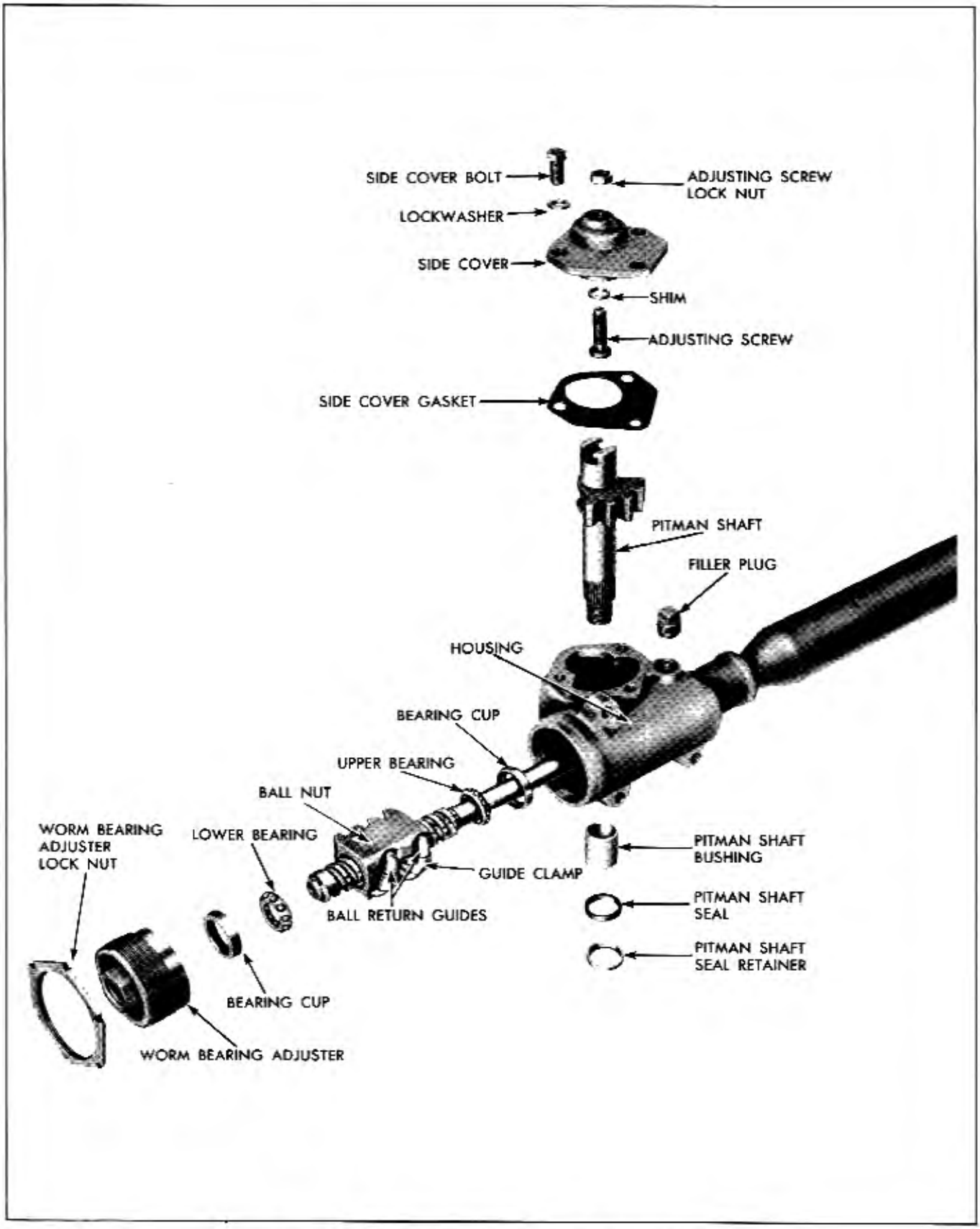


Fig. 9-1 Standard Steering Gear—Exploded View

STEERING

CONTENTS OF THIS SECTION

STANDARD STEERING GEAR

GENERAL DESCRIPTION

The standard steering gear (Fig. 9-1) is of the recirculating ball nut type. The ball nut, mounted on the worm, is driven through steel balls which circulate in helical grooves in both the worm and nut. Ball return guides attached to the nut, serve to recirculate the two sets of twenty-seven balls each in the grooves.

As the steering wheel is turned to the right, the nut moves upward. When the wheel is turned to the left the nut moves downward.

The teeth on the sector, which are forged as part of the pitman shaft, and the ball nut are so designed that a tighter fit exists between the two when the front wheels are straight ahead. Proper engagement between the sector and the ball nut is obtained by an adjusting screw which moves the pitman shaft endwise permitting desired engagement of the tapered teeth of the ball nut and sector gear. The worm bearing adjuster can be turned to provide proper preloading of the upper and lower bearings.

PERIODIC SERVICE RECOMMENDATIONS

Periodic service consists of periodical lubrication as outlined in General Lubrication Section.

ADJUSTMENTS ON CAR

Correct adjustment of the steering gear is extremely important and can only be obtained by following the correct procedure. Before any adjustments are made to the steering gear in an attempt to correct such conditions as shimmy, hard or loose steering and road shocks, careful check should be made to determine that front end alignment, shock absorbers, wheel balance and tire pressure are correctly adjusted and/or operating satisfactorily.

There are two adjustments on the recirculating ball type steering gear:

1. Worm bearing preload adjustment.
2. Sector and ball nut backlash adjustment.

CAUTION: It is very important when adjusting the steering gear, that the adjustment be made in the above sequence. Failure to do so will result in damage to the steering gear.

WORM BEARING PRELOAD—ADJUST

1. Disconnect steering connecting rod from pitman arm (Fig. 9-8) by removing cotter pin and plug from connecting rod.

2. Tighten pitman arm nut to 110-125 lb. ft. torque.

3. Loosen steering column bracket to make certain

column is not sprung due to misalignment. If misaligned, shim at steering gear housing to frame bolts and tighten bracket.

4. Loosen pitman shaft adjusting screw lock nut and back off adjusting screw a few turns (Fig. 9-2).

5. With a spring scale at rim of steering wheel, measure pull required to keep wheel in motion when off high point (at least 30° off center) (Fig. 9-3).

6. Pull required should be between 3/8 and 7/8 pounds. To correct, loosen worm bearing adjuster lock nut with brass drift (Fig. 9-4) and turn adjuster to bring spring scale pull within limits (Fig. 9-5).

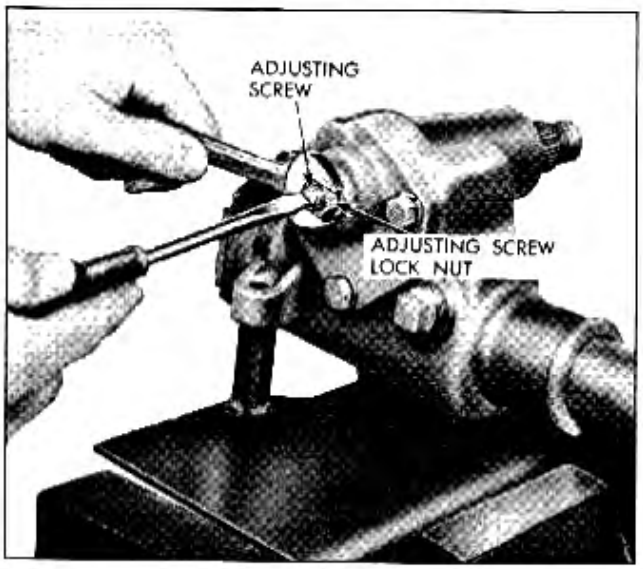


Fig. 9-2 Adjusting Pitman and Ball Nut Backlash

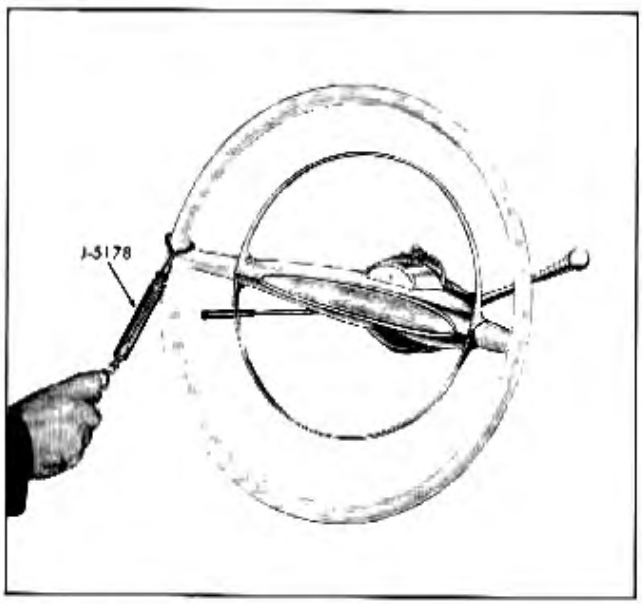


Fig. 9-3 Checking Pull at Wheel Rim

7. Retighten lock nut when adjustment is correct and recheck as in step 6 above.

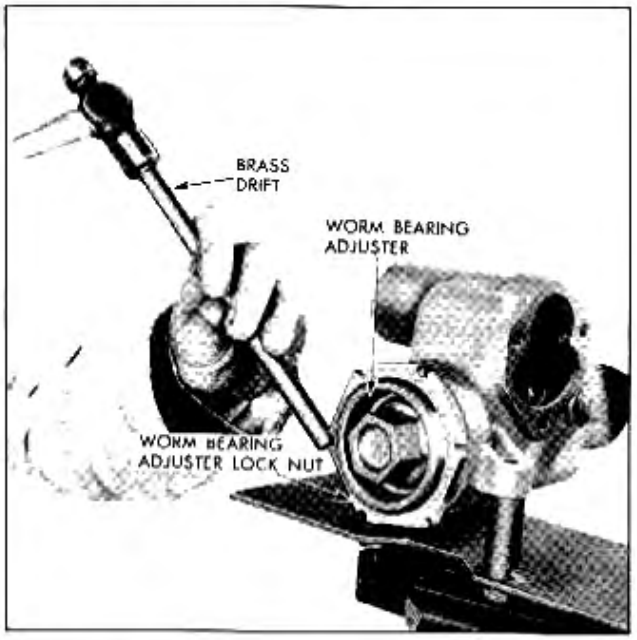


Fig. 9-4 Loosening Worm Bearing Adjuster Lock Nut

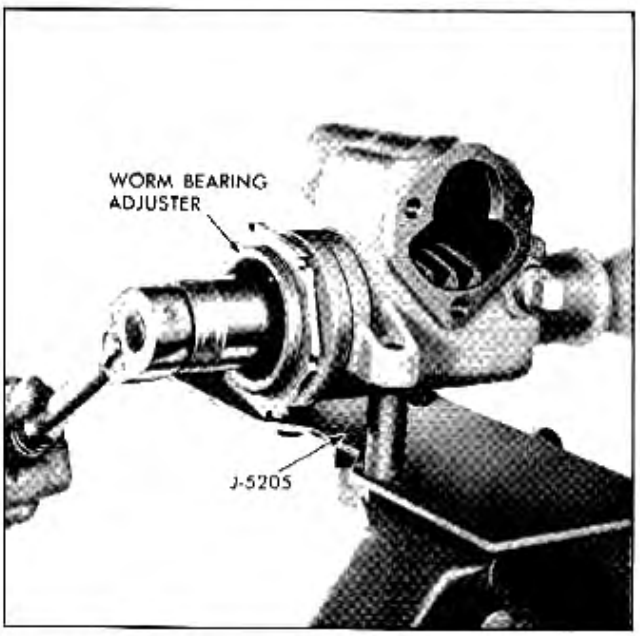


Fig. 9-5 Adjusting Worm Bearing Preload

SECTOR AND BALL NUT BACKLASH—ADJUST

1. When worm bearing preload has been adjusted correctly, pitman shaft adjusting screw (Fig. 9-2) should be turned clockwise until a pull of 1 to 2 pounds at the steering wheel rim is required to turn the wheel through center (Fig. 9-3).

2. Tighten pitman shaft adjusting screw lock nut, and recheck adjustment.

3. Reassemble steering connecting rod to pitman arm. Set spokes of steering wheel in straight ahead position (mark on steering shaft up, Fig. 9-7). If road wheels are not straight ahead, adjust steering tie rods as outlined on page 3-7.

MINOR REPAIRS

STEERING WHEEL—REPLACE

1. Remove deluxe horn ring by removing four screws which retain covers to bottom of horn ring.

2. Remove horn ring side plates, horn ring, horn ring adapter bushing screws and associated parts. (Remove standard horn button by pressing down on one side, inserting screwdriver underneath opposite edge of button, and prying upward.)

3. Remove steering wheel to shaft nut and washer.

4. Remove steering wheel using puller J-3044 (Fig. 9-6).

5. To replace, reverse above procedure. Be sure wheel is in straight ahead position (Fig. 9-7). Tighten steering wheel nut to 25-30 lb. ft. torque.

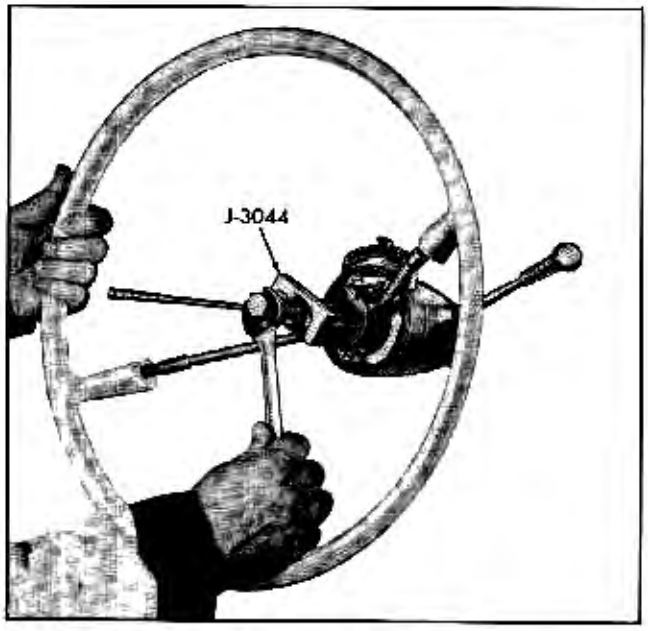


Fig. 9-6 Removing Steering Wheel

STEERING LINKAGE—REPLACE (FIG. 9-8)

Steering connecting rod may be removed from both tie rods, pitman arm and idler arm by removing both cotter pins and threaded plugs in ends of rod.

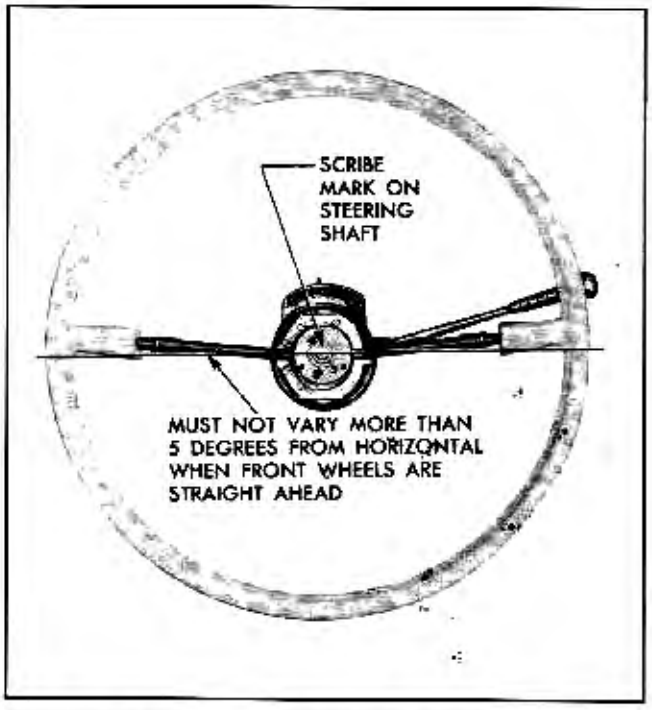


Fig. 9-7 Locating Steering Wheel Position

Connecting rod may be installed by placing tie rod pitman arm and idler lever balls in the rod. Install threaded plugs until tight and back off to nearest cotter pin hole and install new cotter pin. CAUTION: If plugs feel tight before head is approximately flush with end of rod, check for improper position of ball sockets.

After steering connecting rod is removed pitman arm may be removed from pitman shaft by removing the nut and lockwasher and by using puller J-5504. To install pitman arm on pitman shaft, replace arm, lockwasher and nut and tighten to 110-125 lb. ft. torque.

After steering connecting rod is removed, idler arm may be removed by removing two bolts which retain idler support to frame. The idler support and idler arm may then be separated, first threading idler support from bushing and then threading the idler arm from bushing. In reassembling, install bushing in idler arm and tighten to 100 lb. ft. torque; next thread idler support and seal into bushing until distance between upper face of lever and shoulder on support is approximately $1\frac{1}{16}$". Install assembly on frame with two attaching bolts and tighten to 18-20 lb. ft. torque.

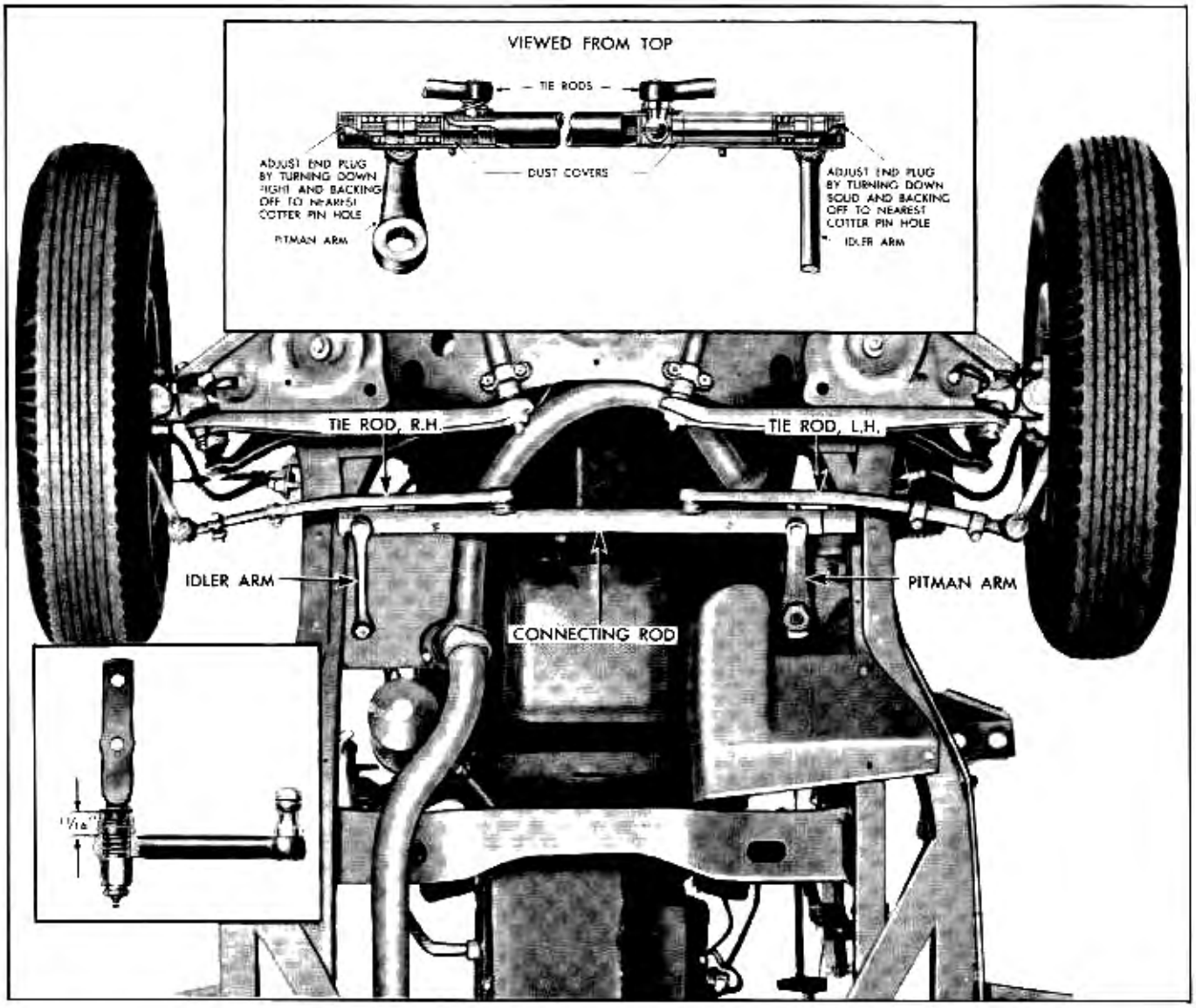


Fig. 9-8 Steering Linkage

Tie rod assembly may be removed from car by removing cotter pin and castellated nut on tie rod ends at steering arms. To separate tie rod and tie rod end, loosen two bolts on tube and clamp assembly, and thread out the part to be replaced. To reassemble, thread new part into tube and clamp assembly to approximate original location, place tie rod end with dust cover in steering arm, tighten castellated nut securely, and install new cotter pin. When new tie rods or tie rod ends are installed it is necessary to check toe-in, page 3–7. Check bolts on tube and clamp assembly for tightness (18-20 lb. ft. torque).

Whenever work is done on steering linkage it should be lubricated.

STANDARD STEERING GEAR—REMOVE

NOTE: If car is equipped with power brakes, remove power brake unit as outlined on page 5–18.

1. Remove steering wheel (page 9–3).

2. Disconnect direction signal wiring harness at connector under instrument panel. Remove direction signal lever.

3. Remove steering column lower finish plate.

4. Roll back floor mat and remove steering column and pedal plates, felts, and felt retainer plate.

5. Disconnect horn wire and neutralizer switch wire.

6. Remove gearshift lever (see Transmission and Gearshift Control, page 7-1).

7. Disconnect gearshift and selector rods from levers on steering column.

8. Raise car on hoist, if available, otherwise on high car stands under BOTH LOWER CONTROL ARMS so as to provide clearance for removing steering gear.

9. Remove engine left side apron.

10. Remove pitman arm from shaft using puller J-5504.

11. Loosen three bolts holding steering gear housing to frame, then remove two bolts leaving the front upper bolt to support steering gear.

12. Remove bolts holding steering column lower bracket to upper bracket on instrument panel.

13. Remove remaining steering gear housing to frame bolt and remove steering gear by bringing it down through floorboard and over steering linkage toward right front wheel. Be sure to save shims found between steering gear housing and frame so these shims can be reinstalled.

STANDARD STEERING GEAR— OVERHAUL AND ADJUSTMENT

DISASSEMBLY

1. Remove steering gear assembly from car (page 9-4) and mount on holding fixture J-5205 (Fig. 9-9).

2. Rotate wormshaft with steering wheel, until wheel is in center of travel. Remove three side cover screws and adjusting screw nut (Fig. 9-1).

3. Remove side cover and gasket by turning adjusting screw clockwise through cover (Fig. 9-9).

4. Remove adjusting screw from slot in end of pitman shaft. Make sure shim found on adjusting screw is kept with screw (Fig. 9-10).

5. Remove pitman shaft from housing using care that threads do not damage seal in housing.

6. Loosen worm bearing adjuster lock nut with brass drift and remove adjuster and lower bearing (Fig. 9-4).

7. Push worm and shaft assembly, with ball nut assembly, through bottom of housing and remove upper bearing.

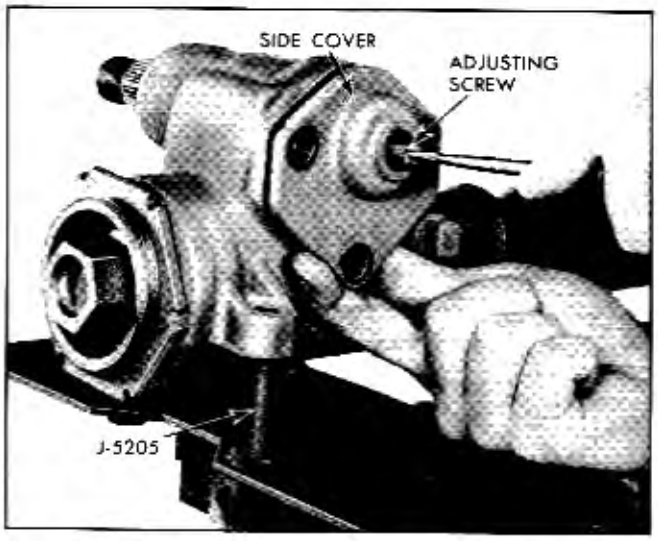


Fig. 9-9 Removing or Replacing Side Cover

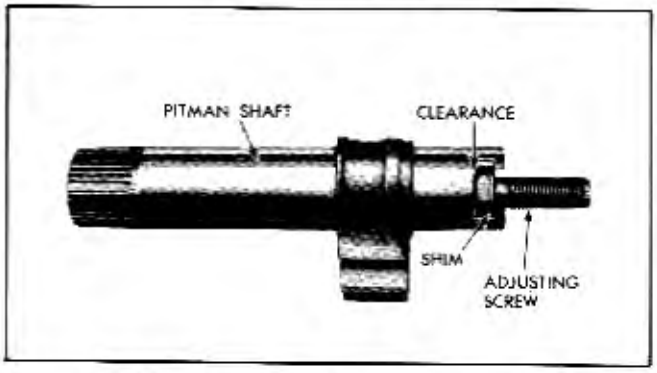


Fig. 9-10 Pitman Shaft and Adjusting Screw

8. Remove ball nut return guide clamp by removing one screw (Fig. 9-11), remove guides, turn ball nut over and remove balls. Rotating shaft slowly from side to side will aid in removing balls.

9. Remove ball nut from worm. NOTE: Unless all balls are removed nut cannot be removed.

CLEANING AND INSPECTION

1. Wash all parts in clean kerosene or other suitable solvent.

2. Inspect all bearings, bearing cups, worm groove, bushings, seals, teeth for scoring, wear, pitting, etc. which would necessitate replacement.

3. Inspect housing and cover for sandholes or cracks.

If pitman shaft bushing, seal, upper and lower bearing cups, steering gear housing or column jacket need replacement see REPAIRS.

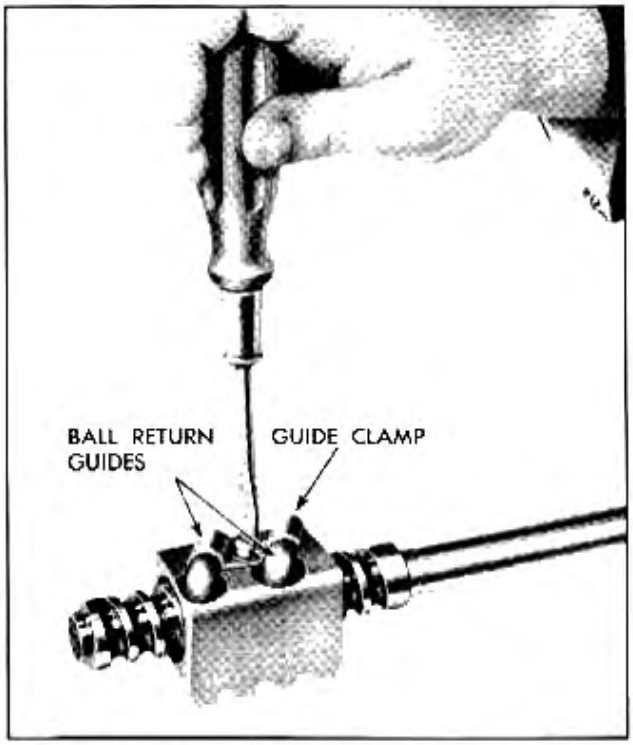


Fig. 9-11 Removing or Replacing Ball Nut Return Guide Clamp

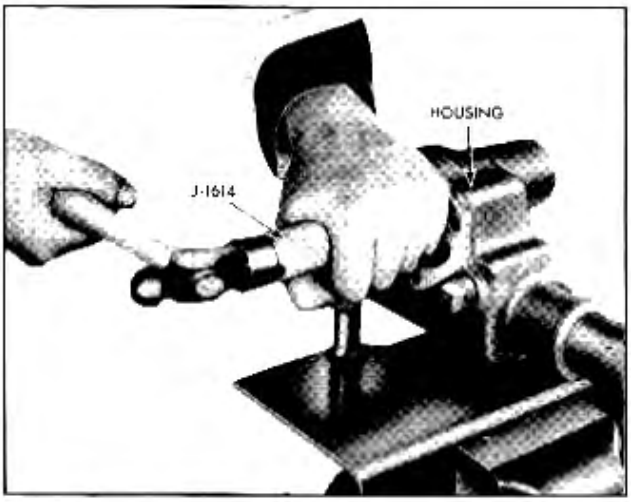


Fig. 9-12 Removing or Replacing Pitman Shaft Bushing

REPAIRS

PITMAN SHAFT SEAL–REPLACE

See step 10, page 9-8 under Assembly.

PITMAN SHAFT BUSHING–REPLACE

Drive out bushing with tool J-1614 (Fig. 9-12). Install new bushing with same tool. Inner end of bushing must be flush with inside surface of housing. Seal must be removed before the bushing is removed.

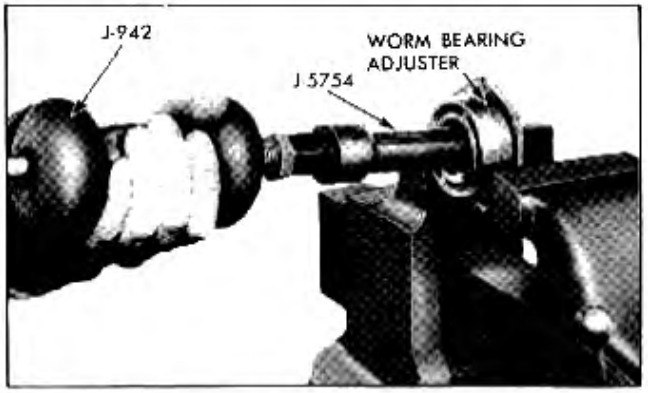


Fig. 9-13 Removing Bearing Cup from Worm Bearing Adjuster

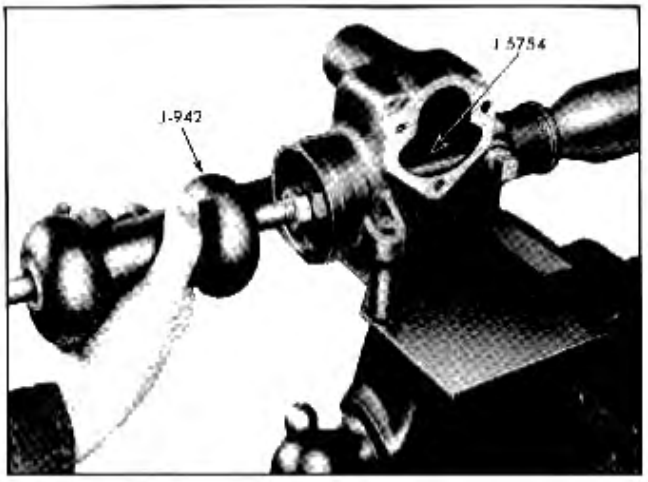


Fig. 9-14 Removing Bearing Cup from Steering Gear Housing

UPPER OR LOWER BEARING CUPS–REPLACE

Remove lower cup from worm bearing adjuster (Fig. 9-13) or upper cup from housing (Fig. 9-14) using tool J-5754 and slide hammer. Install bearing cup in housing (Fig. 9-16) and/or worm bearing adjuster (Fig. 9-15) using tool J-5755.

STEERING GEAR HOUSING OR STEERING COLUMN JACKET–REPLACE

NOTE: Refer to section 7 for replacement of steering column shift linkage.

Steering column jacket is press fit in steering gear housing. When replacing housing and/or jacket the jacket must be properly aligned to housing so holes in jacket will be correctly positioned. Distance between lower mounting screw hole of housing and top of jacket is shown in Fig. 9-17.

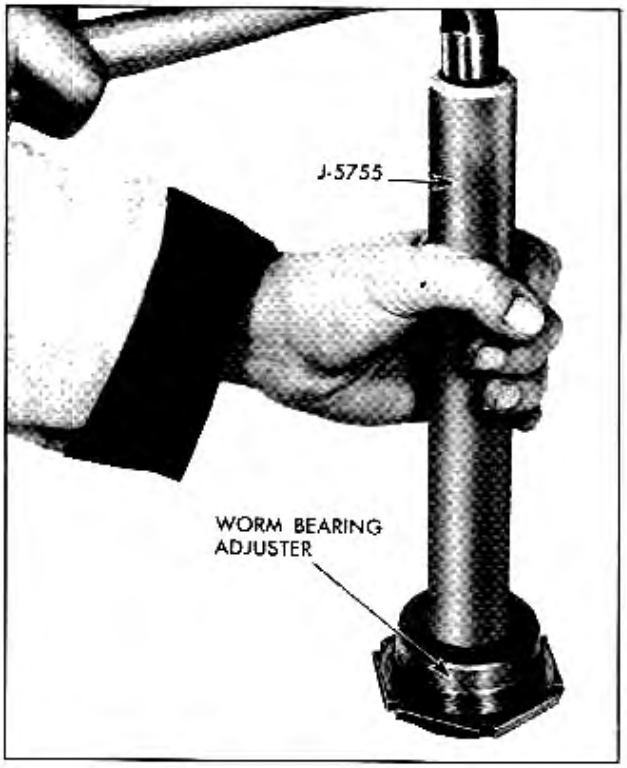


Fig. 9-15 Replacing Bearing Cup in Worm Bearing Adjuster

Fig. 9-16 Replacing Bearing Cup in Steering Gear Housing

ASSEMBLY

NOTE: All seals, bushings and bearings should be prelubricated before assembly.

1. Position ball nut on shaft so that deep side of teeth are located as shown in Fig. 9-18.

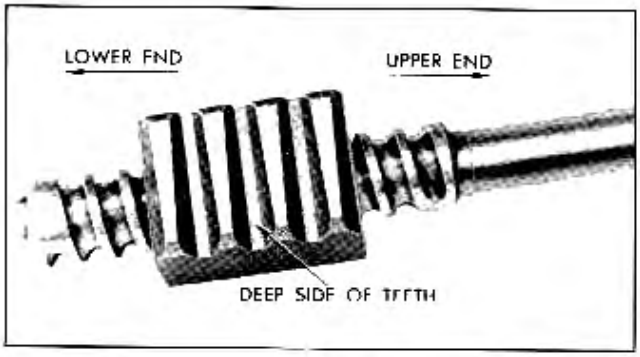


Fig. 9-18 Ball Nut Properly Installed on Shaft

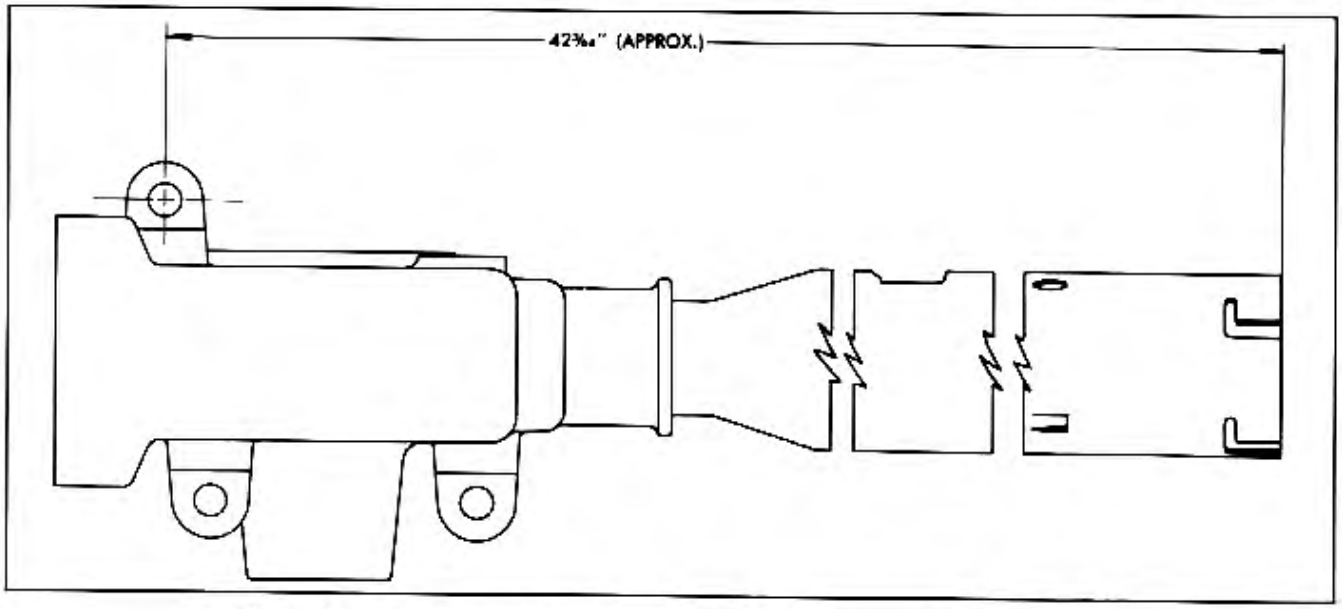


Fig. 9-17 Assembly of Steering Column Housing to Steering Gear Housing

2. Install 18 balls in each circuit of ball nut (rock steering shaft slightly to aid in installing balls) and insert 9 balls in each return guide using petrolatum to hold balls in place. Install return guide clamp and screw (Fig. 9-11). CAUTION: Do not rotate shaft while installing balls, since balls may enter crossover passage between circuits. This will cause improper operation of ball nut.

3. Place upper bearing on shaft. Center ball nut on worm, then slide steering shaft, bearing and nut into housing.

4. Place lower bearing in worm adjuster and install adjuster in housing. NOTE: Adjuster should be installed just tight enough to hold bearing races in place. Final adjustment will be made later.

5. Install pitman shaft adjusting screw and selective shim in pitman shaft (Fig. 9-10). NOTE: Screw must be free to turn, but have no more than .002" end play. If end play of screw in slot is too tight or too loose, select new shim to give proper clearance. Shims are furnished in four thicknesses: .063", .065", .067", and .069".

6. Install pitman shaft and adjusting screw with sector and ball nut teeth positioned as shown in Fig. 9-19.

7. Install side cover and gasket on adjusting screw, turning screw counterclockwise until it projects through cover 5/8" to 3/4".

8. Install three cover attaching screws.

9. Tighten pitman shaft adjusting screw so that teeth on shaft and ball nut engage but do not bind. Final adjustment will be made later.

10. Position seal protector J-5787 on pitman shaft. Place seal over protector and seat seal using tool J-5813 (Fig. 9-20).

11. Fill steering gear with all-season steering gear lubricant.

12. Place steering wheel on shaft and turn steering gear from one extreme to the opposite to make certain there are no unusual binds. NOTE: Never allow ball nut to strike the ends of the ball races in worm due to the possibility of damage to ball guides. Steering gear is now ready for final adjustment of worm bearing preload and sector and ball nut backlash (page 9-1).

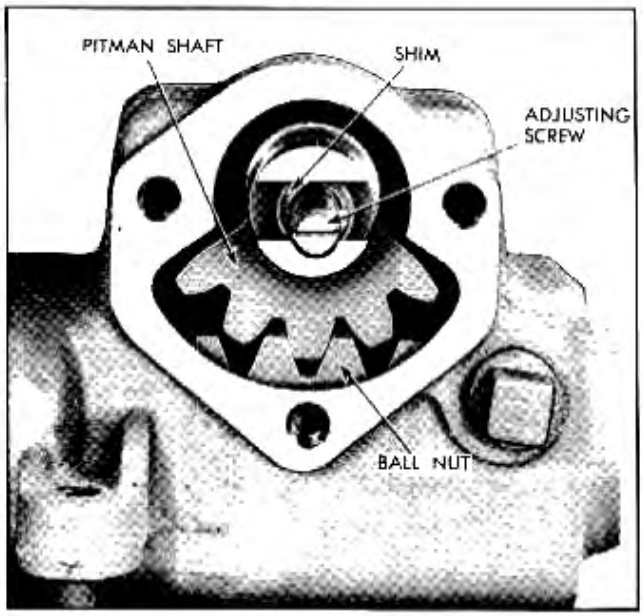


Fig. 9-19 Positioning Pitman Shaft and Ball Nut

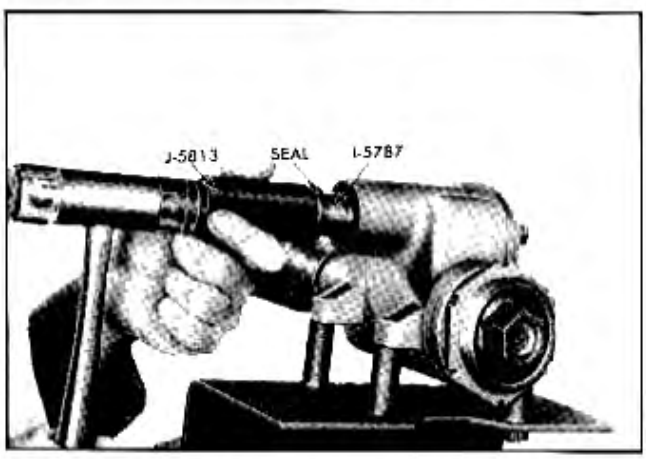


Fig. 9-20 Replacing Pitman Shaft Seal

STANDARD STEERING GEAR—REPLACE

1. Install steering gear from underneath car following same path used to remove assembly from car.

2. Install top front steering gear housing to frame bolt with lockwasher finger tight. CAUTION: Be sure to reinstall shims which were found between steering gear housing and frame on removal of steering gear.

3. Install steering column rubber grommet.

4. Install steering column lower bracket, bolts, and lockwashers on upper bracket at instrument panel. Tighten bolts snugly but not to final tightness.

5. Install two remaining steering gear housing to frame bolts with plain and lockwashers. Tighten all three housing to frame bolts.

6. Check for correct shimming of steering gear housing to frame by seeing if steering column aligns with bracket when bracket bolts are loosened. NOTE: If misalignment exists, it will be necessary to change steering gear housing to frame shims to correct alignment.

7. If steering column alignment is satisfactory, tighten steering column bracket bolts.

8. Install pitman arm on pitman shaft. Make sure lockwasher is in good condition and is installed under pitman shaft nut. Tighten pitman shaft nut to 110-125 lb. ft. torque.

9. Install engine left side apron.

10. Car may now be lowered to floor for added accessibility in completing installation.

11. Install gearshift linkage which was removed during removal of steering gear assembly (see Transmission and Gearshift Control, page 7–1).

12. Install steering column and pedal upper and lower plates, felts, and felt retainer plate. NOTE: If car is equipped with power brakes refer to installation of power brake unit, page 5–26.

13. Install direction signal lever and connect direction signal and horn wiring under instrument panel.

14. Install steering wheel. See that wheel spokes are in straight ahead position when steering gear is on high point of cam with mark on end of steering shaft up (Fig. 9-7) and wheels are in straight ahead position.

15. Connect wires to neutralizer switch on Hydra-Matic models.

TROUBLE DIAGNOSIS AND TESTING

STANDARD STEERING GEAR

For information on steering troubles, cause, and remedy, see Trouble Diagnosis and Testing Section—Front End Suspension, page 3—14.

SPECIFICATIONS

Type	Saginaw Recirculating Ball Nut
Steering Gear Ratio	25:1
Lubricant	See Lubrication Section Page 0-1
Lubricant Capacity	13 Fluid Ounces

TORQUE SPECIFICATIONS

	Lb. Ft. Torque
Steering gear pitman arm nut	110-125
Steering wheel to shaft nut	25-30
Tie rod tube and clamp assembly nuts	18-20
Idler lever nut and bushing	100
Idler support to frame	18-20

POWER STEERING

GENERAL DESCRIPTION OF IN-LINE POWER STEERING

The 1957 power steering gear uses a flexible coupling between the steering gear and steering shaft to cushion road shock. Either the mast jacket and steering shaft assembly or the gear assembly can be removed independently of each other.

A single rack-piston ring of Teflon plastic material is used.

An enclosed type needle bearing is used on the pitman shaft to better control alignment. In addition to this, two oil seals are used on the pitman shaft, the inner seal has a single lip and the outer seal has a double lip. The outer of these lips is to control dust leaks.

The nut which locks the lash adjusting screw contains a Teflon plastic washer to control leakage at that point. The lash adjusting screw is retained in the end of the pitman shaft gear by a nut staked into the gear.

The worm shaft, ball nut, power rack-piston and power cylinder are all in-line (Fig. 9-21). The valve assembly is mounted on top of the gear housing. Pressure and return hoses connect the pump and valve.

Housing of the in-line gear is treated with lubrite to provide an extremely durable bearing surface between the piston and housing.

Over-all steering ratio of the power steering unit is approximately 22.5:1.

This unit is so designed that it requires a maximum of five pounds effort on the steering wheel for parking, the most difficult of turning conditions.

The mechanical element of this steering gear is similar to that used in the standard gear, and consists of a recirculating ball nut in which a number of steel balls act as a highly efficient rolling thread between the steering worm and ball nut. The ball nut is assembled as a rigid part of the rack-piston assembly which engages the pitman shaft gear.

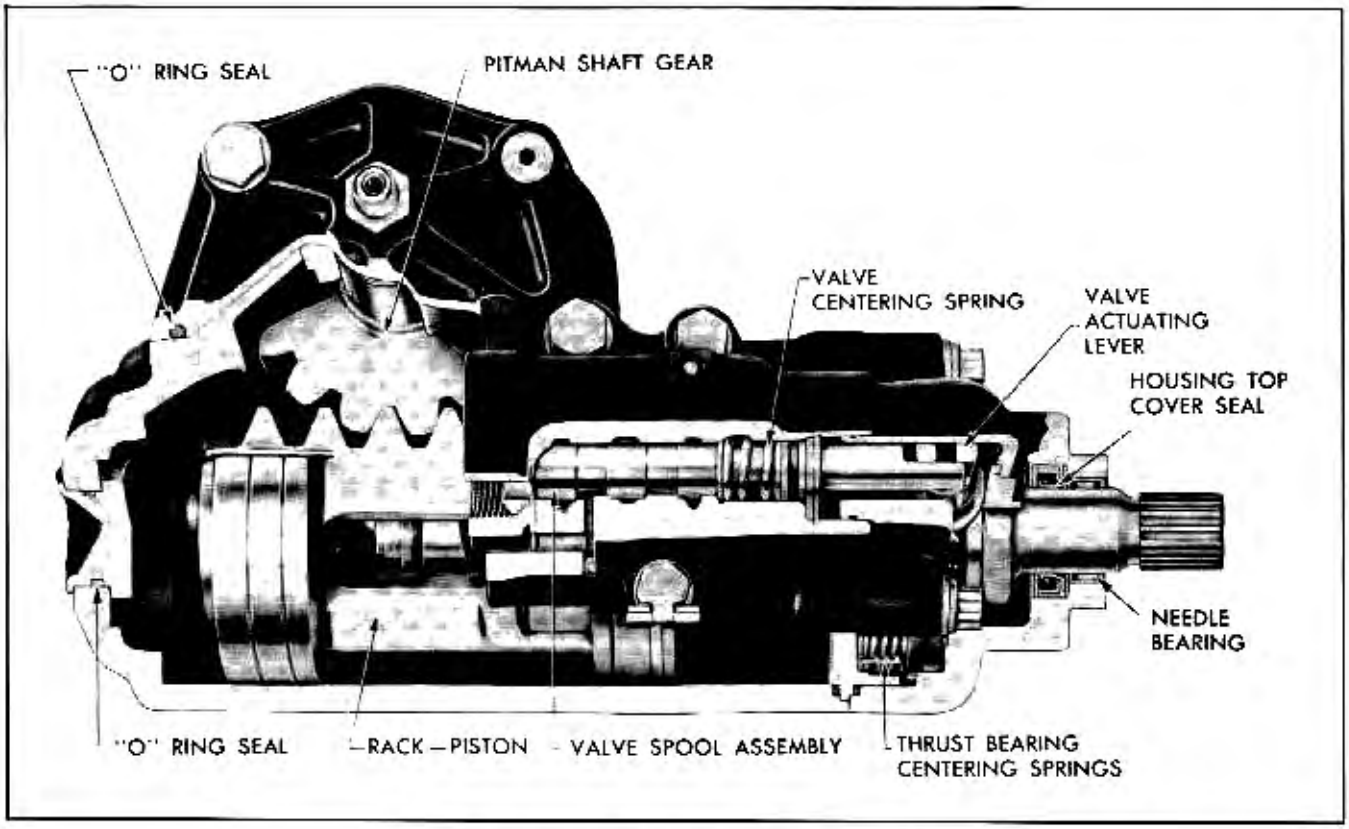


Fig. 9-21 Power Steering Gear Sectional View

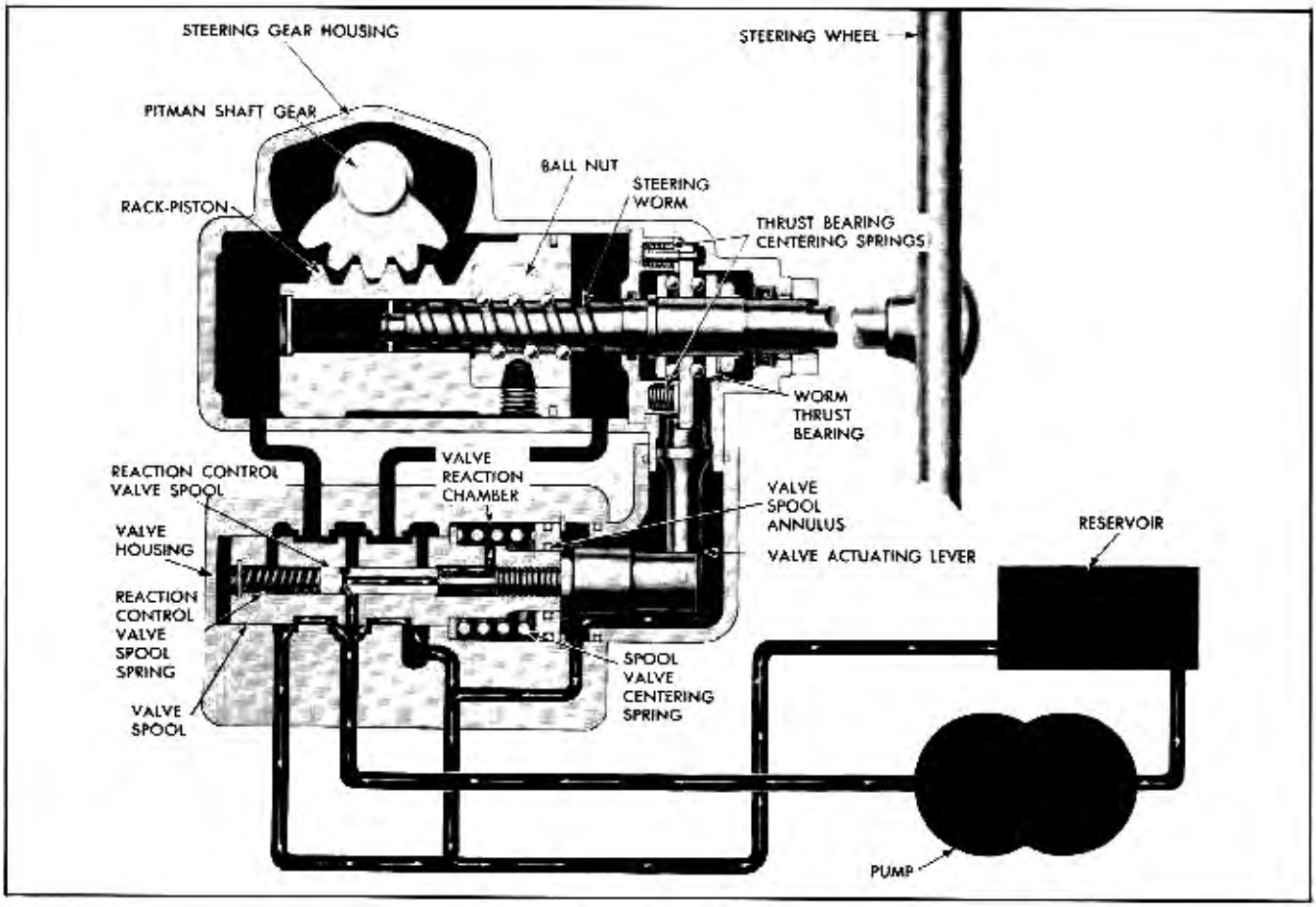


Fig. 9-22 Oil Flow—Straight Ahead Position

DESCRIPTION OF OPERATION OF POWER STEERING

Function of the entire system in the straight-ahead and right turn positions, respectively, is shown schematically in Figs. 9-22 and 9-23. The valve assembly is purposely enlarged to facilitate the explanation of its function. This valve is an open center three way type. The valve spool is held in the neutral position by means of a spool valve centering spring located in the valve reaction chamber, plus the worm thrust bearing centering springs and hydraulic pressure.

A second spool called the reaction control valve spool, is located in the center of the valve spool. The reaction spool establishes the maximum pressure that may build up in the reaction chamber to hydraulically center the valve spool. Limiting the pressure in this manner limits the maximum steering wheel effort, when parking, to a maximum of five lbs.

OIL FLOW IN STRAIGHT-AHEAD POSITION

In neutral or straight-ahead position (Fig. 9-22) the oil flows from the pump, through the open-center valve spool and back to the pump reservoir without circulating in the power cylinder in which the rack-piston is located. Since all passages are open, flow resistance is low in the neutral position, and since the valve remains in this position at all times except when steering in turns, the power required to operate the pump is at the minimum.

The power cylinder is full of oil at all times, although in the straight-ahead position the pressure on both sides of the rack-piston is equal and very low. This oil acts as a cushion that absorbs road shocks so that they are not transferred to the steering wheel, thus giving safer and more effortless driving. In addition, this oil lubricates all internal components of the gear, making it unnecessary to lubricate the gear at any time.

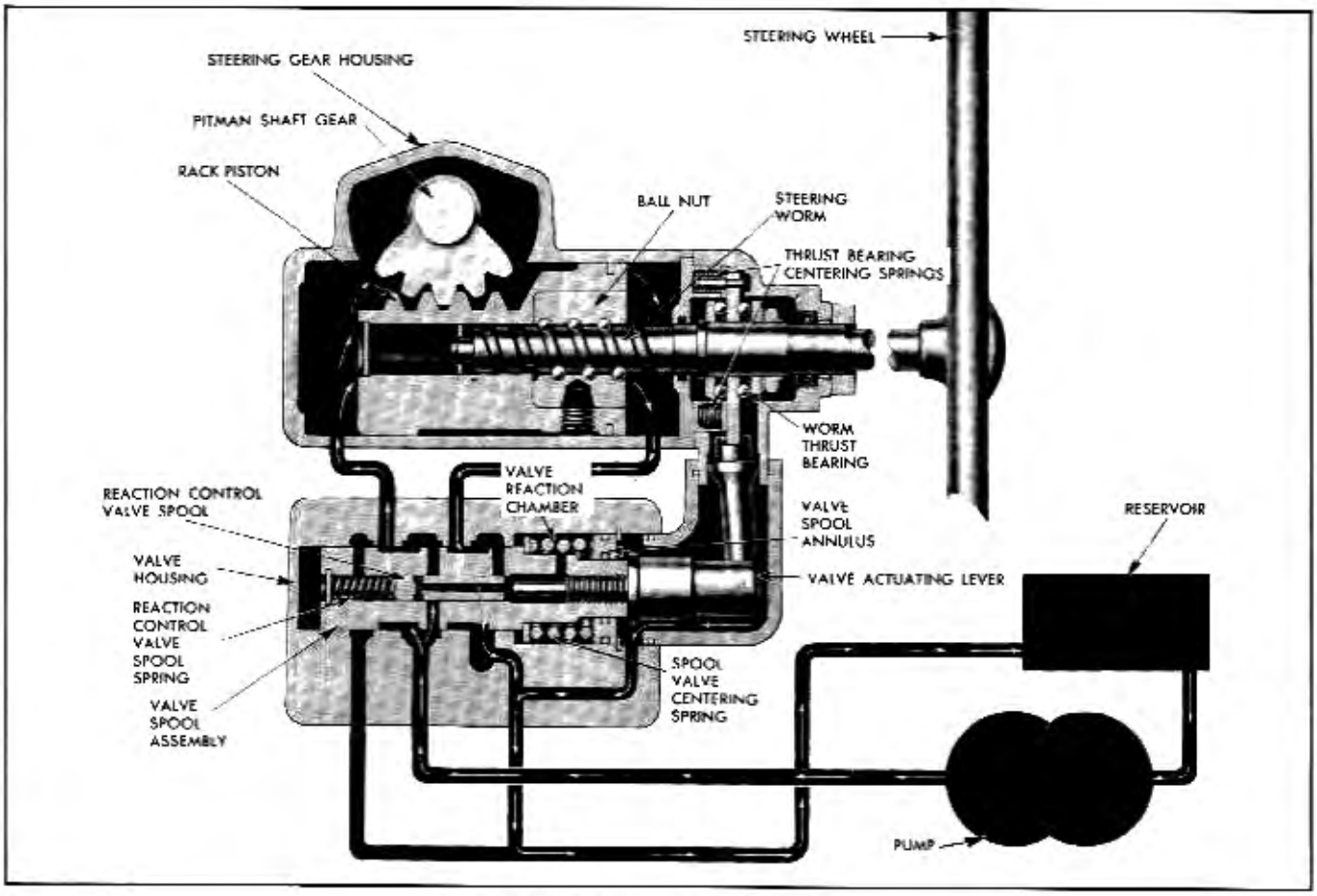


Fig. 9-23 Oil Flow—Right Turn Position

OIL FLOW DURING TURNS

For the purpose of explanation, only right turn will be described (Fig. 9-23). Oil flow and reactions are similar during a left turn except that oil and mechanical movements are in the opposite direction. When the steering wheel is turned to the right, the steering worm tends to screw into the ball nut since the resistance of the wheels on the road tends to prevent the ball nut from moving. Therefore, as the driver applies right turn effort to the steering wheel, the worm is allowed to move downward an imperceptible amount. As the worm moves downward, it also moves the worm thrust bearing downward, which in turn causes the valve actuating lever to move the valve spool upward.

As the spool moves, the relationship between the grooves in the spool and the grooves in the valve housing are changed with respect to each other. As a consequence, the lower spool groove is no longer as fully open to return, but is opened wider to the pressure side of the pump. The upper spool groove is opened more fully to return, but less fully to the pressure side of the pump. This causes the oil to flow into the lower half of the pressure cylinder and forces the rack-piston upward, which in turn applies turning effort to the pitman shaft gear.

Oil in the upper end of the cylinder is simultaneously forced out through the valve and back to the pump reservoir. The higher the resistance to turning between the road and the front wheels, the more the valve spool is displaced and the higher the oil pressure will be on the lower end of the rack-piston. Fig. 9-23 shows the displacement of the valve spool that would occur when the maximum power is required.

Since the amount of valve action and, consequently, the amount of hydraulic pressure built in the cylinder is dependent upon the resistance to turning, the driver is assured of the proper amount of smooth, hydraulic assistance at all times.

OPERATION OF REACTION CONTROL VALVE

Oil is directed through a passage in the valve spool to the reaction control valve spool. The reaction control valve spool spring holds the reaction control valve to the right, allowing pump oil to enter the reaction control valve. The oil then passes through the center of the reaction valve to the reaction chamber (Fig. 9-22). The effect of pressure in the reaction chamber assists the spool valve centering spring in trying to center the spool valve. The higher the pressure the greater the tendency to center the valve and the more effort the driver must apply to the steering wheel to turn the car.

In order to limit the pressure in the reaction chamber, the reaction control valve spool spring is calibrated so that when pressure in the reaction chamber reaches 250 lbs., the reaction spool moves to the left cutting off the entrance of additional oil (Fig. 9-23). If pressure in the reaction chamber exceeds 250 lbs., due to effort on the steering wheel forcing the spool valve farther off center after the reaction spool has closed, the reaction spool moves farther to the left allowing the excess pressure to exhaust through a passage in the spool valve to the pump return passage.

By limiting the pressure in the reaction chamber to a maximum of 250 lbs., the maximum effort required at the steering wheel is limited to approximately 5 lbs.

PERIODIC SERVICE RECOMMENDATIONS

Since the steering gear is lubricated by Type "A" automatic transmission fluid used to operate the unit, it is only necessary to periodically check the fluid level in the pump reservoir.

ADJUSTMENT ON CAR

Before making adjustments to the power steering gear to correct conditions such as, shimmy, hard or loose steering, road shock, wander or weave, a check should be made of front end alignment, shock absorbers, wheel balance, or for tight front wheel bearings, loose steering rod ends or loose pitman arm.

There is only one adjustment of the power steering gear that can be made on the car.

ADJUSTMENT OF LOAD THROUGH CENTER HIGH POINT

1. Disconnect steering connecting rod from pitman arm ball by removing rod end cotter key and plug.

2. Loosen pitman shaft gear lash adjusting screw lock nut. Adjust screw using $\frac{7}{32}$ allen wrench. Pull at steering wheel rim, using spring scale J-5178, should be $1\frac{1}{4}$ to $1\frac{3}{4}$ lbs., through center high point.

3. While holding screw, tighten lock nut to 25 to 30 lb. ft. torque. Recheck by pulling through center high point after lock nut has been tightened.

4. Reassemble connecting rod to pitman arm. Screw in end plug until tight; then back off to align nearest cotter pin hole and insert cotter pin.

MINOR REPAIRS

REMOVAL OF PITMAN SHAFT SEALS WITH GEAR IN CAR

NOTE: Removal of seals can be accomplished with the steering gear in the car using hydraulic pressure to force the seals out of pitman shaft bore as follows:

1. Remove pitman arm retaining nut, lockwasher and pitman arm.

2. Remove pitman shaft seal retaining ring using pliers J-4245.

3. Remove outer back-up washer using screwdriver or similar tool.

4. Place a cloth around housing and pitman shaft to absorb oil leakage from seal bore.

5. With engine running, momentarily turn steering gear to extreme right position for not more than two seconds. This will build up pressure on lower side of piston and in pitman shaft chamber forcing seals and back-up washer out of bore.

6. Turn off engine.

REMOVAL OF POWER STEERING GEAR FROM CAR

REMOVAL OF STEERING GEAR ASSEMBLY

1. Scribe alignment marks on steering shaft and worm shaft flanges (Fig. 9-24).

2. Remove two flange attaching nuts and lockwashers.

3. Disconnect pressure and return hose assemblies from valve body.

4. Remove pitman arm.

5. Remove gear housing to frame bolts.

6. Remove steering gear assembly.

7. Thoroughly clean exterior of steering gear.

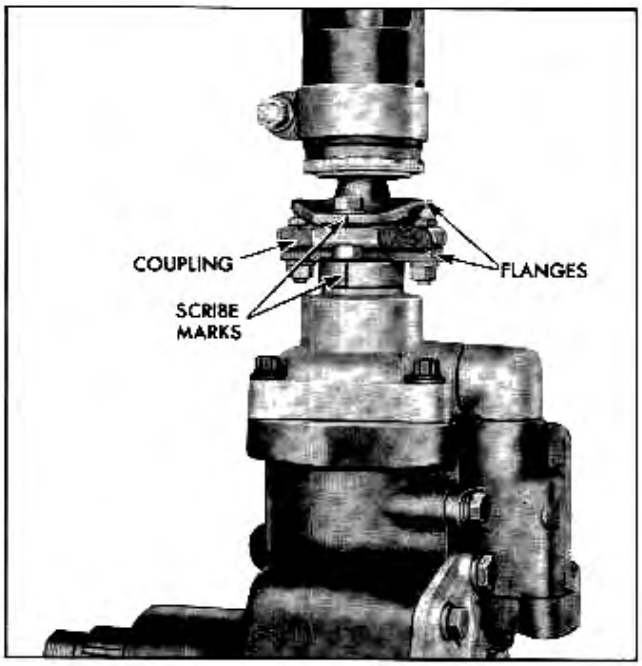


Fig. 9-24 Alignment Marks on Steering Flanges

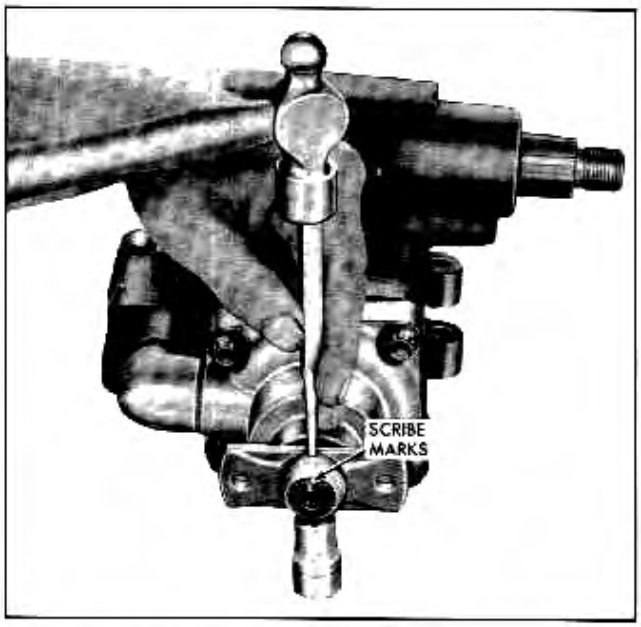


Fig. 9-25 Removing Roll Pin From Flange

POWER STEERING GEAR—OVERHAUL AND ADJUST

GENERAL INFORMATION ON SERVICING POWER STEERING GEAR

Disassembly and reassembly of unit and sub-assemblies must be made on a clean work bench, preferably while the assembly is in a holding fixture. As in repairing any hydraulically operated unit, cleanliness is of utmost importance. Therefore, bench, tools, and parts must be kept clean at all times.

Before disassembly of unit, thoroughly clean exterior with suitable solvent and drain as much fluid as possible.

Assist draining by placing unit with control valve down and turning worm through its entire range two or three times.

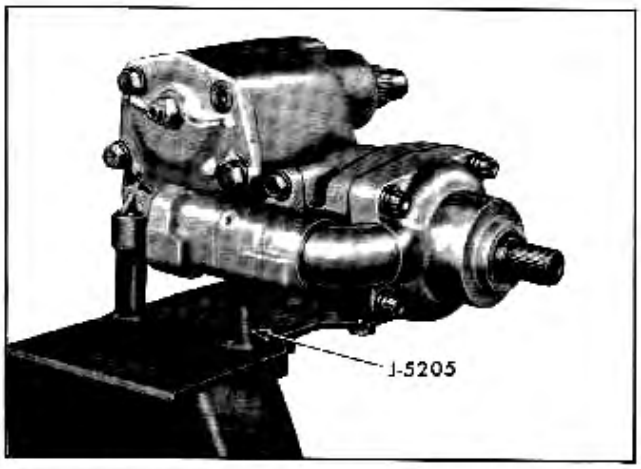


Fig. 9-26 Steering Gear Mounted on Tool J-5205

DISASSEMBLY OF POWER STEERING GEAR

REMOVAL OF WORM SHAFT FLANGE

1. Scribe alignment marks on worm shaft and worm shaft flange.

2. Support worm shaft flange with socket or other suitable tool. Drive roll pin out of flange and shaft. (Fig. 9-25).

3. Remove flange and felt (dust seal).

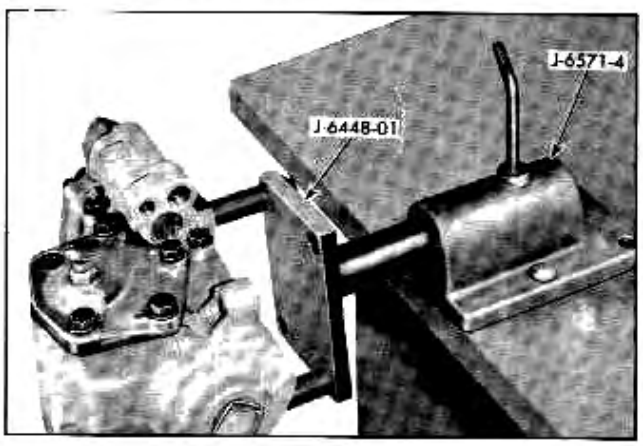


Fig. 9-27 Steering Gear Mounted on Tool J-6448-01

REMOVAL OF VALVE ASSEMBLY FROM STEERING GEAR HOUSING

1. Mount steering gear on holding fixture J-5205 or J-6448-01 (Figs. 9-26 and 9-27). NOTE: If tool J-5205 is available it can be used for 1957 gear by grinding one supporting tube to give required clearance. Tool J-6448-01 is a two-piece tool (see page 9-39) also applicable on some other types of steering gears.

2. Remove valve assembly bolts and washers and lift valve assembly and linkage cover off gear housing (Fig. 9-28).

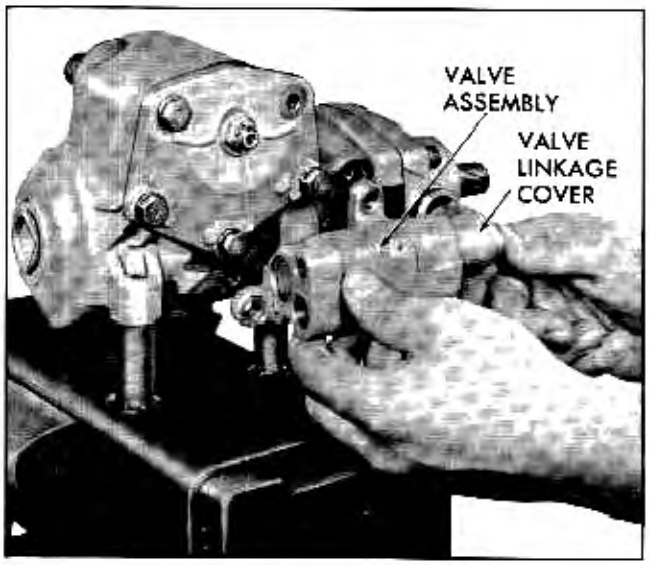


Fig. 9-28 Removing Control Valve and Linkage Cover

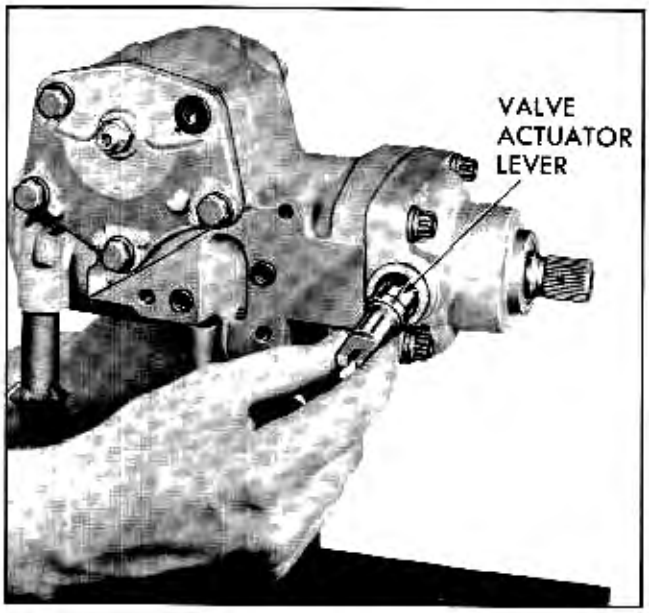


Fig. 9-29 Removing Actuator Lever

3. Remove valve actuator lever from housing top cover (Fig. 9-29).

4. Remove housing top cover to linkage cover "O" ring seal.

5. Remove valve assembly to housing "O" ring seals from housing.

6. Pull linkage cover out of valve body. Remove linkage cover to valve "O" ring seal.

DISASSEMBLY OF VALVE ASSEMBLY

1. Remove retaining ring and annulus retaining washer (Fig. 9-30) using pliers J-4245. NOTE: Pliers can be used more effectively if valve spool assembly is turned to a position so that pivot of pliers can be moved into slot of link.

2. Slide valve spool assembly out of valve body (Fig. 9-31). Care should be taken not to scratch or drop valve spool or body. CAUTION: Valve spool should not be disassembled since it may be distorted when loosening link.

3. Remove retaining ring, end plug and "O" ring (Fig. 9-32) from valve body using pliers J-5403. Remove end plug seal.

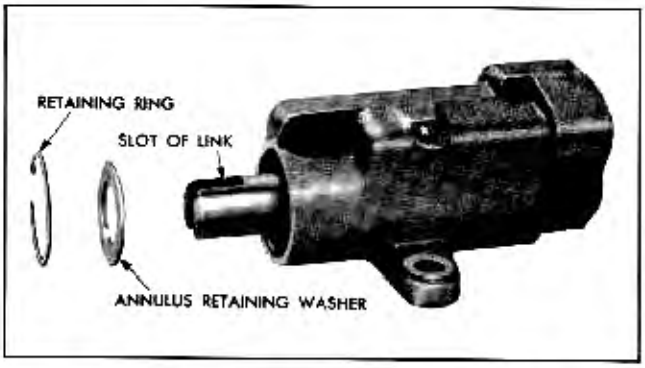


Fig. 9-30 Exploded View—Annulus Retaining Ring and Washer

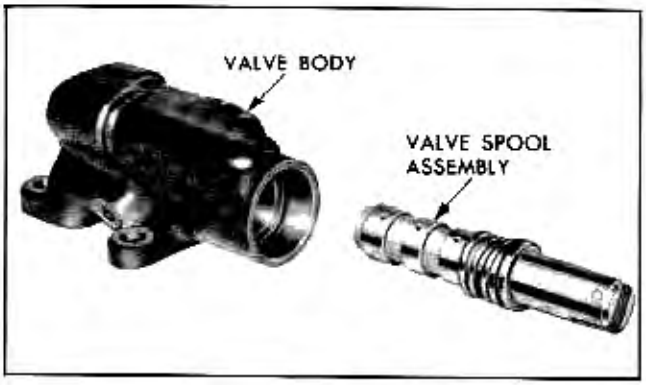


Fig. 9-31 Valve Spool Assembly Removed

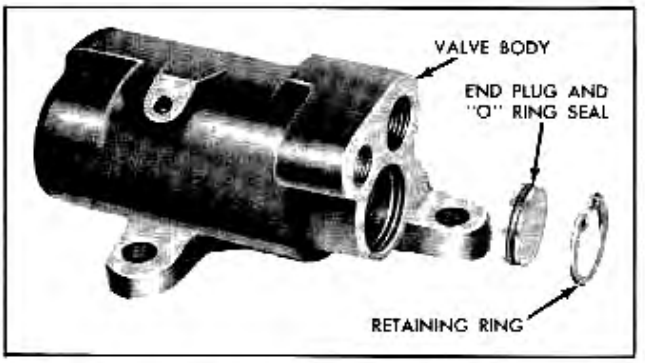


Fig. 9-32 Valve Body End Plug Seal and Retaining Ring

REMOVAL OF PITMAN SHAFT GEAR AND HOUSING SIDE COVER

1. Hold pitman shaft gear adjusting screw with 7/32" allen wrench and remove lock nut.

2. Remove side cover retaining screws and rotate cover one half turn.

3. Align pitman shaft gear with opening in gear housing (Fig. 9-33). Tap end of pitman shaft with a soft hammer and slide shaft out of housing.

DISASSEMBLY OF PITMAN SHAFT GEAR AND HOUSING SIDE COVER

1. Remove "O" ring from housing side cover and discard.

2. Turn adjusting screw out of cover and remove cover. NOTE: Pitman shaft gear and adjusting screw serviced as an assembly. Do not disassemble.

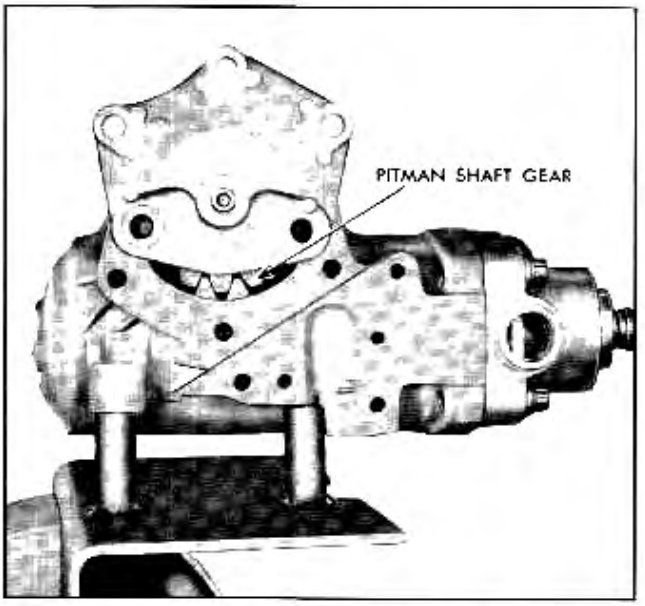


Fig. 9-33 Pitman Shaft Gear Alignment for Removal

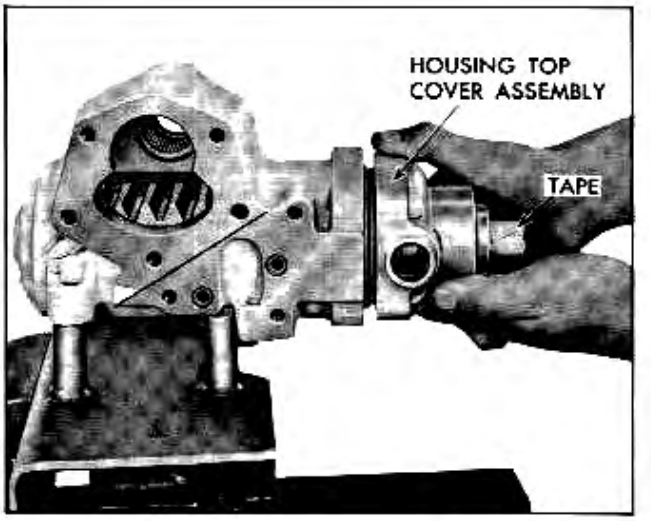


Fig. 9-34 Removing Top Cover from Gear Housing

REMOVAL OF HOUSING TOP COVER

1. Tape splines on end of steering worm to prevent damage to seal.

2. Remove cover bolts and pull assembly off gear housing. (Fig 9-34).

REMOVAL OF RACK-PISTON AND STEERING WORM ASSEMBLY FROM HOUSING

1. Pull rack-piston and steering worm assembly out of housing. (Fig. 9-35).

2. Remove loose thrust bearing centering springs and "O" rings from adapter.

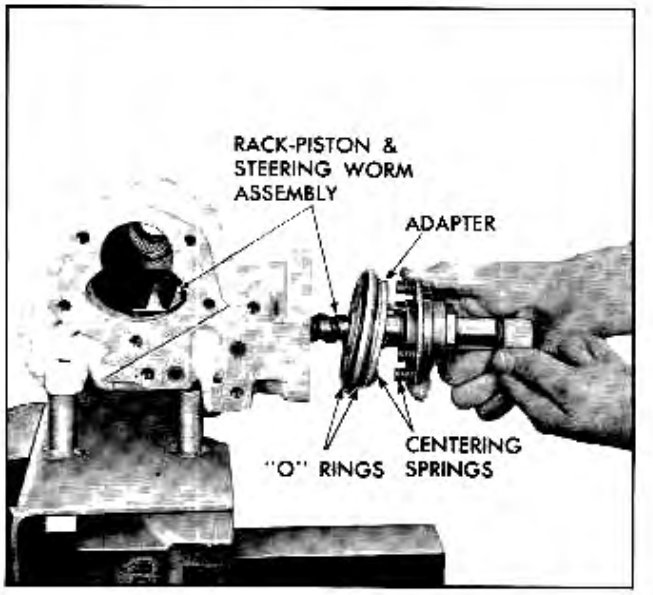


Fig. 9-35 Removing Rack-Piston and Steering Worm Assembly

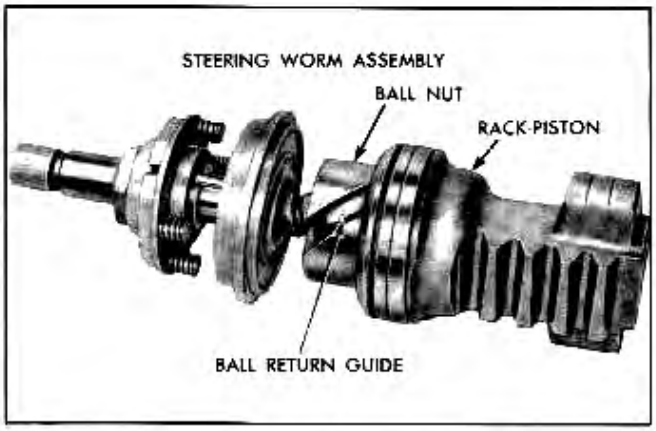


Fig. 9-36 Ball Nut and Steering Worm Assembly Removed from Rack Piston

DISASSEMBLY OF RACK-PISTON AND STEERING WORM ASSEMBLY

1. Remove piston ring from piston.

2. Remove ball nut retaining screw and discard. Slide ball nut and worm assembly out of rack-piston with ball nut retaining screw hole down to prevent ball guide and balls from falling out. (Fig. 9-36) NOTE: If "weld" holding screw in piston interferes with screwdriver, chip to give clearance.

3. Remove ball return guide. Turn nut with ball guide holes downward. Rotate worm back and forth until balls have dropped out. Catch balls in a clean pan or cloth. Remove ball nut and adapter from worm.

4. Remove adapter seal retaining ring, retaining washer, and seal (Fig. 9-37).

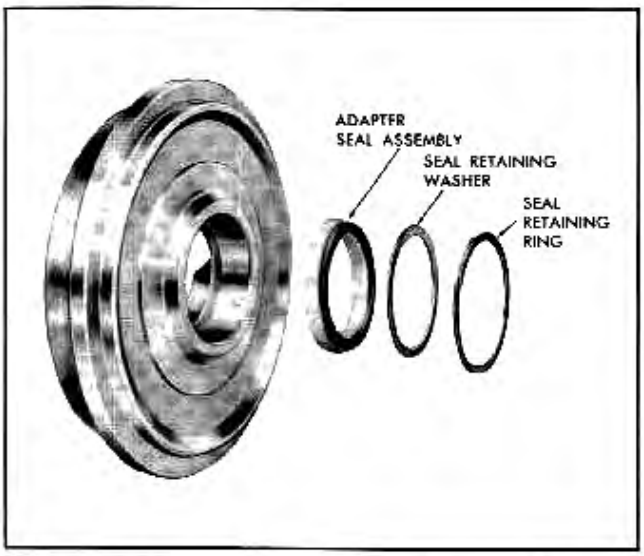


Fig. 9-37 Adapter Assembly—Exploded View

5. Remove seal and related parts from end of steering worm shaft. Push retaining ring, washer and seal toward worm groove and remove retaining ring. Remove washers and seal (Fig. 9-55).

6. If inspection shows worm thrust bearing should be replaced see REPAIRS page 9–18.

DISASSEMBLY OF HOUSING (FIG. 9-38)

1. Remove pitman shaft seal retaining ring using pliers J-4245.

2. Remove seal back-up washer.

3. Remove seal (double lip) by inserting offset screwdriver between seal and back-up washer and prying out of housing (Fig. 9-51).

4. Remove back-up washer.

5. Remove seal (single lip) by inserting offset screwdriver between seal and shoulder in housing and prying seal out of housing. Do not damage housing bore when removing seals. NOTE: If inspection shows pitman shaft needle bearing should be replaced, see REPAIRS page 9–18.

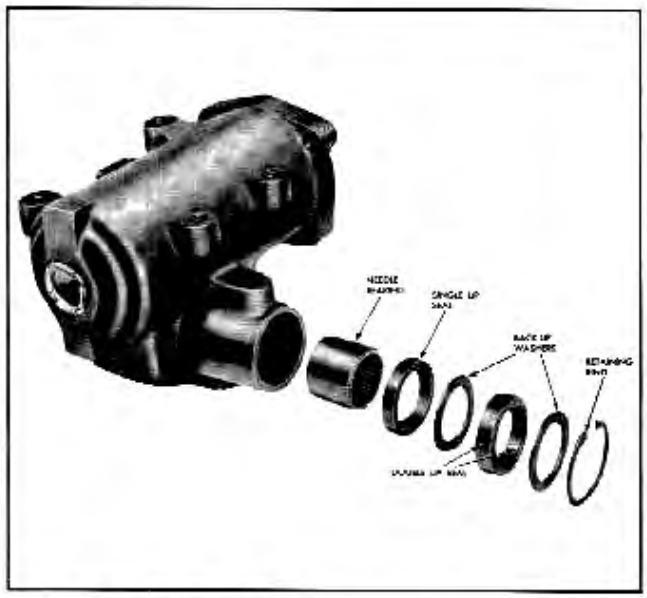


Fig. 9-38 Pitman Shaft Gear Oil Seals and Needle Bearing—Exploded View

CLEANING AND INSPECTION OF POWER STEERING GEAR PARTS

Carefully wash all parts in a suitable cleaning solvent except oil seals and "O" rings which are to be replaced (Fig. 9-49).

INSPECTION OF VALVE BODY AND VALVE SPOOL ASSEMBLY

1. Inspect valve body and valve spool assembly for scores, nicks, and burred edges. If either valve body or spool is damaged, a complete valve assembly must be replaced. Valve body and valve spool assemblies are selectively fitted.

2. Inspect pressure and return line connectors. If badly brinneled or scored, replacement will be necessary. See REPAIRS.

INSPECTION OF PITMAN SHAFT GEAR AND RELATED PARTS

1. Inspect pitman shaft bearing surface in housing side cover for excessive wear or scoring. If worn or scored, replace side cover.

2. Inspect pitman shaft gear teeth and bearing surface, if worn, pitted or scored, replace gear.

3. Inspect lash adjustment screw for excessive end play in pitman shaft. End play should not exceed .002".

INSPECTION OF HOUSING TOP COVER ASSEMBLY

1. Top cover seal should not be removed and replaced unless there was visual evidence of leakage when gear was first removed from car or unless inspection shows damage.

2. Inspect needle bearing. If bearing is damaged, it should be replaced.

NOTE: If oil seal or bearing is to be replaced see REPAIRS.

3. Inspect bushing (in actuator lever bore) for wear. If bushing is worn, replace cover assembly.

INSPECTION OF RACK-PISTON, STEERING WORM, AND BALL NUT

1. Inspect worm and ball nut grooves and all balls for wear or scoring. If either worm or ball nut needs replacing, both must be replaced as a matched assembly, including balls.

2. Inspect ball return guide making sure that ends where balls enter and leave are not damaged.

3. Inspect rack-piston teeth for pitting, wear, and scoring. Inspect all bearing surfaces on rack-piston for scoring. Do not remove rack-piston end plug unless loose. See REPAIRS.

INSPECTION OF WORM THRUST BEARING

1. Inspect thrust bearing for roughness by holding steering worm stationary and rotating bearing. Replace rough bearing. See REPAIRS.

2. Inspect worm thrust bearing centering springs. If any spring riveted to bearing is broken, the bearing assembly must be replaced. If any of the four loose springs are broken or require replacement, replace all four.

3. Test thrust bearing preload. Preload should be between ¾ to 3 lbs. for used thrust bearing and 1¾ to 3 lbs. for new bearing. Measure at outer edge of center bearing through an angle of 90°. Measure bearing preload as follows:

a. Support worm shaft and bearing in flange clamped in vise. (Fig. 9-39).

b. Fasten a cord to one rivet and wind it around center race.

c. Take reading by pulling slowly on scale J-5178 attached to cord.

d. If preload is not within limits see *Replacement of Worm Thrust Bearing and/or Lock Nut.*

INSPECTION OF HOUSING

1. Inspect housing bores and sealing surfaces. If scored or worn, replace housing. Unless there was visual evidence of leakage when gear was first removed from car do not remove the end plug. See REPAIRS.

2. Inspect pitman shaft gear needle bearing. If damaged, replace bearing. See REPAIRS.

REPAIRS

REPLACEMENT OF WORM THRUST BEARING AND/OR LOCK NUT

1. Push staked portion of thrust bearing nut up out of thread grooves, being careful not to damage threads. Remove nut and thrust bearing spring (washer). Discard nut.

2. Use a new thrust bearing if required, with centering springs toward worm. Install preload washer and new nut to obtain ¾ to 3 lbs. pull (Fig. 9-39).

3. After proper preload has been obtained, stake nut into steering worm shaft being careful not to move nut.

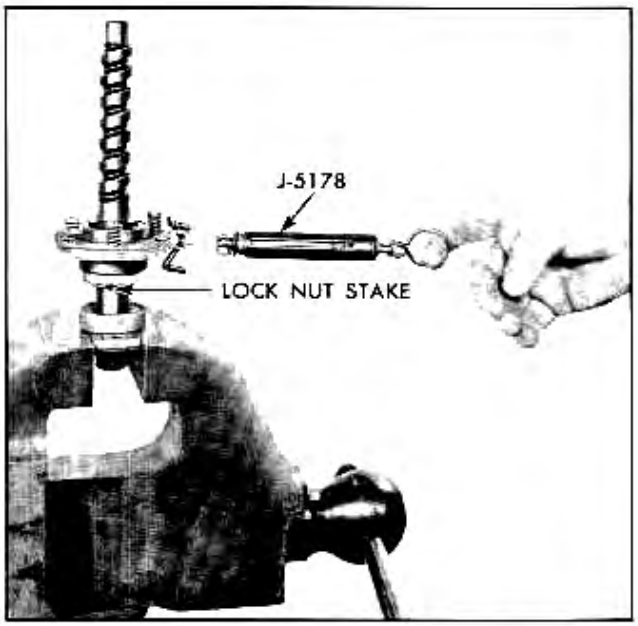


Fig. 9-39 Testing Worm Thrust Bearing Preload

REPLACEMENT OF PRESSURE AND RETURN LINE CONNECTOR

1. Tap threads in holes of large (return) and small (pressure) connectors in valve body using $\frac{5}{16}$-18 tap in the large connector and a 12-24 tap in the small connector.

2. Remove connectors by using bolt threaded into tapped holes with washer and nut as extractor. (Fig. 9-40)

3. Blow out valve body thoroughly to remove any tapping chips.

4. Replace connectors by driving into place with tool J-6217 (Fig. 9-41).

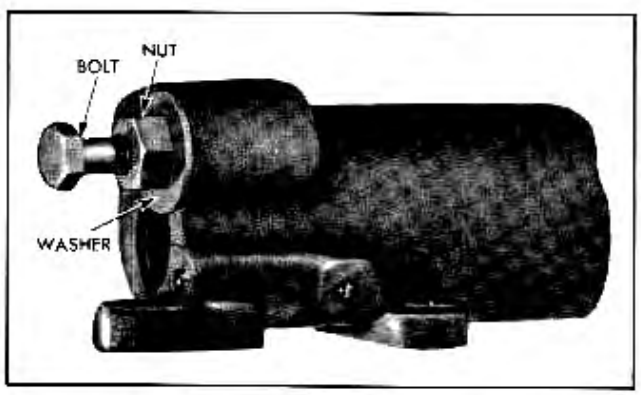


Fig. 9-40 Removing Connector

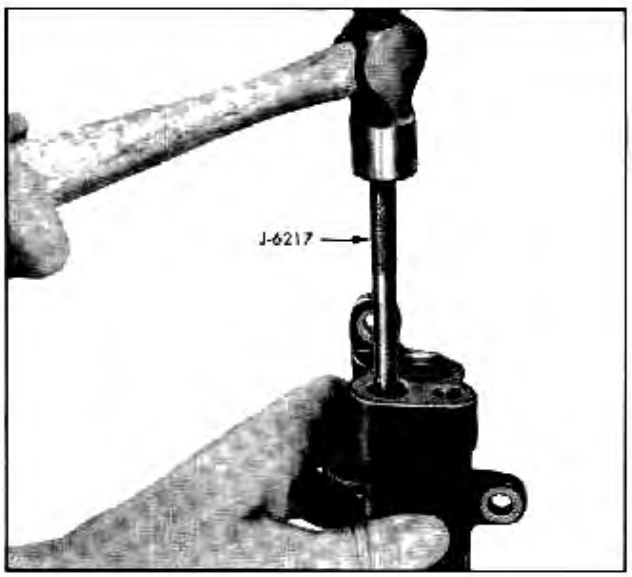


Fig. 9-41 Replacing Connector

REPLACEMENT OF PITMAN SHAFT GEAR NEEDLE BEARING

1. Drive needle bearing out of housing using Remover and Replacer J-6278-1 with adapter J-6278-3 (Fig. 9-42).

2. With stamped end of needle bearing against shoulder of adapter J-6278-3, use Remover and Replacer J-6278-1 to drive needle bearing into bore from outside of housing until flush-to-$\frac{1}{32}$" below shoulder. Make sure needle bearings rotate freely.

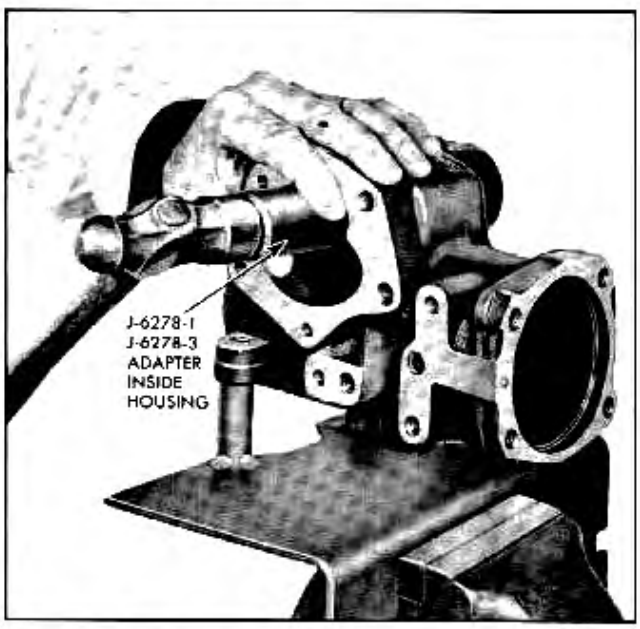


Fig. 9-42 Removing and Replacing Pitman Shaft Needle Bearing

Fig. 9-43 Removing Housing Top Cover Oil Seal

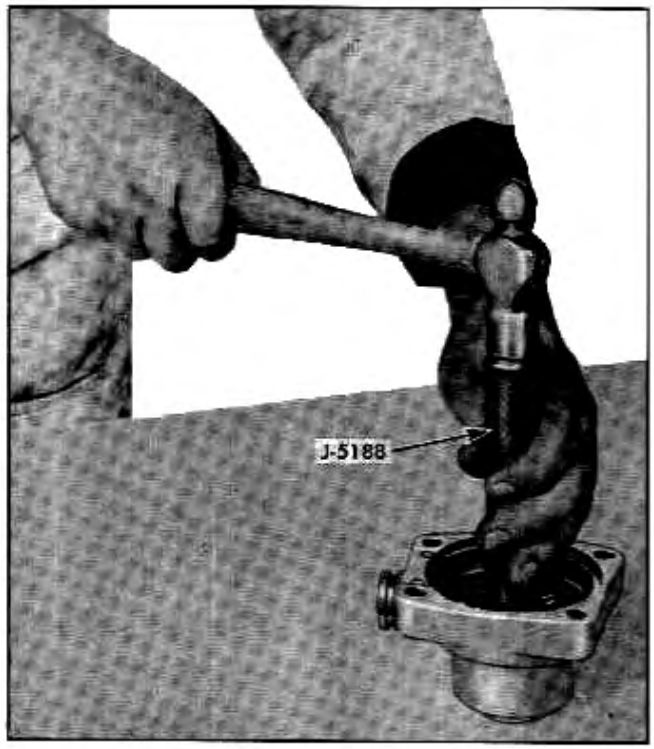


Fig. 9-44 Installing Top Cover Seal or Bearing

REPLACEMENT OF TOP COVER SEAL AND/OR BEARING

Top cover seal may be replaced without replacing bearing. Proceed as follows:

1. Remove seal and back-up washer using a punch in contact with washer and drive away from bearing (toward face of cover) Fig. 9-43.

2. Replace back-up washer in counterbore with chamfered side toward needle bearing. Install seal with lip toward face of cover using tool J-5188 (Fig. 9-44).

If bearing requires replacement, both the bearing and seal should be replaced as follows:

1. Drive out bearing and seal using a punch. Drive toward face of cover (Fig. 9-45).

2. Lubricate needle bearing with wheel bearing lubricant and install in cover. Bearing identification marks must be against shoulder of tool during installation.

3. Install back-up washer and seal as outlined above.

Fig. 9-45 Removing Needle Bearing and Seal from Housing Top Cover

REPLACEMENT OF RACK-PISTON END PLUG

1. Remove rack-piston end plug by driving out from inside of rack-piston using a drift of soft material. NOTE: Care must be taken not to damage inside diameter of rack-piston bore.

2. Replace rack-piston end plug against seat in end of rack-piston. Stake in 3 places spaced evenly. (Fig. 9-46).

REPLACEMENT OF STEERING GEAR HOUSING END PLUG

1. Remove steering gear housing end plug by pushing up or cutting off staked portions and drive plug out of housing using a drift of soft material (Fig. 9-47). NOTE: Care should be taken to prevent scoring sealing diameter in housing.

2. Lubricate seal and install on new end plug. Install plug in housing from inside and drive so that shoulder on plug seats in housing, using drift of soft material.

3. Stake plug lip in 4 places equally spaced, so that plug shoulder is held tightly against housing (Fig. 9-48).

Fig. 9-47 Removing Housing End Plug Staked Portions

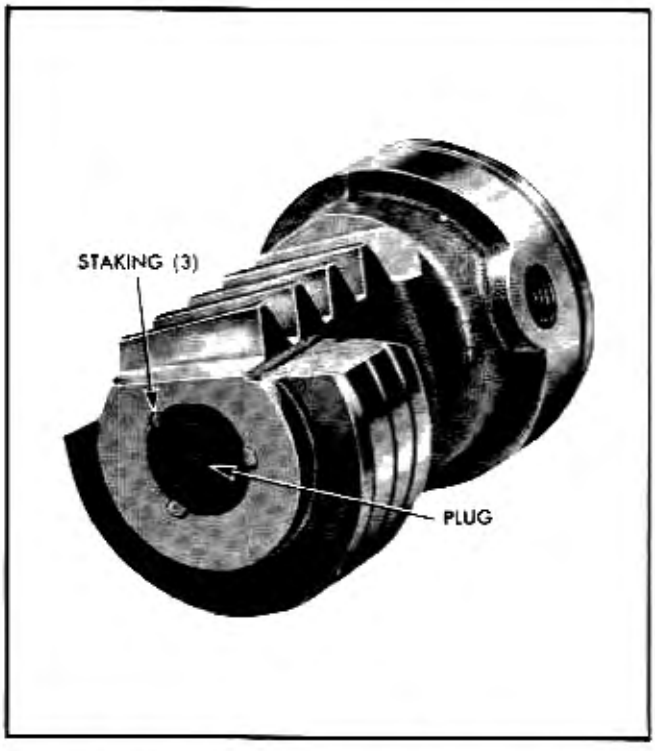


Fig. 9-46 Rack Piston End Plug Staked

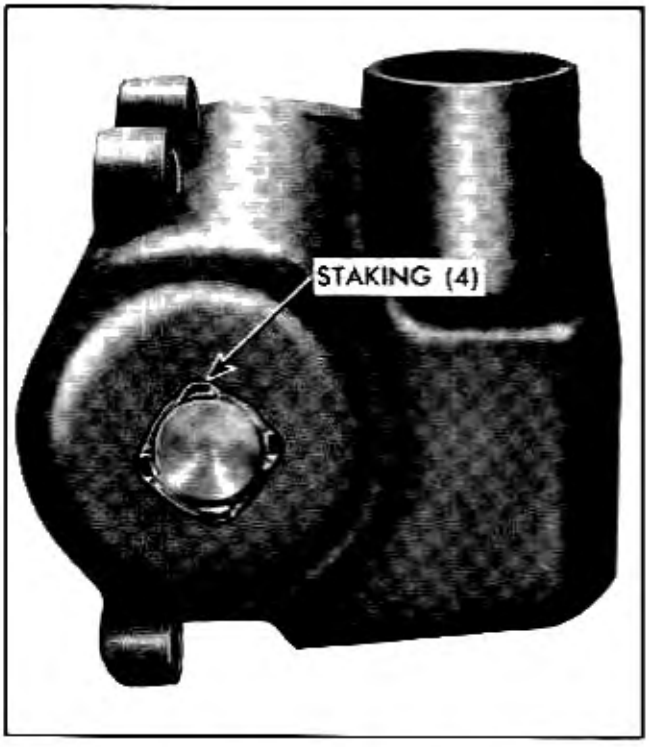
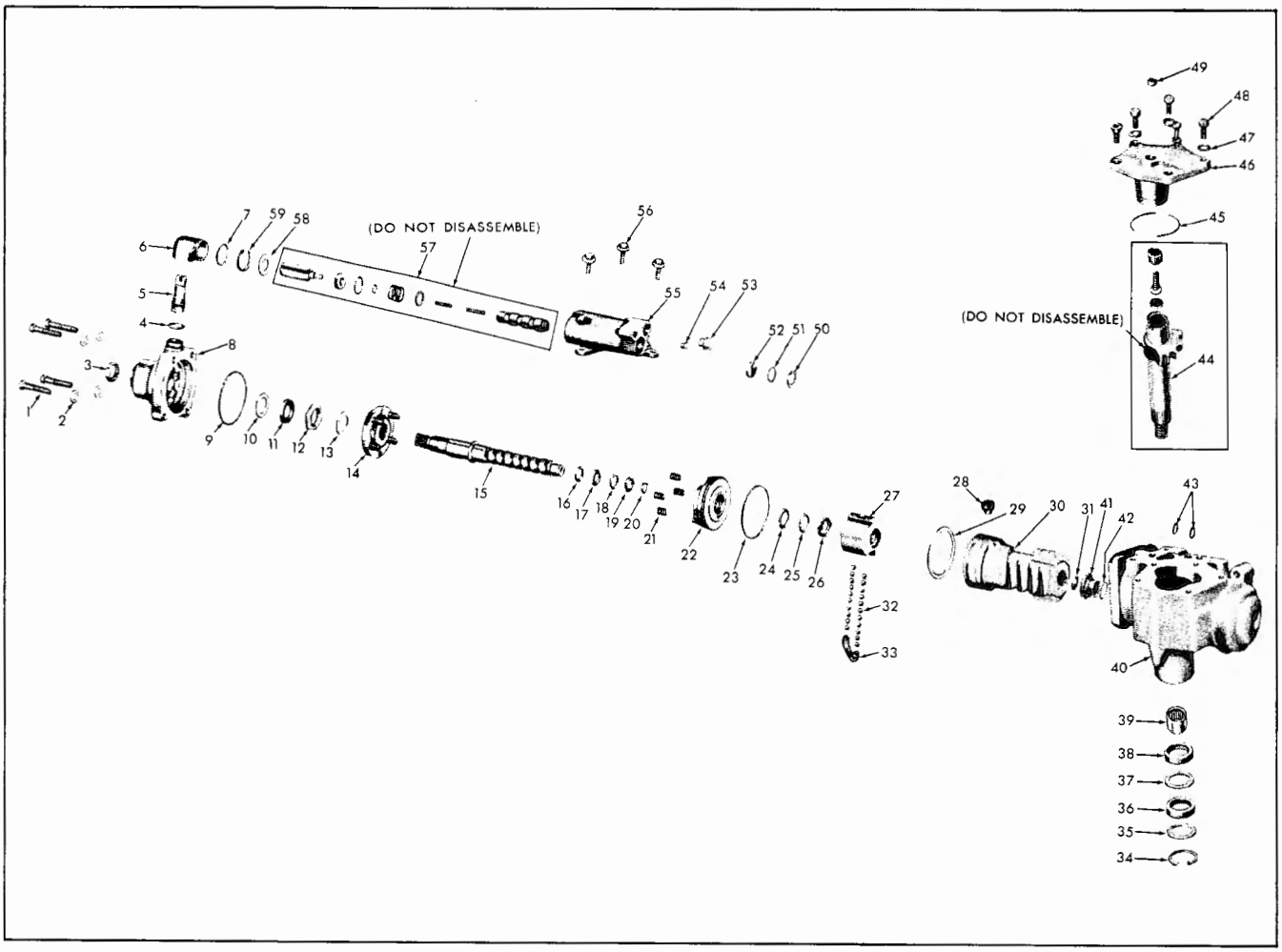


Fig. 9-48 Housing and Plug Staked



1. Housing Top Cover Bolt
2. Housing Top Cover Lock Washer
3. Needle Bearing
4. Housing Top Cover to Link Cover "O" Ring Seal
5. Valve Actuating Lever
6. Valve Linkage Cover
7. Link Cover "O" Ring Seal
8. Housing Top Cover and Bushing Assembly
9. Adapter to Top Cover "O" Ring Seal
10. Seal Back-Up Washer
11. Housing Top Cover Seal
12. Worm Bearing Lock Nut
13. Thrust Bearing Preload Spring
14. Worm Thrust Bearing and Spring Assembly
15. Steering Worm
16. Worm Seal Retaining Washer
17. Worm Seal Assembly
18. Seal Retaining Washer
19. Retaining Ring Washer
20. Washer Retaining Ring
21. Thrust Bearing Centering Springs
22. Adapter
23. Adapter to Housing "O" Ring Seal
24. Adapter Seal Assembly
25. Seal Retaining Washer
26. Retaining Ring
27. Ball Nut
28. Ball Nut Retaining Screw
29. Rack-Piston Ring
30. Rack-Piston
31. End Plug
32. Balls
33. Ball Return Guide
34. Pitman Shaft Seal Retaining Ring
35. Pitman Shaft Back-Up Washer
36. Pitman Shaft Seal (Double Lip)
37. Pitman Shaft Back-Up Washer
38. Pitman Shaft Seal (Single Lip)
39. Pitman Shaft Gear Needle Bearing
40. Steering Gear Housing
41. Housing End Plug "O" Ring Seal
42. Housing End Plug
43. Valve to Housing "O" Ring Seals
44. Pitman Shaft Gear
45. Side Cover to Housing "O" Ring Seal
46. Housing Side Cover
47. Housing Side Cover Lock Washers
48. Housing Side Cover Bolt
49. Lash Adjuster Nut
50. Retaining Ring
51. "O" Ring Seal
52. End Plug
53. Inverted Flare Connector (Return Line)
54. Inverted Flare Connector (Pressure Line)
55. Valve Body
56. Valve Assembly Bolt and Washer
57. Valve Spool Assembly
58. Annulus Retaining Washer
59. Retaining Ring

Fig. 9-49 Power Steering Gear—Exploded View

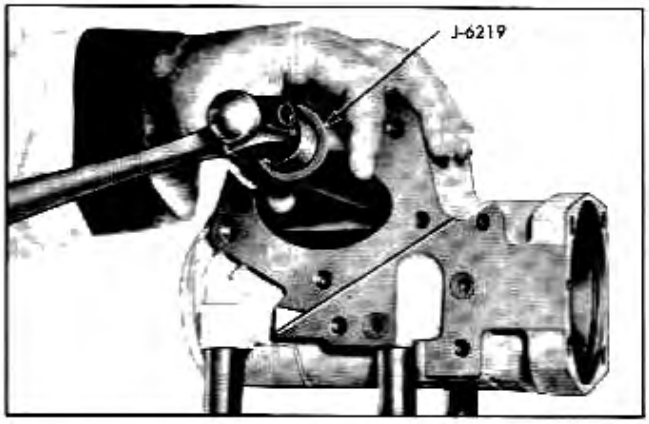


Fig. 9-50 Replacing Pitman Shaft Seals

ASSEMBLY OF POWER STEERING GEAR

NOTE: Lubricate all parts as they are assembled. (See Fig. 9-49—Exploded View.)

ASSEMBLY OF HOUSING

NOTE: Pitman shaft seals should be prelubricated with hydraulic oil before assembly and pitman shaft (double lip) seal should have the cavity between lips thoroughly lubricated with high melting point, water resistant wheel bearing lubricant.

Install pitman shaft seals, back-up washers and retaining ring in housing bore. Use tool J-6219 (Fig. 9-50) for seals and J-4245 for retaining ring. Make sure seal lips are properly positioned, retaining ring is seated, and that approximately 1/16" clearance is maintained (Fig. 9-51).

ASSEMBLY OF RACK-PISTON, STEERING WORM AND BALL NUT

1. Lubricate adapter seal and install seal, retaining washer, and washer retaining ring into adapter. (Fig. 9-37).

2. Assemble adapter to worm, being careful not to damage seal when passing over worm groove. Slide ball nut over worm with chamfered end away from adapter (Fig. 9-52).

3. Align ball return guides with worm groove. Load 17 balls into ball nut. Drop balls into return guide holes farthest from adapter while slowly rotating worm counterclockwise to feed balls through circuit (Fig. 9-53).

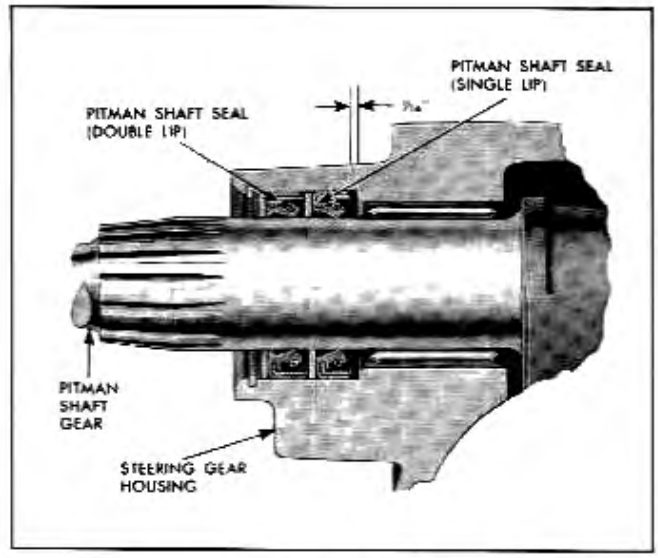


Fig. 9-51 Arrangement of Single and Double Lip Pitman Shaft Seals and Back-up Washers in Housing

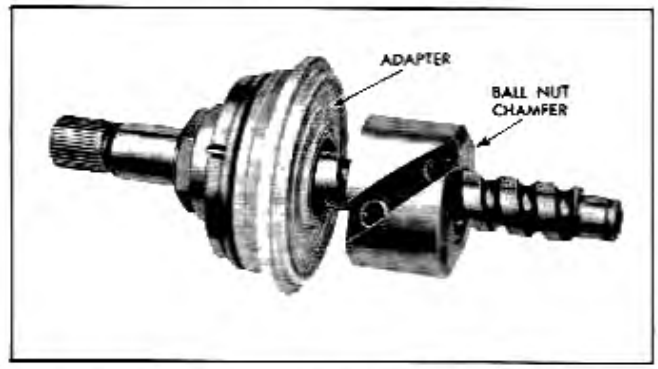


Fig. 9-52 Steering Worm, Ball Nut and Adapter Assembly

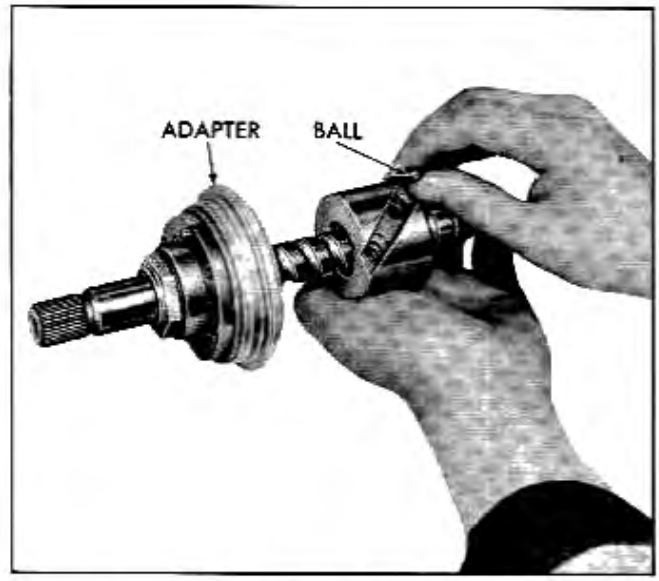


Fig. 9-53 Loading Balls into Ball Nut

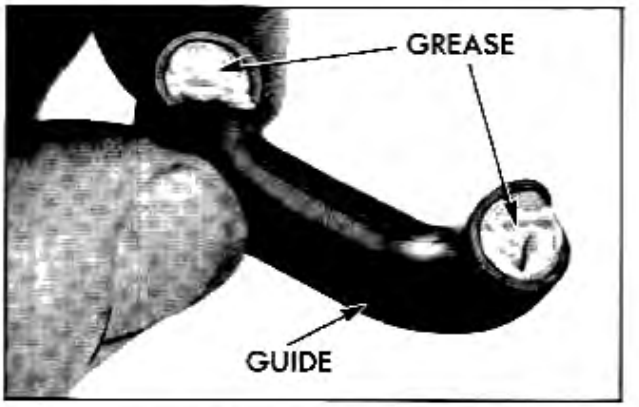


Fig. 9-54 Ball Return Guide

4. Fill one-half of ball return guide with remaining six balls. Place other half of guide over balls and plug ends with grease to prevent balls from falling out when installing guide (Fig. 9-54). Push guide into holes in nut. If guide does not enter easily tap lightly with a soft hammer. Wrap a piece of tape around ball nut and guide (Fig. 9-55).

5. The steering worm groove is ground to provide a "high point" through center. To measure preload, install steering worm flange on worm and clamp in a vise. Fasten a cord to ball nut and wind it around two or three times. Using spring scale J-5178 (Fig. 9-56) pull slowly, unwinding cord and rotating ball nut over "high point". Reading after nut has started to rotate should be between 2 and 6 lbs. If preload is below 2 lbs., install set of next larger balls and recheck (See table). If preload is over 6 lbs., install next smaller size balls and recheck. Original assembly (Except ball code No. 7) is marked on outer diameter of ball nut. Due to wear or use of new parts, it is sometimes necessary to use a size different than indicated.

TABLE OF SELECTIVE SIZES OF STEERING NUT BALLS

1	.28077"	5684001
2	.28085"	5684002
3	.28093"	5684003
4	.28101"	5684004
5	.28109"	5684005
6	.28117"	5684006
7	.28125"	5684007
8	.28133"	5684008
9	.28141"	5684009
10	.28149"	5684010
11	.28157"	5684011
12	.28165"	5684012
13	.28173"	5684013

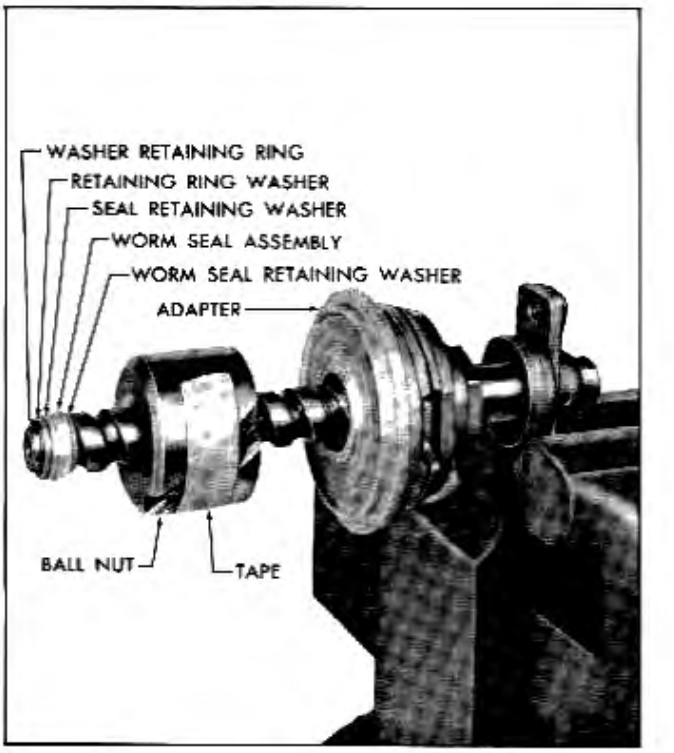


Fig. 9-55 Steering Worm, Seal and Washers Installed

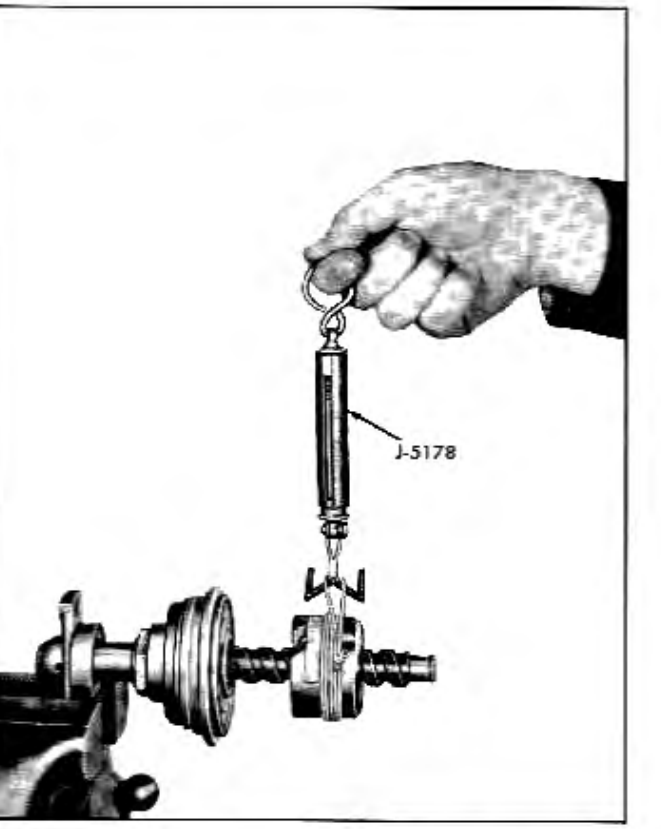


Fig. 9-56 Measuring Preload of Ball Nut Using Spring Scale J-5178

6. Install worm seal retaining washer (steel), seal (with rubber toward ball nut) retainer washer; (bronze) retaining ring washer (with ring relief toward worm) and retaining ring (Fig. 9-55).

7. Install Teflon ring on rack-piston.

8. Clean up threads in hole in rack-piston using 5/8"-18 tap.

9. Lubricate steering worm seal, remove tape from ball nut, and install ball nut in rack-piston being careful not to damage worm seal.

10. Install new ball nut retaining screw and tighten to 30-35 lbs. ft. torque using tool J-6223. Stake screw securely into place using tool J-6285. (Fig. 9-57).

NOTE: Be sure machined surface does not contact vise when staking retaining screw.

ASSEMBLY OF PITMAN SHAFT AND SIDE COVER

1. Assemble housing side cover on pitman shaft gear. Screw lash adjuster through side cover until cover bottoms on pitman shaft gear. Lubricate housing side cover "O" ring seal (large) and install in groove in face of cover.

2. Install lash adjuster nut while holding a screw with 7/32" allen wrench.

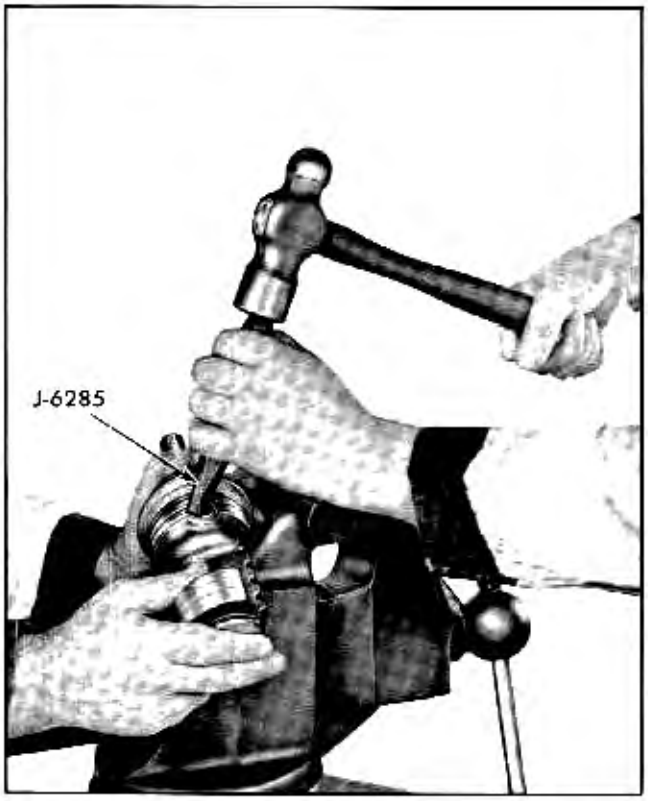


Fig. 9-57 Staking Ball Nut Retaining Screw

ASSEMBLY OF VALVE ASSEMBLY

1. Carefully insert valve spool assembly into valve body. Valve spool and body are selectively fitted and have very little clearance. Only if properly started can spool be inserted in valve body (Fig. 9-58). NOTE: Do not attempt to force spool into body.

2. Install annulus retaining washer and retaining ring making certain that ring is properly seated.

3. Lubricate valve body end plug "O" ring seal. Install plug and seal in body.

4. Install retaining ring, making certain that ring is properly seated.

REPLACEMENT OF RACK-PISTON, STEERING WORM, AND BALL NUT IN HOUSING

1. Lubricate 2 large "O" rings and install on adapter (Fig. 9-59).

2. Install ring compressor tool J-6216 to compress piston ring (Teflon) and hold tool tightly against shoulder of housing. Push rack-piston assembly into housing until ring is inside cylinder bore.

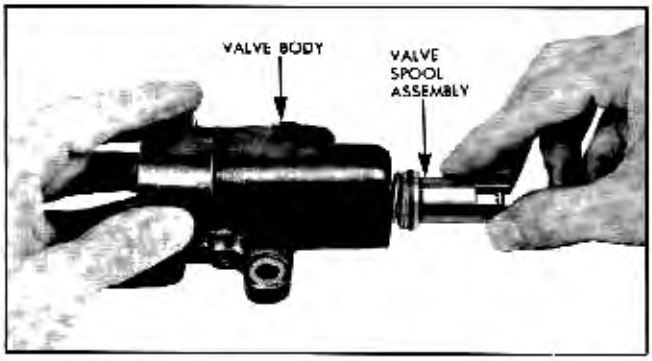


Fig. 9-58 Valve Spool Assembly Started in Valve Body

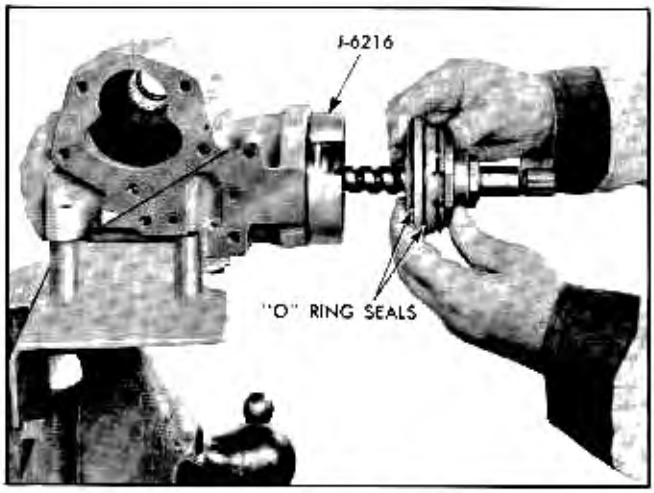


Fig. 9-59 Replacing Rack-Piston

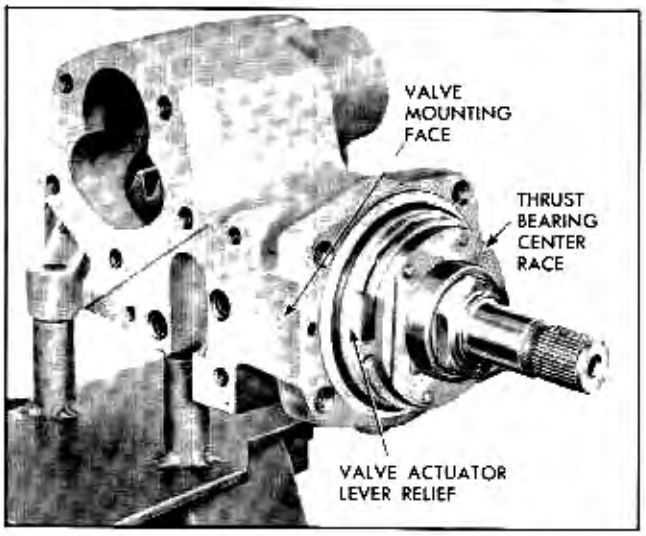


Fig. 9-60 Valve Actuator Lever Relief Alignment

3. Remove ring compressor. If more clearance is needed to remove tool, screw steering worm back out of nut.

4. Align valve actuator lever relief on adapter with valve assembly mounting face on housing. (Fig. 9-60).

REPLACEMENT OF HOUSING TOP COVER ASSEMBLY ON HOUSING

1. Tape serrations on worm shaft to protect seal in top cover.

2. Assemble top cover over worm and adapter. Align cover and install bolts and lock washers. Tighten to 25-30 lbs. ft. torque.

3. Lubricate and install top cover to linkage cover "O" ring seal.

4. Install valve actuator lever in cover making certain that it is seated over thrust bearing center race. Lever should enter freely into cover bushing.

REPLACEMENT OF PITMAN SHAFT GEAR AND RELATED PARTS

1. Turn steering worm until center groove of rack-piston is aligned with center of pitman shaft needle bearing (Fig. 9-61). Tape serrations of pitman shaft before installing to protect oil seals.

2. Install pitman shaft gear so that the center tooth meshes with the center groove of rack-piston. Make sure that side cover "O" ring seal is in place before pushing cover against housing.

3. Install four $\frac{3}{8}$" and one $\frac{5}{16}$" cover screws finger tight. Tighten flat head screw first. Tighten all $\frac{3}{8}$" screws to 25-30 lb. ft. torque and the $\frac{5}{16}$" screw to 15-20 lb. ft. torque.

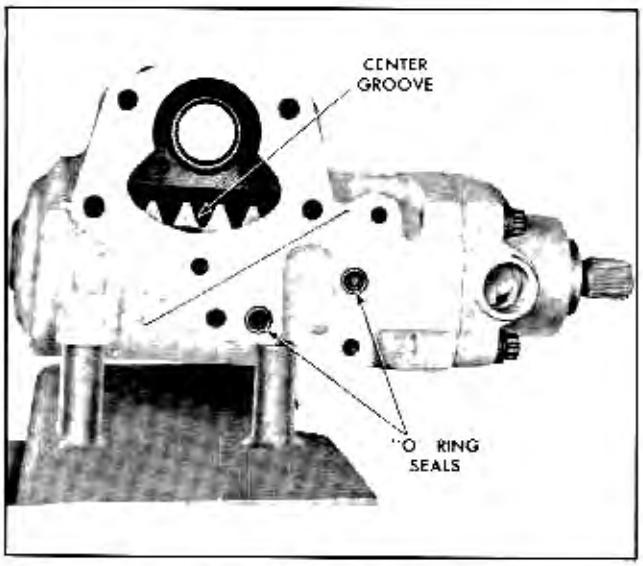


Fig. 9-61 Rack-Piston Centered

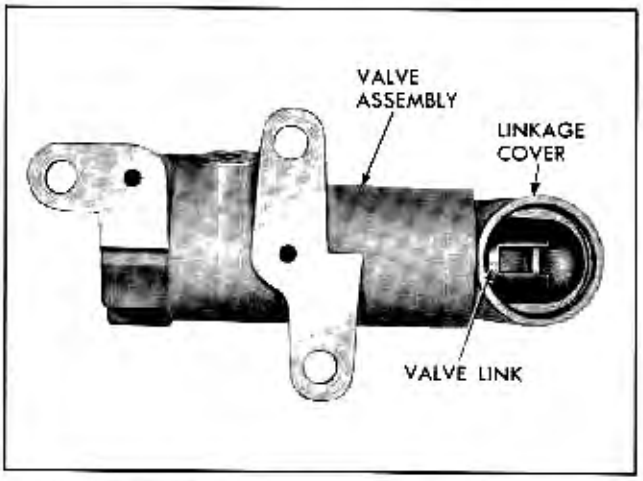


Fig. 9-62 Valve Assembly and Linkage Cover

REPLACEMENT OF VALVE ASSEMBLY ON HOUSING

1. Lubricate valve linkage cover "O" ring seal and install on linkage cover and assemble to control valve. Position valve link so that slot is perpendicular with bottom of valve assembly (Fig. 9-62).

2. Lubricate housing valve port "O" ring seals and assemble to housing (Fig. 9-61).

3. Position valve and valve linkage cover on gear housing and top cover. Start the valve actuator lever into link slot and then push on linkage cover until valve assembly is seated on housing.

4. Install valve assembly retaining screws and finger tighten uniformly. Turn the steering worm to the extreme right or left several times allowing the valve assembly to center itself.

5. Tighten valve assembly retaining screws 15-20 lb. ft. torque starting with the screw nearest the gear mounting lugs first, and the screw on the opposite side of the valve assembly next, and the screw on the lower end of the valve assembly last.

ASSEMBLY OF WORM SHAFT FLANGE

1. After steering gear has been assembled, lubricate new flange felt and install in flange with cloth backing toward housing top cover.

2. Align scribe marks on worm shaft and flange and install flange.

3. With flange pin hole indexed with hole in worm shaft, support flange as in Fig. 9-25 and drive new flange roll pin into flange and worm shaft flush with hub.

ADJUSTMENT OF LOAD THROUGH CENTER HIGH POINT

After steering gear is completely assembled find center or straight-ahead position of worm by rotating worm to full right turn and then reversing approximately two turns. Using adapter J-6281 and spring scale J-5178 (Fig. 9-63) adjust lash adjusting screw so pull on spring scale is between 1¾ to 1¾ lbs. through center high point when rotating worm shaft through an arc of approximately 30°. Tighten lash adjusting screw lock nut to 25-30 lb. ft. torque. Recheck preload after lock nut has been tightened.

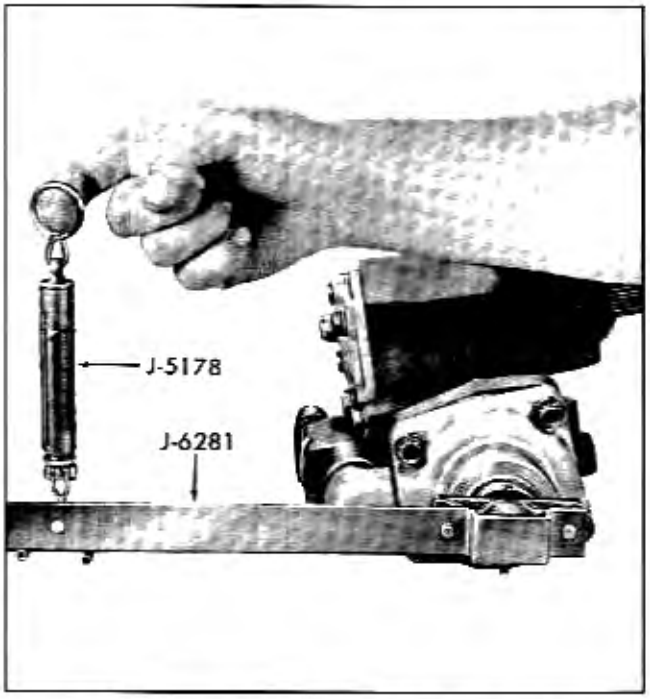


Fig. 9-63 Testing Load Through Center High Point

INSTALLATION OF POWER STEERING GEAR IN CAR

1. Position steering gear assembly in car. NOTE: If same gear housing, replace shims that were removed in same position between housing and frame. If steering gear has new housing, shims should be selected for proper alignment of steering gear and steering column assembly.

2. Install steering housing to frame bolts finger tight. Shift gear assembly to obtain best alignment with flange on steering shaft. Tighten housing to frame bolts to 23-28 lb. ft. torque.

3. Install pitman arm and secure with lockwasher and nut. Tighten nut to 100-125 lb. ft. torque.

4. Connect pressure and return hose assemblies to valve body.

5. Align scribe marks on steering shaft and worm shaft flange (Fig. 9-64).

6. Install two flange attaching nuts and lockwashers and tighten to 15 20 lb. ft. torque.

7. Align steering column jacket and shaft assembly and steering gear so head of lower coupling bolt has ¼ inch clearance from flange on steering shaft. This can be accomplished by shifting either the steering gear assembly or the steering mast jack assembly up or down.

8. Check fluid level in pump reservoir. Fluid should be up to oil level mark in reservoir. If not, add Hydra-Matic fluid or Automatic transmission fluid Type A identified by an AQ-ATF qualification number. With front wheels off floor start engine and bleed hydraulic system by manually steering through cycle several times until there is no evidence of air bubbles in reservoir. Recheck fluid level.

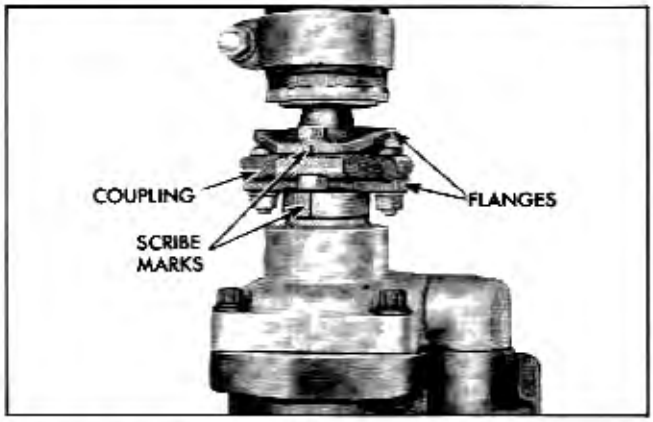


Fig. 9-64 Alignment Marks on Steering Flanges

IN-LINE POWER STEERING
VANE TYPE PUMP

GENERAL DESCRIPTION

The power steering gear pump is mounted on the engine in position to be driven by a belt from the crankshaft pulley. The pump components are explained in the following paragraphs.

The pump body is the intake or low pressure side of the pump and houses two bearings, drive shaft and seal. The pump body is directly connected to the pump reservoir through an opening at the top. The face of the pump body has two kidney shaped slots which function as intake ports.

The pump ring is a flat plate with a cam surface opening. The ring is located next to face of pump body by two dowel pins (Figs. 9-65 and 9-74).

The pressure plate contains four kidney shaped openings, two for intake and two for discharge. It is located next to pump ring by the same dowel pins which locate the pump ring.

The pump cover also is located next to the pump ring and encircles the pressure plate. It is located by four bolts which hold the pump together. The cover also houses the flow control valve and spring and is provided with the pressure fitting for the external circuit (Fig. 9-66).

The reservoir provides oil storage space and a means of directing return oil back to intake side of the pump.

The drive shaft is belt-driven by the crankshaft at a 1.31 ratio to engine r.p.m.

The pump rotor is loosely splined to the end of the drive shaft and is located next to face of pump body and encircled by the pump ring. It contains ten vanes freely mounted in radial positions (Fig. 9-68).

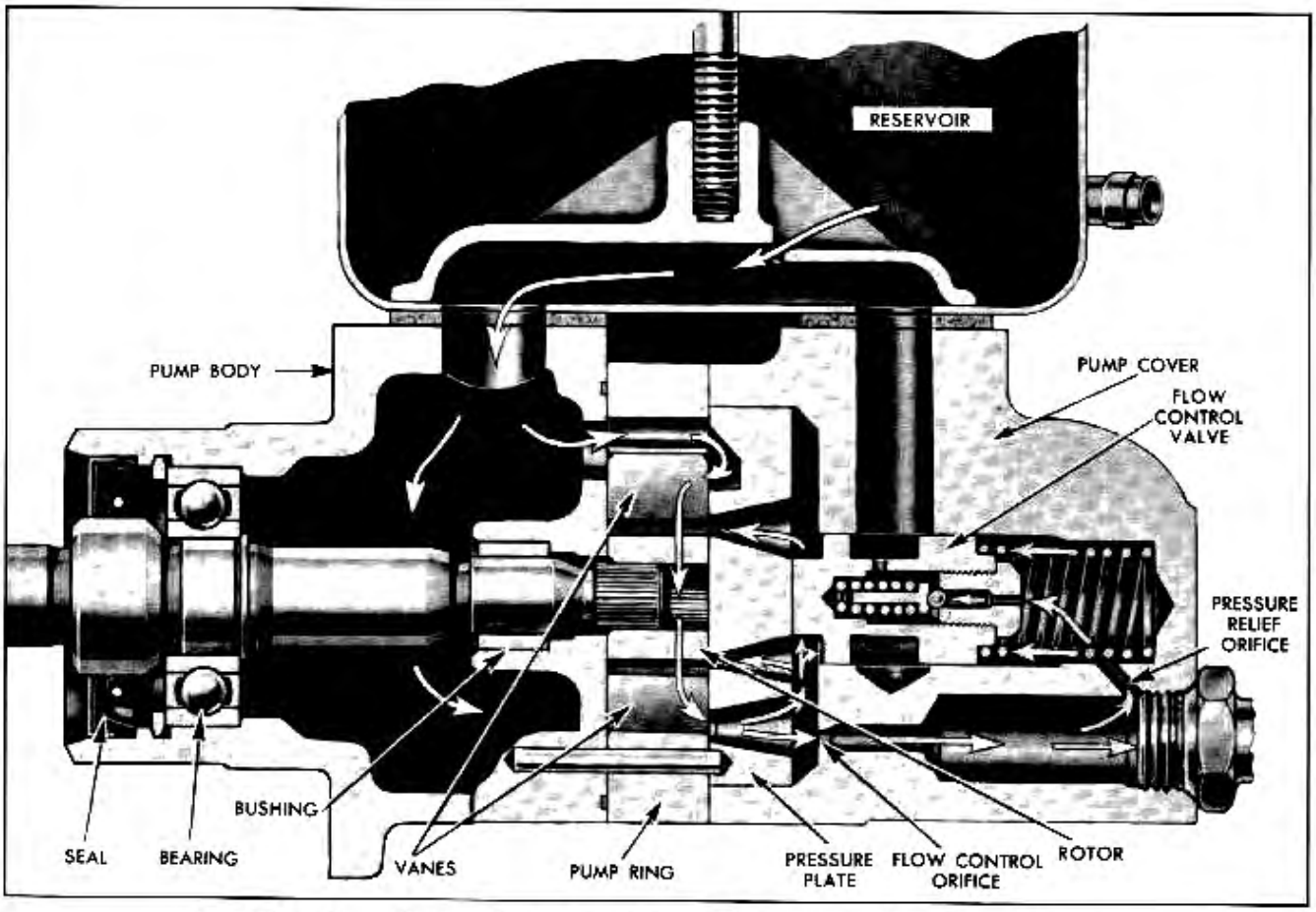


Fig. 9-65 Power Steering Pump, Low Speed During a Partial Turn—Schematic View

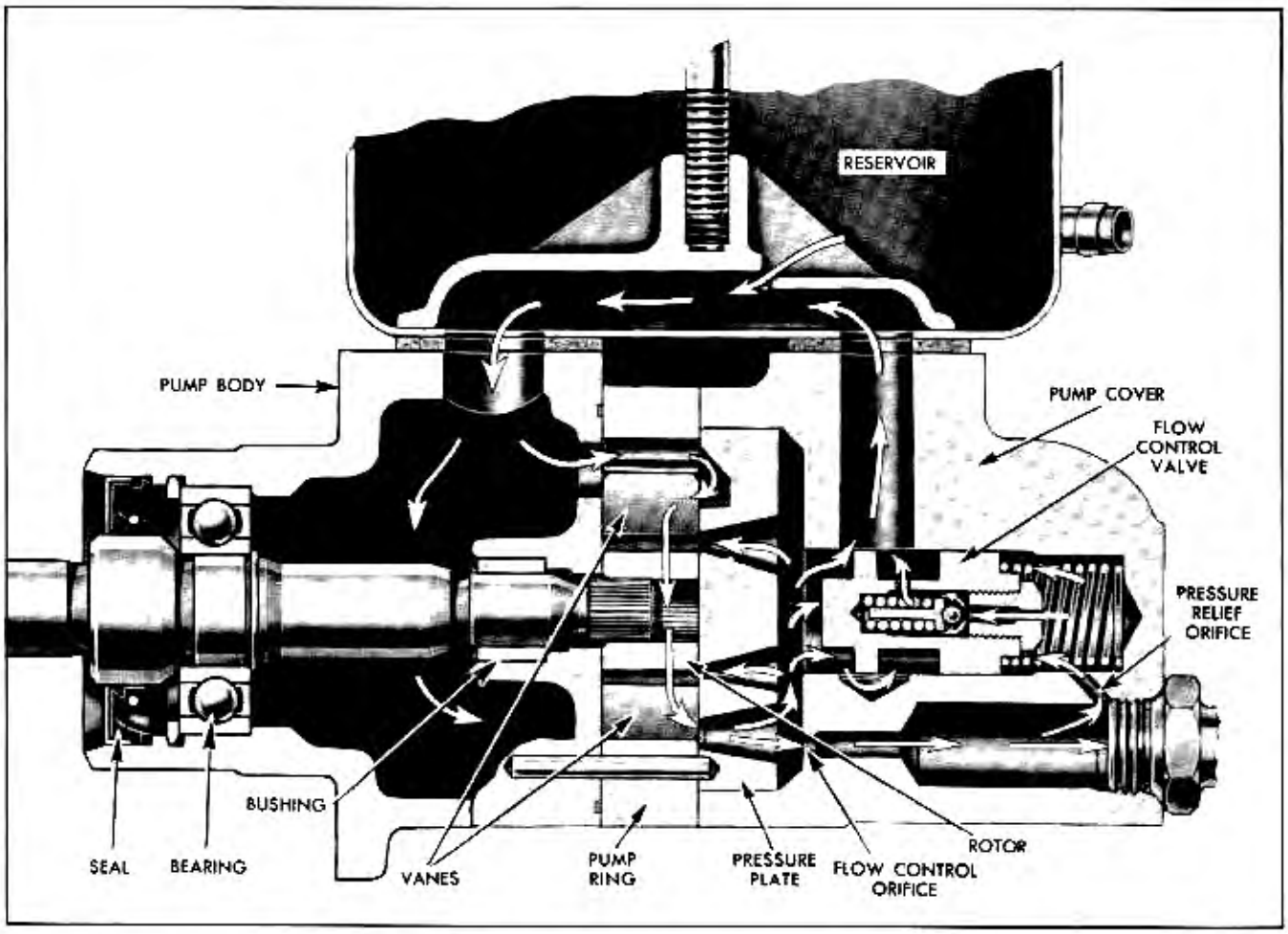


Fig. 9-66 Power Steering Pump. Steering Wheel Turned Against Resistance - Schematic View

DESCRIPTION OF OPERATION OF VANE TYPE OIL PUMP

As the drive shaft rotates the rotor, the vanes follow the cam surface machined in the pump ring. This cam consists of two rising and two falling areas, and, therefore, a complete pumping cycle occurs every 180° (Fig. 9-68).

The spaces between vanes pick up oil on rising portions of cam from two kidney shaped slots in pump body and two in pressure plate. Feeding of kidney shaped slots in pressure plate is accomplished by cross-over holes in pump ring. This oil is then discharged on falling portion of cam through two other kidney shaped openings in pressure plate only. The oil passes through pressure plate into the cavity behind it. A portion of this oil is directed back through other passages in pressure plate so that it may enter behind the vanes forcing them to follow cam surface of pump ring (Fig. 9-68).

The remainder of discharged oil up to 2.2 gallons per minute passes through an orifice in pump cover and circulates through the control valve on steering gear and back to reservoir. This orifice is so calibrated that any flow in excess of 2.2 gallons per minute will cause a pressure rise large enough to force the flow control valve back against the spring pressure of flow control spring. This causes excess oil flow to pass into return passage where it joins oil returning from external circuit and passes through reservoir plate into intake side of the pump.

When circulation of oil is restricted by movement of the control valve on the steering gear, pressure becomes equal on both sides of the orifice and the flow control valve closes allowing pressure to build up as required.

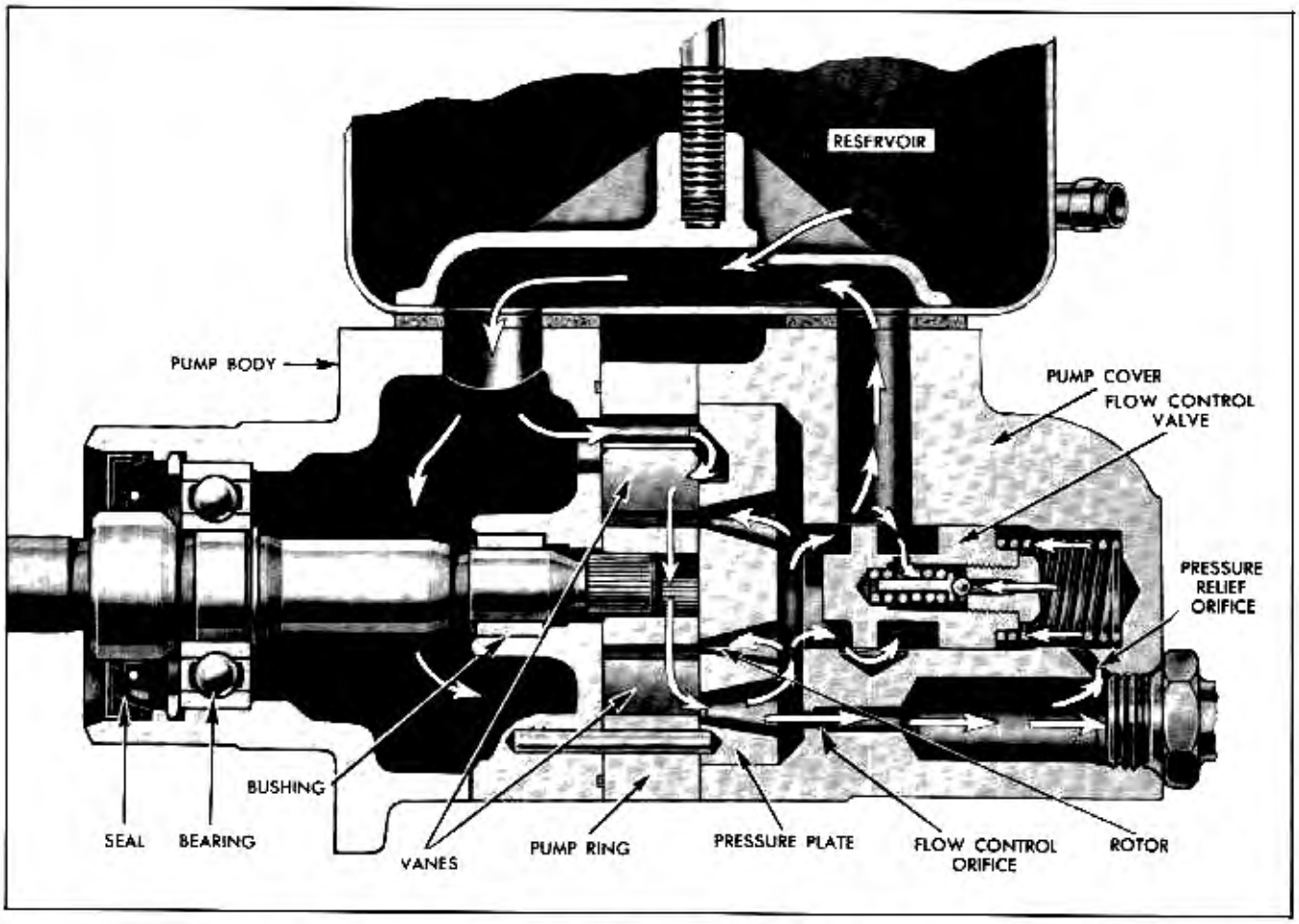


Fig. 9-67 Power Steering Pump. Straight Ahead Position--Schematic View

The pressure relief valve is contained inside flow control valve. If pump pressure exceeds a certain predetermined pressure (775-875), pressure relief ball will open allowing oil to flow through flow control valve and into reservoir.

Fig. 9-65 is typical of pump operating when car is being driven at low speed during a partial turn. The oil pressure cannot build up high enough to cause the pressure relief valve to open as external circuit still allows some oil to flow through the system. Also the flow of oil is less than 2.2 gallons per minute, therefore, flow control valve is completely closed.

Fig. 9-66 is typical of pump operating with medium to high engine speeds when turning steering wheel against resistance and valve spool assembly in steering gear is in closed position. In this case maximum pump pressure is developed and pressure relief occurs as described above.

Fig. 9-67 is typical of pump operating medium to high engine speeds in a straight-ahead position. In this case, the flow control valve has opened to allow all oil flow in excess of 2.2 gallons per minute to bypass into the reservoir.

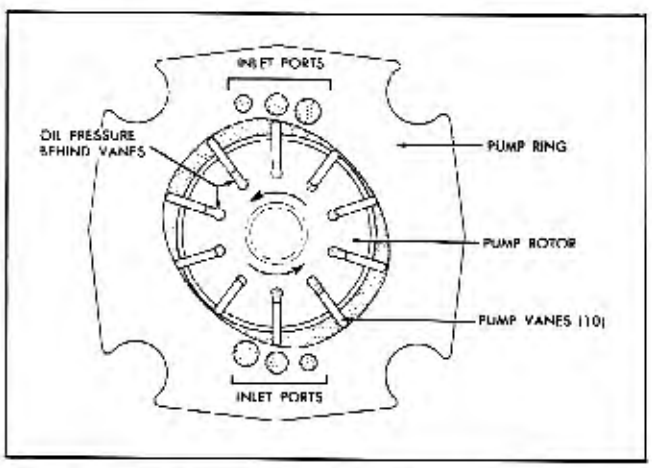


Fig. 9-68 Oil Flow in Rotor and Vanes in Pump Ring

PERIODIC SERVICE RECOMMENDATIONS

No periodic service of the pump is required except checking oil level in reservoir as outlined in general lubrication section.

PUMP BELT TENSION ADJUSTMENT

Loosen pump to bracket bolts two full turns so pump falls of its own weight. Place pump belt tightener J-5574, over head of hinge bolt as shown in Fig. 9-69. Using torque wrench perpendicular to tool, tighten a new belt 58-65 lb. ft. or a used belt 51-53 lb. ft.

Tighten clamp bolt. Remove tool and tighten mounting bolt.

REMOVAL OF PUMP FROM CAR

1. Disconnect hoses at unions on pump. When hoses are disconnected, secure ends in a raised position to prevent drainage of oil.

2. Install two caps at pump fittings to prevent drainage of oil from pump.

3. Remove drive pulley attaching nut.

4. Loosen bracket-to-pump mounting bolts.

5. Remove pump belt.

6. Slide pulley from shaft. NOTE: Do not hammer pulley off shaft as this can damage the pump bearings.

7. Remove bracket-to-pump bolts.

8. Remove pump.

DISASSEMBLY OF PUMP

1. Remove reservoir cover bolt, flat washer, and reservoir cover with gasket.

2. Remove gasket from reservoir cover.

3. Remove filter screen and retainer assembly by lifting up at center (Fig. 9-70).

4. Remove four reservoir-to-pump bolts.

5. Remove reservoir and gaskets under the reservoir.

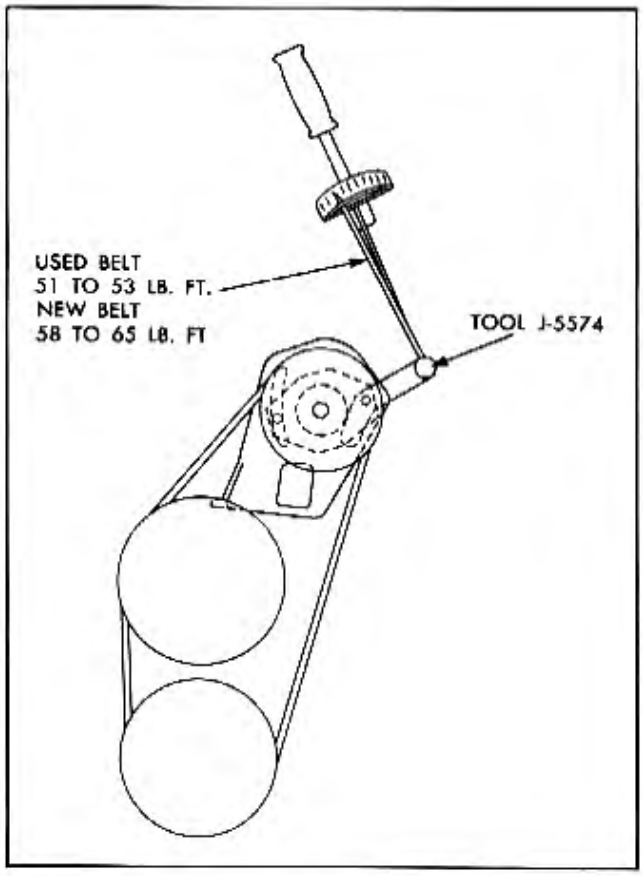


Fig. 9-69 Adjusting Pump Belt Tension

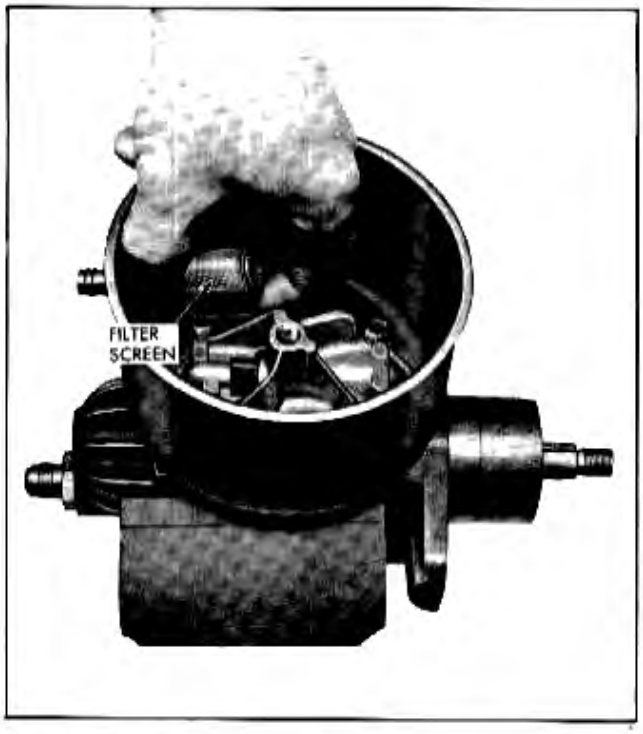


Fig. 9-70 Removing Filter Screen Assembly

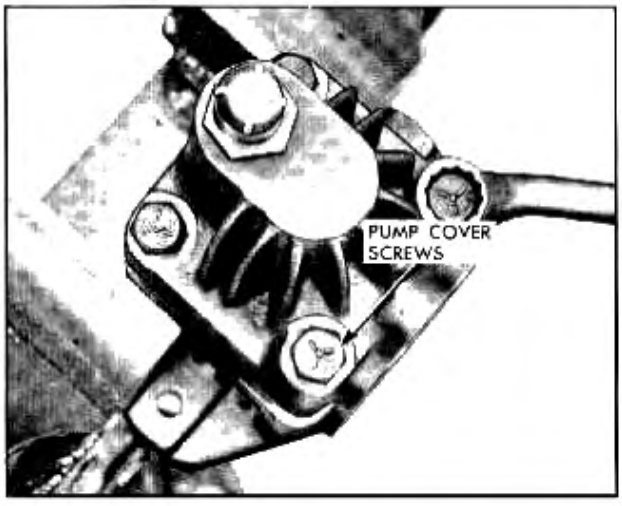


Fig. 9-71 Removing Pump Cover Screws

6. Remove four pump cover to pump body attaching screws (Fig. 9-71). NOTE: Do not clamp on front hub of pump as this may damage the bearing housed therein.

7. Lift off pump cover with flow control valve assembly and spring. Be especially careful to insure that flow control assembly does not drop out (Fig. 9-72).

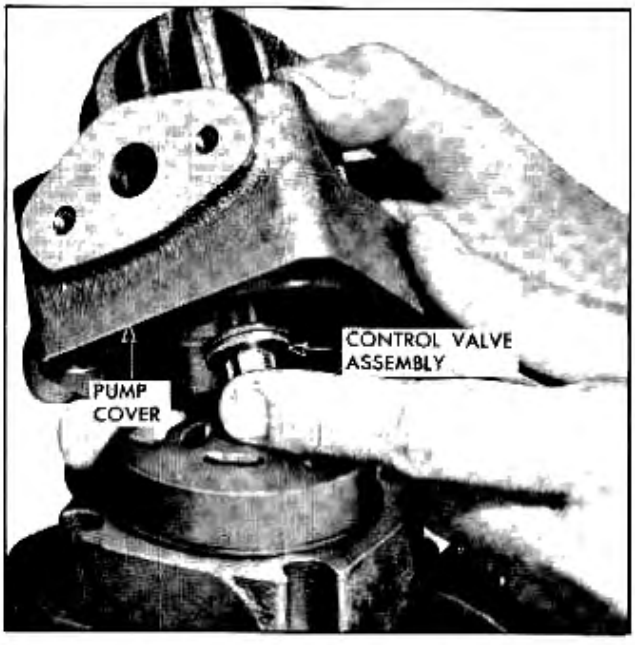


Fig. 9-72 Removing Pump Cover and Control Valve Assembly

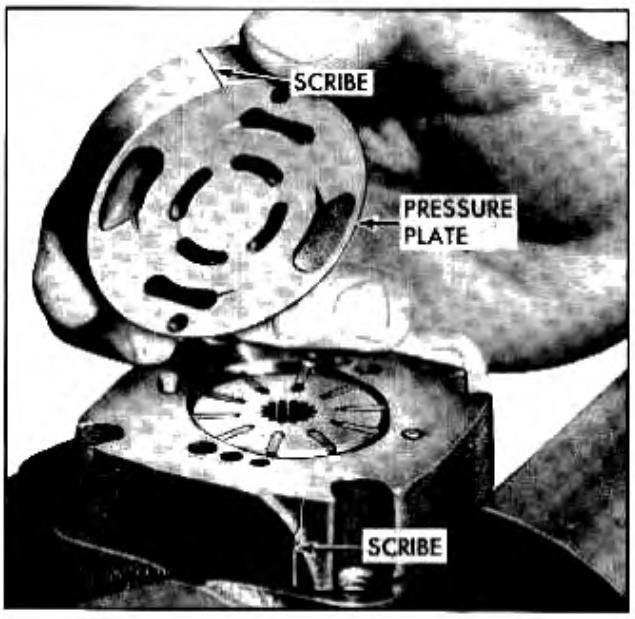


Fig. 9-73 Removing Pressure Plate

8. Scribe position of pressure plate and remove plate from dowel pins (Fig. 9-73).

9. Scribe position of pump ring in relation to pump body, and remove ring from dowel pins (Fig. 9-74). NOTE: Arrows on outer edge of pump ring point in direction of pump rotation.

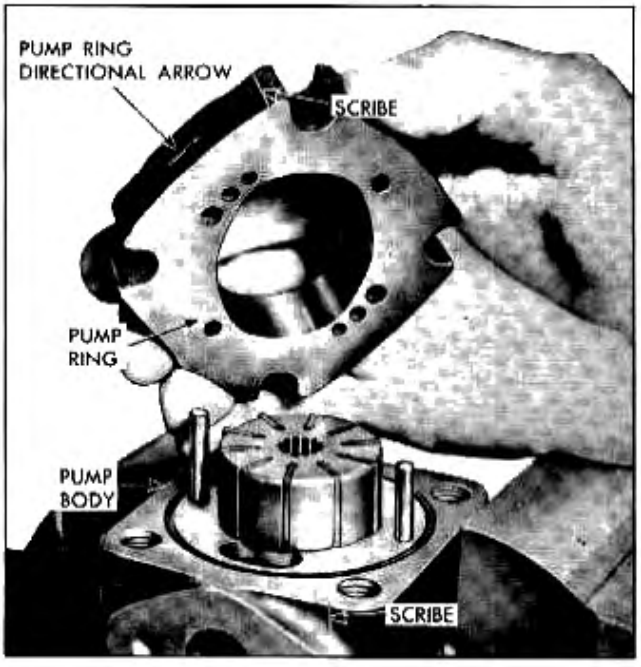


Fig. 9-74 Removing Pump Ring from Pump Body

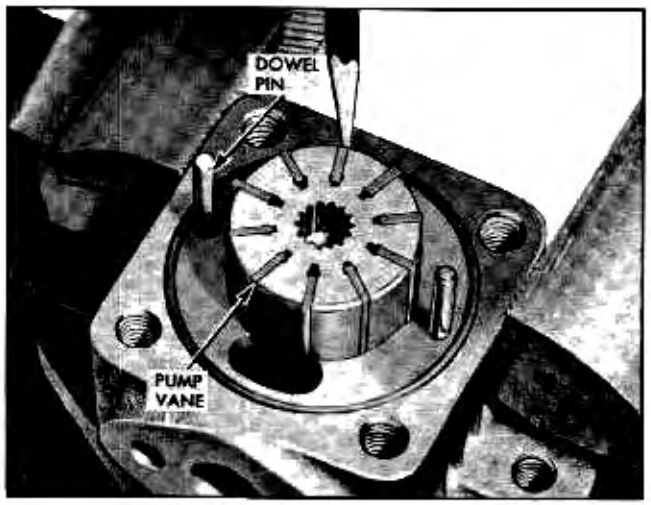


Fig. 9-75 Removing Pump Vanes

10. Remove ten pump vanes (Fig. 9-75).

11. Remove pump rotor (Fig. 9-76).

12. Remove dowel pins from pump body. Any further disassembly should be avoided unless parts are dirty or repair operations are necessary on any of the remaining parts.

13. Remove oil seal from body using a punch or screwdriver and punch a hole through oil seal and pry out of housing (Fig. 9-77).

14. Remove shaft bearing retainer snap ring from front hub of pump body using tool J-4245 (Fig. 9-78).

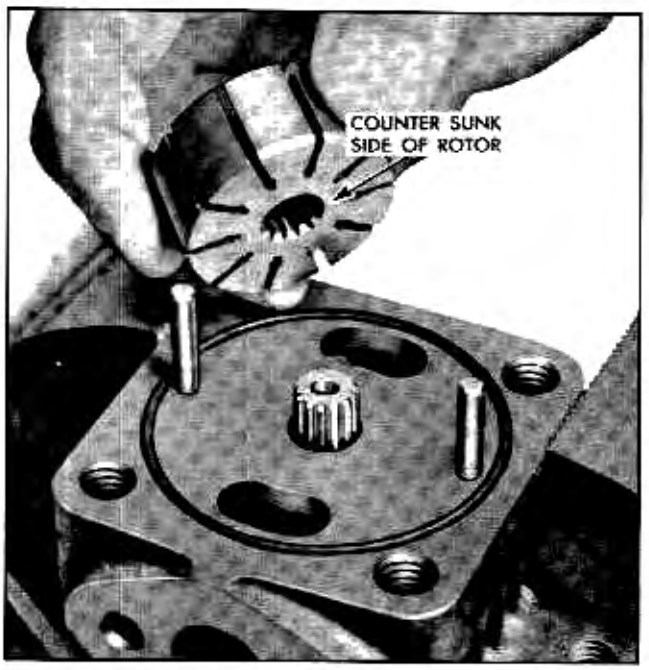


Fig. 9-76 Removing Pump Rotor

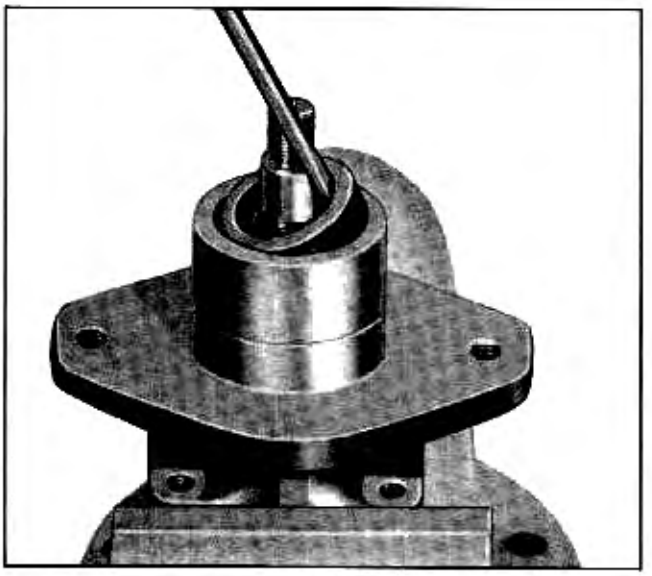


Fig. 9-77 Removing Oil Seal from Pump Body

15. Remove drive shaft with ball bearing by lightly tapping on splined end of shaft (Fig. 9-79).

16. Remove key from shaft.

17. Remove snap ring from shaft.

18. If bearing is to be replaced, remove outer bearing by pressing from the pump shaft. NOTE: Do not remove bearing unless it is to be replaced as it cannot be removed without damage.

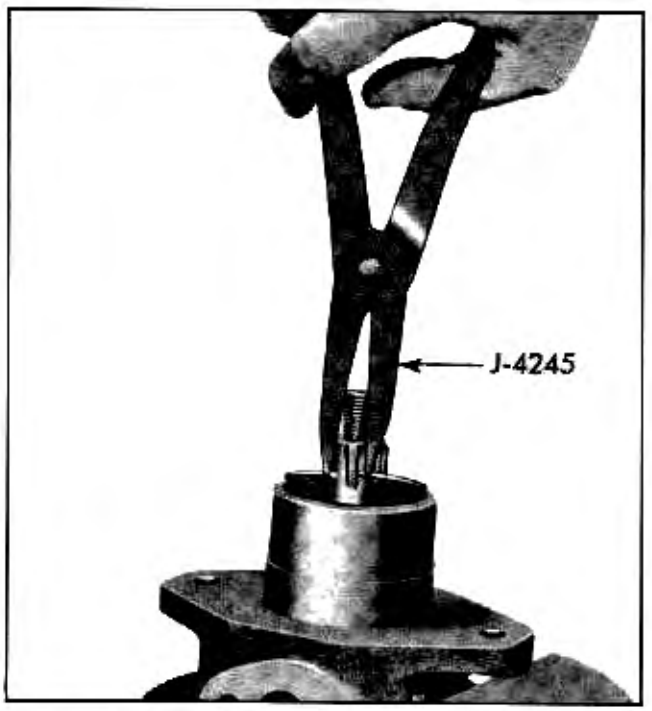


Fig. 9-78 Removing Bearing Retaining Rings

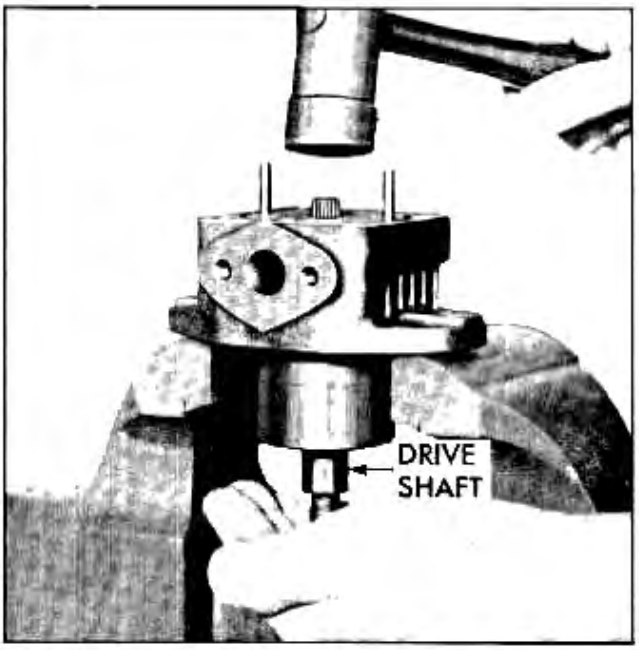


Fig. 9-79 Removing Pump Drive Shaft and Bearing from Pump Body

CLEANING AND INSPECTION OF PUMP PARTS

1. Carefully wash all parts in a suitable cleaning solvent except "O" rings and drive shaft seal which are to be replaced.

2. Inspect pump cover flow control valve bore for scores and wear.

3. Inspect flow control valve for free movement in its bore. Inspect all passages in cover and body for obstructions or dirt.

4. Inspect pressure plate for scoring.

5. Inspect contour surface of pump ring for excessive wear.

6. Inspect rotor faces for metal pick up or scoring.

7. Check vanes for bind in slots of rotor.

8. Inspect face of pump body for scoring or wear.

9. Inspect drive shaft seal surface for scratches and wear.

10. Inspect drive shaft ball bearing for roughness or noisy operation.

11. Inspect pump body inner bushing for wear.

REPAIRS

FLOW CONTROL VALVE

If flow control valve is stuck, dislodge by jarring front of pump cover. If pump cover control valve bore is worn or scored, replace pump cover. If necessary to clean or repair pressure relief valve, grip flow control valve by small hub on end of valve and remove orifice screw, shims, ball, plunger, and spring. If internal parts are found to be worn or scored, replace assembly.

NOTE: The control valve assembly is calibrated at the factory and components of assembly cannot be serviced.

INTERNAL GROUND SURFACES OF PUMP

If pressure plate, pump body, rotor, or pump ring is lightly scored, the following corrections can be made. On a flat surface lap the scored surfaces with a lapping compound until the surfaces are smooth. NOTE: Thoroughly clean in a suitable solvent when lapping operation is completed.

ASSEMBLY OF PUMP

Before assembling make sure all parts are absolutely clean. Lubricate "O" rings, drive shaft seal, and all moving parts as assembled with type "A" Hydra-Matic transmission fluid (Fig. 9-80).

1. Press bearing over splined end of drive shaft by pressing on the inner race only.

2. Install bearing retaining ring.

3. Install key into shaft keyway. NOTE: Shaft should be supported on opposite side when installing key.

4. Install drive shaft and bearing assembly into pump body by pressing on the outer race only. Make sure drive shaft enters pump body bushing freely.

5. Install snap ring in pump body.

6. Install shaft seal in body using tool J-6539 (Fig. 9-81). Install seal with the word "outside" toward front of pump.

7. Install "O" ring in groove of pump body.

8. Install dowel pins in pump body. Tap lightly if necessary.

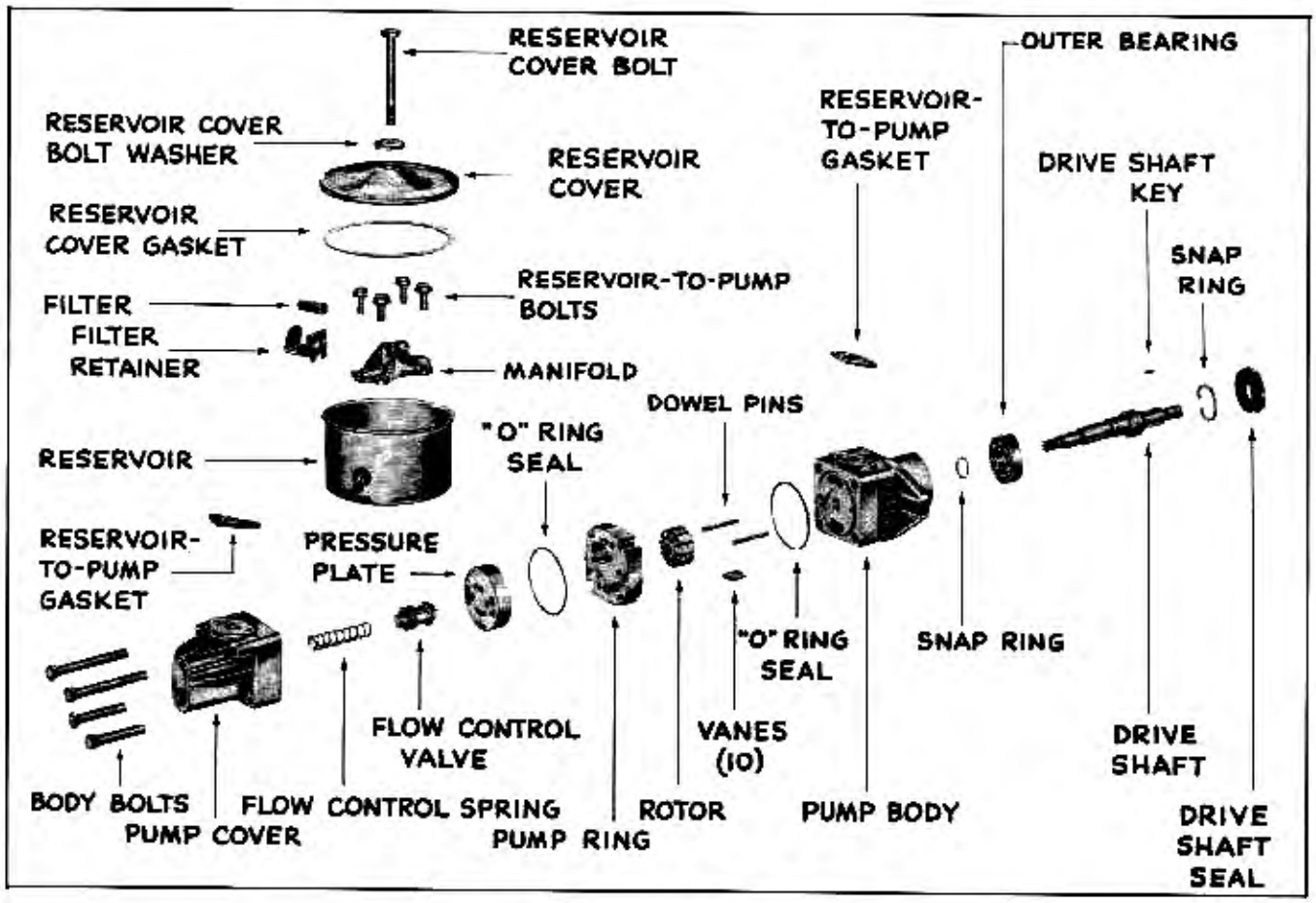


Fig. 9-80 Exploded View of Pump

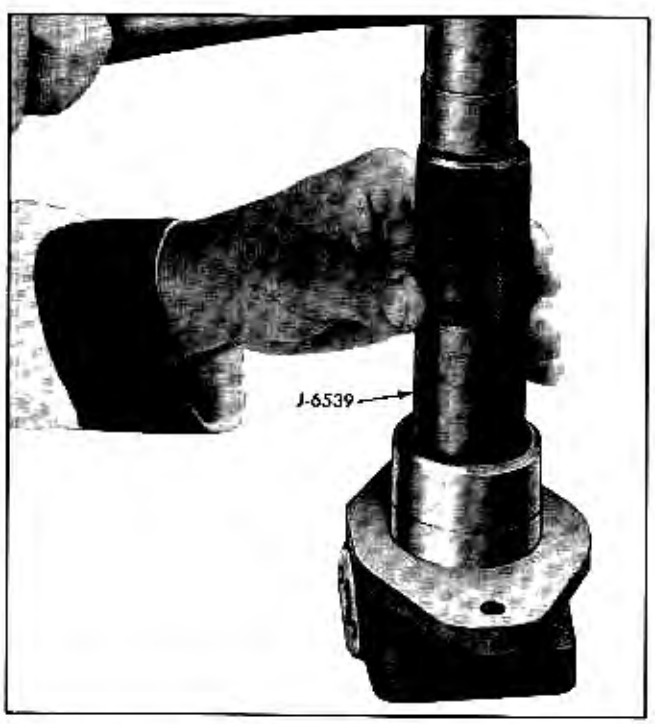


Fig. 9-81 Driving Shaft Seal into Pump Body

9. Install rotor over splined end of drive shaft. NOTE: Assemble rotor with side having countersunk splines toward front of pump and be sure rotor is free on splines (Fig. 9-76).

10. Install vanes in rotor slots with radius edge toward outside.

11. Install pump ring on dowel pins and position correctly according to scribed marks. NOTE: Arrow on outer edge of pump ring points to rotation of pump.

12. Install pressure plate on dowel pins. NOTE: Pressure plate must be free with no binding on dowel pins.

13. Install "O" ring in counterbore of pump cover.

14. Install flow control valve and spring in pump cover. Be sure that end with hex head screw goes into the bore first.

15. Position pump cover assembly over pressure plate being careful not to dislodge "O" ring from cover.

16. Install four cover-to-body attaching bolts. Tighten alternately to 25-30 lb. ft. torque.

17. Install reservoir gaskets on pump body and cover.

18. Position reservoir on pump assembly with extrusions in reservoir bottom inside the smaller gasket holes and install four bolts. Tighten to 8-10 lb. ft. torque.

19. Install filter screen and retainer assembly by placing retainer in groove provided on reservoir oil return tube. NOTE: Tube and filter screen should be in line after assembly.

20. Install reservoir cover with gasket bolt and washer. Tighten cover bolt to 7-9 lb. ft. torque.

INSTALLATION OF PUMP ON CAR

1. Position pump assembly on mounting bracket with holes lined up and install bolts loosely.

2. Slide pulley on shaft. NOTE: Do not hammer on pulley.

3. Install pulley nut finger tight against pulley.

4. Connect and tighten hose fittings.

5. Fill reservoir. Bleed pump by turning pulley backward (counterclockwise as viewed from front) until air bubbles cease to appear.

6. Install pump belt over pulley.

7. Move pump outward until belt is properly adjusted. See Pump Belt Tension Adjustment (Fig. 9-69).

8. Tighten pulley nut to 35-45 lb. ft. torque.

TROUBLE DIAGNOSIS AND TESTING

The power steering pump is not completely noiseless. Some noise will be present at standstill parking, particularly when wheels are against the wheel stops.

Power steering pump noise can be confused with many other noises, such as transmission, rear axle, generator, etc. If it is determined that excessive noise is present, remove the pump drive belt, to determine if the pump is at fault. If it is determined that excessive pump noise is present, see Noisy Pump After Refilling Reservoir.

STEERING KNOCKS WHILE TURNING WITH ENGINE RUNNING

Improper pitman shaft adjustment.

STEERING WHEEL SURGES OR JERKS WHEN TURNING WITH ENGINE RUNNING

Loose pump belt.

NOISY PUMP AFTER REFILLING RESERVOIR

1. Check oil level, fill reservoir to level mark if necessary.

2. Check belt adjustment and all fittings and bolts to insure tightness.

3. Check to make sure hoses are not touching any other parts of car, particularly sheet metal.

4. Be sure there is no air present in oil. Air will show up as bubbles or the oil will appear milky. Very small amounts of air will cause extremely noisy operation. If it is impossible to expell all air, either air is leaking into the system or air is trapped in steering gear cylinder.

5. Air trapped in cylinder should be bled as described for the steering gear. (See page 9-27). Air can leak into the system at any place. Air leaks usually occur at joints in the system where oil passes through at high velocity, such as hose connections. Air can leak into system where no external oil leakage appears. Air can be introduced into the system by reservoir turbulence caused by a plugged or improperly installed filter assembly.

6. When no air present, install pressure gauge in the pressure line between the pump and gear. If, when racing engine to about 1000 RPM and without turning the steering wheel, the pressure exceeds 125 lbs., hoses and/or steering gear are restricting oil flow and these parts should be examined to determine cause of restriction.

7. If the pressure in Step 6 is normal (less than 125 lbs.) and the pump is noisy it will be necessary to remove pump from car and disassemble or partially disassemble following the steps outlined under DISASSEMBLY OF PUMP (page 9-31).

WATER IN FLUID

Should the fluid be cloudy i.e., have the appearance of a mixture of coffee with cream, it is due to water being in the system. Once water is in the system there is no way to clarify the fluid so it is necessary that the fluid be replaced. This can best be done by removing the pump return pipe or flexible hose and catching the discarded fluid in a container. Pump the system as clear as possible, then fill with new fluid and cycle the steering from extreme right to extreme left and in this way force out all the contaminated fluids. When the fluid being pumped through the return hose shows clean of this clouded mixture, connect the hose to the pump, fill the reservoir and again cycle the unit while the pump is operating until there is no evidence of air bubbles in the reservoir. Again fill the reservoir to level and install cover.

HARD STEERING WHEN PARKING

When engine is idling, car stopped, and steering wheel is turned in an effort to park, normal effort required at steering wheel rim is approximately 5 pounds with oil at normal operating temperature between 150°F. and 170°F. measured with a thermometer in the reservoir.

Temperature will build up if steering wheel is turned from side to side with car standing. Therefore, if a complaint of hard steering when parking is encountered, carefully follow procedure below:

Simulate parking by applying hand brake and turning wheels on a clean dry service floor. If effort exceeds 5 pounds when checked with spring scale J-5178, make the following checks:

1. Check pump drive belt tension and adjust. (See page 9-31).

2. Check for lack of lubrication in steering gear linkage and front suspension.

3. Test tires for proper inflation and inflate to recommended pressures.

4. Check tie rod and connecting rod ball seats for being too tight.

5. Check steering pitman shaft adjustment. See Adjustments on Car (page 9-13).

6. Check lines and gear for signs of oil leakage.

7. If the above mentioned checks and their corrections do not eliminate the difficulty, perform pressure test.

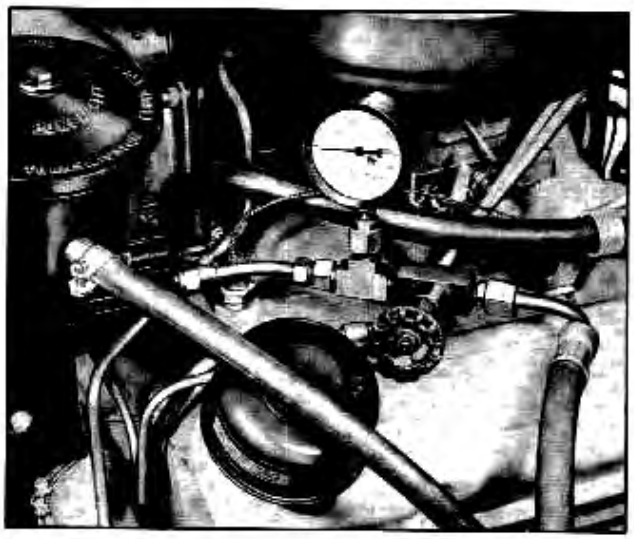


Fig. 9-82 Pressure Gauge Installed Between Pump and Gear

PRESSURE CHECK

TEST NO. 1—OIL CIRCUIT OPEN

1. Install pressure gauge J-5176 (Fig. 9-82) in pressure line between pump and gear and turn valve to open position.

2. Turn steering wheel from one stop to other stop and note pressure on gauge while turning wheel. Especially note maximum pressure that can be built up with steering wheel held in either extreme right or extreme left position. This maximum pressure reading should not be less than 775 lbs., with engine idling and oil temperature in reservoir between 150° and 170° as measured with a thermometer. NOTE: To obtain temperatures of 150° to 170° desired for testing, turn wheels through normal operating range several times. CAUTION: Do not hold steering wheel against stop for any extended period of time.

3. If maximum pressure is below 775 lbs., it indicates there is some trouble in hydraulic circuit; however, it does not indicate whether pump or gear is at fault. To determine if pump alone or if both are at fault, proceed with Test No. 2.

TEST NO. 2—OIL CIRCUIT CLOSED

1. With engine idling, turn shut-off valve of gauge to closed position.

2. Observe and compare maximum pump pressure at idle. It should not be less than 775 lbs. NOTE: By comparing this reading with Test No. 1 (testing complete circuit), it is possible to determine whether fault is with the pump or steering gear, or both.

TEST RESULTS	DIAGNOSIS
1. First Test below 775 lbs.—Second Test normal 775 lbs. minimum; Example: First test 600 lbs., Second test 850 lbs.	Defective steering gear
2. First Test below 850 lbs.—Second Test not more than 50 lbs. greater; Example: First test 400 lbs., Second test 450 lbs.	Defective pump

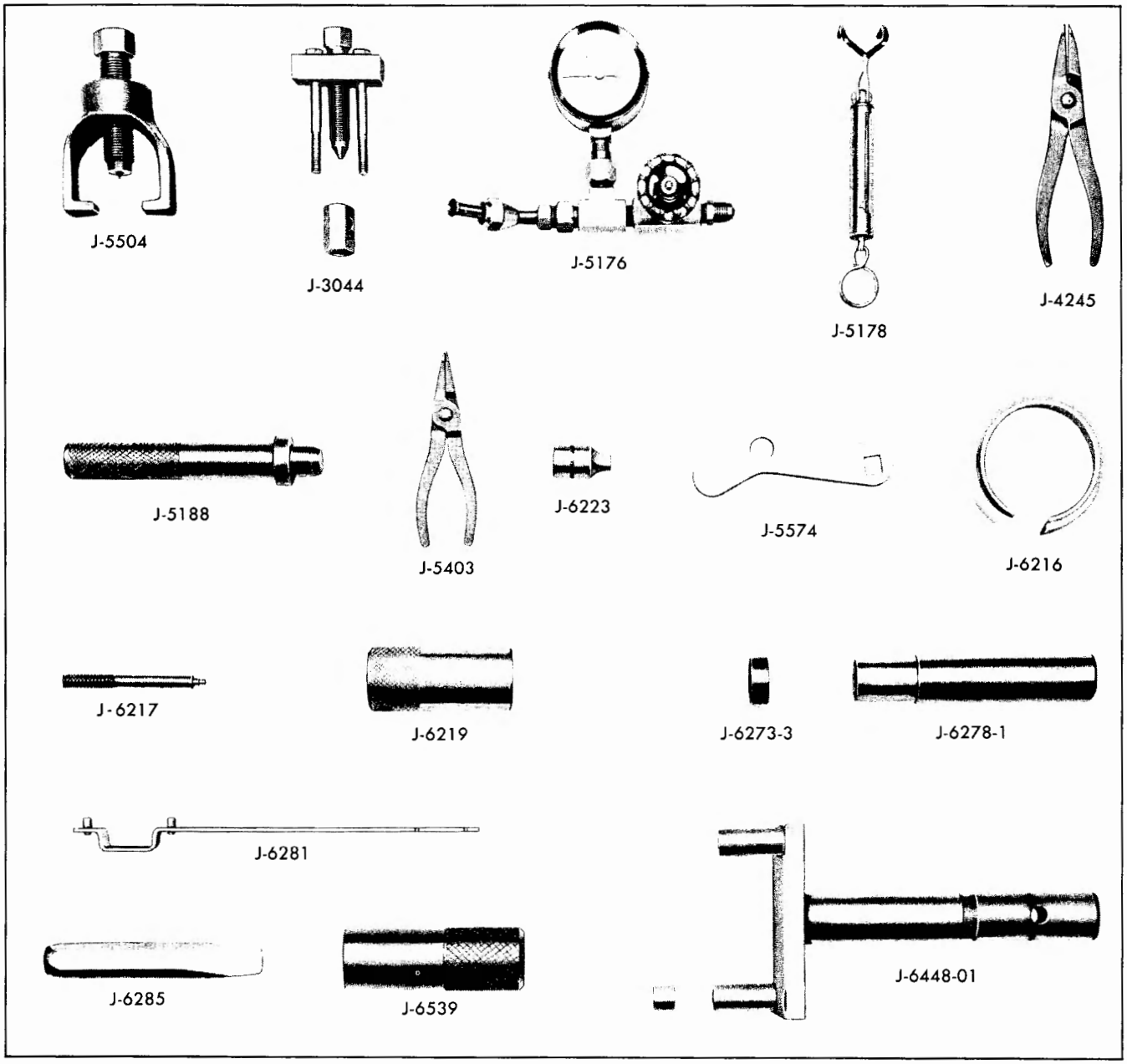
If pressure test under Test No. 1 and Test No. 2 shows pressure above 1000 lbs., remove pressure line fitting from back of pump. Check to determine if small hole inside pump cover drilled at an angle toward flow control valve assembly is plugged. This hole must be through to communicate between downstream side of orifice to the cavity behind flow control valve assembly. If this hole is not plugged, install a new flow control valve assembly, making sure it is free in its bore. Recheck pump pressure after installation of new flow control valve assembly.

TORQUE SPECIFICATIONS

	LB. FT. TORQUE
Tie Rod Clamp Nuts	18 to 20
End Cover to Housing Screws	25 to 30
Steering Gear Pitman Arm Nut	100 to 125
Pitman Shaft Lash Adjusting Screw Nut	25 to 30
Side Cover to Housing Screws (3/8)	25 to 30
Side Cover to Housing Screws (5/16)	15 to 20
Steering Wheel to Shaft Nut	25 to 30
Gear Housing to Frame Bolts	23 to 28
Pump Reservoir Cover Bolts	7 to 9
Reservoir to Pump Bolts	8 to 10
Cover to Pump Body Bolts	25 to 30
Pump Belt Tension New Belt	58 to 65
Pump Belt Tension Used Belt	51 to 53
Pulley Hub to Pump Shaft Nut	35 to 45
Steering Shaft Coupling Flange Nuts	15 to 20

SPECIFICATIONS (POWER STEERING)

Type	In-Line Saginaw Recirculating Ball Nut
Pump	Vane Type
Pull at Steering Wheel	5 lbs. Maximum
Over-All Steering Ratio	22.5:1
Fluid Level	Fill to Filler Line on Reservoir
Engine to Pump Ratio	1.31



SPECIAL TOOLS—STEERING

J-5504	Pitman Arm Puller
J-3044	Steering Wheel Puller
J-4245	Snap Ring Pliers
J-5176	Pressure Checking Gauge
J-5178	Steering Wheel Tension Gauge (15 lb. Scale)
J-5188	End (Top Housing) Cover Needle Bearing and Seal Installer
J-5403	Snap Ring Pliers
J-5574	Pump Belt Tightener
J-6216	Piston Ring Compressor
J-6217	Valve Connector Installer (Pressure and Return Lines)
J-6219	Pitman Shaft (Gear) Seal Installer
J-6223	Ball Nut Retaining Screw Adapter
J-6278-1	Pitman Shaft (Gear) Bushing Remover and Installer Used With Adapter J-6278-3
J-6278-3	Pitman Shaft (Gear) Needle Bearing and Installer Adapter
J-6281	Power Steering Overcenter Adjuster
J-6448-01	Power Steering Gear Holding Fixture and Spacer (Use With Bench Bracket J-6571-4)
J-6539	Power Steering Pump Shaft Seal Installer