

# 11-B

(DIRECT DRIVE)  
crawler tractor

## service manual

### TRANSMISSION

S/N 16C16001 - UP

Form 70682004 English  
(SAME AS 0682004-7)

#### **WARNING**

DO NOT OPERATE THIS MACHINE  
WITHOUT FIRST READING  
THE OPERATOR MANUAL

*English*



## FOREWORD

This manual contains the Fiat-Allis approved procedures for overhaul of 11-B Direct Drive transmission, bevel gear, and drive shaft U-joint.

All torque values given to this manual are for clean and lubricated threads.

Assure best results and maintain original quality by always using Fiat-Allis parts.

Always furnish Dealer with Crawler Tractor Serial Number when ordering parts.

Many equipment owners employ the Dealer's service department for all work other than routine lubrication, adjustments, and minor service. This practice is encouraged, as our Dealers are well informed and equipped to render factory approved service.

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# TOPIC 1 GENERAL DESCRIPTION

## 1.1 TRANSMISSION

### 1.1.1

The transmission is a constant mesh, helical gear, pressure lubricated, speed reduction unit designed to provide proper gear ratios for the required speed or power during operation of the tractor.

### 1.1.2

The transmission is controlled by two shift levers and provides six forward speeds and three reverse speeds. Speed and direction changes are accomplished by disengaging the engine clutch and moving shift lever(s) to desired speed range position. The shift levers move shifting collars into mesh with their corresponding gears by actuating shifting shafts that are clamped to shifting forks engaged with shifting collars. The shifting collars are located on gear hubs assembled on bevel pinion shaft and intermediate shaft.

### 1.1.3

The shifting movement of each shaft is controlled by detents located in shaft lock plates. The detents enter detent notches in the shifting shafts when shafts are shifted to desired speed range.

### 1.1.4

The transmission has a shifting lock mechanism connected by linkage to the engine clutch operating lever. The shifting lock mechanism is designed so the transmission can be shifted only when engine clutch operating lever is disengaged.

### 1.1.5

When engine clutch is engaged, the shifting lock mechanism moves a locking plunger between the shifting shaft detents and locks the detents in the notches of respective shifting

shafts. This locking action locks the shifting collars in mesh with the corresponding gears of the speed range to which the transmission has been shifted.

### 1.1.6

Pressure lubrication to transmission bushings, bearings and gear shift housing is supplied through a line from steering control valve to top shaft front bearing retainer, intermediate shaft front bearing retainer, bevel pinion shaft front bearing retainer, and gear shift housing. Lubricating oil from the various components spills to bottom of transmission housing and is returned to main housing by the rear set of gears in steering pump.

## 1.2 BEVEL GEAR

### 1.2.1

The bevel gear, located in center compartment of main housing, is attached to the flange on bevel gear shaft. The bevel gear shaft is supported at each end by tapered roller bearings contained in removable cages. The bevel gear is driven by transmission bevel pinion; power from bevel gear is transmitted through the steering clutches to the final drives.

## 1.3 DRIVE SHAFT UNIVERSAL JOINT

### 1.3.1

The universal joint transmits engine power from the engine clutch to the transmission. Universal joint can be disconnected and removed for removal of engine clutch and/or transmission without disturbing the engine or the bevel gear and the steering clutches.

# TOPIC 2 HYDRAULIC SYSTEM LUBRICANT SPECIFICATIONS, CAPACITY AND SERVICE

## 2.1 LUBRICANT SPECIFICATIONS

### 2.1.1

Oil for use in the hydraulic system must meet one of the following specifications:

#### 2.1.1.1

Transmission fluid "Type C-1 or C-2".

#### 2.1.1.2

Crankcase oil SAE 10W API classification "Service SD" or "MIL-L-2104B" Grade 10W.

#### 2.1.1.3

Automatic transmission fluid Dexron<sup>®</sup> or "Type A Suffix A".

### CAUTION

API Classification "Service CD" or "Series 3" oil is not recommended.

#### 2.1.1.4

When atmospheric temperature is below -10°F. (-23°C) Automatic Transmission Fluid Dexron<sup>®</sup>, "Type A-Suffix A", or lubricating oil meeting Military Specification MIL-L-10295B-OES must be used.

### CAUTION

Do not use "MIL-L-10295B-OES if the atmospheric temperatures remains consistently above -10°F. (-23°C).

## 2.2 CAPACITY AND SERVICE

### 2.2.1

18.5 gallons (70,0 lit) is required to fill the system after a complete overhaul of the transmission and/or bevel gear.

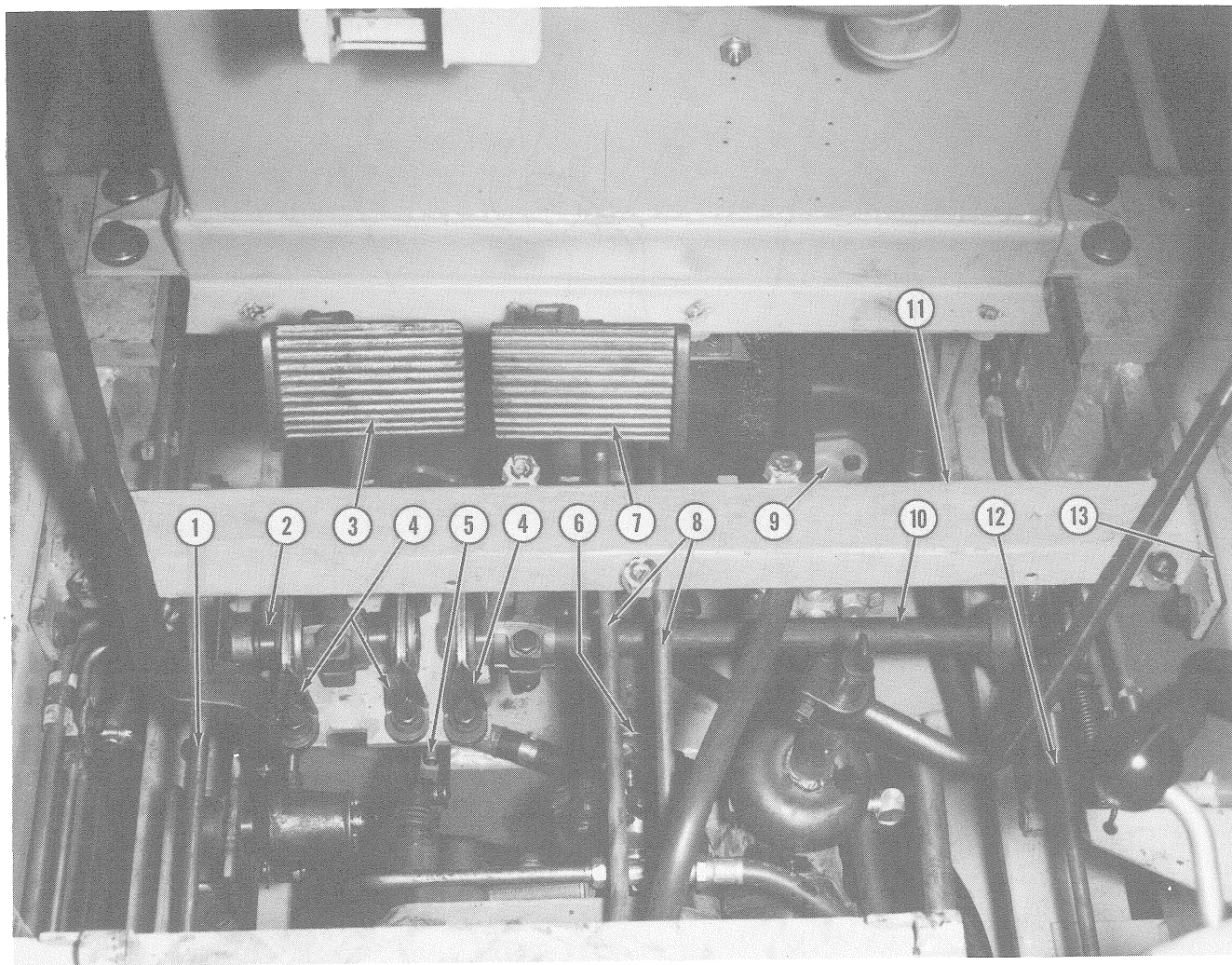
### 2.2.2

Service consists of changing oil, replacing filter element, cleaning steering suction line strainer element and cleaning transmission suction line screen. Perform service after making major repairs to any part of the system; replace filter element and clean steering suction line strainer element again after the first 50 hours of operation. Detailed service instructions; and specified service intervals are given in the Operator's Manual.

# TOPIC 3 TROUBLE-SHOOTING

TROUBLE	POSSIBLE CAUSE	REMEDY
Transmission hard to shift.	Clutch brake not adjusted properly.	Clutch brake adjustment (refer to Engine Clutch Service Manual for adjustment procedure).
	Worn or damaged shifting mechanism.	Inspect shifting shafts, collars, and forks; replace inoperable parts.
Transmission disengages during operation.	Shift lock mechanism worn.	Inspect for worn or broken plungers or springs or rounded off detent notches on shifting shafts. Replace defective parts.
	Shifting forks incorrectly positioned on shafts.	Reposition forks.
	Shifting forks and/or collar worn.	Replace worn parts.
Noise in transmission.	Insufficient lubricant.	Fill system to proper level with specified lubricant.
	Damaged or worn gears, bearings, shafts, or bushings.	Disassemble transmission and replace necessary parts.

## TOPIC 4 TRANSMISSION



T-76770

FIG. 1 BRAKE PEDALS AND SHAFTS

- |                                             |                                    |
|---------------------------------------------|------------------------------------|
| 1. Left brake control rod                   | 7. Right brake pedal               |
| 2. Left pedal shaft                         | 8. Steering control rods           |
| 3. Left brake pedal                         | 9. Steering pump                   |
| 4. Pedal shaft mounting bearings            | 10. Right pedal shaft              |
| 5. Transmission high-low shaft lock linkage | 11. Floor supporting channel       |
| 6. Universal joint                          | 12. Right brake control rod        |
|                                             | 13. Floor supporting channel shims |

### 4.1 REMOVAL

#### 4.1.1

Turn electrical system master switch off.  
Remove seat, floor plates, and transmission bottom guard.

#### 4.1.2

Remove plug from bottom of transmission case to drain oil from transmission; remove the three drain plugs from bottom of main housing to drain oil from bevel gear and steering clutch compartments.

# Transmission

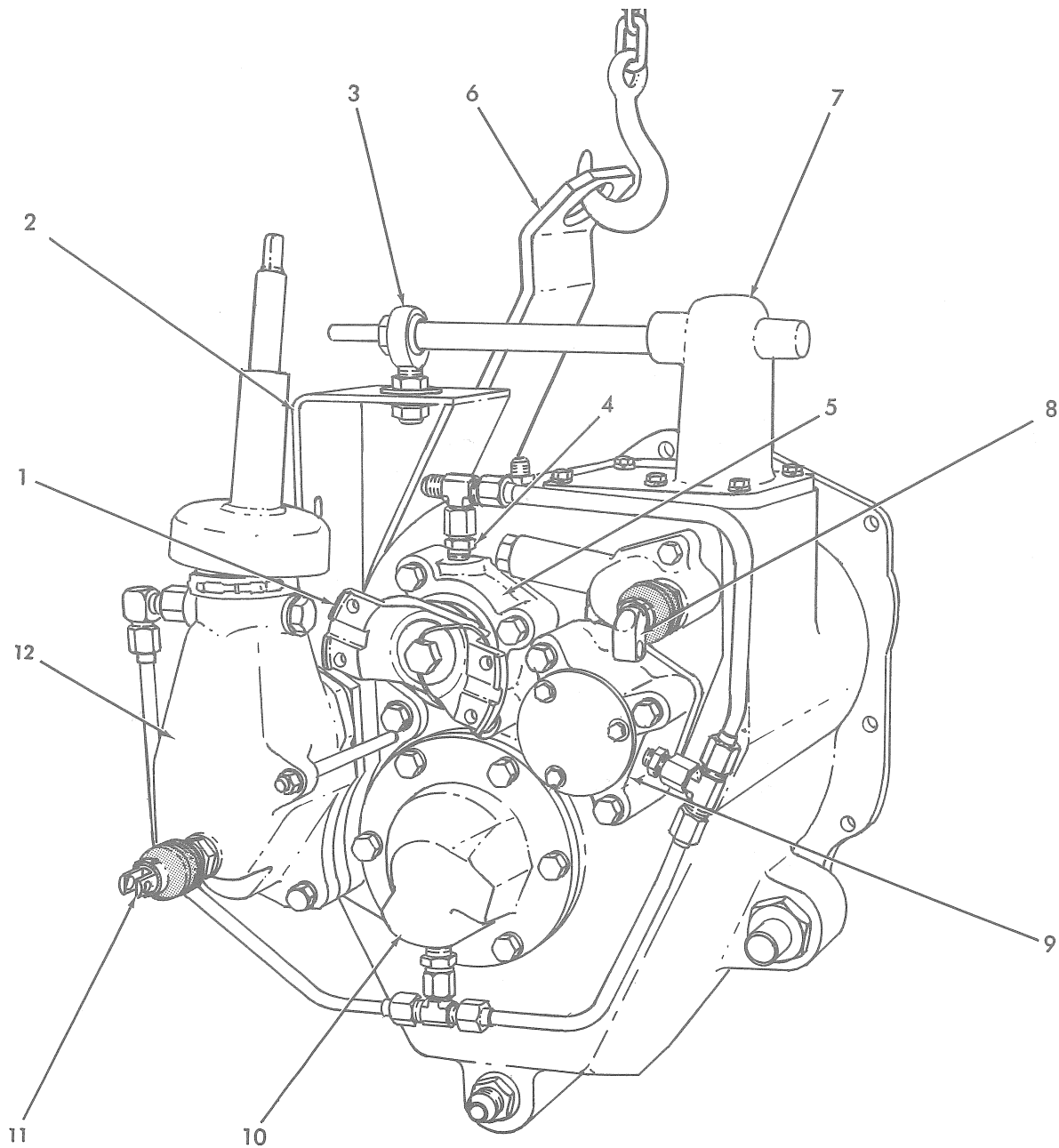
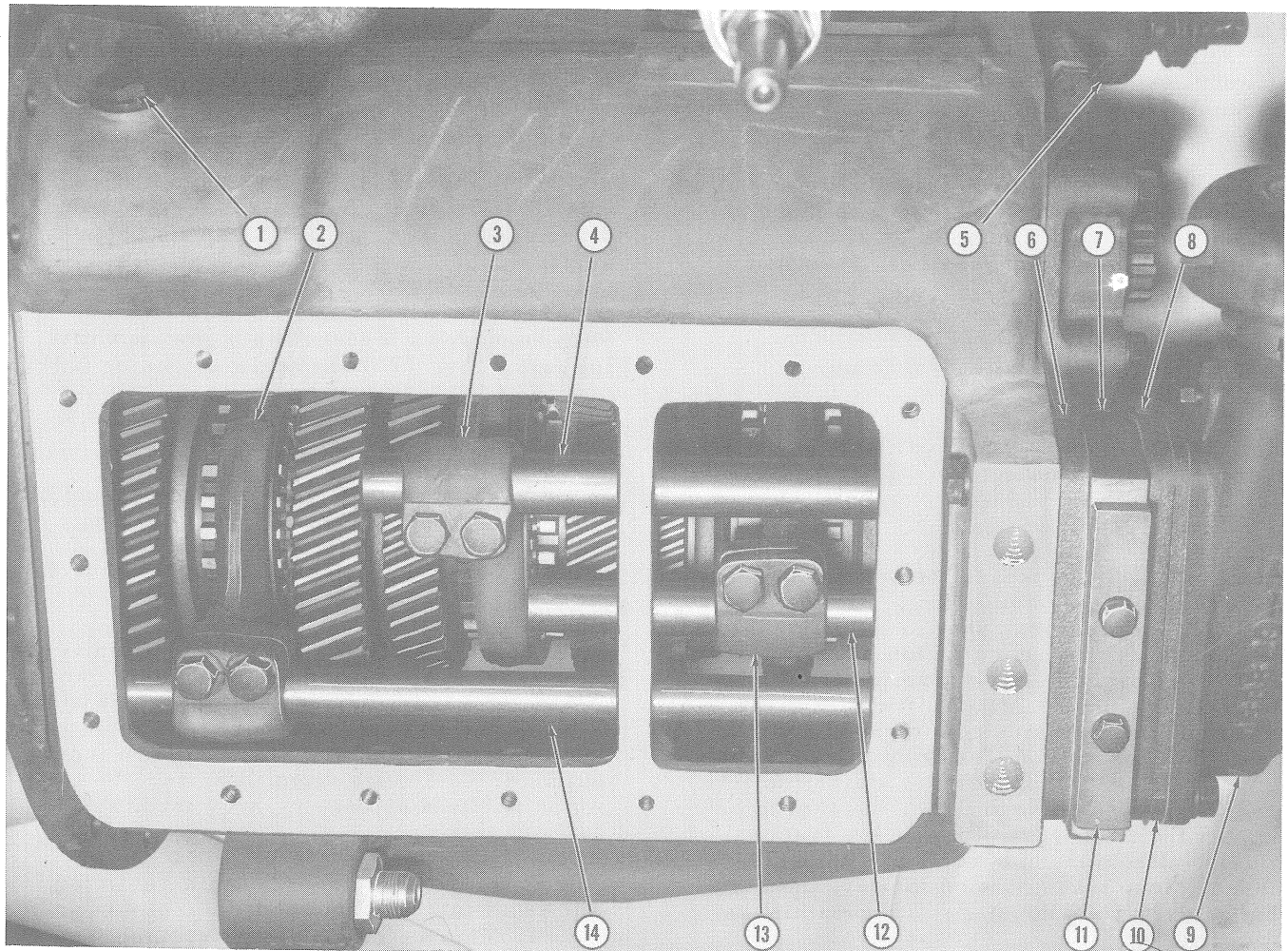


FIG. 2 TRANSMISSION FRONT VIEW

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- |                                      |                                               |
|--------------------------------------|-----------------------------------------------|
| 1. Drive shaft rear yoke             | 7. High-low shift lever housing               |
| 2. High-low gear shift lower bracket | 8. High-low shift lock plunger                |
| 3. Rod end                           | 9. Intermediate shaft front bearing retainer  |
| 4. Restricted connector              | 10. Bevel pinion shaft front bearing retainer |
| 5. Top shaft front bearing retainer  | 11. Speed shift lock plunger                  |
| 6. Lifting bracket                   | 12. Gear shift housing                        |

## Transmission



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FIG. 3 TRANSMISSION SHIFTING SHAFTS AND FORKS - NEUTRAL POSITION

- |                                                    |                                                     |
|----------------------------------------------------|-----------------------------------------------------|
| 1. Sleeve locking screw                            | 8. Shifting shaft front locking plate               |
| 2. 1st reverse, 1st and 2nd forward shifting fork  | 9. Speed selection gear shift housing               |
| 3. 3rd reverse, 4th and 6th forward shifting fork  | 10. Shifting shaft guiding plate                    |
| 4. 3rd reverse, 4th and 6th forward shifting shaft | 11. Detent plunger retaining bar                    |
| 5. High-low gear shift interlock housing           | 12. 2nd reverse, 3rd and 5th forward shifting shaft |
| 6. Shifting shaft rear locking plate               | 13. 2nd reverse, 3rd and 5th forward shifting fork  |
| 7. Shifting shaft plunger plate                    | 14. 1st reverse, 1st and 2nd forward shifting shaft |

### 4.1.3

Disconnect high - low gear shift and dozer control linkage (if so equipped); remove seat frame and support channel.

### 4.1.4

Disconnect steering pump oil lines from lower part of transmission. Disconnect other end of the one line from steering oil strainer below seat frame and remove the strainer.

### 4.1.5

Disconnect lube oil lines from fitting on upper right side of transmission; disconnect engine clutch breather line from top of transmission.

### 4.1.6

Remove floor plate supporting channel; attach spacing shims (if any) to channel so they will not be lost. Disconnect and remove steering control rods, Fig. 1 (8). Disconnect brake control rods (1) (12); remove brake pedals, shafts, and brackets.



## Transmission

### 4.1.7

If unit has a hydraulic dozer, the outlet in hydraulic tank must be plugged so the tank will not drain when dozer pump lines are disconnected. To plug outlet, remove suction line strainer and magnet from hydraulic tank and place a 4" (101,6 mm) diameter ball in strainer seat; rest strainer assembly on ball to hold it in place. After opening is plugged disconnect the dozer pump lines and remove the pump. Cover open end of oil lines that remain on tractor.

### 4.1.8

Remove drive shaft universal joint.

### 4.1.9

Disconnect transmission shaft lock linkage from gear shift housing and high-low interlock housing.

### 4.1.10

Attach a lifting bracket to the transmission. The bracket illustrated in Fig. 2 is made of 1/2" (12,7 mm) stock, shaped to conform to the contour of the transmission case and with the lifting point directly above the transmission center - line. Attach lifting bracket over transmission side cover in the second and third capscrews holes from the rear; use 3/8" NC Grade 8 capscrews to attach the bracket. Attach hoist to lifting bracket to support the transmission while the transmission attaching capscrews are being removed. Move transmission forward until top shaft clears main housing; lift transmission from tractor.

NOTE: Transmission weights approximately 650 lbs. (294,84 kg).

## 4.2 DISASSEMBLY

### 4.2.1

Clean outside of transmission before disassembly. Refer to Fig. 2. Remove high-low shift lever housing, shaft, and bracket; disconnect lubricating oil supply lines from front bearing retainers and from gear shift housing; remove transmission side cover and gasket.

### 4.2.2

Remove speed selection gear shift housing, Fig. 3 (9). Install capscrew in plates (6)(7)(8)(10) to hold them in position until shifting shafts are removed.

### 4.2.3

Remove detent plunger retaining bar, Fig. 3 (11) and gasket, plunger springs, and plungers from shifting shaft plunger plate (7). Loosen shifting fork retaining capscrews.

### 4.2.4

Pull shifting shaft, Fig. 3 (12), free of its shifting fork and through shaft locking plates. Pull shafts (14) and (4) toward front of transmission case until each shifting fork is free of key in shaft. Remove key from each shaft and pull each shaft out through shaft locking plates. Remove shifting forks and bronze wear collars from transmission case and place each collar and fork with its respective shaft.

### 4.2.5

With capscrews loosened in high-low shifting fork, Fig. 17 (20), remove housing (23) and shaft from transmission case; remove fork and bronze collar.

### 4.2.6

Remove shifting shaft guiding plate, Fig. 3 (10), plunger plate (7), and shaft locking plates (8) (6); use care to prevent loss of detents and spacer blocks, Figs. 14 and 15.

### 4.2.7

Refer to Fig. 2. Remove drive shaft universal joint rear yoke and top, intermediate, and pinion shaft front bearing retainers; tie shims to bevel pinion shaft retainer and intermediate shaft retainer. Remove snap ring and inner and outer seal rings from intermediate and pinion shaft front bearing retainers.

### 4.2.8

Unlock and remove front bearing retaining nuts from intermediate shaft and pinion shaft Fig. 4; remove rear bearing retaining nut from intermediate shaft, Fig. 5.

### 4.2.9

Assemble tools as shown in Fig. 6 and press bevel pinion shaft toward rear of transmission case until it is free of the front bearing inner race; remove tools and pull pinion shaft from case. Remove gear cluster (9) from transmission case as an assembly. Disassemble gear cluster (8) in transmission case and remove each component separately. Gear cluster (10) must remain in transmission case until intermediate shaft and components are removed.

NOTE: Do not remove gear bushings from hubs unless bushings are to be replaced.

### 4.2.10

Use tool set-up similar to Fig. 6 and press intermediate shaft toward rear of transmission case until it is free of front bearing inner race and high range gear bearing. Pull intermediate shaft out through rear of transmission case; remove intermediate shaft components as they free the shaft. The intermediate shaft rear bearing inner race,

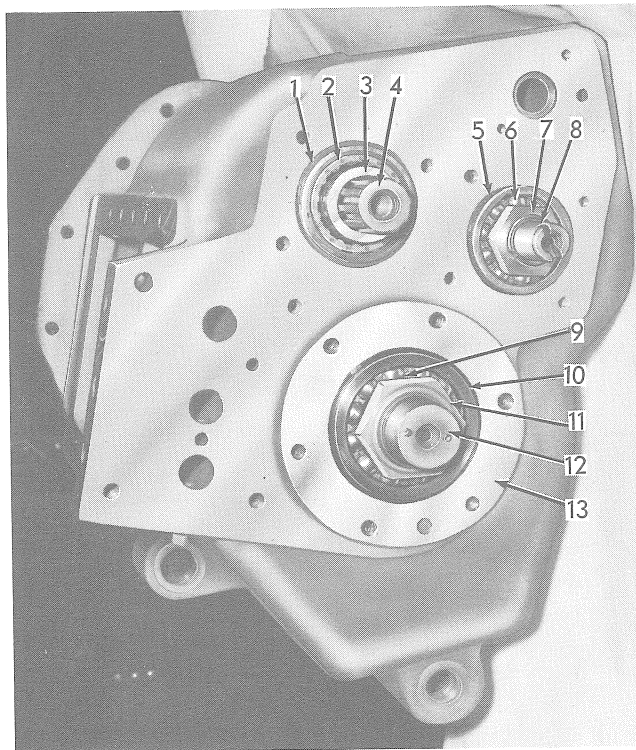
## Transmission

and 1st and 2nd speed gear will be removed with the shaft. Use a suitable press to remove bearing race and gear from shaft.

### 4.2.11

Disassemble bevel pinion shaft rear gear cluster in transmission case and remove each component as it is disassembled.

NOTE: Do not remove gear bushings from hubs unless bushings are to be replaced.



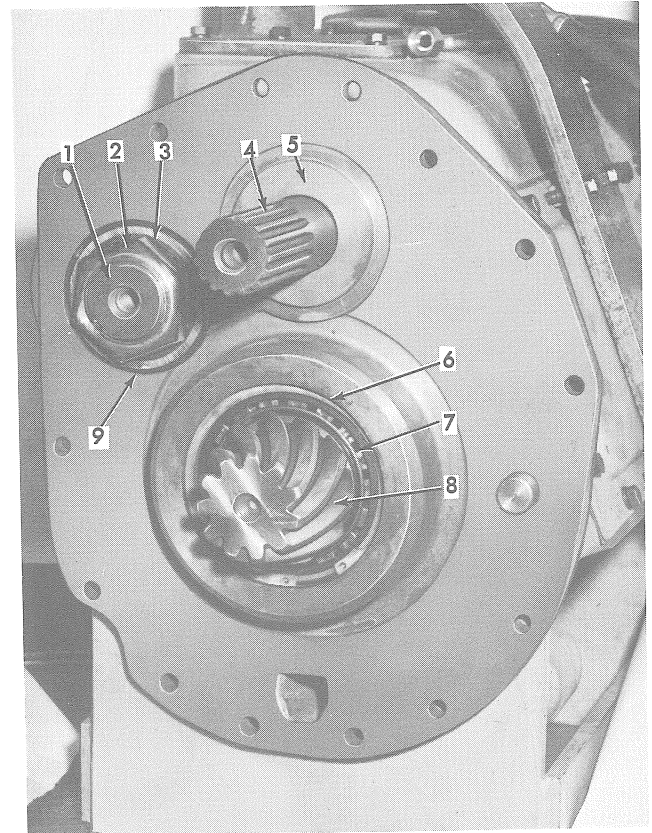
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FIG. 4 TRANSMISSION FRONT VIEW - BEARING RETAINERS REMOVED

- |                   |                                   |
|-------------------|-----------------------------------|
| 1. Snap ring      | 8. Intermediate shaft             |
| 2. Bearing        | 9. Bearing                        |
| 3. Bearing spacer | 10. Snap ring                     |
| 4. Top shaft      | 11. Nut                           |
| 5. Snap ring      | 12. Bevel pinion shaft            |
| 6. Bearing        | 13. Pinion depth adjustment shims |
| 7. Nut            |                                   |

### 4.2.12

Remove top shaft rear bearing sleeve locking screw, Fig. 3 (1); remove sleeve and sleeve adjustment shims. Use tool set-up similar to Fig. 6 and press top shaft out toward rear of transmission case; remove top shaft components as they free the shaft.



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FIG. 5 TRANSMISSION REAR VIEW

- |                          |                        |
|--------------------------|------------------------|
| 1. Intermediate shaft    | 5. Rear bearing sleeve |
| 2. Bearing retaining nut | 6. Snap ring           |
| 3. Rear bearing          | 7. Rear bearing        |
| 4. Top shaft             | 8. Bevel pinion shaft  |
|                          | 9. Snap ring           |

NOTE: The first reverse gear, rear bearings, and bearing retaining nut will remain on top shaft as it is removed from case. While removing top shaft, hold shaft in its normal position so rear bearing will properly enter and pass through outer bore in transmission case.

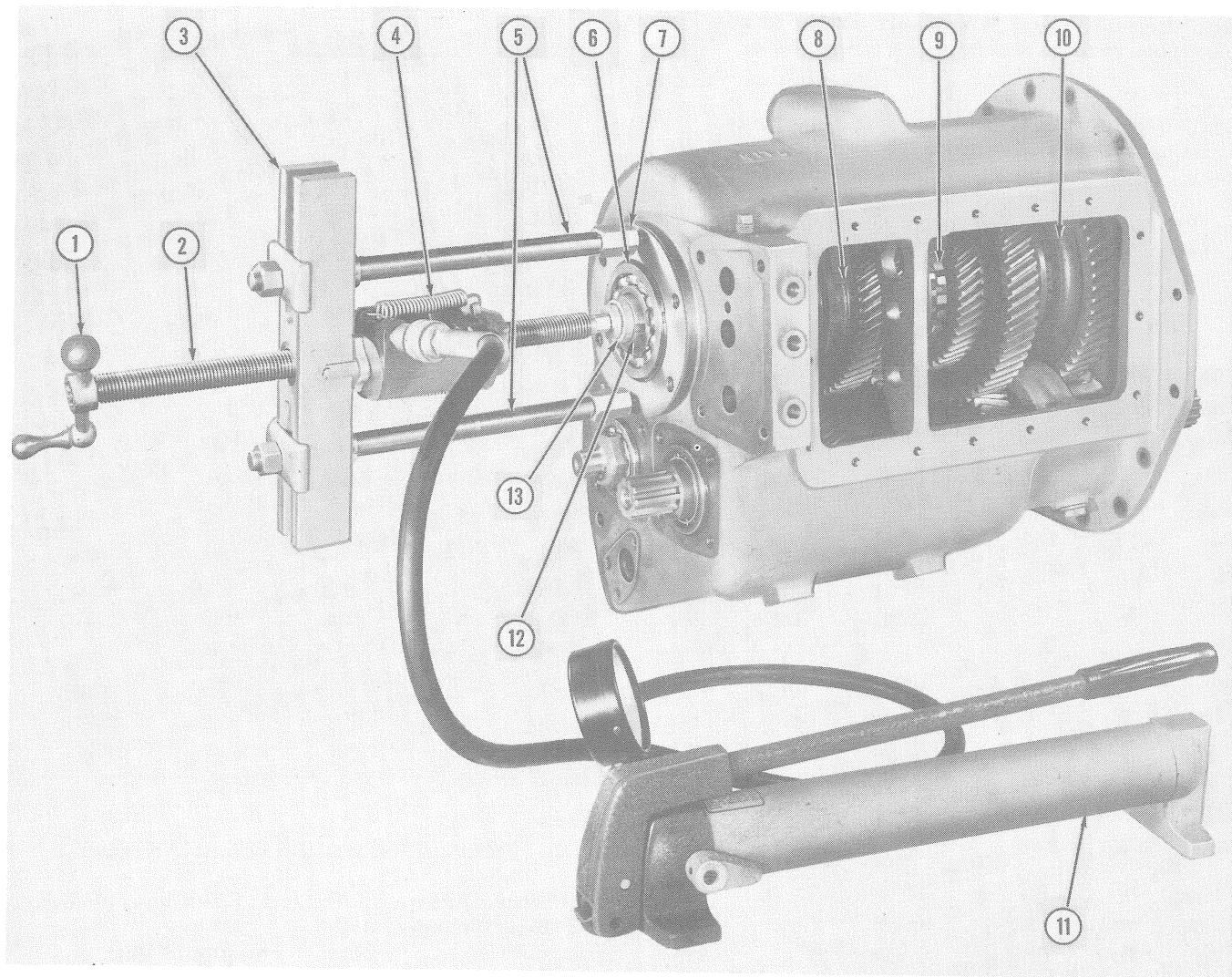
### 4.2.13

Unlock and remove top shaft rear bearing retaining nut. Use suitable press to remove 1st reverse gear and rear bearing from top shaft.

### 4.2.14

Remove snap ring, Fig. 5 (6); use tools similar to those in Fig. 7 to remove bevel pinion shaft rear bearing from bore in case. Remove bevel pinion shaft front bearing, top shaft front bearing, and intermediate shaft front bearing in a similar manner.

## Transmission



T-12118

FIG. 6 PRESSING BEVEL PINION SHAFT FROM FRONT BEARING

- |                           |                                                   |
|---------------------------|---------------------------------------------------|
| 1. Adjusting crank        | 8. 2nd reverse, 3rd and 5th forward gear cluster  |
| 2. Forcing screw          | 9. 3rd reverse, 4th and 6th forward gear cluster  |
| 3. Push-puller head       | 10. 1st reverse, 1st and 2nd forward gear cluster |
| 4. Hydraulic ram (17 ton) | 11. Hydraulic pump                                |
| 5. Puller legs            | 12. Shaft                                         |
| 6. Front bearing          | 13. Shaft protector                               |
| 7. Adapter                |                                                   |

NOTE: Tie pinion depth adjustment shims to front bearing to prevent loss; these shims will be required during assembly.

### 4.3 INSPECTION

NOTE: Refer to FITS and TOLERANCES for size of parts.

#### 4.3.1 BALL AND ROLLER BEARINGS

##### 4.3.1.1

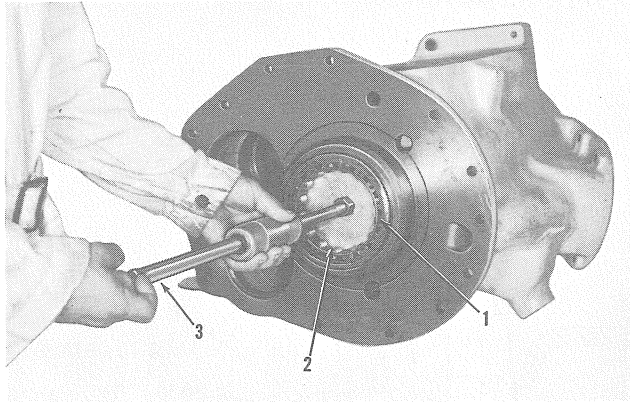
Thoroughly clean bearings in solvent and dry with compressed air free of moisture. Do not spin the bearing while drying it.

##### 4.3.1.2

Inspect bearings to see that they roll freely and are free from cracked, pitted or worn balls, rollers, and races. Make certain ball retainers are in good condition and are not dented or damaged.



## Transmission



T-41437

FIG. 7 REMOVING BEVEL PINION  
SHAFT REAR BEARING

- |                  |                 |
|------------------|-----------------|
| 1. Bearing       | 3. Slide hammer |
| 2. Pulling plate | puller          |

### 4.3.1.3

Badly worn ball bearings can be detected by the presence of excessive end play between outer and inner races. This condition can be detected by holding one race steady and moving other race end wise, comparing the difference in movement of the races of a used bearing with a new bearing.

### 4.3.1.4

Check outer and inner races for indications of bearing creepage. This can be detected by marks on bearing races or on bearing area of bore or shaft where bearing has been used.

### 4.3.1.5

If bearings are to be reused, keep them spotlessly clean, well lubricated, and wrap them in clean oil proof paper to prevent rusting and entrance of dirt. When installing new bearings, do not remove bearings from package until ready for assembling. Do not wash the lubricant from a new bearing.

### 4.3.1.6

Use a press and suitable sleeve or driver when installing bearings. If these are not available a cold rolled soft steel rod and a hammer may be used to drive bearings into position; do not strike bearing shield or ball retainer when installing.

### 4.3.1.7

Bearings may be heated to expand the bore of inner race to facilitate installation of bearing on a shaft. One method of transferring heat to bearings is through the use of hot oil. The bearing should never be placed directly on the bottom of a tank or container, but should be placed on a screen so that they may be heated uniformly. A light or medium grade of clean lubricating oil should be used and heated to approximately 275°F. (135°C).

### 4.3.1.8

When installing a bearing on a shaft, drive or press on inner race when installing it in a bore, drive or press on outer race.

### 4.3.1.9

When using a sliding hammer type puller to remove or install an assembly containing tapered roller bearings, be sure that the pull is evenly distributed on bearing. Do not allow cup and cone of bearings to become separated, as each blow of the sliding hammer (with cup and cone separated) will cause cup and cone to be rammed together and damage to bearing will result.

## 4.3.2 SHAFTS AND SPLINES

### 4.3.2.1

Inspect shafts for worn areas and make certain they are not twisted or bent. Inspect splines of shafts for roughness, burrs, and wear. Remove all burrs and slight roughness from splines with a mill file or stone. Try mating components on shaft to be sure they slide freely on the splines.

### 4.3.2.2

Check bearing journals to be certain they are smooth and within specified tolerances. Make certain all oil passages are clean.

## 4.3.3 OIL SEALS

### 4.3.3.1

When any work is done which involves removal of a shaft from an oil seal, or removal of an oil seal from shaft, the sealing lip of seal must be carefully examined afterwards.

### 4.3.3.2

The sealing lip must not be scratched, folded over, torn, or charred from heat. The lip must be flexible; the spring, located inside the lip must have proper tension to return lip to its proper position when lip is pressed in by hand.

### 4.3.3.3

When installing an oil seal on a shaft, or a shaft through a seal, be sure to protect sealing lip from damage which might be caused from a keyway, splines, threads, or a hole through the shaft. A scratch or cut, or a fold in lip of seal will render seal useless.

### 4.3.3.4

Before installing a seal in its bore, coat bore lightly with liquid-type gasket cement.

### 4.3.3.5

Always lubricate lips of seals with clean oil at assembly.

# Transmission

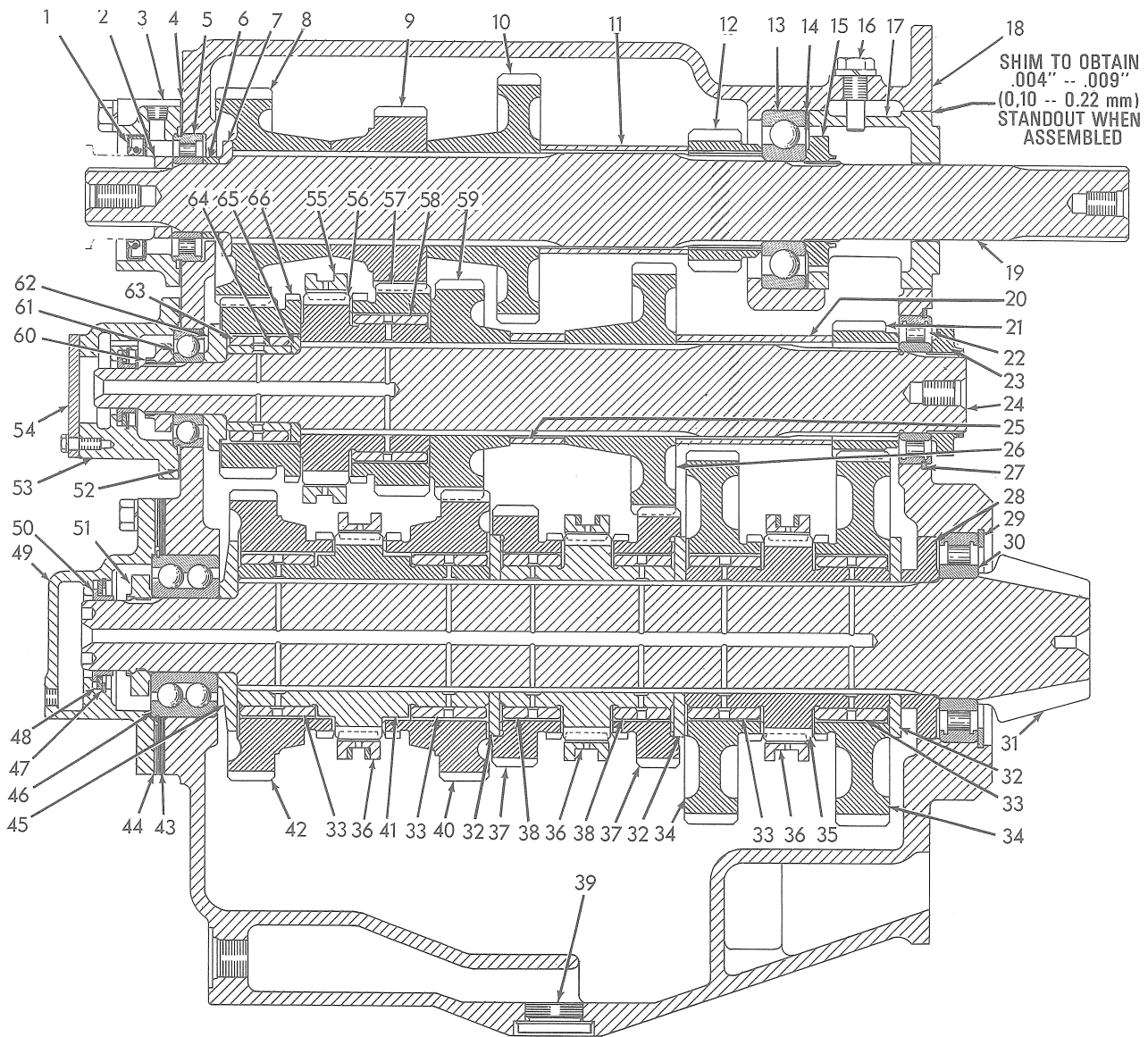


FIG. 8 TRANSMISSION

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## Transmission

### LEGEND FOR FIG. 8

1. Oil seal
2. Spacer (.490" - .495" -- 12,44 - 12,57 mm -- long)
3. Front bearing retainer
4. Gasket
5. Front bearing
6. Sleeve (.435" - .440" -- 11,04 - 11,17 mm -- long)
7. Spacer (.375" - .380" -- 9,52 - 9,65 mm -- long)
8. High range and 2nd reverse gear (41 teeth)
9. Low range gear (34 teeth)
10. 3rd reverse gear (46 teeth)
11. Sleeve (3.883" - 3.886" -- 98,62 - 98,70 mm -- long)
12. 1st reverse gear (21 teeth)
13. Rear bearing
14. Sleeve locating shims
15. Rear nut
16. Sleeve locking screw
17. Rear bearing sleeve
18. Case
19. Top shaft
20. Sleeve (4.124" - 4.127" -- 104,79 - 104,82 mm -- long)
21. 1st and 2nd speed gear (22 teeth)
22. Rear bearing
23. Rear nut
24. Intermediate shaft
25. Sleeve (1.353" - 1.356" -- 34,36 - 34,44 mm -- long)
26. 4th and 6th speed gear (46 teeth)
27. Snap ring
28. Spacer (1.020" - 1.030" -- 25,90 - 26,16 mm -- long at I. D. )
29. Snap ring
30. Rear bearing
31. Bevel pinion shaft
32. Gear spacing washer (.318" - .320" -- 8,07 - 8,32 mm -- wide)
33. Bushing
34. 1st reverse and 1st and 2nd speed gear (62 teeth)
35. Gear hub
36. Shifting collar
37. 3rd reverse and 4th and 6th speed gear (48 teeth)
38. Bushing
39. Drain plug
40. 3rd and 5th speed gear (55 teeth)
41. Gear hub
42. 2nd reverse gear (55 teeth)
43. Pinion depth adjustment shims
44. Bearing adjustment shims
45. Bearing spacing washer (.503" - .508" -- 12,77 - 12,90 mm -- wide at I. D. )
46. Front bearing
47. Snap ring
48. Inner sealing ring
49. Front bearing retainer
50. Outer sealing ring
51. Front nut
52. Bearing end play shims
53. Front bearing retainer
54. Cover plate
55. Shifting collar
56. Gear hub
57. Low range gear (40 teeth)
58. Bushing
59. 3rd and 5th speed gear (41 teeth)
60. Front nut
61. Front bearing
62. Spacing washer (.560" - .565" -- 14,22 - 14,35 mm -- wide at I. D. )
63. Bushing
64. High range gear inner race
65. Spacing washer (.249" - .254" -- 6,32 - 6,45 mm -- wide)
66. High range gear (32 teeth)

#### 4.3.4 GASKETS

##### 4.3.4.1

When a gasket is removed, clean the gasket and inspect it for damage. If it is in good condition and is to be used again, immerse it in a container of clean oil and keep it in the container until it is needed. Do not use a gasket which is torn, hardened, shrunken, or stretched out of shape.

#### 4.3.5 GEARS

##### 4.3.5.1

Thoroughly clean and inspect all gears for worn, pitted, chipped, or cracked teeth.

##### 4.3.5.2

Check internal splines for galling, roughness and wear; make certain gears slide freely on shaft splines.

#### 4.3.6 HUBS AND BUSHINGS

##### 4.3.6.1

Inspect hubs and bushings for excessive wear, scoring and looseness (refer to FITS AND TOLERANCES). Make certain oil holes are clean.

#### 4.3.7 SHIFTING FORK WEAR COLLARS

##### 4.3.7.1

Replace collars if severely worn or if damaged (See FITS AND TOLERANCES)

### 4.4 ASSEMBLY

#### 4.4.1 TOP SHAFT INSTALLATION

##### 4.4.1.1

Install gear Fig.9 (15) on shaft and press bearing (16) on shaft until it bottoms on shoulder. Install nut (18) and torque it to 175 to 200 lbs.ft. (24,18 to 27,65 kg/ m); lock nut by staking.

## Transmission

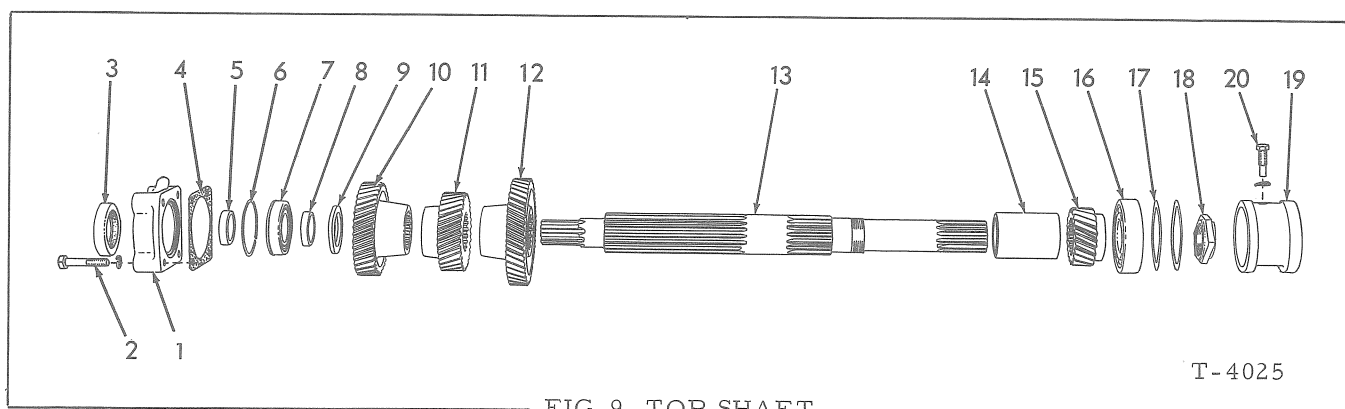


FIG. 9 TOP SHAFT

T-4025

1. Front bearing retainer
2. Capscrew
3. Oil seal
4. Gasket
- \*5. Spacer
6. Snap ring
7. Front bearing
- \*8. Sleeve
- \*9. Spacer
10. High range and 2nd reverse gear (41 teeth)

11. Low range gear (34 teeth)
  12. 3rd reverse gear (46 teeth)
  13. Shaft
  - \*14. Sleeve
  15. 1st reverse gear (21 teeth)
  16. Rear bearing
  17. Sleeve locating shims
  18. Rear nut
  19. Rear bearing sleeve
  20. Sleeve locking screw
- \*See Fig. 8 for size

### 4.4.1.2

Start shaft assembly into rear bore of transmission case; install gears and other components onto shaft as shaft is inserted. Refer to Fig. 8 for proper positioning of each component. Install spacer, Fig. 9 (9), with radius on inner diameter toward gear (10).

NOTE: Drive shaft rear yoke can be used to drive front bearing inner race on shaft.

### 4.4.1.3

Install outer race and bearing, Fig. 9 (7), with snap ring (6) in front bore of transmission case and install spacer (5) on shaft with radius on inner diameter toward bearing.

### 4.4.1.4

Install new oil seal, Fig. 9 (3), in retainer (1) with sealing lip of seal toward gears. Install retainer (with new gasket) on transmission case, but do not tighten capscrews at this time. Install universal joint rear yoke on shaft and through oil seal to center seal and retainer on yoke; tighten retainer capscrews securely and remove yoke from shaft.

### 4.4.1.5

Install original shims, Fig. 8 (14), and sleeve (17) into rear bore of transmission case. Add or remove shims between sleeve and rear bearing until outer diameter of sleeve extends .004" to .009" (0,10 - 0,22 mm) outward from rear face of transmission case. Align hole in sleeve with tapped hole in top of transmission case; install locking screw (16) to hold sleeve in position.

## 4.4.2 INTERMEDIATE SHAFT INSTALLATION

### 4.4.2.1

Install bevel pinion shaft rear gear cluster, Fig. 11 (6) (10) (14) (14A) (15), in case before installing intermediate shaft.

NOTE: If new bushings, Fig. 11 (6), are installed on hub (15), heat the bushings in oil to 275°F. (135°C) before installing them.

### 4.4.2.2

Install gear, Fig. 10 (5) on shaft. Press inner race of bearing (4) on shaft until race is tight against gear.

### 4.4.2.3

If new bushings, Fig. 10 (11) (16) are installed heat them in oil to 275°F. (135°C) and install them on hub and bearing race prior to installing intermediate shaft. Make certain holes in bearing race, hub, and bushings are aligned. Be sure chamfer in I.D. of washer, Fig. 8 (65) is against shoulder on shaft.

### 4.4.2.4

Start shaft through rear bore in case; install the shaft parts, Fig. 10, as the shaft is pushed through case. Position the parts on shaft as shown in Fig. 8.

### 4.4.2.5

Start front bearing on intermediate shaft; hold "bucking bar" against rear end of shaft and drive (or press) simultaneously against inner and outer bearing races until bearing snap

## Transmission

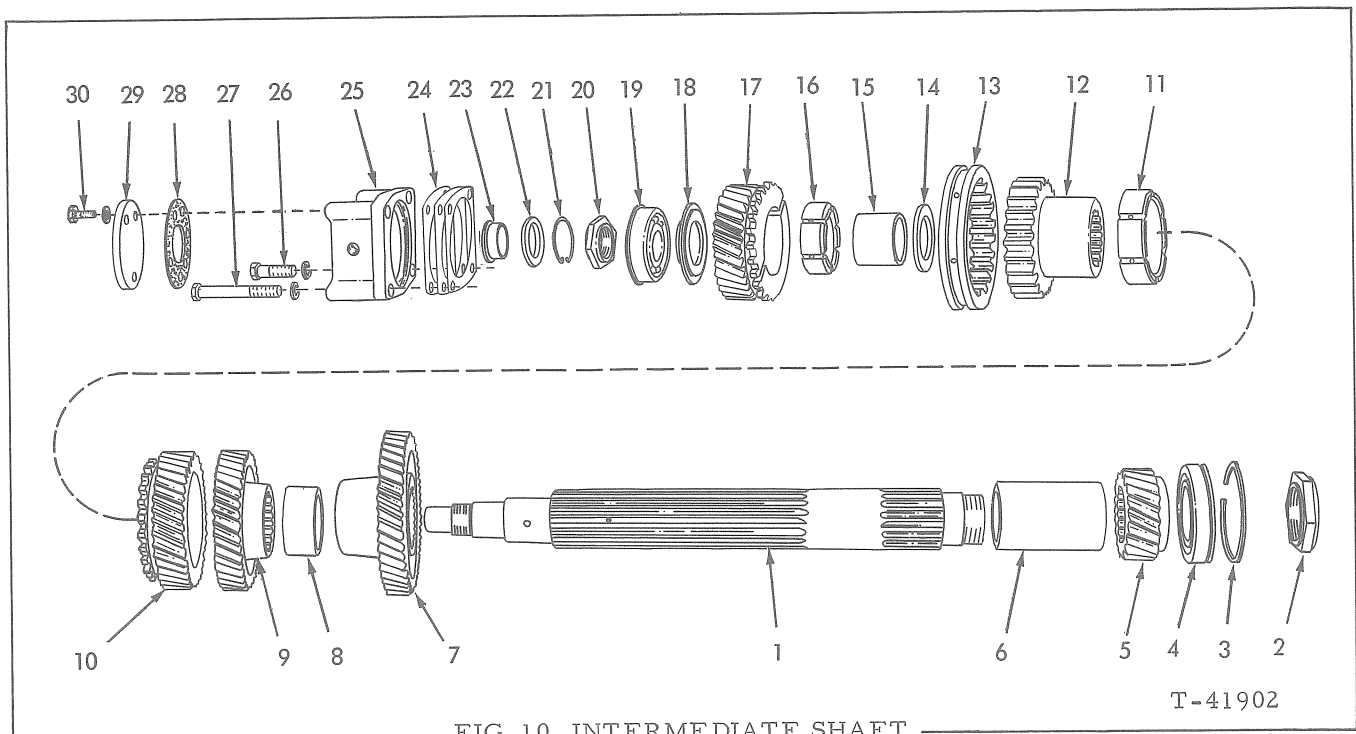


FIG. 10 INTERMEDIATE SHAFT

T-41902

- |                                      |                                |
|--------------------------------------|--------------------------------|
| 1. Shaft                             | 16. Bushing                    |
| 2. Rear nut                          | 17. High range gear (32 teeth) |
| 3. Snap ring                         | *18. Spacing washer            |
| 4. Rear bearing                      | 19. Front bearing              |
| 5. 1st and 2nd speed gear (22 teeth) | 20. Front nut                  |
| *6. Sleeve                           | 21. Snap ring                  |
| 7. 4th and 6th speed gear (46 teeth) | 22. Outer sealing ring         |
| *8. Sleeve                           | 23. Inner sealing ring         |
| 9. 3rd and 5th speed gear (41 teeth) | 24. Bearing end play shims     |
| 10. Low range gear (41 teeth)        | 25. Front bearing retainer     |
| 11. Bushing                          | 26. Capscrew (one used)        |
| 12. Gear hub                         | 27. Capscrew (three used)      |
| 13. Shifting collar                  | 28. Gasket                     |
| *14. Washer                          | 29. Cover plate                |
| 15. High range gear inner race       | 30. Capscrew                   |

\*See Fig. 8 for size

ring is against transmission case, and bearing inner race is tight against bearing spacer. Install front bearing retaining nut but do not tighten.

#### 4.4.2.6

Install rear bearing in transmission case over inner race; install snap ring and rear bearing retaining nut but do not tighten nut.

#### 4.4.3 BEVEL PINION SHAFT INSTALLATION

##### 4.4.3.1

Install rear spacing washer, Fig. 11 (5) and spacer (4) through rear bearing bore -- flange on spacer must be toward front of case.

##### 4.4.3.2

Install rear bearing, Fig. 11 (3) into transmission case and secure with snap ring (2). Turn case bottom up so that when gear clusters are installed they will stay in position.

NOTE: If new bushings are to be installed on any of the gear hubs, heat bushings to approximately 275°F. (135°C) in oil and install them on hubs at this time before proceeding; make certain oil holes are aligned.

##### 4.4.3.3

Install front gear cluster components Fig. 11 (6)(8)(9)(10)(11) and spacer (16) into case (position spacer with flat side toward gear). Position cluster as far forward as possible until cluster gears mesh with top shaft and intermediate shaft gears.

## Transmission

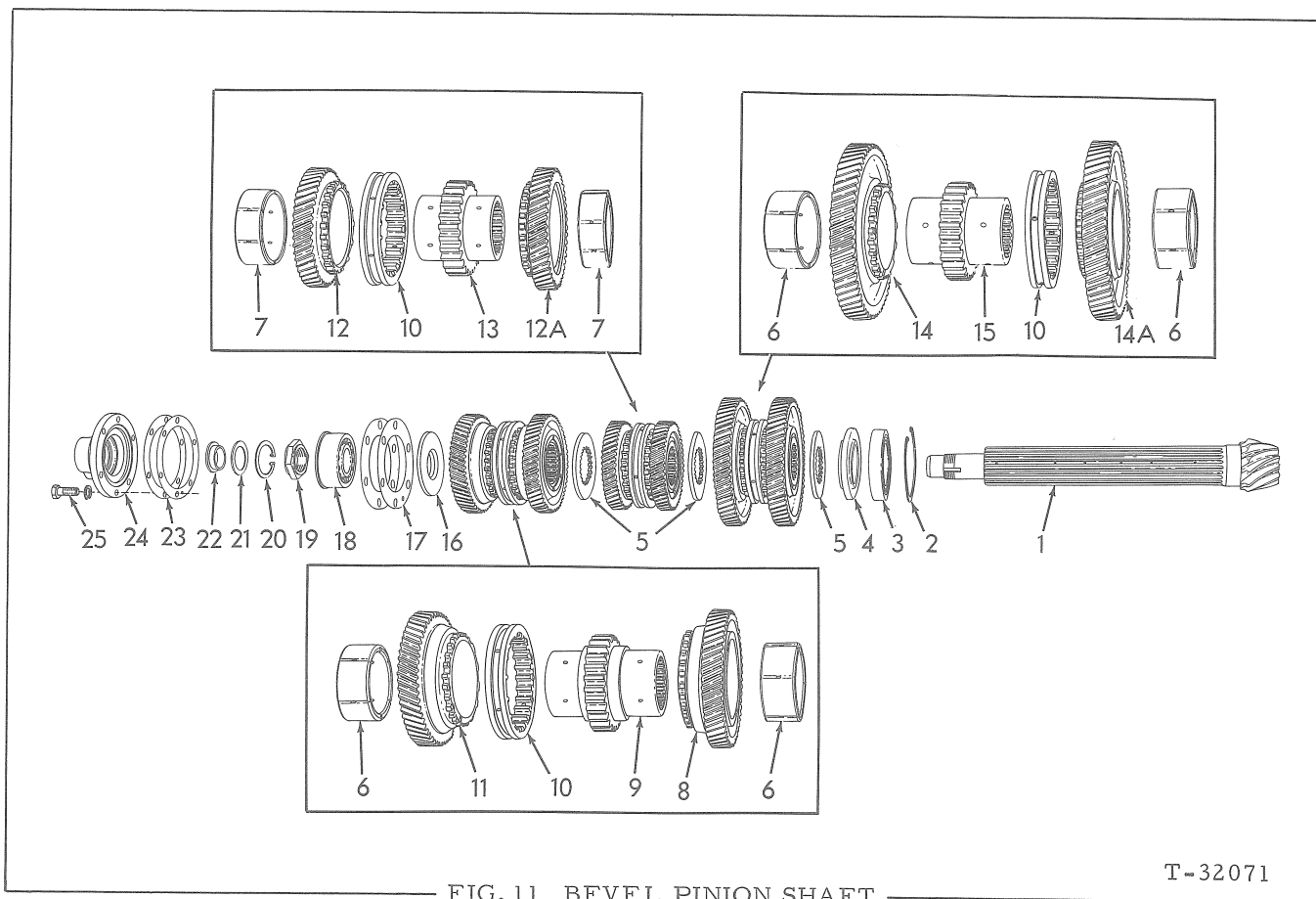


FIG. 11 BEVEL PINION SHAFT

T-32071

- |                                        |                                        |
|----------------------------------------|----------------------------------------|
| 1. Shaft                               | 14. 1st reverse gear (62 teeth)        |
| 2. Snap ring                           | 14A. 1st and 2nd speed gear (62 teeth) |
| 3. Rear bearing                        | 15. Gear hub                           |
| *4. Spacer                             | *16. Bearing spacing washer            |
| *5. Gear spacing washer                | 17. Pinion depth adjustment shims      |
| 6. Bushing (wide)                      | 18. Front bearing                      |
| 7. Bushing (narrow)                    | 19. Front nut                          |
| 8. 3rd and 5th speed gear (55 teeth)   | 20. Snap ring                          |
| 9. Gear hub                            | 21. Outer sealing ring                 |
| 10. Shifting collar                    | 22. Inner sealing ring                 |
| 11. 2nd reverse gear (55 teeth)        | 23. Bearing adjustment shims           |
| 12. 3rd reverse gear (48 teeth)        | 24. Front bearing retainer             |
| 12A. 4th and 6th speed gear (48 teeth) | 25. Capscrew                           |
| 13. Gear hub                           | *See Fig. 8 for size                   |

NOTE: If gears will not mesh, reverse positions of gears (8) and (11). Make certain short shoulder of hub is toward front of case.

### 4.4.3.4

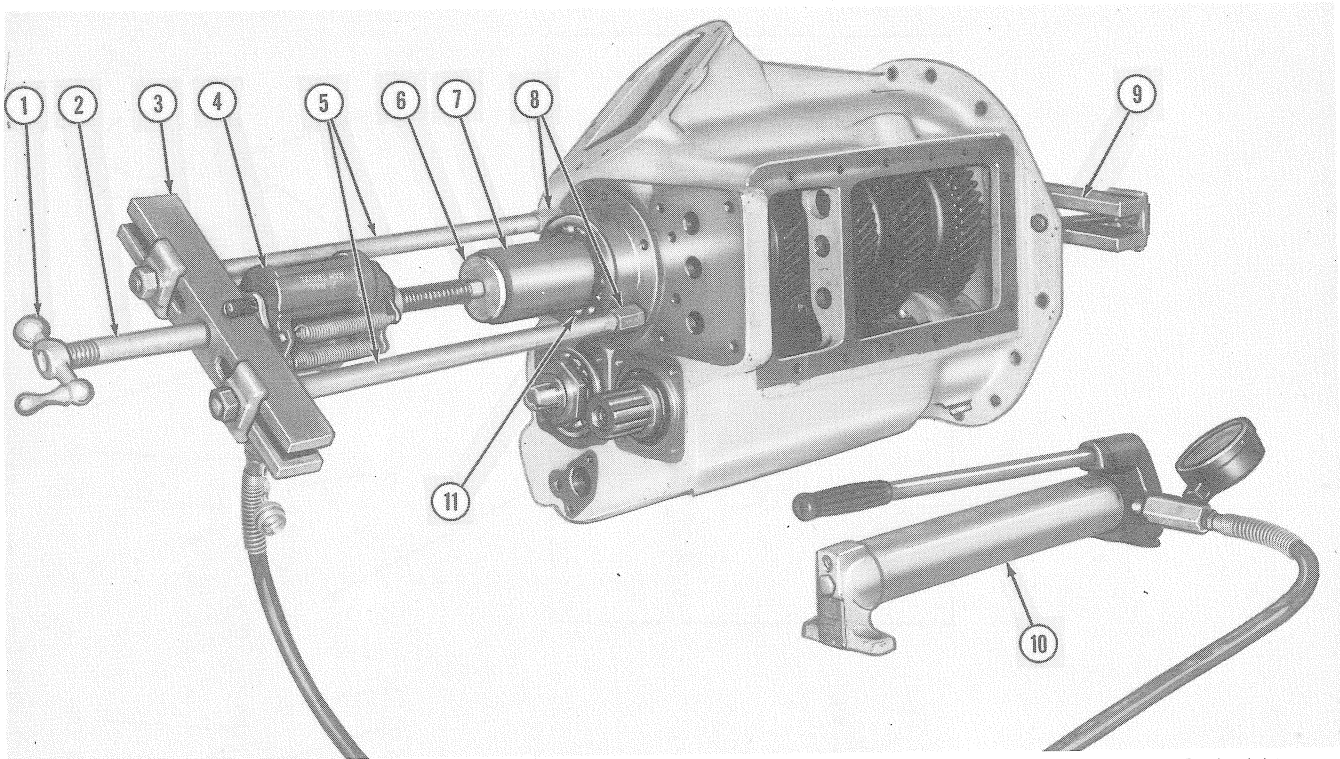
Assemble center gear cluster, Fig. 11 (7)(10) (12) (12A) (13) on work bench; coat one side of each of the two gear spacing washers (5) with heavy grease and position a washer (greased side) against each end of gear cluster; install assembled gear cluster in position transmission case making certain the spacing washers are properly positioned and the

center cluster gears are properly meshed with mating gears on top and intermediate shafts. Place shifting collars (10) in neutral position before installing shaft.

### 4.4.3.5

Press inner race of rear bearing Fig. 11 (3) on shaft until it bottoms solidly on shoulder of shaft.

## Transmission



T-41441

FIG.12 INSTALLING BEVEL PINION SHAFT FRONT BEARING  
(HD16 SHOWN -- HD11 SIMILAR)

- |                           |                 |                     |
|---------------------------|-----------------|---------------------|
| 1. Adjusting crank        | 5. Puller legs  | 9. Push-puller head |
| 2. Forcing screw          | 6. Step plate   | 10. Hydraulic pump  |
| 3. Push-puller head       | 7. Sleeve       | 11. Bearing         |
| 4. Hydraulic ram (17 ton) | 8. Leg adapters |                     |

### 4.4.3.6

Install shaft through rear of transmission case; turn shaft as necessary to align splines on shaft with corresponding splines, gear spacing washers, and gear hubs; push shaft forward until rear bearing inner race is in position in rear roller bearing.

### 4.4.3.7

Remove shims, Fig. 11 (17) from front bearing (18) but do not remove snap ring. Bolt a push-puller head, Fig. 12 (9) over end of pinion shaft to hold shaft in position; assemble tools similar to those shown and install front bearing. Press bearing solid against washer, Fig. 8 (45).

## 4.4.4 INSTALLATION OF SHAFT END PARTS

### 4.4.4.1

Move shifting collars, Fig. 8 (36) on front and rear gear clusters to engaged position to lock transmission gear train. Torque bevel pinion shaft front nut (51) to 480 -- 520 lbs.ft. (66,36 -- 71,89 kg/m); torque intermediate

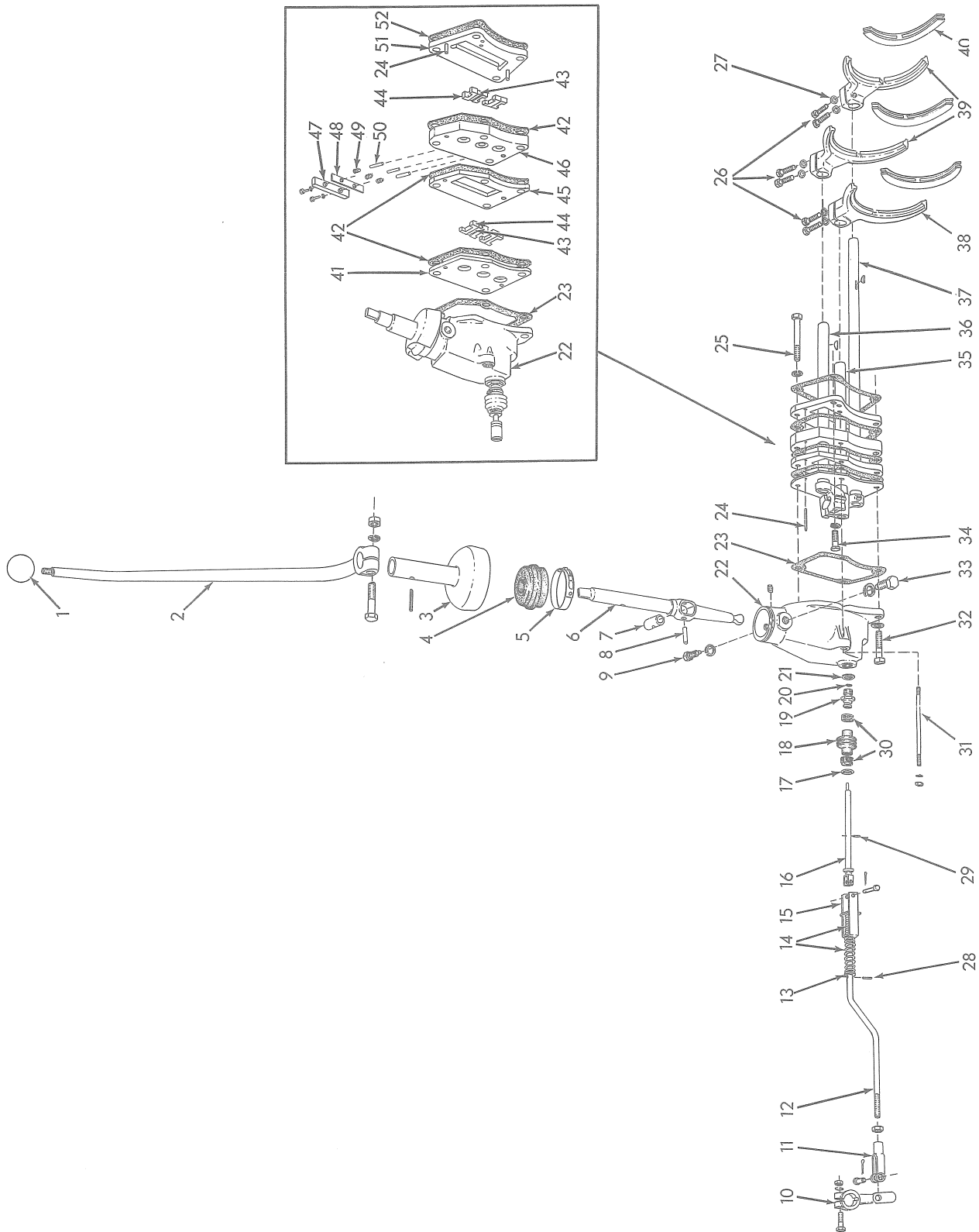
shaft rear nut (23) and front nut (60) to 175 -- 200 lbs.ft. (24,18 -- 27,65 kg/m). Lock nuts by staking.

### 4.4.4.2

Install new inner and outer sealing rings, Fig. 10 (23) (22) in intermediate shaft front bearing retainer (25) -- long side of inner sealing ring goes toward mounting side of retainer. Secure both sealing rings with snap ring (21).

Force intermediate shaft back so front bearing snap ring is against transmission case. Hold front bearing retainer (without shims) firmly against the front bearing and measure gap between retainer and face of case. Make a shim pack, Fig. 10 (24) equal to the measurement plus additional shims to provide .002" -- .007" (0,05 -- 0,17 mm) bearing end play in retainer.

Install retainer and shim pack on transmission case. Install plates, Fig. 10 (29) on retainer; use copper washer under attaching capscrews.



T-32074

FIG. 13 SHIFTING SHAFTS AND INTERLOCK MECHANISM



## Transmission

### LEGEND FOR FIG. 13

1. Shift lever knob
2. Shift extension lever
3. Guard
4. Shift lever boot
5. 3" Clamp
6. Shift lever
7. Pivot shaft
8. Roll pin (3/8" x 1-3/4")
9. Shift lever pivot screw (drilled head)
10. Engine clutch shifting yoke shaft outer lever
11. Adjusting yoke
12. Plunger control rod
13. Spring retaining washer
14. Control rod spring
15. Yoke
16. Shifting lock plunger
17. Seal
18. Boot
19. Sleeve
20. Washer
21. Copper washer
22. Shift lever housing
23. Gasket
24. Locking plate dowel
25. Capscrew (1/2"NC x 4-3/4")
26. Shifting fork capscrews
27. Washer
28. Roll pin (1/8" x 7/8")
29. Roll pin (3/32" x 1/2")
30. 1" clamps
31. Stud (7" long)
32. Capscrews (1/2"NC x 2-1/4")
33. Shift lever pivot screw (solid head)
34. Capscrew (1/2"NC x 1-3/4")
35. 2nd reverse, 3rd and 5th forward shifting shaft
36. 3rd reverse, 4th and 6th forward shifting shaft
37. 1st reverse, 1st and 2nd forward shifting shaft
38. Front shifting fork
39. Center and rear shifting forks
40. Shifting fork wear collar
41. Guiding plate
42. Gasket
43. Interlock spacing block
44. Interlock detent
45. Front locking plate
46. Shifting shaft plunger plate
47. Plunger retaining bar
48. Gasket
49. Plunger spring
50. Shifting shaft plunger
51. Rear locking plate
52. Gasket

#### 4.4.3

Install drive shaft rear yoke on top shaft. Install rubber washer and retaining washer; torque attaching capscrew to 220 - 240 lbs. ft. (30,4 -- 33,1 kg/m). Lock capscrew with wire.

#### 4.4.4.4

Install snap ring in groove around bevel pinion shaft front bearing; force shaft back until snap ring is against front face of transmission. Hold bearing retainer (without shims) firmly against front bearing and measure gap between it and the transmission case. Make up a shim pack equal to the measurement plus .001" (0,02mm) to provide specified .000" to .002" (0,00 to 0,05 mm) bearing end play in retainer. Keep retainer and shim pack together for later use.

#### 4.4.4.5

Drive bevel pinion shaft slightly forward and remove snap ring from front bearing. Install the original pinion depth adjusting shim pack (removed at disassembly), or a pack of approximately .095" (2,41 mm) in position on front bearing. Install snap ring on front bearing and drive bevel pinion shaft toward the rear until snap ring is tight against depth adjusting shims.

#### 4.4.4.6

Install new inner and outer sealing rings, Fig. 11 (22) (21) in bevel pinion shaft front bearing retainer (24) -- long side of inner sealing ring goes toward mounting side of retainer. Secure both sealing rings with snap ring (20). Install bearing retainer with shim pack (23) determined in 4.4.4.4.

### 4.4.5 SHIFTING SHAFTS AND LOCKS INSTALLATION

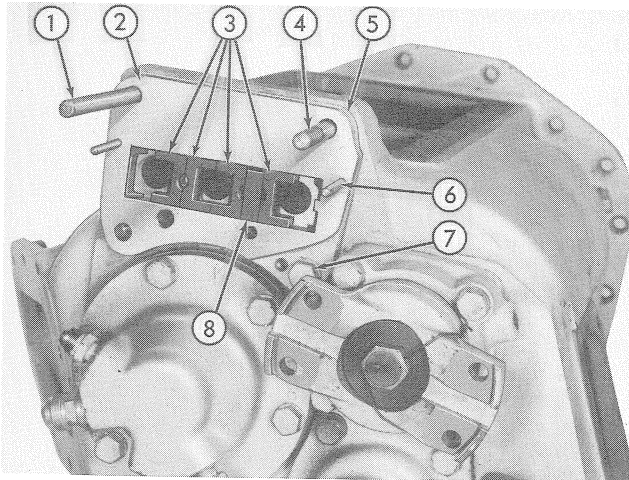
#### 4.4.5.1

With transmission side cover opening facing up, Fig. 14, install 1/2"NC x 4-3/4" capscrew and 1/2"NC x 5" guide stud in transmission case.

#### 4.4.5.2

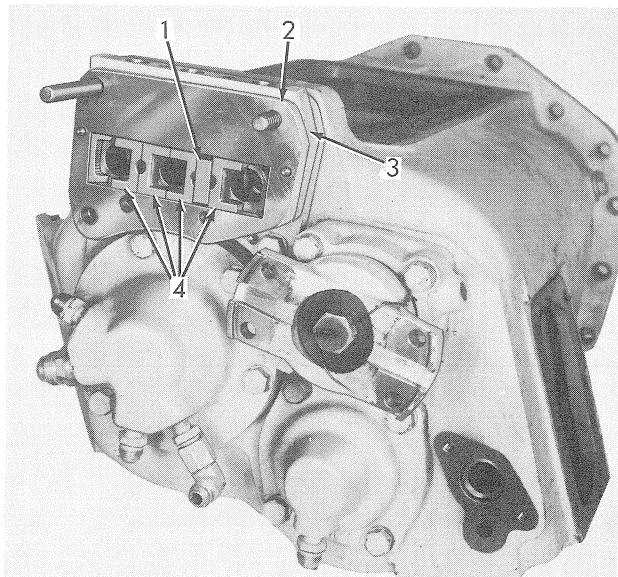
Refer to Figs. 13 and 14; slide gasket and rear locking plate into position against transmission case. Secure plate with a 1/2"NC x 1-1/2" capscrew, Fig. 14 (7). Install dowel pins, four interlock detents, and detent spacer in locking plate.

## Transmission



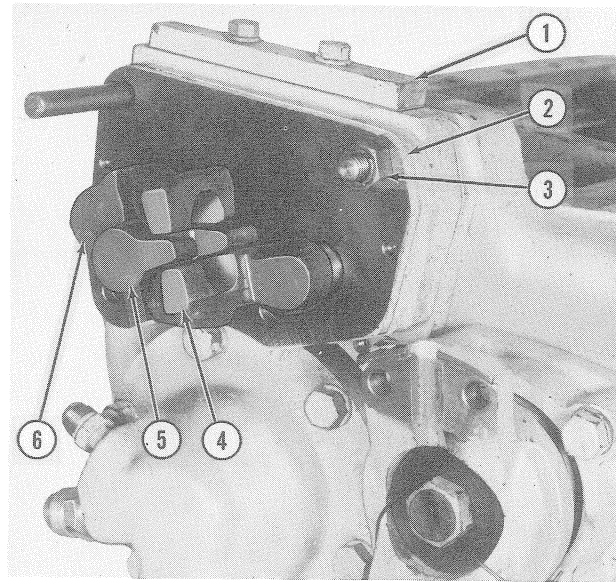
T-41446  
FIG. 14 SHIFTING SHAFT REAR LOCKING  
PLATE WITH DETENTS INSTALLED

- |                           |                     |
|---------------------------|---------------------|
| 1. 1/2"NC x 5" guide stud | 5. Gasket           |
| 2. Rear locking plate     | 6. Dowel pin        |
| 3. Interlock detents      | 7. 1/2"NC x 1-1/2"  |
| 4. 1/2"NC x 4-3/4"        | capscrew            |
|                           | 8. Interlock detent |
|                           | spacer              |



T-41447  
FIG. 15 SHIFTING SHAFT FRONT LOCK-  
ING PLATE WITH DETENTS INSTALLED

- |                            |
|----------------------------|
| 1. Interlock detent spacer |
| 2. Front locking plate     |
| 3. Plunger plate           |
| 4. Interlock detent        |



T-41448  
FIG. 16 SHIFTING SHAFTS INSTALLED  
IN NEUTRAL POSITION

- |                                        |
|----------------------------------------|
| 1. Plunger retaining bar               |
| 2. Shaft guiding plate                 |
| 3. Nut                                 |
| 4. 3rd reverse and 4th and 6th forward |
| shifting shaft                         |
| 5. 2nd reverse and 3rd and 5th forward |
| shifting shaft                         |
| 6. 1st reverse and 1st and 2nd forward |
| shifting shaft                         |

### 4.4.5.3

Refer to Figs. 13 and 15; install plunger plate (with gasket on each side) against rear locking plate; position front locking plate in position against plunger plate.

### 4.4.5.4

Install four interlock detents and detent spacer in front locking plate, Fig. 15.

### 4.4.5.5

Refer to Figs. 13 and 16; install shifting shaft guiding plate and gasket in position against front locking plate. Install nut on 1/2"NC x 4-3/4" capscrew to hold locking plates in position.

### 4.4.5.6

Install shifting forks with bronze wear collars in position on their respective shifting collars. Shifting fork on front shifting collar has no key-way in shifting shaft bore; the other two shifting forks are interchangeable. Install front and rear shifting forks with capscrew bosses toward top of transmission; center shifting fork with capscrew boss toward the bottom, Fig. 3.

# Transmission

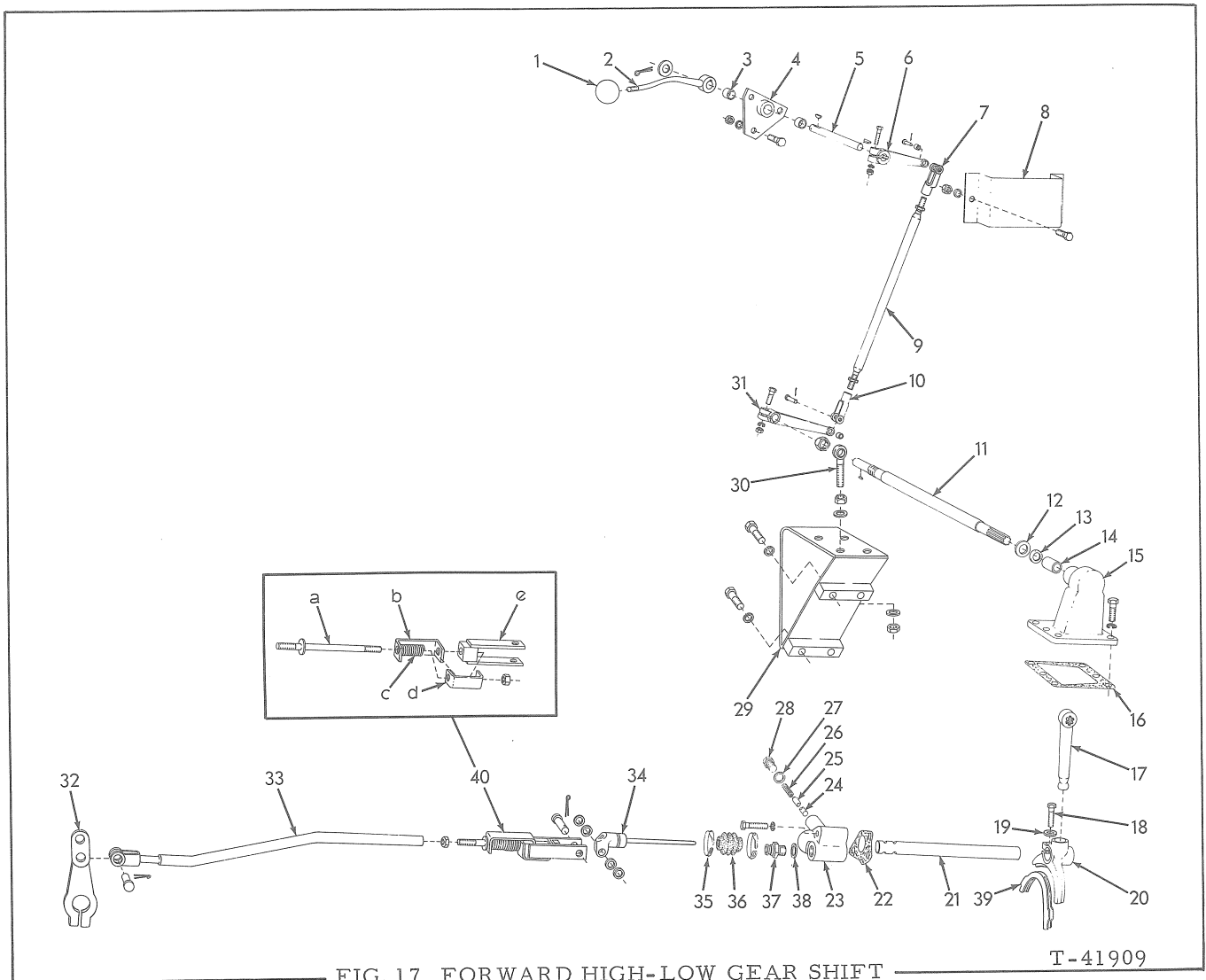


FIG. 17 FORWARD HIGH-LOW GEAR SHIFT

T-41909

- |                           |                            |                                          |
|---------------------------|----------------------------|------------------------------------------|
| 1. Knob                   | 16. Gasket                 | 31. Lower lever                          |
| 2. Gear shift lever       | 17. Shifting lever         | 32. Engine clutch cross shaft left lever |
| 3. Bushing                | 18. Capscrew               | 33. Control rod                          |
| 4. Upper bracket          | 19. Washer                 | 34. Shifting lock plunger                |
| 5. Gear shift lever shaft | 20. Shifting fork          | 35. 1" clamp                             |
| 6. Intermediate lever     | 21. Shifting fork shaft    | 36. Boot                                 |
| 7. Adjusting yoke         | 22. Gasket                 | 37. Sleeve                               |
| 8. Shield                 | 23. Interlock housing      | 38. Copper washer                        |
| 9. Control rod            | 24. Interlock pin          | 39. Shifting fork wear collar            |
| 10. Adjusting yoke        | 25. Shaft locating plunger | 40. Over-travel                          |
| 11. Shifting lever shaft  | 26. Interlock spring       | a. Rod                                   |
| 12. Washer                | 27. Copper washer          | b. Bracket (long)                        |
| 13. Oil seal              | 28. Capscrew (5/8" x 1")   | c. Spring                                |
| 14. Bushing               | 29. Lower bracket          | d. Bracket (short)                       |
| 15. Shift lever housing   | 30. Rod end                | e. Guide                                 |

4. 4. 5. 7

Install shifting shaft, Fig. 16 (6), through lower bore in shaft locking plate assembly. Push shifting shaft through transmission case far enough to install woodruff key in shaft; then push shaft through shifting fork on rear cluster of gears until center detent notch (NEUTRAL) in shifting shaft is aligned with detent plunger bore in plunger plate, Fig. 15 (3).

4. 4. 5. 8

Install shifting shaft, Fig. 16 (4), through upper bore in shaft locking plate assembly. Push shifting shaft through transmission case far enough to install woodruff key in keyway slot nearest to rear end of shaft. Push shaft through shifting fork on center cluster of gears until shaft is in position as shown.

## Transmission

### 4.4.5.9

Install shifting shaft, Fig. 16 (5), through center bore in shaft locking plate assembly. Push shifting shaft through transmission case and shifting fork on front cluster of gears until shaft is in position as shown. Position all shifting shafts in NEUTRAL as shown.

### 4.4.5.10

Install plungers Fig. 13 (50) and springs (49) in plunger plate (46). Install plunger retaining bar (with new gasket) on plunger plate.

### 4.4.5.11

Center all shifting collars on the gear hubs and center shifting forks in the shifting collars; torque shifting fork capscrews to 90 -- 100 lbs. ft. (12,4 -- 13,8 kg/m)

**IMPORTANT:** Use the original washers, Fig. 13 (27) or their exact factory duplicate under the shifting fork capscrews. Do not substitute.

### 4.4.5.12

Remove nut that was installed to hold locking plates in position, Fig. 16. Install gear shift housing, Fig. 13 (22) and gasket (23); start but do not tighten the attaching capscrews and nut.

### 4.4.5.13

Install pivot shaft, Fig. 13 (7) in shift lever (6); secure with roll pin (8). Install shift lever in housing; secure with the two capscrews (9) (33). Be certain lower end of shift lever is in position in notched ends of shifting shafts.

**NOTE:** Install drilled head capscrew in right side of housing to accept the gear housing oil line, Fig. 2.

### 4.4.5.14

Install boot, Fig. 13 (18) on shifting lock plunger (16); secure with clamp (30). Install plunger sleeve (19) and clamp (30) on plunger and into open end of boot. Slide washer (20) over plunger past the roll pin hole; install roll pin (29) so that it protrudes equally on either side of plunger. Place copper washer (21) on sleeve; install plunger and sleeve in shift lever housing and tighten clamp (30) around boot and sleeve.

### 4.4.5.15

Shift transmission to any forward gear; engage plunger in lock position (all the way in) and tighten shift lever housing capscrews. This will position shifting lock detent blocks in detent grooves of shifting shafts.

## 4.4.6 FORWARD HIGH -- LOW SHIFTING SHAFT INSTALLATION

### 4.4.6.1

Install shifting fork with bronze wear collar

on shifting collar; mesh shifting collar with teeth on low range gear. Install shifting fork with capscrew boss toward top shaft.

### 4.4.6.2

Drop interlock pin, Fig. 17 (24) into plunger bore in interlock housing (23); install shifting shaft (21) from mounting side of housing so that front notch in shaft is over the interlock pin. Install plunger (25), spring (26) and capscrew (28) in housing; use copper washer (27) under capscrew.

### 4.4.6.3

Install interlock housing, Fig. 17 (23) and gasket (22) on front of transmission; slide shaft (21) through shifting fork and secure interlock housing to transmission.

### 4.4.6.4

With shifting collar in mesh with low range gear, torque shifting fork capscrews to 90 -- 100 lbs. ft. (12,4 -- 13,8 kg/m).

**IMPORTANT:** Use the original washers or their exact factory duplicate under the shifting fork capscrews. Do not substitute.

Move shifting collar into mesh with high range gear and check for proper engagement; move shifting fork on shaft if necessary.

### 4.4.6.5

Install bushing, Fig. 17 (14) in shift lever housing (15); end of bushing must be flush with inside surface of housing. Install seal (13) in housing -- sealing lip in. Lubricate seal lip.

### 4.4.6.6

Place washer, Fig. 17 (12) against shoulder on shaft (11); protect lip of seal (13) and install shaft in housing (15). Install shifting lever (17) as shaft is pushed through housing.

### 4.4.6.7

Install housing, Fig. 17 (15) and gasket (16) on transmission case; be sure the shift lever (17) enters hole in shifting fork (20). Support other end of shaft (11) until lower bracket (29) can be installed.

### 4.4.6.8

Inspect inside of transmission for foreign objects. Check all capscrews inside the transmission; make certain they have been torqued properly. Using a pry bar or similar tool, move each shifting shaft into its various "detent" positions and check to see if shifting forks are properly located on the shafts so that shifting collars are properly engaged with their corresponding gears. Install transmission side cover and gasket (lower bracket, Fig. 17 (29) must be installed and attached by the front two capscrews in side cover -- see 4.4.6.9).

## Transmission

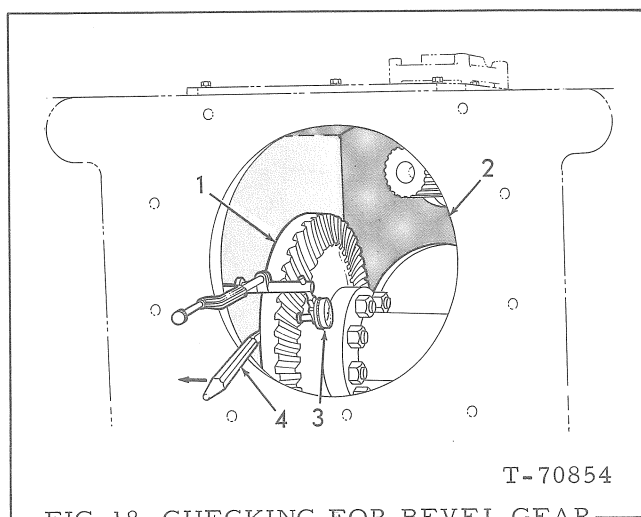


FIG. 18 CHECKING FOR BEVEL GEAR  
END PLAY

- |                                  |                   |
|----------------------------------|-------------------|
| 1. Bevel gear                    | 3. Dial indicator |
| 2. Power take-off<br>access hole | 4. Pry bar        |

### 4.4.6.9

Install rod end, Fig. 17 (30) in left front corner of lower bracket (29); centerline of rod end should be approximately 1.87" (47,4 mm) above top of bracket. Secure rod end with flat washer and jam nut on each side of bracket. Install bracket on transmission; slide rod end (30) over shaft (11) as bracket is installed. Install nut and lower lever (31) on end of shaft.

### 4.4.6.10

Install transmission drain plug and suction oil screen in transmission case. Install oil lines and fittings on outside of case, Fig. 2; be sure the restricted connector (4) is installed in the top shaft retainer.

## 4.5 TRANSMISSION INSTALLATION (With Bevel Gear and Adjustment Checks)

### 4.5.1

Before installing transmission, check the bevel gear shaft bearings for end play. Position a dial indicator through power take-off access hole, Fig. 18, (if tractor has rear mounted equipment work through bevel pinion bore). Pry bevel gear in both directions (not too hard); if ANY end-play is shown on dial indicator, the steering clutches must be removed and bearing preload adjusted (5.3.1).

### 4.5.2

Be sure the adapter ring is fully seated in the bevel pinion shaft bore in main housing; flat on ring must be toward top of housing.

### 4.5.3

Install two guide studs (1/2"NF x 3") in main housing; place a new transmission mounting gasket over guide studs.

Install transmission with a hoist and lifting bracket as shown in Fig. 2; refer to 4.1.10 for description of lifting bracket. Attach transmission to main housing.

### 4.5.4

Check and adjust mounting distance between bevel gear shaft and rear face of bevel pinion shaft (procedure is given in 5.3.2.2).

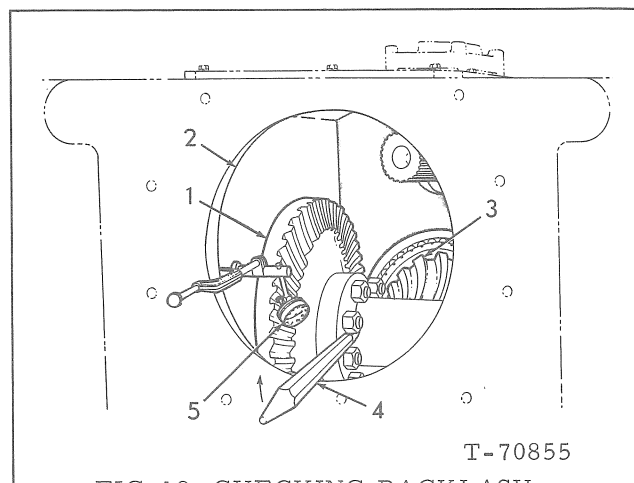


FIG. 19 CHECKING BACKLASH  
BETWEEN BEVEL GEAR AND BEVEL  
PINION

- |                                  |                   |
|----------------------------------|-------------------|
| 1. Bevel gear                    | 3. Bevel pinion   |
| 2. Power take-off<br>access hole | 4. Pry bar        |
|                                  | 5. Dial indicator |

### 4.5.5

Check backlash between bevel gear and bevel pinion; also be certain tooth contact pattern is correct. Following procedure is to be used only when bevel gear is in good condition and was not removed; if bevel gear was removed refer to 5.3.2 for complete procedure.

### 4.5.5.1

Position a dial indicator as shown in Fig. 19. Block bevel pinion solid. Insert a small pry bar and rotate gear back and forth; total gear movement as indicated by reading on dial indicator is the backlash. Check backlash at four points (90° apart) around the gear; block bevel pinion solid each time if reading is being taken from bevel gear.

**IMPORTANT:** Several attempts may be necessary to become accustomed to the "feel" in order to obtain correct backlash readings. Do not hurry this step.

### 4.5.5.2

Specified backlash is .008" -- .014" (0,20 -- 0,35 mm). If backlash is only slightly less or slightly more than specification (and tooth contact pattern has not been set), it is possible

# Transmission

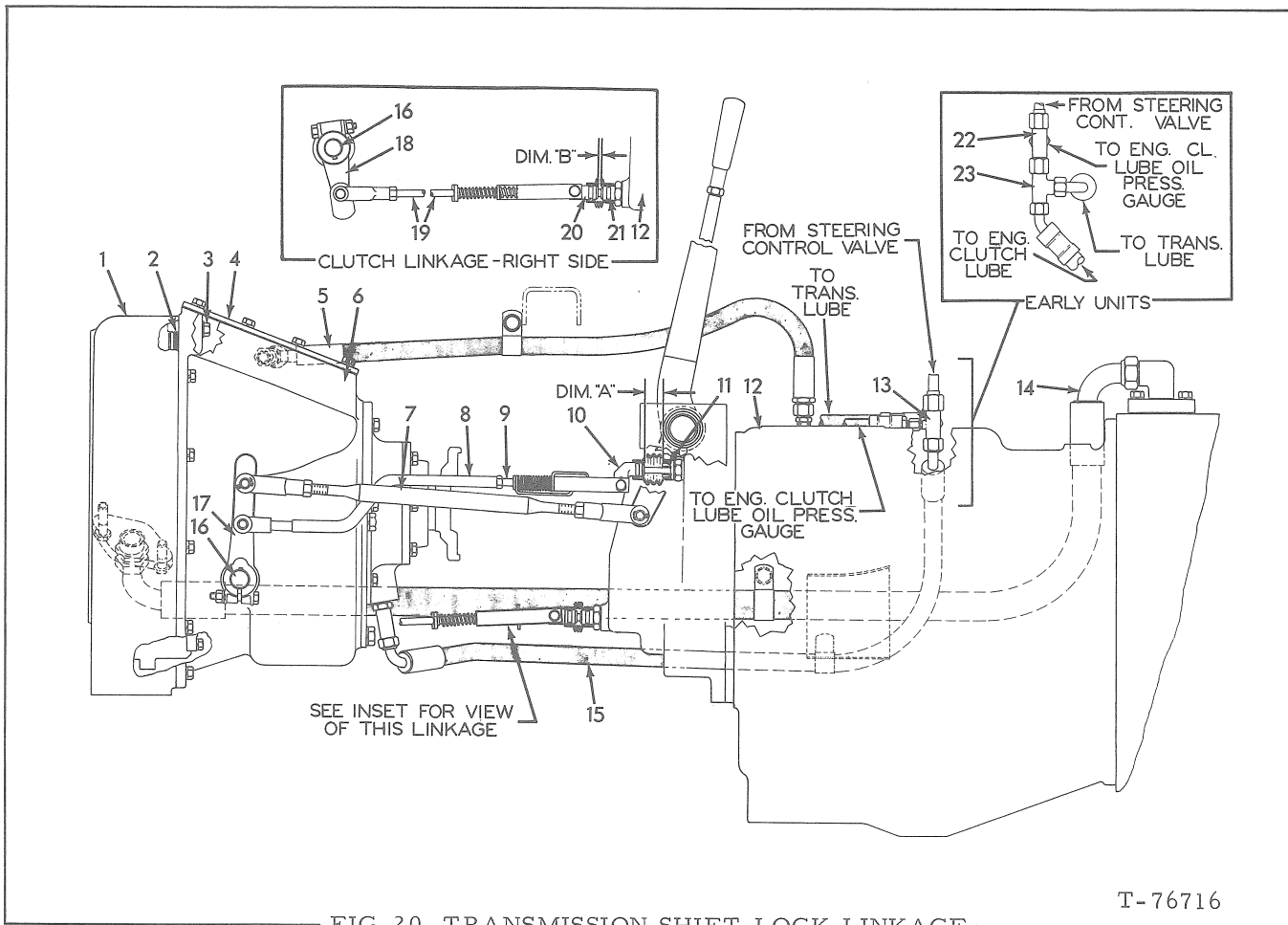


FIG. 20 TRANSMISSION SHIFT LOCK LINKAGE

T-76716

1. Flywheel housing
2. O-ring
3. Capscrew w/copper washer
4. Clutch access cover
5. Breather
6. Engine clutch housing
7. Clutch control rod
8. High-low shift lock plunger control rod
9. Over-travel
10. High-low shift lock plunger
11. Plunger sleeve
12. Transmission

13. Tee
14. Clutch oil return line
15. Clutch oil supply line
16. Shifting yoke shaft
17. Lever
18. Lever
19. Control rod
20. Speed shift lock plunger
21. Plunger sleeve
22. Tee
23. Tee

DIM. "A"--1.25"(31,7mm)with clutch engaged  
DIM. "B"--.12"(3,04mm)with clutch engaged

to obtain correct backlash by adding or removing pinion depth adjustment shims, Fig. 11 (17) between transmission case and snap ring in bevel pinion shaft front bearing. Add shims to increase backlash; remove shims to decrease backlash (if specified backlash cannot be obtained in this manner, refer to BEVEL GEAR AND SHAFT for complete adjustment procedure).

## 4.5.5.3

After obtaining specified backlash, check contact pattern by applying marking compound (bluing or red lead) to approximately 12 bevel gear teeth. Rotate bevel gear enough in both directions to contact pattern on both sides of gear.

NOTE: Gears may be rotated by moving unit (pushing, pulling etc.) or by raising unit and rotating track.

## Transmission

### 4.5.5.4

Correct tooth contact pattern is shown in Fig. 28. If contact pattern is not satisfactory add or remove pinion depth adjustment shims, Fig. 11 (17) until pattern is satisfactory. See Figs. 30, 31 and 32 for example contact patterns and their remedies.

### 4.5.5.5

Recheck backlash; If backlash is not within specifications refer to BEVEL GEAR AND SHAFT and perform complete procedure.

### 4.5.6

Connect the steering pump suction lines to transmission case; clean screen in transmission scavenger line before connecting oil line. Connect transmission and engine clutch lube oil lines to tee on right side of transmission case, Fig. 20.

### 4.5.7

Install drive shaft universal joint.

### 4.5.8

Install dozer pump on left rear side of engine clutch housing; connect oil lines. Remove ball placed in dozer hydraulic tank to prevent oil from draining.

### 4.5.9

Install brake pedals, shafts, and brackets; connect brake control rods, Fig. (1) (12). Install steering control rods (8).

### 4.5.10

Install seat support channel and seat frame; connect high - low gear shift linkage and dozer control linkage. Install floor support channel.

### 4.5.11

Shift lock linkage adjustment procedure:

#### 4.5.11.1

Make adjustments with engine stopped.

#### 4.5.11.2

If control rod, Fig. 20 (7) is not installed, adjust it to a length of 20.44" (518,3 mm) before installing it.

#### 4.5.11.3

Engage engine clutch. Measure distance between plunger, Fig. 20 (10) and sleeve (11); make necessary adjustment at front end of over-travel (9) to obtain specified dimension (DIM. "A").

#### 4.5.11.4

Engage engine clutch. Measure distance between plunger, Fig. 20 (20) and sleeve (21); adjust length of control rod (19) to obtain specified dimension (DIM. "B").

### 4.5.12

Install drain plugs in transmission and bottom of main housing; torque them to 70 -- 75 lbs. ft. (9,6 -- 10,3 kg/m).

### CAUTION

Over-tightening drain plug could extrude gasket from under plug flange and result in leakage.

### 4.5.13

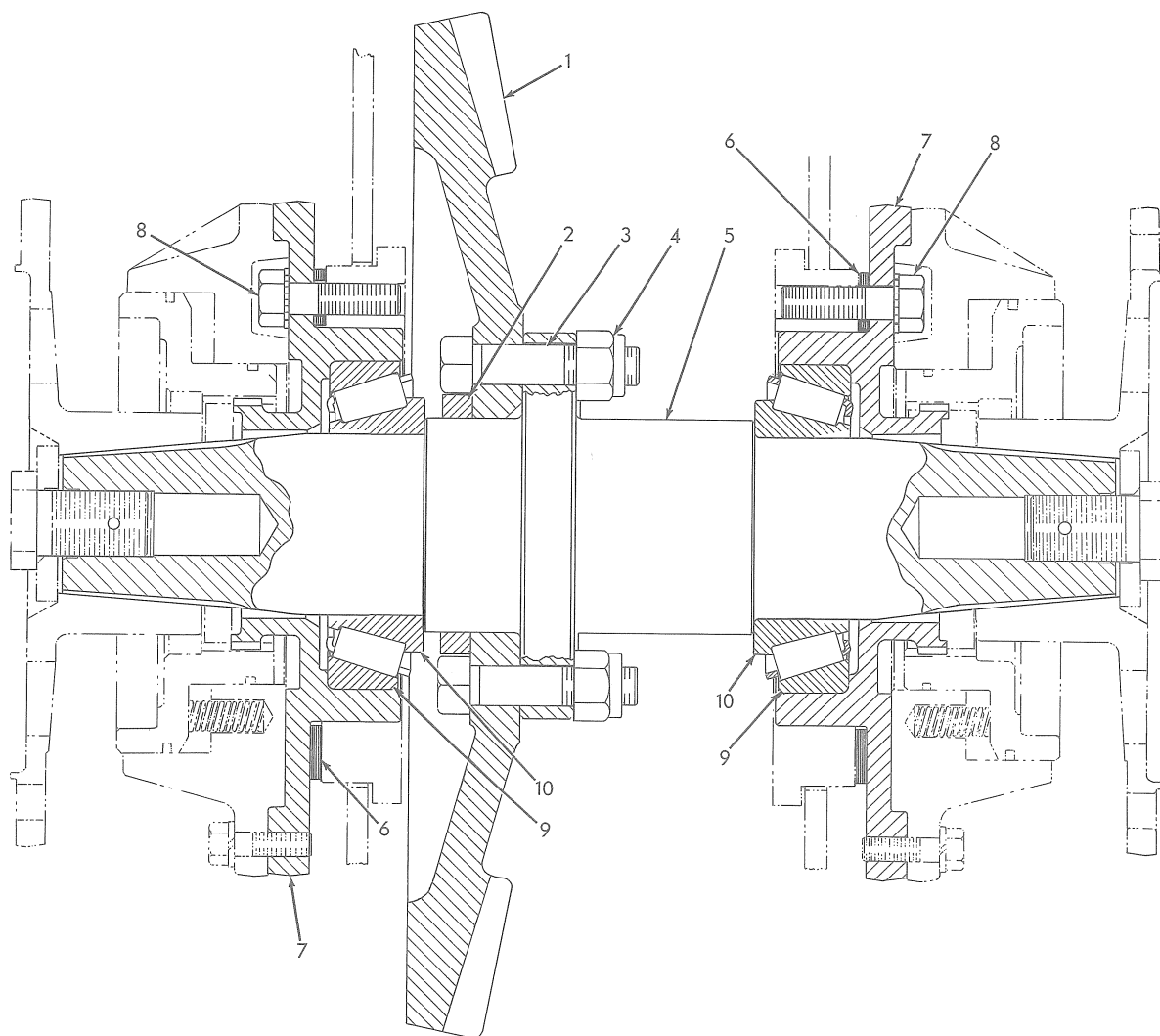
Replace lubricant lost when the transmission and main housing were drained; see 2.1 and 2.2 for specifications. Oil filler pipe is on top of main housing -- under the seat frame.

Replace hydraulic system oil filter and clean steering suction line oil strainer.

### 4.5.14

Run engine at low idle speed for a few minutes to charge system. Stop engine and check system oil level; with oil cold the level should be in lower portion of Operating Range on gauge rod.

## TOPIC 5 BEVEL GEAR AND SHAFT



T-41864

FIG. 21 BEVEL GEAR AND SHAFT - REAR VIEW

1. Bevel gear
2. Capscrew locking ring
3. Capscrew
4. Elastic stop nut
5. Shaft

6. Bearing adjustment shims
7. Bearing cage
8. Capscrew
9. Bearing cup
10. Bearing cone

### 5.1 REMOVAL AND INSPECTION

#### 5.1.1

Before bevel gear and shaft can be removed, it is necessary to remove steering clutches, brakes, and steering clutch throwout bearing assemblies. Refer to Steering Clutches and Brakes Service Manual for detailed information.

#### 5.1.2

Remove bevel gear compartment cover; remove nuts securing bevel gear to flange on bevel gear shaft.

#### 5.1.3

Remove capscrews holding bearing cages, Fig. 21 (7) to inner walls of steering clutch compartment; place wooden block under bevel gear to support gear and shaft before removing bearing cages. Tie bearing adjustment shims (6) to their respective cages to prevent loss. Mark bearing cages so they will be reinstalled in their original positions.



## Bevel Gear and Shaft

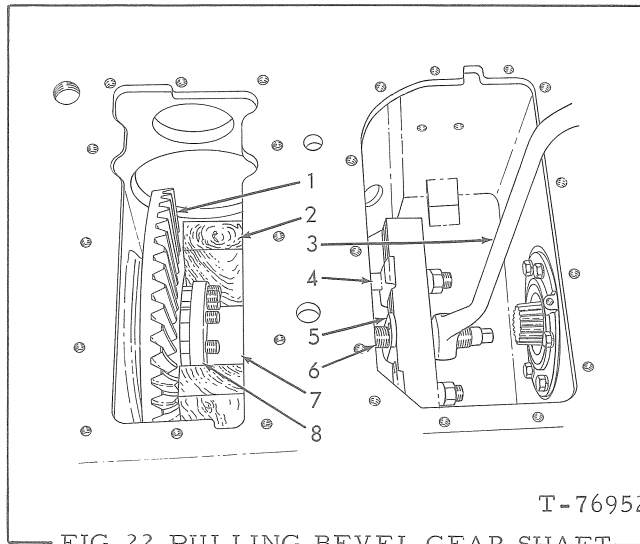


FIG. 22 PULLING BEVEL GEAR SHAFT

- |                  |                        |
|------------------|------------------------|
| 1. Bevel gear    | 5. Push-puller         |
| 2. Wooden blocks | 6. Puller screw (1"NF) |
| 3. Wrench        | 7. Bevel gear shaft    |
| 4. Legs          | 8. Bolting flange      |

### 5.1.4

Refer to Fig. 22. Place wooden blocks between bevel gear teeth and compartment wall to hold gear stationary. Install puller tools on end of shaft facing bevel gear teeth; pull bevel gear shaft from bevel gear.

### 5.1.5

Remove puller tools; remove bevel gear shaft (with other bearing cone) through steering clutch compartment. Remove bevel gear, bearing cone, capscrow locking ring, and wooden blocks from bevel gear compartment.

### 5.1.6

Remove bearing cone from bevel gear shaft; remove bearing cups, Fig. 21 (9) from bearing cages.

### 5.1.7

Clean and inspect all parts for damage or excessive wear.

## 5.2 INSTALLATION

NOTE: If service work was done on bevel gear components without removing transmission, pre-load on bevel gear shaft bearings must be adjusted without bevel gear installed on shaft; then remove shaft and install bevel gear.

### 5.2.1

Press one bearing cone, Fig. 23 (6) on long end of shaft with large O. D. of bearing tight against shoulder on shaft. Place bevel gear on suitable work bench (with teeth of gear downward). Position capscrow locking ring (5) on bevel gear and install capscrows (2) in bevel gear; turn capscrow heads as necessary to clear locking ring as capscrows are installed.

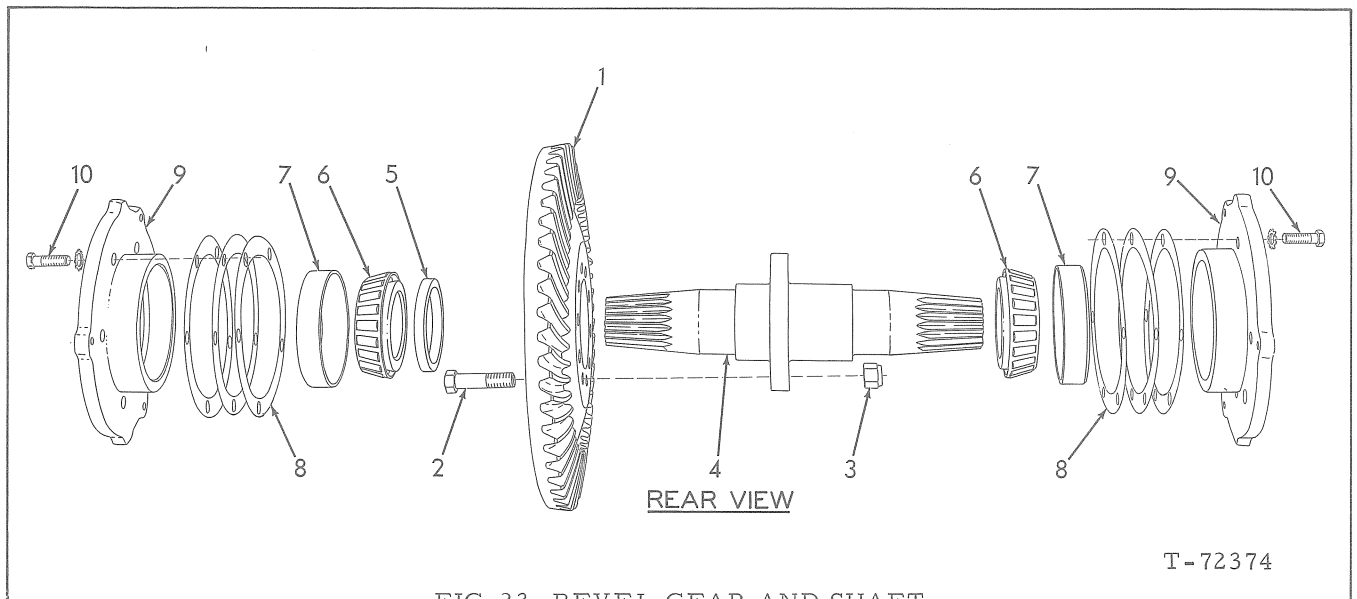
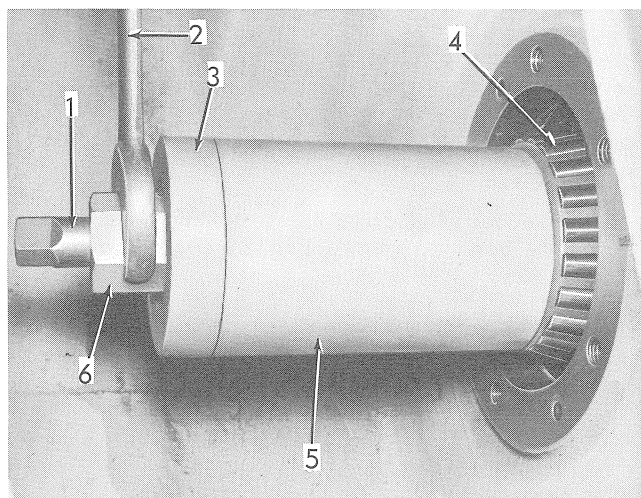


FIG. 23 BEVEL GEAR AND SHAFT

- |                          |                             |
|--------------------------|-----------------------------|
| 1. Gear                  | 6. Bearing cone             |
| 2. Capscrow              | 7. Bearing cup              |
| 3. Nut                   | 8. Bearing adjustment shims |
| 4. Shaft                 | 9. Bearing cage             |
| 5. Capscrow locking ring | 10. Capscrow                |

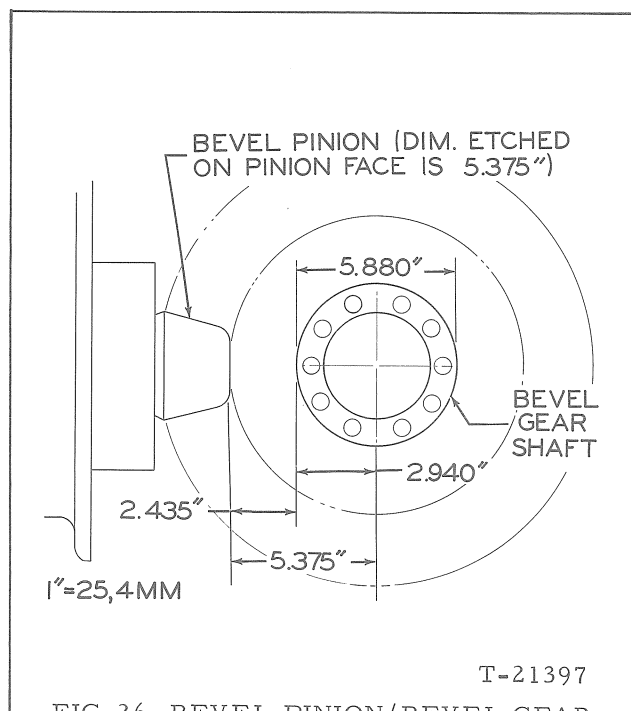
## Bevel Gear and Shaft



T-17899

FIG. 24 INSTALLING BEVEL GEAR  
SHAFT BEARING CONE

- |                   |                 |
|-------------------|-----------------|
| 1. Screw (1"NF)   | 4. Bearing cone |
| 2. Wrench         | 5. Tube         |
| 3. Tube end plate | 6. Hex nut      |



T-21397

FIG. 26 BEVEL PINION/BEVEL GEAR—  
MOUNTING DIMENSIONS

NOTE: Installation of bearing cones on bevel gear shaft will be much easier if bearing cones are heated in oil to approximately 275° F. (135° C) before installation.

### 5.2.2

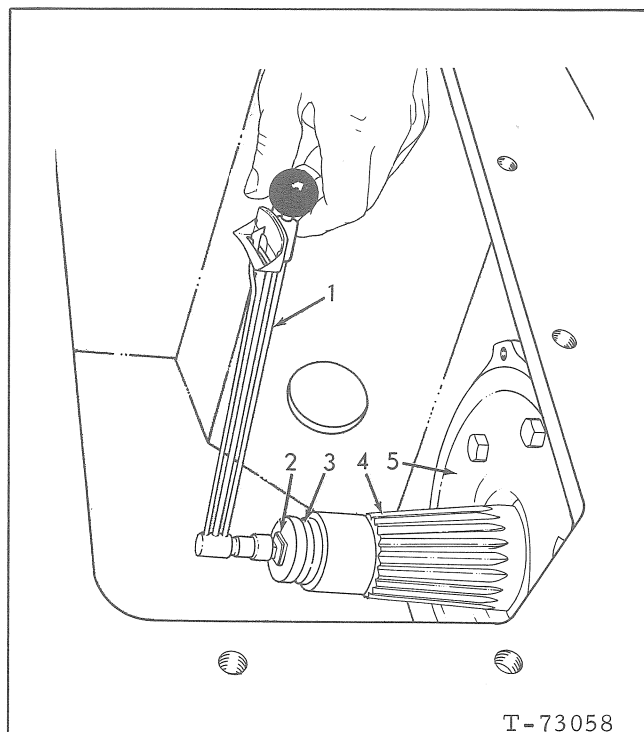
Remove locking ring and position bevel gear in bevel gear compartment, Fig. 21. Install bevel gear shaft through steering clutch compartment on tooth side of bevel gear and align capscrews in bevel gear with holes in bolting flange of shaft. Bump or drive gear shaft into bevel gear until nuts (4) can be started on capscrews. Install locking ring (2) and tighten nuts evenly until bevel gear is properly located on shaft.

### 5.2.3

Lubricate other bearing cone, Fig. 23 (6) and start it on short end of bevel gear shaft with large O. D. of bearing toward bevel gear. Refer to Fig. 24; bottom puller screw (1"NF) in tapped hole in end of shaft and place tube against inner race of bearing cone. Install tube cap, thrust washer, and hex-nut; tighten hex-nut until bearing cone is tight against shoulder on shaft; remove tools.

### 5.2.4

Press bearing cups, Fig. 23(7) into bearing cages (9); be certain cups are seated firmly in cages. Lubricate bearings with clean oil and install each bearing cage (with original bearing adjustment shims) in bore from which it was removed. Start bearing cage attaching capscrews (10) but do not tighten.



T-73058

FIG. 25 CHECKING PRE-LOAD OF BEVEL-  
GEAR SHAFT BEARINGS

- |                                   |           |
|-----------------------------------|-----------|
| 1. Torque wrench<br>(pounds inch) | 3. Socket |
| 2. Adapter                        | 4. Shaft  |
|                                   | 5. Cage   |

## Bevel Gear and Shaft

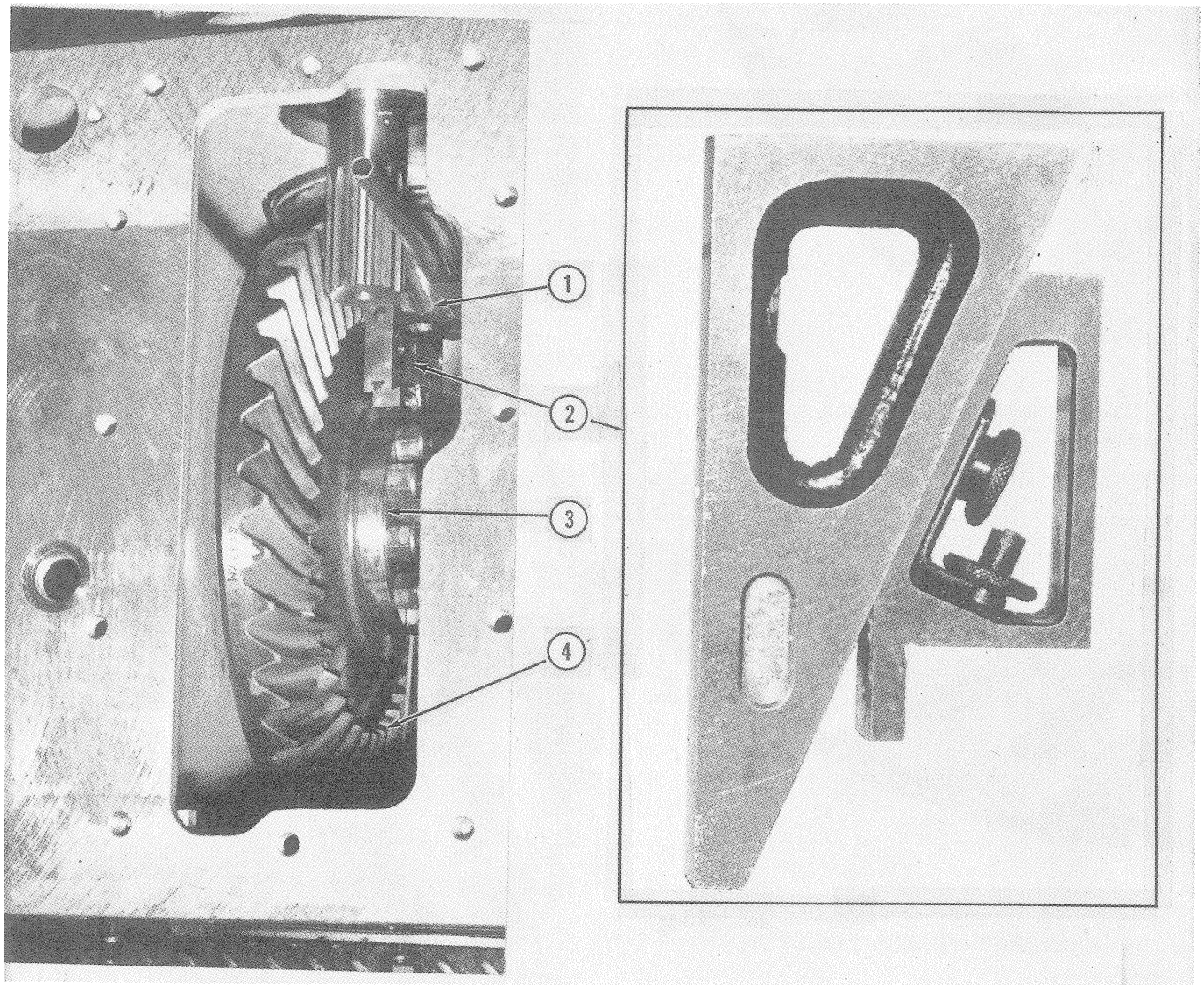


FIG.27 MEASURING MOUNTING DISTANCE

T-76930

- 1. Bevel pinion
- 2. Gauge

- 3. Bevel gear shaft capscrew flange
- 4. Bevel gear

### 5.2.5

Torque nuts, Fig. 21 (4), on bevel gear attaching capscrews to 220--240 lbs. ft. (30,4 -- 33,1 kg/m).

### 5.2.6

Torque bearing cage attaching capscrews, Fig. 21 (8) to 110 -- 120 lbs. ft. (15,2 -- 16,5 kg/m). Bump cages to be certain bearings are properly seated; re-torque cage attaching cap-screw if necessary.

## 5.3 ADJUSTMENTS

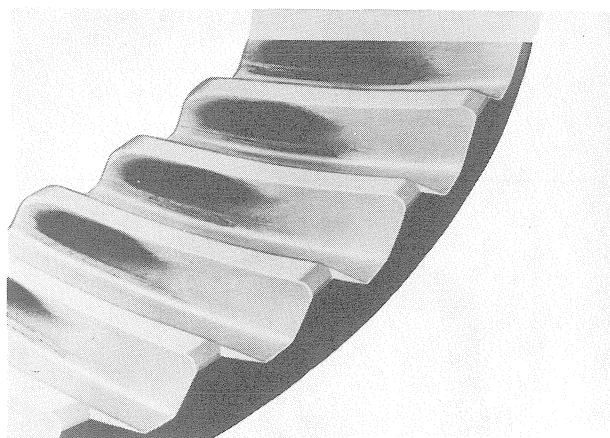
### 5.3.1 BEARING PRE-LOAD

**IMPORTANT:** Adjust bearing pre-load before installing transmission.

#### 5.3.1.1

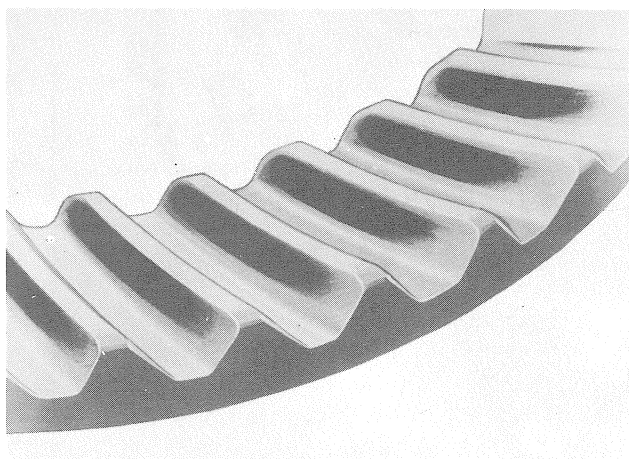
Install capscrew (1"NF) in end of bevel gear shaft and tighten until it bottoms.

## Bevel Gear and Shaft



T-31450

FIG. 28 SATISFACTORY TOOTH CONTACT-NO LOAD



T-31449

FIG. 29 SATISFACTORY TOOTH CONTACT-GEARS LOADED

### 5.3.1.2

Turn bevel gear shaft with torque wrench, Fig. 25, to determine pre-load; specified preload is 10 -- 20 lbs. in. (11,52 -- 23,04 kg/cm).

NOTE: This is approximately .003" -- .004" (0,07 -- 0,10 mm) tight.

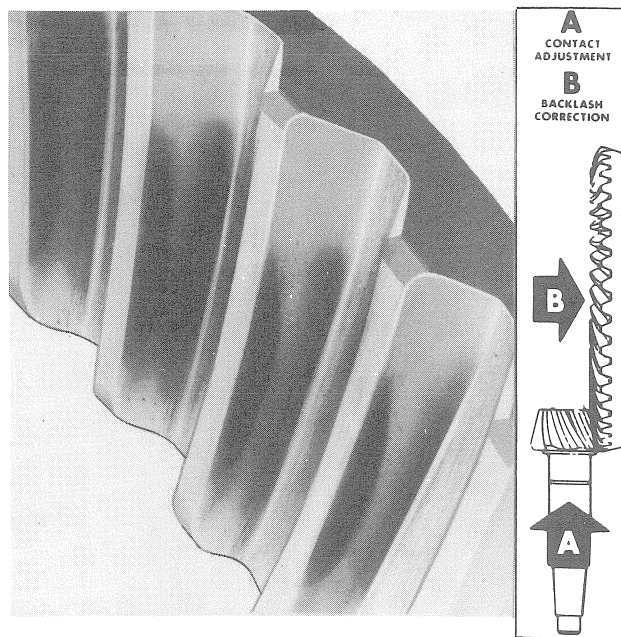
### 5.3.1.3

Add or remove bearing adjustment shims (equally) under bearing cages to obtain specified pre-load. When adjusting, bump bearing cages to be certain bearings are properly seated.

### 5.3.2 BACKLASH AND GEAR TOOTH CONTACT PATTERN

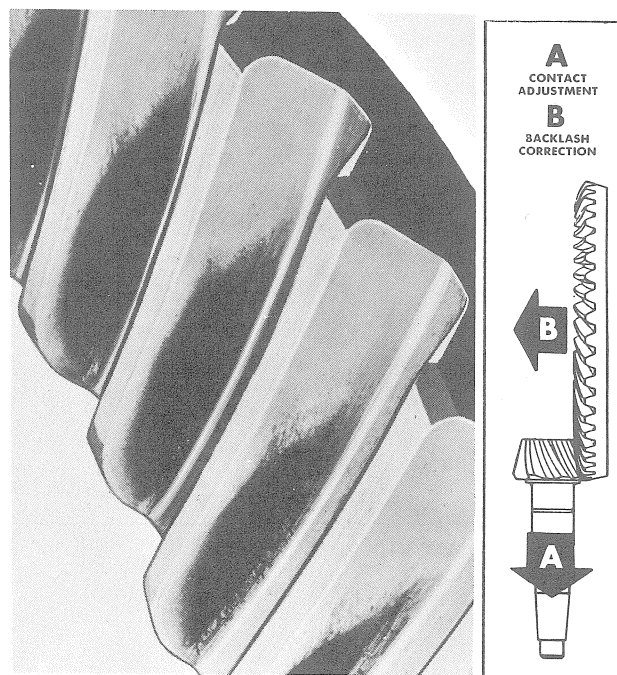
#### 5.3.2.1

Install transmission (4.5).



T-71900

FIG. 30 HIGH CONTACT-NO LOAD

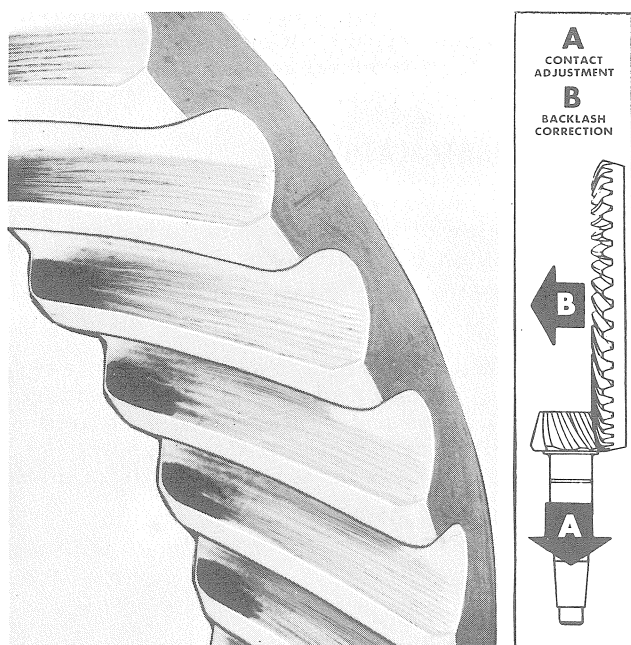


T-26963

FIG. 31 LOW CONTACT-NO LOAD

NOTE: Record the mounting dimension etched on rear face of bevel pinion before the transmission is installed.

## Bevel Gear and Shaft



T-71901

FIG. 32 SHORT TOE CONTACT-NO LOAD

### 5.3.2.2

The exact pinion depth adjustment can now be made. Measure diameter of capscrew flange on bevel gear shaft; divide diameter by 2 to determine the radius. Subtract radius from the dimension etched on rear face of bevel pinion; result is the proper mounting distance from rear face of bevel pinion to flange on bevel gear shaft.

EXAMPLE: Refer to Fig. 26. Diameter of flange on bevel gear shaft is 5.880 (149,25 mm); dimension etched on rear face of bevel pinion is 5.375" (136,51 mm).

$$5.880" \div 2 = 2.940"$$

$$5.375" - 2.940" = 2.435"$$

$$149,25 \text{ mm} \div 2 = 74,61 \text{ mm}$$

$$136,51 \text{ mm} - 74,61 \text{ mm} = 61,90 \text{ mm}$$

2.435" (61,90 mm) is the proper mounting distance between rear face of bevel pinion and flange on bevel gear shaft. Measure mounting distance, Fig. 27. Add shims under bevel pinion shaft front bearing snap ring to increase distance; remove shims to decrease distance.

NOTE: Tolerance on mounting distance is + .005" (0,12 mm).

### 5.3.2.3

Check backlash between bevel gear and bevel pinion. Refer to Fig. 19; mount dial indicator so readings can be taken from bevel gear. Check backlash at four points (90° apart)

around gear; block bevel pinion solid each time reading is taken.

### 5.3.2.4

Specified backlash is .008" -- .014" (0,20 -- 0,35 mm); adjust backlash by transferring bearing adjustment shims from under one bevel gear shaft bearing cage to the other. In this manner, bevel gear is moved, but preload on bearings will remain as adjusted. Increase backlash by transferring shims from bearing cage on tooth side of gear to bearing cage on flat side of gear; decrease backlash by transferring shims from bearing cage on flat side of bevel gear to bearing cage on tooth side of gear.

NOTE: Each .005" (0,12 mm) shim transferred will change backlash approximately .003" (0,07 mm).

### 5.3.2.5

Check bevel gear-to-bevel pinion tooth contact pattern by applying marking compound (bluing or red lead) to both sides of approximately 12 bevel gear teeth. Rotate bevel gear enough in both directions to show a tooth contact pattern on both sides of bevel gear.

NOTE: Gear may be rotated by moving unit (pushing pulling, etc.) or by raising unit and rotating track.

Area of contact (no load) must favor toe of gear tooth, extend approximately 1/2 of the tooth length toward heel, and be centered between top and bottom of tooth, Fig. 28. Area of contact when gears are loaded should increase in length as shown in Fig. 29. Pattern should be nearly the same on both sides of gear.

### 5.3.2.6

HIGH CONTACT as shown in Fig. 30 is not desirable and will result in galling and rolling over of top edges of teeth. To correct high contact move bevel pinion toward bevel gear by removing portion of pinion depth adjusting shims between transmission case and snap ring on bevel pinion shaft front bearing. This adjustment will decrease backlash between bevel pinion and bevel gear. Specified backlash is .008" -- .014" (0,20 -- 0,35 mm). Increase backlash by moving bevel gear away from bevel pinion. Move gear away from pinion by transferring bevel gear shaft bearing adjustment shims from bearing cage on tooth side of gear to bearing cage on flat side of gear.

### 5.3.2.7

LOW CONTACT as shown in Fig. 31 will result in galling and grooving of teeth. To correct low contact, move bevel pinion away from bevel gear by adding pinion depth adjusting shims between transmission case and snap ring on bevel pinion shaft front bearing. This adjustment will



## Bevel Gear and Shaft

increase backlash between bevel pinion and bevel gear. Specified backlash is .008" -- .014" (0,20 -- 0,35 mm). Decrease backlash by moving bevel gear toward bevel pinion; move gear toward pinion by transferring bevel gear shaft bearing adjustment shims from bearing cage on flat side of gear to bearing cage on tooth side of gear.

### 5.3.2.8

SHORT TOE CONTACT as shown in Fig. 32 will result in chipped tooth edges and excessive wear due to small contact area. To correct a short toe contact move bevel pinion away from bevel gear by adding pinion depth adjusting shims between transmission case and snap ring on bevel pinion shaft front bearing. This adjustment will increase backlash between bevel pinion and bevel gear. Specified backlash is .008" -- .014" (0,20 -- 0,35 mm). Decrease backlash by moving bevel gear toward bevel pinion. Move gear toward pinion by transferring bevel gear shaft bearing adjustment shims from bearing cage on flat side of bevel gear to bearing cage on tooth side of bevel gear.

NOTE: Several adjustments of both the bevel pinion and bevel gear may be necessary before the correct tooth contact pattern and correct backlash are obtained.

## 5.4 FINAL INSTALLATION

### 5.4.1

Clean interior of bevel gear compartment and steering clutch compartment. Install bevel gear compartment cover.

### 5.4.2

Install steering clutch throwout bearing assemblies, steering clutches, and steering brakes; fill hydraulic system with specified lubricant. Refer to Steering Clutches and Brakes Service Manual for detailed information.

## TOPIC 6 DRIVE SHAFT UNIVERSAL JOINT

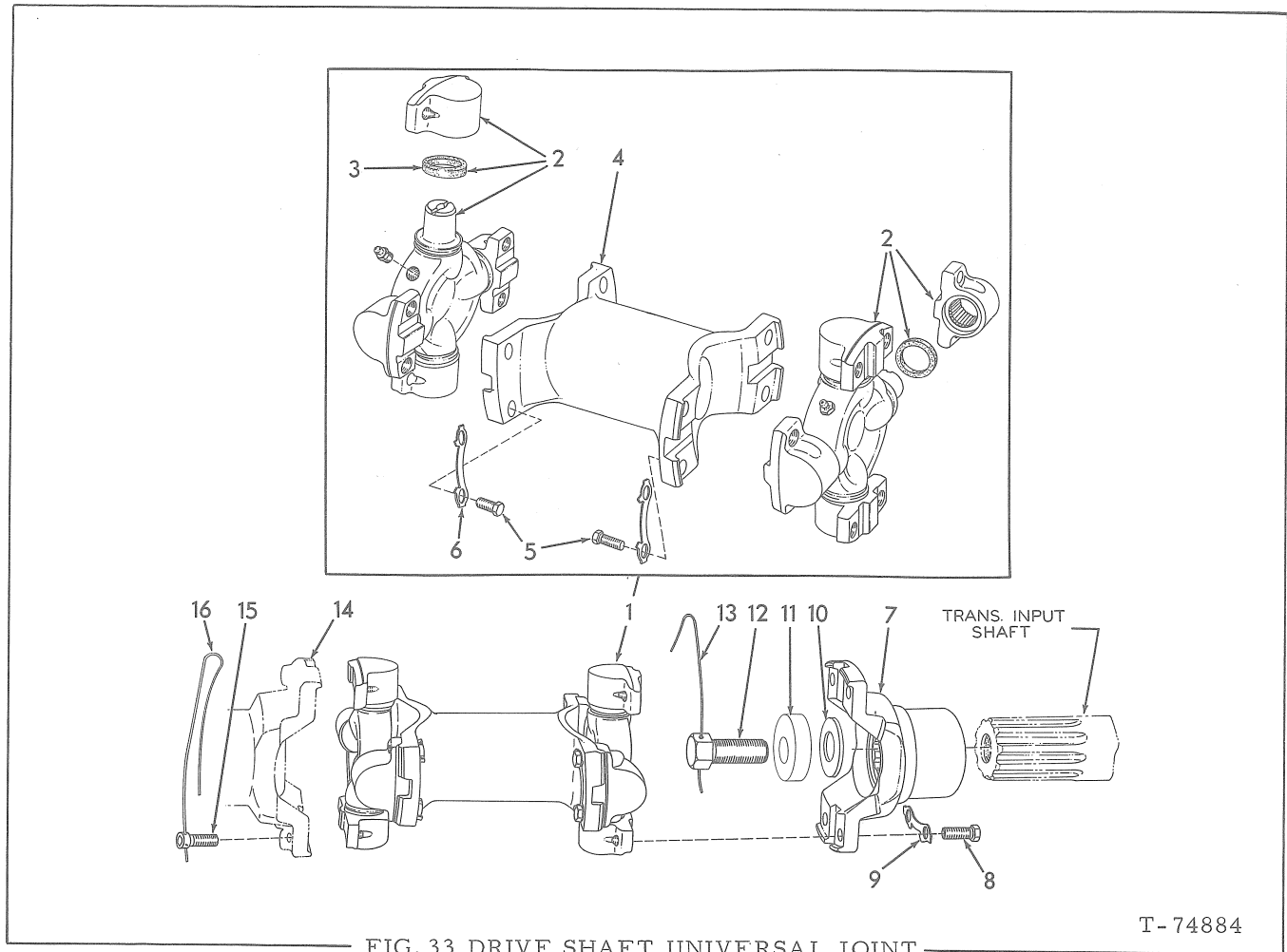


FIG. 33 DRIVE SHAFT UNIVERSAL JOINT

T-74884

- |                    |                   |                           |
|--------------------|-------------------|---------------------------|
| 1. Joint assembly  | 6. Lock           | 11. Yoke retaining washer |
| 2. Spider assembly | 7. Rear yoke      | 12. Capscrew              |
| 3. Sealing washer  | 8. Capscrew       | 13. Lock wire             |
| 4. Center yoke     | 9. Lock           | 14. Front yoke            |
| 5. Capscrew        | 10. Rubber washer | 15. Capscrew              |
|                    |                   | 16. Lock wire             |

### 6.1 REMOVAL, DISASSEMBLY, AND INSPECTION

#### 6.1.1

Turn electrical system master switch off; remove floor plates.

#### 6.1.2

Unlock and remove capscrews, Fig. 33, attaching universal joint to front and rear yokes; pry front yoke forward and remove universal joint. Remove front yoke from engine clutch shaft.

#### 6.1.3

Unlock and remove capscrews, Fig. 33 (5); remove front and rear spider assemblies (2) from center yoke (4).

#### 6.1.4

Remove bearing assemblies from spider assemblies; identify bearing assemblies so they may be installed in original position if re-used.

#### 6.1.5

In most cases, a failed bearing will be plainly visible, a failed bearing requires replacement of the spider assembly. If all the bearing caps turn freely and smoothly on the cross journal, and if there is no evidence of rust around the base of the bearing cap, the spider can be re-packed and re-used. Replace sealing washers, Fig. 33 (3).

## Drive Shaft Universal Joint

### 6.2 ASSEMBLY AND INSTALLATION

#### 6.2.1

Install new sealing washers, Fig. 33 (3) in each bearing cap; lubricate bearing with a coat of grease and install bearing caps on spider journals from which they were removed. Be certain bearings are fully seated on spider journals. Install front and rear spider assemblies (2) on center yoke (4); secure with attaching capscrews (5). Lock capscrews with plates.

NOTE: Install spider assemblies on connecting yoke with lubricating fittings in line. This will allow both fittings to be lubricated without turning drive shaft.

#### 6.2.2

Slide front yoke all the way forward on engine clutch output shaft. If rear yoke was removed, torque attaching capscrew, Fig. 33(12) to 220--240 lbs. ft. (30,4 -- 33,1 kg/m).

#### 6.2.3

Place universal joint assembly on rear yoke and install attaching capscrews; lock capscrews with plates.

#### 6.2.4

Align universal joint with front yoke; move front yoke rearward and install attaching capscrews. Lock capscrews with wire.

#### 6.2.5

Lubricate universal joint with hand-type lubricating gun. Pump grease slowly (4 to 6 shots); stop when back pressure is felt. Do not "pop" sealing washers.

#### 6.2.6

Install floor plates; turn electrical system master switch on.



# TOPIC 7 FITS AND TOLERANCES

## 7.1 TRANSMISSION

### 7.1.1.1

Top shaft front bearing bore - - - - - 3.346" -- 3.347" (84,98 -- 85,01mm)

### 7.1.1.2

Top shaft rear bearing bore - - - - - 4.724" -- 4.727" (119,99 -- 120,07mm)

### 7.1.1.3

Intermediate shaft front bearing bore - - - - - 3.149" -- 3.150" (79,98 -- 80,01mm)

### 7.1.1.4

Intermediate shaft rear bearing bore - - - - - 3.936" -- 3.937" (99,98 -- 100,00mm)

### 7.1.1.5

Bevel pinion shaft front bearing bore - - - - - 4.330" -- 4.331" (109,98 -- 110,00mm)

### 7.1.1.6

Bevel pinion shaft rear bearing bore - - - - - 5.511" -- 5.512" (139,97 -- 140,00mm)

## 7.1.2 TOP SHAFT PARTS (Front to rear)

### 7.1.2.1

#### Shaft

O. D. at front bearing location - - - - - 1.7721" -- 1.7727" (45,011 -- 45,026mm)

O. D. at rear bearing location - - - - - 2.1653" -- 2.1659" (54,998 -- 55,013mm)

### 7.1.2.2

#### Front Bearing Retainer

Seal bore diameter - - - - - 3.249" -- 3.252" (82,52 -- 82,60mm)

Bearing bore diameter - - - - - 3.347" -- 3.349" (85,01 -- 85,06mm)

### 7.1.2.3

#### Front Bearing Spacer

I. D. - - - - - 1.580" -- 1.585" (40,13 -- 40,25mm)

Width - - - - - .490" -- .495" (12,44 -- 12,57mm)

### 7.1.2.4

#### Front Bearing (Roller)

O. D. - - - - - 3.345" -- 3.346" (84,96 -- 84,98mm)

I. D. - - - - - 1.7712" -- 1.7717" (44,988 -- 45,001mm)

### 7.1.2.5

#### Front Bearing Spacing Sleeve

I. D. - - - - - 1.788" -- 1.793" (45,41 -- 45,54mm)

Width - - - - - .435" -- .440" (11,04 -- 11,17mm)

### 7.1.2.6

#### Gear Spacer

I. D. - - - - - 1.788" -- 1.793" (45,41 -- 45,54mm)

Width - - - - - .375" -- .380" (9,52 -- 9,65mm)

### 7.1.2.7

#### High Range and Second Reverse Gear

Number of gear teeth - - - - - 41

Hub width - - - - - 2.562" -- 2.565" (65,07 -- 65,15mm)

### 7.1.2.8

#### Low Range Gear

Number of teeth - - - - - 34

Hub width - - - - - 2.499" -- 2.502" (63,47 -- 63,55mm)

### 7.1.2.9

#### Third Reverse Gear

Number of gear teeth - - - - - 46

Hub width - - - - - 2.905" -- 2.908" (73,78 -- 73,86mm)

## Fits and Tolerances

### 7.1.2.10

#### Spacing Sleeve

O. D. ----- 2.875" (73, 02mm)  
 Length ----- 3.883"--3.886" (98, 62--98, 70mm)

### 7.1.2.11

#### First Reverse Gear

Number of teeth ----- 21  
 Hub width ----- 1.968"--1.971" (49, 98--50, 06mm)

### 7.1.2.12

#### Rear Bearing

O. D. ----- 4.723"--4.724" (119, 96--119, 98mm)  
 I. D. ----- 2.164"--2.168" (54, 96--55, 06mm)

### 7.1.2.13

#### Rear Bearing Sleeve

O. D. ----- 4.720"--4.723" (119, 88--119, 96mm)  
 Length (not including boss) ----- 3.280"--3.290" (83, 31--83, 56mm)

### 7.1.2.14

#### Sleeve locating shims

Thickness ----- .005" (0, 12mm)

### 7.1.3 INTERMEDIATE SHAFT PARTS (Front to rear)

#### 7.1.3.1

O. D. at front bearing location ----- 1.3780"--1.3785" (35, 001--35, 013mm)  
 O. D. at front bearing oil seal ----- 1.124"--1.125" (28, 54--28, 57mm)  
 O. D. at high range gear inner race location ----- 1.8120"--1.8125" (46, 024--46, 037mm)  
 O. D. at rear bearing location ----- 2.1660"--2.1667" (55, 016--55, 034mm)

#### 7.1.3.2

#### Front Bearing Retainer

Seal bore diameter ----- 1.999"--2.001" (50, 77--50, 82mm)  
 Bearing bore diameter ----- 3.150"--3.152" (80, 01--80, 06mm)

#### 7.1.3.3

Inner sealing ring I. D. ----- 1.127"--1.128" (28, 62--28, 65mm)

#### 7.1.3.4

Outer sealing ring O. D. ----- 1.995"--1.997" (50, 67--50, 72mm)

#### 7.1.3.5

#### Front Bearing

O. D. ----- 3.1490"--3.1496" (79, 984--79, 999mm)  
 I. D. ----- 1.377"--1.378" (34, 97--35, 00mm)  
 Width ----- .821"--.826" (20, 85--20, 98mm)

#### 7.1.3.6

#### Front Bearing Spacing Washer

I. D. ----- 1.383"--1.388" (35, 12--35, 25mm)  
 Width ----- .560"--.565" (14, 22--14, 35mm)  
 O. D. ----- 3.44" (87, 37mm)

#### 7.1.3.7

#### High Range Gear Bushing and Race

Race O. D. ----- 2.249"--2.250" (57, 12--57, 15mm)  
 Race I. D. ----- 1.8120"--1.8125" (46, 024--46, 037mm)  
 Race width ----- 1.688"--1.693" (42, 87--43, 00mm)  
 Bushing O. D. ----- 2.870"--2.871" (72, 89--72, 92mm)  
 Bushing I. D. ----- 2.248"--2.249" (57, 09--57, 12mm)  
 Bushing width ----- 1.620"--1.630" (41, 14--41, 40mm)

(Continued)

## Fits and Tolerances

### 7.1.3.8

#### High Range Gear

Number of helical gear teeth	-----	32
Number of clutch gear teeth	-----	24
Bore diameter	-----	2.876"--2.877"(73,05--73,07mm)
Width	-----	2.115"--2.120"(53,72--53,84mm)

### 7.1.3.9

#### Gear Bearing Spacer

I. D.	-----	1.817"--1.822"(46,15--46,27mm)
Width	-----	.249"--.254"(6,32--6,45mm)

### 7.1.3.10

#### Shifting Collar

Number of internal teeth	-----	24
Width	-----	1.125"(28,57mm)
O. D.	-----	6.080"--6.090"(154,43--154,68mm)
Groove width	-----	.620"--.630"(15,74--16,0mm)
Groove depth	-----	.290"--.300"(7,36--7,62mm)

### 7.1.3.11

#### Shifting Fork

Width at wear collar location	-----	.240"--.245"(6,09--6,22mm)
-------------------------------	-------	----------------------------

### 7.1.3.12

#### Bronze wear collar

Width for shifting collar	-----	.590"--.610"(14,98--15,49mm)
Width for shifting fork	-----	.250"--.265"(6,35--6,73mm)
Thickness each side	-----	.172"--.180"(4,36--4,57mm)

### 7.1.3.13

#### Low Range Gear Hub

Number of teeth	-----	24
Hub width	-----	3.374"--3.377"(85,69--85,77mm)
O. D. at bearing location	-----	3.3740"--3.3745"(85,699--85,712mm)

### 7.1.3.14

#### Low Range Gear Bushing

O. D.	-----	3.994"--3.995"(101,45--101,47mm)
I. D.	-----	3.373"--3.374"(85,67--85,69mm)

### 7.1.3.15

#### Low Range Gear

Number of helical gear teeth	-----	40
Number of clutch gear teeth	-----	24
Bore diameter	-----	4.001"--4.002"(101,62--101,65mm)
Width	-----	2.115"--2.120"(53,72--53,84mm)

### 7.1.3.16

#### Third and Fifth Speed Gear

Number of teeth	-----	41
Hub width	-----	2.124"--2.127"(53,94--54,02mm)

### 7.1.3.17

#### Spacing Sleeve

O. D.	-----	2.88"(73,15mm)
Width	-----	1.353"--1.356"(34,36--34,44mm)

### 7.1.3.18

#### Fourth and Sixth Speed Gear

Number of teeth	-----	46
Hub width	-----	2.905"--2.908"(73,78--73,86mm)

## Fits and Tolerances

### 7.1.3.19

#### Spacing Sleeve

O. D. ----- 2.88" (73,15 mm)  
Width ----- 4.124" -- 4.127" (104,79 -- 104,82 mm)

### 7.1.3.20

#### First and Second Speed Gear

Number of teeth ----- 22  
Hub width ----- 1.754" -- 1.757" (44,55 -- 44,62 mm)

### 7.1.3.21

#### Rear Roller Bearing

O. D. ----- 3.936" -- 3.937" (99,97 -- 99,99 mm)  
I. D. ----- 2.164" -- 2.165" (54,96 -- 54,99 mm)  
Width ----- .821" -- .826" (20,85 -- 20,98 mm)

### 7.1.4 BEVEL PINION SHAFT PARTS (Front to rear)

#### 7.1.4.1

##### Shaft

Number of pinion teeth ----- 11  
O. D. at front bearing location ----- 1.9684" -- 1.9689" (49,995 -- 50,010 mm)  
O. D. at front bearing oil seal location ----- 1.874" -- 1.875" (47,59 -- 47,62 mm)  
O. D. at rear bearing location ----- 3.150" -- 3.151" (80,01 -- 80,03 mm)  
Backlash with bevel gear ----- .008" -- .014" (0,20 -- 0,35 mm)

#### 7.1.4.2

##### Front Bearing Retainer

Seal bore diameter ----- 2.874" -- 2.876" (72,99 -- 73,05 mm)  
Bearing bore diameter ----- 4.332" -- 4.334" (110,03 -- 110,08 mm)

#### 7.1.4.3

Inner sealing ring I. D. ----- 1.127" -- 1.128" (28,62 -- 28,65 mm)

#### 7.1.4.4

Outer sealing ring O. D. ----- 1.995" -- 1.997" (50,67 -- 50,72 mm)

#### 7.1.4.5

##### Front Bearing

O. D. ----- 4.3301" -- 4.3307" (109,98 -- 109,99 mm)  
I. D. ----- 1.9680" -- 1.9685" (49,98 -- 49,99 mm)  
Width ----- 1.745" -- 1.750" (44,32 -- 44,45 mm)

#### 7.1.4.6

##### Front Bearing Spacing Washer

I. D. ----- 2.000" -- 2.003" (50,80 -- 50,87 mm)  
Width at I. D. ----- .503" -- .508" (12,77 -- 12,90 mm)

#### 7.1.4.7

##### Second Reverse and Third and Fifth

##### Speed Gear Hub

Number of clutch teeth ----- 26  
O. D. of bushing locations ----- 3.7490" -- 3.7495" (95,224 -- 95,237 mm)  
Length ----- 6.528" -- 6.531" (165,81 -- 165,88 mm)

#### 7.1.4.8

##### Second Reverse and Third and Fifth

##### Speed Gear Bushings

O. D. ----- 4.369" -- 4.370" (110,97 -- 110,99 mm)  
I. D. ----- 3.748" -- 3.749" (95,19 -- 95,22 mm)  
Width ----- 1.995" -- 2.005" (50,67 -- 50,92 mm)

## Fits and Tolerances

### 7.1.4.9

#### Second Reverse Gear

Number of helical gear teeth (R. H.)	-----	55
Number of clutch gear teeth	-----	26
Bore diameter	-----	4.376" -- 4.377" (111,15 -- 111,17 mm)
Width of hub	-----	2.756" -- 2.776" (70,00 -- 70,51 mm)

### 7.1.4.10

#### Third and Fifth Speed Gear

Number of helical gear teeth (L. H.)	-----	55
Number of clutch gear teeth	-----	26
Bore diameter	-----	4.376" -- 4.377" (111,15 -- 111,17 mm)
Width of hub	-----	2.756" -- 2.761" (70,00 -- 70,12 mm)

### 7.1.4.11

#### Second Reverse and Third and Fifth Speed

##### Gear Shifting Collar

Number of internal teeth	-----	26
Width	-----	1,125" (28,57 mm)
O. D.	-----	6.490" -- 6.500" (164,84 -- 165,10 mm)
Groove width	-----	.620" -- .630" (15,74 -- 16,0 mm)
Groove depth	-----	.307" -- .317" (7,79 -- 8,05 mm)

### 7.1.4.12

#### Second Reverse and Third and Fifth Speed

##### Shifting Fork

Width at collar location	-----	.240" -- .245" (6,09 -- 6,22 mm)
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### 7.1.4.13

#### Second Reverse and Third and Fifth Speed

##### Bronze Wear Collar

Width for shifting collar	-----	.590" -- .610" (14,98 -- 15,49 mm)
Width for shifting fork	-----	.250" -- .265" (6,35 -- 6,73 mm)
Thickness each side	-----	.172" -- .180" (4,36 -- 4,57 mm)

### 7.1.4.14

#### Third Reverse and Fourth and Sixth

##### Speed Gear Hub

Number of clutch teeth	-----	26
O. D. at bushing locations	-----	3.7490" -- 3.7495" (95,224 -- 95,237 mm)
Length	-----	4.497" -- 4.500" (114,22 -- 114,30 mm)

### 7.1.4.15

#### Third Reverse and Fourth and Sixth Speed

##### Gear Bushings

O. D.	-----	4.369" -- 4.370" (110,97 -- 110,99 mm)
I. D.	-----	3.748" -- 3.749" (95,19 -- 95,22 mm)
Width	-----	1.558" -- 1.568" (39,57 -- 39,82 mm)

### 7.1.4.16

#### Gear Spacing Washers

Number used	-----	3
O. D.	-----	5.245" -- 5.250" (133,22 -- 133,35 mm)
Width	-----	.318" -- .320" (8,07 -- 8,12 mm)

### 7.1.4.17

#### Third Reverse and Fourth and Sixth Speed

##### Gears

Number used	-----	2
Number of helical gear teeth	-----	48
Number of clutch gear teeth	-----	26
Bore diameter	-----	4.376" -- 4.377" (111,15 -- 111,17 mm)
Width of hub	-----	1.615" -- 1.620" (41,02 -- 41,14 mm)

## Fits and Tolerances

### 7.1.4.18

#### Third Reverse and Fourth and Sixth Speed

##### Gear Shifting Collar

Number of internal teeth	-----	26
Width	-----	1.125" (28,57 mm)
O. D.	-----	6.490" -- 6.500" (164,84 -- 165,10 mm)
Groove width	-----	.620" -- .630" (15,74 -- 16,0 mm)
Groove depth	-----	.307" -- .317" (7,79 -- 8,05 mm)

### 7.1.4.19

#### Third Reverse and Fourth and Sixth Speed

##### Shifting Fork

Width at collar location	-----	.240" -- .245" (6,09 -- 6,22 mm)
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### 7.1.4.20

#### Third Reverse and Fourth and Sixth Speed Bronze

##### Wear Collar

Width for shifting collar	-----	.590" -- .610" (14,98 -- 15,49 mm)
Width for shifting fork	-----	.250" -- .265" (6,35 -- 6,73 mm)
Thickness each side	-----	.172" -- .180" (4,36 -- 4,57 mm)

### 7.1.4.21

#### First Reverse and First and Second Speed

##### Gear Hub

Number of clutch teeth	-----	26
O. D. at bushing locations	-----	3.7490" -- 3.7495" (95,224 -- 95,237 mm)
Length	-----	5.395" -- 5.400" (137,03 -- 137,16 mm)

### 7.1.4.22

#### First Reverse and First and Second Speed

##### Gear Bushings

O. D.	-----	4.369" -- 4.370" (110,97 -- 110,99 mm)
I. D.	-----	3.748" -- 3.749" (95,19 -- 95,22 mm)
Width	-----	1,995" -- 2.005" (50,67 -- 50,92 mm)

### 7.1.4.23

#### First Reverse and First and Second Speed

##### Gears

Number used	-----	2
Number of helical gear teeth	-----	62
Number of clutch gear teeth	-----	26
Bore diameter	-----	4.376" -- 4.377" (111,15 -- 111,17 mm)
Width	-----	2.052" -- 2.057" (52,12 -- 52,24 mm)

### 7.1.4.24

#### First Reverse and First and Second Speed

##### Gear Shifting Collar

Number of internal teeth	-----	26
Width	-----	1.125" (28,57 mm)
O. D.	-----	6.490" -- 6.500" (164,84 -- 165,10 mm)
Groove width	-----	.620" -- .630" (15,74 -- 16,0 mm)
Groove depth	-----	.307" -- .317" (7,79 -- 8,05 mm)

### 7.1.4.25

#### First Reverse and First and Second Speed

##### Shifting Fork

Width at collar location	-----	.240" -- .245" (6,09 -- 6,22 mm)
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### 7.1.4.26

#### First Reverse and First and Second Speed

##### Bronze Wear Collar

Width for shifting collar	-----	.590" -- .610" (14,98 -- 15,49 mm)
Width for shifting fork	-----	.250" -- .265" (6,35 -- 6,73 mm)
Thickness each side	-----	.172" -- .180" (4,36 -- 4,57 mm)

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## TOPIC 8 SERVICE TOOLS

All tools required to perform the repair operations described in this manual are considered to be standard service tools.

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