

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

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DIRECT SUPPORT AND GENERAL SUPPORT  
MAINTENANCE MANUAL  
FOR

TRANSMISSION  
MODEL 3052, NSN 2520-00-347-4520

This copy is a reprint which includes current  
pages from Change 1.

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HEADQUARTERS, DEPARTMENT OF THE ARMY

MAY 1978

**WARNING**  
**EXHAUST GASES CAN BE DEADLY**

EXPOSURE TO EXHAUST GASES PRODUCES SYMPTOMS OF HEADACHE, DIZZINESS, LOSS OF MUSCULAR CONTROL, APPARENT DROWSINESS, AND COMA. PERMANENT BRAIN DAMAGE OR DEATH CAN RESULT FROM SEVERE EXPOSURE.

CARBON MONOXIDE OCCURS IN THE EXHAUST FUMES OF FUEL BURNING HEATERS AND INTERNAL COMBUSTION ENGINES, AND BECOMES DANGEROUSLY CONCENTRATED UNDER CONDITIONS OF INADEQUATE VENTILATION. THE FOLLOWING PRECAUTIONS MUST BE OBSERVED TO INSURE THE SAFETY OF PERSONNEL WHENEVER FUEL BURNING HEATER(S) OR ENGINE OF ANY VEHICLE IS OPERATED FOR MAINTENANCE PURPOSES OR TACTICAL USE.

DO NOT OPERATE HEATER OR ENGINE OF VEHICLE IN AN ENCLOSED AREA UNLESS IT IS ADEQUATELY VENTILATED.

DO NOT IDLE ENGINE FOR LONG PERIODS WITHOUT MAINTAINING ADEQUATE VENTILATION IN PERSONNEL COMPARTMENTS.

DO NOT DRIVE ANY VEHICLE WITH INSPECTION PLATES OR COVER PLATES REMOVED UNLESS NECESSARY FOR MAINTENANCE PURPOSES.

BE ALERT AT ALL TIMES DURING VEHICLE OPERATION FOR EXHAUST ODORS AND EXPOSURE SYMPTOMS. IF EITHER ARE PRESENT, IMMEDIATELY VENTILATE PERSONNEL COMPARTMENTS. IF SYMPTOMS PERSIST, REMOVE AFFECTED PERSONNEL FROM VEHICLE AND TREAT AS FOLLOWS: EXPOSE TO FRESH AIR; KEEP WARM; DO NOT PERMIT PHYSICAL EXERCISE; IF NECESSARY, ADMINISTER ARTIFICIAL RESPIRATION.

IF EXPOSED, SEEK PROMPT MEDICAL ATTENTION FOR POSSIBLE DELAYED ONSET OF ACUTE LUNG CONGESTION. ADMINISTER OXYGEN IF AVAILABLE.

THE BEST DEFENSE AGAINST EXHAUST GAS POISONING IS ADEQUATE VENTILATION.

HEADQUARTERS  
DEPARTMENT OF THE ARMY  
WASHINGTON, DC, 27 February 1981

CHANGE }  
No. 1 }

**Direct Support and General Support  
Maintenance Manual  
for  
TRANSMISSION  
MODEL 3502  
(NSN 2520-00-347-4520)**

TM 9-2520-246-34, 12 May 1978, is changed as follows:

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Technical Manual

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DEPARTMENT OF THE ARMY  
Washington, D.C. 12 May 1978

No. 9-2520-246-34

DIRECT SUPPORT AND GENERAL SUPPORT  
MAINTENANCE MANUAL  
FOR

TRANSMISSION  
MODEL 3052, NSN 2520-00-347-4520

IMPORTANT NOTICE

TM 9-2520-246-34 should be used only for transmission model 3052. For transmission model 3053A, transmission transfer models T-136-21 and T-136-27, and power take-off models WN-7-28, WND-7-28, and P-136-C, use only TM 9-2520-246-34-1.

Current as of 1 September 1977

REPORTING OF ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistake or if you know of a way to improve the procedure, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publication and Blank Forms), or DA Form 2028-2 located in the back of this manual direct to: Commander, U.S. Army Tank Automotive Materiel Readiness Command, ATTN: DRSTA-MB, Warren, Michigan 48090. A reply will be furnished to you.

Table of Contents

	Paragraph	Page
CHAPTER 1. INTRODUCTION		
Section I. General .....	1-1	1-1
II. Description and data .....	1-6	1-1
CHAPTER 2. DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE INSTRUCTIONS		
Section I. Repair parts, special tools, and equipment .....	2-1	2-1
II. Troubleshooting .....	2-5	2-1
III. General maintenance .....	2-7	2-15
IV. Removal and installation of major components and assemblies .....	2-12	2-18
CHAPTER 3. REPAIR OF TRANSMISSIONS		
Section I. Description, operation, and data (model 3052) .....	3-1	3-1
II. Description, operation, and data (model 3053A) .....	3-4	3-9
III. Repair (model 3052) .....	3-7	3-11
IV. Repair (model 3053A) .....	3-12	3-21
V. Test and adjustment (models 3052 and 3053A) .....	3-13	3-21
VI. Repair and replacement standards (models 3052 and 3053A) .....	3-16	3-21

\* This manual supersedes TM 9-2520-246-35, 29 November 1965, including all changes.

Table of Contents — Continued

	Paragraph	Page
CHAPTER 4. REPAIR OF TRANSFERS		
Section I. Description, operation, and data (model T-136-27) . . . . .	4-1	4-1
II. Repair (model T-136-27) . . . . .	4-4	4-3
III. Test and adjustment (model T-136-27) . . . . .	4-9	4-12
IV. Repair and replacement standards (model T-136-27) . . . . .	4-16	4-12
V. Description, operation, and data (model T-136-21) . . . . .	4-18	4-19
VI. Repair (model T-136-21) . . . . .	4-21	4-21
VII. Test and adjustment (model T-136-21) . . . . .	4-26	4-30
VIII. Repair and replacement standards (model T-136-21) . . . . .	4-33	4-31
CHAPTER 5. REPAIR OF POWER TAKEOFFS		
Section I. Description, operation, and data (model WN-7-28) . . . . .	5-1	5-1
II. Repair (model WN-7-28) . . . . .	5-5	5-3
III. Test and adjustment (model WN-7-28) . . . . .	5-8	5-7
IV. Repair and replacement standards (model WN-7-28) . . . . .	5-10	5-7
V. Description, operation, and data (model WND-7-28) . . . . .	5-12	5-11
VI. Repair (model WND-7-28) . . . . .	5-16	5-12
VII. Test and adjustment (model WND-7-28) . . . . .	5-18	5-14
VIII. Repair and replacement standards (model WND-7-28) . . . . .	5-20	5-14
IX. Description, operation, and data (model P-136-C) . . . . .	5-22	5-16
X. Repair (model P-136-C) . . . . .	5-26	5-18
XI. Test and adjustment (model P-136-C) . . . . .	5-28	5-21
XII. Repair and replacement standards (model P-136-C) . . . . .	5-30	5-21
APPENDIX A. REFERENCES . . . . .	A-1	A-1
INDEX . . . . .		Index 1

## LIST OF ILLUSTRATIONS

Figure	Title	Page
1-1.	Transmission models 3052 and 3053A - right front view . . . . .	1-2
1-2.	Transmission models 3052 and 3053A - left rear view. . . . .	1-2
1-3.	Transmission model 3052, five-speed shift pattern . . . . .	1-2
1-4.	Transmission model 3053A, five-speed shift pattern . . . . .	1-2
1-5.	Positive locking transfer model T-136-27 - front view . . . . .	1-3
1-6.	Positive locking transfer model T-136-27 - rear view . . . . .	1-4
1-7.	Sprag equipped transfer model T-136-21 - front view . . . . .	1-5
1-8.	Sprag equipped transfer model T-136-21 - rearview. . . . .	1-5
1-9.	Power takeoff model WND-7-28 . . . . .	1-6
1-10.	Power takeoff model WN-7-28 . . . . .	1-6
1-11.	Power takeoff model P-136-C . . . . .	1-6
3-1.	Transmission models 3052 and 3053A - exterior components . . . . .	3-1
3-2.	Transmission models 3052 and 3053A - equipped with a power takeoff . . . . .	3-2
3-3.	Transmission model 3053A - sectional view (also typical of model 3052) . . . . .	3-3
3-4.	Transmission input shaft and bearing. . . . .	3-4
3-5.	Transmission mainshaft - input shaft removed - model 3052 . . . . .	3-4
3-6.	Transmission mainshaft assembly - model 3052 - exploded view . . . . .	3-5
3-7.	Transmission countershaft assembly . . . . .	3-5
3-8.	Transmission countershaft assembly - exploded view . . . . .	3-6
3-9.	Reverse idler gear and shaft assembly - exploded view . . . . .	3-6
3-10.	Synchronizer construction . . . . .	3-7
3-11.	Synchronizer construction - sectional view . . . . .	3-7
3-12.	Power flow - transmission model 3052. . . . .	3-8
3-13.	Transmission mainshaft assembly-exploded view - transmission model 3053A . . . . .	3-10
3-14.	Transmission countershaft assembly - exploded view - transmission model 3053A . . . . .	3-10
3-15.	Power flow - transmission model 3053A . . . . .	3-10
3-16.	Removal of clutch release bearing support assembly . . . . .	3-11
3-17.	Removal of clutch release yoke and release shaft . . . . .	3-11
3-18.	Removal of clutch bell housing. . . . .	3-12
3-19.	Removal of shifter shaft cover. . . . .	3-12
3-20.	Transmission shifter forks, gears, and synchronizers in neutral position . . . . .	3-12
3-21.	Removal of companion flange . . . . .	3-13
3-22.	Removal of mainshaft rear bearing cap assembly . . . . .	3-13
3-23.	Removal of countershaft rear bearing cover . . . . .	3-13
3-24.	Removal of power takeoff opening cover . . . . .	3-13
3-25.	Removal of input shaft bearing cap. . . . .	3-14
3-26.	Removal of mainshaft rear bearing . . . . .	3-14
3-27.	Removal of fourth- and fifth- speed synchronizer . . . . .	3-14
3-28.	Removal of mainshaft assembly . . . . .	3-15
3-29.	Removal of idler gearshaft and idler gear assembly . . . . .	3-15
3-30.	Removal of countershaft rear bearing . . . . .	3-15
3-31.	Removal of countershaft assembly. . . . .	3-15
3-32.	Removal of countershaft front bearing . . . . .	3-15
3-33.	Disassembly of input shaft assembly . . . . .	3-16
3-34.	Removal of fourth-speed gear . . . . .	3-16
3-35.	Removal of third-speed gear and fourth-speed gear sleeve . . . . .	3-16
3-36.	Removal of second-speed gear, second - and third-speed synchronizer and synchronizer sleeve . . . . .	3-17
3-37.	Removal of second-speed gear, second- and third-speed synchronizer and synchronizer sleeve . . . . .	3-17

**LIST OF ILLUSTRATIONS (Continued)**

Figure	Title	Page
3-38.	Removal of countershaft drive gear (fifth-speed gear) . . . . .	3-17
3-39.	Removal of countershaft fourth-speed gear . . . . .	3-17
3-40.	Removal of mainshaft rear bearing cap oil seal . . . . .	3-17
3-41.	Shifter shaft cover . . . . .	3-18
3-42.	Removal of expansion plugs, setscrews, shifter shafts, actuating lug, and shifter forks . . . . .	3-18
3-43.	Removal of poppet balls and springs . . . . .	3-18
3-44.	Removal of interlock plate and springs . . . . .	3-18
3-45.	Removal of first and reverse shifter shaft oil seal . . . . .	3-19
3-46.	Removal of lower shift lever, lever spring, and spring cap . . . . .	3-19
3-47.	Repair and replacement standard points of measurement for input shaft and bearing . . . . .	3-22
3-48.	Repair and replacement standard points of measurement for transmission mainshaft assembly . . . . .	3-23
3-49.	Repair and replacement standard points of measurement for transmission countershaft and gears . . . . .	3-24
3-50.	Repair and replacement standard points of measurement for transmission, reverse idler gear and shaft assembly . . . . .	3-25
4-1.	Positive locking transfer model T-136-27 - front view . . . . .	4-1
4-2.	Positive locking transfer model T-136-27 - rear view . . . . .	4-2
4-3.	Removal of handbrake assembly . . . . .	4-3
4-4.	Transfer mounted on stand . . . . .	4-4
4-5.	Companion flange removal . . . . .	4-4
4-6.	Air cylinder disassembly . . . . .	4-4
4-7.	Front output shaft case and input shaft bearing cover . . . . .	4-4
4-8.	Front output shaft and shifter assembly . . . . .	4-5
4-9.	Front output clutch and case cover . . . . .	4-5
4-10.	Rear output shaft assembly . . . . .	4-5
4-11.	Top cover and shifter shaft . . . . .	4-5
4-12.	Bearing covers and case plug . . . . .	4-6
4-13.	Shifter fork, input shaft, and countershaft . . . . .	4-7
4-14.	Rear output shaft disassembly-exploded view . . . . .	4-7
4-15.	Countershaft disassembly-exploded view . . . . .	4-8
4-16.	Input shaft disassembly-exploded view . . . . .	4-8
4-17.	Transfer case cover disassembly . . . . .	4-9
4-18.	Remover and replacer with handle . . . . .	4-9
4-19.	Front output shaft cover disassembly . . . . .	4-10
4-20.	Transfer case disassembly . . . . .	4-10
4-21.	Disassembly of handbrake shoe assembly . . . . .	4-10
4-22.	Repair and replacement standard points of measurement for transfer gear train . . . . .	4-13
4-23.	Repair and replacement standard points of measurement for transfer shafts and bearings . . . . .	4-15
4-24.	Repair and replacement standard points of measurement for transfer output shaft and cover . . . . .	4-17
4-25.	Repair and replacement standard points of measurement for transfer case and seals . . . . .	4-18
4-26.	Sprag equipped transfer model T-136-21 - front view . . . . .	4-19
4-27.	Sprag equipped transfer model T-136-21 - rear view . . . . .	4-20
4-28.	Removal of handbrake assembly . . . . .	4-21
4-29.	Transfer mounted on overhaul stand . . . . .	4-22
4-30.	Companion flanges-removal . . . . .	4-22
4-31.	Removal of transfer covers . . . . .	4-22
4-32.	Removal of front output shaft and reverse shift assembly . . . . .	4-23
4-33.	Removal of rear output, idler, and input shaft assemblies . . . . .	4-23



## LIST OF ILLUSTRATIONS (Continued)

Figure	Title	Page
4-34.	Removal of transfer top cover and shifter shaft . . . . .	4-24
4-35.	Removal of rear output shaft rear bearing cover, idler shaft rear bearing cover, and input shaft rear bearing cover . . . . .	4-24
4-36.	Rear output shaft disassembly - exploded view . . . . .	4-25
4-37.	Idler shaft disassembly-exploded view . . . . .	4-25
4-38.	Input shaft disassembly - exploded view . . . . .	4-26
4-39.	Front output shaft disassembly - exploded view . . . . .	4-26
4-40.	Positioning of sprag peaks for front sprag and rear sprag . . . . .	4-27
4-41.	Transfer case cover - disassembly . . . . .	4-28
4-42.	Removing idler shaft front bearing cup . . . . .	4-28
4-43.	Front output shaft cover - disassembly . . . . .	4-29
4-44.	Transfer case-disassembly . . . . .	4-29
4-45.	Handbrake shoe - disassembly . . . . .	4-29
4-46.	Inspecting sprags for wear . . . . .	4-31
4-47.	Repair and replacement standard points of measurement for transfer gear train . . . . .	4-32
4-48.	Repair and replacement standard points of measurement for transfer and bearings . . . . .	4-34
4-49.	Repair and replacement standard points of measurement for transfer output shaft and cover . . . . .	4-36
4-50.	Repair and replacement standard points of measurement for transfer case and seals . . . . .	4-37
5-1.	Power takeoff model WN-7-28 . . . . .	5-1
5-2.	Power takeoff model WN-7-28 -sectional view . . . . .	5-2
5-3.	Removal of power takeoff cover, poppet retainer, poppet spring, and ball . . . . .	5-3
5-4.	Removal of shifter shaft and shifter fork. . . . .	5-3
5-5.	Removal of input gearshaft . . . . .	5-4
5-6.	Removal of input gear, gear roller bearings, and thrust washers . . . . .	5-4
5-7.	Removal of output and reverse shaft rear bearing cap . . . . .	5-4
5-8.	Removal of output shaft front bearing cap and companion flange key . . . . .	5-4
5-9.	Removal of output shaft rear bearing . . . . .	5-5
5-10.	Removal of output shaft high-speed gear snapping and spacer . . . . .	5-5
5-11.	Removal of output shaft high-speed gear and front bearing . . . . .	5-5
5-12.	Removal of reverse gear . . . . .	5-5
5-13.	Removal of reverse gearshaft rear bearing. . . . .	5-6
5-14.	Removal of output shaft front bearing. . . . .	5-6
5-15.	Removal of shifter shaft boot and seal. . . . .	5-6
5-16.	Repair and replacement standard points of measurement for reverse gear and related parts . . . . .	5-8
5-17.	Repair and replacement standard points of measurement for input gear and related parts . . . . .	5-9
5-18.	Repair and replacement standard points of measurement for front output shaft and related parts . . . . .	5-10
5-19.	Power takeoff model WND-7-28. . . . .	5-11
5-20.	Rear output shaft housing-sectional view . . . . .	5-12
5-21.	Removal of rear output shaft housing and shifter shaft retainer, ball, and spring . . . . .	5-13
5-22.	Removal of shifter shaft and shifter shaft fork . . . . .	5-13
5-23.	Removal of output shaft snapping. . . . .	5-13
5-24.	Removal of rear output shaft and sliding clutch sleeve . . . . .	5-13
5-25.	Removal of rear output shaft bearing and shifter shaft boot and oil seal . . . . .	5-14
5-26.	Repair and replacement standard points of measurement for output shaft and related parts- model WND-7-28 . . . . .	5-15

**LIST OF ILLUSTRATIONS (Continued)**

<b>Figure</b>	<b>Title</b>	<b>Page</b>
5-27.	Power takeoff model P-136-C .....	5-16
5-28.	Power takeoff - sectional view .....	5-17
5-29.	Drain plug, two cotter pins, nut, washers, and shifter shaft. ....	5-18
5-30.	Removal of pump, shifter shaft retainer, spring and ball .....	5-18
5-31.	Removal of shifter shaft .....	5-18
5-32.	Removal of output shaft rear bearing retainer and oil seal .....	5-19
5-33.	Removal of output shaft, both bearings and rear tapered roller bearing cup .....	5-19
5-34.	Removal of output shaft front bearing cup .....	5-19
5-35.	Disassembly of output shaft .....	5-19
5-36.	Repair and replacement standard points of measurement for power takeoff model P-136-C .....	5-20

## LIST OF TABLES

Number	Title	Page
2-1.	Special tools . . . . .	2-2
2-2.	Troubleshooting table index . . . . .	2-2
2-2-01.	Transmission models 3052 and 3052A — troubleshooting . . . . .	2-3
2-2-02.	Transfer model T-136-27 troubleshooting . . . . .	2-7
2-2-03.	Transfer model T-136-21 troubleshooting . . . . .	2-11
2-2-04.	Power takeoff models WN-7-28 and WND-7-28 troubleshooting . . . . .	2-12
2-2-05.	Power takeoff model P-136-C . . . . .	2-14
3-1.	Repair and replacement standard points of measurement for input shaft and bearing . . . . .	3-22
3-2.	Repair and replacement standard points of measurement for transmission mainshaft assembly . . . . .	3-23
3-3.	Repair and replacement standard points of measurement for transmission countershaft and gears . . . . .	3-24
3-4.	Repair and replacement standard points of measurement for transmission reverse idler gear and shaft assembly . . . . .	3-25
4-1.	Repair and replacement standard points of measurement for transfer gear train . . . . .	4-13
4-2.	Repair and replacement standard points of measurement for transfer and bearings . . . . .	4-16
4-3.	Repair and replacement standard points of measurement for transfer output shaft and cover . . . . .	4-17
4-4.	Repair and replacement standard points of measurement for transfer case and seals . . . . .	4-18
4-5.	Repair and replacement standard points of measurement for transfer gear train . . . . .	4-32
4-6.	Repair and replacement standard points of measurement for transfer and bearings . . . . .	4-35
4-7.	Repair and replacement standard points of measurement for transfer output shaft and cover . . . . .	4-36
4-8.	Repair and replacement standard points of measurement for transfer case and seals . . . . .	4-37
5-1.	Repair and replacement standard points of measurement for reverse gear and related parts . . . . .	5-8
5-2.	Repair and replacement standard points of measurement for input gear and related parts . . . . .	5-9
5-3.	Repair and replacement standard points of measurement for front output shaft and related parts — model WN-7-28 . . . . .	5-10
5-4.	Repair and replacement standard points of measurement for output shaft and related parts — model WND-7-28 . . . . .	5-15
5-5.	Repair and replacement standard points of measurement for output shaft and related parts model P-136-C . . . . .	5-20

## CHAPTER 1 INTRODUCTION

### Section I. GENERAL

#### 1-1. Scope.

*a.* This manual contains the direct support and general support maintenance instructions for transmission models 3052 and 3053A; transfer models T-136-21 and T-136-27; power takeoff models WN-7-28, WND-7-28, and P-136-C. This manual also provides descriptions of these items and procedures for troubleshooting, removal, disassembly, assembly, cleaning, inspection, test, adjustment, installation, repair, and rebuild, as directed by the maintenance allocation chart.

*b.* Chapter 2 contains information on repair parts, tools, troubleshooting, general maintenance instructions, and removal and installation of major components.

*c.* Chapter 3 contains all repair and overhaul procedures pertinent to transmission models 3052 and 3053A.

*d.* Chapter 4 provides all the repair and overhaul procedures pertinent to transfer models T-136-21 and T-136-27.

*e.* Chapter 5 contains all the repair and overhaul procedures for power takeoff models WN-7-28, WND-7-28, and P-136-C.

*f.* Appendix A provides a list of current and applicable references to the transmissions, transfers, and power takeoffs used on the 2½-ton, 6x6 series trucks.

*g.* Refer to TM 9-2520-246-34P for a listing of parts and special tools for the maintenance of the transmissions, transfers, and power takeoffs for the 2½-ton, 6x6 series trucks.

#### 1-2. Maintenance Forms and Records.

Equipment maintenance forms and procedures for their use are contained in TM 38-750, The Army Maintenance Management System (TAMMS).

**1-3. Quality Assurance/Quality Control.** Repair and replacement standards for transmissions, transfers, and power takeoffs are supplied in each chapter. Through compliance with the engineering tolerances specified in this manual for repairs and adjustments, maintenance of quality control is assured.

#### 1-4. Equipment Improvement Recommendations.

EIR's will be prepared on DA Form 2407, Maintenance Request. Instructions for preparing EIR's are provided in TM 38-750, The Army Maintenance Management System. EIR's should be mailed directly to: Commander, U.S. Army Tank-Automotive Materiel Readiness Command, ATTN: DRSTA-MP, Warren, Michigan 48090. A reply will be furnished directly to you.

**1-5. Use of Metric Measurement Units.** The equipment described herein is nonmetric and does not require metric common or special tools; therefore, metric units are not supplied.

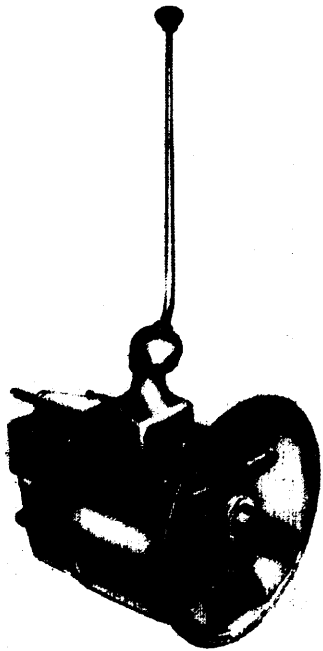
### Section II. DESCRIPTION AND DATA

#### 1-6. Description.

*a. General.* A short description covering each transmission, transfer, and power takeoff is provided. The descriptions are used to familiarize direct support, general support, and depot maintenance personnel with the different types and models of each unit. For a more detailed description and operation of each assembly, refer to Chapters 3, 4, and 5. Differences between models, if pertinent, are included.

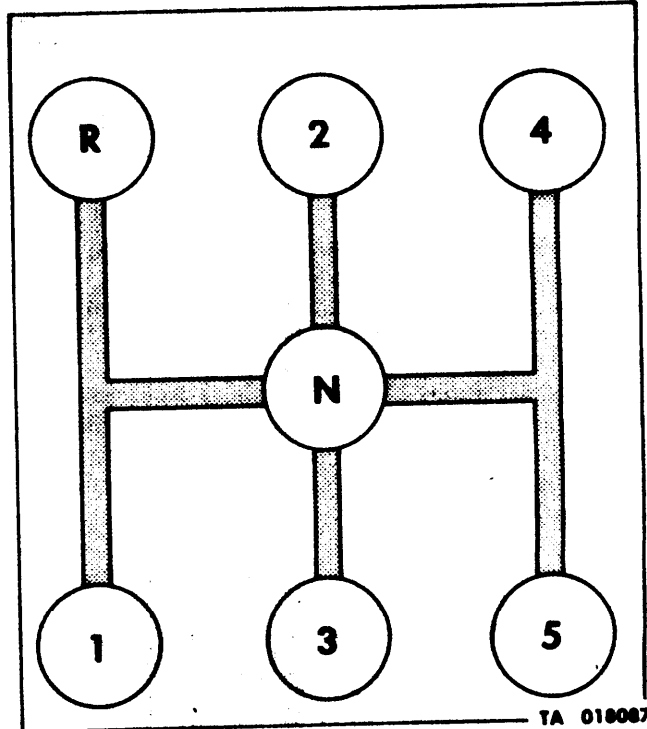
#### *b. Transmissions.*

(1) Transmission models 3051 and 3053A (fig. 1-1 and 1-2) are manual shift, synchromesh, selective gear types with five speeds forward and one reverse. The outer cases are made of cast iron and serve as a support for the various bearing shafts and other parts of the transmission gear train. For a more detailed description and operation refer to Chapter 3.



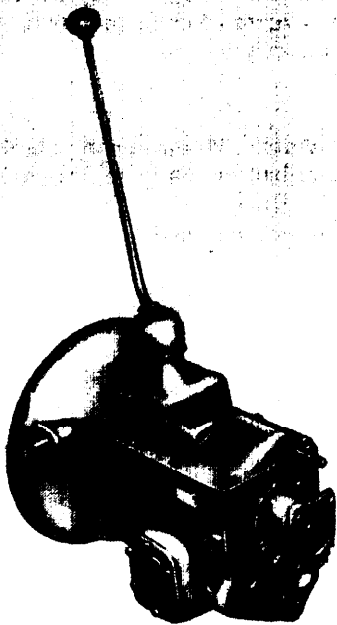
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Figure 1-1. Transmission Models 3052 and 3053A (Right Front View).



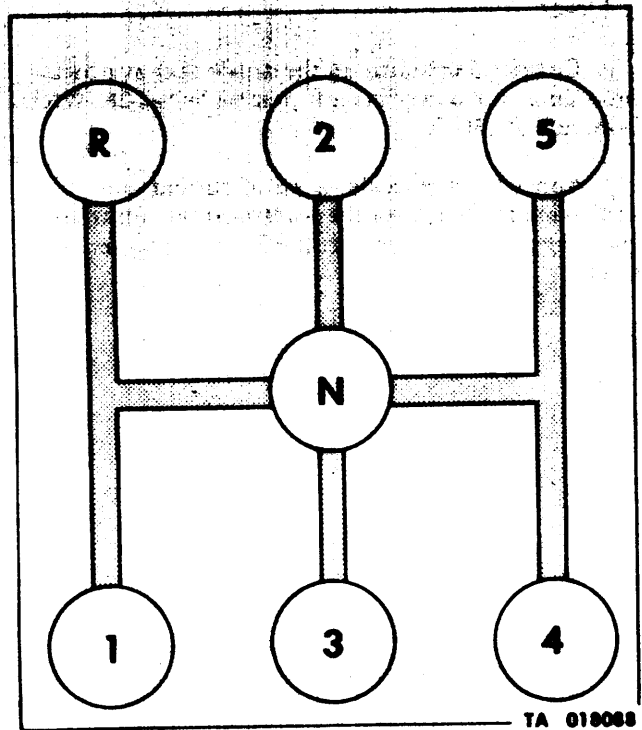
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Figure 1-3. Transmission Model 3052, Five Speed Shift Pattern.



TA 018086

Figure 1-2. Transmission Models 3052 and 3053A (Left Rear View).



TA 018088

Figure 1-4. Transmission Model 3053A, Five Speed Shift Pattern.

(2) Although transmission models 3052 and 3053A appear outwardly identical, the internal mechanism is different. Transmission 3052 is equipped with five forward speeds and fifth speed is a direct drive. Transmission model 3053A also is a five-speed transmission, but fourth speed is a direct drive and fifth speed is overdrive. The different shift patterns for each transmission are shown in figures 1-3 and 1-4.

(3) Transmission model 3052 is installed on all M44, 2½-ton, 6x6 series trucks equipped with a gasoline engine. Transmission model 3053A is installed on all M44A1 and M44A2, 2½-ton, 6x6 series trucks equipped with a multifuel engine.

*c. Transfers.*

(1) Transfer models T-136-21 and T-136-27 are two-speed synchromesh units driven from the transmission through a propeller shaft. The transfers distribute power to front and rear axles through propeller shafts.

(2) Positive locking transfer, model T-136-27, shown in figures 1-5 and 1-6 is a two-speed synchromesh unit driven by the transmission propeller shaft. This transfer is equipped with an air selector valve that enables the air locking assembly to engage the front output shaft to the rear output shaft for driving the front axle. Selection of the high or low ranges of the transfer provides the truck operator with a total of ten forward speeds and two reverse speeds.

(3) Transfer model T-136-21, figures 1-7 and 1-8, is designed to drive the front axle slightly slower than the rear axles and this difference in speed is taken up by an overrunning sprag unit on the front output shaft during normal operation. When the rear wheels lose traction, the sprag unit automatically engages and the front wheels also drive the vehicle. Refer to Chapter 4 for a detailed description and operation of transfers T-136-27 and T-136-21.

(4) Vehicle model application.

(a) Transfer model T-136-21 can be used on all M44 and M44A1, 2½-ton, 6x6 series trucks.

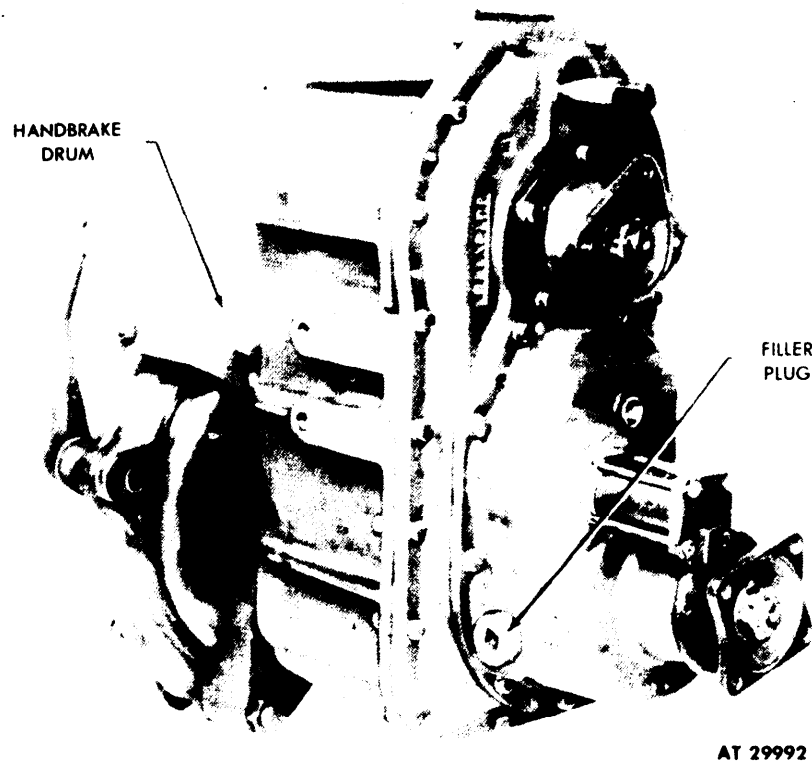
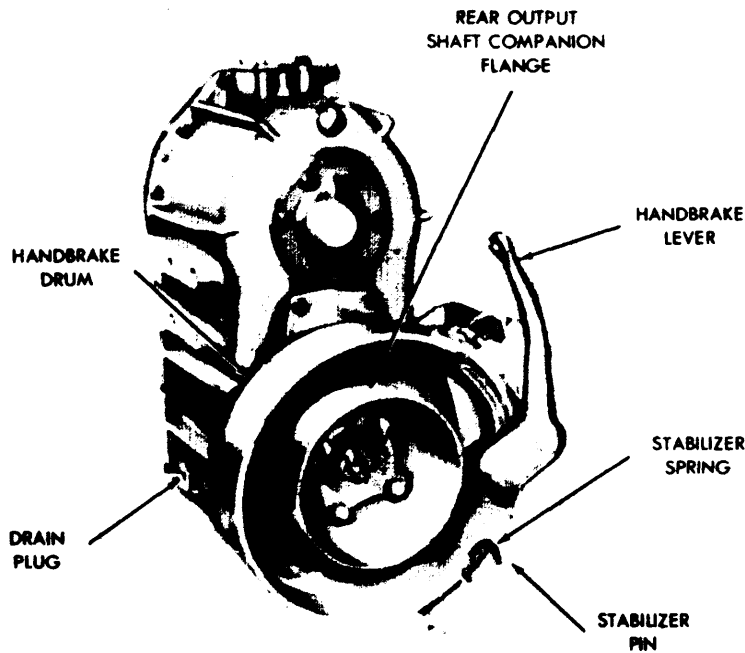


Figure 1-5. Positive Locking Transfer Model T-136-27 (Front View).



AT 29993

Figure 1-6. Positive Locking Transfer Model T-136-27 (Rear View).

(b) Transfer model T-136-27 is used on the following models:

M35A2	M46A2C	M292A5
M35A2C	M49A2C	M342A2
M36A2	M50A2	M621
M36A2C	M50A3	M622
M44A2	M109A3	M623
M45A2	M185A3	M624
M45A2G	M275A2	M756A2
M46A2	M292A2	M764

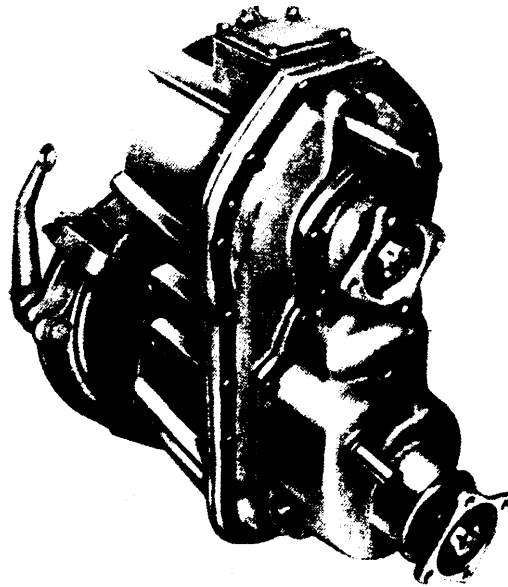
d. Power Takeoffs (Models WN-7-28, WND-7-28, and P-136-C).

(1) Power takeoff models WN-7-28 and WND-7-28, (fig. 1-9 and 1-10) are driven by the transmission and provide power to drive the vehicle winches, pumps, and other special or auxiliary equipment. Both takeoffs are designed to be mounted on a Society of Automotive Engineers' (SAE) standard, six-bolt hole power takeoff opening. However, when required, these units may be mounted on four-hole openings if

suitable filler blocks and driving gears are used. Both units are of the heavy-duty type, having two forward speeds and one reverse speed. The units are designed for either left or right hand mounting on the drive mechanism. The shifter shaft extends through both ends of the case, thus making the shift linkage adaptable to either end of the shaft. For a more detailed description and operation of the power takeoffs, refer to Chapter 5.

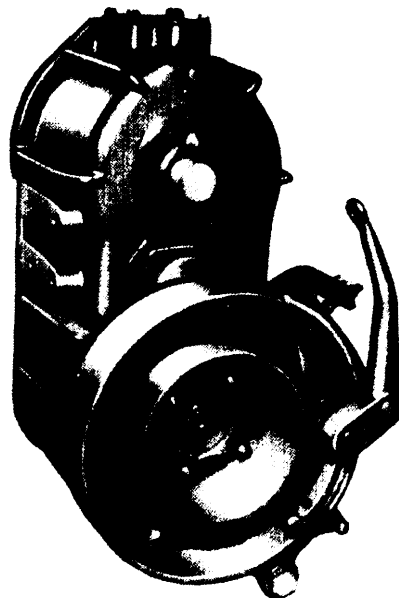
(2) Power takeoffs WN-7-28 and WND-7-28 are nearly identical throughout the mechanism. However, power takeoff model WND-7-28 uses two output shafts, and model WN-7-28 has only one output shaft. The internal gearing is identical for both units, except for the additional output shaft.

(3) Power takeoff model P-136-C (fig. 1-11) is a single drive, one-speed unit designed to mount only on transfers. The outer carriers are circular in shape and serve as a support for the main drive shaft and driveshaft bearings. This unit is used to drive various types of auxiliary vehicle equipment. Refer to Chapter 5 for a more detailed description and operation of the transfer-mounted power takeoff.



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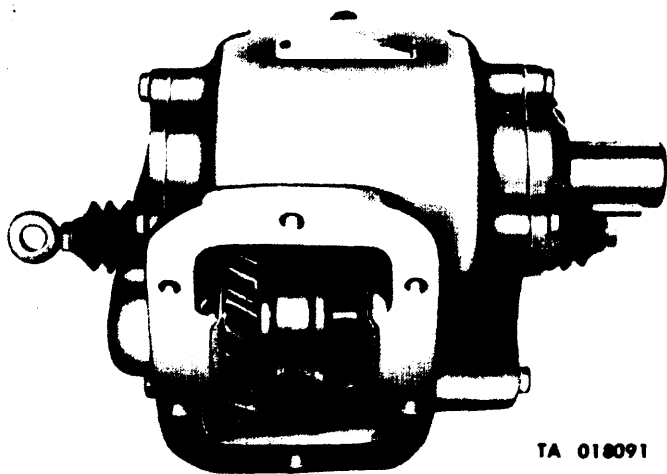
*Figure 1-7. Sprag Equipped Transfer Model T-136-21 (Front View).*



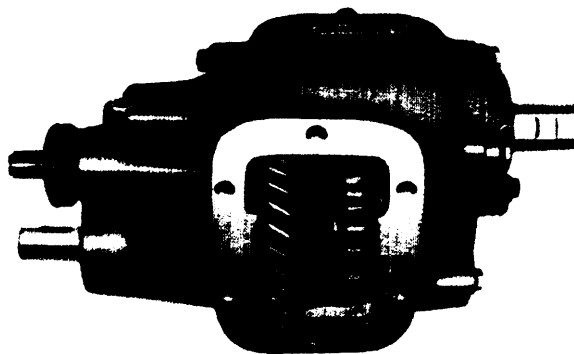
TA 018090

*Figure 1-8. Sprag Equipped Transfer Model T-136-21 (Rear View).*





TA 018091



TA 018092

Figure 1-9. Power Takeoff Model WND-7-28.

Figure 1-10. Power Takeoff Model WN-7-28.

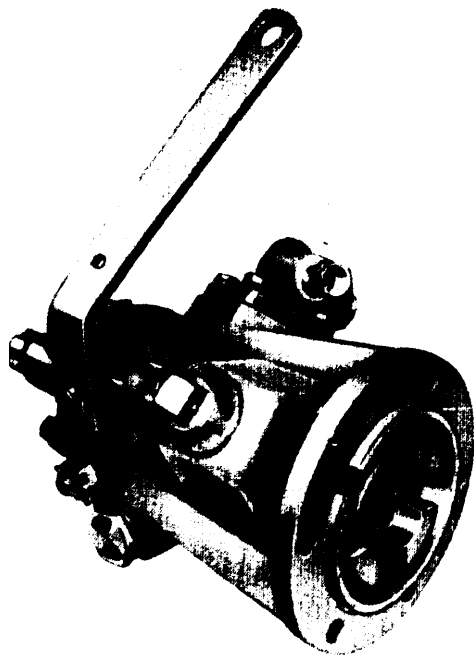
(4) Power takeoff models WND-7-28 and WN-7-28 are nearly identical throughout the mechanism; however, power takeoff model WND-7-28 has two output shafts, and model WN-7-28 has only one output shaft. The internal gearing is identical for both units, except for the additional output shaft.

(a) Power takeoff model WND-7-28 is used with the following vehicle models:

M47	M58	M59
M57	M58A1	M342

(3) Power takeoff model WN-7-28 is used with the following vehicle models:

M34	M45A2	M60
M35	M46	M108
M35A1	M46A1	M109
M35A2	M46C	M109A1
M35A2C	M48	M109A2
M36A2	M49	M109A3
M36C	M49A1C	M185A2
M36	M49A2C	M185A3
M44	M49C	M275
M44A1	M50	M275A1
M44A2	M50A1	M275A2
M45	M50A2	VT17-A/MTQ
M45A1	M50A3	VT18-A/MTQ



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Figure 1-11. Power Takeoff Model P-136-C.

(c) Power takeoff model P-136-C is used on the following vehicle models:

M621	M623
M622	M624

## CHAPTER 2 DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

### Section I. REPAIR PARTS, SPECIAL TOOLS, AND EQUIPMENT

**2-1. General.** Tools, equipment, and repair parts, over and above those available to the using organization, are supplied to direct support and general support maintenance shops for maintaining, repairing, and/ or rebuilding the material.

**2-2. Repair Parts.** Repair parts required for the maintenance of the transmissions, transfers, and power takeoffs are listed in TM 9-2520-246-34P, which is the authority for requesting or ordering replacement parts.

**2-3. Special Tools and Equipment.** The special tools and equipment, tabulated in table 2-1, are listed

and illustrated in TM 9-2520-246-34P which is the authority for requisitioning. Table 2-1 lists only the special tools and equipment necessary to perform the direct support, general support, and field maintenance operations described in this technical manual. Table 2-1 is included for information purposes only, and is not to be used as a basis for requisitioning.

**2-4. Common Tools and Equipment.** Standard and commonly used tools having general application to this material are listed in DA Supply Manuals SC 4910-95-CL-A01, A02, A50, A63, A64, A65, A67, A68, A69, A72, A73, and A74, SC 5180-90-CL-N23, SC 4910-95-CL-A31 and A32.

### Section II. TROUBLESHOOTING

#### 2-5. General.

*a. Purpose.* The information in this section is for the use of support personnel in conjunction with, and supplemental to the troubleshooting section in the pertinent Organizational Maintenance Manual (TM 9-2320-209-20/1). This information therefore provides the continuation of instructions in the Organizational Manual wherein a reference is made to direct support and general support maintenance personnel for corrective action.

*b. Operation.* Operation of a transmission, transfer, or power takeoff without a preliminary examination can cause further damage to the components and possible injury to personnel. Required inspection and troubleshooting will eliminate further damage to equipment and injury to personnel. Causes of faulty operation in a unit or component can often be determined without extensive disassembly.

*c. Inspection.* Inspection after the component is removed from the vehicle is performed to verify the diagnosis made while the component was installed in the vehicle, to uncover further defects or to determine malfunctions if the unit or component alone is received by the support organization. This inspection is particularly important in the final case because it is often the only means of determining the malfunction without completely disassembling the component.

Refer to Chapter 2, section III for general cleaning, inspection, and repair procedures.

#### 2-6. Introductory Information.

*a.* This section contains troubleshooting information for locating and correcting most of the operating troubles which may develop in the transmission models 3052 and 3053A, transfer models T-136-27 and T-136-21, and power takeoff models WN-7-28, WND-7-28, and P-136-C. Each malfunction for an individual component unit or system is followed by a list of tests or inspections which will help you to determine corrective actions to take. You should perform the tests/inspections and corrective actions in the order listed.

*b.* This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

*c.* The table lists the common malfunctions which you may find during the maintenance of the transmission models 3052 and 3053A, transfer models T-136-21 and T-136-27, and power takeoff models WN-7-28, WND-7-28, and P-136-C or their components. You should perform the tests/inspections and corrective actions in the order listed.

Table 2-1. Special Tools

Item No.	Item	NSN	Reference		Use
			Fig.	Para	
1	BRACKET, angle (used with stand 4910-00-529-8387) (7010363)	5240-00-610-0920	4-4	4-5	Used to adapt right side of transfer case to stand.
2	BRACKET, angle (used with stand 4910-00-529-8387) (7010362)	5340-00-610-0919	4-4	4-5	Used to adapt left side of transfer case to stand.
3	ADAPTER, mechanical puller (used with puller 5120-00-313-9496) (7083254)	5120-00-708-3254	3-29	3-8	Used to remove transmission reverse idler gear shaft.
4	PULLER KIT, mechanical companion flange) (8708724)	5120-00-338-6721	3-21 4-5 4-22	3-8 4-5 4-30	Used to remove companion flange from transmission, transfer, and and carrier.
5	HANDLE, used with remover and replacer 5120-00-708-3247 (7083241)	5120-00-708-3241	4-18 4-42	4-6 4-23	Used to remove or replace transfer idle shaft front bearing cup.
6	REMOVER AND REPLACER (used with handle 5120-00-708-3241) (7083247)	5120-00-708-3247	4-18 4-42	4-6 4-23	Used to remove or replace transfer idle shaft front bearing cup.

Table 2-2. Troubleshooting Table Index

No.	Title	Page
2-2.01	Transmission Models 30-52 and 3053A	2-3
2-2.02	Transfer Model T-136-27	2-7
2-2.03	Transfer Model T-136-21	2-11
2-2.04	Power Takeoff Models WND-7-28 and WN-7-28	2-12
2-2.05	Power Takeoff Model P-136-C	2-14

Table 2-2.01. Troubleshooting

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<b>MALFUNCTION</b>	<b>TEST OR INSPECTION</b>	<b>CORRECTIVE ACTION</b>
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**TRANSMISSION MODELS 3052 AND 3053A**

**NOTE**

If possible, make external and operational inspection in accordance with TM 9-2320-209-20/1 before disassembling transmission.

**1. LUBRICANT LEAKING FROM TRANSMISSION.**

Test 1. Inspect transmission thoroughly for source of transmission leakage.

Step 1. Disassemble transmission as required. (Refer to para 3-8, 3-9, and 3-12.)

Step 2. Replace all seals. (Refer to para 3-8, 3-9, and 3-12.)

Step 3. Replace all gaskets. (Refer to para 3-8, 3-9, and 3-12.)

Step 4. Assemble transmission (to complete assembly). (Refer to para 3-10, 3-11, and 3-12.)

Step 5. Fill transmission with lubricant. (Refer to LO 9-2320-209-12 gasoline or LO 9-2320-209-12/1 multifuel.)

Test 2. Inspect transmission for cracked or defective shifter shaft cover. (Refer to para 2-9b(10).)

Step 1. Replace shifter shaft cover. (Refer to para 3-8b.)

Step 2. Check wear of parts. (Refer to para 3-16 and 3-17.)

Test 3. Inspect transmission for cracked or defective case.

Step 1. Replace transmission case. (Refer to para 3-8, 3-10, and 3-12.)

Step 2. Check wear of parts. (Refer to para 3-16 and 3-17.)

**2. HARD SHIFTING**

Test 1. Inspect gear shift lever for binding or sticking in shifter shaft cover.

Step 1. Free up gear shift lever in shifter shaft cover.

Step 2. Replace gear shift lever. (Refer to para 3-9e and 3-10a.)

Step 3. Replace shifter shaft cover. (Refer to para 3-8b and 3-11o.)

Step 4. Replace interlock plate and springs. (Refer to para 3-9e and 3-10a.)

Test 2. Inspect shifter shaft cover and shifter shafts for binding. (Refer to para 2-9b(13) and 2-9b(16).)

Step 1. Free up shifter shafts.

Step 2. Replace detent poppet balls and springs. (Refer to para 3-9e and 3-10a.)

Step 3. Replace shifter shaft cover. (Refer to para 3-8b and 3-11o.)

Table 2-2.01. Troubleshooting (Continued)

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<b>MALFUNCTION</b>	<b>TEST OR INSPECTION</b>	<b>CORRECTIVE ACTION</b>
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Test 3. Inspect shifter forks for wear, twists, bends, and breaks. (Refer to para 2-9b(15).)

Replace shifter forks, as required. (Refer to para 3-9b and 3-11o.)

Test 4. Inspect 1st and reverse sliding gear. (Refer to para 3-16 and 3-17.)

Replace 1st and reverse sliding gear. (Refer to para 3-8j and 3-10g.)

Test 5. Inspect 2nd and 3rd and 4th and 5th speed synchronizers for wear and breakage. (Refer to para 3-16 and 3-17.)

Step 1. Replace 2nd and 3rd speed synchronizers. (Refer to para 3-9b and 3-10c.)

Step 2. Replace 4th and 5th speed synchronizers. (Refer to para 3-8i and 3-11h.)

Step 3. Replace gears, as required. (Refer to para 3-8, 3-9, 3-10, and 3-11.)

Step 4. Overhaul transmission. (Refer to Chapter 3.)

### **3. INCOMPLETE SHIFTING.**

Test 1. Inspect shifter forks for loose attachment to shifter shafts.

Step 1. Tighten setscrews securing shifter forks and shafts.

Step 2. Replace shifter shafts. (Refer to para 3-9e and 3-10a.)

Step 3. Replace shifter forks. (Refer to para 3-9e and 3-10a.)

Test 2. Check for bent shifter fork(s). (Refer to para 2-9b(15).)

Replace shifter fork(s). (Refer to para 3-9e and 3-10a.)

Test 3. Inspect shifter fork(s) for cracks or broken out areas.

Replace shifter fork(s). (Refer to para 3-9e and 3-10a.)

Test 4. Inspect shifter shaft cover for breaks, cracks, oversize shaft bores, and stripped threads. (Refer to para 2-9b(16).)

Step 1. Repair cover, as necessary.

Step 2. Replace cover. (Refer to para 3-8b and 3-11o.)

Test 5. Inspect gears and synchronizers for wear or looseness. (Refer to para 3-16 and 3-17.)

Step 1. Replace synchronizers. (Refer to para 3-8i, 3-9b, 3-10b, and 3-10c.)

Step 2. Replace gears and shafts. (Refer to 3-8, 3-9, 3-10, and 3-11.)

Step 3. Repair or overhaul transmission. (Refer to para 3-7e, 3-10, and 3-11.)

Table 2-2.01. Troubleshooting (Continued)

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MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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**4. LOOSE SHIFTING.**

Test 1. Inspect gear shift lever for wear or bends.

Step 1. Straighten gear shift lever.

Step 2. Replace gear shift lever. (Refer to para 3-9e and 3-10a.)

Test 2. Check for bent or broken shifter forks. (Refer to para 2-9b(15).)

Replace shifter forks. (Refer to para 3-9b and 3-11o.)

Test 3. Inspect for loose lugs and setscrews, and worn or broken shifter shafts. (Refer to para 2-9b(13).)

Step 1. Tighten or replace loose lug and setscrews. (Refer to para 3-9e and 3-10a.)

Step 2. Replace worn or broken shifter shafts. (Refer to para 3-9e and 3-10a.)

Test 4. Inspect shifter shaft cover for wear, breaks, cracks, missing sections, oversize bores, and stripped threads. (Refer to para 2-9(16).)

Step 1. Retap threaded holes.

Step 2. Weld cover, where possible.

Step 3. Install fabricated bushings in oversize bores, if possible.

Step 4. Replace cover assembly. (Refer to para 3-8b and 3-11a.)

Test 5. Check gears and synchronizers for wear or looseness. (Refer to para 3-16 and 3-17.)

Step 1. Replace synchronizers. (Refer to para 3-8i, 3-9b, 3-10b, and 3-10c.)

Step 2. Replace gears and shafts. (Refer to para 3-8, 3-9, 3-10, and 3-11.)

Step 3. Repair or overhaul transmission. (Refer to Chapter 3.)

Test 6. Check main drive gear assembly for wear and flaws. (Refer to para 3-16 and 3-17.)

Step 1. Replace main drive gear assembly (Refer to para 3-9b and 3-10c.)

Step 2. Repair or overhaul transmission. (Refer to Chapter 3.)

Test 7. Inspect case for cracks, breaks, distortion, broken out pieces, sections, and areas, stripped or missing threads, out-of-round bore, and irregular surfaces. (Refer to para 2-9b(1).)

Replace case. (Refer to para 3-8 and 3-11.)

Table 2-2.01. Troubleshooting (Continued)

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<b>MALFUNCTION</b>
<b>TEST OR INSPECTION</b>
<b>CORRECTIVE ACTION</b>

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**5. NOISY OPERATION.**

Test 1. Locate origin of noise.

Step 1. Disassemble transmission for inspection. (Refer to para 3-8, 3-9, and 3-12.)

Step 2. Replace worn and defective parts. (Refer to para 3-16 and 3-17.)

Step 3. Repair or overhaul transmission. (Refer to Chapter 3.)

Test 2. Inspect for mismatched gears. (Refer to para 3-16 and 3-17.)

Step 1. Replace gears and bearings. (Refer to para 3-8, 3-9, and 3-12.)

Step 2. Repair or overhaul transmission. (Refer to Chapter 3.)

Test 3. Check clutch release bearing.

Replace clutch release bearing. (Refer to para 3-8a and 3-11r.)

Table 2-2.02. Troubleshooting

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<b>MALFUNCTION</b>	<b>TEST OR INSPECTION</b>	<b>CORRECTIVE ACTION</b>
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**TRANSFERS**  
**TRANSFER MODEL T-136-27**

**NOTE**

If possible, make external and operational inspection in accordance with TM 9-2320-209-34 before disassembling transfer. Troubleshooting is done with the transfer removed from the vehicle.

**1. LUBRICANT LEAKING FROM GASKETS AND SEALS.**

Test 1. Inspect transfer thoroughly for source of leakage.

Step 1. Disassemble transfer, as required. (Refer to para 4-5 and 4-6.)

Step 2. Replace seal(s). (Refer to para 4-5 and 4-6.)

Step 3. Replace gasket(s). (Refer to para 4-5 and 4-6.)

Step 4. Assemble transfer (to complete assembly). (Refer to para 4-7 and 4-8.)

Step 5. Fill transfer with lubricant. (Refer to LO 9-2320-209-12 gasoline or LO 9-2320-209-12/1 multifuel.)

Test 2. Inspect transfer for cracked or defective front output shaft case.

Step 1. Replace front output shaft case. (Refer to para 4-5f and 4-7d.)

Step 2. Add lubricant to level. (Refer to LO 9-2320-209-12 gasoline or LO 9-2320-209-12/1 multifuel.)

Test 3. Inspect transfer for cracked or defective transfer case cover.

Step 1. Replace transfer case cover. (Refer to para 4-6d and 4-7d.)

Step 2. Add lubricant to level. (Refer to LO 9-2320-209-12 gasoline or LO 9-2320-209-12/1 multifuel.)

Test 4. Inspect transfer case for cracks, breaks, galling, stripped threads, missing threads, out-of-round bores, irregular surfaces, and broken casting. (Refer to para 4-16 and 4-17.)

Step 1. Replace transfer case. (Refer to para 4-6f and 4-7b.)

Step 2. Add lubricant to level. (Refer to LO 9-2320-209-12 gasoline or LO 9-2320-209-12/1 multifuel.)

**2. LUBRICANT LEAKING FROM AIR CYLINDER ASSEMBLY.**

Test 1. Inspect air cylinder tube gasket for leakage or damage.

Step 1. Replace air cylinder tube gasket. (Refer to para 4-5e and 4-8m.)

Step 2. Add lubricant to level. (Refer to LO 9-2320-209-12 gasoline or LO 9-2320-209-12/1 multifuel.)



Table 2-2.02. Troubleshooting (Continued)

<b>MALFUNCTION</b>	<b>TEST OR INSPECTION</b>	<b>CORRECTIVE ACTION</b>
	Test 2. Check piston air cylinder seal for damage or leakage.	<p>Step 1. Replace piston air cylinder seal. (Refer to para 4-5e and 4-8m.)</p> <p>Step 2. Add lubricant to level. (Refer to LO 9-2320-209-12/1.)</p>
<b>3. SHIFTING DIFFICULTIES.</b>		
	Test 1. Check for damaged shifter shafts. (Refer to para 2-9b(13).)	Replace damaged shifter shafts. (Refer to para 4-5h, 4-5l, 4-8f, and 4-8j.)
	Test 2. Inspect for bent, twisted, cracked, or broken shifter shaft fork. (Refer to para 2-9b(15).)	Replace shifter shaft fork. (Refer to para 4-5h, 4-5l, 4-8f and 4-8j.)
	Test 3. Check for loose shifter shaft fork setscrew.	<p>Step 1. Tighten shifter shaft fork setscrew. (Refer to para 4-5h.)</p> <p>Step 2. Install safety wire on shifter shaft fork setscrew.</p>
	Test 4. Inspect synchronizer for wear, breaks, cracks, or damage that would make it unserviceable. (Refer to para 4-16 and 4-17.)	<p>Step 1. Replace synchronizers. (Refer to para 4-6c and 4-7e.)</p> <p>Step 2. Replace synchronizer and related parts. (Refer to para 4-6c and 4-7e.)</p> <p>Step 3. Overhaul transfer. (Refer to Chapter 4.)</p>
<b>4. AIR CYLINDER ASSEMBLY NOT ENGAGING.</b>		
	Test 1. Check for loss of air pressure.	<p>Step 1. Correct air leak; tighten connections.</p> <p>Step 2. Replace hose(s).</p>
	Test 2. inspect air cylinder for leaks.	<p>Step 1. Replace air cylinder tube gasket. (Refer to para 4-5e and 4-8m.)</p> <p>Step 2. Replace air cylinder piston seal. (Refer to para 4-5e and 4-8m.)</p>
	Test 3. Inspect for foreign material lodged in air cylinder.	Remove, clean, and reinstall air cylinder. (Refer to para 4-5e and 4-8m.)
	Test 4. Check clutch shifter shaft for breaks, cracks, twists, or broken pieces. (Refer to para 2-9b(13).)	Replace clutch shifter shaft. (Refer to para 4-5h and 4-8l.)

Table 2-2.02. Troubleshooting (Continued)

<b>MALFUNCTION</b>	<b>TEST OR INSPECTION</b>	<b>CORRECTIVE ACTION</b>
	Test 5. Inspect clutch shifter shaft fork for breaks, cracks, twists, broken out sections, and bends. (Refer to para 4-5h and 4-8j.)	Replace clutch shifter shaft fork.
	Test 6. Check for loose shifter fork setscrew.	<p>Step 1. Tighten loose shifter fork setscrew. (Refer to para 4-5h and 4-8j.)</p> <p>Step 2. Install safety wire on shifter fork setscrew. (Refer to para 4-5h and 4-8j.)</p> <p>Step 3. Replace shifter fork, setscrew, and safety wire. (Refer to para 4-5h and 4-8j.)</p>
	Test 7. Inspect output sliding clutch for roughness, cracks, breaks and broken out pieces.	Replace output sliding clutch. (Refer to para 4-5h and 4-8j.)
	Test 8. Check driving clutch for cracks, breaks, distortion and broken-out pieces.	Replace driving clutch. (Refer to para 4-5h and 5-8j.)
	Test 9. Check clutch driving setscrew for looseness.	<p>Step 1. Tighten clutch driving setscrew. (Refer to para 4-5h and 4-8j.)</p> <p>Step 2. Install safety wire on clutch driving setscrew. (Refer to para 4-5h and 4-8j.)</p> <p>Step 3. Replace setscrew and safety wire. (Refer to para 4-5h and 4-8j.)</p>
<b>5. AIR CYLINDER ASSEMBLY NOT DISENGAGING.</b>		
	Test 1. Check for foreign material lodged in air cylinder.	Remove, clean, and replace air cylinder. (Refer to para 4-5e and 4-8m.)
	Test 2. Inspect clutch shaft shifter fork for cracks, breaks, distortion, and missing pieces.	Replace clutch shaft shifter fork. (Refer to para 4-5h and 4-8j.)
	Test 3. Inspect shifter fork setscrew for looseness.	<p>Step 1. Tighten setscrew. (Refer to para 4-5h and 4-8j.)</p> <p>Step 2. Install safety wire on setscrew. (Refer to para 4-5h and 4-8j.)</p> <p>Step 3. Replace setscrew and safety wire. (Refer to para 4-5h and 4-8j.)</p>
	Test 4. Check shifter shaft compression spring for broken coil(s), distortion, breaks, cracks, or missing coil(s).	Replace spring. (Refer to para 4-5h and 4-8j.)

Table 2-2.02. Troubleshooting (Continued)

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<b>MALFUNCTION</b>	<b>TEST OR INSPECTION</b>	<b>CORRECTIVE ACTION</b>
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**6. REAR OUTPUT SHAFT DOES NOT TURN OR TURNS ERRATICALLY WHEN INPUT SHAFT TURNS (LOW RANGE).**

Test 1. Refer to malfunction 3, test 1.

Test 2. Check low range input gear for missing or broken gear teeth, broken-out section(s), or missing pieces.

Replace low range input gear. (Refer to para 4-5p, 4-6c, 4-7d, and 4-8b.)

Test 3. Inspect low range counter gear for broken or missing gear teeth, broken-out section(s), or missing pieces.

Replace low range counter gear. (Refer to para 4-5p, 4-6b, 4-7f, and 4-8b.)

Test 4. Check driven output gear for broken or missing gear teeth, broken-out section(s) or missing pieces.

Replace driven output gear. (Refer to para 4-5k, 4-6a, 4-7g, and 4-8g.)

**7. REAR OUTPUT SHAFT DOES NOT TURN OR TURNS ERRATICALLY WHEN INPUT SHAFT TURNS (HIGH SELECTION).**

Test 1. Refer to malfunction 3, test 1.

Test 2. Check high range input gear for missing teeth, cracks, breaks, missing section(s), and missing pieces.

Step 1. Replace high range input gear. (Refer to para 4-5p, 4-6c, 4-7d, and 4-8b.)

Step 2. Replace countershaft. (Refer to para 4-5p, 4-6b, 4-7f, and 4-8b.)

Test 3. Inspect high range counter gear for missing teeth, cracks, breaks, missing section(s), and missing pieces.

Step 1. Replace high range counter gear. (Refer to para 4-5p, 4-6b, 4-7f, and 4-8 b.)

Step 2. Replace countershaft. (Refer to para 4-5p, 4-6b, 4-7f, and 4-8b.)

Test 4. Check drive output clutch for missing teeth, cracks, breaks, missing section(s), and missing pieces.

Step 1. Replace drive output clutch. (Refer to para 4-5h and 4-8j.)

Step 2. Replace countershaft. (Refer to para 4-5p, 4-6b, 4-7f, and 4-8b.)

**8. FRONT OUTPUT SHAFT DOES NOT TURN OR TURNS ERRATICALLY WHEN INPUT SHAFT TURNS (LOW OR HIGH RANGE).**

Test 1. Refer to malfunctions, 4 or 5.

Test 2. Inspect front output shaft for cracks, breaks, shearing, twists, and deformities.

Replace front output shaft. (Refer to para 4-5h and 4-8j.)

Table 2-2.03. Troubleshooting

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<b>MALFUNCTION</b>	<b>TEST OR INSPECTION</b>	<b>CORRECTIVE ACTION</b>
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**TRANSFER MODEL T-136-21**

**1. FRONT OUTPUT SHAFT WILL NOT TURN CLOCKWISE BY HAND.**

Check for defective sprag unit.

- Step 1. Disassemble transfer, clean, and inspect drive sprag assembly. (Refer to para 4-22, 4-23, and 4-25.)
- Step 2. Replace drive sprag assembly. (Refer to para 4-24.)
- Step 3. Replace related parts, gaskets, and seals as required. (Refer to para 4-23, 4-24, and 4-25.)
- Step 4. Replace transfer assembly. (Refer to TM 9-2320-209-20 gasoline or TM 9-2320-209-34 multifuel. )

**2. THE FRONT OUTPUT SHAFT SLIPS, GRABS, AND TURNS WHEN HOLDING THE INPUT SHAFT STATIONARY AND TRYING TO TURN THE OUTPUT SHAFT COUNTERCLOCKWISE BY HAND.**

Inspect for a defective or worn sprag unit.

- Step 1. Disassemble transfer, clean, and inspect drive sprag unit and related parts. (Refer to para 4-22, 4-23, and 4-35. )
- Step 2. Replace drive sprag unit. (Refer to para 4-24.)
- Step 3. Replace related parts, gaskets, and seals as required. (Refer to para 4-23, 4-24, and 4-25.)
- Step 4. Replace transfer assembly. (Refer to TM 9-2320-209-20 gasoline or TM 9-2320-209-34 multifuel.)

**3. INPUT SHAFT WILL NOT TURN BY HAND WITH TRANSFER SHIFTER SHAFT IN EITHER HIGH OR LOW RANGE WITH THE REVERSE SHIFTER SHAFT HELD IN THE REVERSE SHIFT POSITION.**

Check for damage to one or more gears in the transfer gear train.

- Step 1. Disassemble transfer and replace damaged gears. (Refer to para 4-22, 4-23, and 4-24.)
- Step 2. Replace related parts, gaskets, and seals as required. (Refer to para 4-23, 4-24, and 4-25.)
- Step 3. Replace transfer assembly. (Refer to TM 9-2320-209-20 gasoline or TM 9-2320-209-34 multifuel.)

**4. FRONT OUTPUT SHAFT WILL NOT TURN BY HAND WITH TRANSFER SHIFTER SHAFT IN EITHER HIGH OR LOW RANGE WITH THE REVERSE SHIFTER SHAFT HELD IN THE REVERSE POSITION.**

Inspect for a defective sprag unit.

- Step 1. Disassemble transfer and replace sprag unit. (Refer to para 4-22, 4-23, and 4-24.)
- Step 2. Replace related parts, gaskets, and seals as required. (Refer to para 4-23, 4-24, and 4-25.)
- Step 3. Replace transfer assembly. (Refer to TM 9-2320-209-20 gasoline or TM 9-2320-209-34 multifuel.)

Table 2-2.04. Troubleshooting

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<b>MALFUNCTION</b>	<b>TEST OR INSPECTION</b>	<b>CORRECTIVE ACTION</b>
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**POWER TAKEOFF MODELS WN-7-28 AND WND-7-28**

**1. GREASE OR LUBRICANT LEAKS.**

Inspect power takeoff for leaking seals and gaskets.

Step 1. Replace seals. (Refer to para 5-6, 5-7, 5-16, and 5-17.)

Step 2. Replace gaskets. (Refer to para 5-6, 5-7, 5-16, and 5-17.)

**2. FAULTY OPERATION, POOR ENGAGEMENT, OR NO ENGAGEMENT.**

Test 1. Check input gear for breaks, cracks, missing pieces, and stripped or missing gear teeth.

Step 1. Replace input gear. (Refer to para 5-6c and 5-7i.)

Step 2. Overhaul power takeoff, as required. (Refer to para 5-6, 5-7, 5-16, and 5-17.)

Test 2. Inspect shifter shaft fork for breaks, cracks, twists, and broken-out sections.

Step 1. Replace shifter shaft fork. (Refer to para 5-6b and 5-7j.)

Step 2. Replace shifter shaft. (Refer to para 5-6b and 5-7j.)

Test 3. Check for loose shifter shaft fork setscrew.

Step 1. Tighten shifter shaft fork setscrew. (Refer to para 5-6b and 5-7j.)

Step 2. Install safety wire on setscrew. (Refer to para 5-6b and 5-7j.)

Step 3. Replace shifter shaft fork setscrew and safety wire. (Refer to para 5-6b and 5-7j.)

Test 4. Check output and reverse shaft rear bearing cap for breaks, cracks, broken-out sections, and distortion.

Replace output and reverse shaft rear bearing cap. (Refer to para 5-6d and 5-7h.)

Test 5. inspect front bearing cap for breaks, cracks, broken-out sections, and distortion.

Replace front bearing cap. (Refer to para 5-6e and 5-7g.)

Test 6. Inspect all bearings for galling, binding, chipped balls, and missing balls.

Replace front and rear bearings. (Refer to para 5-6 and 5-7.)

Test 7. Check all gears for breaks, cracks, missing teeth, and missing sections.

Replace gear(s). (Refer to para 5-6 and 5-7.)

Test 8. Check power takeoff case for breaks, cracks, stripped threads, missing threads, broken pieces, and broken-out sections.

Replace power takeoff case. (Refer to para 5-6, 5-7, 5-16, and 5-17.)

Table 2-2.04. Troubleshooting (Continued)

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MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
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**3. NOISY OPERATION.**

Test 1. Search for trouble.

Step 1. Check all parts for wear, breaks, chips, or other damage; drain and flush; inspect drainings for metal chips, broken teeth, bearings, parts, etc. (Refer to para 5-6, 5-7, 5-16, and 5-17.)

Step 2. Disassemble, and repair or replace parts, as required. (Refer to para 5-6, 5-7, 5-16, and 5-17.)

Step 3. Overhaul assembly. (Refer to para 5-6, 5-7, 5-16, and 5-17.)

Test 2. Check for mismatched gears (overhauled unit).

Step 1. Disassemble, and repair or replace parts, as required. (Refer to para 5-6, 5-7, 5-16, and 5-17.)

Step 2. Overhaul assembly. (Refer to para 5-6, 5-7, 5-16, and 5-17.)

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<b>MALFUNCTION</b>		
<b>TEST OR INSPECTION</b>		
<b>CORRECTIVE ACTION</b>		

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**POWER TAKEOFF MODEL P-136-C**

**1. GREASE OR LUBRICANT LEAKS.**

Inspect power takeoff for leaking seals and gaskets.

Step 1. Replace seals. (Refer to para 5-26 and 5-27.)

Step 2. Replace gaskets. (Refer to para 5-26 and 5-27.)

**2. FAULTY OPERATION, POOR ENGAGEMENT, OR NO ENGAGEMENT.**

Test 1. Inspect sliding clutch for burs, cracks, breaks, broken teeth, missing sections, and galling.

Replace sliding clutch. (Refer to para 5-26b and 5-27e.)

Test 2. Inspect bearings for binding, looseness, scraping, galling, grinding, and binding.

Replace all takeoff bearings. (Refer to para 5-26 and 5-27.)

Test 3. Check output shaft for breaks, cracks, burs, galling, bends, and broken pieces.

Replace output shaft. (Refer to para 5-26 and 5-27.)

Test 4. Check shifter shaft for breaks, cracks, twists, bends, and broken pieces.

Replace shifter shaft. (Refer to para 5-26b and 5-27e.)

Test 5. Inspect pump assembly for breaks, cracks, galled surfaces, and stripped threads.

Replace pump assembly. (Refer to para 5-26b and 5-27e.)

Test 6. Inspect housing for cracks, breaks, galling, oversize or out-of-round bearing bores, stripped threads, missing parts, broken sections, and irregular surfaces.

Replace housing. (Refer to para 5-26 and 5-27.)

## Section III. GENERAL MAINTENANCE

**2-7. General.** Because the transmissions, transfers, and power takeoffs are very similar in construction and material, use generalized cleaning practices, as recommended. If and when special cleaning practices are required, refer to the specific cleaning instructions in the pertinent chapter.

### 2-8. Cleaning.

*a. Cleanliness.* Cleanliness of personnel, tools, and area surroundings is not only good practice, but it is a fundamental requirement when mechanical repairs are performed. This is particularly true of the areas in which transmissions, transfers, and power takeoffs are repaired or rebuilt. All of the information and instructions contained in this manual are given with the assumption that these conditions prevail in the working area. Transmission, transfer, and power takeoff repairs, except those of an emergency nature, should never be accomplished under any other conditions.

*b. Precautions.*

(1) Do not use drycleaning solvent, type II, (SD-2) Fed Spec P-D-680, near an open flame because it is flammable. Fire extinguishers must be provided when this material is used. Avoid contact of these solvents with the skin as they may cause cracks, mild irritation or inflammation of the skin.

(2) Avoid contact of drycleaning solvent or lubricants with rubber parts since these materials can cause deterioration.

(3) The use of gasoline, mineral spirits paint thinner, or benzine for cleaning is strictly prohibited.

*c. Cleaning Transmission, Transfer, and Power Takeoff Assemblies Prior to Disassembly.*

(1) Scrape or brush all accumulations of dirt or road mud from the transmission case and attached parts with a scraper or wire brush. Note and mark, by scratching the case with a sharp-pointed tool, any moist oil spots or unusually heavy accumulations of oil-soaked road mud, for these are good clues to the location of small cracks or holes that might escape notice in a visual inspection. However, do not confuse these accumulations with those that result from leaking gaskets or oil seals. A leak at a seal or a gasket is more or less normal for an assembly that has been in service for any length of time, and the area covered is generally localized around the shaft bores, power takeoff openings, etc.

(2) Complete external cleaning with steam-

cleaning equipment, or by hand brushing, using drycleaning solvent, type II (SD-2), Fed Spec P-D-680, as a cleaning agent. Total immersion in a dip tank is also approved, provided the cleaning agent is drycleaning solvent. The use of stronger cleaning agents, such as caustic soda or detergents, is prohibited because of the corrosive effect on bearings.

*d. Cleaning Component Parts After Disassembly.*

(1) It is essential that the equipment used during the cleaning operation suit the particular cleaning job being performed. Round brushes should be used for internal bores, and square or rectangular brushes should be used for flat or external surfaces. Each part should be cleaned thoroughly and individually.

### NOTE

Bearings require special handling. Cleaning, inspection, and preparation for use of ball and roller bearings are covered in TM 9-214.

(2) Clean all other parts of hardened oil, lacquer deposits, and dirt, paying particular attention to the small oil holes in the gears and to the lock ball bores in the shifter shaft cover. Remove all gaskets or parts of gaskets from surfaces, using a putty knife or other suitable scraper. Be careful to avoid scratching or gouging the surface metal.

(3) Rinse the parts in clean drycleaning solvent type II (SD-2), Fed Spec P-D-680. This is a highly important operation. Spraying solvent over the parts or suspending the part in a mechanically agitated bath of solvent are the preferred methods of rinsing. In the absence of such facilities, however, the parts may be rinsed by immersing them in a container of clean drycleaning solvent and shaking them vigorously. Dry the parts with compressed air.

### 2-9. Inspection.

*a. General.*

(1) This section contains general inspection procedures for transmissions, transfers, and power takeoffs. Not all inspection procedures will apply to each assembly. Therefore, it will be up to maintenance personnel to apply the pertinent procedure to the assembly which they are inspecting. Most inspection procedures will apply to all assemblies. Special inspection procedures for an assembly are given in the respective chapter for that assembly.

(2) All parts must be thoroughly examined and



inspected to determine serviceability. Some wear or damage will be visually evident; however, it may be necessary to use tools or gages to, determine the extent of wear. The inspection procedure has two objectives: the first is to eliminate any part or parts that are unsuitable for use or doubtful parts that could conceivably cause the premature failure of the rebuilt unit; the second, and equally important, is to reduce scrapping of parts that retain a high percentage of useful life. Because the decision whether a part should be scrapped or reused is frequently a matter of judgment, this operation should be performed by personnel experienced in the maintenance of transmissions, transfers, and power takeoffs.

(3) Instructions for the removal of minor imperfections and defects are included in this section because they facilitate the inspection procedure. Every part which requires it must be washed, rinsed, and dried upon completion of the repair.

*b. Inspection Procedure.*

(1)  *Casting.* Inspect all gasket surfaces, all bearing caps and shifter shaft covers. Remove any burs, scratches, or gouges from these surfaces with a hand-honing stone. Clean all burs or foreign material from snapping grooves and expansion plug grooves. Check the cases for cracks or small pin holes, paying particular attention to areas that were marked for attention prior to initial cleaning. Cracks that do not extend into bearing bores or mounting holes may be repaired. Refer to TM 9-237 for procedures for welding or brazing cast iron. Check and clean all tapped holes. Mark any damaged holes or damaged or broken studs for repair. Try the gearshafts in the shaft bores of the cases. The shafts should be a snug fit in both the front and rear bore. If there is loose fit in any bore, try a new, unused shaft in the bore. Discard either the case or the old gearshaft, whichever is found to cause looseness.

(2)  *Clutch Housing.* Inspect the clutch housing for breaks or cracks. Small cracks that do not extend into the mounting holes may be repaired by welding.

(3)  *Bearing Caps.* Press the oil seal from the main shaft rear bearing cap, and discard the seal. Inspect all bearing caps for burs, gouges, or scratches on the gasket surface, and smooth out with hand-honing stone if necessary.

(4)  *Gear Spacers and Thrust Washers.* Replace all main shaft gear spacers, bearing spacers, and thrust washers.

(5)  *Snaprings.* Replace all snaprings. Snaprings furnished as part of ball bearings may be reused if not

distorted or damaged.

(6)  *Expansion Plugs.* Replace all expansion plugs.

(7)  *Retaining Nuts.* Replace retaining nuts that have damaged threads, cuts, or cracks.

(8)  *Gearshafts.* Inspect gearshafts for gall marks or flat spots. Check gearshafts for fit as outlined in para b(1) above. Check bearing-to-shaft fit. Refer to repair and rebuild standards. Smooth any minor imperfections with crocus cloth or honing stone. Reject for any other damage. Shafts that are scored or pitted must be replaced.

(9)  *Gears.* The experience and good judgment of the inspector are required to a greater degree in judging gears than in any other operation. It is not possible to give arbitrary instructions as to when a particular condition makes a gear unfit for further use. The major and minor defects can only be pointed out, leaving the in-between scrap or salvage decision to the discretion of the individual.

(a) Small nicks or burs on the engaging ends of the teeth may be removed with a small honing stone. This is only practical for minor defects. Fractures of the teeth are cause for rejection.

(b) Teeth which are fractured or burred must be examined very carefully. Small burs may be removed by honing. Fractured areas, provided there are no hairline cracks radiating away from the area, may also be smoothed by honing.

(c) Fractures due to metal fatigue are cause for rejection.

(d) When the hubs of gears are scored, gouged, or burred seriously, the gears must be discarded. Minor imperfections may be smoothed out by honing. Excessive wear will be revealed when end play is checked during the subsequent assembly operations.

(e) Examine the internal splines of all sliding gears. Twisted or broken splines are cause for rejection. Remove minor defects by honing. The inspection of splines is discussed in para (10) below.

(10)  *Mainshafts and Output Shafts.* Inspect bearing journals; reject for obvious defects such as scored or galled spots or wear beyond limits specified in the repair and replacement standards contained in the respective chapter for each assembly. Inspect threads on output end of shaft. Clean any flattened threads with a three-cornered file and wrap the threads with three or four turns of friction tape as a protective measure against further damage until the

transmission is assembled. Mount the mainshafts in test centers and check for misalignment at bearing journals and along the entire length of the shaft by using a dial indicator. Misalignment in excess of 0.001 inch is cause for rejection. Inspect the splines and reject the shaft if splines are twisted, scored, or obviously worn. Smooth minor defects with slip stone or honing stone. Install the sliding internally splined gears on the mainshaft and clamp the mainshaft upright in a bench vise. Check each gear, in turn, for spline clearance by inserting a narrow feeler gage on edge between the splines. Refer to repair and replacement standards contained in the respective chapter for each assembly. If clearance is in excess of this established tolerance, check with a new gear and new shaft to determine whether gear splines or shaft splines are at fault. Reject the part at fault. Check wear on front and rear bearings.

(11) *Countershafts.* Follow the same procedure, when applicable to the countershaft, as outlined above for the mainshaft. Use a honing stone to smooth out any burs, gouges, or scratches. Pay particular attention to the section of the shaft that carries the press fit gears, especially in and around the key slots. Any deviation from the normal condition in this area will cause considerable trouble when reassembling the gears on the shaft. Try the woodruff keys in the key slots. If neither the key nor the slot is distorted or misshapen, the key will require only light tapping to completely seat in the slot. Do not attempt to force the key into place; if difficulty is encountered, use a new key.

(12) *Input Shaft.* Inspect the splines on the input shaft for wear, twisting, or galling. Inspect bearing journals for wear. Determine that the gear teeth are not cracked, broken, or otherwise damaged.

(13) *Shifter Fork Shafts.* Check the shifter fork shafts for misalignment by rolling them across a smooth, level surface. Failure to roll, or rolling with a bumping sound, indicates misalignment. Bent or sprung shafts must be rejected, unless suitable straightening equipment is available. Inspect the shaft poppet ball detents for wear or damage. Reject the shaft if detents are chipped or are not sharply defined.

(14) *Poppet Balls and Springs.* Reject all poppet balls with flat spots and all weak or broken springs. Use only those parts that are completely satisfactory.

(15) *Shifter Forks.* Inspect shifter forks, paying particular attention to the lower fork ends. Bent, broken, or sprung parts are to be rejected outright, as repairs are impossible. Worn parts may be used at the discretion of the inspector.

(16) *Shifter Shaft Cover.* Inspect shifter shaft

cover for cracks or breakage. Small cracks that do not extend into the mounting holes can be repaired. Check and clean out all tapped holes; mark for repair any damaged holes or broken off studs in tapped holes. Use a honing stone to smooth out any scratches, burs, or gouges on the gasket surface. Carefully check the shifter shaft and poppet ball bores. If the shifter shaft bores are seriously scored, gouged, or galled, the cover must be rejected. Clean up minor imperfections with crocus cloth. Reject the cover if the edges of the poppet ball bores are chipped or rounded.

## 2-10. Repair.

### a. General.

(1) This section contains repair instructions for the assemblies discussed in this manual. Because the material and construction are similar, the repair instructions will be given in general form. If special repair is required, refer to Cleaning, Inspection, and Repair section of the respective chapter for the assembly.

(2) Only high quality repairs are acceptable. Makeshift or temporary repairs are not acceptable, except in extreme emergencies.

(3) Small holes or cracks in assembly cases, shifter shaft covers, or clutch housings may be repaired by welding or brazing, provided they do not extend into the bearing bores or mounting surfaces. It should be noted, however, that these parts are cast iron. A special technique is required to satisfactorily weld this type of material; ordinary welding methods and materials are not suitable. (Refer to TM 9-237.)

(4) Remove the short ends of any bolts or studs broken off in tapped holes. Clean out and inspect all tapped holes; retap where necessary. If hole threads are stripped, or if holes are out-of-round, drill out to next larger size and tap. Install a bolt or stud of the correct size to fit the newly tapped hole.

### b. Handling After Inspection and Repair.

(1) All parts, whether new or used, must be lightly coated with lube oil (OE/HDO 30), ICE, MIL-L-2104, immediately after inspection and/or repair, prior to assembly into the transmission. Oiling the parts gives them a rust-preventive coating and facilitates the assembly operations.

(2) Make sure that all new gaskets and replacement parts are available to replace those discarded.

(3) Check to be sure that all parts are at hand so the assembly operations may proceed without

interruptions.

(4) When preparing a new oil seal for assembly, place it in a small container of lube oil (OE/HDO 10)

ICE, MIL-L-2104. Allow the seal to soak for 45 minutes before installation.

**2-11. Lubrication.** Refer to LO 9-2320-209-12/1 for lubrication instructions.

## Section IV. REMOVAL AND INSTALLATION OF MAJOR COMPONENTS AND ASSEMBLIES

**2-12. General.** This section provides procedures for the removal and installation of the following major components and assemblies: transmission, transfer, and power takeoff assemblies.

**2-13. Transmissions, Models 3052 and 3053A.** Refer to TM 9-2320-209-34 for multifuel engine powered vehicles or TM 9-2320-209-20 for gasoline powered vehicles.

**2-14. Transfer, Models T-136-21 and T-136-27.** Refer to TM 9-2320-209-34 for multifuel engine powered vehicles or TM 9-2320-209-20 for gasoline engine powered vehicles.

**2-15. Power Takeoffs, Models WN-7-28, WND-7-28, and P-136-C.** Refer to TM 9-2320-209-34 for multifuel engine powered vehicles or TM 9-2320-209-20 for gasoline engine powered vehicles.

## CHAPTER 3 REPAIR OF TRANSMISSIONS

### Section I. DESCRIPTION, OPERATION, AND DATA (MODEL 3052)

**3-1. General.** This chapter contains the repair instructions for transmission models 3052 and 3053A. This section provides the description, operation, and data pertinent to the five-speed synchromesh, manually shifted transmission model 3052.

**3-2. Description.**

*a. General.* Transmission model 3052, shown in figure 3-1, is utilized on the 2½-ton, 6x6, M44 series vehicles using a gas engine, not equipped with a front winch. This same transmission is used with vehicles equipped with a front winch. The transmission has a power takeoff mounted on the left side (fig. 3-2) which is used to drive the winch. The construction of the transmission is illustrated in figures 3-3 to 3-11.

*b. Operation.*

*(1) Power Flow.* The flow of power through the transmission gear train and shafts is graphically shown in figure 3-12. In operation, the input gear is constantly applying power to the countershaft, regardless of the speed selected by the operator,

because the input gear and countershaft drive gear are continuously meshed. Because the countershaft gears are integral with, or keyed to, the countershaft, power is continuously available at any countershaft gear. Due to the constant mesh of second, third, and fifth (overdrive) gears of the mainshaft and countershaft, locking any one of these gears to the mainshaft causes the mainshaft to rotate at a rate proportionate to the ratio of that gear to the countershaft gear with which it is meshed. Rotation of the mainshaft is in the same direction as that of the input shaft, except in reverse gear.

*(2) Reverse Gear Power Flow.* Power is transmitted by the countershaft second-speed reverse-idler gear and the constantly meshed reverse-idler gear to the mainshaft first-speed reverse gear, which is splined to the mainshaft, driving the mainshaft in the direction opposite to the input shaft. (See fig. 3-12, view A.)

*(3) First Speed Power Flow.* Power is transmitted by the countershaft and mainshaft first-speed gears to the mainshaft. (See fig. 3-12, view B.)

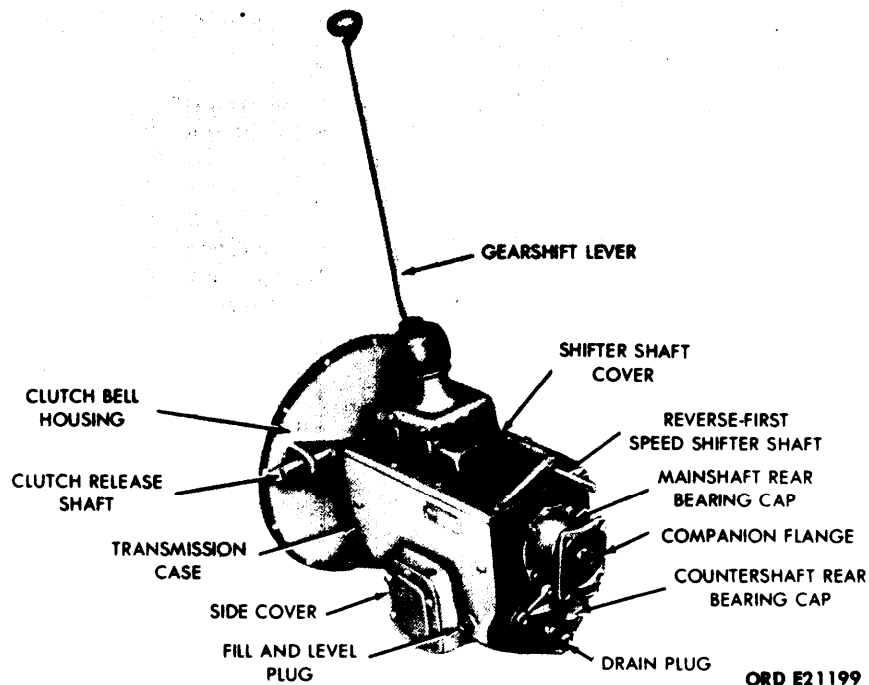


Figure 3-1. Transmission Models 3052 and 3053A - Exterior Components.

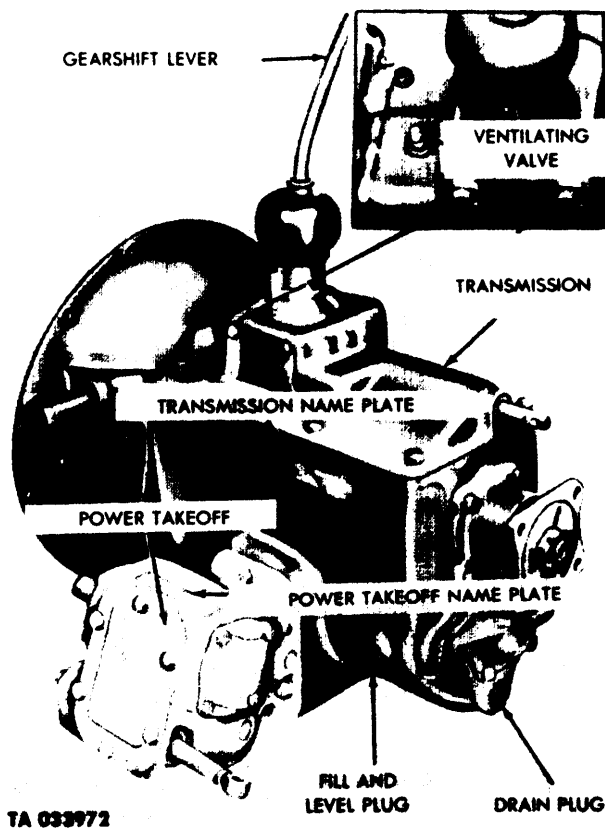


Figure 3-2. Transmission Models 3052 and 3053A Equipped With a Power Takeoff.

(4) *Second Speed Power Flow.* Power is transmitted by the countershaft second-speed reverse-idler gear to the mainshaft second-speed gear, which is coupled to the mainshaft by the second-third gear synchronizer, and to the main shaft. (See fig. 3-12, view C.)

(5) *Third Speed Power Flow.* Power is transmitted by the countershaft third-speed gear and to the mainshaft third-speed gear, which is coupled to the mainshaft by the second-third speed synchronizer, and through the mainshaft. (See fig. 3-12, view D.)

(6) *Fourth Speed Power Flow.* Power is transmitted by the countershaft fourth-speed gear through the mainshaft fourth-speed gear, which is coupled to the mainshaft by the fourth-fifth speed synchronizer, and to the mainshaft. (See fig. 3-12, view E.)

(7) *Fifth Speed Power Flow.* Power is transmitted by the input gear, which is coupled to the mainshaft by the fourth-fifth speed synchronizer, directly to the mainshaft. Since the interlocking action of the synchronizer in effect makes one continuous shaft of the input shaft and mainshaft, the drive here is direct, i.e., a 1.00-1.00 ratio. (See fig. 3-12, view F.)

**3-3. Data.**

National stock number . . . . . 2520-00-347-4520  
 Ordnance number . . . . . 7520995  
 Make . . . . . Spicer  
 Model . . . . . 3052  
 Type . . . . . Synchromesh

**Speeds:**

Forward . . . . . 5  
 Reverse . . . . . 1

**Gear types:**

Input . . . . . Helical  
 Mainshaft (except first-reverse) . . . . . Helical  
 Mainshaft (first-reverse) . . . . . Spur  
 Countershaft (except first) . . . . . Helical  
 Countershaft first . . . . . Spur  
 Reverse idler . . . . . Spur-helical

**Bearings:**

Input shaft . . . . . Ball  
 Mainshaft front . . . . . Straight roller  
 Mainshaft rear . . . . . Ball  
 Countershaft front . . . . . Straight roller  
 Countershaft rear . . . . . Ball  
 Reverse idler . . . . . Straight roller

**Lubrication capacity:**

W/O pto . . . . . 8½ pt  
 W/p to . . . . . 10½ pt

**Input shaft size:**

Spline diameter . . . . . 1.499 in.  
 Number of splines . . . . . 10  
 Full length of splines . . . . . 2.375 in.

**Mainshaft (output end) size:**

Spline diameter . . . . . 1.499 in.  
 Number of splines . . . . . 10  
 Full length of splines . . . . . 1.906 in.

**Gear ratios:**

First speed . . . . . 7.55 to 1.00  
 Second speed . . . . . 4.18 to 1.00  
 Third speed . . . . . 2.45 to 1.00  
 Fourth speed . . . . . 1.45 to 1.00  
 Fifth speed . . . . . 1.00 to 1.00  
 Reverse . . . . . 7.36 to 1.00

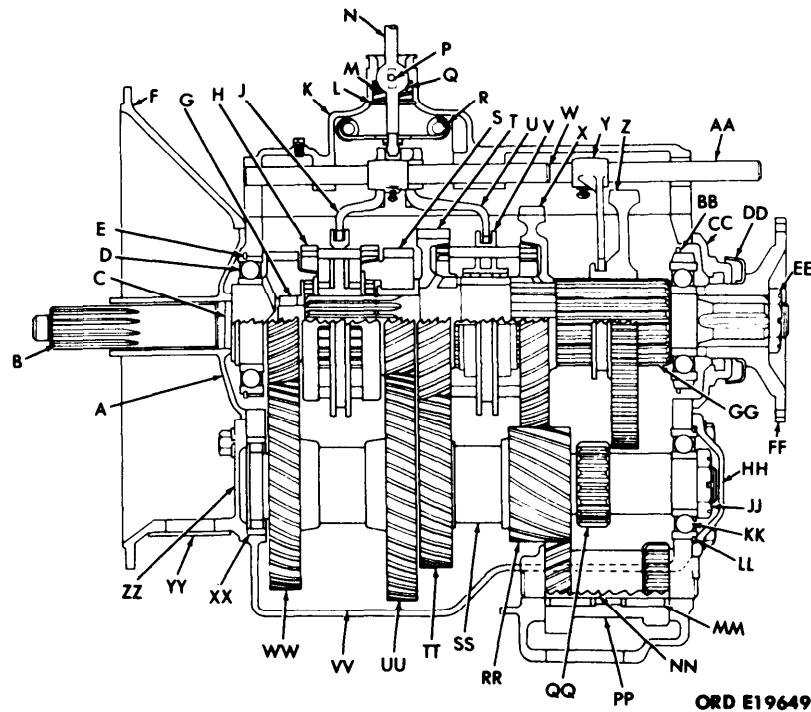


Figure 3-3. Transmission Model 3053A Sectional View (Also Typical of Model 3052).

Legend for fig. 3-3:

<u>Key</u>	<u>Item</u>	<u>Key</u>	<u>Item</u>
A	Cap, input shaft bearing	AA	Shaft, reverse-first speed shifter
B	Shaft, input	BB	Snapping, mainshaft rear bearing outer race
C	Snapping, input shaft bearing	CC	Cap, mainshaft rear bearing
D	Bearing, input shaft	DD	Slinger, companion flange grease
E	Snapping, input shaft bearing outer	EE	Nut, lock
F	Housing, clutch bell	FF	Flange, companion
G	Roller, mainshaft front bearing	GG	Mainshaft
H	Synchronizer, fourth-fifth speed	HH	Cap, countershaft rear bearing
J	Fork, fourth-fifth speed shifter	JJ	Nut, lock
K	Cover, shifter shaft	KK	Bearing, countershaft rear
L	Ring, gearshift lever support spring retaining	LL	Snapping, countershaft rear bearing outer race
M	Spring, gearshift lever support	MM	Bearing, reverse idler gear roller
N	Lever, gearshift	NN	Shaft, reverse idler gear
P	Pin, gearshift lever pivot	PP	Gear, reverse idler
Q	Cup, gearshift lever support	QQ	Gear, countershaft first speed (integral)
R	Plate, interlock	RR	Gear, countershaft second-reverse idler (integral)
S	Gear, mainshaft fifth speed (free)	SS	Countershaft
T	Gear, mainshaft third speed (free)	TT	Gear, countershaft third speed (integral)
U	Fork, second-third speed shifter	UU	Gear, countershaft fifth speed (keyed)
V	Synchronizer, second-third speed	VV	Housing, transmission
W	Shaft, second-third and fourth-fifth speed shifter	WW	Gear, countershaft drive fourth-speed (keyed)
X	Gear, mainshaft second speed (free)	XX	Bearing, countershaft front
Y	Fork, reverse-first speed gear	YY	Cover, clutch (bell) housing inspection
Z	Gear, reverse-first speed (sliding splined)	ZZ	Cap, countershaft front bearing

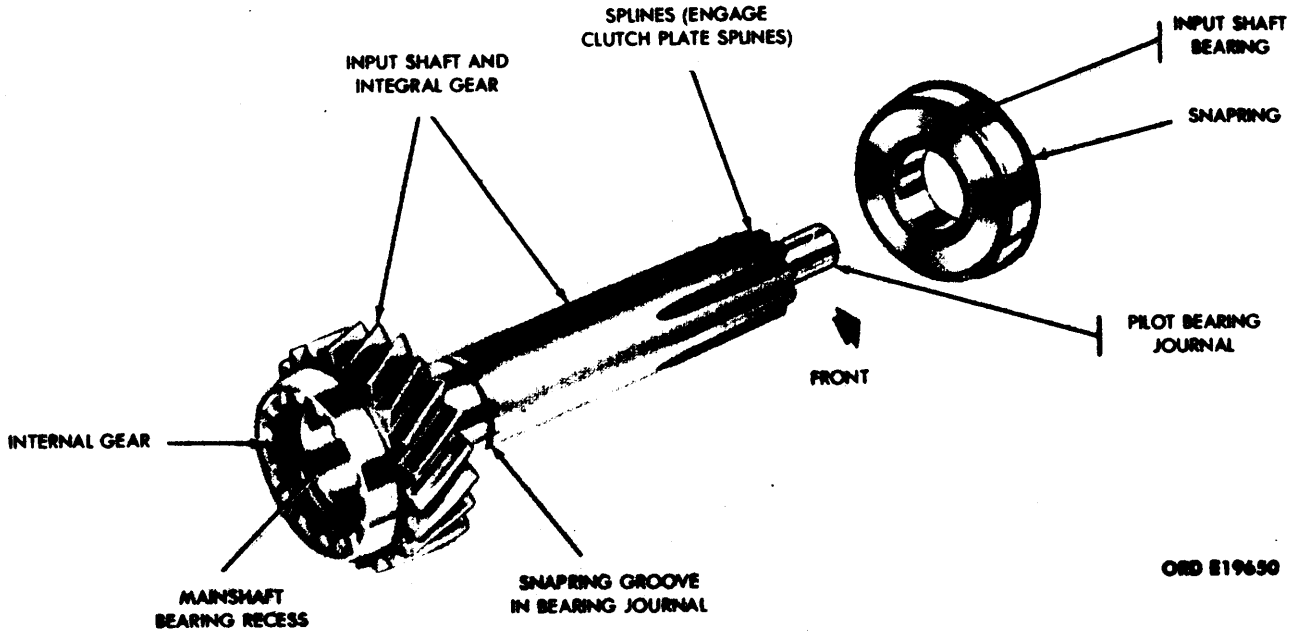


Figure 3-4. Transmission Input Shaft and Bearing.

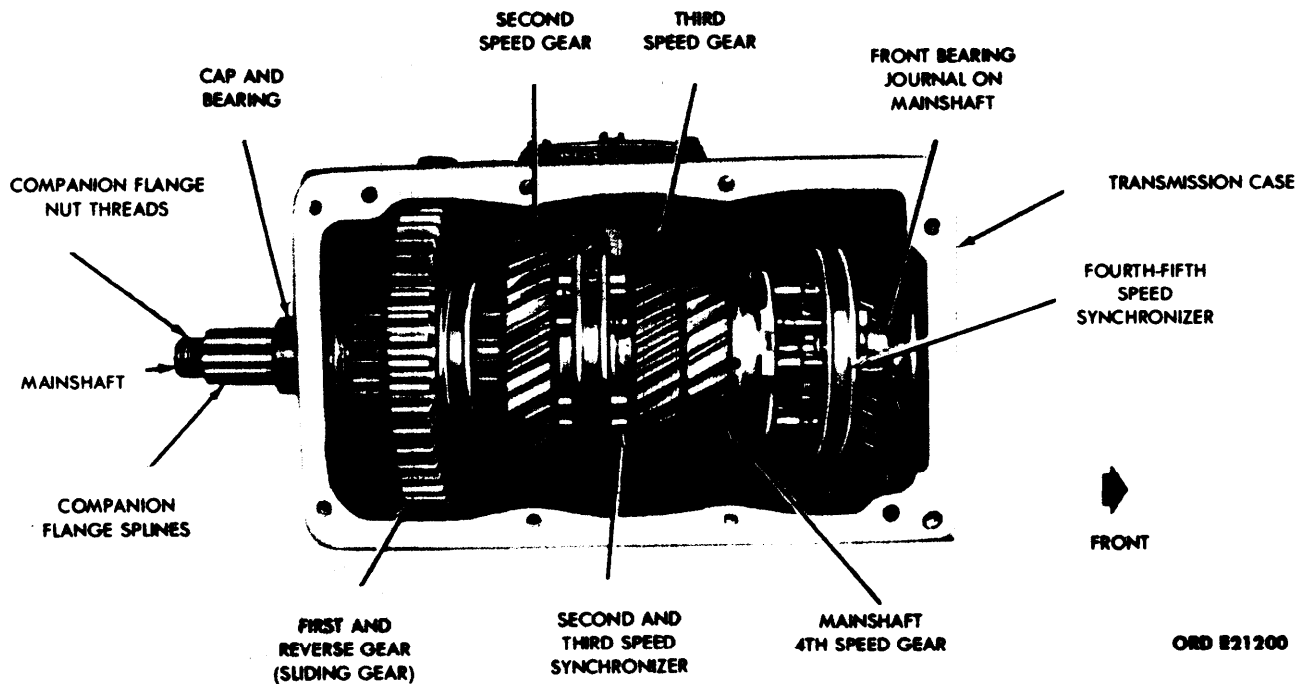


Figure 3-5. Transmission Mainshaft — Input Shaft Removed — Model 3052.

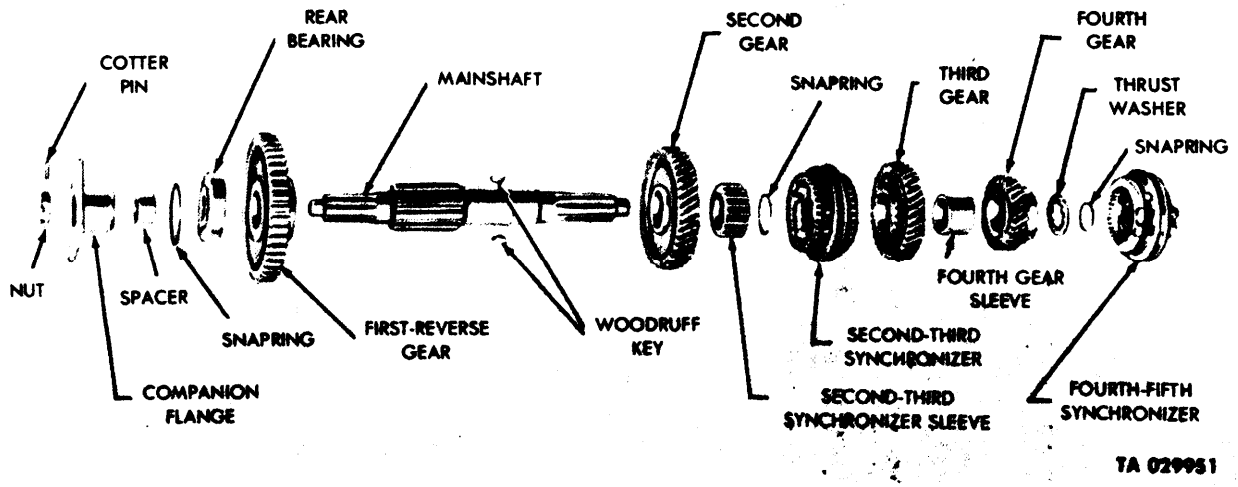


Figure 3-6. Transmission Mainshaft Assembly — Model 3052 — Exploded View.

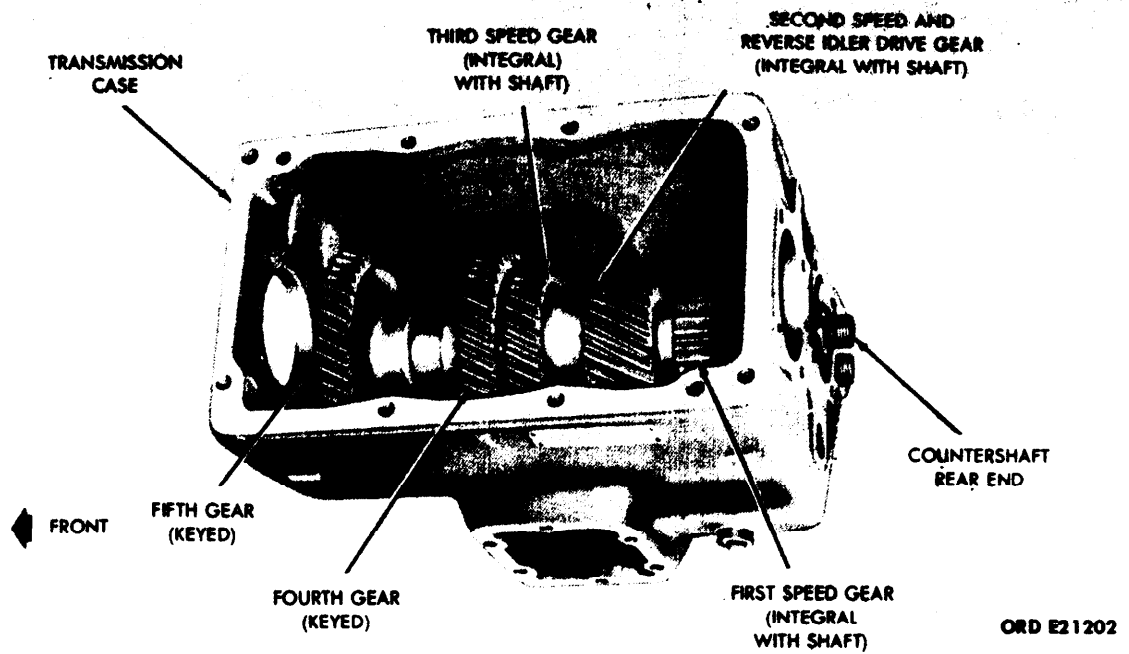


Figure 3-7. Transmission Countershaft Assembly.



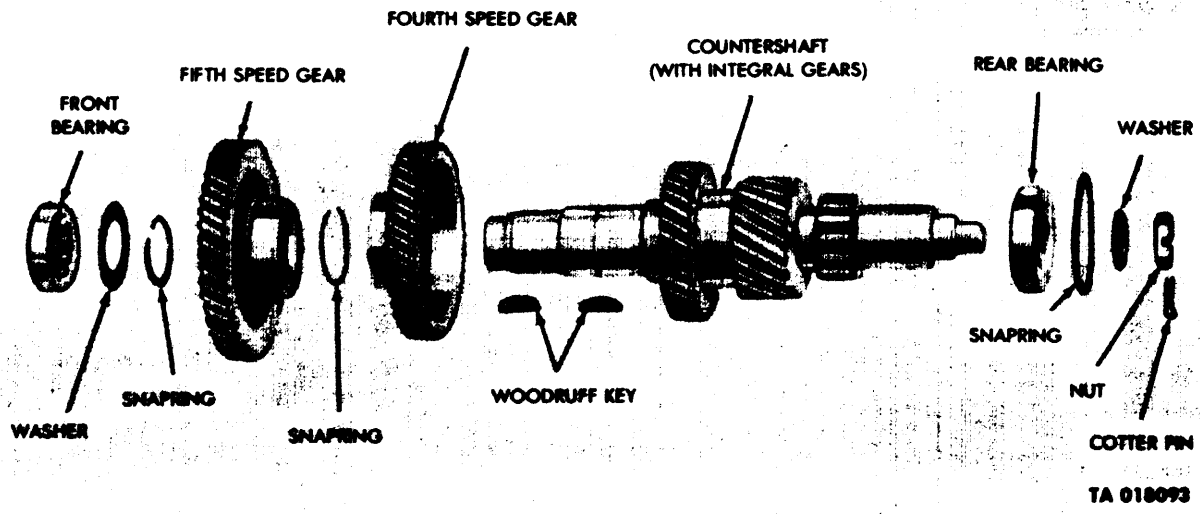


Figure 3-8. Transmission Countershaft Assembly — Exploded View.

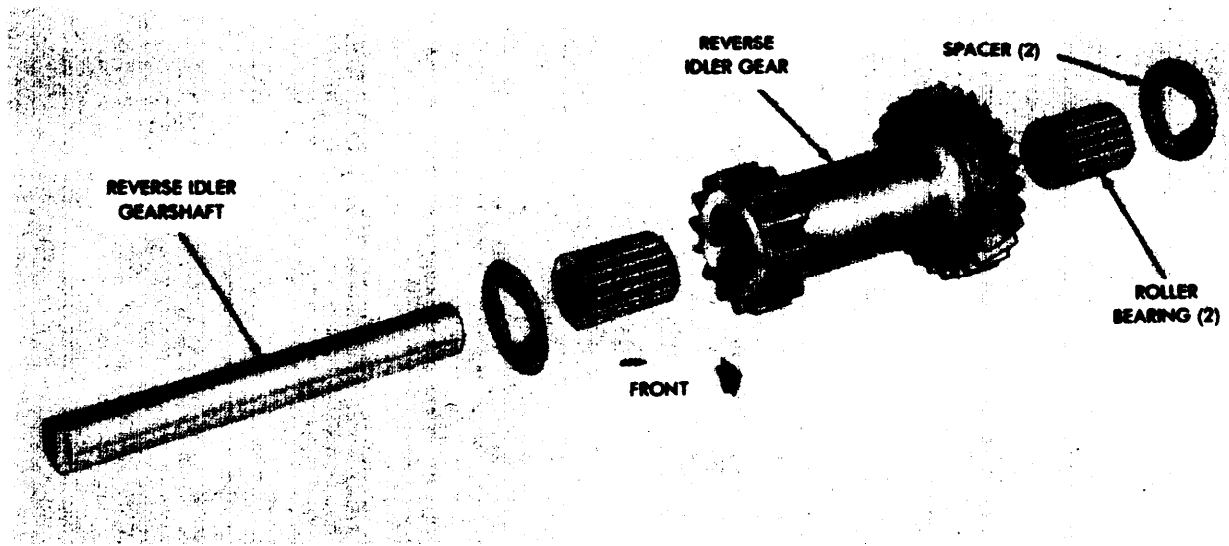


Figure 3-9. Reverse Idler Gear and Shaft Assembly — Exploded View.

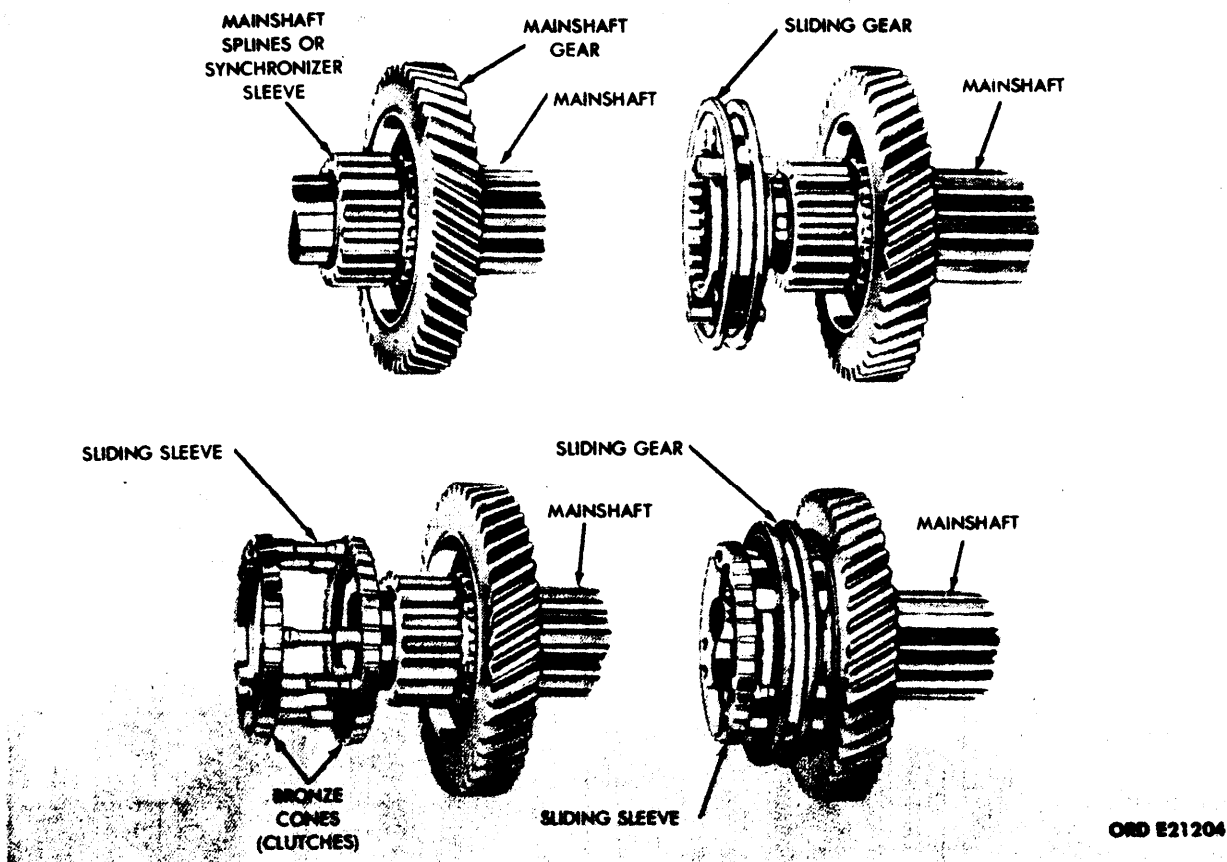
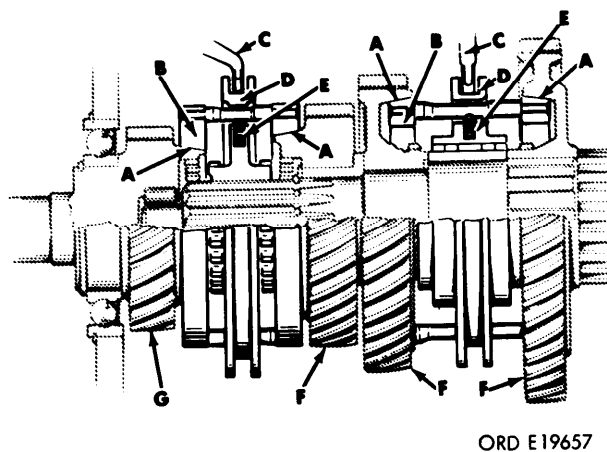


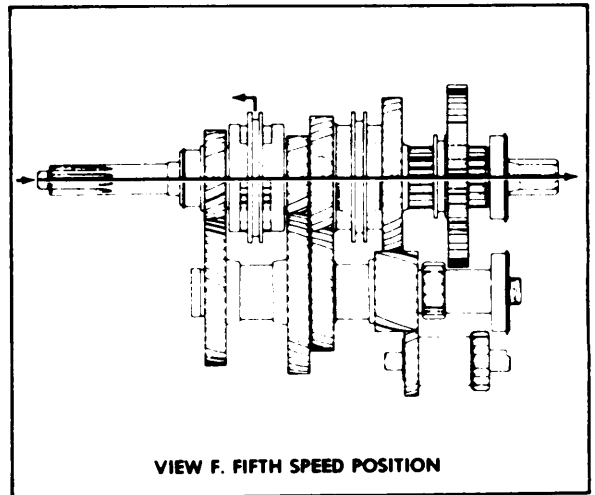
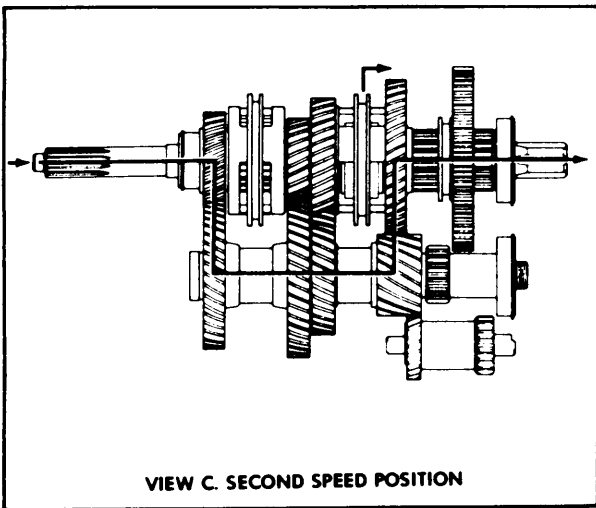
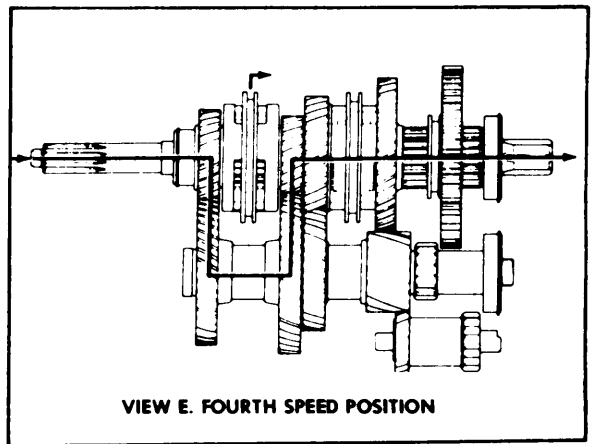
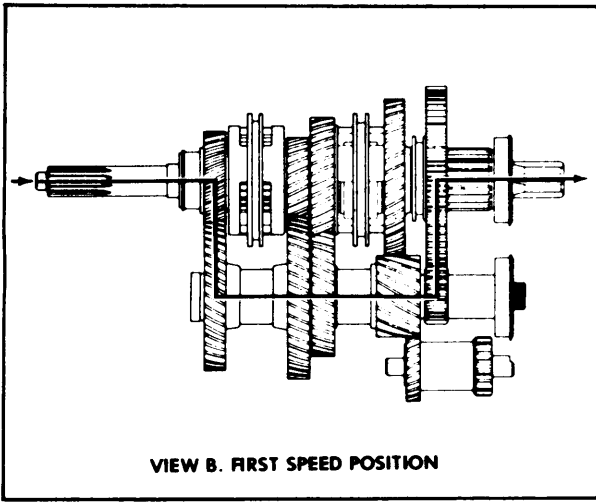
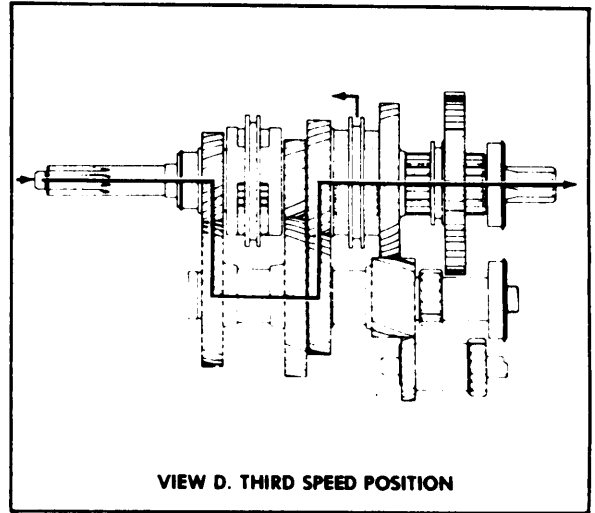
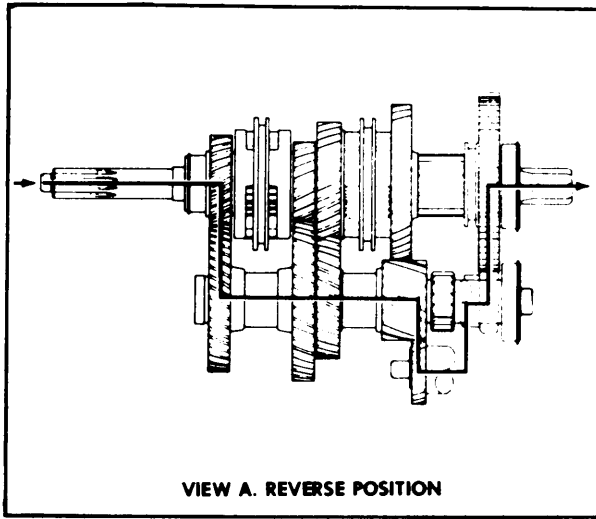
Figure 3-10. Synchronizer Construction.



Legend for fig. 3-11:

<u>KEY</u>	<u>ITEM</u>	<u>KEY</u>	<u>ITEM</u>
A	Friction surface	E	Detent ball and spring
B	Synchronizer sleeve	F	Mainshaft gears
C	Shifter fork	G	Input shaft integral gear
D	Synchronizer sliding gear		

Figure 3-11. Synchronizer Construction — Sectional View.



ORD E19658

Figure 3-12. Power Flow — Transmission Model 3052.

## Section II. DESCRIPTION, OPERATION, AND DATA (MODEL 3053A)

**3-4. General.** The description and operation of the transmission model 3053A is very similar to that of transmission model 3052. Therefore, this section will refer to Section I, where applicable, to avoid repetition. Only the differences will be given in this section.

### 3-5. Description and Operation.

*a. Description.* Figure 3-1 shows the transmission model 3053A used on the 2½-ton, 6x6, multifuel engine vehicles without front winch equipment. This transmission can also power a front winch by means of a power takeoff mounted on the left side of the transmission. (See fig. 3-2.) The construction of transmission model 3053A is almost identical to that of transmission model 3052, except for the fourth and fifth gear arrangements. This difference is shown by comparison between figures 3-13 and 3-6 and figures 3-14 and 3-8.

*b. Operation.*

(1) *Power Flow.* Power flow for transmission model 3053A is the exact opposite of the power flow for transmission model 3052. See figure 3-15 for the difference in power flow. See figure 3-12 for first-, second-, and third-speed power flow.

(2) *Fourth-Speed Power Flow.* Power is transmitted from the input gear, which is coupled to the mainshaft by the fourth-fifth synchronizer, directly to the mainshaft. Because the interlocking action of the synchronizer in effect makes one continuous shaft of the input shaft and mainshaft, the drive here is direct; i.e., a 1-to-1 ratio. (See fig. 3-15, view A.)

(3) *Fifth-Speed (Overdrive) Power Flow.* Power is transmitted by the countershaft fifth-speed (overdrive) gear to the mainshaft fifth-speed (overdrive) gear, which is coupled to the fourth-fifth

(overdrive) synchronizer and to the mainshaft. (See fig. 3-15, view B.)

### 3-6. Data.

National stock number . . . . .	2520-00-884-4833
Ordnance number . . . . .	10872096
Make . . . . .	Spicer
Model . . . . .	3053A
Type . . . . .	Synchromesh
Speeds:	
Forward . . . . .	5
Reverse . . . . .	1
Gear types:	
Input . . . . .	Helical
Mainshaft (except first-reverse) . . . . .	Helical
Mainshaft first-reverse . . . . .	Spur
Countershaft (except first) . . . . .	Helical
Countershaft first . . . . .	Spur
Reverse idler . . . . .	Spur-helical
Bearings:	
Input shaft . . . . .	Ball
Mainshaft front . . . . .	Straight roller
Mainshaft rear . . . . .	Ball
Countershaft front . . . . .	Straight Roller
Countershaft rear . . . . .	Ball
Reverse idler . . . . .	Straight roller
Input shaft size:	
Spline diameter . . . . .	1.499 in.
Number of splines . . . . .	10
Full length of splines . . . . .	2.375 in.
Mainshaft (output end) size:	
Spline diameter 1 . . . . .	1.499 in.
Number of splines . . . . .	10
Full length of splines . . . . .	1.906 in.
Gear ratios:	
First speed . . . . .	5.02 to 1
Second speed . . . . .	2.78 to 1
Third speed . . . . .	1.62 to 1
Fourth speed . . . . .	1.00 to 1.00
Fifth speed (overdrive) . . . . .	0.79 to 1
Reverse . . . . .	4.90 to 1

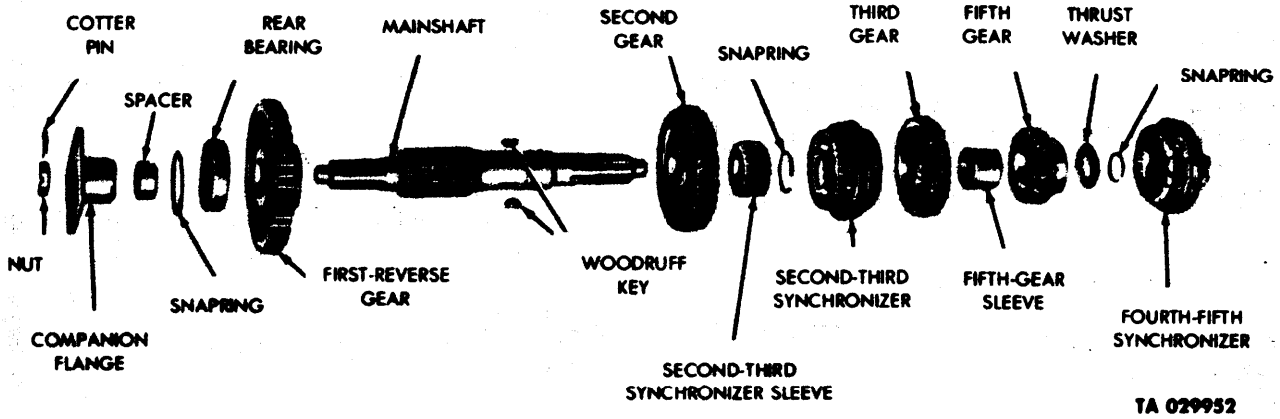


Figure 3-13. Transmission Mainshaft Assembly — Exploded View — Transmission Model 3053A.

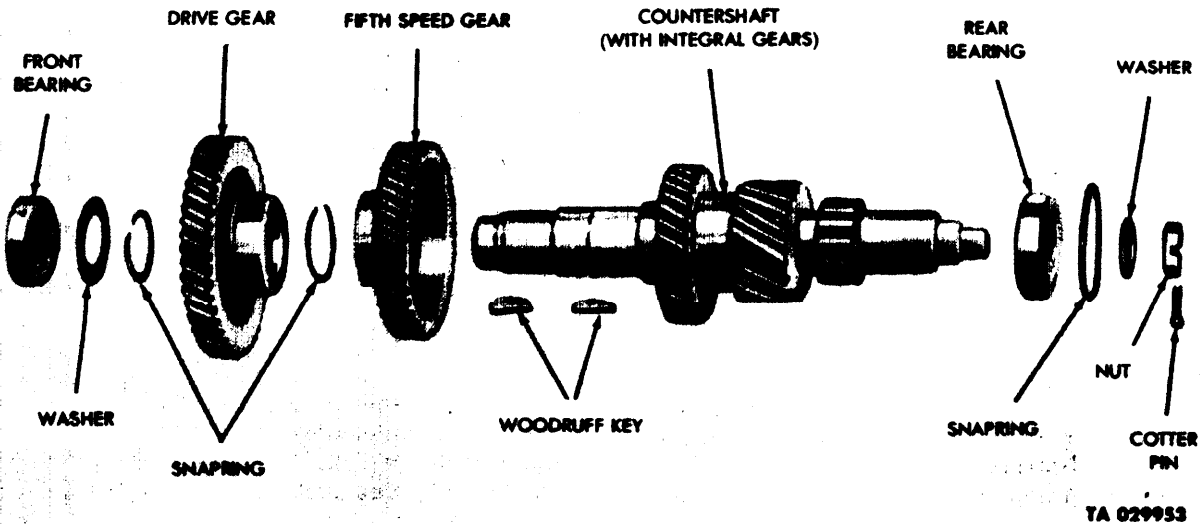
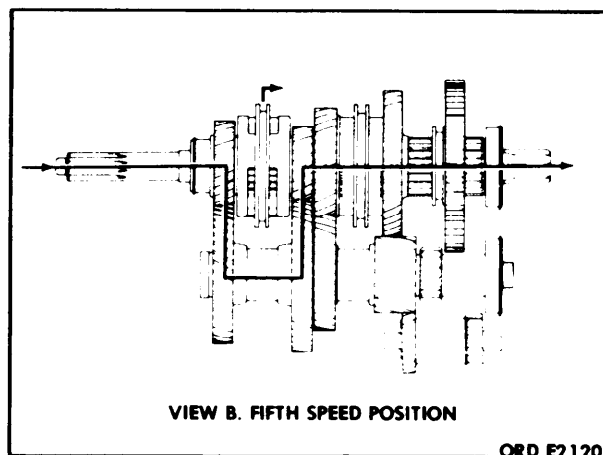
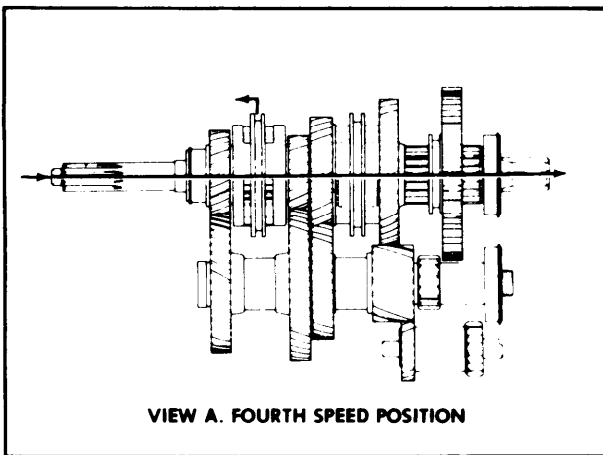


Figure 3-14. Transmission Countershaft Assembly — Exploded View — Transmission Model 3053A.



ORD E21207

Figure 3-15. Power Flow — Transmission Model 3053A.

## Section III. REPAIR (MODEL 3052)

### 3-7. General.

a. Clean the exterior of the transmission in accordance with Chapter 2, section III of this manual.

b. Refer to Chapter 2, section II of this manual for troubleshooting procedures.

c. When a transmission is repaired, it must be disassembled completely so that the parts may be thoroughly cleaned and inspected for wear or damage. Refer to Chapter 2, section III of this manual for instructions on the repair and rebuilding of the transmissions.

d. Disassembly is accomplished in two stages: first, disassembly into subassemblies; second, disassembly of the subassemblies. Always use separate containers for the parts of each subassembly. If more than one transmission is being rebuilt at the same time, provision must be made for keeping the parts of each transmission separate. This is especially important when some parts are to be used again.

e. Disassembly of the transmission is accomplished by following logical step-by-step procedures. Paragraph 3-8 provides disassembly to the subassembly level, paragraph 3-9 provides the disassembly procedures from the subassembly level to the piece part. Assembly procedures are given only where special attention to a part or assembly is required or needed. The assembly of the transmission is the exact opposite of disassembly except where otherwise specified for clarity. Always use new gaskets and seals during assembly.

### 3-8. Disassembly of Transmission Into Subassemblies.

#### a. Clutch Release Assembly.

(1) Unhook the two support springs securing the release bearing support assembly to the clutch release yoke and remove from the input shaft bearing cap. (See fig. 3-16.)

(2) Remove the two capscrews and lockwashers securing the clutch release yoke to the clutch shaft. (See fig. 3-16.) Partially slide the clutch release shaft through the clutch bell housing and remove the two yoke keys from the shaft. (See fig. 3-17.) Remove the clutch release yoke from the shaft and complete the removal of the clutch release shaft from the clutch housing.

(3) Remove the five capscrews and lockwashers securing the clutch bell housing to the transmission

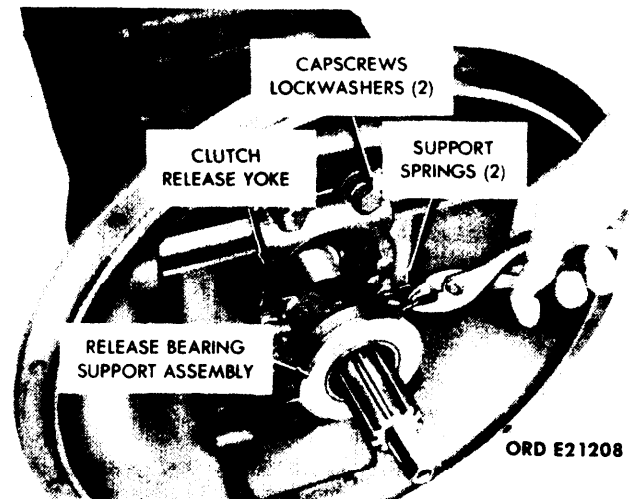


Figure 3-16. Removal of Clutch Release Bearing Support Assembly.

case. (See fig. 3-18.) Remove clutch bell housing gasket from the face of the transmission case.

b. *Shifter Shaft Cover.* Position the transmission shifter shaft in neutral. Remove the eight capscrews and washers securing the shifter shaft cover, and lift straight up to clear transmission case; discard the cover gasket (See fig. 3-19.)

#### NOTE

When installing shifter shaft cover, position the shifter shaft in neutral and place the shifter forks in the mainshaft synchronizer grooves. (See fig. 3-20.)

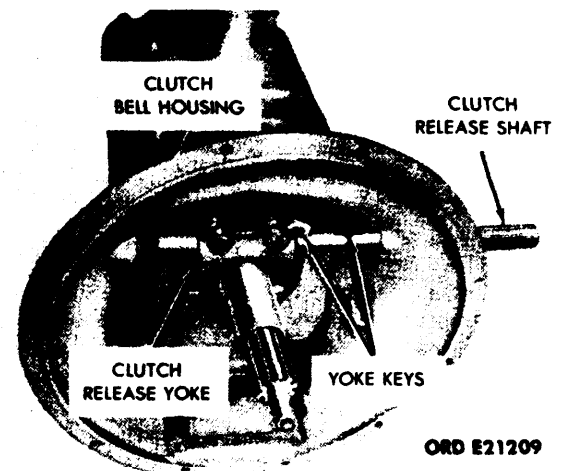


Figure 3-17. Removal of Clutch Release Yoke and Release Shaft.

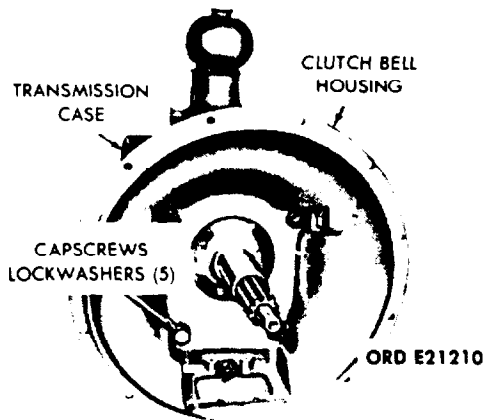


Figure 3-18. Removal of Clutch Bell Housing.

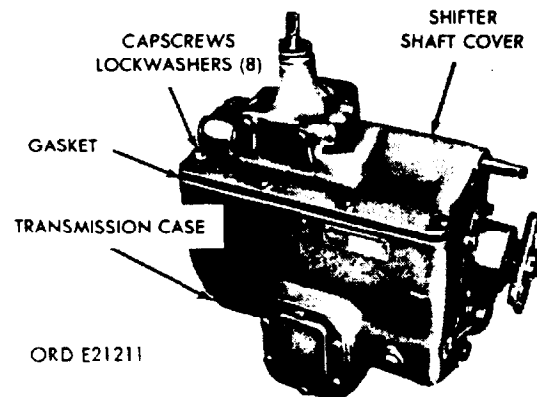


Figure 3-19. Removal of Shifter Shaft Cover.

c. Companion Flange. Slide the gears on the mainshaft to lock the transmission. Remove the cotter pin from the mainshaft and nut. Remove the retaining nut securing the companion flange to the mainshaft. (See fig. 3-20.) Using the universal puller (item 4, table 2-1) remove the companion flange. (See fig. 3-21.)

**NOTE**

When assembling the companion flange, coat the companion flange seal bearing surface with a light coating of grease, artillery and automotive (GAA), MIL-G-10924. Use care not to damage the bearing surface of the seal. Tighten the companion flange retainer nut to 120-150 lb-ft torque.

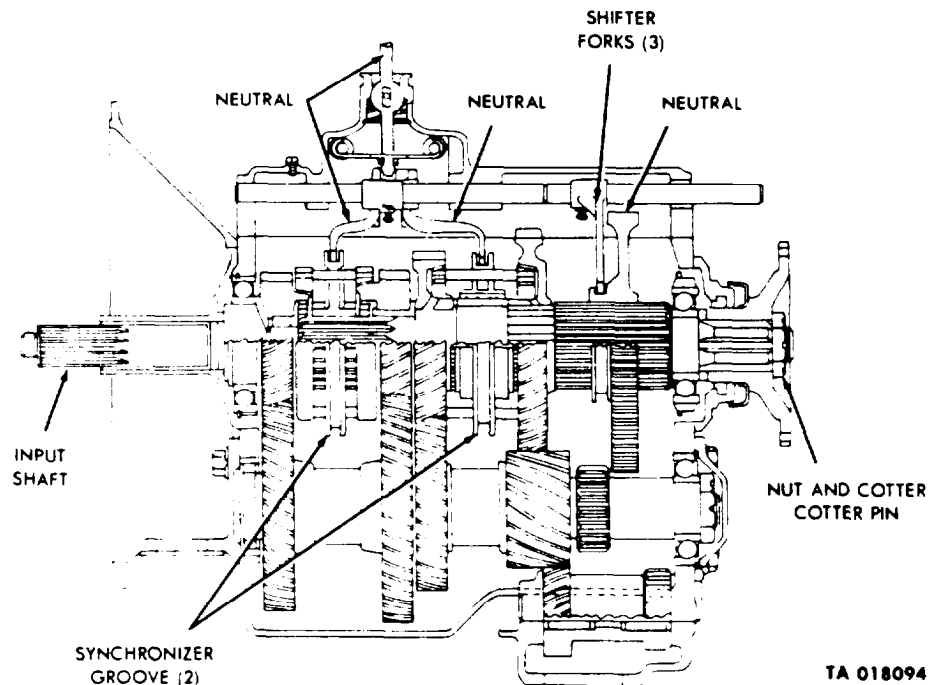
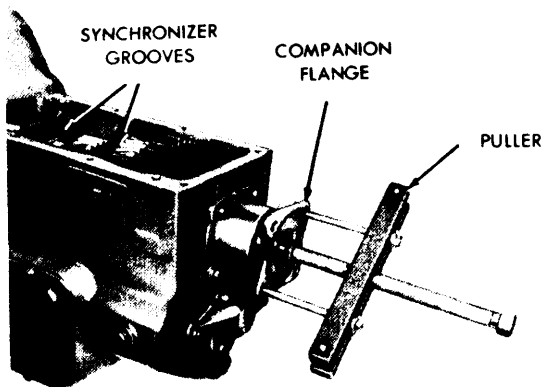


Figure 3-20. Transmission Shifter Forks, Gears, and Synchronizers in Neutral Position.



TA 029954

Figure 3-21. Removal of Companion Flange.

d. *Mainshaft Rear Bearing Cap Assembly.* Remove the four capscrews and lockwashers securing the bearing cap assembly to the transmission case. (See fig. 3-22.) Remove the bearing cap assembly, spacer, and gasket. Discard the gasket.

e. *Countershaft Rear Bearing Cover.* Remove the four capscrews and lockwashers securing the countershaft rear bearing cover to the transmission case. (See fig. 3-23.) Remove the countershaft rear bearing cover and gasket. Discard the gasket.

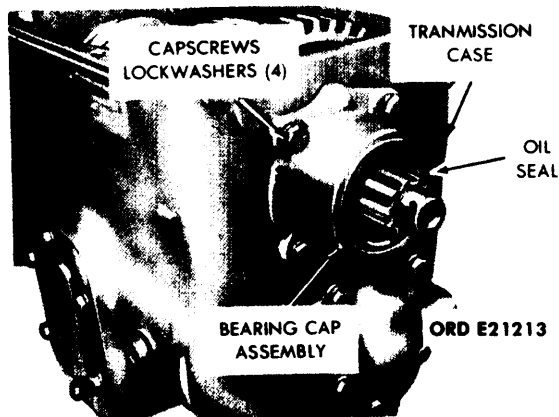


Figure 3-22. Removal of Mainshaft Rear Bearing Cap Assembly.

f. *Power Takeoff Cover Opening.* Remove the six capscrews and lockwashers securing the power takeoff opening cover to the transmission case. (See fig. 3-24.) Remove the cover and gasket. Discard the gasket.

g. *Input Shaft Bearing Cap.* Remove the four capscrews and lockwashers securing the input shaft bearing cap to the transmission case. (See fig. 3-25.) Remove the input shaft bearing cap, spacer, and

gasket. Discard the gasket. Slide the input shaft and bearing assembly straight out from the transmission. Keep input shaft-to-mainshaft roller bearings together for use in assembly purposes.

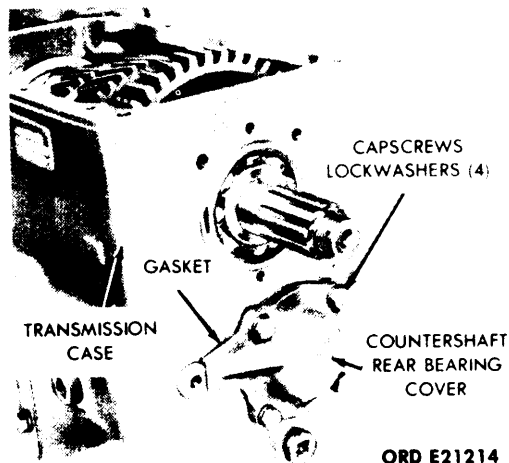


Figure 3-23. Removal of Countershaft Rear Bearing Cover.

**NOTE**

On installation, coat the roller bearings with grease, artillery and automotive (GAA) MIL-G-10924. This practice prevents the roller bearings from dropping out of place during assembly.

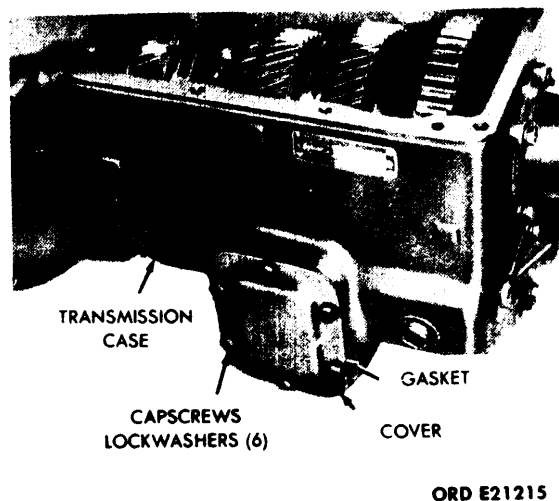


Figure 3-24. Removal of Power Takeoff Opening Cover.

h. *Mainshaft Rear Bearing.* With the use of a block of wood, drive the mainshaft rearward to force the rear bearing from the transmission case. (See fig. 3-26.) Use a universal puller to remove the rear bearing from the mainshaft.

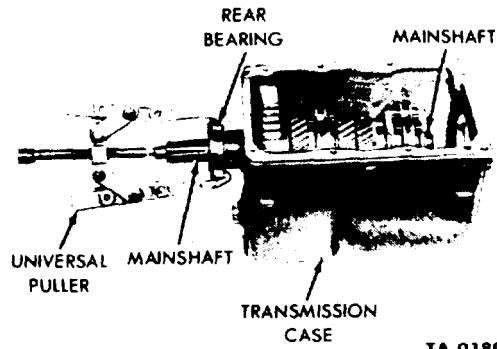


**NOTE**

During installation, place rear bearing on the mainshaft and align the bearing with the transmission opening. Use wooden block and mallet to drive the bearing into place.

*i. Fourth- and Fifth-Speed Synchronizer.* Firmly apply downward pressure to the rear of the mainshaft while sliding the fourth- and fifth-speed synchronizer from the mainshaft. (See fig. 3-27.)

*j. Mainshaft Assembly.* Hold the mainshaft in the rear position as illustrated in figure 3-28, and tilt the front of the shaft upward. Slide the mainshaft from the first and reverse gear, leaving the gear in the case.



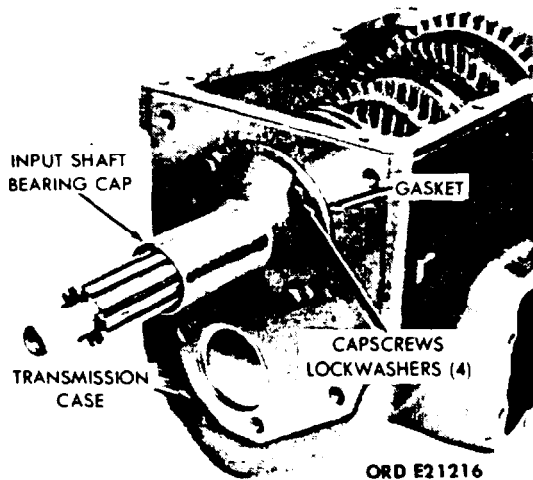
TA 018077

Figure 3-26. Removal of Mainshaft Rear Bearing.

1. Countershaft Rear Bearing. Hold the countershaft gears in locked position by using a wood wedge block between the gears and the transmission case. Remove the cotter pin from the countershaft assembly, the retaining nut, and the washer. (See fig. 3-30.)

**NOTE**

During installation, slide the mainshaft into the first and reverse gear and through the transmission case bearing opening.



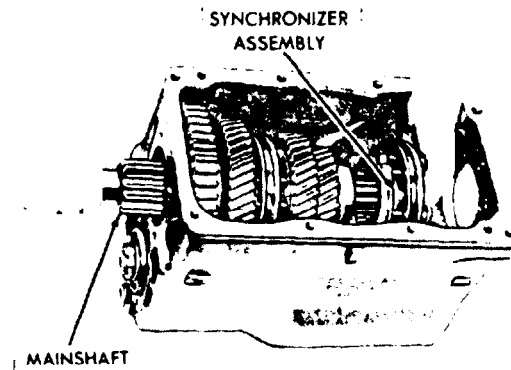
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Figure 3-25. Removal of Input Shaft Bearing Cap.

*k. Idler Gear Assembly.* Screw adapter (item 3, table 2-1) into idler gear shaft. Thread slide handle puller into adapter and pull idler gear shaft from housing. (See fig. 3-29.) Tilt idler gear.

**NOTE**

During installation, insert the idler gear shaft in the outer transmission case opening and through the idler gear assembly. Align the shaft with the bracket opening and, using a soft hammer, drive the shaft into position. The indentation of the shaft must be aligned with the outer case housing and cutaway section of the countershaft rear bearing cap.



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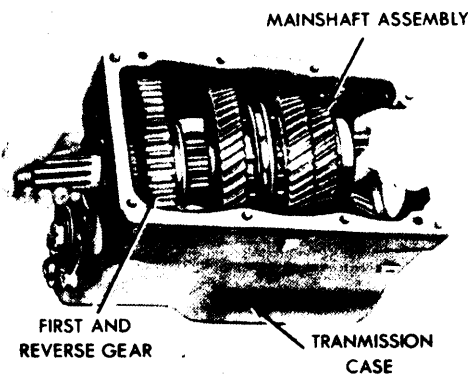
Figure 3-27. Removal of Fourth- and Fifth-Speed Synchronizer.

**NOTE**

When installing the retaining nut, tighten to 120- 150 lb-ft torque.

*m. Countershaft.* Slide the shaft rearward out of the front bearing. Extend the shaft out of the front bearing and extend the shaft through the rear bearing bore. then remove the countershaft assembly from the transmission case. (See fig. 3-31.)

*n. Countershaft Front Bearing.* Using a soft drift pin and mallet, working from inside the transmission case assembly, drive the front bearing retainer from the transmission case. (See fig. 3-32.) Remove bearing from transmission case.



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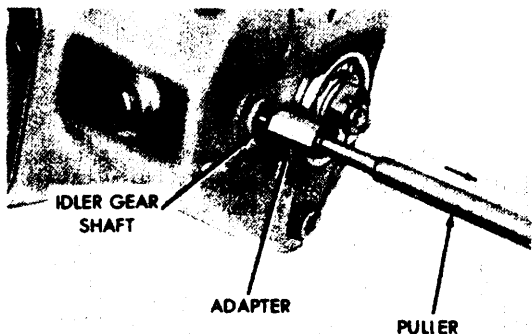
Figure 3-28. Removal of Mainshaft Assembly.

3-9. Disassembly of Subassemblies.

CAUTION

Use extreme care not to lose roller bearings from the mainshaft end of the input shaft.

a. *Input Shaft Assembly.* Using a pair of pliers, remove the input shaft ball bearing retainer snapping. (See fig. 3-33.) Place the input shaft between two parallel blocks, spline upward. Using an arbor press, push the input shaft ball bearing from the shaft.

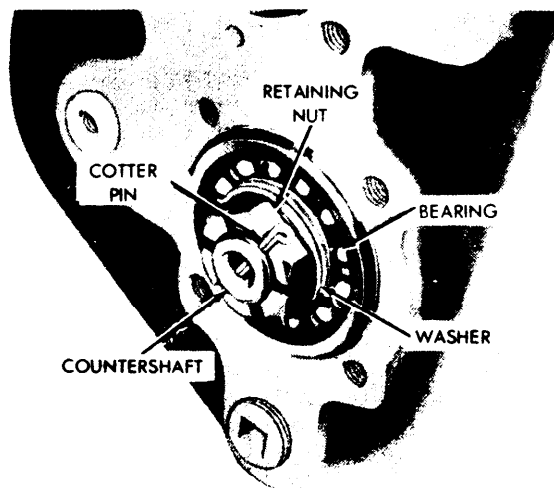


TA 018080

Figure 3-29. Removal of Idler Gearshaft and Idler Gear Assembly.

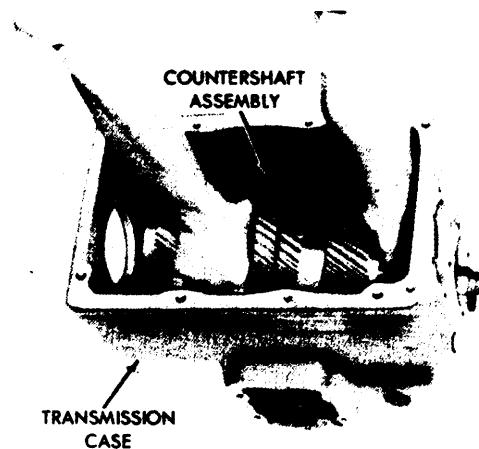
NOTE

When installing the input shaft roller bearings, keystone construction of assembly requires endwise insertion of last roller. Also, coat the input shaft and ball bearing bore with white lead pigment, Fed Spec TT-W-261C, before pressing the ball bearing assembly back on the shaft.



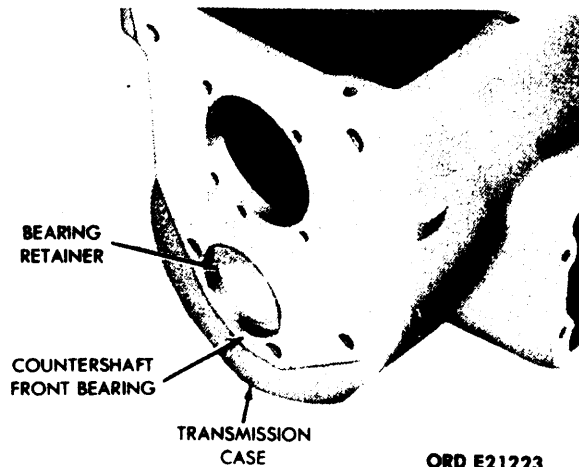
ORD E21221

Figure 3-30. Removal of Countershaft Rear Bearing.



ORD E21222

Figure 3-31. Removal of Countershaft Assembly.



ORD E21223

Figure 3-32. Removal of Countershaft Front Bearing.

*b. Main Drive Gear Assembly.*

(1) Remove the snapping and fourth-speed gear thrust washer from mainshaft assembly. (See fig. 3-34.) Slide the fourth-speed gear from the mainshaft.

(2) Set up fixture as shown in figure 3-35. Apply pressure from the press ram and remove fourth-speed gear sleeve and third-speed gear.

(3) Slide second- and third-speed synchronizer free of mainshaft. Using a pair of pliers, remove the snapping which holds the second-speed synchronizer sleeve in position. Set up press as shown in figure 3-36. Press second- and third-speed synchronizer sleeve approximately 1/4 inch. Do not press second-speed gear onto woodruff keys of mainshaft. Install the puller on second and third speed synchronizer sleeve as shown in figure 3-37. Continue to remove synchronizer sleeve from shaft and remove the two woodruff keys, then remove second-speed gear.

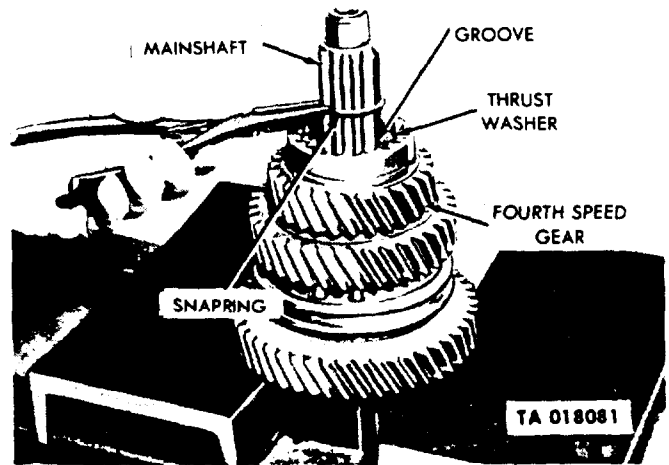


Figure 3-34. Removal of Fourth-Speed Gear.

(2) Using a punch and hammer, remove the expansion plugs. Clip the safety wire and loosen the four setscrews holding the shift forks and actuating lug in position. (See fig. 342.) Then remove the three shifter shafts.

(3) Turn the shifter cover right side up and remove the poppet balls and springs. (See fig. 3-43.)

(4) Pry the interlock plate up and remove the interlock plate, springs, and interlock plate spring washers. (See fig. 3-44.)

(5) Drive first and reverse shifter shaft oil seal (fig. 3-45) out with punch and hammer and discard seal.

(6) Remove the lower shift lever, lockring, spring, and spring cup. (See fig. 346.) Slide the shifter shaft lever through the shifter shaft cover.

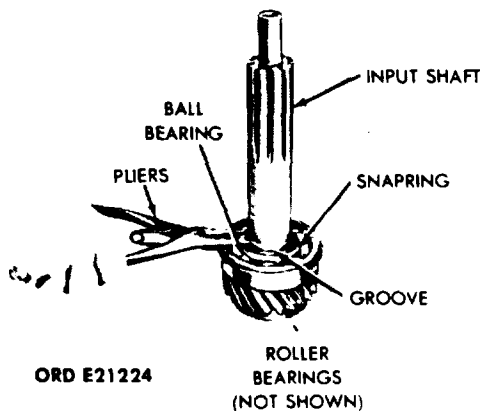


Figure 3-33. Disassembly of Input Shaft Assembly.

*c. Countershaft Assembly.*

(1) Using a pair of pliers, remove snapping. Position countershaft on press as shown in figure 3-38. Install a puller adapter under the drive gear and press the shaft from the gear. Remove woodruff key.

(2) Place into press as shown in figure 3-39. Remove fourth-speed gear snapping and press the shaft. Then remove fourth-speed woodruff key.

d. Mainshaft Rear Bearing Cap. Using a round suitable block, drive the oil seal from the bearing cap. (See fig. 3-40.)

*e. Shifter Shaft Cover Assembly).*

(1) Remove the interlock safety nuts and bolts. (See fig. 3-41.)

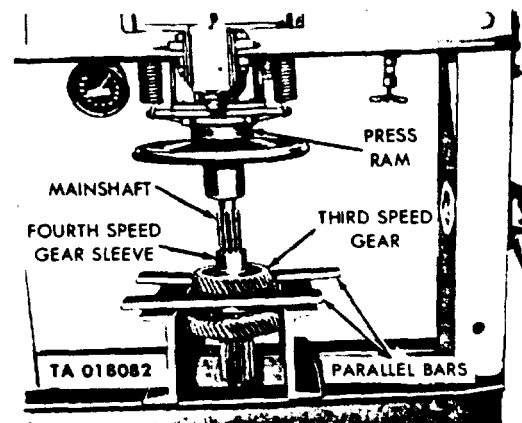


Figure 3-35. Removal of Third-Speed Gear and Fourth-Speed Gear Sleeve.

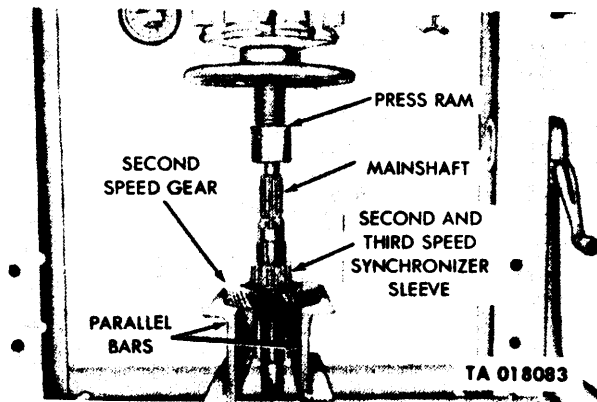


Figure 3-36. Removal Second-Speed Gear, Second- and Third-Speed Synchronizer and Synchronizer Sleeve.

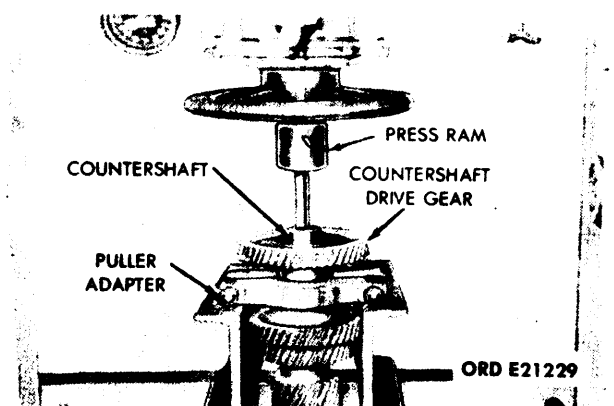


Figure 3-38. Removal of Countershaft Drive Gear (Fifth-Speed Gear).

### 3-10. Assembly of Subassemblies.

#### a. Shifter Shaft Cover.

(1) Using a new oil seal, install the first and reverse shifter shaft oil seal. (See fig. 3-45.)

#### NOTE

Soak felt seal in universal gear lubricant (GO 90), MIL-L-2105, before assembly.

(2) Slide the lower shift lever into cover at fulcrum pivot pins. Install lower shift lever, cup, spring, and lockring. (See fig. 3-46.)

(3) Place the interlock plate into position and install the springs and plate spring washers. Plate spring washers are installed between the springs and the shifter shaft cover. (See fig. 3-44.) Install the safety nuts and bolts. (See fig. 3-41.)

(4) Turn shifter shaft cover upside down, and insert the springs and poppet balls into the shifter shaft cover holes. (See fig. 3-43) Depress the spring and ball with a punch and slide the shaft through the shifter fork cover. Use the same procedure for installing the remaining two poppet springs and balls.

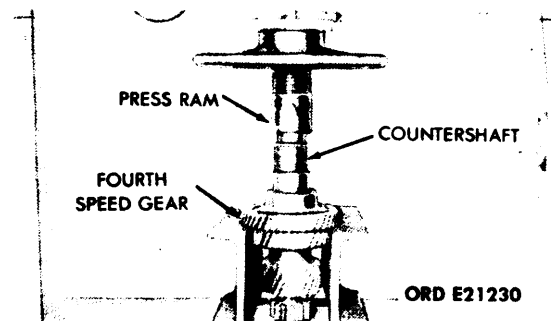


Figure 3-39. Removal of Countershaft Fourth-Speed Gear.

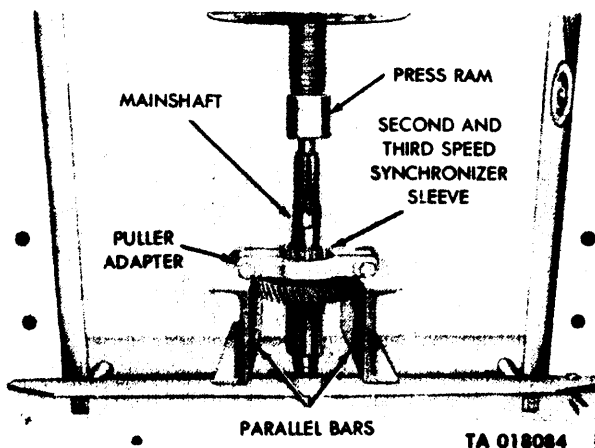


Figure 3-37. Removal of Second-Speed Gear, Second- and Third-Speed Synchronizer and Synchronizer Sleeve.

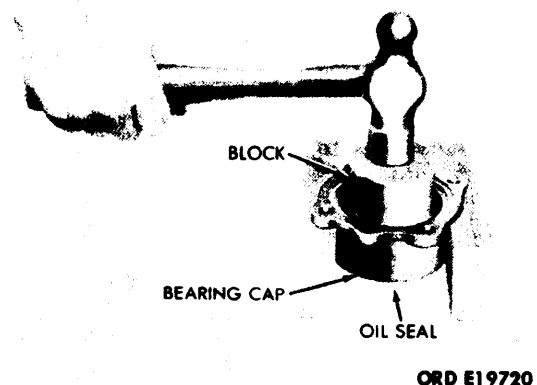


Figure 3-40. Removal of Mainshaft Rear Bearing Cap Oil Seal

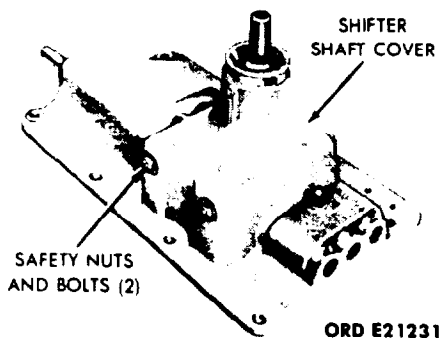
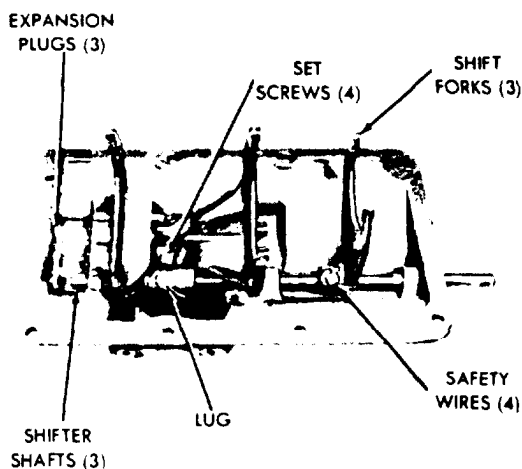


Figure 3-41. Shifter Shaft Cover.

(5) Tighten the four setscrews securing the shift forks and actuating lug in position. (See fig. 3-42.) Install safety wire on the setscrew. Install the expansion plugs, using a hammer and suitable punch.

(6) Tighten interlock safety nuts and bolts to 40-50 lb-ft torque (See fig. 341.)

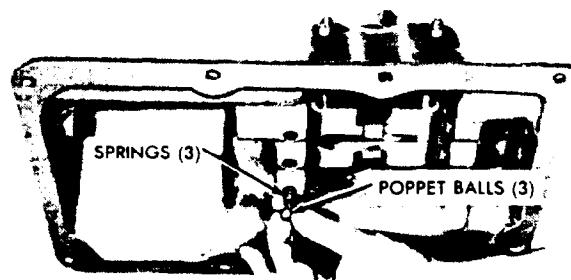


ORD E21232

Figure 3-42. Removal of Expansion Plugs, Setscrews, Shifter Shafts, Actuating Lug and Shifters Forks.

b. Countershaft.

(1) Install woodruff key in countershaft at fourth-speed gear position. Coat countershaft at fourth-speed gear bore with a light coating of grease, artillery and automotive (GAA), MIL-G-10924. Place assembly in press, align fourth-speed gear slot with woodruff key and press the gear onto the countershaft. Secure gear in place with a new snapping. See figure 3-39 for positioning of the fourth-speed gear.



TA 018109

Figure 3-43. Removal of Popper Ball and Springs.

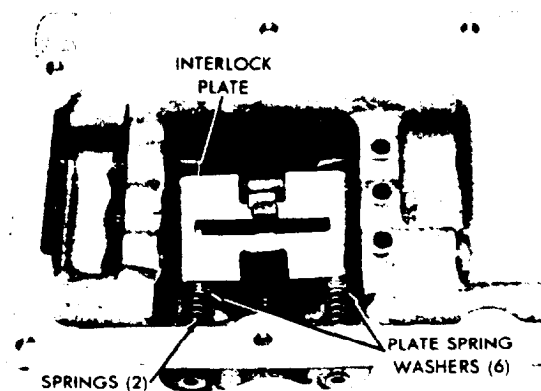
NOTE

Install fourth-speed gear with the collar of the gear facing toward the front of the countershaft.

(2) Install woodruff key in countershaft at fifth-speed gear position. Coat countershaft and fifth-speed gear bore with a light coating of grease, artillery and automotive (GAA), MIL-G-10924. Place the countershaft and fifth-speed gear (countershaft drive gear) under the press, line up the woodruff key with the slot in the gear and press into position. Secure gear in place with a new snapping. See figure 3-38 for positioning of the fifth-speed gear.

NOTE

Install fifth-speed gear with the collar of the gear facing toward rear of the countershaft.



ORD E21234

Figure 3-44. Removal of Interlock Plate and Springs.

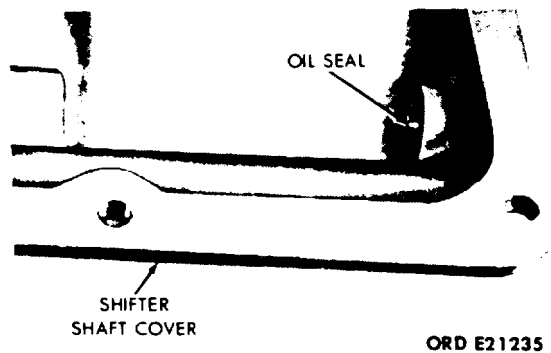


Figure 3-45. Removal of First and Reverse Shifter Shaft Oil Seal

c. Mainshaft.

**CAUTION**

Do not press directly on the flange of the sleeve. Use a short piece of pipe or tubing and press on end of sleeve. Direct pressure on the flange of the sleeve may damage it.

(1) Slide the second speed gear on the mainshaft. Coat the second- and third-speed synchronizer sleeve bore and mainshaft with a light coating of grease, artillery and automotive (GAA), MIL-L-10924. Start the sleeve on the mainshaft. Place into the press, face down, between two parallel bars. Press sleeve into position and secure it using a new snapping. See figure 3-37 for positioning of the second- and third-speed synchronizer.

(2) Coat the fourth-speed gear sleeve and mainshaft with white lead. Fed Spec TT-W-261C. Make an opening in the adapter puller large enough to slip through. Position the third-speed gear and fourth-speed gear sleeve to main drive shaft and press into place. See figure 3-35 for the correct positioning of third-speed gear and fourth-speed gear sleeve.

(3) Install mainshaft fourth-speed gear and thrust washer. Secure in place using a new snapping.

**NOTE**

Be sure snapping is fully seated in the mainshaft groove.

d. Mainshaft Rear Bearing Cap.

(1) Press seal into place using a block of wood and a press.

(2) See fig. 3-22 for positioning of seal.

e. Input Shaft.

(1) Place the input shaft ball bearing on the input shaft. Place the input shaft between two parallel blocks, spline downward. Using an arbor press, press the input shaft ball bearing onto the shaft. Secure bearing to input shaft using a new snapping. See fig. 3-33 for positioning of bearing and snapping.

**NOTE**

Coat the input shaft and ball bearing bore with white lead pigment, Fed Spec TT-W-261C, before pressing the ball bearing assembly on the shaft.

(2) Coat the input shaft roller bearing bore with a light coating of grease, artillery and automotive (GAA), MIL-G-10924. Install the input shaft roller bearings. Insert the last roller bearing end wise into the bearing assembly. (See para 3-9 note.)

**3-11. Assembly.**

a. Install countershaft front bearing and washer. (See fig. 3-32.)

b. Install new countershaft front bearing retainer (See fig. 3-32.)

c. Install countershaft assembly. (See fig. 3-31.)

d. Install countershaft rear bearing (fig. 3-30) and snapping.

e. Install countershaft rear bearing retaining nut. Tighten nut to 120-150 lb-ft torque. Secure nut to mainshaft using a new cotter pin (fig. 3-30).

**NOTE**

After applying torque, tighten nut to closest cotter pin hole.

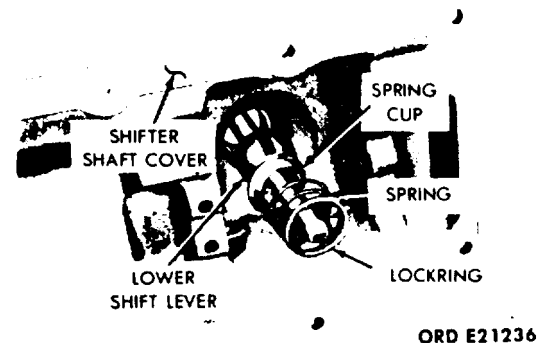


Figure 3-46. Removal of Lower Shift Lever, Lever Spring, and Spring Cap

*f.* Install idler gear assembly and idler gear shaft. See figure 3-29 for positioning of idler gear shaft.

*g.* Install mainshaft. (See fig. 3-28.)

*h.* Install the fourth-and fifth-speed synchronizer on mainshaft, (See fig. 3-27.)

*i.* Install mainshaft rear bearing. Use a wooden block and mallet to drive bearing into place. See figure 3-26 for positioning of rear bearing.

*j.* Install the input shaft and input shaft bearing cap using a new gasket. (See fig. 3-25.) Tighten the four capscrews to 13-17 lb-ft torque.

*k.* Install countershaft rear bearing cover using a new gasket. (See fig. 3-23.) Tighten the four capscrews and lockwashers to 25-32 lb-ft torque.

*l.* Install power takeoff opening cover using a new gasket. (See fig. 3-24.) Tighten the six capscrews and lockwashers to 10-15 lb-ft torque.

*m.* Install mainshaft rear bearing cap assembly using a new gasket. (See fig. 3-22.) Tighten the six capscrews and lockwashers to 25-32 lb-ft torque.

*n.* Install companion flange. Coat companion flange bearing surface with a light coating of grease, artillery and automotive (GAA), MIL-G-10924. Slide the gears

on the mainshaft to lock the transmission shafts from turning. Tighten companion flange retaining nut to 120-150 lb-ft torque. Install new cotter pin to secure nut. Be especially careful not to damage rear bearing cap seal. See figure 3-21 for positioning of companion flange.

#### NOTE

After applying torque, tighten nut to closest cotter pin hole.

*o.* Place shifter forks in cover, and place transmission gears and synchronizers in neutral position. (See fig. 3-20.) Install shifter shaft cover using a new gasket. Be sure cover assembly is seated and tighten the eight capscrews and lockwashers to 25-32 lb-ft torque. (See fig. 3-19.)

*p.* Install clutch bell housing using a new gasket. Tighten the five capscrews and lockwashers to 60-80 lb-ft torque. (See fig. 3-18.)

*q.* Install the clutch release yoke, yoke keys, and clutch release shaft. Tighten the two capscrews and lockwashers to 40-50 lb-ft torque. (See fig. 3-16 and 3-17.)

*r.* Install the clutch release bearing support assembly and secure in position using the two support springs. See figure 3-16 for positioning of springs.

## Section IV. REPAIR (MODEL 3053A)

**3-12. General.** Disassembly and assembly procedures for transmission model 3053A are almost identical to those of transmission model 3052 with the exception of the positions of fourth and fifth gears. Therefore, the repeating of these procedures is not necessary. During the disassembly and assembly procedures for the transmission, keep in mind that in transmission model 3053A the fourth and fifth speed gears are just the reverse of those in transmission

model 3052, both on the main drive shaft and on the countershaft. For disassembly and assembly procedures, refer to paragraphs 3-8, 3-9, 3-10, and 3-11.

### NOTE

The input shaft is removed from the inside of case or towards the rear of the transmission.

## Section V. TEST AND ADJUSTMENT (MODELS 3052 AND 3053A)

### 3-13. General.

*a. Lubrication.* Remove transmission lubricant filler plug and make sure transmission is filled to the proper level with correct lubricant before testing. Refer to lubrication order LO 9-2520-209-12/1 for lubrication specifications.

*b. Preparation for Test.* Assemble transmission to an engine installed on the dynamometer.

**3-14. Shift Test.** Shift transmission through the entire gear range while in operation. Shift lever should shift transmission easily, without binding, and snap in and out of gear with no tendency to slip out of gear or slide into neutral. There should be a definite

change in gear noise between each shift.

### 3-15. Power Test.

*a. Operation Analysis.* Operate transmission in each shift position with varying torque on input shaft and listen for unusual gear noises that would indicate gears not fully in mesh or more than normal clearance between the gear teeth. Pay particular attention to any tendency to slip into neutral.

*b. Leakage Check.* During power test, check outside of transmission case and cover for lubricant leakage at gasket joints and shaft seals. Check thoroughly all over the transmission assembly for any leakage or malfunction.

## Section VI. REPAIR AND REPLACEMENT STANDARDS (MODELS 3052 AND 3053A)

### 3-16. General.

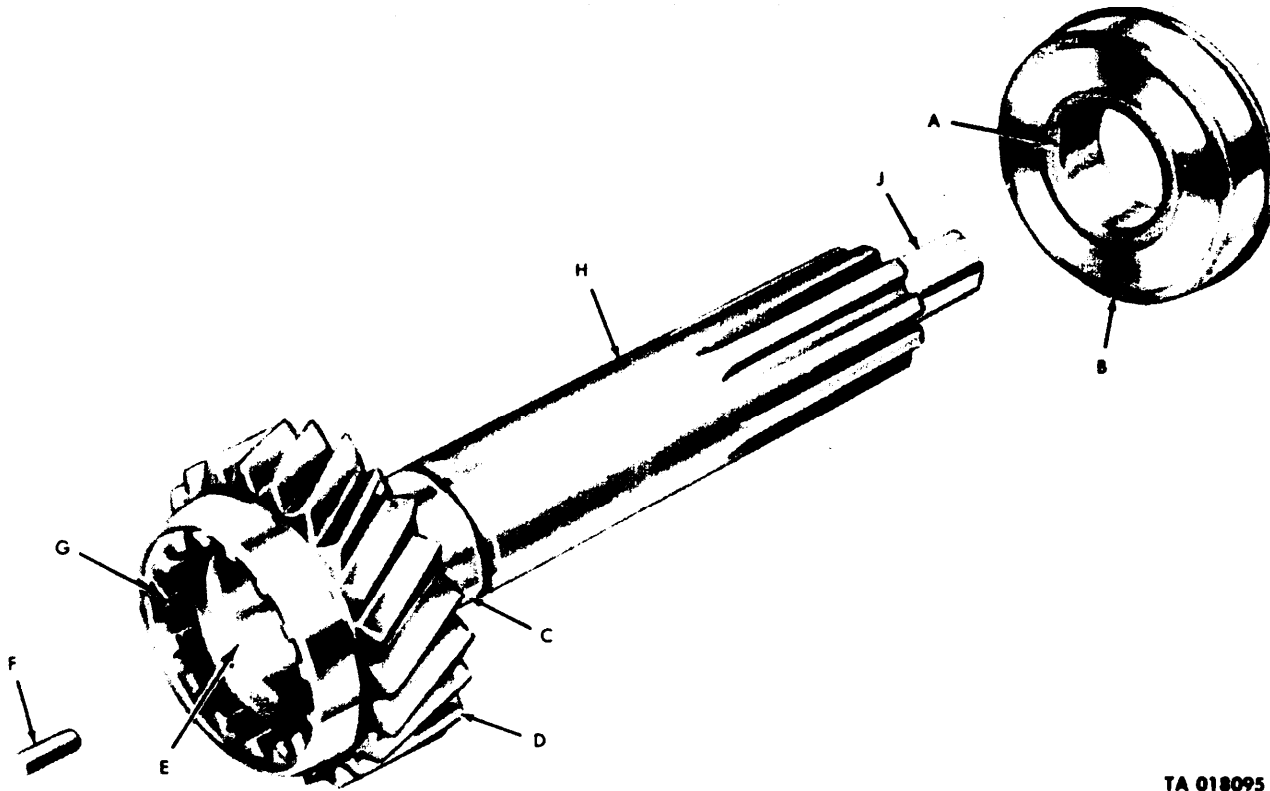
*a.* The wear limits are the same for transmission model 3052 and transmission model 3053A.

*b.* The repair and replacement standards included herein give the minimum, maximum, and key clearances of new parts. They also give wear limits which indicate the point to which a part or parts may be worn before replacement, in order to receive maximum service with minimum replacement. Normally, all parts which have not been worn beyond the dimensions shown in the "Wear Limits" column or damaged by corrosion will be approved for service. An asterisk (\*) in the "Wear Limits" column indicates

that the part or parts should be replaced when worn beyond the limits given in the "Size and Fit of New Parts" column. In the "Size and Fit of New Parts" column, the letter "L" indicates a loose fit (clearance) and the letter "T" indicates a tight fit (interference). A double asterisk (\*\*) in the "Wear Limits" column indicates that the part may be used by selective fitting as long as the resulting fit is within the tolerance specified. The letters GA in the "Size and Fit of New Parts" column mean gage.

**3-17. Repair and Replacement Standard Points of Measurement.** Figures 3-37, 3-48, 3-49, and 3-50 and corresponding tables 3-1, 3-2, 3-3, and 3-4 provide the repair and replacement points of measurement for transmission models 3052 and 3053A.



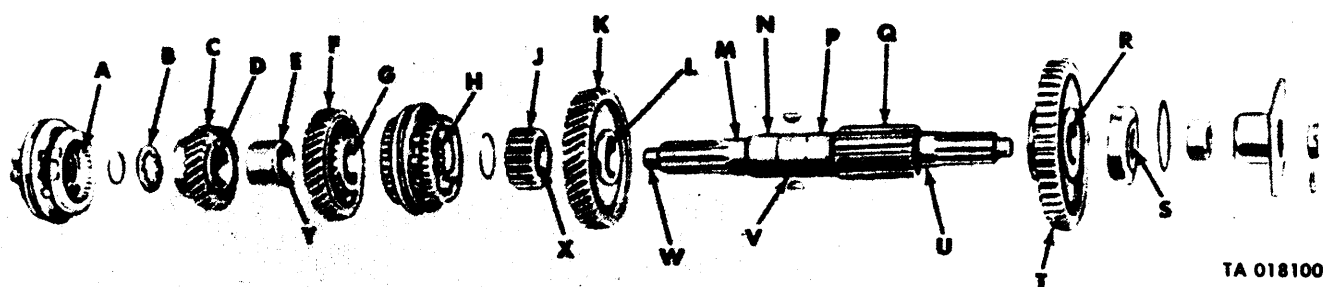


TA 018095

Figure 3-47. Repair and Replacement Standard Points of Measurement for Input Shaft and Bearing.

Table 3-1. Repair and Replacement Standard Points of Measurement for Input Shaft and Bearing

Fig. No.	Ref Letter	Point of Measurement	Size and Fit of New Parts	Wear Limits
3-47	A	Inside diameter of bearing	1.5748-1.5753	(*)
3-47	B	Outside diameter of bearing	3.5427-3.5433	(*)
3-47	C	Diameter of bearing journal	1.5748-1.5752	(*)
3-47	A-C	Fit of bearing on shaft	0.0005L-0.0004T	(*)
3-47	D	Input shaft to countershaft drive gear (backlash)	0.006-0.012	.016
3-49	N			
3-47	E	Inside diameter of bearing bore	1.7193-1.7198	.0008
3-47	F	Diameter of roller bearing	0.3123-0.3127	.0006
3-47	G	Fit of internal gear and fourth-fifth synchronizer	0.004-0.009	.018
3-47	H	Spline width	0.229-0.231	0.015
3-47	J	Pilot diameter	0.7465-0.7475	0.020

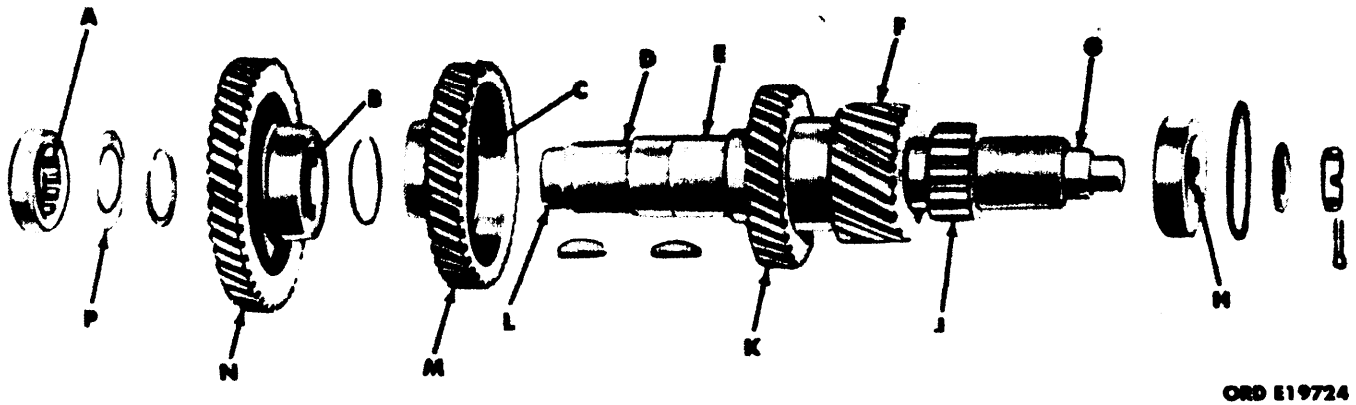


TA 018100

Figure 3-48. Repair and Replacement Standard Points of Measurement for Transmission Mainshaft Assembly.

Table 3-2. Repair and Replacement Standard Points of Measurement for Transmission Mainshaft Assembly

Fig. No.	Ref Letter	Point of Measurement	Size and Fit of New Parts	Wear Limits
3-48	A-M	Fit of synchronizer and shaft splines	.004L-.007L	.010L
3-48	B	Thickness of thrust washer	.150-.152	.010
3-48	C	Fifth gear to countershaft		
3-49	M	fifth gear (backlash)	.006L-.012L	.019L
3-48	D	Inside dia of fifth gear	2.1250-2.1255	.001
3-48	E	Outside dia of sleeve	2.1205-2.1210	.001
3-48	D-E	Fit of fifth gear on sleeve	0.004L-0.005L	.008L
3-48	F	Third gear to countershaft		
3-49	K	third gear (backlash)	.006L-.012L	.016L
3-48	G	Inside dia of third gear	1.9680-1.9685	.004
3-48	H-J	Fit of synchronizer and sleeve splines	.004L-.007L	.0106L
3-48	K	Second gear to countershaft		
3-49	F	second-reverse idler gear (backlash)	.006L-.012L	.019L
3-48	L	Inside diameter of second gear	2.0780-2.0785	(*)
3-48	M	Dia of shaft at journal	1.7500-1.7505	(*)
3-48	N	Dia of shaft journal	1.9640-1.9645	.004
3-48	G-N	Fit of third gear on shaft	0.0035L-0.0045L	.010L
3-48	P	Diameter of shaft journal	2.0740-2.0745	(*)
3-48	L-P	Fit of second gear on shaft	0.0035L-0.0045L	.010L
3-48	Q-R	Fit of first-reverse gear on shaft splines	.006L-.012L	.016L
3-48	S	Inside dia of bearing	1.5748	(*)
3-48	T	First-reverse gear to		
3-49	J	countershaft first gear (backlash)	.008L-.014L	.019L
3-48	T	First-reverse gear to reverse		
3-50	G	idler gear (backlash)	.008L-.014L	.019L
3-48	U	Dia of shaft journal	1.5746-1.5750	(*)
3-48	S-U	Fit of bearing on shaft	0.0002L-0.0002T	(*)
3-48	V	Dia of shaft journal	1.9688-1.9698	(*)
3-48	W	Dia of shaft journal	1.0908-1.0913	.001
3-48	X	Inside dia of synchronizer sleeve	1.9680-1.9685	(*)
3-48	X-V	Fit of synchronizer sleeve on shaft	0.003T-0.0018T	(*)
3-48	Y	Inside dia of sleeve	1.7495-1.750	(*)
3-48	M-Y	Fit of sleeve on shaft	0.000-0.001T	(*)
3-48	W	Fit of main shaft in		
3-47	F-E	bearing rollers, and input shaft	0.00261L-0.0044L	.0059L

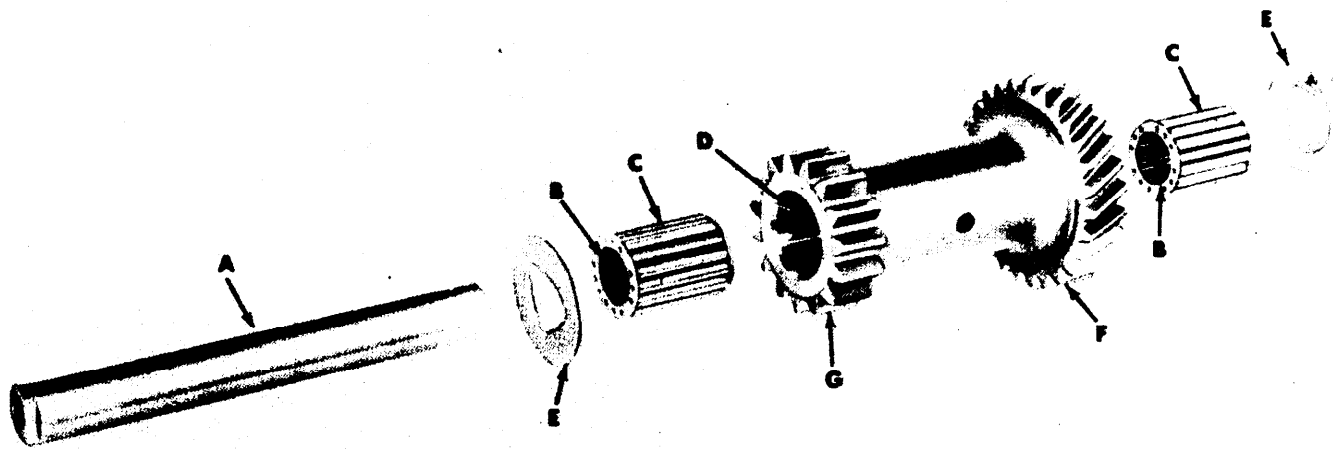


ORD E19724

Figure 3-49. Repair and Replacement Standard Points of Measurement for Transmission Countershaft and Gears.

Table 3-3. Repair and Replacement Standard Points of Measurement for Transmission Countershaft and Gears

Fig. No.	Ref Letter	Point of Measurement	Size and Fit of New Parts	Wear Limits
3-49	A	Inside diameter of bearing	1.7332-1.7337	.001
3-49	B	Inside diameter of drive gear	1.9995-2.0005	(*)
3-49	C	Inside diameter of fifth gear	2.2495-2.2505	(*)
3-49	D	Diameter of shaft journal	2.001-2.002	(*)
3-49	B-D	Fit of drive gear on shaft	0.0005T-0.0025T	(*)
3-49	E	Diameter of shaft journal	2.251-2.252	(*)
3-49	C-E	Fit of fifth gear on shaft	0.0005T-0.0025T	(*)
3-49	F	Second-reverse gear to mainshaft second gear (backlash)	.006-.012L	.019L
3-48	K	Second-reverse gear to reverse idler gear (backlash)	.006L-.012L	.019L
3-50	F	Reverse idler gear (backlash)	.006L-.012L	.019L
3-49	G	Diameter of journal on shaft	1.3788-1.3782	(*)
3-49	H	Inside diameter of bearing	1.3780	(*)
3-49	G-H	Fit of bearing on shaft	.0002L-.0002T	(*)
3-49	J	First gear to mainshaft first-reverse gear (backlash)	.008L-.014L	.019L
3-48	T	First-reverse gear (backlash)	.008L-.014L	.019L
3-49	K	Third gear to mainshaft third gear (backlash)	0.006L-0.0012L	.019L
3-48	F	Third gear (backlash)	0.006L-0.0012L	.019L
3-49	L	Diameter of journal on shaft	1.7317-1.7322	.002
3-49	A-L	Fit of bearing on shaft	.0005L-.0015L	(*)
3-49	M	Fifth gear to mainshaft fifth gear (backlash)	.006L-.012L	.019L
3-48	C	Fifth gear (backlash)	.006L-.012L	.019L
3-49	N	Drive gear to input shaft gear (backlash)	.006L-.012L	.019L
3-47	D	Drive gear to input shaft gear (backlash)	.006L-.012L	.019L
3-49	P	Thickness of thrust washer	16GA (.0598)	.007



TA 018101

Figure 3-50. Repair and Replacement Standard Points of Measurement for Transmission Reverse Idler Gear and Shaft Assembly

Table 3-4. Repair and Replacement Standard Points of Measurement for Transmission Reverse Idler Gear and Shaft Assembly

Fig. No.	Ref Letter	Point of Measurement	Size and Fit of New Parts	Wear Limits
3-50	A	Outside diameter of shaft	1.010-1.015	.0015
3-50	B	Inside diameter of bearing	1.0155	(*)
3-50	A-B	Fit of bearing on shaft	.0005L-.0015L	(*)
3-50	C	Outside diameter of bearing	1.5000	(*)
3-50	D	Inside diameter of gear	1.5005-1.5015	.007
3-50	C-D	Fit of bearing in gear	.0005L-0.0015L	.010
3-50	E	Thickness of thrust washer	0.091-0.093	#
3-50	F	Reverse idler gear to countershaft		
3-49	F	second-reverse gear (backlash)	0.006-0.012L	.016
3-50	G	Reverse idler gear to mainshaft		
3-48	T	first-reverse gear (backlash)	0.008L-0.014L	.019

# Replace when bronze is partially or completely worn off.



## CHAPTER 4 REPAIR OF TRANSFERS

### Section I. DESCRIPTION, OPERATION, AND DATA (MODEL T-136-27)

**4-1. General.** This chapter provides the repair instructions for positive locking transfer model T-136-27. (See fig. 4-1 and 4-2.)

#### 4-2. Description and Operation.

*a. Description.* The positive locking transfer is a two-speed synchromesh unit with front and rear output shafts. The transfer unit is driven by the regular 5-speed transmission through a propeller shaft. Low or high gear selection through the transfer gives the truck a total of ten forward gears, and two reverse gears. With the operation of an air selector valve (fig. 4-1), the air locking assembly engages the front output shaft to the rear output shaft to drive the front axle. The transfer distributes the power to front and rear axles through the propeller shafts. The handbrake drum is mounted in the transfer rear output shaft companion flange. (See fig. 4-2.) The handbrake inner

and outer brakeshoe and lever assembly is supported on the transfer rear output rear bearing cover.

*b. Operation.* The selection of high or low range in the transfer is accomplished by a shifting mechanism, which moves the synchronizer into contact with the input-shaft low-speed gear or the input-shaft high-speed gear. With positive locking engaged, power is distributed to front and rear axles when transmission is placed in the selected gear.

*(1) Low Range.* When the transfer is shifted to low range, the synchronizer assembly is moved forward on the input shaft to engage the input-shaft low-speed gear which is in mesh with the countershaft low-speed gear. Because the low-speed gear is keyed to the countershaft, the power flow is through the countershaft gears, to the rear (and front if lock-up assembly is engaged) output-shaft gears and to the companion flanges.

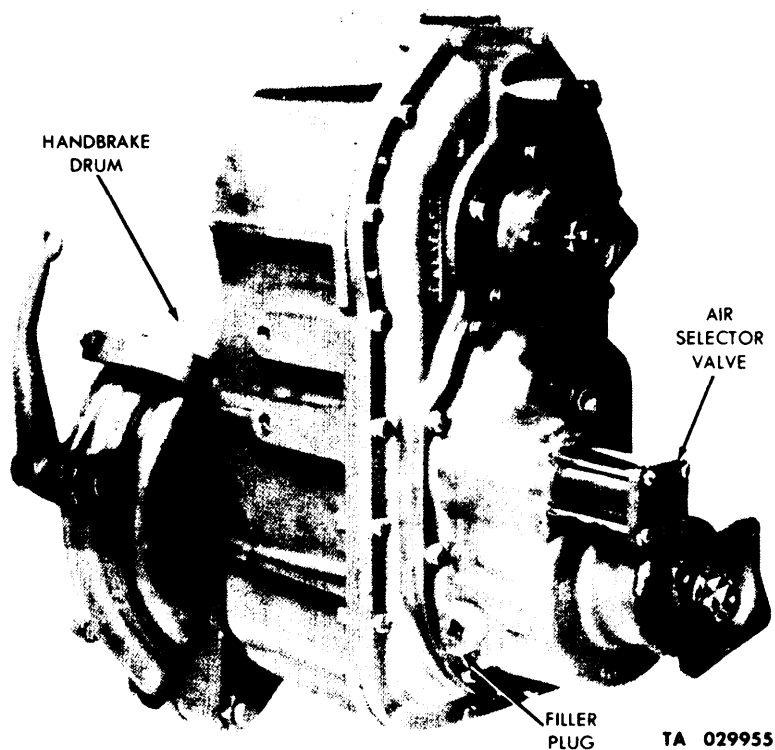


Figure 4-1. Positive Locking Transfer Model T-136-27 — Front View.

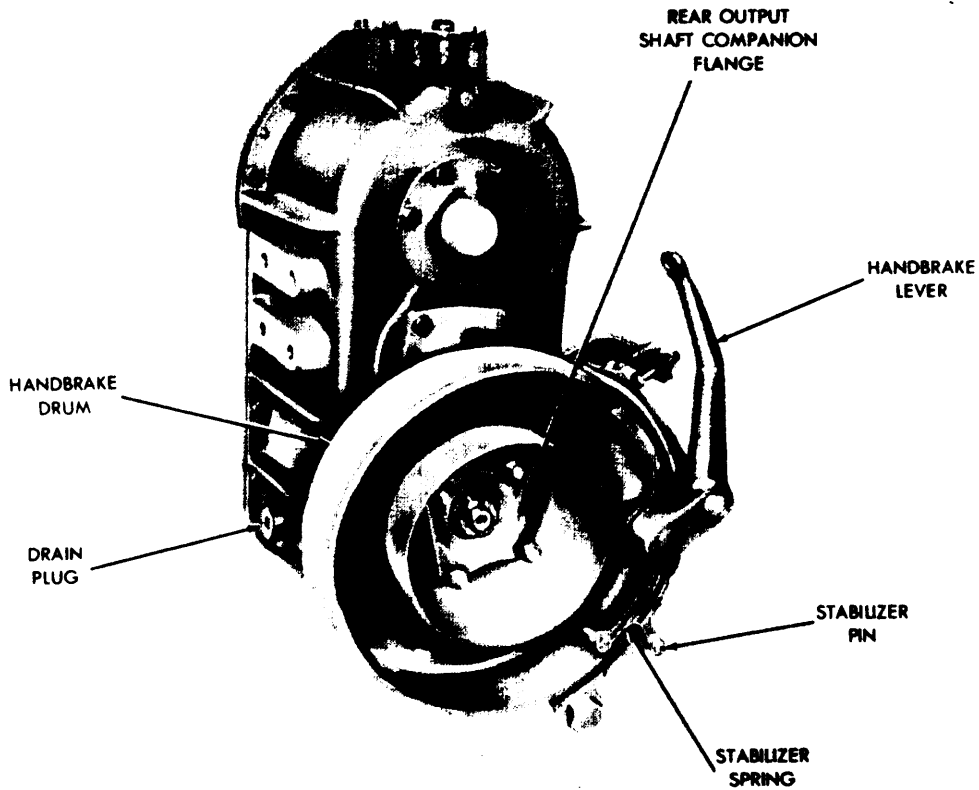
(2) *High Range.* When the transfer is shifted into high range, the synchronizer assembly is moved rearward on the input shaft to engage the input-shaft high-speed gear, which is in mesh with the countershaft high-speed gear. Because the high-speed gear is keyed to the countershaft, power flow is through the countershaft gears to the rear (and front, if lockup assembly is engaged) output shafts and gears.

(3) *Reverse.* When the transmission is shifted into reverse, the input shaft is turned in the opposite direction, and power is delivered to the rear (and front, if lockup assembly is engaged) axles, according to the range the transfer is in.

(4) *Neutral.* A neutral position is provided to allow operation of the gear train when no motion of the vehicle is desired.

**4-3. Data.**

National stock number . . . . .	2520-00-089-8287
Ordance number . . . . .	11609224
Model:	
Without power takeoff . . . . .	T-136-27
With power takeoff . . . . .	T-136-28
Type . . . . .	Two-speed synchromesh
Ratios to rear and front axles:	
Low . . . . .	1.980 to 1.000
High . . . . .	1.000 to 1.000
Lubricant capacity . . . . .	7 qt



AT 22993

Figure 4-2. Positive Locking Transfer Model T-136-27 — Rear

## Section II. REPAIR (MODEL T-136-27)

### 4-4. General.

a. This section contains disassembly and assembly procedures for transfer model T-136-27.

b. Clean, inspect, and follow repair procedures as stated in Chapter 2, section III of this manual.

c. Transfer disassembly is accomplished by the logical step-by-step procedures in paragraphs 4-5 and 4-6. Refer to paragraphs 4-7 and 4-8 for assembly procedures.

### 4-5. Disassembly of Transfer Into Subassemblies.

a. *Handbrake Drum and Shoe Assembly.* Remove the cotter pin (fig. 4-3) from the rear output shaft, front output shaft, and front input shaft. Engage input shaft gears in HI or LOW position. Attach shop air hose to transfer air cylinder. Apply air and engage front output shaft with rear output shaft. Apply the hand brake by hand, and remove the companion flange nuts and washers from the three shafts. Shut off shop air hose and remove the hose from the air cylinder. Disconnect and remove the shoe return spring. Remove the jamnut from the shoe anchor pin. Unscrew the anchor pin from the rear output shaft rear bearing retainer, do not lose washers. Slide the hand brake shoe assembly from the brakedrum. Pull the companion flange, brakedrum, and brake guard from the rear output shaft. (See fig. 4-5.) Remove the two capscrews and lockwashers securing the shoe stop bracket to the transfer case and remove bracket. (See fig. 4-3.)

#### NOTE

Apply white lead pigment. Fed Spec TT-W-261C, to the spline of the rear output shaft before installing hand brake drum and rear output shaft companion flange. Tighten nut to 300-400 lb-ft torque. Place washers on anchor pin to space brakeshoe so 1.16 inch of drum shows. Tighten pin until bind occurs when brake is applied, and back-off  $\frac{1}{8}$  turn. Tighten locknut to 153-196 lb-ft torque.

b. *Positioning of Transfer on Overhaul Stand.* Install transfer on overhaul stand using brackets (items 1 and 2, table 2-1). (See fig. 4-4.)

c. *Draining.* Remove transfer case magnetic drain plug (fig. 4-3) and front output shaft cover filler plug (fig. 4-4). inspect magnetic drain plug for chips.

#### NOTE

If chips are found, inspect in accordance with repair and replacement standards. (Refer to section V.)

### d. Companion Flanges.

#### NOTE

Apply a coating of white lead pigment. Fed Spec TT-W-261C, to input shaft spline before installing companion flange. Tighten flange nut to 300-400 lb-ft torque.

(1) Using a puller (item 4, table 2-1), remove input shaft companion flange. (See fig. 4-5.)

#### NOTE

Apply a coating of white lead pigment, Fed Spec TT-W-261C, to front output shaft spline before installing companion flange. Tighten flange nut to 300-400, lb-ft torque.

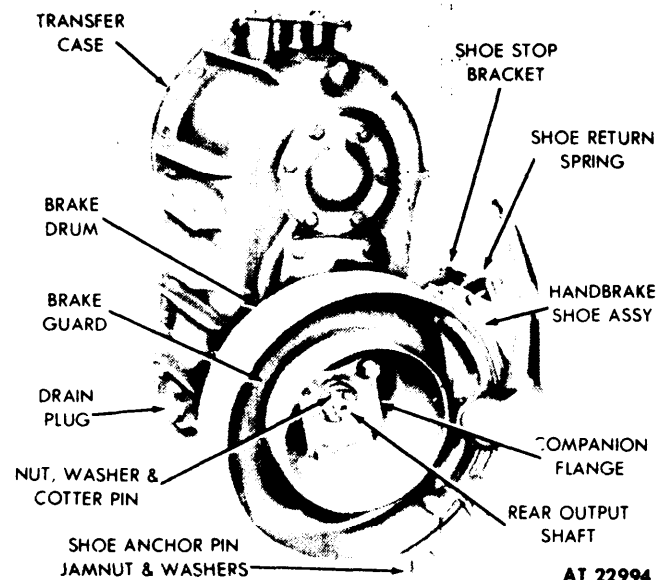


Figure 4-3. Removal of Handbrake Assembly.

(2) Using a puller (item 4, table 2-1) remove front output shaft companion flange.

### e. Air Cylinder.

#### NOTE

Reinstallation of air cylinder requires that cleaning, inspection and repair procedures be followed in Chapter 2, section III of this manual.

#### NOTE

To eliminate air leaks, install new gaskets and rubber seal. Make certain that the air cylinder tube cover is tightened evenly when reinstalled. Tighten screws to 5-9 lb-ft torque.



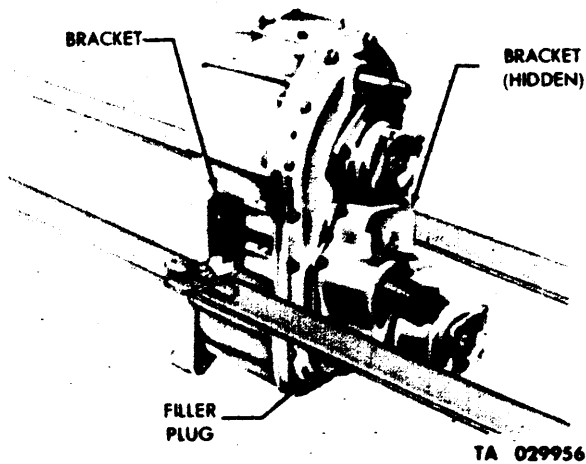


Figure 4-4. Transfer Mounted on Stand.

Remove screws and key washers attaching air cylinder assembly to drive output case. Lift and remove air tube cover. Slide air tube away from cylinder piston. Remove nut and washers that connect air piston to shifter. Remove piston and rubber seal, leaving clutch shaft in place. (See fig. 4-6.)

f. Front Output Shaft Case.

NOTE

When assembling, install new gasket and tighten capscrews to 45-55 lb-ft torque.

Remove 10 capscrews and lockwashers securing the front output shaft case to the transfer case cover. (See fig. 4-7.) Install puller screws into the two puller screw holes in the flange of the front output shaft

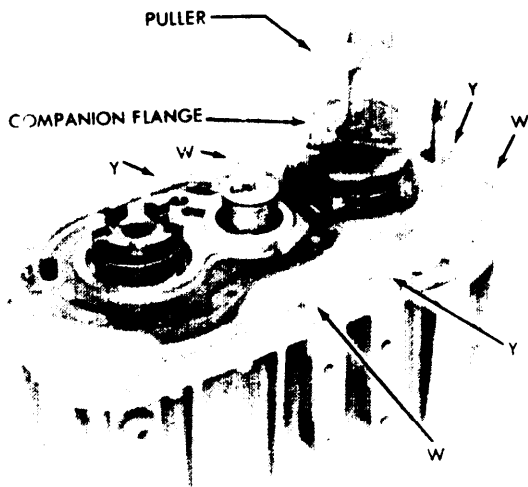


Figure 4-5. Companion Flange Removal.

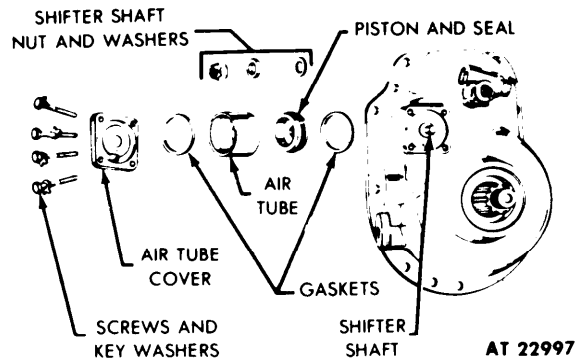


Figure 4-6. Air Cylinder Disassembly.

case. Pull the case assembly from the dowel pins on the transfer case cover. Remove puller screws and discard gasket.

g. Input Shaft Front Bearing Cover.

NOTE

When assembling, install new gasket and tighten capscrews to 60-77 lb-ft torque.

Remove the five capscrews and lockwashers from the input shaft bearing cover; remove cover and gasket. (See fig. 4-7.) Using a suitable tool, remove the oil seal from the cover. Remove outer thrust washer from input shaft.

h. Front Output Shaft.

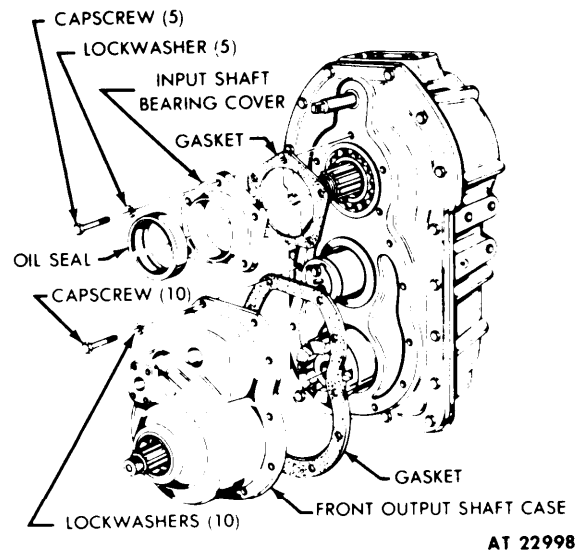


Figure 4-7. Front Output Shaft Case and Input Shaft Bearing Cover.

**NOTE**

Follow procedures for cleaning and inspection as outlined in Chapter 2, section III of this manual.

**NOTE**

When assembling, tighten setscrew to 90-118 lb-ft torque. Remove front output shaft, sliding clutch, shifter fork, shifter shaft, shifter shaft spring, and retainer from front output shaft case. (See fig. 4-8.) Remove safety wire, loosen setscrew, and remove shifter shaft from shifter fork.

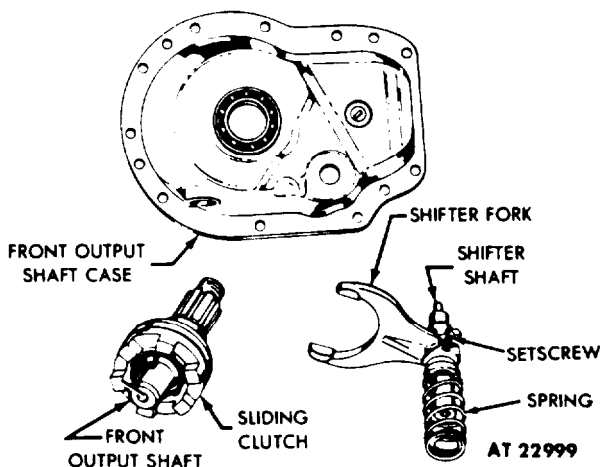


Figure 4-8. Front Output Shaft and Shifter Assembly

i. Front Output Clutch.

**NOTE**

When assembling, tighten setscrew to 45-57 lb-ft torque and install safety wire.

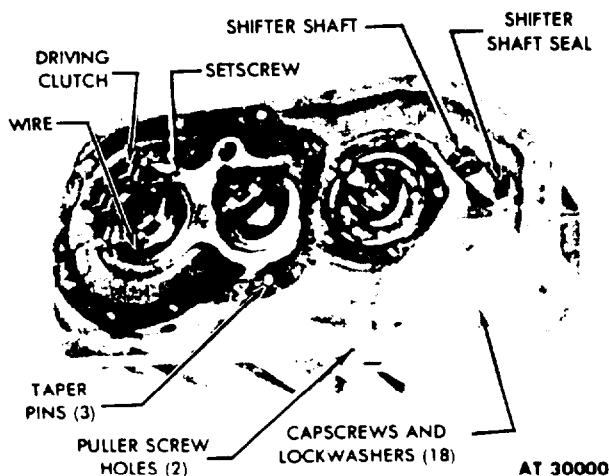


Figure 4-9. Front Output Clutch Drive and Case Cover.

Remove safety wire from clutch setscrew. Loosen clutch setscrew and slide clutch from rear output shaft. (See fig. 4-9.)

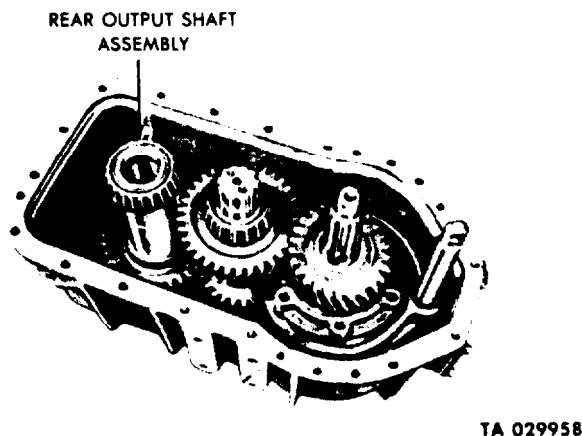


Figure 4-10. Rear Output Shaft Assembly

j. Case Cover.

**NOTE**

Take care not to damage or lose taper pins during removal; they are nonsupply items which must be fabricated if lost or damaged. Case and cover are a matched set, mark both parts to retain identity for assembly. Install taper pins and new gasket. Aline case cover with taper pins, and tighten nut and capscrews evenly and alternately. Tighten screws (indicated by Y and W, fig. 4-5) to 60-77 lb-ft torque. Tighten remaining 12 screws to 67-87 lb-ft torque.

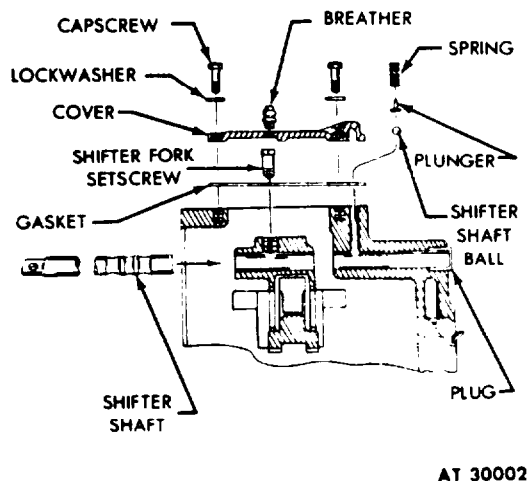


Figure 4-11. Top Cover and Shifter Shaft

**NOTE**

Follow procedures for cleaning and inspection as outlined in Chapter 2, section III of this manual.

**NOTE**

When assembling, tighten setscrew to 90-118 lb-ft torque. Remove front output shaft, sliding clutch, shifter fork, shifter shaft, shifter shaft spring, and retainer from front output shaft case. (See fig. 4-8.) Remove safety wire, loosen setscrew, and remove shifter shaft from shifter fork.

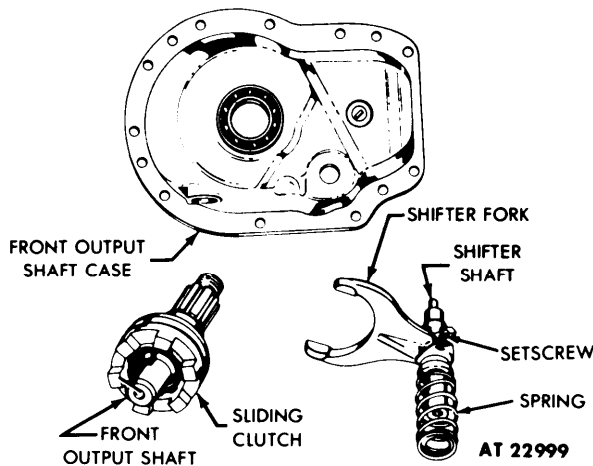


Figure 4-8. Front Output Shaft and Shifter Assembly

i. Front Output Clutch.

**NOTE**

When assembling, tighten setscrew to 45-57 lb-ft torque and install safety wire.

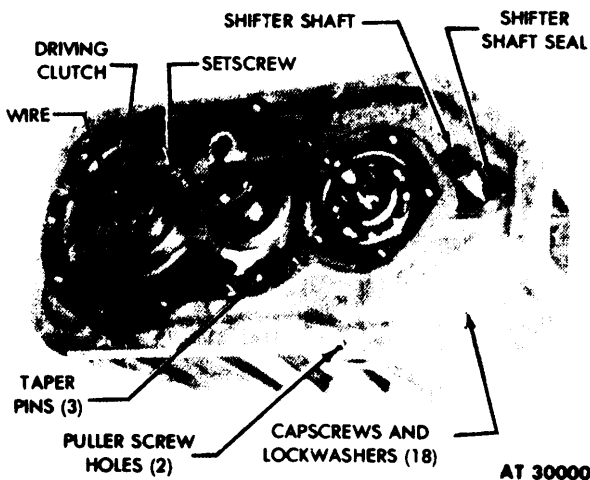


Figure 4-9. Front Output Clutch Drive and Case Cover.

Remove safety wire from clutch setscrew. Loosen clutch setscrew and slide clutch from rear output shaft. (See fig. 4-9.)

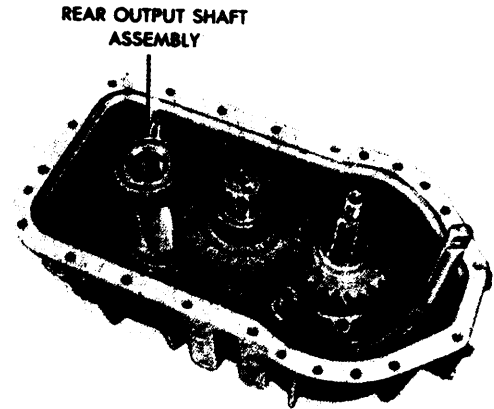


Figure 4-10. Rear Output Shaft Assembly.

j. Case Cover.

**NOTE**

Take care not to damage or lose taper pins during removal; they are nonsupply items which must be fabricated if lost or damaged. Case and cover are a matched set, mark both parts to retain identity for assembly. Install taper pins and new gasket. Aline case cover with taper pins, and tighten nut and capscrews evenly and alternately. Tighten screws (indicated by Y and W, fig. 4-5) to 60-77 lb-ft torque. Tighten remaining 12 screws to 67-87 lb-ft torque.

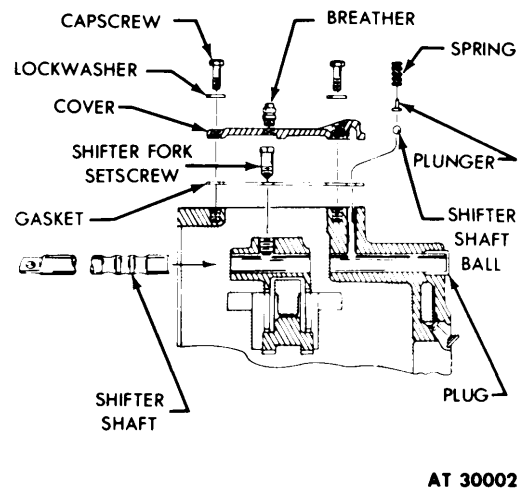


Figure 4-11. Top Cover and Shelter Shaft.

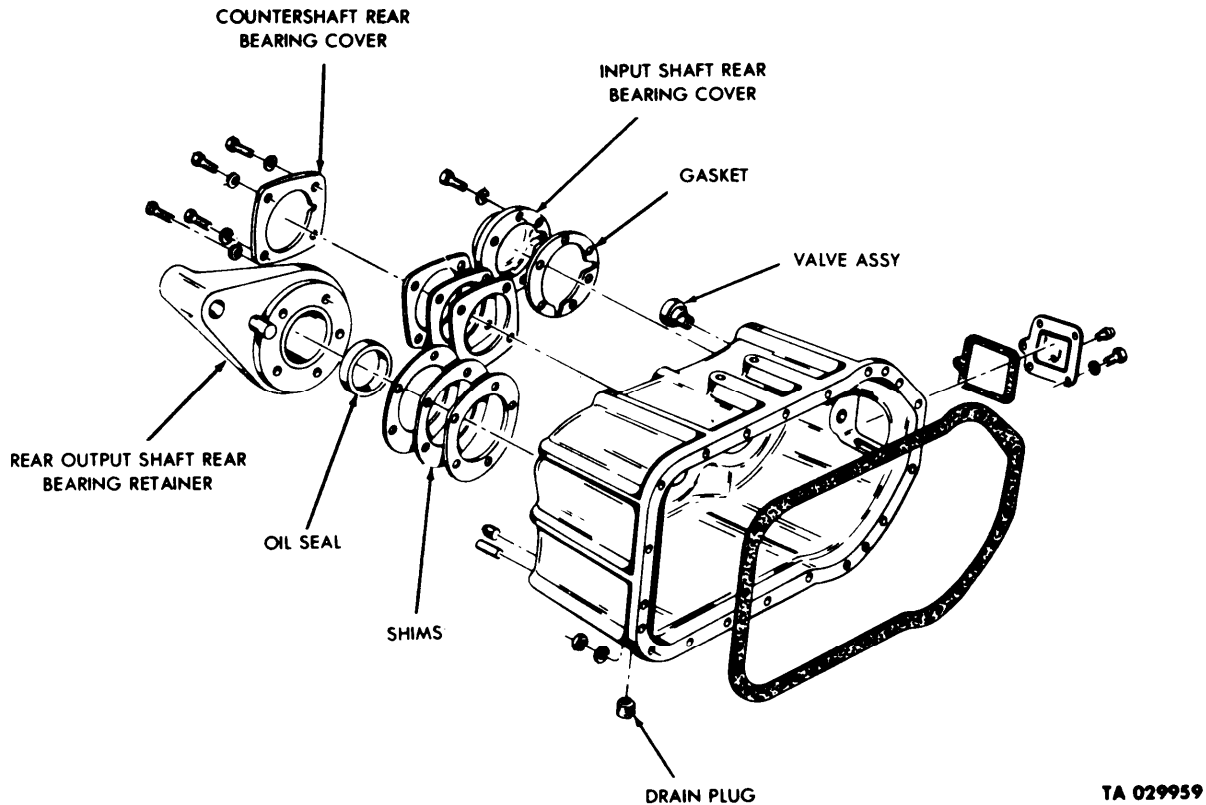


Figure 4-12. Bearing Covers and Case Plug.

Remove the 18 capscrews, nuts, and lockwashers securing the case cover to the case. (See fig. 4-9.) Install puller screws in the two puller screw holes located in the flange of the case cover. If necessary, tap on the end of the input shaft and the end of the shifter shaft with a mallet. Lift the cover assembly from the case. Remove and discard the gasket. Remove the inner thrust washer from the input shaft. Remove the shifter shaft seal.

k. *Rear Output Shaft Assembly.* With the case cover removed, lift the rear output shaft assembly from the transfer case. (See fig. 4-10.)

l. *Top Cover and Shelter Shaft.*

**NOTE**

During assembly, use new gasket and install new safety wire. Tighten setscrew to 90-118 lb-ft torque.

Remove the four capscrews and lockwashers securing top cover to the transfer case. (See fig. 4-11.) Remove the top cover and top cover gasket. Discard the gasket. Remove the shifter shaft spring, plunger, and ball. Using a pair of wire cutters, remove the

safety wire from the fork setscrew. Remove the setscrew, then remove the shifter shaft from the fork assembly. Check the breather assembly. Remove and clean or replace it, as necessary.

m. *Countershaft Rear Bearing Cover.*

**NOTE**

During assembly, tighten countershaft rear bearing capscrews to 60-77 lb-ft torque. Use shims to obtain 0.002- to 0.005-inch end play. The shims are provided as a set. The part number for the set is 7521437; the part numbers for shim sizes are:

Ordinance No.	Thickness
7521441	.003 ± .0005
7521446	.005 ± .0005
7521447	.010 ± .001

Remove the four capscrews and lockwashers securing the countershaft rear bearing cover to the transfer case. (See fig. 4-12.) Remove cover and rear bearing shims.

n. *Rear Output Shaft Rear Bearing Retainer.*

**NOTE**

During assembly, tighten the rear output shaft rear bearing retainer capscrews to 60-77 lb-ft torque. Use shims to obtain 0.002- to 0.005-inch end play. The shims are provided as a set. The part number for the set is 7521437. The part numbers and shim sizes are:

Ordance No.	Thickness
7521277	.003 ± .001
7521278	.005 ± .001
7521279	.010 ± .001

Remove the six capscrews and lockwashers securing the rear output shaft rear bearing retainer to the transfer case. (See fig. 4-12.) Remove bearing retainer and shims from the rear output shaft bearing retainer.

o. *Input Shaft Rear Bearing Cover.*

**NOTE**

During assembly, install a new gasket. Tighten capscrews to 60-77 lb-ft torque.

Remove the six capscrews and lockwashers securing the input shaft rear bearing cover to the transfer case. (See fig. 4-12.) Remove rear bearing cover and gasket; discard the gasket.

p. *Shifter Fork, Input Shaft Assembly and Countershaft Assembly.* Using a soft pin and hammer, drive the input shaft loose. (See fig. 4-13.) Then lift the input shaft assembly, synchronizer assembly, fork assembly, and countershaft assembly from the transfer case.

q. *Transfer Case Shifter Shaft Plug and Valve Assembly.* Using a suitable tool, remove the shifter

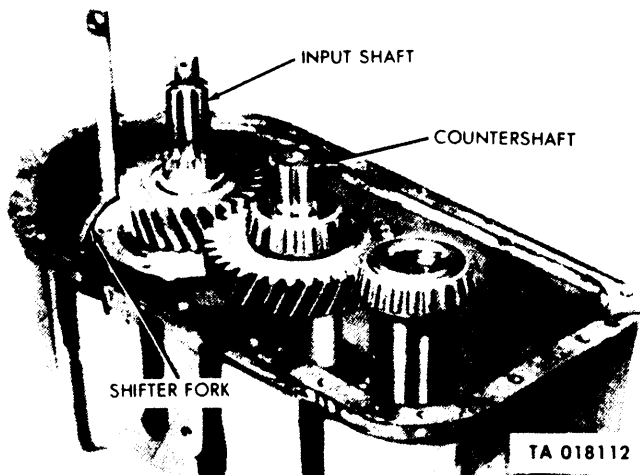


Figure 4-13. Shifter Fork, Input Shaft, and Countershaft.

shaft plug (fig. 4-11). Remove valve assembly (fig. 4-12) from PTO flange.

**NOTE**

On assembly, install the valve with spring toward inside of case.

**4-6. Disassembly of Subassemblies.**

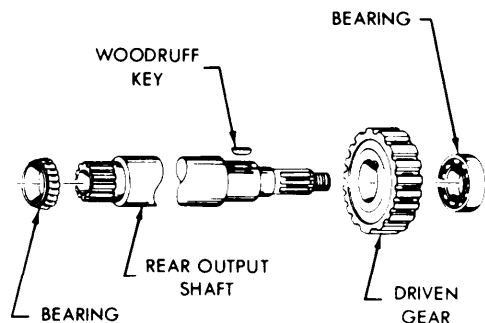
a. *Rear Output Shaft Disassembly and Assembly.*

**NOTE**

Before pressing the gear and bearings on rear output shaft, coat shaft with white lead pigment, Fed Spec TT-W-261C. When assembling the rear output shaft assembly, install the parts separately, so as not to damage front and rear bearings.

(1) Place rear output shaft assembly (fig. 4-14) in an arbor press with front tapered roller bearing cone up. Place support bars beneath the cone. Press shaft from cone.

(2) Place rear output shaft assembly (fig. 4-14) in an arbor press with the rear output shaft driven gear up. Place support bars beneath the rear output shaft driven gear and press shaft free of the gear. Removal of the rear output shaft driven gear in this manner will also push the rear output shaft rear bearing from the shaft. Remove the woodruff key from the shaft.



AT 23776

Figure 4-14. Rear Output Shaft Disassembly — Exploded View.

b. *Countershaft Disassembly and Assembly.*

**NOTE**

Before pressing the gears and bearings on countershaft, coat shaft with white lead pigment, Fed Spec TT-W-261C. When assembling the countershaft assembly, install parts separately so as not to damage front and rear bearings. Discard old capscrew locking plates and replace with new.

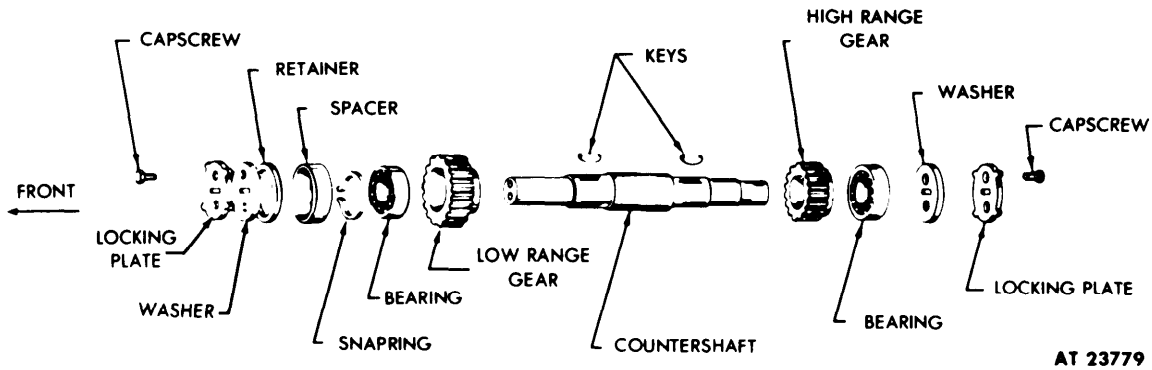


Figure 4-15. Countershaft Disassembly — Exploded View.

(1) Using a suitable tool, bend the front and rear locking plate ears away from capscrews and remove capscrews, locking plates, washers, and spacer (front only). (See fig. 4-15.)

(2) Place countershaft in a press with the countershaft high range gear (fig. 4-15) and rear bearing up. Place support bars beneath the high range gear and rear bearing. Remove woodruff key.

(3) Place the countershaft assembly in an arbor press with the low range gear (fig. 4-15) and front bearing up. Place support bars beneath the low range gear. Press shaft from countershaft low range gear and front bearing. Snapping and retainer is removed with transfer case cover. Remove woodruff key.

c. Input Shaft Disassembly and Assembly.

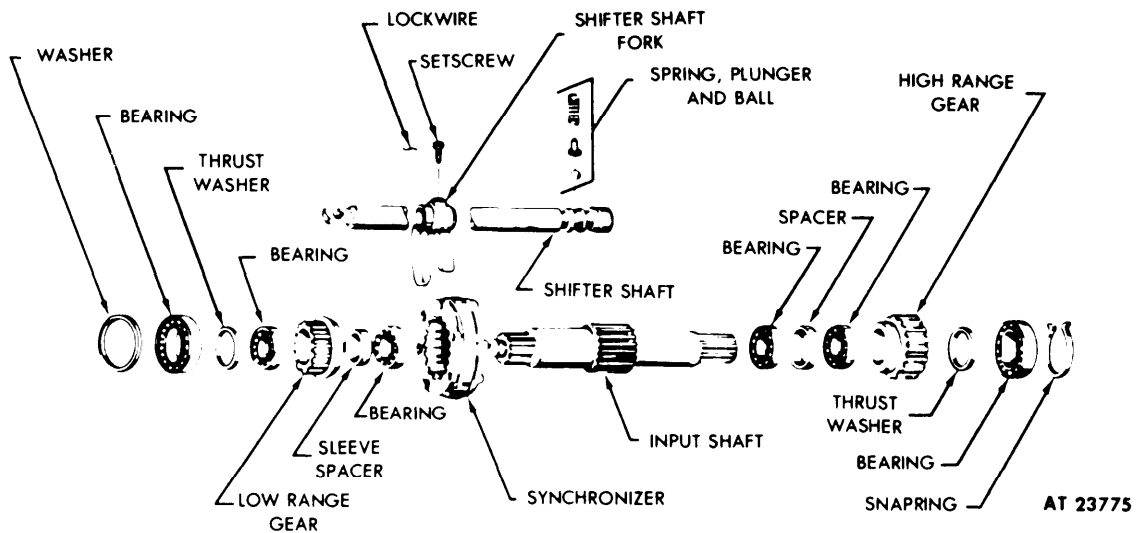


Figure 4-16. Input Shaft Disassembly — Exploded View.

**NOTE**

Visually inspect synchronizer assembly for broken, nicked, or worn gear teeth. If any of these conditions prevail, the synchronizer must be replaced. For replacement, use synchronizer part number 7346755.

**NOTE**

Before pressing bearings into gears, and gears onto the input shaft, coat all installation surfaces with white lead pigment, Fed Spec TT-W-261C.

(1) Remove shifter fork from synchronizer assembly. (See fig. 4-16.)

(2) Remove input shaft rear bearing snapping (fig. 4-16) from the end of input shaft. Place input shaft assembly in arbor press with rear bearing and high range gear up. Install a suitable puller (item 4, table 2-1) around input shaft high range gear. Removal of high range gear in this manner will push the gear bearings, spacer, thrust washer, and rear bearing from the input shaft.

(3) Place the high range gear in an arbor press and press high range gear ball bearings and spacer from bore of the high range gear. Apply pressure to the inner race of the bearing only. (See fig. 4-16.)

(4) Slide synchronizer assembly from input shaft. (See fig. 4-16.)

(5) Place input shaft assembly (fig. 4-16) in arbor press, low range gear up. Place support bars beneath the low range gear and press shaft from input shaft low range gear, gear bearings, spacer, and thrust washer (if still installed).

(6) Place input shaft low range gear (fig. 4-16) in a press, and press low range gear bearings and spacer from input shaft low range gear. Apply pressure to the inner race of bearing only.

*d. Transfer Case Cover.*

**NOTE**

When installing input shaft front bearing, apply pressure on the outer race of the bearing only. Also, replace shifter shaft oil seal.

(1) Press input shaft front bearing and snapping (fig. 4-17) from the front cover using suitable remover and replacer (item 6, table 2-1).

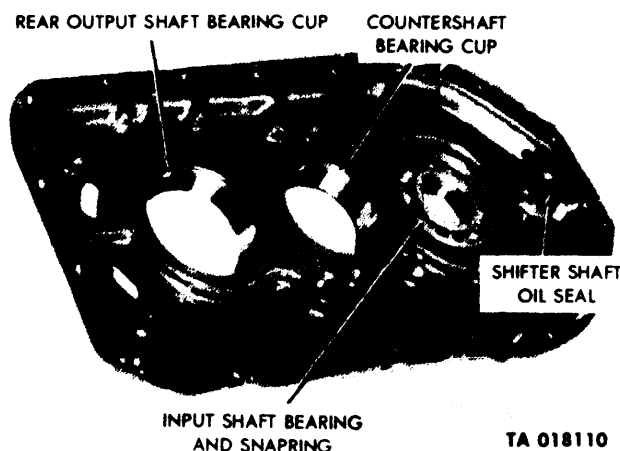


Figure 4-17. Transfer Case Cover Disassembly.

(2) Using a suitable tool, remove the shifter shaft oil seal (fig. 4-17) from cover.

(3) Remove snapping and press countershaft front bearing cup from the front cover using a suitable remover and replacer. (See fig. 4-18.)

(4) Remove snapping and press rear output shaft bearing cup (fig. 4-17) from the front cover using a suitable remover and replacer.

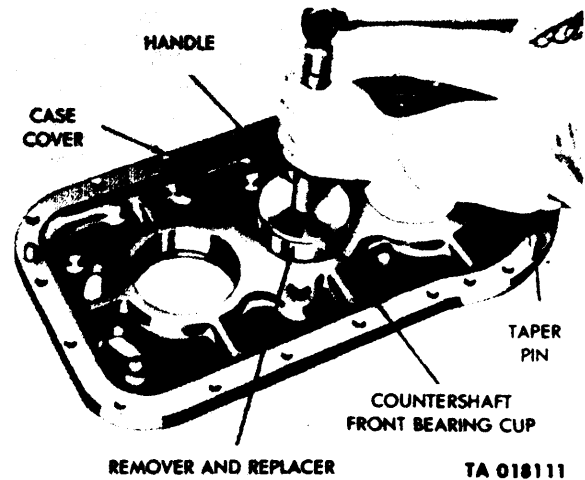


Figure 4-18. Remover and Replacer with Handle.

*e. Front Output Shaft Cover.*

**NOTE**

Coat output shaft and oil seals with a universal gear lubricant (GO), MIL-L-2105, before assembling to prevent damage to seals.

Remove front output shaft oil seal snapping. (See fig. 4-19.) To remove seal from cover, place in press and press against front bearing thrust washer.

*f. Transfer Case.*

**NOTE**

When pressing bearing cups back in transfer case, be sure that bearing cups are not cocked, because damage to bearing cups and transfer case might result.

Remove countershaft and rear output shaft bearing cups from the transfer case, using suitable remover and replacer (item 6, table 2-1). (See fig. 4-20.)

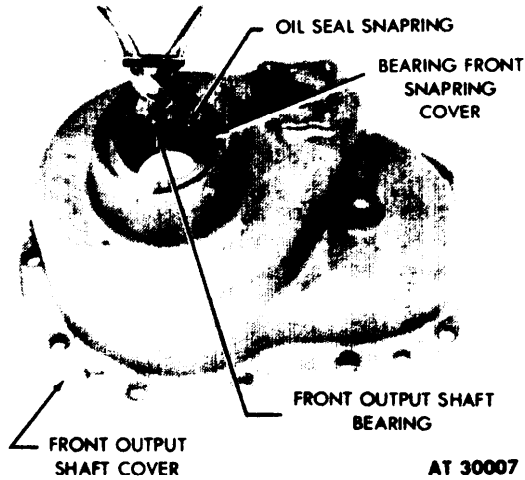
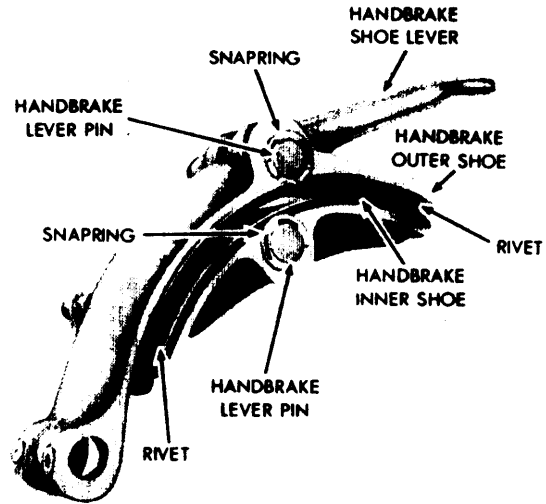


Figure 4-19. Front Output Shaft Cover Disassemble.



TA 018114

g. Handbrake Shoe Assembly.

**NOTE**

Sometimes the handbrake shoes are not worn enough to warrant replacement. Replace lining when worn to within 1/16 inch of rivet head. Worn shoe linings can result in injury to personnel and damage to vehicle. Refer to TM 9-2320-209-20/1 for adjustment.

- (1) Remove the two snaprings holding the handbrake lever pins in position. (See fig. 4-21.)
- (2) Remove the two slotted washers holding the stabilizer spring in position and remove the brake stabilizer spring and pin.
- (3) Remove the handbrake shoe lever and lever pins. (See fig. 4-21.)

**WARNING**

Replacement brakeshoes must be drilled for rivet holes. Be sure to wear a mask to prevent asbestos dust particles from entering lungs. Drilling must be done in a well-ventilated area away from unprotected personnel. Eyeshields must also be worn during drilling operation. Failure to observe these precautions may result in injury to personnel.

- (4) If replacement is necessary, remove the sixteen (16) rivets securing the lining to the inner and outer brakeshoes of the handbrake assembly. (See fig. 4-21.)

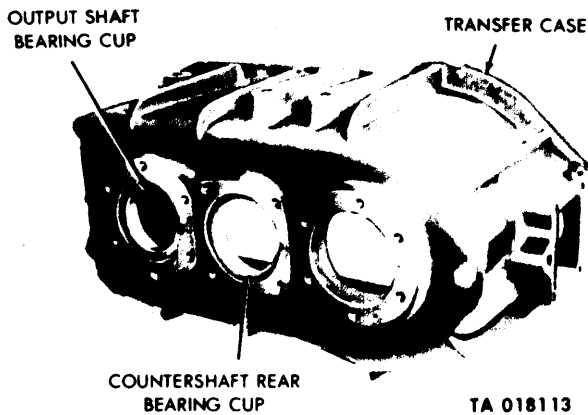


Figure 4-20. Transfer Case Disassembly.

**4-7. Assembly of Subassemblies (Sequence).**

- a. Hand brake (fig. 4-21).
- b. Transfer case (fig. 4-20).
- c. Front output shaft cover (fig. 4-19).
- d. Transfer case cover (fig. 4-17 and 4-18).
- e. Input shaft (fig. 4-16).
- f. Countershaft (fig. 4-15).
- g. Rear output shaft (fig. 4-14).



**4-8. Assembly of Transfer (Sequence).**

*a.* Transfer case shifter shaft plug and valve assembly. (See figs 4-11 and 4-12.)

*b.* Shifter fork, input shaft assembly, and countershaft assembly. (See fig. 4-13.)

*c.* Input shaft rear bearing cover. (See fig. 4-12.)

*d.* Rear output shaft rear bearing retainer. (See fig. 4-12.)

*e.* Countershaft rear bearing cover. (See fig. 4-12.)

*f.* Top cover and shifter shaft. (See fig. 4-11.)

*g.* Rear output shaft. (See fig. 4-10.)

*h.* Case cover. (See fig. 4-9.)

*i.* Front output clutch. (See fig. 4-9.)

*j.* Front output shaft. (See fig. 4-8.)

*k.* Input shaft front bearing cover. (See fig. 4-7.)

*l.* Front output shaft case. (See fig. 4-7.)

*m.* Air cylinder assembly. (See fig. 4-6.)

*n.* Companion flanges. (See fig. 4-5.)

*o.* Draining transfer. (See fig. 4-4.)

*p.* Positioning transfer on overhaul stand. (See fig. 4-4.)

*q.* Handbrake drum and shoe assembly. (See fig. 4-3.)

**Section III. TEST AND ADJUSTMENT (MODEL T-136-27)**

**4-9. General.** This section provides for the tests and adjustments of transfer model T-136-27.

**4-10. Lubrication.** Tighten drain plug (fig. 4-2). Lay transfer on side with filler plug up. Remove filler plug and pour ½ pint of universal gear lubricant (GO), MIL-L-2105, through the plug opening. Install and tighten filler plug. Lubrication of the complete unit should be accomplished after installation. Attach a tag to filler plug giving instructions for filling before transfer is placed in service. Refer to paragraph 4-3 for transfer data and lubrication order (LO 9-2320-209-12/1) for lubrication specifications.

**4-11. Shift Test.**

*a. Neutral.* Place shifter shaft in neutral position (between low, shifter shaft out, and high, shifter shaft in). Turn input shaft by hand. Front and rear output shafts should not turn.

*b. High.* Push shifter shaft in to shift to high position. Turn input shaft in clockwise direction. Rear output shaft should revolve in same direction. Front output shaft should not turn.

*c. Low.* Pull shifter shaft out to shift to low position. Turn input shaft by hand and note if rear output shaft turns approximately one-half as fast as

when in high position (step b). Front output shaft should not turn.

*d. Front Output Shaft Air Lockup.* Apply air pressure, check for sound of lock engaging. Repeat steps b and c, both output shafts should turn. Remove air pressure and repeat step b. Front output shaft should be disengaged.

**4-12. Handbrake Test.** Pull handbrake lever (fig. 4-2) to engage brakeshoes with handbrake drum. Release lever and note if shoe return spring pulls shoes free of drum. For in-vehicle handbrake lever adjustment, refer to TM 9-2320-209-20/1.

**4-13. Handbrake Shoe Adjustment.**

*a.* If shoes do not clear brakedrum (para 4-12) check adjustment of shoe anchor pin. (See fig. 4-3.) If outer shoe is free on anchor pin, tighten bolt in shoe stop bracket to increase shoe-to-drum clearance. For in-vehicle adjustment, refer to TM 9-2320-209-20/1.

*b.* To ensure brakeshoe assembly is correctly positioned on brakedrum, use spacer washers between brakeshoe assembly and rear bearing cover to obtain 1/16-inch of brakedrum extending beyond brakeshoe assembly.

**4-14. Countershaft Rear Bearing Adjustment.**

a. Use shims in combination to obtain 0.002- to 0.005-inch end play.

b. The shims are provided as a set. The part number for the set is 7521437. The part numbers and shim sizes are:

Ordance No.	Thickness
7521441	.003 ± .0005
7521446	.005 ± .0005
7521447	.010 ± .001

**4-15. Rear Output Shaft Rear Bearing Adjustment.**

a. Use shims in combination to obtain 0.002- to 0.005-inch end play.

b. The shims are provided as a set. The part number for the set is 7521437, the part numbers for shim sizes are:

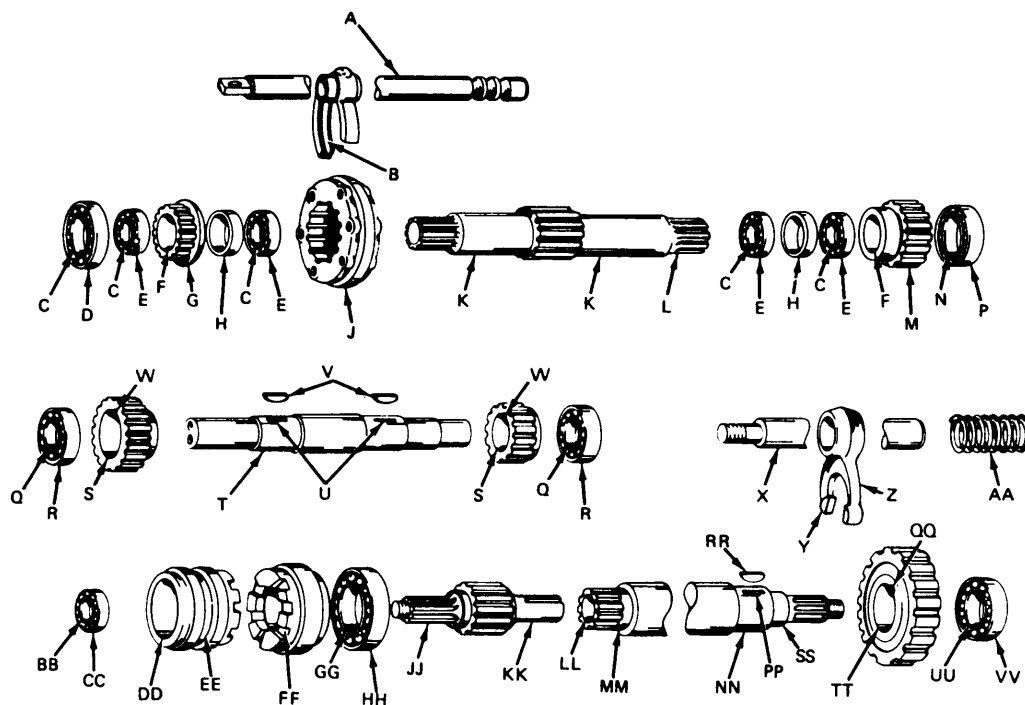
Ordance No.	Thickness
7521277	.003 ± .001
7521278	.005 ± .001
7521279	.010 ± .001

**Section IV. REPAIR AND REPLACEMENT STANDARDS  
(MODEL T-136-27)**

**4-16. General.** The repair and replacement standards included herein provide the minimum, maximum, and key clearances of new parts. (See fig. 4-22, 4-23, 4-24, and 4-25 and corresponding tables 4-1, 4-2, 4-3, and 4-4.) Standards also provide wear limits which indicate the point to which a part or parts may be worn before replacement is required, in order to receive maximum service with minimum replacement. Normally, all parts which have not been worn beyond the dimensions shown in the "Wear Limits" column, or damaged by corrosion, will be approved for service. An asterisk (\*) in the "Wear

Limits" column indicates that the part or parts should be replaced when worn beyond the limits given in the "Size and Fit of New Parts" and "Wear Limits" columns. In the "Size and Fit of New Parts" and "Wear Limits Columns", the letter "L" indicates a loose fit (clearance) and the letter "T" indicates a tight fit (interference).

**4-17. Repair and Replacement Standard Points of Measurement.** Figures 4-22, 4-23, 4-24, and 4-25 and corresponding tables 4-1, 4-2, 4-3, and 4-4 provide the repair and replacement standard points of measurement for transfer model T-136-27.



AT 23780

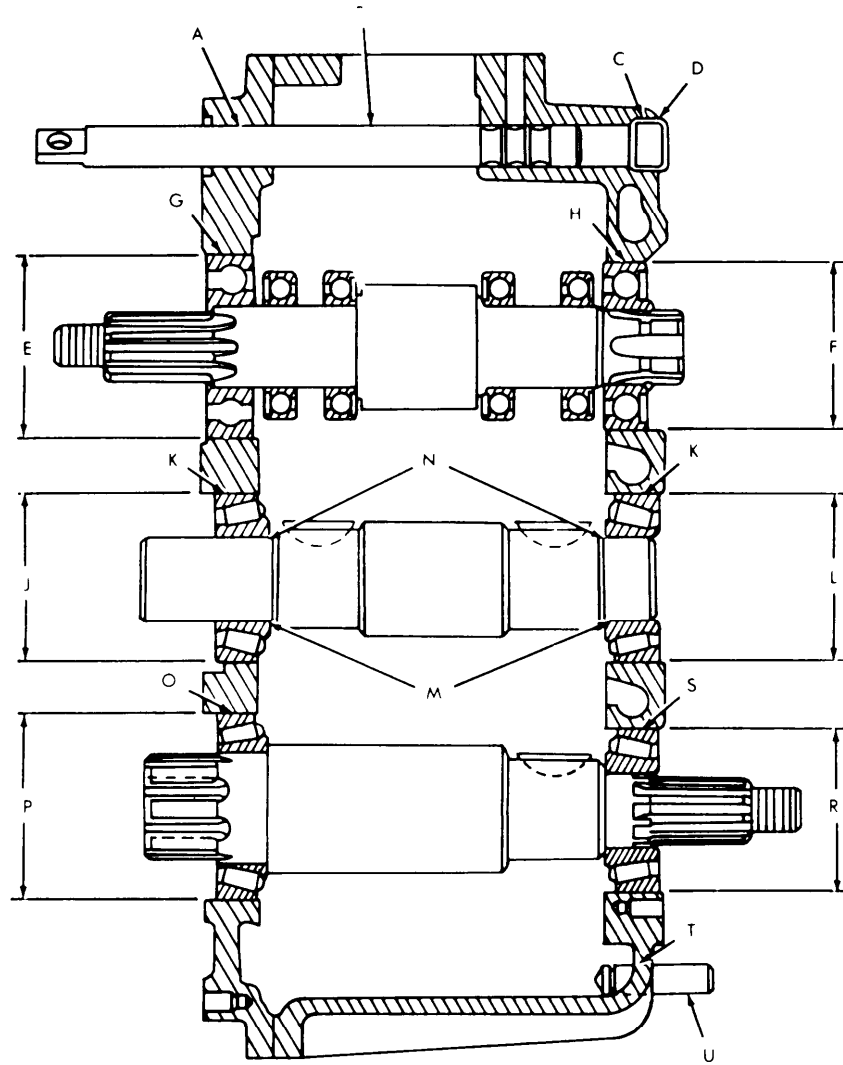
Figure 4-22. Repair and Replacement Standard Points of Measurement for Transfer Gear Train.

Table 4-1. Repair and Replacement Standard Points of Measurement for Transfer Gear Train

Fig. No.	Ref Letter	Point of Measurement	Size and Fit of New Parts	Wear Limits
4-22	A	Low range shifter shaft outside diameter	0.9945-0.9955	(*)
4-22	B	Shifter fork groove width	0.712-0.720	0.7400
4-22	C	Bearing inside diameter	1.9680-1.9685	(*)
4-22	D	Bearing outside diameter	4.3301-4.3307	(*)
4-22	E	Bearing outside diameter	3.5427-3.5433	(*)
4-22	F	Low range input gear bore	3.5425-3.5434	3.5439
4-22	E-F	Fit of bearing in gear bore	0.0007T-0.0009L	0.0012L
4-22	G	Low range input gear outside diameter	5.3255-5.3265	(*)
4-22	H	Spacer sleeve inside diameter	1.979-1.989	(*)
4-22	J	Clutch ring width	0.682-0.687	0.6600
4-22	B-J	Fit of fork on clutch	0.0250L-0.0380L	0.0800L
4-22	K	Input shaft outside diameter (front)	1.9682-1.9687	(*)
4-22	C-K	Fit of bearing on input shaft	0.0002T-0.0007T	0.0001T
4-22	L	Input shaft outside diameter (rear)	1.7716-1.7721	1.7716
4-22	M	High range gear outside diameter	6.895-6.900	(*)
4-22	N	Bearing inside diameter	1.7712-1.7717	(*)
4-22	L-N	Fit of bearing on input shaft (rear)	0.0009T-0.0004T	(*)
4-22	P	Bearing outside diameter	3.9364-3.9370	(*)
4-22	Q	Bearing inside diameter	2.000-2.0005	(*)
4-22	R	Bearing outside diameter	4.000-4.0010	(*)
4-22	S	Countershaft low range gear bore	2.375-2.376	2.3765

Table 4-1. Repair and Replacement Standard Points of Measurement for Transfer Gear Train (Continued)

Fig. No.	Ref Letter	Point of Measurement	Size and Fit of New Parts	Wear Limits
4-22	T	Countershaft outside diameter	2.3765-2.3775	2.3755
4-22	S-T	Fit of gear on shaft	0.0005T-0.0025T	0.0010L
4-22	U	Countershaft keyway width	0.4990-0.5010	0.5028
4-22	V	Key width	0.5000-0.5010	(*)
4-22	U-V	Fit of key in keyway	0.0010L-0.0020T	.0030L
4-22	W	Gear keyway width	0.5000-0.5025	0.5052
4-22	X	Shifter shaft outside diameter	0.8715-0.8725	0.8685
4-22	Y	Shifter fork pad width	0.562-0.572	0.5550
4-22	Z	Shifter fork perpendicularity of pad to bore	0.005	0.030
4-22	AA	Spring (free height)	2.64-2.85	2.55 min
4-22	BB	Bearing inside diameter	1.7712-1.7717	(*)
4-22	CC	Bearing outside diameter	3.3459-3.3465	(*)
4-22	DD	Clutch inside diameter	2.515-2.517	(*)
4-22	EE	Sliding clutch groove width	0.630-0.635	(*)
4-22	FF	Clutch jaw taper	0.006-0.013	0.0020
4-22	Y-EE	Fit of fork in groove	0.058-0.073L	0.088L
4-22	GG	Bearing inside diameter	2.6250-2.6260	(*)
4-22	HH	Bearing outside diameter	4.4375-4.4385	(*)
4-22	JJ	Front axle output shaft outside diameter (front)	1.7716-1.7721	1.7716
4-22	BB-JJ	Fit of bearing on front axle output shaft (front)	0.0001T-0.0009T	(*)
4-22	KK	Front axle output shaft outside diameter (rear)	1.245-1.246	1.2435
4-22	LL	Rear output shaft bushing bore	1.248-1.250	1.256
4-22	LL-KK	Fit of shaft in bore	0.002L-0.004L	0.0055L
4-22	MM	Rear output shaft outside diameter (front)	2.6265-2.6270	2.6260
4-22	GG-MM	Fit of bearing on rear output shaft (front)	0.0005T-0.0025T	0.0010L
4-22	NN	Rear output shaft outside diameter (rear)	2.3765-2.3775	2.3755
4-22	PP	Rear output shaft keyway width	0.4985-0.5005	0.5028
4-22	QQ	Gear keyway width	0.5000-0.5025	0.5052
4-22	RR	Key width	0.5000-0.500	(*)
4-22	PP-RR	Fit of key in keyway	0.0005L-0.0027T	0.0028L
4-22	SS	Rear output shaft outside diameter (rear)	1.7510-1.7515	1.7505
4-22	TT	Driven gear bore	2.375-2.376	2.3765
4-22	NN-TT	Fit of gear on shaft	0.0005T-0.0025T	0.0010L
4-22	UU	Bearing inside diameter	1.7500-1.7505	(*)
4-22	VV	Bearing outside diameter	3.8750-3.8760	(*)
4-22	SS-UU	Fit of bearing on shaft	0.0015T-0.0005T	0.000T



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Figure 4-23. Repair and Replacement Standard Points of Measurement for Transfer and Bearings.

Table 4-2. Repair and Replacement Standard Points of Measurement for Transfer and Bearings

Fig. No.	Ref Letter	Point of Measurement	Size and Fit of New Parts	Wear Limits
4-23	A	Shifter shaft housing bore	0.9995-1.0015	1.0022
4-23	B	Shifter shaft outside diameter	0.9945-0.9955	0.9938
4-23	A-B	Fit of shifter shaft in bore	0.007L-0.004L	0.0077L
4-23	C	Shifter shaft housing bore (rear)	1.247-1.249	1.2514
4-23	D	Expansion plug outside diameter	1.256-1.260	(*)
4-23	C-D	Fit of plug in shifter shaft housing bore	0.007T-0.013T	0.0046T
4-25	E	Input shaft cover bore (front)	4.3305-4.3315	4.3320
4-23	F	Input shaft housing bore (rear)	3.9368-3.9378	3.9382
4-23	G	Bearing outside diameter	4.3301-4.3307	(*)
4-23	H	Bearing outside diameter	3.9364-3.9370	(*)
4-23	E-G	Fit of bearing in input shaft bore (front)	0.0014L-0.0002T	0.0019L
4-23	F-H	Fit of bearing in input shaft bore (rear)	0.0014L-0.0002T	0.0018L
4-23	J	Countershaft cover bore (front)	3.998-3.999	4.00
4-23	K	Bearing outside diameter	4.000-4.001	(*)
4-23	J-K	Fit of bearing in countershaft cover bore (front)	0.001T-0.003T	0.000T
4-23	L	Countershaft housing bore (rear)	4.000-4.001	4.0012
4-23	K-L	Fit of bearing in countershaft housing bore (rear)	0.001L-0.0010T	0.0012L
4-23	M	Bearing bore	2.000-2.005	(*)
4-23	N	Countershaft outside diameter	2.0010-2.0015	2.0005
4-23	M-N	Fit of bearings on countershaft (each end)	0.0005T-0.0015T	0.000T
4-23	P	Front axle output shaft cover bore	4.4355-4.4365	4.4375
4-23	Q	Bearing outside diameter	4.4375-4.4385	(*)
4-23	P-Q	Fit of bearing in front axle shaft cover bore	0.0010T-0.0030T	0.000T
4-23	R	Rear output shaft housing bore	3.8750-3.8760	3.8765
4-23	S	Bearing outside diameter	3.8750-3.8760	(*)
4-23	R-S	Fit of bearing in rear output shaft housing bore	0.0010T-0.0010L	0.0015L
4-23	T	Dowel pin case bore	0.748-0.749	0.7498
4-23	U	Dowel pin outside diameter	0.7501-0.7503	(*)
4-23	T-U	Fit of dowel pin in case bore	0.011T-0.0023T	0.0003T

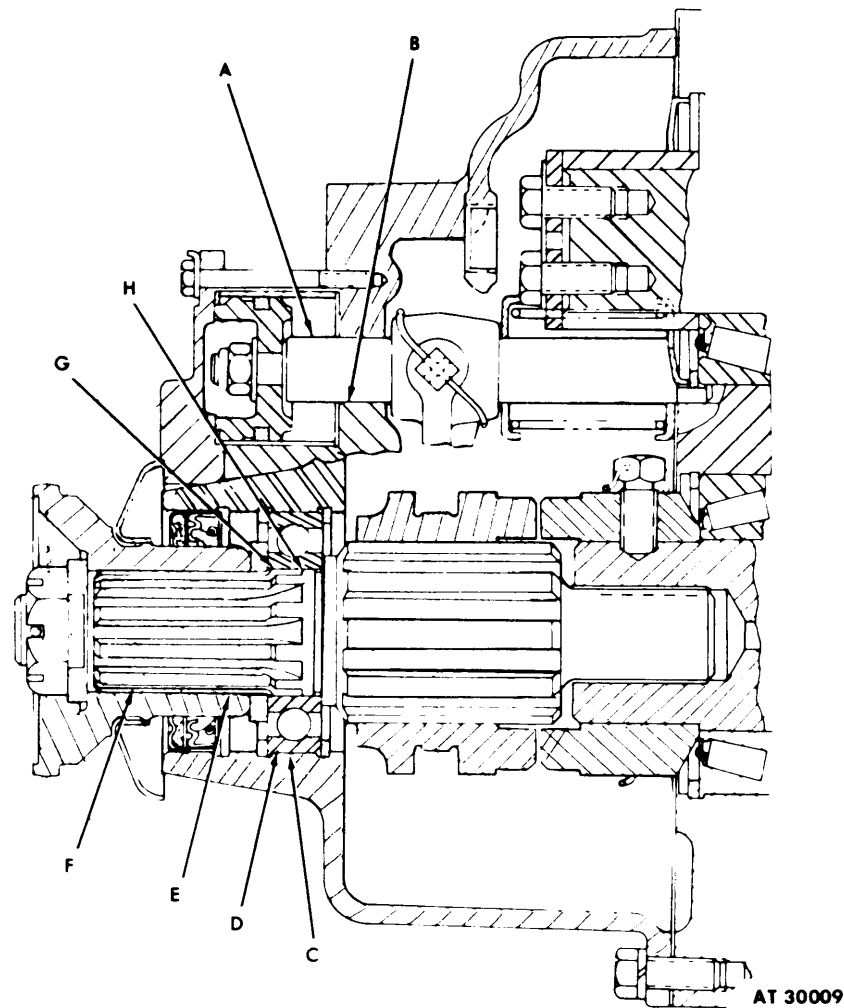
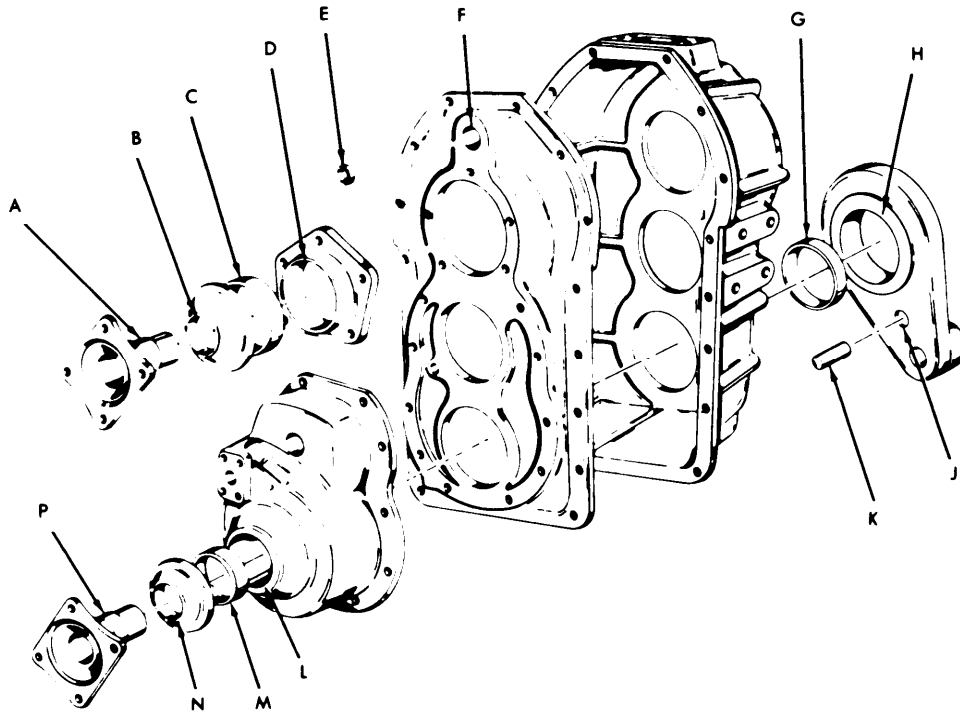


Figure 4-24. Repair and Replacement Standard Points of Measurement for Transfer Output Shaft and Cover.

Table 4-3. Repair and Replacement Standard Points of Measurement for Transfer Output Shaft and Cover

Fig. No.	Ref. Letter	Point of Measurement	Size and Fit of New Parts	Wear Limits
4-24	A	Clutch shifter shaft outside diameter	0.8715-0.8725	0.8685
4-24	B	Clutch shifter shaft case bore	0.8745-0.8765	0.8800
4-24	A-B	Fit of clutch shifter shaft in bore	0.0030L-0.0040L	0.0115L
4-24	C	Front axle output shaft bearing case bore	3.3463-3.3473	3.3483
4-24	D	Bearing outside diameter	3.3459-3.3465	(*)
4-24	C-D	Fit of bearing in front axle output shaft bearing case bore	0.0024L-0.0002T	.0024L
4-24	E	Companion flange inside diameter	1.621-1.624	1.627
4-24	F	Front axle output shaft outside diameter	1.621-1.623	1.619
4-24	E-F	Fit of flange on shaft	0.0020T-0.0030L	0.0073L
4-24	G	Bearing inside diameter	1.7712-1.7717	(*)
4-24	H	Front axle output shaft outside diameter	1.7716-1.7721	1.7716
4-24	G-H	Fit of bearing on shaft	0.0009T-0.0001L	0.0001L



AT 23774

Figure 4-25. Repair and Replacement Standard Points of Measurement for Transfer Case and Seals.

Table 4-4. Repair and Replacement Standard Points of Measurement for Transfer Case and Seals

Fig. No.	Ref Letter	Point of Measurement	Size and Fit of New Parts	Wear Limits
4-25	A	Oil seal outside diameter	1.501-1.505	(*)
4-25	B	Shifter shaft cover bore (front)	1.498-1.500	1.4985
4-25	A-B	Fit of seal in shifter shaft cover bore	0.001T-0.007T	0.0065T
4-25	C	Input shaft flange outside diameter	2.522-2.530	2.5150
4-25	D	Input shaft deflector inside diameter	2.506-2.511	(*)
4-25	C-D	Fit of deflector on flange	0.011T-0.024T	0.0008T
4-25	E	Oil seal outside diameter	3.353-3.357	(*)
4-25	F	Input shaft cover bore	3.348-3.350	3.3495
4-25	E-F	Fit of oil seal in input shaft cover bore	0.003T-0.009T	0.0020T
4-25	G	Front axle output shaft flange outside diameter	2.522-2.530	2.5150
4-25	H	Front axle output shaft deflector inside diameter	2.506-2.511	(*)
4-25	G-H	Fit of deflector on flange	0.011T-0.024T	0.0008T
4-25	J	Front axle output shaft oil seal outside diameter	3.353-3.357	(*)
4-25	K	Front axle output shaft case bore	3.348-3.350	3.3495
4-25	J-K	Fit of oil seal in front axle output shaft case bore	0.003T-0.009T	0.0020T
4-25	L	Rear output shaft oil seal outside diameter	3.353-3.357	(*)
4-25	M	Rear output shaft case bore	3.348-3.350	3.3510
4-25	L-M	Fit of oil seal in rear output case bore	0.003T-0.009T	0.0020T
4-25	N	Dowel pin outside diameter	0.7501-0.7503	(*)
4-25	P	Dowel pin case bore	0.7500-0.7510	0.7525
4-25	N-P	Fit of dowel pin in case bore	0.0009L-0.0003T	0.0024L



## Section V. DESCRIPTION, OPERATION, AND DATA (MODEL T-136-21)

**4-18. General.** This section provides repair instructions for the sprag equipped transfer, model T-136-21 (See fig. 4-26 and 4-27.)

### 4-19. Description and Operation.

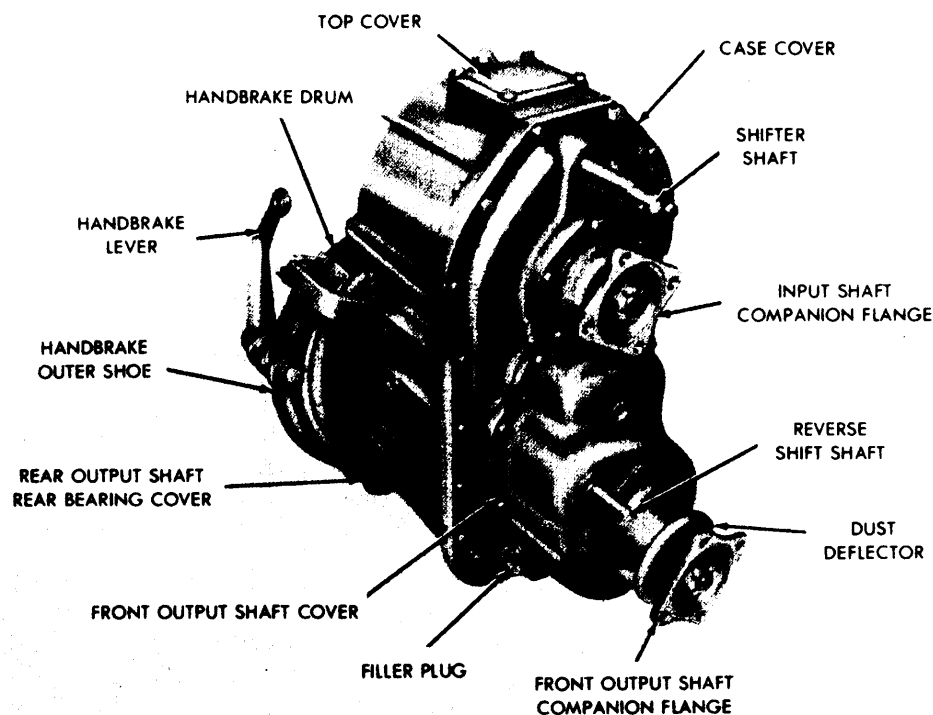
*a. Description.* Sprag equipped transfer, model T-136-21, is a 2-speed synchromesh unit driven from the transmission by a propeller shaft. The transfer distributes power to front and rear axles through the propeller shafts. In addition to high and low speeds, the transfer gearing is designed to drive the front axle slightly slower than the rear axles and this difference in speed is taken up by an overrunning sprag unit on the front output shaft during normal operation. When the rear wheels lose traction, the sprag unit automatically engages, causing the front wheels to drive the vehicle also. The handbrake drum is mounted on the transfer-rear-output-shaft companion flange. (See fig. 4-27.)

*b. Operation.* The selection of high or low range in the transfer is accomplished by a shifting mechanism,

which moves the synchronizer into contact with the input shaft low-speed gear or the input shaft high-speed gear. Power is distributed to all three axles, although the overrunning sprag units allow the front wheels to turn freely until the rear wheels lose traction, at which time the front wheels are engaged in drive also.

(1) *Low Range.* When the transfer is shifted to low range, the synchronizer assembly is moved forward on the input shaft to engage the input shaft low-speed gear which is in mesh with the idler shaft low-speed gear. Because the low-speed gear is keyed to the idler shaft, the power flow is through the idler shaft gears, to the rear and front output shaft and shaft gears, and to the companion flanges.

(2) *High Range.* When the transfer is shifted into high range, the synchronizer assembly is moved rearward on the input shaft to engage the input shaft high-speed gear which is in mesh with the idler shaft high-speed gear. Because the high-speed gear is keyed to the idler shaft, power flow is through the idler shaft gears to the rear and front output shaft and gears.



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Figure 4-26. Sprag Equipped Transfer Model T-136-21 — Front View.

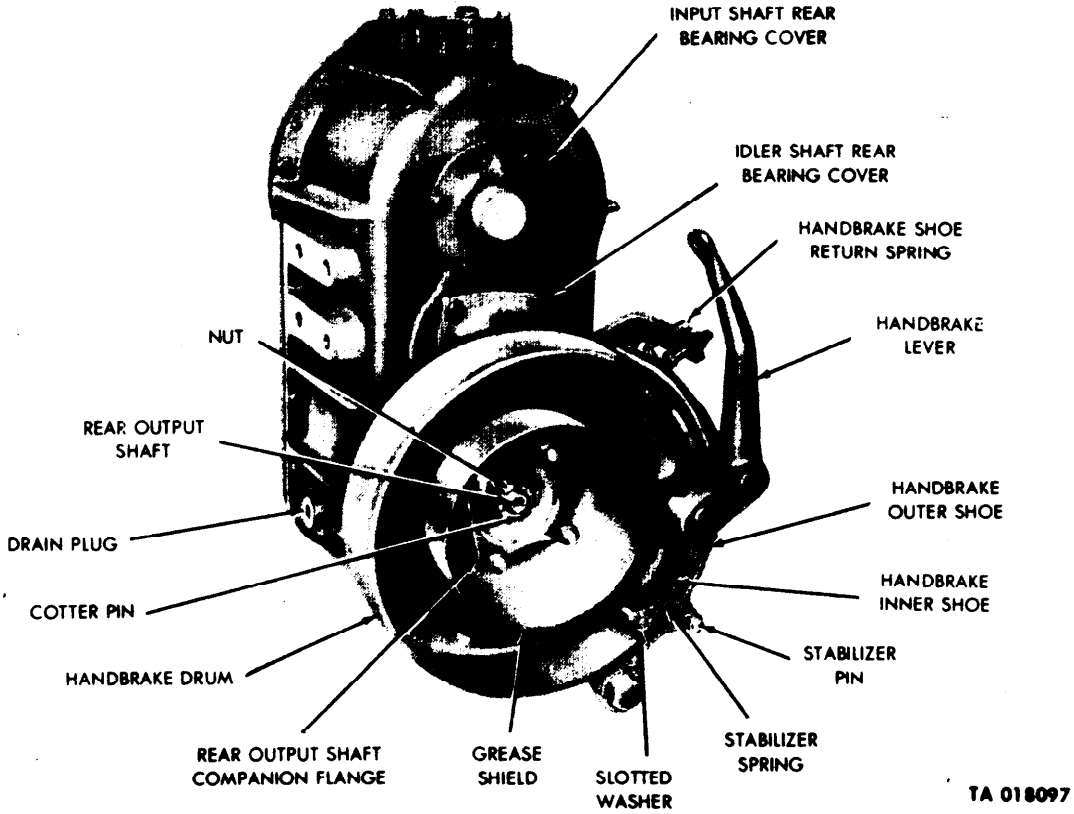


Figure 4-27. Sprag Equipped Transfer Model T-136-21 — Rear View.

(3) *Reverse.* When the transmission is shifted into reverse, the reverse-shaft linkage automatically shifts from one sprag unit to the second sprag unit and power is delivered to both front and rear axles.

**4-20. Data.**

National stock no. . . . . 2520-00-001-7855  
 Make . . . . . Rockwell-Standard-Timken  
 Model . . . . . T-136-21

Ratios to front axle:  
 Low . . . . . 2:137 to 1.000  
 High . . . . . 1.078 to 1.000

Ratios to rear axle:  
 Low . . . . . 1.980 to 1.000  
 High . . . . . 1.000 to 1.000

Gear type . . . . . Helical

Companion flange splines (all shafts):

Diameter . . . . . 1 5/8 in.  
 Full depth of splines . . . . . 2 1/8 in.  
 Number of splines . . . . . 10  
 Lubricant capacity . . . . . 7 qt

## Section VI. REPAIR (MODEL T-136-21)

### 4-21. General.

a. This section contains disassembly and assembly procedures for the model T-136-21 transfer.

b. Clean, inspect, and follow the repair procedures in Chapter 2, section III, of this manual.

c. Transfer disassembly is accomplished by the logical step-by-step procedures in paragraphs 4-22 and 4-23. Refer to paragraphs 4-24 and 4-25 for assembly procedures.

#### NOTE

Assembly procedures are given only where special attention to a part or assembly is needed. Assembly of the transfer is the exact opposite of disassembly, unless otherwise specified or stated.

### 4-22. Disassembly of Transfer into Subassemblies.

a. *Handbrake Drum and Shoe Assembly.* Remove the cotter pin from the rear output shaft and nut. (See fig. 4-27.) Apply the hand brake by hand, and remove the rear output shaft companion flange, nut, and washer. Disconnect and remove the handbrake shoe return spring. Remove the jamnut from the shoe anchor pin. (See fig. 4-28.) Unscrew the anchor pin from the rear-output-shaft rear-bearing cover. Slide the brakeshoe assembly from the brakedrum. Pull the companion flange, brake drum, and grease shield from the rear output shaft. (See fig. 4-27.) Remove the two capscrews and lockwashers securing the shoe-stop bracket (fig. 4-28) to the transfer case and remove the bracket.

#### NOTE

Apply white lead pigment (Fed Spec TT-W-261C) to the spline of the rear output shaft before installing handbrake drum and rear output shaft companion flange. Tighten nut to 300-400 lb-ft torque. Place washers on anchor pin to space brake shoe so that 1/16 inch of drum shows. Tighten pin until binding occurs when brake is applied and back off 1/8 turn. Tighten locknut to 153-196 lb-ft torque.

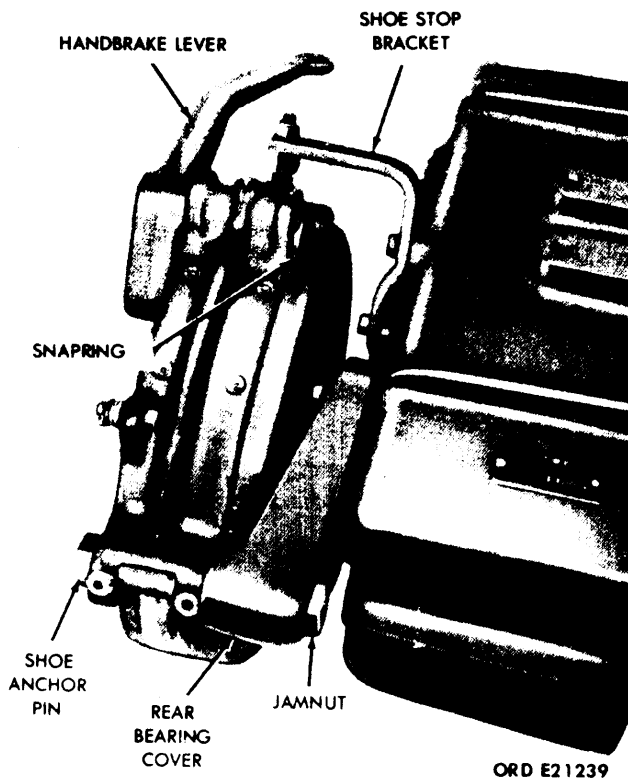


Figure 4-28. Removal of Handbrake Assembly.

b. *Installation of Transfer on Overhaul Stand.* Install transfer on overhaul stand using brackets. (See fig. 4-29.)

c. *Draining.* Remove transfer case magnetic drain plug (fig. 4-27) and front output shaft cover filler plug (fig. 4-29) and drain transfer lubricant into a suitable container. Inspect magnetic plugs for chips.

#### NOTE

If chips are found, inspect in accordance with repair and replacement standards. (Refer to section VIII.)

d. *Companion Flanges.*

#### NOTE

Apply a coating of white lead pigment, Fed Spec TT-W-261C, to input shaft spline before installing companion flange. Tighten flange nut to 300-400 lb-ft torque.

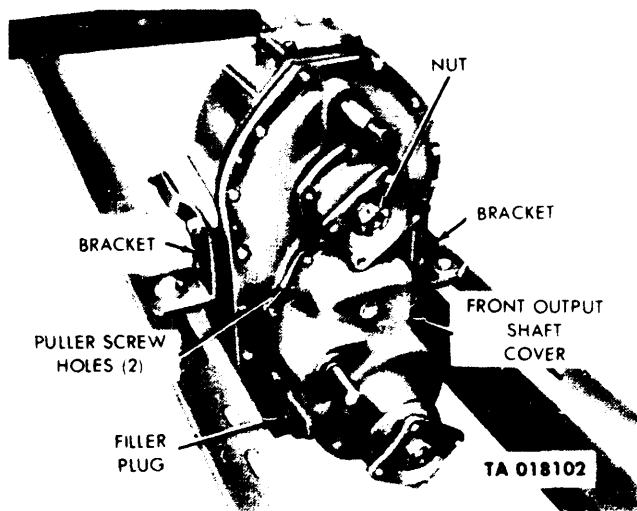


Figure 4-29. Transfer Mounted on Overhaul Stand,

(1) Using a puller (item 4, table 2-1), remove input shaft companion flange. (See fig. 4-30.)

**NOTE**

Apply a coating of white lead pigment, Fed Spec TT-W-261C, to front output shaft spline before installing companion flange. Tighten flange nut.

(2) Using a puller (item 4, table 2-1), remove front output shaft companion flange. (See fig. 4-30.)

*e. Front Output Shaft Cover Assembly.*

**NOTE**

During assembly, install new gasket and tighten capscrews to 45-55 lb-ft torque.

Remove the 10 capscrews and lockwashers securing the front output shaft cover to the transfer case cover. (See fig. 4-30.) Install puller screws into the two puller-screw holes (fig. 4-29) in the flange of the front output shaft cover. Pull the cover assembly from the dowel pins (fig. 4-31) on the transfer case cover. Remove puller screws and discard gasket.

*f. Front Output Shaft and Reverse Shift Shaft Assembly.* Position the output shaft cover assembly in an arbor press with the shafts facing upward and press the output shaft and reverse shift assembly free from the cover. (See fig. 4-32.)

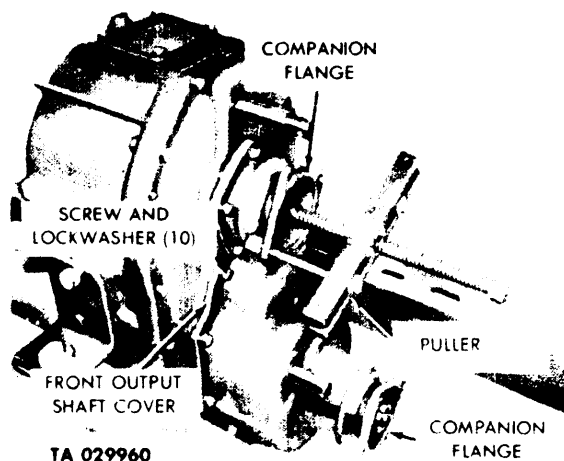


Figure 4-30. Companion Flanges — Removal.

*g. Input Shaft Front Bearing Cover.*

**NOTE**

During assembly, install new gasket and tighten capscrews to 60-77 lb-ft torque.

Remove the five capscrews and lockwashers from the input shaft front bearing cover and cover gasket. (See fig. 4-31.) Using a suitable tool, remove the oil seal cover.

*h. Idler Shaft Driving Gear.*

Bend locking plate tabs away from two capscrews. Remove the two capscrews securing the idler shaft driving gear to the idler shaft. (See fig. 4-31.) Remove the idler shaft gear.

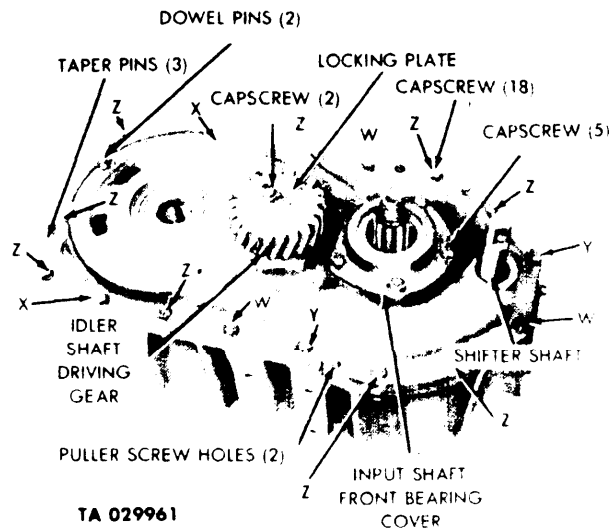


Figure 4-31. Removal of Transfer Covers.

i. Case Cover.

**NOTE**

Use care not to damage or lose taper pins during removal since they are non-supply items and must be fabricated if lost or damaged.

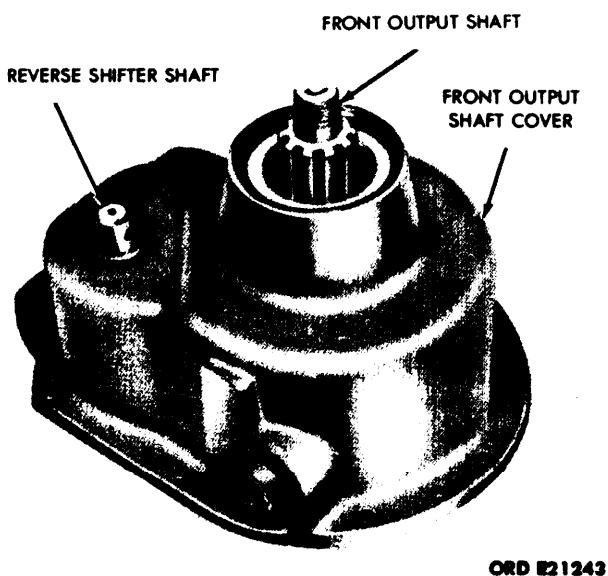
(1) Polish the end of the shifter shaft to remove roughness and paint. (See fig. 4-31.) Remove the 18 capscrews, nuts, and lockwashers securing the case cover to the case. Remove the three taper pins from the case and cover, with a drift or punch.

**NOTE**

Install taper pins, install new gasket, aline case cover with taper pins, and tighten nut and capscrews evenly and alternately. Tighten capscrews marked Y and W to 60-77 lb-ft torque. Tighten remaining capscrews marked Z to 67-87 lb-ft torque.

(2) Install puller screws in the two puller-screw holes located in the flange of the case cover. (See fig. 4-31.) If necessary, drive on the end of the input shaft and tap on the end of the shifter shaft with a mallet. Lift the cover assembly from the case. Remove and discard the gasket. Remove the outer thrust washer from the input shaft.

j. Rear Output Shaft Assembly. After the case cover has been removed, lift the rear output shaft assembly (fig. 4-33) from the transfer case.



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Figure 4-32. Removal of Front Output Shaft and Reverse Shift Assembly.

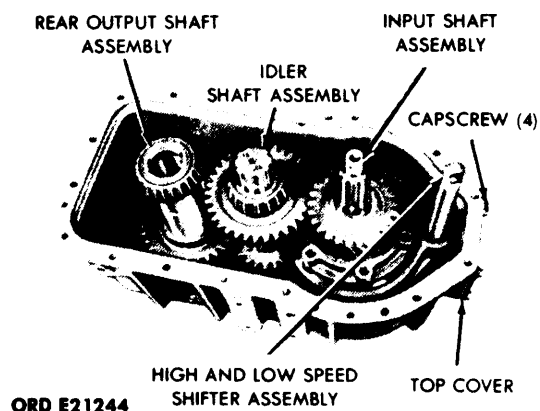
k. Transfer Top Cover and Shifter Shaft.

**NOTE**

When assembling, use a new gasket and install new lockwire. Tighten capscrews and lockwashers to 22-28 lb-ft torque.

Remove the four capscrews and lockwashers securing the top cover to the transfer case. (See fig. 4-33). Remove the top cover and top cover gasket. Discard the gasket. Remove the shifter shaft spring, plunger, and ball. (See fig. 4-34.) Using a pair of wire cutters, remove the lockwire from the fork setscrew. Remove the setscrew, then remove the shifter shaft from the fork assembly.

l. Input Shaft Assembly, Fork Assembly, and Idler Shaft Assembly. Using a soft drift pin and hammer, drive the input shaft assembly, fork assembly, and idler shaft assembly from the transfer case.



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Figure 4-33. Removal of Rear Output, Idler, and Input Shaft Assemblies

m. Rear Output Shaft Rear Bearing Cover.

**NOTE**

When assembling, tighten rear output shaft rear bearing cover capscrews to 60-77 lb-ft torque. For the installation of shims and rear bearing adjustments, refer to section VII of this chapter.

Remove the six capscrews and lockwashers securing the rear output shaft rear bearing cover to the transfer case. (See fig. 4-35.) Remove the bearing cover and shims from the case. Using a suitable tool, remove the oil seal from the rear output shaft cover.

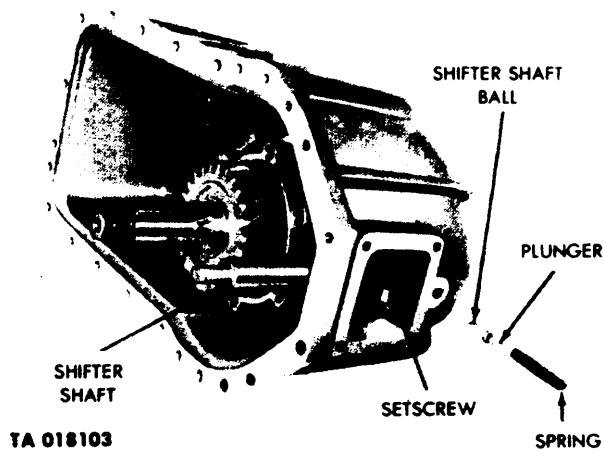


Figure 4-34. Removal of Transfer Top Cover and Shifter Shaft.

n. Idler Shaft Rear Bearing Cover.

**NOTE**

During assembly, tighten the idler shaft

rear bearing cover capscrows to 60-77 lb-ft torque. Refer to section VII of this chapter for bearing adjustment procedures.

Remove the four capscrows and lockwashers securing the idler shaft rear bearing cover to the transfer case. (See fig. 4-35.) Remove the cover and rear bearing shims.

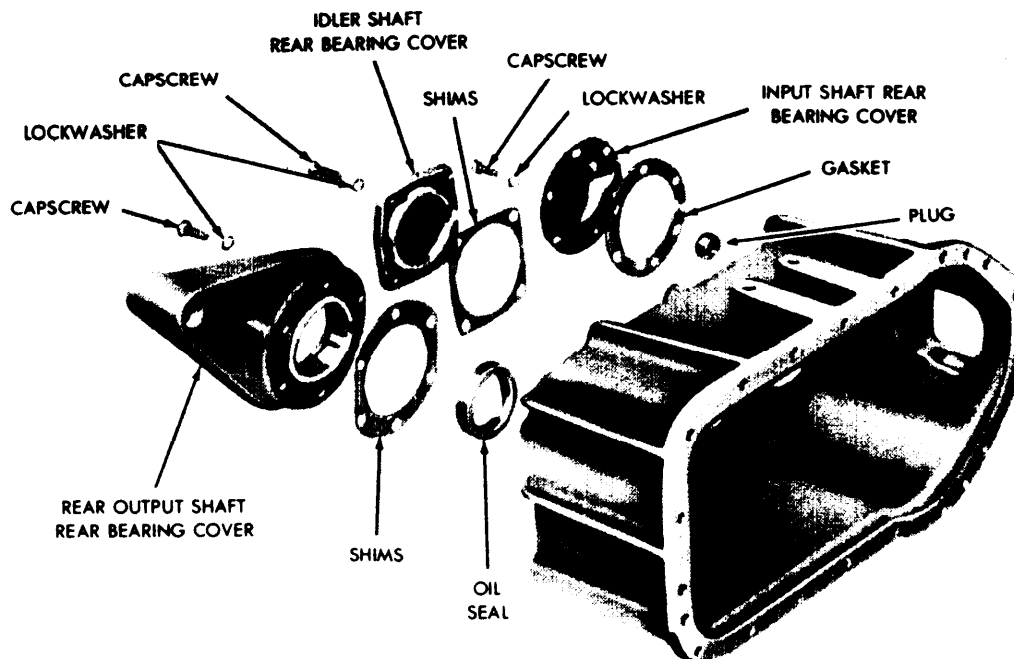
o. Input Shaft Rear Bearing Cover.

**NOTE**

During assembly, use a new gasket. Tighten capscrows to 60-77 lb-ft torque.

**NOTE**

Remove the six capscrows and lockwashers securing the input shaft rear bearing cover to the transfer case. (See fig. 4-35.) Remove the rear bearing cover and gasket; discard the gasket.



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Figure 4-35. Removal of Rear Output Shaft Rear Bearing Cover, Idler Shaft Rear Bearing Cover, and Input Shaft Rear Bearing Cover.

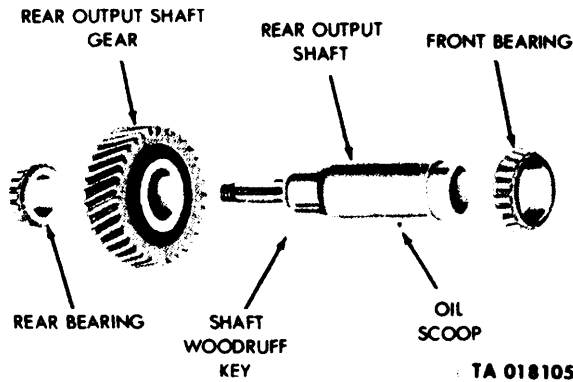


Figure 4-36. Rear Output Shaft Disassembly — Exploded View.

**4-23. Disassembly and Assembly of Subassemblies.**

*a. Rear Output Shaft Assembly.*

**NOTE**

Before pressing the gear and bearings on the rear shaft, coat the shaft with white lead pigment, Fed Spec TT-W-261C. When assembling the rear output shaft assembly, install parts separately so as not to damage the front and rear bearings.

(1) Place rear output shaft assembly in an arbor press with front tapered roller bearing cone (fig. 4-36) up. Place support bars beneath the cone. Press the cone from the shaft.

(2) Place the rear output shaft assembly in an arbor press with the rear output shaft gear up. (See fig. 4-36.) Place support bars beneath the rear output shaft gear and press the gear free of the shaft. Removal of the rear output shaft gear in this manner will also push the rear output shaft rear bearing from the shaft. Remove the woodruff key from the shaft.

*b. Idler Shaft Assembly.*

**NOTE**

Before pressing the gears and bearings on the idler shaft, coat the shaft with white lead pigment, Fed Spec TT-W-261C. When assembling the idler shaft assembly, install parts separately so as not to damage front and rear bearings. Discard the old capscrew locking plate and replace it with a new one.

(1) Using a suitable tool, bend the rear bearing and gear locking plate ears away from capscrews and remove the two capscrews, locking plate, and the rear bearing gear-lock. (See fig. 4-37.)

(2) Place the idler shaft assembly in a press with the high speed gear and rear bearing up. (See fig. 4-

37.) Place support bars beneath the high-speed gear, and press idler shaft high-speed gear and rear bearing from the shaft. Remove high-speed gear woodruff key.

(3) Place the idler shaft assembly in an arbor press with low-speed gear and front bearing up. (See fig. 4-37.) Place support bars beneath the low-speed gear. Press idler shaft low-speed gear and front bearing from the idler shaft. Remove the low-speed gear woodruff key from the idler shaft.

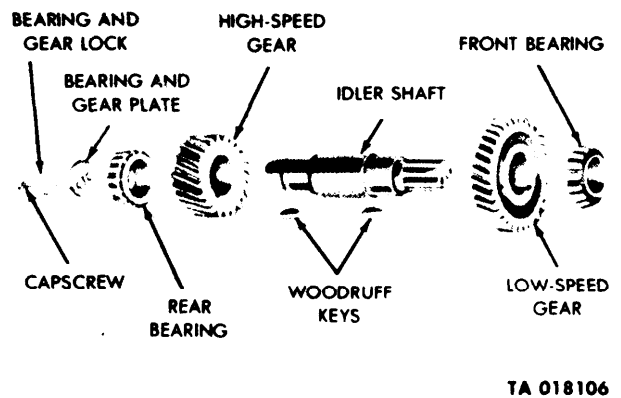


Figure 4-37. Idler Shaft Disassembly — Exploded View.

*c. Input Shaft Assembly.*

**NOTE**

Visually inspect synchronizer for broken, nicked, or worn gear teeth. If any of these conditions prevail, the synchronizer must be replaced. For replacement, use synchronizer part number 7346755.

**NOTE**

Before pressing the bearing into the gears, and the gears on the input shaft, coat all installation surfaces with white lead pigment, Fed Spec TT-W-261C.

(1) Remove the shifter shaft fork from the synchronizer assembly. (See fig. 4-38.)

(2) Remove the input shaft rear bearing snapping from the end of the input shaft. (See fig. 4-38.) Place the input shaft assembly in an arbor press with the rear bearing and high-speed gear up. Install a suitable puller around the input shaft high-speed gear and press the high-speed gear free from the shaft. Removal of high-speed gear in this manner will push the gear bearing spacer, gear bearing, thrust washer, and rear bearing from the input shaft.

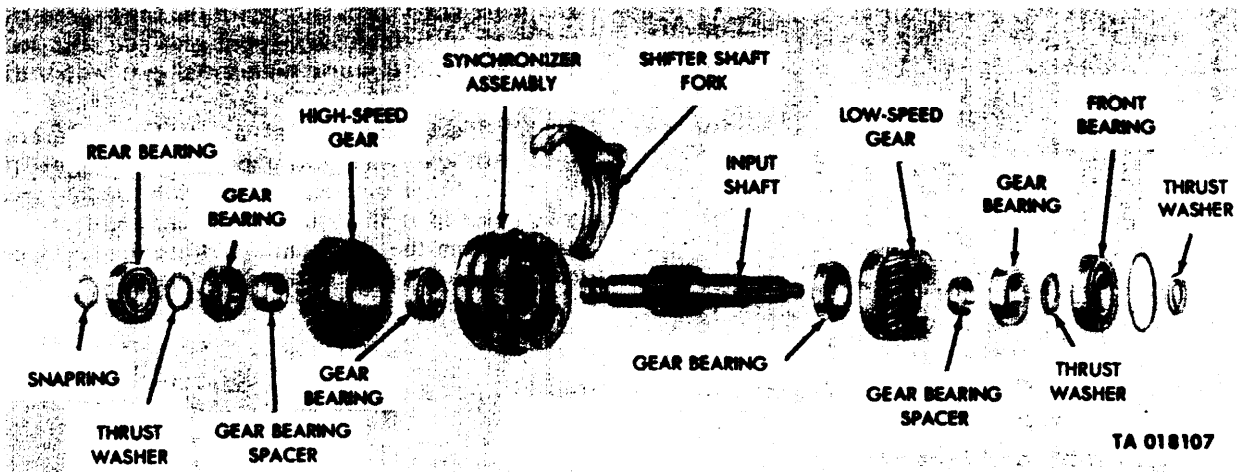


Figure 4-38. Input Shaft Disassembly — Exploded View.

(3) Place the high-speed gear in a press and press high-speed gear ball bearings and high-speed gear bearing spacer from the bore of the high-speed gear. (See fig. 4-38.) Apply pressure to the inner race of the bearing only.

(4) Slide synchronizer assembly from the input shaft. (See fig. 4-38.)

(5) Place the input shaft assembly in an arbor press, front bearing up. (See fig. 4-38.) Place support bars beneath the low-speed gear, and press the low-speed gear, gear bearing, thrust washer, and front bearing from the shaft.

(6) Place the low-speed gear in a press and press low-speed gear bearings, and gear bearing spacer from low-speed gear. (See fig. 4-38.) Apply pressure to the inner race of the bearing only.

d. Front Output Shaft.

**NOTE**

Before installing the inner race and shaft drive gear onto the shaft, coat the front output shaft with white lead pigment, Fed Spec TT-W-261C.

(1) Remove the reverse shifter shaft fork from the reverse shift collar. (See fig. 4-39.)

(2) Align both of the outer races and slip the reverse shift collar from the shaft assembly. (See fig. 4-39.)

(3) Remove the snapping and spacer and slip the front outer race from the shaft assembly. (See fig. 4-39.)

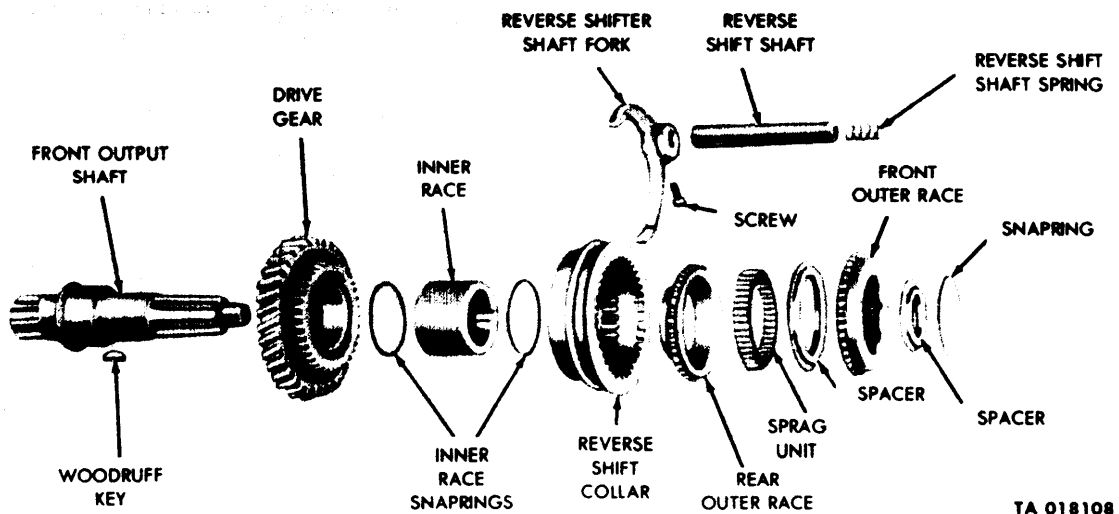
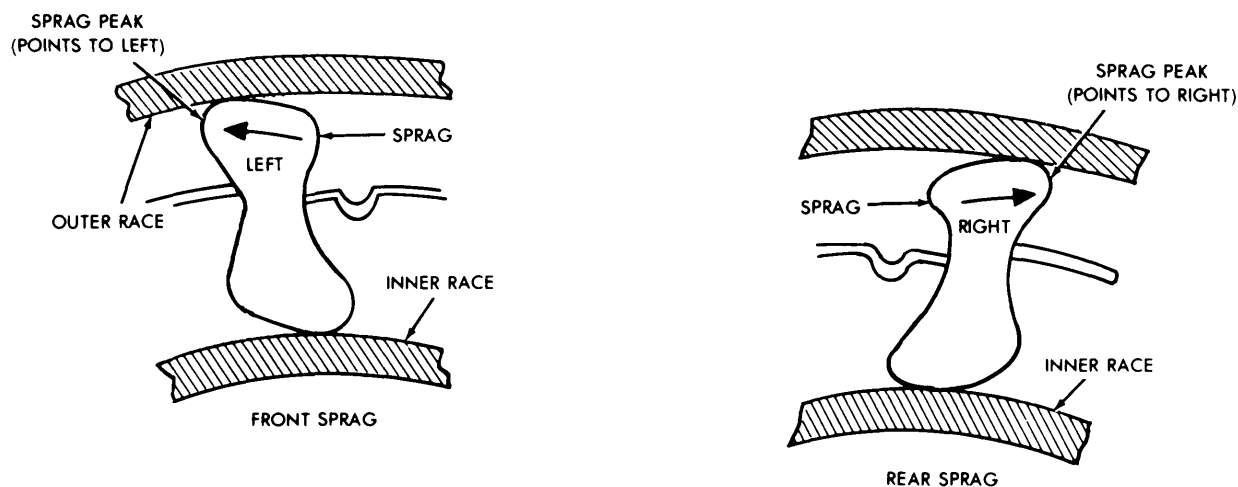


Figure 4-39. Front Output Shaft Disassembly — Exploded View.





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Figure 4-40. Positioning of Sprag Peaks For Front Sprag and Rear Sprag.

(4) Remove the two inner race snaprings and place the front output shaft assembly in an arbor press with the drive gear resting on two parallel blocks. (See fig. 4-39.) Press the gear from the shaft. Removal of the drive gear in this manner will also remove the inner race. Remove the woodruff key from the shaft.

*e. Disassembly and Assembly of Sprag Units.*

**NOTE**

When looking toward the front end of the front output shaft, the front sprag peaks will be pointing to the left and the rear sprag peaks will be pointing to the right. (See fig. 4-40.)

(1) Remove the sprag units from the front and rear outer races; remove the two energizing springs, and inspect the sprags as directed in section VIII of this chapter.

(2) When all 84 sprags are removed, lay both outer races flat with the open end up. Place one energizing spring in the bottom of each outer race. Each sprag is designed to fit the contour of the energizing spring; this slight groove must face toward the outside of the outer races.

**NOTE**

Some space will be necessary for the action of the sprags, and does not indicate that any sprags are missing. Place the sprag units on the front output shaft in the exact order they were removed in disassembly.

(3) When assembling, a slender stylus will be needed for the last few sprags to push the energizing spring into the notch in the end of the sprags. With all the sprags in place, insert the outer energizing spring in the exposed end of the sprags. With the spring in position, start at one side and slide fingers along the spring, pushing it into the sprag notches until fingers meet at the opposite side. Run fingertips along all sprags once or twice to make sure all are in position with none cocked or twisted.

*f. Transfer Case Cover.*

**NOTE**

When installing input shaft front bearing, apply pressure on the inner race of the bearing only. Also replace shift shaft oil seal.

(1) Press the input shaft front bearing and snapping (fig. 4-41) from the front cover, using a suitable remover and replacer.

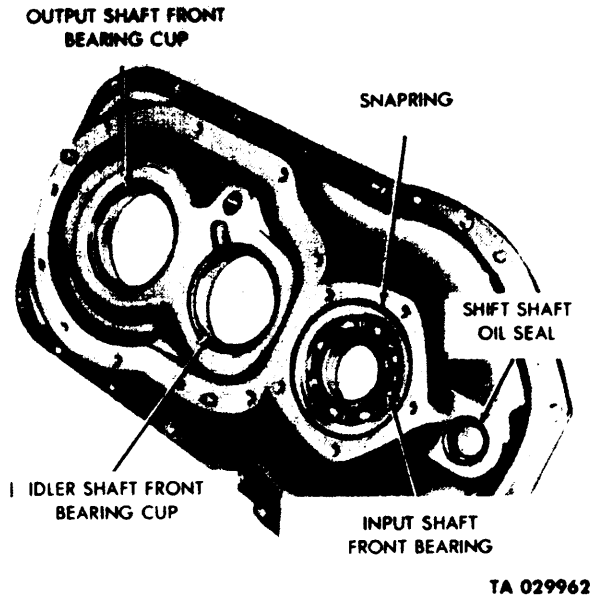


Figure 4-41. Transfer Case Cover — Disassembly.

(2) Remote the input shaft front bearing snapping from the input shaft front bearing.

(3) Using a suitable tool, remove the shift shaft oil seal from the cover.

(4) Remove the idler-shaft front bearing cup by removing the bearing cup snapping. Using a suitable remover and replacer with handle (table 2-1, items 5 and 6), drive the idler-shaft front bearing cup from the transfer case cover. (See fig. 4-42.)

(5) Remove the rear output front bearing cup by removing the bearing cup snapping and, using suitable remover and replacer, table 2-1, items 5 and 6, drive the bearing cup from the transfer case cover. (See fig. 4-22.)

*g. Front Output Shaft Cover.*

**NOTE**

Coat the output shaft, shift shaft, and oil seals with grease, artillery and automotive (GAA) MIL-G-10924, before assembling to prevent damage to seals.

(1) Remove the output shaft oil seal snapping (fig. 4-43). Discard the oil seal. To remove the seal from the cover, place in a press and exert pressure upon the front bearing thrust washer.

(2) Remove the reverse shift shaft oil seal, using a suitable tool, and drive the shift shaft seal from the output shaft cover. (See fig. 4-43.).

*h. Transfer Case.*

**NOTE**

When pressing bearing cups back in transfer case, be sure that the bearing cups are not cocked, to avoid damage to the bearing cups and transfer case which may result.

Press the idler shaft rear bearing cup and rear output shaft rear bearing cup from the transfer case (fig. 4-44), using a suitable remover and replacer. Refer to table 2, items 5 and 6.

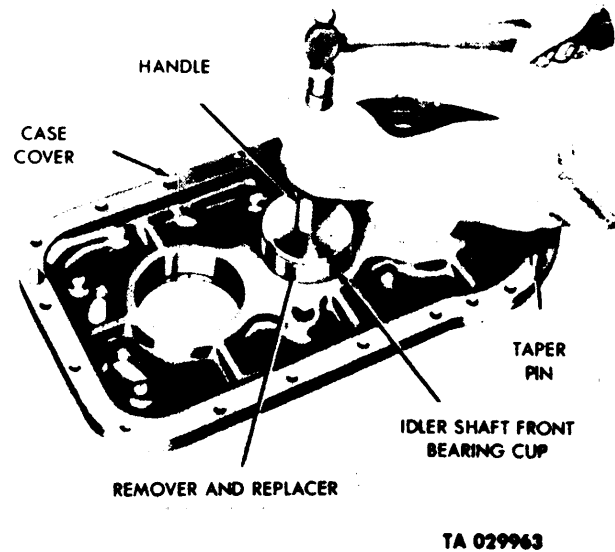


Figure 4-42. Removing Idler Shaft Front Bearing Cup.

*i. Handbrake Shoe Assembly.*

**NOTE**

Sometimes the handbrake shoes are not worn enough to warrant replacement. Use good judgment in determining the condition of the shoes. Replace brake lining when worn to 1/16 inch of the rivet heads. Worn shoe linings can result in injury to personnel and damage to the vehicle. Refer to TM 9-2320-209-20/1 for wear limits and adjustments.

(1) Remove the two snaprings holding the handbrake lever pins in position. (See fig. 4-45.)

(2) Remove the two slotted washers which hold the stabilizer spring in position. (See fig. 4-27.) Remove the brakeshoe stabilizer spring and pin.

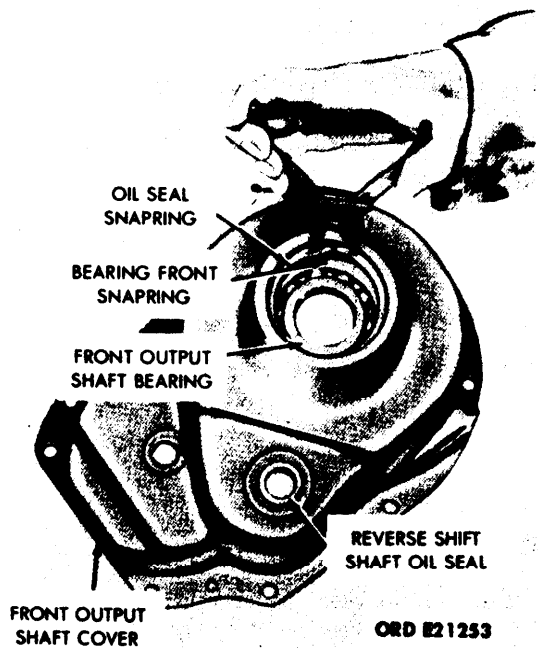


Figure 4-43. Front Output Shaft Cover — Disassembly.

(3) Remove the handbrake shoe lever and lever pins. (See fig. 4-45.)

**WARNING**

Replacement brakeshoes must be drilled for rivet holes. Be sure to wear a mask to prevent asbestos dust particles from entering the lungs. Drilling must be done in a well-ventilated area away from unprotected personnel. Eyeglasses must also be worn during drilling operation. Failure to observe these precautions may result in injury to personnel.

(4) Remove the 16 rivets securing the inner and outer brakeshoes to the handbrake assembly. (See fig. 4-45.)

**4-24. Assembly of Subassemblies.**

- a. Handbrake (fig. 4-45).
- b. Transfer case (fig. 4-44).
- c. Front output shaft cover (fig. 4-43).
- d. Transfer case cover (figs. 4-41, 4-42).

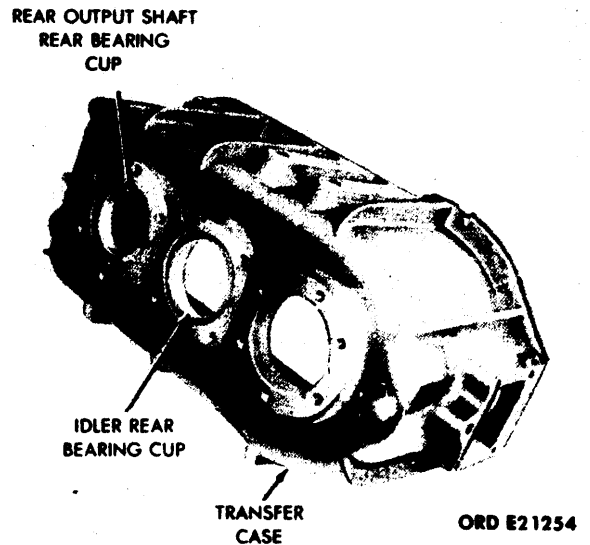


Figure 4-44. Transfer Case — Disassembly.

- e. Sprag units (fig. 4-40).
- f. Front output shaft (fig. 4-39).
- g. Input shaft assembly (fig. 4-38).
- h. Idler shaft assembly (fig. 4-37).
- i. Rear output shaft assembly (fig. 4-36).

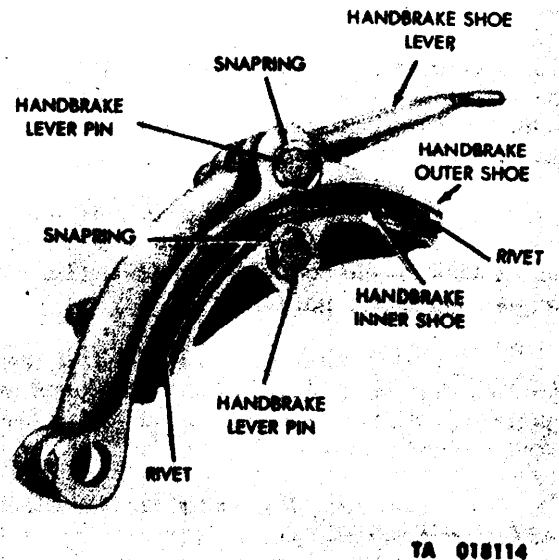


Figure 4-45. Handbrake Shoe — Disassembly.

#### 4-25. Assembly of Transfer (Sequence).

- a. Idler shaft rear bearing cover (fig. 4-35).
- b. Rear output shaft rear bearing cover (fig. 4-35).
- c. Input shaft assembly, fork assembly, and idler shaft assembly (fig. 4-33).
- d. Transfer top cover and shifter shaft (fig. 4-34).
- e. Rear output shaft assembly (fig. 4-33).
- f. Case cover (fig. 4-31).

- g. Idler shaft driving gear (fig. 4-31).
- h. Input shaft front bearing cover (fig. 4-31).
- i. Front output shaft and reverse shift shaft assembly (fig. 4-32).
- j. Front output shaft cover assembly (fig. 4-29, 4-32).
- k. Companion flanges (fig. 4-30).
- l. Handbrake drum and shoe assembly (fig. 4-27, 4-28).

## Section VII. TEST AND ADJUSTMENT (MODEL T-136-21)

**4-26. General.** This section provides for the tests and adjustments of model T-136-21 transfer.

**4-27. Lubrication.** Tighten drain plug (fig. 4-27). Lay transfer on side with filler plug up (fig. 4-26). Remove filler plug and pour ½ pint of universal gear lubricant (GO), MIL-L-2105, through the plug opening. Install and tighten plug. Lubrication of complete unit should be accomplished after installation. Attach tag to filler plug giving instructions for filling before transfer is placed in service. Refer to paragraph 4-20 and lubrication order (LO 92320-209-12/1) for lubrication specifications. Tighten filler plug to 40-55 lb-ft torque.

#### 4-28. Shift Test.

a. *Neutral.* Place shifter shaft in neutral position (between “low” (shifter shaft out) and “high” (shifter shaft in)). Turn input shaft by hand. Front and rear output shafts should not turn.

b. *High.* Push shifter shaft in to shift to high position. Turn input shaft in clockwise direction. Rear output shaft should revolve in same direction. Front output shaft should not turn.

c. *Low.* Pull shifter shaft out to shift to low position. Turn input shaft by hand and note if rear-output shaft turns approximately one-half as fast as when in high (b above).

d. *Sprag Unit Test.* With shifter shaft in either low or high position, front output shaft should turn freely in a clockwise direction but should not turn counterclockwise when input shaft is held stationary. With reverse shift shaft held in, front output shaft should turn freely in counterclockwise direction but should not turn clockwise when input shaft is held stationary.

**4-29. Handbrake Test.** Pull handbrake lever (fig. 4-27) to engage brake shoes with handbrake drum. Release lever and note if shoe return spring pulls free of drum. For vehicle test refer to TM 9-2320-209-20/1.

**4-30. Handbrake Shoe Adjustment.** If shoes do not clear drum (4-29 above), check adjustment of shoe anchor pin. If outer shoe is free on anchor pin, tighten bolt in shoe stop to increase shoe-to-drum clearance. For in-vehicle adjustment refer to TM 9-2320-209-20/1.

#### 4-31. Adjustment of Rear Output Shaft Bearing.

a. *Test Bearing Adjustment.* Reach inside of case and turn rear output shaft assembly. Shaft should drag slightly when turned by hand. If tests indicate bearings are too tight or too loose, shims must be added or removed as directed in b below.

b. *Add or Remove Shims.* Remove six capscrews and lockwashers holding the rear output shaft-rear bearing cover (fig. 4-35) to case, and remove cover. Add or remove shims as required to obtain a slight drag when shaft assembly is turned by hand from inside the case. Place cover on case, making sure pin in cover enters hole in case. Install six capscrews and lockwashers and tighten to 60-77 lb-ft torque.

c. *Add Shim.* When slight drag adjustment has been obtained, remove rear output shaft rear bearing cover and add one 0.003-inch shim. Install cover (b. above). This will provide and ensure the proper end play.

#### 4-32. Adjustment of Idler Shaft Bearing.

a. *Test Bearing Adjustment.* Reach inside of case and turn idler shaft assembly. Shaft should have slight

drag when turned by hand. If test indicates bearings are too tight or too loose, shims must be added or removed as directed in *b* below.

*b. Add or Remove Shims.* Remove four capscrews and lockwashers holding the idler shaft rear bearing cover (fig. 4-35) to case. Remove cover and add or remove shims as required to obtain a slight drag when

assemblies are turned by hand from inside the case. Position cover on case and secure with four capscrews and lockwashers. Tighten to 60-77 lb-ft torque.

*c. Add Shim.* When slight drag adjustment has been obtained, remove cover and add one 0.005-inch shim. Install cover (b above). This will provide and ensure the proper end play.

### Section VIII. REPAIR AND REPLACEMENT STANDARDS (MODEL T-136-21)

**4-33. General.** The repair and replacement standards included herein provide the minimum, maximum, and key clearances of new parts. (See fig. 4-46, 4-47, 4-48, 4-49, and 4-50, and corresponding tables 4-5, 4-6, 4-7, and 4-8.) Standards also provide wear limits which indicate the point to which a part or parts may be worn before replacement is required, in order to receive maximum service with minimum replacement. Normally, all parts which have not been worn beyond the dimensions shown in the "Wear Limits" column, or damaged by corrosion, will be approved for service. An asterisk (\*) in the "Wear Limits" column, indicates that the part or parts should be replaced when worn beyond the limits given in the "Size and Fit of New Parts" column. In the "Size and Fit of New Parts" and "Wear Limits" column, the letter L indicates a loose fit (clearance) and a letter T indicates a tight fit (interference).

**4-34. Repair and Replacement Standard Points of Measurement.** Figures 4-46, 4-47, 4-48, 4-49, and 4-50, and corresponding tables 4-5, 4-6, 4-7 and 4-8, provide the repair and replacement standard points of measurement for transfer model T-136-21.

**4-35. Sprags and Energizing Springs.**

**NOTE**

When checking sprags, the anvil end and spindle of the micrometer and flat backs of the sprag must all rest on a flat surface (fig.

4-46), to make sure they are in the same plane. If three or more sprags are worn to a size 0.375 inch or smaller, replace sprag unit with new sprags.

*a.* Since the wear on all sprags in any one sprag unit will be quite uniform, it is only necessary to inspect two or three sprags in each assembly.

*b.* Inspect the sprags for evidence of wear on the cam surface which contacts the inner race. If the wear on the inner edge of the sprag is not more than 1/16 of an inch wide, the sprag is still usable. This inspection procedure is shown in fig. 4-46.

*c.* Inspect the energizing springs for evidence of wear, kinking, or twisting. If any of the above defects are present, replace the spring with a new one.

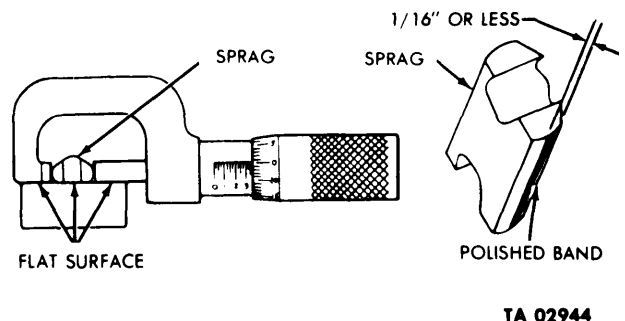


Figure 4-46. Inspecting Sprags for Wear.

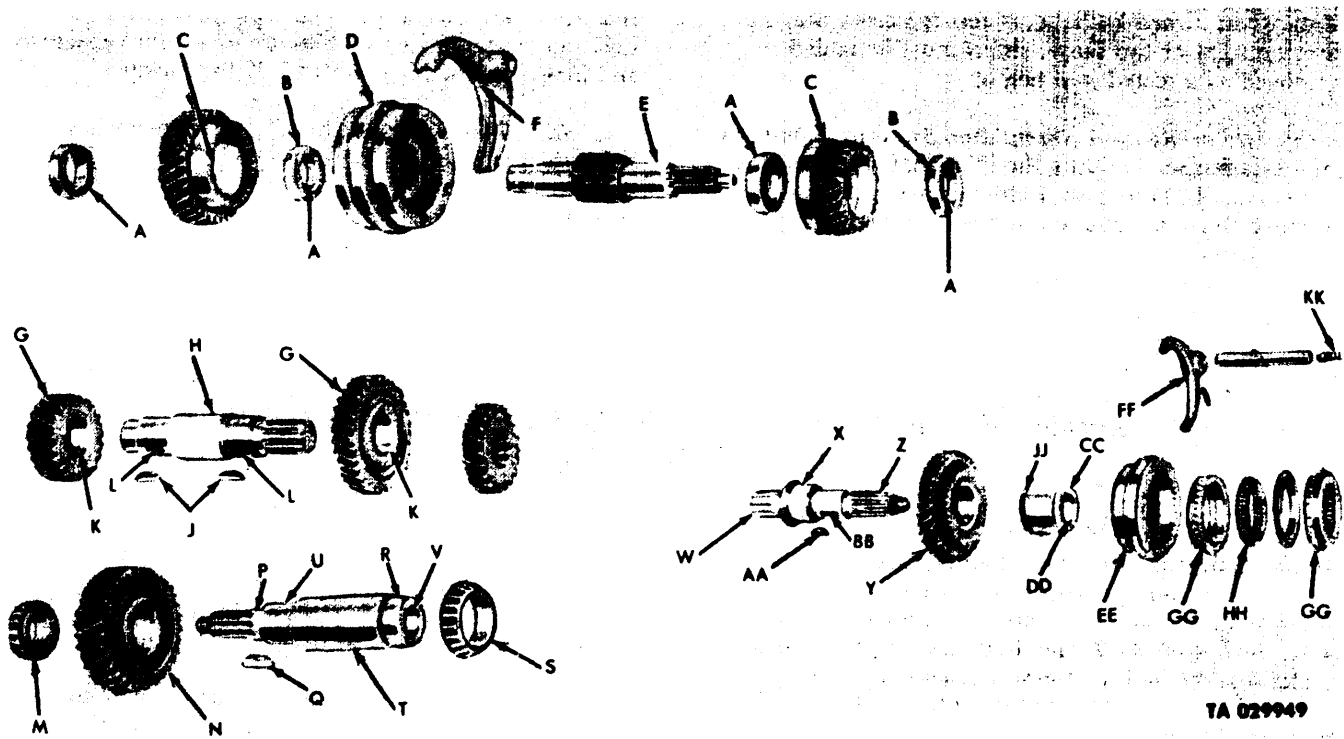


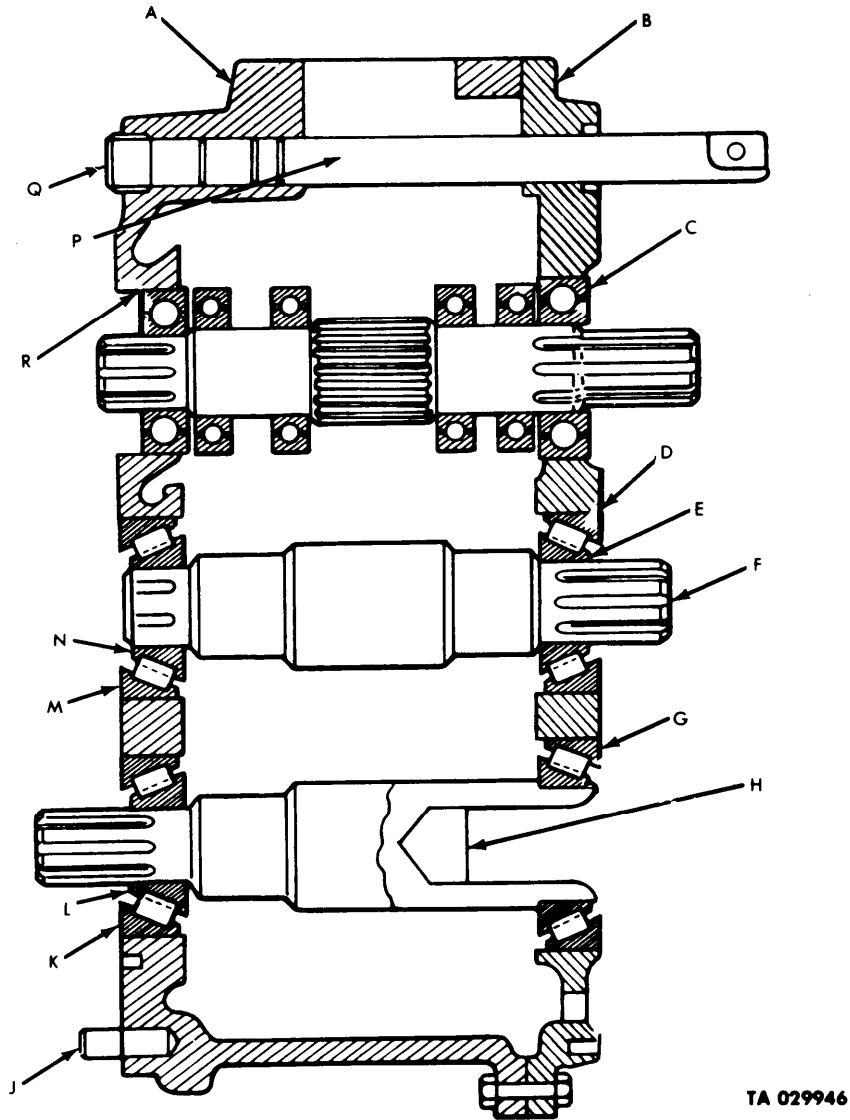
Figure 4-47. Repair and Replacement Standard Points of Measurement for Transfer Gear Train.

Table 4-5. Repair and Replacement Standard Points of Measurement for Transfer Gear Train.

Fig. No.	Ref Letter	Point of Measurement	Size and Fit of New Parts	Wear Limits
4-47	B	Bearing outside diameter	3.5427-3.5433	(*)
4-47	C	Gear bore	3.5426-3.5435	3.5439
4-47	B-C	Fit of bearing in gear bore	0.0007T-0.0008L	0.0012L
4-47	A	Bearing inside diameter	1.9680-1.9685	(*)
4-47	E	Shaft outside diameter	1.9683-1.9689	(*)
4-47	A-E	Fit of bearing on shaft	0.0002L-0.0009T	0.0005L
4-47	F	Shifter fork groove width	0.7090-0.7170	0.7320
4-47	D	Ring width	0.6890-0.6930	0.6650
4-47	F-D	Fit of fork on ring	0.0160L-0.0280L	0.0670L
4-47	G	Gear bore	2.3750-2.3760	2.3765
4-47	H	Idler shaft outside diameter	2.3765-2.3775	2.3755
4-47	H-G	Fit of gear on shaft	0.0005T-0.0025T	0.0010L
4-47	K	Gear keyway width	0.5000-0.5032	0.5052
4-47	J	Key width	0.5032-0.5012	(*)
4-47	J-L	Fit of key in keyway	0.0000T-0.0032L	0.0052L
4-47	L	Idler shaft keyway width	0.4984-0.5000	0.5024
4-47	J	Key width	0.5000-0.5012	(*)
4-47	J-L	Fit of key in shaft keyway	0.0028T-0.0004L	0.0024L
4-47	DD	Race bore	2.0028-2.0040	2.0045
4-47	Z	Shaft outside diameter	2.0028-2.0036	2.0023

Table 4-5. Repair and Replacement Standard Points of Measurement for Transfer Gear Train (Continued)

Fig. No.	Ref Letter	Point of Measurement	Size and Fit of New Parts	Wear Limits
4-47	DD-Z	Fit of shaft in race bore	0.0008T-0.0012L	0.0015L
4-47	CC	Race keyway width	0.3740-0.3760	0.3780
4-47	AA	Key width	0.3750-0.3760	(*)
4-47	AA-CC	Fit of key in race keyway	0.0020T-0.0010L	0.0030L
4-47	BB	Shaft keyway width	0.3736-0.3756	(*)
4-47	AA	Key width	0.3750-0.3760	(*)
4-47	AA-BB	Fit of key in shaft keyway	0.0006L-0.0024T	0.0006L
4-47	JJ	Race (inner) outside diameter	3.0875-3.0885	3.0865
4-47	GG	Race (outer) inside diameter	3.8338-3.8348	3.8378
4-47	HH	Sprag width	0.3770-0.3780	0.3750
4-47	KK	Spring free length	2.290-2.440	(*)
		Spring length at pressure -	2-3/32 in. 12-18 lb 1-1/2 in. 41 - 44 lb	
4-47	EE	Collar groove width	0.6060-0.6100	0.6180
4-47	FF	Fork thickness	0.5705-0.5665	0.5590
4-47	FF-EE	Fit of fork in groove	0.0355L-0.0435L	0.0590L
4-47	S	Bearing cone inside diameter	2.6250-2.6260	(*)
4-47	R	Rear output shaft outside diameter	2.6265-2.6275	2.6260
4-47	S-R	Fit of bearing cone on shaft	0.0005T-0.0025T	0.000T
4-47	M	Bearing cone inside diameter	1.7500-1.7505	(*)
4-47	P	Rear output shaft outside diameter	1.7510-1.7515	1.7505
4-47	M-P	Fit of bearing cone on shaft	0.0005T-0.0015T	0.000T
4-47	V	Rear output shaft bore	1.8126-1.8136	1.8142
4-47	W	Front output shaft outside diameter	1.8096-1.8106	1.8087
4-47	W-V	Fit of shaft in shaft bore	0.0020L-0.0040L	0.0055L



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Figure 4-48. Repair and Replacement Standard Points of Measurement for Transfer and Bearings.



Table 4-6. Repair and Replacement Standard Points of Measurement for Transfer and Bearings.

Fig. No.	Ref Letter	Points of Measurement	Size and Fit of New Parts	Wear Limits
4-48	B	Cover bore	4.3300-4.3309	4.3316
4-48	C	Bearing outside diameter	4.3301-4.3307	(*)
4-48	C-B	Fit of bearing in bore	0.0008L-0.0007T	0.0015L
4-48	A	Case bore	3.9363-3.9372	3.9379
4-48	R	Bearing outside diameter	3.9364-3.9370	(*)
4-48	R-A	Fit of bearing in bore	0.0007T-0.0008L	0.0015L
4-48	B	Cover bore	3.9980-3.9990	4.000
4-48	D	Bearing cup outside diameter	4.0004.001	(*)
4-48	D-B	Fit of cup in bore	0.003T-0.001T	0.000T
4-48	A	Case bore	3.995-4.005	4.0010
4-48	M	Bearing cup outside diameter	4.0004.0010	(*)
4-48	M-A	Fit of cup in bore	0.005L-0.0015T	0.0010L
4-48	B	Cover bore	4.4355-4.4365	4.4375
4-48	G	Bearing cup outside diameter	4.4375-4.4385	(*)
4-48	G-B	Fit of cup in bore	0.0010T-0.0030T	0.000T
4-48	A	Case bore	3.8750-3.8760	3.8765
4-48	K	Bearing cup outside diameter	3.8750-3.8760	(*)
4-48	K-A	Fit of cup in bore	0.0010T-0.0010L	0.0015L
4-48	A	Case bore	1.000-1.0012	1.0020
4-48	P	Shifter shaft outside diameter	0.9949-0.0061	0.9941
4-48	P-A	Fit of shaft in bore	0.0039L-0.0063L	0.0070L
4-48	B	Cover bore	1.000-1.0012	1.0020
4-48	P	Shifter shaft outside diameter	0.9949-0.9961	0.9941
4-48	P-B	Fit of shaft in bore	0.0039L-0.0063L	0.0070L
4-48	A	Case bore	1.2480-1.2496	1.2520
4-48	Q	Plug and oil seal outside diameter	1.2540-1.2580	(*)
4-48	Q-A	Fit of plug in bore	0.0024T-0.0100T	0.0020T
4-48	A	Case bore	0.7461-0.7472	0.7480
4-48	J	Dowel pin outside diameter	0.7500-0.7510	(*)
4-48	J-A	Fit of pin in bore	0.0028T-0.0049T	0.0020T
4-48	E	Bearing cone bore	2.0000-2.0005	(*)
4-48	F	Idler shaft outside diameter	2.0010-2.0015	2.0005
4-48	E-F	Fit of bearing on shaft	0.0005T-0.0015T	0.000T
4-48	N	Bearing bore	2.000-2.0005	(*)
4-48	F	Idler shaft outside diameter	2.0015-2.0010	2.0005
4-48	N-F	Fit of bearing on shaft	0.0005T-0.0015T	0.000T
4-48	L	Bearing bore	1.7500-1.7505	(*)
4-48	H	Rear output shaft outside diameter	1.7515-1.7510	1.7505
4-48	L-H	Fit of bearing on shaft	0.0005T-0.0015T	0.000T

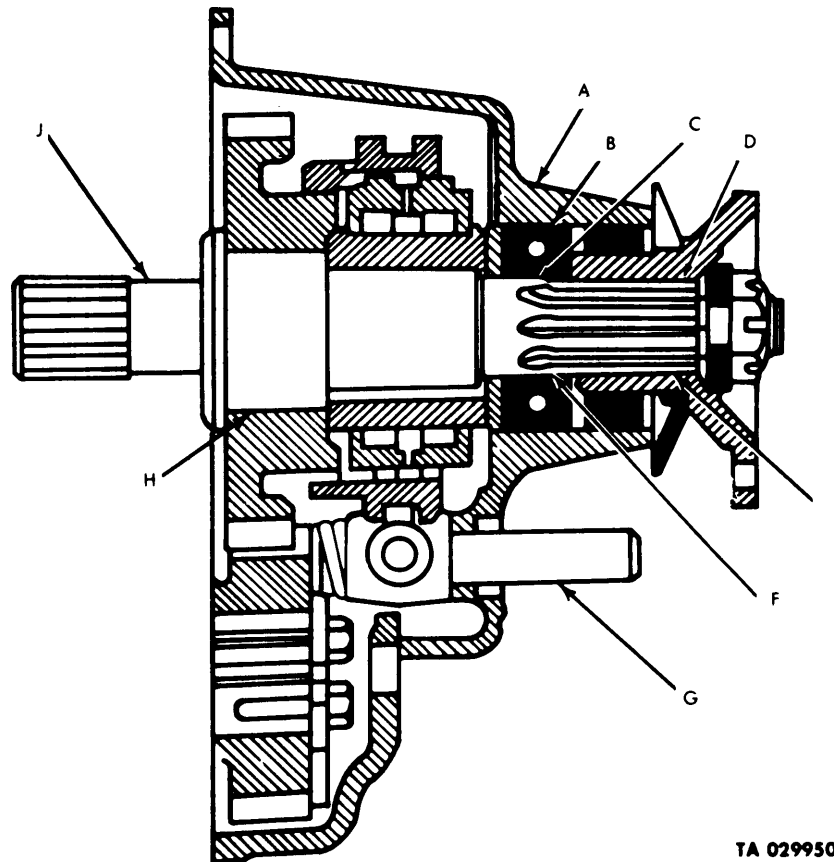


Figure 4-49. Repair and Replacement Standard Points of Measurement for Transfer Output Shaft and Cover.

Table 4-7. Repair and Replacement Standard Points of Measurement, for Transfer Output Shaft and Cover.

Fig. No.	Ref Letter	Point of Measurement	Size and Fit of New Parts	Wear Limits
4-49	A	Cover bore	3.3457-3.3466	3.3478
4-49	B	Bearing outside diameter	3.3458-3.3464	(*)
4-49	B-A	Fit of bearing in bore	0.0007T-0.00081L	0.0015L
4-49	A	Cover bore	0.8760-0.8780	0.8800
4-49	E	Reverse shift shaft outside diameter	0.8728-0.8740	0.8700
4-49	G-A	Fit of shaft in bore	0.0020L-0.0052L	0.0100L
4-49	D	Flange inside diameter	1.621-1.624	1.627
4-49	E	Shaft outside diameter	1.621-1.623	1.619
4-49	D-E	Fit of flange on shaft	0.0020T-0.0030L	0.0073L
4-49	C	Bearing bore	1.7712-1.7717	(*)
4-49	F	Front output shaft outside diameter	1.7715-1.7721	1.7711
4-49	C-F	Fit of bearing on shaft	0.0009T-0.0002L	0.0006L
4-49	H	Gear bore	2.6260-2.6278	2.6290
4-49	J	Shaft outside diameter	2.6240-2.6248	2.6230
4-49	H-J	Fit of gear on shaft	2.0012L-0.0038L	0.0060L

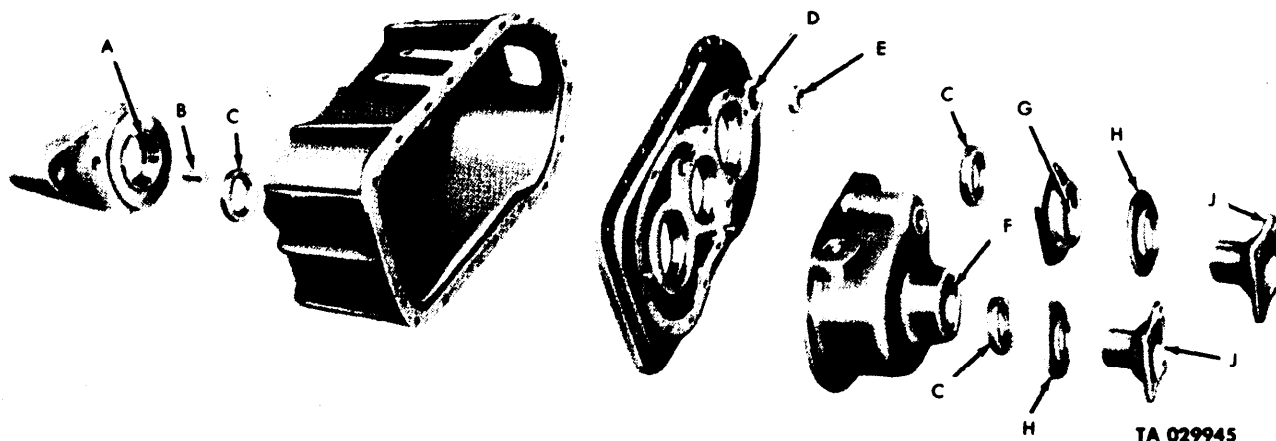


Figure 4-50. Repair and Replacement Standard Points of Measurement for Transfer Case and Seals.

Table 4-8. Repair and Replacement Standard Points of Measurement for Transfer Case and Seals.

Fig. No.	Ref Letter	Point of Measurement	Size and Fit of New Parts	Wear Limits
4-50	G	Cover bore	3.3465-3.3485	3.3495
4-50	C	Oil seal outside diameter	3.3524-3.3563	(*)
4-50	C-G	Fit of seal in bore	0.0038T-0.0098T	0.0025T
4-50	A	Cover bore	3.3465-3.3485	3.3495
4-50	C	Oil seal outside diameter	3.3524-3.3563	(*)
4-50	C-A	Fit of seal in bore	0.0038T-0.0098T	0.0025T
4-50	F	Case bore	3.3465-3.3485	3.3495
4-50	C	Oil seal outside diameter	3.3524-3.3563	(*)
4-50	C-F	Fit of seal in bore	0.0038T-0.0098T	0.0025T
4-50	D	Cover bore	1.4961-1.4971	1.4985
4-50	E	Oil seal outside diameter	1.5000-1.5039	(*)
4-50	E-D	Fit of seal in bore	0.0024T-0.0078T	0.0015T
4-50	A	Cover bore	0.7510-0.7530	0.7530
4-50	B	Dowel pin outside diameter	0.7500-0.7510	(*)
4-50	B-A	Fit of pin in bore	0.0000T-0.0020L	0.0025L
4-50	H	Deflector inside diameter	2.3956-2.3996	(*)
4-50	J	Flange outside diameter	2.4016-2.4056	2.4010
4-50	H-J	Fit of deflector on flange	0.0020T-0.0100T	0.0010T



## CHAPTER 5 REPAIR OF POWER TAKEOFFS

### Section I. DESCRIPTION, OPERATIONAL AND DATA (MODEL WN-7-28)

**5-1. General.** This chapter contains the rebuild instructions for power takeoff models WN-7-28, WND-7-28, and P-136-C.

**5-2. Description (Figure 5-1).** Heavy-duty power takeoff model WN-7-28, is designed for mounting on an SAE standard 6-hole or 6-stud power takeoff opening. The unit is designed to be mounted on the left or right side of the driving mechanism. The shifter shaft extends through each end of the case so that the shifting control linkage may be attached at either end. The output shaft extends from the front of the case and is provided with a woodruff key for mounting the winch propeller shaft companion flange. Boots are installed over the ends of the shifter shaft to protect the surface of the shaft. The input gear of the power takeoff is a cluster composed of a helical gear which is constantly in mesh with the helical gear of the transmission reverse idler gear, and the driving gear which is of spur tooth construction. The power takeoff has two speeds forward, neutral, and one speed in reverse. A shifting mechanism provides for selection of the desired speed and direction of rotation of the output shaft. The shifting mechanism in neutral position disengages the output shaft gears from the driving gear.

**5-3. Operation.**

**NOTE**

The reference letters in parentheses pertain to figure 5-2.

*a. Input Gear.* The helical input gear (P) is in constant mesh with the helical gear of the transmission reverse-idler gear and therefore, is in constant rotation when the transmission is engaged. (Refer to transmission, Chapter 3.) The input gear (P) is installed on a nonrotating input gearshaft (L) and is mounted on the input gear roller bearings (N). The shaft is pressed into the housing and secured with a cotter pin. A thrust washer (M) is located at each end of the input gear. The helical tooth portion of the input gear (P) is in constant mesh with the reverse gear (FF) which is installed on the reverse gearshaft (JJ) and secured with the reverse gear pin (EE). The reverse gearshaft rotates in two supporting bearings (GG and FF).

*b. Output Shaft.* The output shaft (H) is supported in the housing on two ball bearings (F and S). Two gears are installed on the output shaft (H). One is the output shaft sliding gear (AA) which is moved

forward and backward on the shaft by the shifter fork (Z). The other is the output shaft high speed gear (BB) which is free on the output shaft (H) and is in constant mesh with the input gear (P). The sliding gear (AA) is splined to the output shaft (H) and may be meshed with the spur teeth of the reverse gear (FF), with the spur teeth of the input gear (P) (for low speed operation) or may act as a clutch gear to couple the output shaft high speed gear (BB) to the output shaft (H).

*c. Shifter Fork.* The shifter fork (Z) is attached to the shifter shaft (A) by a capscrew. The fork engages the circumferential groove on the sliding gear (AA).

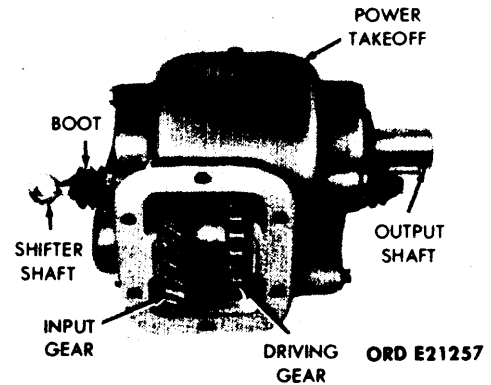
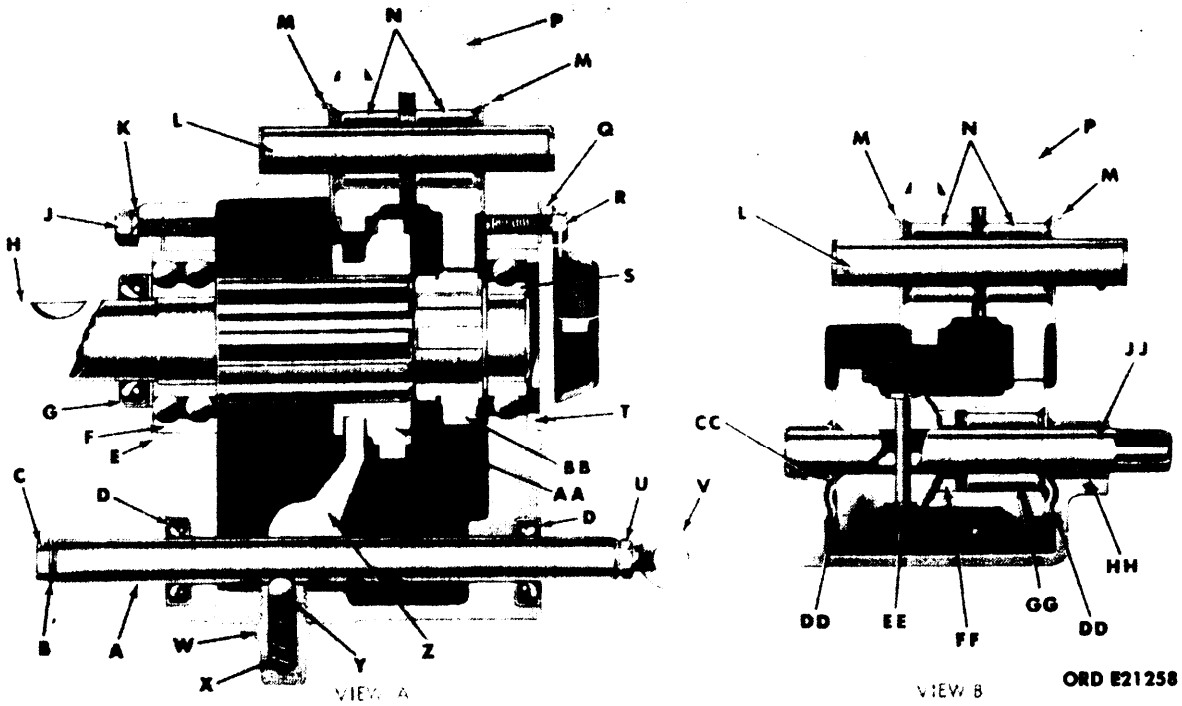


Figure 5-1. Power Takeoff Model WN-7-28.

**5-4. Data.**

National stock number . . . . .	252040-7061137
Ordinance number . . . . .	7061137
Manufacturer . . . . .	Spicer Div. - Dana Corp.
Model . . . . .	WN-7-28
Type . . . . .	Heavy-duty
Speeds . . . . .	2 forward, 1 reverse
Drive . . . . .	Transmission
Input gear . . . . .	Helical
Output shaft . . . . .	1¼ in. dia; 5/16 in. keyway
<b>Bearings:</b>	
Output shaft . . . . .	Two-ball type
Input shaft . . . . .	Two-roller type
Reverse gear . . . . .	Two-roller type
<b>Horsepower delivered:</b>	
100 rpm . . . . .	2.7
500 rpm . . . . .	13
1000 rpm . . . . .	27
Gear pitch . . . . .	7/9 in.
Backlash (allowable) . . . . .	0.008 in.



Legend for fig. 5-2:

KEY	ITEM	KEY	ITEM
A	Shifter shaft	T	Output shaft rear bearing spacer
B	Plain washer	U	Hex-nut
C	Capscrew	V	Eyebolt
D	Shifter shaft oil seal	W	Retainer
E	Output shaft front bearing cap	X	Spring
F	Output shaft front bearing	Y	Ball
G	Output shaft oil seal	Z	Fork
H	Output shaft	AA	Output shaft sliding gear
J	Capscrew	BB	Output shaft high speed gear
K	Lockwasher	CC	Reverse gear shaft front bearing
L	Input gear shaft	DD	Reverse gear thrust washer
M	Input gear thrust washer	EE	Reverse gear pin
N	Input gear roller bearings	FF	Reverse gear
P	Input gear	GG	Reverse gear shaft needle bearing
Q	Output shaft rear bearing cap	HH	Reverse gear shaft rear bearing
R	Capscrew	JJ	Reverse gear shaft
S	Output shaft rear bearing		

Figure 5-2. Power Takeoff Model WN-7-28 — Sectional View.

## Section II. REPAIR (MODEL WN-7-28)

### 5-5. General.

a. This section contains disassembly and assembly instructions for power takeoff model WN-7-28.

b. Cleaning and repair procedures are contained in chapter 2, section III of this manual.

c. Use a separate container for the parts of each subassembly. If more than one power takeoff is being rebuilt at the same time, use marked, separate containers for each power takeoff to avoid getting individual parts mixed up.

d. Power takeoff disassembly and assembly are accomplished by the following logical step-by-step procedures. The assembly procedures are provided only where special attention to a part or an assembly is required. Refer to paragraph 5-7 for the sequence of assembly operations. Assembly of the power takeoff is the exact opposite of disassembly, unless otherwise specified.

### 5-6. Disassembly and Assembly (Model WN-7-28).

a. *Power Takeoff Cover, Poppet Retainer, and Poppet Spring and Ball.*

(1) Remove the six capscrews and star washers securing the power takeoff cover to the carrier. (See fig. 5-3.) Remove the cover and the cover gasket.

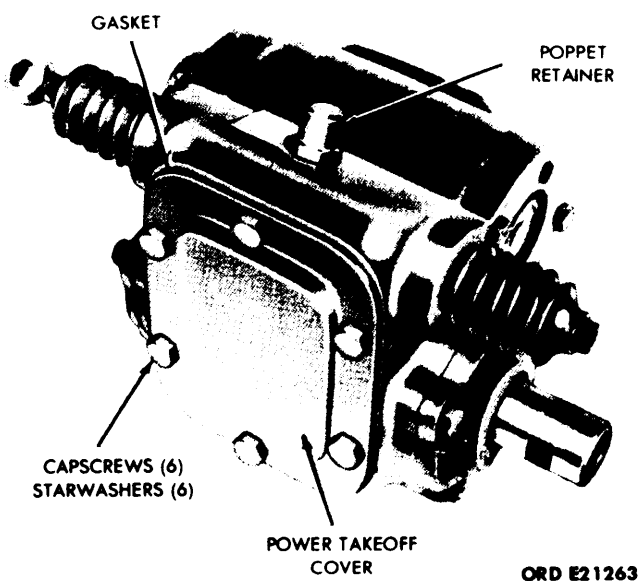


Figure 5-3. Removal of Power Takeoff Cover, Poppet Retainer, Poppet Spring and Ball.

Discard the gasket.

(2) Remove the poppet retainer (fig. 5-3). Turn the power takeoff on the side and remove the poppet spring and ball.

#### NOTE

During assembly of the power takeoff, always install a new cover gasket.

b. *Shifter Shaft and Shifter Fork.*

(1) Remove the safety wire and fork setscrew from the shifter fork. (See fig. 5-4.)

(2) Remove the shaft capscrew and flatwashers from the end of the shifter shaft. (See fig. 5-4.) Pull the shifter shaft rearward through the shifter fork. Remove the shifter fork and continue to slide the shifter shaft from the power takeoff case.

#### NOTE

During assembly, install the shifter fork with the screw hole on the rear side.

c. *Input Gearshaft and Input Gear.*

(1) Remove the input gearshaft cotter pin from the input gearshaft. (See fig. 5-5.) Using a soft driftpin, drive the input gearshaft from the case.

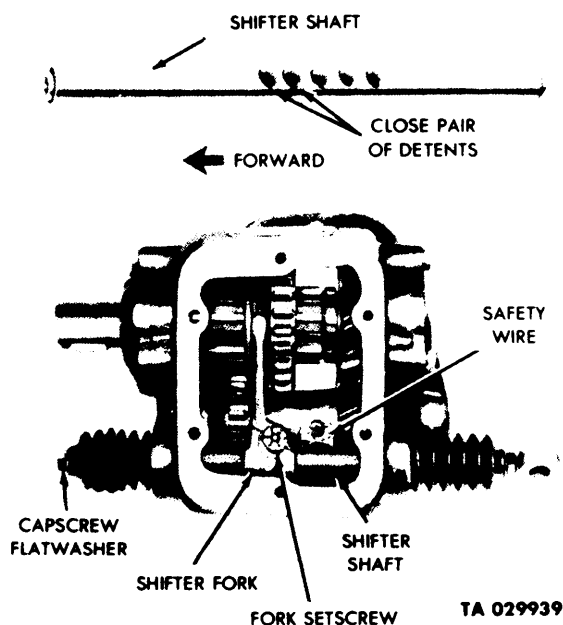


Figure 5-4. Removal of Shifter Shaft and Shifter Fork.

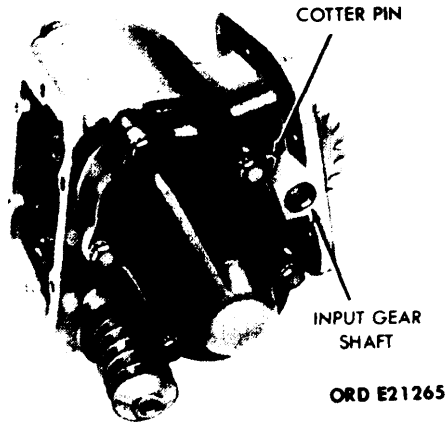


Figure 5-5. Removal of Input Gearshaft.

(2) Lift the gear from the case and remove the roller bearings from the gear, then remove the thrust washers from the respective positions. (See fig. 5-6.)

*d. Output and Reverse Shaft Rear Bearing Cap.*

(1) Remove the five capscrews and star washers securing the rear bearing cap to the power takeoff case. (See fig. 5-7.) Remove the rear bearing cap and cap gasket. Discard the gasket.

**NOTE**

On assembly, always install a new gasket.

(2) Remove the output shaft rear bearing spacer in front of the output shaft rear bearing.

*e. Output Shaft Front Bearing Cap and Companion Flange Key.*

(1) Remove the output shaft key from the output shaft. (See fig. 5-8.)

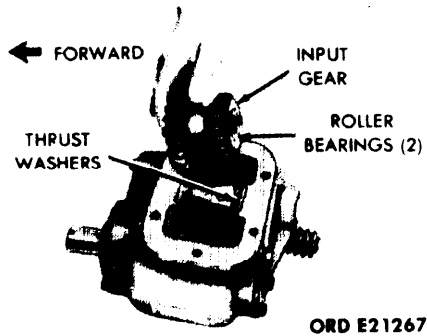


Figure 5-6. Removal of Input Gear, Gear Roller Bearings, and Thrust Washers.

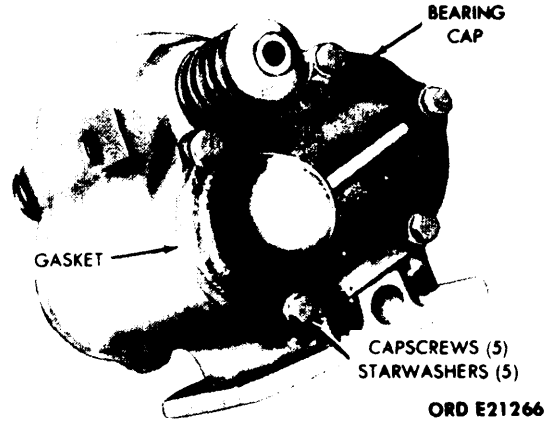


Figure 5-7. Removal of Output and Reverse Shaft Rear Bearing Cap.

(2) Remove the four capscrews and star washers securing the output shaft front bearing cap to the power takeoff. Remove the output shaft front bearing cap and gasket. Discard the gasket.

**NOTE**

On assembly, always install a new gasket.

**NOTE**

Do not remove the output shaft front bearing cap unless seal replacement is required. If seal is to be replaced, remove with suitable tool. Install by pressing or driving against the seal with a wooden block.

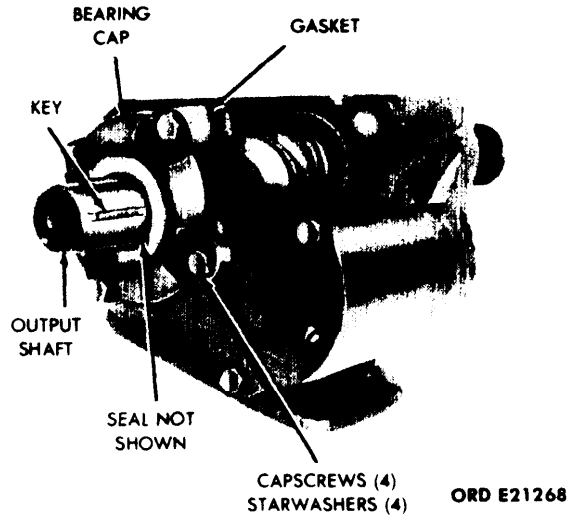


Figure 5-8. Removal of Output Shaft Front Bearing Cap and Companion Flange Key.



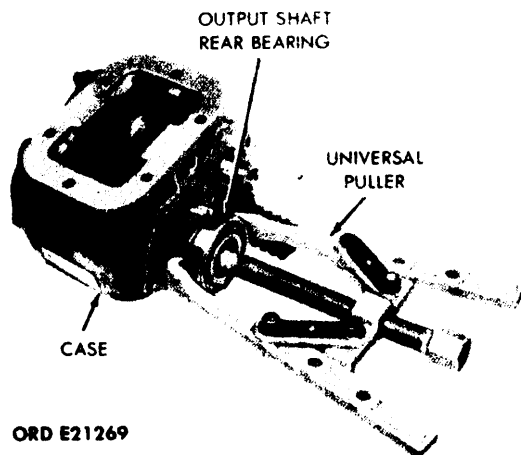


Figure 5-9. Removal of Output Shaft Rear Bearing.

f. Output Shaft Rear Bearing.

(1) Push or tap output shaft rearward enough to allow the rear bearing (fig. 5-9) to be removed.

(2) Using a universal puller remove the output shaft rear bearing. (See fig. 5-9.)

**NOTE**

Use a wooden block or press to install rear bearing on the shaft and into the rear bearing bore.

g. Output Shaft and High-Speed Gear.

(1) After the output shaft rear bearing is removed, push the output shaft back into place. Remove the snapping securing the high-speed gear and

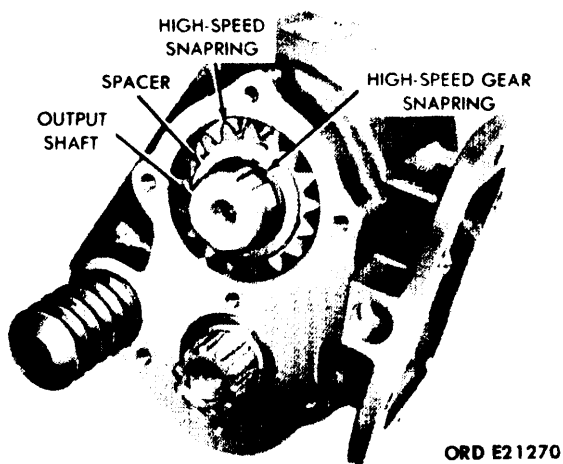


Figure 5-10. Removal of Output Shaft High Speed Gear Snapping and Spacer.

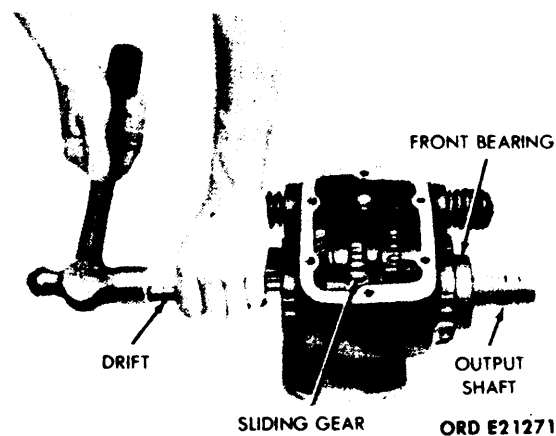


Figure 5-11. Removal of Output Shaft, High-Speed Gear, and Front Bearing.

spacer. (See fig. 5-10.)

(2) Push or tap the output shaft and front bearing from the case. (See fig. 5-11.) Lift the sliding gear out of the case.

h. Reverse Gear.

(1) Remove the cotter pin securing the reverse gear pin and remove the reverse gear pin. (See fig. 5-12.)

(2) Using a soft drift pin, tap the reverse gearshaft and front roller bearing from the case. Remove the front roller bearing from the shaft.

(3) Remove the reverse gear thrust washers (fig. 5-12).

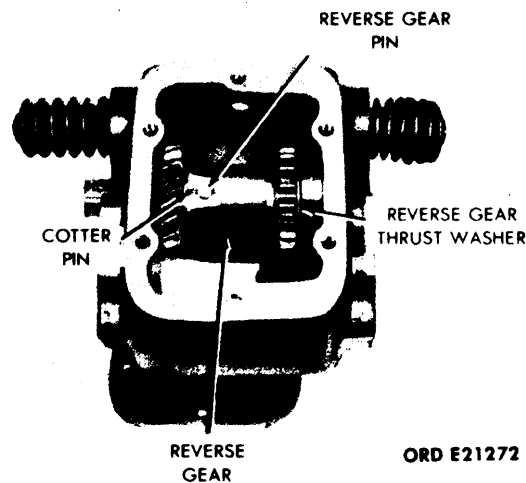


Figure 5-12. Removal of Reverse Gear.

**NOTE**

Use a wooden block when tapping the end roller bearing into the housing. Coat the thrust washers with grease, automotive and artillery (GAA), MIL-G-10924; this holds the washers in position for installation of the reverse gearshaft.

*i. Reverse Gear Rear Bearing.*

Using an arbor press or a soft drift pin, remove the reverse gearshaft rear bearing from the housing. (See fig. 5-13.)

**NOTE**

When installing reverse gearshaft rear bearing into the housing, tap the bearing into position with a block of wood and hammer so as not to damage the bearing.

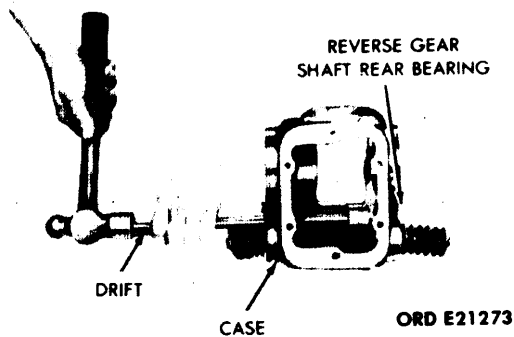


Figure 5-13. Removal of Reverse Gearshaft Rear Bearing.

*j. Output Shaft Front Bearing.* Using a universal or suitable puller, pull the output shaft front bearing from the shaft. (See fig. 5-14.)

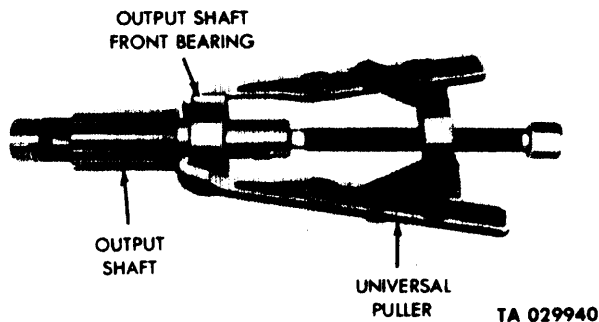


Figure 5-14. Removal of Output Shaft Front Bearing.

**NOTE**

Use an arbor press to install the output shaft front bearing on the output shaft.

*k. Shifter Shaft Boot and Seal.* Using a blunt rod, tap the seal and boot from the seat in the counter bore. (See fig. 5-15.) It is not necessary to remove the seal unless it is damaged.

**NOTE**

During installation tap the boot into the seat using a small wooden block. Work around the base of the boot until it is evenly seated. If the seal was removed, install the seal first. Tap the seal into place with a suitable arbor or wooden dowel.

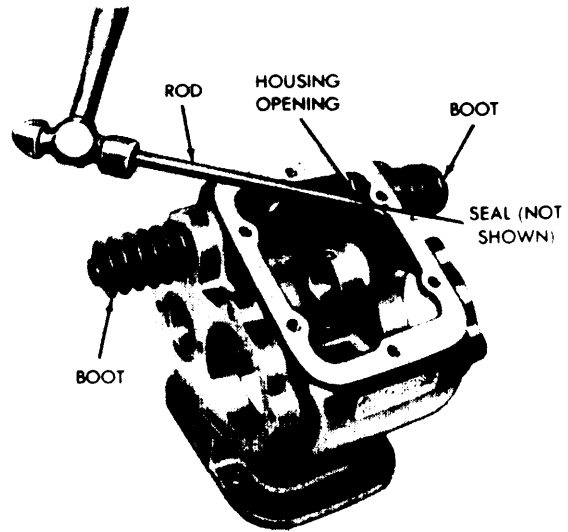


Figure 5-15. Removal of Shifter Shaft Boot and Seal.

**5-7. Assembly Sequence — Power Takeoff (Model WN-7-28).**

- a. Shifter shaft boot and seal. (See fig. 5-15.)
- b. Output shaft front bearing. (See fig. 5-14.)
- c. Reverse gearshaft rear bearing. (See fig. 5-13.)
- d. Reverse gear. (See fig. 5-12.)
- e. Output shaft and high-speed gear. (See fig. 5-10 and 5-11.)
- f. Output shaft rear bearing. (See fig. 5-9.)
- g. Output shaft front bearing cap and companion flange key. (See fig. 5-8.)
- h. Output and reverse shaft rear bearing cap. (See fig. 5-7.)
- i. Input gearshaft and input gear. (See fig. 5-5 and 5-6.)
- j. Shifter shaft and shifter fork. (See fig. 5-4.)
- k. Power takeoff cover, poppet retainer, and poppet spring and ball. (See fig. 5-3.)

**Section III. TEST AND ADJUSTMENT (MODEL WN-7-28)**

**5-8. General.** Tests and adjustments can either be accomplished by installation on the vehicle or on a transmission coupled to an engine prepared for a dynamometer test.

a. *Operation.* Test power takeoff WN-7-28 for the following

- (1) Quiet operation.
- (2) Smooth and positive shifting.
- (3) Check for lubricant leaks.

b. *Adjustments.*

(1) There are no adjustments on the power takeoff assembly.

(2) Refer to TM 9-2320-209-20/1 for the power takeoff linkage adjustment.

**5-9. Lubrication.** Lubrication of the power takeoff is provided by the transmission. Refer to LO 9-2320-209-12/1 for lubrication specifications.

**Section IV. REPAIR AND REPLACEMENT STANDARDS (MODEL WN-7-28)**

**5-10. General.** The repair and replacement standards included herein give the minimum, maximum, and key clearance of new parts. The standards also give wear limits which indicate the point to which a part or parts may be worn before replacement, in order to receive maximum service with minimum replacement. Normally, all parts which have not been worn beyond the dimensions shown in the "Wear Limits" column, or damaged by corrosion, will be approved for service. An asterisk (\*) in the "Wear Limits" column indicates that the part or parts should be replaced when worn beyond

the limits given in the "Size and Fit of New Parts" column. In the "Size and Fit of New Parts" and "Wear Limits" columns the letter "L" indicates a loose fit (clearance) and the letter "T" indicates a tight fit (interference).

**5-11. Repair and Replacement Standard Points of Measurement.** Figures 5-16, 5-17, and 5-18 and corresponding tables 5-1, 5-2, and 5-3 provide the repair and replacement standard points of measurement for power takeoff model WN-7-28.

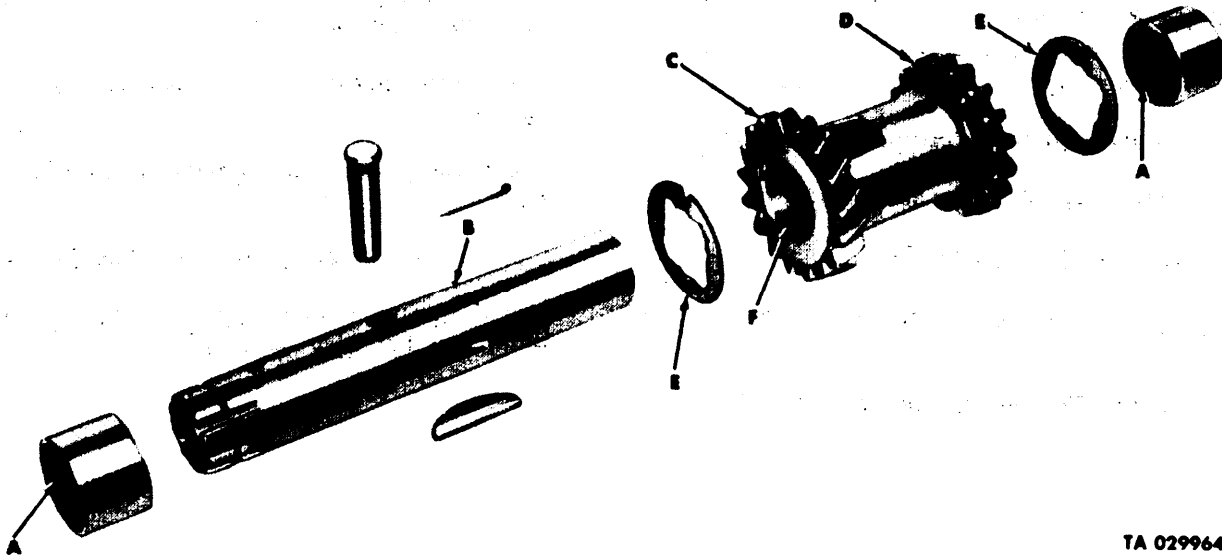
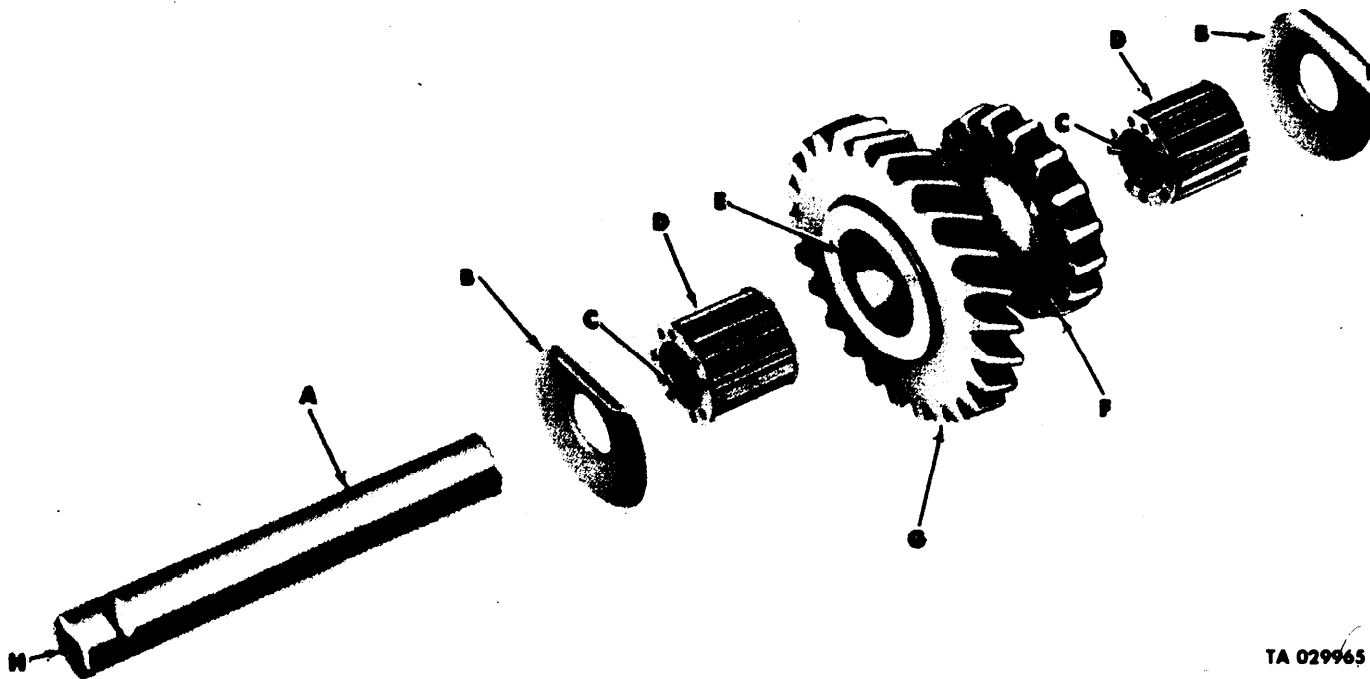


Figure 5-16. Repair and Replacement Standard Points of Measurement for Reverse Gear and Related Parts.

Table 5-1. Repair and Replacement Standard Points of Measurement for Reverse Gear and Related Parts.

Fig. No.	Ref Letter	Point of Measurement	Size and Fit of New Parts	Wear Limits
5-16	A	Inside diameter of bearing	1.2510-1.2520	.001
5-16	B	Outside diameter of shaft	1.2495-1.2505	.003
5-16	A-B	Fit of bearing on shaft	0.0005L-0.0025L	.004
5-16	C	Reverse gear to input drive gear (backlash)	.006L-.009L	.016L
5-17	G	Reverse gear to output sliding gear (backlash)	.008L-.011L	.018L
5-16	D	Thickness of thrust washer (a)	.061-.063	(*)
5-18	L	Inside diameter of reverse gear	1.252-1.253	(*)
5-16	E	Fit of gear on shaft	.0015L-.0035L	.0055L
5-16	F			
5-16	B-F			

(a) Replace when bronze facing is partially or entirely worn off.



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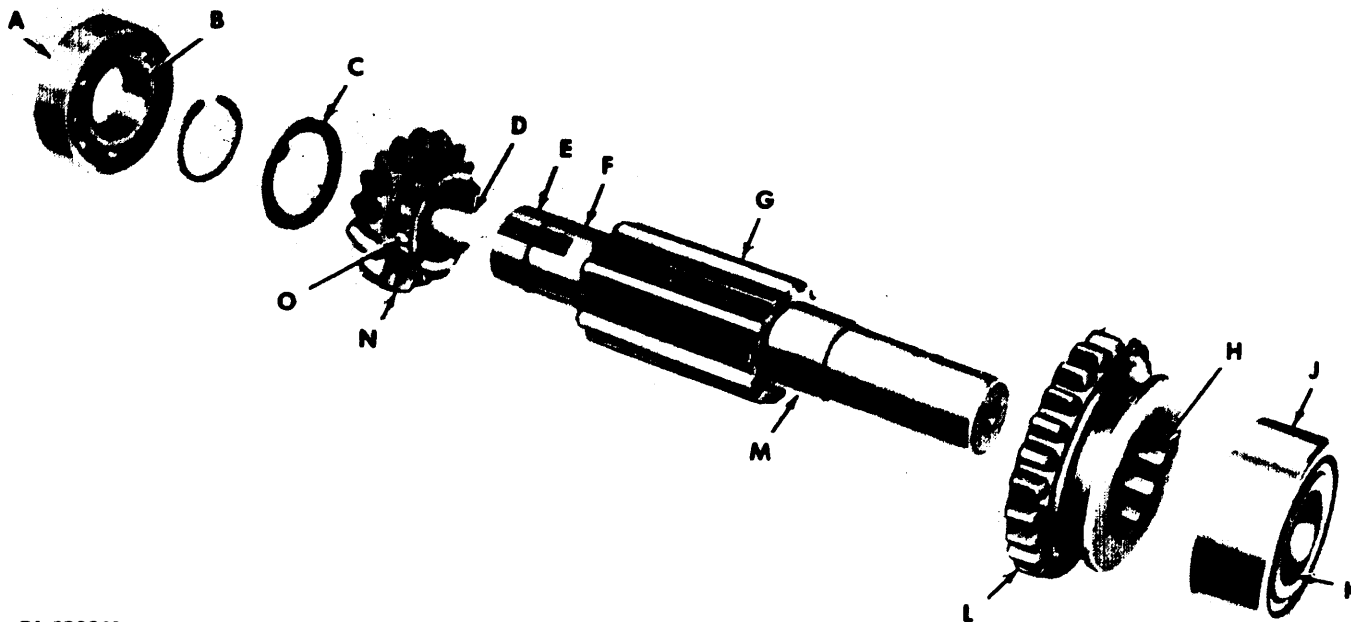
Figure 5-17. Repair and Replacement Standard Points of Measurement for Input Gear and Related Parts.

Table 5-2. Repair and Replacement Standard Points Of Measurement for Input Gear and Related Parts

Fig. No.	Ref Letter	Point of Measurement	Size and Fit of New Parts	Wear Limits
5-17	A	Diameter of shaft	0.7495-0.7500	0.003
5-17	B	Thickness of thrust washer	0.061-0.063	See note $\phi$
5-17	C	Inside diameter of bearing	0.7500	(*)
5-17	A-C	Fit of bearing on shaft	0.0000L-.0005L	0.004L
5-17	D	Outside diameter of bearing	1.250	(*)
5-17	E	Inside diameter of gear	1.250-1.251	0.007
5-17	D-E	Fit of bearing in gear	0.000L-.0001L	.004L
5-17	F	input low gear to output sliding gear (backlash)	0.008L-0.011L	0.0172
5-18	L	Input gear to output high-speed gear (backlash)	0.006L-.009L	0.018L
5-17	G	Input gear to reverse gear (backlash)	0.006L-.009L	.016L
5-16	C			
5-17	H	Diameter of outer end of shaft	0.7510-.7515	See note #

( $\phi$ ) Replace when bronze facing is partially or entirely worn off.

(#) Press fit of case.



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Figure 5-18. Repair and Replacement Standard Points of Measurement for Front Output Shaft and Related Parts.

Table 5-3. Repair and Replacement Standard Points of Measurement for Front Output Shaft and Related parts — Model WN-7-28

Fig. No.	Ref Letter	Point of Measurement	Size and Fit of New Parts	Wear Limits
5-18	A	Outside diameter of rear bearing	2.8346	(*)
		Diameter of bearing bore in housing	2.8346-2.8356	0.001
		Fit of bearing in housing bore	0.0000L-0.0010L	(*)
5-18	B	Inside diameter of rear bearing	1.3780	(*)
5-18	C	Thickness of thrust washer	0.112-0.124	0.006
5-18	D	Inside diameter of high-speed gear	1.4060-1.4065	
5-18	E	Diameter of output shaft	1.3785-1.3795	(*)
5-18	B-E	Fit of bearing on shaft	0.0005T-0.0015T	(*)
5-18	F	Diameter of output shaft	1.3985-1.4000	0.003
5-18	D-F	Fit of gear on shaft	0.006L-0.008L	
5-18	H-G	Fit of gear to shaft and gear splines	0.004L-0.007L	0.011
5-18	J	Outside diameter of front bearing	2.8346	(*)
		Diameter of bearing bore in housing	2.8346-2.8356	0.0008
		Fit of bearing in housing bore	0.0000L-0.0010L	0.0018L
5-18	K	Inside diameter of front bearing	1.3780	(*)
5-18	L	Sliding gear to input low speed gear (backlash)	0.008L-0.011L	0.017L
5-18	L	Sliding gear to reverse gear (backlash)	0.008L-0.011L	0.017L
5-18	M	Diameter of shaft	1.3785-1.3795	(*)
5-18	K-M	Fit of bearing on shaft	0.005T-0.0015T	(*)
5-18	N	High-speed gear to input gear (backlash)	0.0066-0.009L	0.018L
5-18	O-H	Fit of gear splines to gear splines	0.004L-0.007L	

## Section V. DESCRIPTION, OPERATION, AND DATA (MODEL WND-7-28)

**5-12. General.** Because power takeoff model WND-7-28 and power takeoff model WN-7-28 are identical, except for the added accessory drive on model WND-7-28, only the accessory drive will be covered in this section. For the disassembly and assembly pertaining to the remaining portion of power takeoff model WND-7-28, refer to section II for power takeoff model WN-7-28 and use these same disassembly and assembly procedures.

**5-13. Description.** Power takeoff model WND-7-28 is actually a model WN-7-28 power takeoff with an accessory drive attached. This modification is accomplished by removing the output shaft rear bearing cap from power takeoff model WN-7-28 and replacing it with an oversized bearing cap called a rear output shaft housing (fig. 5-19). The rear output shaft housing contains a shifter shaft and fork that controls the movement of the sliding clutch sleeve. (See fig. 5-20.) The sliding sleeve clutch slides back and forth on the output shaft gear, thus engaging and disengaging the output shaft.

**5-14. Operation.** For operation of power takeoff model WND-7-28 see section I, power takeoff model WN-7-28, description, operation, and data.

**5-15. Data.**

National stock number . . . . .	2520-00-706-1136
Ordnance number . . . . .	7061136
Manufacturer . . . . .	Spicer Div. - Dana Corp.
Model . . . . .	WND-7-28
Type . . . . .	Heavy-duty
Speeds . . . . .	2 forward, 1 reverse
Drive . . . . .	Transmission
Input gear . . . . .	Helical
Output shaft (front) . . . . .	1¼ in. dia, 5/16 in. keyway
Output shaft (rear) . . . . .	7/8 in. dia, 5/16 in. keyway
<b>Bearings:</b>	
Output shaft (front) . . . . .	Two-ball type
Output shaft (rear) . . . . .	One-ball type
Input gear . . . . .	Two-roller type
Reverse gear . . . . .	Two-roller type
<b>Horsepower delivered:</b>	
100 rpm . . . . .	2.7
500 rpm . . . . .	13
1000 rpm . . . . .	27
Gear pitch . . . . .	7/9 in.
Backlash (allowable) . . . . .	0.008 in.

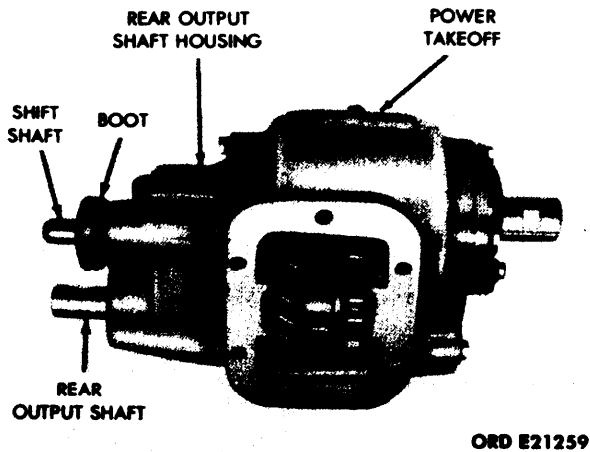
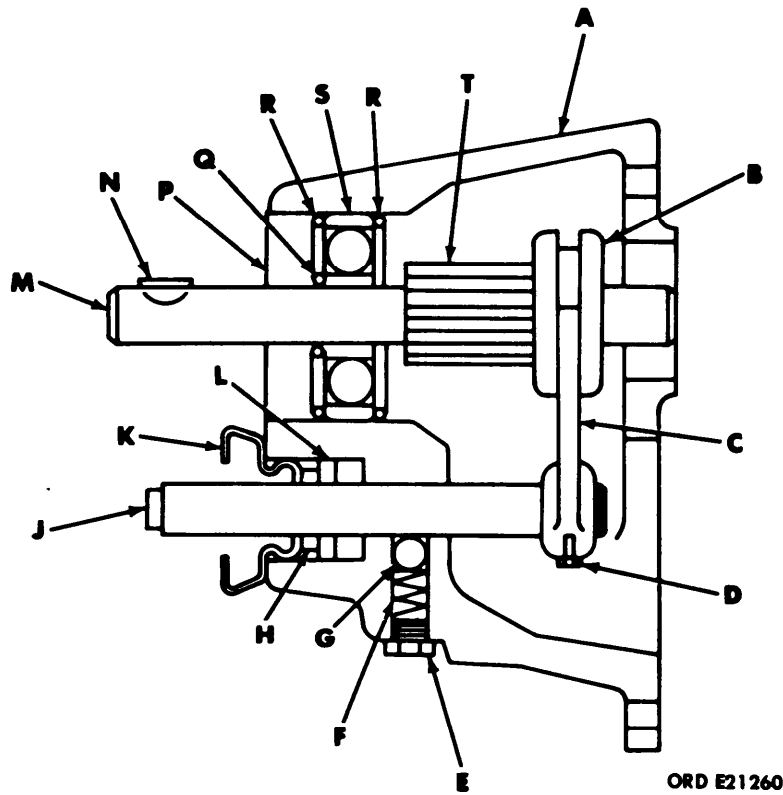


Figure 5-19. Power Takeoff Model WND-7-28.



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Legend for fig. 5-20:

KEY	ITEM	KEY	ITEM
A	Housing	K	Boot
B	Sliding clutch sleeve	L	Oil seal
C	Shifter fork	M	Output shaft
D	Fork locking screw	N	Key
E	Retainer	P	Oil seal
F	Spring	Q	Snapping
G	Ball	R	Snapping
H	Retainer	S	Bearing
J	Shifter shaft	T	Output shaft gear

Figure 5-20. Rear Output Shaft Housing — Sectional View.

## Section VI. REPAIR (MODEL WND-7-28)

### 5-16. Disassembly and Assembly of Accessory Drive.

#### a. Rear Output Shaft Housing and Shifter Shaft Retainer, Ball, and Spring.

(1) Remove the five capscrews securing the rear output shaft housing to the power takeoff case. (See fig. 5-21.) Remove the housing and housing gasket. Discard the gasket.

(2) Remove the retainer, spring, and ball from the rear output shaft housing. (See fig. 5-21.)

### NOTE

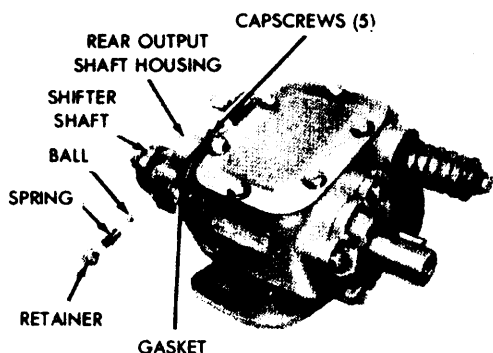
During assembly, always install a new gasket.

#### b. Shifter Shaft and Shifter Shaft Fork.

(1) Cut safety wire and remove from housing. (See fig. 5-22.)

(2) Remove the lock screw securing the shifter fork to the shifter shaft and remove the shaft and fork from the housing. (See fig. 5-22.)





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Figure 5-21. Removal of Rear Output Shaft Housing Shifter Shaft Retainer, Ball, and Spring.

c. Rear Output Shaft and Sliding Clutch Sleeve.

(1) Using a pair of snapping pliers, remove the output shaft snapping securing the shaft to the bearing. (See fig. 5-23.)

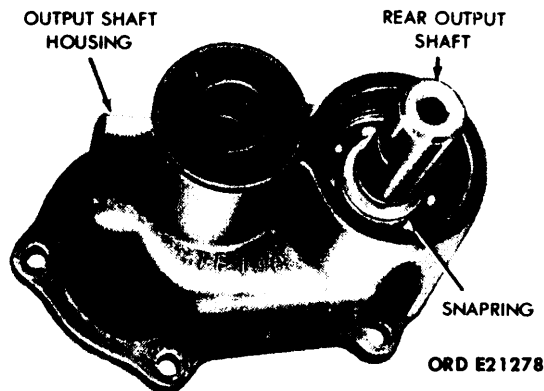


Figure 5-23. Removal of Output Shaft Snapping.

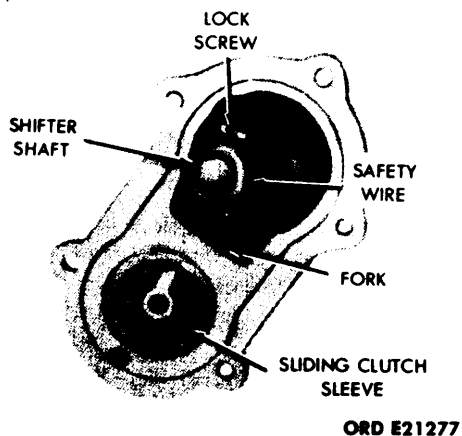


Figure 5-22. Removal of Shifter Shaft and Shifter Shaft Fork.

(2) Place the rear output shaft housing in a vise. Using a soft drift pin, drive the rear output shaft from the housing and remove the sliding clutch sleeve. (See fig. 5-24.)

d. Rear Output Shaft Bearing and Shifter Shaft Boot and Oil Seal.

(1) Using a pair of snapping pliers, remove the bottom and top snaprings securing the rear output shaft bearing in the housing and remove the bearing. (See fig. 5-25.)

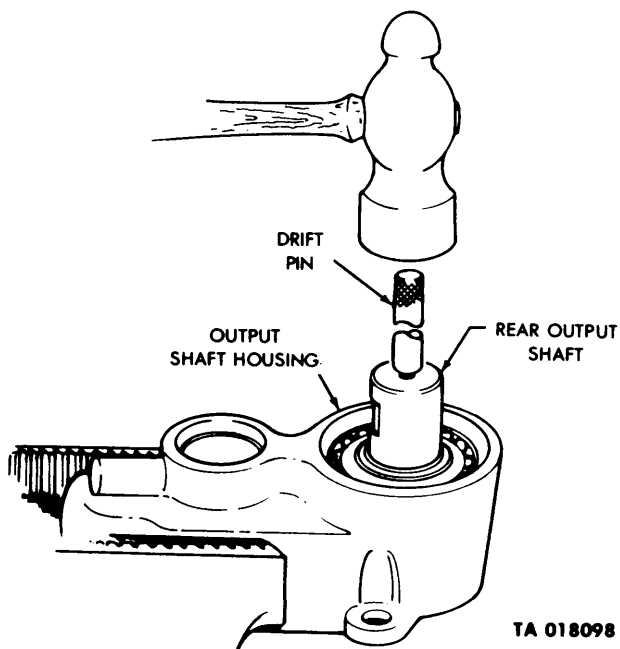


Figure 5-24. Removal of Rear Output Shaft and Sliding Clutch Sleeve.

**NOTE**

When installing the shifter shaft boot and oil seal, press the oil seal in part way and fit the boot around the seal, then continue to press the seal into position.

**NOTE**

Coat the oil seal with universal gear lubricant (GO), MIL-L-2105, before assembling to housing, to prevent damage to seal.

**5-17. Assembly Sequence for Accessory Drive.**

- a. Rear output shaft bearing and shifter shaft boot and oil seal. (See fig. 5-25.)
- b. Rear output shaft and sliding clutch sleeve. (See fig. 5-23 and 5-24.)
- c. Shifter shaft and shifter fork. (See fig. 5-22.)
- d. Rear output shaft housing and shifter shaft retainer, ball, and spring. (See fig. 5-21.)

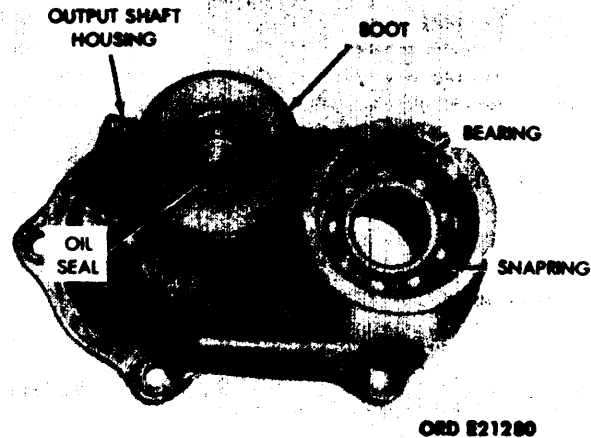


Figure 5-25. Removal of Rear Output Shaft Bearing and Shifter Shaft Boot and Oil Seal.

**Section VII. TEST AND ADJUSTMENT (MODEL WND-7-28)**

**5-18. General.** Tests and adjustments can either be accomplished by installation on the vehicle or on a transmission coupled to an engine prepared for a dynamometer test.

a. *Operation.* Test power takeoff WND-7-28 for the following:

- (1) Quiet operation.
- (2) Smooth and positive shifting.
- (3) Observe for lubricant leaks.

b. *Adjustments.*

- (1) There are no adjustments required on the power takeoff assembly.
- (2) Refer to TM 9-2320-209-20/1 for the power takeoff linkage adjustment.

**5-19. Lubrication.** Lubrication of power takeoff is provided by the transmission. Refer to LO 9-2320-209-12/1 for lubrication instructions.

**Section VIII. REPAIR AND REPLACEMENT STANDARDS (MODEL WND-7-28)**

**5-20. General.** The repair and replacement standards included herein give the minimum, maximum, and key clearances of new parts. The standards also give wear limits which indicate the extent to which a part or parts may be worn before replacement, in order to receive maximum service with minimum replacement. Normally, all parts which have not been worn beyond the dimensions shown in the "Wear Limits" column, or damaged by corrosion, will be approved for service. An asterisk (\*) in the "Wear Limits" column indicates that the part or parts should

be replaced when worn beyond the limits given in the "Size and Fit of New Parts" column. In the "Size and Fit of New Parts" column the letter "L" indicates a loose fit (clearance) and the letter "T" indicates a tight fit (interference).

**5-21. Repair and Replacement Standard Points of Measurement.** Figure 5-26 and table 5-4 provide the repair and replacement standard points of measurement for power takeoff model WND-7-28.

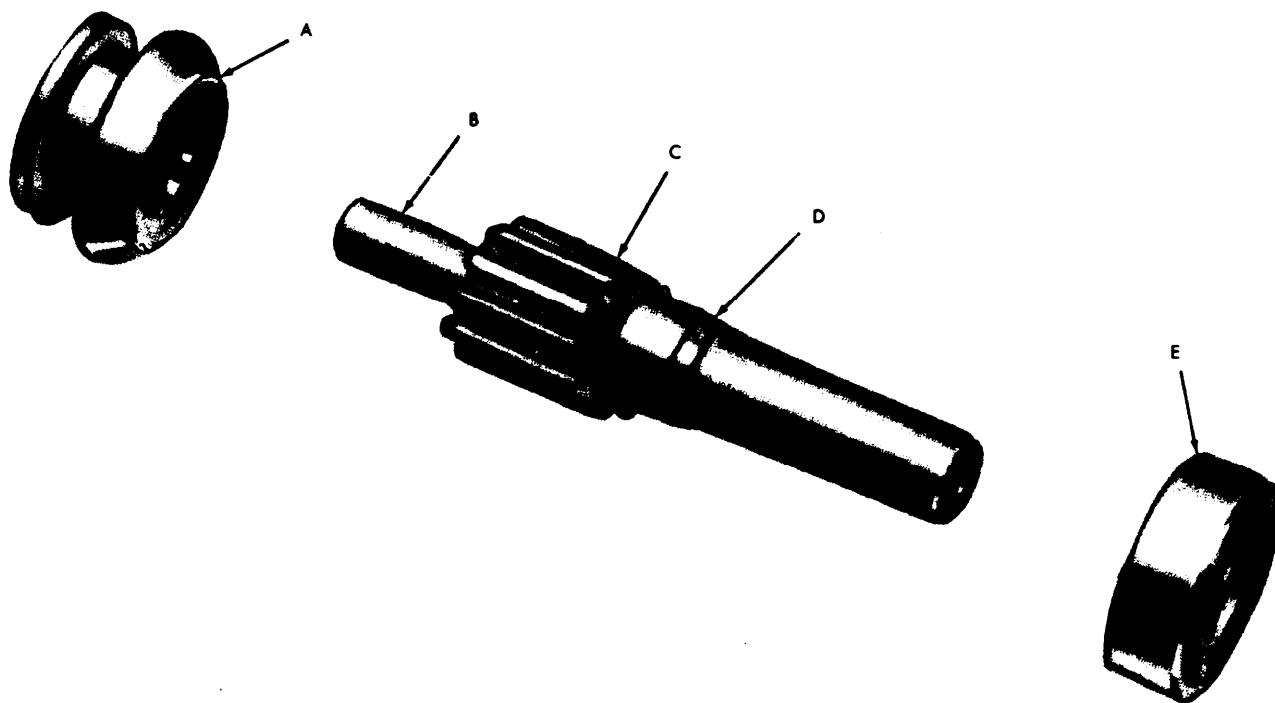


Figure 5-26. Repair and Replacement Standard Points of Measurement for Output Shaft and Related Parts – Model WND-7-28.

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Table 5-4. Repair and Replacement Standard Points of Measurement for Output Shaft and Related Parts — Model WND-7-28

Fig. No.	Ref Letter	Point of Measurement	Size and Fit of New Parts	Wear Limits
5-26	A-C	Output shaft gear to sliding clutch (backlash)	.0010L-.0021L	(*)
5-26	B	Outside diameter of shaft	0.6230-0.6235	(*)
5-26	D-E	Fit of bearing on shaft	0.0003T-0.0007T	(*)
5-26	D	Outside diameter of shaft	0.9843-0.9847	(*)
5-26	E	Inside diameter of bearing	0.9840	(*)

## Section IX. DESCRIPTION, OPERATION, AND DATA (MODEL P-136-C)

### 5-22. General.

a. Cleaning and repair procedures are contained in Chapter 2, section III of this manual.

b. Use a separate container for parts of each assembly. If more than one power takeoff is being rebuilt at one time, some provisions must be made for keeping the parts of each power takeoff separated. This is especially important when some parts are to be used again.

c. Power takeoff disassembly and assembly are accomplished by following the logical step-by-step procedures. Assembly procedures are provided only where special attention to a particular part or an assembly is needed. Assembly of the power takeoff is the exact opposite of disassembly, unless otherwise specified. (Refer to para 5-27 for assembly sequence.)

**5-23. Description.** The power takeoff is a single drive, one-speed unit and is designed to be mounted only on transfers. The power takeoff is cylindrical in shape and is secured to the transfer by six capscrews. A small pump (fig. 5-27), located on the exterior of the carrier (fig. 5-27), pumps lubricant from the transfer case into the power takeoff carrier; the lubricant then flows back into the transfer case through the input shaft or relief valve. The pump is driven by the power takeoff output shaft (fig. 5-27). The center of the output shaft contains a pump cam lobe (C, fig. 5-28) which raises and lowers the pump plunger (N, fig. 5-28) thus creating the suction that pulls the lubricant from the transfer case. There are two check valves (V, fig. 5-28) in the oil pump instead of one at the transfer case. The jaws of the clutch halves (A and P, fig. 5-28) are designed to provide highly efficient lubrication and drive in both directions of rotation. Shifting is accomplished by the shift lever (fig. 5-27) mounted on the side of the power takeoff carrier, which moves the shifter shaft (fig. 5-27) and shifter fork (B, fig. 5-28) back and forth to engage or disengaged the power takeoff sliding clutch (A, fig. 5-28) from the transfer output shaft driving clutch (P, fig. 5-28).

### 5-24. Operation.

#### NOTE

The reference letters in parentheses pertain to figure 5-28.

On trucks powered by gasoline engines, the speed at which the power takeoff operates is governed by the vehicle governor. The governor is attached to

the power takeoff by removing the governor plug (D) on the power takeoff and installing the vehicle governor drive assembly so as to engage the governor gear (E) of the power takeoff drive shaft (K). When the power takeoff exceeds a set limit of operation, the vehicle engine governor cuts in, governing the output speed of the power takeoff. On trucks powered by multifuel engines, speed regulation is maintained by throttle position, connected by Bowden wire from the PTO shift lever to the control lever on the injection pump. Normal operation of the governor section of the injection pump maintains the engine speed determined by this throttle setting.

### 5-25. Data.

National stock number . . . . .	2520-00-229-5673
Ordinance number . . . . .	11609228
Model . . . . .	P-136-C
Speeds . . . . .	One (variable with engine rpm and transmission gear selection)
Drive . . . . .	Transfer
Output shaft . . . . .	Tapered 1½ in. to 1 in.
Bearing:	
Output shaft . . . . .	Two-roller type
Horsepower delivered . . . . .	Same as engine HP

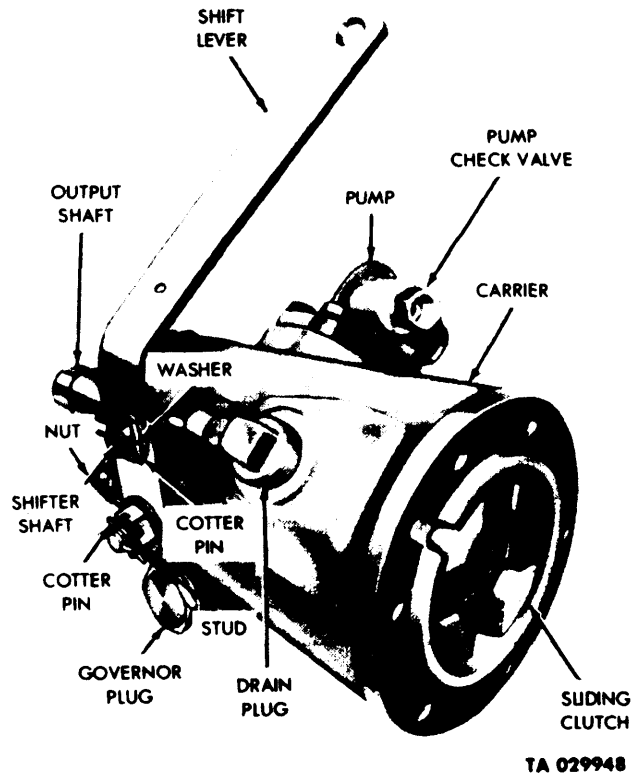
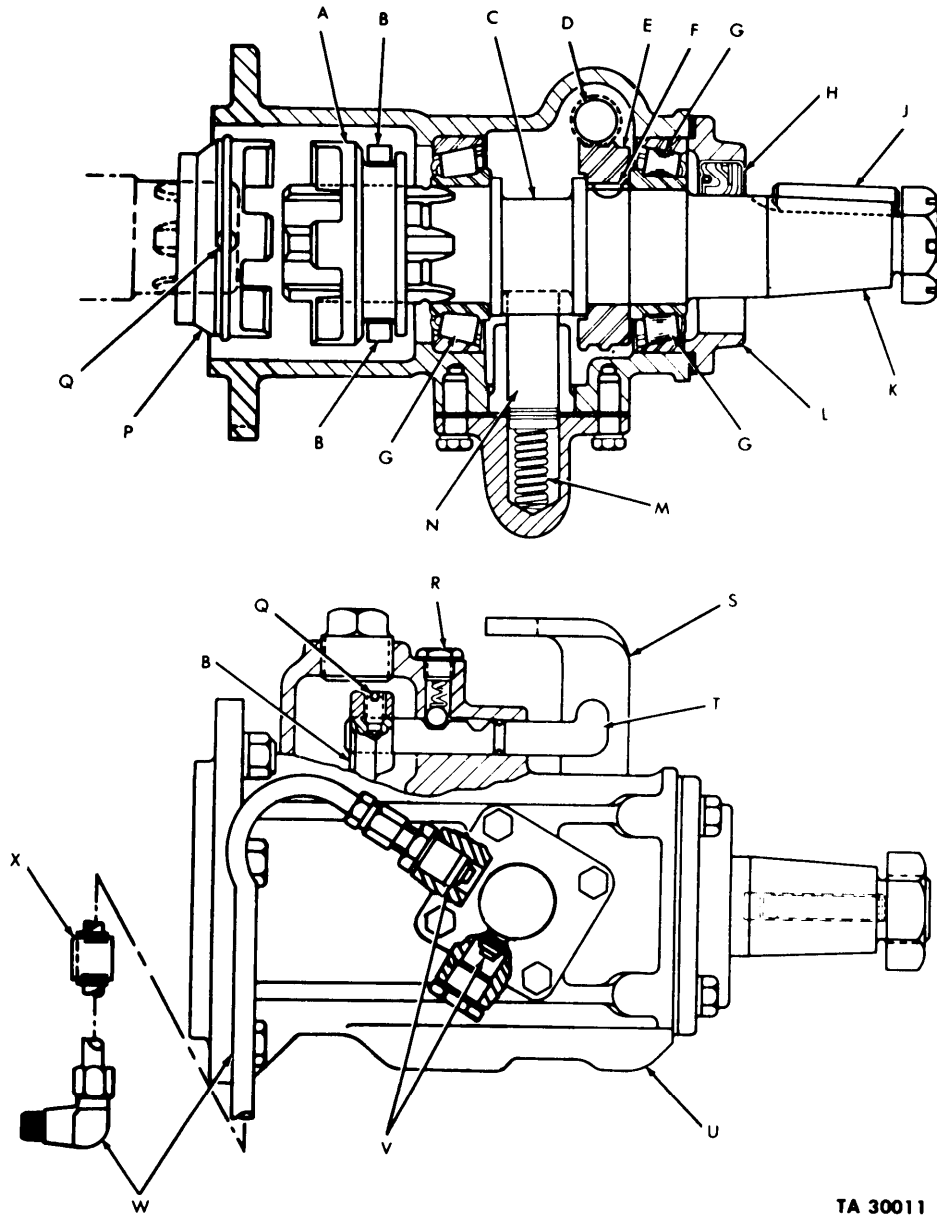


Figure 5-27. Power Takeoff Model P-136-C.



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Legend for fig. 5-28:

KEY	ITEM	KEY	ITEM	KEY	ITEM
A	Clutch, sliding	J	Key (machine)	S	Lever
B	Shifter fork	K	Drive shaft	T	Shifter shaft
C	Pump cam lobe	L	Retainer (bearing and seal)	U	Carrier
D	Plug	M	Pump spring	V	Valve, check
E	Governor gear	N	Pump plunger	W	Oil line, bushing, and elbow
F	Key (woodruff)	P	Clutch, driving	X	Clamp
G	Roller bearing	Q	Setscrew and safety wire		
H	Oil seal	R	Retainer, spring, and ball		

Figure 5-28. Power Takeoff — Sectional View.

Section X. REPAIR (MODEL P-136-C)

5-26. Disassembly and Assembly.

a. Drain Plug and Shift Lever.

(1) Remove the drain plug (fig. 5-29) and drain the power takeoff.

(2) Remove the two cotter pins, nut, and washers securing the shift lever to the carrier. (See fig. 5-29.) Remove the shift lever from the carrier.

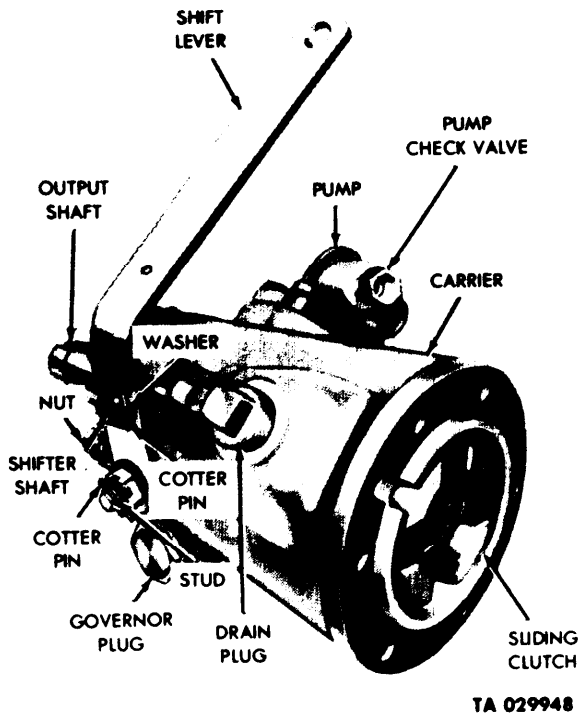


Figure 5-29. Drain Plug, Two Cotter Pins, Nut, Washers, and Shifter Shaft.

**NOTE**

During assembly, use new cotter pins.

b. Pump and Shifter Shaft.

(1) Remove the four capscrews and lockwashers securing the pump to the carrier. (See fig. 5-30.) Remove the pump and gasket. Discard the gasket.

**NOTE**

Assemble using a new gasket.

(2) Remove the shifter fork setscrew and remove the shifter shaft. (See fig. 5-31.)

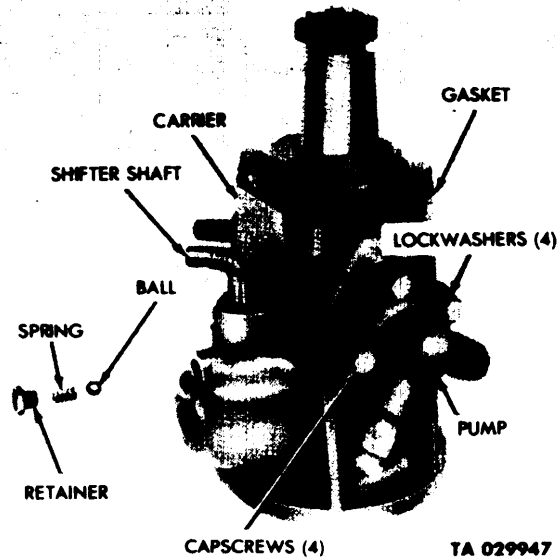


Figure 5-30. Removal of Pump, Shifter Shaft Retainer, Spring, and Ball.

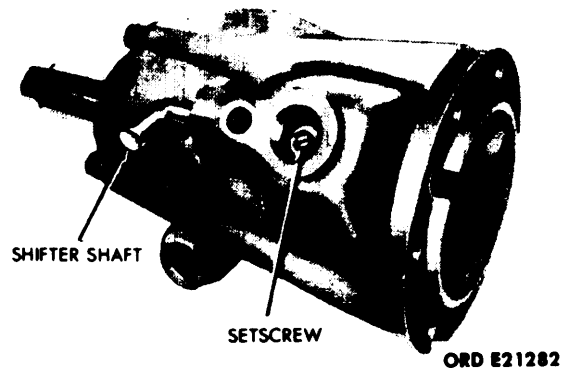


Figure 5-31. Removal of Shifter Shaft.

c. Output Shaft Rear Bearing Retainer and Oil Seal.

(1) Remove the four capscrews and lockwashers securing the retainer to the carrier. (See fig. 5-32.)

(2) Place the retainer in a vise, and drive the oil seal from the retainer using a suitable punch and hammer. See figure 5-32 for location and positioning of the oil seal.

**NOTE**

Upon assembly, use a new oil seal.

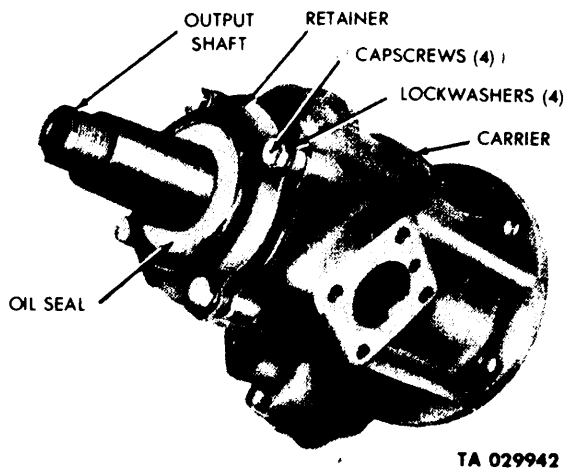


Figure 5-32. Removal of Output Shaft Rear Bearing Retainer and Oil Seal.

d. *Output Shaft.* Use a soft drift pin and hammer to drive the output shaft and both bearings from the carrier. (See fig. 5-33.) Removal of the output shaft will also remove the rear tapered roller bearing cup.

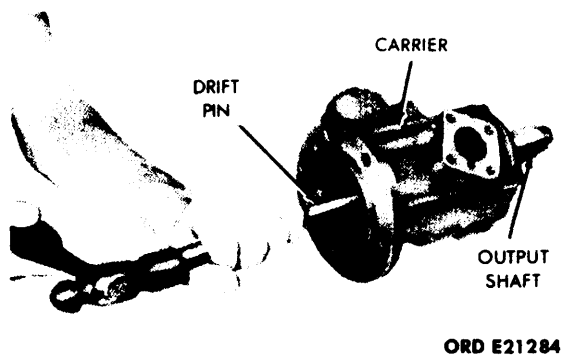


Figure 5-33. Removal of Output Shaft, Both Bearings, and Rear Tapered Roller Bearing Cup.

e. *Output Shaft Front Bearing Cup.* Place the carrier and front bearing cup in an arbor press. (See fig. 5-34.) Press the cup from the carrier.

**NOTE**

Upon assembly, make sure the bearing cup is installed with the taper of the cup facing toward the center of the carrier.

f. *Output Shaft.* Using an arbor press, press the governor drive gear, rear bearing, and front bearing from the output shaft. (See fig. 5-35.)

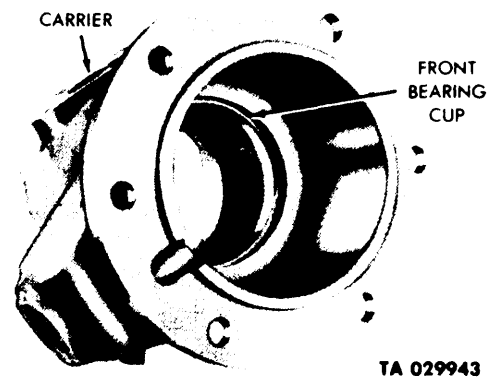


Figure 5-34. Removal of Output Shaft Front Bearing Cup.

**NOTE**

Upon assembling the output shaft, make sure rear bearing, governor drive gear, and front bearing are installed as shown in fig. 5-35.

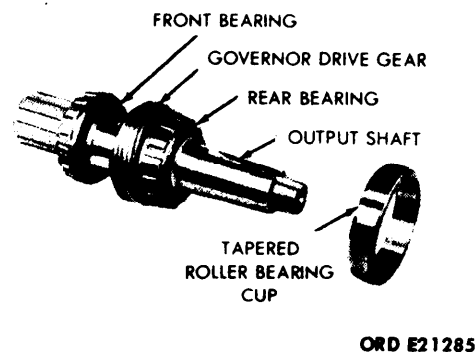
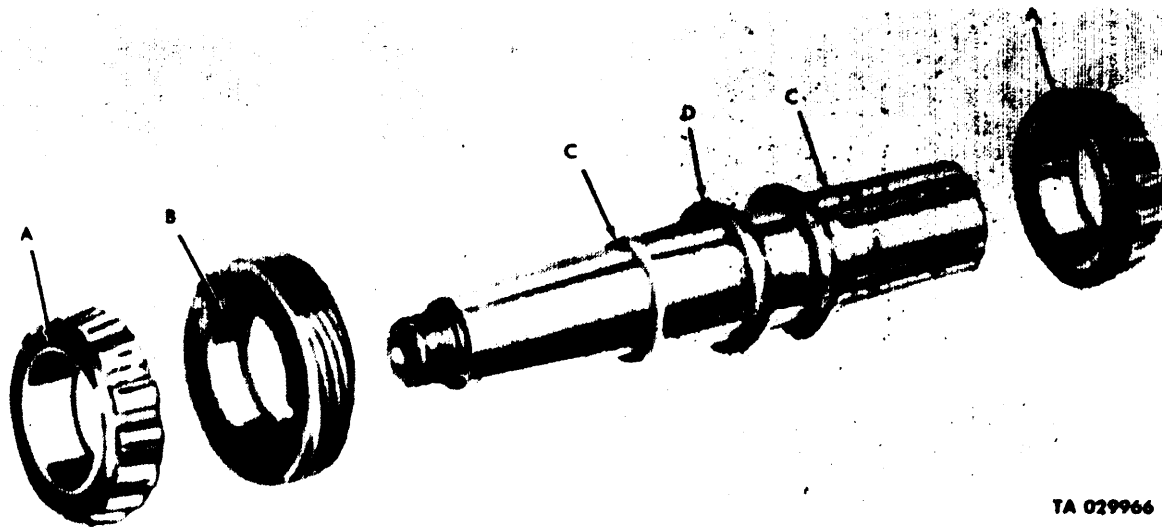


Figure 5-35. Disassembly of Output Shaft.

**5-27. Assembly Sequence.**

- a. Assembly of output shaft. (See fig. 5-35.)
- b. Output shaft front bearing cup. (See fig. 5-34.)
- c. Output shaft. (See fig. 5-33.)
- d. Output shaft rear bearing cup, retainer, and oil seal. (See fig. 5-32.)
- e. Pump and shifter shaft. (See fig. 5-30 and 5-31.)
- f. Drain plug and shift lever. (See fig. 5-29.)



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Figure 5-36. Repair and Replacement Standard Points of Measurement for Output Shaft and Related Parts - Model P-136-C.

Table 5-5. Repair and Replacement Standard Points of Measurement for Output Shaft and Related Parts - Model P-136-C.

Fig. No.	Ref Letter	Point of Measurement	Size and Fit of New Parts	Wear Limits
5-26	A	Inside diameter of bearing	1.688	(*)
5-26	C	Outside diameter of shaft	1.6885-1.6895	(*)
5-26	A-C	Fit of bearing on shaft	0.0005T-0.0015T	(*)
5-26	B	Inside diameter of gear	1.6900-1.6915	(*)
5-26	B-C	Fit of gear on shaft	0.0005L-0.003L	(*)
5-26	D	Cam section of output shaft	1.685-1.690	(*)



## Section XI. TEST AND ADJUSTMENT (MODEL P-136-C)

**5-28. General.** Tests and adjustments can either be accomplished by installation on the vehicle or on a transfer unit that is coupled to an engine and transmission installed on a dynamometer.

*a. Operation.* Test power takeoff model P-136-C for the following:

- (1) Quiet operation.
- (2) Smooth and positive shifting.
- (3) Observe for lubricant leaks.
- (4) Inspect oil pump operation. Remove pipe plug covering the shifter shaft setscrew and observe

the movement of lubricant through the hole. Replace pipe plug.

*b. Adjustment.*

(1) There are no adjustments required on the power takeoff assembly.

(2) Refer to TM 9-2320-209-20/1 for the power takeoff linkage adjustment.

**5-29. Lubrication.** Lubrication of the power takeoff is provided by the transfer. Refer to LO 9-2320-209-12/1 for lubrication instructions.

## Section XII. REPAIR AND REPLACEMENT STANDARDS (MODEL P-136-C)

**5-30. General.** The repair and replacement standards included herein give the minimum, maximum, and key clearance of new parts. The standards also give wear limits which indicate the point to which a part or parts may be worn before replacement, in order to receive maximum service with minimum replacement. Normally, all parts which have not been worn beyond the dimensions shown in the "Wear Limits" column, or damaged by corrosion, will be approved for service. An asterisk (\*) in the "Wear Limits" column indicates that

the part or parts should be replaced when worn beyond the limits given in the "Size and Fit of New Parts" column. In the "Size and Fit of New Parts" column, the letter "L" indicates a loose fit (clearance) and the letter "T" indicates a tight fit (interference).

**5-31. Repair and Replacement Standard Points of Measurement.** Figure 5-36 and table 5-5 provide the repair and replacement standard points of measurement for power takeoff model P-136-C.



## APPENDIX A REFERENCES

### A-1. Publication Indexes and General Reference.

Indexes should be consulted frequently for the latest changes or revisions of references given in this appendix and for new publications relating to materiel covered in this technical manual.

*a. Military Publications Indexes.*

Index of Army Motion Pictures  
and Related Audio-Visual Aids DA Pam 108-1

Index of Administrative  
Publications . . . . . DA Pam 310-1

Index of Blank Forms . . . . . DA Pam 310-2

Index of Doctrinal Training and  
Organizational Publications . DA Pam 310-3

Military Publications:

Index of Technical Manuals, Technical  
Bulletins, Supply Bulletins, and  
Lubrication Orders . . . . . DA Pam 310-4

Index of Supply Catalogs and  
Supply Manuals (excluding types  
7, 8 and 9) . . . . . DA Pam 310-6.

Index of Modification Work  
Orders . . . . . DA Pam 310-7

Common Tools and Equipment  
Supply Manuals . . . . . DA Supply Manuals  
SC-4910-95-CL-A01, A02, A50,  
A63, A64, A65, A67, A68, A72, A73,  
and A74. SC-5180-90-CL-N-23,  
SC-4910-95-CL-A31 and -A32

*b. General Reference.*

Authorization Abbreviations and  
Brevity Codes . . . . . AR310-50

Dictionary of United States  
Army Terms . . . . . AR310-25

### A-2. Forms.

The following forms pertain to this materiel (refer to DA pamphlet 310-2 for index of blank forms and to TM 38-750 for explanation of their use).

Recommended Changes to  
Publications . . . . . DA Form 2028

Maintenance Request - Continuation  
Sheet . . . . . DA Form 2407-1

Equipment Log Assembly  
(Records) . . . . . DA Form 2408

Processing and Reprocessing Records  
for Shipment, Storage, and Issue of  
Vehicles and Spare Engines . DA Form 1397

### A-3. Other Publications.

*a. Vehicle.*

Lubrication Order . . . . . LO 9-2320-209-12/1

Operator's Manual . . . . . TM 9-2320-209-10/1

Organizational Maintenance Manual  
(Multifuel Engine) . . . . . TM 9-2320-209-20/1

Organizational Maintenance Manual  
(Gasoline Engine) . . . . . TM 9-2320-209-20

Direct Support and General Support  
Maintenance Manual  
(Multifuel Engine) . . . . . TM 9-2320-209-34

Direct Support and General Support  
Maintenance Manual  
(Gasoline Engine) . . . . . TM 9-2320-209-35

Organizational Maintenance Repair Parts  
and Special Tool List . . . . . TM 9-2320-209-20P

Direct Support and General Support  
Maintenance Repair Parts and  
Special Tool List . . . . . TM 9-2320-209-34P

*b. General.*

Inspection, Care, and Maintenance of  
Antifriction Bearings . . . . . TM 9-214

Welding Theory and  
Application . . . . . TM 9-237

Army Maintenance  
Management System . . . . . TM 38-750



## INDEX

Subject	Paragraph	Page
<b>A</b>		
Adjustment, handbrake shoe, transfers		
Model T-136-21 .....	4-30	4-30
Model T-136-27 .....	4-13	4-11
Air cylinder assembly		
Elimination of air leak .....	4-5e	4-3
Removal .....	4-5e	4-4
Troubleshooting, table 2-2.02 .....		2-7
Assembly, clutch release, transmission, models 3052 and 3053A		
Removal .....	3-8	3-11
Assembly, countershaft, transfer		
Model T-136-27 .....	4-5p	4-7
Assembly, idler shaft, transfer		
Model T-136-21 .....	4-23b	4-25
Assembly, front output shaft and reverse shift shaft, transfer removal		
Model T-136-21 .....	4-22f	4-22
Model T-136-27 .....	4-5h	4-4
Assembly, handbrake drum and shoe, transfers, removal		
Model T-136-21 .....	4-22a	4-21
Model T-136-27 .....	4-5a	4-3
Assembly, handbrake shoe disassembly, transfers		
Model T-136-21 .....	4-23i	4-28
Model T-136-27 .....	4-6g	4-10
Assembly, idler gear, transmission		
Models 3052 and 3053A, removal .....	3-8k	3-14
Assembly, input shaft		
Transfers		
Model T-136-21 .....	4-22i	4-23
Model T-136-27 .....	4-5p	4-7
Transmission		
Model 3052 .....	3-11	3-19
Model 3053A .....	3-12	3-21
Assembly, mainshaft rear bearing cap, transmission, models 3052 and 3053A		
Assembly .....	3-11m	3-20
Removal .....	3-8d	3-13
Assembly, mainshaft, transmission, models 3052 and 3053A		
Assembly .....	3-11g	3-20
Removal .....	3-8j	3-14
Assembly, front output shaft cover, transfer, removal		
Model T-136-21 .....	4-22e	4-22
Model T-136-27 .....	4-5f	4-4
Assembly, pump and shifter shaft, power takeoff, model P-136-C, removal	5-26b	5-18
Assembly, rear output shaft, transfers		
Model T-136-21		
Assembly .....	4-25e	4-30
Removal .....	4-22j	4-23
Model T-136-27		
Assembly .....	4-8g	4-11
Removal .....	4-5k	4-6
Assembly of subassemblies		
Transfers		
Model T-136-21 .....	4-24	4-29
Model T-136-27 .....	4-7	4-10
Transmission		
Model 3052 .....	3-10	3-17
Model 3053A .....	3-12	3-21

INDEX (Continued)

Subject	Paragraph	Page
Assembly of transmission		
Model 3052 . . . . .	3-11	3-19
Model 3053A . . . . .	3-12	3-21
<b>B</b>		
Bearing cap, mainshaft, rear, transmissions, models 3052 and 3053A		
Assembly . . . . .	3-11m	3-20
Removal . . . . .	3-8d	3-13
Seal replacement . . . . .	3-9d	3-16
Bearing cups, case, transfer		
Model T-136-21		
Assembly . . . . .	4-24d	4-29
Removal . . . . .	4-23f	4-27
Model T-136-27		
Assembly . . . . .	4-7b	4-10
Removal . . . . .	4-6f	4-9
Bearing cups, case cover, transfer		
Model T-136-21		
Assembly . . . . .	4-24d	4-29
Removal . . . . .	4-23f	4-27
Model T-136-27		
Assembly . . . . .	4-7d	4-10
Removal . . . . .	4-6d	4-9
Bearing, rear output shaft and shifter shaft boot and oil seal, power takeoff		
Model WND-7-28		
Assembly . . . . .	5-17a	5-14
Removal . . . . .	5-16d	5-13
Bearing, output shaft rear, power takeoff, model WN-7-28		
Assembly . . . . .	5-7f	5-7
Removal . . . . .	5-6f	5-5
Boot and seal, shifter shaft, power takeoff, model WN-7-28		
Assembly . . . . .	5-7a	5-7
Removal . . . . .	5-6k	5-6
<b>C</b>		
Cap, input shaft bearing, transmission, models 3052 and 3053A		
Assembly . . . . .	3-11j	3-20
Removal . . . . .	3-8g	3-13
Caps, bearing inspection . . . . .	2b(3)	2-16
Castings, inspection . . . . .	2-9b(1)	2-16
Cleaning		
Assemblies . . . . .	2-8c	2-15
Power takeoff . . . . .	2-8c	2-15
Transfers . . . . .	2-8c	2-15
Transmissions . . . . .	2-8c	2-15
Component parts, after disassembly . . . . .	2-8d	2-15
General . . . . .	2-7	2-15
Precautions . . . . .	2-8b	2-15
Cleaning, inspection and repair		
General . . . . .	2-7	2-15
Power takeoff . . . . .	2-8c	2-15
Transfer . . . . .	2-8c	2-15
Transmissions . . . . .	2-8c	2-15
Common tools and equipment . . . . .	2-4	2-1

## INDEX (Continued)

Subject	Paragraph	Page
Construction		
Transmission, Model 3052 .....	3-2a	3-1
Transmission, Model 3053A .....	3-5a	3-9
Countershaft		
Transfer, model T-136-27		
Rear bearing cover removal .....	4-5m	4-6
Removal .....	4-5p	4-7
Subassembly, assembly and disassembly .....	4-6b	4-7
Transmission, model 3052		
Assembly .....	3-11	3-19
Disassembly .....	3-8	3-11
Inspection .....	2-9	2-15
Removal .....	2-13	2-18
Transmission, model 3053A		
Assembly .....	3-12	3-21
Disassembly .....	3-12	3-21
Inspection .....	2-9	2-15
Removal .....	2-13	2-18
Cover, countershaft bearing rear, transmission, models 3052 and 3053		
Removal .....	3-8e	3-13
Cover, front output shaft, transfer, disassembly		
Model T-136-21 .....	4-22e	4-22
Model T-136-27 .....	4-5f	4-4
Cover, power takeoff opening, transmission, models 3052 and 3053		
Removal .....	3-8f	3-13
Cover, shifter shaft		
Transfers, shifter shaft and top cover		
Model T-136-21 .....	4-22k	4-23
Model T-136-27 .....	4-5l	4-6
Transmissions		
Assembly		
Model 3052 .....	3-11	3-19
Model 3053A .....	3-12	3-21
Inspection .....	2-9	2-15
Removal		
Model 3052 .....	3-8b	3-11
Model 3053A .....	3-12	3-21
Covers, transfer		
Model T-136-21		
Case .....	4-22i	4-23
Disassembly, case .....	4-23f	4-27
Front output shaft .....	4-22e	4-22
Idle shaft rear bearing .....	4-22n	4-24
Input shaft front bearing .....	4-22g	4-22
Input shaft rear bearing .....	4-22o	4-24
Rear output shaft rear bearing .....	4-22m	4-23
Top .....	4-22k	4-23
Model T-136-27		
Case .....	4-5j	4-5
Countershaft, rear bearing .....	4-5m	4-6
Disassembly, case .....	4-6e	4-9
Front output shaft case/cover .....	4-5f	4-4
Input shaft front bearing .....	4-5g	4-4
Input shaft rear bearing .....	4-50	4-7
Rear output shaft rear bearing .....	4-5m	4-7
Top .....	4-5l	4-6

INDEX (Continued)

Subject	D	Paragraph	Page
Data			
Power takeoff			
Model WN-7-28 .....		5-4	5-1
Model WND-7-28 .....		5-15	5-11
Model P-136-C .....		5-25	5-16
Transfers			
Model T-136-21 .....		4-20	4-20
Model T-136-27 .....		4-3	4-2
Transmissions			
Model 3052 .....		3-3	3-2
Model 3053A .....		3-6	3-9
Description			
General .....		1-6a	1-1
Power takeoffs			
Model WN-7-28 .....		5-2	5-1
Model WND-7-28 .....		5-13	5-11
Model P-136-C .....		5-23	5-14
Transfers			
Model T-136-21 .....		4-19	4-22
Model T-136-27 .....		4-2	4-1
Transmissions			
Model 3052 .....		3-2	3-1
Model 3053A .....		3-5	3-9
Disassembly and assembly			
Power takeoffs			
Model WN-7-28 .....		5-6	5-3
Model WND-7-28 .....		5-16	5-7
Model P-136-C .....		5-26	5-12
Transfers			
Model T-136-21 .....		4-22	4-21
Model T-136-27 .....		4-5	5-18
Transmissions			
Model 3052 .....		3-8	3-11
Model 3053A .....		3-12	3-21
Disassembly of subassemblies			
Transfers			
Model T-136-21 .....		4-23	4-25
Model T-136-27 .....		4-6	
Disassembly into subassemblies			
Transfers			
Model T-136-21 .....		4-22	4-21
Model T-136-27 .....		4-5	4-3
Transmissions			
Model 3052 .....		3-8	3-11
Model 3053A .....		3-12	3-21
Draining			
Power takeoff, model P-136-C .....		5-26a	5-18
Transfers			
Model T-136-21 .....		4-22c	4-21
Model T-136-27 .....		4-5c	4-3
Drain plug and shift lever, power takeoff, model P-136-C			
Assembly .....		5-27f	5-19
Removal .....		5-26a	5-18
Drain plugs			
Power takeoff, model P-136-C .....		5-26a	5-18
Transfers			
Model T-136-21 .....		4-22c	4-21
Model T-136-27 .....		4-5c	4-3



## INDEX (Continued)

Subject	Paragraph	Page
Driving clutch front output transfer, model T-136-27		
Assembly .....	4-8i	4-11
Removal .....	4-5i	4-5
<b>E</b>		
Equipment and tools		
Common .....	2-4	2-1
Special .....	2-4	2-1
Equipment improvement recommendations .....	1-4	1-1
<b>F</b>		
Flange, Companion		
Transfers		
Model T-136-21		
Installation .....	4-25k	4-30
Removal .....	4-22d	4-21
Model T-136-27		
Installation .....	4-8n	4-11
Removal .....	4-5d	4-3
Transmissions, models 3052 and 3053A		
Installation .....	3-11n	3-20
Removal .....	3-8c	3-12
Forks, shifter, removal		
Power takeoff		
Model WN-7-28 .....	5-6b	5-3
Model WND-7-28 .....	5-16b	5-12
Model P-136-C .....	5-26b	5-18
Transfers		
Model T-136-21 .....	4-22i	4-23
Model T-136-27 .....	4-5i	4-6
Transmission		
Models 3052 and 3053A .....	3-9e	3-16
Forms, records and maintenance (see maintenance forms and records) .....	1-2	1-1
Front bearing, countershaft		
Transmission, removal models 3052 and 3053A .....	3-8n	3-14
Front bearing, output shaft, removal		
Power takeoff		
Model WN-7-28 .....	5-6g	5-5
Model WND-7-28 .....	5-6g	5-5
Model P-136-C .....	5-26e,f	5-19
Transfers		
Model T-136-21 .....	4-23d	4-26
Model T-136-27 .....	4-6e	4-9
Front output shaft		
Transfer model T-136-21		
Assembly, cover .....	4-22e	4-22
Disassembly, cover .....	4-23g	4-28
Removal, shafts .....	4-22f	4-22
Removal, cover .....	4-22i	4-23
Transfer, model T-136-27		
Disassembly, case cover .....	4-6d	4-9
Disassembly, shaft cover .....	4-6e	4-9
Removal, shaft .....	4-5h	4-4
Removal, case .....	4-5f	4-4

INDEX (Continued)

Subject	Paragraph	Page
<b>G</b>		
Gasket, power takeoff, models WN-7-28 and WND-7-28		
Front bearing cap . . . . .	5-6e	5-4
Power takeoff cover . . . . .	5-6a	5-3
Rear bearing cap . . . . .	5-6d	5-4
Power takeoff, model P-136-C, pump assembly . . . . .	5-26b	5-18
Gasket, transfer model T-136-27		
Air cylinder . . . . .	4-5e	4-3
Case cover . . . . .	4-5j	4-5
Front output shaft case . . . . .	4-5f	4-4
Input shaft front bearing cover . . . . .	4-5g	4-4
Input shaft rear bearing cover . . . . .	4-50	4-7
Top cover . . . . .	4-51	4-6
Gasket, transfer model T-136-21		
Case cover . . . . .	4-22i	4-23
Front output shaft cover . . . . .	4-22e	4-22
Input shaft front bearing cover . . . . .	4-22g	4-22
Input shaft rear bearing cover . . . . .	4-220	4-24
Top cover . . . . .	4-22k	4-23
Gasket, transmission, models 3052 and 3053A		
Clutch bell housing to transmission . . . . .	3-8a(3)	3-11
Countershaft rear bearing cover . . . . .	3-8e	3-13
Input shaft bearing cap . . . . .	3-8g	3-13
Mainshaft rear bearing cap . . . . .	3-8d	3-13
Power takeoff opening cover . . . . .	3-8f	3-13
PTO opening cover . . . . .	3-8f	3-13
Shifter shaft cover . . . . .	3-8b	3-11
Gear spacers and thrust washers, inspection . . . . .	2-9b(4)	2-16
Gears, input, power takeoffs, operation		
Model WN-7-28 . . . . .	5-3a	5-1
Model WND-7-28 . . . . .	5-14	5-11
Gears, inspection . . . . .	2-9b(9)	2-16
Gearshaft, and gear, power takeoff, models WN-7-28 and WND-7-28		
Input . . . . .	5-6c	5-3
Output . . . . .	5-6g	5-5
Gearshafts, inspection . . . . .	2-9b(8)	2-16

**H**

Handbrake, drum and shoe-assembly		
Transfer, model T-136-21		
Adjustment, handbrake shoe . . . . .	4-30	4-30
Description . . . . .	4-19a	4-19
Disassembly, handbrake shoe . . . . .	4-23i	4-28
Removal . . . . .	4-23i	4-28
Test, handbrake . . . . .	4-29	4-30
Transfer, model T-136-27		
Adjustment, handbrake shoe . . . . .	4-13	4-11
Description . . . . .	4-2a	4-1
Disassembly, handbrake shoe . . . . .	4-6g	4-10
Removal . . . . .	4-6g	4-10
Test, handbrake . . . . .	4-12	4-11
Handbrake test, transfers		
Model T-136-21 . . . . .	4-29	4-30
Model T-136-27 . . . . .	4-12	4-12
Handling after inspection and repair . . . . .	2-10b	2-17

## INDEX (Continued)

Subject	Paragraph	Page
Housing, clutch, inspection .....	2-9b(2)	2-16
Housing, rear output shaft, and shifter shaft retainer, ball and spring, power takeoff WND-7-28, removal .....	5-16a	5-12
I		
Idler shaft, transfer, model T-136-21		
Assembly .....	4-24h	4-29
Disassembly and assembly .....	4-23b	4-25
Removal .....	4-22l	4-23
Idler shaft driving gear, transfer, model T-136-21		
Assembly .....	4-25g	4-30
Removal .....	4-22h	4-22
Input shaft, transfer, model T-136-21		
Assembly .....	4-25c	4-30
Removal .....	4-22l	4-23
Front bearing cover		
Assembly .....	4-25h	4-30
Removal .....	4-22g	4-22
Rear bearing cover		
Assembly .....	4-25b	4-30
Removal .....	4-22o	4-24
Subassembly		
Assembly .....	4-24g	4-29
Disassembly .....	4-23c	4-25
Input shaft, transfer, model T-136-27		
Assembly .....	4-8b	4-11
Removal .....	4-5p	4-7
Front bearing cover		
Assembly .....	4-8k	4-11
Removal .....	4-5g	4-4
Rear bearing cover		
Assembly .....	4-8c	4-11
Removal .....	4-5o	4-7
Subassembly		
Disassembly and assembly .....	4-6c	4-8
Input shaft, transmission		
Model 3052		
Assembly .....	3-10e	3-19
Disassembly .....	3-9a	3-15
Removal .....	3-8g	3-13
Model 3053A		
Assembly .....	3-10e	3-19
Disassembly .....	3-9a	3-15
Removal .....	3-12	3-21
Input shaft bearing cap, transmission, models 3052 and 3053A		
Assembly .....	3-11j	3-20
Removal .....	3-8g	3-13
Inspection		
General .....	2-9a	2-15
Procedure .....	2-9b	2-16
Bearing caps .....	2-9b(3)	2-16
Castings .....	2-9b(1)	2-16
Clutch housings .....	2-9b(2)	2-16
Countershafts .....	2-9b(11)	2-17
Expansion plugs .....	2-9b(6)	2-16

## INDEX (Continued)

Subject	Paragraph	Page
Gear spacers and thrust washers . . . . .	2-9b(4)	2-16
Gears . . . . .	2-9b(9)	2-16
Gearshafts . . . . .	2-9b(8)	2-16
Input shafts . . . . .	2-9b(12)	2-17
Mainshafts and output shafts . . . . .	2-9b(10)	2-16
Poppet balls and springs . . . . .	2-9b(14)	2-17
Retaining nuts . . . . .	2-9b(7)	2-16
Shifter fork shafts . . . . .	2-9b(13)	2-17
Shifter forks . . . . .	2-9b(15)	2-17
Shifter shaft covers . . . . .	2-9b(16)	2-17
Snaprings . . . . .	2-9b(5)	2-16

### L

Lubrication		
Power takeoffs		
Model WN-7-28 . . . . .	5-9	5-7
Model WND-7-28 . . . . .	5-19	5-14
Model P-136-C . . . . .	5-29	5-21
Transfer		
Model T-136-21 . . . . .	4-27	4-30
Model T-136-27 . . . . .	4-10	4-11
Transmission		
Model 3052 and 3053A . . . . .	3-13a	3-21

### M

Maintenance, general . . . . .	2-7	2-15
Maintenance forms and records . . . . .	1-2	1-1
Metric measurement, use of . . . . .	1-5	1-1

### N

Nuts, retaining, inspection . . . . .	2-9b(7)	2-16
---------------------------------------	---------	------

### O

Operation		
Power takeoffs		
Model WN-7-28 . . . . .	5-3	5-1
Model WND-7-28 . . . . .	5-14	5-11
Model P-136-C . . . . .	5-24	5-16
Transfers		
Model T-136-21 . . . . .	4-19b	4-19
Model T-136-27 . . . . .	4-2b	4-1
Transmissions		
Model 3052 . . . . .	3-2b	3-1
Model 3053A . . . . .	3-5b	3-9
Output and reverse shaft rear bearing cap, power takeoff, model WN-7-28		
Installation . . . . .	5-7h	5-7
Removal . . . . .	5-6d	5-4
Output shaft and high-speed gear, power takeoff, model WN-7-28		
Installation . . . . .	5-7e	5-7
Removal . . . . .	5-6g	5-5
Output shaft front beating cap and companion flange key, power takeoff. model WN-7-28		

INDEX (Continued)

Subject	Paragraph	Page
Installation . . . . .	5-7g	5-7
Removal . . . . .	5-6e	5-4
Output shaft, front, transfer		
Model T-136-21		
Assembly . . . . .	4-24f	4-29
Disassembly . . . . .	4-23d	4-26
Model T-136-27 . . . . .		
Assembly . . . . .	4-8j	4-11
Disassembly . . . . .	4-5h	4-4
Overhaul stand, transfer		
Model T-136-21		
Installation . . . . .	4-22b	4-21
Model T-136-27		
Installation . . . . .	4-5b	4-3
<b>P</b>		
Parts, repair . . . . .	2-2	2-1
Plugs		
Drain, power takeoff, model P-136-C . . . . .	5-26a	5-18
Expansion, inspection . . . . .	2-9b(6)	2-16
Filler, transfers, model T-136-21 . . . . .	4-22c	4-21
Filler, transfers, model T-136-27 . . . . .	4-5c	4-3
Transmissions, models 3052 and 3053A . . . . .	3-13a	3-21
Magnetic drain, transfers, model T-136-21 . . . . .	4-22c	4-21
Magnetic drain, transfers, model T-136-27 . . . . .	4-5c	4-3
Poppet balls and springs, inspection . . . . .	2-9b(14)	2-17
Power flow		
Transmission		
Model 3052 . . . . .	3-2b	3-1
Model 3053A . . . . .	3-5b	3-9
Power takeoff, model WND-7-28		
Data . . . . .	5-15	5-11
Description . . . . .	5-13	5-11
Disassembly and assembly		
Removal		
Bearings, rear output shaft and shifter shaft boot and oil seal . . . . .	5-16d	5-13
General . . . . .	5-12	5-11
Rear output shaft and sliding clutch sleeve . . . . .	5-16c	5-13
Rear output shaft housing and shifter shaft retainer, ball and spring . . . . .	5-16a	5-12
Repair and replacement standards . . . . .	5-20,21	5-14
Shifter shaft and shifter shaft fork . . . . .	5-16b	5-12
Troubleshooting		
General . . . . .	2-5	2-1
Introductory information . . . . .	2-6	2-1
Table 2-2.04 . . . . .		2-12
Power takeoff, model WN-7-28		
Data . . . . .	5-4	5-1
Description . . . . .	5-2	5-1
Disassembly and assembly		
General . . . . .	5-5	5-3
Removal		
Bearing, output shaft rear . . . . .	5-6f	5-5
Boot and seal, shifter shaft . . . . .	5-6k	5-6
Front bearing; output shaft . . . . .	5-6g	5-5
Input gearshaft and input gear . . . . .	5-6c	5-3
Output and reverse shaft rear bearing cap . . . . .	5-6d	5-4
Output shaft and high-speed gear . . . . .	5-6g	5-5
Output shaft front bearing cap and companion flange key . . . . .	5-6e	5-4

**INDEX (Continued)**

Subject	Paragraph	Page
Power takeoff cover, poppet retainer, poppet spring and ball . . . . .	5-6a	5-3
Rear bearing, reverse gear . . . . .	5-6i	5-6
Reverse gear . . . . .	5-6h	5-5
Shifter shaft and shifter fork . . . . .	5-6b	5-3
Operation		
Fork, shifter . . . . .	5-3c	5-1
Gear, input . . . . .	5-3a	5-1
Shaft, output . . . . .	5-3b	5-1
Repair and replacement standards . . . . .	5-10	5-7
Troubleshooting		
General and introductory information . . . . .	2-5,6	2-1
Table 2-2.04 . . . . .		2-12
Power takeoff, model P-136-C		
Data . . . . .	5-25	5-16
Description . . . . .	5-23	5-16
Disassembly and assembly		
General . . . . .	5-22	5-16
Removal		
Assembly, pump and shifter shaft . . . . .	5-26b	5-18
Disassembly, output shaft . . . . .	5-26f	5-19
Drain plug and shift lever . . . . .	5-26a	5-18
Front bearing cup, output shaft . . . . .	5-26e	5-19
Rear bearing cup, output shaft . . . . .	5-26d	5-19
Retainer, output shaft rear bearing and oil seal . . . . .	5-26c	5-18
Shaft, output . . . . .	5-26f	5-19
Repair and replacement standards . . . . .	5-30	5-21
Troubleshooting		
General and introductory information . . . . .	2-5,6	2-1
Table 2-2.05 . . . . .		2-14
Power test		
Transmissions, models 3052 and 3053A . . . . .	3-15	3-21
<b>Q</b>		
Quality assurance/quality control . . . . .	1-3	1-1
<b>R</b>		
Rear bearing, countershaft, transmissions, removal		
Model 3052 and 3053A . . . . .	3-81	3-14
Rear bearing, reverse gear, power takeoff, removal, model WN-7-28 . . . . .	5-6i	5-6
Rear output shaft and sliding clutch sleeve, power takeoff model WND-7-28, removal . . . . .	5-16c	5-13
Repair		
General . . . . .	2-10a	2-17
Handling after inspection and repair . . . . .	2-10b	2-17
Repair and replacement standards		
Power takeoffs		
Model WN-7-28 . . . . .	5-10	5-7
Model WND-7-28 . . . . .	5-20	5-14
Model P-136-C . . . . .	5-30	5-21
Transfer		
Model T-136-21 . . . . .	4-33	4-31
Model T-136-27 . . . . .	4-16	4-12
Transmission		
Model 3052 . . . . .	3-16	3-21

## INDEX (Continued)

Subject	Paragraph	Page
Model 3053A .....	3-16	3-21
Recommendations, equipment improvement (see equipment improvement recommendations) .....	1-4	1-1
Records, forms and maintenance (see maintenance forms and records) .....	1-2	1-1
Retainer, output shaft rear bearing and oil seal, power takeoff, model P-136-C, removal . . .	5-26c	5-18
Reverse gear, power takeoff, model WN-7-28, removal . . . . .	5-6h	5-5
<b>S</b>		
Scope .....	1-1	1-1
Seal, oil replacement .....	2-10b(3)	2-18
Shaft, output, power takeoff, operation		
Model WN-7-28 .....	5-3b	5-1
Model WND-7-28 .....	5-14	5-11
Model P-136-C .....	5-24	5-16
Shaft, output power takeoff, model P-136-C		
Assembly .....	5-27c	5-19
Disassembly .....	5-26f	5-19
Removal .....	5-26d	5-19
Shafts, inspection		
Countershaft .....	2-9b(11)	2-17
Input .....	2-9b(12)	2-17
Main and output .....	2-9b(10)	2-16
Shifter fork .....	2-9b(15)	2-17
Shifter shaft cover .....	2-9b(16)	2-17
Shift test		
Power takeoff		
Model WN-7-28 .....	5-8a	5-7
Model WND-7-28 .....	5-18a	5-14
Model P-136-C .....	5-28a	5-20
Transfer		
Model T-136-21 .....	4-28	4-30
Model T-136-27 .....	4-11	4-11
Transmission		
Model 3052 and 3053A .....	3-14	3-21
Shifter forks		
Inspection .....	2-9b(15)	2-17
Power takeoff, model WN-7-28, Operation .....	5-3c	5-1
Shifter shaft and shifter shaft fork, power takeoff, model WND-7-28, removal .....	5-16b	5-12
Shifter shaft and shifter shaft fork, power takeoff, model WN-7-28, removal .....	5-6b	5-3
Snapping		
Inspection .....	2-9b(5)	2-16
Special tools and equipment .....	2-3	2-1
Sprag units, transfer model T-136-21, disassembly and assembly .....	4-23e	4-27
Springs and poppet balls, inspection .....	2-9b(14)	2-17
Synchronizer, low and high range, transfer		
Model T-136-21 .....	4-23c	4-25
Model T-136-27 .....	4-6c	4-8
Synchronizer, fourth and fifth speed, transmission		
Model 3052 and 3053A .....	3-8i	3-14
Synchronizer, second and third speed, transmission		
Model 3052 and 3053A .....	3-9b(3)	3-16

## INDEX (Continued)

Subject	Paragraph	Page
<b>T</b>		
Tables		
Table 2-1. Special tools .....		2-2
Table 2-2. Index, troubleshooting table .....		2-2
Table 2-2.01. Transmission, troubleshooting .....		2-3
Table 2-2.02. Transfer, model T-136-27, troubleshooting .....		2-7
Table 2-2.03. Transfer, model T-136-21, troubleshooting .....		2-11
Table 2-2.04. Power takeoffs, models WN-7-28, WND-7-28, troubleshooting .....		2-12
Table 2-2.05. Power takeoff, model P-136-C, troubleshooting .....		2-14
Table 3-1. Repair and replacement standard points of measurement for input shaft and bearing .....		3-22
Table 3-2. Repair and replacement standard points of measurement for transmission mainshaft assembly .....		3-23
Table 3-3. Repair and replacement standard points of measurement for transmission countershaft and gears .....		3-24
Table 3-4. Repair and replacement standard points of measurement for transmission reverse idler gear and shaft assembly .....		3-25
Table 4-1. Repair and replacement standard points of measurement for transfer gear train, model T-136-27 .....		4-13
Table 4-2. Repair and replacement standard points of measurement for transfer shafts and bearings, model T-136-27 .....		4-16
Table 4-3. Repair and replacement standard points of measurement of transfer output shaft and cover, model T-136-27 .....		4-17
Table 4-4. Repair and replacement standard points of measurement for transfer case and seals, model T-136-27 .....		4-18
Table 4-5. Repair and replacement standard points of measurement for transfer gear train, model T-136-21 .....		4-32
Table 4-6. Repair and replacement standard points of measurement for transfer and bearings, model T-136-21 .....		4-35
Table 4-7. Repair and replacement standard points of measurement for transfer output shaft and cover, model T-136-21 .....		4-36
Table 4-8. Repair and replacement standard points of measurement for transfer case and seals, model T-136-21 .....		4-37
Table 5-1. Repair and replacement standard points of measurement for reverse gear and related parts .....		5-8
Table 5-2. Repair and replacement standard points of measurement for input gear and related parts .....		5-9
Table 5-3. Repair and replacement standard points of measurement for output shaft and related parts .....		5-10
Table 5-4. Repair and replacement standard points of measurement for output shaft and related parts, model WND-7-28 .....		5-15
Table 5-5. Repair and replacement standard points of measurement for output shaft and related parts, power takeoff model P-136-C .....		5-20
Tests and adjustments		
Power takeoffs		
Model WN-7-28		
Adjustment .....	5-8b	5-7
Operation .....	5-8a	5-7
Model WND-7-28		
Adjustments .....	5-18b	5-14
Operation .....	5-18a	5-14
Model P-136-C		
Adjustment .....	5-28b	5-20
Operation .....	5-28a	5-20
Transfers		
Model T-136-21		



INDEX (Continued)

Subject	Paragraph	Page
General . . . . .	4-26	4-30
Handbrake shoe adjustment . . . . .	4-30	4-30
Handbrake test . . . . .	4-29	4-30
Idler shaft bearing . . . . .	4-32	4-30
Lubrication . . . . .	4-27	4-30
Rear output shaft rear bearing . . . . .	4-31	4-30
Shift test . . . . .	4-28	4-30
Model T-136-27		
Countershaft rear bearing . . . . .	4-14	4-12
General . . . . .	4-9	4-11
Handbrake shoe adjustment . . . . .	4-13	4-11
Handbrake test . . . . .	4-12	4-11
Lubrication . . . . .	4-10	4-11
Rear output shaft rear bearing . . . . .	4-15	4-12
Shift test . . . . .	4-11	4-11
Transmissions		
Model 3052 and 3053A		
General . . . . .	3-13	3-21
Power test . . . . .	3-15	3-21
Shift test . . . . .	3-14	3-21
Thrust washers and gear spacers, inspection . . . . .	2-9b(4)	2-16
Tools and equipment		
Common . . . . .	2-4	2-1
Special . . . . .	2-3	2-1
Top cover, transfer, and shifter shaft		
Model T-136-21		
Assembling . . . . .	4-25d	4-30
Removal . . . . .	4-22k	4-23
Model T-136-27 . . . . .		
Assembling . . . . .	4-8f	4-11
Removal . . . . .	4-5l	4-6
Transfer, model T-136-21		
Assembly of subassemblies		
Assembly, idler shaft . . . . .	4-24h	4-29
Assembly, input shaft . . . . .	4-24g	4-29
Assembly, rear output shaft . . . . .	4-24i	4-29
Case, transfer . . . . .	4-24b	4-29
Cover, front output shaft . . . . .	4-24c	4-29
Cover, transfer case . . . . .	4-24d	4-29
Handbrake . . . . .	4-24a	4-29
Shaft, front output . . . . .	4-24f	4-29
Sprag units . . . . .	4-24e	4-29
Assembly of transfer		
Assembly, front output and reverse shifter shaft . . . . .	4-25i	4-30
Assembly, front output shaft cover . . . . .	4-25j	4-30
Assembly, handbrake drum and shoe . . . . .	4-25l	4-30
Assembly, rear output shaft . . . . .	4-25e	4-30
Assembly, input shaft, fork and idler shaft . . . . .	4-25c	4-30
Cover, case . . . . .	4-25f	4-30
Cover, idler shaft rear bearing . . . . .	4-25a	4-30
Cover, input shaft front bearing . . . . .	4-25h	4-30
Cover, rear output shaft rear bearing . . . . .	4-25b	4-30
Flanges, companion . . . . .	4-25k	4-30
Gear, idler shaft driving . . . . .	4-25g	4-30
Topcover and shifter shaft . . . . .	4-25d	4-30
Cleaning, inspection and repair		
General . . . . .	2-7	2-15
Data . . . . .	4-20	4-20

INDEX (Continued)

Subject	Paragraph	Page
Description .....	1-6c	1-3
Description and operation		
Description .....	4-19a	4-19
Operation .....	4-19b	4-19
Disassembly of subassemblies		
Assembly, cover front output shaft .....	4-23g	4-28
Assembly, cover, transfer case .....	4-23f	4-27
Assembly, idler shaft .....	4-23b	4-25
Assembly, input shaft .....	4-23c	4-25
Assembly, output shaft, front .....	4-23d	4-26
Assembly, rear output shaft .....	4-23a	4-25
Assembly, sprag units .....	4-23e	4-27
Disassembly of transfer into subassemblies		
General .....	4-21	4-21
Removal		
Assembly, input shaft, fork and idler shaft .....	4-22i	4-23
Assembly, front output shaft, and reverse shift shaft .....	4-22f	4-22
Assembly, handbrake drum and shoe .....	4-22a	4-21
Assembly, output shaft, front, cover .....	4-22e	4-22
Assembly, rear output shaft .....	4-22j	4-23
Cover, case .....	4-22i	4-23
Cover, idler shaft rear bearing .....	4-22n	4-24
Cover, input shaft front bearing .....	4-22g	4-22
Cover, input shaft rear bearing .....	4-22o	4-24
Cover, rear output shaft rear bearing .....	4-22m	4-23
Draining .....	4-22c	4-21
Flanges, companion .....	4-22d	4-21
Gear, idler shaft driving .....	4-22h	4-22
Installation, transfer on overhaul stand .....	4-22b	4-21
Transfer top cover and shifter shaft .....	4-22k	4-23
Repair and replacement standards		
General .....	4-33	4-31
Wear limits .....	4-33	4-31
Sprags and energizing springs .....	4-35	4-31
Test and adjustment		
Handbrake shoe adjustment .....	4-30	4-30
Handbrake test .....	4-29	4-30
Idler shaft bearing adjustment .....	4-32	4-30
Lubrication .....	4-27	4-30
Rear output shaft rear bearing adjustment .....	4-31	4-30
Shift test .....	4-28	4-30
Troubleshooting		
General .....	2-5	2-1
Introductory information .....	2-6	2-1
Table 2-2.03 .....		2-11
Transfer, model T-136-27		
Assembly of subassemblies		
Assembly, countershaft .....	4-7f	4-10
Assembly, handbrake .....	4-7a	4-10
Assembly, input shaft .....	4-7e	4-10
Assembly, rear output shaft .....	4-7g	4-10
Case, transfer .....	4-7b	4-10
Cover, front output shaft .....	4-7c	4-10
Cover, transfer case .....	4-7d	4-10
Assembly of transfer		
Assembly, air cylinder .....	4-8m	4-11
Assembly, handbrake drum and shoe .....	4-8q	4-11

## INDEX (Continued)

Subject	Paragraph	Page
Assembly, shifter fork, input shaft, and countershaft . . . . .	4-8b	4-11
Assembly, transfer case shifter shaft plug and valve . . . . .	4-8a	4-11
Case, front output shaft . . . . .	4-8l	4-11
Clutch, front output . . . . .	4-8i	4-11
Cover, case . . . . .	4-8h	4-11
Cover, countershaft rear bearing . . . . .	4-8e	4-11
Cover, input shaft front bearing . . . . .	4-8k	4-11
Cover, input shaft rear bearing . . . . .	4-8c	4-11
Draining transfer . . . . .	4-8o	4-11
Flanges, companion . . . . .	4-8n	4-11
Positioning transfer on overhaul stand . . . . .	4-8p	4-11
Retainer, rear output shaft rear bearing . . . . .	4-8d	4-11
Shaft, front output . . . . .	4-8j	4-11
Shaft, rear output . . . . .	4-8g	4-11
Shaft, top cover and shifter . . . . .	4-8f	4-11
Cleaning, inspection and repair		
General . . . . .	2-7	2-15
Data . . . . .	4-3	4-2
Description . . . . .	1-6c	1-3
Description and operation		
Description . . . . .	4-2a	4-1
Operation . . . . .	4-2b	4-1
Disassembly of subassemblies		
Assembly, countershaft . . . . .	4-6b	4-7
Assembly, input shaft . . . . .	4-6c	4-8
Assembly, rear output shaft . . . . .	4-6a	4-7
Assembly, handbrake shoe . . . . .	4-6g	4-10
Case, transfer . . . . .	4-6f	4-9
Cover, front output shaft . . . . .	4-6e	4-9
Cover, transfer case . . . . .	4-6d	4-9
Disassembly of transfer into subassemblies		
General . . . . .	4-4	4-3
Removal		
Assembly, air cylinder . . . . .	4-5e	4-3
Assembly, input shaft, fork and idler countershaft . . . . .	4-5p	4-7
Assembly, front output shaft and shifter shaft . . . . .	4-5h	4-4
Assembly, handbrake drum and shoe . . . . .	4-5a	4-3
Assembly, front output shaft case . . . . .	4-5f	4-4
Assembly, rear output shaft . . . . .	4-5k	4-6
Clutch, front output . . . . .	4-5i	4-5
Cover, case . . . . .	4-5j	4-5
Cover, countershaft rear bearing . . . . .	4-5m	4-6
Cover, input shaft front bearing . . . . .	4-5g	4-4
Cover, input shaft rear bearing . . . . .	4-5o	4-7
Draining . . . . .	4-5c	4-3
Flanges, companion . . . . .	4-5d	4-3
Installation, transfer on overhaul stand . . . . .	4-5b	4-3
Plug, shifter shaft and valve . . . . .	4-5q	4-7
Retainer, rear output shaft rear bearing . . . . .	4-5n	4-7
Shaft, shifter, and top cover . . . . .	4-5l	4-6
Repair and replacement standards		
General . . . . .	4-16	4-12
Points of measurement . . . . .	4-17	4-12
Test and adjustment		
Countershaft rear bearing adjustment . . . . .	4-14	4-12
Handbrake shoe adjustment . . . . .	4-13	4-11
Handbrake test . . . . .	4-12	4-11
Lubrication . . . . .	4-10	4-11

INDEX (Continued)

Subject	Paragraph	Page
Rear output shaft rear bearing adjustment . . . . .	4-15	4-12
Shift test . . . . .	4-11	4-11
Troubleshooting		
General . . . . .	2-5	2-1
Introductory information . . . . .	2-6	2-1
Table 2-2.02 . . . . .		2-7
Transmission, models 3052 and 3053A		
Assembly of subassemblies		
Assembly, countershaft . . . . .	3-10b	3-18
Assembly, input shaft . . . . .	3-10e	3-19
Assembly, mainshaft . . . . .	3-10c	3-19
Assembly, shifter shaft cover . . . . .	3-10a	3-17
Mainshaft rear bearing cap . . . . .	3-10d	3-19
Synchronizer, second- and third-speed . . . . .	3-10c(1)	3-19
Assembly of transmission		
Assembly, clutch release . . . . .	3-11pqr	3-20
Assembly, countershaft . . . . .	3-11c	3-19
Assembly, idler gear and shaft . . . . .	3-11f	3-20
Assembly, input shaft and bearing cap . . . . .	3-11j	3-20
Assembly, mainshaft . . . . .	3-11g	3-20
Assembly, mainshaft rear bearing cap . . . . .	3-11m	3-20
Cap, input shaft bearing . . . . .	3-11j	3-20
Cover, power takeoff opening . . . . .	3-11	3-20
Cover, shifter shaft and forks . . . . .	3-110	3-20
Flange, companion . . . . .	3-11n	3-20
Front bearing, countershaft . . . . .	3-11a	3-19
Input shaft and bearing cap . . . . .	3-11j	3-20
Mainshaft . . . . .	3-11g	3-20
Nut, countershaft rear bearing retaining . . . . .	3-11e	3-19
Retainer, countershaft front bearing . . . . .	3-11b	3-19
Rear bearing, countershaft . . . . .	3-11d	3-19
Synchronizer, fourth- and fifth-speed . . . . .	3-11h	3-20
Cleaning, inspection and repair		
General . . . . .	2-7	2-15
Data . . . . .	3-3	3-2
Description . . . . .	1-6b	1-1
Description and operation		
General . . . . .	3-2a	3-1
Operation . . . . .	3-2b	3-1
Disassembly of subassemblies		
Assembly, countershaft . . . . .	3-9c	3-16
Assembly, input shaft . . . . .	3-9a	3-15
Assembly, main drive gear . . . . .	3-9b	3-16
Assembly, shifter shaft cover . . . . .	3-9e	3-16
Mainshaft, rear bearing cap . . . . .	3-9d	3-16
Disassembly into subassemblies		
General . . . . .	3-7	3-11
Removal		
Assembly, clutch release . . . . .	3-8a	3-11
Assembly, countershaft . . . . .	3-8m	3-14
Assembly, idler gear . . . . .	3-8k	3-14
Assembly, mainshaft . . . . .	3-8j	3-14
Assembly, mainshaft rear bearing cap . . . . .	3-8d	3-13
Cap, input shaft bearing . . . . .	3-8g	3-13
Cover, countershaft rear bearing . . . . .	3-8e	3-13
Cover, power takeoff opening . . . . .	3-8f	3-13
Flange, companion . . . . .	3-8c	3-12
Front bearing, countershaft . . . . .	3-8n	3-14

**INDEX (Continued)**

<b>Subject</b>	<b>Paragraph</b>	<b>Page</b>
Input shaft . . . . .	3-8g	3-13
Mainshaft . . . . .	3-8j	3-14
Rear bearing, countershaft . . . . .	3-8l	3-14
Models, differences between . . . . .	1-6b	1-1
Repair and replacement standards . . . . .	3-16	3-21
Transmission 3053A (only)		
Data . . . . .	3-6	3-9
Description and operation . . . . .	3-5	3-9
Repair		
General . . . . .	3-12	3-21
Troubleshooting, models 3052 and 3053A, table 2-2.01 . . . . .		2-3
Troubleshooting		
General . . . . .	2-5	2-1
Introductory information . . . . .	2-6	2-1
Index, table 2-2 . . . . .		2-2
Tables		
Table 2-2. Index, table . . . . .		2-2
Table 2-2.01. Transmissions, models 3052 and 3053A . . . . .		2-3
Table 2-2.02. Transfer, model T-136-27 . . . . .		2-7
Table 2-2.03. Transfer, model T-136-21 . . . . .		2-11
Table 2-2.04. Power takeoff models WN-7-28 and WND-7-28 . . . . .		2-12
Table 2-2.05. Power takeoff model P-136-C . . . . .		2-14

**V**

Valve assembly, shifter shaft plug, transfer case, removal . . . . .	4-5q	4-7
Vehicle model application		
Power takeoffs		
Model WN-7-28 . . . . .	1-6d(4)b	1-6
Model WND-7-28 . . . . .	1-6d(4)a	1-6
Model P-136-C . . . . .	1-6d(4)c	1-6
Transfers		
Model T-136-21 . . . . .	1-6c(4)(a)	1-3
Model T-136-27 . . . . .	1-6c(4)(b)	1-4
Transmissions		
Model 3052 and 3053A . . . . .	1-6b(3)	1-3

**W**

Wear limits, general		
Power takeoffs		
Model WN-7-28 . . . . .	5-10	5-7
Model WND-7-28 . . . . .	5-21	5-14
Model P-136-C . . . . .	5-30	5-20
Transmission, models 3052 and 3053A . . . . .	3-16	3-21
Transfer		
Model T-136-21 . . . . .	4-33	4-31
Model T-136-27 . . . . .	4-16	4-12



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## THE METRIC SYSTEM AND EQUIVALENTS

### LINEAR MEASURE

1 Centimeter = 10 Millimeters = 0.01 Meters = 0.3937 Inches  
 1 Meter = 100 Centimeters = 1,000 Millimeters = 39.37 Inches  
 1 Kilometer = 1,000 Meters = 0.621 Miles

### WEIGHTS

1 Gram = 0.001 Kilograms = 1,000 Milligrams = 0.035 Ounces  
 1 Kilogram = 1,000 Grams = 2.2 Lb  
 1 Metric Ton = 1,000 Kilograms = 1 Megagram = 1.1 Short  
 Tons

### LIQUID MEASURE

1 Milliliter = 0.001 Liters = 0.0338 Fluid Ounces  
 1 Liter = 1,000 Milliliters = 33.82 Fluid Ounces

### SQUARE MEASURE

1 Sq Centimeter = 100 Sq Millimeters = 0.155 Sq Inches  
 1 Sq Meter = 10,000 Sq Centimeters = 10.76 Sq Feet  
 1 Sq Kilometer = 1,000,000 Sq Meters = 0.386 Sq Miles

### CUBIC MEASURE

1 Cu Centimeter = 1,000 Cu Millimeters = 0.06 Cu Inches  
 1 Cu Meter = 1,000,000 Cu Centimeters = 35.31 Cu Feet

### TEMPERATURE

5 9 (°F -32) = °C  
 212° Fahrenheit is equivalent to 100° Celsius  
 90° Fahrenheit is equivalent to 32.2° Celsius  
 32° Fahrenheit is equivalent to 0° Celsius  
 9 5 C° +32 = F°

## APPROXIMATE CONVERSION FACTORS

TO CHANGE	TO	MULTIPLY BY
Inches	Centimeters	2.540
Feet	Meters	0.305
Yards	Meters	0.914
Miles	Kilometers	1.609
Square Inches	Square Centimeters	6.451
Square Feet	Square Meters	0.093
Square Yards	Square Meters	0.836
Square Miles	Square Kilometers	2.590
Acres	Square Hectometers	0.405
Cubic Feet	Cubic Meters	0.028
Cubic Yards	Cubic Meters	0.765
Fluid Ounces	Milliliters	29.573
Pints	Liters	0.473
Quarts	Liters	0.946
Gallons	Liters	3.785
Ounces	Grams	28.349
Pounds	Kilograms	0.454
Short Tons	Metric Tons	0.907
Pound-Feet	Newton-Meters	1.356
Pounds Per Square Inch	Kilopascals	6.895
Miles Per Gallon	Kilometers Per Liter	0.425
Miles Per Hour	Kilometers Per Hour	1.609

TO CHANGE	TO	MULTIPLY BY
Centimeters	Inches	0.394
Meters	Feet	3.280
Meters	Yards	1.094
Kilometers	Miles	0.621
Square Centimeters	Square Inches	0.155
Square Meters	Square Feet	10.764
Square Meters	Square Yards	1.196
Square Kilometers	Square Miles	0.386
Square Hectometers	Acres	2.471
Cubic Meters	Cubic Feet	35.315
Cubic Meters	Cubic Yards	1.308
Milliliters	Fluid Ounces	0.034
Liters	Pints	2.113
Liters	Quarts	1.057
Liters	Gallons	0.264
Grams	Ounces	0.035
Kilograms	Pounds	2.205
Metric Tons	Short Tons	1.102
Newton-Meters	Pound-Feet	0.738
Kilopascals	Pounds Per Square Inch	0.145
Kilometers Per Liter	Miles Per Gallon	2.354
Kilometers Per Hour	Miles Per Hour	0.621

