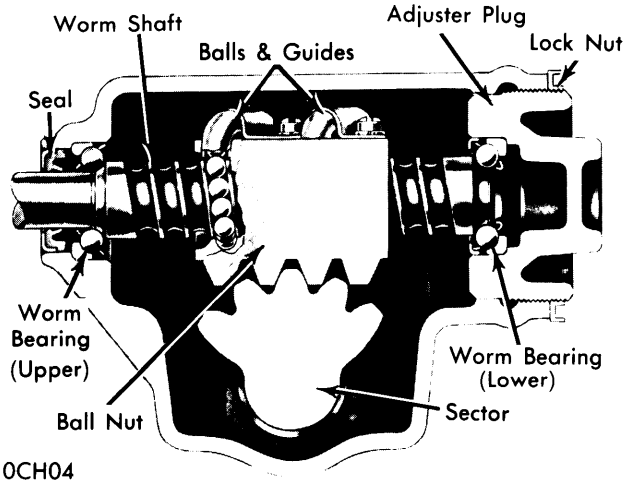
GENERAL MOTORS (SAGINAW) RECIRCULATING BALL

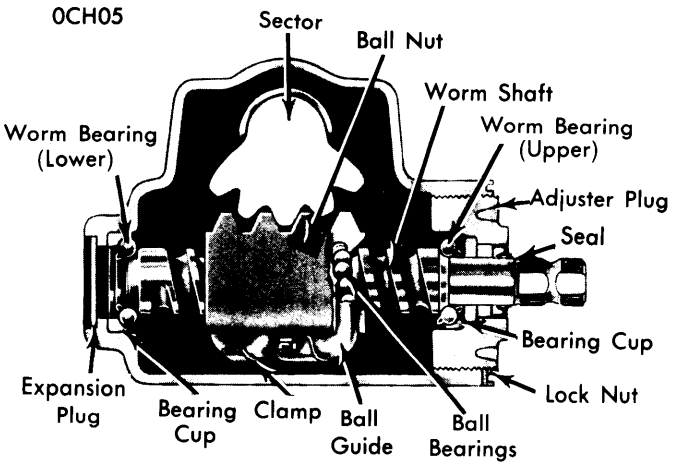
Chevrolet (1965-74)
GMC (1965-74)

DESCRIPTION & OPERATION

Steering gear is a recirculating ball type and consists of a ball nut connected to steering worm and in mesh with sector gear. Gears are basically the same for all models and service procedures will apply to all gears unless noted otherwise. Precision finished helical grooves within ball nut match helical grooves in worm. Ball bearings roll within grooves when steering wheel is turned. There are two complete circuits using tubular ball guides to deflect balls away from their helical path at one end of groove and guide them back to other end. When steering wheel is turned to right, nut moves upward; when turned to left, nut moves downward. The teeth on sector (forged as part of pitman shaft) and the ball nut are so designed that a tighter fit exists between the two when the front wheels are straight ahead. Proper engagement between sector and ball nut is obtained by an adjusting screw, which moves pitman shaft endwise, permitting desired engagement of tapered teeth of the ball nut and sector gear. Worm bearing adjuster can be turned to provide proper preloading of the upper and lower bearings.



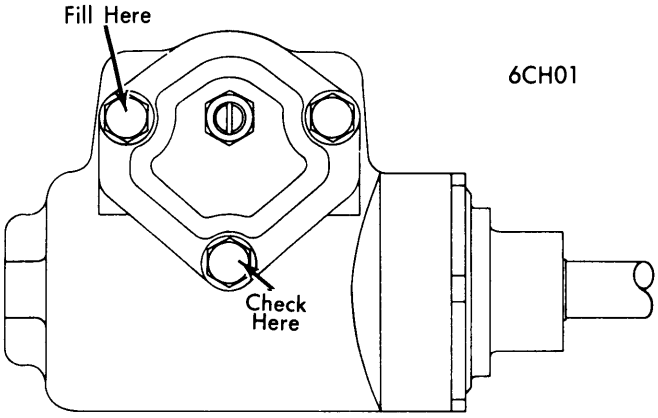
STEERING GEAR CROSS SECTION (EXC. "G" MODELS)



STEERING GEAR CROSS SECTION ("G" MODELS)

LUBRICATION

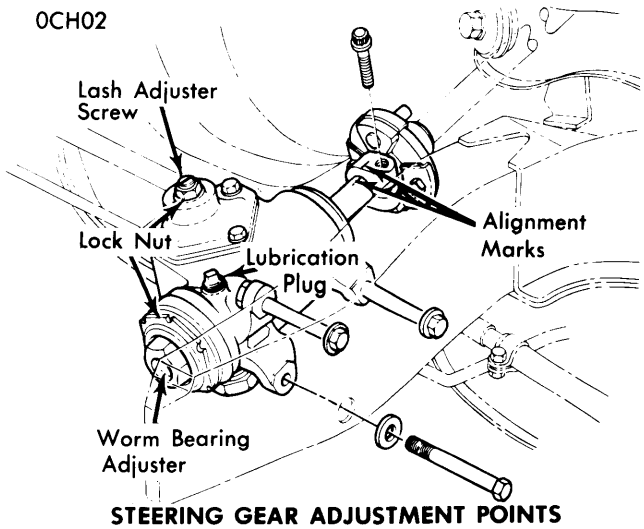
Steering gear is filled with a water resistant grease. Seasonal change of lubricant is unnecessary and should not be drained except at overhaul. Lubricant level should be checked every 36,000 miles. Use steering gear lubricant meeting GM specification, GM 4673, or equivalent to fill steering gear.



LUBRICATION CHECK & FILL (GEARS WITHOUT HOUSING PLUG)

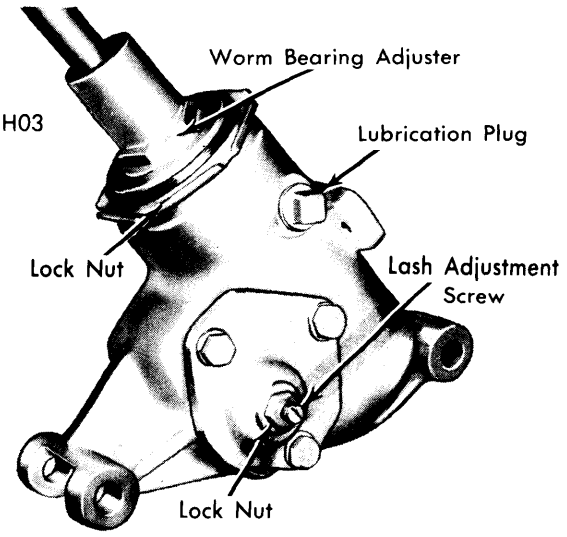
ADJUSTMENT

NOTE – Before any adjustments are made to steering gear, check for binding at frame bracket mounting bolts and at instrument panel bracket or flexible coupling. Steering shaft should turn through full range, in both directions, without binding. Binding indicates misaligned steering gear on mountings or coupling. Rough spots indicate damaged bearings or parts. Hard pull indicates excessive preload adjustment. Steering gear adjustments may be made with gear on or off the car. Set Worm Bearing Preload before setting Over-Center Preload.



STEERING GEAR ADJUSTMENT POINTS (EXC. "G" MODELS)

GENERAL MOTORS (SAGINAW) RECIRCULATING BALL (Cont.)



STEERING GEAR ADJUSTMENT POINTS ("G" MODELS)

WORM BEARING PRELOAD

1) Disconnect battery ground and raise vehicle. Remove sector shaft nut and mark relationship of pitman arm-to-sector shaft. Remove pitman arm with suitable puller. Loosen steering gear adjuster plug lock nut and back adjuster plug off 1-3 turns. Remove horn shroud or button cap. Turn steering wheel slowly in one direction until stopped by gear, then turn back one-half turn. *CAUTION — Do not turn steering wheel hard against stops with linkage disconnected from gear as damage to ball guides could result.*

2) Measure and record Bearing Drag with an INCH pound torque wrench applied to steering wheel nut rotating through a 90° arc. *NOTE — Do not use a torque wrench having a maximum torque reading of more than 50 INCH Lbs.* Adjust thrust bearing preload by tightening adjuster plug until proper preload is obtained (see specifications).

3) When proper preload has been obtained, tighten adjuster plug lock nut and check Bearing Drag again. If gear feels lumpy after adjustment, bearings, worm shaft or ball nut may be worn or damaged. Disassemble gear for inspection and component service. With Worm Bearing Preload properly adjusted, proceed to Over-Center Preload adjustment.

OVER-CENTER PRELOAD

1) Turn steering wheel slowly from stop to stop counting total number of turns, then turn wheel back exactly half-way to center position. Loosen lash adjuster lock nut. Turn lash adjuster screw clockwise to take out all lash between ball nut and sector shaft teeth, then tighten lock nut.

2) Check torque at steering wheel recording highest reading as wheel is turned through center position (see specifications). If necessary, loosen lock nut and readjust lash adjuster screw to obtain proper torque reading. Tighten lock nut and again check torque reading. If maximum specification is exceeded, turn lash adjuster screw counterclockwise, then come up on adjustment by turning adjuster clockwise.

3) Reinstall pitman arm to sector shaft lining up marks made during disassembly. Torque sector shaft nut. *NOTE — If a clamp type pitman arm is used, spread pitman arm with a wedge just enough to slip arm onto shaft by hand pressure. Do not hammer on pitman arm or damage to steering gear may result.* Install horn button or shroud and connect battery ground.

Worm Bearing Preload

Application	① INCH Lbs.
1965-66 All Models	② 1 1/16-1 1/4
1967 Models	
C 10-30, G 10-20, P-10	5-9
K 10-20	4-7
P 20-30	9-13
1968-74 Models	
C 10-30, K 10-20, P-10	4-6
P 20-30	9-12
G 10-20 (1968-70)	4-6
G 10-30 (1971-74)	6-11

① — Measured with INCH Lb. torque wrench on steering wheel nut (except as noted).

② — Pounds as measured on spring scale hooked to outer edge of steering wheel and spoke.

Over-Center Preload

Application	① INCH Lbs.
1965-66 All Models	② 1 1/4 -2 1/8
1967 Models	
C 10-30, G 10-20, P-10	5-11
K 10-20	4-7
P 20-30	18-22
1968-74 Models	
C 10-30, G 10-20, P-10	③4-10
G 10-30 (1971-74)	③5-11
P 20-30	③9-13

① — Measured with INCH Lb. torque wrench on steering wheel nut (except as noted).

② — Pounds as measured on spring scale hooked to outer edge of steering wheel and spoke.

③ — In excess of worm bearing preload.

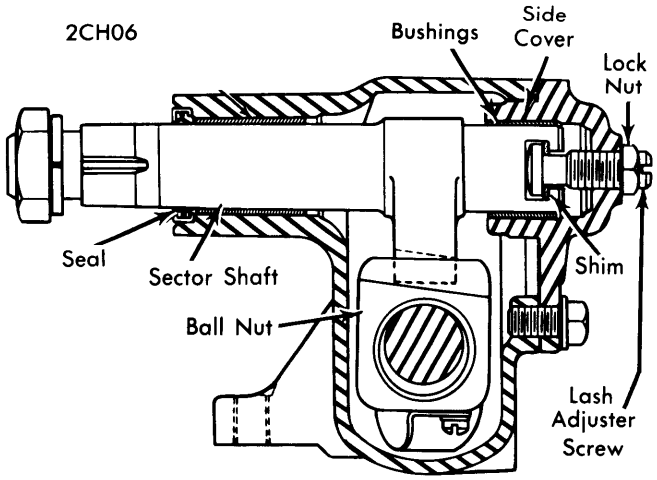
STEERING GEAR HIGH POINT CENTERING

1) Set front wheels in straight ahead position, check mark on worm shaft designating steering gear high point. Mark on shaft may either be on top side (12 o'clock position) or on bottom side (6 o'clock position) of shaft, and lined up with coupling lower clamp.

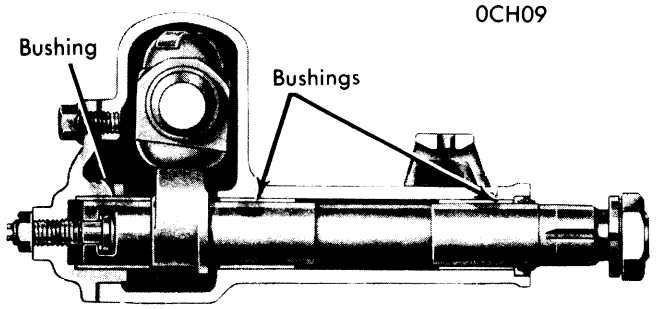
2) With independent suspension, if gear has been moved off high point when setting wheels in straight ahead position, proceed as follows: Loosen right and left tie rod adjusting sleeves, and turn both sleeves an equal number of turns in same direction to bring gear back on high point. *NOTE — Turning sleeves in different directions or unequal number of turns will disturb toe-in setting.*

3) On "I"-beam axle models, if gear has been moved off high point when setting wheels in straight ahead position, loosen connecting rod sleeve clamps and turn sleeve to bring gear back on high point. Readjust toe-in if necessary. *See Wheel Alignment Specifications & Procedures in WHEEL ALIGNMENT Section.*

GENERAL MOTORS (SAGINAW) RECIRCULATING BALL (Cont.)



STEERING GEAR SECTOR SHAFT CROSS SECTION (EXC. "G" MODELS)



SECTOR SHAFT CROSS SECTION ("G" MODELS)

REMOVAL & INSTALLATION

NOTE — All steering component fasteners are made of special quality materials. Replacement fasteners must be of same part number or equivalent. Torque all fasteners to specification and install new cotter pins.

STEERING GEAR

1965-67 "P" 20-30 Models — Remove steering wheel. Loosen and pull mast jacket seal away from floor pan. Remove floor pan from around mast jacket. Remove pitman arm from steering gear and remove gear-to-frame mounting bolts. Remove mast jacket-to-dash panel support. Lift steering gear and mast jacket assembly out of vehicle. Mark mast jacket-to-steering gear relationship and then loosen mast jacket-to-steering gear clamp. Slide mast jacket off steering shaft. To install steering gear, reverse removal procedure.

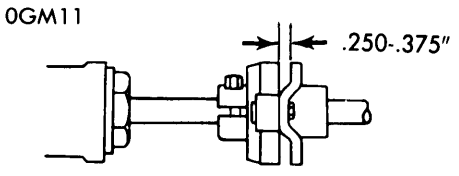
1965-70 All Models (Exc. "G" Vans) — 1) Set wheels in straight ahead position. Mark steering shaft-to-worm shaft relationship and loosen bolt attaching lower end of shaft coupling to steering gear. Remove pitman arm from sector shaft using suitable puller and remove steering gear-to-frame mounting bolts, and remove gear from vehicle.

2) To install gear, proceed as follows: Determine correct mid-position of worm shaft by turning shaft from lock to lock counting number of turns, then turn shaft back one-half the total number of turns to mid-position. Install gear on frame and at same time slide worm shaft into flexible or universal joint coupling. Check that steering wheel is aligned in straight ahead position. Tighten gear mounting bolts and coupling bolt. Install pitman arm and torque nut or clamping bolt to specification.

1965-70 "G" Vans — Steering gear is cradle mounted in frame rail and must be removed from inside vehicle. Place vehicle on suitable hoist or jack stands. Remove steering wheel. Remove air deflector and extension assembly. Remove pitman arm from sector shaft after marking arm-to-shaft relationship. Disconnect brake pedal from lower brake pedal assembly and disconnect transmission shift linkage from levers. Remove gear-to-frame mounting bolts and from inside vehicle, remove brake pedal previously disconnected. Pull back floor mat and disconnect toe pan seal, and remove toe pan cover. Remove mast jacket bracket from support. Remove steering gear, mast jacket, and transmission controls as an assembly. Remove transmission lever housing from gear mounting pad and loosen mast jacket after noting mast jacket-to-steering shaft position. Remove mast jacket from steering gear shaft. To install steering gear, reverse removal procedure.

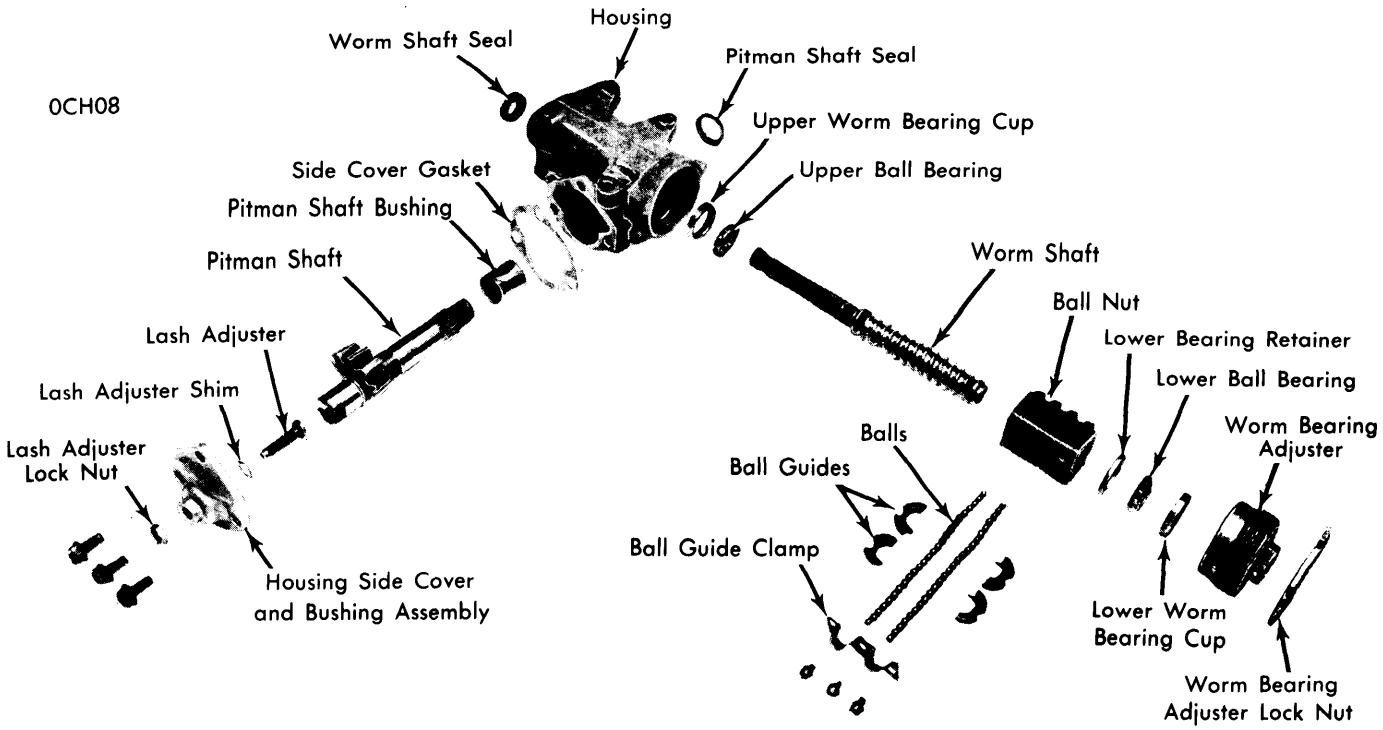
1971-74 All Models — 1) Set front wheels in straight ahead position. Remove flexible coupling-to-steering shaft flange bolts or lower universal joint pinch bolt. Mark position of universal yoke-to-worm shaft. Mark relationship of pitman arm-to-sector shaft. Remove pitman arm using suitable puller (J-6632). Remove steering gear mounting bolts and remove gear assembly. If equipped with flexible coupling, remove pinch bolt and coupling from steering gear worm shaft. To install steering gear on "C", "G" and "K" models, see next step; for "P" models, see step **3**).

2) Install flexible coupling on worm shaft aligning flat on coupling with flat on shaft. Push coupling on shaft until shaft hits shoulder and install pinch bolt. *NOTE — Pinch bolt must pass through shaft undercut.* Place gear in position guiding coupling bolt into steering shaft flange. Install gear-to-frame bolts and torque to specification. If flexible coupling alignment pin plastic spacers are used, make sure they are bottomed on pins, tighten flange bolt nuts and remove plastic spacers. *NOTE — Plastic spacers must be removed before driving vehicle.* Purpose of plastic spacers are to aid in centering pins in flange openings and also maintain correct coupling-to-flange dimension. Check that flexible coupling-to-steering shaft flange dimension is .250-.375". If flexible coupling alignment pin plastic spacers are not used, center pins in slots in steering shaft flange and then install and tighten flange bolt nuts.



FLEXIBLE COUPLING ADJUSTMENT

GENERAL MOTORS (SAGINAW) RECIRCULATING BALL (Cont.)



STEERING GEAR (TYPICAL)

3) With "P" models, place steering gear in position guiding worm shaft into universal joint assembly lining up marks made during removal. *NOTE – If a new gear is installed, line up mark on worm shaft with slit in universal joint yoke.* Install gear mounting bolts and torque to specification. Install universal joint pinch bolt, bolt must pass through shaft undercut. Install pitman arm lining up marks and tighten shaft nut or pinch bolt.

SECTOR SHAFT SEAL

1965-74 Models – 1) With most models, sector shaft seal can be replaced without removing steering gear from vehicle. On "G" Vans, and all "K" models, gear must be removed. Rotate steering wheel from stop to stop counting number of turns, then turn wheel back half-way placing gear on center of travel. Loosen lash adjuster lock nut and turn lash adjuster a few turns counterclockwise.

2) Remove bolts attaching side cover to housing, and lift sector shaft and side cover assembly from housing. Pry sector shaft seal from housing using a screwdriver being careful not to scratch housing bore. Inspect gear lubricant for contamination, if lubricant is contaminated in any way, gear should be completely overhauled.

3) Lubricate new sector shaft seal with suitable steering gear lubricant (GM 4673M). Position seal in sector shaft bore and tap into place using a suitable socket. Remove lash adjuster lock nut, and side cover from sector shaft assembly by turning lash adjuster screw clockwise. Install sector shaft in gear so center tooth of sector enters center tooth space of ball nut. Fill gear housing with lubricant and install a new side cover gasket on gear housing. Install side cover over sector shaft by reaching through cover hole with a screwdriver and turning lash adjuster screw counterclockwise until screw bottoms, then back off screw one-half turn. Install side cover bolts and tighten to specification. Install lash adjuster lock nut and perform steering gear adjustments.

OVERHAUL

DISASSEMBLY

1965-74 All Models – 1) Place steering gear in a vise clamping onto one mounting tab or suitable fixture. Worm shaft should be in a horizontal position. Loosen sector shaft lock nut and turn lash adjuster a few turns counterclockwise. Loosen lock nut on adjuster plug and turn adjuster plug counterclockwise a few turns. Rotate worm shaft from stop to stop counting number of turns, then turn shaft back one-half total number of turns to center sector shaft. Place a pan under assembly to catch oil and remove three self-locking bolts holding side cover to housing.

2) Tap on end of sector shaft with a mallet and lift side cover and sector shaft assembly from gear housing. If sector does not clear opening easily, turn worm shaft by hand until sector can be removed. Remove adjuster plug and lock nut assembly with lower worm shaft bearing (upper worm shaft bearing on "G" models). Remove worm shaft and nut assembly from housing in a horizontal position to prevent ball nut from running down worm shaft. *CAUTION – Damage to ball guides may result if ball nut is allowed to run down worm shaft.* Remove upper bearing from worm shaft (on "G" models, remove lower bearing from inside gear housing).

GENERAL MOTORS (SAGINAW) RECIRCULATING BALL (Cont.)

3) Using a screwdriver, pry lower bearing retainer (exc. "G" models) from adjuster plug housing and remove bearing. Remove lock nut from lash adjuster screw in side cover. Remove lash adjuster screw by turning clockwise. Slide screw and shim out slot in end of sector shaft. Pry out and discard both sector shaft and worm shaft seals.

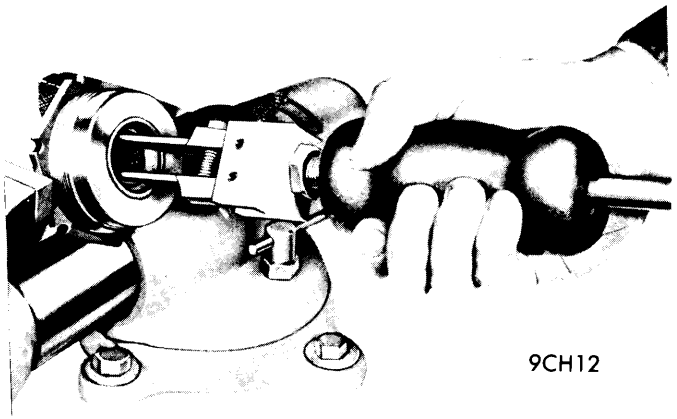
CLEANING & INSPECTION

Wash parts with clean solvent and blow dry with air. Inspect bearings and races for signs of wear. Any parts that show signs of wear should be replaced. Inspect sector shaft fit in side cover bushing. If bushing is worn, a new side cover and bushing assembly should be installed. Check ball nut and worm shaft assembly for wear or being bent.

COMPONENT SERVICE

Sector Shaft & Worm Shaft Seals – Pry out seals using a suitable screwdriver if not previously removed. Before installing new seals, check condition of sector shaft bushings and upper worm shaft bearing race. Use a suitable size socket pressing on outer diameter of seal to replace seal. Avoid installing seals in a cocked position.

Sector Shaft Bushing(s) – Support steering gear in a suitable arbor press and press sector shaft bushing(s) from housing using suitable tool (J-1614), inserted from lower end of housing. Press new bushing(s) into position reversing removal procedure. Replacement bushings are diamond bored to size and require no further reaming.

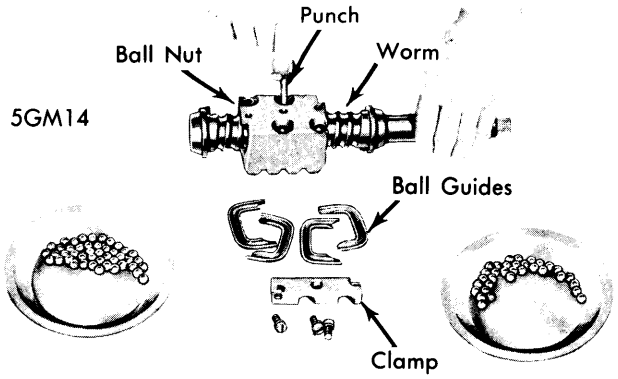


9CH12

REMOVING WORM SHAFT BEARING CUP

Worm Shaft Bearing Race (In Adjuster Plug) – Remove worm shaft bearing race using suitable tool (J-5882) and a slide hammer (exc. "G" models). With "G" models, use a hammer and punch to drive bearing race out of adjuster plug. Press new bearing race into position using suitable tool (J-5755).

Worm Shaft Bearing Race (In Housing) – With "G" models, drive out sheet metal expansion plug using a drift or punch. With all other models, drive out housing bearing race with a punch and press in a new bearing race using suitable tool (J-5755). With "G" models, install a new expansion plug and press on center of plug to deform it inward to secure in housing.



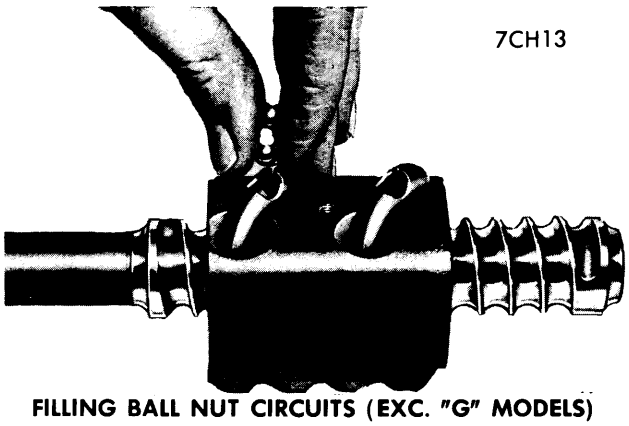
FILLING BALL NUT ("G" MODELS)

Ball Nut & Worm Shaft – Ball nut disassembly is not necessary unless there is indication of binding or tightness when rotating worm. If unit is disassembled, proceed as follows:

1) Remove clamp retaining ball guides and pull guides from nut (catch balls in a clean pan). Turn nut over and rotate worm until all balls have dropped out of nut and remove worm. Wash parts and inspect worm, nut grooves, and ball bearings for indentations. Check ball guides for damage at ends where they deflect or pick up balls from helical path.

2) To reassemble ball nut and worm shaft, insert ball nut over worm so ball nut teeth shallow end is to left from steering wheel position. Align grooves in worm and nut by sighting through ball guide holes. With all models except early "G" Vans, place guide halves together and insert then into ball nut. Count 24 balls into a suitable container for one circuit. Load balls through guide holes while turning worm gradually.

3) With "G" Vans, count 27 balls into a suitable container. This is the proper number of balls for one circuit. Load balls into one ball nut circuit while turning worm gradually. Lay half of a ball guide on bench and place remaining balls in guide. Put guide halves together and plug each end with petroleum jelly so balls will not fall out while installing guide. Push guide into ball nut completing one circuit. If guide does not push down easily, tap lightly with wood handle of a screwdriver on guide. Fill second circuit using same procedure. Install ball guide clamp and tighten screw. Check assembly by rotating worm to see that it moves freely. Lubricate ball nut with suitable steering gear lubricant (GM 4673M).



7CH13

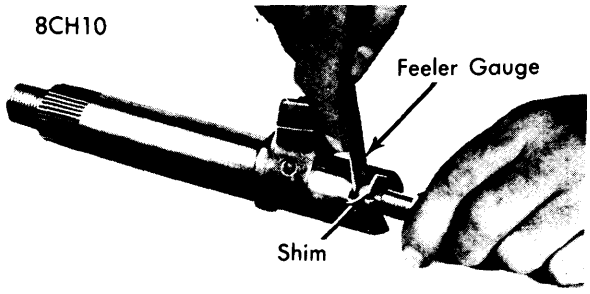
FILLING BALL NUT CIRCUITS (EXC. "G" MODELS)

GENERAL MOTORS (SAGINAW) RECIRCULATING BALL (Cont.)

REASSEMBLY

1965-74 All Models – 1) Place gear housing in a vise with worm shaft bore horizontal and side cover opening up. With sector shaft and worm shaft seals, sector shaft bushings and worm shaft bearing races installed, and ball nut assembly together, proceed as follows: With "G" Vans, see step **2**). Slip upper ball bearing over worm shaft and insert worm and nut assembly into housing feeding end of shaft through upper ball bearing race and seal. Place ball bearing in adjuster race and press stamped retainer into place with suitable socket. Install adjuster and lock nut into housing carefully guiding worm shaft into bearing until nearly all end play is removed from worm shaft.

2) With "G" Vans, place worm shaft bearing in housing race. Slide other bearing and adjuster plug assembly over upper end of worm shaft. Insert worm shaft, nut and adjuster assembly into housing guiding lower end of worm into housing bearing. Thread adjuster into housing until nearly all end play is removed from worm shaft.



CHECKING LASH ADJUSTER END CLEARANCE (TYPICAL)

3) With all models, position lash adjuster (with shim) in slotted end of sector shaft. Check end clearance which should not be more than .002" (see illustration). If clearance is greater than .002", a steering gear lash adjuster shim kit is available. Kit contains shims .063", .065", .067" and .069" thick. Lubricate gear with 11 ozs. of suitable steering gear lubricant (GM 4673M) as follows: Rotate worm until ball nut is at end of travel, place as much lubricant into housing as possible without losing it out sector shaft opening. Rotate worm until ball is at other end and apply more lubricant.

4) Rotate worm until ball nut is in center of worm, this will help sector and ball nut engage properly. Insert sector shaft and lash adjuster screw (without side cover) into housing so center tooth of sector enters center tooth space in ball nut. Apply remaining portion of lubricant into housing. Install side cover gasket. Install side cover over sector shaft by reaching through cover with a screwdriver and turning lash adjuster screw counterclockwise until screw bottoms; then back screw off one-half turn. Loosely install a new lock nut onto adjuster screw. Install and tighten side cover bolts to specification. *NOTE – If new side cover bolts are used, they must be specified bolts which are self-locking.* Adjust worm bearing preload and over-center preload as previously outlined in Adjustments.

TIGHTENING SPECIFICATIONS

Application	Ft. Lbs.
Worm Bearing Lock Nut	
1965-74 All Models	85
Sector Lash Lock Nut	
1965-72 All Models (Exc. 1971 "G")	30
1971 G 10-30	23
1973-74 All Models	35
Gear-To-Frame Bolts	
1966 All Models	100
1967-68 Models	
G & K 10-20	100
P 20-30 (Horizontal Bolts)	100
P 20-30 (Vertical Bolts)	50
All Other Models	65
1969 Models	
G 10-20	100
All Other Models	65
1970 All Models	65
1971-74 Models	
G 10-30	110
All Other Models	65
Pitman Arm-To-Pitman Shaft Nut	
1966 All Models	95
1967-68 Models	
G 10-20	95
C 10-30, P-10	140
P 20-30	115
K 10-20	125
1969-71 Models	
G 10-20	95
C & P 10-30	125
K 10-20	90
1972-74 Models	
C, G & P 10-30	140
K 10-20	90
Side Cover-To-Housing	25-40