Eaton Fuller RTO-14610 Transmission Service Manual

This is the Eaton Fuller RTO-14610 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.

Pro Gear stocks every part for your Eaton transmission including: Valve Assemblies, Synchronizers, Yoke Assemblies, O-Ring Kits, Drive Gears, Gaskets, Bearing and Seal Kits, and much more.

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Service Manual

Fuller Heavy Duty Transmissions TRSM0525

October 2007

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FOREWORD

This manual is designed to provide detailed information necessary to service and repair the Fuller® Transmissions 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 Shift Bar Housing, you will find instructions for removal, disassembly and reassembly on page 44. Instructions for installation are on page 125. Service Manuals, Illustrated Parts Lists, Drivers Instructions, Driver Training Programs 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

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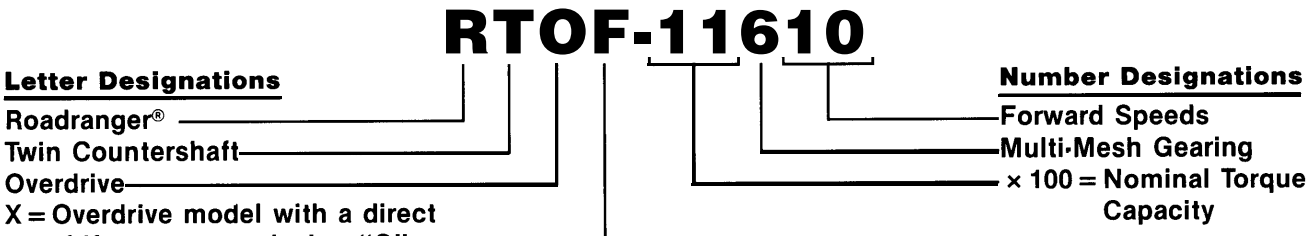
MODEL DESIGNATIONS AND SPECIFICATIONS

Nomenclature:



IMPORTANT: All 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.

10-Speed Transmissions (On-Highway):

Models	No Spds	Gear Ratios											Relative Speed PTO Gear To Input R. PM.		1 Length In	2 Weight Lbs.	Oil Cap Pints
		1 St	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	Reverse	Right	Bottom			
RT-11610 (F)	10	996	763	590	4.54	357	279	214	1 65	1.27	1 00	2.76/9.84	696	.696	28.9	620	26
RTO-11610 (F) (X)	10	783	6.00	463	357	280	219	1.68	1 30	1.00	78	2.16/7.73	885	885	28.9	620	26
RT-12610 (F) (X)	10	996	763	590	454	3.57	2.79	2.14	1 65	1,27	1 00	2.76/9.84	696	.696	28.9	685	26
RTO-12610 (F) (X)	10	7.83	6.00	463	357	280	219	1 68	1 30	1,00	78	2.16/7.73	885	885	289	685	26
RT-14610 (F)	10	996	763	590	.,54	357	279	214	165	1,27	100	2.76/9.84	.696	696	29.5	697	26
RTO-14610 **(F) (X)**	10	783	6.00	463	357	280	2.19	1 68	1 30	1 00	78	2.16/7.73	885	885	29.5	697	26

See Chart Notes.

15-Speed Transmissions (On/Off-Highway):

Models	No Spds.	Gear Ratios											Relative Speed PTO Gear To Input R. PM.		1 Length In,	2 Weight Lbs.	Oil Cap. Pints
		1 St	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	Reverse	Right	Bottom			
RT-11615 (F)	15	9.96 14.88	7.63 1140	590 881	4.54 678	357 533	2.79	214	1 65	1.27	1 00	2.76/9 84 1469	.696	696	32.1	670	28
RTO-11615 (F) (X)	15	783 1169	600 896	463 692	3.57 533	280 4,19	219	1 68	1 30	100	78	2.16/7 73 11.54	.885	885	321	670	28
RT-14615 (F) (X)	15	9.96 1552	7,63 11.89	590 919	4.54 7.08	3.57 5.56	279	2.14	1 65	1.27	1.00	2,76/9 84 15.33	696	696	33.6	779	30
RTO-14615 (F) (X)	15	7.83 1220	600 9.35	4.63 722	357 556	2.80 4.37	2.19	1.68	1.30	1 00	.78	2.16/7.73 12,04	.885	885	33.6	779	30
RT-15615 (F) (X)	15	996 1552	7.63 11.89	590 919	454 708	357 556	279	214	1 65	1 27	1 00	2.76/!3.84 1533	696	.696	336	792	**30**
RTO-15615 (F) (X)	15	7.83 12.20	6.00 9.35	463 7.22	357 5.56	2.80 4,37	2.19	1.68	1.30	1 00	.78	2.16/7.73 1204	885	.885	33.6	792	30

CHART NOTES:

1 Lengths measured from face of clutch housing to front bottoming surface of companion flange or yoke.

2 Weights include SAE No. 1 cast iron clutch housing and standard controls (control valve, gear shift lever and housing assembly, and air lines), less clutch release parts. For information on available clutch housings, refer to Publication FUL-140–"Clutch Housing Chart." 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.

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, ail 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—Heavy Duty and Mid-Range	
First 3,000 to 5,000 miles (4827 to 8045 Km)	Factory fill Inltlal drain
Every 10,000 miles (16090 Km)	Check fluid level Check for leaks
Heavy Duty Highway Change Interval	
Every 250,000 miles (402336 Km)	Change transmission fluid,
Mid-Range Highway Change Interval	
Every 100,000 miles (160,000 Km) or every 3 years whichever occurs first	Change transmission fluid.
OFF-HIGHWAY USE	
First 30 hours	Factory fill Initial drain,
Every 40 hours	Inspect fluid level Check for leaks
Every 500 hours	Change transmission fluid where severe dirt conditions exist.
Every 1,000 hours	Change transmission fluid (Normal off-highway use),
Heavy Duty Engine Lubricant or Mineral Gear Lubricant	
HIGHWAY USE	
First 3,000 to 5,000 miles (4827 to 8045 Km)	Factory fill Initial drain.
Every 10,000 miles (16090 Km)	Inspect lubricant level, Check for leaks,
Every 50,000 miles (80450 Km)	Change transmission lubricant,
OFF-HIGHWAY USE	
First 30 hours	Change transmission lubricant on new units
Every 40 hours	Inspect lubricant level Check for leaks
Every 500 hours	Change transmission lubricant where severe dirt conditions exist.
Every 1,000 hours	Change transmission lubricant (Normal off-highway use),

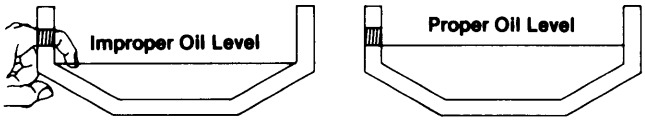
Change the oil filter when fluid or lubricant is changed.

Recommended Lubricants		
Type	**Grade (SAE)**	**Fahrenheit (Celsius) Ambient Temperature**
Eaton® Roadranger® CD50 Transmission Fluid	**50**	**All**
Heavy Duty Engine 011 MI L-L-2104B C or D or API-SF or API-CD (Previous API designations acceptable)	50 40 30	Above 10°F(-12°C.) Above 10°F(-12°C.) Below 10°F(-12°C.)
Mineral Gear 011 with rust and oxidation Inhibitor API-GL-1	90 80W	Above 10°F(-12°C.) 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 incompatibility.

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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). 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

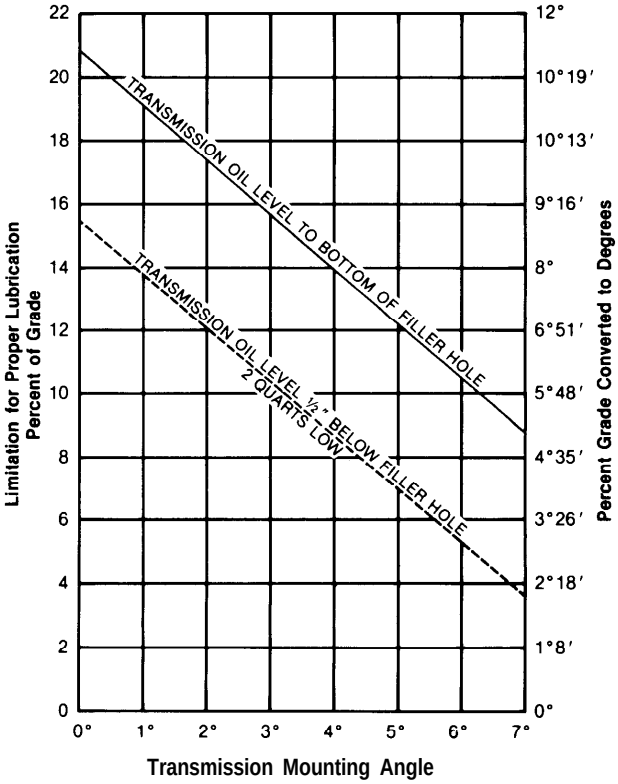
If the transmission operating angle is more than 12 degrees, improper lubrication can occur. The operating angle is the transmission mounting angle in the chassis plus the percent of upgrade (expressed in degrees).

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 O 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!



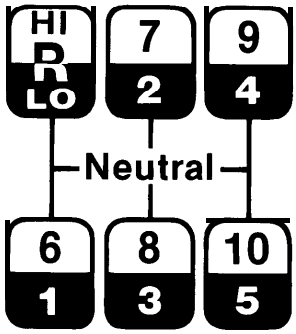
Dotted line showing "2 Quarts Low" is for reference only. Not recommended.

OPERATION

10-Speed Transmissions

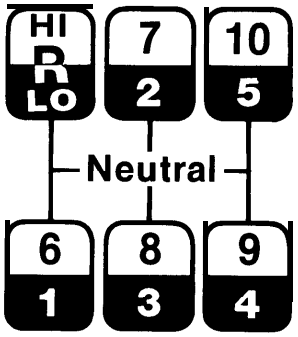
Shift Lever Patterns and Shifting Controls

RT (Direct) Models
RTX (Overdrive) Models

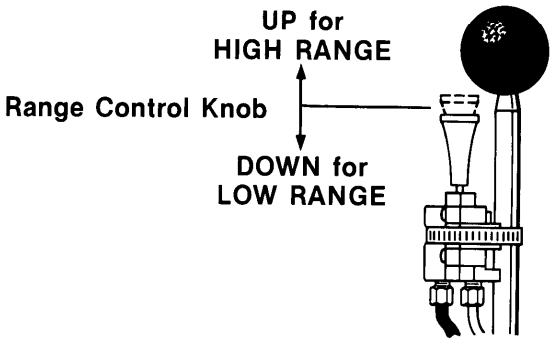


Shift 1-2-3-4-5 in Low Range.
Range shift. . .
And shift 6-7-8-9-10 in High Range.

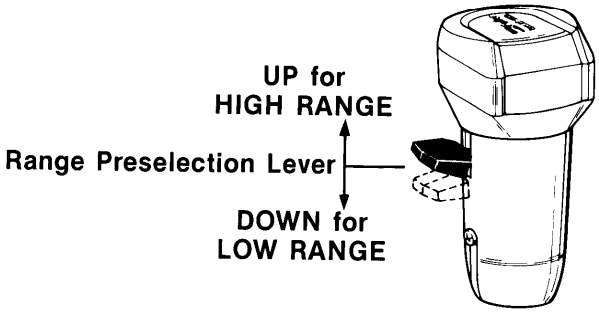
RTO (Overdrive) Models



Range Valve
(A-3546)



Roadranger Valve
(A-5010)

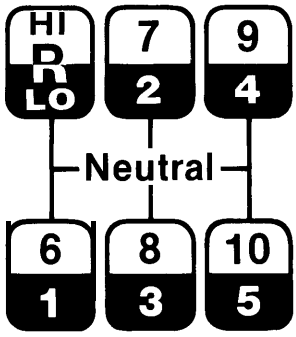


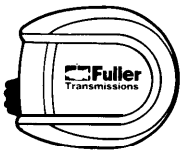
OPERATION

15-Speed Transmissions

Shift Lever Patterns and Shifting Controls

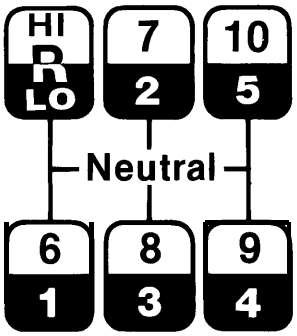
RT (Direct) Models
RTX (Overdrive) Models

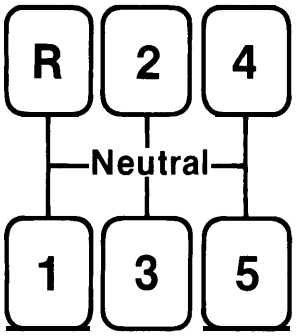


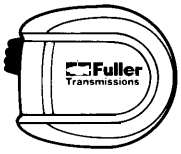


With Deep Reduction Lever/ Button in the "OUT"/REARWARD position. . .
Shift 1-2-3-4-5 in Low Range.
Range shift. . .
And shift 6-7-8-9-10 in High Range.

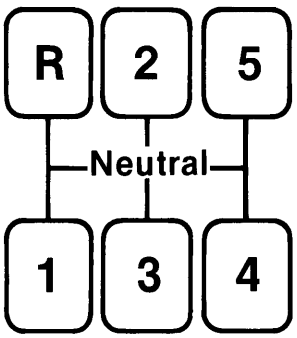
RTO (Overdrive) Models



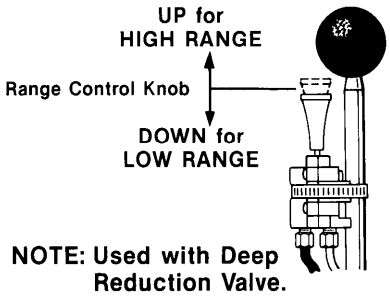




WHILE IN LOW RANGE ONLY and Deep Reduction Lever/Button in the "IN"/FORWARD position. . .
Shift 1-2-3-4-5 in Deep Reduction.

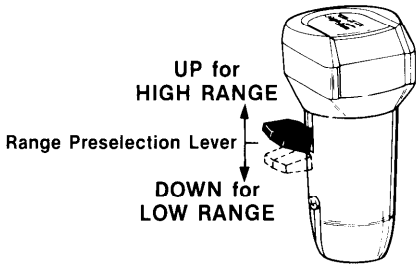


Range Valve
(A-3546)



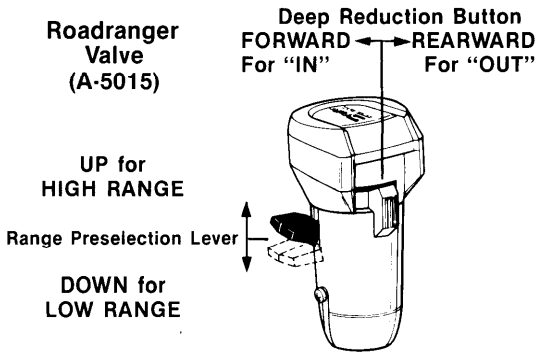
NOTE: Used with Deep Reduction Valve.

Roadranger Valve
(A-5010)



NOTE: Used with Deep Reduction Valve.

Roadranger Valve
(A-5015)



POWER FLOW

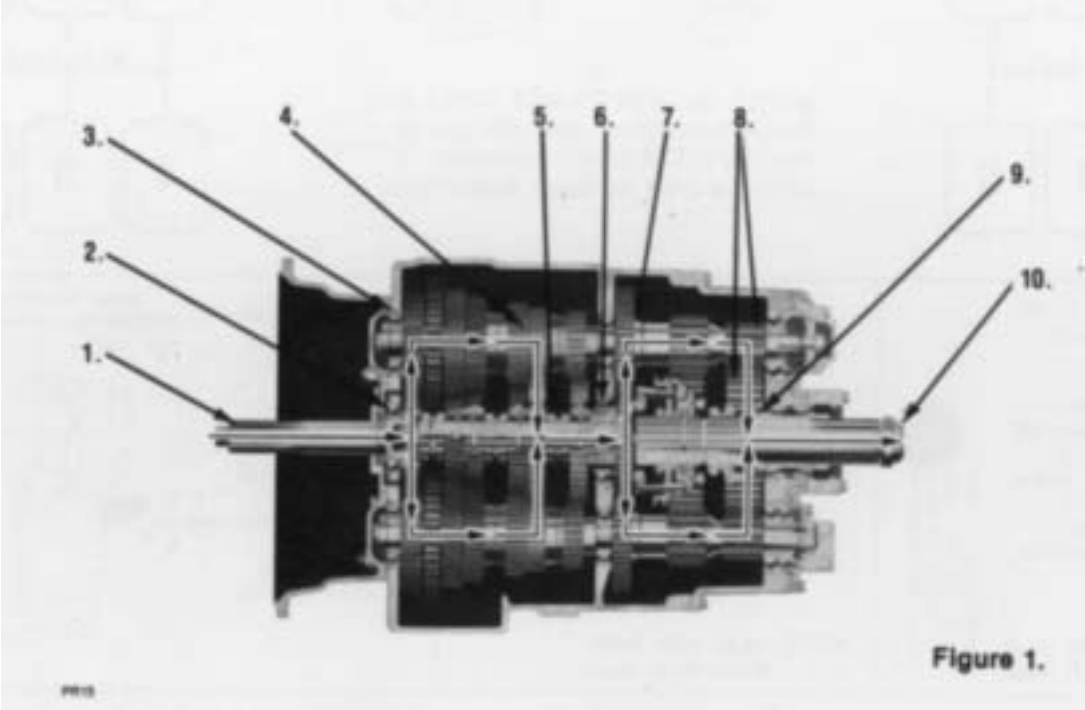
The transmission must efficiently transfer the engine's power, in terms of torque, to the vehicle's rear wheels. Knowledge of what takes place in the transmission during torque transfer is essential when trouble-shooting and making repairs.

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 1-3) illustrate a 1st/6th speed gear engagement.
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: DEEP REDUCTION (15-Speed Models Only)

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 DEEP REDUCTION 1st.



DEEP REDUCTION 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 the "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.

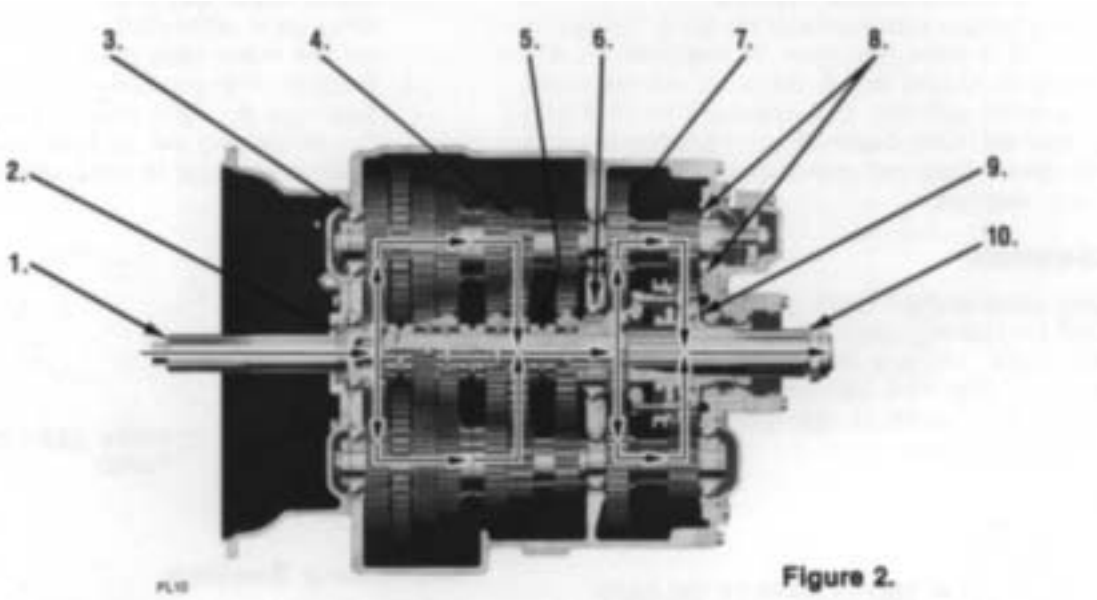


Figure 2.

LOW RANGE POWER FLOW
(10-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 6th.

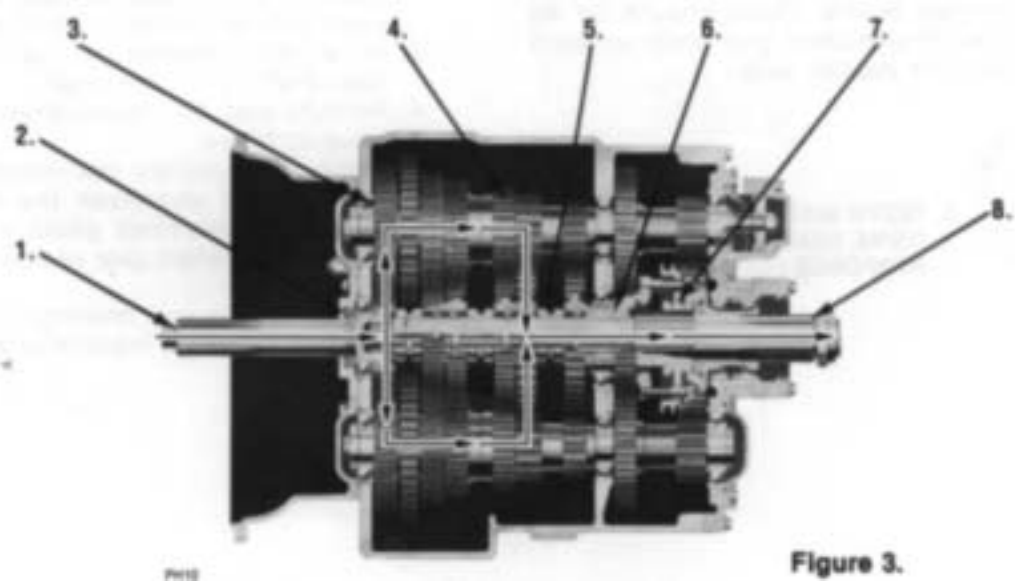


Figure 3.

HIGH RANGE POWER FLOW
(10-Speed Model Shown.)

TIMING

Timing Procedures: All Models

All Fuller twin countershaft transmissions are "timed" at assembly. It is important that proper timing procedures are followed when reassembling the transmission. Timing assures that the countershaft gears will contact the mating mainshaft gears at the same time, allowing mainshaft gears to center on the mainshaft and equally divide the load.

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 or deep reduction gear set is timed in the auxiliary section.

Front Section

A. Marking countershaft drive gear teeth.

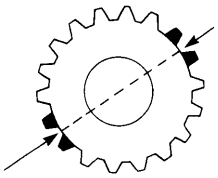
1. Prior to placing each countershaft assembly into case, clearly mark the tooth located directly over the keyway of drive gear as shown. This tooth is stamped with an "O" to aid identification.

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

Cut 7300 H-11/86

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.

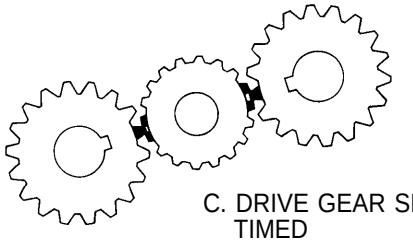


B. TEETH MARKED ON MAIN DRIVE GEAR FOR TIMING PURPOSES

Cut 7300G-11 /86

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.



C. DRIVE GEAR SET PROPERLY TIMED

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Auxiliary Section

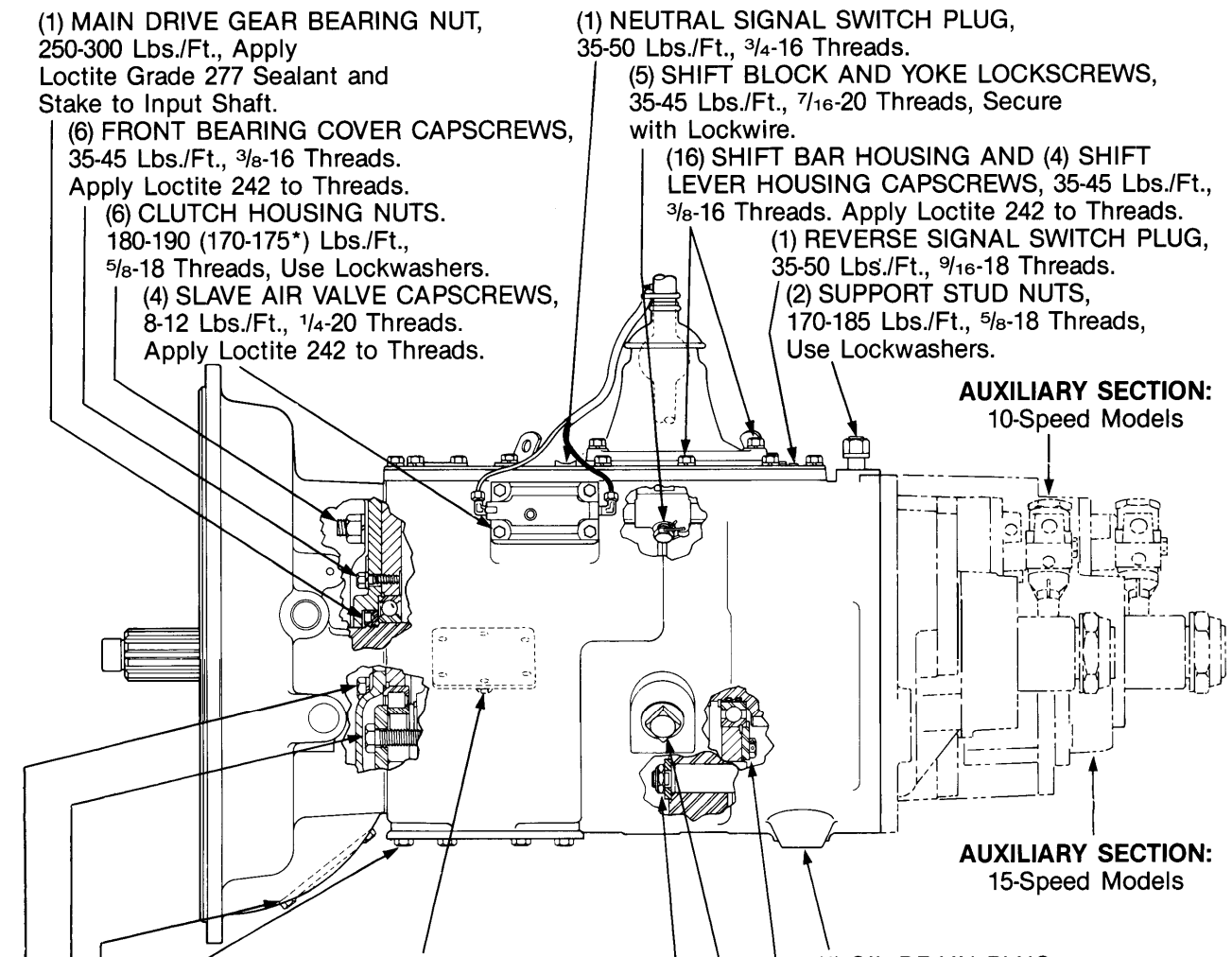
A. Timing the low range gear set of 10-Speed Models OR the deep reduction gear set of 15-Speed Models.

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. Partially seat the countershaft rear bearings in housing bores.
5. 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.
6. 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 instances, eventually cause damage to transmission gears, shafts, and/or bearings. Use a torque wrench whenever possible to attain recommended lbs./ft. ratings. Do not torque capscrews dry.

FRONT SECTION: ALL MODELS



*With Aluminum Clutch Housing

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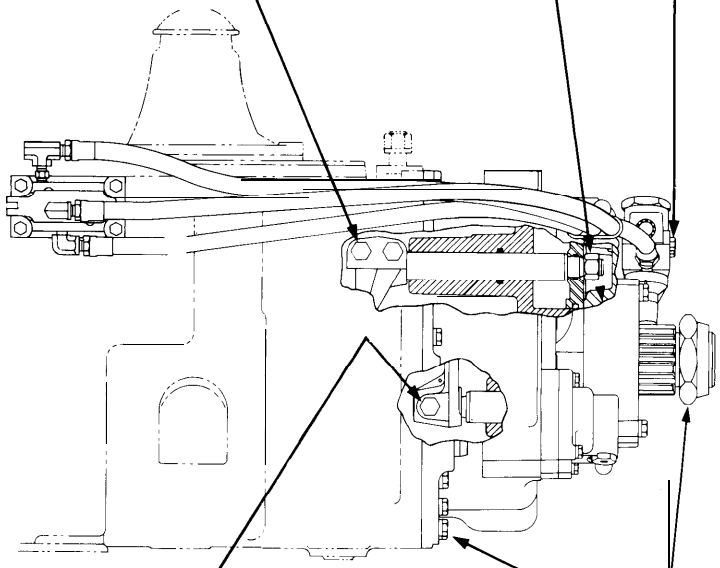
TORQUE RECOMMENDATIONS

AUXILIARY SECTIONS

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

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

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



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

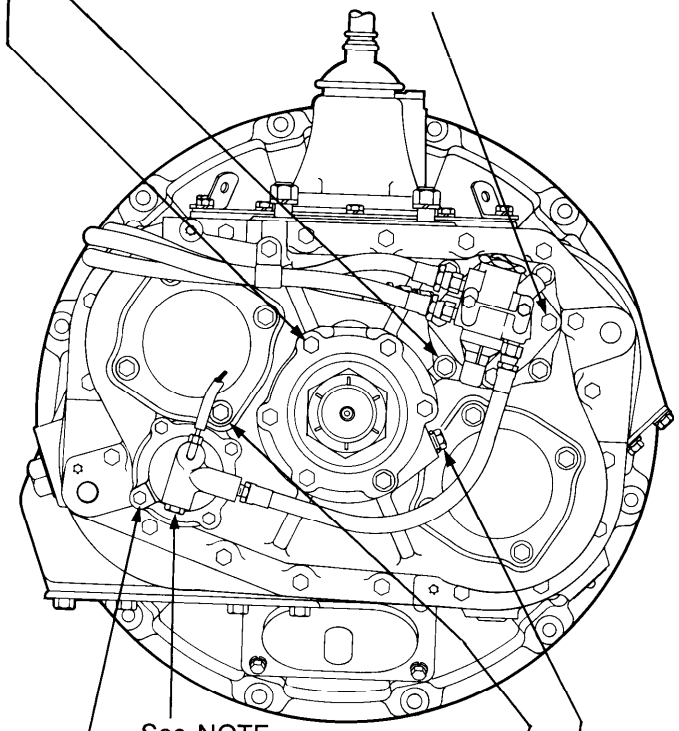
(19) AUXILIARY HOUSING CAPSCREWS, 35-45 Lbs./Ft., 3/8-16 Threads. Apply Loctite 242 to Threads.

(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., 3/8-16 Threads. Apply Loctite 242 to Threads.

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

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



See NOTE.

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

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

(1) SPEEDOMETER HOUSING PLUG, 35-50 Lbs./Ft., 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., 5/8-18 Threads.

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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.

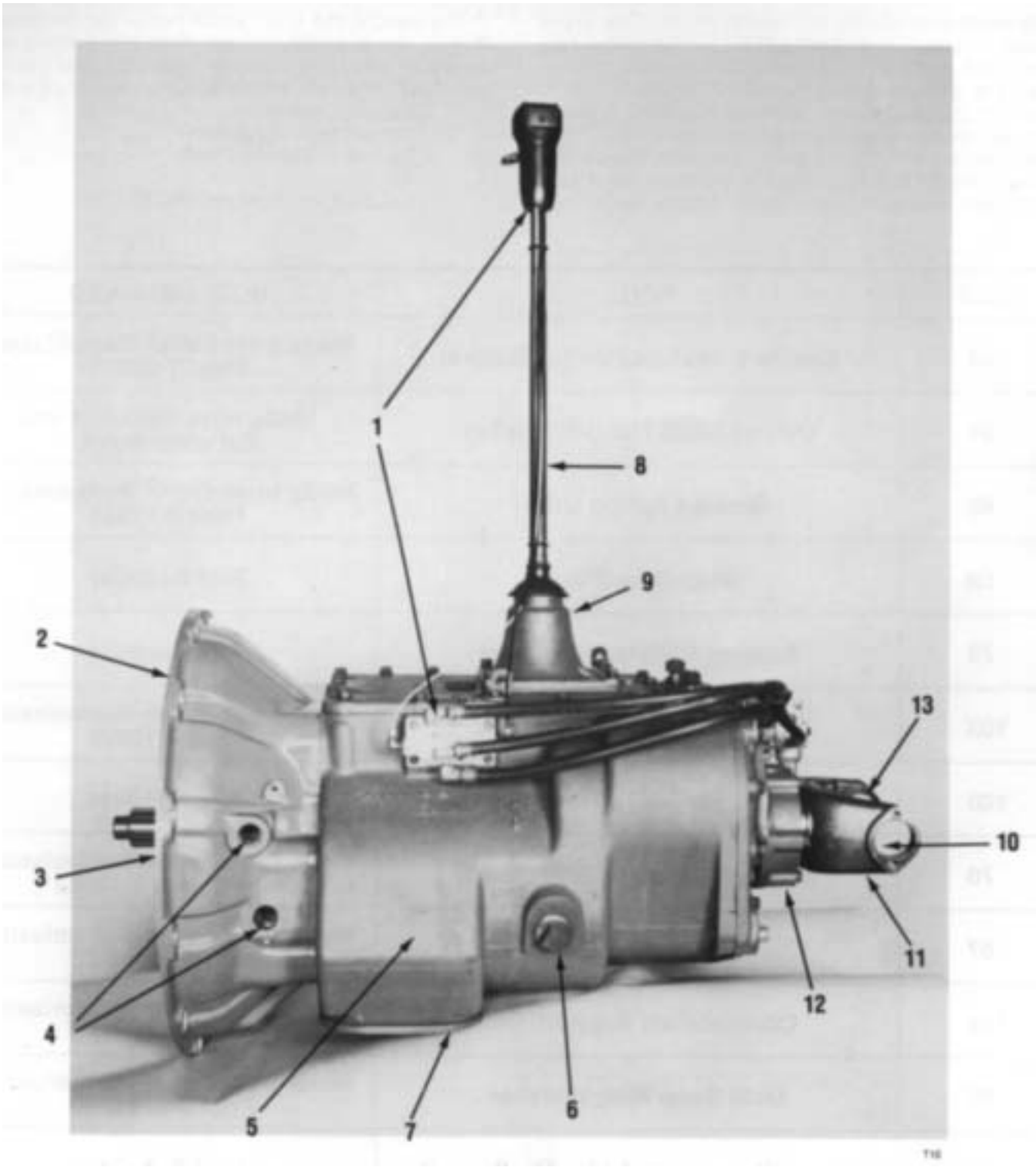
The specialized tools listed below can be obtained from a tool supplier or made from dimensions as required by the individual user. Detailed Fuller Transmission Tool Prints are available upon request by writing.

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

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

***Dimensions necessary to determine specific tool number required.**

PREVENTIVE MAINTENANCE



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.

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PRECAUTIONS

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, ILLUS. TRATIONS 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

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 bearing 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.

1. 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.

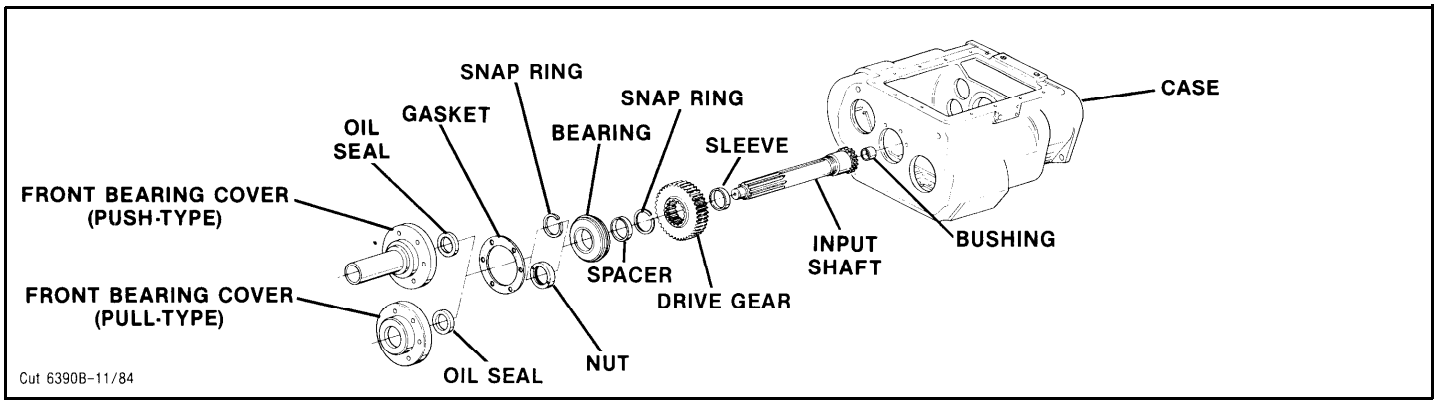
IMPORTANT: REFER TO THE APPROPRIATE ILLUSTRATED PARTS LIST (SPECIFIED BY MODEL SERIES) TO ENSURE THAT PROPER PARTS ARE USED DURING REASSEMBLY OF THE TRANSMISSION.

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 and mainshaft 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 spacer on input shaft.
5. Using a flanged-end drive, 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.

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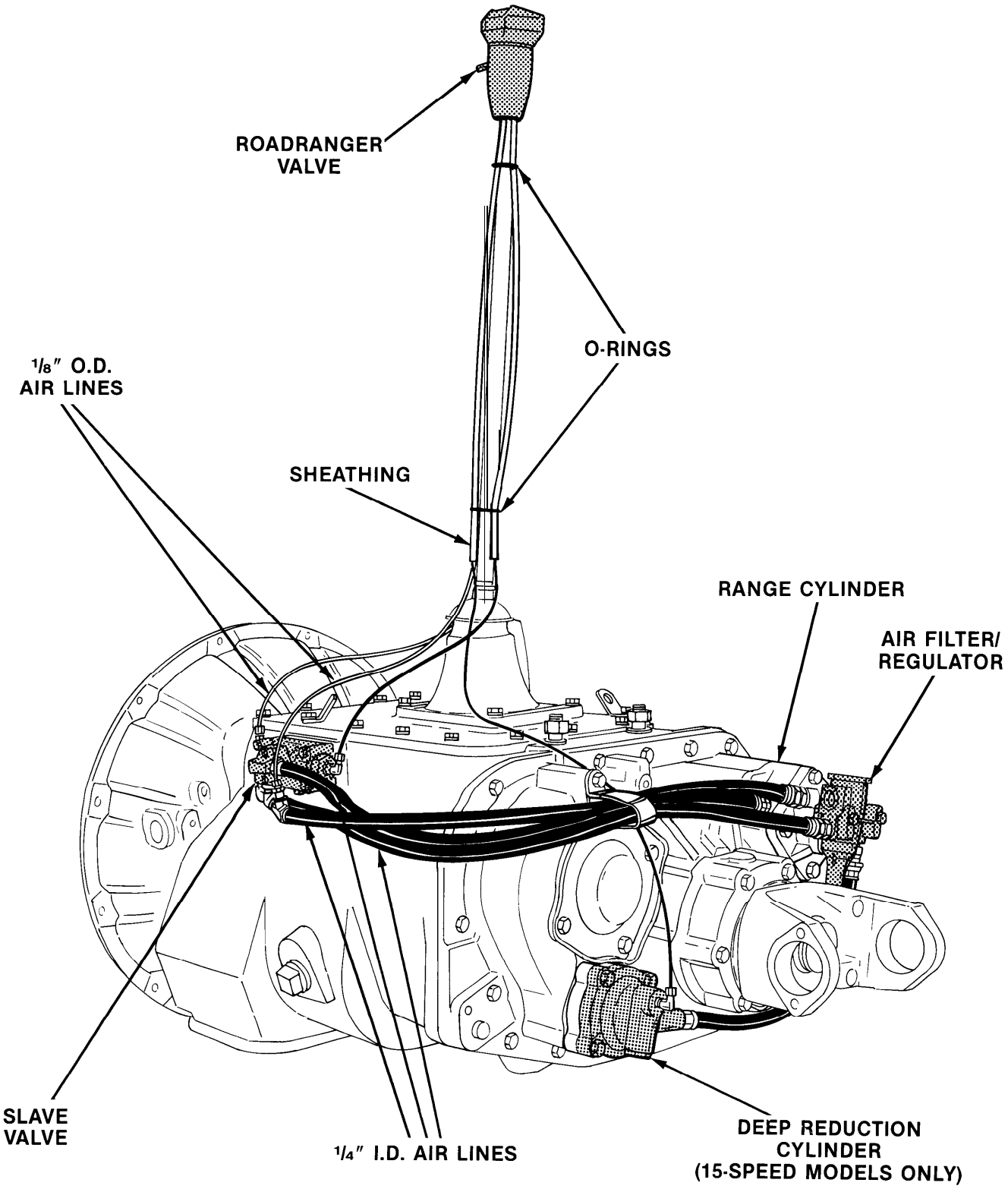
AIR SYSTEM



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AIR SYSTEM

RANGE SHIFT AIR SYSTEM—ALL MODELS

Operation

The Range Shift Air System consists of the air filter/regulator, slave valve, a Range Valve or Roadranger 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 range valve.

WHILE IN LOW RANGE, the range 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 range 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 piston, 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 range valve and slave valve, there will be CONSTANT AIR flowing from the exhaust port of range 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 range valve, O-rings and/or related parts of the range 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 23.)
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. RANGE VALVE (See Pages 24 and 25.)
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 range valve.

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 range valve is operating properly. Reconnect air line.

B. If range valve does not operate properly, check for restrictions and air leaks. Leaks in: dicate 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 level 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 salve 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.

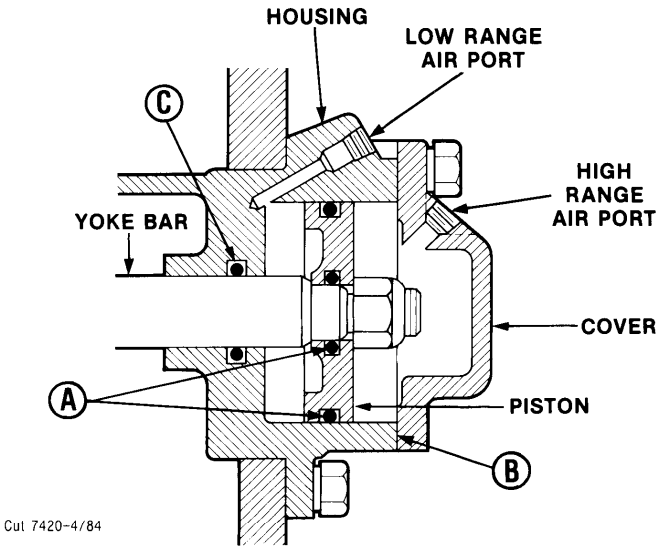
7. RANGE CYLINDER (Refer to the following illustration.)

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.

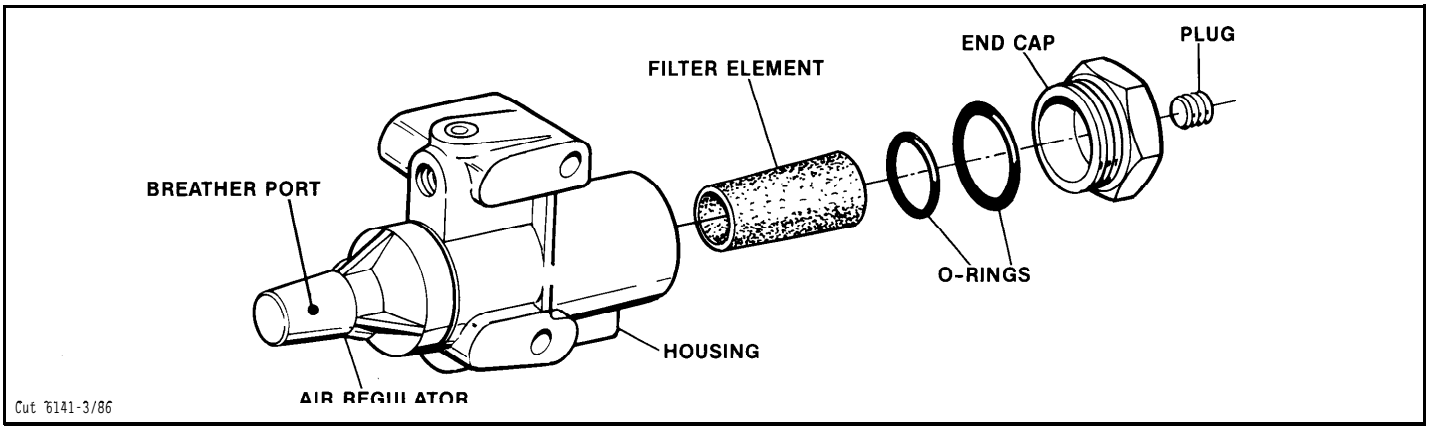
C. Leak at O-ring C results in a slow shift to LOW RANGE; pressurizing of transmission case.



Range Cylinder Assembly—All Models

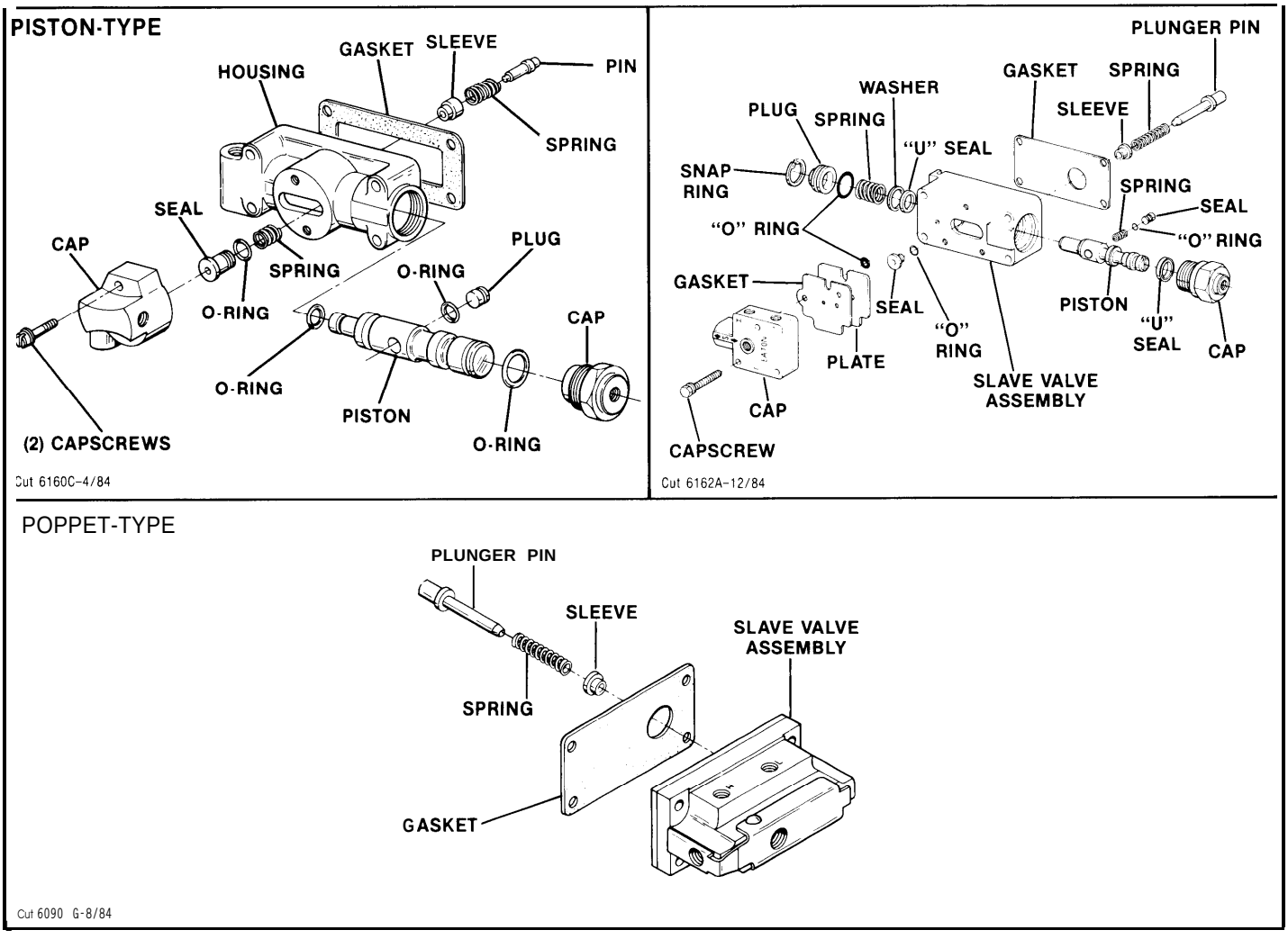
AIR SYSTEM

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

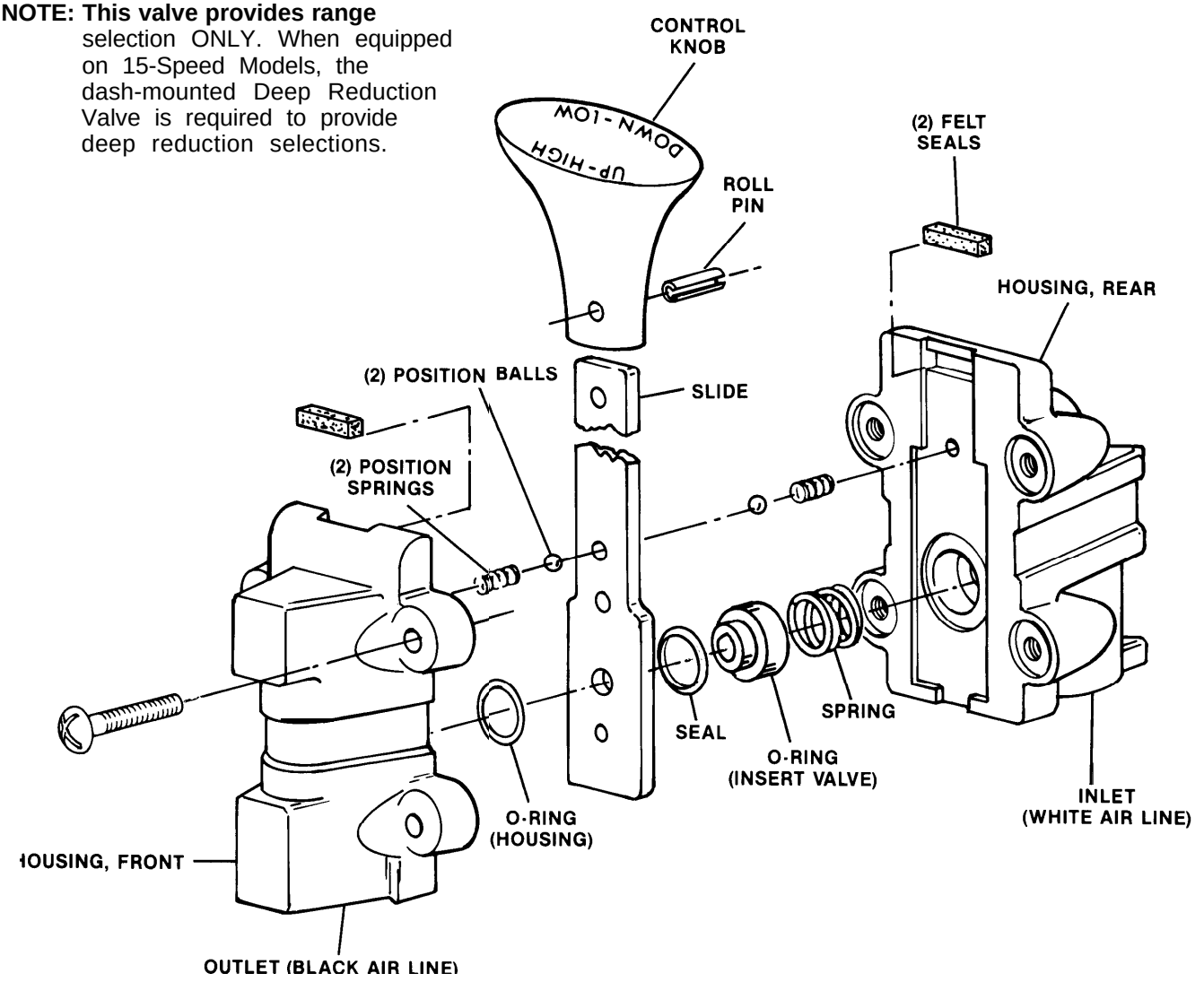


Refer to the drawing for disassembly and reassembly of the piston-type slave valve assembly. **Should the poppet-type slave valve assembly prove to be defective, replace the complete assembly, as it is non-serviceable. The actuating components** used with these valve assemblies are non-interchangeable. 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.



Removal and Disassembly

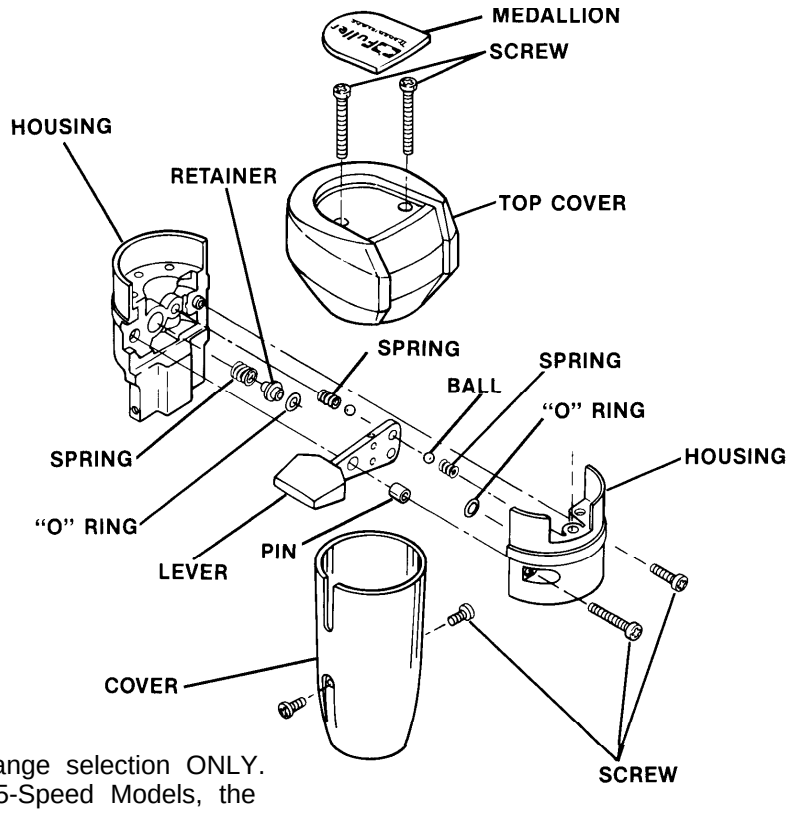
1. Disconnect the air lines and loosen clamp securing the valve to gear shift lever. Remove valve.
2. Remove the four screws to separate the front and rear housings and remove the slide and two sets of position springs and balls.
3. Remove the seal, insert valve O-ring and spring from rear housing.
4.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

ROADRANGER VALVE A-5010



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 6146 G-4/86

Removal and Disassembly

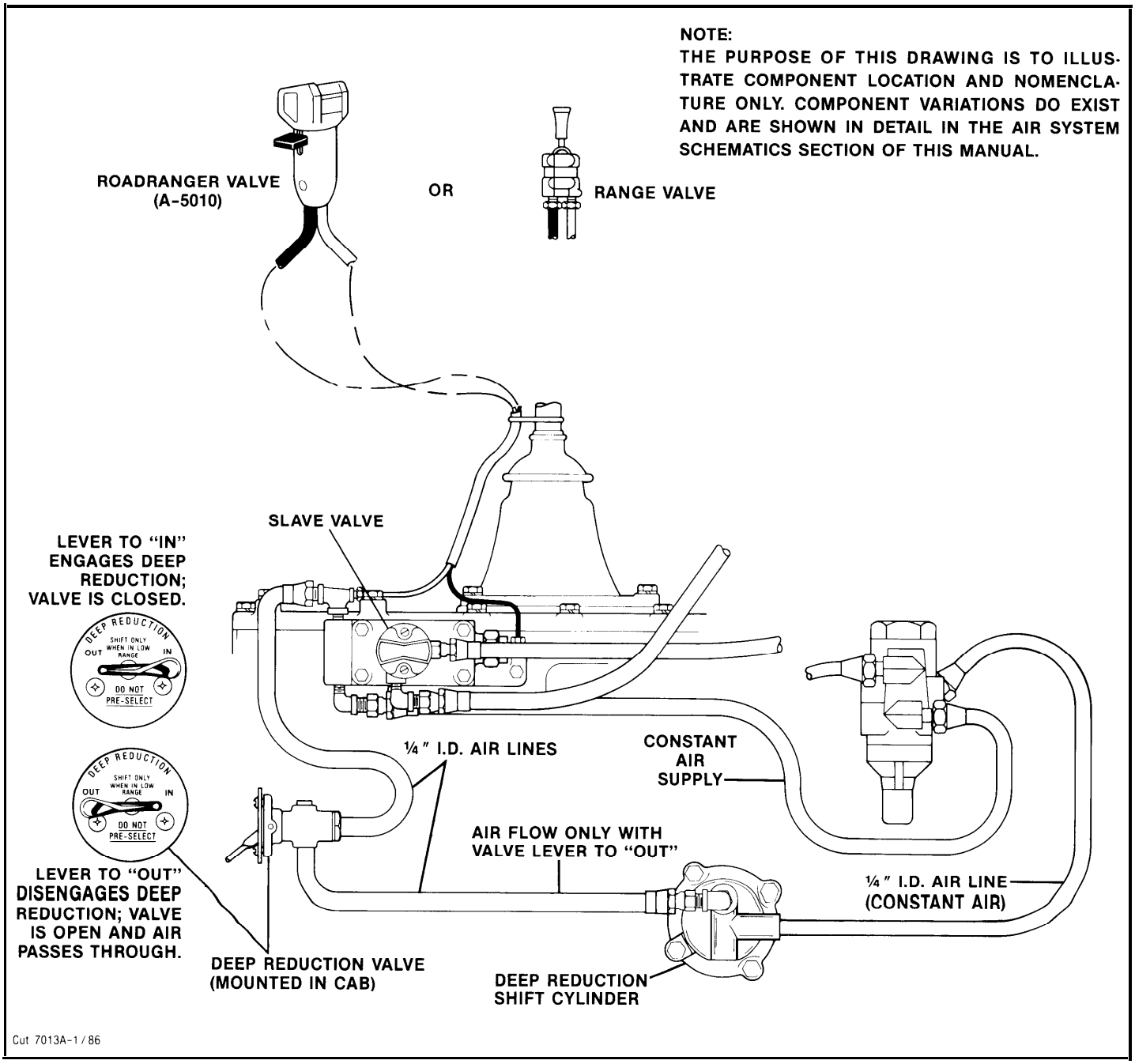
1. Remove two screws holding bottom cover to valve and slide cover down gearshift lever to expose air line fittings. Disconnect air lines.
2. Loosen jam nut and turn Roadranger valve from gear shift lever.
3. Pry medallion from recess in top cover.
4. Turn out the two screws to remove the top cover from 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 Roadranger valve on gear shift lever and tighten jam nut.
3. Attach air lines and reinstall bottom cover.

AIR SYSTEM

Deep Reduction Air System: 15-Speed Models Only
With Dash-Mounted Deep Reduction Valve



Operation

In addition to the components of the Range Air System, the Deep Reduction Air System utilizes a reduction cylinder and a separate dash-mounted deep reduction valve.

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

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.

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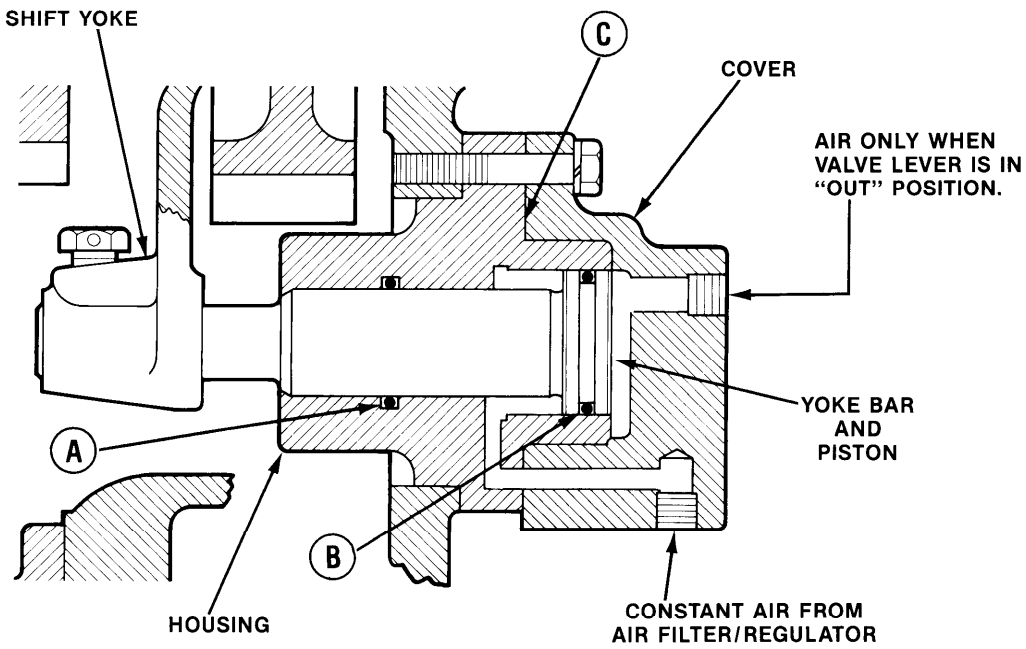
AIR SYSTEM

Deep Reduction Air System: With Dash-Mounted Deep Reduction Valve



REDUCTION CYLINDER ASSEMBLY

Cut 7440-4/84

Troubleshooting

If the transmission fails to shift or shifts too slowly to or from DEEP REDUCTION, 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.

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

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.

2. Deep Reduction Valve

With the gear shift lever in neutral, disconnect the air line 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 above 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.

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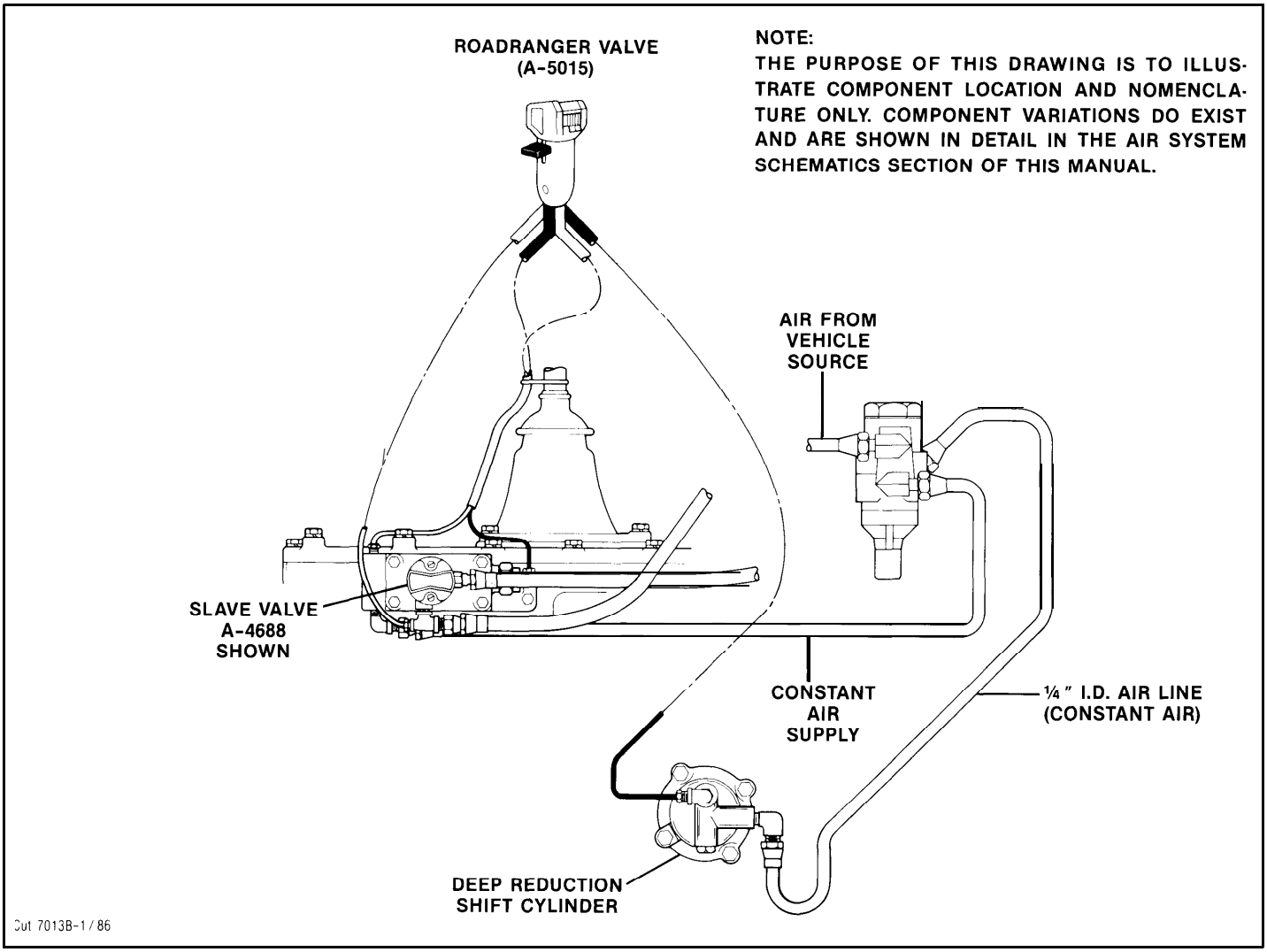
AIR SYSTEM

Deep Reduction Air System: With A-5015 Roadranger Valve



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 Roadranger valve A-5015.

NOTE: When the A-5015 Roadranger valve is used the deep reduction cover must be equipped with an insert valve.

CONSTANT AIR from the air filter/regulator assembly is supplied to the Roadranger 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 is installed in the cylinder cover to provide the proper air flow needed to move the reduction piston in the cylinder.

With the deep reduction button in the REARWARD position, the '"SP" port of Roadranger valve is CLOSED and NO AIR is supplied to the center port of cylinder cover.

WHILE IN LOW RANGE, the button can be moved FORWARD to operate in DEEP REDUCTION. The "SP" port of valve is OPENED when deep reduction selection is made, supplying AIR to the center port of cylinder cover.

WHILE IN HIGH RANGE, the mechanical interlock of the Roadranger valve prevents movement of deep reduction button to the FORWARD position.

Troubleshooting

If the transmission fails to shift or shifts too slowly to or from DEEP REDUCTION, 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.

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

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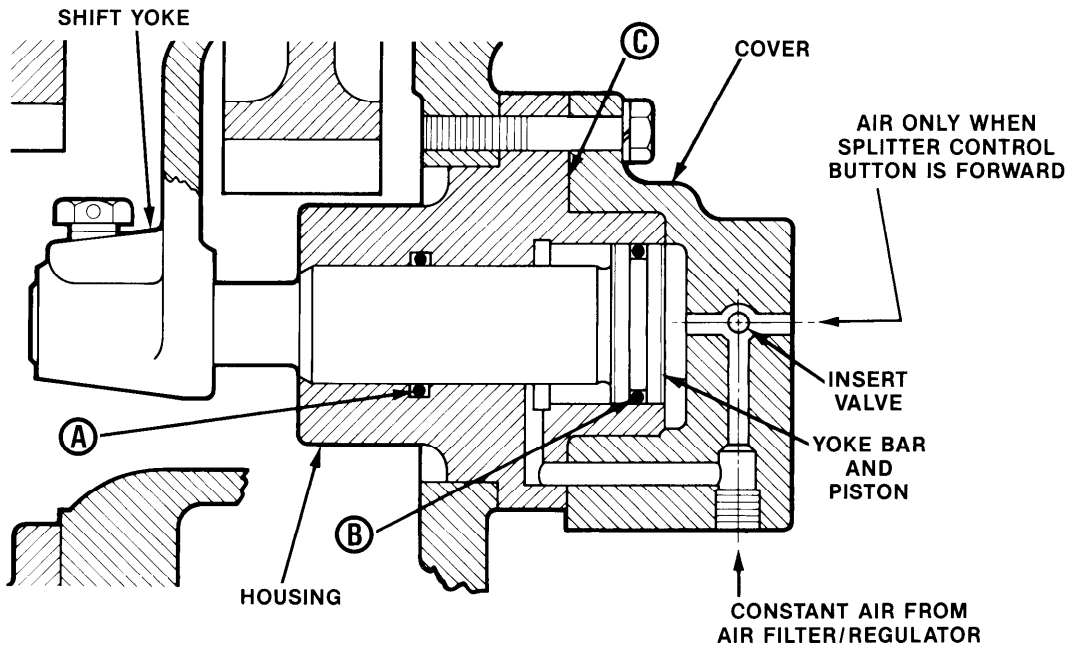
AIR SYSTEM

Deep Reduction Air System: With A-501 5 Roadranger Valve (cont.)



Cut 7441-4184

REDUCTION CYLINDER ASSEMBLY

Troubleshooting (cont'd.)

1. Air Supply

With the gear shift lever in neutral, select LOW RANGE and loosen the connection at the "H" port of Roadranger 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"OD air line between the Roadranger valve and slave valve, making sure this line is connected to tee fitting at the low range, or "L" port, of slave valve.

2. Roadranger Valve

With the 'gear shift lever in neutral, disconnect the 1/8" OD air line at the center port of reduction cylinder cover, making sure this line leads from the "SP" port of Roadranger 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 Roadranger valve is defective, or there is a restriction-in the air lines.

3. Reduction Cylinder (Refer to the above 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 Roadranger 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 next page.)

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 OD 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 Roadranger valve WHILE DEEP REDUCTION BUTTON IS REARWARD (providing the Roadranger valve is operating properly).

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

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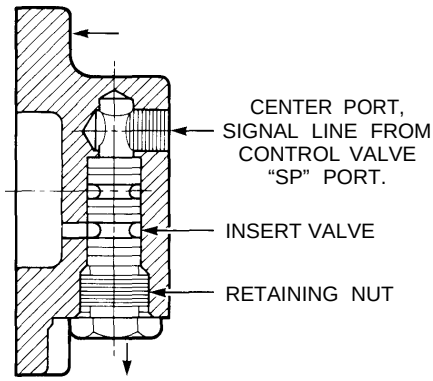
AIR SYSTEM

Deep Reduction Air System: With A-5015 Roadranger Valve (cont.)

The insert valve is a self-contained 1 3/I6" valve assembly located in the reduction 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.

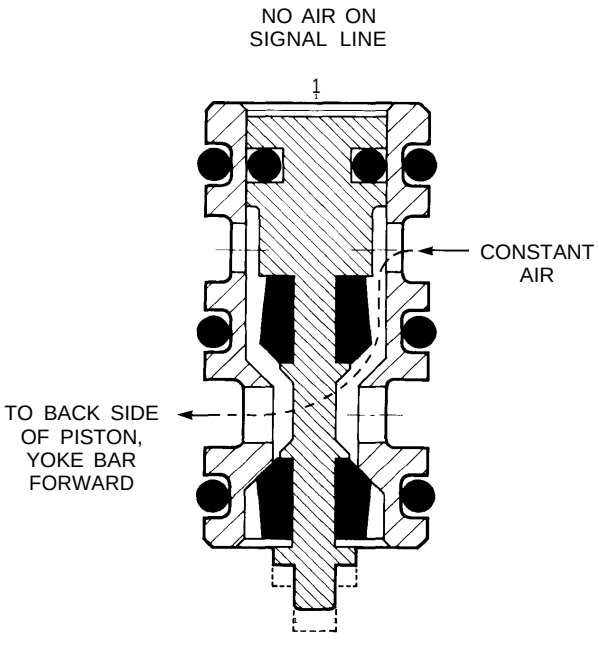


cut 7450-4/84

When installing the insert valve in bottom bore 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 adhesive sealant (Pt. No. 71205) or its equivalent to threads and tighten.

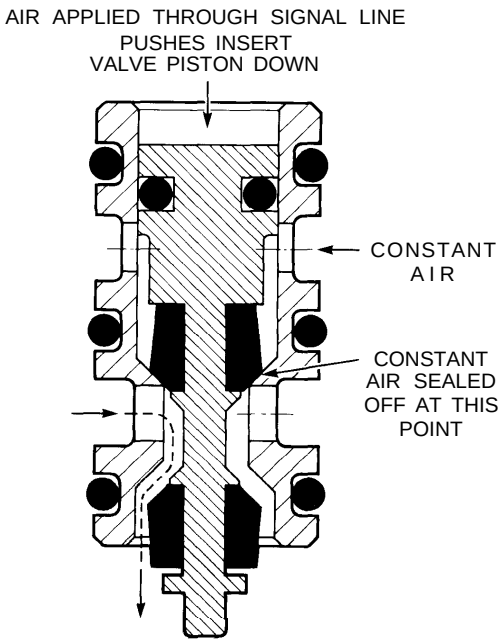
Travel of the small insert valve piston is only 1/ 32". As shown in the illustrations below, when NO AIR is applied to the top side of valve piston, CONSTANT AIR supplied from the air filter/regulator passes freely through the insert valve and to the backside of cylinder piston, moving the yoke bar forward to disengage deep reduction gearing (LOW RANGE AND HIGH RANGE). When AIR is applied to the top side of valve piston through the 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 the cover when CONSTANT AIR supplied from the regulator is directed to the front side of cylinder piston, moving the yoke bar rearward to engage deep reduction gearing (DEEP REDUCTION).

LOW RANGE AND HIGH RANGE



Cut 7450A-4184

DEEP REDUCTION

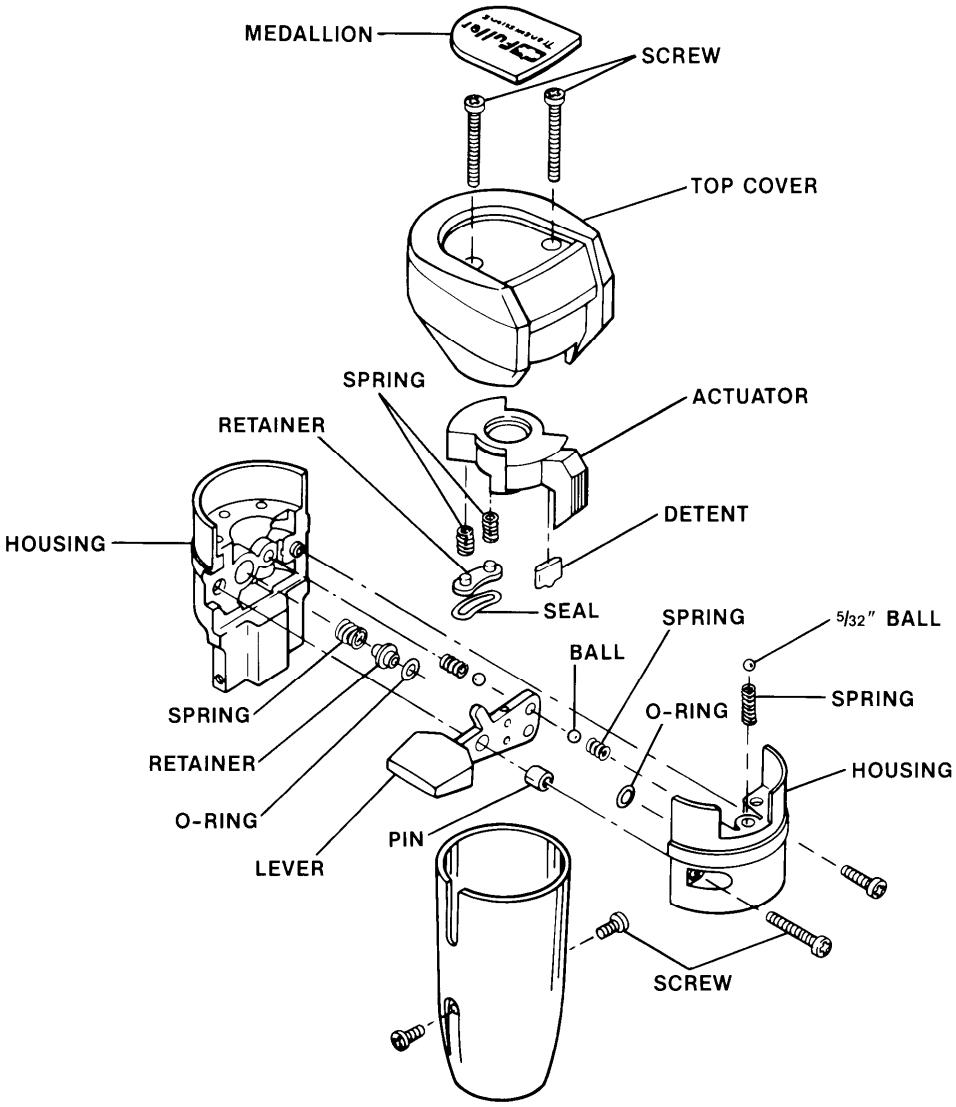


Cut 7450 B-4\84

INSERT VALVE

AIR SYSTEM

Deep Reduction Air System: With A-50 15 Roadranger Valve (cont.)



Cut 6147 G-4/86

A-5015 ROADRANGER VALVE

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 Roadranger 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 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 Roadranger valve on gear shift lever and tighten jam nut.
3. Attach air lines and reinstall bottom cover.

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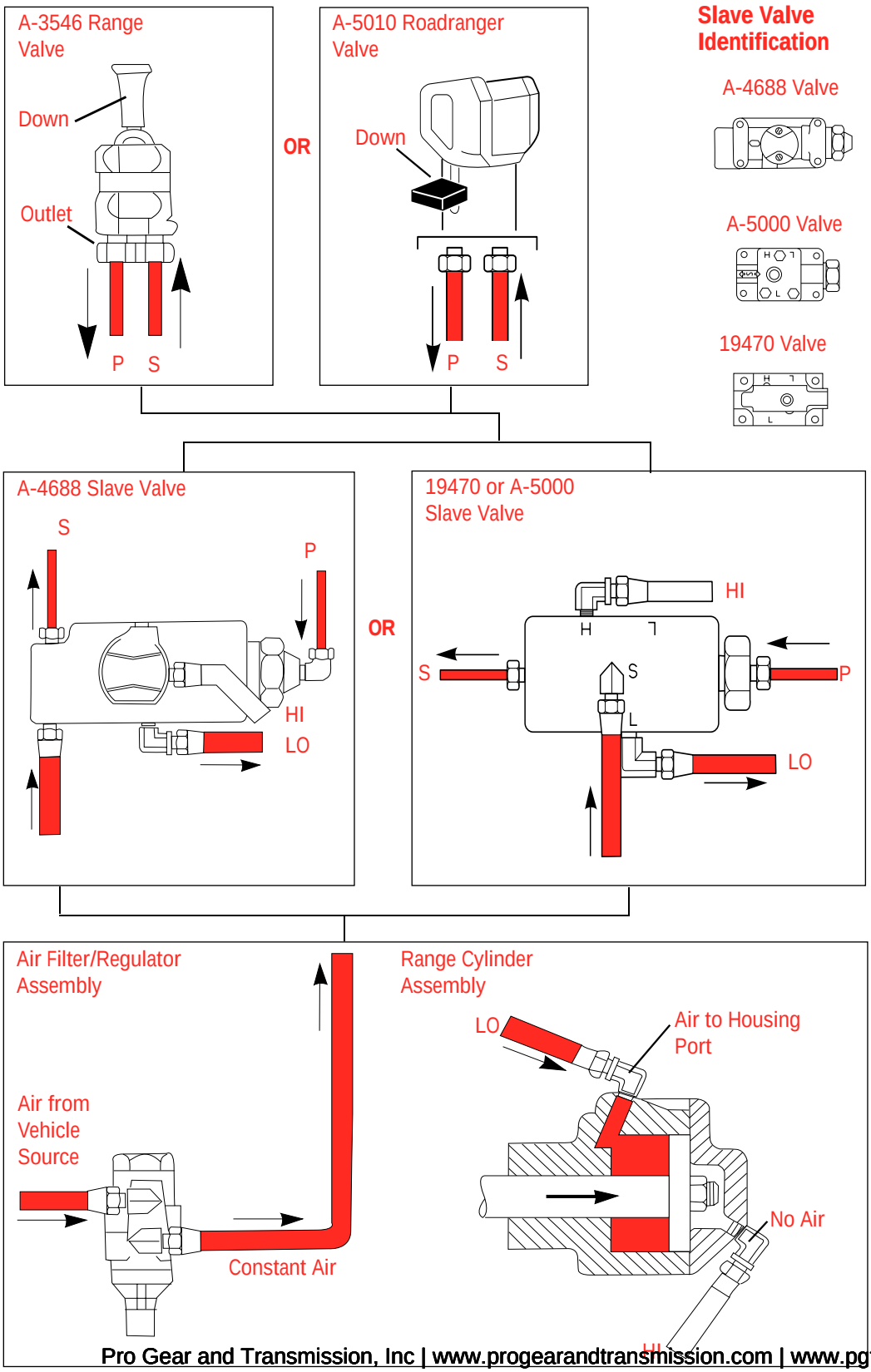
7L: 8: 9: and 10 Speed (2-Speed Auxiliary)

Range—LO

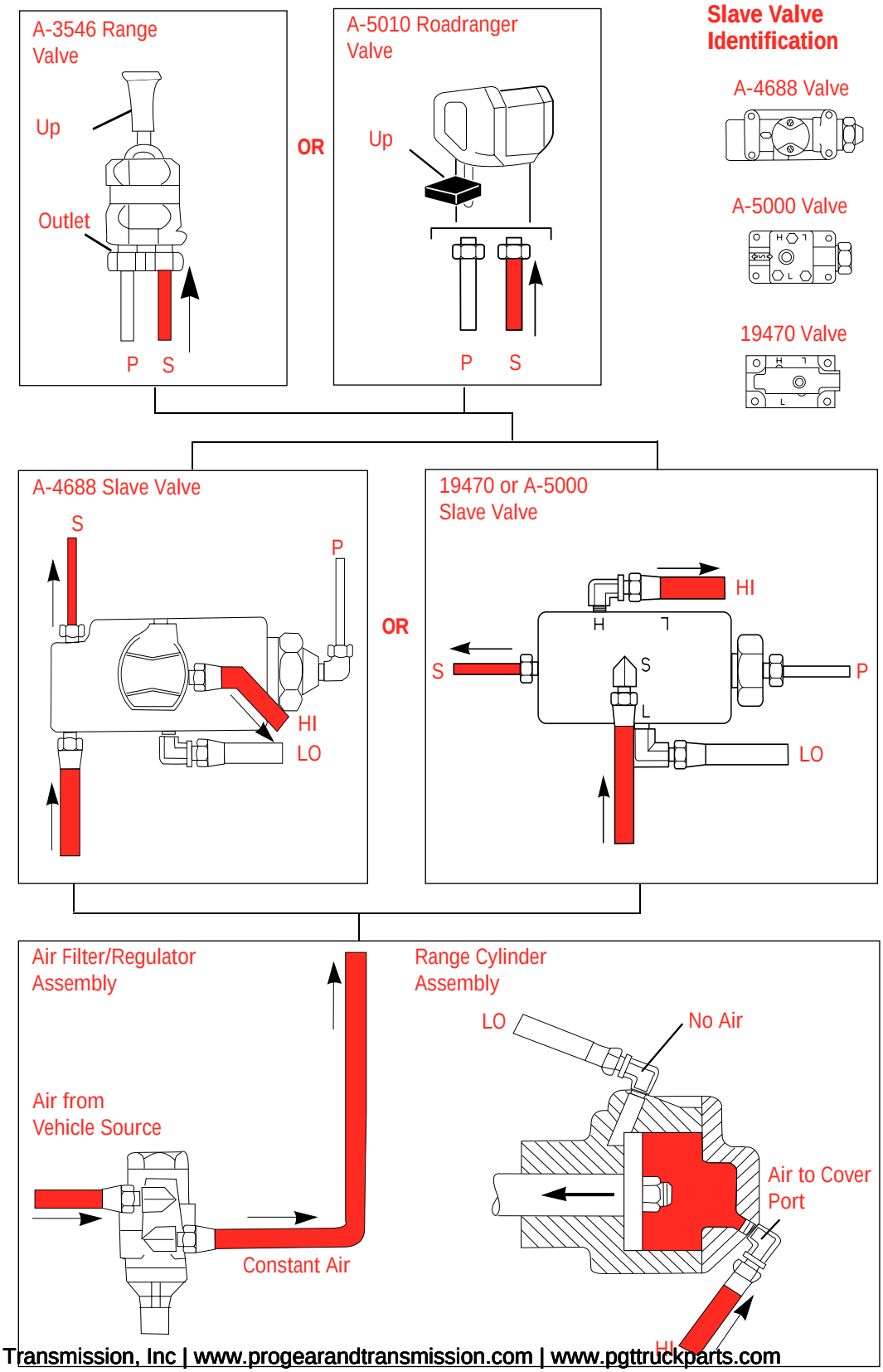


Schematic

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

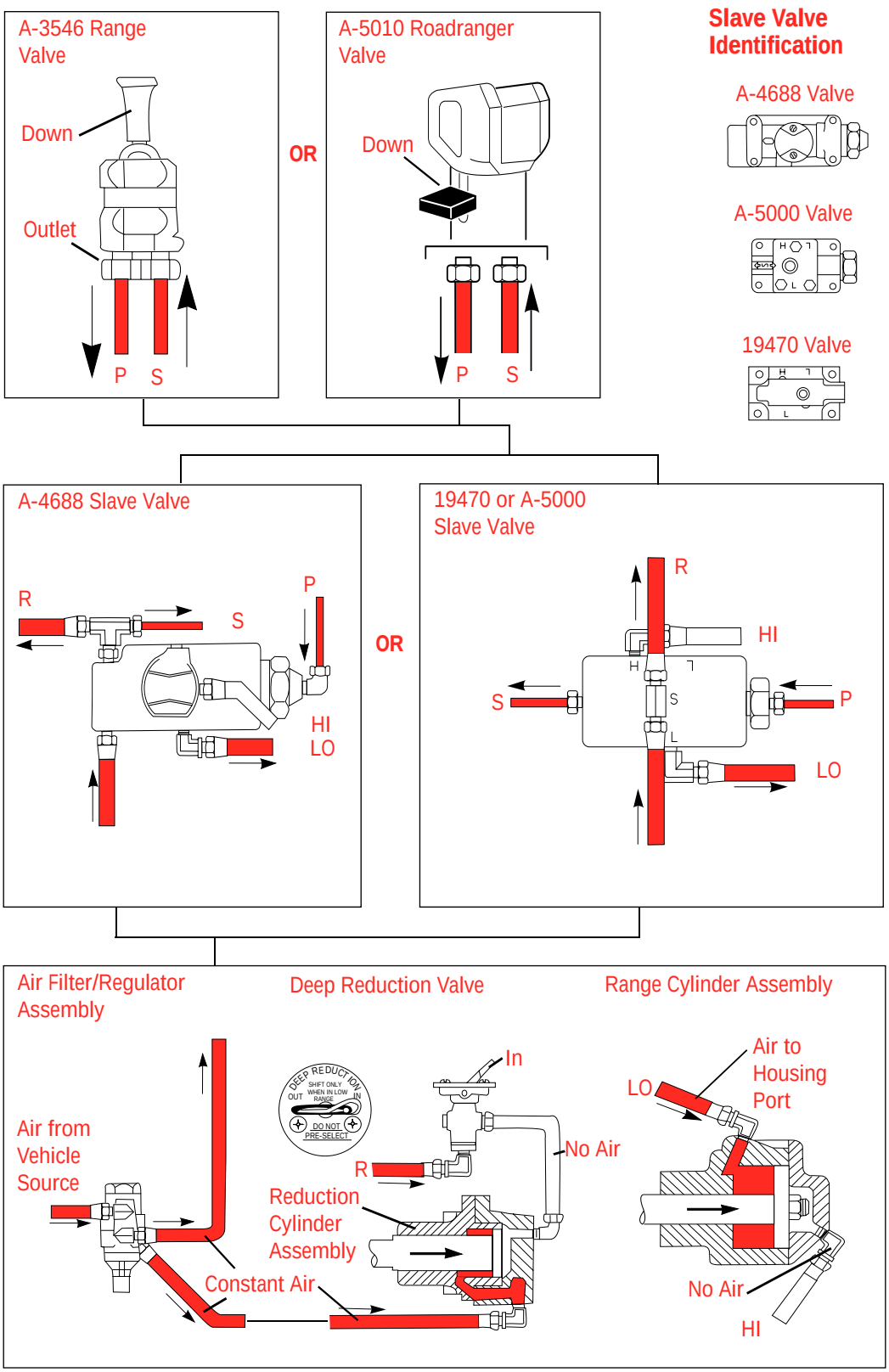


Schematic

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

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

Deep Reduction

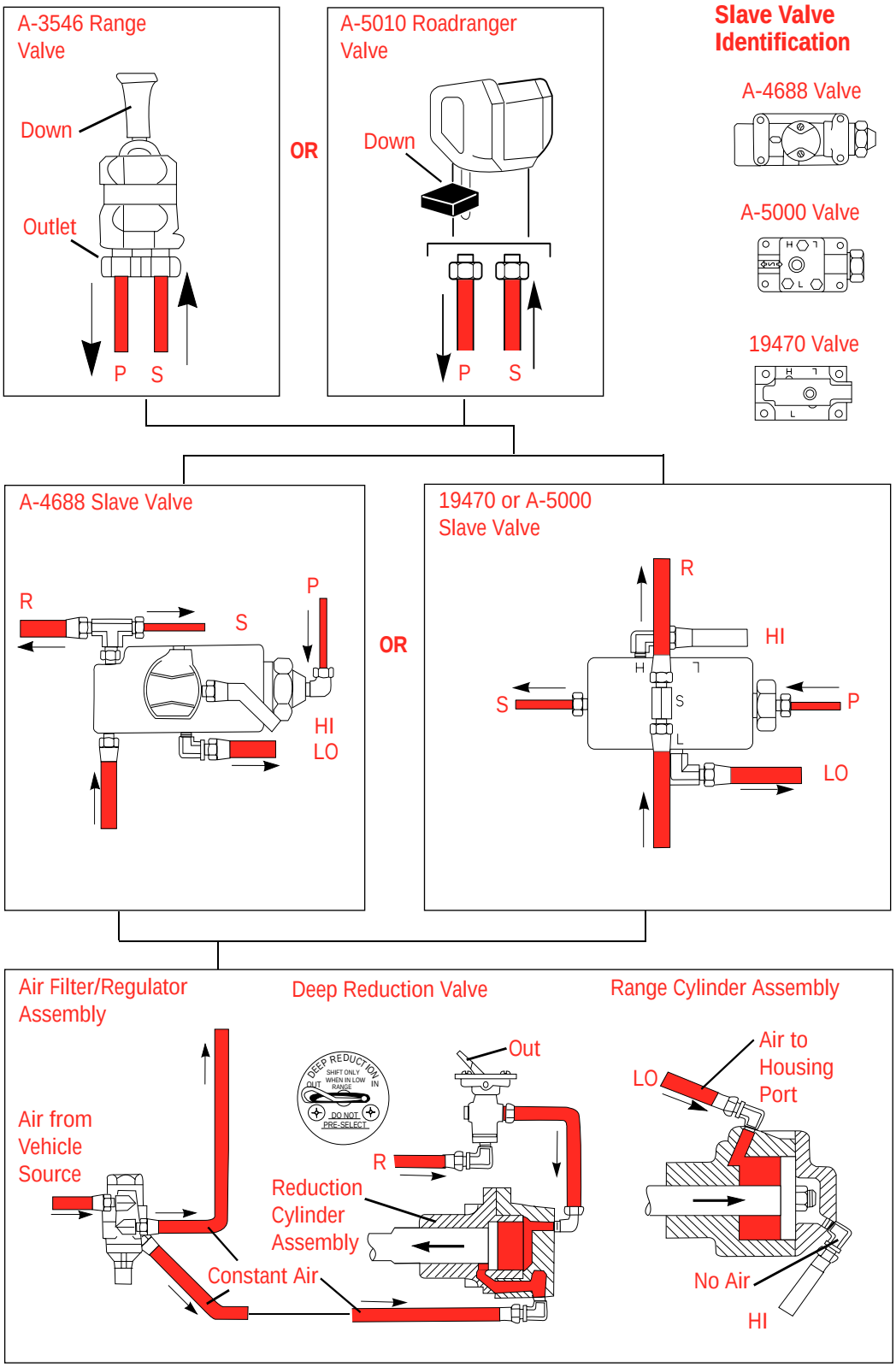


Schematic

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

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

Range—LO

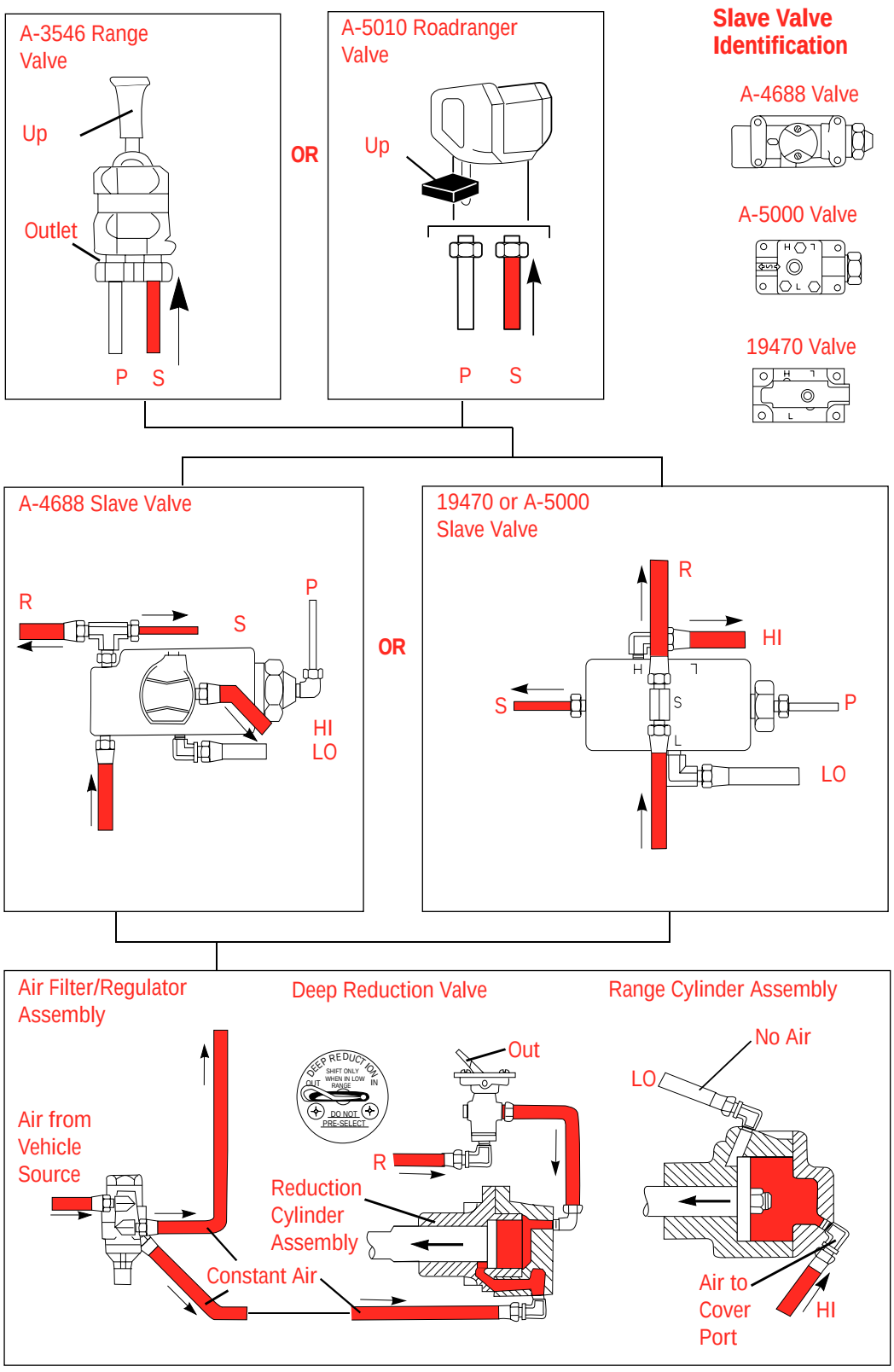


Schematic

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

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

Range—HI

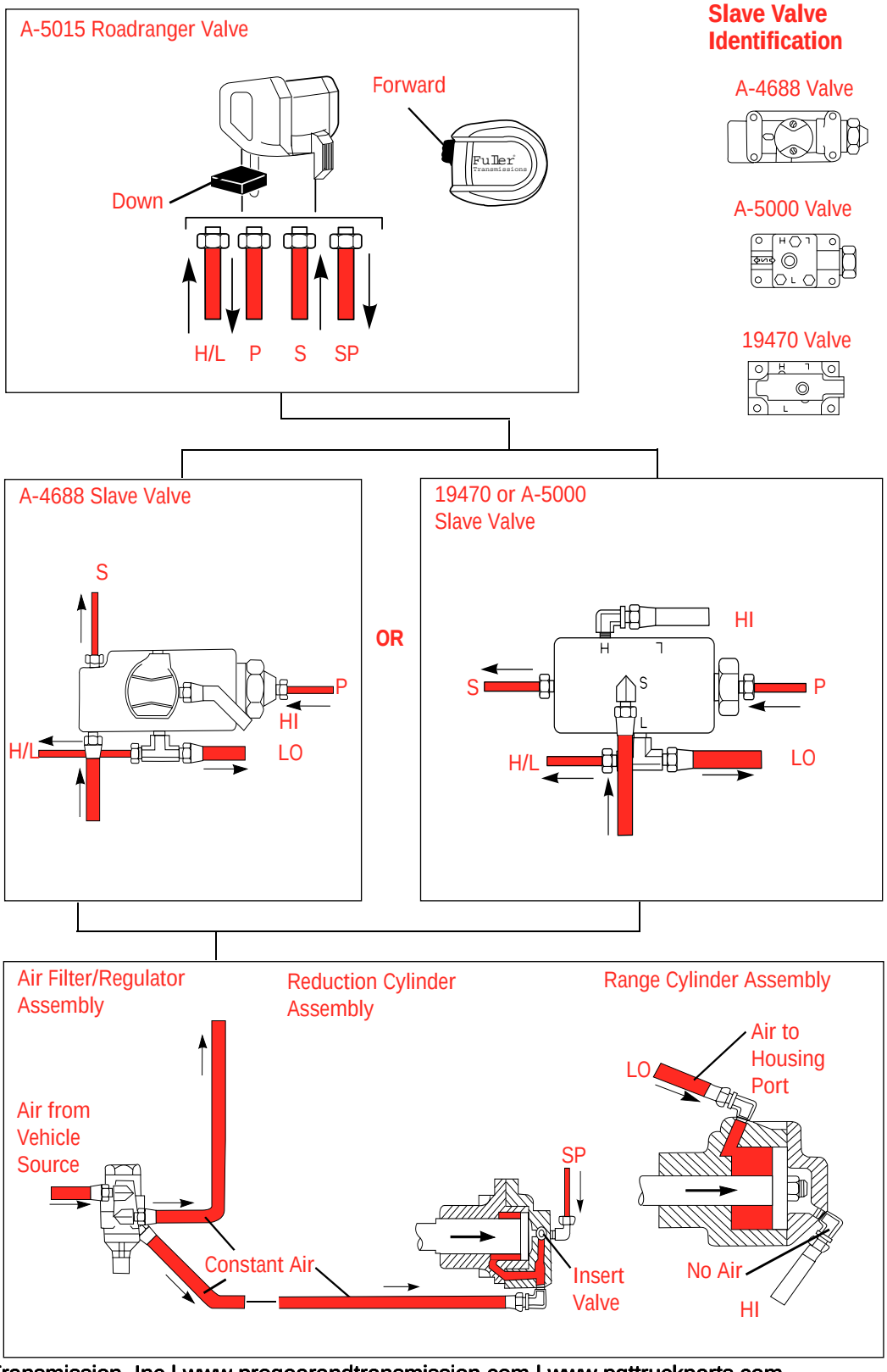


Schematic

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

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

Deep Reduction

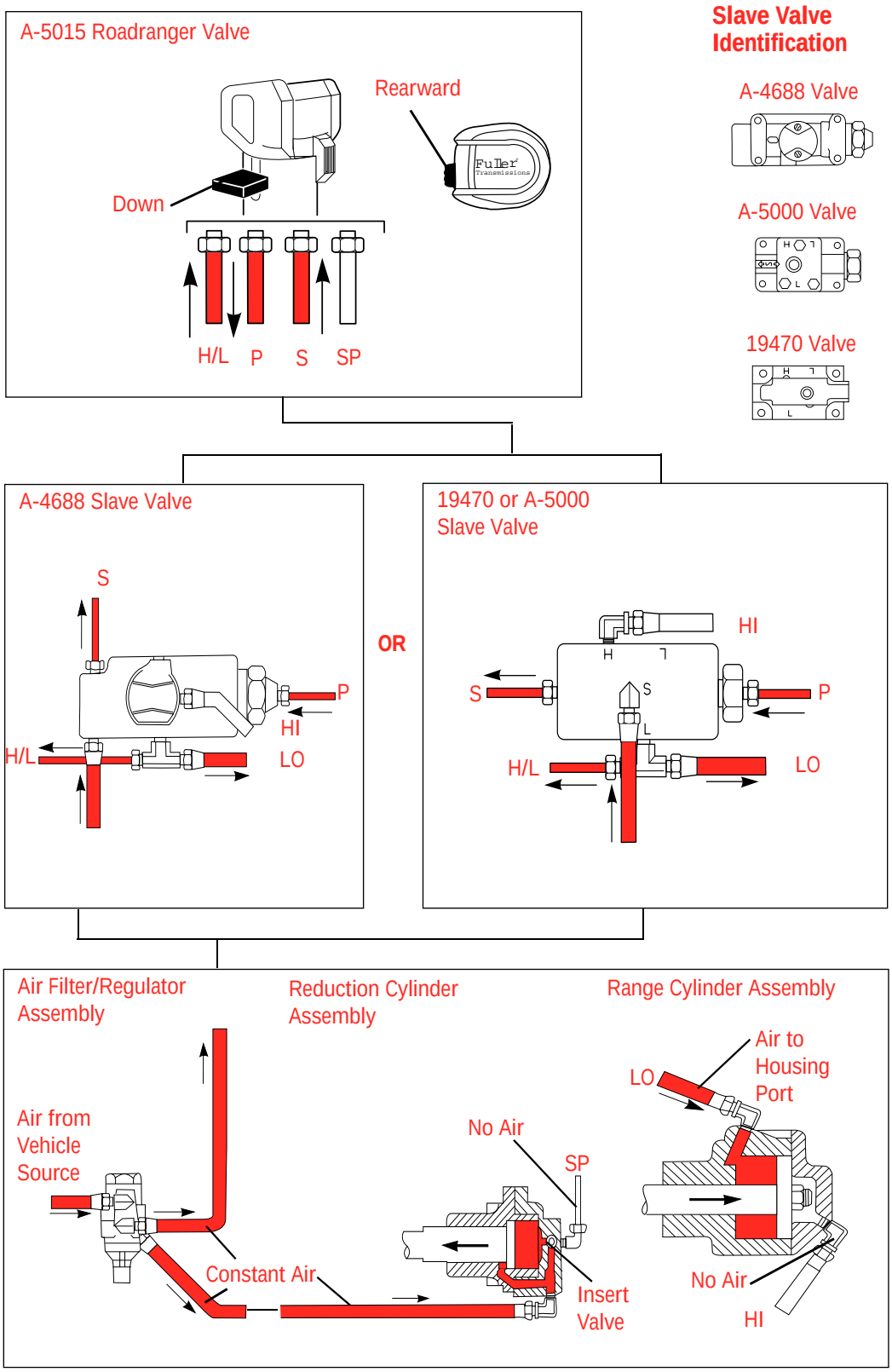


Schematic

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

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

Range—LO

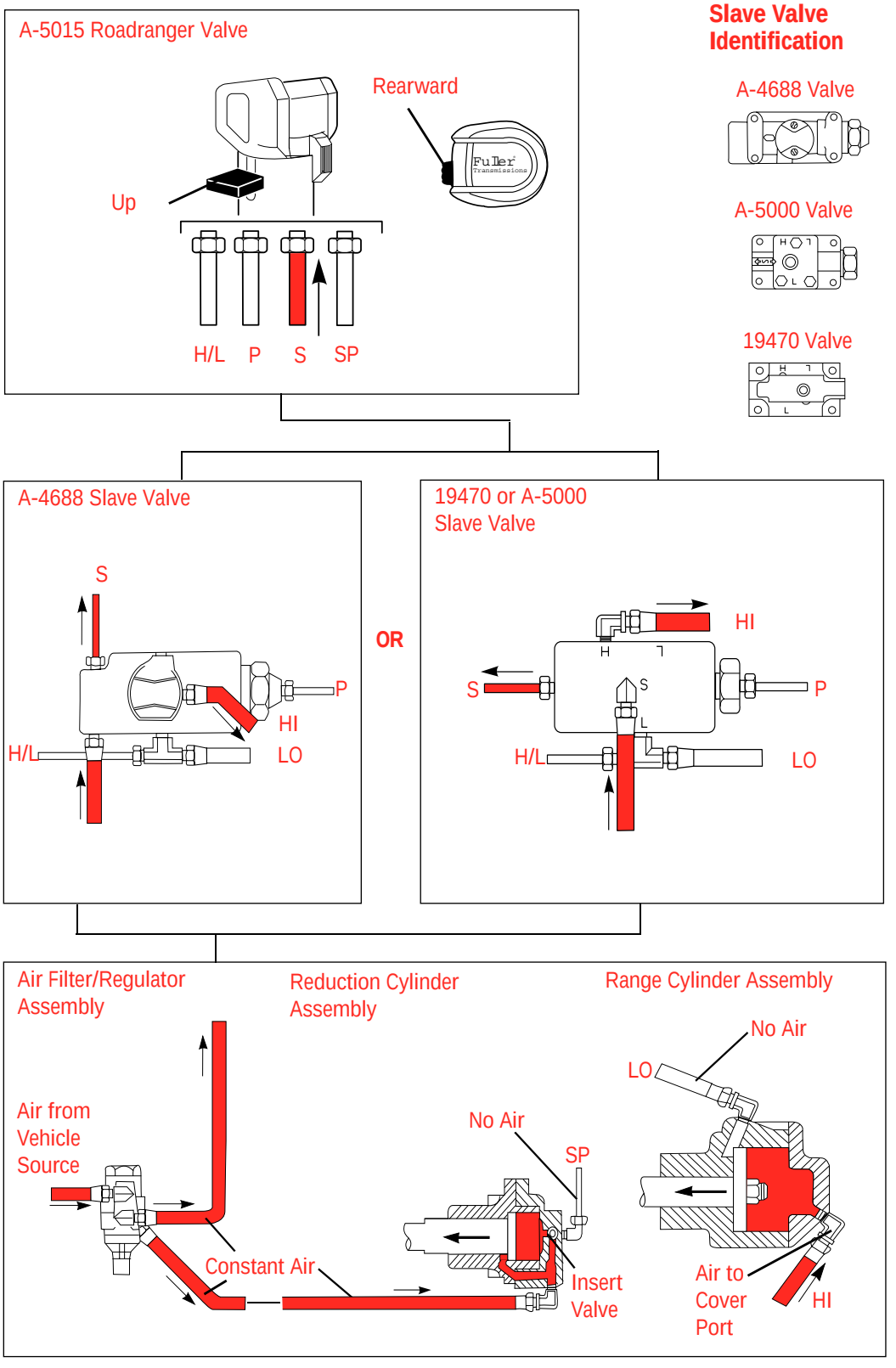


Schematic

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

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

Range—HI

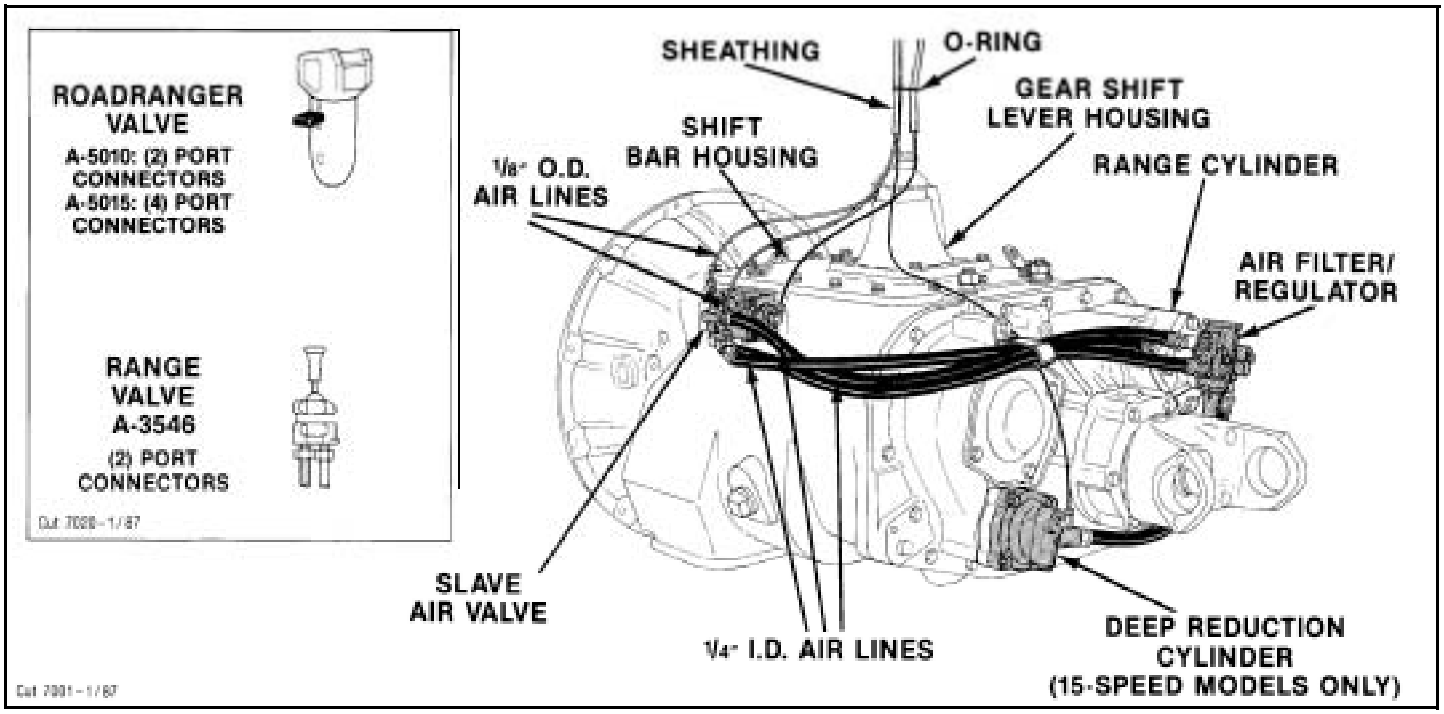


Schematic

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

DISASSEMBLY AND REASSEMBLY
SHIFTING CONTROLS

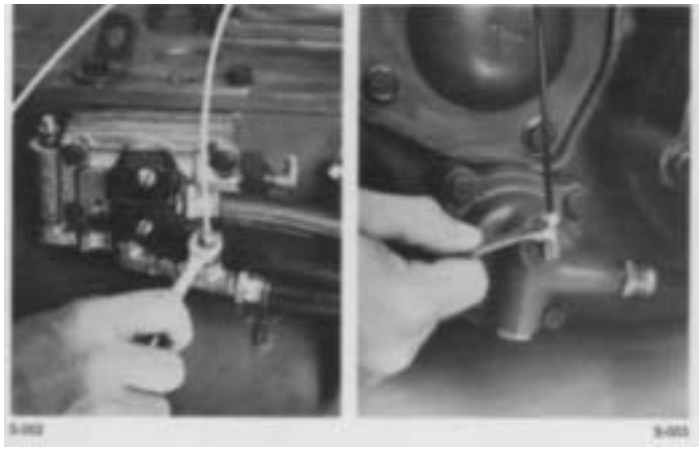
AIR SYSTEM



A. Removal of Control Valve

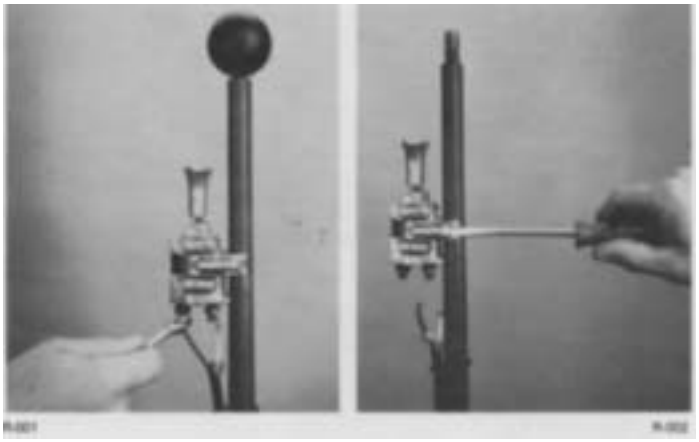
NOTE: For removal and disassembly of models also equipped with the Countershaft Brake Control, see OPTIONS.

1. Disconnect the two l/8" O.D. air lines at the "S" or Supply Port and the "P" or End Port of slave valve on transmission case.
NOTE: For models equipped with the Range Valve A-3546 or Roadranger Valve A-5010, the gear shift lever housing assembly can now be removed from shift bar housing.

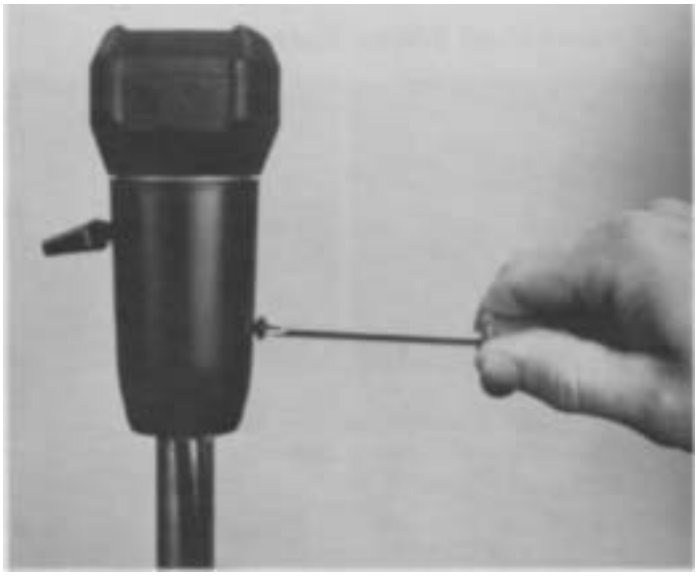


2. For models equipped with the Roadranger Valve A-5015, also disconnect the 1/8" O.D. air line at the "L" or Low Range Port of slave valve (left); and the 1/8" O.D. air line at the Center Port of reduction cylinder cover (right).
NOTE: If desired, the gear shift lever housing assembly can now be removed from shift bar housing.

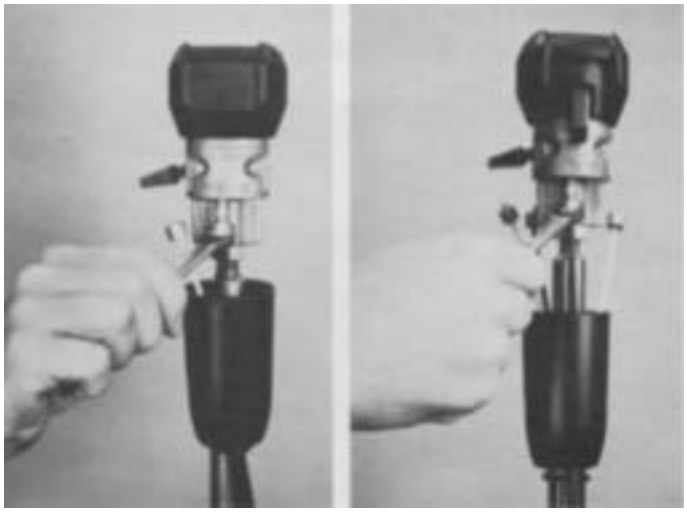
DISASSEMBLY AND REASSEMBLY SHIFTING CONTROLS



3. Disconnect the two 1/8Ó 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 24.



4. For models equipped with a Roadranger Valve, turn out the two mounting screws in valve cover.



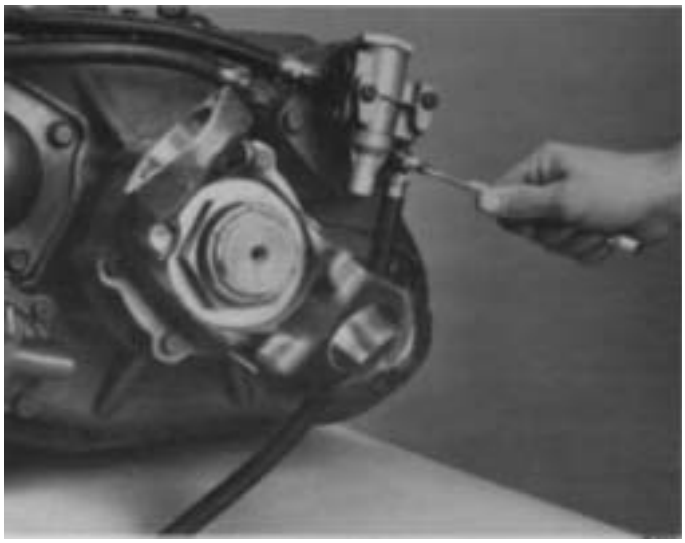
5. Slide the cover down shift lever to expose valve ports and disconnect the two 1/8" O.D. air lines at the A-5010 valve OR the four 1/8" O.D. air lines at the A-5015 valve.

6. Loosen the jam nut and turn the Roadranger Valve and nut from gear shift lever. Remove the valve cover, air lines, sheathing and O-rings from lever.
NOTE: For disassembly and reassembly of Roadranger Valve, see Page 25 (A-501 O); or Page 31 (A-5015).

DISASSEMBLY AND REASSEMBLY
SHIFTING CONTROLS

B. Removal of Air Filter Regulator Assembly

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



2. For 15-Speed Models ONLY, also disconnect the 1/4" I.D. air line between the air filter/regulator assembly and reduction cylinder.

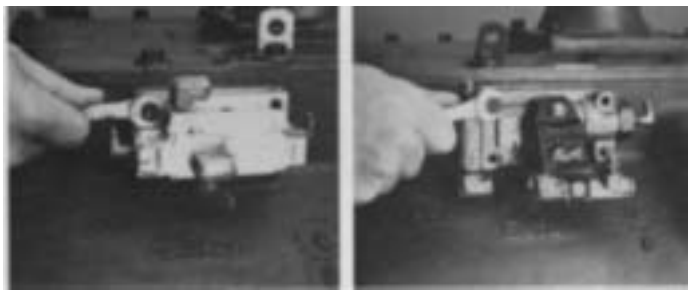
3. Turn out the two capscrews and remove the air filter/regulator assembly.
NOTE: For disassembly and reassembly of Air Filter/Regulator Assembly, see Page 23.

C. Removal of Slave Valve

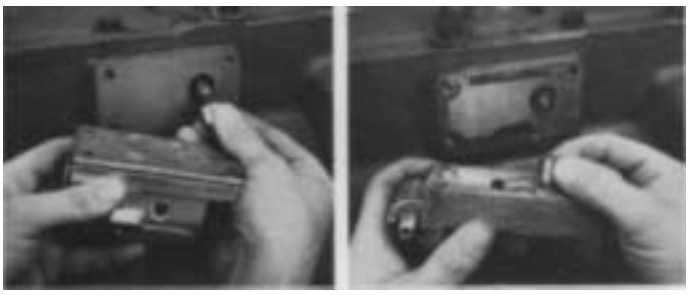
1. Disconnect and remove the 1/4" I.D. air line between the slave valve and Low Range Port in housing of range cylinder.

DISASSEMBLY AND REASSEMBLY SHIFTING CONTROLS

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

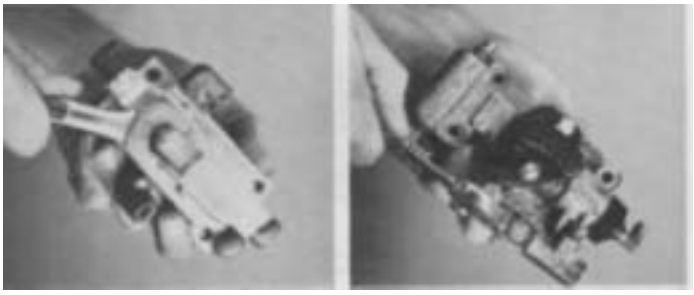


3. Turn out the four retaining capscrews and remove slave valve from transmission case.



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

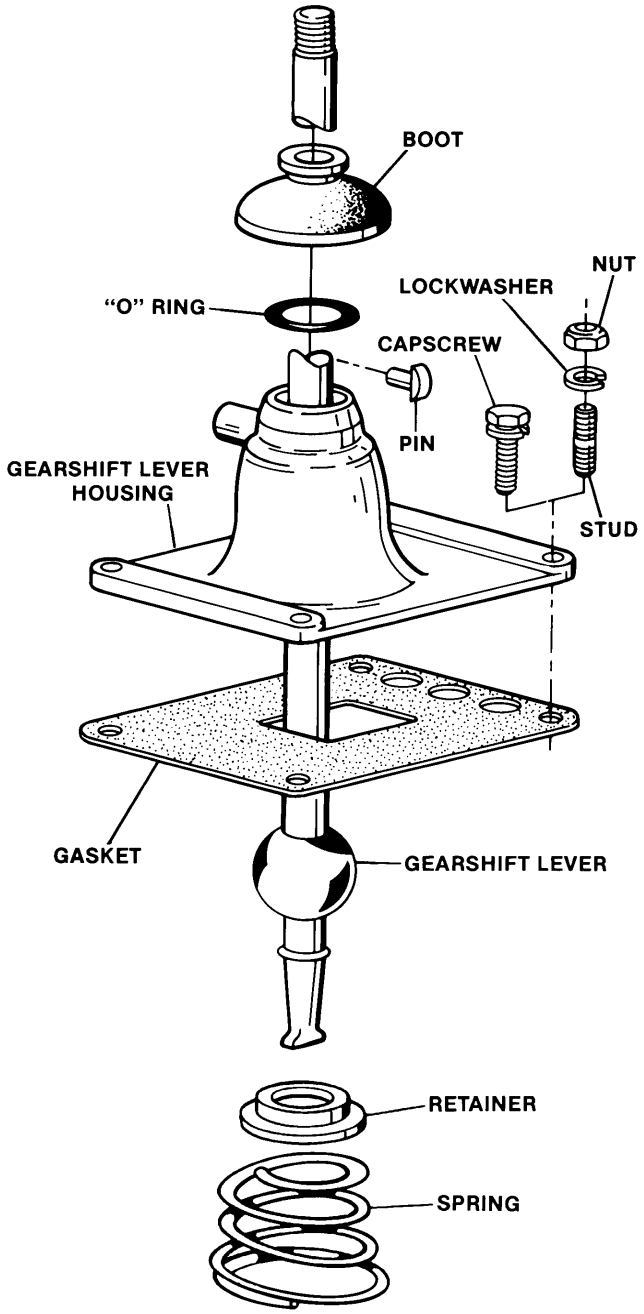
5. Remove the spring and plunger pin from bore in transmission case. Remove slave valve gasket.



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

NOTE: For disassembly and reassembly of piston-type Slave Valve Assembly ONLY, see Page 23.

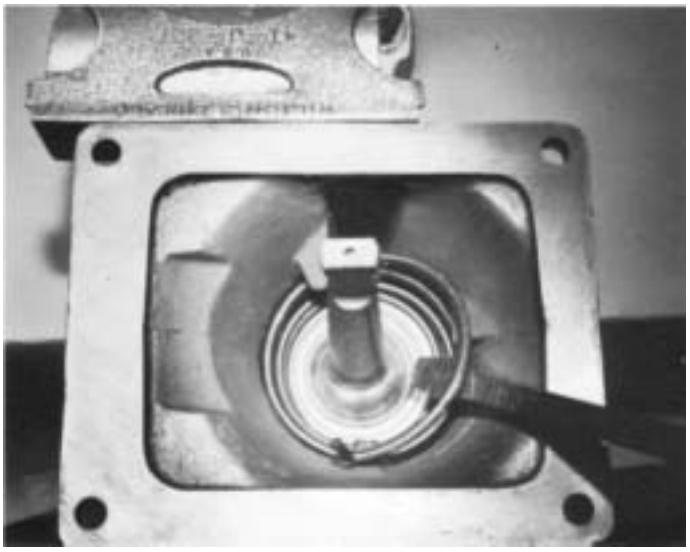
DISASSEMBLY GEAR SHIFT LEVER ASSEMBLY



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 11-Iustrated 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.

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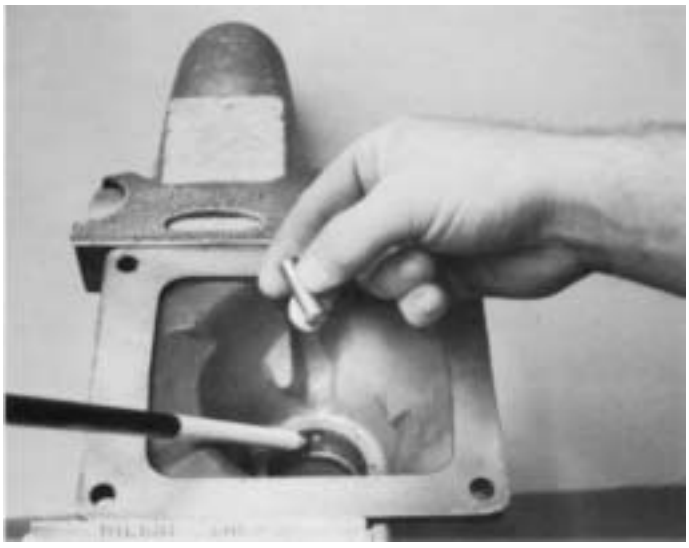
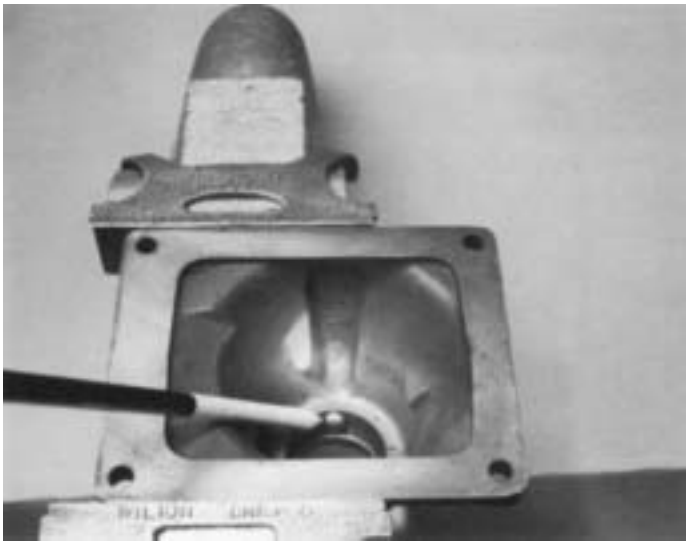
REASSEMBLY GEAR SHIFT LEVER ASSEMBLY

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



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

B. Reassembly of Gear Shift Lever Housing Assembly



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

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

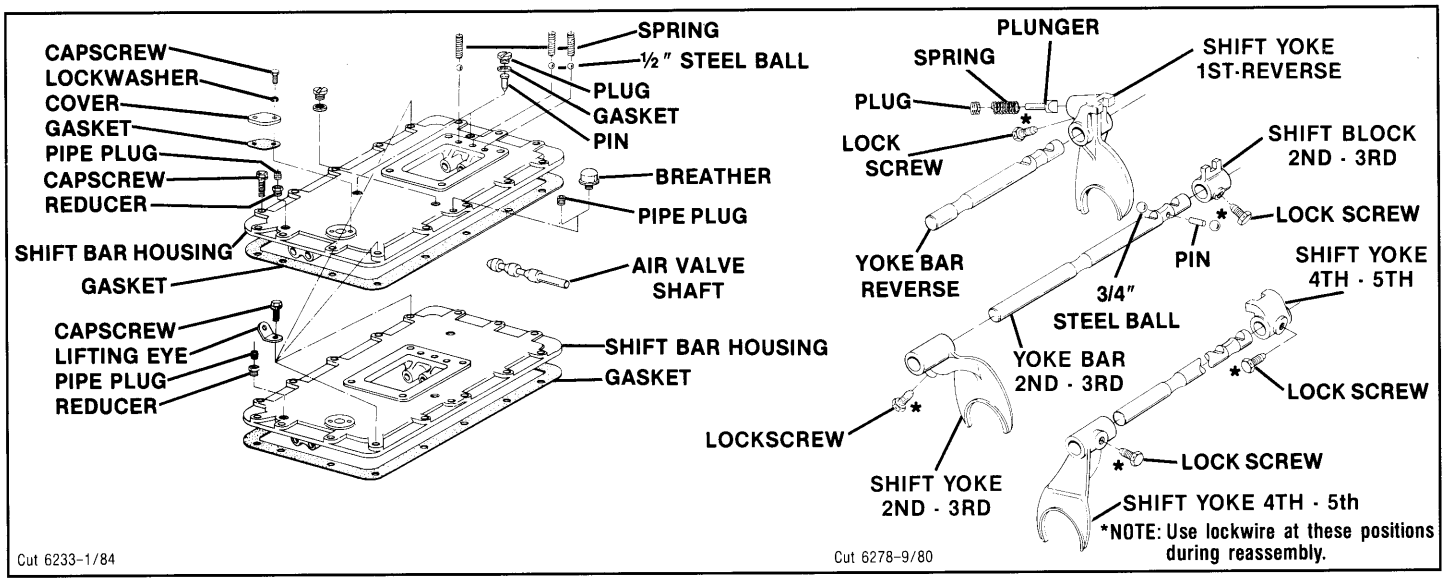
REASSEMBLY GEAR SHIFT LEVER ASSEMBLY

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
SHIFT BAR HOUSING

SHIFT BAR HOUSING ASSEMBLY



A. Removal and Disassembly of the Shift Bar Housing Assembly

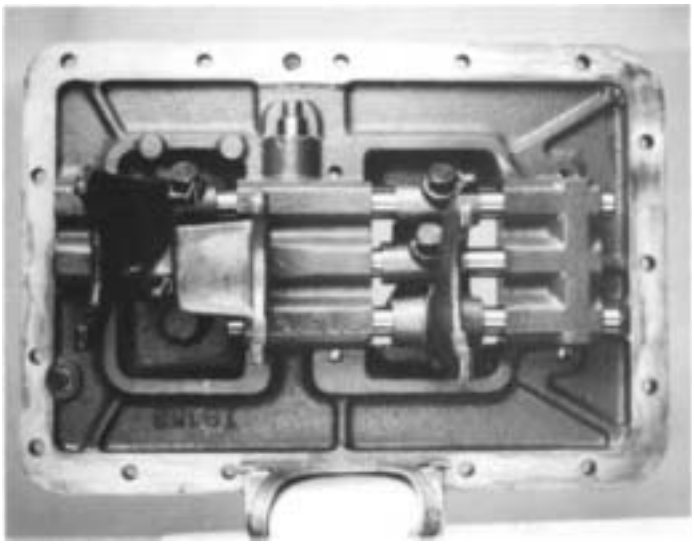
For models equipped with an Oil Pump and/or Cooler Assemblies, make sure to disconnect the lube line at the fitting on the shift bar housing before doing the following instructions.

1. Turn out the retaining capscrews. Jar the top to break the gasket seal and lift the shift bar housing from the transmission case. Remove the gasket.

NOTE: During disassembly, lay all parts on a clean bench in order of removal from the housing to make reassembly easier. Shift bars not being removed must be kept in the neutral position or the interlocking parts will lock the bars.

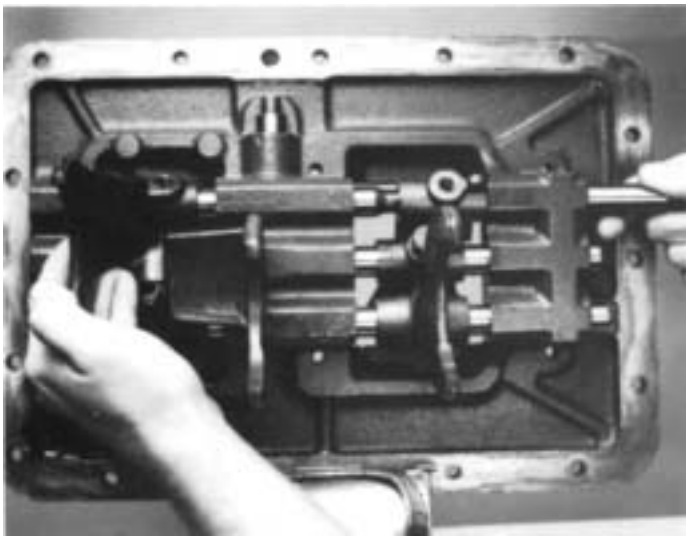
2. Tilt the assembly and remove the three sets of tension springs and balls from the housing bores.

DISASSEMBLY AND REASSEMBLY
SHIFT BAR HOUSING

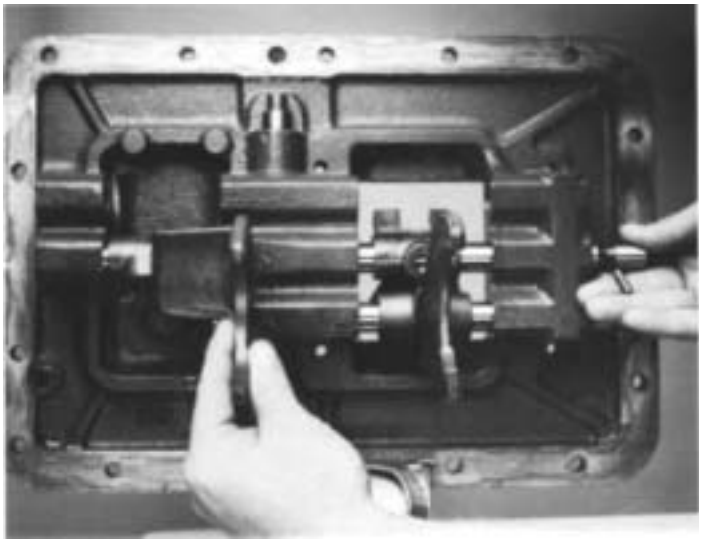


3. Secure the assembly in a vise with the plunger-side up. (The front of the housing will be to the left.) For models so equipped, cut the lockwire and turn out the retaining capscrews to remove the oil trough from the housing.

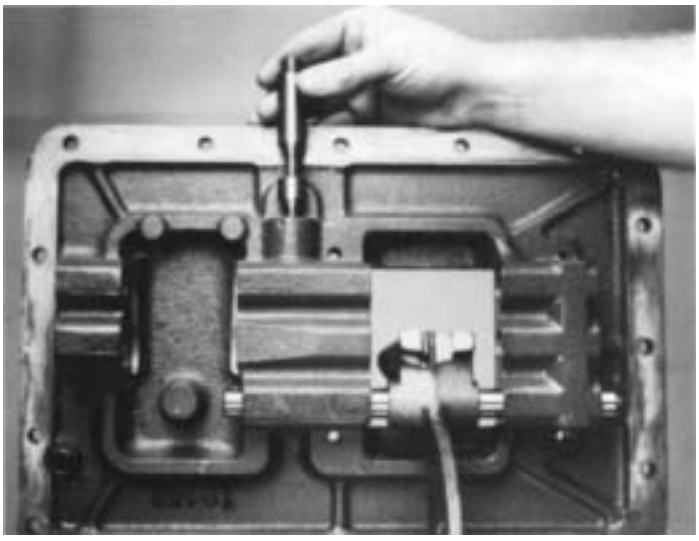
NOTE: Start with the upper shift bar, move all bars to the right and out the rear boss bore. Cut the lockwire and remove the lockscrews from each bar just before their removal.



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

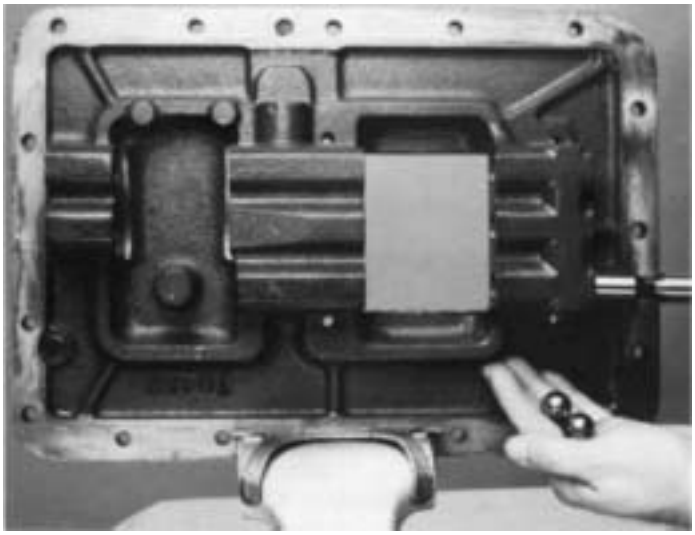


5. Move the 1st-2nd speed shift bar to the housing rear, removing the yoke and block from the bar. As the neutral notch in the bar clears the rear boss, remove the small interlock pin from the bore.



6. Remove the actuating plunger from the center boss bore.

DISASSEMBLY AND REASSEMBLY
SHIFT BAR HOUSING



7. Move the short LO-Reverse speed shift bar to the housing rear, remove the yoke from the bar. As the shift bar is removed from the housing, two 3/4 interlock balls will drop from the rear boss bottom bore.

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

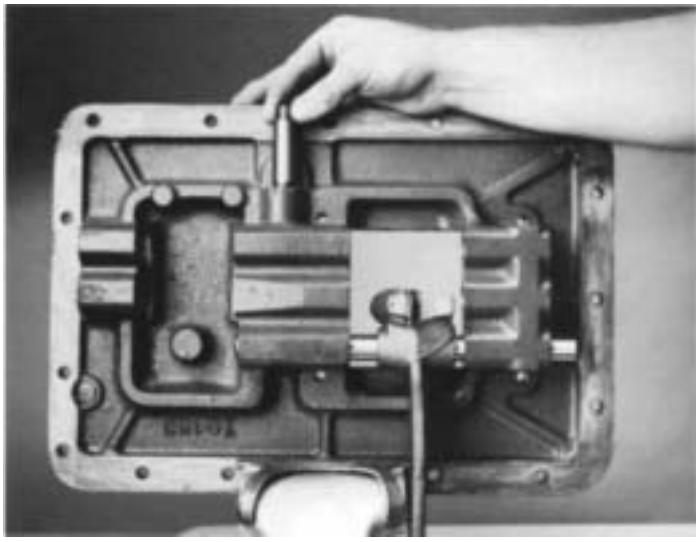
B. Reassembly of the Shift Bar Housing Assembly.

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

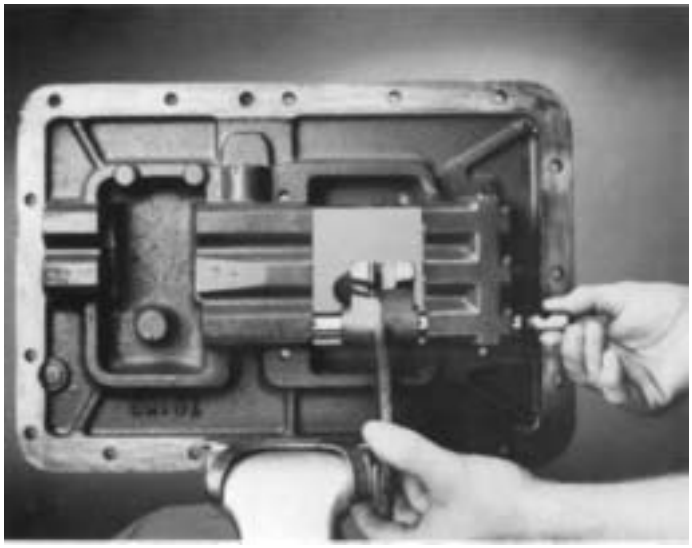
2. Install the spring in the yoke bore and on the plunger shank.

DISASSEMBLY AND REASSEMBLY
SHIFT BAR HOUSING

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

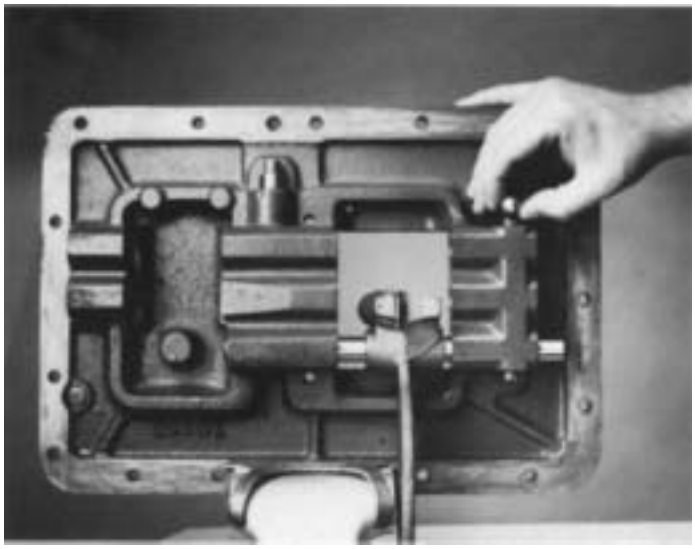


5. While holding the plunger shank, install the actuating plunger in the center boss bore.



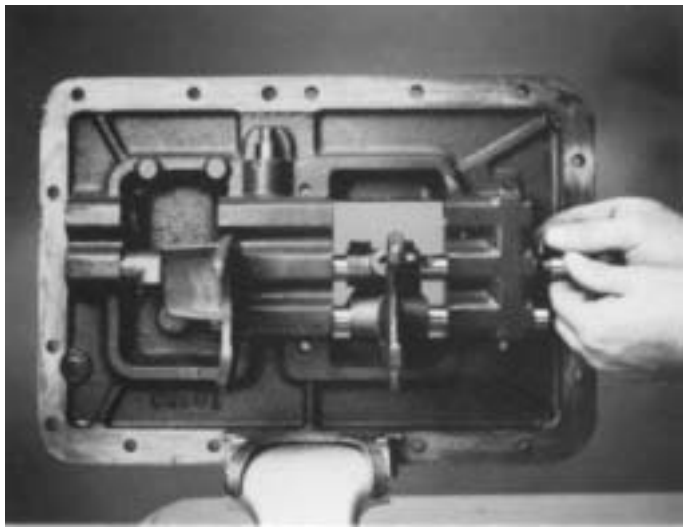
4. Secure the shift bar housing in a vise. Hold the notched-end of the short LO-Reverse speed shift bar, install the bar in the lower bore of the shift bar housing bosses . Install the yoke lockscrew , tighten and wire securely.

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



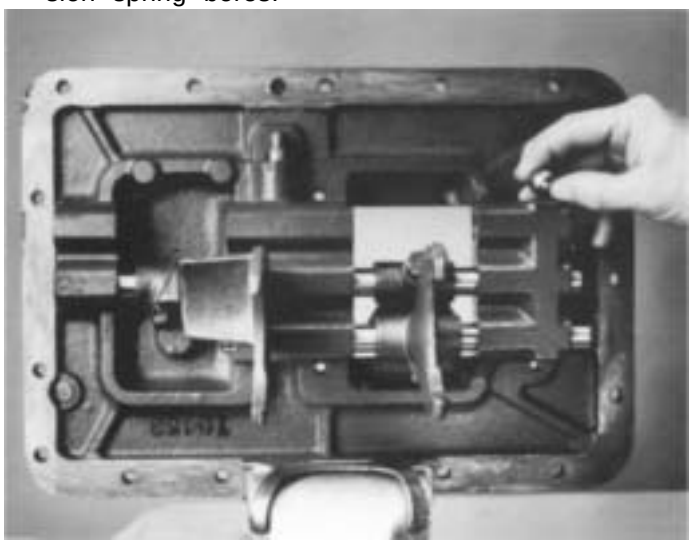
6. Install one 3/4" interlock ball in the rear boss top bore. This ball rides between LO-Reverse and 1st-2nd speed shift bars.

DISASSEMBLY AND REASSEMBLY
SHIFT BAR HOUSING

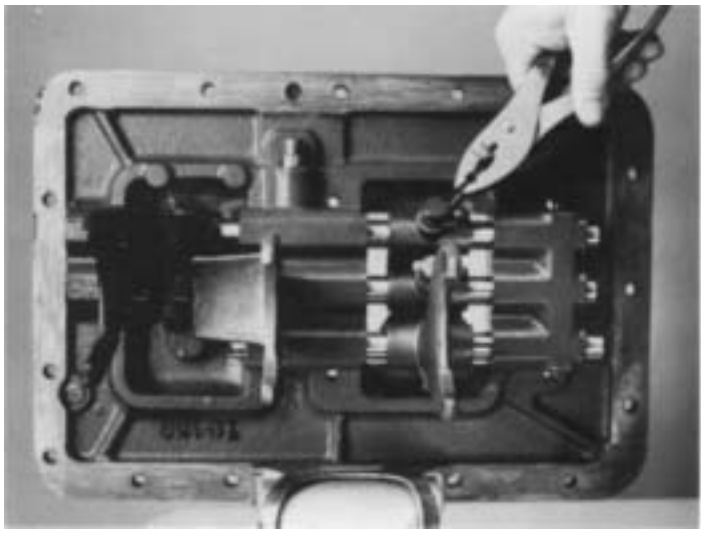


7. While holding the notched-end of the bar, install the 1st-2nd speed shift bar in the housing boss middle bore. Position the shift block on the bar between the center and rear bosses, and the yoke on the bar between the front and center bosses, long hub to the housing front. Just before inserting the notched-end of the rear boss bar, install the small interlock pin VERTICALLY in the neutral notch bore. Install the block and yoke lockscrews, tighten, and lockwire securely.

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



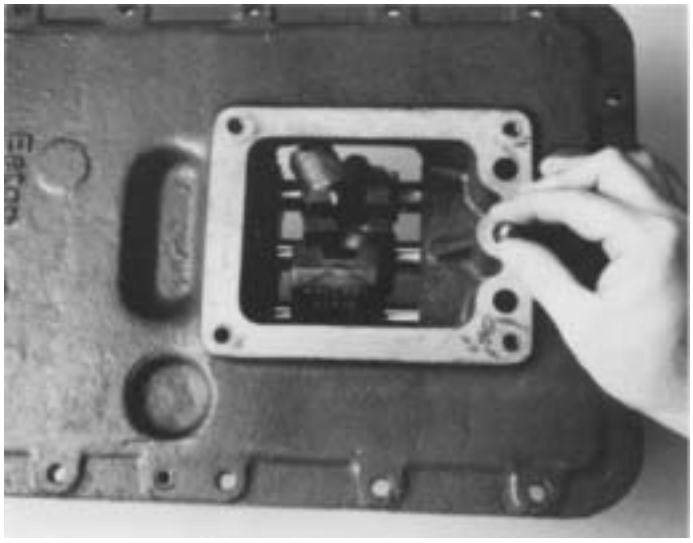
8. Install the other 3/4" interlock ball in the rear boss top bore. This ball rides between the 1st-2nd and the 3rd-4th speed shift bars.



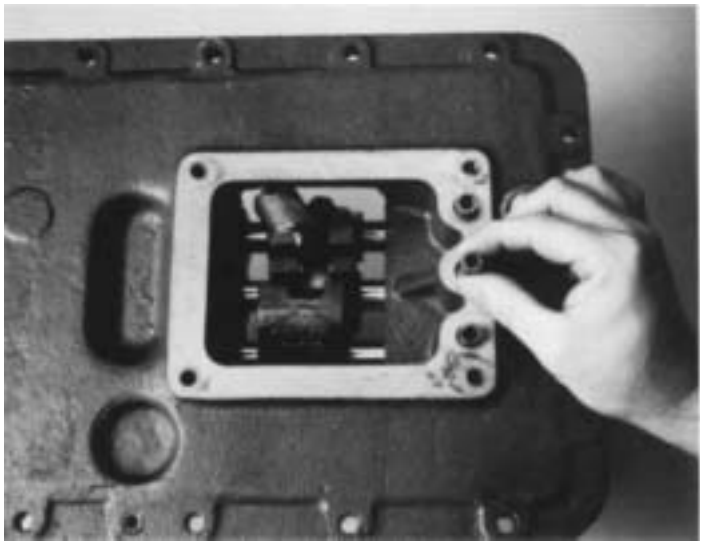
9. While holding notched-end of the bar, install the 3rd-4th speed shift bar in the housing boss upper bore, position the shift block on the bar between the front and center bosses, long hub to the housing rear. Install the block and yoke lockscrews, tighten, and lockwire securely.

10. For models so equipped, install the oil trough on the housing. Tighten the capscrews and lockwire securely.

DISASSEMBLY AND REASSEMBLY
SHIFT BAR HOUSING



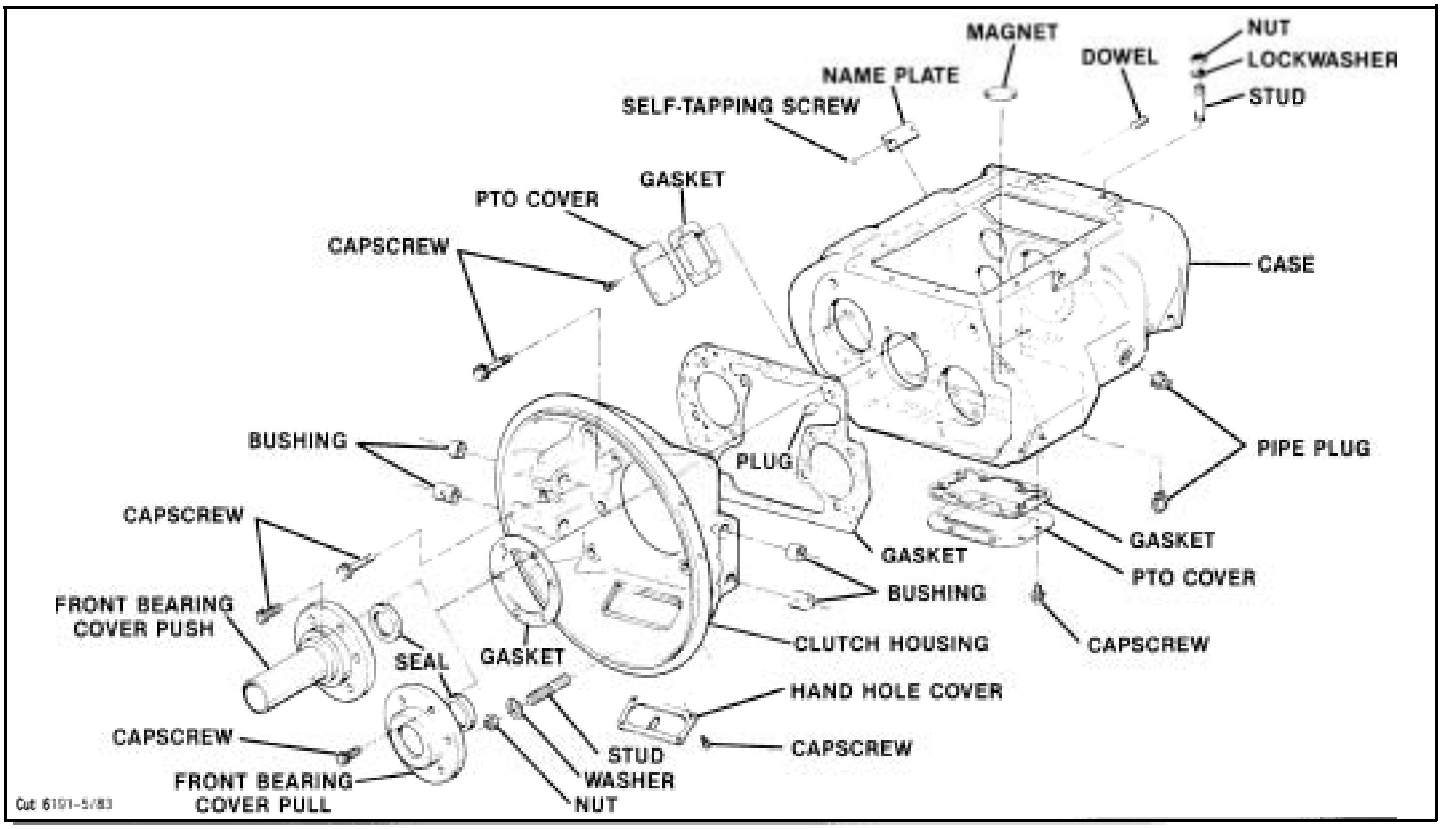
11. Remove the assembly from the vise. Install the three tension balls, one in each bore on the housing top.



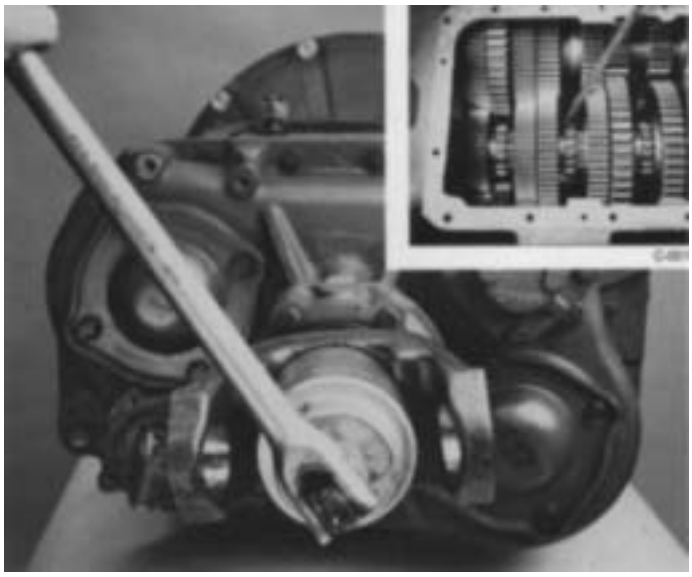
12. Install the three tension springs, one over each ball in the housing bores.

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 mainshaft 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 gear or spacer.

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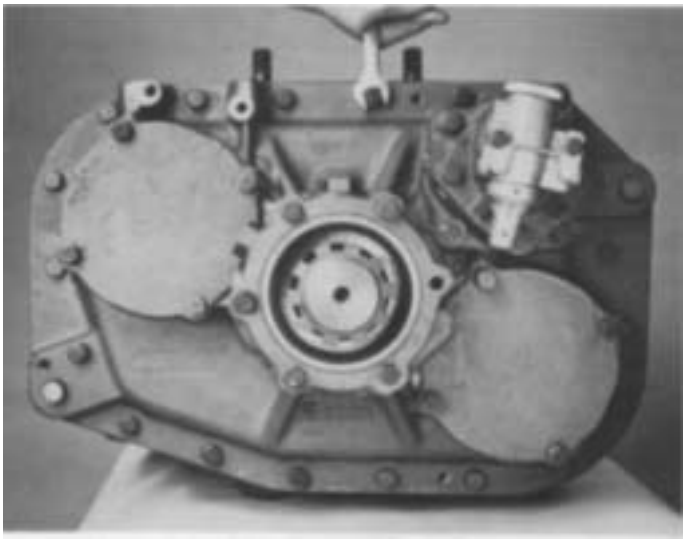
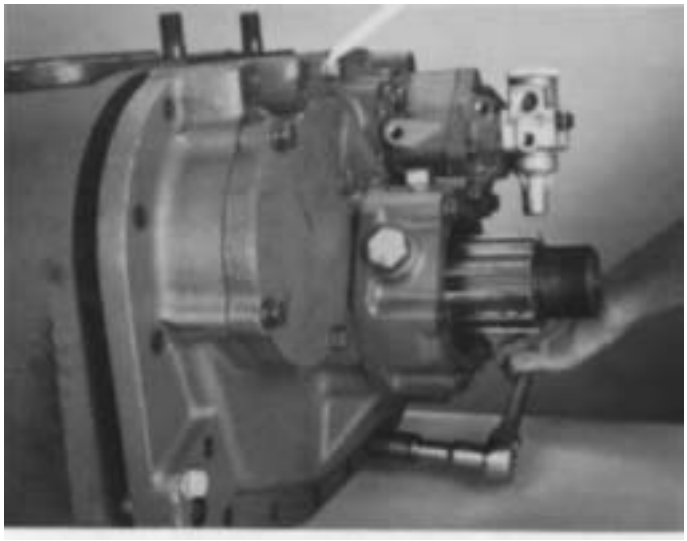
REMOVAL - COMPANION FLANGE, AUXILIARY SECTION AND CLUTCH HOUSING

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.

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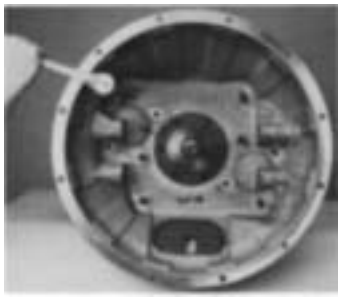
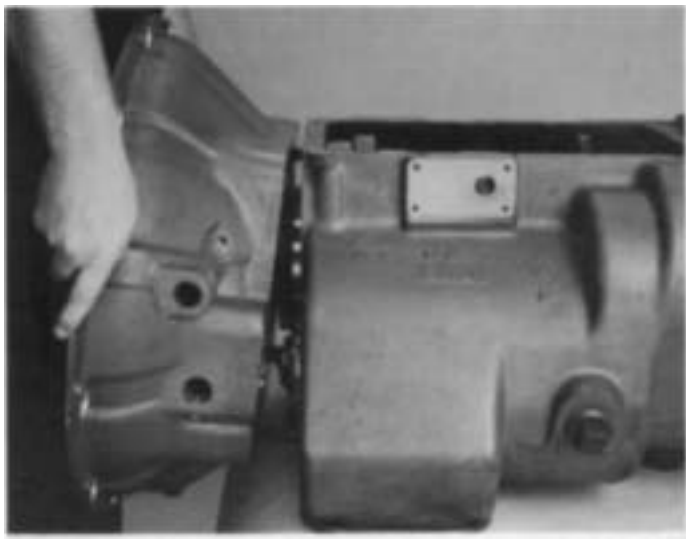
REMOVAL-COMPANION FLANGE, AUXILIARY SECTION AND CLUTCH HOUSING

C. Removal of Clutch Housing

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



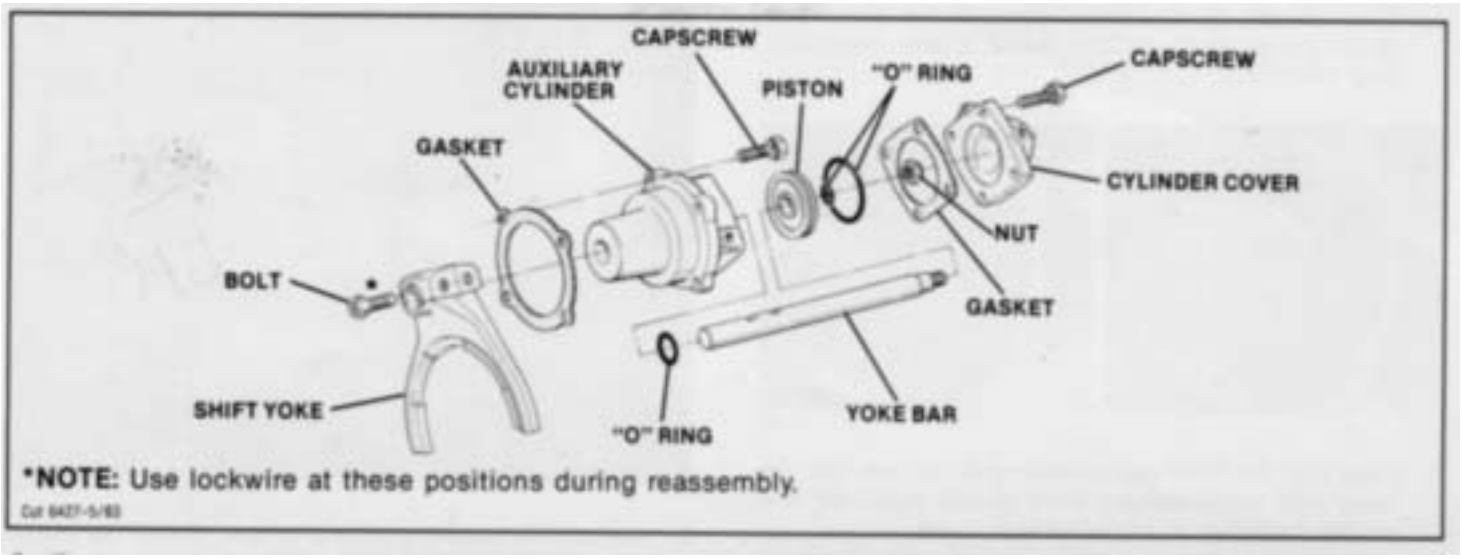
2. Turn out the four capscrews and remove the six nuts and lockwashers from studs securing the clutch housing to transmission case.



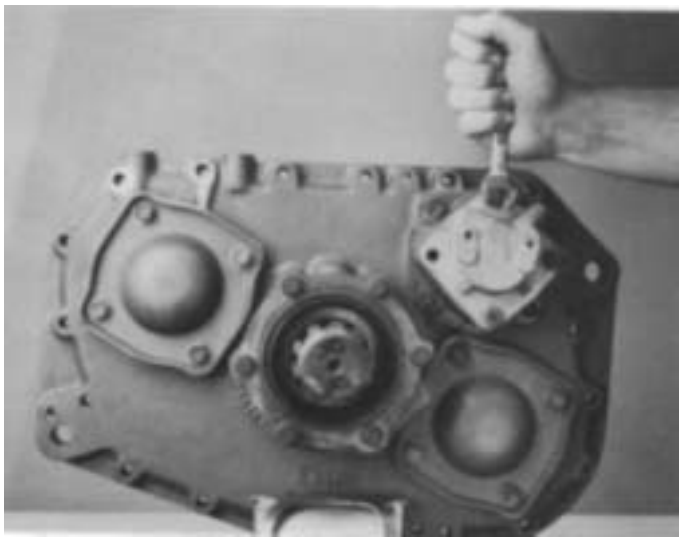
3. Jar clutch housing with a rubber mallet to break gasket seal and pull from transmission case. Remove gasket.

DISASSEMBLY - AUXILIARY SECTION (10-SPEED MODELS)

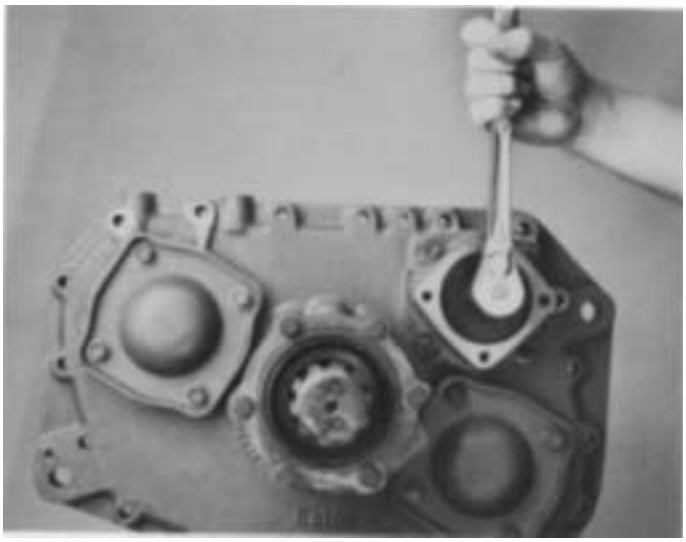
AUXILIARY SECTION (10-SPEED MODELS)



A. Removal and Disassembly of Range Cylinder Assembly

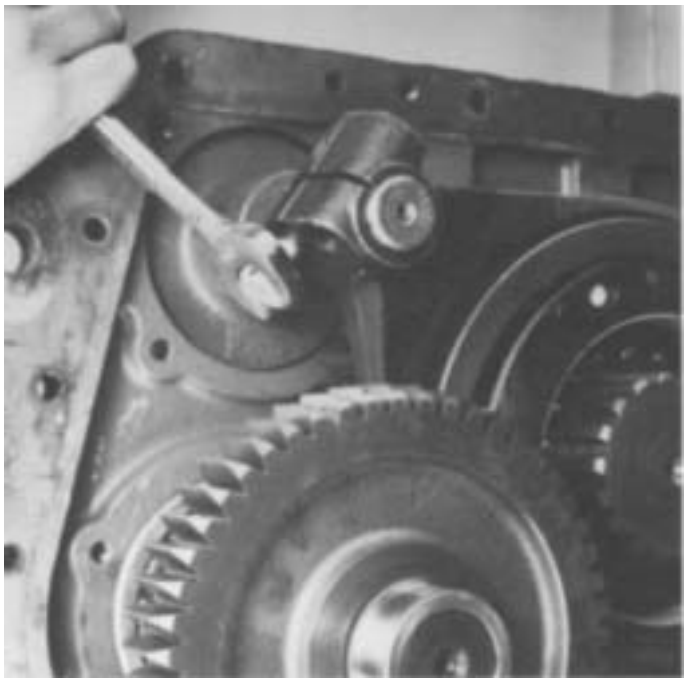


1. For ease of disassembly, mount the auxiliary section upright in a vise. Turn out the capscrews and remove the range cylinder cover and gasket.



2. Remove nut from end of yoke bar.

DISASSEMBLY-AUXILIARY SECTION (10-SPEED MODELS)



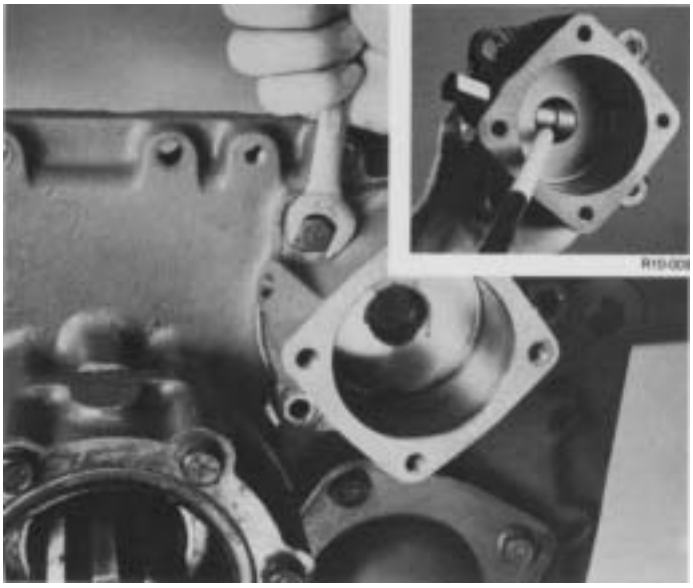
3. Cut lockwire and remove two yoke lockscrews.

4. Pull yoke bar from bore of cylinder housing.

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

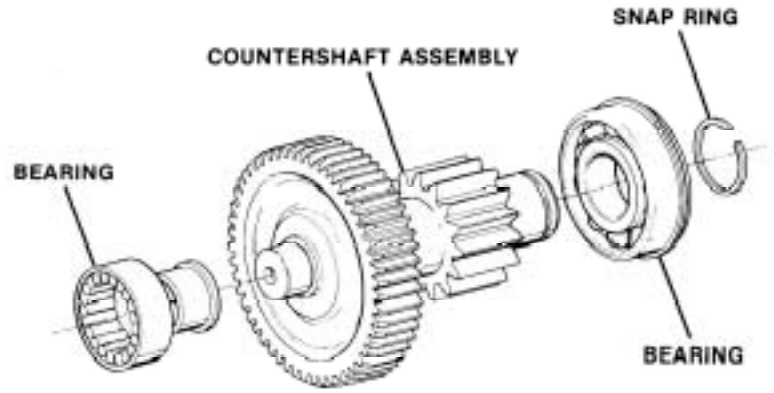
6. Remove the range piston from cylinder bore. If necessary, remove the O-rings from piston I.D. and O.D. (inset).

DISASSEMBLY-AUXILIARY SECTION (10 - SPEED MODELS)

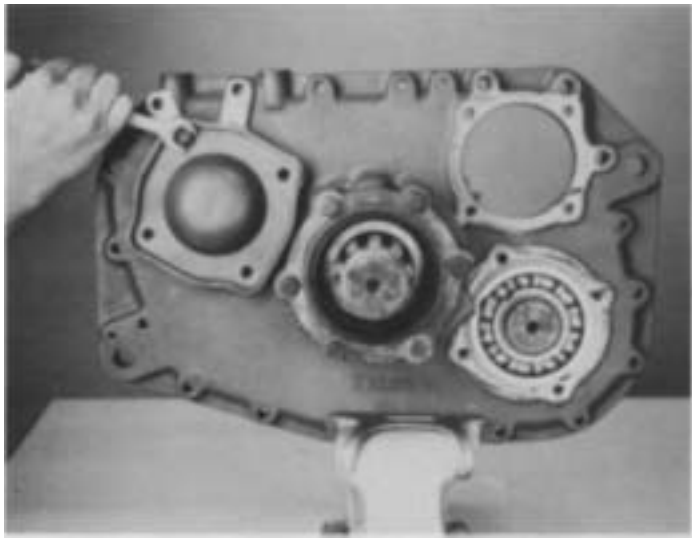


7. Turn out the capscrews and remove the range cylinder housing and gasket. If necessary, remove the small O-ring from groove in housing bore (inset).

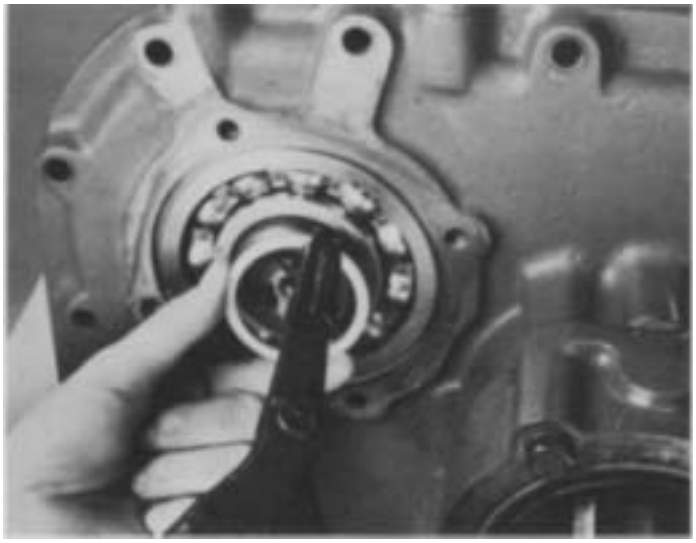
DISASSEMBLY-AUXILIARY SECTION (10-SPEED MODELS)



B. Removal of Auxiliary Countershaft Assemblies



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

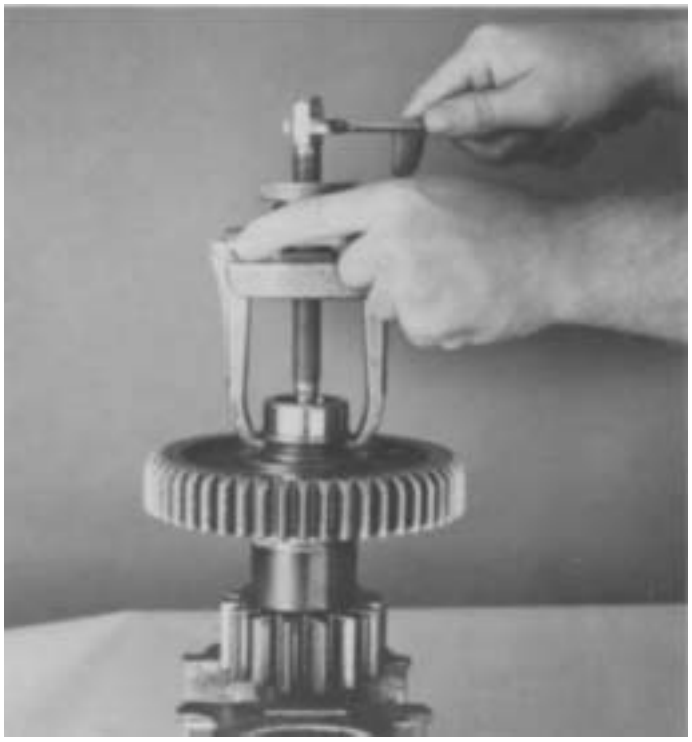


2. Remove the snap ring from groove at rear of each countershaft.

DISASSEMBLY-AUXILIARY SECTION (10-SPEED MODELS)

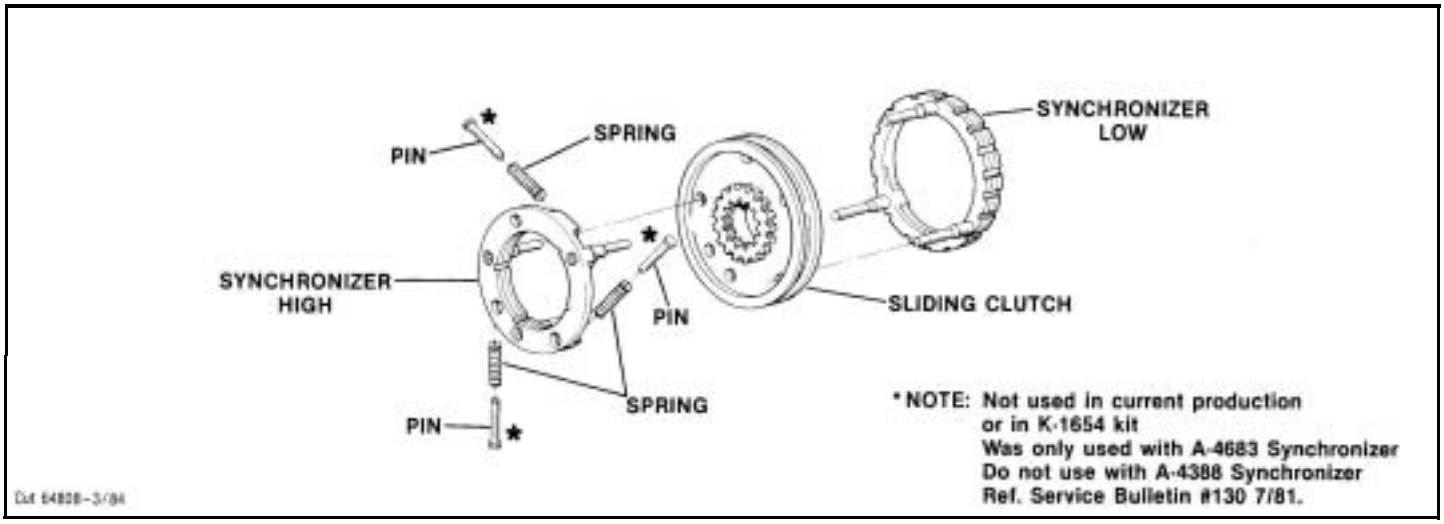
3. Use a soft bar and maul to drive the countershafts forward and from rear bearings.

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 (10-SPEED 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 synchronizer ring.

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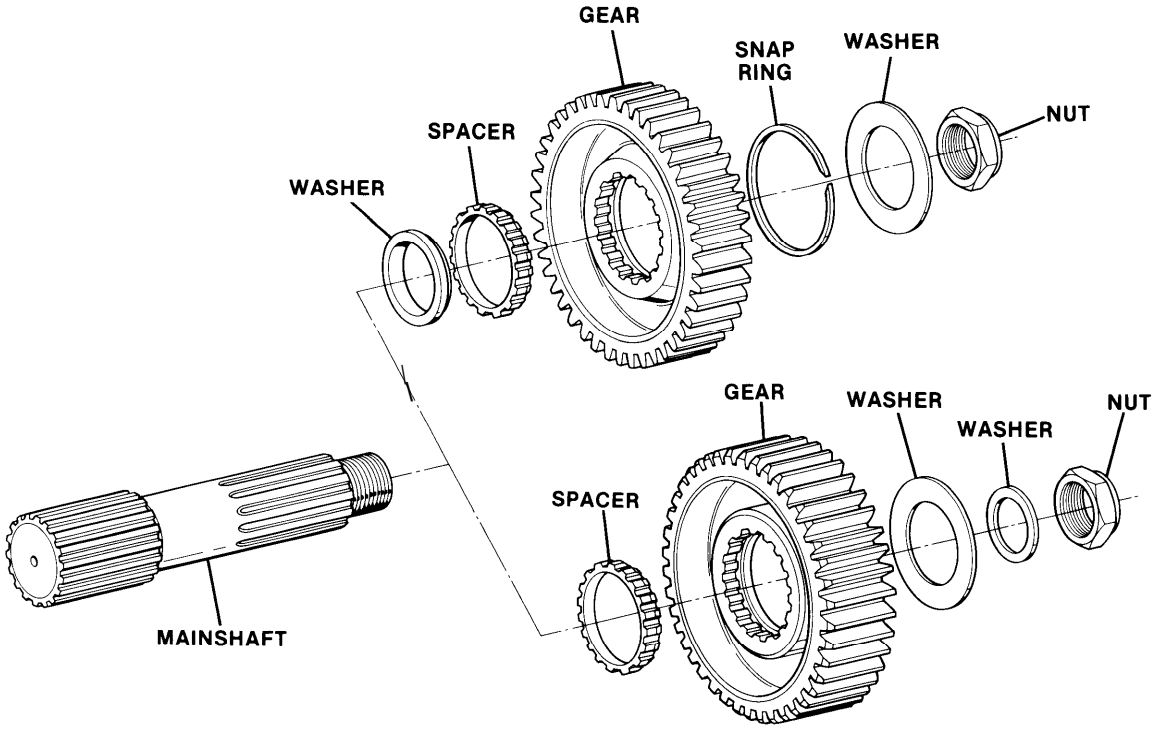
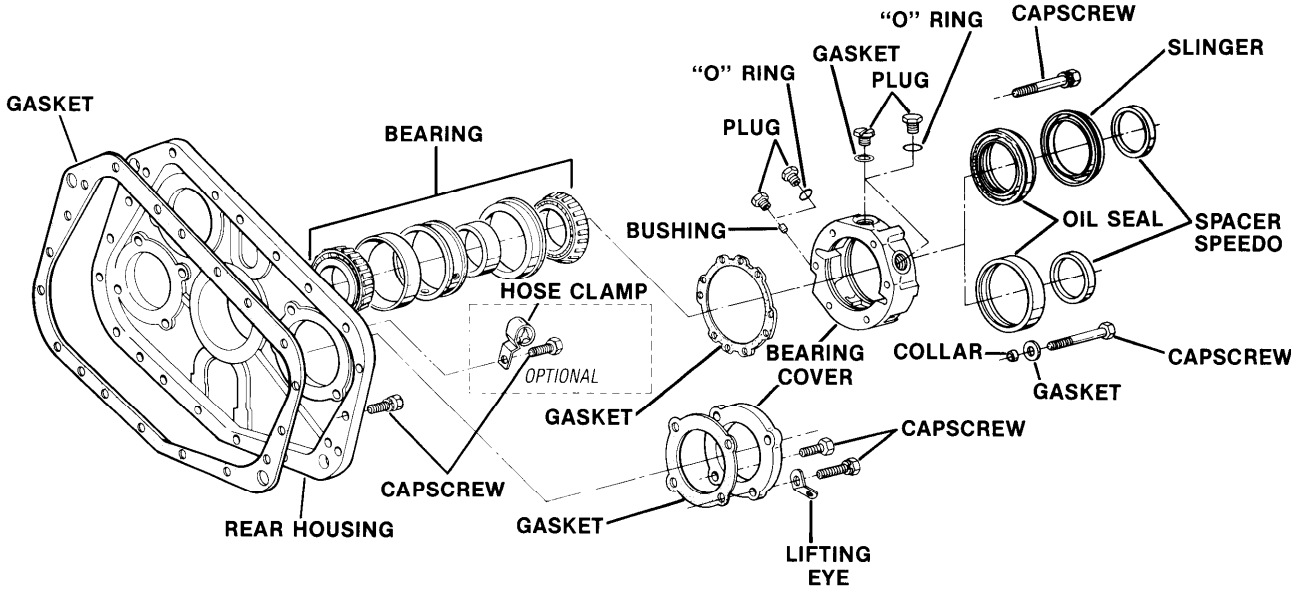
DISASSEMBLY—AUXILIARY SECTION (10-SPEED MODELS)





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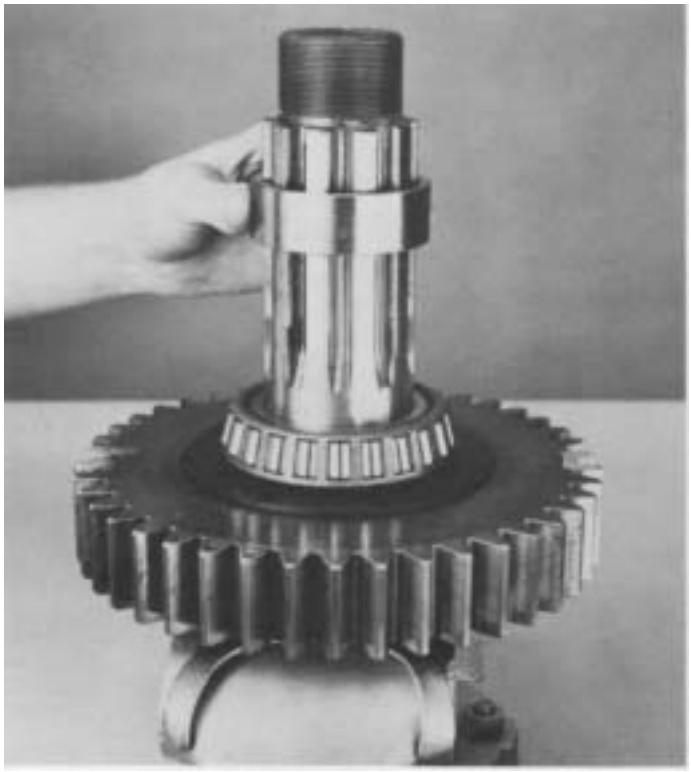
DISASSEMBLY-AUXILIARY SECTION (10-SPEED MODELS)

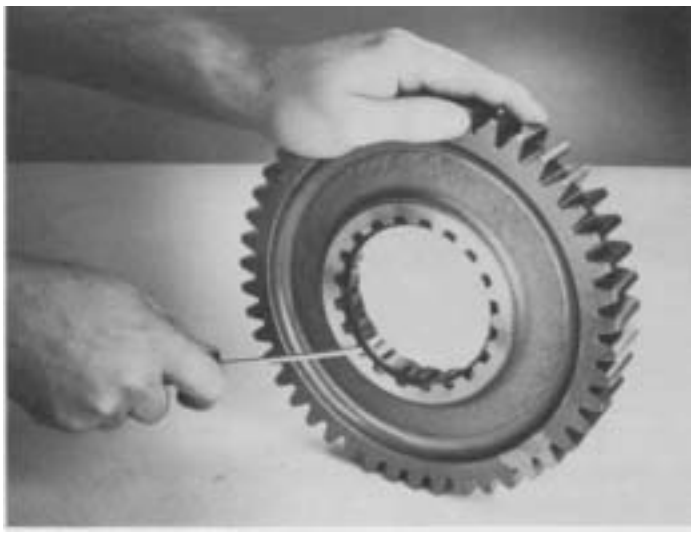
D. Removal and Disassembly of Output Shaft and Rear Bearing Assemblies

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.

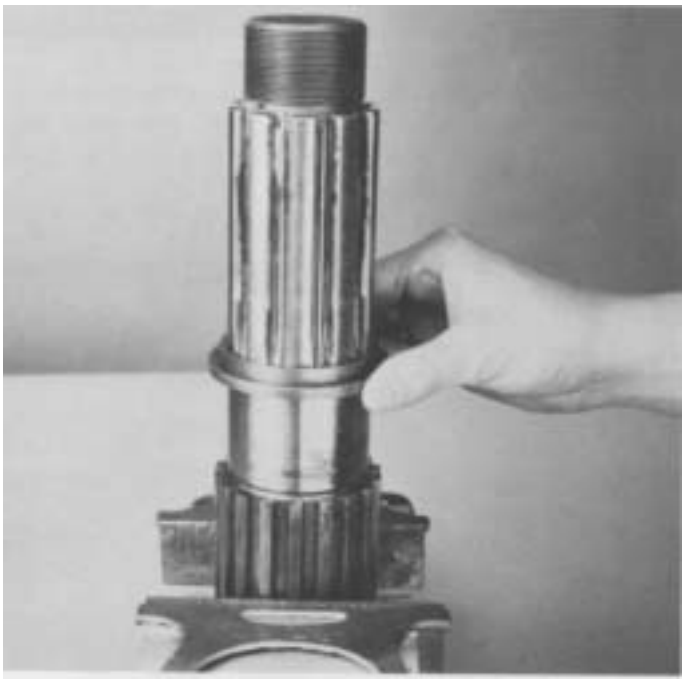
3. Using the front face of low range gear as a base, press the output shaft through the gear and bearing. Remove the bearing and washer from hub of low range gear.



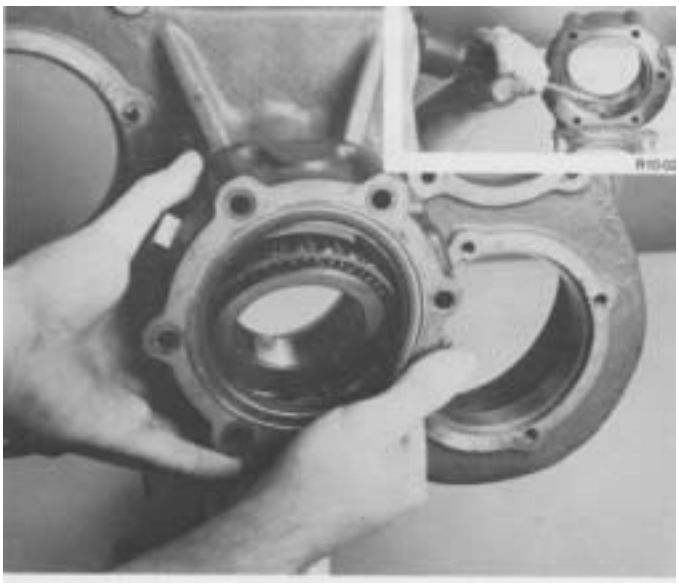
4. If necessary, remove the snap ring from low range gear of models so equipped.

DISASSEMBLY-AUXILIARY SECTION (10-SPEED MODELS)

5. Remove the splined spacer from output shaft.



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



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).

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

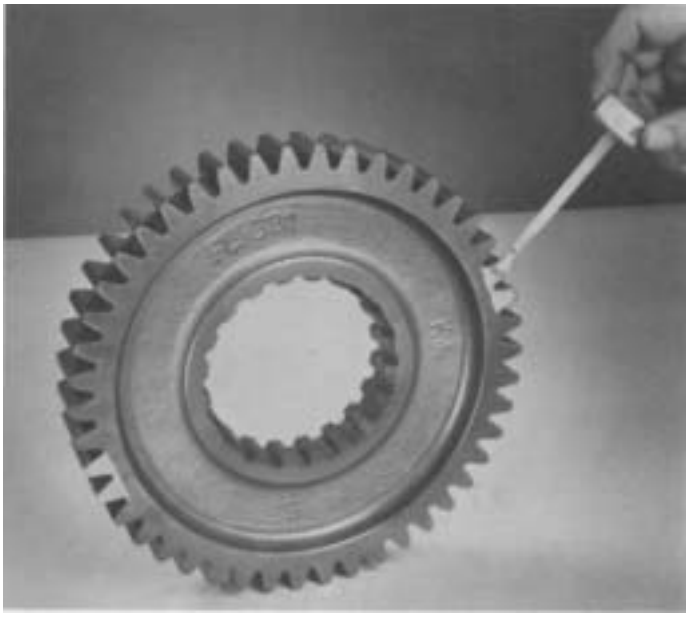
REASSEMBLY-AUXILIARY SECTION (10-SPEED MODELS)

AUXILIARY SECTION (10-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.

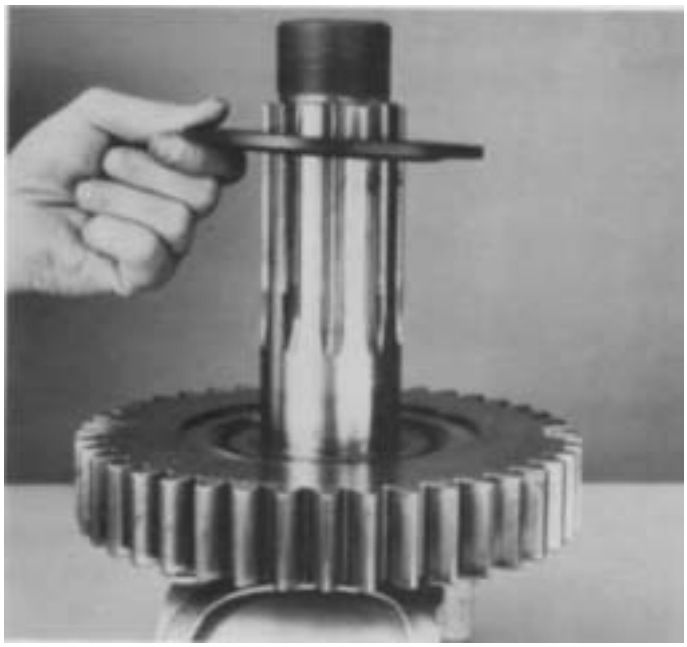
2. For 14610 models, install the spacer with large diameter splines down.



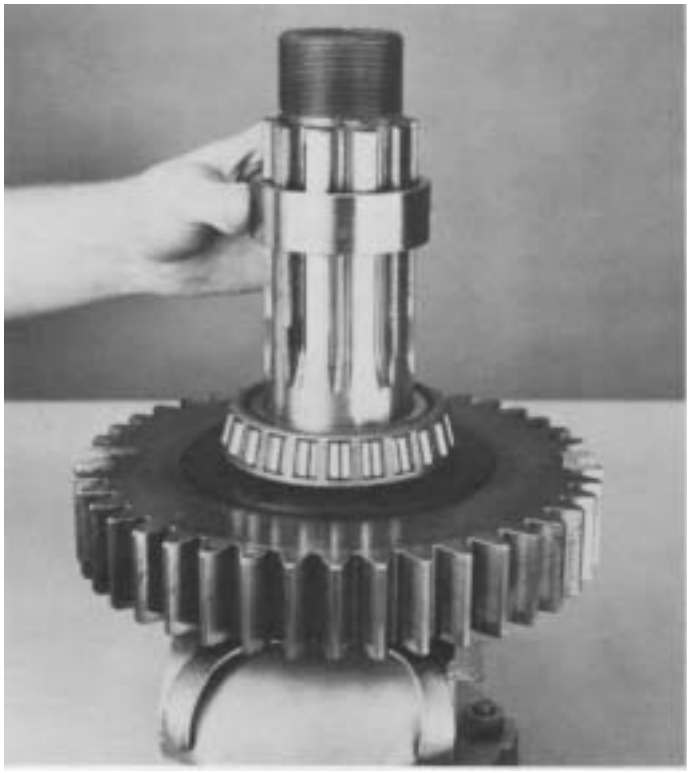
3. IMPORTANT: Mark any two adjacent teeth on low range gear and repeat the procedure for the two adjacent teeth directly opposite the first set marked. A highly visible color of toolmakers" dye is recommended.

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 (10-SPEED MODELS)



5. Install the washer on shaft; 11610, 12610 models flat side of washer facing up, 14610 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 275ºF (136ºC). 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.

REASSEMBLY-AUXILIARY SECTION (10-SPEED MODELS)

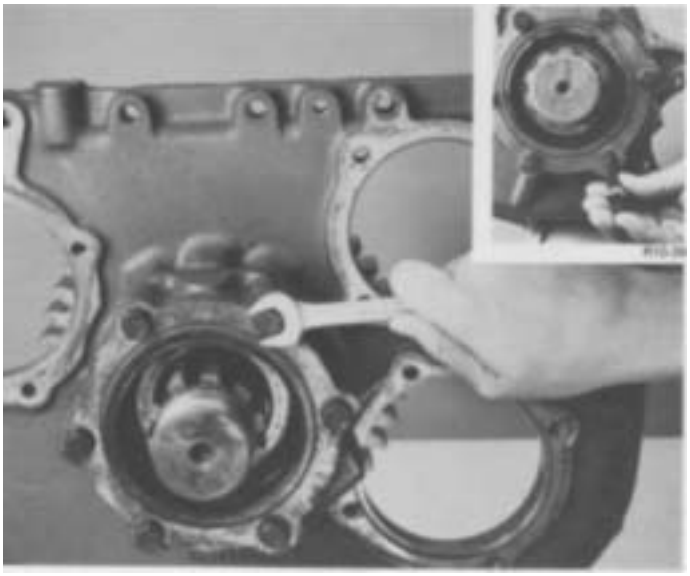
9. Place the bearing outer spacer against cup and use a soft bar or flanged-end driver to move both parts evenly into bore.

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 (10-SPEED MODELS)

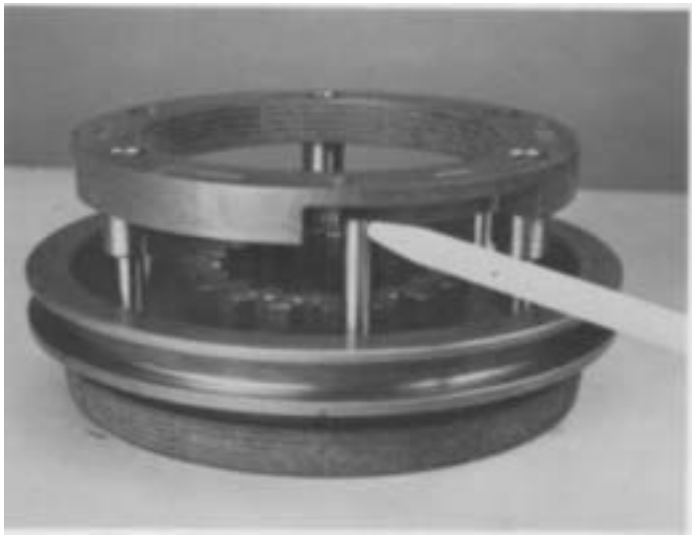


13. Remount the assembly upright in vise and secure on flange of auxiliary plate. Position the corresponding new gasket on cover mounting surface and install the rear bearing cover. Use the nylon collar and brass washer with capscrew at the chamfered hole which intersects speedometer bore (inset). Tighten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



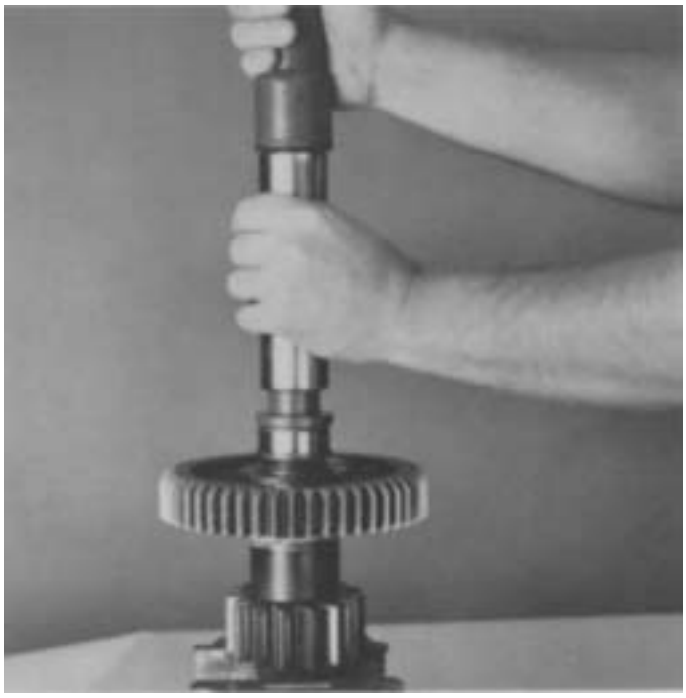
3. Place the high range synchronizer ring over blocker pins of low range synchronizer, seating the springs against pins.

REASSEMBLY-AUXILIARY SECTION (10-SPEED MODELS)

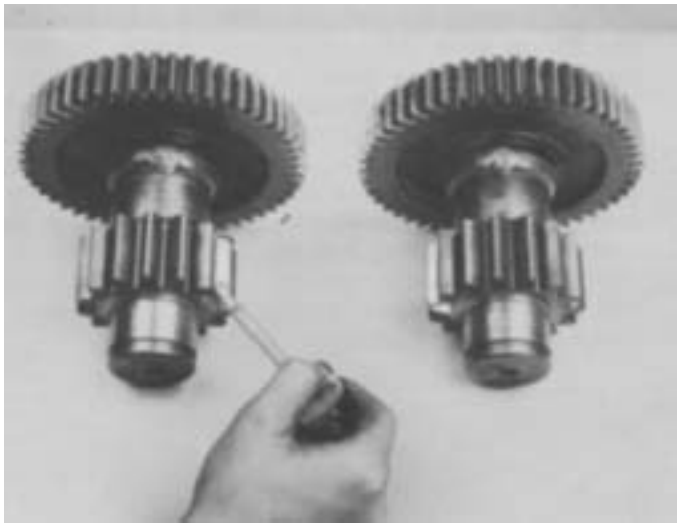
4. Apply downward pressure to the high range synchronizer ring WHILE TWISTING COUNTER-CLOCKWISE to compress the springs and fully seat ring on blocker pins of low range synchronize r.

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.

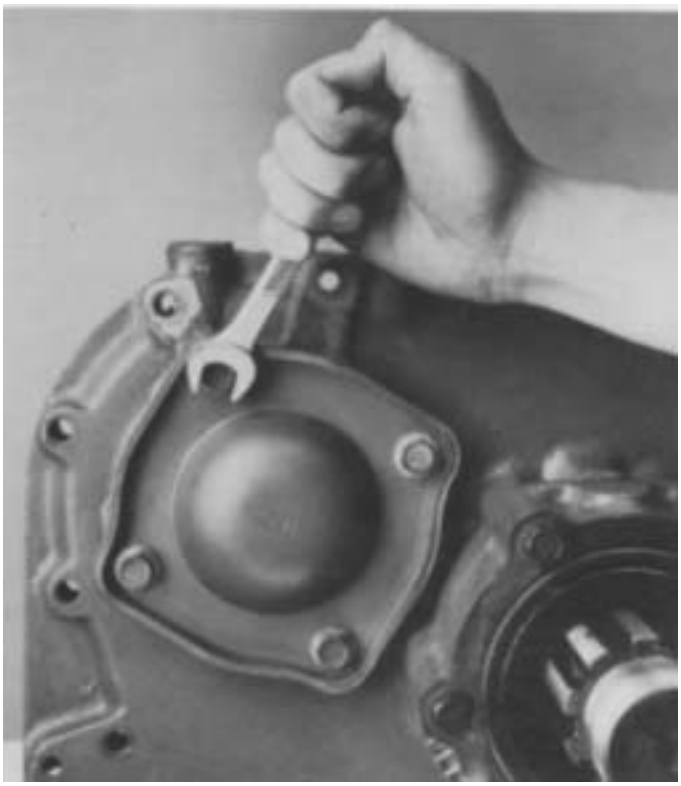


2. IMPORTANT: On the low range gear of each auxiliary countershaft assembly, use a highly visible color of toolmaker's dye to mark the tooth stamped with an "O" for timing purposes.

REASSEMBLY-AUXILIARY SECTION (10-SPEED 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.

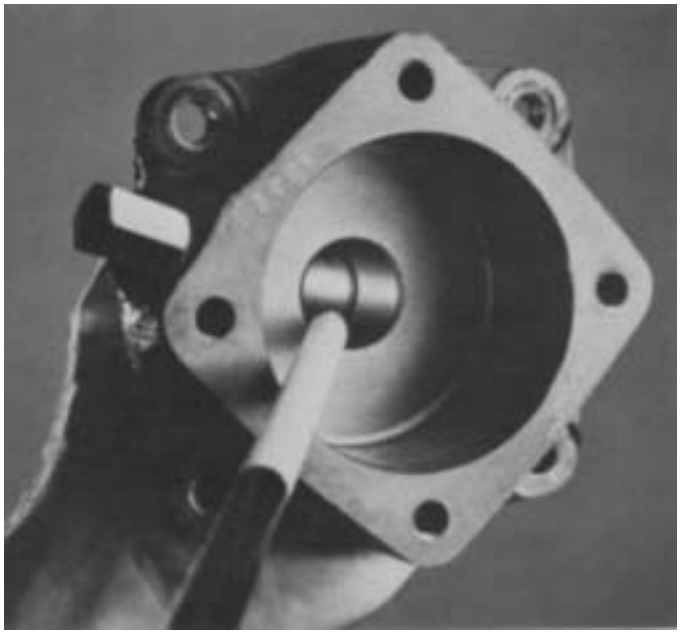
4. Install the snap ring in groove at rear of each countershaft.



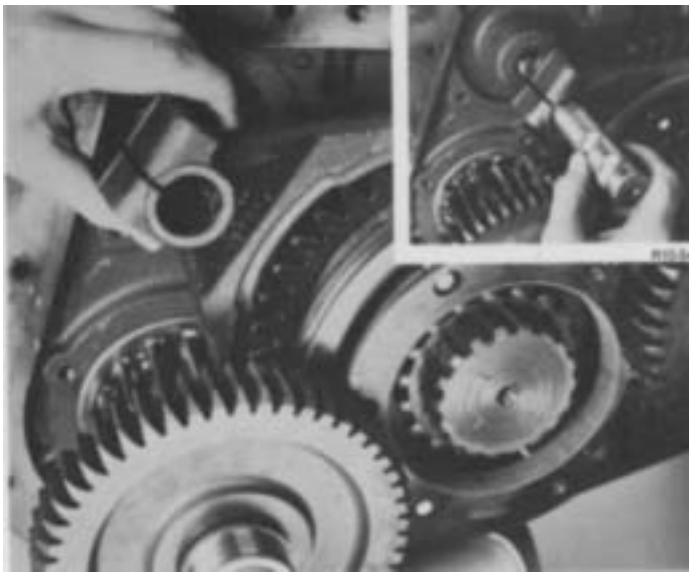
5. Position the corresponding new gasket on cover mounting surface and install both rear bearing covers. Tighten capscrews to secure covers to auxiliary plate.

REASSEMBLY-AUXILIARY SECTION (10-SPEED MODELS)

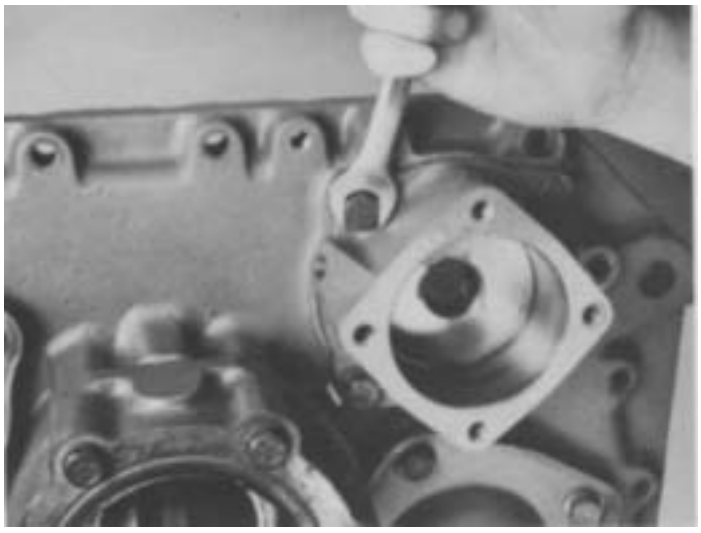
D. Reassembly and Installation of Range Cylinder Assembly



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-11610/12610 Series); long hub of yoke to the rear (RT-14610 Series). Insert threaded-end of yoke bar through yoke and into bore of range cylinder housing, aligning the notches in bar with yoke lockscrew holes (inset).

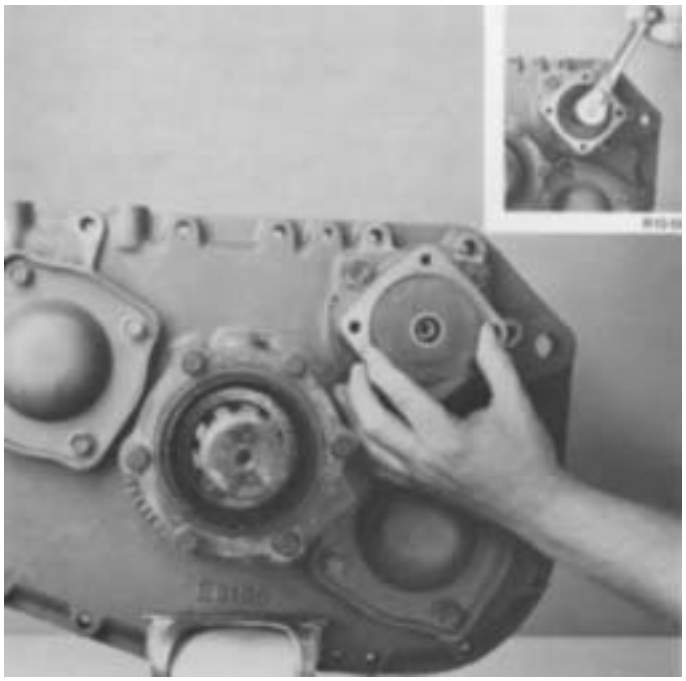


2. Position the corresponding new gasket on housing mounting surface and install the cylinder housing in rear bore of auxiliary plate, air fitting to the upper left. Secure housing to plate with capscrews tightened to recommended torque ratings.

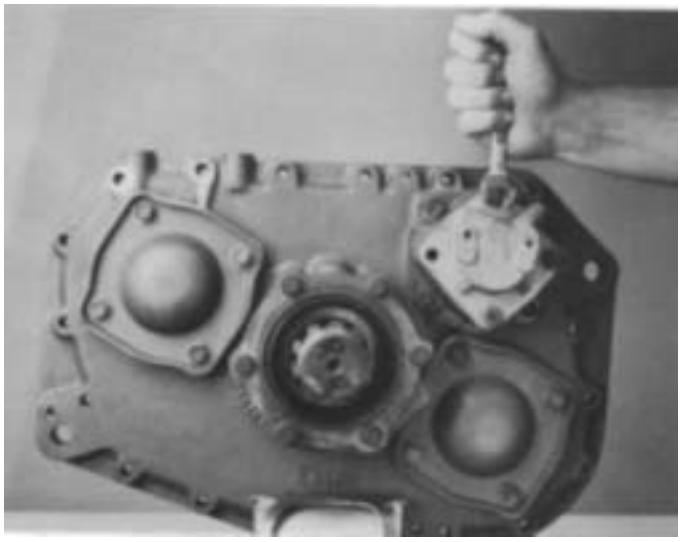
4. Install the two yoke lockscrews, tighten and wire securely.

REASSEMBLY-AUXILIARY SECTION (10-SPEED MODELS)

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



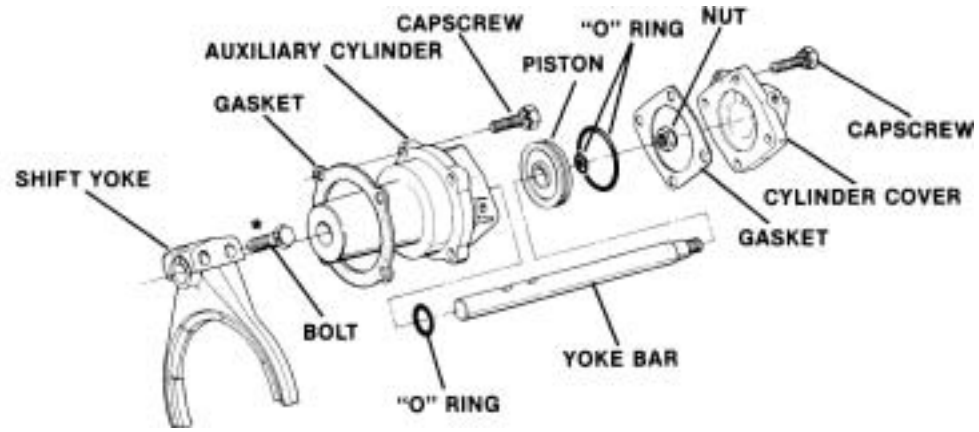
6. In cylinder housing bore, install the range piston on yoke bar, flat side to the rear. Secure with nut tightened to recommended torque ratings (inset).



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.

DISASSEMBLY-AUXILIARY SECTION (15-SPEED MODELS)

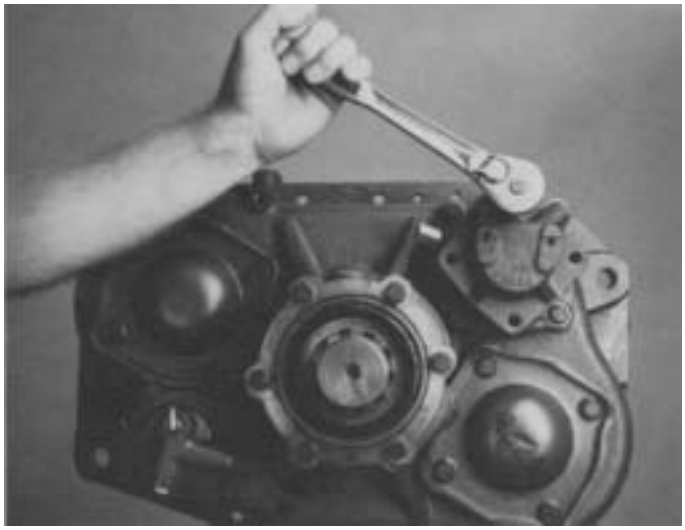
AUXILIARY SECTION (15-SPEED MODELS)



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

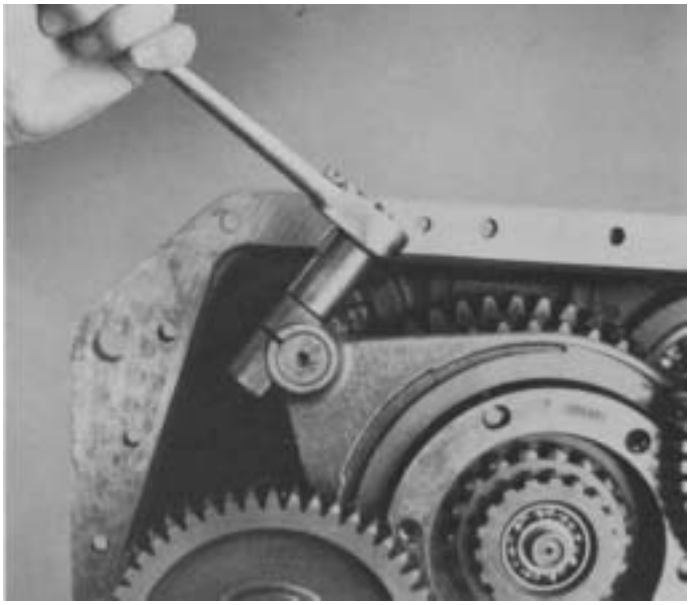
Cut 6426-10/80

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.



3. Cut lockwire and remove two yoke lockscrews.

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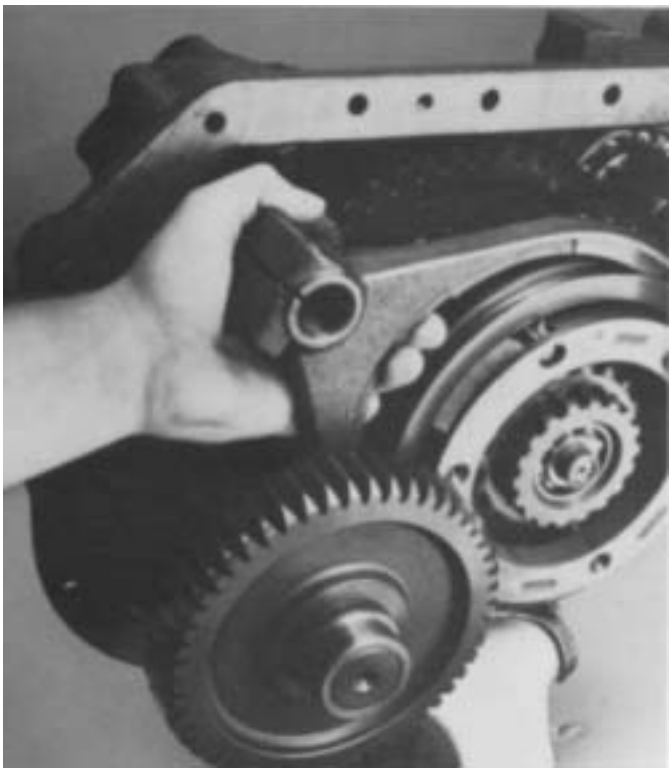
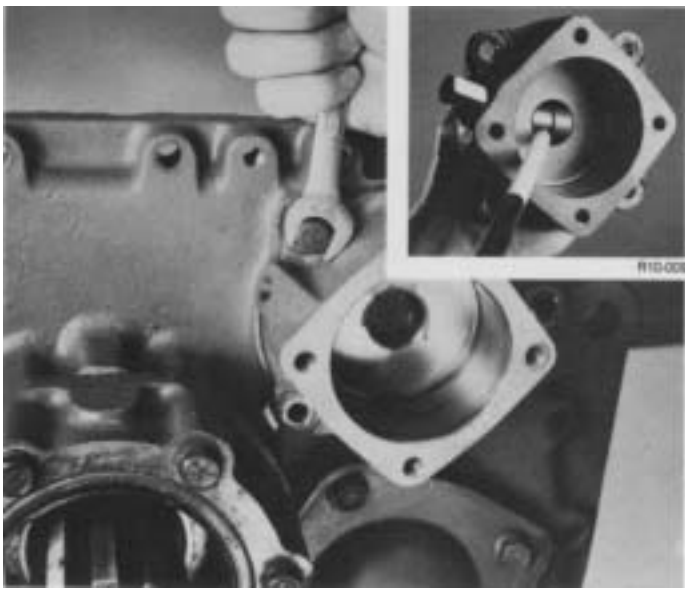
DISASSEMBLY-AUXILIARY SECTION (15-SPEED MODELS)

4. Pull yoke bar from bore of cylinder housing.



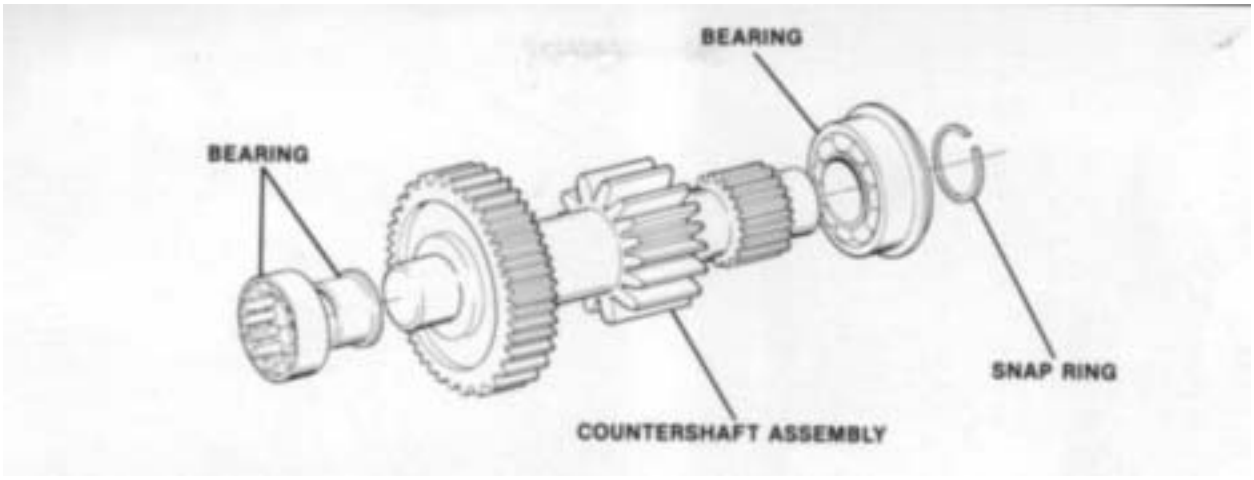
5. Remove range yoke from sliding clutch of synchronizer assembly.

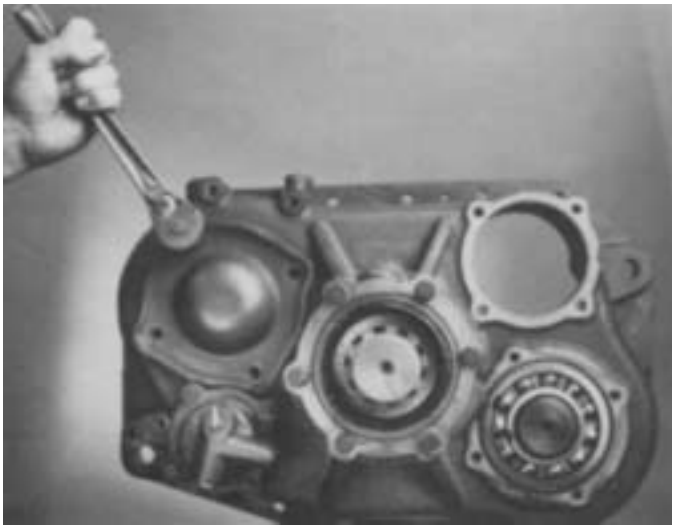
6. Remove the range piston from cylinder bore. If necessary, remove the O-rings from piston I.D. and O.D. (inset).



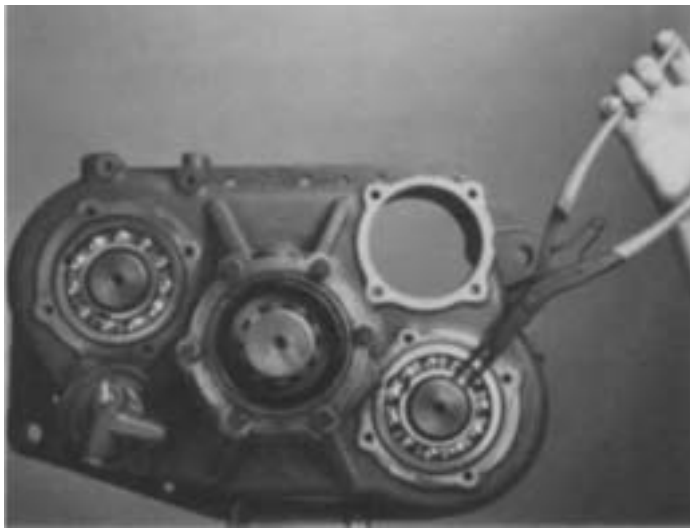
7. Turn out the capscrews and remove the range cylinder housing and gasket. If necessary, remove the small O-ring from groove in housing bore (inset).

DISASSEMBLY - AUXILIARY SECTION 5-SPEED MODELS)





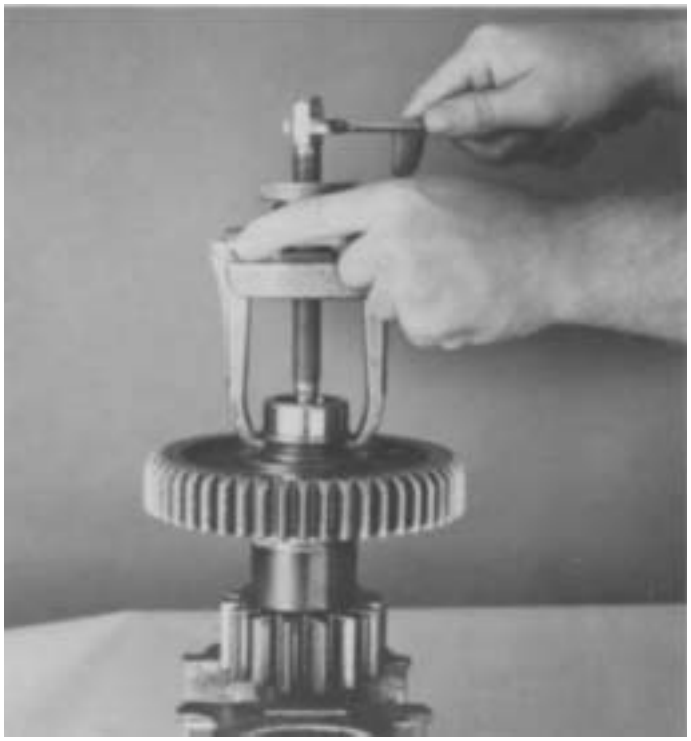
1. Turn out the capscrews and remove both countershaft rear bearing covers.
NOTE: For removal and disassembly of models equipped with an Auxiliary Oil Pump Assembly on rear of countershaft, see OPTIONS.



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

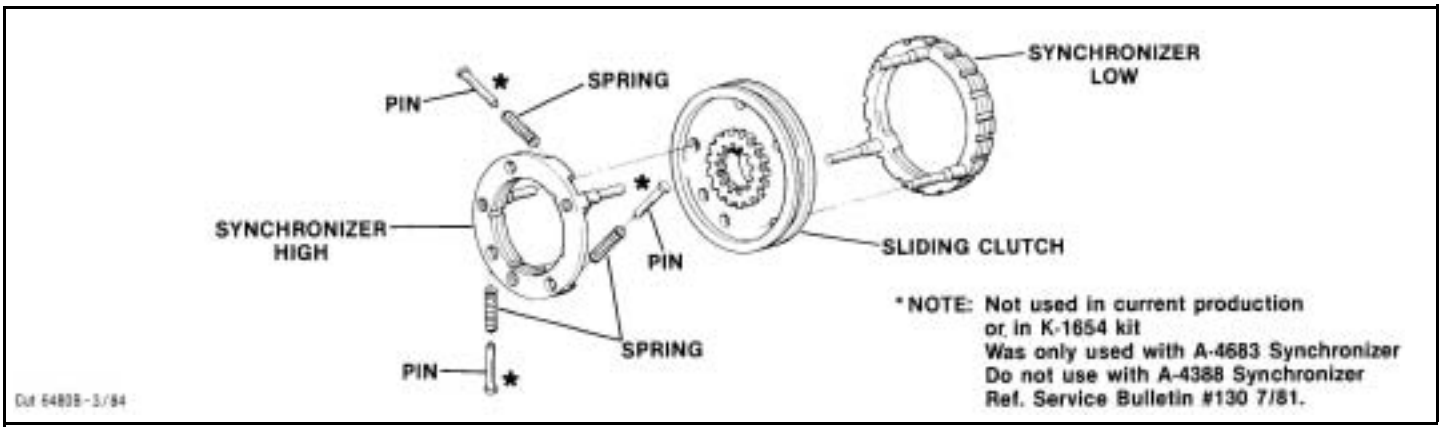
DISASSEMBLY-AUXILIARY SECTION (15-SPEED MODELS)

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

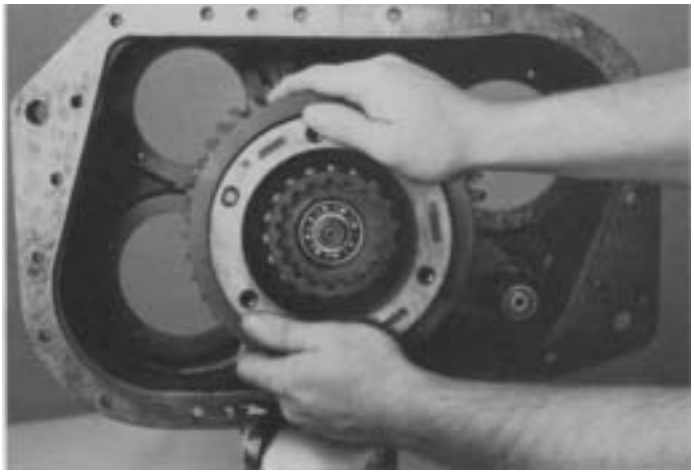


4. If necessary, secure the assembly in a vise and remove the bearing inner race from front of countershaft with jaw pullers.
NOTE: The vise used should be equipped with brass jaws or wood blocks to prevent damage to

DISASSEMBLY-AUXILIARY SECTION (15-SPEED 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.

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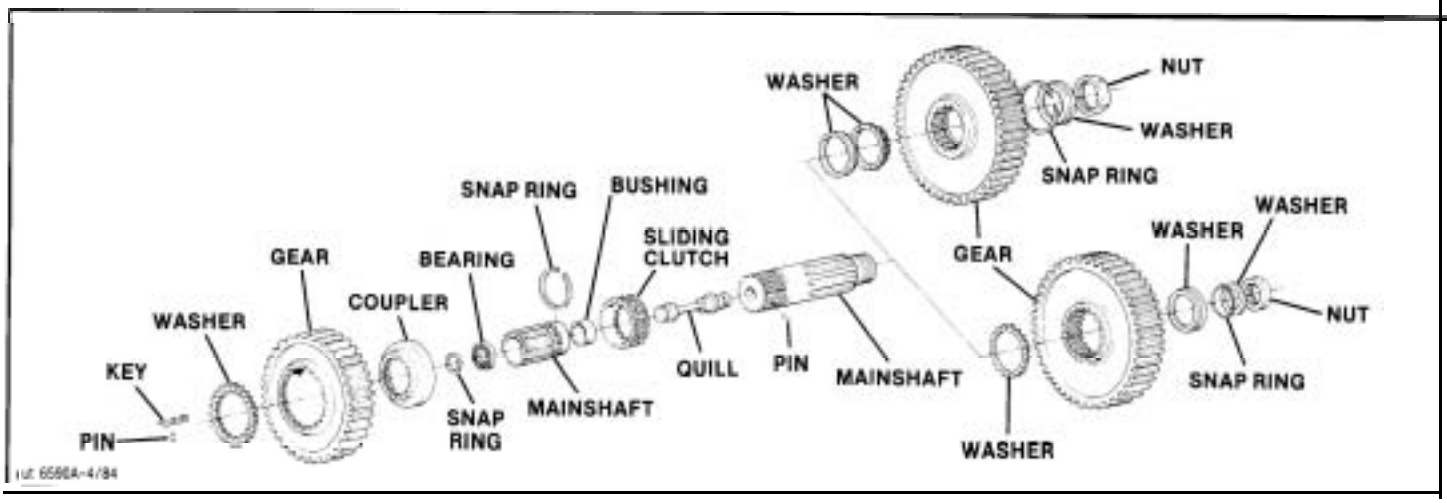
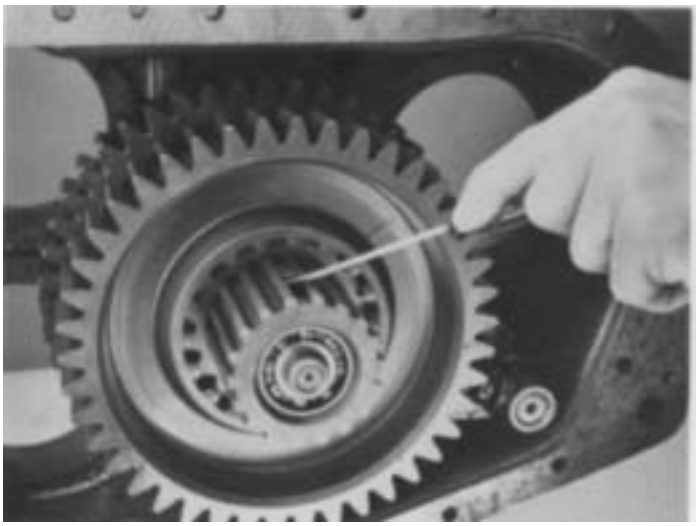
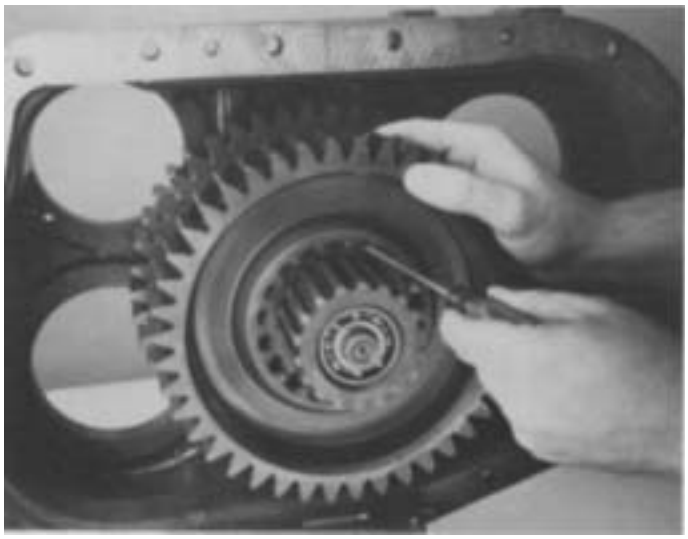
DISASSEMBLY-AUXILIARY SECTION (15-SPEED MODELS)



D. Removal of Low Range Gear



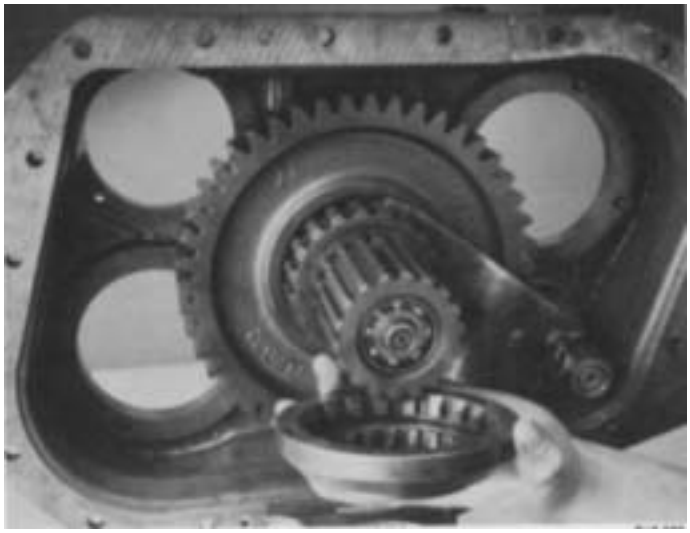
1. Remove the key from keyway of range mainshaft.



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

DISASSEMBLY-AUXILIARY SECTION (15-SPEED MODELS)

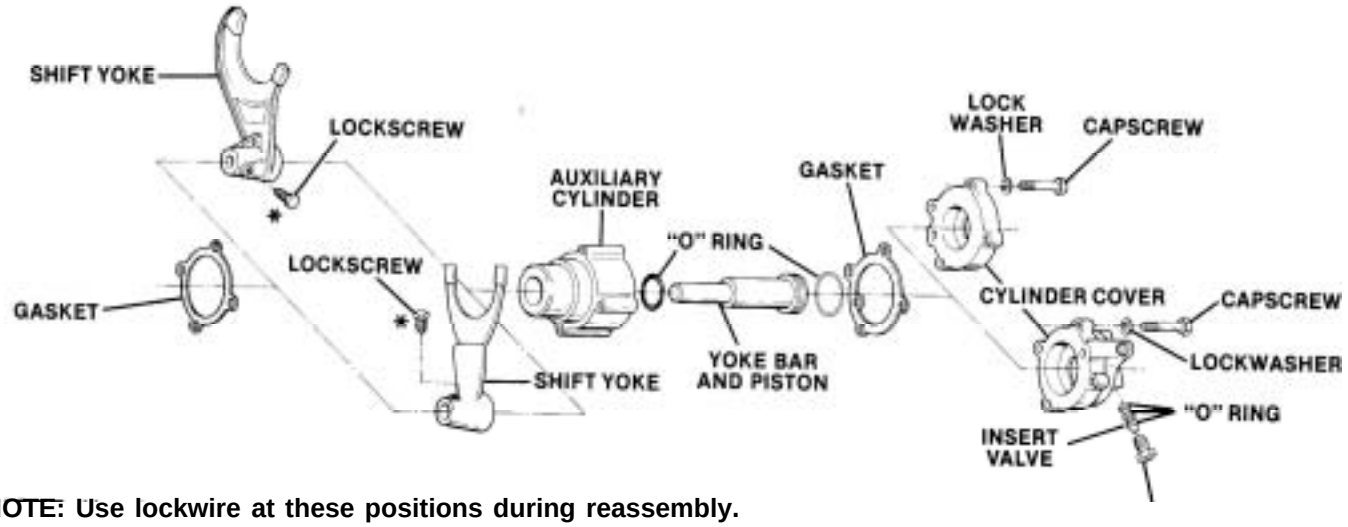
3. Pull the low range gear and washer from splines of range mainshaft.



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.

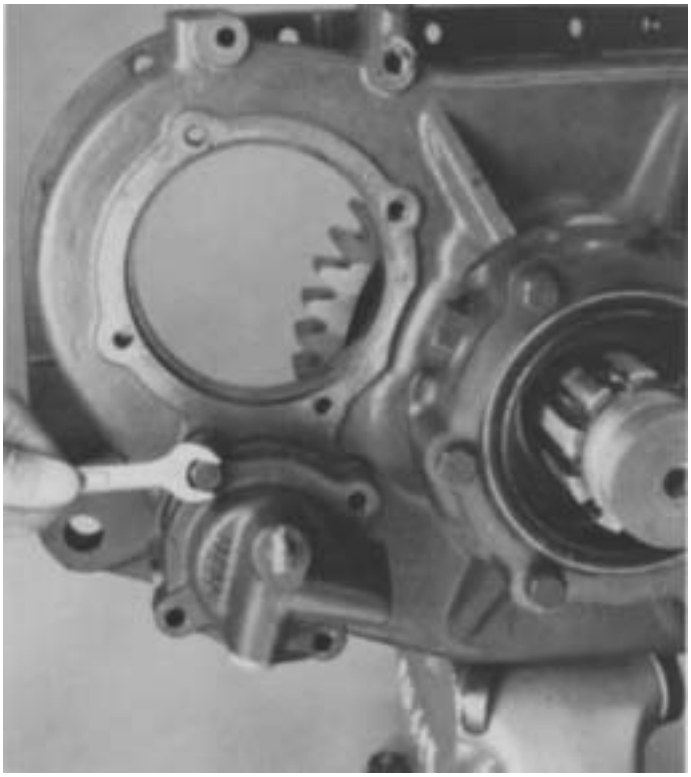
DISASSEMBLY-AUXILIARY SECTION (15-SPEED MODELS)



NOTE: Use lockwire at these positions during reassembly.

Cut 6443-12/83

E. Removal and Disassembly of Deep Reduction Cylinder Assembly

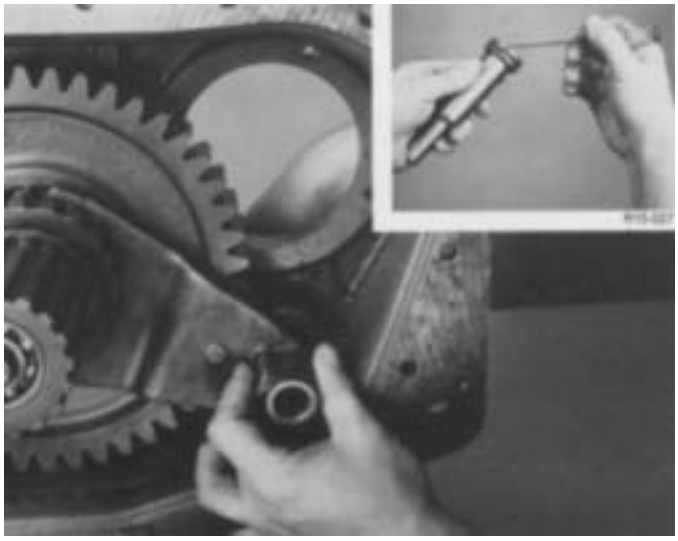


1. Turn out the capscrews and remove the deep reduction cylinder cover and gasket.

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

DISASSEMBLY-AUXILIARY SECTION (15-SPEED MODELS)

3. Cut lockwire and remove the lockscrew 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.

F. Removal and Disassembly of Range Mainshaft Assembly

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

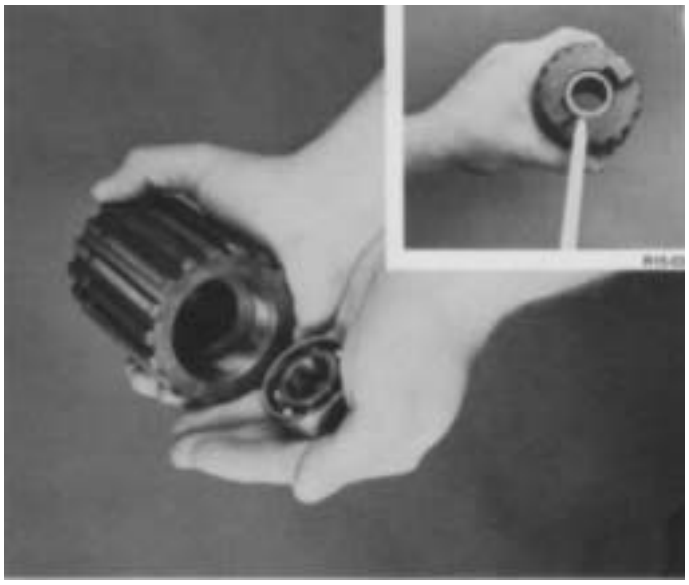
1. Remove snap ring from range mainshaft.

2. Remove deep reduction sliding clutch.

DISASSEMBLY-AUXILIARY SECTION (15-SPEED MODELS)

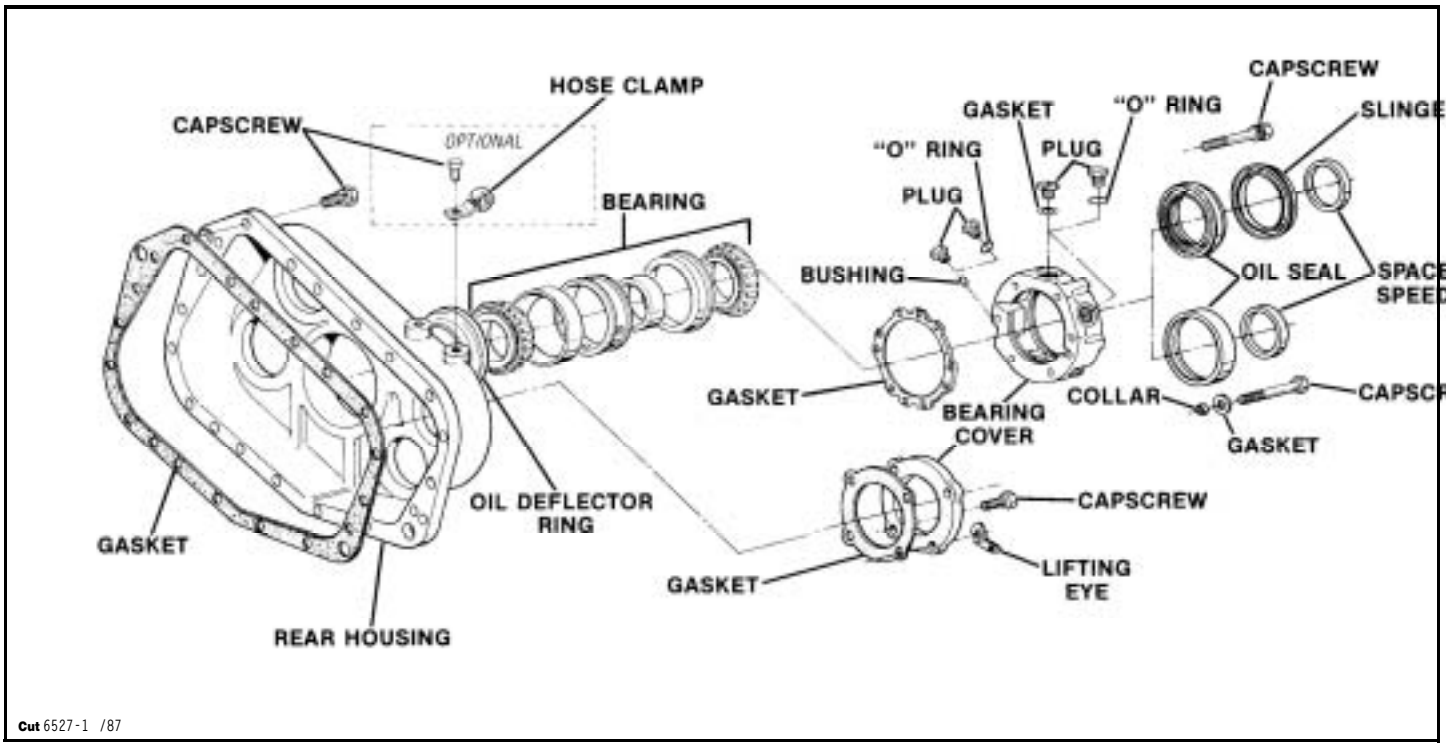
3. Remove the "C" ring from groove at front of mainshaft quill.

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



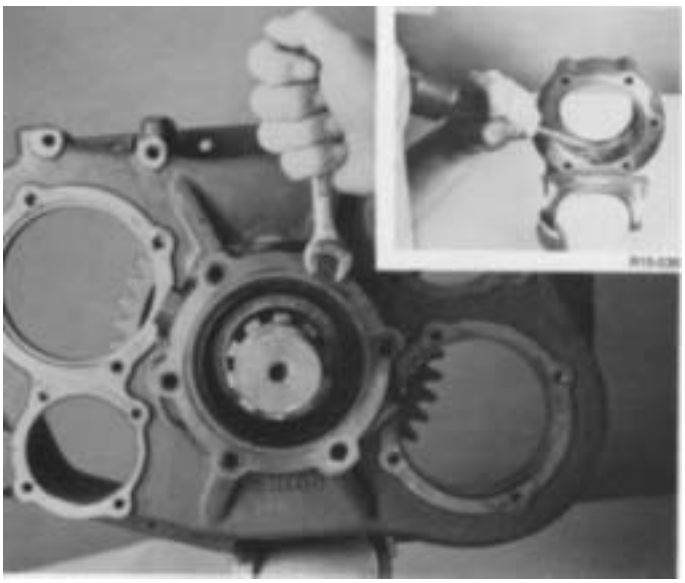
5. Remove the front bearing from bore in range mainshaft. If necessary, press the bushing from mainshaft bore (inset).

DISASSEMBLY-AUXILIARY SECTION (15-SPEED MODELS)



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

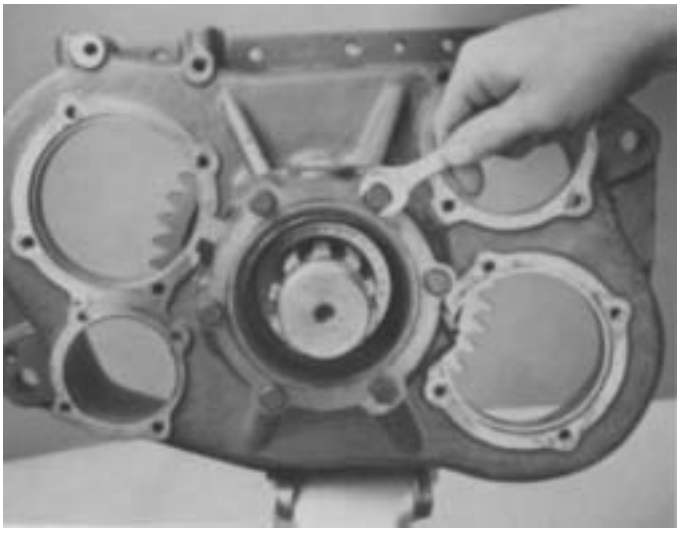
NOTE: In addition to the above, refer to the illustration provided at Part D of this section.



1. Turn out the capscrews 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 (15-SPEED MODELS)



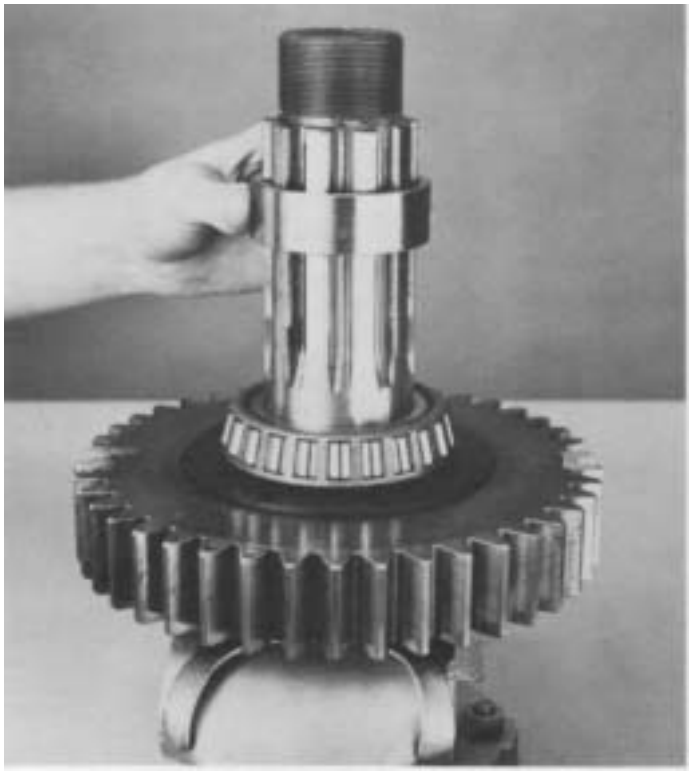
3. Temporarily reinstall rear bearing cover in position on housing ONLY to catch rear bearing cone released from bore in the following procedure.

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.

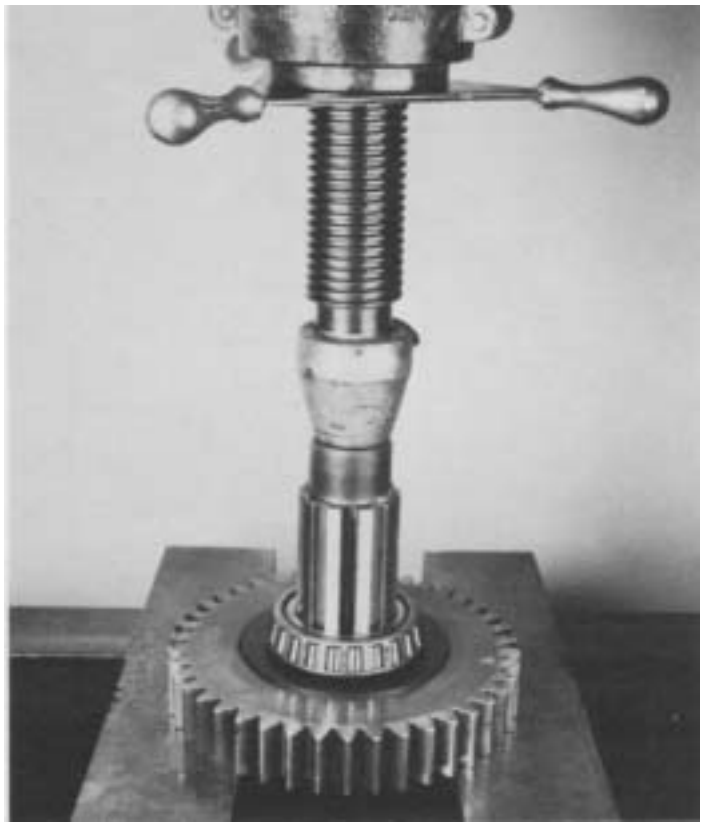
5. Remove rear bearing cover and bearing cone.

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

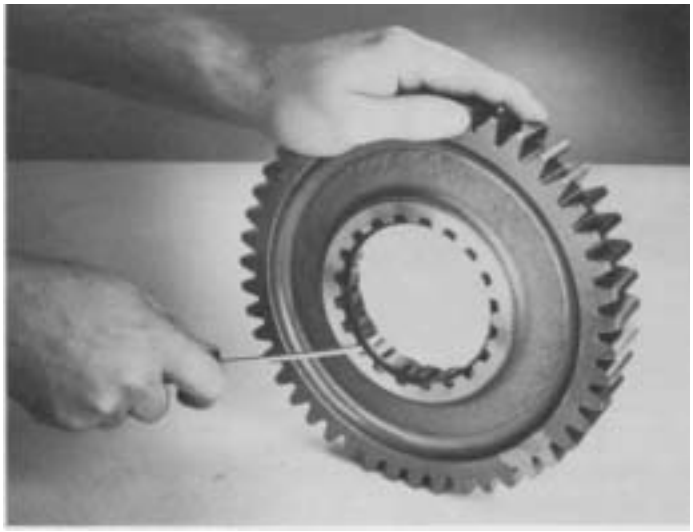
DISASSEMBLY-AUXILIARY SECTION (15-SPEED MODELS)



7. Remove the bearing inner spacer from outpu shaft.



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.



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

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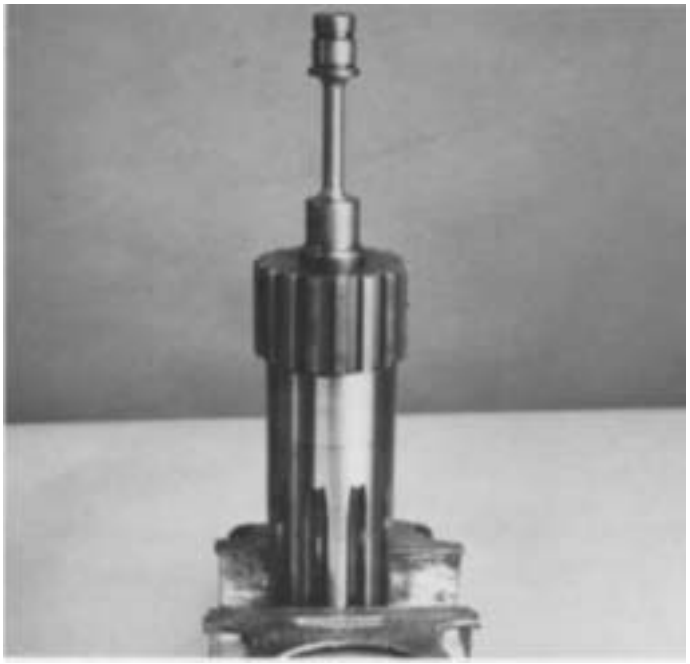
REASSEMBLY-AUXILIARY SECTION (15-SPEED MODELS)

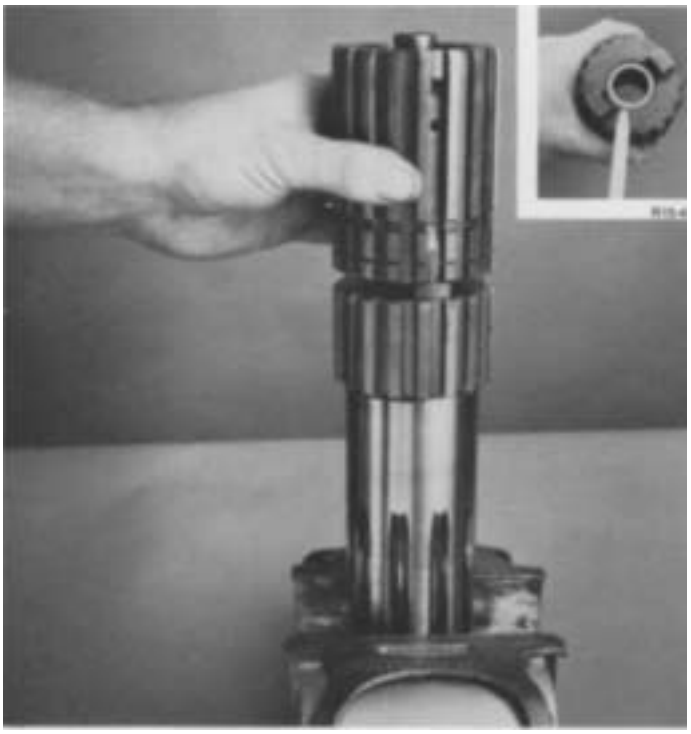
AUXILIARY SECTION (15-SPEED MODELS)

A. Reassembly and Installation of Range Mainshaft Assembly



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

3. Install the 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 on quill.

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

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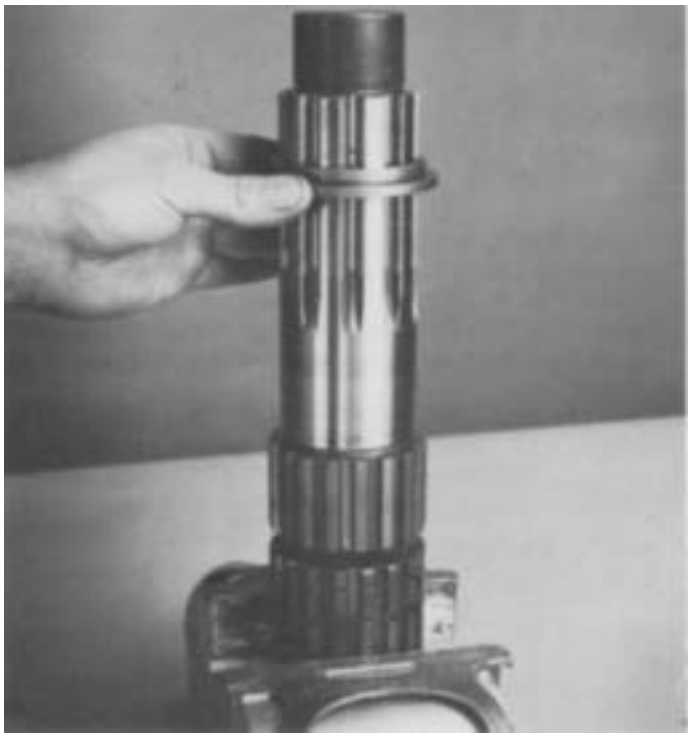
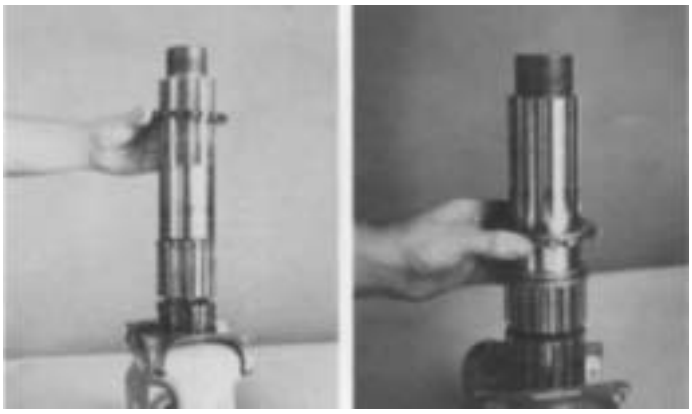
REASSEMBLY-AUXILIARY SECTION (15-SPEED MODELS)

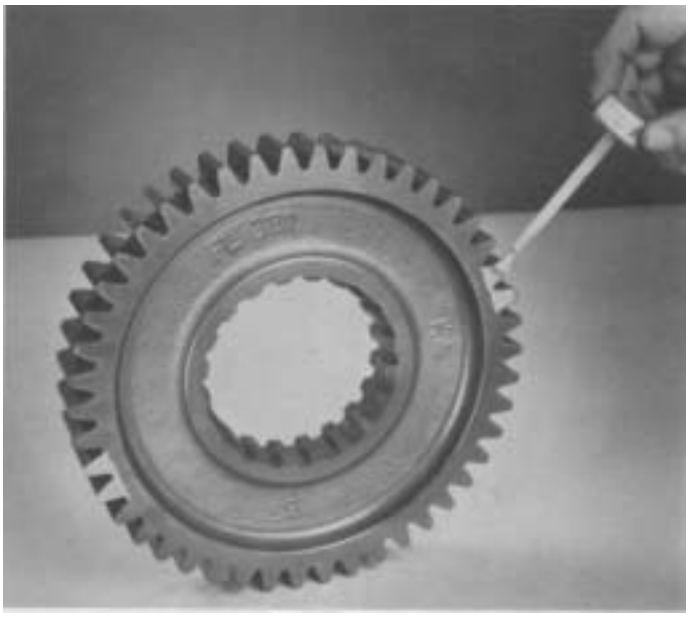
B. Reassembly and Installation of Output Shaft and Rear



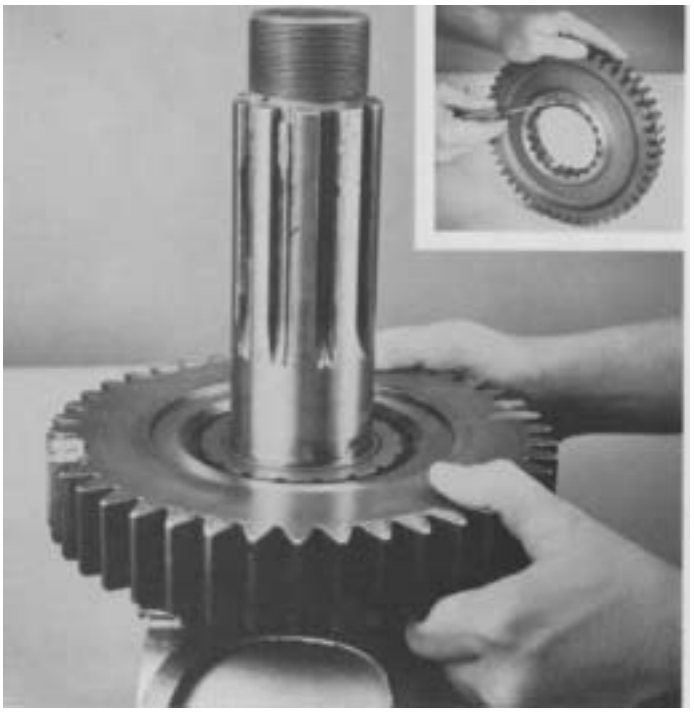
1. Remount the output shaft in vise with threaded-end up and secure on range mainshaft. For models so equipped, install the stepped washer on shaft, large diameter step down.



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.



R15-52

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.

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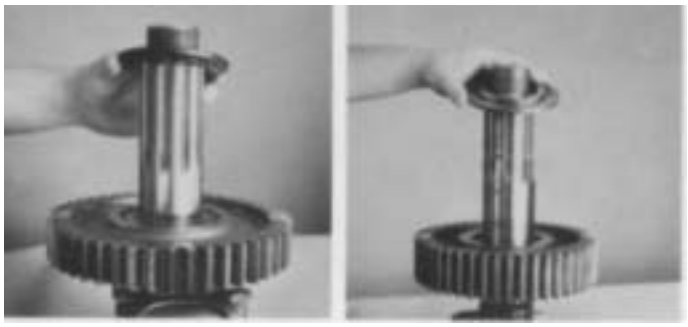
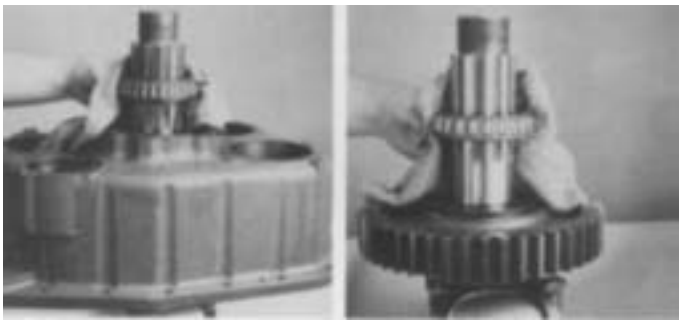
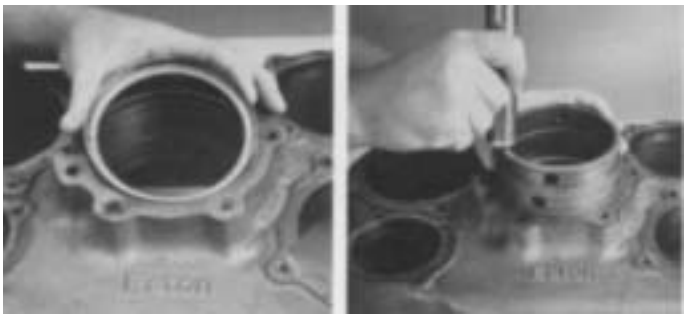
REASSEMBLY-AUXILIARY SECTION (15-SPEED MODELS)



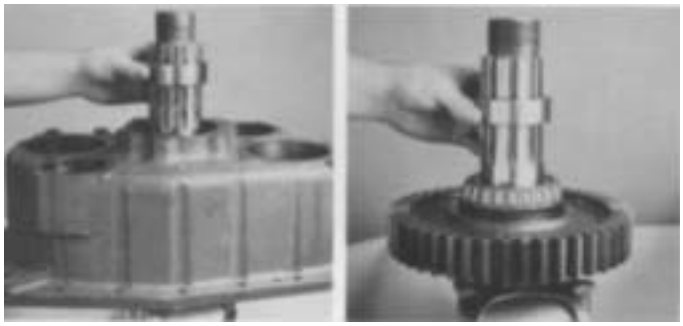
5. Install the washer on shaft against deep reduction gear, small diameter step down (Left: 11615 Models); or side with large groove up (Right: 15615 and 14615 Models).
NOTE: For models not equipped with the oil retention ring in auxiliary housing, proceed to No. 8.



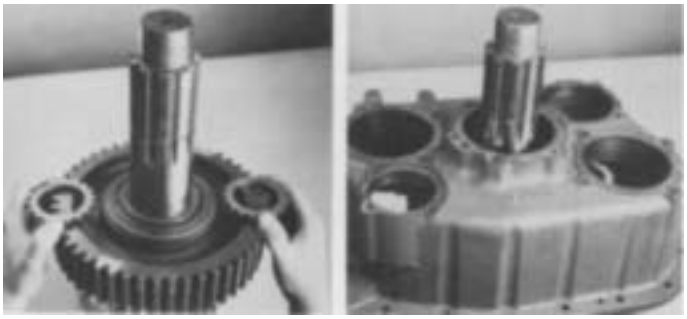
8. Heat the front bearing cone and install on output shaft against oil retention ring, bearing taper-up (left). For models not equipped with the oil retention ring in auxiliary housing, install the heated bearing cone on shaft against washer, taper up (right).
NOTE: DO NOT HEAT BEARING ABOVE 275ºF (136ºC). If possible, use heat lamps as source.



6. 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.



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

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

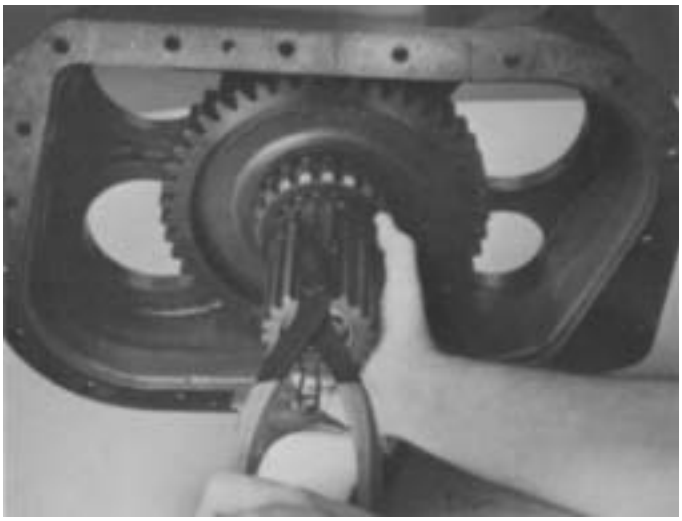
REASSEMBLY-AUXILIARY SECTION (15-SPEED MODELS)

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 275ºF (136ºC).

13. For models equipped with the oil retention ring in auxiliary housing, 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).

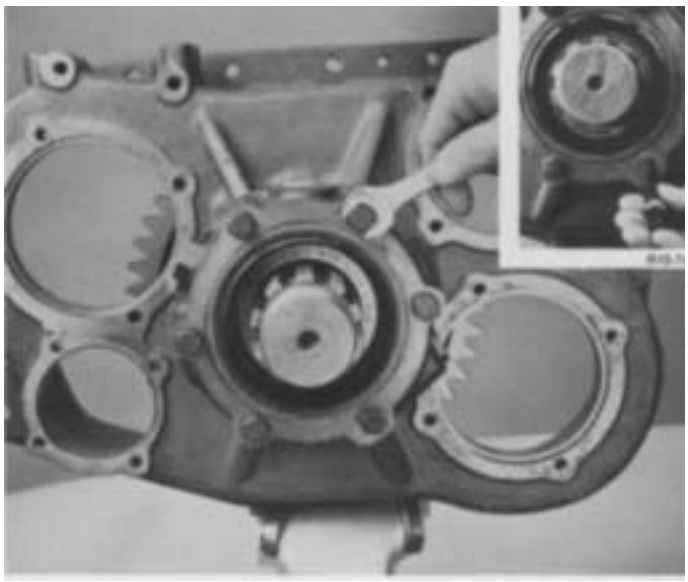
14. Remount assembly upright in vise and secure. Install the deep reduction sliding clutch on output shaft, internal splines toward gear and engaged with splines of shaft.



15. Install snap ring in groove of range mainshaft.

REASSEMBLY - AUXILIARY SECTION (15-SPEED MODELS)

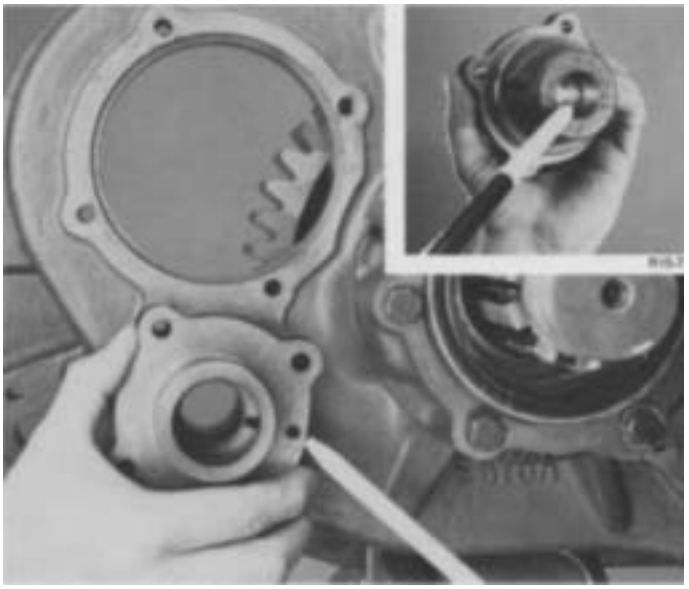
16. If previously removed, install the oil seal in rear bearing cover (inset). Seal should be installed so the spring is to the front of cover.



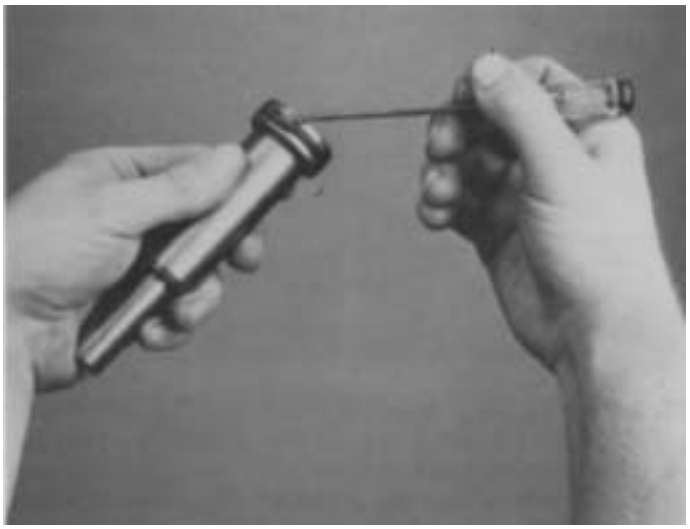
17. Position gasket on cover mounting surface and install the rear bearing cover on auxiliary housing. Use the nylon collar and brass washer with capscrew at the chamfered hole which intersects speedometer bore (inset). Tighten capscrews to secure cover to housing.

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.

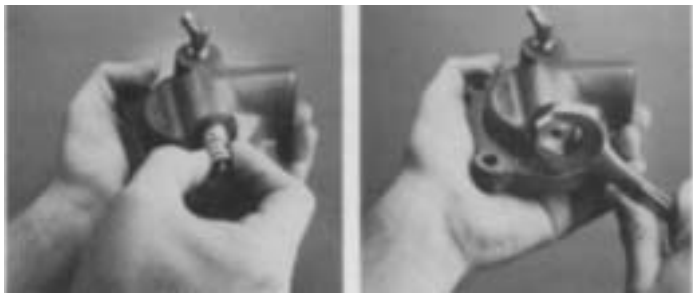


2. If previously removed, install the O-ring in groove of yoke bar piston.

REASSEMBLY-AUXILIARY SECTION (15-SPEED MODELS)

3. Place the reduction yoke into position with sliding clutch, lockscrew 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 lockscrew hole.

4. Install the yoke lockscrew, 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.

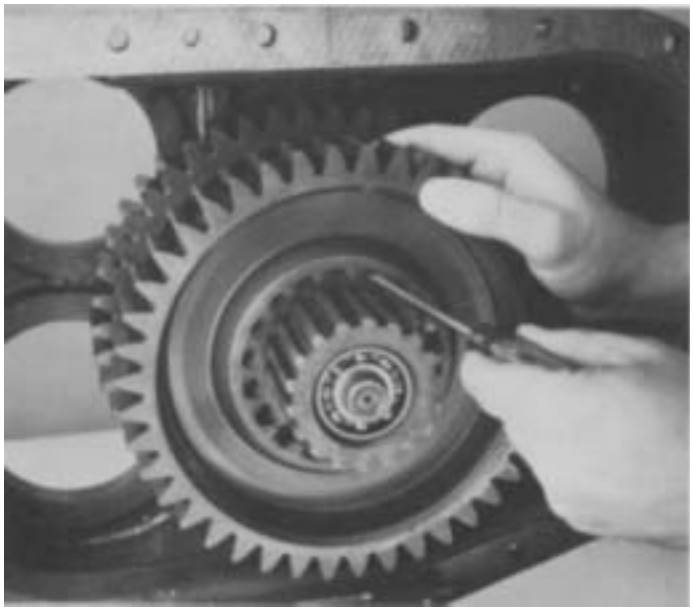
6. Position the corresponding new gasket on cover mounting surface and install the deep reduction cylinder cover, aligning the air channel with channel in cylinder housing. Tighten capscrews to secure cover to cylinder housing.

REASSEMBLY-AUXILIARY SECTION (15-SPEED MODELS)

D. Installation of Low Range Gear

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

2. Install the low range gear on mainshaft against couplete, clutching teeth.



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.

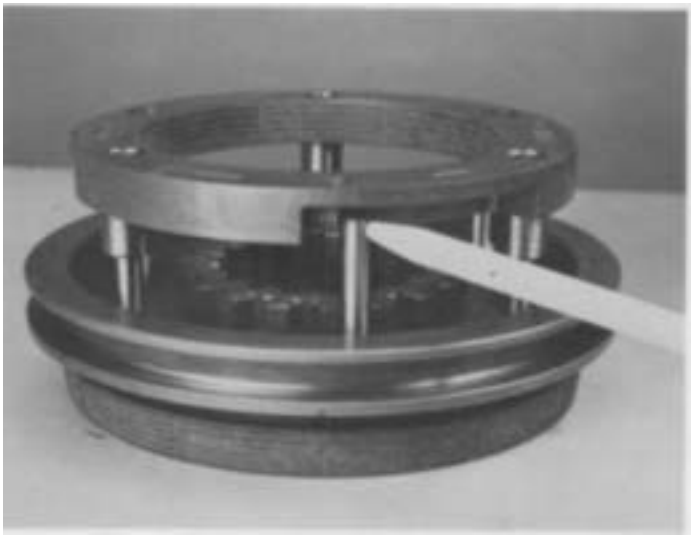
4. Install the key in keyway of range mainshaft, inserting the thick end of key in square internal spline of tolerance washer to lock low range gear on shaft.

REASSEMBLY-AUXILIARY SECTION (15-SPEED 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.

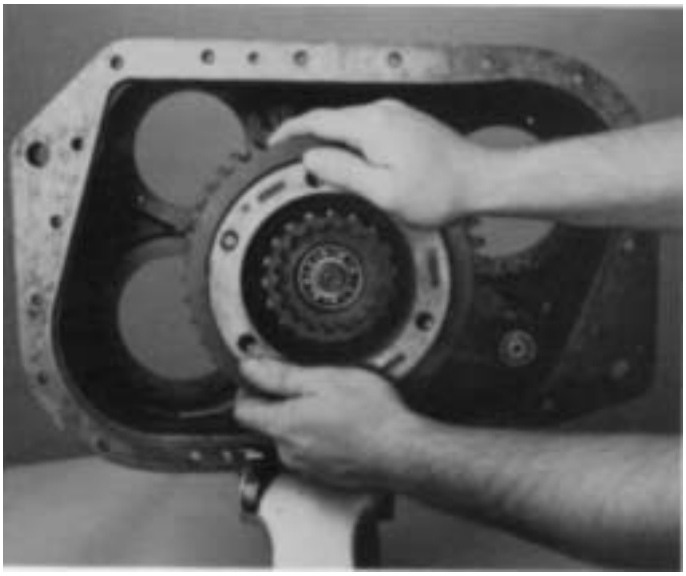
2. Install the three springs in bores of high range synchronizer ring.



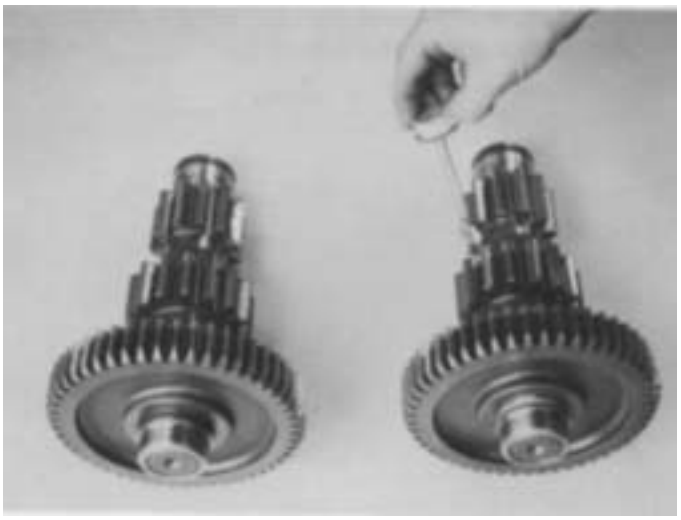
3. Place the high range synchronizer ring over blocker pins of low range synchronizer, seating the springs against pins.

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 (15-SPEED MODELS)

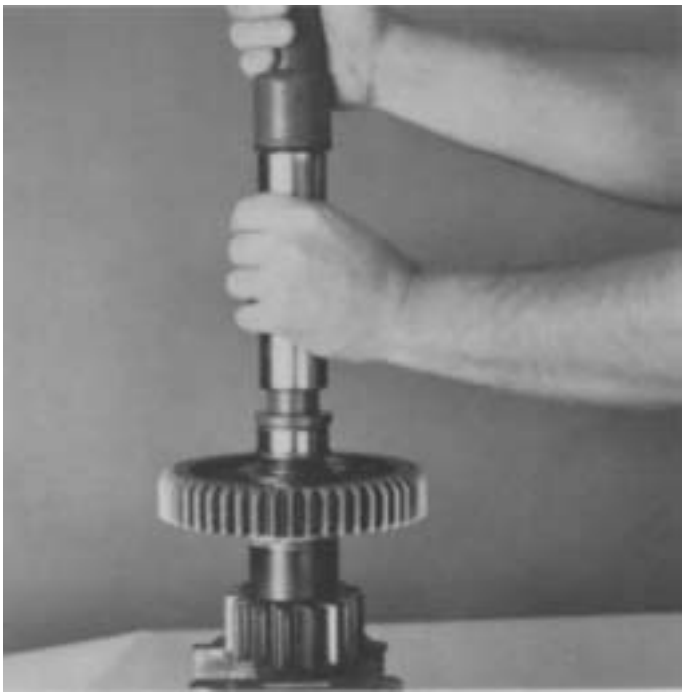


5. Install the synchronizer assembly on splines of range mainshaft, low range ring towards rear.



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.

F. Timing and Installation of Auxiliary Countershaft Assemblies

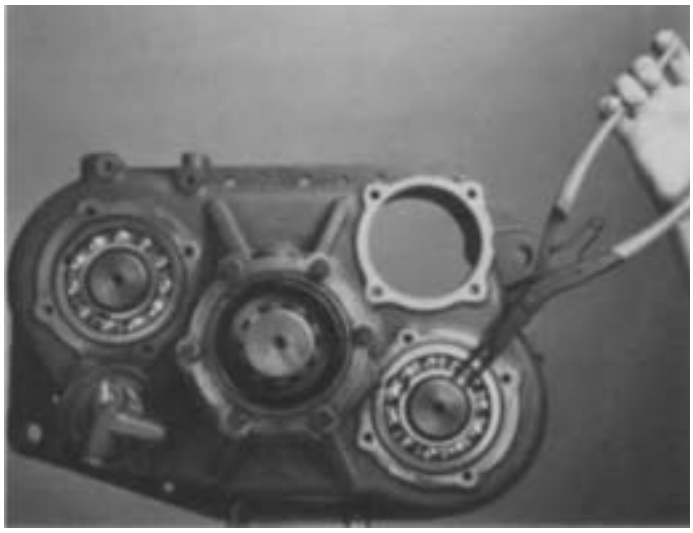


1. If previously removed, install the bearing inner race on front of each countershaft.

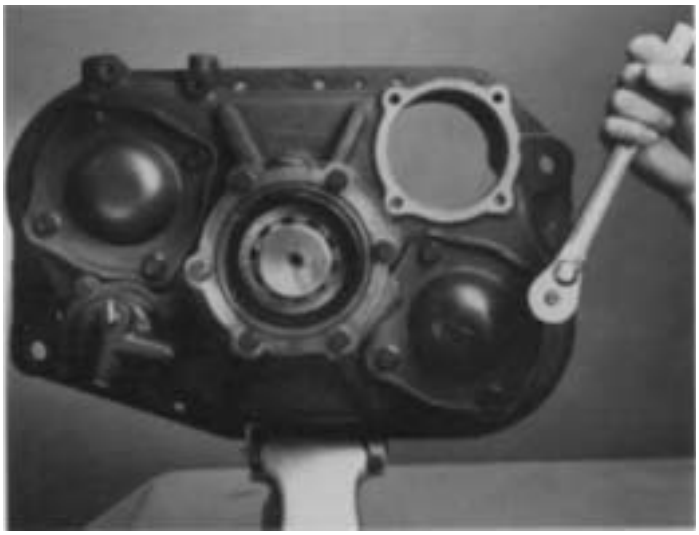
3. Place one countershaft into position in housing, meshing the marked tooth of countershaft gear with either set of two marked teeth of mainshaft deep reduction gear (inset). Center rear of countershaft in bearing bore, start rear bearing in bore and complete installation with a flanged-end driver and 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 (15-SPEED MODELS)



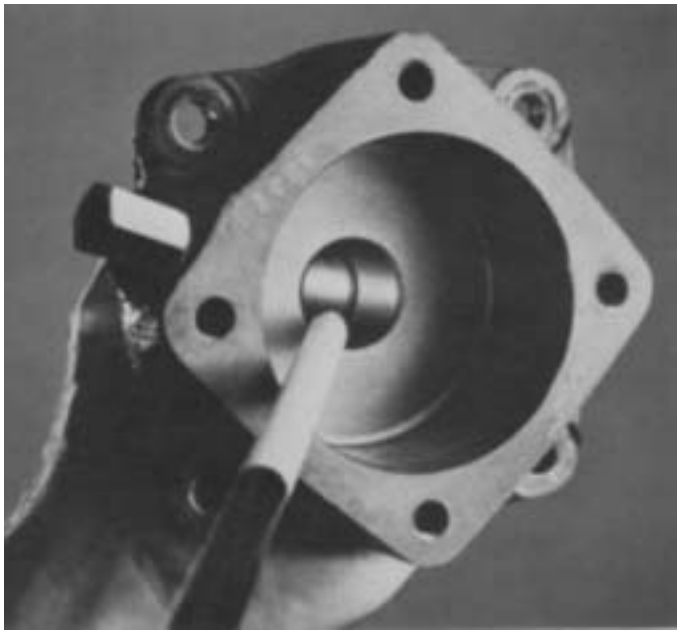
4. Install the snap ring in groove at rear of each countershaft.



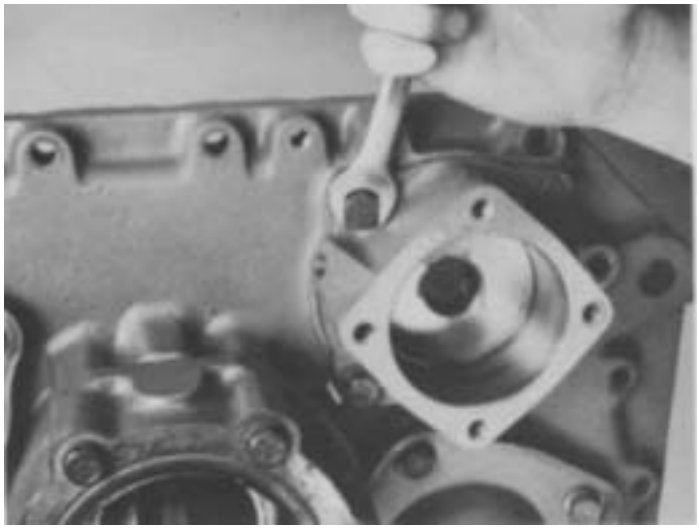
5. Position the corresponding new gasket on cover mounting surface and install both rear bearing covers. Tighten capscrews to secure covers to auxiliary housing.

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

G. Reassembly and Installation of Range Cylinder Assembly



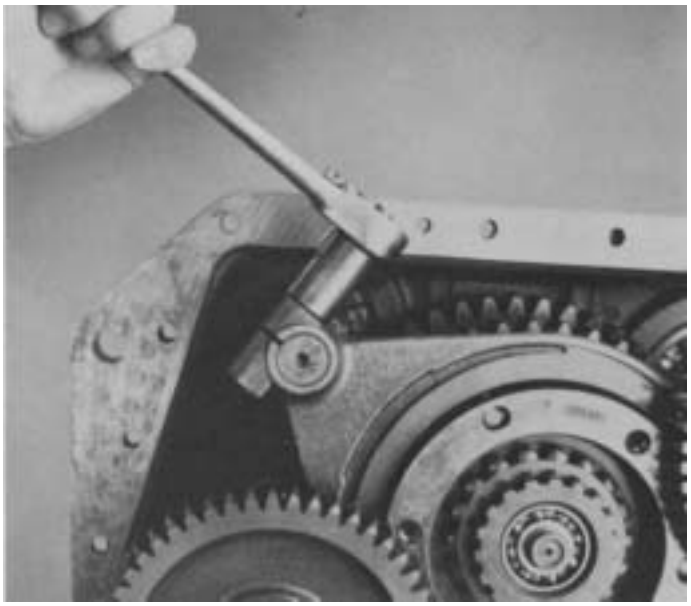
1. If previously removed, install the O-ring in bore of range cylinder housing.



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 (15-SPEED 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 lockscrew holes.



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

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

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).

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.

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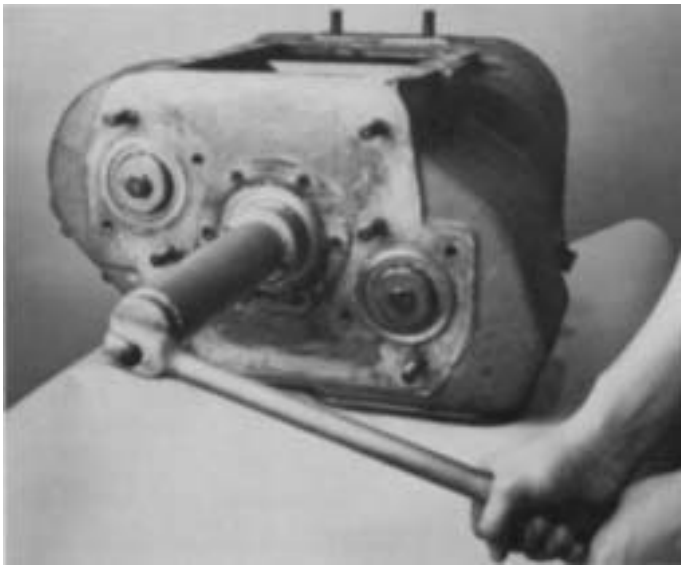
DISASSEMBLY-FRONT SECTION

A. Removal of Front Bearing Cover and Input Shaft Nut

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

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

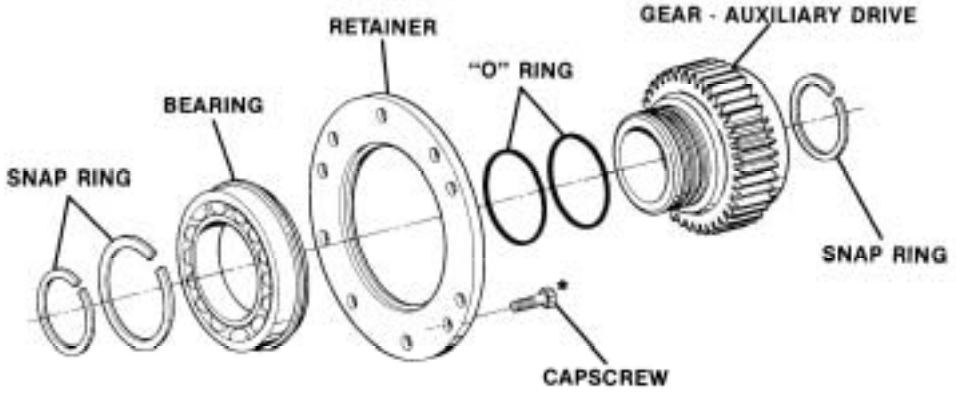


3. Engage two mainshaft sliding clutches into gear, this prevents transmission from rotating. Remove nut (left hand thread) with drive gear nut removing tool.

NOTE: On models using snap ring in place of nut, remove snap ring.

DISASSEMBLY-FRONT SECTION

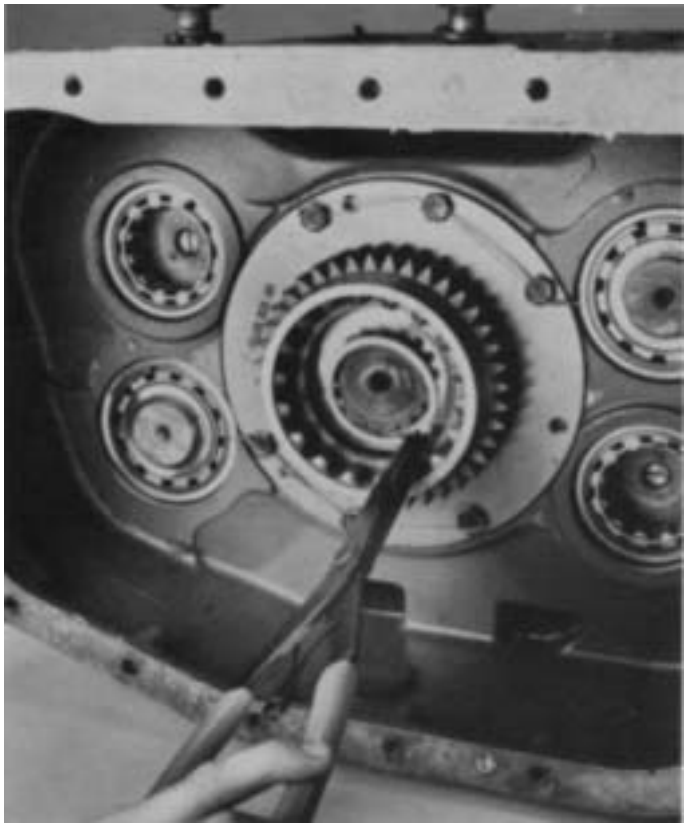
CASE ASSEMBLIES



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

Cut 6417-9/80

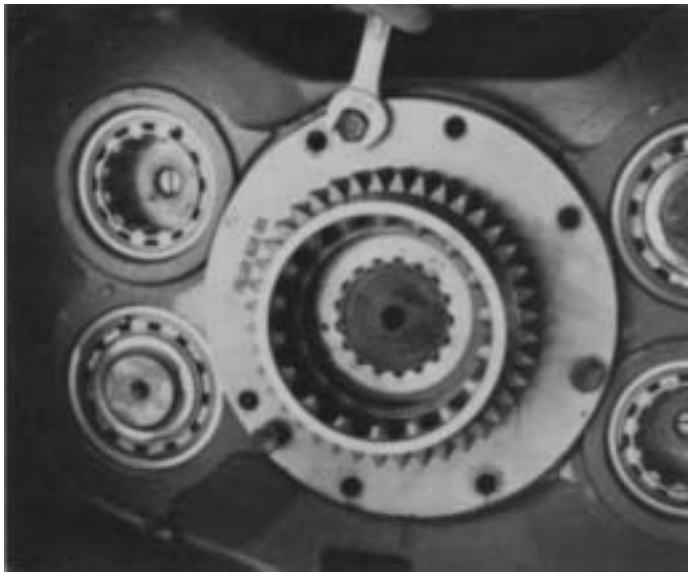
B. Removal and Disassembly of Auxiliary Drive Gear Assembly



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

2. Cut lockwire and remove the capscrews from bearing retainer ring.

DISASSEMBLY-FRONT SECTION



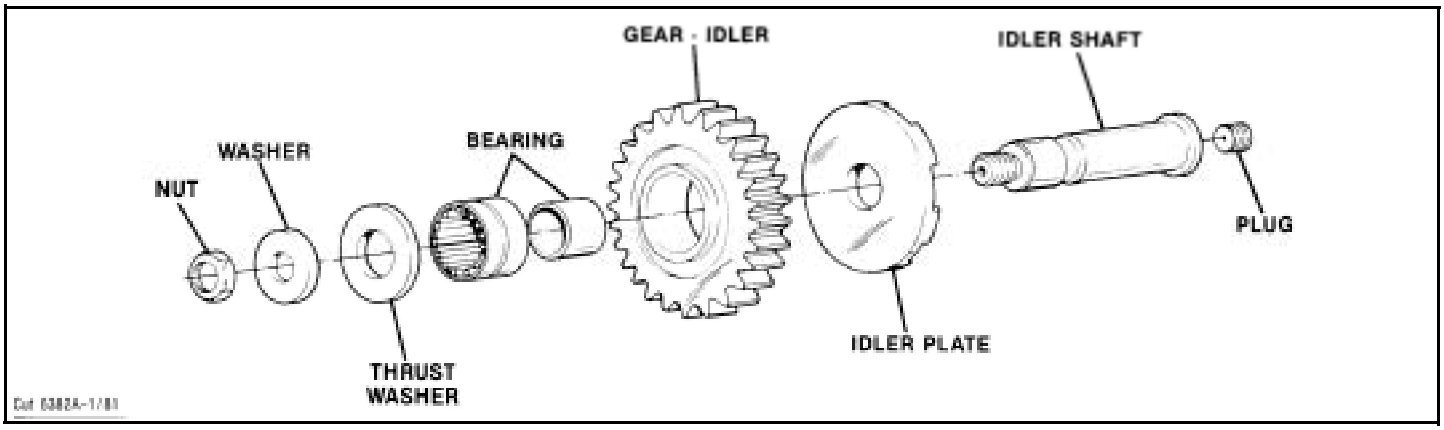
3. Insert three puller screws in the specially tapped holes of retainer ring. Tighten screws evenly to pull the auxiliary drive gear assembly from case bore.

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

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

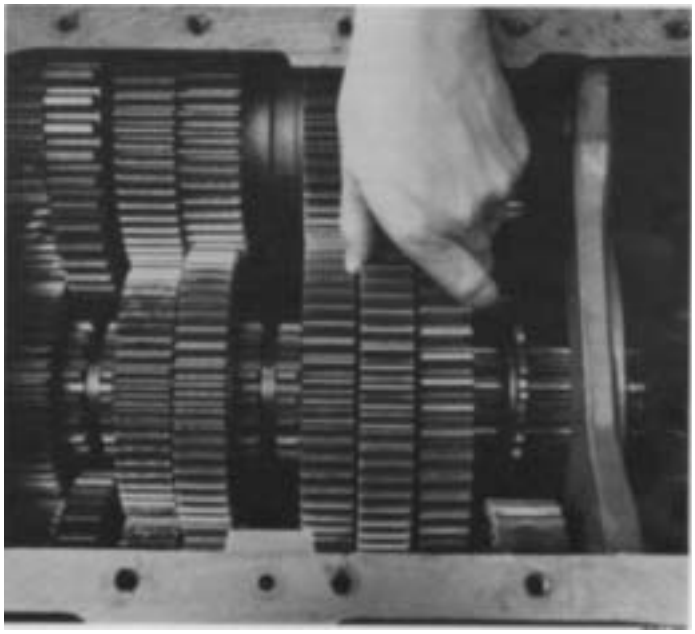
6. If necessary, remove the O-rings from hub O.D. of auxiliary drive gear.

DISASSEMBLY-FRONT SECTION



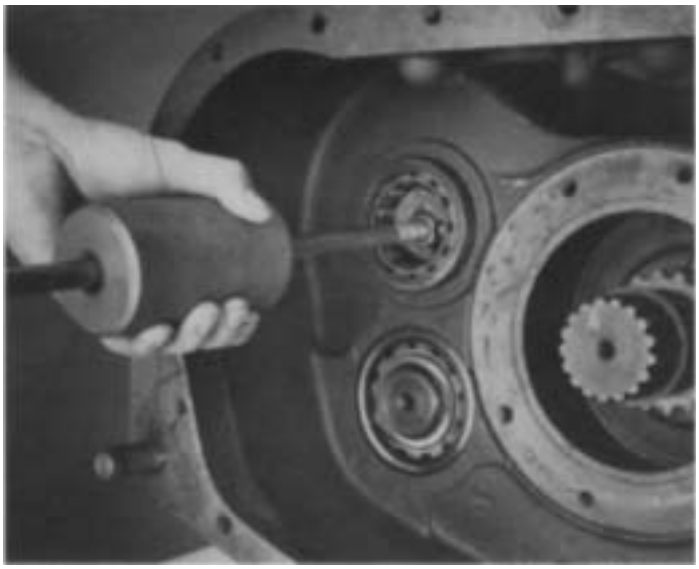
C. Removal and Disassembly of Left Reverse Idler Gear Assembly

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

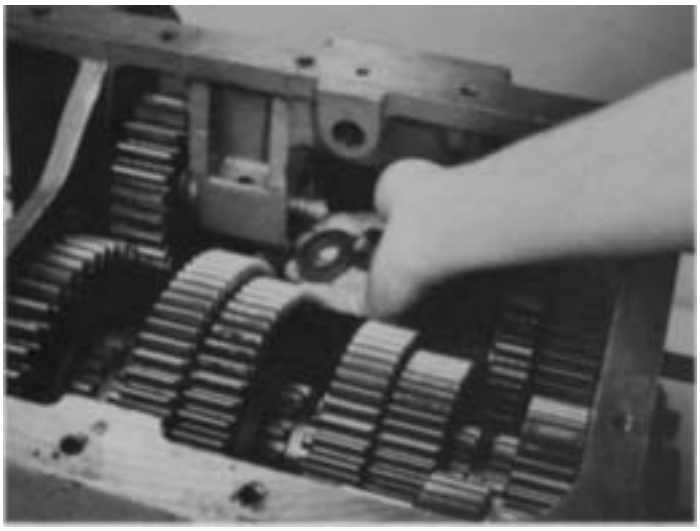


2. Move the reverse gear forward and against the 1st speed gear, engaging the splines of mainshaft sliding clutch.

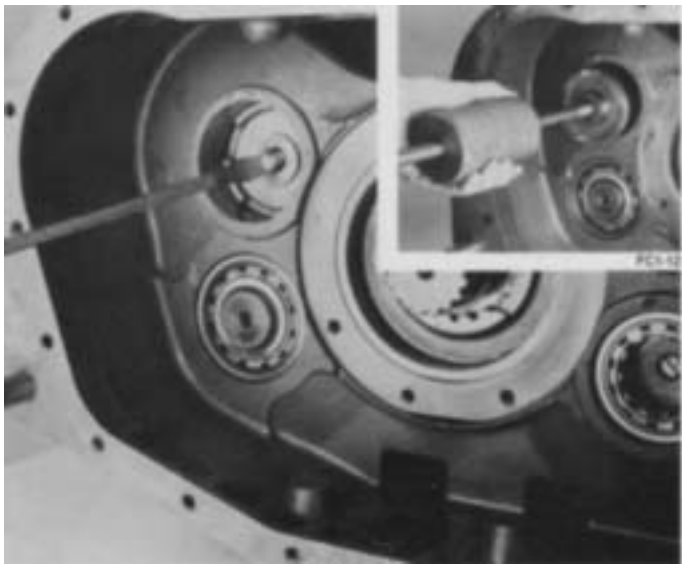
DISASSEMBLY-FRONT SECTION



3. Using inside 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.



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



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).

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

7. If necessary, remove the inner race from bearing and press needle bearing from idler gear.

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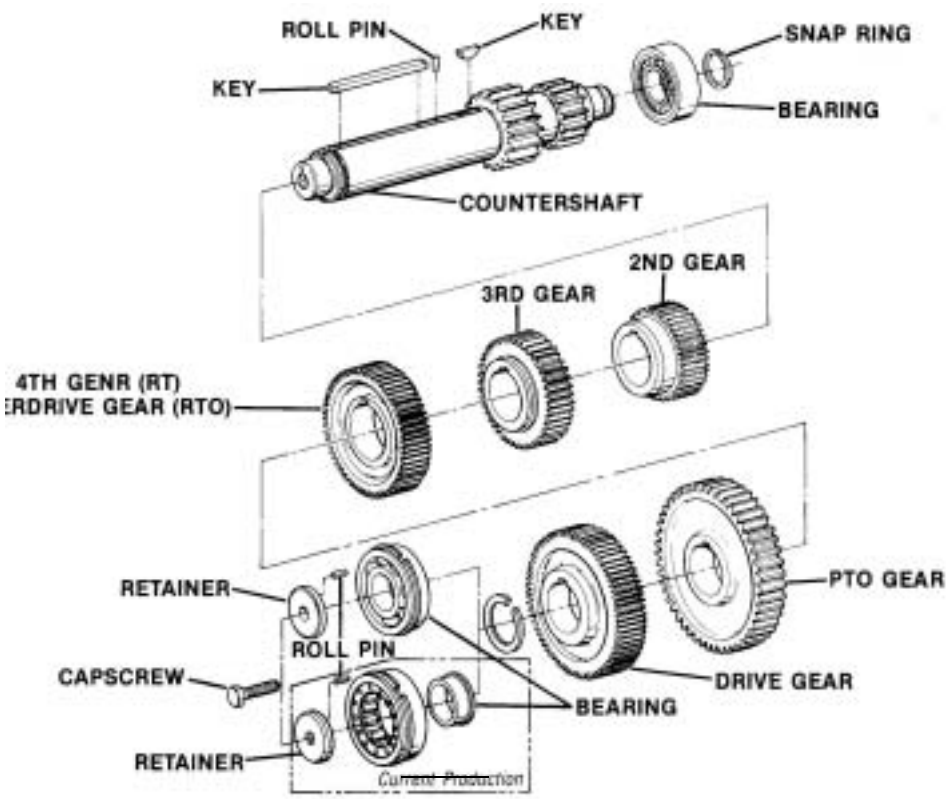
DISASSEMBLY-FRONT SECTION

COUNTERSHAFT ASSEMBLY



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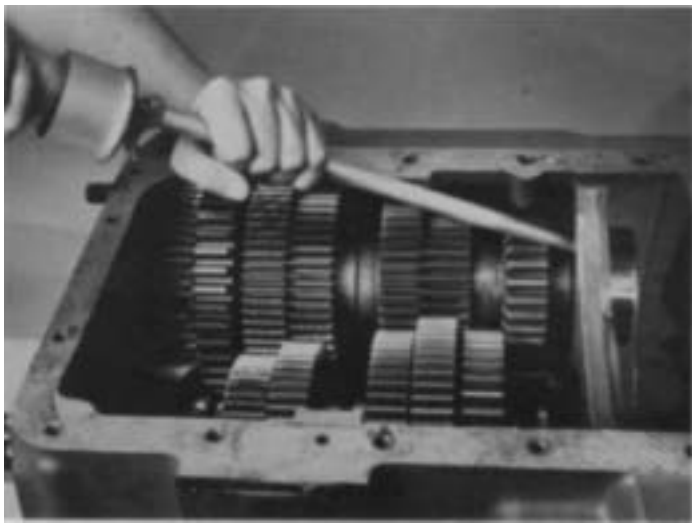
D. Removal of Countershaft Bearings

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.

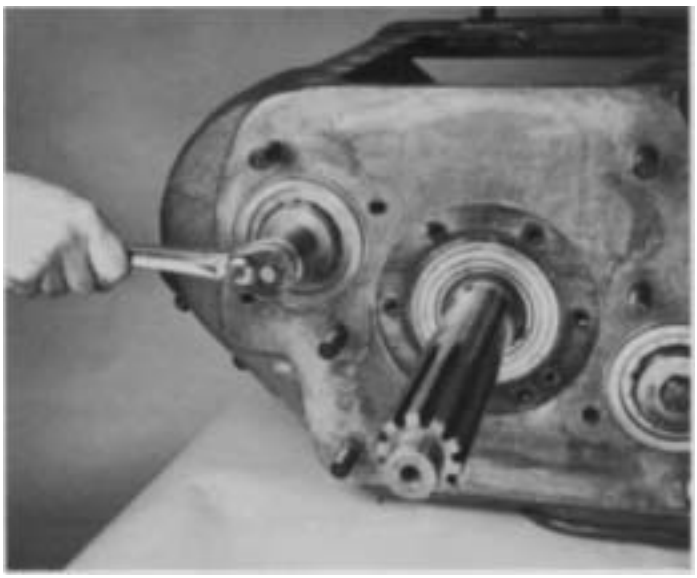
1. Remove the snap ring from groove at rear of each countershaft.



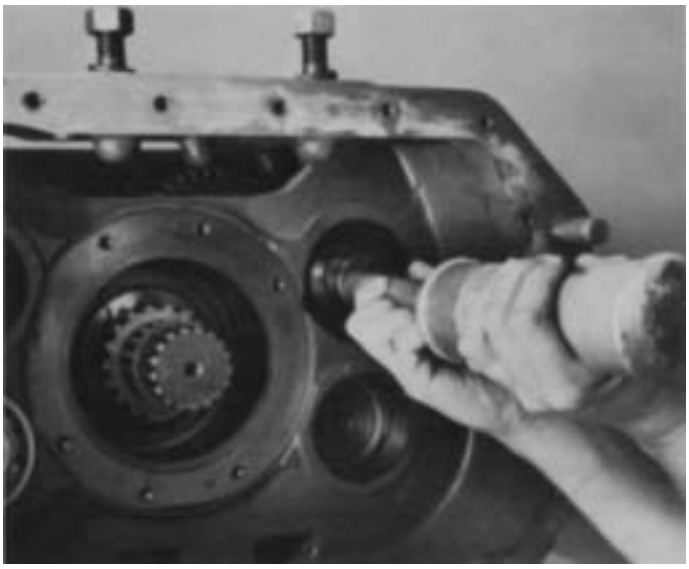
2. From inside the case, use a soft punch and maul to drive the countershaft rear bearings to the rear and from case bores.

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

DISASSEMBLY-FRONT SECTION



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

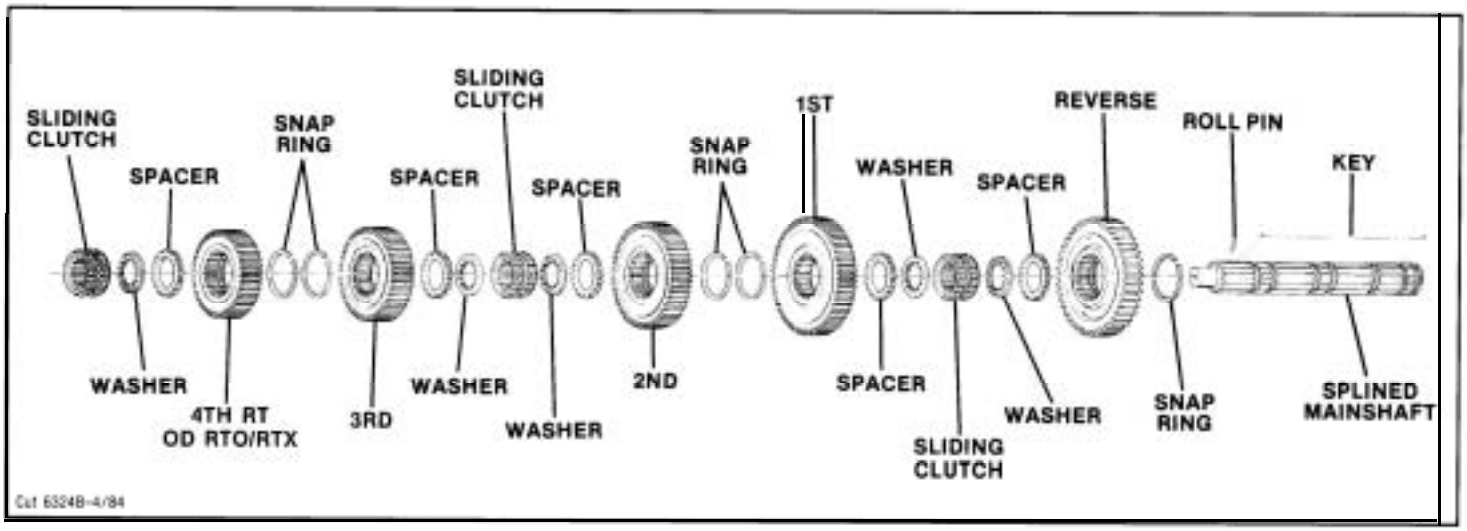


5. From the rear of case, use a soft bar and maul to drive each countershaft forward to unseat the front bearings from case bores and expose the bearing snap rings.

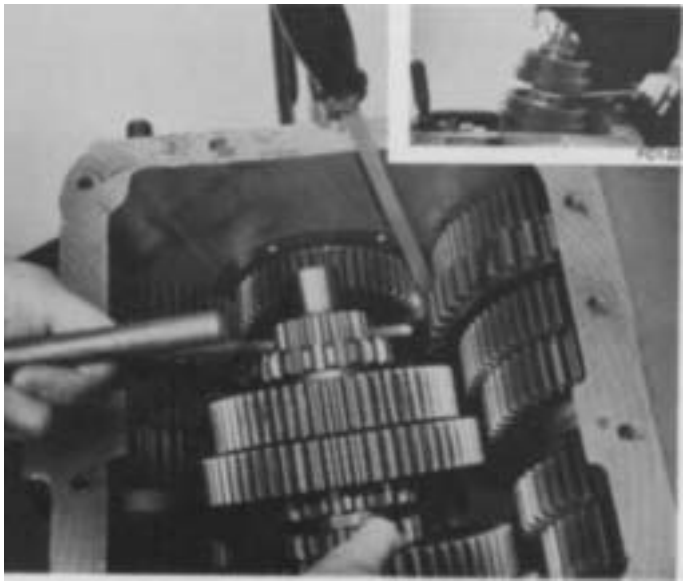
4. Use a soft bar and maul to drive each countershaft to the rear as far as possible. This will partially unseat the front bearings.
NOTE: The soft bar used should have a flattened end that is large enough so as not to damage holes for roll pin and capscrew.

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.

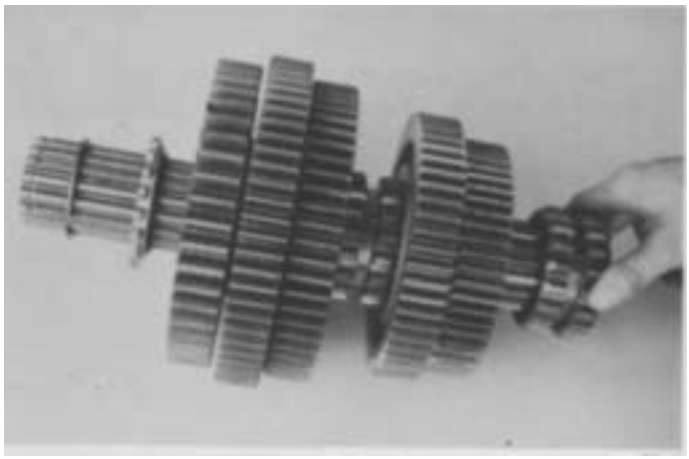
DISASSEMBLY-FRONT SECTION



E. Removal and Disassembly of Mainshaft Assembly

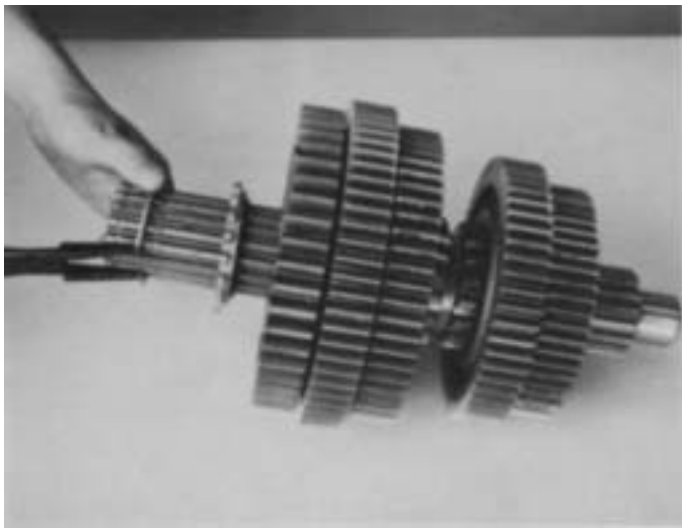


1. Block the right countershaft assembly against case wall and pull the mainshaft assembly to the rear to free pilot from pocket of input shaft. Tilt front of mainshaft up and lift the assembly from case (inset). Use caution as the reverse gear is free and can fall from shaft.

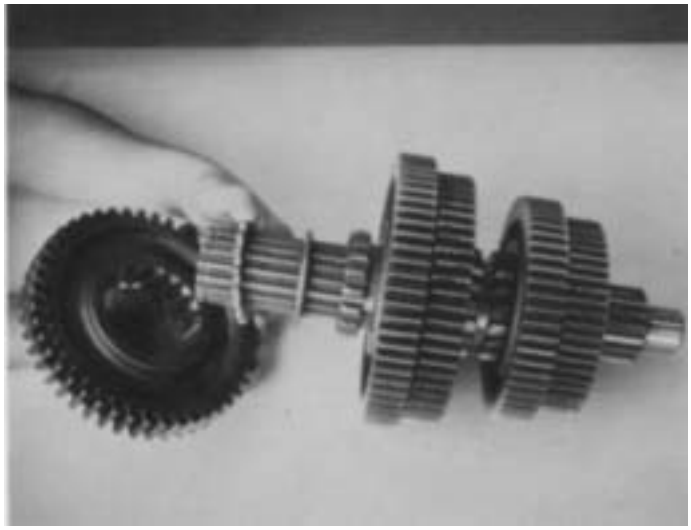


2. Remove the 4th-5th speed sliding clutch from front of mainshaft.

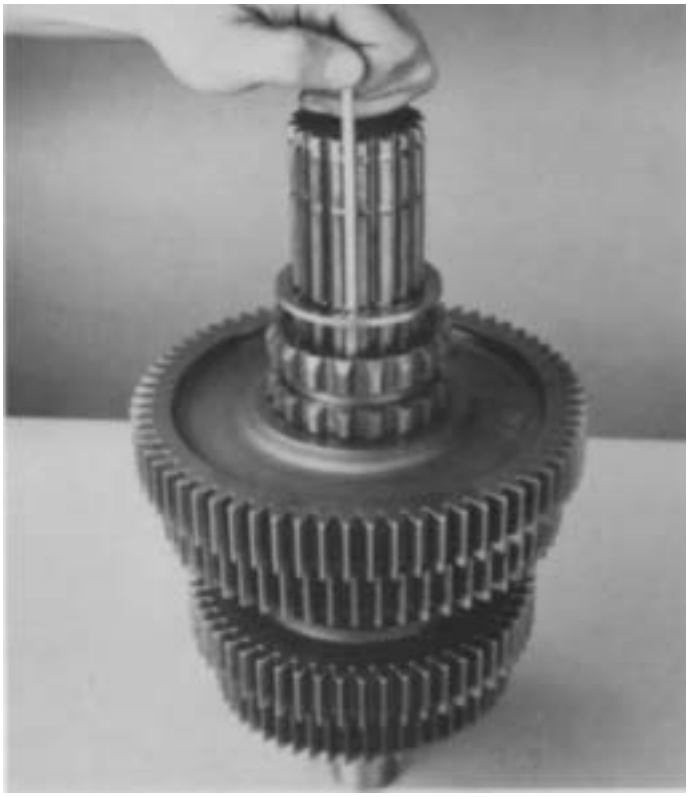
DISASSEMBLY-FRONT SECTION



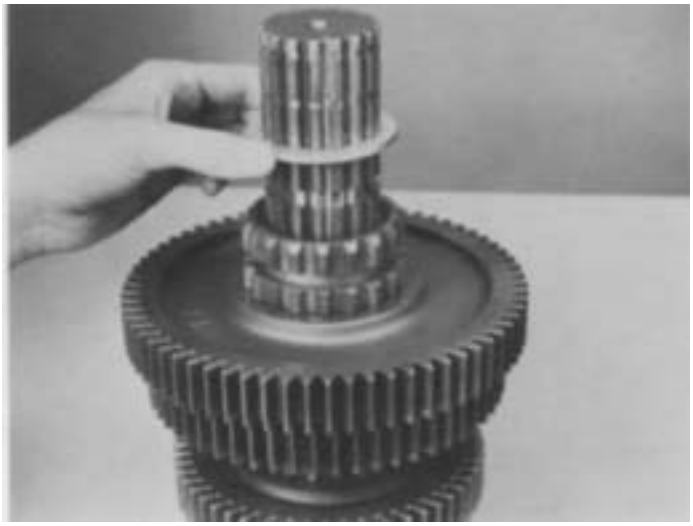
3. Remove the snap ring from groove at rear of mainshaft.



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

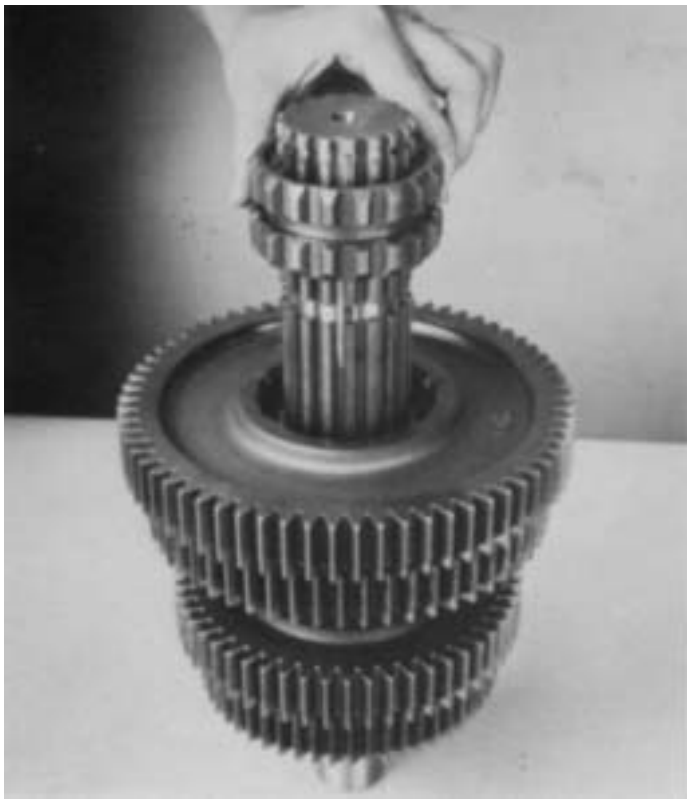


5. From rear of mainshaft, pull the key from mainshaft keyway.
NOTE: When removing limit washers, spacers and gears, note their location on mainshaft to facilitate reassembly. Keep the internal-splined washers and external-splined spacers with the gear from which they were removed. There is ONLY one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



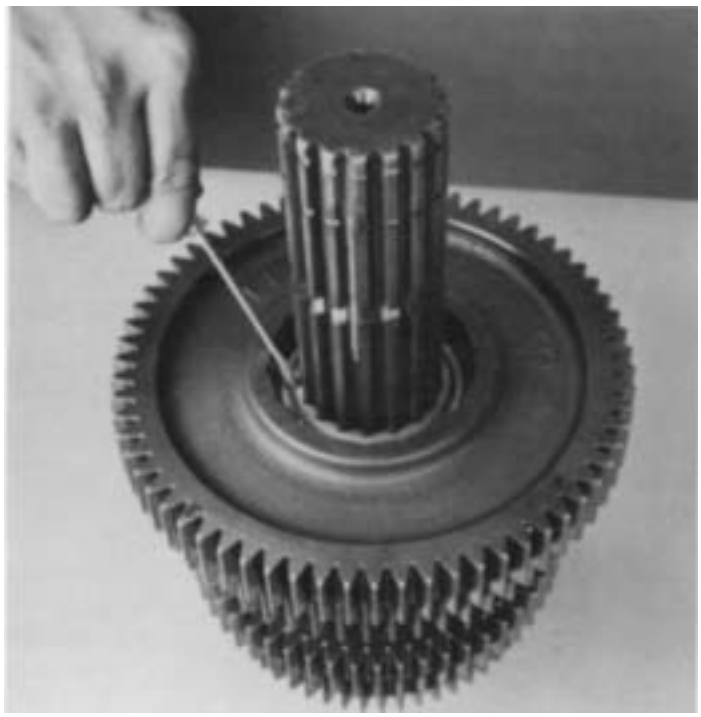
6. Turn the reverse gear limit washer to align its splines with those of mainshaft and remove washer.

DISASSEMBLY-FRONT SECTION

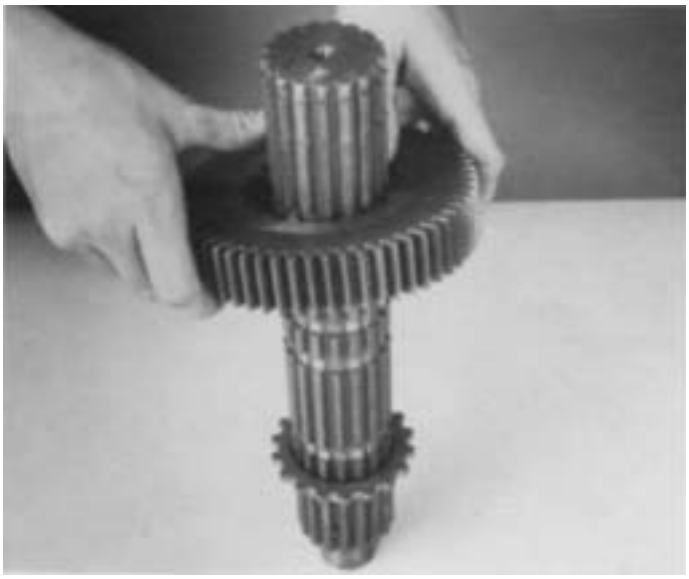


7. Remove the 1st-Reverse speed sliding clutch from mainshaft.

9. Pull the 1st 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 1st 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.

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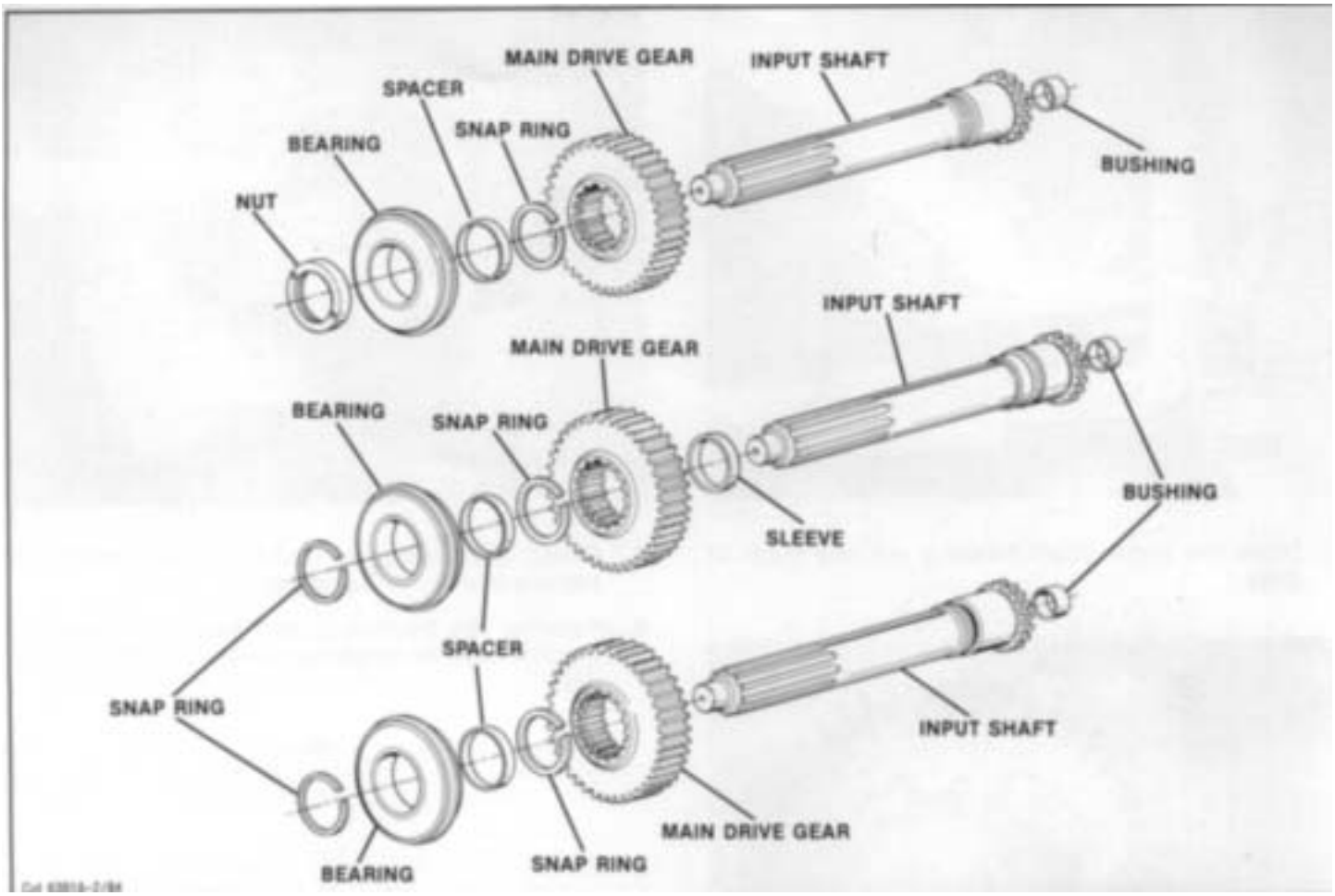
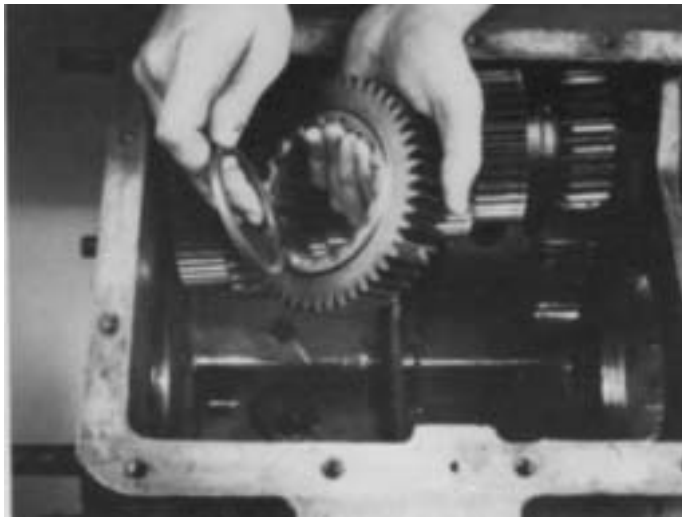
DISASSEMBLY - FRONT SECTION



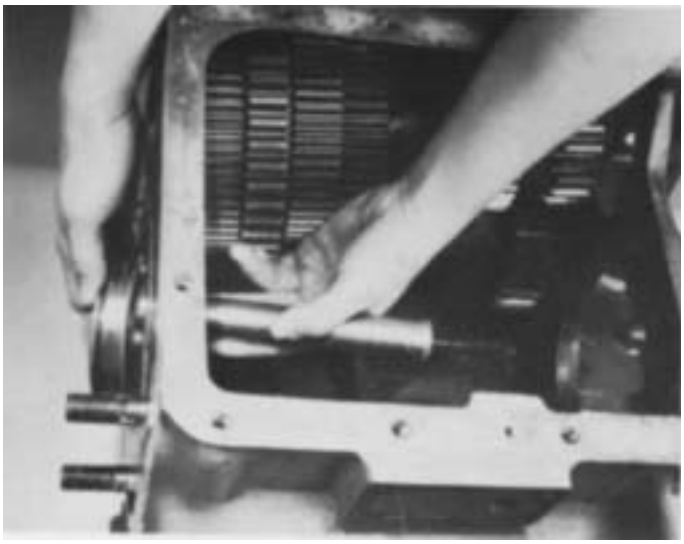
F. Removal and Disassembly of Main Drive Gear Assembly

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

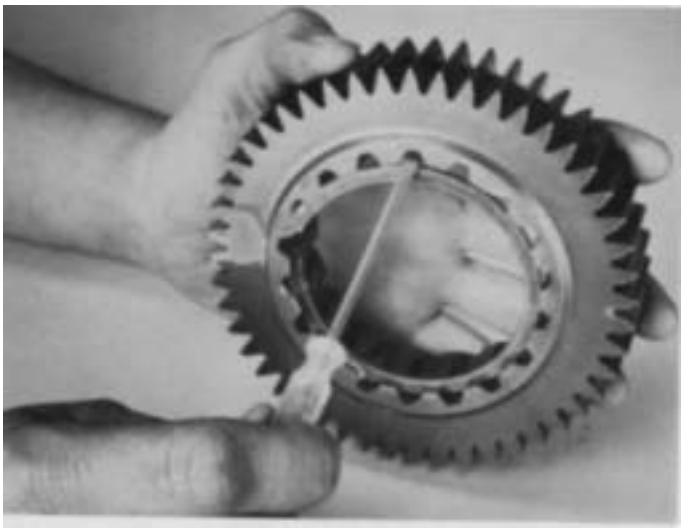


2. Move upper countershaft to right and remove drive gear and spacer from case.

DISASSEMBLY-FRONT SECTION



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



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

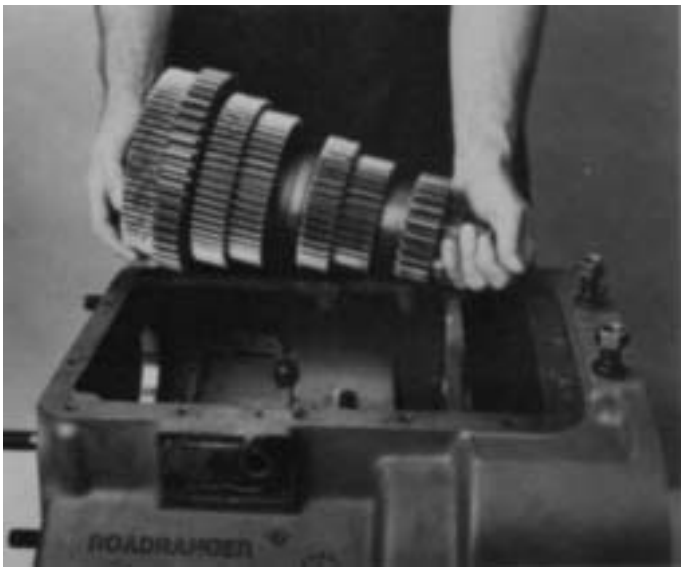
5. Check the bushing in pocket of input shaft and replace if worn or damaged.

6. Remove the front and rear bearings from left countershaft as described in Part D of this section.

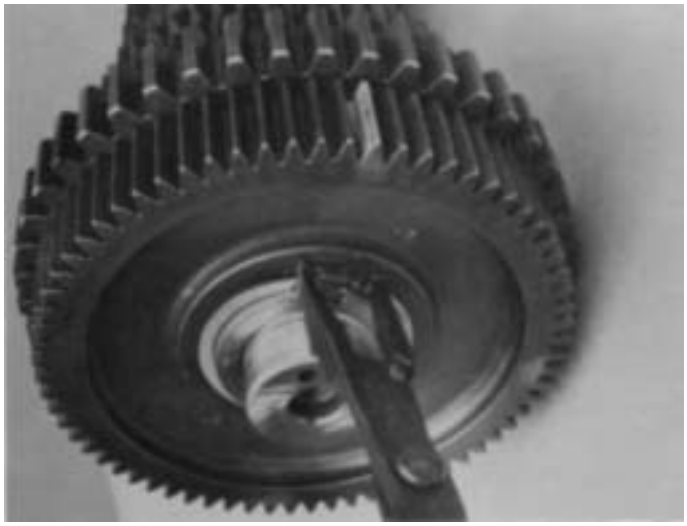
DISASSEMBLY-FRONT SECTION

G. Removal and Disassembly of Countershaft Assemblies

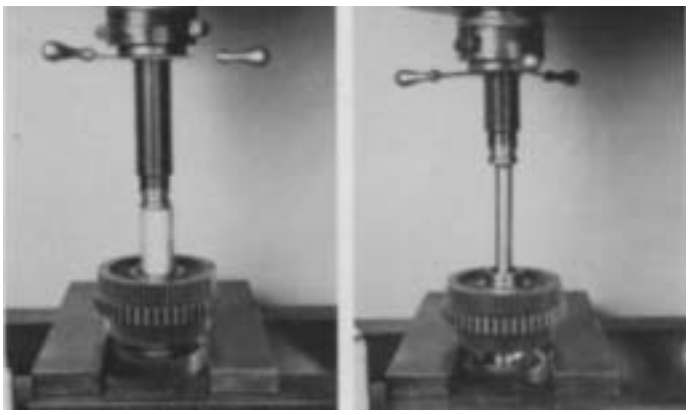
NOTE: Refer to the illustration provided at Part D of this section. Except for the PTO gears, the left and right countershaft assemblies are identical and disassembled in the same manner.



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 B of this section.



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



3. Using the rear face of 4th speed gear as a base, press the drive gear, PTO gear and 4th 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 2nd speed gear as a base, press the 3rd speed and 2nd 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

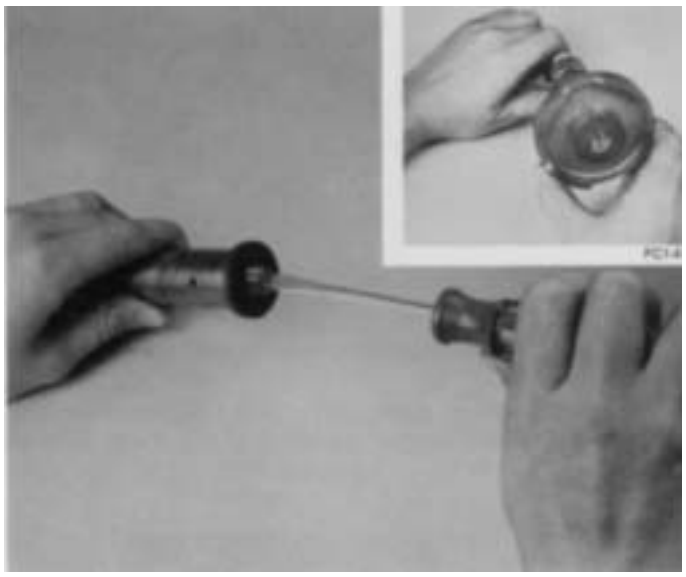
5. If necessary, remove the key and roll pin from countershaft.

REASSEMBLY-FRONT SECTION

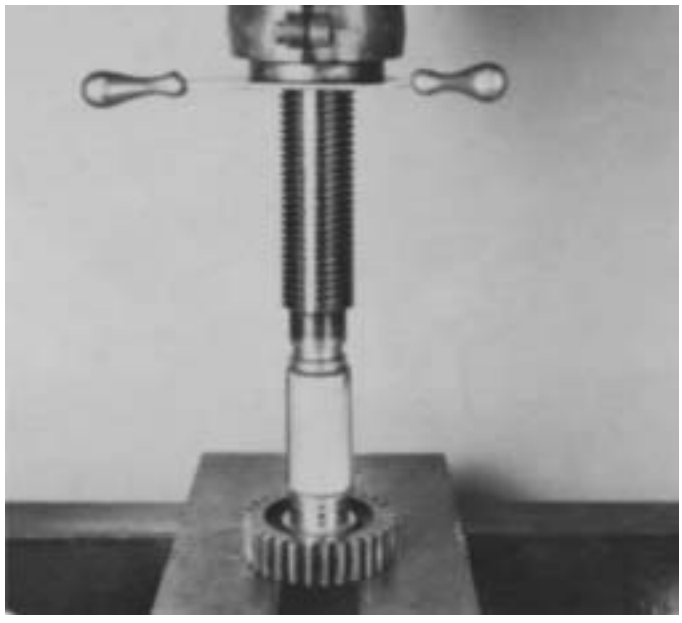
CASE ASSEMBLIES

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.

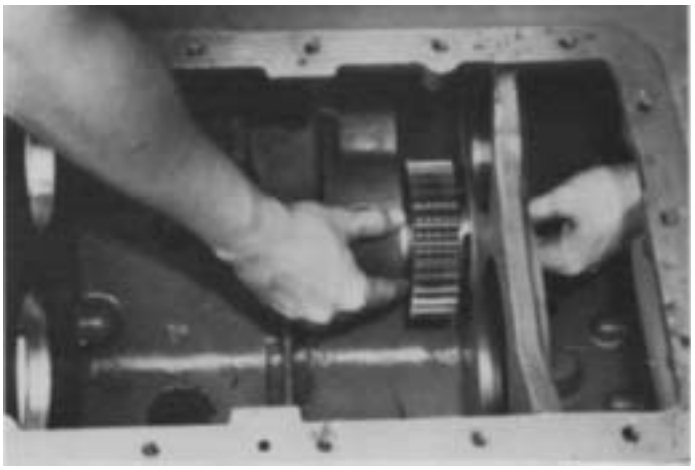
A. Reassembly and Installation of Right Reverse Idler Gear Assembly



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



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



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.

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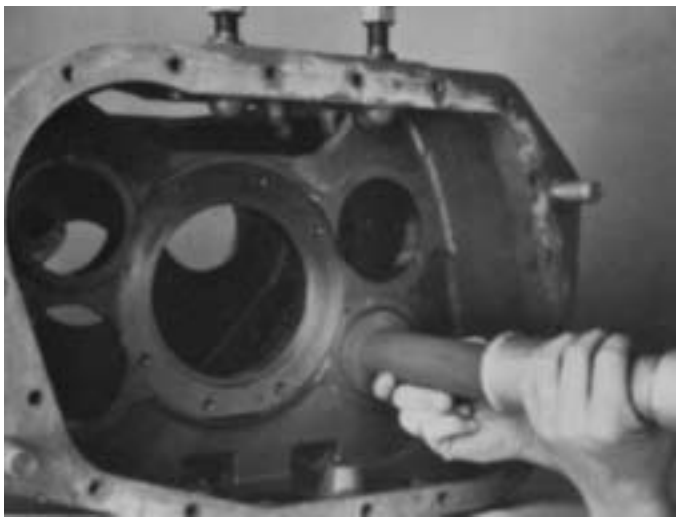
REASSEMBLY-FRONT SECTION



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

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.

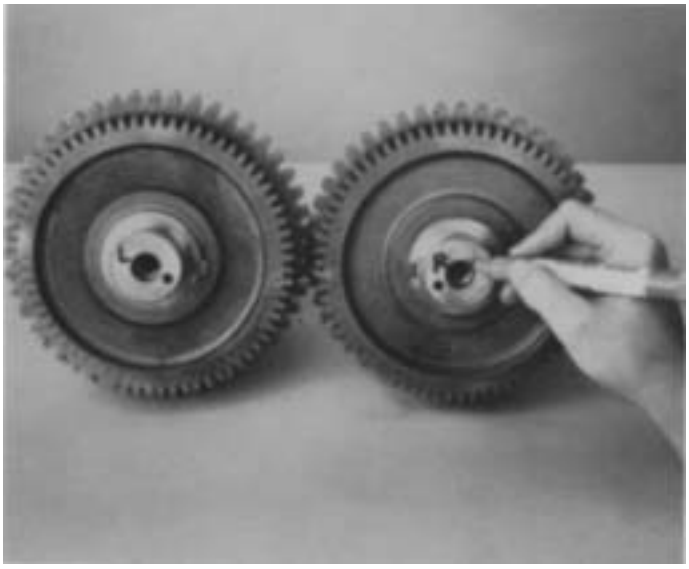
2. Align keyway of gear with key in countershaft and press the 2nd speed gear on shaft, long hub of gear to the front of countershaft.

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

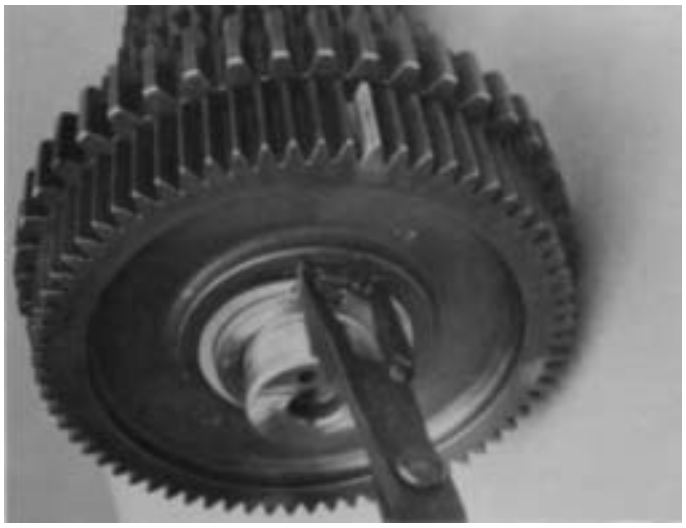
REASSEMBLY-FRONT SECTION

4. Press the 4th 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.



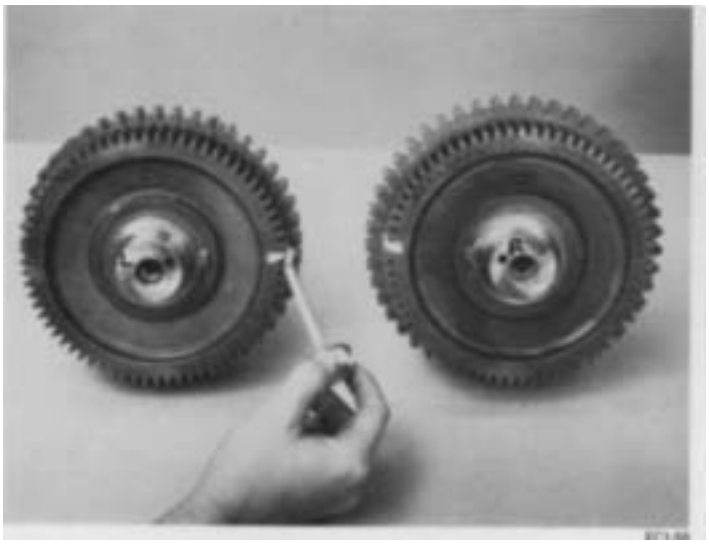
6. To avoid confusion during installation, mark the end of left countershaft with an "L"; the end of right countershaft with an "R".



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

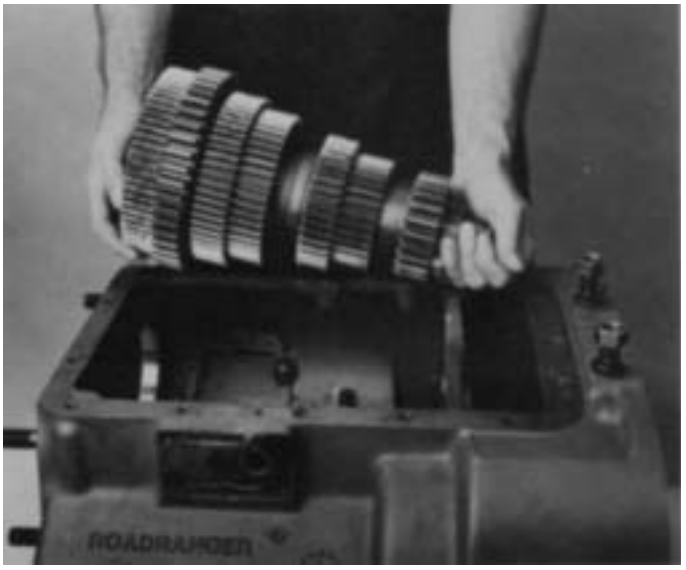
REASSEMBLY-FRONT SECTION

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.

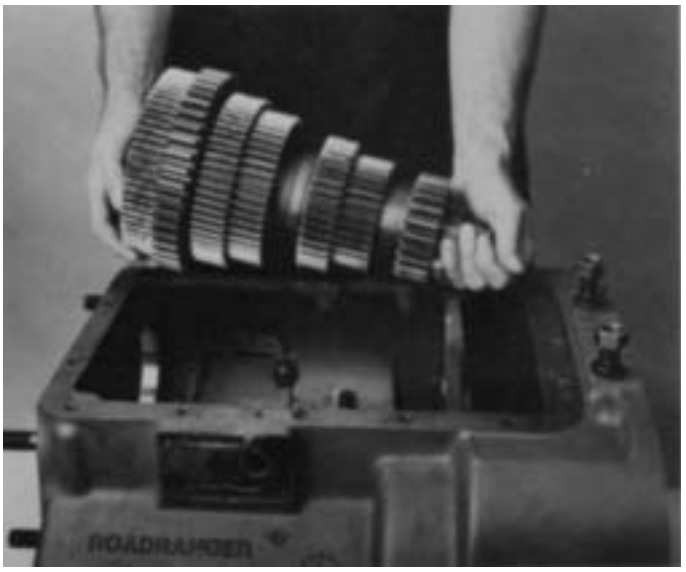


IMPORTANT: Mark the countershaft drive gear for timing purposes. On the drive gear of each countershaft assembly, mark the tooth aligned with keyway of gear and stamped with an "O" for easy identification. A highly visible color of toolmakers' dye is recommended for making timing marks.

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.

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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.

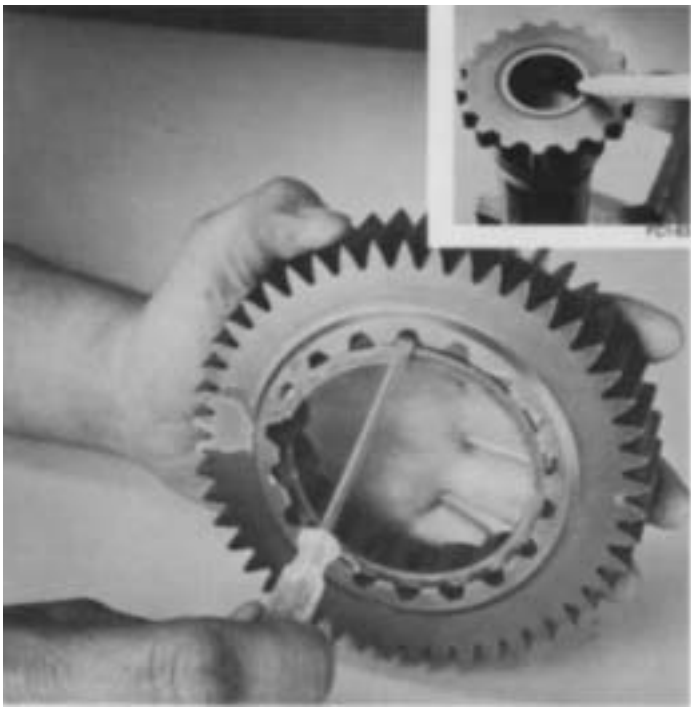
REASSEMBLY-FRONT SECTION

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.

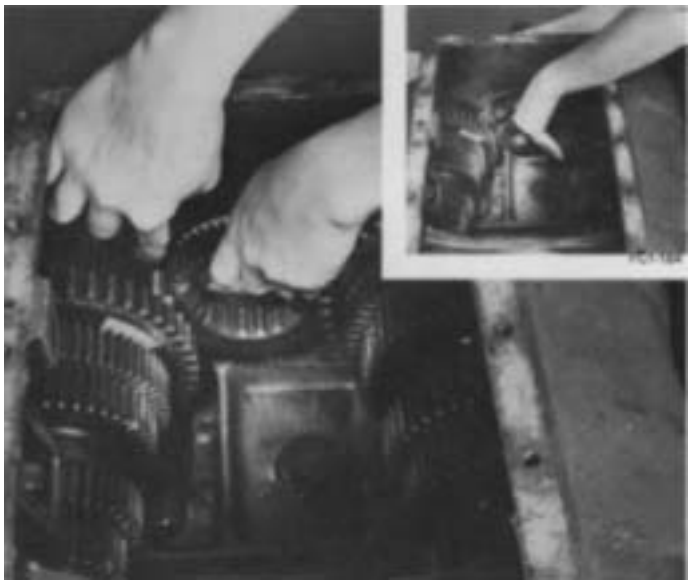
REASSEMBLY-FRONT SECTION

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

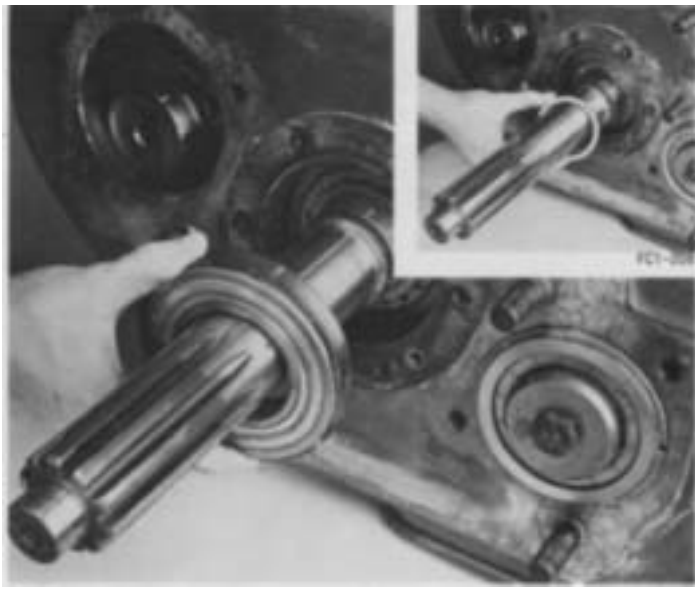


1. If previously removed, install the snap ring in I.D. of main drive gear and the bushing in pocket of input shaft (inset).

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 making timing marks.



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.

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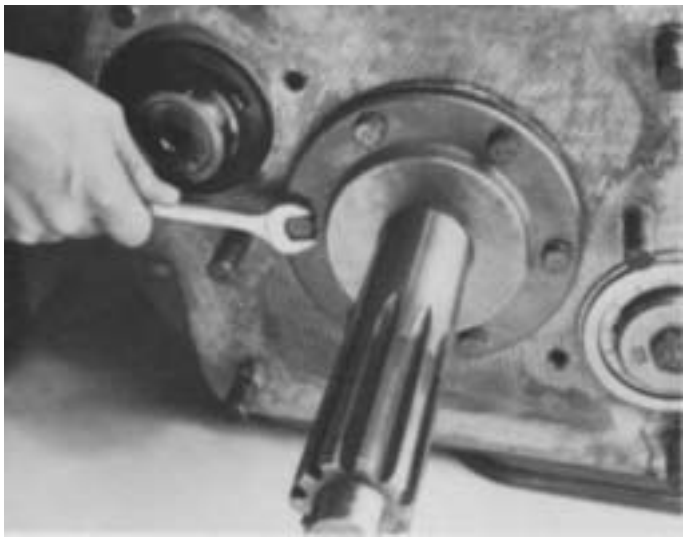
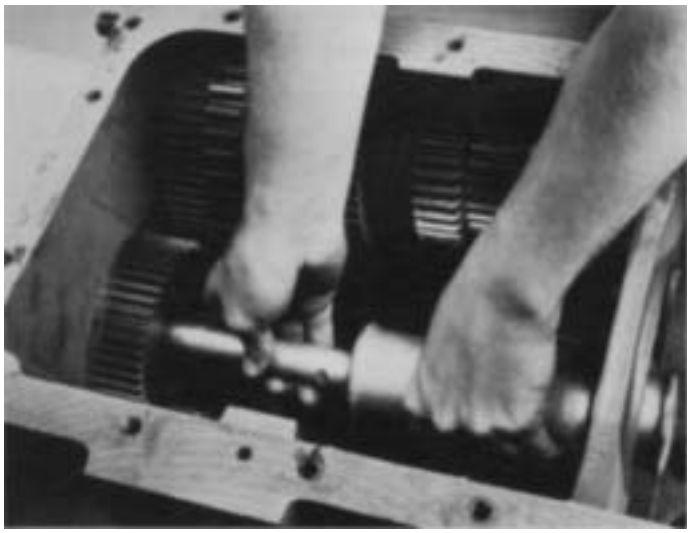
REASSEMBLY-FRONT SECTION

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



6. Temporarily install the front bearing cover.



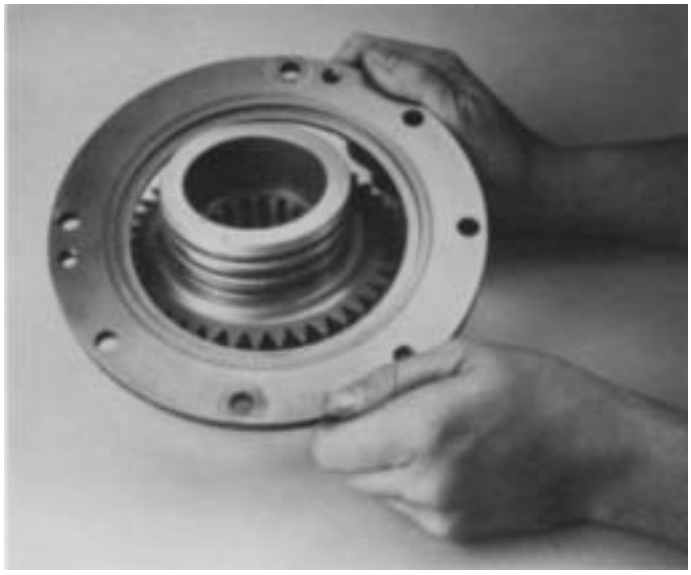
7. Use a soft bar and maul to drive the input shaft through bearing. Remove front bearing cover.

F. Reassembly of Auxiliary Drive Gear Assembly

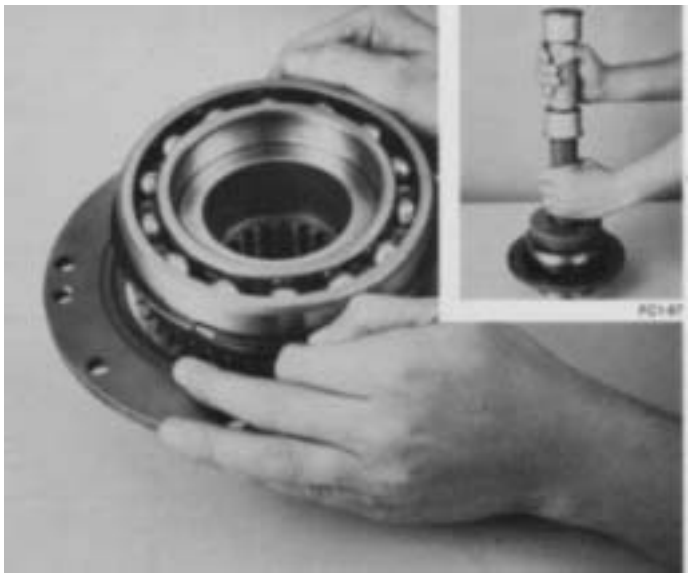
NOTE: Because the auxiliary drive gear assembly is used in checking reverse gear axial clearances and centering mainshaft in rear bearing bore during Reassembly and Partial Installation of Mainshaft Assembly, it is necessary to complete the following instructions BEFORE proceeding to Part G.

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.



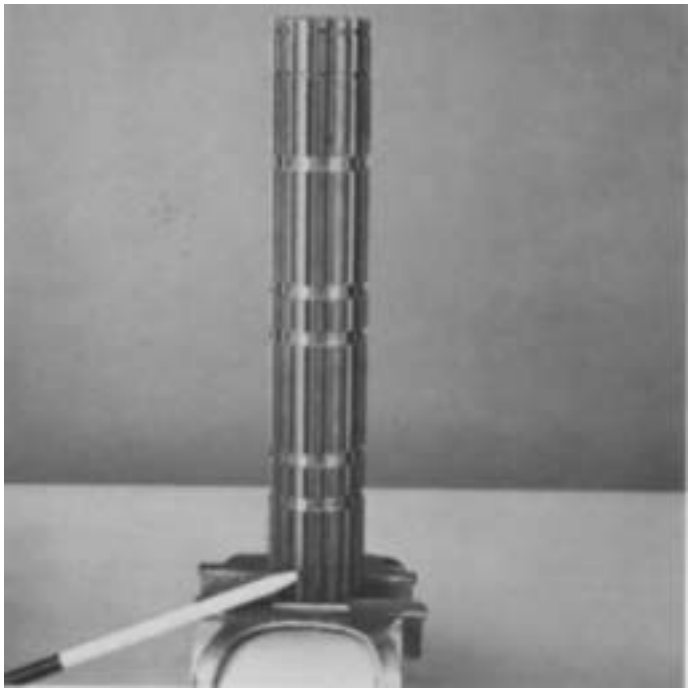
3. Start the auxiliary drive gear bearing on front hub, bearing snap ring facing groove in retainer ring. Using both the inner and outer race of bearing as a base, press the bearing on gear with snap ring in groove of retainer ring or use a bearing driver (inset).

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

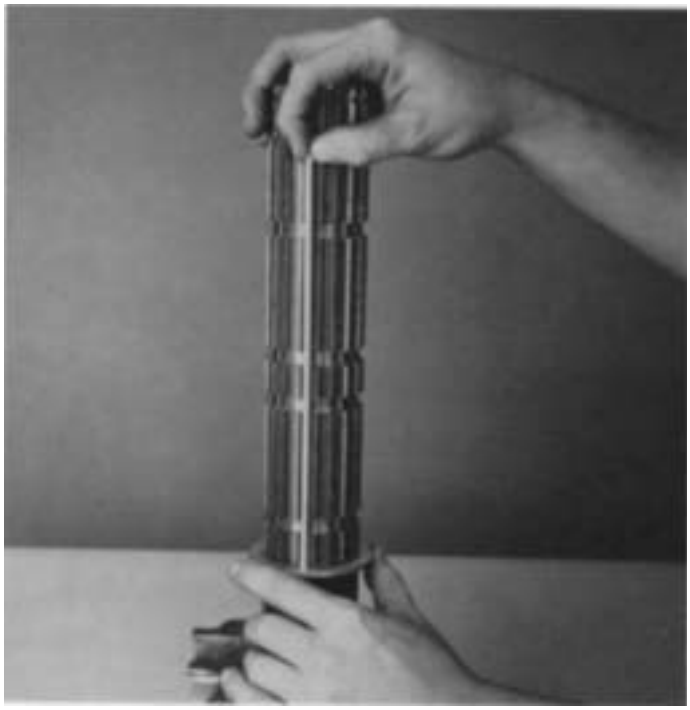
G. Reassembly and Partial Installation of Mainshaft Assembly

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

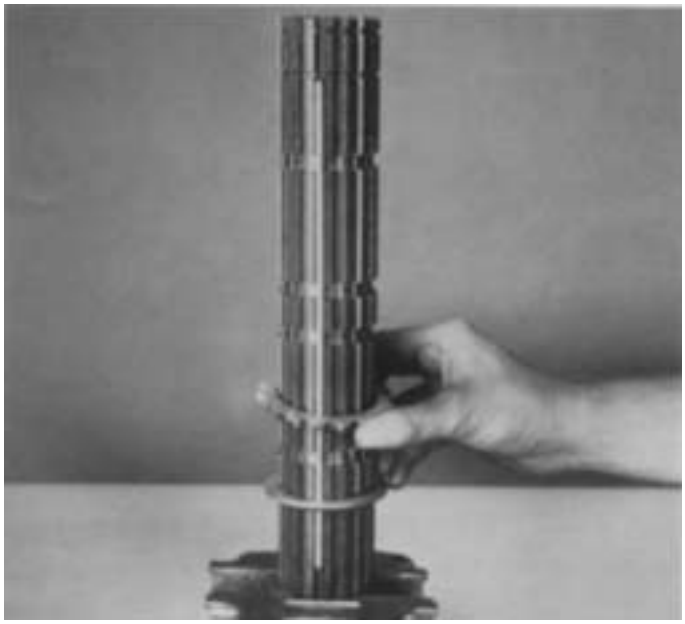
REASSEMBLY-FRONT SECTION



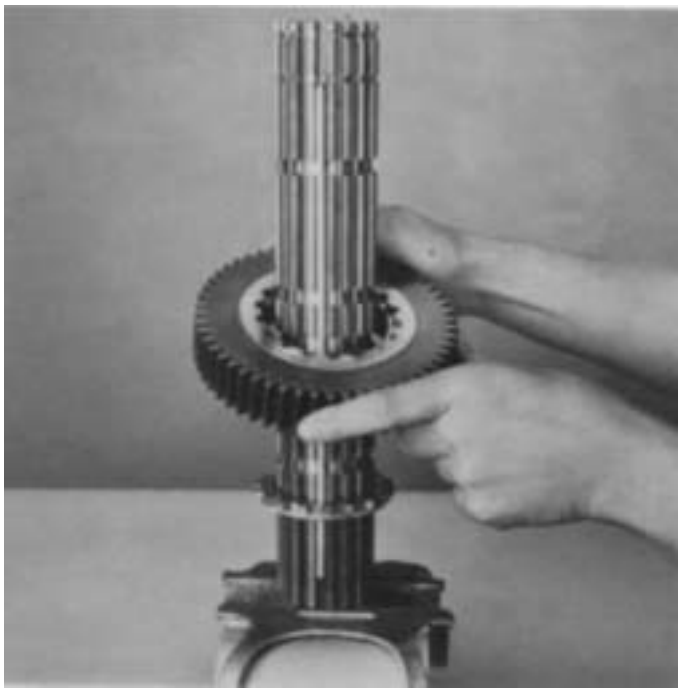
2. Secure the mainshaft in a vise equipped with brass jaws or wood blocks, pilot-end of shaft down. If previously removed, install the roll pin in keyway.



3. Install the 4th 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.



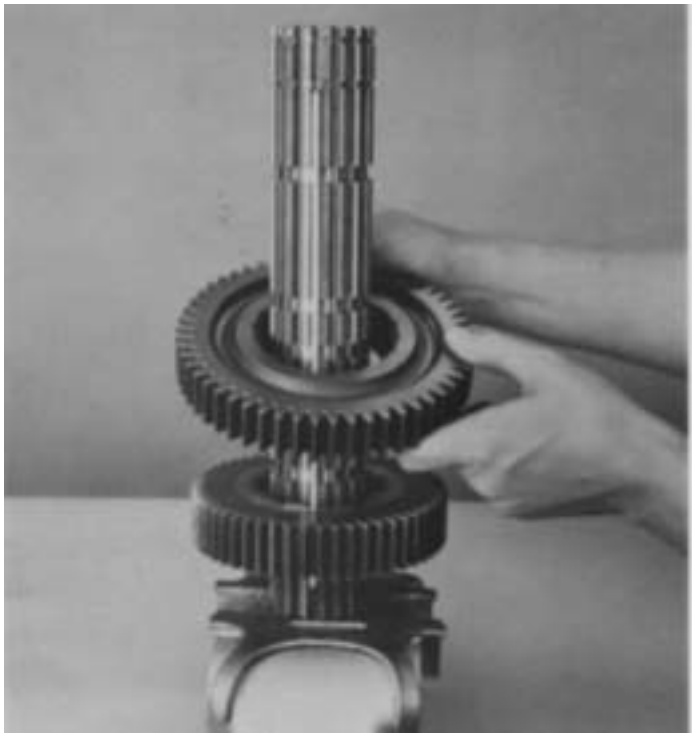
4. Install the spacer on shaft against washer.



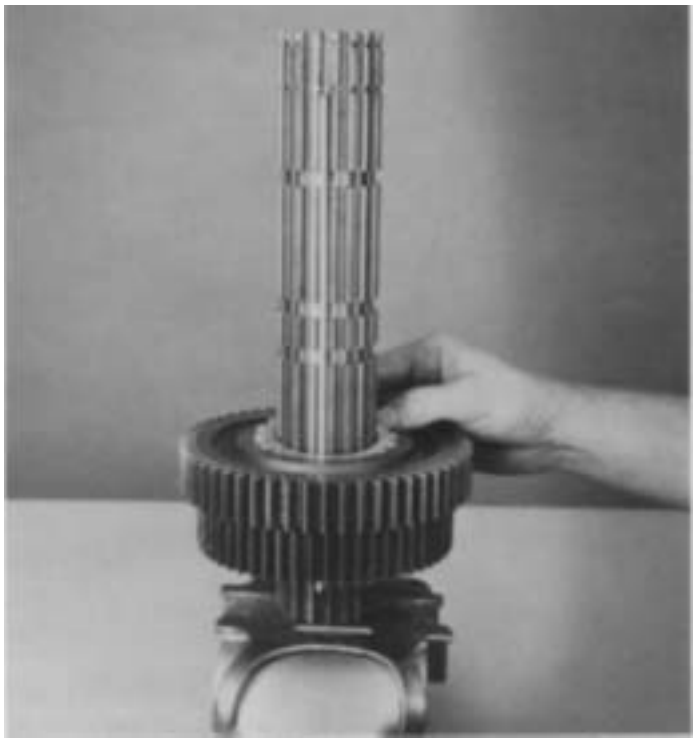
5. Install the 4th speed (or Overdrive) gear on mainshaft, clutching teeth down and engaged with external splines of spacer.

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.

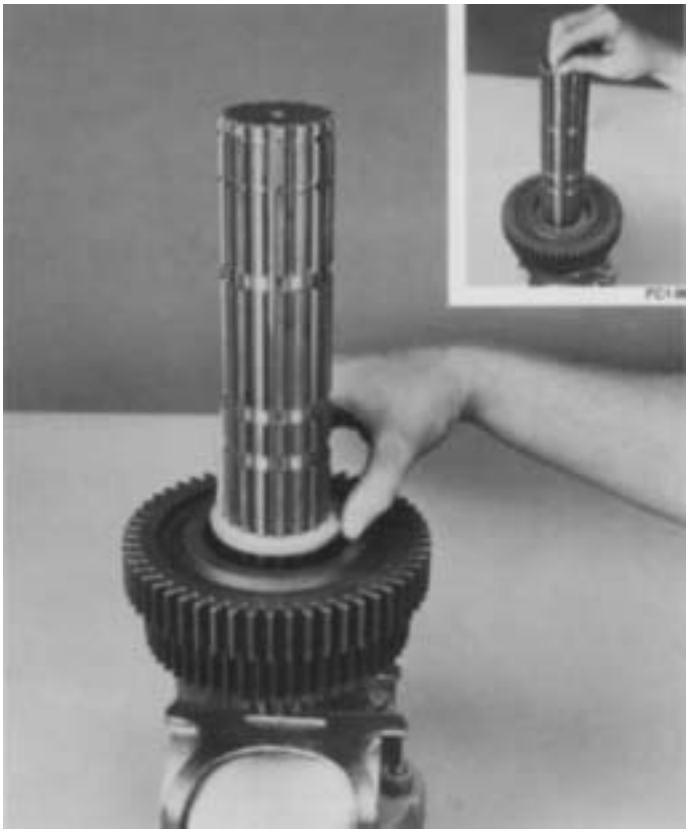
REASSEMBLY-FRONT SECTION



6. Install the 3rd speed gear on shaft against 4th speed (or Overdrive) gear, clutching teeth up.

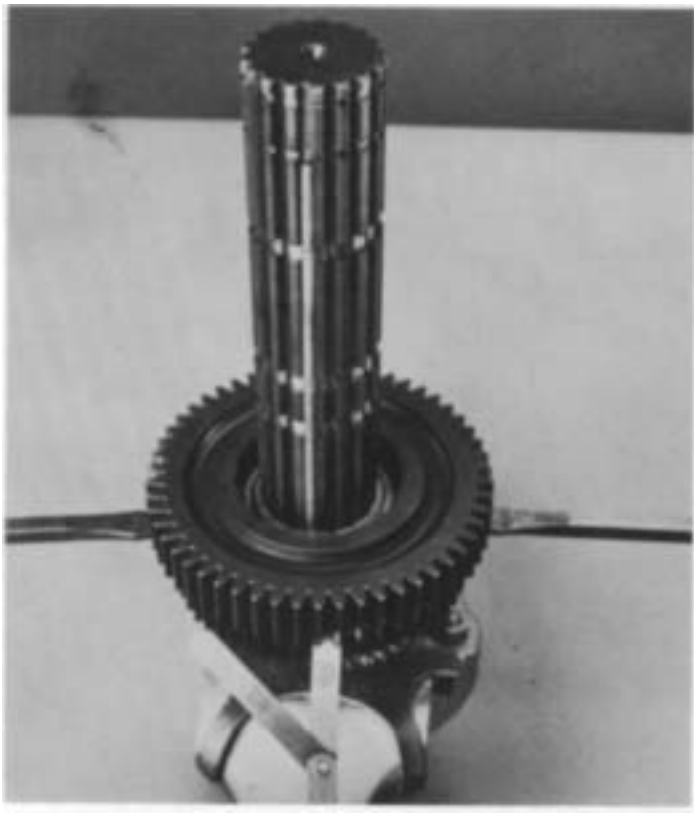


7. Install the spacer in 3rd speed gear, engaging the external splines of spacer with clutching teeth of gear.

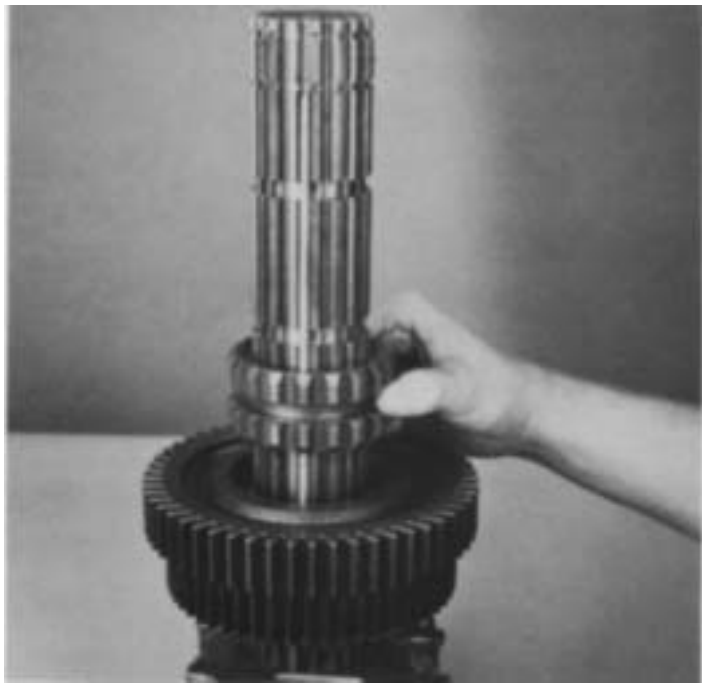


8. Remove the key from keyway and install the 3rd speed gear limit washer on mainshaft, flat side of washer down and against spacer. Rotate washer in the 2nd groove of mainshaft to align the splines of washer with those of the mainshaft and reinsert key in keyway to lock washer in place (inset).

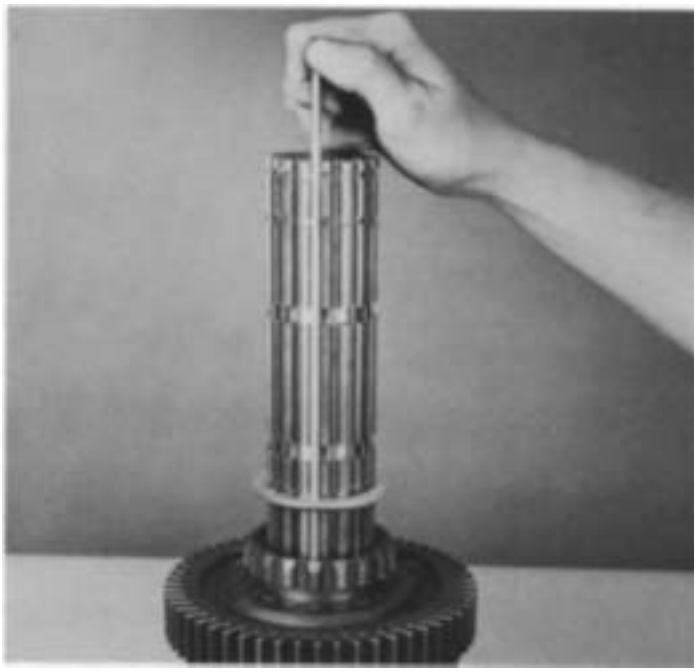
REASSEMBLY-FRONT SECTION



9. Insert two large screwdrivers between the 3rd and 4th 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 3rd 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 3rd speed gear. This would decrease the axial clearance between the gears.



10. Install the 2nd-3rd speed sliding clutch, aligning the missing internal spline of sliding clutch with key in mainshaft.



11. Remove the key from keyway and install the 2nd speed gear limit washer on mainshaft, flat side of washer up. Rotate washer in the 3rd 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:

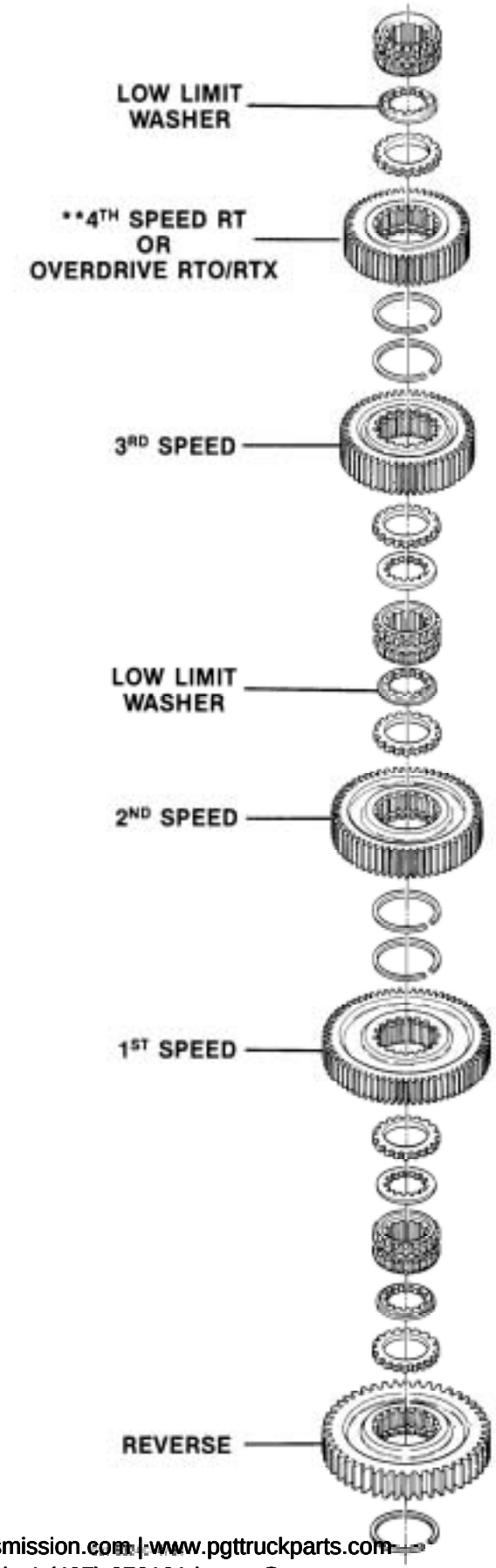
LIMITS (INCH)	COLOR CODE
,248-.250	WHITE
.253 -.255	GREEN
.258-.260	ORANGE
.263-.265	PURPLE
.268-.270	YELLOW
.273-.275	BLACK
*	"PLUS RED"

***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 .).

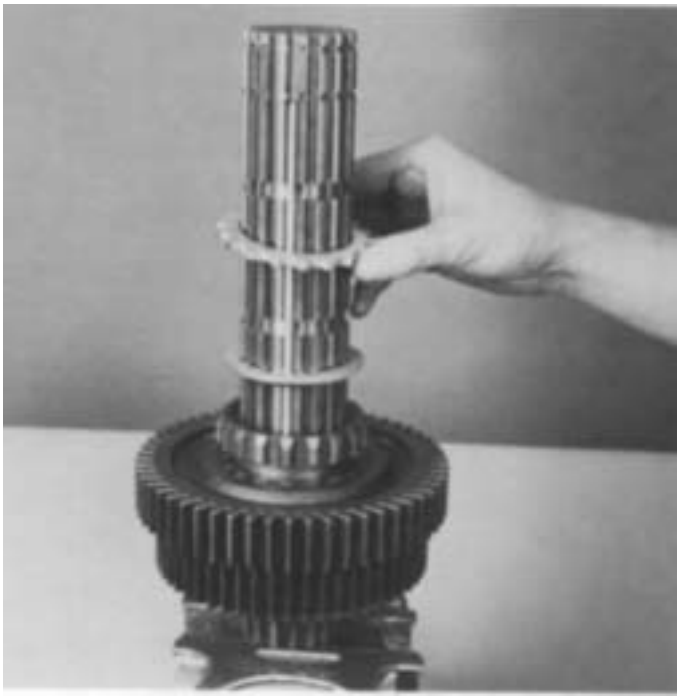
Refer to Illustrated Parts Lists for washer part numhers.

Always use the .248-.250" low limit washer ("White" or "white plus red") in the 2nd and 4th speed gear positions as shown at right.

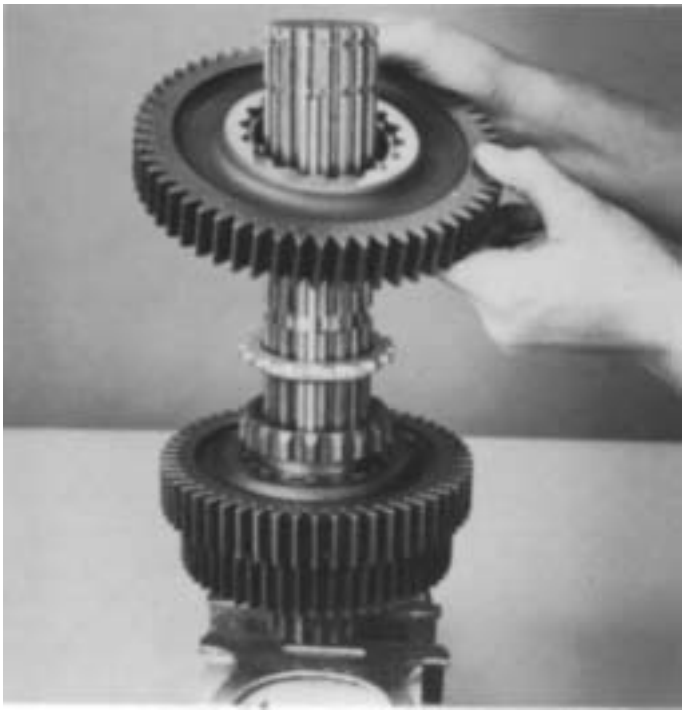
**On Overdrive models, the 4th speed gear becomes 5th speed.



REASSEMBLY-FRONT SECTION

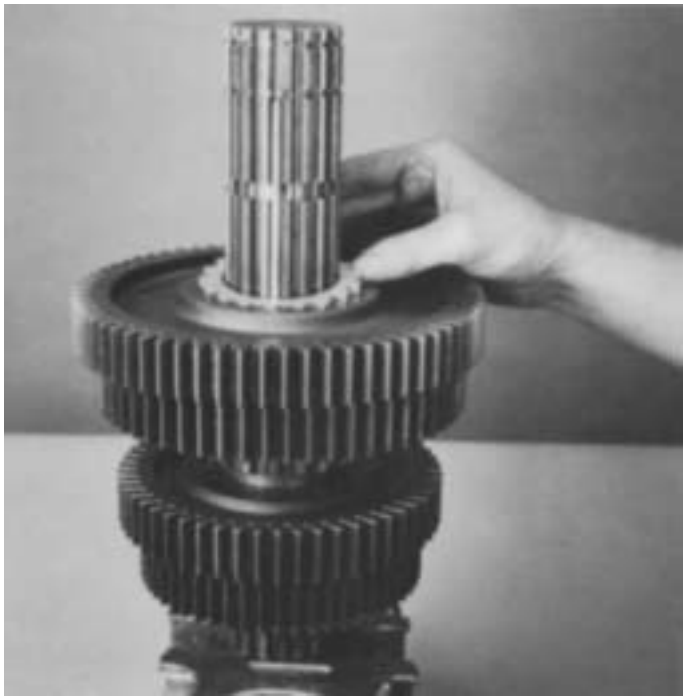


12. Install the spacer on shaft against washer.



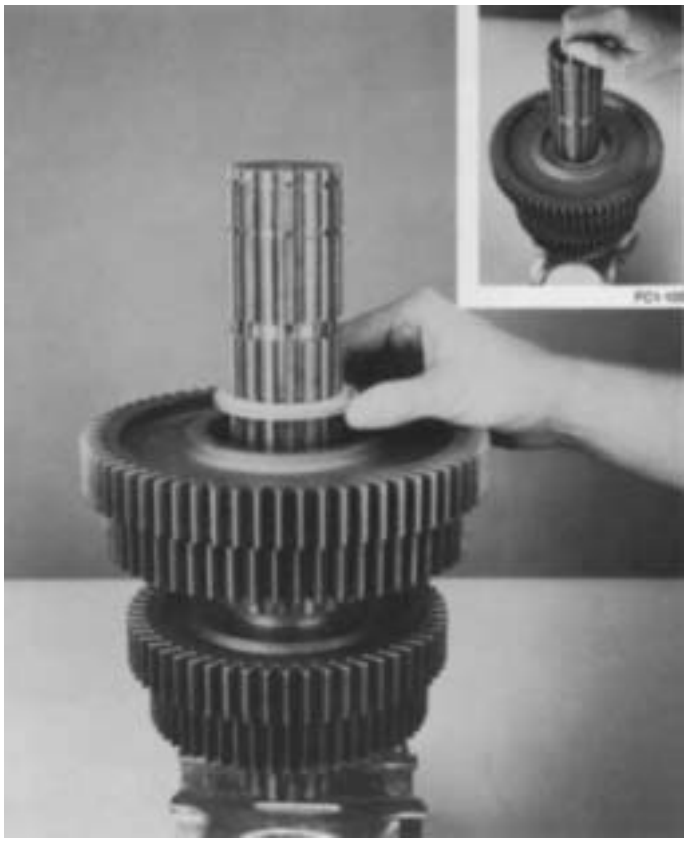
13. Install the 2nd speed gear on mainshaft, clutching teeth down and engaged with external splines of spacer.

14. Install the 1st speed gear on shaft against 2nd speed gear, clutching teeth up.

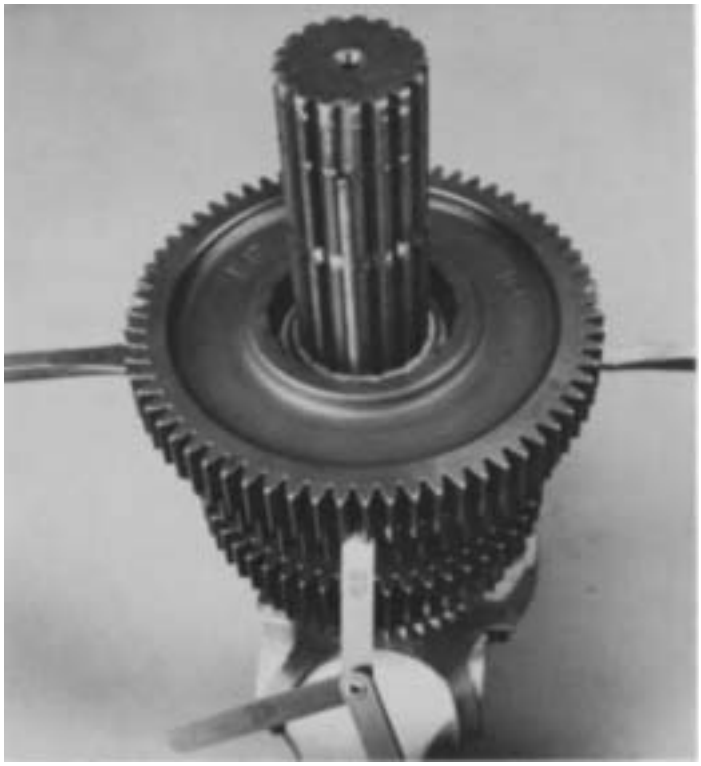


15. Install the spacer in 1st speed gear, engaging the external splines of spacer with clutching teeth of gear.

REASSEMBLY-FRONT SECTION

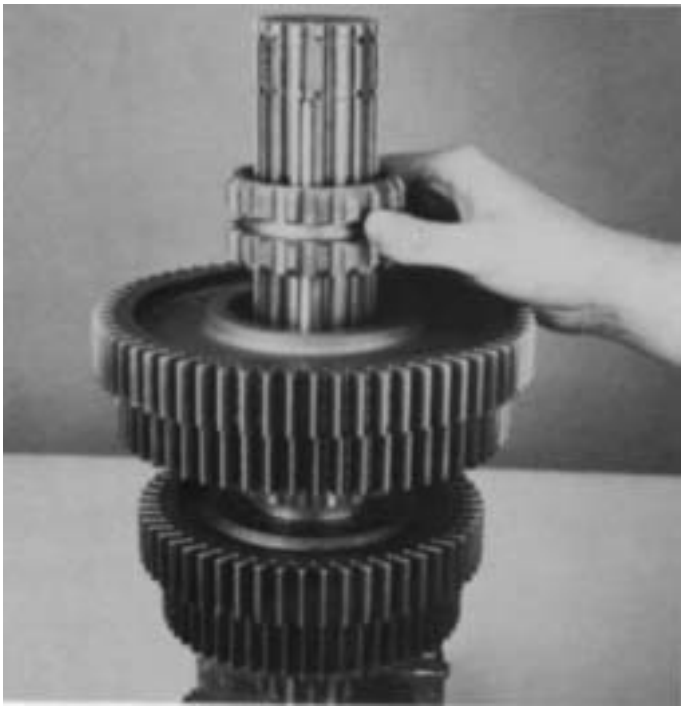


16. Remove the key from keyway and install the 1st speed gear limit washer on mainshaft, flat side of washer down and against spacer. Rotate washer in the 4th groove of mainshaft to align the splines of washer with those of the mainshaft and reinsert key in keyway to lock washer in place (inset).

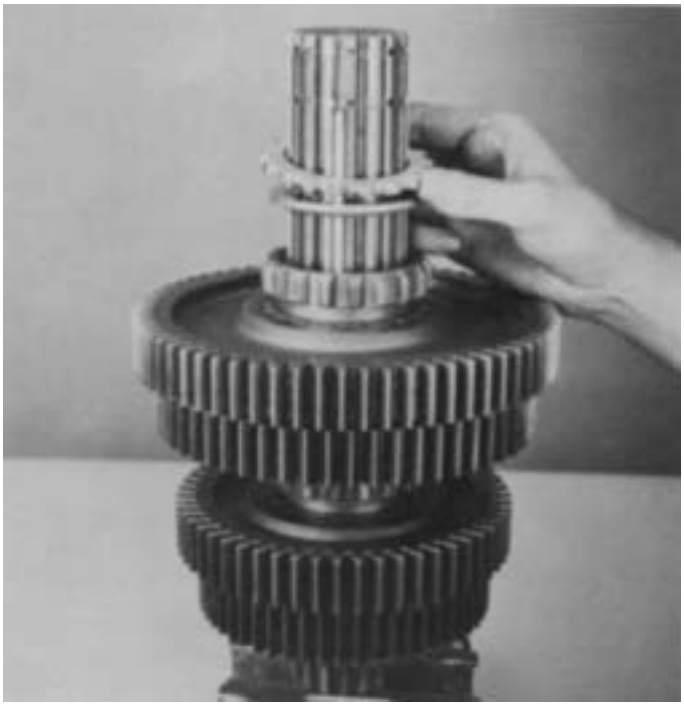


17. Check axial clearances and make adjustments, if necessary, between the 1st and 2nd speed gears as described in No. 9 of this section.

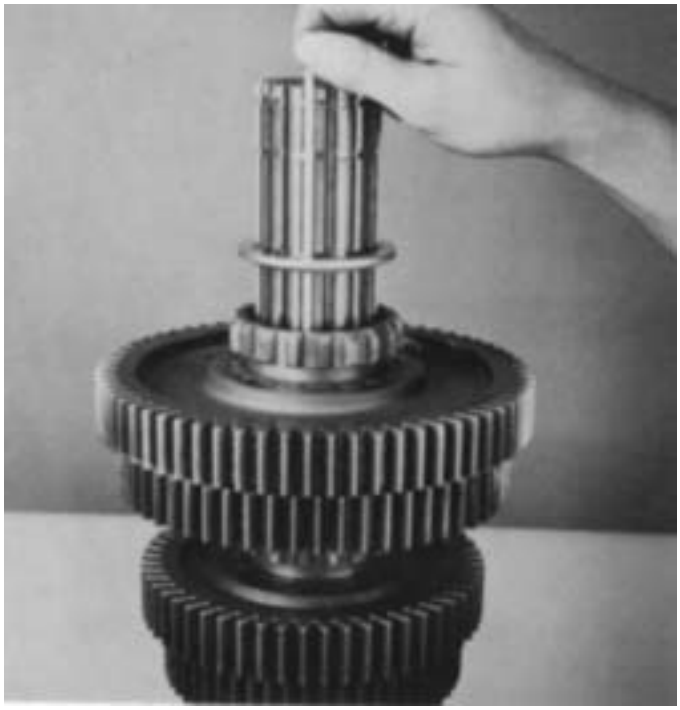
REASSEMBLY-FRONT SECTION



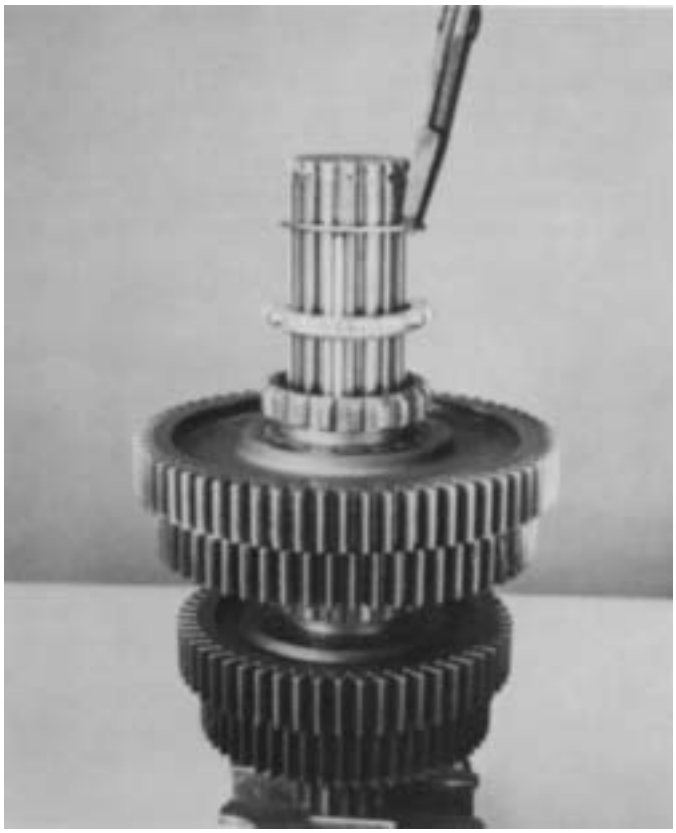
18. Install the 1st-Reverse speed sliding clutch, aligning the missing internal spline of sliding clutch with key in mainshaft.



20. Install the spacer on shaft against washer.

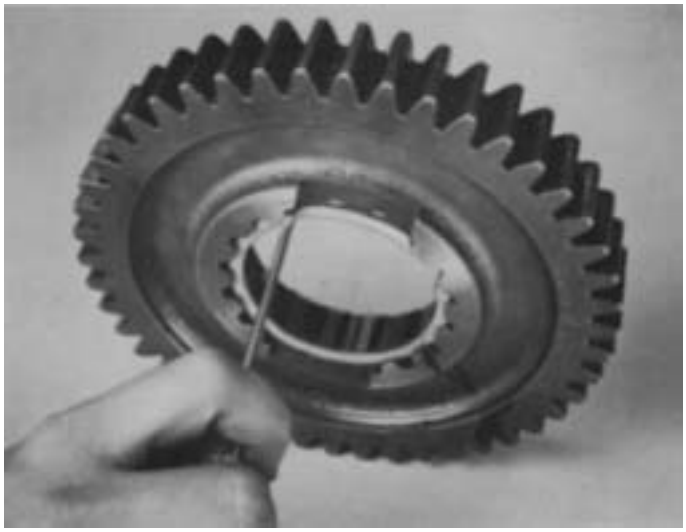


19. Remove the key from keyway and install the reverse gear limit washer on mainshaft, flat side of washer up. Rotate washer in the 5th groove of mainshaft to align the splines of washer with those of the mainshaft and reinsert key in keyway to lock washer in place.



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.

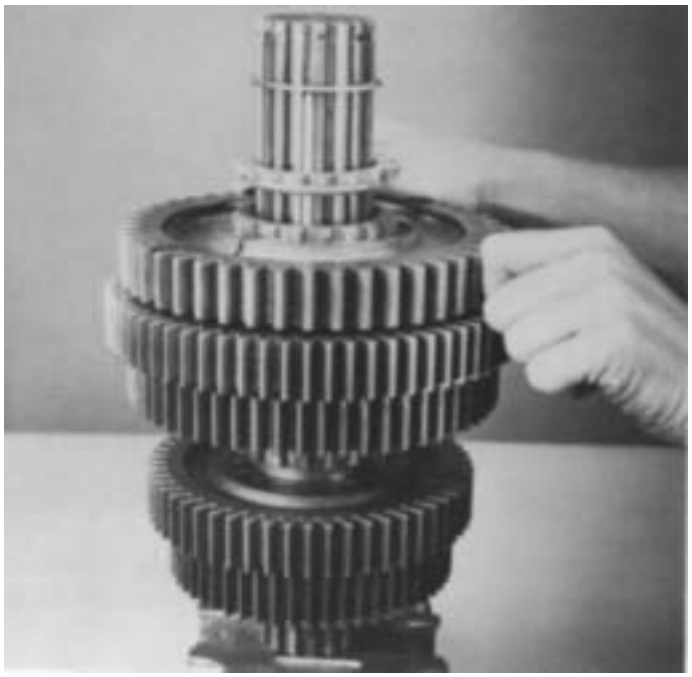
24. Install the auxiliary drive gear assembly in its proper position on rear of mainshaft.

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.

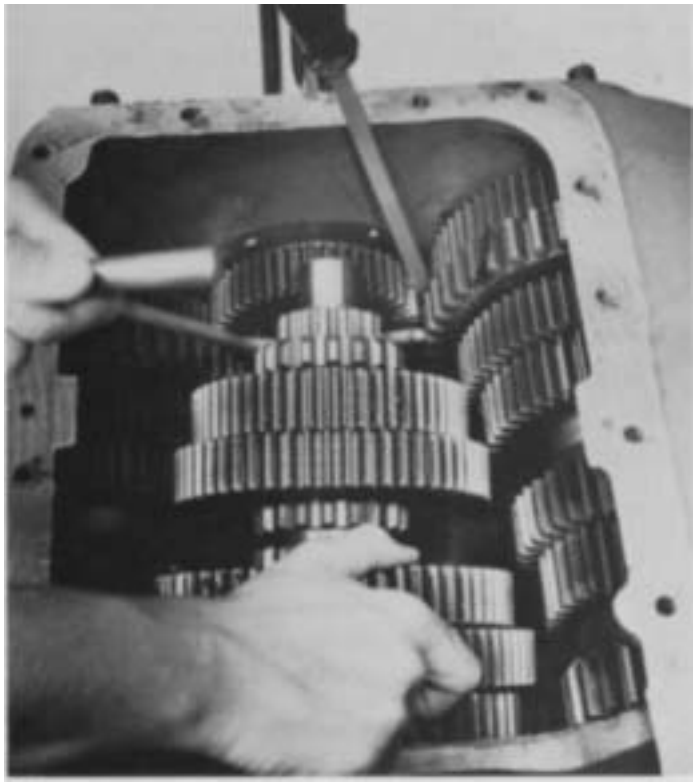
26. With the proper reverse gear limit washer installed on mainshaft, remove the auxiliary drive gear assembly and reverse gear.



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 1st speed gear.

REASSEMBLY-FRONT SECTION

28. Remove the mainshaft assembly from vise. Align the missing internal spline of 4th-5th speed sliding clutch with key in mainshaft and install on front of shaft, engaging the external splines of sliding clutch with clutching teeth of 4th speed (or Overdrive) gear.

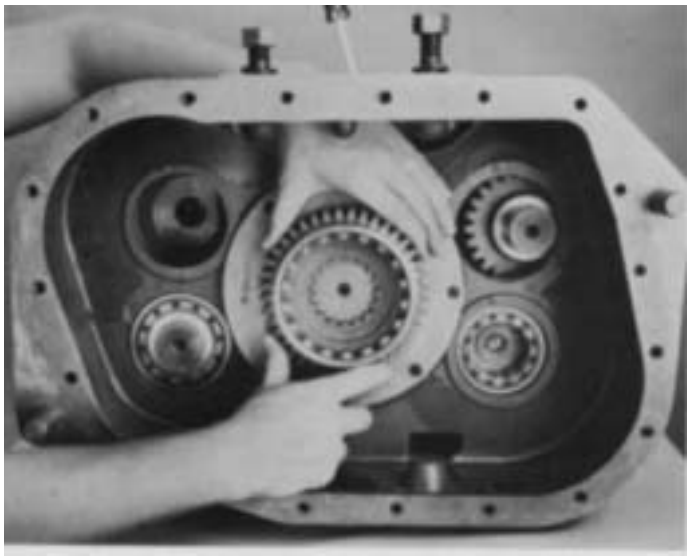


29. Block the right countershaft assembly against case wall and lower the mainshaft assembly into position with the reverse gear held against 1st speed gear and rear of shaft moved into case bore.

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

REASSEMBLY-FRONT SECTION

31. With the reverse gear remaining against 1st 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.



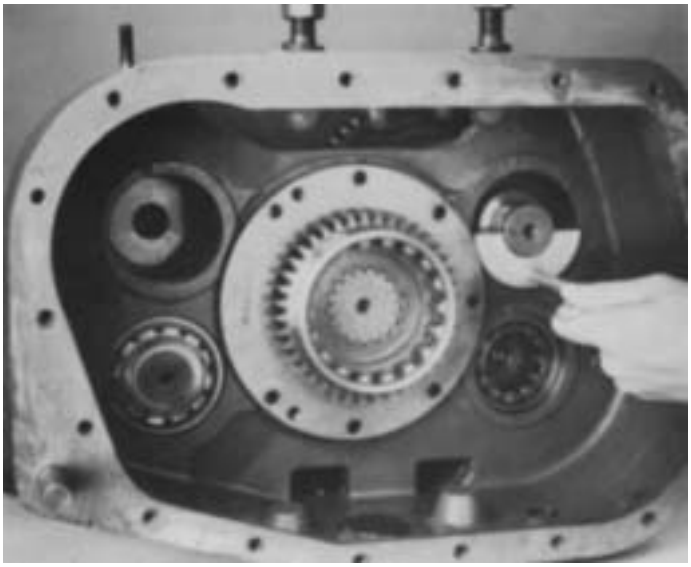
32. Center rear of mainshaft in case bore and install the auxiliary drive gear assembly on shaft, partially seating the bearing in bore. DO NOT COMPLETE INSTALLATION AT THIS TIME.

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.

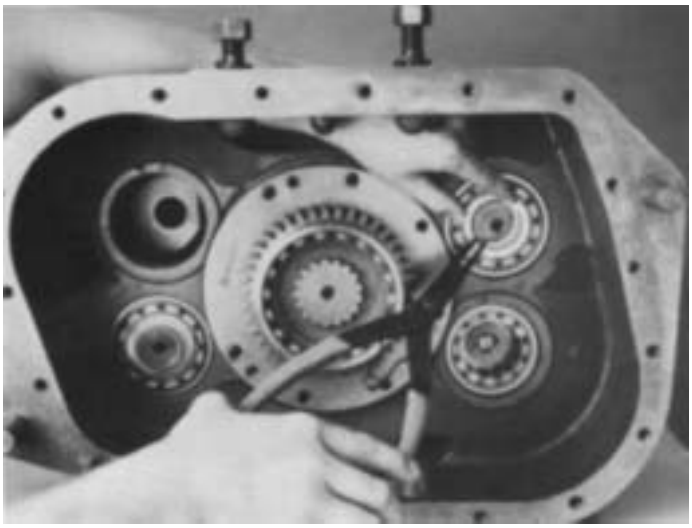
1. Remove blocking from right countershaft assembly and place it parallel to mainshaft assembly. Mesh the marked tooth of right countershaft drive gear with remaining set of two marked teeth on main drive gear.

REASSEMBLY-FRONT SECTION

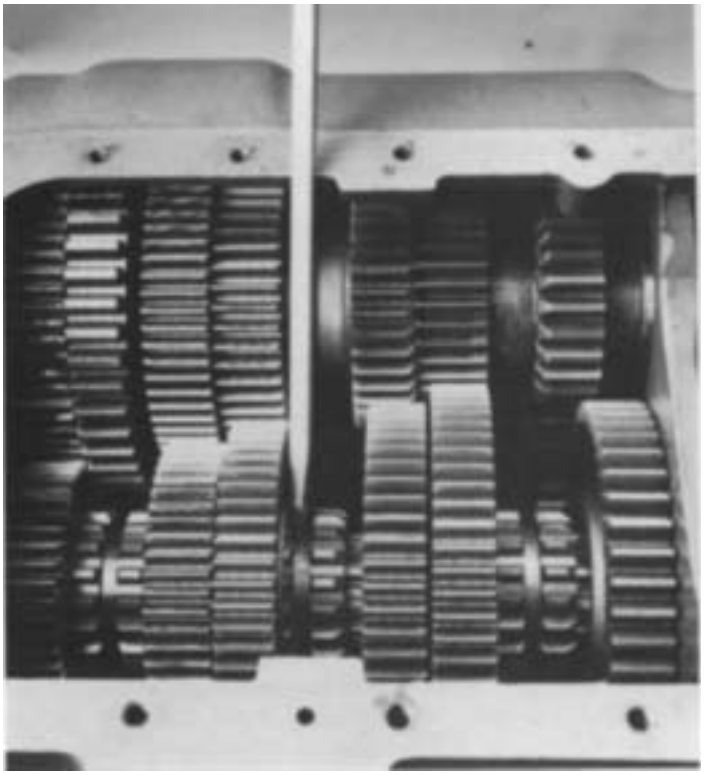


2. Insert countershaft support tool or blocking in rear bearing bore.

3. Install the right countershaft bearings in the same manner described in Part D for left countershaft bearings.



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



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.

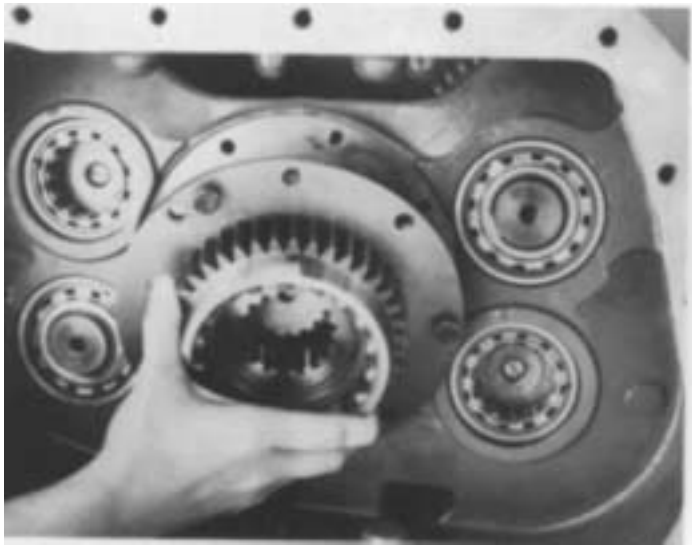
NOTE: Do not engage sliding clutches with more than one gear at the same time. This will lock the gearing and prevent the mainshaft and countershaft assemblies from rotating.

1. Reassembly and Installation of Left Reverse Idler Gear Assembly

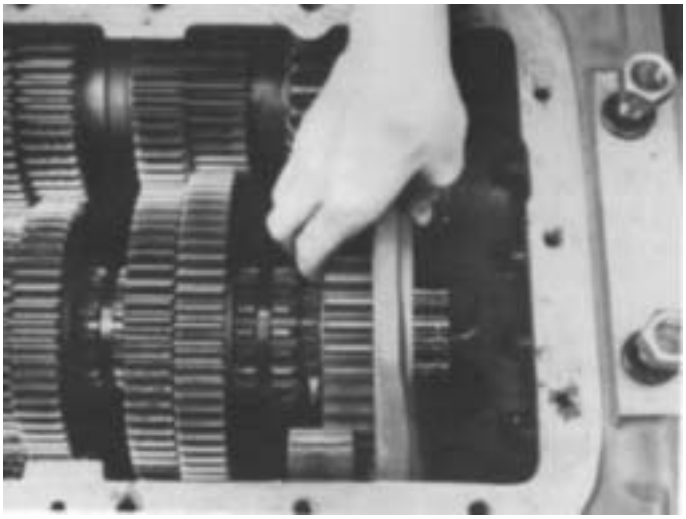
NOTE: Since the left and right reverse idler gear assemblies are identical, reassembly and installation of the left reverse idler gear assembly should be performed at this time as described in Part A of this section.

REASSEMBLY-FRONT SECTION

J. Completed Installation of Mainshaft and Auxiliary Drive Gear Assemblies

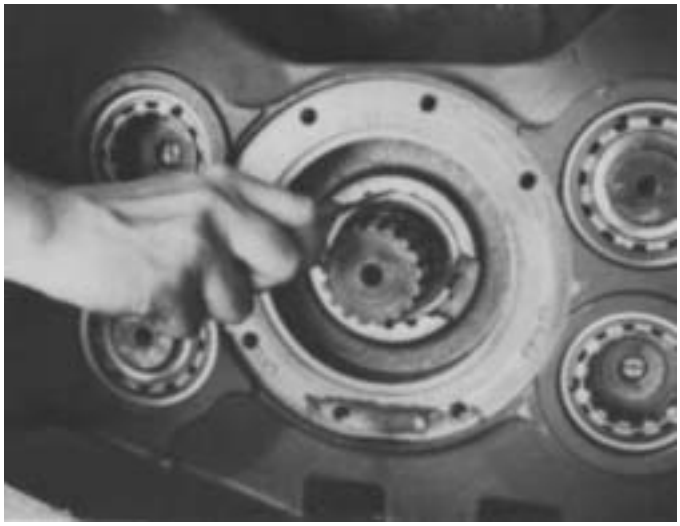


1. Remove the auxiliary drive gear assembly from mainshaft and rear bearing bore. Do not allow mainshaft to move to rear when removing auxiliary drive gear.



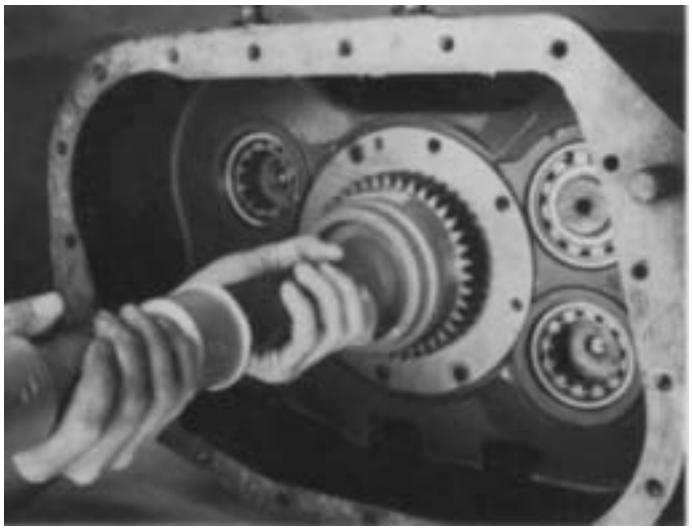
2. Move the reverse gear to the rear as far as possible, meshing teeth of gear with those of the reverse idler gears.

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

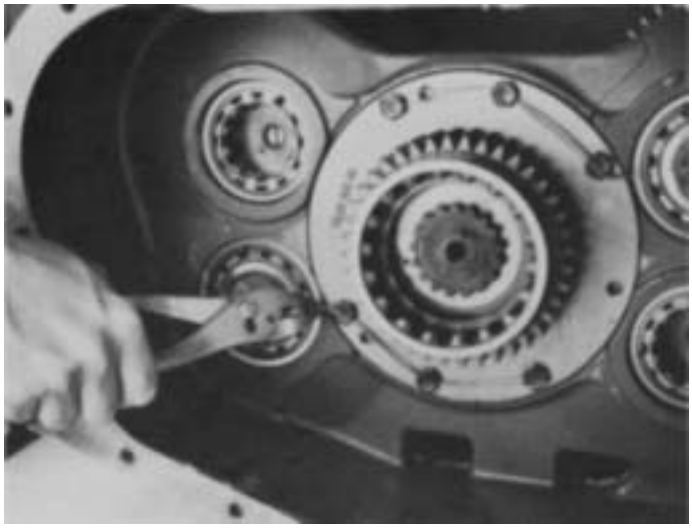


4. Install the snap ring in hub of reverse gear and move the reverse gear forward on mainshaft and into proper position in case.

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 main-shaft.

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. 3.

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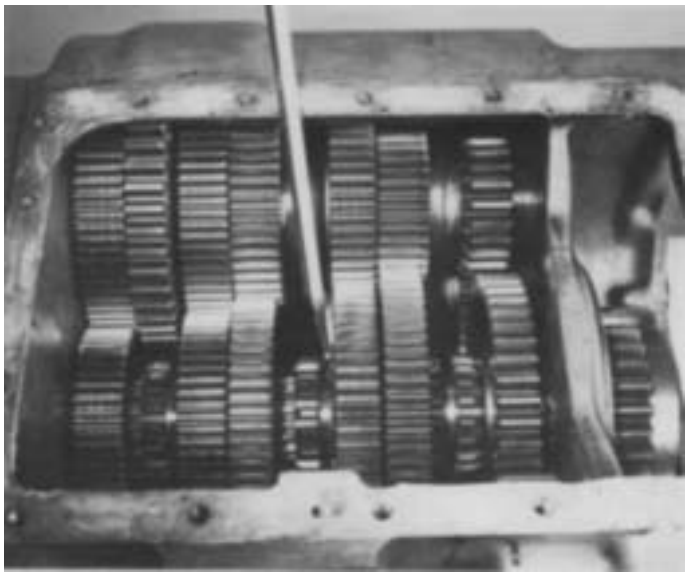
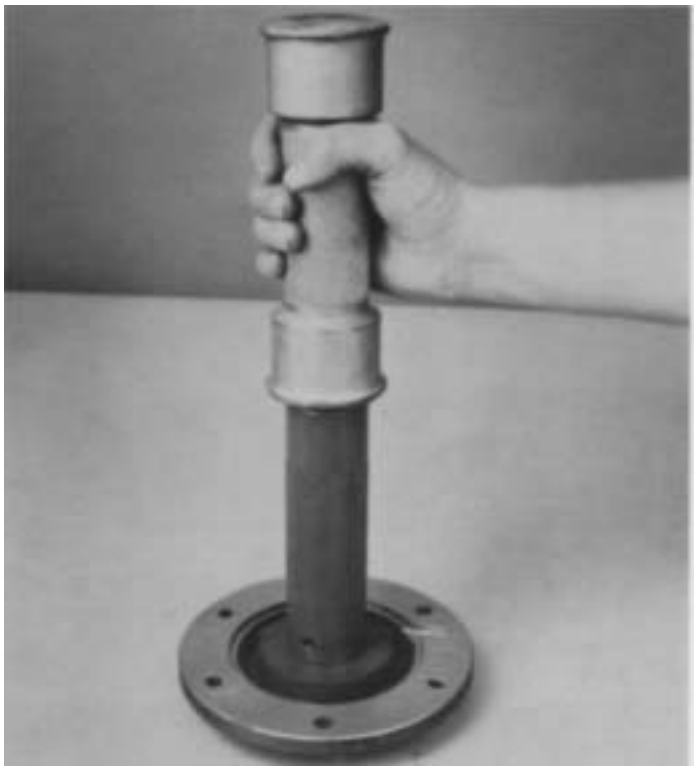
REASSEMBLY-FRONT SECTION

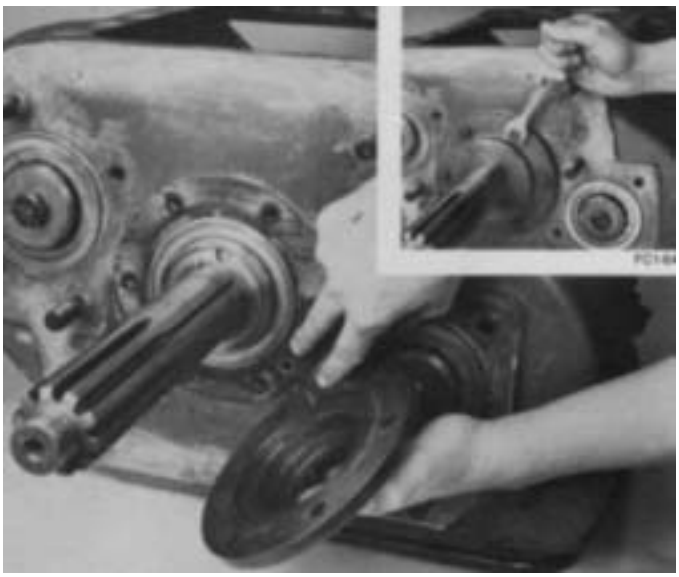


2. Engage two mainshaft sliding clutches into gear to prevent transmission from rotating.

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.

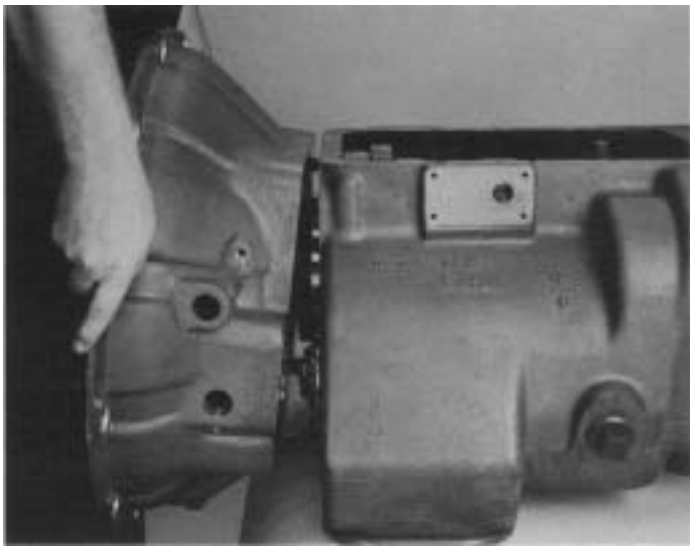


5. Install the drive gear bearing cover and gasket, making sure to align the oil return hole in case. Secure cover on case with retaining capscrews (inset).

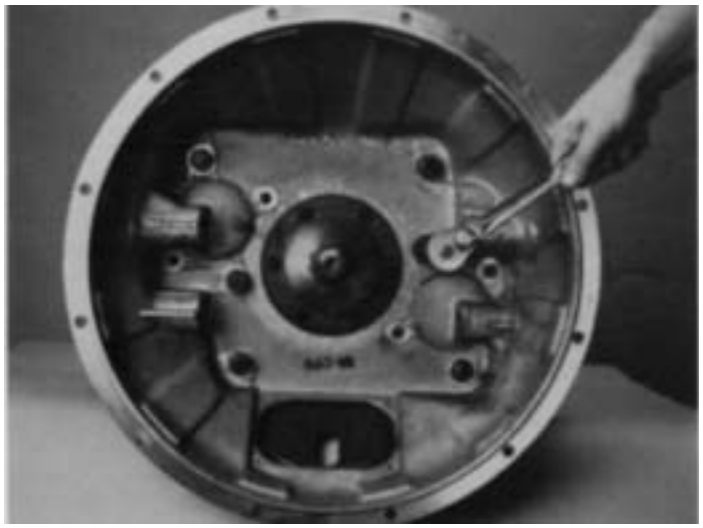
INSTALLATION-COMPANION FLANGE, AUXILIARY SECTION AND CLUTCH HOUSING

COMPANION FLANGE, AUXILIARY SECTION AND CLUTCH HOUSING

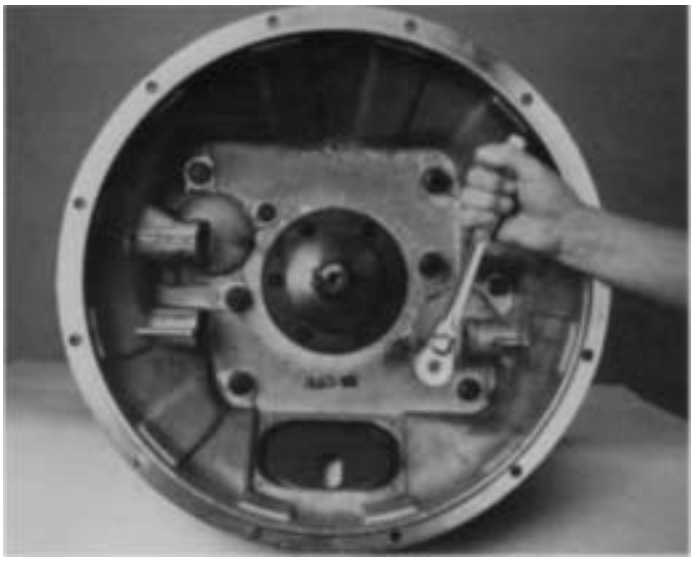
A. Installation of Clutch Housing



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.



2. Install the six nuts with washers or lockwashers on studs and tighten. See TORQUE RECOMMENDATIONS.



3. Install the four capscrews with lockwashers and tighten. See TORQUE RECOMMENDATIONS.

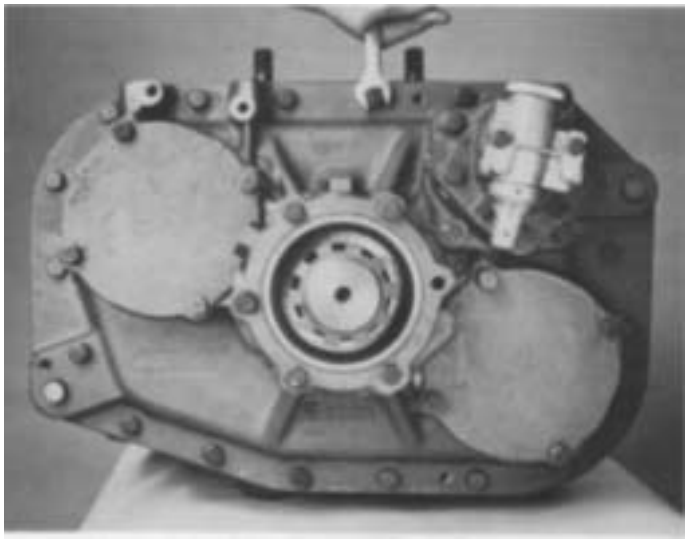
4. For models so equipped, install the clutch release mechanism and/or clutch brake assembly. See OPTIONS.

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 BE. FORE 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 15-speed auxiliary sections, shift the deep reduction sliding clutch into deep reduction before installing auxiliary. This will prevent possible timing error.



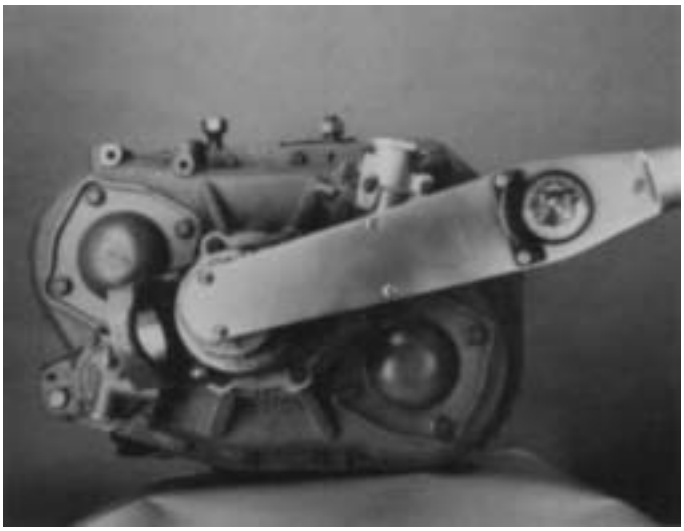
2. Install the retaining capscrews in flange of auxiliary plate/housing and tighten to secure the auxiliary section to the front section. See TORQUE RECOMMENDATIONS.

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 15-speed auxiliary sections, shift the deep reduction sliding clutch into deep reduction before installing auxiliary. This will prevent possible timing error.

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 14615/15615 models, the speedometer drive gear or replacement spacer is installed on output shaft prior to installation of rear bearing cover.

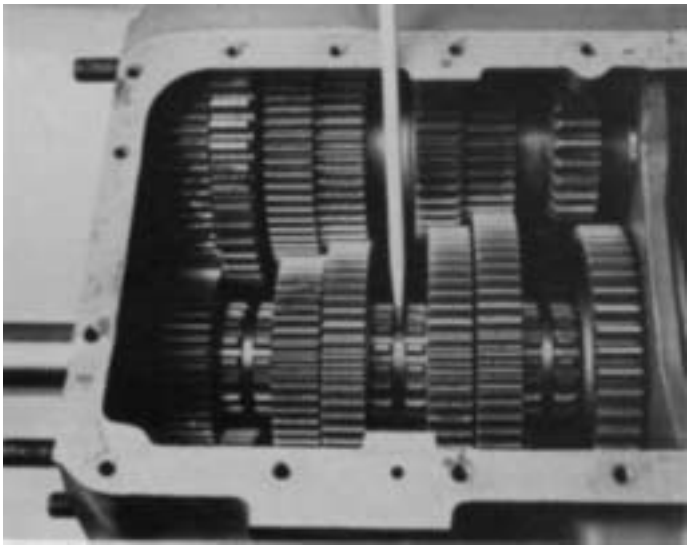


2. Lock the transmission by engaging two mainshaft gears with sliding clutches. Install the washer and/or nut on output shaft and tighten nut using 450-500 lbs/ft of torque.

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.

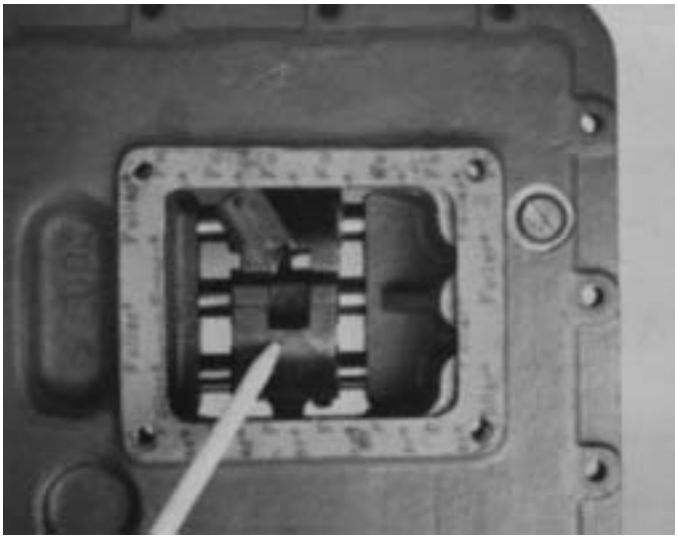
3. Install the capscrews in housing and tighten to secure the assembly to case.

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.

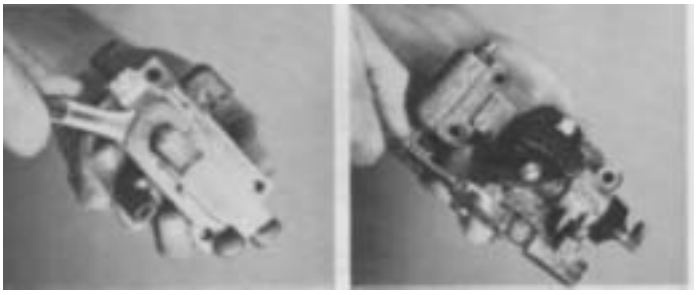
2. Install the new gear shift lever housing gasket in position on shift bar housing and install the gear shift lever housing assembly on shift bar housing, fitting the lever into shift block and yoke notches.

3. Install the retaining capscrews in housing flange and tighten to secure the assembly to shift bar housing.

INSTALLATION-
SHIFTING CONTROLS

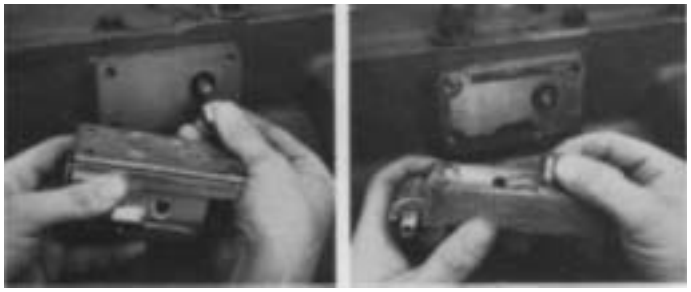
AIR SYSTEM

A. Installation of Slave Valve

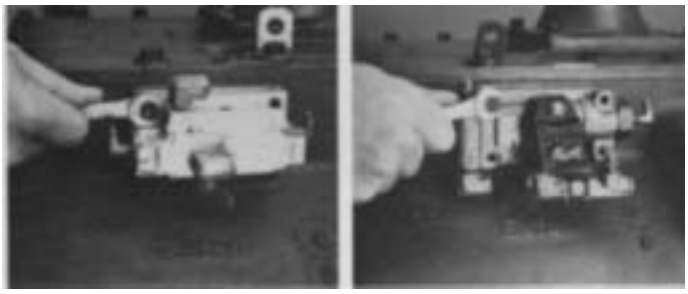


1. If previously removed, install the air line fittings on slave valve.

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 32-36.)

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