

Power Steering Gears

SAGINAW ROTARY VALVE

Chrysler Corp. (Exc. "B" & "PB" Models)
 Ford Motor Co. ("E" & "U" Models)
 General Motors (All Models)
 International Harvester (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.

LUBRICATION, TROUBLE SHOOTING & TESTING

See Power Steering General Servicing in this section.

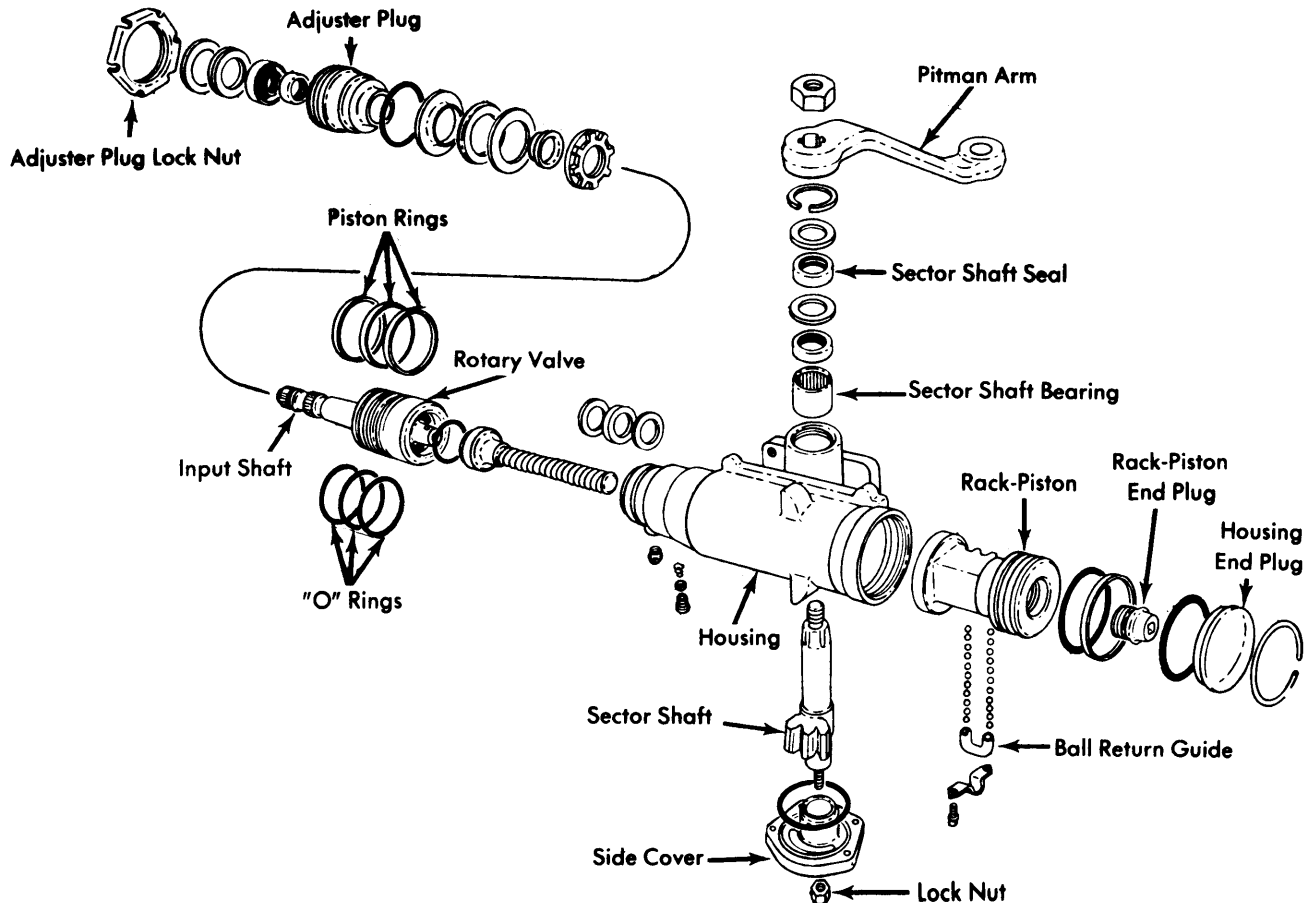


Fig. 1 Disassembled View of Saginaw Power Steering Gear
 (International Harvester is Model Shown)

ADJUSTMENT

NOTE — Following adjustments are made with steering gear REMOVED from vehicle and hydraulic fluid drained.

THRUST BEARING PRELOAD

NOTE — Two thrust bearing preload adjustment procedures are given. With the gear assembled it is not possible to determine whether conical or flat thrust races are being used. On all models except Ford, start adjustment procedures by performing conical thrust race procedure and then proceed as instructed in the procedure. For Ford, go straight to procedure for flat thrust races.

Conical Thrust Races — 1) Rotate input shaft from stop to stop several times to force all fluid from steering gear. Mount gear in a soft-jawed vise, then loosen and remove adjuster plug lock nut. Using a spanner wrench, turn adjuster plug clockwise until plug and thrust bearing are firmly bottomed.

2) Place an index mark on housing, opposite the hole in adjuster plug. Measure 1/2" counterclockwise (Chevrolet, GMC, and GMC Motor Home) or 3/16"-1/4" counterclockwise (all other models) and again mark housing. Rotate adjuster plug counterclockwise until hole in adjuster plug is in line with second mark. Tighten lock nut while holding adjuster plug in position.

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3) Check drag torque as follows: Turn input shaft to right stop, then back $\frac{1}{4}$ turn. Using an INCH lbs. torque wrench attached to input shaft, measure rotational torque required to turn input shaft through an arc of 60° . Reading should be taken with beam of torque wrench near vertical while turning it counterclockwise at an even rate.

4) If reading is MORE than 10 INCH lbs., or LESS than 4 INCH lbs., then it is necessary to proceed to procedure for flat thrust races and perform that procedure. If reading is 4-10 INCH lbs., record the reading and thrust bearing preload adjustment is complete.

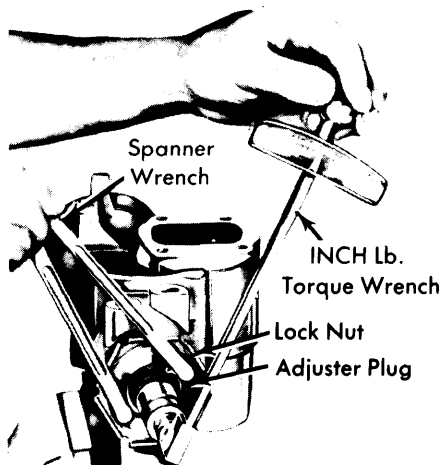


Fig. 2 Measuring Thrust Bearing Preload

Flat Thrust Races — 1) Rotate input shaft from stop to stop several times to force all fluid from gear. Mount gear in a soft-jawed vice, loosen sector shaft adjuster lock nut, then turn adjuster $1\frac{1}{2}$ turns counterclockwise and retighten lock nut. **NOTE** — If adjuster bottoms when turning it counterclockwise, turn back clockwise $\frac{1}{2}$ turn.

2) Loosen adjuster plug lock nut, and using a spanner wrench, loosen adjuster plug one turn counterclockwise. Turn input shaft to right turn stop, then back $\frac{1}{4}$ turn. Using an INCH lb. torque wrench, measure the drag torque required to turn stub shaft.

3) Tighten adjuster plug until it bottoms, then loosen plug until torque reading is 3-4 INCH lbs. greater than previously noted. Tighten adjuster plug lock nut and recheck preload torque.

CAUTION — It is not possible to properly adjust preload unless adjuster plug is firmly bottomed and torque set while plug is being loosened. Never attempt to adjust preload while tightening plug into gear assembly.

OVERCENTER POSITION

Rotate input shaft from stop to stop counting number of turns, then turn shaft back exactly halfway to center. Using an INCH lb. torque wrench attached to input shaft, rotate shaft approximately 20° to each side of center and note torque reading. Loosen lock nut and turn sector adjuster clockwise until rotational torque is 4-5 INCH lbs. greater than previously noted. **NOTE** — Total torque reading should not exceed 14 INCH lbs. Tighten adjuster lock nut. **NOTE** — If gear has been in service less than 400 miles, total rotational torque should not exceed 18 INCH lbs.

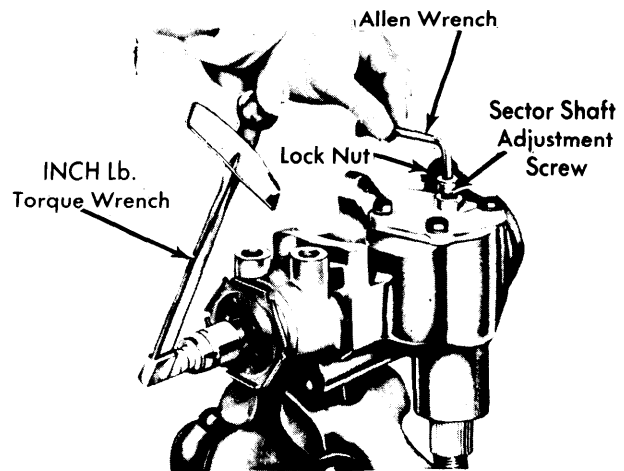


Fig. 3 Measuring Overcenter Preload and Making Adjustment

REMOVAL & INSTALLATION

STEERING GEAR

Removal & Installation — 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. On IHC models using a gear with a vertical sector shaft, disconnect and remove battery. 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 withdraw gear from vehicle. To install, reverse removal procedure and bleed hydraulic system. See procedure given in *Power Steering General Servicing* article in this section.

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 ring 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. **CAUTION** — Do not rotate shaft more than is necessary to remove plug as ball bearings will fall out of worm and rack piston assembly. Rotate input shaft clockwise $\frac{1}{2}$ turn to draw rack-piston inward, then remove piston end plug from rack-piston.

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

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

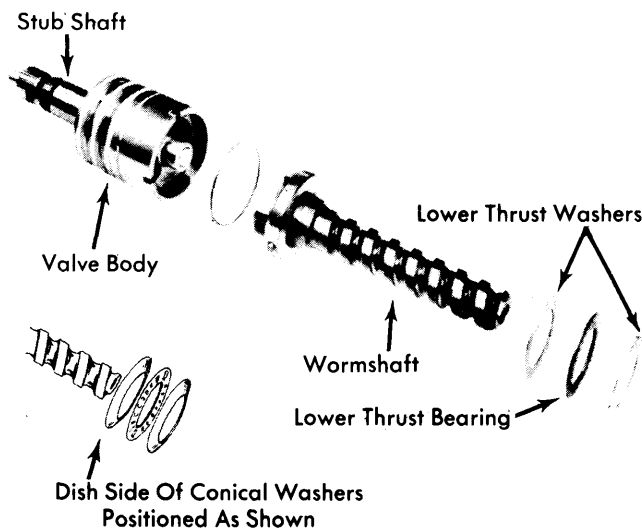


Fig. 4 Reassembly of Valve Body and Wormshaft Assembly.

2) 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. 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.

3) Install a new sector shaft cover "O" ring, then thread sector shaft cover onto adjuster screw until bottomed. Back off $1\frac{1}{2}$ turns. Install sector shaft so that center gear tooth meshes with center groove in rack-piston, then install cover attaching bolts. Install adjuster lock nut halfway on, then install piston end 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.

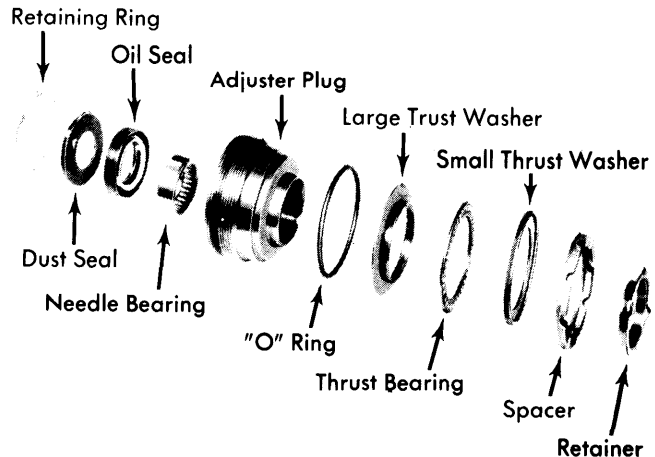


Fig. 5 Disassembled View of Adjuster Plug Assembly

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

Reassembly — Press needle bearing into adjuster plug identification end down, until bearing bottoms on input shaft seal bore. Install input shaft seal with spring in seal facing adjuster plug. Install dust seal with lip facing upward into adjuster plug, then install retainer ring. Install adjuster plug "O" ring. Assemble thrust bearing, thrust bearing races, 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. *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. Check ball guides for pinching at ends. Inspect low thrust bearing races for cracking, scoring, or pitting.

Reassembly — 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. Install correct number of balls in ball guide, while alternating colors, hold in place with chassis lubricant and install return ball guide assembly into position. Install clamp and tighten attaching bolts.

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Rack-Piston & Worm Assembly Ball Bearings

Application	Rack-Piston	Guide
Chevrolet & GMC	17	7
Chrysler Corp.		
Motor Home (Mdl. 708) ..	17	5
Motor Home (Mdl. 710) ..	28	6
All Others (Constant)	17	5
All Others (Variable)	19	5
Ford		
All Models (Constant)	16	6
All Models (Variable)	16	8
GMC Motor Home	17	5
International Harvester	16	6
Jeep	16	①

① — Install the remaining balls.

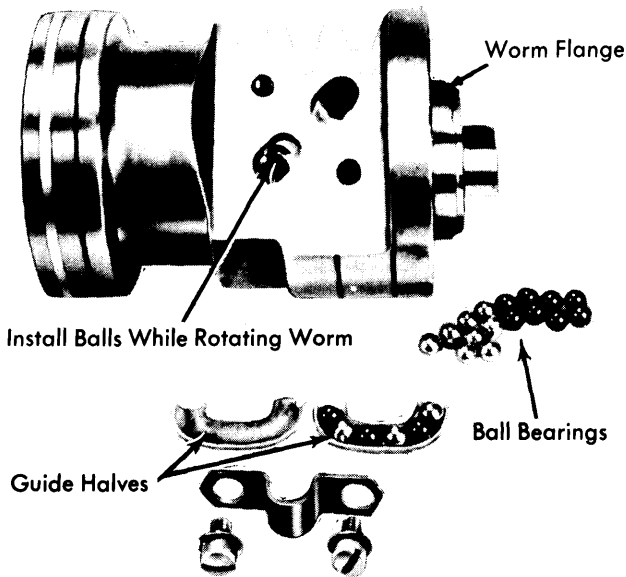


Fig. 6 Installing Ball Bearings into Rack-Piston Assembly

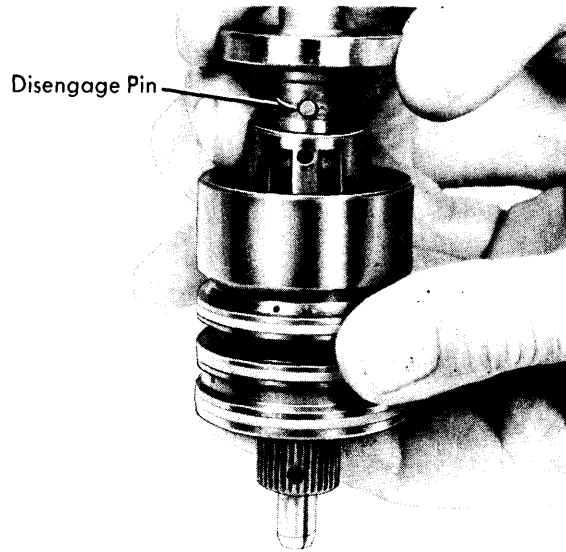


Fig. 7 Pulling Shaft From Valve Assembly

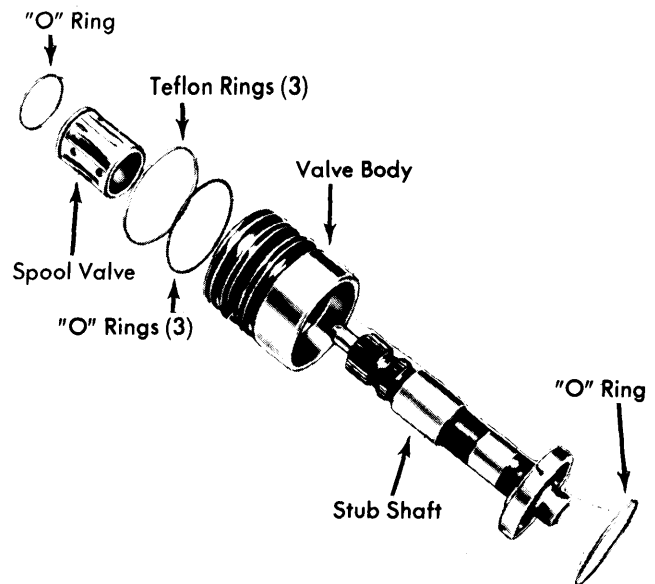


Fig. 8 Disassembled View of Valve Body and Input (Stub) Shaft Assembly

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.

Disassembly — Lightly tap torsion bar end of valve on the bench until torsion bar cap separates from valve body. Remove and discard valve-to-body "O" ring. Push input shaft down through valve body until drive pin hole is visible. Tilt input shaft to disengage drive pin from valve spool, then remove input shaft from valve body. Slide the valve spool out of the top of valve body.

Reassembly — Lubricate dampener "O" ring with power steering fluid and install on spool. Insert spool into valve body using a turning motion, until spool is even with valve body bottom and drive pin hole is directly opposite the deep notch in valve body. Install input shaft into valve spool, making sure drive pin holes are aligned. Insert drive pin into hole in valve spool and pull assembly into valve body, keeping cap slot and body pin aligned. **NOTE** — Cap is seated correctly when top surface of cap is at least $\frac{3}{32}$ " below deep notch in valve body. Install cap-to-body "O" ring.

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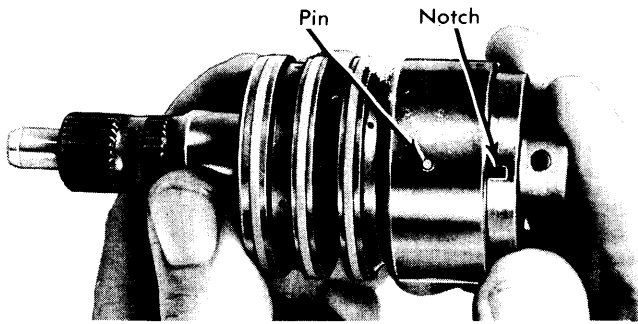


Fig. 9 Aligning Pin and Notch for Input (Stub) Shaft

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 $\frac{3}{16}$ -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.

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.

STEERING GEAR HOUSING

Disassembly - Remove sector shaft seal retaining ring and remove lower spacer washer. Remove lower seal, spacer

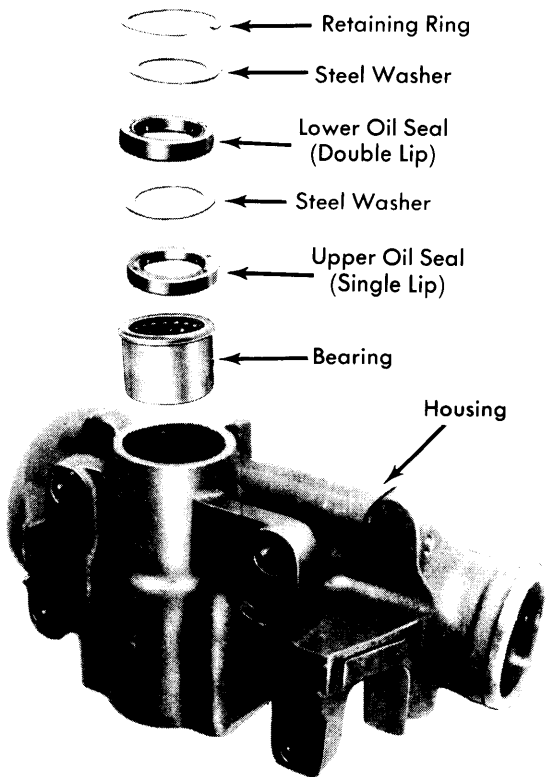


Fig. 10 Gear Housing Seals and Bearing

TIGHTENING SPECIFICATIONS

Application	Ft. Lbs.
Adjuster Plug Lock Nut	
Chrysler & General Motors	80
Ford, IHC & Jeep	50-110
Sector Shaft Adjuster Lock Nut	
Chrysler & General Motors	33
Ford	30-35
IHC & Jeep	27-37
Pitman Arm Attaching Nut	
Chrysler	180
Ford	170-230
General Motors	
"K" Models	90
Motor Home	125
All Others	185
IHC	100-160
Jeep	160-210
Rack-Piston End Plug	
Chrysler & General Motors	75
Ford, IHC & Jeep	50-100
Side Cover Bolts	
Chrysler	45
Ford	30-35
General Motors	30
IHC	25-35
Jeep	30-45
Gear-to-Frame Attaching Bolts	
Chrysler	85
Ford	52-90
General Motors	
"G" Models	110
GMC Motor Home	70-80
All Others	65
IHC	45-55
Jeep	60-80