

GROUP 8 STEERING GEAR AND LINKAGE

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SECTION 8-A MANUAL STEERING GEAR AND LINKAGE

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8-1 MANUAL STEERING GEAR AND LINKAGE SPECIFICATIONS

a. Tightening Specifications

Use a reliable torque wrench to tighten the

parts listed to insure proper tightness without straining or distorting parts. These specifications are for clean and lightly lubricated threads only; dry or dirty threads produce increased friction which prevents accurate measurement of tightness.

Part	Location	Thread Size	Torque-Ft. Lbs.
Bolt & Nut	Lower Coupling Clamp	7/16-20	25-35
Bolt & Nut	Tie Rod Clamp	3/8 -24	20-25
Bolt	Gear Side Cover to Housing	3/8 -16	25-35
Bolt	Idler Arm Support to Front Suspension Cross Member	3/8 -24	30-40
Bolt & Nut	Gear Housing to Front Suspension Cross Member	7/16-20	45-60
Nut	Tie Rod Ball Stud to Steering Arm	1/2 -20	35-50
Nut	Steering Wheel to Steering Shaft	5/8 -18	20-30
Nut	Pitman Arm to Pitman Shaft	3/4 -16	90-110
Bushing	Idler Arm	11/16-11	110-115
Bolt & Nut	Toe Pan Cover Clamp	5/16-18	3-5
Nut	Lash Adjuster Lock	7/16-20	18-27

b. Steering Gear Specifications

Items	Items
Gear Type	Recirculating Ball Worm and Nut
Make	Saginaw
Housing Material	Cast Aluminum
Ratio, Gear Only	22 to 1
Ratio, Overall (Including Linkage)	26.2 to 1
Turns of Wheel, Lt. to Rt. (Gear connected)	5

Items

Lubrication	Plug in Housing
Oil Capacity	11 oz.
Steering Wheel Diameter	17"
Number and Type of Pitman Shaft Bearings	2 Bushings
Number and Type of Worm Shaft Bearings	2 Ball Bearings
Worm and Nut Balls - No. and Diameter	50, 9/32"
Adjusting Screw and Shim Clearance in Pitman Shaft	0 to .002"
Worm Bearing Preload - Lbs. Pull at Wheel Rim	1/4 to 3/4 lbs.
Pitman Shaft Overcenter - Lbs. Pull at Wheel Rim	1/2 to 1 lb. Higher than worm Bearing Preload
Worm Bearing Preload - Torque at Spline	2 to 7 in. lbs.
Pitman Shaft Overcenter - Torque at Spline	4 to 8 in. lbs. Higher than worm Bearing Preload

c. Steering Linkage Specifications

Type	Parallelogram
Make	Saginaw
Intermediate Rod Plug Adjustments	See fig. 8-4
Toe-in, Caster, Camber, etc.	See Group 7
Turning Circle Diameter (Curb to Curb)	38 feet

8-2 DESCRIPTION OF MANUAL STEERING GEAR AND LINKAGE

a. Steering Gear Assembly

The steering gear is the recirculating ball worm and nut type. The worm on lower end of the steering shaft and the ball nut which is mounted on the worm have mating spiral grooves in which steel balls circulate to provide a low-friction drive between worm and nut. See Figure 8-1.

Two sets of 25 balls are used, with each set operating independently of the other. The circuit through which each set of balls circulates includes the grooves in worm and ball nut and a ball return guide attached to outer surface of nut.

When the wheel and steering shaft turn to the left the ball nut is moved downward by the balls

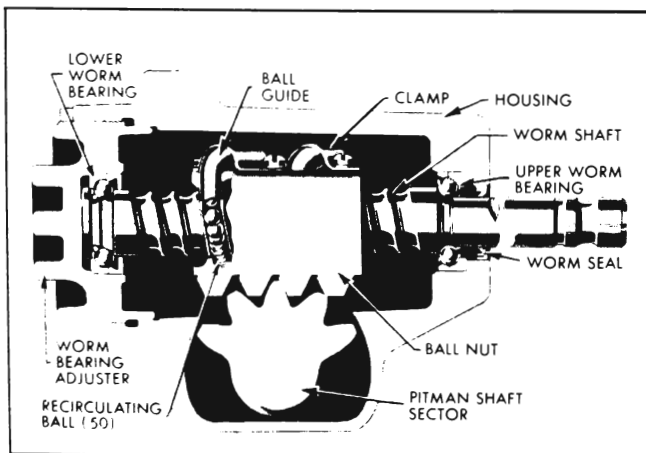


Figure 8-1—Steering Gear Worm and Ball Nut

which roll between the worm and nut. As the balls reach the outer surface of nut they enter the return guides which direct them across and down into the ball nut, where they enter the circuit again. When a right turn is made, the ball nut moves upward and the balls circulate in the reverse direction. See Figure 8-1.

Teeth on the ball nut engage teeth on a sector forged integral with the pitman shaft. The teeth on the ball nut are made so that a "high point" or tighter fit exists between the ball nut and pitman shaft sector teeth when front wheels are in the straight-ahead position. The teeth of sector are slightly tapered so that a proper lash may be obtained by moving the pitman shaft endways by means of a lash adjuster screw which extends through the gear housing side cover. The head of lash adjuster and a selectively fitted shim fit snugly into a T-slot in the end of the pitman shaft, so that the screw also controls end play of shaft. The screw is locked by an external lock nut. See Figure 8-2.

The pitman shaft is carried by a bushing in the steering gear housing and a bushing in the housing side cover. A seal in the housing prevents leakage of lubricant at the lower end of the shaft. See Figure 8-2.

The steering worm shaft is carried by two ball thrust bearings which bear against seats on the ends of the worm. The outer race or cup of the upper worm bearing is pressed into the gear housing.

The outer race or cup of the lower worm bearing is pressed into the worm bearing adjuster which screws into the housing and is locked by a nut.

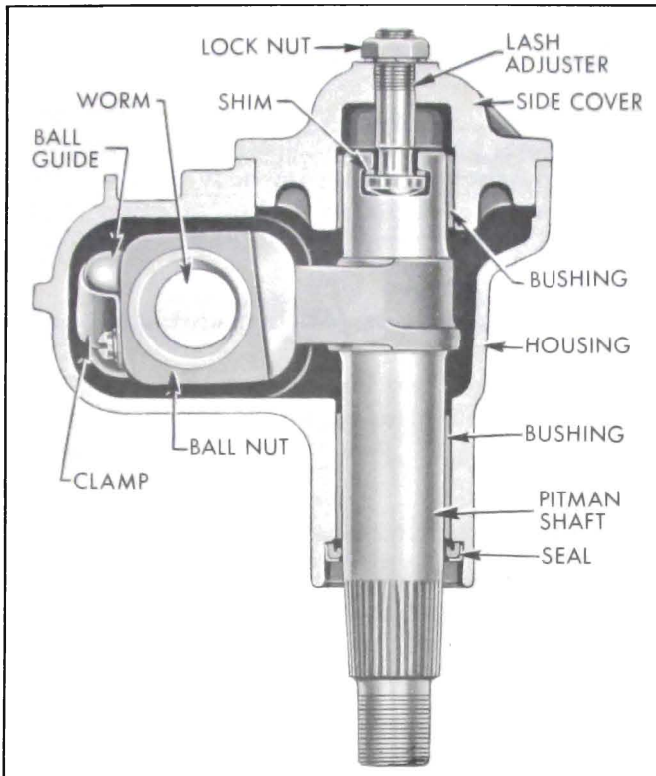


Figure 8-2—Steering Gear Pitman Shaft and Ball Nut

This adjuster is turned to provide proper pre-loading of the upper and lower worm bearings. The steering gear housing is attached to the frame by three bolts.

The upper steering shaft is a separate shaft supported in the steering column jacket. Its upper end is supported by a ball bearing; its lower end by an adapter and ball bearing assembly.

The upper steering shaft is connected to the

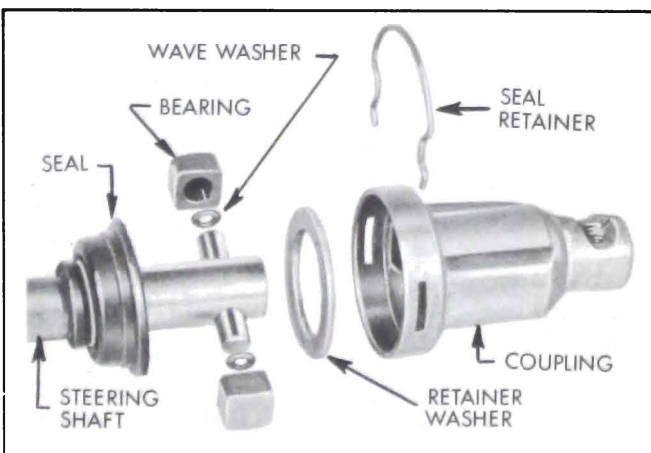


Figure 8-3—Steering Shaft Coupling Assembly

steering worm shaft through a Universal joint type coupling. See Figure 8-3. This coupling allows slight variations in alignment between the steering gear worm shaft and the steering shaft.

b. Steering Linkage

The parallelogram type steering linkage is used to connect both front wheels to the steering gear pitman arm. As shown in Figure 8-4, the right and left tie rods are connected to a tubular intermediate rod. The left end of the intermediate rod is supported by the pitman arm and the right end is supported by an idler arm which pivots on a support attached to the front suspension cross member. The pitman and idler arms are always parallel with each other and move through symmetrical arcs.

Four ball sockets are held between pairs of ball socket bearings contained in the intermediate rod. The bearings are held in firm contact with the ball sockets through pressure applied by coil springs located at the tie rod socket bearings. Steel spacers transmit this spring pressure to the pitman and idler arm bearings. The spring tension is adjusted by the threaded end plugs.

Steel plugs extending through the springs act as spring guides, permit a restricted movement of ball sockets and bearings as the springs absorb road shock, and prevent the bearings from spreading and releasing the ball studs in the event of spring breakage.

The openings through which the ball sockets enter the intermediate rod are protected by steel dust covers to keep lubricant in and dirt and water out. Bearings and ball sockets receive lubrication from inside the intermediate rod which is provided with two grease fittings. Located on each ball socket is a spring which keeps the dust seal properly seated on intermediate rod.

The tie rod end, which connects each tie rod to a steering arm, is a spring-loaded ball stud and socket unit assembly. A rubber dust seal fits over the stud where it emerges from the socket, to provide protection against entrance of dirt and water. The tie rods are connected to the tie rod ends by internally threaded sleeves which provide for toe-in adjustment. The sleeves are slotted and provided with clamps at each end to lock them in place. See Figure 8-4.

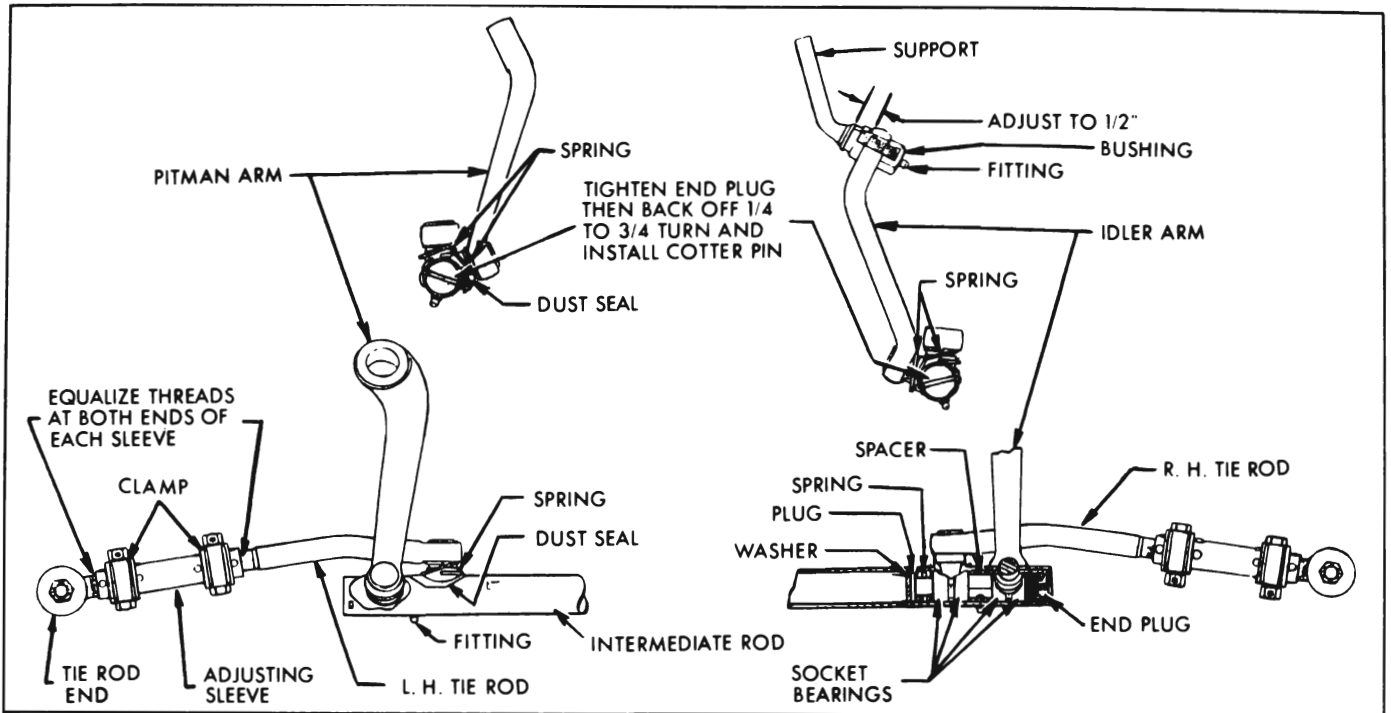


Figure 8-4—Manual and Power Steering Linkage

The linkages used for manual steering and power steering are the same except for the power steering pitman arm which has a 1/8" larger internal spline than the arm used with the manual gear.

8-3 TROUBLE DIAGNOSIS—MANUAL STEERING GEAR AND LINKAGE

This paragraph covers improper steering actions which are most likely to be caused by the steering gear assembly or tie rods. Improper steering actions which are most likely to be caused by chassis suspension members are covered in Group 7.

a. Excessive Play or Looseness in Steering System

- (1) Front wheel bearings loosely adjusted (Group 7).
- (2) Worn upper ball joints (Group 7).
- (3) Steering wheel loose on shaft, loose pitman arm, tie rods, or steering arms.
- (4) Excessive pitman shaft sector to ball nut lash (par. 8-4).
- (5) Worm bearings loosely adjusted (par. 8-4).

b. Hard Steering—Excessive Effort Required at Steering Wheel

- (1) Low or uneven tire pressure (Group 1).
- (2) Insufficient or improper lubricant in steering gear or front suspension (Group 1).
- (3) Excessive steering shaft coupling misalignment.
- (4) Steering gear adjusted too tight or idler arm binding on support (par. 8-4).
- (5) Front wheel alignment incorrect (Group 7).

c. Rattle or Chuckle in Steering Gear

- (1) Insufficient or improper lubricant in steering gear (Group 1).
- (2) Excessive back lash between ball nut and pitman shaft sector in straight ahead position or worm thrust bearings adjusted too loose (par. 8-4). NOTE: On turns a slight rattle may occur, due to the increased lash between ball nut and sector as gear moves off the center or "high point" position. This is normal and lash must not be reduced to eliminate this slight rattle.
- (3) Pitman arm loose on shaft, tie rod connections loose, or steering gear loose at mounting bolts.
- (4) Loose or worn steering shaft bearing.

8-4 ADJUSTMENT OF MANUAL STEERING GEAR AND LINKAGE

IMPORTANT: Never attempt to adjust the steering gear while it is connected to the intermediate rod. The steering gear must be free of all outside load in order to properly make any steering gear adjustment.

a. Adjustment of Steering Gear in Car

NOTE: If an inch pound torque wrench is not available, a spring scale may be used to check adjustment following specifications in Par. 8-1, b.

There are two adjustments on the steering gear: worm bearing preload, and pitman shaft overcenter preload. See Figure 8-5.

1. Torque steering gear to cross member bolts to 55 ft. lbs.
2. Disconnect intermediate rod from pitman arm by unscrewing end plug until bearings will release ball socket.
3. Turn steering wheel slowly from one extreme to the other. **CAUTION:** Never turn the wheel hard against the stopping point in the gear, as damage to the ball nut assembly may result.

Steering wheel should turn freely and smoothly through entire range. Roughness indicates faulty internal parts, requiring disassembly of the steering gear. Hard pull or binding indicates an excessively tight adjustment of worm bearings, or excessive misalignment of steering shaft. Any excessive misalignment must be corrected before steering gear can be properly adjusted.

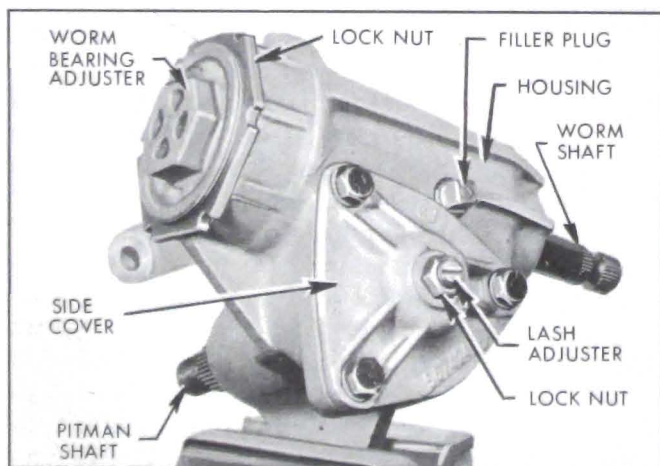


Figure 8-5—Manual Steering Gear Adjusters

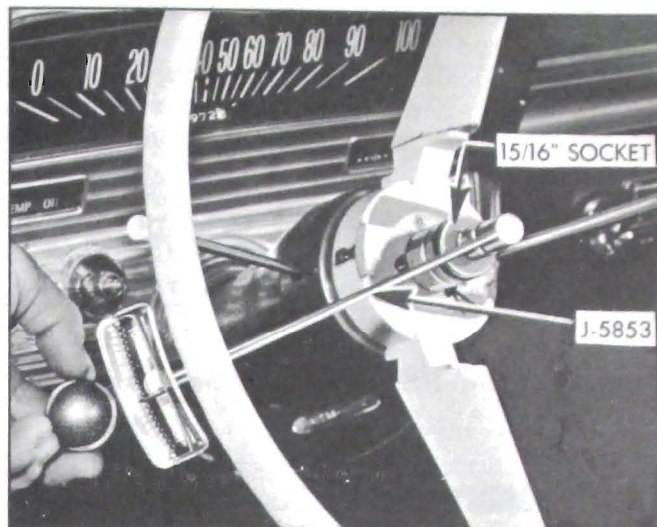


Figure 8-6—Checking Adjustments in Car

4. Remove emblem or cap from steering wheel hub.
5. Check Worm Bearing Preload. Turn steering wheel gently in one direction until it stops. This positions gear away from "high point" load.
6. Attach torque wrench J-5853 to steering wheel retaining nut and check the torque required to turn the wheel steadily in the range where lash exists between ball nut and pitman shaft sector. See Figure 8-6. The torque required to keep wheel turning should be between 2 and 7 inch pounds. Adjust worm bearing preload if necessary.
7. Adjust Worm Bearing Preload. Loosen worm bearing adjuster lock nut using a drift. See Figure 8-5. Turn bearing adjuster as required to bring pull between 2 and 7 inch pounds. Tighten lock nut, then recheck preload.
8. Torque side cover bolts to 30 ft. lbs.
9. Check Pitman Shaft Overcenter Preload. Turn steering wheel from one extreme to the other while counting the total turns, then turn wheel back 1/2 the number of turns. This positions steering gear on "high point" where a preload should exist between ball nut and pitman shaft teeth.
10. Check the torque required to turn wheel through the "high point" range. Torque should be between 4 and 8 inch pounds higher than worm bearing preload. Adjust pitman shaft lash adjuster if necessary. Total "overcenter" pull should not exceed 13 inch pounds.
11. Adjust Pitman Shaft Overcenter Preload. Loosen lock nut and turn pitman shaft lash

adjuster screw as required to bring torque between 4 and 8 inch pounds higher than worm bearing preload. After tightening lock nut, rotate steering wheel back and forth through the "high point" and through the entire range to check for tight spots.

NOTE: If lash cannot be removed at "high point", or if gear load varies greatly and feels rough, gear assembly should be removed for inspection of internal parts.

b. Adjustment of Steering Gear on Bench

1. Attach torque wrench J-5853 to worm shaft and turn shaft to extreme right or left position. See Figure 8-7.

2. Turn worm bearing adjuster to obtain a reading of 2 to 7 inch pounds with worm shaft turning slowly. Worm bearing preload adjustment must be made within 1/2 turn of worm shaft from extreme position.

3. Tighten worm bearing adjuster lock nut and recheck reading.

4. Turn worm shaft from one extreme to the other while counting turns, then turn back 1/2 the total number of turns. This places the steering gear on the "high point".

5. Turn pitman shaft lash adjuster clockwise until a reading of 4 to 8 inch pounds higher than worm bearing preload is obtained while rotating worm shaft through the "overcenter" range. Tighten lock nut and recheck reading. Total "overcenter" pull should not exceed 13 inch pounds.

c. Adjustment of Steering Linkage

The intermediate rod must be maintained in a level position to insure good steering action.

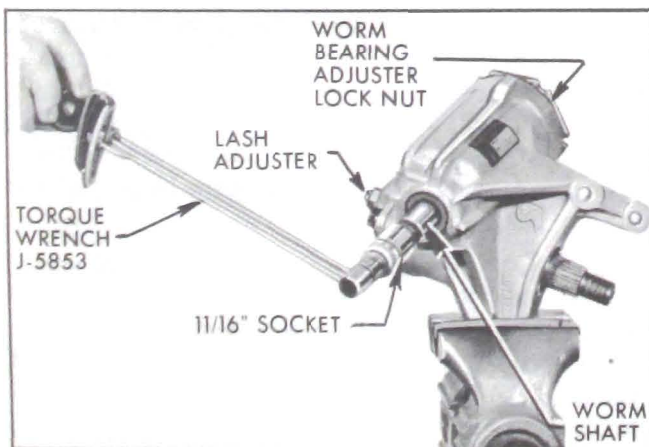


Figure 8-7—Checking Adjustments on Bench

This requires proper location of the idler arm on its support so that the idler arm ball socket will be level with the pitman arm ball socket. The support must be threaded into the idler arm bushing until the distance from the shoulder of support to the nearest face of idler arm is 1/2" as shown in Figure 8-4. When the idler arm is installed on the support, it must be free to rotate approximately 90 degrees in both directions. After any adjustment of idler arm on its support the front wheels should be checked to insure proper toe-in.

IMPORTANT: If the idler arm support is dismantled from the cross member for other work, wire the support to the idler arm so that it cannot turn from its existing position and possibly change the toe-in of the front wheels.

Whenever the intermediate rod is being connected to the idler arm, tie rods or pitman arm, be careful to properly seat the bearings around the ball sockets and make sure that the pressed steel dust seal properly protects the opening around ball socket. Also be sure that dust cover spring is installed on each socket. To adjust end plugs on both ends of rod, turn end plug up tight, then back off 1/4 to 3/4 turn (1/2 turn preferred) and install cotter pin.

CAUTION: If end plug becomes tight before head is flush with end of rod, check for improper position of bearings around ball sockets. After completing work on steering linkage, linkage should be lubricated.

See Group 7 for adjustment of tie rods to obtain proper toe-in of front wheels.

d. Road Test after Adjustment

Road test car for ease of steering. If steering gear was adjusted to specified load limits and hard steering exists, the front suspension members should be checked for lubrication and alignment and tire inflation pressures should be checked. When car is moving straight ahead, the steering wheel should be in the straight-ahead position, or not over 5/8" to either side of the straight-ahead position. If steering wheel is too far to either side, check wheel for proper position on steering shaft (par. 8-5) and check tie rods for equal adjustment and toe-in (Group 7). It is important to have the steering gear in the no-lash range when car is moving straight forward.

8-5 STEERING WHEEL REMOVAL AND INSTALLATION

(See Figures 10-48 and 10-49.)

a. Removal of Steering Wheel

1. Unplug horn ground (tan) wire connector at mast jacket to prevent horn from blowing.
2. Remove emblem from steering wheel hub. On standard steering wheels, remove cap assembly by inserting screw driver through hole in cap and loosening retaining screw. Unplug horn connector brush wire from cap.
3. Loosen steering wheel retaining nut several turns. Do not remove nut.
4. Attach Puller J-3274 to wheel hub and pull wheel up to nut. See Figure 8-8. If wheel hub is very tight on shaft, apply a moderate strain with puller then tap end of puller screw to break hub loose from shaft without distorting wheel hub. Remove puller, nut, and steering wheel.

b. Installation of Steering Wheel

1. Install steering wheel with location marks on shaft and hub of wheel in line.

NOTE: Location marks for proper installation of steering wheel on steering shaft are provided to insure a straight-ahead position of the steering wheel when front wheels are in straight-ahead position.

2. With wheel properly located on shaft, install nut and tighten to 25 ft. lbs.

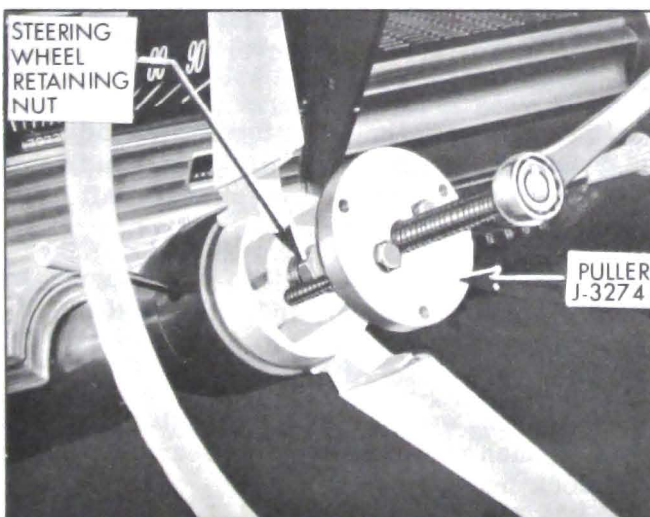


Figure 8-8—Removing Steering Wheel

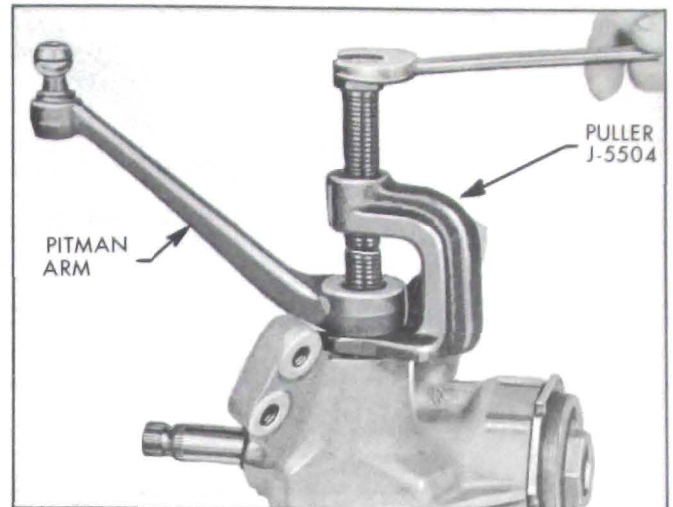


Figure 8-9—Removing Pitman Arm

3. On standard wheel, plug horn wire terminals together and install cap assembly on steering wheel hub. Tighten retaining screw.

NOTE: Be sure insulator is positioned over horn wire terminals.

4. On deluxe wheel, install emblem.
5. Plug horn wires together at mast jacket.

8-6 REMOVAL AND INSTALLATION OF MANUAL GEAR ASSEMBLY

a. Removal of Steering Gear

NOTE: Due to the close clearance it is necessary to remove gear from car to remove pitman arm and nut from pitman shaft.

1. Remove lower coupling clamp bolt and nut.
2. Loosen clamp that retains mast jacket to toe pan cover and U-bolt that retains jacket to instrument panel. See Figures 8-73 and 8-74. Pull mast jacket assembly up far enough so that lower coupling can be removed from worm shaft.
3. Jack up car and disconnect pitman arm from intermediate rod by unscrewing end plug until socket bearings will release ball socket. See Figure 8-4.
4. Remove the four steering gear to front suspension cross member bolts and nuts and remove gear assembly.

NOTE: Do not remove pitman arm from gear unless pitman shaft assembly or seal are going to be removed.

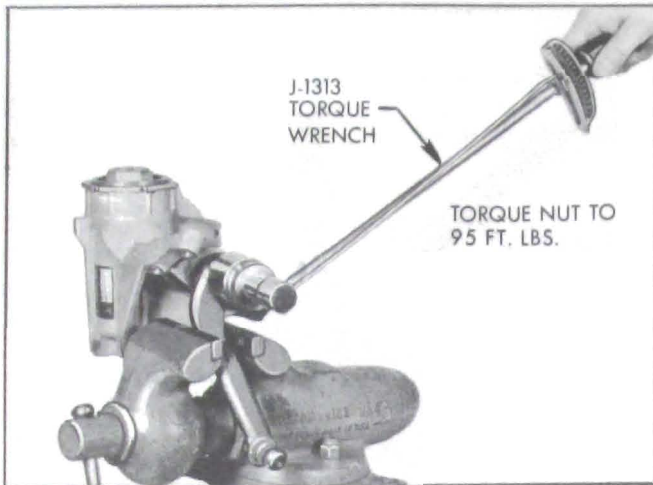


Figure 8-10—Torquing Pitman Arm Nut

5. Place pitman arm in vise as shown in Figure 8-10 and remove pitman arm nut and lock washer.

6. Remove pitman arm from pitman shaft using Puller J-5504. See Figure 8-9.

b. Installation of Steering Gear

1. Install pitman arm, lock washer and nut on pitman shaft. Place assembly in vise as shown and torque nut to 95 ft. lbs. See Figure 8-10.

2. Attach gear assembly to cross member with four bolts and nuts and torque to 55 ft. lbs.

3. Install pitman arm socket in intermediate rod being sure that socket bearings are properly seated around socket. Adjust end plug as shown in Figure 8-4 and install cotter pin.

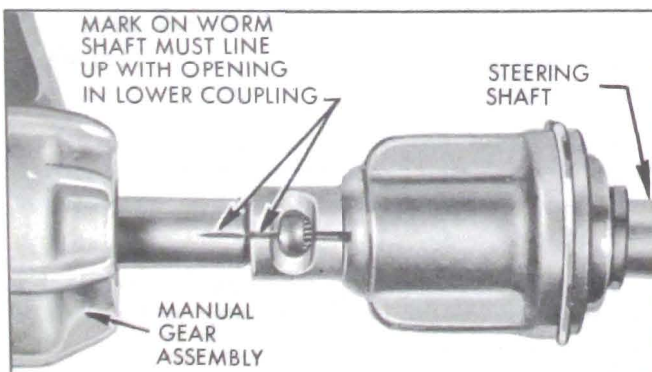


Figure 8-11—Correct Worm to Lower Coupling Attachment

4. Slide lower coupling on worm shaft so that slot in coupling lines up with mark on shaft. See Figure 8-11.

5. Tighten mast jacket clamp and U-bolt. Be sure that tang of mast jacket saddle engages slot in jacket and that steering shaft is centered in end of jacket assembly. See Figures 8-74 and 8-75.

6. Align coupling and clamp with groove on worm shaft and install clamp bolt and nut.

8-7 DISASSEMBLY AND ASSEMBLY OF MANUAL STEERING GEAR

a. Disassembly of Steering Gear

It is not necessary to disassemble gear to replace worm shaft seal. Remove worm seal with awl being careful not to damage housing or shaft and install a new seal with Installer J-8564. See Figure 8-17.

1. Thoroughly clean exterior of gear assembly with a suitable solvent.

2. Place steering gear in a soft jaw vise. See Figure 8-5. Do not clamp too tightly in vise as aluminum housing may be damaged.

If only pitman shaft seal is going to be replaced do not disassemble pitman shaft and side cover, but remove and install as an assembly.

3. Rotate worm shaft to center of travel, approximately $3 \frac{1}{8}$ turns from either extreme.

4. Remove pitman shaft lash adjuster lock nut. Remove three side cover bolts with lock washers.

5. Remove side cover by turning lash adjuster clockwise through cover. Slip lash adjuster with shim from slot end of pitman shaft. Remove and discard side cover gasket.

6. Remove pitman shaft from housing by lightly tapping on spline end with a soft mallet. Pry pitman shaft seal out of housing with a screwdriver. Discard seal.

7. Loosen worm bearing adjuster lock nut with a punch and remove worm bearing adjuster and lock nut.

8. Remove worm shaft and ball nut assembly and upper worm bearing from housing.

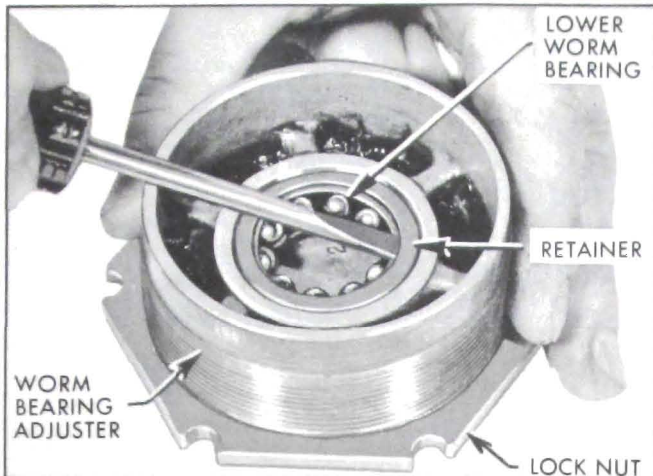


Figure 8-12—Removing Lower Worm Bearing Retainer

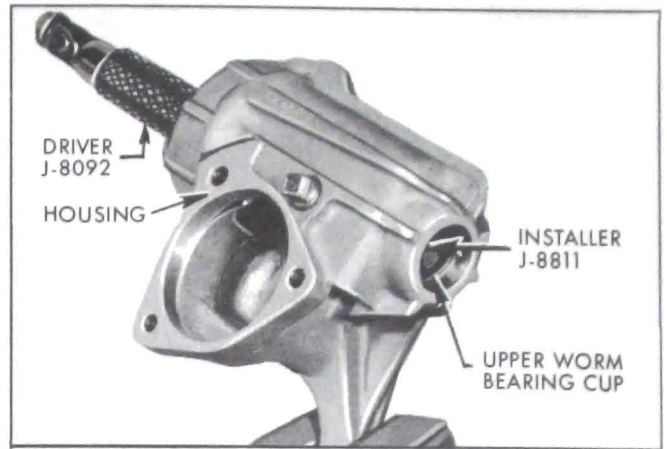


Figure 8-13—Installing Upper Worm Bearing Cup

9. Remove lower worm bearing from adjuster by prying retainer out with a screwdriver. See Figure 8-12.

10. Remove ball return guide clamp and guides from ball nut. Turn ball nut over and rotate worm shaft back and forth until all balls (50) drop out into a clean cloth. Remove ball nut from worm shaft.

11. Pry worm shaft seal from housing with screwdriver. Discard seal.

b. Inspection of Steering Gear

1. Wash all parts in clean solvent and wipe dry with a clean lint free cloth.

2. Inspect worm bearings and cups for damage or excessive wear. Replace bearings if necessary. The lower worm bearing cup is not replaced separately, but is serviced with the worm bearing adjuster. If upper worm bearing cup is defective, drive cup out of housing with a punch and install new cup using Installer J-8811 with Driver Handle J-8092. See Figure 8-13.

NOTE: J-8811 may be used for installing pitman shaft seal in housing when pitman shaft is removed.

3. Check fit of the pitman shaft in the bushing in side cover. If bushing is worn, side cover must be replaced as bushing is not serviced separately.

4. Inspect the worm and nut balls and the grooves of worm and nut for damage or excessive wear. Replace parts as necessary.

5. Inspect teeth of ball nut and pitman shaft for pitting or scoring which would require replacement of nut or pitman shaft. Inspect pitman shaft bushing for excessive wear or scoring. If necessary, remove pitman shaft bushing and install a new bushing with Remover and Replacer J-8810 and Drive Handle J-8092. See Figure 8-14.

6. Check pitman shaft surface for wear or scoring, then check fit of pitman shaft lash adjuster and shim in the slot in end of pitman shaft by inserting feeler gauge between the head of screw and bottom of slot. Adjuster must be free to turn and end play should not exceed .002". If end play exceeds .002" install proper shim. The shims are available in four different thicknesses - .063", .065", .067", and .069".

7. Check ball guides for damage and replace if necessary.

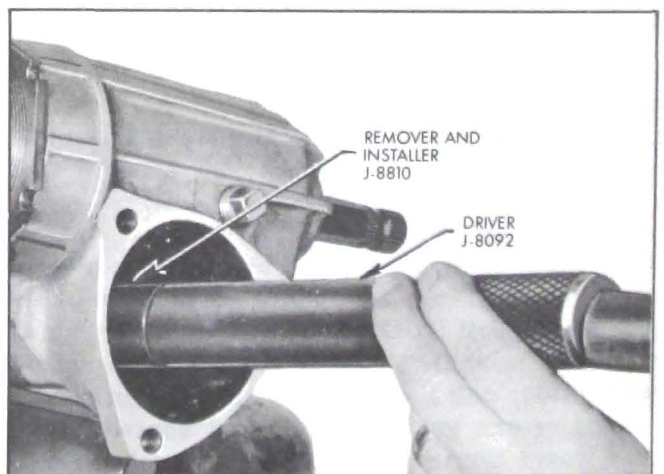


Figure 8-14—Installing Pitman Shaft Bushing

c. Assembly of Steering Gear

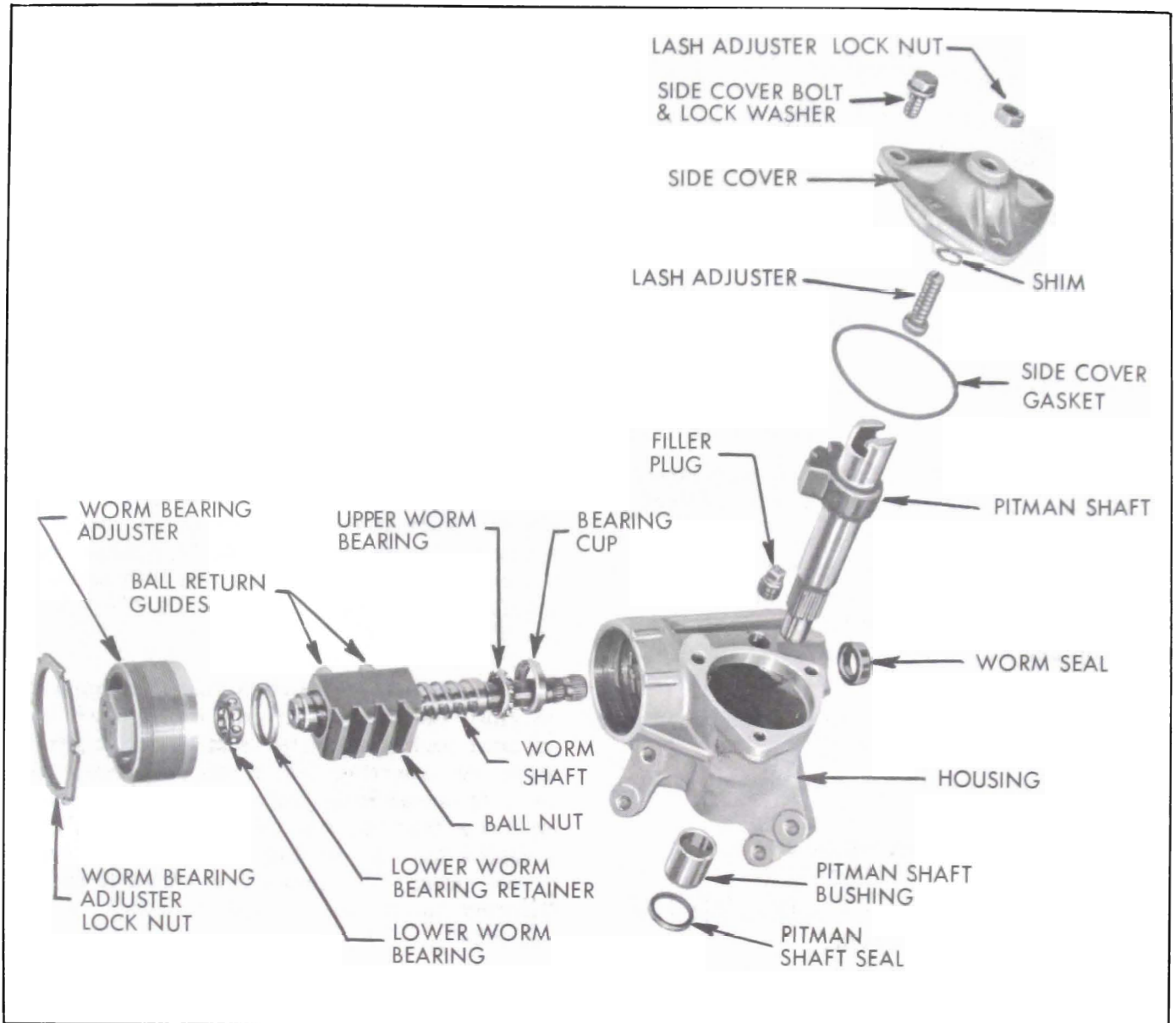


Figure 8-15—Exploded View of Manual Steering Gear

NOTE: Lubricate all seals, bushings, bearings and gears with multi-purpose gear lubricant just before assembling.

1. Position ball nut over worm shaft so that deep side of teeth will be toward side cover when installed in gear housing. Install 19 balls in each circuit (rock worm shaft slightly to aid in installing balls). Place 6 balls in each return guide, using grease to hold balls in place. Install return guides, clamp and screws. Rotate worm through its complete travel several times to insure balls are installed correctly and rotate freely.

2. Place upper bearing on worm shaft and slide worm shaft assembly into housing.

3. Place lower bearing in worm bearing adjuster and install bearing retainer with Installer J-8564. Install adjuster assembly with lock nut in housing. Tighten adjuster only enough to hold worm bearings in place. Final adjustment will be made later.

4. Turn worm shaft until center groove in ball nut lines up with center of pitman shaft bushing. Install pitman shaft and lash adjuster with shim so that center tooth meshes with center groove in ball nut.

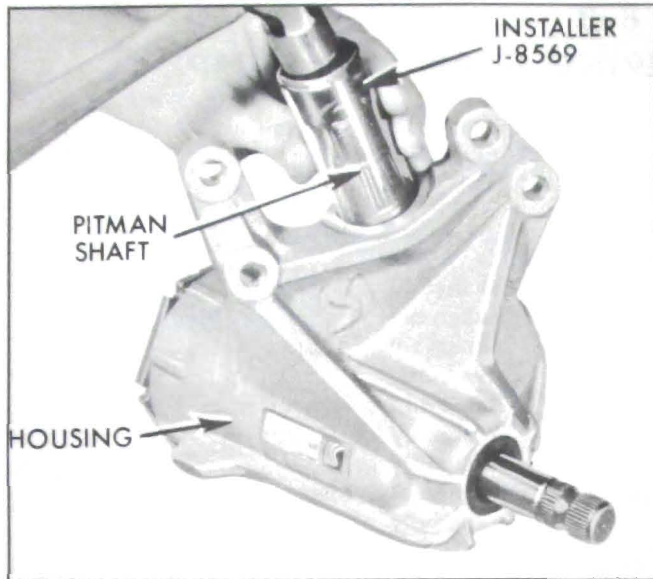


Figure 8-16—Installing Pitman Shaft Seal

5. Place new gasket on side cover. Install side cover with gasket on lash adjuster by turning adjuster counterclockwise.

6. Install three side cover bolts and lock washers. Torque to 30 foot pounds.

7. Turn lash adjuster so that teeth on shaft and ball nut engage but do not bind. Install lash adjuster lock nut loosely. Final adjustment will be made later.

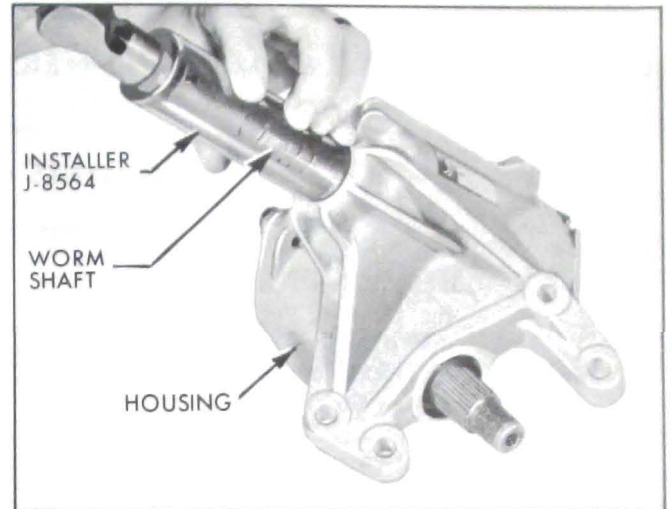


Figure 8-17—Installing Worm Shaft Seal

8. To protect pitman shaft seal from damage, cover shaft splines with masking tape. Slide new seal into place and seat against shoulder in housing using Installer J-8569. See Figure 8-16.

9. Install new worm shaft seal using Installer J-8564. See Figure 8-17. Drive seal flush with surface of housing.

10. Fill steering gear with multi-purpose gear lubricant. Gear is now ready for final adjustment on bench as described in Paragraph 8-4.