SAGINAW ROTARY VALVE

Chrysler Corp. (Exc. "B" & "PB" Modes)
Ford Motor Co. ("E" 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.

ADJUSTMENT

THRUST BEARING PRELOAD

Chrysler Corp. – 1) This procedure is with steering gear removed from vehicle. Remove adjuster plug lock nut. Turn adjuster plug clockwise with a spanner wrench and seat in housing. About 20 ft. lbs. of torque is required to seat adjuster plug.

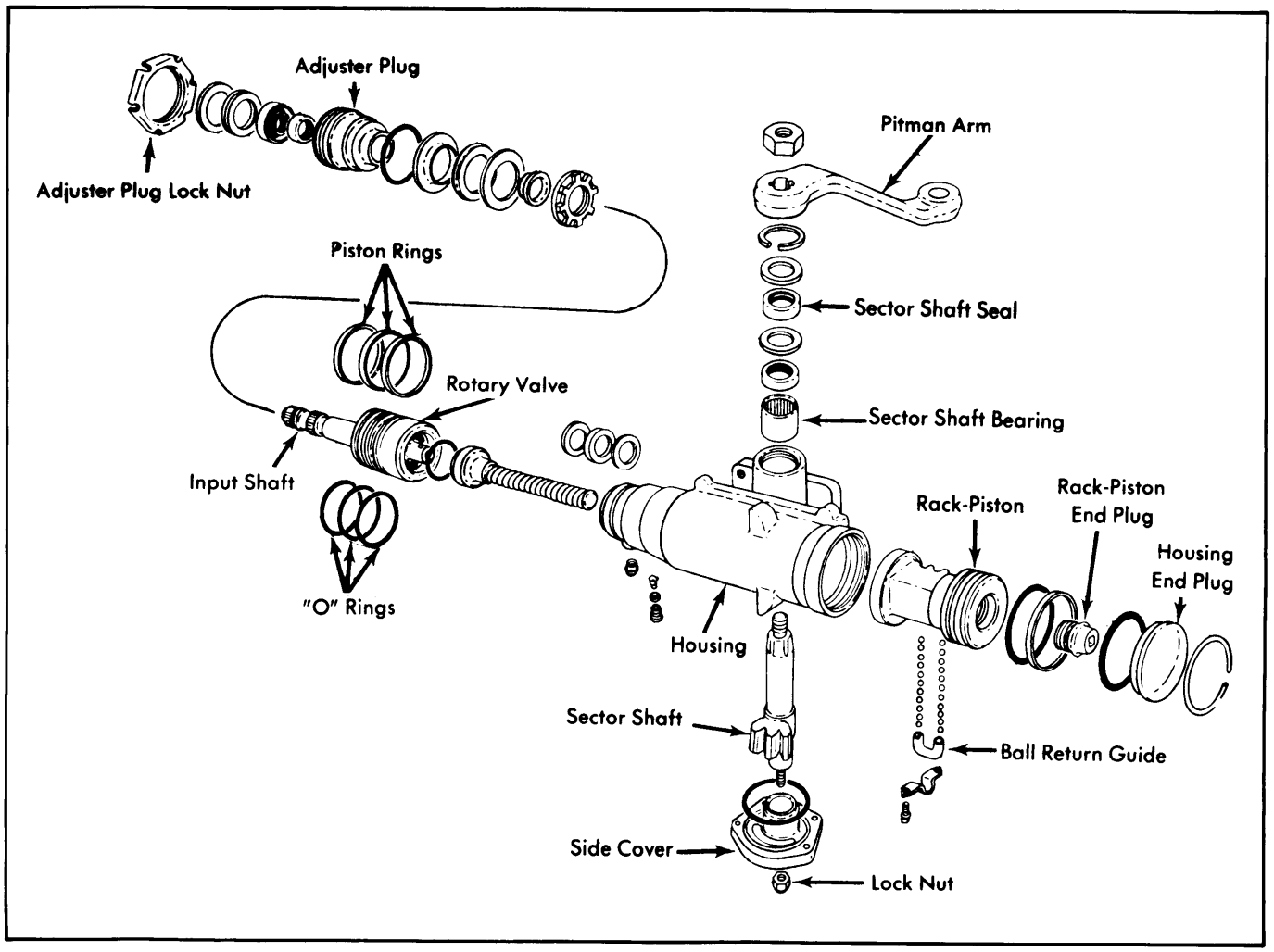

Fig. 1 Disassembled View of Saginaw Power Steering Gear (International Harvester is Model Shown)

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2) Place an index mark on housing opposite one spanner wrench hole in adjuster. Measure 3/16" to 1/4" counterclockwise and again mark housing. Rotate adjuster counterclockwise until hole in adjuster plug aligns with second mark. Tighten lock nut while holding adjuster in this position.

3) Attach an INCH lb. torque wrench to end of input shaft. Turn input shaft to right stop, then back 1/4 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.

NOTE – *If reading does not fall within the 4-10 INCH lb. range, use the following alternate procedure.*

Chrysler Corp. (Alternate Procedure) – 1) Loosen lock nut on sector shaft preload adjuster screw. Turn adjuster screw 1 1/2 turns counterclockwise. Retighten lock nut.

NOTE – *If preload screw bottoms, turn back clockwise 1/2 turn.*

2) Loosen but do not remove adjuster plug lock nut. Loosen adjuster plug one turn counterclockwise. Turn input shaft to right stop then back 1/4 turn. Using an INCH lb. torque wrench, measure drag torque required to turn input shaft.

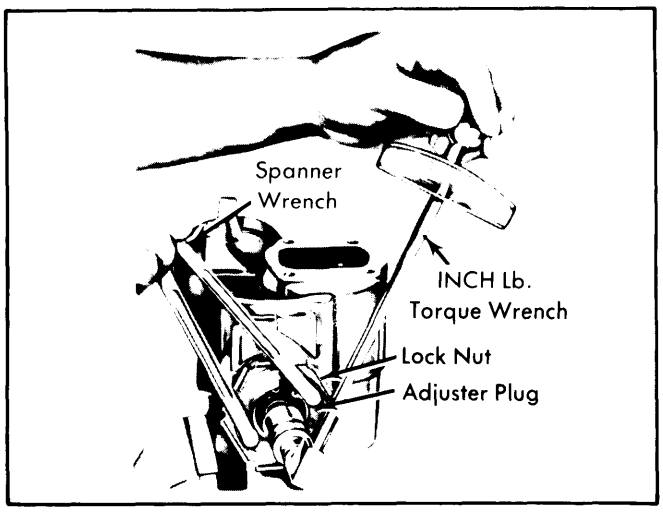

Fig. 2 Measuring Thrust Bearing Preload

3) Turn adjuster plug clockwise and bottom with a minimum of 20 ft. lbs. torque. Now back off until torque reading is 3-4 INCH lbs. in excess of input shaft drag torque. Tighten adjuster plug lock nut. Recheck preload and adjust again if necessary.

Ford Motor Co. – 1) **NOTE** – *This adjustment is made during steering gear assembly. See Steering Gear Reassembly procedure to determine when adjustment is made.* Turn adjuster plug clockwise until it bottoms. Back off adjuster plug 1/4 turn.

2) Attach an INCH lb. torque wrench to end of input shaft and measure seal drag. Again bottom out adjuster plug. Now back off again until torque reading on wrench is 3-4 INCH lbs. in excess of seal drag. Do not back off adjuster plug more than 10° (.200" measured on rim of adjuster plug). Tighten lock nut and recheck torque.

General Motors – 1) Remove steering gear from vehicle. Rotate input shaft several times from stop to stop to remove all power steering fluid. Loosen and remove adjuster plug lock nut. Turn plug clockwise using a suitable spanner wrench (J-7624) until it and thrust washer are bottomed with approximately 20 ft. lbs.

2) Mark housing even with one of spanner wrench holes in adjuster plug. Measure back counterclockwise from mark 1/2" and mark housing again. Turn adjuster plug back until hole lined up with first mark is aligned with second mark. Tighten adjuster nut, making sure plug remains in position.

International Harvester – 1) **NOTE** – *This adjustment is made during steering gear assembly. See Steering Gear Reassembly procedure to determine when adjustment is made.* Turn adjuster plug clockwise until it bottoms. Now back off plug 1/8 turn.

2) Attach an INCH lb. torque wrench to end of input shaft. Measure and record torque reading while rotating input shaft through a 45° arc. This torque reading is seal drag.

3) Now adjust preload by turning adjusting plug in or out of housing until reading is 7 INCH lbs. for steering gears with vertical sector shaft and 8 INCH lbs. for horizontal sector shaft. This reading includes seal drag reading previously noted. Tighten lock nut and recheck preload torque.

Jeep – 1) This procedure is with steering gear removed from vehicle. Remove adjuster plug lock nut. Turn adjuster plug clockwise with a spanner wrench and seat in housing. About 20 ft. lbs. of torque is required to seat adjuster plug.

2) Place an index mark on housing opposite one spanner wrench hole in adjuster. Measure 3/16" to 1/4" counterclockwise and again mark housing. Rotate adjuster counterclockwise until hole in adjuster plug aligns with second mark. Tighten lock nut while holding adjuster in this position.

3) Attach an INCH lb. torque wrench to end of input shaft. Turn input shaft to right stop, then back 1/4 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.

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 wormshaft thrust bearings and races may be defective. Repair as required and readjust preload.*

OVERCENTER PRELOAD TORQUE

1) Rotate input shaft from stop to stop counting number of turns. Now turn shaft back exactly halfway. 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 and note torque reading going overcenter.

SAGINAW ROTARY VALVE (Cont.)

2) Loosen lock nut and turn sector adjuster clockwise until torque reading (see Overcenter Preload Specifications) going overcenter is to specification. Total torque should not exced 18 INCH lbs. for a new steering gear (under 400 miles) or 14 INCH lbs. for a used steering gear (over 400 miles).

Overcenter Preload Specifications

Application	Arc	Overcenter Preload②
Chrysler Corp.	90°①	4-5
Ford Motor Co.	180°	4-6
General Motors	20°	4-5
International Harvester	60°	4-5
Jeep	45°	4-5

① – Arc on Motor Home Chasis models should be 180°.
② – Reading should be 4-8 INCH lbs. with total reading not to exceed 14 INCH lbs. for a new steering gear (less than 400 miles.)

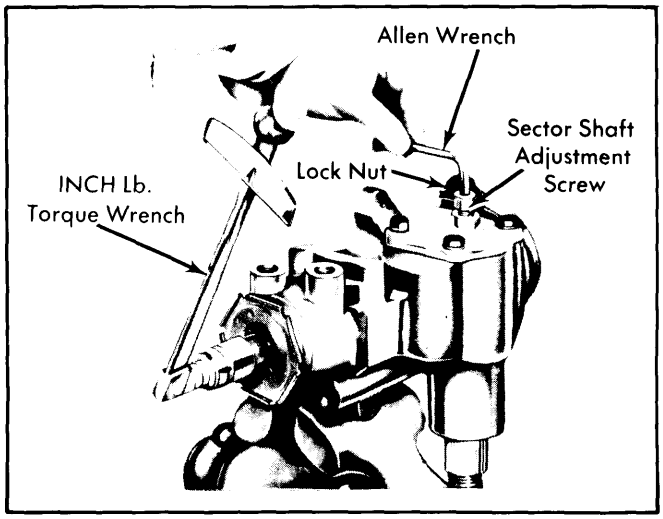

Fig. 3 Measuring Overcenter Preload and Making Adjustment

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 ½ 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 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

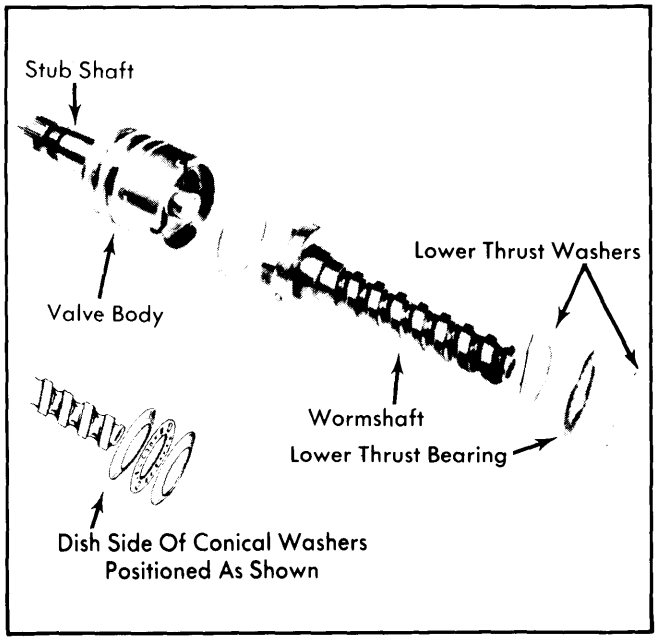

Fig. 4 Reassembly of Valve Body and Wormshaft Assembly

SAGINAW ROTARY VALVE (Cont.)

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.

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 too.

3) 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. 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.

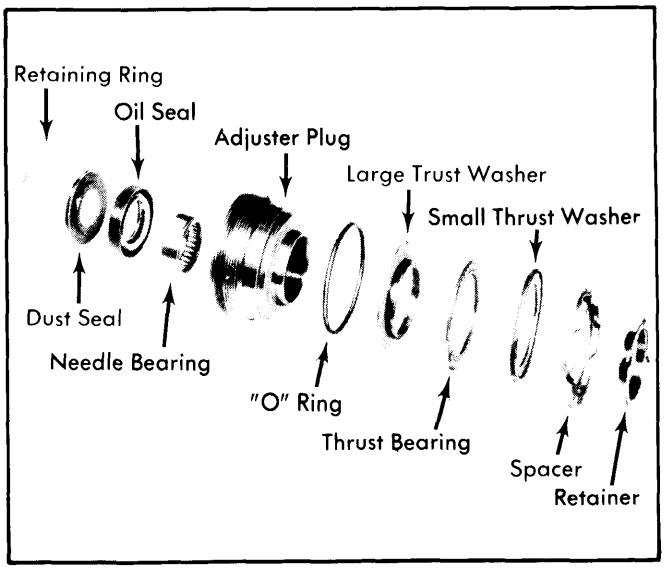

Fig. 5 Disassembled View of Adjuster Plug Assembly

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.

Rack-Piston & Worm Assembly Ball Bearings

Application	Rack-Piston	Guide
Chevrolet & GMC	17	7
Chrysler Corp.		
Motor Home (Mdls. 708)	17	5
Motor Home (Mdls. 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	18	①

① – Install the remaining balls.

SAGINAW ROTARY VALVE (Cont.)

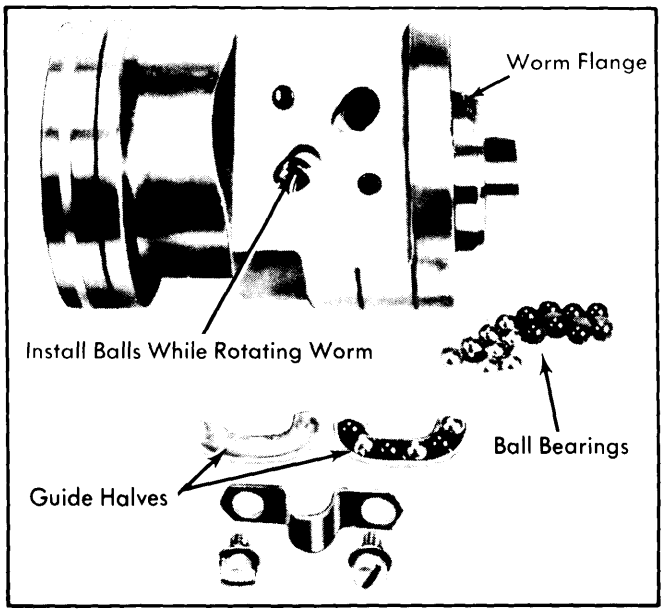

Fig. 6 Installing Ball Bearing into Rack-Piston Assembly

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.*

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.

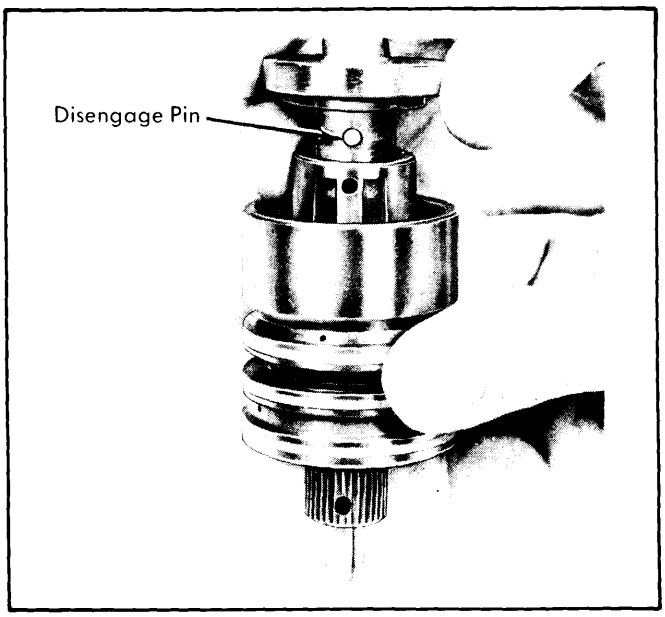

Fig. 7 Pulling Shaft from Valve Assembly

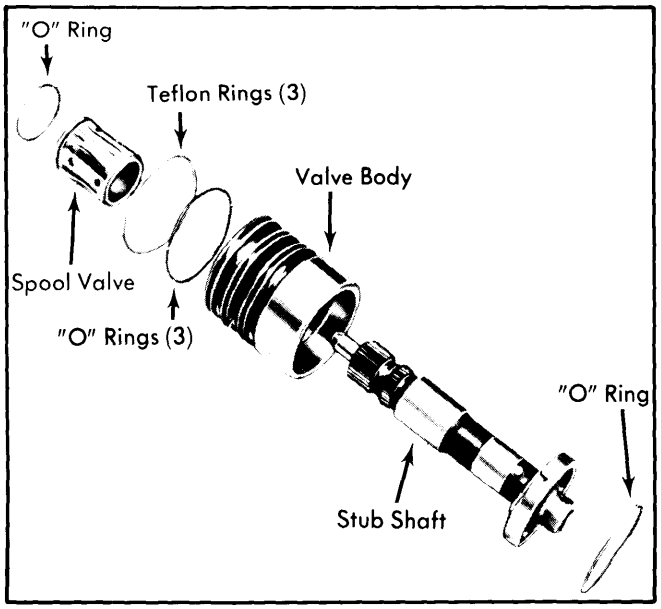

Fig. 8 Disassembled View of Valve Body and Input (Stub) Shaft Assembly

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 3/32" below deep notch in valve body.* Install cap-to-body "O" ring.

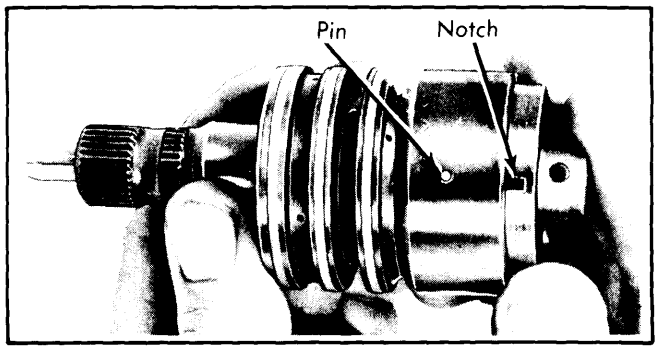

Fig. 9 Aligning Pin and Notch for Input (Stub) Shaft

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.

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

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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.

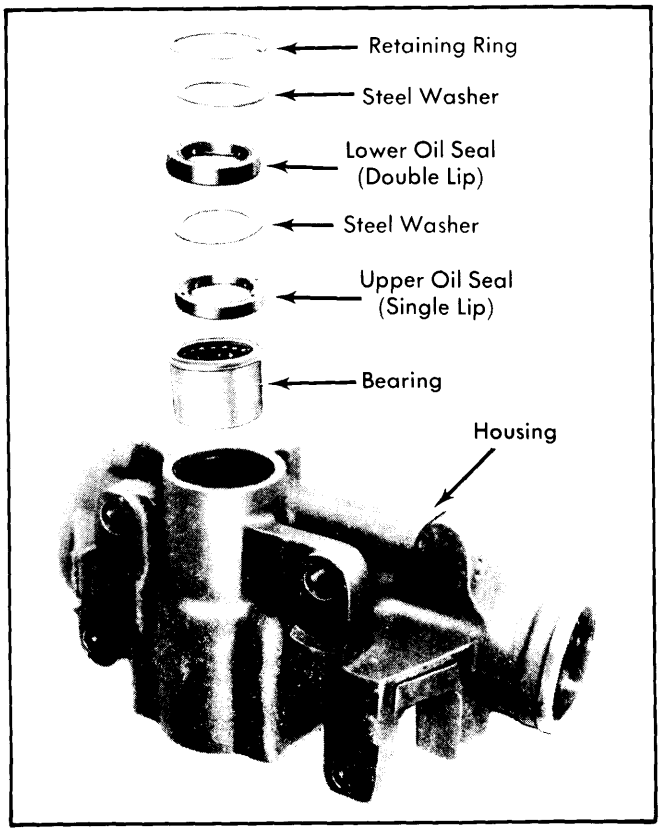

Fig. 10 Gear Housing Seals and Bearing

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	27-37
IHC & Jeep	27-37
Pitman Arm Attaching Nut	
Chrysler	180
Ford	200-250
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	40-50
General Motors	30
IHC	25-35
Jeep	30-45
Gear-to-Frame Attaching Bolts	
Chrysler	85
Ford	60-80
General Motors	
"G" Models	110
GMC Motor Home	70-80
All Others	65
IHC	45-55
Jeep	60-80