# CHAPTER 5

# PROPELLER SHAFTS, UNIVERSAL JOINTS, AND PILLOW BLOCK



## 39. DESCRIPTION AND DATA.

**a. General.** A total of five propeller shafts and a pillow block are used to transmit power from the transmission through the transfer case to the three driving axles.

(1) UNIVERSAL JOINTS. Universal joints are used at both ends of each propeller shaft. Each universal joint consists of two yokes, a journal, and four needle bearing assemblies. The bearings are held in place by either a snap ring or U-bolt. The slip joint is mounted on one end of shaft through male splines on shaft and female splines in yoke.

(2) PROPELLER SHAFTS. Propeller shaft used between transmission and transfer case is solid, while all others are tubular type. Each shaft has a yoke welded to one end, while opposite end has a splined shaft welded to tube.

(3) PILLOW BLOCK. The pillow block assembly is an oil and watertight unit mounted on rear axle front (intermediate) unit and connects the propeller shafts from the main transfer case to the rearward rear axle.

**b. General Data.**

(1) SHAFTS.

| | |
|---|---|
| Shafts—quantity used | 5 |
| Make of shaft and joint | Spicer and Saginaw |

(2) PILLOW BLOCK.

| | |
|---|---|
| Location | Top of rear axle front (intermediate) unit |
| Bearings | |
| Make | Timken |
| Number | Bearing cone 16150<br>Bearing cup 16284 |

## 40. PROPELLER SHAFTS.

**a. Description.** Five propeller shafts are used to transmit power from transmission to transfer case and driving axles. Each shaft is equipped with two universal joint assemblies and a slip joint. All

shafts are tubular type, except one used between transmission and transfer case, which is solid type.

**b. Disassembly.** Propeller shaft is completely disassembled when universal joints are removed (par. 41).

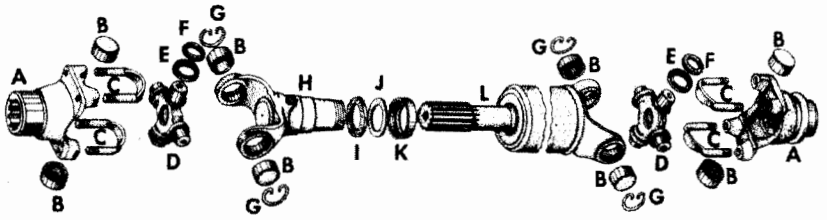
**c. Cleaning and Inspection.**

(1) CLEANING. Immerse shaft in dry-cleaning solvent to loosen old grease or foreign deposits. Remove shaft from cleaning solvent, then remove all lubricant or foreign matter loosened by cleaning solvent.

(2) INSPECTION.

*(a) Procedure.*

| Part to Inspect | Inspect for | Remedy |
|---|---|---|
| Splines | Wear at spline | Replace |
| Yoke | Burrs | Clean up with hone or replace |
| | Cracked | Replace |
| Shaft | Bent | Replace |




| | |
|---|---|
| A FLANGE | G SNAP RING |
| B BEARING ASSEMBLY | H YOKE |
| C U-BOLT | I CORK WASHER |
| D JOURNAL ASSEMBLY | J STEEL WASHER |
| E GASKET RETAINER | K CAP |
| F GASKET | L PROPELLER SHAFT |

RA PD 307520

***Figure 69—Propeller Shaft and Univesal Joint Disassembled***

*(b) Inspection Operations.*

*1. Splines.* Install slip yoke on shaft splines and check clearance between yoke and shaft splines. Refer to paragraph 43 for new limits. Replace shaft when wear is excessive.

*2. Yoke.* Carefully inspect shaft yoke for evidence of cracks. Replace shaft if defective.

*3. Shaft.* Place shaft in lathe or on knife edge rollers and check for bent condition. Replace if bent or otherwise damaged.

**d. Assembly.** Propeller shaft is completely reassembled when universal joints are installed (par. 41).

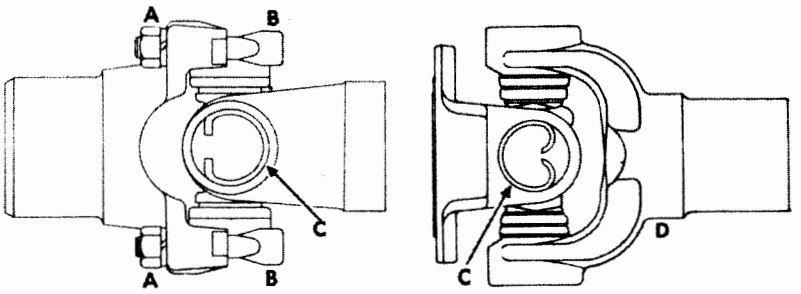



***Figure 70—Universal Joint Snap Rings and U-Bolts***

## 41. UNIVERSAL JOINTS.

**a. Description** (figs. 69 and 70). Universal joints used at each end of propeller shafts consist of a flange, journal, four needle bearing assemblies, four gaskets and retainers, relief fitting, and lubrication fitting. A sleeve yoke is used at one end of each propeller shaft, which serves as a slip joint and is a part of the universal joint assembly. Opposite end of shaft is fitted with a yoke welded to the shaft, to which the universal joint connects. Universal joint trunnion and bearings are held to flanges by snap rings or U-bolts.

**b. Disassembly** (figs. 69, 70, and 71).

(1) REMOVE SLIP JOINT. Before disassembling slip joint, look for arrow mark on shaft and yoke (fig. 71). If these marks are not readily discernible, punch mark both members so that they can be reassembled in exactly the same relative position. Unscrew dust cap from yoke (female member), then remove cork, steel washers, and dust cap.

(2) DISASSEMBLE UNIVERSAL JOINT. Pinch ends of snap rings together and remove rings. Remove U-bolt nuts and lock washers and remove the U-bolts. Remove lubrication fitting, which will facilitate removal of journal. Strike journal sharply to force each bearing assembly far enough out of yoke to permit withdrawal of bearing. Remove journal by moving it sideways as far as possible,

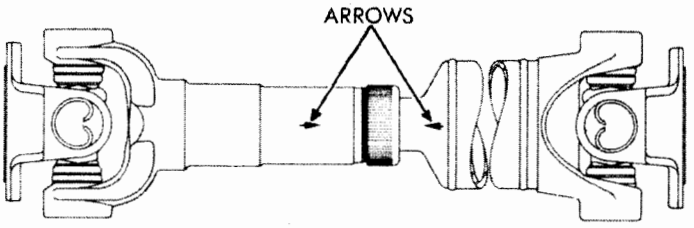



***Figure 71—Alinement of Splines on Shaft and Yoke***

then tilt to clear side of yoke. Remove four gaskets and retainers, also relief valve from journal.

**c. Cleaning and Inspection.**

(1) CLEANING. Clean all parts in dry-cleaning solvent. Make sure journal bearing surfaces and slip joint splines are thoroughly cleaned. Allow bearing assemblies to remain in cleaning solvent long enough to loosen any particles of hard grease. Remove parts from dry-cleaning solvent and clean thoroughly, using a small stiff brush. Blow dry with compressed air.

(2) INSPECTION.

*(a) Procedure.*

| Part to Inspect | Inspect for | Remedy |
|---|---|---|
| Slip joints | Wear at splines | Replace |
| Journals | Burrs | Clean up with hone or replace |
| Yokes | Burrs | Clean up with hone or replace |
| Bearing assemblies | Worn or missing needles | Replace bearing |
| Gaskets | | Always replace |
| Gasket retainers | Bent | Replace |

*(b) Inspection Operations.*

*1. Slip yoke.* Carefully inspect yoke for cracks, wear, or bent condition. Small burrs can usually be cleaned up with a hone. Clearance between shaft and yoke splines is 0.001 - 0.004 inch when new. Replace if defective or worn. Check to be sure that small lubrication relief hole in expansion plug is clean and open.

*2. Journals.* Inspect journal bearing surfaces for evidence of wear. Wear is usually indicated by roughness or needle bearing grooves in bearing surface of journal. Replace journal and bearing assemblies when this condition is found. Carefully inspect lubrication passages for cleanliness.

*3. Journal bearings.* Carefully inspect each bearing assembly for missing needles. Each bearing contains 27 needles and if any are missing, replace complete bearing assembly. Worn condition is usually indicated if needles drop out of retainer, or if journal bearing surface shows marks of needles. Replace journal and four bearing assemblies if evidence of wear is apparent.

*4. Gasket retainers.* Inspect gasket retainers for bent condition and replace if damaged.

**d. Assembly** (figs. 69, 70, and 71).

(1) INSTALL SLIP JOINT. Install dust cap over splined end of shaft. Install split steel washer over shaft and position inside of dust cap. Install cork washer over shaft and inside of dust cap. Aline punch marks or arrows on shaft and yoke, then slide yoke onto shaft splines. Thread dust cap onto slip yoke.

(2) ASSEMBLE UNIVERSAL JOINT. Install four retainers and new gaskets on journal. Install pressure relief valve in center of journal. Insert one trunnion of journal into shaft yoke, tilt journal until

# CHAPTER 7

# BANJO TYPE FRONT AXLE

## Section I

## DESCRIPTION AND DATA



### 46. DESCRIPTION AND OPERATION.

**a. General.** The banjo type front axle is single-reduction type, consisting essentially of the housing, differential and pinion assembly, axle shaft and universal joint assemblies, and the steering knuckle support assemblies. Power is transmitted from the transfer case to the front axle differential assembly through a tubular propeller shaft. Power is transmitted from the differential to the wheels through the axle shaft and universal joint assemblies. The action of the universal joints permits delivery of power to the wheels when they are turned from the straight-ahead position. The engagement and disengagement of the front axle is controlled at the transfer case by a shift lever in the cab.

**b. Axle Housing.** The axle housing is of the conventional one-piece construction with opening near the center for mounting the differential and carrier assembly. The spherical shaped housing outer ends, spring seats, and steering knuckle stops are welded to the axle housing. Axle shaft oil seals are pressed in and axle shaft thrust washers are staked in place in seats provided in the housing outer ends. The external surfaces of the spherical shaped housing outer ends are machined and polished to permit proper functioning of the housing outer end seals.

**c. Axle Shaft and Universal Joint Assemblies.** The axle shafts are full-floating type with constant velocity universal joints at the steering knuckles. Each axle shaft assembly consists of an inner and outer shaft with yokes at the universal joint ends. The outer shaft is splined to the axle drive flange and the inner shaft is splined to the differential side gear. The outer shafts are the same for both the right and left-hand sides; the inner shafts are of different lengths due to the differential being off center in the axle housing. Each universal joint contains four drive balls and one center ball. The drive balls are select fit and the center ball (with hole and groove) is a standard size. The center ball is held in place by a center ball pin and lock pin. The drive balls are retained in the races by the yokes. The universal joint assemblies are enclosed within the steering knuckle supports.

## DESCRIPTION AND DATA—BANJO TYPE FRONT AXLE

**d. Steering Knuckle Supports.** The steering knuckle supports are supported on the housing outer ends by tapered roller bearings. Supports are secured in position on the bearings by the steering knuckle trunnions which permit the steering knuckle supports to oscillate as the front wheels are turned. Adjustment of the bearings is accomplished through the use of shims between the trunnions and the steering knuckle supports. The steering knuckle arms are integral with the steering knuckle supports. The tie rod is connected to these arms by yokes and yoke bolts. The steering knuckle arms contain replaceable bushings so that play caused by wear from the tie rod yoke bolts can be corrected by installing new bushings. The housings outer end seals, attached to the inner sides of the steering knuckle supports, prevents leakage of lubricant from the steering knuckle assemblies and prevents the entrance of dirt.

**e. Steering Knuckles.** The steering knuckles are attached to the steering knuckle supports with 12 cap screws and lock washers in conjunction with the oil deflector, brake flange plate (dust shield), and brake shoe anchor plate spacer. They act as spindles around which the wheels revolve and also transfer the turning force from the steering knuckle supports to the wheel and hub assemblies. The outer ends of the steering knuckles are threaded for the wheel bearing adjusting nuts. The steering knuckle bushings are pressed into the inside of the knuckles and the axle shaft thrust washers are staked in position at the inner end. A groove in the steering knuckle flanges permits escape of any lubricant which might leak past the hub inner oil seal.

**f. Tie Rod Assembly.** The tie rod is a solid rod threaded at each end with a double offset to clear the differential and pinion housing. The tie 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 the steering knuckle arms by means of yokes, screwed onto the ends of the rod, and yoke bolts, nuts, and cotter pins. A lock is provided at the left end of the tie rod to hold the tie rod in its relative position to the differential housing, so that it will not strike the differential housing when wheels are turned. The lock fits into a groove in the end of the rod and is held in place by the inner tie rod yoke clamp bolt. In addition to controlling front wheel toe-in, the tie rod transmits the turning force from the left-hand steering knuckle support to the right-hand steering knuckle support.

**g. Differential and Carrier Assembly.** The differential and carrier assembly in the banjo type front axle is the same as those used in the banjo type rear axles. The information given on these assemblies in Chapter 7 applies equally to the front axle and will not be repeated in this chapter.

## POWER TRAIN, CHASSIS AND BODY, GMC 2½-TON 6 x 6 TRUCK

### 47. GENERAL DATA.

a. Data.

| | |
|---|---|
| Make | GM Corporation |
| Housing | Banjo type |
| Model number (with high traction differential gears) | |
| With conventional brake drums | 3663017 |
| With demountable brake drums | 3678601 |
| Model number (with standard differential gears) | |
| With conventional brake drums | 3665635 |
| With demountable brake drums | 3678645 |

# CHAPTER 7

# BANJO TYPE FRONT AXLE

## Section II

## FRONT AXLE DISASSEMBLY



### 48. GENERAL.

a. The following procedures are based on the assumption that the axle assembly is removed from the vehicle. These same opera-

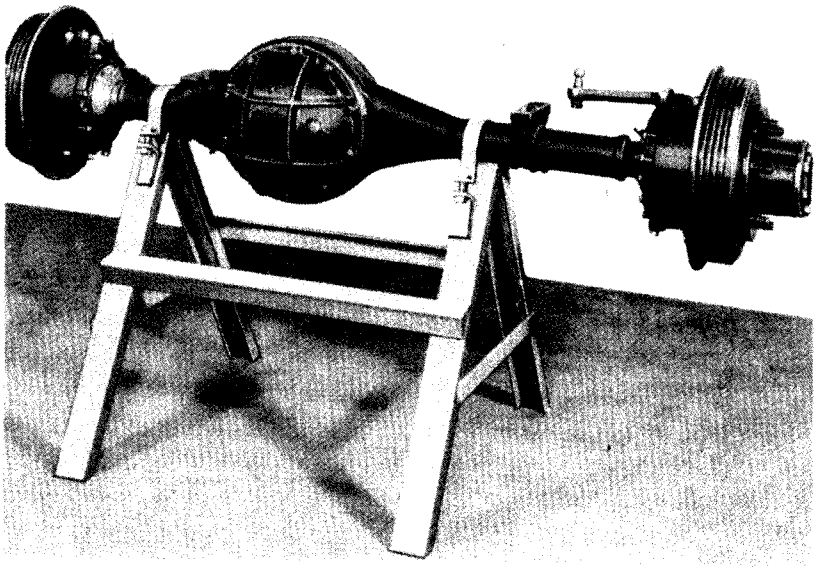


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***Figure 85—Banjo Type Front Axle Assembly Mounted in Axle Stand***

tions can be performed with the axle assembly installed on the vehicle, but for maximum accessibility and efficiency, the axle should be removed from the vehicle and placed on a suitable axle stand (fig. 85).

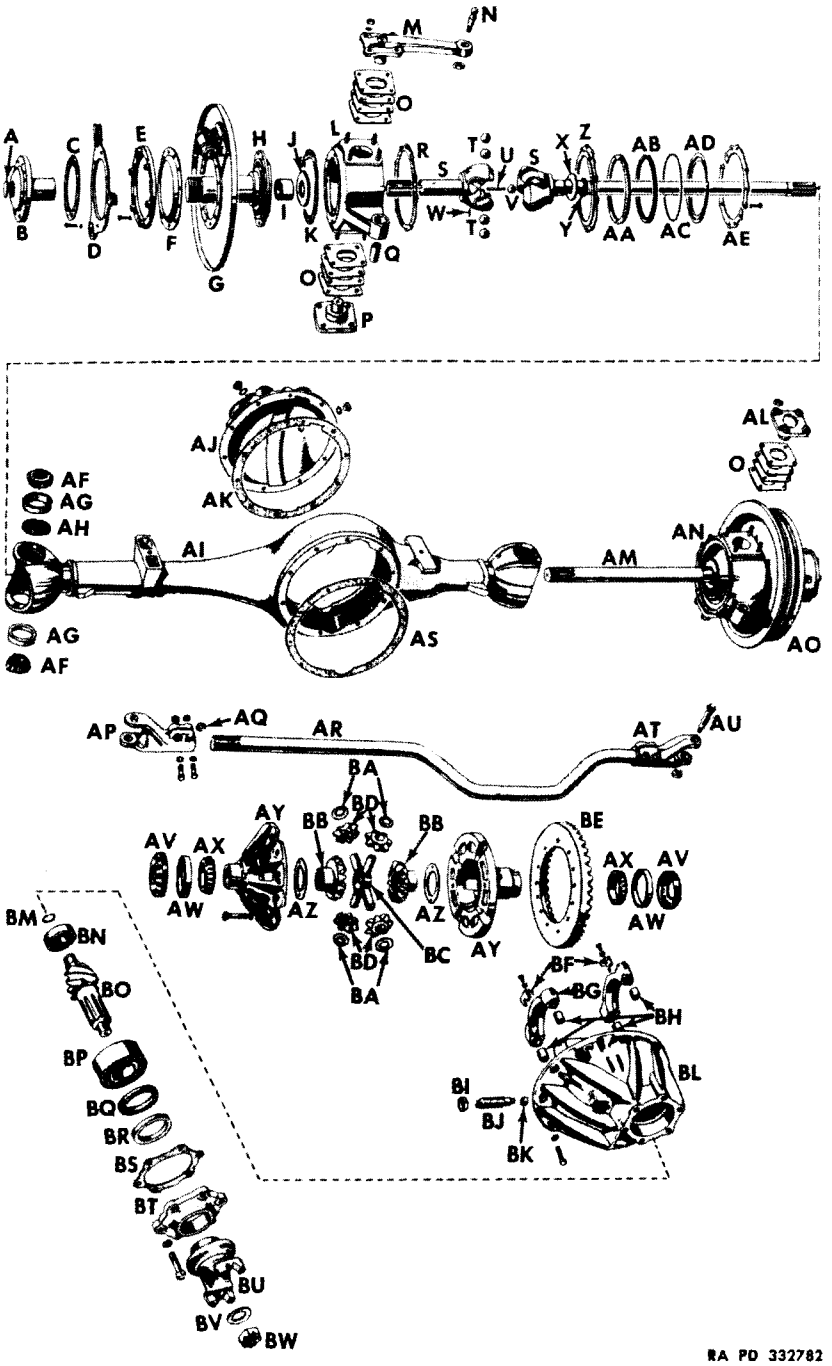


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*Figure 86—Banjo Type Front Axle—Disassembled*

## FRONT AXLE DISASSEMBLY—BANJO TYPE

A PLUG
B DRIVE FLANGE
C DRIVE FLANGE GASKET
D ANCHOR PLATE
E ANCHOR PLATE SPACER
F OIL DEFLECTOR
G BRAKE FLANGE PLATE
H STEERING KNUCKLE
I STEERING KNUCKLE BUSHING
J AXLE SHAFT THRUST WASHER
K GASKET
L STEERING KNUCKLE SUPPORT
M STEERING ARM
N STEERING ARM BALL
O SHIMS
P TRUNNION
Q STEERING KNUCKLE SUPPORT BUSHING
R GASKET
S AXLE SHAFT
T DRIVE BALLS
U CENTER BALL PIN
V CENTER BALL
W CENTER BALL PIN LOCK PIN
X AXLE SHAFT THRUST WASHER
Y OIL SEAL
Z OUTER RETAINER
AA HOUSING OUTER END SEAL
AB SEAL
AC SEAL SPRING
AD SEAL RETAINER
AE INNER RETAINER
AF STEERING KNUCKLE BEARING CONE
AG BEARING CUP
AH OIL RETAINER
AI AXLE HOUSING
AJ HOUSING COVER
AK GASKET
AL TRUNNION
AM AXLE SHAFT
AN STEERING KNUCKLE SUPPORT
AO HUB AND DRUM ASSEMBLY
AP TIE ROD YOKE
AQ TIE ROD LOCK
AR TIE ROD
AS GASKET
AT TIE ROD YOKE
AU TIE ROD YOKE BOLT
AV DIFFERENTIAL SIDE BEARING ADJUSTING NUT
AW DIFFERENTIAL SIDE BEARING CUP
AX DIFFERENTIAL SIDE BEARING CONE
AY DIFFERENTIAL COVER AND CASE
AZ DIFFERENTIAL SIDE GEAR THRUST WASHERS
BA DIFFERENTIAL PINION THRUST WASHERS
BB DIFFERENTIAL SIDE GEARS
BC DIFFERENTIAL SPIDER
BD DIFFERENTIAL PINION GEARS
BE RING GEAR
BF ADJUSTING NUT LOCK
BG DIFFERENTIAL SIDE BEARING CAPS
BH DOWELS
BI LOCK NUT
BJ DRIVE GEAR THRUST SCREW
BK THRUST PAD
BL DIFFERENTIAL CARRIER
BM DRIVE PINION INNER BEARING LOCK
BN DRIVE PINION INNER BEARING
BO PINION
BP DRIVE PINION OUTER BEARING
BQ OIL SEAL
BR PACKING
BS GASKET
BT OIL SEAL RETAINER
BU PROPELLER SHAFT FLANGE
BV WASHER
BW NUT

RA PD 3327828

***Legend for Figure 86***

**b. Inspection and Cleaning (Before Disassembly).** Before disassembling the axle, it should be thoroughly inspected for leakage of lubricant which would not be visible after the parts are cleaned. Make a note of all points of leakage so the cause may be determined after disassembly. Thoroughly clean the assembly before starting disassembly procedures to prevent dirt and grit getting into the bearings upon removal.

### 49. AXLE DISASSEMBLY.

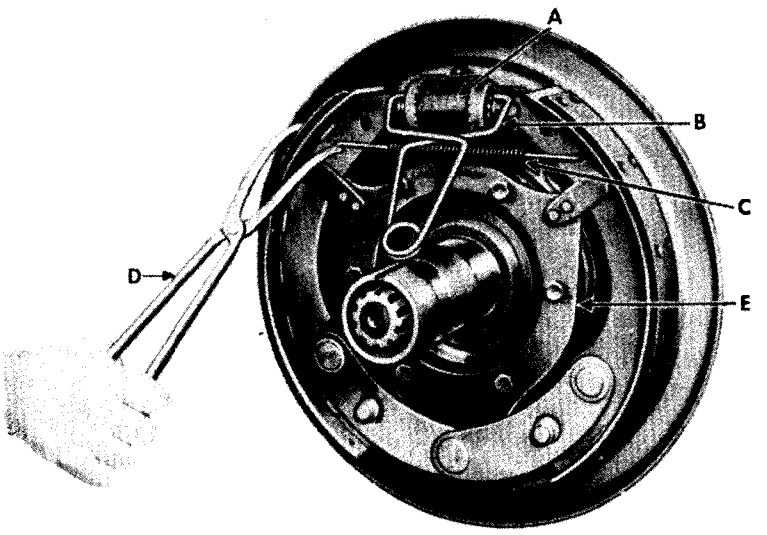
**a. Preliminary Instructions.** The following procedures, **b** through **m**, are applicable to both the right and left-hand end of axle assembly. For removal of axle shaft only, perform operations **b** through **i**. After performing operations at one end of axle, the same operations must be repeated at other end. Refer to figure 86.

**b. Remove Drive Flange.** Remove eight cap screws and lock washers (or lock plate) attaching drive flange to hub. (If lock plate is used, it should be discarded and lock washers installed at reas-

sembly). Install two drive flange cap screws in the two tapped holes in the drive flange and pull drive flange off splined outer end of axle shaft by alternately turning in the two cap screws. Remove the drive flange to hub gasket and discard.

**c. Remove Hub and Drum Assembly.** Remove wheel bearing adjusting nuts and remove hub and drum assembly.

**d. Install Wheel Cylinder Clamp.** Install wheel cylinder clamp (41-C-1835) on wheel cylinder (fig. 87) to prevent wheel cylinder ends coming off.




A WHEEL CYLINDER
B CLAMP
C RETURN SPRING
D PLIERS
E ANCHOR PLATE

RA PD 316846

***Figure 87—Brake Shoe Return Spring Removal (Clamp 41-C-1835 and Pliers 41-P-1579)***

**e. Remove Brake Shoe Return Spring.** Remove brake shoe return spring (fig. 87) using brake spring pliers (41-P-1579).

**f. Remove Anchor Plate and Brake Shoe Assembly.** Remove six cap screws and lock washers attaching brake shoe anchor plate to anchor plate spacer, and remove anchor plate and brake shoe assembly.

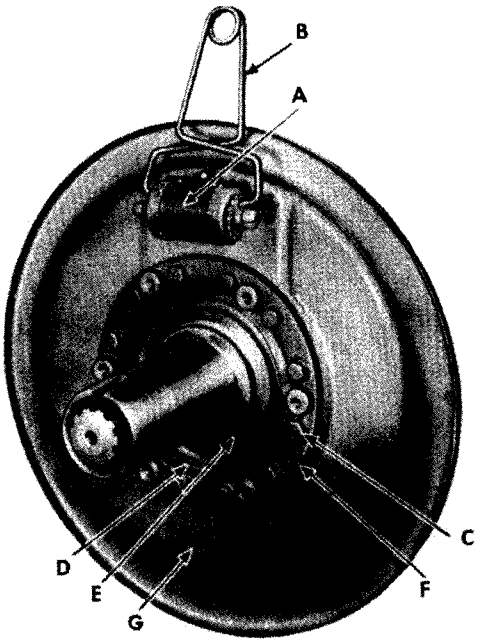
**g. Remove Anchor Plate Spacer and Oil Deflector** (fig. 88). Remove 12 cap screws and lock washers attaching brake shoe anchor plate spacer, inner oil deflector, brake flange plate, and steer-

ing knuckle to steering knuckle support, and remove anchor plate spacer and oil deflector.

**h. Remove Brake Flange Plate and Steering Knuckle** (fig. 88). Remove brake flange plate from steering knuckle and slide steering knuckle off outer end of axle shaft (fig. 89). Remove steering knuckle to steering knuckle support gasket.

**i. Remove Axle Shaft and Universal Joint Assembly.** Remove axle shaft and universal joint assembly from axle housing by pulling straight out as in figure 89.

A WHEEL CYLINDER
B CLAMP
C CAP SCREW
D OIL DEFLECTOR
E STEERING KNUCKLE
F ANCHOR PLATE SPACER
G BRAKE FLANGE PLATE




RA PD 316803

***Figure 88—Drive Flange, Hub, Drum, Anchor Plate, and Brake Shoes Removed (Clamp 41-C-1835)***

**j. Remove Tie Rod.** Remove cotter pin and nut from tie rod yoke bolt and remove bolt. Remove tie rod yoke from arm on steering knuckle support.

**k. Disassemble Housing Outer End Seal** (fig. 90). Remove 12 seal retainer to steering knuckle support cap screws and lock washers. Remove seal parts from steering knuckle support and remove seal retainer gasket. All new seal parts must be installed at assembly except the outer retainer.

**POWER TRAIN, CHASSIS AND BODY, GMC 2½-TON 6 x 6 TRUCK**

l. **Remove Steering Knuckle Trunnions.** Remove nuts and lock washers from studs attaching steering knuckle trunnions to steering knuckle supports. The steering arm is integral with the trunnion on upper left-hand side. Mark or tag each trunnion so that they can be reinstalled in their original location. Remove upper and lower

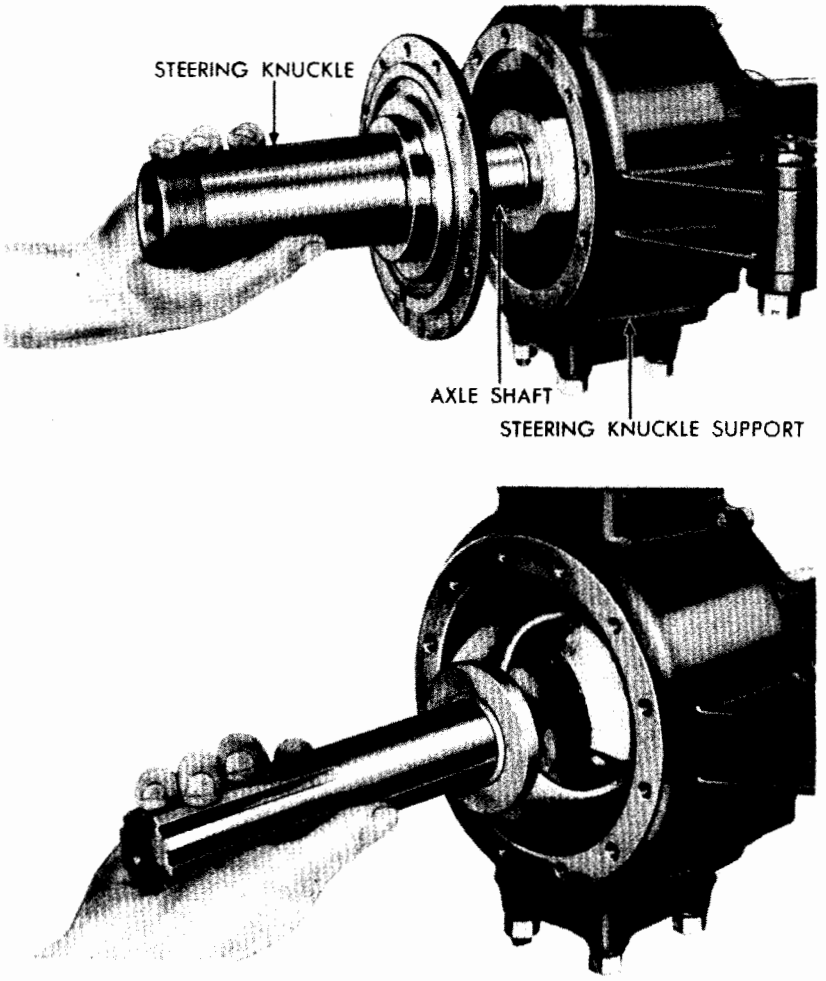



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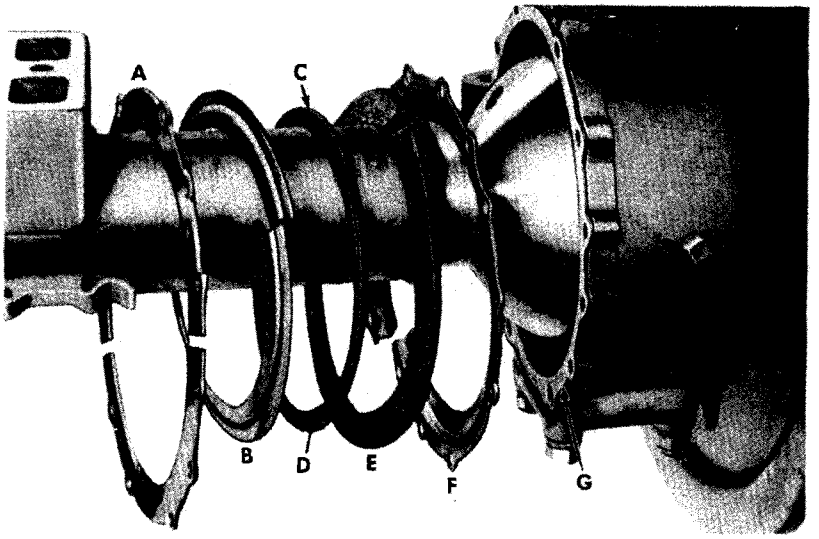
***Figure 89—Steering Knuckle and Axle Shaft Removal***

trunnions and shims (fig. 91). Attach shims to their respective trunnion so they will be reinstalled in their original position.

**m. Remove Steering Knuckle Support and Bearings.** Lift steering knuckle off housing outer end, catching the lower bearing

as the support is lifted off. Remove the upper bearing from housing outer end and tag both bearings so they may be reinstalled in their original positions.

**n. Remove Axle Housing Cover.** Remove bottom cap screw and lock washer attaching axle housing cover to axle housing and allow lubricant to drain from differential. Catch lubricant in a suitable container. After lubricant has drained out, remove the remaining nine cap screws and lock washers attaching axle housing cover to axle housing and remove cover and gasket.




A INNER RETAINERS
B SEAL RETAINER
C SPRING
D DUST SEAL
E OIL SEAL
F OUTER RETAINER
G GASKET

RA PD 316873

***Figure 90—Housing Outer End Seal and Related Parts***

**o. Remove Differential and Carrier Assembly.** Remove 10 cap screws and lock washers attaching differential carrier to axle housing and withdraw differential and carrier assembly from housing.

**p. Remove Breather.** Remove breather from top of axle housing.

## 50. AXLE SHAFT AND UNIVERSAL JOINT DISASSEMBLY (BENDIX-WEISS) (fig. 95).

**a. Wash Axle Shaft and Universal Joint Assembly.** Wash axle shaft and universal joint assembly in dry-cleaning solvent to remove grease from joint.

**b. Check Universal Joint for Play or Backlash.** To determine if excessive play or backlash exists in the universal joint, place the assembly in a vise in a vertical position, with the outer shaft up, and the vise jaws gripping the inner shaft just below the universal joint. Use soft metal or wood protectors in jaws of vise. Firmly push down on the outer shaft so that it rests on the center ball, at the same time attempt to twist the joint in both directions. If any play

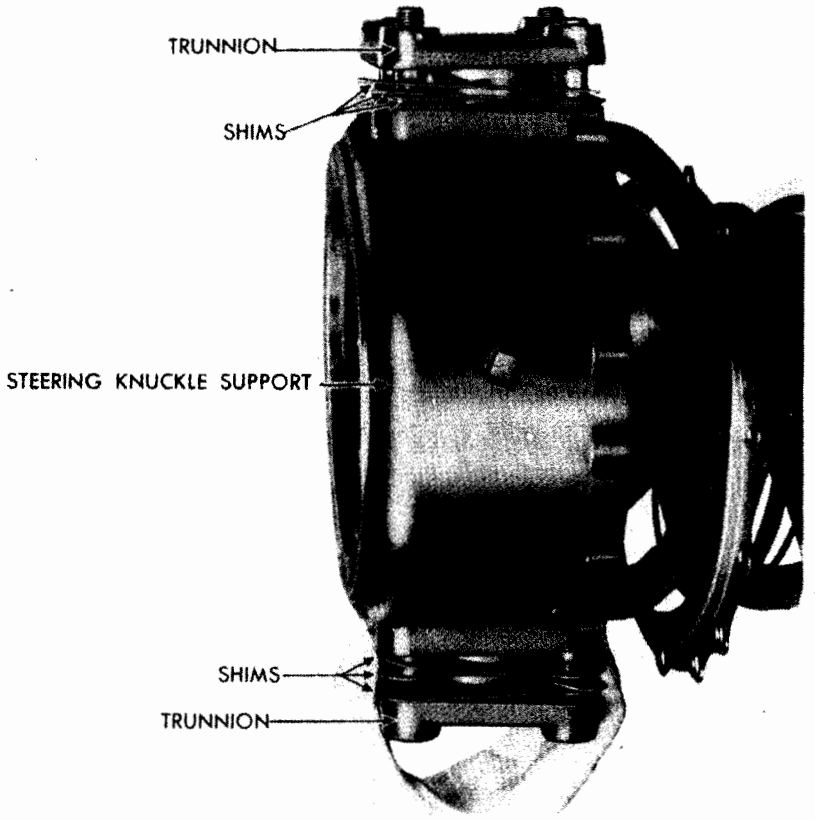



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***Figure 91—Trunnions and Shims Removal***

or backlash is evident, oversize drive balls should be installed at reassembly (par. 58).

**c. Remove Center Ball Pin Lock Pin.** Position axle shaft and universal joint assembly in a vise or lay on bench. Using a suitable punch, drive out center ball pin lock pin (fig. 92).

**d. Dislodge Center Ball Pin.** Remove assembly from vise, and holding it in a vertical position, bounce the outer end of the shaft

on a wood block (fig. 93) to dislodge the center ball pin, allowing the pin to drop farther into the drilled passage in the outer shaft.

e. **Remove Balls.** With the assembly in a vertical position, inner shaft up, clamp the outer shaft in a vise. Swing the inner shaft to one side (fig. 94), at the same time raise it slightly to pull the two

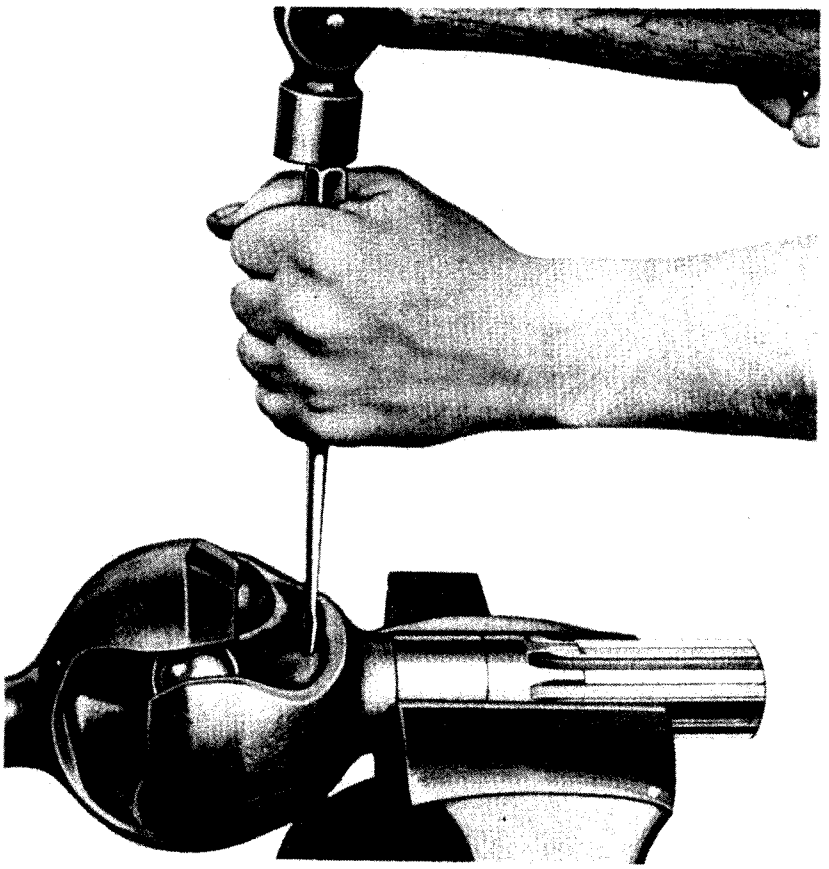

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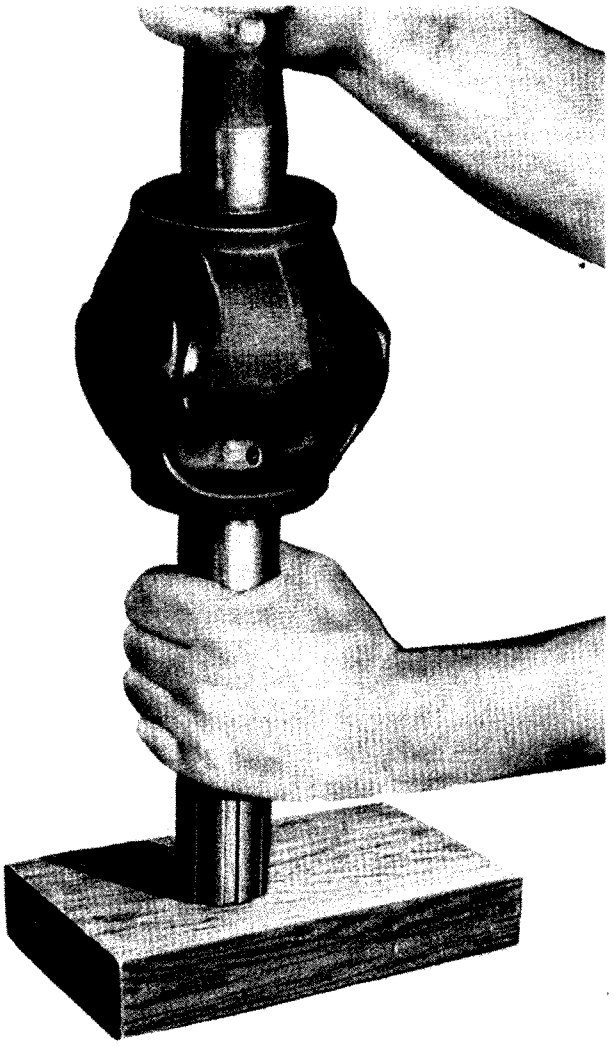
***Figure 92—Universal Joint Center Ball Lock Pin Removal***

shafts apart and loosen the center ball. Turn the center ball with thumb and finger so that the groove in center ball lines up with one of the drive balls. That drive ball can be removed by pulling it past the center ball groove with thumb and finger. By bending the shaft sharply in the opposite direction, the remaining three drive balls and the center ball will be released, separating the two shafts (fig. 95).

f. **Remove Center Ball Pin.** Remove outer shaft from vise and



RA PD 307457

***Figure 93—Dislodging Universal Joint Center Ball Pin***

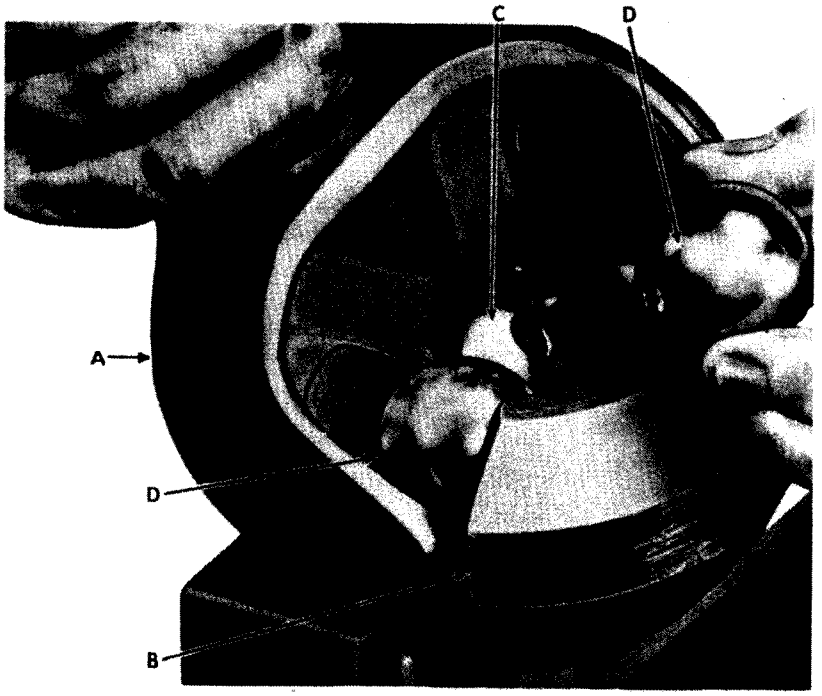
turn other end up to allow center ball pin to drop out of drilled passage in shaft.

g. NOTE: Components of the right- and left-hand shaft assemblies must be kept separate, so they will be reassembled in the respective assembly from which they were removed.

## 51. DIFFERENTIAL AND CARRIER DISASSEMBLY.

a. This procedure is the same as for the banjo type rear axle differential and carrier assemblies and is fully covered in paragraph 82.

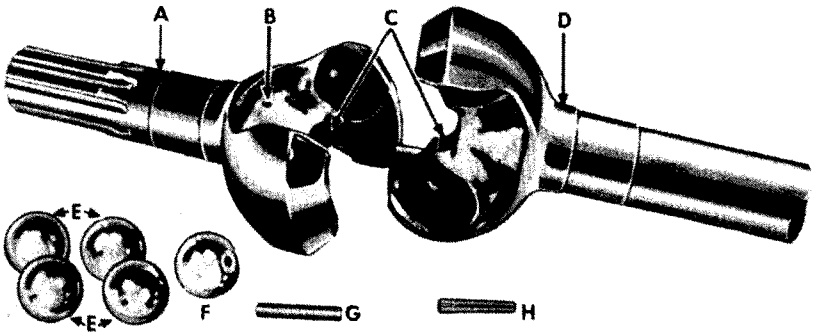
FRONT AXLE ASSEMBLY—BANJO TYPE




A OUTER AXLE SHAFT
B INNER AXLE SHAFT
C CENTER BALL
D DRIVE BALLS

RA PD 307475

***Figure 94—Universal Joint Drive Balls Removal or Installation***




A OUTER SHAFT
B LOCK PIN HOLE
C CENTER BALL SOCKETS
D INNER SHAFT
E DRIVE BALLS
F CENTER BALL
G CENTER BALL PIN
H CENTER BALL PIN LOCK PIN

RA PD 316611

***Figure 95—Bendix-Weiss Axle Shaft and Universal Joint—Disassembled***

52. TIE ROD DISASSEMBLY (fig. 86).

a. **Remove Tie Rod Yoke Clamp Bolts and Lock.** Remove two nuts, lock washers and clamp bolts from each tie rod yoke. Remove tie rod lock from slot in left-hand yoke. Remove lubrication fittings from tie rod yoke bolts.

b. **Remove Tie Rod Yokes.** Remove tie rod yokes from tie rod by unscrewing them from the ends of the tie rod.

# CHAPTER 7

# BANJO TYPE FRONT AXLE

## Section III

## CLEANING, INSPECTION, AND REPAIR



### 53. GENERAL.

**a. Facilities Required.** A suitable tank of a sufficient capacity to permit immersion of all parts should be available. Make sure tank is clean and does not contain any dirt or grit that might be injurious to bearings and machined surfaces. Brushes of various shapes and sizes should be at hand for use in removing hard deposits of grease. Clean rags and compressed air should be in readiness for wiping and drying parts.

**b. Cleaning Fluid.** Dry-cleaning solvent should be used in a sufficient quantity to completely cover all parts in tank.

**c. Precaution.** Care should be exercised not to mix parts of assemblies which must be reassembled to their respective units. Place components of one assembly in tank and thoroughly clean and dry them before placing components of another assembly in tank.

### 54. CLEANING.

**a. Drive Flange.** Clean inside and outside, using brush. Be sure internal splines are thoroughly cleaned. Dry splines with compressed air and wipe outside dry.

**b. Hub and Drum Assemby.** Refer to Chapter 15.

**c. Brake Shoe Assembly.** Refer to Chapter 12, Section II.

**d. Steering Knuckle** Thoroughly clean inside and out. Make sure slot in flange is free from hardened deposits of grease and dirt. Dry thoroughly with compressed air or clean rags.

**e. Axle Shaft and Universal Joint Assembly.** Thoroughly clean yokes and splines on shafts. Be sure drilled passage in outer shaft is clean to permit free movement of center ball pin. Clean balls and center ball pin, being sure center ball pin works freely in hole in center ball.

**f. Steering Knuckle Support.** Be sure all particles of gaskets are removed from the steering knuckle support. With compressed air, blow all dirt out of dowel ring spaces around two outside studs on top of left-hand support. Wash inside and out, using a brush to

loosen grease and dirt. Rinse in dry-cleaning solvent and dry with compressed air or clean rags.

**g. Steering Knuckle Bearings.** Place bearings in dry-cleaning solvent and permit parts to soak for a few minutes. Slush the bearings up and down in the fluid several times. Use a brush to clean parts thoroughly. Strike larger side of bearing flat against a wood block to knock out heavier portions of old lubricant and dirt. Wash in dry-cleaning solvent again. Wipe bearings dry or dry with compressed air. Direct air stream across bearings. Never spin dry bearings with air or with hands.

**h. Axle Housing.** Clean housing inside and out, using a long handled brush to remove dirt and grease from inside. Be sure all particles of gasket are removed from housing cover and differential carrier contact surfaces. Clean and polish housing outer ends.

**i. Tie Rod Bolts.** Make sure lubrication openings through tie rod bolts are thoroughly cleaned.

**j. Miscellaneous.** Parts not mentioned in the preceding instructions do not require any special attention; however, they should also be thoroughly cleaned and dried and placed in order for inspection.

## 55. INSPECTION.

**a. Procedure.**

| Part to Inspect | Inspect for | Remedy |
|---|---|---|
| Drive flange | Worn holes or damaged splines | Replace drive flange |
| Steering knuckle | Damaged threads | Replace knuckle |
| | Worn or damaged thrust washer | Replace thrust washer |
| | Twisted or bent | Replace knuckle |
| Steering knuckle support | Bent or cracked | Replace support |
| | Worn or damaged bushing (tie rod) | Replace bushing |
| | Damaged studs | Replace studs |
| | Stripped threads | Replace support |
| Steering arm | Bent | Replace |
| Trunnions | Cracks | Replace |
| Axle shaft and universal joint assembly | Damaged splines | Replace assembly |
| | Twisted or bent shaft | Replace assembly |
| | Excessively worn ball races | Replace assembly |
| | Grooved, scratched, or pitted ball races | Replace assembly |
| | Pitted, scratched, or out-of-round balls | Replace balls |

## CLEANING, INSPECTION, AND REPAIR—BANJO AXLE

| Part to Inspect | Inspect for | Remedy |
|---|---|---|
| Steering knuckle bearings | Cracks or worn spots | Replace bearings |
| Tie rod bolts | Worn | Replace |
| | Damaged threads | Repair or replace |
| Tie rod | Damaged threads | Repair or replace |
| | Twisted or bent | Replace |
| Tie rod yokes | Sprung or cracked | Replace yoke |
| | Damaged threads | Replace yoke |
| | Worn or broken tie rod bolt shoulders | Repair or replace |
| Axle housing | Twisted or cracked | Replace housing |
| | Broken or bent steering knuckle stop plugs | Replace plugs |
| | Axle shaft oil seals | Always replace |
| | Worn or damaged axle shaft thrust washers | Replace thrust washers |
| | Worn or damaged steering knuckle support bearing cups | Replace cups |
| | Scored or scratched housing outer end | Replace housing |
| | Stripped threads in cap screw holes | Replace housing |
| Axle housing cover | Distorted or cracked | Replace cover |
| | Stripped filler plug threads | Replace cover |
| Cap screws | Damaged threads | Replace |
| Gaskets | | Always replace |

**b. Inspection Operations.**

(1) DRIVE FLANGE. Inspect holes in drive flange for worn condition. Examine splines for chips, nicks, or excessive wear. If any of these conditions exist, install new drive flange.

(2) STEERING KNUCKLE. Inspect threads for damage. Inspect bushing for excessive wear, rough spots, or damage. Insert axle shaft and check clearance between shaft and bushing. If clearance exceeds 0.024 inch, a new bushing must be installed. Inspect axle shaft thrust washer in inner end of knuckle. Original thickness of thrust washer is 0.155 - 0.157 inch. If worn excessively or damaged, a new thrust washer must be installed.

(3) STEERING KNUCKLE SUPPORT. Closely inspect for cracks or distortion. Inspect steering knuckle trunnion studs for damaged threads. Inspect bushing in steering knuckle arm. Insert tie rod yoke bolt and check clearance between bolt and bushing. If clearance exceeds 0.0025 inch, a new bushing must be installed. Check threads in cap screw holes for damage. Install new steering knuckle support if damaged threads are found.

(4) STEERING ARM. Inspect steering arm for distorted condition. See that shim face is clean and smooth. Inspect steering arm ball stud for damage or excessive wear. Install new ball stud if necessary. Make sure dowel rings are securely in place in two outer holes.

(5) STEERING KNUCKLE TRUNNIONS. Inspect for distortion or damaged shim surfaces. Use new parts if damaged.

(6) AXLE SHAFT AND UNIVERSAL JOINT ASSEMBLY. Inspect axle shaft splines for damage. Examine ball races in yokes for excessive wear. If either the inner or outer shaft is damaged, a complete new axle shaft and universal joint assembly must be installed. Check balls for cracks, chips, 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 50 b indicated the necessity of installing oversize balls. Check shafts for twisted or bent condition.

(7) STEERING KNUCKLE BEARINGS. Inspect bearings for chips, cracks, or worn spots. Use new bearings if necessary.

(8) TIE ROD BOLTS. Inspect bolts for bent or worn condition, also diameter. Original diameter is 0.7483 - 0.7493 inch. Replace if damaged or worn excessively. Inspect threads and repair or replace bolts.

(9) TIE ROD. Inspect threads for damage. Check for twisted or bent condition. Use new part if necessary.

(10) TIE ROD YOKES. Examine threads for damage. Check tie rod yoke bolt holes for wear. Check shoulder on top of yoke. This shoulder should fit against yoke bolt head. If damaged or worn, shoulder can be built up by brazing.

(11) AXLE HOUSING. Check axle housing for twisted or distorted condition. Use a new housing if this condition is found. Check for broken or bent steering knuckle stop plugs. Install new plugs if damaged. Inspect axle shaft thrust washers. Original thickness of thrust washers is 0.155 - 0.157 inch. If worn excessively or damaged, install new parts. Examine bearing cups in housing outer ends. Install new parts if worn excessively or damaged. Check seal surface of housing outer end for scratches or other damage. Check threads in cap screw holes for damage. Use a new housing if threads are damaged.

(12) AXLE HOUSING COVER. Check for cracks or distortion. Check filler plug hole threads for damage. Install a new cover if damaged.

(13) CAP SCREWS. Examine all cap screws and replace any that are twisted or have damaged threads with new parts.

(14) GASKETS. Discard all gaskets and replace with new ones.

(15) LOCK WASHERS. Always use new lock washers at assembly.

(16) OIL SEALS. Always replace oil seals with new parts.

## CLEANING, INSPECTION, AND REPAIR—BANJO AXLE

### 56. REPAIR.

a. Steering Knuckle.

(1) BUSHING REPLACEMENT. Use a suitable arbor press and bushing replacer (41-R-2389-35) and press bushing out of flange end of steering knuckle. Turn steering knuckle over and press new bushing into flange end of steering knuckle, making certain bushing is fully seated against shoulder in knuckle. Burnish or ream to dimensions given in paragraph 62.

(2) AXLE SHAFT THRUST WASHER REPLACEMENT.

*(a) Place Steering Knuckle in Vise.* Place steering knuckle in vise with flange end up. Use soft metal or wood protectors in vise jaws, and do not tighten vise tight enough to distort steering knuckle.

*(b) Remove Thrust Washer.* Using a sharp chisel, force thrust washer out of steering knuckle by driving chisel in behind washer. Make sure chisel does not damage thrust washer seat in steering knuckle.

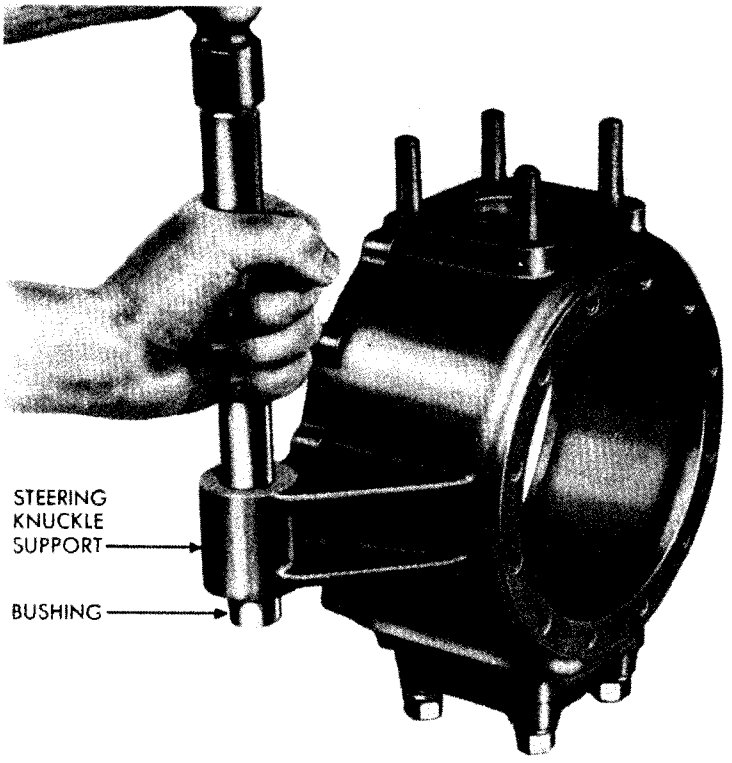



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***Figure 96—Steering Knuckle Support Bushing Removal (Remover and Replacer 41-R-2389-40)***

*(c) Install Thrust Washer.* Position new thrust washer in steering knuckle and stake in place at four places. Thrust washer must be flat and fully seated and must not be distorted in staking operation.

**b. Steering Knuckle Support.**

(1) BUSHING REPLACEMENT.

*(a) Remove Bushing.* Place steering knuckle support on bench. Using bushing remover and replacer (41-R-2389-40), drive bushing out of steering knuckle support (fig. 96).

*(b) Install Bushing.* Using same tool, drive bushing into place in steering knuckle support.

*(c) Ream Bushing.* Ream bushing to size given in paragraph 62.

(2) STUD REPLACEMENT.

*(a) Remove Studs.* Remove damaged studs from knuckle support, using a stud removing tool.

*(b) Install Stud.* Install new studs and tighten securely in place with a stud replacing tool.

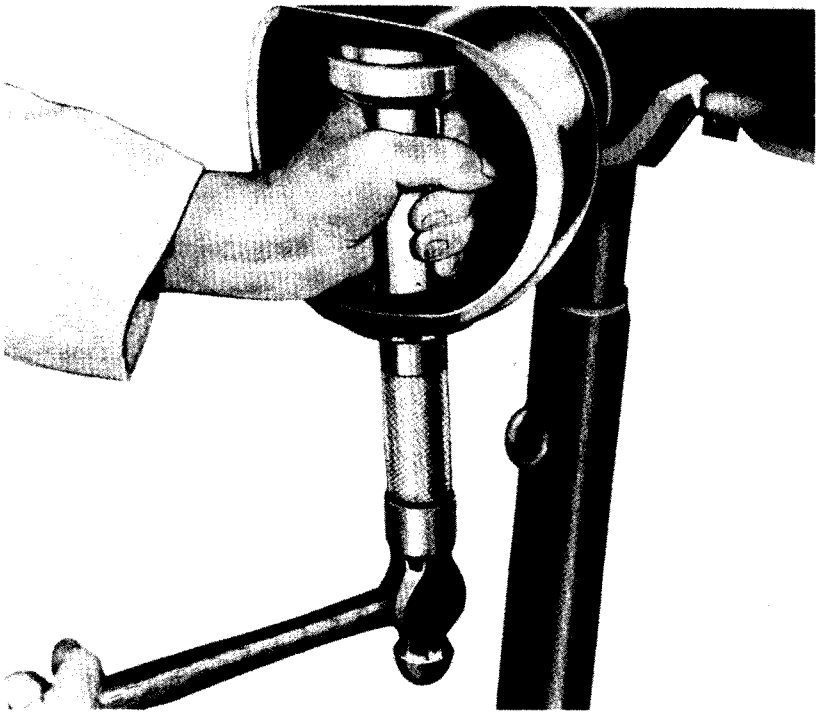

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***Figure 97—Steering Knuckle Bearing Cup Removal (Driver Head 41-H-1782—Handle 41-H-1074)***

## CLEANING, INSPECTION, AND REPAIR—BANJO AXLE

**c. Steering Arm Ball Stud Replacement.**

(1) REMOVE BALL STUD. Remove cotter pin from stud. Loosen nut until it is just beyond the threaded end of stud. Hit nut with a soft hammer to loosen stud, and remove nut and ball stud.

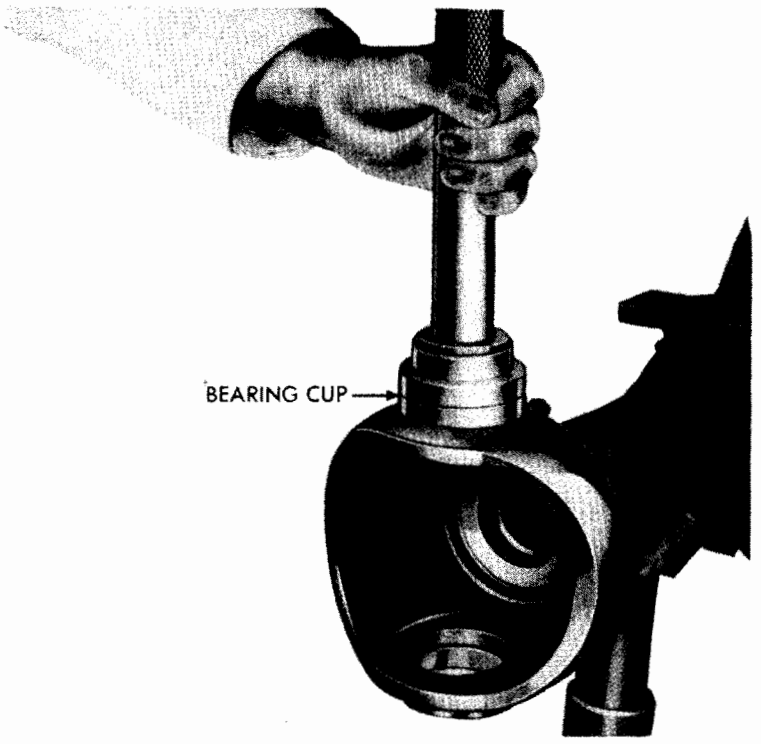
(2) INSTALL BALL STUD. Install new ball stud and install nut. Hit ball stud two or three times with soft hammer to make sure stud is fully seated. Tighten nut securely, and install new cotter pin.

**d. Tie Rod Yoke.** Using suitable brazing equipment, build up shoulder on top of yoke, then grind square with yoke bolt head contact surface so side of shoulder fits flush against flat side of bolt head to prevent bolt from turning.

**e. Axle Housing.**

(1) STEERING KNUCKLE BEARING CUP REPLACEMENT.

*(a) Remove Bearing Cups.* Remove upper bearing cup and oil retainer, using driver head (41-H-1782) and handle (41-H-1074) through lower bearing (fig. 97). After upper bearing cup and oil retainer have been removed, lower bearing cup may be driven out from the top, using the same tool.




RA PD 307465

***Figure 98—Steering Knuckle Bearing Cup Installation (Driver Head 41-H-1782—Handle 41-H-1074)***

*(b) Install Bearing Cups.* Install oil retainer and new bearing cup at top, using driver head (41-H-1782) and handle (41-H-1074) (fig. 98). Install lower bearing cup, using same tool. No oil retainer is used at bottom.

(2) AXLE SHAFT OIL SEAL REPLACEMENT. Two types of external construction are used in the fabrication of axle shaft oil seals. Both types bear the same part number.

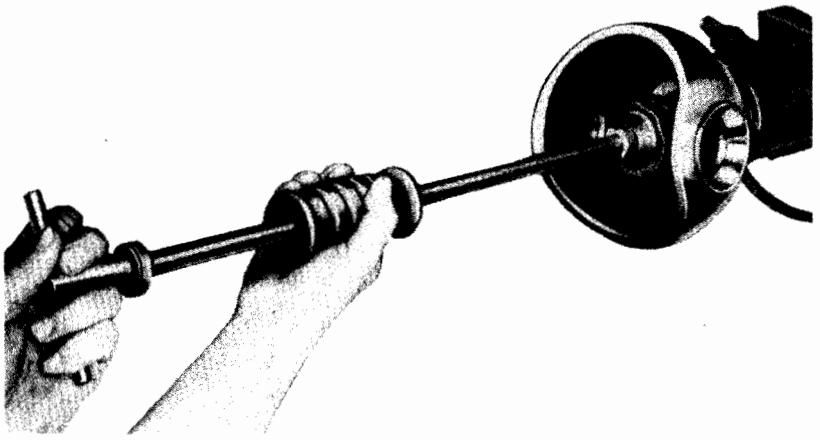
*(a) Remove Oil Seal.* Remove oil seal from housing outer end, using universal puller (41-P-2957) as shown in figure 99.

*(b) Prepare New Seal.* Soak new seal in warm oil until leather is soft and pliable.

*(c) Install Oil Seal.* Axle shaft thrust washer must be in place when making this installation. Drive seal in, with lip of seal toward differential, until shoulder on driver contacts thrust washer (fig. 100). By driving seal in with replacer (KM-J-4220) seal will be located with proper clearance (1/32-3/32 in.) between inner side of seal and washer in housing.

(3) AXLE SHAFT THRUST WASHER REPLACEMENT.

*(a) Remove Thrust Washer.* Remove thrust washer from housing outer end by driving a sharp chisel between thrust washer and thrust washer seat at stake marks. Be careful not to damage thrust washer seat in housing with chisel.



RA PD 316805

***Figure 99—Axle Shaft Oil Seal Removal (Puller 41-P-2957)***

## CLEANING, INSPECTION, AND REPAIR—BANJO AXLE

*(b) Install Thrust Washer.* Install new thrust washer and secure in place by staking at four points. Washer must be flat and fully seated and must not be distorted in staking operation.

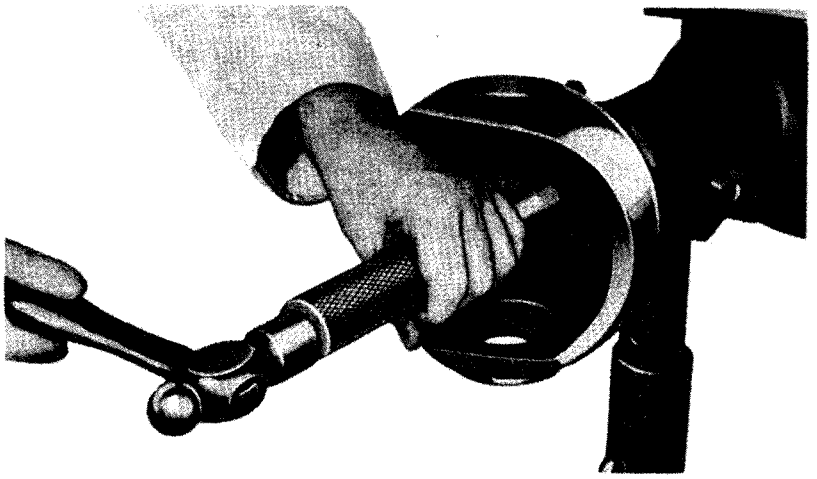


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***Figure 100—Axle Shaft Oil Seal Installation (Replacer KM-J-4220)***

# CHAPTER 7

# BANJO TYPE FRONT AXLE

## Section IV

## FRONT AXLE ASSEMBLY



### 57. GENERAL.

**a.** Before starting to assemble the axle and component assemblies, be sure all parts have been thoroughly cleaned, inspected, and repaired, when possible, as directed in Section III. Obtain new parts to be used in place of damaged or worn parts. Discard all gaskets and lock washers and obtain new ones for assembly.

**b.** The differential and carrier assembly must be disassembled, cleaned, inspected, repaired, and assembled as instructed in paragraphs 82, 83, and 84. The brake shoe assemblies and the hub and drum assemblies must be treated likewise as directed in their respective chapters.

### 58. AXLE SHAFT AND UNIVERSAL JOINT ASSEMBLY BENDIX-WEISS) (fig. 95).

**a. Select Correct Size Balls.** If play develops from wear in a universal joint (par. 50 **b**), and the ball races are in good condition, the difficulty may be remedied by the installation of larger drive balls. Drive balls are available in kits of seven sizes: 0.001, 0.002, 0.003 inch undersize, standard, and 0.001, 0.002, and 0.003 inch oversize. Measure the 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 drive 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 drive balls should be installed diagonally across from each other.

**b. Place Inner Shaft in Vise.** Place inner shaft in vise with universal joint end up. Be sure vise does not grip on a ground surface.

**c. Position Center Ball.** Place center ball, the one with hole and groove, on the seat at the center of the inner shaft yoke.

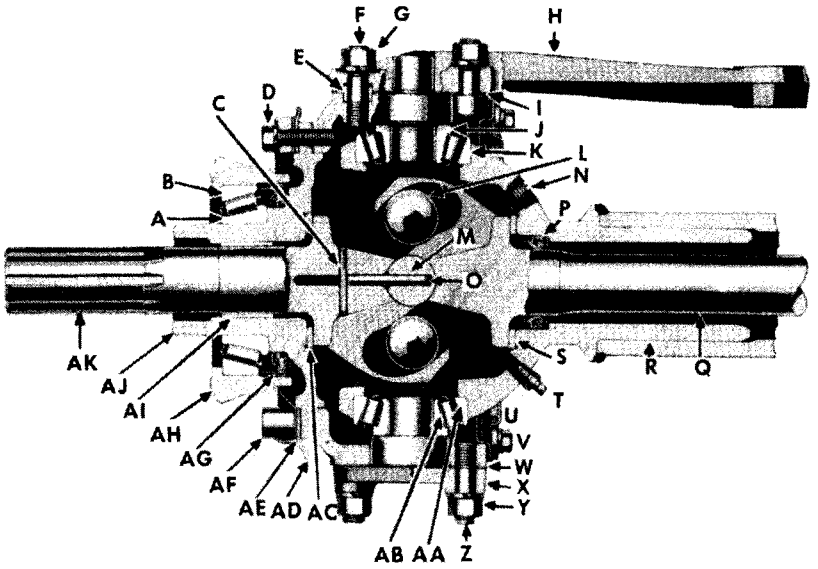
## FRONT AXLE ASSEMBLY—BANJO TYPE

**d. Install Center Ball Pin.** Insert center ball pin in drilled passage in outer shaft (fig. 102).

**e. Position Outer Shaft.** Place outer shaft in position over inner shaft, being sure that center ball pin does not drop out during this operation.

**f. Install Three Drive Balls.** Bend outer shaft to an extreme angle at joint and slip three drive balls into the races. Be sure the two largest drive balls are diagonally across from each other.

**g. Install Fourth Drive Ball.** Bend outer shaft at joint in opposite direction to give clearance to install fourth drive ball. Rotate




A BEARING CONE AND ROLLER ASSEMBLY
B BEARING CUP
C CENTER BALL PIN LOCK PIN
D CAP SCREW
E DOWEL RING
F STUD
G STUD NUT
H STEERING ARM
I SHIMS
J STEERING KNUCKLE BEARING CONE
K STEERING KNUCKLE BEARING CUP
L BALL
M CENTER BALL
N HOUSING OUTER END PLUG
O CENTER BALL PIN
P AXLE SHAFT OIL SEAL
Q INNER AXLE SHAFT
R AXLE HOUSING
S THRUST WASHER
T LUBRICATION FITTING
U HOUSING OUTER END SEAL INNER RETAINER
V CAP SCREW
W SHIMS
X KNUCKLE TRUNNION
Y STUD NUT
Z STUD
AA STEERING KNUCKLE BEARING CUP
AB STEERING KNUCKLE BEARING CONE
AC THRUST WASHER
AD BRAKE FLANGE PLATE
AE OIL DEFLECTOR
AF BRAKE ANCHOR PLATE SPACER
AG WHEEL BEARING OIL SEAL
AH HUB
AI STEERING KNUCKLE BUSHING
AJ STEERING KNUCKLE
AK OUTER AXLE SHAFT

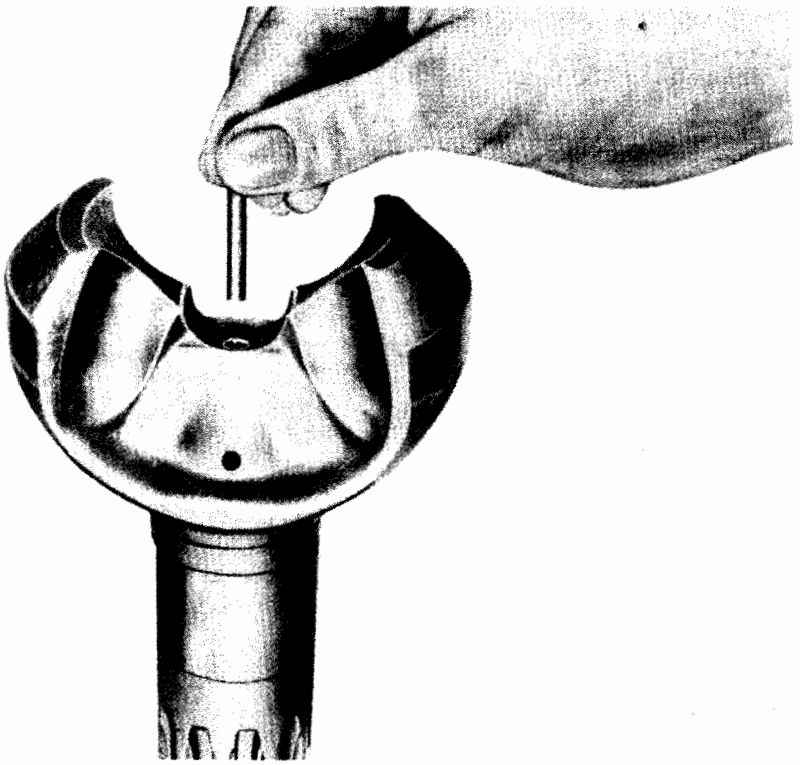
RA PD 316819

***Figure 101—Banjo Axle Steering Knuckle and Universal Joint Assembly***

center ball to line up grooved side with race for the remaining drive ball (fig. 94). Slip the fourth drive ball past center ball into race and bend outer shaft to a straight position.

**h. Position Center Ball Pin.** Raise outer shaft to loosen center ball and rotate center ball until center ball pin drops into drilled hole.

**i. Install Center Ball Pin Lock Pin.** Install a new lock pin in hole drilled in outer shaft and drive into position. Remove axle shaft and universal assembly from vise and lay on bench or anvil so as



RA PD 307426

***Figure 102—Center Ball Pin Installation***

to support one end of the lock pin. Strike end of lock pin sharply with prick punch to expand the end of the pin and lock it in position. Turn assembly over and expand other end of lock pin in the same manner.

**j. Check Universal Joint Play or Backlash.** When oversize drive balls have been installed in used races, it is only necessary to see that no play or backlash exists when shaft is in a vertical position, and that not more than 35 pounds pull is required to move shaft through its normal operating range.

**FRONT AXLE ASSEMBLY—BANJO TYPE**

(1) POSITION ASSEMBLY IN VISE. Install axle shaft and universal joint assembly in a 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 metal or wood protectors in jaws of vise.

(2) DETERMINE PLAY OR BACKLASH. Firmly push down on outer shaft so that it rests on 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 drive balls.

(3) DETERMINE PULL REQUIRED TO MOVE SHAFT THROUGH ITS NORMAL OPERATING RANGE. With assembly still mounted in vise, attach a spring scale to the extreme outer 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 35 pounds indicates that drive balls of too large an oversize have been installed. Ideal conditions when oversize drive balls are installed in used races are:

Vertical or straight position—free with no lash.

10 to 15 degree turn—slight drag, not to exceed 35 pounds.

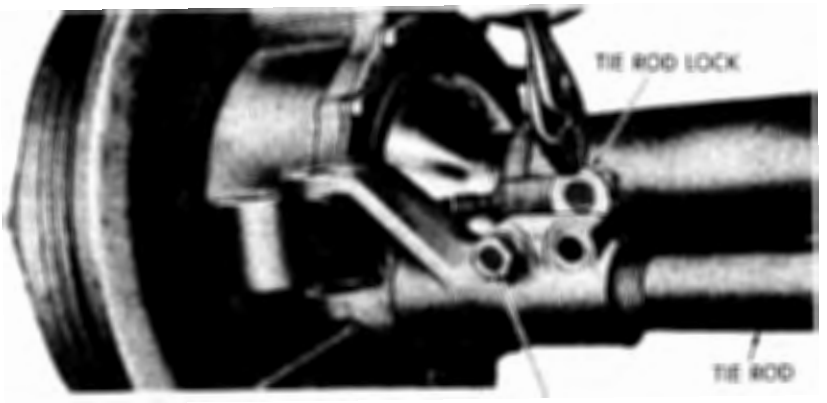
15 to 30 degree or full turn—free with some lash permissible.

## 59. DIFFERENTIAL AND CARRIER ASSEMBLY.

**a.** This procedure is the same as for the banjo type rear axle differential and carrier assemblies and is fully covered in paragraph 84.

## 60. TIE ROD ASSEMBLY.

**a. Install Tie Rod Yokes.** Thread left-hand tie rod yoke (fine threads) on left end of tie rod. Thread right-hand tie rod yoke (coarse threads) on right end of tie rod. Turn yokes on tie rod until overall length from centers of tie rod yoke bolt holes is 54-21/32 inches. Thread engagement must be approximately equal at both ends.




TIE ROD YOKE TIE ROD YOKE CLAMP BOLT

RA PD 332877

***Figure 103—Installing Tie Rod Lock***

**b. Install Clamp Bolts, Nuts, Lock Washers, and Tie Rod Lock.** Install two clamp bolts, new lock washers, and nuts in right-hand yoke. Install outer clamp bolt, new lock washer, and nut in left-hand yoke. Install tie rod lock in slot (fig. 103) in left-hand yoke, insert inner clamp bolt through yoke and lock, and install new lock washer and nut. Do not tighten nuts on clamp bolts, since toe-in will have to be adjusted when axle assembly is installed on vehicle.

## 61. AXLE ASSEMBLY (fig. 86).

**a. Install Differential and Carrier Assembly.** Installation of the front axle differential and carrier assembly is the same as for the rear axles and is fully covered in paragraph 85.

**b. Install Axle Housing Cover.**

(1) POSITION GASKET. Position gasket on axle housing with holes in gasket alined with cap screw holes in housing.

(2) INSTALL COVER. Install axle housing cover with the words "Front Oil Level" right side up. Aline holes in cover with cap screw holes in housing and install 10 cover to housing cap screws with new lock washers. Tighten cap screws alternately and evenly until tight.

**c. Install Steering Knuckle Support and Bearings.**

(1) LUBRICATE BEARINGS. Make sure bearings are clean. Pack

RA PD 64531

*Figure 104—Dust Seal Installation*

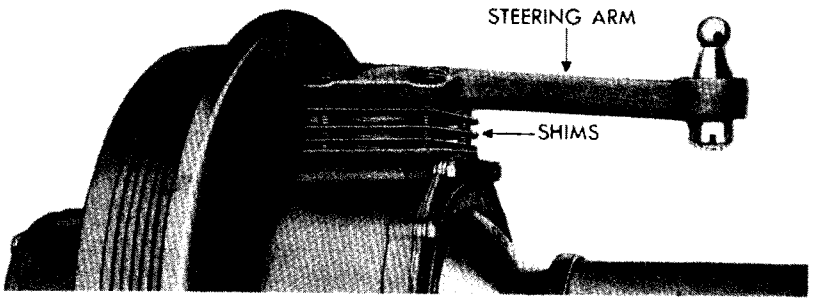
bearings with chassis grease (CG). By hand or with bearing lubricator, force lubricant into bearings. Coat bearing cups in housing outer ends with chassis grease.

(2) INSTALL DUST SEAL AND GASKET. Slide outer retainer to steering knuckle support gasket and dust seal over housing outer end in manner illustrated in figure 104, and hang on axle housing near spring seat. Beveled side of dust seal must be toward housing outer end.

(3) INSTALL BEARINGS. Install bearings in bearing cups in housing outer ends, being sure bearings are in their original position (unless new bearings are being installed). Lower bearings will have to be held in place while steering knuckle support is being installed.

(4) INSTALL STEERING KNUCKLE SUPPORT. Place steering knuckle support over housing outer end with tie rod yoke arm toward rear of vehicle.

(5) INSTALL SHIMS (fig. 105). Coat shims with grease and install over studs, using one each of the following sizes at each trunnion: 0.002, 0.005, 0.010, and 0.030 inch. The same total shim thickness must be used at both top and bottom. At upper left-hand trunnion, be sure large holes in shims are over the outer studs so the dowel rings in the steering arm will seat properly.




RA PD 332878

***Figure 105—Steering Arm Installation***

(6) INSTALL TRUNNIONS (fig. 105). Install trunnions over trunnion studs and shims, seat trunnions and shims solidly, and install stud nuts with new lock washers (steering arm forms upper left-hand trunnion). Tighten trunnion stud nuts securely and evenly at top and bottom.

(7) CHECK STEERING KNUCKLE SUPPORT BEARING ADJUSTMENT. Install a torque wrench (41-W-3630) on trunnion stud nut in same position as illustrated in figure 106 and measure torque required to turn the steering knuckle support. Torque wrench scale reading should be 10 - 12 foot-pounds with steering knuckle support in motion. This test can be made with axle assembly installed on vehicle, but must be made with axle shaft removed, housing outer end seal removed, and with tie rod disconnected. Add or remove