SAGINAW ROTARY VALVE

American Motors
General Motors

DESCRIPTION

Gear is variable ratio recirculating ball type. Steel balls work as a rolling thread between steering gear worm shaft and rack-piston nut. Wormshaft is supported by a thrust preload bearing and two conical thrust races at lower end, and a bearing assembly in adjuster plug at upper end. This design provides continual spring loaded pressure on wormshaft to prevent loss of thrust bearing preload for life of gear. Adjuster plug provides initial preload adjustment and service adjustment when servicing gear. As wormshaft is turned right, rack-piston moves upward in gear; turning wormshaft left moves rack-piston downward in gear. Rack-piston teeth mesh with sector which is forged as part of pitman shaft. Turning wormshaft turns pitman shaft which turns wheels through mechanical linkage.

NOTE – *Model 605 (Small Gear) is similar to the model 800-808 (Large Gear) described above with the following exceptions:*

- *Small gear has a round side cover held in place by a retaining ring while large gear has a rectangular side cover held in place with 4 bolts.*
- *The worm and rack are directly mated rather than separated by recirculating balls as in the large gear.*
- *Thrust bearing adjustment is at lower end of gear by hex-driver instead of at stub shaft end with spanner.*

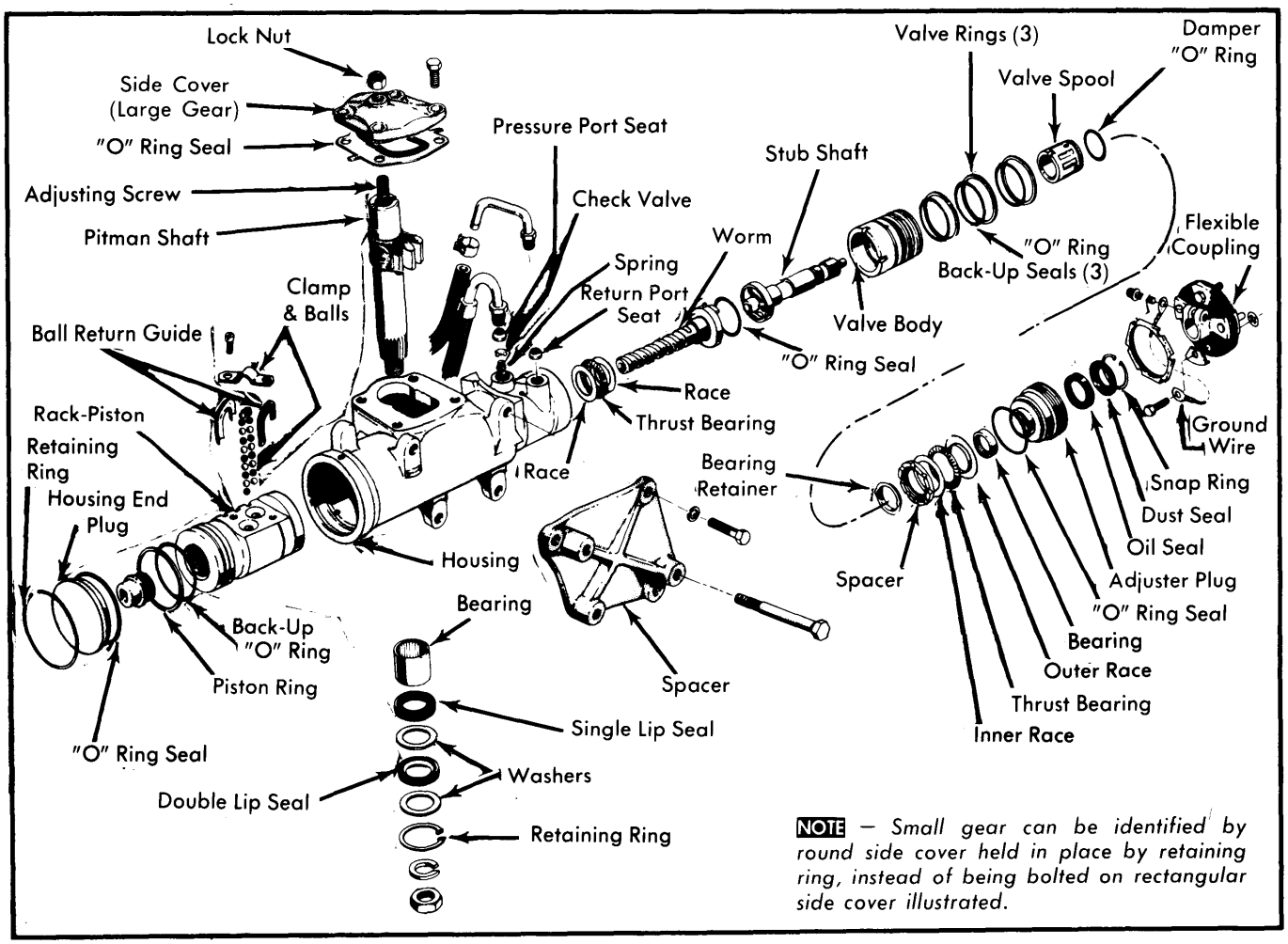
LUBRICATION, TROUBLE SHOOTING & TESTING

See Power Steering General Servicing in this section.

ADJUSTMENT

STEERING GEAR

NOTE – *Due to difficulty in adjusting worm bearing preload and drag induced by hydraulic oil, adjustments should be made with gear removed from vehicle. Thrust bearing adjustment procedures follow. Some service gears and overhaul kits may have flat races. If uncertain about race type, perform thrust bearing preload for conical thrust races to determine type used.*



NOTE – *Small gear can be identified by round side cover held in place by retaining ring, instead of being bolted on rectangular side cover illustrated.*

Fig. 1 Saginaw Rotary Valve Power Steering Gear (Model 800-808 Shown)

SAGINAW ROTARY VALVE (Cont.)

Thrust Bearing Preload – 1) Drain gear fluid by rotating stub shaft from stop-to-stop several times. Mount gear in vise and remove adjuster plug lock nut. Using spanner wrench for large gear or hex driver for small gear, turn adjuster plug until plug and thrust bearings are firmly bottomed (about 20 ft. lbs. for large gear or 30 ft. lbs. for small gear).

2) Scribe an index mark on housing and adjuster plug, then measure ½" counterclockwise (3/16-¼" on American Motors models) and mark housing. Back up adjuster plug so mark aligns with new mark on housing and tighten lock nut while holding adjuster plug to maintain position. Check for 4-10 INCH Lbs. torque required to turn stub shaft. See *Fig. 2*.

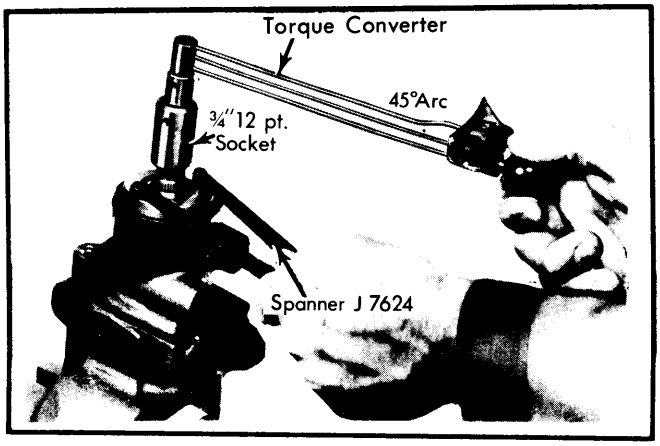


Fig. 2 Thrust Bearing Preload Adjustment (Large Gear Shown)

Pitman Shaft Overcenter Sector Adjustment – Ensure that gear is at center of travel. Back off preload adjuster until it stops, then turn in one full turn. (Note that small gear has LEFT HAND THREADS on adjuster and lock nut.) Check torque required to turn stub shaft and turn adjuster in until 6-10 INCH Lbs. more torque is required to turn shaft. Tighten adjuster screw lock nut and recheck torque. Total torque required should not exceed 14 INCH Lbs. for used gear or 18 INCH Lbs. for new gear. See *Fig. 3*.

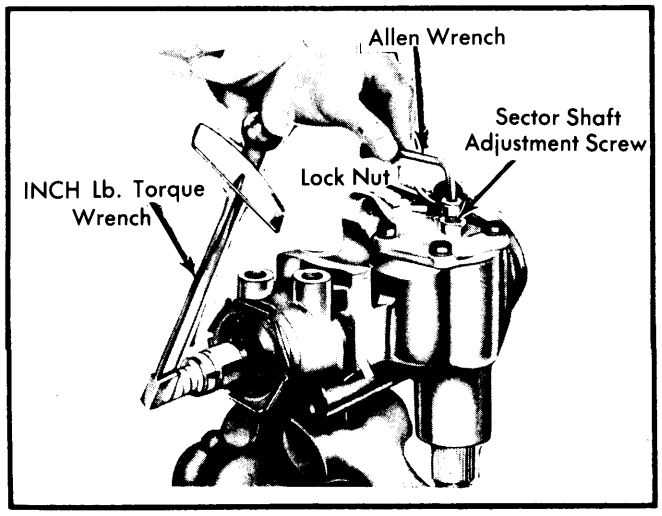


Fig. 3 Pitman Shaft End Play Adjustment

REMOVAL & INSTALLATION

STEERING GEAR

American Motors – Position wheels straight ahead and place drain pan under steering gear. Disconnect hoses from gear and secure above pump level. Cap open hose ends. Remove flexible coupling nuts, noting placement for assembly. Raise car and mark pitman arm and shaft for assembly reference. Using suitable puller, remove pitman arm. Unbolt steering gear and remove assembly. To install, center steering gear by turning stub shaft stop to stop, then back one half total turns. Flat on stub shaft should be facing upward. Reverse removal procedure and tighten to specifications.

NOTE – *On Eagle models, it will be necessary to remove skid plate, left side crossmember-to-sill support brace, and stabilizer bar brackets from frame to remove gear. On all models, stake pitman arm nut to shaft after tightening.*

General Motors – Place drain pan under gear to catch fluid and disconnect lines from gear. Plug openings to prevent contamination and loss of fluid. Disconnect battery ground cable and remove stone shield from flexible coupling. Remove pinch bolt and disconnect flexible coupling from worm shaft. Remove pitman arm nut, then remove pitman arm using a puller. Remove gear attaching bolts and lower gear from vehicle. To install, reverse removal procedures, ensuring that hoses do not touch chassis, or they may become chafed and rupture.

OVERHAUL

STEERING GEAR

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

Disassembly – 1) Thoroughly clean exterior and drain as much fluid as possible from steering gear. Use soft jaws on vise to hold unit. Remove pitman shaft preload adjuster nut. Rotate stub shaft to center gear. On small gear, use punch through retaining ring guide hole to lift retaining ring and remove side cover retaining ring. On large gear, remove side cover retaining bolts. Tap on pitman shaft end with soft faced hammer to remove pitman shaft and cover.

2) On small gear, loosen adjuster lock nut and back out adjuster plug. Push on stub shaft and remove rack piston and valve assembly together. On large gear, use punch through retaining ring access hole to lift ring and pry retaining ring from gear. Rotate stub shaft counterclockwise only enough to push out end cover. Remove rack piston plug and insert ball retainer (J-21552 or equivalent). Hold retainer and turn stub shaft counterclockwise to force rack piston onto tool.

3) Remove lock nut and adjuster plug assembly from stub shaft end. Grasp stub shaft end and pull valve and worm assembly from housing bore. Separate valve from worm, noting that pin in worm fits slot in valve. On small gear, turn valve and worm assembly counterclockwise to separate from rack. Remove retaining ring holding worm to valve and separate worm and valve assembly.

Reassembly – 1) Lubricate all parts with power steering fluid. Install all parts in reverse order of removal. See *Fig. 1*. Install lower shaft cap "O" ring in valve body so it is seated against lower shaft cap. Align narrow notch in valve body with pin in worm, then install valve shaft assembly in gear housing.

SAGINAW ROTARY VALVE (Cont.)

NOTE – *Valve body is properly seated when oil return hole in housing is entirely uncovered.*

2) Install new "O" ring in adjuster plug groove. Place suitable seal protector (J-6222) over stub shaft; then install adjuster plug assembly in housing until it seats against valve body. Remove seal protector. Position suitable seal compressor against shoulder of housing. With ball retainer (J-21552) in place in rack piston, push rack piston into housing until tool contacts center of worm. Turn lower shaft clockwise to thread rack piston onto worm shaft,then remove tool.

3) Install new "O" ring in pitman shaft side cover. Turn lower shaft until rack piston teeth are centered in pitman shaft opening, then install shaft and cover so center tooth of pitman shaft engages center groove of rack piston. Install side cover bolts and tighten as required. Install rack piston plug and tighten as required. Install housing end plug "O" ring, fill gear end with power steering fluid, then install end plug and retaining ring. Perform steering gear adjustments before installing gear in vehicle.

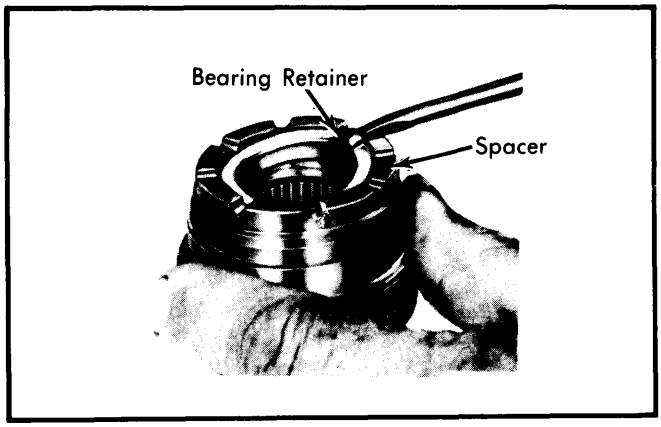


Fig. 4 Removing Upper Thrust Bearing Retainer (Large Gear Shown)

ADJUSTER PLUG

Disassembly – Remove thrust bearing retainer being careful not to score needle bearing bore. Remove thrust bearing spacer, bearing and bearing races. Remove adjuster plug "O" ring and stub shaft seal snap ring. Remove dust seal. Remove stub shaft seal. Inspect adjuster plug needle bearings for being broken or pitted. Remove bearing by pressing from thrust bearing end.

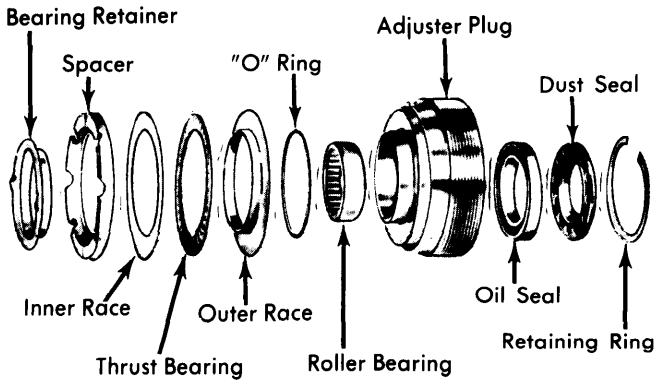


Fig. 5 Adjuster Plug Assembly (Large Gear)

Inspection – Inspect thrust bearing spacer for cracks and bearing rollers for pitting or scoring. Check bearing races for scoring, cracks or brinelling. If any of these conditions exists, replace both thrust bearing races and spacer.

Reassembly – Press needle bearing into adjuster plug with identification marks facing press tool until bottomed on input shaft seal bore. Install input seal with spring in seal facing inside of adjuster plug. 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.

ROTARY VALVE

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

Disassembly – 1) Remove and discard "O" ring seal in shaft cap end of valve assembly. While holding assembly with lower shaft down, lightly tap stub shaft against bench until shaft cap is free in valve body. Pull shaft assembly until shaft clears body by approximately ¼".

CAUTION – *Do not pull shaft assembly too far or spool valve may become cocked in valve body.*

2) Disengage shaft pin from valve spool and remove shaft assembly. Push spool valve out flush end of valve body until dampener "O" ring is exposed, then pull spool from body while rotating valve. If spool becomes cocked, realign valve, then remove. Remove dampener "O" ring from spool valve and discard. Cut plastic oil rings and "O" rings from valve body and discard.

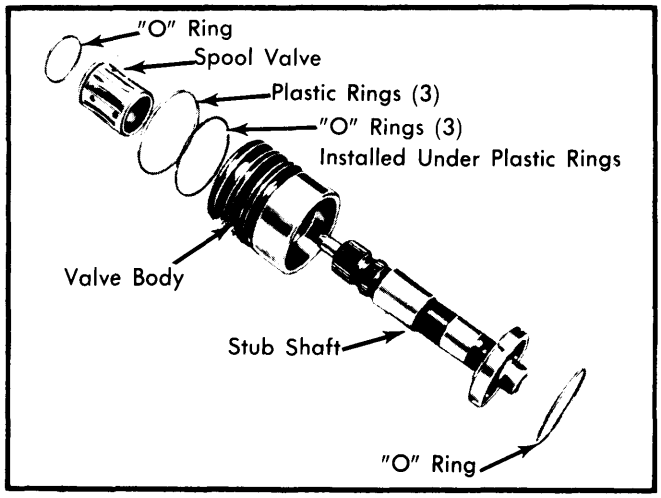


Fig. 6 Rotary Valve & Stub Shaft Assembly

Inspection – 1) Check spool valve drive pin for cracks or excessive wear; replace complete valve and shaft assembly as required. Check machined surfaces of stub shaft and spool valve for nicks, scratches or bad wear spots. If nicks cannot be cleaned up with crocus cloth, replace complete valve and shaft assembly.

2) A slight polishing is normal on valve surfaces. If small notch in valve skirt is worn, replace valve assembly. Lubricate spool valve and check fit in valve body with "O" ring removed. If binding occurs, replace valve and shaft assembly.

NOTE – *Small flat spots on either side of spool valve drive pin head are normal.*

SAGINAW ROTARY VALVE (Cont.)

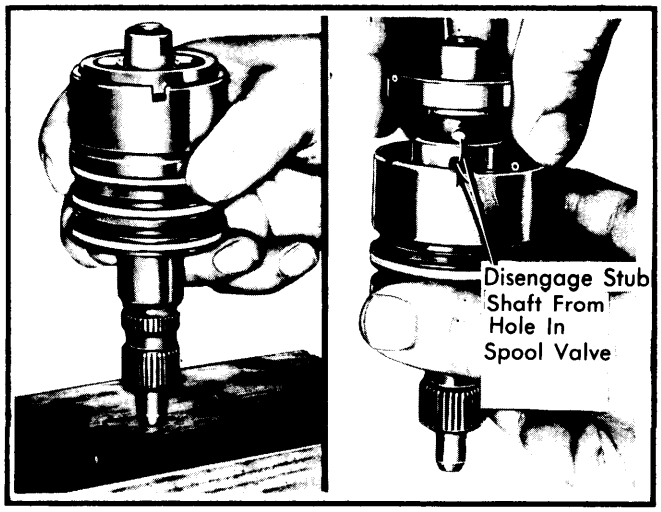


Fig. 7 Removing Stub Shaft Assembly

Reassembly – Lubricate back-up "O" ring seals and install on valve body. Avoid twisting seals. Install valve plastic rings over "O" rings. Lubricate new spool valve damper "O" ring with Vaseline and install in spool groove. Lubricate spool valve and slide into valve body until shaft pin hole is visible from other end (spool valve flush with cap end of valve body). Carefully install shaft assembly into spool valve until shaft pin can be inserted into spool valve. Align notch in shaft cap with pin in valve body and press spool valve and shaft assembly into valve body. Lubricate new cap-to-worm shaft "O" ring and install in valve body.

NOTE – *Check that shaft cap notch is mated with valve body pin before installing valve body into gear assembly.*

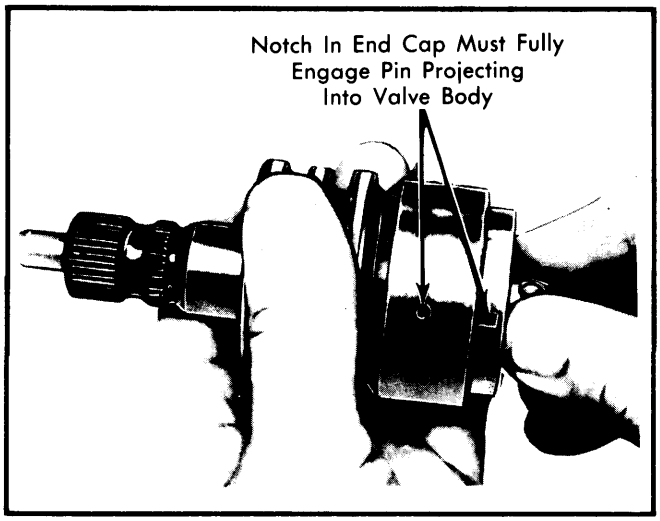


Fig. 8 Stub Shaft Installation

PITMAN SHAFT & SIDE COVER

Disassembly – Remove pitman shaft adjuster lock nut and unscrew side cover from adjusting screw. (LEFT HAND THREAD on small gear.) Do NOT disassemble pitman shaft.

Inspection – Clean and dry all parts. If shaft bearing surface in side cover is badly worn or scored, replace side cover. Make sure sealing and bearing surfaces of pitman shaft are not rough, cracked, nicked, or badly scored. If shaft teeth are damaged, replace shaft. Check pitman shaft lash adjusting screw for ease in turning with no end play. If adjusting screw is loose, replace pitman shaft assembly.

Reassembly – Thread side cover onto pitman shaft adjusting screw until it bottoms, then turn in ½ turn. Install new adjusting screw lock nut and make over-center adjustment. See *Steering Gear Adjustment.*

RACK PISTON & WORM

NOTE – *Procedures for small gear are similar except for reference to recirculating balls which are used only with large gear.*

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 at ends. Inspect lower thrust bearing races for cracks, scoring or pitting.

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

Reassembly – 1) Install "O" ring on rack-piston, using care not to twist rings. Install worm into rack-piston until worm is against piston shoulder. Install light and dark colored balls alternately into rack piston while turning shaft slowly counterclockwise. Pack one ball return guide half with petroleum jelly and place remaining balls in guide.

NOTE – *Ensure that balls in guide alternate color in same sequence as balls in rack piston.*

2) Install guide clamp and tighten clamp attaching screws. Install arbor tool (J-21552 or equivalent) and withdraw worm from rack-piston. Leave tool in place and install rack-piston in housing.

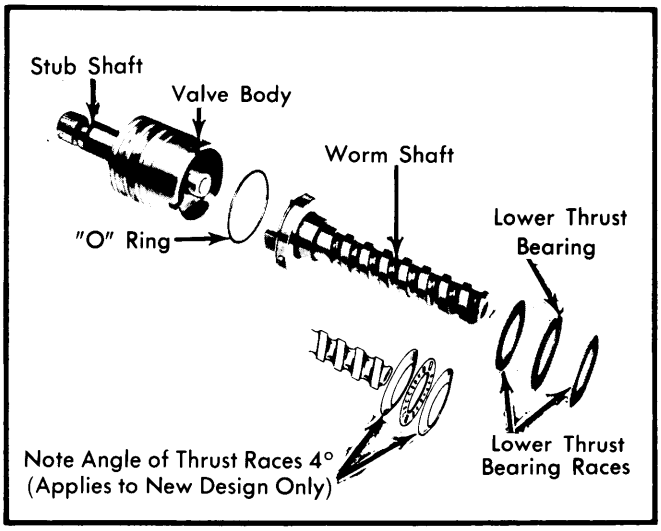


Fig. 9 Worm and Valve Body Assembly (Large Gear)

SAGINAW ROTARY VALVE (Cont.)

PITMAN SHAFT SEALS & BEARING REPLACEMENT

NOTE – *Seals may be replaced with steering gear on or off vehicle.*

Removal – Remove seal retaining ring, dust seal, washers and inner seal. Remove needle bearing from pitman arm end of housing with suitable tool (J-21551).

Installation – 1) Press bearing into housing with suitable tool until tool bottoms in housing. Install seals with lips facing inward using suitable tool (J-21553) only far enough to allow clearance for washers and retaining ring.

CAUTION – *Do not drive bearing or seals into housing farther than is necessary. Press bearing on stamped end only.*

2) Install retaining ring. Be sure ring is completely seated in housing groove.

STEERING GEAR HOSE CONNECTOR SEATS & CHECK VALVE

CAUTION – *Because of possibility of metal chips entering gear, it is recommended removing gear before performing this procedure.*

Removal – Turn gear up side down or pack inside of connector seats with Vaseline to prevent chips from entering gear. Tap threads in connector seats using a 5/16-18 tap. Tap only two or three theads to avoid hitting check valve. Thread a bolt with nut and flat washer into tapped hole. Hold bolt and turn nut to pull seat from housing. Wipe housing clean and remove check valve and spring from pressure port.

Installation – Install new check valve spring with large end down. Make sure spring is seated in counterbore. Install new valve over spring with tangs pointing down. Install connector seat using Vaseline to hold seat on valve, and drive seat into place using suitable installer tool (J-6217).

TIGHTENING SPECIFICATIONS

Application	Ft. Lbs.
Worm Adjuster Lock Nut	75-85
Sector Shaft Adjuster Lock Nut	25-35
Rack Piston Plug	
American Motors	50
General Motors	75
Pitman Arm-to-Sector Shaft Nut	
American Motors	①115
General Motors	180
Flexible Coupling-to-Flange Nuts	20-25
Flexible Coupling Pinch Bolt	30
Hose Fittings at Gear	30-40

① – Nut must be staked to shaft threads.