

## 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

Check fluid level in power steering pump reservoir at each engine oil change period. If necessary, add power steering fluid only to bring fluid up to proper level on pump dipstick.

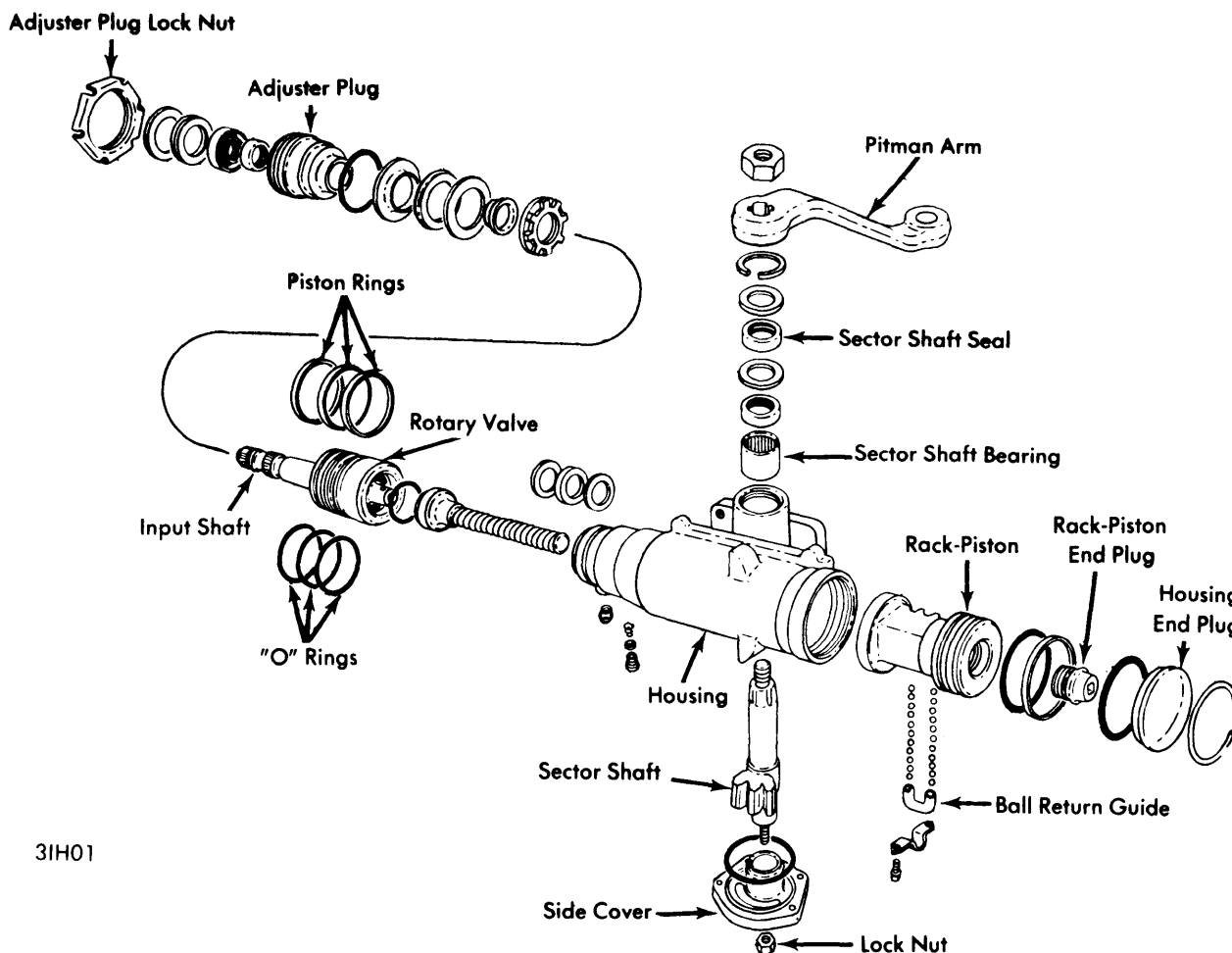
### ADJUSTMENT

*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 follow. The first is for steering gears with conical lower thrust bearing washers, and the second for gears with flat races.

**Conical Thrust Races** — 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. Place an index mark on housing, opposite the hole in adjuster plug. Measure  $\frac{3}{16}$  -  $\frac{1}{4}$ " and again mark housing. Rotate adjuster



3IH01

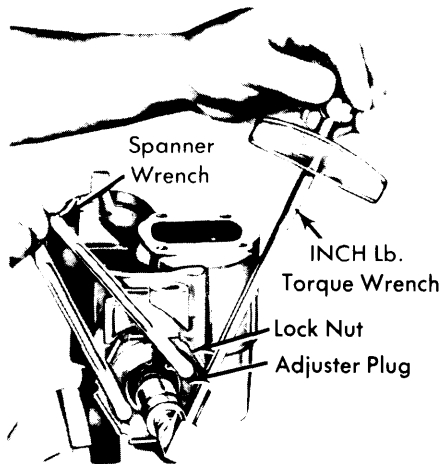
### SAGINAW POWER STEERING GEAR ASSEMBLY (INTERNATIONAL HARVESTER SHOWN)

## SAGINAW ROTARY VALVE (Cont.)

plug counterclockwise until hole in adjuster plug is in line with second mark. Tighten lock nut while holding adjuster plug in position.

**NOTE** — This procedure gives proper preload for steering gears with conical thrust races. Since gear is assembled and it cannot be determined for certain whether thrust races are conical or flat, drag torque must be checked as follows AFTER adjustment for conical thrust races has been completed:

Turn input shaft to right stop, then back  $\frac{1}{4}$  turn. Using an INCH lb. torque wrench attached to input shaft, measure rotational torque required to turn input shaft through an arc of  $60^\circ$ . Reading should be taken with beam of torque wrench near vertical while turning it counterclockwise at an even rate. If reading is more than 10 INCH lbs., or less than 4 INCH lbs., proceed to the adjustment procedure for flat thrust races. If reading is 4-10 INCH lbs., record reading as unit has conical thrust races.



5FO02

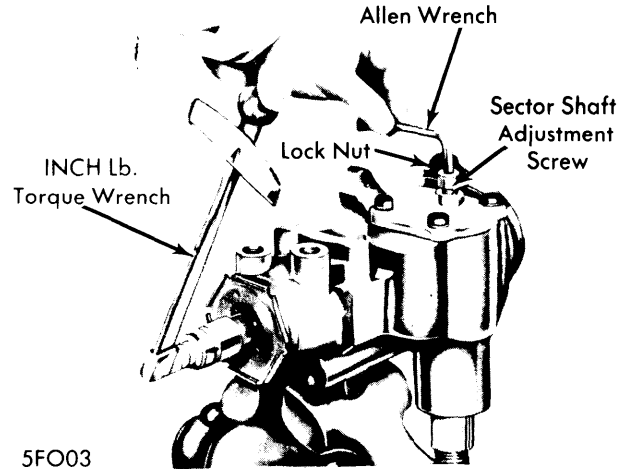
### THRUST BEARING PRELOAD ADJUSTMENT

**Flat Thrust Races** — Rotate input shaft from stop to stop several times to force all fluid from gear. Mount gear in a soft-jawed vise, 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. 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. Attach an INCH lb. torque wrench to input shaft, and measure rotational torque required to turn input shaft through an arc of  $60^\circ$ . 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 thrust bearing preload unless adjuster plug is firmly bottomed and torque set while plug is being loosened. Never attempt to adjust thrust bearing preload while tightening adjuster 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  $20^\circ$  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.



5FO03

### OVERCENTER ADJUSTMENT

### TESTING

See procedure given in Saginaw Vane Type or Thompson Slipper Type power steering pump article in this Section.

## 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 Saginaw Vane Type or Thompson Slipper Type power steering pump article in this Section.

### OVERHAUL

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

### STEERING GEAR

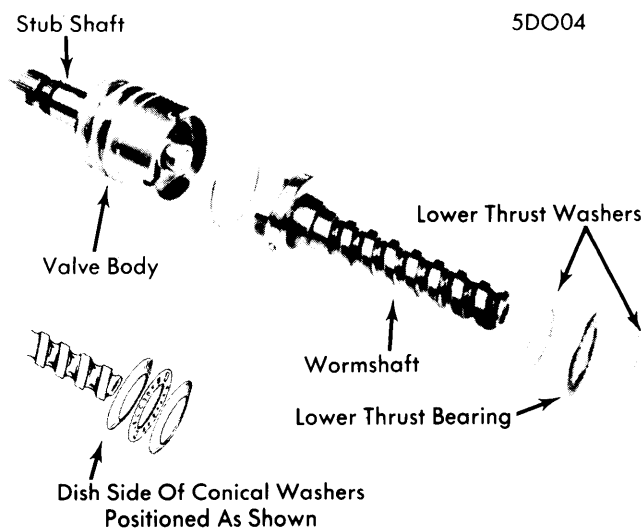
**Disassembly** — 1) Rotate housing end plug retainer ring until one end of ring is over hole in housing. Force end of ring from groove in housing and remove. Rotate input shaft counterclockwise to force housing end plug out of housing. **CAUTION** — Do not rotate shaft more than is necessary to remove 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.

## SAGINAW ROTARY VALVE (Cont.)

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. *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.



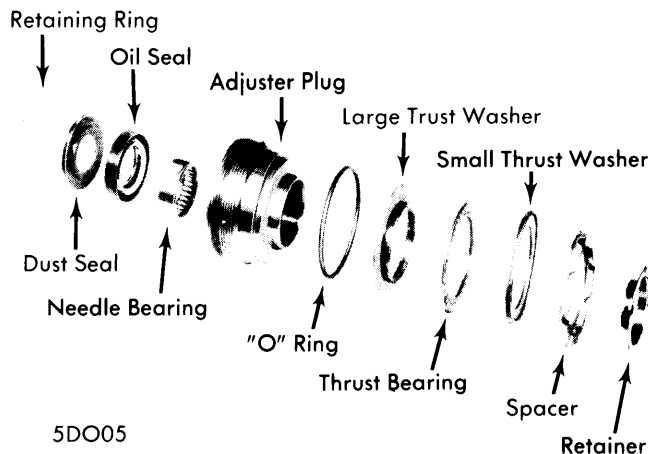
**VALVE BODY & WORMSHAFT ASSEMBLY**

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 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, and install piston end plug in rack-piston. Install housing end plug and end plug 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.



**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.

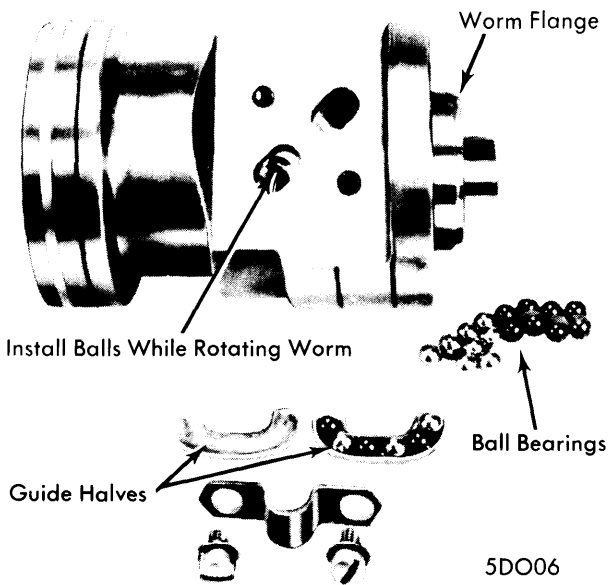
**Inspection** - Clean and dry all parts. Inspect worm and rack-piston grooves for scoring. Inspect ball bearings for damage. *NOTE - If either worm or rack-piston are damaged, both must be replaced as a matched set. If any ball bearings are damaged, replace entire set.* Check ball guides for pinching at ends. Inspect low thrust bearing races for cracking, scoring, or pitting.

**Reassembly** - Install "O" ring and piston ring on rack-piston, using care not to twist them. Install worm into rack-piston until worm is against piston shoulder. Install 17 (19 if variable ratio) ball bearings into rack-piston, while slowly rotating worm counterclockwise. *NOTE - Install light and dark colored balls alternately.* Install remaining balls into ball return guide, making sure balls in guide alternate in color with

# Power Steering Gears

## SAGINAW ROTARY VALVE (Cont.)

last ball installed in rack-piston. Install ball guide, guide clamp, and tighten screws.

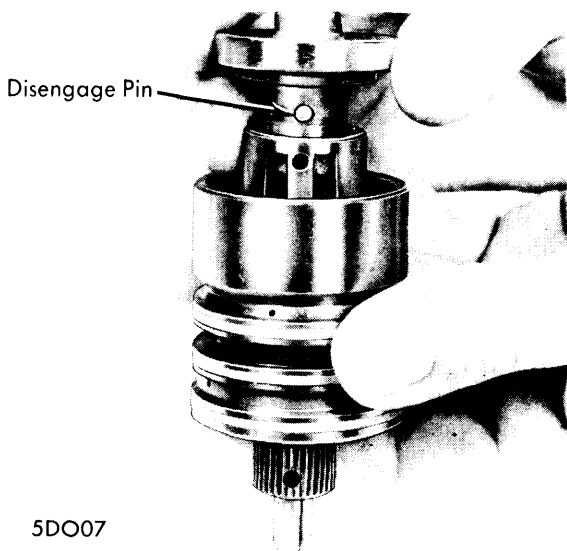


**RACK-PISTON ASSEMBLY**

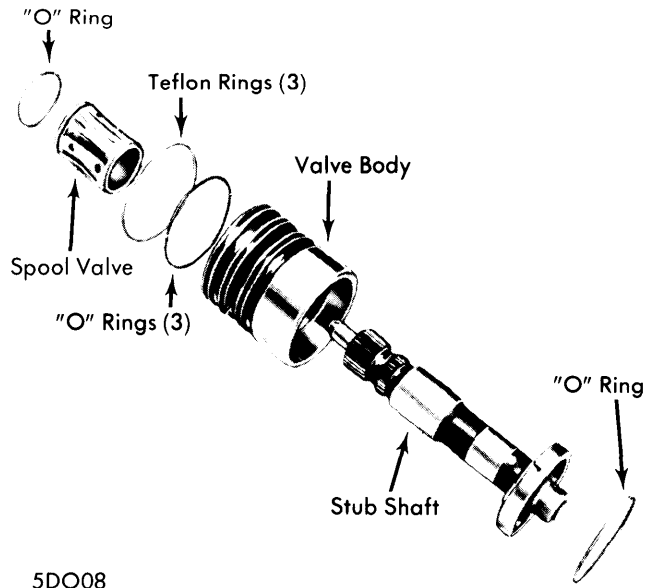
### ROTARY VALVE

**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.

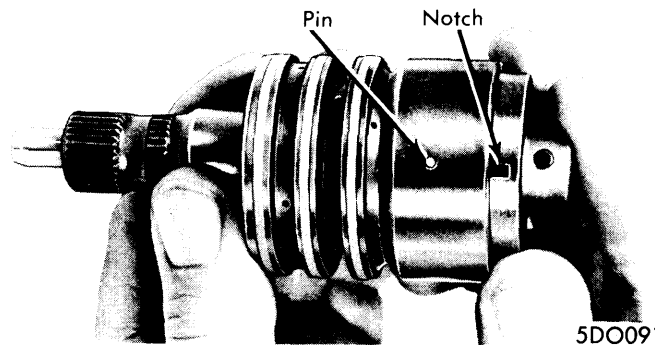


**REMOVING SHAFT FROM VALVE ASSEMBLY**



**VALVE BODY & 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  $\frac{3}{32}$ " below deep notch in valve body. Install cap-to-body "O" ring.



**INSTALLING INPUT (STUB) SHAFT**

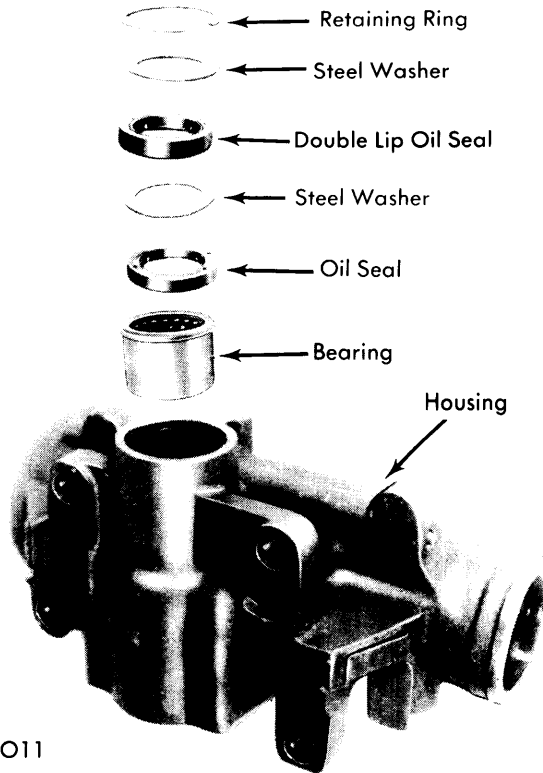
### STEERING GEAR HOUSING

**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  $\frac{5}{16}$ -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.

**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.

## SAGINAW ROTARY VALVE (Cont.)

If port seat was removed, position a new seat over opening in housing, and drive into place using a brass drift.



5DO11

**GEAR HOUSING ASSEMBLY**

### TIGHTENING SPECIFICATIONS

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