

POWER STEERING GEAR AND PUMP

GENERAL DESCRIPTION

Power steering is a combination of a recirculating ball nut steering gear and a hydraulic booster linked to the pitman shaft through a separate set of gear teeth and controlled by a spool valve on the steering shaft. Oil pressure for the hydraulic booster is provided by a positive displacement type pump, belt driven off the engine. A flow control valve located in the pump regulates pump output and pump pressure.

All normal steering is accomplished with a maximum steering effort of approximately nine pounds on the steering wheel with the engine running. The booster cylinder does not assist in steering until a steering effort of approximately three pounds is required of the driver.

The hydraulic system is only a booster and accomplishes no steering except through guidance of the driver. The unit does NOT steer beyond the path the driver has set. This can be illustrated in driving on a curve. If the driver removes his hands from the

steering wheel, the car will attempt to right itself and follow a straight course as with standard steering.

DESCRIPTION OF OPERATION OF POWER STEERING GEAR

The schematic diagram in Fig. 9-21 shows the component parts of the power steering system. The pitman shaft incorporates two sets of gears. One set indexes with the ball nut on the steering shaft worm; the other indexes with the power rack connected to the power piston.

Flow of oil to the power piston is controlled by the spool valve which is attached to the steering shaft. The spool is held in the centered or neutral position by ten plungers and five springs which bear against the back side of the large bearing races. The plungers and springs are designed so that when a force of approximately three pounds or more is applied at the steering wheel rim the thrust between the pitman shaft and ball nut will cause the springs to be compressed giving axial movement of the steering shaft. Due to the fact that the spool is connected to the shaft through the ball thrust bearings it will move inside the valve body accordingly.

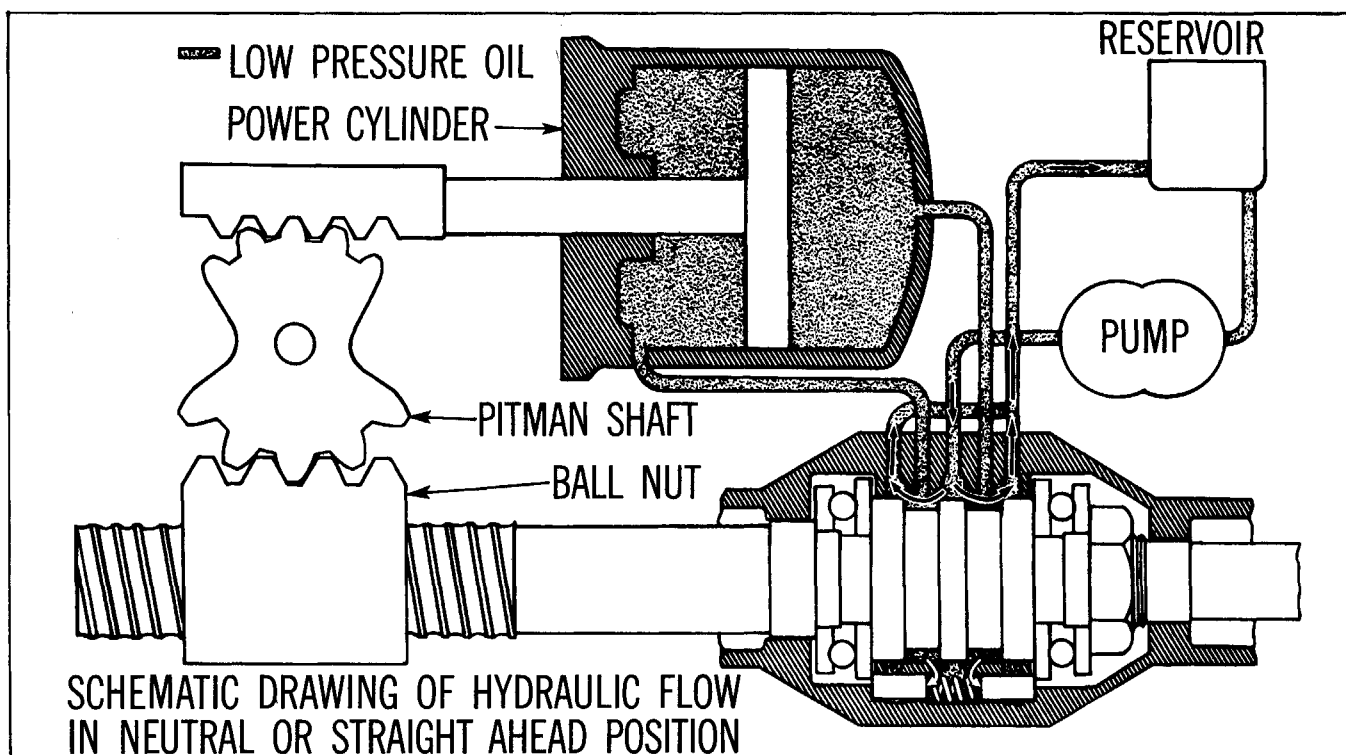


Fig. 9-21 Operation of Power Steering Unit in Neutral

OIL FLOW IN NEUTRAL

When the steering wheel is not being turned or is turned with a force of less than three pounds, the spool valve will remain centered as shown in Fig. 9-21. Pump output will then be directed from the pressure inlet of the valve body past the spool valve to the return line to the reservoir. This pump output will simply be recirculated in the system without doing any work.

OIL FLOW DURING TURNS

When the steering wheel is turned, a thrust will be developed between the pitman shaft and the ball nut. This thrust will increase as the steering effort at the steering wheel increases. When the effort at the wheel reaches three pounds, the force on the ball nut will move the steering shaft, compressing the plunger springs and moving the spool valve with it.

When the spool valve moves as shown in Fig. 9-22 on a left turn, oil is directed past the spool valve to the left side of the power piston. This pushes the piston to the right, assisting the driver in turning the wheel. Oil from the other side of the piston is directed back through the valve body to the pump reservoir.

In addition oil pressure is directed against the spool centering plungers to supplement spring force in trying to center the spool. This causes the force required to turn the wheel to increase as the front wheels get harder to turn, giving the driver a natural feel of steering.

When making a right turn the steering shaft and spool move in the opposite direction. This directs pressure to the opposite side of the piston. Oil flow is similar to that when making a left turn except it is in the opposite direction.

A check valve in the control valve body allows the flow of oil from one side of the piston to the other, permitting normal manual steering of the car in case of pump failure.

DESCRIPTION OF OPERATION OF POWER STEERING PUMP

The vane type pump is a positive displacement pump. Oil from the reservoir enters the pump body and is picked up by rotor vanes through two inlet ports and pockets and discharged under pressure through outlet ports in the pump pressure plate (Fig. 9-23 and 9-24). Sufficient oil under pressure is directed

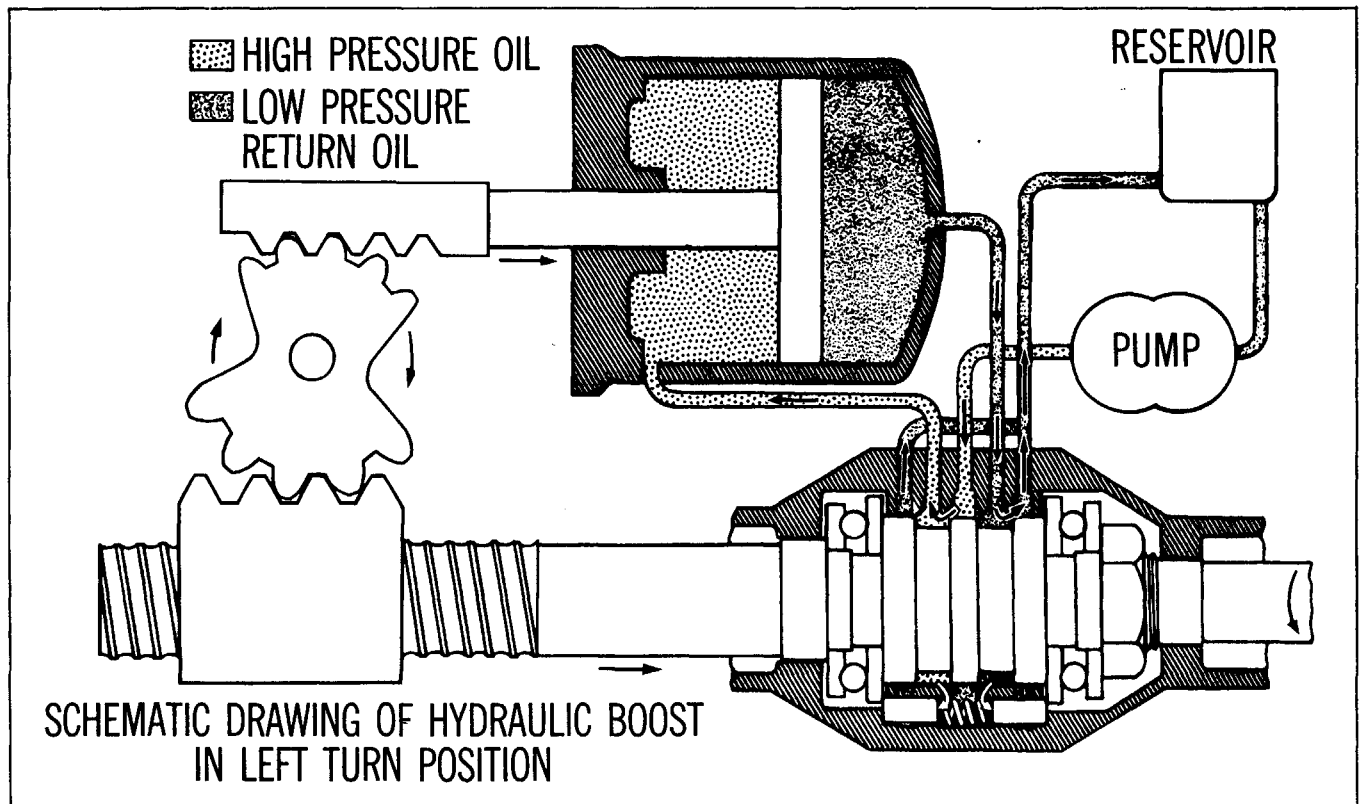


Fig. 9-22 Operation of Power Steering Unit During Left Turn

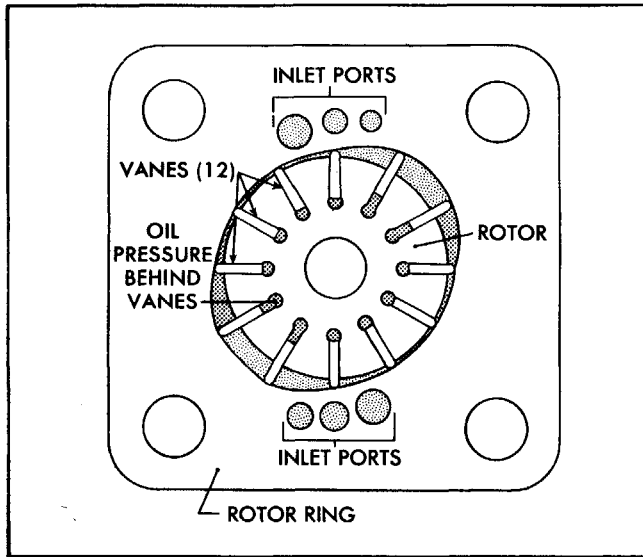


Fig. 9-23 Oil Flow in Rotor and Vanes in Rotor Ring

through another passage in the pressure plate so that it may enter behind the rotor vanes to force the vanes to follow the contour of the rotor ring. The remainder of the oil is directed through an orifice in the pressure plate.

The orifice in the pressure plate is calibrated so that pump output in excess of 1.8 gallons per minute will cause a back pressure. This pressure will open the flow control valve, against spring force, allowing excess oil to return to the reservoir. When flow to the steering gear is restricted as when using power steering, the pressure on both sides of the flow control valve becomes equal and the flow control valve spring closes the valve, allowing pressure to increase to provide the force required for power steering.

If oil pressure in the steering gear reaches 750-900 psi, the pressure relief valve will open against spring force to limit maximum oil pressure. When the pressure relief valve opens, it allows oil in the pressure outlet passage to pass through the flow control valve to the reservoir.

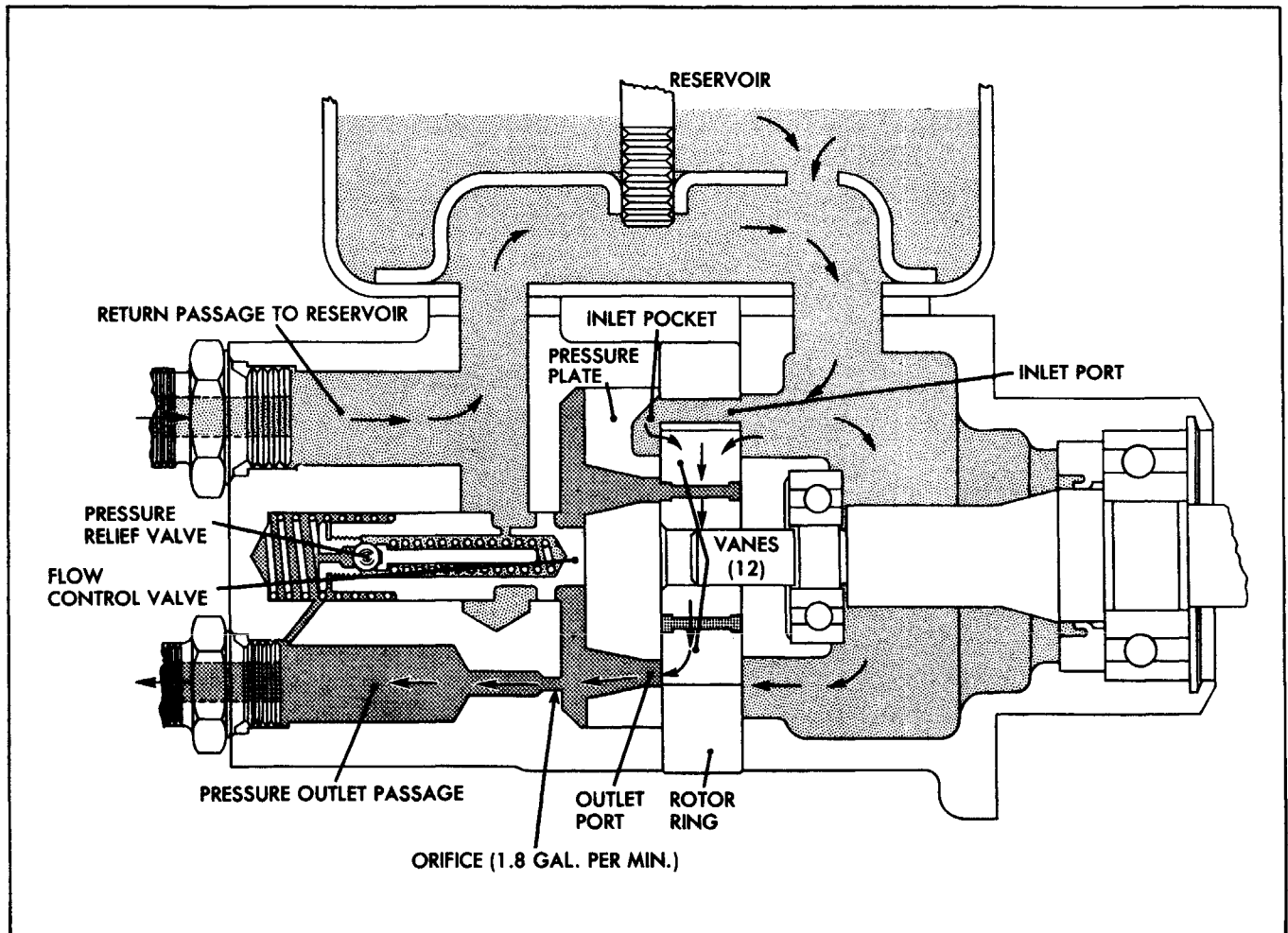


Fig. 9-24 Oil Flow in Pump With Low Car Speed and Partial Turn

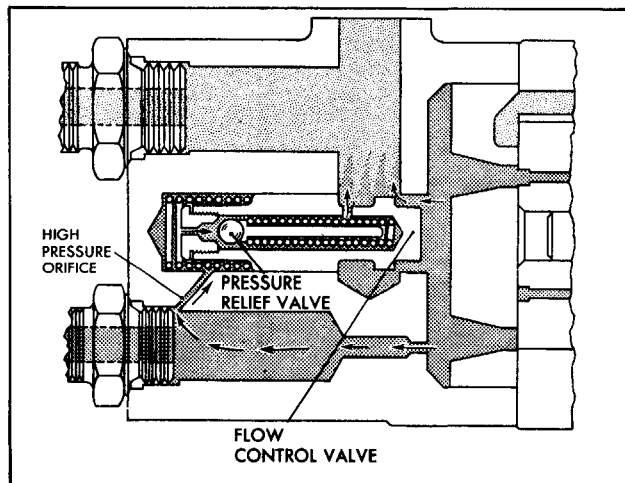


Fig. 9-25 Oil Flow in Pump With Low Car Speed and Full "U" Turn

The schematic diagram in Fig. 9-24 is typical of pump operation when the car is being driven at low speed during a partial turn. The oil pressure cannot become high enough to open the relief valve, because the spool valve in the steering gear is still partially open allowing some oil to return to the pump reservoir. Also, due to the low pump speed, the oil flow is not great enough to open the flow control valve.

The schematic diagram in Fig. 9-25 is typical of pump operation when the car is being driven in a full "U" turn at low speed with wheels cramped against stops. In this case maximum pump pressure is being applied to the piston to assist in the turn and the spool valve stops the flow of oil to the reservoir. The high oil pressure that develops opens the pressure relief valve. The restricted orifice between the outlet passage and the valve chamber causes the pressure to

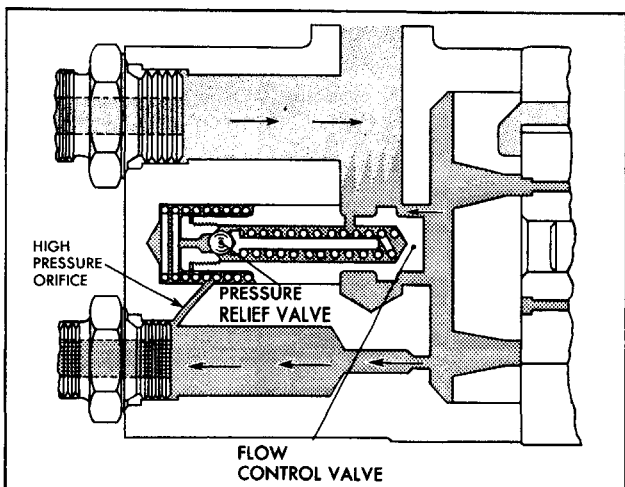


Fig. 9-26 Oil Flow in Pump With High Car Speed

drop and the flow control valve to open slightly, which in turn limits the pressure by allowing oil to return to the reservoir.

The schematic diagram in Fig. 9-26 shows the operation of the flow control valve when the car is being driven at high speed. The pump output at high speed exceeds 1.8 gallons per minute and opens the flow control valve to let oil return to the reservoir. This occurs during turns as well as in straight ahead driving.

ADJUSTMENTS ON CAR

Before any adjustments are made to the power steering gear in an attempt to correct such conditions as shimmy, hard or loose steering, and road shocks, a careful check should be made to determine that front end alignment, shock absorbers, wheel balance and tire pressure are correct.

There are three major adjustments of the power steering gear which can be made on the car:

1. PITMAN SHAFT END PLAY ADJUSTMENT.
2. POWER RACK GUIDE ADJUSTMENT.
3. PUMP BELT TENSION ADJUSTMENT.

PITMAN SHAFT END PLAY ADJUSTMENT

1. Disconnect steering connecting rod from pitman arm by removing cotter pin and plug from connecting rod.

2. Loosen four power rack guide cover bolts. Do not loosen two center bolts.

3. Loosen pitman shaft adjusting screw lock nut and back off adjusting screw a few turns, using an offset screwdriver.

4. With steering gear "on center", adjust pitman shaft thrust screw (Fig. 9-27) so that pull on steering wheel rim through a 3" arc using J-544-A spring scale, is 1 to 1¼ lbs. through center. Turning screw clockwise increases pull, counterclockwise decreases pull.

5. Tighten nut while holding screw with offset screwdriver and recheck pull at rim of steering wheel.

POWER RACK GUIDE ADJUSTMENT

After pitman shaft end play has been adjusted, clearance between power rack gear and ball nut must be adjusted to prevent binding or excessive lash at this point.

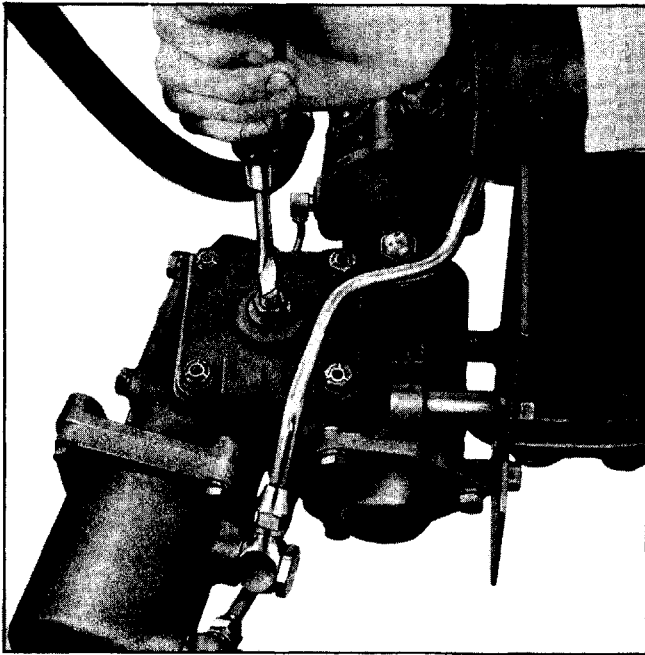


Fig. 9-27 Adjusting Pitman Shaft End Play

1. Make note of the final pull through center established by pitman shaft end play adjustment.
2. Tighten four power rack guide cover bolts evenly.
3. Again check pull at steering wheel, in "no lash" range or center position. Pull through a 3" arc at the rim is 1½ lb. maximum.
4. If pull through "no lash" range increased in Step 2 above maximum, shims .003" thickness should be added under power rack guide cover until last shim added decreases load.
5. If pull through "no lash" range remains the same in Step 2, shims of .003" thickness should be removed until load increases over that obtained in Step 1, under Pitman End Play Adjustment. Then add one .003" shim to provide proper adjustment of power rack guide. **CAUTION:** Be sure bolt threads do not pick up shims when tightening cover to housing.

COMPLETE GEAR ASSEMBLY

The total over center load while rotating the steering shaft from the end of travel shall not exceed 2 lb. pull at the rim with spring scale. If pull exceeds 2 lb., check thrust bearing adjustment as given on page 9-21.

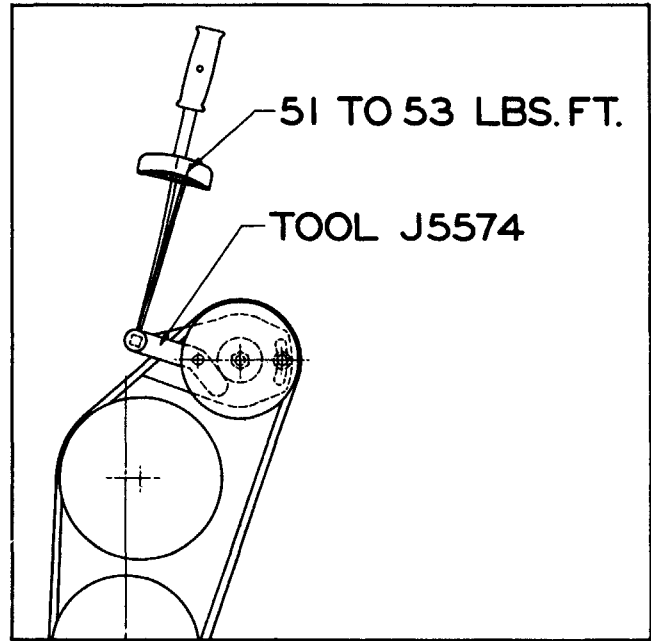


Fig. 9-28 Adjusting Pump Belt Tension

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. 9-28. 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.

PERIODIC SERVICE RECOMMENDATIONS

Periodic service consists of lubricating periodically as outlined in General Lubrication Section.

REMOVAL OF POWER STEERING GEAR FROM CAR

NOTE: If car is equipped with power brakes refer to page 5-20 for removal of power brake unit.

1. Hook front suspension in five passenger load position using tool J-5571 front suspension hold down hook (Fig. 9-29).
2. Remove steering wheel using puller J-3044.

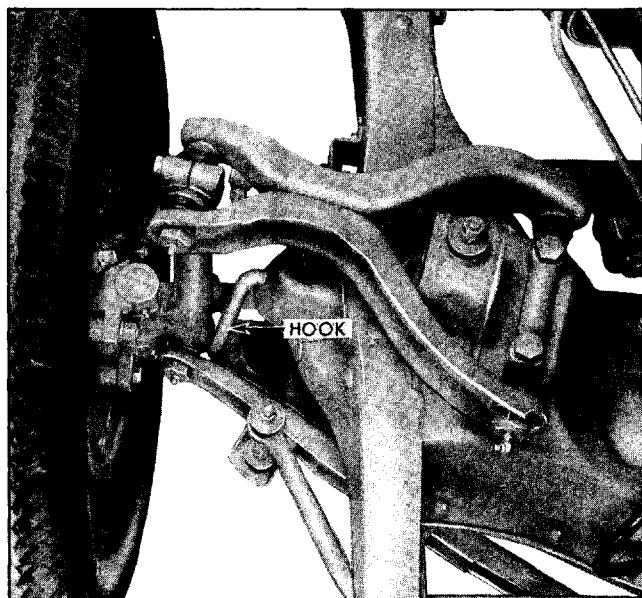


Fig. 9-29 Hold Down Hook J-5571 Installed

3. Remove direction signal switch handle and gearshift lever.

4. Remove steering column to instrument panel bracket cap.

5. Slide rubber grommet up steering column jacket. Roll back floor mat and remove pedal plates from floor.

6. Remove neutralizer and back-up light switch on Hydra-Matic equipped cars.

7. Disconnect gearshift and selector rods.

8. Disconnect direction signal wires.

9. Disconnect power steering oil lines at gear and secure lines so ends are higher than reservoir to prevent fluid leaking. Install plastic plugs or tape to cover gear and line openings and prevent entry of dirt.

10. Protect all finished surfaces on steering column with masking tape.

11. Raise car on hoist.

12. Remove starter motor.

13. Remove pitman arm.

14. Remove left side tie rod end and drop steering linkage.

15. Remove engine left side apron.

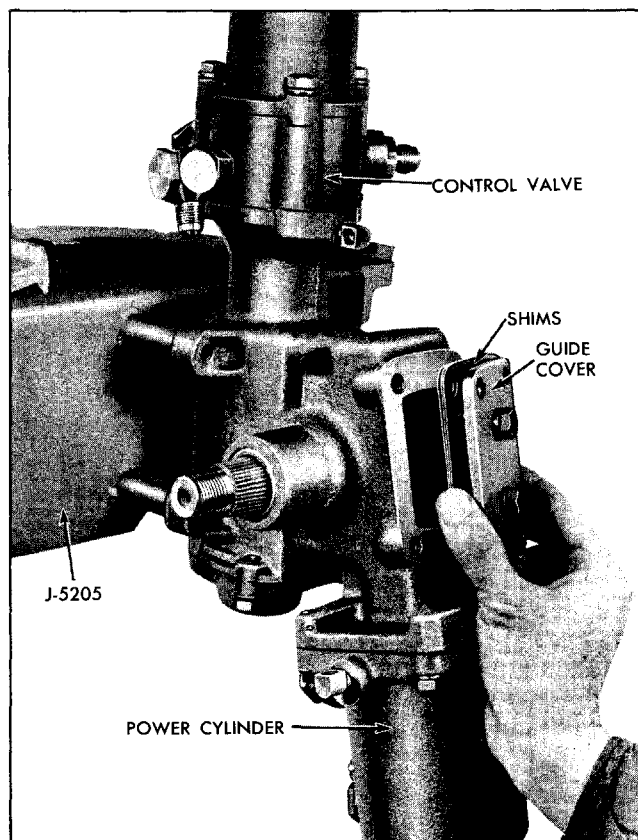


Fig. 9-30 Steering Gear Mounted on Tool J-5205

16. Remove brake pedal hairpin spring retainer and slide pedal to right as far as it will go.

17. If car is on a twin post hoist it will be necessary to place stands under both front frame ends and lower front post approximately three feet to allow steering assembly to clear hoist.

18. Push steering connecting linkage down and toward rear of car, remove steering assembly to frame attaching bolts, removing front upper bolt last, and lower assembly between lower control arm and steering connecting linkage. **NOTE:** Check amount of shims and do not lose shims that are between steering gear housing and frame.

19. Thoroughly clean exterior of steering gear.

20. Mount holding fixture (J-5205) in vise or differential carrier holding stand (J-945) or (J-3289) and attach gear to fixture with three long bolts which are part of J-5205 (Fig. 9-30).

21. Hydraulic fluid can be drained into a container by removing tape or plugs from elbows and turning gear through steering range several times. Lubricant in gear housing should also be drained into separate container.

DISASSEMBLY OF POWER STEERING GEAR

REMOVAL OF VALVE BODY FROM GEAR ASSEMBLY (FIG. 9-33)

1. Remove two pipes from valve body and cylinder and small by-pass pipe from cylinder and gear housing. **NOTE:** Do not loosen line elbows unless seals are to be replaced because of leaks. Leaving fittings tight will aid when reassembling oil lines. It is not necessary to remove small brass fittings, one of which is located in power cylinder, and the other in valve body.

2. Scribe mark cover, body, and gear housing to ensure same positioning of parts on reassembly (Fig. 9-31).

3. Remove three valve cover to gear housing attaching screws and remove column jacket, gearshift controls and cover as an assembly. Remove large "O" ring seal and remove steering shaft seal from valve body cover if damaged.

4. Cut out staked area from thrust bearing nut using a small chisel (nut should be discarded). **CAUTION:** Remove all metal chips from keyway immediately.

5. Turn steering shaft counterclockwise to end of travel and remove thrust bearing nut using tool J-5680, and remove spring washer, small bearing race, bearing and large bearing race.

6. With gear assembly in horizontal position, remove valve body and spool valve as an assembly, being careful not to lose plungers or springs from valve body (Fig. 9-32).

7. Remove large bearing race, bearing and small bearing race.

8. Remove "O" ring seal from gear housing upper flange if leaking or damaged.

DISASSEMBLY OF VALVE BODY (FIG. 9-33)

1. A clean piece of paper should be laid on bench to protect valve body parts from foreign material.

2. Slide spool valve out of body carefully so as not to nick or score valve or body.

3. Remove ten plungers and five springs using care not to nick or score plungers.

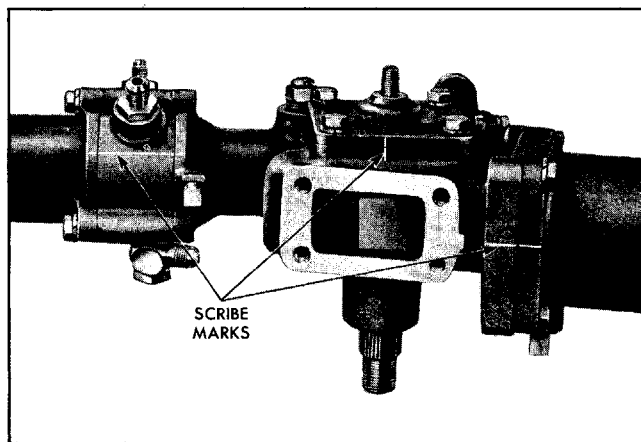


Fig. 9-31 Scribe Marks on Cover, Body and Gear Housing

4. Remove return line union and remove check valve from valve body, using screwdriver.

REMOVAL OF POWER CYLINDER ASSEMBLY FROM GEAR HOUSING (FIG. 9-33)

1. Remove four outer power rack cover to gear housing screws and remove power rack cover with guide spacing shims (Fig. 9-30). **NOTE:** Do not remove two bolts in center of cover.

2. Remove side cover screws and adjusting screw nut. Turn adjusting screw down through cover to remove side cover from housing. Remove cover and gasket.

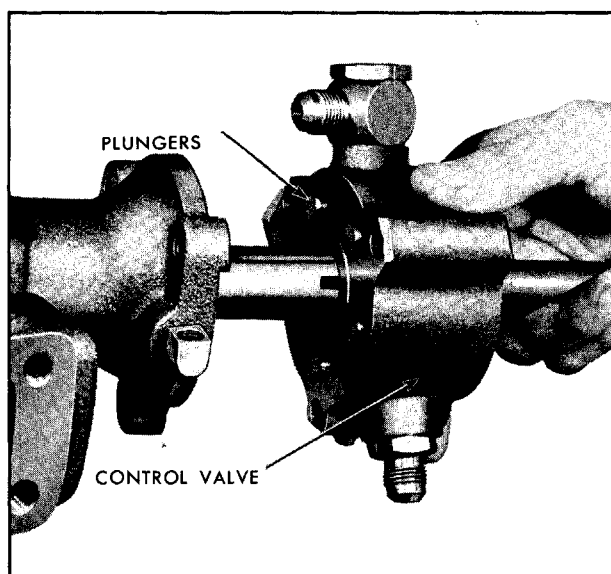
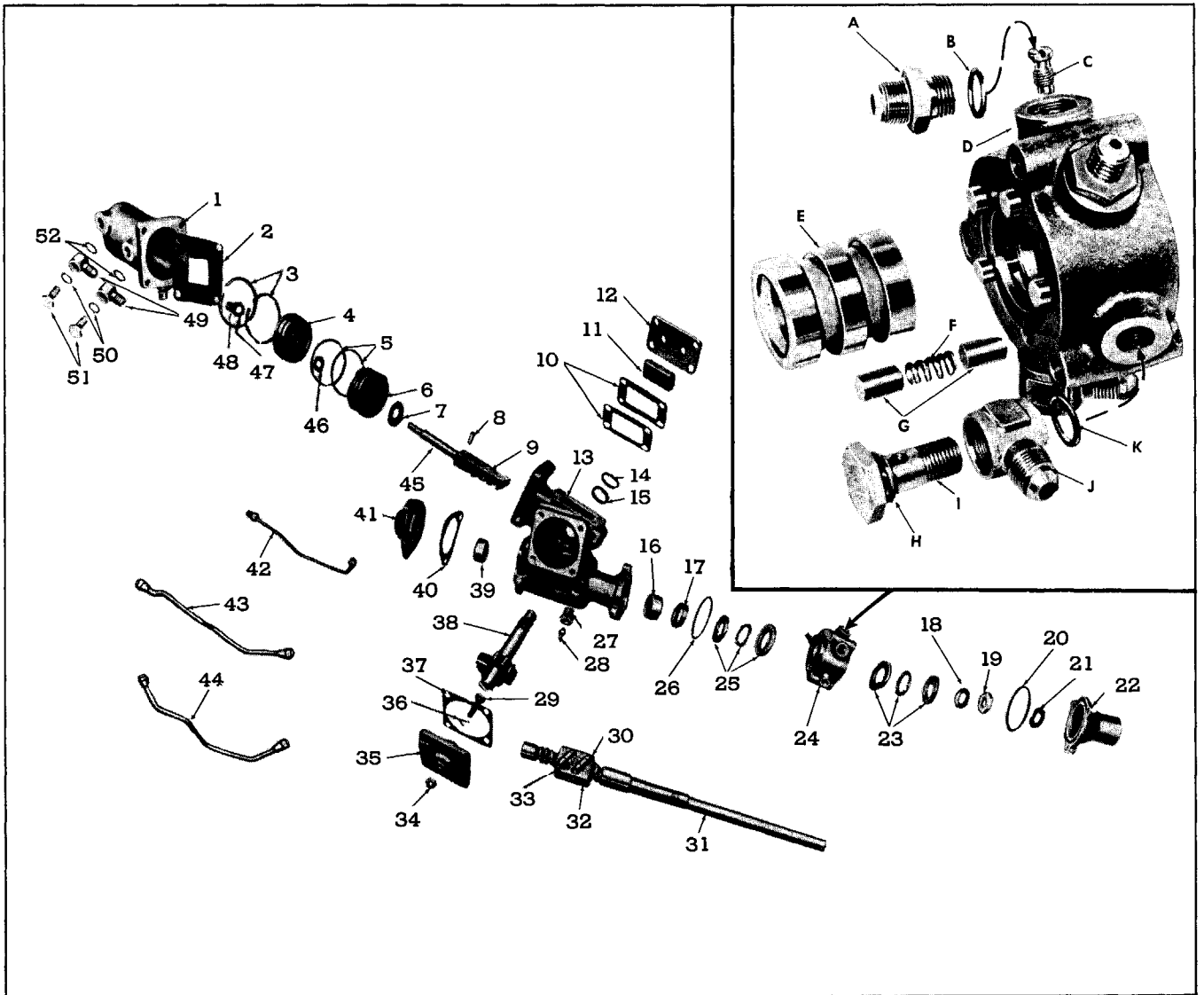


Fig. 9-32 Removing Valve Body and Spool Valve



EXPLODED VIEW POWER STEERING GEAR

- | | | | |
|---------------------------------------|---|-------------------------------------|---------------------------------------|
| 1. Power Cylinder | 16. Steering Gear Housing
Worm Bearing | H. "O" Ring Seal | 38. Pitman Shaft |
| 2. Cylinder Gasket | 17. Steering Gear Housing
Worm Seal | I. Universal Elbow Bolt | 39. End Cover Worm Bearing |
| 3. Piston Rings | 18. Bellville Washer | J. Universal Elbow | 40. End Cover Gasket |
| 4. Power Cylinder Piston | 19. Thrust Bearing Nut | K. "O" Ring Seal | 41. End Cover |
| 5. "O" Ring Seals | 20. "O" Ring Seal | 25. Thrust Bearing Assembly | 42. By-Pass Pipe |
| 6. Power Cylinder Adapter | 21. Valve Cover Seal | 26. "O" Ring Seal | 43. Valve to Base
of Cylinder Pipe |
| 7. Power Rack Stop Plate | 22. Valve Body Cover | 27. Bushing | 44. Valve to Head
of Cylinder Pipe |
| 8. Piston Rod to Rack
Retainer Pin | 23. Thrust Bearing Assembly | 28. Housing Vent | 45. Piston Rod |
| 9. Power Rack | 24. Valve Body Assembly | 29. Pitman Shaft Adjusting
Screw | 46. Thrust Washer |
| 10. Power Rack Cover Shims | A. Return Line Union | 30. Ball Nut Guide | 47. Thrust Washer |
| 11. Power Rack Guide | B. "O" Ring Seal | 31. Steering Shaft | 48. Piston Rod Lock Nut |
| 12. Power Rack Cover | C. Check Valve | 32. Ball Nut | 49. Universal Elbows |
| 13. Steering Gear Housing | D. Valve Body | 33. Ball Nut Guide Clamp | 50. "O" Ring Seals |
| 14. Pitman Shaft Seal
Retainer | E. Spool Valve | 34. Adjusting Screw Nut | 51. Universal Elbow Bolts |
| 15. Pitman Shaft Seal | F. Spring | 35. Housing Side Cover | 52. "O" Ring Seals |
| | G. Plungers | 36. Adjusting Screw Shim | |
| | | 37. Side Cover Gasket | |

Fig. 9-33 Power Steering Gear—Exploded View

3. Remove adjusting screw from slot in pitman shaft. Make sure shim found on adjusting screw is kept with screw.

4. Remove pitman shaft and gear from housing using caution to prevent splines from damaging pitman shaft seal in housing.

5. Scribe mark on cylinder and housing and remove cylinder to gear housing screws. Remove cylinder and gasket, guiding power rack through hole in housing.

DISASSEMBLY OF CYLINDER (FIG. 9-33)

1. Place power rack in a vise with jaws against sides of rack and pull cylinder off adapter and piston assembly (Fig. 9-34). Do not place machined surfaces of rack in jaws.

2. With power rack still in vise, remove piston rod lock nut, thrust washer, piston with rings, thrust washer, and adapter assembly.

3. Remove stop plate from adapter assembly.

4. Remove large "O" ring seals from adapter if necessary to replace.

5. Remove piston rod seal from adapter if defective.

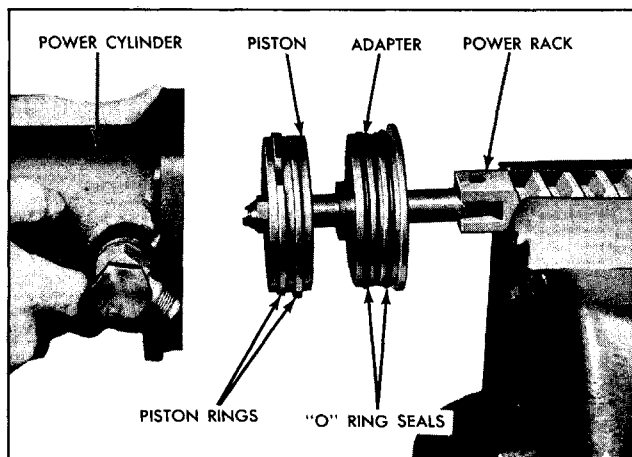


Fig. 9-34 Removing Cylinder From Adapter and Piston

DISASSEMBLY OF STEERING GEAR HOUSING (FIG. 9-33)

1. Remove three end cover attaching screws and remove cover with roller bearing and gasket.

2. Using puller tool J-5190, remove roller bearing from end cover (Fig. 9-35), if it is to be replaced.

3. Slide steering shaft and ball nut, as an assembly, out of gear housing (Fig. 9-36).

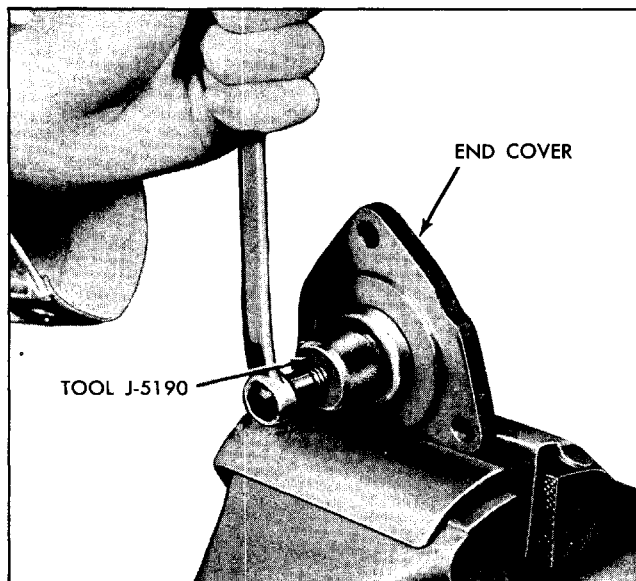


Fig. 9-35 Removing Bearing From End Cover

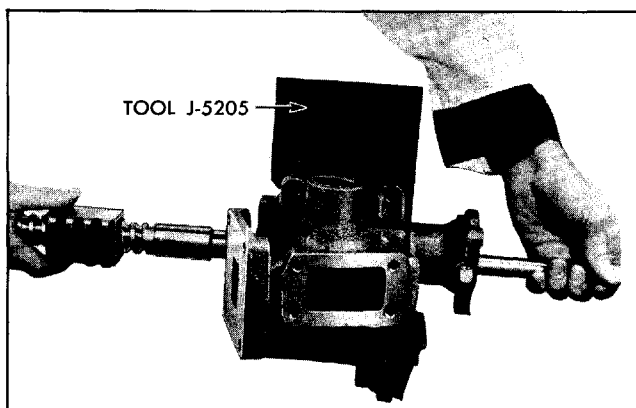


Fig. 9-36 Removing Steering Shaft and Ball Nut

4. Remove guide clamp, guides and balls from ball nut and remove ball nut from steering shaft.

5. Remove steering gear housing worm bearing if it is to be replaced, by driving bearing down from upper end of housing.

6. Remove pitman shaft seal from housing if damaged.

7. If replacement is required, remove worm bearing seal from housing upper flange with offset screwdriver (Fig. 9-37).

INSPECTION OF PARTS

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

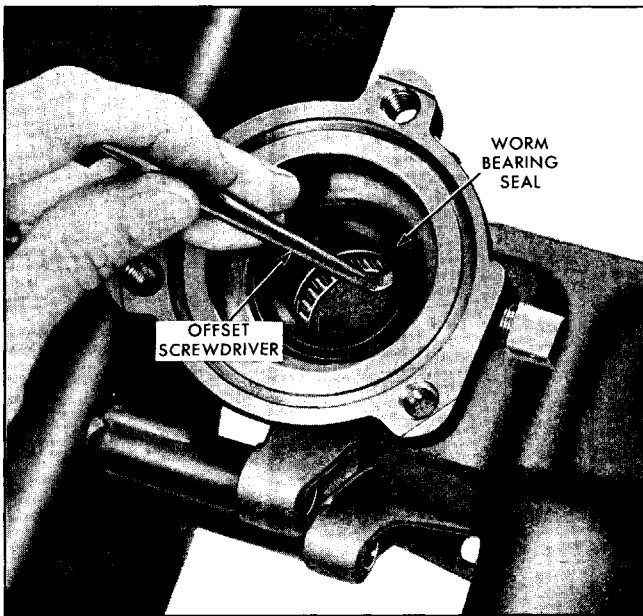


Fig. 9-37 Removing Seal From Housing Upper Flange

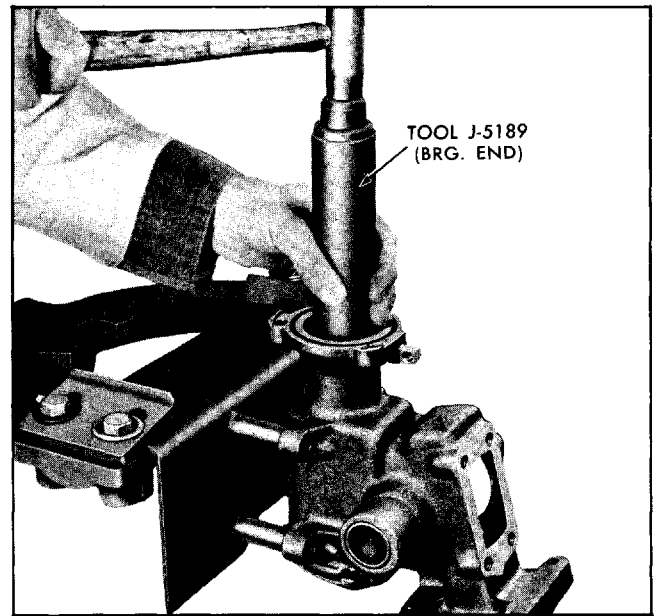


Fig. 9-38 Installing Seal in Housing Upper Flange

2. Inspect bearings, bushings, seals, teeth, for scoring, wear, pitting, etc., which would necessitate replacement.

3. All "O" ring seals and gaskets should be carefully inspected and replaced if necessary.

4. Inspect power rack and piston rod assembly to ensure that link pin is securely staked.

5. Install 21 balls in each circuit of ball nut (rock steering shaft slightly to aid in installing balls) and install 9 balls in each return guide using petrolatum to hold balls in place. Install return guides, clamp and screw. **CAUTION:** Do not rotate shaft while installing balls, since balls may enter crossover passage between circuits. This will cause improper operation of ball nut.

ASSEMBLY OF POWER STEERING GEAR

ASSEMBLY OF GEAR HOUSING (FIG. 9-33)

NOTE: Steps 1-3 apply only if seal and bearings are being replaced. All seals and bearings should be pre-lubricated before installation.

1. Install new seal in housing upper flange using tool J-5189 (Fig. 9-38). Use soft hammer to prevent damage to tool.

2. Install new bearing in housing using soft hammer (to avoid damaging tool) and installing tool J-5189 (Fig. 9-39). (Side of bearing with trademark should be against tool.)

3. Press new bearing into end cover using tool J-5191 (Fig. 9-40). (End with trademark should be up.)

4. Position ball nut on shaft with teeth up so wide or large spaces are toward you when upper end of shaft is toward your right (Fig. 9-41).

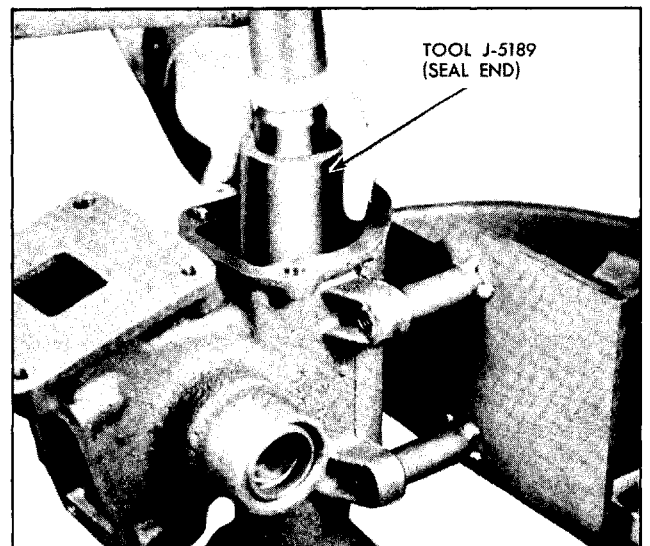


Fig. 9-39 Installing Bearing in Housing

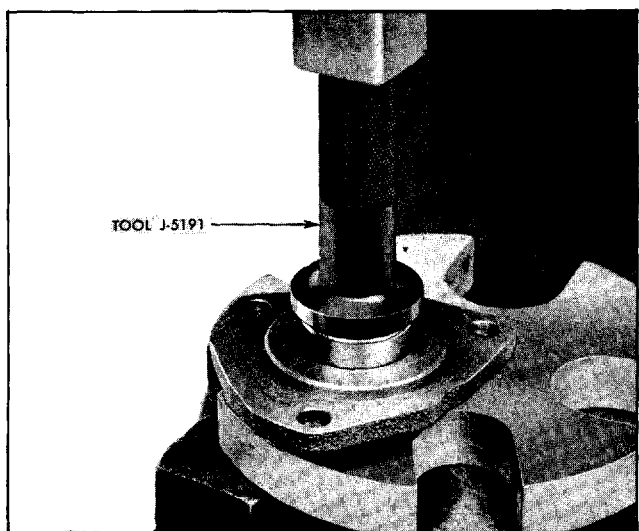


Fig. 9-40 Installing Bearing in End Cover

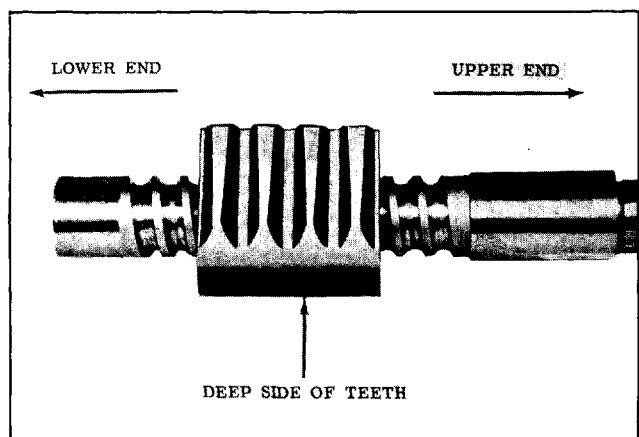


Fig. 9-41 Ball Nut Properly Installed on Shaft

6. Run ball nut to upper end of worm, then slide steering shaft and nut into housing with tool J-5210 in place on upper threads of steering shaft to protect upper housing seal (Fig. 9-42).

7. Install end cover with gasket on housing and tighten screws.

ASSEMBLY OF VALVE BODY (FIG. 9-33)

1. Install check valve in return line of valve body. Install "O" rings on return line union and install union in valve body.

2. Place valve body on table so that lettering on bosses for oil lines faces up.

3. Very carefully install spool valve in body with shallow, counterbored end of spool up. (When installed on steering gear, this end must be toward steering wheel.)

INSTALLATION OF VALVE BODY AND COVER (FIG. 9-33)

1. Install small bearing race, bearing, and large bearing race on steering shaft.

2. Install new "O" ring seal in groove in housing flange, if removed.

3. Slide valve body assembly over steering shaft with counterbored end of spool valve and lettering on oil line bosses toward upper end of shaft.

4. Install plungers and springs in valve body; finished surfaces of plungers should face outside of body.

Some early production 1955 power steering gears will be equipped with 1954 valve assemblies. The valve centering springs and plungers are also interchangeable; that is, 1954 springs and plungers may be used as replacement parts in 1955 valve assemblies and vice-versa.

Because of the difference in lengths of springs and plungers for these two years it is imperative that these parts be replaced in sets. A "set" in this instance means two plungers and one spring.

The part numbers, lengths, and identification features of the springs and plungers for 1954 and 1955 are given in Fig. 9-43.

5. Align scribe marks on body with scribe marks on housing, place valve body retaining collar J-5182 over valve body, install valve body to housing screws, and tighten (Fig. 9-44).

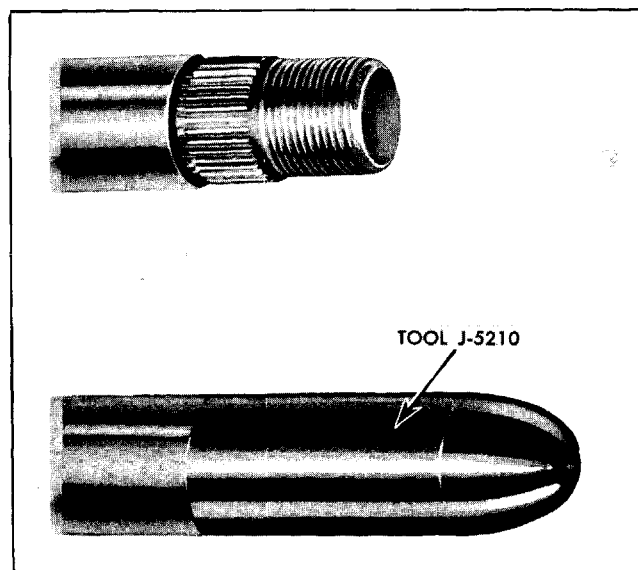


Fig. 9-42 Tool J-5210 Installed on Steering Shaft

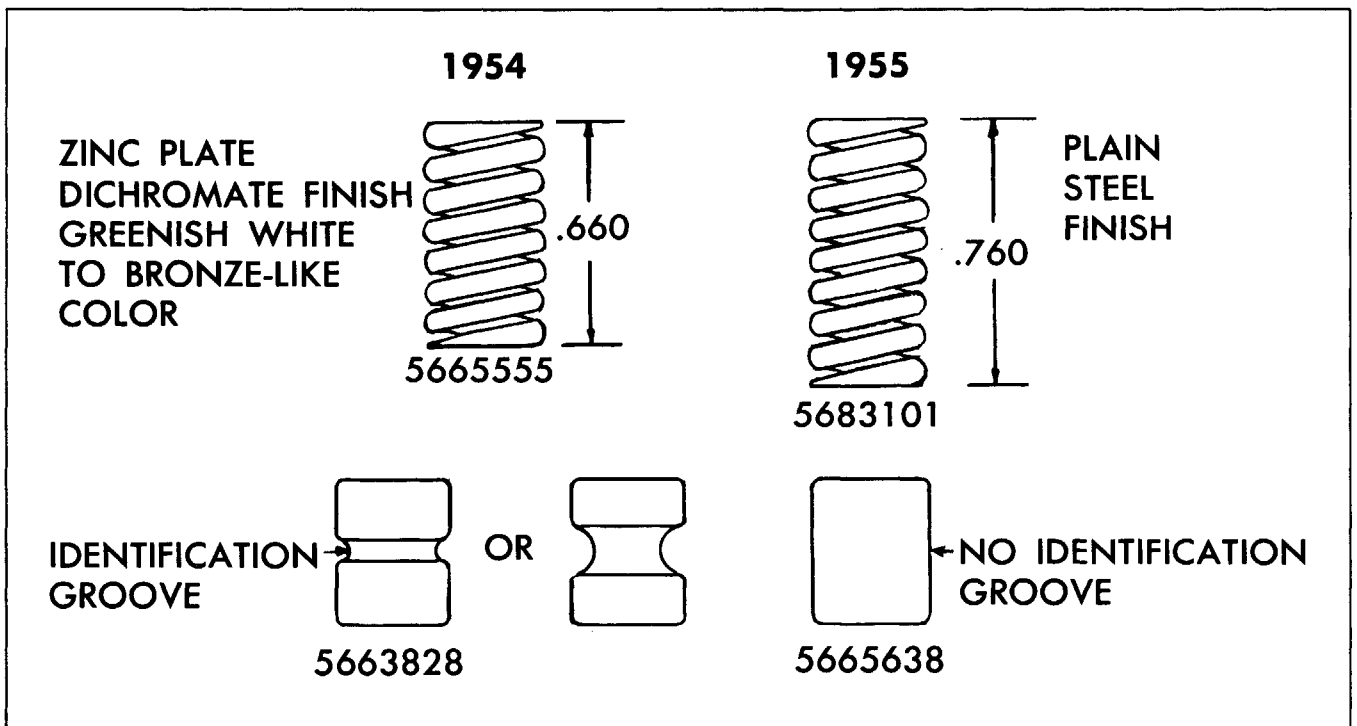


Fig. 9-43 Comparison of 1954 and 1955 Power Steering Valve Centering Springs and Plungers

6. Install large bearing race, bearing, and small bearing race against valve body.

7. Install special spring type washer with concave face toward bearing and thrust bearing nut loosely. Use new nut.

8. Worm Bearing Adjustment.

a. Install steering wheel and turn counterclockwise to stop. Maintain constant pressure on the wheel to compress plunger springs.

b. Tighten locknut against spring washer (and spool valve) 20 to 30 lb. ft. torque, making sure the thrust bearings are properly seated and then back off nut $\frac{1}{4}$ to $\frac{1}{3}$ turn and stake in place. Use crowfoot wrench tool J-5680 and torque wrench (Fig. 9-45). To check bearings rotate the gear in each direction, observing for freedom of movement. Any bind or drag is indicative of improperly seated bearings.

The pull at the rim of the steering wheel to turn steering shaft through a 3" arc at the rim will be approximately $\frac{1}{2}$ to $\frac{3}{4}$ lb. This includes seal drag.

c. Remove steering wheel and remove retaining collar J-5182 from valve body.

9. Install new seal in valve body cover, if seal was removed, using tool J-5188 (Fig. 9-46).

10. Install "O" ring seal in valve body cover, if

seal was removed.

11. Install valve cover, column jacket and gearshift controls as an assembly. Be sure parts are lined up as indicated by scribed marks on housing, body and cover, and install cover attaching screws.

ASSEMBLY OF POWER CYLINDER (FIG. 9-33)

1. Install new seal in adapter if seal was removed.
2. Install "O" ring seals on adapter, if removed.
3. Slide stop plate over piston rod.

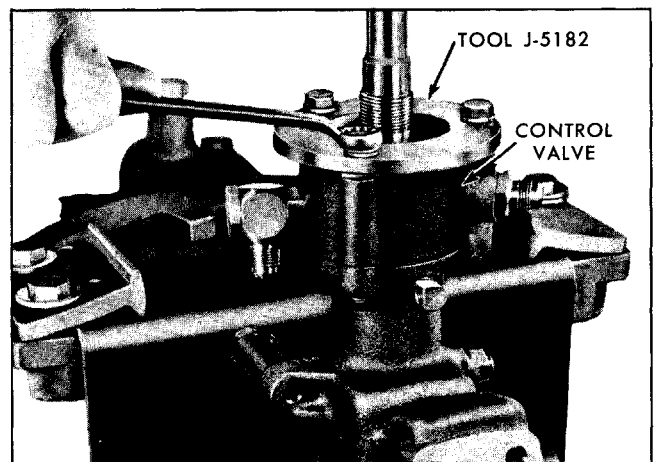


Fig. 9-44 Installing Tool J-5182 on Valve Body Cylinder

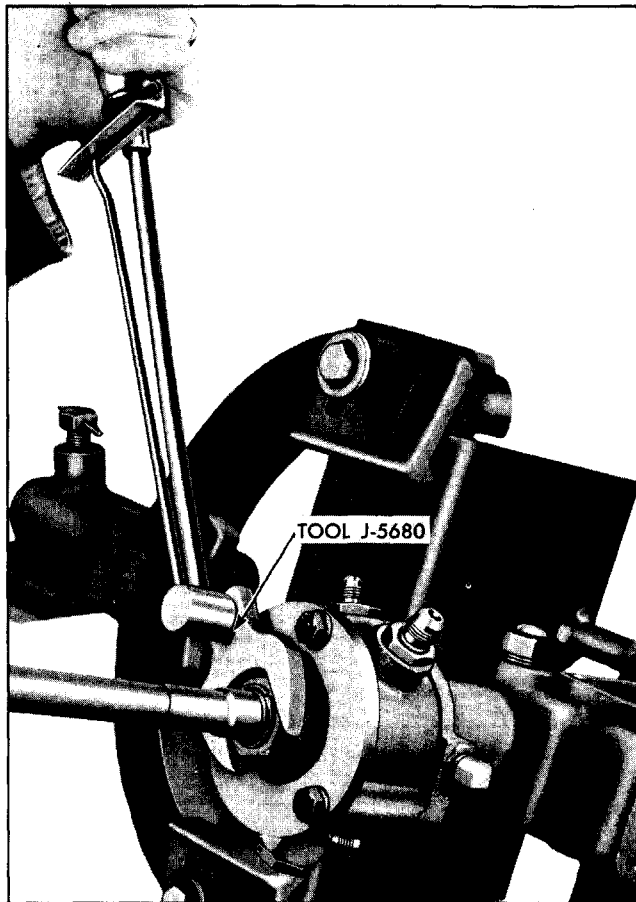


Fig. 9-45 Adjusting Thrust Bearing Nut Using Tool J-5680

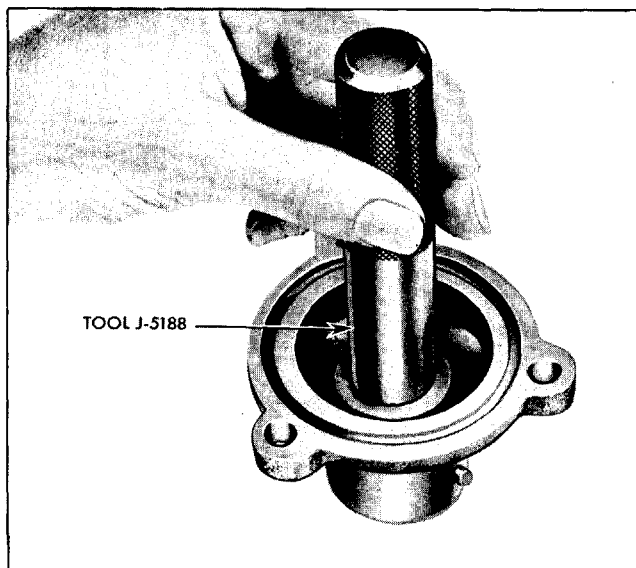


Fig. 9-46 Installing Seal in Valve Body Cover

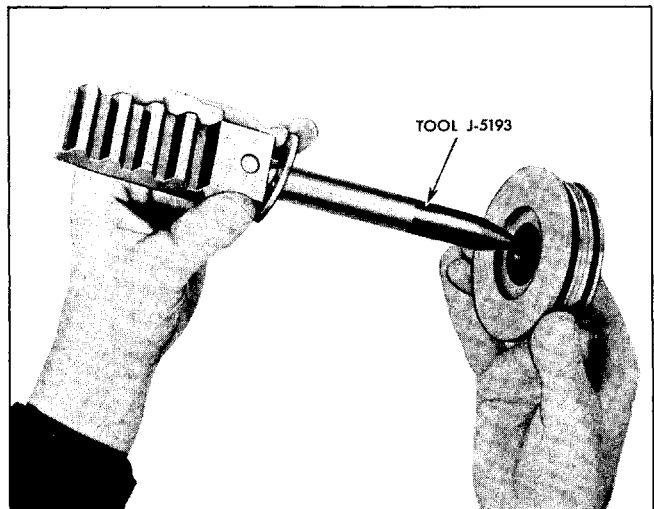


Fig. 9-47 Installing Adapter on Piston Rod

4. Install tool J-5193 over threaded end of piston rod and slide adapter over piston rod (Fig. 9-47). Remove tool.

5. Install thrust washer on piston rod.

6. Install piston assembly on rod (either side out).

7. Install thrust washer and nut on piston rod and tighten securely with rack in vise. Vise jaws should be against sides of rack.

8. Install piston and adapter assembly into cylinder using tool J-5168-A to compress piston rings (Fig. 9-48). Hold adapter against power rack while installing piston to prevent ring compressor from cutting "O" ring seals. **NOTE:** Position ring gaps on opposite sides of piston.

9. Remove ring compressor and carefully slide adapter with seals into cylinder.

10. Push power rack and piston assembly into cylinder as far as possible.

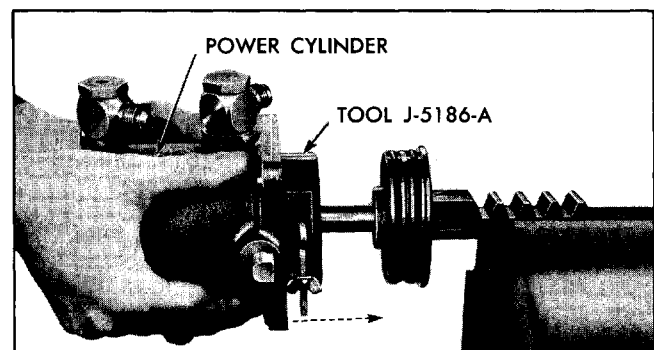


Fig. 9-48 Installing Piston and Adapter in Cylinder

INSTALLATION OF CYLINDER ASSEMBLY ON GEAR HOUSING (FIG. 9-33)

1. Place gasket on cylinder and guide power rack through opening in gear housing with teeth on rack pointing toward center of housing.
2. With scribe marks on cylinder and housing aligned, install cylinder to housing attaching screws.
3. Turn steering wheel clockwise to run ball nut to upper end of its travel.
4. Install pitman shaft seal in housing if seal was removed.
5. Install pitman shaft in housing with tapered teeth contacting ball nut, engage first tooth of gear with first tooth of power rack and worm gear ball nut as shown in Fig. 9-49.
6. Install pitman shaft adjusting screw with shim in slot of pitman shaft. Fit of adjusting screw in slot should be from no play to .002" loose. If end play of screw in slot is incorrect, select new shim to give proper clearance. Shims are furnished in four thicknesses (.063", .065", .067", .069").
7. Install side cover with gasket on adjusting screw, turning screw counterclockwise until it projects through cover $\frac{5}{8}$ " to $\frac{3}{4}$ " with cover seated against housing.
8. Install cover attaching screws.
9. Install adjusting screw nut loosely.
10. Install power rack guide, with same number of spacing shims as were removed, and leave attaching screws loose.
11. Connect by-pass pipe to fittings in cylinder and gear housing flange.
12. Install cylinder to valve body pipes. Use new "O" ring seals at each elbow if replacement was necessary and tighten elbow bolts to 20-30 lb. ft. torque.
13. Adjust pitman shaft end play (page 9-13).
14. Adjust power rack guide (page 9-13).

INSTALLATION OF POWER STEERING GEAR IN CAR

1. With hairpin spring retainer removed, move brake pedal as far to right as it will go.
2. Push steering connecting linkage down and toward rear and install steering gear assembly by guiding between lower control arm and steering connect-

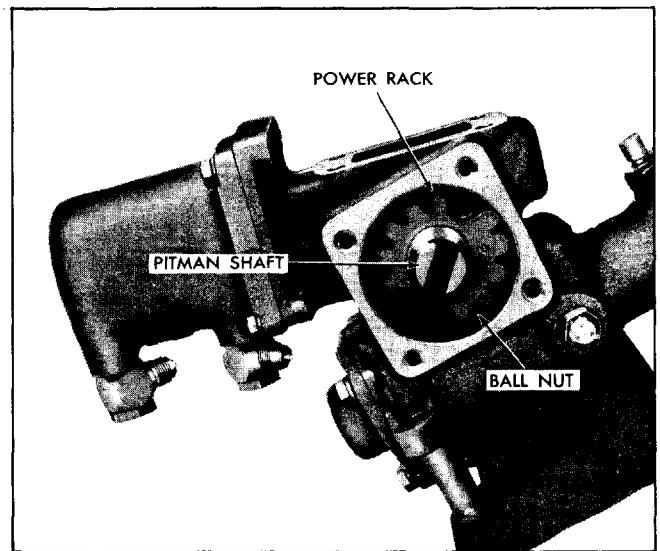


Fig. 9-49 Pitman Shaft Correctly Installed

ing linkage. Remove tool J-5571 hold down hook.

3. Install top front steering gear housing to frame bolt with lockwasher finger tight. **CAUTION:** Be sure to install shims which were between steering gear housing and frame when unit was removed.
4. Install steering column lower bracket with lockwashers and bolts to upper bracket on instrument panel.
5. Install two remaining steering gear housing to frame bolts with plain and lockwashers and tighten all three bolts.
6. Check for correct shimming of steering gear housing to frame by seeing if steering column aligns with upper bracket when bracket bolts are loosened. If alignment is correct, tighten steering column bracket bolts. **NOTE:** If misalignment exists, it will be necessary to change steering gear housing to frame shims to correct alignment.
7. Position brake pedal and install hairpin retaining spring.
8. Connect direction signal wires.
9. Connect power steering oil lines to gear.
10. Connect gear shift and selector rods.
11. Install engine left side pan.
12. Install pitman arm and secure with lockwasher and nut. Tighten nut to 110 to 125 lb. ft. torque.
13. Install starter motor.

14. Install neutralizer and back-up light switch on Hydra-Matic equipped cars.

15. Install pedal plates, floor mat and position steering column jacket rubber grommet on floor.

16. Install direction signal switch handle and gear-shift lever.

17. Install steering wheel.

18. Fill steering gear housing with All-Season Steering Gear Lubricant.

19. Check fluid level in pump reservoir. Fluid should be up to mark near top of reservoir. If not, add Hydra-Matic Fluid or Automatic Transmission Fluid identified by an AQ-ATF qualification number. Start engine and bleed hydraulic system by manually steering through cycles several times (with front wheels off floor) until there is no evidence of air bubbles in reservoir. Recheck fluid level.

REMOVAL OF PUMP FROM CAR

1. Cover generator to protect it from accidental spillage of oil.

2. Remove reservoir cover attaching bolt, lock-washer, and plain washer, and remove reservoir cover and gasket. Use care not to lose bolt guide and gasket.

3. Remove oil in pump reservoir.

4. Disconnect lines if not done in Step 3 and secure ends of lines up high to avoid spilling oil.

5. Remove pulley to pump shaft attaching nut and washer. Hold pulley hub with $1\frac{5}{16}$ " open end wrench.

6. Loosen two bolts attaching pump to bracket. Remove pulley. **NOTE:** Do not remove key from shaft unless damaged.

7. Remove pump to bracket attaching bolts and remove pump from car.

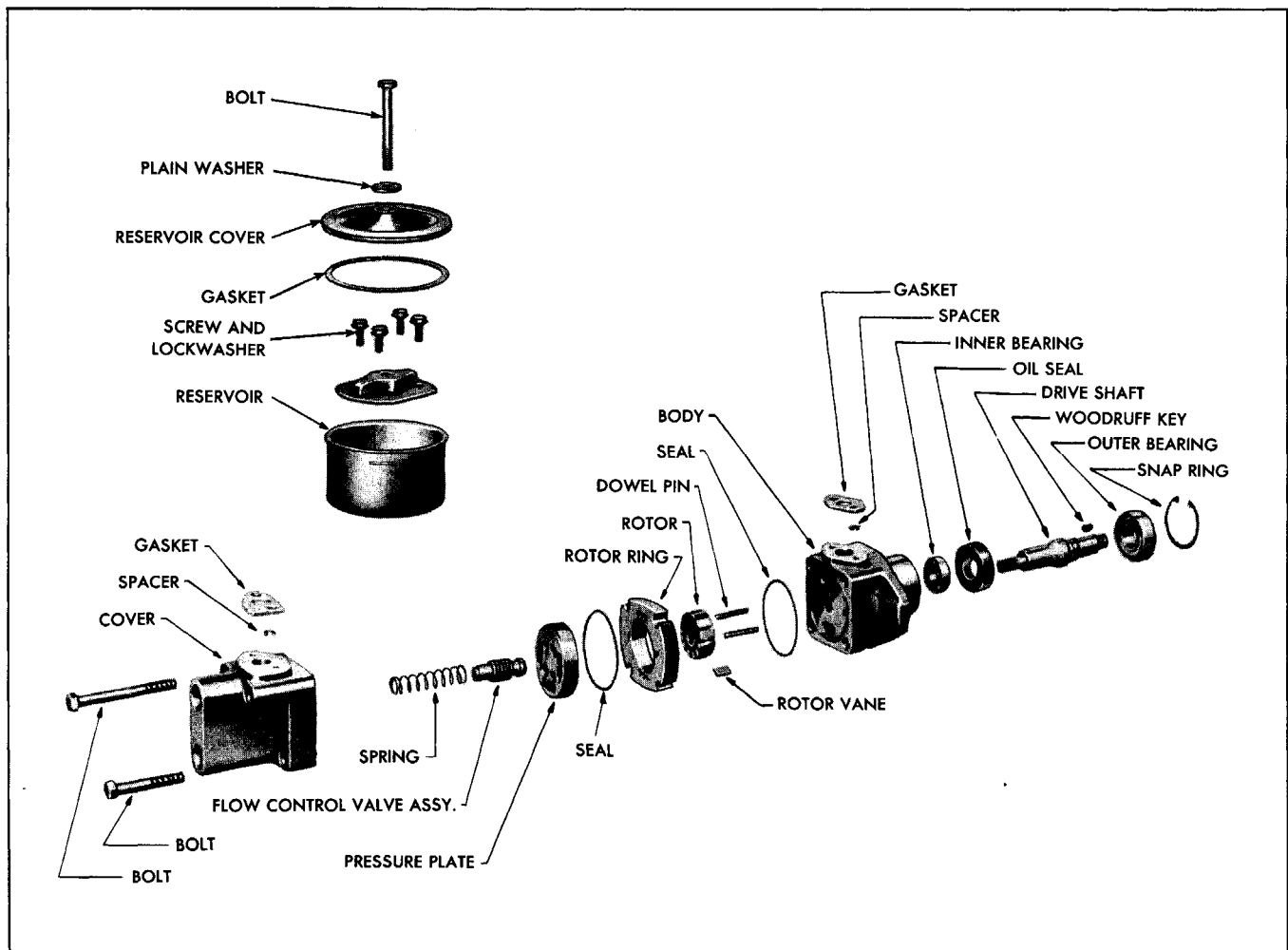


Fig. 9-50 Power Steering Pump—Exploded View

DISASSEMBLY OF PUMP

Clean exterior of pump using care to prevent dirt and foreign material from entering pump. A clean sheet of paper should be used on bench to keep pump parts clean.

1. Remove reservoir body from pump body and cover (Fig. 9-50). Use care not to lose spacers and reservoir to body and cover gaskets.

2. Remove four pump cover to pump body attaching bolts, and carefully remove pump cover with flow control valve and spring.

3. Lift pressure plate off dowel pins extending through rotor ring and remove rotor ring "O" ring seal.

4. Remove rotor ring from dowel pins and remove rotor, vanes and second rotor ring "O" ring seal. Remove dowel pins from pump body.

5. Remove outer bearing snap ring from groove in pump body using tool J-4245.

6. Properly support pump body and remove drive shaft and outer bearing by tapping on end with soft hammer.

7. If drive shaft seal or inner bearing is to be replaced, seal must be removed using a punch. The inner bearing is removed by lightly tapping on inner race.

8. Disassemble flow control and relief valve, maintaining pressure on spring loaded plug to prevent loss of poppet ball. Use care not to score ground surfaces of flow control valve (Fig. 9-51).

9. Union fittings in cover should only be removed if "O" ring seals leak or fittings are damaged.

CLEANING AND INSPECTION OF PUMP PARTS

1. Wipe bearing and shaft assembly with clean cloth; do not soak in cleaning solvent as the lubricant sealed into bearing may be diluted by solvent. Wash all other parts in clean kerosene or other solvent and wipe dry with clean lint-free cloth.

2. Inspect drive shaft for wear and check both ball bearings for roughness or noisy operation. If outer bearings must be replaced, press off shaft with tool J-5573 (Fig. 9-52).

3. Check fit of vanes in slots of rotor; vanes must slide freely but snugly in slots. Tightness may be

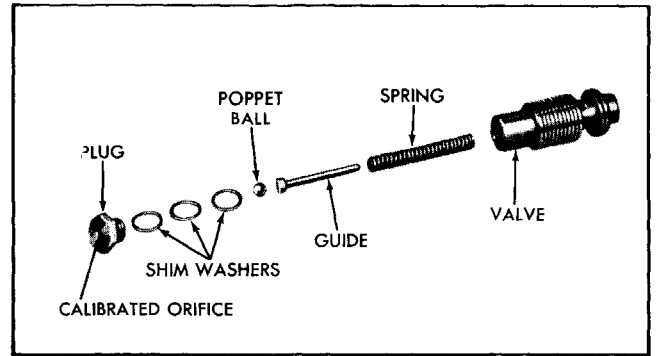


Fig. 9-51 Flow Control Valve—Exploded View

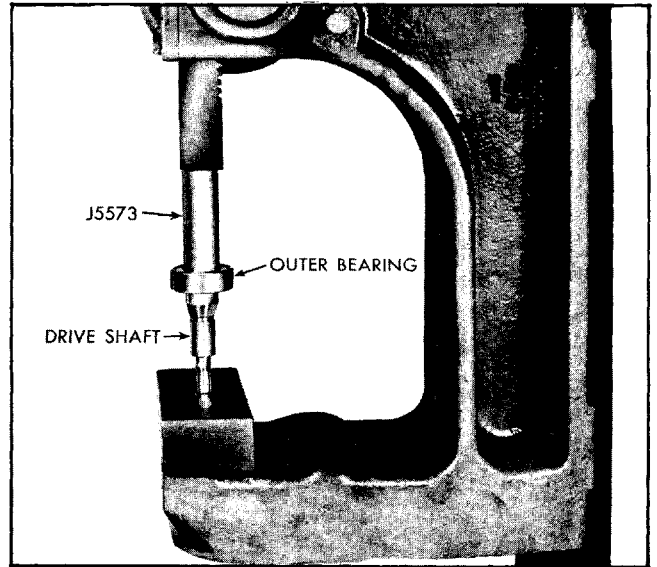


Fig. 9-52 Installing Outer Bearing on Shaft

relieved by thorough cleaning, or removal of irregularities. Replace rotor if excessive looseness exists between rotor and vanes, and replace vanes if worn or scored.

4. Inspect all ground surfaces of rotor ring for roughness or irregular wear. Slight irregularities may be removed with a hard stone. Replace ring if inside cam surface is scored or worn.

5. Inspect flat faces of the pressure plate and pump body for wear or scoring. Light scores may be smoothed by lapping, after which all lapping compound must be thoroughly washed away.

6. Inspect ground surfaces of flow control valve, paying particular attention to seating surfaces. Check freedom of movement of flow control valve within its bore. Slight irregularities may be corrected by lapping or polishing.

7. Inspect all passages in cover and body for obstructions or dirt.

ASSEMBLY OF PUMP

Before assembling, make sure all parts are absolutely clean, and lubricate all moving parts with clean Hydra-Matic fluid. All "O" ring seals removed should be discarded.

1. Install inner bearing (Fig. 9-50) in pump body by tapping lightly on bearing outer race.
2. Position new drive shaft seal in body, being sure the chamfered side (side with two $\frac{1}{16}$ " holes) is facing out. **NOTE:** Use a pipe or shaft $1\frac{3}{4}$ " in diameter to apply pressure to outer edge of seal during installation. Apply a small amount of Hydra-Matic fluid to lip of seal.
3. If removed, install outer bearing on shaft using tool J-5573 (Fig. 9-52).
4. Install shaft and bearing assembly in pump body using care to avoid damaging lip of seal. Tap lightly on outer race of outer bearing until bearing is seated and install snap ring with flat side of snap ring against outer bearing race.
5. Install dowel pins in pump body.
6. Install rotor over splines on drive shaft and assemble vanes in rotor with radius edge outward.
7. Install new rotor ring "O" ring seal in groove of pump body. Carefully position rotor ring over rotor and vanes. **CAUTION:** Arrows on rotor ring must be pointing in a clockwise direction when ring is assembled to pump body and viewed from the front.
8. Position pressure plate over dowel pins and on rotor ring.
9. Place new rotor ring "O" ring seal around pressure plate surface of rotor ring.
10. Assemble flow control and relief valve (Fig. 9-51). Be sure to install all shim washers which were originally used, as altering shim thickness will change relief pressure.
11. Install flow control valve spring and valve in pump cover and assemble cover to body with four attaching bolts. Tighten to 25-30 lb. ft. torque.
12. If removed, install new "O" ring seals on union fittings and install fittings.
13. Position cork gaskets with spacers on pump body and cover, and install reservoir. Secure reservoir with four hex-head screws and tighten to $3\frac{1}{2}$ -4 lb. ft. torque.

14. Install reservoir cover gasket, cover, and secure with vent washer and reservoir cover attaching bolt. Plug or mask union fittings. These precautions are taken to exclude dirt or foreign material from pump until it is installed.

INSTALLATION OF PUMP ON CAR

1. Position pump on pump bracket and install two attaching bolts with plain washers and lockwashers, but do not tighten bolts.
2. Install new key if required and slide pulley on shaft and secure with washer and self-locking nut. Hold pulley hub with $1\frac{5}{16}$ " open end wrench and tighten nut to 50-55 lb. ft. torque.
3. Remove plug or masking from union fittings and connect oil lines to fittings.
4. Position pump drive belt over pulley and adjust pump belt tension (page 9-14).
5. Refill with fluid and cycle steering several times to discharge air from system.

TROUBLE DIAGNOSIS AND TESTING

Before performing diagnosis, oil level in pump reservoir should be checked with engine idling after steering has been cycled several times. Oil level should be up to mark on side of reservoir. If low add Hydra-Matic Fluid or Automatic Transmission Fluid identified by an AQ-ATF qualification number.

STEERING KNOCKS WHILE TURNING WITH ENGINE RUNNING

- Improper pitman shaft adjustment.
- Improper power rack adjustment.
- Improper thrust bearing adjustment.

STEERING WHEEL SURGES OR JERKS WHEN TURNING WITH ENGINE RUNNING

- Loose pump belt.

NOISY PUMP AFTER REFILLING RESERVOIR

Air in system, bleed by lifting wheels off floor and turning through several cycles. Be sure pump pulley to shaft nut or bolt is properly tightened.

NOTE: Cycling may not discharge all air immediately and pump will be noisy until entire system has been freed of trapped air.

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 of 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 10 pounds with oil at normal operating temperature of approximately 170°.

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 10 pounds (with 150° to 170° oil temperature) when checked with spring scale J-5178, make the following checks:

1. Check pump drive belt tension and adjust as outlined on page 9-14.
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 gear adjustments for being tight. Adjust accordingly.
6. Spot check all lines and gear for signs of leakage.
7. If the above mentioned checks and their corrections do not eliminate the difficulty, perform pressure test.

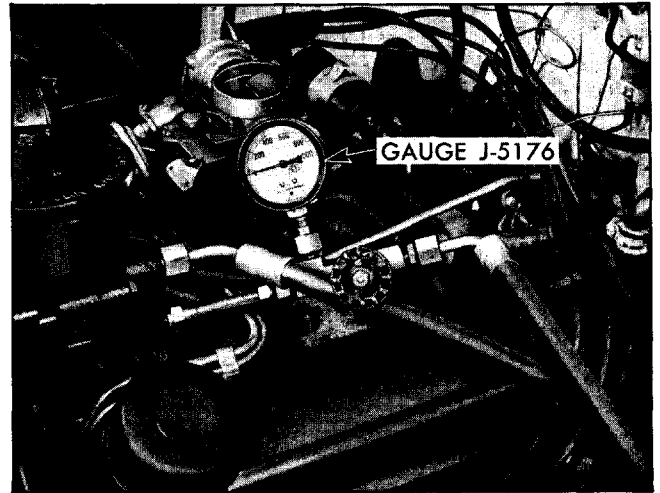


Fig. 9-53 Pressure Gauge J-5176 Installed

PRESSURE CHECK

TEST NO. 1

1. Install 0-1000 pound gauge, tool J-5176, in pressure line between pump and gear (Fig. 9-53). Turn valve to "open" position.

2. Turn steering wheel from one stop to the other and note pressure on gauge while turning wheel. Especially note maximum pressure that can be built up with steering wheel held momentarily in either extreme right or extreme left position. This maximum pressure reading should not be less than 650 lbs. with engine idling at 375 RPM, and oil temperature in reservoir between 150° to 170°. **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 an extended period of time.

If maximum pressure is below 650 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 gear alone or if both are at fault, proceed with TEST NO. 2.

TEST NO. 2

1. With engine idling at 375 RPM, turn shut-off valve of gauge J-5176 to closed position.

2. Observe and compare maximum pump pressure at idle when turning wheel to extreme left and right. It should not be less than 650 lbs. **NOTE:** By comparing this reading with TEST NO. 1, it is possible to determine whether fault is with pump or steering gear, or both as follows:

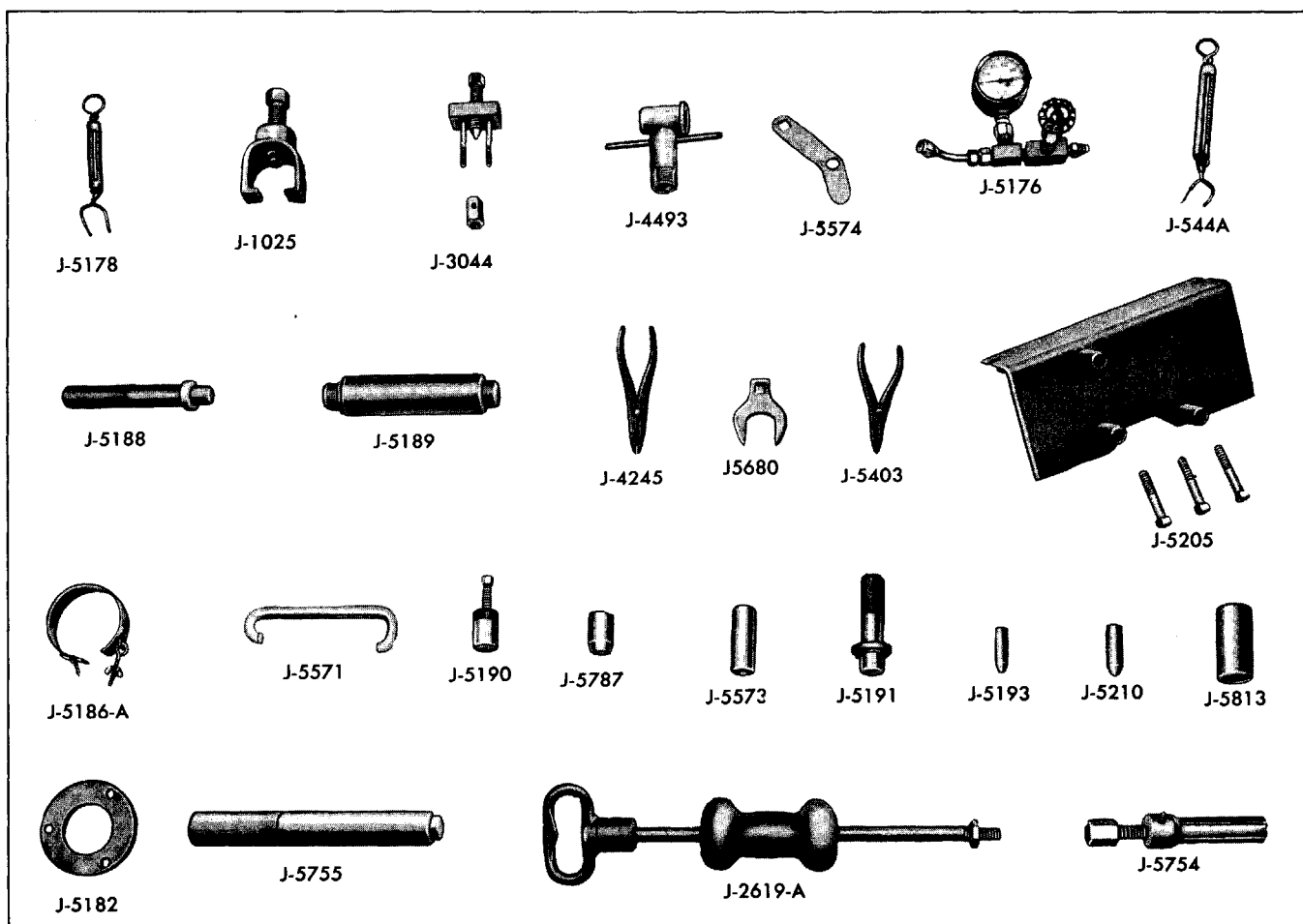
TEST RESULTS	DIAGNOSIS
1. First Test—below 650 lbs. Second Test—normal 650 lbs. minimum	Defective steering gear
2. First Test—below 650 lbs. Second Test—not more than 50 lbs. greater than first test.	Defective pump
3. First Test—below 650 lbs. Second test—more than 50 lbs. greater than first test, but below 150 lbs.	Defective steering gear and pump

TORQUE SPECIFICATIONS

	Lb. Ft. Torque
Tie rod clamp nuts	18-20
Idler lever nut and bushing	100
Steering gear pitman arm nut	110-125
Steering wheel to shaft nut	25-30
Reservoir to pump body screws	3.5-4.0
Pump belt tension	Page 9-14
Pulley hub to pump shaft nut (Vane type)	50-55
Pump cover bolts	8-10

SPECIFICATIONS (POWER STEERING)

Type	Saginaw Recirculating Ball Nut
Pump	Rotor type (1953 and early 1954) Vane type (1954)
Pull at steering wheel	10 lbs. maximum
Steering jacket diameter	2 $\frac{3}{8}$ "
Steering gear ratio	19.1:1
Gear mesh adjustment	Shims
Lubricant level—Pump (Hydra-Matic fluid)	Fill to filler line on reservoir
Lubricant level—Steering gear	Fill to bottom of filler plug hole
Lubricant capacity—Steering gear	24 fluid oz.



SPECIAL TOOLS—STEERING

J-5178	Power Steering Wheel Tension Gauge (15 lb. scale)
J-1025	Pitman Arm Puller
J-3044	Steering Wheel Puller
J-4493	Steering Mast Jacket Bearing Remover and Replacer
J-5574	Power Steering Pump Belt Tightener
J-5176	Power Steering Pressure Gauge
J-544A	Steering Gear Checking Scale
J-5188	Power Steering Valve Body Cover Seal Installer
J-5189	Power Steering Housing Upper Seal and Bearing Installer
J-4245	Snap Ring Pliers—Power Steering Pump Shaft Bearing Retainer
J-5680	Power Steering Worm Bearing Adjuster (Crowfoot Adapter)
J-5403	Snap Ring Pliers—Power Steering Relief Valve Retainer
J-5205	Steering Gear Holding Fixture
J-5186-A	Power Steering Piston Ring Compressor
J-5571	Front Suspension Hold Down Hook
J-5190	Power Steering Lower Worm Shaft Bearing Remover
J-5787	Pitman Shaft Seal Protector
J-5573	Power Steering Pump Sealed Bearing Installer
J-5191	Power Steering Lower Worm Bearing Installer
J-5193	Power Steering Piston Rod Inserter
J-5210	Power Steering Shaft Inserter
J-5813	Pitman Shaft Seal Installer
J-5182	Power Steering Valve Body Retainer
J-5755	Steering Shaft Worm Bearing Cup Replacer
J-2619-A	Slide Hammer Assembly (Use with J-5754)
J-5754	Steering Shaft Worm Bearing Cup Remover

