344. Phantom View of Syncro-Mesh Transmission Assembly

DISASSEMBLE TRANSMISSION

1. Disconnect the lower shift rod and selector rod at the transmission.
2. Remove transmission.
3. Remove transmission cover.
4. Remove helper spring and transmission shift lever bolt from left end of selector shaft. Remove stamped shift lever.
5. Remove the selector rod lower lever from left side of case.
6. Remove the speedometer driven gear.
7. Remove the transmission rear bearing housing and main shaft assembly which is secured to the transmission case by four cap screws.
8. Remove the four set screws from shifter forks and selector shaft cams, using Tool KMO-244. (See Fig. 346)
9. Drive selector shaft through the right side of transmission case, using babbitt hammer. Removal of the selector shaft will push the welch plug at the right side of the case

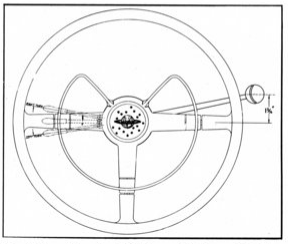


Fig. 345. Adjusting Shift Lever Horizontal Position

Fig. 346. Removing Shifter Rail Lock Screw

out. Do not let shifting cams drop into case.

10. Remove the shift rails and forks.

    NOTE—It is not necessary to completely remove the shift rails to remove the shifting forks. The shifting rails may be pushed toward the back of the case sufficiently to allow removal of the forks and yet not require removal of the rail and poppet springs which are underneath the shifter rails.

    NOTE—The second and high speed shifter rail is shorter than the low and reverse rail, and the second and high speed shifting cam is shorter than the low and reverse cam.

11. Remove the low and reverse gear and sliding sleeve.
12. Remove countershaft by pushing shaft to rear of transmission, using Tool J-1449. Make sure Tool J-1449 follows countershaft closely to prevent needle bearings falling in bottom of case. Allow countershaft gear to drop in bottom of case.
13. Remove the main drive gear snap ring and remove gear toward rear of case.
14. Remove countershaft gear and Tool J-1449. Raise gear carefully to prevent damage to gear teeth.
15. Remove idler shaft lock pin by driving pin into idler shaft. Remove idler gear and shaft.

Fig. 347. Removing Countershaft with Tool J-1449

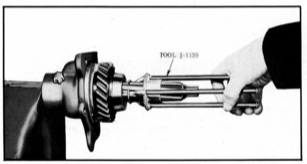


Fig. 348. Removing Second Speed Gear Snap Ring

16. Remove the selector shaft oil seal if it is to be replaced. Do not remove the seal if not necessary as a new one must then be installed.

To assemble, reverse sequence of operations and note—

a. Be sure that helper spring installation is made correctly.
b. If removed, be sure to use new welch plugs at front end of second and third shift rail and at end of selector shaft.
c. When assembling transmission fill the extension assembly with ½ pt. of transmission lubricant after transmission has been assembled in car and propeller shaft is in place. This is in addition to the normal amount added to the transmission.
d. Hold transmission shift lever in neutral when assembling shift lever bolt in place. Otherwise damage to the shifting cams may result.
e. When assembling the idler shaft lock pin, drive it into case until the outer end of the pin is ¾″ inside case.

Disassemble Transmission Rear Bearing Housing Assembly

1. Remove second speed synchronizing drum by prying ring over shoulder on second speed gear.
2. Remove second speed gear snap ring, using Tool J-1130. (See Fig. 348)

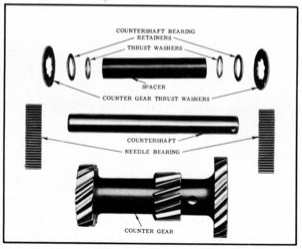


Fig. 349. Countershaft Assembly Details

NOTE—Replace with Tool J-1267. (See Fig. 351) Always use new snap ring.

3. Remove second speed gear and front thrust washer.
4. Remove transmission rear bearing snap ring.
5. Remove transmission main shaft and bearing from housing by pounding rear end of shaft on block of wood, or piece of lead. (See Fig. 352)
6. Remove bearing, thrust washer, speedometer drive gear and spacer from shaft by removing bearing snap ring behind bearing with Tool J-1041 and then pressing off bearing and gear. (See Fig. 355)

NOTE—The shielded side of bearing is to the front of transmission.

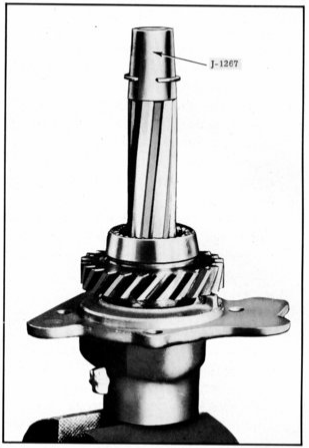


Fig. 351. Replacing Second Speed Gear Snap Ring

7. Inspect the rear oil seal and if necessary, replace. Also inspect surface on which oil seal runs (slip yoke), making sure that it is smooth and free from dirt. The seal has a shoulder properly located in the rear bearing housing. Check vent in housing to be sure that it is open.

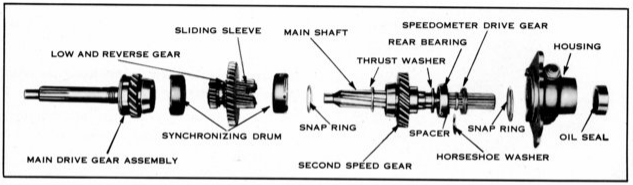


Fig. 350. Transmission Main Drive Shaft Details

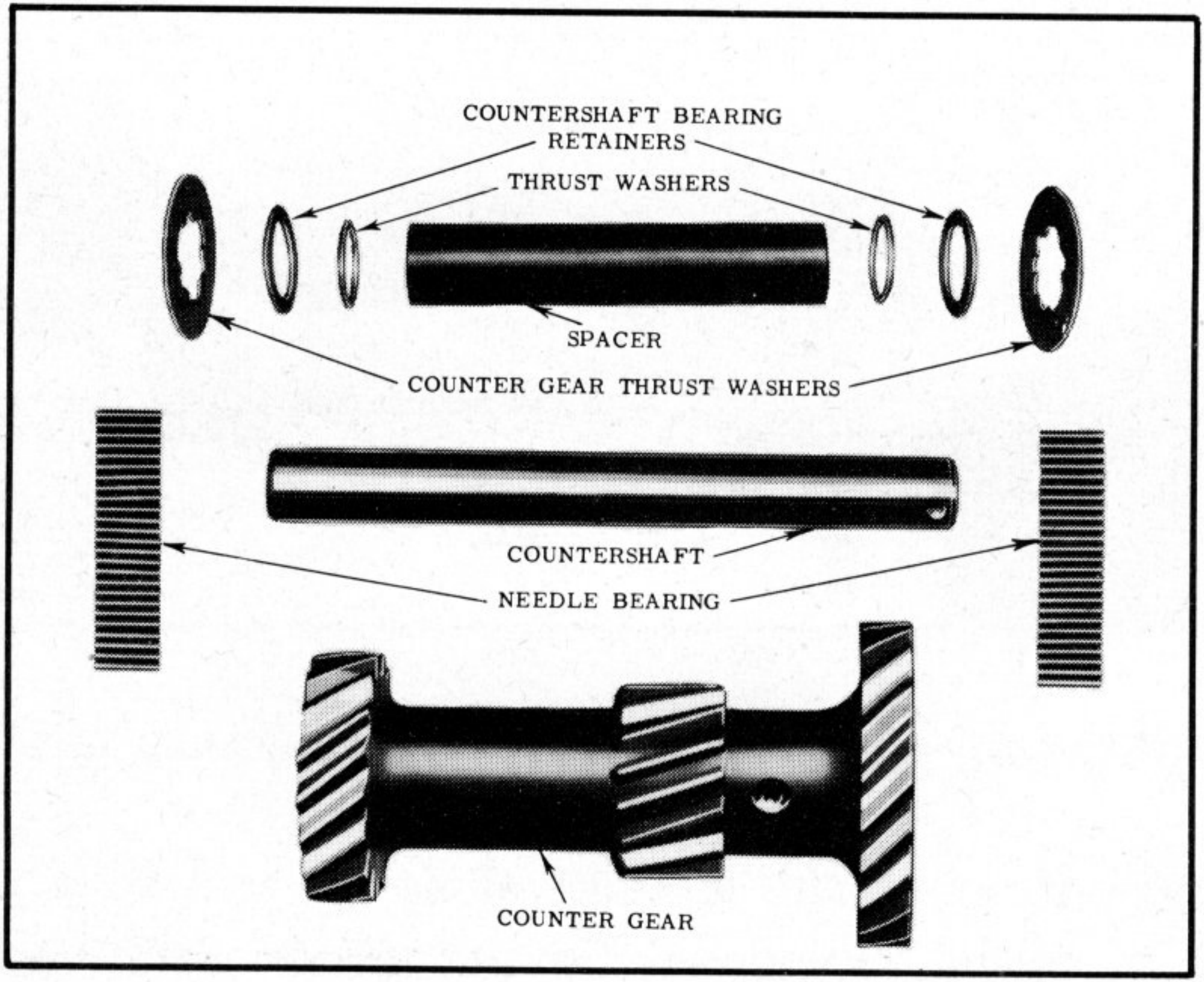


Fig. 349. Countershaft Assembly Details

Fig. 352. Removing Transmission Main Shaft and Bearing

CAUTION—Whenever transmission rear bearing oil seal is removed, a new one must be installed. Before installing a new seal, soak in light engine oil for approximately five minutes. Install seal with felt to the rear and using special Tool J-1050. (See Fig. 351)

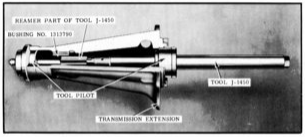


Fig. 353. Installing Transmission Extension Bushing

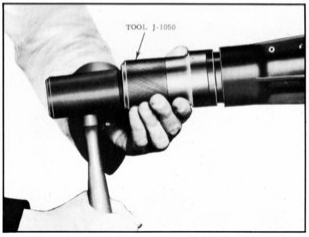


Fig. 354. Installing Transmission Rear Bearing Oil Seal

Transmission Rear Bearing Housing

A steel back bronze bushing is used at the rear of the rear bearing retainer extension to support the transmission main shaft.

The bushing is serviced separately from the housing. If replacement is necessary, the bushing may be removed with special Tool No. J-1450, and a new bushing pressed in place with Tool No. J-1450. (See Fig. 353)

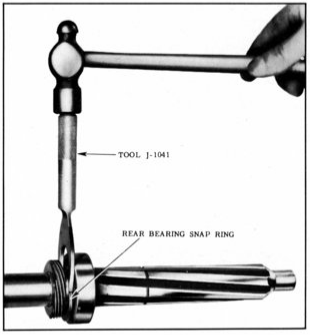


Fig. 355. Removing Transmission Rear Bearing Snap Ring

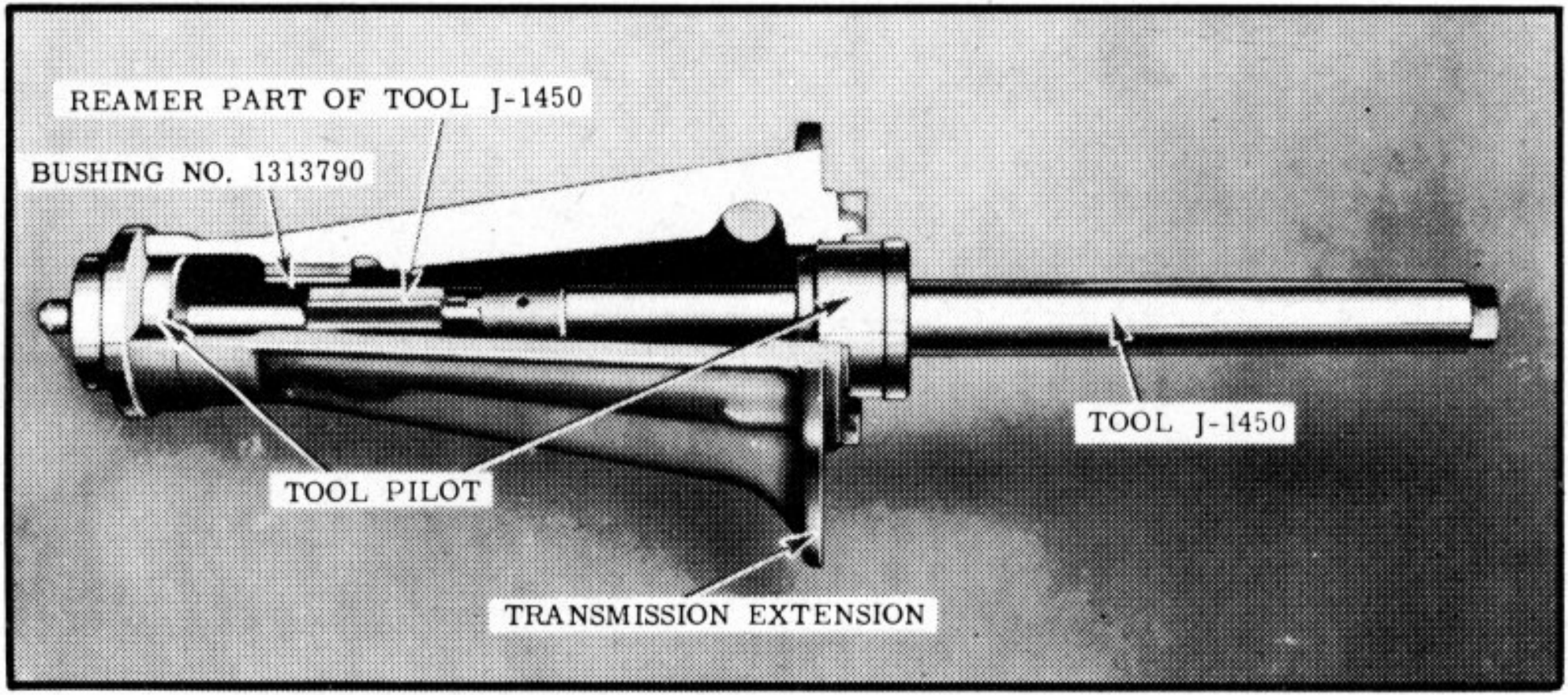


Fig. 353. Installing Transmission Extension Bushing

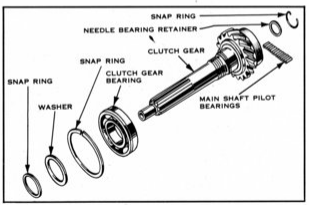


Fig. 356. Clutch (Main Shaft) Gear Assembly

The running clearance between inside diameter of bushing and main shaft is .0025″ to .004″

After having driven bushing in place, ream inside diameter, using Tool J-1450.

Disassemble Main Drive Gear Assembly

1. Remove high speed synchronizing drum by prying retaining ring over shoulder of gear.
2. Remove snap ring and spring washer holding bearing inner race on shaft.
3. Remove bearing by jarring shaft on block of wood or piece of lead.

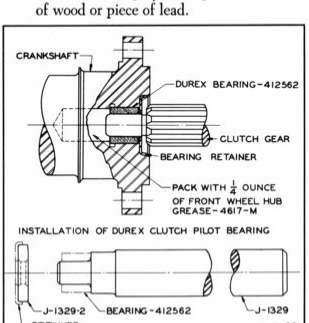


Fig. 357. Installing Clutch Shaft Pilot Bearing with Tool J-1329

CLUTCH SHAFT PILOT BEARING

The same durex bushing is used on 1949 Syncro-Mesh models as was used in 1948. There is a recess in the end of the crankshaft to provide a reservoir for lubricant. A felt is not used. The bushing is held in place by means of a sheet metal retainer pressed in the crankshaft. (See Fig. 357)

On engines equipped with Syncro-Mesh transmission, the bushings are lubricated at assembly with wheel bearing lubricant and do not require further lubrication unless removed, at which time any lubricant in the reservoir should be removed and ¼ oz. (level tablespoonful) of front wheel bearing lubricant should be placed in the reservoir. Do not fill the reservoir nor use more lubricant than specified above.

Remove and Replace Clutch Shaft Pilot Bearing

After the bearing retainer, transmission and clutch assembly have been removed, the clutch shaft pilot bearing may be removed with Tool J-1448, as shown in Fig. 359. Bearing may be replaced with Tool J-1329 and J-1329-2, as shown in Fig. 357.

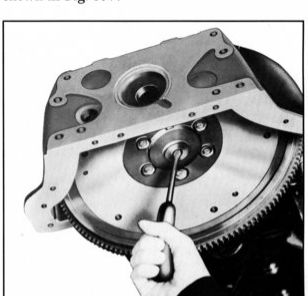


Fig. 358 Removing Clutch Shaft Pilot Bearing

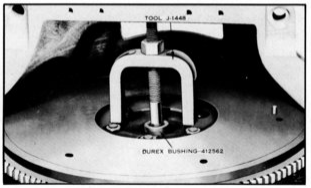


Fig. 359. Removing Clutch Shaft Pilot Bearing with Tool J-1448

SPEEDOMETER

The AC speedometer used on all models is equipped with an odometer, which registers in miles and tenths of a mile.

Due to the different axle ratios and tire sizes used, different speedometer gear ratios are necessary.

If a change in tire size or differential gear ratio is made, then it may be necessary to change the speedometer gear ratio. The specification section lists the various speedometer gear ratios. Whenever a change is made, it is only necessary to change the speedometer driven gear and sleeve assembly.

NOTE—The speedometer drive and driven gears are lubricated by means of oil thrown off the second speed gear and an opening in the transmission rear bearing housing.

Speedometer Cable Lubrication

The speedometer cable is lubricated at the time of assembly and should not require further lubrication under normal conditions, however, when a new speedometer cable is installed, it should be lubricated. All old grease must be removed from the casing and a thin coating of good quality speedometer graphite grease applied to the lower two-thirds of the cable only. This will properly lubricate the upper one-third of the casing, giving an even coating of lubricant the full length of the flexible shaft, without danger of excess grease working up into the speedometer head.

NOTE—Always dip speedometer gears in light oil before assembly.

SYNCRO-MESH TRANSMISSION BEARING TEST CHART

Car Position				Transmission Bearing Position		
Engine	Transmission	Clutch	Car	Front	Pilot Trans. Main Shaft	Rear
Idle	Neutral	Engaged	Stopped	Turning	Turning	Stationary
Off	Neutral	Engaged	Coasting	Stationary	Turning	Turning
Off	High	Disengaged	Coasting	Turning	Stationary	Turning
Countershaft needle bearings are turning whenever engine or car is in motion. See below. (Unless the clutch has been disengaged and the transmission has been in neutral for an appreciable time.)						
CLUTCH SHAFT PILOT BEARING TEST						
Idle	Any gear	Disengaged	Stop	The clutch pilot bearing is working		

The preceding chart shows the position (turning or stationary) of transmission bearings under various car operating conditions. In addition to the needle bearing assembly at each end of the

countershaft, there are three bearings in the transmission. The countershaft needle bearings are turning at any time there is power transmitted to the transmission, whether that power is from the engine (idle or running) or from the rear wheels (coasting). Two of the other three transmission bearings are working at all times. The fact that each one can be stopped under various conditions as shown in the chart makes it possible to road test the car to determine by a comparison of noise characteristics which bearing is noisy before the transmission is torn down.

For example, we will suppose that the transmission main shaft pilot bearing is noisy. Then by referring to the chart we see that with the engine off, the transmission in high, the clutch disengaged, and the car coasting, the transmission pilot bearing is stationary. If the noise persisted under all conditions and disappeared under this condition, then it would be reasonable to assume before disassembly that only the pilot bearing was noisy and no other bearing replacement should be required.

As stated in the chart, the countershaft needle bearings are, as a rule, turning whenever the car or engine is in motion. Therefore, they cannot be tested directly as above. However, a check can be made to determine that the other three transmission bearings are not noisy. Then any existing bearing noise would, undoubtedly, be countershaft bearings. Furthermore, countershaft needle bearing noise is much more pronounced upon acceleration in second speed.

Clutch shaft pilot bearing noise is sometimes confused with transmission bearing noise. The condition of the pilot bearing can be checked before disassembly as follows: The clutch pilot bearing is working when the engine is idling, the clutch is disengaged, the transmission is in any gear. If the pilot bearing is noisy under these conditions, it will undoubtedly require replacement.

SYNCRO-MESH TRANSMISSION BEARING INSPECTION

There are three different types of bearings used in the Syncro-Mesh transmission—single row ball, cageless roller, and needle.

Before any attempt is made to inspect the ball bearings, they should be cleaned as follows:

1. Rotate bearing by hand in clean kerosene or gasoline until free from grease and oil.
2. Blow out with air hose by directing air through the bearing at the same time rotating the bearing by hand. Do not spin the bearing with air pressure.

   CAUTION—Due to the presence of water in the air line, be sure all water is removed.
3. If necessary, repeat cleaning operation to be sure all foreign substance has been removed.
4. After cleaning thoroughly, lubricate with clean engine oil and rotate by hand and inspect for rough spots.

Before any attempt is made to inspect the cageless roller or needle bearings, they should be cleaned in kerosene or gasoline until free from oil. After thoroughly cleaning, the needle and roller bearings should be inspected for flat spots and wear. The end play of the roller bearing, when in position in the main drive gear, should not exceed .015″ to .025″. The ball bearings are built with initial end play of .004″ to .006″. They should not be replaced for excessive end play unless there is more than .008″.

SYNCRO-MESH TRANSMISSION SPECIFICATIONS
1949 MODEL

SUBJECT AND REMARKS	
1. GEAR RATIO	
a. Low Speed	2.666:1
b. Second Speed	1.661:1
c. High Speed	Direct
d. Reverse Speed	3.022:1
2. LUBRICANT CAPACITY	2 lbs.
3. BEARINGS	
a. Clutch Pilot Shaft	
(1) Make	Durex
(2) Type	Plain
(3) Number	412562
b. Main Drive Shaft Pilot Bearing	
(1) Make	Olds
(2) Type	Roller
(3) Number	1294780
c. Main Drive Gear Bearing	
(1) Make	N. D.
(2) Type	Ball
(3) Number	954144
d. Main Drive Shaft Rear Bearing	
(1) Make	N. D.
(2) Type	Ball
(3) Number	907506
e. Counter Shaft Bearings	
(1) Type	Needle Bearing
f. Reverse Idler Bearings	
(1) Type	Bronze Bushing
4. SPEEDOMETER	
a. Make	AC
b. Cable Length	
(1) Syncro-Mesh Transmission	56⅛″
c. Casing Length	
(1) Syncro-Mesh Transmission	55″

1949 SPEEDOMETER GEAR CHART

Model	Tire Size	Trans.	Axle		Number of Teeth on Speedometer Gears		Part Numbers
					Drive	Driven	Driven Gear and Sleeve Assem.
76	7.10 x 15	S.M.	4.1	41:10	7	20	1315521
76	7.60 x 15	S.M.	4.1	41:10	7	20	1315521
76	7.60 x 15	S.M.	4.3	43:10	7	21	1315522
76 Hilly	7.10 x 15	S.M.	4.3	43:10	7	21	1315522
76	7.10 x 15	H.T.	3.64	40:11	7	18	1315536
76	7.60 x 15	H.T.	3.64	40:11	7	18	1315536
76	7.60 x 15	H.T.	3.9	39:10	7	19	1315062
76 Hilly	7.10 x 15	H.T.	3.9	39:10	7	19	1315062
88	7.60 x 15	H.T.	3.23	42:13	8	18	1315536
88	7.60 x 15	H.T.	3.42	41:12	8	19	1315062
98	7.60 x 15	H.T.	3.64	40:11	8	20	1315521
98 Export Opt.	7.60 x 15	H.T.	3.9	39:10	8	22	1315063
98	8.20 x 15	H.T.	3.64	40:11	8	20	1315521
98	8.20 x 15	H.T.	3.9	39:10	8	21	1315522

HYDRA-MATIC DRIVE

The construction of Oldsmobile's Hydra-Matic Drive consists of a fluid coupling combined with a fully automatic transmission.

The fluid coupling consists of two members or rotors, the driving rotor, which is driven by the crankshaft through the front unit and which revolves with the engine, and the driven rotor, which is fastened to the transmission main shaft. Radial vanes are located around the inside surface of the rotors. Both rotors are enclosed in a housing into which oil is pumped from the transmission under pressure to insure an adequate supply of oil for smooth transmission of power at all speeds. The oil is thrown by centrifugal force from the vanes on the driving rotor against the vanes of the driven rotor.

The transmission consists primarily of two constantly meshed planetary gear sets, placed in series, so that torque may be stepped up by either or both. This arrangement makes possible four forward speeds.

The automatic selection of the most efficient gear for any speed is controlled by a centrifugal governor incorporated in the transmission. The action of this governor is also influenced by the throttle opening through linkage between the motor and the transmission. The change from one speed to another is accomplished through hydraulically actuated pistons which control bands on the planetary gear sets and clutches within the planetary units.

When the transmission is in low gear, the brake bands of both gear sets are held tightly around the planetary drums and both sets of gears are in reduction. When in second, the brake band of the forward gear set is released so that power is transmitted directly through this unit without gear reduction by means of clutches within the planetary units, and then through the rear gear set. In third, the rear unit band is released and the clutches locked, the front band is tightened and the front clutch is released. The drive is through the forward unit with gear reduction and directly through the rear unit without gear reduction. When in fourth, the bands of both gear sets are released and power is transmitted directly through the transmission from the engine to the rear axle. Fourth gear is a direct drive, not an overdrive.

The control for the operation of Oldsmobile's Hydra-Matic consists of a selector lever mounted in the steering column directly beneath the steering wheel. The indicator segment is illuminated for night operation, and has four positions, "N", "Dr", "Lo", and "R".

The normal operating position is the "Dr" (drive) range. With the selector lever moved to "drive", the car will start in first and shift automatically into second at approximately 5 to 15 M.P.H., into third at approximately 10 to 32 M.P.H., and into fourth (direct drive) at any speed between 18 M.P.H. at light throttle and 68 M.P.H. at full throttle. The speed at which shifts occur is determined by throttle opening.

When the car is started in the "Lo" range position and the driver continues to accelerate at part throttle, the transmission will automatically shift from first to second at approximately 17 M.P.H. If the throttle is opened wide, this upshift will occur at approximately 30 M.P.H. The car will continue to operate in second unless the car speed drops below 6 M.P.H. in which case the transmission will down-shift into first again.

The shift from "Dr" range to "Lo" range, car moving, is made by manually moving the selector lever from "Dr" to "Lo" range position and the actual shift occurs only when the car speed

is below 45 M.P.H. This shift provides a means of obtaining braking effort from the engine when descending long, steep grades, and is comparable to shifting from high to second in the Syncro-Mesh transmission.

On deceleration with closed throttle, lever in "Dr", the shift from fourth to third gear occurs automatically at approximately 15 M.P.H. Continuing to decelerate, the transmission will shift automatically from third to first at approximately 2-6 M.P.H.

Shifting from fourth to third gear for increased acceleration and hill climbing ability can be accomplished below 57 M.P.H. by merely pressing the accelerator pedal to the floor.

In like manner at speeds below 10 M.P.H. a downshift from third to second or first gear may be made.

To reverse, the car should be brought to a complete stop, and the selector lever moved firmly to the "R" position.

NOTE: When the selector lever is moved from "N" through forward positions, to "R", the synchronizer momentarily impedes the lever travel between "Lo" and "R".

As an added safety measure for parking on grades, the selector lever may be moved into reverse (after the engine has been shut off with the selector lever in a forward driving position) locking the drive system so that the car will not move.

While it is possible to hold the car stationary on upgrades by slightly opening the throttle, thereby slipping the fluid coupling, it is not recommended that this practice be used for any appreciable length of time.

POWER DRIVE

Creep, under engine idle conditions is practically eliminated by locating the fluid members, in effect, between the front and rear units of the transmission where the speed of the fluid driving member has been reduced to .7 engine speed

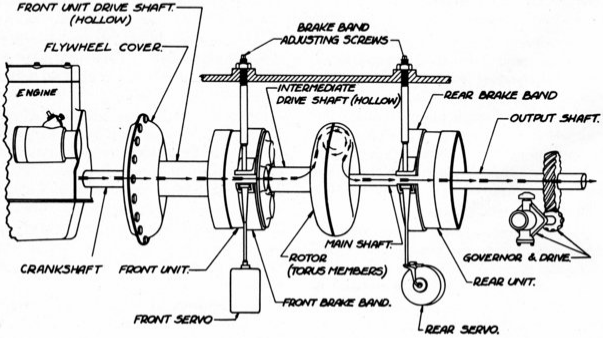


Fig. 360. Power Drive First - Second

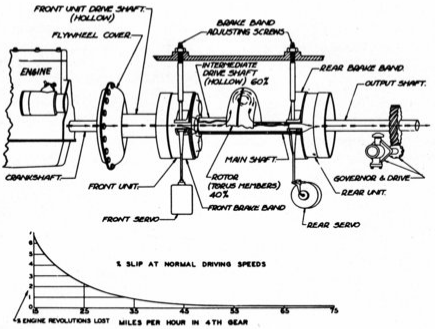


Fig. 361. Power Drive Third - Fourth

because the flow of power first passes through the gear reduction of the front planetary.

Excessive slip under normal driving conditions is undesirable because of the resultant losses in power and the reductions in fuel economy. The flow of power through the Hydra-Matic is such that slip is kept at a minimum. This is accomplished by an arrangement in which only 40% of the torque is transmitted through the fluid drive in 3rd and 4th gears. Thus, in 4th gear, the slip through the HYDRA-MATIC Drive is less than 1% over a large part of the driving range.

Fluid Coupling

The fluid coupling of the HYDRA-MATIC DRIVE is composed of two rotors or "torus members", each of which is splined to an independent shaft.

One member is known as the "driving" member; the other as the "driven" member. Both members are identical in construction except for the hubs which serve to secure the members to their respective shafts. The fluid coupling makes for a softness of feel not possible with a mechanical drive.

The function of the driving torus member is to impart centrifugal force to the oil within this member, and to direct the flow of oil so that its energy is most efficiently transmitted from the driving to the driven torus member. This function is achieved in the following manner:

Under action of centrifugal force, due to rotation of the driving torus member, the oil contained therein moves radially outward, the tendency increasing with rotating speed. As the oil is forced to the outer extreme of the housing, it must cross over to the driven torus and as it does, a driving force is set up in the driven member.

Governor

The governor is the speed control of the Hydra-Matic Drive, consisting of two weighted plunger valves, G-1 and G-2, and is actually a

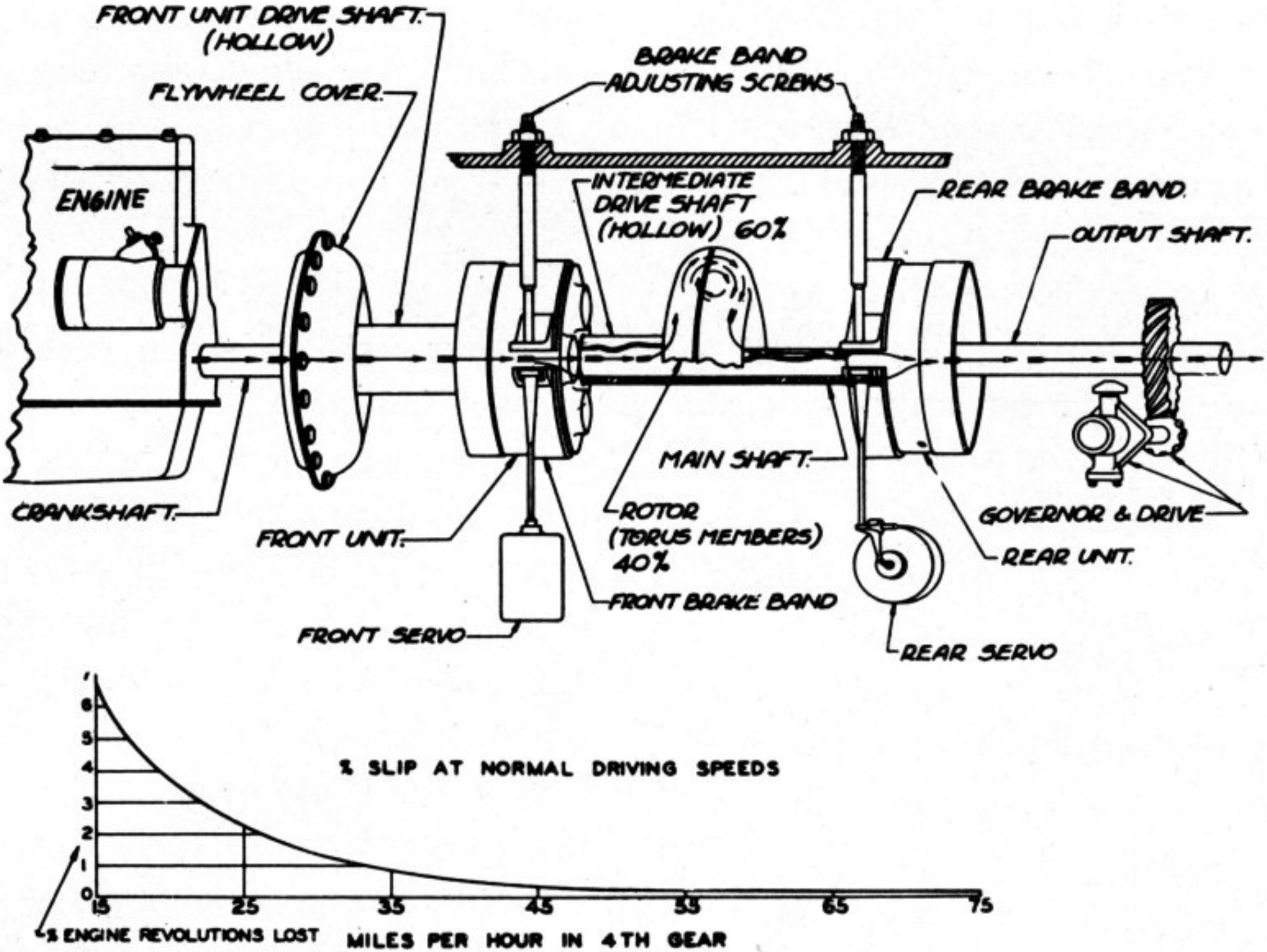


Fig. 361. Power Drive Third - Fourth

pressure regulator. Two valves, producing two different pressure curves, are used in order to secure greater flexibility of control than would be possible with a single valve. Oil under pressure is delivered from the oil pumps through the manual valve to the governor where it is regulated and directed to the shifter valves to effect gear changing. The governor is driven from the output shaft of the transmission and rotates only when the car is moving.

Shifting

The following explanation is representative, in a general way, of all the forward shifts possible with the transmission.

Referring to the simplified diagram, Fig. 363, oil is admitted to the governor valve body through the 80-pound line from the pump. As the governor spins, centrifugal force acting upon the governor valves produces regulated pressures, which increase with car speed. This governor pressure is applied to one end of a shift valve; for example, the valve which shifts between 1st and 2nd speed. On the opposite end of this valve is applied a fixed spring pressure and another variable pressure known as throttle valve pressure. Throttle valve pressure is regulated by the throttle position which actuates another balanced valve as shown.

When force exerted by governor pressure on the 1st and 2nd valve exceeds that exerted by throttle valve pressure plus spring pressure on the opposite end, the valve shifts and oil is directed to the front unit clutch piston and the brake release piston of the front unit servo. This shift from 1st to 2nd occurs at approximately 5 M.P.H. at light throttle.

If the throttle is opened, the throttle valve pressure is increased. Thus, before the shift can be made under these conditions, governor pressure must be increased. This can be accomplished only by raising the car speed. Therefore, increasing the throttle opening results in a 1st to 2nd shift at higher speeds. At full throttle, this shift is made at approximately 15 M.P.H. (in the "Dr" range).

CONTROL

Two oil pumps provide oil to the pressure regulator unit which in turn directs the fluid to the fluid coupling, lubrication system, valve body, and governor. The outer valve body contains all of the control valves: the manual valve controlled by the selector lever, the throttle valve positioned by the accelerator pedal, the compensator valve and auxiliary plug which influence the operation of the two servo units, and the double transition valve. The inner half of the valve body contains the governor plugs, shifter valves and the regulator plugs which direct the flow of oil to the clutches and servos.

The fluid coupling and the front and rear planetary gear sets transmit the power through the Hydra-Matic unit. Pump pressure is supplied to the governor, throttle valve and compensator valve. These valves regulate between inlet and exhaust openings to exactly balance several variable forces and to produce pressures which are generally lower than pump pressure, such as throttle, compensator, and governor pressures. The pressures regulated by their valves control the shifts in the transmission.

Oil Pressures (Fig. 364)

PUMP PRESSURE

The first requirement of the hydraulic control system is a source of oil pressure. The source of oil pressure for the Hydra-Matic transmission control system consists of two gear-type oil pumps. One at the front of the transmission, driven by the engine (A), the other at the rear, driven by the transmission output shaft (B). The front pump operates whenever the engine is running, the rear pump operates whenever the car is in forward motion. The front pump delivers its maximum capacity directly to the

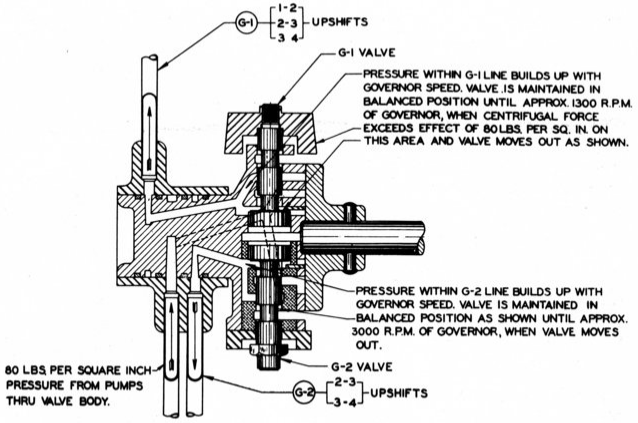


Fig. 362. Governor Operation

valve body as soon as the engine is started. When the pressure builds up to approximately 80 pounds the pressure regulator valve (C) opens to permit oil flow to the fluid coupling (D) and thence to the lubrication system (E). Whenever the lubrication pressure reaches approximately 70 pounds, a by-pass valve (F) opens to discharge the surplus into the transmission case.

When the car moves forward, the rear pump builds up pressure against a small check valve (G); when the check valve opens, the rear pump oil flows to the valve body together with the front pump oil. Both oil pumps then deliver their maximum capacity directly to the valve body where it is directed to the various units to operate the transmission. Maximum pump pressure is regulated at approximately 84 pounds and is dependent on the speed of the pump gears and the temperature of the oil.

THROTTLE PRESSURE

As the carburetor is opened, linkage to a lever on the transmission moves "T" valve (H). "T" valve movement opens throttle valve (I) through spring force. Throttle valve pressure is a variable pressure dependent on carburetor opening. This pressure is directed to the regulator plugs (J, K, L), which aids fixed spring force to oppose governor pressure on the opposite end of the shifter valves.

When the throttle valve is opened, oil pressure—which is pump pressure—flows through the opening (M) of the valve. There is a passage leading to a large area (N) on the throttle valve against which this pressure flows to push the throttle valve closed against the spring force, closing off the valve opening. The farther the throttle is opened the more force is exerted against the spring to open the valve; therefore,

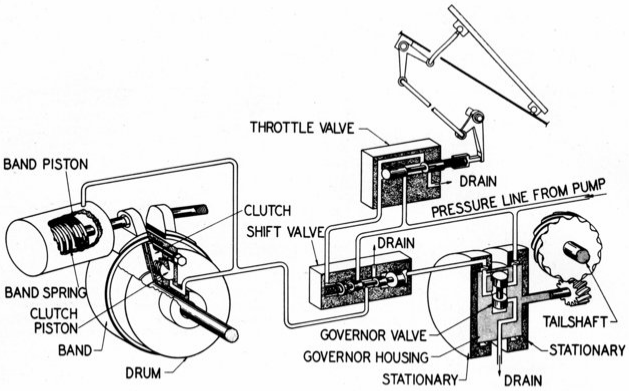


Fig. 363. Principles of Shifting

more oil pressure is exerted on the opposite side of the throttle valve to close it against the spring force. In this manner, the valve becomes a balanced valve, balanced between spring force and throttle pressure.

If the carburetor is opened lightly, the throttle pressure against the shift valves will be low. Oil pressure from the governor will then open the shift valves at a low car speed, and as a result, will shift the transmission at a low car speed. If the carburetor is opened wide, greater car speed will be required to build up governor pressure to open the shift valves; therefore, the transmission will shift at a higher car speed.

COMPENSATOR PRESSURE

Another pressure which is related to throttle pressure and which should be considered at this time is compensator pressure (O). Compensator pressure is controlled by throttle pressure. That is, the same throttle pressure which is directed to the regulator plugs is directed against the large end of the compensator valve (P).

This pressure pushes the compensator valve in, and opens a port for pump pressure at (Q).

The pump pressure metered against the large section of the valve, and against the compensator valve plug, closes the compensator valve against throttle pressure. The compensator valve then becomes a balanced valve, except in this case, the valve is balanced between two pressures (throttle pressure and compensator pressure). The movement of the compensator valve regulates pump pressure in proportion to the throttle pressure.

Inasmuch as the throttle pressure is regulated by carburetor opening which is accompanied by an increase in power and speed, the demand on the servos increases for tighter band application to prevent slippage. Therefore, regulated compensator pressure is directed to compensator pistons of the front and rear servos to assist the

normal apply force to keep the bands tightly held around the drums.

NOTE: Compensator pressure also positions the double transition valve when the carburetor is opened for proper upshift after bringing the car to a stop with a closed throttle. It also positions the double transition valve for a 3rd to 2nd down-shift when slowing down with carburetor opened while climbing a steep grade.

MODULATED THROTTLE PRESSURE

In "Hi" range position, the 1st to 2nd, and 2nd to 3rd, shift valves have modulated throttle pressure under them at approximately one-third throttle opening (R, S).

This is due to the light regulator spring between the shift valve and regulator plug which must be overcome by throttle pressure before the regulator plug can be moved. As the throttle pressure increases, it moves the regulator plug sufficiently to open a port (T, U) permitting throttle pressure to meter past the regulator plug and work against the shift valves to oppose governor pressure. This is called MODULATED THROTTLE PRESSURE. It provides for shifts at low speed at light carburetor openings, and shifts at higher speed at heavy carburetor openings; all shifts between low and high speeds are proportional to carburetor opening.

Throttle pressure is used under the 3rd to 4th shift valve (V) without modulation.

NOTE: With the selector lever in the "Lo" range position pump pressure is directed under the 1st to 2nd regulator plug to open a port so that throttle pressure is directed under the 1st to 2nd shift valve without exerting any of its force to move the regulator plug against the spring.

The increased throttle pressure under the shift valve requires higher governor pressure to shift the valve. This function provides for a shift from 1st to 2nd at a higher car speed in "Lo" range than in "Hi" range position for the same throttle opening.

This is explained under FIRST SPEED—"LO" RANGE.

GOVERNOR PRESSURES

Governor pressure is used to shift the valves in the valve body to their open position, but, this same governor pressure is resisted by springs and throttle pressure delivered to the opposite end of the shift valves as explained earlier to control the time of shifts. There are two governor pressures—one called G1 (W), from the large governor weight, and another G2 (X) from the small governor weight. These two pressures work against the shifter valves and governor plugs (1-2), (2-3), and (3-4). Looking at the valve body, separator plate side of body up, the center valve controls the shift from 1st to 2nd speed.

The G1 pressure controls the shift of this valve entirely because it delivers high pressure at low vehicle speed. The G2 governor pressure along with the G1 governor pressure controls the shift of the 2nd to 3rd and 3rd to 4th speeds. The G2 pressure works against the governor plug and small end of the 2nd to 3rd shift valve which is the top valve; while G1 pressure works against the large surface of the valve. By directing the pressure in this manner, it is possible to delay the shift to higher car speed or until the G2 pressure, which builds up slowly, has reached high enough pressure to assist the G1 pressure to open the shifter valve. G1 pressure by this time is practically full regulated pump pressure. The valve at the bottom is the 3 to 4 shift valve and controls the 3rd to 4th speed shift. The G1 pressure is directed to the governor plug, while the G2 pressure is directed against the large surface of the shift valve.

Governor pressures will not shift the transmission at partial carburetor opening until the pressure are great enough to hold the shift valves open against full throttle pressure.

The downshifts are controlled in the same manner but occur when throttle pressure and

spring force overcomes governor pressure as vehicle speed decreases. All possible shifts will be explained later.

Fourth to Third Downshift Valve

The fourth to third downshift valve (Y) is located in the front servo and has a small orifice in one end. The valve operates from front band apply and G1 governor pressure. That is, front band apply pressure pushes the valve out so there is no restriction in the band apply pressure passage. At about 28 M.P.H. the G1 governor pressure moves the valve so that the small orifice is in the front band apply passage. If a forced 4th to 3rd downshift is made above 28 M.P.H. the front band apply pressure must pass through the small orifice. (See Fig. 364)

This same action takes place on a 2nd to 3rd wide open throttle up-shift because the 2nd to 3rd wide open throttle up-shift occurs at approximately 30 M.P.H. and the G1 governor pressure is great enough to have moved the 4th to 3rd downshift valve so the small orifice is in place in the front band apply passage. The purpose of the 4th to 3rd valve is to time the front band application with clutch release for smooth shifting when making a forced downshift 4th to 3rd above 28 M.P.H.

Blocker Piston

The reverse blocker piston (Z) is located in the reverse bracket assembly. Its function is to prevent engagement of the reverse anchor into the reverse internal gear until the rear band is applied to the drum to stop the internal gear from turning.

Rear band release pressure is directed back of the blocker piston to hold the piston out, so that if the selector lever is moved from NEUTRAL to REVERSE position without hesitation in the "Lo" range position, the reverse crank will strike the blocker piston preventing a clash between the anchor and internal gear. (See Fig. 364)

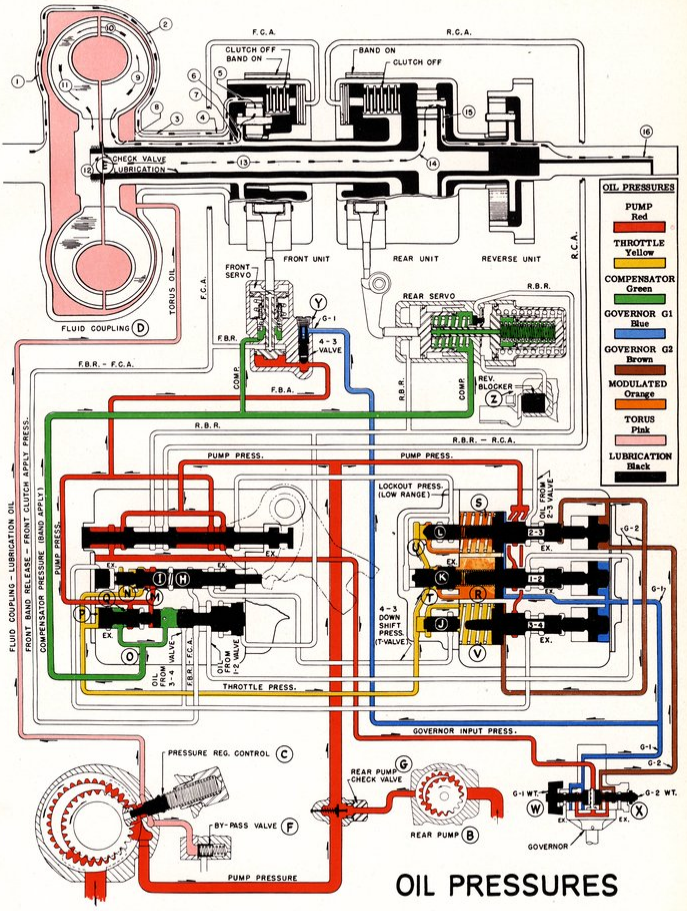


Fig. 364. Hydraulic Control and Oil Flow

Hydraulic Control and Power Flow

NEUTRAL—ENGINE RUNNING (Fig. 365)

Oil Flow

1. When the transmission selector lever is in neutral and engine is started, the front servo and the front and rear clutches are held in the released position by spring force. The manual valve directs full pump pressure to the rear servo which operates the release pistons to release the rear band. Inasmuch as the front servo and front and rear clutches were already released, the release of the rear servo satisfies the conditions for neutral when the engine is running.
2. The manual valve also directs the oil into the large end of the double transition valve, the large end of the 2-3 shift valve and the small end of the 1-2 regulator plug, and to the valve ports of the shift valves. The oil pressures at these valves, however, has no function when the transmission is in neutral.

Power Flow

The power flow in neutral from the engine is from the flywheel (1) through the torus cover (2) which is bolted to the flywheel and splined at (3) to the front unit drive gear (4) up to the internal teeth and planet gears (5). With both bands free and both clutches disengaged no drive can be transmitted through the transmission.

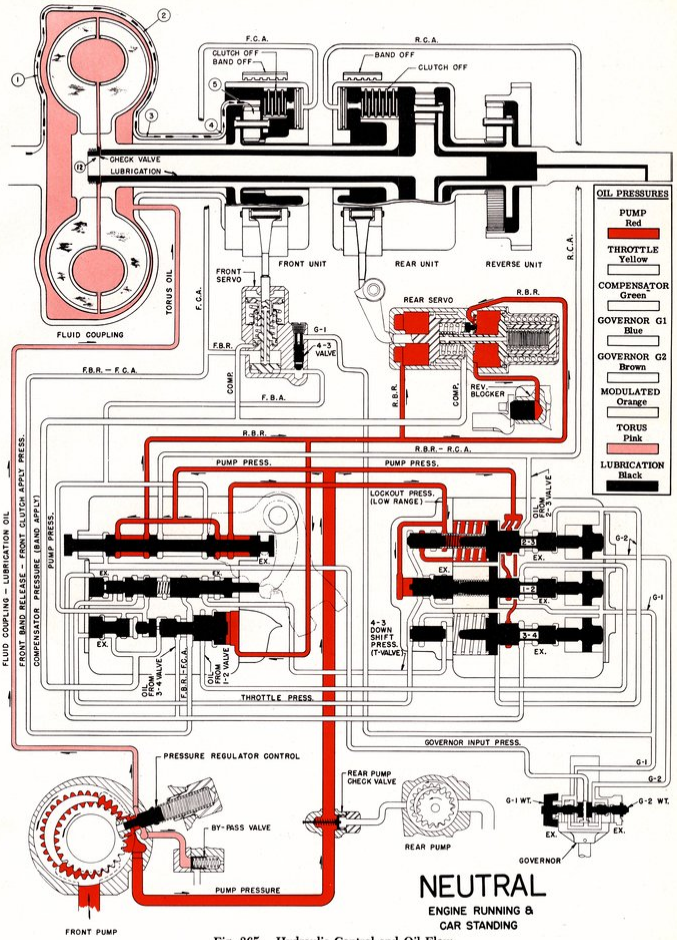


Fig. 365. Hydraulic Control and Oil Flow

FIRST GEAR (Fig. 366)

Oil Flow

1. In order to secure proper reduction for first gear, both servos must be applied, both clutches must be released, and the selector lever must be in the "Drive" or "Lo" position. As the selector lever is moved from the neutral to the "Drive" position, the manual valve operates as follows:
2. The manual valve, operated by linkage from the selector lever, is so positioned to cut off the oil pressure releasing the rear servo. The oil in the rear servo is exhausted through the opened port of the 2-3 shift valve. While the oil pressure in the rear servo is exhausted, the rear band is applied by spring force.
3. Oil pressure is also directed by the manual valve to the front servo apply piston. This pressure against the piston overcomes the small release spring and applies the front band.
4. Oil pressure is also directed to the input side of the governor and to the input ports of the throttle valve and compensator valve. This oil pressure has no function until the throttle is depressed and the vehicle begins to move forward.
5. As the throttle is opened and the vehicle begins to move forward, the load on the two bands increases and it is, therefore, necessary to provide an additional means of holding the bands securely against the front and rear unit drums to keep them from turning. This is accomplished by the "compensator" oil pressure.

Power Flow

With both bands applied and both clutches released, both planetary assemblies will be in reduction (First Gear). The power flow in first gear continues through planet carrier assembly (6), intermediate shaft (7) which is splined at (8) to the rear (driving) torus (9). Power is taken through oil across gap (10) to the driven torus (11) which is splined at (12) to the main shaft (13). The power then progresses through driving sun gear (14) into rear planetary carrier assembly (15), and out through the output shaft (16) through the propeller shaft direct to the rear axle. (The transmission ratio in first gear is 3.82:1).

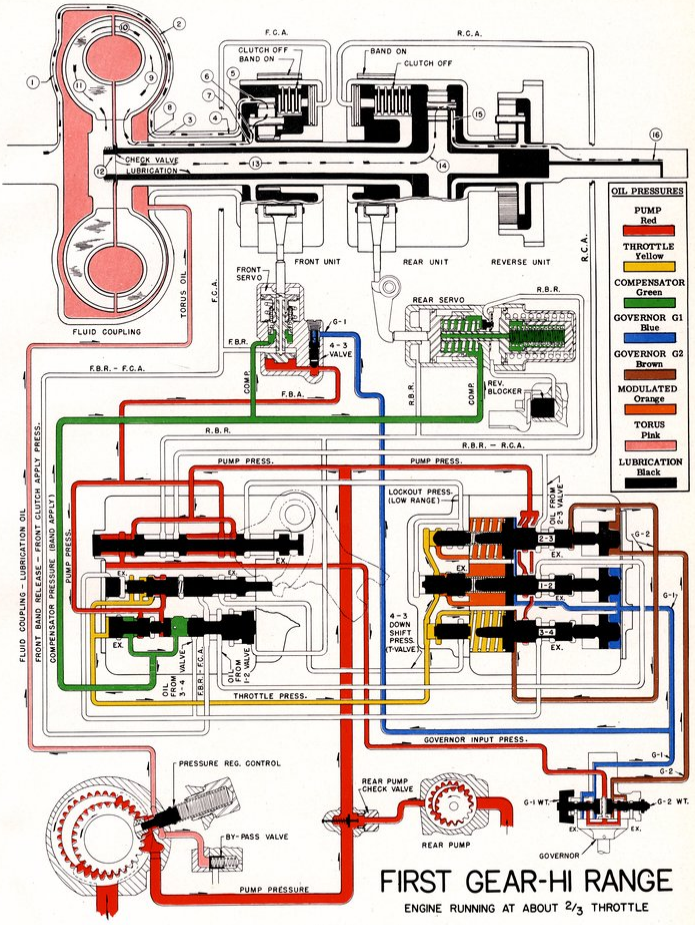


Fig. 366. Hydraulic Control and Oil Flow

1-2 UPSHIFT AND SECOND GEAR (Fig. 367)

Oil Flow

1. As the speed of the vehicle increases in first gear, the governor pressure increases accordingly, so that G1 oil pressure builds up against the 1-2 governor plug and the large area of the 1-2 shift valve. This governor pressure tends to open the shift valve against the opposition offered it by the 1-2 shift valve spring force, and modulated pressure operating against the large area of the shift valve.
2. When governor pressure exceeds the spring force plus the modulated throttle pressure on the opposite end of the 1-2 shift valve, the valve moves to its open position, causing the following action to result:
3. Pump pressure is directed past the shift valve, through passageways to the double transition valve, which has been pushed to the outward position by compensator pressure. The oil then passes through a port at this valve to the front unit clutch.
4. In addition, this same oil pressure is directed to the release side of the two pistons in the front servo. These two release forces, plus the release spring force, overcome the apply pressure and compensator pressure in the front servo, releasing the band at the same time that the front clutch is engaged, changing the front unit from reduction to direct drive.
5. This change of the front unit from reduction to direct drive, with the rear unit remaining in reduction, changes the operation of the transmission from first to second speed.

NOTE: The front band apply pressure is pushed back in the line and is ready to apply the front band whenever release pressure is exhausted.

Power Flow

As in first gear, the power flow progresses to internal gear teeth (5) where it is transferred to the front planetary carrier (6) which, in the second gear is a direct drive through the front unit. The power then proceeds through intermediate shaft (7), splines (8), rotor elements (9), (10), (11), and (12) to main shaft (13) where it is transmitted through rear unit elements (14) and (15) which are still in reduction into output shaft (16) to the propeller shaft and into the rear axle. (The transmission ratio in second gear is 2.63:1.)

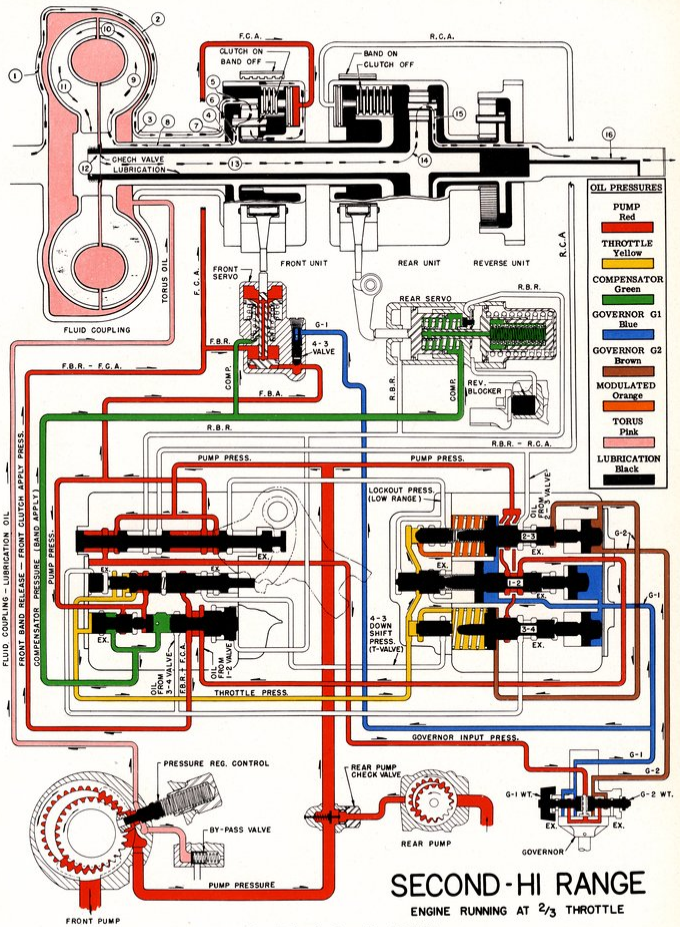


Fig. 367. Hydraulic Control and Oil Flow

2-3 UPSHIFT AND THIRD GEAR (Fig. 368)

Oil Flow

1. As the throttle is opened and the vehicle speed increases in second gear, the oil pressure from both governor valves becomes greater proportionately. The G1 pressure on the large area of the 2-3 shift valve and the G2 pressure on the governor plug and small area of the 2-3 shift valve tend to overcome the modulated throttle pressure and spring force, which are keeping the 2-3 valve closed. When the governor pressure exceeds the spring force and modulated throttle pressure, the 2-3 shift valve opens, causing the following operations:
2. Full pump pressure is applied through the 2-3 shift valve port to the rear unit clutch piston and applies the rear unit clutch. At the same time, pump pressure is also directed around the manual valve to release the rear band. The application of the rear unit clutch and the release of the rear unit band results in changing the operation of the rear unit from reduction to direct drive.
3. At the same time, oil pressure from the 2-3 shift valve port is applied to the large end of the double transition valve. The movement of this valve closes a port, shutting off the pressure that applied the front clutch and released the front band, and opens a line to the 3-4 shift valve exhaust port to exhaust the front clutch apply and front band release oil pressure.
4. Thus, the front unit clutch has been released and the front unit band has been applied changing the operation of the front unit from direct drive to reduction. Inasmuch as the rear unit is in direct, the conditions for third speed are all satisfied.

Power Flow

The power flow is the same as in first through front unit planet carrier assembly (6). However, with the rear band released and the rear clutch engaged, the rear unit will be in a direct drive and when the power enters intermediate shaft (7) the torque is split two ways. Approximately 40% goes through torus member elements (9), (10), (11), and (12), and main shaft (13) as in first gear. The remainder (approximately 60%) is carried by the intermediate shaft through splines (17), to clutch hub (18), clutch (19), and internal gear teeth (20) to rear unit planet carrier (15). At this point, the portion of the torque (40%) carried by shaft (13) is imparted through the sun (center) gear (14) to the rear unit planet carrier (15). Both portions (mechanical 60% and hydraulic 40%) are transmitted to the output shaft (16) which is an integral part of the rear unit planet carrier. Third gear has a reduction of 1.45:1.

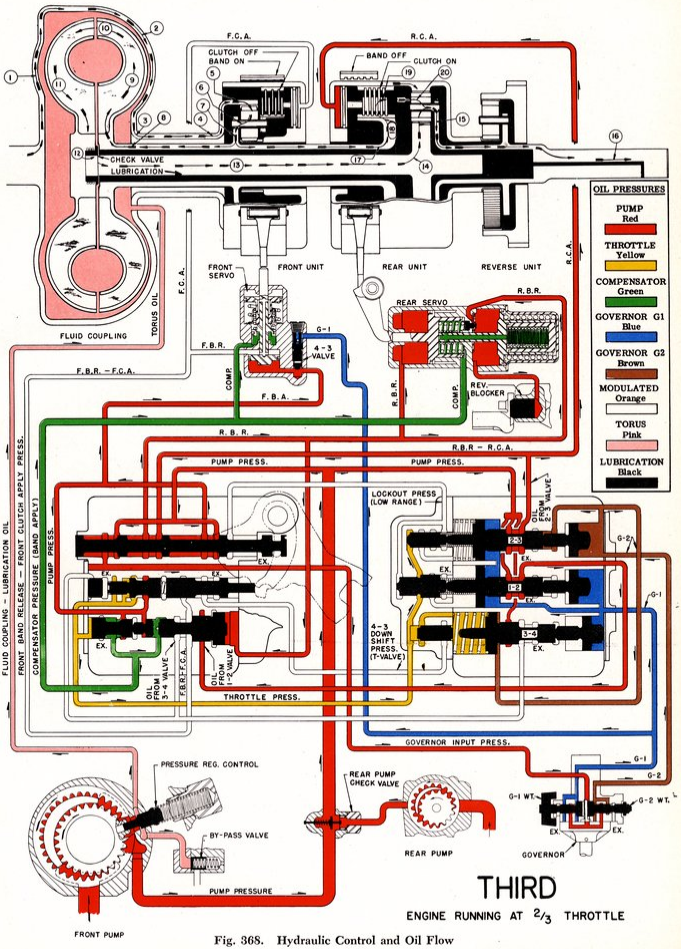


Fig. 368. Hydraulic Control and Oil Flow

3-4 UPSHIFT AND FOURTH GEAR (Fig. 369)

Oil Flow

1. As vehicle speed increases in third speed, the centrifugal force acting on the governor valves continues to increase, resulting in increased governor pressures against the 3-4 governor plug and the large area of the 3-4 shift valve. When the governor pressures on the plug and shift valve exceed the throttle pressure and spring force holding the 3-4 shift valve closed, the valve is moved to its open position, causing the following operations:
2. Full pump pressure passes through the 3-4 shift valve port to the double transition valve where it is directed to the front unit and detent plug. Refer back to Fig. 367 and note that when front unit shifted into direct in second speed, the double transition valve was at the outward position, placed there by compensator pressure in the absence of pump pressure on the large end. The oil to the front unit came from the 1-2 shift valve.
3. The oil passage at the double transition valve is directing oil pressure to apply the front unit clutch and release the front unit band exactly in the same manner as described in the 1-2 upshift.
4. Full pump pressure is directed against a detent plug at the end of throttle valve, adding an increased pressure to oppose the "T" valve pressure. This added pressure is to prevent the "T" valve from opening the down-shift port at normal full carburetor opening.
5. When the front clutch is applied and the front servo is released, the operation of the front unit is changed from reduction to direct drive. Inasmuch as the rear unit is already in direct drive, the transmission is operating in fourth speed.

Power Flow

In fourth, the front band is again released and the clutch engaged and the drive through the front unit is the same as in second, the power flows through (1) to (6) to intermediate shaft (7). The rear unit remains the same as in third gear (direct drive) and at intermediate shaft point (7) the power splits, as in third gear, 40% progressing through (8) to (14) and 60% through (17) to (20) and thence through carrier (15) and output shaft (16). Fourth gear is a direct drive with no reduction in the transmission.

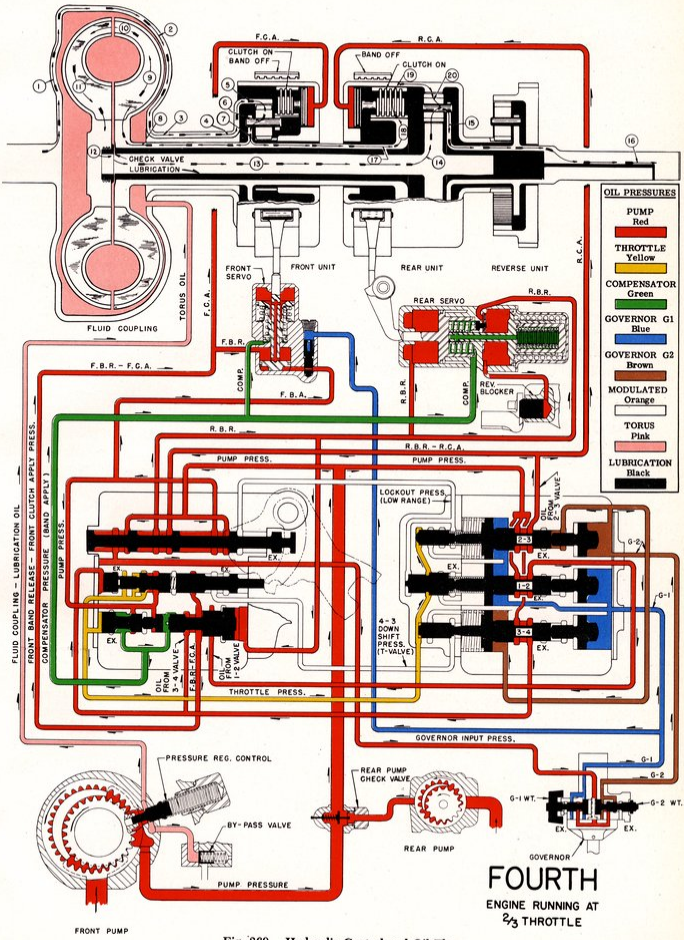


Fig. 369. Hydraulic Control and Oil Flow

REVERSE (Fig. 370)

Oil Flow

1. When shifting into reverse the manual control lever on the control valve body assembly actuates the reverse anchor crank and engages the reverse pawl mechanically with the external teeth on the reverse unit internal gear.
2. The manual valve is positioned such that pump pressure is directed to the release pistons of rear servo, to release the rear band. Pump pressure is also directed through the manual valve to the apply piston of the front servo, to apply the front band and place front unit in reduction. Pump pressure is also directed to the spring side of the 2-3 shift valve and 1-2 regulator plug.
3. Throttle pressure is directed to the large area of 1-2 and 3-4 shift valve and to the end of the 2-3 regulator plug.
4. The movement of the manual valve shuts off the oil supply to the governor.
5. As the carburetor opens, compensator pressure to the front servo assists in holding the band tightly wrapped around the front unit drum. Compensator pressure directed to the rear servo is not sufficient to overcome the release pressure.

The above action places the front unit into reduction and releases the rear unit band and clutches.

Power Flow

In reverse a third planetary gear set, (21), (22) and (23), not previously described, comes into use. These gears combine with (14), (20) and (24), to form a compound planetary set having a stationary gear (23) locked to the case through external teeth (25) and pawl (26). The power flow is the same as in first gear through the front unit and fluid coupling to rear unit sun gear (14) where the flow of power splits between carrier (15) and internal gear (24). From (24) part of the power goes through drum end (27), reverse planet gears (22) and rejoins the rest of the power in the reverse carrier (28) which is splined to the output shaft (16). The direction of rotation of the output shaft (16) reverses because the reverse internal gear (23) of the compound planetary gear set is stationary. (Reduction ratio in the transmission in reverse gear is 4.30:1.)

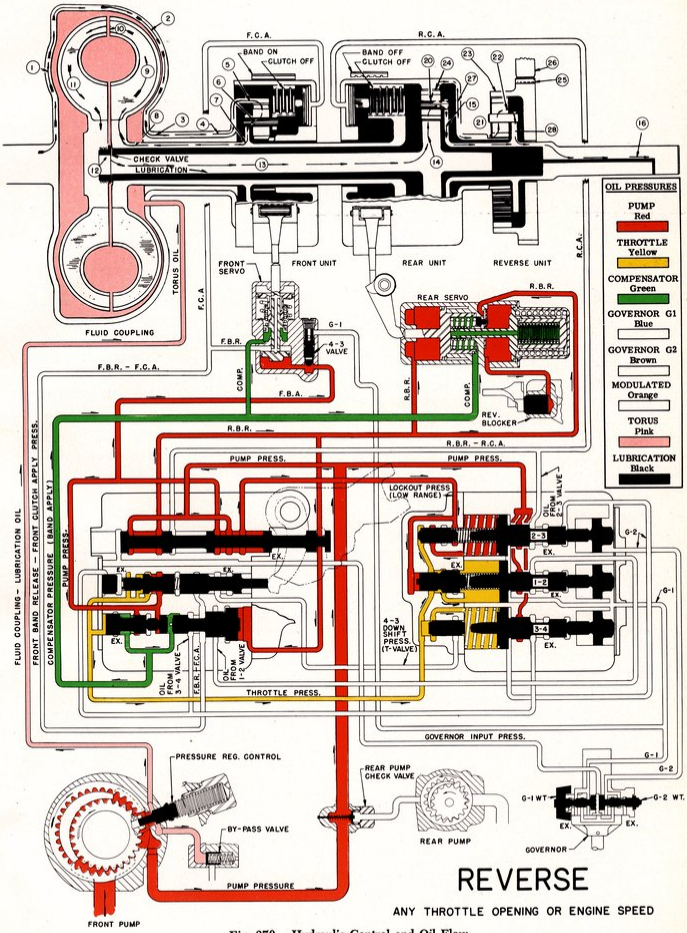


Fig. 370. Hydraulic Control and Oil Flow

FIRST GEAR "LO" RANGE (Fig. 371)

Oil Flow

1. Under certain operating conditions, it may be desirable to keep the vehicle operating in first and second speed gear ratios regardless of vehicle speed. This can be accomplished by moving the selector lever to the "Lo" position, causing the following conditions to occur:
2. The manual valve is positioned such that oil pressure is directed to the outer end of the 1-2 regulator plug. This pressure, combined with throttle valve pressure, moves the regulator plug against the 1-2 shift valve spring force and uncovers a port, allowing throttle valve pressure to enter the large area of the 1-2 shift valve. This action provides modulated throttle pressure only after approximate 2/3 throttle opening.
3. With the exception of the valve action, the operation of the transmission in first speed "Lo" range, is exactly the same as operation in first speed "Dr" range.

Power Flow

The power flow in first speed "Lo" range is the same as for first speed "Hi" range.

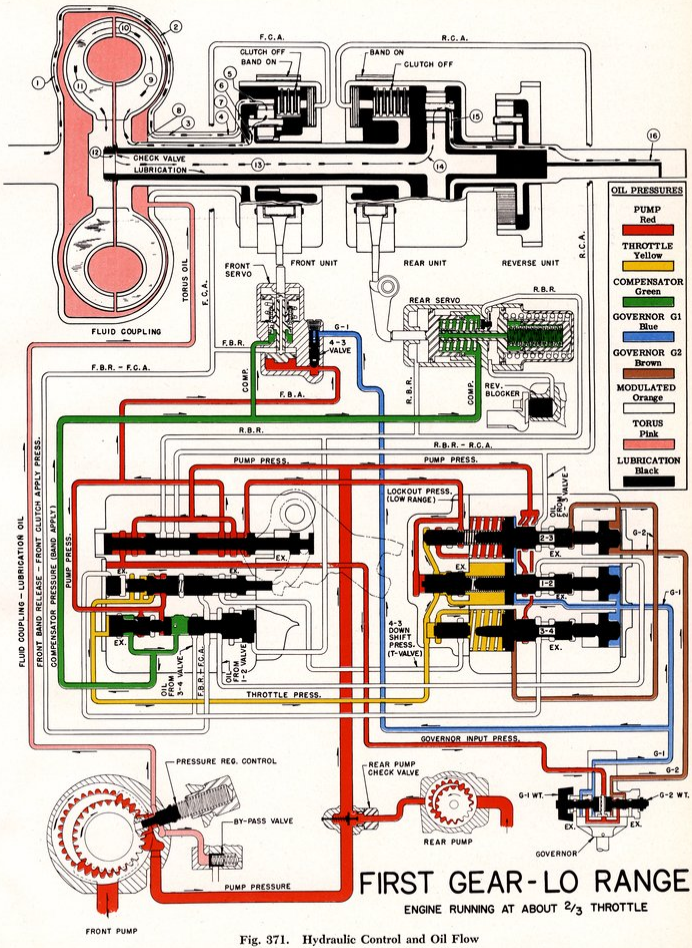


Fig. 371. Hydraulic Control and Oil Flow

1-2 UPSHIFT & SECOND GEAR "LO" RANGE (Fig. 372)

Oil Flow

1. As vehicle gains speed in first gear, "Lo" range, the throttle pressure, plus the spring force against the 1-2 shift valve, holds the valve in the closed position much longer than in "Dr" range, therefore, the shift from first gear to second gear comes at higher speed.
2. The manual valve also directs oil pressure to the large area of the 2-3 shift valve. Inasmuch as this is full pump pressure, the governor pressure in 2nd gear is unable to overcome the combined spring force and oil pressure to get a 2-3 upshift; therefore, the transmission will not shift above second gear. Power flow second speed "Lo" range is the same as for second speed "Hi" range.

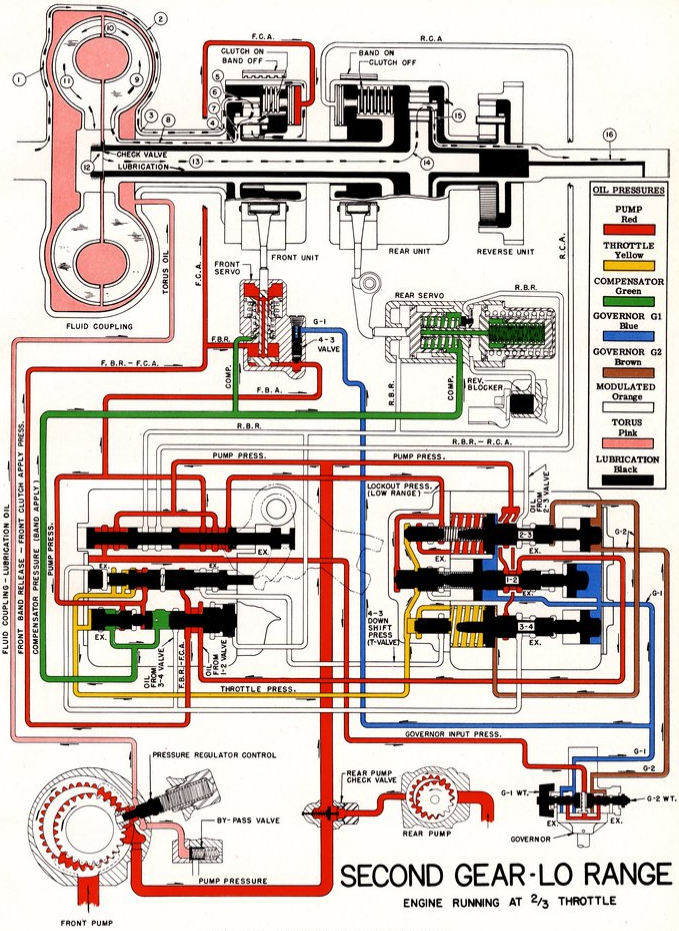


Fig. 372. Hydraulic Control and Oil Flow

FULL THROTTLE 4-3 DOWNSHIFT (Fig. 373)—Before Shift is Completed

Oil Flow

1. As mentioned before, the throttle valve pressure opposing the upshifts of the transmission increases as the carburetor opening is increased. When the transmission is either in third or fourth speed, however, the throttle may be opened wide without downshifting the transmission at a time when increased gear ratio would not be desirable.
2. In order to gain increased acceleration, it may be desirable to downshift the transmission from fourth to third at a speed higher than the regular 4-3 downshift would occur. The 4-3 downshift may be had by depressing the accelerator pedal past the wide-open carburetor position.
3. When the throttle valve moves the detent outward, a port is opened at the "T" valve which allows full pump pressure to be directed to the larger area of the 3-4 shift valve, by-passing the 3-4 regulator plug. This full pump pressure, plus throttle valve pressure on the regulator plug and spring pressure against the 3-4 shift valve, will overbalance the governor pressure on the opposite end of the valve. As a result, the shift valve closes and the transmission downshifts from fourth to third speed. The governor pressure is great enough to prevent downshifting at a speed which would cause excessive speed-up of the engine, or at a speed where a higher gear reduction would not result in increased performance.

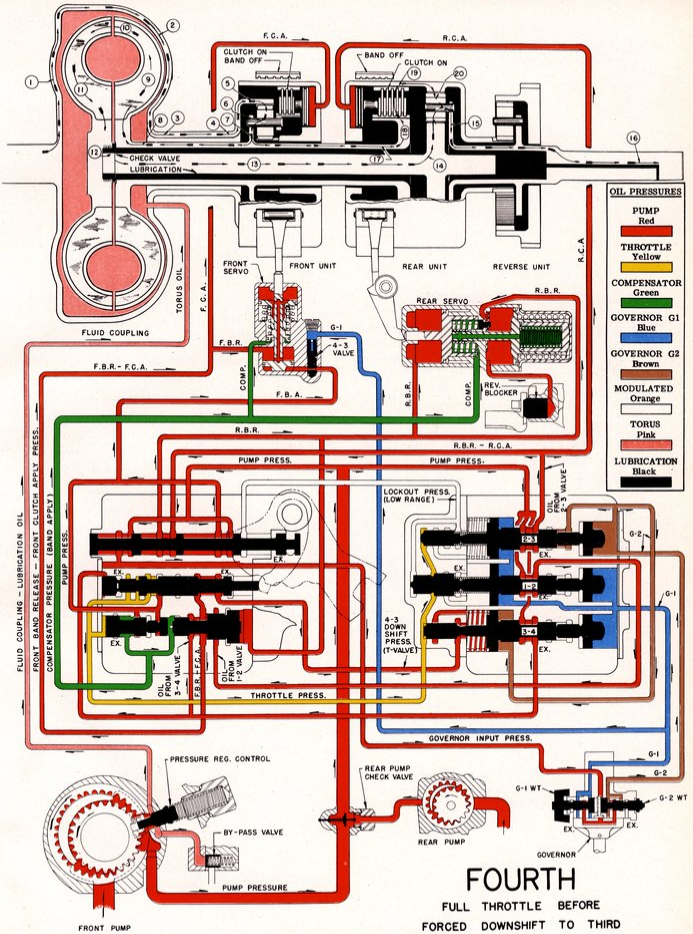


Fig. 373. Hydraulic Control and Oil Flow

FULL THROTTLE 4-3 DOWNSHIFT

(Fig. 374)—After Shift is Completed

1. When the 3-4 shift valve is closed, the pressure applying the front clutch and releasing the front band is discharged out through the 3-4 shift valve exhaust, therefore, the front servo apply pressure and compensator pressure applies the band at the same time the front clutch is released, thus placing the front unit in reduction. Throttle valve pressure applied against the large area of the shift valve holds the shift valve in the closed position until the vehicle speed has again increased to a point where the G1 and G2 governor pressure is sufficient to overcome the combined throttle pressure and spring force holding the shift valve closed.
2. After a forced 4-3 downshift, the transmission will shift back to fourth speed any time accelerator pedal is released, reducing throttle pressure. If accelerator pedal is held in the same position that caused downshift, the upshift will not occur until vehicle has attained a speed of approximately 65 m.p.h. At this speed the G1 governor valve is wide open, and the G2 governor valve is regulating G2 pressure at 87% (approx.) of pump pressure, therefore governor pressures are great enough to overcome the throttle pressure and spring force. At that time, the 3-4 shift valve will again move to its open position and the 3-4 upshift will occur.

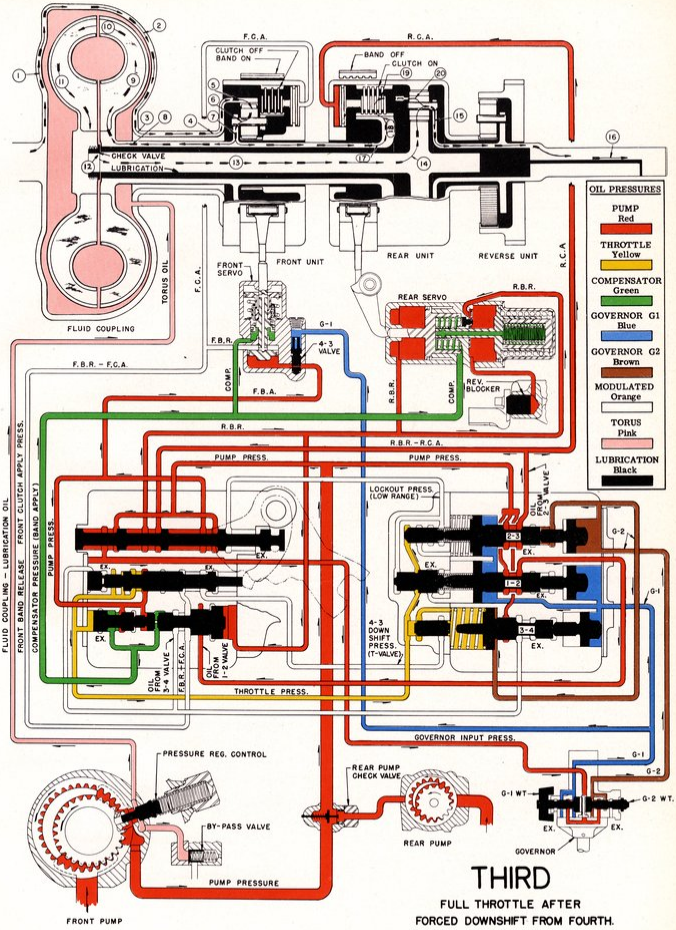


Fig. 374. Hydraulic Control and Oil Flow

FULL THROTTLE 3-2 DOWNSHIFT

Oil Flow

1. If the vehicle is ascending a grade which is so steep that a higher gear ratio is desirable than that obtained in third speed, the transmission will downshift to second speed. In this instance, the throttle valve pressure against the 2-3 regulator plug, combined with the spring force against the 2-3 shift valve, will close the valve when the vehicle speed has decreased to a point where the governor pressure is no longer able to hold the shift valve open. When the 2-3 shift valve moves to its closed position, the following operations occur:
2. The pressure applying the rear clutch and releasing the rear band is cut off, and as a result, the clutch is released and the band is applied by spring force and compensator pressure. Thus, the rear unit is changed from direct drive to reduction. In order to secure rapid application of the rear band under these conditions, it is necessary that the release pressure in the accumulator section of the rear servo be discharged as rapidly as possible. This is accomplished by a small piston which is actuated by compensator pressure. This piston raises the accumulator check valve off its seat, opening the large port and allowing rapid discharge of the servo release pressure.
3. In addition, the closing of the 2-3 shift valve shuts off the oil pressure which has been holding the double transition valve open. Compensator pressure on the opposite end of the double transition valve then closes it, permitting oil pressure to release the front unit band and apply the front unit clutch.
4. This action changes the operation of the front unit from reduction to direct drive. Inasmuch as the rear unit is now in reduction, the conditions for second speed are all satisfied.

FULL THROTTLE 2-1 DOWNSHIFT

Oil Flow

1. If the vehicle speed is decreased even further by a steep grade, the governor pressure applied to the 1-2 governor plug and the large area of the 1-2 shift valve will be reduced to a point where the spring force plus throttle pressure against the end of the 1-2 regulator plug forces the valve to its closed position. The action of the shift valve shuts off the pressure applying the front clutch and releasing the front band. As this pressure is exhausted, the apply pressure and compensator pressure in the front servo applies the band. Inasmuch as the rear servo is already applied by spring and compensator pressure, both units are in reduction and the transmission is in first speed.

CLOSED THROTTLE DOWNSHIFTS

Oil Flow

1. When the vehicle is operating in fourth speed and the carburetor is closed to allow the vehicle to coast to a stop, the governor pressure will gradually reduce as the speed reduces and the transmission downshifts as follows:
2. When the spring force on the 3-4 shift valve overcomes the opposing governor pressure on this valve, the valve will close, shutting off the oil pressure that has been applying the front clutch and releasing the front band. When this pressure is exhausted, the front servo will be applied and the front clutch released, thus putting the front unit in reduction and down-shifting the transmission to third gear.
3. Further reduction of vehicle speed will result in the governor pressure that holds the 2-3 shift valve open, becoming less than the spring force against the valve. As the spring forces the 2-3 shift valve closed

against the reduced governor pressure, the oil pressure that has been applying the rear clutch and releasing the rear band will be cut off, thus the rear band will be applied by spring force and the rear unit will be in reduction. Due to the fact that the front unit is already in reduction for third speed, the downshift will be from third to first rather than third to second.

NOTE: The oil pressure directed to the large end of the double transition valve is cut off. Since there is no compensator pressure being applied to the small end of the double transition valve, it remains in the 3rd speed position, therefore, oil pressure is not available to apply the front clutch and release the front band.

4. If the throttle were open, however, compensator pressure against the small end of the double transition valve would force it outward, opening the port and allowing oil pressure to be applied to the front clutch and to the release pistons of the front servo as explained previously. When this occurs, the operation of the front unit would be changed from reduction to direct drive, resulting in a downshift of third to second rather than third to first gear.

Servicing the 1949 Hydra-Matic Transmission

REMOVING THE HYDRA-MATIC TRANSMISSION

The Hydra-Matic Transmission, rear bellhousing, torus cover and torus members are removed as one assembly. To remove assembly, proceed as follows:

1. Remove the foot accelerator rod at the bellcrank, and remove the floor mat.
2. Remove screws from center floor pan and remove floor pan.
3. Remove upper cap screws, transmission to bellhousing.
4. Raise the car off floor.
5. Remove the ⅛" hex head plug from torus cover and the drain plug from rear of transmission to drain oil.
6. Remove side pans, starter wiring, and starter. (8 cylinder, only).

   NOTE: Wires should be identified so that they can be properly reinstalled.
7. Remove lower flywheel housing (8 cylinder, only) by removing eight cap screws after removing exhaust pipe bracket and crankcase ventilator bracket from housing.
8. Install Rear Engine Support, tool number BT-28.
9. Remove two bolts, motor mount to frame cross member, (left side only).

   Remove two cap screws from motor mount to flywheel housing, (right side only).
10. Remove two bolts attaching intermediate lever bracket to frame cross member.
11. Remove three bolts from each side of cross member to frame.
12. Lift engine approximately ½", and remove frame cross member.

    CAUTION: Do not raise engine more than is necessary to remove cross member.
13. Remove the flywheel housing pan.
14. Remove the 30 torus cover to flywheel attaching cap screws and lock washers.
15. Disconnect speedometer cable at transmission.
16. Disconnect throttle and manual control rods from transmission levers.
17. Remove the two remaining transmission to bellhousing cap screws.
18. Remove transmission assembly by moving the transmission toward the rear of car, and at the same time lowering assembly to the floor.

NOTE: To prevent end of main shaft striking the flywheel to crankshaft bolts when lowering the transmission, be sure to turn the flywheel so the end of the main shaft passes between two bolts.

DISASSEMBLY OF THE TRANSMISSION

Remove Torus Members, Torus Cover and Flywheel Housing from Transmission

1. Place transmission and fluid coupling assembly on bench.
2. Move manual control lever on side of transmission to reverse position.
3. Straighten main shaft nut lock plate, using a chisel and a light hammer.
4. Remove main shaft lock nut, using tool KMO-334. (Fig. 375)
5. Slide driven torus member off transmission main shaft.
6. Remove driving torus member snap ring from intermediate shaft, using Snap Ring Pliers. (Fig. 376)
7. Remove torus cover and driving torus member as one unit. (Fig. 377)

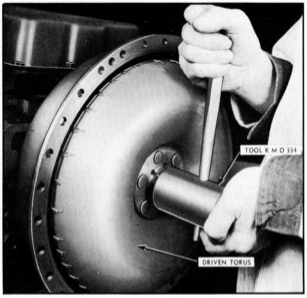


Fig. 375. Removing Main Shaft Lock Nut

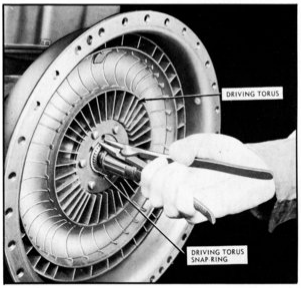


Fig. 376. Removing Driving Torus Snap Ring

CAUTION: DO NOT ATTEMPT TO REMOVE TORUS COVER AND DRIVING TORUS BY PULLING AND PUSHING ON TORUS COVER IN A ROUGH MANNER AS THIS MAY RESULT IN A BROKEN OIL SEAL RING. INSTEAD, WORK HUB OF

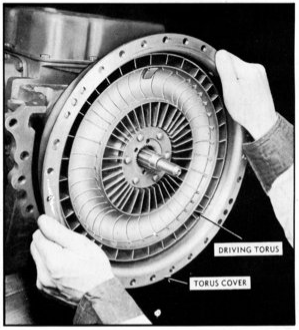


Fig. 377. Removing Torus Cover and Driving Torus

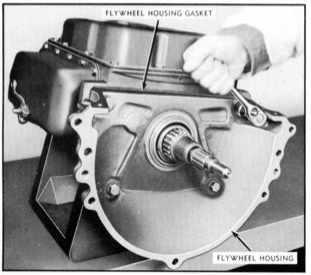


Fig. 378. Removing Flywheel Housing

TORUS COVER BACK THROUGH OIL SEALS GENTLY, AND THEN PULL TORUS COVER FORWARD WITH A QUICK JERK.

8. Remove four cap screws and lock washers holding flywheel housing to front of transmission case, remove flywheel housing and gasket. (Fig. 378)
9. Remove oil level dip stick from transmission case.
10. Remove ⅛" oil pressure line plug from transmission case.
11. Place transmission into holding fixture. (Fig. 379)

Disassemble Transmission

1. Loosen lock screw holding manual control lever to lever shaft at side of transmission, and remove manual control lever.
2. Remove open type driven torus retainer ring from main shaft using special tool J-1458. (Fig. 380)
3. Remove bottom oil pan cap screws and lock washers, remove oil pan and gasket.

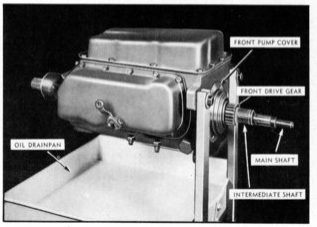


Fig. 379. Transmission Ready for Disassembly

4. Remove side cover cap screws and copper washers, remove side cover and gasket.
5. Remove oil pan screen by lifting screen from rear pump intake pipe.
6. Straighten two front oil pump intake pipe bolt locks. Loosen two cap screws while lifting slightly on pipe to avoid dropping cap screw .
7. Lift front oil pump intake pipe, cap screws, locks and paper gasket from transmission.

Fig. 380. Removing Driven Torus Snap Ring

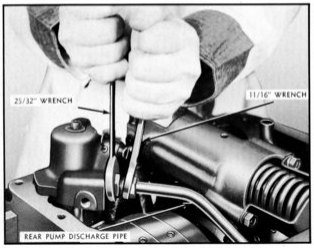


Fig. 381. Loosening Rear Pump Discharge Pipe

Remove Servos and Oil Control Units

1. Hold rear pump discharge pipe brass coupling in front servo and loosen pipe nut.

   Do not remove pipe from coupling. (Fig. 381)
2. Loosen front and rear band adjusting screw lock nuts, then loosen adjusting screws approximately five turns each.
3. Remove front and rear servo attaching screws.
4. Remove both servos as one unit.

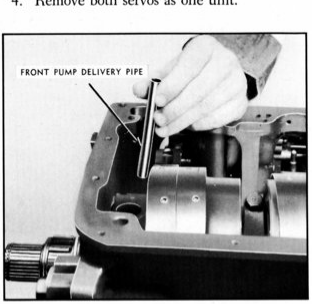


Fig. 382. Removing Front Pump Oil Delivery Pipe

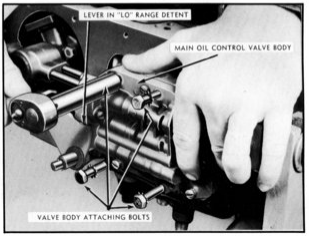


Fig. 383. Removing Main Oil Control Valve Body

NOTE: As servos are lifted from transmission case, the rear pump discharge pipe will rotate in the coupling and fall free without bending the pipe. The pipe is connected in the same manner when installing the servos to the transmission case.

5. Remove rear pump discharge pipe from rear pump.
6. Remove front pump delivery pipe. (Fig. 382)

Remove Main Oil Control Valve Body

1. Position manual control detent lever so steel ball is in the "LO" range detent position, (Fig. 383), then remove four control valve body mounting screws and lock washers.
2. Remove control valve body by sliding forward along transmission case. (Fig. 384)

   NOTE: Oil delivery pipes from control valve body to governor sleeve may come off with control valve body. If pipes do not come off with control valve body, they should be pulled out of governor sleeve at this time.

Remove Reverse Shifter Bracket Assembly

1. Remove two reverse shifter bracket mounting bolts and lock washers. (Fig. 385)

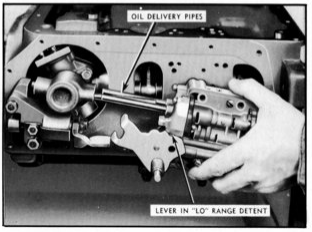


Fig. 384. Removing Oil Control Body

2. Remove reverse shifter bracket, shims, retracting spring and roller. Do not loose shims. (Fig. 386)

Remove Rear Oil Pump and Governor Assembly

1. Remove two screws and lock washers holding rear oil pump and governor to transmission case.
2. To remove rear oil pump and governor as an assembly from transmission case, position one reverse drive flange attaching screw *up*. Governor must be rotated so that the large round governor weight is toward the *front* of transmission while removing assembly. (Fig. 387)
3. Remove assembly by raising pump out of case.

   CAUTION: Do not loose plug from governor sleeve.

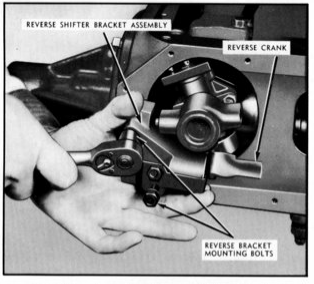


Fig. 385. Removing Reverse Shifter Bracket Assembly Bolts

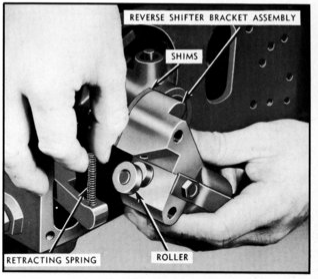


Fig. 386. Removing Reverse Bracket and Shims from Case

Remove Pressure Regulator Assembly

1. Loosen pressure regulator plug in transmission case.

   CAUTION: Pressure regulator assembly is under spring pressure.
2. Hold pressure against regulator plug while unscrewing plug by hand. (Fig. 388)
3. Remove plug, spring and valve from side of transmission case.

Remove Front Oil Pump and Front Unit Drive Gear

1. Remove snap ring holding front unit drive gear on front end of intermediate shaft using Snap Ring Pliers, (Fig. 389), and remove steel and bronze thrust washers from intermediate shaft.

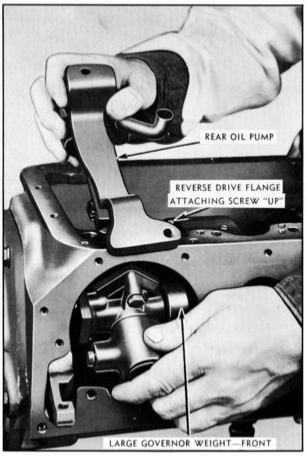


Fig. 387. Positioning Rear Oil Pump for Removal

NOTE: These washers have a smaller outside diameter than similar washers used in the transmission and should be kept separate to avoid confusion when assembling.

2. Remove two front pump retaining screws and copper washers.
3. Remove front pump locating washer from its counterbore using Snap Ring Pliers. (Fig. 390)
4. Remove front pump, gasket and front unit drive gear as an assembly.

   NOTE: Tap lightly from rear with light hammer and brass drift if necessary.
5. Remove bronze thrust washer in front of front planet carrier.

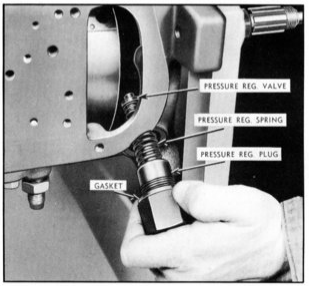


Fig. 388. Removing Pressure Regulator Plug Assembly

Check End Clearance of Main Shaft

1. Install main shaft guide tool J-2171 over main shaft and intermediate shaft to support main shaft.
2. Place dial indicator on end of main shaft held in place by means of tool J-1465.

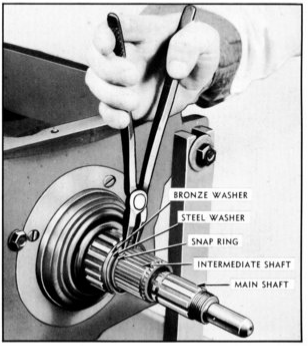


Fig. 389. Removing Front Unit Drive Gear Snap Ring

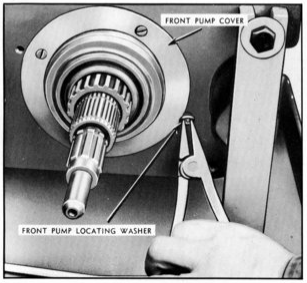


Fig. 390. Removing Front Pump Locating Washer

3. Insert special tool J-2173 between front drum and center bearing cap, holding planetary units forward.
4. Move main shaft back and forth. (Fig. 391) End clearance should be .004" to .015".

   NOTE: Be sure to record amount of end clearance so that the proper selective washer can be installed when the transmission is again assembled.
5. Remove tool J-2173 from between front drum and center bearing cap.

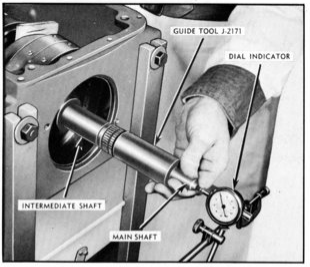


Fig. 391. Checking Main Shaft End Play

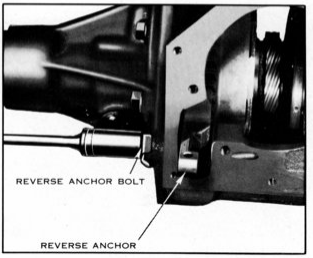


Fig. 392. Removing Reverse Anchor and Support Bolt

6. Remove dial indicator, tool J-1465 and tool J-2171.

Remove Reverse Gear Assembly and Main Shaft

1. Remove six reverse drive flange attaching screws, holding rear drum so it will not rotate.

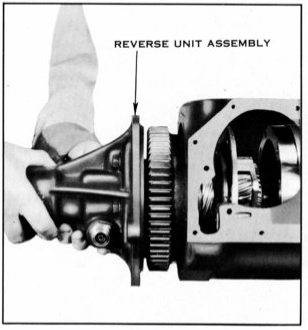


Fig. 393. Removing Reverse Assembly from Case

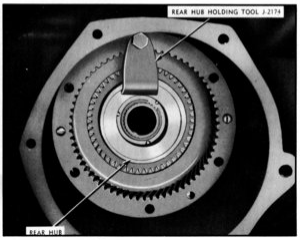


Fig. 394. Holding Rear Hub with Tool J-2174

2. Straighten the reverse anchor support bolt "lock", then remove the reverse anchor support bolt and reverse anchor. (Fig. 392)
3. Remove five rear bearing retainer to transmission attaching screws and lock washers.
4. Remove reverse assembly from transmission case. (Fig. 393)

   CAUTION: The selective washer may stick to the main shaft or it may remain in the counterbore of the driven shaft. Be sure to remove the selective washer when reverse assembly is removed.
5. Remove main shaft from intermediate shaft through rear of transmission.
6. Remove bronze thrust washer from rear clutch hub.

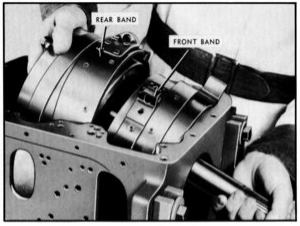


Fig. 395. Removing Units from Case

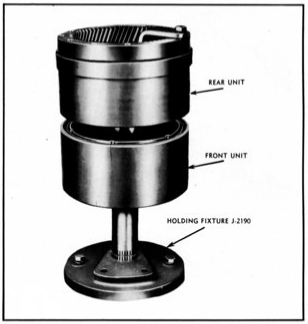


Fig. 396. Disassembly of Front and Rear Units

Remove Front and Rear Units From Transmission Case

1. Install rear hub holding tool J-2174 to rear drum held in place with one rear drive flange attaching screw. (Fig. 394)
2. Using a light hammer and chisel, bend back edges of lock plate under two center bearing cap, mounting screws.
3. Remove two center bearing cap mounting screws and lock plate.
4. Remove center bearing cap.
5. Lift both front and rear planetary assemblies, with bands from transmission case. (Fig. 395)

Disassemble Rear Unit and Front Unit From Intermediate Shaft

1. Remove both bands.
2. Place intermediate shaft with front and rear planet assemblies into holding fixture J-2190. (Fig. 396)
3. Remove rear clutch hub rear snap ring, using Snap Ring Pliers. (Fig. 397)

Fig. 397. Removing Rear Clutch Hub Rear Snap Ring

4. Lift rear unit and rear clutch hub as an assembly from intermediate shaft.
5. Remove rear clutch hub front snap ring from intermediate shaft, using Snap Ring Pliers.

Fig. 398. Removing Rear Clutch Hub Front Snap Ring

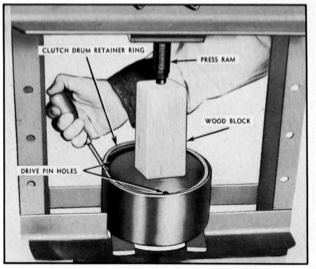


Fig. 399. Removing Clutch Drum Retainer Ring

6. Remove oil delivery sleeve from intermediate shaft.
7. Remove snap ring back of front unit center gear. (Fig. 398)

   CAUTION: Hold snap ring open with Snap Ring Pliers while lifting snap ring from shaft to avoid damaging bearing surface on intermediate shaft.
8. Lift front unit assembly from intermediate shaft.
9. Remove steel and bronze thrust washers from drum back of front unit center gear.

   NOTE: These washers are similar to those used in front of the front unit drive gear and should not become mixed.

DISASSEMBLY OF INDIVIDUAL UNITS

Disassembly of Front Unit

1. Place front unit assembly in press and remove clutch drum retainer ring. (Fig. 399)
2. Remove assembly and separate drums by tapping front face of center gear with soft hammer. (Fig. 400)

   NOTE: Use care not to lose springs.

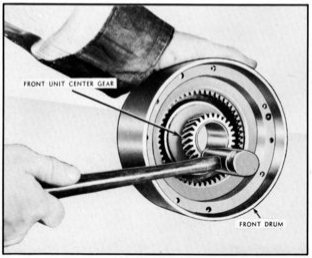


Fig. 400. Removing Center Gear from Drum

3. Remove annular piston from clutch drum by bumping front face of center gear on soft wood block. (Fig. 401)
4. Remove six inner and six outer front clutch release springs from front drum.
5. Remove three composition and three steel clutch plates from drum. (four each on 8 cyl.)
6. Remove rubber seal and brass liner from annular piston and clutch drum piston. Use blunt edge screw driver. (Fig. 402)

Disassembly of Rear Unit

1. Remove rear clutch hub tool J-2174 from drum.

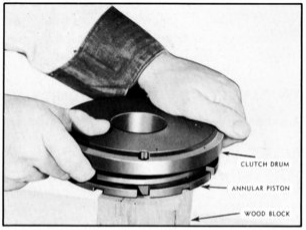


Fig. 401. Removing Annular Clutch Piston

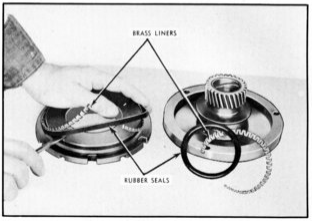


Fig. 402. Removing Rubber Seals and Brass Liners

2. Remove rear clutch hub with front thrust washer from drum.
3. Place rear unit assembly in press and remove clutch drum retainer ring.
4. Remove assembly and separate drums by tapping lightly on rear thrust face of clutch drum with block of wood and hammer. (Fig. 403)
5. Remove annular piston from bore in clutch drum by tapping on wood block.
6. Remove six inner and six outer clutch release springs with guide pins.

   NOTE: Front and rear clutch release springs are interchangeable, but guide pins are used only in the rear unit. (Fig. 404)
7. Remove six composition and six steel clutch plates. (seven on 8 cyl.)

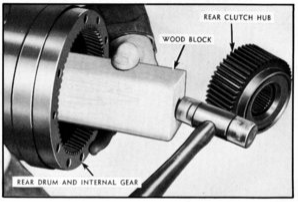


Fig. 403. Removing Rear Clutch Drum

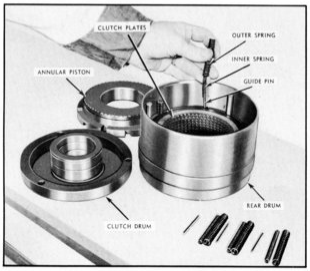


Fig. 404. Removing Clutch Release Springs and Guide Pins

8. Remove two fillister head screws that retain rear unit internal gear to rear drum and remove internal gear by tapping lightly with a soft hammer. (Fig. 405)
9. Remove rubber seal and brass liner from annular pistons and clutch drum piston in the same manner as shown in Fig. 402.

Disassembly of Reverse Unit Assembly

1. Remove speedometer driven gear and sleeve assembly from rear bearing retainer.

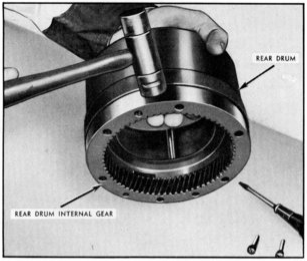


Fig. 405. Removing Rear Drum Internal Gear

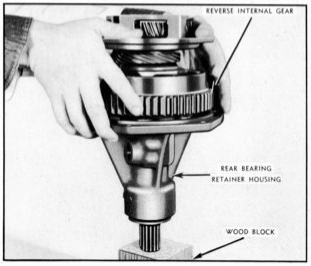


Fig. 406. Removing Rear Bearing Retainer

2. Remove five reverse internal gear support bolts and copper washers.
3. Remove rear bearing retainer by bumping end of shaft on wood block. (Fig. 406)
4. Remove open type snap ring from back of ball bearing on driven shaft using tool J-2182. (Fig. 407)
5. Place reverse assembly in a press, supporting assembly at outer edge of reverse internal gear. (Fig. 408)
6. Press driven shaft out of rear internal gear support and speedometer drive gear.
7. Remove reverse internal gear support snap ring; remove internal gear. (Fig. 409)

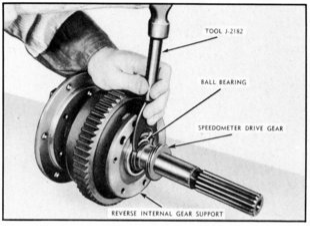


Fig. 407. Removing Ball Bearing Snap Ring

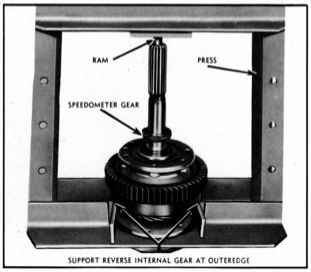


Fig. 408. Removing Reverse Internal and Speedometer Gear

8. With a light, soft hammer, tap the ball bearing from internal gear support.
9. Remove reverse planet carrier assembly from driven shaft. (If carrier is tight on splines, bump end of shaft on wooden block.)
10. Remove reverse planet carrier snap ring from driven shaft using Snap Ring Pliers.

    CAUTION—Keep snap ring spread to avoid damage to splines.
11. Lift reverse center gear and drive flange assembly from driven shaft as a complete assembly.

    CAUTION—Do not disassemble the reverse center gear and drive flange, as this is serviced as a complete unit. (Fig. 410)
12. Remove steel and bronze thrust washer from driven shaft.
13. Remove oil seal from rear bearing retainer housing.

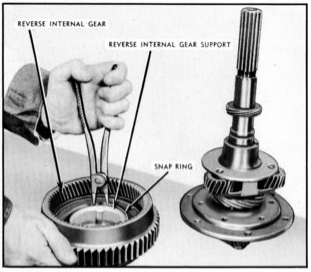


Fig. 409. Removing Reverse Internal Gear Support

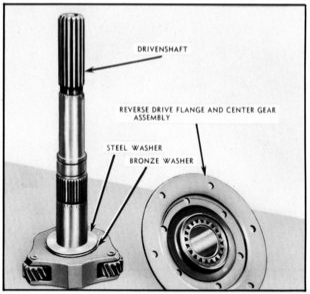


Fig. 410. Reverse Drive Flange and Drive Shaft

Dissassembly of Front Pump and Front Unit Drive Gear

1. Remove front pump from front unit drive gear; tap gear with composition hammer if necessary.

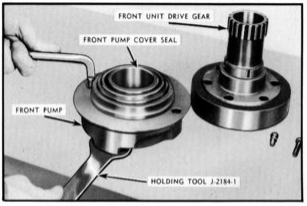


Fig. 411. Removing Front Pump Cover

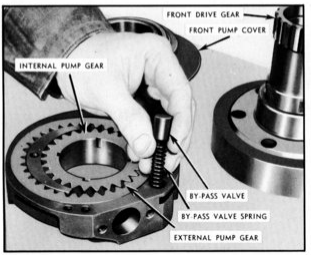


Fig. 412. Removing Front Pump By-Pass Valve and Spring

2. Remove gasket from front pump cover.
3. Hold front pump assembly with special tool J-2184-1. (Fig. 411)

   CAUTION—It is important to use tool J-2184-1 while removing the pump body attaching screws. NO ATTEMPT SHOULD EVER BE MADE TO HOLD PUMP BODY BY INSERTING A BAR INTO THE INTAKE BORE OR PRESSURE REGULATOR PISTON BORE.
4. Remove two 1" long and one ⅝" long screws and copper washers from front pump cover, using an offset screw driver. (Fig. 411)

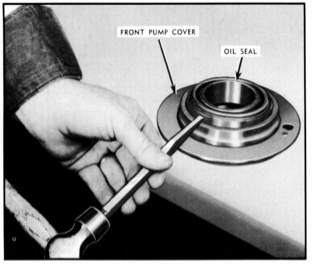


Fig. 413. Removing Oil Seal from Pump Cover

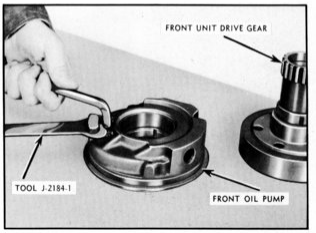


Fig. 414. Removing Front Pump to Cover Attaching Screw

5. Remove one 1⅜" screw and copper washer from the rear of pump. (Fig. 414)
6. Remove front pump cover from body.

   CAUTION—Tap lightly with a soft hammer (if necessary) at dowel area but DO NOT PRY WITH A SCREW DRIVER, as this will damage lapped surface. Use care not to drop gears out of gear pockets in body when cover is removed.
7. Remove by-pass valve and spring from pump body. (Fig. 412)
8. Remove both the internal and external pump gears.
9. Remove oil seal from pump cover, using a small chisel. (Fig. 413)
10. Remove two oil seal rings from front cover.

Disassembly of Rear Oil Pump and Governor

1. Remove plug from governor oil delivery sleeve.
2. Pull governor oil delivery sleeve off governor body.
3. Mark edge of governor body and edge of governor drive flange so that they may be installed later in original position.
4. Remove two screws and lock washers holding governor body to governor drive flange.

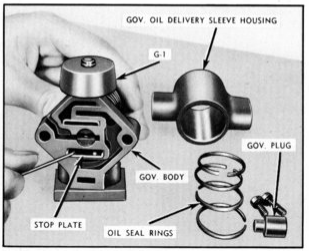


Fig. 415. Removing G-2 Governor Valve Stop Plate

5. Remove governor oil seal rings from governor body, being very careful not to damage rings while they are being removed.

   NOTE—NO ATTEMPT SHOULD BE MADE TO REMOVE GOVERNOR WEIGHTS.

6. Remove two attaching screws and lock washers, holding G-2 governor sleeve in governor body.
7. Remove G-2 governor valve stop plate. (Fig. 415)
8. Pull G-2 governor valve and sleeve assembly from governor body.

   NOTE—If after thoroughly cleaning governor and valves, the G-1 valve still sticks, the complete governor assembly should be replaced. If only the G-2 valve sticks, then the G-2 valve and sleeve assembly should be replaced.

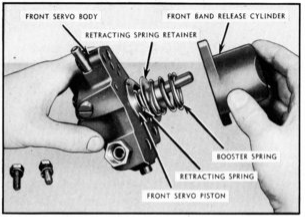


Fig. 416. Removing Front Band Release Cylinder

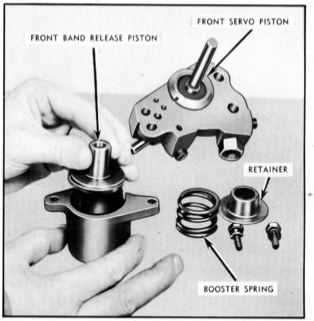


Fig. 417. Removing Front Band Release Piston

9. Remove four screws and lock washers holding pump cover to body and remove cover.
10. Remove idler gear from pump body.

Disassembly of Front Servo

1. Separate front and rear servos from oil delivery pipes.
2. Remove two cap screws and lock washers holding front band release cylinder to servo body, and remove front band release cylinder. (Fig. 416)
3. Remove booster spring.
4. Remove retracting spring retainer.
5. Remove retracting spring.
6. Remove front band release piston from cylinder. (Fig. 417)
7. Remove front servo piston assembly from servo body. (Fig. 418)

   NOTE—Piston assembly must not be

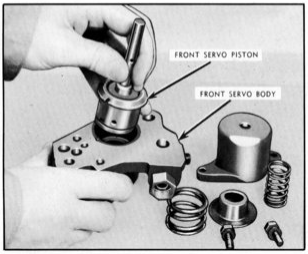


Fig. 418. Removing Servo Piston

disassembled as it is furnished as a complete unit.

8. Remove pipe plug and lock wire holding 4 to 3 valve in place. (Fig. 419)
9. Remove 4 to 3 valve from front servo body. (Fig. 420)
10. Remove brass coupling over rear pump check valve.

Disassembly of Rear Servo

1. Place rear servo in press and bring ram down to rest on spring retainer.
2. Remove two retainer screws and lock

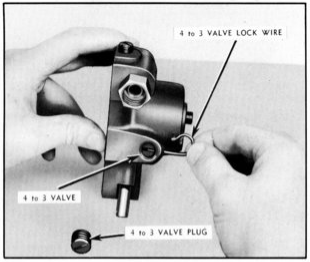


Fig. 419. Removing 4 to 3 Valve Lock Wire

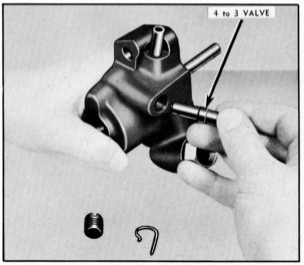


Fig. 420. Removing 4 to 3 Valve

washers holding spring retainer to servo body using open end wrench while keeping ram of press against spring retainer. (Fig. 421)

3. Release press slowly until servo springs are released, and remove rear servo assembly from press.
4. Remove servo spring retainer, accumulator

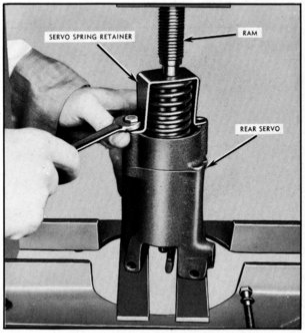


Fig. 421. Removing Rear Servo Spring Retainer Screws

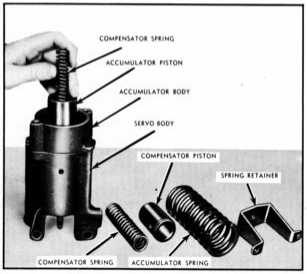


Fig. 442. Disassembling Rear Servo

spring, compensator piston, and two compensator springs. (Fig. 422)

5. Remove accumulator body and piston assembly from servo body.
6. Rest accumulator body on a vise with copper jaws and tap accumulator piston through spring and accumulator body. (Fig. 423)

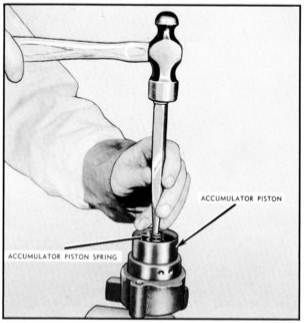


Fig. 423. Removing Accumulator Piston Spring

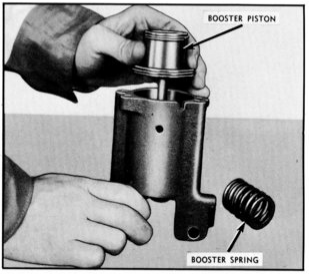


Fig. 424. Removing Booster Piston

7. Remove booster spring and booster piston from servo body. (Fig. 424)

   NOTE—To replace broken or leaking accumulator check valve, see instructions under INSTALLING A NEW ACCUMULATOR CHECK VALVE. (See Figs. 529 & 530)

Disassembly of Reverse Bracket Assembly

1. Position reverse crank to clear blocker piston bore.

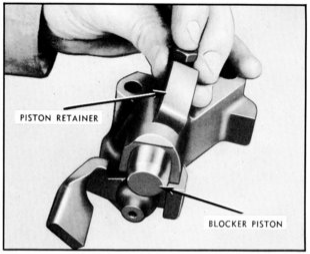


Fig. 425. Removing Blocker Piston

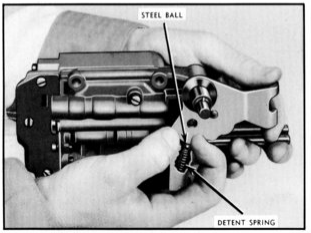


Fig. 426. Removing Detent Spring and Steel Ball

2. Remove cap screw and remove blocker piston retracting spring. (Fig. 425)
3. Remove blocker piston from bore.

Disassembly of Oil Control Valve Body

CAUTION—Manual lever detent steel ball is under spring tension and may become lost unless care is used to remove detent tension spring and steel ball.

1. Move manual lever slowly past reverse position while holding fingers around casting to catch detent tension spring and steel ball. (Fig. 426)
2. Remove rubber seal and two spring washers from manual control shaft. (Fig. 427)

NOTE—Extreme care must be taken in handling the Hydra-Matic Transmission main control valve Body Assembly. Never grip the casting in a vise or use force in removing or installing valves or plugs. It is suggested that the valve body be laid flat on a clean paper for disassembling.

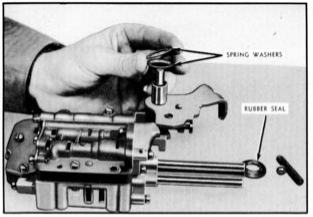


Fig. 427. Removing Rubber Seal and Spring Washers

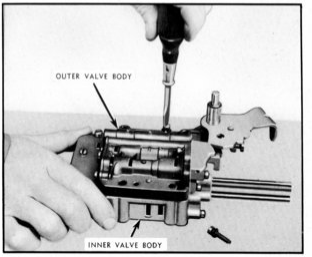


Fig. 428. Removing Outer Valve Body Screws

3. Remove two screws holding inner and outer valve body castings together, using a small screw driver. (Fig. 428)
4. Separate castings and remove separator plate.
5. Remove three screws holding governor pipe end casting to valve body (using a small screw driver) and remove governor pipe end casting, and separator. (Fig. 429)

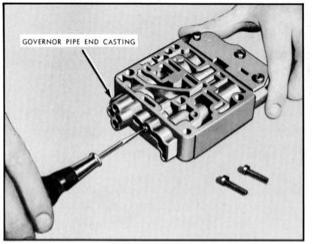


Fig. 429. Removing Governor Pipe End Casting

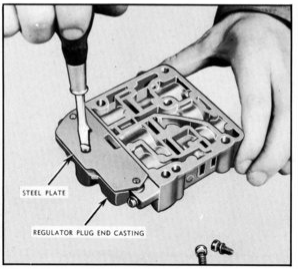


Fig. 430. Removing Steel Plate from Regulator Plug End Casting

6. Remove three screws holding steel cover plate to regulator plug casting and remove plate. (Fig. 430)
7. Remove three screws holding regulator plug end casting to inner casting and remove end casting. Hold regulator plug end casting and inner valve body together while removing screws to avoid springs jumping out of place. (Fig. 431)
8. Remove 1st and 2nd regulator plug spring, 2nd to 3rd shifter valve spring, 2nd to 3rd regulator plug spring and 3rd to 4th shifter valve spring.

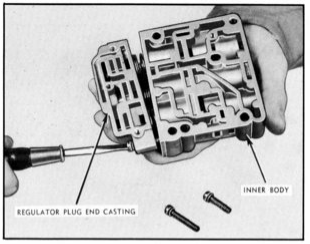


Fig. 431. Removing Regulator Plug End Casting

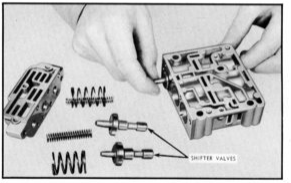


Fig. 432. Removing Shifter Valves

9. Remove three shifter valves. Valves should be free to move from body by pushing on opposite ends against governor plugs with fingers. (Fig. 432)
10. Remove three governor plugs by bumping casting on palm of hand if necessary.
11. Remove three screws from detent ball and spring retainer and remove retainer. (Fig. 433)
12. Remove three screws holding steel plate over compensator valve and throttle detent plug in outer valve body. Remove plate. (Fig. 434)
13. Remove compensator valve, spring, and detent plug from outer valve body.

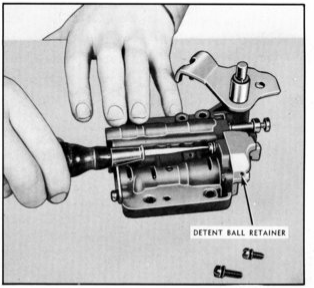


Fig. 433. Removing Detent Ball Retainer

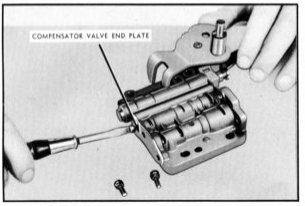


Fig. 434. Removing Compensator Valve End Plate

14. Remove double transition valve.
15. Remove T-valve, throttle valve spring and throttle valve. (Fig. 435)
16. Remove pin holding compensator valve auxiliary plug in place. (Fig. 436)
17. Remove compensator valve auxiliary plug by inserting a 1/8" punch in hole in plug and using another small punch to push valve from body. (Fig. 437)

    CAUTION—Since this plug is short, be very careful not to let it drop from punch and become lodged in valve body.

Disassemble Torus Check Valve From Driven Torus

1. Bend locks of check valve retainer away from the two mounting screws.

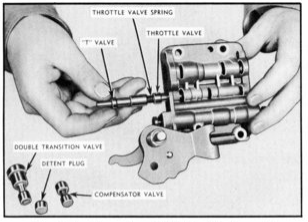


Fig. 435. Removing "T" Valve, Spring, and Throttle Valve

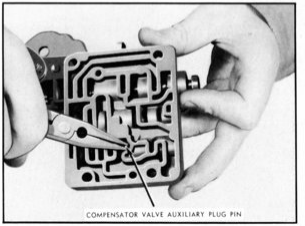


Fig. 436. Removing Auxiliary Plug Pin

2. Remove two mounting screws, retainer valve and spring.

INSPECTION OF THE HYDRA-MATIC TRANSMISSION

Group Disassembled Units for Inspection

Since the Hydra-Matic Transmission is dependent in many ways upon certain parts meeting engineering specifications in order for it to function properly, a thorough inspection should be made of each part after the transmission is completely disassembled.

It is very important when inspecting each part to distinguish between parts that are simply "worn-in" and those worn to the degree of af-

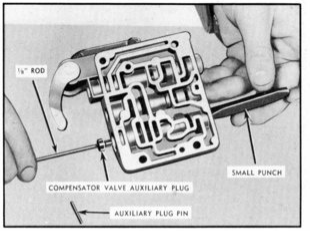


Fig. 437. Removing Auxiliary Plug

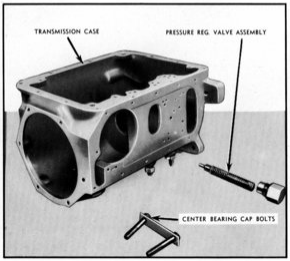


Fig. 438. Transmission Case Disassembled

fecting the dependability of the unit. Only worn, broken, or damaged parts should be replaced.

A list of all parts which need to be replaced should be made while inspecting each unit. When this is done, a complete list of parts for replacement will be available, assuring better service from the Parts Department with less chance of error and a saving in time for the mechanic.

Inspection of Transmission Case

1. Thoroughly clean the transmission case in cleaning fluid.
2. With an air hose, clear all oil passages through case.
3. Inspect transmission case for cracks and restricted oil passages.
4. Temporarily place oil delivery sleeve into transmission case and tighten center bearing cap.

NOTE—If oil delivery sleeve is loose, attempt correction by installing new oil delivery sleeve. If new oil delivery sleeve is

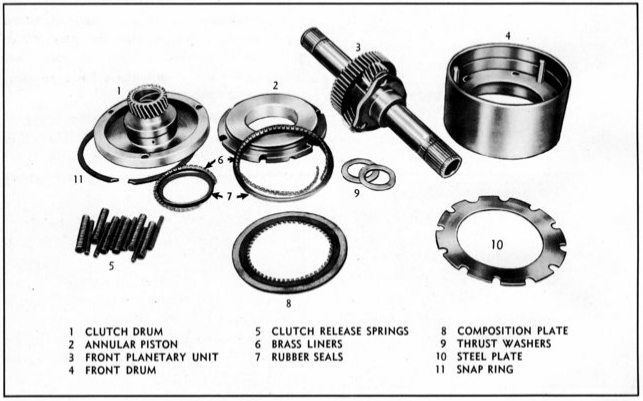


Fig. 439. Disassembled View of Front Planetary Unit

loose, dress bearing cap down with fine emery cloth and surface plate until sleeve fits tight.

5. Remove bearing cap and oil delivery sleeve.
6. Inspect pressure regulator valve, spring and gasket for damage.

Inspection of Front Planetary Unit

1. Inspect clutch drive pins in drum. If they are scored, loose or distorted, replace drum and drive pin assembly. (Pins are not furnished separately.)
2. Inspect drum for deep grooves or scores at band surface and clutch plate surface.
3. Inspect clutch release springs for distortion or collapsed coils.

   NOTE—Slight wear, "Bright Spots", on side of outer release springs, denoting slight contact with drum, is permissible.
4. Inspect composition clutch plates for damaged surfaces and loose facings.

   NOTE—If flakes of facing material can be removed by scratching the surface with the thumbnail, the plate should be replaced. Composition plates may become discolored in service. The discoloration is not an indication of failure.
5. Inspect steel clutch plates for scored surfaces.

   NOTE—Steel plates must be flat.
6. Inspect annular clutch piston for scores.
7. Inspect front clutch drum for scores in piston bore, oil delivery sleeve bore and oil seal grooves. Inspect gear teeth and thrust faces for damage.
8. Inspect front unit pinion gears for chipped gears and excessive roller bearing wear.
9. Inspect bearing surfaces of intermediate shaft, including front end surface for torus check valve seal.
10. Inspect steel and bronze thrust washers.
11. Clean all parts thoroughly, making a list of those denoting damage, that are to be replaced.

    NOTE—Be sure oil seal grooves are thoroughly cleaned.

Inspection of Rear Unit and Oil Delivery Sleeve

1. Inspect rear unit internal gear for damage or chipped teeth.
2. Inspect clutch drive pins. If they are scored, loose or distorted, replace rear drum and drive pin assembly. Pins are not furnished separately.
3. Inspect drum for deep grooves or scores at band surface and clutch plate surface.
4. Inspect composition plates for damage surfaces and loose facings.

   NOTE—If flakes of facing material can be removed by scratching the surface with the thumbnail, the plate should be replaced. Composition plates may become discolored in service. The discoloration is not an indication of failure.
5. Inspect steel clutch plates for scored surfaces.

   NOTE—Steel plates must be flat.
6. Inspect rear unit clutch drum for scores in piston bore and thrust surface.
7. Inspect inside bearing surface of babbitt bushing in clutch drum.
8. Inspect annular clutch piston for scores.
9. Inspect clutch release springs for distortion or collapsed coils.

   NOTE—Slight wear, "Bright Spots", on side of outer release springs, denoting light contact with drum, is permissible.
10. Inspect clutch release spring guide pins for distortion and make sure pins are correct length (1⅝").
11. Inspect oil delivery sleeve for scored surfaces and restricted oil passages.

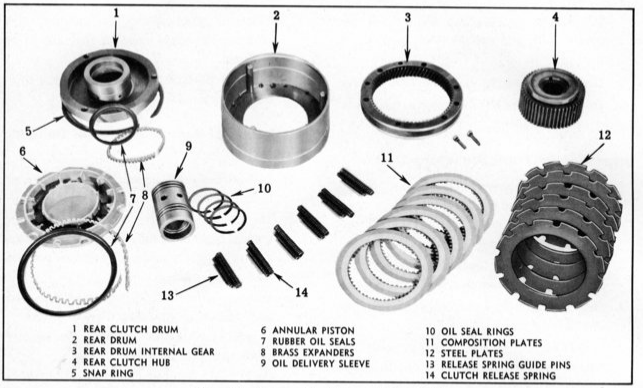


Fig. 440. Disassembled View of Rear Unit

12. Inspect inside babbitt bearing oil delivery sleeve for scores, pits or wear.
13. Check oil seal ring gaps with rings installed in bores of clutch drum. Gap should be .001″ to .007″. If more than .007″, correct condition by installing new rings or clutch drum.
14. Clean all parts thoroughly, making a list of those damaged which are to be replaced. NOTE—Be sure oil seal grooves are thoroughly cleaned.

Inspection of Reverse Assembly and Main Shaft

1. Inspect ball bearing by first thoroughly cleaning and oiling, then rotate slowly by hand, feeling for rough spots.
2. Inspect bearing surface of internal gear support.
3. Inspect internal gear for chipped teeth and scored inside bearing and thrust faces. Inspect snap ring.
4. Inspect reverse planet carrier for chipped teeth and worn roller bearings. If replacement of pinion gears is necessary, see INSTALLING NEW REVERSE PINION GEARS, PINS AND NEEDLE BEARINGS. (Figs. 518 through 523)
5. Inspect splines of reverse planet carrier for damage.
6. Inspect bronze oil pump drive gear for damage or excessive wear.

   NOTE—If inspection of bronze oil pump drive gear reveals that replacement is necessary, see procedure under, REPLACEMENT OF BRONZE OIL PUMP DRIVE GEAR. (Figs. 526, 527, & 528)
7. Inspect reverse center gear for damaged teeth or worn bushing.

   (If replacement is necessary, complete center gear and drive flange assembly must be replaced. The center gear is not furnished separately.)

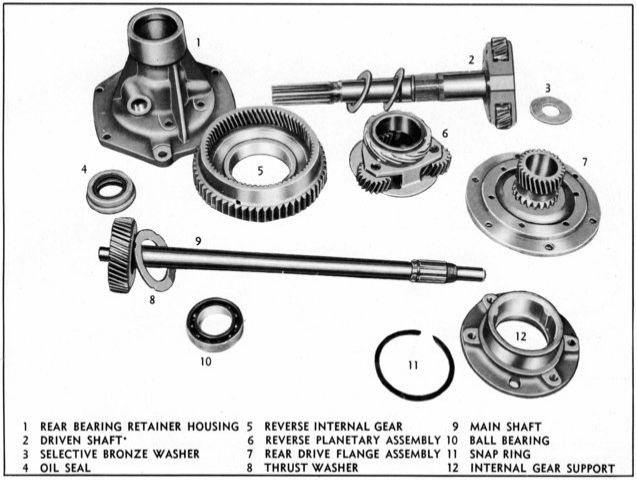


Fig. 441. Disassembled View of Reverse Assembly

8. Inspect driven shaft assembly for scored thrust and bearing surfaces.
9. Inspect splines for nicks and burrs.
10. Inspect rear pinion gears for chipped teeth or worn bearings.

    NOTE—If replacement of pinion gears is necessary, see INSTALLING REAR PINION GEARS, PINS AND NEEDLE BEARINGS. (Figs. 514 through 517)
11. Inspect steel and bronze thrust washer for excessive wear.
12. Inspect rear bearing retainer bushing for excessive wear and see that oil holes in casting are clear.

    NOTE—Rear bearing retainer bushing is not furnished separately. If replacement is necessary, replace rear bearing retainer assembly.
13. Inspect driven shaft oil seal. If replacement is necessary, see INSTALLING DRIVEN SHAFT OIL SEAL. (Fig. 473)
14. Inspect main shaft for chipped gear teeth, thrust and bearing surfaces.
15. Clean all parts thoroughly, making a list of those denoting damage that are to be replaced.

Inspection of Front Oil Pump and Front Unit Drive Gear

1. Inspect pump internal and external gears for chipped or scored teeth or scored end surfaces.

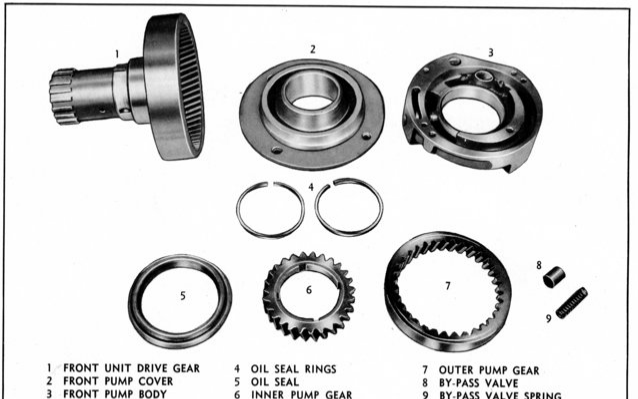


Fig. 442. Disassembled View of Front Pump and Drive Gear

2. Inspect pump body for scored gear pockets.
3. Inspect all passages for obstruction. (Particularly inspect the small drilled hole at end of pressure regulator bore.)
4. Check fit of pressure regulator valve in bore and spring on valve.
5. Inspect babbitt bushing in body for wear or scores.
6. Inspect pump cover for scored surfaces, loose dowels or obstructed passages. Be sure pump cover is concentric with pump body.
7. Inspect oil seal rings for damage or wear.
8. Inspect front unit drive gear for scored surfaces, worn bushings or chipped teeth.
9. Inspect Woodruff keys and keyways for wear or loose keys. If keyways are worn, replace front unit drive gear.

   NOTE—If any of the following parts are damaged, it will be necessary to replace the complete pump assembly;—pump gears, body, cover or main drive gear bushing in pump body.
10. Clean all parts thoroughly. Be sure lapped surface of pump cover and body are clean. Make a list of parts denoting damage, that are to be replaced.

    NOTE—To install a new front cover oil seal, see procedure under INSTALLING NEW FRONT COVER OIL SEAL. (Figs. 472 & 474)

Inspection of Rear Pump and Governor Assembly

1. Inspect pump gears for chipped teeth.
2. Inspect cover and gear pockets in body for scores.
3. Inspect governor ring lands. If chipped lands cause oil leaks, it will be necessary to replace the complete governor assembly.
4. Inspect both the G-1 valve and G-2 valve for free movement.

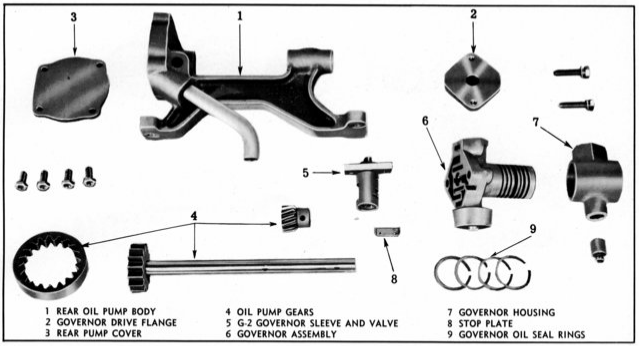


Fig. 443. Disassembled View of Rear Oil Pump and Governor

5. Inspect governor oil delivery sleeve for ring scores.
6. Inspect mounting face for flatness to get oil-tight joint.
7. Clean all parts thoroughly, making a list of those denoting damage, that are to be replaced.

Inspection of Front and Rear Bands

1. Inspect both bands for burned or worn lining.
2. Inspect steel bands for distortion or cracks.
3. Check strut on rear band for alignment and free pivoting. The rear band is furnished with strut attached.
4. Inspect anchor ends of front band for broken welds.

   CAUTION—Do not pry either band open or distort bands in any manner as they are surface ground at the factory for drum fit.

Inspection of Front Servo

1. Inspect servo body for scores and obstructed passages.
2. Inspect servo piston assembly for scores, broken rings and obstructed passages.
3. Inspect front band release cylinder for scores.
4. Inspect front band release piston for scores or broken ring.
5. Inspect 4th to 3rd valve for obstructed orifice or scores.
6. Inspect front servo springs for distortion or collapsed coils.
7. Clean all parts thoroughly. Make a list of those denoting damage that are to be replaced.

Inspection of Rear Servo

1. Inspect servo body for scores and obstructed passages.
2. Inspect actuating lever for free operation.
3. Inspect booster piston for scores.
4. Inspect booster piston rings for wear or breakage and be sure they are free in groves.
5. Inspect accumulator body for scores or obstructed passages.

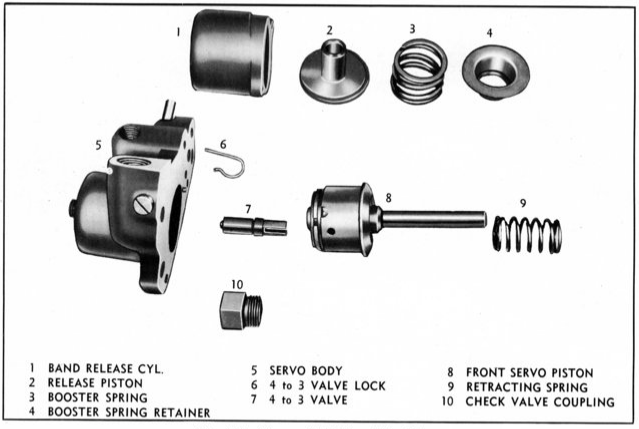


Fig. 444. Disassembled View of Front Servo

NOTE—To replace broken or leaking accumulator check valve, see procedure under INSTALLING A NEW ACCUMULATOR CHECK VALVE. (Figs. 529 & 530)

6. Inspect accumulator piston for scores, worn or damaged rings, or obstructed passages in stem. (Ring must be free in groove.)
7. Inspect compensator piston for scores, worn or damaged ring.
8. Inspect all servo springs for damage, distortion or collapsed coils.
9. Clean all parts thoroughly, making a list of those denoting damage that are to be replaced.

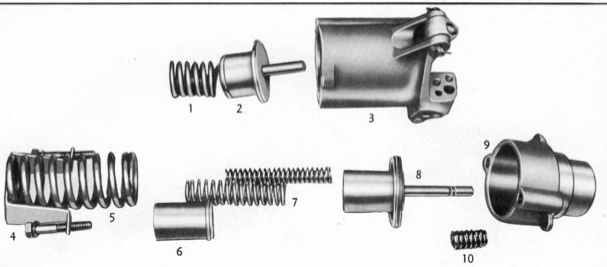
Inspection of Reverse Shifter Bracket Assembly

1. Inspect blocker piston for scores.
2. Inspect blocker piston bore for scores or damage.
3. Check blocker piston in bore for free movement.
4. Clean all parts thoroughly.
5. Inspect gasket shims for damage.
6. Make a list of those parts denoting damage, that are to be replaced.

Inspection of Oil Control Valve Body

Before inspecting the valve body and valves, the valve body and all valves should be thoroughly washed and cleaned with CLEAN gasoline or other cleaning fluid.

1. Inspect all valves carefully to see that they are free from burrs and that they are not damaged (scored, for example) in any way. burrs can be removed by carefully using a fine flat hone. In removing burrs, do not round off shoulders, as this type of valve has sharp corners, which are necessary to prevent dirt from wedging between valve and body.



1 BOOSTER SPRING
2 BOOSTER PISTON
3 SERVO BODY
4 SPRING RETAINER
5 ACCUMULATOR SPRING (MAIN)
6 COMPENSATOR PISTONS
7 COMPENSATOR SPRINGS (INNER-OUTER)
8 ACCUMULATOR PISTON
9 ACCUMULATOR BODY
10 ACCUMULATOR PISTON SPRING

Fig. 445. Disassembled View of Rear Servo

2. With the valves and valve body clean and dry, check each shifter valve, governor plug, and regulator plug for free movement in their respective bores and operating positions.

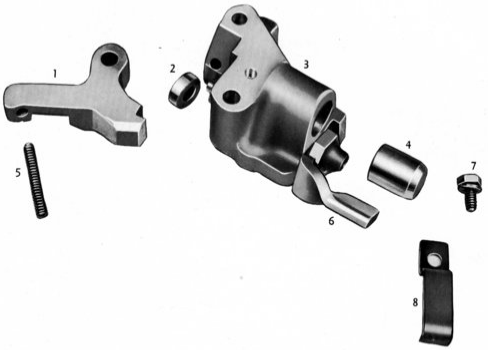
   NOTE—Valves can be assumed to be free in their operating position if they will fall of their own weight in their respective bores when valve body is shaken slightly. All governor plugs are identical. Likewise, the 2nd to 3rd and 3rd to 4th shifter valves are identical. Therefore, when assembling, if it is found that a shifter valve or governor plug does not slide freely in one bore of valve body, attempt correction by changing it to a different bore of the valve body.

   Individual valves of the oil control valve body *are not* furnished separately, except for manual valve which *is* furnished separately. If it becomes necessary to replace one of the other valves or one of the bodies (inner or outer) a complete inner valve body with regulator valve and casting assembly may be replaced, or a complete outer valve body less manual valve may be replaced. The large separator plate between the inner and outer valve body assemblies is also furnished separately.

   Clean all parts thoroughly. Make a list of those denoting damage, that are to be replaced.

Inspection of Driven Torus Check Valve

1. Inspect the face of check valve (bearing surface) for scores.
2. Inspect the inside diameter of valve for scores.
3. Position the valve over ground surface of driven torus to check if valve is free to work without bind.
4. Clean all parts thoroughly. Make a list of those denoting damage, that are to be replaced.



1 REVERSE ANCHOR
2 ROLLER
3 REVERSE SHIFTER BRACKET
4 BLOCKER PISTON
5 RETRACTING SPRING
6 REVERSE CRANK
7 BLOCKER PISTON RETAINER CAP SCREW
8 BLOCKER PISTON RETAINER

Fig. 446. Disassembled View of Reverse Shifter Bracket

ASSEMBLY OF INDIVIDUAL UNITS

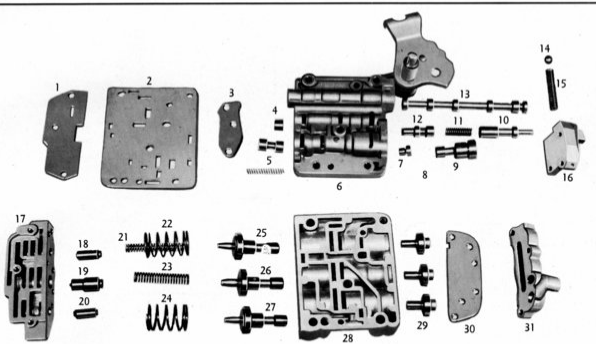
Before attempting to assemble the Hydra-Matic transmission, all parts should have been inspected, and those parts denoting damage that are to be replaced should be obtained from the Parts Department and placed in their respective group, thoroughly cleaned of any rust preventive oils and ready for assembly.

Assembly of Front Unit

1. Place intermediate shaft in holding fixture J-2190 with clutch hub up.
2. Place front drum over hub to rest on pinion gears with drive pins up. (Fig. 449)
3. Install three composition and three steel plates into front drum, alternating plates. (four each, on 8 cyl.)

   CAUTION—Start with a composition plate and finish with a steel plate.

   The composition plates must be assembled with the face having the *large* diameter *fiber* and *small* diameter *cork* lining up. Assemble the steel plates with the square notches over the drive pins. (Fig. 455)
4. Install six outer clutch release and then six inner clutch release springs in spring holes of drum. (Fig. 450)
5. Place inner piston rubber seal over front center gear to rest on piston with lip down.
6. Install new inner brass expander into ring groove in clutch drum with expanding lips down. (Fig. 451)



1	REG. PLUG END PLATE	11	THROTTLE SPRING	22	2-3 SHIFTER SPRING
2	SEPARATOR PLATE	12	THROTTLE VALVE	23	1-2 SHIFTER SPRING
3	COMPENSATOR VALVE END PLATE	13	MANUAL VALVE	24	3-4 SHIFTER SPRING
4	DETENT PLUG	14	DETENT BALL	25	2-3 SHIFT VALVE
5	COMPENSATOR VALVE AND SPRING	15	DETENT SPRING	26	1-2 SHIFT VALVE
6	OUTER VALVE BODY	16	DETENT END CASTING	27	3-4 SHIFT VALVE
7	COMPENSATOR VALVE AUXILIARY PLUG	17	REG. PLUG END CASTING	28	INNER VALVE BODY
8	AUXILIARY PLUG PIN	18	2-3 REG. PLUG	29	GOVERNOR PLUGS
9	DOUBLE TRANSITION VALVE	19	1-2 REG. PLUG	30	GOVERNOR END PLATE
10	"T" VALVE	20	3-4 REG. PLUG	31	GOVERNOR END CASTING
		21	2-3 REG. PLUG SPRING		

Fig. 447. Disassembled View of Valve Body

7. While holding brass expander into position, install new inner piston rubber seal over brass expander into ring groove with lip down. (Fig. 451)

   NOTE—With seal assembly installed, work brass expander well back into position under rubber seal so brass edges are not exposed.

8. Install new brass expander in ring groove of front annular piston with lips up.

9. While holding the brass expander into position, install a new rubber seal over expander well into groove with lip up.

   NOTE—When seal is installed, work expander well back into position under seal so brass edges do not protrude above seal lip.

10. Install annular piston into front clutch drum resting on outer rubber seal. Align square notches in annular piston with holes in drum. Start outer seal into drum bore with blunt blade screw driver. (Fig. 448) After seal has been initially started, piston can then be pressed into place by hand.

11. Install clutch drum assembly over intermediate shaft into front drum.

    CAUTION—Be sure clutch release spring enters into counterbore of clutch drum.

12. Lift front unit assembly off intermediate

Fig. 448. Installing Front Annular Piston

shaft, place in press and compress clutch drum. While drum is under compression, install clutch drum retainer ring, having gap of retainer ring so positioned that it is located between two drive pin holes. (Fig. 399)

13. Release press and remove assembly.
14. Tap front face of center gear with a soft hammer so the clutch drum will snap back into place, properly seating against retainer ring. (Fig. 452)

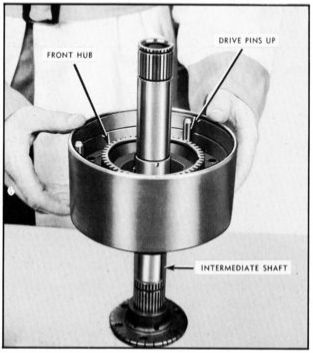


Fig. 449. Assemble Front Drum to Intermediate Shaft

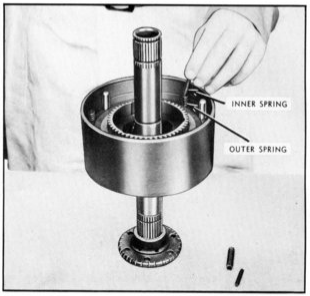


Fig. 450. Installing Clutch Release Spring

15. Temporarily remove intermediate shaft from holding fixture to align clutch plates with hub splines. Insert intermediate shaft into front unit clutch plates and drum by rolling drum on bench while pressing the shaft firmly into the clutch plates. (Fig. 453)

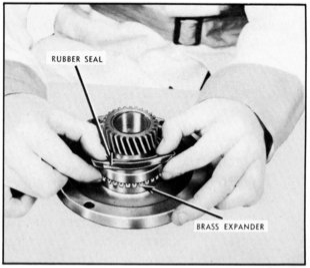


Fig. 451. Installing Brass Expander and Rubber Seal

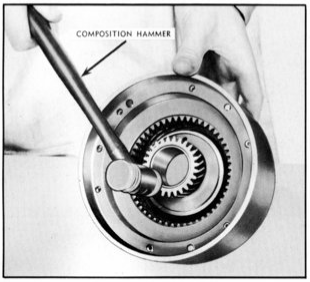


Fig. 452. Seating Clutch Drum Against Retainer Ring

16. Place intermediate shaft and drum assembly into holding fixture.
17. Install bronze then steel thrust washer over intermediate shaft. (Fig. 454)

    NOTE—Locating lug on steel washer must fit over flat portion of intermediate shaft.
18. Install snap ring over intermediate shaft into groove to hold assembly in place.

    CAUTION—Do not allow snap ring to scrape bearing surface of intermediate shaft while ring is being positioned over shaft.

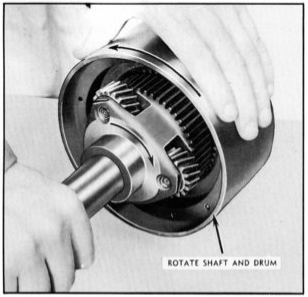


Fig. 453. Aligning Clutch Plates

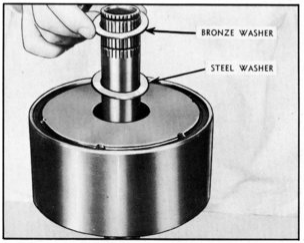


Fig. 454. Installing Front Unit Thrust Washers

Assembly of Rear Unit

1. Assemble rear unit internal gear to rear drum, properly locating dowel and install two fillister head screws and tighten.
2. Place rear drum on the bench with internal gear teeth down.
3. Install six composition and six steel clutch plates into rear drum, alternating plates. (seven each on 8 cyl.)

   NOTE—Start with a composition and finish with a steel plate. The composition plates should be assembled with the side having the *large* outside *fibre* and *small* inside *cork* lining up. The steel plates are assembled with the square notches over drive pins. (Fig. 455)
4. Install six outer then six inner clutch release springs into counterbores of drum indexing springs with round notches in steel plates.
5. Install six clutch release spring guide pins. (Fig. 456)
6. Position inner rubber seal on inner piston of clutch drum. Install new small (brass) expander into ring groove of clutch drum

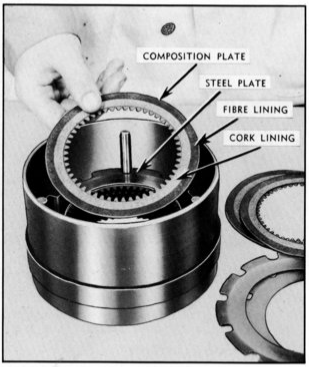


Fig. 455. Assembling Clutch Plates

with lip toward bottom of piston bore. (Fig. 457)

7. While holding the brass expander into position, install new rubber seal over expander into ring groove with lip down. (Fig. 458)

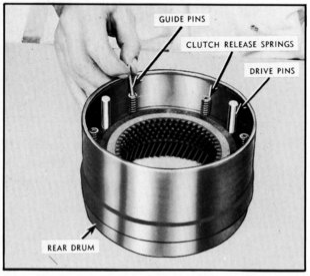


Fig. 456. Installing Clutch Release Springs and Guide Pins

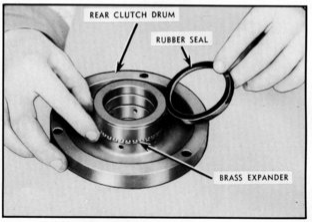


Fig. 457. Installing Brass Expander

NOTE—With seal assembly installed, work brass expander well back into position under rubber seal so brass edges are not exposed.

8. Install new large (brass) expander into groove of annular clutch piston with lips up.
9. While holding brass expander into position, install a new rubber seal over expander into ring groove with lip up.

NOTE—With seal assembly installed, work brass expander well back into position under rubber seal so brass edges are not exposed.

10. Place rear unit annular piston into clutch drum to rest on seal. Align square notches in annular piston with holes in drum. While applying slight hand pressure to

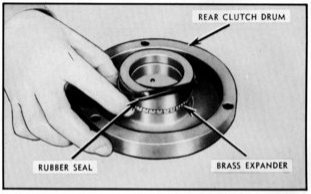


Fig. 458. Installing Rubber Seal over Brass Expander

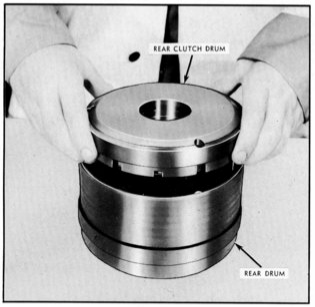


Fig. 459. Installing Rear Clutch Drum

piston, guide seal in bore with a blunt edge screw driver.

11. Install rear clutch drum and piston assembly over drive pins into rear drum. (Fig. 459)
12. Place rear unit assembly into press to assemble clutch drum into rear drum. While clutch drum is under pressure, install retainer ring with gap between two drive pin holes the same as operation shown in Fig. 399.

    NOTE—Remove unit from press and with a block and hammer, tap clutch drum rear thrust face until drum snaps into place, properly seating against retainer ring. (Fig. 460)

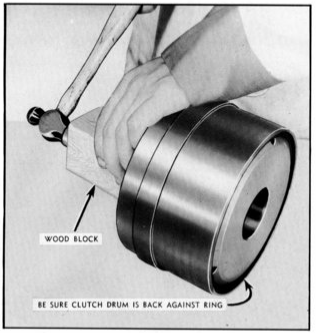


Fig. 460. Seating Clutch Drum Against Retainer Ring

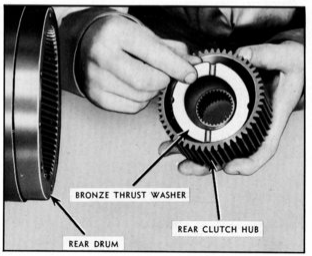


Fig. 461. Installing Rear Clutch Hub Front Thrust Washer

13. Install front bronze thrust washer into deep counterbore of rear clutch hub and retain with vaseline. (Fig. 461)
14. Install rear hub and thrust washer into rear

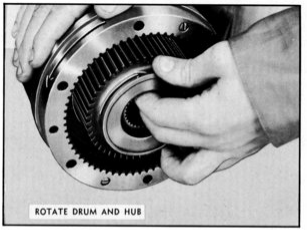


Fig. 462. Installing Rear Clutch Hub

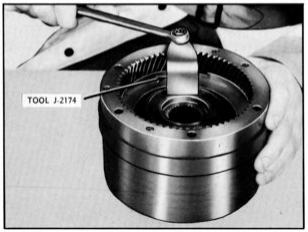


Fig. 463. Installing Rear Hub Tool J-2174 to Drum

drum assembly. This is done by rotating hub and drum assembly on bench to mesh splines of rear hub with teeth of composition plates. (Fig. 462)

15. Install rear clutch hub tool J-2174 on rear drum to hold clutch hub in place. Use one rear drive flange attaching screw to hold tool in place. (Fig. 463)
16. Install rings on oil delivery sleeve.
17. Install oil delivery sleeve (long bearing up) over intermediate shaft. Compress rings with ring compressor J-1537 and tap oil delivery sleeve into bore of front drum with composition hammer. (Fig. 464)

Fig. 464. Installing Oil Delivery Sleeve

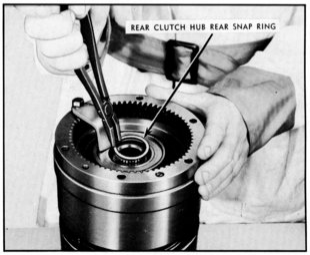


Fig. 465. Installing Rear Clutch Hub Rear Snap Ring

18. Install rear clutch hub front snap ring into second groove on intermediate shaft.
19. Using ring compressor J-1537 to compress rings, install rear unit drum assembly on intermediate.
20. Lock rear unit drum assembly in place by installing rear clutch hub rear snap ring. (Fig. 465)

    NOTE—Test both units by rotating them by hand. Both the front drum and rear drum should be free to rotate under slight pressure. If either drum binds, the unit

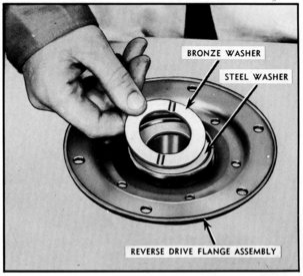


Fig. 466. Installing Driven Shaft Thrust Washers

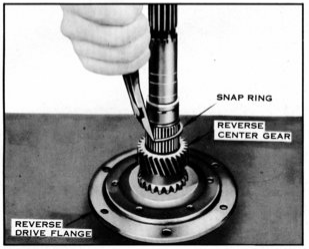


Fig. 467. Installing Reverse Center Gear Snap Ring

should be disassembled and the cause of trouble corrected.

Assembly of Reverse Assembly

1. Install first the steel and then the bronze thrust washer into thrust washer retainer on reverse center gear. (Retain in place with vaseline.) (Fig. 466)
2. Install reverse drive flange and center gear assembly over end of output shaft and bring to rest against thrust surface of rear planet carrier.
3. Lock assembly in place with snap ring. (Fig. 467)

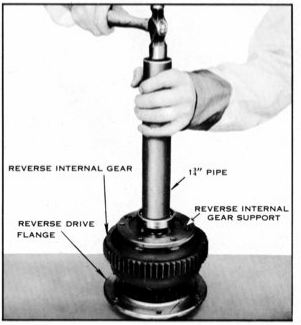


Fig. 469. Installing Ball Bearing

Fig. 468. Assembling Reverse Internal Gear

Fig. 470. Installing Ball Bearing Retainer Ring

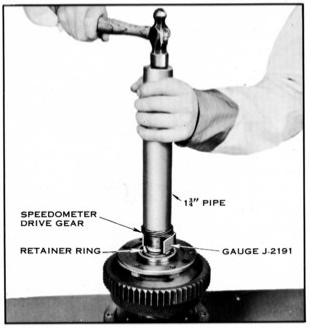


Fig. 471. Installing Speedometer Drive Gear

NOTE—This snap ring is slightly larger than other snap rings used in transmission.

4. Install reverse planet carrier over driven shaft with bronze oil pump drive gear down.

   CAUTION—Be sure pinions mesh with reverse center gear.

5. Assemble reverse internal gear on gear support and lock in place with large retainer ring. (Fig. 468)
6. Place internal gear and support over driven shaft and mesh internal teeth with pinions.
7. Place ball bearing over driven shaft and tap bearing into counterbore of reverse internal gear support. (Fig. 469)
8. Lock assembly into place by installing OPEN TYPE snap ring in groove of driven shaft behind inner race of ball bearing using a flat punch and hammer. (Fig. 470)
9. Place speedometer drive gear over shaft and drive into place. Speedometer drive gear is properly positioned on shaft with use of gauge No. J-2191. (Fig. 471)
10. Install a new output shaft oil seal in rear bearing retainer housing. (Fig. 473)
11. Slide rear bearing retainer housing over driven shaft and make sure that mounting screw holes in housing line up with screw holes in reverse internal gear support.
12. Dip the threads of five attaching screws into sealing compound (Permatex No. 3, Aviation Form-A-Gasket Cement) and

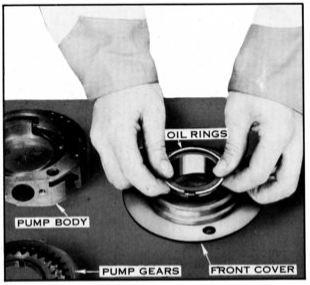


Fig. 472. Installing Front Cover Oil Seal Rings

Fig. 473. Installing Rear Bearing Retainer Oil Seal

Fig. 474. Installing Front Cover Oil Seal

just start the screws with COPPER washers into the reverse internal gear support.

13. With housing properly lined up with gear support, tap housing in place with soft hammer.
14. Tighten five retainer housing bolts evenly to internal gear support.
15. Install speedometer driven gear and sleeve assembly.

Assembly of Front Pump

1. Install two oil seal rings in pump cover. (Fig. 472)
2. Place new seal into pump cover having step side up and drive seal into place with use of tool J-2170. (Fig. 474)

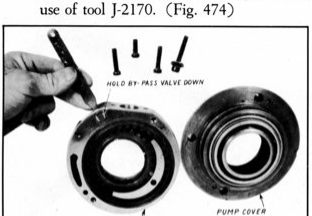


Fig. 475. Holding By-Pass Valve in Place

3. Seal around edge of cover and seal with sealing compound (Permatex No. 3, Aviation Form-A-Gasket Cement) before driving seal into place.
4. Use Hydra-Matic fluid to lubricate both pump gears, then install both the internal and external gears in gear pockets of the pump body.
5. Install first the by-pass valve spring, and then the by-pass valve into the pump body. (Fig. 475)
6. Compress spring by pushing down on valve until top of valve is below opening (slot) in casting.
7. Slide a small feeler gauge between top of valve and body.
8. Install pump cover to pump body, properly locating dowels.
9. Remove feeler gauge.

   NOTE: BE SURE FEELER GAUGE IS REMOVED.
10. Apply sealing compound, (Permatex No. 3, Aviation Form-A-Gasket Cement) under heads of screws.
11. Install two 1" long and one 5/8" long screws and copper washers. Hold pump with tool J-2184-1 and tighten screws 12-15 ft. lbs. (Fig. 476)

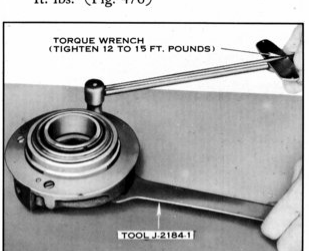


Fig. 476. Installing Pump Cover

12. Turn pump assembly over and install ONE 1-3/8" long screw and copper washer, tighten 12-15 ft. lbs.
13. Assemble the front pump over front unit drive gear, aligning keyways in pump gear with TWO Woodruff keys on front unit drive gear.

Assembly of Rear Oil Pump and Governor

1. Install internal gear.
2. Position cover on pump body and install four mounting screws and lock washers. Lock washers are not used on I-X type rear pump because screws have self-locking heads.
3. Install G-2 valve and sleeve assembly in governor body, having slot for stop plate in sleeve up. (Fig. 477)
4. Tighten G-2 valve and sleeve assembly into governor body with two attaching screws and lock washers.
5. While holding G-2 valve closed, install the G-2 valve stop plate with two small holes up.

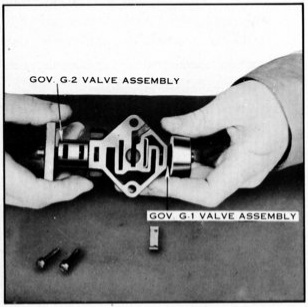


Fig. 477. Assembling G-2 Governor Valve

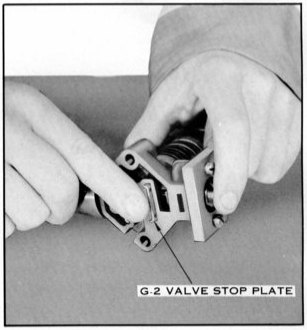


Fig. 478. Installing G-2 Governor Valve Stop Plate

NOTE—Be sure plate does not protrude above surface of governor body. (Fig. 478)

6. Install governor oil seal rings and install governor oil delivery sleeve with chamfered side down; use care not to damage rings while compressing them into oil delivery sleeve.
7. Position governor assembly on drive flange lining up with locating marks.
8. Install two cap screws and lock washers to hold governor drive flange to body.
9. Install small plug into governor oil delivery sleeve.

Assembly of Front Servo

1. Install brass pipe coupling into servo body and tighten.
2. Install the small 4th to 3rd valve into bore of body. Align slot with hole for spring lock and install spring lock. (Fig. 482)
3. Install screw plug over 4 to 3 valve and tighten.

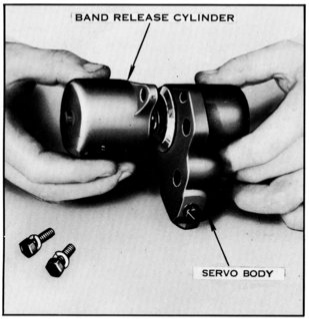


Fig. 479. Assembling Front Servo

4. Install front servo piston assembly into body. Be sure to align slot in sleeve over the small dowel pin in body. (Fig. 481)
5. Install front band release piston into cylinder, using particular care when compressing ring.
6. Install booster spring over front band release piston.
7. Place retracting spring retainer over piston stem, down onto booster spring. (Fig. 480)

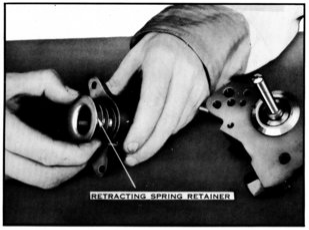


Fig. 480. Installing Retractor Spring Retainer

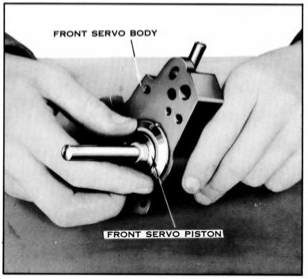


Fig. 481. Installing Front Servo Piston

8. Place retracting spring over front servo piston stem.
9. Position band release cylinder assembly into servo body and tighten in place with two mounting screws and lock washers. (Fig. 479)

Assembly of Rear Servo

1. Install accumulator piston in accumulator body. Be careful not to damage piston ring.
2. Install small accumulator piston spring over

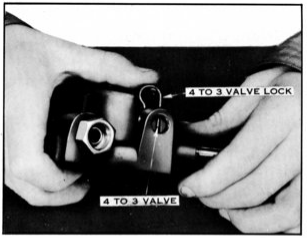


Fig. 482. Installing 4 to 3 Valve Spring Lock

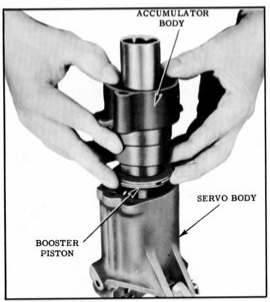


Fig. 483. Installing Accumulator Body Assembly into Servo Body

rod with small tapered end of spring toward accumulator body and tap spring on rod until small end of spring seats against shoulder.

3. Install booster piston into accumulator body being careful not to break ring or booster piston.
4. Install accumulator body assembly, including booster piston into the servo body taking care not to damage booster piston ring.
5. Place two compensator springs in bore of accumulator piston.
6. Position compensator piston over the two compensator springs. Compress the compensator piston oil seal ring by means of a fine tag wire tightened in place.
7. Place servo spring and retainer with two mounting screws and lock washers in position in accumulator body.
8. Place complete assembly into press, slowly compress springs while tightening mounting screws.
   CAUTION—Extreme care must be used to avoid breaking oil seal ring on comcompensator piston. (Fig. 484)
9. Remove assembly and finish tightening two mounting screws. Remove the tag wire used in Operation 6 to compress the oil seal ring by means of a pointed nose pliers inserted through the coils of the servo spring.
10. Assemble front and rear servos onto transfer pipe.

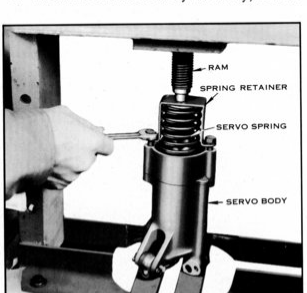


Fig. 484. Installing Rear Servo Spring Retainer

Assembly of Reverse Bracket

1. Position reverse bracket to clear blocker piston bore.
2. Install blocker piston (with chamfer out) into bore of reverse bracket.
3. Leave piston part way out of bore, place retracting spring notched end on piston while tightening cap screw. Push piston into bore.

Assembly of Oil Control Valve Body

1. Carefully assemble compensator valve auxiliary plug "A" into the valve body "B", using a punch to hold plug. Hold plug into place with pin "C".
2. Install throttle valve "D", throttle valve spring "E", "T" valve "F" and detent plug "G",—check for freeness.

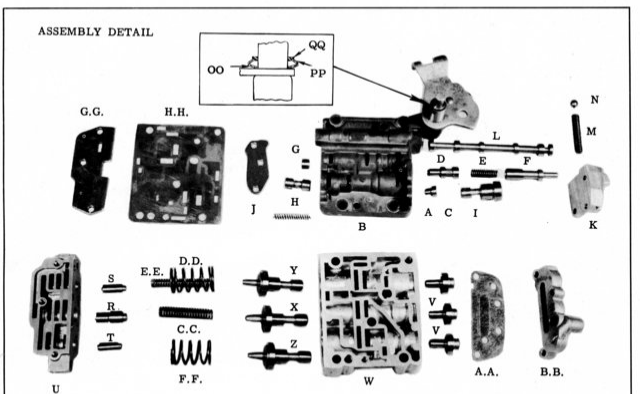


Fig. 485. Assembling of Oil Control Valve Body

3. Install compensator valve "H" and spring and double transition valve "I"—check for freeness.
4. Position compensator valve end plate "J" on outer valve body and install three mounting screws and lock washers.
5. Position the detent ball retainer "K" on valve body being sure the throttle lever is inside stop, and install three screws holding retainer to valve body.
6. Install the manual valve "L" making sure operating pin engages valve correctly. To do this:

   (a) Rotate control lever back past the reverse position.

   (b) Insert detent spring "M" in bore of detent ball retainer.

   (c) Insert detent ball "N" over spring.

   (d) Push ball and spring into bore with finger while rotating manual control lever into detent position.
7. Install inside steel washer ("O.O.") with small inside diameter over the manual control shaft with the dish up.
8. Install the outside steel washer ("P.P.") with the large inside diameter over the manual control shaft with the dish down.
9. Install the rubber seal ("Q.Q.") over the manual control shaft with lip down centered into the inside diameter of steel washer. (See Fig. 485 for assembly detail.)
10. Install 1-2 (R), 2-3 (S), and 3-4 (T) regulator plugs in regulator plug end of casting (U), and check for freeness.
11. Install the three governor plugs "V" in valve body "W".
12. Install 1-2 shift valve "X", 2-3 shift valve "Y" and 3-4 shift valve "Z" in valve body and check for freeness.

13. Position separator plate ("A.A.") and governor pipe end casting ("B.B.") on body.
    NOTE—Make sure separator plate is installed with holes in line with passages in end casting.
14. Install three screws holding governor pipe end casting and separator plate to valve body, using a small screw driver.
15. Install 1-2 shift valve spring ("C.C.") in valve body.
16. Install 2-3 shift valve springs ("D.D.") and ("E.E.") in valve body.
17. Install 3-4 shift valve spring ("F.F.") in valve body. (Fig. 485)
18. Position the regulator plug end casting assembly "U" on valve body.
    NOTE—Make sure valve springs register with holes in casting.
19. Install three screws holding regulator plug end casting to valve body using a small screw driver.
20. Position regulator plug end casting plate ("G.G.") on regulator casting and install three mounting screws, using a small screw driver.
21. Position the inner and outer valve body separator plate ("H.H") onto the inner valve body.

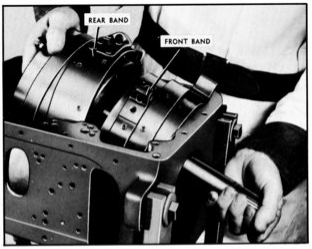


Fig. 486. Installing Units into Transmission Case

NOTE—The separator plate can only be installed one way. With the two holes in line with the two attaching screws, temporarily insert the 4 valve body to transmission case attaching bolts in place through mounting holes. This will hold separator plate in its proper position while tightening the inner and outer valve body together with two attaching screws.

CAUTION—Make sure all assembly screws are tight in valve body by double checking, using a small screw driver.

Assembly of Driven Torus Check Valve

1. Position spring into torus member.
2. Position check valve into spring.
3. Place check valve retainer over assembly.
4. Press assembly into driven torus and tighten in place with two mounting screws.
5. Bend ends of retainer against flats of mounting screws to lock screws.
6. Check valve for free operation.

ASSEMBLE UNITS INTO TRANSMISSION CASE

1. Remove planet assemblies from holding fixture No. 2190 and position rear band over rear drum so anchor end will be positioned to fit over adjusting screw when units are placed in the transmission case.
2. Position front band over front drum so short anchor end will be positioned to fit over adjusting screw when units are placed in the transmission case.
3. Install front and rear units (with bands) in transmission case by lowering front end of intermediate shaft into case first. (Fig. 486)
4. Position both bands over adjusting screws.
   NOTE—Make sure single hole in oil delivery sleeve is centered between center

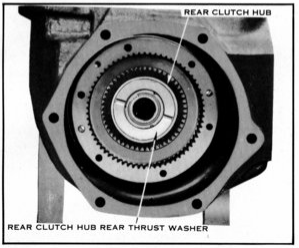


Fig. 487. Installing Rear Clutch Hub Rear Thrust Washer

bearing cap mounting holes and is facing up.

5. Position center bearing cap over oil delivery sleeve. Use care to index dowel with single dowel hole in oil delivery sleeve. Tap bearing cap in place with a light hammer.
6. Install a new center bearing cap lock plate over mounting bolts and tighten bearing cap in place.

Fig. 488. Installing Selective Washer

7. Bend lock plate up around screws using a large pair of pliers.
   CAUTION—Do not use a screw driver to pry corners of lock plate up, as this may damage lapped edges of transmission case.
8. Remove rear clutch hub tool J-2170 from rear drum.
9. Position rear clutch hub rear thrust washer in the counterbore of rear hub and retain with vaseline. (Fig. 487)
10. Install main shaft through intermediate shaft from rear.
    NOTE—If main shaft did not have correct end-clearance prior to disassembly, select proper washer to bring end clearance within the limits of .004"–.015".
11. Install correct size selective washer in counterbore of driven shaft and retain in place with vaseline. (Fig. 488)
12. Install a new rear bearing retainer gasket to transmission case, align holes and retain in place with vaseline.
13. Position reverse unit assembly into rear end of transmission case. (Fig. 489)
    NOTE—Revolve driven shaft and main shaft to facilitate meshing planet gears with

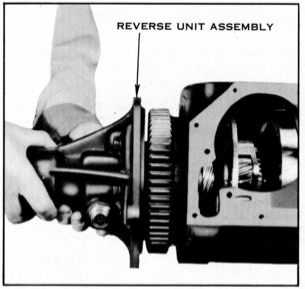


Fig. 489. Installing Reverse Unit Assembly

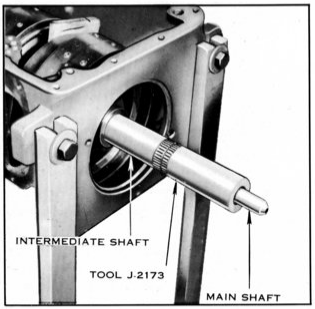


Fig. 490. Installing Tool J-2173 on Main Shaft

main shaft gear and rear drum internal gear.

14. Position reverse anchor assembly into transmission case and install special mounting bolt and lock. Do not tighten bolt. (Fig. 392)

    Just start five rear bearing retainer to case mounting screws with lock washers as guides. Push or tap rear bearing retainer in place, then tighten mounting screws and special bolt, evenly; lock special bolt.

15. Position reverse drive flange to rear drum so mounting screw holes are in line with holes in drum.
16. Install six reverse drive flange bolts and lock washers. Tighten bolts while holding drum with large screw driver.

    CAUTION—Tighten six screws evenly to draw flange into rabbet in drum without distorting flange.

Check Main Shaft End Clearance

1. Install tool J-2173 between front drum and center bearing cap.
2. Install special tool J-2171 over main shaft and intermediate shaft to pilot main shaft. (Fig. 490)
3. Fasten tool J-1465 to transmission case and mount dial indicator so button is located in end of main shaft proper. (Fig. 491)
4. Move main shaft back and forth and note indicator reading. End clearance should be .004" - .015". If end clearance is not within these limits, remove tool J-2173 and remove reverse assembly. Check selective washer and install a washer to give proper clearance.
5. Install reverse assembly into transmission case, and again check main shaft end clearance as above.
6. Remove dial indicator assembly guide tool J-2171 and spacer tool J-2173.

Install Front Pump and Front Unit Drive Gear

1. Position gasket over front pump cover.
2. Position bronze thrust washer over intermediate shaft against bearing surface of front planet carrier. (Fig. 492)
3. Install front pump and front unit drive

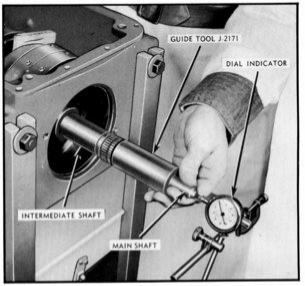


Fig. 491. Checking Main Shaft End Clearance

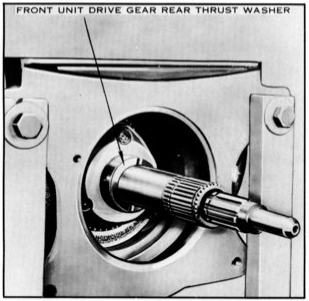


Fig. 492. Front Unit Drive Gear Thrust Washer in Place

gear assembly on intermediate shaft, aligning front pump cover locating slot with counterbore in transmission case for pump locating washer.

4. Install pump cover locating washer in counterbore. (Fig. 493)
5. Install two front pump cap screws with large flat copper washers. Leave screws loose until front and rear servos have been installed and tightened in place.
6. Install first the bronze, then steel thrust washer over intermediate shaft, against front end of front unit drive gear.
7. Install snap ring holding thrust washers in place. (Fig. 389)
8. Install open type snap ring in groove on main shaft.

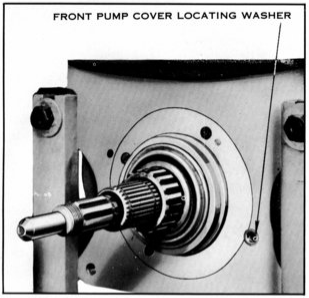


Fig. 493. Installing Pump Cover Locating Washer

Fig. 494. Installing Oil Pump and Governor Assembly

Install Rear Pump and Governor Assembly

1. Position the large round governor weight to the front of transmission and locate one reverse drive flange mounting screw up to provide clearance for pump and governor assembly to slide into transmission case. (Fig. 494)
2. Slide the pump and governor assembly into position in case and install two mounting screws and lock washers.

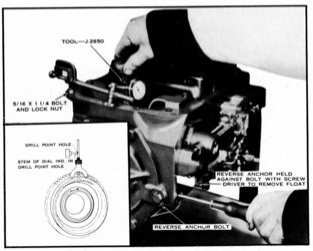


Fig. 495. Checking Backlash with Tool J-2650 and Dial Indicator

Install Reverse Shifter Bracket and Shims

1. Position retracting spring and roller onto bracket assembly. (Fig. 496)
2. Assemble bracket and steel shims to transmission case.
3. Install attaching bolts with lock washers and tighten.
4. In checking backlash between reverse internal gear and anchor, use reverse backlash gauge J-2650 and proceed as follows:
   (a) Place reverse internal gear by means of tool J-2650 as shown in Fig. 495.
   (b) Rotate reverse internal gear by means of tool J-2650 as shown in Fig. 495.
   (c) Dial indicator (with stem of indicator in drill point hole on tool J-2650) will show amount of backlash.
   (d) Remove or add steel shims between reverse bracket and transmission case to obtain correct backlash of .016" to .049".

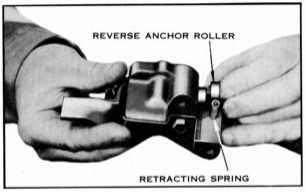


Fig. 496. Assembling Spring and Roller

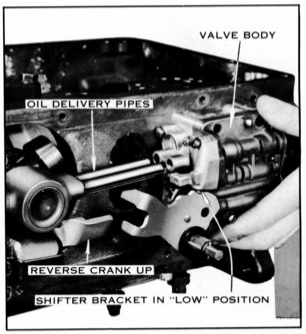


Fig. 497. Installing Oil Control (Valve) Body

Install Oil Control Valve Body

1. Install three oil delivery pipes into holes in governor sleeve.
2. With shifter bracket in the "Low" range detent and reverse crank up, push valve body toward rear. (Fig. 497)
3. Install four valve body mounting screws and lock washers holding valve body to case. Tighten 6 to 8 ft. lbs.

Install Front and Rear Servos

1. Install front pump oil delivery pipe into front pump body. (Fig. 498)
2. Position both servos on transmission case engaging rear band strut with actuating lever and front servo piston pin in clip on end of front band. (Fig. 499)

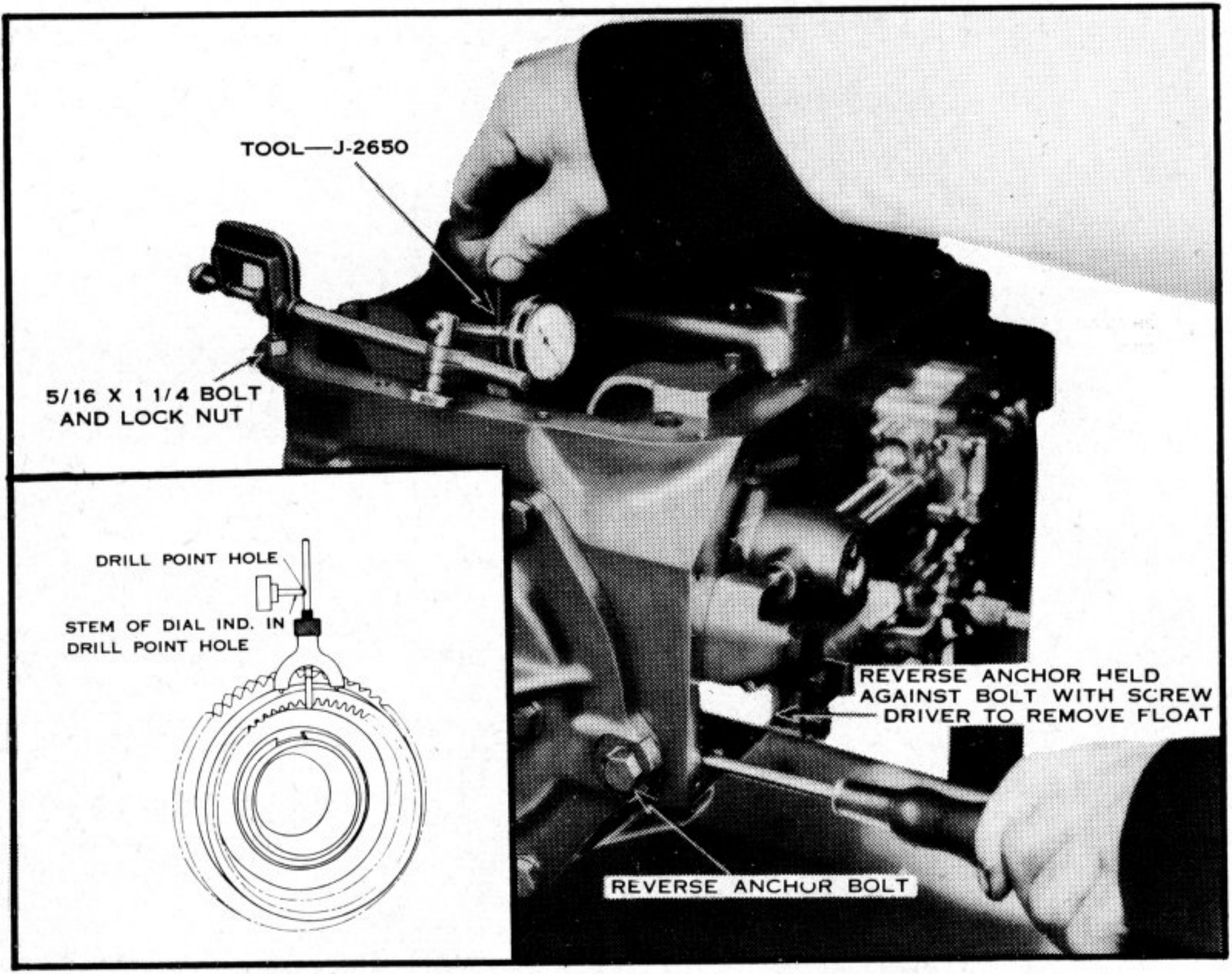


Fig. 495. Checking Backlash with Tool J-2650 and Dial Indicator

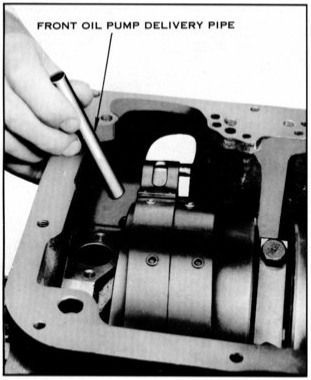


Fig. 498. Installing Front Pump Delivery Pipe

3. Lift assembly (if necessary) so front pump oil delivery pipe can be entered into hole in front servo body.
4. Push plain end of rear oil pump discharge pipe into hole in rear oil pump, then rotate pipe coupling end, into brass fitting on front servo. START pipe coupling threads, but do not tighten. (Fig. 500)
5. Install four servo attaching bolts and lock washers and tighten servos to transmission case.
6. Using a 25/32" and an 11/16" open end wrench, tighten coupling end of rear pump discharge pipe into front servo.
7. Install front pump intake pipe to front pump, using a new gasket and mounting screw locks. (Fig. 502)
8. Tighten mounting screws and bend locks up against heads of screws.
9. Tighten two front oil pump cap screws which were left loose.

NOTE—Cover should protrude .003 to .013 inches out of case. (Fig. 501)

Check Governor Runout

1. Mount a dial indicator on side of transmission case so that spindle of indicator rests against governor oil delivery sleeve, as shown in Fig. 503.
2. Rotate transmission driven shaft by hand several revolutions and note runout as measured on dial indicator. Total runout should not exceed .005".
3. If governor oil delivery sleeve runout is within the .005" limit, remove dial indicator.
4. If governor oil delivery sleeve runout exceeds .005", mark position of governor body on driven flange. Remove two screws holding governor body to drive flange.
5. Relocate dial indicator on transmission case so that spindle of indicator rests

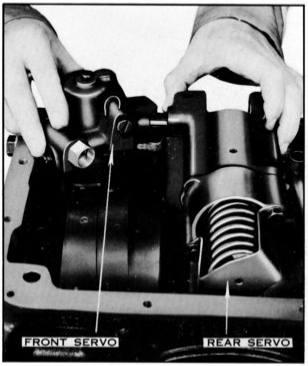


Fig. 499. Installing Both Servos

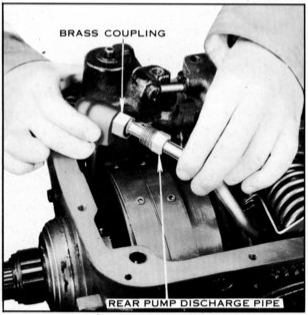


Fig. 500. Installing Rear Pump Discharge Pipe

against face of governor drive flange. (Fig. 504)

6. Rotate transmission driven shaft several revolutions by hand and note runout of drive flange as measured on dial indicator. Runout should not exceed .002".

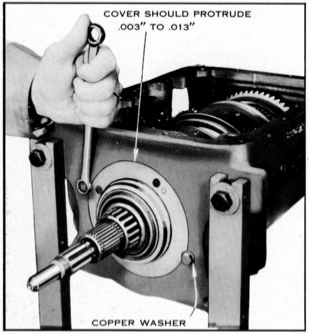


Fig. 501. Installing Pump Cover Cap Screws

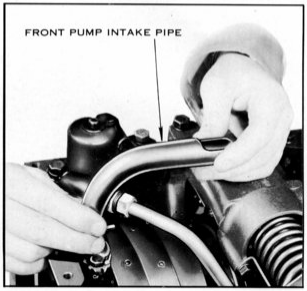


Fig. 502. Installing Front Pump Intake Pipe

7. If runout of drive flange exceeds .002", correct condition by replacing one or all of the following parts—governor drive flange, gear set or complete rear oil pump assembly.
8. If the runout of governor drive flange is less than .002", rotate governor body 180° from original position on flange and reinstall governor body on flange.

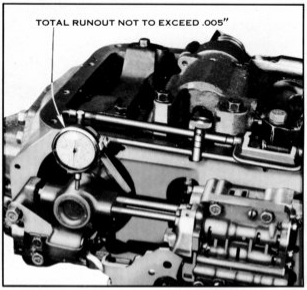


Fig. 503. Checking Governor Runout

Fig. 504. Checking Drive Flange Runout

9. Relocate dial indicator on governor sleeve and check runout as described in step (2).
10. If governor body oil delivery sleeve runout still exceeds .005", replace governor and sleeve.

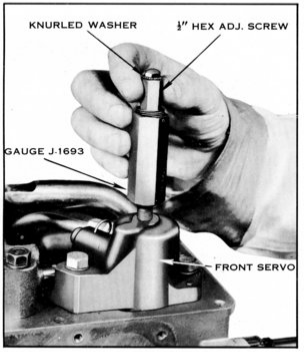


Fig. 505. Adjusting Front Band

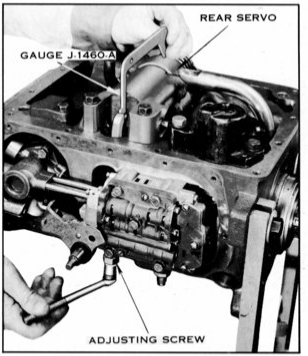


Fig. 506. Adjusting Rear Band

Adjust Front Servo Band

1. Remove the screw plug from bottom of front servo and screw gauge J-1693 in place, tightening by HAND ONLY.
2. Tighten the ½" "hex" adjusting screw with fingers until the stem of gauge J-1693 is felt to *JUST* touch piston in front servo. (Fig. 505)
3. Using a ½" wrench, tighten this same ½" "hex" adjusting screw six complete turns from the point where it was felt by hand that stem *JUST* touched piston.
4. Tighten front band adjusting screw until knurled washer just begins to loosen on top of the band adjusting gauge J-1693. While tightening screw, always turn drum so band becomes centered over drum.
5. Hold adjusting screw and tighten band adjusting screw lock nut securely.
6. Loosen ½" "hex" adjusting screw and remove gauge J-1693 and reinstall screw plug and tighten.

Adjust Rear Servo Band

1. Using rear servo band gauge J-1460-A or gauge J-5071 tighten rear servo adjusting screw until front face of gauge contacts band actuating lever. (Fig. 506) While tightening screw, always turn drum so band becomes centered over drum.

   CAUTION—Do not go beyond adjustment. If adjusting screw is accidently turned beyond adjustment, loosen screw two or three turns and again make adjustment.
2. Hold band adjusting screw in this position and tighten adjusting screw lock nut.
3. Remove gauge.

Install Pressure Regulator Assembly and Pressure Line Plug

1. With pressure regulator valve assembled into spring, locate valve on seat in front pump.
2. Place a new gasket over pressure regulator plug.
3. Position regulator plug over spring and tighten in transmission case.

Install Side Cover

1. Just start attaching screws with copper washers to line up pan. Center hole over manual lever shaft and tighten pan in place.
2. Install outer manual control lever using care to align serrations on manual control shaft and lever. Tighten clamp bolt.

   NOTE—Outer throttle lever was removed from throttle shaft before the transmission was removed from the car. Outer throttle lever should be installed on shaft *after* the transmission is installed in the car. This will prevent accidentally bending throttle lever when transmission is being removed or installed.

Installing Bell Housing and Torus Members

1. Remove transmission from holding fixture and place on bench.
2. Position gasket over front pump retaining screws against face of transmission case.
3. Position rear half of bell housing on front of transmission case, and install four mounting screws and lock washers.
4. Install torus cover on splines of front unit drive gear. Be careful not to damage oil seal rings.
5. Install drive torus on splines of intermediate shaft and install snap ring on intermediate shaft.
6. Install driven torus on main shaft against open type snap ring.
7. Move manual control lever (short lever) into reverse position. (All the way back.)
8. Install a NEW main shaft nut lock plate and install main shaft nut. Tighten with tool K.M.O. 334.
9. Bend main shaft nut lock plate up around nut.
10. Install oil dip stick.

    THE HYDRA-MATIC TRANSMISSION IS NOW READY FOR INSTALLATION INTO THE CAR.

    NOTE—When installing throttle lever, see Throttle Control Adjustments, Figs. 537 & 541, to assure correct position of hole in lever.

INSTALLING HYDRA-MATIC TRANSMISSION INTO CAR

1. Be sure the face of flywheel is thoroughly cleaned.
2. Place a new gasket to the face of flywheel. It is very important that the gasket be in

perfect condition, that the flywheel is free of any burrs and a good seal is made to prevent any possible leaks. Gasket should be held in place with white vaseline. Do not use shellac or sealer.

3. Lift transmission into position with Hydra-Lift.

   NOTE—While lifting transmission into car, position main shaft pilot into end of crankshaft.

4. Push transmission forward to position rear bell housing over dowels in front bell housing, and torus cover over dowel pins in flywheel. Tighten transmission in place by installing rear bell housing attaching bolts with lock washers. Remove lift.

   NOTE—On 8 cylinder engine one dowel is larger than standard. Torus cover can be assembled in one position only.

5. Install and tighten torus cover to flywheel cap screws with a speed wrench and then draw cap screws up to 30 ft. lbs. with a torque wrench.
6. Be sure to tighten the torus cover and oil pan drain plugs.

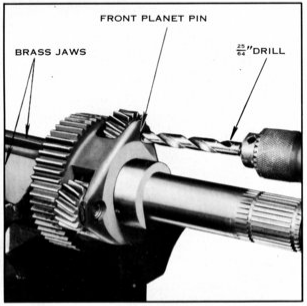


Fig. 507. Removing Swaged Metal from Pin

7. Raise the engine to approximately ½" above its normal height (just enough to install cross member).
8. Assemble the engine support cross member to the frame.
9. Lower the engine, being sure the engine mountings seat properly into the cross member.
10. Install rear engine mounting nuts with lock washers and tighten.
11. Remove rear engine support bar.
12. Install flywheel housing pan.
13. Install lower flywheel housing, starter, wiring, side pans, exhaust pipe bracket, and crankcase ventilator bracket.
14. Install propeller shaft.
15. Install speedometer cable.
16. Install throttle lever, rod, manual control rod and clevises.
17. Install front floor pan, mat and accelerator pedal.
18. Fill transmission with Hydra-Matic Drive Fluid. See Hydra-Matic Transmission Fluid Capacity, under MINOR ADJUSTMENTS.
19. Adjust throttle and manual control rods.
20. Lower the car to floor.

HYDRA-MATIC MAINTENANCE SERVICE

Planetary Pinion Pins

The planetary pinion pins in the Hydra-Matic transmission are induction hardened, and are pre-headed on one end. All planet pins are installed at the factory from the back face of each unit and swaged out at three spots into a small countersink at the front end. Therefore, whenever a planet pin is removed, the front end having the three swage spots must be drilled to remove the metal forced into the small counterbore, before the pin is removed.

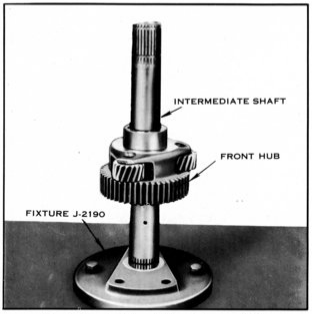


Fig. 508. Position Shaft to Remove Pins

Installing New Front Pinion Gears, Pins and Needle Bearings

1. Hold the front planetary assembly in a vise having soft jaws to prevent any possible damage to the hub.
2. With the use of a 25/64" drill, remove the swaged metal from the front end of each pin. (Fig. 507)
   NOTE—Drill only to the depth of counterbore to avoid removing any metal from sides of hole in the carrier.
3. Remove unit from vise and place into holding fixture with hub down. (Fig. 508)
4. With use of tool J-2144-3 and a light hammer drive planet pins through carrier, thrust washers and needle bearings. (Fig. 509)
5. Thoroughly clean the hub and then replace assembly into holding fixture with the hub up.
6. With the use of tool J-2144-2, assemble 19 needle bearings into pinion gear, using vaseline to hold needle bearings in place in gear.
7. Assemble top thrust washer to hub held in place with vaseline.

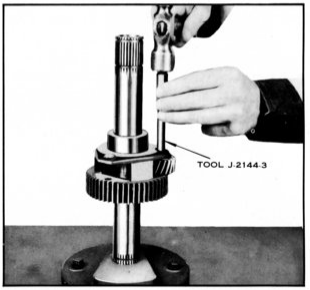


Fig. 509. Removing Planet Pins

8. Assemble bottom thrust washer to pinion gear over tool J-2144-2.
9. Slide pinion gear, needle bearings, thrust washer and tool J-2144-2 into position in hub, aligning hole in hub with hole in pinion gear. (Fig. 510)
10. Lift shaft from holding fixture just enough to push pilot of tool J-2190-8 through pinion gear removing tool J-2144-2. Assemble unit back into holding fixture with tool

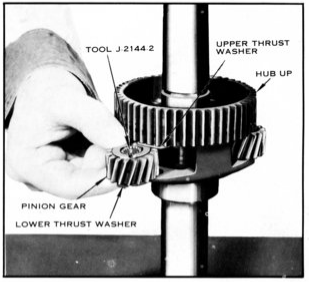


Fig. 510. Installing Pinion Gear

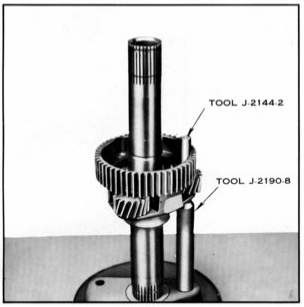


Fig. 511. Removing Tool J-2144-2

J-2190-8 in place in holding fixture. The new pin is driven into the assembly while the spring loaded pilot holds the pinion gear, needle bearings and thrust washer in place. (Fig. 511)

11. Start new pin into hole in hub by tapping lightly with a hammer.

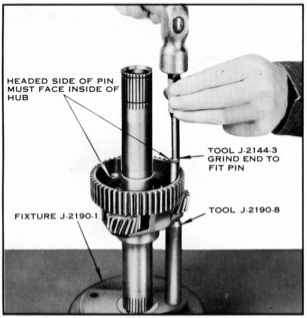


Fig. 512. Installing Planet Pins

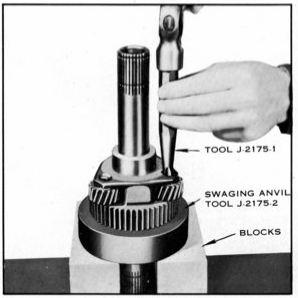


Fig. 513. Swaging Planet Pins

CAUTION—The shoulder section or headed side of pin must face the *inside* of the hub. (Fig. 512)

12. Finish driving pin up to the shoulder by placing tool J-2144-3 in center of pin. (Fig. 512)
13. Remove assembly from holding fixture and place over anvil J-2175-2. Position the swaging tool J-2175-1 over planet pin and swage end of each pin. (Fig. 513)

    CAUTION—Be sure a solid job of swaging is done. This can be determined by examining the pin to see that swaging has moved the metal out into the small counterbore at three spots.
14. Check gears for free movement.

Installing New Rear Pinion Gears, Pins and Needle Bearings

1. Hold the output shaft in a vise having soft jaws to protect shaft against damage while drilling pins.
2. With the use of a 25/64″ drill, remove the swaged metal from the front end of each pin.

   NOTE—Drill only to the depth of the counterbore to avoid removing any metal

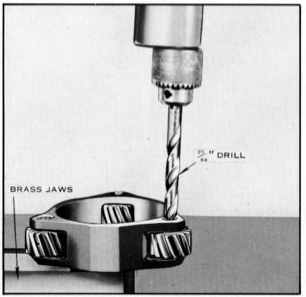


Fig. 514. Drilling Rear Unit Planet Pins

from the sides of the hole in carrier. (Fig. 514)

3. With the use of tool J-2144-3 and a light hammer, drive planet pins through carrier, thrust washers and needle bearings. (Fig. 515)
4. Thoroughly clean assembly.
5. With the use of tool J-2144-2 assemble 19 needle bearings into pinion gear, held in place with vaseline.

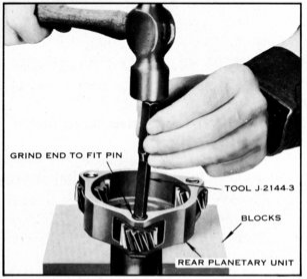


Fig. 515. Removing Rear Unit Planet Pins

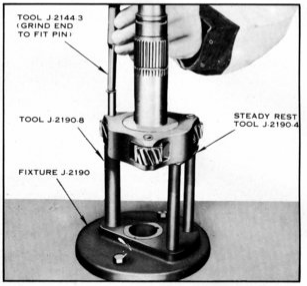


Fig. 516. Installing Rear Unit Planet Pins

6. Position top and bottom thrust washer onto pinion gear.
7. Slide pinion gear, needle bearings, thrust washers and tool J-2144-2 into position in carrier, aligning hole in carrier with hole in pinion gear. (Fig. 517)
8. Push the pilot of tool J-2190-8 through pinion gear, removing tool J-2144-2.

   NOTE—Tool J-2190-4 should be placed over dowels of holding fixture, to steady the output shaft. (Fig. 516)

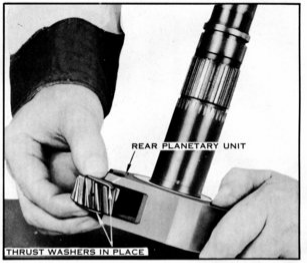


Fig. 517. Installing Rear Pinion Gears

9. Start new pin into hole in hub by tapping lightly with a hammer.

   NOTE—There is no specified position for the shoulder, "Headed Side", of pin in the *rear* unit.

10. Finish driving pin up to shoulder by placing tool J-2144-3 in center of pin. (Fig. 516)
11. Remove assembly and place over anvil J-2175-2, (having heads of pins against anvil). Position the swaging tool J-2175-1 over planet pin and swage end of each pin in the same manner as shown in Fig. 513.

    CAUTION—Be sure a solid job of swaging is done. This can be determined by examining the pin to see that swaging has moved the metal out into the small counterbore at three spots.
12. Check gear for free movement.

Installing New Reverse Pinion Gears, Pins and Needle Bearings

The installation of pinion pins in the reverse carrier assembly requires first, the removal of the rear oil pump bronze drive gear from hub of reverse carrier. Removing and replacing the bronze drive gear is covered under REPLACEMENT OF BRONZE OIL PUMP DRIVE GEAR. (Figs. 526, 527 & 528) With bronze gear removed, proceed as follows to replace pinion and pins:

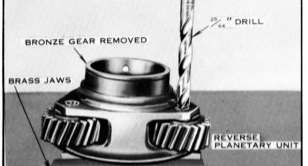


Fig. 518. Drilling Reverse Planet Pins

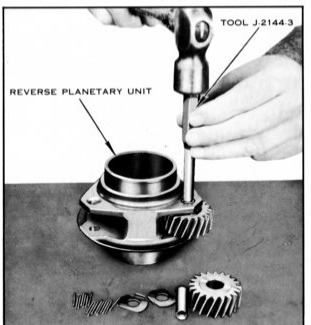


Fig. 519. Removing Reverse Planet Pins

1. Hold the reverse planet carrier assembly in a vise having soft jaws. (Fig. 518)
2. With the use of a 25/64″ drill, remove the swaged end of each pin. (Fig. 518)
3. Using tool J-2144-3 and a light hammer drive planet pins through carrier, thrust washers and needle bearings. (Fig. 519)
4. Thoroughly clean assembly.
5. With the use of tool J-2144-2 assemble 19 needle bearings into pinion gear, held in place with vaseline.
6. Position top and bottom thrust washer to pinion gear.
7. Slide pinion gear, needle bearings, thrust washers, pinion pin and tool J-2144-2 into position in carrier aligning hole in carrier with hole in pinion gear. (Fig. 522)
8. Push pilot of tool J-2190-2 through pinion gear, removing tool J-2144-2.

   NOTE—Place assembly into holding fixture so new pins can be driven into the as-

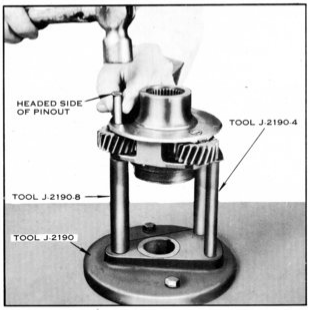


Fig. 520. Starting New Pin into Assembly

sembly while spring loaded pilot holds pinion gear, needle bearings and thrust washers in place. (Fig. 521)

9. Start new pin into hole in carrier by tapping lightly with a hammer.

   CAUTION—The shoulder or headed section of pin must be positioned so it faces the *outside* of the carrier. (Fig. 520)

10. Finish driving pin up to shoulder by plac-

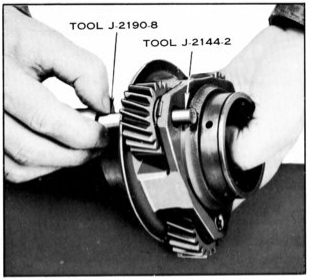


Fig. 521. Removing Tool J-2144-2

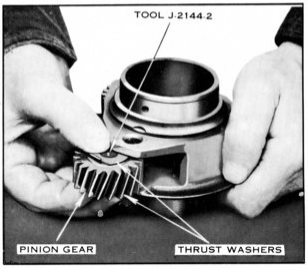


Fig. 522. Installing Reverse Pinion Gears

ing tool J-2144-3 in center of pin. (Fig. 523)

11. Remove assembly and place over anvil J-2175-2 (having heads of pins against anvil). Position swaging tool J-2175-1 over end of planet pin and swage end of each pin in the same manner as shown in Fig. 513.

    CAUTION—Be sure a solid job of swaging has moved the metal out into the small counterbore at three spots.

12. Check gears for free movement.

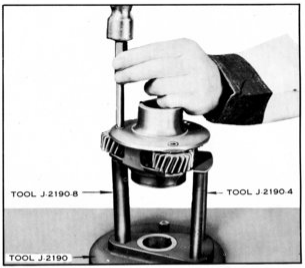


Fig. 523. Installing Reverse Planet Pins

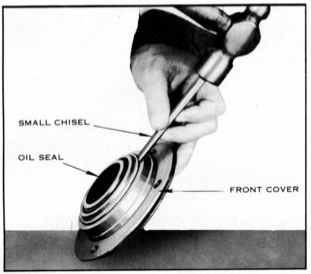


Fig. 524. Removing Front Cover Oil Seal

13. Install a new bronze drive gear. (Figs. 528 & 529)

Installing New Front Cover Oil Seal

1. Remove the oil seal assembly from front pump cover. This is done by using a small chisel and hammer. Drive the blade into the metal and outward.

Fig. 525. Installing Front Cover Oil Seal

NOTE—Seal will be damaged as this is the only way to remove seal without possible damage to the cover. (Fig. 524)

2. Thoroughly wash cover removing all particles of dirt and sealing compound.
3. Place the cover on a bench, having the oil seal and oil seal installer in position in the cover. (Fig. 525)
4. With oil seal assembly lined up with hole in cover, tap oil seal into cover.

   NOTE—Use sealing compound, (Permatex No. 3, Aviation Form-A-Gasket Cement) to seal between cover and seal.

Replacement of Bronze Oil Pump Drive Gear

1. Remove bronze drive gear retainer ring with use of snap ring pliers and small screw driver. (Fig. 526)
2. Carefully hold the reverse planet assembly in a vise.
3. Saw the bronze gear between two gear teeth to within 1/32" of hub.

   CAUTION—Use care not to saw into hub. After the gear has been sawed to within

Fig. 526. Removing Bronze Gear Retainer Ring

Fig. 527. Remove Bronze Drive Gear

1/32" of hub, select a chisel that has a blunt taper to split gear. Do not use a slender tapered chisel.

4. Place a small chisel in saw groove and split bronze gear to remove gear. (Fig. 527)
5. Remove small steel locating ball from hub.

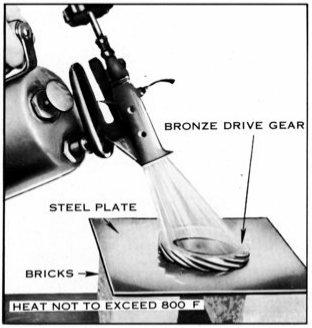


Fig. 528. Heating Bronze Drive Gear

Fig. 529. Removing Check Valve Rivet

6. Thoroughly clean all grit or filings from hub. Use a small stone to smooth edges of the sharp shoulder and snap ring groove.
7. Place small steel locating ball in hole in hub, held in place with vaseline.
8. Place a new bronze gear on metal plate supported by two bricks; heat gear with a torch until gear just begins to discolor or shows traces of blue.

   CAUTION—Gear must not be heated to more than 800° F. for shrinking in place. (Fig. 528)
9. Using heavy canvas gloves, pick the gear up and drop it quickly over reverse planet carrier and immediately hold gear all the way down against shoulder.
10. Inspect assembly to be sure gear is properly positioned.
11. Install retaining ring.

Installing a New Accumulator Check Valve

1. With a small punch and light hammer, remove the small rivet holding the check valve in the accumulator body. (Fig. 529)
2. Remove check valve.
3. Remove plunger type release valve, flat check valve and rivet. (Fig. 530)
4. Clean plunger type release valve and accumulator body.

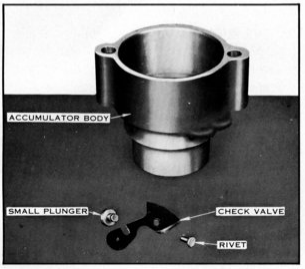


Fig. 530. View of Check Valve Disassembled from Body

5. Replace plunger type release valve into accumulator body.
6. Position the check valve into accumulator body, slipping notch in valve under the shoulder at the small end of plunger. (Fig. 531)
7. Push rivet through hole in check valve and accumulator body.

   NOTE—Head of rivet must be toward flat check valve.

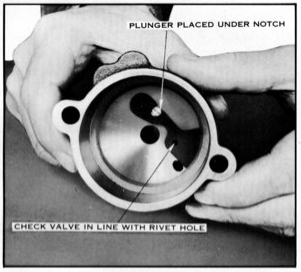


Fig. 531. Check Valve and Plunger Assembled in Body

8. With check valve held in proper position (be sure small bleed hole is fully open over bleed hole in body, and that check valve does not touch the side of casting), stake rivet holding valve in place.
9. Check assembly by working small plunger type release valve to be sure the flat check valve is free.

MINOR SERVICE ADJUSTMENTS

Hydra-Matic Transmission Lubrication

The Hydra-Matic Transmission should be drained through the torus cover and oil pan at the end of the first 15,000 miles and at each 15,000 mile interval thereafter. The fluid level should be checked every 2,000 miles and Hydra-Matic Drive Fluid added if necessary. It is important that only Oldsmobile Hydra-Matic Drive Fluid be used in the Oldsmobile Hydra-Matic Drive. This all-season fluid, good for year-round operation, is available through authorized dealers.

NOTE—In cases of emergency, when Hydra-Matic Fluid is not available, any good grade of 20-W engine oil will operate for a temporary period. When such oil is used, however, all the fluid should be replaced as soon as possible by Oldsmobile Hydra-Matic Fluid.

Checking Fluid Level

1. Raise right edge of front compartment mat.
2. Remove small sheet metal cover over dip stick.

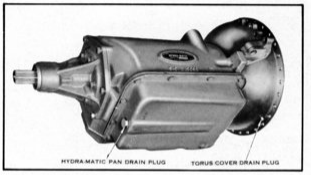


Fig. 532. Hydra-Matic Transmission Drain Plugs

CAUTION—Be sure to clean gravel, sand or lint from floor around oil dip stick before removing oil dip stick from transmission.

3. Set hand brake and start engine. (Allow engine to remain idling.) Move the control lever to the DR range.
4. Remove dip stick and wipe dry.
5. While engine is still idling, replace dip stick and remove quickly to check level of fluid. Fluid level should check to the "FULL" mark. Additional fluid should be added to bring the fluid level up to the "FULL" mark with the engine idling whenever fluid is required.

Draining Hydra-Matic Transmission

NOTE—Whenever the Hydra-Matic Transmission fluid is changed, the fluid must be removed through the drain plug hole in the torus cover and rear of transmission oil pan.

To drain oil, proceed as follows:

1. Remove (flywheel under pan) clutch housing pan on 6 cylinder, inspection plate on 8 cylinder.
2. Remove "hex head" ⅛" pipe plug from torus cover.
3. Remove drain plug at back of transmission oil pan. (Fig. 532)
4. Replace both drain plugs and tighten.
5. Replace (flywheel under pan) clutch housing pan on 6 cylinder, inspection plate on 8 cylinder.
6. Raise right edge of front compartment mat.
7. Remove small sheet metal cover.

   CAUTION—Be sure to clean gravel, sand or lint from floor and around oil dip stick before removing oil dip stick from transmission.
8. First add eight quarts of Hydra-Matic Fluid to the transmission.
9. Set the hand brake and start the engine, let engine run for one-half minute. Then add three more quarts of fluid.

   NOTE—Eleven quarts of oil are required to fill the transmission after the transmission is drained. After fluid has been added, level should be checked to make sure that the oil level is up to the "FULL" mark on the oil level dip stick.

Filling Hydra-Matic Transmission After Rebuilding

(Transmission Replaced in Car)

1. Remove oil level dip stick.
2. Add eight quarts of Hydra-Matic Fluid.
3. Set the hand brake and start the engine. Let the engine run for several minutes. Then add three and one-half quarts of fluid.

   NOTE—Eleven and one-half quarts of oil are required to fill the transmission after rebuilding the transmission. To be sure eleven and one-half quarts have been added, again check the fluid level to see that the oil level is up to the "FULL" mark on the oil level dip stick.

Adjusting Hydra-Matic Bands Externally

To make certain that the Hydra-Matic transmission band adjustment is correct after the run-in period, it is recommended that the bands be checked and adjusted if necessary at the end of the first 2,000 miles of operation. After making certain that the band adjustment is correct by an initial 2,000 mile inspection, it is unnecessary to make any further periodic band adjustment except as indicated by transmission performance. The bands can be adjusted externally provided that tool J-2681 and a tachometer are available.

DO NOT ATTEMPT TO ADJUST BAND EXTERNALLY WITHOUT TOOL J-2681 AND A TACHOMETER.

If tool J-2681 and tachometer are not available, bands should be adjusted as outlined under

ADJUSTING HYDRA-MATIC BANDS WITH PAN REMOVED.

To adjust bands externally proceed as follows:

1. Set parking brake firmly and block front wheels to prevent car moving forward during adjustment.
2. Remove floor mat and adjusting hole cover.
3. Start engine and allow it to run until temperature is normal (choke and fast idle off).
4. Connect electric tachometer to engine.
5. Position selector lever in Drive range (DR).
6. Adjust carburetor idle to 700 R.P.M. Be sure tachometer idle speed adjusting switch is set on 1000 R.P.M. scale.

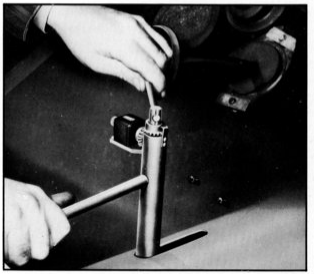


Fig. 533. Adjusting Bands with Tool J-2681

Front Band Adjustment

1. Using band adjusting tool J-2681 loosen band adjusting screw lock nut. (Fig. 533)
2. Loosen band adjusting screw until engine speed increases to 900-1000 R.P.M. (front drum now spinning freely).

   NOTE—If engine fails to increase speed to 900-1000 R.P.M. this is an indication that the band is slipping badly under normal driving conditions. The transmission oil pan should be dropped and the bands and drums inspected for damage. If no apparent damage is evident, adjust both bands using tools J-1693 and J-5071 as outlined under ADJUSTING HYDRA-MATIC BANDS WITH PAN REMOVED. It will not then be necessary to reset the band externally after the pan is installed.
3. Tighten band adjusting screw slowly until engine speed returns to 700 R.P.M. (front drum now stopped).
4. Loosen band adjusting screw until engine speed again increases and retighten slowly until engine speed returns to 700 R.P.M.

   NOTE—The object in loosening and retightening the screw is to locate the exact point at which the band stops the drum from spinning.
5. After loosening and retightening band to the exact point of which the drum stops turning, wait 30 seconds. If engine speed increases, tighten screw 1/10 of a turn. Wait 30 seconds and if engine speed again increases, tighten screw 1/10 of a turn more.

   Repeat this procedure until engine speed remains at 700 R.P.M. for at least 30 seconds.
6. Set counter on tool J-2681 to Zero (0.0).
7. While holding lock nut stationary with long handle of tool, tighten adjusting screw exactly 5½ turns with short handle (counter will read 5.5).
8. Hold adjusting screw stationary with short handle and tighten lock nut with long handle.

Rear Band Adjustment

1. Repeat operations 1, 2, 3, 4, 5 and 6 under heading FRONT BAND ADJUSTMENT.
2. Position selector lever in neutral (N).
3. While holding lock nut stationary with

long handle of tool, tighten band adjusting screw exactly 2 turns with short handle (counter will read 2.0).

4. Position selector in drive range (DR).
5. Hold adjusting screw stationary with short handle and tighten lock nut with long handle.
6. Return selector lever to neutral (N) position. NOTE: ADJUST ENGINE IDLE SPEED TO 375 R.P.M. ENGINE AND TRANSMISSION WARM, SELECTOR LEVER IN NEUTRAL POSITION.

Adjusting Hydra-Matic Bands With Pan Removed

NOTE—The speedometer is no measuring stick to adjust bands. Band adjustment is made if ever there is an indication of slipping or if for any reason the pan is removed, the adjustment should be inspected.

1. Drain Hydra-Matic fluid from transmission.
2. Raise front end of car to rest on car jacks to remove transmission oil pan.
3. Raise left side of front, compartment mat.
4. Remove metal plate over band adjusting screws.
5. Loosen both servo band adjusting screw lock nuts.

Front Band Adjustment

1. Loosen band adjusting screw approximately five (5) turns.
2. Loosen ½" "hex" adjusting screw of servo gauge J-1693, until approximately ⅛" of threads are exposed above gauge.
3. Remove pipe plug from bottom of front servo.
4. Screw front servo gauge J-1693 into front servo, tighten by HAND only.
5. Tighten the ½" "hex" adjusting screw with fingers until the stem of gauge J-1693 is felt to *JUST* touch piston in front servo.
6. With a ½" wrench, continue tightening plunger six full turns from the point where it was felt by hand that stem of gauge *JUST* touched piston.
7. Tighten band adjusting screw using a ⅜" wrench until knurled washer on gauge has just lifted (free) off its seat.
8. Tighten band adjusting screw lock nut securely, while holding adjusting screw.
9. Loosen ½" "hex" adjusting screw first and then remove gauge from servo.
10. Install screw plug in servo.

Rear Band Adjustment

1. Place servo gauge J-1460-A or gauge J-5071 on finished surface of accumulator body, having leg of gauge resting on servo stem.
2. Back off adjusting screw until face of actuating lever is well away from face of gauge.
3. Tighten band adjusting screw to the point at which band actuating lever face just touches face of gauge.
4. Tighten band adjusting screw lock nut securely while holding adjusting screw.

   NOTE—Do not actuate lever, but recheck setting with gauge after lock nut has been tightened.

Hydra-Matic Transmission Manual Control Adjustment

1. Loosen two clevis check nuts, one at the lower control relay rod to manual lever on side of transmission and one at the lower control rod to intermediate lever on bracket mounted to cross member.
2. Remove cotter pins, clevis pins and spring washer from both clevises.

   NOTE—It is important to use spring washers when assembling clevis ends to levers to eliminate rattle.
3. Move manual control lever at the side of transmission all the way back into the re-

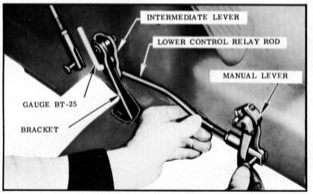


Fig. 534. Adjusting Lower Control Relay Rod

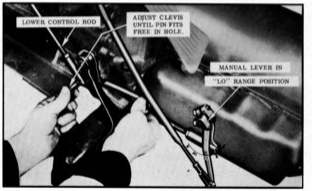


Fig. 535. Adjusting Lower Control Rod

verse position. To insure lever being in the extreme reverse position, rotate propeller shaft by hand until engagement of anchor is felt and lever is against stop.

4. Move intermediate lever on bracket until gauging hole is indexed with hole in bracket. Insert tool BT-25 through gauging hole in lever and bracket. (Fig. 534)
5. With manual lever on side of transmission held all the way back, adjust clevis so pin just slips freely through the clevis and lever.
6. Assemble pin, spring washer, cotter pin and tighten check nut.
7. Remove tool BT-25 from intermediate lever.
8. Move the manual lever on the side of transmission into the "LO" range position.

   NOTE—To find the "LO" range position:

   (a) Move the manual lever on side of transmission all the way forward ("NEUTRAL") position.

   (b) Move the manual lever back again to the second detent ("LO" range position).
9. Place upper (selector) lever against stop which prevents shifting into reverse without raising lever.

   NOTE—This can be done by pulling down on the lower control rod until stop is felt.
10. With the lower control rod held so the upper (selector) lever is against the stop, and the manual lever is in the "LO" range position, adjust clevis of lower control rod so that pin slips in hole freely. (Fig. 535)
11. Remove pin and lengthen rod one full turn of clevis from this position.
12. Assemble clevis pin, spring washer, cotter pin, and tighten check nut.

Hydra-Matic Safety Switch Adjustment (Solenoid Starter)

The Hydra-Matic Safety Switch adjustment should never be made until the manual control adjustment is correctly made.

To adjust safety switch, proceed as follows:

1. Loosen switch bracket locking screw just enough to permit moving of slotted bracket.
2. Move the selector lever into the neutral ("N") position.
3. Adjust switch so there is a clearance of 1/16" to 3/32" between lever and stop.
4. Tighten switch bracket locking screw.

Checking Hydra-Matic Transmission "Line" Oil Pressure

Oil pressure gauge adapter J-1467-8 is used with both oil gauges J-1467 and J-1467-M6 when checking oil pressure in the Hydra-Matic Transmission.

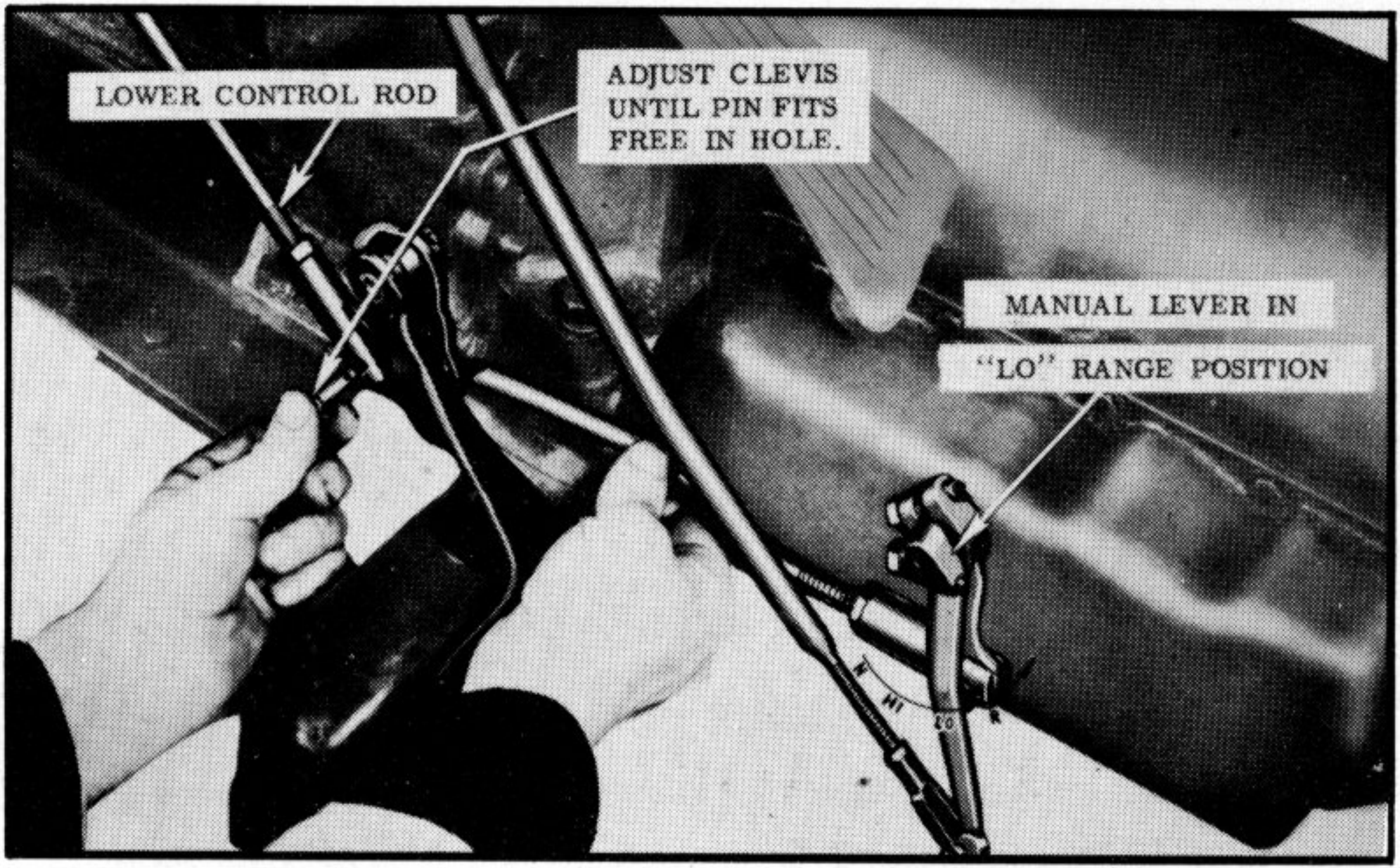


Fig. 535. Adjusting Lower Control Rod

To check the oil pressure proceed as follows:

1. Raise the left side of front compartment mat.
2. Remove metal plate over adjusting screws.
3. Remove ⅛" oil pressure line plug from transmission case.
4. Screw adapter J-1467-8 into transmission.
5. Disconnect adapter used for checking oil pressure in the transmission from hose of oil checking fixture J-1467 or J-1467-M6. NOTE—A small sleeve is used when using adapter J-1467-8 with fixture J-1467-M6.
6. With transmission oil warm, oil pressure should be from 55 lbs. to 85 lbs. with 375 R.P.M. engine idle. (Fig. 536)

Transmission Serial Numbers

The 1949 Oldsmobile Hydra-Matic Transmission will start with serial number P9 - 1 for the six cylinder engine and 09 - 1 for the eight cylinder engine. The number is stamped on a small plate found on the right side of the transmission case.

Hydra-Matic Drive Engine serial is to be suffixed by a letter "H" on six cylinder engines only; i.e. 6A1001H.

REPORTS ON HYDRA-MATIC DRIVE TRANSMISSION MUST ALWAYS INCLUDE THE TRANSMISSION NUMBER AS WELL AS CAR AND SERIAL NUMBERS.

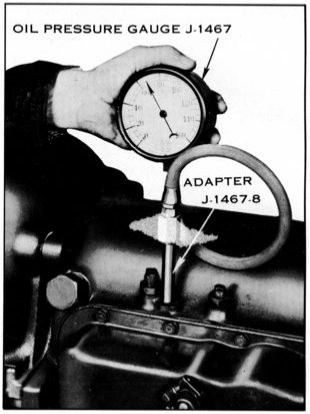


Fig. 536. Checking Hydra-Matic Oil Pressure

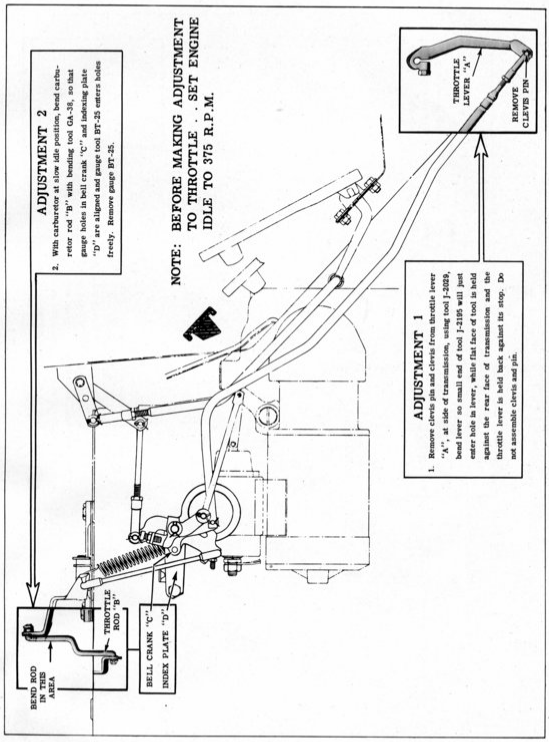


Fig. 537. Six Cylinder Hydra-Matic Throttle Control Adjustment

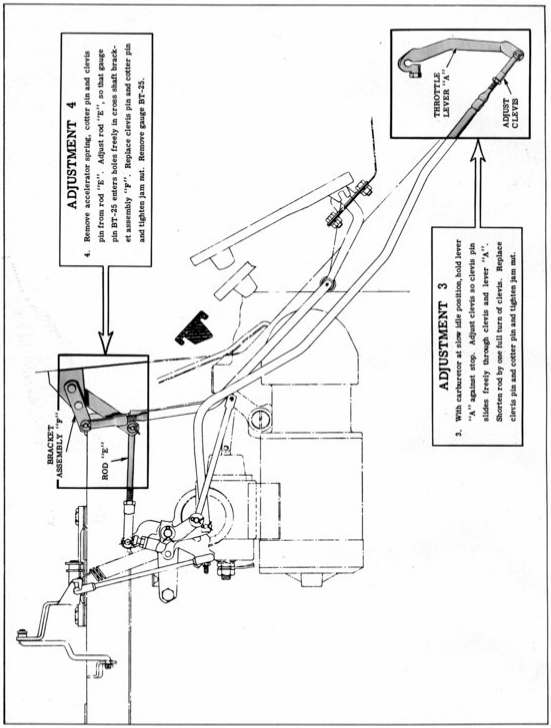


Fig. 538. Six Cylinder Hydra-Matic Throttle Control Adjustment

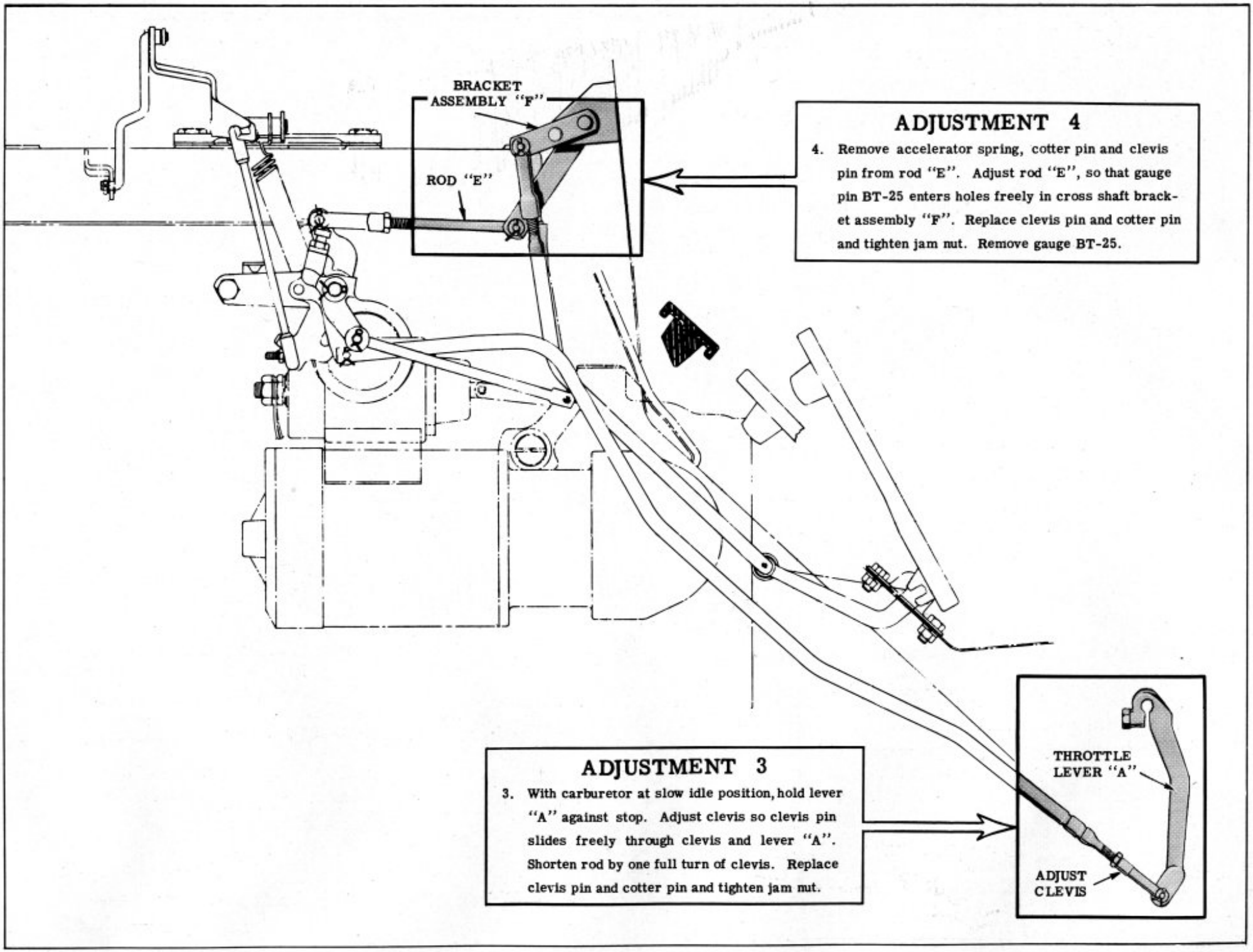


Fig. 538. Six Cylinder Hydra-Matic Throttle Control Adjustment

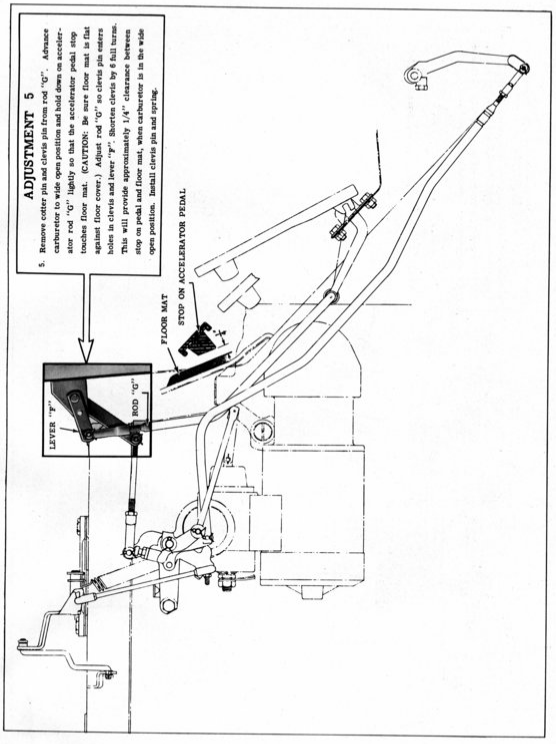
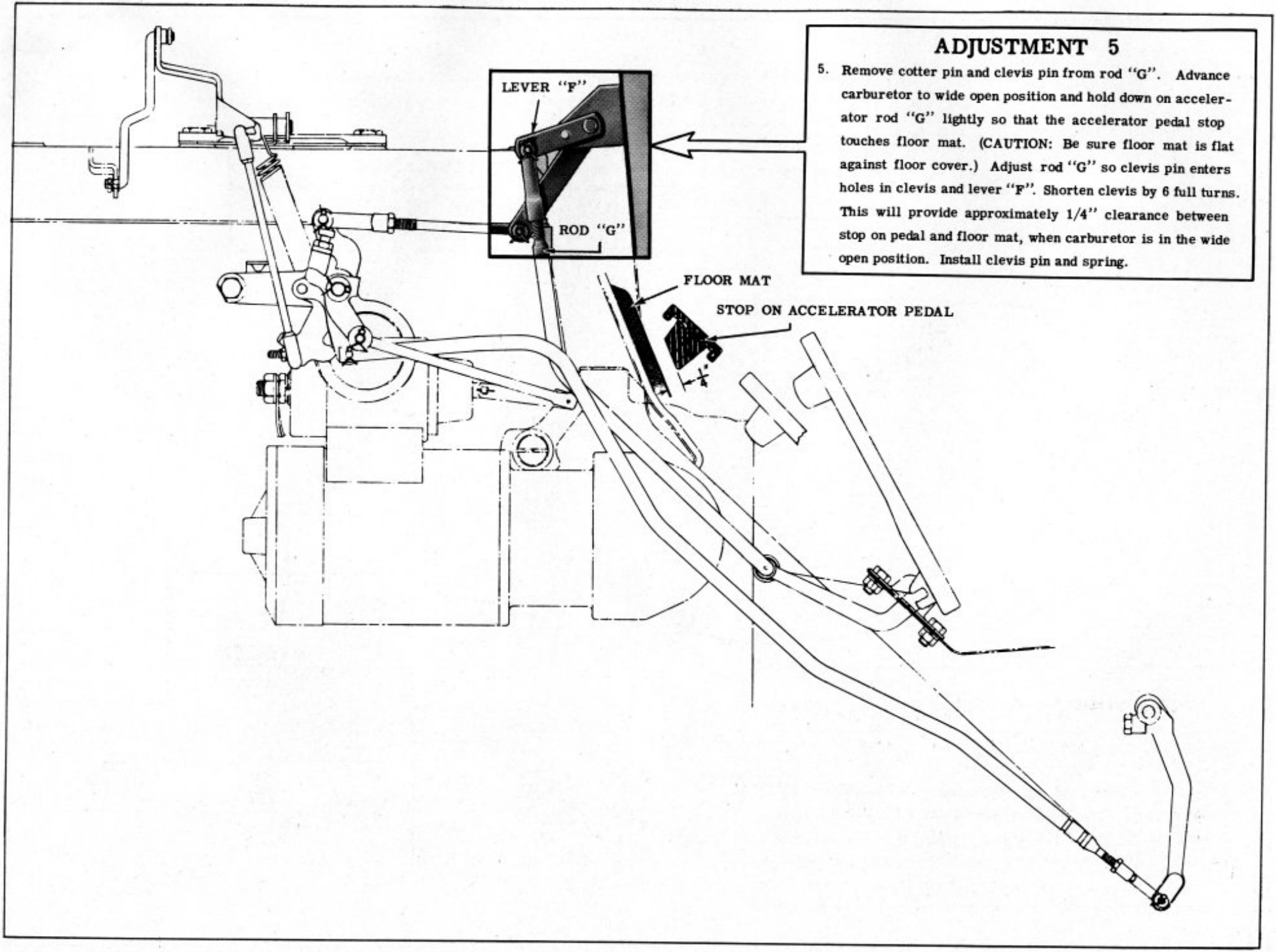


Fig. 539. Six Cylinder Hydra-Matic Throttle Control Adjustment



ADJUSTMENT 5

5. Remove cotter pin and clevis pin from rod "G". Advance carburetor to wide open position and hold down on accelerator rod "G" lightly so that the accelerator pedal stop touches floor mat. (CAUTION: Be sure floor mat is flat against floor cover.) Adjust rod "G" so clevis pin enters holes in clevis and lever "F". Shorten clevis by 6 full turns. This will provide approximately 1/4" clearance between stop on pedal and floor mat, when carburetor is in the wide open position. Install clevis pin and spring.

Fig. 539. Six Cylinder Hydra-Matic Throttle Control Adjustment

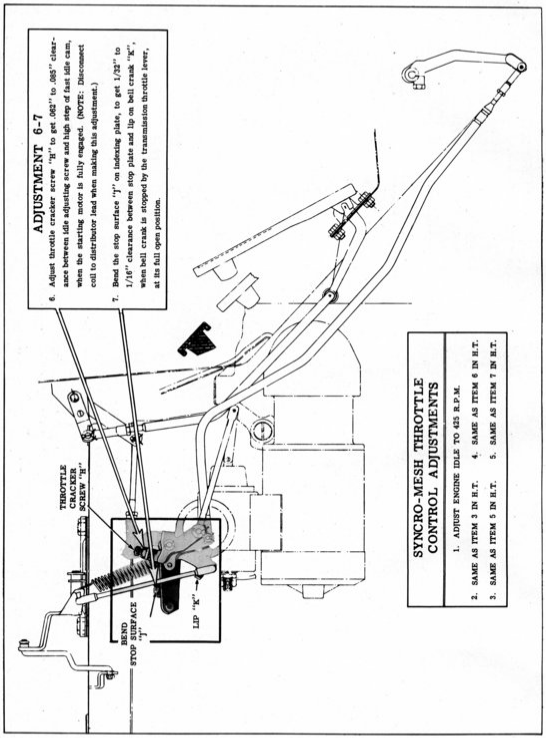


Fig. 540. Six Cylinder Hydra-Matic Throttle Control Adjustment

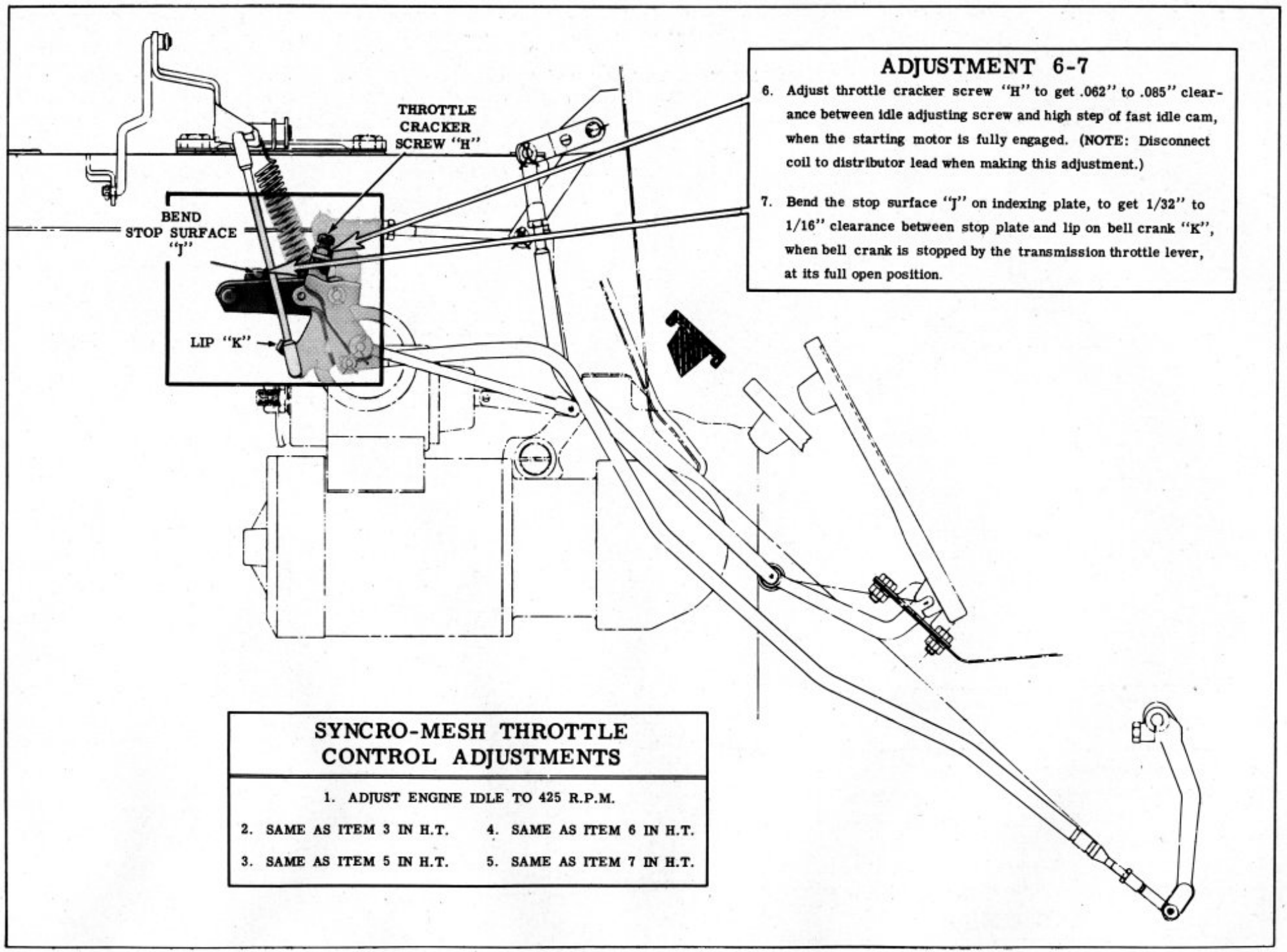


Fig. 540. Six Cylinder Hydra-Matic Throttle Control Adjustment

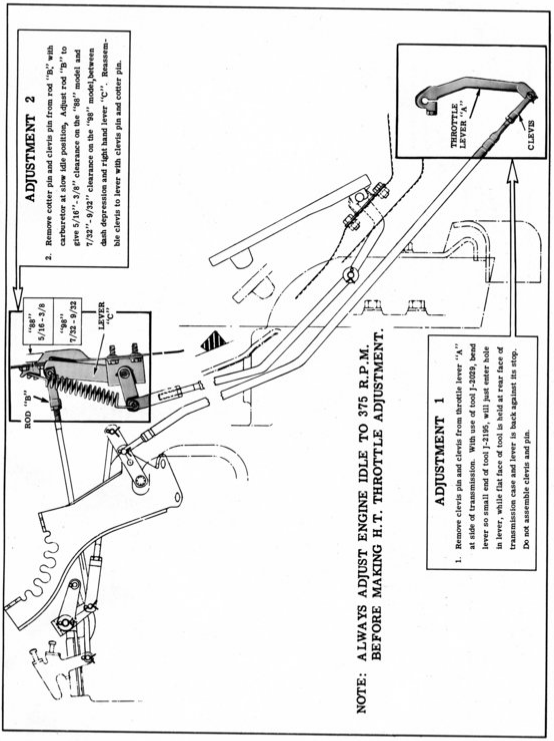


Fig. 541. Eight Cylinder Hydra-Matic Throttle Control Adjustment

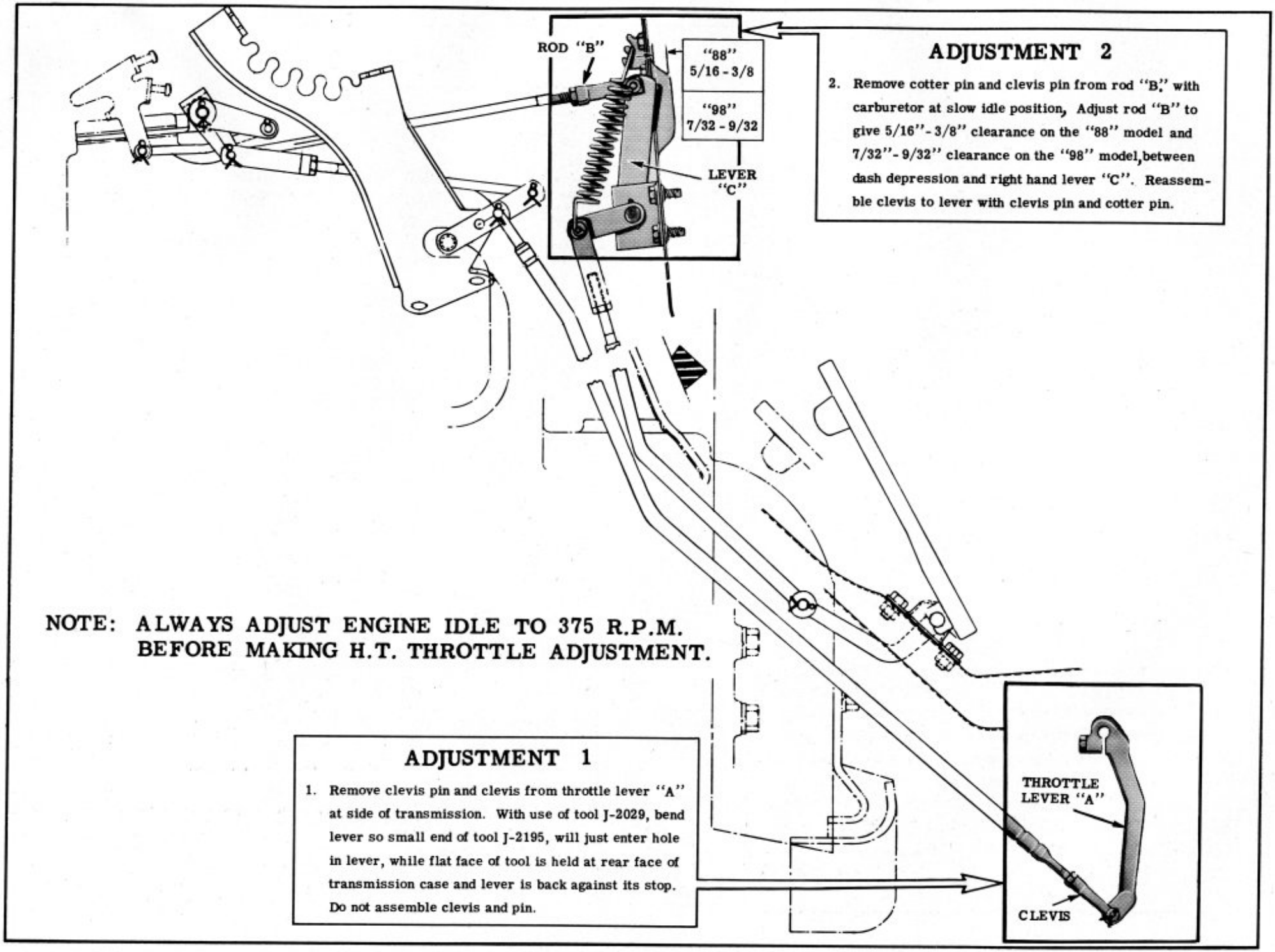


Fig. 541. Eight Cylinder Hydra-Matic Throttle Control Adjustment

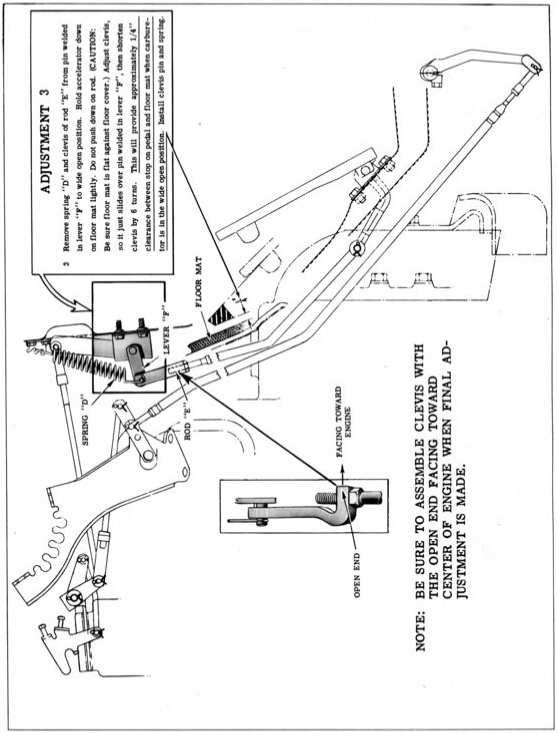


Fig. 542. Eight Cylinder Hydra-Matic Throttle Control Adjustment

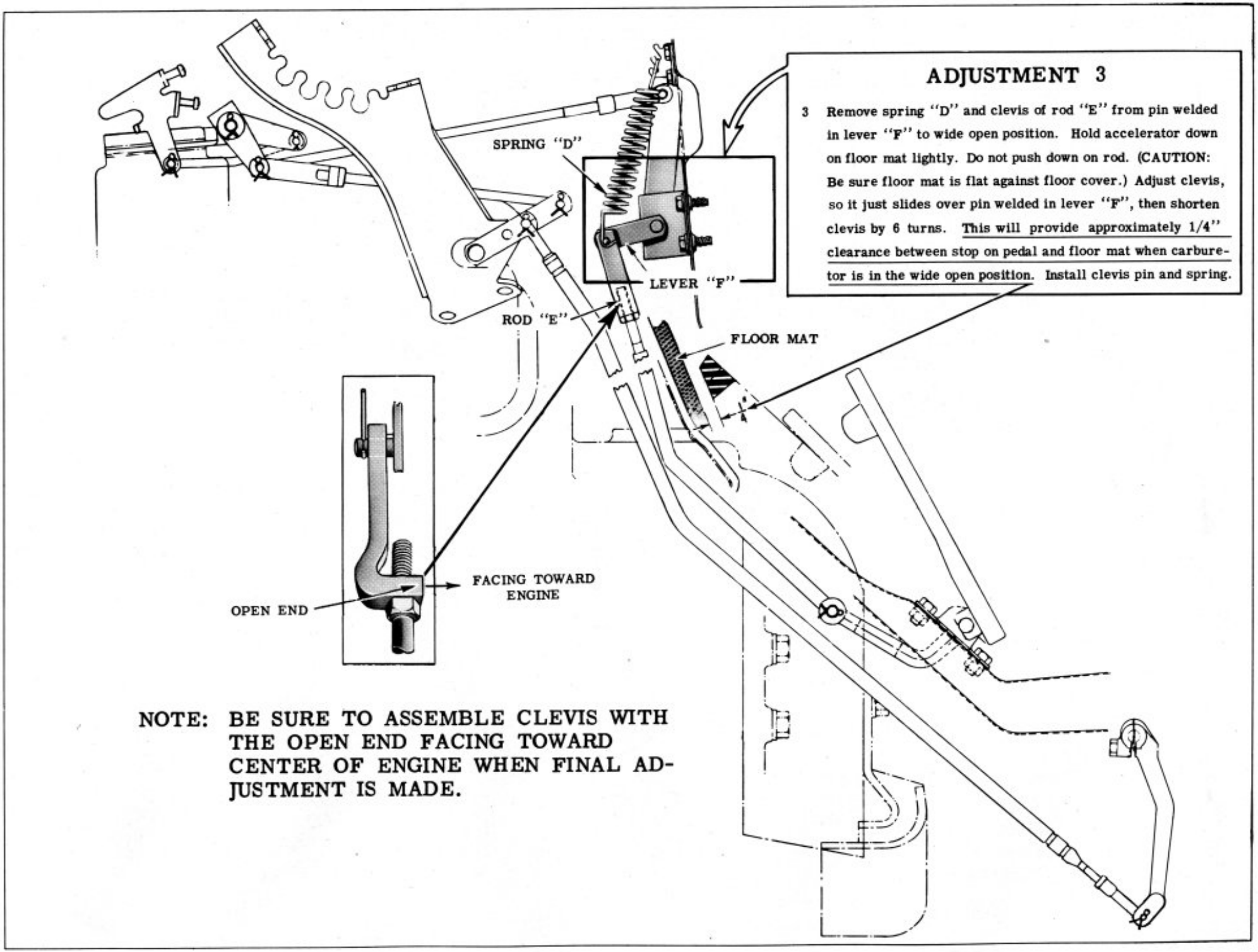


Fig. 542. Eight Cylinder Hydra-Matic Throttle Control Adjustment

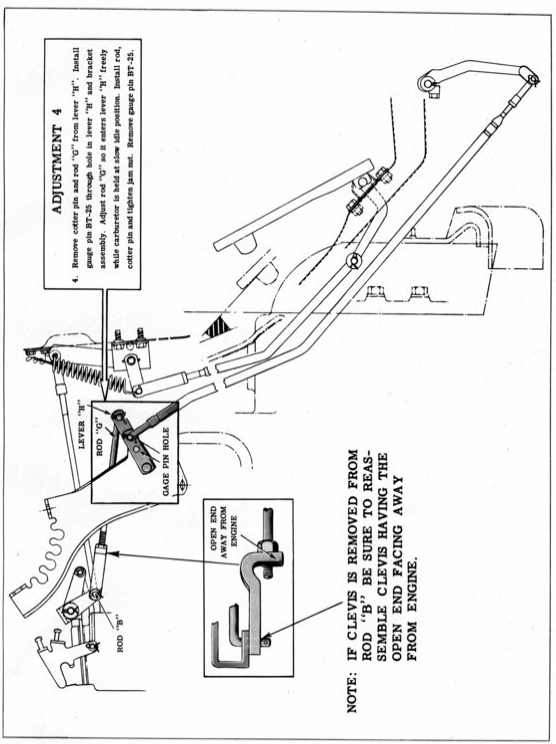


Fig. 543. Eight Cylinder Hydra-Matic Throttle Control Adjustment

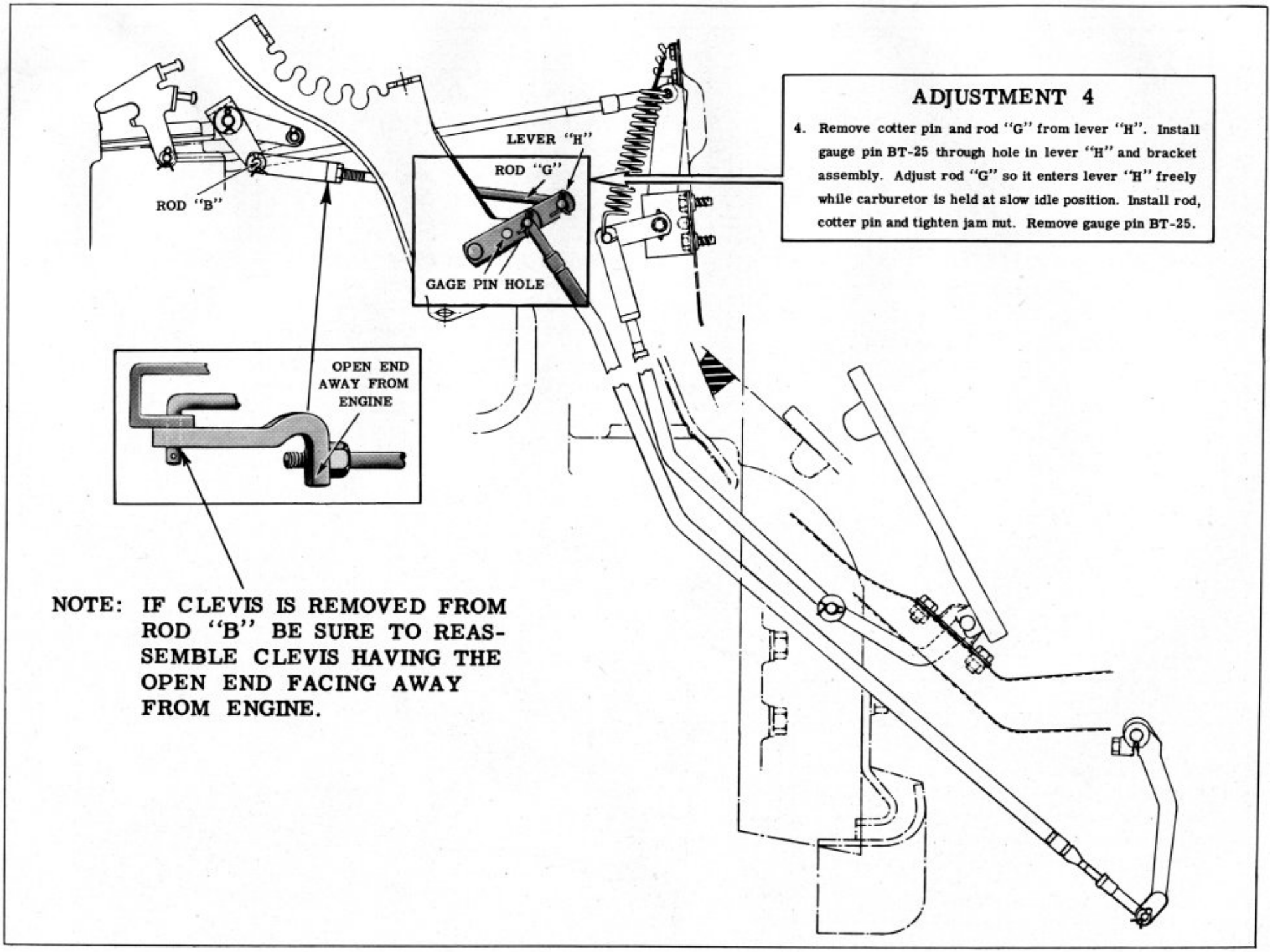


Fig. 543. Eight Cylinder Hydra-Matic Throttle Control Adjustment

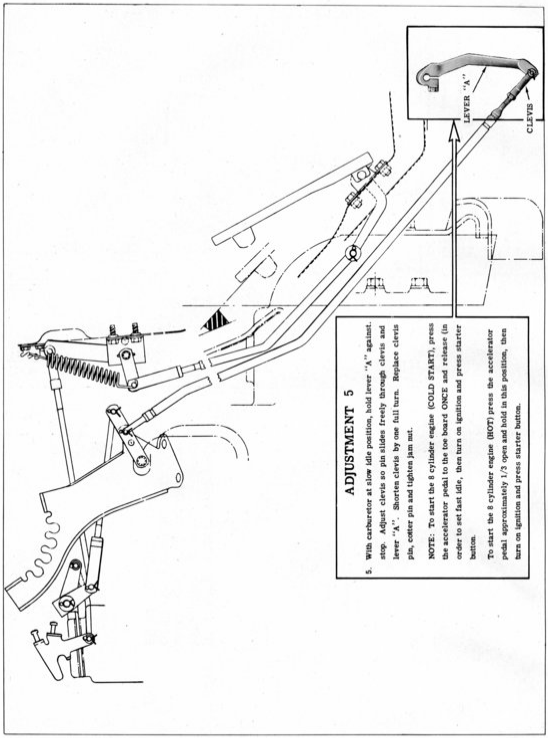
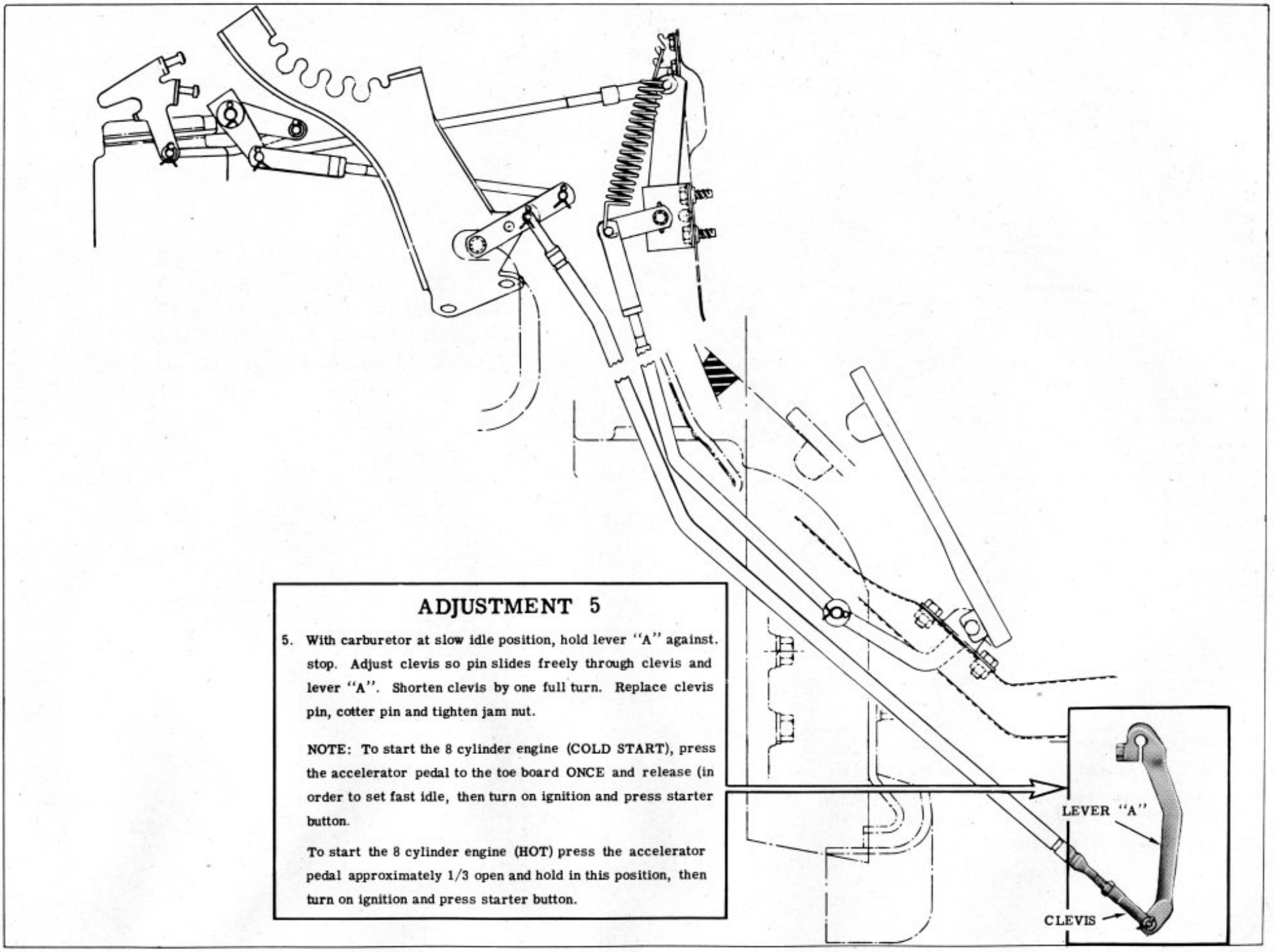


Fig. 544. Eight Cylinder Hydra-Matic Throttle Control Adjustment



ADJUSTMENT 5

5. With carburetor at slow idle position, hold lever "A" against stop. Adjust clevis so pin slides freely through clevis and lever "A". Shorten clevis by one full turn. Replace clevis pin, cotter pin and tighten jam nut.

NOTE: To start the 8 cylinder engine (COLD START), press the accelerator pedal to the toe board ONCE and release (in order to set fast idle, then turn on ignition and press starter button.

To start the 8 cylinder engine (HOT) press the accelerator pedal approximately 1/3 open and hold in this position, then turn on ignition and press starter button.

Fig. 544. Eight Cylinder Hydra-Matic Throttle Control Adjustment

HYDRA-MATIC TRANSMISSION SHIFT POINTS

"76"-"98" MODEL SHIFT POINTS

HIGH RANGE–UPSHIFTS

Shifts	M.P.H.
1-2	5-15
2-3	10-30
3-4	22-68

Dependent on Throttle Opening

HIGH RANGE–DOWNSHIFTS

Shifts	M.P.H.
4-3 (closed throttle)	15-12
3-1 (closed throttle)	4-2
4-3 (wide open carburetor)	19-17
3-2 (full throttle)	12-10
2-1 (full throttle)	8-6

HIGH RANGE–FORCED UPSHIFT

Shifts	M.P.H.
3-4	63-68

LOW RANGE–UPSHIFTS

Shifts	M.P.H.
1-2	17-30

Dependent on Throttle Opening

LOW RANGE–DOWNSHIFTS

Shifts	M.P.H.
2-1 (closed throttle)	6-3
2-1 (full throttle)	12-10

THROTTLE DOWNSHIFTS

Shifts	M.P.H.
4-3	58-13
3-1	10-2

LOW RANGE LOCKOUT

Shifts	M.P.H.
4-2	40-44

"88"–MODEL SHIFT POINTS

HIGH RANGE–UPSHIFTS

Shifts	M.P.H.
1-2	5-15
2-3	10-34
3-4	25-76

Dependent on Throttle Opening

HIGH RANGE–DOWNSHIFTS

Shifts	M.P.H.
4-3 (closed throttle)	15-12
3-1 (closed throttle)	4-2
4-3 (wide open carburetor)	21-19
3-2 (full throttle)	12-10
2-1 (full throttle)	8-6

HIGH RANGE–FORCED UPSHIFT

Shifts	M.P.H.
3-4	70-76

LOW RANGE–UPSHIFTS

Shifts	M.P.H.
1-2	19-34

Dependent on Throttle Opening

LOW RANGE–DOWNSHIFTS

Shifts	M.P.H.
2-1 (closed throttle)	6-3
2-1 (full throttle)	12-10

THROTTLE DOWNSHIFTS

Shifts	M.P.H.
4-3	63-13
3-1	10-2

LOW RANGE LOCKOUT

Shifts	M.P.H.
4-2	45-50

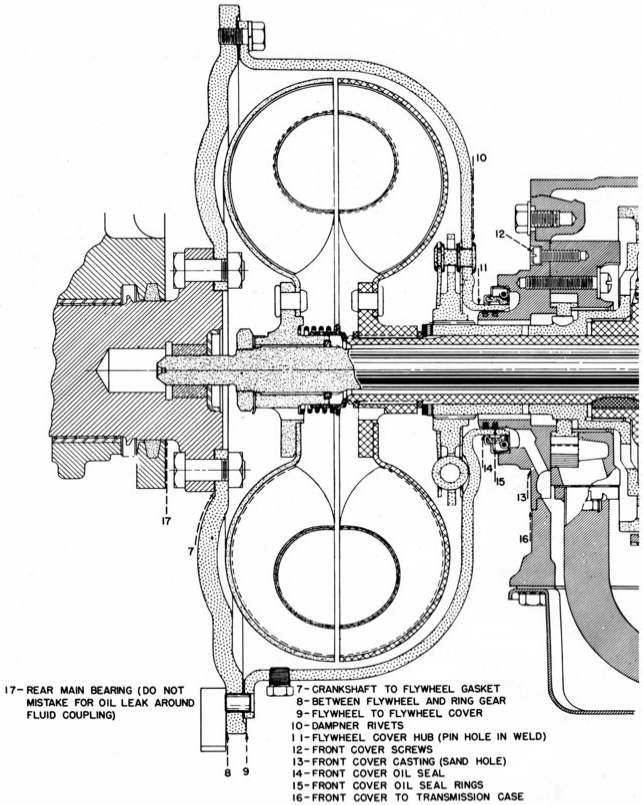


Fig. 545. Possible Points of Oil Leaks

HYDRA-MATIC TRANSMISSION DIAGNOSIS GUIDE

A number of factors which will affect the operation of the Hydra-Matic Transmission must be considered when trouble in the unit is diagnosed.

First, fluid level should be checked and corrected if necessary, to eliminate malfunctions due to intake of air and intermittent low oil pressure. A road test and observation for oil leaks should always be made when the level is found to be low, as the Hydra-Matic transmissions use very little oil except through leaks.

If oil is dirty and shows signs of metallic particles, future trouble may be averted by transmission disassembly to locate the part which is wearing. Fine particles in the oil will be picked up by the pumps and circulated through the control system, causing sticking governor valves, shifter valves and servos.

Oil PRESSURE is the most important factor in the operation of the Hydra-Matic Transmission and should always be checked for correct diagnosis of trouble before transmission is removed for disassembly. Checking the oil pressure will:

1. Determine if pressure regulator valve is working.
2. Indicate excessive oil leak.

The pressure of both pumps may be checked with the transmission in the car by the use of a 100 lbs. oil pressure gauge tool J-1467 or J-1467-M6 assembled into transmission case as shown in Fig. 536.

Check Operation of Front Pump

1. Leave selector lever in neutral.
2. Run engine until transmission oil is warm.
   NOTE—With transmission oil warm, oil pressure should be from 55 lbs. to 85 lbs. with 375 R.P.M. engine idle.

Check Operation of Rear Pump

The operation of the rear pump alone, can be checked by driving the car at 30 to 40 M.P.H. in fourth gear.

1. Move shift control lever to neutral.
2. Turn ignition switch off.
   NOTE—The pressure on oil gauge at speeds above 30 M.P.H. under above test should be 55 to 85 lbs.

Turning off the ignition switch and coasting stops the front pump. Therefore, no oil will be supplied by the front pump. If the rear pump is not working, this test must not be continued.

NOTE—If oil pressure is low while checking both pumps, this indicates oil leak in system. If low from ONE pump, this indicates the pump alone is at fault.

Low Oil Pressure Must Be Corrected to Assure Proper Transmission Operation.

Test For Missing Or Sticking Torus Check Valve

A missing or stuck torus check valve will cause the engine to speed up excessively when starting away after car has been standing. By checking the rate at which fluid drains back from the coupling into the transmission, it is possible to determine the effectiveness of the torus check valve. With the engine warm and the coupling full, the fluid level in the transmission should not raise more than ½" in a period of 10 minutes. If the drain-back of fluid is greater than this, the transmission should be removed and the torus check valve checked to see that it is properly installed and does not bind over the torus hub.

NOTE—While the possibility is rather remote, a missing by-pass valve in the front pump may also cause excessive drain-back of fluid.

Factors Effecting Transmission Operation

Another factor which will have a great deal of effect on the operation and performance of

the transmission, is the engine. If the engine is not performing properly, its performance is reflected in the transmission. A missing, sluggish engine will delay the shift points, or the transmission will shift into a higher gear, but the engine will not have power enough to pull the car.

Throttle and control linkage is another VERY IMPORTANT factor to consider. The rods, levers and brackets are all positioned to a standard and this standard must be maintained. Manual and throttle control levers should always be checked for tightness on shafts at transmission. The manual shift control must position manual control valve in control body correctly.

The throttle control rods also move a predetermined distance at a specified throttle opening. Transmission throttle pressure, in relation to throttle opening, must be delivered to the regulator plugs in control body to resist the governor pressure for shift control. This same throttle pressure controls the compensator pressure to the servos and must be correct to avoid band slippage.

Internal oil leaks are often harmful and will cause excessive wear, erratic shifting, and band drag.

a. Excessive Wear: Due to lack of lubrication. If pump pressure does not build up a force greater than the regulator valve spring, then no oil is supplied for lubrication.
b. Erattic Shifting: Caused by oil pressure too low to release or apply servos or apply clutches. An oil leak in control body will permit oil to flow into the wrong passage and perhaps apply or release a band or clutch at the wrong time.
c. Band Drag: Pressure too low to overcome spring force to fully release band. The oil pressure must be greater than the spring force to completely release band.

A transmission that is disassembled for repairs should be thoroughly inspected as the part that failed may be the result of improper functioning of another unit. If the cause is not located, life of replacement parts will be very brief. After the worn part is located further examination should be made to determine the cause of the rapid wear. This is the reason oil passages should be examined to determine if part which failed had been properly lubricated. Both oil pumps as well as the governor should be examined for wear; if one pump is worn, the other one, no doubt, will also be worn. Any wear at the governor sleeve may be attributed to excessive (over .005 inch) governor run-out and replacement of necessary parts is required to correct the trouble. Governor sleeve wear will usually cause sticking valves because most of the cuttings are carried directly into the governor valves.

Improperly adjusted throttle and control linkage can cause excessive wear to thrust washers, bands and clutch discs by permitting a band to apply before the clutch is released or a clutch to apply before the band is fully released. Throttle adjustment must be started at the throttle lever with tool J-2195.

A servo band in need of adjustment can cause wear to other parts. The application of the band is timed to contact the drum when the clutch is at a predetermined point of release and if band is too loose and servo has to travel farther to apply it, there will be band or clutch slippage.

Stall or Torque Test

A test known as the "Stall or Torque Test" may be made to determine engine and transmission performance. This test which must be used with moderation to avoid overheating the transmission, may be performed as follows:

a. Start engine and let warm up to operating temperature.
b. Set hand brake and hold foot tight on foot brake pedal.

c. Place selector lever in "DR" position.

d. Press accelerator pedal to floor board.

This action places transmission in low gear, but car cannot move because brakes are applied. Opening the throttle and speeding up the engine is comparable to slipping a mechanical clutch, as the driving torus is turning and trying to turn the driven torus which is held stationary by the transmission being in gear and brakes locked.

The engine will speed up until the friction created between the torus members equals the horsepower output of the engine. Engine speed will denote engine efficiency and should be between 1400 to 1600 R.P.M., (less at elevations above 1000 ft.) when checked with an electrical tachometer.

a. Engine R.P.M. of 1200 to 1300 (less at elevations above 1000 ft.), indicates engine is in need of a tune-up.

b. If engine continues to speed up to, or above, 2,000 R.P.M., this indicates bands are not holding or the torus members are slipping excessively due to missing check valve or damaged vanes.

CAUTION—Extreme care must be used in making this test. THROTTLE MUST NEVER BE HELD OPEN MORE THAN ONE MINUTE. If engine speeds up to 2000 R.P.M. throttle must be closed immediately to avoid possible damage to transmission and bands.

Check Cause For Slipping Under "Stall Test"

1. Make oil drain-back check for missing or leaking check valve.
2. If check valve is O.K., adjust bands.
3. If slip still occurs after band adjustment, start car in motion under FULL THROTTLE.

   NOTE—If transmission slips in all upshifts, clean the valve body, being sure compensator valve is free.
4. If slip occurs, examine torus members for damage.

Sometimes it is desirable to know which band is slipping. After test is made in "DR" position, it can be repeated in reverse. If slippage still occurs, fault is with front band or both. If slipping does not occur, then all slippage is in the rear band.

Possible Causes of Trouble and Corrections

To assist in the quick and accurate diagnosis of trouble, possible causes and recommended corrections for particular Hydra-Matic troubles are listed on the following pages.

It is suggested that this information be used in conjunction with the Oldsmobile Hydra-Matic Test Sheet.

HYDRA-MATIC TRANSMISSION DIAGNOSIS GUIDE

Nature	Cause	Correction
	1	
Transmission jumps out of reverse.	Rods connecting manual control lever to transmission adjusted too short. Improper backlash between reverse anchor and internal gear.	Readjust manual control lever. Adjust reverse anchor backlash to .016" to .049" with gauge, J-2650.
	2	
Transmission will not reverse when shifting into reverse.	Broken reverse detent shift lever. Broken reverse crankshaft. Broken reverse anchor.	Replace detent shift lever. Replace reverse bracket assembly. Replace anchor.
	3	
Difficult to shift out of reverse.	Low front pump idle pressure. High engine idle speed. Drag in front unit clutch. Interference between reverse anchor and bracket on case. Improper backlash between reverse anchor and internal gear. No lock plate on reverse anchor support bolt. Worn stops in upper bearing retainer on steering column. Linkage binding.	Correct as required.
	4	
2nd-3rd and 3rd-4th light throttle shift points are excessively high, but full throttle shift points are normal.	Incorrectly adjusted throttle linkage.	Adjust throttle linkage.
	5	
Full throttle shift points are either low, high or do not occur at all.	1. Governor valves not operating properly. 2. Leakage at governor assembly. 3. Broken oil rings or missing governor balancing plug. 4. Governor ring lands worn.	Free up valves, examine for warped surfaces, and replace parts as necessary.
	6	
When accelerating through different speeds with part throttle and in "Hi" range, the shift from 2nd to 3rd speeds occurs too soon after 1st to 2nd speed shift.	Incorrectly adjusted throttle linkage.	Adjust throttle linkage.

HYDRA-MATIC TRANSMISSION DIAGNOSIS GUIDE—Continued

Nature	*Cause*	*Correction*
	7	
Transmission will not throttle downshift from 4th to 3rd speeds above 20 M.P.H.	Insufficient accelerator travel due to interference of throttle linkage or at floor carpet. Throttle controls improperly adjusted, levers bent or loose on shaft. Spring lock missing, mispositioning 4 to 3 downshift valve.	Remove interference at relay. Adjust throttle linkage. Tighten, straighten or replace lever. Position 4-3 downshift valve, install spring lock.
	8	
Transmission does not respond to shift lever position.	Pin which picks up manual valve in valve body is not operating in groove in manual valve.	To check, shift selector lever into reverse. If severe clashing results, or if lever goes into reverse but car locks up and fails to move backward, pick-up pin is not operating manual valve. Remove side cover and engage pin.
	9	
Transmission fails to drive car when lever is moved to any driving position.	Usually caused by failure of one or both bands to be applied. Some of specific causes are: 1. Low oil pressure. a. Low oil level. b. Pressure regulator valve stuck open. c. Excessive oil leakage at control valve assembly or front servo. d. Front oil pump inoperative. 2. Front or rear band adjustment incorrect. 3. Manual valve mispositioned. 4. Sticking torus check valve; car will operate after engine has been running a short time.	Examine for probable causes listed, and correct as necessary.
	10	
Erratic response to shift lever.	Inner manual control lever loose on shaft.	Replace manual control lever assembly.

HYDRA-MATIC TRANSMISSION DIAGNOSIS GUIDE—Concluded

Nature	*Cause*	*Correction*
	11	
Transmission drives car in 1st speed, but acts as if it were in neutral after shifting out of 1st speed, or slips when shifting into 2nd speed under normal throttle.	Front clutch does not apply, caused by: 1. Leakage in oil to clutch. 2. Leakage in valve body. 3. Drilled hole in transmission case to oil delivery sleeve plugged. 4. Obstruction in oil delivery sleeve passage. 5. Oil delivery sleeve not located correctly on dowel. 6. Oil delivery sleeve ring broken. 7. Clutch oil seal leakage. 8. Clutch piston stuck in release position.	Replace valve body or correct other conditions as necessary.
	12	
Transmission drives car in 1st and 2nd speeds, but acts as if it were in neutral after shifting out of 2nd speed.	Rear clutch does not apply, caused by same reasons listed in Item 11.	Same as Item 11.
	13	
Transmission slips in 1st, 3rd and reverse speeds but operates properly in 2nd and 4th speeds.	Front band not holding, due to: 1. Leakage in valve body, case or servo. 2. Sticking servo pistons. 3. Improper band operation. 4. Improper band adjustment. 5. Valves in valve body sticking. 6. Throttle linkage not operating properly.	Adjust bands to proper setting. If condition persists, inspect front servo valve body and oil holes in case. Correct as necessary.
	14	
Transmission slips in 1st and 2nd speeds, but operates properly in 3rd, 4th and reverse speeds.	Rear band not holding, due to same reasons listed in Item 13 applying to rear unit.	Inspect and correct as necessary.
	15	
Transmission slips or chatters on throttle downshift 3rd to 2nd speeds or 3rd to 1st speeds.	1. Rear band not operating properly, due to reasons given in Item 13. 2. Rear servo not operating properly due to— a. Accumulator check valve stuck closed. b. Weak or broken servo springs. 3. Insufficient compensator pressure, improperly operating throttle linkage or stuck compensator valve.	Inspect and correct as necessary.

HYDRA-MATIC TRANSMISSION DIAGNOSIS GUIDE—Continued

Nature	Cause	Correction
	16	
Throttle downshift 3rd to 2nd speeds or 3rd to 1st speeds does not occur until throttle is opened excessively, or until long after car is stopped. Usually occurs when transmission is cold.	Sticking valves in valve body or governor.	Completely disassemble and inspect valve body assembly. Inspect, free up or replace governor parts as necessary.
	17	
Severe clunk on 3rd to 1st speed at an excessively high speed with throttle closed.	Rear servo check valve not operating properly. Stuck or broken ring in accumulator piston. Sticking valves in valve body. Rear clutch piston binding on its pilot.	Inspect and repair or replace check valve plunger or accumulator piston. Completely disassemble and inspect valve body assembly. Clean up rear unit clutch piston pilot.
	18	
Transmission downshifts into 1st speed at an excessively high speed with throttle closed.	1. Governor not operating properly. 2. Leakage at governor assembly. 3. Broken oil seal rings or missing governor plug.	Free up valves, examine for warped surfaces, and replace parts as necessary.
	19	
Transmission downshifts to 3rd with light throttle above 20 M.P.H. or hunts between 4th and 3rd.	1. Improperly adjusted throttle linkage. 2. Sticking valves in valve body.	Inspect and correct as required.
	20	
Car starts in 3rd or 4th speed in "Hi" range and 2nd speed in "Lo" range. May have 4th gear in "Lo" range.	One or both governor valves stuck open. Sticking valves in valve body.	Completely disassemble and inspect valve body assembly. Inspect, free up or replace governor valves.
	21	
Transmission misses 2nd speed on upshifts.	Sticking valves in valve body.	Completely disassemble and inspect valve body assembly.
	22	
Transmission misses 3rd speed.	Sticking valves in valve body.	Completely disassemble and inspect valve body assembly.

HYDRA-MATIC TRANSMISSION DIAGNOSIS GUIDE—Continued

Nature	Cause	Correction
	23	
Transmission starts in 2nd speed but makes all other shifts.	Sticking valves in valve body or governor.	Completely disassemble and inspect valve body assembly and governor assembly.
	24	
Transmission operates only in 1st and 2nd speeds, or only in 3rd and 4th speeds.	Sticking valves in valve body or governor.	Completely disassemble and inspect valve body assembly and governor assembly.
	25	
Transmission shifts through 1st, 2nd and 3rd speeds satisfactorily, but will not shift into 4th speed.	Sticking valves in valve body or governor.	Completely disassemble and inspect valve body assembly and governor assembly.
	26	
Transmission upshifts at light throttle occur at excessively high speeds. Band applications are violent on shifts from "Neutral" into "Hi" or "Lo" with car standing. Downshift 3rd to 1st speed occurs at 10 M.P.H. with throttle closed.	Sticking valves in valve body or governor.	Completely disassemble and inspect valve body assembly and governor assembly.
	27	
Clutch engagement severe at light throttle, but normal at greater throttle openings.	Sticking valves in valve body.	Completely disassemble and inspect valve body assembly.
	28	
Car will not back up unless throttle is opened excessively. On light or closed throttle, transmission is locked up.	Rear band not released due to low oil pressure caused by leakage or auxiliary plug pin missing.	Check front pump pressure and correct low oil pressure. Examine for missing auxiliary plug pin in valve body.
	29	
Car creeps in "DR" range.	Engine idle above 375 R.P.M.	Adjust engine idle.

HYDRA-MATIC TRANSMISSION DIAGNOSIS GUIDE—Continued

Nature	*Cause*	*Correction*
	30	
Car creeps forward when control is in "Reverse".	Rear unit inoperative. Excessive drag in rear unit clutch.	Correct rear unit as necessary. Disassemble transmission and repair as necessary.
	31	
With shift lever in "DR", "Lo", or "Rev.", engine speeds up and bands are applied violently.	Low oil pressure. Low oil level. Sticking pressure regulator valve. Front pump not operating properly. Bad oil leak.	Check oil level. Free up pressure regulator valve, or install new pressure regulator valve assembly. Correct pump difficulty. Correct oil leak.
	32	
Transmission slips in "Hi" or "Lo" range but operates in reverse.	Rear band not operating properly, due to reasons given in Item 13.	Correct as necessary.

When a trouble exists the nature of which cannot be found in the Diagnosis Guide, the study of another similar condition may help in diagnosis of cause and correction. Conditions not covered in Diagnosis Guide section may be diagnosed by further road testing car, each shift and the relation of one unit to another being studied.

Road Testing The Car

The Hydra-Matic transmission, when in need of service, should be road tested and an accurate diagnosis made of the operations of each component part; i.e., to place the malfunction in one individual unit. If more than one individual unit could be the cause of a certain malfunction of the transmission, the simple cause should be checked first.

A complete ROAD TEST or, where available, a Chassis Dynamometer test, will aid in the determining of the exact cause of trouble and uncover any hidden faults that might otherwise be overlooked.

The Oldsmobile Hydra-Matic Test Sheet provides a means for making uniform and systematic trouble diagnosis which is both accurate and thorough. As a means of a quick and ready reference guide for the tester when checking the shifting condition of a Hydra-Matic transmission, the shift points covering the 1940 through 1949 models are listed on the back of each test sheet and complete instructions covering the use of sheets are printed on the inside cover of each Test Sheet pad.

The Test Sheet not only lists possible causes of trouble, but it also indicates the units which may be responsible for the condition. It relates the cause of trouble to certain component parts of the transmission and makes possible accurate diagnosis and specific repair of the faulty unit.

FUEL TANK and EXHAUST SYSTEM

FUEL TANK

The 1949 fuel tanks have been redesigned in order to allow the lowering of the rear compartment floor.

The same modified elliptical tank body is used on all models; however, tank assemblies are not the same due to different filler neck requirements. Ribs are pressed into the tank body to improve rigidity, and internal braces serve as baffles and prevent distortion of tank. 1949 fuel tank capacity is 18 gallons.

The filler tube is accessible through the left rear fender filler door and is covered with an easily applied cap. A vent pipe is provided inside the filler tube which makes it easier to fill the fuel tank.

The tank is fitted with a tank gauge unit having a direct acting float, the movement of which is transferred to the tank unit rheostat contact by a link arm. Dampening of the gauge pointer is accomplished by the use of silicone dampening fluid in the dash unit pointer shaft bearings. The suction pipe is separate (See Fig. 546) and positioned to prevent starvation as gasoline tank becomes nearly empty.

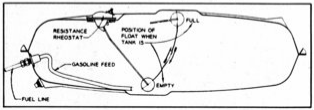


Fig. 546. Fuel Tank and Gauge

Considerable attention has been given to locating the gasoline feed lines so as to reduce vapor lock to a minimum. The main feed line is located on the outside of the left hand frame side rail—opposite side to the exhaust system—and passes over to the fuel pump side of the engine, along the front side of the frame front cross member. In this way, the lines are exposed to outside air currents along the side and front of the car frame.

CAUTION—If car is to be stored for any appreciable length of time, the gasoline should be drained from the complete fuel system—including carburetor, fuel pump, all fuel lines, and fuel tank in order to prevent gum formations and resultant improper engine performance.

The fuel tank, which is mounted at the rear of the body by two gas tank straps, is easily removed by disconnecting the fuel line, gasoline gauge connection, and straps.

MUFFLER

Mufflers are the straight through type specially developed to accommodate the two engines.

A different muffler is used on the six and eight cylinder engines, the eight cylinder muffler

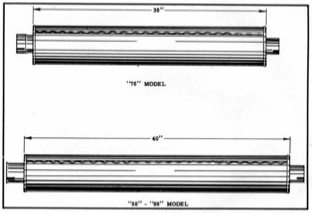


Fig. 547. 6 and 8 Cylinder Mufflers

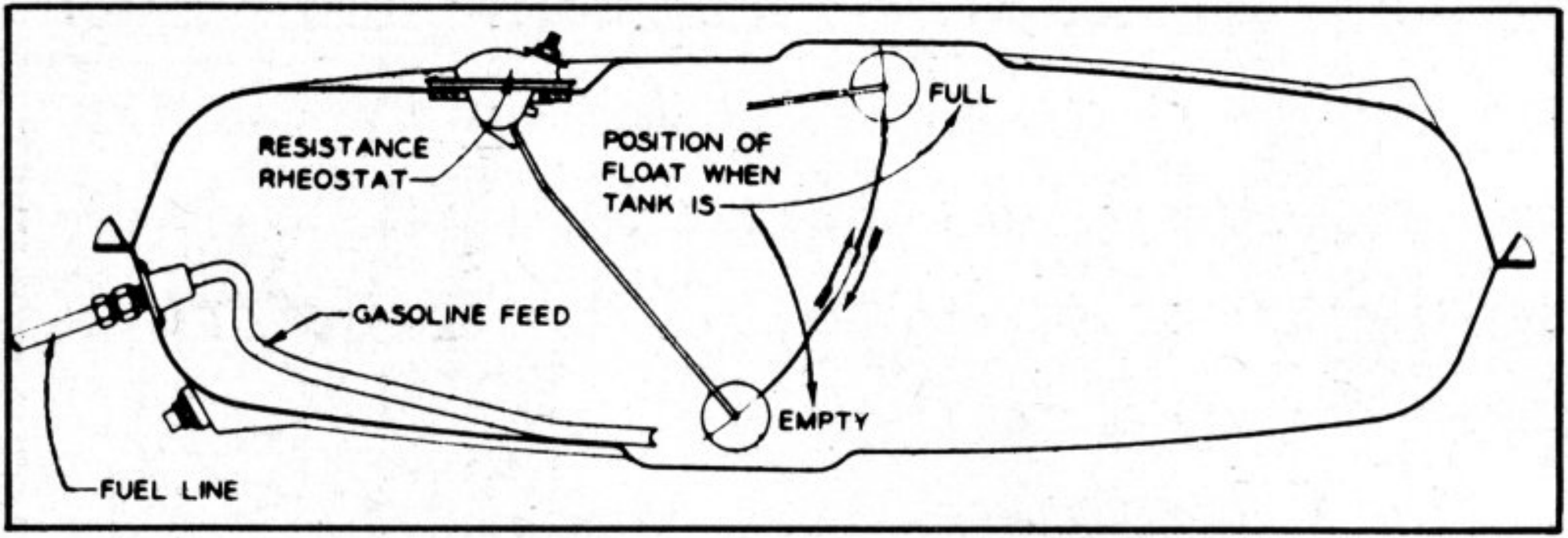


Fig. 546. Fuel Tank and Gauge

being longer and having an asbestos and steel outer shell to improve silencing characteristics.

The six cylinder muffler may be identified by the letters GM-6, and the eight cylinder muffler by the letters GM-8, embossed on the outer shell.

The muffler is supported at its front end by the exhaust pipe bracket while the rear end is supported by a rubber insulated hanger, which is a part of the rear clamp.

The flexible type muffler rear support is used on all models; (See Fig. 548) however, the mounting is not interchangeable between six and eight cylinder, due to difference in size.

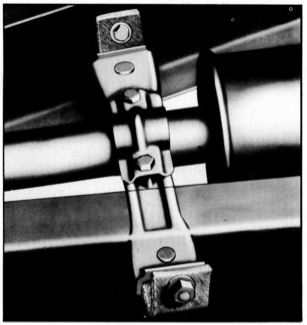


Fig. 548. Muffler Support

Remove and Replace Muffler

The bell-mouthed ends of the muffler must seat against the bead on the tail pipe and exhaust pipe and index with the bead on the clamp bracket. (See Fig. 549)

Exhaust Pipe and Tail Pipe

The exhaust pipe extends from the exhaust manifold to the muffler with a supporting bracket at the flywheel housing.

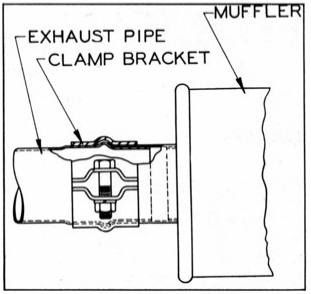


Fig. 549. Clamp Type Muffler Mounting

The exhaust pipe is made very rigid at the manifold connection by the use of a reinforcing sleeve together with a very effective metal covered asbestos seal against exhaust gas leaks. (See Fig. 550)

Three different exhaust pipes and three different tail pipes are used in the 1949 models.

The tail pipe is suspended by a rubber insulated bracket supported at the rear of the frame rear cross member.

The tail pipes may be removed and installed more easily if, in addition to disconnecting at the muffler and tail pipe bracket, the car weight is raised (with chain falls or bumper jack).

CAUTION—Do not disconnect shock absorber arms, but merely raise car weight enough

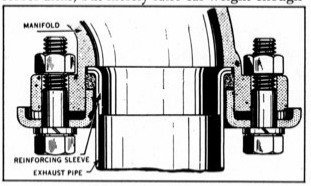


Fig. 550. Exhaust Pipe to Manifold Mounting—6 Cylinder Engine

to provide clearance at axle housing for removing tail pipe.

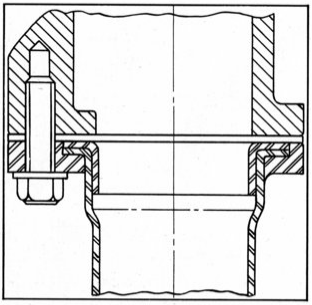


Fig. 551. Exhaust Pipe to Manifold Mounting—8 Cylinder Engine

Installing Exhaust Pipe to Manifold

Fig. 550 and Fig. 551 show relative position of the seals at the junction of the exhaust pipes and exhaust manifolds on the 6 and 8 cylinder engines respectively. Care should be exercised in attaching the exhaust pipe to prevent exhaust gas leak.

When attaching the exhaust pipe:

1. Be sure that the reinforcing sleeve is in exhaust pipe.
2. Install the metal-covered asbestos seal on the exhaust pipe. (6 Cyl.)
3. Install exhaust gasket on manifold studs (8 Cyl.)
4. Install the seal into the cavity between the manifold and pipe. (6 Cyl.)
5. Put the attaching bolts in place and draw the flange up evenly. When tightening the flange bolts, tap the flange at each bolt with a hammer, to make sure the joint is tight. On 8 cylinder engines, install the left exhaust pipe first and tighten both pipes evenly.

   NOTE—When installing the left exhaust pipe on the 8 cylinder engine the heat valve gasket should be replaced at the same time the exhaust pipe gasket is replaced in order to assure against any leakage at that point.
6. Run engine sufficiently to warm connection and retighten attaching bolts.

STEERING

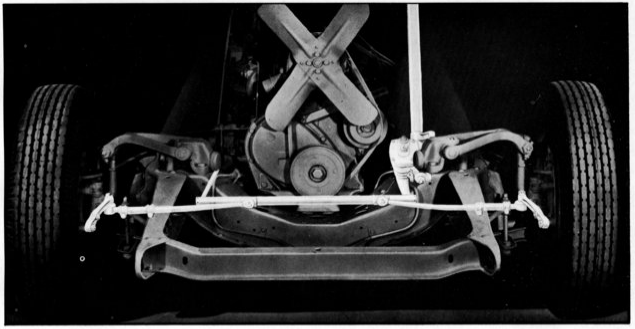


Fig. 552. Steering Control

The 1949 steering mechanism is of the same basic design as that used in the 1948 models.

The cross link type steering control is used on all models. In the cross link steering hook-up, the pitman arm moves crosswise of the car and supports the steering relay rod at one end while the other end of the rod is supported by an idler arm, the bearing for which is mounted to the right frame side rail. The steering tie rods are mounted to the steering relay rod. Important—See STEERING IDLER ARM.

The outer ends of the tie rods are self-adjusting, with the bearing for the supporting stud moving on a spherical seat. Loosening and rattling is prevented by the compression spring beneath the ball seat.

The opening for the tie rod ball studs at top of the tie rod ends are slotted in one direction only so that the ball studs cannot come loose from the end sockets even though they might wear considerably.

The steering gear is of the worm and roller type. The worm is mounted on the steering shaft between two taper roller bearings, which are in turn mounted in an eccentric sleeve.

The double roller tooth is carried on two rows of ball bearings with the bearing cones clamped in the forked end of the pitman shaft by a bolt. End play of pitman shaft is eliminated by a thrust screw located in the housing top cover.

The pitman shaft rotates on two bronze bushings, one in the housing and the other in the top cover. The bushing in the housing floats, permitting the shaft to rotate in the bushing and the bushing to rotate in the housing. A leather type oil seal is installed in the housing at the outer end of the pitman shaft.

The pitman arm used on the 98 series has a different offset from that used on the 76 and 88 models, and, therefore, these arms must not be interchanged.

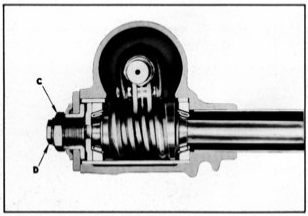


Fig. 553. Worm Shaft Mounting

Preload on the worm bearings is obtained by means of an adjusting screw located in the lower end cover assembly of the steering gear housing; while adjustment between worm and roller is brought about by rotating the eccentric sleeve in the steering gear housing; this sleeve may be moved by means of lash adjuster "F". (See Fig. 555) When the eccentric sleeve is rotated, the worm is moved closer to or drawn away from the roller on the pitman shaft.

LUBRICATION

The steering gears are filled at the factory with a special all-season steering gear lubricant. This lubricant is of a light non-flowing grease that may be used from extreme summer conditions to below zero temperatures without effect upon the efficiency of the steering gear. The steering gear should be checked every 5,000 miles and kept filled at all times with Saginaw All-Season Steering Gear Lubricant, G. M. Specification 4673M-UMS 270664.

CAUTION—A large filler plug is located on top of the gear in the cover. Lubricant should never be forced into the gear under pressure, as it will be forced up the steering jacket and into the driving compartment of the car. See Lubrication Chart for further instructions on lubrication.

All working parts of the steering control are provided with grease fittings. See Lubrication Chart for proper care and grade of lubricant to use for the front end construction.

Steering Gear Adjustments

There are three adjustments on the steering gear which should be checked and, when necessary, should be made in the following order:

1. PITMAN SHAFT END PLAY.
2. WORM BEARING PRELOAD.
3. BACKLASH BETWEEN WORM AND ROLLER (high point).

In making these adjustments, proceed as follows:

1. Disconnect pitman arm.
2. Check tightness of top cover and end cover on gear and tighten if necessary.
3. Adjust gear as outlined below.

Adjustment for Pitman Shaft End Play

(a) Loosen lock nut "A" on the thrust screw in the top cover.

(b) Using a screw driver only, draw down thrust screw "B" until it is tight, then back off 5° to 10° (just ease off).

(c) Tighten lock nut "A" securely, making sure that thrust screw does not turn.

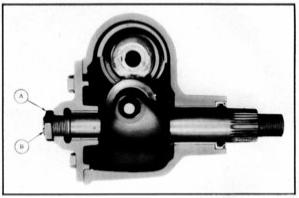


Fig. 554. Steering Gear Cross Section Through Roller Shaft

Adjustment for Worm Bearing Preload

(a) Turn the steering wheel one turn either side of straight ahead position (out of high spot range) for the purpose of getting correct preload of worm bearings. This preload is determined by the position of thrust screw "D" at bottom of steering gear.

(b) LOCKNUT "C" SHOULD BE LOOSENED, THEN SCREW "D" TIGHTENED (OR LOOSENED) UNTIL A LOAD (OFF THE HIGH SPOT) OF ½ LB. TO ⅞ LB. IS MEASURED IN EITHER DIRECTION AT THE STEERING WHEEL RIM WITH A SPRING SCALE. TIGHTEN LOCK NUT "C".

Adjustment for Backlash Between Worm and Roller (High Point)

(a) Set the steering gear in the straight ahead position.

(b) Slack off screw "E" going through lash adjuster "F" at bottom of steering gear.

(c) Using a soft hammer, lightly tap on adjuster "F" until a load of 1½ lb. to 2 lbs. can be measured with a spring scale at the rim of the steering wheel.

Rotation of this lash plate affects the relative engagement of the worm and roller; movement in the direction of the arrow makes this engagement tighter. The high spot load should be felt for a minimum of ¼ turn on both sides of the center position.

(d) Tighten screw "E".

4. Check tightness of steering gear attaching bolts and idler arm support at frame.

5. In case there are definite tight spots or other noticeable irregularities within one turn of the steering wheel off straight ahead position (with pitman shaft disconnected), replacement of the worm and shaft assembly, and possibly the pitman shaft assembly as well, will probably be necessary.

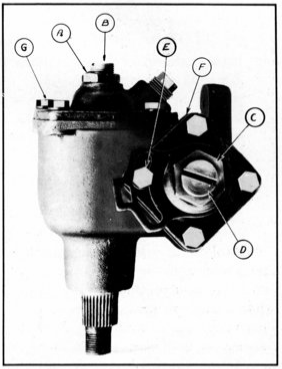


Fig. 555. Adjustment of Pitman Shaft

NOTE—Before either assembly is replaced, check should be made to assure that no distortion of the steering column is present due to improper mounting at frame or instrument panel.

6. The pitman arm may now be reassembled and the car road tested.

For straight ahead driving, the center spoke of the steering wheel should point straight down and, if such is not the case, the following procedure should be followed to correct the condition:

1. Remove the horn blowing mechanism as outlined under HORN BUTTON REMOVAL.

2. Check to see that mark on the steering wheel hub and the mark on the end of the steering gear shaft line up and are in the "12 O'clock" (straight up) position.
3. If the center spoke does not point straight down when steering wheel is in proper position on the steering gear shaft, and car is moving straight forward, it will be necessary to adjust the tie rod ends until steering wheel assumes the proper position.

   NOTE—Assuming that the toe-in is set correctly, extreme care should be exercised to make sure the right and left tie rod ends are turned the same amount but in opposite directions in order not to disturb the toe-in setting.

The "short cut" of falsely repositioning the steering wheel on the steering gear shaft serrations should never be resorted to, as doing so puts the center engagement point of the worm at other than its proper position and, in many cases, will prevent the steering mechanism from making its full travel in one direction.

DISASSEMBLE STEERING GEAR

1. Remove steering wheel.
2. Remove steering gear assembly from car.
3. Remove pitman arm.
4. Remove cover plate from end of pitman shaft.
5. Remove pitman shaft.
6. Loosen locknut "C" and back off adjusting screw "D" from end of worm shaft. (See Fig. 553)
7. Remove cover from lower end of worm shaft.
8. Push worm and shaft assembly down through bottom of housing, removing eccentric sleeve, worm and bearings.

ASSEMBLE STEERING GEAR

1. Before assembling steering gear, wash all parts in clear gasoline and inspect bearings and races for any rough spots and worm and rollers for any defects.
2. Assemble two tapered roller bearings on

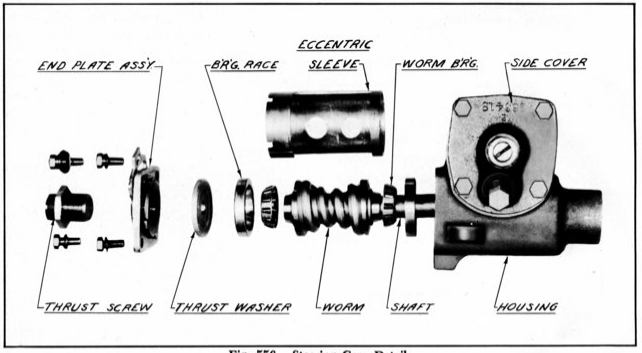


Fig. 556. Steering Gear Details

worm shaft and slide eccentric sleeve over bearings.

3. Put lower thrust washer in place inside eccentric sleeve to hold bearing in place.
4. Start thrust screw "D" into end plate, then attach end plate to lower end of housing, holding worm and bearings in place.

   NOTE—Screw "D" should be screwed just tight enough at this time to hold bearing races in place. Proper adjustment will be made later.
5. Slide pitman shaft in place and attach end cap to housing. Install adjusting screw "B" and locknut "A". (See Fig. 554)
6. Fill steering gear with specified lubricant.
7. Steering gear should be bench adjusted before it is assembled into car as follows:
   (a) Place steering wheel on shaft.
   (b) Turn steering gear from one extreme to the opposite in order to make certain there are no unusual binds.
   (c) Adjust steering gear as outlined under:
      1. ADJUSTMENT FOR PITMAN SHAFT END PLAY.
      2. ADJUSTMENT FOR WORM BEARING PRELOAD.
      3. ADJUSTMENT FOR BACKLASH BETWEEN WORM AND ROLLER (High Point).
8. Remove steering wheel from shaft, assemble steering gear in car, re-attach steering wheel and road test.
9. When mark on steering wheel hub and steering shaft line up, the center spoke of wheel should point straight down as car is being driven straight forward. If this is not the case, it will be necessary to adjust the tie rod ends until steering wheel assumes its proper position. When a new steering gear is installed, it is usually necessary to adjust tie rod ends even though this adjustment may have been correct for old gear.

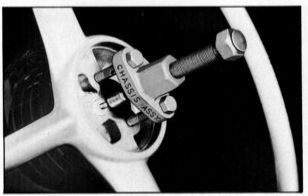


Fig. 557. Steering Wheel Removal

NOTE—Tie rod ends should be turned exactly the same amount but in opposite directions in order to maintain the original toe-in setting.

STANDARD HORN BUTTON REMOVAL

The horn button on the standard wheel is held in place by means of three dimples on the horn button retainer cup, inside the steering wheel hub and the rubber ring in the horn button. The horn button may be removed by inserting a sharp instrument underneath the edge of the horn button and prying upward. Removal of the steering wheel nut will permit removal of the contact assembly.

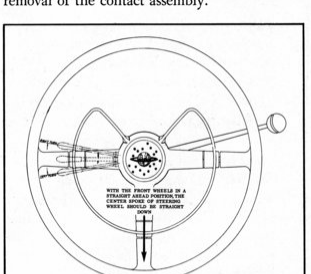


Fig. 558. Position of Steering Wheel When Centered

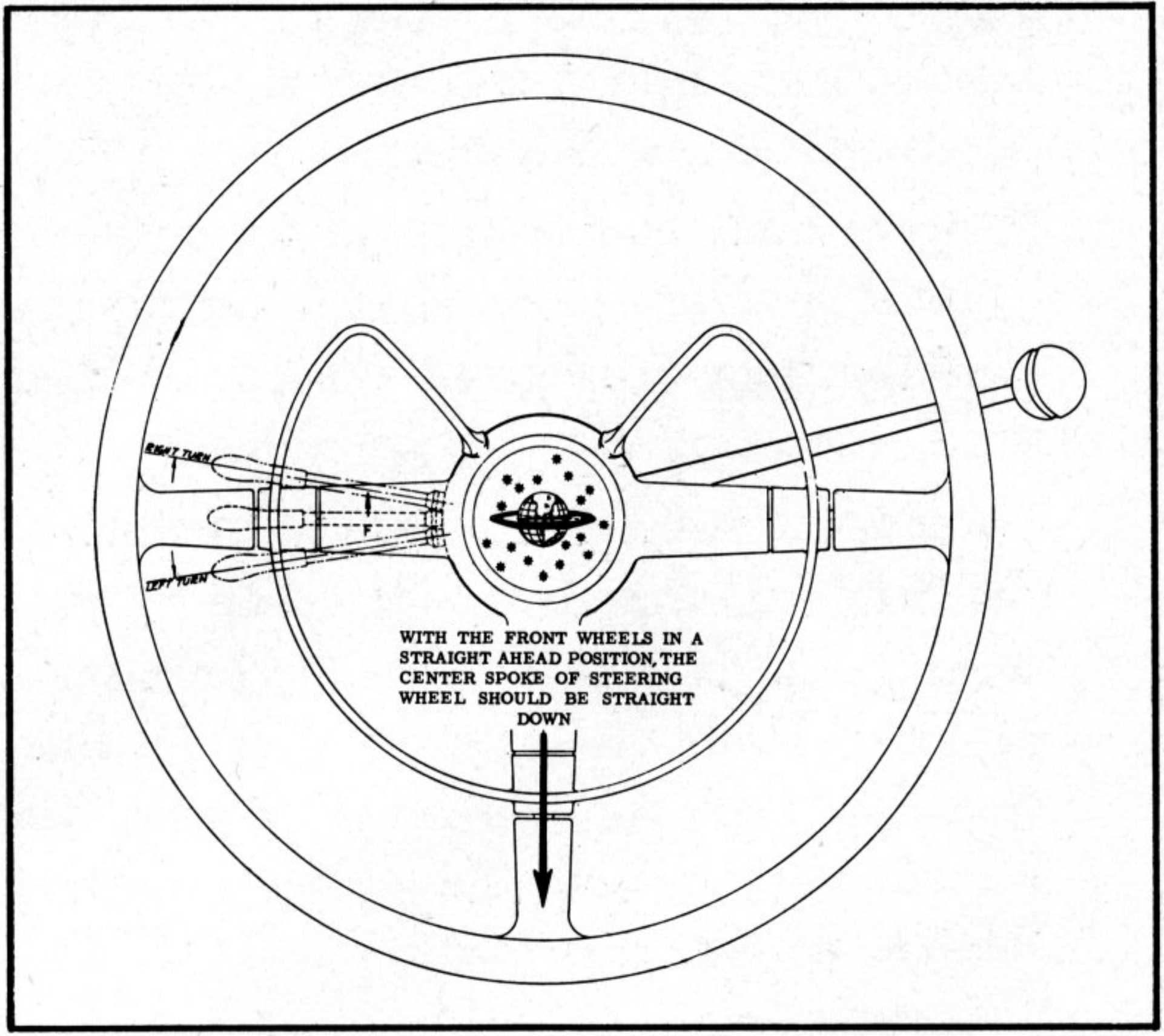


Fig. 558. Position of Steering Wheel When Centered

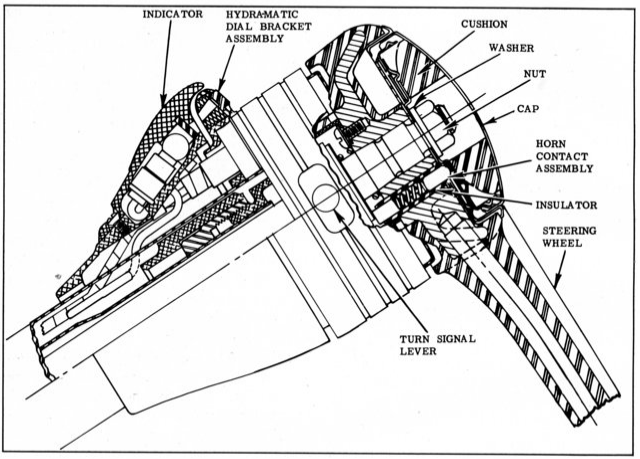


Fig. 559. Standard Horn Button Details

DELUXE HORN BUTTON REMOVAL

1. Place palm of hand squarely on horn button, press firmly, and turn slightly in a counter-clockwise direction.
2. Remove horn button and rubber cushion.

   NOTE—Horn wire should be disconnected at relay to prevent blowing of horn when horn button is being removed.
3. To reinstall, reverse sequence of operations making sure that both upper and lower horn button cushions are in place. Upper cushion should be installed with flat face upward, and the three projections on opposite end should lie in horn contact retainer depressions.

   NOTE—If contact plate has been removed, care should be exercised to insure correct reinstallation. (Word "top" should face upward.)

STEERING RELAY ROD

One end of the steering relay rod is mounted to the pitman arm, the other end is mounted to the idler arm. When installing the steering relay rod, the opening for the left hand tie rod ball stud is closer to the end of the rod than the opening for the right hand tie rod ball stud.

NOTE—A grease retainer is fitted over the inner ends of the ball stud spacers. (See Fig. 561) The cup-shaped retainer having a small hole at the center, assures more equal distribution of lubricant to the two ball studs at either end of the relay rod.

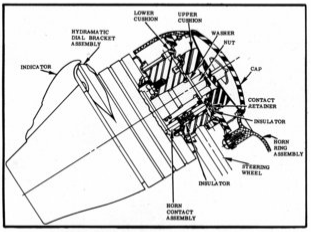


Fig. 560. DeLuxe Horn Button Details

Assemble parts in the steering relay rod as illustrated in Fig. 561. Notice that one of the spacers is longer than the other. The proper adjustment of the threaded end plug on the steering relay rod is: Draw nut tight, then back off ¼ to ½ turn. The same adjustment for both ends.

STEERING IDLER ARM

The steering idler arm is supported at the right hand front extension rail by means of an idler arm support.

The idler arm support bushing is prevented from loosening by the use of a right hand thread on the outside of the hardened idler arm bushing and a left hand thread on the inside of the bushing and at the idler arm support. Whenever the idler arm is disassembled from the idler arm support, it must be reassembled so that there is a dimension of 23/32″ between upper face of the idler arm and the shoulder on the support, as shown in Fig. 561.

Since the right hand threads on the outside of the idler bushing thread into the idler arm and those on the inside thread onto the idler arm support, this adjustment must be made with support removed from the frame, assembled to the bushing and the arm, and then the assembly mounted to the frame. To assemble the idler arm, proceed as follows:

1. Screw idler arm bushing into idler arm and tighten in place.
2. Screw idler arm support into bushing until the distance between the upper face of the arm and shoulder on the support is 23/32″, as shown in Fig. 561.
3. Mount assembly to frame.

TIE RODS

Tie rod ends are serviced as an assembly. In case of accident, the entire unit must be replaced. Both left and right tie rods are adjustable for length.

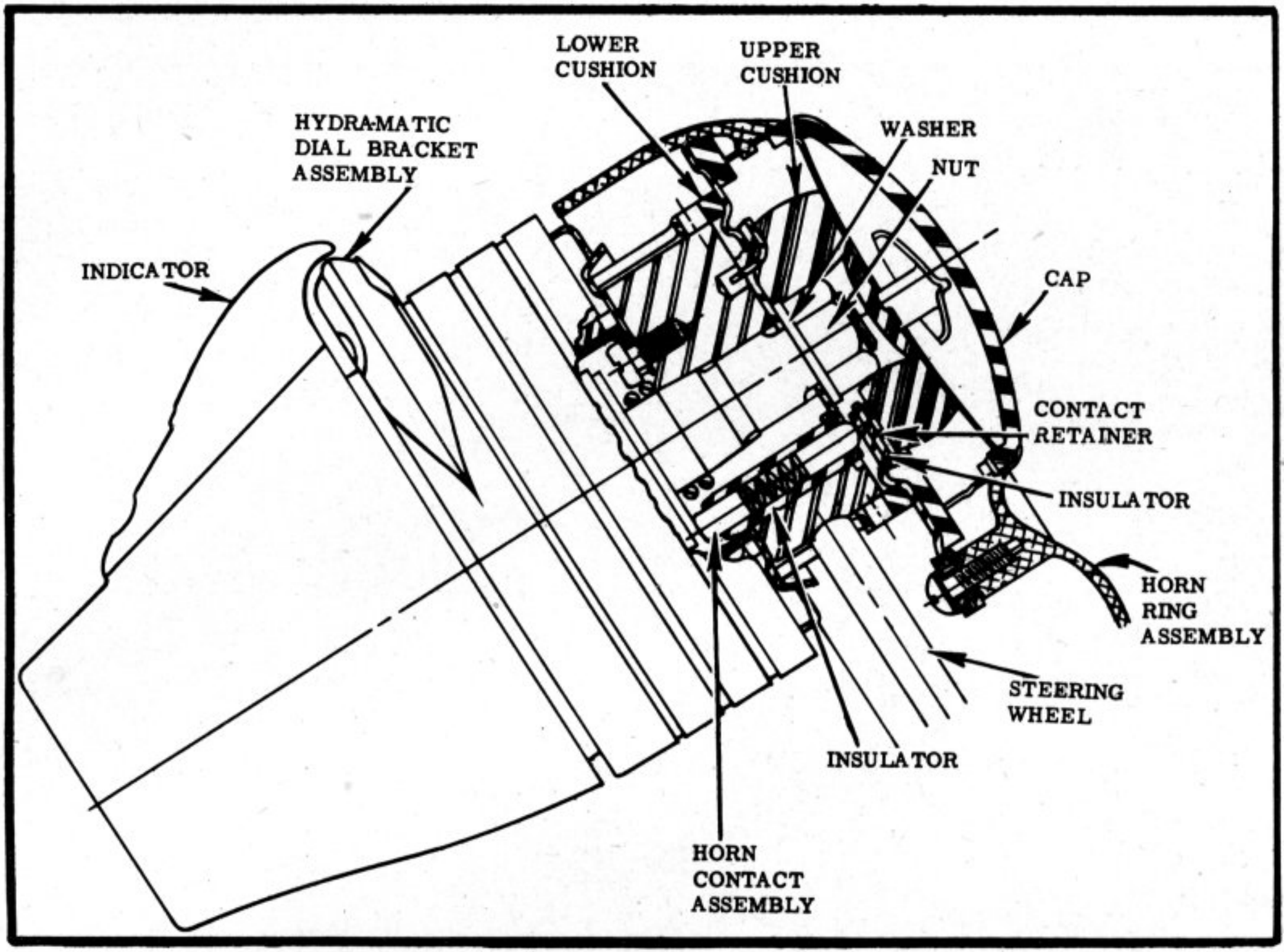


Fig. 560. DeLuxe Horn Button Details

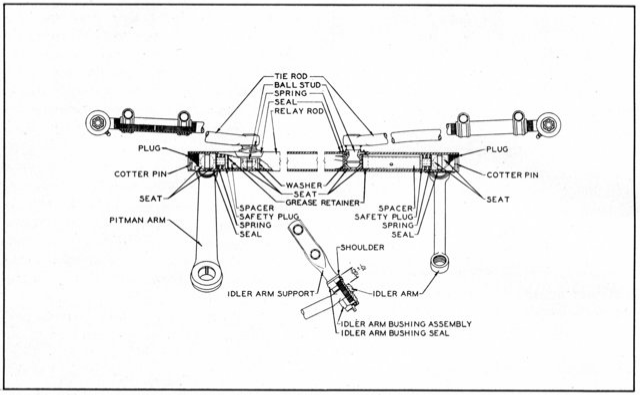


Fig. 561. Steering Control Details

STEERING SPECIFICATIONS—1949 MODEL

SUBJECT AND REMARKS	119½" WHEELBASE	125" WHEELBASE
1. TYPE	Worm and Roller	Worm and Roller
2. STEERING GEAR RATIO	19:1	19:1
3. STEERING WHEEL DIAMETER	18"	18"
4. TURNING RADIUS—FEET		
a. Right	20′	21′
b. Left	20′	21′

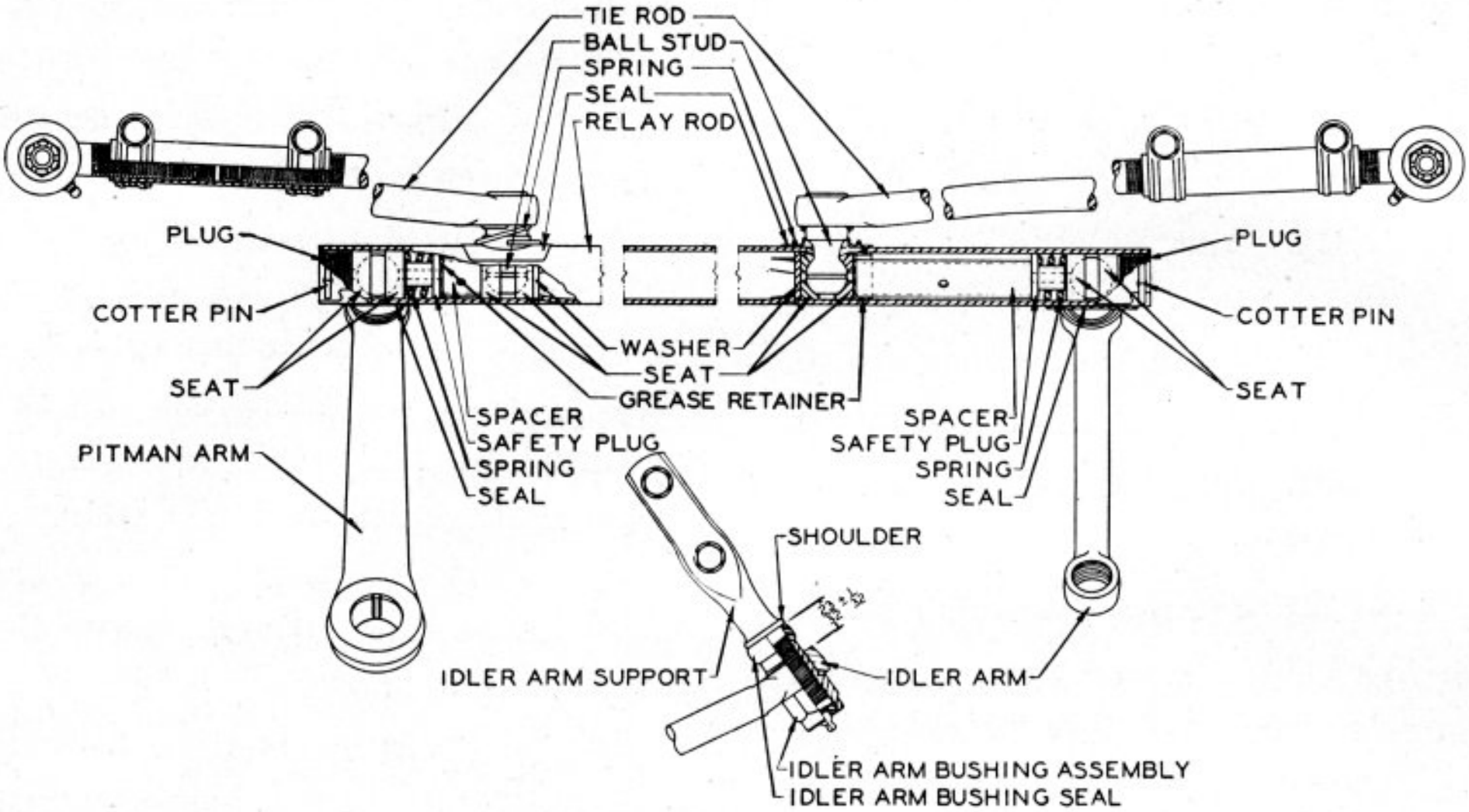


Fig. 561. Steering Control Details

WHEELS AND TIRES

Extra low pressure tires are standard equipment on all 1949 model Oldsmobiles instead of being provided as optional equipment and deluxe as in 1948.

Tire sizes and the wheels used on various models are as follows:

76 Std. models (except Convertible) are equipped with 7:10x15 tires on 15x5.50 wheels.

88 Std. models are equipped with 7:60x15 tires on 15x5.50 wheels.

98 Std. models are equipped with 7:60x15 tires on 15x5.50 wheels.

76 Del. models (and Std. Convertible) are equipped with 7:60x15 tires on 15x5.50 wheels.

88 Del. models are equipped with 7:60x15 tires on 15x5.50 wheels.

98 Del. models (except Convertible)* are equipped with 7:60x15 tires on 15x5.50 wheels.

98 Del Convertibles are equipped with 8:20x15 tires on 15x6.00 wheels.

The wheels on all models are all-steel demountable type, having the hub and spokes formed from a heavy one-piece stamping, which is riveted to the drop-center type rim at the spoke-ends. The spokes are formed to give an attractive appearance and at the same time, the shape of the rim and spokes forms a very rigid construction.

The outer end of the hub is enclosed by a hub cap which conforms to the wheel shape. The front hub and brake drum assembly is mounted on the steering knuckle spindle on two large New Departure adjustable cup-and-cone type bearings. The rear hub and brake drums are bolted to and driven by the flange integral with the axle shaft.

Special precautions have been taken to protect the front wheel bearing against road splash by the use of a deflector behind the inner bearing inner race, and an oil guard bolted to the brake backing plate. Any water hitting the deflector, likewise any lubricant that may be thrown off the inner wheel bearing, is prevented from getting into the brake by the oil guard.

*8.20x15 tires on 15x6.00 wheels available as optional equipment at extra cost.

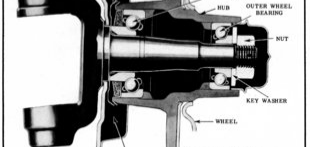


Fig. 562. Front Wheel Mounting—Bearing Protection

LUBRICATION—WHEEL BEARINGS

Front wheel bearings should be lubricated every 5,000 miles. Nothing but high melting point front wheel bearing grease, sold by reputable oil companies should be used in front wheel bearings.

It is not necessary to "pack" the hub. A small amount of lubricant applied to the bearing is sufficient.

When it is found necessary to remove the front wheel bearings for cleaning, the bearings should be washed in clean gasoline (not light oil). If the bearings are washed in light oil, the grease will not adhere to the bearings and the bearings will run dry.

The rear wheel bearings which are the shielded radial type, are lubricated when assembled, and need no further lubrication.

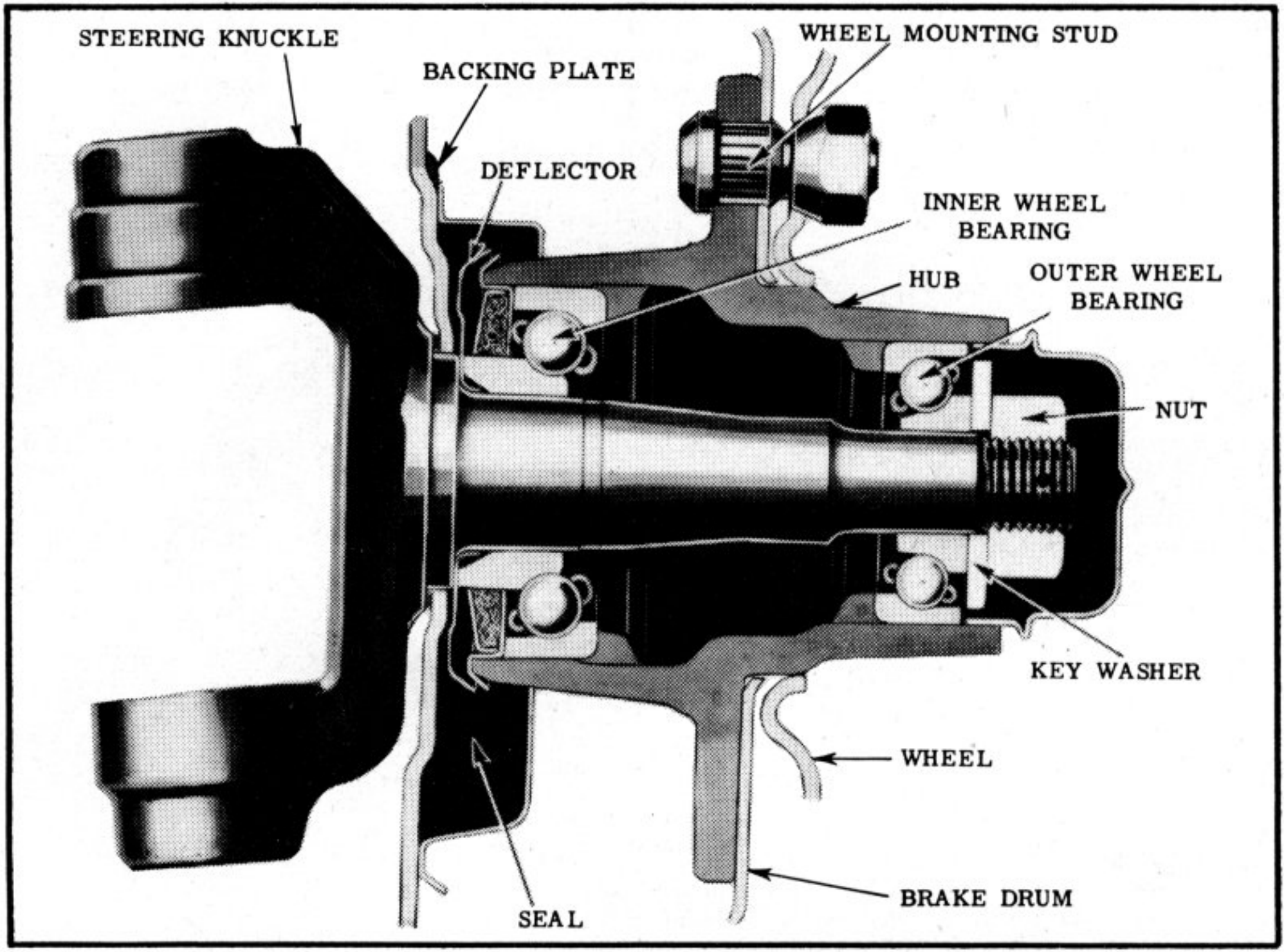


Fig. 562. Front Wheel Mounting—Bearing Protection

Servicing Wheels and Tires

FRONT WHEEL MOUNTING

When installing front wheel hub and drum assembly, the complete inner bearing, including the cone, should always be assembled to the hub and drum and the wheel then installed on spindle. DO NOT PLACE THE INNER BEARING CONE ON WHEEL SPINDLE BEFORE INSTALLING WHEEL HUB AND DRUM.

FRONT WHEEL TRAMP AND SHIMMY

Front wheel "tramp" and front wheel "shimmy" are two entirely different conditions. Front wheel tramp which usually occurs at high speed is a wheel "hop" caused from an unbalanced condition of wheels, loose linkage in the front end or imperfectly operating shock absorbers.

Shimmy may occur at the lower speeds and is a wobbly condition of the front wheels caused from an unbalanced condition, loose front end linkage, loose steering gear parts or faulty steering gear adjustment. Shimmy will be felt on the steering wheel, tramp will be felt in the whole car. Shimmy is a front wheel condition entirely, while tramp may result from either front or rear wheels. (See STATIC WHEEL BALANCE, and DYNAMIC WHEEL BALANCE following for tramp and shimmy correction).

Tire Balance

Due to the irregularities in tread wear, caused by sudden brake application, misalignment, low inflation pressure, tube or tire repair, etc., a wheel and tire assembly may lose its original balance. Consequently, if front-end instability develops, the tire and wheel assembly should be checked for static and dynamic balance.

The wheel and tire assembly should also be checked for static and dynamic balance if puncture proof tubes are used, or the original tires are replaced, or if heavier ply tires are used.

Both front and rear tire and tube assemblies are balanced to within 20-inch ounces.

Tire and tube assemblies are marked with a red triangle. The valve stems should always align with this mark for tire and tube assembly balance.

Static Wheel Balance

Static wheel balance is necessary to prevent tramp. Wheel and tire assemblies are statically balanced before the cars leave the factory. However, tire wear and other conditions sometimes make further static wheel balancing necessary. Bad cases of "tramp" can usually be traced to static unbalance of the front wheels.

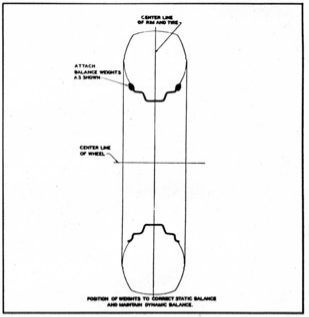


Fig. 563. Placing Weights for Static Wheel Balance

Statically balancing of wheels means having the weight so distributed about the axis of rotation that there is no tendency to revolve in either direction when suspended on frictionless bearings.

Fig. 563 shows how weights should be placed on the rim of a wheel to bring about static balance. This figure simply shows how the weights are positioned on the light side of the wheel to bring about static balance and has nothing to

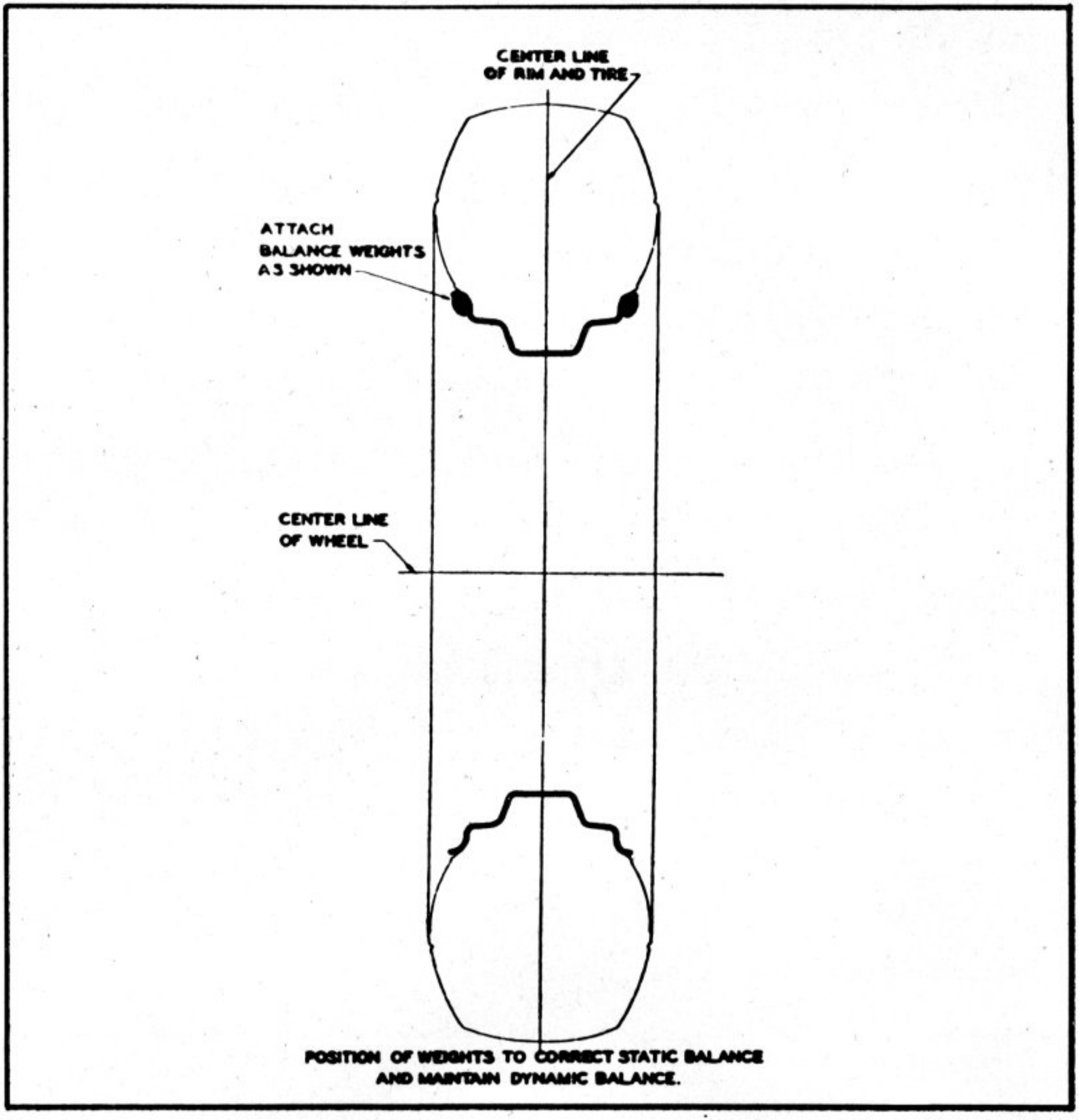


Fig. 563. Placing Weights for Static Wheel Balance

do with how the weights should be placed to maintain dynamic balance, which is discussed under DYNAMIC WHEEL BALANCE.

How to Determine Position of Weights for Static Balance if Specialized Balancing Equipment is not Available

1. Remove complete wheel assembly with hub.
2. Remove the wheel bearings and felt retainers.
3. Thoroughly clean grease from bearings, races and hub.
4. Inflate tire to correct pressure.
5. Clamp a clean spindle in a bench vise, or if one is not available, clean the spindle on the car.
6. Replace bearings and mount the wheel on the spindle.
7. Adjust the bearings loose so that the wheel is held in position and is practically frictionless.
8. Start the wheel in motion and allow it to come to rest. Mark the heavy side which will be at the bottom when the wheel stops.

   NOTE—Weights for correction of unbalanced conditions in front wheel and tire assemblies are available through the Parts Department and can be attached to the wheel rim.
9. Install balance weight on the light side directly opposite to the mark on the heavy side.
10. If more than one weight is necessary, use two weights placed together at the light point, and move them apart an equal distance from this point until the wheel is in balance.
11. Install new felt retainer in wheel hub.
12. Lubricate bearings by applying grease to the ball races and cups only, using not more than two teaspoonfuls per wheel. (See Lubrication Chart.)
13. Where specialized equipment for balancing wheels is available follow instructions furnished with the machine.
14. Install wheel assembly and adjust the wheel bearings as outlined under FRONT WHEEL BEARING ADJUSTMENT.

Dynamic Wheel Balance (Running Balance)

A wheel should always be put in static balance before dynamic balance is attempted.

Even though the wheels on all cars are usually in dynamic balance before the cars leave the factory, still, frequently, there are cases where it becomes necessary at times to rebalance the wheels dynamically.

Dynamic balance (running balance) means that the wheel runs smoothly both on its axis of rotation and on an axis through the center of the tire and rim perpendicular to the axis of rotation. (Axis XX, Fig. 564)

If a front wheel is badly balanced dynamically, shimmy will be manifest at different speeds when driving, and particularly at high car speeds.

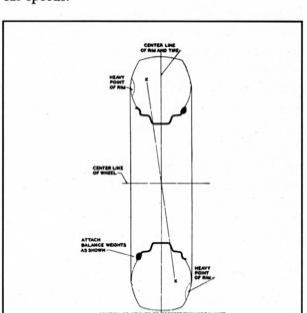
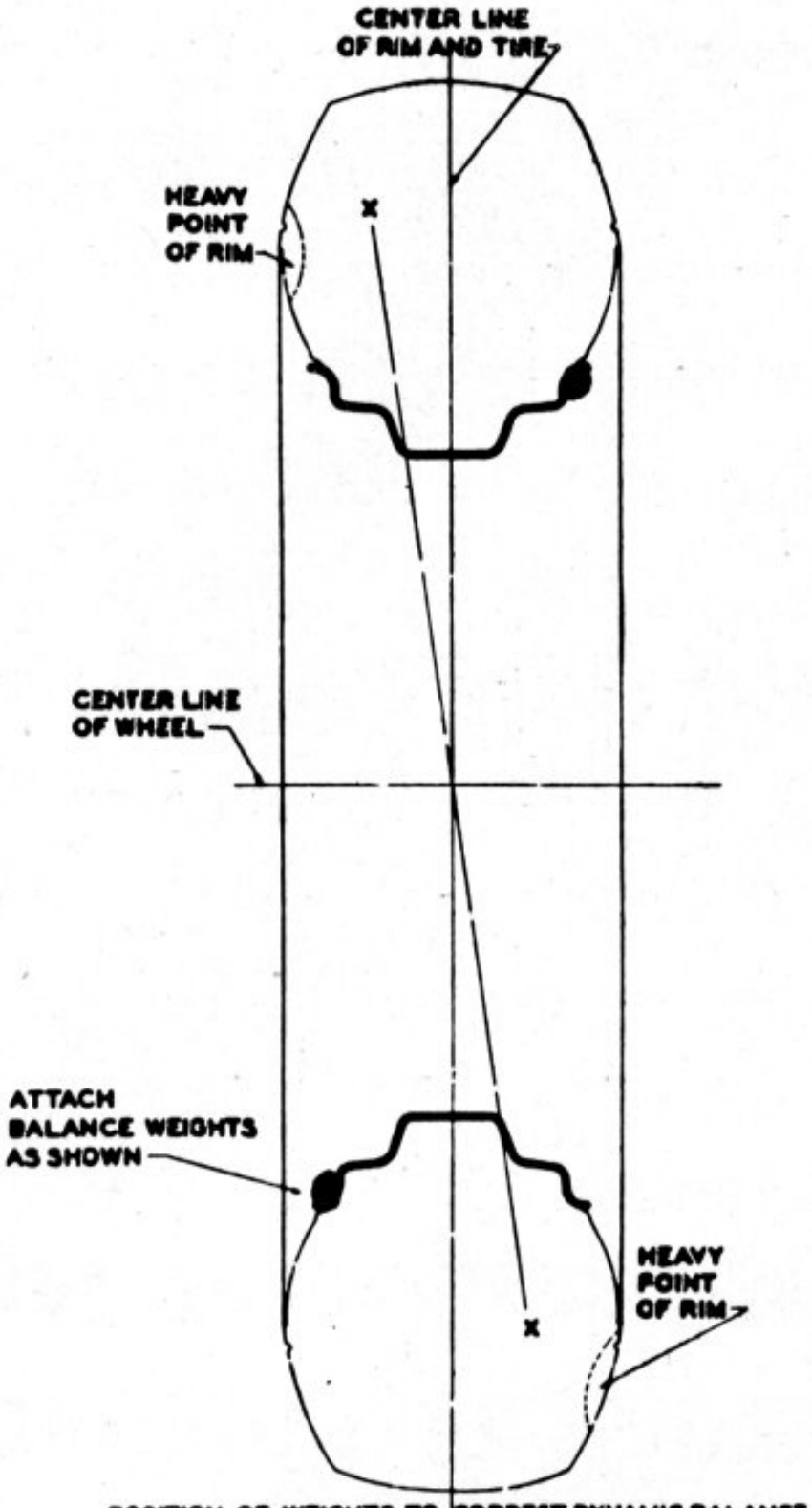


Fig. 564. Placing Weights for Dynamic Wheel Balance



POSITION OF WEIGHTS TO CORRECT DYNAMIC BALANCE AND MAINTAIN STATIC BALANCE.

Fig. 564. Placing Weights for Dynamic Wheel Balance

Two different cases may arise in connection with dynamic wheel balance:

1. Where the wheel is dynamically balanced, and weight must be added to put the wheel in static balance. The proper positioning of weights in this case is shown in Fig. 563.
2. Where the wheel is out of balance dynamically but static balance is maintained. The correct positioning of weights in this case is shown in Fig. 564.

Positioning of Weights for Dynamic Wheel Balance

Necessary instructions usually accompany dynamic wheel balancers, showing where and how weights should be placed for proper dynamic balance.

Fig. 563 shows how the weights should be placed on the rim of the wheel to maintain dynamic balance when it is necessary to add weights for static balance, providing the wheel was in dynamic balance before static balance was attempted. Note in this case, that half the weight required for static balance is placed on one side of the rim and the other half on the opposite side of the rim. In this way, the wheel has been put in static balance and dynamic balance has not been affected.

Fig. 564 shows how the weights should be placed on the rim of the wheel to maintain static balance while bringing about dynamic balance. Note in this case that half of the total weight required for dynamic balance is placed on the opposite side of the rim to the point where the wheel is out of balance dynamically, whereas, the other half is placed 180° circumferentially to the first weight and on the opposite side of the rim.

FRONT WHEEL BEARING ADJUSTMENT

The adjustment of front wheel bearings should be made as follows:

Take up the nut until no shake can be felt in the wheel. Do not mistake loose king bolts and bushings for bearing looseness. Back off nut until a very slight shake can be felt, then tighten up nut to the nearest cotter pin hole. Bearings will have longer life with tight adjustment up to one-sixth turn tight than with any looseness. When front wheel bearings are lubricated, always see that they are adjusted properly. See LUBRICATION–WHEEL BEARINGS.

TIRE INFLATION

The importance of proper tire inflation cannot be over-emphasized. Maintenance of the correct inflation pressure is one of the most important elements in tire care. (See Specifications, for correct tire pressure.)

Too great tire pressure is detrimental, but not so much so as under-inflation. Higher inflation pressure than recommended will give:

1. A harder riding car.
2. Tire more susceptible to various types of bruises.
3. More tire chatter, resulting in uneven wear.
4. Fast tread wear at the center.

Even when a tire is properly inflated, it is not round. It is flat where it contacts the road so that the car at all times is actually being pushed up a hill. This condition is exaggerated on an under-inflated tire. More power is required, therefore, more gasoline consumed when driving with under-inflated tires.

Inflation pressures lower than recommended will result in:

1. Higher gasoline consumption.
2. Rapid and uneven wear on the edges of the tire tread.
3. A tire more susceptible to rim bruises and various types of rupture.
4. Increased cord fatigue or broken tire cords.
5. Hard steering.
6. Higher tire temperatures.
7. Tramp and shimmy troubles.
8. Car roll on sharp curves.
9. Tire squeal on curves.

REMOVING AND APPLYING TIRES—GENERAL INSTRUCTIONS

Removing or applying tires on drop-center rims is not difficult if the instructions hereafter given are followed. In fact, the smaller sized can be applied with the hands, although ordinarily it is easier to proceed with the proper tools. If it is found that tools longer than 12" are necessary, it is evident that the method of applying the tire is incorrect and the instructions should be reviewed. If the following points are observed, tire changing will not be difficult.

CAUTION—Excessive use of talc or soap when installing tires and tubes should be avoided. The practice of putting talc or soap in one place and depending upon the tire rotation to distribute the substance should also be avoided. When used, a small amount only is necessary, and it should be distributed evenly to prevent all of the substance collecting in several spots.

1. The toe of each bead has a soft rubber tip, which must not be damaged in the process of removing or applying the tire. This soft rubber tip protects the tube from chafing. (See Fig. 565)

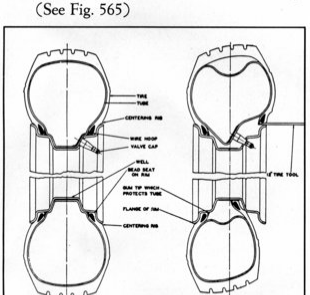


Fig. 565. Drop Center Rim

2. Be careful not to pinch the tube with the tire tools.
3. In prying the bead over the flange, if it seems to take too much force, it is an indication that the bead is not down in the well on the opposite side of the rim. Inside of each tire bead, there is a hoop of wire which must not be broken or unnecessarily strained.
4. In no case should attempt be made to remove or apply both beads at the same time.
5. Before inflating the tire, after it has been assembled, it is imperative that the tire be centered on the rim. The beads must be up on the bead seat. The centering rib must show uniformly above the rim flange.
6. Tire changing is made extremely easy by coating the inside and outside of bead as required, with a vegetable oil soft soap, which also protects the soft rubber tips of the tire bead. The use of soft soap is highly recommended. Do not use oil or grease.

TIRE NOISE AND WEAR

Uneven tire wear is frequently the cause of tire noises which are attributed to rear axles, gears, bearings, etc. Many times work has been done on rear axle assemblies in an endeavor to correct tire noises.

Method to Determine Tire Noise

The determination of tire noise is relatively simple. The car should be driven at various speeds and the effect of part throttle, sudden acceleration and deceleration noted on axle or exhaust noises under these varying conditions. The tire noise will not change with these changes.

A further check may be made for tire noises by driving the car on a concrete or brick road with normal tire pressures and then immediately driving on a tarvia or dirt road (not gravel). In the change from the concrete or brick to the tarvia or dirt road, the tire noise will disappear.

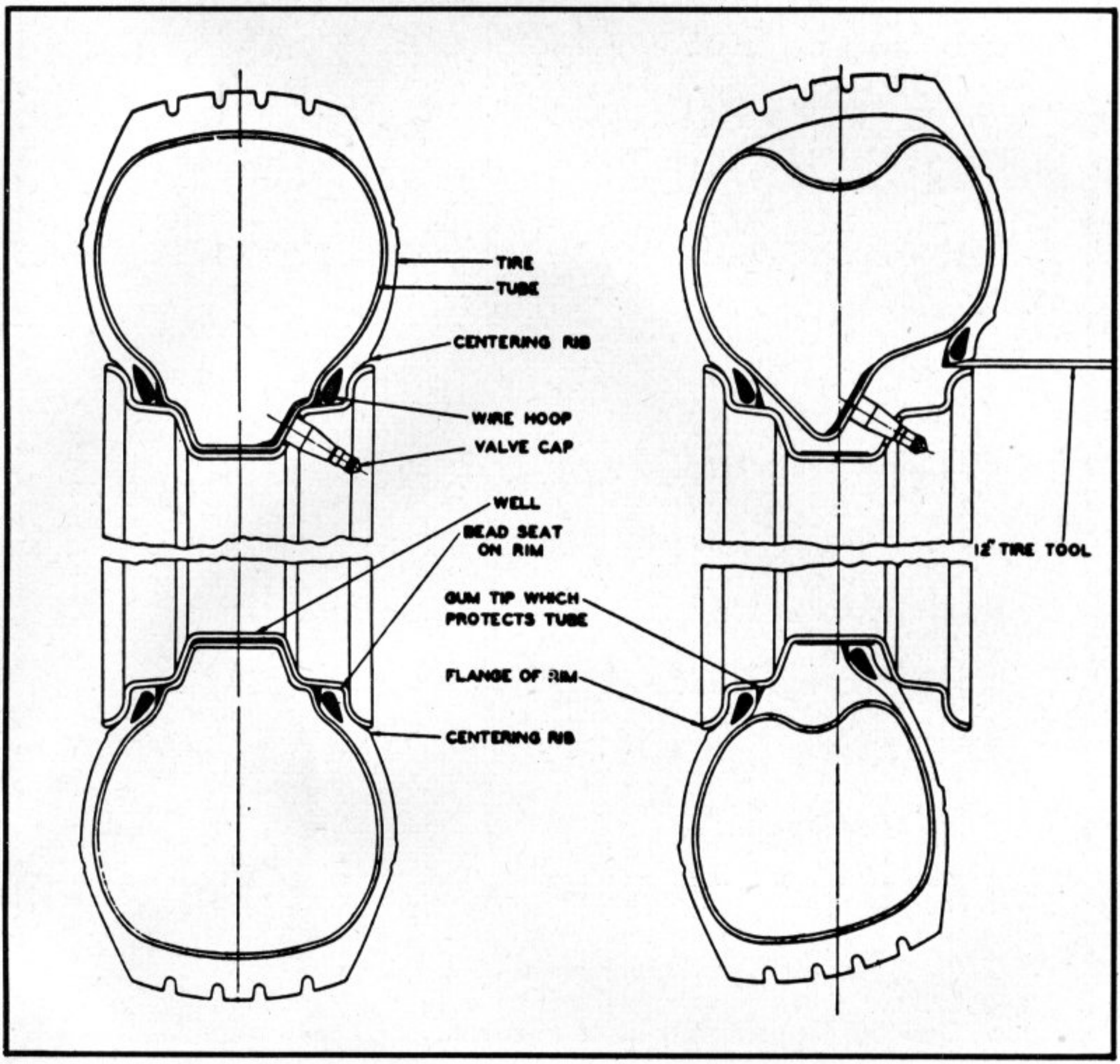


Fig. 565. Drop Center Rim

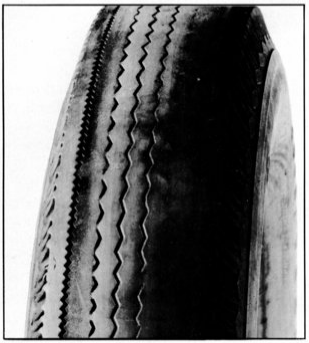


Fig. 566. Side Wear Due to Camber

Fig. 568. Toe-In or Toe-Out Wear

Various Types of Tire Wear

Tire wear may be divided into the following classifications:

1. Side wear due to improper camber.
2. Side wear due to rounding turns at high rate of speed (Cornering).
3. Side wear due to excessively crowned roads.
4. Toe-in or toe-out misalignment wear.

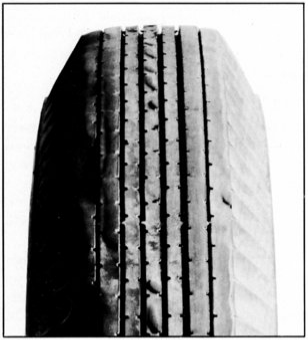


Fig. 567. Wear Due to Mechanical Condition

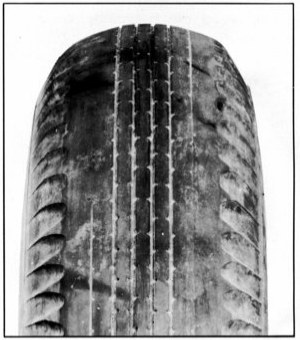


Fig. 569. Side Wear Due to Under-Inflation

5. Uneven tire wear due to bent, loose or misaligned parts (Mechanical Condition).
6. Side wear due to under-inflation.
7. Side wear due to unbalanced tire and wheels.
8. Rapid wear due to high speed driving.
9. Rapid and often uneven wear caused by sudden starts and stops.

Correction for Tire Wear

Correction for tire wear from excessive camber, toe-out or toe-in is a complete check and proper alignment of the front wheels. If side wear is due to bent or misaligned parts such as uneven caster, bent axle, bent spindles, wobbly wheels, out-of-round drums, unequally adjusted brakes, etc., these parts should have a complete check and then parts should be either reworked, or replaced to correct the condition.

Tire inflation should be carefully watched to guarantee against tire wear from under-inflation.

In order to obtain maximum tread life from tires and keep the spare tire from deteriorating due to lack of use, tires should be rotated at 5,000 mile intervals.

The method of rotation illustrated in Fig. 570 results in the same number of miles on each wheel positioned at the end of four switches with the least amount of tread wear.

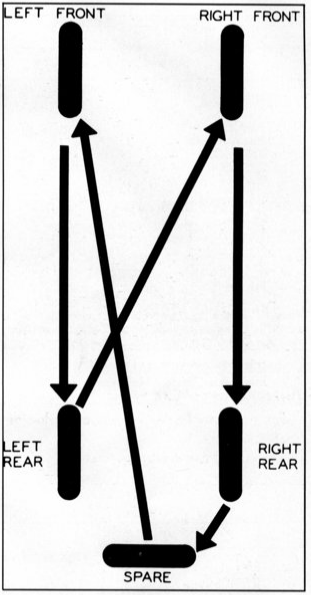


Fig. 570. Method of Rotating Tires

SPECIFICATIONS—1949 MODEL

SUBJECT AND REMARKS	76	88	98
1. WHEELBASE	119½"	119½"	125"
2. WHEELS			
a. Rim Diameter	15"	15"	15"
b. Rim Width	5.50"	5.50"	5.50"
c. Bolt Circle	5"	5"	5"
d. Number of Studs	5	5	5
3. WHEEL BEARINGS			
a. Make	N. D.	N. D.	N. D.
b. Type	Ball	Ball	Ball
4. TIRES			
a. Size	7:10x15	7:60x15	7:60x15
b. Ply	4	4	4
NOTE—If oversize tires are installed, (other than at the factory) it may be necessary to change speedometer gears. See Speedometer Gear Chart.			
5. WHEEL AND TIRE BALANCE			
a. Front, Rear, Spare, (Maximum)	20 in. oz.	20 in. oz.	20 in. oz.

TIRE INFLATION PRESSURE

Inflation pressure is determined by the tire size, not by the model on which it is used. Operate tires at the following pressures:

7:10x15 tires—24 lbs.—both front and rear

7:60x15 tires—24 lbs.—both front and rear

8:20x15 tires—22 lbs.—both front and rear

SHEET METAL

The front end sheet metal layout which includes the hood, front fenders, and radiator grille is designed to permit easy removal of either all of the sheet metal as an assembly or the individual parts. Removal and installation of the various sheet metal grille assemblies is readily apparent after the hood is raised. Figs. 572 and 573 indicate how the various assemblies are attached.

Hood—Emblem—Ornaments

To raise the hood it is necessary to release the latch from inside the body. This is accomplished by a "Push-Pull" control knob located to the left of the steering column on the instrument panel. Pulling back on the control knob releases the latch at the front of the hood. When the control is released, it automatically returns to original position. When the hood is unlatched, it raises approximately 1½" at the front and is held there by the "Safety Hook". This is released by inserting the fingers in the opening between hood and grille at the center and pushing up on the tab on the "Safety Hook". The hood can then be raised.

The upper latch assembly which includes the "Safety Hook" and pointed dovetail, is attached to the hood assembly. The lower latch assembly is attached to the top of the radiator baffle plate.

The hood when lowered centers itself automatically to the proper position by means of an aligning bolt and hole in the lower hood latch at the front of the hood assembly.

Removal of the hood ornament or emblem is apparent when the hood is in the open position.

Hood Adjustment

The clearance between the back end of the hood and the dash should be ⅛" and even all the way across. The hood is adjustable:

1. By means of the enlarged holes in the cowl where the hood hinges are attached. The enlarged holes provide for an adjustment both forward, backward, up, and down.
2. By means of the self-aligning bolt at the front of the hood which automatically aligns the hood as it is lowered. The latch spring and aligning bolt as well as the lower latch assembly are adjustable in enlarged holes in order to facilitate correct alignment.

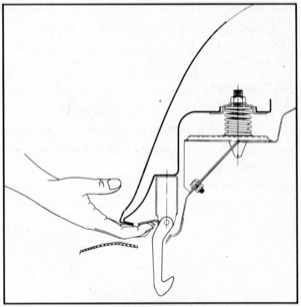


Fig. 571. Hood Safety Latch Mechanism

3. The purpose of the adjustable support located in the middle of the lock support between the two hood hinges on 98 series cars is to prevent hood distortion when the hood is raised or lowered. The support is properly adjusted when it contacts the hood panel with tension but not enough tension to move the panel away from the cowl ledge. Adjustment of this support does not change the clearance of the hood between the cowl and fenders.

Due to the design of the 76 and 88 series hoods, there is no adjustment support required at the center of the hood support between the hinges.

HOOD ASSEMBLY REMOVAL

NOTE—Mark hood hinge support bracket location on cowl to facilitate alignment when reinstalling.

98 Series

1. Disconnect under-hood lamp wire.
2. Remove body to hinge springs, both sides.
3. Remove hood prop pins, both sides.
4. Remove bolt from hood hinge brace to hood hinge bracket, both sides.
5. Remove two hood hinge to body bracket bolts from inside body, both sides.
6. To install, reverse sequence of operations reinstalling insulators in correct position, and align hood.

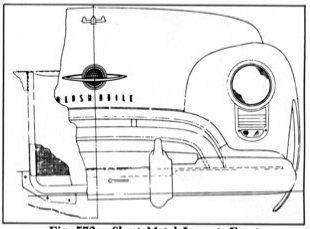


Fig. 572. Sheet Metal Layout—Front

76 and 88 Series

1. Disconnect under-hood lamp wire.
2. Remove hood hinge bracket to hood support springs, both sides.
3. Remove two hood hinge to body bracket bolts from outside, both sides.
4. Lower hood and remove one hood hinge

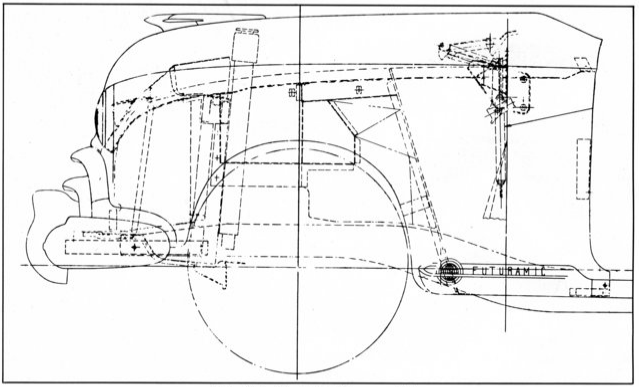


Fig. 573. Sheet Metal Layout—Side

to body bracket bolt from inside body, both sides.

5. To install, reverse sequence of operations reinstalling insulators in correct position, and align hood.

REMOVE AND REPLACE FRONT END SHEET METAL AND RADIATOR ASSEMBLY

1. Drain cooling system.
2. Disconnect radiator hoses, upper and lower.
3. Disconnect battery terminals and remove battery.
4. Disconnect wiring harness from junction blocks and from clips on radiator tie bar.
5. Disconnect hood latch operating cable from latch plate at radiator upper baffle, and from clips on baffle and left hand filler plate.
6. Detach flexible fresh air tubes near front of dash, left and right.
7. Disconnect fresh air inlet pulls, right side on 98 series, left side on 76 and 88 series.
8. Disconnect heater hose from right front fender.
9. Disconnect heater motor wire, right side.
10. Disconnect windshield washer hose from bottle and right top of fender.
11. Disconnect antenna wire from radio and pull out through left side of body. (Antenna will remain connected to fender.)
12. Remove front bumper assembly.
13. Disconnect radiator dust shield.
14. Disconnect lower fender to frame dust shields, both sides.
15. Remove two center, one upper, and two lower (one lower on 76 and 88 series) rear of front fender to body bolts, both sides.
16. Remove nut from front frame cross member bolt (center).
17. Remove front radiator support bolt.
18. Remove complete front end assembly.
19. To replace, reverse sequence of operations and align assembly.

Remove Front Fender

1. Raise hood.
2. Disconnect battery cables.
3. Disconnect hood latch control wire from latch and upper radiator baffle.
4. Disconnect hood latch control cable along fender (left only).
5. Remove front radiator to grille upper baffle.
6. Remove headlight, and parking light wires from junction block on radiator tie bar, right or left.

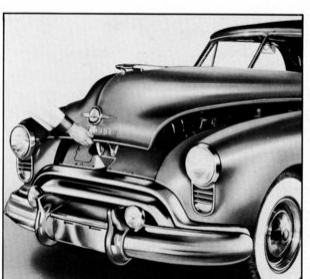


Fig. 574. Method of Raising Hood

7. Remove window washer hose (right only).
8. Remove battery (left only).
9. Disconnect flexible fresh air duct near front of dash, right or left.
10. Disconnect fresh air pull cable, right side on 98, left side of 76 and 88 series.
11. Disconnect heater wire (right only).
12. Disconnect all wiring from voltage regulator, horn, relay, and fender filler plate (left only).
13. Remove front wheel, right or left.
14. Remove seven bolts, fender to grille, right or left (eight on 76 and 88 series).

15. Disconnect lower dust baffle, fender to frame, right or left.
16. Remove three bolts top front of fender to radiator support; right or left.
17. Remove three bolts lower front of fender to radiator support; right or left.
18. Remove one upper, two center, and one lower (two lower on 98 series) rear of fender to body bolts, right or left.
19. Remove fender.
20. To replace, reverse sequence of operations, and align fender.

Fender Alignment

Whenever a fender is installed, care must be exercised to obtain the proper alignment. The holes in the body and cowl for attaching the fender are enlarged to permit adjustment. When making installation, all the fender bolts should be tightened just enough to permit shifting as required, then, after alignment, completely tightened. Sufficient gap should be left to just permit the door to open (and equal to gap on opposite side).

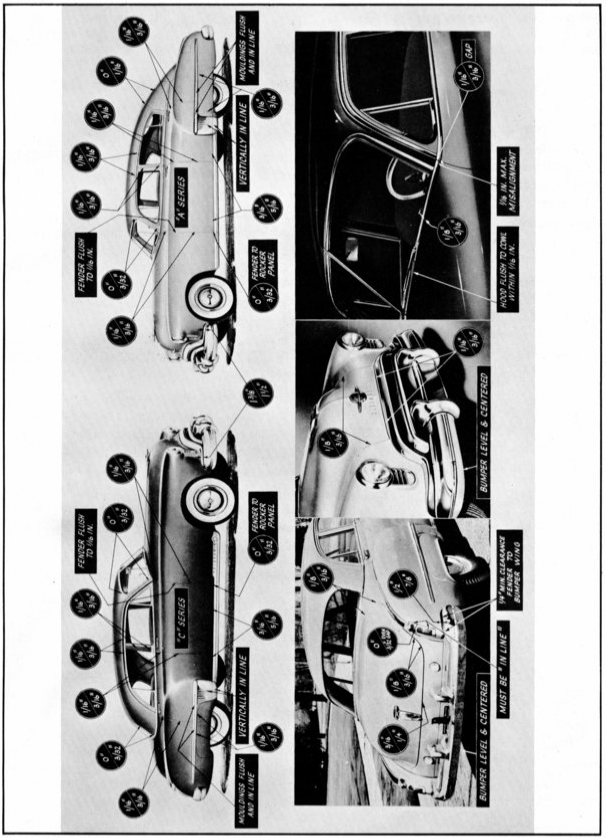


Fig. 575. Sheet Metal Clearances


"C" SERIES
FENDER FLUSH TO 1/16 IN.
1/16" 3/16"
0" 3/32"
MOULDINGS FLUSH AND IN LINE
VERTICALLY IN LINE
3/16" 5/16"
FENDER TO ROCKER PANEL
1 3/8" 1 1/2"
"A" SERIES
0" 1/16"
1/16" 3/16"
BUMPER LEVEL & CENTERED
1/8" 3/16"
0" 3/32 GAP
3/16" 1/4"
1/2" 7/8"
MUST BE "IN LINE"
1/4" MIN. CLEARANCE FENDER TO BUMPER WING
HOOD FLUSH TO COWL WITHIN 1/16 IN.
1/16 IN. MAX. MISALIGNMENT
GAP

ELECTRICAL SYSTEM

Starting Motors

The two Delco-Remy starting motors used on 1949 - 6 and 8 cylinder Oldsmobiles are both 6 volt, 4 brush, 4 field units with the armatures supported by oilless bushings in the end frames. The starter, which is attached to the flywheel housing by means of a special flanged mounting, electrically cranks the engine so that it will start and run. The overrunning clutch type of drive, operated by means of a shift lever linked to the solenoid switch mounted on the motor frame, is used to engage the starter clutch pinion with the flywheel. The solenoid switch, standard equipment on all models, is operated by a starter push switch, mounted on the instrument panel which closes the circuit from the battery to the starter upon completion of the engagement of the clutch pinion with the flywheel. The ignition switch need not be in the "on" position in order to crank the engine with the starting motor.

STARTING MOTOR MAINTENANCE

Starter maintenance may be divided into two sections, normal maintenance required to assure continued operation of a starter, and the checking and repairing of an inoperative starter.

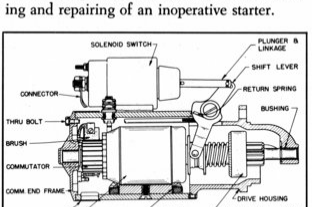


Fig. 576. Solenoid Starting Motor Details

NORMAL STARTING MOTOR MAINTENANCE

Lubrication

When the starting motor is disassembled for servicing, 4 to 5 drops of light engine oil should be added to the bushings in the end frame and in the pinion housing. Starter should not be oiled excessively and the commutator should *NEVER* be oiled.

Inspection

The coverband should be removed periodically and the brushes and commutator inspected. If the commutator is dirty, it may be cleaned with No.00 sandpaper. EMERY CLOTH MUST *NOT* BE USED TO CLEAN COMMUTATOR. If the commutator is rough, out of round, or has high mica, it should be turned down on a lathe and the mica undercut. The mica should be cut away to a depth of 1/32". Worn brushes should be replaced; however, if the brushes wear with excessive rapidity, a check should be made for excessive brush spring tension, (should be 24 to 28 lbs.) roughness, or high mica of the commutator.

CRANKING MOTOR DISASSEMBLY

If it is necessary to disassemble the starter for cleaning, inspection, or repair, it is important that the overrunning clutch, armature and fields are not cleaned with grease dissolving solvents, since these would dissolve the lubricant in the clutch mechanism and would damage the insulation in the armature and field coils. All worn parts should be replaced, and the commutator turned down in a lathe if necessary. Rosin flux should be used in making soldered connections on reassembly. ACID FLUX MUST NOT BE USED ON ELECTRICAL CONNECTIONS.

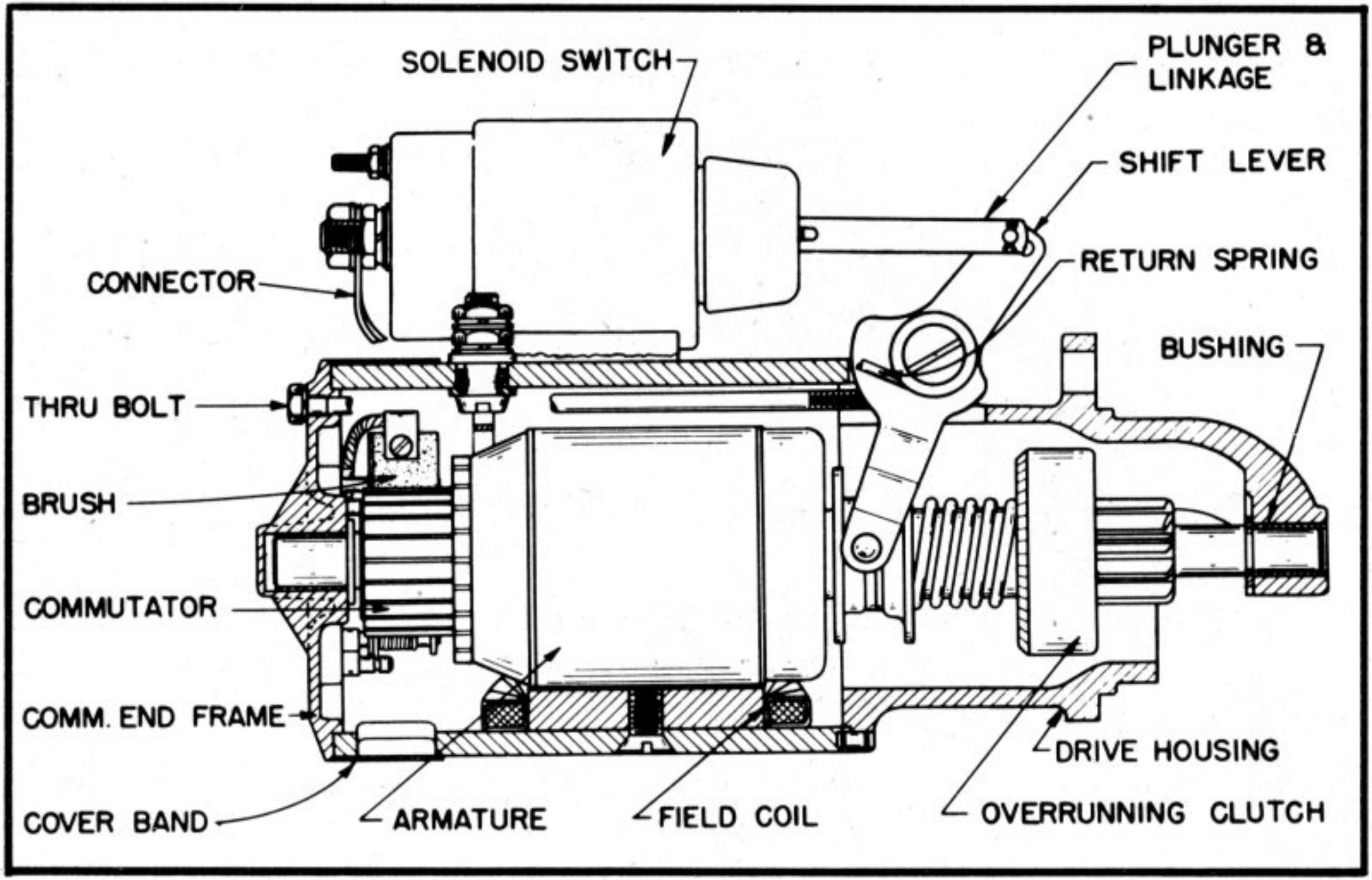


Fig. 576. Solenoid Starting Motor Details

The clearance between the starter pinion and the housing when the clutch pinion is in the operating position, should be 3/16 inch. After a starter overhaul or a solenoid switch replacement, adjustment of this clearance can be made quickly by clamping the motor in a vise and using battery current to hold the solenoid plunger in the "bottomed" position. The solenoid to motor lead should be disconnected so that the starting motor will not operate. A piece of 3/16" bar stock or gauge placed between the pinion and housing will position the pinion. The solenoid circuit should be closed and the plunger pushed in by hand. Battery current will hold the plunger in while the pinion clearance is adjusted. After the solenoid switch mounting screws have been loosened, the solenoid switch should be pulled away from the shift lever until play is taken out of lever and clutch mechanism.

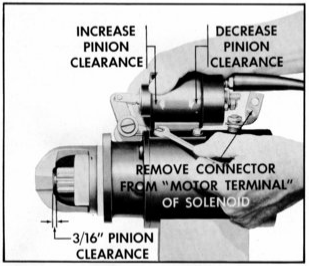


Fig. 577. Positioning Solenoid on Starting Motor Frame

Moving the switch toward the lever increases the clearance and moving the switch away from lever decreases the clearance. Care should be exercised not to compress the overrunning clutch spring. After proper adjustment has been made, the switch mounting screws may be tightened.

Checking Inoperative Cranking Motor

If the starting motor does not develop rated torque and cranks the engine slowly or not at all, the battery, battery terminals and connections, the ground cable and the battery to cranking motor cable should be checked. Corroded, frayed, or broken cables should be replaced, and loose or dirty connections corrected.

The overrunning clutch should withstand 50 to 60 foot pounds torque without slipping, and the pinion should turn freely and smoothly in the overrunning direction. The solenoid switch contacts should be checked for burned conditions and the contact disc and terminal studs replaced if necessary.

If the above are all in order, the coverband should be removed and the brushes and commutator inspected. The brushes should form a good contact with the commutator and should have the correct spring tension. A dirty commutator can be cleaned with No. 00 sandpaper. If the commutator is rough, dirty, burned, or has high mica, it should be turned in a lathe and the mica undercut.

If there are burned bars in the commutator, it may indicate open circuited armature coils which prevent proper cranking. The soldered connections at the commutator riser bars should be inspected and these connections resoldered and commutator turned down as necessary. An open armature will show excessive arcing at the commutator which is open, on the no load test. Tight or dirty bearings will reduce armature speed or prevent the armature from turning. A worn bearing, bent shaft, or loose pole shoe will allow the armature to drag, causing slow speed or failure of the armature to rotate.

If the brushes, bearings, commutator, switch, battery, external circuit, etc., appear to be in good condition, and the cranking motor still does not operate correctly, the cranking motor should be removed for bench check.

BENCH CHECK

No load Test

The cranking motor should be connected in series with a battery of the specified voltage and an ammeter capable of indicating several hundred amperes. If an R.P.M. Indicator is available, the armature R.P.M. may also be read.

Torque Test

Torque testing equipment, if available, may be used to determine if the motor will develop rated torque. A high current carrying variable resistance should be connected into the circuit so the specified voltage at the cranking motor may be obtained since a small variation in the voltage will produce a marked difference in the torque developed.

INTERPRETATION OF NO LOAD AND TORQUE TEST

1. Low free speed and high current draw with low torque indicate:
   a. Tight, dirty, or worn bearings, bent shaft or loose pole shoe screws.
   b. Grounded armature or field. Check further by raising grounded brushes, insulating them from commutator, and checking with a test lamp between the insulated terminal and frame. If test lamp lights, raise other brush from commutator and check fields and commutator separately to determine whether the fields or armature are grounded.
   c. Shorted armature. Check further on growler.
2. Failure to operate with high current draw indicates:
   a. Direct ground in switch, terminal or fields.
   b. Frozen shaft bearings.
3. Failure to operate with no current draw indicates:
   a. Open field circuit. Inspect internal connections and trace circuit with a test lamp.
   b. Open armature coils. Inspect commutator for badly burned bars. Running free speed an open armature will show excessive arcing at the commutator bar which is open.
   c. Broken or weak brush springs, worn brushes, high mica on the commutator or other causes which would prevent contact between the brushes and the commutator.
4. Low no-load speed, with low torque and low current draw indicates:
   a. An open field winding. Raise and insulate ungrounded brushes from commutator and check fields with test lamp.
   b. High internal resistance due to poor connections, defective leads, dirty commutator and causes listed under 3c above.
5. High free speed with low developed torque and high current draw indicates shorted fields. There is no easy way to detect shorted fields, since the field resistance is normally low. If shorted fields are suspected, replace the fields and check for improved performance.

Solenoid Switch

The starter control, designed for minimum effort on the part of the driver, consists of a push button mounted on the instrument panel to the right of the steering column. When the control switch is closed, current from the battery flows through the neutral safety switch (Hydra-Matic equipped cars only) and the pull-in and hold-in solenoid windings producing a magnetic field which pulls in the plunger. Movement of the plunger is transmitted to the starter shift lever by means of a linkage, and the starter drive pinion is shifted into mesh with the engine flywheel ring gear. Completion of the plunger

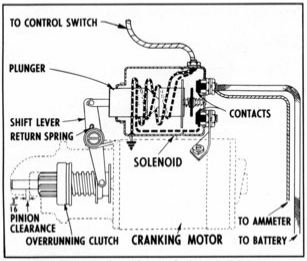


Fig. 578. Solenoid Switch Wiring Diagram

travel closes the main switch contacts, connecting the starter directly to the battery. Closing of the main switch contacts shunts out the pull-in winding since this winding is connected across the main contacts. The magnetism produced by the hold-in winding is sufficient to hold the plunger in, and shunting out of the pull-in winding reduces the drain on the battery. When the control switch is opened, the hold-in winding is disconnected from the battery so that the shift lever spring can withdraw the plunger from the solenoid, opening the solenoid switch contacts and, at the same time, withdrawing the drive pinion from mesh.

On Hydra-Matic equipped cars, a safety switch prevents contact at the starter unless the selector lever is in neutral position.

Solenoid Current Check

The solenoid windings can be tested with the solenoid either off or on the starting motor. Two tests must be made to determine the current draw of both windings in parallel and of the hold-in winding alone. For the first test, the lead from the terminal on the starting motor should be disconnected and the main solenoid terminal, which is normally connected to the cranking motor, grounded to the solenoid base with a jumper lead. A source of variable voltage (battery and a variable resistance) should then be connected in series with an ammeter and in parallel with a voltmeter between the solenoid base and the small solenoid switch terminal. Voltage should be slowly increased and note made of the current draw at the voltage specified in the solenoid test specifications. To check the current draw of the hold-in winding, the jumper lead should be disconnected, grounding the main solenoid terminal; and the variable resistance readjusted to obtain the specified voltage.

IMPORTANT—Whenever the solenoid has been removed or replaced, the clearance of the motor drive pinion must be readjusted after the solenoid has been remounted on the cranking motor. (See section on CRANKING MOTOR DISASSEMBLY.

The 1949 starter system wiring is such that the engine can be cranked with the ignition key in the "off" position. IT IS RECOMMENDED THAT THE CAR BATTERY BE DISCONNECTED WHENEVER ANYONE IS WORKING UNDER THE CAR OR WHENEVER THE FRONT END OF THE CAR IS JACKED UP OFF THE FLOOR.

NEUTRAL SAFETY SWITCH AND ADJUSTMENT

With transmission lever held *firmly* against its stop in the "Neutral" position, adjust neutral safety switch against its stop and tighten.

Check the setting as follows:

1. Apply hand brake and turn ignition switch "on."
2. Put shift lever into "Dr" range and push in on starter button.
3. While holding starter push button in, slowly move shift lever toward neutral until engine cranks and starts.
4. Without moving the shift lever after engine begins to crank, accelerate to determine whether or not transmission is in gear.

   If neutral safety switch is properly adjusted, transmission will not be in gear, and

approximately ⅛" movement of the shift indicator pointer will be required to engage transmission.

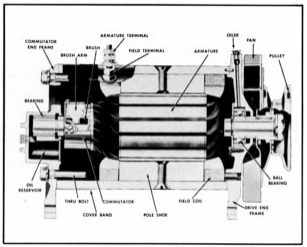


Fig. 579. Generator Details

Generators

The 1949 generator which is mounted on the engine, and driven by the fan belt, is a 6 volt bipolar, high capacity shunt machine, controlled externally by a voltage and current regulator.

The armature is supported by a ball bearing at the drive end and by a bronze bushing at the commutator end. Forced ventilation is provided by a fan, incorporated in the drive pulley, which rotates with the armature shaft.

The unit is mounted on the motor on hinged brackets, and two through bolts hold the end frames in place to the field frame.

The brushes, which are not manually adjustable, are held by reaction type holders, provided with springs, which cause the brushes to bear on the commutator.

GENERATOR MAINTENANCE

Generator maintenance may be divided into two sections, normal maintenance required to assure continued operation of generator, and the checking and repairing of inoperative units.

NORMAL GENERATOR MAINTENANCE

Lubrication

The two hinge cap oilers should be supplied with 10 to 20 drops of light engine oil every 1,000 miles of operation. Do not oil excessively. NEVER OIL COMMUTATOR.

Inspection

The cover band should be removed and the commutator and brushes inspected at regular intervals. If the commutator is dirty, it may be cleaned with No. 00 sandpaper. Blow out all dust after cleaning. NEVER USE EMERY CLOTH TO CLEAN COMMUTATOR. If the commutator is rough, out of round, or has high mica, it should be turned down on a lathe and the mica undercut.

Worn brushes should be replaced. They can be seated with a brush seating stone. When held against the revolving commutator, the abrasive material carries under the brushes, seating them in a few seconds. Blow out abrasive particles after seating brushes. Normally, brushes will require replacement after 25,000 to 45,000 miles of service.

Check brush spring tension, which should be approximately 25 ounces.

GENERATOR DISASSEMBLY

At times, it may be necessary to disassemble the generator for a thorough cleaning and inspection of all parts. Never clean the armature or fields in any degreasing tank, or with grease dissolving materials, since these may damage the insulation. The ball bearing should be cleaned and repacked with a good grade of ball bearing grease. The commutator should be trued in a lathe and the mica undercut if necessary. All wiring and connections should be checked. Rosin flux should be used in making all soldered connections. Acid flux must never be used on electrical connections.

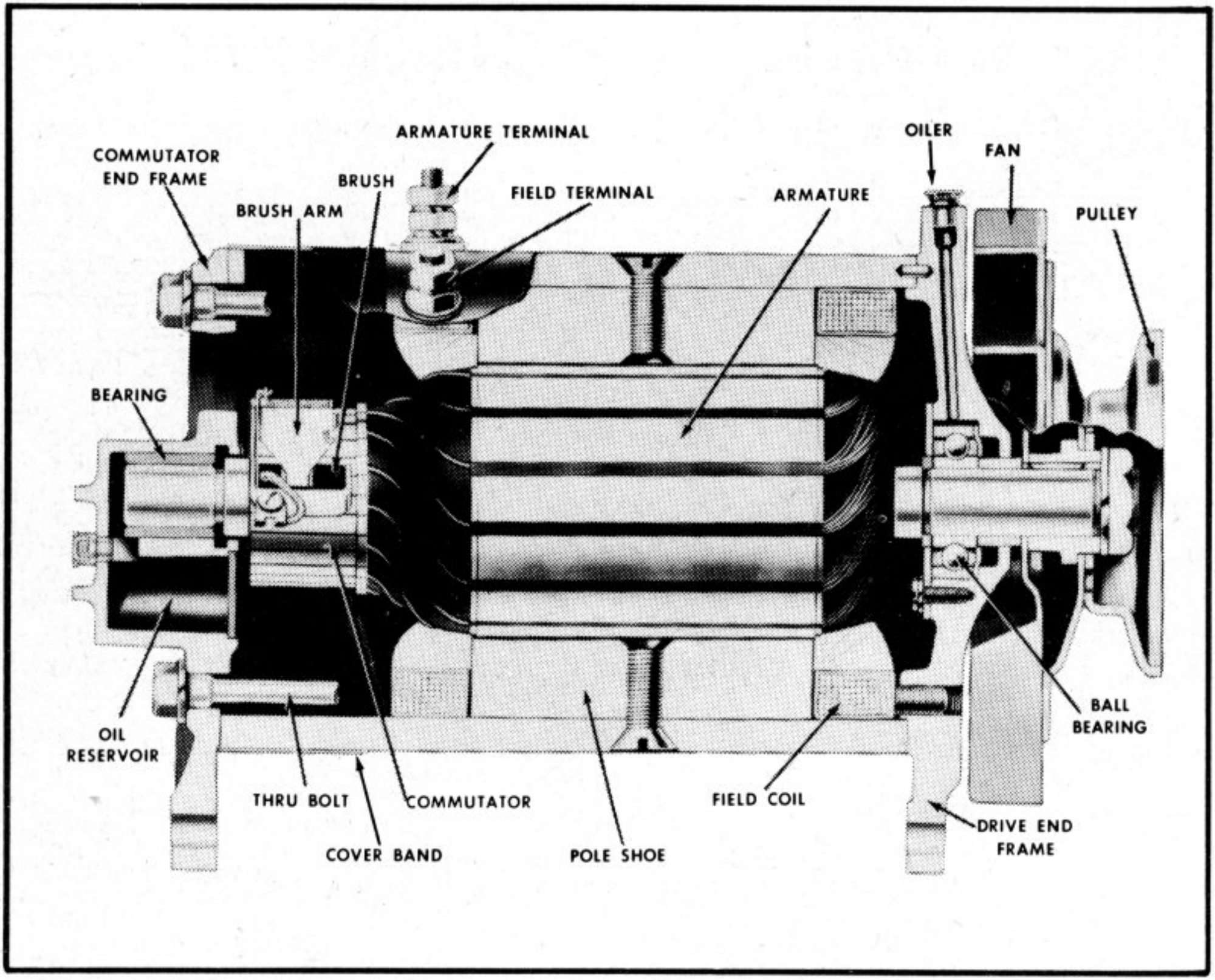


Fig. 579. Generator Details

Checking Inoperative Generator

Several conditions may necessitate removal of the generator from the engine and further checking of the generator, as follows:

1. No Output
2. Unsteady or Low Output
3. Excessive Output
4. Noisy Generator

1. No Output

Remove cover band and check for sticking or worn brushes and burned commutator bars. Burned bars, with other bars fairly clean, indicate open circuited coils. If brushes are making good contact with commutator, and commutator appears to be in good condition, use test leads and light checking as follows:

a. Raise grounded brush, check with test points from "A" terminal to frame. Light should not light. If it does, the generator is grounded; raise other brush from commutator and check field, commutator and brush holder to locate ground.
b. If generator is not grounded, check field for open circuit.
c. If the field is not open, check for shorted field. Field draw at 6 volts should be 1.90 - 2.03 amperes. Excessive current draw indicates shorted field.
d. If trouble has not yet been located, remove armature and check on growler for short circuit.

2. Unsteady or Low Output

Check as follows:

a. Check drive belt tension.
b. Check brush spring tension and brushes for sticking.
c. Inspect commutator for roughness, grease and dirt, dirt in slots, high mica, out of round, burned bars. With any of these conditions, the commutator must be turned down in a lathe and the mica undercut. In addition, with burned bars which indicate open circuit, the open circuit condition must be eliminated or the armature replaced.

3. Excessive Output

Excessive output usually results from a grounded generator field, grounded either internally, or in the regulator. Opening the field circuit (disconnecting lead from "F" terminal of regulator or generator) operating at a medium speed will determine which unit is at fault. If the output drops off, the regulator is causing the condition. If the output remains high, the field is grounded in the generator either at the pole shoes, leads, or at the "F" terminals.

4. Noisy Generator

Noisy generator may be caused by loose mounting or drive pulley, worn, dry or dirty bearings, or improperly seated brushes. Brushes may be seated by using brush seating stone, referred to under NORMAL GENERATOR MAINTENANCE.

Installation Caution

After the generator is reinstalled on the engine, or at any time after leads have been disconnected and then reconnected to the generator, a jumper lead should be connected MOMENTARILY between the BATTERY and ARMATURE terminals of the regulator, *before starting the engine.* This allows a momentary surge of current from the battery to the generator which correctly polarizes the generator with respect to the battery it is to charge.

Current and Voltage Regulator

The Delco-Remy 6 volt Current and Voltage Regulator, shown in Fig. 580, is mounted on the left front fender filler plate. This unit, which contains a cut-out relay regulator, a voltage

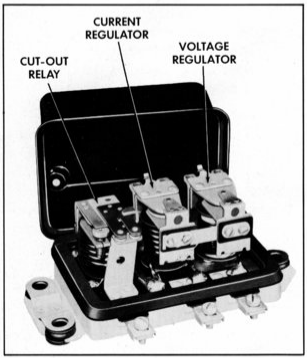


Fig. 580. Current-Voltage Regulator Unit

regulator and a current regulator, is designed for use with a negative grounded battery and Delco-Remy shunt type generator, with externally grounded field circuits. Construction and operation of each of these units is discussed in the following sections.

Cutout Relay

The cutout relay (Fig. 581) has two windings assembled on one core, a series winding of a few turns of heavy wire (solid line) and a shunt winding of many turns of fine wire (dashed line). The shunt winding is shunted across the generator so that generator voltage is impressed upon it at all times. The series winding is connected in series with the charging circuit so that generator output passes through it.

The relay core and windings are assembled into a frame onto which is attached a flat steel armature. A flexible hinge centers the armature above the end of the core so that the two armature contact points are located just above a similar number of stationary contact points. When the generator is not operating, the armature contact points are held away from the stationary points by the tension of a flat spring riveted on the side of the armature.

Cutout Relay Action

When the generator voltage builds up to a value great enough to charge the battery, the magnetism induced in the relay windings is sufficient to overcome the armature spring tension and pull the armature toward the core so that the contact points close. This completes the circuit between the generator and battery. The current which flows from the generator to the battery passes through the series winding in the proper direction to add to the magnetism holding the armature down and the contact points closed.

When the generator slows down or stops, current begins to flow from the battery to the generator. This reverses the direction that the current flows through the series winding, thus causing a reversal of the series winding magnetic field. The magnetic field of the shunt winding does not reverse. Therefore, instead of helping each other, the two windings now magnetically oppose so that the resultant magnetic field becomes insufficient to hold the armature down. The flat spring pulls the armature away from the core so that the points separate; this opens the circuit between the generator and battery.

VOLTAGE REGULATOR

The voltage regulator (Fig. 581) has two windings assembled on a single core, a shunt winding consisting of many turns of fine wire (shown as dashed line) which is shunted across the generator, and a series winding of a few turns of relatively heavy wire (shown as solid line) which is connected in series with the generator field circuit when the regulator contact points are closed.

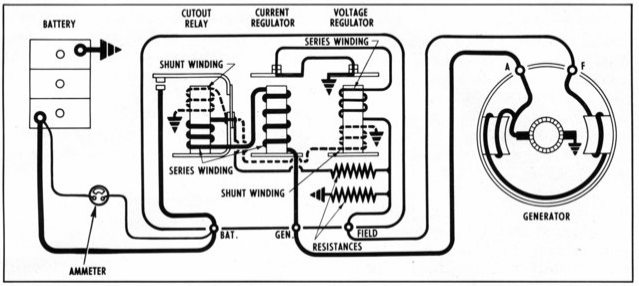


Fig. 581. Current-Voltage Regulator Wiring Diagram

The windings and core are assembled into a frame. A flat steel armature is attached to the frame by a flexible hinge so that it is just above the end of the core. The armature contains a contact point which is just beneath a stationary contact point. When the voltage regulator is not operating, the tension of a spiral spring holds the armature away from the core so that the points are in contact and the generator field circuit is completed to ground through them.

Voltage Regulator Action

When the generator voltage reaches the value for which the voltage regulator is adjusted, the magnetic field produced by the two windings (shunt and series) overcomes the armature spring tension and pulls the armature down so that the contact points separate. This inserts resistance into the generator field circuit so that the generator field current and voltage are reduced. Reduction of the generator voltage reduces the magnetic field of the regulator shunt winding. Also, opening the regulator points opens the regulator series winding circuit so that its magnetic field collapses completely. The consequence is that the magnetic field is reduced sufficiently to allow the spiral spring to pull the armature away from the core causing the contact points to again close. This directly grounds the generator field circuit so that generator voltage and output increase. The above cycle of action again takes place and the cycle continues at a rate of 150 to 250 times a second, regulating the voltage to a constant value. By thus maintaining a constant voltage, the generator supplies varying amounts of current to meet the varying states of battery charge and electrical load.

CURRENT REGULATOR

The current regulator has a series winding of a few turns of heavy wire (shown as solid line) which carries all generator output. The winding core is assembled into a frame. A flat steel armature is attached to the frame by a flexible hinge so that it is just above the core. The armature has a contact point which is just below a stationary contact point. When the current regulator is not operating, the tension of a spiral spring holds the armature away from the core so that the points are in contact. In this position the generator field circuit is completed to ground through the current regulator contact points in series with the voltage regulator contact points.

Current Regulator Action

When the load demands are heavy, as for example, when electrical devices are turned on and the battery is in a discharged condition, the voltage may not increase to a value sufficient to cause the voltage regulator to operate. Consequently, generator output will continue to increase until the generator reaches rated maximum. This is the current value for which the current regulator is set. Therefore, when the generator reaches rated output, this output, flowing through the current regulator winding, creates sufficient magnetism to pull the current regulator armature down and open the contact points. With the points open, resistance is inserted into the generator field circuit so that the generator output is reduced.

As soon as the generator output starts to fall off, the magnetic field of the current regulator winding is reduced, the spiral spring tension pulls the armature up, the contact points close and directly connect the generator field to ground. Output increases and the above cycle is repeated. The cycle continues to take place while the current regulator is in operation 150 to 250 times a second, preventing the generator from exceeding its rated maximum.

When the electrical load is reduced (electrical devices turned off or battery comes up to charge), then the voltage increases so that the voltage regulator begins to operate and tapers the generator output down. This prevents the current regulator from operating. Either the voltage regulator or the current regulator operates at any one time—the two do not operate at the same time.

Resistances

The current and voltage regulator circuits use a common resistance (Fig. 581) which is inserted in the field circuit when either the current or voltage regulator operates. A second resistance (Fig. 581) is connected between the regulator field terminal and the relay frame, which places it in parallel with the generator field coils. The sudden reduction in field current occurring when either the current or voltage regulator contact points open, is accompanied by a surge of induced voltage in the field coils as the strength of the magnetic field changes. These surges are partially dissipated by the two resistances, thus preventing excessive arcing at the contact points.

Temperature Compensation

Voltage regulators are compensated for temperature by means of a bi-metal thermostatic hinge on the armature. This causes the regulator to regulate for a higher voltage when cold which partly compensates for the fact that a higher voltage is required to charge a cold battery.

Regulator Polarity

Some regulators are designed for use with negative grounded batteries while other regulators are designed for use with positive grounded batteries. Using the wrong polarity regulator on an installation will cause the regulator contact points to pit badly and give very short life. As a safeguard against installation of the wrong polarity, regulators designed for positive grounded systems have copper plated current and voltage regulator armatures while regulators for negative grounded systems have cadmium plated armatures.

REGULATOR MAINTENANCE

General Instructions

1. Mechanical checks and adjustments (air gaps, point opening) must be made with battery disconnected and regulator preferably off the vehicle.

   CAUTION—The cutout relay contact points must never be closed by hand with the battery connected to the regulator. This would cause a high current to flow through the units which would seriously damage them.

2. Electrical checks and adjustments may be made either on or off the vehicle. The regulator must always be operated with the type generator for which it is designed.
3. The regulator must be mounted in the operating position with cover in place when electrical settings are checked, and it must be at operating temperature when checks and adjustments are made.
4. After any tests or adjustments, the generator on the vehicle must be repolarized after leads are connected but before the engine is started, as follows:

Repolarizing Generator

After reconnecting leads, *momentarily* connect a jumper lead between the "GEN" and "BAT" terminals of the regulator. This allows a momentary surge of current to flow through the generator which correctly polarizes it.

Failure to do this may result in severe damage to the equipment since reversed polarity causes vibration, arcing and burning of the relay contact points.

QUICK CHECKS OF GENERATOR AND REGULATOR

In analyzing difficulties in generator-regulator operation, any of several basic conditions may be found.

(1) Fully Charged Battery and Low Charging Rate—This indicates normal generator-regulator operation. Regulator settings may be checked as outlined in the following section.

(2) Fully Charged Battery and a High Charging Rate—This indicates that the voltage regulator is not reducing the generator output as it should. A high charging rate to a fully charged battery will damage the battery and the accompanying high voltage is very injurious to all electrical units.

This operating condition may result from:

(a) Improper voltage regulator setting.
(b) Defective voltage regulator unit.
(c) Grounded generator field circuit (in either generator, regulator or wiring).
(d) Poor ground connection at regulator.
(e) High temperature (over 135° F.) which reduces the resistance of the battery to charge so that it will accept a high charging rate even though the voltage regulator setting is normal.

If the trouble is not due to high temperature, determine the cause of trouble by disconnecting the lead from the regulator "F" terminal with the generator operating at medium speed. If the output remains high, the generator field is grounded either in the generator or in the wiring harness. If the output drops off, the regulator it at fault and it should be checked for a high voltage setting or for grounds.

(3) Low Battery and High Charging Rate—This is normal generator-regulator action. Regulator settings may be checked as outlined in the following section.

(4) Low Battery and Low or No Charging Rate—This condition could be due to:

(a) Loose connections, frayed or damaged wires.
(b) Defective battery.
(c) High circuit resistance.
(d) Low regulator setting.
(e) Oxidized regulator contact points.
(f) Defects within the generator.

If the condition is not caused by loose connections, frayed or damaged wires, proceed as follows to locate cause of trouble.

To determine whether the generator or regulator is at fault, momentarily ground the "F" terminal of the regulator and increase generator speed. If the output does

not increase, the generator is probably at fault and it should be checked.

If the generator output increases, the trouble is due to:

(a) A low voltage (or current) regulator setting.

(b) Oxidized regulator contact points which insert excessive resistance into the generator field circuit so that output remains low.

(c) Generator field circuit open within the regulator at the connections or in the regular winding.

(5) Burned Resistances, Windings or Contacts—These result from open circuit operation or high resistance in the charging circuit. Where burned resistances, windings or contacts are found, always check car wiring before installing a new regulator. Otherwise, the new regulator may also fail in the same way.

(6) Burned Relay Contact Points—This is due to reversed generator polarity. Generator polarity must be corrected after any checks of the regulator or generator, or after disconnecting and reconnecting leads.

Cleaning Contact Points

The contact points of a regulator will not operate indefinitely without some attention. It has been found that a great majority of all regulator trouble can be eliminated by a simple cleaning of the contact points, plus some possible readjustment. The flat points should be cleaned with a spoon or riffler file. On negative grounded regulators which have the flat contact point on the regulator armatures, loosen the contact bracket mounting screws so that the bracket can be tilted to one side. (Fig. 582) (On positive grounded regulators, the flat point is in the upper contact bracket so the bracket must be removed for cleaning the points.) A flat file cannot be used successfully to clean the flat

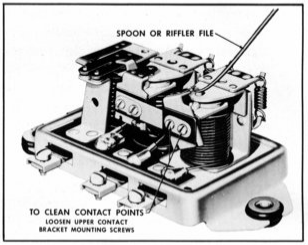


Fig. 582. Cleaning Current-Voltage Regulator Contact Points

contact points since it will not touch the center of the flat point where point wear is most likely to occur. NEVER USE EMERY CLOTH OR SANDPAPER TO CLEAN THE CONTACT POINTS.

REGULATOR CHECK AND ADJUSTMENTS

Cutout Relay Check and Adjustments

The cutout relay requires three checks and adljustments: air gap, point opening and closing voltage. The air gap and point opening adjustments must be made with the battery disconnected.

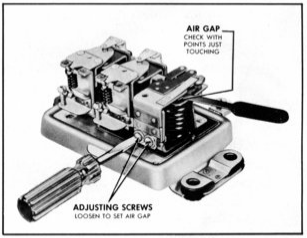


Fig. 583. Adjusting Cutout Relay Air Gap

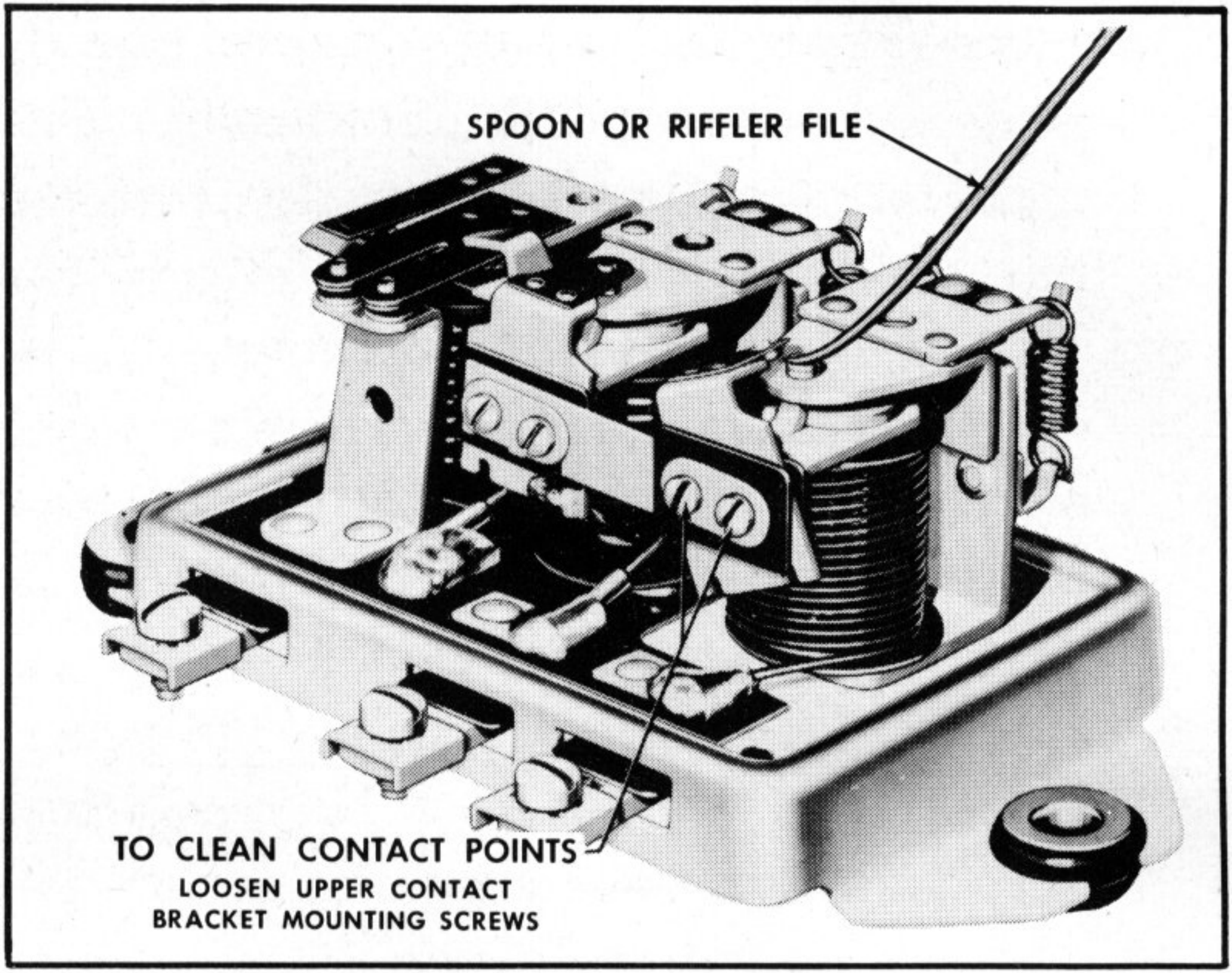


Fig. 582. Cleaning Current-Voltage Regulator Contact Points

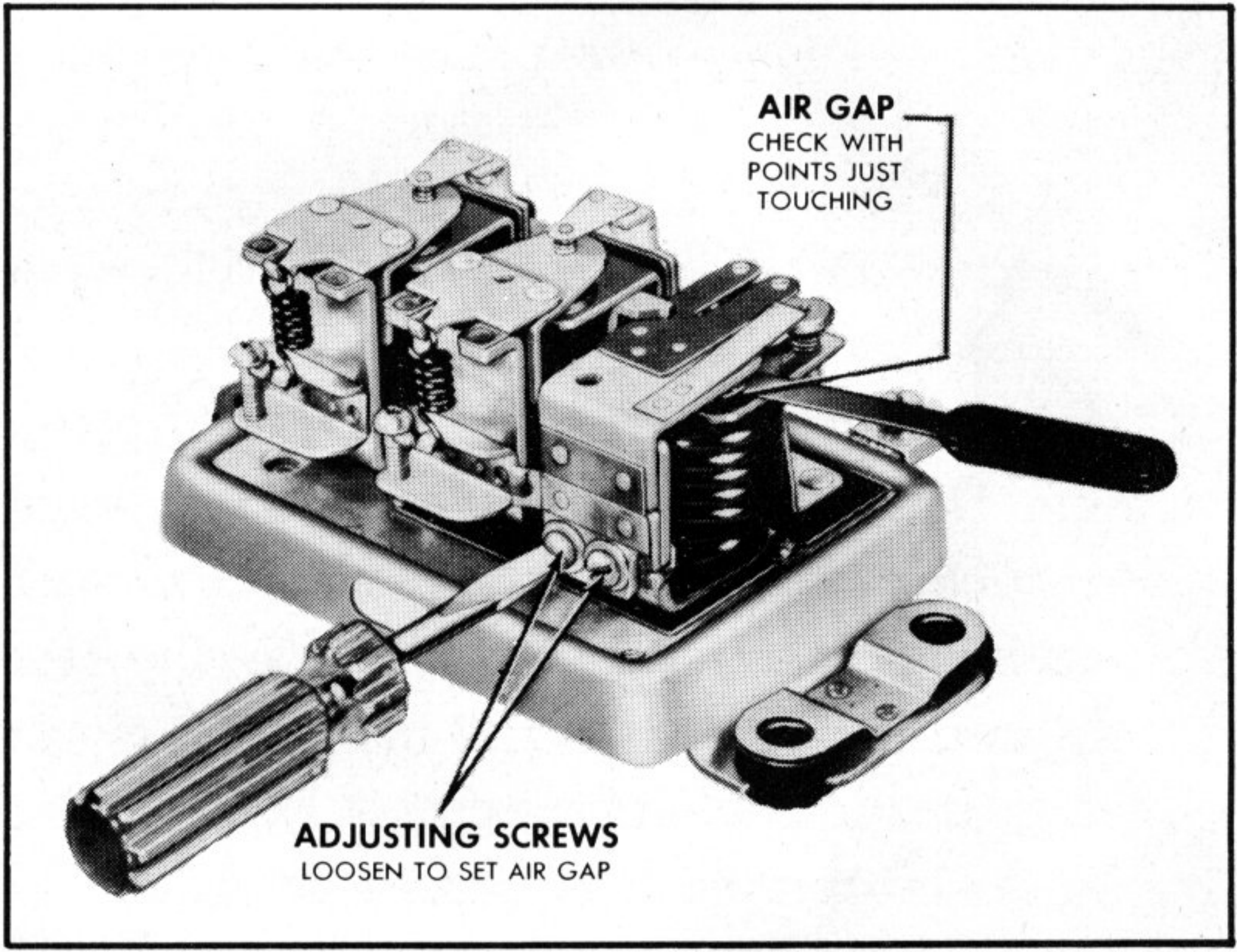


Fig. 583. Adjusting Cutout Relay Air Gap

Air Gap—Place fingers on armature directly above core and move armature down until points just close and then measure air gap between armature and center of core. (Fig. 583) Make sure that all points close simultaneously. If they do not, bend spring finger so they do. To adjust air gap, loosen two screws at the back of relay and raise or lower the armature as required. Tighten screws after adjustment.

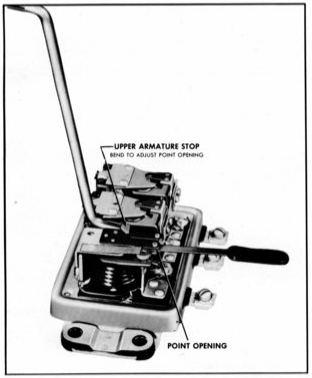


Fig. 584. Adjusting Cutout Relay Point Opening

Point Opening—Check point opening and adjust by bending the upper armature stop. (Fig. 584)

Closing Voltage—To check the closing voltage of the cutout relay, connect the regulator to the proper generator and battery, and connect a voltmeter between the regulator "GEN" terminal and regulator base, and connect an ammeter into the charging circuit at the regulator "BAT" terminal as shown in Fig. 585. Slowly increase the generator speed and note relay closing voltage. Adjust closing voltage by

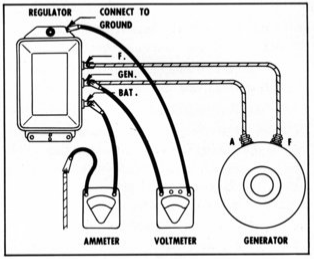


Fig. 585. Checking Closing Voltage of Cutout Relay

turning adjusting screw. (Fig. 586) Turn screw clockwise to increase spring tension and closing voltage and turn counterclockwise to decrease closing voltage.

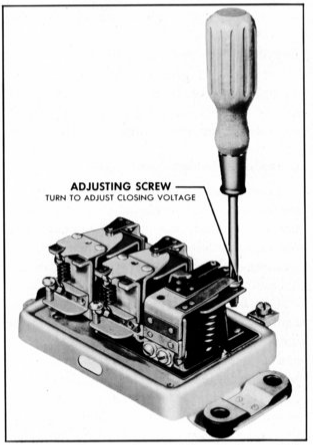


Fig. 586. Adjusting Closing Voltage of Cutout Relay

Voltage Regulator Checks and Adjustments

Two checks and adjustments are required on the voltage regulator, air gap and voltage setting.

Air Gap—To check air gap, push armature down to the core and release it until the contact points just touch and then measure air gap. (Fig. 587) Adjust by loosening the contact mounting screws and raise or lower the contact bracket as required. Be sure the points are lined up and tighten screws after adjustment.

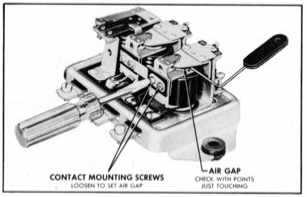


Fig. 587. Adjusting Voltage Regulator Air Gap

Voltage Setting—There are two ways to check the voltage setting—the fixed resistance method and the variable resistance method. (Figs. 588 & 590)

FIXED RESISTANCE METHOD—With this method, a fixed resistance is substituted for the external charging circuit by connecting it between the regulator "BAT" terminal and ground in parallel with a voltmeter with the lead disconnected from this terminal as shown in Fig. 588.

The resistance must be ¾ ohm for 6 volt units and must be capable of carrying 10 amperes without any change of resistance with temperature changes. With generator operating at a speed at which it would normally produce rated output, and with the regulator at operating temperature (after at least 15 minutes of operation), note voltage setting. Cover must be in place.

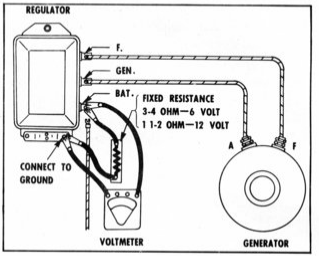


Fig. 588. Voltage Setting Checked with Fixed Resistance

Adjust voltage setting by turning adjusting screw. (Fig. 589) Turn screw clockwise to increase voltage setting and counterclockwise to decrease voltage setting.

CAUTION—If adjusting screw is turned down (clockwise) beyond the normal range

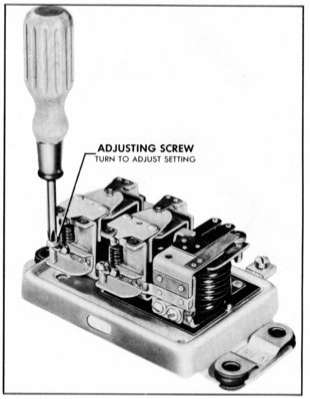


Fig. 589. Adjusting Voltage Setting

required for adjustment, the spring support may be bent beyond its elastic limit and fail to return when pressure is relieved. In such a case, turn the screw counterclockwise until sufficient clearance develops between the screw head and the spring support, then bend spring support upward carefully with small pliers until contact is made with the screw head. The final setting of the unit should always be approached by increasing the spring tension, never by reducing it. In other words, if the setting is found to be too high, the unit should be adjusted below the required value and then raised to the exact setting by increasing the spring tension.

After each adjustment and before taking voltage reading, replace the regulator cover, reduce generator speed until relay points open, and then bring the generator back to speed again.

VARIABLE RESISTANCE METHOD—Connect ammeter into charging circuit at the "BAT" terminal in series with a ¼ ohm variable resistance and connect voltmeter from this terminal to ground as shown in Fig. 590. Increase generator speed to where it would normally produce rated output. If less than 8 amperes is obtained, turn on lights to permit increased generator output.

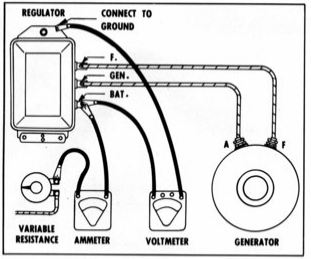


Fig. 590. Voltage Setting Checked with Variable Resistance

Cut in resistance until output is reduced to 8-10 amperes. Operate until regulator reaches operating temperature. Retard generator speed until relay points open and then bring generator back to speed and note voltage setting. Voltage reading must be taken with regulator at operating temperature and with 8-10 amperes flowing. Cover must be in place.

Adjust regulator as previously outlined. In using the variable resistance method, it is necessary to readjust the variable resistance after each voltage adjustment, and then reduce and increase generator speed before taking the voltage reading.

Current Regulator Checks and Adjustments

Two checks and adjustments are required on the current regulator, air gap and current setting.

Air Gap—The air gap on the current regulator is checked and adjusted in exactly the same manner as for the voltage regulator already described.

Current Setting—To check the current regulator setting, the voltage regulator must be prevented from operating. Three methods of preventing voltage regulator operation are avail-

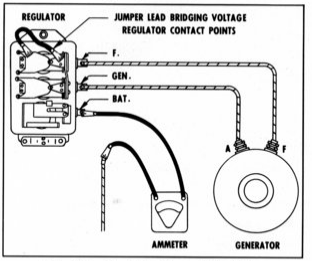


Fig. 591. Checking Current Regulator Setting

able. Regardless of the method used, an ammeter must be connected into the charging circuit at the regulator "BAT" terminal. (Fig. 591) The three methods are as follows:

1. JUMPER LEAD METHOD – Remove the regulator cover and connect a jumper lead across the voltage regulator contact points. (Fig. 591) Turn on lights and accessories to prevent high voltage during the test. With generator operating at medium speed, and with regulator at operating temperature, note the current setting. Adjust by turning adjusting screw clockwise to increase the current setting or counterclockwise to decrease the setting. See caution note under VOLTAGE SETTING of VOLTAGE REGULATOR CHECKS AND ADJUSTMENTS section.
2. BATTERY DISCHARGE METHOD– Partly discharge battery by cranking the engine for 30 seconds with ignition turned off. Never use cranking motor more than 30 seconds since this would overheat and damage it. Immediately after cranking, start engine, turn on lights and accessories and note current setting with engine operating at medium speed.
3. LOAD METHOD–If a load approximating the current regulator setting is placed across the battery during the time that the current regulator setting is being checked, the voltage will not increase sufficiently to cause the voltage regulator to operate. This load may be provided by a carbon pile or a bank of lights.

REGULATOR REPAIRS

Replacing Contact Support Brackets

Voltage or current regulator contact support brackets can be replaced by following the relationship illustrated in Fig. 592. Note particularly that the connector strap is insulated

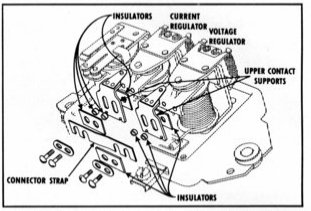


Fig. 592. Replacing Contact Support Brackets

from the voltage regulator contact mounting screws while it is connected to the current regulator contact mounting screws. New bushings should always be used when installing a contact support bracket since the old bushing may be distorted or damaged.

Installing New Spring

If it becomes necessary to replace the spring on either the current or voltage regulator unit, the new spring should first be hooked on the lower spring support and then stretched up until it can be hooked at the upper end. Stretch the spring only by means of a screwdriver blade inserted between the turns–do not pry the spring into place as this is likely to bend the spring supports.

REGULATOR PERFORMANCE

1. The voltage regulator unit limits the voltage of the circuit, thus protecting the battery, distributor points, lights, and other accessories from high voltage.
2. The current regulator unit provides protection to the generator, preventing it from exceeding its maximum rated output.
3. Never set the current regulator above the maximum specified output of the generator.
4. Many of the regulators are designed to be used with a positive grounded battery only, while others are designed to be used with a negative grounded battery only. Never

attempt to use the wrong polarity regulator on an application.

5. The majority of reported regulator troubles arise from dirty and oxidized contact points, which cause a reduced generator output. Clean the contact points with a spoon or riffler file as explained previously. NEVER USE EMERY CLOTH OR SANDPAPER TO CLEAN POINTS.
6. Always make sure that the rubber gasket is in place between the cover and base before replacing the cover. The gasket prevents entrance of moisture, dust and oil vapors which might damage the regulator.
7. The proper testing equipment in the hands of a qualified mechanic is necessary to assure proper and accurate regulator settings. Any attempt on the part of untrained personnel to adjust regulators is apt to lead to serious damage to the electrical equipment and should be discouraged.
8. After any generator or regulator tests or adjustments, the generator must be repolarized in order to avoid damage to the equipment.

Delco Batteries

The Delco battery used in 1949–6 Cylinder Oldsmobile, is a 6 volt unit containing 15 plates per cell. The 8 Cylinder battery is a 6 volt unit containing 17 plates per cell. Both models are assembled in hard rubber containers and are fitted with the new "visual level fill" cell covers.

The design of the battery case is such that a convenient installation is made inside a battery carrier along the left side of the engine. The close proximity of the battery to the engine renders the battery very accessible for servicing. A metal cover over the top of the battery prevents any electrolyte escaping from the battery cells and reaching nearby wires, resulting in shorts or damage.

This cover is equipped with a plate, held in place by a tongue and spring catch, which enables easier checking and servicing of the battery.

BATTERY REGISTRATION

The battery manufacturer is represented by Authorized Service Stations which are prepared to carry out the terms of the maker's warranty. In order that Oldsmobile owners shall have the benefit of this warranty, it is necessary for the dealer to register the battery with the local station in all new car deliveries.

BATTERY CARE

The storage battery requires very little attention, but periodical inspection is essential to secure maximum efficiency and life of the unit.

When installing the storage battery, care must be used to make certain that the NEGATIVE terminal is grounded. This is important to insure the proper operation of the various electrical units. An occasional inspection should be made of the ground strap connections between battery and starting motor, as looseness in this connection is a frequent cause of burning out headlamps.

To prevent corrosion of battery terminals and connections, a coating of vaseline should be applied over the battery post and strap terminals, making sure that connections are properly tightened. If corrosion occurs, posts and terminals should be cleaned with a strong soda solution before vaseline is applied.

The use of the new "visual level" battery cell covers introduces noteworthy changes in the techniques of watering and of checking the electrolyte level. Furthermore, the new covers allow an electrolyte depth above the separators of approximately 19/32 inch, which gives a greater margin of safety against the dangers of low-level operation. These new cell covers are molded with a long, circular, tapered vent well

which extends below the upper inside surface of the cover to a point even with the lower edge of the cover. A narrow vertical opening or slot is molded in the side wall of the vent well, extending from a point slightly below the upper inside surface of the cover to the end of the well.

This slot serves as a vent for gas accumulating above the electrolyte level. Viewed from above, through the vent opening, the lower end of the vent well presents the appearance of a ring with a portion of the circumference missing. The lower end of the vent well in these covers serves as the reference point in determining the proper level of electrolyte. 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 which is readily observable. The "visual level fill" does not prevent overfilling, and care must be taken to prevent this. If some overfilling occurs, the amount can be readily estimated by the height of the liquid in the vent well itself. In the same way, a quick glance will disclose whether or not a cell requires the addition of water.

The electrolyte should always be maintained at the proper level and pure distilled water added to each cell when necessary. Usually electrolyte should be checked and replenished if necessary, once a week in the summer and semi-monthly in the winter. In freezing weather, any addition of solution should be made just before using the car. Filler plugs should be kept tight at all times and the top of the battery kept dry. Periodical hydrometer readings are advisable and this inspection should be made by the dealer or at an authorized battery service station. When the specific gravity of the electrolyte in the cells of the battery is tested, it is important that the hydrometer float is freely suspended in the electrolyte and that reading is taken at eye level. The following tabulation translates specific gravity into terms of battery state of charge:

STATE OF BATTERY CHARGE IN TERMS OF ELECTROLYTE SPECIFIC GRAVITY

(Temperature at 80° F.)

SPECIFIC GRAVITY	STATE OF CHARGE
1.265-1.290	fully charged battery
1.235-1.260	¾ charged
1.205-1.230	½ charged
1.170-1.200	¼ charged
1.140-1.165	barely operative
1.110-1.135	completely discharged

Since the specific gravity of the electrolyte varies with temperature it is necessary to add four gravity points per 10° that the electrolyte is over 80° F. In every 10 degrees that the electrolyte is below 80°, four gravity points must be subtracted from the gravity reading.

Examples:

1. A gravity reading of 1.235 is obtained at 110° F. Add 12 gravity points (4 x 3) to get corrected reading of 1.247.
2. A gravity reading of 1.250 at 0° F. is corrected by subtracting 32 gravity points (4 x 8) to get a corrected reading of 1.218.

During cold weather, a battery which is less than ¾ charged, i.e. corrected specific gravity reading less than 1.250, should be recharged at an authorized service station unless car is to be driven on highway for a period of an hour or so.

If car is to be taken out of service for a long period of time, the battery should be removed from car and maintained in a charged condition.

It is inadvisable to experiment with so-called quick electrolytes for the purpose of keeping the battery fully charged.

The guarantee and adjustment policy on storage batteries becomes void on batteries over six months old; therefore, batteries should be rotated whenever there is a possibility of a car being left over long periods of time on showroom floors, etc.

IMPORTANT NOTE—If a battery replacement is required and the standard Oldsmobile Delco battery cannot be obtained, it is very important that adequate clearance exists between the battery cover and the positive battery terminal of the replacement battery.

Instrument Panel Ammeter

The shunt type ammeter incorporates push-on type terminals which lessens the number of connections in the generator circuit.

Only a portion (10% approx.) of the generator output goes through the ammeter. Therefore, extra wiring must not be connected to the ammeter terminal. It will make the ammeter read incorrectly and, furthermore, the ammeter wires are inadequate to carry the additional accessory current.

NOTE—See installation instructions included with accessory packages for electrical accessory hook-up.

Even though only a portion of the generator output goes through the ammeter, the gauge reads as though the full generator output (4 to 40 amps. approx.) were going through it.

Under driving conditions the dash ammeter may show from one to thirty amperes plus charge, depending upon the condition of the battery and the lamp load. If the battery is fully charged, and no lamp or radio load is imposed, the dash ammeter will show practically no charge. If the battery is in a low charged condition, the ammeter will indicate charge.

From this information it will be seen that the condition of the generator cannot be determined from the reading of the dash ammeter. Before changing any dash ammeter for inaccuracy, therefore, the operation of the ammeter should be thoroughly understood.

The ammeter hand may oscillate slightly when the voltage regulator is operating at low frequency. This is to be expected with the vibrating type regulator and does not indicate either generator trouble or an incorrect ammeter.

Ignition Coil

The ignition coil, placed on the engine to decrease secondary transmission losses and to improve radio performance, is operated remotely through a wire connected to the ignition switch.

SERVICE SUGGESTIONS—DEFECTIVE IGNITION COIL

Primary Winding Shorted

Indications:

Ignition current abnormally high; weak spark; engine misses or fails to start.

Causes:

(a) Damaged or defective insulation in coil.

(b) Overheating of coil.

Tests:

Measure current drawn by coil, if it exceeds 6 amperes, the primary winding is shorted.

Remedy:

Install new coil.

Primary Winding Grounded

Indications:

Engine misses or fails to start; weak spark; ignition current does not drop to zero when breaker points in distributor separate.

Causes:

(a) Damaged or defective insulation.

(b) Condenser may be shorted.

Tests:

Disconnect low tension lead to distributor, remove all leads at switch and turn switch on. Connect a 110 volt test lamp between the primary coil terminal and an unpainted surface of the coil. If the lamp lights, the primary circuit is grounded.

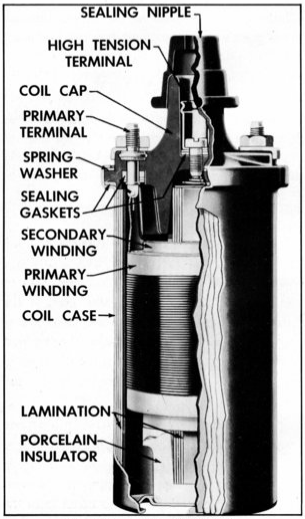


Fig. 593. Ignition Coil Details

Remedy:

Correct obvious trouble but if ground still exists, replace coil.

Primary Winding Open-circuited

Indications:

Engine will not start; no spark from coil; no primary current.

Causes:

(a) Primary winding of coil burned out.
(b) Lead broken; switch points dirty or not making contact.

Test:

Connect 6 volt test lamp in series between low tension terminal at lower end of coil and wire to distributor. With ignition switch turned on, if the lamp does not light, there is an open circuit.

Remedy:

Install new coil.

Secondary Winding of Coil Grounded

Indications:

Engine misses or fails to start; weak spark; primary current normal.

Cause:

Damaged or defective insulation in secondary winding.

Test:

Connect 110 volt test lamp between secondary terminal and metal cover of coil. If the lamp lights, the secondary is grounded.

Remedy:

Install new coil.

Ignition Switch

The ignition switch, located on the instrument panel to the right of the steering column, is easily operated by an ignition key, the same key used on door locks. Two terminals, a battery terminal and an ignition coil terminal, are located on the back of the switch. Connected to the ignition switch terminal are wires to the radio, cigar lighter, heater and defroster. Other electrical accessories are connected to the headlight switch. Further information regarding accessory wiring may be found in the installation instructions included with accessory packages and on the wiring diagrams.

Distributor

DISTRIBUTOR (8 CYLINDER)

The Delco-Remy 8 cylinder distributor is a vacuum-automatic unit having a manual adjust-

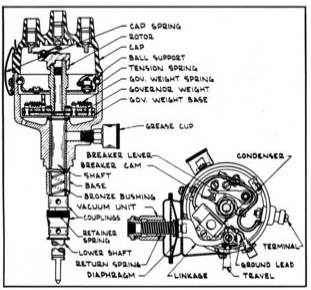


Fig. 594. Six Cylinder Distributor

ment of 30 engine degrees. The shaft revolves in special porous bushings at the upper and lower ends, the upper bushing spanning an oil reservoir in the distributor housing. During initial assembly of the distributor, this reservoir is filled with oil and the oil plug is installed and sealed with sealing compound. During operation of the distributor, the oil seeps through the bushing, providing shaft lubrication. The breaker plate, supported on three balls traveling in a track in the wall of the distributor housing, is linked to and controlled by the vacuum control assembly, which gives a vacuum advance of 20 engine degrees.

DISTRIBUTOR (6 CYLINDER)

The 6 cylinder ignition distributor is the full automatic type, combining the centrifugal spark advance with a vacuum controlled additional advance to meet part throttle requirements.

The distributor is driven by the camshaft through a jointed shaft, which, when viewed from the top, revolves in a counterclockwise direction.

A six-lobe cam is used. (See Fig. 594) To assure adequate circulation of air within the distributor assembly two holes are drilled through the bottom of the distributor housing. This air circulation has the effect of producing more consistent improved breaker point performance.

A ground lead assembly connects the breaker point plate and the distributor housing. The ground lead, which is an additional ground to the three ball bearing plate supports, assures more positive point performance.

DISTRIBUTOR OPERATION

The speed-controlled centrifugal spark advance mechanism consists of two centrifugal weights and springs which have no adjustment and require no attention. As the speed of the distributor shaft increases with increased engine speed, the weights are gradually thrown outward. This advances the cam in the direction of rotation, thus opening the points earlier and advancing the spark.

The vacuum controlled advance mechanism consists of a spring loaded diaphragm linked to the distributor breaker plate which is mounted on three ball bearings. The vacuum for operating this advance mechanism is taken from the carburetor riser just above the throttle valve, preventing spark advance while the engine is idling. Under normal driving conditions the vacuum is sufficient to operate the diaphragm and cause the breaker plate to move, thus advancing the spark and decreasing fuel consumption. During acceleration or when the engine is pulling heavily, however, the vacuum is not sufficient to operate the diaphragm, and the breaker plate is held in retarded position by the calibrated return spring which bears against the vacuum diaphragm.

The centrifugal advance starts at approximately 500 R.P.M. of the engine and reaches a maximum of 22° at 3200 R.P.M. The vacuum advance starts at approximately 5″ to 7″ of mercury

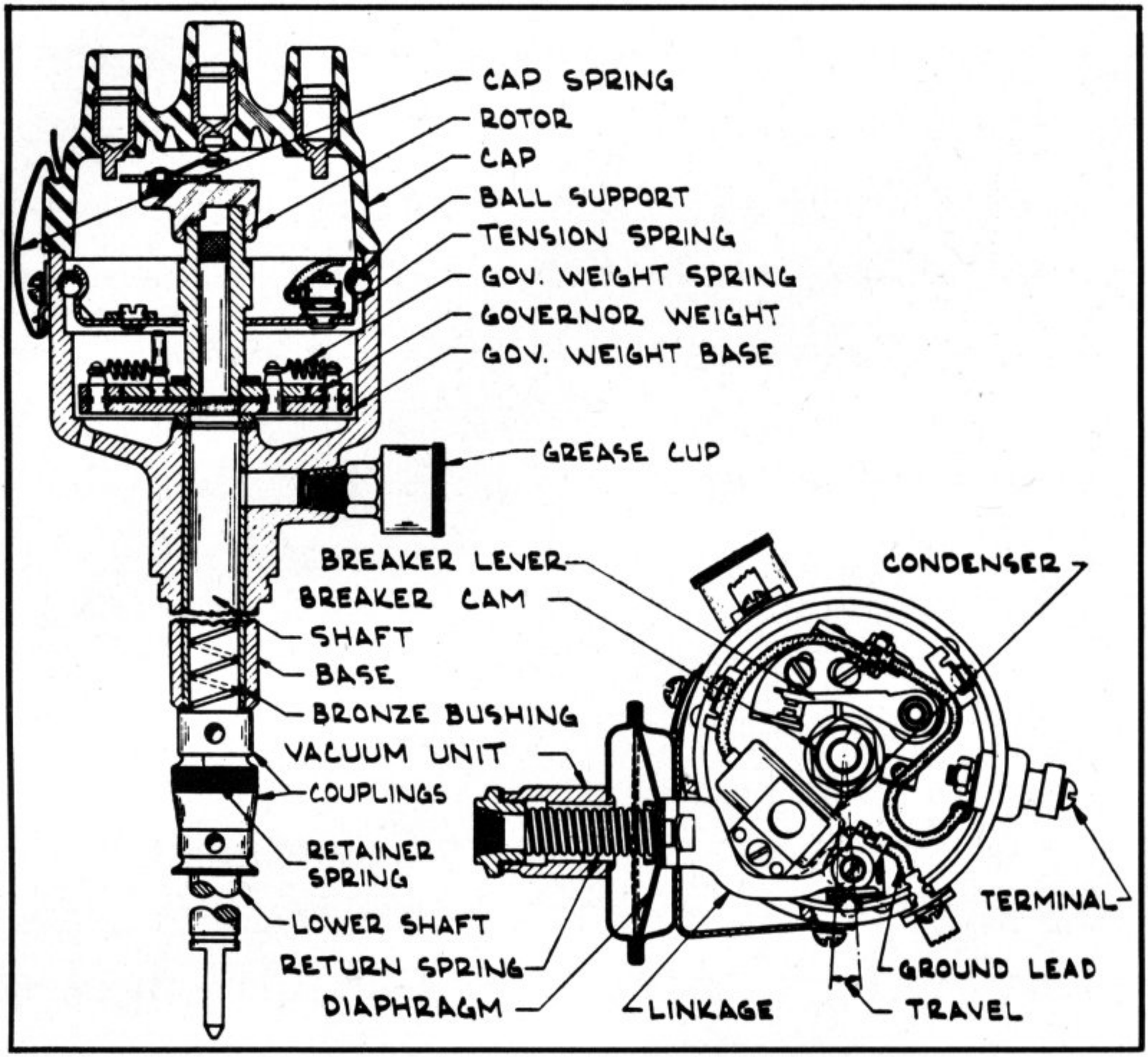


Fig. 594. Six Cylinder Distributor

at approximately 600 R.P.M. of the engine, and reaches a maximum of 16° at 16½" to 18½" of mercury at 1200 R.P.M. of the engine.

The six cylinder contact point opening should be .018" to .024" (preferably .020"). The spring tension of the contact arm should be 17 to 21 ounces.

The centrifugal advance starts at approximately 600 R.P.M. of the engine and reaches a maximum of 30° at 3700 R.P.M. The vacuum advance starts at approximately 6½" to 8½" of mercury at approximately 600 R.P.M. of the engine, and reaches a maximum of 20° at 19" to 21" of mercury at 1500 R.P.M. of the engine.

The eight-cylinder contact point opening should be .0125" to .0175" (preferably .015"), and the spring tension of the contact arm should be 19 to 23 ounces.

When a new distributor or new distributor points are installed, a higher than normal gap is necessary to compensate for the rapid initial wear of the new fiber rubbing block. Settings should be as follows:

6 cylinder – .021" to .026"
8 cylinder – .016" to .021"

Settings should be made to the high side.

DISTRIBUTOR MAINTENANCE

Lubrication—The pipe plug in distributor oil reservoir should not be removed, as the reservoir behind the shaft bushing is filled with light engine oil and is sealed at assembly. The supply of oil is sufficient to last for 25,000 miles of operation under normal conditions. Thus the plug need not be removed oftener than every 25,000 miles (or at time of overhaul) for lubrication except when unusual heat or other adverse operating conditions are experienced. Grade SAE No. 20 oil should be added when needed; however, overfilling should be avoided. There should be a small air space left above the plug hole when the plug is replaced after which the plug should be sealed with oil holding sealing compound.

Every 5,000 miles one drop of light engine oil should be put on the breaker lever pivot and on each of the three breaker plate supporting balls and a few drops on the felt wick under the rotor. A trace of high melting point ball bearing grease should be placed on the breaker cam every 1,000 miles.

Inspection

The cap should be removed at regular intervals and the contact points, rotor, and cap examined. The high tension wiring should be checked for damaged insulation and poor connections, and faulty parts should be replaced. Replacement of the cap or rotor should be made if investigation reveals cracks or carbonized paths over the surface of the material, indicating secondary current leakage to ground.

Contact Points

Contact points that are burned or pitted should be replaced or dressed with a clean, fine-cut contact file. It is important that the file is not used on other metals and is not allowed to become greasy or dirty. EMERY CLOTH SHOULD NEVER BE USED TO CLEAN CONTACT POINTS. Contact surfaces, after considerable use, may not appear bright and smooth, but this is not necessarily an indication that they are functioning unsatisfactorily.

Oxidized contact points may be caused by high resistance or loose connections in the condenser circuit, oil or foreign material on the contact surfaces, or most commonly, high voltages. Checks for these conditions should be made where burned contacts are experienced.

The contact point opening must be set to the proper limits, as points set too closely may tend to burn and pit rapidly. Points with excessive separation tend to cause a weak spark at high speed. The point opening of new points

may be checked with a feeler gauge, however, the roughness of used points makes the accurate setting of point opening by this method impossible. A dial indicator is recommended to check the point opening.

When it is necessary to check and adjust point opening with a feeler gauge, proceed as follows:

1. Rotate breaker cam until breaker lever rubbing block is on the high point of the cam lobe, thus giving the maximum point opening.
2. Loosen the clamp screw holding the contact support, and adjust point opening by turning the eccentric screw in the contact support.
3. Tighten clamp screw and check with gauge again after tightening clamp screw.

NOTE–THE CONTACT POINTS SHOULD BE CLEANED BEFORE THEY ARE ADJUSTED IF THEY HAVE BEEN IN SERVICE.

Contact point pressure must fall within the limits given as weak tension will cause point chatter and ignition miss at high speed, while excessive tension will cause undue wear of the contact points, cam and rubbing block.

Use of Synchroscope

The synchroscope which accurately checks spark advance and synchronization on distributors removed from the car, will also indicate, by variation in synchronization, excessive distributor shaft eccentricity.

After a distributor has been repaired, the calibration of the centrifugal automatic mechanism should be checked, as proper engine performance cannot be obtained unless the centrifugal curve is within the limits specified for the particular engine.

CONDENSER

A cartridge type condenser is mounted on the inside of the distributor. The condenser is spaced across the points to reduce arcing and to prevent excessive burning and also to assist the ignition coil to deliver a snappy spark.

Four factors affect condenser performance, and each factor must be considered in making any condenser tests.

1. BREAKDOWN is a failure of the insulating material, a direct short between the metallic elements of the condenser. This prevents any condenser action.
2. LOW INSULATION RESISTANCE or leakage prevents the condenser from holding a charge. A condenser with low insulation resistance is said to be "weak". All condensers are subject to leakage which, up to a certain limit, is not objectionable. When it is considered that the ignition condenser performs its function in approximately 1/12,000 of a second, it can be seen that, although leakage must be considered in any condenser test, it can be large without detrimental effects.
3. HIGH SERIES resistance is excessive resistance in the condenser circuit due to broken strands in the condenser lead or to defective connections. This will cause burned points and ignition failure upon initial start and at high speeds.
4. CAPACITY is built into the condenser and is determined by the area of the metallic elements and the insulating and impregnating materials.

For a complete check of the condenser, it is desirable to use a tester which will check for the above four conditions.

IGNITION TIMING (EIGHT CYLINDER)

When the ignition timing is set, the arrow point on the distributor hold down plate should be in the center "O" position when the timing operation is completed.

Eight Cylinder ignition timing is set by means of two steel balls on the crankshaft harmonic

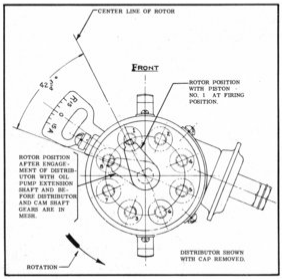


Fig. 595. Eight Cylinder Distributor

balancer. (One ball indicates top dead center and the other 5° before top dead center.) Inasmuch as correct timing is 2½° before top dead center, the pointer on the lower left front side of the engine front cover should point exactly half way between the two steel balls as the No. 1 cylinder fires.

After breaker points have been cleaned and adjusted to .0175″ gap and the throttle has been set for correct engine idle, the ignition timing

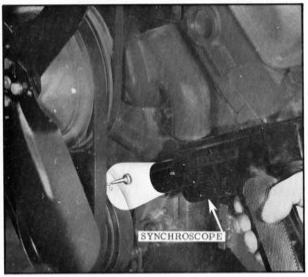


Fig. 596. Eight Cylinder Ignition Timing

should be set with the use of tool No. HMO-161 as follows:

1. Connect the green (large) wire terminal to the No. 1 cylinder spark plug, the red lead to hot wire on voltage regulator, and the black lead to ground.
2. Loosen hold down plate on distributor and place arrow point in center "O" position, then tighten bolt.
3. Start engine and revolve distributor the required amount to bring balls on balancer into position so that pointer points exactly half way between the two balls. (Clockwise to advance.)
4. Tighten clamp bolt, making sure distributor does not move.

   NOTE—See that hold down plate arrow is in center "O" position.

If synchroscope is not available, ignition timing may be performed with engine not running as follows:

1. Clean and adjust breaker points to .0175″ gap.
2. Set No. 1 cylinder in firing position by means of the steel balls on balancer.

   NOTE—In turning the engine, the No. 1 cylinder is in firing position when pointer is half way between two balls.
3. Connect wire to low tension post on side of distributor and snap test light and bracket on radiator.
4. Loosen hold down plate bolt on distributor and place arrow point in center "O" position, then tighten clamp bolt.
5. Turn on ignition switch and loosen distributor body clamp bolt. Revolve distributor head (clockwise to advance) until light just starts to light when contact is starting to break on No. 1 cylinder firing point.
6. Tighten clamp bolt and re-check by turning engine to be sure that timing light just lights when the pointer is half way between the two balls on balancer.

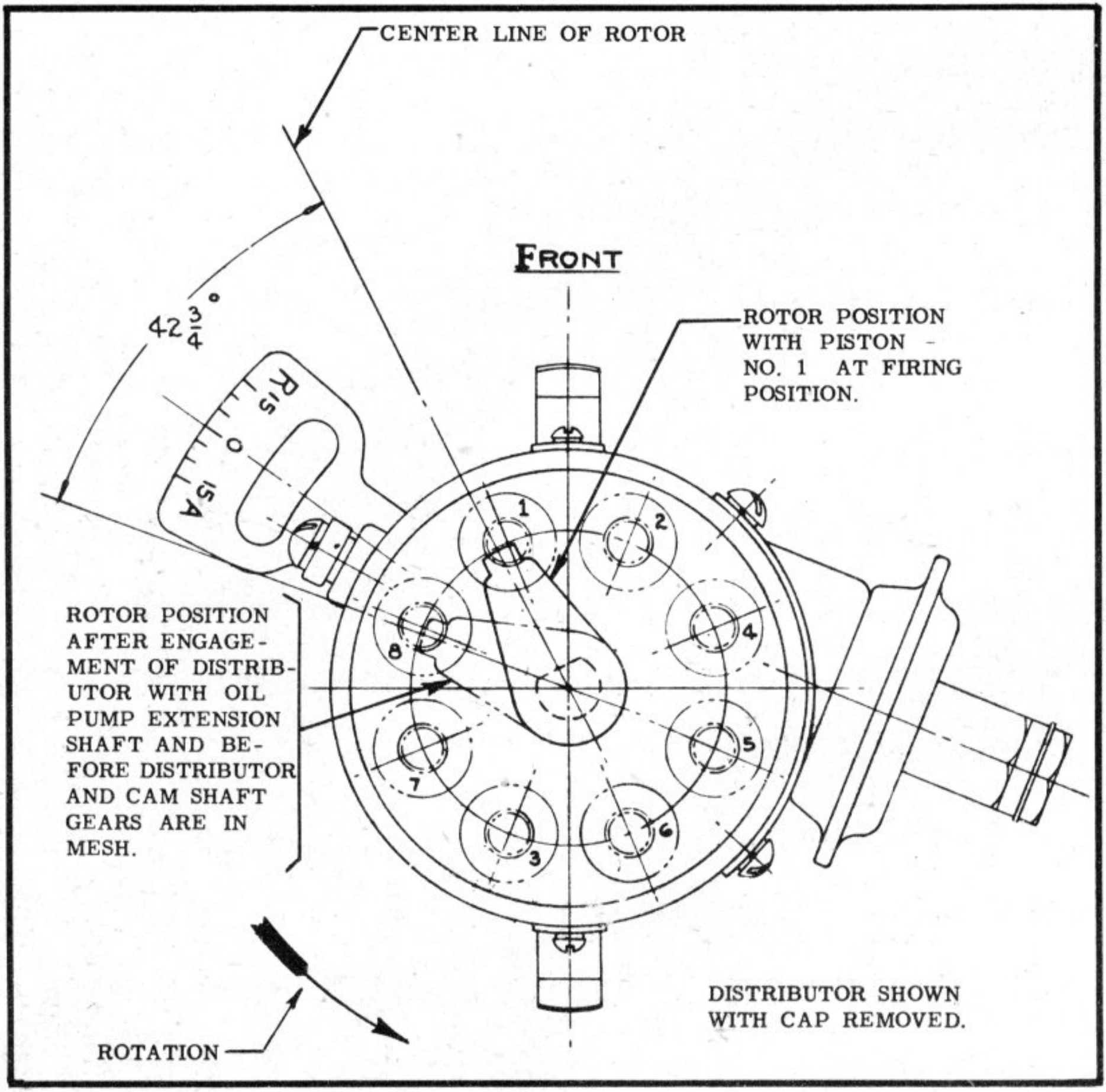


Fig. 595. Eight Cylinder Distributor

IGNITION TIMING (SIX CYLINDER)

The ignition timing on the six cylinder engine is set by means of a steel ball (which is top dead center) placed on the flywheel and visible through the timing hole in the flywheel housing. A steel pointer is provided at the timing hole which must be lined up with the steel ball in the flywheel when timing.

Ignition should be timed so that No. 1 cylinder fires when ball on flywheel and steel pointer are in line.

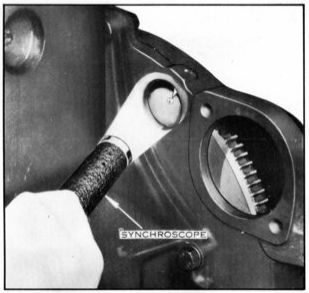


Fig. 597. Six Cylinder Ignition Timing

After breaker points have been cleaned and adjusted to .020" gap, the throttle should be set for correct engine idle and ignition timing set by means of synchroscope Tool No. HMO-161 as follows:

1. Rotate timing hole cover to one side.
2. Attach one lead of synchroscope to No. 1 cylinder spark plug and the other lead to ground.
3. Loosen hold down plate on back of distributor and place arrow point in center "O" position, then tighten bolt.

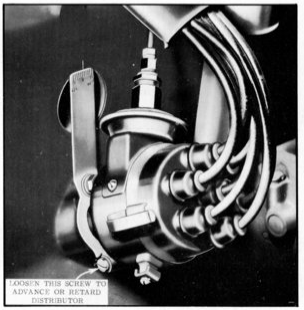


Fig. 598. Distributor Hold-down Plate

4. Loosen distributor clamp bolt and hold synchroscope at timing hole. Revolve distributor the required amount to bring pointer and steel ball on flywheel in line. (Clockwise to advance.)
5. Tighten clamp bolt, making sure distributor does not move.

   NOTE—See that hold down plate arrow is in center "O" position.

If synchroscope is not available, ignition timing may be performed with engine not running as follows:

1. Clean and adjust breaker points to .021" gap.
2. Set No. 1 cylinder in firing position by means of steel ball on flywheel.

   NOTE—In turning engine, when steel ball on flywheel is directly in line with steel pointer on flywheel housing, engine is in firing position.
3. Connect wire to low tension post on side of distributor and snap test light and bracket on radiator.
4. Loosen hold down plate bolt on back of distributor and place arrow point in center "O" position, then tighten clamp bolt.

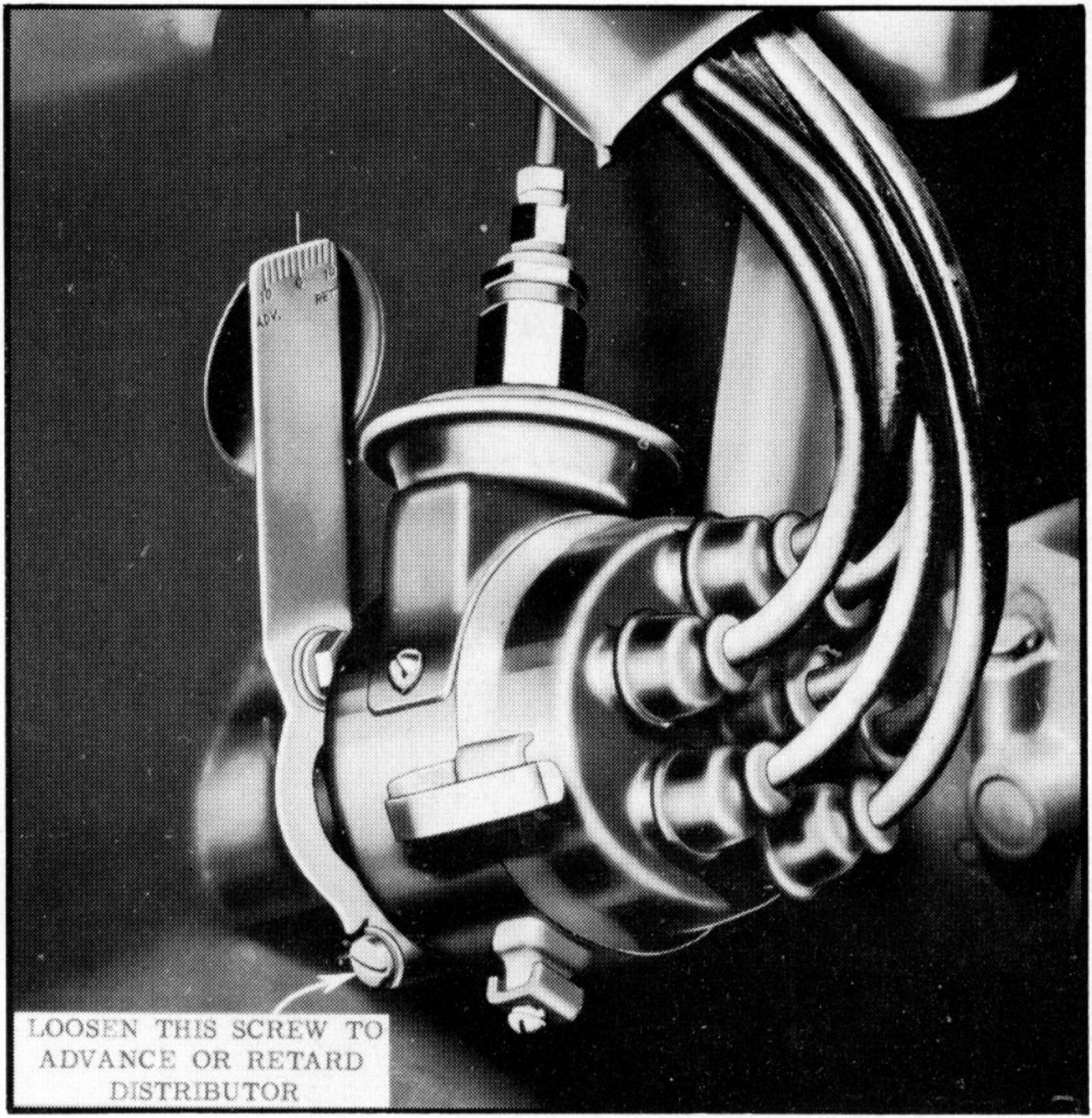


Fig. 598. Distributor Hold-down Plate

5. Turn on ignition switch and loosen distributor body clamp bolt. Revolve distributor head (clockwise to advance) until the light just starts to light when contact is starting to break on No. 1 cylinder firing point.
6. Tighten clamp bolt and re-check by turning engine to be sure that timing light just lights when the pointer at the timing hole and steel ball on the flywheel are in line.

IGNITION TIMING—DIAL INDICATOR METHOD ALL MODELS

If no other means are available, a dial indicator in the spark plug hole may be used to set the ignition timing. Timing should be set so that the 6-cylinder syncromesh engine fires at top dead center. The 6 cylinder Hydra-Matic equipped engine should fire at .0005" before piston reaches top dead center and the 8 cylinder engine, .002" before piston reaches top dead center.

SERVICE HINTS — DISTRIBUTOR MECHANISM DEFECTIVE

Breaker Points Grounded

Indications:

Engine misfires or fails to start; weak spark at spark plug; primary current does not decrease to zero when contacts separate.

Cause:

Metal chips or dirt on distributor circuit breaker base; damaged or imperfect insulation.

Test:

Disconnect low tension lead at coil. Make sure that contacts are separated, then test with lamp between the insulated contact and the distributor housing.

Remedy:

Clean circuit breaker with gasoline. Examine low tension lead and terminal where it is connected to circuit breaker. If ground persists after cleaning circuit breaker, replace circuit breaker plate.

Point Opening Incorrect

Indications:

Engine misfires. If point opening is too much, misfiring will be noticeable at high speeds.

Causes:

Wear of arm rubbing block; loose lock screw on contact arm plate.

Test:

With rubbing block resting on lobe of cam, measure distance between the contacts.

Remedy:

Adjust contacts and tighten lock screw.

Breaker Arm Spring Weak or Broken

Indications:

Engine misses especially at high speed, engine may fail to start.

Causes:

Damaged or defective spring; spring not properly installed. Poor connection or damaged insulation; broken wires.

Test:

Measure spring tension: examine wires carefully—test wires for grounds, shorts or open circuits.

Remedy:

Install new spring or form old one to give necessary tension — make proper connections to replace defective wires.

Spark Plugs

AC Spark Plugs—Type 45, are used on all models. Plugs are of the Metric Type with 14

m.m. threads and 13/16" hex body. The proper gap setting is .040" on six cylinder and .030" on the eight cylinder model. Spark plugs should be checked and tested frequently, and to obtain maximum performance, should be replaced at intervals of 10,000 miles. Satisfactory results can be assured only when genuine AC plugs of the type recommended are used.

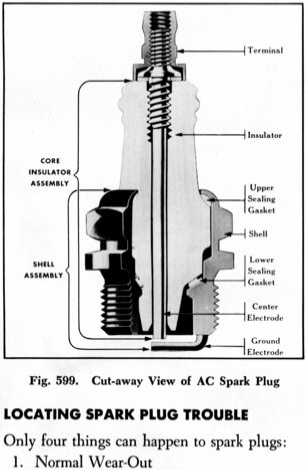


Fig. 599. Cut-away View of AC Spark Plug

LOCATING SPARK PLUG TROUBLE

Only four things can happen to spark plugs:

1. Normal Wear-Out
2. Dirty Plugs
3. Worn Gap
4. Broken Insulators

1. Normal Plug Wear-Out

Spark plugs wear out. It is reasonable to expect about 10,000 miles or 250 hours of operation from a spark plug, but operating conditions govern plug life entirely. Worn or dirty spark plugs may still fire an idling engine and apparently still be good, but under operating conditions, they may fail, wasting gasoline. Scientific tests prove that worn spark plugs waste as much as one gallon of gasoline in ten. In addition, worn or dirty spark plugs cause loss of power, loss of speed, hard starting and generally sluggish performance.

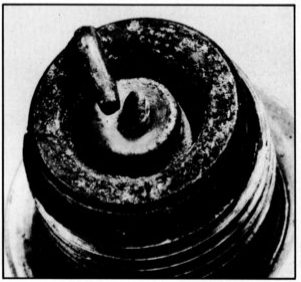


Fig. 600. Worn Out Plug

Worn out plugs should be replaced with new plugs of proper type and gaps set to the correct limits with the use of *round* feeler gauge wire.

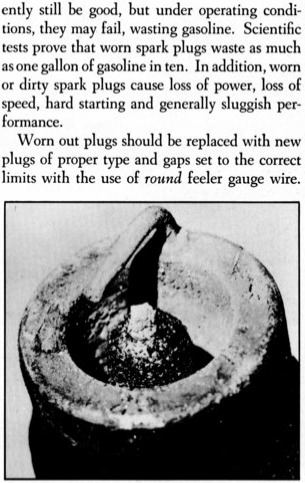


Fig. 601. Worn Out Plug

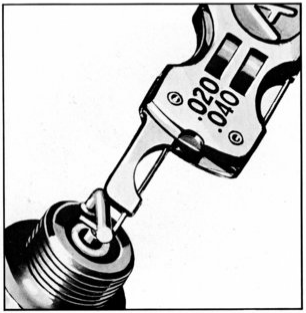


Fig. 602. Gapping Spark Plug

2. Dirty Spark Plugs

BLACK CARBON OR SOOT DEPOSITS—are usually caused by slow speed driving and short runs because the engine rarely reaches efficient operating temperature under these conditions. Worn pistons or rings, faulty ignition, too rich carburetion or the use of "too cool" plugs will also cause carbon deposits and subsequent fouling of plugs.

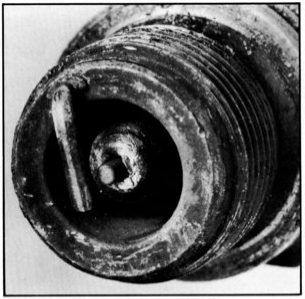


Fig. 603. Plug with Heavy Oxide Deposit

Fig. 604. Plug with Heavy Carbon Soot Deposit

RED, BROWN, YELLOW OR BLISTERED OXIDE DEPOSITS—are the most

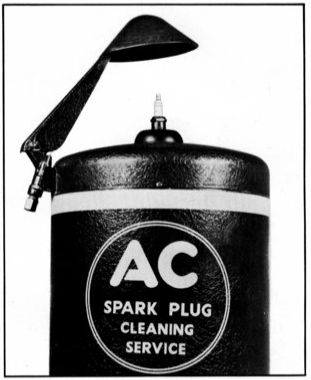


Fig. 605. AC Spark Plug Cleaner

Fig. 606. Cleaning Electrodes with Emery Cloth

prevalent cause of plug failure under severe operating conditions. Oxide coating causes intermittent missing especially at high speeds and on hard pulls, and many times complete failure because this coating, especially when hot, is a conductor of electricity.

Dirty plugs should be cleaned with the A.C. Spark Plug Cleaner. New gaskets must *always* be used when replacing plugs.

3. Worn Spark Plug Gap

NORMAL WEAR—The spark plug gap will gradually widen due to wear after several thousand miles or many hours of normal service.

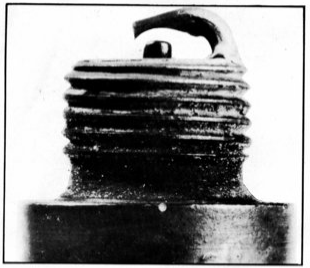


Fig. 607. Rapidly Worn Electrode

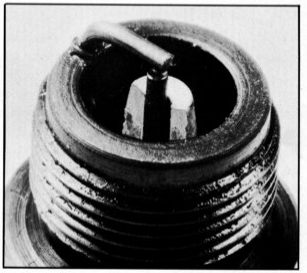


Fig. 608. Spark Plug Insulator Broken at Lower End

RAPID WEAR—A gap may widen or wear *quickly* at low mileage, indicating that the plug is operating "too hot". This is usually due to the use of the wrong type plug. Plugs with improper gap should be re-gapped, and those which are worn out should be replaced with the correct type of plug.

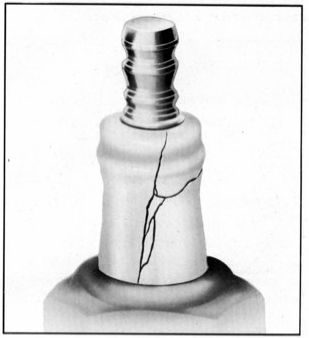


Fig. 609. Spark Plug Insulator Broken at Upper End

4. Broken Insulators

UPPER END BREAKAGE—can *never* be caused by the engine but rather is caused by an outside blow or by the use of a poor fitting wrench when installing or removing the plugs. A newly broken insulator may not cause missing immediately, but as soon as oil or moisture penetrates the fracture, the plug will "cut out". The actual crack may not be visible if it occurs just below the crimped part of the shell.

LOWER END BREAKAGE—is most often the result of faulty workmanship in regapping, through bending or straining the center electrode. Plugs should always be gapped by bending only the side electrode.

This lower end breakage may also occur when operating conditions are abnormally hot or when wrong type of plug (too hot) is used. Plugs with broken insulators should be replaced, using a correct size spark plug wrench.

Fig. 610. Installing Plug with Proper Wrench

Horns

Delco-Remy dual unit horns of the "sea shell" type, are standard on all models.

The dual horns consist of a high and low note horn designed to give a blended tone. They are mounted in front of the radiator and are easily accessible for adjustment.

Identification letters "H" and "L" molded in the horn castings indicate high and low note units.

QUICK CHECKS FOR HORN TROUBLE

In analyzing faulty horn operation, any of several basic conditions may be found. Before any horn checks are started, however, the battery should be checked to make sure it is capable of cranking engine readily. If it is not, it should be recharged or replaced before proceeding. Also, horn mounting should be checked to assure that they are securely mounted.

Both Horns Operate Intermittently—

This condition may result from:

(1) Loose connections in wiring circuit

(2) Defective horn switch

(3) Defective horn relay (see HORN RELAY CHECK)

One Horn Operates Intermittently

(1) Current adjustment set too low. Remove *both* horns for bench check.

Neither Horn Operates

This trouble may result from various conditions. To locate source of difficulty, check each horn separately with voltmeter. Connect test voltmeter from ground to horn lead at junction block under hood. Close horn switch and read voltage. Voltage readings may be interpreted as follows:

(1) Zero Voltage
- (a) Open circuit in wiring
- (b) Defective horn relay (see HORN RELAY CHECK)

(2) Voltage less than 3.5 volts
- (a) Poor wiring (wires too small, bad connections, etc.)
- (b) Shorted coil in horn. Remove horn for bench check.

(3) Voltage approximately 4 volts
- (a) Current adjustment set too high
- (b) Air gap too wide

(c) Foreign matter in air gap. Remove horn for bench check.

(4) Voltage approximately 6 volts

(a) Open circuit inside horn (broken leads, etc.)

(b) Current adjustment too low. Remove horn for bench test.

BENCH CHECK

Inspection

With back shell removed, inspect horn carefully for loose or broken leads or defective soldering. Be sure air gap is free of foreign material, burrs, steel shavings, etc. Clean gap with air if necessary.

Current Adjustment (Tone)

Insert .007 inch gauge (not more than ¼ inch wide) between adjusting nut and contact blade or contact blade insulator. (Fig. 611) Do not allow gauge to touch horn contact points. Connect horn to two cells (4 volts) of fully charged 6 volt test battery using short No. 12 leads.

If horn is inoperative, proceed. If horn operates, loosen lock nut and turn adjusting nut down until horn makes no sound. Break circuit, back adjusting nut off less than one-tenth (1/10) turn and tighten lock nut. With gauge still in place, check to see if horn will blow. If it does not, back off adjusting nut again (less than 1/10 turn), tighten lock nut and retest horn. Repeat until horn *barely* blows. Remove gauge and try horn. Horn should now operate fairly well at approximately 4 volts. (If horn does not operate, check, adjust air gap and test again at 4 volts. If horn operates, connect to a 6 volt source (3 cells of battery) and note tone. Horn tone should now be satisfactory and current draw will be correct (approximately 18 amperes on either high or low note horns).

Fig. 611. Adjusting Horn Air Gap

NOTE—If a notch has been worn in the adjusting nut (where contact blade vibrates against it), either replace the nut or turn it over so worn place is on top side. Otherwise worn place may prevent obtaining perfect adjustment.

Air Gap Adjustment

It is seldom necessary to adjust air gap, and slight deviations from specifications may be ignored if current adjustment gives satisfactory operation. The gap must be uniform across the entire surface of the armature and should be as follows:

High note horn—.035" to .039"
Low note horn—.045" to .049"

Adjust air gap by means of air gap adjusting nuts. (Fig. 611)

HORN RELAY CHECKS AND ADJUSTMENTS

Three checks and adjustments are required on the horn relay: air gap, point opening and closing voltage. The air gap and contact point opening checks and adjustments should be made with the battery disconnected.

Air Gap

The air gap should not normally require adjustment unless the relay has been misadjusted. Check the air gap with the points barely touching and adjust if necessary by bending the lower point support. (Fig. 612)

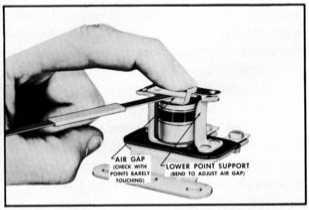


Fig. 612. Checking Horn Relay Air Gap

Contact Point Opening

Check the contact point opening and adjust by bending the upper armature stop. (Fig. 613)

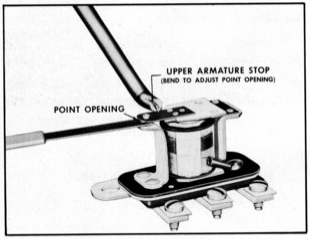


Fig. 613. Adjusting Horn Relay Contact Point Opening

Closing Voltage

To check the relay closing voltage, connect a variable resistance of 10 ohms in series with the relay "B" terminal and connect a voltmeter between the "S" and the "B" terminals as shown in Fig. 614. With the horn button closed, slowly decrease the amount of resistance in order to check the relay closing voltage. Adjust the closing voltage by bending the armature spring post. (Fig. 615) Bending down to increase the spring tension increases the closing voltage while bending up decreases the closing voltage.

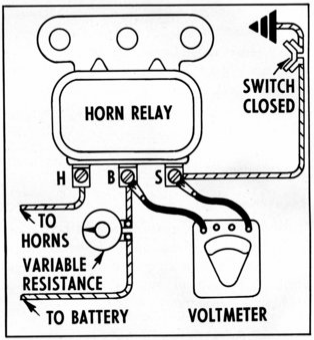


Fig. 614. Checking Horn Relay Closing Voltage

NOTE—Horn relay terminals may not carry any markings but relationship of the terminals is as shown in Fig. 614.

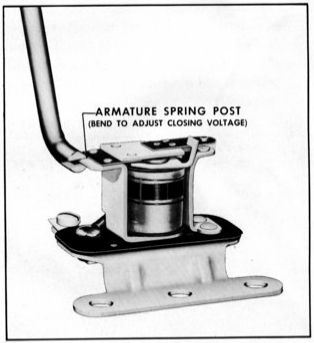


Fig. 615. Adjusting Horn Relay Closing Voltage

Headlamps

A "Sealed Beam" headlighting system (Fig. 616) is used on all models. These lamps are designed so that the light source, the reflector, the lens and the gasket are all assembled in one securely sealed unit.

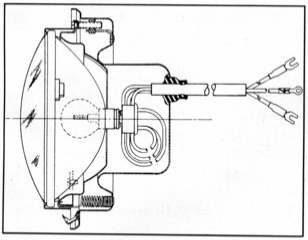


Fig. 616. Section Through "Sealed Beam" Headlamp

"Sealed Beam" headlamps provide two separate and distinct beams:

1. A country (upper) beam (bright lights) (Fig. 617) is designed to illuminate the road evenly for considerable distance ahead of the car. This beam is for use on the open highway when no other vehicles are approaching.

Fig. 617. Country Beam Light Pattern

2. A traffic (lower) beam (Fig. 618) is also provided and is low enough on the left side to avoid glare in the eyes of the oncoming drivers. It is intended for use in cities and on heavily traveled highways and should always be used when meeting other vehicles. At the same time the distribution of light is such that the right side of the road is illuminated as far ahead as is practicable without causing glare on curves.

Fig. 618. Traffic (Lower) Beam Light Pattern

The operation of the headlights is a simple one, allowing the motorist to use either the country (upper) or the traffic (lower) beam as traffic and road conditions demand by the use of a conveniently located foot switch. By pulling the light button on the instrument board to the second or last position, either the upper or lower headlamp beams are obtained alternately by operating the foot switch.

When the upper beams are lighted a red pilot bulb in the instrument cluster will be illuminated, making it convenient for the driver to determine when this beam is in use. NEVER PASS AN APPROACHING CAR WITH THIS RED LIGHT BURNING. ALWAYS USE THE TRAFFIC (LOWER) BEAM IN THE CITY AND ALSO WHEN MEETING OTHER CARS.

LAMP CONSTRUCTION

The "Sealed Beam" reflector unit (A) (Fig. 619) is held to a sub-body (B) by a retainer ring (C) and three screws which must be removed for removal of the unit. The sub-body forms a ball and socket joint with a lamp housing (D) and is held to the housing by a coil spring (E), plus the vertical adjustment screw (F), and the horizontal adjustment screw (G). With this type of mounting, the horizontal light beam adjustment can be made without disturbing the vertical light beam setting and vice versa. The reflector unit is provided with three locating lugs (H) which fit into corresponding slots in the sub-body. These lugs are so located that the reflector unit can be mounted in only one position.

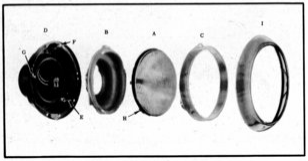


Fig. 619. "Sealed Beam" Lamp Construction Detail

With this system, the problem of maintenance has been greatly simplified, requiring only aiming of the beams and the replacement of burned out or broken reflector units.

"Sealed Beam" uses a securely sealed unit which incorporates the light source, the reflector, and the lens all assembled into one unit. When the filament burns out or the lens breaks, a new unit is installed, giving the equivalent of a brand new headlamp. Neither dust nor moisture can reach the reflector because the entire unit is sealed.

The units in both the left and right hand headlamps are identical and are so designed that they can not be installed improperly, nor can the electrical connections be attached in any but the right way. The filaments are very accurately prefocused in these units with respect to the reflector and their position cannot be changed. This prefocusing feature makes the replacement unit take substantially the same aim as that of the previous unit.

To Replace Lamp Unit

Two types of "Sealed Beam" headlamp units are available. One of these types is made entirely of hard glass and the other is a composite unit consisting of a metal reflector and a glass lens. Both are completely interchangeable from the standpoint of electrical connections, beam patterns and physical dimensions.

1. Remove headlamp door rim (I). (See Fig. 619)
2. Remove the three screws holding the retaining ring and remove the retaining ring.
3. Disconnnect connector plug and remove reflector unit.
4. Install new unit by reversing above operation.

"SEALED BEAM" HEADLAMP AIMING ADJUSTMENT

To obtain the maximum results in road illumination and the safety that has been built into the headlighting equipment, the headlamps must be properly aimed.

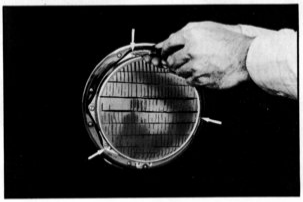


Fig. 620. Adjusting Headlamp Focus

The unloaded car should be placed on a level stretch with a light colored vertical screen 25 feet ahead. For best road lighting results, a horizontal line should be drawn on this surface at the level of a point 3" below the headlamp center. Certain states require a loading allowance in which case this horizontal line should be drawn below the above mentioned line, by the amount required by the particular state in which the car is registered.

In order to determine a point on the horizontal line midway between the headlights, it is necessary to sight through the rear window over the center of the hood ornament first to the right and then to the left of the windshield centerline. The mid-point between the two points so determined will also be the mid-point between the headlights. Vertical lines should then be drawn through points at the right and left of the center point directly ahead of the center of each headlamp.

The lighting switch should be placed in the position which produces the upper beam (bright light), illuminating the lower filaments of both lamps.

Independent adjustment of both horizontal and vertical aim is provided in "Sealed Beam" headlamps with the adjustment screws accessible from the front of the lamp after the door rim is removed. Fig. 619 shows the vertical adjusting screw (F) and the horizontal adjusting screw (G). The light beam is moved to the right or left by tightening or loosening this horizontal adjusting screw (G).

The beam may be raised or lowered by turning the vertical adjusting screw (F).

One lamp should be covered to obscure the beam of light, and the beam from the other lamp adjusted so that the center of the zone of highest intensity falls on the intersection of the horizontal line 3" below the headlamp center and the vertical line directly ahead of the lamp. The operation will then be repeated for the other lamp. Figs. 621 and 622 illustrate the left beam

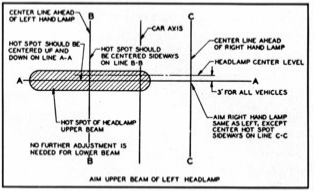


Fig. 621. Light Beam Aiming Instructions

correctly aimed. No further adjustment is needed for the traffic (lower) beam.

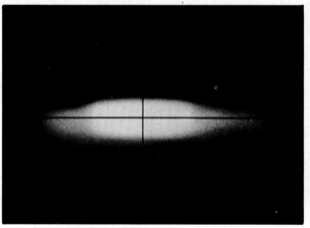


Fig. 622. Light Beam Aiming Instructions

LIGHT SWITCH CONTROL

The headlighting system on all models is controlled by two switches—the control switch on the instrument panel and the foot control selector switch on the toe board.

The instrument panel control has three positions, "Off," "Park," and "Drive," as follows:

1. First position out switches on the parking and tail lights.
2. Second position out switches on the tail lights and the headlamp upper beam or lower beam depending upon the position of the foot switch.

The upper and lower beams may be readily selected by means of the foot control switch.

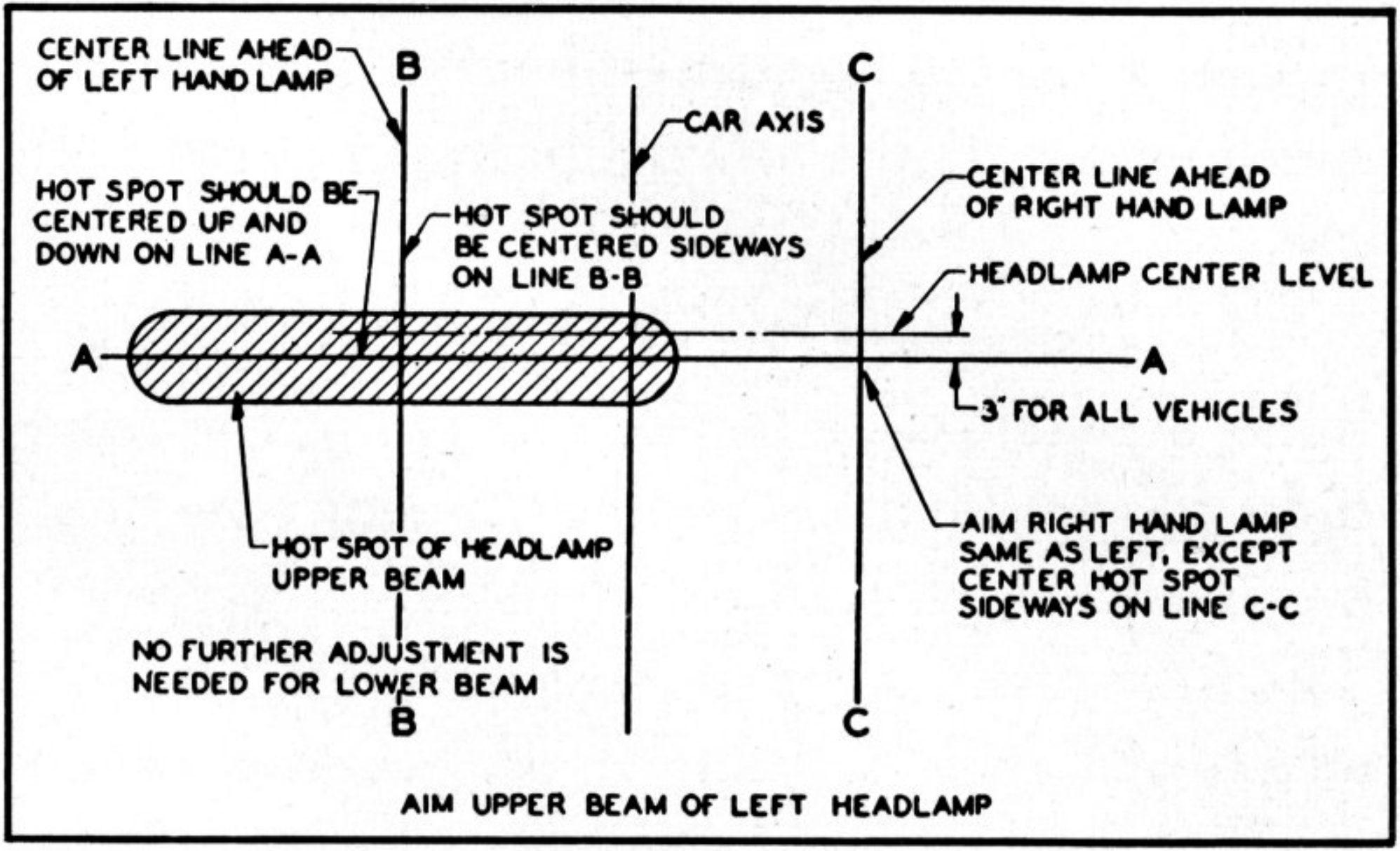


Fig. 621. Light Beam Aiming Instructions

The small red indicator above the face of the speedometer, lights when the upper beam is in use.

The instrument panel direct and indirect lights are controlled by the rotation of the headlight control knob on the instrument panel and a rheostat which is a part of the lighting switch. The instrument panel lights can be turned on or off, brightened or dimmed, by rotation of the headlamp switch instrument panel knob. Since the instrument light switch is a part of the main lighting switch, the instrument panel lights cannot be left on when the other lights have been turned off.

All electrical accessories, except radio, cigar lighter, heater and defroster, are connected to the headlamp switch.

REAR SIGNAL LAMPS

The standard rear lamp arrangement is the same on all models (except station wagon) and consists of two combination tail and stop lights attached to the rear fenders, and two license plate lights mounted in the rear bumper guards at each end of the license.

The combination stop and tail lamp lens incorporates STIMSONITE construction, which provides a reflection from the approaching light. The tail and stop lamp bulb is of double filament type.

To avoid the possibility of inserting the bulb in the socket the wrong way, one of the base pins of the bulb is offset ⅛" from the other pin. Therefore, the bulb can be assembled only in the correct position.

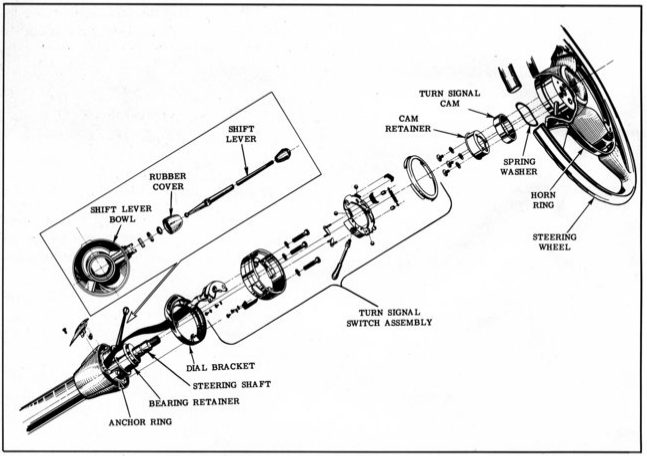


Fig. 623. Details of Turn Signal Construction

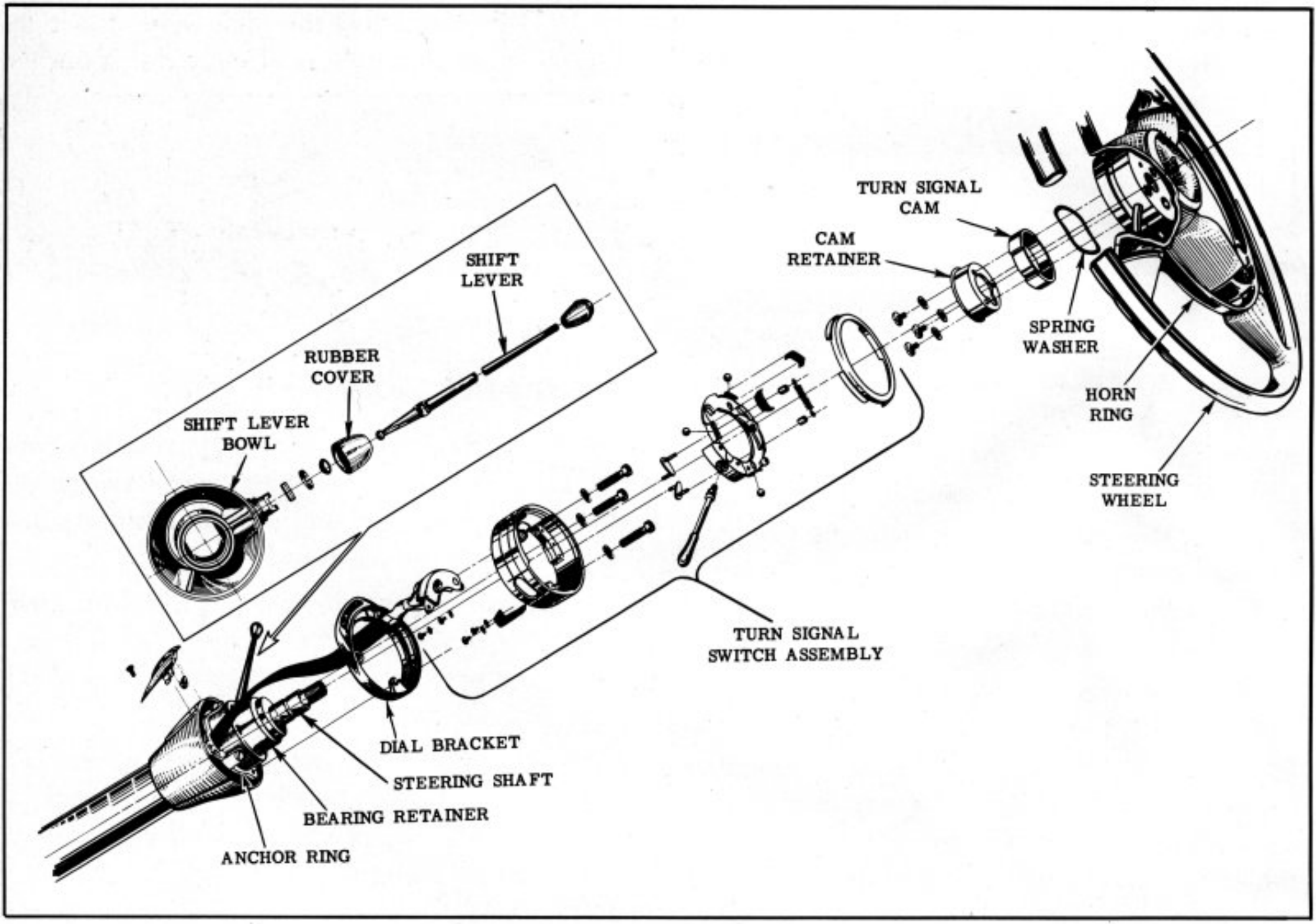


Fig. 623. Details of Turn Signal Construction

STOP LAMP SWITCH

The stop lamp switch is mounted on the brake master cylinder and is actuated by pressure built up when brake pedal is depressed. Push-on type terminals are used.

The wiring on all models is such that both lamps operate simultaneously. The tail switch wiring is equipped with a fuse located on the headlamp switch.

TURN SIGNAL

A turn signal, included on "98" series cars and all Deluxe models, is used to indicate when a turn is about to be made. The signal is operated by a small control lever, mounted at the left side of the housing just below the steering wheel.

When a turn is to be signaled, the lever should be pushed up for a right turn or down for a left turn which will cause the parking light at the front and the stop light at the rear, as well as a pilot light at one side of the speedometer face, to automatically flash the direction to be turned at the rate of 80 to 100 flashes per minute. (The flasher is not adjustable.)

In case a turn is accidentally signaled in one direction and is made in the opposite direction, the switch will automatically shut off as the turn is being made.

The switch can be turned off manually; however, after the turn has been completed and wheels are straightened, the signal will automatically be turned off by a ratchet in the steering mechanism.

In order to eliminate the possibility of signal lights operating when engine is not running, the wiring is connected to the ignition switch so that signal cannot operate when ignition switch is turned off.

NOTE: Failure of the pilot bulb on the instrument panel to light indicates either a burned

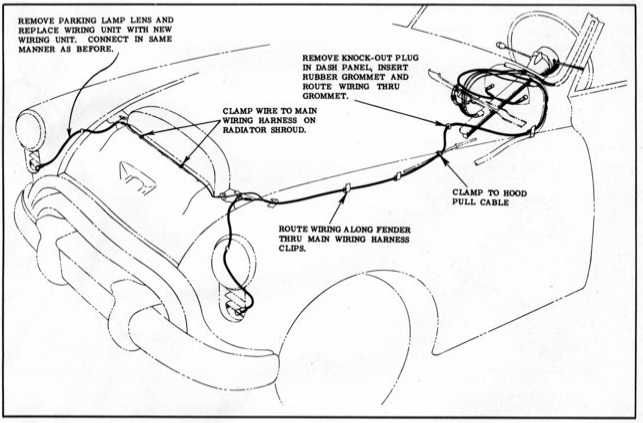


Fig. 624. Proper Routing of Turn Signal Wiring Harness

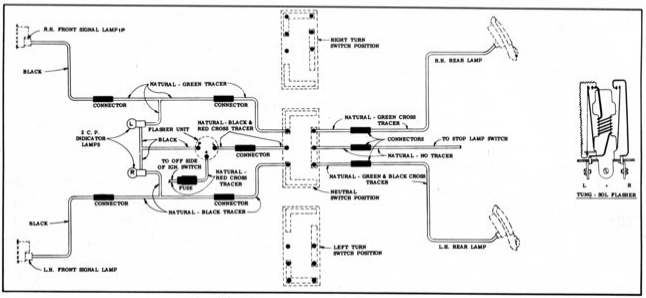


Fig. 625. Turn Signal Schematic Wiring Diagram

out bulb in the parking, tail or pilot lamp or a failure in the signal system.

Turn Signal—Installation Instructions

1. Disconnect positive battery terminal.
2. Install signal wiring harness and route wires as shown in Fig. 624.
3. Remove steering wheel and install switch parts as shown in Fig. 626.
4. Connect wires as shown in Fig. 624 and Fig. 628.
5. Adjust turn signal cam as follows:

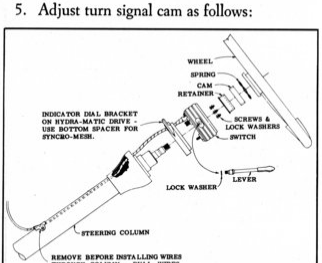


Fig. 626. Turn Signal Switch Installation Details

a. With car wheels in straight ahead position and steering wheel center spoke pointing down, place signal lever in "Off" (center) position as shown in "A", Fig. 627.
b. Place switch lever in "up" position for right hand turn as shown in "B", Fig. 627, and while holding lever firmly in this position, rotate steering wheel for left hand turn to position shown.
c. Place switch in "down" position for left hand turn as shown in "C", Fig. 627, and while holding lever firmly in this position, rotate wheel for right hand turn to position shown.

6. Check adjustment of turn signal cam, as follows:
   a. With car wheels in straight ahead position and steering wheel center spoke pointing down, place switch lever in "up" position for right turn.
   b. Rotate steering wheel 180° clockwise for right turn as shown in "E", Fig. 627.
   c. Return steering wheel to straight ahead position. Turn signal level should automatically return to "off" (center) position when steering wheel reaches posi-

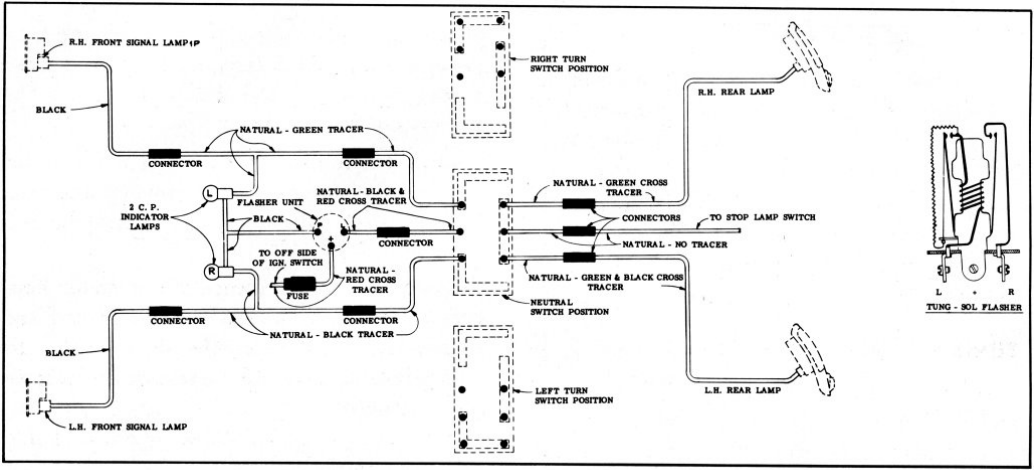


Fig. 625. Turn Signal Schematic Wiring Diagram

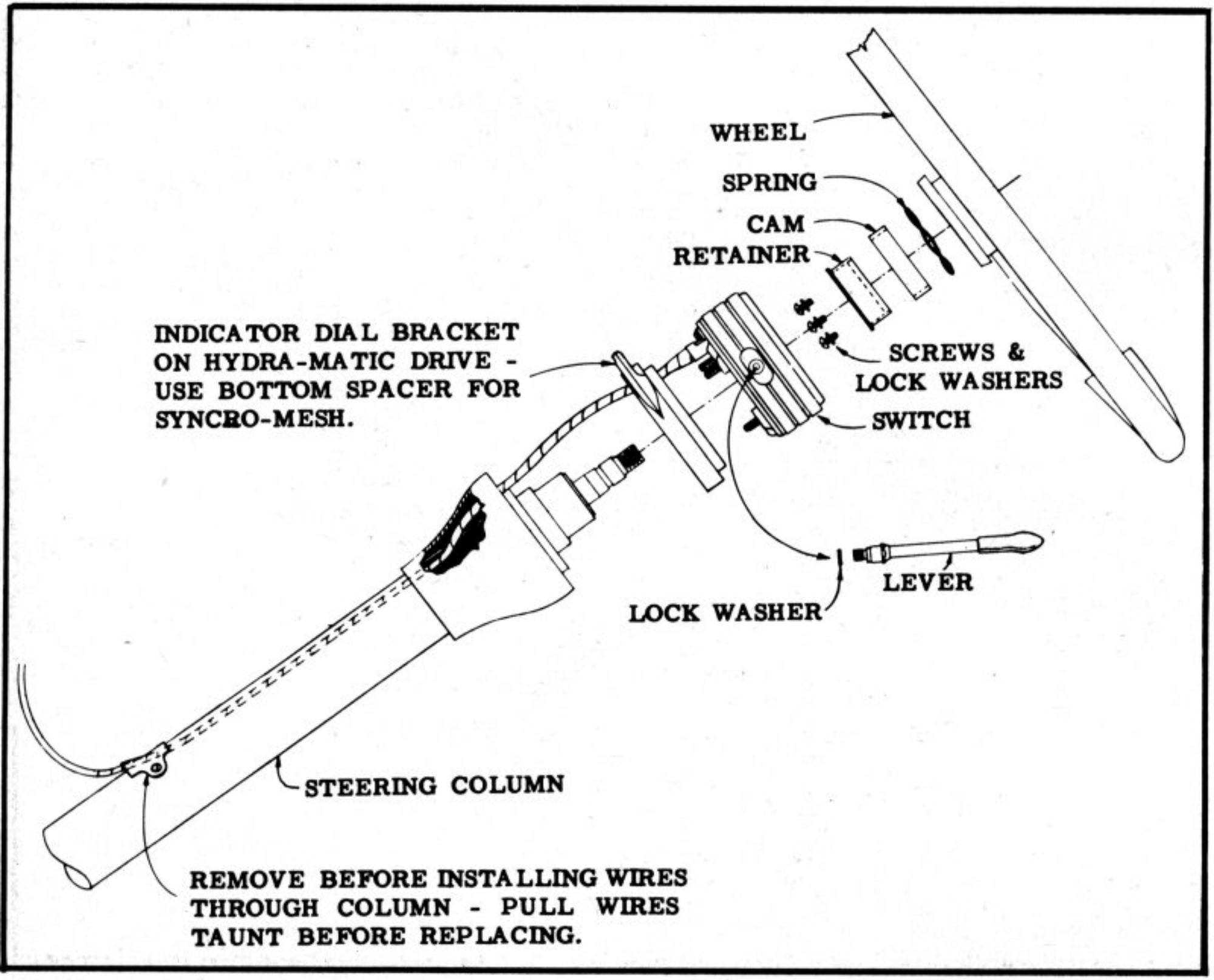


Fig. 626. Turn Signal Switch Installation Details

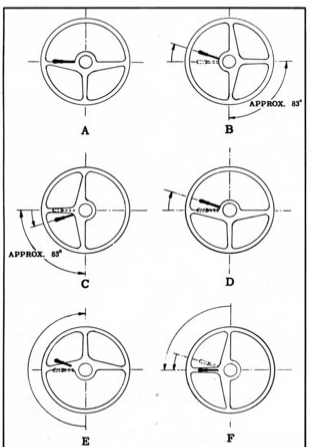


Fig. 627. Turn Signal Cam Adjustment

tion shown in "F", Fig. 627, as it is being returned to straight ahead position.

LAMP CURRENT LIMIT RELAY

A current limit relay is a part of the lighting switch on all models. The function of this unit is to protect the lighting system from damage which might result from short circuits. The horn and ignition circuits are not protected by the relay.

The normal lighting current is not sufficient to operate the relay, but a short circuit in any of the lighting circuits will cause the relay to function and make the lights flicker and the ammeter hand vibrate, which provides a distinctive warning. This will continue until the trouble is remedied or the battery is completely discharged.

The relay is non-adjustable and should permit continuous load of 30 amps. at 70°F. Points should open in less than 3 minutes under 42 amps. at 70° F., and a dead short should limit current to about 18 amps.

Gasoline Gauge

An electric gasoline gauge with push on type terminals, manufactured by the AC Spark Plug Division is used on all models.

The instrument panel unit consists principally of two coils spaced 90° apart with an armature and pointer assembly mounted at the intersection of the coil axes.

Dampening of the gauge pointer is accomplished by the use of silicone dampening fluid in the pointer shaft bearings which prevents vibration of the pointer on rough roads.

The tank unit is essentially a rheostat, the movable contact of which is actuated by a float

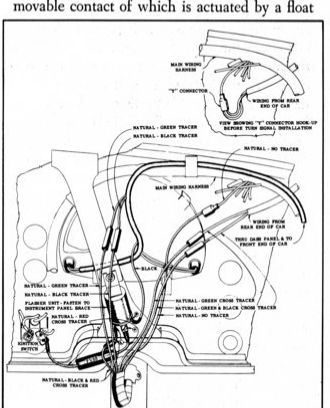


Fig. 628. Turn Signal Wiring Harness Details

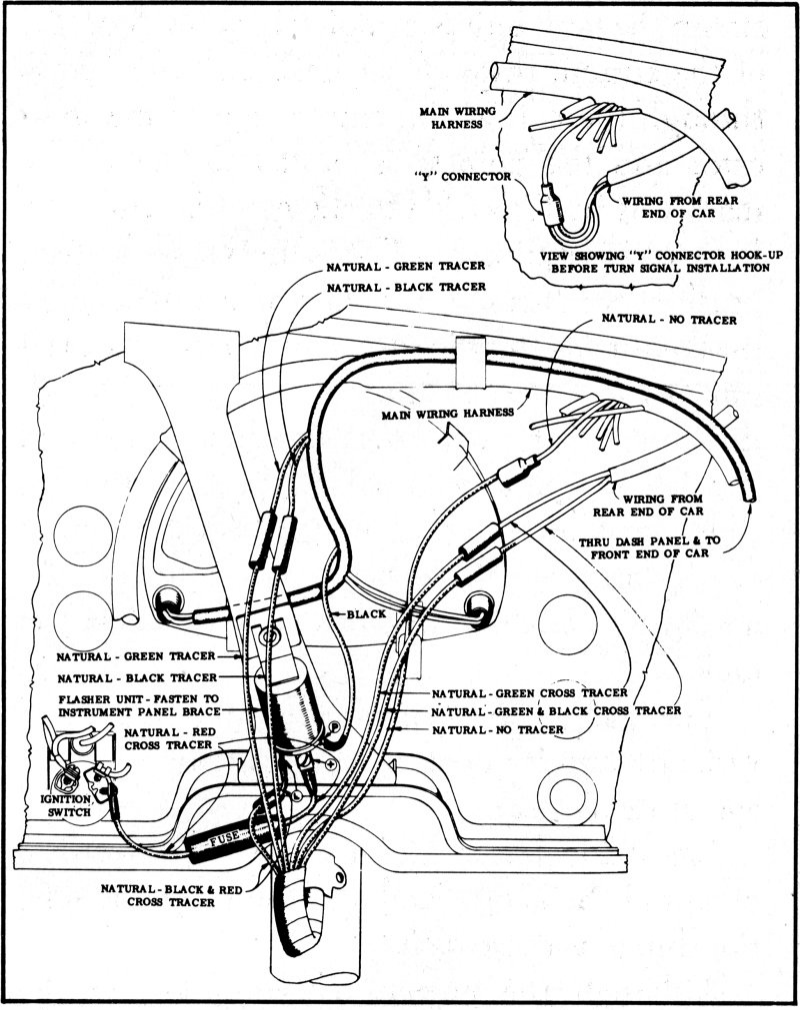


Fig. 628. Turn Signal Wiring Harness Details

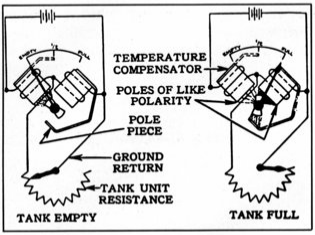


Fig. 629. Gasoline Gauge Diagram

which rests on the surface of the gasoline in the tank. Movement of the float is transferred to the rheostat contact by a link arm. A flat spring damper at the gauge end of the float rod assists in dampening vibration of the gas gauge pointer.

When the gasoline tank is empty, the float assembly is at its lowest position where the rheostat in the tank unit is completely grounded. All of the current through the dash unit then flows through the coil at the empty side of the indicator and the pointer is pulled to the empty mark. As fuel is added in the gasoline tank, the float assembly rises. This moves the contact brush in the rheostat, introducing resistance into the circuit which grounds the full coil in the dash unit, so that part of the current flows through this coil and the pointer is attracted away from "empty" to a position of balance between the two coils. Its point of rest depends upon the amount of resistance which, in turn, is governed by the quantity of gasoline that has been added in the tank.

The gauge is compensated for temperature variation and is not affected by variation in voltage of the battery.

Fig. 629 shows the fundamental electrical circuit of the gauge, and also the magnetic relationship of the two coils

Although the current consumption of the gauge is only approximately .15 amperes, it is connected in series with the ignition switch so that there is no discharge of current when the ignition switch is off.

CHECKING TANK UNIT AND INSTRUMENT PANEL OF THE GAS GAUGE

The gas gauge is composed of two units: a unit mounted in the instrument panel, and a second unit mounted in the gas tank. The accuracy of these units may be checked individually or collectively by the use of the AC Gas Gauge Tester Unit by following the instructions given below:

A. (1) With ignition switch "OFF", disconnect wire from back of instrument panel unit which comes from tank unit. (This is on the larger or right hand terminal, viewed from driving position.)

(2) Attach tester wire "A" (red) to this terminal and tester wire "B" (black) to any grounded part of the car.

(3) Turn ignition switch "ON", move tester arm up and down, dash unit should register "FULL" and "EMPTY." If so, turn ignition switch "OFF" and reconnect tank wire.

(4) If unit does not indicate on above test, check to see if unit is getting current by connecting a 6-volt lamp from ignition terminal (left hand terminal of gauge unit) to "GROUND". Turn on ignition switch—if bulb lights, dash unit is faulty; if bulb does not light, ignition switch is faulty.

B. If dash unit is OK, next check the wiring between dash and tank units as follows:

(1) Disconnnect tank unit wire at bayonet connection inside of trunk compartment.

(2) Attach tester wire "A" (red) to the connection running to the dash and wire "B" (black) to "GROUND" of car.

(3) Turn ignition switch "ON", move tester arm up and down, observing dash unit indication which should move from "EMPTY" to "FULL" if wiring is OK.

(4) If, on this test, dash unit reads "EMPTY" at all times or the reading is noticeably lower than during the check at the dash unit, look for shorts or leaks in the wiring between dash and tank. Leaks are most liable to occur at terminal junctions. If dash unit reads above "FULL" at all times, or if it reads higher at "EMPTY" and "FULL" than readings obtained when checking at the dash, look for poor connection or break in the wiring. Be sure contacts in bayonet connectors are clean and if terminal blocks are used, be sure wires are clean and secured in place.

C. (1) If dash unit and wiring check OK, drop tank and remove tank unit. Clean away all dirt that has collected around tank unit terminal, as road dirt, particularly calcium chloride, causes an electrical leak that will throw the unit out of calibration.

(2) After cleaning thoroughly, connect tank to wire leading to dash, grounding tank unit with a short piece of wire from outer edge to any part of car. Turn ignition switch "ON" and move float arm up and down. If this unit is OK, dash unit will give corresponding "EMPTY" and "FULL" readings.

(3) If tank unit is OK, reinstall in the tank; if not, replace with a new tank unit, but first repeat above test before installing in the tank.

NOTE: Always check tank units for freedom of movement of the float arm by raising it to various positions and observing that it will fall to "EMPTY" position in every instance.

REMOVING GASOLINE GAUGE TANK UNIT

Before the gasoline gauge tank unit is removed, all gasoline should be drained from the tank. See FUEL AND EXHAUST section.

NOTE: When connecting wires to dash unit, make certain that the wire which leads to the tank unit does not come in contact with ammeter connection or the upper terminal on dash unit marked "ignition," as this might result in damage to the tank unit rheostat.

Electrical System Service Suggestions

The following suggestions may be of assistance in servicing the electrical equipment of the car:

STARTING MOTOR FAILS TO CRANK ENGINE

1. Check starter switch and neutral safety switch for defective contacts.
2. Switch on headlamps and note if they are lighted normally.
3. Engage starter as usual, and note the intensity of the light from the headlamps. If dimmed considerably, or lights go out, the trouble may be as follows:
   a. Battery low or completely discharged. Check specific gravity with hydrometer; see INSTRUCTIONS FOR CARE OF BATTERY.
   b. Terminals of wire connections to battery posts may be loose or corroded. Remove terminal from posts by loosening clamp bolt, and scrape the inside of the terminal and outside of the post with a knife blade so that it is clean. Place a small amount of petroleum jelly on the battery post and tighten terminal securely in place.

c. Cables to starting motor loose. Check to see that these are securely fastened.
d. Poor contact at any of the following points:
   1. Starter end casting to starter frame.
   2. Starter frame to starter front casting.
   3. Starter front casting to engine bell-housing.
   4. Bell-housing to engine block.

LIGHTS INOPERATIVE

If lights do not burn in any of the "ON" positions, but starter cranks, check as follows:

1. Check contact of current limit relay attached to light switch. Clean if necessary.
2. Examine bulbs and if all are burned out, trouble may be caused by loose connection in generator circuit. This condition will cause high voltage, and will usually be indicated by lamps flaring up when engine speed is increased.
3. Check wiring.

LIGHTS FLARE UP EXCESSIVELY AS ENGINE IS SPEEDED UP

The headlamp beams flare up noticeably as the engine speed is raised above idle. This flare-up is a normal condition and is caused by the high-output generator increasing the voltage as the engine speed is raised above idle.

Excessive light flare, however, indicates a loose connection in the circuit from the generator to battery, and the following connections should be carefully checked:

1. See that terminal connections at starting motor are tight.
2. Remove battery terminals, scrape outside of battery posts and inside of battery cable terminals and coat surfaces with petroleum jelly.
3. Check battery cable ground terminal on engine to see that connection is clean and tight.
4. Check connections of ground strap—cylinder head to dash—to be sure connections are tight.

LAMPS HAVE SHORT LIFE AND MUST BE REPLACED FREQUENTLY

1. If frequent replacement is necessary, check wiring circuits as outlined under previous paragraphs.
2. Check voltage regulator; adjust if necessary.
3. Check battery—dry battery will cause lights to burn out.

ENGINE FAILS TO FIRE WHEN SWITCH IS "ON" AND WHEN CRANKED BY STARTING MOTOR

1. Remove high tension wire from one of the spark plugs and hold terminal approximately ¼" from metal base of plug while engine is being turned over with starting motor. The spark should jump the gap readily. If it does not and ammeter flickers to discharge while the engine is being cranked, trouble can be traced as follows:
   (a) Breaker points pitted or out of adjustment (fail to open properly).
   (b) Defective condenser.
   (c) Broken-down ignition coil.
2. If spark produced is satisfactory and engine will not fire:
   (a) Remove plugs and examine for foul condition. If dirty, clean with AC Spark Plug Cleaner.
   (b) Check ignition timing.

ENGINE FIRES IRREGULARLY

1. Clean spark plugs with AC Spark Plug Cleaner and inspect.
2. Inspect breaker points for proper clearance and cleanliness.

   If it is necessary to adjust breaker points,

also check ignition timing, as the timing is also changed when points are adjusted.

3. Check high tension wires to spark plugs for poor insulation.

AMMETER SHOWS DISCHARGE WHEN IGNITION AND LIGHT SWITCHES ARE "OFF"

Disconnect the feed wire from ammeter terminal.

If ammeter hand does not return to zero after tapping instrument with the finger, ammeter is incorrect, and there is no fault in other parts of the electrical system. If ammeter hand returns to zero, it indicates fault is in the headlamp or stoplight switch or in the wiring.

NOTE—Due to large current fluctuations caused by the voltage regulator, it has been found necessary to dampen the pointer movement of the ammeter, which occasionally causes the pointer to stop slightly off zero. Tapping the instrument should cause the pointer to take the correct position.

GENERATOR DOES NOT CHARGE BATTERY

This trouble may be caused by loose or dirty connections in the generator charging circuit, and electrical system should be inspected as follows:

1. Test all wires and connections from battery through starting motor terminal, ammeter, switch, regulator and generator for open circuits, and check operation of voltage and current regulator.
2. Examine all generator brushes for good seats and spring tension.
3. Check generator, regulator, and cutout.

GASOLINE GAUGE DOES NOT REGISTER WHEN IGNITION SWITCH IS TURNED "ON"

1. This may be caused by break in line between dash unit and ignition switch.
2. Left coil wire broken in dash unit. Replace dash unit. See CHECKING OF TANK AND DASH UNITS.
3. Grounded wiring to tank unit—check connection in trunk compartment.

GAUGE SHOWS "FULL" UNDER ALL CONDITIONS

1. This may be caused by break in line between dash unit and tank unit. To remedy this, check line and all connections. Examine plug which connects body and chassis gas gauge wiring.
2. Tank unit burned out. Replace tank unit.
3. Tank unit improperly "grounded" due to loose mounting screws or paint under the screw heads.
4. Tighten screws holding the tank unit. Ground the tank to the chassis and test. See CHECKING OF TANK AND DASH UNITS.

GAUGE SHOWS "EMPTY" UNDER ALL CONDITIONS

1. This may be caused by wires being reversed on dash unit. To correct this trouble, reattach wires to proper terminals.
2. Lead to tank unit grounded or tank unit rheostat continually grounded.
3. Right coil wire broken in dash unit. Replace dash unit.

The work in locating the trouble will be considerably simplified by using gas gauge tester.

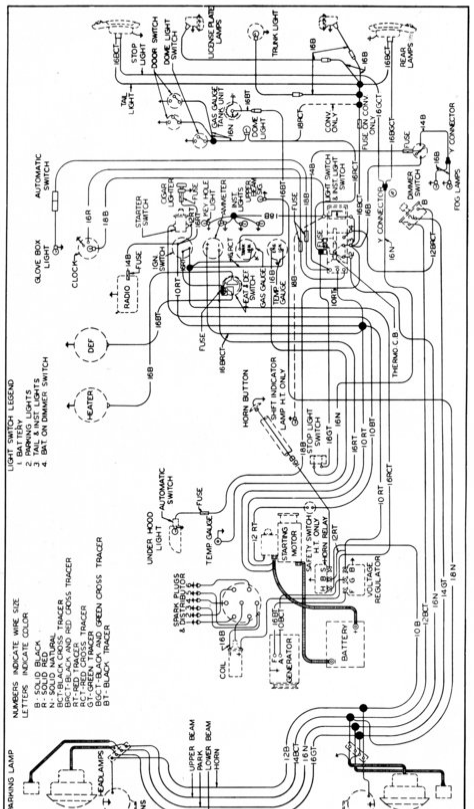


Fig. 630. Chassis Wiring Diagram—76 Series (Without Turn Signal)

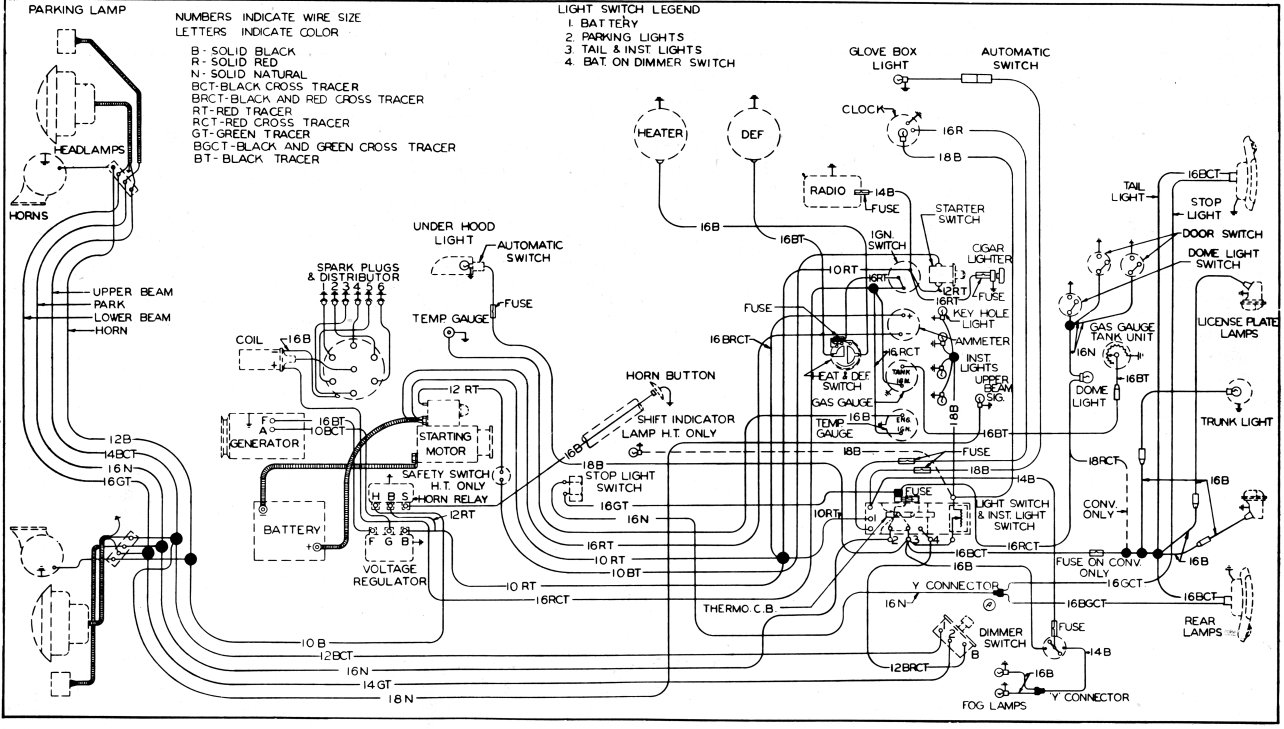


Fig. 630. Chassis Wiring Diagram—76 Series (Without Turn Signal)

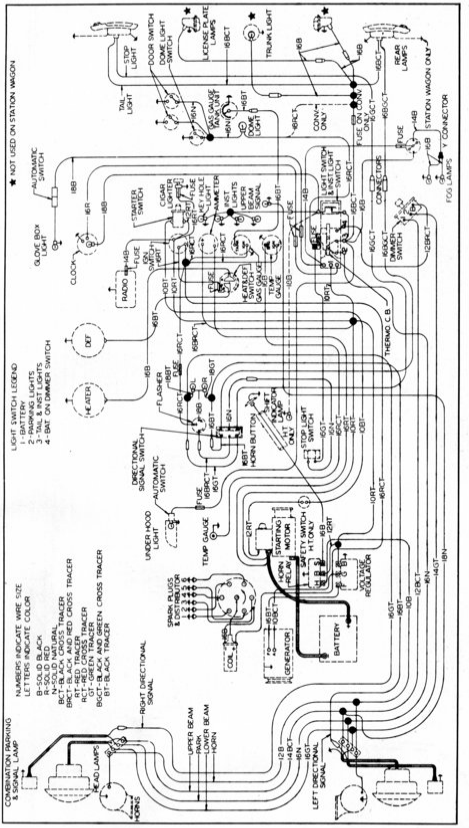


Fig. 631. Chassis Wiring Diagram—76 Series
(With Turn Signal)

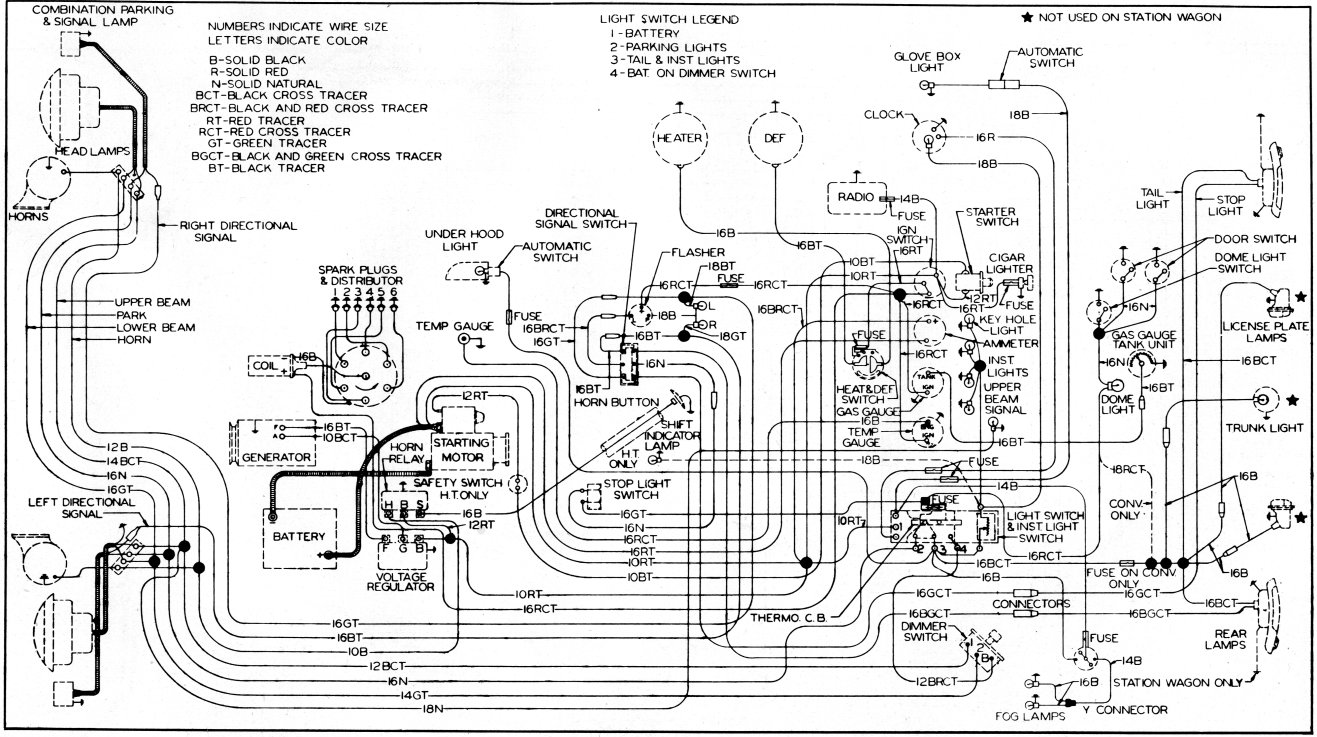


Fig. 631. Chassis Wiring Diagram—76 Series (With Turn Signal)

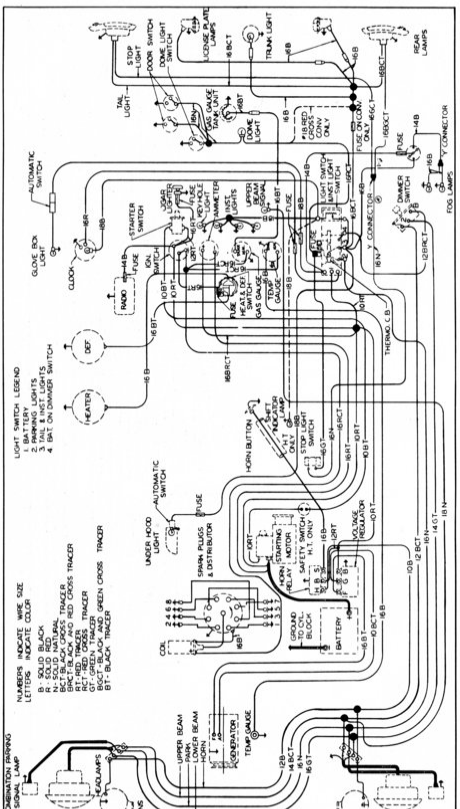


Fig. 632. Chassis Wiring Diagram—88 Series (Without Turn Signal)

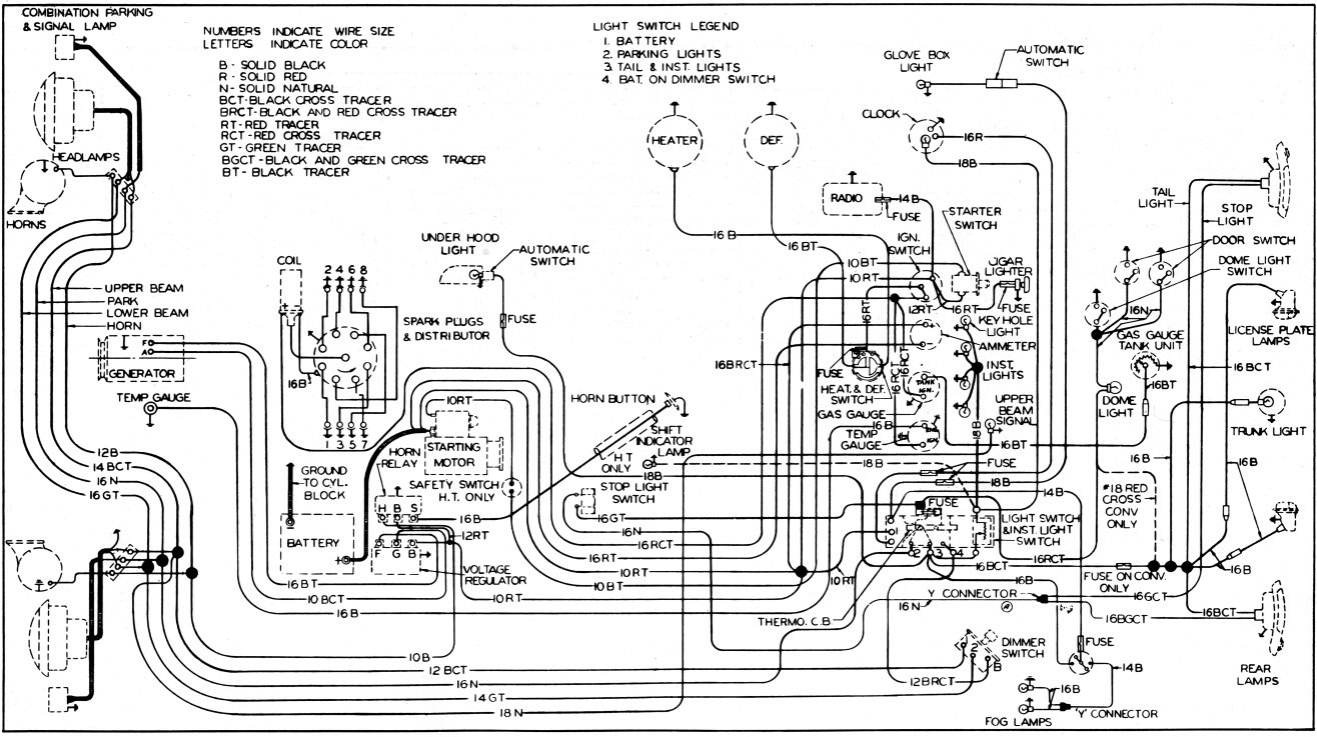


Fig. 632. Chassis Wiring Diagram—88 Series (Without Turn Signal)

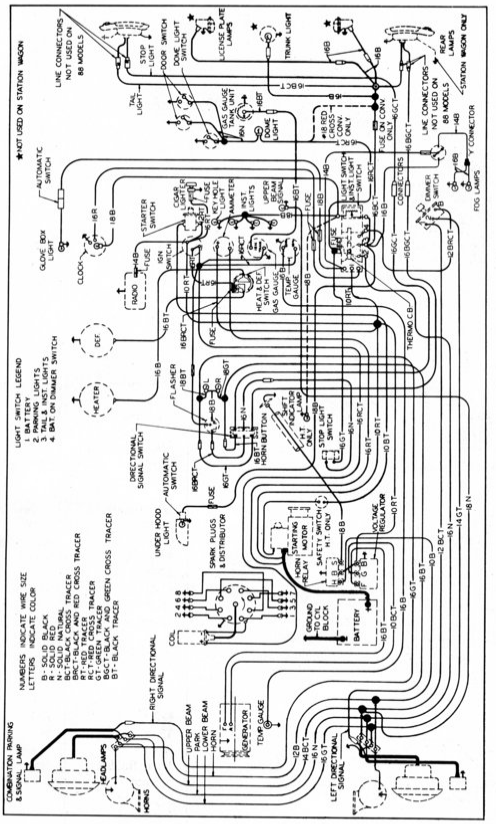


Fig. 633 Chassis Wiring Diagram—98 Series and 88 Series (With Turn Signal)

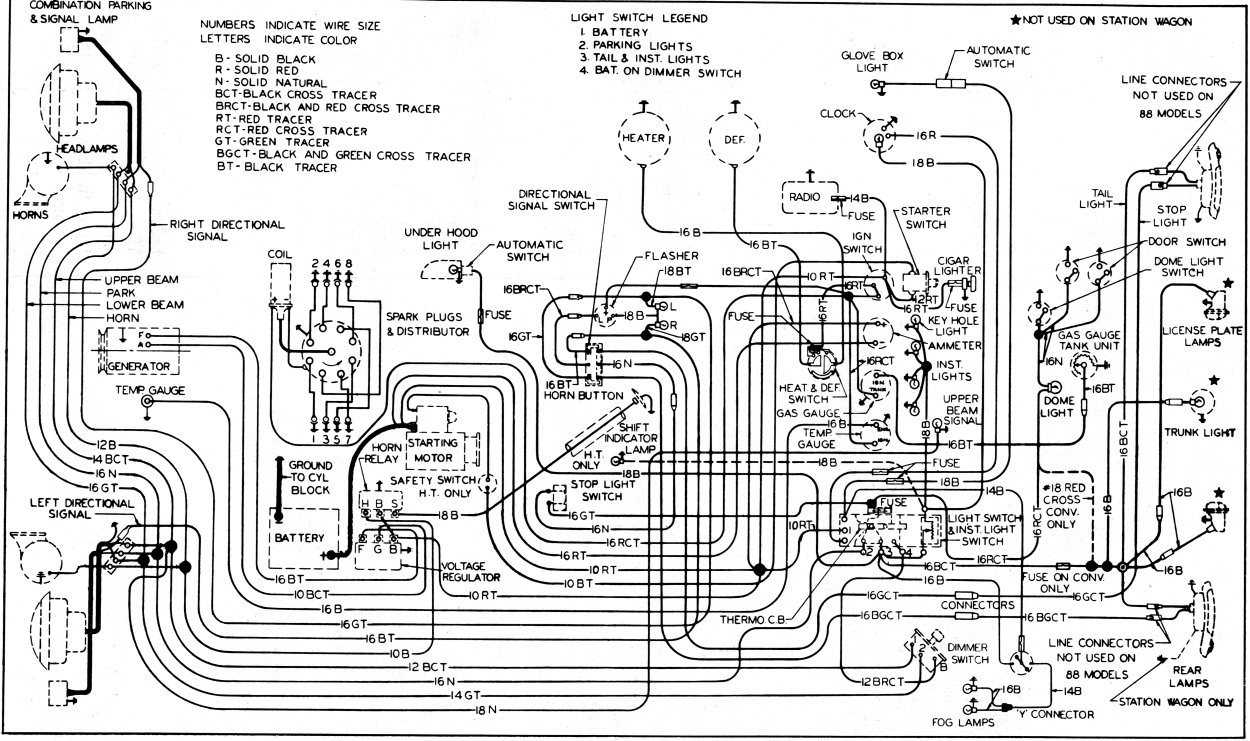


Fig. 633 Chassis Wiring Diagram—98 Series and 88 Series (With Turn Signal)

ELECTRICAL SPECIFICATIONS—1949 MODEL

SUBJECT AND REMARKS	6 CYLINDER	8 CYLINDER
1. STARTING MOTOR		
a. Make	Delco Remy	Delco Remy
b. Type	Solenoid	Solenoid
c. Lock Torque in Ft. Lbs.	15	15
d. Lock Amperage	600	600
e. Lock Voltage	3.00	3.00
f. Brush Spring Tension	24 to 28 oz.	24 to 28 oz.
g. No. of Brushes Used	4	4
h. No. of Fields	4	4
i. No. of Teeth on Starter Pinion	9	9
j. No. of Teeth on Flywheel	145	145
k. Ratio Between Starter Pinion and Gear Flywheel	16.1:1	16.1:1
l. Rotation, viewed from Drive end	Clockwise	Clockwise
2. SOLENOID SWITCH		
a. Current Consumption, Both Windings at 5 volts @ 80°F.	85-90 Amps.	85-90 Amps.
b. Current Consumption, Hold in Windings at 5 volts @ 80°F.	14-16 Amps.	14-16 Amps.
3. GENERATOR		
a. Make	Delco-Remy	Delco-Remy
b. Charging Rate Cold—at 8.0 Volts @ 1900 r.p.m.	40 Amps. Min.	40 Amps. Min.
c. Charging Rate Hot—at 8.0 Volts @ 2330 r.p.m.	40 Amps. Min.	40 Amps. Min.
d. Brush Spring Tension	24 to 28 oz.	24 to 28 oz.
e. Field Current at 6 Volts	1.90-2.03 Amps.	1.90-2.03 Amps.
f. Armature Rotation, viewing Drive End	Clockwise	Clockwise
4. CURRENT VOLTAGE CONTROL UNIT		
a. Make	Delco-Remy	Delco-Remy
b. Cutout Relay Air Gap	.020″	.020″
c. Cutout Relay Point Opening	.020″	.020″
d. Cutout Relay Closing Voltage at Operating Temperature	6.3-6.5 Volts	6.3-6.5 Volts
e. Current Regulator Air Gap	.075″	.075″
f. Current Regulator Setting at Operating Temperature	41-43 Amps.	41-43 Amps.
g. Voltage Regulator Air Gap	.075″	.075″
h. Voltage Setting at Operating Temperature	Adjust to 7.4 V.	Adjust to 7.4 V.
Note: Operating temperature shall be assumed to exist after not less than 15 minutes of continuous operation with a charge rate of 8-10 amperes.		
5. STORAGE BATTERY		
a. Make	Delco	Delco
b. Plates	15	17
c. Capacity at 20 Hr. Rate	100	115
d. Case	Hard Rubber	Hard Rubber
e. Hours at 25 Amps. Discharge @ 80°F.	3 hours	3.5 hours
6. AMMETER		
a. Make	AC	AC

ELECTRICAL SPECIFICATIONS—1949 MODEL—Continued

SUBJECT AND REMARKS	6 CYLINDER	8 CYLINDER
7. COIL		
a. Make	Delco-Remy	Delco-Remy
8. IGNITION SWITCH		
a. Make	Delco-Remy	Delco-Remy
9. DISTRIBUTOR		
a. Make	Delco-Remy	Delco-Remy
b. Contact Point Opening	.016"-.021"	.012"-.0175"
10. SPARK PLUGS		
a. Make	AC	AC
b. Type	45	45
c. Thread	Metric-14 m.m.	Metric-14 m.m.
d. Body	13/16" hex.	15/16" hex.
e. Spark Gap	.040"	.030"
11. HORNS		
a. Make	Delco-Remy	Delco-Remy
12. HORN RELAY		
a. Air gap—Points Closed	.015"	.015"
b. Point Opening	.025"	.025"
c. Closing Voltage	2.75-4.0 V	2.75-4.0 V
13. LIGHTS		
a. Headlamp type	Sealed Beam	Sealed Beam
b. Bulb Sizes:		
(1) Headlights	35-45 Watts	35-45 Watts
(2) Parking Lights (Without Turn Signal)	3 c.p.	3 c.p.
(3) Instrument Panel Lights	1 c.p.	1 c.p.
(4) Stop Light and Tail Lights	21-3 c.p.	21-3 c.p.
(5) Dome Light (Except Convertible)	15 c.p.	15 c.p.
(6) Rear License Lights	3 c.p.	3 c.p.
(7) Glove Compartment Light	2 c.p.	2 c.p.
(8) Beam Indicator	1 c.p.	1 c.p.
(9) Underhood Lamp	6 c.p.	6 c.p.
(10) Rear Compartment Lamp	6 c.p.	6 c.p.
(11) Dome Light (Convertible)	2 c.p.	2 c.p.
(12) Trouble Lamp	15 c.p.	15 c.p.
(13) Fog Lamps	35 watt	35 watt
(14) Spot Lamp	32 c.p.	32 c.p.
(15) Back-Up Lamps	32 c.p.	32 c.p.
(16) Ignition Switch Lamp	1 c.p.	1 c.p.
(17) Hydra-Matic Shift Indicator Lamp	1 c.p.	1 c.p.
(18) Radio Dial Lamp	1 c.p.	1 c.p.
(19) Turn Signal Indicator Lamps	2 c.p.	2 c.p.
(20) Electric Clock Lamp	2 c.p.	2 c.p.
(21) Parking Lights (With Turn Signal)	21-3 c.p.	21-3 c.p.

ELECTRICAL SPECIFICATIONS—1949 MODEL—Continued

SUBJECT AND REMARKS	6 CYLINDER	8 CYLINDER
14. LIGHTING SWITCH		
a. Make	Delco-Remy	Delco-Remy
15. TURN SIGNAL		
a. Flashes per Minute (non-adjustable)	80-100	80-100
16. GASOLINE GAUGE		
a. Make	AC	AC
17. GASOLINE GAUGE (Tank Unit)		
a. Make	AC	AC
18. FUSES (ALL)		
a. Head light switch	14 Amp., SFE	14 Amp., SFE
b. Cigar lighter	30 Amp., AGC	30 Amp., AGC
c. Dome and tail light (Convertibles only)	20 Amp., AGC	20 Amp., AGC
d. Electric Clock	2 Amp., AGA	2 Amp., AGA
e. Heater	20 Amp., SFE	20 Amp., SFE
f. Radio	15 Amp., AGC	15 Amp., AGC
g. Glove box lamp	5 Amp., AGA	5 Amp., AGA
h. Underhood lamp	5 Amp., AGA	5 Amp., AGA
i. Back-up lamp (Bumper Mounting)	9 Amp., SFE	9 Amp., SFE
j. Back-up lamp (Body Mounting)	14 Amp., SFE	14 Amp., SFE
k. Turn signal lamp	9 Amp., SFE	9 Amp., SFE
l. Fog lamp	30 Amp., AGC	30 Amp., AGC
m. Spot lamp	14 Amp., SFE	14 Amp., SFE

RADIO

OLDSMOBILE ANTENNA INSTALLATION INSTRUCTIONS

The 1949 Oldsmobile three section fender antenna is designed expressly for installation on Oldsmobiles for use with 1949 custom-built radios. The antenna is telescopic, i.e., it can be extended or lowered. Reception of distant broadcasts will be improved by extending the antenna to its full length.

When the antenna is installed, it is important that the model car being equipped is noted and instructions are carefully followed making sure that the proper drilling template is selected.

1. Position template as shown in Fig. 634 and drill 19/32" diameter hole for antenna mast.
2. With mast removed, insert antenna bushing up through hole drilled in fender.
3. Clean paint off fender metal along inside ledge to provide ground for antenna bracket.
4. Attach antenna bracket to inside edge of fender using screws provided. Slotted holes are provided in fender for mounting screws. Align holes in bracket with slotted holes in fender, making sure antenna mast is at correct angle with respect to car body—(mast should tilt back slightly). Tighten thin hex nut only after antenna mast is properly aligned and mounting bracket screws are tight.
5. Install spacers, gaskets and mounting nuts in sequence shown in Fig. 634.
6. Punch hole in body blind grommet with screw driver or other sharp tool and pull antenna lead-in through, into body.
7. Route lead-in over top of kick pad and over hand brake lever bracket as shown in illustration, Fig. 634.
8. Fasten lead-in in clip provided on defroster nozzle.
9. Plug lead-in in side of radio case, fully extend antenna mast, and adjust radio antenna trimmer screw as per radio installation instructions.

Care of Antenna

Accumulation of road dust and insects will cause antenna telescopic sections to bind and stick, making it difficult to raise or lower the antenna. The antenna mast should be cleaned frequently to avoid this trouble.

PREPARING CAR FOR RADIO INSTALLATION

The Distributor Suppressor

One elbow type suppressor is placed in the distributor center lead as indicated in Fig. 635. Remove the lead from its socket in the distributor and remove the metal tip from the lead. Place the nipple over the distributor suppressor and screw the suppressor to the distributor center lead as shown. The high tension wire should clear the battery, heater hose, and distributor metal parts.

On 76 series cars, severe cases of ignition noise may result from the heater hoses lying on top of or too near the distributor cap. Heater hoses should be routed to one side and beneath the distributor for best results.

Front Wheel Static Collectors

Install the front wheel static collectors as shown in Fig. 636. Insert the static collector to the bottom of the inner cap so that the rounded contact button at the center of the helical spring is toward the open end of the spindle. Be careful to keep the plane of the selector button paral-

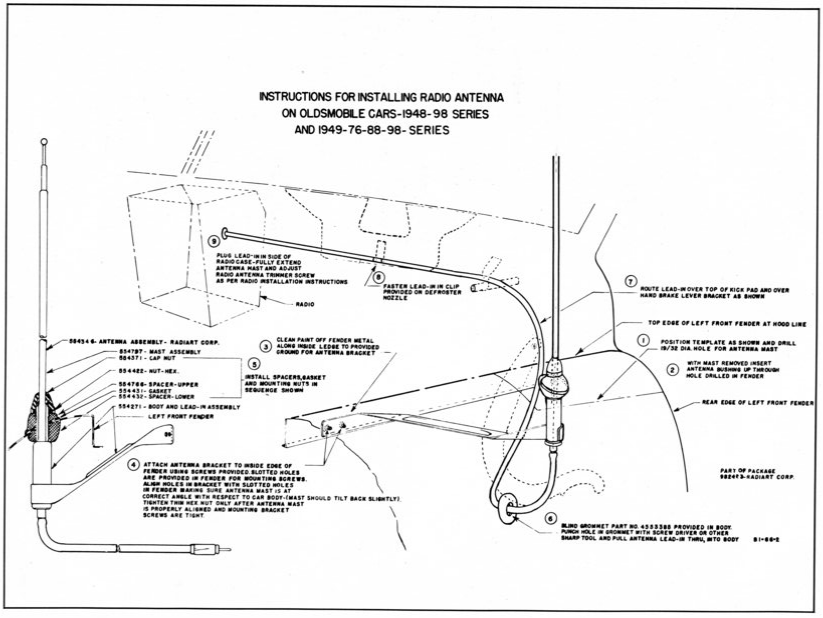


Fig. 634. Antenna Installation Instructions

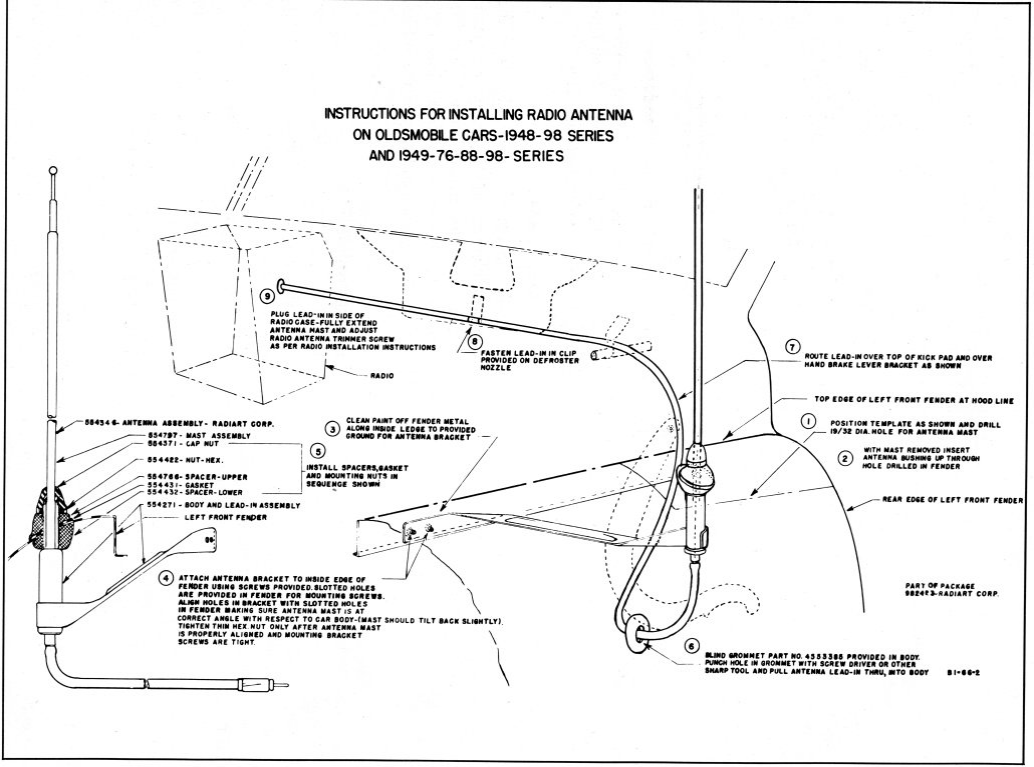


Fig. 634. Antenna Installation Instructions

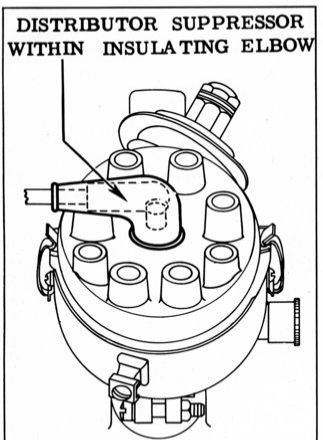


Fig. 635. Distributor Suppressor Installation

lel to the open side of the dust cap to prevent uneven wear. Any grease in the lathe center hole on the axle should be removed and any burrs which may be found in the center holes should be filed away to prevent excessive wear on the static collector contact point. Cotter pin ends should be bent back against the flat of the nut to avoid interference with the static collector spring. Replace the inner cap and the large hub cap on each wheel.

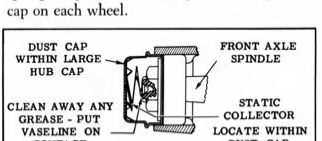


Fig. 636. Static Collector Installation

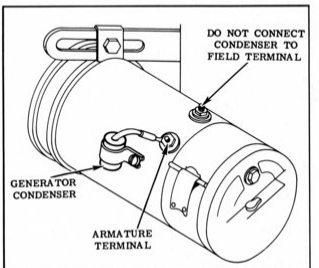


Fig. 637. Generator Condenser Installation

Mounting the Generator Condenser

Mount and connect the generator condenser as shown in Fig. 637. Scrape away all paint and dirt to insure a good electrical connection.

Ignition Coil Condenser

Assemble the ignition coil condenser to the ignition coil bracket and scrape away any paint, grease, or dirt from contact surface. Connect lug on the condenser lead to the positive (+) terminal on the ignition coil as indicated in Figs. 640 and 641.

Hood Grounding Clip

Install hood grounding clip as shown in Fig. 638, making sure the clip breaks the paint to establish good electrical contact.

Voltage Regulator Condenser

Attach the voltage regulator condenser by means of the upper left hand voltage regulator attaching bolt as indicated in Fig. 639, and attach the lead to the battery terminal of the voltage regulator as shown.

Tire Static Powder

After installation of the radio and antenna, the car should be road-tested on dry pavement for presence of tire static. With radio set at full

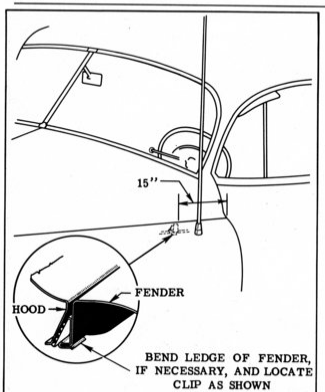


Fig. 638. Installation of Hood Grounding Clip

volume on a weak station, car should be driven over both "blacktop," and concrete pavements at speeds from 20-70 M.P.H. If tire static is heard in radio and front wheel static collectors

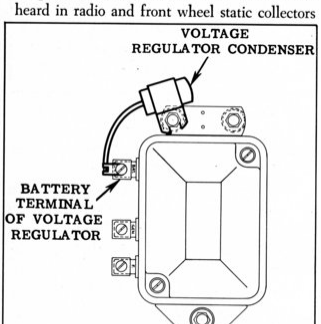


Fig. 639. Voltage Regulator Condenser Installation

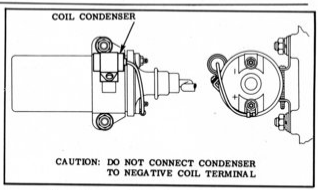


Fig. 640. Coil Condenser Installation—6 Cylinder Engine

are properly installed, Static Eliminator Powder, GM package #986035 should be injected into tires as per instructions on package.

Powder injector, part #986033, is available at GMPD warehouses.

INSTALLING THE RECEIVER

Deluxe and Super Deluxe model radios are available as optional equipment for all 1949 Oldsmobiles. Attaching parts are the same for all radios and the only difference between packages is the receiver itself.

Following are the installation instructions which apply to all radios:

1. Remove the back cover from the receiver and make sure that all tubes and the vibrator are firmly seated in their proper sockets.
2. Connect the receiver to a battery and bench test to be sure that it is operating properly before installation.

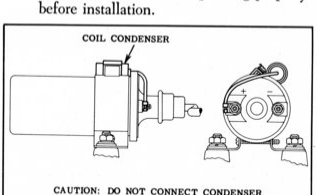


Fig. 641. Coil Condenser Installation—8 Cylinder Engine

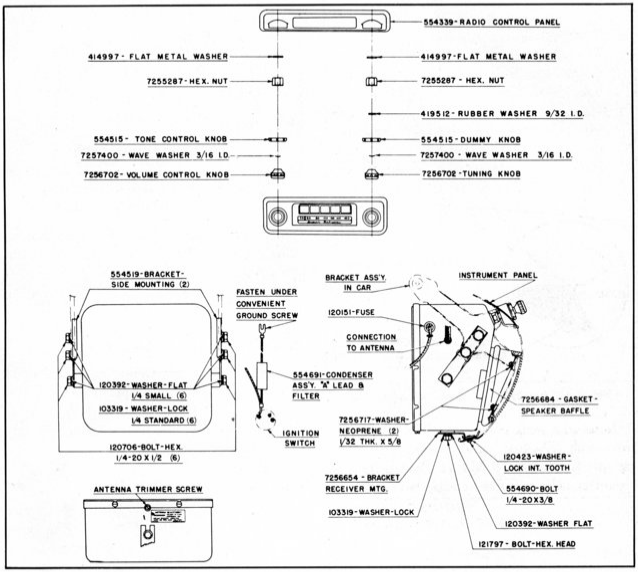


Fig. 642. Installing the Receiver

3. If a new receiver is being installed, scribe the date of purchase in the blank provided on the serial number plate at the bottom of the receiver and replace the cover.
4. Connect the end of the "A" lead to which the filter condenser is attached to the hot terminal of the ignition switch as shown in Fig. 642.
5. Fasten the free end of the filter condenser under the head of any convenient instrument panel screw. (Do not connect to receiver.)

NOTE—Be sure the contact surfaces are free of paint, grease, and dirt.

6. Remove the decorative plate from the center of the instrument panel above the radio grille by removing the hex nuts from the mounting studs behind the instrument panel.
7. Remove the nuts and lockwashers from the two studs on the center of the radio grille behind the instrument panel and, using these nuts and lockwashers along with the

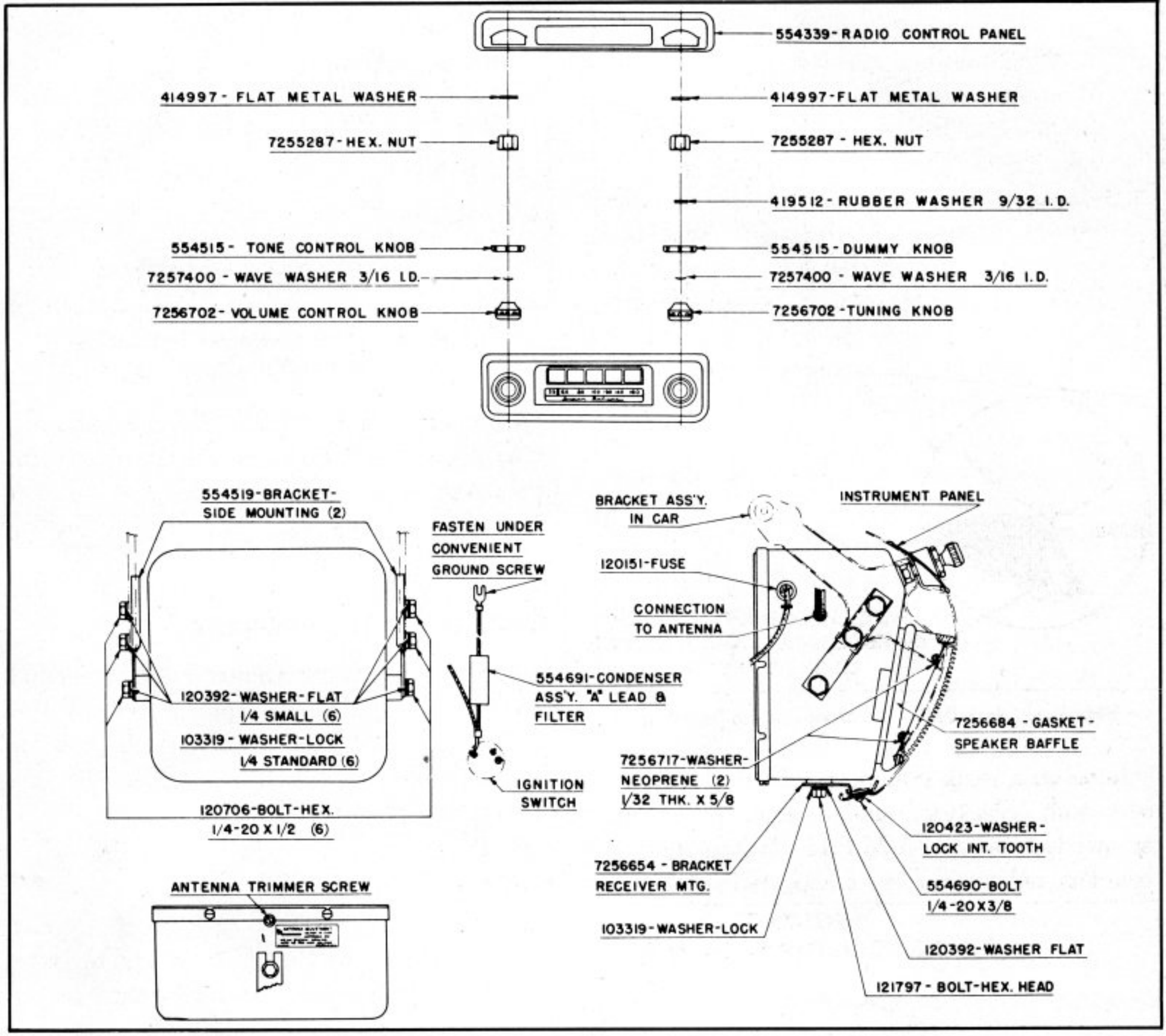


Fig. 642. Installing the Receiver

spacers furnished with the radio, mount the speaker shroud as shown in Fig. 642.

8. Mount the two side mounting brackets to the brackets in the car as shown, and turn bolts "hand tight."
9. Place the receiver in position behind the instrument panel with the control bushings protruding through the instrument panel. Place the escutcheon trim plate over the bushings and fasten the radio in place.
10. Place the bottom mounting bracket in place and fasten it securely to the instrument panel as shown in Fig. 642. Fasten the receiver to bottom bracket turning the bolt "hand tight."
11. Position receiver so that the speaker shroud escutcheon is flush with the escutcheon trim plate on the instrument panel. Tighten all screws, bolts, and the hex nuts on the bushings until the radio is held securely in place.
12. Assemble the control knobs, tone knob, and dummy knob to control shafts as shown, using the necessary washers.
13. Plug the antenna lead into the receiver.
14. Place the fuse in the receptacle on the side of the receiver and fasten the loose end of the "A" lead over the fuse.

Antenna Trimmer Adjustments

1. With the antenna fully extended, turn the radio on.
2. Turn the volume control full on and tune the receiver to a weak station near 140 on the dial.
3. With a small screwdriver adjust the antenna trimmer (see sticker on receiver) for maximum volume.

Adjusting the Push Buttons

Automatic push button tuning of five preselected stations is accomplished easily and quickly by means of the new push-pull lockup tuning mechanism. The procedure outlined below is a simple one-hand operation.

1. Allow the receiver to warm up for ten minutes or more.
2. Select a push button for the desired station. Pull the button slightly to the left and then out as far as it will go. (Fig. 643)

Fig. 643. Pull to Left and Out on Push Button

3. Tune in the desired station manually. (Fig. 644)

Fig. 644. Tune In Station

4. Push the selected button to its maximum IN position. This is the locking operation. (Fig. 645)

Fig. 645. Push Button to Maximum "In" Position

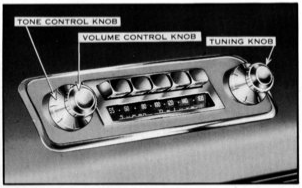
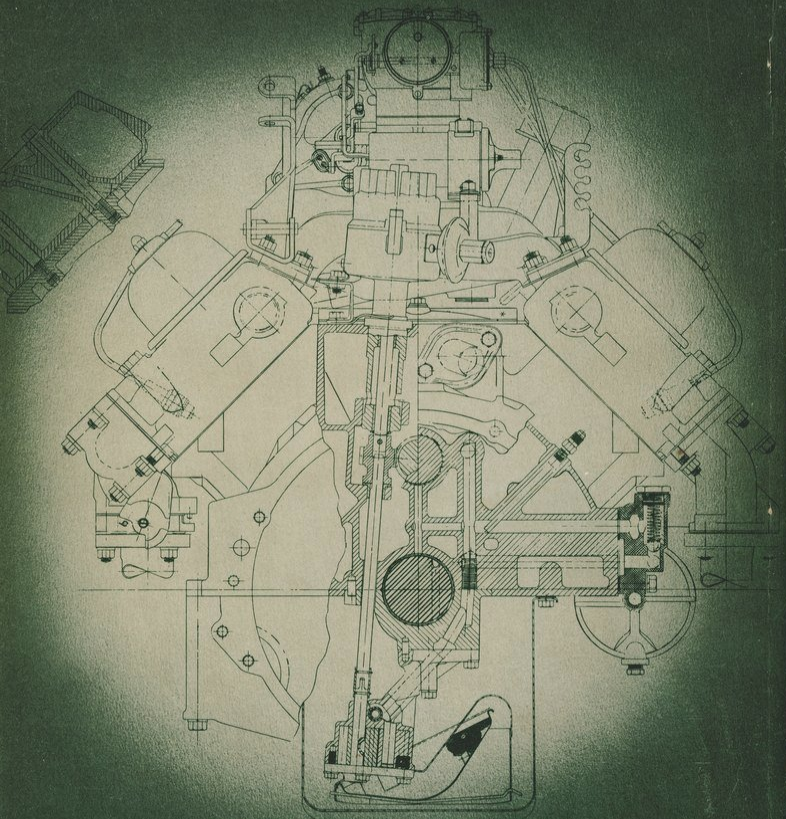


Fig. 646. Radio Dial and Tuning Knobs

5. Proceed in the same manner for the remaining stations.
6. After all the buttons have been adjusted, recheck the settings. Push each button and see if the station can be tuned in more accurately manually. If so, pull the button slightly to the left and then out as far as it will go, reset the station manually, and push the button to its maximum IN position.
7. A station setting may be changed at any time by repeating the foregoing procedure.

THE "ROCKET" OLDSMOBILE'S GREATEST ENGINE



OLDSMOBILE DIVISION

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