SAGINAW ROTARY VALVE

Chrysler Corp.
(Exc. "B", "CB", "MB" & "PB" Models)
Ford ("E" Models)
General Motors (All Models)
Jeep (All Models)

DESCRIPTION

Steering gear is a recirculating ball type, available in either a constant or a variable ratio design. Steel balls work as a rolling thread between steering gear worm shaft and rack-piston nut. Worm shaft thrust is taken by a thrust bearing and two races at the lower end, and by a bearing in the adjuster plug at the upper end. This design provides continual spring loaded pressure on worm shaft to prevent loss of thrust bearing preload. The adjuster plug provides initial preload adjustment and the service adjustment when repairing gear. As worm shaft is turned right, the rack-piston is moved upward in gear. As worm shaft is turned left, the rack-piston is moved downward in gear. The rack-piston teeth mesh with the sector, which is forged as part of the sector shaft. Rotating the worm shaft moves the sector shaft, which turns the wheels through mechanical linkage. *See Fig. 1.*

LUBRICATION, TROUBLE SHOOTING & TESTING

See Power Steering General Servicing in this section.

ADJUSTMENT

THRUST BEARING PRELOAD

1) This procedure is to be performed with steering gear removed from vehicle. Remove adjuster plug lock nut. Turn adjuster plug clockwise with a suitable spanner wrench till plug is seated in housing. Chrysler Corp. and Jeep vehicles will require about 20 ft. lbs. of torque. Ford and General Motors vehicles require about 30 ft. lbs. of torque to seat adjuster plug.

2) Place an index mark on housing opposite one spanner wrench hole in adjuster plug. Measure ½" counterclockwise from mark and again mark housing. Rotate plug counterclockwise until hole in adjuster lines up with second mark. Tighten locknut, making sure adjuster remains in position.

3) Attach an INCH lb. torque wrench to end of input shaft. Turn input shaft to right stop, then back ¼ turn. Using torque wrench, measure rotational torque required to turn shaft. Reading should be taken with beam of torque wrench near vertical while turning it counterclockwise at an even rate. Torque reading should be 4-10 INCH lbs. *See Fig. 2.*

NOTE – *If reading does not fall within the 4-10 INCH lb. range, the adjuster plug may have turned while lock nut was being tightened. Steering gear may be incorrectly assembled or worm shaft thrust bearings and races may be defective. Repair as required and readjust preload.*

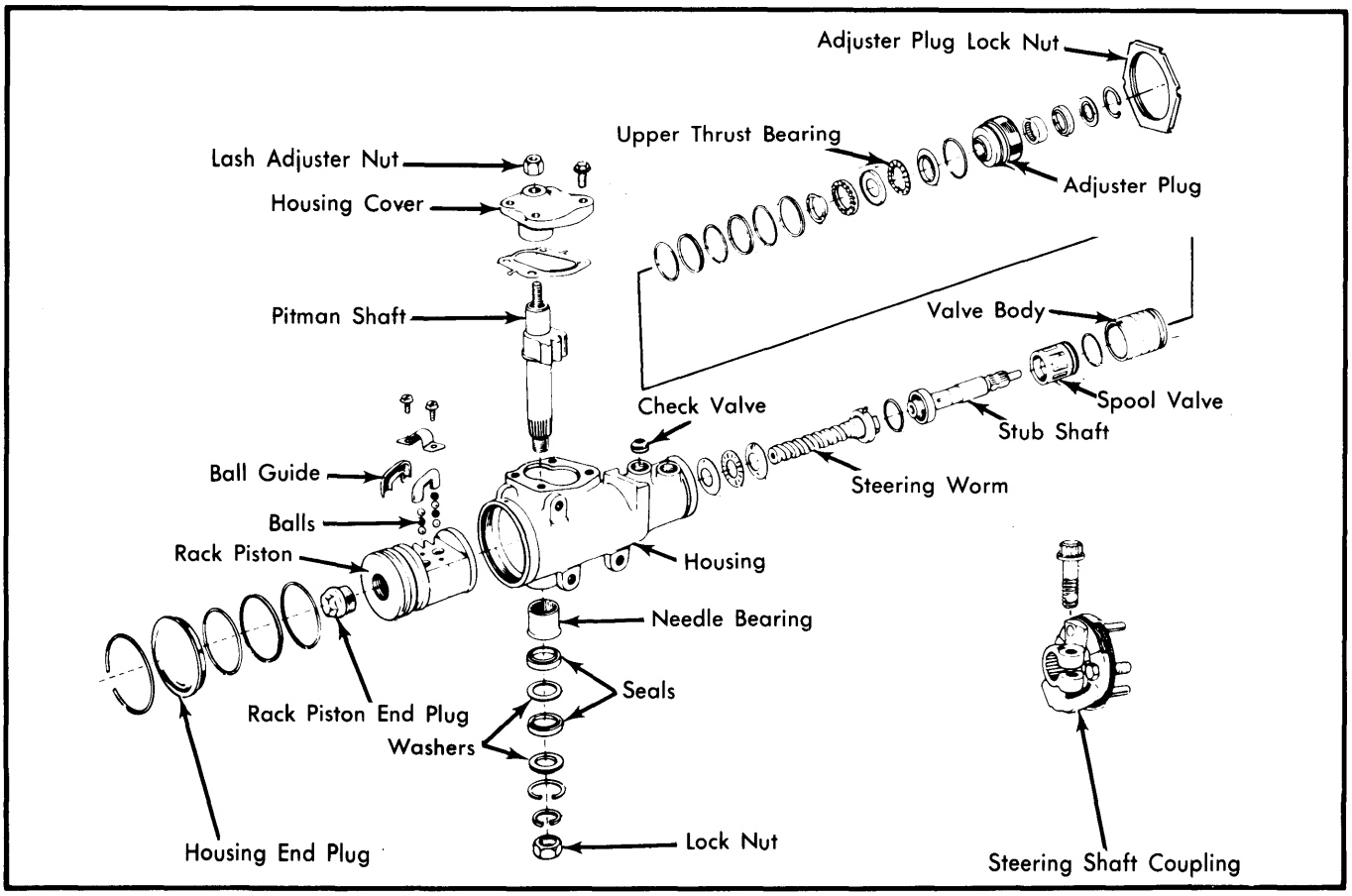

Fig. 1 Exploded View of Saginaw Rotary Valve Power Steering Gear

SAGINAW ROTARY VALVE (Cont.)

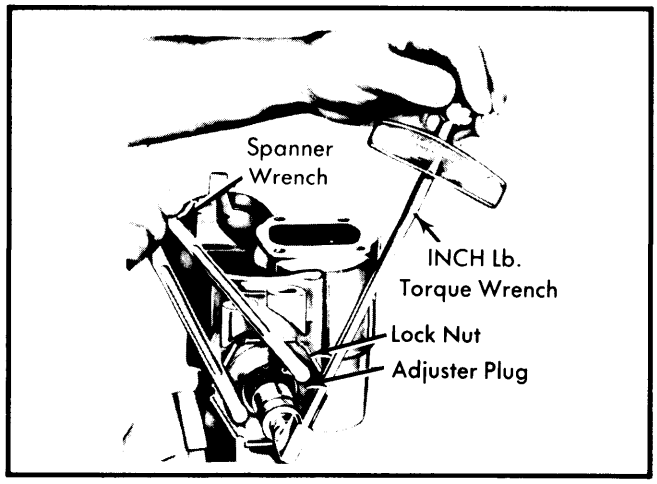

Fig. 2 Measuring Thrust Bearing Preload

OVERCENTER PRELOAD TORQUE

Loosen adjuster screw locknut. Back off adjuster screw until stopped, then turn in 1 full turn. Rotate input shaft from stop to stop counting the number of turns. Turn shaft ½ way back, to center position. Attach an INCH lb. torque wrench to input shaft. Refer to *Overcenter Preload Specifications* and turn shaft from side to side the specified amount of arc on each side of center noting torque reading going overcenter. *See Fig. 3.*

Overcenter Preload Specifications

Application	Arc	Overcenter Preload① INCH lbs.
Chrysler Corp.	90°	4-5
Ford	45°	4-6
General Motors	20°	4-8
Jeep	45°	4-5

① – Reading should not exceed 4-8 INCH lbs. with total reading not to exceed 20 INCH lbs. (14 for Jeep, 18 for Chrysler) for a new steering gear (less than 4000 miles).

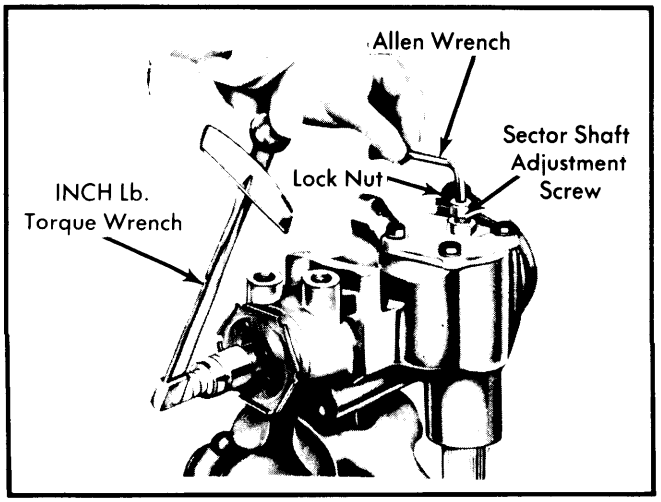

Fig. 3 Measuring Overcenter Preload and Making Adjustment

REMOVAL & INSTALLATION

NOTE – *To avoid damage to collapsible steering column, it is recommended column be completely removed from vehicle before steering gear is removed.*

STEERING GEAR

Removal – Raise and support vehicle, then place a drain pan under steering gear assembly. Center steering gear and tie steering wheel in this position. Disconnect hydraulic hoses from gear and cap ends to prevent fluid loss. Disconnect steering linkage from pitman arm (if necessary) and remove arm from gear. Remove flexible coupling clamp bolt and bolts retaining steering gear to frame, disconnect gear from flexible coupling, and remove gear from vehicle. On Jeep "CJ" and Scrambler models, remove steering gear and mounting bracket as an assembly.

Installation – To install, reverse removal procedures, noting the following. On Ford models, attach flex coupling before placing gear in vehicle.

OVERHAUL

NOTE – *If complete assembly is not to be overhauled, remove subassembly to be serviced, and then proceed with disassembly and reassembly of that unit.*

STEERING GEAR

Disassembly – 1) Rotate housing end plug retainer ring until one end of plug is over hole in housing. Force end of ring from groove in housing and remove. Rotate input shaft counterclockwise to force housing end plug out of housing. Rotate input shaft clockwise ½ turn to draw rack-piston inward, then remove piston and plug from rack-piston.

CAUTION – *Do not rotate shaft more than is necessary to remove plug as ball bearings will fall out of worm and rack piston assembly.*

2) Remove lock nut from sector shaft adjuster, then remove sector shaft cover. Remove and discard "O" ring from cover. Turn input shaft until sector shaft teeth are centered in housing. Tap end of sector shaft with a soft-faced hammer to free shaft from housing, then remove sector shaft. Remove adjuster plug lock nut, and using a spanner wrench, remove adjuster plug.

3) Insert a suitable arbor tool into end of rack-piston until tool just contacts worm shaft. Rotate input shaft counterclockwise until worm is free of rack-piston, then remove rack-piston assembly from housing taking care to keep tool fully inserted to prevent ball bearings from falling out. Remove input shaft and control valve assembly from housing. Lift worm, lower thrust bearing, and races from housing.

Reassembly – 1) Lubricate all parts with clean power steering fluid before reassembly. Install thrust bearing and races on worm. *See Fig. 4.*

SAGINAW ROTARY VALVE (Cont.)

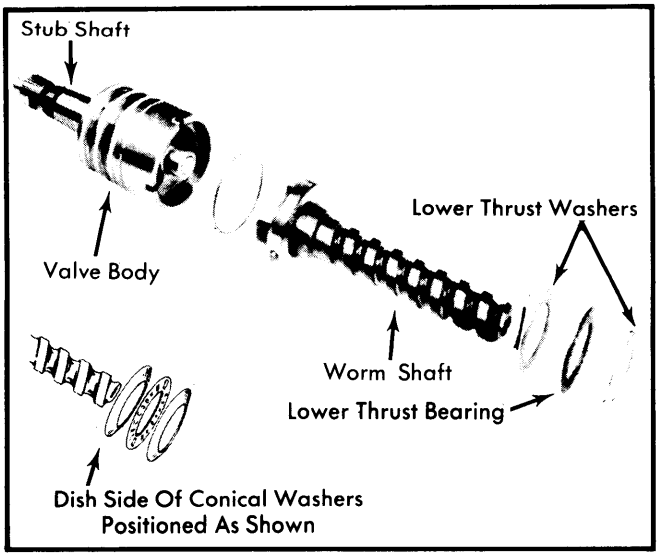

Fig. 4 Reassembly of Valve Body and Worm Shaft Assembly

NOTE – *If conical thrust races are used, make sure tapered surfaces are parallel to each other and that cupped sides face toward stub shaft.*

2) Align valve body drive pin on worm with narrow pin slot in valve body, and install "O" ring between valve body and worm head. Install valve body and worm assembly into housing, making sure return hole in gear is fully visible.

3) Position a suitable seal protector over input shaft, install a new adjuster plug "O" ring, then install adjuster plug. Remove seal protector from housing and loosely install adjuster plug lock nut. Adjust thrust bearing preload at this time.

4) Insert arbor tool into rack-piston and place assembly into housing. Force rack-piston into housing until arbor tool contacts worm shaft. Turn input shaft clockwise until middle rack groove in rack-piston is aligned with center of sector shaft roller bearing, then remove arbor tool.

5) Install a new sector shaft cover "O" ring, then thread sector shaft cover onto adjuster screw until bottomed. Back off 1½ turns. Install sector shaft so that center gear tooth meshes with center groove in rack-piston, then install cover attaching bolts.

6) Install adjuster lock nut halfway on, then install piston and plug in rack-piston. Install housing end plug "O" ring, end plug and retainer ring. Adjust overcenter position at this time.

ADJUSTER PLUG

Disassembly – Remove thrust bearing retainer ring with a screwdriver, taking care not to score needle bearing bore. Discard retainer ring. Remove thrust bearing spacer, thrust bearing and bearing races. Remove and discard adjuster plug "O" ring, then remove input shaft seal retainer. Remove and discard dust seal, then pry input shaft seal from adjuster plug. Inspect needle bearing in adjuster plug, and if necessary, remove by pressing out from spacer end. See *Fig. 5*.

Inspection – Inspect thrust bearing for cracks and rollers for pitting, scoring, or cracking. Check thrust races and spacer for damage. Replace parts as necessary.

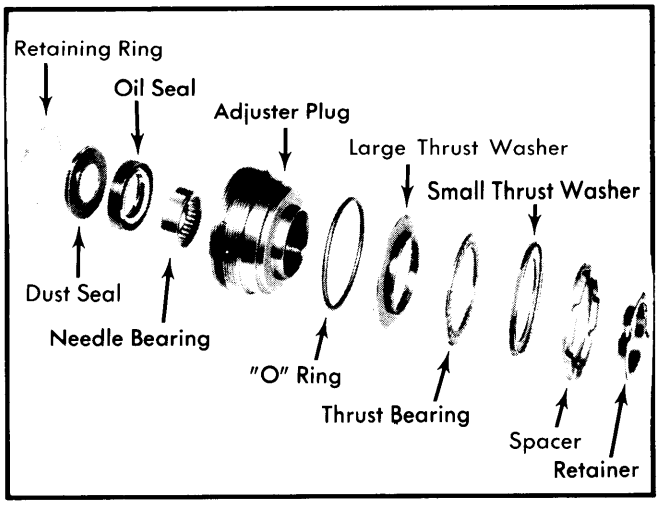

Fig. 5 Disassembled View of Adjuster Plug Assembly

Reassembly – **1)** Press roller bearing into adjuster plug, identification end facing tool, until bearing bottoms on input shaft seal bore. Install input shaft seal with spring in seal facing adjuster plug.

2) Install dust seal with lip facing upward into adjuster plug, then install retainer ring. Install adjuster plug "O" ring. Assemble thrust bearing, thrust bearing race, and thrust bearing spacer on adjuster plug. Using a brass or wooden dowel, press bearing retainer into needle bearing bore.

RACK-PISTON & WORM

Disassembly – Remove piston ring and back-up "O" ring from rack-piston nut. Remove ball return guide clamp, ball return guide, arbor tool, and all ball bearings from rack-piston.

Inspection – Clean and dry all parts. Inspect worm and rack-piston grooves for scoring. Inspect ball bearings for damage. Check ball guides for pinching of ends. Inspect lower thrust bearing races for cracking, scoring, or pitting.

NOTE – *If either worm or rack-piston are damaged, both must be replaced as a matched set. If any ball bearings are damaged, replace entire set.*

Reassembly – **1)** Install "O" ring and piston ring onto the rack-piston, using care not to twist them. Install worm into rack-piston until worm is against piston shoulder. Install ball bearings into rack-piston while slowly rotating worm counterclockwise.

NOTE – *See following table for number of balls to be installed. BE SURE to install light and dark colored balls alternately, as the black balls are .0005" smaller than the silver balls.*

2) Install correct number of balls in ball guide while alternating colors. Hold balls in place with chassis lubricant and install return ball guide assembly into position. Install clamp and tighten attaching bolts. See *Fig. 6*.

SAGINAW ROTARY VALVE (Cont.)

Rack Piston & Worm Assembly Ball Bearings

Application	Rack-Piston	Guide
Chrysler Corp.	19	5
Ford	16	6
General Motors	17	7
Jeep	18	6

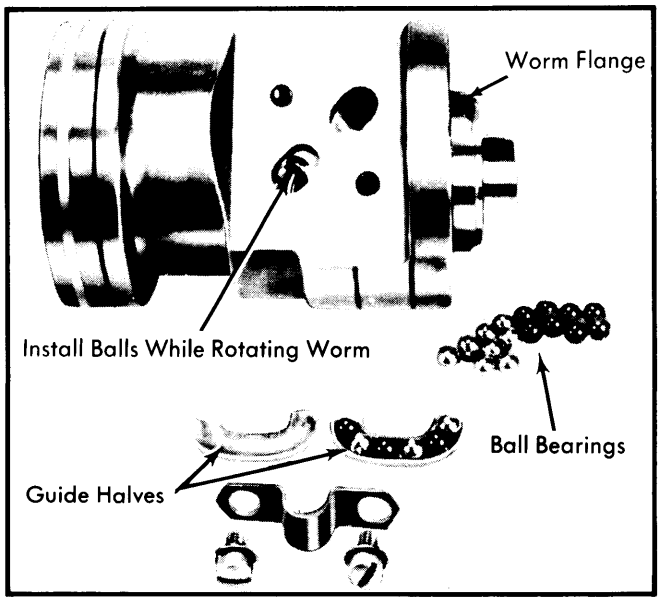

Fig. 6 Installing Ball Bearing into Rack-Piston Assembly

ROTARY VALVE

NOTE – *Complete valve assembly is hydraulically balanced during the manufacturing process. If replacement of any part other than rings or seals is necessary, replace complete valve assembly.*

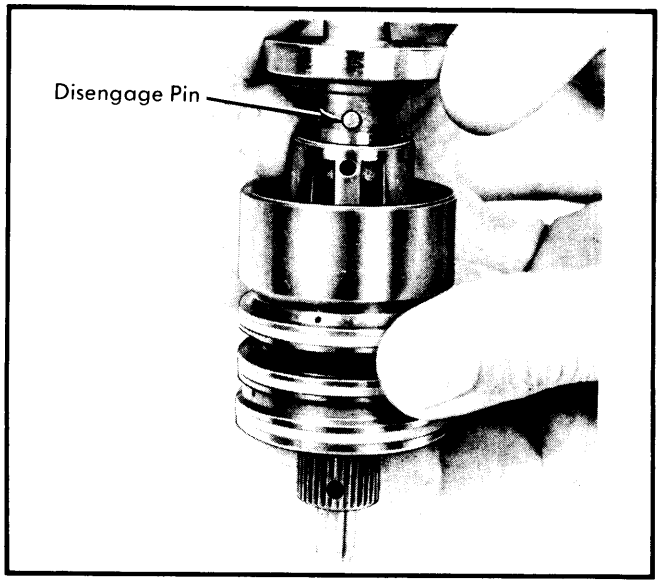

Fig. 7 Pulling Shaft from Valve Assembly

Disassembly – 1) Remove and discard stub shaft cap "O" ring. Invert valve and lightly tap end of stub shaft against work bench until shaft is free of valve body. Pull stub shaft outward until drive pin hole is visible. See *Fig. 7*.

NOTE – *Do not pull shaft any further than ¼" or spool valve may become cocked in valve body.*

2) Disengage drive pin and carefully remove stub shaft from valve body and spool assembly with a twisting motion. If binding occurs, realign valve and try removal again.

CAUTION – *Do not force spool out of valve body. See Fig. 8.*

3) Remove and discard all "O" ring and Teflon rings.

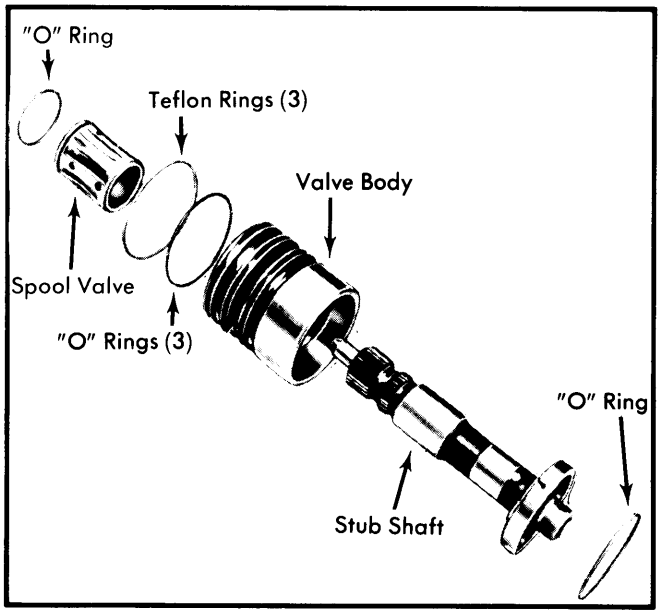

Fig. 8 Disassembled View of Valve Body and Input (Stub) Shaft Assembly

Reassembly – 1) Lubricate all valve body components with power steering fluid. Install replacement backup "O" rings in seal grooves and install replacement seal rings over backup rings. Take care not to damage seal rings during installation.

NOTE – *Teflon seal rings may appear to be distorted after installation. However, heat of operation will straighten them.*

2) Lubricate replacement spool valve damper "O" ring with petroleum jelly and install on spool valve. Carefully insert spool valve into valve body. Push valve through valve body until locating pin hole is visible at opposite end of valve body and spool valve is flush with notched end of valve.

3) Install stub shaft in spool valve and valve body. Be sure stub shaft locating pin is aligned with spool valve locating hole. Align notch in stub shaft cap with stub shaft locating pin and press stub shaft and spool valve into valve body. Install stub shaft cap "O" ring into valve body. See *Fig. 9*.

CAUTION – *Before installing assembled valve body into gear housing, be sure valve body stub shaft locating pin is fully engaged in stub shaft cap notch. Do not allow stub shaft to disengage from valve body pin.*

SAGINAW ROTARY VALVE (Cont.)

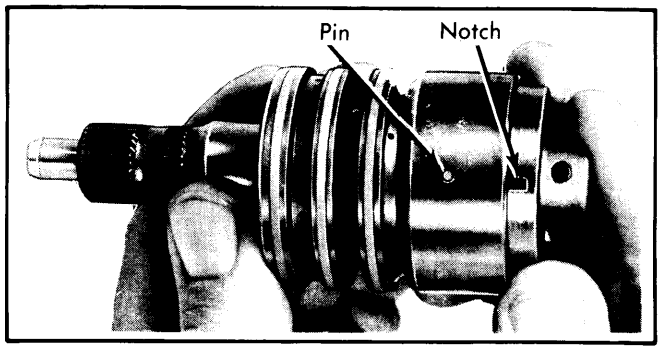

Fig. 9 Aligning Pin and Notch for Input (Stub) Shaft

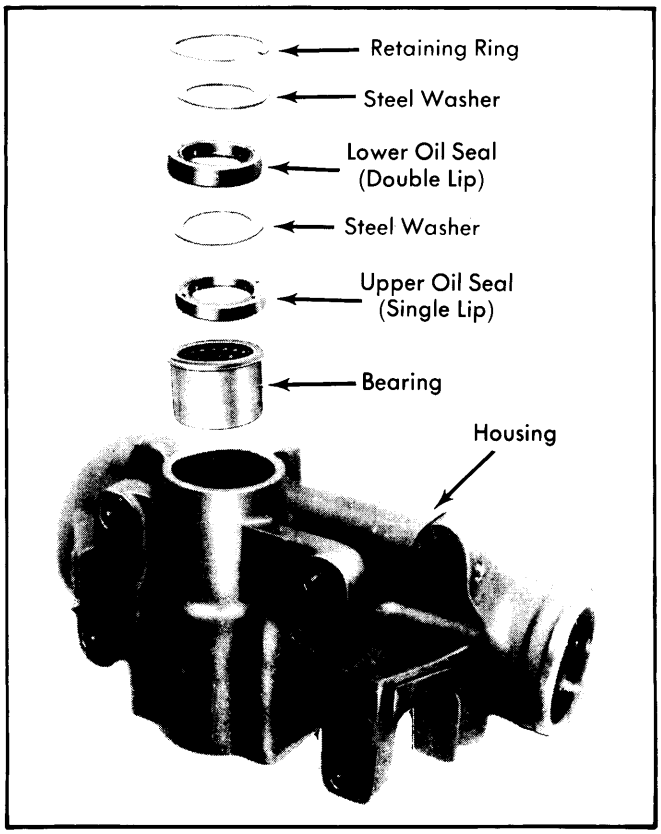

Fig. 10 Gear Housing Seals and Bearing

STEERING GEAR HOUSING

Disassembly – Remove sector shaft seal retaining ring and remove lower spacer washer. Remove lower seal, spacer washer and upper seal from housing. Press sector shaft bearing out of housing from lower end. To remove port seat, tap out seat using a 5/16-18 thread tap, then install a bolt with a flat washer and nut into the seat. Hold bolt from turning and tighten nut to extract seat from housing. Remove check valve and spring from inlet port. *See Fig. 10.*

Reassembly – Working from upper end, press a new bearing into housing until it is seated .030" below edge of bore. Lubricate new seal with power steering fluid and install single lipped seal, spacer washer, double lipped seal, and second spacer washer. Install sector shaft seal retaining ring. If port seat was removed, position spring, check valve, and a new seat over opening in housing and drive into place using a brass drift.

TIGHTENING SPECIFICATIONS

Application	Ft. Lbs.
Adjuster Plug Lock Nut	
Chrysler Corp.	85
Ford	55-110
General Motors	80
Sector Shaft Adjuster Lock Nut	
Chrysler Corp.	28
Ford	27-37
General Motors	20
Jeep	33
Pitman Arm Attaching Nut	
Chrysler Corp.	175
Ford	170-230
General Motors	180
Jeep	185
Rack Piston End Plug	
Chrysler Corp.	50
Ford	80-140
General Motors & Jeep	75
Gear-to-Frame Attaching Bolts	
Chrysler Corp.	100
Ford	70
General Motors	80
Jeep	
"CJ" & Scrambler Models	55
Cherokee, Wagoneer & Truck Models	70