

- (7) *Drive shaft.*—Check spiral splines on drive shaft (Q) for damaged, chipped, or worn condition. Replace shaft if splines are damaged. Check outer surface of shaft at front end. The drive shaft front bearing assembly (G) operates directly on shaft. Check surface for excessive wear (par. 345). Check keyway for damage. Check outer surface of rear end of drive shaft where drive shaft bearings balls (T) contact. Surface must not be grooved, rough, or worn (par. 345). Shaft must be replaced if damaged as described.
- (8) *Drive shaft thrust washers and bearing balls.*—Inspect thrust washers (S) for excessive wear (par. 345). Inspect drive shaft bearing balls (T) for roughness or wear. There are 21 bearing balls. Replace balls if any damage is evident. Inspect bearing ball retainer ring (U) for damage or excessively worn inside surface.
- (9) *Drive shaft rear bearing cap.*—Check drive shaft rear bearing cap (X) for damage. Replace drive shaft oil seal assembly (Y) if necessary as described in paragraph 147. Drive shaft rear bearing cap gasket (W) must be replaced with new part at assembly.
- (10) *Drive shaft front bearing cap.*—Inspect threads on drive shaft front bearing cap (E) for stripped or damaged condition. Front bearing cap gasket (F) must be replaced at assembly.
- (11) *Shifter poppet ball and retainer.*—Inspect ball spring retainer (J) for stripped or damaged threads. Ball spring retainer seal (L) must be replaced with new part at assembly. Check free length of shifter poppet ball spring (M). Replace if not to standard (par. 345). Examine shifter poppet ball (N) for roughness, excessive wear, or checks. Replace if damaged.
- (12) *Housing plug.*—Housing plug (BB) may be sprung or damaged when shifter shaft is removed. Replace plug with new part at assembly.

147. Repair of Tank Truck Accessory Drive

Note. Key letters in text refer to figure 99 unless otherwise indicated.

a. Drive Shaft Front Bearing Assembly Replacement.

- (1) With a suitable tool, remove drive shaft front bearing assembly (G) from housing. Use care not to damage housing bore.
- (2) Drive new bearing into case, using plastic hammer (fig. 100). Drive bearing assembly into housing one-sixteenth of an-inch from outer surface housing.

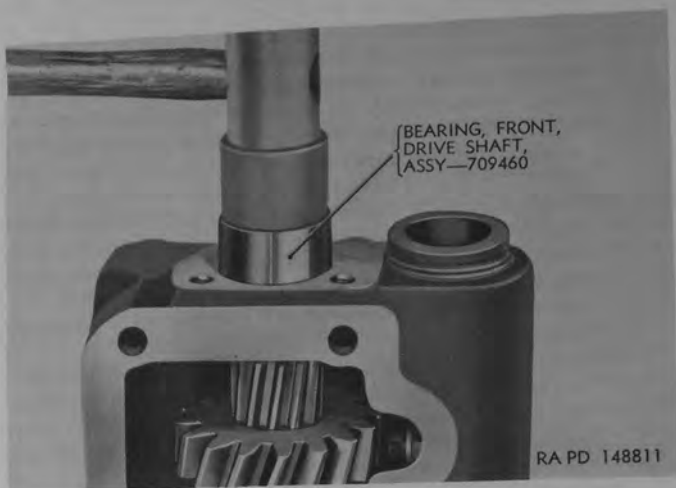


Figure 100. Installing drive shaft front bearing assembly.

b. Drive Shaft Rear Bearing Assembly Replacement.

- (1) Inner race (R) is pressed onto drive shaft (Q). Remove old inner race from shaft, using care not to damage shaft.
- (2) Press new inner race (R) onto shaft until it bottoms on shoulder of shaft. Refer to figure 103 for location of inner race.
- (3) With suitable tool, remove drive shaft rear bearing assembly (P) from housing.
- (4) Press new bearing into housing until it is flush with outer surface of housing. Make certain that tool used to install bearing assembly contacts entire edge surface of bearing to prevent damage to bearing assembly.

c. Shifter Shaft Oil Seal Assembly Replacement.

- (1) With a suitable tool, drive out old shifter shaft oil seal assembly (JJ) from housing.
- (2) Coat outer surface of seal assembly with plastic type gasket cement. Do not coat inner surface.
- (3) Apply small quantity of universal gear lubricant (GO) on lip of seal.
- (4) Install seal in housing with lip of seal, toward outer edge until seal bottoms in housing. Refer to item X, figure 97 for correct position of oil seal assembly. After installation,

wipe surplus gasket cement from exposed surface of seal assembly.

d. Drive Shaft Oil Seal Assembly Replacement.

- (1) Drive shaft oil seal assembly (Y) is pressed into drive shaft rear bearing cap (X). With suitable tool, remove old seal assembly.
- (2) Coat outer surface of seal assembly with plastic type gasket cement. Do not coat inner surface.
- (3) Apply small quantity of universal gear lubricant (GO) on lips of seal.
- (4) Press seal assembly into drive shaft rear bearing cap (X) with spring-loaded seal lip toward inside. Press seal flush with outer surface of cap. Refer to item N, figure 97 for correct position of oil seal assembly. After installation, wipe surplus gasket cement from exposed surface of seal assembly.

148. Assembly of Tank Truck Accessory Drive

Note. Key letters in text refer to figure 99 unless otherwise indicated. The sectional view (fig. 97) shows the various components in their correct positions.

a. With shifter fork (DD) in position in housing, insert shifter shaft (B) through front hole in housing and through shifter fork. Install shifter fork spacer (EE) on shaft; then insert shifter shaft into rear hole in housing. Shaft must be installed in housing with threaded holes in shaft in position to attach shifter fork.

b. Install $\frac{1}{4}$ -20 x $\frac{5}{8}$ cap screw and $\frac{1}{4}$ -inch lock washer which attach fork to shaft. Note items V and W, figure 97 for correct in-

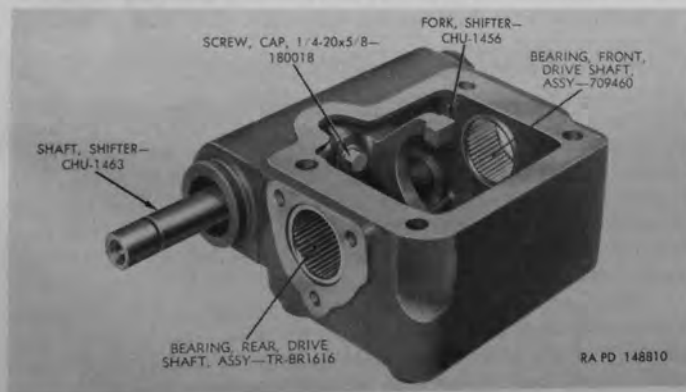


Figure 101. Shifter fork and shaft installed.

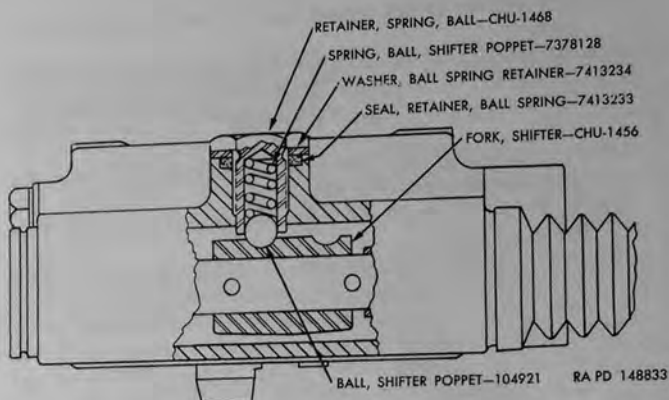


Figure 102. Sectional view showing shifter poppet ball installed.

stallation of cap screw and washer. Tighten cap screw firmly. Refer also to figure 101 which shows shifter fork installed.

c. Insert shifter poppet ball (N) into housing to engage notch on shifter fork (DD). Refer to figure 102 for correct installation of poppet ball and retaining parts. Insert shifter poppet ball spring (M), new ball spring retainer seal (L), ball spring retainer washer (K), and ball spring retainer (J). Tighten ball spring retainer firmly.

d. Install new housing plug (BB) into housing, bottoming plug on housing shoulder.

e. With drive shaft (Q) positioned as shown in figure 103, install a thrust washer (S), then install bearing ball retainer ring (U).

f. Lubricate drive shaft bearing balls (T); then place 21 bearing balls into retainer ring.

g. Place second thrust washer (S) over bearing balls. Install new locking ring (V) onto shaft groove of shaft.

h. Thoroughly lubricate drive shaft front (G) and rear (P) bearing assemblies. With sliding gear (HH) in place on shifter fork (groove toward rear of housing), insert assembled drive shaft in housing through drive shaft rear bearing assembly (P), then through sliding gear and drive shaft front bearing assembly (G). Make certain that thrust washer (S) at front bottoms against drive shaft rear bearing assembly.

i. With new drive shaft rear bearing cap gasket (W) in place, install drive shaft rear bearing cap (X) with drive shaft oil seal assembly (Y) in place. Use three $\frac{5}{16}$ -18 x $1\frac{1}{4}$ fillister head cross-recess screws and $\frac{5}{16}$ -inch special lock washers. Tighten screws firmly.

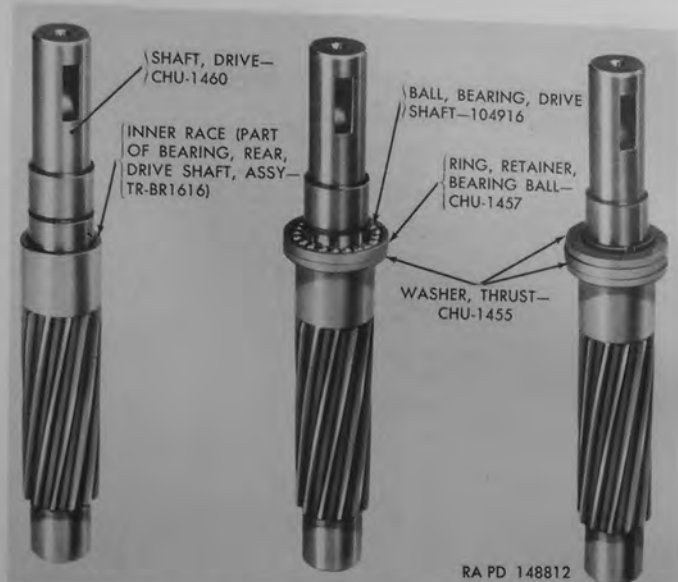


Figure 103. Method of installing drive shaft bearing balls.

j. With new drive shaft front cap gasket (F) in place, install drive shaft front bearing cap (E) with three $\frac{5}{16}$ -18 x $\frac{3}{4}$ cap screws and $\frac{5}{16}$ -inch lock washers. Tighten cap screws firmly.

k. Install shifter shaft boot (A) over drive shaft and on housing. Clamp both ends of boot with wire if necessary.

Section VII. REBUILD OF DUMP TRUCK ACCESSORY DRIVE UNIT

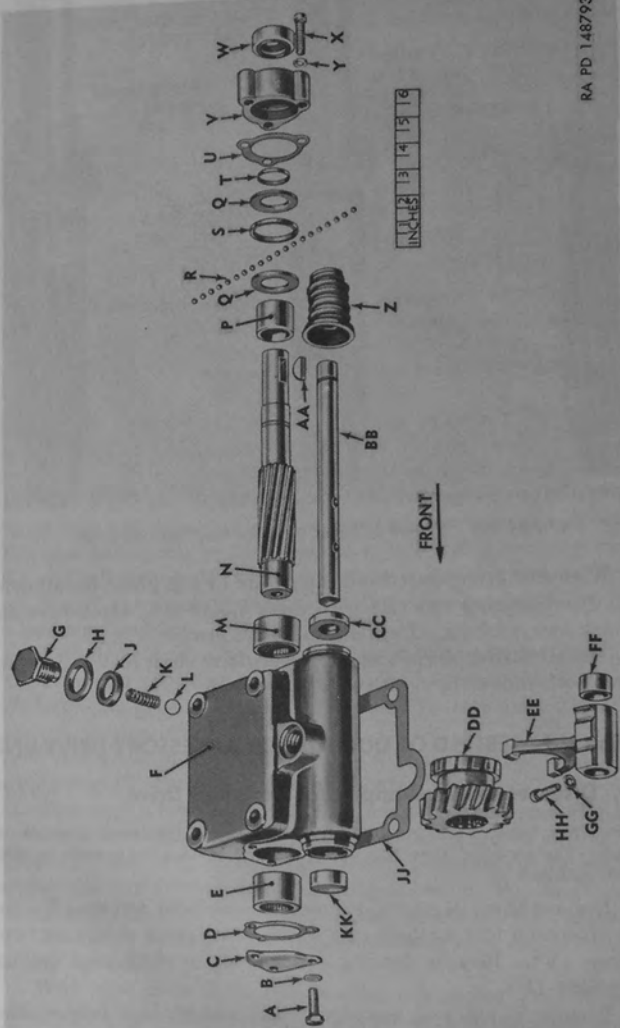
149. Disassembly of Dump Truck Accessory Drive

Note. Key letters noted in parentheses are in figure 104 unless otherwise indicated. The sectional view (fig. 98) shows the various components in their correct positions.

a. Remove three $\frac{5}{16}$ -18 x $1\frac{1}{4}$ cross-recess head screws (X) and $\frac{5}{16}$ -inch special lock washers (Y) which attach drive shaft rear bearing cap (V). Remove bearing cap and drive shaft rear bearing cap gasket (U).

b. Remove $\frac{5}{16}$ -18 x $\frac{1}{2}$ cap screws (A) and $\frac{5}{16}$ -inch lock washers (B) which attach drive shaft front bearing cap (C) to housing (F).

c. With brass drift applied to front end of drive shaft (N), force drive shaft through housing. Drive shaft front bearing assembly



A—SCREW, CAP, $\frac{5}{16}$ -18 X $\frac{1}{2}$ —180073

B—WASHER, LOCK, $\frac{5}{16}$ -IN.—120214

C—COVER, FRONT BEARING, DRIVE SHAFT—CHU-1458

D—GASKET, COVER, FRONT BEARING—CHU-407

E—BEARING, FRONT, DRIVE SHAFT, ASSY—709460

F—HOUSING—CHU-1450

G—RETAINER, SPRING, BALL—CHU-1468

H—WASHER, BALL SPRING RETAINER—7413234

J—SEAL, RETAINER, BALL SPRING—7413233

K—SPRING, BALL, SHIFTER POPPET—CHU-152

L—BALL, SHIFTER POPPET—104921

M—BEARING, REAR, DRIVE SHAFT, ASSY—TR-BR1616

N—SHAFT, DRIVE—CHU-1460

P—RACE, INNER (PART OF REAR BEARING ASSY)—CHU-1454

Q—WASHER, THRUST—CHU-1455

R—BALL, BEARING, DRIVE SHAFT—104916

S—RING, RETAINER, BEARING BALL—CHU-1457

T—RING, LOCKING—CHU-403A

U—GASKET, CAP, DRIVE SHAFT REAR BEARING—CHU-407

V—CAP, BEARING, REAR, DRIVE SHAFT—CHU-1451

W—SEAL, OIL, DRIVE SHAFT, ASSY—CHU-1464

X—SCREW, CROSS-RECESS, $\frac{5}{16}$ -18 X $1\frac{1}{4}$ —154000

Y—WASHER, LOCK, SPECIAL, $\frac{5}{16}$ -IN.—CHU-1087

Z—BOOT, SHIFTER SHAFT—CHU-1462

AA—KEY, WOODRUFF—112139

BB—SHAFT, SHIFTER—CHU-1463

CC—SEAL, OIL, SHIFTER SHAFT, ASSY—CHU-1465

DD—GEAR, SLIDING—7412888

EE—FORK, SHIFTER—CHU-1456

FF—SPACER, SHIFTER FORK—CHU-1470

GG—WASHER, LOCK, $\frac{1}{4}$ -IN.—120380

HH—SCREW, CAP, $\frac{1}{4}$ -20 X $\frac{5}{8}$ —180018

JJ—GASKET, ACCESSORY DRIVE-TO-POWER TAKE-OFF—7412884

KK—PLUG, HOUSING—CHU-1467

Figure 104. Components of accessory drive unit for dump truck.

(E) will remain in housing. The inner race (P) of the drive shaft rear bearing assembly (M) will remain on drive shaft. Remove sliding gear (DD) from housing.

d. Remove locking ring (T) from drive shaft. Remove two thrust washers (Q), bearing ball retainer ring (S), and 21 drive shaft bearing balls (R).

e. Remove shifter shaft boot (Z).

f. Remove ball spring retainer (G), ball spring retainer washer (H), ball spring retainer seal (J), shifter poppet ball spring (K), and shifter poppet ball (L).

g. Remove $\frac{1}{4}$ -20 x $\frac{5}{8}$ cap screw (HH) and $\frac{1}{4}$ -inch lock washer (GG) which attach shifter fork (EE) to shifter shaft (BB).

h. With soft hammer applied at rear end of shifter shaft (BB), drive shaft toward front of housing until housing plug (KK) is forced from housing. Shaft can then be removed from housing. Remove shifter fork (EE) from housing.

i. Drive shaft front (E) and rear (M) bearing assemblies may remain in housing until inspected (par. 150). Drive shaft oil seal assembly (W) and shifter shaft oil seal assembly (CC) may remain in place until after inspection (par. 150).

150. Cleaning and Inspection of Dump Truck Accessory Drive

Note. Key letters noted in parentheses are in figure 104 unless otherwise indicated.

a. *Cleaning.*—Clean all parts thoroughly with dry-cleaning solvent or volatile mineral spirits. Thoroughly scrub drive shaft rear bearing assembly (M) and drive shaft front bearing assembly (E) so that needle bearings can be inspected. Do not clean shifter shaft boot (Z) with solvent.

b. *Inspection.*

- (1) *Housing.*—Thoroughly inspect housing (F) for cracks and damaged threads. Examine mounting surface for scores or roughness. Small nicks may be honed out. Check clearance of shifter shaft (BB) in passages in housing. Replace shifter shaft or housing if clearance is excessive (par. 345).
- (2) *Drive shaft front and rear bearings.*—Examine needle bearings in drive shaft front bearing assembly (E), and drive shaft rear bearing assembly (M). If needle bearings are checked, bent, or otherwise damaged, replace with new parts (par. 151). The inner race (P), which is a part of drive shaft rear bearing assembly (M), is pressed on drive shaft (N). Examine outer surface of race for roughness or scores. If race is damaged, the rear bearing assembly (with inner race) must be replaced (par. 151).

- (3) *Oil seals*.—Examine shifter shaft oil seal assembly (CC) for damage or looseness in housing. Examine drive shaft oil seal assembly (W) in drive shaft rear bearing cap (V) for similar damage. Replace if necessary as described in paragraph 151.
- (4) *Shifter shaft*.—Inspect shifter shaft (BB) for damage. Check outside diameter and clearance as described in (1) above. Refer to paragraph 345 for dimensions. Inspect shifter shaft boot (Z) for stretched or damaged condition. The boot must fit tightly in shifter shaft groove and groove on housing (refer to figure 98). Replace boot if damaged.
- (5) *Sliding gear*.—Check inner splines of sliding gear (DD) for roughness or damage. Check teeth for chipped, rough, or damaged condition. Small nicks or burs on teeth may be honed out. Check condition of shifter fork groove on sliding gear. Check clearance of shifter fork pads to groove ((6) below). If groove of gear is excessively worn (par. 345), replace gear.
- (6) *Shifter fork*.—Inspect shifter fork (EE) for damaged or sprung fork legs and worn fork pads. Check clearance of fork pads in sliding gear groove ((5) above). If clearance is excessive (par. 345), check width of pads for excessive wear (par. 345).
- (7) *Drive shaft*.—Check spiral splines on drive shaft (N) for damaged, chipped, or worn condition. Replace shaft if splines are damaged. Check outer surface of shaft at front end. The drive shaft front bearing assembly (E) operates directly on shaft. Check surface for excessive wear (par. 345). Check keyway for damage. Check outer surface of rear end of shaft where drive shaft bearing balls (R) contact. Surface must not be grooved, rough, or worn (par. 345).
- (8) *Drive shaft thrust washers and bearing balls*.—Inspect thrust washers (Q) for excessive wear (par. 345). Inspect drive shaft bearing balls (R) for roughness or wear. There are 21 bearing balls. Replace balls if any damage is evident. Inspect bearing ball retainer ring (S) for damage or excessively worn inside surface.
- (9) *Drive shaft rear bearing cap*.—Check drive shaft rear bearing cap (V) for damage. Replace drive shaft oil seal assembly (W) if necessary as described in paragraph 151. Drive shaft rear bearing cap gasket (U) must be replaced with a new part at assembly.

- (10) *Drive shaft front bearing cover.*—Drive shaft front bearing cover (C) must not be distorted. Front bearing cover gasket (D) must be replaced at assembly.
- (11) *Shifter poppet ball and retainer.*—Inspect ball spring retainer (G) for stripped or damaged threads. Ball spring retainer seal (J) must be replaced with new part at assembly. Check compression of shifter poppet ball spring (K). Replace if not up to standard (par. 345). Examine shifter poppet ball (L) for roughness, excessive wear, or checks. Replace if damaged.
- (12) *Housing plug.*—Housing plug (KK) may be sprung or damaged when shifter shaft is removed. Replace plug with new part at assembly.

151. Repair of Dump Truck Accessory Drive

Note. Key letters noted in parentheses are in figure 104 unless otherwise indicated.

a. Drive Shaft Front Bearing Assembly Replacement.

- (1) With a suitable tool, remove drive shaft front bearing assembly (E) from housing. Use care not to damage housing bore.
- (2) Drive new bearing into case, using plastic hammer in manner illustrated in figure 100. Drive bearing assembly into housing one-sixteenth of an inch from outer surface of housing.

b. Drive Shaft Rear Bearing Assembly Replacement.

- (1) Inner race (P) is pressed onto drive shaft (N). Remove old inner race from shaft, using care not to damage shaft.
- (2) Press new inner race (P) onto shaft until it bottoms on shoulder of shaft. Refer to figure 103 for location of inner race.
- (3) With suitable tool, remove drive shaft rear bearing assembly (M) from housing.
- (4) Press new bearing into housing until it is flush with outer surface of housing. Make certain that tool used to install bearing assembly contacts entire edge surface of bearing to prevent damage to bearing assembly.

c. Shifter Shaft Oil Seal Assembly Replacement.

- (1) With a suitable tool, drive out old shifter shaft oil seal assembly (CC) from housing.
- (2) Coat outer surface of seal assembly with plastic type gasket cement. Do not coat inner surface.
- (3) Apply small quantity of universal gear lubricant (GO) on lip of seal.

- (4) Install seal in housing with lip of seal toward outer end until seal bottoms in housing. Refer to item X, figure 98 for correct position of oil seal assembly. After installation, wipe surplus gasket cement from exposed surface of seal assembly.
- d. *Drive Shaft Oil Seal Assembly Replacement.*
 - (1) Drive shaft oil seal assembly (W) is pressed into drive shaft rear bearing cap (V). With suitable tool, remove old seal assembly.
 - (2) Coat outer surface of seal assembly with plastic type gasket cement. Do not coat inner surface.
 - (3) Apply small quantity of universal gear lubricant (GO) on lips of seal.
 - (4) Press seal assembly into drive shaft rear bearing cap (V) with spring-loaded leather lip toward inside. Press seal flush with outer surface of cap. Refer to item N, figure 98 for correct position of oil seal assembly. After installation, wipe surplus gasket cement from exposed surface of seal assembly.

152. Assembly of Dump Truck Accessory Drive

Note. Key letters noted in parentheses are in figure 104 unless otherwise indicated. The sectional view (fig. 98) shows the various components in their correct positions.

a. With shifter fork (EE) in position in housing, insert shifter shaft (B) through rear hole in housing and through shifter fork spacer (EE) and shifter fork; then insert shifter shaft into rear hole in housing. Shaft must be installed in housing with threaded holes in shaft in position to attach shifter fork.

b. Install $\frac{1}{4}$ -20 x $\frac{5}{8}$ cap screw and $\frac{1}{4}$ -inch lock washer which attach fork to shaft. Note items V and W, figure 98, for correct installation of cap screw and lock washer. Tighten cap screw firmly. Refer also to figure 101 which shows fork installed.

c. Insert shifter poppet ball (L) into housing to engage notch on shifter fork (EE). Refer to figure 102 for correct installation of poppet ball and retaining parts. Insert shifter poppet ball spring (K), new ball spring retainer seal (J), ball spring retainer washer (H), and ball spring retainer (G). Tighten ball spring retainer firmly.

d. Install new housing plug (KK) into housing, bottoming plug on housing shoulder.

e. With drive shaft (N) positioned as shown in figure 103, install a thrust washer (Q); then install bearing ball retainer ring (S).

f. Lubricate drive shaft bearing balls (R); then place 21 bearing balls into retainer ring.

g. Place second thrust washer (Q) over bearing balls. Install new locking ring (T) onto shaft groove of shaft.

h. Thoroughly lubricate drive shaft front (E) and rear (M) bearing assemblies. With sliding gear (DD) in place on shifter fork (groove toward rear of housing), insert assembled drive shaft in housing through drive shaft rear bearing assembly (M), then through sliding gear and drive shaft front bearing assembly (E). Make certain that thrust washer (Q) at front bottoms against drive shaft rear bearing assembly.

i. With new drive shaft rear bearing cap gasket (U) in place, install drive shaft rear bearing cap (V) with drive shaft oil seal assembly (W) in place. Use three $\frac{5}{16}$ -18 x $1\frac{1}{4}$ fillister head cross-recess screws and $\frac{5}{16}$ -inch special lock washers. Tighten screws firmly.

j. With new drive shaft front cover gasket (D) in place, install drive shaft front bearing cover (C) with three $\frac{5}{16}$ -18 x $\frac{1}{2}$ cap screws and $\frac{5}{16}$ -inch lock washers. Tighten cap screws firmly.

k. Install shifter shaft boot (Z) over drive shaft and on housing. Clamp both ends of boot with wire if necessary.

CHAPTER 7

FRONT AXLE

Section I. DESCRIPTION AND DATA

153. Description and Operation

a. General.—Front axle assembly (fig. 105) is hypoid, single-reduction type consisting of a housing, differential and carrier assembly, axle shaft and universal joint assemblies, and steering knuckle support assemblies. Power is transmitted from transfer to drive pinion through a tubular propeller shaft. Power is transmitted from drive pinion to drive gear and differential assembly, then to the wheels through axle shaft and universal joint assemblies. Action of universal joints permits delivery of power to the wheels when they are turned from straightahead position. Front axle is automatically engaged and disengaged by action of a jaw-type clutch located in transfer unit. Normally, front axle is disengaged except when tractive effort is required.

b. Axle Housing.—The axle housing is of the conventional one-piece banjo type with carrier assembly and cover openings near center of housing. The spherical shaped housing outer ends, torque rod brackets, spring seats, and steering knuckle stops are welded to the axle housing. Oil seals are used at outer ends of housing to prevent lubricant losses, also thrust washers are installed at outer ends of housing to absorb end thrust of universal joint assembly. External surface of housing outer ends are machined and polished to provide smooth surface for housing outer end oil and dust seals.

c. Axle Shaft and Universal Joint Assemblies.—The axle shafts are full-floating type with constant-velocity universal joints at steering knuckles. Each assembly consists of inner and outer shafts with integral yokes which form a universal joint around five steel balls. Outer shafts are the same for right and left sides and are splined at outer ends to engage drive flange. Inner shafts are of different lengths and are splined at inner ends to engage side gears at differential. Universal joint outer balls are select fit and the center ball is stand-

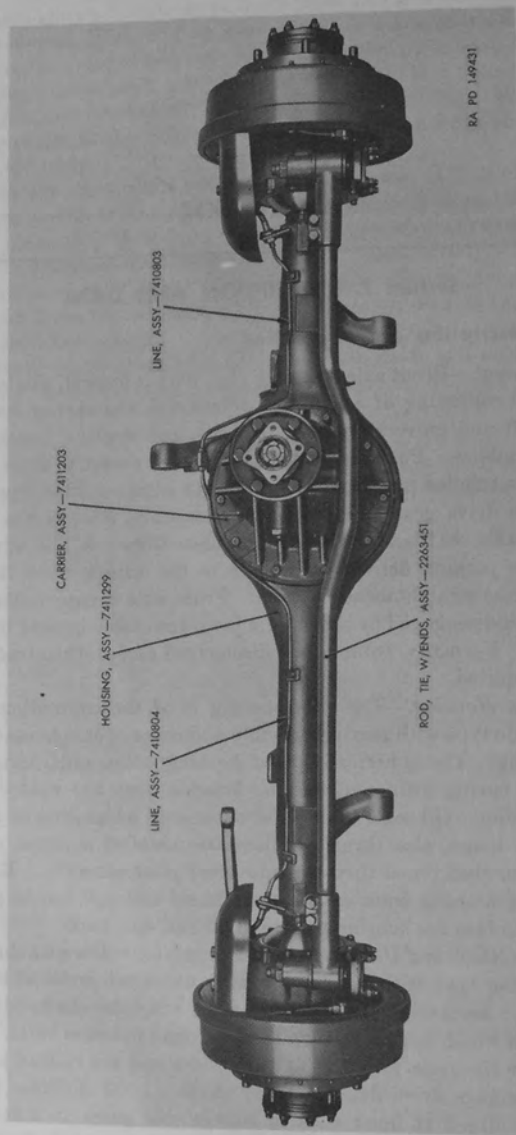


Figure 105. General view of front axle assembly.

ard size. Universal joint assemblies are completely enclosed within the steering knuckle supports.

d. Steering Knuckle Supports.—Steering knuckle supports are supported at outer ends of housing by tapered roller bearings. Supports are held in position on the bearings by steering knuckle trunnions, which permit steering knuckle supports to turn as front wheels are turned to right or left. Bearing adjustment is accomplished by use of shim pack between steering knuckle support and trunnions. Steering arms, to which tie rod ends attach, are integral with steering knuckle supports. Housing outer end oil and dust seals are attached to inner side of steering knuckle supports and are held in place by suitable retainers.

e. Steering Knuckles.—Steering knuckles are attached to steering knuckle supports by bolts and lock washers, which also serve to attach brake backing plate and brake anchor blocks. Steering knuckles act as spindles for mounting wheel hubs and bearings. Bushing type bearings are pressed inside steering knuckle which supports outer axle shaft; thrust washer, staked in place at inner side of steering knuckle flange, absorbs end thrust of universal joint assembly. A brake oil shield is installed at outer side of steering knuckle flange which prevents any escaping lubricant reaching brake linings.

f. Tie Rod Assembly.—The tie rod is a solid rod, threaded at each end and double offset to clear the differential carrier assembly. Rod has finer threads (16 per in.) on the left end than on the right end (12 per in.) to permit a finer degree of toe-in adjustment. The tie rod is attached to integral arm on steering knuckle supports by tapered stud installed in tie rod end. Tapered stud is held to support arm by nut and in tie rod end by snap ring. Tie rod is threaded into tie rod ends and securely held by clamp bolts, also a lock at left end. In addition to controlling toe-in, tie rod also transmits the turning force from the left steering knuckle support to the right steering knuckle support.

g. Differential and Carrier Assembly.—The differential and carrier assembly used in the front axle is the same as used in rear axles, except for the method of installation. Complete description and service information is given in chapter 8 and will not be repeated in this chapter.

154. Data

Manufacturer	GM Corporation
Type	hypoid, single-reduction
Ratio	6.17 to 1
Universal joints	Bendix-Weiss

Section II. FRONT AXLE ALINEMENT

155. Front Axle Alinement

a. General.—Front axle alinement factors, such as camber, caster, turning angle, and toe-in, have a major effect on steering from the standpoint of control, ease of steering, and safety. Front axle misalignment is a major cause of premature and uneven tire wear.

b. Caster.—Front axle caster is the inclination of the center line through the upper and lower steering knuckle support trunnion bearings toward the rear of the vehicle ((L), fig. 106). Caster is established by design; therefore no adjustment can be made. The axle is given this caster angle to provide a "castering" action at the front wheels when the vehicle is in motion. When the front axle has proper caster, the wheels will tend to point straightahead as long as the vehicle is in motion. Caster angle is affected by a twisted axle housing, loose spring "U" bolts, or sagging springs. Insufficient caster will permit front wheels to wander out of straightahead position. Excessive caster will cause hard steering when turning. Caster angle must be checked with the axle installed on the vehicle, using wheel alinement indicator 41-I-130 for this purpose (fig. 107). Refer to paragraph 156 for caster angle.

c. Camber.—Camber is the sidewise inclination of the front wheels. Positive camber is the outward inclination of the wheels as viewed from the front of the vehicle; that is, the wheels are farther apart at the top than at the bottom ((H) minus (G), fig. 106). Camber is established by design; therefore no adjustment can be made. A bent axle housing, bent steering knuckle, loose steering knuckle support trunnion bearings, or loose wheel bearings will affect camber. Unequal camber will cause vehicle to pull toward side having most camber. Camber may be measured with a square and rule in manner illustrated in figure 106; however, a more accurate determination can be made by use of wheel alinement indicator 41-I-130 for this purpose (fig. 107). Camber dimensions given in paragraph 156 are for straight-ahead position only and must be checked with axle installed on vehicle.

d. Toe-In.—Toe-in is the amount which the front wheels are closer together at the front than at the rear ((A) minus (B), fig. 106). An adjustable tie rod, connecting the two steering knuckle supports, is used to adjust toe-in. Camber causes both wheels to tend to turn outward from the vehicle; however, by adjusting tie rod to give wheels proper toe-in, the tendency to turn outward is counteracted and the wheels roll straightahead with no scuffing action on tires. Toe-in is affected by loose wheel bearings, bent axle housing, bent steering knuckle, loose steering knuckle support trunnion bearings, or a bent or improperly adjusted tie rod. Improper toe-in causes excessive tire wear or "scuffing." Unequal toe-in may cause the vehicle to pull

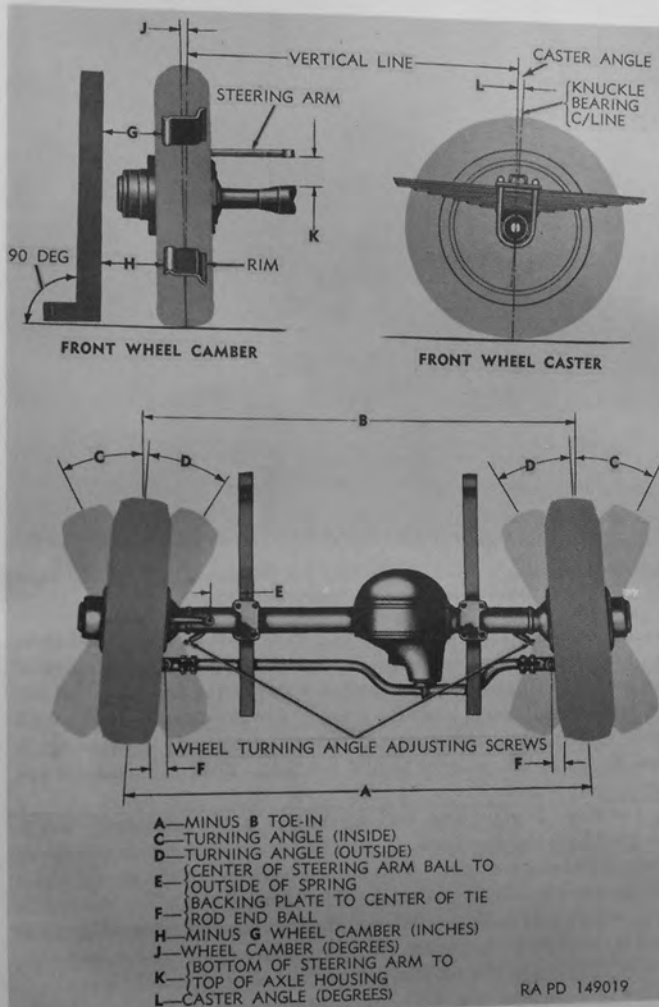


Figure 106. Front wheel and axle alignment chart.

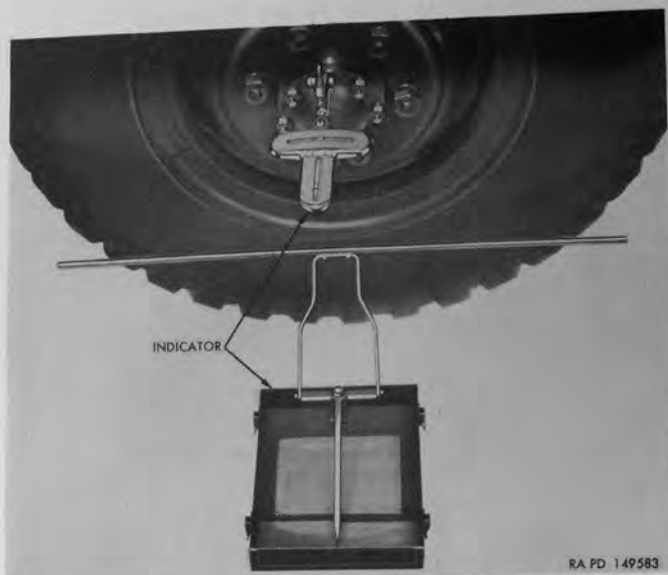


Figure 107. Checking camber, caster, king pin inclination, and turning angle with wheel alinement indicator 41-I-130.

toward the side having the least toe-in. When wheels are turned from straightahead to either right or left, toe-in changes, until at extreme right or left positions they are farther apart at the front than at the rear. This condition is termed toe-out. Always measure toe-in with wheels in straightahead position, either by actually measuring A minus B, figure 106 or refer to TM 9-819A. Toe-in dimensions are given in paragraph 156.

e. Turning Angle.—The turning angle is the maximum angle through which the front wheels may be turned to right or left from the straightahead position. This angle is greater for the inside wheel than the outside wheel on a turn. The turning angle for the inside wheel is shown as C, figure 106, and the turning angle for the outside wheel is shown as D, figure 106. Turning angle should be checked with the axle installed on the vehicle, using wheel alinement indicator 41-I-130 for this purpose (fig. 107). Stop plugs, threaded and welded in housing (fig. 108), are provided to limit the angle through which the inside wheel can turn. Refer to paragraph 156 for inside and outside turning angle, and to *f* below for adjustment procedure.

f. Turning Angle Adjustment.

- (1) *Remove stop plug (screw).*—Cut braze (weld) attaching steering knuckle support stop plug (screw) (fig. 108) to axle

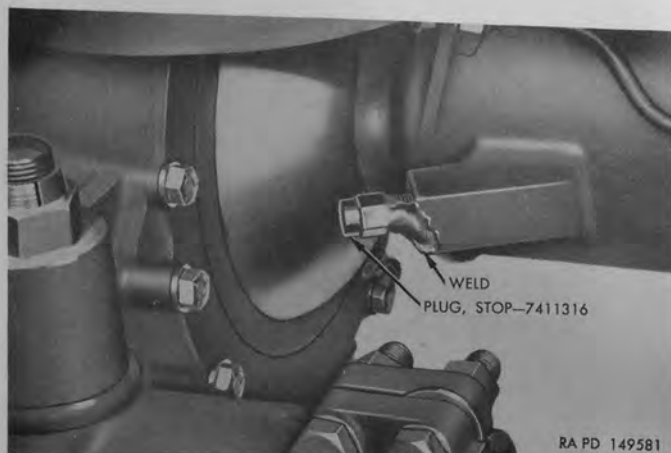
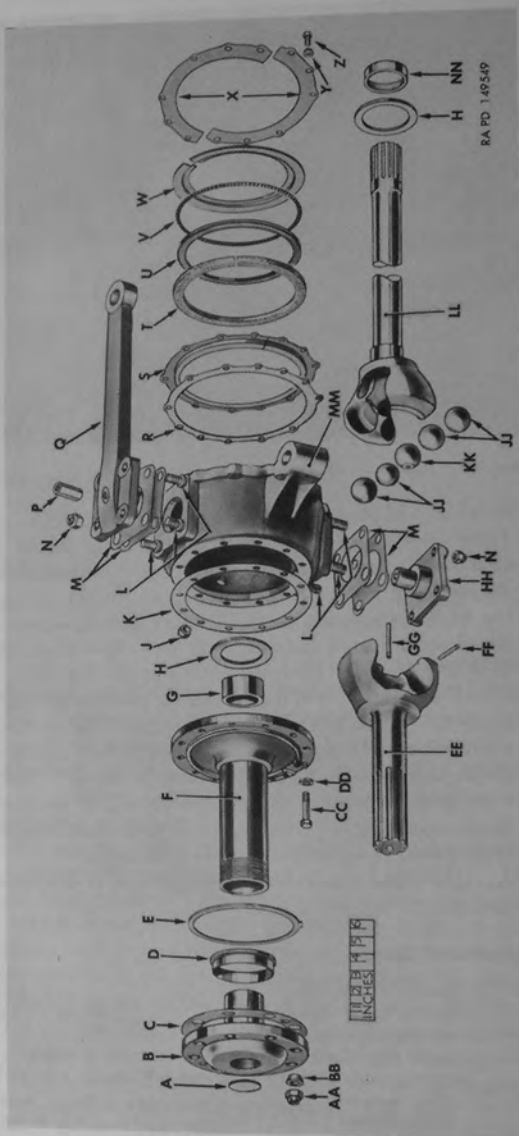


Figure 108. Steering knuckle support stop plug installed in housing.

- housing. If plug head is damaged, plug should be replaced.
- (2) *Install new stop plug.*—Install new steering knuckle support stop plug (screw) (fig. 108) by threading it into axle housing.
 - (3) *Adjust stop plug.*—Adjust stop plug by threading into or out of housing until angle C, figure 106, is correct for left wheel as indicated in paragraph 156. Use wheel alinement indicator 41-I-130 to obtain correct angle (fig. 107).
 - (4) *Check angle "D."*—With wheels in position giving correct angle for "C" on left wheel, check angle D, figure 106, for the right wheel. If this angle is different than given in paragraph 156, toe-out on turns will not be correct. Inspect for bent, loose, or twisted tie rod and correct as necessary.
 - (5) *Braze stop plug.*—When correct settings have been obtained, braze (weld) stop plug (fig. 108) to housing.
 - (6) At right wheel, repeat operations previously described in (1) through (5) above.

156. Alinement Data

A minus B	toe-in (at hub C/C)	$\frac{5}{32}$ to $\frac{3}{32}$ in.
C	turning angle—inside	28 deg + 1 deg, - 0 deg
D	turning angle—outside	26 deg
E	center line of steering arm ball to outside of spring	$3\frac{1}{4}$ in.
F	backing plate to center of tie rod end pin	$2\frac{3}{4}$ in.
H minus G	wheel camber	$2\frac{7}{64}$ in. to 0 in.
J	wheel camber	$\frac{3}{4}$ deg to 0 deg
K	bottom of steering arm to top of axle housing	$3\frac{3}{8}$ in.
L	caster angle	1 deg 45 min



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Figure 109. Components of steering knuckle, support, oil seals, and universal joint (left side shown).

- A-PLUG, EXPANSION, $1\frac{1}{16}$ -IN.—7411411
 B-FLANGE, DRIVE, HUB—YT-2283030
 C-GASKET—7411285
 D-SLEEVE, OIL SEAL—7411433
 E-SHIELD, OIL, BRAKE—7411431
 F-KNUCKLE, STEERING—YT-2275666
 G-BEARING, BUSHING TYPE—7411312
 H-WASHER, THRUST—7411310
 J-PLUG, PIPE, $\frac{3}{8}$ -IN.—143980
 K-GASKET—7411313
 L-STUD, $\frac{1}{2}$ -13-20 X $1\frac{1}{16}$ —7411451
 M-SHIM, TRUNNION BEARING
 0.002-IN.—7377411
 0.005-IN.—7377241
 0.010-IN.—7377412
 0.020-IN.—CV-3678167
 N-NUT, $\frac{1}{2}$ -20—442801
 P-SPACER (INNER)—7538373
 SPACER (OUTER REAR)—7411315
 Q-ARM, STEERING—7411311
 R-GASKET—CV-3659641
 S-RETAINER, OIL SEAL, OUTER—7411301
 T-SEAL, OIL—CV-3659639
 U-SEAL, DUST—7411303
 V-SPRING, DUST SEAL—7411305
 W-RETAINER, DUST SEAL—7411302
 X-RETAINER, OIL SEAL, INNER—7411300
 Y-WASHER, LOCK, $\frac{1}{16}$ -IN.—120638
 Z-SCREW, CAP, $\frac{1}{16}$ -18 X $\frac{5}{8}$ —180075
 AA-NUT, $\frac{1}{4}$ -20—442801
 BB-WEDGE, DOWEL, TAPERED—7411264
 CC-SCREW, CAP $\frac{3}{16}$ -16 X $1\frac{1}{16}$ —7412113
 SCREW, CAP $\frac{3}{16}$ -16 X $1\frac{1}{16}$ —7412112
 DD-WASHER, LOCK, $\frac{3}{8}$ -IN.—120382
 EE-SHAFT, OUTER—YT-2283033
 FF-PIN, TAPER-GROOVE, $\frac{3}{16}$ X $1\frac{1}{2}$ —187798
 GG-PIN, CENTER BALL—7377358
 HH-TRUNNION, STEERING KNUCKLE—7411454
 JJ-BALL, UNIVERSAL JOINT, OUTER
 1.372 DIAM—CV-3660105
 1.373 DIAM—7377050
 1.374 DIAM—7377051
 1.375 DIAM—CV-3660108
 1.376 DIAM—7377049
 1.377 DIAM—7377046
 1.378 DIAM—CV-3660111
 KK-BALL, UNIVERSAL JOINT, CENTER—YT-2056647
 LL-SHAFT, INNER, LEFT—YT-2277364
 SHAFT, INNER, RIGHT—YT-2277363
 MM-SUPPORT, STEERING KNUCKLE, LEFT—7411453
 SUPPORT, STEERING KNUCKLE, RIGHT—7411452
 NN-SEAL, OIL, SHAFT, ASSY—7411307

Section III. DISASSEMBLY OF FRONT AXLE INTO SUBASSEMBLIES

157. General

a. The following procedures are based on the assumption that the axle assembly has been removed from the vehicle in accordance with instructions outlined in TM 9-819A. Many of the following operations can be performed with the axle assembly installed on the vehicle; however, for maximum accessibility and efficiency, the axle should be removed from the vehicle and placed on a suitable work stand whenever available.

b. Before cleaning or disassembling the axle, make careful visual inspection for evidence of lubricant leakage which might not otherwise be visible after the assembly or parts have been cleaned. Make a note of all such points so that the cause may be determined either during disassembly or at time of inspection after disassembly. Thoroughly clean the assembly, using steam or other suitable method, to remove all accumulated dirt or other foreign material which might injure parts if it were not removed.

158. Preliminary Disassembly Operations

a. Drain Lubricant.—Place suitable receptacle under axle; then remove plug and gasket from axle housing to permit lubricant to drain.

b. Remove Wheel Hub, Drums, and Bearings.—Remove wheel hubs, brake drums, and bearings as directed in paragraph 256b.

c. Remove Brake Assembly.—Remove brake backing plate and shoe assembly, also brake hose and shield as directed in paragraph 229.

159. Removal of Axle Shaft and Universal Joint Assembly

a. Remove Steering Knuckle.—Use brass or soft hammer (fig. 110) to tap steering knuckle ((F), fig. 109) on all sides to loosen knuckle from steering knuckle support ((MM), fig. 109). When loose, pull knuckle straight outward to complete removal. Remove and discard gasket ((K), fig. 109) from knuckle or support.

b. Remove Axle Shaft and Universal Joint Assembly.—Grasp outer shaft (fig. 111) and pull shaft and universal joint assembly straight out of axle housing.

Note. In some instances it may be necessary to use a small block of wood as a pry between universal joint and steering knuckle support to loosen splined inner shaft from side gear splines.

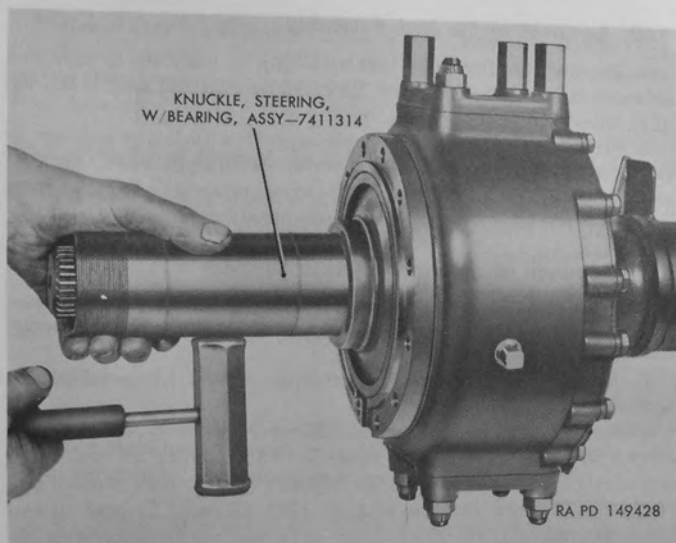


Figure 110. Removing steering knuckle.

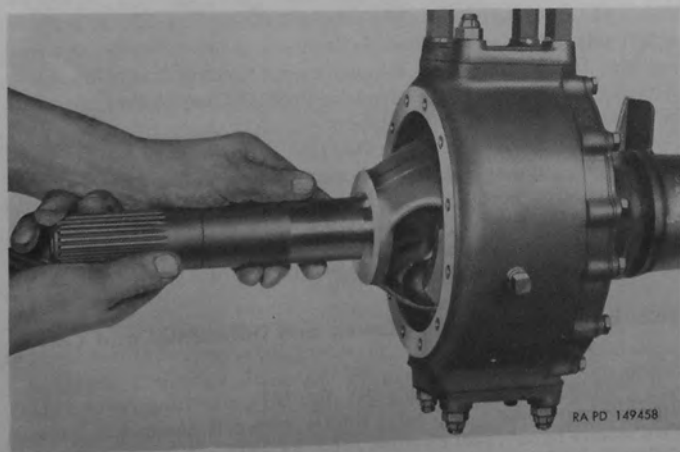


Figure 111. Removing or installing universal joint assembly.

160. Removal of Tie Rod Assembly

a. Remove nuts ((A), fig. 124) attaching tie rod studs to right and left steering knuckle supports. Remove tie rod stud seal ((B), fig. 124) from each stud.

b. Strike arm on steering knuckle support with heavy hammer as downward pressure is applied to tie rod end with a pinch bar. Several sharp blows at arm may be required to loosen tapered tie rod stud from arm. Tie rod assembly can now be completely removed.

161. Removal of Steering Knuckle Support

Note. Steering knuckle support and associated parts are illustrated in figure 109 and key letters noted in parentheses refer to this illustration unless otherwise indicated.

a. General.—The following instructions should be performed at both ends of axle housing.

b. Remove Seals and Retainers.—Remove twelve $\frac{5}{16}$ -18 x $\frac{5}{8}$ cap screws (Z) and $\frac{5}{16}$ -inch lock washers (Y) attaching oil seal inner retainers (X) to steering knuckle support (MM); then remove two retainers. Remove dust seal retainer (W), oil seal (T), and oil seal outer retainer (S), all of which are split and can be completely removed at this time. Dust seal (U) and dust seal spring (V) cannot be removed until steering knuckle support (MM) is removed.

c. Remove Steering Knuckle Trunnions.—Remove four $\frac{1}{2}$ -20 nuts (N) attaching steering knuckle trunnions (HH) to bottom of steering knuckle support (MM). Remove $\frac{1}{2}$ -20 nut (N) and three spacers (P) attaching steering knuckle trunnion ((L), fig. 121) to top of steering knuckle support at right side, or steering arm (Q) to support at left side. The steering knuckle trunnion is pressed into the steering arm (Q) at left side. Remove each trunnion and shim pack. Attach shims to their respective trunnions and tag so that they can be installed in their original location.

d. Remove Steering Knuckle Support and Bearings.—Lift steering knuckle support (MM) off housing outer end and catch lower trunnion bearing cone ((T), fig. 121) as support is lifted off. Remove upper trunnion bearing cone ((C), fig. 121) from support. Attach identification tag to upper and lower bearing cones so that they can be installed in their original position.

162. Removal of Housing Cover, and Differential and Carrier Assembly

a. Remove ten $\frac{7}{16}$ -20 nuts ((E), fig. 121) attaching cover ((H), fig. 121) to housing. Tap cover lightly with soft hammer to loosen; then remove from $\frac{7}{16}$ -20 x 2 studs ((P), fig. 121) in housing. Remove and discard gasket ((J), fig. 121).

b. Remove ten $\frac{7}{16}$ -20 nuts ((AA), fig. 132) attaching carrier ((Z), fig. 132) to housing. Tap carrier lightly with soft hammer to loosen carrier from housing; then withdraw differential and carrier assembly from housing. Remove and discard gasket ((Y), fig. 132).

163. Rebuild of Front Axle Differential and Carrier Assembly

Since this procedure is the same as for rear axle differential and carrier assembly, this information will not be repeated in this section. Refer to paragraphs 197 through 202 for rebuild of differential and carrier assembly.

Section IV. REBUILD OF AXLE SHAFT AND UNIVERSAL JOINT

164. General

The following procedures cover the disassembly, cleaning, inspection, and reassembly of axle shaft and universal joint assembly. Refer to paragraph 159 for removal procedures.

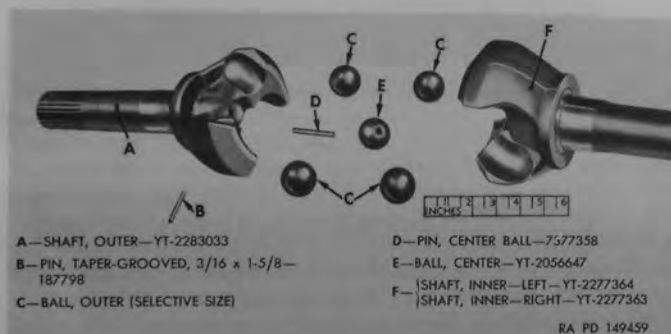


Figure 112. Axle shaft and universal joint components.

165. Disassembly

Note. Key letters noted in parentheses are in figure 112 unless otherwise indicated.

a. *Cleaning.*—Immerse assembly in dry-cleaning solvent or volatile mineral spirits to remove oil, grease, or other deposits.

b. *Check Universal Joint for Play or Backlash.*—Before disassembling, it should be determined if excessive play or backlash exists in the universal joint. Place the assembly in a vise in a vertical position, with the outer (short) shaft (A) up, and the vise jaws gripping the inner shaft (F) just below the machined surface on the shaft.

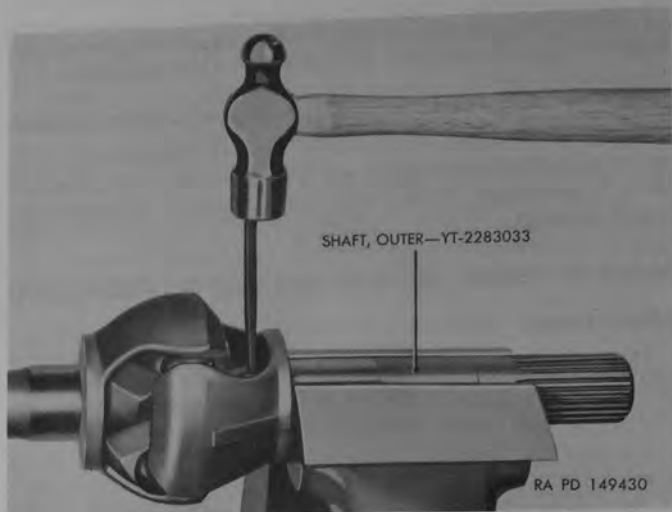


Figure 113. Universal joint center ball lock pin removal or installation.

Soft metal or wood protectors should be used in jaws of vise. Firmly push down on the outer shaft so that it rests on the center ball, and at the same time attempt to twist the joint in both directions. If any play or backlash is evident, oversize outer balls should be installed at assembly (par. 169).

c. Remove Center Ball Pin Lock Pin.—Position axle shaft and universal joint in a vise (fig. 113) or lay on a bench. Use a suitable punch and hammer to drive $\frac{3}{16}$ x $1\frac{5}{8}$ taper-grooved pin (B) out of outer shaft (fig. 113).

d. Dislodge Center Ball Pin.—Remove assembly from vise and hold in a vertical position with outer shaft (A) down. Bounce the outer shaft on a block of wood (fig. 114) to dislodge center ball pin (D), allowing the pin to drop downward in drilled passage in outer shaft.

e. Remove Balls.—With the assembly in a vertical position, inner shaft (F) up, clamp the outer shaft (A) in a vise, using soft metal jaw plates. Swing the outer shaft to one side and at the same time raise it slightly to pull the two shafts apart and loosen the center ball. Turn the center ball with thumb and finger, so that groove in center ball lines up with one of the outer balls (fig. 115). Outer ball can be removed by pushing it past the center ball groove, using thumb (fig. 115). Bend outer shaft sharply in opposite direction to release three



Figure 114. Dislodging universal joint center ball pin.

remaining outer balls. Separate the outer shaft from the inner shaft; then remove center ball. Remove outer shaft from vise; then remove center ball pin from hole in outer shaft.

166. Cleaning

Immerse balls, shafts, and pins in dry-cleaning solvent or volatile mineral spirits to loosen all grease or other deposits. Remove balls from cleaning solution and dry thoroughly, being sure hole in center ball is clean. Remove shafts and clean any remaining deposits in splines and ball races with cleaning solution and bristle brush. Be sure drilled passages in outer shaft are clean.

167. Inspection

Note. Key letters noted in parentheses are in figure 112 unless otherwise indicated.

a. Shafts.—Inspect shaft splines for wear, twist, or other damage. Examine ball races in yokes for excessive wear, roughness, or other damage. Carefully examine joints for cracks. Inspect shafts for twisted or bent condition. Whenever either the inner or outer shaft is damaged, a complete new shaft and universal joint assembly must be installed.



Figure 115. Universal joint outer balls removal or installation.

b. Balls.—Carefully examine balls for chips, cracks, or rough spots. Use a micrometer and check balls for out-of-round condition. Replace damaged balls with new balls of same diameter unless check made in paragraph 165*b* indicated that oversize balls are necessary.

c. Pins.—Examine center ball pin (D) for damage. Check freedom of pin in drilled hole in outer shaft, also in center ball. Center ball pin is locked with a $\frac{3}{16} \times 1\frac{1}{8}$ taper-grooved pin (B) which should be replaced if not tight in drilled hole in outer shaft.

168. Repair

Whenever inspection of shafts or universal joints indicated that these parts are worn or damaged, they must be replaced with new parts; therefore, no repair is recommended.

169. Assembly

Note. Key letters noted in parentheses are in figure 112 unless otherwise indicated.

a. Select Correct Size Balls.—Whenever check (par. 165*b*) indicates that play or backlash exists, this condition can be corrected

by installation of larger outer balls. Outer balls (C) are available in seven sizes: 0.001-, 0.002-, and 0.003-inch undersize, standard, and 0.001-, 0.002-, and 0.003-inch oversize. Measure diameter of the original balls with a micrometer to determine the size of each ball. Select one or two balls 0.001 inch larger than the smallest ball originally used in the assembly. It is desirable to keep the balls within 0.001 inch of the same size and the variation should not exceed 0.002 inch. As the universal joint is being assembled, the two largest balls should be installed diagonally across from each other.

b. Position Inner Shaft.—Place inner shaft (F) in vise, using soft jaw plates, with universal joint end up. Be sure vise does not grasp on a ground surface.

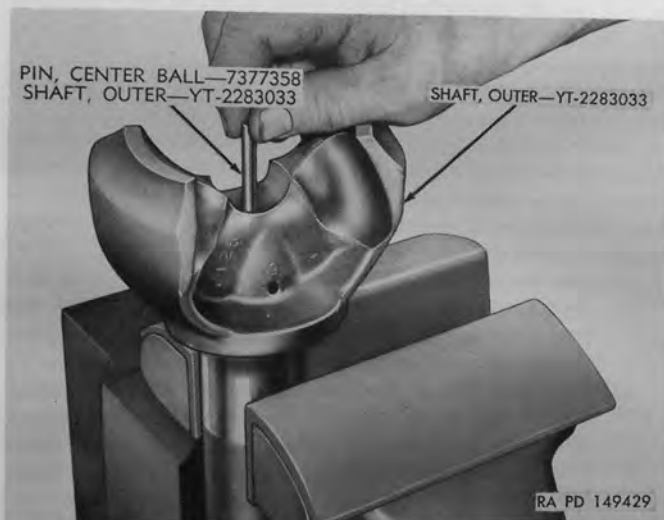


Figure 116. Universal joint center ball pin installation.

c. Position Center Ball.—Place center ball (E) on the seat at the center of the inner shift.

d. Install Center Ball Pin.—Insert center ball pin (D) into hole in outer shaft (fig. 116). Check pin several times to be sure it slides freely and does not stick.

e. Position Outer Shaft.—Place outer shaft (A) over inner shaft (F) with outer shaft resting on center ball (E). Be sure center ball pin (E) does not drop out of outer shaft during this operation.

f. Install Three Outer Balls.—Bend outer shaft at joint to an extreme angle as necessary to slip three of the outer balls (C) into the

aces. Be sure the two largest balls are diagonally across from each other.

g. Install Fourth Outer Ball.—Bend outer shaft at joint in opposite direction to obtain necessary clearance to install fourth outer ball. Rotate center ball to line up groove in ball with race for the remaining ball (fig. 115). Slip the fourth ball past the center ball and into race; then bend outer shaft to a straight position.

h. Position Center Ball Pin.—Raise outer shaft only sufficient to free the center ball; then rotate ball until center ball pin drops into drilled hole in ball.

i. Install Center Ball Pin Lock Pin.—Install a new $\frac{3}{16} \times 1\frac{1}{8}$ taper-grooved pin (B) into drilled hole in outer shaft and drive into position (fig. 113). Remove assembly from vise and lay on bench or anvil so as to support one end of pin. Strike end of pin sharply with prick punch to expand end and lock it in position. Turn assembly over and expand opposite end of pin in the same manner.

j. Check Universal Joint Play or Backlash.—When oversized outer balls have been installed in used races, it is only necessary to determine that no play or backlash exists when shaft is in vertical position, and that a maximum of 35 pounds pull is required to move shaft through its normal operating range.

- (1) *Position Assembly in Vise.*—Install assembly in vise in a vertical position with the outer shaft at the top and the vise jaws gripping the inner shaft just below the universal joint. Use soft jaw plates to protect shaft.
- (2) *Determine Play or Backlash.*—Firmly push down on outer shaft so that it rests on the center ball, at the same time, attempt to twist the joint in both directions. The presence of play or backlash indicates the need of still larger outer balls.
- (3) *Determine Pull Required to Move Shaft Through Its Normal Operating Range.*—With assembly still mounted in vise, attach a spring scale within one inch of end of outer shaft. With spring scale, pull shaft through its normal operating range and note reading on spring scale. A pull of more than 30 pounds indicates that outer balls of too large an oversize have been installed. Ideal conditions when oversize outer balls are installed in used universal joints are as follows: Vertical or straight position—no play or backlash; 10 to 15 degree turn—30 pound maximum drag; 15 to 32 degree or full turn—free with slight lash permissible.

Section V. REBUILD OF STEERING KNUCKLE, SUPPORT, TRUNNIONS, SEALS, AND BEARINGS

170. General

All parts covered in this section have been disassembled during their removal from axle assembly; therefore, no disassembly instructions are included in this section.

171. Cleaning

Immerse all parts in dry-cleaning solvent or volatile mineral spirits to loosen and remove all accumulations of grease, dirt, or other foreign deposits. Remove each part separately and use bristle brush to remove all accumulated deposits. Whenever available, compressed air may also be used to remove deposits and to dry parts. Particular attention should be given to trunnion bearing cones. Slush the bearings up and down in cleaning fluid. Use a bristle brush to clean thoroughly, repeating immersion and brushing until all dirt is removed. Dry bearings with compressed air, directing air in such a manner so as not to spin bearing.

172. Inspection

Note. Key letters noted in parentheses are in figure 100 unless otherwise indicated.

a. General.—Before any attempt is made to inspect parts, they must have been thoroughly cleaned as directed in paragraph 171. Refer to chapter 21 for dimensional data or other necessary inspection data.

b. Steering Knuckle.—Inspect threads for damage and clean up with thread restoring tool, otherwise install new steering knuckle (F) assembly. Inspect bushing type bearing (G) inside steering knuckle for wear, roughness, or other damage. Refer to paragraph 346 for dimensional data, also to paragraph 173*a* whenever inspection indicates that new part should be installed. Inspect thrust washer (H) for wear, roughness, or other damage. Refer to paragraph 346 for thrust washer thickness and paragraph 173*b* for instructions necessary to install new part. Inspect brake oil shield (E) for bent or damaged condition, also for proper installation (fig. 117). Inspect oil seal sleeve (D) for roughness or grooves and replace as directed in paragraph 173*c* if necessary.

c. Steering Knuckle Support.—Inspect steering knuckle (MM) for cracked, broken, or distorted condition. Inspect for stripped or damaged threads in tapped holes. Inspect hole in integral boss to which the tie rod stud attaches for evidence of wear due to loose stud. Install new support if any of the above conditions exist. Inspect $\frac{1}{2}$ -13-20 x $1\frac{5}{16}$ studs (L) for looseness in support, also for damaged or stripped

threads and tighten or replace as necessary. Inspect shim and gasket surfaces for smoothness and clean up with fine file if necessary.

d. Steering Knuckle Trunnion.—Inspect steering knuckle trunnions (HH) for distortion or other damage. Inspect shim surface for smoothness. Replace with new part if damaged or clean up shim surface with fine file.

e. Steering Arm.—Inspect steering arm (Q) for bent or other damaged condition. Inspect drag link tapered hole in end of arm for wear due to loose stud. Inner or drag link end of arm has an upward offset of twenty-seven thirty seconds of an inch, when shim surface is flat on a face plate. Replace with new part if bent or otherwise defective. Clean up shim surface with fine file if necessary. If trunnion which is pressed into steering arm requires replacement, it can be removed and installed using an arbor press.

f. Trunnion Bearings.—Inspect trunnion bearing cones ((C), fig. 121) for chipped, cracked, or worn condition. Replace with new parts if damaged or worn.

g. Seals and Retainers.—Felt type oil seal (T), rubber dust seal (U), and dust seal spring (V) should be discarded and new parts installed. Inspect outer oil seal retainer (S), dust seal retainer (W), and inner oil seal retainer (X) for bent or damaged condition that

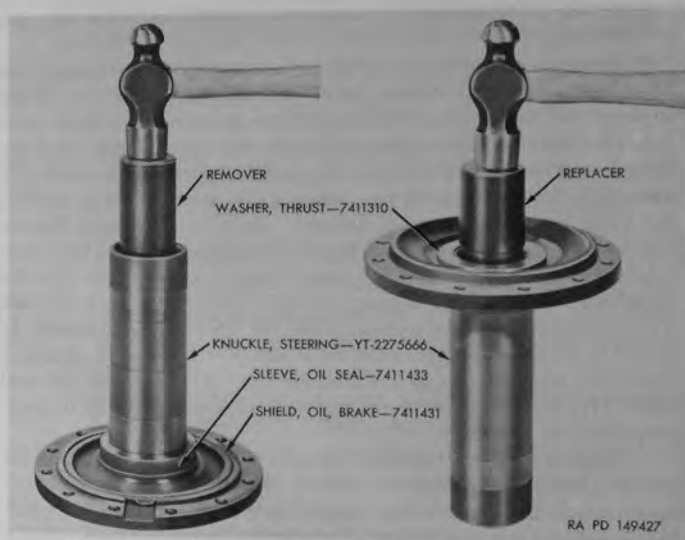


Figure 117. Removing or installing steering knuckle bushing type bearing, using remover 41-R-2369-725 or replacer 41-R-2388-250.

would render these parts unfit for further use. Straighten or replace, whichever is necessary.

173. Repair

a. Steering Knuckle Bearing.

(1) *Removal.*—Place steering knuckle in arbor press or on bench and use steering knuckle bearing remover 41-R-2369-725 to press or drive bushing type bearing (G) from steering knuckle (fig. 117).

(2) *Installation.*—Place steering knuckle in arbor press or on bench and use steering knuckle bearing replacer 41-R-2388-250 to press or drive bushing type bearing (G) into steering knuckle (fig. 117). Shoulder inside steering knuckle properly locates bearing in its correct position (fig. 118). Burnish or grind bearing to 1.786 to 1.788-inch diameter.

b. Steering Knuckle Thrust Washer.

(1) *Removal.*—Use sharp chisel to remove metal stakes retaining thrust washer (fig. 119) to steering knuckle; then remove

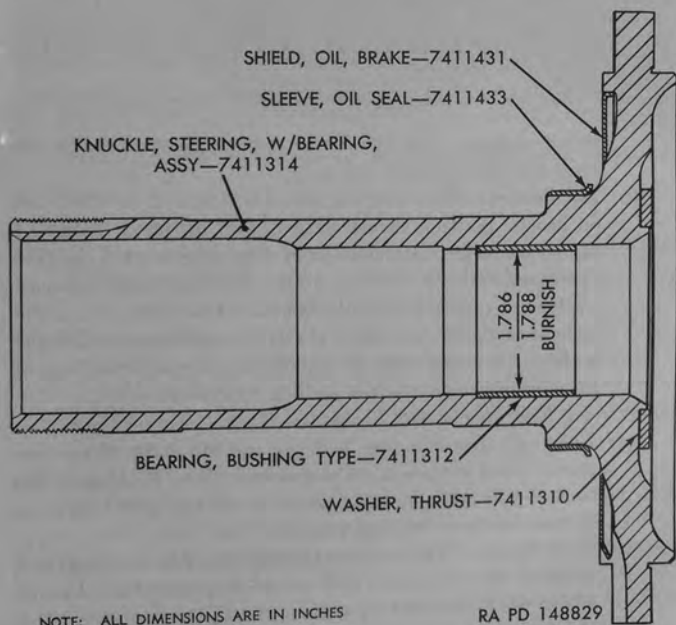


Figure 118. Sectional view of steering knuckle assembly.

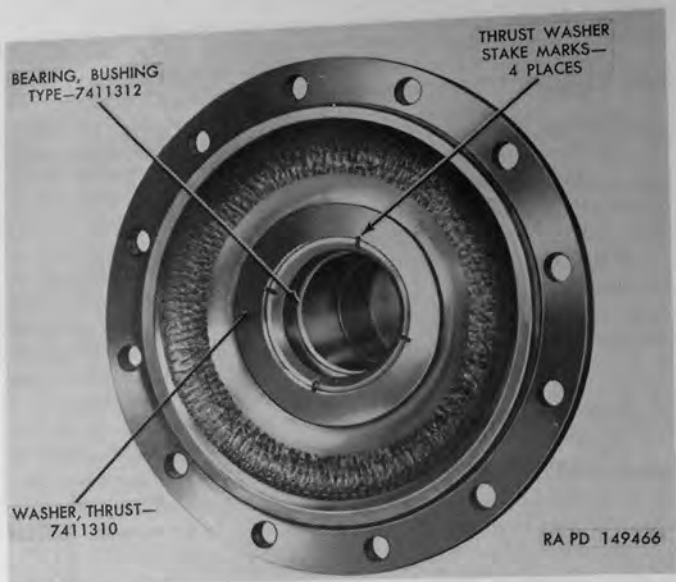


Figure 119. Steering knuckle bushing type bearing and thrust washer installed.

thrust washer. Use fine file to remove sharp stake points from steering knuckle.

- (2) *Installation.*—With steering knuckle standing on outer end on bench, position thrust washer (H) at inside flange of steering knuckle, with chamfered outer edge toward knuckle. Use block of hard wood or plastic hammer to drive thrust washer into place until fully seated. Use sharp chisel and stake steering knuckle (fig. 119) at four places to hold thrust washer. Use fine stone to remove any metal from face of thrust washer as a result of staking operation.

c. Steering Knuckle Oil Seal Sleeve.

- (1) *Removal.*—Use ball peen hammer and tap entire circumference of outer surface of oil seal sleeves (D). Peening of this surface will cause metal in sleeve to stretch until sleeve can be removed from steering knuckle.
- (2) *Installation.*—With steering knuckle standing on flange end, position oil seal sleeve (D) on steering knuckle. Use replacer 41-R-2395-518 in manner illustrated in figure 120 to drive sleeve onto knuckle until edge of sleeve is flush with shoulder on steering knuckle (fig. 118).

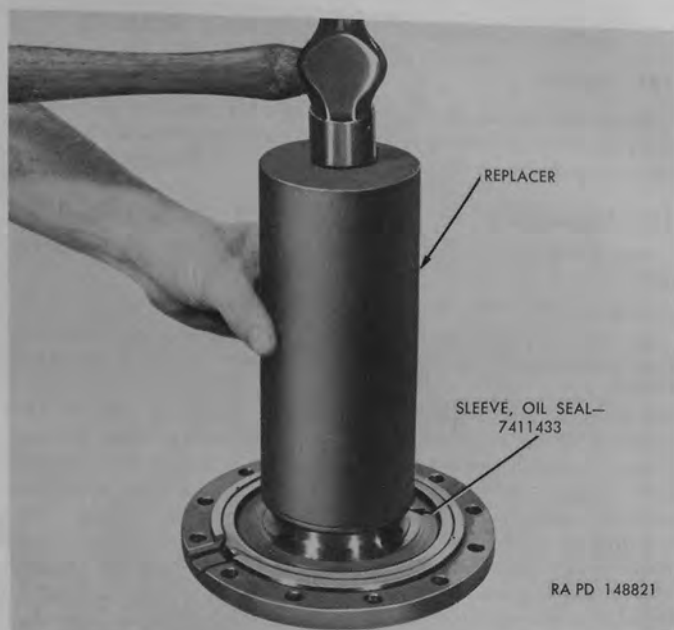


Figure 120. Installing oil seal sleeve on steering knuckle using replacer 41-R-2395-518.

d. Steering Knuckle Brake Oil Shield.

- (1) *Removal.*—Insert screw driver on other similar tool under brake oil shield (E) at slot in steering knuckle; then pry shield from steering knuckle (fig. 117).
- (2) *Installation.*—Position brake oil shield (E) on steering knuckle with lip of shield in steering knuckle slot (fig. 117). Use soft hammer and tap shield until fully seated in knuckle. If necessary, stake knuckle in several places to hold shield in knuckle.

e. Steering Knuckle Trunnion Studs.

- (1) *Removal.*—Remove damaged $\frac{1}{2}$ -13-20 \times 1 $\frac{5}{16}$ studs (L) from steering knuckle support, using a stud remover.
- (2) *Installation.*—Install new $\frac{1}{2}$ -13-20 \times 1 $\frac{5}{16}$ studs (L), using stud replacing tool. Height of all studs should be 1 $\frac{3}{8}$ inches, except two at upper outside of left steering knuckle (where dowel rings are used) (fig. 127), which should be driven to a height of 1 $\frac{3}{16}$ inches.

Section VI. REBUILD OF FRONT AXLE HOUSING

174. General

The following procedures cover disassembly, cleaning, inspection, and repair of axle housing after axle assembly has been disassembled into subassemblies as directed in paragraphs 157 through 163.

175. Disassembly

Note. Key letters noted in parentheses are in figure 121 unless otherwise indicated.

a. Remove Trunnion Bearing Cups.

Note. Bearing cups need not be removed unless inspection (par. 177b) indicates that these parts should be replaced with new parts, then proceed as follows:

Use brass rod and hammer to drive trunnion bearing cup (B) and trunnion bearing oil retainer (A) upward to remove from housing. Discard trunnion bearing oil retainer, since this part has probably been damaged during removal. Use brass rod and hammer to drive trunnion bearing cup (S) downward to remove from housing.

b. Remove Brake Line Assemblies.—Remove three cap screws, lock washers, and clips attaching brake lines to axle housing. Loosen brake line fitting nut attaching each line to junction block located on top of axle housing, then remove right and left brake line assemblies (fig. 105).

c. Remove Thrust Washer.—Remove thrust washer (V) from housing outer end by driving a sharp chisel between thrust washer and housing at stake marks. Use care not to damage thrust washer seat in housing.

d. Remove Shaft Oil Seal.—Position remover 41-R-2371-850 through shaft oil seal (U); then strike remover several sharp blows with hammer to remove seal (fig. 122).

176. Cleaning

Note. Key letters noted in parentheses are in figure 121 unless otherwise indicated.

a. General.—Immerse parts in dry-cleaning solvent or volatile mineral spirits to loosen and remove all accumulated grease, dirt, or other deposits. Use of bristle brush and repeated use of cleaning solvent will remove all deposits.

b. Housing.—Clean housing (D) inside and out, using long-handled brush or swab to remove dirt and grease from inside. Be sure that all particles of gaskets are removed, also remove sealing compound if present. Clean polished surfaces at housing outer ends. Clean oil seal and thrust washer seating surfaces at outer ends of housing.

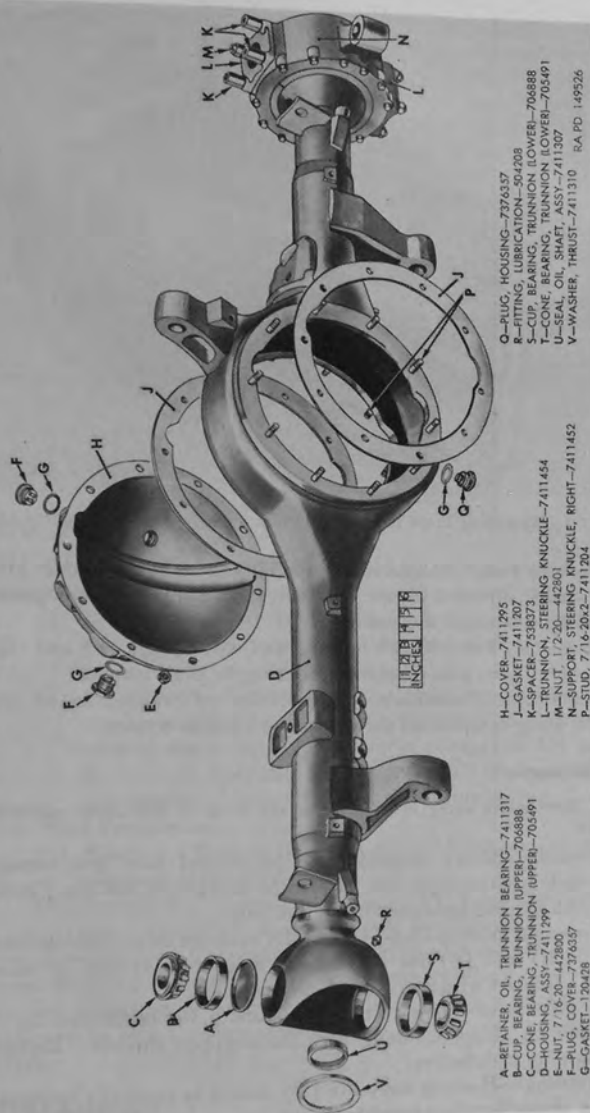


Figure 121. Front axle housing and associated parts.



Figure 122. Removing shaft oil seal assembly using remover 41-R-2371-850.

c. Housing Cover.—Clean inside and outside of housing cover (H) to remove all dirt and grease. Be sure that all particles of gasket and sealing compound are removed.

d. Magnetic Plugs.—Clean housing and cover plugs (F) and (Q) to remove all particles of metal adhering to plug magnet.

e. Brake Line Assemblies.—Clean inside of brake lines of any deposits, using compressed air to remove all obstructions.

177. Inspection

Note. Key letters noted in parentheses are in figure 121 unless otherwise indicated.

a. General.—Before inspecting, all parts must have been cleaned as directed in paragraph 176. Refer to paragraph 346 for dimensional data or other necessary inspection data.

b. Trunnion Bearing Cups.—Carefully examine each trunnion bearing cup (B) and (S) for evidence of wear, pits, cracks, or other defects. Replace with new part if defective.

c. Brake Lines.—Inspect brake line tubing for bends, cracks, or other defects. Inspect tubing nuts for stripped threads. Replace line assembly if defective.

d. Housing.—Housing assembly (D) should be carefully inspected visually or use locally available checking equipment to determine if bent, twisted, or otherwise damaged. Repair or replace, whichever is the more practical, dependent upon the nature of the defect and

the availability of adequate straightening equipment. Inspect spherical surfaces at each end of housing for evidence of scratches or other marks that might impair efficiency of oil and dust seals. Slight imperfections can sometimes be cleaned up with crocus cloth or fine stone; if not, replace housing. Inspect machined gasket surfaces to be sure they are smooth. Inspect housing cover and carrier studs (P) to be sure that they are tight and that threads are not stripped. Replace damaged studs. Inspect all parts welded to housing to be sure they are not damaged or bent, also that welding is not broken.

e. Housing Cover.—Carefully inspect cover (H) for evidence of distortion or cracks. Gasket surface should be flat to provide good cover-to-housing seal. Inspect cover plug threads for damage or stripping. Install new cover if damaged.

f. Thrust Washer.—Inspect thrust washer (V) for roughness at thrust surface, also check thickness to determine if worn. Refer to paragraph 346 for thrust washer thickness.

g. Shaft Oil Seal.—Shaft oil seal, assembly (U) installed in outer end of housing should always be replaced whenever axle is disassembled.

178. Repair

a. Stop Plug Replacement.—Stop plugs, used to control turning radius, are welded in place to prevent unauthorized adjustment.

(1) *Removal.*—Use torch to loosen tack weld holding threaded plug in its correct position; then remove plug by threading out of bracket welded to housing.

(2) *Installation.*—Thread new stop plug into bracket. Check turning angle as described in paragraph 155*e*. When proper turning angle (fig. 106) given in paragraph 156 has been obtained as described in paragraph 155*f*, plugs should be tack welded to prevent loosening and tampering.

b. Stud Replacement.

(1) *Removal.*—Remove damaged studs (P) from axle housing, using a stud remover.

(2) *Installation.*—Install new studs (P), using stud replacing tool. Height of all studs should be $1\frac{3}{8}$ inch.

c. Straightening Housing.—Axle housing assembly (D) can sometimes be straightened provided suitable straightening equipment and trained operating personnel are available. Each straightening job presents its own problem, therefore no specific instructions can be given.

179. Assembly

a. Shaft Oil Seal Installation.—Apply thin coating of plastic type gasket cement to outer surface of seal contacting housing. Position

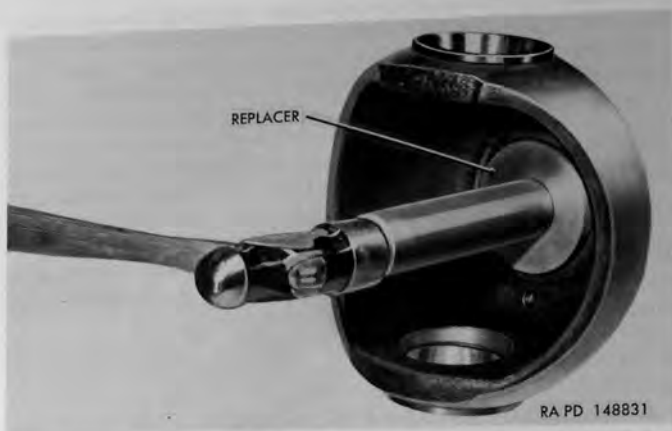


Figure 123. Installing shaft oil seal assembly using replacer 41-R-2392-640.

shaft oil seal assembly (U) into end of housing with lip of seal toward housing. Use oil seal replacer 41-R-2392-640 to drive and properly position seal into housing (fig. 123).

b. Thrust Washer Installation.—Position thrust washer (V) into end of housing with chamfered outer edge toward housing. Use block of hard wood or plastic hammer to drive thrust washer into place until fully seated. Use sharp chisel and stake thrust washer to housing at four points. Use fine stone to remove any protruding metal as a result of staking.

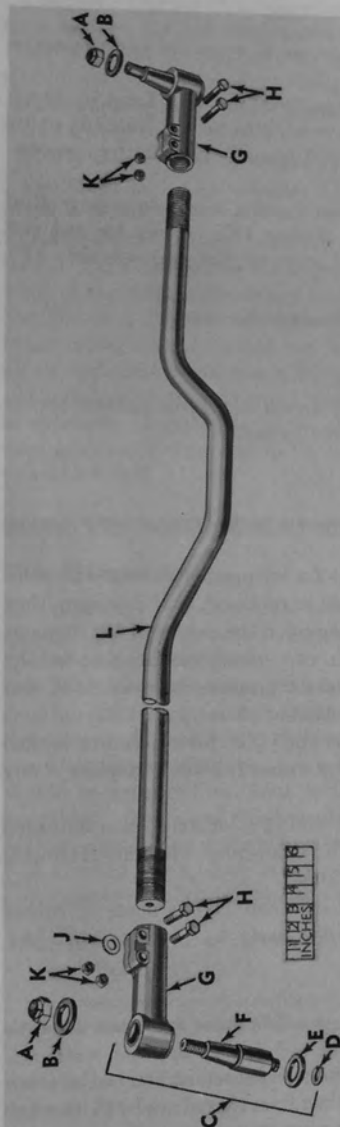
c. Trunnion Bearing Cup Installation.—At top of housing only, install trunnion bearing oil retainer (A), being sure that it rests in counterbore below bearing cup seat. Position trunnion bearing cups (B and S) squarely in housing, then use block of hard wood or plastic hammer to drive cups into housing until fully seated.

d. Brake Line Installation.—Position brake line assemblies on housing, thread line fitting nuts into junction block on top of axle housing, and tighten firmly. Secure lines to housing with three clips, three $\frac{1}{4}$ -inch lock washers, and three $\frac{1}{4}$ -28 x $\frac{1}{2}$ cap screws. Tighten cap screws firmly.

Section VII. REBUILD OF TIE ROD

180. General

The following procedures cover disassembly, cleaning, inspection, repair, and assembly of tie rod after removal from axle assembly as directed in paragraphs 157 through 163.



- A—NUT, 7/8-14-442805
 B—SEAL, TIE ROD STUD—7411418
 C—END, TIE ROD, LEFT, ASSY—
 7411416
 D—RING, SNAP, STUD—YT-2287559
 E—WASHER, STUD—YT-2287559
 F—STUD, TIE ROD, ASSY—
 YT-2275616

- G—END, TIE ROD, LEFT—
 YT-2271940
 END, TIE ROD, RIGHT—
 YT-2271939
 H—SCREW, CAP, 1/2-20x2-1/2—
 181709
 J—LOCK, TIE ROD—7411419
 K—NUT, 1/2-20-442801
 L—ROD, TIE—7411417

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Figure 124. Components of front axle tie rod assembly.

181. Disassembly

Note. Key letters noted in parentheses are in figure 124 unless otherwise indicated.

a. Tie Rod End Removal.—Remove $\frac{1}{2}$ -20 nut (K) from $\frac{1}{2}$ -20 x 2 cap screws (H), then remove cap screws, also tie rod lock (J) at tie rod left end. Remove tie rod ends (G) from tie rod (L) by unscrewing ends from tie rod.

b. Tie Rod Stud Removal.—Use snap ring pliers to remove stud snap ring (D), then remove stud washer (E). Place tie rod end assembly on bed of arbor press and press tie rod stud assembly (F) from tie rod end (G).

Note. Pressure should be applied at threaded end of stud.

182. Cleaning

Immerse all parts in dry-cleaning solvent or volatile mineral spirits to remove all grease, dirt, or other foreign matter.

183. Inspection

Note. Key letters noted in parentheses are in figure 124 unless otherwise indicated.

a. Tie Rod.—Examine tie rod (L) for stripped or damaged threads. If threads are stripped, tie rod should be replaced, or if damaged, they can sometimes be repaired, depending upon the nature of the damage. Inspect for bent condition, which can sometimes be detected by measuring length of rod. Rod should measure between $55\frac{7}{8}$ and $56\frac{3}{8}$ inches, otherwise it is probably bent at offset.

b. Tie Rod Ends.—Inspect tie rod ends (G) for cracked or broken condition. Inspect for damaged or stripped threads. Replace if any of the foregoing conditions exist.

c. Tie Rod Stud.—Inspect tie rod stud (F) for stripped or damaged threads. Inspect for looseness of stud in bushing. Replace if threads are damaged or if stud is loose in bushing.

d. Tie Rod Stud Seal.—Tie rod stud seal (B) is made of rubber and should always be replaced with new part.

184. Assembly

Note. Key letters noted in parentheses are in figure 124 unless otherwise indicated.

a. Tie Rod Stud Installation. Position tie rod end on bed of arbor press with clamp bolt holes down; then start tie rod stud (F) through tie rod end bore. Install piece of pipe or ring over stud in such a manner as to press against the stud bushing.

Caution: During this operation do not press on the stud as this may damage the bonding material between the stud and bushing. Press stud and bushing into tie rod end until bushing is flush with tie rod end. Install stud washer (E) and secure with stud snap ring (D), using snap ring pliers. Install tie rod stud seal (B) over tapered end of tie rod stud.

b. Tie Rod End Installation.

Note. Right tie rod end assembly has coarse threads (12 per in) while left tie rod end assembly has fine threads (16 per in).

Thread each tie rod end assembly (C) onto tie rod (L) an equal distance. Each tie rod end will engage tie rod a distance of three inches when in approximately correct location.

c. Tie Rod Length Adjustment.—Carefully measure distance between center line of tie rod end studs and thread tie rod ends on or off tie rod until dimension is $62\frac{17}{32}$ inches. Since right and left tie rod ends have different thread sizes, a finer degree of adjustment can be obtained. Install $\frac{1}{2}$ -20 x $2\frac{1}{2}$ cap screws (H) and $\frac{1}{2}$ -20 nuts (K) used to clamp tie rod end to tie rod; also install tie rod lock (J) at tie rod left end.

Section VIII. ASSEMBLY OF FRONT AXLE FROM SUBASSEMBLIES

185. General

a. Assembly procedures, are arranged in logical sequence. All sub-assemblies should be rebuilt, repaired, and adjusted before beginning operations described herein.

b. Whenever necessary, procedures are given for checking fits and determining clearances or adjustments. Specifications of new parts, clearances, and repair or rebuild standards are listed in chapter 21.

c. Cleanliness is important in handling axle components. All parts should be arranged on clean surface and protected from dirt until assembled. Tools and equipment must be clean to prevent contaminating parts during assembly procedures.

d. Gaskets, seals, snap rings, and lock washers must be replaced as indicated in following procedures.

186. Installation of Steering Knuckle Support and Trunnion Bearings

Note. Sectional view of steering knuckle, support, and universal joint assembly installed is shown in figure 125.

a. Dust Seal and Spring Installation. Install dust seal spring and dust seal by stretching these parts over housing outer end as illustrated in figure 126.

Note. Be sure seal is installed so that bevel at inner surface of seal will fit contour of housing outer end.

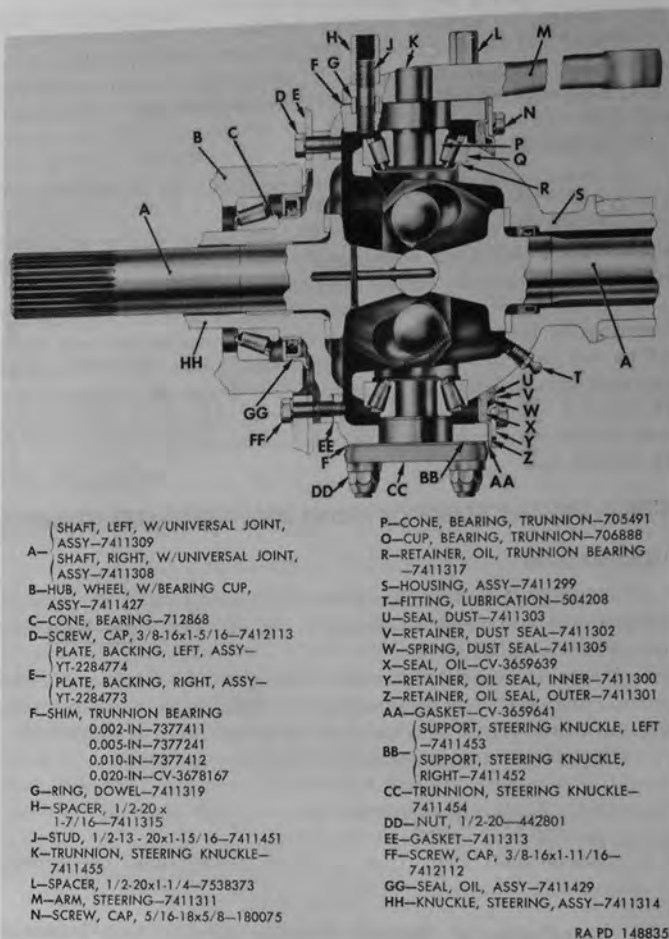


Figure 125. Sectional view of steering knuckle, support, and universal joint assembly.

b. Trunnion Bearing Lubrication.—Make sure that trunnion bearing cones ((C), fig. 121) are clean. Pack bearings with automotive and artillery grease (GAA) by hand pack method or with bearing lubricator until grease is forced between all rollers. Coat trunnion bearing cups with same lubricant.



Figure 126. Housing outer dust seal and spring installation.

c. *Steering Knuckle Support Installation.*—Install trunnion bearing cone ((C), fig. 121) in trunnion bearing cup ((B), fig. 121) at top of housing, being sure that cone is in its original location (unless new bearings are installed) as identified by tag at time of disassembly.

Note. Be sure that steering knuckle support with dowel rings (fig. 127) is installed at left (steering arm) end of housing.

Position steering knuckle support ((MM), fig. 109) over upper trunnion bearing cone, being sure that tie rod integral arm is toward rear. Position trunnion bearing cone ((T), fig. 121), steering knuckle trunnion ((HH), fig. 109), and shims ((M), fig. 109), removed at time of disassembly, at bottom of steering knuckle support and secure temporarily with four $\frac{1}{2}$ -20 nuts (fig. 128). At right side install steering knuckle trunnion ((L), fig. 121) or steering arm ((Q), fig. 109) at left side, using shims (fig. 128) removed at time of disassembly. Secure right upper trunnion with one $\frac{1}{2}$ -20 nut ((M), fig. 121) at outer front stud and three $1\frac{1}{4}$ -inch long spacers ((K), fig. 121) at other three studs. Secure steering arm ((Q), fig. 109) with $\frac{1}{2}$ -20 nut ((N), fig. 109) at front outer stud, one $\frac{1}{16}$ -inch long spacer ((P), fig. 109) at rear outer stud, and two $1\frac{1}{4}$ -inch long spacers at two inner studs.

d. *Trunnion Bearing Adjustment.*—Tighten spacers or nuts ((P) and (N), fig. 109) attaching steering knuckle trunnions or steering arm to steering knuckle support to torque of 70 to 80 pound-feet. Use torque wrench as illustrated in figure 129 and measure pound-

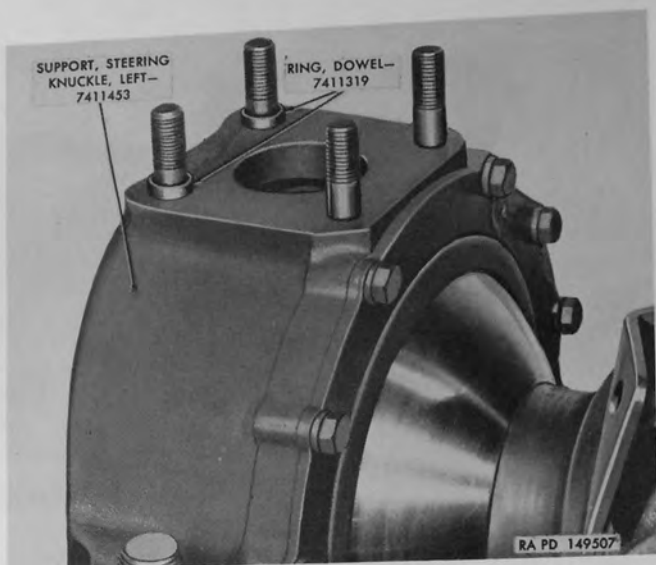


Figure 127. Location of dowel rings in left steering knuckle support.

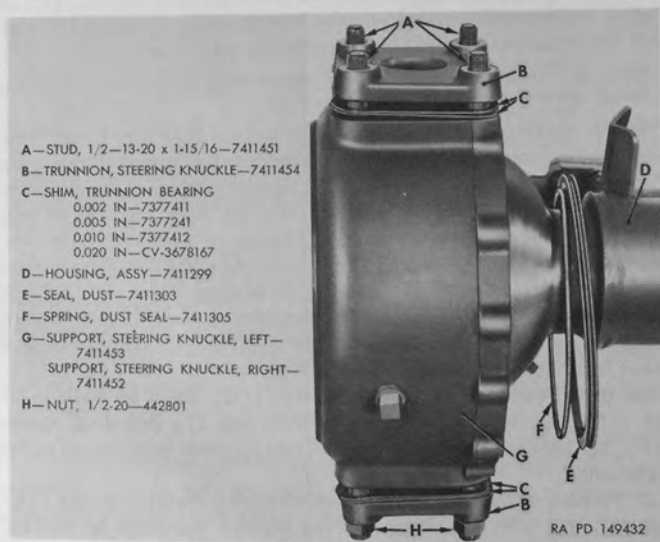


Figure 128. Steering knuckle support trunnions and bearing adjusting shims.

feet torque required to turn steering knuckle support. Torque wrench reading should be 8 to 12 pound-feet with steering knuckle support in motion. Add or remove trunnion bearing shims ((M), fig. 109) as necessary to obtain correct torque reading.

Caution: Be sure that the same total shim thickness is used at upper and lower trunnions. Shim pack should be measured with a micrometer. Adjust right and left trunnion bearings separately.



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Figure 129. Checking steering knuckle trunnion support bearing adjustment.

e. Housing Outer Seal Installation.

- (1) *Gasket installation.*—Apply light coating of plastic type gasket cement to both sides of gasket ((R), fig. 109); then position gasket on steering knuckle support.
- (2) *Oil seal retainer installation.*—Outer oil seal retainer ((S), fig. 109) is positioned over housing by spreading at split. Position retainer against steering knuckle support with split in retainer at top.
- (3) *Dust seal retainer installation.*—Inner dust seal retainer ((W), fig. 109) is positioned over housing by spreading at split.
- (4) *Lubricate parts.*—Apply film of automotive and artillery grease (GAA) to spherical surface of housing, oil seal, and dust seal to provide initial lubrication when unit is first placed in service, also as a preservative after installation.
- (5) *Oil seal installation.*—Position oil seal ((T), fig. 109) into outer oil seal retainer ((S), fig. 109) with split in seal at right angles to split in retainer.

- (6) *Dust seal and spring installation.*—Fit dust seal spring ((V), fig. 109) into groove in edge of dust seal ((U), fig. 109); then position seal and spring assembly against oil seal (felt), as dust seal retainer ((W), fig. 109) is positioned to retain seals. While holding dust seal retainer against seals, install two inner oil seal retainers ((X), fig. 109), with splits on a horizontal line, and secure with twelve $\frac{5}{16}$ -18 x $\frac{5}{8}$ cap screws and $\frac{5}{16}$ -inch lock washers. Cap screws should be drawn up only enough to hold parts in place until seals and retainers can be properly positioned; then make final tightening of cap screws.

187. Differential Carrier Installation

a. *Gasket Installation.*—Apply light coating of plastic type gasket cement to both sides of gasket ((J), fig. 121); then position gasket over studs and against housing.

b. *Carrier Assembly Installation.*—Position differential and carrier assembly on housing, being sure that drive pinion is above the center line of axle housing (fig. 105). Install ten $\frac{7}{16}$ -20 nuts on studs and tighten to torque of 45 to 55 pound-feet.

188. Housing Cover Installation

a. *Gasket Installation.*—Apply light coating of plastic type gasket cement to both sides of gasket ((J), fig. 121); then position gasket over studs and against housing.

b. *Cover Installation.*

Note. Covers used on front and rear axles are the same, however, they are installed differently; therefore, follow instructions carefully.

When installing cover on front axle, make certain that oil filler hole marked "FRONT OIL LEVEL" is upright (not upside down). Position cover over studs and install ten $\frac{7}{16}$ -20 nuts on studs and tighten to torque of 45 to 55 pound-feet.

189. Tie Rod Installation

a. *Tie Rod Adjustment.*—Measure distance between center line of tie rod end studs (par. 184c) to be sure dimension is $62\frac{1}{32}$ inches.

b. *Tie Rod Installation.*—Be sure seal is placed over tapered stud, then insert tie rod end studs into tapered holes of arms on steering knuckle support. Install nut on each tie rod end stud and tighten to torque of 175 to 200 pound-feet (fig. 130).

c. *Check Installation.*—Swing left steering knuckle support against steering knuckle stop plug. Measure clearance between tie rod and rib on differential carrier. Clearance must be at least one-eighth of an inch.

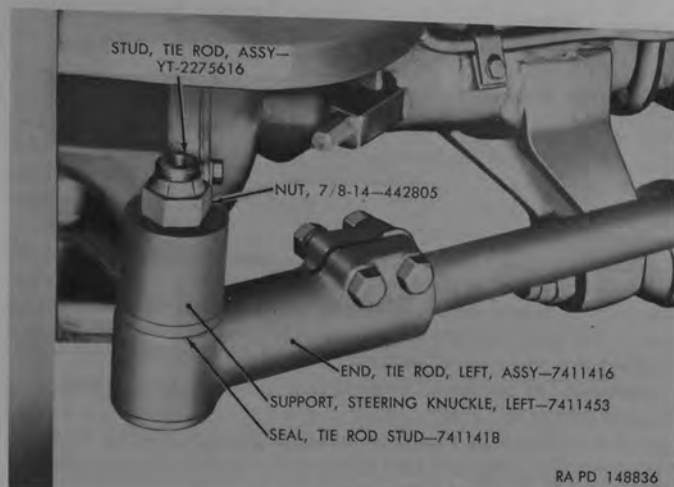


Figure 130. Steering tie rod—Rod installed.

190. Axle Shaft and Universal Joint Installation

a. Lubricate.—Using universal gear lubricant (GO), apply to oil seal and thrust washer in end of axle housing, also apply generously to universal joint balls.

b. Assembly Installation.

Note. Right and left assemblies have different length inner shafts; long shaft is used at left side while shorter shaft is used at right side.

Insert inner shaft of assembly carefully through oil seal at outer end of housing so as not to damage seal, guiding splined end of inner shaft into differential side gear splines until thrust face of inner shaft is against thrust washer at outer end of housing (fig. 111).

191. Steering Knuckle Installation

a. Lubricate.—Using universal gear lubricant (GO), apply generously to thrust washer at flange end, also to bushing type bearing inside knuckle.

b. Gasket Installation.—Apply light coating of plastic type gasket cement to both sides of gasket ((K), fig. 109); then position gasket against outer surface of steering knuckle support, being careful to align gasket with cap screw holes.

c. Knuckle Installation.—Position steering knuckle ((F), fig. 109) over outer shaft ((EE), fig. 109); then rotate as necessary to position lip in brake oil shield ((E), fig. 109) downward to drain any lubricant

leakage. When oil shield lip is down and cap screw holes are in alignment, push steering knuckle against steering knuckle support.

192. Final Assembly Operations

a. Brake Assembly Installation.—Install brake backing plate and shoe assembly, also brake hose and shield as directed in paragraph 234.

b. Wheel Hub, Drum, and Bearings Installation.—Install wheel hub, drum, and bearings as directed in paragraph 256*e*, also adjust bearings as directed in paragraph 256*f*.

c. Leakage Test.—Install a suitable air pressure gage in axle vent line hole in torque rod bracket on top of axle housing. Using a suitable adapter, attach air line to one of filler plug holes in axle housing cover. Fill axle with air to a pressure of 15 p.s.i. Air must not escape faster than 5 pounds in 45 seconds.

Caution: Do not apply more than 15 pounds air pressure. Remove air line and gage.

d. Lubrication.—Lubricate universal joint and steering knuckle, also axle differential, with type and quantity of lubricant specified in TM 9-819A or on official lubrication order.

CHAPTER 8

REAR AXLE

Section I. DESCRIPTION AND DATA

193. Description and Operation

a. General.—Both rear axles (fig. 131) are hypoid, single-reduction, full-floating type equipped with banjo type housing. Differential and carrier is mounted as an assembly in housing. Forward rear axle and rear rear axle are mounted in tandem with upper and lower torque rods connecting each axle to vehicle frame. The two rear axles are similar in design and construction, the major difference between the two is that the opening for the differential carrier in the forward rear axle is off-center. Forward rear axle housing also supports the propeller shaft pillow block assembly which transmits drive to rear rear axle.

b. Operation.—Power is transmitted from the transfer by two propeller shafts, one to each of the rear axles. Forward rear axle is driven direct from transfer by a single shaft, while drive to rear rear axle is through two propeller shafts and a pillow block mounted on a bracket attached to forward rear axle housing. Driving force is transmitted from axles to vehicle frame by six torque rods. Three torque rods are attached to each axle and take all the driving and braking load at rear axles.

194. Data

Manufacturer.....	GM Corporation
Type.....	hypoid, single-reduction
Ratio.....	6.17 to 1

Section II. DISASSEMBLY OF REAR AXLE INTO SUBASSEMBLIES

195. General

a. The following procedures are based on the assumption that the axle assembly has been removed from the vehicle in accordance with instructions contained in TM 9-819A. Some of the following opera-

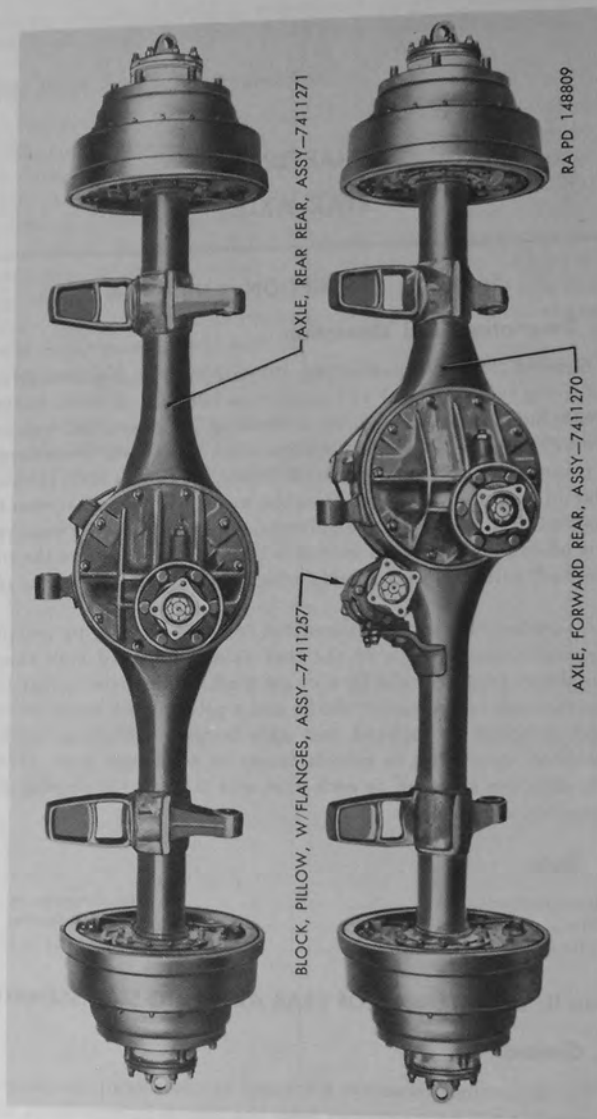


Figure 131. General view of rear axles.

tions can be performed with the axle assembly installed on the vehicle, however, for maximum accessibility and efficiency, the axle should be removed from the vehicle and placed on a suitable work stand.

b. Before cleaning or disassembling the axle, make a careful visual inspection for evidence of lubricant leakage which might otherwise not be visible after the assembly or parts have been cleaned. Make a note of any such points, so that the cause may be determined either during disassembly or at time of inspection after disassembly. Thoroughly clean the assembly, using steam or other suitable method, to remove all accumulated dirt or other foreign material.

196. Disassembly Operations

a. *Drain Lubricant.*—Place suitable receptacle under axle, then remove plug and gasket from axle housing to permit lubricant to drain.

b. *Removal of Wheel Hubs, Drums, and Bearings.*—Remove wheel hubs, brake drums, and bearings as directed in paragraph 256.

c. *Removal of Brake Assembly.*—Remove brake backing plate and shoe assembly as directed in paragraph 229.

d. *Removal of Housing Cover.*—Remove ten $\frac{7}{16}$ -20 nuts ((G), fig. 148) attaching cover ((H), fig. 148) to housing. Tap cover lightly with soft hammer to loosen, then remove from $\frac{7}{16}$ -20 x 2 studs ((K), fig. 148) in housing. Remove and discard gasket ((J), fig. 148).

e. *Removal of Differential and Carrier Assembly.*—Remove ten $\frac{7}{16}$ -20 nuts ((AA), fig. 132) attaching carrier assembly ((Z), fig. 132) to housing. Tap carrier with soft hammer to loosen carrier assembly from housing, then withdraw differential and carrier assembly from housing. Remove and discard gasket ((Y), fig. 132) used between carrier and housing.

f. *Removal of Brake Line Assemblies.*—Remove two cap screws, lock washers, and clips attaching each line to axle housing. Loosen brake line fitting nut attaching each line to elbow in junction block located on top of axle housing, then remove right and left brake line assemblies.

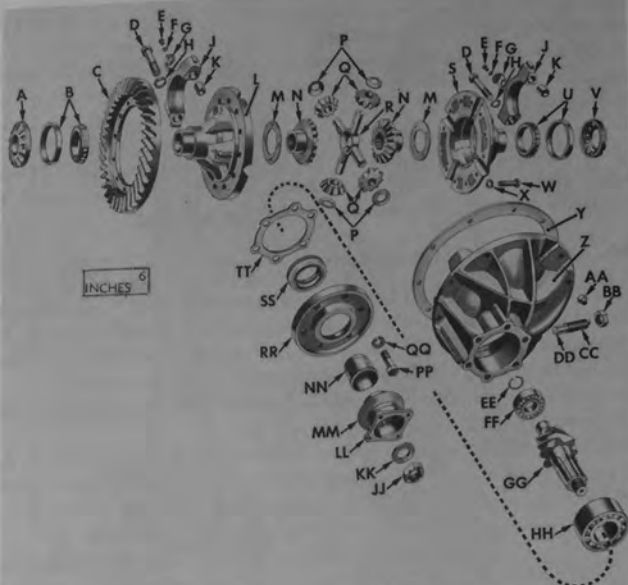
Section III. REBUILD OF DIFFERENTIAL AND CARRIER ASSEMBLY

197. General

The following procedures cover disassembly, cleaning, inspection, and repair of differential and carrier assembly, after unit has been removed from axle housing as directed in paragraph 196.

198. Disassembly

Note. Key letters noted in parentheses are in figure 132 unless otherwise indicated.



A—NUT, ADJUSTING, BEARING—7411214
 B—BEARING, ASSY—707695
 C—GEAR, DRIVE—CV-3652522
 D—SCREW, CAP, 11/16-11x3-5/8—
 CV-3652254
 E—SCREW, CAP, 5/16-18x5/8—180075
 F—WASHER, LOCK, 5/16-IN—120638
 G—LOCK, BEARING ADJUSTING NUT—
 7411212
 H—WASHER, LOCK, 11/16-IN—131141
 J—CAP, BEARING—CV-3652275
 K—DOWEL, CAP—7411225
 L—CASE—CV-3661872
 M—WASHER, THRUST (SIDE GEAR)—
 7411222
 N—GEAR, SIDE—7411209
 P—WASHER, THRUST (SPIDER PINION)—
 7411221
 Q—PINION, SPIDER—7411217
 R—SPIDER—7411223
 S—COVER, CASE—CV-3661873
 T—CAP, BEARING—CV-3652275
 U—BEARING, ASSY—707695
 V—NUT, ADJUSTING, BEARING—7411214
 W—SCREW, CAP, 1/2-20x1-1/8—7411211
 X—WASHER, LOCK, 1/2-IN—131101
 Y—GASKET—7411207

Z—CARRIER, ASSY, (W/BOLT, CAP,
 DOWEL, AND WASHER)—CV-605925
 AA—NUT, 7/16-20—442800
 BB—NUT, 7/8-14—124954
 CC—SCREW (THRUST PAD), 7/8-14x3-3/4—
 6196340
 DD—PAD, THRUST—7411216
 EE—LOCK, PINION INNER BEARING—
 7411213
 FF—BEARING (DRIVE PINION INNER)—
 707652
 GG—PINION, DRIVE—CV-3652549
 HH—BEARING (DRIVE PINION OUTER)—
 710143
 JJ—NUT (DRIVE PINION) 1-1/8-18—
 7411215
 KK—WASHER, PLAIN, 1-5/32 IDx2-1/16
 OD—7411224
 LL—FLANGE, W/DEFLECTOR, AND SLEEVE,
 ASSY—7411206
 MM—DEFLECTOR, FLANGE—7377182
 NN—SLEEVE, FLANGE—7411220
 PP—SCREW, CAP, 5/8-11x1-3/4—7411219
 QQ—WASHER, LOCK, 5/8-IN—131140
 RR—RETAINER, PINION OIL SEAL—
 7413230
 SS—SEAL, OIL, PINION—7413229
 TT—GASKET—7411208

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Figure 132. Components of differential and carrier assembly.

a. Mount Carrier Assembly. Mount assembly in a suitable work stand to facilitate disassembly operations.

b. Removal of Differential Assembly.

- (1) *Removal of thrust pad and screw.*—Loosen $\frac{7}{8}$ -14 nut (BB) which locks $\frac{7}{8}$ -14 x $3\frac{3}{4}$ screw (CC) in differential carrier; then remove $\frac{7}{8}$ -14 x $3\frac{3}{4}$ screw (CC) and thrust pad (DD) from carrier.
- (2) *Removal of bearing adjusting nut.*—Remove $\frac{5}{16}$ -18 x $\frac{5}{8}$ cap screws (E), $\frac{5}{16}$ -inch lock washers (F), and bearing adjusting nut locks (G). Loosen $\frac{11}{16}$ -11 x $3\frac{5}{8}$ cap screws (D) several turns to free adjusting nuts. Use spanner wrench 41-W-3247-500 in manner illustrated in figure 144 to remove adjusting nuts.
- (3) *Removal of bearing caps.*

Note. Use prick punch to mark each bearing cap (J) and carrier assembly (Z) so that caps can be installed in their original location.

Remove four $\frac{11}{16}$ -11 x $3\frac{5}{8}$ cap screws (D) and $\frac{11}{16}$ -inch lock washers (H) attaching bearing caps (J) to carrier. Tap bearing caps with soft hammer sufficiently to loosen and remove.

- (4) *Removal of differential assembly.*—Carefully withdraw differential assembly from carrier and lay aside for further disassembly. Remove differential side bearing cups and tag for location identification at time of assembly.

c. Disassembly of Differential Assembly.

- (1) *Removal of drive gear.*—Determine that a match mark (fig. 133) is clearly visible on case and case cover. If mark is not clearly legible, make a new mark. Stand assembly on end to prevent damage to differential side bearings. Loosen and remove twelve $\frac{1}{2}$ -20 x $1\frac{1}{8}$ cap screws (W) and $\frac{1}{2}$ -inch lock washers (X) attaching drive gear (C) to case (L); then remove drive gear.
- (2) *Separate Differential Case and Cover.*—Tap lightly with soft hammer to separate case cover (S) from case (L); then remove side gears (N), thrust washers (M) and (P), spider pinions (Q), and spider (R).
- (3) *Removal of differential side bearings.*

Note. If inspection (par. 200d) indicates that bearings are satisfactory for further service, they need not be removed.

With case or cover resting on bench, install adapter 41-A-18-293 and remover 41-R-2367-950 in manner illustrated in figure 134, being sure that remover is adjusted to inner race to prevent damage to bearing cage and rollers.

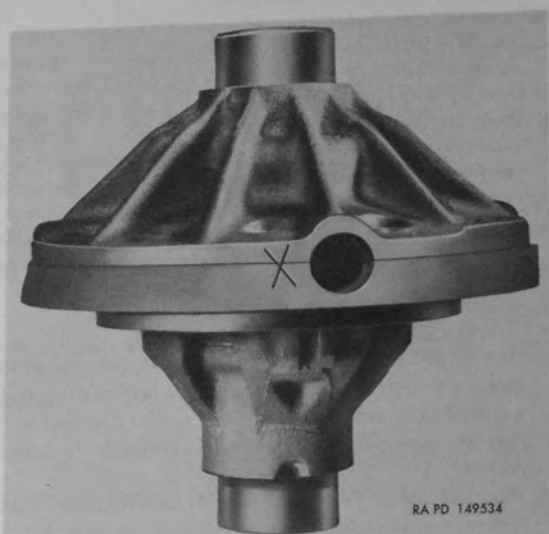


Figure 133. Differential case and cover match marks.

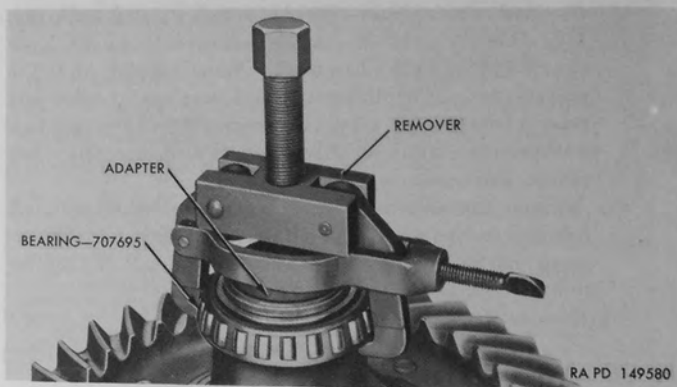


Figure 134. Use of differential side bearing remover 41-R-2367-950 and adapter 41-A-18-293.

d. Removal of Drive Pinion Assembly.

- (1) *Removal of propeller shaft flange.*—Use tool 41-T-3215-910 to prevent flange with deflector and sleeve assembly (LL) from turning while nut (JJ) is removed, also remove plain washer (KK). Install remover 41-R-2367-950 in manner illustrated in figure 135; then thread screw into puller until flange is removed.

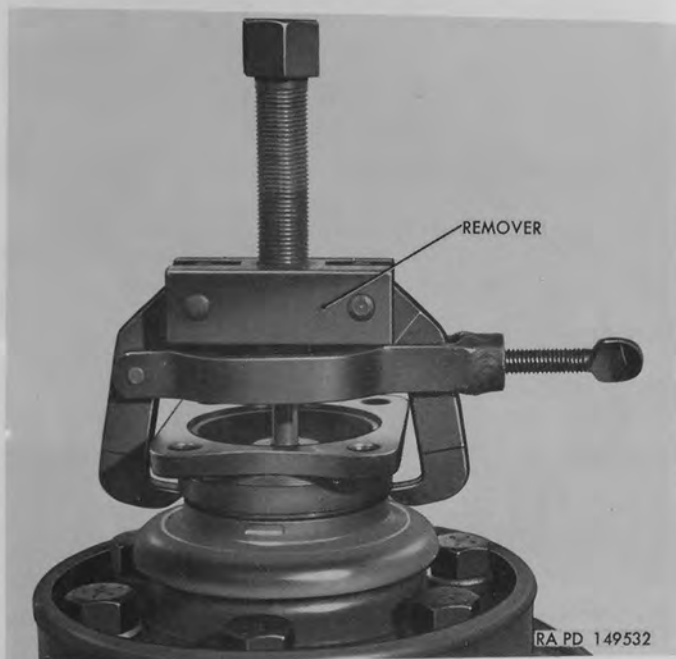


Figure 135. Removal of propeller shaft flange with remover 41-R-2367-950.

- (2) *Removal of pinion oil seal retainer.*—Remove six $\frac{5}{8}$ -11 x $1\frac{3}{4}$ cap screws (PP) and $\frac{5}{8}$ -inch lock washers (QQ) attaching pinion oil seal retainer (RR) to carrier; then tap retainer with soft hammer to remove. Remove and discard gasket (TT).
- (3) *Removal of pinion assembly from carrier.*—Place brass rod against inner end of drive pinion (GG), then drive drive pinion and bearings assembly from carrier assembly (Z).

e. Disassembly of Drive Pinion.

Note. Following procedures need not be accomplished until inspection of bearings (par. 200c) indicate the need for replacement.

- (1) *Removal of pinion inner bearing.*—Use suitable snap ring pliers in manner illustrated in figure 136 to remove pinion inner bearing lock (EE). Install attachment 41-A-345-328 (part of puller 41-P-2905-60) onto drive pinion; then place in arbor press to press pinion out of bearing (fig. 137).

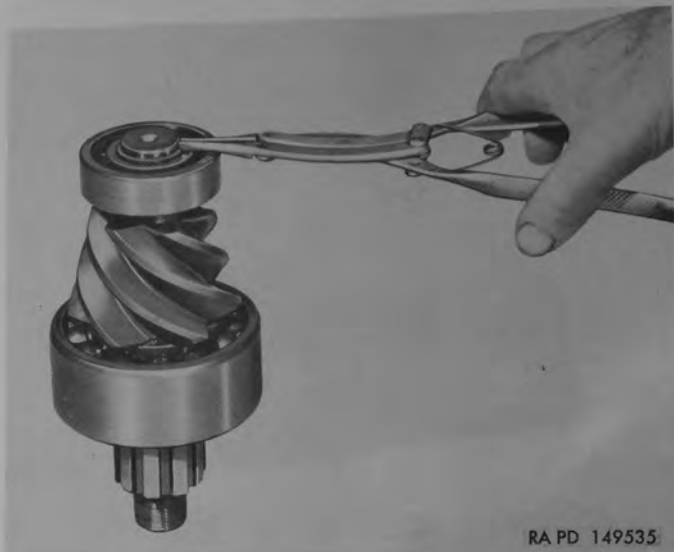


Figure 136. Removal or installation of pinion inner bearing lock with snap ring pliers.

- (2) *Removal of pinion outer bearing.*—Install attachment 41-A-345-328 (part of puller 41-P-2905-60) onto drive pinion, then place in arbor press to press drive pinion (GG) out of bearing (fig. 138).

199. Cleaning

a. General.—Immerse all parts in dry-cleaning solvent or volatile mineral spirits to loosen and remove all grease or other deposits. Remove each part and examine carefully for cleanliness; use bristle brush if necessary to remove deposits. Remove sealing compound and pieces of gaskets from gasket surfaces.

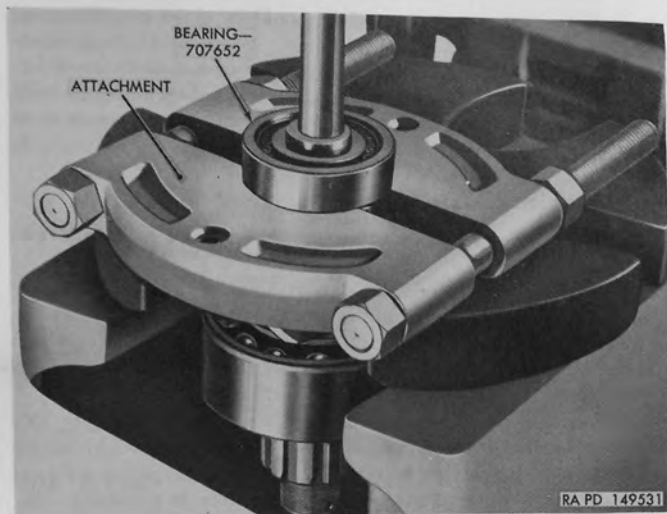


Figure 137. Removal of drive pinion inner bearing with attachment 41-A-345-328 (part of puller set 41-P-2905-60).

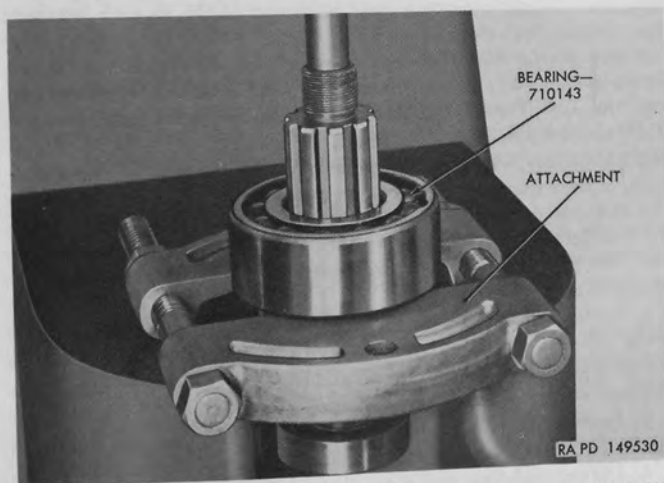


Figure 138. Removal of drive pinion outer bearing with attachment 41-A-345-328 (part of puller set 41-P-2905-60).

b. Bearings.—Particular attention should be given to differential side bearings, also drive pinion bearings. Slush bearings in cleaning fluid and use bristle brush to remove all traces of dirt; repeat immersion and brushing until bearings are clean. Dry bearings with compressed air, directing air through bearing in such a manner so as not to spin bearings.

200. Inspection

Note. Key letters noted in parentheses are in figure 132 unless otherwise indicated.

a. General.—Before inspection, all parts must have been thoroughly cleaned as previously directed in paragraph 199. Whenever available, the magnaflux method should be applied to all steel parts, except ball or roller bearings. Refer to paragraph 347 for new part dimensions or other necessary inspection data.

b. Differential Carrier.—Carefully inspect carrier assembly (Z) for cracks, breaks, or distortion, or other damage that would render the carrier unfit for further service. Inspect for damaged or stripped threads, and repair or replace carrier, whichever is necessary. Inspect gasket surfaces for smoothness and clean up with fine file or stone if necessary.

c. Drive Pinion Bearings.—Rotate each bearing slowly and carefully by hand and note if any roughness is evident, also visually inspect balls and rollers for chipped, cracked, or pitted condition. Replace if defective. Apply universal gear lubricant (GO) to each bearing; then wrap in clean cloth or paper.

d. Differential Side Bearings.—Inspect bearing assemblies (B and U) for evidence of chipped, cracked, or worn condition of rollers and cup. Replace if defective, otherwise apply universal gear lubricant (GO) and wrap in clean cloth or paper.

e. Side Gears.—Inspect side gears (N) for chipped or worn gear teeth. Check diameter of pilot on gear at point of contact with case (L) and case cover (S) to determine if worn. Install gears on axle shaft to determine if worn at splines. Check thrust washer face of gear for scratched, scuffed, or worn condition. Replace worn or damaged gears.

f. Spider Pinion.—Inspect spider pinion (Q) for chipped or worn teeth. Install pinion on spider (R) to determine if worn. Check thrust washer face of gear for scratched, scuffed, or worn condition. Replace worn or damaged gears.

g. Spider.—Inspect spider (R) for cracks or wear by installing spider pinion (Q) on each spider arm. Replace if worn or damaged.

h. Differential Case and Case Cover.—Inspect case (L) and case cover (S) for cracked or broken condition. Inspect thrust washer

surfaces for worn or scored condition. Replace both parts if either is damaged.

i. *Drive Gear and Drive Pinion.*—Inspect drive gear (C) and drive pinion (GG) for chipped, broken, or scuffed teeth. Inspect cap screw threads in drive gear. Inspect splines and threads on drive pinion. Replace both parts if either is damaged.

j. *Pinion Oil Seal.*—Inspect pinion oil seal for wear or cuts on lip of seal. If wear or damage is evident, replace seal as directed in paragraph 201a.

k. *Propeller Shaft Flange.*—Inspect flange with deflector and sleeve assembly (LL) for damage or wear at splines. Replace if worn or damaged. Inspect flange sleeve (NN) for scratched, worn, or grooved condition and replace as directed in paragraph 201b. Inspect for damaged flange deflector (MM) and replace as directed in paragraph 201c.

l. *Thrust Pad.*—Inspect thrust pad (DD) for wear and replace if necessary.

201. REPAIR

Note. Key letters noted in parentheses are in figure 132 unless otherwise indicated.

a. *Pinion Oil Seal*

- (1) *Removal.*—Use suitable drift or rod and hammer to drive pinion oil seal (SS) from retainer. Clean seal contact surface in retainer to remove any accumulated sealing compound or other matter.
- (2) *Installation.*—Place retainer on flat surface with outer side down. Coat outer surface of seal with a light film of plastic type gasket cement. Position seal in retainer with lip of seal up. Use pinion shaft oil seal replacer 41-R-2393-175 in manner illustrated in figure 139 to drive and properly locate seal in retainer.

b. *Propeller Shaft Flange Sleeve.*

- (1) *Removal.*—Use ball peen hammer and tap entire circumference of outer surface of flange sleeve (NN). Peening of this surface will cause metal in sleeve to stretch until sleeve can be removed from flange.
- (2) *Installation.*—Position flange sleeve (NN) over flange; then use oil seal sleeve replacer 41-R-2395-515 in manner illustrated in figure 140 to install and properly locate flange sleeve.

c. *Deflector Replacement.*

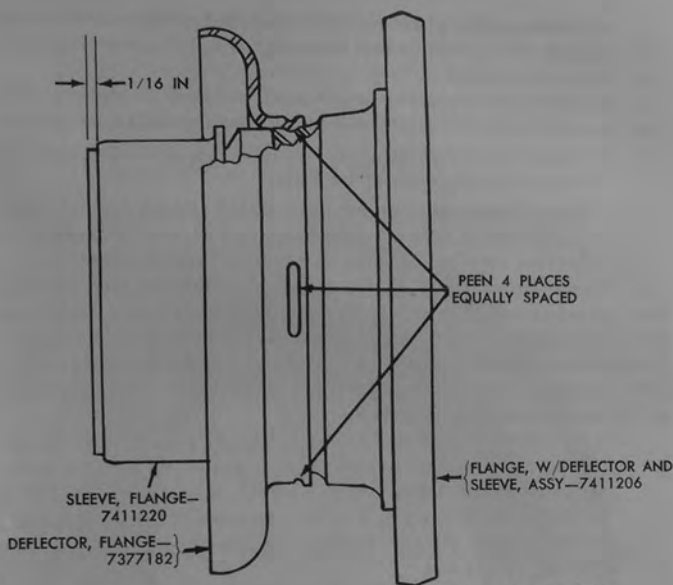
- (1) *Removal.*—Press or drive flange deflector (MM) from flange.
- (2) *Installation.*—Press flange deflector (MM) onto flange to dimension given in figure 141. Stake deflector into groove in



Figure 139. Drive pinion oil seal installation using replacer 41-R-2393-175.



Figure 140. Flange sleeve installation with replacer 41-R-2395-515.



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Figure 141. Flange sleeve and deflector installation.

flange at four equally spaced points. Each stake should be approximately one-half of an inch in length (fig. 141).

202. Assembly

Note. Key letters noted in parentheses are in figure 132 unless otherwise indicated.

a. General.—During assembly operations each part must be thoroughly lubricated with universal gear lubricant (GO).

b. Mount Carrier.—Mount carrier assembly (Z) in suitable work stand to facilitate assembly operations.

c. Assembly of Drive Pinion.—If inspection indicated that drive pinion (GG) is to be replaced, it will also be necessary to install a new drive gear (C), as these parts are serviced in matched sets.

- (1) *Installation of pinion inner bearing.*—Position drive pinion (GG) in arbor press and locate bearing (FF) on pinion; then press bearing onto pinion until inner race is seated against shoulder on pinion.

Note. Do not apply pressure to bearing outer race as this would damage bearing rollers.

Use snap ring pliers (fig. 136) to spread pinion inner bearing lock (EE); then install lock in groove, being sure that lock is fully seated.

- (2) *Installation of pinion outer bearing.*—Position drive pinion (GG) in arbor press and locate bearing (HH) on pinion.

Note. Inner race extends beyond outer race on one side only and this side must be toward pinion teeth.

Press bearing onto pinion until seated against heel of teeth, being careful that pressure is applied at inner race only as bearing may be damaged by pressing on outer race.

d. Installation of Drive Pinion Assembly.—Be sure that bearing bore in carrier assembly (Z) is thoroughly cleaned before installing pinion assembly. Insert pinion assembly into carrier, being careful to align bearing with carrier bore. Use suitable driver or soft hammer at outer race to drive assembly into carrier until bearing is fully seated against shoulder in carrier.

- (1) *Installation of oil seal retainer.*—Apply light film of plastic type gasket cement to both sides of gasket (TT); then position gasket to carrier. Install pinion oil seal retainer (RR); then secure with six $\frac{5}{8}$ -11 x $1\frac{3}{4}$ cap screws (PP) and $\frac{5}{8}$ -inch lock washers (QQ). Tighten cap screws to a torque of 160 to 180 pound-feet.

- (2) *Installation of propeller shaft flange.*—Be sure that oil seal and flange sleeve are lubricated to facilitate assembly. Install flange with deflector and sleeve assembly (LL) over pinion splines: $1\frac{5}{32}$ ID x $2\frac{1}{16}$ OD plain washer (KK) and $1\frac{1}{8}$ -18 drive pinion nut (JJ). Use flange holding tool 41-T-3215-910 to prevent flange turning while tightening nut to a torque of 160 to 280 pound-feet. Align slot in nut with hole in pinion; then install and bend cotter pin.

e. Assembly of Differential.

- (1) *Installation of spider pinion and side gears.*—Clean inside of case and case cover thoroughly and lubricate all parts. Install new thrust washer (M) in case cover with side having oil grooves toward case cover; then install side gear (N) in case cover. Install spider pinion (Q) and new thrust washer (P) over each arm of spider (R); then install spider and pinion assembly over side gear previously installed. Install remaining side gear (N) and new thrust washer (M) over spider. Position case (L) over previously assembled parts, being sure that match marks are in alignment (fig. 133).
- (2) *Installation of drive gear.*—Cut heads off two old $\frac{1}{2}$ -20 x $1\frac{1}{8}$ cap screws; then taper the shank of screws slightly and cut slot in end of screw with hack saw. Install two screws in drive gear to serve as guide pins (fig. 142) and facilitate

alinement of drive gear with case. Position drive gear (C) over case (L), using guide pins to properly aline gear, case, and case cover. Install ten $\frac{1}{2}$ -20 x $1\frac{1}{8}$ cap screws (W) and $\frac{1}{2}$ -inch lock washers (X); then remove two guide pins and install two remaining $\frac{1}{2}$ -20x $1\frac{1}{8}$ cap screws and $\frac{1}{2}$ -inch lock washers. Tighten 12 cap screws evenly and alternately to a torque of 85 to 95 pound-feet.

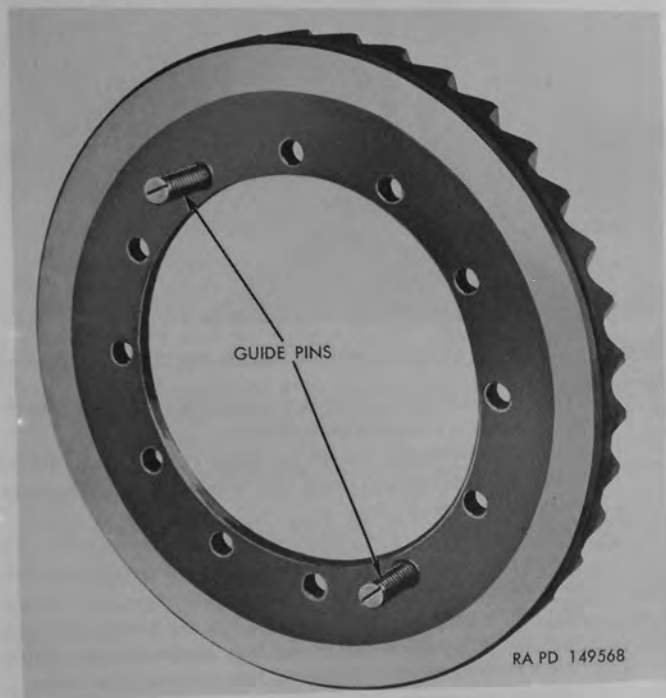


Figure 142. Use of guide pins in drive gear.

- (3) *Installation of differential side bearings.*—Install cone of bearing assemblies (B) and (U) in case and case cover, using replacer 41-R-2381-220 in manner illustrated in figure 143. Bearing must seat solidly against shoulder of case and case cover.

f. Installation of Differential Assembly.

- (1) *Position carrier.*—Rotate carrier in holding fixture so that bearing caps are on top. Observe that cap dowels (K) are

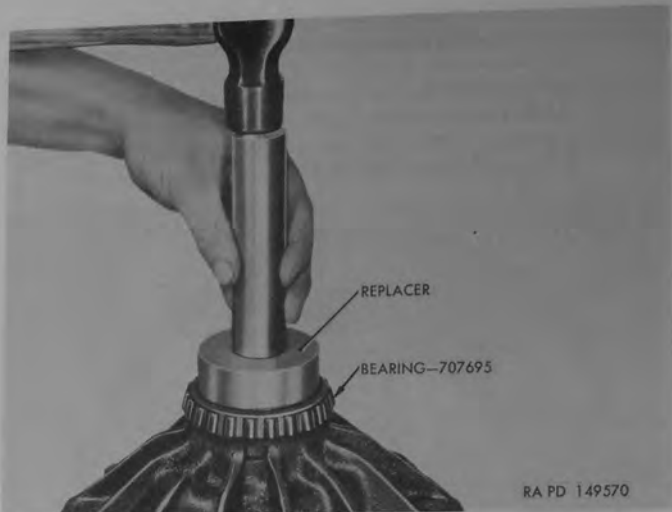


Figure 143. Installing differential side bearing with replacer 41-R-2381-220.

- in cap or carrier and cap is properly identified by punch marks made at time of disassembly.
- (2) *Position differential assembly.*—Place cup on each differential side bearing cone; then carefully position differential assembly in carrier.
 - (3) *Installation of bearing caps.*—Select proper bearing cap (J) according to identification marks made at time of disassembly and install in proper position, being sure that cap dowels (K) are in place. Install $\frac{11}{16}$ -11 x $3\frac{5}{8}$ cap screws (D) and $\frac{11}{16}$ -inch lock washers (H). Tighten cap screws only until lock washers just start to flatten, being certain that bearing cups are not cocked.
 - (4) *Installation of bearing adjusting nuts.*—Use extreme care when starting bearing adjusting nuts (A) and (V) to be sure that they are not cross-threaded. When certain that nuts are properly started, tighten $\frac{11}{16}$ -11 x $3\frac{5}{8}$ cap screws (D) until bearing adjusting nuts (A) and (V) can just be turned. Use adjustable spanner wrench 41-W-3247-500 in manner illustrated in figure 144 and thread each nut into carrier alternately and equally until tight. During tightening, rotate differential to be sure that bearings are seating.

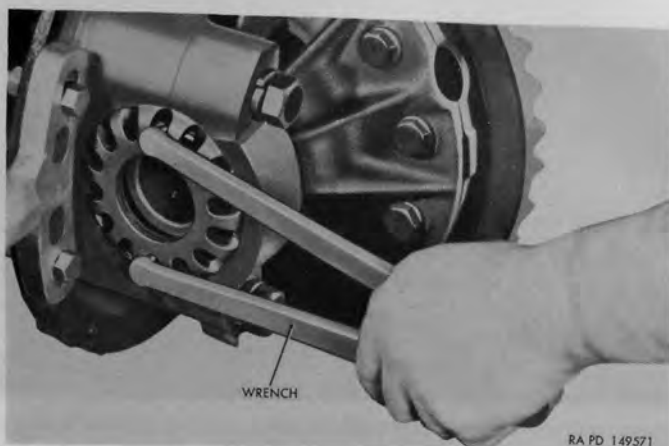


Figure 144. Adjusting drive gear and pinion with spanner wrench
41-W-3247-500.

g. Adjustment of Drive Gear and Drive Pinion Backlash.

- (1) *Removal of backlash.*—Back off bearing adjusting nut (A) on tooth side of drive gear, then tighten bearing adjusting nut (V) until all backlash between drive gear and drive pinion is removed.

Note. Make each change in small steps and revolve differential each step.

- (2) *Seating bearings.*—Back off bearing adjusting nut (V) on plain side of bevel gear approximately two notches, stopping nut in position to permit bearing adjusting nut lock (G) to engage nut. Tighten bearing adjusting nut (A), on tooth side of drive gear, to seat bearings. Back off same nut until free of bearing; then tighten enough to eliminate all end play in bearings.
- (3) *Preload bearings.*—When bearing adjusting nut (A), on tooth side of drive gear, has been tightened to remove all play in bearings (2) above, tighten an additional one or two more notches to preload bearings, stopping at a position where bearing adjusting nut lock can be installed.
- (4) *Checking backlash.*—Install a dial indicator in manner illustrated in figure 145. Oscillate drive gear slightly and note dial indicator reading. Backlash should be 0.005 to 0.008 inch.
- (5) *Adjusting backlash.*—If backlash is less than 0.005 inch, loosen bearing adjusting nut (V) on plain side of bevel gear



Figure 145. Checking drive gear and drive pinion backlash with dial indicator 41-I-100.

one notch; then tighten opposite bearing adjusting nut (A) one notch to maintain preload adjustment. Revolve differential assembly a number of times to assure bearing alignment, then take another backlash reading at dial indicator. If backlash is more than 0.008 inch, loosen bearing adjusting nut (A) on tooth side of drive gear one notch, then tighten opposite bearing adjusting nut (V) one notch to maintain preload adjustment. Revolve differential assembly a number of times to assure bearing alignment; then take another backlash reading at dial indicator.

- (6) *Final bearing cap tightening.*—Tighten two $\frac{11}{16}$ -11 x $3\frac{5}{8}$ cap screws (D) at each bearing cap to a torque of 130 to 160 pound-feet.
- (7) *Checking drive gear runout.*—Install a dial indicator 41-I-100 in manner illustrated in figure 146. Rotate differential assembly slowly and note total runout. Drive gear runout limit is 0.004 inch.
- (8) *Installation of adjusting nut locks.*—Install one bearing adjusting nut lock (G) at each bearing cap, being sure that ears on lock engage bearing adjusting nut. Secure lock with $\frac{5}{16}$ -18 x $\frac{5}{8}$ cap screw (E) and $\frac{5}{16}$ -inch lock washer (F) and tighten cap screw.
- (9) *Installation of thrust pad and screw.*—Install new thrust pad (DD) on thrust pad screw (CC) and thread screw into carrier until thrust pad just contacts drive gear. Rotate differential slowly and note any variations in contact of thrust pad against drive gear. Adjust thrust pad at point of maxi-

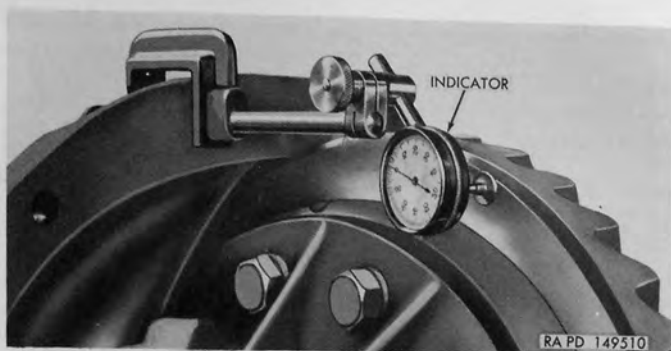


Figure 146. Checking drive gear runout with dial indicator 41-1-100.



Figure 147. Thrust pad screw adjustment.

imum contact. Back-off thrust pad screw one-twelfth of a turn and tighten nut (fig. 147).

Section IV. CLEANING AND INSPECTION OF REAR AXLE HOUSING AND AXLE SHAFTS

203. Cleaning

Note. Key letters noted in parentheses are in figure 148 unless otherwise indicated.

a. General.—Immerse all parts in dry-cleaning solvent or volatile mineral spirits to loosen and remove all accumulated grease, dirt, or

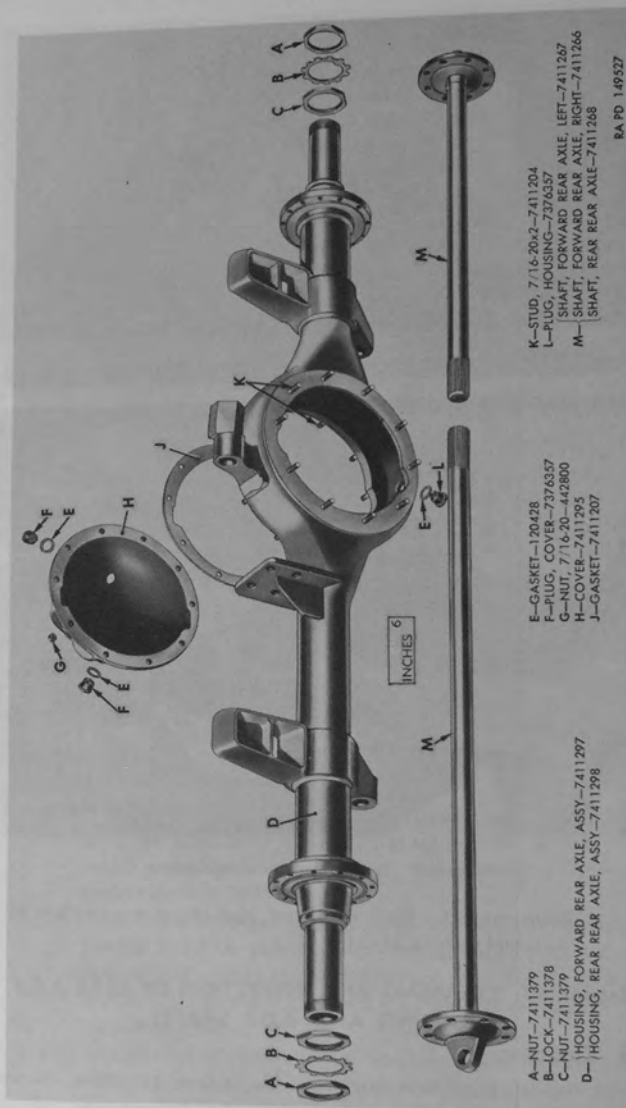


Figure 148. Rear axle housing and associated parts.

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other deposits. Use of bristle brush and repeated use of cleaning solvent should remove all deposits.

b. Housing.—Clean rear axle housing inside and out using long-handled brush or swab to remove dirt and grease from inside of housing. Be sure that all particles of gasket and sealing compound are removed and that bolting surfaces are clean.

c. Housing Cover.—Clean inside and outside of cover (H) to remove all dirt and grease. Be sure that all particles of gasket and sealing compound are removed and that bolting surface is clean.

d. Magnetic Plugs.—Clean housing plug (L) and cover plugs (F) to remove all particles of metal adhering to plug magnet.

e. Brake Line Assemblies.—Clean inside of brake lines of any deposits, using compressed air to remove all obstructions.

f. Axle Shafts.—Clean axle shafts of all accumulated grease and dirt. Be sure splines are cleaned thoroughly. Remove all gasket particles from inside of flange.

204. Inspection

Note. Key letters noted in parentheses are in figure 148 unless otherwise indicated.

a. General.—Before inspecting, all parts must have been cleaned as directed in paragraph 203.

b. Housing.—Housing assembly should be carefully inspected visually or use locally available checking equipment to determine if bent, twisted, or otherwise damaged. Replace or repair, whichever is the more practical, depending upon the nature of the defect and availability of adequate straightening equipment. Inspect machined gasket surfaces to be sure they are smooth and that gasket will form a tight seal. Inspect adjusting nut threads at each end of housing, and if necessary, clean up with thread restoring tool. Inspect cover and carrier studs (K) to be sure they are tight and threads are not stripped. Replace damaged studs. Inspect all parts welded to housing to be sure they are not damaged, cracked, or bent, also that welding is not broken.

c. Housing Cover.—Carefully inspect cover (H) for evidence of distortion or cracks. Gasket surface should be smooth and free of imperfections that would prevent good gasket seal. Inspect cover plug threads for damage or stripping. Install new cover if damaged.

d. Adjusting Nuts and Locks.—Inspect nuts (A) and (C) for damaged or stripped threads and replace if necessary. Inspect locks (B) for broken locking tabs and replace if necessary.

e. Axle Shafts.—Inspect axle shafts for twisted, worn, or damaged splines. Inspect tapered dowel wedge holes in flange of axle shaft for evidence of excessive wear by fitting new dowel wedge in each hole. Dowel should protrude, otherwise wear is indicated at tapered

hole. Shaft flange and splines must be square with each other within 0.003-inch total dial indicator reading.

f. Brake Lines.—Inspect brake line tubing for bends, cracks, or other defects. Inspect tubing nuts for stripped threads. Replace line assembly if defective.

Section V. ASSEMBLY OF REAR AXLE FROM SUBASSEMBLIES

205. General

a. Assembly procedures are arranged in logical sequence. All sub-assemblies should be rebuilt, repaired, and adjusted before beginning operations described in text following.

b. Cleanliness is important in handling axle components. All parts should be protected from dirt during assembly operations. Tools and equipment must be clean to prevent contaminating parts during assembly procedures.

c. Gaskets, seals, and lock washers must be replaced with new parts wherever required.

206. Installation of Differential Carrier Assembly

a. Installation of gasket.—Apply light coating of plastic type gasket cement to both sides of gasket ((J), fig. 148); then position gasket over studs and against housing.

b. Installation of carrier assembly.—Position differential carrier assembly over studs and tightly against housing. Install ten $\frac{7}{16}$ -20 nuts ((AA), fig. 132) on studs and tighten to 45 to 55 pound-feet.

207. Installation of Housing Cover

a. Installation of gasket.—Apply light coating of plastic type gasket cement to both sides of gasket ((J), fig. 148); then position gasket over studs and against housing.

b. Installation of Cover.

Note. Covers used on front and rear axles are the same; however, they are installed differently; therefore, follow instructions carefully.

When installing cover ((H), fig. 148) on rear axle, make certain that oil filler hole marked "REAR OIL LEVEL" is upright (not upside down). Position cover over studs and install ten $\frac{7}{16}$ -20 nuts ((G), fig. 148) on studs and tighten to 45 to 55 pounds.

208. Installation of Brake Lines

Position right and left brake lines on housing and attach line fitting to elbow in junction block. Secure each line to housing with two clips, $\frac{1}{4}$ -28 x $\frac{1}{2}$ cap screws, and $\frac{1}{4}$ -inch lock washers. Tighten clip cap screws and line fittings.

209. Final Assembly Operations

a. Brake Assembly Installation.—Install brake backing plate and shoe assembly as directed in paragraph 234.

b. Wheel Hub, Drum, and Bearings Installation.—Install wheel, hub, drum, and bearings as directed in paragraph 256*e*, also adjust bearings as directed in paragraph 256*f*.

c. Lubrication.—Lubricate axle differential with type and quantity of lubricant specified in TM 9-819A or on official lubrication order.

CHAPTER 9

PROPELLER SHAFTS, UNIVERSAL JOINTS, AND PILLOW BLOCK

Section I. DESCRIPTION

210. Arrangement of Propeller Shafts

Propeller shaft and universal joint assemblies interconnect the transmission and transfer, and the transfer and front and rear axles in arrangement illustrated in figure 149. The propeller shafts transmit power from the transmission to the transfer, and from the transfer to front and rear axles. Replacement procedures for all propeller shaft assemblies and pillow block assembly are contained in TM 9-819A.

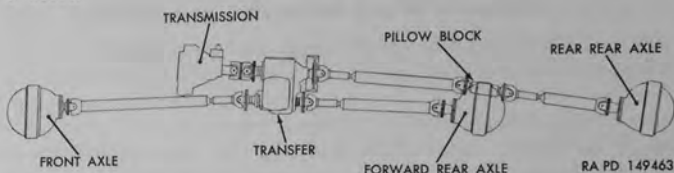


Figure 149. Arrangement of propeller shafts and universal joints.

211. Axle Propeller Shafts and Universal Joints

The four axle propeller shaft assemblies (fig. 150) are tubular type equipped with fixed yoke universal joint assembly at one end, and slip yoke universal joint at the opposite end. Each joint is equipped with a flange which bolts to a companion flange at the axle differential carriers, transfer output shafts, or pillow block assembly as illustrated in figure 149. Universal joint assemblies at fixed and slip joint ends are identical, and are needle roller bearing type. Each roller bearing assembly is retained in place on journals in yokes by a snap ring. Rebuild procedures for axle propeller shafts are contained in section II of this chapter.

212. Transmission-to-Transfer Propeller Shaft

(fig. 152)

Power from transmission to transfer is through two universal joint assemblies which are bolted together, thus eliminating shaft

usually used. Slip joint between transmission and transfer is through splined sleeve yoke (Q) which engages transmission output shaft. The universal joints are needle roller bearing type, with bearings retained in place with journal bearing caps (C) secured to yokes with $\frac{5}{16}$ -24 x $\frac{1}{2}$ cap screws (A). Rebuild procedures for this propeller shaft assembly are contained in paragraphs 218 through 221.

213. Pillow Block Assembly

The pillow block assembly (fig. 155), mounted on top of housing of forward rear axle (fig. 149), connects and supports the two propeller shafts required to transmit power from transfer to rear rear axle. Rebuild procedures for pillow block assembly are contained in paragraphs 222 through 225.

Section II. REBUILD OF AXLE PROPELLER SHAFT AND UNIVERSAL JOINTS

214. Description

The four axle propeller shaft assemblies ((C), (D), (E), and (F), fig. 150) are identical in construction except lengths of tubular shaft and stub shaft assemblies. Each shaft has a slip joint at one end to permit telescopic action of shaft during operation. One half of the

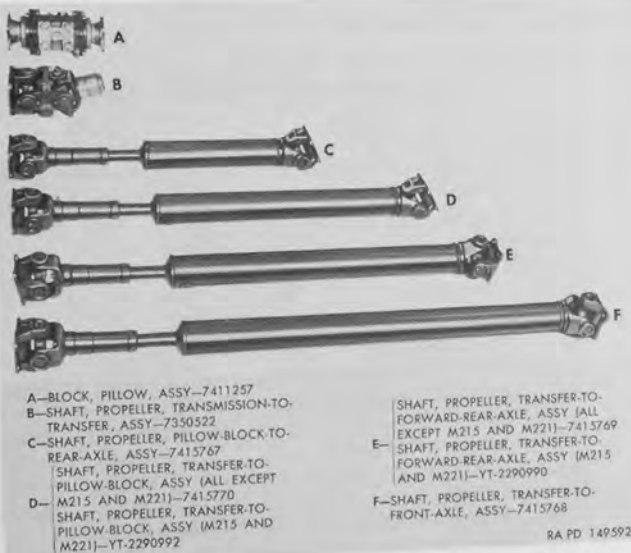


Figure 150. Propeller shaft assemblies and pillow block assembly removed.

slip joint is a splined solid stub shaft welded to tubular shaft ((L), fig. 151). The slip joint sleeve yoke ((G), fig. 151) fits over the stub shaft splines, thus forming the slip joint.

215. Disassembly

Note. Key letters noted in parentheses are in figure 151. Disassembly procedures for all axle propeller shaft assemblies are identical.

a. Loosen dust cap (K) which is threaded to slip joint sleeve yoke assembly (G). Slide sleeve yoke from stub shaft.

b. Pinch ends of bearing snap rings (B) together; then remove four snap rings from each universal joint.

c. Strike the yokes sharply with lead hammer to force the roller bearing assembly (C) from yokes far enough to permit removal.

Note. The roller bearings are loose in the bearing retainer and may fall out when bearing assembly is removed.

d. Remove opposite roller bearing from yoke. Push universal joint journal assembly (M) to one side as far as possible. Tilt yoke and remove journal from yoke. Repeat procedures on opposite yoke. Remove bearing gaskets (D) and bearing gasket retainers (E) from journal.

e. Opposite universal joint assembly can be disassembled as explained in *b* through *d* above.

216. Cleaning and Inspection

Note. Key letters noted in parentheses are in figure 151.

a. Cleaning.—Clean all parts thoroughly with dry-cleaning solvent or volatile mineral spirits.

b. Inspection.

(1) *Shaft assemblies.*—The shaft assemblies with stub shaft and yoke (L) are of different lengths, depending upon location. Examine shaft assembly for bent condition. Each shaft is balanced and no attempt should be made to repair the shafts. If shaft is bent, or if yoke or splines are damaged, replace with new part.

(2) *Universal joint flange yokes.*—Inspect universal joint flange yokes (A) for damage. Replace with new parts if damaged. Do not attempt to repair yokes.

(3) *Slip joint sleeve yoke assembly.*—Remove relief valve (P) and lubrication fitting (F) and thoroughly clean out interior of slip joint sleeve yoke assembly (G). Examine yoke for damage. Replace if yoke is distorted or damaged in any manner. The dust cap cork washer (H) should be replaced with new part at assembly.

(4) *Universal joint journal assemblies.*—Inspect bearing surfaces on universal joint journal assemblies (M) for roughness

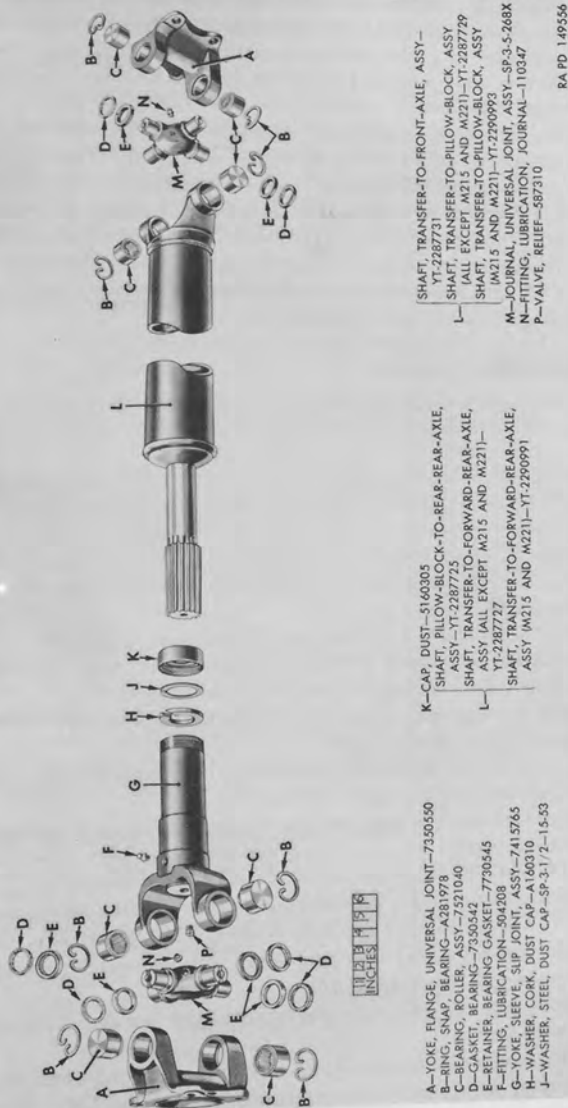


Figure 151. Axle propeller shaft and universal joint components.

or scoring. Make certain that lubricant passages in journals are clean and free. Upon installation, use new bearing gasket retainers (E) and bearing gaskets (D) on journals. Make certain that journal lubrication fittings (N) are clean and firmly installed.

- (5) *Roller bearing assemblies.*—Examine rollers in roller bearing assemblies (C) for bent or scuffed condition. There are 34 rollers mounted in the retainer. The rollers are not held in place with a retainer. If the rollers are damaged, replace with new parts. If outer retainer is damaged or scuffed, replace entire bearing assembly. If the bearing snap rings (B) have been damaged or stretched during disassembly, replace with new parts at assembly.

217. Assembly

Note. Key letters noted in parentheses are in figure 151. All parts should be thoroughly lubricated during assembly with automotive and artillery grease (GAA).

a. Install a new bearing gasket retainer (E) and a new bearing gasket (D) on each end of the universal joint journal assembly (M). Position journal in place in universal joint flange yoke (A).

b. Install 34 rollers in bearing retainer. Apply small quantity of grease to hold rollers in place. Install a roller bearing assembly (C) into yoke over each end of journal.

c. Install relief valve (P) into end of slip joint sleeve yoke (G). Position journal in place in yoke of slip joint sleeve yoke. Install a roller bearing assembly into yoke over each end of journal.

d. Install bearing snap ring (B) at each bearing, making certain snap ring engages groove in yokes.

e. Universal joint at fixed end of shaft may be assembled in the same manner described in a through d above.

f. One splined tooth in slip joint sleeve yoke assembly (G) is blank. This blank spline must match with a similar blank spline on stub shaft of propeller shaft to assure proper universal joint alinement.

g. Position dust cap (K) over stub shaft; then install dust cap steel washer (J) and a new dust cap cork washer (H). Insert slip joint sleeve yoke assembly (G) over stub shaft splines, matching blank spline of yoke with blank spline of shaft.

h. Thread dust cap (K) onto sleeve yoke. Do not use a wrench. Tighten with fingers.

i. Install lubrication fitting (F) in slip joint sleeve yoke, and journal lubrication fittings (N) in universal joint journals (M). Thoroughly lubricate universal joints with automotive and artillery grease (GAA).

Section III. REBUILD OF TRANSMISSION-TO-TRANSFER PROPELLER SHAFT ASSEMBLY

218. Description

The propeller shaft assembly between transmission and transfer (B, fig 150) consists of two universal joint assemblies bolted together to form a propeller shaft assembly. The sleeve yoke assembly (Q, fig. 152) fits on splined output shaft of transmission to form a slip joint. The flange yoke (P, fig. 152) bolts to a companion flange on transfer input shaft. Needle type roller bearing assemblies are used at each universal joint.

219. Disassembly

Note. Key letters noted in parentheses are in figure 152.

a. Remove the four $\frac{1}{2}$ -20 safety nuts (K) from $\frac{1}{2}$ -20 x $1\frac{3}{8}$ special bolts (N). Separate flange yokes (L) and (M).

b. Remove lubrication fitting (J) from universal joint journal assembly (H) at the sleeve yoke end of the propeller shaft.

c. Straighten lugs on lock straps (B) at the four journal bearing caps (C). Remove two $\frac{5}{16}$ -24 x $1\frac{1}{2}$ cap screws (A) from each journal bearing cap. Remove lock straps (B) and journal bearing caps (C).

d. Strike either flange yoke or sleeve yoke sharply with lead hammer to force a journal bearing assembly (D) out of yoke far enough to permit removal. Remove opposite bearing assembly from yoke.

e. Push universal joint journal assembly (H) to one side as far as possible. Tilt yoke and remove yoke from journal. Repeat procedures on opposite yoke. Remove journal bearing gaskets (E) and gasket retainers (F) from journal.

f. Remove relief valve (G) from universal joint journal (H).

g. Opposite universal joint assembly can be disassembled as explained in b through f above.

220. Cleaning, Inspection, and Repair

Note. Key letters noted in parentheses are in figure 152 unless otherwise indicated.

a. *Cleaning.* Thoroughly clean all parts with dry-cleaning solvent or volatile mineral spirits.

b. *Inspection and Repair.*

(1) *Flange yokes.*—Inspect flange yokes (L), (M), and (P) for distortion, damage, or stripped threads. Replace yokes if these conditions exist.

(2) *Sleeve yoke assembly.*—Inspect splines of sleeve yoke assembly (Q) for distortion, chipped condition, or excessively worn condition. If these conditions exist, replace sleeve yoke assembly. Examine sleeve yoke sleeve (R) for scoring,

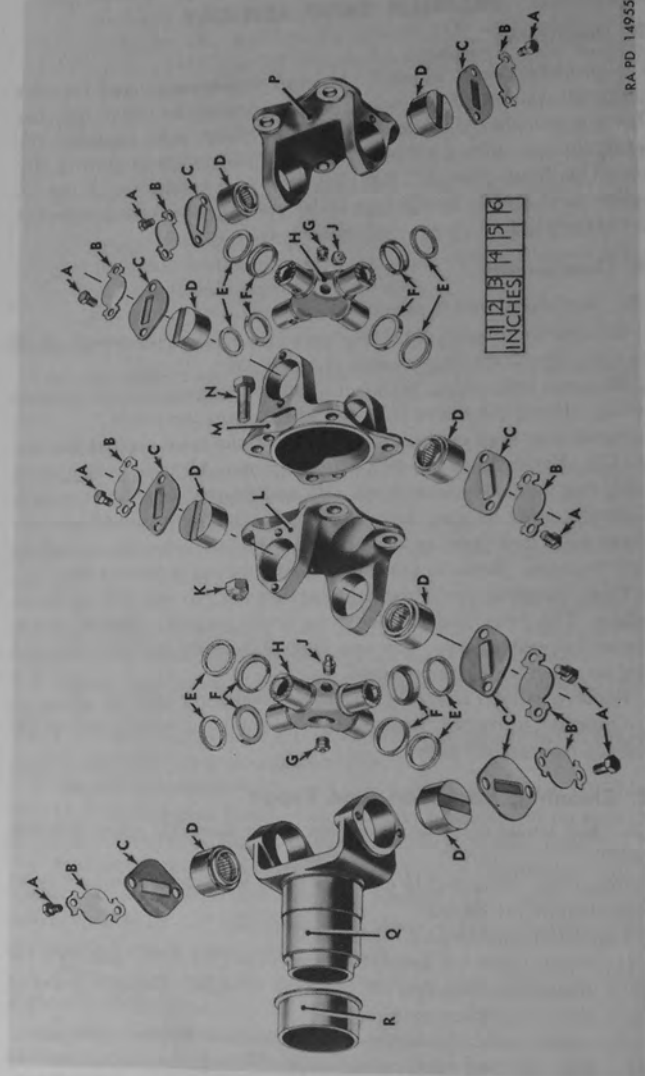


Figure 152. Transmission-to-transfer propeller shaft components.



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Figure 153. Installing yoke oil seal sleeve with replacer 41-R-2395-535.

Figure 152.—Continued.

- A—SCREW, CAP, $\frac{5}{16}$ -24 x $\frac{1}{2}$ —5284326
- B—STRAP, LOCK—5281981
- C—CAP, JOURNAL BEARING—5283074
- D—BEARING, JOURNAL, ASSY—A281980
- E—GASKET, JOURNAL BEARING—5283081
- F—RETAINER, GASKET—5282858
- G—VALVE, RELIEF—587310
- H—JOURNAL, UNIVERSAL JOINT, ASSY—YT-2284934
- J—FITTING, LUBRICATION—504208
- K—NUT, SAFETY, $\frac{1}{2}$ -20—442801
- L—YOKE, FLANGE (CENTER FRONT)—7350527
- M—YOKE, FLANGE (CENTER REAR)—7350526
- N—BOLT, SPECIAL, $\frac{1}{2}$ -20 X $1\frac{3}{8}$ —7350528
- P—YOKE, FLANGE (AT TRANSFER)—7350526
- Q—YOKE, SLEEVE, ASSY—7350525
- R—SLEEVE, SLEEVE YOKE—7350523

checking, and looseness. If sleeve is damaged, replace with new part. With replacer 41-R-2395-535 (fig. 153), drive new sleeve onto sleeve yoke.

- (3) *Journal bearing assemblies*.—Examine bearing assembly (D) needle roller bearings for broken condition or scoring. Bearing rollers are held in place with a retainer. If retainer or rollers are damaged, replace bearing assembly.
- (4) *Universal joint journal assemblies*.—Inspect bearing surfaces on journals for roughness or scoring. Make certain that lubricant passages in journals are clean and free.
- (5) *Journal Bearing Caps and Lock Straps*.—Journal bearing caps (C) should be inspected for damage. As a general rule, lock straps (B) should be replaced at assembly; however, straps can be reused if one lug at each end has not been bent.

221. Assembly

Note. Key letters noted in parentheses are in figure 152. Thoroughly lubricate all parts with automotive and artillery grease (GAA).

a. Install relief valve (G) and lubrication fitting (J) in universal joint journal (H).

b. Install new gasket retainer (F) and journal bearing gasket (E) on each end of journal.

c. Assemble front universal joint first. Place universal joint journal assembly (H) in place in sleeve yoke assembly (Q).

d. Install a journal bearing assembly (D) into sleeve yoke over each end of journal cross.

e. Insert journal into center front flange yoke; then install journal bearing over each end of journal cross.

f. Install journal bearing cap (C) over each journal bearing, engaging cap lug with slot in bearing retainer.

g. Position lock strap (B) over each cap. Install two $\frac{5}{16}$ -24 x $\frac{1}{2}$ cap screws (A) and tighten firmly. Bend one lug of lock strap against face of cap screw.

h. Assemble opposite universal joint in the same manner as described in *a* through *g* above.

i. Bolt center front and center rear flange yokes (L) and (M) together, using four $\frac{1}{2}$ -20 x $1\frac{3}{8}$ special bolts (N) and four $\frac{1}{2}$ -20 safety nuts (K). Tighten nuts firmly.

Note. The front and rear universal joint assemblies must be in same plane when bolted together.

Section IV. REBUILD OF PILLOW BLOCK ASSEMBLY

222. Description

Note. Key letters noted in parentheses are in figure 155 unless otherwise indicated.

a. Pillow block assembly (fig. 155) consists of a shaft (K) supported by a ball bearing assembly (G) at both ends. Bearings are pressed on the shaft and are retained in place in pillow block by shaft bearing retainers (E) which are bolted to pillow block (H). Ball bearing at front is equipped with a snap ring (F) which fits in groove of bearing and shaft bearing retainer. Double lip shaft bearing oil seal assemblies (D) are installed in shaft bearing retainers. A splined flange assembly with oil seal sleeve and deflector (B) is installed over splines at each end of shaft and held in place with shaft nut (A) and cotter pin.

b. The pillow block assembly is mounted on forward rear axle housing (fig. 149) and supports the two propeller shafts required to transmit power from transfer to rear rear axle.

223. Disassembly

Note. Key letters noted in parentheses are in figure 154 unless otherwise indicated.

a. Remove pipe plug (J), inspection hole plug and gasket (K) and (L), pipe plug (Q), lubrication and oil level plug (M), lubrication fitting elbow (N), and lubrication fitting (P) and allow lubricant to drain from housing.

b. Place assembly firmly in a vise. With holding tool 41-T-3215-910 over flange with deflector and sleeve assembly (B) at rear in similar manner as illustrated in figure 51, remove cotter pin at shaft nut (A). Remove shaft nut.

c. Remove flange with deflector and sleeve assembly (B) from end of shaft. Use brass hammer to tap flange from shaft.

d. Remove four $\frac{3}{8}$ -16 x $1\frac{1}{8}$ cap screws (R) and lock washers (S) which retain the shaft bearing retainer (D) to pillow block (H). Remove shaft bearing retainer (D) with shaft bearing oil seal assembly (C), and bearing retainer gasket (E). Do not remove shaft bearing oil seal assembly (C) until inspection (par. 224b).

e. At the front end, remove shaft nut (A), flange with deflector and sleeve assembly (B), shaft bearing retainer (D), shaft bearing oil seal assembly (C), and bearing retainer gasket (E) in same manner as described in b, c, and d above.

f. With brass drift at rear of shaft (T), drive shaft through ball bearing assembly (G) at rear. Shaft (T) and ball bearing (G) at front, together with front bearing snap ring (F), will be removed as an assembly. Press ball bearing from shaft.

224. Cleaning, Inspection, and Repair

Note. Key letters noted in parentheses are in figure 154 unless otherwise indicated.

a. *Cleaning.*—Thoroughly clean parts in dry-cleaning solvent or volatile mineral spirits. Do not spin ball bearings with compressed air.

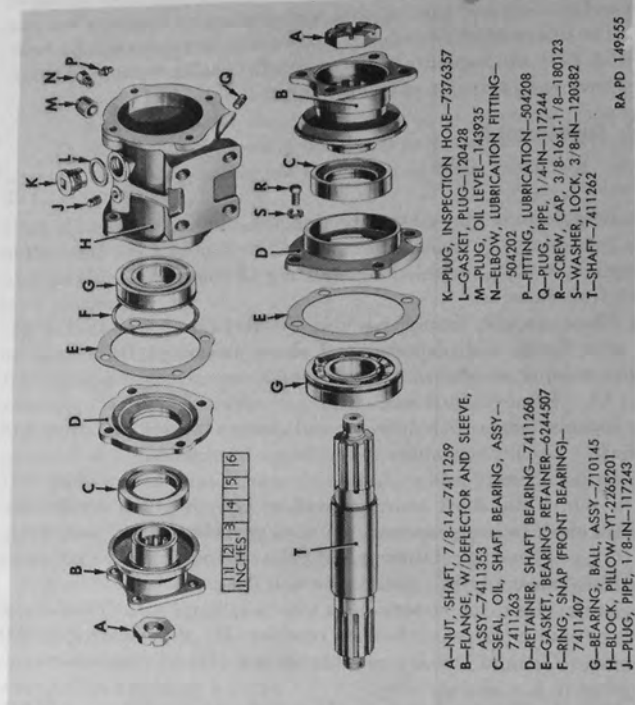


Figure 154. Pillow block assembly components.