



## Eaton Fuller RTX-12609R Transmission Service Manual

This is the Eaton Fuller RTX-12609R Transmission Service Manual brought to you by Pro Gear and Transmission to assist you identifying the the service repair procedures for your Eaton Fuller transmission unit.

If you need any assistance identifying the correct Eaton/Fuller unit for your truck and equipment, contact your Eaton replacement part specialists at Pro Gear and Transmission.

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# Fuller Heavy Duty Transmissions TRSM0430

July 2010

|              |              |              |
|--------------|--------------|--------------|
| RT-8608L     | RTX-13609R   | RTXF-13609R  |
| RTF-8608L    | RTX-14608LL  | RTXF-14608LL |
| RTO-11608LL  | RTX-14609A   | RTXF-14609A  |
| RTO-14608LL  | RTX-14609B   | RTXF-14609B  |
| RTOF-11608LL | RTX-14609P   | RTXF-14609P  |
| RTOF-14608LL | RTX-14609R   | RTXF-14609R  |
| RTX-11608LL  | RTXF-11608LL |              |
| RTX-11609A   | RTXF-11609A  |              |
| RTX-11609B   | RTXF-11609B  |              |
| RTX-11609P   | RTXF-11609P  |              |
| RTX-11609R   | RTXF-11609R  |              |
| RTX-12609A   | RTXF-12609A  |              |
| RTX-12609B   | RTXF-12609B  |              |
| RTX-12609P   | RTXF-12609P  |              |
| RTX-12609R   | RTXF-12609R  |              |
| RTX-13609A   | RTXF-13609A  |              |
| RTX-13609B   | RTXF-13609B  |              |
| RTX-13609P   | RTXF-13609P  |              |



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SUPPORT

# TABLE OF CONTENTS

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## FOREWORD

## MODEL DESIGNATIONS AND SPECIFICATIONS

## LUBRICATION

## OPERATION

### 8-SPEED "LL" MODELS

### 9-SPEED AND 8608L MODEL

### 13-SPEED MODELS

## POWER FLOW

## TIMING

## TORQUE RECOMMENDATIONS

## TOOL REFERENCE

## PREVENTIVE MAINTENANCE

## PRECAUTIONS

### DISASSEMBLY

### INSPECTION

### REASSEMBLY

## CHANGING INPUT SHAFT

## AIR SYSTEM

### RANGE SHIFT SYSTEM:

### DEEP REDUCTION AIR SYSTEM: 8-SPEED "LL" MODELS

### SPLITTER SHIFT AIR SYSTEM: 13-SPEED MODELS

### AIR SYSTEM SCHEMATICS

## DISASSEMBLY AND REASSEMBLY-SHIFTING CONTROLS

### AIR SYSTEM

### GEAR SHIFT LEVER HOUSING ASSEMBLY

### SHIFT BAR HOUSING ASSEMBLY

## REMOVAL/DISASSEMBLY-COMPANION FLANGE, AUXILIARY SECTION AND CLUTCH HOUSING

### DISASSEMBLY-AUXILIARY SECTION (8-SPEED "LL" MODELS)

### REASSEMBLY-AUXILIARY SECTION (8-SPEED "LL" MODELS)

### DISASSEMBLY-AUXILIARY SECTION (9-SPEED MODELS AND 8608L)

### REASSEMBLY-AUXILIARY SECTION (9-SPEED MODELS AND 8608L)

### DISASSEMBLY-AUXILIARY SECTION (13-SPEED MODELS)

### REASSEMBLY-AUXILIARY SECTION (13-SPEED MODELS)

### DISASSEMBLY-FRONT SECTION

### REASSEMBLY-FRONT SECTION

## INSTALLATION-COMPANION FLANGE, AUXILIARY SECTION AND CLUTCH HOUSING

## INSTALLATION-SHIFTING CONTROLS

### SHIFT BAR HOUSING

### GEAR SHIFT LEVER HOUSING ASSEMBLY

### AIR SYSTEM

## APPENDIX TAPERED ROLLER BEARING SHIMMING PROCEDURE

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# FOREWORD

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This manual is designed to provide detailed information necessary to service and repair the Fuller® Transmission listed on the cover.

As outlined in the Table of Contents, the manual is divided into 3 main sections:

- a. Technical information and reference
- b. Removal, disassembly, reassembly and installation
- c. Options

The format of the manual is designed to be followed in its entirety if complete disassembly and reassembly of the transmission is necessary. But if only one component of the transmission needs to be repaired, refer to the Table of Contents for the page numbers showing that component. For example, if you need to work on the Shifting Controls, you will find instructions for removal, disassembly and reassembly on page 48. Instructions for installation are on page 174. Service Manuals, Illustrated Parts Lists, Drivers Instructions, and other forms of

product service information for these and other Fuller Transmissions are available upon request. A Technical Literature Order Form may be found in the back of this manual. You may also obtain Service Bulletins, detailing information on product improvements, repair procedures and other service-related subjects by writing to the following address:

EATON CORPORATION  
TRANSMISSION DIVISION  
Technical Service Department  
P.O. Box 4013  
Kalamazoo, Michigan 49003  
(616) 342-3344

Every effort has been made to ensure the accuracy of all information in this brochure. However, **Eaton Transmission Division makes no expressed or implied warranty or representation based on the enclosed information.** Any errors or omissions may be reported to Training and Publications, Eaton Transmission Division, P.O. Box 4013, Kalamazoo, MI 49003.

# MODEL DESIGNATIONS AND SPECIFICATIONS

## Nomenclature:

# RTOF-11609A

Roadranger®

Twin Countershaft

Overdrive

X = Overdrive model with a direct shift pattern, replacing "O" designation (RTXF-11609A).

Forward position of gear shift lever.

Does not affect shift pattern.

Ratio Set

Forward Speeds

Multi-Mesh Gearing

× 100 = Nominal Torque Capacity

**IMPORTANT:** All Eaton Fuller Transmissions are identified by model and serial number. This information is stamped on the transmission identification tag and affixed to the case.  
DO NOT REMOVE OR DESTROY THE TRANSMISSION IDENTIFICATION TAG.

## 8-Speed "LL" Series Transmissions

| Models      | No. Spds. | Gear Ratios |      |      |      |      |      |      |      |      |     |                    | Relative Speed PTO Gear To Input R.P.M. |      | 1 Length In. (mm) | 2 Weight Lbs. (Kg.) | 3 Oil Cap Pints (Liters) |
|-------------|-----------|-------------|------|------|------|------|------|------|------|------|-----|--------------------|-----------------------------------------|------|-------------------|---------------------|--------------------------|
|             |           | LowLow      | Low  | 1st  | 2nd  | 3rd  | 4th  | 5th  | 6th  | 7th  | 8th | Reverse            | Right                                   | Left |                   |                     |                          |
| RTO-11608LL | 8 + 2     | 14.05       | 9.41 | 6.23 | 4.62 | 3.40 | 2.53 | 1.83 | 1.36 | 1.00 | .74 | 2.89/9.83<br>14.69 | .935                                    | .935 | 32.1<br>(815)     | 644<br>(289.8)      | 29<br>(13.6)             |
| RTO-14608LL | 8 + 2     | 14.66       | 9.41 | 6.23 | 4.62 | 3.40 | 2.53 | 1.83 | 1.36 | 1.00 | .74 | 2.89/9.83<br>15.33 | .935                                    | .935 | 33.6<br>(853.4)   | 698<br>(314.1)      | 29<br>(13.6)             |

## RT-8608L Series Transmissions

| Models   | No. Spds. | Gear Ratios |       |      |      |      |      |      |      |      |            | Relative Speed PTO Gear To Input R.P.M. |      | 1 Length In. (mm) | 2 Weight Lbs. (Kg.) | 3 Oil Cap Pints (Liters) |
|----------|-----------|-------------|-------|------|------|------|------|------|------|------|------------|-----------------------------------------|------|-------------------|---------------------|--------------------------|
|          |           | Low         | 1st   | 2nd  | 3rd  | 4th  | 5th  | 6th  | 7th  | 8th  | Reverse    | Right                                   | Left |                   |                     |                          |
| RT-8608L | 9         | 17.21       | 10.23 | 7.23 | 5.24 | 3.83 | 2.67 | 1.89 | 1.37 | 1.00 | 4.70/17.99 | .575                                    | .575 | 28.9<br>(734.0)   | 666<br>(299.7)      | 27<br>(12.69)            |

### CHART NOTES:

- 1 Lengths measured from face of clutch housing to front bottoming surface of companion flange or yoke.
- 2 Weight — Listed weights are **without** clutch housing. Weights include standard controls, which consist of gear shift lever housing, gear shift lever, range and splitter controls and attaching lines. Weight of standard controls is approximately 10 lbs. (4.5 kg). All weights are approximate.
- 3 Oil Capacities are approximate, depending on inclination of engine and transmission. Always fill transmission with proper grade and type of lubricant to level of filler opening. See LUBRICATION.

# MODEL DESIGNATIONS AND SPECIFICATIONS

## Speed Transmissions

| Models     | No. Spds. | Gear Ratios |      |      |      |      |      |      |      |      |              | Relative Speed PTO Gear To Input R.P.M. |      | 1 Length In. (mm) | 2 Weight Lbs. (Kg.) | 3 Oil Cap Pints (Liters) |
|------------|-----------|-------------|------|------|------|------|------|------|------|------|--------------|-----------------------------------------|------|-------------------|---------------------|--------------------------|
|            |           | Low         | 1st  | 2nd  | 3rd  | 4th  | 5th  | 6th  | 7th  | 8th  | Reverse      | Right                                   | Left |                   |                     |                          |
| RT-11609A  | 9         | 12.65       | 8.38 | 6.22 | 4.57 | 3.40 | 2.46 | 1.83 | 1.34 | 1.00 | 3.89 / 13.22 | .696                                    | .696 | 28.9 (734)        | 590 (265.5)         | 27 (12.69)               |
| RT0-11609A | 9         | 9.41        | 6.23 | 4.62 | 3.40 | 2.53 | 1.83 | 1.36 | 1.00 | .74  | 2.89 / 9.83  | .935                                    | .935 | 28.9 (734)        | 590 (265.5)         | 27 (12.69)               |
| RT0-11609B | 9         | 12.56       | 7.47 | 5.28 | 3.82 | 2.79 | 1.95 | 1.38 | 1.00 | .73  | 3.43 / 13.14 | .788                                    | .788 | 28.9 (734)        | 590 (265.5)         | 27 (12.69)               |
| RT-12609A  | 9         | 12.65       | 8.38 | 6.22 | 4.57 | 3.40 | 2.46 | 1.83 | 1.34 | 1.00 | 3.89 / 13.22 | .696                                    | .696 | 28.9 (734)        | 602 (270)           | 27 (12.69)               |
| RT0-12609A | 9         | 9.41        | 6.23 | 4.62 | 3.40 | 2.53 | 1.83 | 1.36 | 1.00 | .74  | 2.89 / 9.83  | .935                                    | .935 | 28.9 (734)        | 602 (270)           | 27 (12.69)               |
| RT0-12609B | 9         | 12.56       | 7.47 | 5.28 | 3.82 | 2.79 | 1.95 | 1.38 | 1.00 | .73  | 3.43 / 13.14 | .788                                    | .788 | 28.9 (734)        | 602 (270)           | 27 (12.69)               |
| RT-13609A  | 9         | 12.65       | 8.38 | 6.22 | 4.57 | 3.40 | 2.46 | 1.83 | 1.34 | 1.00 | 3.89 / 13.22 | .696                                    | .696 | 28.9 (734)        | 679 (308)           | 27 (13)                  |
| RTX-13609A | 9         | 9.41        | 6.23 | 4.62 | 3.40 | 2.53 | 1.83 | 1.36 | 1.00 | .74  | 2.89 / 9.83  | .935                                    | .935 | 28.9 (734)        | 679 (308)           | 27 (13)                  |
| RTX-13609B | 9         | 12.56       | 7.47 | 5.28 | 3.82 | 2.79 | 1.95 | 1.38 | 1.00 | .73  | 3.43 / 13.14 | .788                                    | .788 | 28.9 (734)        | 679 (308)           | 27 (13)                  |
| RT-14609A  | 9         | 12.65       | 8.38 | 6.22 | 4.57 | 3.40 | 2.46 | 1.83 | 1.34 | 1.00 | 3.89 / 13.22 | .696                                    | .696 | 29.5 (749)        | 616 (277.2)         | 27 (12.69)               |
| RT0-14609A | 9         | 9.41        | 6.23 | 4.62 | 3.40 | 2.53 | 1.83 | 1.36 | 1.00 | .74  | 2.89 / 9.83  | .935                                    | .935 | 29.5 (749)        | 616 (277.2)         | 27 (12.69)               |
| RT0-14609B | 9         | 12.56       | 7.47 | 5.28 | 3.82 | 2.79 | 1.95 | 1.38 | 1.00 | .73  | 3.43 / 13.14 | .788                                    | .788 | 29.5 (749)        | 616 (277.2)         | 27 (12.69)               |

| Models     | No. Spds. | Gear Ratios |      |      |      |      |      |      |      |     |              | Relative Speed PTO Gear To Input R.P.M. |      | 1 Length In. (mm) | 2 Weight Lbs. (Kg.) | 3 Oil Cap Pints (Liters) |
|------------|-----------|-------------|------|------|------|------|------|------|------|-----|--------------|-----------------------------------------|------|-------------------|---------------------|--------------------------|
|            |           | 1st         | 2nd  | 3rd  | 4th  | 5th  | 6th  | 7th  | 8th  | 9th | Reverse      | Right                                   | Left |                   |                     |                          |
| RTX-11609P | 9         | 10.58       | 7.55 | 5.39 | 3.83 | 2.77 | 1.97 | 1.41 | 1.00 | .83 | 2.89 / 11.06 | .935                                    | .935 | 28.9 (734)        | 590 (265.5)         | 27 (12.69)               |
| RTX-12609P | 9         | 10.58       | 7.55 | 5.39 | 3.83 | 2.77 | 1.97 | 1.41 | 1.00 | .83 | 2.89 / 11.06 | .935                                    | .935 | 28.9 (734)        | 602 (270.9)         | 27 (12.69)               |
| RTX-13609P | 9         | 10.58       | 7.55 | 5.39 | 3.83 | 2.77 | 1.97 | 1.41 | 1.00 | .83 | 2.89 / 11.06 | .935                                    | .935 | 28.9 (734)        | 679 (308)           | 27 (13)                  |
| RTX-14609P | 9         | 10.58       | 7.55 | 5.39 | 3.83 | 2.80 | 2.01 | 1.41 | 1.00 | .83 | 2.89 / 11.06 | .935                                    | .935 | 29.5 (749.3)      | 616 (277.2)         | 27 (12.69)               |
| RTX-11609R | 9         | 10.58       | 7.55 | 5.39 | 3.83 | 2.77 | 1.97 | 1.41 | 1.00 | .80 | 2.89 / 11.06 | .935                                    | .935 | 28.9 (734)        | 590 (265.5)         | 27 (12.69)               |
| RTX-12609R | 9         | 10.58       | 7.55 | 5.39 | 3.83 | 2.77 | 1.97 | 1.41 | 1.00 | .80 | 2.89 / 11.06 | .935                                    | .935 | 28.9 (734)        | 602 (270.9)         | 27 (12.69)               |
| RTX-13609R | 9         | 10.58       | 7.55 | 5.39 | 3.83 | 2.77 | 1.97 | 1.41 | 1.00 | .80 | 2.89 / 11.06 | .935                                    | .935 | 28.9 (734)        | 679 (308)           | 27 (13)                  |
| RTX-14609R | 9         | 10.58       | 7.55 | 5.39 | 3.83 | 2.80 | 2.01 | 1.41 | 1.00 | .80 | 2.89 / 11.06 | .935                                    | .935 | 29.5 (749.3)      | 616 (277.2)         | 27 (12.69)               |

## 13-Speed Transmissions

| Models     | No. Spds. | Gear Ratios |      |      |      |      |      |      |      |      |      |      |      |      |              | Relative Speed PTO Gear To Input R.P.M. |      | 1 Length In. (mm) | 2 Weight Lbs. (Kg.) | 3 Oil Cap Pints (Liters) |
|------------|-----------|-------------|------|------|------|------|------|------|------|------|------|------|------|------|--------------|-----------------------------------------|------|-------------------|---------------------|--------------------------|
|            |           | Low         | 1st  | 2nd  | 3rd  | 4th  | 5UD  | 5th  | 6UD  | 6th  | 7UD  | 7th  | 8UD  | 8th  | Reverse      | Right                                   | Left |                   |                     |                          |
| RT-11613   | 13        | 12.56       | 8.32 | 6.18 | 4.54 | 3.38 | 2.86 | 2.46 | 2.12 | 1.83 | 1.56 | 1.34 | 1.16 | 1.00 | 3.89 / 13.13 | .696                                    | .696 | 32.1 (815)        | 653 (293.8)         | 28 (13.2)                |
| RT-14613   | 13        | 12.56       | 8.32 | 6.18 | 4.54 | 3.38 | 2.86 | 2.46 | 2.12 | 1.83 | 1.56 | 1.34 | 1.16 | 1.00 | 3.89 / 13.13 | .696                                    | .696 | 32.4 (823)        | 665 (299.2)         | 29 (13.6)                |
| RT-15613   | 13        | 12.56       | 8.32 | 6.18 | 4.54 | 3.38 | 2.86 | 2.46 | 2.12 | 1.83 | 1.56 | 1.34 | 1.16 | 1.00 | 3.89 / 13.13 | .696                                    | .696 | 32.4 (823)        | 685 (308.2)         | 29 (13.6)                |
|            |           | Low         | 1st  | 2nd  | 3rd  | 4th  | 5th  | 5UD  | 6th  | 6UD  | 7th  | 7UD  | 8th  | 8UD  |              |                                         |      |                   |                     |                          |
| RT0-11613  | 13        | 12.56       | 8.32 | 6.18 | 4.54 | 3.38 | 2.46 | 2.15 | 1.83 | 1.60 | 1.34 | 1.17 | 1.00 | .87  | 3.89 / 13.13 | .696                                    | .696 | 32.1 (815)        | 653 (293.8)         | 28 (13.2)                |
| RT00-11613 | 13        | 12.12       | 7.21 | 5.09 | 3.69 | 2.70 | 1.95 | 1.66 | 1.38 | 1.17 | 1.00 | .85  | .73  | .62  | 3.43 / 12.68 | .788                                    | .788 | 32.1 (815)        | 653 (293.8)         | 28 (13.2)                |
| RT0-14613  | 13        | 12.56       | 8.32 | 6.18 | 4.54 | 3.38 | 2.46 | 2.15 | 1.83 | 1.60 | 1.34 | 1.17 | 1.00 | .87  | 3.89 / 13.13 | .696                                    | .696 | 32.4 (823)        | 665 (299.2)         | 29 (13.6)                |
| RT00-14613 | 13        | 12.13       | 7.21 | 5.09 | 3.69 | 2.70 | 1.95 | 1.66 | 1.38 | 1.17 | 1.00 | .85  | .73  | .62  | 3.43 / 12.68 | .788                                    | .788 | 32.4 (823)        | 665 (299.2)         | 29 (13.6)                |
| RT0-15613  | 13        | 12.56       | 8.32 | 6.18 | 4.54 | 3.38 | 2.46 | 2.15 | 1.83 | 1.60 | 1.34 | 1.17 | 1.00 | .87  | 3.89 / 13.13 | .696                                    | .696 | 32.4 (823)        | 685 (308.6)         | 29 (13.6)                |

# LUBRICATION

## Proper Lubrication . . . the Key to long transmission life

Proper lubrication procedures are the key to a good all-around maintenance program. If the oil is not doing its job, or if the oil level is ignored, all the maintenance procedures in the world are not going to keep the transmission running or assure long transmission life.

Eaton® Fuller® Transmissions are designed so that the internal parts operate in a bath of oil circulated by the motion of gears and shafts.

Thus, all parts will be amply lubricated if these procedures are closely followed:

1. Maintain oil level. Inspect regularly.
2. Change oil regularly.
3. Use the correct grade and type of oil.
4. Buy from a reputable dealer.

### Lubrication Change and Inspection

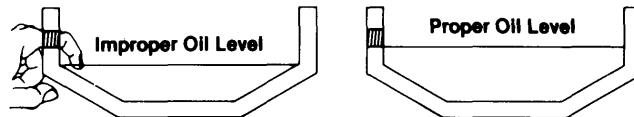
| Eaton® Roadranger® CD50 Transmission Fluid               |                                                                      |
|----------------------------------------------------------|----------------------------------------------------------------------|
| HIGHWAY USE                                              |                                                                      |
| First 3,000 to 5,000 miles<br>(4827 to 8045 Km)          | Factory fill<br>Initial drain.                                       |
| Every 10,000 miles<br>(16090 Km)                         | Check fluid level.<br>Check for leaks.                               |
| Every 250,000 miles<br>(402336 Km)                       | Change transmission<br>fluid.                                        |
| OFF-HIGHWAY USE                                          |                                                                      |
| First 30 hours                                           | Factory fill<br>Initial drain.                                       |
| Every 40 hours                                           | Inspect fluid level, Check for leaks.                                |
| Every 500 hours                                          | Change transmission fluid where<br>severe dirt conditions exist.     |
| Every 1,000 hours                                        | Change transmission fluid<br>(Normal off-highway use).               |
| Heavy Duty Engine Lubricant or<br>Mineral Gear Lubricant |                                                                      |
| HIGHWAY USE                                              |                                                                      |
| First 3,000 to 5,000 miles<br>(4827 to 8045 Km)          | Factory fill<br>initial drain.                                       |
| Every 10,000 miles<br>(16090 Km)                         | Inspect lubricant level.<br>Check for leaks.                         |
| Every 50,000 miles<br>(80450 Km)                         | Change transmission<br>lubricant.                                    |
| OFF-HIGHWAY USE                                          |                                                                      |
| First 30 hours                                           | Change transmission<br>lubricant on new units.                       |
| Every 40 hours                                           | Inspect lubricant level. Check for leaks.                            |
| Every 500 hours                                          | Change transmission lubricant where<br>severe dirt conditions exist. |
| Every 1,000 hours                                        | Change transmission lubricant<br>(Normal of highway use).            |

| Recommended Lubricants                                                                                        |                |                                                                   |
|---------------------------------------------------------------------------------------------------------------|----------------|-------------------------------------------------------------------|
| Type                                                                                                          | Grade<br>(SAE) | Fahrenheit<br>(Celsius)<br>Ambient<br>Temperature                 |
| Eaton® Roadranger®<br>CD50 Transmission<br>Fluid                                                              | 50             | All                                                               |
| Heavy Duty Engine Oil<br>MIL-L-2104B, C or D or<br>API-SF or API-CD<br>(Previous API designations acceptable) | 50<br>40<br>30 | Above 10°F (-12°C.)<br>Above 10°F (-12°C.)<br>Below 10°F (-12°C.) |
| Mineral Gear Oil with rust<br>and oxidation inhibitor<br>API-GL-1                                             | 90<br>80W      | Above 10°F (-12°C.)<br>Below 10°F (-12°C.)                        |

**The use of mild EP gear oil or multi-purpose gear oil is not recommended, but if these gear oils are used, be sure to adhere to the following limitations:**

Do not use mild EP gear oil or multi-purpose gear oil when operating temperatures are above 230°F (110°C). Many of these gear oils, particularly 85W140, break down above 230°F and coat seals, bearings and gears with deposits that may cause premature failures. If these deposits are observed (especially a coating on seal areas causing oil leakage), change to Eaton Roadranger CD50 transmission fluid, heavy duty engine oil or mineral gear oil to assure maximum component life and to maintain your warranty with Eaton. (Also see "Operating Temperatures".)

Additives and friction modifiers are not recommended for use in Eaton Fuller transmissions.



### Proper Oil Level

Make sure oil is level with filler opening. Because you can reach oil with your finger does not mean oil is at proper level. **One inch of oil level is about one gallon of oil.**

### Draining Oil

Drain transmission while oil is warm. To drain oil remove the drain plug at bottom of case. Clean the drain plug before re-installing.

### Refilling

Clean case around filler plug and remove plug from side of case. Fill transmission to the level of the filler opening. If transmission has two filler openings, fill to level of both openings.

The exact amount of oil will depend on the transmission inclination and model. Do not over fill—this will cause oil to be forced out of the transmission.

**When adding oil, types and brands of oil should not be mixed because of possible in-**

# LUBRICATION

## Operating Temperatures

### —With Eaton® Roadranger® CD50 Transmission Fluid Heavy Duty Engine Oil and Mineral Oil

The transmission should not be operated consistently at temperatures above 250°F (120°C). However, intermittent operating temperatures to 300°F (149°C) will not harm the transmission. Operating temperatures above 250°F increase the lubricant's rate of oxidation and shorten its effective life. When the average operating temperature is above 250°F, the transmission may require more frequent oil changes or external cooling.

The following conditions in any combination can cause operating temperatures of over 250°F: (1) operating consistently at slow speeds, (2) high ambient temperatures, (3) restricted air flow around transmission, (4) exhaust system too close to transmission, (5) high horsepower, overdrive operation.

External oil coolers are available to reduce operating temperatures when the above conditions are encountered.

### Transmission Oil Coolers are:

#### Recommended

- With engines of 350 H.P. and above with overdrive transmissions

#### Required

- With engines 399 H.P. and above with overdrive transmissions and GCW'S over 90,000 lbs.
- With engines 399 H.P. and above and 1400 Lbs.-Ft. or greater torque
- With engines 450 H.P. and above

### — With EP or Multipurpose Gear Oil

Mild EP gear oil and multipurpose gear oil are not recommended when lubricant operating temperatures are above 230°F (110°C). In addition, transmission oil coolers are not recommended with these gear oils since the oil cooler materials may be attacked by these gear oils. **The lower temperature limit and oil cooler restriction with these gear oils generally limit their success to milder applications.**

## Proper Lubrication Levels as Related to Transmission Installation Angles

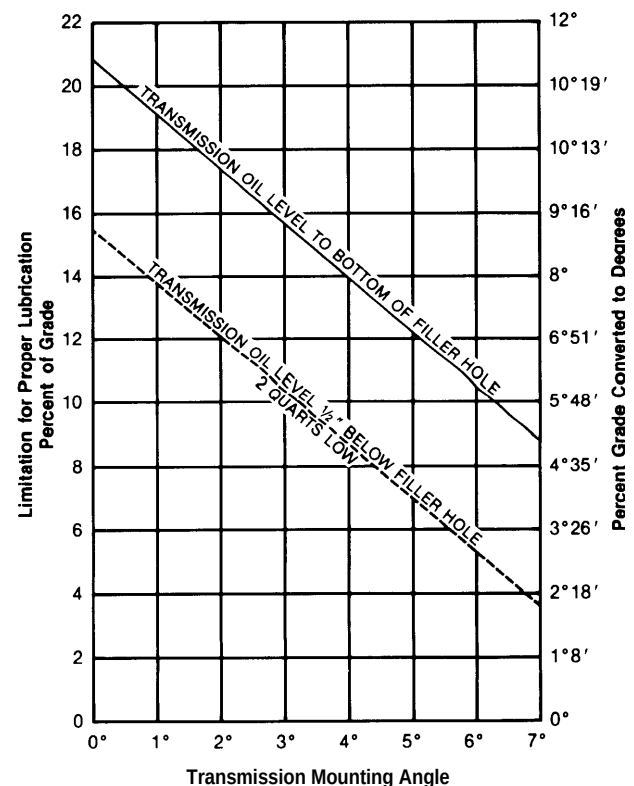
If the transmission operating angle is more than 12 degrees, improper lubrication can occur. The operating angle is the transmission mounting angle in the chassis plus the percent of upgrade (expressed in degrees).

The chart below illustrates the safe percent of upgrade on which the transmission can be used with various chassis mounting angles. For example: if you have a 4 degree transmission mounting angle, then 8 degrees (or 14 percent of grade) is equal to the limit of 12 degrees. If you have a 0 degree mounting angle, the transmission can be operated on a 12 degree (21 percent) grade.

Anytime the transmission operating angle of 12 degrees is exceeded for an extended period of time the transmission should be equipped with an oil pump or cooler kit to insure proper lubrication.

Note on the chart the effect low oil levels can have on safe operating angles. Allowing the oil level to fall 1/2" below the filler plug hole reduces the degree of grade by approximately 3 degrees (5.5 percent).

### Proper Lubrication Levels are Essential!



Dotted line showing "2 Quarts Low" is for reference only. Not recommended.

# OPERATION

## 8-Speed "LL" Series Transmissions

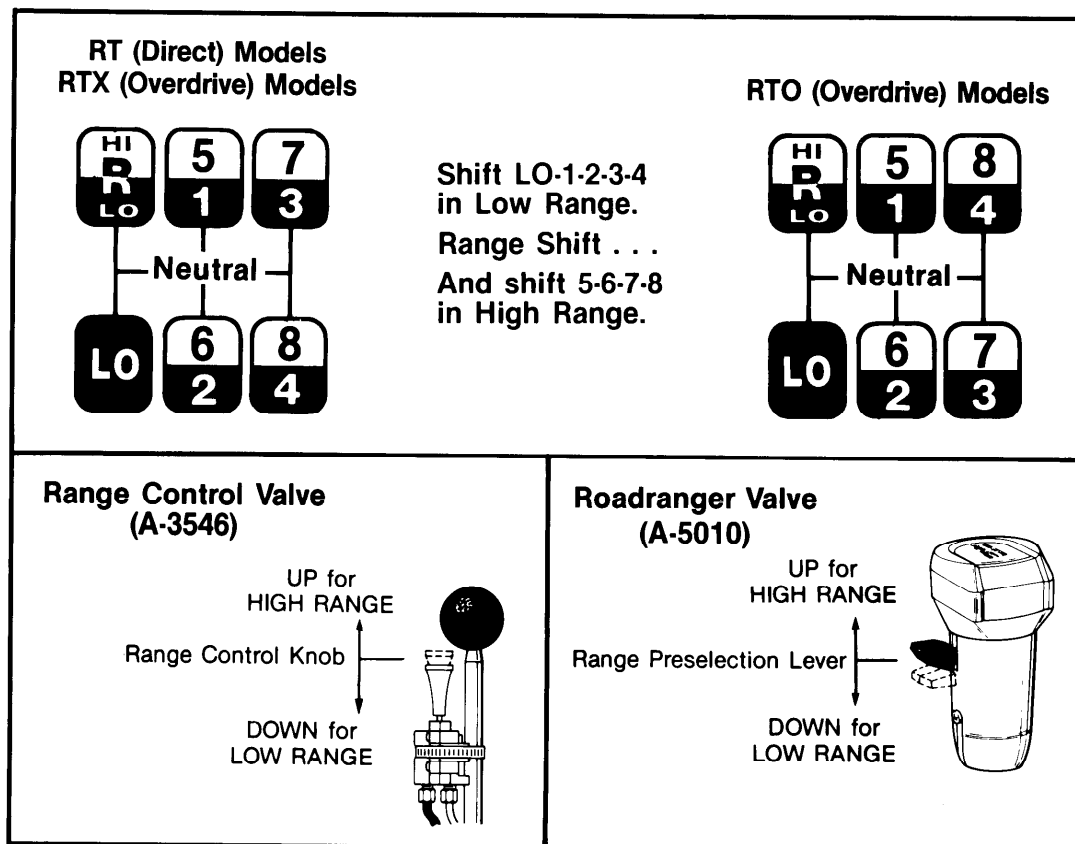
### Shift Lever Patterns and Shifting Controls

| RTX (Overdrive) Models                                                                                                                                   |                                                                                                                                                                                                    | RTO (Overdrive) Models                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|
| <p>RTX (Overdrive) Models</p>                                                                                                                            | <p>14651</p> <p>A-5015</p> <p>With Deep Reduction Lever/ Button in the "OUT"/REARWARD position . . .<br/>Shift LO-1-2-3-4 in LOW RANGE.<br/>Range Shift . . .<br/>Shift 5-6-7-8 in HIGH RANGE.</p> | <p>RTO (Overdrive) Models</p>           |
| <p>WHILE IN LOW RANGE ONLY and shift lever in LO . . .<br/>LO-LO can be obtained by moving Deep Reduction Lever/Button to the "IN"/FORWARD position.</p> | <p>14651</p> <p>A-5015</p>                                                                                                                                                                         |                                         |
| <p><b>Range Control Valve (A-3546)</b></p>                                                                                                               | <p><b>Roadranger Valve (A-5010)</b></p>                                                                                                                                                            | <p><b>Roadranger Valve (A-5015)</b></p> |

# OPERATION

## 9-Speed and RT-8608L Transmissions

### Shift Lever Patterns and Shifting Controls

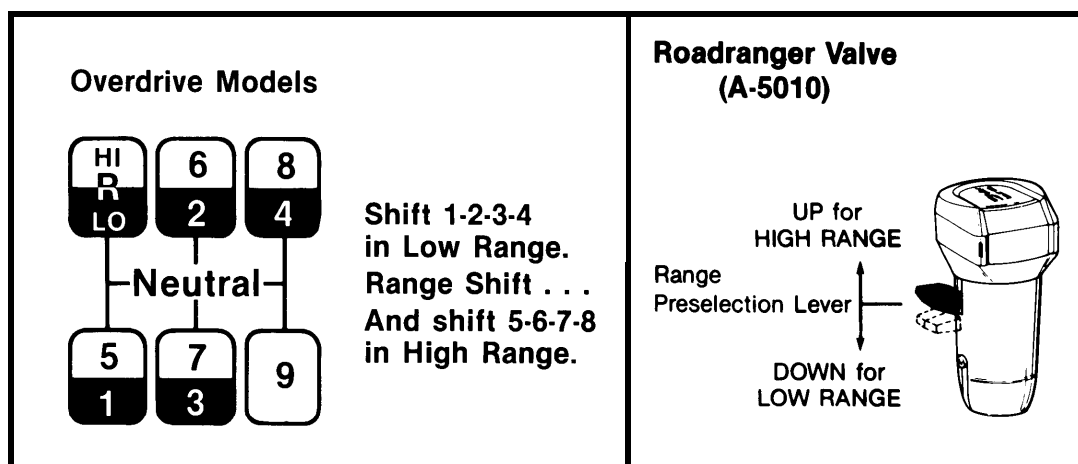


## RTX-11609P and RTX-11609R Transmissions

## RTX-12609P and RTX-12609R Transmissions

## RTX-14609P and RTX-14609R Transmissions

### Shift Lever Patterns and Shifting Controls



# OPERATION

## 13-Speed Underdrive Models

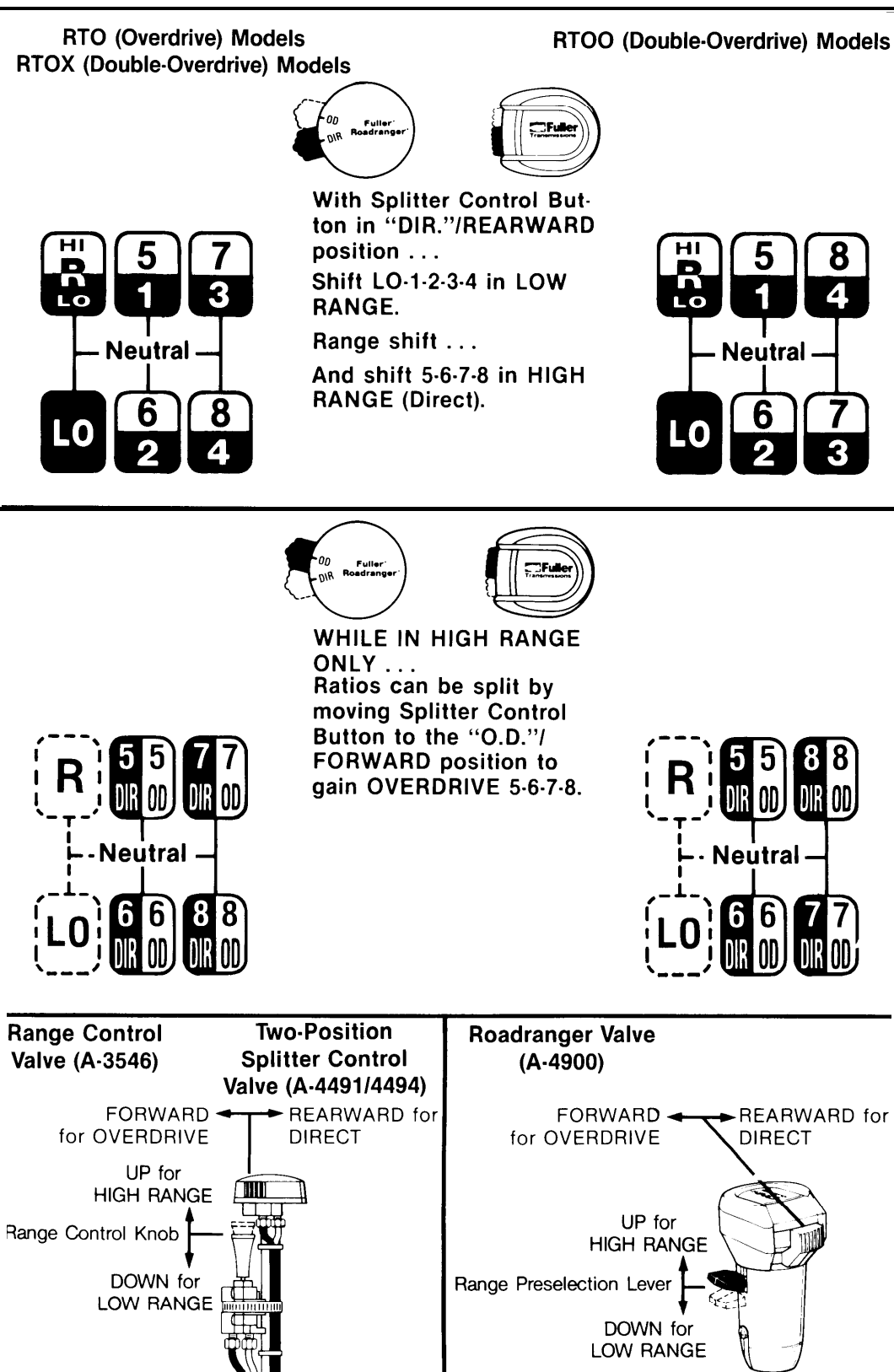
### Shift Lever Patterns and Shifting Controls

|                                                                                                                                                                                                                      |                                                                                                                                                                                                         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                      | <p>With Splitter Control Button in "DIR."/ REARWARD position ...<br/>Shift LO-1-2-3-4 in LOW RANGE.<br/>Range shift ...<br/>And shift 5-6-7-8 in HIGH RANGE (Direct).</p>                               |
|                                                                                                                                                                                                                      | <p>WHILE IN HIGH RANGE ONLY ...<br/>Ratios can be split by moving Splitter Control Button to the "U.D."/ FORWARD position to gain UNDER-DRIVE 5-6-7-8.</p>                                              |
| <p><b>Two-Position Splitter Control Valve (A-4493)</b></p> <p>FORWARD for UNDERDRIVE ← REARWARD for DIRECT</p> <p>UP for HIGH RANGE<br/>Range Control Knob<br/>DOWN for LOW RANGE</p> <p>SPLITTER CONTROL BUTTON</p> | <p><b>Roadranger Valve (A-4900)</b></p> <p>FORWARD for UNDERDRIVE ← REARWARD for DIRECT</p> <p>UP for HIGH RANGE<br/>Range Preselection Lever<br/>DOWN for LOW RANGE</p> <p>SPLITTER CONTROL BUTTON</p> |

# OPERATION

## 13-Speed Overdrive Models

### Shift Lever Patterns and Shifting Controls



# POWER FLOW

The transmission must efficiently transfer the engine's power, in terms of torque, to the vehicle's rear wheels. Knowledge of what takes place in the transmission during torque transfer is essential when trouble-shooting and making repairs become necessary.

## Front Section Power Flow (All Models)

1. Power (torque) from the vehicle's engine is transferred to the transmission's input shaft.
2. Splines of input shaft engage internal splines in hub of main drive gear.
3. Torque is split between the two countershaft drive gears.
4. Torque is delivered along both countershaft to mating countershaft gears of "engaged" mainshaft gear. The following cross section views (Figures 2-4) illustrate a 1st/5th speed gear engagement. Figure 1 illustrates the engagement of the Lo Speed Gear.
5. Internal clutching teeth in hub of engaged mainshaft gear transfers torque to mainshaft through sliding clutch.
6. Mainshaft transfers torque directly to auxiliary drive gear.

## Auxiliary Section Power Flow: LO-LO (8-Speed "LL" Models)

7. The auxiliary drive gear splits torque between the two auxiliary countershaft drive gears.
8. Torque is delivered along both auxiliary countershaft to the mating "engaged" deep reduction gear on output shaft.
9. Torque is transferred to output shaft through sliding clutch.
10. Output shaft delivers torque to driveline as LO-LO.

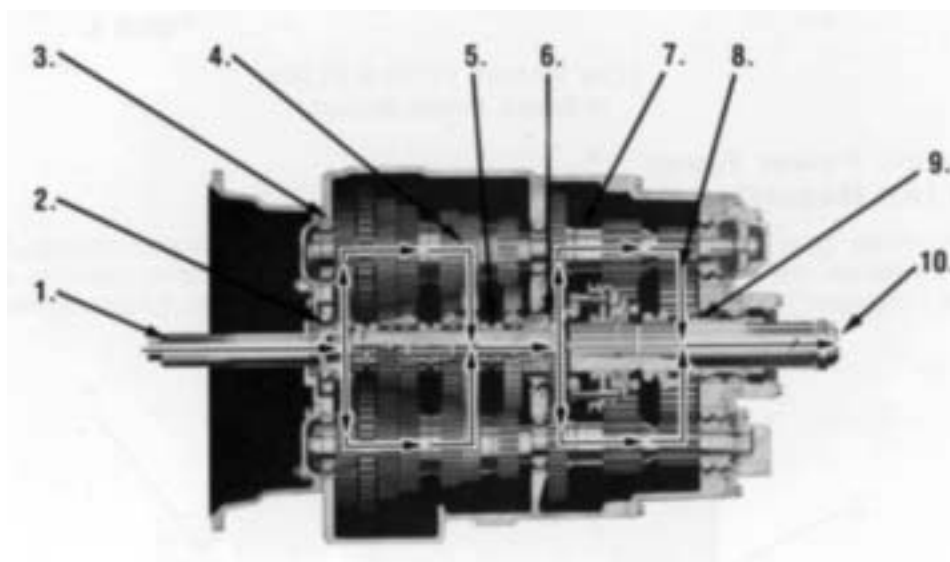


Figure 1.

PR15

## LO-LO POWER FLOW

# POWER FLOW

## Auxiliary Section Power Flow: LOW RANGE (All Models)

7. The auxiliary drive gear splits torque between the two auxiliary countershaft drive gears.
8. Torque is delivered along both countershaft to "engaged" low range gear on range mainshaft or output shaft.
9. Torque is transferred to range mainshaft or output shaft through sliding clutch.
10. Torque is delivered to driveline as LOW RANGE 1st.

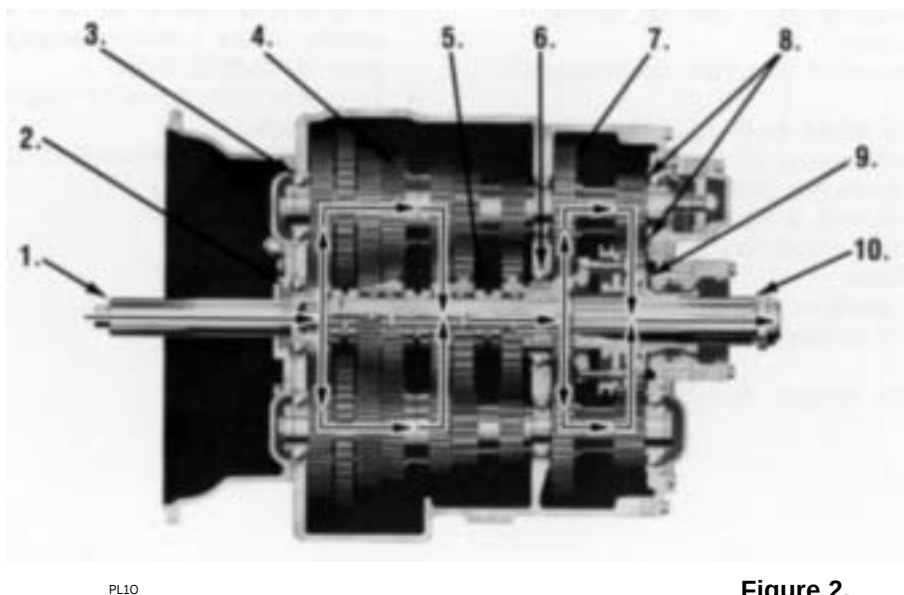


Figure 2.

### LOW RANGE POWER FLOW (9-Speed Model Shown.)

## Auxiliary Section Power Flow: HIGH RANGE (All Models)

7. The auxiliary drive gear transfers torque directly to the range mainshaft or output shaft through "engaged" sliding clutch.
8. Torque is delivered through range mainshaft and/or output shaft to driveline as HIGH RANGE 5th. 5th direct with 13-speed models.

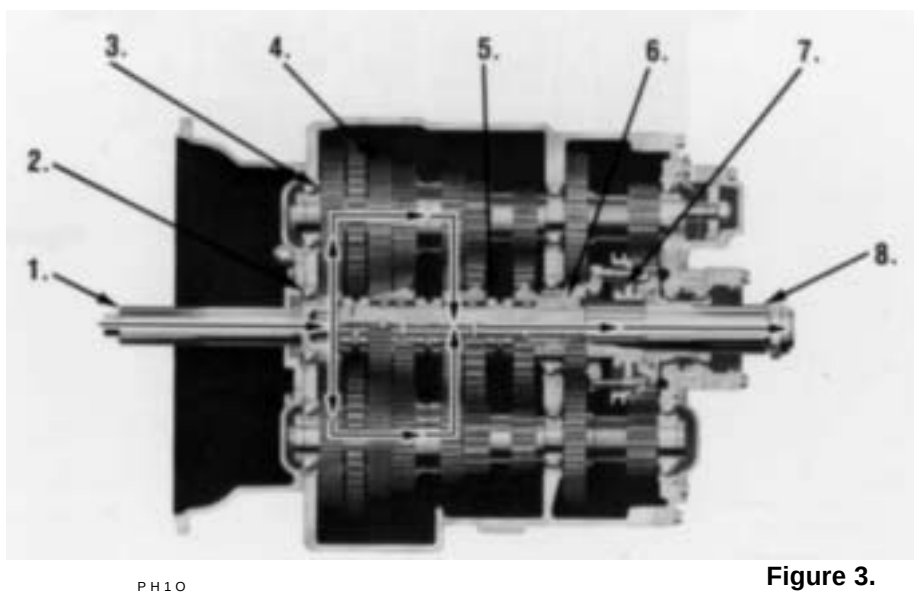


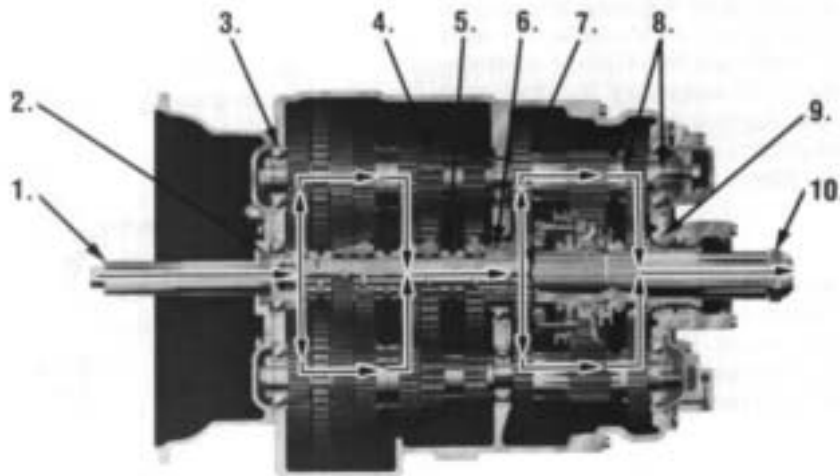
Figure 3.

### HIGH RANGE POWER FLOW

# POWER FLOW

## Auxiliary Section Power Flow: UNDERDRIVE/OVERDRIVE (13-Speed Splitter Models ONLY)

7. The auxiliary drive gear splits torque between the two auxiliary countershaft drive gears.
8. Torque is delivered along both auxiliary countershafts to mating countershaft gears of "engaged" underdrive or overdrive splitter gear on output shaft.
9. Torque is transferred to output shaft through sliding clutch.
10. Output shaft delivers torque to driveline as 5th UNDERDRIVE or OVERDRIVE.



Pulo 10

Figure 4.

### UNDERDRIVE/OVERDRIVE POWER FLOW

# TIMING

## Timing Procedures: All Models

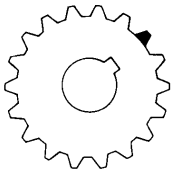
It is essential that both countershaft assemblies of the front and auxiliary sections are “timed.” This assures proper tooth contact is made between mainshaft gears seeking to center on the mainshaft during torque transfer and mating countershaft gears that distribute the load evenly. If not properly timed, serious damage to the transmission is likely to result from unequal tooth contact causing the mainshaft gears to climb out of equilibrium.

Timing is a simple procedure of marking the appropriate teeth of a gear set prior to installation and placing them in proper mesh while in the transmission. In the front section, it is necessary to time only the drive gear set. And depending on the model, only the low range, deep reduction, or splitter gear set is timed in the auxiliary section.

### Front Section

#### A. Marking countershaft drive gear teeth.

1. Prior to placing each countershaft assembly into case, clearly mark the tooth located directly over the keyway of drive gear as shown. This tooth is stamped with an “O” to aid identification.

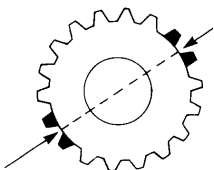


cut 7300

**A. TOOTH MARKED ON EACH COUNTERSHAFT DRIVE GEAR FOR TIMING PURPOSES**

#### B. Marking main drive gear teeth.

1. Mark any two adjacent teeth on the main drive gear.
2. Mark the two adjacent teeth located directly opposite the first set marked on the main drive gear. As shown below, there should be an equal number of unmarked gear teeth on each side between the marked sets.



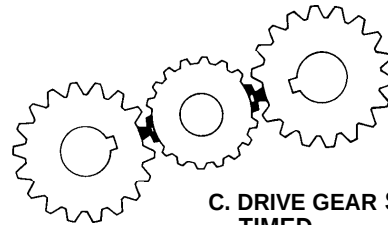
cut 7300A

**B. TEETH MARKED ON MAIN DRIVE GEAR FOR TIMING PURPOSES**

#### C. Meshing marked countershaft drive gear teeth with marked main drive gear teeth.

(After placing the mainshaft assembly into case, the countershaft bearings are installed to complete installation of the countershaft assemblies.)

1. When installing the bearings on left countershaft, mesh the marked tooth of countershaft drive gear with either set of two marked teeth on the main drive gear.
2. Repeat the procedure when installing the bearings on right countershaft, making use of the remaining set of two marked teeth on the main drive gear to time assembly.



cut 7300B

**C. DRIVE GEAR SET PROPERLY TIMED**

### Auxiliary Section

#### A. Timing the deep reduction gear set of 8-speed “LL” models; the low range gear set of 9-speed models; or the splitter gear set of 13-speed models.

1. Mark any two adjacent teeth on the mainshaft gear of set to be timed. Then mark the two adjacent teeth located directly opposite the first set marked as shown in Illustration B.
2. Prior to placing each auxiliary countershaft assembly into housing, mark the tooth stamped with an “O” on gear to mate with timed mainshaft gear as shown in Illustration A.
3. Install the mainshaft gear in position on range mainshaft OR output shaft.
4. Place the auxiliary countershaft assemblies into position and mesh the marked teeth of mating countershaft gears with the marked teeth of mainshaft gear as shown in Illustration C.
5. Fully seat the rear bearings on each countershaft to complete installation.

# TORQUE RECOMMENDATIONS

Correct torque application is extremely important to assure long transmission life and dependable performance. Over-tightening or under-tightening can result in a loose installation and, in many instance, eventually cause damage to transmission gears, shafts, and/or bearings. Use a torque wrench whenever possible to attain recommended lbs./ft. ratings. Tighten clutch housing fasteners in a cross-pattern to help insure even clamp distribution.

## FRONT SECTION: ALL MODELS

(1) MAIN DRIVE GEAR BEARING NUT,  
250-300 Lbs./Ft., Apply Loctite Grade 277  
Sealant and Stake to Input Shaft.

(6) FRONT BEARING COVER CAPSCREWS,  
35-45 Lbs./Ft., 3/8-16 Threads.  
Apply Loctite 242 to Threads.

(6) CLUTCH HOUSING NUTS.  
35 Lbs./Ft. (47 N.m) +90° CW rotation or  
175 Lbs./ft. (237 N.m)

(4) SLAVE AIR VALVE CAPSCREWS,  
8-12 Lbs./ft., 1/4-20 Threads.  
Apply Loctite 242 to Threads.

(1) NEUTRAL SIGNAL SWITCH PLUG,  
35-50 Lbs./Ft., 3/4-16 Threads.

(5) SHIFT BLOCK AND YOKE LOCKSCREWS,  
35-45 Lbs./Ft., 7/16-20 Threads, Secure  
with Lockwire.

(16) SHIFT BAR HOUSING AND (4) SHIFT  
LEVER HOUSING CAPSCREWS, 35-45 Lbs./Ft.,  
3/8-16 Threads. Apply Loctite 242 to Threads.

(1) REVERSE SIGNAL SWITCH PLUG,  
35-50 Lbs./Ft., 9/16-18 Threads.

(2) SUPPORT STUD NUTS,  
170-185 Lbs./Ft., 5/8-18 Threads,  
Use Lockwashers.

AUXILIARY SECTION:  
9-Speed Models

AUXILIARY SECTION:  
8LL & 13-Speed Models

(6) SMALL P.T.O Cover Capscrews,  
20-25 Lbs./Ft., 3/8-16 Threads.  
Apply Loctite 242 to Threads.

(8) LARGE P.T.O COVER CAPSCREWS,  
50-65 Lbs./Ft., 7/16-14 Threads.  
Apply Loctite 242 to Threads.

(4) HAND HOLE COVER CAPSCREWS,  
20-25 Lbs./Ft., 5/16-18 Threads.

(2) COUNTERSHAFT FRONT BEARING RETAINER  
CAPSCREWS, 90-120 LBS./Ft., 5/8-18 Threads.

(4 or 6) CLUTCH HOUSING CAPSCREWS, 115 Lbs./Ft. (156 N.m)

(1) OIL DRAIN PLUG,  
45-55 Lbs./Ft., 3/4 Pipe Threads.

(6) MAINSHAFT REAR BEARING RETAINER  
CAPSCREWS, 35-45 Lbs./Ft.,  
3/8-16 Threads, Secure with Lockwire.

(1) OIL FILL PLUG,  
60-75 Lbs./Ft., 1 1/4 Pipe Threads.

(2) REVERSE IDLER SHAFT NUTS,  
50-60 Lbs./Ft., 5/8-18 Threads.

# TORQUE RECOMMENDATIONS

## AUXILIARY SECTIONS

(2) AIR FILTER/REGULATOR MOUNTING  
CAPSCREWS 8-12 Lbs./Ft.,  $\frac{1}{4}$ -20 Threads.  
Apply Loctite 242 to Threads.

(1) RANGE CYLINDER SHIFT BAR NUT,  
70-85 Lbs./Ft.,  $\frac{5}{8}$ -18 Threads.

(2) RANGE SHIFT YOKE CAPSCREWS,  
50-65 Lbs./Ft.,  $\frac{1}{2}$ -20 Threads,  
Secure with Lockwire.

(1) REDUCTION OR SPLITTER SHIFT  
YOKE LOCKSCREW,  
35-45 Lbs./Ft.,  $\frac{7}{16}$ -20 Threads,  
Secure with Lockwire.

(19) AUXILIARY HOUSING CAPSCREWS,  
35-45 Lbs./Ft.,  $\frac{3}{8}$ -16 Threads.  
Apply Loctite 242 to Threads.

(1) OUTPUT SHAFT NUT,  
450-500 Lbs./Ft.,  
2-16 Threads Oiled at  
Vehicle Installation.

(6) MAINSHAFT REAR BEARING COVER  
CAPSCREWS, 35-45 Lbs./Ft.,  $\frac{3}{8}$ -16 Threads.  
Apply Loctite 242 to Threads.

(4) RANGE CYLINDER MOUNTING  
CAPSCREWS, 35-45 Lbs./Ft.,  $\frac{3}{8}$ -16 Threads.  
Apply Loctite 242 to Threads.

(4) RANGE CYLINDER COVER  
CAPSCREWS, 35-45 Lbs./Ft.,  $\frac{3}{8}$ -16 Threads.  
Apply Loctite 242 to Threads.

(4) REDUCTION OR SPLITTER CYLINDER  
COVER CAPSCREWS, 20-25 Lbs./Ft.,  
 $\frac{5}{16}$ -18 Threads.  
Apply Loctite 242 to Threads.

(8) COUNTERSHAFT REAR BEARING  
COVER CAPSCREWS, 35-45 Lbs./Ft.,  
 $\frac{3}{8}$ -16 Threads.  
Apply Loctite 242 to Threads.

(1) SPEEDOMETER HOUSING PLUG,  
35-50 Lbs./Ft.,  $\frac{13}{16}$ -20 Threads.  
Apply Loctite 242 to Threads.

**NOTE:** If insert valve is used in reduction or splitter cylinder cover. . .

(1) RETAINING NUT/PLUG, 40-50 Lbs./Ft.,  $\frac{5}{8}$ -18 Threads.

Cut 7191-11/84

# TOOL REFERENCE

Some repair procedures pictured in this manual show the use of specialized tools. Their actual use is recommended as they make transmission repair easier, faster, and prevent costly damage to critical parts.

But for the most part, ordinary mechanic's tools such as socket wrenches, screwdrivers, etc., and other standard shop items such as a press, mauls and soft bars are all that is needed to successfully disassemble and reassemble any Fuller Transmission.

The specialized tools listed below can be obtained from a tool supplier or made from dimensions as required by the individual user. Detailed Fuller Transmission Tool Prints are available upon request by writing.

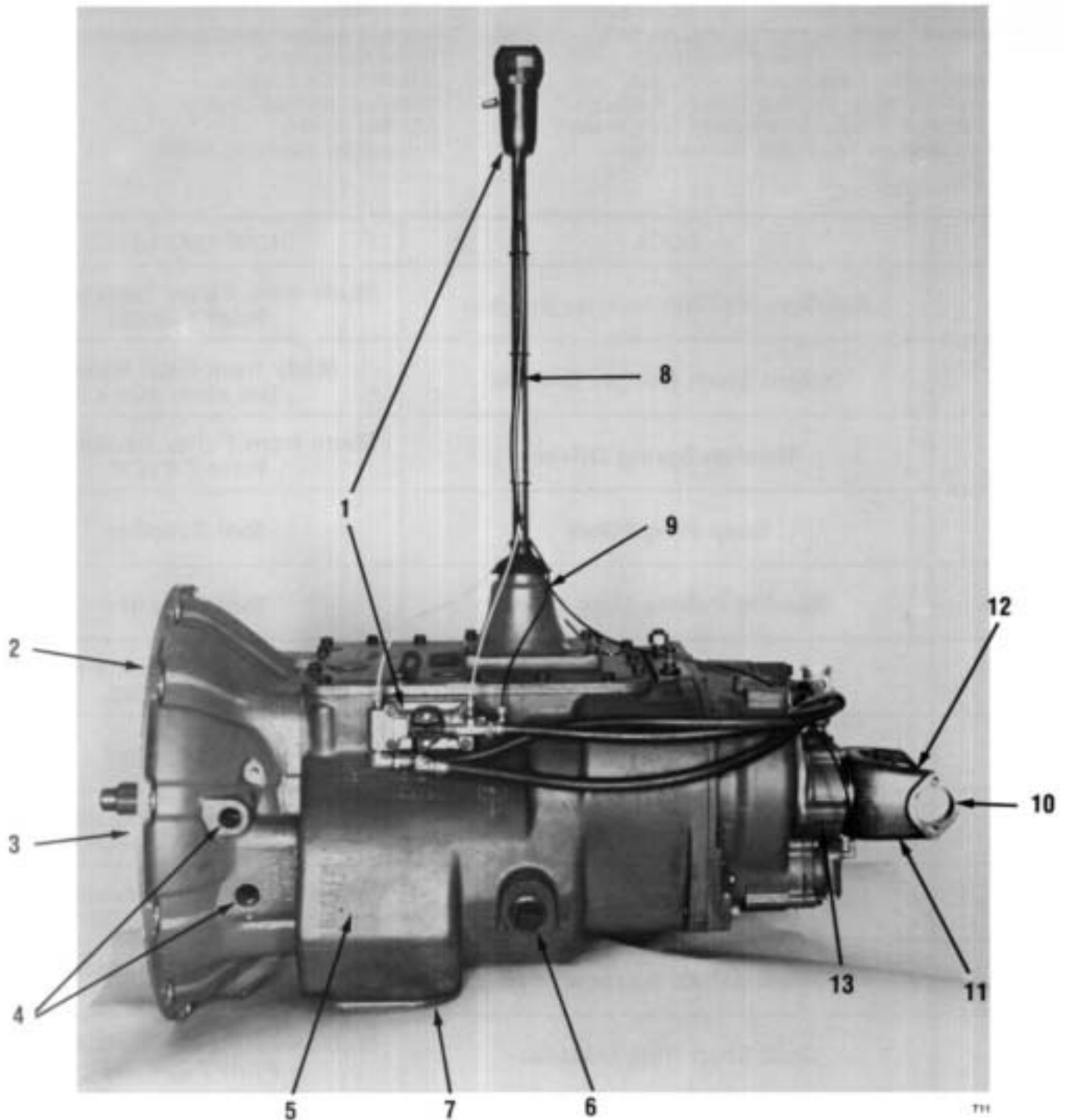
Eaton Corporation  
Transmission Division  
Technical Service Dept.  
P.O. Box 4013  
Kalamazoo, Michigan 49003

| PAGE  | TOOL                                  | HOW OBTAINED                                        |
|-------|---------------------------------------|-----------------------------------------------------|
| 6 2   | Auxiliary Section Hanger Bracket      | Made from Fuller Transmission Print T-22823         |
| 62    | Output Shaft Hanger Bracket           | Made from Stop Nut and flat steel stock             |
| 54    | Tension Spring Driver                 | Made from Fuller Transmission Print T-11938         |
| 6 6   | Snap Ring Pliers                      | Tool Supplier                                       |
| 67    | Bearing Pullers (Jaw-Type)            | Tool Supplier                                       |
| 1 0 9 | Bearing Puller w/Set Screw            | Made from Fuller Transmission Print T-10325         |
| 1 3 7 | Impact Puller (1/2-13 Threaded End)   | Tool Supplier                                       |
| 1 3 0 | Bearing Drivers (Flanged-End)         | Made from Fuller Transmission Print Series T-18042* |
| 9 9   | Oil Seal Driver                       | Made from Fuller Transmission Print T-18088-23      |
| 1 6 7 | Countershaft Support Tool             | Made from Fuller Transmission Print T-22247         |
| 7 7   | Quill Snap Ring Installer             | Made from Fuller Transmission Print T-22917-F       |
| 1 7 3 | Torque Wrench, 1000 Lbs./Ft. Capacity | Tool Supplier                                       |
| 1 7 0 | Input Shaft Nut Installer             | Made from Fuller Transmission Print T-22553-A       |

\*Dimensions necessary to determine specific tool number required.

# PREVENTIVE MAINTENANCE

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# PREVENTIVE MAINTENANCE

## PREVENTIVE MAINTENANCE CHECK CHART

### CHECKS WITHOUT PARTIAL DISASSEMBLY OF CHASSIS OR CAB

1. **Air System and Connections**
  - a. Check for leaks, worn air lines, loose connections and capscrews. See AIR SYSTEM.
2. **Clutch Housing Mounting**
  - a. Check all capscrews of clutch housing flange for looseness.
3. **Clutch Release Bearing (Not Shown)**
  - a. Remove hand hole cover and check radial and axial clearance in release bearing.
  - b. Check relative position of thrust surface of release bearing with thrust sleeve on push-type clutches.
4. **Clutch Pedal Shaft and Bores**
  - a. Pry upward on shafts to check wear.
  - b. If excessive movement is found, remove clutch release mechanism and check bushings in bores and wear on shafts.
5. **Lubricant**
  - a. Change at specified service intervals.
  - b. Use only the types and grades as recommended. See LUBRICATION.
6. **Filler and Drain Plugs**
  - a. Remove filler plugs and check level of lubricant at specified intervals. Tighten filler and drain plugs securely.
7. **Capscrews and Gaskets**
  - a. Check all capscrews, especially those on PTO covers and rear bearing covers for looseness which would cause oil leakage. See TORQUE RECOMMENDATIONS.
  - b. Check PTO opening and rear bearing covers for oil leakage due to faulty gasket.
8. **Gear Shift Lever**
  - a. Check for looseness and free play in housing. If lever is loose in housing, proceed with Check No. 9.
9. **Gear Shift Lever Housing Assembly**
  - a. Remove air lines at slave valve and remove the gear shift lever housing assembly from transmission.
  - b. Check tension spring and washer for set and wear.
  - c. Check the gear shift lever spade pin and slot for wear.
  - d. Check bottom end of gear shift lever for wear and check slot of yokes and blocks in shift bar housing for wear at contact points with shift lever.

### CHECKS WITH DRIVE LINE DROPPED

#### 10. Universal Joint Companion Flange or Yoke Nut

- a. Check for tightness. Tighten to recommended torque.

#### 11. Output Shaft (Not Shown)

- a. Pry upward against output shaft to check radial clearance in mainshaft rear bearing.

### CHECKS WITH UNIVERSAL JOINT COMPANION FLANGE OR YOKE REMOVED

NOTE: If necessary, use solvent and shop rag to clean sealing surface of companion flange or yoke. DO NOT USE CROCUS CLOTH, EMERY PAPER OR OTHER ABRASIVE MATERIALS THAT WILL MAR SURFACE FINISH.

#### 12. Splines on Output Shaft (Not Shown)

- a. Check for wear from movement and chucking action of the universal joint companion flange or yoke.

#### 13. Mainshaft Rear Bearing Cover

- a. Check oil seal for wear.

# PRECAUTIONS

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## Disassembly

It is assumed in the detailed assembly instructions that the lubricant has been drained from transmission, the necessary linkage and air lines disconnected and the transmission has been removed from vehicle chassis. Removal of the gear shift lever housing assembly (or remote control assembly) is included in the detailed instructions (Disassembly and Reassembly - Shifting Controls); however, this assembly **MUST** be detached from shift bar housing before transmission can be removed.

**FOLLOW CLOSELY EACH PROCEDURE IN THE DETAILED INSTRUCTIONS, MAKING USE OF THE TEXT, ILLUSTRATIONS AND PHOTOGRAPHS PROVIDED.**

- 1. BEARINGS** - Carefully wash and relubricate all reusable bearings as removed and protectively wrap until ready for use. Remove bearings planned to be reused with pullers designed for this purpose.
- 2. ASSEMBLIES** - When disassembling the various assemblies, such as the mainshaft, countershaft, and shift bar housing, lay all parts on a clean bench in the same sequence as removed. This procedure will simplify reassembly and reduce the possibility of losing parts.
- 3. SNAP RINGS** - Remove snap rings with pliers designed for this purpose. Snap rings removed in this manner can be reused, if they are not sprung or loose.
- 4. INPUT SHAFT** - The input shaft can be removed from transmission without removing the countershafts, mainshaft, or main drive gear. Special procedures are required and provided in this manual.
- 5. CLEANLINESS** - Provide a clean place to work. It is important that no dirt or foreign material enters the unit during repairs. Dirt is an abrasive and can damage bearings. It is always good practice to clean the outside of the unit before starting the planned disassembly.
- 6. WHEN USING TOOLS TO MOVE PARTS** - Always apply force to shafts, housings, etc, with restraint. Movement of some parts is restricted. Never apply force to the part being driven after it stops solidly. The use of soft hammers, bars and mauls for all disassembly work is recommended.

## Inspection

Before reassembling the transmission, check each part carefully for abnormal or excessive wear and damage to determine reuse or replacement. When replacement is necessary, use only genuine Fuller Transmission parts to assure continued performance and extended life from your unit.

Since the cost of a new part is generally a small fraction of the total cost of downtime and labor, avoid reusing a questionable part which could lead to additional repairs and expense soon after initial reassembly. To aid in determining the reuse or replacement of any transmission part, consideration should also be given to the unit's history, mileage, application, etc.

Recommended inspection procedures are provided in the following checklist.

### A. BEARINGS

1. Wash all bearings in clean solvent. Check balls, rollers and raceways for pitting, discoloration, and spalled areas. Replace bearings that are pitted, discolored, or spalled.
2. Lubricate bearings that are not pitted, discolored, or spalled and check for axial and radial clearances.  
Replace bearings with excessive clearances.
3. Check bearing fits. Bearing inner races should be tight to shaft; outer races slightly tight to slightly loose in case bore. If bearing spins freely in bore, however, the case should be replaced.

### B. GEARS

1. Check gear teeth for frosting and pitting. Frosting of gear tooth faces present no threat of transmission failure. Often in continued operation of the unit, frosted gears will "heal" and not progress to the pitting stage. And in most cases, gears with light to moderate pitted teeth have considerable gear life remaining and can be reused. But gears with advanced stage pitting should be replaced.
2. Check for gears with clutching teeth abnormally worn, tapered, or reduced in length from clashing in shifting. Replace gears found in any of these conditions.

# PRECAUTIONS

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## Inspection (cont'd.)

3. Check axial clearance of gears. Where excessive clearance is found, check gear snap ring, washer, spacer, and gear hub for excessive wear. Maintain .005" to .012" axial clearance between mainshaft gears.

## C. SPLINES

1. Check splines on all shafts for abnormal wear. If sliding clutch gears, companion flange, or clutch hub have worn into the sides of the splines, replace the specific shaft affected.

## D. TOLERANCE/LIMIT WASHERS

1. Check surfaces of all limit washers. Washers scored or reduced in thickness should be replaced.

## E. REVERSE IDLER GEAR ASSEMBLIES

1. Check for excessive wear from action of roller bearings.

## F. GRAY IRON PARTS

1. Check all gray iron parts for cracks and breaks. Replace or repair parts found to be damaged. Heavy castings may be welded or brazed provided the cracks do not extend into bearing bores or bolting surfaces. When welding, however, never place the ground so as to allow current to pass through the transmission.

## G. CLUTCH RELEASE PARTS

1. Check clutch release parts. Replace yokes worn at cam surfaces and bearing carrier worn at contact pads.
2. Check pedal shafts. Replace those worn at bushing surfaces.

## H. SHIFT BAR HOUSING ASSEMBLY

1. Check for wear on shift yokes and blocks at pads and lever slot. Replace excessively worn parts.
2. Check yokes for correct alignment. Replace sprung yokes.
3. Check lockscrews in yokes and blocks. Tighten and rewire those found loose.
4. If housing has been disassembled, check neutral notches of shift bars for wear from interlock balls.

## I. GEAR SHIFT LEVER HOUSING ASSEMBLY

1. Check spring tension on shift lever. Replace tension spring and washer if lever moves too freely.
2. If housing is disassembled, check spade pin and corresponding slot in lever for wear. Replace both parts if excessively worn.

## J. BEARING COVERS

1. Check covers for wear from thrust of adjacent bearing. Replace covers damaged from thrust of bearing outer race.
2. Check bores of covers for wear. Replace those worn oversize.

## K. OIL RETURN THREADS AND SEALS

1. Check oil return threads in front bearing cover. If sealing action of threads has been destroyed by contact with input shaft, replace bearing cover.
2. Check oil seal in rear bearing cover. If sealing action of lip has been destroyed, replace seal.

## L. SLIDING CLUTCHES

1. Check all shift yokes and yoke slots in sliding clutches for extreme wear or discoloration from heat.
2. Check engaging teeth of sliding clutches for partial engagement pattern.

## M. SYNCHRONIZER ASSEMBLY

1. Check synchronizer for burrs, uneven and excessive wear at contact surface, and metal particles.
2. Check blocker pins for excessive wear or looseness.
3. Check synchronizer contact surfaces on the auxiliary drive and low range gears for excessive wear.

## N. O-RINGS

1. Check all O-rings for cracks or distortion. Replace if worn.

# PRECAUTIONS

---

## Reassembly

Make sure that interiors of case and housings are clean. It is important that dirt and other foreign materials be kept out of the transmission during reassembly. Dirt is an abrasive and can damage polished surfaces of bearings and washers. Use certain precautions, as listed below, during reassembly.

1. **GASKETS** - Use new gaskets throughout the transmission as it is being rebuilt. Make sure all gaskets are installed. An omission of any gasket can result in oil leakage or misalignment of bearing covers.
2. **CAPSCREWS** - To prevent oil leakage, use Loctite 242 thread sealant on all capscrews. For torque ratings, see TORQUE RECOMMENDATIONS.
3. **O-RINGS** - Lubricate all O-rings with silicon lubricant.
4. **ASSEMBLY** - Refer to the illustrations provided in the detailed disassembly instructions as a guide to reassembly.
5. **INITIAL LUBRICATION** - Coat all limit washers and splines of shafts with Lubriplate during reassembly to prevent scoring and galling of such parts.
6. **AXIAL CLEARANCES** - Maintain original axial clearances of .005" to .012" for mainshaft gears.
7. **BEARINGS** - Use of flanged-end bearing drivers is recommended for the installation of bearings. These special drivers apply equal force to both bearing races, preventing damage to balls/rollers and races while maintaining correct bearing alignment with bore and shaft. Avoid using a tubular or sleeve-type driver, whenever possible, as force is applied to only one of the bearing races. See TOOL REFERENCE.
8. **UNIVERSAL JOINT COMPANION FLANGE OR YOKE** - Pull the companion flange or yoke tightly into place with the output shaft nut, using 450-500 foot-pounds of torque. Make sure the speedometer drive gear or a replacement spacer of the same width has been installed. Failure to pull the companion flange or yoke tightly into place will permit the output shaft to move axially with resultant damage to the rear bearing.

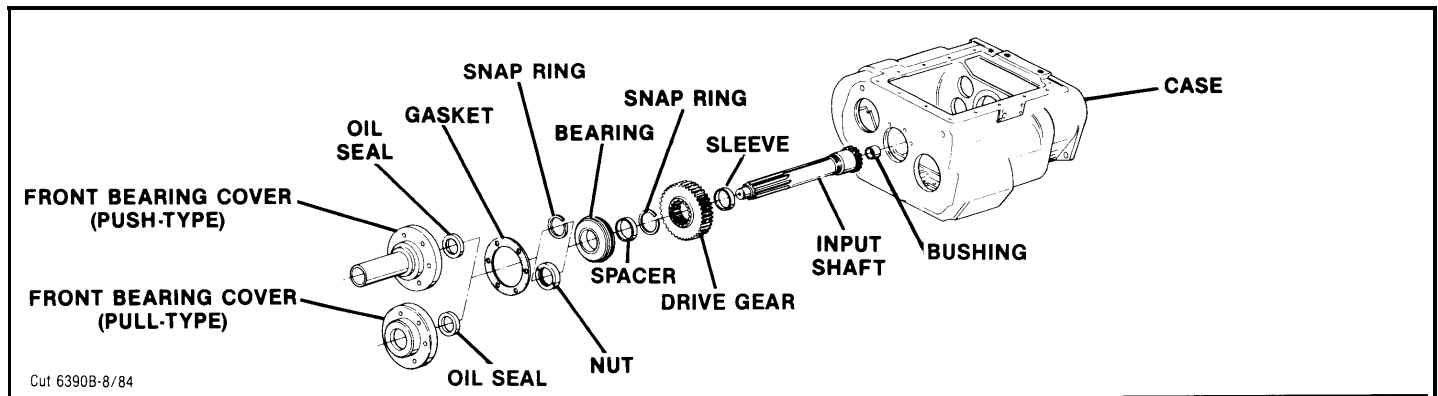
**IMPORTANT: REFER TO THE APPROPRIATE ILLUSTRATED PARTS LIST (SPECIFIED BY MODEL SERIES) TO ENSURE THAT PROPER PARTS ARE USED DURING REASSEMBLY OF THE TRANSMISSION.**

# CHANGING INPUT SHAFT

## Special Procedure

In some cases, it may become necessary to replace the input shaft due to excessive clutch wear on the splines. Except for removal of the shift bar housing assembly, the input shaft can be removed without further disassembly of the transmission. Removal of the clutch housing is optional.

NOTE: The following illustration and instructions pertain to changing the input shaft ONLY. To change the main drive gear, disassembly of the front section is required.



## Disassembly

1. Remove the gear shift lever housing assembly (or remote control assembly) from shift bar housing, if necessary, and the shift bar housing assembly from transmission case.
2. Remove the front bearing cover and gasket. If necessary, remove the oil seal from cover of models so equipped.
3. Remove the drive gear bearing nut (left hand threads) or snap ring from input shaft.  
**Suggestion:** For removal of nut ONLY, engage two mainshaft sliding clutches into gear to prevent the mainshaft from rotating.
4. Move the main drive gear assembly as far forward as possible and remove the drive gear bearing.
5. Remove the spacer from input shaft.
6. From the front of transmission, remove the snap ring from I.D. of main drive gear using two small screwdrivers. If mainshaft was previously locked in two gears, it may become necessary to place sliding clutches in the neutral position to rotate input shaft for removal of snap ring.
7. Pull the input shaft forward and from splines of drive gear.

## Reassembly

1. If necessary, install bushing in pocket of input shaft.
2. Install new input shaft into splines of main drive gear just far enough to expose snap ring groove in I.D. of drive gear.
3. Install snap ring in groove of drive gear.
4. Install drive gear bearing nut, left-hand threads, on input shaft. Tighten nut with 250-300 Lbs./Ft. of torque.

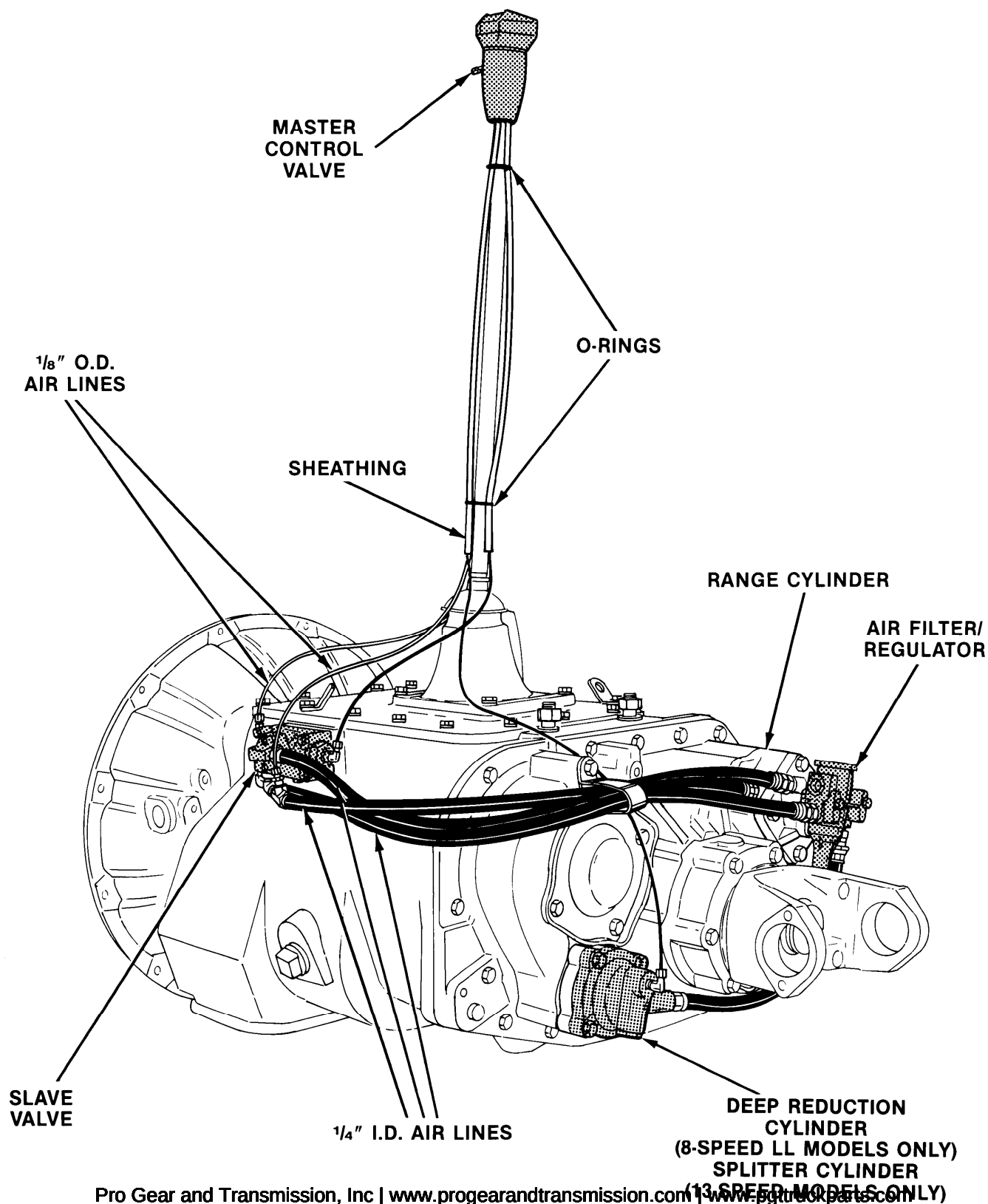
5. Using a flanged-end driver, install the drive gear bearing on shaft and into case bore. When applying force to driver, use caution so as not to damage bearing shield.

**Suggestion:** Engaging the sliding clutch into main drive gear and blocking it forward will hold the input shaft forward.

6. When drive gear bearing nut is used, degrease the threads of input shaft and new nut. DO NOT REUSE OLD NUT. When snap ring is used, install the snap ring in groove of input shaft and proceed to #10.
7. Apply Fuller Transmission adhesive sealant #71204 or equivalent to the cleaned threads of input shaft and nut, using caution so as not to contaminate bearing with sealant.
8. Engage two mainshaft sliding clutches into gear to prevent the mainshaft from rotating and install the new drive gear bearing nut, left-hand threads, on input shaft. Tighten nut with 250-300 Lbs./Ft. of torque.  
**Suggestion:** To avoid damaging the O.D. of nut, use the tool specifically designed for this purpose. See TOOL REFERENCE.
9. With a punch and maul, peen the nut into the two milled slots of input shaft, using caution so as not to distort O.D. of nut.
10. To facilitate proper reinstallation of the shift bar housing assembly on case, make sure mainshaft sliding-clutches are placed in the neutral position.

11. Reinstall the shift bar housing assembly, the front bearing cover and all other parts and assemblies previously removed, making sure to replace the gaskets used.

# AIR SYSTEM



# AIR SYSTEM

## RANGE SHIFT AIR SYSTEM—ALL MODELS

### Operation

The Range Shift Air System consists of the air filter/regulator, slave valve, a Range Control Valve or Master Control Valve, range cylinder, fittings and connecting air lines. See Air System Schematics.

CONSTANT AIR from the air filter/regulator is supplied to the "S" or Supply Port of slave valve and passed through to the INLET or "S" Port of control valve.

WHILE IN LOW RANGE, the control valve is OPEN and AIR is returned to slave valve at the "P" or End Port. This signals the valve to supply AIR in line between the Low Range or "L" Port of slave valve and the Low Range Port of range cylinder housing. AIR received at this port moves the range piston to the rear and causes the auxiliary low range gear to become engaged.

WHILE IN HIGH RANGE, the control valve is CLOSED and NO AIR is returned to the slave valve. This signals the slave valve to supply AIR in line between the High Range or "H" Port of valve and the High Range Port of range cylinder cover. AIR received at this port moves the range piston forward to engage the auxiliary drive gear with sliding clutch and bypass the low range gear set.

Range shifts can be made ONLY when the gear shift lever is in, or passing through, neutral. Thus, the range desired can be PRESELECTED while the shift lever is in -a gear position. As the lever is moved through neutral, the actuating plunger in the shift bar housing releases the slave valve, allowing it to move to the selected range position.

### Trouble Shooting

If the transmission fails to make a range shift or shifts too slowly, the fault may be in the Range Shift Air System or actuating components of the shift bar housing assembly.

To locate the trouble, the following checks should be made with normal vehicle air pressure applied to the system, but with the engine off.

**CAUTION: NEVER WORK UNDER A VEHICLE WHILE ENGINE IS RUNNING** as personal injury may result from the sudden and unintended movement of vehicle under power.

#### 1. INCORRECT AIR LINE HOOK-UPS

(See Air System Schematics)

With the gear shift lever in neutral, move the control that provides range selection UP and DOWN.

- A. If the air lines are crossed between control valve and slave valve, there will be CONSTANT AIR flowing from the exhaust port of control valve WHILE IN HIGH RANGE.

- B. If the air lines are crossed between the slave valve and range cylinder, the transmission gearing will not correspond with the range selection. A LOW RANGE selection will result in a HIGH RANGE engagement and vice versa.

#### 2. AIR LEAKS

With the gear shift lever in neutral, coat all air lines and fittings with soapy water and check for leaks, moving the control that provides range selection UP and DOWN.

- A. If there is a steady leak from the exhaust port of control valve, O-rings and/or related parts of the control valve are defective.
- B. If there is a steady leak from breather of slave valve: an O-ring in valve is defective, or there is a leak past O-rings of range cylinder piston.
- C. If transmission fails to shift into LOW RANGE or is slow to make the range shift and the case is pressurized, see Check No. 7 of this section.
- D. Tighten all loose connections and replace defective O-rings and parts.

#### 3. AIR FILTER/REGULATOR

(See illustration, Page 27.)

With the gear shift lever in neutral, check the breather of air filter/regulator assembly. There should be NO AIR leaking from this port. The complete assembly should be replaced if a steady leak is found.

Cut off the vehicle air supply to the air filter/regulator assembly, disconnect the air line at fitting in Supply OUTLET and install an air gage in opened port. Bring the vehicle air pressure to normal. Regulated air pressure should be 57.5 to 62.5 PSI.

**DO NOT ADJUST SCREW AT BOTTOM OF REGULATOR TO OBTAIN CORRECT READINGS.**

The air regulator has been PREADJUSTED within the correct operating limits. Any deviation from these limits, especially with regulators that have been in operation for some time, is likely to be caused by dirt or worn parts. If replacement or cleaning of the filter element does nothing to correct the air pressure readings, replace the complete assembly, as the air regulator is nonserviceable.

#### 4. CONTROL VALVE (See Pages 28 and 29.)

With the gear shift lever in neutral, select HIGH RANGE and disconnect the 1/8" O.D. air line at the OUTLET or "P" Port of control valve.

# AIR SYSTEM

A. When LOW RANGE is selected, a steady blast of air will flow from opened port. Select HIGH RANGE to shut off air flow. This indicates the control valve is operating properly. Reconnect air line.

B. If control valve does not operate properly, check for restrictions and air leaks. Leaks indicate defective or worn O-rings.

## 5. HIGH RANGE OPERATION

With the gear shift lever in neutral, select LOW RANGE and disconnect the 1/4" I.D. air line at the port of range cylinder cover. Make sure this line leads from the High Range or "H" Port of slave valve.

A. When HIGH RANGE is selected, a steady blast of air should flow from disconnected line. Select LOW RANGE to shut off air flow.

B. Move the shift lever to a gear position and select HIGH RANGE. There should be NO AIR flowing from disconnected line. Return the gear shift lever to the neutral position. There should now be a steady flow of air from disconnected line. Select LOW RANGE to shut off air flow and reconnect air line.

C. If the air system does not operate accordingly, the slave valve or actuating components of the shift bar housing assembly are defective.

### IMPORTANT: RANGE PRESELECTION

The plunger pin, located in case bore between the slave valve and actuating plunger of shift bar housing, prevents the slave valve from operating while the shift lever is in a gear position. When the lever is moved to or through the neutral position, the pin is released and the slave valve becomes operational.

## 6. LOW RANGE OPERATION

With the gear shift lever in neutral, select HIGH RANGE and disconnect the 1/4" I.D. air line at the fitting on range cylinder housing. Make sure this line leads from the Low Range or "L" Port of slave valve.

A. When LOW RANGE is selected, a steady blast of air should flow from disconnected line. Select HIGH RANGE to shut off air flow.

B. Move the shift lever to a gear position and select LOW RANGE. There should be NO AIR flowing from disconnected line. Return the gear shift lever to the neutral position. There should now be a steady flow of air from disconnected line. Select HIGH RANGE to shut off air flow and reconnect air line.

C. If the air system does not operate accordingly, the slave valve or actuating components of the shift bar housing assembly are defective.

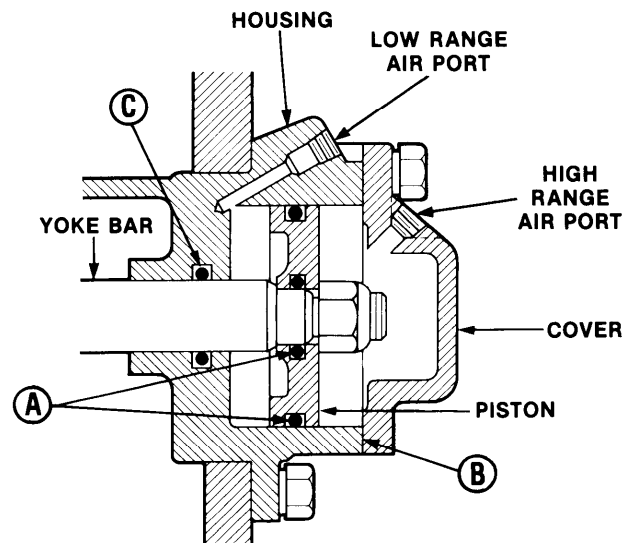
## 7. RANGE CYLINDER (Refer to the following illustration.)

If any of the seals in the range cylinder assembly are defective, the range shift will be affected.

A. Leak at either O-ring A results in complete failure to make a range shift; steady flow of air from breather of slave valve in both ranges.

B. Leak at gasket B results in a steady flow of air to atmosphere while in HIGH RANGE.

C. Leak at O-ring C results in a slow shift to LOW RANGE; pressurizing of transmission case.

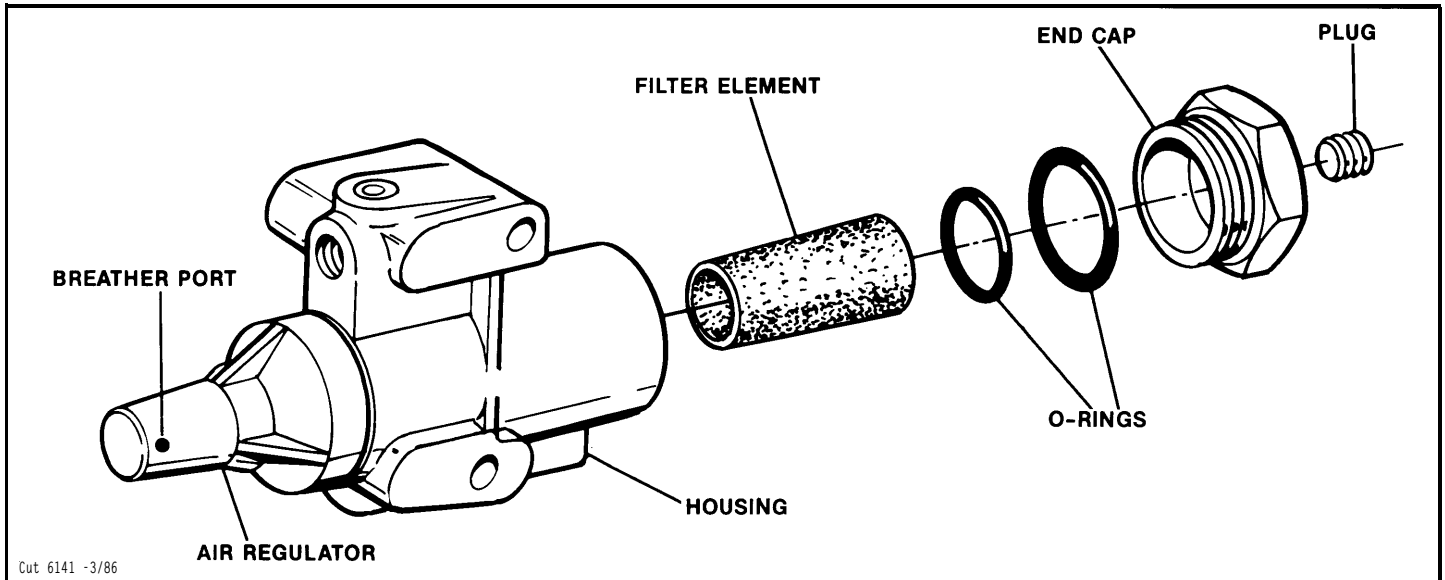


Cut 7420-4/84

Range Cylinder Assembly—All Models

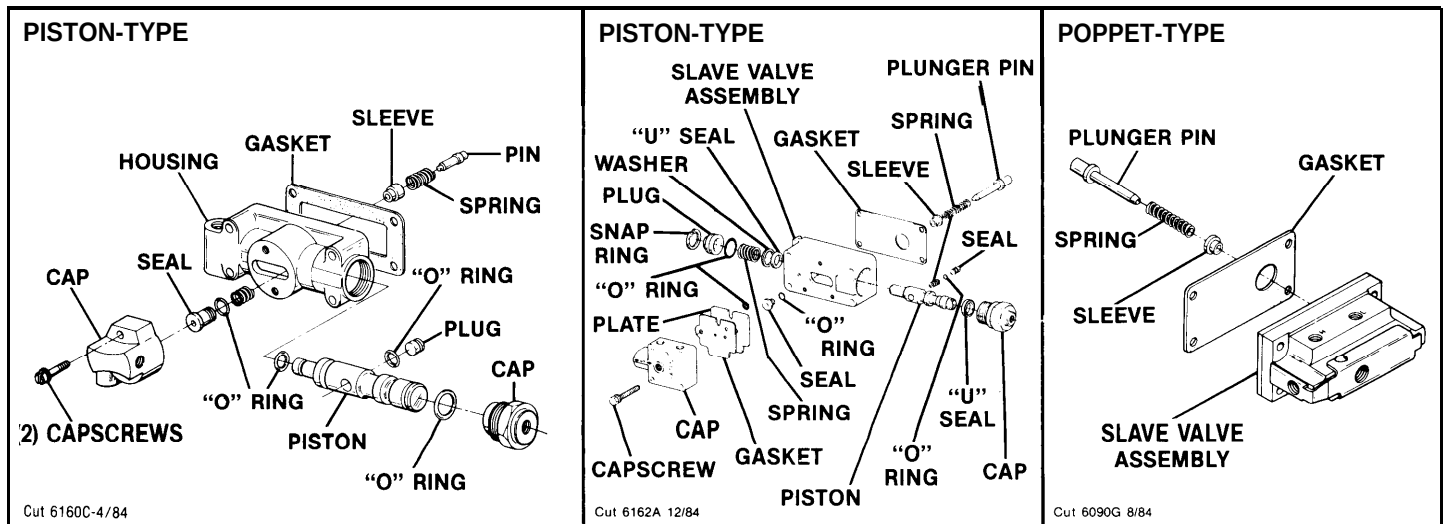
# AIR SYSTEM

## AIR FILTER/REGULATOR ASSEMBLY



The air filter contains a replaceable filter element which can be removed by turning out the end cap. This element should be cleaned at each oil change, or more often under high humidity conditions. Replace if necessary.

## SLAVE VALVES

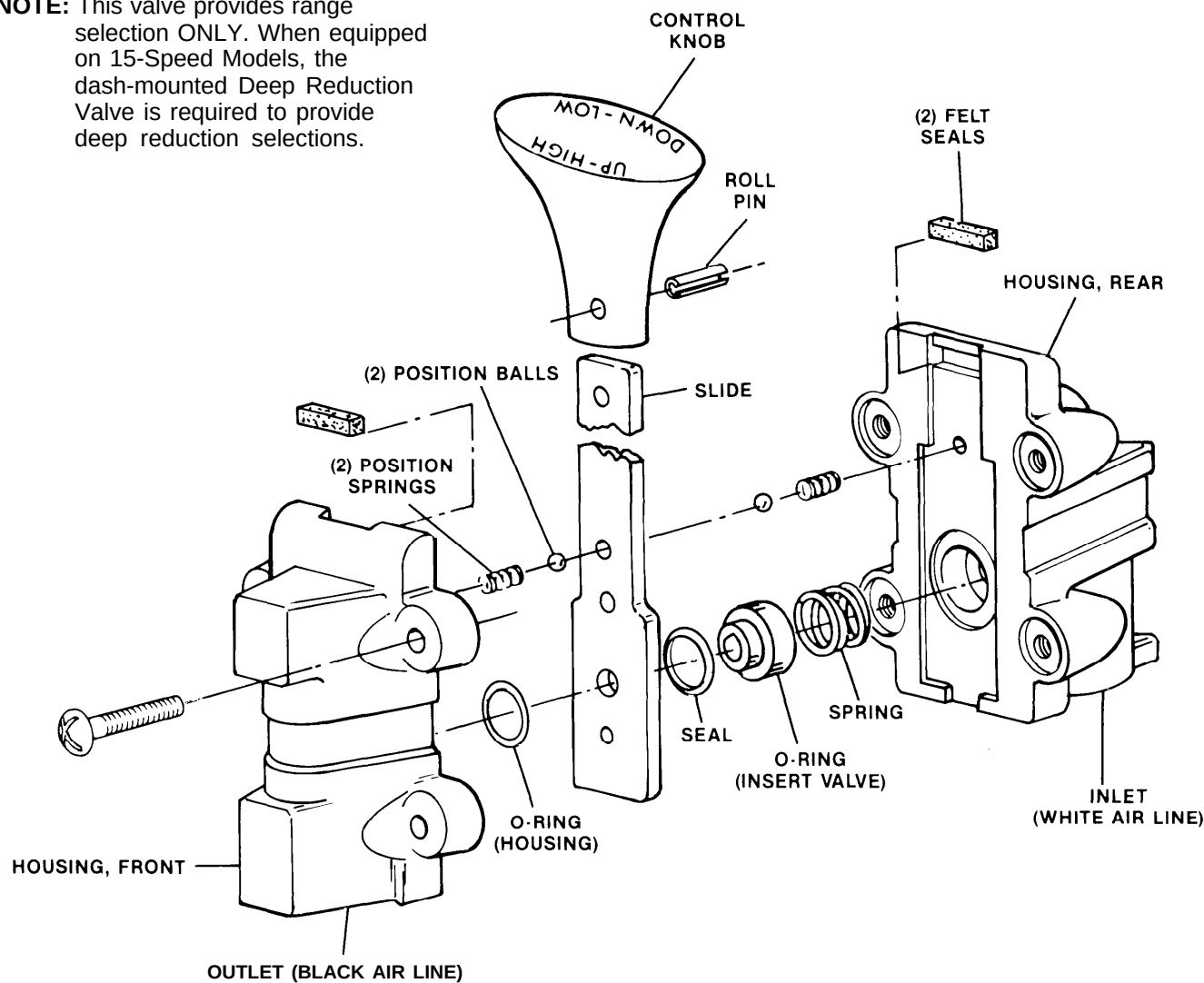


Refer to the drawing for disassembly and reassembly of the piston-type slave valve assemblies. **Should the poppet-type slave valve assembly prove to be defective, replace the complete assembly, as it is non-serviceable.** The actuating components used with these valve assemblies are non-interchangeable. Failure to use the correct plunger pin, spring, and alignment sleeve during installation on the transmission will cause hard shifting in Low Range gears.

# AIR SYSTEM

## RANGE VALVE A-3546

**NOTE:** This valve provides range selection ONLY. When equipped on 15-Speed Models, the dash-mounted Deep Reduction Valve is required to provide deep reduction selections.



Cut 6155-1/84

### Removal and Disassembly

1. Disconnect the air lines and loosen clamp securing the valve to gear shift lever. Remove valve.
2. Remove the four screws to separate the front and rear housings and remove the slide and two sets of position springs and balls.
3. Remove the seal, insert valve O-ring and spring from rear housing.
4. If necessary, remove the two felt seals. Punch out the roll pin to remove the control knob from slide.

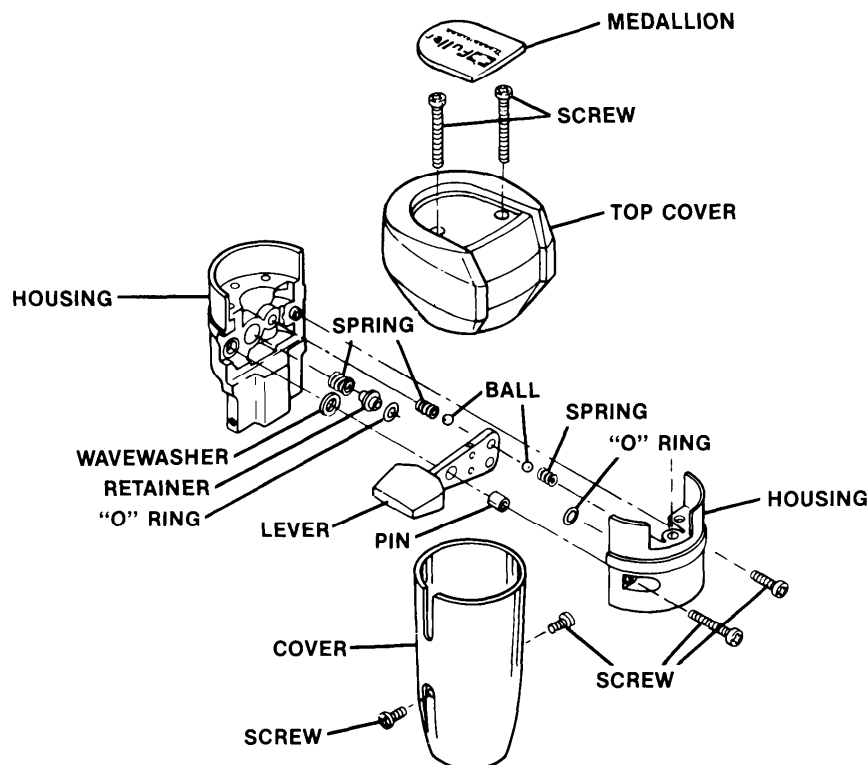
### Reassembly and Installation

1. Refer to the drawing for proper reassembly. Use a VERY SMALL amount of silicone lubricant on the O-rings to avoid clogging ports. A small amount of grease on the position springs and balls will help to hold them in place during reassembly.
2. Install the air lines with their sheathing and O-rings on the gear shift lever.
3. Secure the valve on gear shift lever with mounting clamp. The control knob should face to the front and be approximately 6" below the centerline of ball grip.
4. Attach the air lines.

# AIR SYSTEM

## RANGE VALVE A-501 O

### ROADRANGER VALVE ASSEMBLY



### Removal and Disassembly

1. Remove two screws holding bottom cover to valve and slide cover down gearshift lever to expose air line fittings. Disconnect air lines.
2. Loosen jam nut and turn control valve from gear shift lever.
3. Pry medallion from recess in top cover.
4. Turn out the two screws to remove the top cover from valve housing.
5. Turn out the two screws in side of valve housing to separate the housing.
6. Remove the Range Preelection Lever from left housing and the position balls and guide from lever.
7. If necessary, remove spring and O-ring from bores in left housing.
8. If necessary, remove springs, O-ring and sleeve from bores in right housing.

### Reassembly and Installation

1. Refer to the drawing for proper reassembly. Use a VERY SMALL amount of silicone lubricant on the O-rings to avoid clogging ports. A small amount of grease on the position springs and balls will help to hold them in place during reassembly.
2. Reinstall control valve on gear shift lever and tighten jam nut.
3. Attach air lines and reinstall bottom cover.

# AIR SYSTEM

## DEEP REDUCTION AIR SYSTEM: 8-SPEED "LL" MODELS ONLY

### Operation

In addition to the various components of the Range Shift Air System, the Deep Reduction Air System utilizes a reduction cylinder and a separate dash-mounted Deep Reduction Valve OR the Master Control Valve A-5015.

CONSTANT AIR from the air filter/regulator assembly is supplied to the reduction cylinder at the port on right side of cylinder cover. See Air System Schematics.

With the Deep Reduction Lever in the "OUT" position, the valve is OPENED and AIR is supplied to the Center Port of cylinder cover, moving the reduction piston forward to disengage deep reduction gearing. With the lever moved to the "IN" position, the valve is CLOSED and NO AIR is supplied to the Center Port. CONSTANT AIR from the air filter/regulator assembly moves the reduction piston rearward to engage reduction gearing.



Lever to "OUT"  
(Valve OPENED)

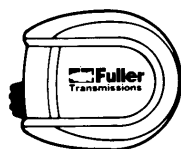


Lever to "IN"  
(Valve CLOSED)

For models equipped with the Master Control Valve A-5015, AIR is supplied to the built-in deep reduction valve ONLY WHILE IN LOW RANGE from tee fitting at the Low Range or "L" Port of slave valve. The insert valve (see page 37) MUST be installed in cylinder cover to provide the proper air flow needed to move the reduction piston in the cylinder. See schematic provided on Page 32.

**NOTE:** The insert valve is NOT USED in the reduction cylinder cover of models equipped with the dash mounted Deep Reduction Valve.

With the Deep Reduction Button in the REARWARD position, the "SP" Port of control valve is CLOSED and NO AIR is supplied to the Center Port of cylinder cover.



Button REARWARD  
("SPY" Port CLOSED)

WHILE IN THE LO SPEED GEAR POSITION, the button can be moved FORWARD to operate in LO-LO. The "SP" Port of valve is OPENED when deep reduction selection is made, supplying AIR to the Center Port of cylinder cover.



Button FORWARD  
("SPY" Port OPENED)

**NOTE:** WHILE IN HIGH RANGE, the mechanical interlock of Master Control Valve prevents movement of Deep Reduction Button to the FORWARD position.

### Trouble Shooting

If the transmission fails to shift or shifts too slowly to or from LO-LO, the fault may be in the Deep Reduction Air System or related components of the Range Shift Air System.

To locate the trouble, the following checks should be made with normal vehicle air pressure supplied to the system, but with the engine off. See CAUTION, Page 25.

**NOTE:** It is assumed that correct PSI readings were obtained from the air filter/regulator and all air lines have been checked for leaks.

### For Models Equipped with the Deep Reduction Valve . . .

#### 1. Air Supply (See Air System Schematics.)

With the gear shift lever in neutral, loosen the connection at the INLET (End Port) of Deep Reduction Valve until it can be determined that CONSTANT AIR is supplied to valve. Reconnect air line.

If there is NO AIR, check for a restriction in line between the Deep Reduction Valve and slave valve, making sure this line is connected to tee fitting at the Supply or "S" Port of slave valve.

# AIR SYSTEM

## 2. Deep Reduction Valve (See Air System Schematics.)

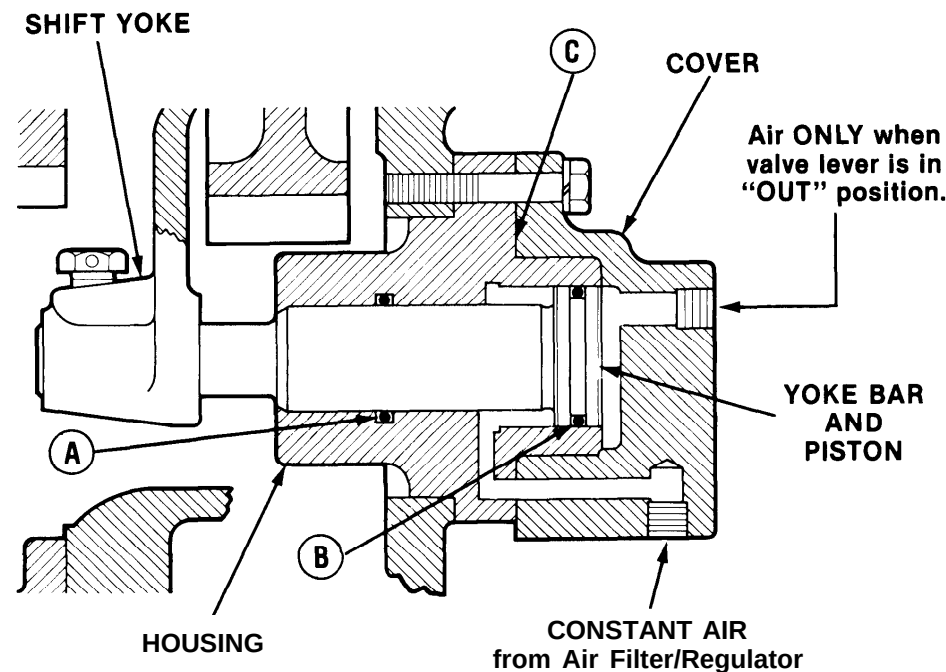
With the gear shift lever in neutral, disconnect the air line leads from OUTLET of Deep Reduction Valve.

- A. WHILE IN LOW RANGE, move the Deep Reduction Valve Lever to the "IN" position. There should be NO AIR flowing from disconnected line.
- B. Move the valve lever to the "OUT" position. There should now be CONSTANT AIR flowing from disconnected line. Return the valve lever to the "IN" position to shut off air flow and reconnect air line.

## 3. Reduction Cylinder (Refer to the following illustration.)

If any of the seals in the reduction cylinder assembly are defective, the deep reduction shift will be affected. The degree of air lost will govern the degree of failure, from slow shifting to complete shift failure.

- A. Leak at O-ring A results in a slow shift to engage deep reduction gearing; pressurizing of transmission case; deep reduction gearing can be disengaged.
- B. Leak at O-ring B results in slow shifting or complete failure to engage and disengage deep reduction gearing; steady flow of air from exhaust port of Deep Reduction Valve when lever is in the "IN" position.
- C. Leak at gasket C results in a slow shift to disengage deep reduction gearing; steady flow of air to atmosphere.



Cut 7440-4/84

**REDUCTION CYLINDER ASSEMBLY**  
(Models equipped with Deep Reduction Valve ONLY.)

# AIR SYSTEM

## For Models Equipped with the Master Control Valve A-5015 . . .

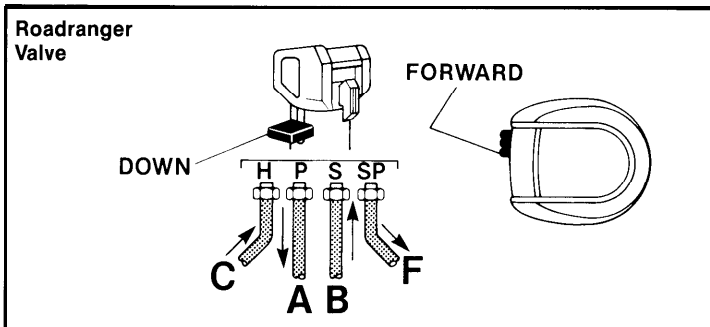
### 1. Air Supply (See schematic below.)

With the gear shift lever in neutral, select LOW RANGE and loosen the connection at the "H" Port of control valve until it can be determined that AIR is supplied to valve. Reconnect air line.

If there is NO AIR, check for a restriction in the 1/8" O.D. air line between the control valve and slave valve, making sure this line is connected to tee fitting at the Low Range or "L" Port of slave valve.

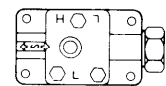
## LO-LO

NOTE: ARROWS INDICATE DIRECTION OF AIR FLOW.  
SHADED AREAS INDICATE CHARGED LINES.

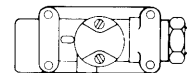


## SLAVE VALVE IDENTIFICATION

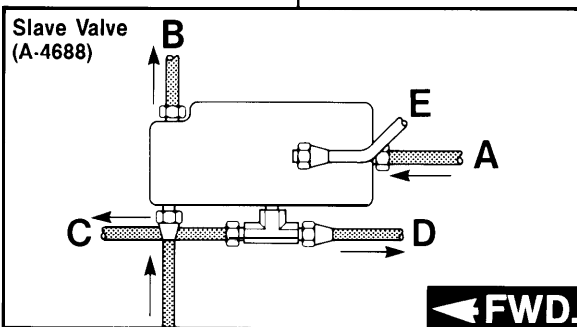
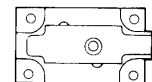
A-5000 VALVE



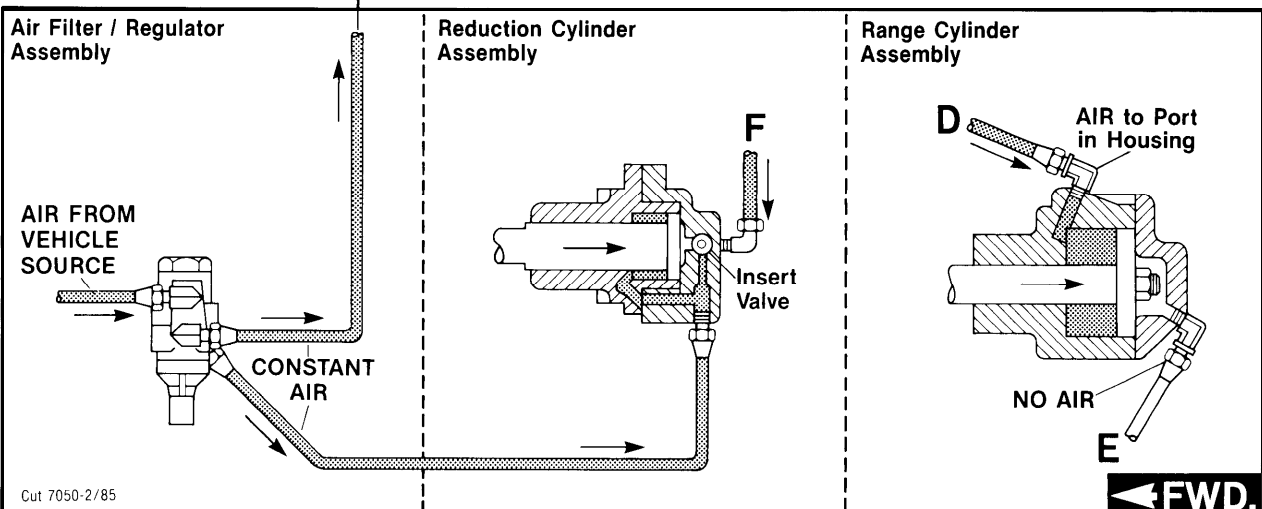
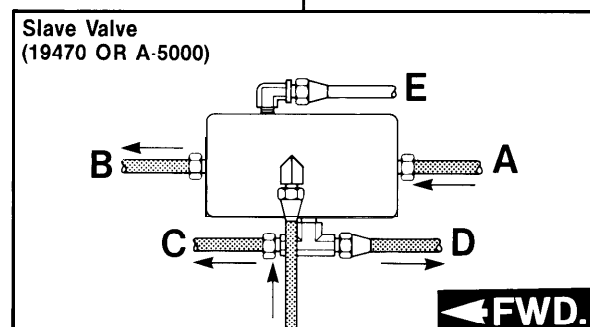
A-4688 VALVE



19470 VALVE



OR



# AIR SYSTEM

## 2. Roadranger Valve (See Page 34 and schematic on preceding page.)

With the gear shift lever in neutral, disconnect the 1/8" O.D. air line at the Center Port of reduction cylinder cover, making sure this line leads from the "SP" Port of control valve.

- A. WHILE IN LOW RANGE, move the Deep Reduction Button FORWARD. There should be AIR flowing from disconnected line. Move the button REARWARD to shut off air flow and reconnect air line.
- B. If the preceding conditions did not exist, the control valve is defective, or there is a restriction in the air lines.

## 3. Reduction Cylinder (Refer to the following illustration.)

If any of the seals in the reduction cylinder assembly are defective, the deep reduction shift will be affected. The degree of air lost will govern the degree of failure, from slow shifting to complete shift failure.

- A. Leak at O-ring A results in a slow shift to engage deep reduction gearing; pressurizing of transmission case; deep reduction gearing can be disengaged.
- B. Leak at O-ring B results in slow shifting or complete failure to engage and disengage deep reduction gearing; steady flow of air from exhaust port of control valve and/or cylinder cover when Deep Reduction Button is in the FORWARD position.
- C. Leak at gasket C results in a slow shift to disengage deep reduction gearing; steady flow of air to atmosphere.

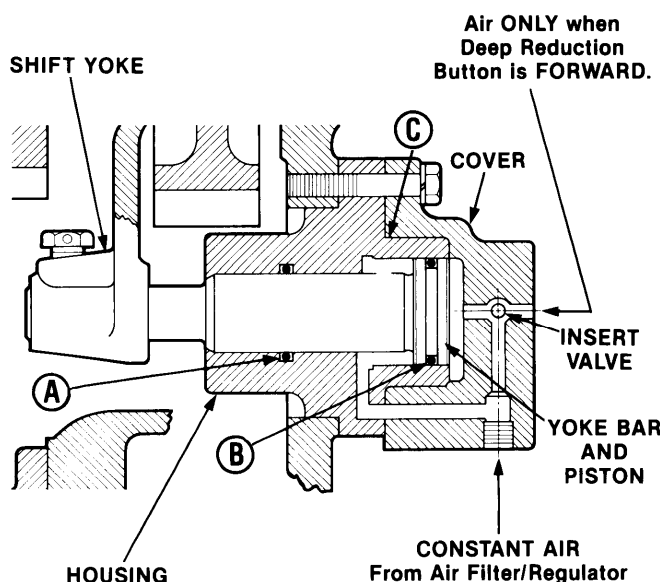
## 4. Insert Valve (See page 37.)

Any constant flow of air from exhaust port of cylinder cover usually indicates a faulty insert valve. Exhaust should occur ONLY BRIEFLY when Deep Reduction Button is moved FORWARD WHILE IN LOW RANGE.

A faulty insert valve, leaking at the O-rings of valve O.D. or from inner seals will result in shift failure. Two indications of defective O-rings or seals are:

- A. CONSTANT AIR flowing from exhaust port of cylinder cover.
- B. CONSTANT AIR flowing from exhaust port "E" of control valve WHILE DEEP REDUCTION BUTTON IS REARWARD (providing the control valve is operating properly).

The three O-rings in position on valve O.D. can be replaced. However, if an inner seal is damaged, the complete assembly MUST be replaced.

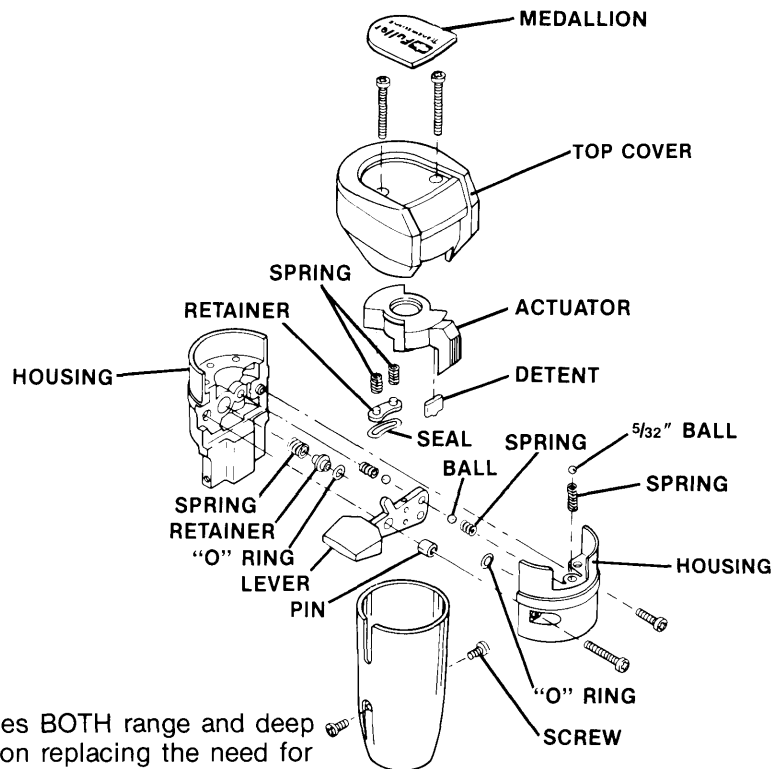


Cut 7441-4/84

**REDUCTION CYLINDER ASSEMBLY**  
(Models equipped with Master Control A-5015 ONLY.)

# AIR SYSTEM

## ROADRANGER VALVE A-5015



**NOTE:** This valve provides BOTH range and deep reduction selection replacing the need for separate units (Range Control Valve A-3546 or Roadranger Valve A-5010 with dash-mounted Deep Reduction Valve.)

Cut 6147A-11/83

### Removal and Disassembly

1. Remove two screws holding bottom cover to valve and slide cover down gearshift lever to expose air line fittings. Disconnect air lines.
2. Loosen jam nut and turn control valve from gear shift lever.
3. Pry medallion from recess in top cover.
4. Turn out the two screws to remove the top cover from valve housing.
5. Remove the actuator button from valve housing and the spring retainer, springs, seal & detent parts from actuator and/or valve housing.
6. Turn out the two screws in side of valve housing to separate the housing.
7. Remove the Range Preelection Lever from left housing and the position balls and guide from lever.
8. If necessary, remove springs, O-ring and retainer from bores in right housing.

### Reassembly and Installation

1. Refer to the drawing for proper reassembly. Use a VERY SMALL amount of silicone lubricant on the O-rings to avoid clogging ports. A small amount of grease on the position springs and balls will help to hold them in place during reassembly.
2. Reinstall control valve on gear shift lever and tighten jam nut.
3. Attach air lines and reinstall bottom cover.

# AIR SYSTEM

## SPLITTER SHIFT AIR SYSTEM: 13-SPEED SPLITTER MODELS ONLY

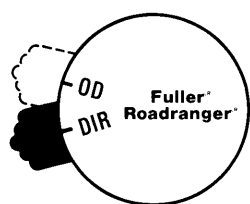
### Operation

In addition to the various components of the Range Shift Air System, the Splitter Shift Air System utilizes a splitter cylinder and a separate lever-mounted Splitter Selector Valve OR the Roadranger Control Valve A-4900. See Air System Schematics.

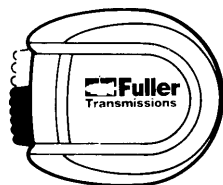
CONSTANT AIR from the air filter/regulator assembly is supplied to the splitter cylinder at the port on right side of cylinder cover. The Insert valve installed in cover (see Page 37) provides the proper air flow needed to move the splitter piston in the cylinder (rearward to engage splitter gearing; forward to disengage splitter gearing).

WHILE IN HIGH RANGE ONLY, AIR needed to make the splitter selection and complete the shift is supplied to the control valve from tee fitting at the High Range or "H" Port of slave valve. When the splitter selection is made, the AIR passes through the control valve and is supplied to the Center Port of cylinder cover.

With Splitter Control Button in the "DIR."/ REARWARD position, the "D" or "SP" Port of control valve is CLOSED and NO AIR is supplied to the Center Port of Splitter cylinder cover.

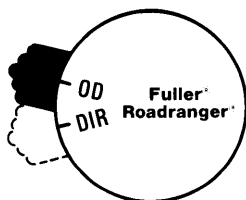


Button in "DIR."  
("D" Port CLOSED)

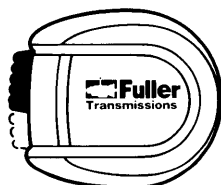


Button REARWARD  
("SP" Port CLOSED)

WHILE IN HIGH RANGE, the button can be moved FORWARD to operate in UNDERDRIVE or OVERDRIVE. The "D" or "SP" Port of valve is OPENED when splitter selection is made, supplying AIR to the Center Port of Splitter cylinder cover.



Button in "U. D." or "O.D."  
("D" Port OPENED)



Button FORWARD  
("SP" Port OPENED)

**NOTE:** WHILE IN LOW RANGE, the mechanical interlock of Master Valve prevents movement of Splitter Control Button to the FORWARD position.

### Trouble Shooting

If the transmission fails to shift or shifts too slowly to or from the "split" position, the fault may be in the Splitter Shift Air System or related components of the Range Shift Air System.

To locate the trouble, the following checks should be made with normal vehicle air pressure supplied to the system, but with the engine off. See CAUTION, Page 25.

**NOTE:** It is assumed that correct PSI readings were obtained from the air filter/regulator and all air lines have been checked for leaks.

#### 1. Air Supply (See Air System Schematics.)

With the gear shift lever in neutral, select HIGH RANGE and loosen the connection at the "S" Port of Splitter Selector Valve or "H" Port of Master Control Valve until it can be determined that AIR is supplied to valve. Reconnect air line.

If there is NO AIR, check for a restriction in the 1/8" O.D. air line between the control valve and slave valve, making sure this line is connected to tee fitting at the High Range or "H" Port of slave valve.

#### 2. Selector or Roadranger Valve (See Pages 38-39 and Air System Schematics.)

With the gear shift lever in neutral, disconnect the 1/8" O.D. air line at the Center Port of splitter cylinder cover, making sure this line leads from the "D" Port of Splitter Selector Valve or "SP" Port of Master Valve.

A. WHILE IN HIGH RANGE, move the Splitter Control Button FORWARD. There should be AIR flowing from disconnected line. Move the button REARWARD to shut off air flow and reconnect air line.

B. If the preceding conditions did not exist, the control valve is defective, or there is a restriction in the air lines.

#### 3. Splitter Cylinder. (Refer to the following illustration.)

If any of the seals in the splitter cylinder assembly are defective, the splitter shift will be affected. The degree of air lost will govern the degree of failure, from slow shifting to complete shift failure.

A. Leak at O-ring A results in a slow shift to engage splitter gearing; pressurizing of transmission case; splitter gearing can be disengaged.

# AIR SYSTEM

- B. Leak at O-ring B results in slow shifting or complete failure to engage and disengage splitter gearing; steady flow of air from exhaust port of control valve and/or cylinder cover when Splitter Control Button is in the FORWARD position.
- C. Leak at gasket C results in a slow shift to disengage splitter gearing; steady flow of air to atmosphere.

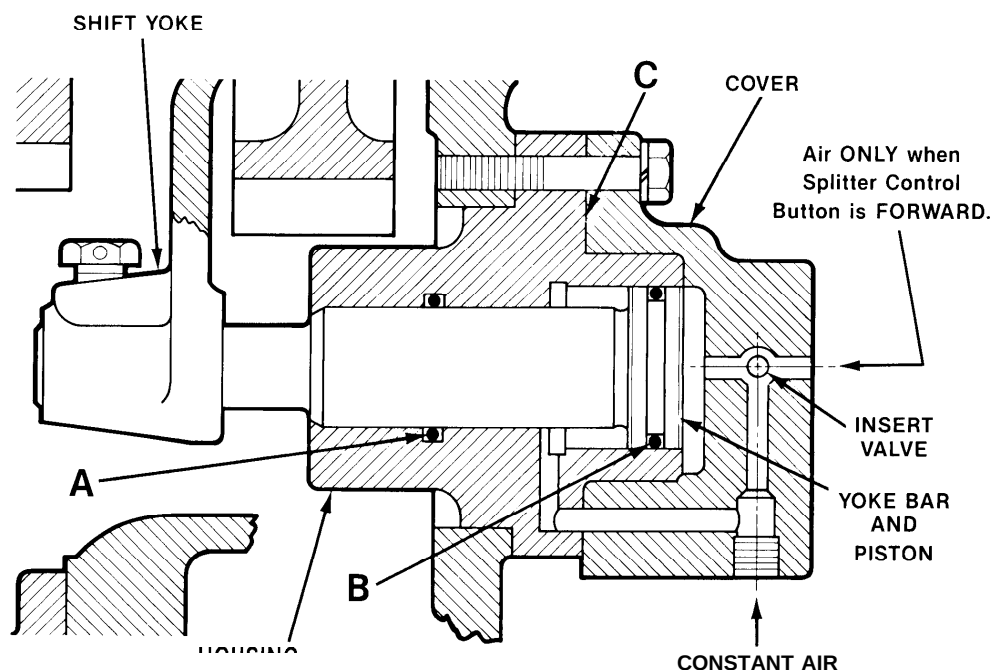
## 4. Insert Valve (See Page 37).

Any constant flow of air from exhaust port of cylinder cover usually indicates a faulty insert valve. Exhaust should occur **ONLY BRIEFLY** when Splitter Control Button is moved FORWARD WHILE IN HIGH RANGE.

A faulty insert valve, leaking at the O-rings of valve O.D. or from inner seals will result in shift failure. Two indications of defective O-rings or seals are:

- A. CONSTANT AIR flowing from exhaust port of cylinder cover.
- B. CONSTANT AIR flowing from Exhaust Port "E" of control valve WHILE SPLITTER CONTROL BUTTON IS REARWARD (providing the control valve is operating properly).

The three O-rings in position on valve O.D. can be replaced. However, if an inner seal is damaged, the complete assembly, **MUST** be replaced.

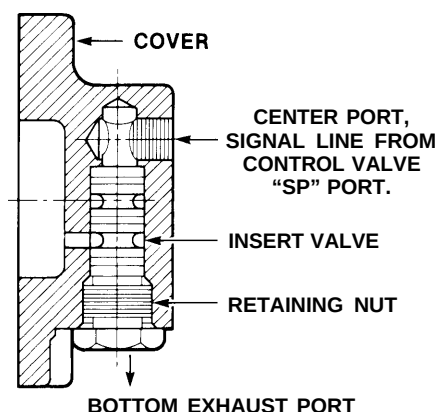


**SPLITTER CYLINDER ASSEMBLY**  
(13-Speed Splitter Models ONLY)

# AIR SYSTEM

## INSERT VALVE: 8-SPEED "LL" MODELS (EQUIPPED WITH ROADRANGER VALVE A-5015) AND 13-SPEED SPLITTER MODELS

The insert valve is a self-contained 1-3/16" valve assembly located in the reduction or splitter cylinder cover. It CANNOT be disassembled except for the three O-rings on outer diameter. The O-rings provide a stationary seal and do not move in cylinder.

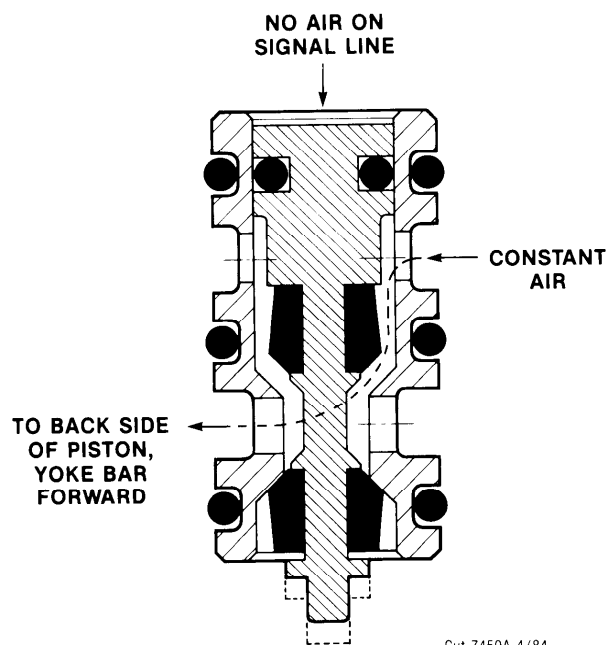


Cut 7450-4/84

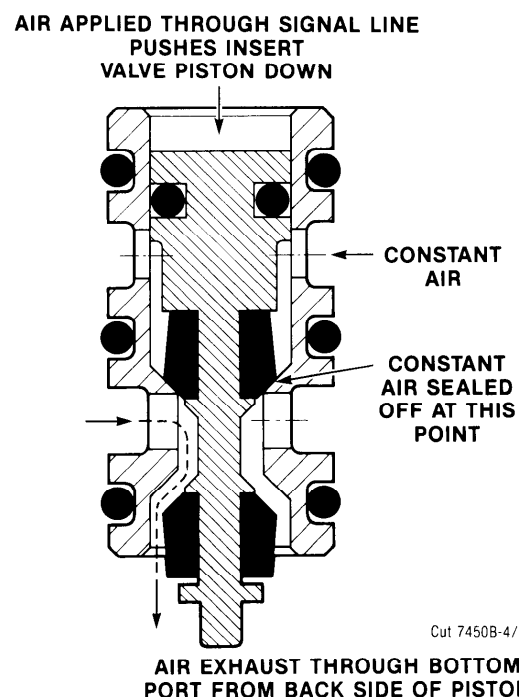
When installing the insert valve in bottom edge of cover, apply Fuller #71206 silicone lubricant or its equivalent to O-rings and cylinder walls. Install valve in bore with flat surface to the inside. When installing the special valve retaining nut, apply Fuller #71204 adhesive/sealant or its equivalent to threads and tighten. See TORQUE RECOMMENDATIONS.

Travel of the small insert valve piston is only 3/16" As shown in the illustrations below, when NO AIR is applied to the top side of valve piston, CONSTANT AIR supplied from the regulator passes freely through the insert valve and to the backside of cylinder piston, moving the yoke bar forward to disengage deep reduction or splitter gearing (LOW RANGE AND HIGH RANGE OR DIRECT). When AIR is applied to the top side of valve piston through signal line, the piston moves down to cut off air supplied to the backside of cylinder piston. This air is exhausted out bottom port of cover when CONSTANT AIR supplied from the regulator is directed to the frontside of cylinder piston, moving the yoke bar rearward to engage deep reduction or splitter gearing (LO-LO AND UNDERDRIVE/OVERDRIVE).

### LOW RANGE AND HIGH RANGE OR DIRECT

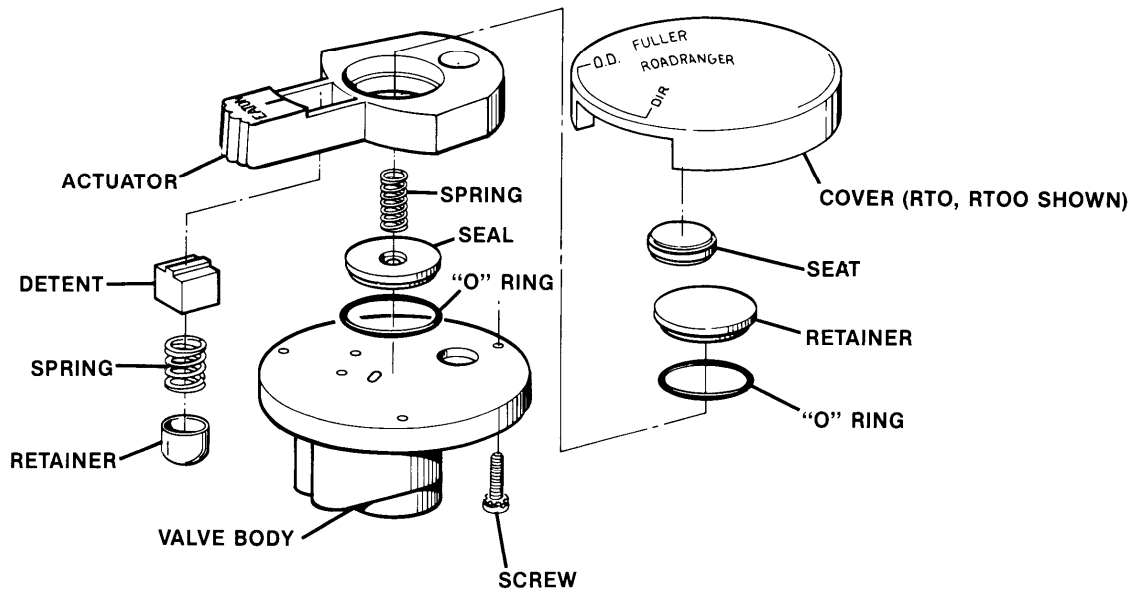


### LO-LO OR UNDERDRIVE/OVERDRIVE



# AIR SYSTEM

## SELECTOR VALVE



**NOTE:** This valve is used as a separate unit with Range Valve to provide splitter selections.

Cut 6152-3/84

### Removal and Disassembly

1. Disconnect all air lines to the valve. Loosen the jam nut securing the valve to gear shift lever and turn the valve from lever.
2. Turn out the three screws from bottom of valve body and remove the top cover.
3. Remove the actuator (control button) from cover post and the springs, seals, O-rings and detent parts from actuator.

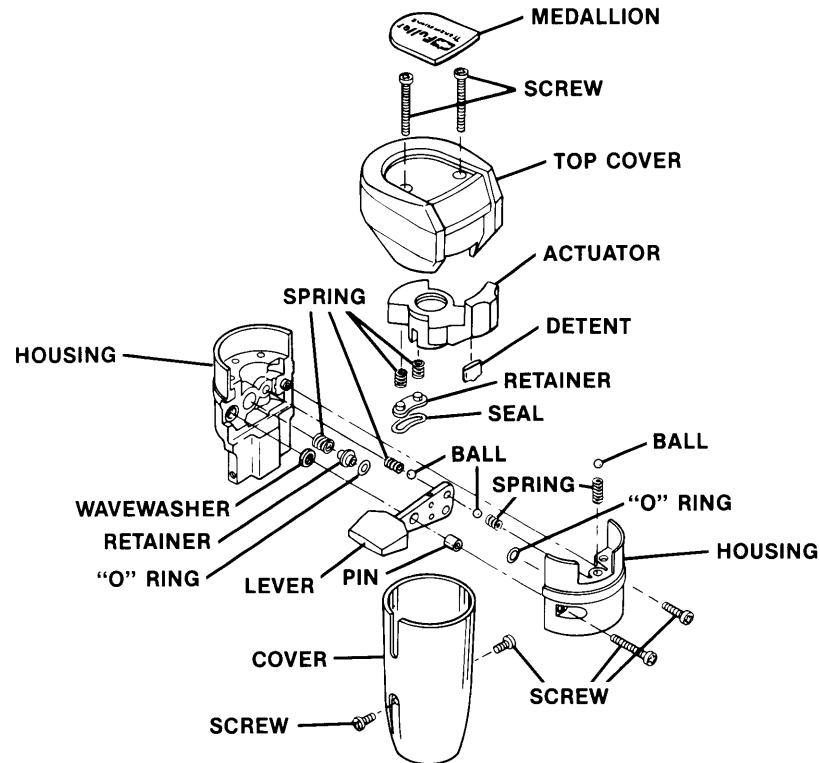
### Reassembly and Installation

1. Refer to the drawing for proper reassembly. Use a VERY SMALL amount of silicone lubricant on the O-rings to avoid clogging ports.
2. Install the air lines with their sheathing and O-rings on the gear shift lever.
3. Install the jam nut and valve on lever. Use the nut to lock the valve in position with control button on driver's side.
4. Connect the 1/8" O.D. air line from Center Port of splitter cylinder cover to "D" Port; air line from tee fitting at the High Range or "H" Port of slave valve to "S" Port.

# AIR SYSTEM

## ROADRANGER VALVE A-4900

### ROADRANGER VALVE ASSEMBLY



Cut 6145 G-2/88

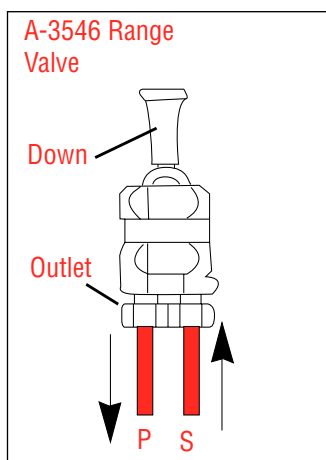
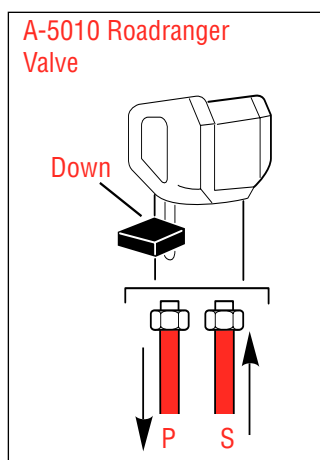
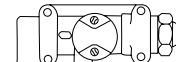
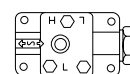
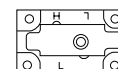
### Removal and Disassembly

1. Remove two screws holding bottom cover to valve and slide cover down gear shift lever to expose air line fittings. Disconnect air lines.
2. Loosen jam nut and turn control valve from gear shift lever.
3. Pry medallion from recess in top cover.
4. Turn out the two screws to remove the top cover from valve housing.
5. Remove the actuator button from valve housing and the spring retainer, springs, seal and detent parts from actuator and/or valve housing.
6. Turn out the two screws inside of valve housing to separate the housing.
7. Remove the Range Preelection Lever from left housing and the position balls and guide from lever.
8. If necessary, remove the spring and O-ring from bores in left housing.

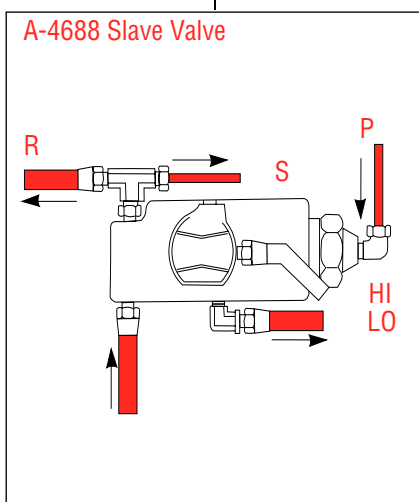
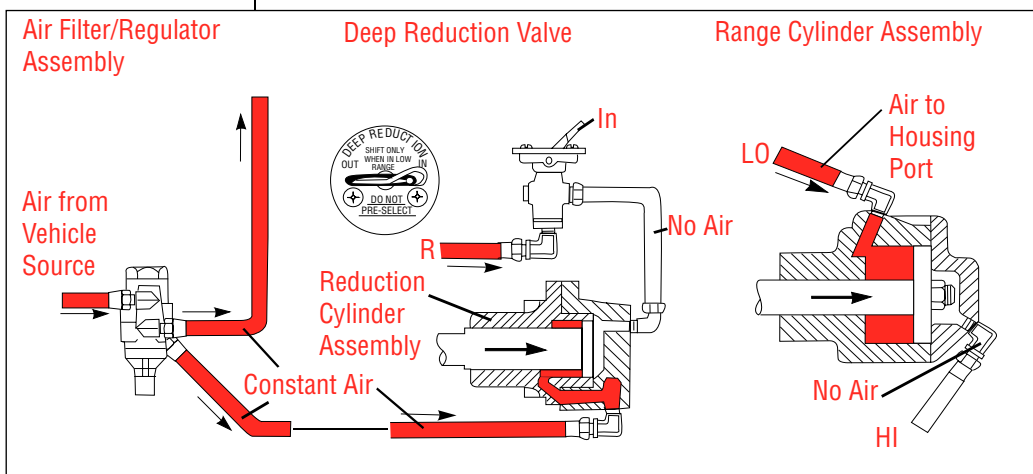
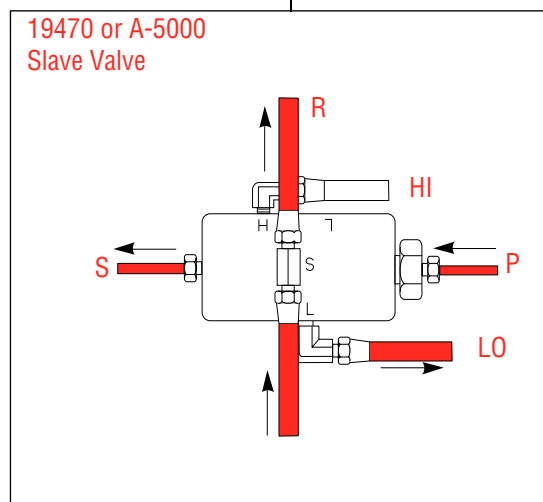
9. If necessary, remove the springs, O-ring and retainer from bores in right housing.

### Reassembly and Installation

1. Refer to the drawing for proper reassembly. Use a VERY SMALL amount of silicone lubricant on the O-rings to avoid clogging ports. A small amount of grease on the position springs and balls will help to hold them in place during reassembly.
2. Reinstall control valve on gear shift lever and tighten jam nut.
3. Attach air lines and reinstall bottom cover.

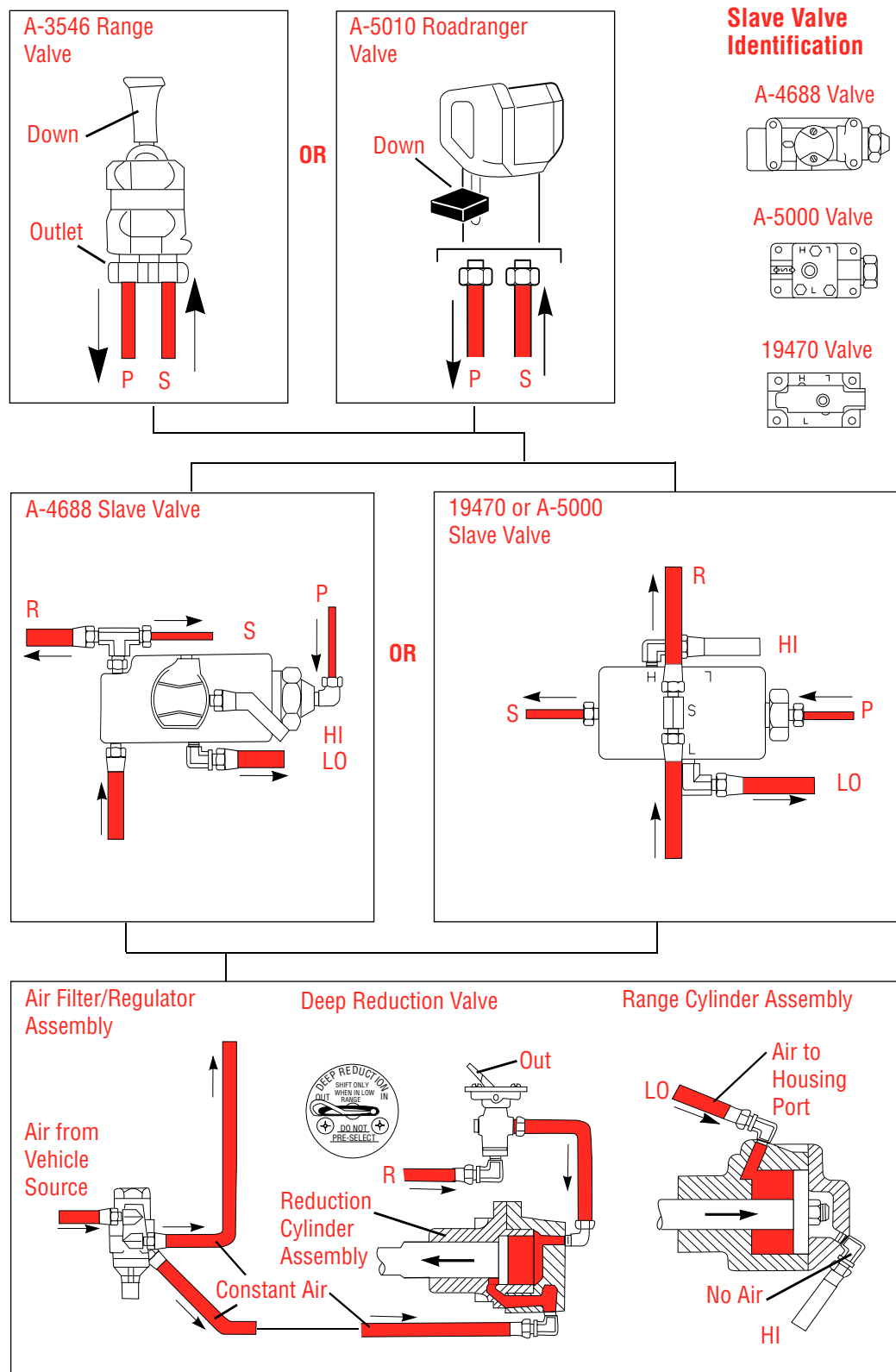
**RT, RTO, & RTX XX607LL: XX608LL: and XX615 Models****Deep Reduction****OR****Slave Valve Identification****A-4688 Valve****A-5000 Valve****19470 Valve****Schematic**

For all questions concerning removal and replacement, refer to Eaton Service and Parts Literature.

**OR**

**RT, RTO, & RTX XX607LL: XX608LL: and XX615 Models**

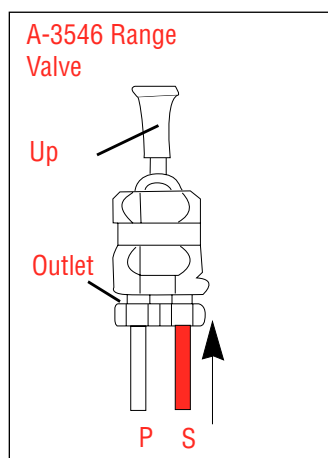
Range—LO

**Schematic**

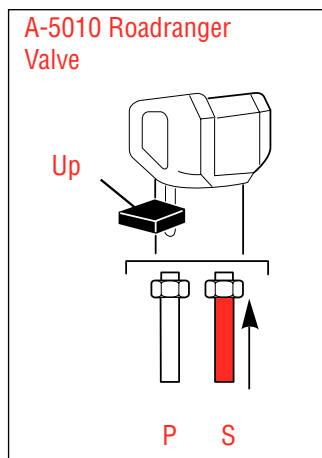
For all questions concerning removal and replacement, refer to Eaton Service and Parts Literature.

**RT, RTO, & RTX XX607LL: XX608LL: and XX615 Models**

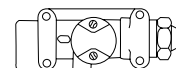
Range—HI



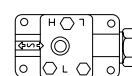
OR

**Slave Valve Identification**

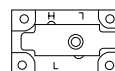
A-4688 Valve



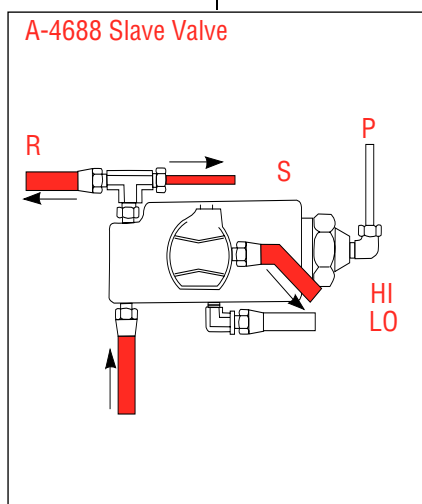
A-5000 Valve



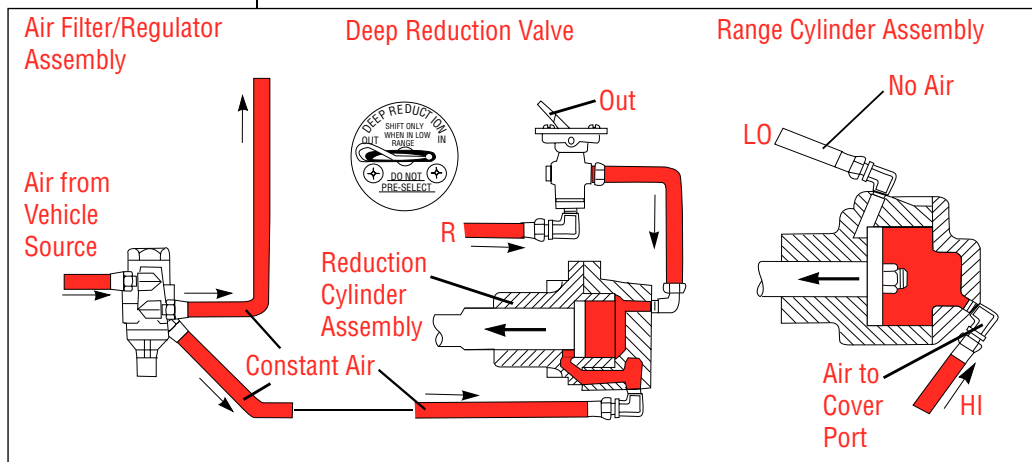
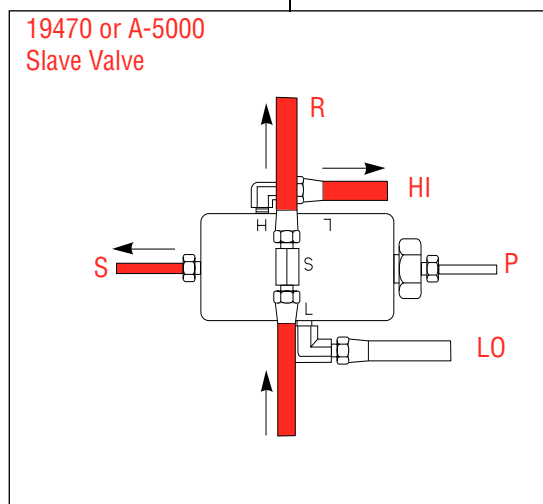
19470 Valve

**Schematic**

For all questions concerning removal and replacement, refer to Eaton Service and Parts Literature.

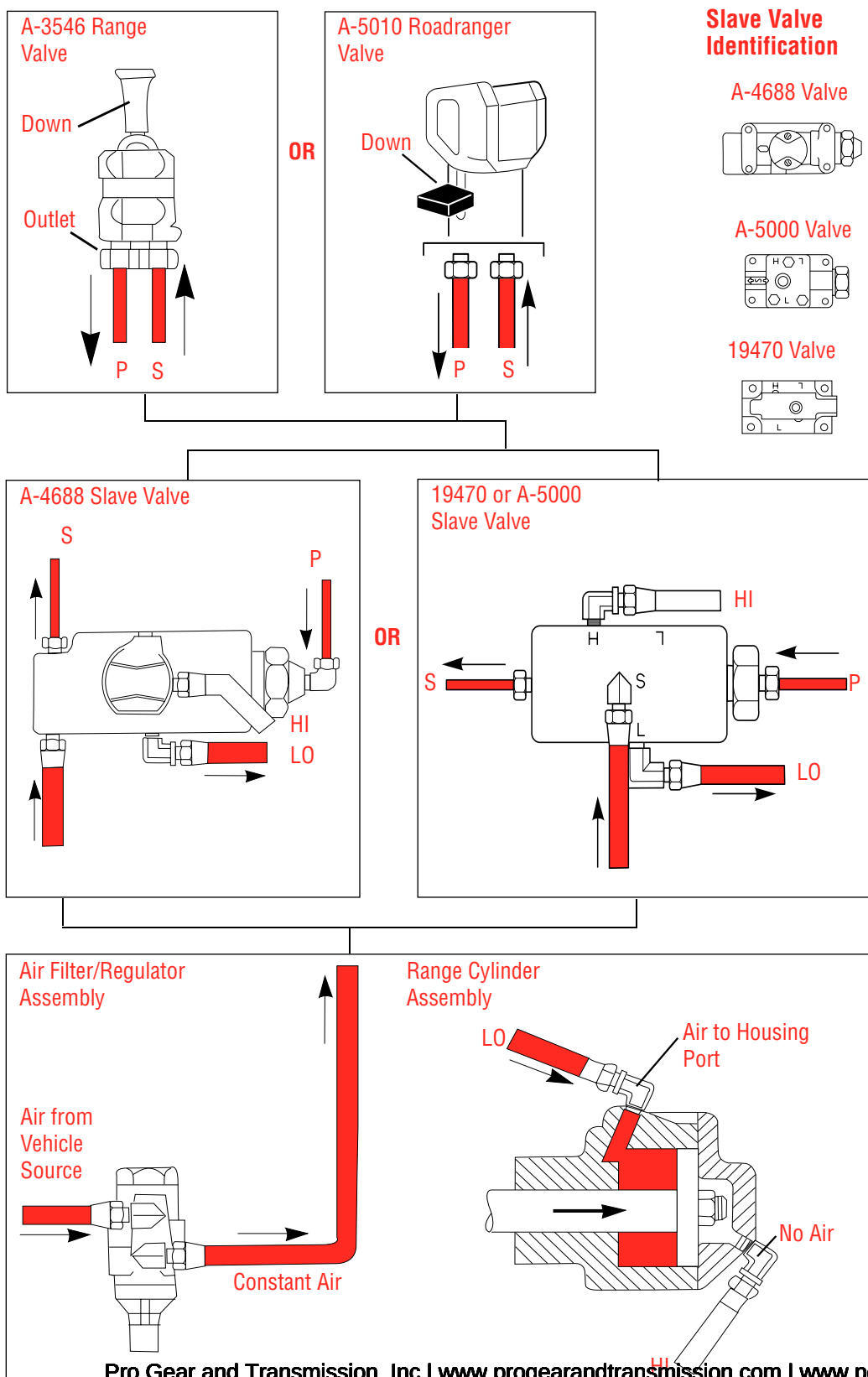


OR



**7L: 8: 9: and 10 Speed (2-Speed Auxiliary)**

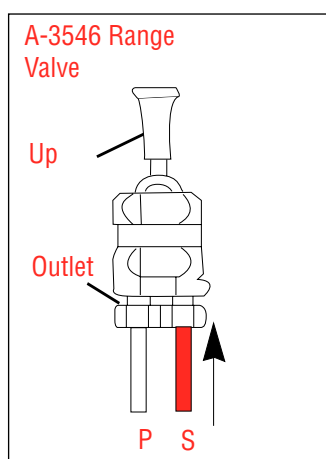
Range—LO

**Schematic**

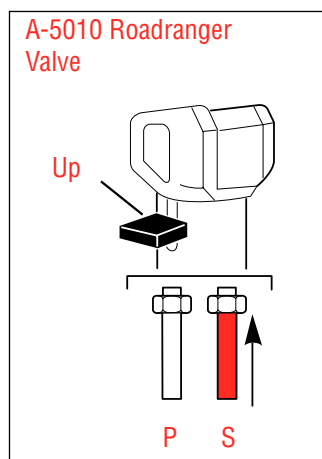
For all questions concerning removal and replacement, refer to Eaton Service and Parts Literature.

**7L: 8: 9: and 10 Speed (2-Speed Auxiliary)**

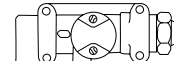
Range—HI



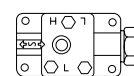
OR

**Slave Valve Identification**

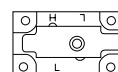
A-4688 Valve



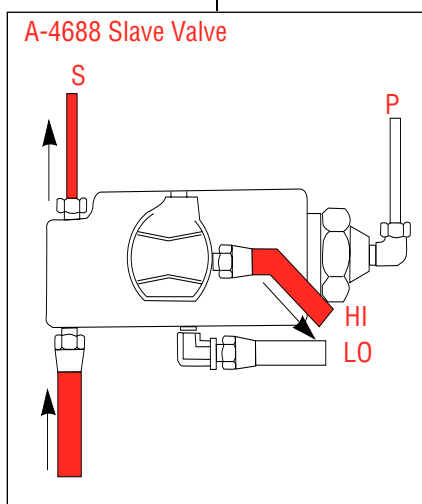
A-5000 Valve



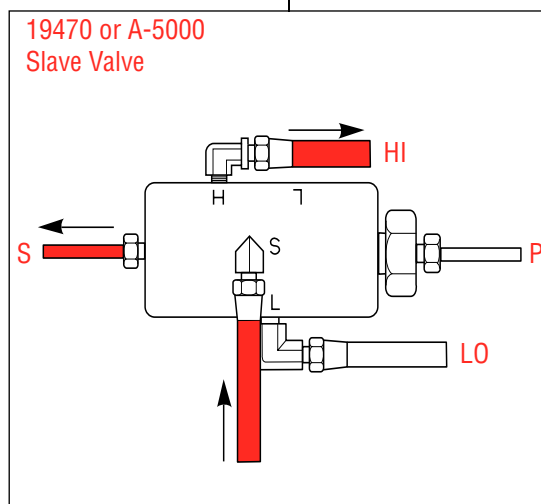
19470 Valve

**Schematic**

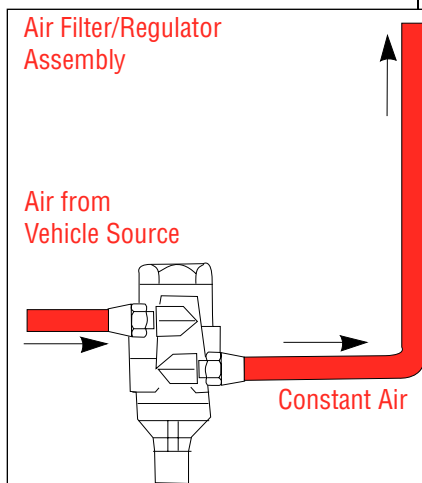
For all questions concerning removal and replacement, refer to Eaton Service and Parts Literature.



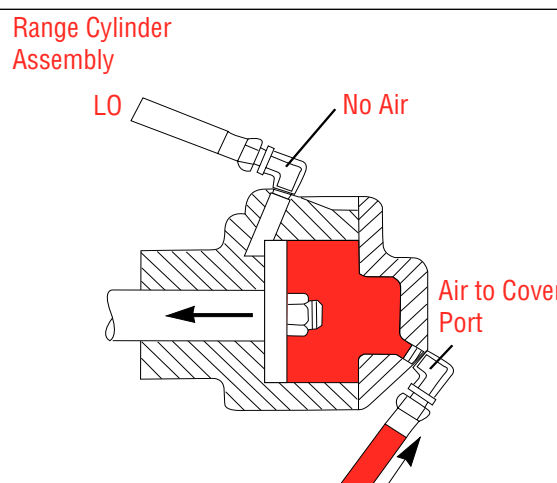
OR



**Air Filter/Regulator Assembly**

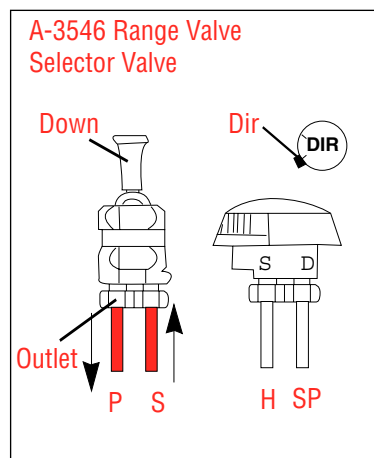


**Range Cylinder Assembly**

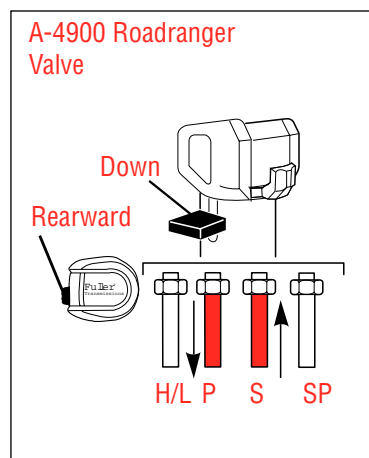


**RT, RT0, & RT00 XX613 and XX813 Models**

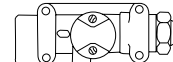
Range—LO



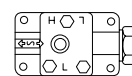
OR

**Slave Valve Identification**

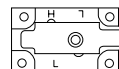
A-4688 Valve



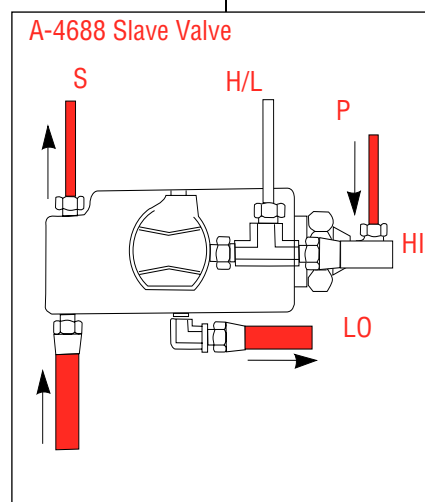
A-5000 Valve



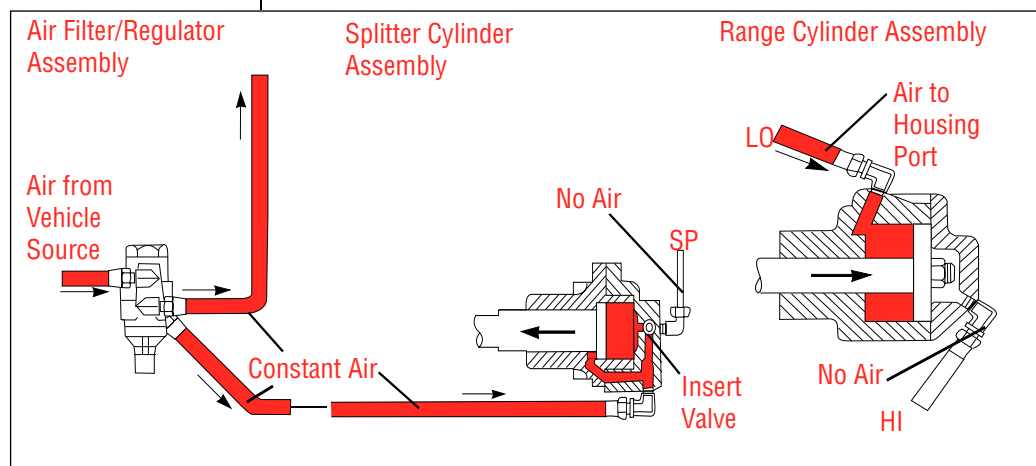
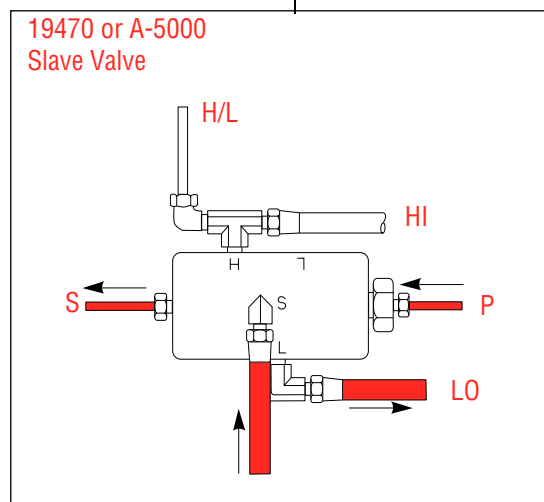
19470 Valve

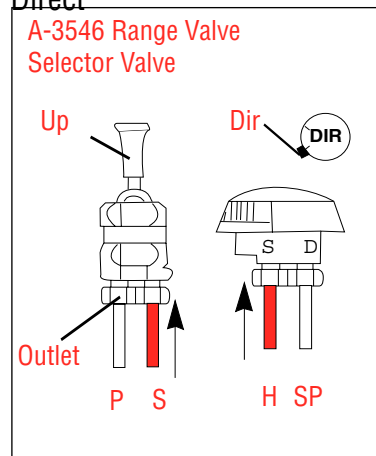
**Schematic**

For all questions concerning removal and replacement, refer to Eaton Service and Parts Literature.

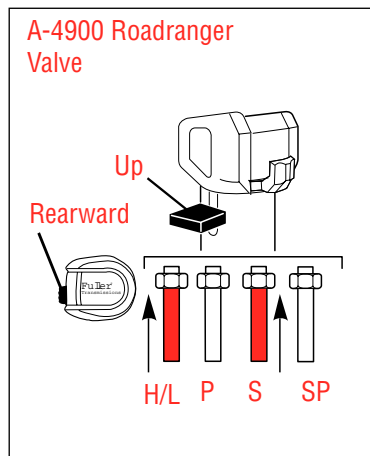
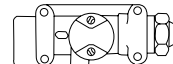
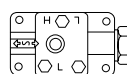
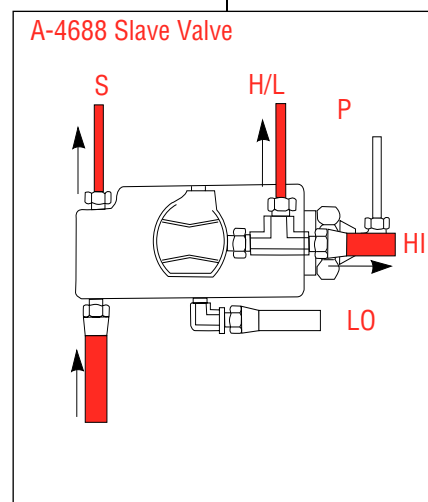
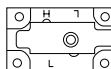


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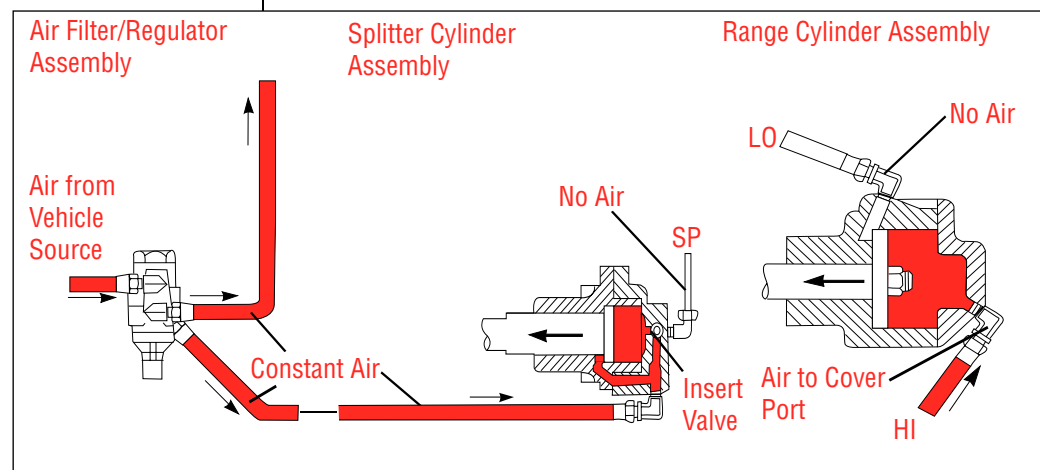
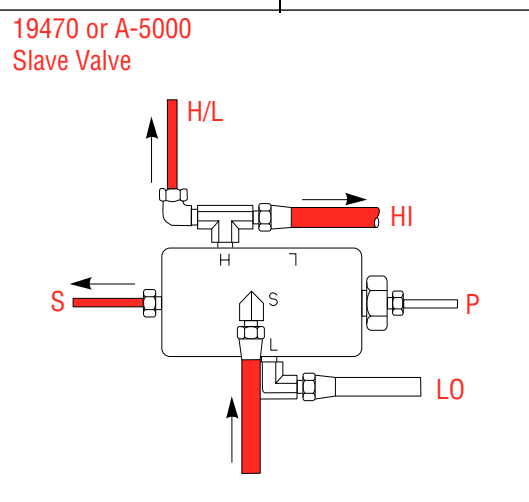


**RT, RT0, & RT00 XX613 and XX813 Models**Range—HI/Splitter—  
Direct

OR

**Slave Valve Identification****A-4688 Valve****A-5000 Valve****19470 Valve**

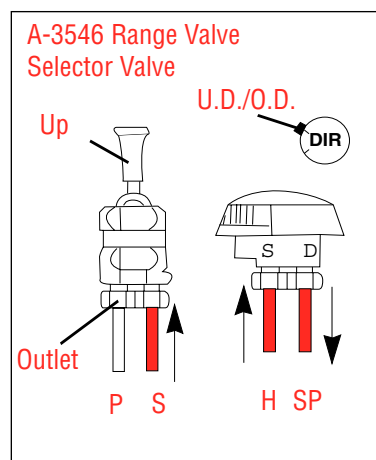
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**Schematic**

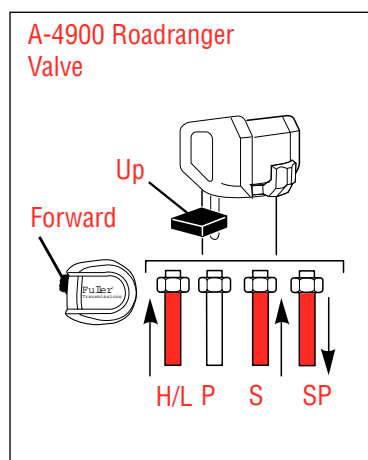
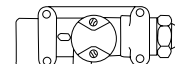
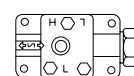
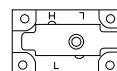
For all questions concerning removal and replacement, refer to Eaton Service and Parts Literature.

**RT, RTO, & RTOO XX613 and XX813 Models**

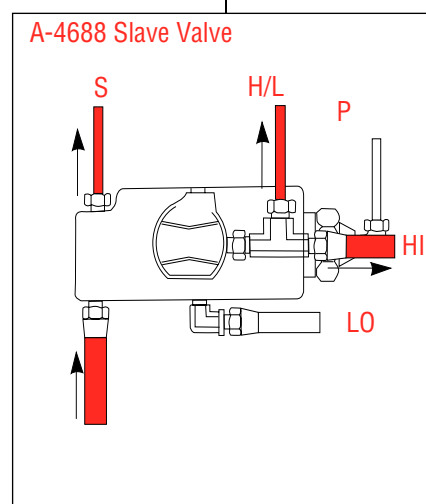
Range—HI/Splitter—Underdrive or Overdrive



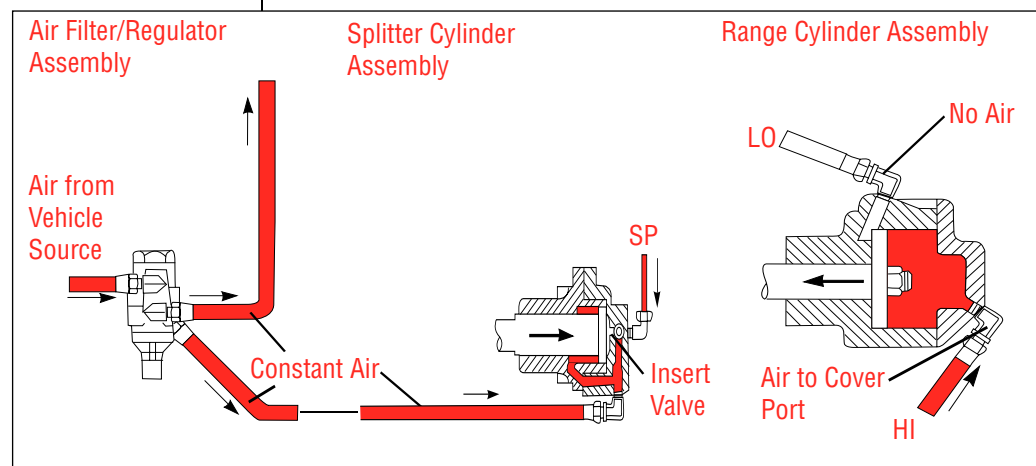
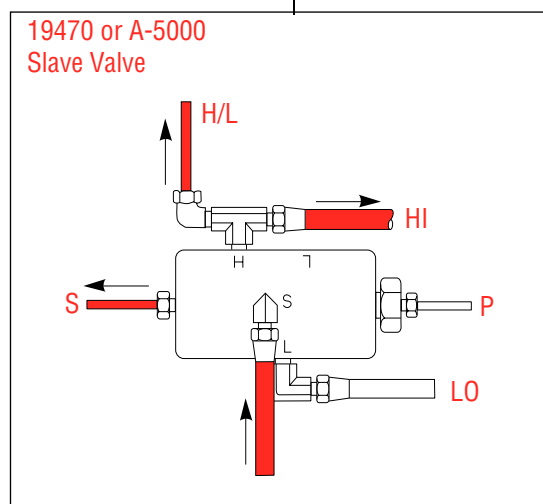
OR

**Slave Valve Identification****A-4688 Valve****A-5000 Valve****19470 Valve****Schematic**

For all questions concerning removal and replacement, refer to Eaton Service and Parts Literature.

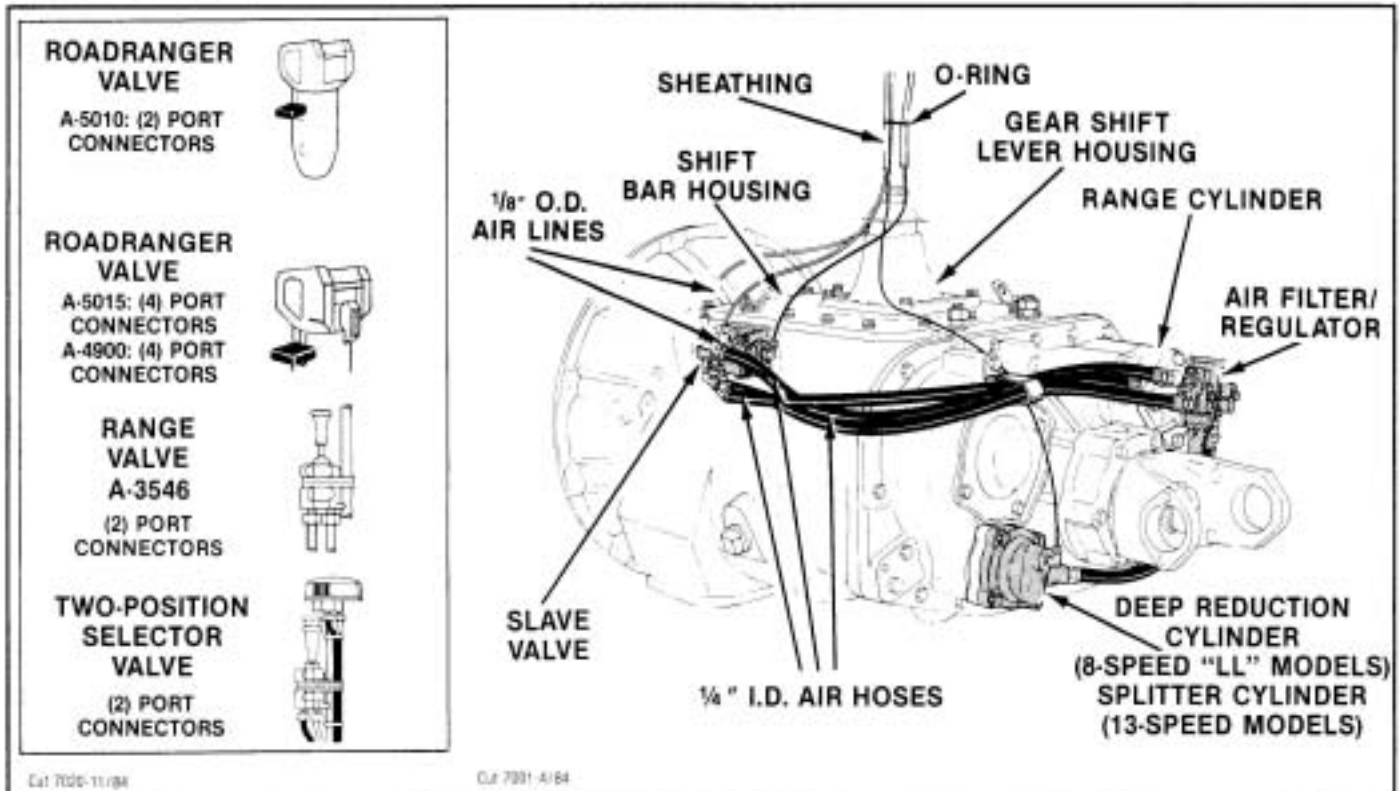


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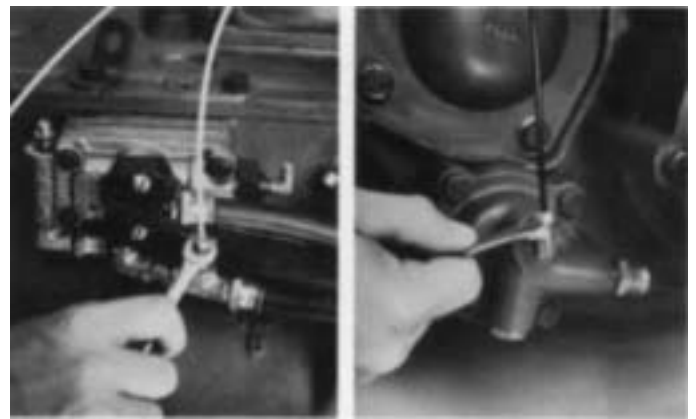
# DISASSEMBLY AND REASSEMBLY SHIFTING CONTROLS

## AIR SYSTEM



### A. Removal of Air Control

**NOTE:** For removal and disassembly of models also equipped with the Countershaft Actuator Valve, see OPTIONS.



- For models equipped with the Roadranger Valve A-5015 or A-4900, also disconnect the 1/8" O.D. air hose line at the "L" or Low Range Port of slave valve (left); and the 1/8" O.D. air line at the Center Port of reduction cylinder/splitter cylinder cover (right).

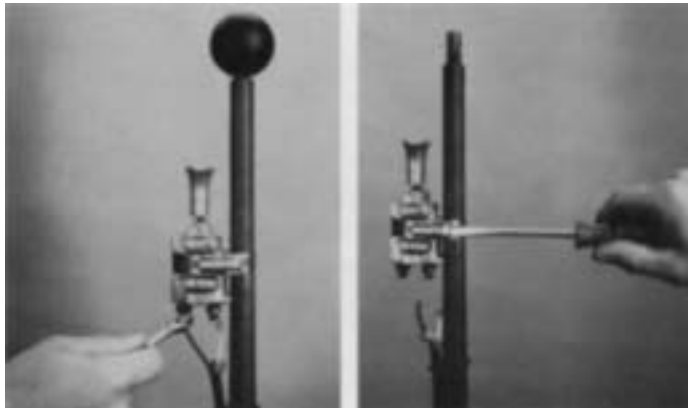
**NOTE:** If desired, the gear shift lever housing assembly can now be removed from shift bar housing.

- Disconnect the two 1/8" O.D. air line or at the "S" or Supply Port and the "P" or End Port of slave valve on transmission case.

**NOTE:** For models equipped with the A-3546 or Roadranger Valve A-5010, the gear shift lever housing assembly can now be removed from shift bar housing.

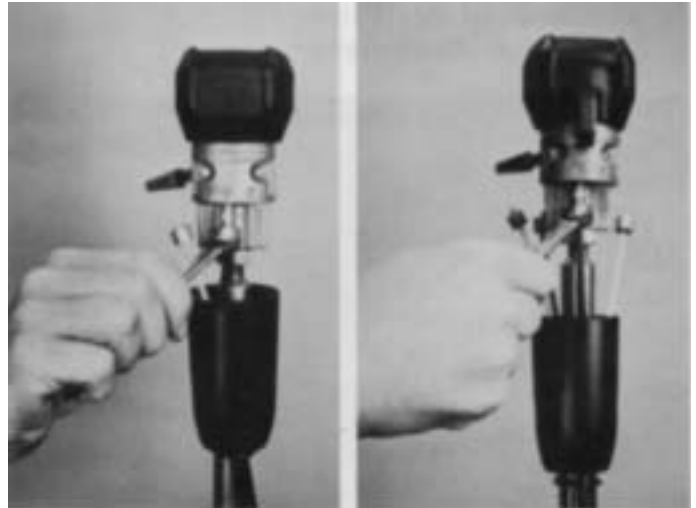
# DISASSEMBLY AND REASSEMBLY SHIFTING CONTROLS

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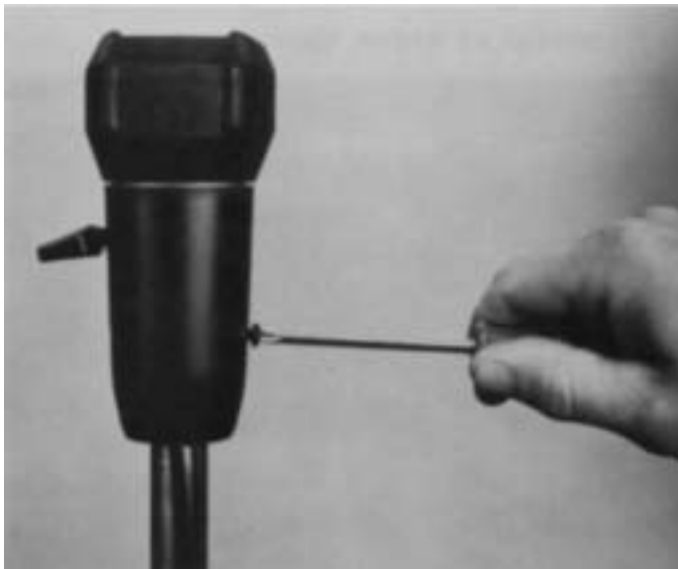


1. Disconnect the two 1/8" O.D. air lines at the Range Valve of models so equipped (left). Remove the ball grip, loosen the valve mounting clamp and remove the valve, mounting clamp, air lines, sheathing and O-rings from gear shift lever (right).

**NOTE:** For disassembly and reassembly of Range Valve, see Page 28.



5. Slide the cover down shift lever to expose valve ports and disconnect the 1/8" O.D. air lines.



4. For models so equipped, turn out the two mounting screws in valve cover.



6. Loosen the jam nut and turn the Valve and nut from gear shift lever. Remove the valve cover, air lines, sheathing and O-rings from lever.

# DISASSEMBLY AND REASSEMBLY SHIFTING CONTROLS

## B. Removal of Air Filter Regulator Assembly



1. Disconnect and remove the 1/4" I.D. air hose between the slave valve and air filter/regulator assembly.



3. Turn out the two capscrews and remove the air filter/regulator assembly.

**NOTE:** For disassembly and reassembly of Air Filter/Regulator Assembly, see Page 27.

## C. Removal of Slave Valve



2. For 8-Speed "LL" or 13-Speed Models, also disconnect the 1/4" I.D. air hose between the air filter/regulator assembly and reduction/splitter cylinder.



1. Disconnect and remove the 1/4" I.D. air hose between the slave valve and Low Range Port in housing of range cylinder.

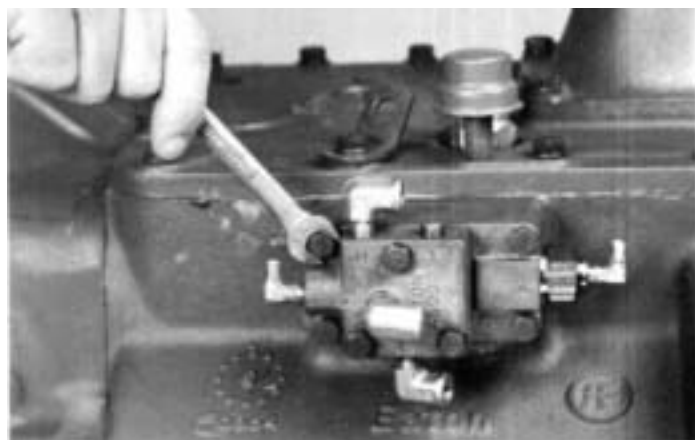
# DISASSEMBLY AND REASSEMBLY SHIFTING CONTROLS



2. Disconnect and remove the 1/4" I.D. air hose between the slave valve and High Range Port in cover of range cylinder.



5. Remove the spring and plunger pin from bore in transmission case. Remove slave valve gasket.



3. Turn out the four retaining capscrews and remove slave valve from transmission case.



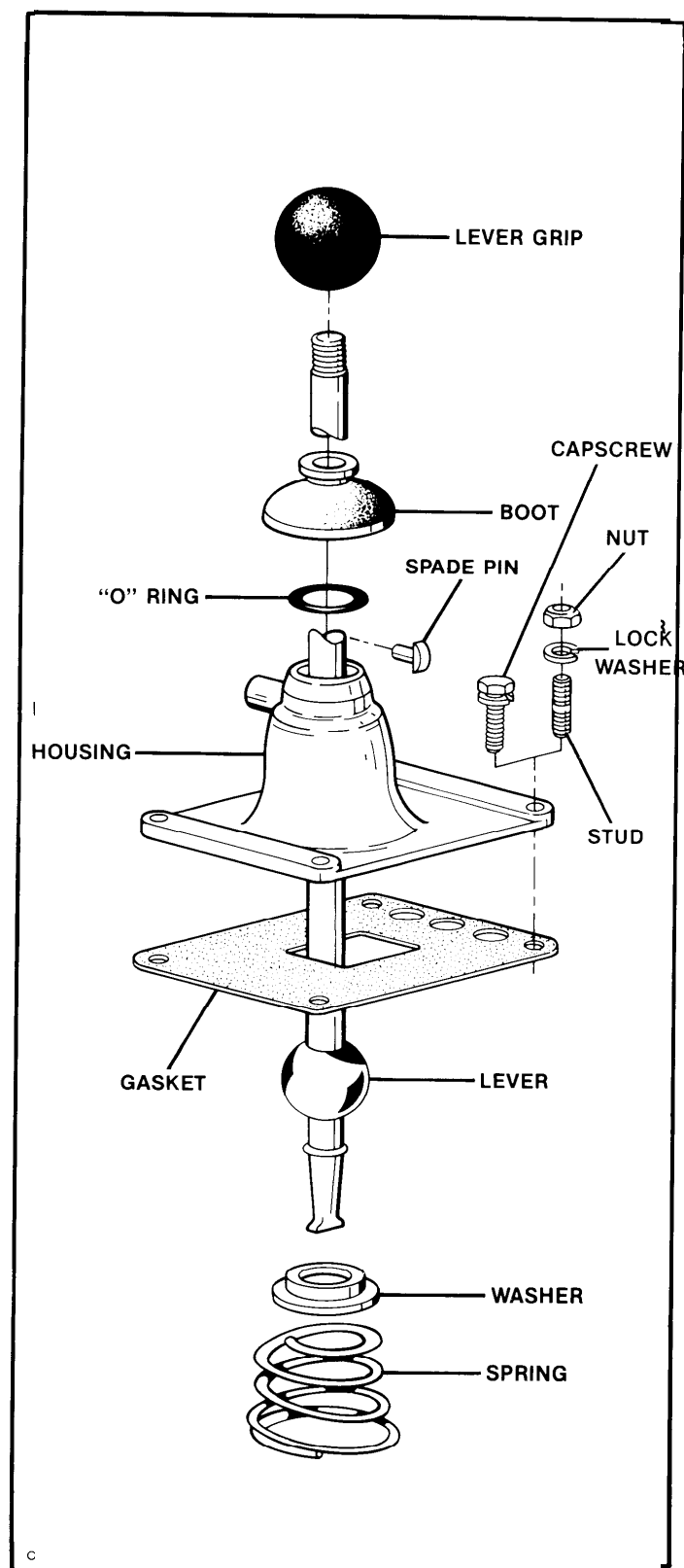
6. If necessary, remove the air hose fittings from slave valve.

**NOTE:** For disassembly and reassembly of piston-type Slave Valve Assembly ONLY, see Page 27.

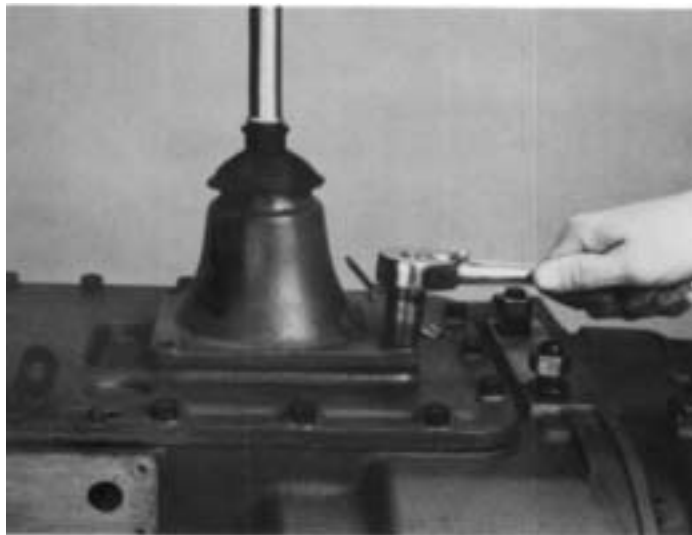


4. Remove the hat-type alignment sleeve from bore in slave valve.

# DISASSEMBLY AND REASSEMBLY SHIFTING CONTROLS



## A. Removal and Disassembly



1. Turn out the four retaining capscrews, jar lightly to break gasket seal and remove the gear shift lever housing and gasket from shift bar housing. NOTE: Remote control housings are removed from shift bar housing in the same manner. For disassembly and reassembly of LRC Assemblies, see Illustrated Parts List No. P-541. For disassembly and reassembly of SRC Assemblies, see Illustrated Parts List No. P-515.



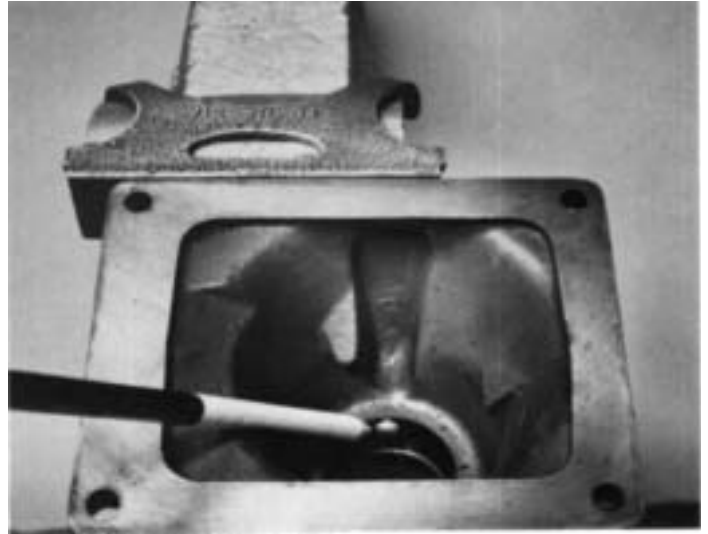
2. Remove the boot from gear shift lever and secure assembly in vise with bottom of housing up. Use a large screwdriver to twist between the spring and housing, forcing the spring from under the lugs in housing. Do one coil at a time.

# DISASSEMBLY AND REASSEMBLY SHIFTING CONTROLS

## B. Reassembly of Gear Shift Lever Housing Assembly



3. Remove the tension spring, washer and gear shift lever from housing.



1. With the gear shift lever housing secured in vise as during disassembly, install the spade pin in bore of housing tower. If previously removed, install the O-ring in tower groove.



4. Remove the spade pin from bore in housing tower. If necessary, remove the O-ring from groove inside tower.



2. Position the gear shift lever in housing with spade pin in lever ball slot and install the tension spring washer over ball, dished-side up.

# DISASSEMBLY AND REASSEMBLY SHIFTING CONTROLS

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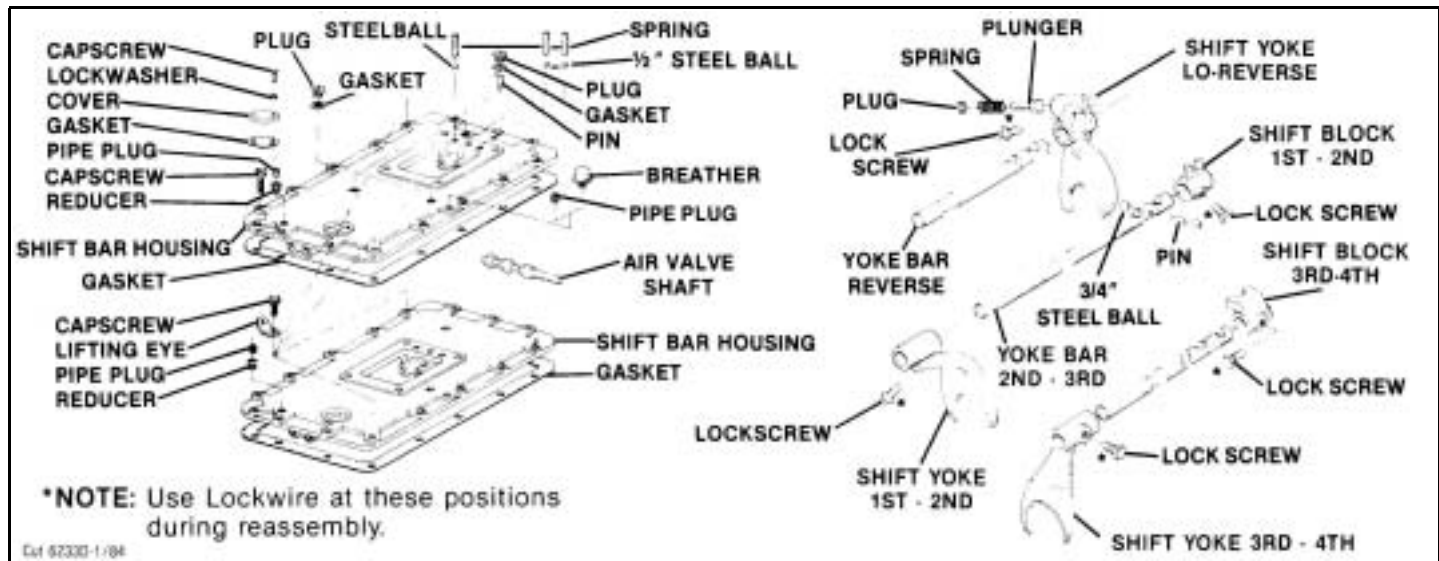
3. Install the tension spring under lugs in housing, seating one coil at a time. Use of a spring driving tool is recommended.



4. Remove the assembly from vise and install the rubber boot over gear shift lever and against housing.

# DISASSEMBLY AND REASSEMBLY SHIFTING CONTROLS

## SHIFT BAR HOUSING ASSEMBLY



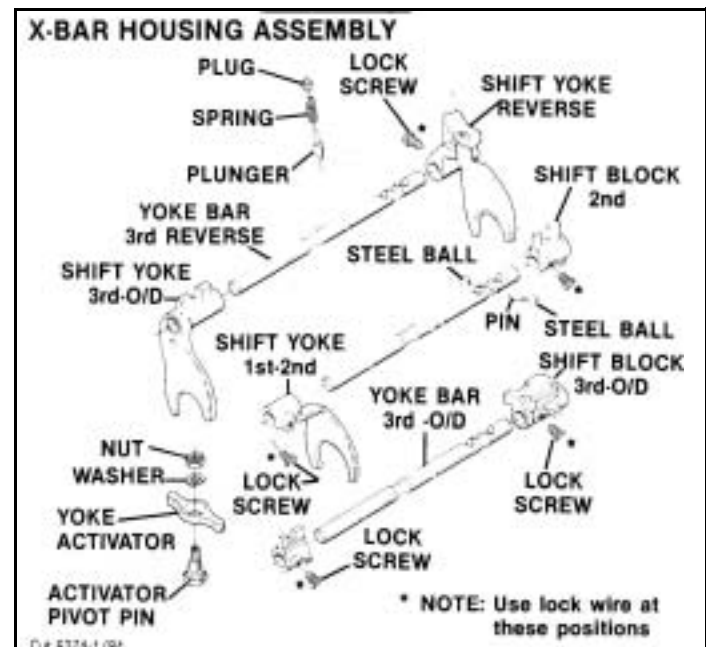
### A. Removal and Disassembly

**NOTE:** For models equipped with an Oil Pump and/or Cooler Assemblies, make sure to disconnect the lube line at fitting on shift bar housing prior to proceeding with the following instructions.



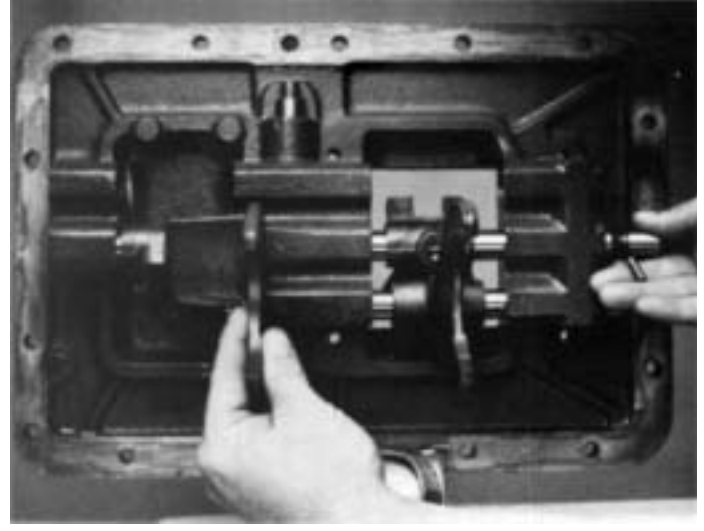
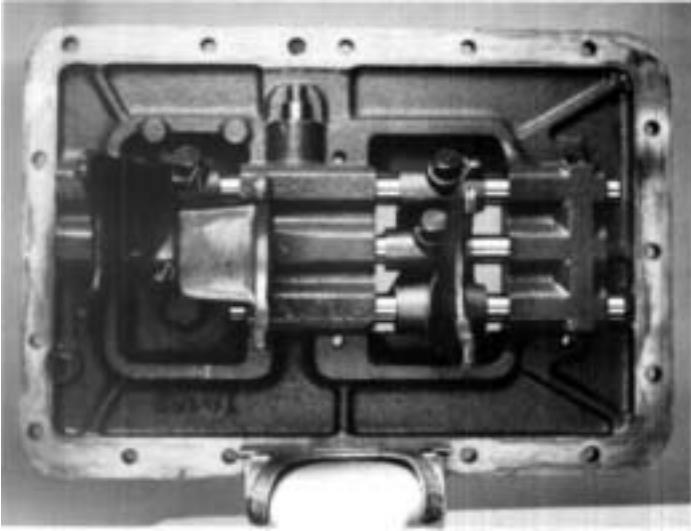
1. Turn out the retaining capscrews, jar to break gasket seal and lift the shift bar housing from case. Remove gasket.

**NOTE:** During disassembly, lay all parts on a clean bench in order of removal from housing to facilitate reassembly. Shift bars not being removed **MUST** be kept in the neutral position or interlock parts will lock bars. For disassembly and reassembly of "X" and "F" model assemblies, see Illustrated Parts List.



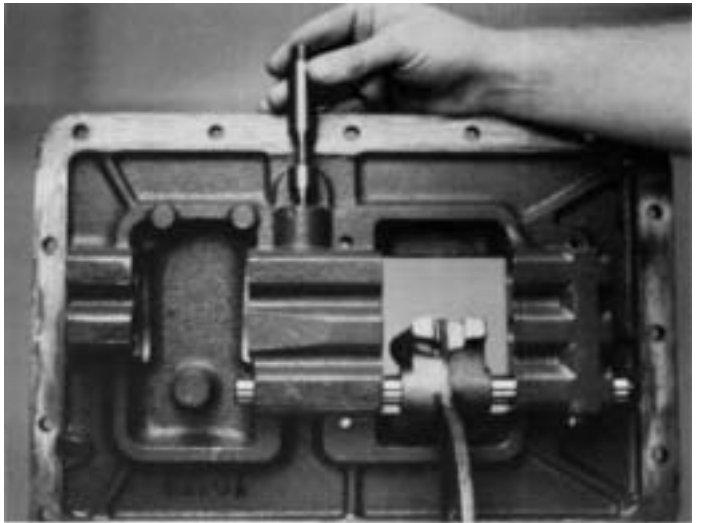
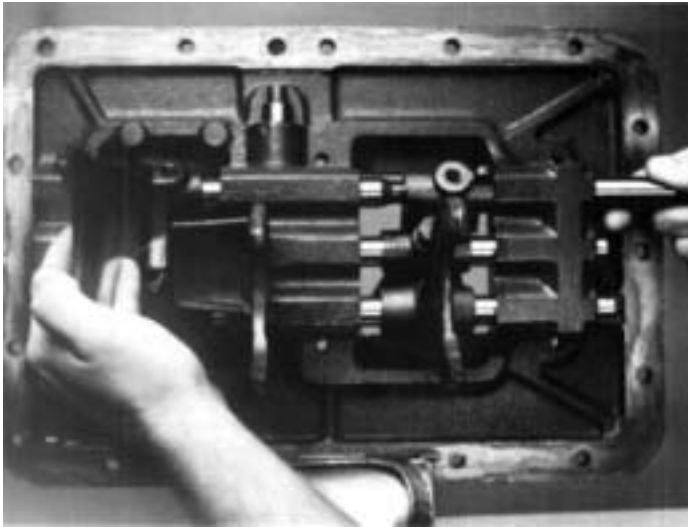
2. Tilt the assembly and remove the three sets of tension springs and balls from bores in top of housing.

# DISASSEMBLY AND REASSEMBLY SHIFTING CONTROLS



3. Mount the assembly in a vise with plunger-side up and secure on housing flange. (The front of housing will be to the left.) For models so equipped, cut lockwire and turn out the retaining capscrews to remove oil trough from housing.  
**NOTE:** Starting with the upper shift bar, move all bars to the right and out bore of rear boss. Cut lockwire and remove lockscrews from each bar just prior to their removal from housing.

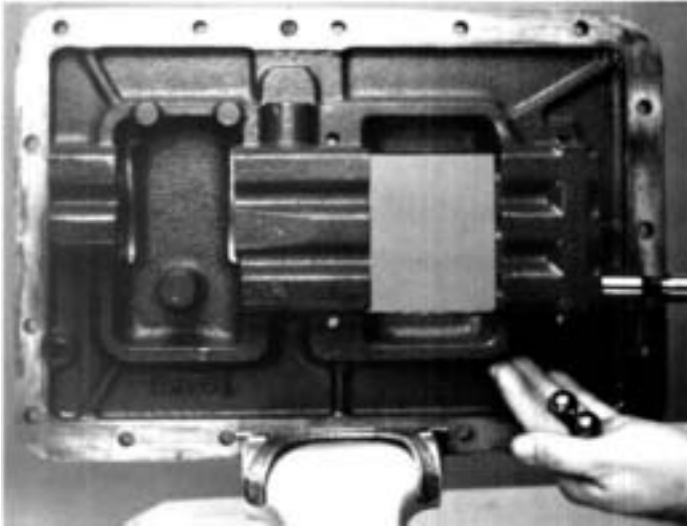
5. Move the 1st-2nd speed shift bar to the rear of housing, removing the yoke and block from bar. As the neutral notch in bar clears the rear boss, remove the small interlock pin from bore at notch.



4. Move the 3rd-4th speed shift bar to the rear of housing, removing the yoke and block from bar.

6. Remove the actuating plunger from bore at top of center boss.

# DISASSEMBLY AND REASSEMBLY SHIFTING CONTROLS



7. Move the short LO-Reverse speed shift bar to the rear of housing, removing the yoke from bar. As the shift bar is removed from housing, two  $\frac{3}{16}$ " interlock balls will drop from bottom bore of rear boss.



8. If necessary, remove the plug, spring and reverse-stop plunger from bore in LO-Reverse speed shift yoke.

## B. Reassembly of Shift Bar Housing Assembly

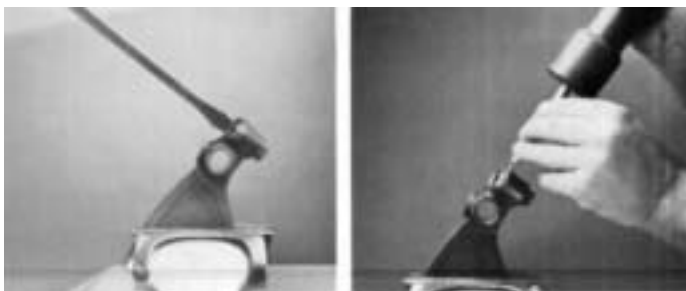


1. If previously removed, install the reverse-stop plunger in LO-Reverse shift yoke, making sure plunger is fully seated in bore at yoke slot.



2. Install the spring in bore of yoke and onto shank of plunger.

# DISASSEMBLY AND REASSEMBLY SHIFTING CONTROLS

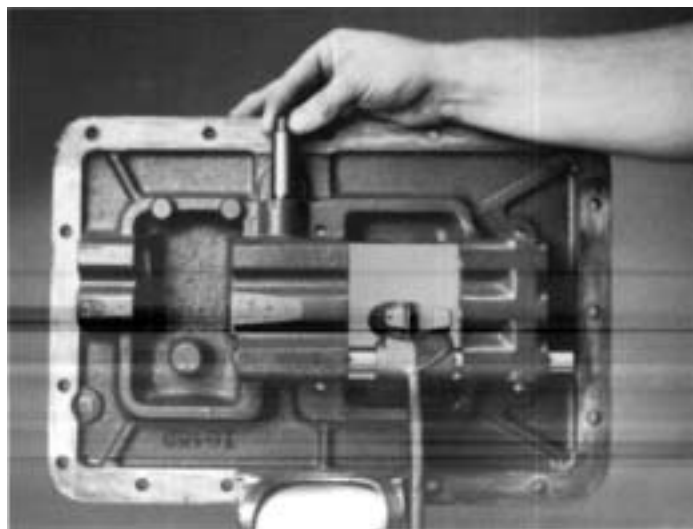


3. Install the plug and tighten to compress spring (left). Back the plug out 1-1 1/2 turns and stake plug through the small hole in yoke (right).

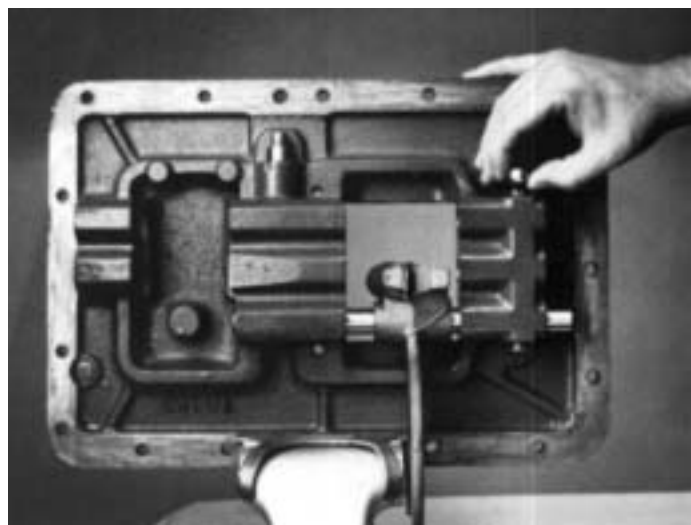


4. With the shift bar housing secured in vise as during disassembly, hold notched-end of short LO-Reverse speed shift bar and install in lower bore of housing bosses, positioning the yoke on bar between the bosses. Install the yoke lock-screw, tighten and wire securely.

**NOTE:** Start with the lower shift bore of rear boss and move to the left (front of housing). Keep bars in the neutral position during installation. DO NOT EXCEED the recommended torque ratings for yoke lock screws as over-tightening may distort shift bars.

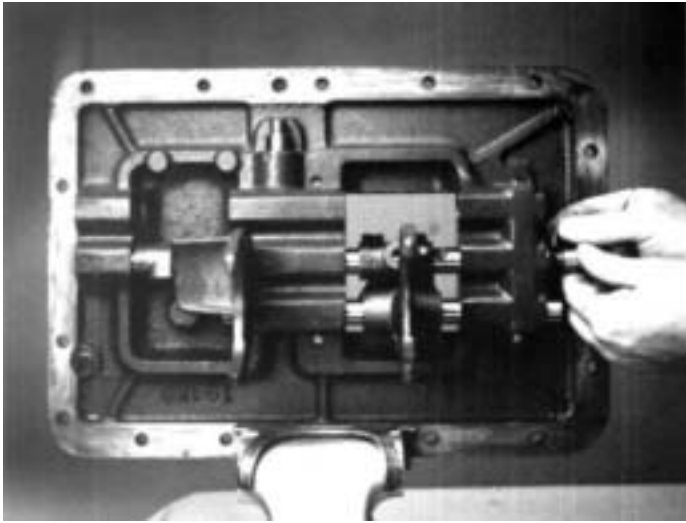


5. Holding shank of plunger, install the actuating plunger in bore at top of center boss.



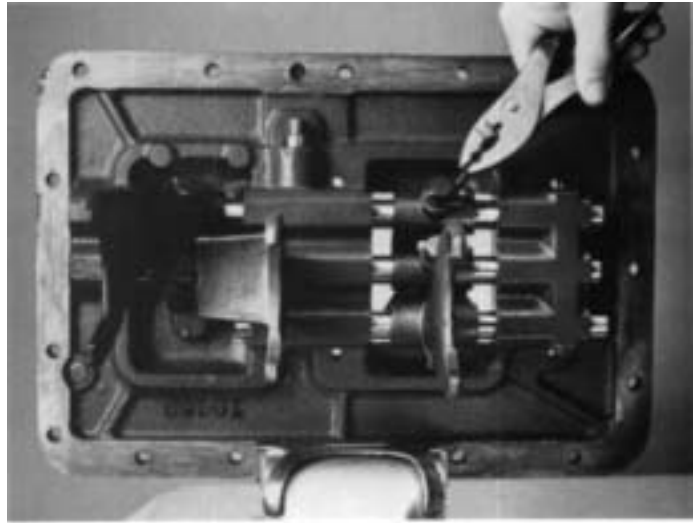
6. Install one 3/4" interlock ball in bore at top of rear boss. This ball rides between LO-Reverse and 1st-2nd speed shift bars.

# DISASSEMBLY AND REASSEMBLY SHIFTING CONTROLS

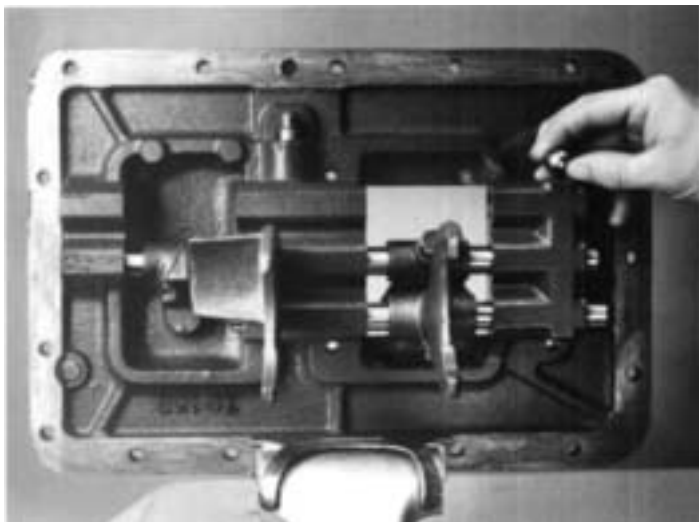


7. Holding notched-end of bar, install the 1st-2nd speed shift bar in middle bore of housing boss, positioning the shift block on bar between the center and rear bosses; and the yoke on bar between the front and center bosses, long hub to the front of housing. Just prior to inserting notched-end of bar in rear boss, install the small interlock pin VERTICALLY in bore at neutral notch. Install the block and yoke lock screws, tighten and wire securely.

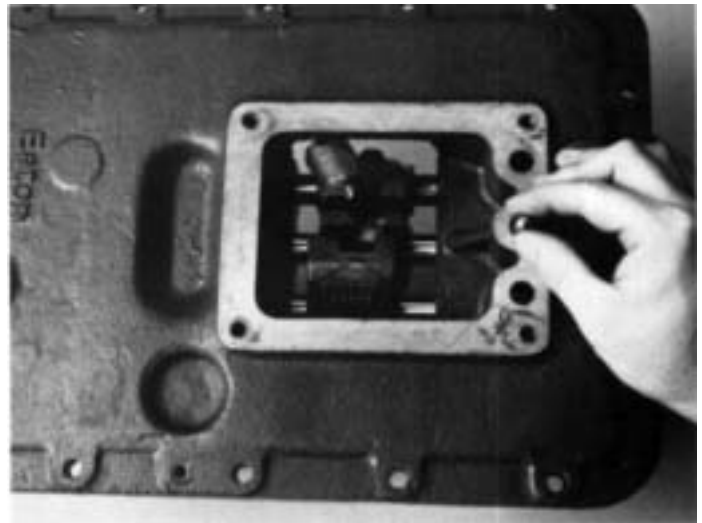
**NOTE:** It is necessary that interlock pin remain in a vertical position during reassembly as rotation of the bar will cause pin to jam in tension spring bores.



9. Holding notched-end of bar, install the 3rd-4th speed shift bar in upper bore of housing boss, positioning the shift block on bar between the center and rear bosses; and the yoke on bar between the front and center bosses, long hub to the rear of housing. Install the block and yoke lock screws, tighten and wire securely.
10. For models so equipped, install the oil trough on housing. Tighten capscrews and wire securely.



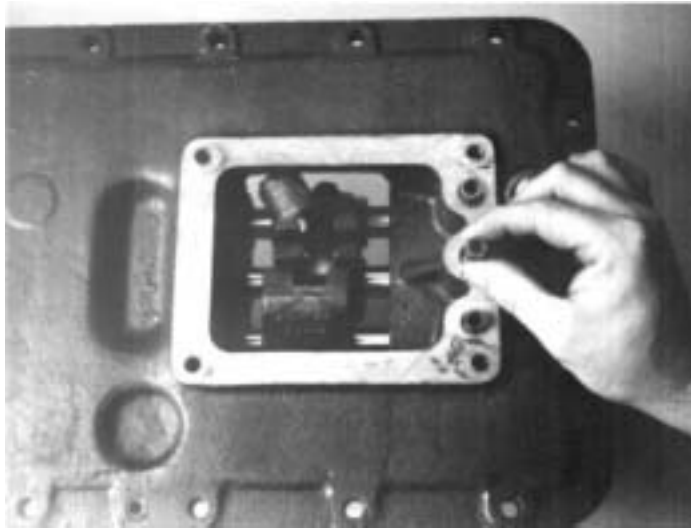
8. Install the other 3/4" interlock ball in bore at top of rear boss. This ball rides between the 1st-2nd and 3rd-4th speed shift bars,



11. Remove the assembly from vise and install the three tension balls, one in each bore on top of housing.

# DISASSEMBLY AND REASSEMBLY SHIFTING CONTROLS

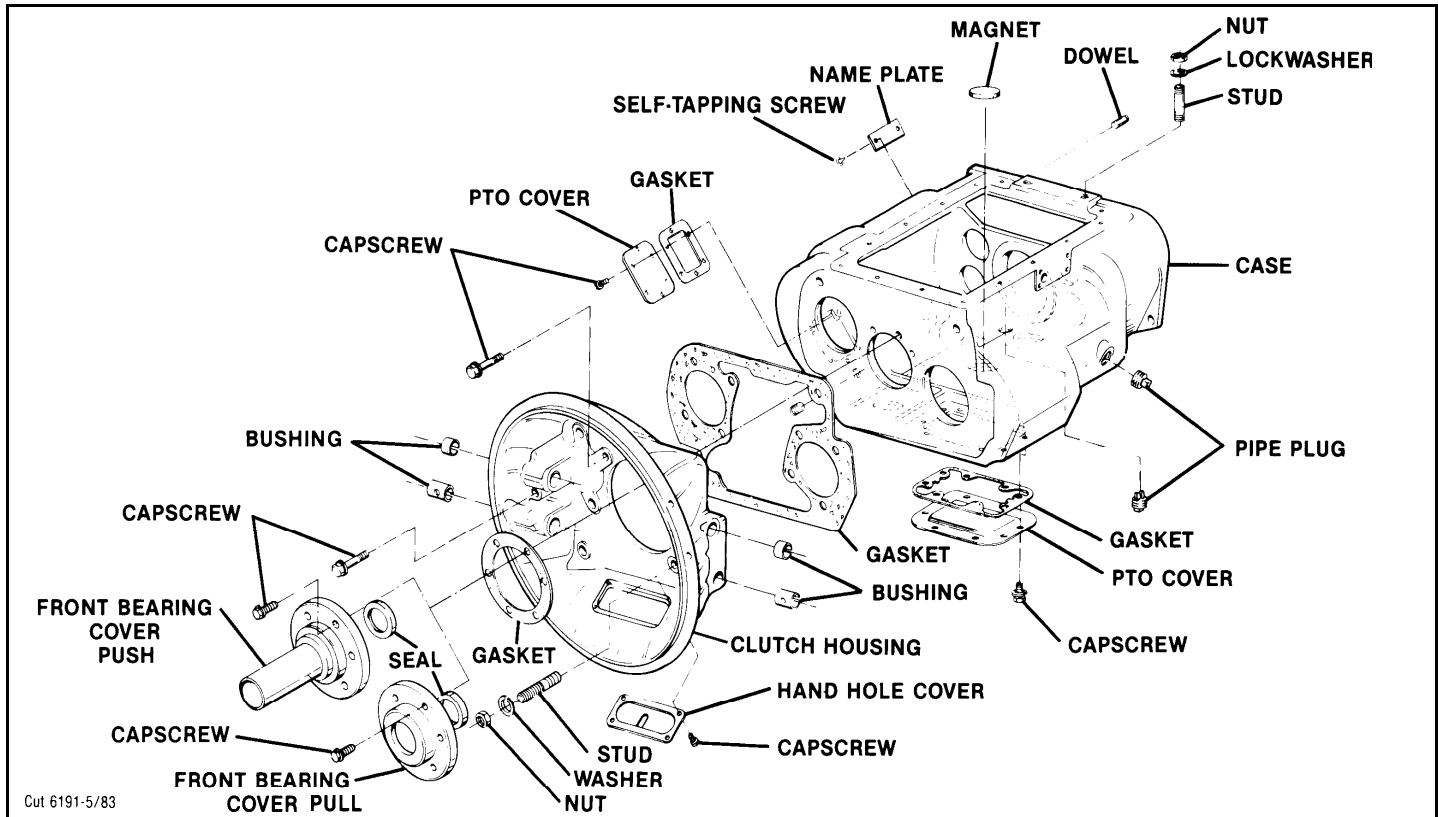
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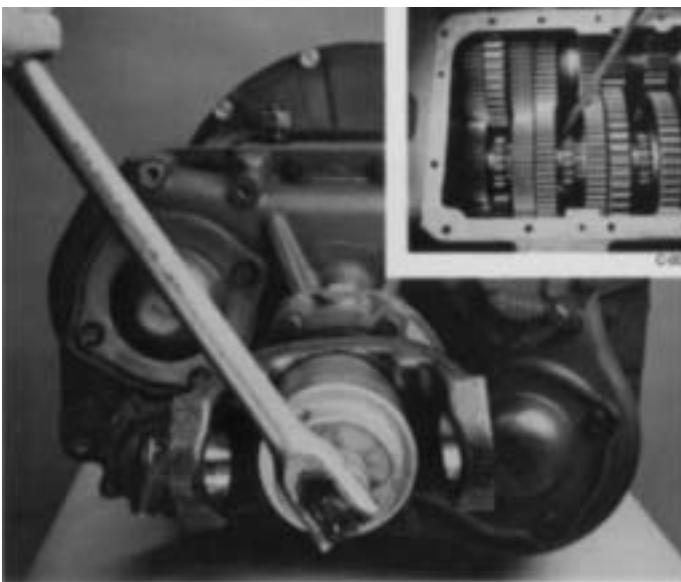
- 12.** Install the three tension springs, one over each ball in housing bores.

# REMOVAL - COMPANION FLANGE, AUXILIARY SECTION AND CLUTCH HOUSING

## COMPANION FLANGE, AUXILIARY SECTION AND CLUTCH HOUSING



### A. Removal of Universal Joint Companion Flange or Yoke



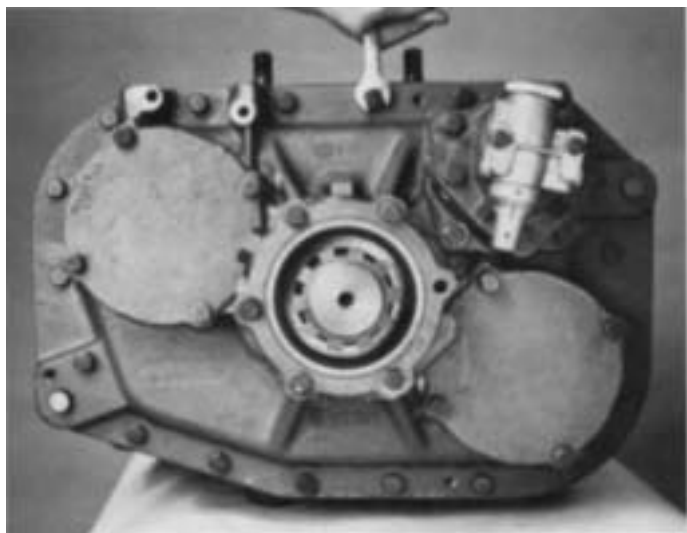
1. Lock the transmission by engaging two main-shaft gears with sliding clutches (inset). Use a large breaker bar to turn the nut from output shaft and remove washer if so equipped.



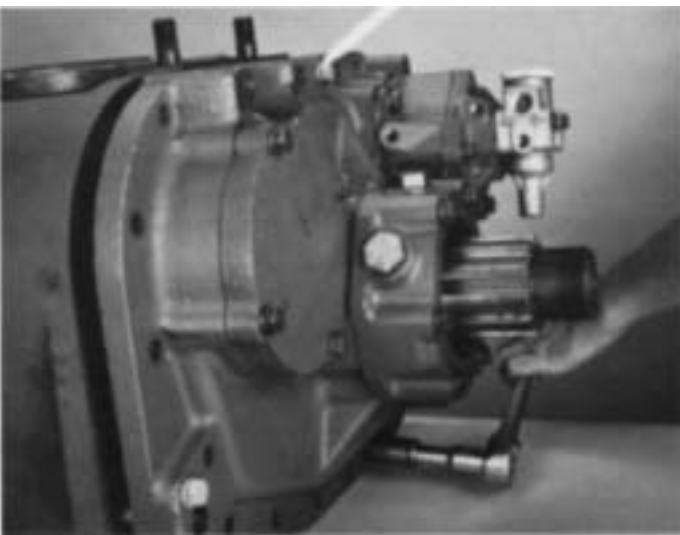
2. Pull the companion flange or yoke from splines of output shaft. Remove the speedometer drive gear or replacement spacer from hub of flange/yoke or from inside rear bearing cover remaining on output shaft (inset). For some models, it is necessary to remove the snap ring in groove of output shaft PRIOR to removal of the speedometer.

# REMOVAL - COMPANION FLANGE, AUXILIARY SECTION AND CLUTCH HOUSING

## B. Removal of Auxiliary Section



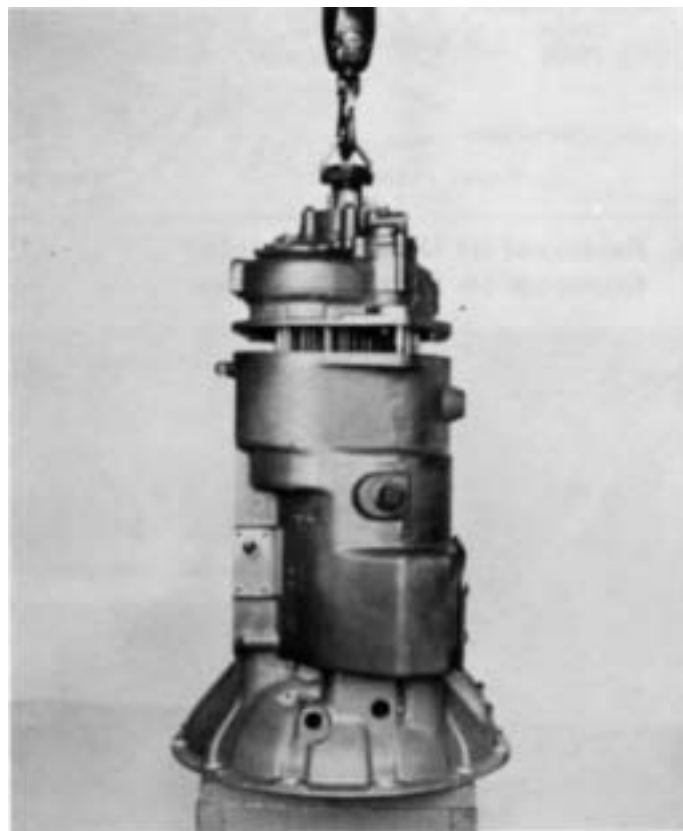
1. Turn out the retaining capscrews in auxiliary housing flange.



2. Insert three puller screws in the tapped holes of housing flange. Tighten evenly to move auxiliary section to the rear and just far enough from front section to break gasket seal.



3. Remove puller screws and attach a chain hoist to auxiliary section. Move the assembly to the rear until free of front section and remove gasket.

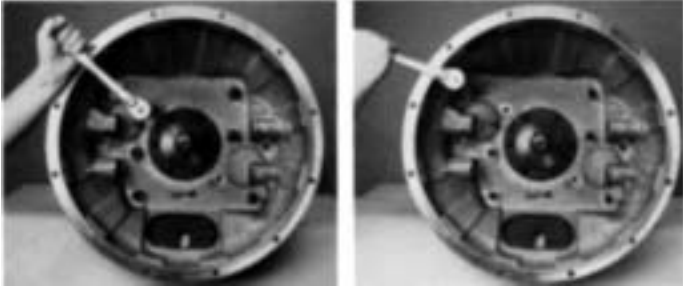


4. The auxiliary section can also be removed with transmission set in the vertical position. Block under the clutch housing to prevent damage to the input shaft, remove the retaining capscrews in housing flange and lift the assembly from front section. Remove gasket.

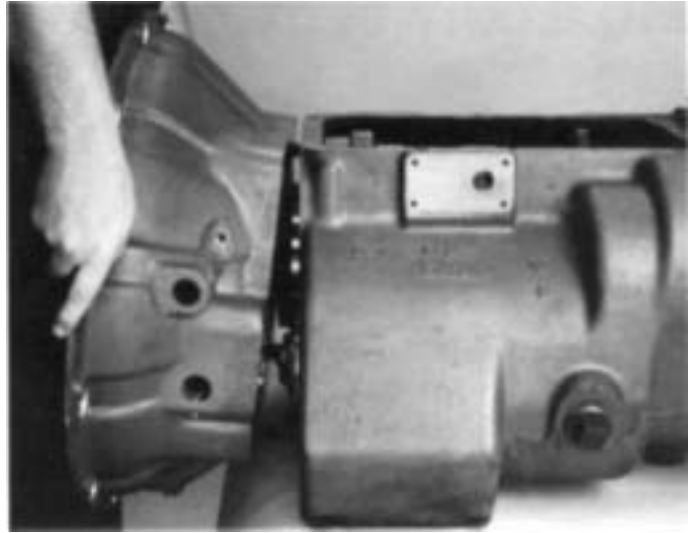
# REMOVAL - COMPANION FLANGE, AUXILIARY SECTION AND CLUTCH HOUSING

## C. Removal of Clutch Housing

1. For models so equipped, remove the clutch release mechanism and/or clutch brake assembly. See OPTIONS.



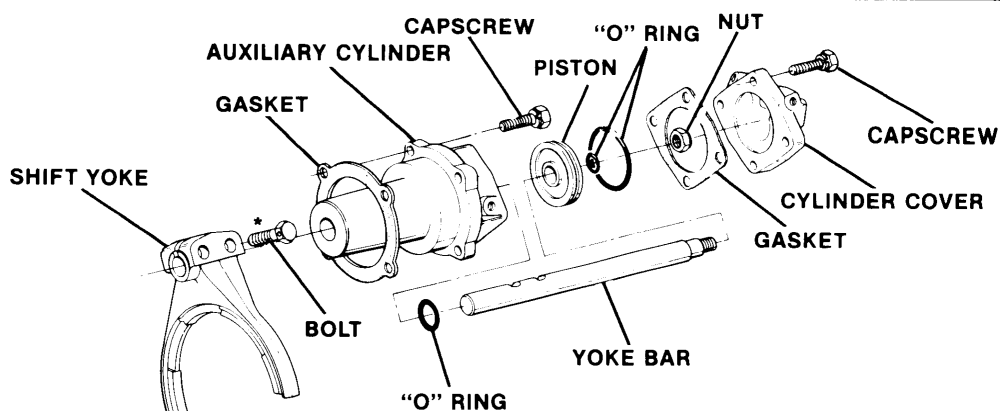
2. Turn out the four capscrews and remove the six nuts and lockwashers from studs securing the clutch housing to transmission case.



3. Jar clutch housing with a rubber mallet to break gasket seal and pull from transmission case. Remove gasket.

# DISASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)

## AUXILIARY SECTION (8-SPEED "LL" MODELS)



Cut 6426-10/80

**\*NOTE:** Use lockwire at these positions during reassembly.

### A. Removal and Disassembly of Range Cylinder Assembly



1. For ease of disassembly, mount the auxiliary section upright in a vise. Turn out the cap screws and remove the range cylinder cover and gasket.



2. Remove nut from end of yoke bar.



3. Cut lockwire and remove two yoke lockscrews.

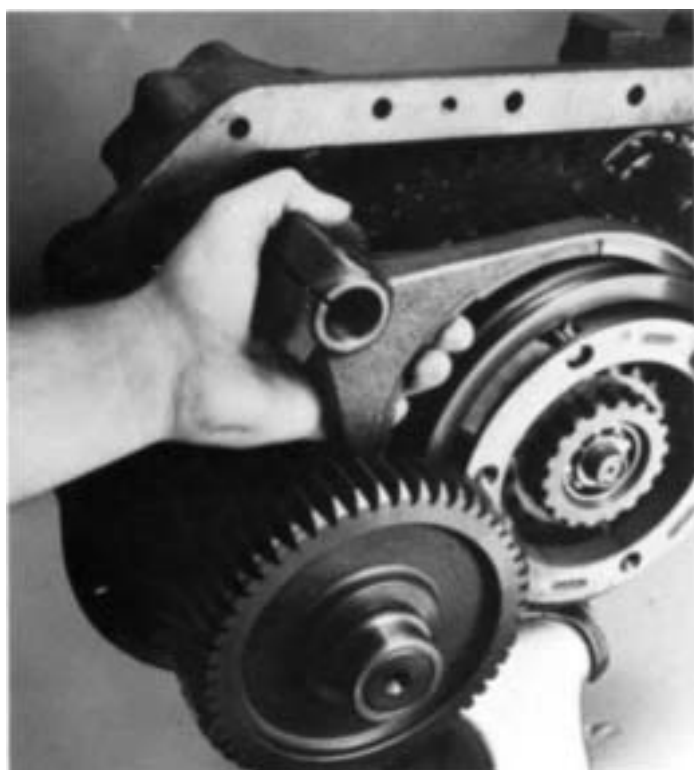
# DISASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)



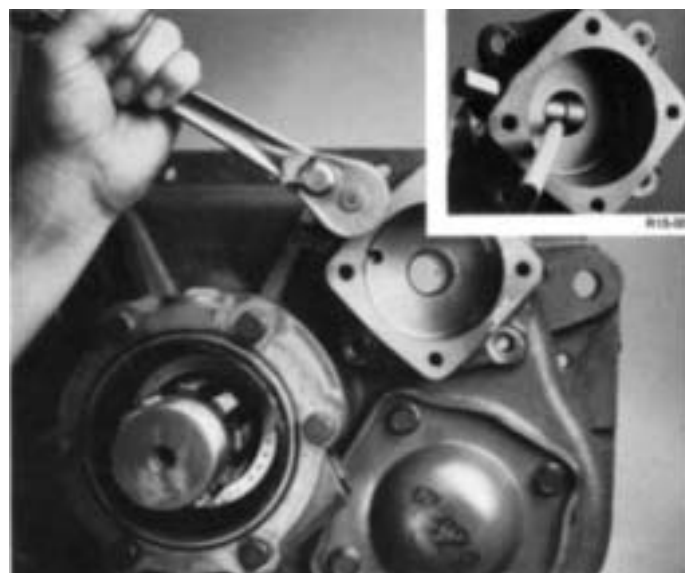
4. Pull yoke bar from bore of cylinder housing.



6. Remove the range piston from cylinder bore. If necessary, remove the O-rings from piston I.D. and O.D. (inset).

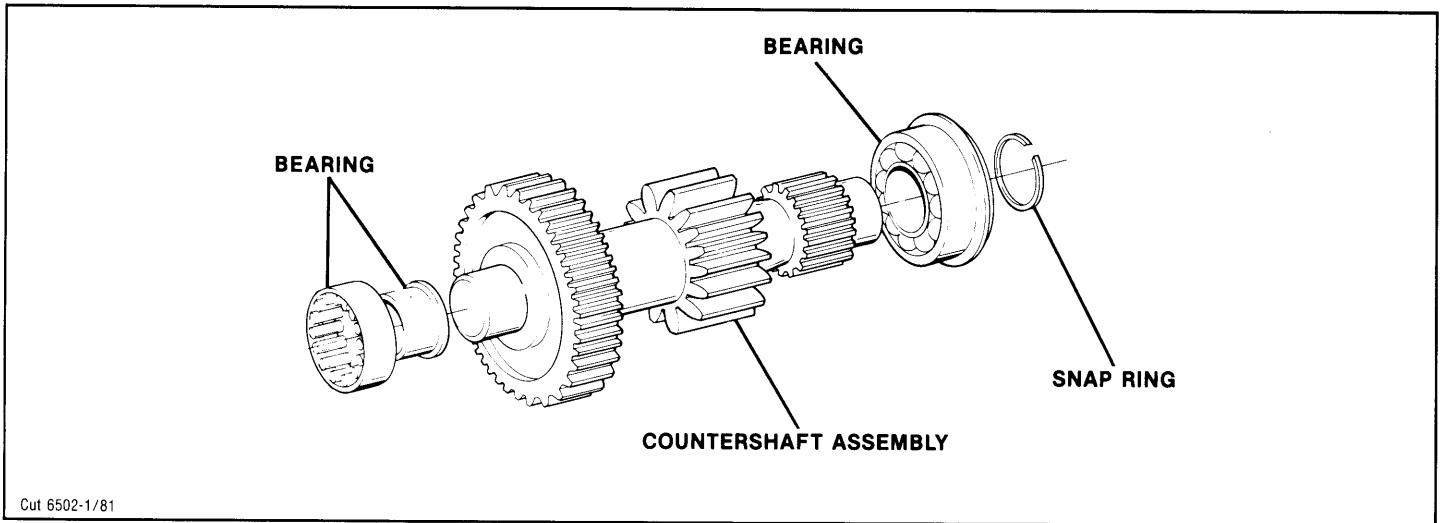


5. Remove range yoke from sliding clutch of synchronizer assembly.

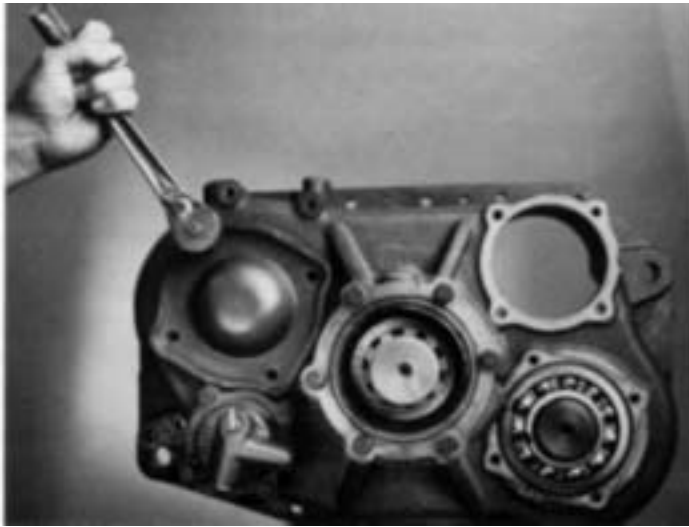


7. Turn out the capscrews and remove the range cylinder housing and gasket. If necessary, remove the small O-ring from groove in housing bore (inset).

# DISASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)



## B. Removal of Auxiliary Countershaft Assemblies



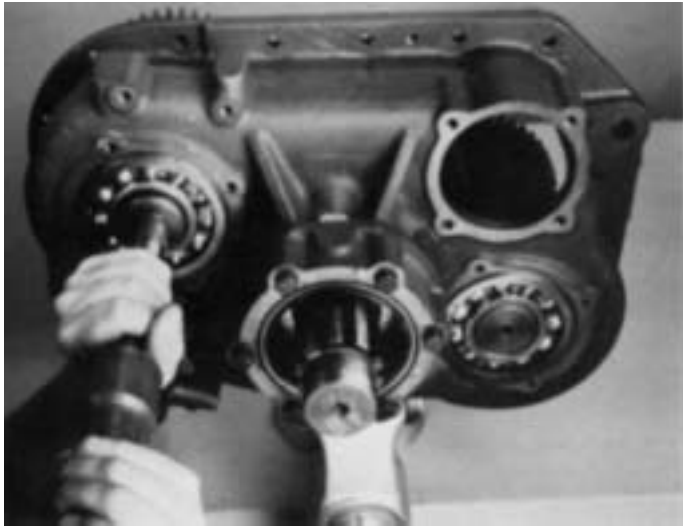
1. Turn out the capscrews and remove both countershaft rear bearing covers.  
**NOTE:** For removal and disassembly of models equipped with an Auxiliary Oil Pump Assembly on rear of countershaft, see OPTIONS.



2. Remove the snap ring from groove at rear of each countershaft.

# DISASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)

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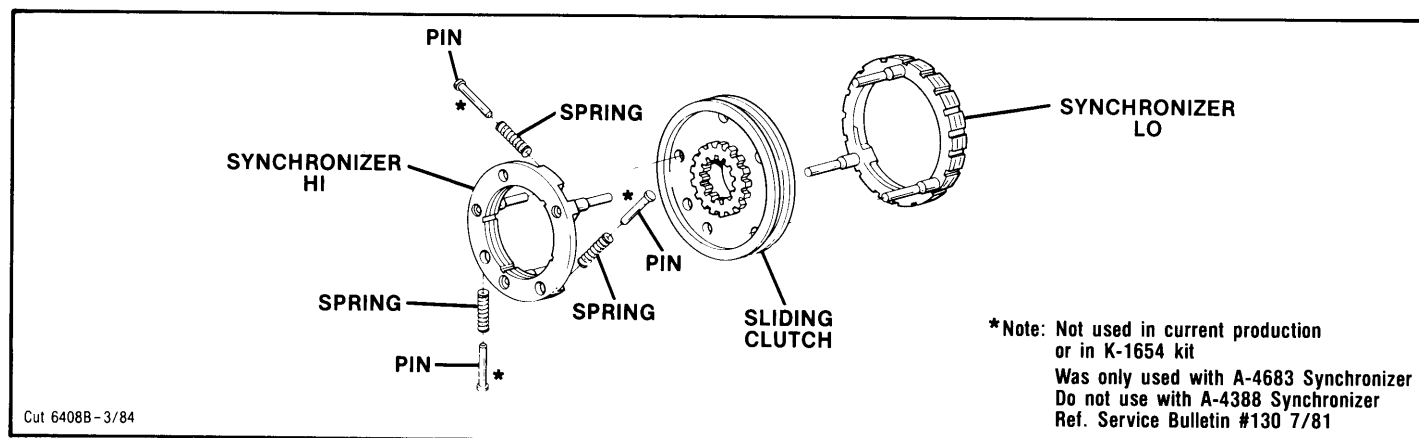
3. Use a soft bar and maul to drive the countershaft forward and from rear bearings.



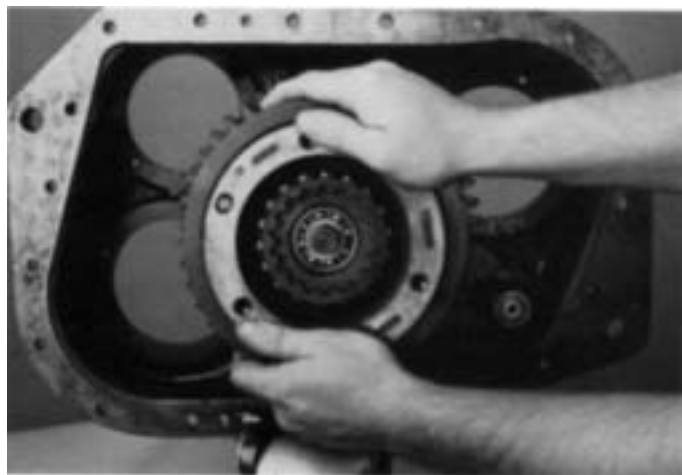
4. If necessary, secure the assembly in a vise and remove the bearing inner race from front of countershaft with jaw pullers.

**NOTE:** The vise used should be equipped with brass jaws or wood blocks to prevent damage to the countershaft.

# DISASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)



## C. Removal and Disassembly of Synchronizer Assembly



1. Pull the synchronizer assembly from the splines of range mainshaft.

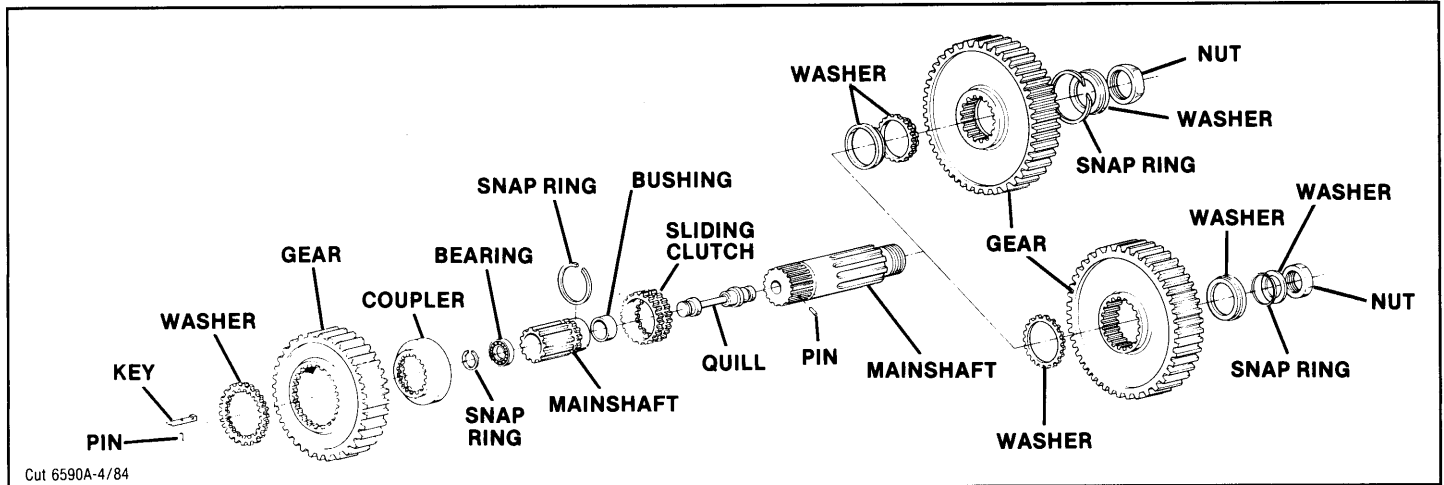


3. Remove the sliding clutch from pins of low range synchronizer ring.



2. Place the larger low range synchronizer ring on bench and pull the high range synchronizer from blocker pins. However, before doing so, cover the assembly with a shop rag to prevent losing the three springs released from high range synchronizer at pin locations.

# DISASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)



## D. Removal of Low Range Gear



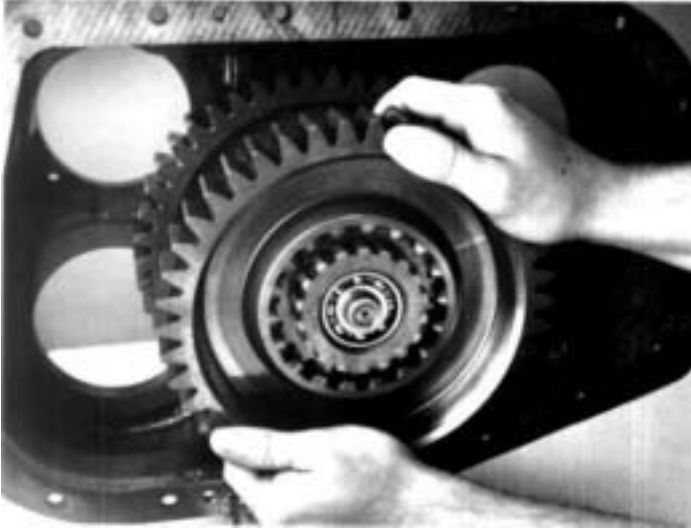
1. Remove the key from keyway of range mainshaft.



2. Turn the washer located in the hub at low range gear so that the splines of washer align with the splines of mainshaft.

# DISASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)

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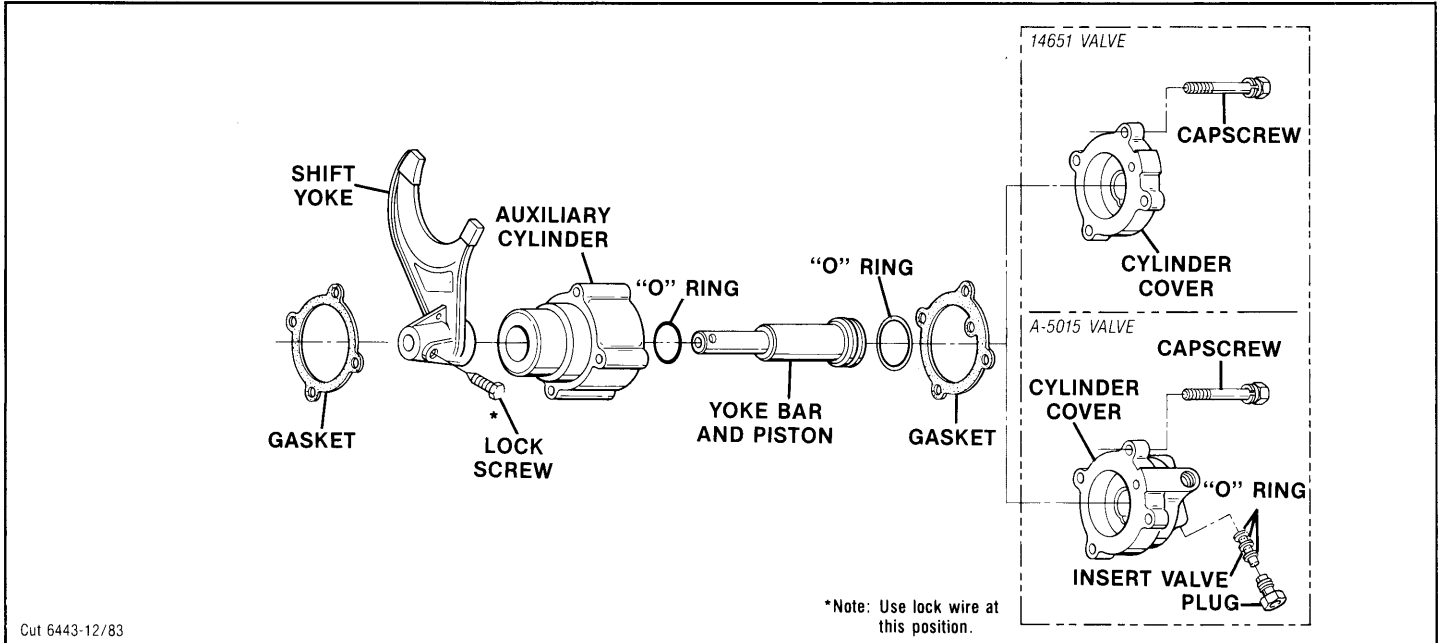
3. Pull the low range gear and washer from splines of range mainshaft.



4. Remove the coupler from splines of range mainshaft.

**NOTE:** If desired, Removal and Disassembly of Range Mainshaft Assembly may be performed prior to Removal and Disassembly of Deep Reduction Cylinder Assembly.

# DISASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)



## E. Removal and Disassembly of Deep Reduction Cylinder Assembly



1. Turn out the capscrews and remove the deep reduction cylinder cover and gasket.



2. If necessary, turn out the insert valve retaining nut of covers so equipped and remove insert valve from bore.

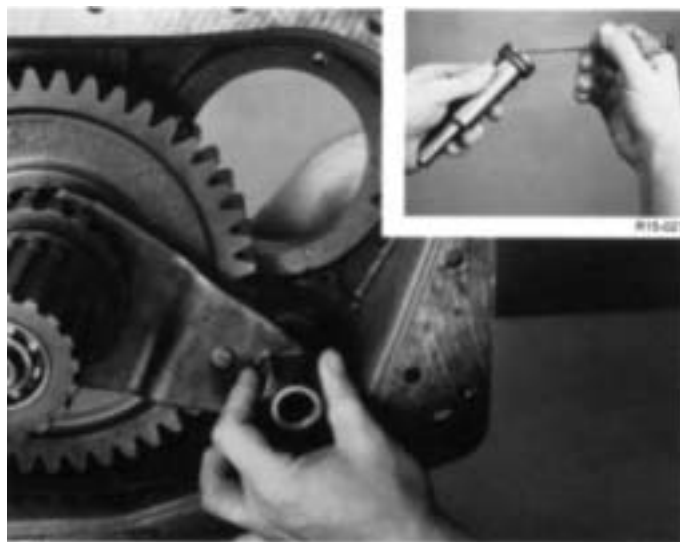
# DISASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)

## F. Removal and Disassembly of Range Mainshaft Assembly

NOTE: Refer to the illustration provided at Part D of this section.



3. Cut lockwire and remove the lock screw from shift yoke.



4. Pull the yoke bar from cylinder housing and remove shift yoke. If necessary, remove the O-ring from piston O.D. (inset).



5. Remove the deep reduction cylinder housing and gasket from auxiliary housing. If necessary, remove the small O-ring from bore in cylinder housing.



1. Remove snap ring from range mainshaft.



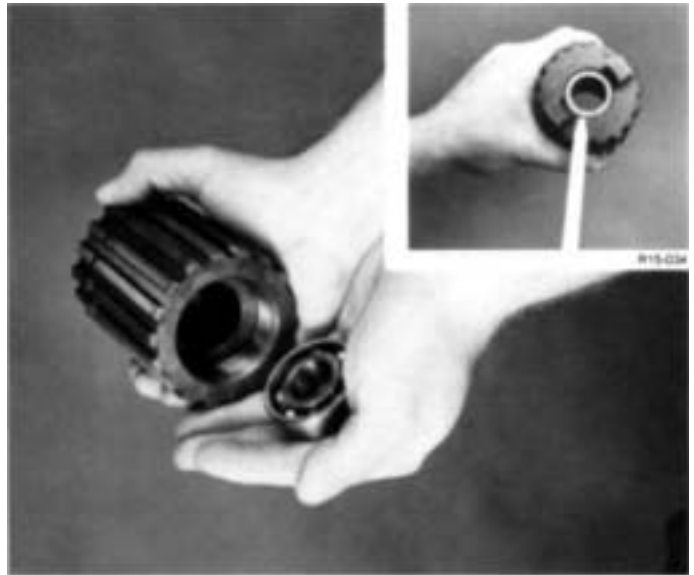
2. Remove deep reduction sliding clutch.

# DISASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS]

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3. Remove the "C" ring from groove at front of mainshaft quill.



5. Remove the front bearing from bore in range mainshaft. If necessary, press the bushing from mainshaft bore (inset).

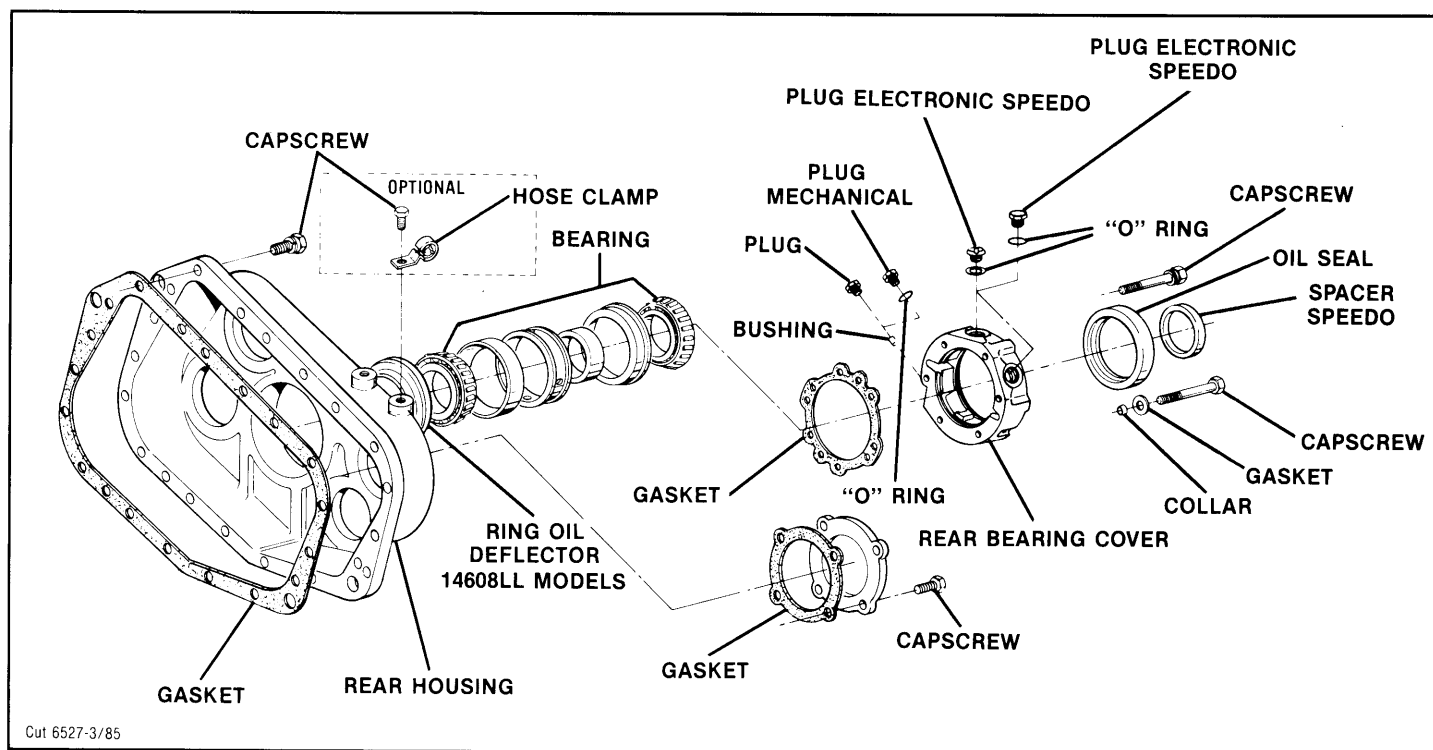


4. Insert jaws of puller behind range mainshaft and pull from quill.

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# DISASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)



## G. Removal and Disassembly of Output Shaft and Rear Bearing Assemblies

**NOTE:** In addition to the above, refer to the illustration provided at Part D of this section.

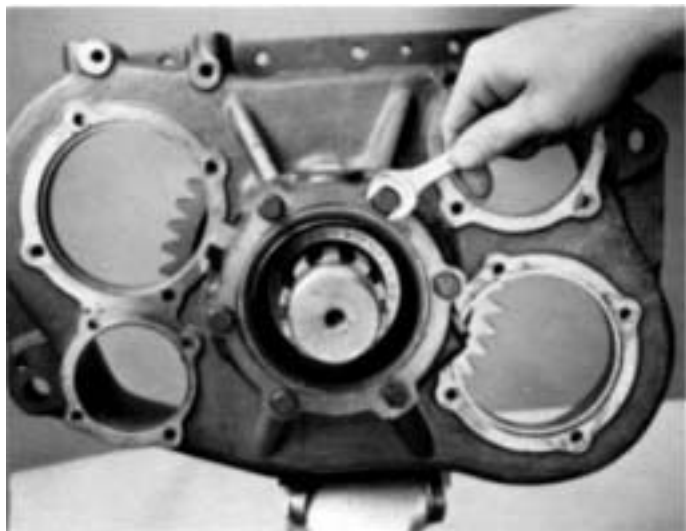


1. Turn out the cap screws and remove the rear bearing cover and gasket. If necessary, remove the oil seal from cover (inset).



2. If not previously done so, remove the snap ring and speedometer drive gear or replacement spacer from output shaft of models so equipped.

# DISASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)



3. Temporarily reinstall rear bearing cover in position on housing ONLY to catch rear bearing cone released from bore in the following procedure.



5. Remove rear bearing cover and bearing cone.



4. Use a soft bar and maul to drive the output shaft forward and through rear bearing assembly. This will cause the rear bearing cone to be released from bore in auxiliary housing.

**NOTE:** When applying force to rear of output shaft, DO NOT DAMAGE THREADS. Support front of shaft to avoid damaging the mainshaft quill once output shaft is free of bearing.

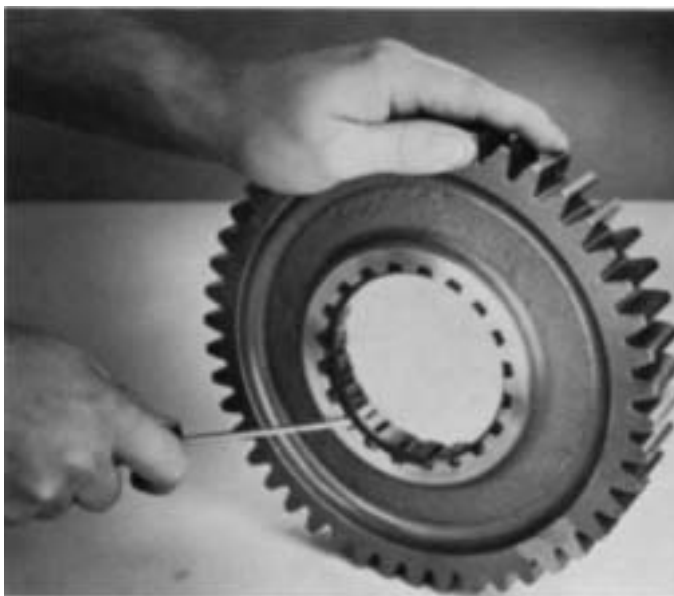


6. Remove the two bearing cups and outer spacer from bore in auxiliary housing.

# DISASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)



7. Remove the bearing inner spacer from output shaft.



9. If necessary, remove the snap ring from I.D. of deep reduction gear of models so equipped.

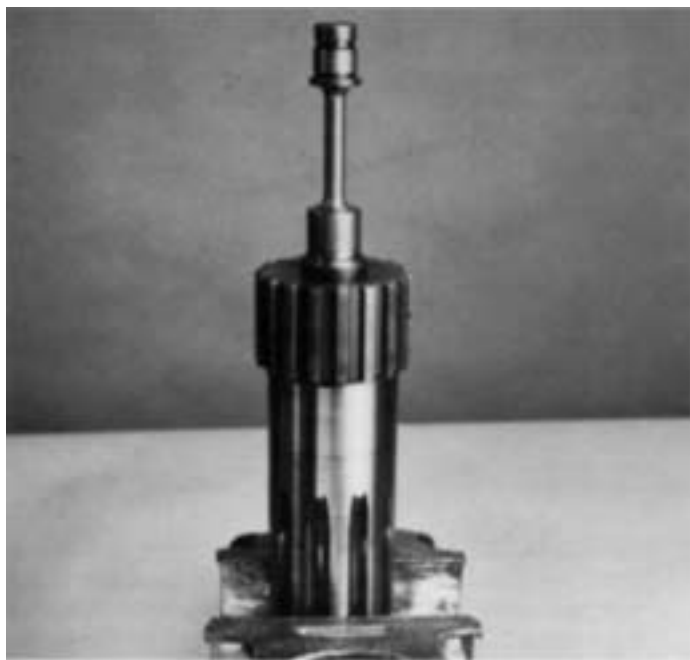


8. Using the front face of deep reduction gear as a base, press the output shaft through the bearing and gear. This will free the bearing, gear, washer, and, for models so equipped, the spacer or oil retention ring. DO NOT DAMAGE MAINSHAFT QUILL.

# REASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)

## AUXILIARY SECTION (8-SPEED "LL" MODELS)

### A. Reassembly and Installation of Range Mainshaft Assembly



1. Secure the output shaft in a vise with mainshaft quill up.



3. Install the bearings in front bore of range mainshaft. Use a small flanged-end driver to properly seat bearing in bore on mainshaft quill.



2. If necessary, press the bushing in rear bore of range mainshaft (inset) and install the mainshaft in position.



4. Install the "C" ring in groove of mainshaft quill to retain bearing.

# REASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)

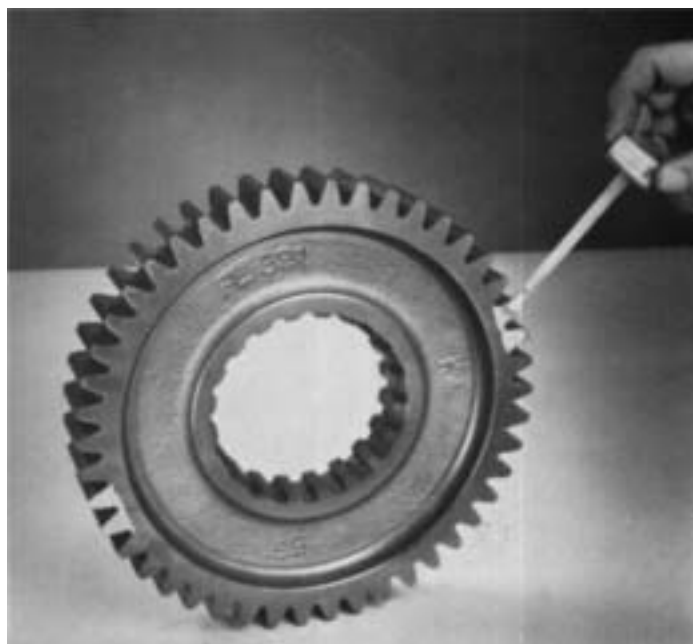
## B. Reassembly and Installation of Output Shaft and Rear Bearing Assemblies



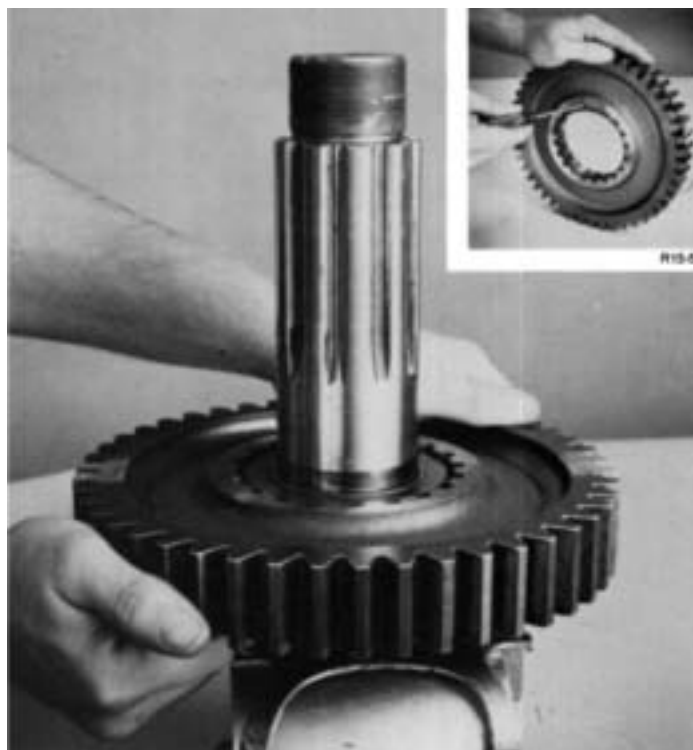
1. Remount the output shaft in vise with threaded-end up and secure on range mainshaft. For models so equipped, install the stepped washer on shaft, large diameter step down.



2. Install the splined spacer on output shaft. For models equipped with stepped washer on shaft, install the spacer with large diameter splines down (right).



3. **IMPORTANT:** Mark any two adjacent teeth on deep reduction gear and repeat the procedure for the two adjacent teeth directly opposite the first set marked. A highly visible color of toolmakers' dye is recommended for making timing marks.



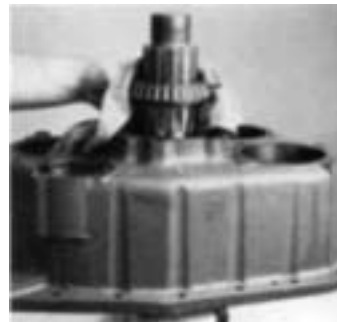
4. If previously removed, install the snap ring in deep reduction gear of models so equipped (inset). Install the gear on output shaft, clutching teeth down and engaged with splines of spacer.

# REASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)



5. Install the washer on shaft against deep reduction gear, small diameter step down (Left: 11608LL Models); or side with large groove up (Right: 14608LL Models).

**NOTE:** For models not equipped with the oil retention ring in auxiliary housing, proceed to No. 8.



8. Heat the front bearing cone and install on output shaft against oil retention ring, bearing taper up (left). For models not equipped with the oil retention ring in auxiliary housing, install the heated bearing cone on shaft against washer, taper up (right).

**NOTE:** DO NOT HEAT BEARING ABOVE 275° (136°C). If possible, use heat lamps as source.



6. **14608LL Models only** - Place the oil retention ring in housing bore, cupped side up (left). Use a soft bar and two rear bearing outer spacers stacked on top of each other to move the oil retention ring 2" deep into bore. The ring will be at the proper depth when top of second spacer is flush with housing bore. Remove the spacers when installation is completed.



9. Install the bearing inner spacer on output shaft against front bearing cone.



10. Place the front bearing cup in housing bore, taper to the inside, and use a soft bar to start cup into bore.

7. Place two mainshaft spacers or flat steel stock of equivalent thickness (.190") on rear face of deep reduction gear, 180° from each other (left). Install the auxiliary housing over end of output shaft assembly, allowing the housing to rest on blocking (right).

# REASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)



11. Stack the bearing outer spacer and rear bearing cup on top of the front bearing cup in proper sequence. Use a soft bar or a flanged driver to move all three parts evenly into housing bore until lip of rear bearing cup seats on housing.



12. If not previously done so, install the auxiliary housing over end of output shaft assembly. Heat the rear bearing cone and install on shaft, taper down and inside bearing cup.  
NOTE: DO NOT HEAT BEARING ABOVE 275° (136°C).



13. For 14608-LL Model, install the speedometer drive gear or replacement spacer on output shaft and retain with snap ring installed in groove of shaft (left). Remove the blocking (two mainshaft spacers or flat steel stock) from between the deep reduction gear and auxiliary housing (right).



14. Remount assembly upright in vise and secure. install the deep reduction-sliding clutch on output shaft, internal splines toward gear and engaged with splines of shaft.

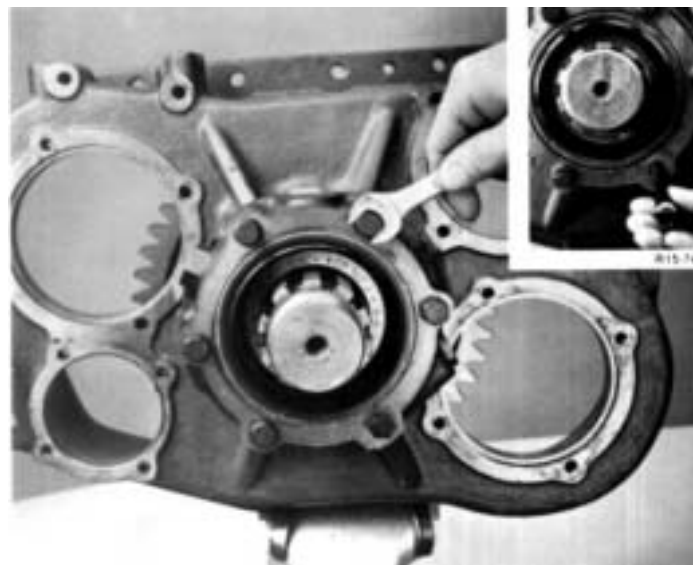


15. Install snap ring in groove of range mainshaft.

# REASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)



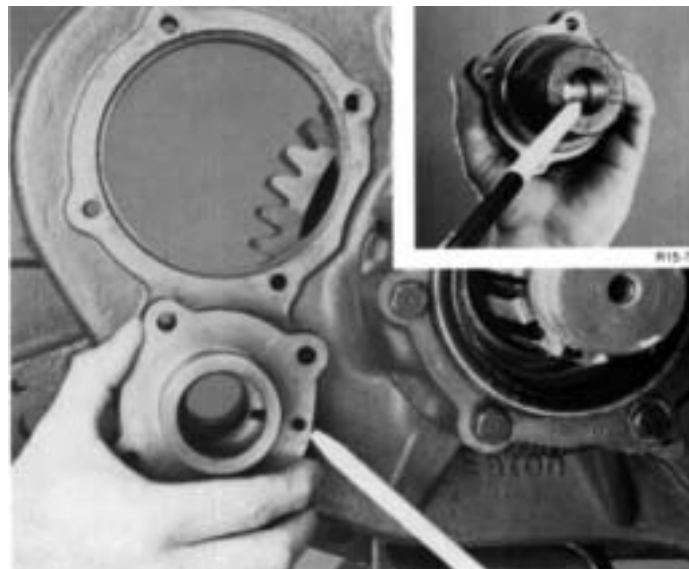
16. If previously removed, install the oil seal in rear bearing cover (inset). Seal should be installed so the spring is to the front of cover.



17. Position gasket on cover mounting surface and install the rear bearing cover on auxiliary housing. Use the nylon collar and brass washer with capscrew at the chamfered hole which intersects speedometer bore (inset). Tighten capscrews to secure cover to housing.

**NOTE:** Because the collar becomes distorted when compressed, DO NOT REUSE OLD NYLON COLLAR.

## C. Reassembly and Installation of Deep Reduction Cylinder Assembly



1. If previously removed, install the small O-ring in bore of cylinder housing (inset). Position the corresponding new gasket on housing mounting surface and install the deep reduction cylinder housing in rear bore of auxiliary housing, air channel to the right.



2. If previously removed, install the O-ring in groove of yoke bar piston.

# REASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)



3. Place the reduction yoke into position with sliding clutch, lock screw hole to the front. From rear of auxiliary housing, insert the yoke bar through cylinder bore and into yoke, aligning the notch in bar with yoke lock screw hole.



4. Install the yoke lock screw, tighten and wire securely.



5. For models so equipped, install the insert valve in bottom exhaust port of cylinder cover as shown (left). Install the valve retaining nut in exhaust port of cover and tighten to recommended torque ratings (right).

NOTE: Prior to installation of insert valve, apply a small amount of silicone lubricant to O-rings on O.D. of valve.



6. Position the corresponding new gasket on cover mounting surface and install the deep reduction cylinder cover, aligning the air channel with channel in cylinder housing. Tighten capscrews to secure cover to cylinder housing.

# REASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)

## D. Installation of Low Range Gear



1. Install the coupler on range mainshaft, clutching teeth to the rear.



3. Install the splined tolerance washer on mainshaft and in hub of low range gear. Rotate the washer in groove of mainshaft to engage external splines with clutching teeth of gear and align square internal spline with keyway of mainshaft.

**IMPORTANT:** This washer is available in varying thicknesses. Use the splined tolerance washer that provides a snug fit in gear hub.



2. Install the low range gear on mainshaft against coupler, clutching teeth to the front.



4. Install the key in keyway of range mainshaft, inserting the thick end of key in square internal spline of tolerance washer to lock low range gear on shaft.

# REASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)

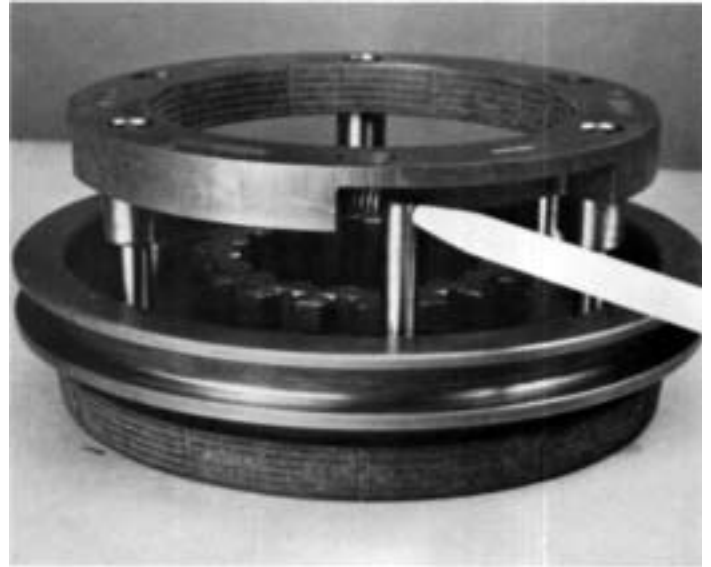
## E. Reassembly and Installation of Synchronizer Assembly



1. Place the larger low range synchronizer ring on bench and install the sliding clutch on blocker pins, recessed side up.



2. Install the three springs in bores of high range synchronizer ring.

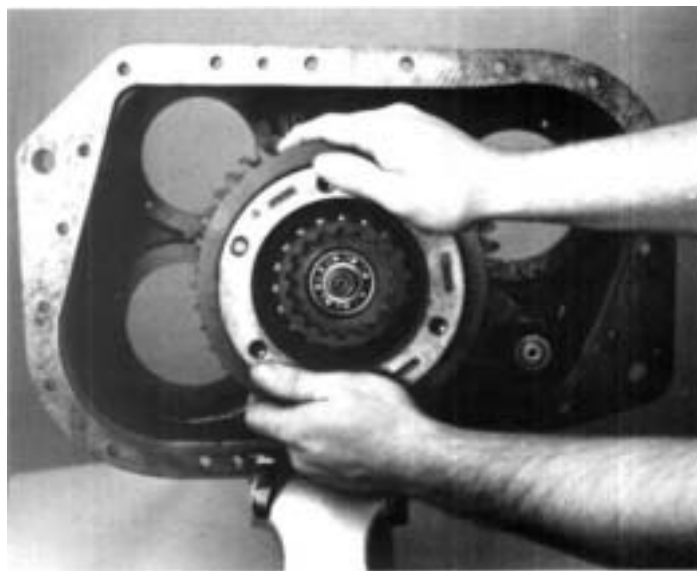


3. Place the high range synchronizer ring over blocker pins of low range synchronizer, seating the springs against pins.



4. Apply downward pressure to the high range synchronizer ring WHILE TWISTING COUNTER-CLOCKWISE to compress the springs and fully seat ring on blocker pins of low range synchronizer.

# REASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)

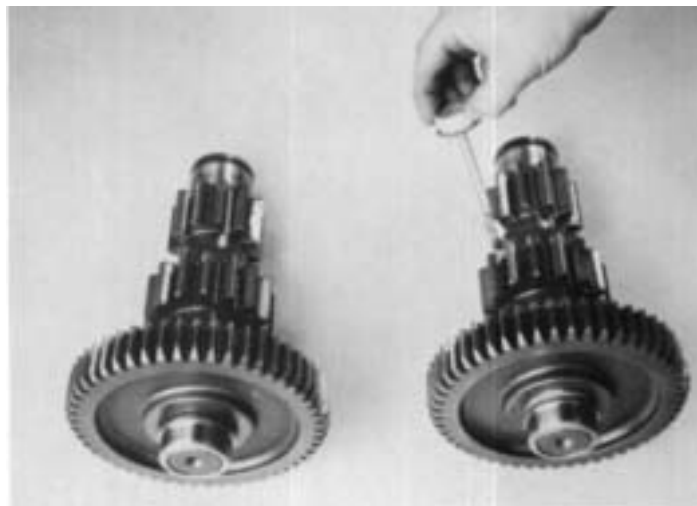


5. Install the synchronizer assembly on splines of range mainshaft, low range ring towards rear.

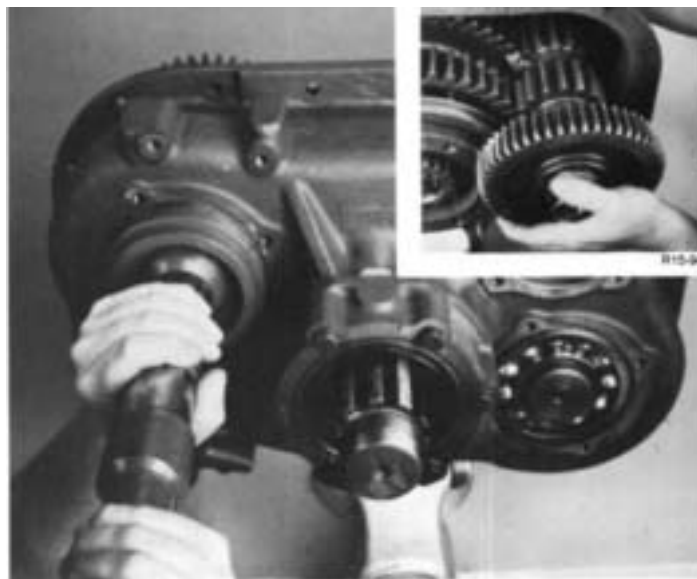
## F. Timing and Installation of Auxiliary Countershaft Assemblies



1. If previously removed, install the bearing inner race on front of each countershaft.



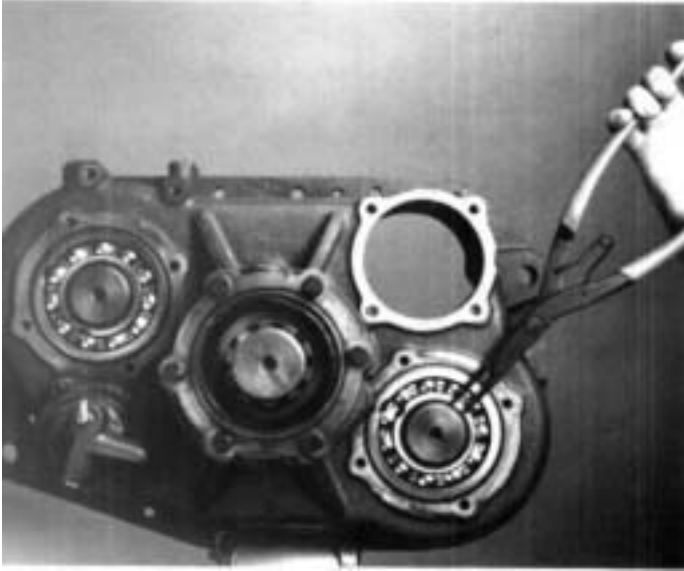
2. **IMPORTANT:** On the low range gear of each auxiliary countershaft assembly locate the "O" stamped on one tooth. Align tooth with "O", with smaller deep reduction gear tooth and mark with high visible color of toolmakers' dye.



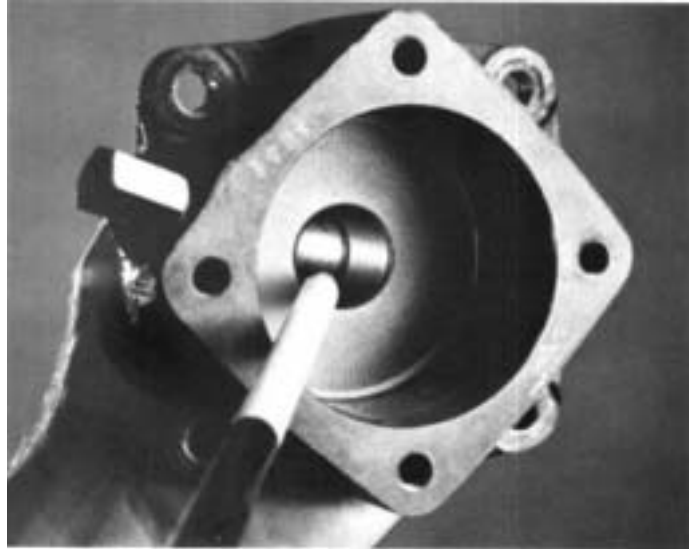
3. Place one countershaft into position in housing, meshing the marked tooth of countershaft gear with either set of two marked teeth of mainshaft deep reduction gear (inset). Center rear of countershaft in bearing bore, start rear bearing in bore and complete installation with a flanged-end driver and maul. Repeat the procedure with other auxiliary countershaft assembly, making sure the deep reduction gear set remains in time during bearing installation.

**NOTE:** Check synchronizer assembly for springs that may be released during bearing installation.

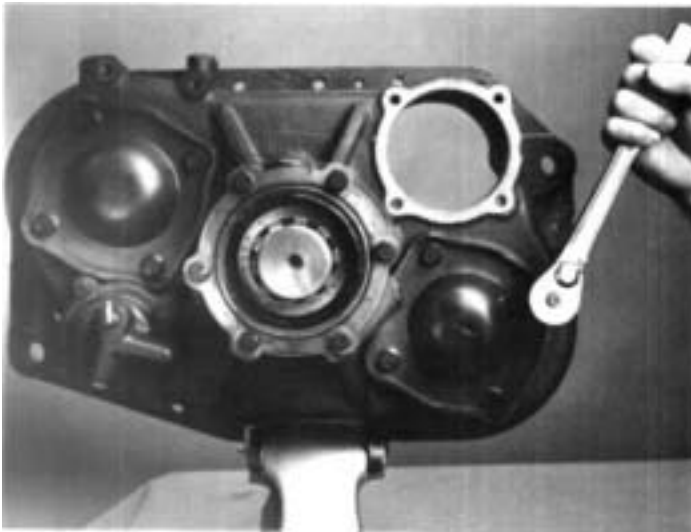
# REASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS),



4. Install the snap ring in groove at rear of each countershaft .

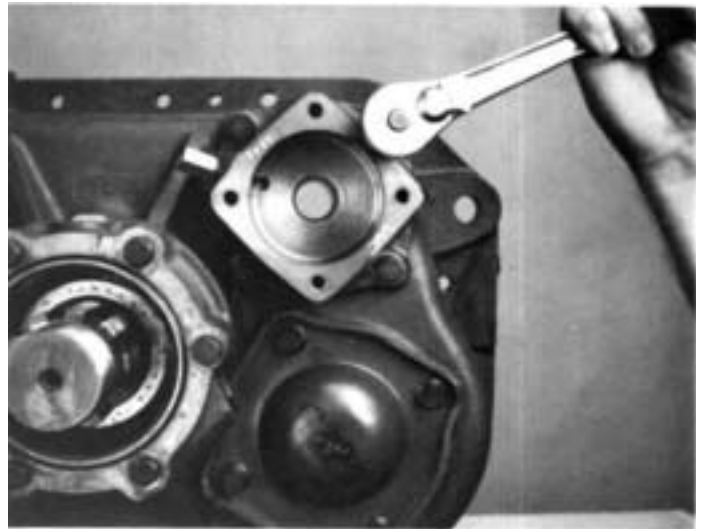


1. If previously removed, install the O-ring in bore of range cylinder housing.



5. Position the corresponding new gasket on cover mounting surface and install both rear bearing covers. Tighten capscrews to secure covers to auxiliary housing.

**NOTE:** For reassembly and installation of models equipped with an Auxiliary Oil Pump Assembly on rear of countershaft, see OPTIONS.



2. Position the corresponding new gasket on housing mounting surface and install the cylinder housing in rear bore of auxiliary housing, air fitting to the upper left. Tighten capscrews to secure cylinder housing to auxiliary housing.

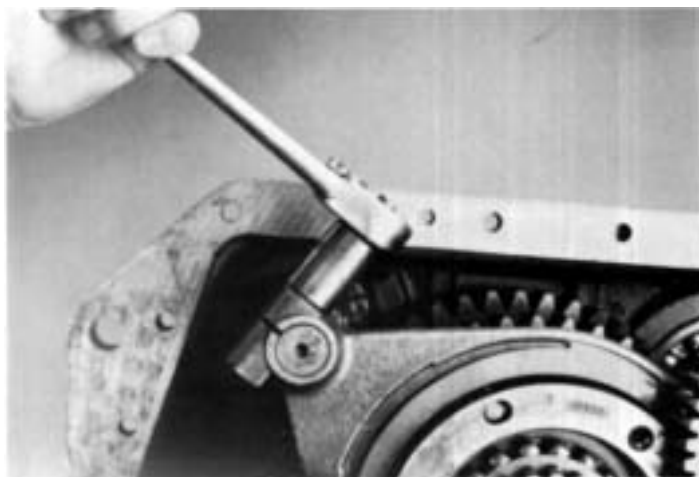
# REASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)



3. Place the range yoke into position with sliding clutch of synchronizer assembly, long hub of yoke to the rear. Insert threaded-end of yoke bar through yoke and into bore of range cylinder housing, aligning the notches in bar with yoke lock screw holes.



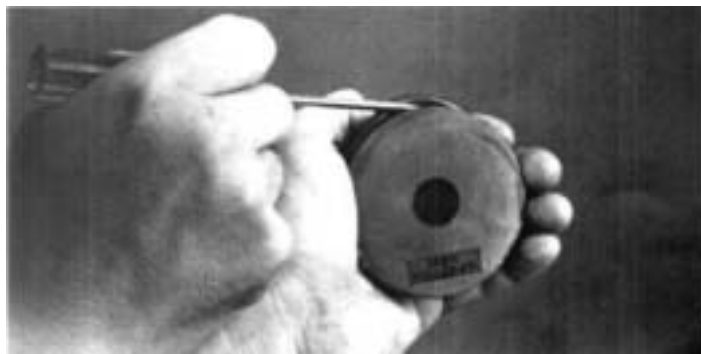
6. In cylinder housing bore, install the range piston on yoke bar, flat side to the rear. Secure with nut tightened to recommended torque ratings (inset).



4. Install the two yoke lock screws, tighten and wire securely.



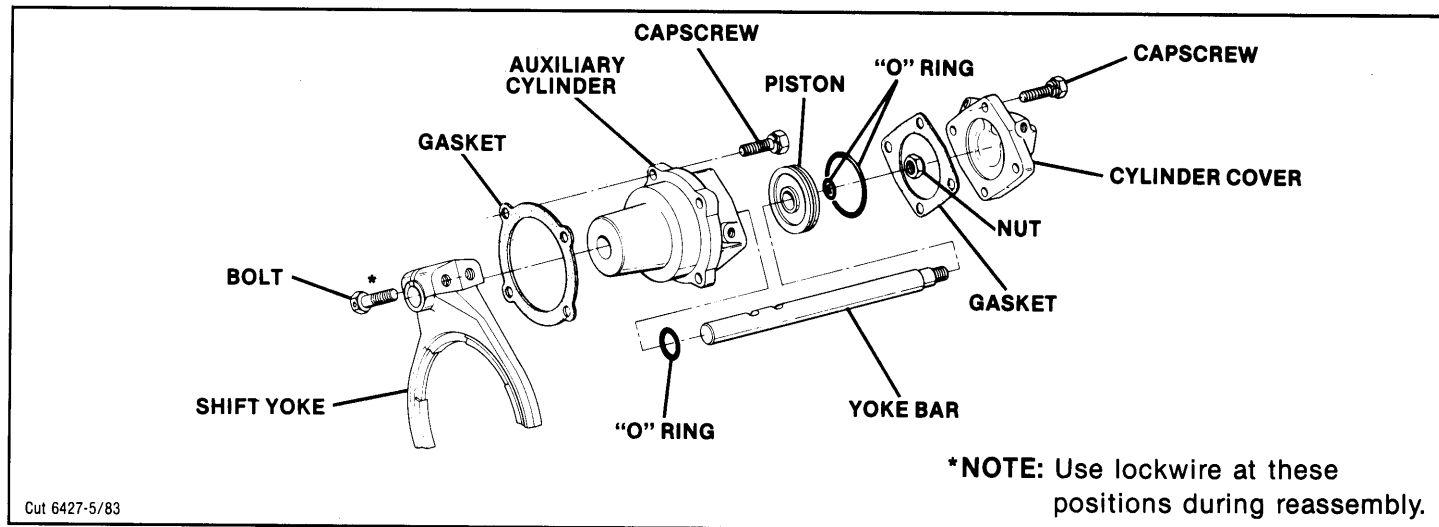
7. Position the corresponding new gasket on cover mounting surface and install the range cylinder cover on housing, open port to the upper left. Tighten cap screws to secure cover to housing.



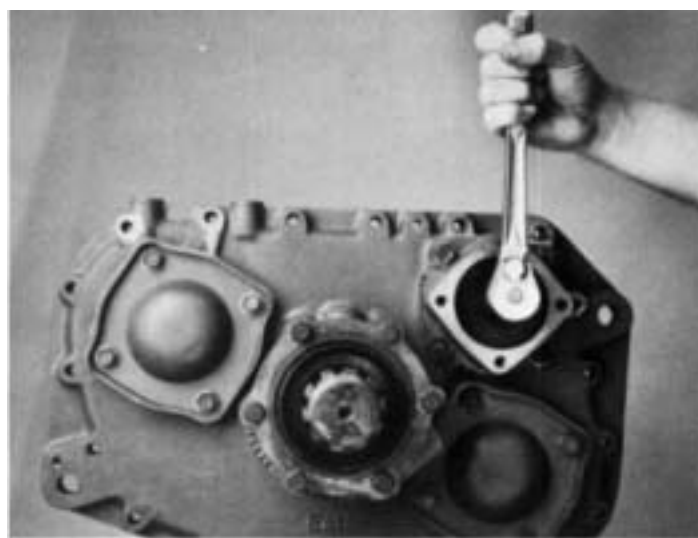
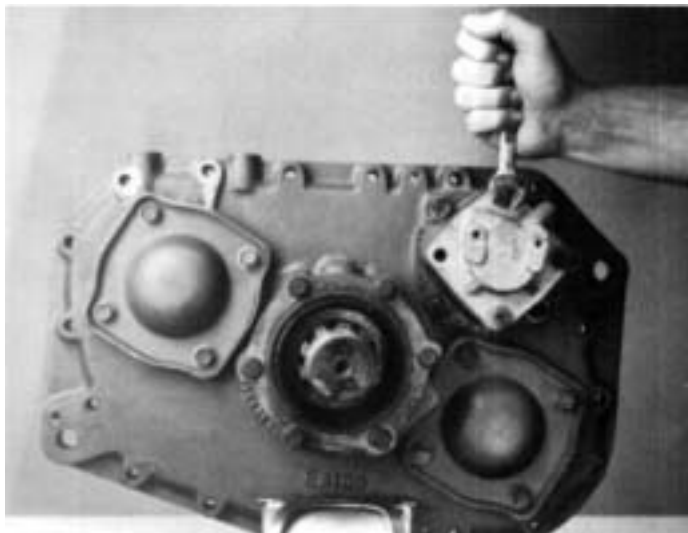
5. If previously removed, install the O-rings in the I.D. and O.D. of range piston.

# DISASSEMBLY - AUXILIARY SECTION (9-SPEED AND RT-8608L MODELS)

## AUXILIARY SECTION (9-SPEED MODELS)



### A. Removal and Disassembly of Range Cylinder Assembly



2. Remove nut from end of yoke bar.

1. For ease of disassembly, mount the auxiliary section upright in a vise. Turn out the capscrews and remove the range cylinder cover and gasket.

# DISASSEMBLY - AUXILIARY SECTION (9-SPEED AND RT-8608L MODELS)



3. Cut lockwire and remove two yoke lockscrews.



5. Remove range yoke from sliding clutch of synchronizer assembly.



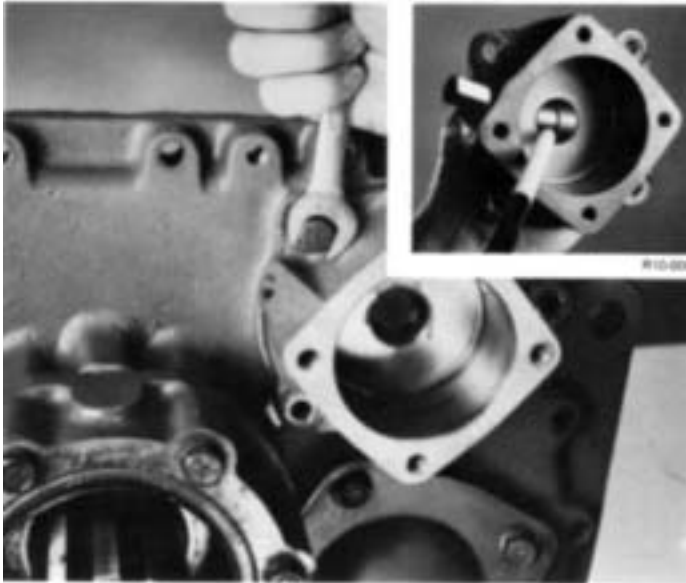
4. Pull yoke bar from bore of cylinder housing.



6. Remove the range piston from cylinder bore. If necessary, remove the O-rings from piston I.D. and O.D. (inset).

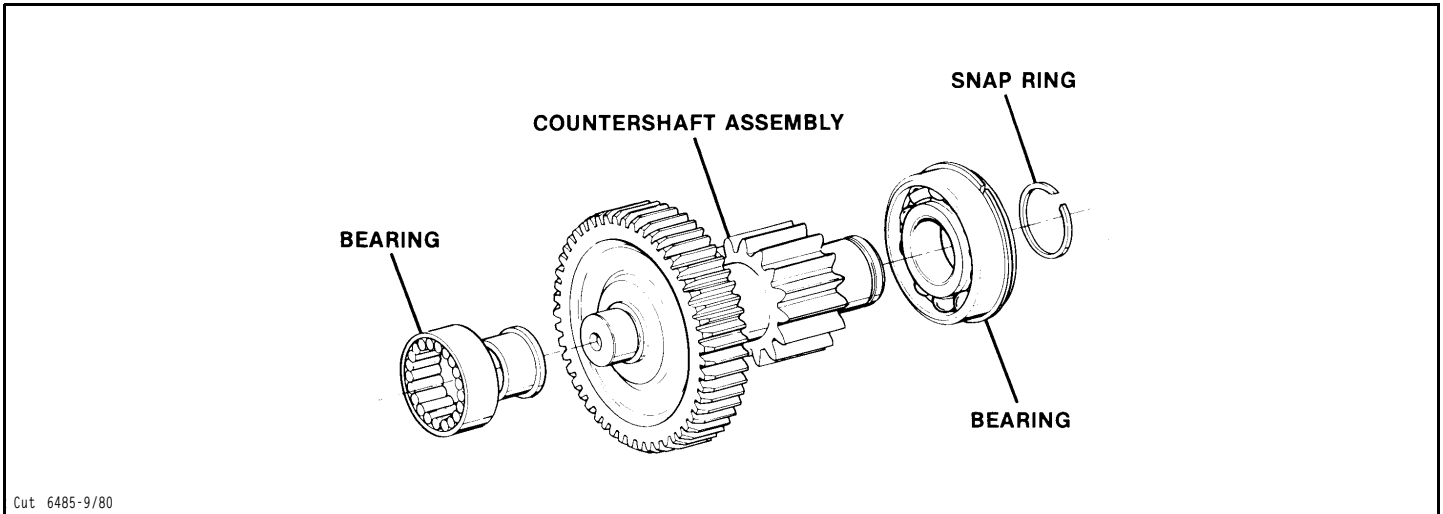
# DISASSEMBLY - AUXILIARY SECTION (9-SPEED AND RT-8608L MODELS)

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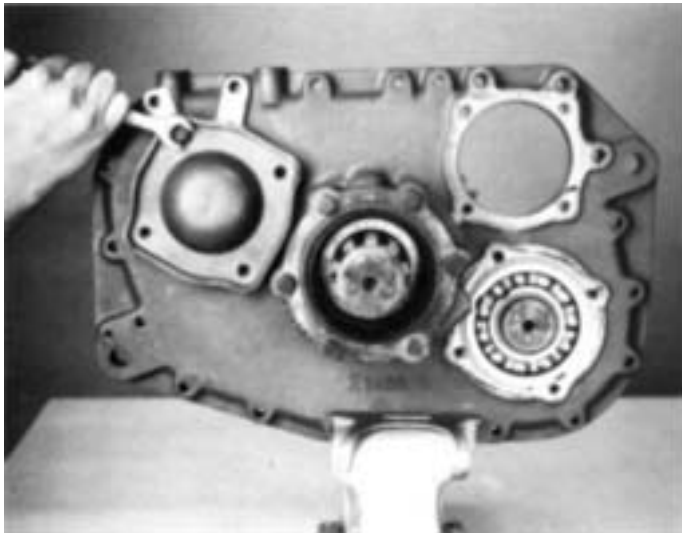


7. Turn out the capscrews and remove the range cylinder housing and gasket. If necessary, remove the small O-ring from groove in housing bore (inset).

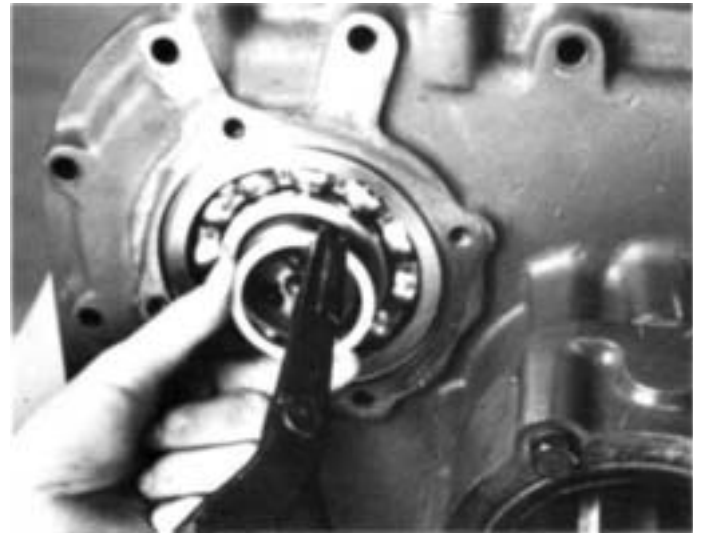
# DISASSEMBLY - AUXILIARY SECTION (9-SPEED AND RT-8608L MODELS)



## B. Removal of Auxiliary Countershaft Assemblies



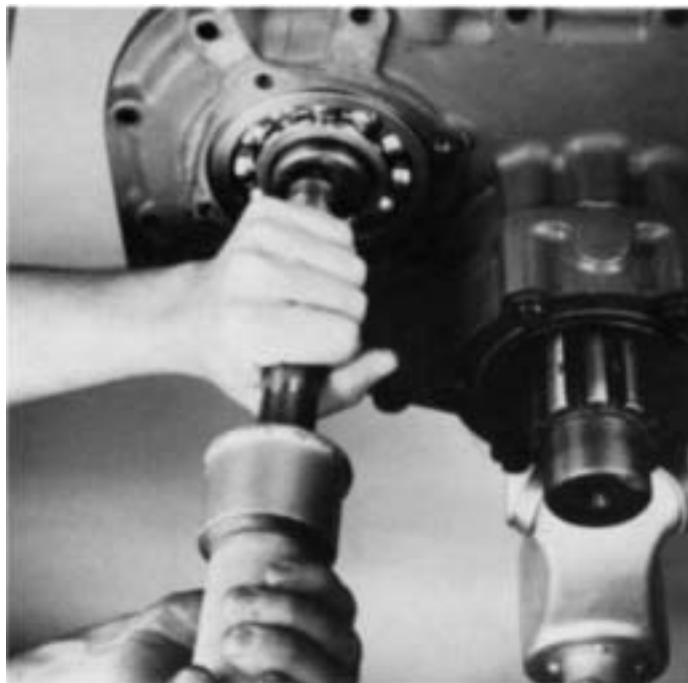
1. Turn out the capscrews and remove both countershaft rear bearing covers and gaskets.



2. Remove the snap ring from groove at rear of each countershaft.

## DISASSEMBLY - AUXILIARY SECTION (9-SPEED AND RT-8608L MODELS)

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3. Use a soft bar and maul to drive the countershaft forward and from rear bearings.



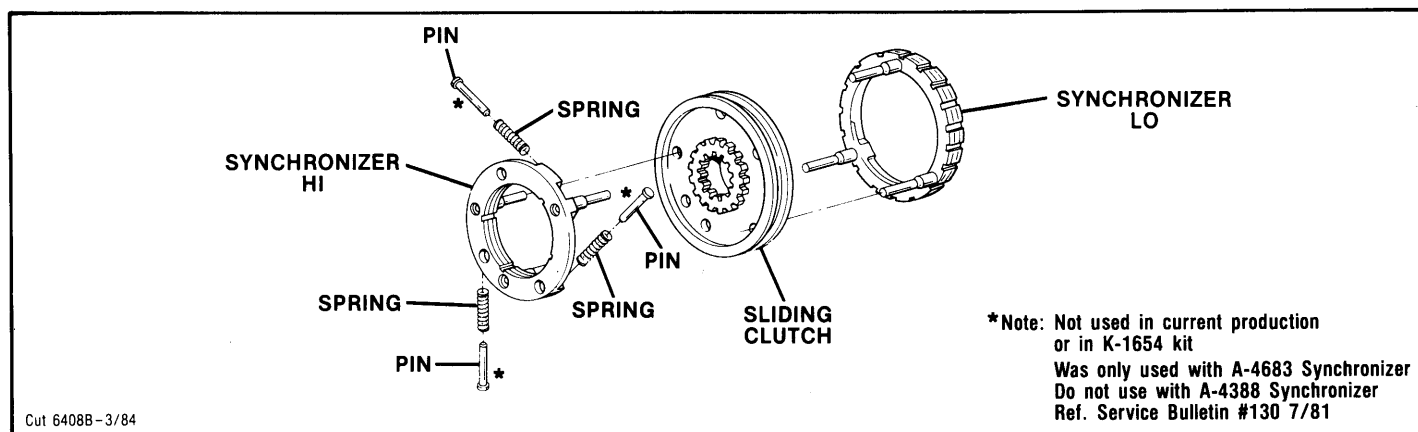
4. Remove the bearings from bores in auxiliary plate by tapping lightly and evenly to the rear with a soft bar.



5. If necessary, secure the assembly in a vise and remove the bearing inner race from front of countershaft with jaw pullers.

**NOTE:** The vise used should be equipped with brass jaws or wood blocks to prevent damage to the countershaft.

# DISASSEMBLY - AUXILIARY SECTION (9-SPEED AND RT-8608L MODELS)



## C. Removal and Disassembly of Synchronizer Assembly



1. Pull the synchronizer assembly from the splines of output shaft.



2. Place the larger low range synchronizer ring on bench and pull the high range synchronizer from blocker pins. However, before doing so, cover the assembly with a shop rag to prevent losing the three springs released from high range synchronizer at pin locations.



3. Remove the sliding clutch from pins of low range

Diagram illustrating the assembly components for a gear set, showing the Mainshaft, Gear, Spacer, Washer, Snap Ring, and Nut.

The diagram shows the Mainshaft (a shaft with a splined end) and the Gear (a large gear). The assembly components are shown in an exploded view, indicating their relative positions and assembly sequence:

- GEAR**: The large gear component.
- SPACER**: A small gear-like component used for spacing.
- WASHER**: A flat circular component used for spacing.
- SNAP RING**: A ring component used for securing the assembly.
- NUT**: A threaded fastener used to secure the assembly.

The diagram shows the Mainshaft and Gear assembly, with the Gear and Spacer components shown in an exploded view, indicating their relative positions and assembly sequence.

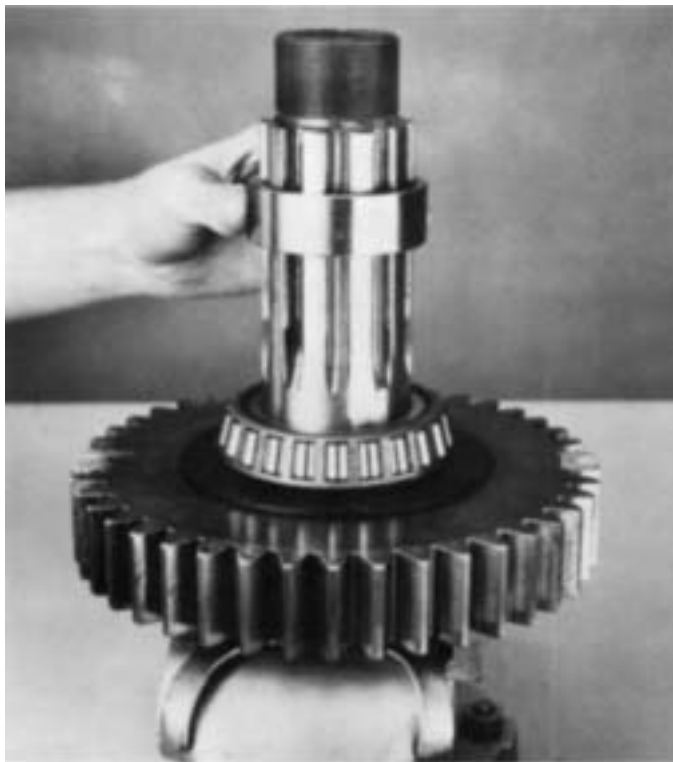


# DISASSEMBLY - AUXILIARY SECTION (9-SPEED AND RT-8608L MODELS)

## D. Removal and Disassembly of Output Shaft and Rear Bearing Assemblies



1. Use a soft bar and maul to drive the output shaft forward and through rear bearing assembly.



2. Remove the bearing inner spacer from output shaft.



3. Using the front face of low range gear as a base, press the output shaft through the gear and bearing. Remove the bearing and washer from hub of low range gear.



4. If necessary, remove the snap ring from low range gear of models so equipped.

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# DISASSEMBLY Ñ AUXILIARY SECTION (9-SPEED AND RT-8608L MODELS)



5. Remove the splined spacer from output shaft.



7. Turn out the capscrews and remove the rear bearing cover and gasket. The rear bearing cone will drop from bore in auxiliary plate when cover is removed. If necessary, remove the oil seal from cover (inset).



6. Remove the stepped washer from shaft of models so equipped.



8. Remove the two bearing cups and outer spacer from bore in auxiliary plate.

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# REASSEMBLY - AUXILIARY SECTION (9-SPEED AND RT-8608L MODELS)

## AUXILIARY SECTION (9-SPEED MODELS)

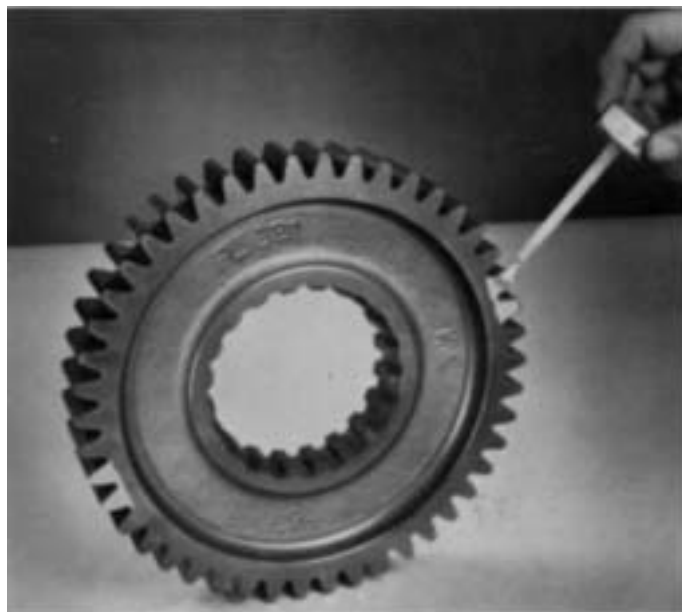
### A. Reassembly and Installation of Output Shaft and Rear Bearing Assemblies



1. Secure the output shaft in a vise with threaded end up. For models so equipped, install the stepped washer on shaft large diameter step down (arrow), then install the splined spacer.



2. For 14609 models, install the spacer with large diameter splines down.



3. **IMPORTANT:** Mark any two adjacent teeth on low range gear and repeat the procedure for the two adjacent teeth directly opposite the first set marked. A highly visible color of toolmakers  $\text{Ö}$  dye is recommended.



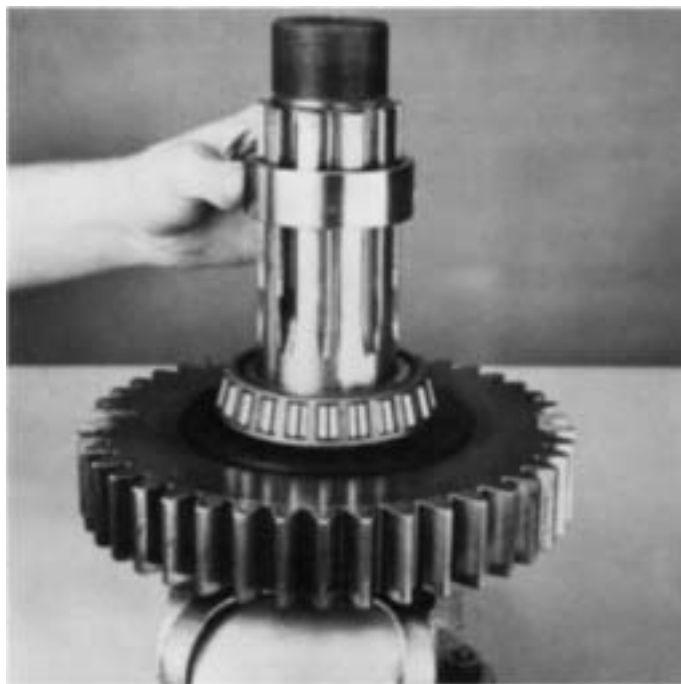
4. If previously removed, install the snap ring in low range gear of models so equipped (inset). Install the gear on output shaft, clutching teeth down and engaged with splines of spacer.

# REASSEMBLY - AUXILIARY SECTION (9-SPEED AND RT-8608L MODELS)

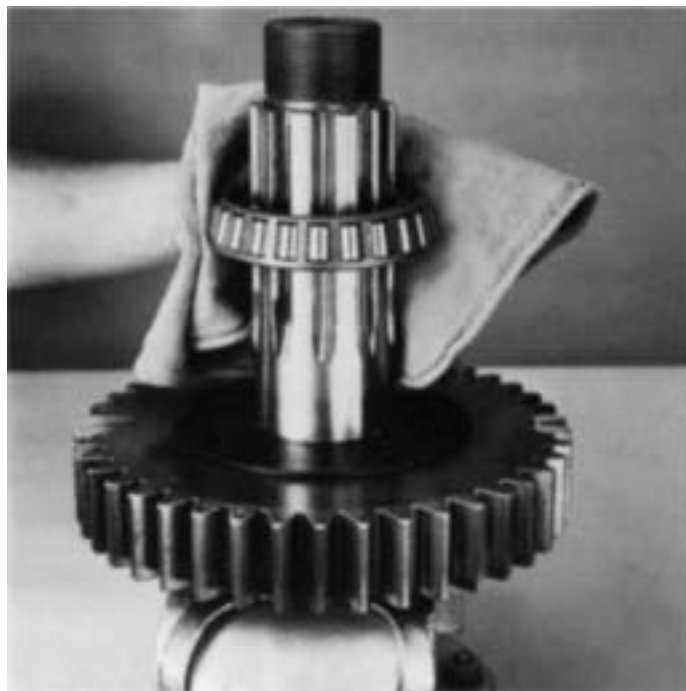
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5. Install the washer on shaft; 11609, 12609 models flat side of washer facing up, 14609 models flat side of washer facing down.



7. Install the bearing inner spacer on output shaft.



6. Heat the front bearing cone and install on shaft against washer, bearing taper up.  
NOTE: DO NOT HEAT BEARING ABOVE 275°F (136°C). If possible, use heat lamps as source.



8. Install the front bearing cup in bore of auxiliary plate, taper to the inside. Use a soft bar to start cup into bore.

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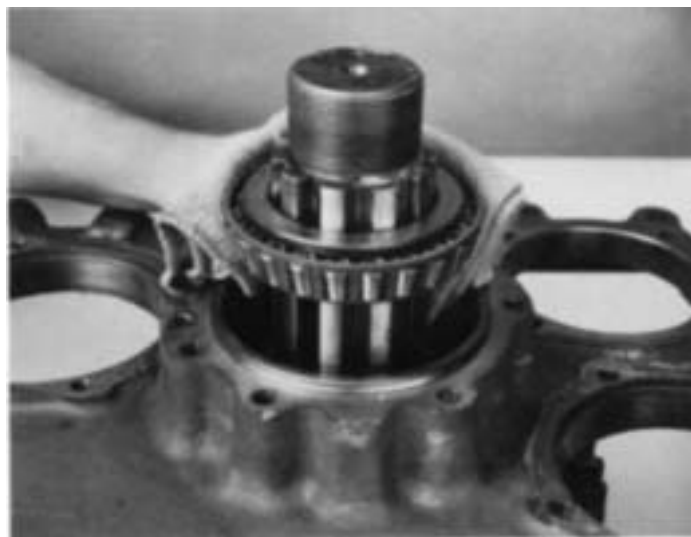
# REASSEMBLY - AUXILIARY SECTION (9-SPEED AND RT-8608L MODELS)



9. Place the bearing outer spacer against cup and use a soft bar or flanged-end driver to move both parts evenly into bore.



10. Place the rear bearing cup against spacer. Use a flanged-end driver to move all three parts evenly into bore until lip of rear bearing cup seats on auxiliary plate.

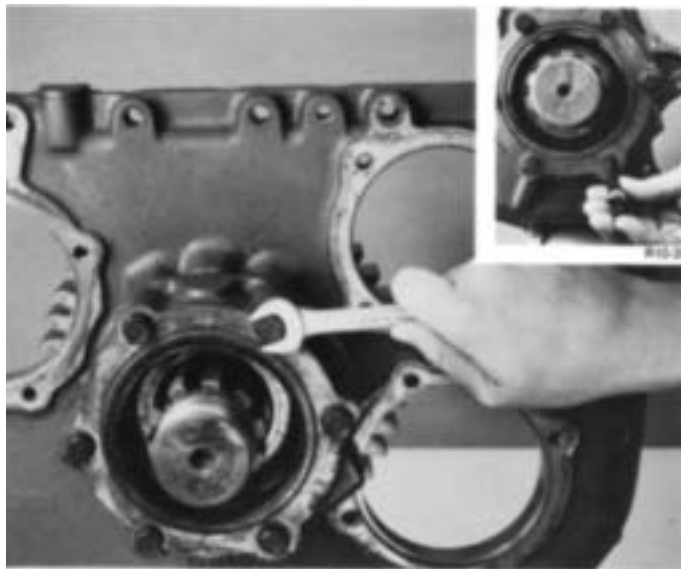


11. Install the auxiliary plate over end of output shaft assembly. Heat the rear bearing cone and install on shaft, taper down and inside bearing cup.  
NOTE: DO NOT HEAT BEARING ABOVE 275°F (136°C).



12. If previously removed, install the oil seal in rear bearing cover with a flanged driver (inset). Seal should be installed so the spring is to the front of transmission.

# REASSEMBLY - AUXILIARY SECTION (9-SPEED AND RT-8608L MODELS)



13. Remount the assembly upright in vise and secure on flange of auxiliary plate. Position the corresponding new gasket on cover mounting surface and install the rear bearing cover. Use the nylon collar and brass washer with capscrew at the chamfered hole which intersects speedometer bore (inset) Tighten the capscrews to secure cover to auxiliary plate.

NOTE: Because the collar becomes distorted when compressed, DO NOT RE-USE OLD NYLON COLLAR.

## B. Reassembly and Installation of Synchronizer Assembly



1. Place the larger low range synchronizer ring on bench and install the sliding clutch on blocker pins, recessed side up.



2. Install the three springs in bores of high range synchronizer ring.



3. Place the high range synchronizer ring over blocker pins of low range synchronizer, seating the springs against pins.

# REASSEMBLY - AUXILIARY SECTION (9-SPEED AND RT-8608L MODELS)



1. Apply downward pressure to the high range synchronizer ring WHILE TWISTING COUNTER-CLOCKWISE to compress the springs and fully seat ring on blocker pins of low range synchronizer.

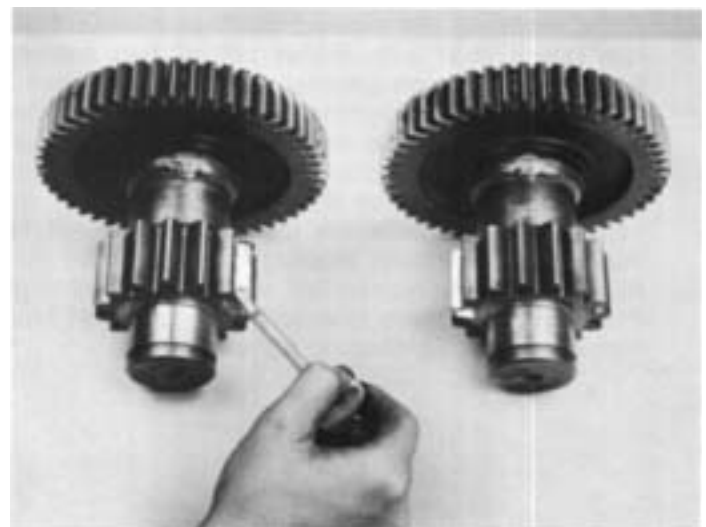


5. Install the synchronizer assembly on splines of output shaft, low range ring in recess of low range gear.

## C. Timing and Installation of Auxiliary Countershaft Assemblies



1. If previously removed, install the bearing inner race on front of each countershaft.



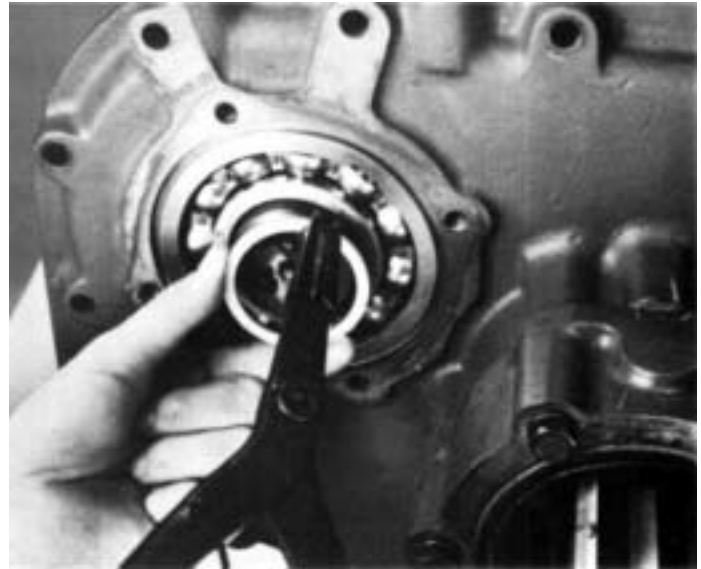
2. **IMPORTANT:** On the low range gear of each auxiliary countershaft assembly, use a highly visible color of toolmaker's dye to mark the tooth stamped with an "O" for timing purposes.

# REASSEMBLY - AUXILIARY SECTION (9-SPEED AND RT-8608L MODELS)



3. Place one of the assemblies into position in rear plate, meshing the marked tooth of countershaft low range gear with either set of two marked teeth of low range gear on output shaft (inset). Center rear of countershaft in bearing bore, start rear bearing in bore and complete installation with a flanged-end driver and maul. Repeat the procedure with other auxiliary countershaft assembly, making sure the low range gear set remains in time during bearing installation.

**NOTE:** Check synchronizer assembly for springs that may have been released from bores in high range ring during bearing installation.



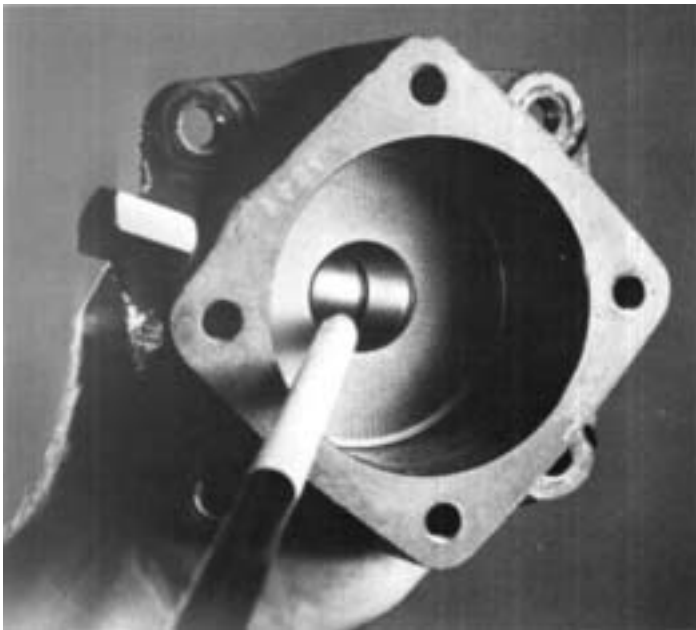
4. Install the snap ring in groove at rear of each countershaft .



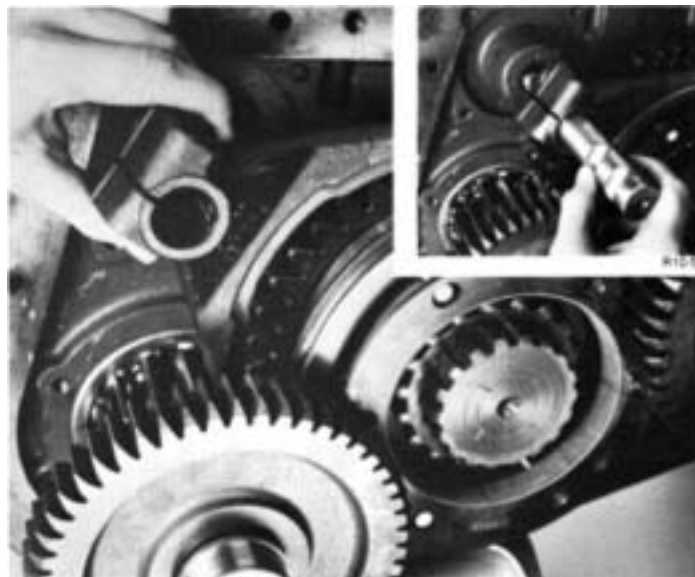
5. Position the corresponding new gasket on cover mounting surface and install both rear bearing covers. Tighten capscrews to secure covers to auxiliary plate.

# REASSEMBLY - AUXILIARY SECTION (9-SPEED AND RT-8608L MODELS)

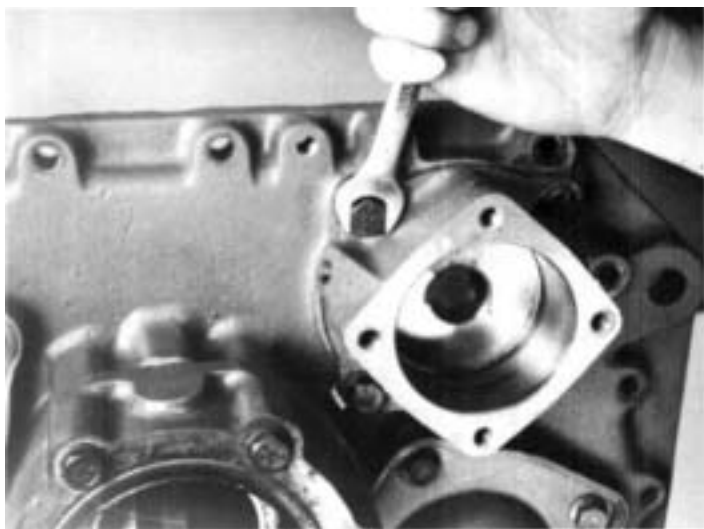
## D. Reassembly and Installation of Range Cylinder Assembly



1. If previously removed, install the O-ring in bore of range cylinder housing.



3. Place the range yoke into position with sliding clutch of synchronizer assembly, long hub of yoke to the front (RT-11609/12609 Series); long hub of yoke to the rear (RT-14609 Series). Insert threaded-end of yoke bar through yoke and into bore of range cylinder housing, aligning the notches in bar with yoke lock screw holes (inset).



2. Position the corresponding new gasket on housing mounting surface and install the cylinder housing in rear bore of auxiliary plate, air fitting to the upper left. Secure housing to plate with capscrews tightened to recommended torque ratings.

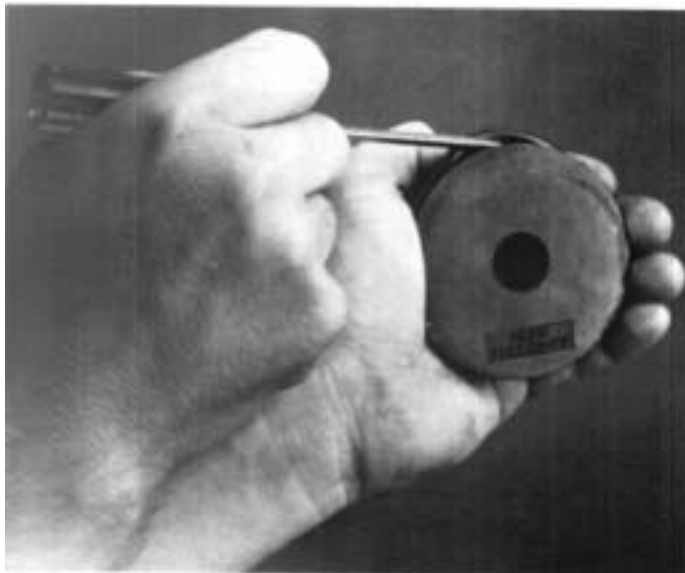


4. Install the two yoke lock screws, tighten and wire securely.

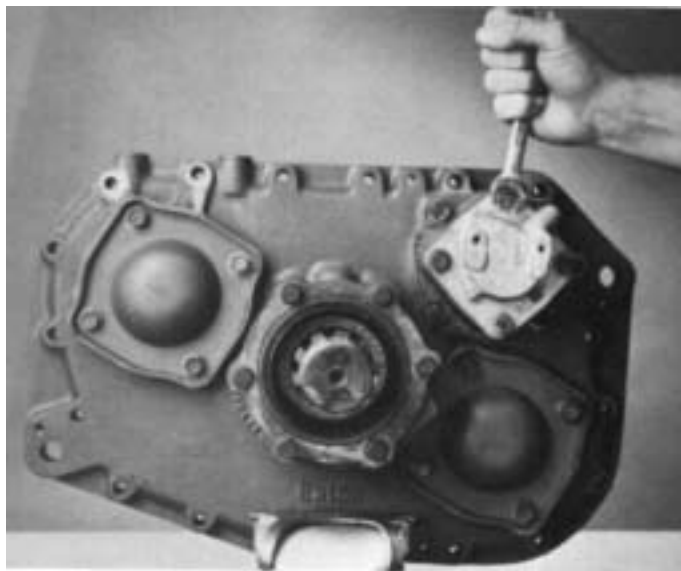
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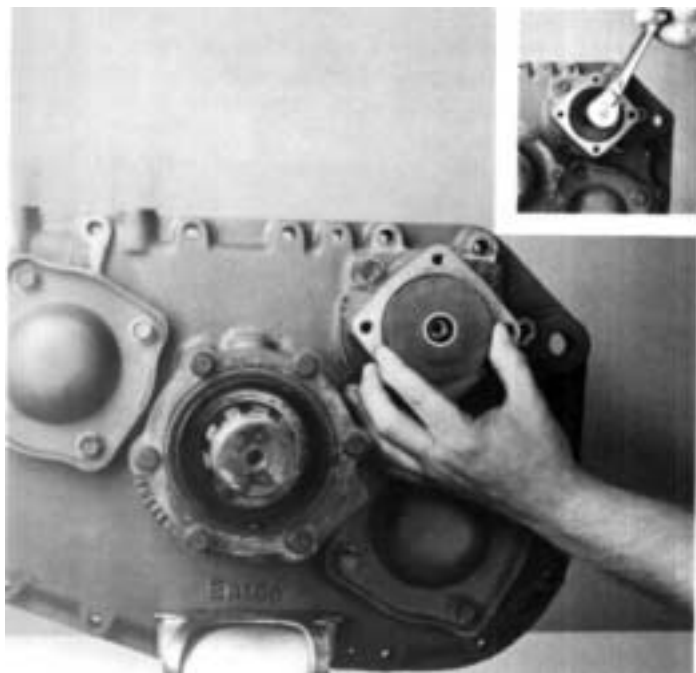
# REASSEMBLY - AUXILIARY SECTION (9-SPEED AND RT-8608L MODELS)



5. If previously removed, install the O-rings in the I.D. and O.D. of range piston.



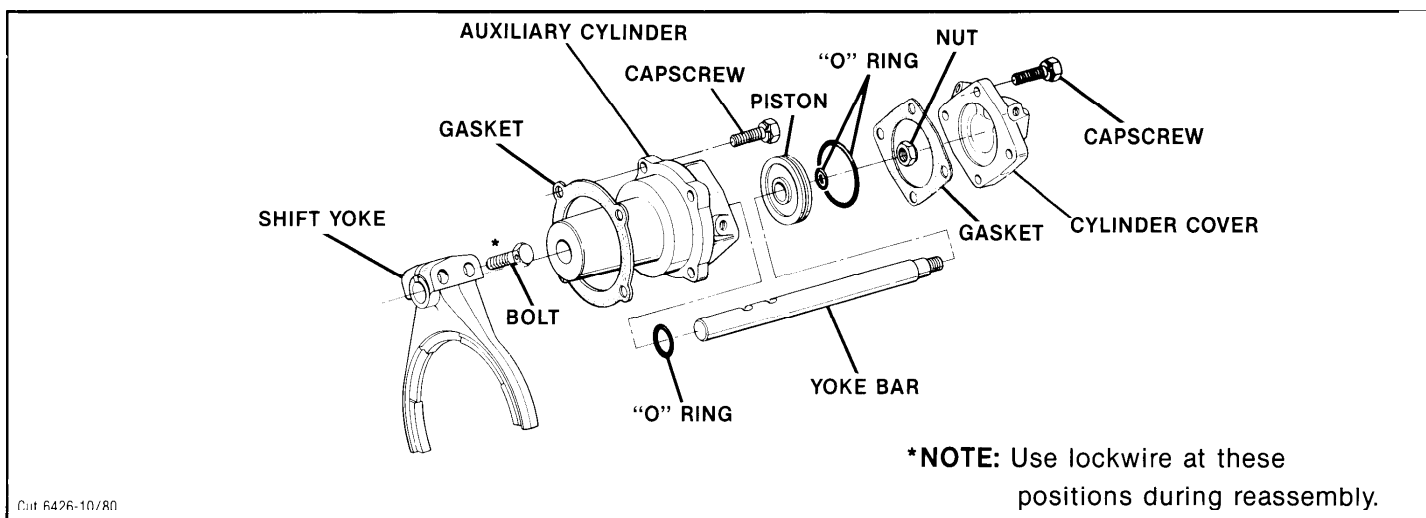
7. Position the corresponding new gasket on cover mounting surface and install the range cylinder cover on housing, open port to the upper left. Tighten capscrews to secure cover to housing.



6. In cylinder housing bore, install the range piston on yoke bar, flat side to the rear. Secure with nut tightened to recommended torque ratings (inset).

# DISASSEMBLY-AUXILIARY SECTION (13-SPEED MODELS)

## AUXILIARY SECTION (13-SPEED SPLITTER MODELS)



### A. Removal and Disassembly of Range Cylinder Assembly

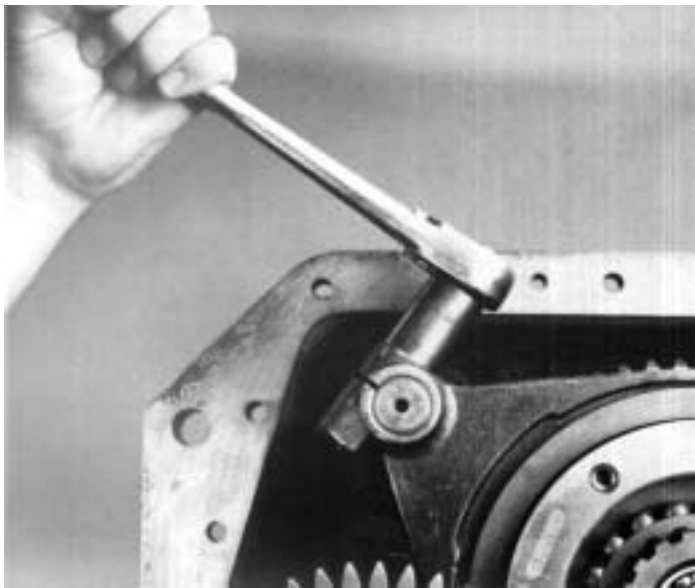


1. For ease of disassembly, mount the auxiliary section upright in a vise. Turn out the capscrews and remove the range cylinder cover and gasket.

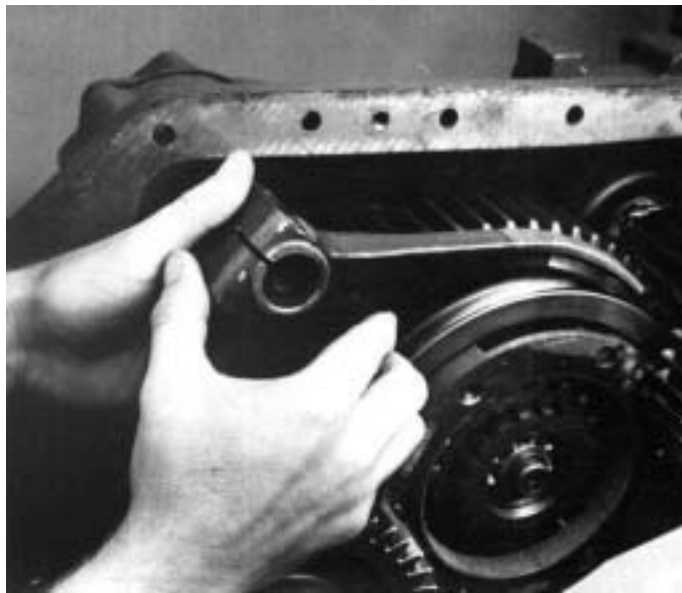


2. Remove nut from end of yoke bar.

# DISASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)



3. Cut lockwire and remove two yoke lock screws.



5. Remove range yoke from sliding clutch of synchronizer assembly.



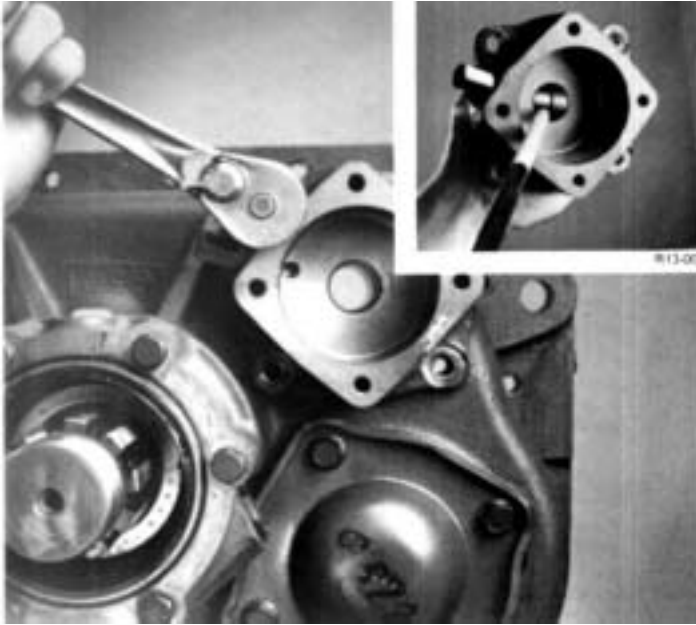
4. Pull yoke bar from bore of cylinder housing.



6. Remove the range piston from cylinder bore.  
If necessary, remove the O-rings from piston I.D.  
and O.D. (inset).

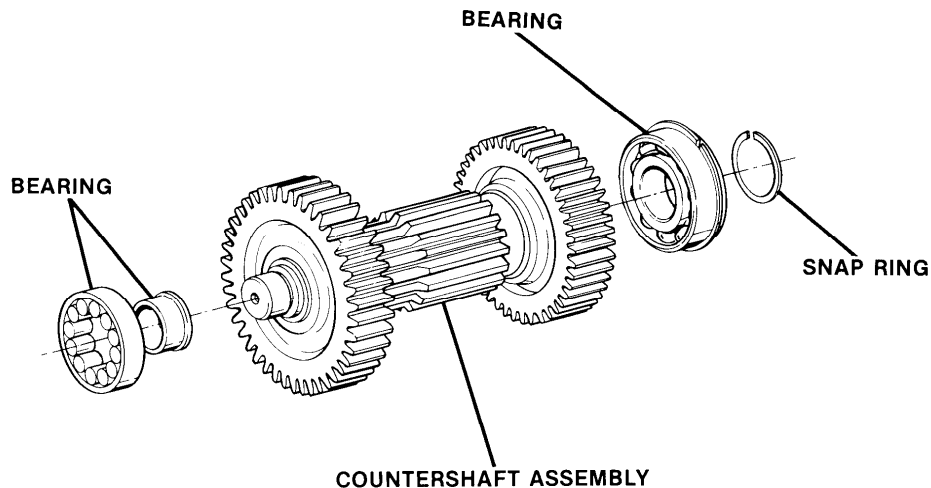
# DISASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)

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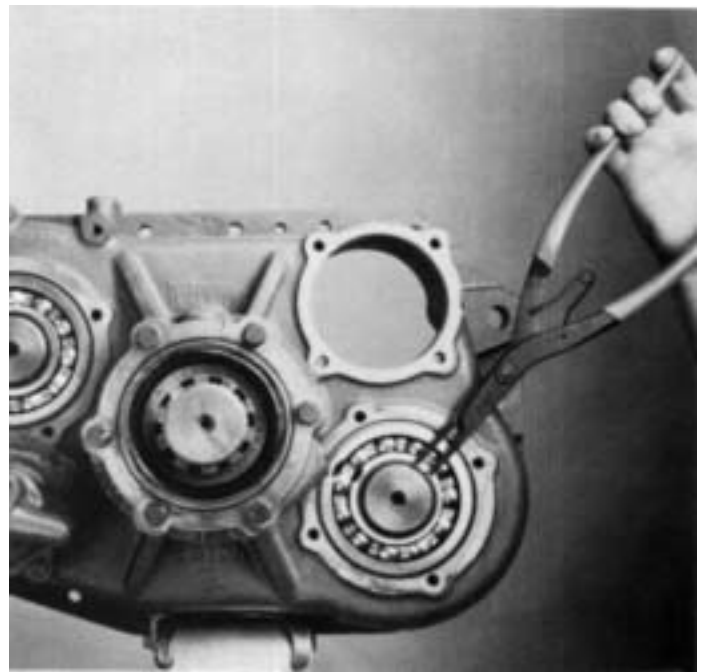
7. Turn out the capscrews and remove the range cylinder housing and gasket. If necessary, remove the small O-ring from groove in housing bore (inset).

# DISASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)



Cut 6503-9/80

## B. Removal of Auxiliary Countershaft Rear Bearings



1. Turn out the capscrews and remove both countershaft rear bearing covers.

**NOTE:** For removal and disassembly of models equipped with an Auxiliary Oil Pump Assembly on rear of countershaft, see OPTIONS.

2. Remove the snap ring from groove at rear of each countershaft.

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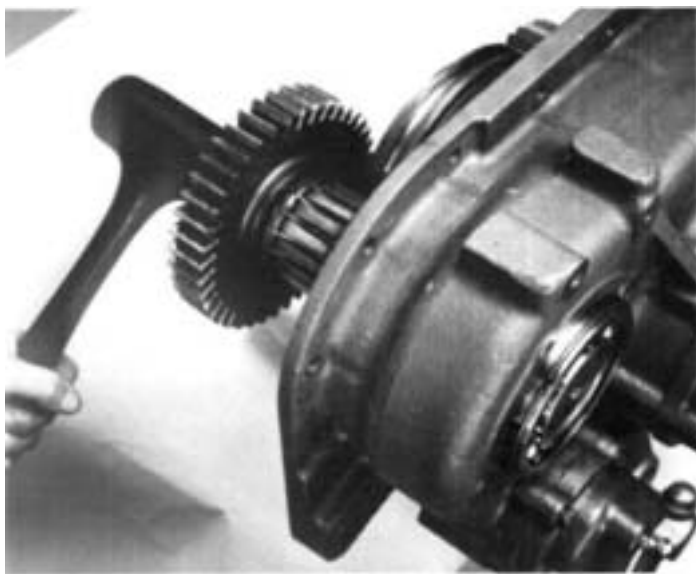
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# DISASSEMBLY-AUXILIARY SECTION (13-SPEED MODELS)

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3. Use a soft bar and maul to drive the countershaft forward far enough to partially unseat rear bearings.



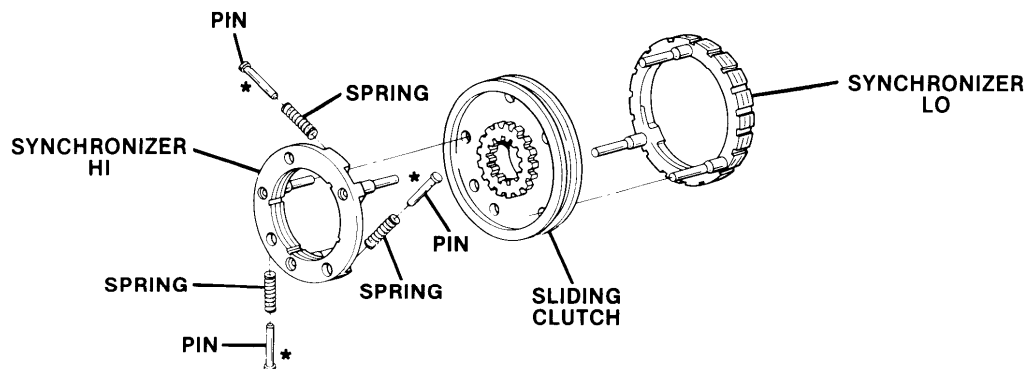
4. Using caution so as not to damage the bearing inner race on front of each countershaft, drive the shafts to the rear to expose the bearing snap rings.



5. Use a puller to remove the countershaft rear

**NOTE:** The auxiliary countershaft assembly **CAN-NOT** be removed from housing until splitter shift yoke is removed.

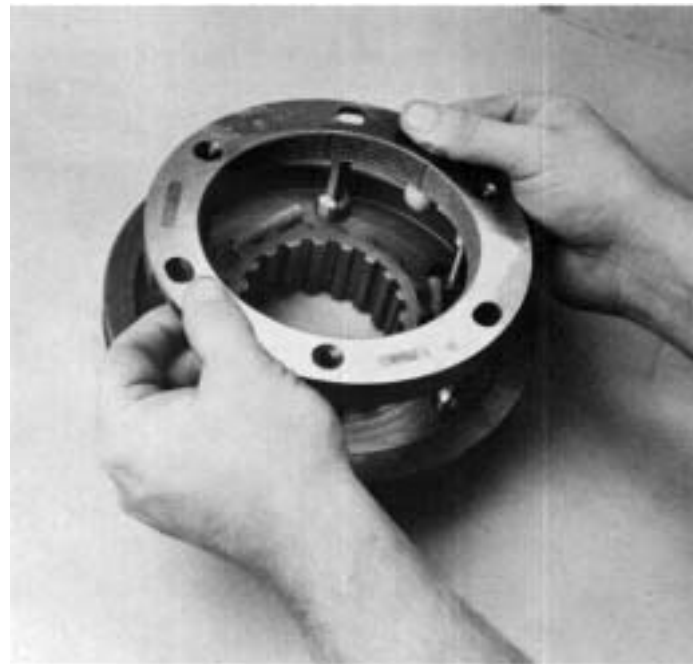
# DISASSEMBLY-AUXILIARY SECTION (13-SPEED MODELS)



\*Note: Not used in current production  
or in K-1654 kit  
Was only used with A-4683 Synchronizer  
Do not use with A-4388 Synchronizer  
Ref. Service Bulletin #130 7/81

Cut 6480 B-3/84

## C. Removal and Disassembly of Synchronizer Assembly



1. Spread the countershaft assemblies and pull the synchronizer assembly from splines of rang mainshaft.  
**NOTE:** To spread countershaft far enough to remove synchronizer on RTO & RTOO models move the splitter clutch to the forward position.

2. Place the larger low range synchronizer ring on bench and pull the high range synchronizer from blocker pins. However, before doing so, cover the assembly with a shop rag to prevent losing the three springs released from high range synchronizer at pin locations.

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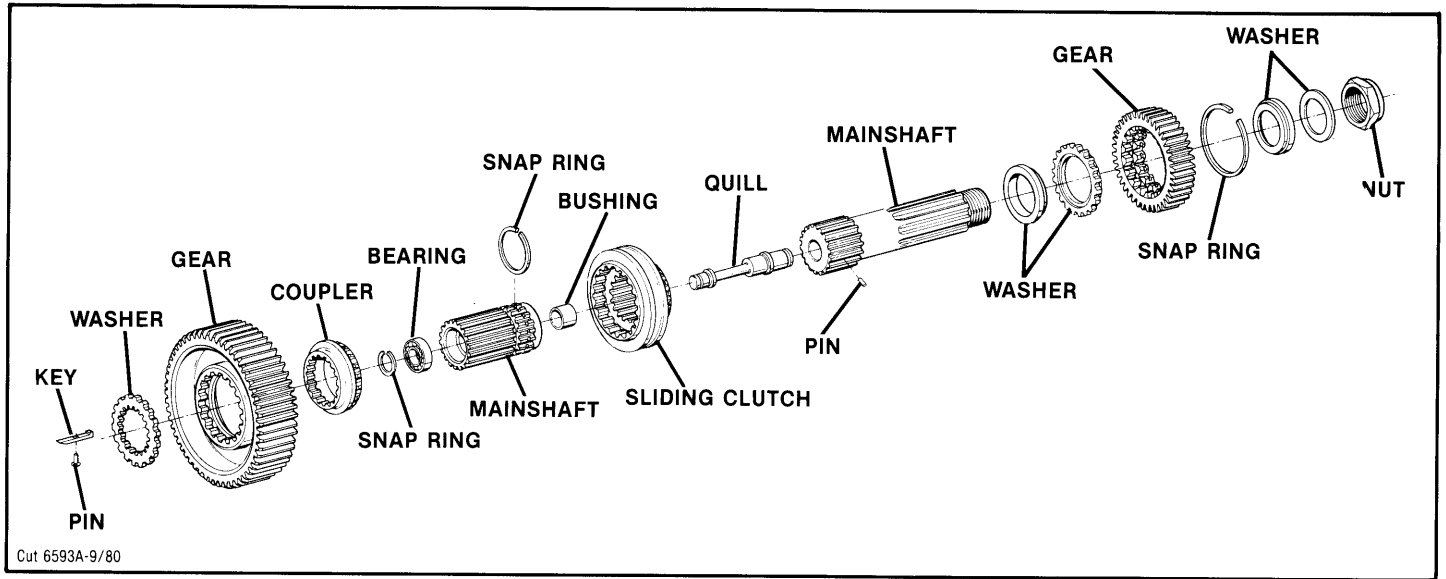
# **DISASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)**

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3. Remove the sliding clutch from pins of low range synchronizer ring.

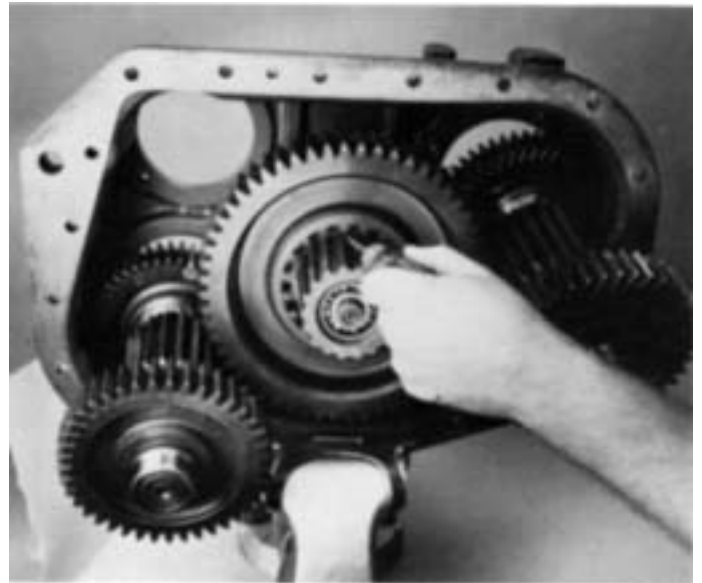
# REASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)



## D. Removal of Low Range Gear



1. Remove the key from keyway of range mainshaft.



2. Turn the washer located in the hub of low range gear so that the splines of washer align with the splines of mainshaft.

# DISASSEMBLY-AUXILIARY SECTION (13-SPEED MODELS)

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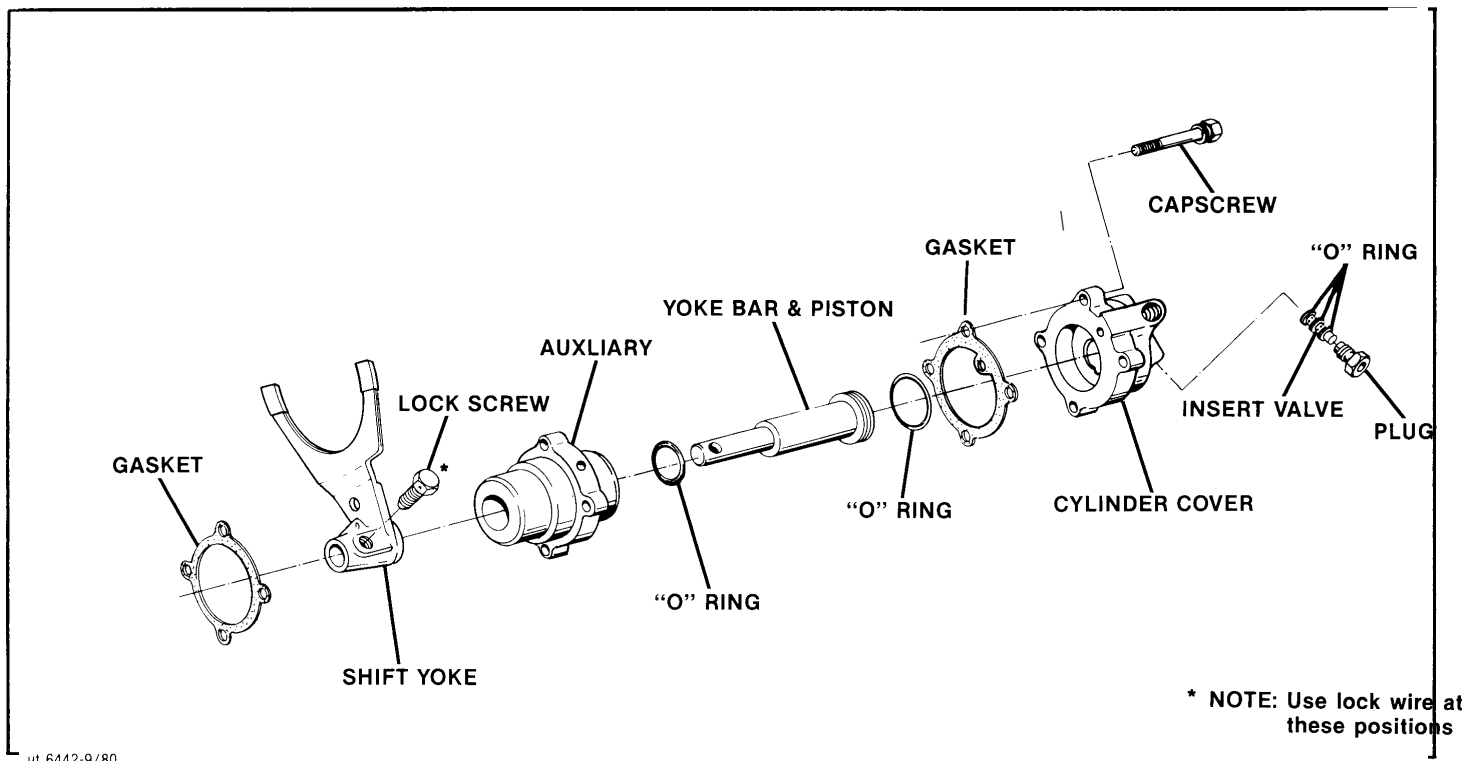
3. Spread the countershaft assemblies and pull the low range gear and washer from splines of mainshaft.



4. Remove the coupler from splines of range mainshaft.

**NOTE:** If desired, Removal and Disassembly of Range Mainshaft Assembly may be performed prior to Removal and Disassembly of Splitter Cylinder Assembly.

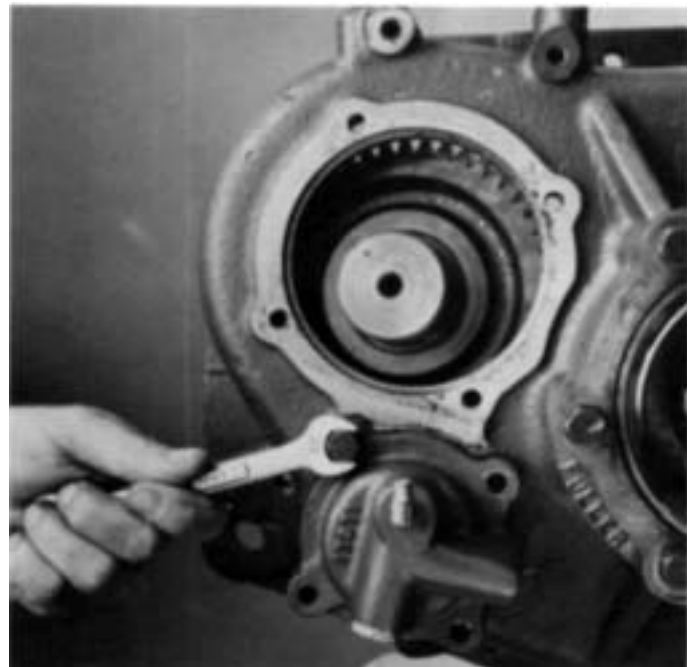
# DISASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)



## E. Removal and Disassembly of Splitter Cylinder Assembly



1. Cut lockwire and remove the lock screw from shift yoke.



2. Turn out the cap screws and remove the splitter cylinder cover and gasket.

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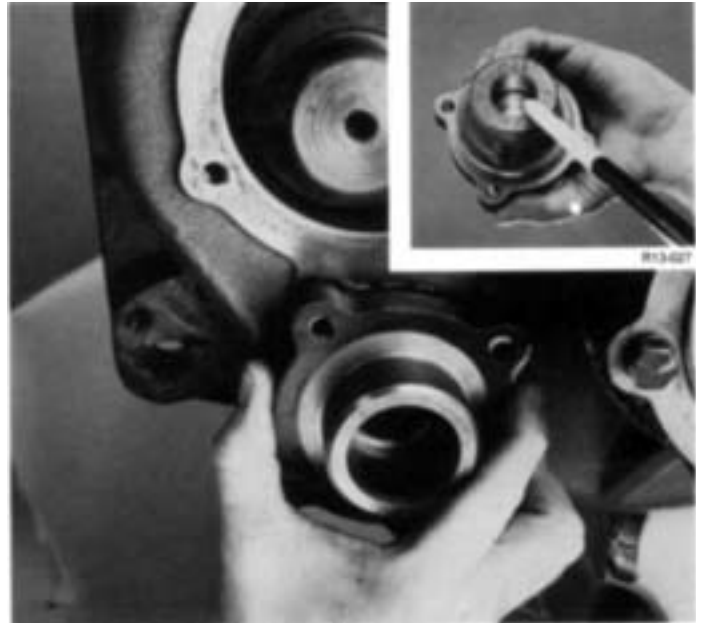
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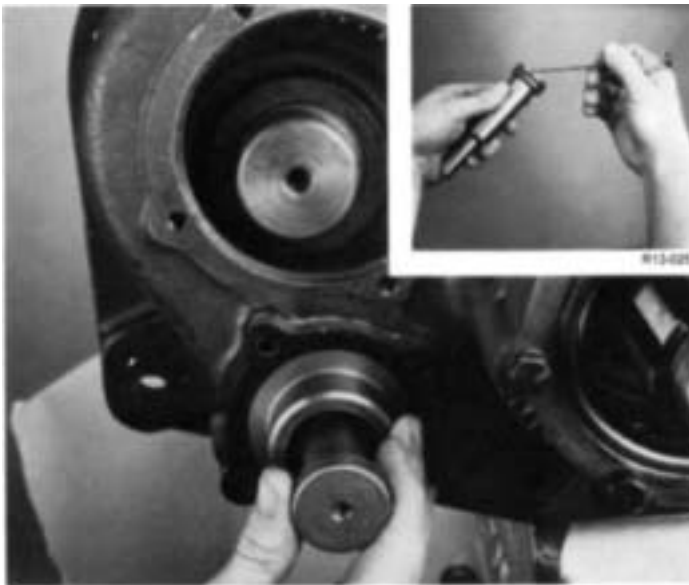
# DISASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)



3. If necessary, turn out the plug in bottom bore of cover and remove the insert valve.



5. Remove the splitter cylinder housing and gasket from auxiliary housing. If necessary, remove the small O-ring from bore in cylinder housing (inset).



4. Remove the yoke bar from cylinder housing bore. If necessary, remove the O-ring from piston O.D. (inset).

# DISASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)

## F. Removal and Disassembly of Range Mainshaft Assembly



1. Remove the snap ring from the groove of range mainshaft.



2. Remove splitter shift yoke and sliding clutch.



3. Remove both auxiliary countershafts.



4. Remove the "C" ring from the groove at front of mainshaft quill.

# DISASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)

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5. Remove range mainshaft with jaw puller.

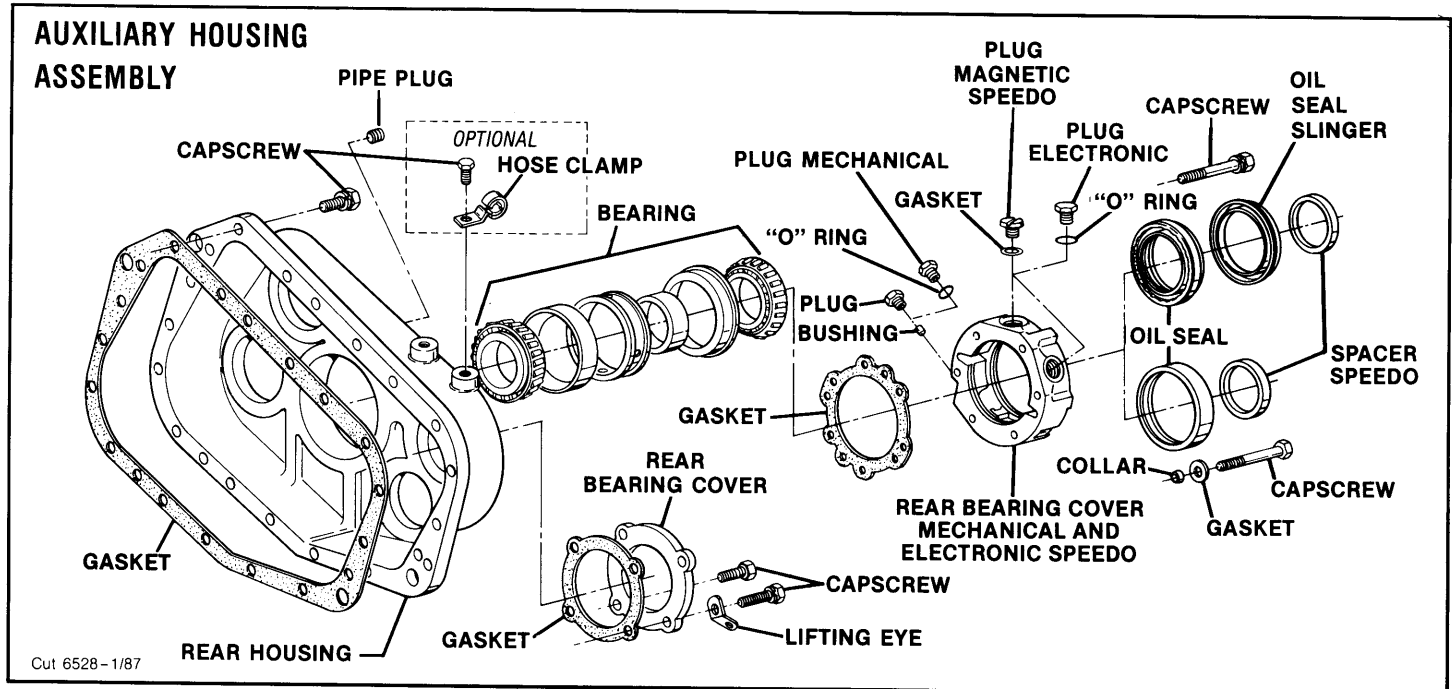


7. Remove bearing inner race from front of countershaft with jaw puller.



6. Remove bearing from front bore of mainshaft. If necessary, press bushing from mainshaft (inset).

# DISASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)

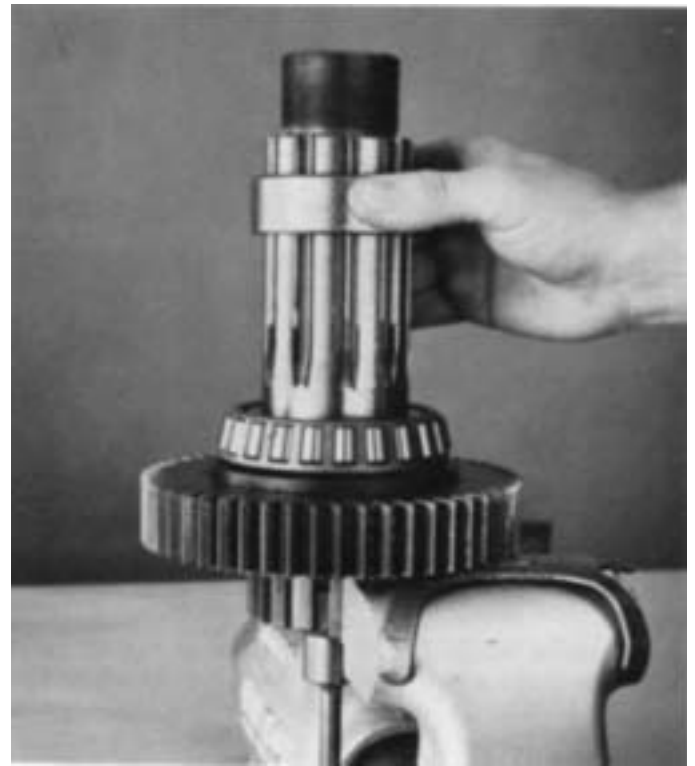


## G. Removal and Disassembly of Output Shaft and Rear Bearing Assemblies

**NOTE:** In addition to the above, refer to the illustration provided at Part D of this section.

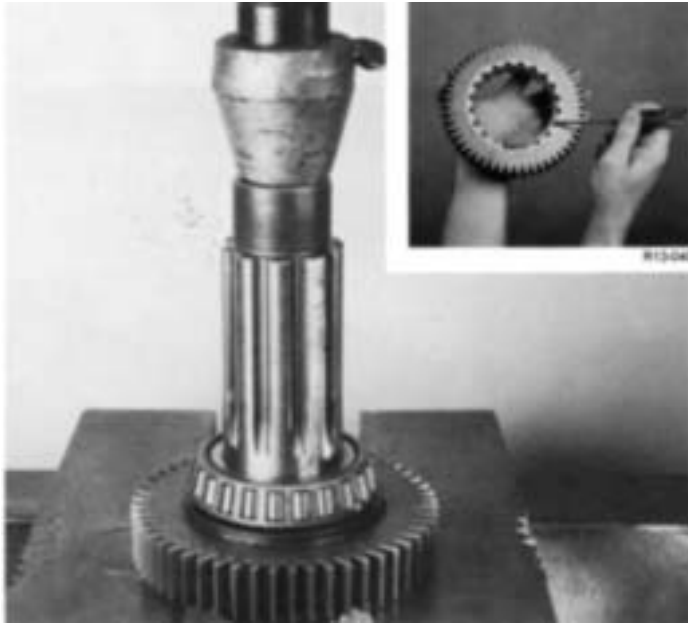


1. Use a soft bar and maul to drive the output shaft forward and through rear bearing assembly.  
**NOTE:** When applying force to rear of output shaft, DO NOT DAMAGE THREADS. Support front of shaft to avoid damaging the mainshaft quill once output shaft is free of bearing assembly.

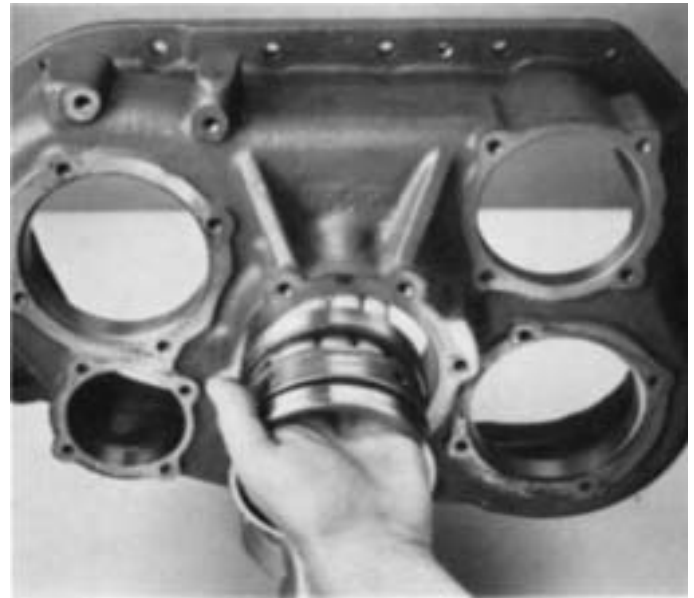


2. Remove the bearing inner spacer from output shaft.

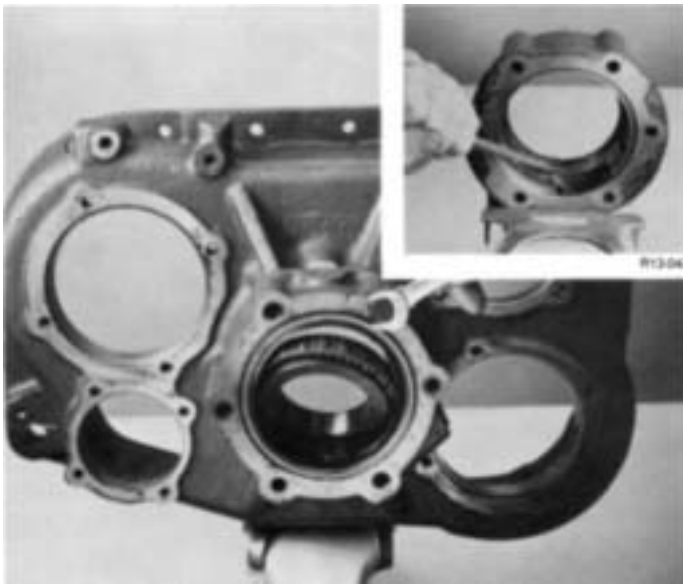
# DISASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)



3. Using the front face of splitter gear as a base, press the output shaft through the bearing, washer and gear. DO NOT DAMAGE MAINSHAFT QUILL. If necessary, remove the snap ring from I.D. of splitter gear (inset).



5. Remove the two bearing cups and outer spacer from housing bore.



4. Turn out the retaining capscrews and remove the rear bearing cover and gasket from auxiliary housing. The rear bearing cone will drop from housing bore when cover is removed. If necessary, remove the oil seal from cover (inset).

# REASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)

## AUXILIARY SECTION (13-SPEED MODELS)

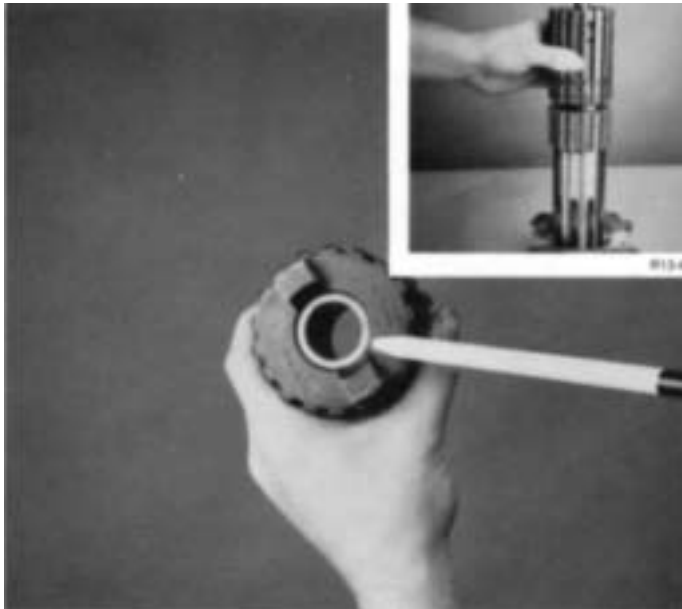
### A. Reassembly and Installation of Range Mainshaft Assembly



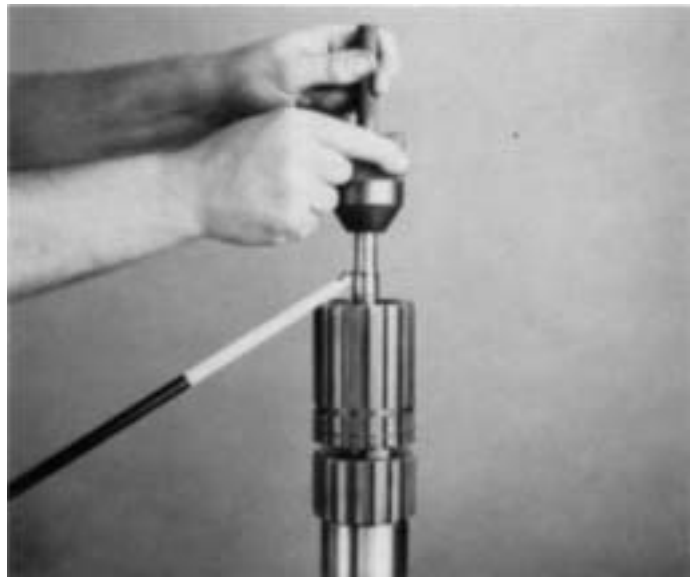
1. Secure the output shaft in a vise with mainshaft quill up.



3. Install the bearing in front bore of range mainshaft. Use a small flanged-end driver to properly seat bearing in bore on mainshaft quill.



2. If necessary, press the bushing in rear bore of range mainshaft and install the mainshaft in position on quill. (inset)



4. Install the "C" ring in groove of mainshaft quill to retain bearing.

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# REASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)

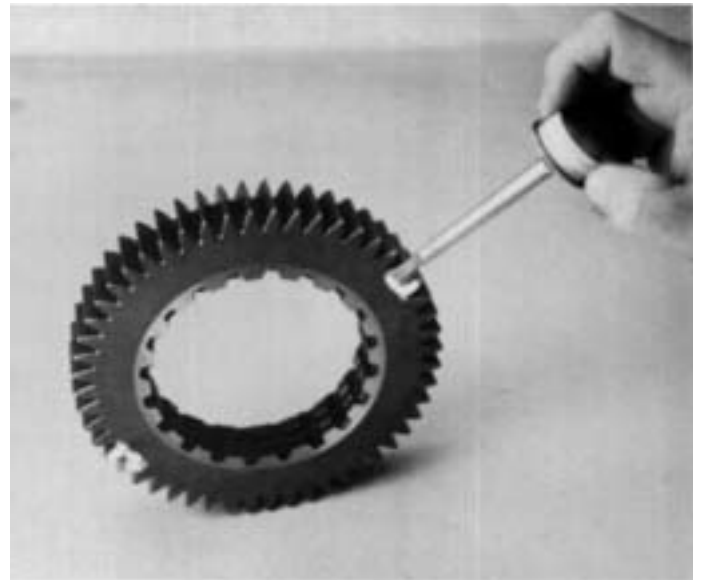
## B. Reassembly and Installation of Output Shaft and Rear Bearing Assemblies



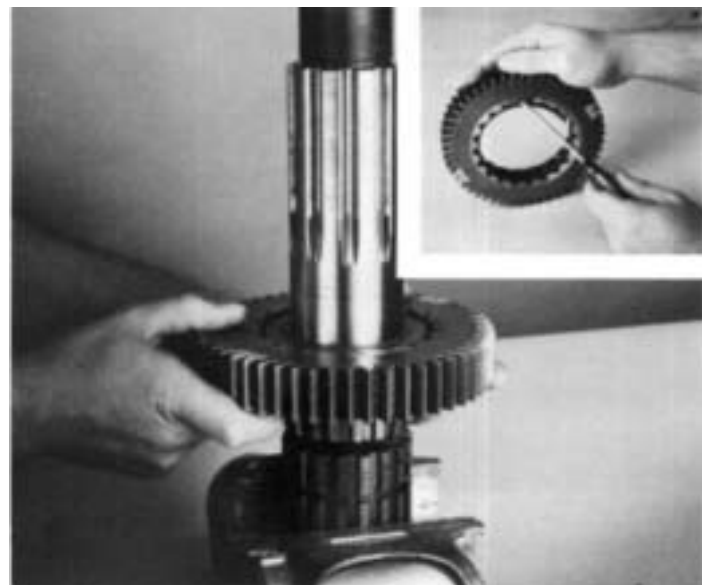
1. Remount the output shaft in vise with threaded-end up and secure on range mainshaft. Install the stepped washer on shaft, flat side down.



2. Install the splined spacer and output shaft against washer, shoulder up.

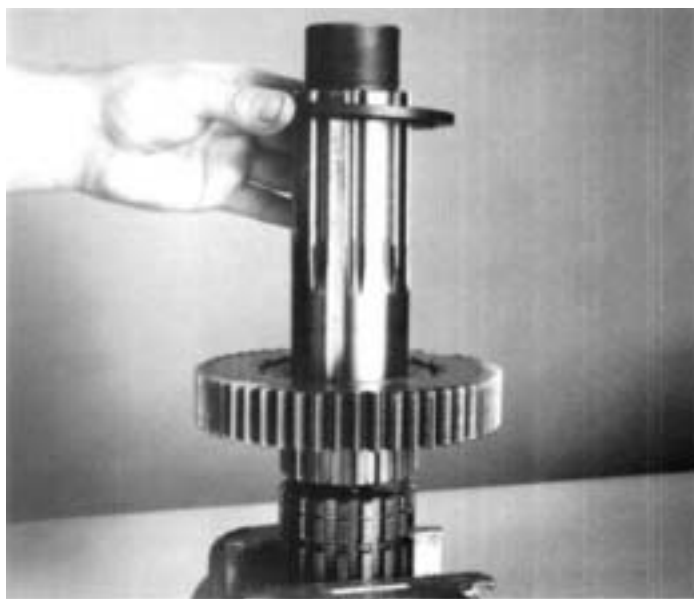


3. **IMPORTANT:** For timing purposes, mark any two adjacent teeth on splitter gear and repeat the procedure for the two adjacent teeth directly opposite the first set marked. A highly visible color of toolmakers' dye is recommended.



4. If previously removed, install the snap ring in splitter gear (inset). Install the gear on output shaft, snap ring up and clutching teeth engaged with splines of spacer.

# REASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)



5. Install the stepped washer on shaft against gear, flat side up.



7. Install the bearing inner spacer on output shaft.



6. Heat the front bearing cone and install on output shaft against washer, bearing taper up.  
NOTE: DO NOT HEAT BEARING ABOVE 275°F (136°C). If possible, use heat lamps as source.



8. Place the front bearing cup in housing bore, taper to the inside, and use a soft bar to start cup into bore.

# REASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)



9. Stack the bearing outer spacer and rear bearing cup on top of front bearing cup in proper sequence. Use a flanged-end driver to move all three parts evenly into bore until lip of rear bearing cup seats on housing.



11. Heat the rear bearing cone and install on shaft, taper down and inside cup. Make sure the lip of rear bearing cup is fully seated on housing with bearing installed.

**NOTE:** DO NOT HEAT BEARING ABOVE 275°F (136°C).



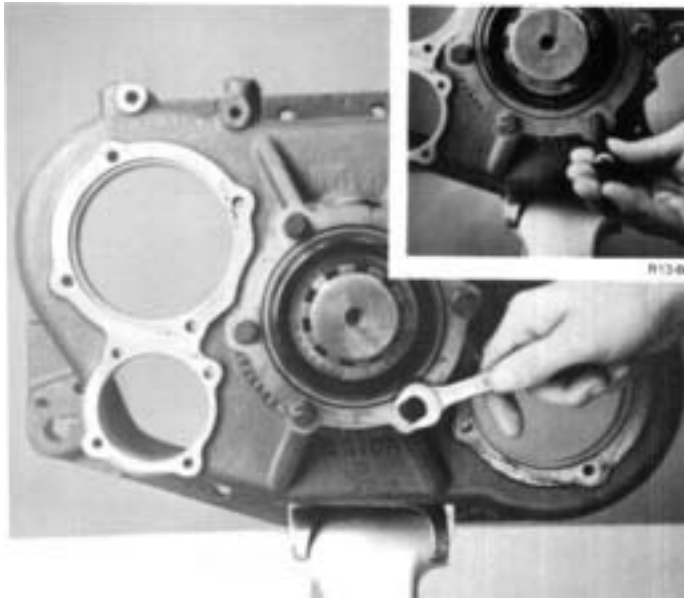
10. Install the auxiliary housing over end of output shaft assembly, seating the front bearing cone on shaft in cup.



12. If previously removed, install the oil seal in rear bearing cover. Seal should be installed so the spring is to the front of cover (inset).

# REASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)

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- 13.** Position the corresponding new gasket on cover mounting surface and install the rear bearing cover on auxiliary housing. Use the nylon collar and brass washer with capscrew at the chamfered hole which intersects speedometer bore (inset). Tighten the capscrews to secure cover to housing.

NOTE: Because the collar becomes distorted when compressed, DO NOT REUSE OLD NYLON COLLAR.

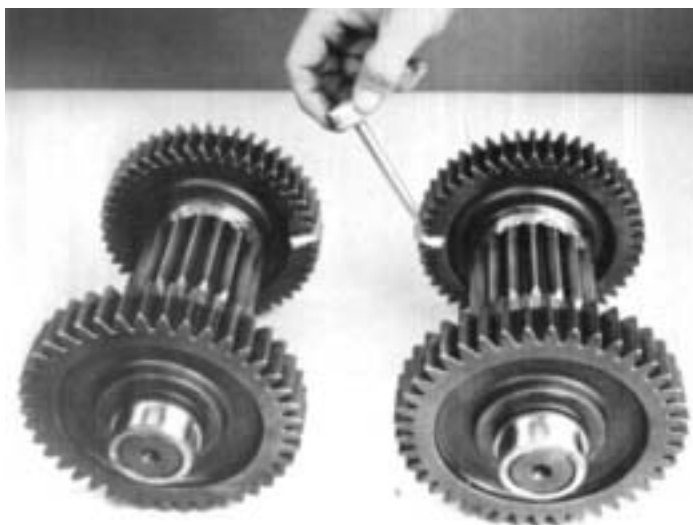
# REASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)

## C. Timing and Installation of Auxiliary Countershaft Assemblies

**NOTE:** The auxiliary countershaft assemblies **CANNOT** be installed in housing with prior installation of the splitter shift yoke.



1. If previously removed, install the bearing inner race on front of each countershaft.



2. On the splitter gear of each assembly, use a highly visible color of toolmakers' dye to mark the tooth stamped with an "O" for timing purposes.



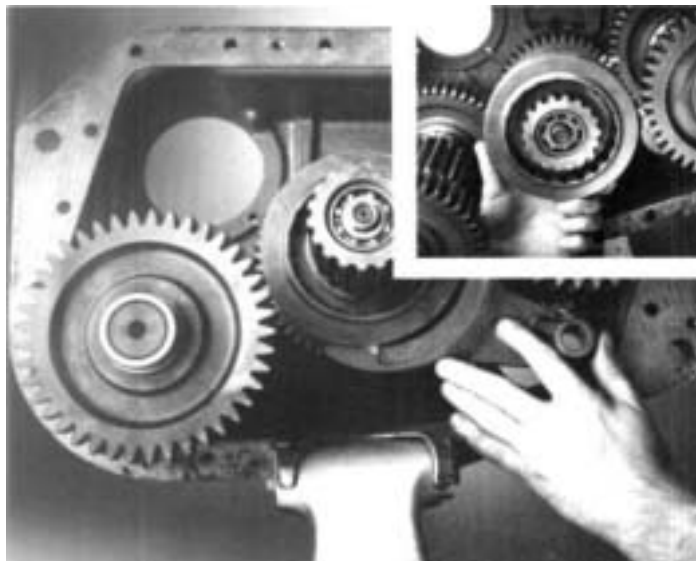
3. Place the left countershaft assembly into position in housing and mesh the marked tooth of countershaft splitter gear with either set of two marked teeth of splitter gear on output shaft. **DO NOT INSTALL REAR BEARING AT THIS TIME.**



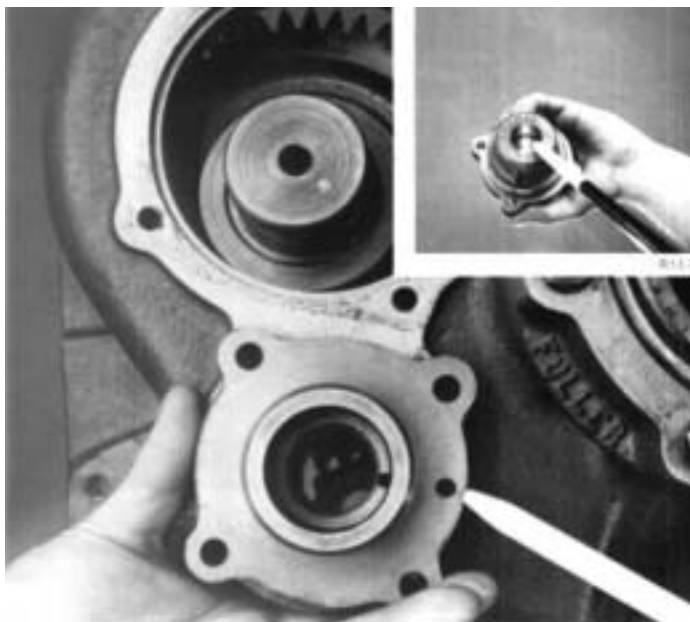
4. Repeat the previous procedure with the right countershaft assembly, meshing the marked tooth of countershaft splitter gear with the remaining set of two marked teeth of splitter gear on output shaft. **DO NOT INSTALL REAR BEARING AT THIS TIME.**

# REASSEMBLY-AUXILIARY SECTION (13-SPEED MODELS)

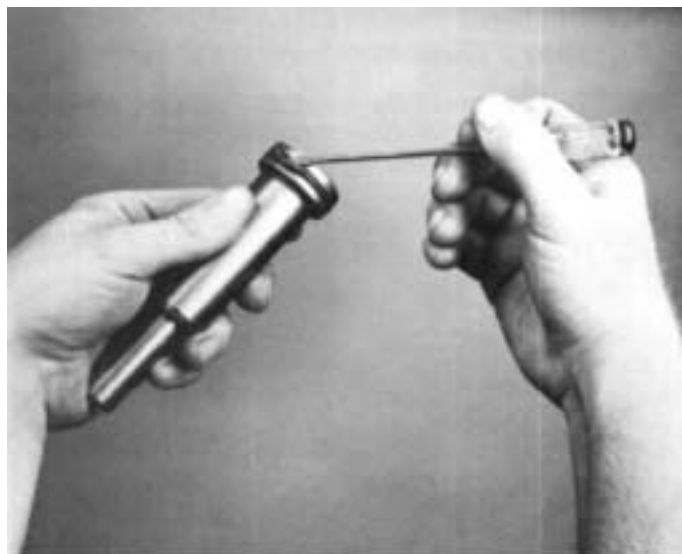
## D. Reassembly and Installation of Splitter Cylinder Assembly



1. Install the splitter sliding clutch on output shaft, internal splines toward gear and engaged with splines of shaft (inset). Place the splitter shift yoke into position with sliding clutch on output shaft, yoke hub to the front of housing.



2. If previously removed, install the small O-ring in bore of cylinder housing (inset). Position the corresponding new gasket on housing mounting surface and install the splitter cylinder housing in rear bore of auxiliary housing, air channel to the right.

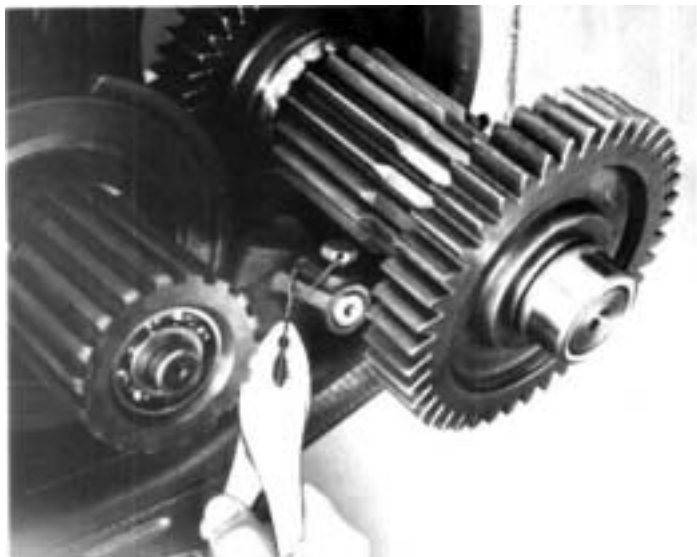


3. If previously removed, install the O-ring in O.D. groove of yoke bar piston.

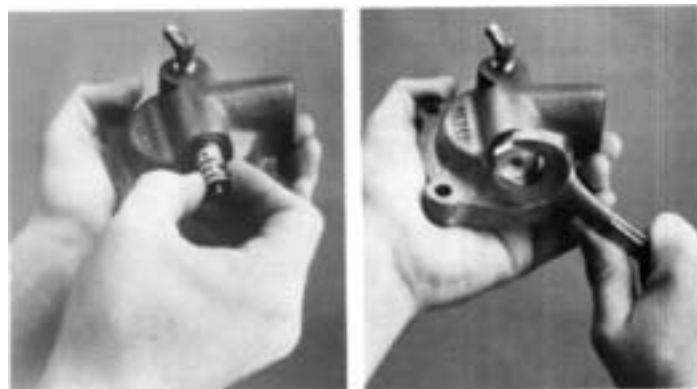


4. From the rear of housing, insert the yoke bar through cylinder bore and into shift yoke, aligning the notch in bar with lockscrew hole in yoke hub.

# REASSEMBLY-AUXILIARY SECTION (13-SPEED MODELS)



5. Install the yoke lockscrew, tighten and wire secure.



6. If previously removed, install the insert valve in bottom bore of cylinder cover, flat end to the inside (left). Install the valve retaining nut in exhaust port of cover and tighten to recommended torque ratings (right).

**NOTE:** Prior to installation of insert valve, make sure the three O-rings on valve O.D. are not defective. Replace, if necessary.



7. Position the corresponding new gasket on cover mounting surface and install the splitter cylinder cover on cylinder housing, exhaust port down. install the capscrews in cover and tighten to secure the assembly on auxiliary housing.

**NOTE:** With the cover installed in this manner, the air channel of cover will align with that of cylinder housing.

## E. Installation of Low Range Gear



1. Install the snap ring in groove of range mainshaft (inset). Install the coupler on range mainshaft against snap ring, clutching teeth to the rear.

# REASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)



2. Spread the countershaft assemblies with splitter gear set remaining in time and install the low range gear on shaft against coupler, clutching teeth to the front.

**NOTE:** To spread countershaft far enough to install low range gear, move the splitter clutch to the forward position.



4. Install the key in keyway of range mainshaft, inserting the thick end of key in keyway of tolerance washer to lock low range gear on shaft.

## F. Reassembly and Installation of Synchronizer Assembly



3. Install the splined tolerance washer on mainshaft and in hub of low range gear. Rotate the washer in groove of mainshaft to engage external splines with clutching teeth of gear and align the keyway of washer with keyway of mainshaft.  
**IMPORTANT:** This washer is available in varying thicknesses. Use the splined tolerance washer that provides a snug fit in gear hub.



1. Place the larger low range synchronizer ring on bench and install the sliding clutch on blocker pins, recessed side up.

# REASSEMBLY - AUXILIARY SECTION (1 3-SPEED MODELS)

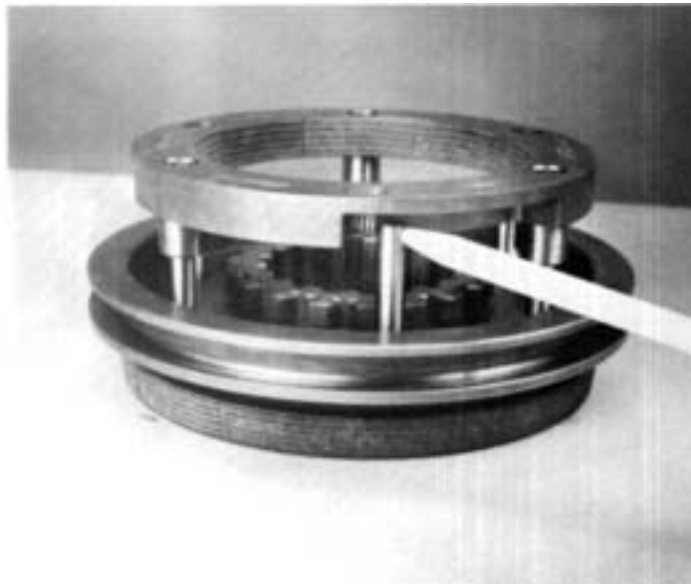
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2. Install the three springs in bores of high range synchronizer ring.



4. Apply downward pressure to the high range synchronizer ring WHILE TWISTING COUNTER-CLOCKWISE to compress the springs and fully seat ring on blocker pins of low range synchroni-



3. Place the high range synchronizer ring over blocker pins of low range synchronizer, seating the springs against pins.

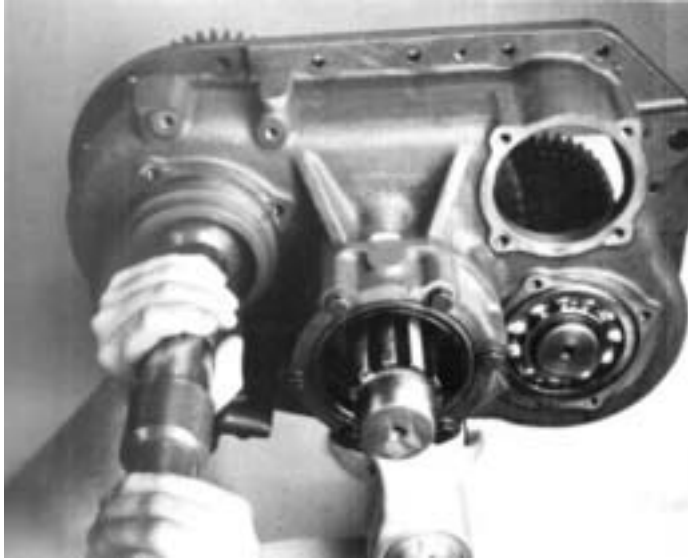


5. Spread the countershaft assemblies with splitter gear set remaining in time and install the synchronizer assembly on splines of range mainshaft, low range ring in recess of low range gear.

# REASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)

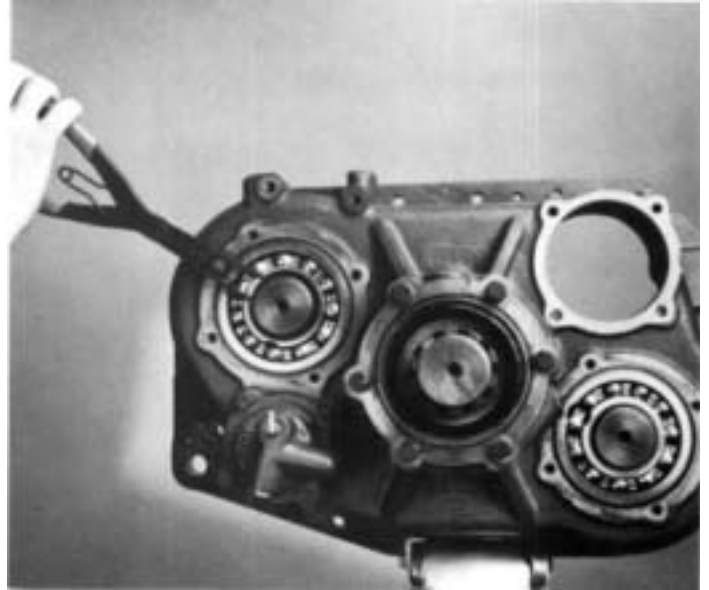
## G. Installation of Auxiliary Countershaft Rear Bearings

**NOTE:** The splitter gear set **MUST** remain in time during the installation of rear bearings.

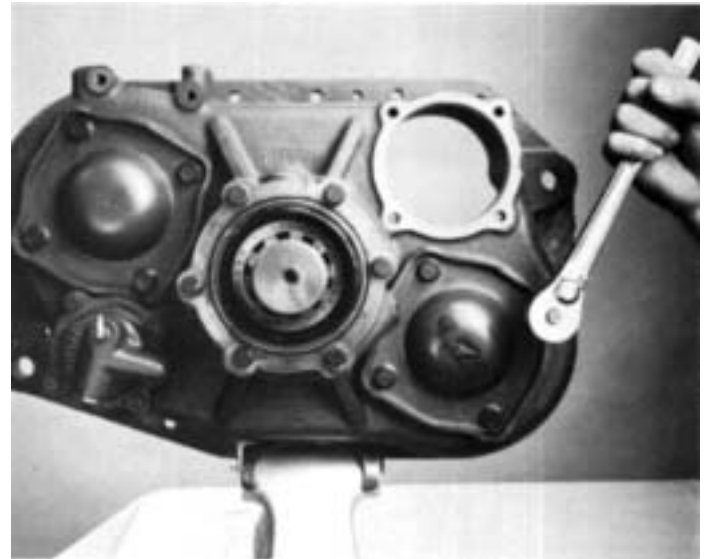


1. Center the rear of either countershaft assembly in bearing bore and use a soft bar to start rear bearing in bore. Complete installation with a flanged-end bearing driver and maul. Repeat the procedure with other auxiliary countershaft assembly, making sure the splitter gear set has remained in time.

**NOTE:** Check the synchronizer assembly for springs that may have been released from bores in high range ring during bearing installation.



2. Install the snap ring in groove at rear of each countershaft.

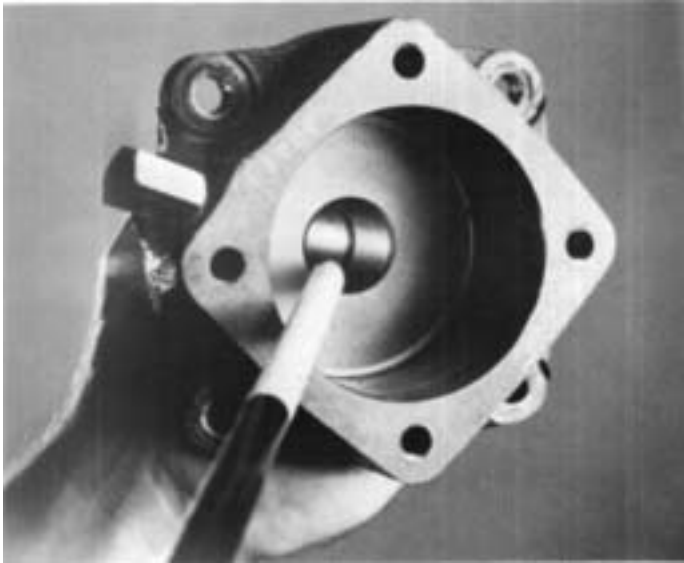


3. Position the corresponding new gasket on cover mounting surface and install both rear bearing covers. Tighten capscrews to secure covers to auxiliary housing.

**NOTE:** For reassembly and installation of models equipped with an Auxiliary Oil Pump Assembly on rear of countershaft, see OPTIONS.

# REASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)

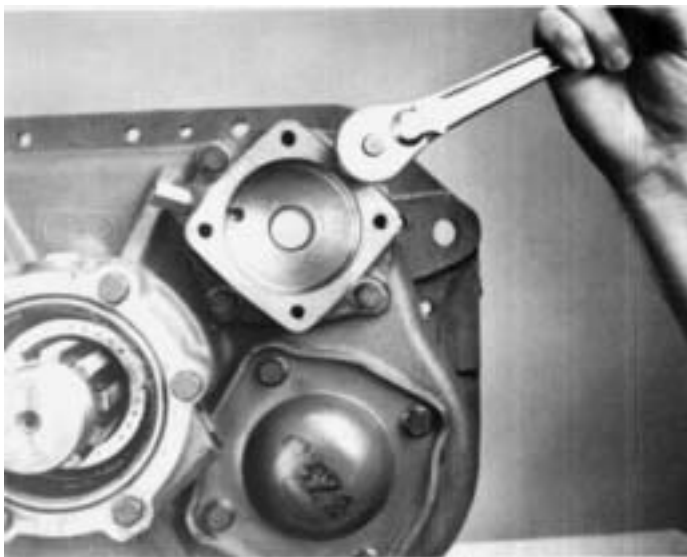
## H. Reassembly and Installation of Range Cylinder Assembly



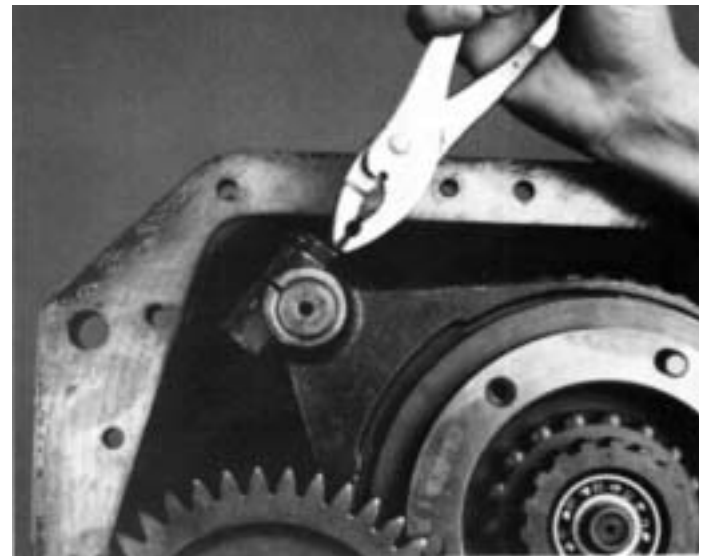
1. If previously removed, install the O-ring in bore of range cylinder housing.



3. Place the range yoke into position with sliding clutch of synchronizer assembly, long hub of yoke to the rear. Insert threaded-end of yoke bar through yoke and into bore of range cylinder housing, aligning the notches in bar with yoke lockscrew holes.



2. Position the corresponding new gasket on housing mounting surface and install the cylinder housing in rear bore of auxiliary housing, air fitting to the upper left. Tighten capscrews to secure cylinder housing to auxiliary housing.



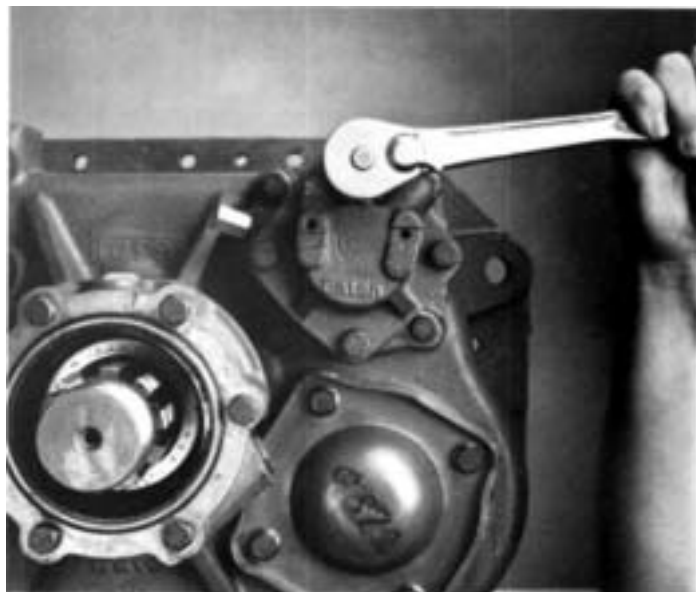
4. Install the two yoke lockscrews, tighten and wire securely.

# REASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)

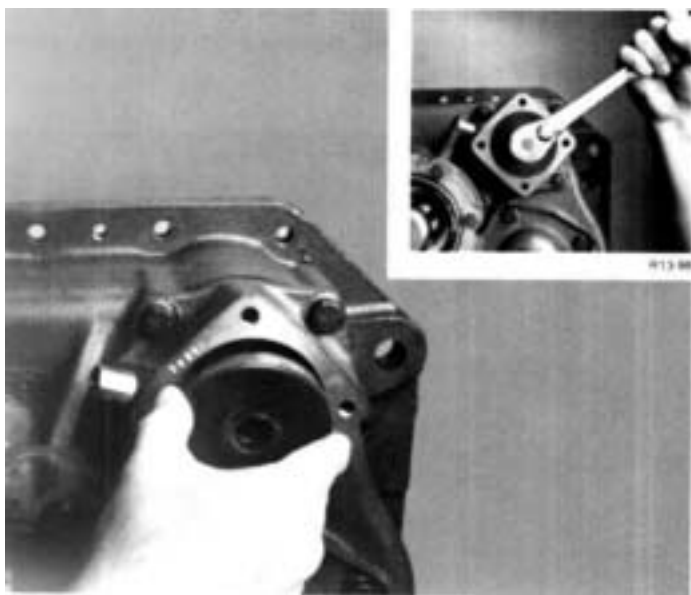
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5. If previously removed, install the O-rings in the I.D. and O.D. of range piston.



7. Position the corresponding new gasket on cover mounting surface and install the range cylinder cover on housing, open port to the upper left.



6. In cylinder housing bore, install the range piston on yoke bar, flat side to the rear. Secure with nut tightened to recommended torque ratings (inset).

# DISASSEMBLY - FRONT SECTION

## A. Removal of Front Bearing Cover and Input Shaft Nut



1. Turn out the retaining cap screws and remove the drivegear bearing cover and gasket.



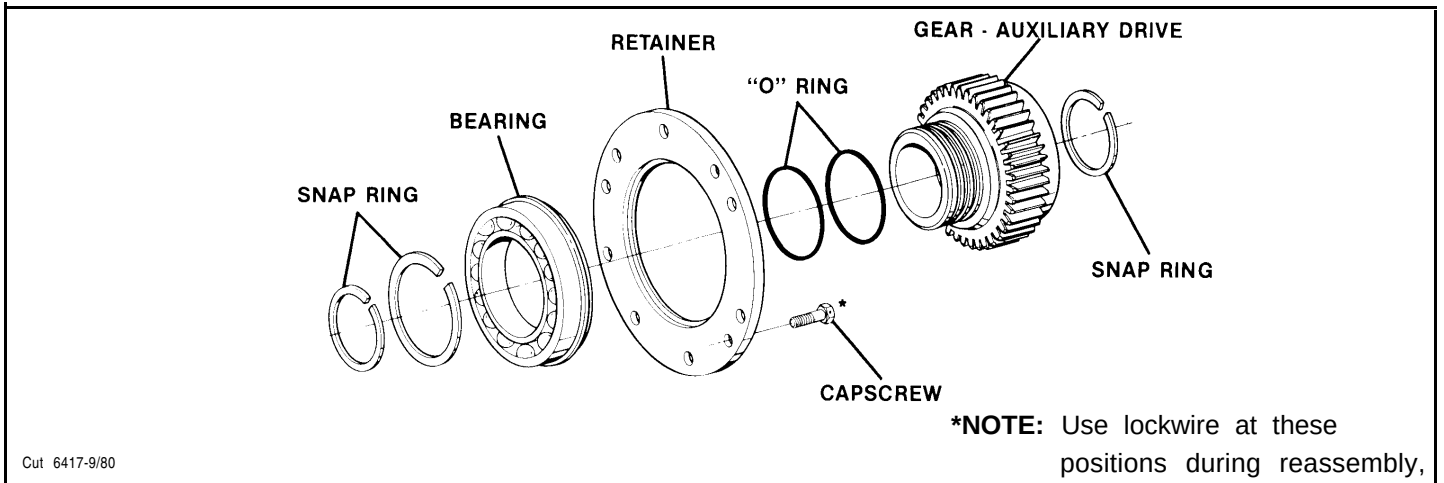
3. Engage two mainshaft sliding clutches into gear, this prevents transmission from rotating. Remove nut (left hand thread) with drive gear nut removing tool.



2. If necessary remove the oil seal from cover of models so equipped.

# DISASSEMBLY - FRONT SECTION

## CASE ASSEMBLIES



### B. Removal and Disassembly of Auxiliary Drive Gear Assembly

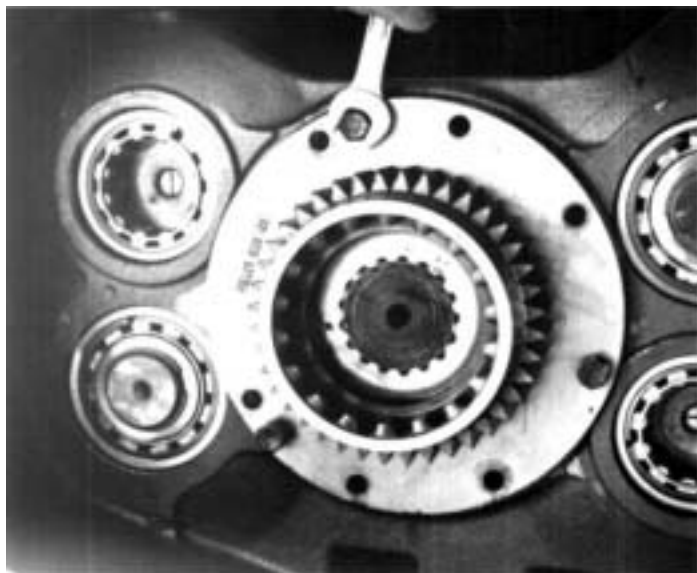


1. Remove the snap ring from groove at rear of mainshaft.



2. Cut lockwire and remove the cap screws from bearing retainer ring.

# DISASSEMBLY - FRONT SECTION



3. Insert three puller screws in the specially tapped holes of retainer ring. Tighten screws evenly to



5. Using the rear face of retainer ring as a base, press the drive gear through bearing.

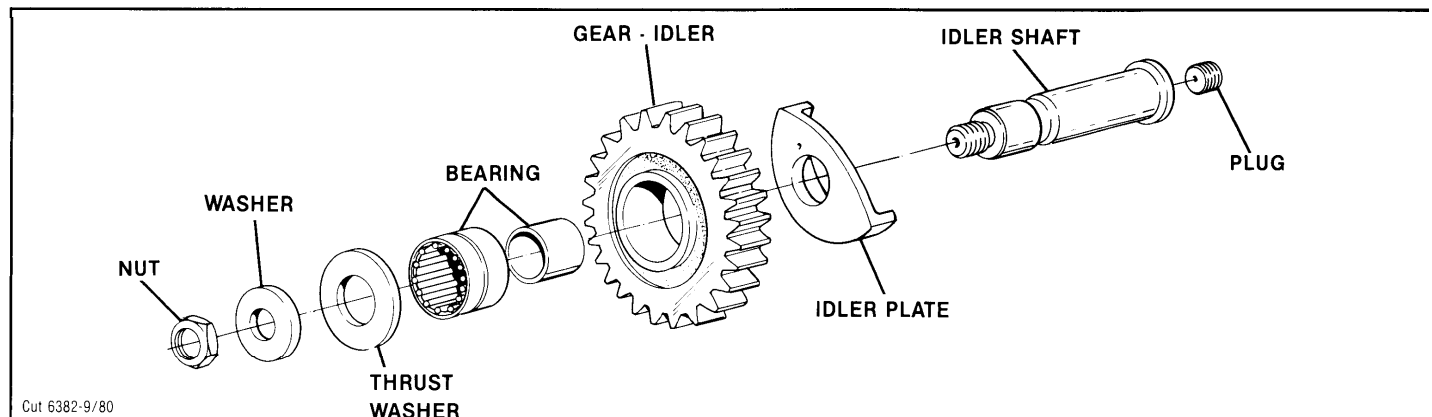


4. Remove the snap ring from hub of auxiliary drive gear.



6. If necessary, remove the O-rings from hub O.D. of auxiliary drive gear.

# DISASSEMBLY - FRONT SECTION



## C. Removal and Disassembly of Left Reverse Idler Gear Assembly

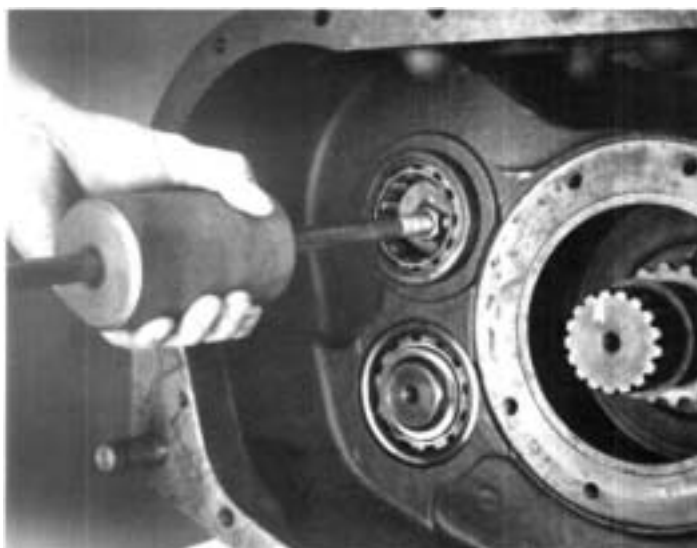


1. Move the mainshaft reverse gear as far to the rear as possible and remove the snap ring from I.D. of gear.

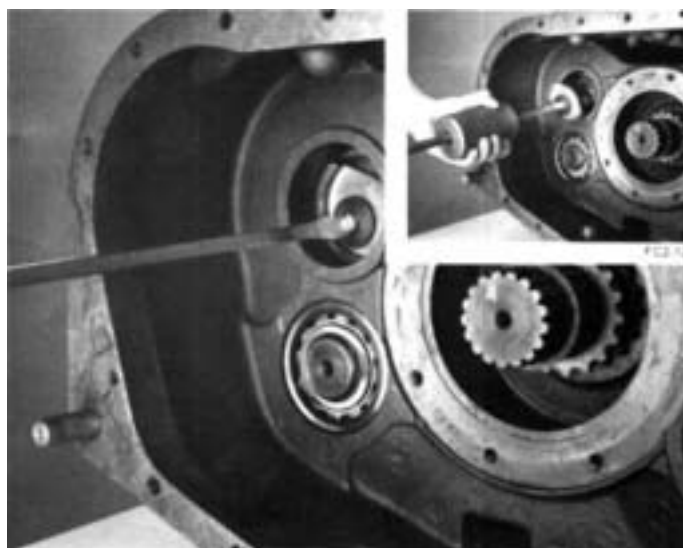


2. Move the reverse gear forward and against the LOW speed gear, engaging the splines of mainshaft sliding clutch.

# DISASSEMBLY - FRONT SECTION



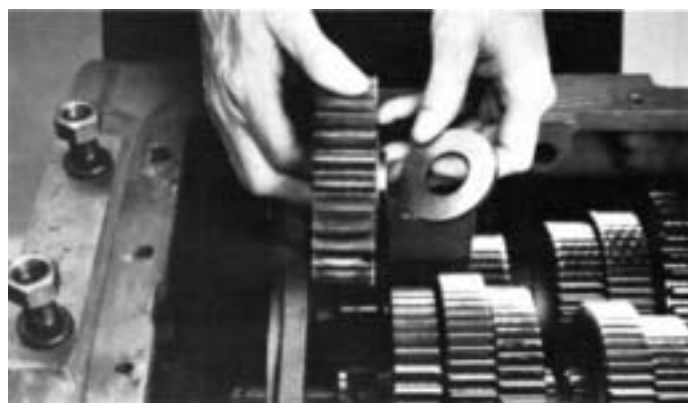
3. Using jaw pullers or impact puller, remove the auxiliary countershaft front bearing from left reverse idler gear bore. If necessary, repeat the procedure for removing the auxiliary countershaft front bearing from right reverse idler gear bore.



5. Remove the pipe plug from rear of idler shaft and use an impact puller, 1/2-13 threaded end, to remove shaft from case bore (inset).



4. Turn out the stop nut from front of idler shaft and remove washer.

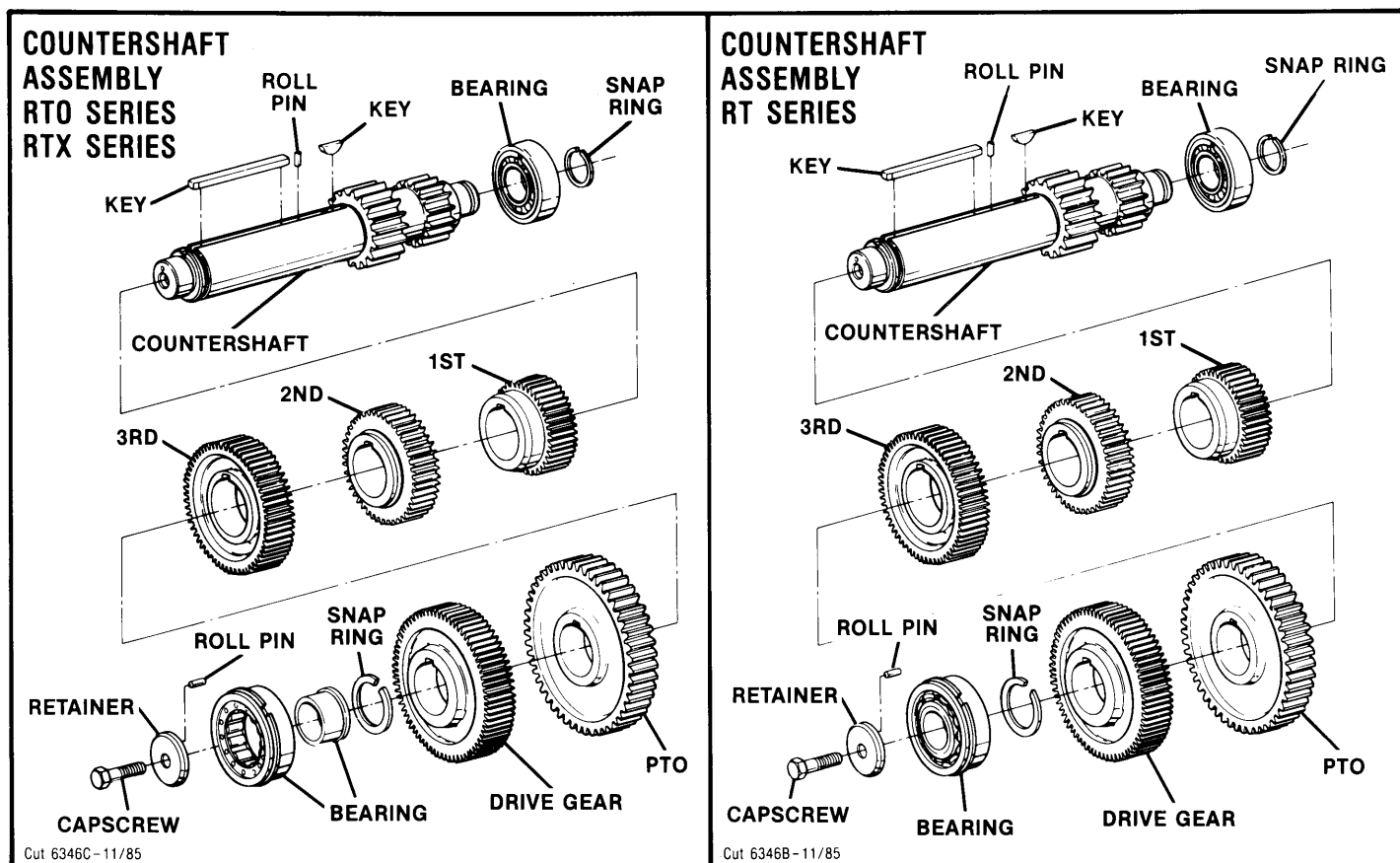


6. As the idler shaft and idler plate are moved to the rear, remove the thrust washer, and gear from case.



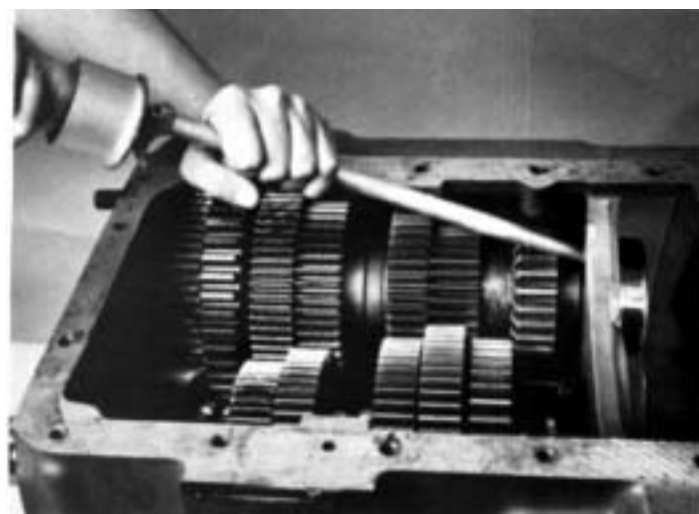
7. If necessary, remove the inner race from bearing.

# DISASSEMBLY FRONT SECTION



## D. Removal of Countershaft Bearings

**NOTE:** In the following instructions, the front and rear bearings from BOTH countershaft are removed. For removal of the mainshaft assembly from case, it is necessary to remove the bearings from right countershaft ONLY.

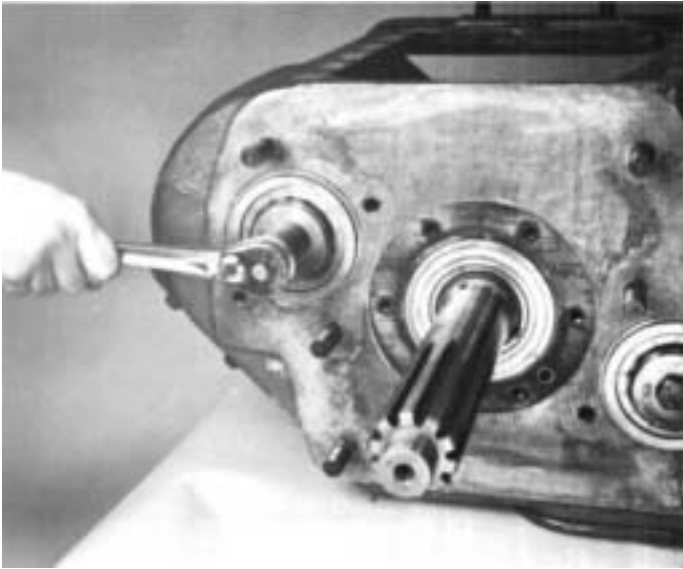


2. From inside the case, use a soft punch and maul to drive the countershaft rear bearings to the rear and from case bores.

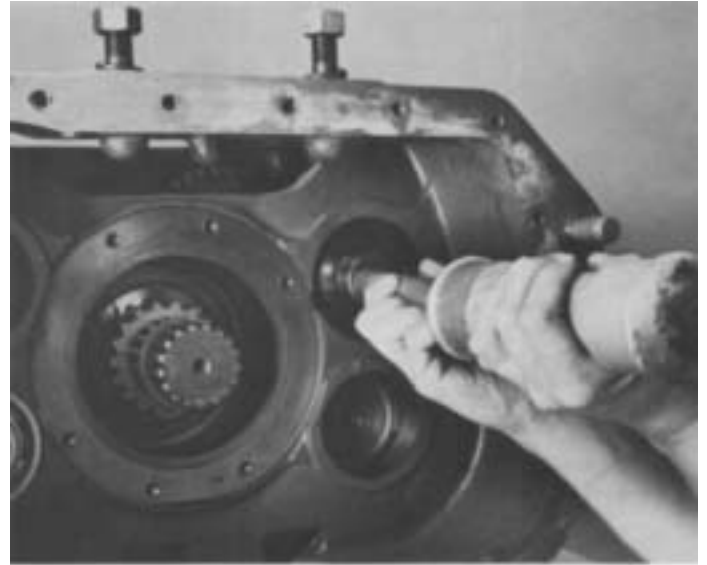
**NOTE:** This procedure will damage the bearings and should not be attempted unless replacement of the bearings is planned.

1. Remove the snap ring from groove at rear of each countershaft.

# DISASSEMBLY - FRONT SECTION



3. Turn out the cap screw and remove the front bearing retainer plate from each countershaft.



5. From the rear of case, use a soft bar and maul to drive each countershaft forward to unseat the front bearings from case bores and expose the bearing snap rings.

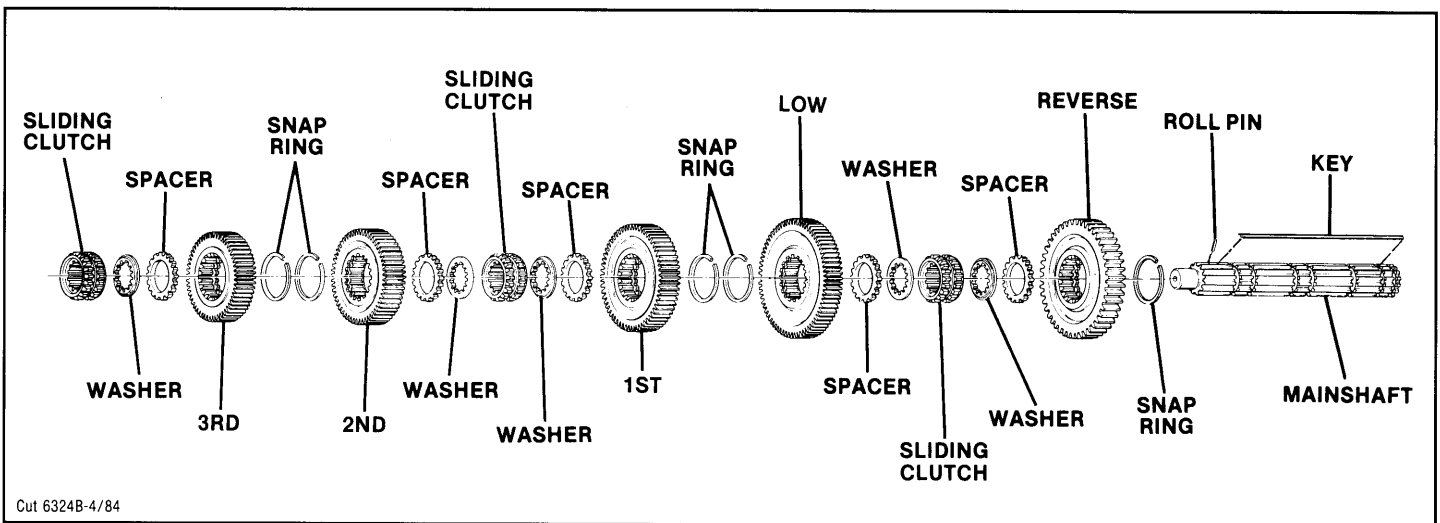


4. Use a soft bar and maul to drive each countershaft to the rear as far as possible. This will partially unseat the front bearings.  
**NOTE:** The soft bar used should have a flattened end that is large enough so as not to damage holes for roll pin and cap screw.

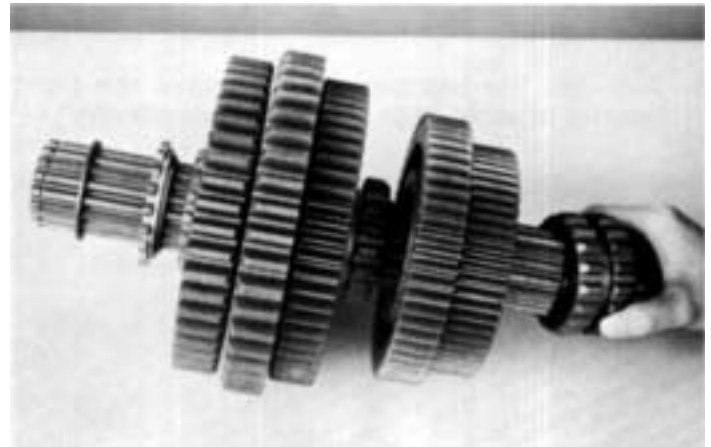


6. Use a bearing puller or pry bars to remove the countershaft front bearings.  
**NOTE:** The bearing inner race of models equipped with roller-type front bearings will remain pressed on countershaft.

# DISASSEMBLY - FRONT SECTION

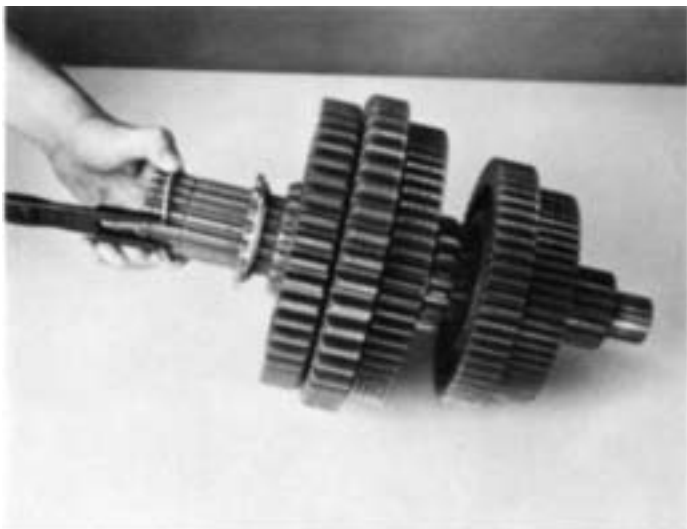


## E. Removal and Disassembly of Mainshaft Assembly

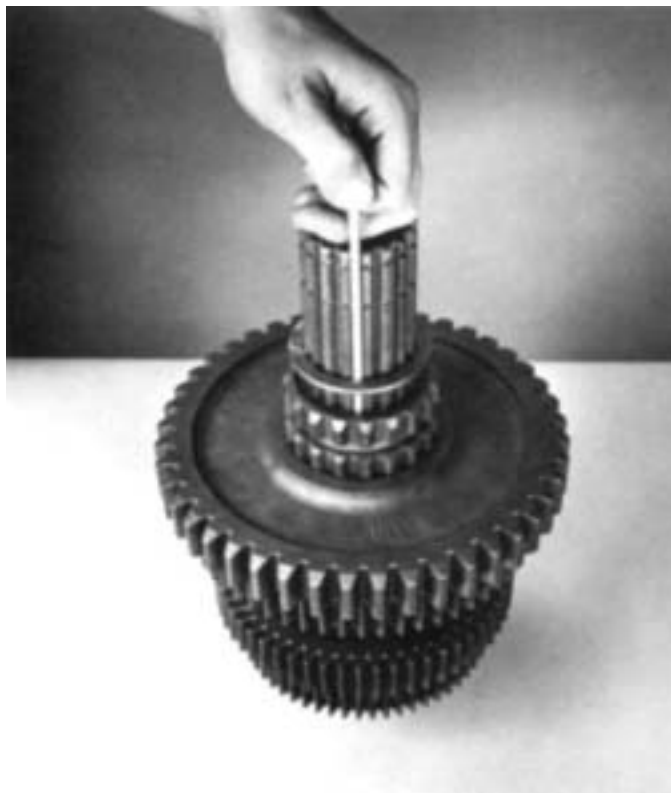


1. Block the right countershaft assembly against case wall and pull the mainshaft assembly to the rear to free pilot from pocket of input shaft. Tilt front of mainshaft up and lift the assembly from case (inset). Use caution as the reverse gear is free and can fall from shaft.
2. Remove the 3rd-4th speed sliding clutch from front of mainshaft.

# DISASSEMBLY - FRONT SECTION

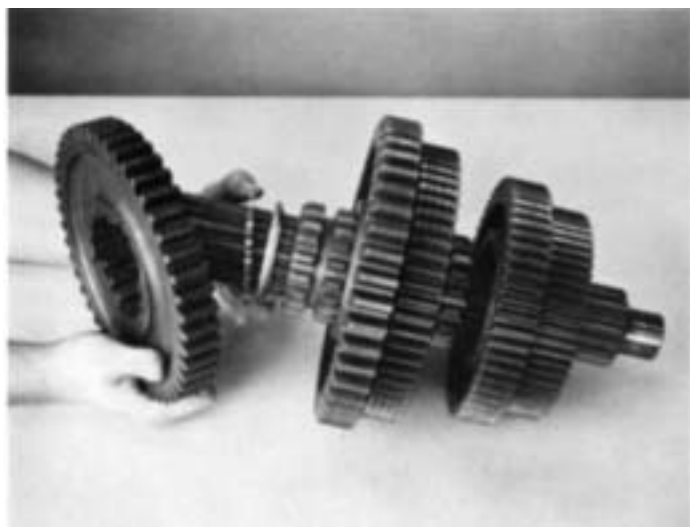


3. Remove the snap ring from groove at rear of mainshaft.

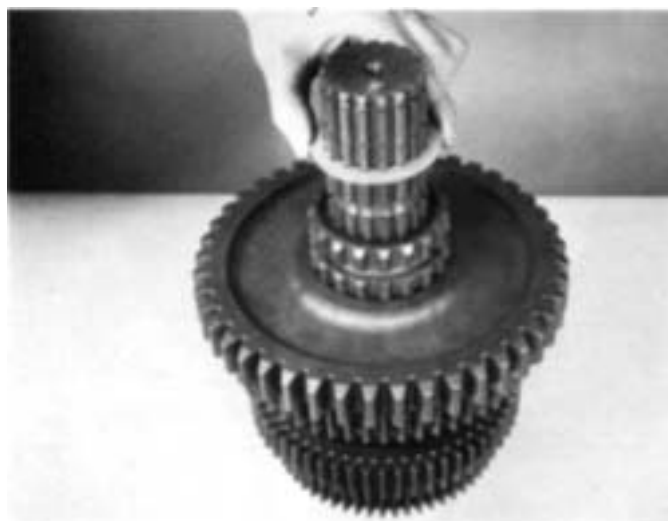


5. From rear of mainshaft, pull the key from mainshaft keyway.

**NOTE:** When removing limit washers, spacers and gears, note their location on mainshaft to facilitate reassembly. Keep the internal-splined washers and external-splined spacers with the gear from which they were removed. There is ONLY one limit washer and one spacer belonging to each gear.



4. Remove the reverse gear and spacer from rear of mainshaft.



6. Turn the reverse gear limit washer to align its splines with those of mainshaft and remove

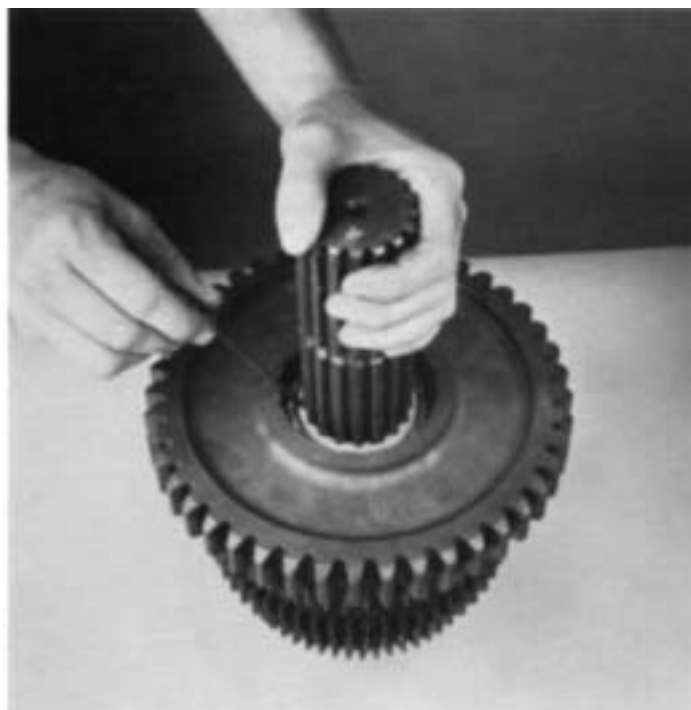
# DISASSEMBLY - FRONT SECTION



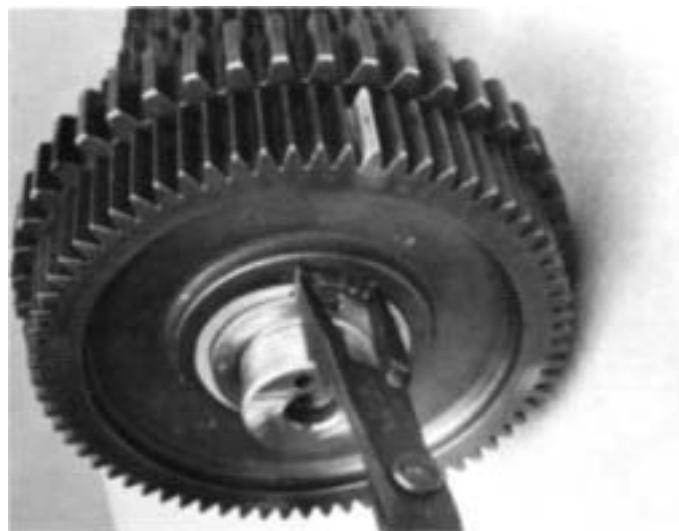
7. Remove the LO-Reverse speed sliding clutch from mainshaft.



9. Pull the LO speed gear from rear of mainshaft to remove limit washer, spacer and gear. If necessary, remove the snap ring from I.D. of gear (inset).

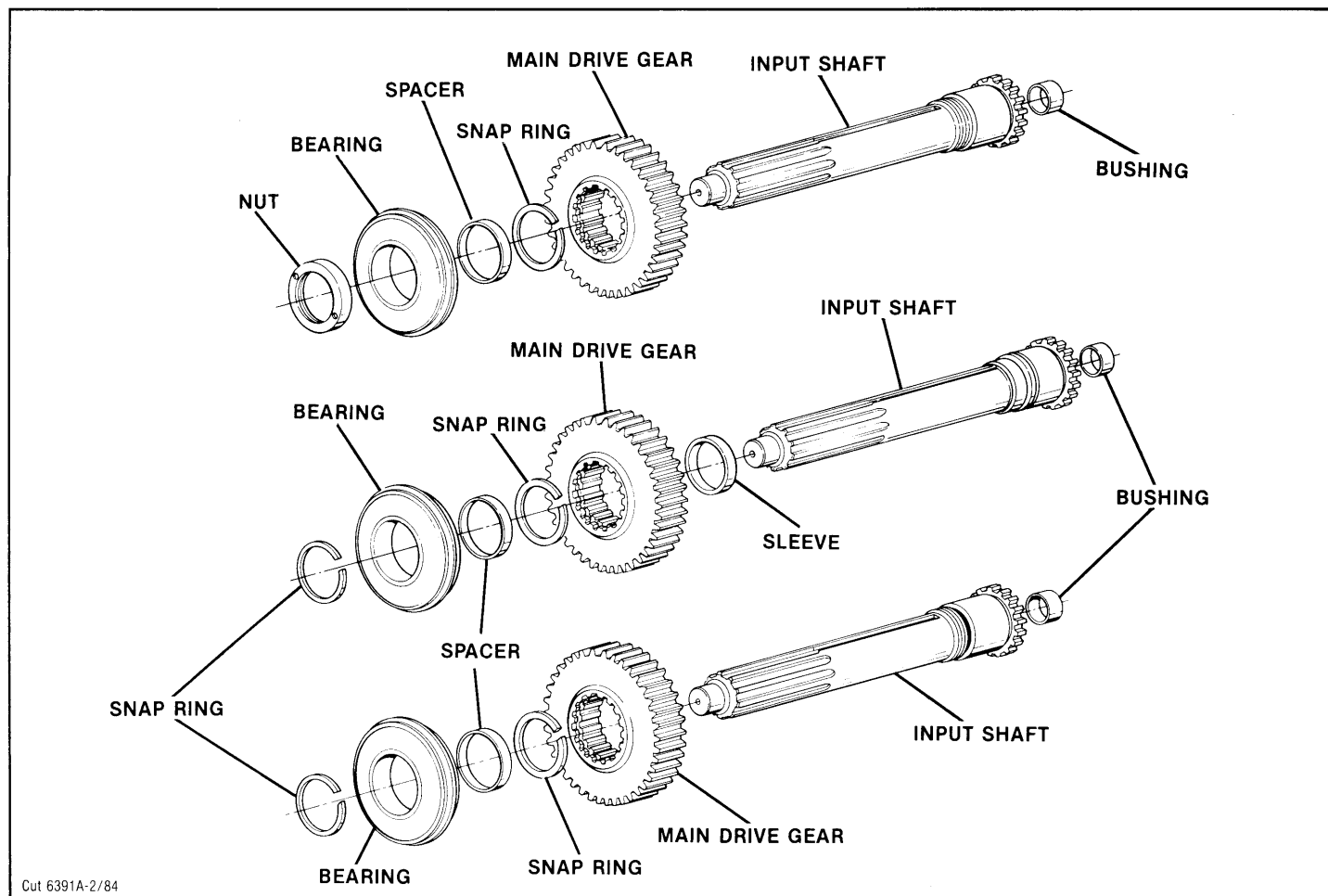


8. Using a small screwdriver, turn the limit washer in hub of LO speed gear to align its splines with those of the mainshaft.

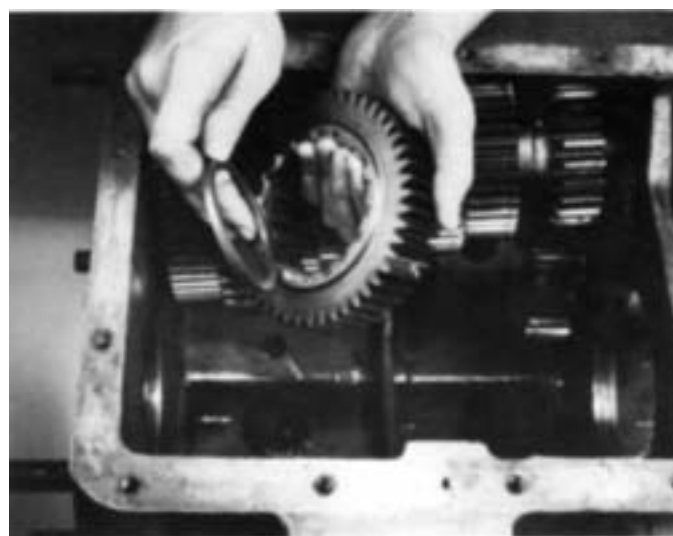


10. Remove each remaining gear, limit washer, spacer and sliding clutch from mainshaft in the same manner previously detailed. And, if necessary, remove the snap ring from I.D. of each gear.

# DISASSEMBLY - FRONT SECTION



## F. Removal and Disassembly of Main Drive Gear Assembly

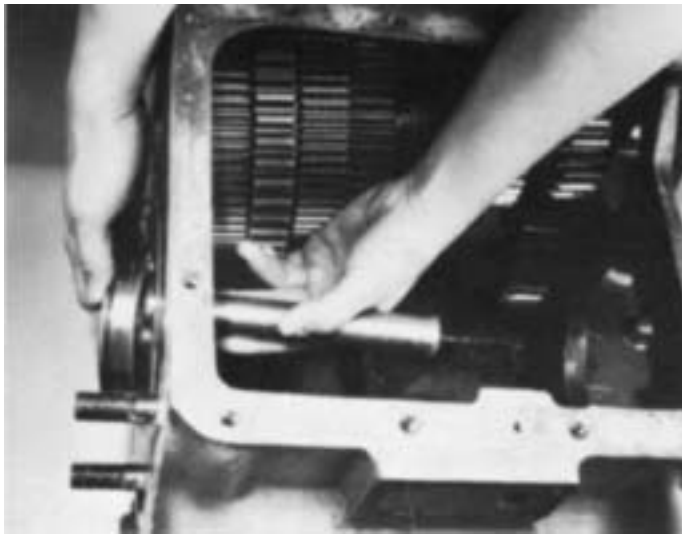


1. Drive the input shaft back through bearing with a soft bar and maul. Remove input shaft from case (inset).

2. Move upper countershaft to right and remove drive gear and spacer from case.

# DISASSEMBLY - FRONT SECTION

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3. Drive the input shaft bearing out the front of case.



5. Check the bushing in pocket of input shaft and replace if worn or damaged.
6. Remove the front and rear bearings from left countershaft as described in Part D of this section.

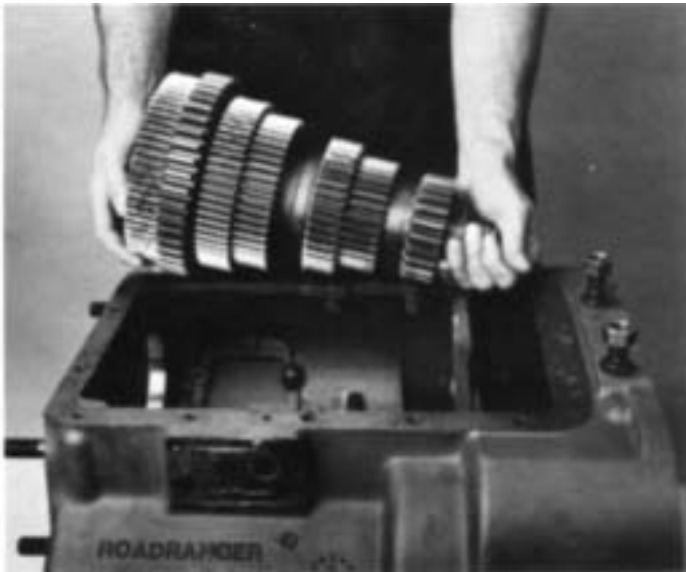


4. If necessary, remove the snap ring from drive gear.

# DISASSEMBLY - FRONT SECTION

## G. Removal and Disassembly of

**NOTE:** Refer to the illustration provided at Part D of this section. Except for the PTO gears, the left and right countershaft assemblies are identical and disassembled in the same manner.



1. Move the right countershaft assembly to the rear as far as possible so front of shaft can be removed from case bore and moved to the center of case. Lift the assembly from case and repeat the procedure for left countershaft assembly.

**NOTE:** The left and right reverse idler gear assemblies are identical and disassembled in the same manner. If removal and disassembly of this assembly is necessary, refer to Part C of this section.



2. Remove the drive gear retaining snap ring from front of each countershaft.



3. Using the rear face 3rd speed gear as a base, press the drive gear, PTO gear and 3rd speed (or overdrive) gear from each countershaft (left). This will also remove the front bearing inner race from countershaft of models so equipped (right).

**IMPORTANT:** NEVER USE THE PTO GEAR AS A PRESSING BASE. The narrow face width of this gear makes it very susceptible to breakage.



4. Using the rear face of 1st speed gear as a base, press the 2nd speed and 1st speed gears from each countershaft.

**NOTE:** Always use caution when pressing a cluster of gears from countershaft. It is necessary to press these gears off in a cluster of three and, then, in a cluster of two.

# DISASSEMBLY-FRONT SECTION

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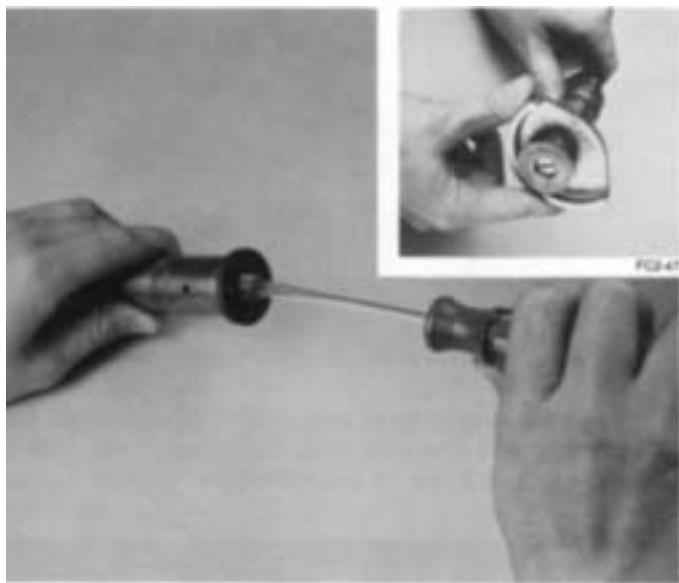
5. If necessary, remove the keys and roll pin from countershaft.

# REASSEMBLY - FRONT SECTION

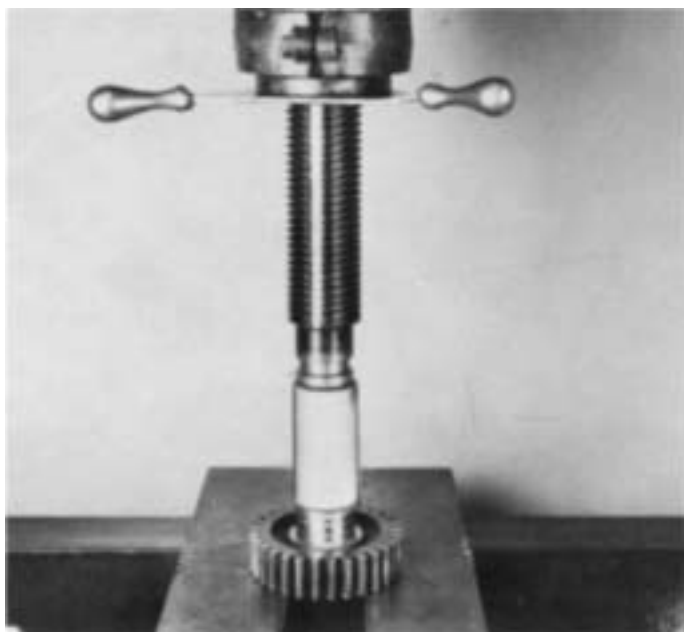
## CASE ASSEMBLIES

**NOTE:** Before starting reassembly, make sure the three magnetic discs are solidly in place at bottom of case. These can be secured to disc mounting surfaces with Scotch Grip Rubber Adhesive or equivalent adhesive.

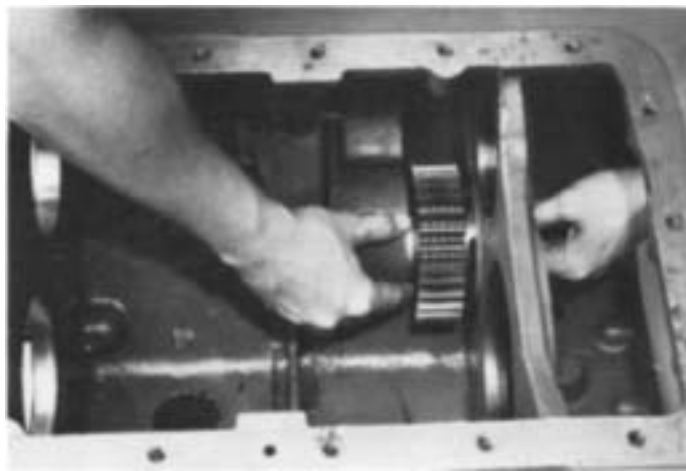
### A. Reassembly and Installation of Right Reverse Idler Gear Assembly



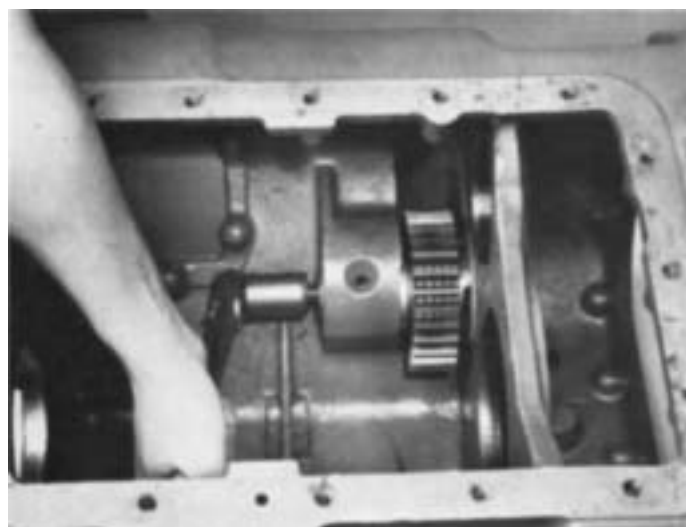
1. If previously removed, thread pipe plug in rear of reverse idler shaft and tighten. Install the idler plate on shaft, flat side to the front (inset).



2. If previously removed, press the needle bearing into bore of reverse idler shaft.

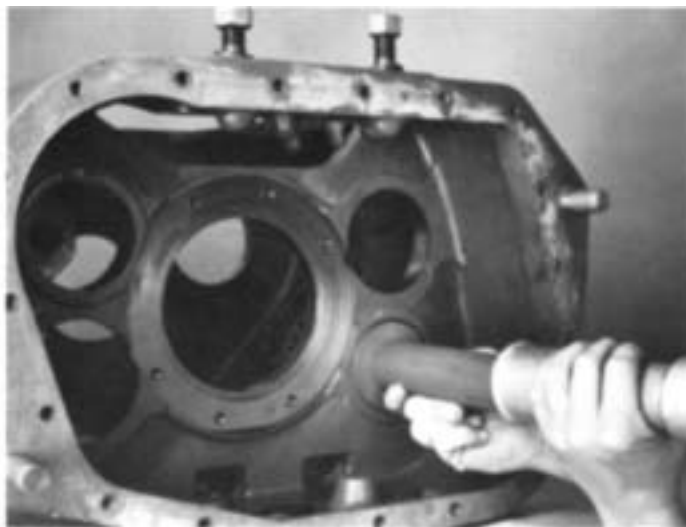


3. Install the bearing inner race on idler shaft and insert shaft into case bore, threaded-end of shaft to the front. As the idler shaft is moved forward, install the reverse idler gear on shaft, long hub to the front and seating on bearing inner race. Position the thrust washer on shaft between the gear and support boss in case and continue with movement of idler shaft forward into bore of support boss.



4. Making sure that the reverse idler shaft is seated in bore of support boss and forward as far as possible, install the washer and stop nut on front of shaft. Tighten nut to recommended torque rating.

# REASSEMBLY-FRONT SECTION



5. Install the OUTER RACE of auxiliary countershaft front bearing into case bore and against idler plate.

**NOTE:** The bearing INNER RACE is installed on front of auxiliary countershaft and never with outer race.

## B. Reassembly of Countershaft Assemblies

**NOTE:** Except for the PTO gears, the left and right countershaft assemblies are identical and reassembled in the same manner.



1. If previously removed, install the roll pin and key in keyway of countershaft.



2. Align keyway of gear with key in countershaft and press the 1st speed gear on shaft, long hub of gear to the front of countershaft.



3. Press the 2nd speed gear on countershaft, long hub of gear against 1st speed gear hub.

# REASSEMBLY - FRONT SECTION

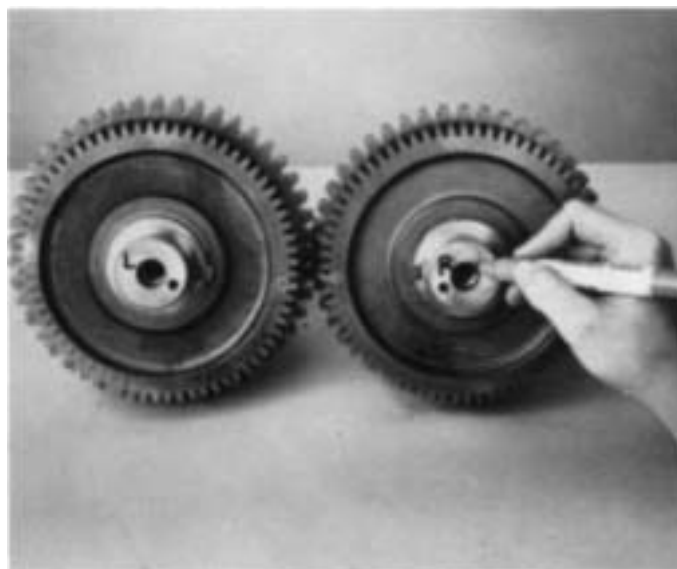


4. Press the 3rd speed (or Overdrive) gear on countershaft, long hub of gear to the front of shaft.

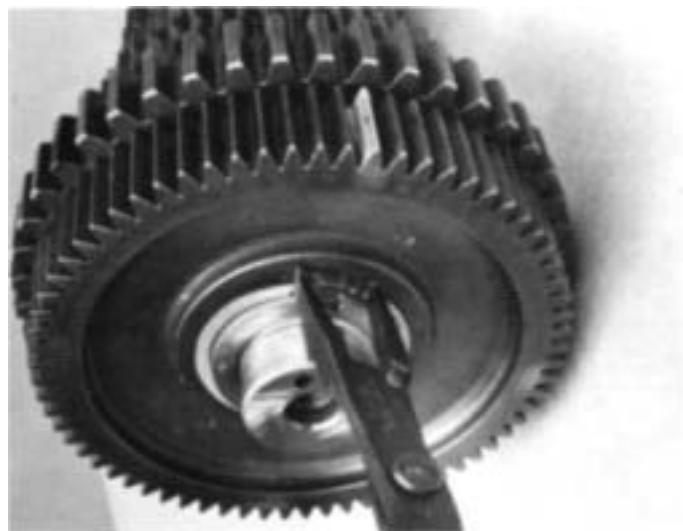


5. Start the PTO gear onto countershaft, bullet-nose side of teeth facing up and toward rear of shaft. Align keyway of drive gear with key in countershaft and press BOTH gears onto shaft, long hub of drive gear against PTO gear.

**NOTE:** The left countershaft assembly has a 47-tooth PTO gear; the right countershaft assembly has a 45-tooth PTO gear.



6. To avoid confusion during installation, mark the end of left countershaft with an "L"; the end of right countershaft with an "R".

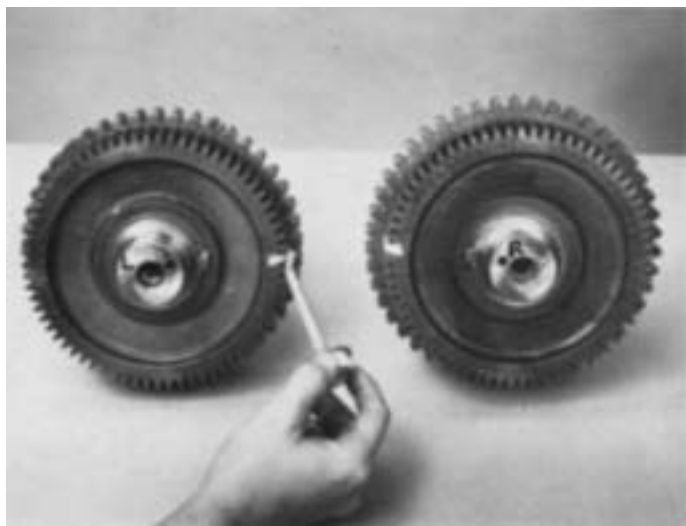


7. Install the drive gear retaining snap ring in groove on front of each countershaft.

# REASSEMBLY - FRONT SECTION

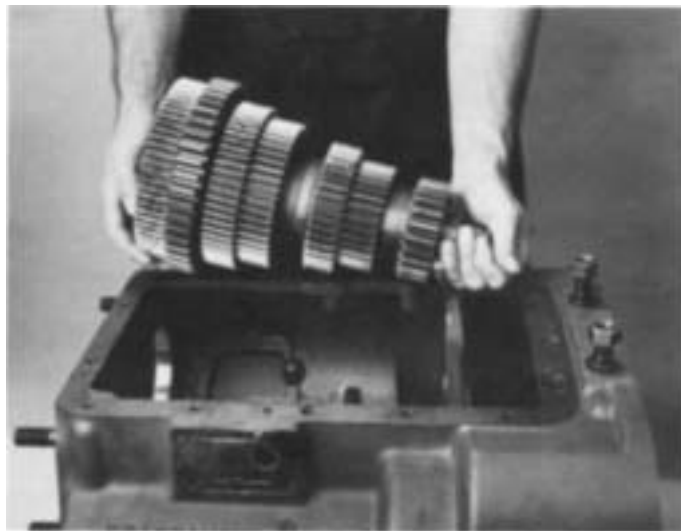


8. For models equipped with roller-type front bearings, use a rubber mallet or flanged-end driver to install bearing inner race on shaft, shoulder of race against shoulder of countershaft.



**IMPORTANT:** Mark the countershaft drive gear for timing purposes. On the drive gear of each countershaft assembly, mark the tooth aligned with keyway of gear and stamped with an "O" for easy identification. A highly visible color of toolmakers' dye is recommended for making timing marks.

## C. Partial Installation of Countershaft Assemblies



1. Place the left countershaft assembly into position in case, making sure that the "L"-marked assembly has the larger 47-tooth PTO gear.



2. Place the right countershaft assembly into position in case, making sure that the "R"-marked assembly has the smaller 45-tooth PTO gear.

# REASSEMBLY - FRONT SECTION

## D. Bearing Installation of Left Countershaft Assembly



1. Move the left countershaft assembly to the rear and insert countershaft support tool or blocking to center shaft in rear case bore.



2. Use a flanged-end bearing driver to start the bearing in case bore.  
**NOTE:** The inner race of roller-type front bearing is pressed on front of countershaft.



3. Center the front of left countershaft in bearing and move the assembly forward.



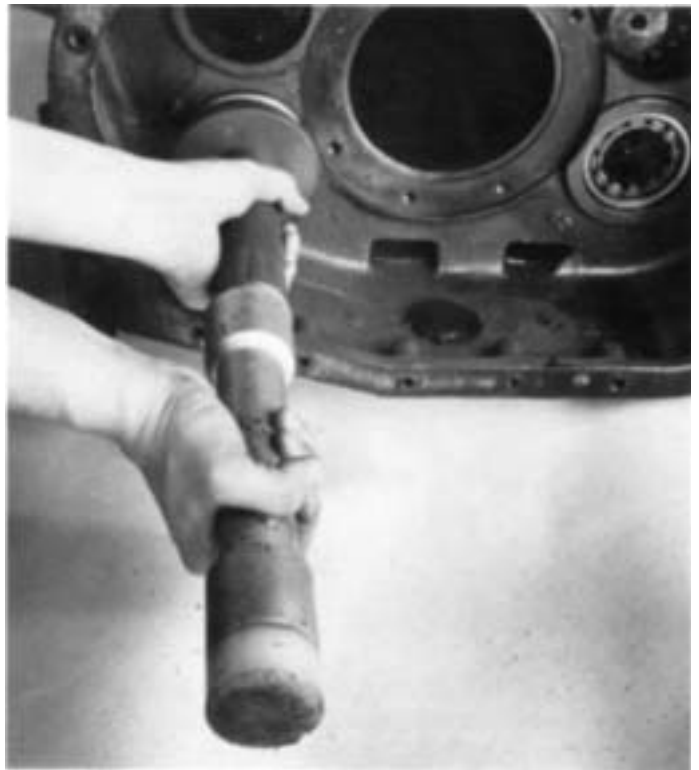
4. Use a flanged-end bearing driver to completely seat front bearing or bearing outer race in case bore.

# REASSEMBLY - FRONT SECTION

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5. Position the retainer plate on front of left countershaft, roll pin in hole at end of shaft, and secure with capscrew tightening to recommended torque ratings.



6. Remove countershaft support tool or blocking from rear case bore and install the left countershaft rear bearing with larger I.D. lead chamfer to the front of shaft and install the snap ring in groove at rear of left countershaft.

# REASSEMBLY - FRONT SECTION

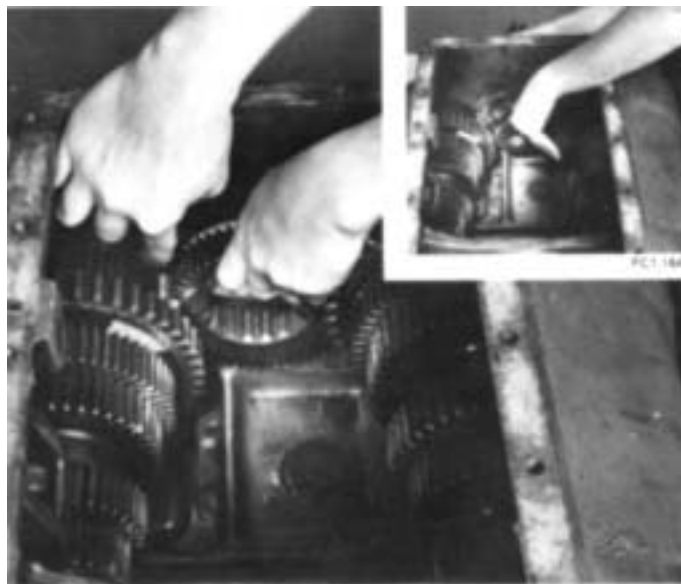
## E. Reassembly, Installation and Timing of Main Drive Gear Assembly



1. If previously removed, install the snap ring in I.D. of main drive gear and the bushing in pocket of input shaft (inset).



2. Mark the main drive gear for timing purposes. Mark any two adjacent teeth on drive gear and repeat the procedure for the two adjacent teeth directly opposite the first set marked. A highly visible color of toolmakers' dye is recommended for marking.



3. Mesh the marked tooth of left countershaft drive gear with either set of two marked teeth on main drive gear. Slide the input shaft through the main drive gear (inset).



4. Install spacer (inset) and bearing on the input shaft with external snap ring to the outside.

# REASSEMBLY - FRONT SECTION



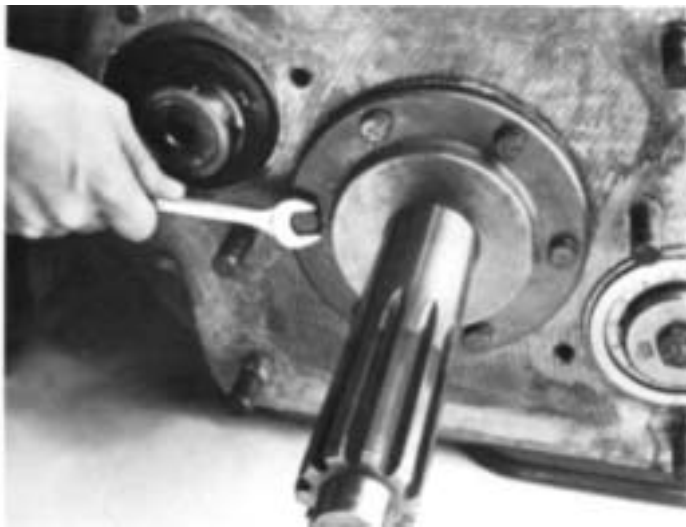
5. Tap the bearing into position in the bore with a soft mallet.



7. Use a soft bar and maul to drive the input shaft through bearing. Remove front bearing cover.

## F. Reassembly of Auxiliary Drive Gear Assembly

**NOTE:** Because the auxiliary drive gear assembly is used in checking reverse gear axial clearances and centering mainshaft in rear bearing bore during Reassembly and Partial Installation of Mainshaft Assembly, it is necessary to complete the following instructions BEFORE proceeding to Part G.

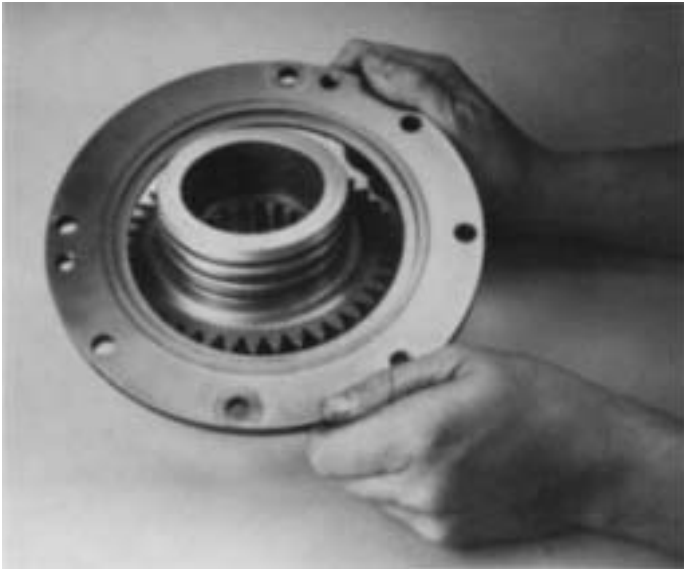


6. Temporarily install the front bearing cover,



1. If previously removed, install the O-rings on extended front hub of auxiliary drive gear.

# REASSEMBLY - FRONT SECTION



2. Install the retainer ring on auxiliary drive gear, snap ring groove facing front hub and away from gear teeth.



4. Install the snap ring in groove of front gear hub to retain bearing.

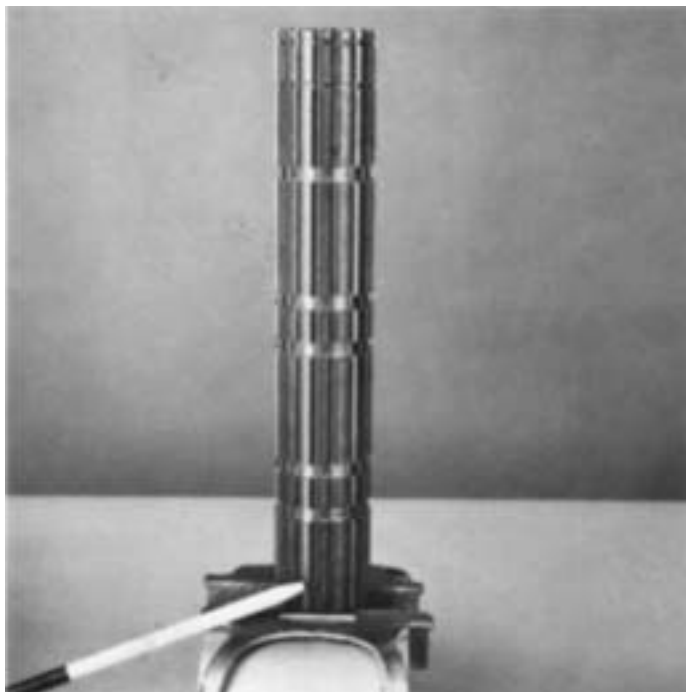
## G. Reassembly and Partial Installation of Mainshaft Assembly

1. If previously removed, install the corresponding snap rings in I.D. of mainshaft gears.

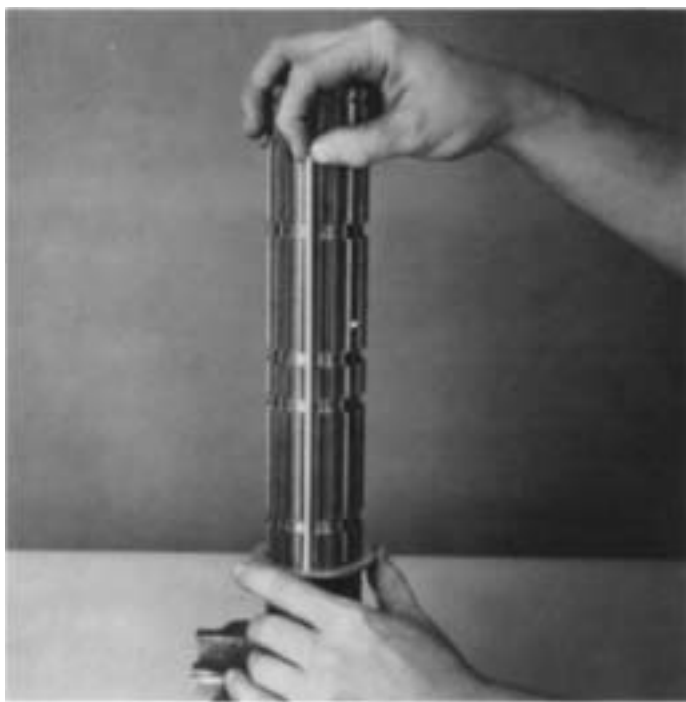


3. Start the auxiliary drive gear bearing on front hub, bearing snap ring facing groove in retainer ring. Using both the inner and outer race of bearing as a base, press the bearing on gear with snap ring in groove of retainer ring or use a bearing driver (inset).

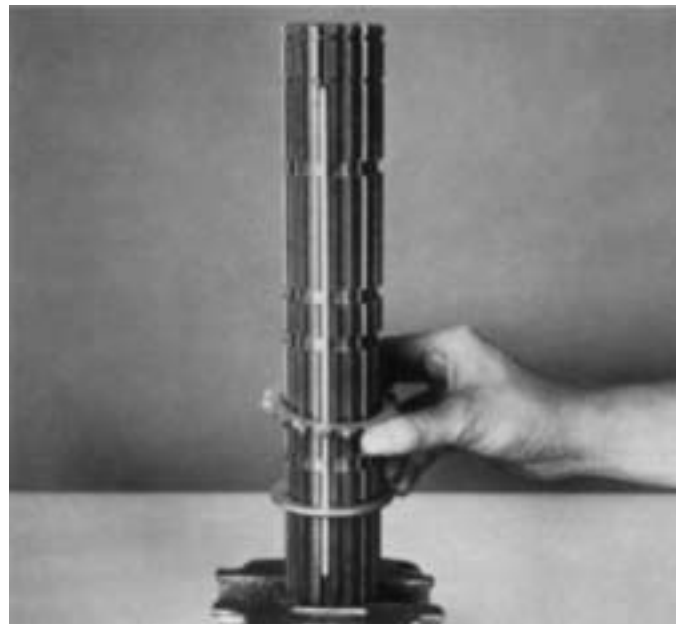
# REASSEMBLY - FRONT SECTION



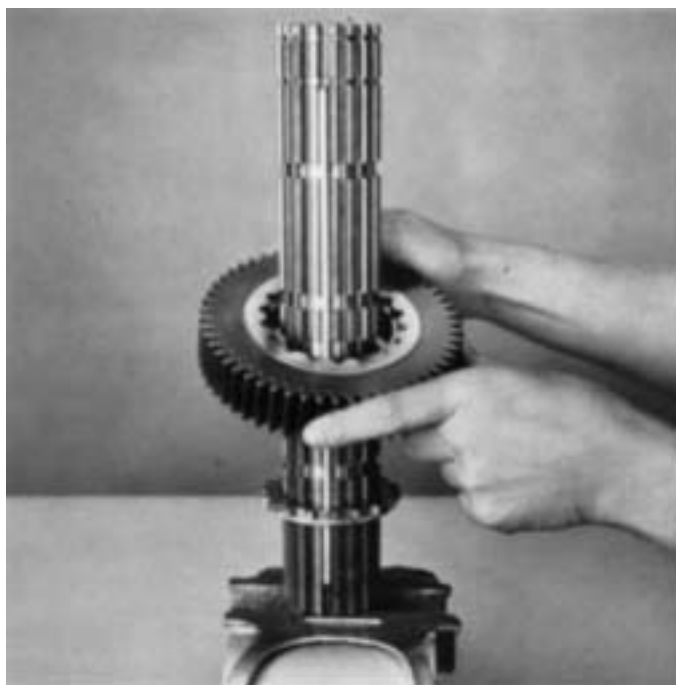
2. Secure the mainshaft in a vise equipped with brass jaws or wood blocks, pilot-end of shaft down. If previously removed, install the roll pin in keyway.



3. Install the 3rd speed gear limit washer on mainshaft, flat side of washer up. Rotate washer in the 1st or bottom groove of mainshaft to align the splines of washer with those of the mainshaft. install the key in mainshaft keyway to lock washer in place.



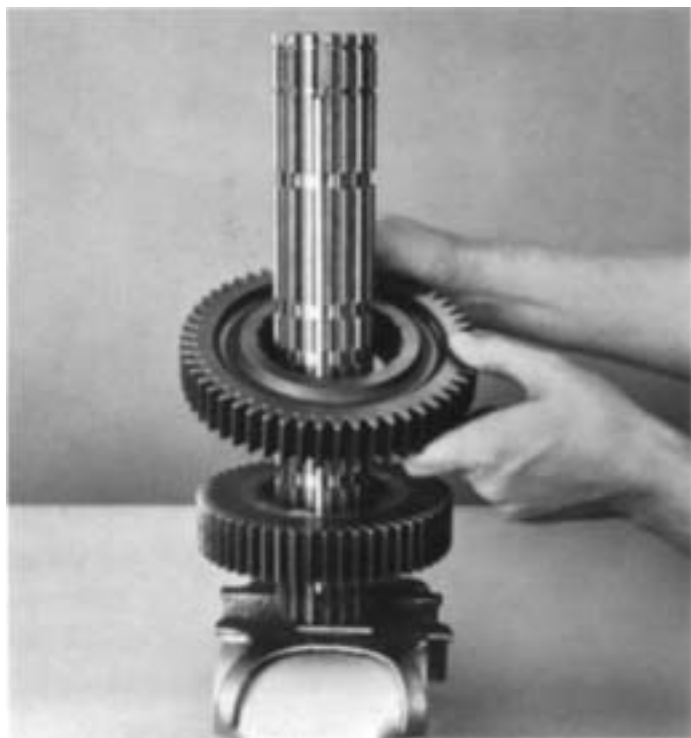
4. Install the spacer on shaft against washer.



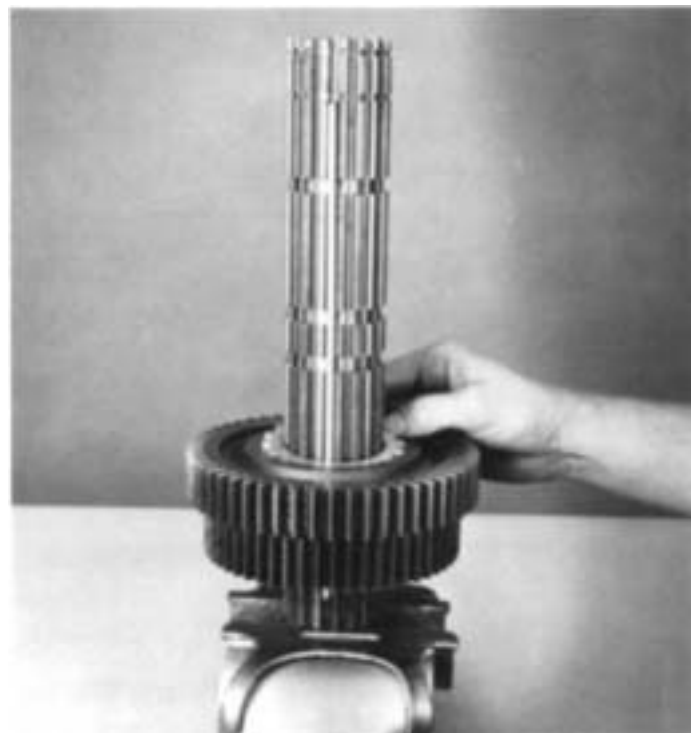
5. Install the 3rd speed (or Overdrive) gear on mainshaft, clutching teeth down and engaged with external splines of spacer.

**NOTE:** Gear limit washers are internally splined and locked to mainshaft by the key. Gear spacers are externally splined to engage with clutching teeth in gear hubs. There is one limit washer and one spacer for each gear in the mainshaft assembly.

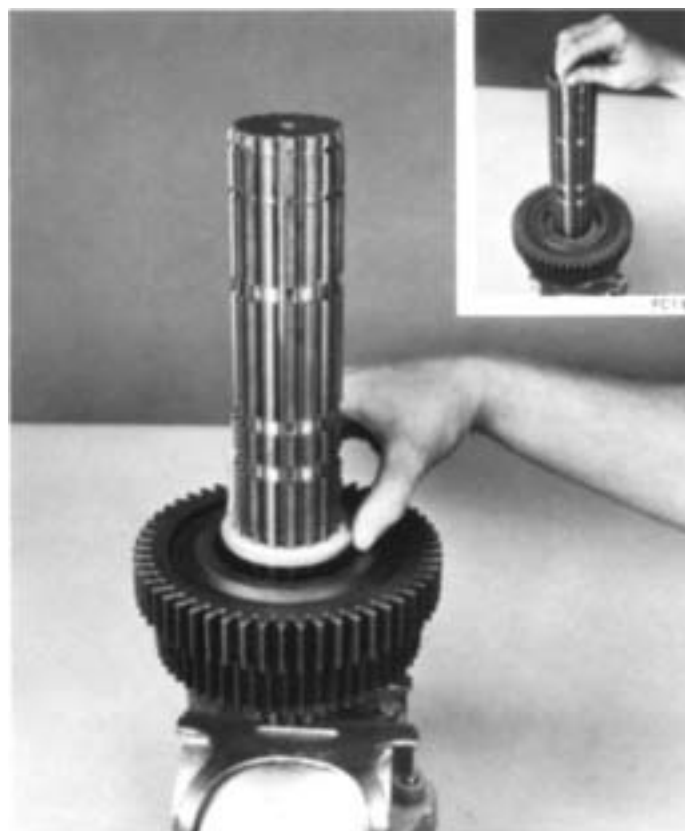
# REASSEMBLY - FRONT SECTION



6. Install the 2nd speed gear on shaft against 3rd speed (or Overdrive) gear, clutching teeth up.

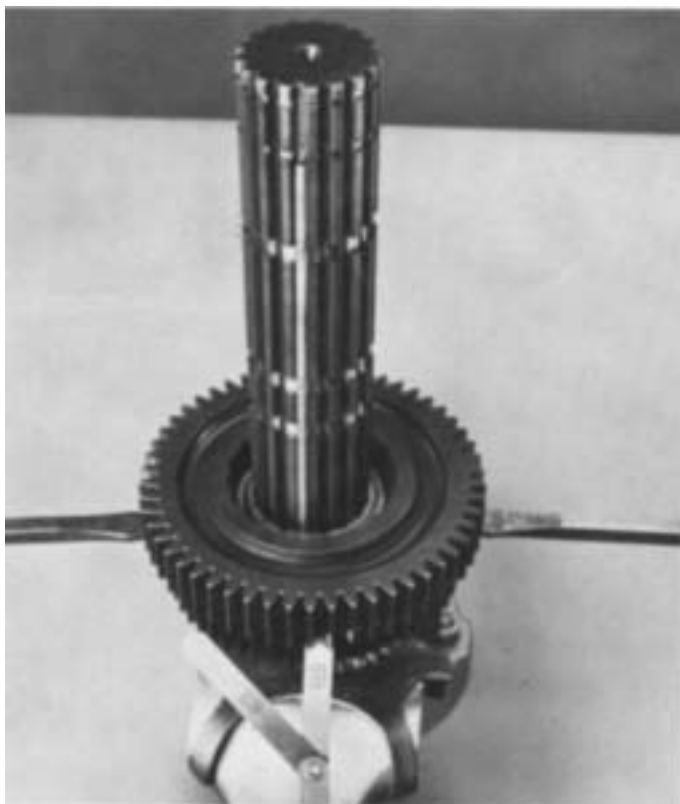


7. Install the spacer in 2nd speed gear, engaging the external splines of spacer with clutching teeth of gear.

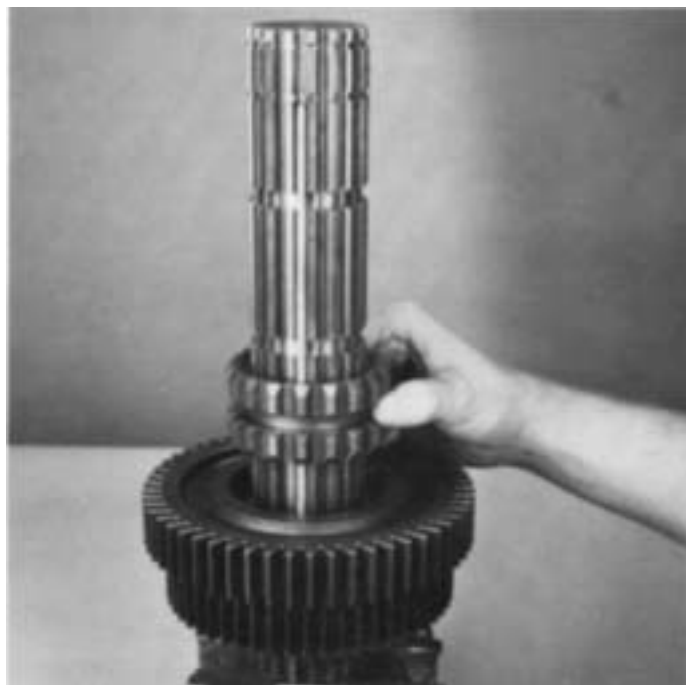


8. Remove the key from keyway and install the 2nd speed gear limit washer on mainshaft, flat side of washer down and against spacer. Rotate washer in the 2nd groove of mainshaft to align the splines of washer with those of the mainshaft and reinsert key in keyway to lock washer in place (inset).

## REASSEMBLY - FRONT SECTION



9. Insert two large screwdrivers between the 2nd and 3rd speed (or Overdrive) gears to check axial clearances. Apply slight downward pressure on screwdriver handles to spread gears evenly. Making sure the gear hubs are parallel, insert a feeler gage between hubs. Correct axial clearance should be from .005" to .012". If the clearance is less than the minimum .005" tolerance, the limit washer in the 2nd speed gear should be replaced by a thinner limit washer. This will increase the axial clearance between the gears. If the clearance checked is greater than the maximum .012" tolerance, a thicker limit washer should be installed in the 2nd speed gear. This would decrease the axial clearance between the gears.



10. Install the 1st-2nd speed sliding clutch, aligning the missing internal spline of sliding clutch with key in mainshaft.



11. Remove the key from keyway and install the 1st speed gear limit washer on mainshaft, flat side of washer up. Rotate washer in the 2nd groove of mainshaft to align the splines of washer with those of the mainshaft and reinsert key in keyway to lock washer in place.

# REASSEMBLY—FRONT SECTION

## SETTING CORRECT AXIAL CLEARANCES FOR MAINSHAFT GEARS

**Axial Clearance (End-Play) Limits Are:**

.005" -.012" for all mainshaft gears

Washers are used to obtain the correct limits; six thicknesses are available as follows:

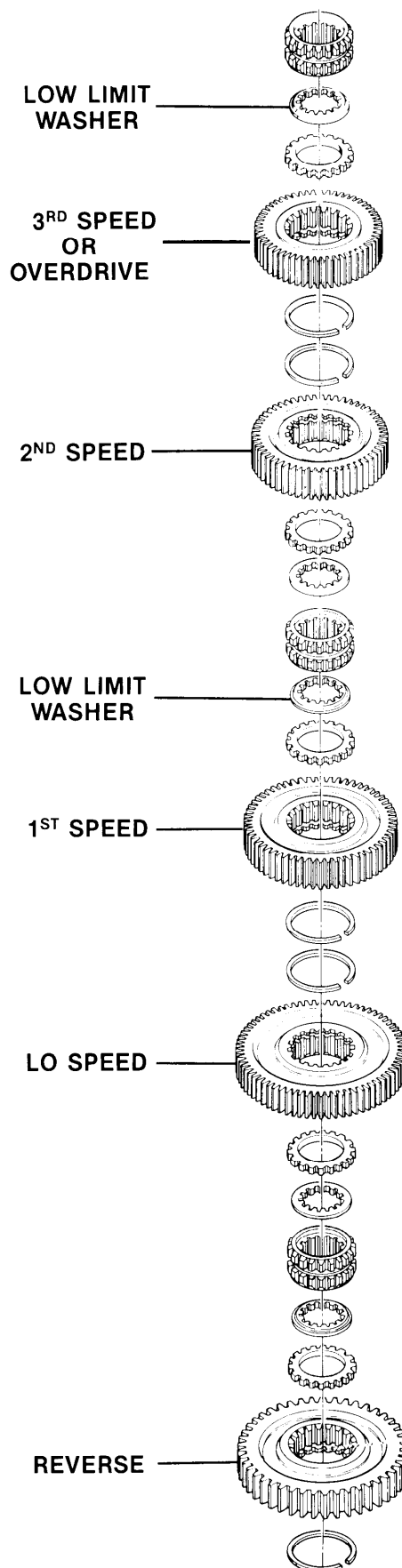
| LIMITS (INCH) | COLOR CODE |
|---------------|------------|
| .248 -.250    | WHITE      |
| .253 -.255    | GREEN      |
| .258 -.260    | ORANGE     |
| .263 -.265    | PURPLE     |
| .268-.270     | YELLOW     |
| .273 -.275    | BLACK      |
| *             | "PLUS RED" |

**\*NOTE:** New style limit washers come in a full range of tolerances as corresponding colors listed above "plus red." (Example: "Orange plus red" limit washer has an inch limit thickness of .258 -.260.)

Refer to Illustrated Parts Lists for washer part numbers.

Always use the .248-.250" low limit washer ("White" or "white plus red") in the 1st and 3rd speed gear Positions as shown at right.

**IMPORTANT: REFER TO THE APPROPRIATE ILLUSTRATED PARTS LIST (SPECIFIED BY MODEL SERIES) TO ENSURE THAT PROPER PARTS ARE USED DURING REASSEMBLY OF THE TRANSMISSION.**



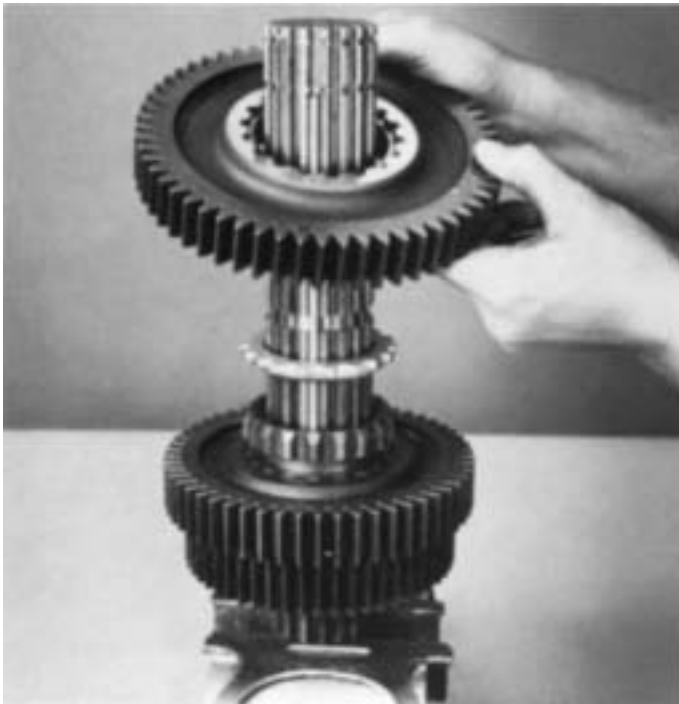
# REASSEMBLY - FRONT SECTION



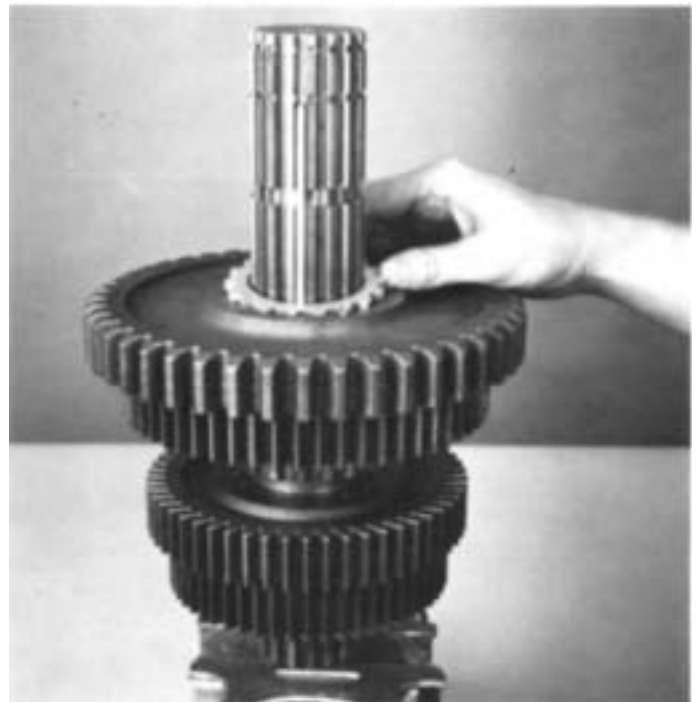
**12.** Install the spacer on shaft against washer.



**14.** Install the LO speed gear on shaft against 1st speed gear, clutching teeth up.



**13.** Install the 1st speed gear on mainshaft, clutching teeth down and engaged with external splines of spacer.

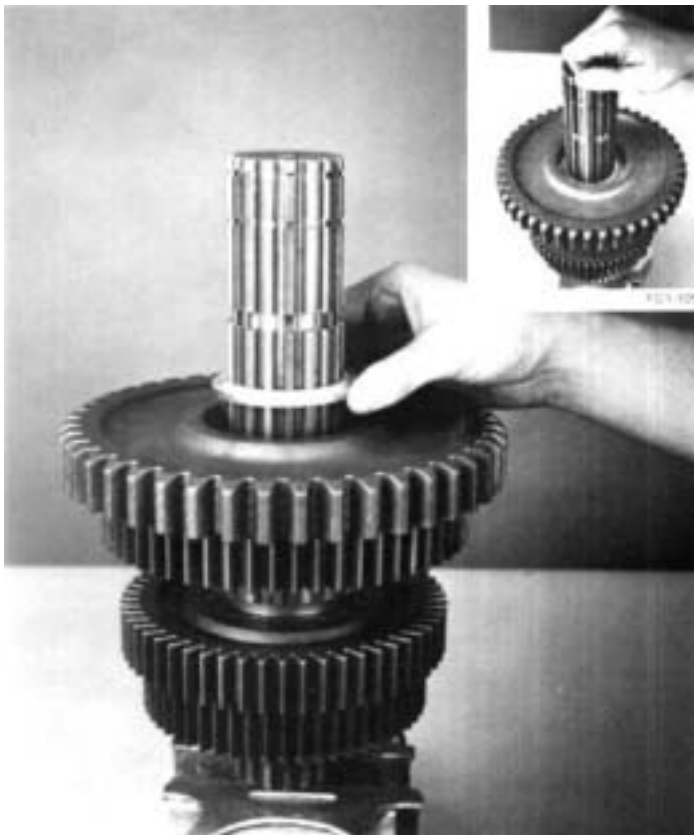


**15.** Install the spacer in LO speed gear, engaging the external splines of spacer with clutching teeth of gear.

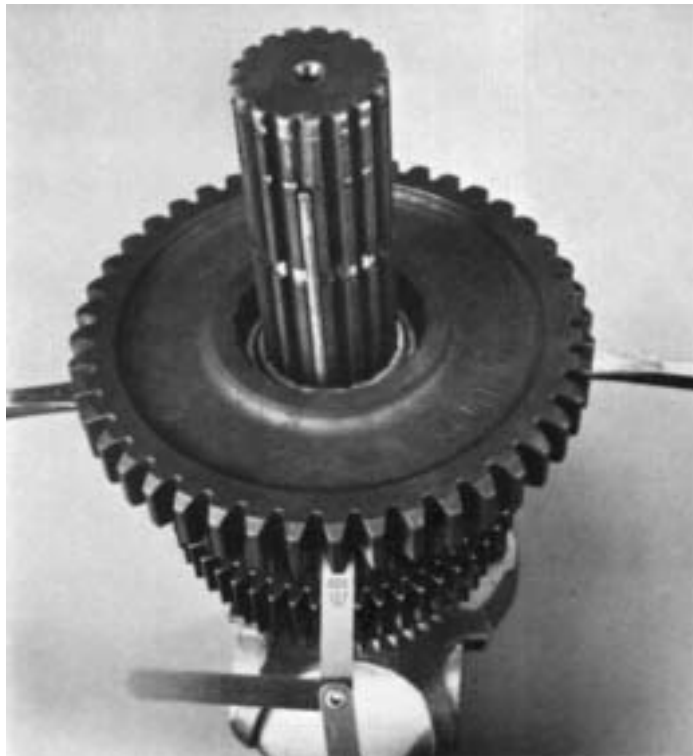
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# REASSEMBLY-FRONT SECTION



16. Remove the key from keyway and install the LO speed gear limit washer on mainshaft, flat side of washer down and against spacer. Rotate washer in the 4th groove of mainshaft to align the splines of washer with those of the mainshaft and reinsert key in keyway to lock washer in place (inset).

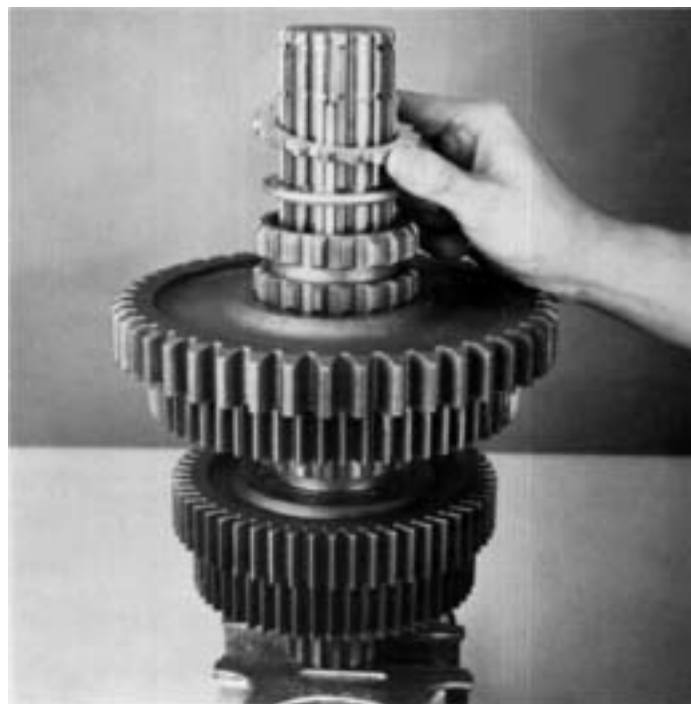


17. Check axial clearance and make adjustments, if necessary, between the LO and 1st speed gears as described.

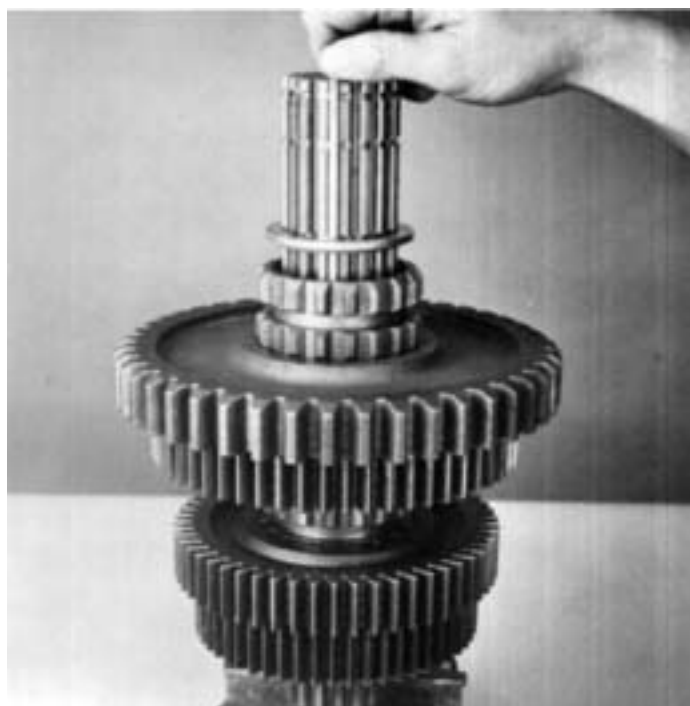
# REASSEMBLY-FRONT SECTION



18. Install the LO-Reverse speed sliding clutch, aligning the missing internal spline of sliding clutch with key in mainshaft.



20. Install the spacer on shaft against washer.



19. Remove the key from keyway and install the reverse gear limit washer on mainshaft, flat side of washer up. Rotate washer in the 5th groove of mainshaft to align the splines of washer with those of the mainshaft and reinsert key in keyway to lock.



21. Install the snap ring in 6th groove of mainshaft to retain key in keyway.

# REASSEMBLY-FRONT SECTION



22. Install the snap ring in hub of reverse gear ONLY TO CHECK AXIAL CLEARANCE (END-PLAY) LIMITS.

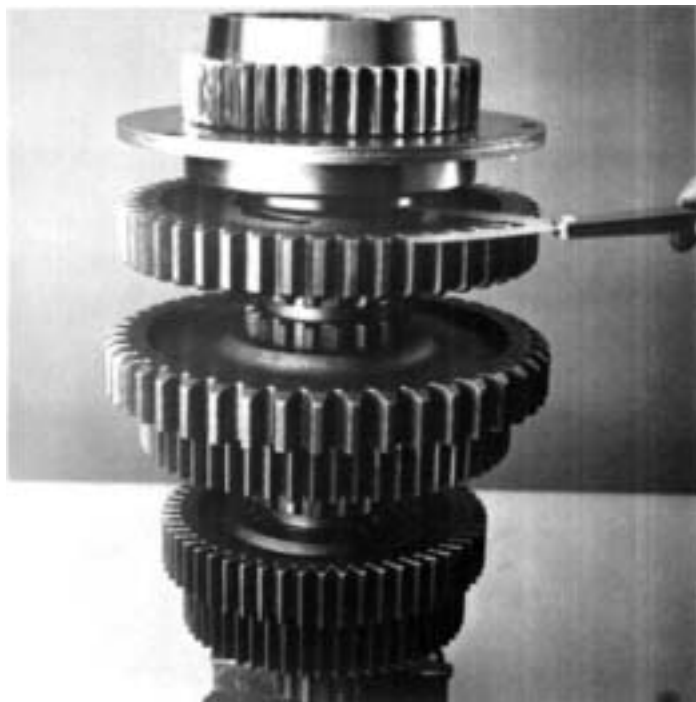


23. Install the reverse gear on mainshaft, clutching teeth down and engaged with external splines of spacer.



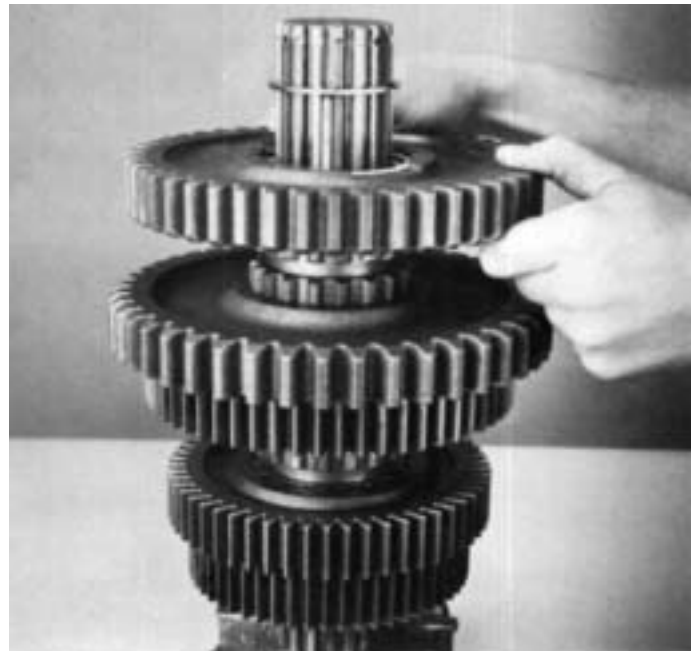
24. Install the auxiliary drive gear assembly in its proper position on rear of mainshaft.

# REASSEMBLY - FRONT SECTION



25. Force both the reverse gear and auxiliary drive gear downward on the shaft to flatten their respective snap rings. Making sure the gear hubs are parallel, insert a feeler gage between the hubs of the reverse gear and auxiliary drive gear. Correct axial clearance should be from .005" to .012". If clearance is less than the minimum .005" tolerance, the reverse gear limit washer should be replaced by a thinner limit washer. This will increase the axial clearance between the gears. If the clearance checked is greater than the maximum .012" tolerance, a thicker limit washer should be installed in the reverse gear. This would decrease the axial clearance between the gears.

NOTE: THIS CHECK IS MADE WITHOUT SPREADING THE GEARS WITH SCREWDRIVERS.



26. With the proper reverse gear limit washer installed on mainshaft, remove the auxiliary drive gear assembly and reverse gear.



27. Remove the snap ring from hub of reverse gear and reinstall the gear on mainshaft. Engage the clutching teeth of gear with the splines of spacer and sliding clutch and move the reverse gear against the LO speed gear.

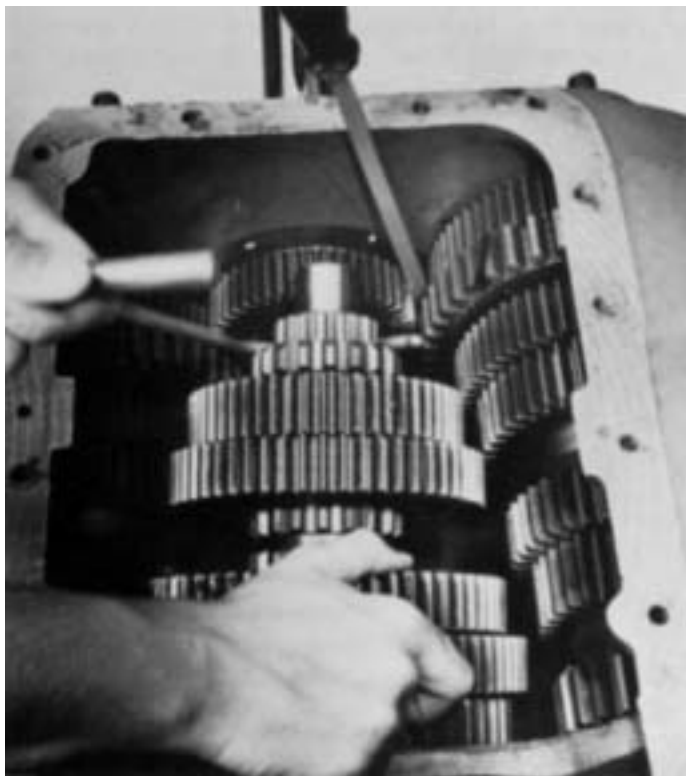
# REASSEMBLY-FRONT SECTION



28. Remove the mainshaft assembly from vise. Align the missing internal spline of 3rd-4th speed sliding clutch with key in mainshaft and install on front of shaft, engaging the external splines of sliding clutch with clutching teeth of 3rd speed (or Overdrive) gear.



30. Move the pilot-end of mainshaft into pocket bushing of input shaft.



29. Block the right countershaft assembly against case wall and lower the mainshaft assembly into position with the reverse gear held against LO speed gear and rear of shaft moved into case bore.

# REASSEMBLY - FRONT SECTION



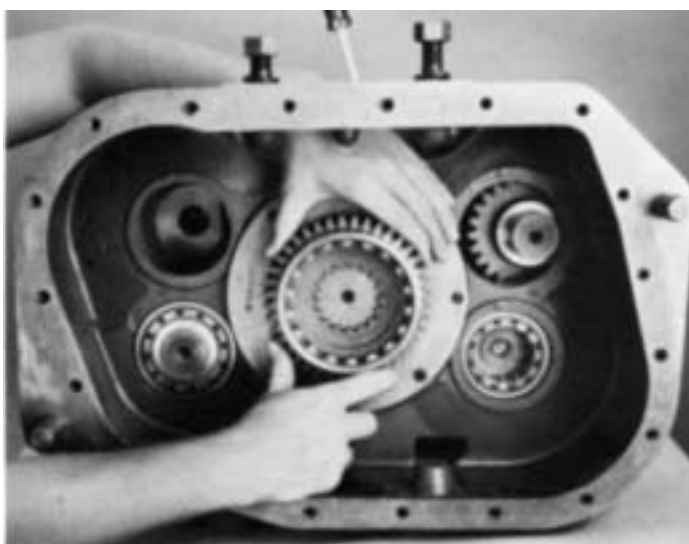
31. With the reverse gear remaining against LO speed gear, mesh the corresponding forward speed gears of left countershaft assembly. Check to make sure that marked tooth on left countershaft drive gear has remained in mesh with marked set of teeth on main drive gear.

## H. Bearing Installation and Timing of Right Countershaft Assembly

**IMPORTANT:** The left countershaft assembly **MUST** remain in time with main drive gear when timing right countershaft assembly.

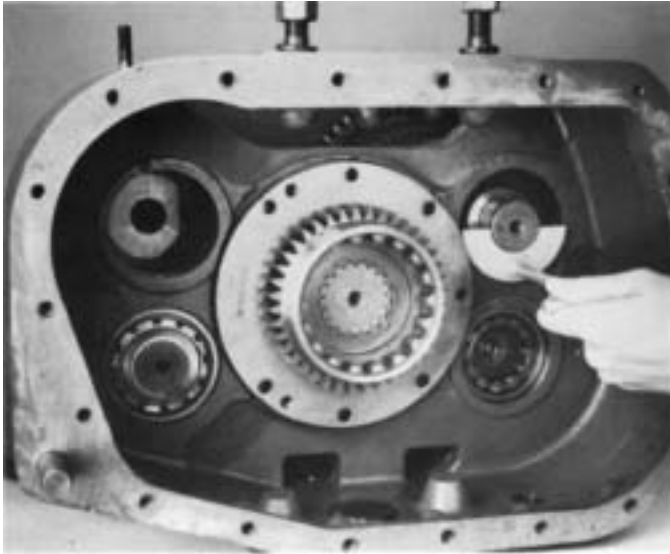


1. Remove blocking from right countershaft assembly and place it parallel to mainshaft assembly. Mesh the marked tooth of right countershaft drive gear with remaining set of two marked teeth on main drive gear.

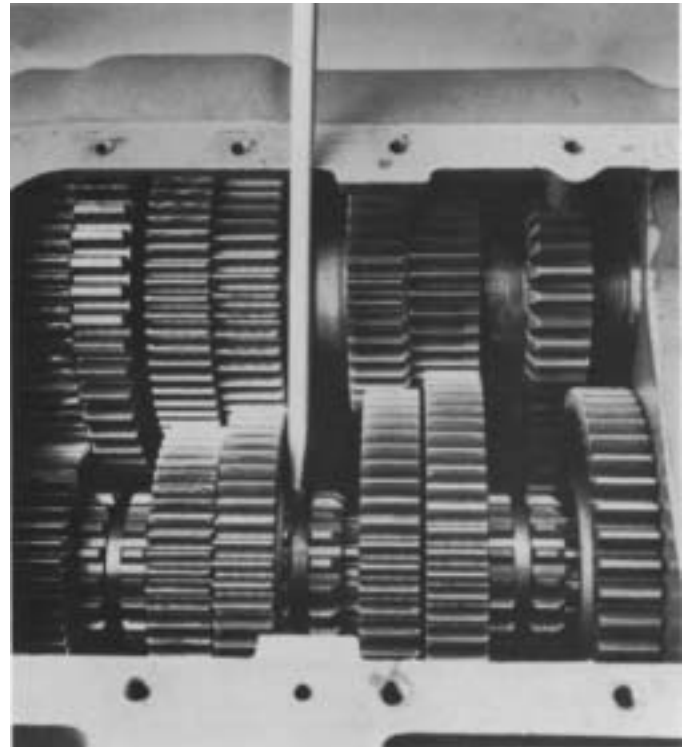


32. Center rear of mainshaft in case bore and install the auxiliary drive gear assembly on shaft, partially seating the bearing in bore. DO NOT COMPLETE

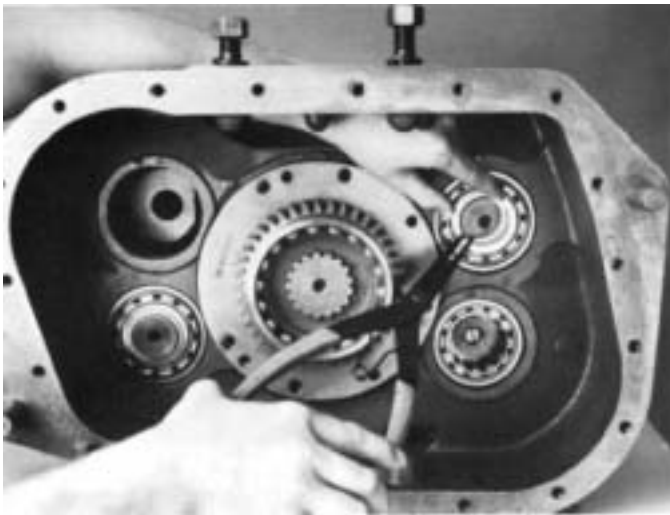
# REASSEMBLY - FRONT-SECTION



2. Insert countershaft support tool or blocking in rear bearing bore.
3. Install the right countershaft bearings in the same manner described in Part D for left countershaft bearings.



5. Move the reverse gear to the rear on mainshaft and use a screwdriver to engage sliding clutches with all forward speed gears. A sliding clutch that will not engage with a gear indicates the gear set is not in proper mesh. The bearings of the right countershaft would then need to be removed and the drive gear set retimed.  
**NOTE:** Do not engage sliding clutches with more than one gear at the same time. This will lock the gearing and prevent the mainshaft and countershaft assemblies from rotating.



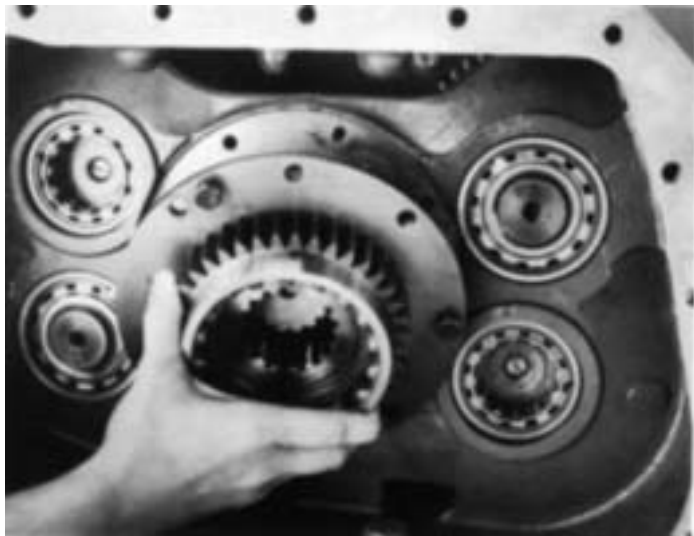
4. With bearing installation complete, install the snap ring in groove at rear of right countershaft.

## 1. Reassembly and Installation of Left Reverse Idler Gear Assembly

**NOTE:** Since the left and right reverse idler gear assemblies are identical, reassembly and installation of the left reverse idler gear assembly should be performed at this time as described in Part A of this section.

# REASSEMBLY - FRONT SECTION

## J. Completed Installation of Mainshaft and Auxiliary Drive Gear Assemblies



1. Remove the auxiliary drive gear assembly from mainshaft and rear bearing bore. Do not allow mainshaft to move to rear when removing auxiliary drive gear.



2. Move the reverse gear to the rear as far as possible, meshing teeth of gear with those of the reverse idler gears.

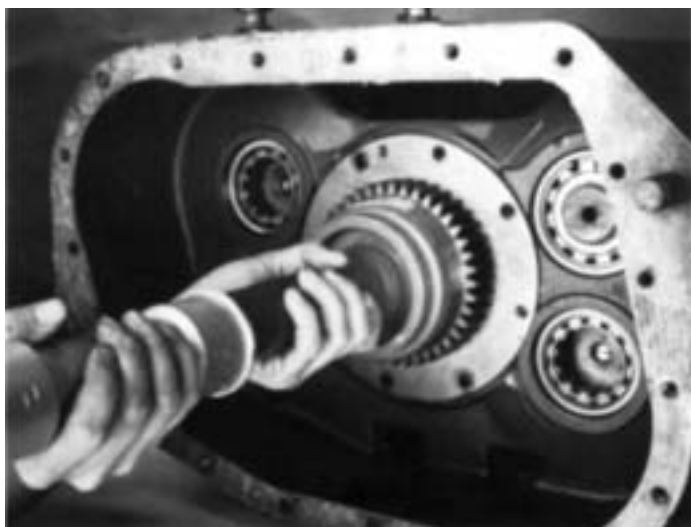


3. Align the external splines of spacer with clutching teeth of reverse gear and move spacer forward on mainshaft and into gear.

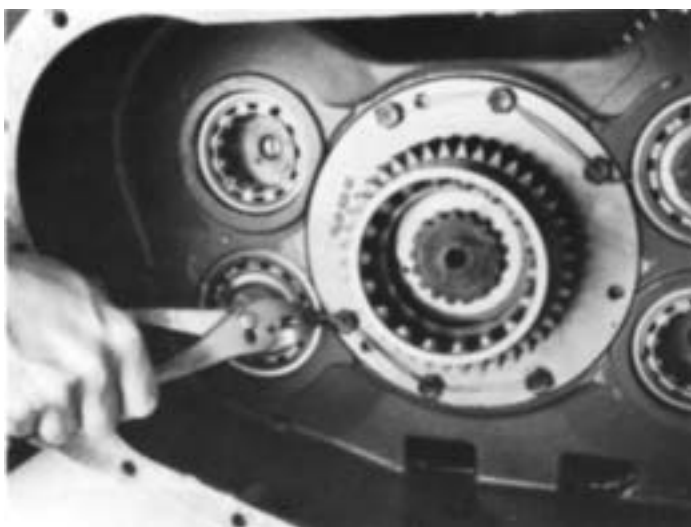


4. Install the snap ring in hub of reverse gear and move the reverse gear forward on mainshaft and into proper position in case.

# REASSEMBLY - FRONT SECTION



5. Reinstall the auxiliary drive gear assembly on rear of mainshaft. Use a flanged-end driver and maul to seat bearing in case bore.



6. Align the six capscrew holes in retainer with the tapped holes in case and install capscrews. Tighten to recommended torque ratings and lock-wire the capscrews in groups of three.



7. Install the snap ring in groove at end of mainshaft.

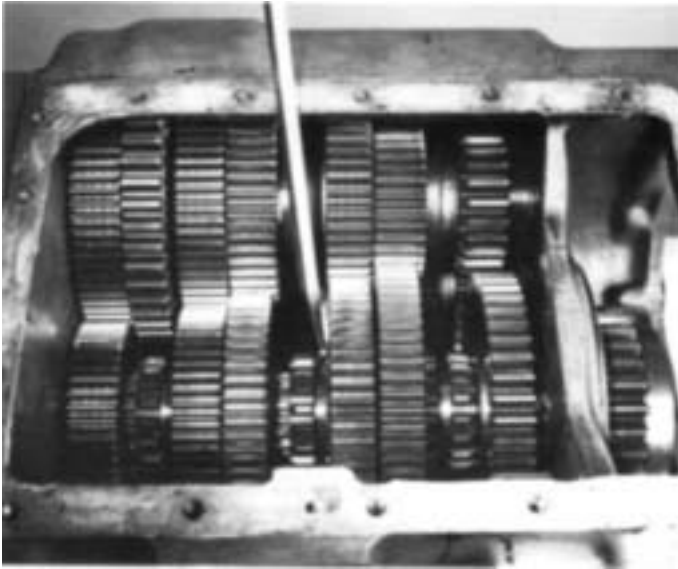
## K. Installation of Drive Gear Nut and Front Bearing Cover



1. Apply Loctite grade 277 sealant to cleaned threads of new drive gear bearing nut. DO NOT REUSE OLD NUT.

**NOTE:** For models equipped with a snap ring to retain bearing, install the snap ring in groove of input shaft and proceed to No. 4.

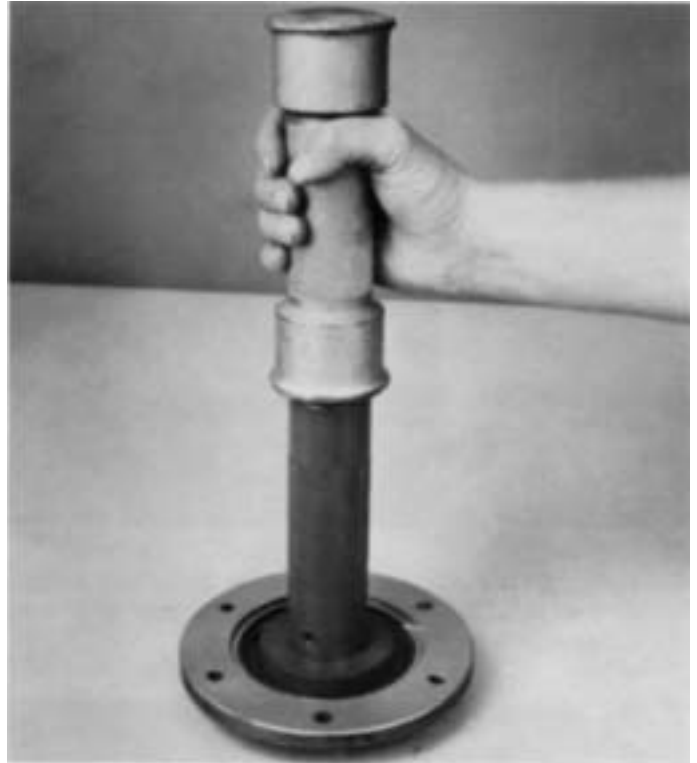
# REASSEMBLY-FRONT SECTION



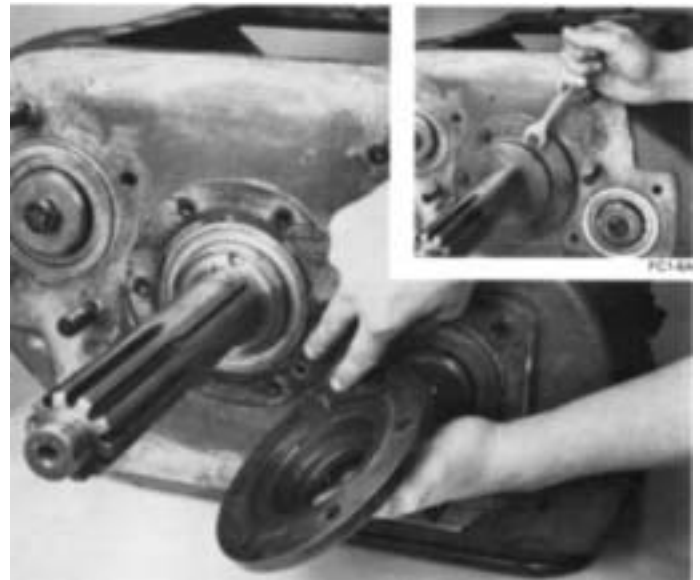
2. Engage two mainshaft sliding clutches into gear to prevent transmission from rotating.



3. Install the nut on shaft (left hand threads). Using a drive gear nut installer, tighten to 250-300 lbs/ft of torque. Use a punch and maul to peen the nut into the two milled slots of input shaft.



4. If previously removed, install the oil seal in drive gear bearing cover of models so equipped.



5. Install the drive gear bearing cover and gasket, making sure to align the oil return hole in case. Secure cover on case with retaining capscrews (inset).

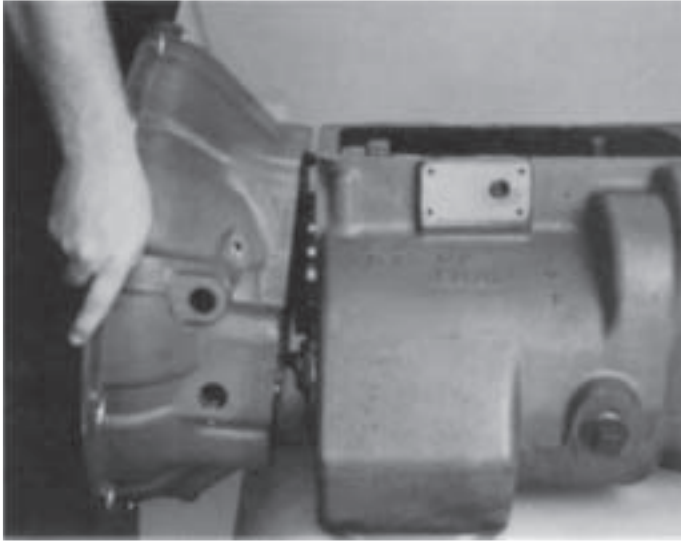
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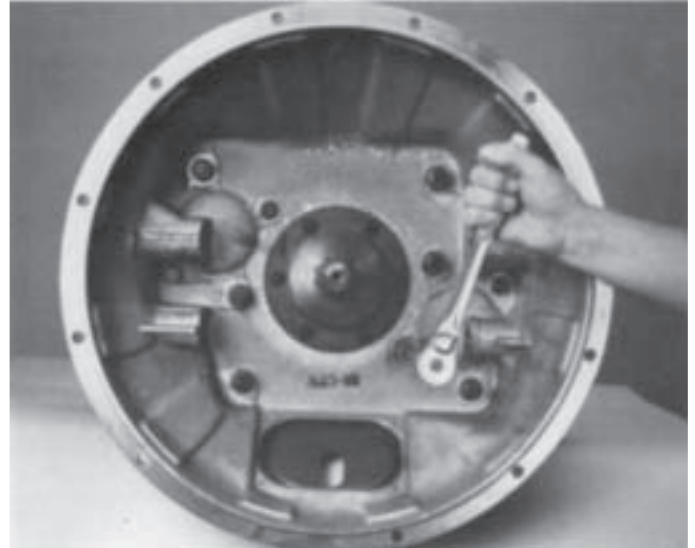
# INSTALLATION - COMPANION FLANGE, AUXILIARY SECTION AND CLUTCH HOUSING

## COMPANION FLANGE, AUXILIARY SECTION AND CLUTCH HOUSING

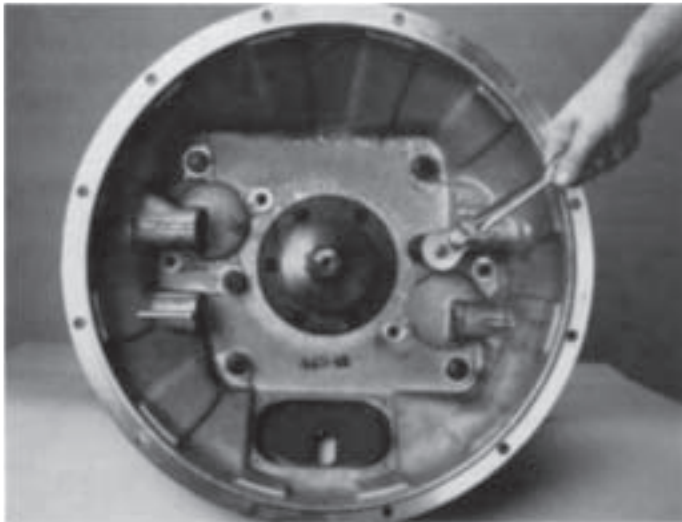
### A. Installation of Clutch Housing



1. Position the corresponding new gasket on housing mounting surface and install the clutch housing on front case, piloting on the six studs and drive gear bearing cover.



3. Install the four capscrews and tighten in cross-pattern. See TORQUE RECOMMENDATIONS.
4. For models so equipped, install the clutch release mechanism and/or clutch brake assembly. See OPTIONS.

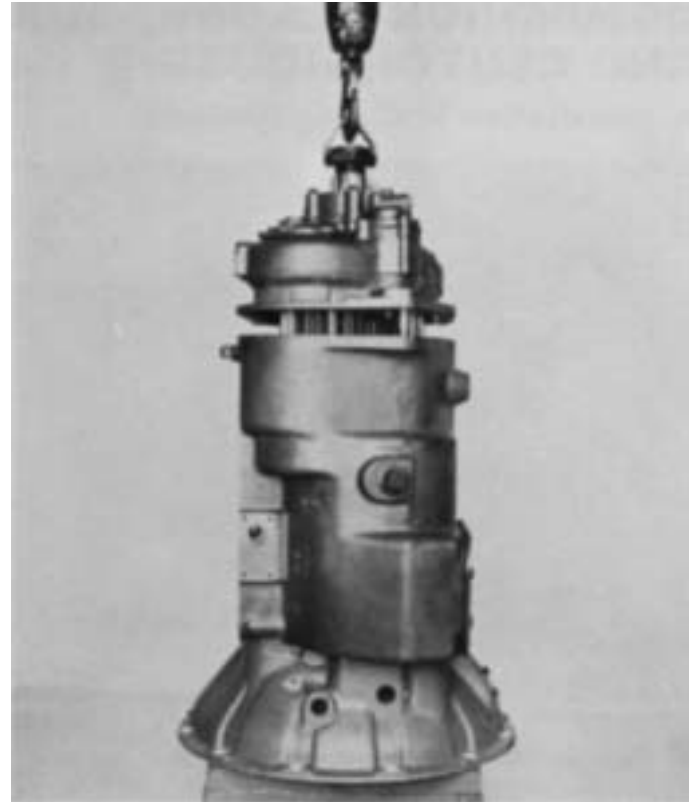


2. Install the six nuts with washers on studs and tighten in cross-pattern. See TORQUE RECOMMENDATIONS.

# INSTALLATION-COMPANION FLANGE, AUXILIARY SECTION AND CLUTCH HOUSING

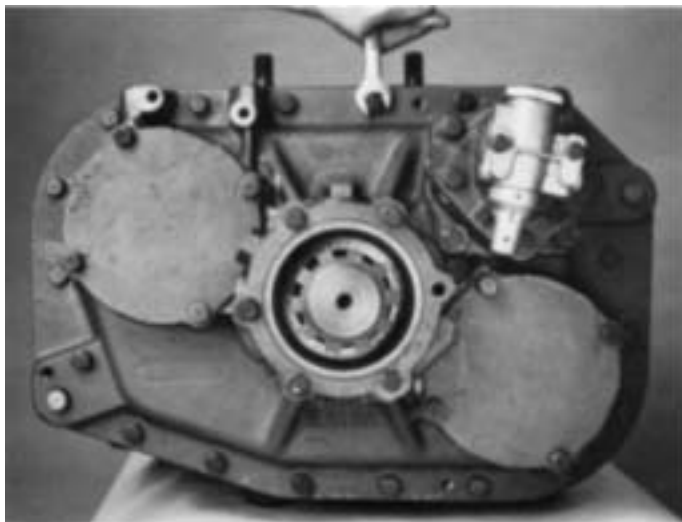
## B. Installation of Auxiliary Section

**NOTE:** Make sure the bearing inner race is installed on front of each auxiliary countershaft **BEFORE** proceeding with the following.



1. Attach a chain hoist to auxiliary. Move the assembly evenly into rear of front case, piloting it on the dowel pins. As assembly is moved forward, the countershaft drive gears will mesh with the auxiliary drive gear.

**IMPORTANT:** On 8-speed "L" model auxiliary sections, shift the deep reduction sliding clutch into deep reduction before installing auxiliary. This will prevent possible timing error.



3. The auxiliary section can also be installed with transmission set in the vertical position. Block under the clutch housing to prevent damage to the input shaft, position the corresponding new gasket on plate/housing mounting surface and lower the assembly onto rear of front case. Install the retaining capscrews and tighten securely. See **TORQUE RECOMMENDATIONS**.

**IMPORTANT:** On 8-speed "LL" model auxiliary sections, shift the deep reduction sliding clutch into deep reduction before installing auxiliary. This will prevent possible timing error.

2. Install the retaining capscrews in flange of auxiliary plate/housing and tighten to secure the auxiliary section to the front section. See **TORQUE RECOMMENDATIONS**.

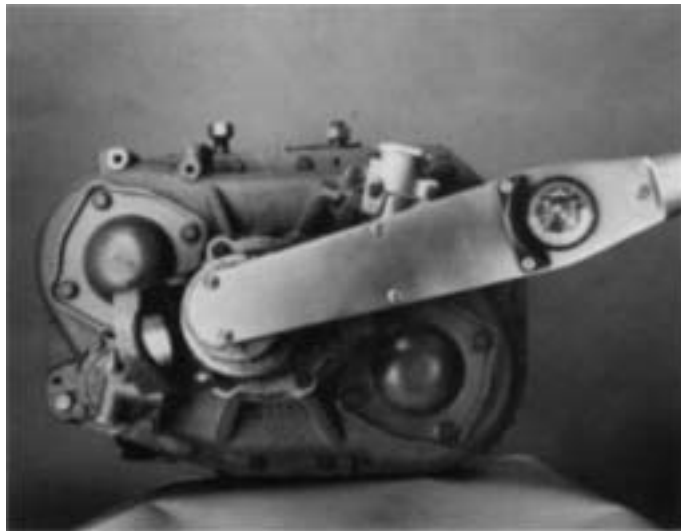
# INSTALLATION - COMPANION FLANGE, AUXILIARY SECTION AND CLUTCH HOUSING

## C. Installation of Universal Joint Companion Flange or Yoke



1. For models so equipped, install the speedometer drive gear or replacement spacer in position on hub of companion flange or yoke. Install the companion flange or yoke on splines of output shaft and move into rear bearing cover.

**NOTE:** For 14608LL models, the speedometer drive gear or replacement spacer is installed on output shaft prior to installation of rear bearing cover.

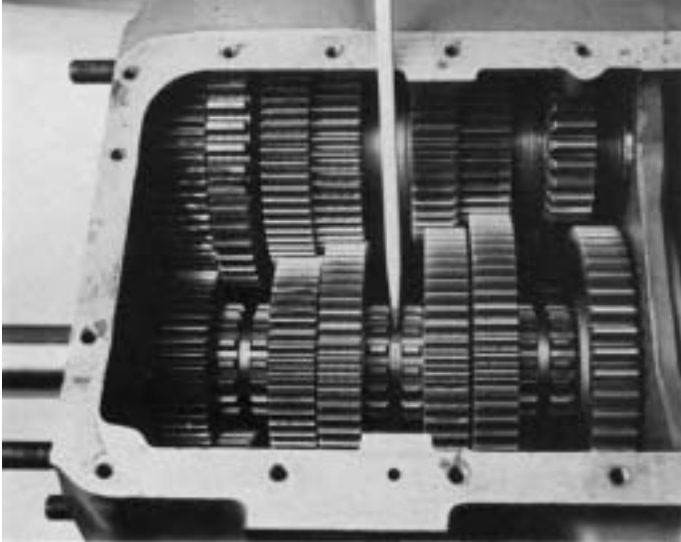


2. Lock the transmission by engaging two main-shaft gears with sliding clutches. Install the washer and/or nut on output shaft and tighten nut using 450-500 lbs/ft of torque.

# INSTALLATION - SHIFTING CONTROLS

## SHIFT BAR HOUSING ASSEMBLY

### A. Installation



1. Place all three mainshaft sliding clutches in the neutral position.



Install the new shift bar housing gasket in position on case.

2. With all three shift bars in the neutral position, install the shift bar housing assembly on case, fitting the shift yokes into slots of corresponding sliding clutches.

**NOTE:** Avoid tilting the assembly during installation as the three sets of tension springs and balls are free to be released from bores in top of housing.



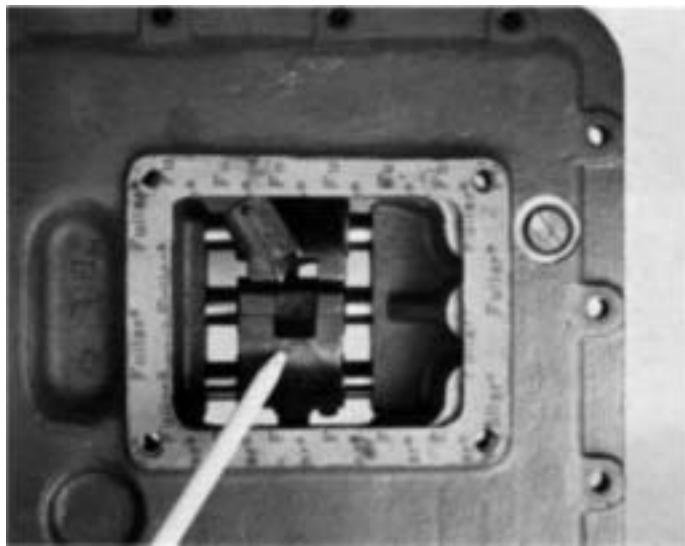
3. Install the cap screws in housing and tighten to secure the assembly to case.

# INSTALLATION- SHIFTING CONTROLS

## GEAR SHIFT LEVER HOUSING ASSEMBLY

### A. Installation

NOTE: For models equipped with a LRC or SRC Assembly, the housing is installed in the same manner described in the following instructions.



1. Check the shift bar housing assembly to make sure shift block and yoke notches are aligned in the neutral position.



2. Install the new gear shift lever housing gasket in position on shift bar housing and install the gear shift lever housing assembly on shift bar housing, fitting the lever into shift bar and yoke notches.



3. Install the retaining capscrews in housing flange and tighten to secure the assembly to shift bar housing.

# INSTALLATION - SHIFTING CONTROLS

## AIR SYSTEM

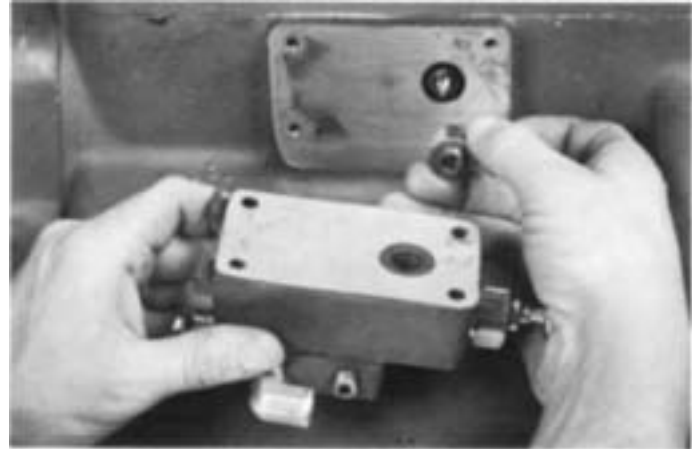
### A. Installation of Slave Valve



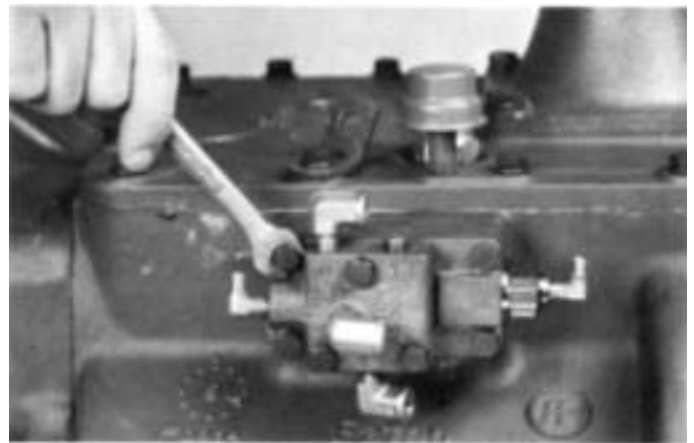
1. If previously removed, install the air line fittings on slave valve.



2. Install the spring on shank of actuating pin and insert in bore of transmission case.



3. Install the hat-type alignment sleeve in bore of slave valve.



4. Position the corresponding new gasket on valve mounting surface and install the slave valve on case, inserting the end of actuating pin into alignment sleeve. Secure the valve to case with four retaining capscrews tightened evenly.

### B. Installation of Air Lines

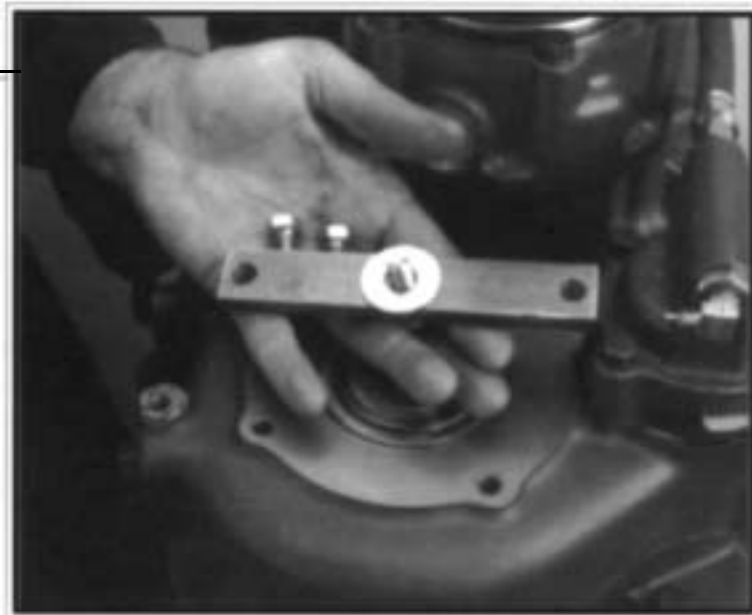
(See Air System Schematics on pages 40-47.)

# Tapered Roller Bearing Shimming Procedure

Note: The auxiliary section may be shimmed in either the vertical or horizontal position. Vertical shimming is performed with the transmission removed from the truck while horizontal shimming takes place with the transmission still in the truck.

1

Before installing the auxiliary section, install countershaft straps on each countershaft. Use three (3) 3/8" x 1" capscrews for each strap.



2

For vertical shimming, place the transmission in the vertical position. Place (2) wood blocks under the clutch housing to prevent the transmission from tipping and damaging the input shaft. Place the auxiliary housing on the front box.



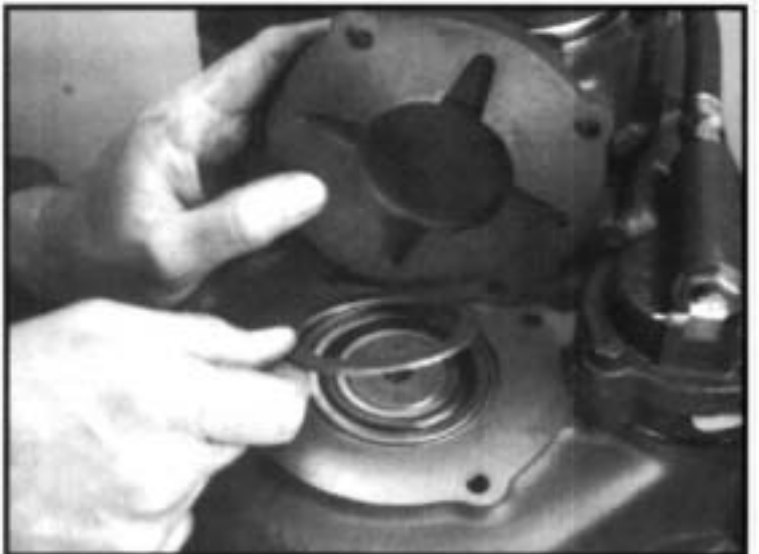
3

Install the auxiliary housing capscrews. Tighten to the recommended torque.



4

Remove each countershaft strap.



5

Install the .125 gaging shim and the countershaft bearing cover. **Make sure the shim is properly aligned on the bearing race.**



6

Use two (2) 3/8" x 1" capscrews without lock washers. Install the capscrews directly across from each other.



7

**Tighten to 7 in. lbs. of torque.**

**Do not over torque. Incorrect readings will be produced. Make sure the countershaft rear bearing cover gaskets have been removed.**



8

Rotate the output shaft six times in the clockwise direction, then six times counterclockwise to properly seat the bearings. Use a feeler gauge to measure the clearance between the shim gauge and auxiliary housing surface near each capscrew location. Record each measurement and average the two measurements. Refer to the Shimming Endplay Chart and select the number in the left column which corresponds to the average measurement which was achieved. Follow the column to the right to determine the proper thickness and shim required. Note part number and shim color. Repeat this procedure for the other countershaft.



After the correct shim has been selected, place the shim on the rear countershaft bearing race, install the countershaft rear bearing gasket and cover. Check for proper shim alignment. If misaligned, the bearing cover may be damaged when final torque is applied to cover capscrews. Perform the same procedure on the other rear countershaft.



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