



# **Twin Splitter Transmission**

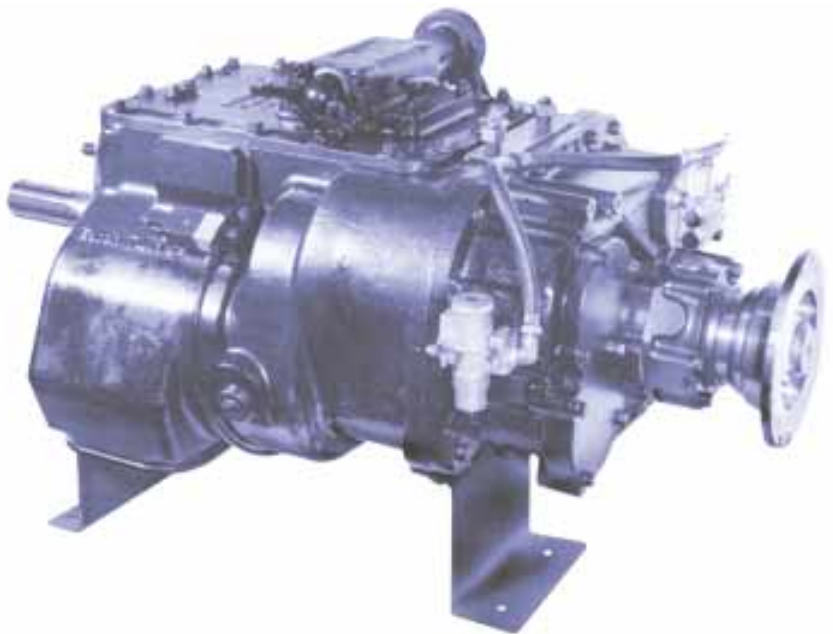
## **Service Manual**

# Eaton Twin Splitter Transmission



Truck Components Operations Europe  
PO Box 11 Worsley  
Manchester M28 5GJ  
England

## Service Manual



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# Section 1      General



# General

## Letter and Model Designation

### Example: TS 12612A TSO 12612A

- T - Twin Countershaft
- S - Splitter Transmission
- O - Overdrive
- 12 - Code input torque
- 6 - Design level
- 12 - Number of forward speeds
- A - Specific ratio type

# General Technical Data

MODELS TS(O) 11612A, TS(O) 12612A, TS(O) 13612A, TS(O) 15612A

## Permissible Torque

TS(O) 11612A	1560 Nm
TS(O) 12612A	1730 Nm
TS(O) 13612A	1815 Nm
TS(O) 15612A	2080 Nm

Weight<sup>1)</sup> 325 kg

Length<sup>2)</sup> 745 mm

Oil capacity approx. 12,5 lit

## Aux. Drive possibilities

1 x Rear of transmission, lower left  
Right side SAE - standard 6 bolt  
Bottom SAE - standard 8 bolt

Output speed X Engine  
for rear PTO and drive  
SAE 6 and 8 bolt

0,51

## Clutch Housing

SAE 1 or 2 for Pull and Push Clutch  
Grey Iron  
or  
Aluminium

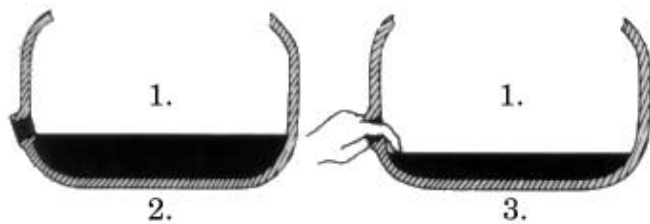
1) excluding oil, clutch housing and controls

2) from front of main case to the mounting face of the output flange (depending on flange fitted)

# General Lubrication

## Proper Oil Level

Before checking the oil level or refilling, vehicle should be on level ground. Make sure that the oil is level with the filler opening. Because you can reach the oil with your finger does not mean oil is at the proper level.



1. Oil Level      2. Yes      3. No

## Draining Oil

Drain transmission while oil is warm. To drain oil remove the drain plug at the bottom of case.

## Refilling

Clean the drain plug before re;installing. Clean area round filler plug. Fill transmission to the level of the filler opening.

The exact amount of oil will depend on the transmission inclination. In every instance, fill to the level of the filler opening. Do not overfill; this will cause oil to be forced out of the case past the mainshaft and input shaft seals.

## Adding Oil

It is recommended that different types and brands of oil are not intermixed because of possible incompatibility.

## Operating Temperature

It is important that the transmission operating temperature does not exceed 120°C for an extended period of time. Operating temperatures above 120°C will cause breakdown of oil and shorten transmission life.

The following conditions in any combination can cause operating temperatures of over 120°C:

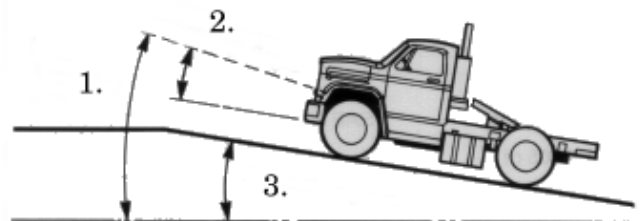
1. Operating consistently at road speeds under 32 km/h (20 m.p.h.)

2. High engine RPM
3. High ambient temperature
4. Restricted air flow around transmission
5. Exhaust system too close to transmission
6. High horsepower, over;drive operation

High operating temperatures may require more frequent oil changes.

External cooler kits are available to keep the transmission operating temperature under 120°C when the conditions described above are encountered.

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



1. Max. Operating Angle
2. Transmission Mounting Angle
3. Percent of grade

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

Note the effect low oil levels can have on safe operating angles. Allowing the oil level to fall 13 mm (0,5 in) below the filler plug hole reduces the degree of grade by approx. 3° (5,5%).

## Towing

When towing the vehicle, the propeller shaft between the axle and transmission must be disconnected.



## General Recommended Lubricants

Only use recommended lubricants to ensure smooth running.

### Lubrication Change and Inspection

#### Highway Use

First 8,000 km	Change transmission oil on new units
Every 16,000 km	Inspect oil level. Check for leaks.
Every 80,000 km	Change transmission oil

#### Off Highway

First 30 hours	Change transmission oil on new unit
Every 40 hours	Inspect oil level. Check for leaks
Every 500 hours	Change transmission oil when severe dirt conditions exist
Every 1,000 hours	Change transmission oil (normal off-highway use)

**Change oil filter element, if so equipped, at each oil change**

Type	Quality	Temperature
Heavy Duty Engine Oil to Specification	SAE 50	over -12°C
MIL-L-2104C or MIL-L-46152	SAE 40	over -12°C
or API-SC or API-CC	SAE 30	under -12°C
Mineral Gear Oil to Specification	SAE 90	over -12°C
API-GL-1	SAE 80 W	under -12°C
Mild EP Gear Oil* to Specification	SAE 90	from -12°C to 38°C
MIL-L-2105 or API-GL-4	SAE 80 W	from -26°C to 21°C
Multi-purpose Gear Oil* to Specification	SAE 85 W 140	over -12°C
MIL-L-2105B or MIL-L-2105C	SAE 80 W 140	over -26°C
or API-GL-5	SAE 90	from -12°C to 38°C
	SAE 80 W 90	from -26°C to 38°C
	SAE 80 W	from -26°C to 21°C
	SAE 75 W	from -40°C to -26°C

\* These oils are NOT recommended when lubricant operating temperatures are above 110°C.

**Note: Synthetic oils are NOT recommended.**

## General

# Torque Tightening Recommendations

## Screws and Nuts

**1. All 1/8" Compression Fittings.** 7 to 10 Nm.

**2. Clutch Housing.** 4 Capscrews M12 Thread.

Aluminium Housing: 84 to 96 Nm with Shakeproof Internal Lockwasher.

Cast Iron Housing: 96 to 109 Nm with Spring Lockwashers.

**3. Clutch Housing.** 6 Nuts M16 Thread.

Aluminium Housing: 190 to 203 Nm with Plain Washer and Nylon Locking Nut.

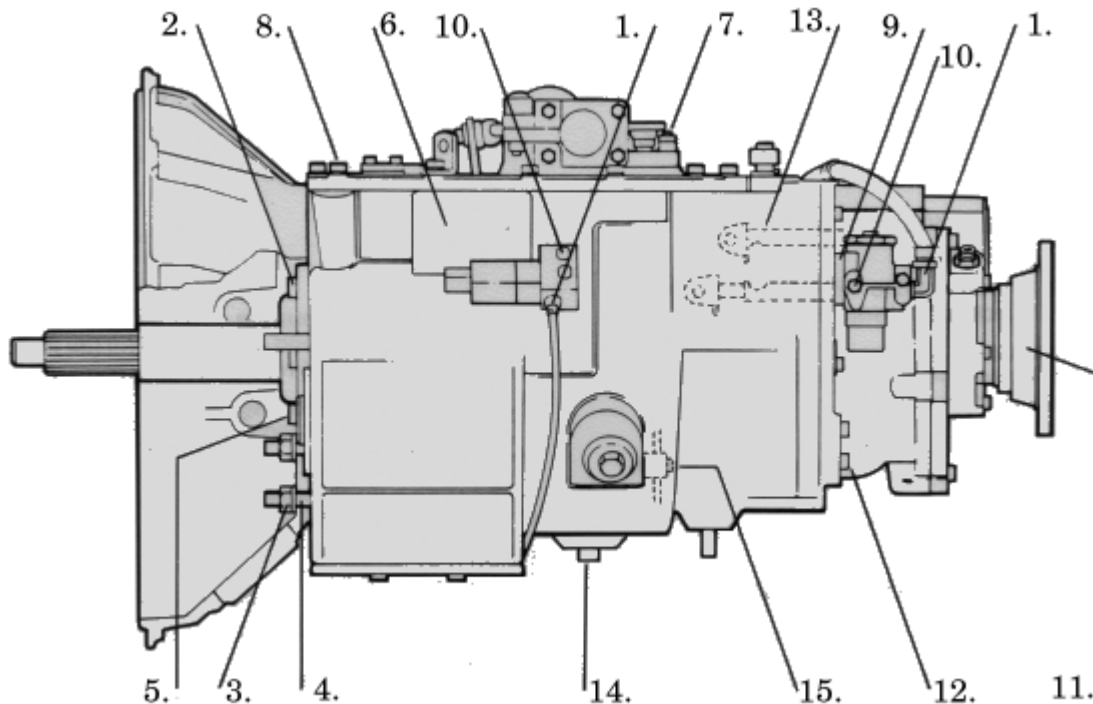
Cast Iron Housing: 244 to 270 Nm with standard Nut and Spring Lockwashers.

**8. Shift Bar Housing.** 16 Capscrews M10 Thread - 53 to 66 Nm. Thread coated with Loctite.

**9. Air Filter Bracker.** 2 Capscrews M10 Thread - 53 to 66 Nm Spring Lockwashers.

**10. Filter Pressure Regulator and Pulse Unit.** 2 Capscrews M6 Thread - 11 to 16 Nm. With Spring Lockwashers and Plain Nuts.

**11. Output Shaft.** Nut 2" - 16 Thread- 610 to 680 Nm. With Nylon Locking Insert or Staking Collar. Ensure nut is securely staked into the shaft groove.



**4. Clutch Housing.** 6 Studs - M16 Thread - minimum 81 Nm, driven until bottomed. Installed with Loctite 270.

**5. Input Shaft Front Bearing Cover.** 6 Capscrews M10 Thread - 53 to 66 Nm. Thread coated with Loctite 270.

**6. 5 Yoke Lockscrews.** 7/16" - 20 Thread - 47 to 61 Nm secure with Lockwire.

**7. Shift Lever Remote Control Housing Studs.** 4 M10 Thread - 53 Nm, driven until bottomed.

(Note: Style of Nuts and Washers will vary with specification.)

**12. Auxiliary Housing.** 17 Capscrews M10 Thread - 53 to 66 Nm. Spring Lockwashers.

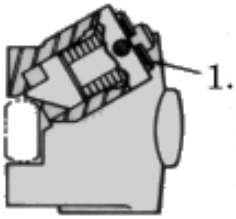
**13. Splitter Cylinder Yokes.** 2 Yoke Screw 7/16" - 20 Thread - 47 to 61 Nm. Secure with Lockwire.

**14. Oil Drain Plug.** 3/4" Pipe Thread, 61 to 75 Nm.

**15. Reverse Idler Shafts.** 2 Capscrews M10 Thread - 53 to 66 Nm. Thread coated with Loctite.

## General

### Plunger in Reverse Yoke



1. After installing Plunger and Spring, tighten Plug and back off 1/4 to 1/2 Turn. Stake Threads in Hole.  
N.B. Not fitted on SAMT transmissions.

**1. 4 Support Studs.** M16 Thread - minimum 81 Nm. Drive until bottomed, installed with Loctite 270.

**2. 4 Support Studs Nuts.** M16 Thread - 230 to 250 Nm oiled at vehicle location, with Lockwashers.

**3. Air Filter Plug.** 1 1/4" - 18 Thread - 23 to 28,5 Nm.

**4. Auxiliary Countershaft Rear Bearing Cover.**

11 Capscrews M10 Thread - 53 to 66 Nm. Thread coated with Loctite 270.

**5. Oil Filler Plug.** 1 1/4" Pipe Thread - 81 to 102 Nm.

**6. Lower P.T.O. Cover.** 8 Capscrews M12 Thread - 96 to 109 Nm. Thread coated with Loctite, Lockwashers.

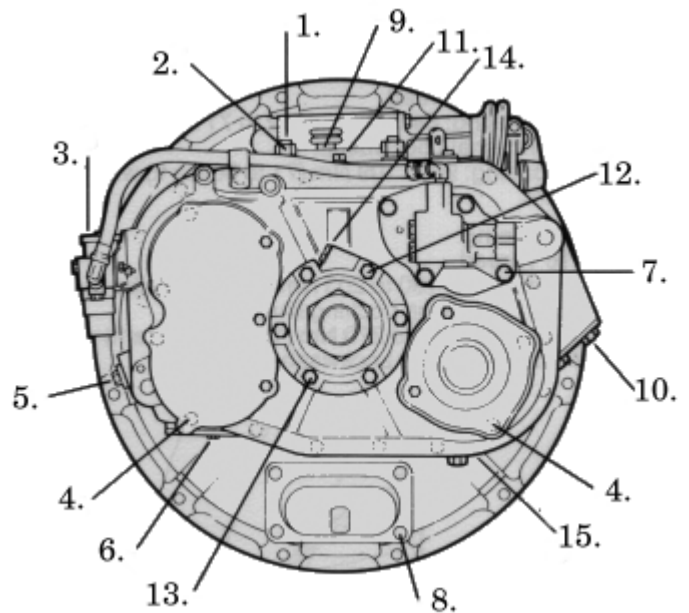
**7. Splitter Cylinder Cover.** 4 Capscrews M10 Thread - 41 to 47 Nm. Thread coated with Loctite.

**8. Cover - Clutch Housing.** 4 Capscrews M8 Thread - 29 to 34 Nm.

**9. Plug.** 9/16 - 18 Thread - 47 to 68 Nm.

**10. Side Power Take Off Cover.** 6 Capscrews M10 Thread - 53 to 66 Nm. Thread coated with Loctite.

**11. Plug.** 1/4" Pipe Thread - 13 to 16 Nm.



**12. Speedometer Housing.** 1 Capscrew M10 Thread - 53 to 66 Nm, with Brass Flatwasher and Nylon Seal.

**13. Speedometer Housing.** 5 Capscrews M10 Thread - 53 to 66 Nm, Lockwashers.

**14. Speedometer Housing Plug.** 47 to 61 Nm.

**15. Upshift Brake.** 2 Capscrews & 4 Socket head M10 Thread - 53 to 66 Nm.

1 Capscrew (on Keep Plate) M12 Thread - 95,0 to 102,0 Nm.

2 C/S Screws M8 Thread - 17,0 to 21,0 Nm.

## General Disassembly Precautions

It is assumed in the detailed disassembly instructions that: The lubricant has been drained. The necessary linkage and air lines removed from the chassis. Removal of the gear shift remote control housing assembly is included in the detailed instructions; however, this assembly must also be removed from transmission before removing unit from vehicle.

Follow each procedure closely in each section, making use of both the text and the pictures.

**1. Cleanliness** - Provide a clean place to work. It is important that no dirt or foreign material enters the unit during repairs. The outside of the unit should be carefully cleaned before starting the disassembly. Dirt is abrasive and can damage bearings.

**2. Bearings** - Carefully wash and relubricate all bearings as removed and protectively wrap until ready for use. Remove bearings with pullers designed for this purpose.

**3. 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.

**4. Snap rings** - Remove snap rings with pliers designed for this purpose. Rings removed in this manner may be reused, except where new ones are specified in 'Reassembly'.

**5. Input shaft** - The drive gear or input shaft can be removed without removing the countershaft or mainshaft. Take care not to misplace or lose the mainshaft spigot thrust races and washers.

**6. When Pressing** - Apply force to shafts, housings etc. with restraint. Movement of some parts is restricted. Do not apply force after the part is restricted. Do not apply force after the part being driven stops solidly. Use soft hammers and bars for all disassembly work.

## Inspection of Expendable Parts

Before reassembling the transmission, the individual parts should be carefully checked to eliminate those damaged. They should be renewed. This inspection procedure should be carefully followed to ensure the maximum of wear life from the rebuilt unit.

The cost of a new part is generally a small fraction of the total cost of downtime and labour, should the use of a questionable part make additional repairs necessary before the next regularly scheduled overhaul.

Recommended inspection procedures are set forth in the following check list:

### A. Bearings

1. Wash all bearings in clean solvent. Check balls, rollers and races for pits and spalled areas. Renew damaged bearings.
2. Lubricate undamaged bearings and check for axial and radial clearances. Renew bearings with excessive clearances.
3. Check fits of bearings in housing bores. If outer races turn too freely in the bores, the housing should be renewed. Check housing bores for signs of wear prior to taking this action. Only replace housing if wear is seen as a result of bearing spin.

### B. Gears

1. Check gear teeth for pitting of the tooth faces. Gears with pitted teeth should be renewed.
2. Check all engaging gear teeth. Gears with teeth worn, tapered or reduced in length from clashing in shifting should be renewed.
3. Check axial clearances of gears. Where excessive clearance is found, check gear snap ring, washer, spacer and gear hub for excessive wear.

Maintain 0.13 to 0.30 mm axial clearance on mainshaft forward gears and on reverse gear.

### C. Bearing Sleeve - Mainshaft

1. Sleeves with groove formation, pits or which have either been overheated or worn out must be renewed.
2. Radial clearance between bush and shaft should be 0.76 mm to 1 mm.

## General

### D. Splines

1. Check splines on all shafts for wear. If sliding clutch gears, output drive flange or clutch hub have worn into the sides of the splines, the shafts in this condition must be renewed.

### E. Thrust Washers

1. Check surfaces of all thrust washers.

Washers scored or reduced in thickness should be renewed.

### F. Reverse Idler Gear

1. Check bearing sleeve for wear from action of roller bearings.

### G. Grey Iron Parts

1. Check all grey iron parts for cracks and breaks. Renew or repair parts found to be damaged. Heavy castings may be welded or brazed providing the cracks do not extend into bearing bores or bolting surfaces.

### H. Clutch Release Parts

1. Check clutch release parts, yokes and bearing carrier. Check pedal shafts. Renew worn shafts and bearings.

### I. Shifting Bar Housing

1. Check yokes and gates for wear at contact points. Renew worn parts.

2. Check yokes for alignment.

3. Check yokes for excessive wear, renew worn yokes.

4. Check lockscrews in yokes and gates. Tighten and re-wire those found loose. Lockscrews with worn tapers must be renewed.

5. If housing has been dismantled, check neutral notches of shifting bars for wear from interlock balls. Bars indented at points adjacent to the neutral notch should be renewed.

### J. Gear Shift Remote Control

1. Check spring tension on shift shaft. Renew tension spring if shaft moves too freely.

2. If housing is dismantled, check shift shaft and finger and the sliding bearings for wear. Renew worn parts.

### K. Bearing Covers

1. Check covers for wear from thrust. Renew covers worn or grooved from thrust of bearing outer race.

2. Check bores of covers for wear. Renew those worn oversize.

### L. Oil Return Threads and Seals

1. Check oil seal in front bearing cover for damage and wear, renew if necessary.

2. Check oil seal in speedometer housing for damage or wear, renew if necessary. Renew grit shield if worn or loose on flange.

### M. Sensor/Jaw Clutches

1. Check the sensors and jaw clutches for burrs, uneven and excessive wear at contact surface, and metal particles. Check the 'gylon' faces for wear or damage.

2. Check energiser rings for excessive wear or loss of tension. Renew if in any doubt.

3. Check sensor contact surfaces on the gears for excessive wear. If burnt out contact surfaces are evident, gears should be renewed.

### N. Sliding Clutches

1. Check all yokes and yoke slots in sliding clutches for extreme wear or discolouration from heat.

2. Check engaging teeth of sliding clutches for partial engagement pattern. Clutches with engaging teeth worn, tapered or reduced in length from clashing should be renewed.

### O. O-Rings

1. Renew all O-rings.

## General

# Reassembly Precautions

Make sure that interiors of all housings are clean. It is important that dirt be kept out of transmission during reassembly. Dirt is 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, as omission of a gasket can result in oil leakage or misalignment of bearing covers.

**2. Capscrews** - To prevent oil leakage, use thread sealant on all capscrews. The corresponding torque ratings are to be found in 'Torque Recommendations for Screws and Nuts'.

**3. O-Rings** - Lubricate all O-rings lightly with silicone lubricant.

**4. Initial lubrication** - Stick mainshaft thrust race packs onto mainshaft spigots with petroleum jelly to assist in preventing them becoming displaced during reassembly.

**5. Axial Clearances** - Maintain the axial clearances of mainshaft forward speed and reverse gears at 0.13 to 0.30 mm.

**6. Bearings** - Use of flange-end bearing drivers is recommended for the installation of bearings. These drivers apply equal force to both races of the

bearing, preventing damage to balls and races and maintaining correct bearing alignment with shaft and bore. A Tubular type driver, if used, will apply force only to the inner race.

**7. Output Shaft Drive Flange** - Replace any flanges with worn or damaged seal journals. Secure the flange by torquing the nut to 610 to 680 Nm.

If the nut is a staked nut, ensure that nut is adequately staked into the groove on the shaft. Failure to do this allows the shaft to move axially resulting in damage to the bearing and mainshaft thrust races.

Prior to refitting a flange (or yoke) ensure that the seal track is not grooved scored or pitted. If in doubt, it must be replaced.

## General Special Tools

Some illustrations show the use of specialised tools. These tools are recommended for disassembly and reassembly of the transmission. They make repair easier, faster and prevent damage.

The following tools are available from SPX UK (Ltd) Tel : +44 (0)1327 704461



**LC105A** Main Tool Assembly



**LC 204** Dummy Support - Countershaft Rear Journal



**E 105-1** Adaptor Auxiliary Countershaft Rear Bearing



**E 108** Installer Main Tool



**E 105-2** Adaptor Countershaft Front Bearing



**E 108-1** Countershaft Front Bearing Installer



**E 105-3** Adaptor Countershaft Rear Bearing



**E 108-2** Output Shaft Bearing Installer

## General



**E 108-3** Countershaft Rear Bearing Installer



**E 109-3** Input Shaft Bush and Output Shaft Bush Installer



**E 108-4** Oil Seal Installer



**E 108-5** Auxiliary Countershaft Bearing and Input Shaft Bearing Installer



**E 113** Jaw Clutch Spring Compressor



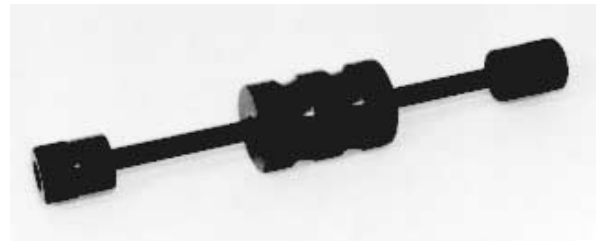
**E 109** Handle - Installer



**LC 284/11** Rev Idler Shaft Puller Adaptor



**E 109-1** Rev Idler Bearing Installer



**MS 284** Slide Hammer



## Section 2      Air System

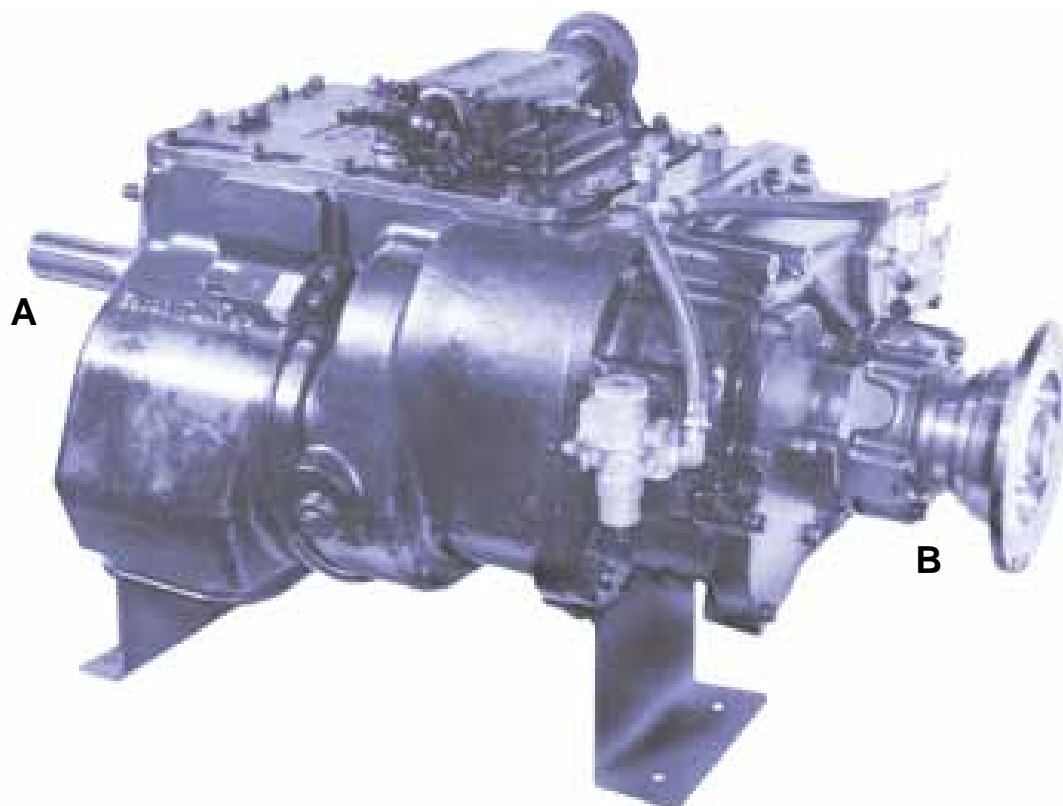


# Air System

## General Description

### Twin Splitter 12 speed

A = Main section      B = Auxiliary section



The Twin Splitter Transmission has a 4 speed main section with an auxiliary section containing 3 splitter ratios

#### Main section

4 forward speeds  
1 reverse speed

Gear shift by means  
of shift lever

#### Auxiliary section

I Low  
II Intermediate  
III High

Pneumatic gear shift  
by means of a splitter  
switch

Each forward gear is split  
three times, giving twelve  
gears in total

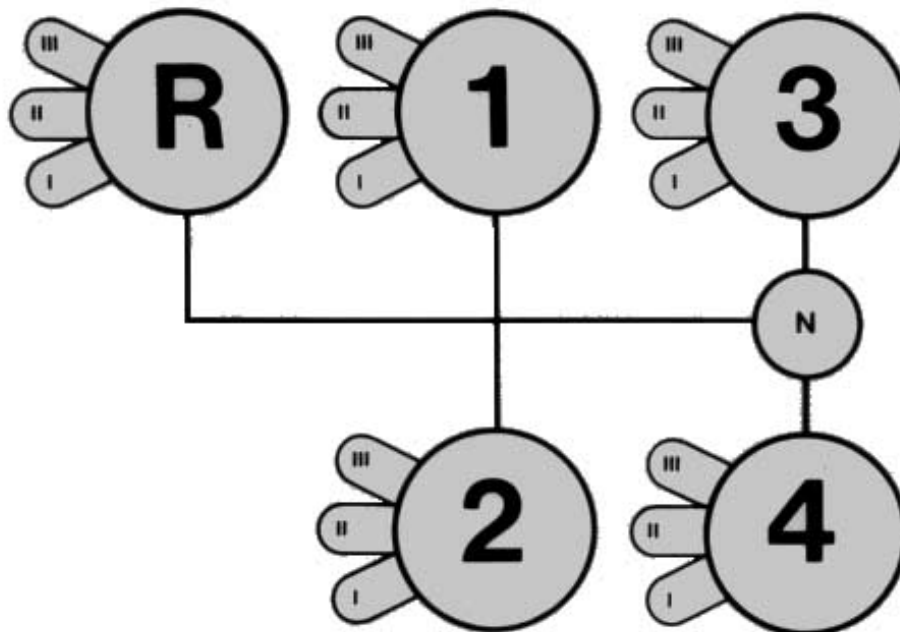
## Air System Maintenance

In order to ensure that the transmission functions without problems and has a long life, the compressed air reservoirs on the vehicle must be drained regularly and the filter on the transmission cleaned every 80,000 kms (or 6 months). Please consult the Operating Instructions supplied by the vehicle manufacturer.

## Air System

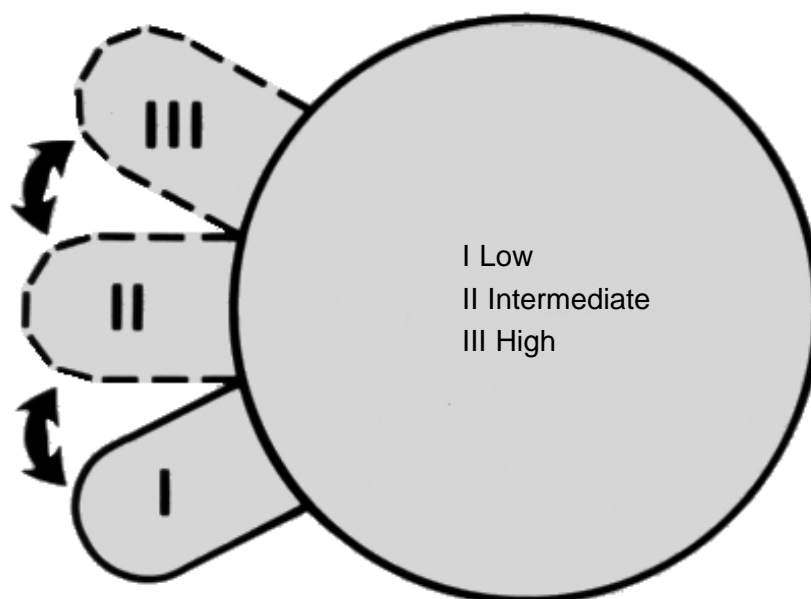
### Twin Splitter Single 'H' Pattern

#### Gearshift



Single 'H' pattern gate, four position plus reverse, three splitter gears available in each position.

#### Splitter



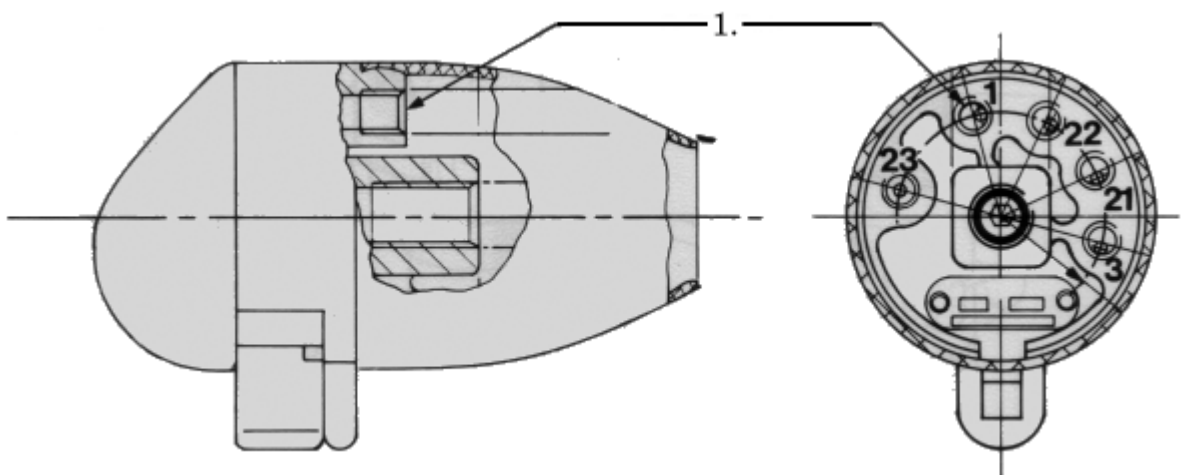
Three position flick-switch, Low (I), Intermediate (II) and High (III), for pre-selection of splitter gears engaged through throttle operation or clutch control.

## Air System

### Splitter System - Signal Connections

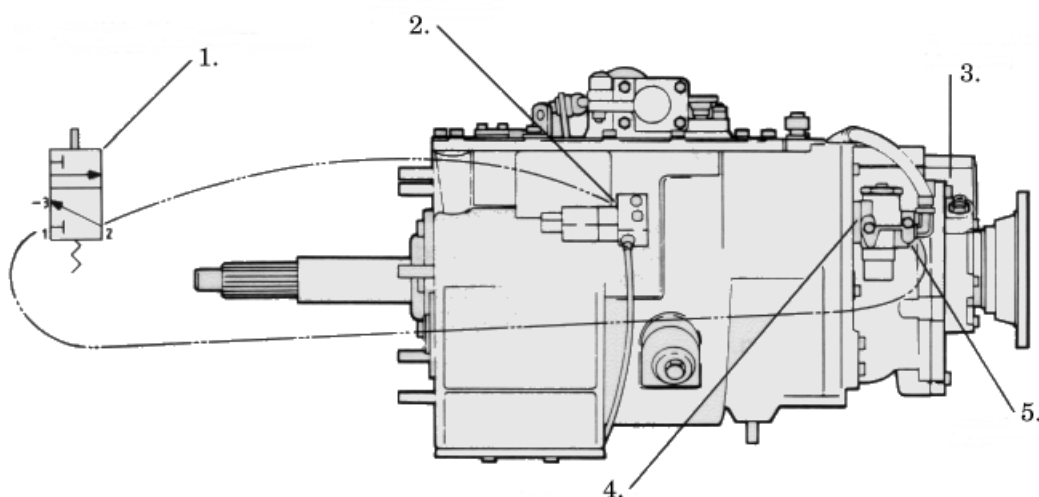
Switch Port No.	Transmission Connections	
	Overdrive	Direct
1	Filter/Regulator	Filter/Regulator
3	Exhaust	Exhaust
21	Shift Cover 'R'	Shift Cover 'R'
22	Shift Cover 'F'	Blank Off
23	Blank Off	Shift Cover 'F'

### Splitter Switch - Signal Pipe Connections



1. Splitter Switch Signal Connection

### Transmission Air Connections - Upshaft Brake and Splitter Cylinder

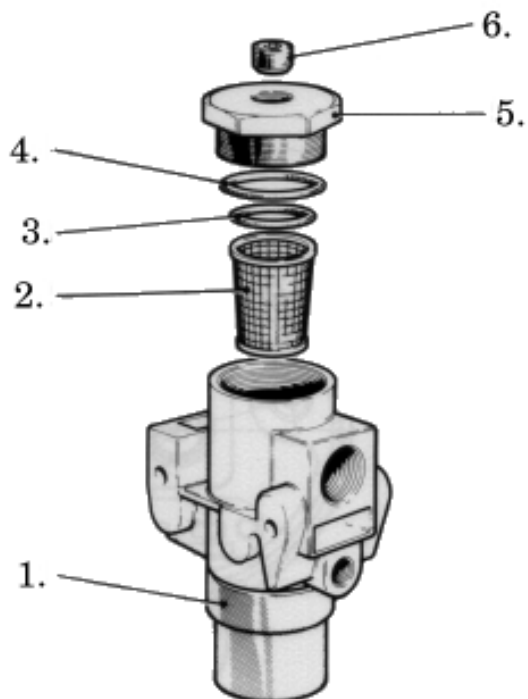


1. 3 Way Pilot Valve to be operated only when the clutch is fully depressed
2. Pulse Unit Supply (5.5 bar)
3. 'R' Port and 'F' Port (shift cover)
4. Air Supply (7-8 bar)
5. Regulated Air (5.5 bar)

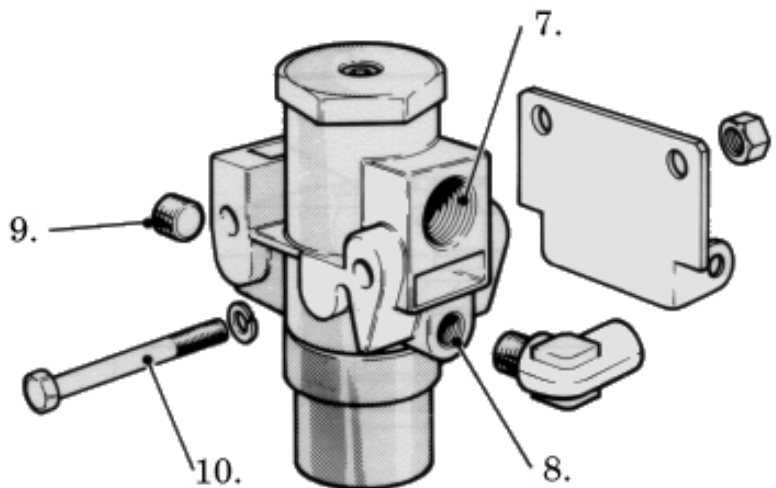
# Air System

## Filter Pressure Regulator

### Filter Maintenance



- 1. Filter pressure regulator
- 2. Filter element
- 3. Seal ring
- 4. 'O' ring
- 5. End cap



- 6. Plug
- 7. Air supply port
- 8. Outlet port \*
- 9. Outlet seal plug \*
- 10. Capscrew with lockwasher

### A. Removal and Disassembly

- 1. Remove end cap
- 2. Remove filter insert from housing and clean. Cleanser: Soap and water solution, cold cleaner etc. Then blow element from inside using compressed air.
- 3. Clean filter regulator housing.

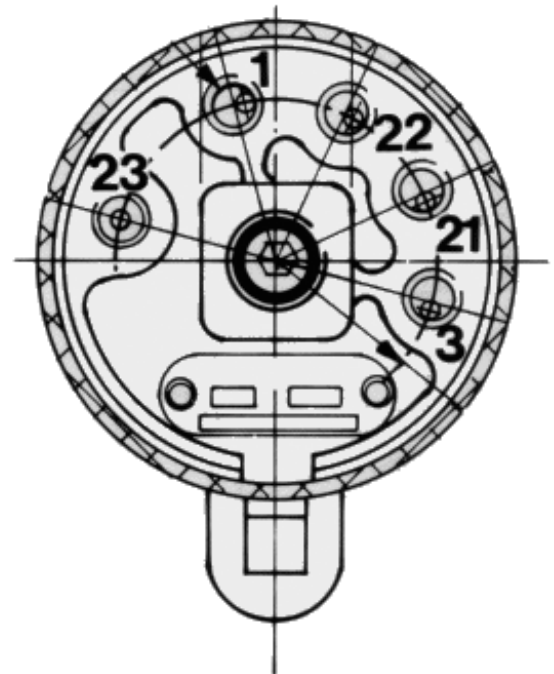
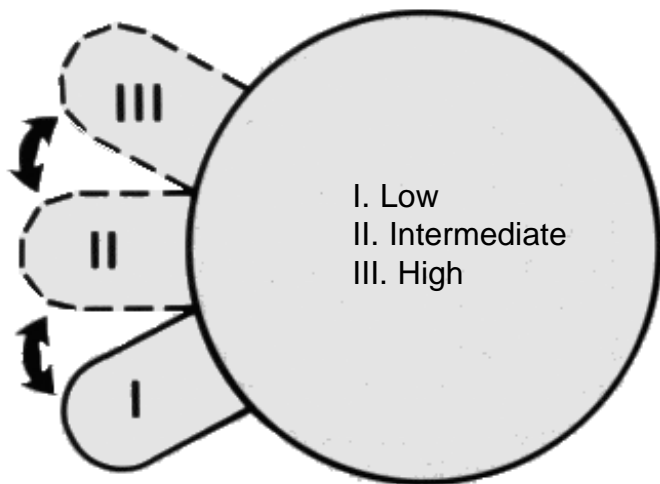
\* Alternative positions

### B. Assembly and Installation

- 1. Renew filter element, seal ring and O ring if necessary.
- 2. Fit end cap.
- 3. Check filter regulator function. Unscrew seal plug (9), attach test connection with gauge. Recommended operating pressure 5.34-5.69 bar.

# Air System Selector Switch

## Splitter Ratios



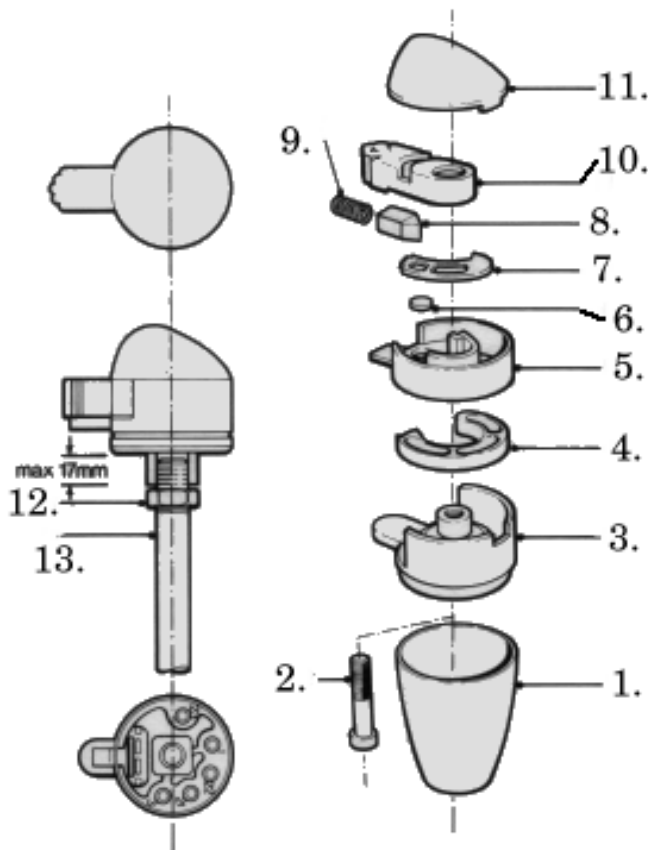
## Function

Constant air supply to '1' from filter/regulator.

	Overdrive	Direct
Shift Position I	Air supply from 21 to shift cover 'R' and from 22 to shift cover 'F'.	Air supply from 21 to shift cover 'R'
Shift Position II	Air supply from 22 to shift cover 'F'.	No air supply from valve in this position.
Shift Positon III	No air supply from valve in this position.	Air supply from 23 to shift cover 'F'.

## Air System

# Selector Valve Removal and Re-fitment



1. Cowl
2. Socket head screw
3. Base
4. Seal
5. Housing
6. Pressure pad
7. Anti-rattle spring
8. Plunger
9. Compression spring
10. Lever
11. Cap
12. Lock nut
13. Shift lever
14. max 17 mm
- Lubricant (sachet)

## Removal and Disassembly

1. Remove cowl.
2. Disconnect all air lines.
3. Loosen lock nut and unscrew selector valve from shift lever.
4. To disassemble the valve remove socket head screw (2).

**Note:** Take care not to break tang from cap.

5. Thoroughly clean inside of selector valve.

## Re-fitment

1. Renew seal ensuring that it is fitted correctly.
2. Smear sealing surface of base using lubricant supplied in Service Kit.

Caution: Do not use any other type of lubricant.

3. Reassemble valve and tighten socket headed screw to the correct torque.
4. Screw selector valve onto shift lever and secure with lock nut.

Note: Only screw down max. 17mm, otherwise the housing will be deformed and the valve will leak.

5. Connect all air lines and test for leaks.
6. Refit cowl.

Torque:

Socket head screw (No.2) = 10-12 Nm.

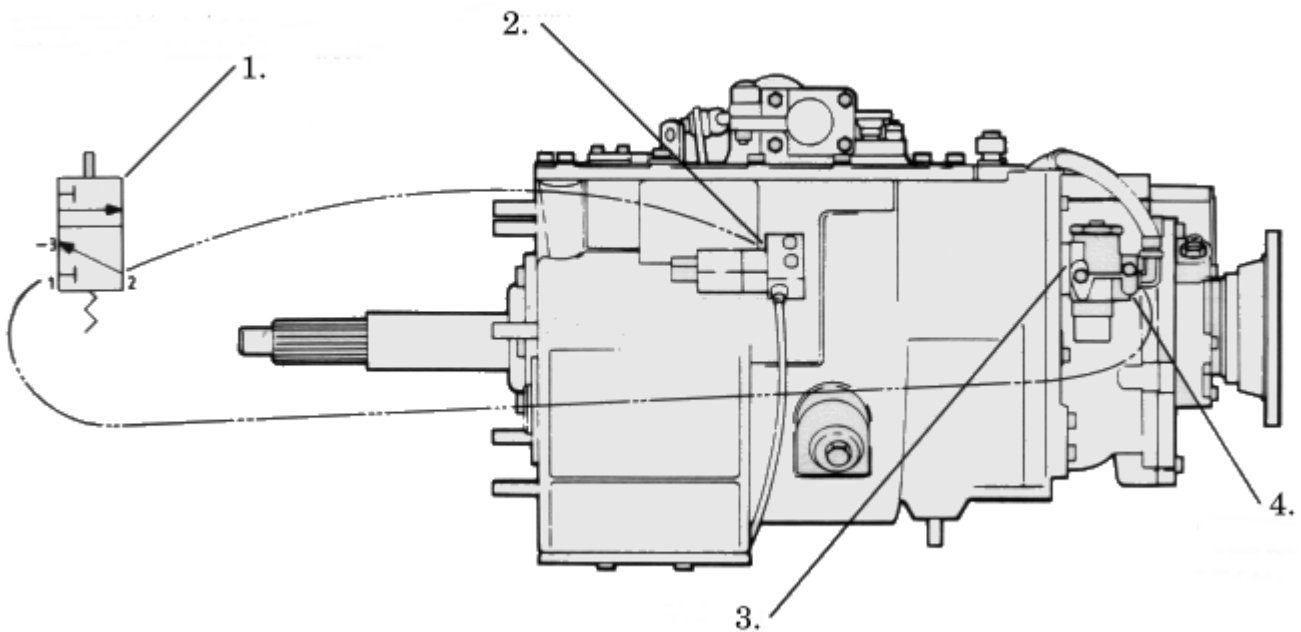
Air connection = 2.7-3.4 Nm.

## Trouble Shooting Hints

- Check that valve functions correctly.
- Check all air connections for leaks.
- Remove valve from gear lever and check socket head screw (No.2) for tightness.
- If leaks persist renew the seal (No.4). (Service Kit No. T20137).

## Air System

### Upshift Clutch Brake - Pulse Unit



1. 3 Way Pilot Valve to be operated only when the clutch is fully depressed
2. Pulse unit supply 1/8 27 N.P.T.F.
3. Air Supply 3/8 - 18 N.P.T.F.
4. Regulated Air 5.5 bar 1/8 N.P.T.F.

A pulse valve gives a controlled pulse of air to the upshift brake activated by a pilot valve usually fitted under the clutch pedal.

When the clutch pedal is fully depressed the pulse unit is activated, giving a single pulse of air for up to a maximum of 0.45 second.

### Trouble Shooting Hints

In case of suspected failure.

1. Check clutch pedal area of cab to ensure that the pilot valve is able to operate effectively.
2. Check air supply to pulse unit when clutch pedal is fully depressed.
3. Disconnect the air connection at the upshift brake. Fully depress the clutch pedal and check that a pulse of air is being supplied. If no air is being supplied, renew the pulse unit.



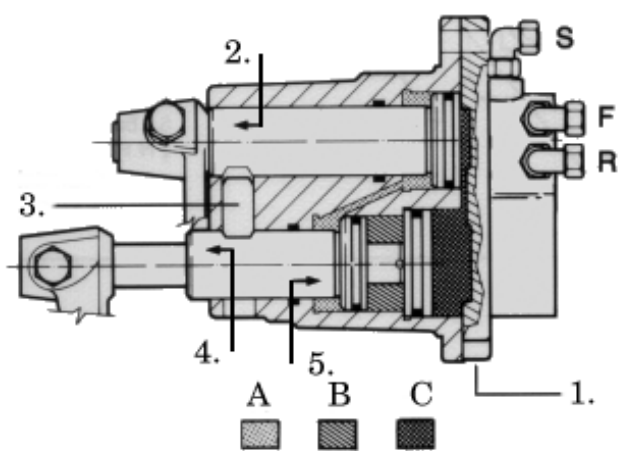
# Air System

## Splitter shift

### Cylinder Operation

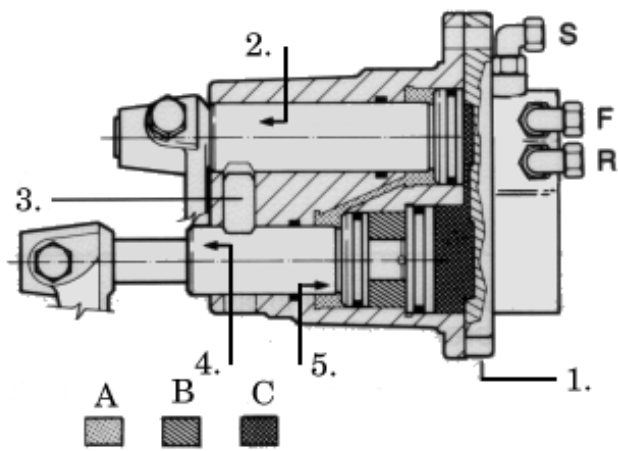
Constant air is supplied to the shift cylinder cover port 'S' from the filter/regulator. Pilot signals (to F and R) from the splitter switch in the cab cause the valves on the cylinder cover to supply air to the pistons. Refer to Table 1 and Figures 1 and 2. The interlock pin prevents both piston shafts being selected at the same time.

Fig. 1 Overdrive Transmission



- 1. Shift Cylinder Cover
- 2. Intermediate
- 3. Interlock Pin
- 4. Low
- 5. High

Fig. 2 Direct Transmission



- 1. Shift Cylinder Cover
- 2. High
- 3. Interlock Pin
- 4. Low
- 5. Intermediate

Table 1

Splitter/Cylinder	Overdrive			Direct		
	A	B	C	A	B	C
I Low	P	P	E	P	P	E
II Intermediate	P	E	P	P	E	E
III High	P	E	E	P	E	P

P = Pressure, E = Exhaust, see figs, 1 and 2.

## Air System

### Splitter Cylinder Cover Assembly - Logic Valves

The splitter cylinder cover assembly consists of a cast aluminium housing with internal drillings on which are mounted three, sealed, air operated logic valve units.

All three units are of similar design but perform different functions. Two units are designated YES units and the third, a NOT unit.

The NOT unit is a 'normally open' valve whereby supply pressure to port 2 (the centre port) holds the valve open and supplies air straight to output port 3. When a signal pressure supply is applied to port 1 the valve is closed by the opposing air pressure and port 3 is vented to atmosphere.

The two YES units are identical and each is a 'normally closed' valve whereby the supply pressure to port 2 holds the valve closed and prevents air from going to the output port 3 (which is vented to atmosphere). When a signal pressure supply is applied to port 1, the opposing air pressure closes port 3 to atmosphere opens the valve and air pressure from port 2 is supplied to port 3.

A constant air pressure to port 'S' supplies ports 2 of both the left hand and right hand 'YES' units and port 1 of the splitter cylinder.

If signal pressure is now applied to ports 'R' and 'F' the 'NOT' unit is closed and the left hand 'YES' unit will open to give pressure to port 2 of the splitter cylinder.

If signal pressure is applied to port 'F' (and cut off from port 'R') the 'NOT' unit will open, the left hand 'YES' unit will open, the left hand 'YES' unit will close and the right hand 'YES' unit will open to give pressure to port 3 of the splitter cylinder.

For individual circuit diagrams, refer to Splitter Air Circuit Diagrams - Logic Valves: Overdrive Transmission, Direct Drive Transmission.

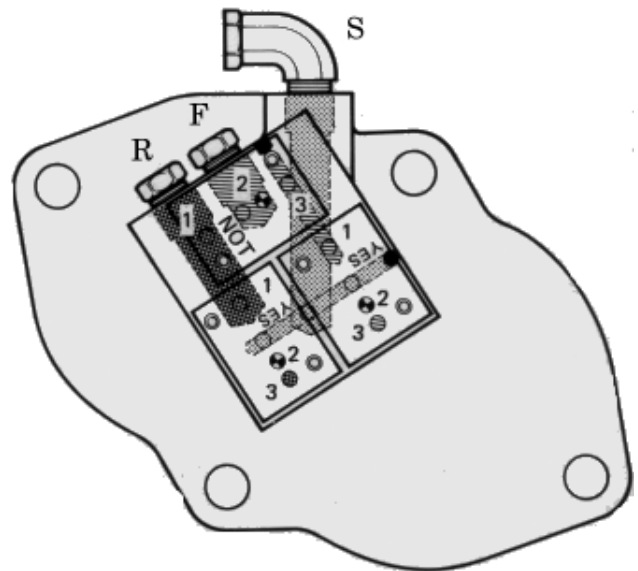


Fig. 1 Splitter Cylinder Cover Internal Drillings

## Air System

# Splitter Cylinder Cover Assembly - Twin Spool Valves

### Twin Spool Valve Unit

The splitter cylinder cover assembly consists of a cast aluminium housing containing two glandless sleeve-and-spool valve assemblies. Each sleeve is supported radially and axially in the cover assembly in 'O' rings, but there are no seals or 'O' rings fitted to the valve spool which relies on extremely close tolerances (1 micron) to form the seal between it and the sleeve, Internal drillings in the housing connect the two valves to one another and the splitter operating cylinder housing.

Three ports marked 'S', 'F' and 'R' connect to the air supply and the splitter selector switch.

Port 'S' receives constant air pressure which is passed to both spool valves and to port 1 of the selector valve. Ports 'F' and 'R' receive signal control air supply from the selector switch, depending on its position.

The upper, shorter spool valve has a single chamber and acts as an ON/OFF switch to port 3 of the splitter cylinder.

The lower, longer, spool valve has two chambers and performs two functions. The left hand chamber acts as an ON/OFF switch to port 2 of the splitter cylinder while the right hand chamber acts as an ON/OFF switch to control the upper spool valve in response to signals to ports F and R from the splitter selector switch.

If signal air pressure is supplied to port 'R' on the housing, the air pressure forces the lower spool valve to the left against spring pressure and uncovers the constant air supply from port 'S' to give pressure to port 2 of the splitter cylinder. In the

circuit diagram it will be seen that in TSO low, port 'F' also receives signal pressure but this is shut off by the lower spool valve and serves no purpose in this range.

When signal air pressure to port 'R' is shut off and the line exhausted out of port 3 on the splitter selector switch, the lower spool valve returns to the right under pressure of the spring. This shuts off the constant air pressure to port 2 of the splitter cylinder, exhausts the line and also opens the signal air supply passage from port 'F' to the upper spool valve. If signal air pressure is now applied to port 'F' the upper spool valve is forced to the left against spring pressure and opens the constant air supply feed to port 3 on the splitter cylinder.

When signal air pressure is shut off from both 'F' and 'R' ports, both spool valves are enabled to return to the right under spring pressure and the lines vented to atmosphere.

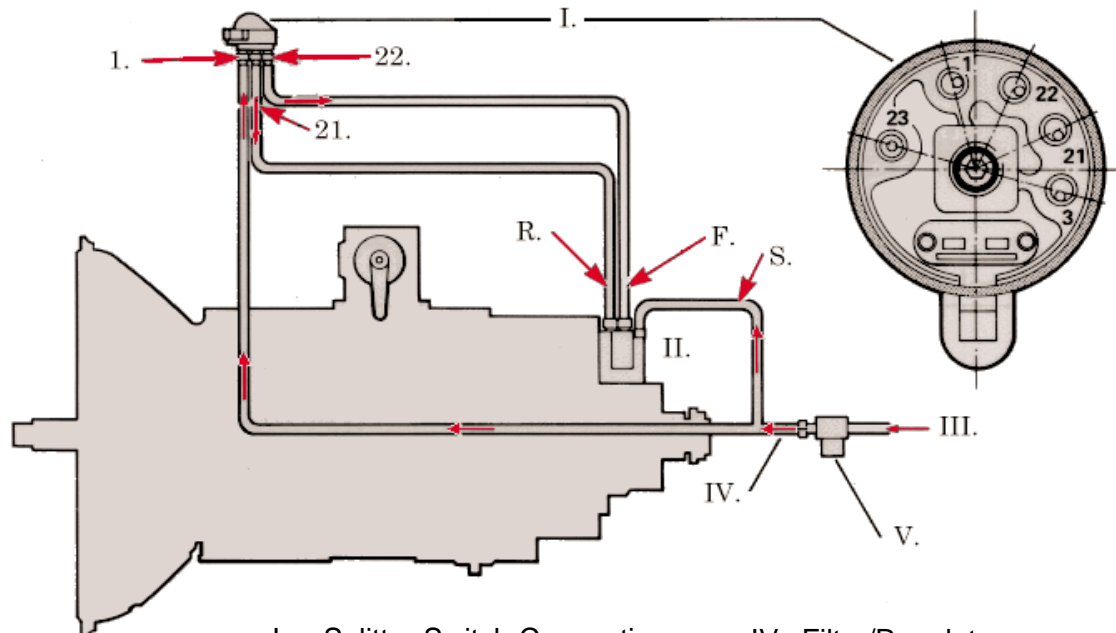
The mechanical functions within the transmission are identical whether a logic valve or a spool valve assembly is fitted.

## Air System

### Splitter System - Splitter Gear Air Line Connections

#### 12 Speed Twin Splitter Transmission Models

#### Overdrive



I. Splitter Switch Connections

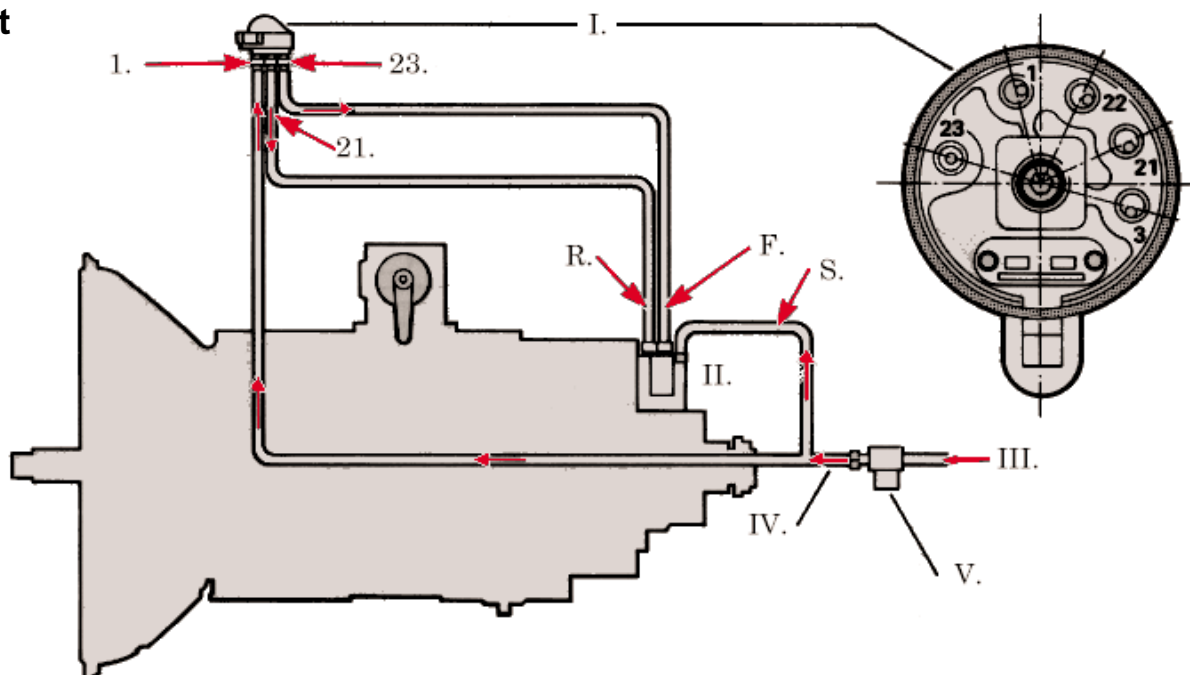
II. Splitter Shift Cylinder

III. Filter/Regulator

IV. Filter/Regulator

V. Regulated Air (5,5 bar)

#### Direct



I. Splitter Switch Connections

II. Splitter Shift Cylinder

III. Filter/Regulator

IV. Filter/Regulator

V. Regulated Air (5,5 bar)

# Air System Splitter Air Circuit Diagrams - Logic Valves

## Overdrive Transmissions

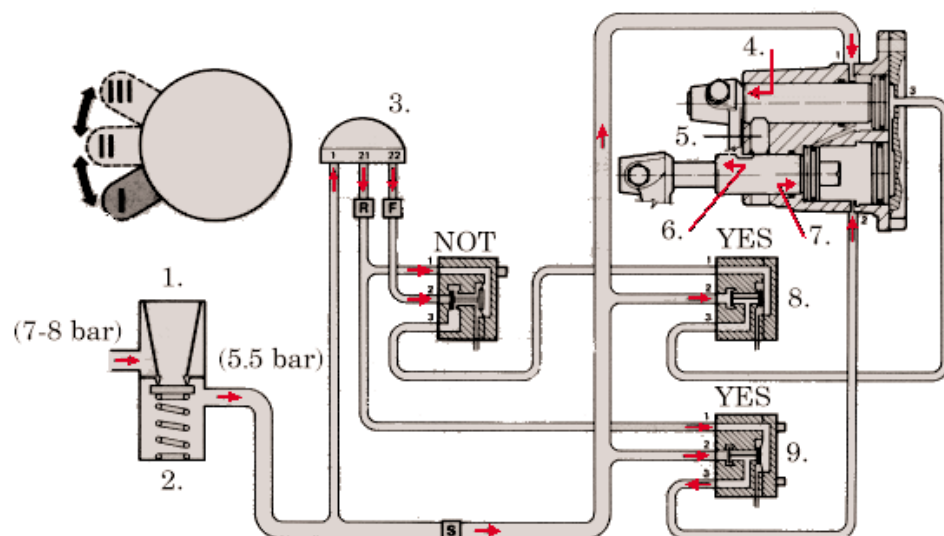


Fig. 1 TSO - Low

1. Filter
2. Regulator
3. Switch
4. Intermediate
5. Interlock Pin
6. Low
7. High
8. Right hand
9. Left hand

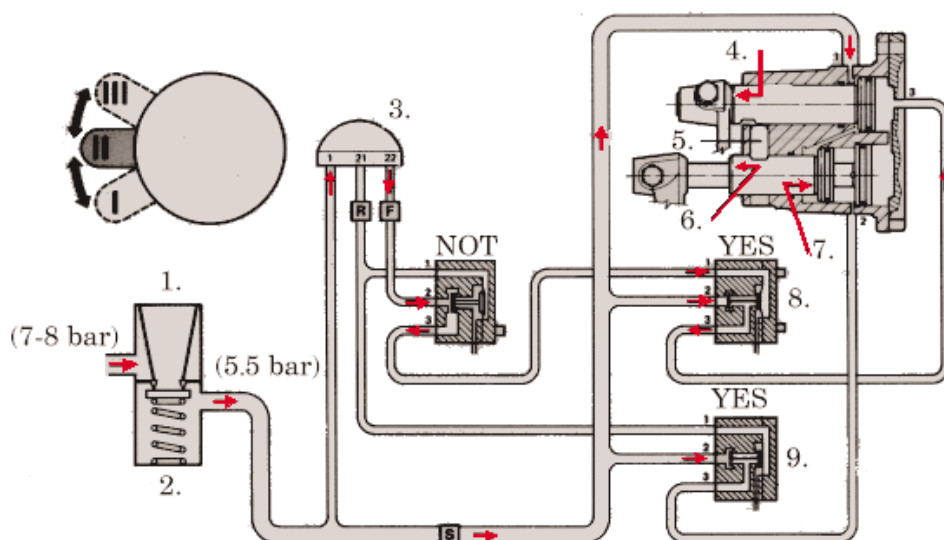


Fig. 2 TSO - Intermediate

1. Filter
2. Regulator
3. Switch
4. Intermediate
5. Interlock Pin
6. Low
7. High
8. Right hand
9. Left hand

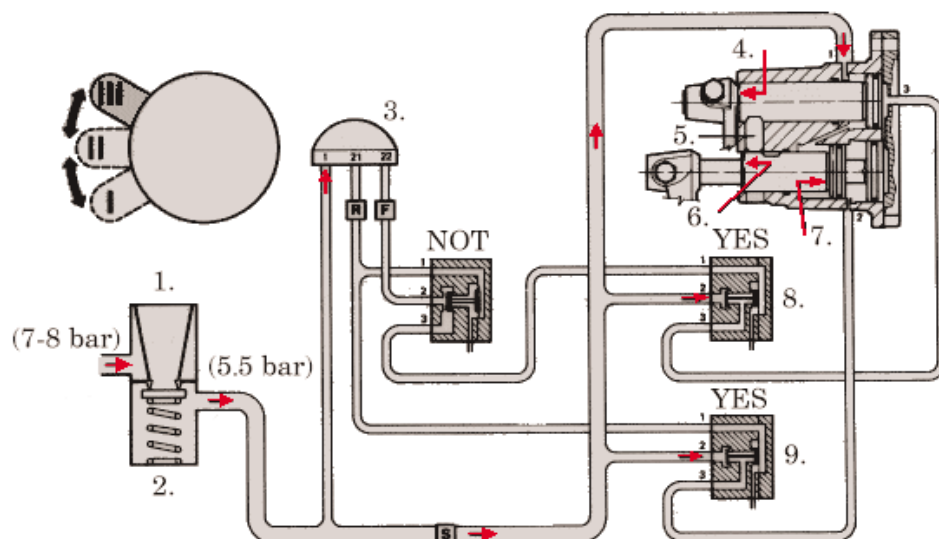


Fig. 3 TSO - High

1. Filter
2. Regulator
3. Switch
4. Intermediate
5. Interlock Pin
6. Low
7. High
8. Right hand
9. Left hand

# Air System

## Direct Drive Transmission

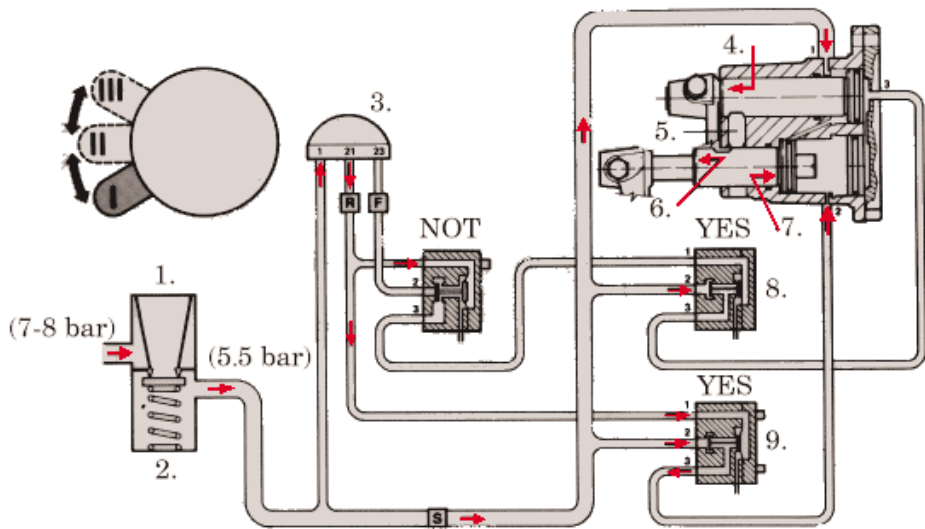


Fig. 1 TS - Low

- 1. Filter
- 2. Regulator
- 3. Switch
- 4. High
- 5. Interlock Pin
- 6. Low
- 7. Intermediate
- 8. Right hand
- 9. Left hand

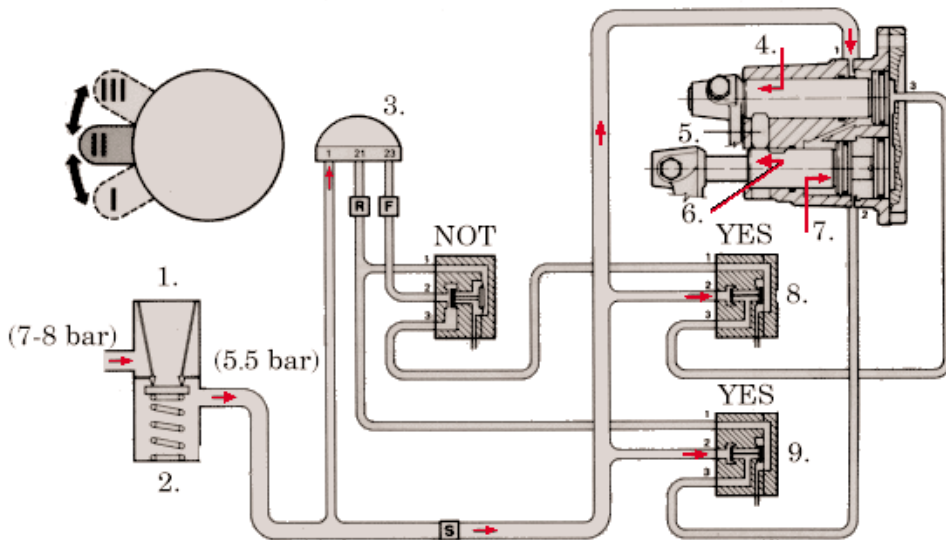


Fig. 2 TS - Intermediate

- 1. Filter
- 2. Regulator
- 3. Switch
- 4. High
- 5. Interlock Pin
- 6. Low
- 7. Intermediate
- 8. Right hand
- 9. Left hand

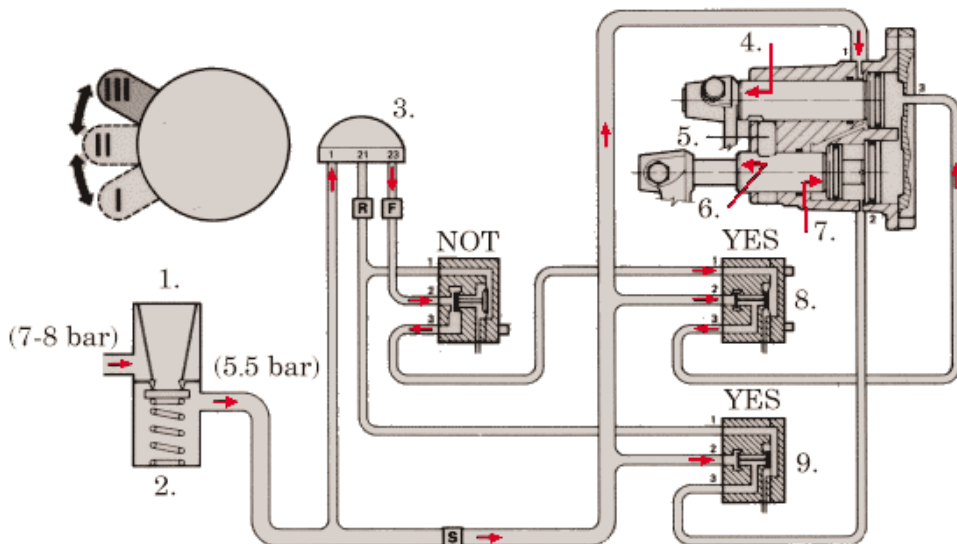


Fig. 3 TS - High

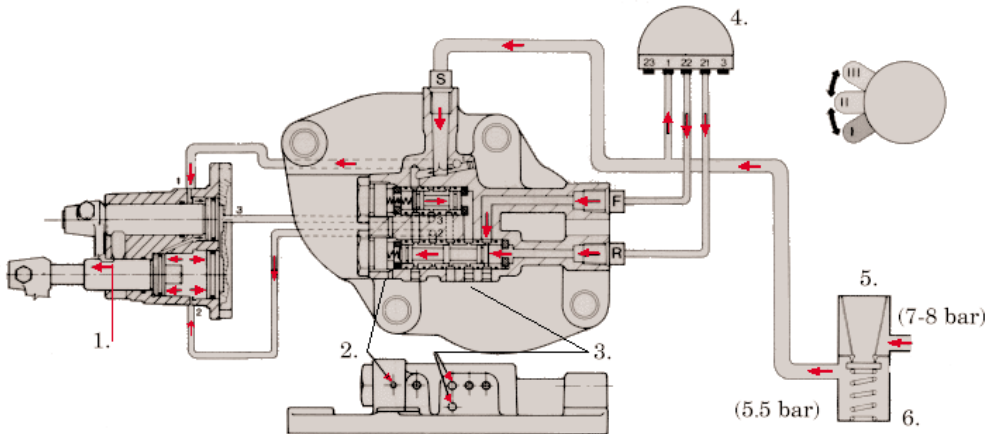
- 1. Filter
- 2. Regulator
- 3. Switch
- 4. High
- 5. Interlock Pin
- 6. Low
- 7. Intermediate
- 8. Right hand
- 9. Left hand



# Air System

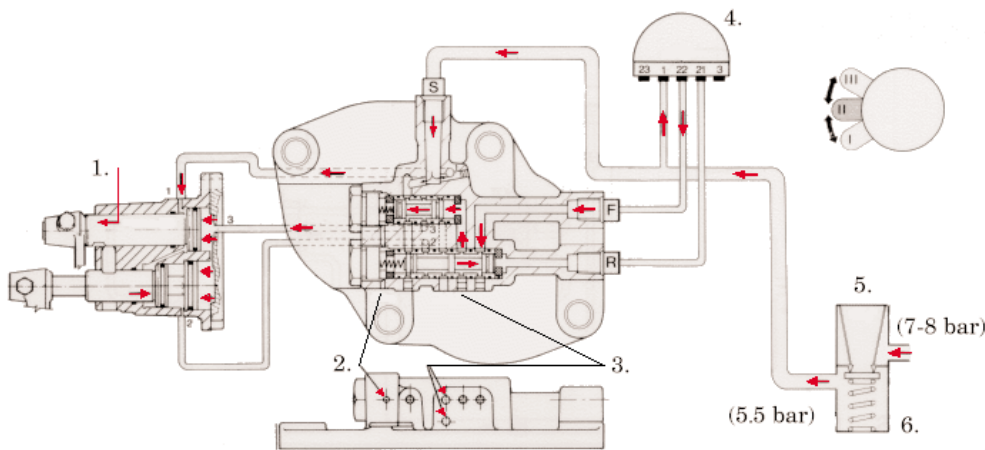
## Splitter Air Circuit Diagrams - Twin Spool Valves

### Overdrive Transmission



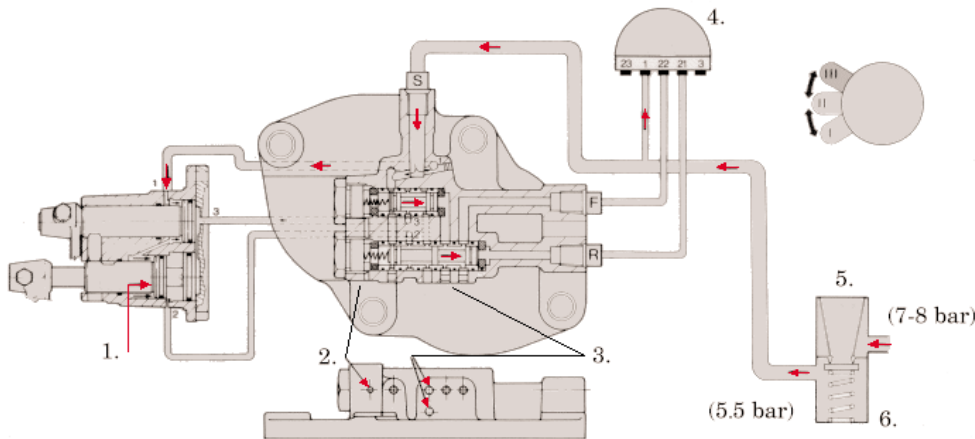
**Fig. 1 TSO - Low**

- Low
- Vent
- Exhaust
- Switch
- Filter
- Regulator



**Fig. 2 TSO - Intermediate**

- Intermediate
- Vent
- Exhaust
- Switch
- Filter
- Regulator

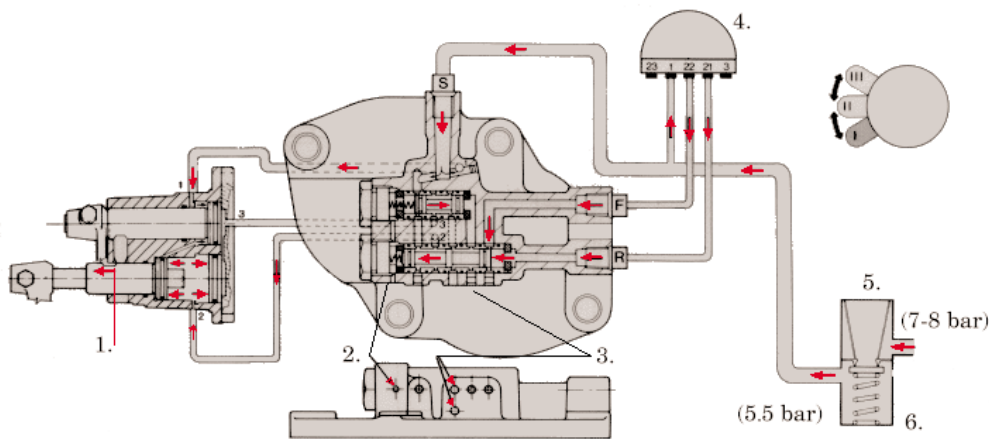


**Fig. 3 TSO - High**

- High
- Vent
- Exhaust
- Switch
- Filter
- Regulator

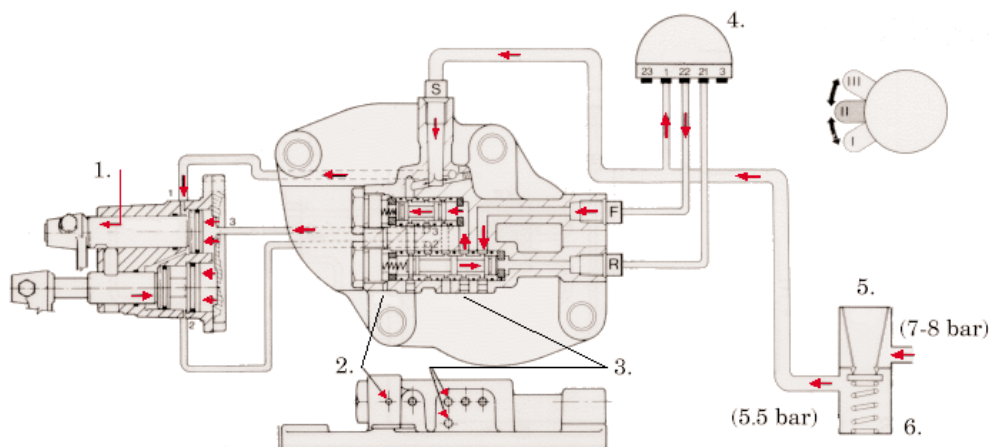
## Air System

### Direct Drive Transmission



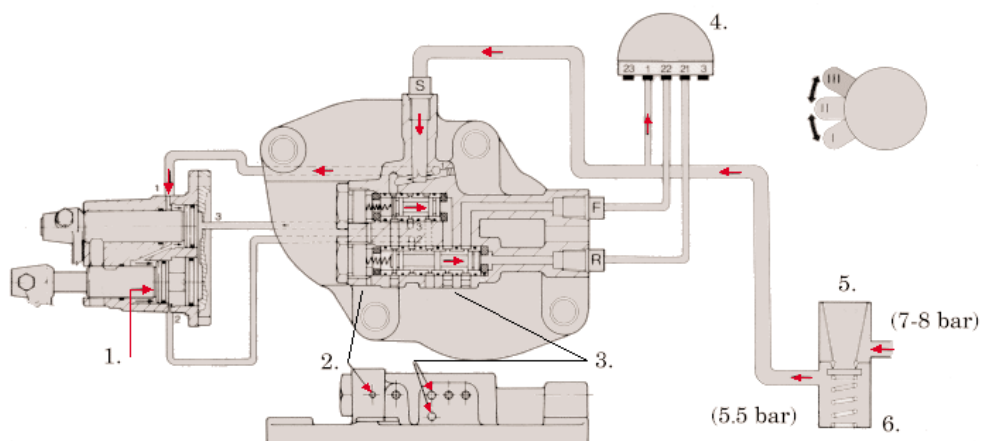
**Fig. 1 TS - Low**

- 1. Low**
- 2. Vent**
- 3. Exhaust**
- 4. Switch**
- 5. Filter**
- 6. Regulator**



**Fig. 2 TS - Intermediate**

- 1. Intermediate**
- 2. Vent**
- 3. Exhaust**
- 4. Switch**
- 5. Filter**
- 6. Regulator**



**Fig. 3 TS - High**

- 1. High**
- 2. Vent**
- 3. Exhaust**
- 4. Switch**
- 5. Filter**
- 6. Regulator**



# Air System

## Splitter Cylinders

### Disassembly and Reassembly

(Cylinder removed from transmission)

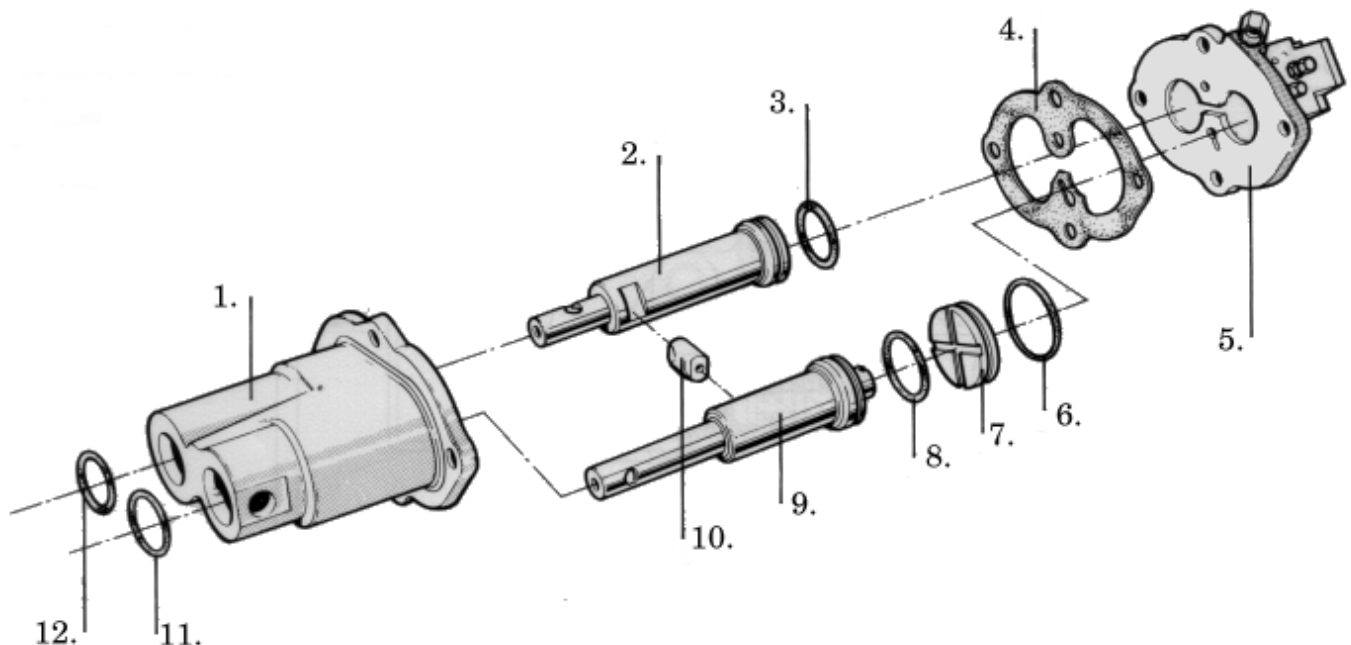
1. Push or tap out the longer shift bar (with the double piston) from the splitter cylinder.
2. Push or tap out the second piston from the splitter cylinder.
3. Remove the interlock pin.
4. Remove the O rings from the cylinder bores and the sealing rings from the pistons. Clean all parts.

2. Carefully install the single piston (with the shorter shift bar) into the cylinder. Position the piston so that the slot is aligned with the interlock pin bore.
3. Install the interlock pin, pushing it fully home and ensuring that the chamfered end is correctly aligned into the slot in the piston shaft.
4. Install the inner piston into the second bore, followed by the outer piston. Push the outer piston into by bore until flush with the face of the cylinder.
5. Protect the assembly from ingress of dirt until ready for reinstallation.

### Reassembly

1. Assemble the new O rings into the cylinder bores using a light application of silicone lubricant, assemble new sealing rings to the pistons using a light application of silicone lubricant. Excessive lubricant causes contamination in the splitter valves and adversely affects the performance.

### Splitter Cylinder Assembly - Exploded View



1. Splitter Cylinder
2. Piston
3. Seal ring
4. Gasket

5. Cover assembly
6. Seal ring
7. Piston (neutral stop)
8. Seal ring

9. Piston
10. Interlock pin
11. O ring
12. O ring

# Air System

## Splitter Air Circuit Diagrams - Logic Valves

### Troubleshooting Hints

#### Checking operation of YES and NOT logic valve units

Each unit is fitted with two, small, coloured indicator plungers, one red and one green.

These indicators 'pop out' approximately 3,0 mm upon initial application of air pressure and remain 'out' unless pushed back in by hand for checking/trouble shooting purposes. In all cases the Red indicator is on the output port 3, and the Green indicator on the input signal port 1.

Referring to the air circuit diagram it will be seen that with air pressure to the supply port 'S' only, all six indicators on the three logic valve units should be able to be pushed in.

If signal pressure is applied to port 'F' the Red indicator on the NOT unit and the Green and Red indicators on the right hand YES unit should 'pop out' and feel to be under pressure if an attempt is made to push them back in.

If signal pressure is now also applied to port 'R' as well as port 'F'; the Green indicator on the NOT unit and the Green Red indicators on the left hand YES unit should 'pop out' and felt to be under pressure. Additionally it should now be possible to push in the Red indicator on the NOT unit and the Red and Green indicators on the right hand YES unit. Table 1 indicates the plungers which should be under pressure when a particular range is selected.

TSO			
	NOT	L/H YES	R/H YES
Low	Green	Green/Red	No
Int	Red	No	Green/Red
High	No	No	No

TS			
	Green	Green/Red	No
Low	Green	Green/Red	No
Int	No	No	No
High	Red	No	Green/Red

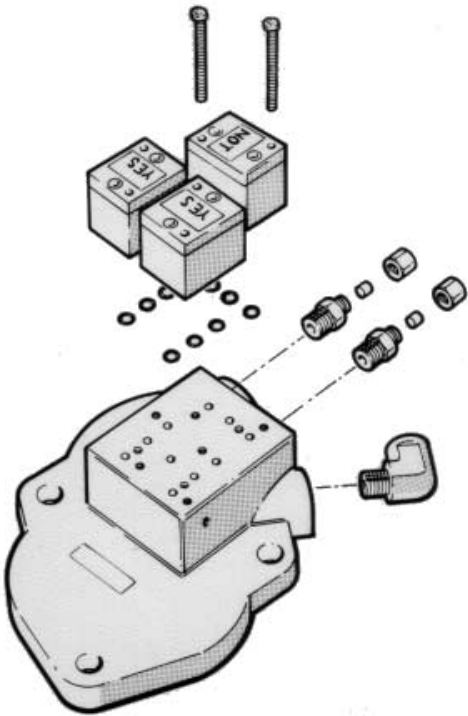
**Table 1:** Logic valve units indicator plunger checking chart

Air leaks from the valve unit exhaust port(s) could indicate either a leaking valve unit diaphragm or valve seat, or a leaking splitter control piston O ring.

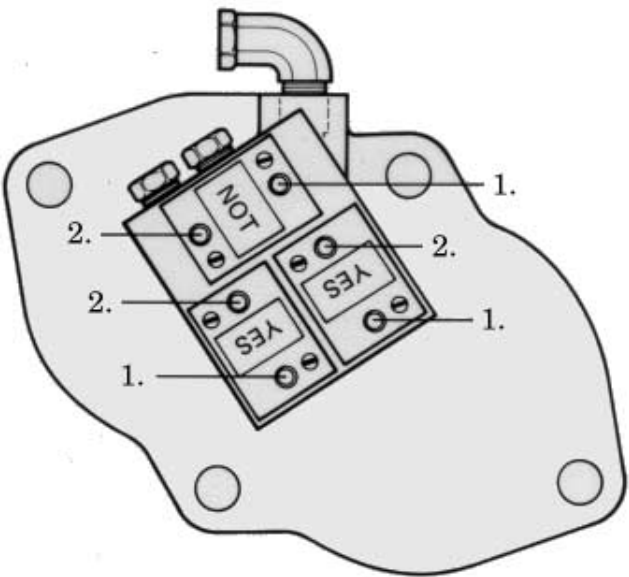
If the valve unit is at fault it must be renewed

To renew a valve unit, remove the two screws and remove the unit from the splitter cylinder cover assembly.

Note the position of the location pip when installing the valve. Always fit new O rings.



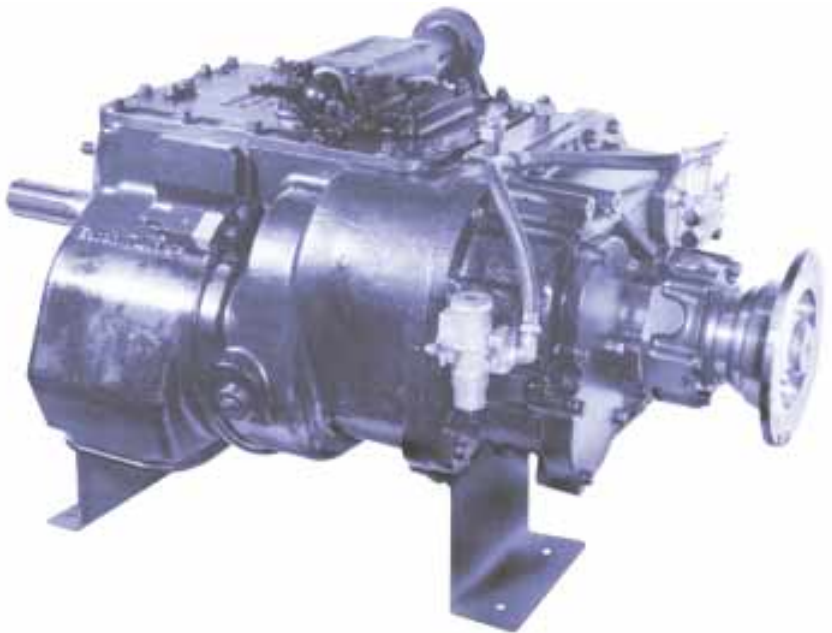
**Fig. 1** Splitter Cylinder Cover - Exploded View.



1. Red 2. Green

**Fig. 2** Logic valve units indicator plungers.

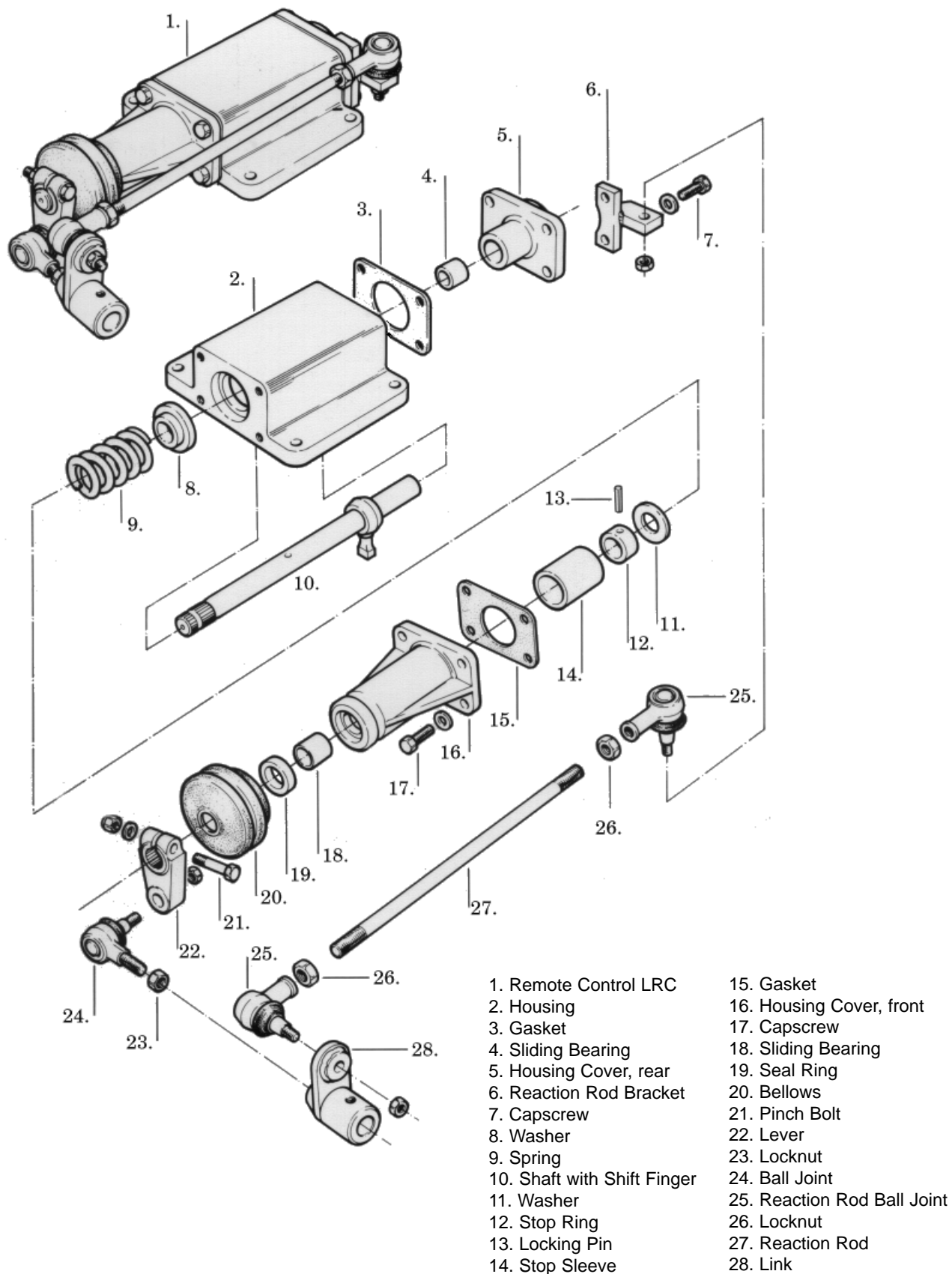
## Section 3      Shifting Controls



# Shifting Controls

## Shift Bar Housing - Single 'H' Shift

### Remote Control (LRC) - Single 'H' Shift - Exploded View

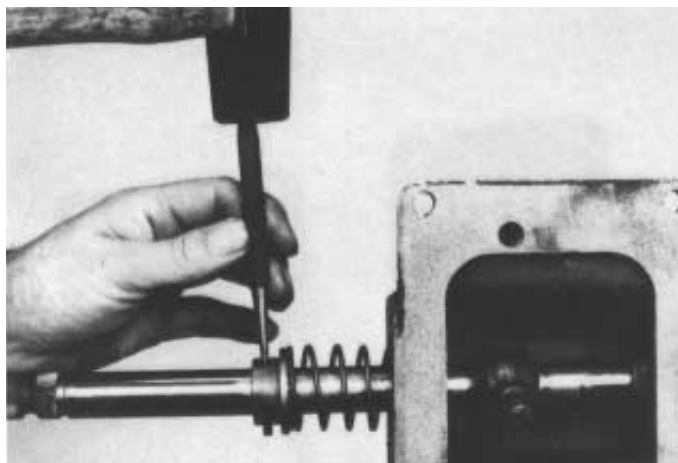


## Shifting Controls

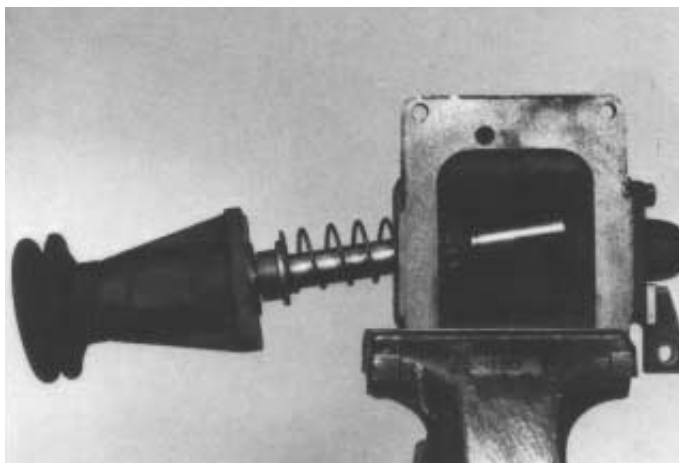
### A. Disassembly of Remote Control (LRC)



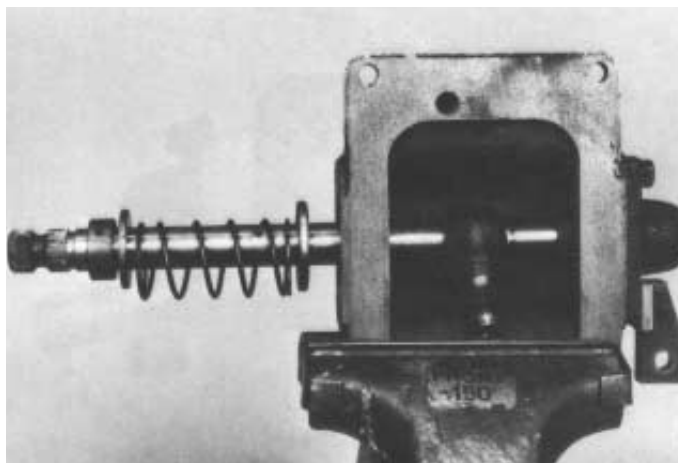
1. Remove the remote control from the shift bar housing, remove the shift lever and reaction rod



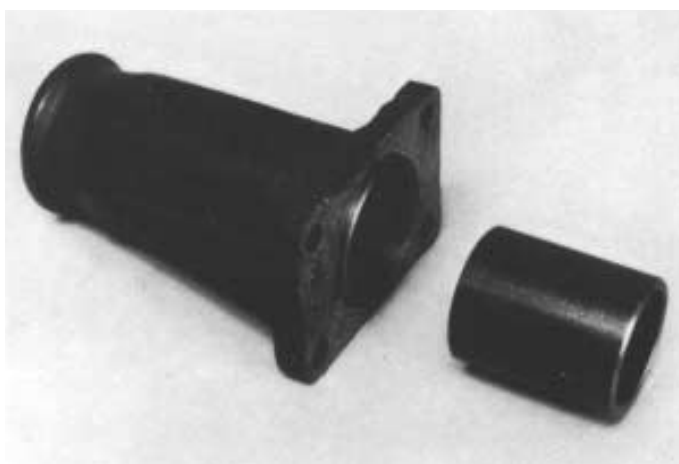
4. Drive out the locking pin from the stop ring.



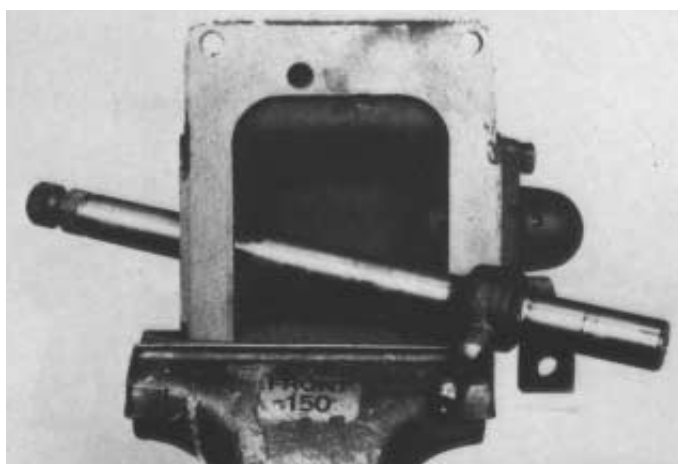
2. Remove the housing front cover.



5. Remove the stop ring, spring and lockwasher.



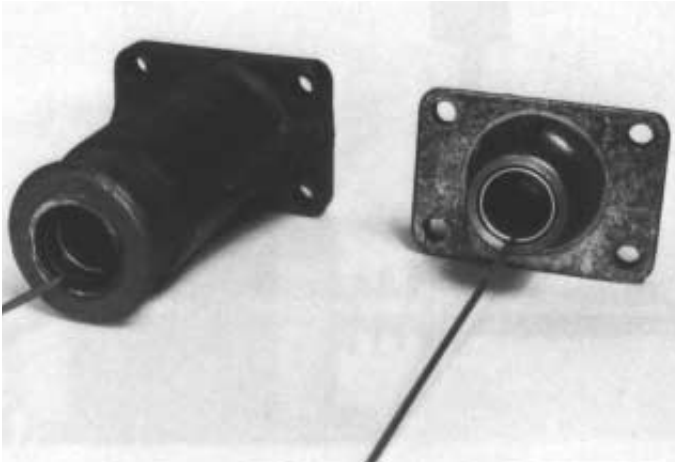
3. Remove the stop sleeve from the housing front cover.



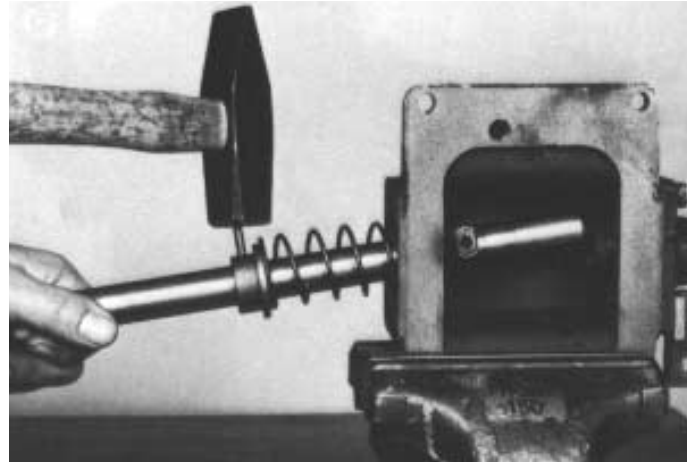
6. Manoeuvre the shift shaft and finger out of the housing. Remove the housing rear cover and reaction rod bracket.

## Shifting Controls

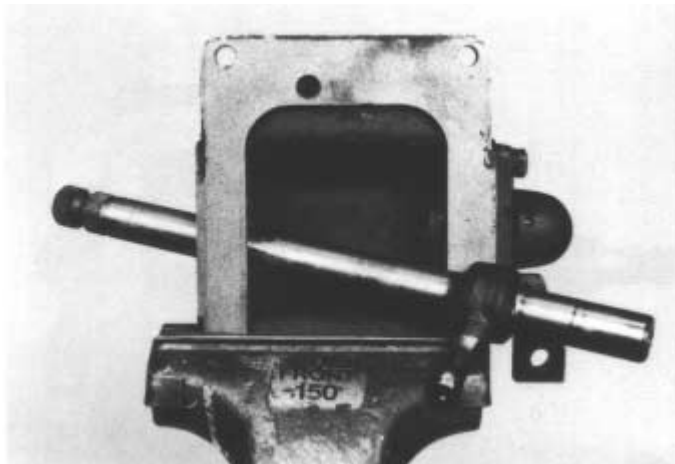
### B. Reassembly of Remote Control (LRC)



7. If necessary renew the sliding bearings and the seal ring in the housing front cover.



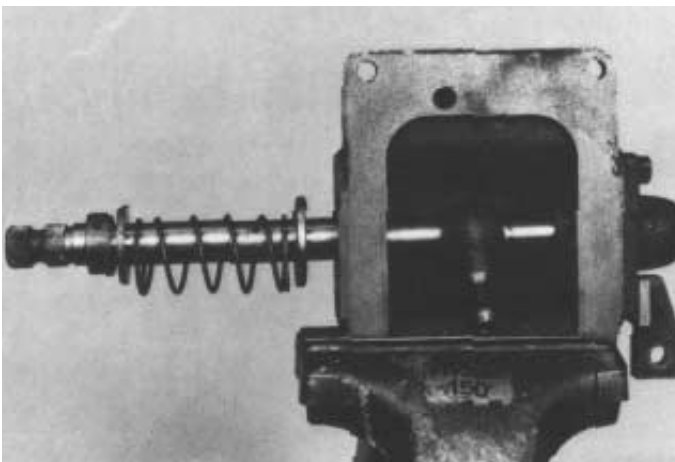
10. Drive in a new stop ring lock pin.



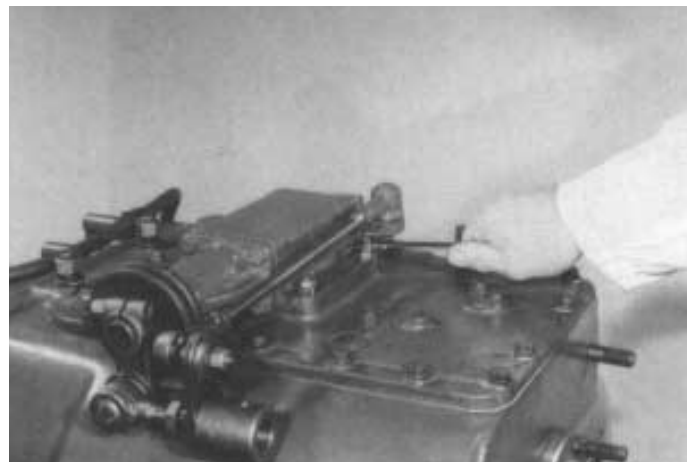
8. Fit the housing rear cover and reaction rod bracket. Install the shift shaft and finger into the housing.



11. Install the stop sleeve into the housing front cover.



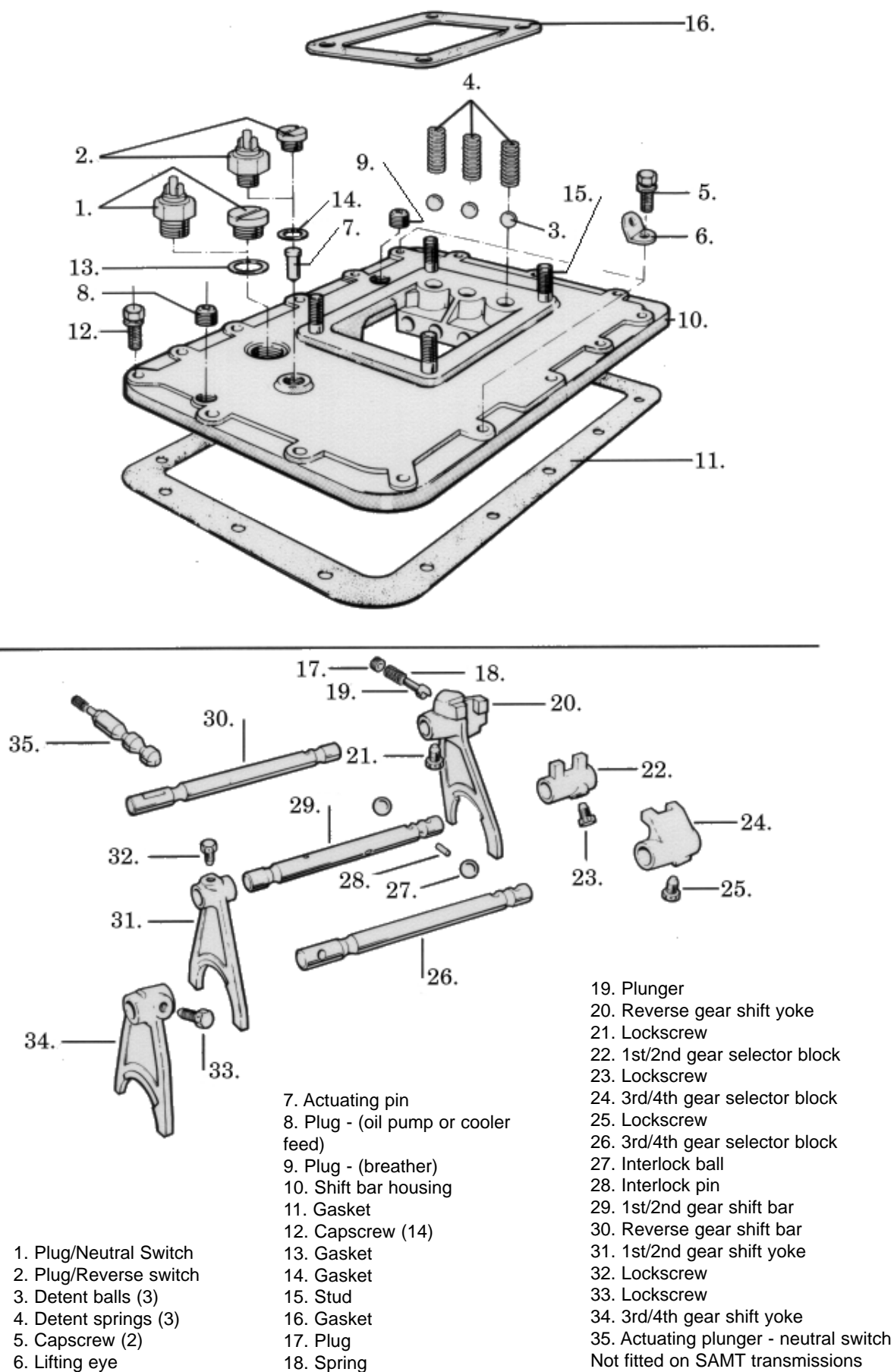
9. Assemble the lockwasher, spring stop washer and stop ring over the shaft.



12. Install the housing front cover. Refit the shift lever and reaction rod and install the remote control onto the shift bar housing.

## Shifting Controls

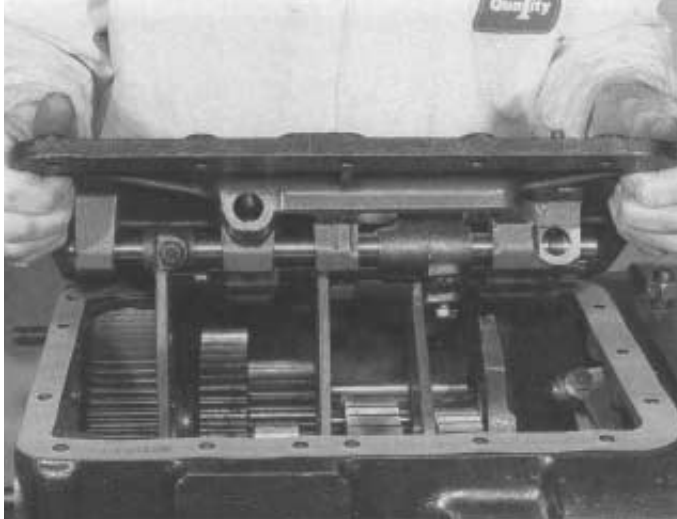
### Shift Bar Housing Assembly - Exploded View



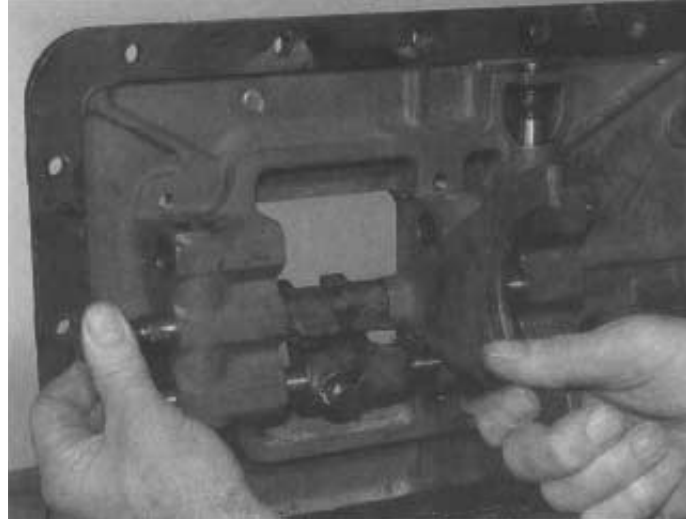


## Shifting Controls

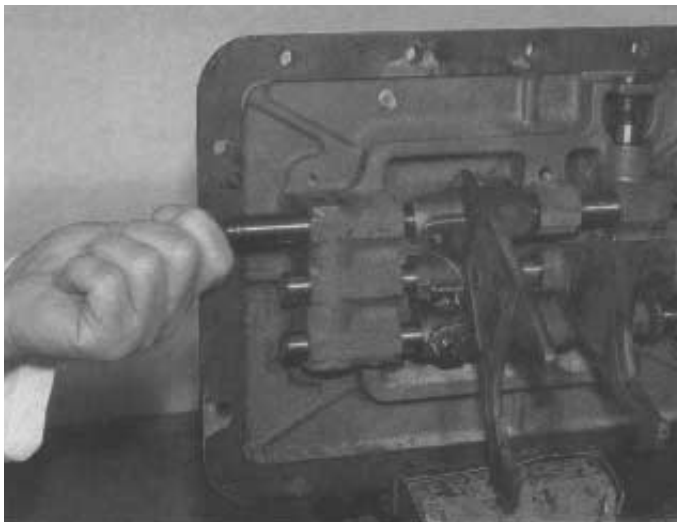
### A. Removal and Disassembly



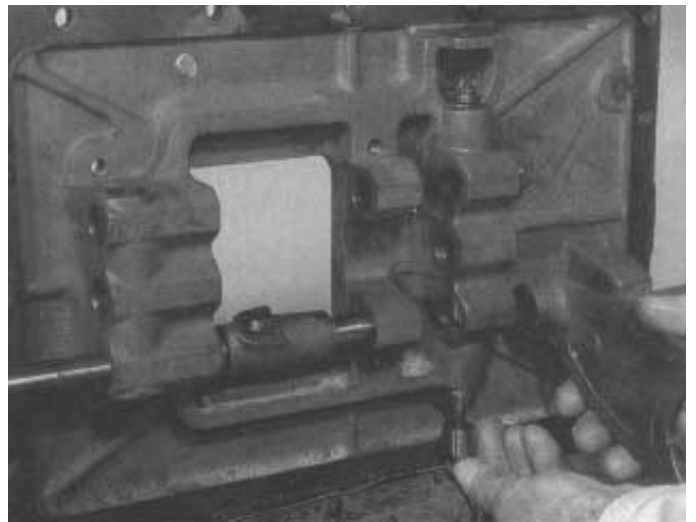
1. Make sure that the shift bars are in the neutral position. Remove the three detent springs. Remove the retaining capscrews and lift off the shift bar housing. Invert the housing and release the detent balls by tapping the housing lightly.



3. Remove the 1st/2nd selector block lock screw slide the yoke with the bar into the aperture and remove the yoke lock screw (from the top side of the housing). Remove the block, bar gate and yoke. As the notch clears the housing remove the interlock pin from the shift bar.



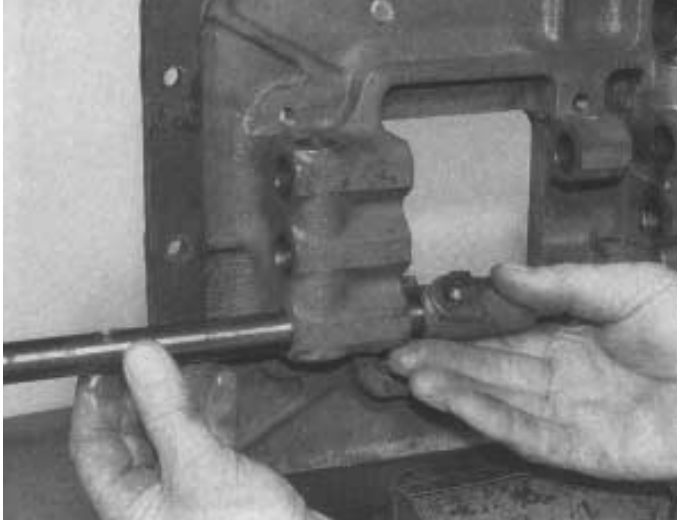
2. Mount the housing in a vice fitted with protected jaws, rear end of housing to the left. Cut and remove all lockwires. Remove the reverse yoke lock screws and remove the reverse shift bar and yoke.



4. Remove the 3rd/4th selector block and yoke lock screws, remove the yoke. Slide the shift bar out to the right collecting the two interlock balls.



## Shifting Controls



5. As the shift bar clears the actuating plunger boss, remove the actuating plunger, spring and retaining cup.

**Note:** These parts are not fitted on SAMT transmissions.

## B. Reassembly and Installation



1. If previously removed, install the reverse stop plunger in the reverse yoke. Ensure that the plunger is fully seated in the bore.



6. If necessary support the reverse yoke in the vice and remove the reverse stop plunger plug.

Caution: The plug is under spring pressure.

**Note:** Plunger and spring are not fitted in the SAMT transmission.

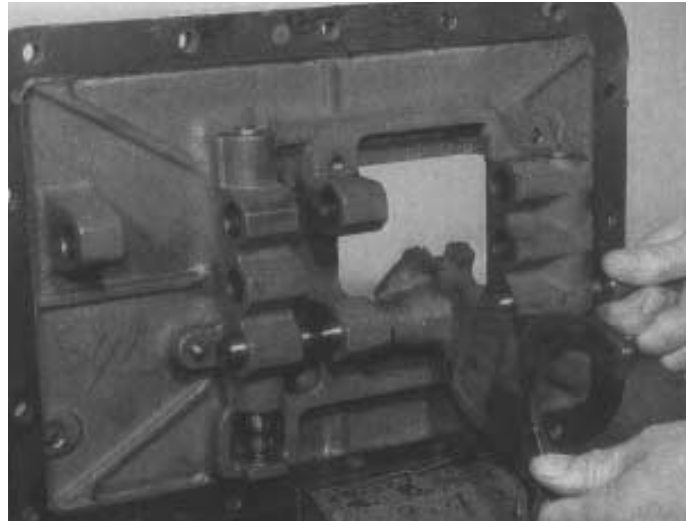


2. Install the spring in the bore and on the plunger.

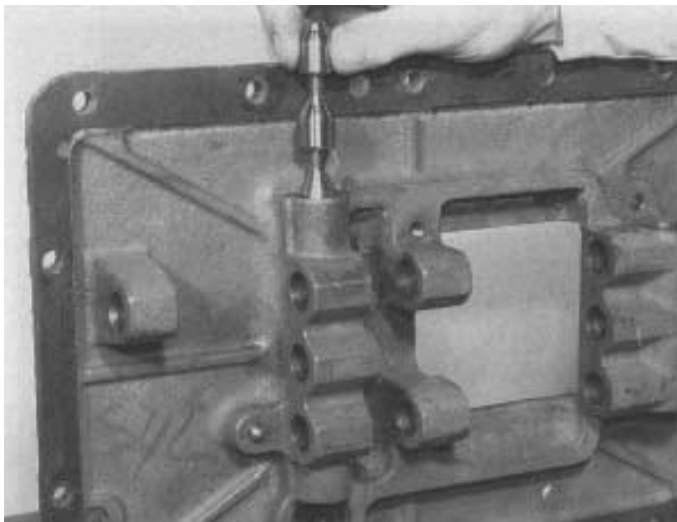
## Shifting Controls



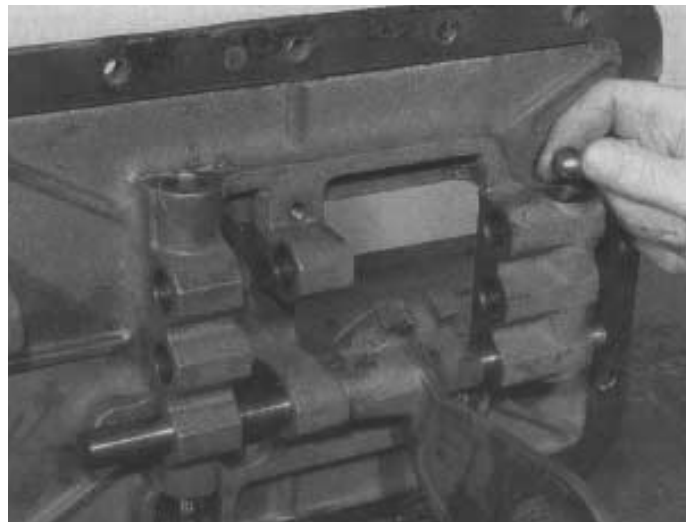
3. Install the plug. Tighten the plug until flush with the yoke then unscrew 1 to 1 1/2 turns. Stake the plug threads through the hole in the yoke to secure.



5. Push down the actuating plunger and install the reverse gear shift bar and yoke. Tighten the lockscrew to the correct torque and lockwire to secure.

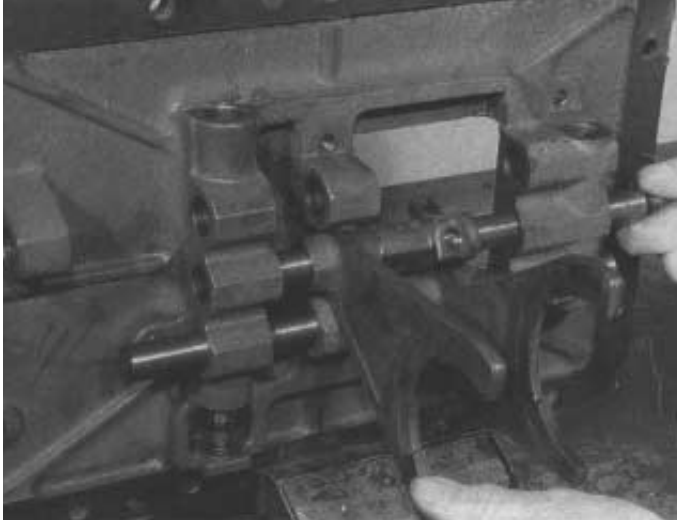


4. Mount the shift bar housing in the vice, rear end of the housing to the right i.e. the opposite way to disassembly. Install the neutral switch actuating plunger, spring and spring retaining cup.

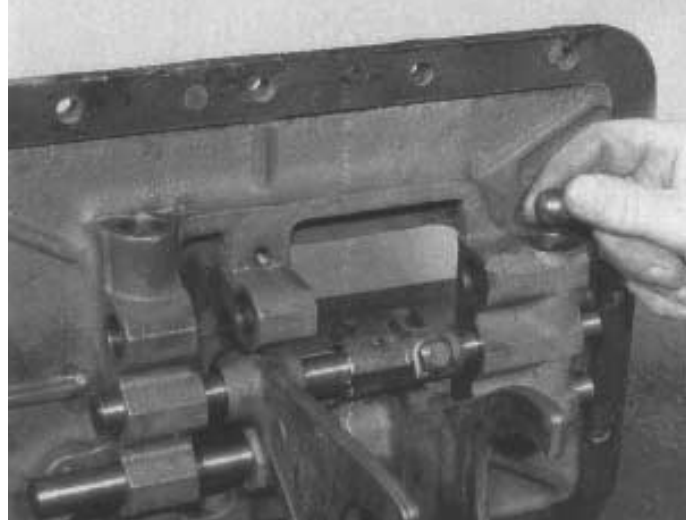


6. Install one of the interlock balls in the housing bore. Ensure that the reverse shift bar is in the neutral position and that the ball is resting in the neutral notch in the bar.

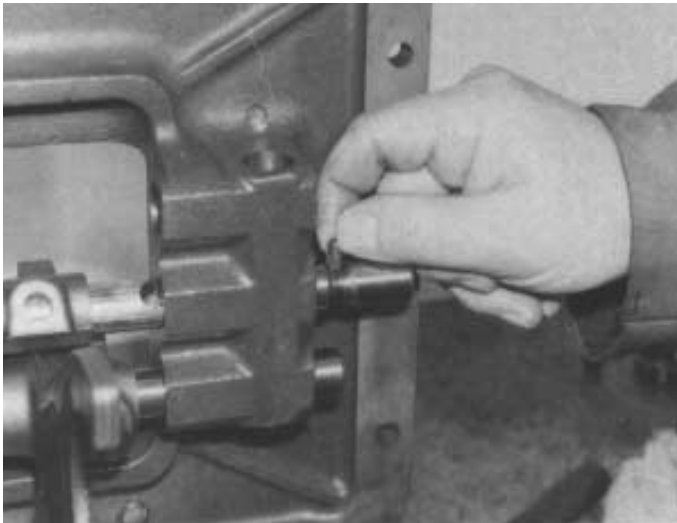
## Shifting Controls



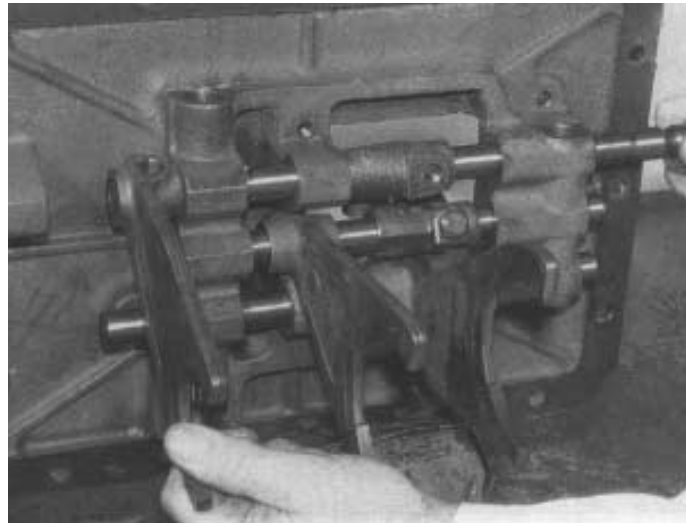
7. Insert the 1st/2nd gear shift block and shift bar into the housing. Insert the shift bar from the right. Install the yoke on the bar, larger offset to the left.



9. Install the second interlock ball.



8. Insert the interlock pin into the bar using grease to hold it in place, and push the bar through until the yoke lockscrew can be installed. Tighten the lockscrew to the correct torque and lockwire to secure. Slide the yoke and bar to the neutral position and install the block lockscrew. Tighten to the correct torque and lockwire to secure.



10. Install the 3rd/4th gear shift bar and block. Install the yoke, longer offset to the right. Tighten the lockscrews to the correct torque and lockwire to secure. Check to ensure interlock only allows one shift yoke to move at a time and remove the housing from the vice.

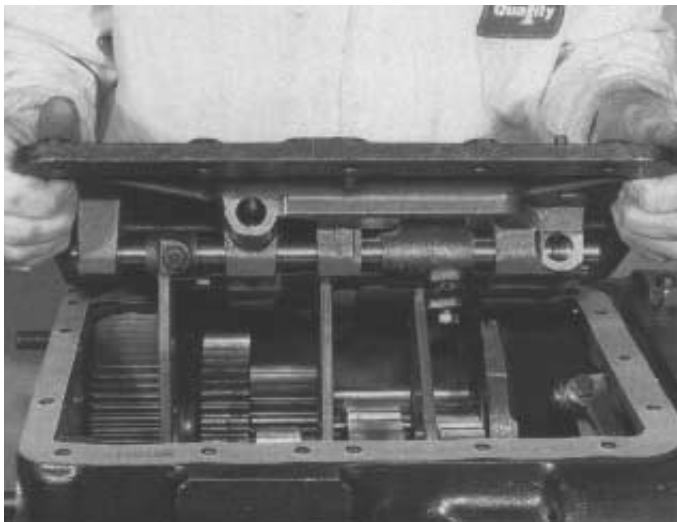
## Shifting Controls



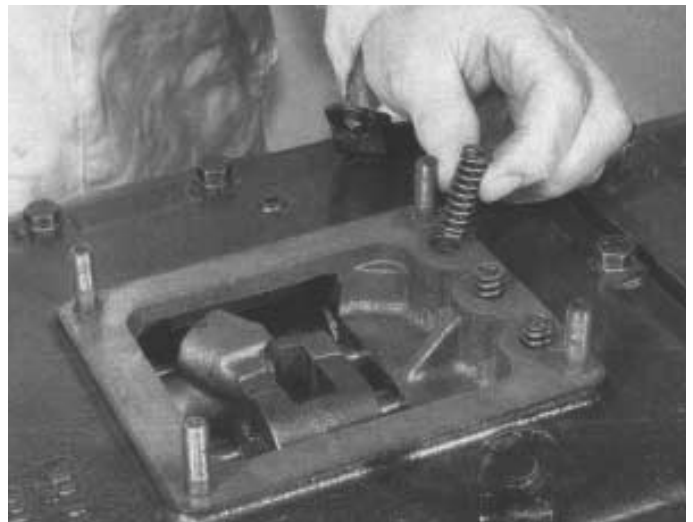
11. Install the three detent balls into the shift bar housing bores.



13. Install the retaining capscrews and lifting eyes. Note the position of the lifting eyes and the corresponding longer capscrews. **Note:** It is essential that the long capscrews are installed in the correct positions or they may otherwise jam on the countershaft gear teeth. Tighten the capscrews to the correct torque.

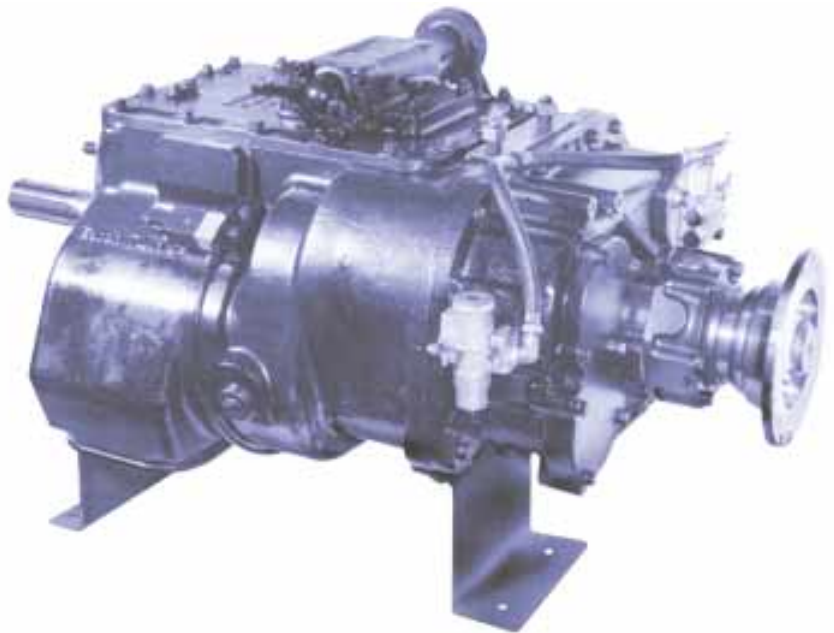


12. Ensure the sliding clutches and the shift yokes are in the neutral position and install the shift bar housing and gasket on to the main transmission housing.



14. Ensure all the shift bars are in neutral and install the three detent springs in the bores.

## **Section 4      Main Transmission**



# Main Transmission

## A. Removal/Disassembly of Auxiliary Section

### Caution: Drain Gear Oil

Note: The overdrive auxiliary section is shown in the following steps. The procedure is the same for the direct version except that the actual gear sizes in respect to the number of teeth on each gear will differ from these illustrated. In order to avoid confusion between the functions of any particular gear in the auxiliary section of either model, i.e. high/low/intermediate/overdrive, the splitter gears installed on the main shaft will be referred to by their relative positions, not their functions.



1. Remove the shift bar housing assembly. Remove the lockwire and lockscrew from the splitter yoke.

**Caution:** Take care not to allow the lockscrew to drop into the case

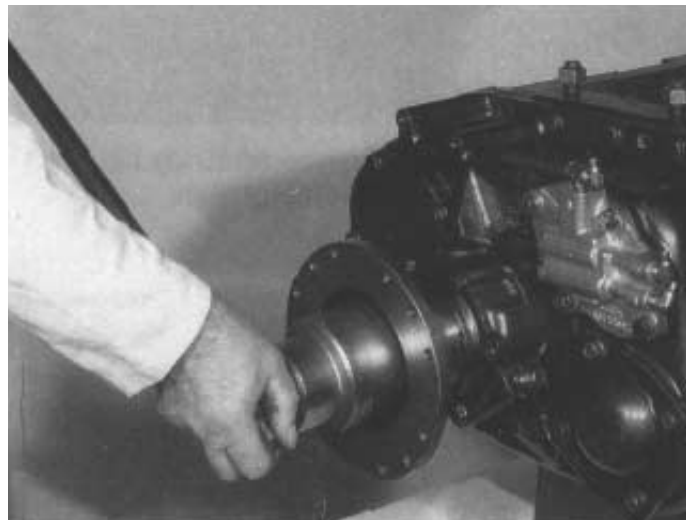


3. Disconnect the air hose from the splitter valve and remove the regulator and hose.



2. Insert two wooden wedges between the reverse gear and the housing webs. This is to prevent the mainshaft moving backward allowing the front thrust race pack to be dislodged.

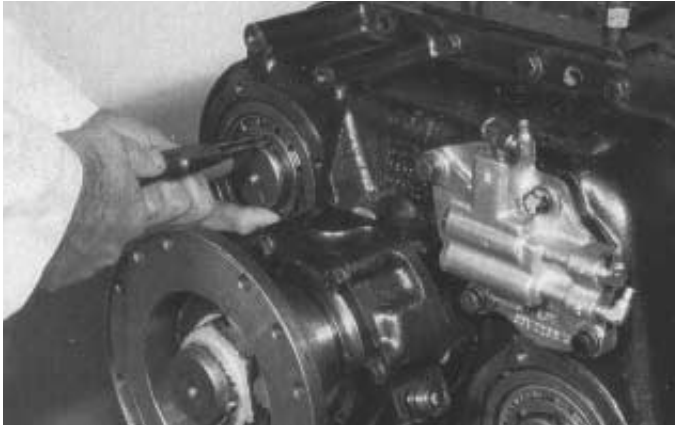
**Note:** On SAMT transmissions, the speed transducers must be removed from the transmission case.



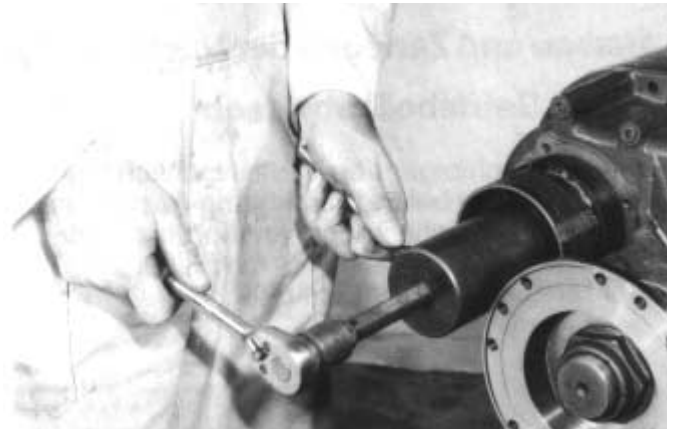
4. Remove the speedometer drive pinion. Engage two gears in the main transmission and low (if not already engaged) in the auxiliary section. Slacken but do not remove the flange securing nut.



## Main Transmission



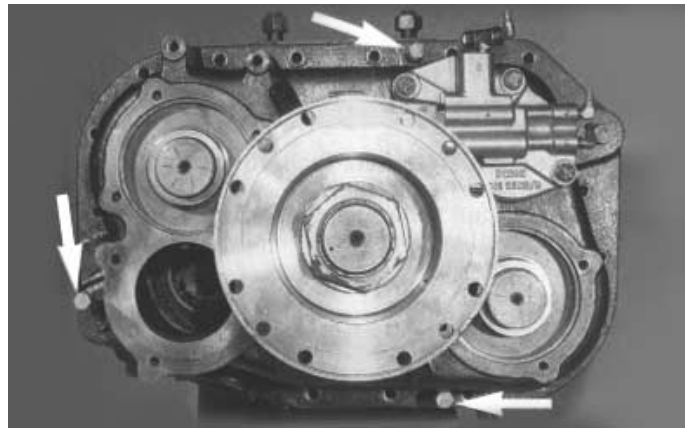
5. Remove the lower (right-hand) auxiliary countershaft rear bearing cover. Remove the upper (left-hand) auxiliary countershaft rear bearing cover/PTO cover. Remove the snap rings from the rear of both auxiliary countershafts.



8. Remove the snap ring from the bearings. Remove both bearings using the special puller engaged into the snap ring groove.



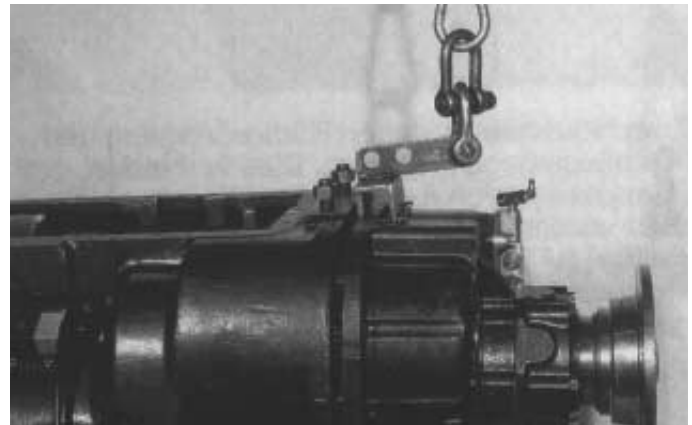
6. Remove the bearing spacers from the rear of both auxiliary countershafts.



9. Remove the auxiliary housing retaining bolts (Note the positions of the two longer bolts). Using three M10 x 37mm bolts into the three threaded holes as pullers, jack the auxiliary housing away from the main case.



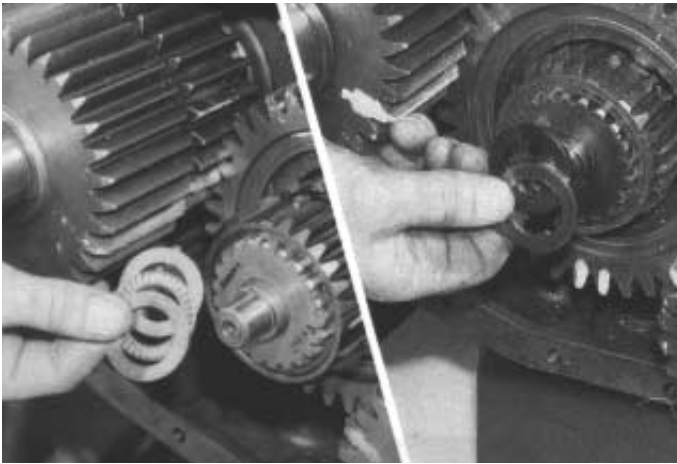
7. Using a suitable lever, prise both auxiliary countershafts rearward to expose the snap rings on the two rear bearings.



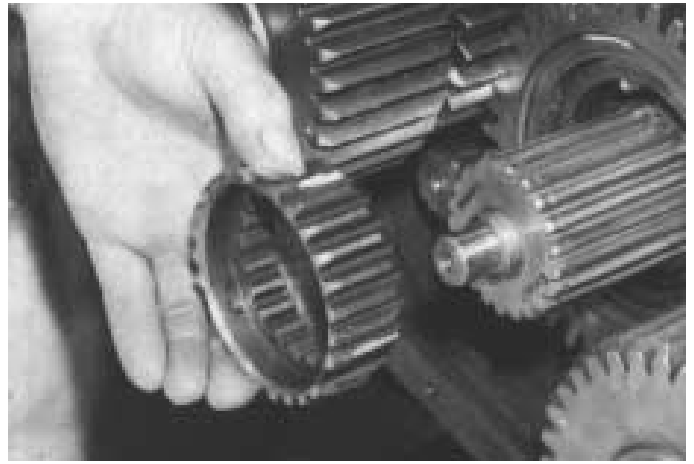
10. Attach the special lifting bracket and using a hoist remove the auxiliary housing.

**Note:** Guide the centre gear cluster yoke off the selector bar as the housing is removed.

## Main Transmission



11. Remove the mainshaft rear thrust bearing pack (one standard washer, one thrust race and one graded washer OR one vespel washer and one graded washer) from the mainshaft rear spigot.



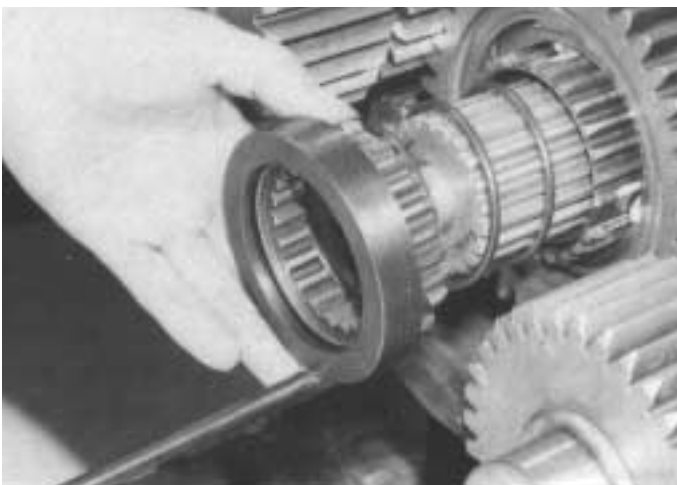
14. Push the centre gear cluster forward and remove the centre jaw clutch.



12. Using the jaw clutch spring compressor remove the snap ring from the rear of the mainshaft.



15. Remove the centre gear cluster selector yoke.



13. Remove the rear jaw clutch and spring from the mainshaft.



## Main Transmission



16. Slide the centre gear cluster rearward again approximately 25mm. Slide the upper (left-hand) auxiliary countershaft rearward approximately 12mm.

Lay a 20mm diameter rod (arrowed) under the lower (right-hand) auxiliary countershaft and push it into the hole in the casing web. Slide the auxiliary countershaft rearward until clear of its front bearing and support it on the rod.

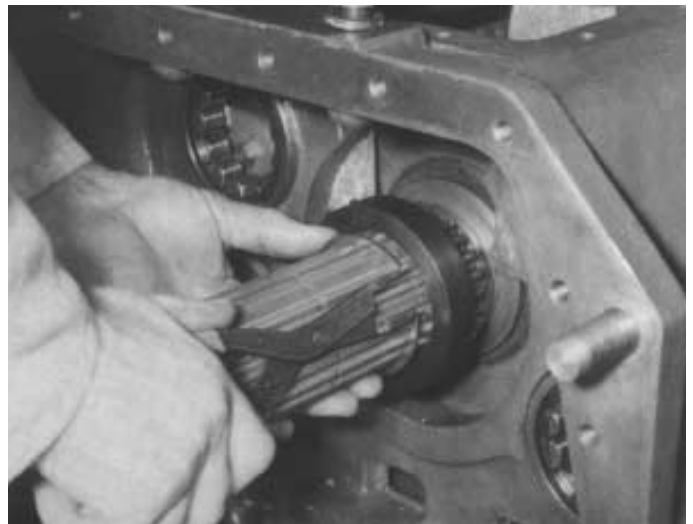


18. Lift out the lower (right-hand) auxiliary countershaft. Remove the support rod. Slide out the upper (left-hand) auxiliary countershaft. Remove the snap ring from the mainshaft.



17. **Carefully** manoeuvre the centre gear cluster out between the teeth of the two auxiliary countershafts and remove it from the housing.

**Note:** A snap ring on the mainshaft will restrict the gear cluster from sliding along it easily during removal.

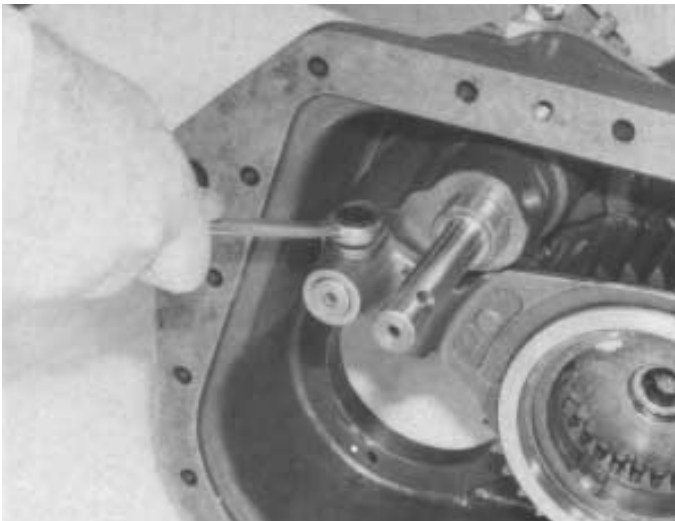
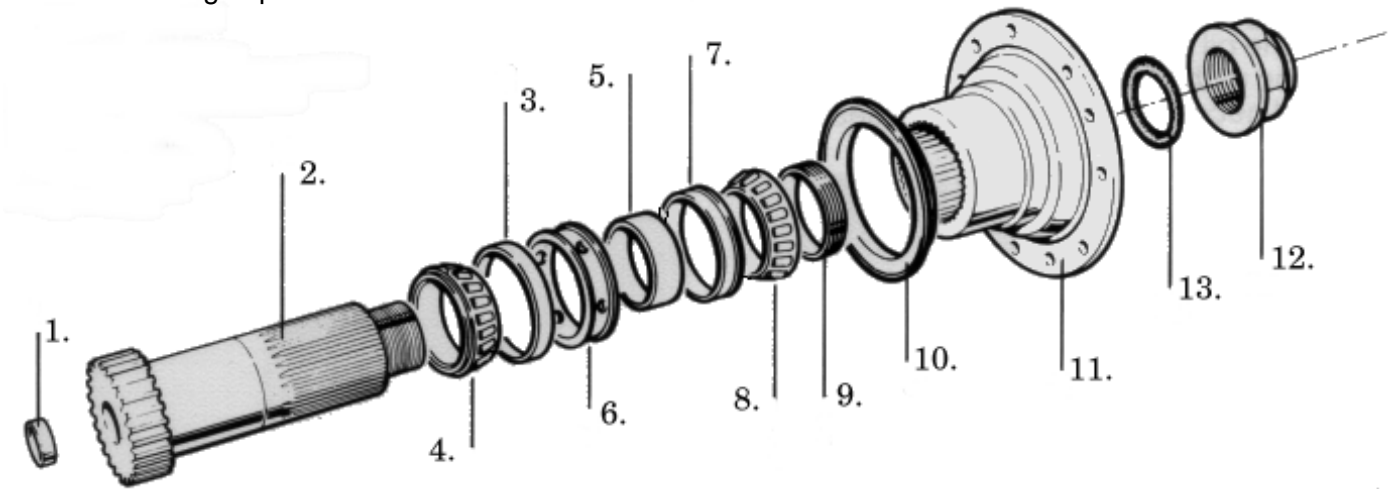


19. Using the jaw clutch spring compressor tool, compress the spring and remove the front jaw clutch retaining snap ring. Remove the jaw clutch, spring and spring retainer.

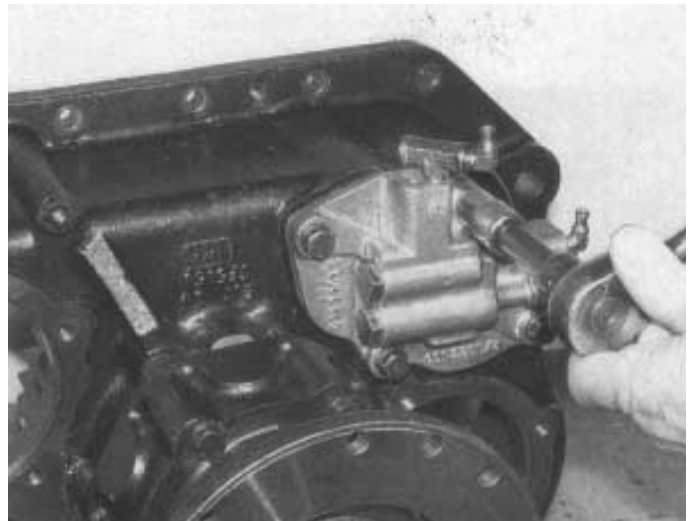
## Main Transmission

### B. Removal and Disassembly of the Output shaft and Auxiliary Section Rear Sliding Gear

- |                                   |                                   |
|-----------------------------------|-----------------------------------|
| 1. Bush                           | 8. Outer bearing cone and rollers |
| 2. Output shaft                   | 9. Speedometer drive gear         |
| 3. Inner bearing cup              | 10. Grit shield                   |
| 4. Inner bearing cone and rollers | 11. Output drive flange           |
| 5. Inner spacer                   | 12. Flange retaining nut          |
| 6. Outer spacer                   | 13. O-ring                        |
| 7. Outer bearing cup              |                                   |

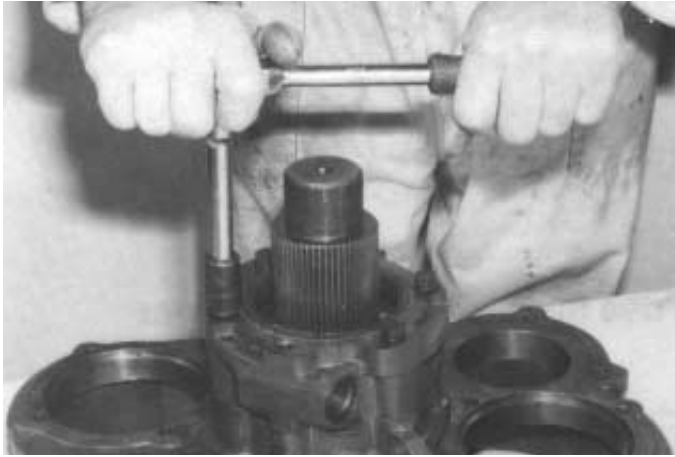


1. Remove the lockwire and lockscrew from the lower selector yoke. Withdraw the yoke and the rear sliding gear from the output shaft.



2. Remove the splitter valve and actuating cylinder taking care not to damage the mating faces. Protect valve and cylinder from dirt, grease and oil.

## Main Transmission



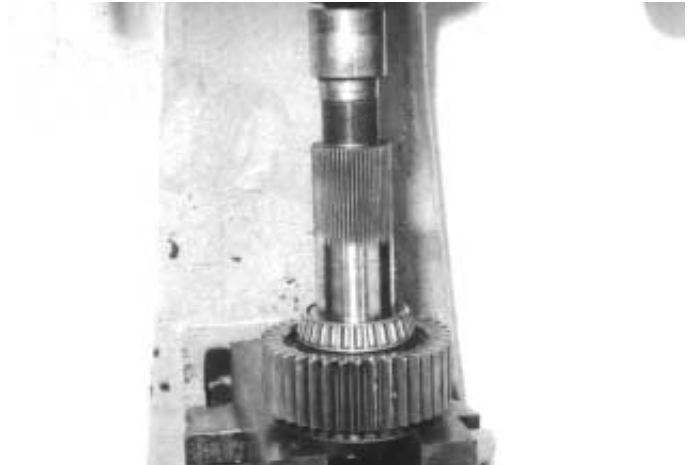
3. Remove the flange retaining nut, lift off the flange and grit shield. Remove the cap screws securing the oil seal and pinion housing. Note the position of the two special bolts. Lift off the housing. If necessary drift out the oil seal



6. Remove the two taper roller bearing cups and the outer spacer from the auxiliary housing.



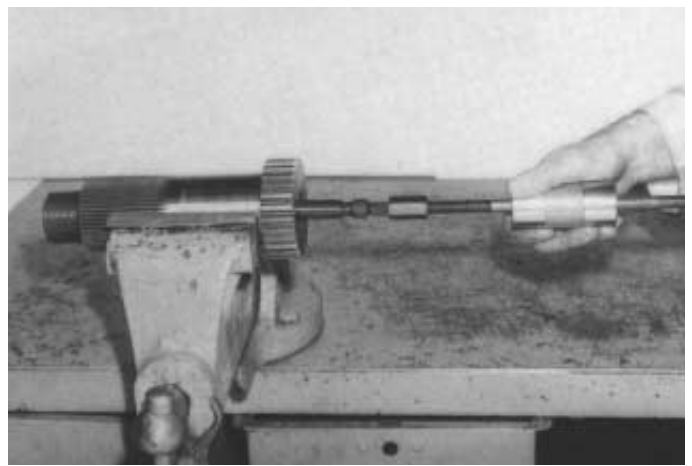
4. Lift off the speedometer drive gear.



7. Using the auxiliary rear sliding gear as a support, press the output shaft through the bearing cone and roller assembly.



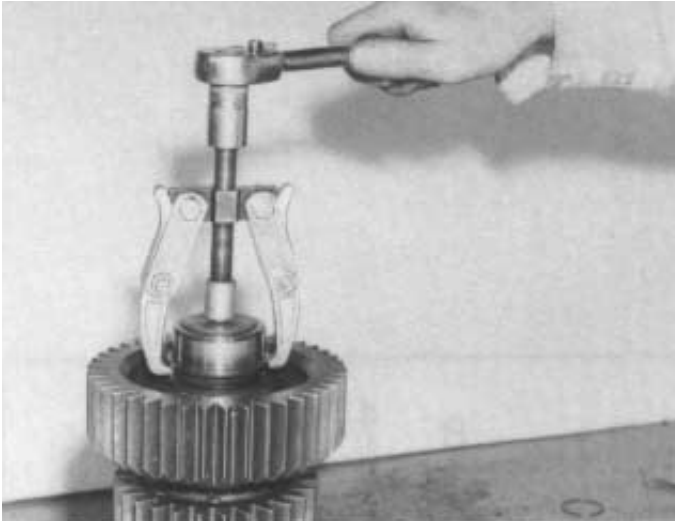
5. Press or drift out the output shaft



8. Remove the spigot bush from the output shaft using a suitable internal extractor.

## Main Transmission

### C. Auxiliary Countershaft Bearing Renewal



1. When fitted, remove the snap ring and remove the bearing tracks using a suitable puller. If a snap ring groove is not provided on the front end of the shaft, the bearing track is retained with Loctite. Carefully heat the bearing track if necessary to deactivate the Loctite.



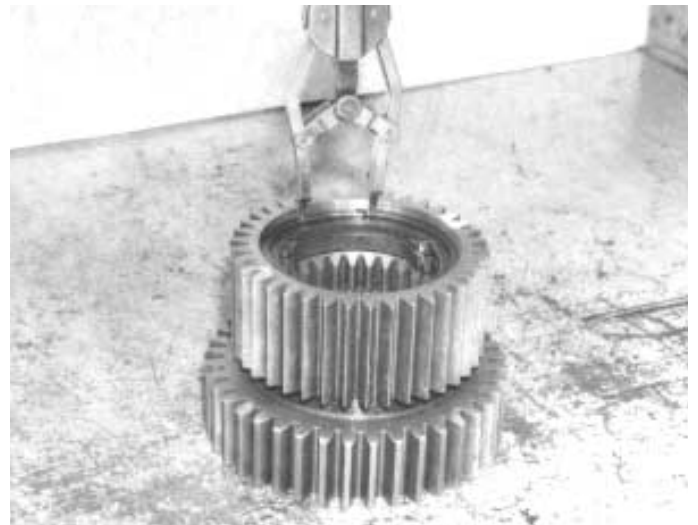
2. Apply a thin bead of Loctite 601 to the auxiliary countershaft front bearing spigot. (On shafts with a circlip groove machined on the front bearing spigot, the snap ring may be omitted if Loctite is used.)

3. Heat the new front bearing inner track to a maximum of 135°C and place it on the auxiliary countershaft, shouldered side towards the gears.

### D. Auxiliary Section Splitter Gears and Sensor Disassembly

**Note:** The three sensors, one in each of the three splitter sliding gears are identical in all respects. Unless they are all to be renewed it is essential that each assembly is kept separate for reinstallation in the same sliding gear from which it was removed.

**Note:** The centre sliding gear clusters consist of two separate gears which are assembled together in production. They cannot be separated in service.



1. Using suitable circlip pliers remove the sensor retaining snap ring. Lift out the sensor. (Centre gear cluster illustrated).



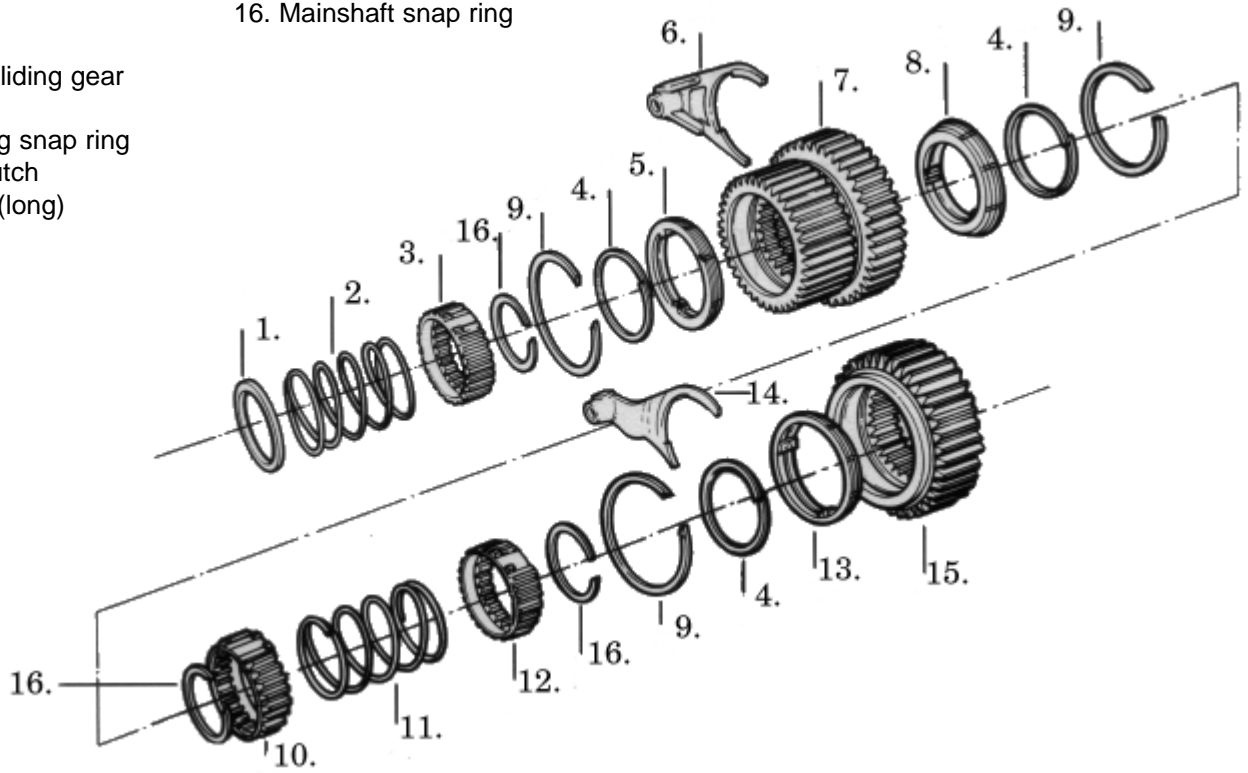
2. Remove the energiser ring from the sensor using angled grips or pliers

## Main Transmission

### E. Splitter Gears Reassembly

#### Splitter Sliding Gears and Jaw Clutches - Exploded View.

- |                        |                         |
|------------------------|-------------------------|
| 1. Spring retainer     | 12. Jaw clutch          |
| 2. Spring (short)      | 13. Sensor              |
| 3. Jaw clutch          | 14. Yoke                |
| 4. Energiser ring      | 15. Rear sliding gear   |
| 5. Sensor              | 16. Mainshaft snap ring |
| 6. Yoke                |                         |
| 7. Centre sliding gear |                         |
| 8. Sensor              |                         |
| 9. Retaining snap ring |                         |
| 10. Jaw clutch         |                         |
| 11. Spring (long)      |                         |



1. Mount the sensor in the vice as illustrated. Insert the new energiser ring into the groove, overlapping part at the bottom. Using two screwdrivers expand the ring until the ends abut and snap into the groove.

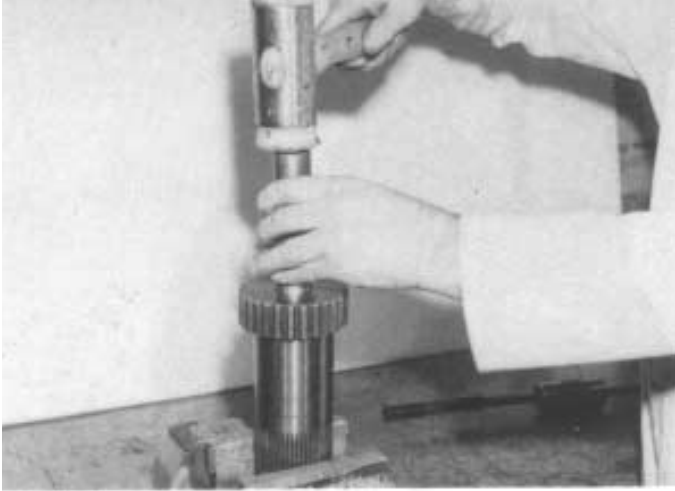


2. Place the sensor in the sliding gear (centre gear cluster illustrated) and fit the retaining snap ring.



## Main Transmission

### F. Rear Sliding Gear and Output Shaft Reassembly and Installation



1. Support the shaft and using a suitable installer and mallet drive in the new bush until fully home against the shoulder.



3. Heat both output shaft bearing inner cones and roller assemblies to a maximum of 135°C before installation. Install the (heated) front bearing cone and roller assembly on to the shaft against the splined flange. Install the inner spacer against the bearing.

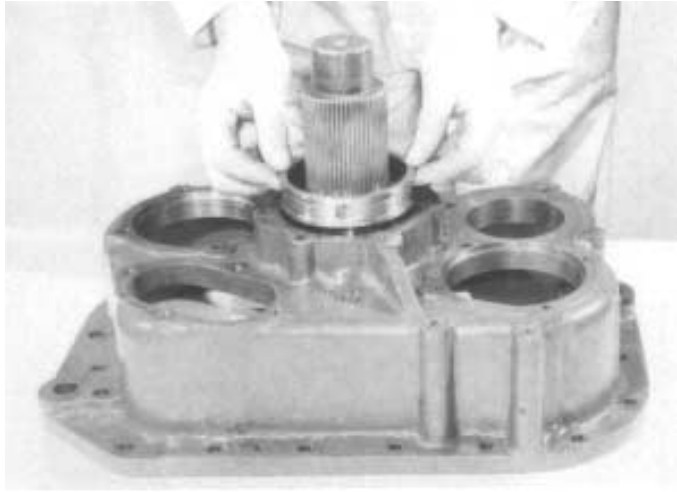


2. The output shaft bearing and spacers are a matched set. All six items are etched with a serial number (i.e. 84/21994). Both parts of one of the bearings are marked with the suffix A. It is essential that these parts are assembled together, and that all parts carry the same serial number



4. Stand the output shaft, with the assembled bearing on a wood block approximately 50mm thick. Place the housing over the shaft.

## Main Transmission



5. Drive the outer cup of the inner bearing conical face downwards into the auxiliary housing. Install the outer spacer with the lubricating oil hole aligned with the hole in the housing bore, and the outer bearing cup, shoulder uppermost, on the inner bearing cup. Drive all three parts into the housing bore.



7. If previously removed install a new oil seal, flat face uppermost, into the speedometer housing.



6. Install the (heated) outer bearing inner cone and roller assembly over the shaft against the spacer. Make sure that the outer bearing cup shoulder abuts the housing and the bearing fits closely.



8. Place the speedometer drive gear over the output shaft. (If a speedometer drive gear is not fitted, a spacer of equivalent thickness must be installed.)

## Main Transmission



9. Place the speedometer housing and gasket on the auxiliary housing, and insert the speedometer pinion into the housing. Ensure that speedometer housing is correctly positioned.

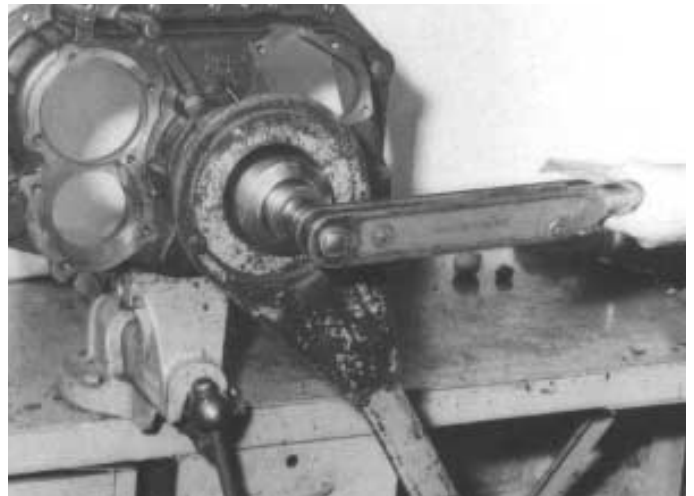


11. Locate the plastic grit shield on to the output drive flange, dished face away from the flange. Do not push fully on to the flange. Install the flange and grit shield onto the output shaft.



10. Install the capscrew and tighten to correct torque.

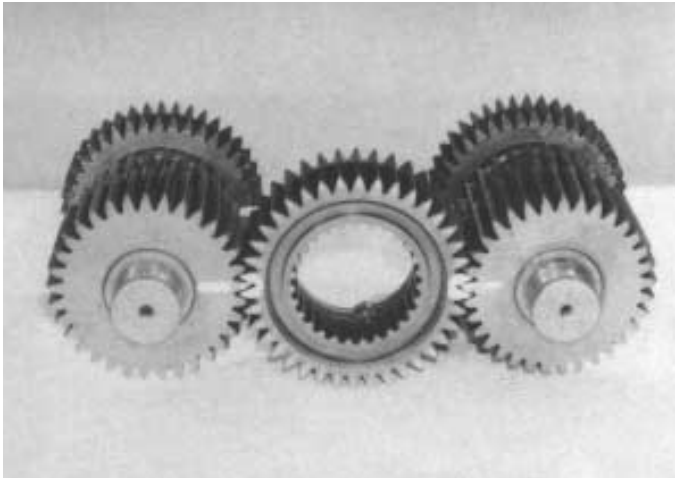
**Note:** Install the capscrew adjacent to the speedometer pinion with a new nylon washer.



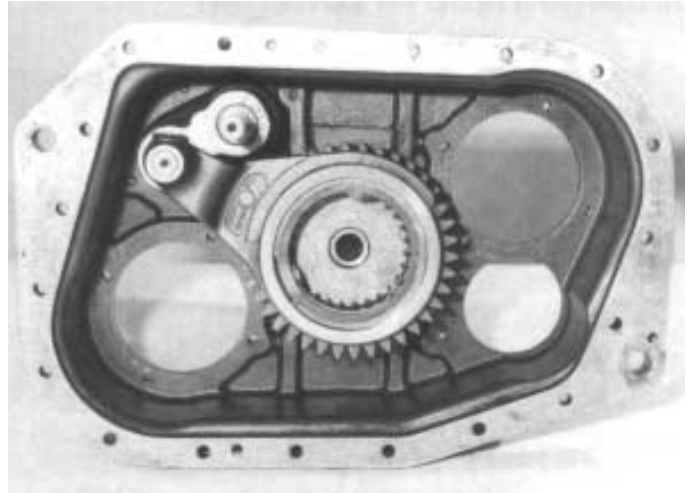
12. Install a new self-locking nut and tighten to the correct torque. Rotate the shaft as the nut is tightened to ensure that the bearings are correctly seated. Finally ensure that the nut is adequately staked into the output shaft groove.



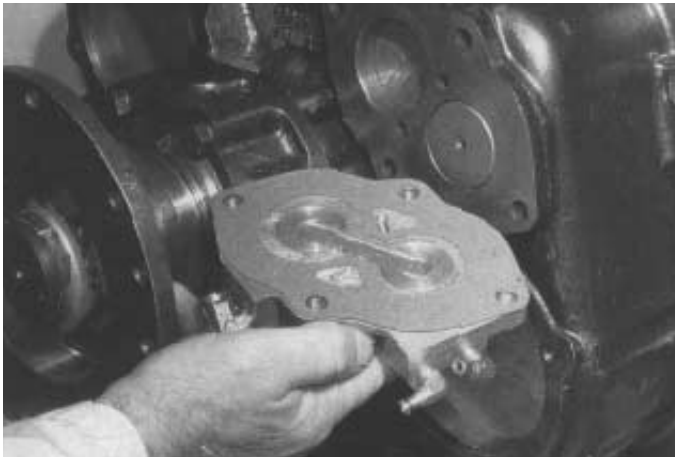
## Main Transmission



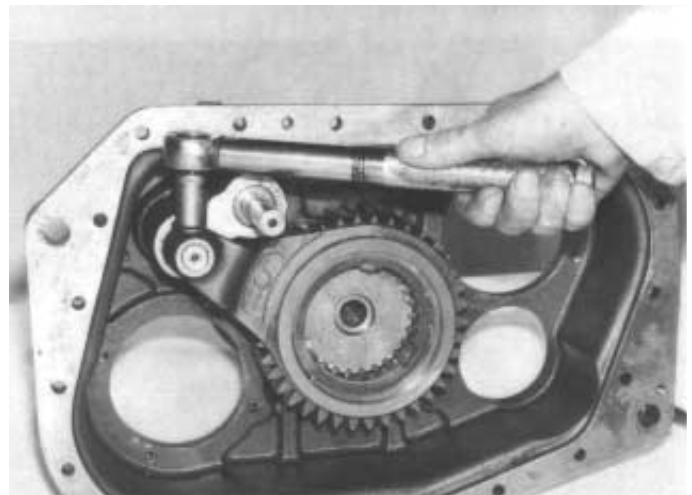
13. Put timing marks on the rear sliding gear (in preparation for installation of rear housing to main case). Paint any two adjacent teeth and then the two teeth directly opposite the first two.



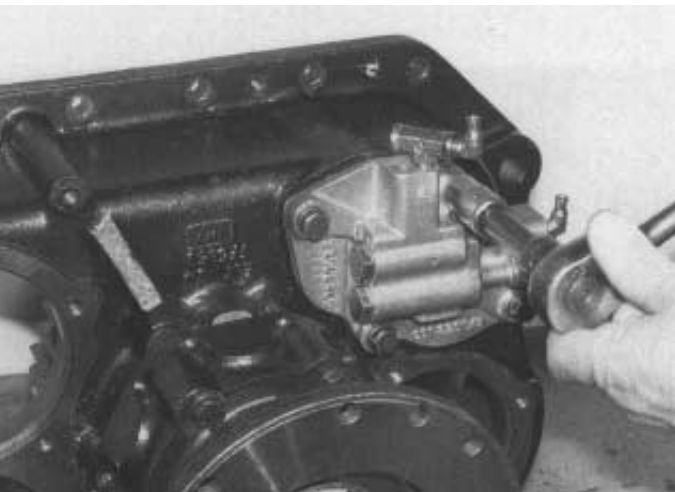
16. Install the rear sliding gear on to the output shaft, sensor facing forward. Install the selector yoke into the groove in the sliding gear and onto the lower selector piston bar.



14. Place the selector cylinder into the rear of the auxiliary housing.



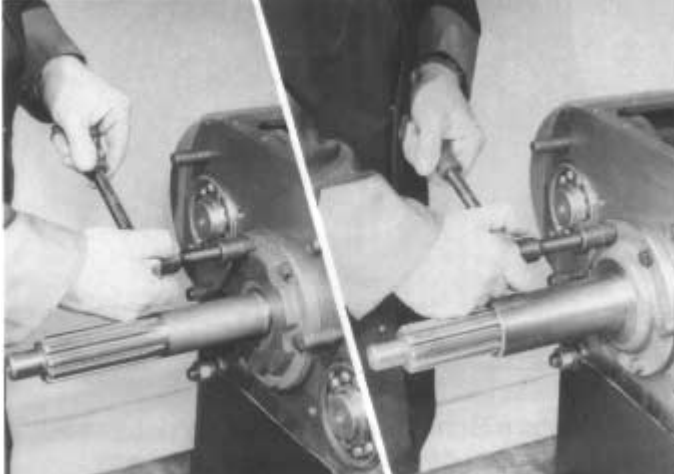
17. Install the lockscrew and tighten to the correct torque. Lockwire to secure.



15. Secure the selector cylinder together with the splitter valve, using new gaskets, to the rear of the housing. Tighten the capscrews to the correct torque.

## Main Transmission

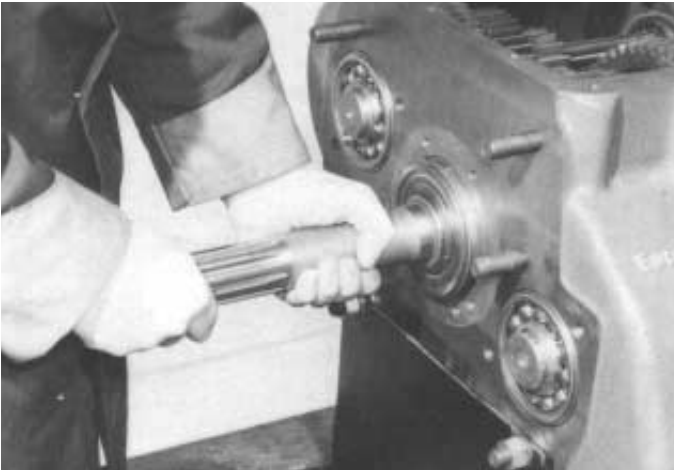
### G. Main Section Disassembly



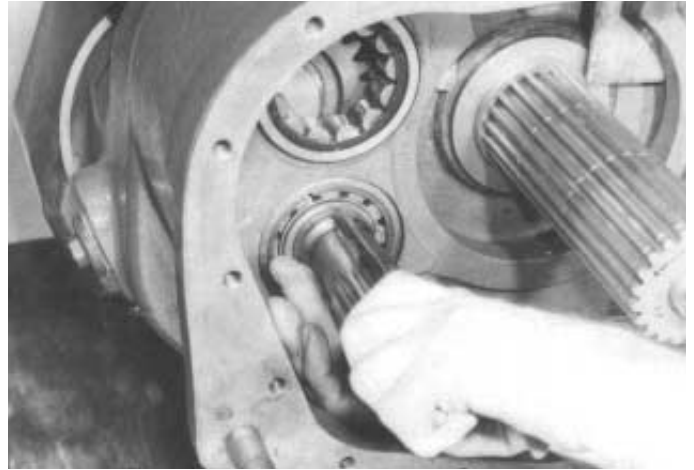
1. Remove the input shaft cover. Note the position of the two capscrews with drilled heads. (Push type clutch release bearing only).



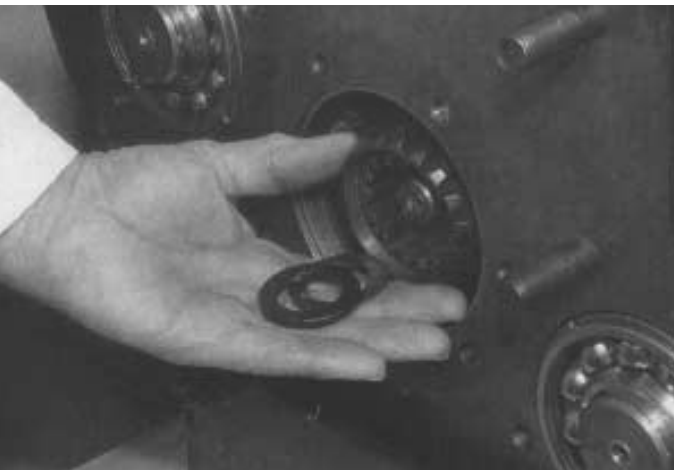
4. Remove the snap rings from the front of both countershafts.



2. Grasp the input shaft firmly and joggle the shaft, gear and bearing out of the housing. Retain the parts in order for the reassembly.



5. Remove the snap rings from the rear of both countershafts.

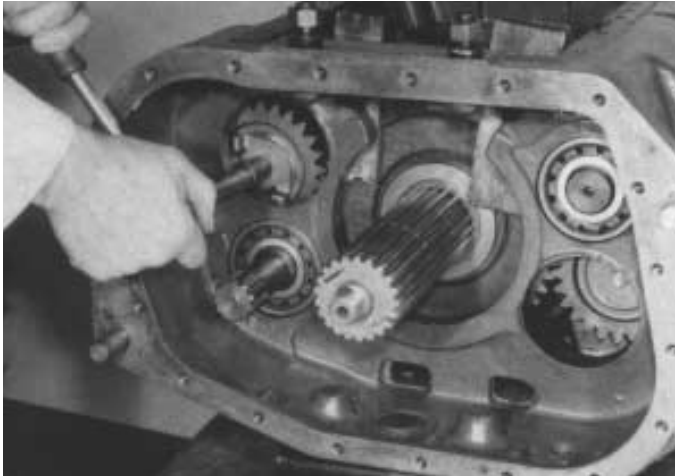


3. Remove the mainshaft thrust washers and the 3rd/4th gear sliding clutch from the mainshaft.

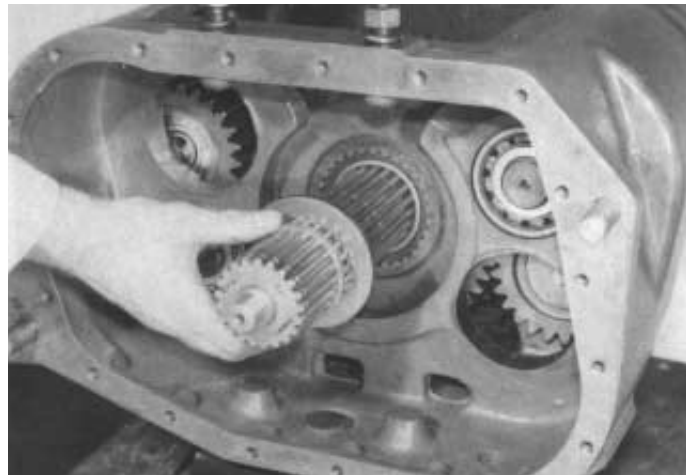


6. Using a pry bar remove the two auxiliary countershaft front bearings from the housing.

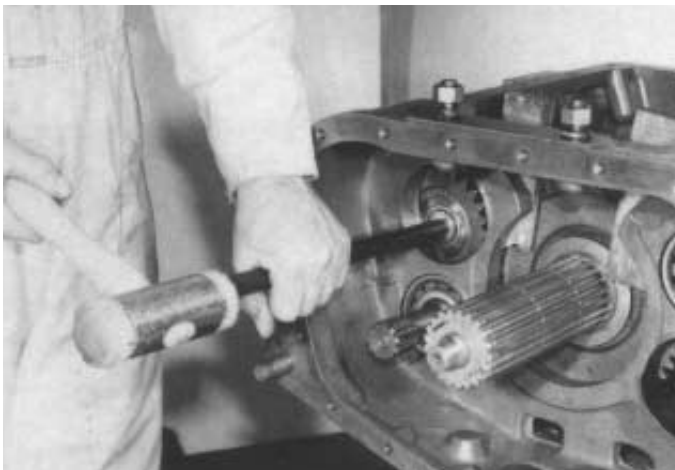
## Main Transmission



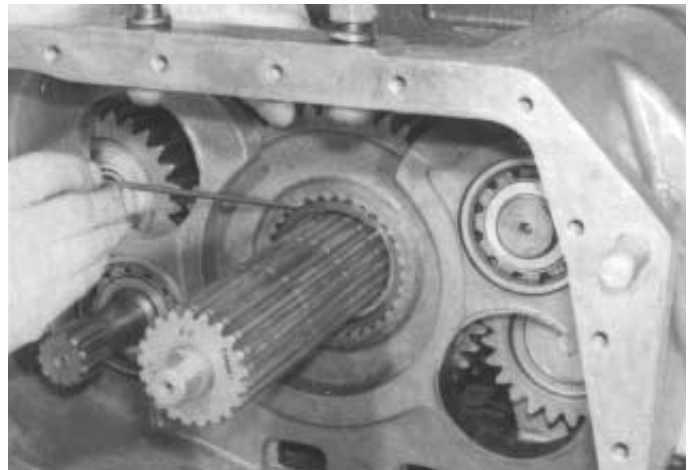
7. Remove the left-hand (upper) reverse idler gear shaft support washer.



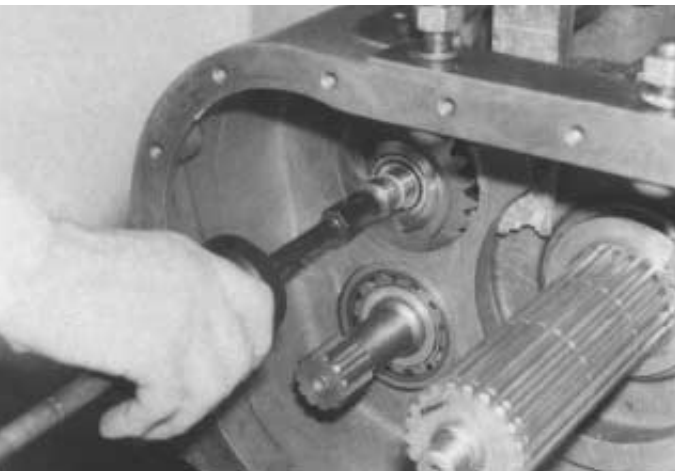
10. Remove the reverse gear retaining snap ring from the mainshaft. Remove the plain spacer and the large internally splined spacer.



8. Tap the idler gear shaft forwards approximately 10mm and remove the circlip from the front end of the shaft.



11. Remove the wedges and slide the reverse gear rearward on the shaft. Using a probe push the internal spacer in the gear forward and carefully prise out the snap ring.

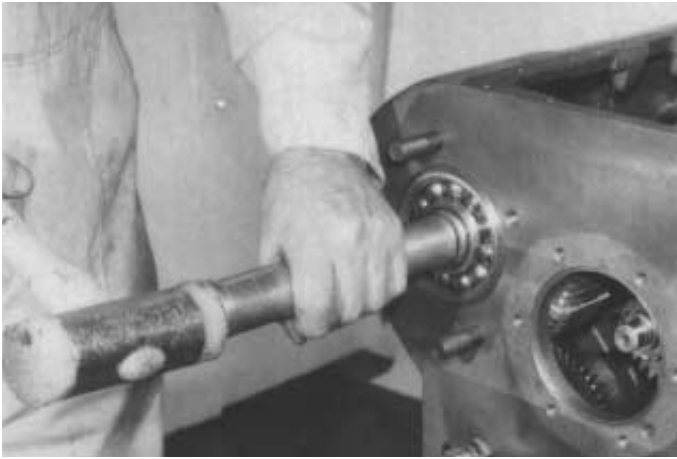


9. Using a slide hammer screwed into the rear of the shaft, withdraw the shaft. Roll the reverse idler gear away from the mainshaft (the washer will drop into the case).

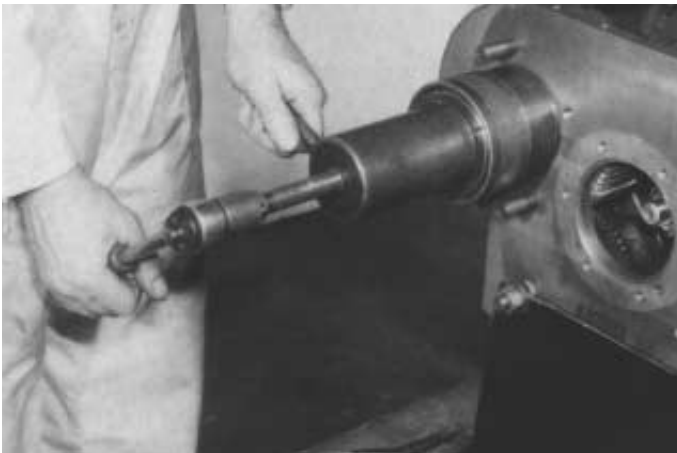


12. Slide the reverse gear forward onto the reverse sliding clutch and against 1st gear. Remove the spacer and the graded washer.

## Main Transmission



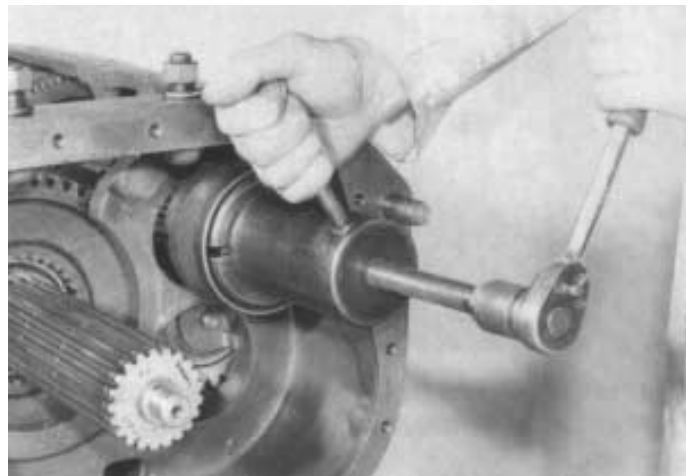
13. Slide the complete mainshaft rearwards in the housing. Using a soft drift and heavy mallet drive the right-hand (upper) countershaft rearward approximately 5mm (max) through the front bearing. Drive the countershaft forward again, from the rear, to expose the snap ring around the front bearing.



14. Remove the snap ring and assemble the special puller into the snap ring groove. Remove the bearing from the shaft and housing.



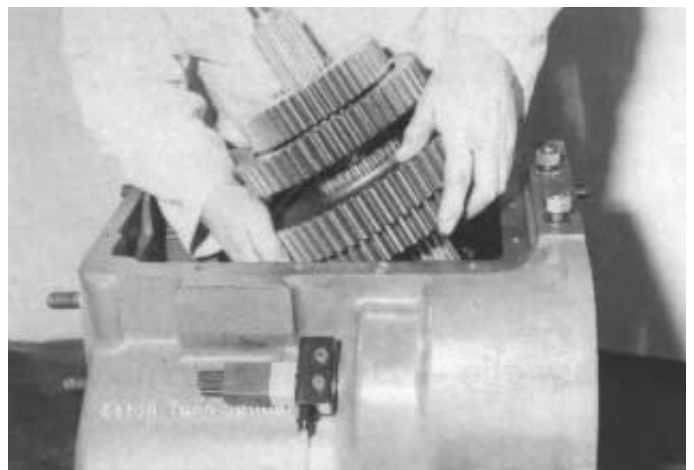
15. Using a soft faced mallet drive the countershaft rearwards again until the rear bearing is clear of its bore in the housing.



16. Using the special puller remove rear bearing from the countershaft.



17. Using suitable wooden blocks in the front and rear bearing bores block the countershaft away from the mainshaft.



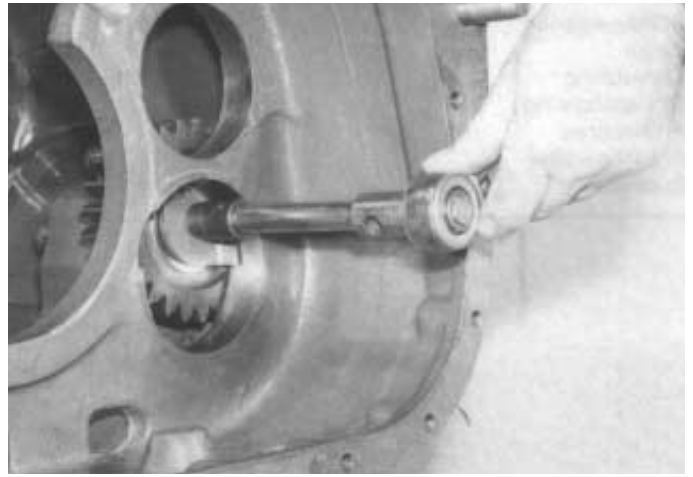
18. Lift the mainshaft assembly from the housing.



## Main Transmission



19. Remove the reverse idler gear and the idler gear washer from the housing.



22. Remove the right-hand (lower) reverse idler gear support washer, shaft washer and idler gear from the housing in the same manner as described in operations 7 to 9 and 19 inclusive for the left-hand idler gear.



20. Remove the upper (right-hand) countershaft from the housing.



23. Remove the upshift brake from the bottom of the housing.

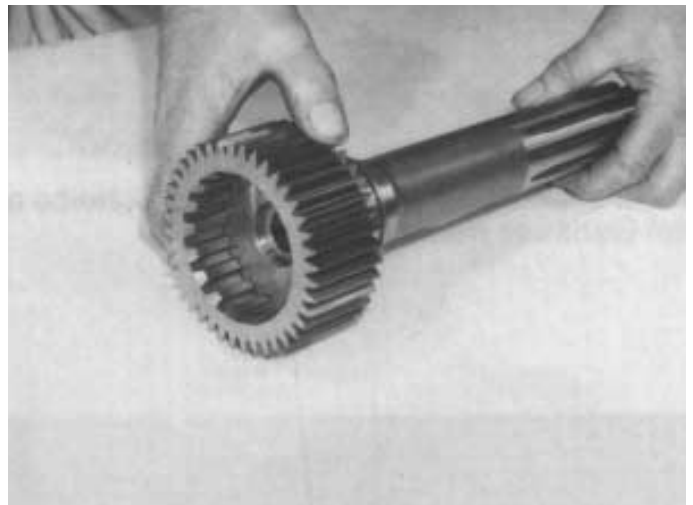
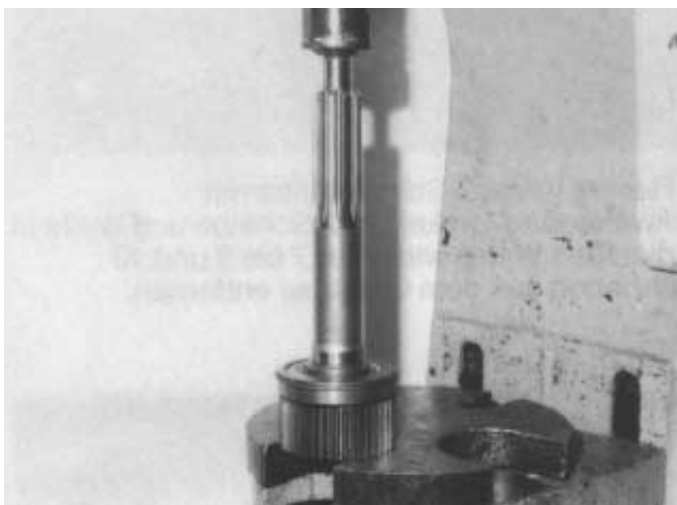
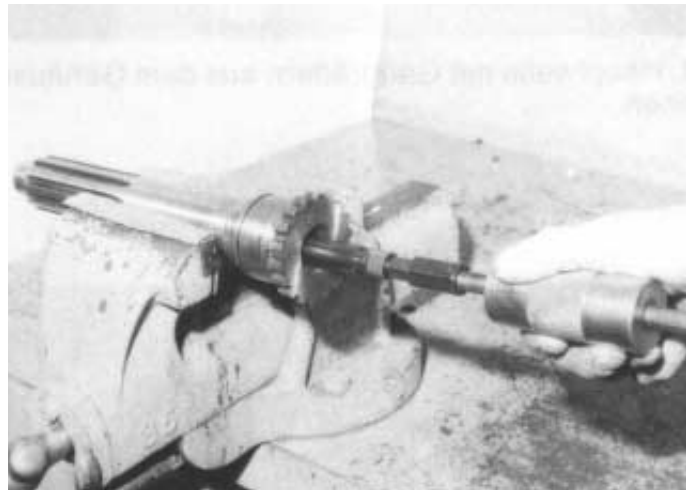
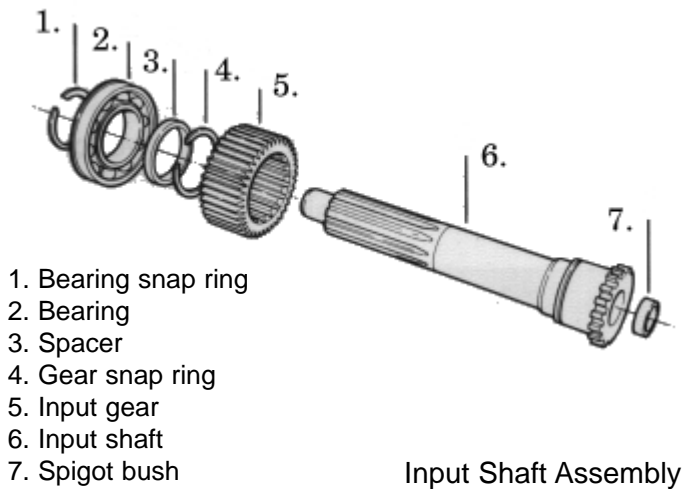


21. Remove the bearings from the lower (left-hand) countershaft in the same manner as described in operations 13 to 16 inclusive for the upper countershaft, and remove the countershaft from the housing.

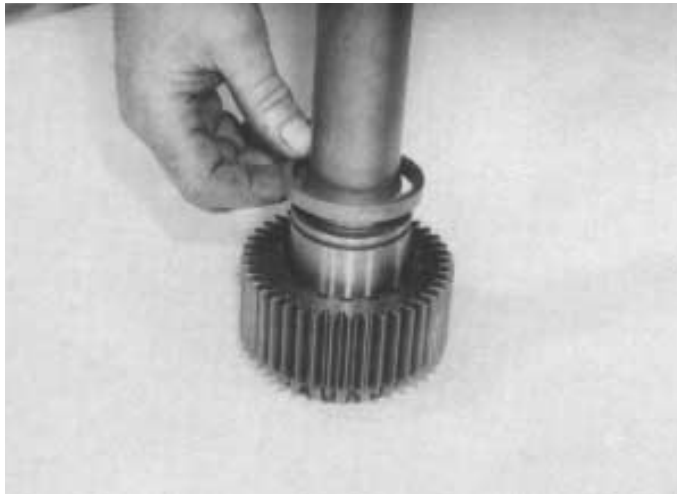
## Main Transmission

### H. Input Shaft Disassembly

### I. Input Shaft Reassembly



## Main Transmission



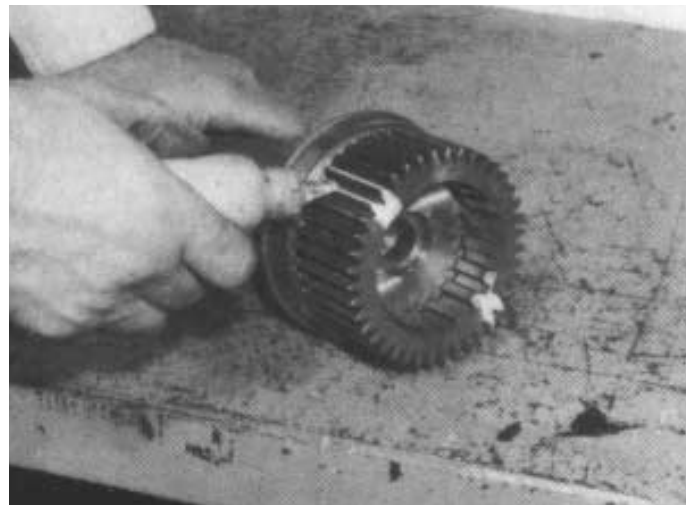
3. Place the 3rd/4th gear sliding clutch into the drive gear against the end of the input shaft and stand the assembly on the sliding clutch on the bench. Fit the spacer over the input shaft.



5. Fit the snap ring.



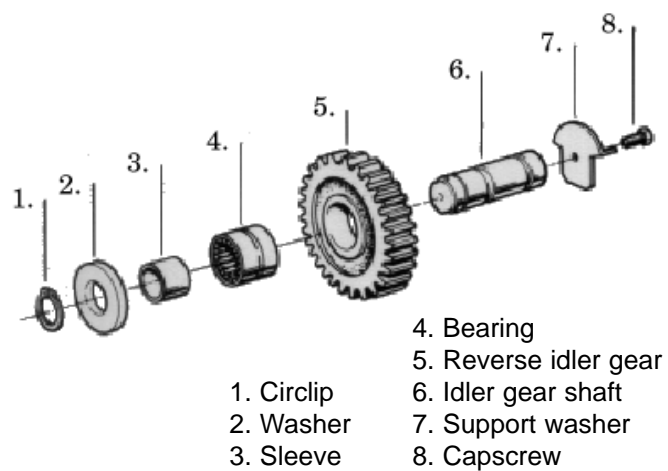
4. Drive the bearing, shrouded face uppermost onto the shaft using a suitable driver.



6. Paint timing marks on any two adjacent gear teeth on the input gear. Then paint two gear teeth exactly opposite the first two.

## Main Transmission

### J. Reverse Idler Gear Disassembly and Reassembly



#### Reverse Idler Gear Assembly



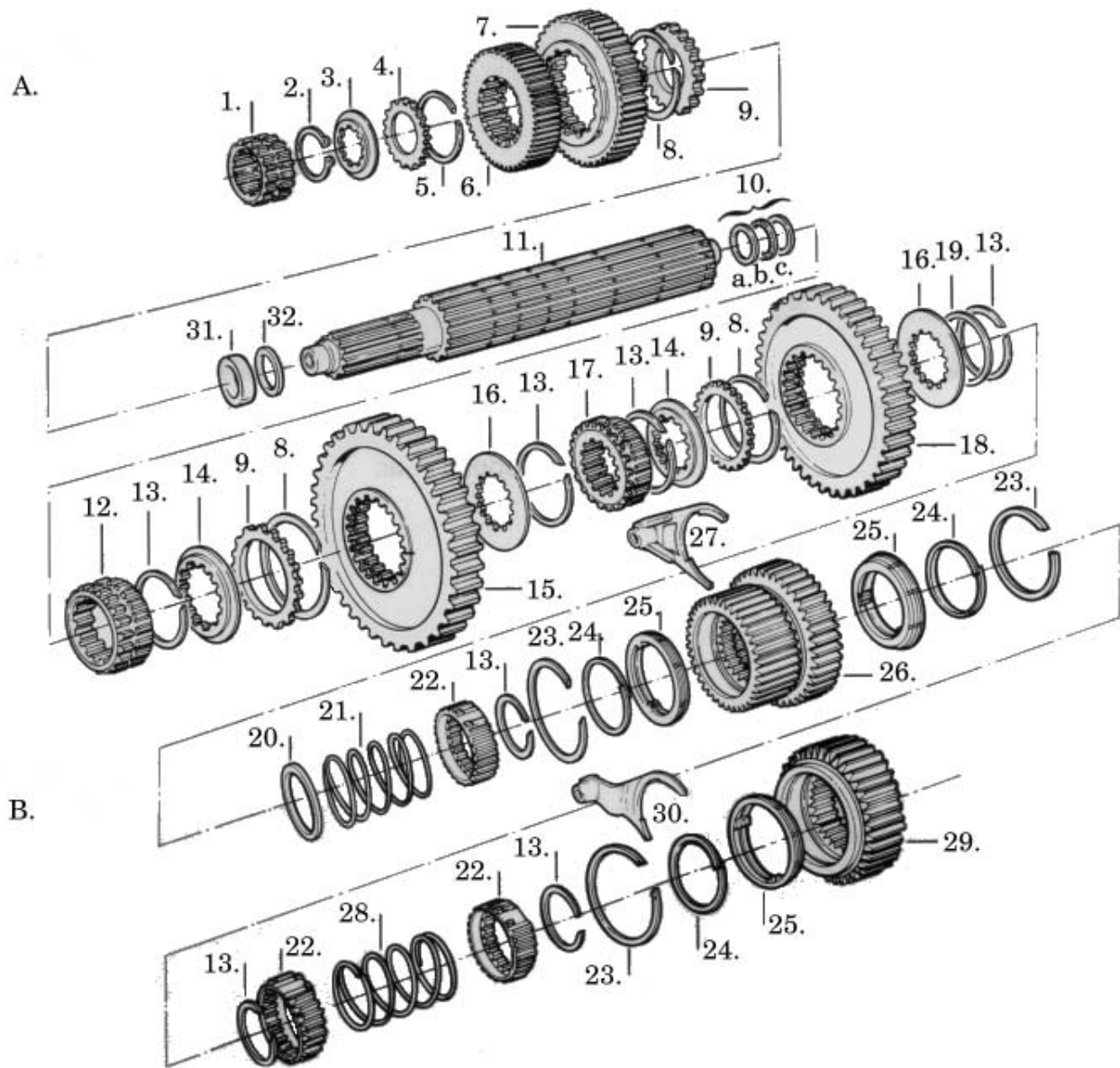
1. Support the gear and press or drive out the needle roller bearing using a suitable mandrel. Support the gear and press or drive in the new bearing until flush with the gear face.



## Main Transmission

### K. Mainshaft Disassembly

Serial Numbers: upto and including N 535711 (ERF), upto and including N 537124 (all other models).



A. Main Section

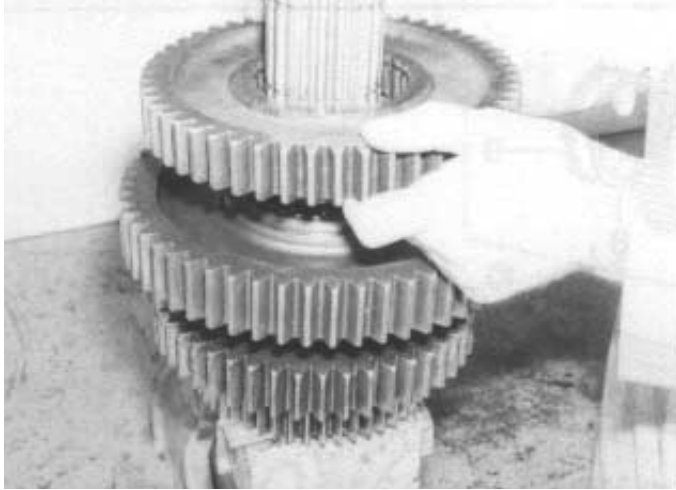
B. Auxiliary Section

- |                             |                                       |   |
|-----------------------------|---------------------------------------|---|
| 1. Sliding clutch           | 11. Main shaft                        | 23. Retaining snap ring                   |
| 2. Circlip                  | 12. Sliding clutch 1st/2nd speed gear | 24. Energiser ring                        |
| 3. Graded washer - 3rd gear | 13. Mainshaft snap ring               | 25. Sensor                                |
| 4. Spacer                   | 14. Graded washer                     | 26. Auxiliary sliding gear centre cluster |
| 5. Snap ring                | 15. 1st speed gear                    | 27. Shift yoke                            |
| 6. 3rd speed gear           | 16. Plain washer                      | 28. Jaw clutch spring - long              |
| 7. 2nd speed gear           | 17. Reverse gear sliding clutch       | 29. Auxiliary sliding gear - rear         |
| 8. Snap ring                | 18. Reverse gear                      | 30. Shift yoke                            |
| 9. Spacer                   | 19. Spacer ring                       | 31. Graded thrust washer                  |
| 10. Thrust race pack        | 20. Spring retainer plate             | 32. Thrust washer                         |
| a Standard washer           | 21. Jaw clutch spring - short         |   |
| b Needle roller thrust race | 22. Jaw clutch                        |   |
| c Graded washer             |                                       |   |

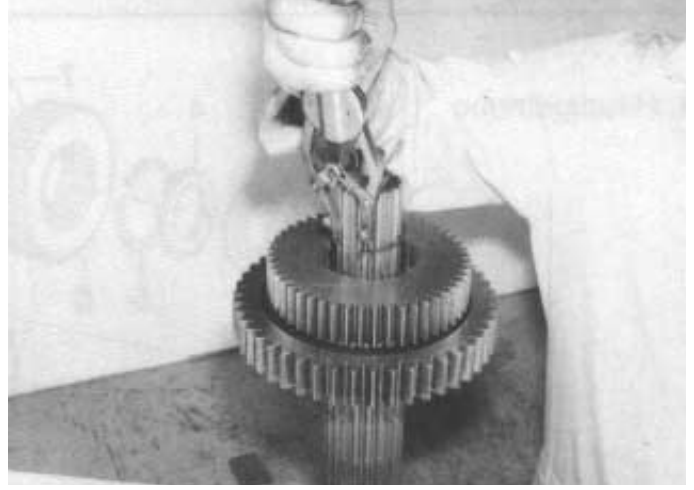
## Main Transmission

### K. Mainshaft Disassembly

Serial Numbers: upto and including N 535711 (ERF), upto and including N 537124 (all other models).



1. Support the mainshaft assembly in the vice, forward end downwards and lift off the reverse gear.



3. Invert the mainshaft in the vice and remove the 3rd speed gear circlip, spacer, washer and 3rd speed gear.



2. Remove the following in order: Snap ring, reverse gear sliding clutch, 1st speed (rear) snap ring and the large internally splined washer. Remove the 1st speed gear, the externally splined spacer and the internally splined graded washer. Remove the snap ring and the 1st/2nd gear sliding clutch.

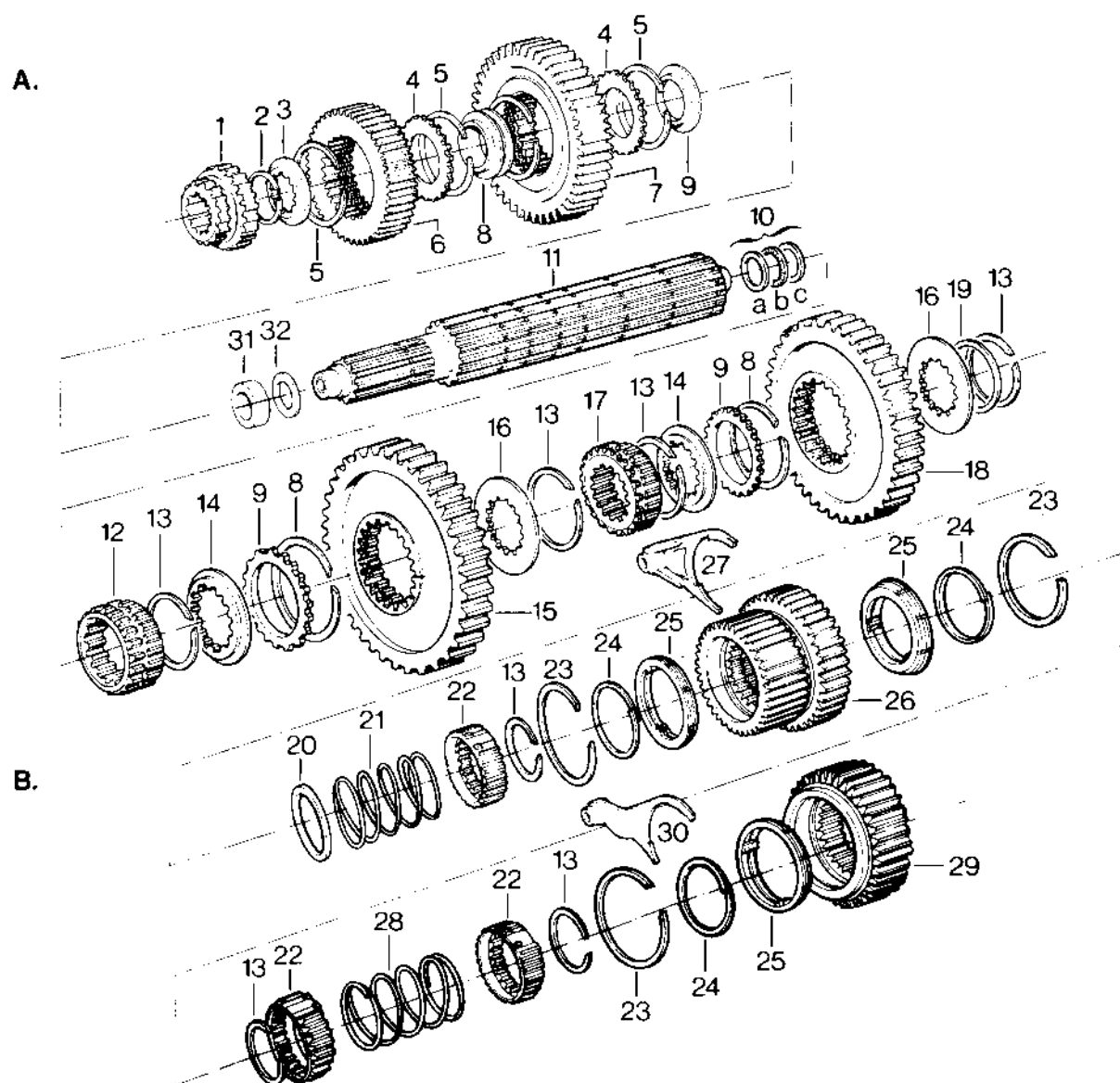


4. Lift off the 2nd speed gear and remove the 2nd gear stepped spacer. If necessary remove the internal snap rings from 1st, 2nd, 3rd and reverse gears.

# Main Transmission

## K. Mainshaft Disassembly

Serial Numbers: N 535712 and above (ERF); N 537125 and above (all other models).



A. Main Section

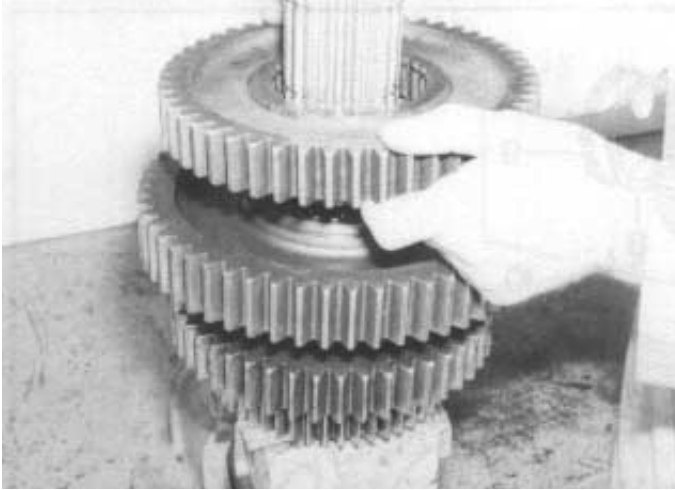
B. Auxiliary Section

- |                             |                                       |   |
|-----------------------------|---------------------------------------|---|
| 1. Sliding clutch           | 11. Main shaft                        | 23. Retaining snap ring                   |
| 2. Snap ring                | 12. Sliding clutch 1st/2nd speed gear | 24. Energiser ring                        |
| 3. Graded washer - 3rd gear | 13. Mainshaft snap ring               | 25. Sensor                                |
| 4. Spacer                   | 14. Graded washer                     | 26. Auxiliary sliding gear centre cluster |
| 5. Snap ring                | 15. 1st speed gear                    | 27. Shift yoke                            |
| 6. 3rd speed gear           | 16. Plain washer                      | 28. Jaw clutch spring - long              |
| 7. 2nd speed gear           | 17. Reverse gear sliding clutch       | 29. Auxiliary sliding gear - rear         |
| 8. 2nd/3rd gear spacer      | 18. Reverse gear                      | 30. Shift yoke                            |
| 9. 2nd gear spacer          | 19. Spacer ring                       | 31. Graded thrust washer                  |
| 10. Thrust race pack        | 20. Spring retainer plate             | 32. Thrust washer                         |
| a Standard washer           | 21. Jaw clutch spring - short         |   |
| b Needle roller thrust race | 22. Jaw clutch                        |   |
| c Graded washer             |                                       |   |

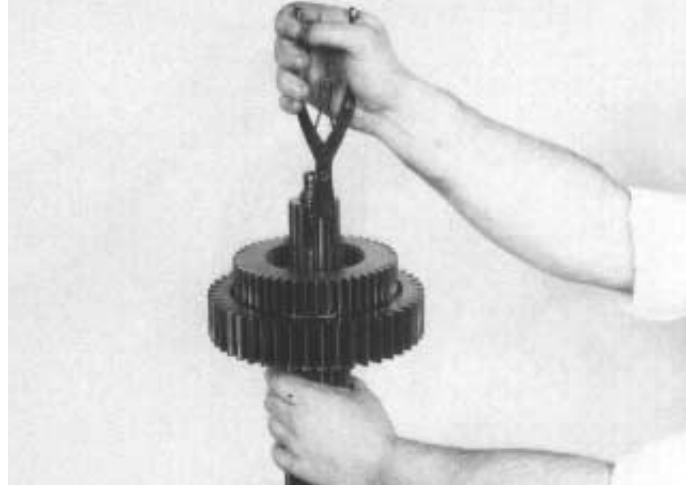
## Main Transmission

### K. Mainshaft Disassembly

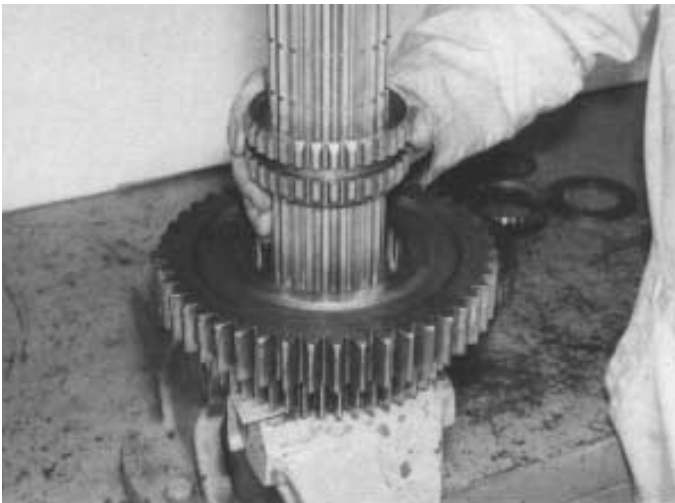
Serial Numbers: N 535712 and above (ERF); N 537125 and above (all other models).



1. Support the mainshaft assembly in the vice, forward end downwards and lift off the reverse gear.



3. Invert the mainshaft in the vice and remove the snap ring, graded spacer and 3rd gear assembly.



2. Remove the following in order: Snap ring, reverse gear sliding clutch, 1st speed (rear) snap ring and the large internally splined washer. Remove the 1st speed gear, the externally splined spacer and the internally splined graded washer. Remove the snap ring and the 1st/2nd gear sliding clutch.

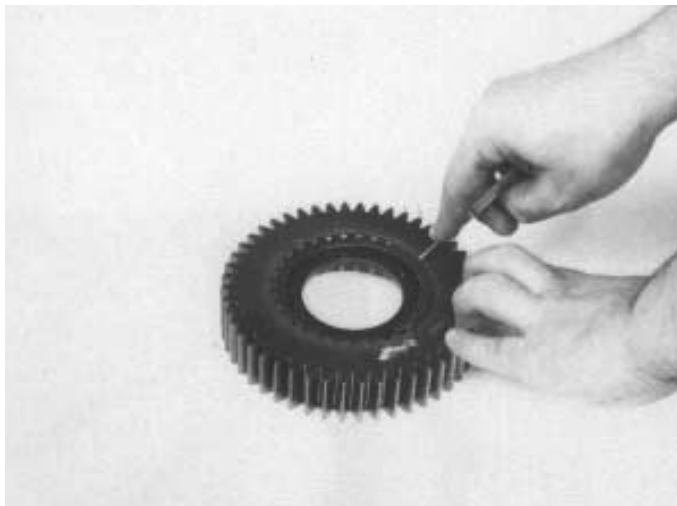


4. Using a suitable puller or press remove the 2nd gear assembly and 2nd/3rd gear mainshaft spacer.

## Main Transmission

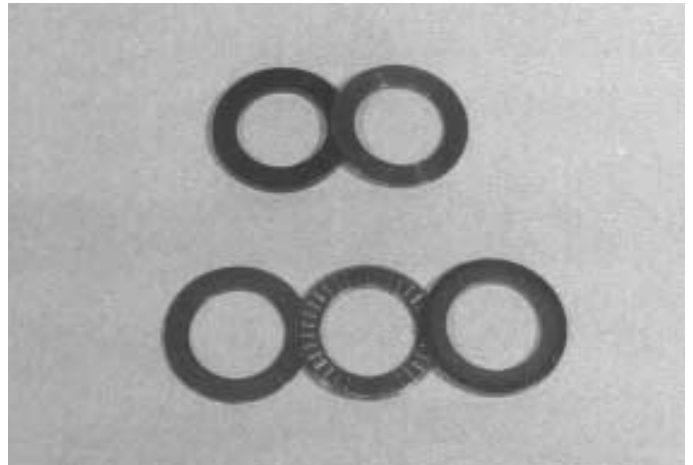


5. The second gear spacer, again using a suitable puller or press can now be removed from the mainshaft.



6. If necessary the snap ring and splined spacer can be removed from the 2nd and 3rd gears.

## L. Determine and Adjust Mainshaft End Float



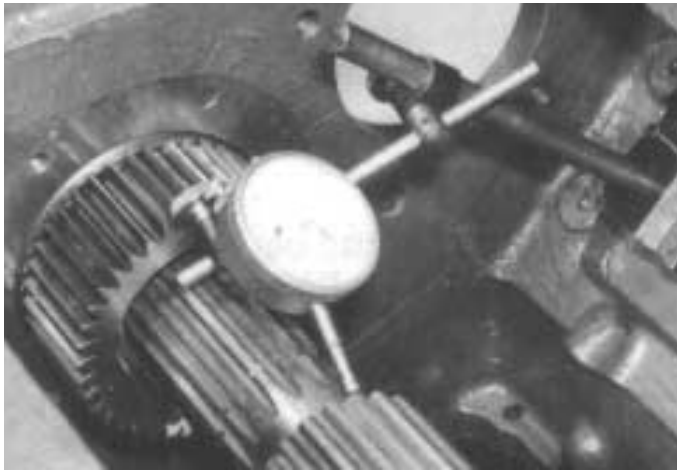
1. Using a new gasket, position the auxiliary housing, complete with fully assembled output shaft, onto the rear of the main housing. Secure with at least 6 capscrews. Tighten to the correct torque. Assemble onto the mainshaft front end spigot one thrust race pack consisting of one standard thickness steel washer and one vespel thrust washer, the steel washer against the shaft. Retain in place with petroleum jelly.



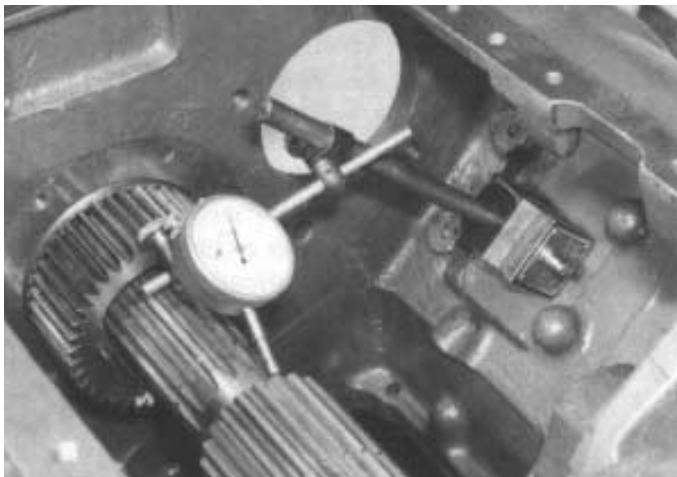
2. Assemble onto the mainshaft rear spigot a thrust race pack consisting of one thrust race with one standard thickness washer and one graded thickness washer. Alternatively, one graded thickness steel washer and one vespel thrust washer may be used. Use the thinnest available new graded washer. Retain with petroleum jelly. Position the mainshaft and install the input shaft and cover using a new gasket. Secure with at least 3 capscrews tighten to the correct torque.



## Main Transmission



3. Position a dial gauge and magnetic base in the housing with the plunger against the shoulder on the mainshaft. Push both the input shaft and mainshaft rearwards and zero the gauge.



4. Hold the input shaft and push the mainshaft forward and note the end float reading. If the end float is outside the specified limits, 0,13 - 0,71mm, a thicker or thinner graded washer must be selected to replace the existing graded washer on the rear spigot of the mainshaft.

Washers are available in the following thicknesses/colour codes.

White	1,52 to 1,60mm
Green	1,84 to 1,92mm
Orange	2,16 to 2,44mm
Purple	2,48 to 2,56mm
Black	2,80 to 2,88mm
Yellow	3,12 to 3,20mm

5. Remove the input shaft and mainshaft. If necessary reassemble with the new size graded washer rearmost on the rear spigot and recheck the end float as before. Remove the input shaft, mainshaft and rear housing. Retain the thrust race packs in their order for installation later.

## Main Transmission

### M. Mainshaft Reassembly (Main Section)

Serial Numbers upto and including N 535711 (ERF), upto and including N 537124 (all other models).

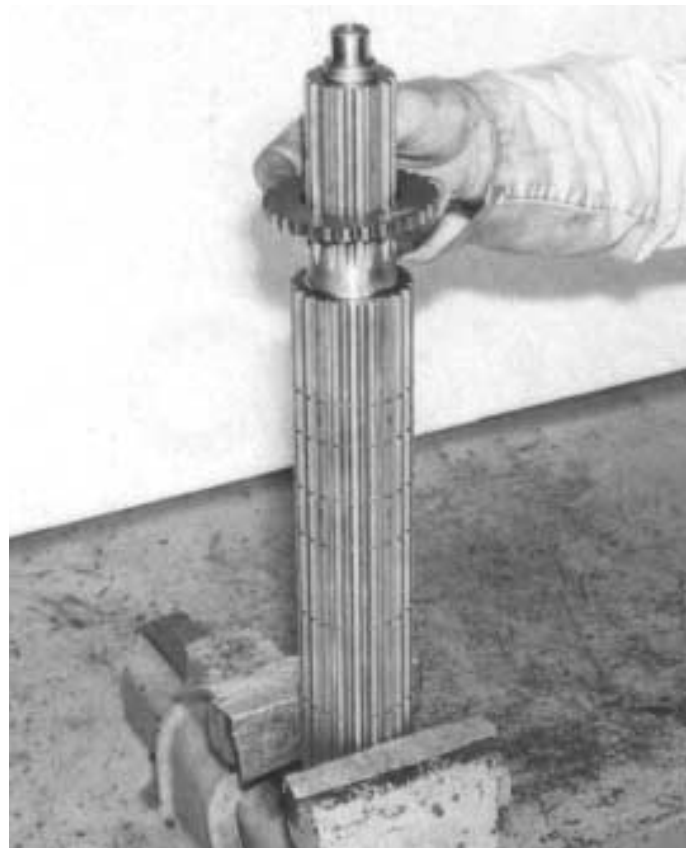
#### Mainshaft Gears - Axial Clearances

The axial clearances for mainshaft gears are:

Reverse/Forward speed gears - 0,13-0,30mm

Graded washers are used to obtain the clearances within the correct limits; six different thicknesses are available as follows:

Thickness	Colour Code
6,30 - 6,35mm	White
6,43 - 6,48mm	Green
6,55 - 6,60mm	Orange
6,68 - 6,73mm	Purple
6,80 - 6,86mm	Yellow
6,93 - 6,99mm	Black



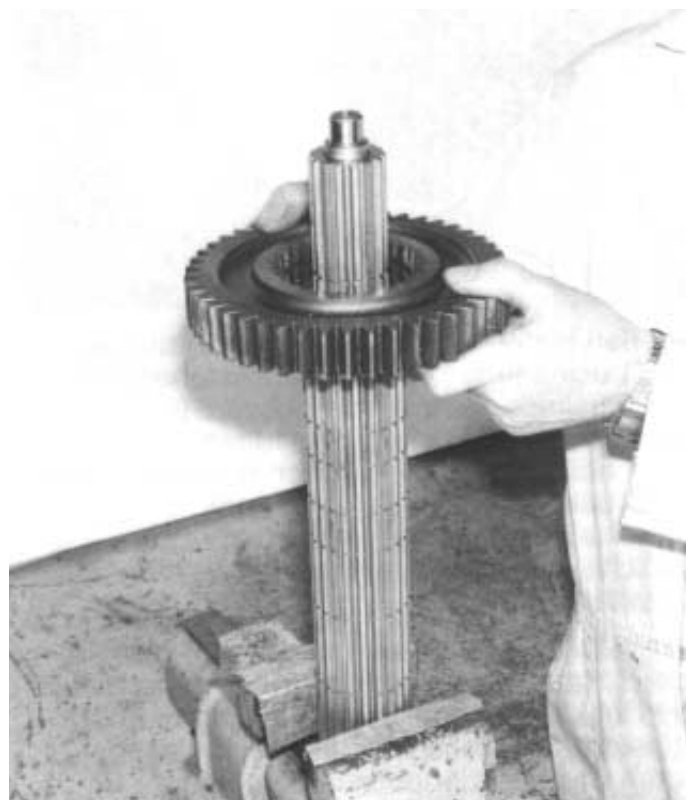
2. Support the mainshaft in a soft jawed vice, forward end uppermost. Place the shouldered spacer on the mainshaft, shoulder downwards.



Refer to Illustrated Parts List for part numbers.

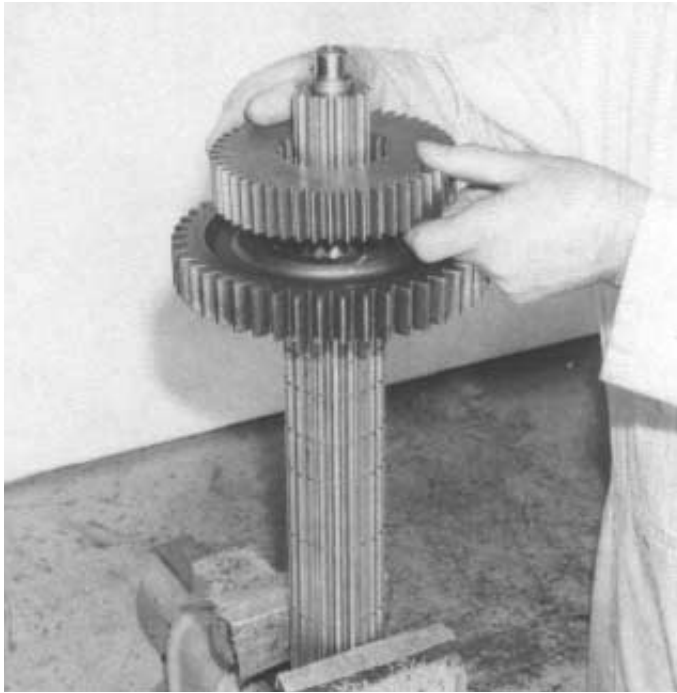
**Note:** During reassembly of the mainshaft it is essential to ensure the correct part numbers are used in the correct locations. (All major components have their part number stamped into them.)

1. If removed, install new snap rings into the 1st, 2nd, 3rd and reverse speed gears.

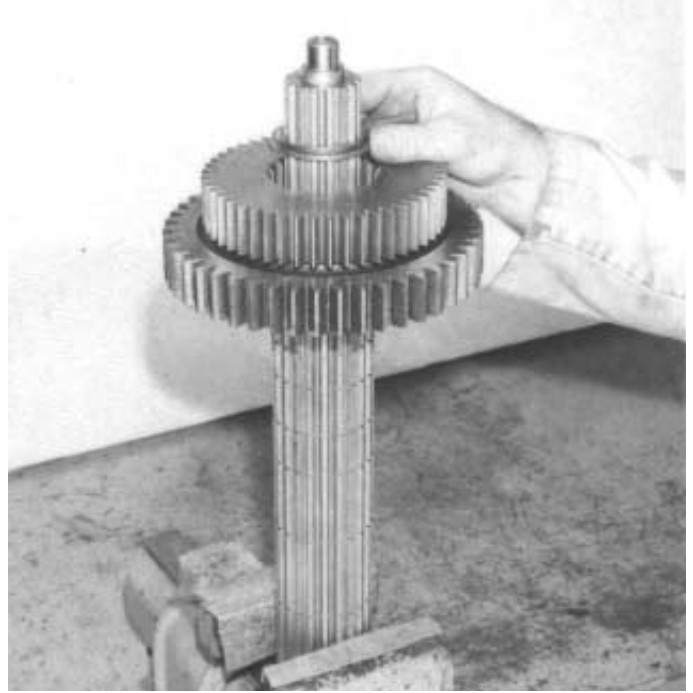


3. Install the 2nd speed gear over the washer, clutching teeth downward.

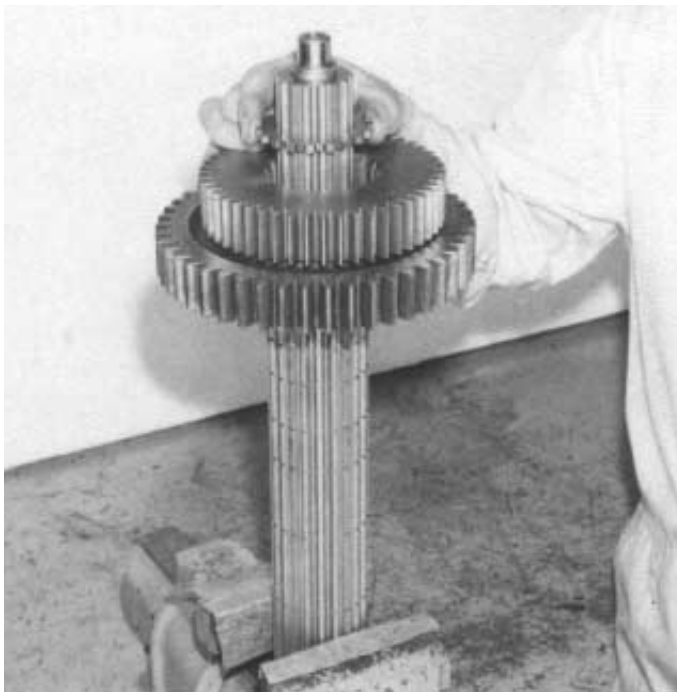
## Main Transmission



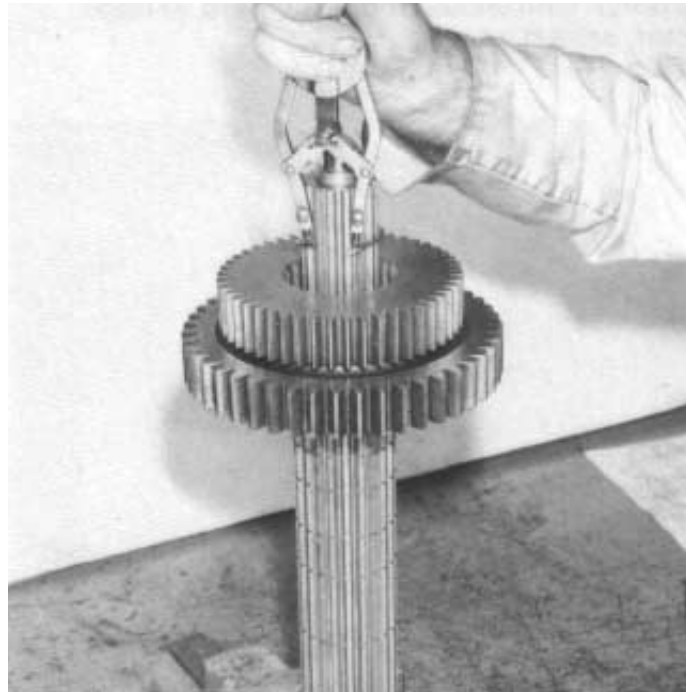
4. Place the 3rd speed gear over the shaft against the 2nd speed gear, clutching teeth uppermost.



6. Install the graded washer into the 3rd speed gear, chamfered face uppermost.



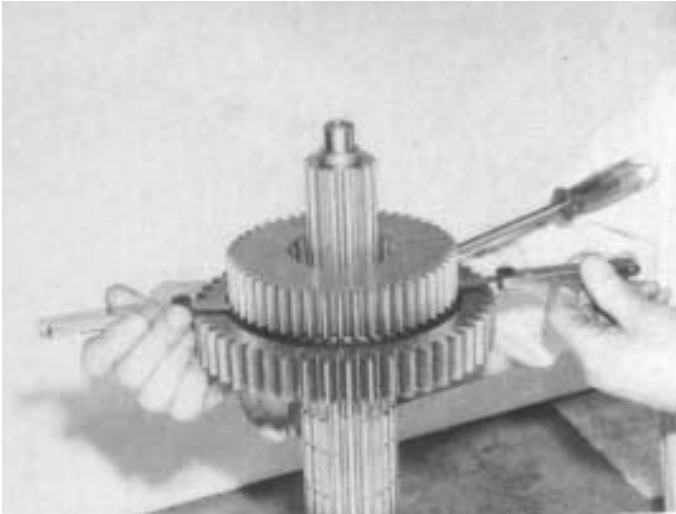
5. Install the spacer into the 3rd speed gear.



7. Install the 3rd speed gear retaining circlip.



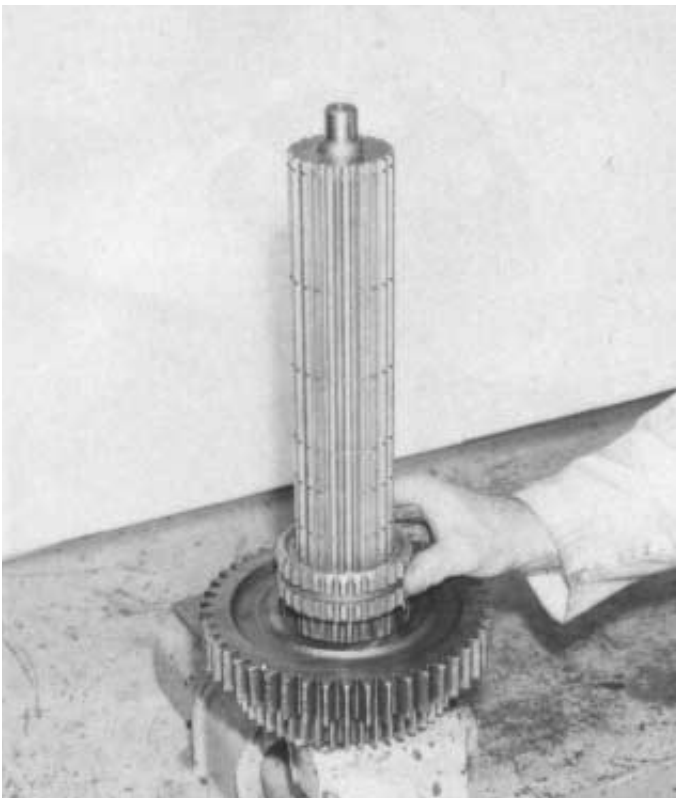
## Main Transmission



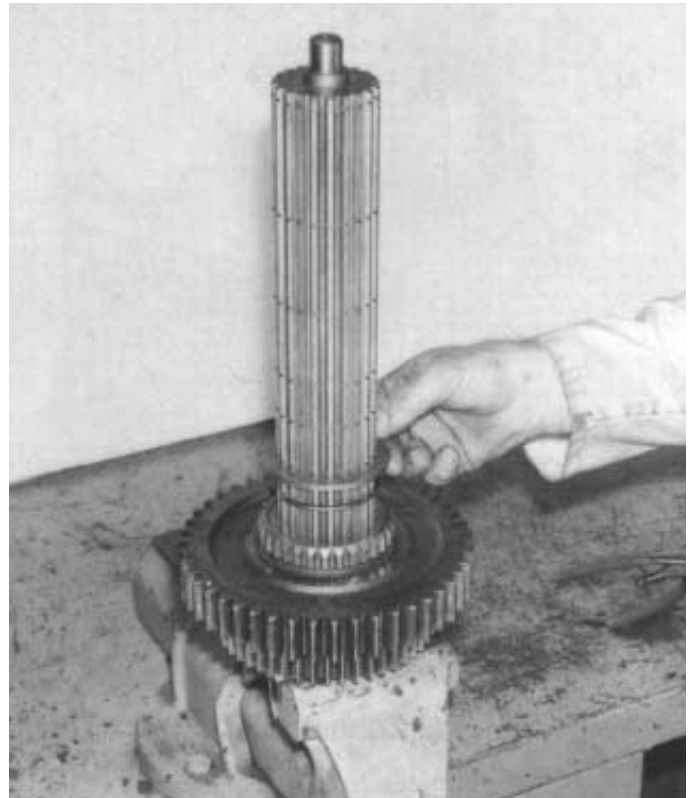
8. Check the clearance between 2nd and 3rd gears using two sets of feeler gauges. If the clearance is not within the correct limits the graded washer should be removed again and a thicker or thinner graded washer installed as required in its place.



10. Install the 1st speed gear snap ring into its groove in the mainshaft.



9. Invert the shaft and gears in the vice and install the 1st/2nd gear sliding clutch.



11. Place a graded washer over the shaft, chamfered face against the snap ring.

## Main Transmission

### M. Mainshaft Reassembly (Main Section)

Serial Numbers: N 535712 and above (ERF); N 537125 and above (all other models).

#### Mainshaft Gears - Axial Clearances

The axial clearances for mainshaft gears are:

Reverse/Forward speed gears - 0,13-0,30mm

Graded washers are used to obtain the clearances within the correct limits; six different thicknesses are available as follows:

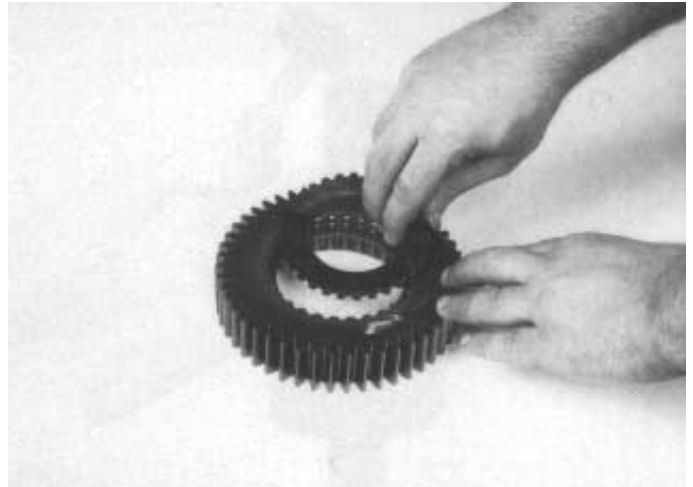
Thickness	Colour Code
6,30 - 6,35mm	White
6,43 - 6,48mm	Green
6,55 - 6,60mm	Orange
6,68 - 6,73mm	Purple
6,80 - 6,86mm	Yellow
6,93 - 6,99mm	Black

Refer to Illustrated Parts List for part numbers.

**Note:** During reassembly of the the mainshaft it is essential to ensure the correct part numbers are used in the correct locations. (All major components have their part number stamped into them.)



1. If removed, install new snap rings into the 1st and reverse speed gears



2. Check the 2nd and 3rd gear splined spacers for wear and if still acceptable refit them into the gears along with new snap rings.



3. Press the 2nd gear spacer onto the mainshaft and then fit the 2nd gear assembly clutching teeth down.

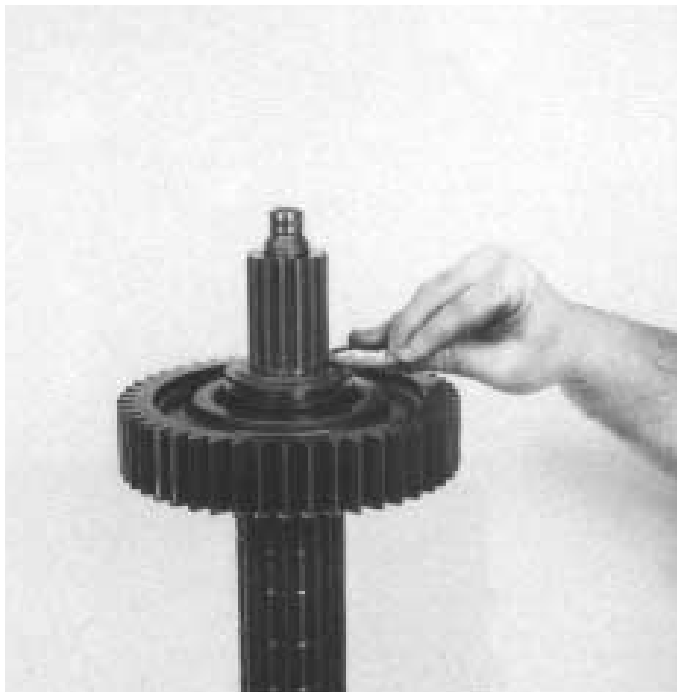
## Main Transmission



4. Press the 2nd/3rd gear spacer onto the shaft.



6. Remove the chosen graded mainshaft washer.

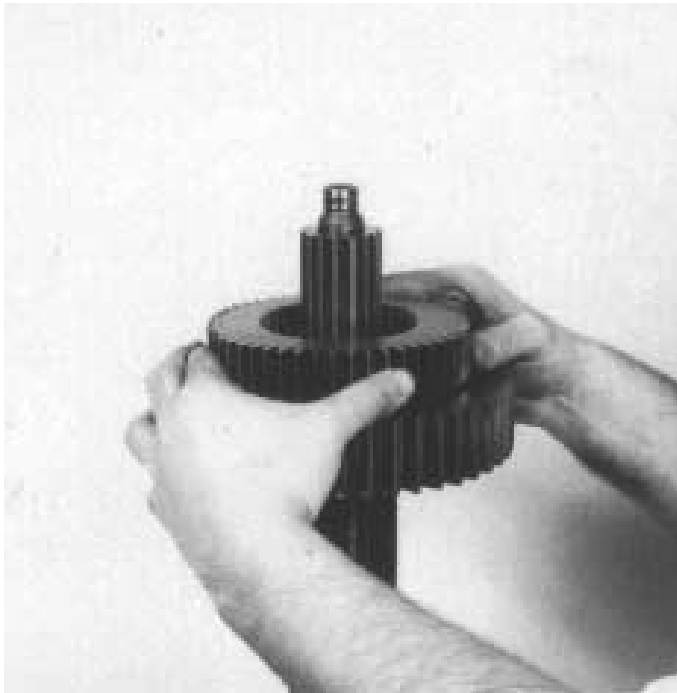


5. From the range of graded mainshaft washers select one which allows the least amount of clearance between the snap ring and the 2nd/3rd gear spacer.

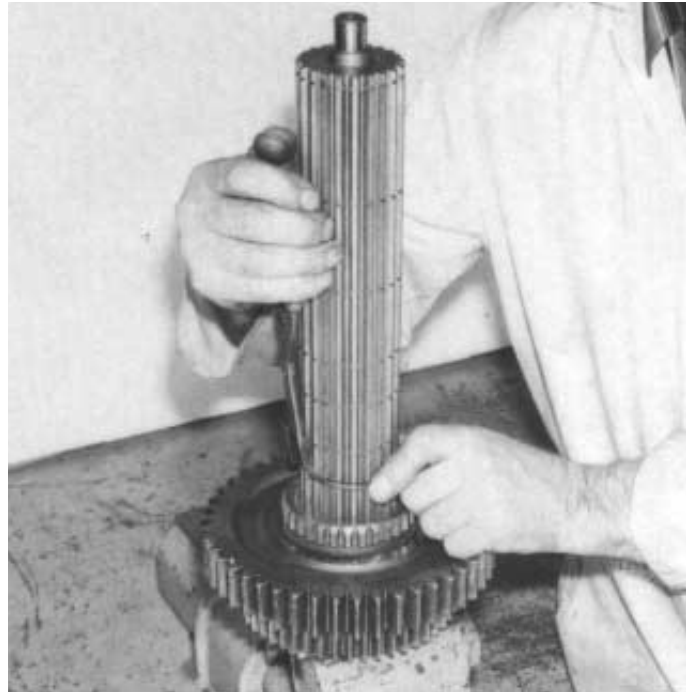


7. Fit the 3rd gear assembly clutching teeth up, selected graded mainshaft washer and snap ring.

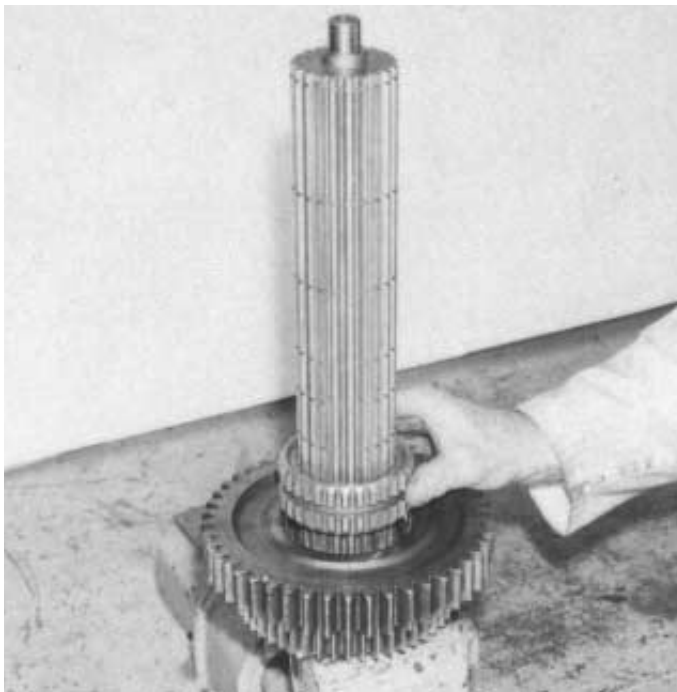
## Main Transmission



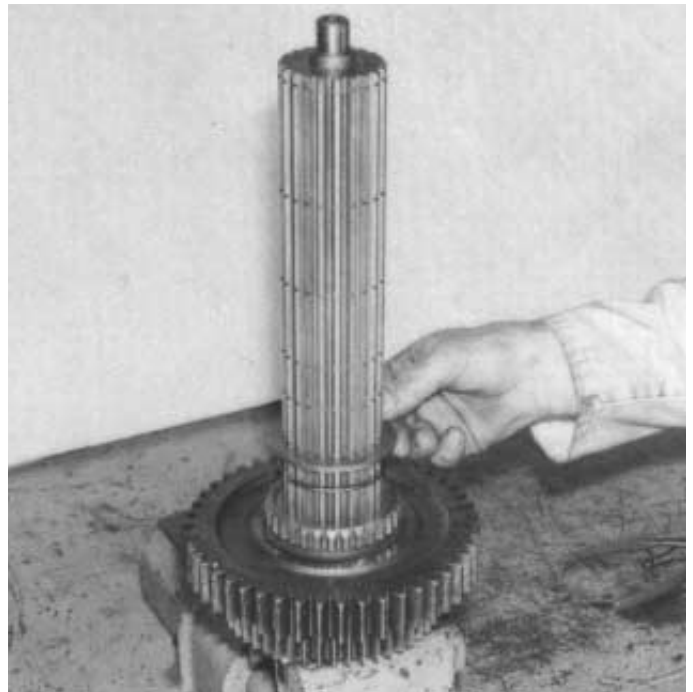
8. The 2nd/3rd gear mainshaft clearance should now be set.



10. Install the 1st speed gear snap ring into its groove in the mainshaft.

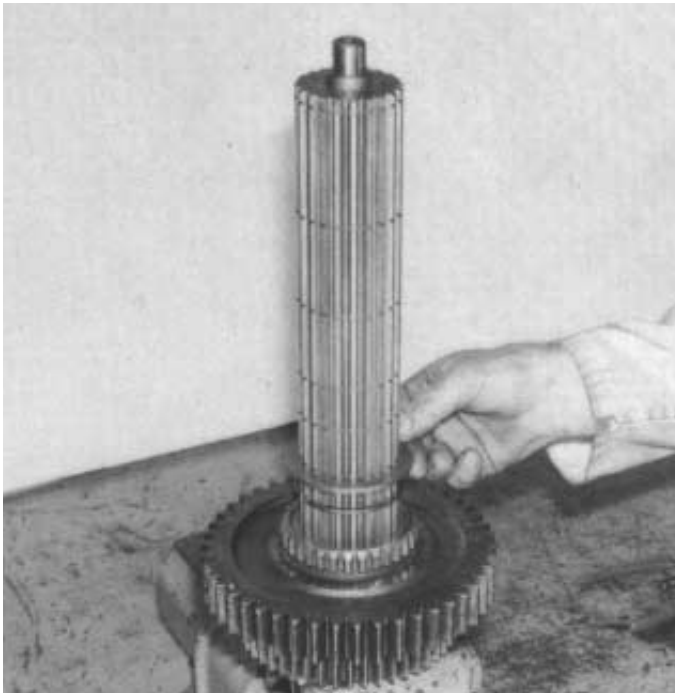


9. Invert the shaft and gears in the vice and install the 1st/2nd gear sliding clutch.

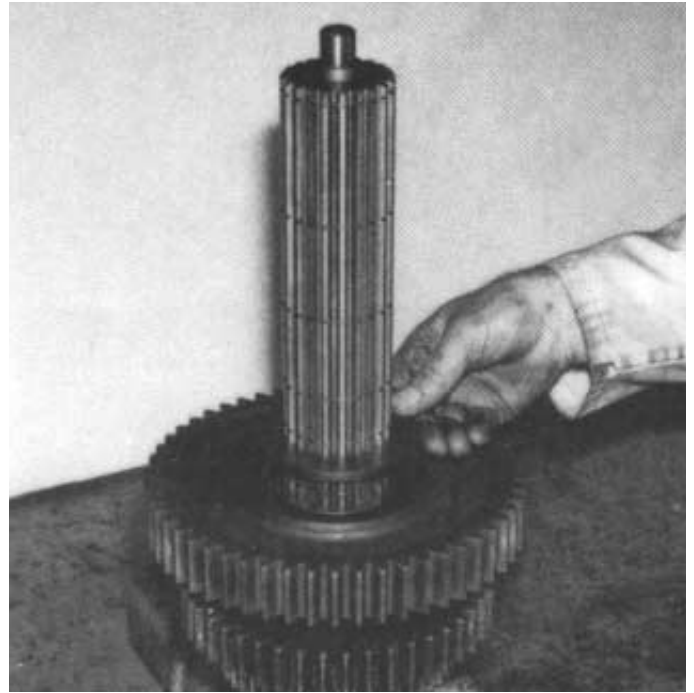


11. Place a graded washer over the shaft, chamfered face against the snap ring.

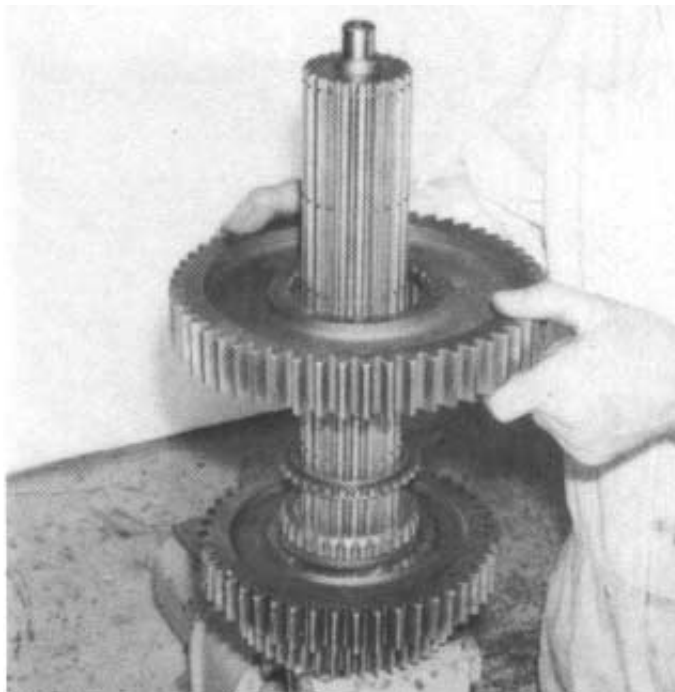
## Main Transmission



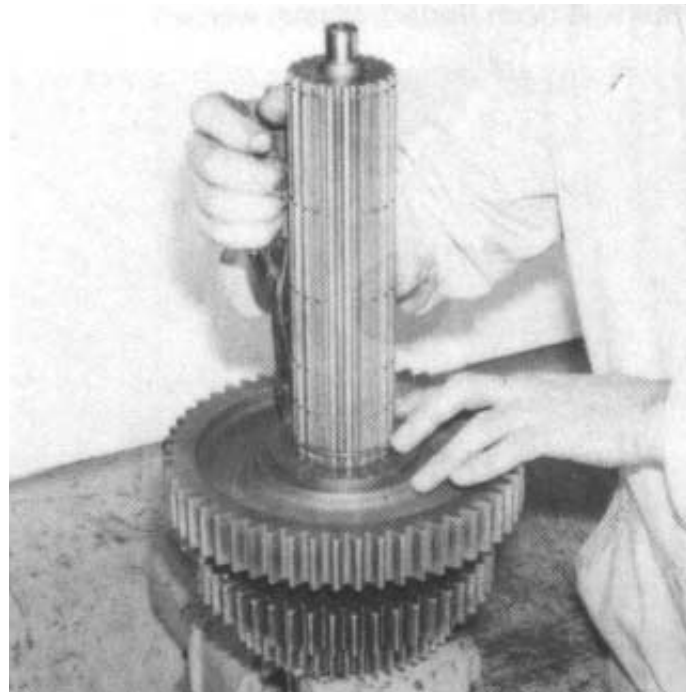
12. Place a spacer over the shaft, flat (mating) face against the graded washer.



14. Fit the plain washer against the 1st speed gear.



13. Install the 1st speed gear on the shaft and over the spacer, clutching teeth downwards towards the sliding clutch.

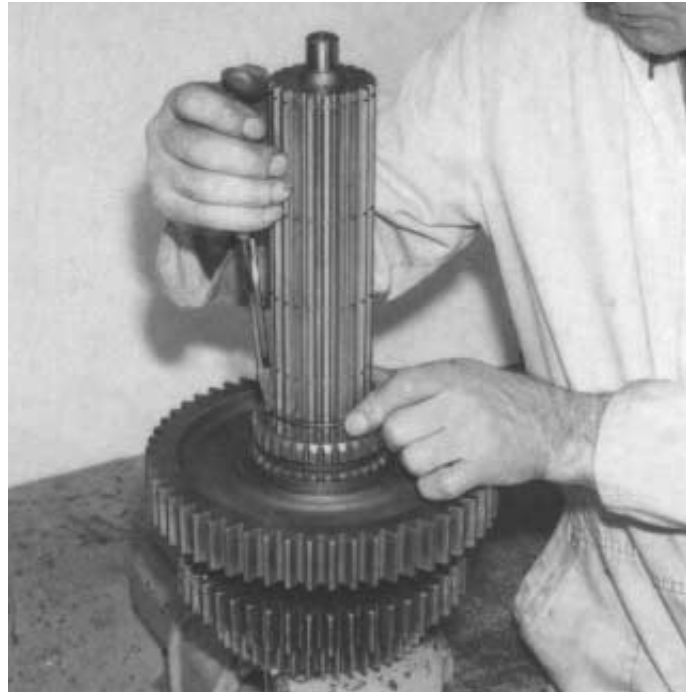


15. Install the 1st speed gear retaining snap ring.

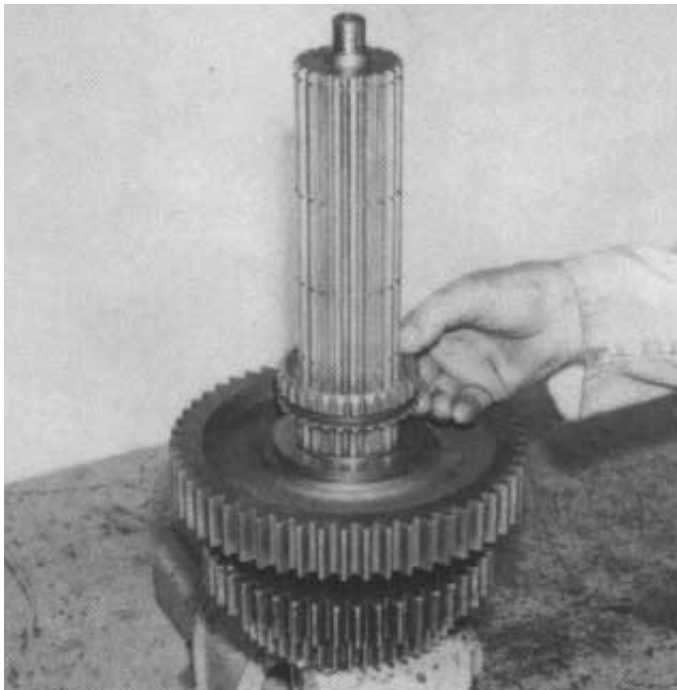
## Main Transmission



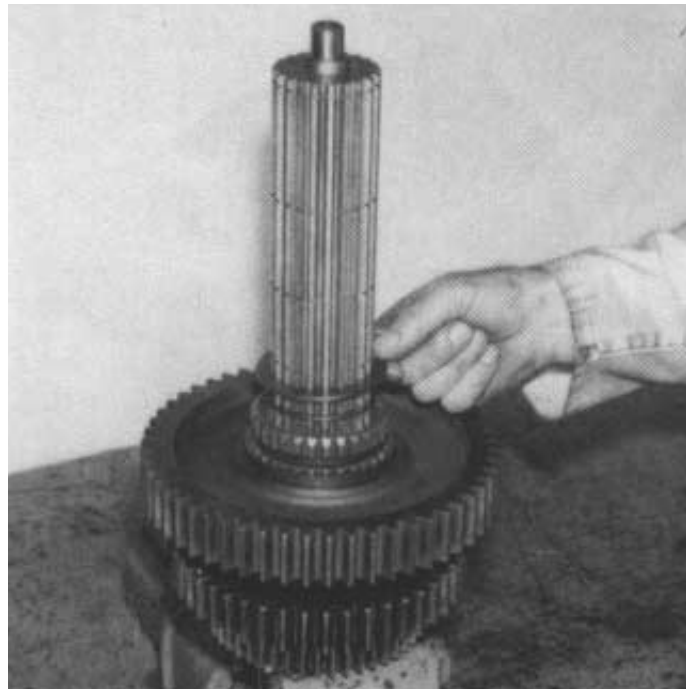
16. Check the clearance between 1st speed gear and the washer using two sets of feeler gauges. If the clearance is not within the correct limits the graded washer should be removed again and a thicker or thinner graded washer installed as required in its place.



18. Install the reverse gear front snap ring into the groove in the mainshaft.



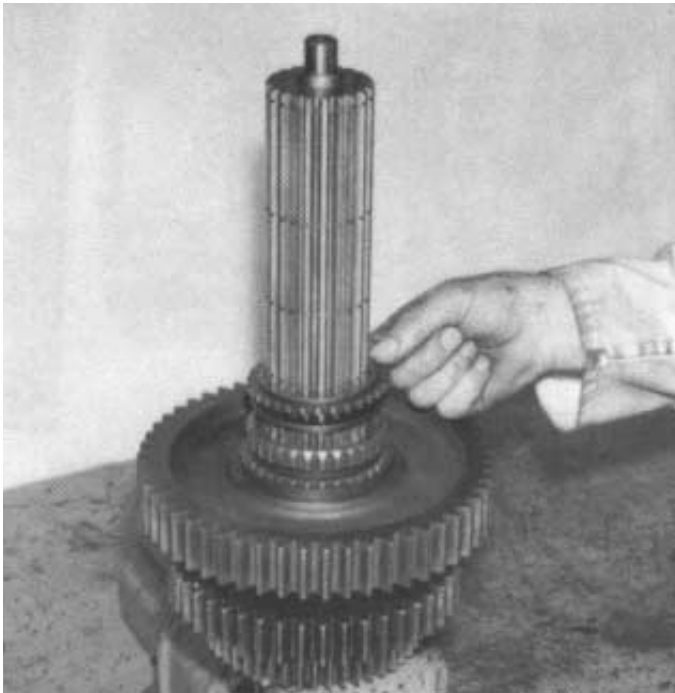
17. Install the reverse gear sliding clutch, longer, clutching teeth uppermost.



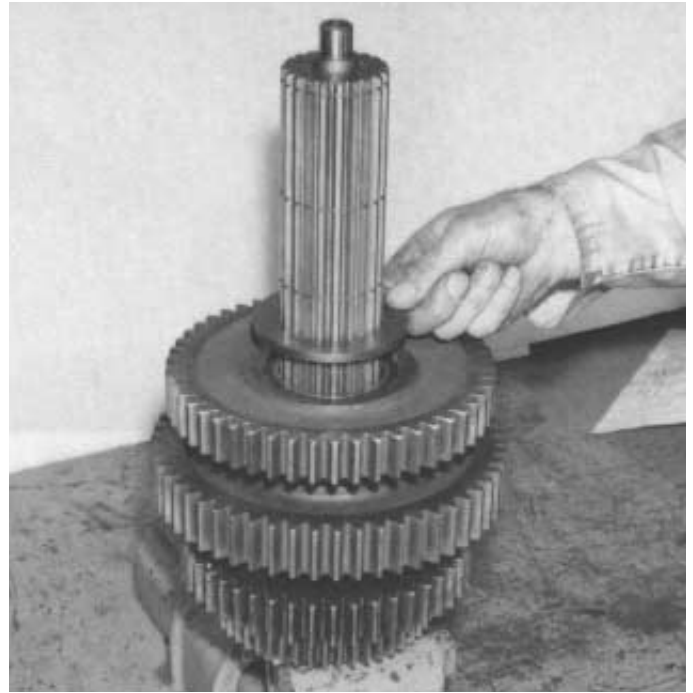
19. Place the reverse gear graded washer over the shaft, chamfered face downwards against the snap ring.



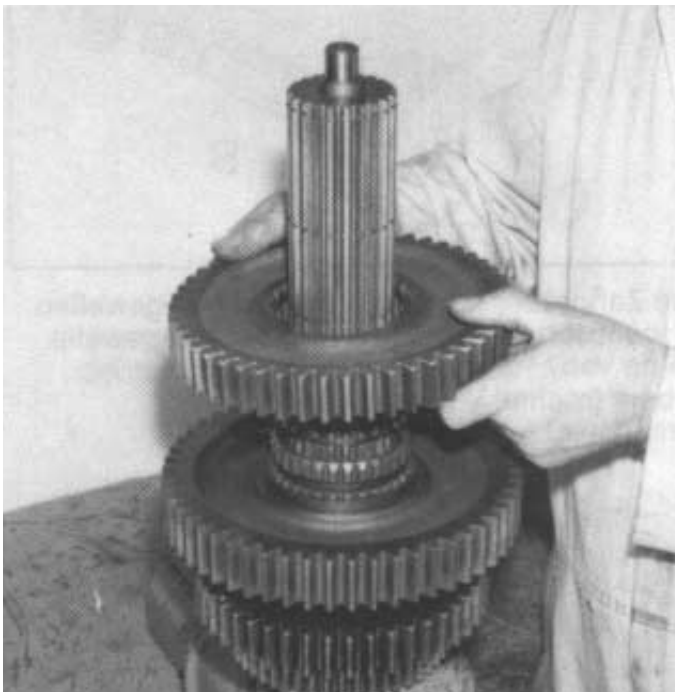
## Main Transmission



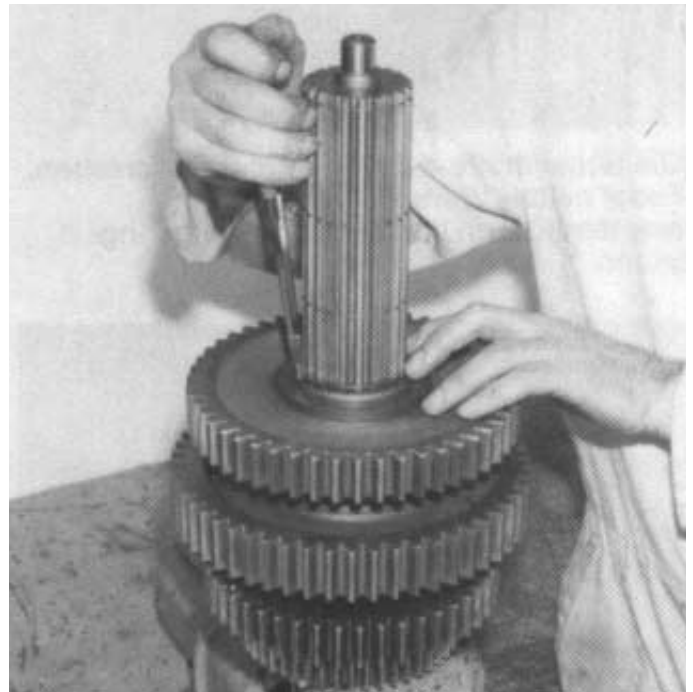
20. Install the spacer, flat (mating) face against the graded washer.



22. Fit the flat washer against the reverse gear and the spacer ring against the flat washer.



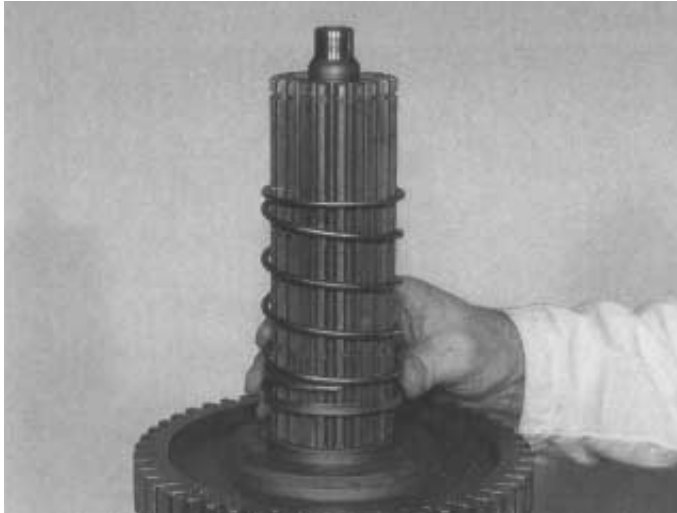
21. Install the reverse gear over the spacer, clutching teeth downwards towards the sliding clutch.



23. Install the reverse gear retaining rear snap ring.



## Main Transmission



24. Install the spring retainer plate and the short jaw clutch spring onto the mainshaft.



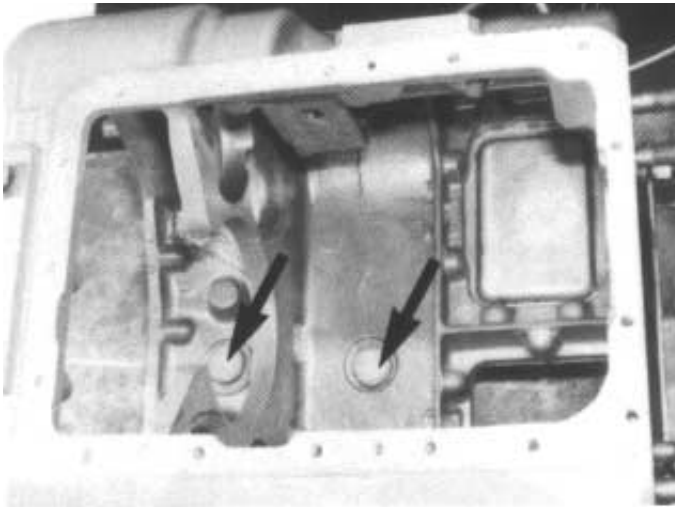
25. Locate the jaw clutch on the mainshaft; using the special tool E113 compress the spring and install the retaining snap ring.



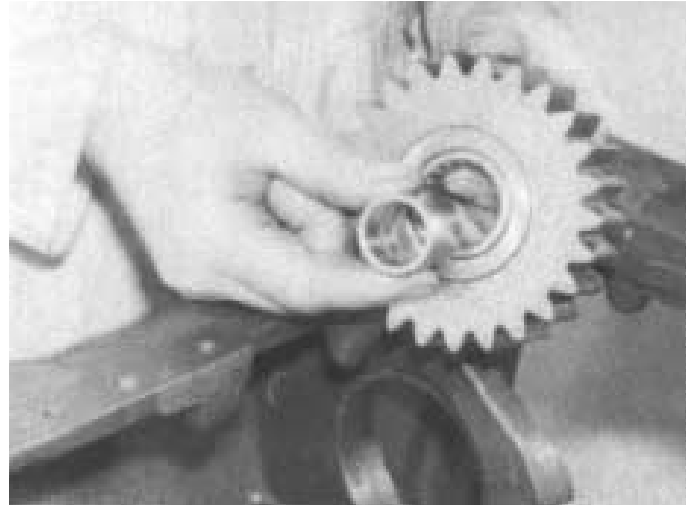
26. Check the clearance between the reverse gear and the flat washer using two sets of feeler gauges. If the clearance is not within the correct limits the graded washer must be removed again and a thicker or thinner graded washer installed as required in its place. Remove the assembly from the vice.

## Main Transmission

### N. Main Transmission Reassembly

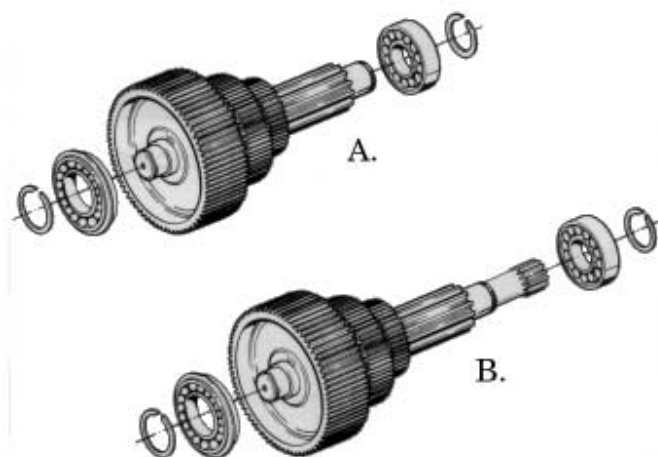


1. Before starting reassembly, make sure the two magnetic discs are cleaned of swarf and are securely adhering to the floor of the housing.



3. Install the bearing sleeve into the right-hand (lower) reverse idler gear/bearing.

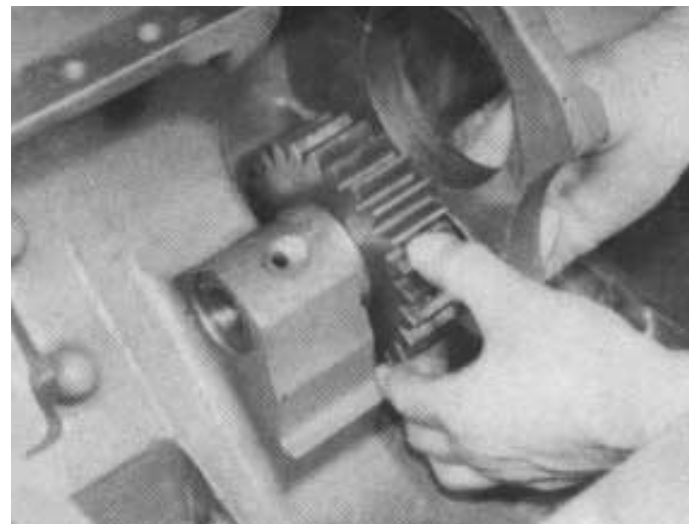
**Note:** Both gears are identical. When using the original gears assemble the gears back in the same position from which they were removed in order to maintain wear patterns.



2. The gears on the two countershafts are identical. The lower (left-hand) countershaft has an extended shaft for a power take off.

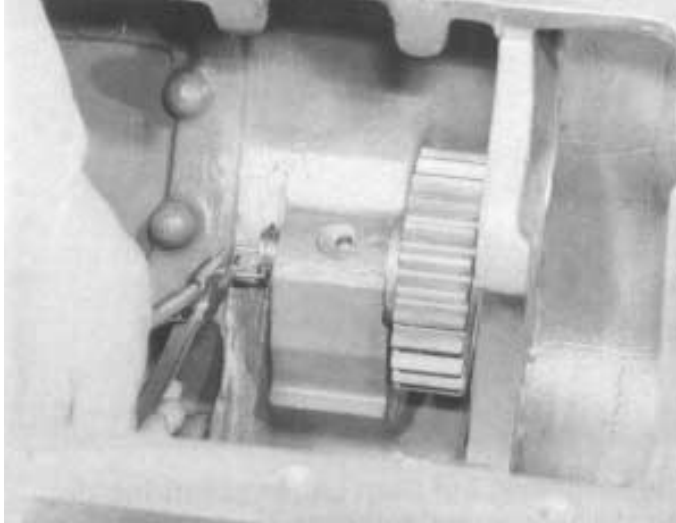
A. Upper (right-hand) countershaft

B. Lower (left-hand) countershaft

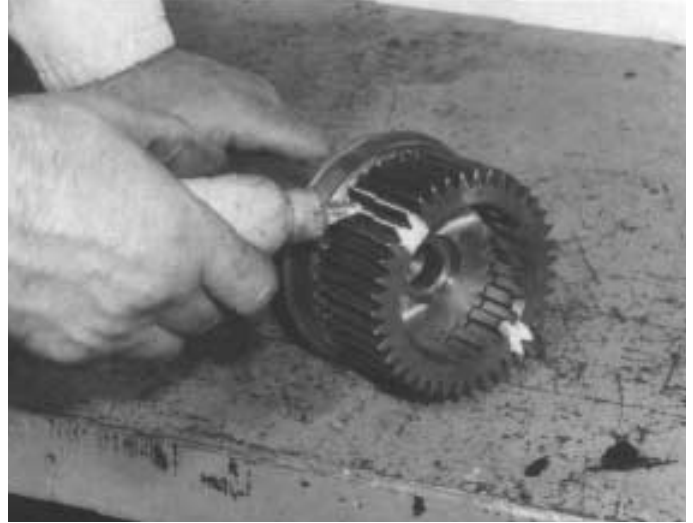


4. Position the reverse idler gear, counterbored face rearmost, into the housing with the washer located forward of the gear against the support. Insert the idler gear shaft through the bearing sleeve and washer into the housing using a little petroleum jelly to assist retention of the washer.

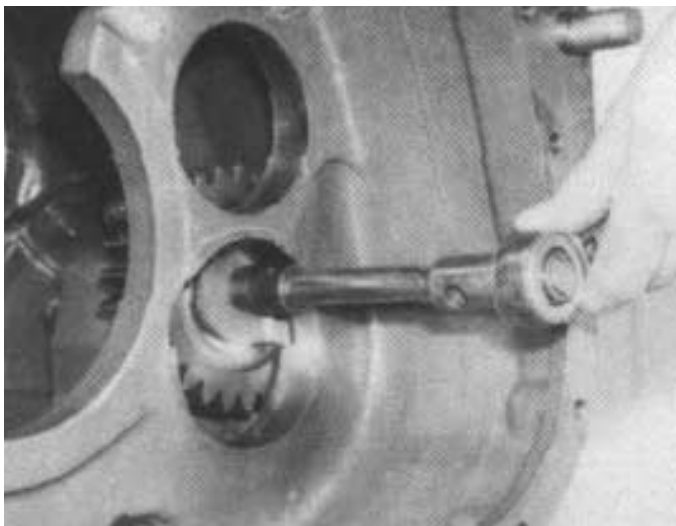
## Main Transmission



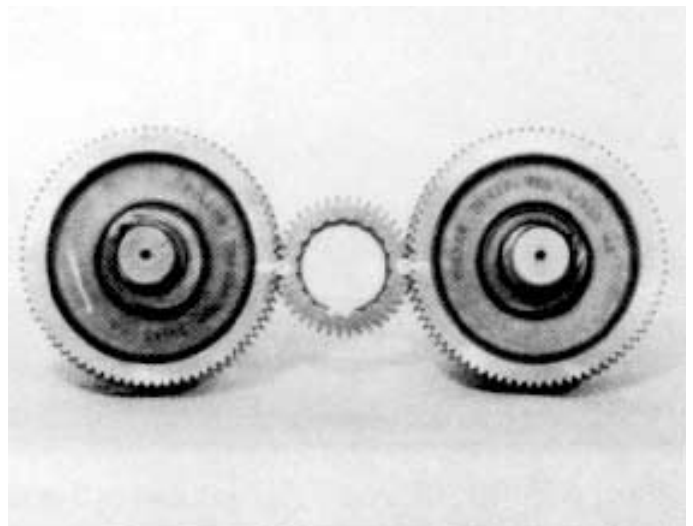
5. Drive the shaft into the housing until the circlip groove is accessible and install the circlip. Pull or drive the shaft rearward again (gently) until the circlip abuts the housing.



7. Paint timing marks on the drive gear and on the two countershafts. On the drive gear, if not already marked, paint any two adjacent teeth. Then paint the two teeth directly opposite the first two.

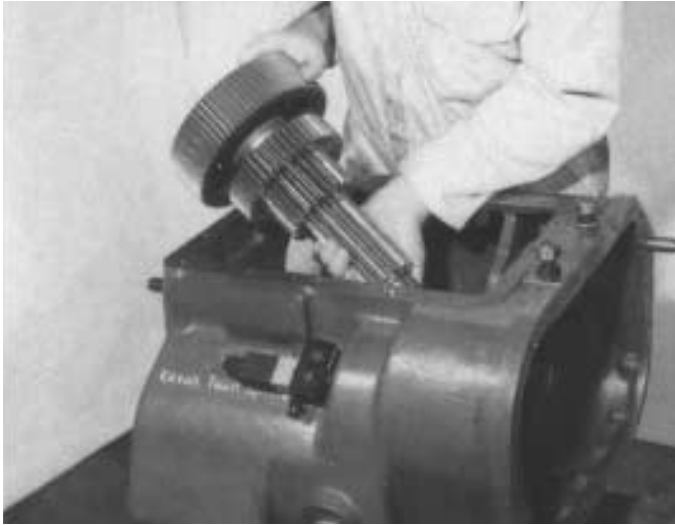


6. Rotate the shaft to align the slot with the oil hole in the housing. Apply sealer to the capscrew threads and install the support washer. Do not overtighten.



8. On each countershaft, the front (drive) gear is marked on its rear race with an 'O' by one of the teeth. Paint this tooth on each gear. Illustration shows the three gears (disassembled) correctly marked.

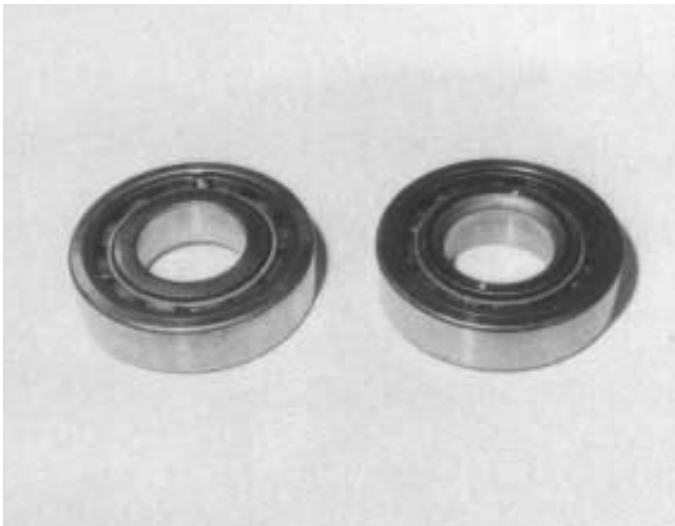
## Main Transmission



9. Locate the lower (left-hand) countershaft (extended shaft) into the housing centralising it in the bearing bores.



11. Using a suitable flanged installer drive the bearing onto the shaft and into the housing. Fit the retaining snap ring on the shaft.



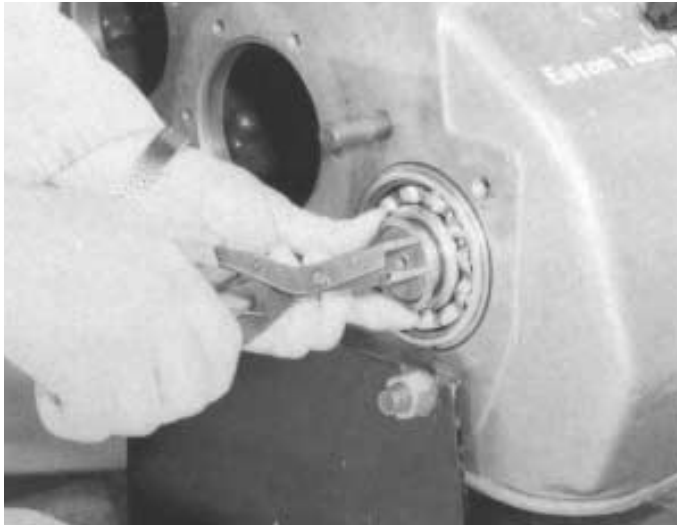
10. Locate the countershaft rear bearing over the shaft and into the housing.

**Note:** The inner track of the bearing is radiused on one face and chamfered on the other. The radiused face **must** be toward the front, chamfer to the rear.

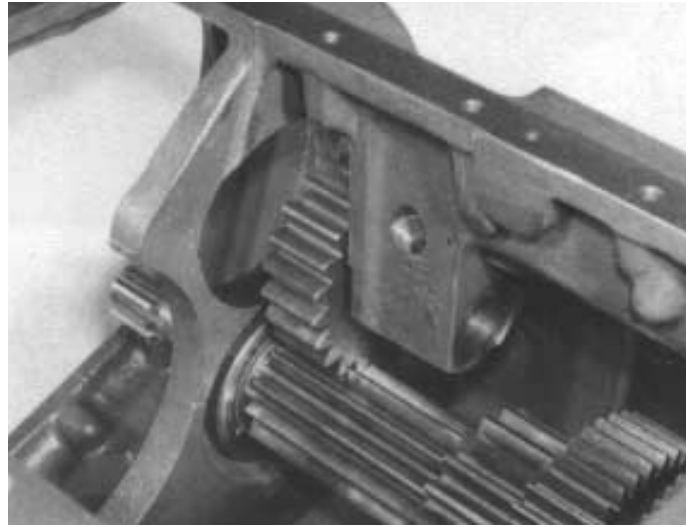


12. Locate the countershaft front bearing on the shaft, snap ring groove outermost and using a suitable flanged installer, drive the bearing onto the shaft and into the housing.

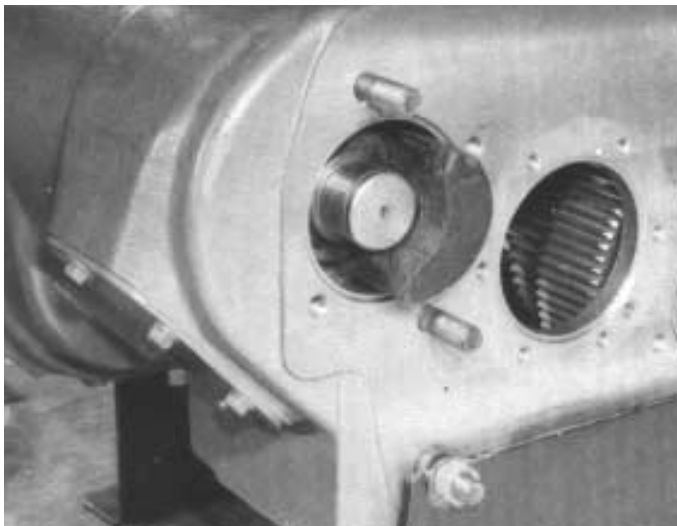
## Main Transmission



13. Install the bearing retaining snap ring on the shaft. Rotate the shaft to bring the timing mark in line with the mainshaft bores.



15. Place the upper (left-hand) reverse idler gear into position, counterbored face to the rear, resting it in mesh with the countershaft and against the left side of the case.

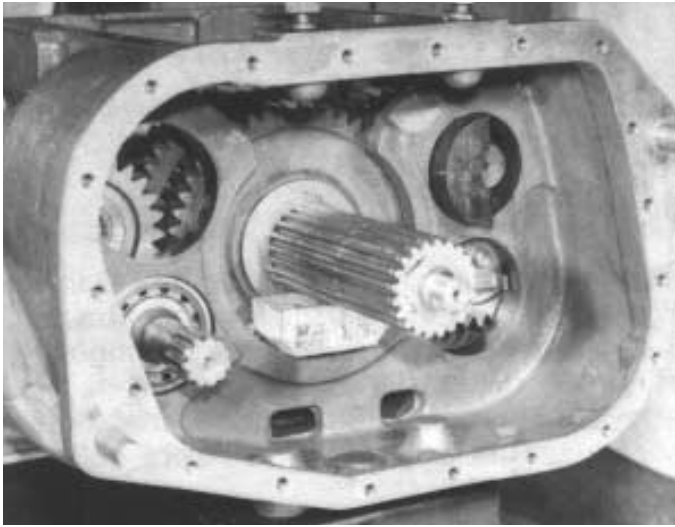


14. Place the upper (right-hand) countershaft in the housing. Use wooden blocks in the bearing bores to support the countershaft as far to the right-hand side as possible and align the timing marks to face the lower countershaft.

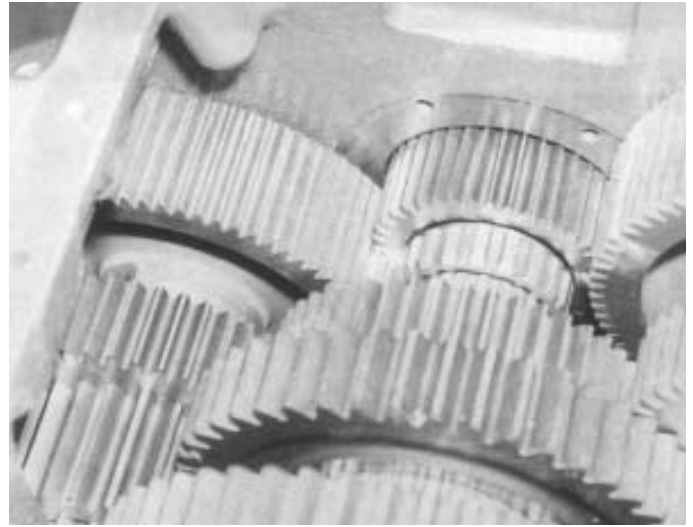


16. Place the assembled mainshaft into the housing (rear end first).

## Main Transmission



17. Locate the mainshaft approximately in position and in mesh with the lower countershaft and support at the rear on a suitable wood block.

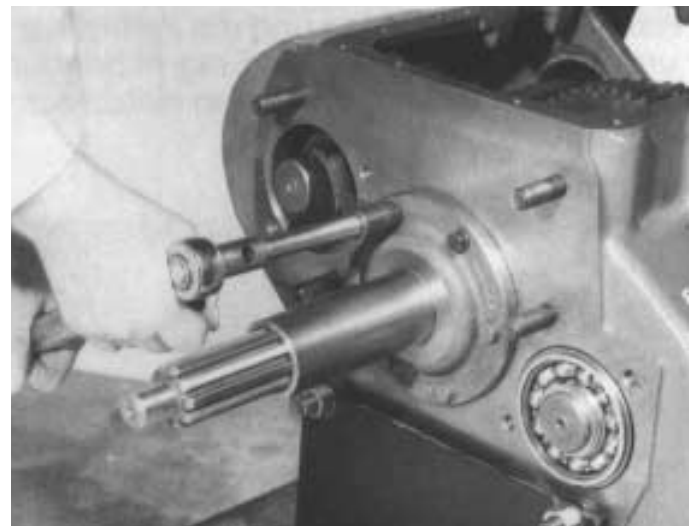


19. Place the 3rd/4th gear sliding clutch into the end of the assembled input shaft. Align the timing marks on the input shaft with the lower (left-hand) countershaft and install the input shaft, taking care not to dislodge the thrust race pack.

**Note:** Note the different sizes of clutching teeth on Serial Numbers N 535712 and above (ERF), N 537125 and above (all other models).



18. Place the mainshaft front thrust race pack onto the mainshaft front spigot, steel washer against the shaft. Retain in place with petroleum jelly.

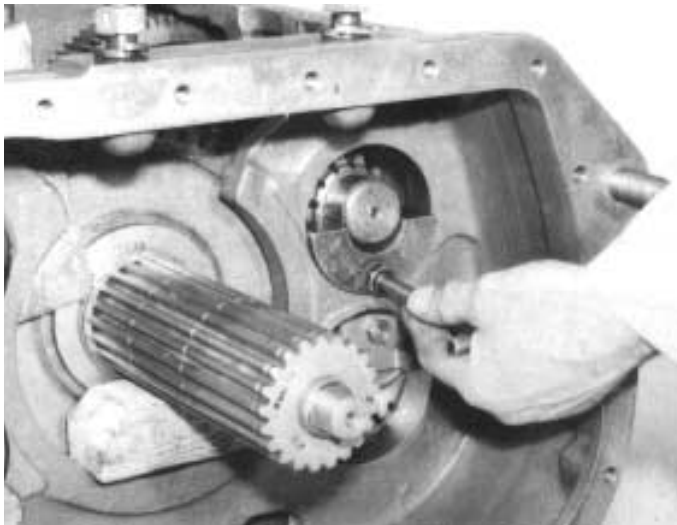


20. Push the input shaft fully home and install the input shaft cover. Note the correct position of the drilled capscrews, when fitted. Tighten to the correct torque. Insert two wedges between reverse gear and the housing to prevent the mainshaft sliding rearwards.

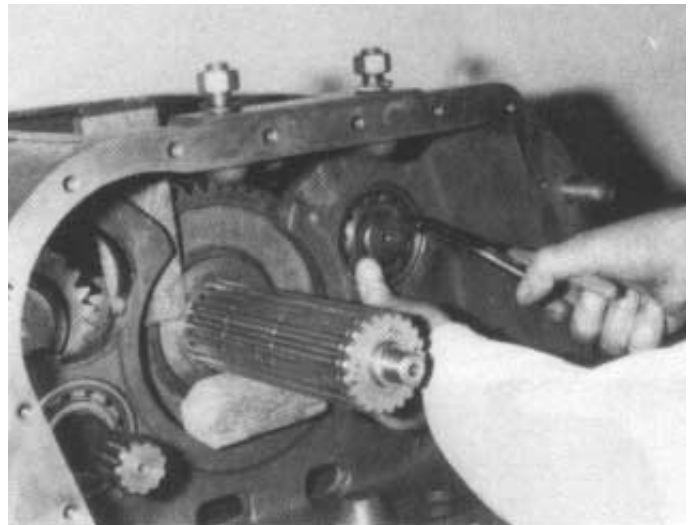
Check to ensure that the countershaft is still correctly timed to the input shaft.



## Main Transmission



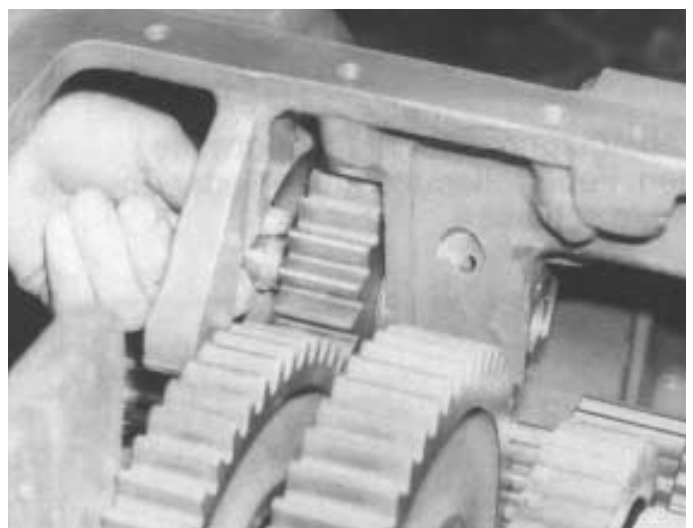
21. Rotate the upper (right-hand) countershaft as necessary to align the timing marks with the input shaft, engage the gear teeth and support the countershaft in position with a dummy support tool.



23. Remove the dummy support from the rear of the upper (right-hand) countershaft and install the rear bearing as described in sub-operations 10 and 11 ensuring that the radiused face of the inner track is toward the front, chamfer to the rear. Fit the snap ring.



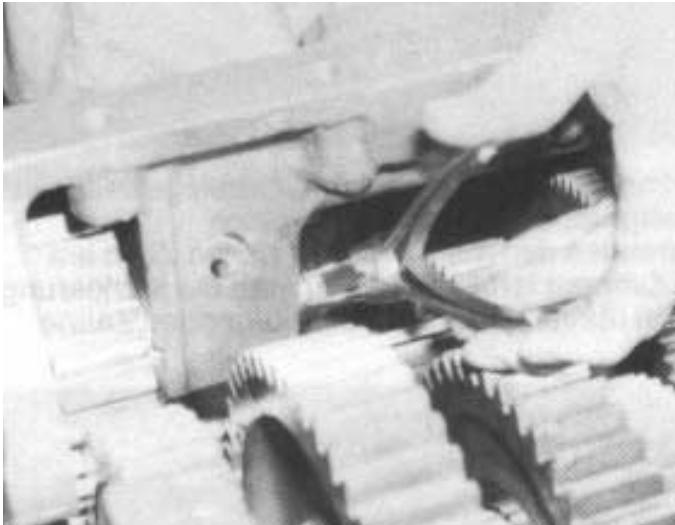
22. Partially install the countershaft front bearing and check the timing marks are aligned correctly. Using a suitable flanged installer drive the countershaft front bearing onto the shaft and into the housing. Fit the snap ring.



24. Raise the rear of the mainshaft slightly and roll the upper reverse idler gear into mesh with the reverse gear. Grease one side of the thrust washer and insert it between the front face of the gear and the housing. Insert the idler gear shaft into the housing.



## Main Transmission



25. Drive the shaft into the housing until the circlip groove is accessible and install the circlip. Align the slot in the shaft with the oil hole in the housing, apply sealer to the capscrew threads and install the support washer.



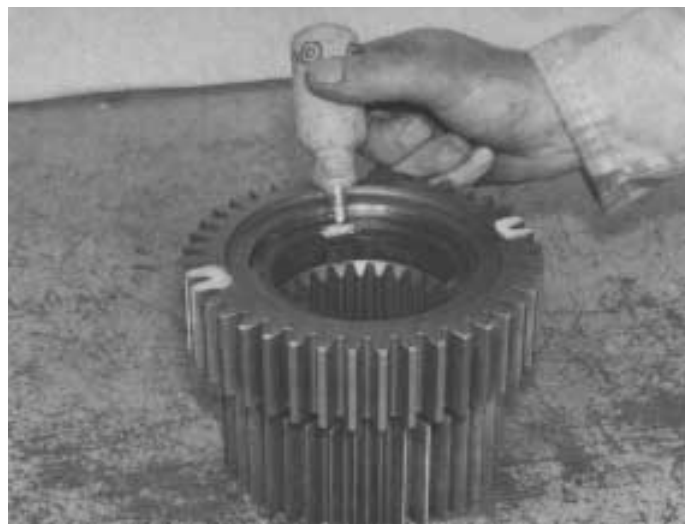
26. Install the upper and lower auxiliary countershaft front bearings, driving them into the housing bores using a suitable flanged driver, until they abut the two reverse idler gear support washers.

## Main Transmission

### O. Reassembly of Auxiliary Section



1. Paint timing marks on both auxiliary countershafts. Paint along all three gear teeth on each countershaft in line with the 'O' stamped on the front gear..



2. On the forward sliding gear paint any two adjacent teeth and then two teeth directly opposite the first two. Paint highlighting marks on the sensor ring blocker teeth to aid alignment with the jaw clutches during assembly.

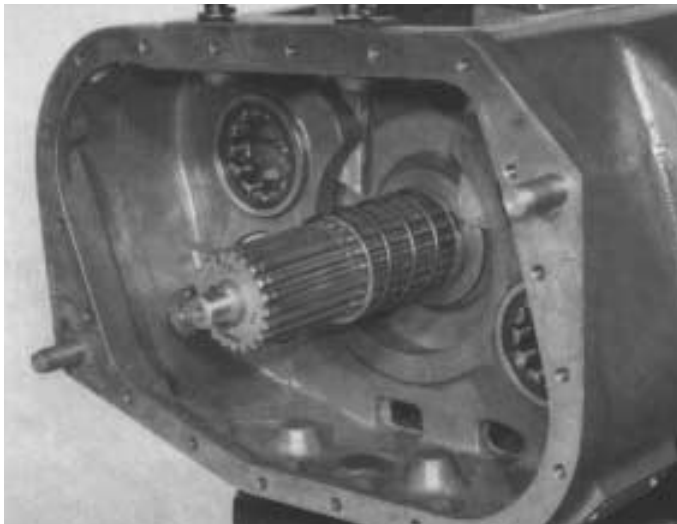
## Main Transmission



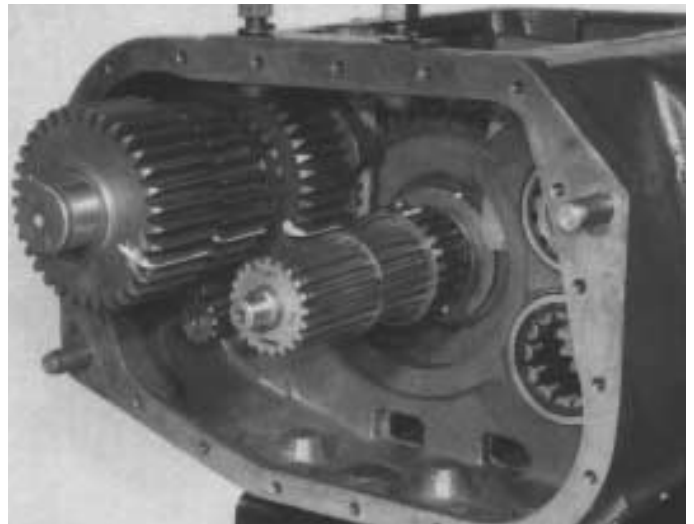
3. Paint highlighting marks on the two teeth, one each side of the master blocking spline on the jaw clutches, to aid alignment with the sensor ring during assembly.



5. Locate the jaw clutch on the mainshaft with the marked master spline uppermost. Using the special tool, compress the spring and install the front jaw clutch retaining snap ring on the mainshaft.

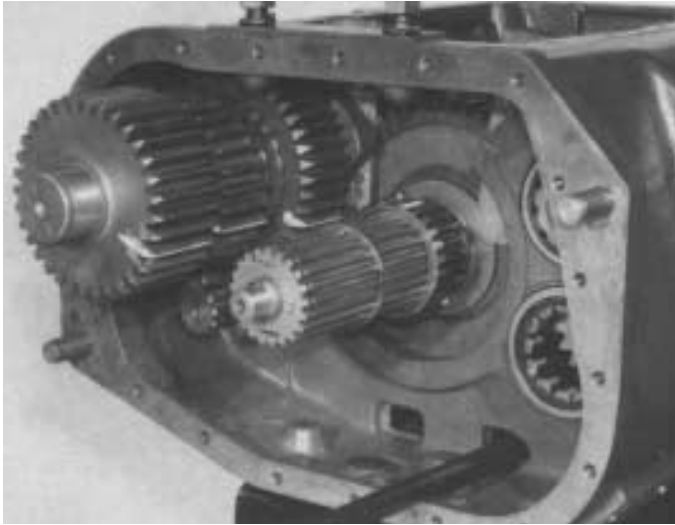


4. Remove the support block and install the spring retainer plate and the short jaw clutch spring on the mainshaft.

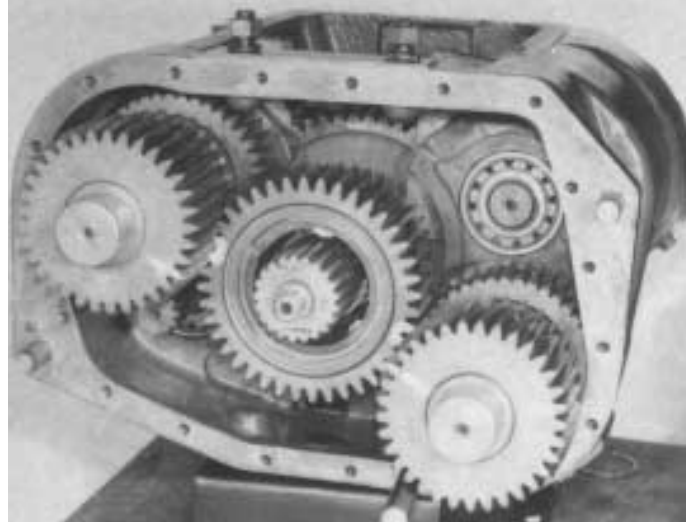


6. Install the centre jaw clutch snap ring on the mainshaft. Install the upper (left-hand) auxiliary countershaft into its front bearing. Align the timing marks toward the mainshaft.

## Main Transmission



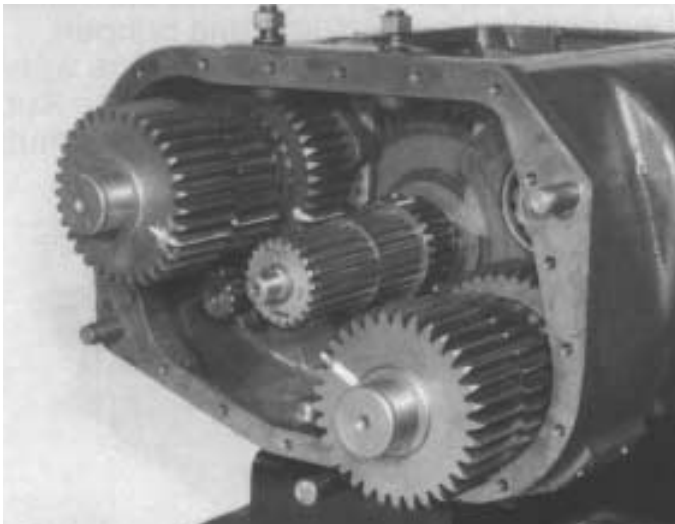
7. Place a 20 mm dia x 300 mm long bar in the housing with the end located in the housing web. Chamfer the end of the bar if necessary.



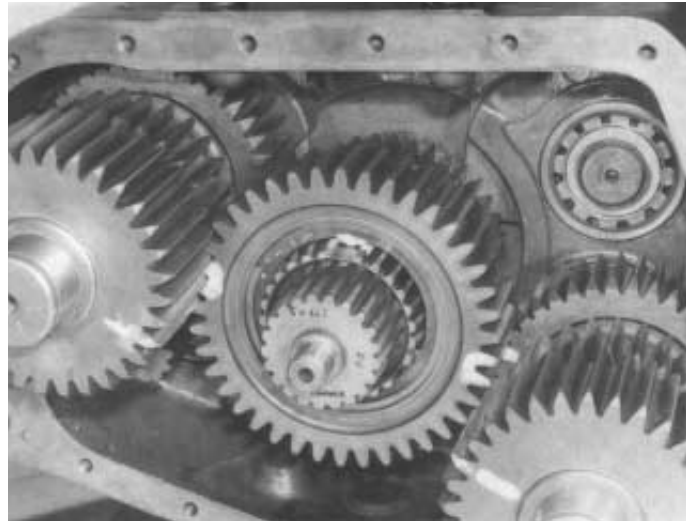
9. Install the sliding gear cluster onto the mainshaft ensuring that:

a: blocker spline on front sensor is aligned with jaw clutch.

b: timing mark on front sliding gear is correctly meshed with upper (left-hand) countershaft timing mark.



8. Lay the lower (right-hand) auxiliary countershaft on to the bar and against the side of the housing. Align the timing marks towards the mainshaft.



10. Install the jaw clutch for the rearmost gear of the cluster into the sensor and against the snap ring on the mainshaft.

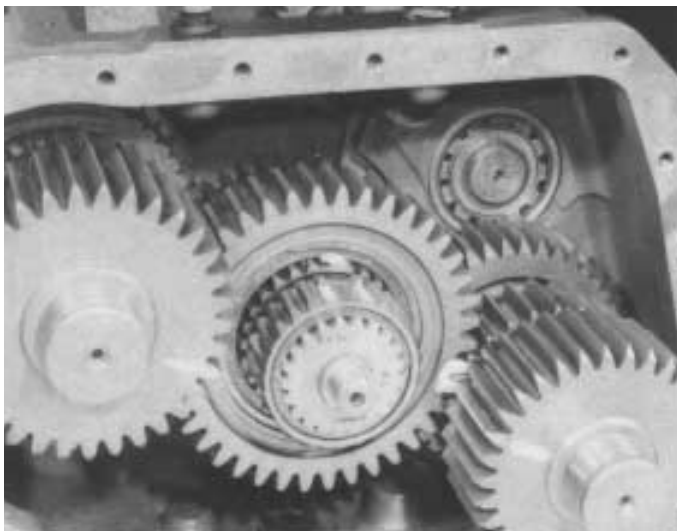
## Main Transmission



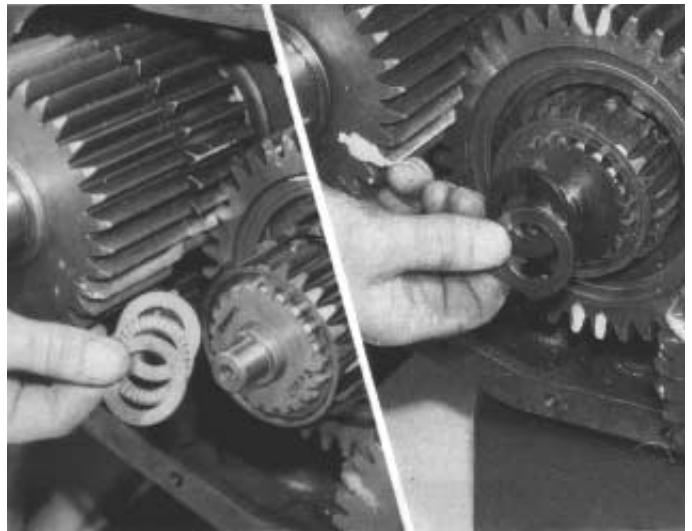
11. Place the longer jaw clutch spring on the mainshaft, place the rear jaw clutch against the spring. Using the special tool compress the spring and install the rear snap ring onto the mainshaft.



13. Install the sliding gear cluster yoke into the cluster, offset boss towards the front.

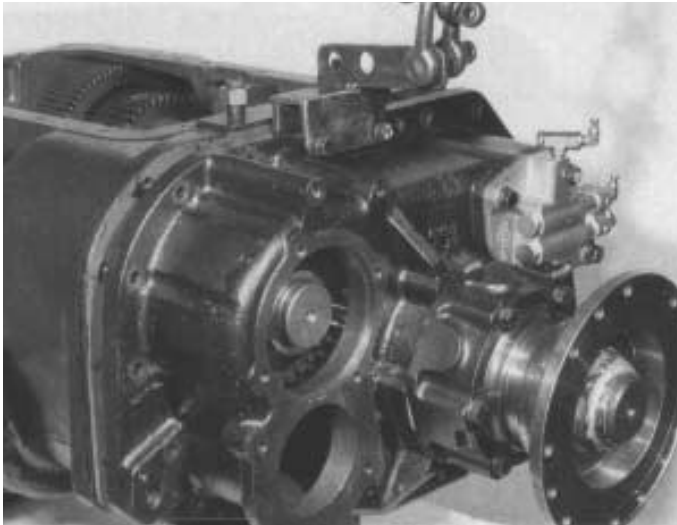


12. Remove the bar supporting the lower (right-hand) auxiliary countershaft, align the timing marks and install the countershaft into its front bearing. Check to ensure the gears are correctly timed.



14. Install the mainshaft rear thrust race pack (one standard washer, one thrust race and one graded washer OR one graded washer and one vespel thrust washer) onto the mainshaft rear spigot. Retain in place with petroleum jelly.

## Main Transmission



15. Install the gasket. Raise the auxiliary rear housing using the lifting bracket and a hoist.

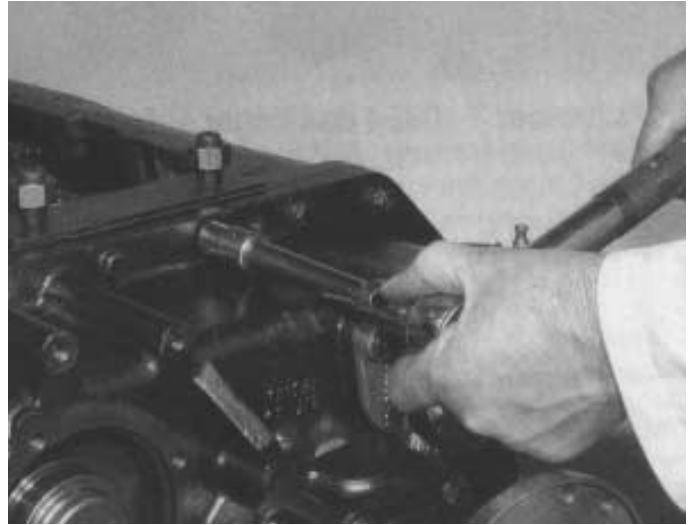
16. Install the auxiliary housing to the main housing ensuring that:

- a. Timing marks align and engage
- b. Jaw clutch aligns and engages
- c. Yoke boss aligns with the piston operating bar

Remove the lifting bracket, push the housing fully home and temporarily secure with two capscrews.

**17. Carry out the following checks before proceeding any further.**

- a. Engage one of the sliding clutches in the main section and rotate the input shaft several times. The main gear train should rotate without binding.
- b. Rotate the output shaft flange. The auxiliary gear train should rotate without binding.
- c. Engage the sliding gear cluster on to one of the jaw clutches and again rotate the input shaft. The entire drive train through to the output shaft flange should rotate without binding.
- d. If there is any binding either a jaw clutch is not aligned or the auxiliary gear train is not correctly timed.



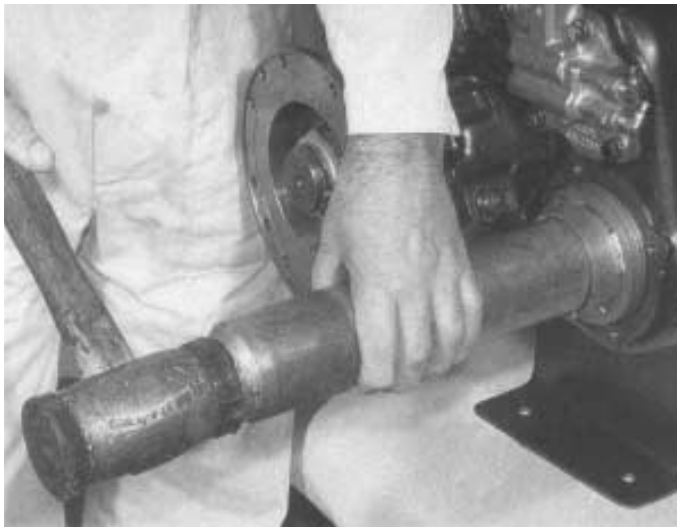
18. Fit the remaining capscrews and tighten to the correct torque. Note the correct positions of the two longer capscrews.



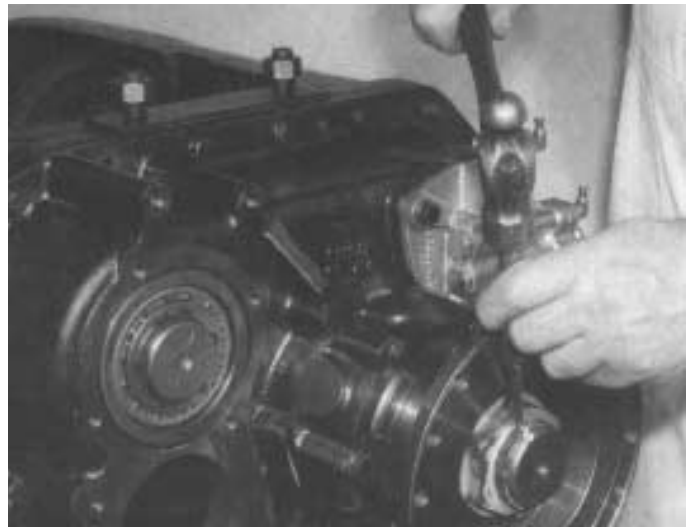
19. Align the sliding gear yoke with the splitter cylinder bar and install the lockscrew. Tighten to the correct torque and lockwire to secure.



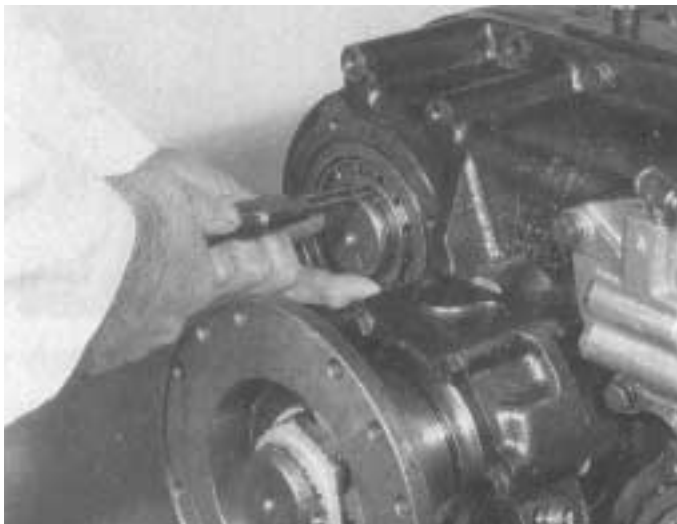
## Main Transmission



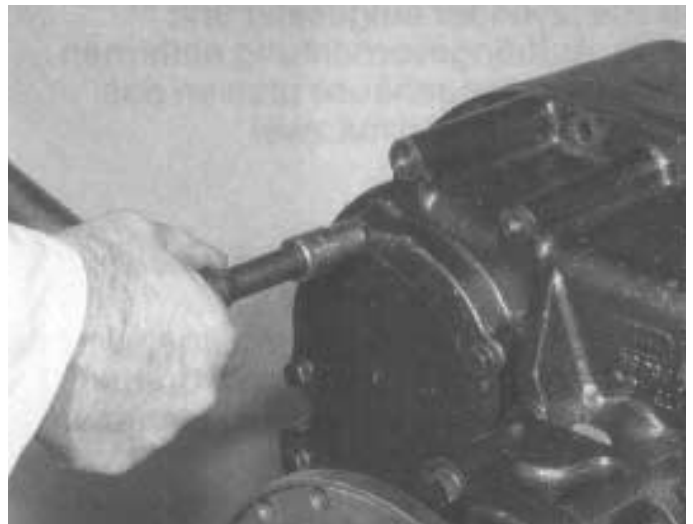
20. Using a suitable flanged driver drive the bearing into the housing. Similarly fit and install the upper auxiliary countershaft rear bearing.



22. Tighten the flange nut to correct torque. Stake the nut into the groove on the shaft.

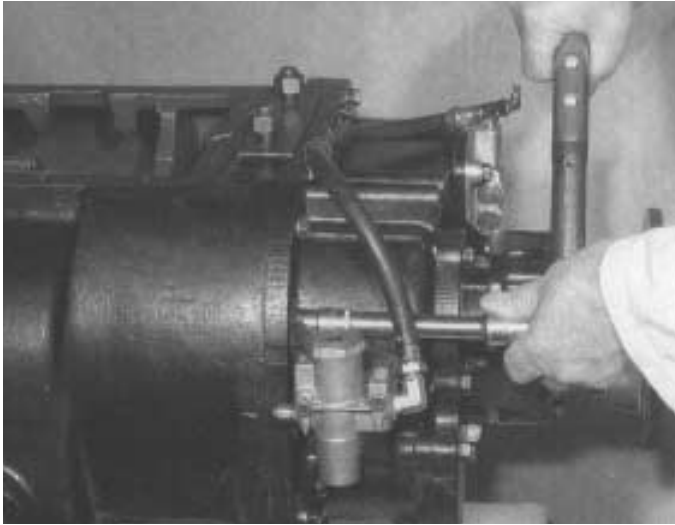


21. Fit bearing outer spacers and the snaprings.

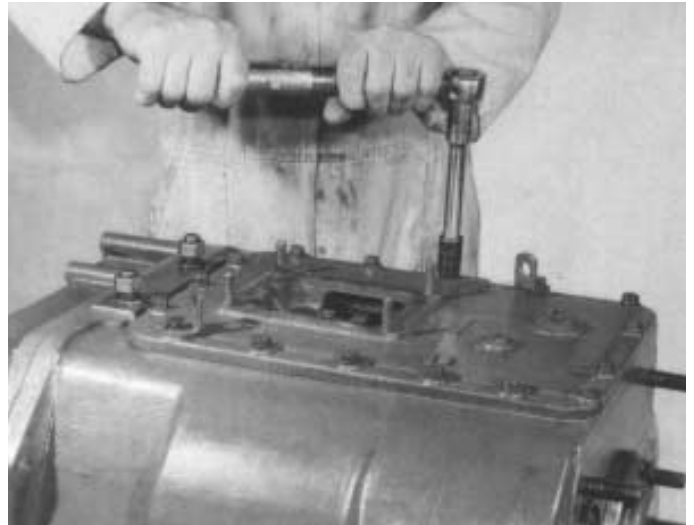


23. Install the bearing covers using new gaskets. Tighten the capscrews to the correct torque.

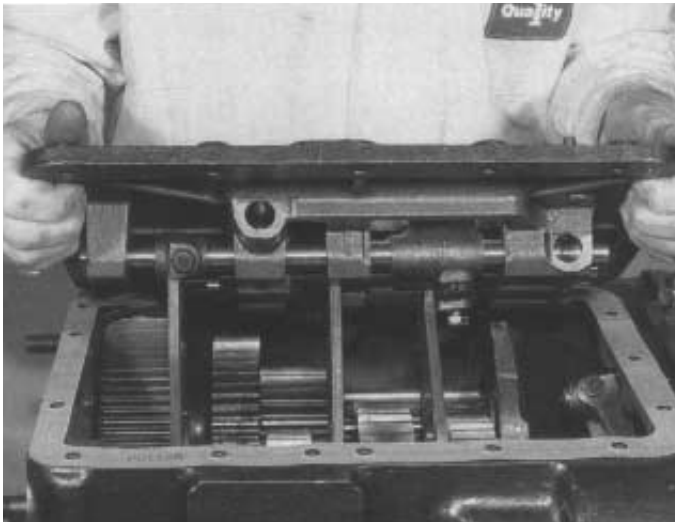
## Main Transmission



24. Install the pressure regulating valve and the air lines. Check the operation of the air system using a dry, regulated air supply and ensure freedom from leaks.



26. Fit the shift bar housing capscrews and tighten to the correct torque. Note the position of the lifting eyes together with the longer bolts.



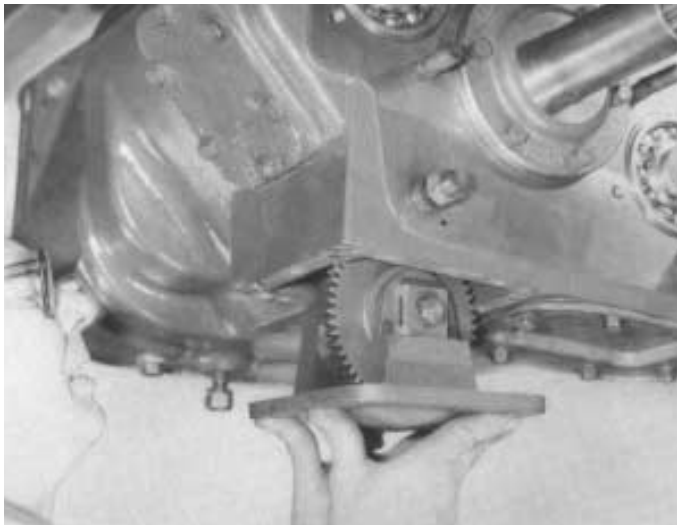
25. Ensure that all the sliding clutches and the shift bar housing yokes are in neutral and install the shift bar housing, using a new gasket.



27. Install the remote control housing and gasket. Note the conical nuts, tighten to the correct torque, then fit and tighten the lock nuts.



## Main Transmission



28. Raise the transmission from the stand and install the upshift brake using a new gasket. Fit the capscrews and tighten to the correct torque. Check backlash as described. Connect the air line to the pulse unit.

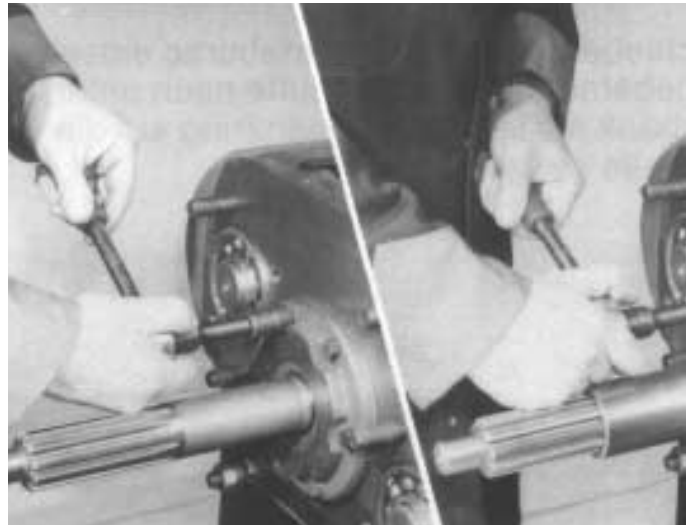
## **Section 5      Changing the Input Shaft**



## Changing the Input Shaft

In some cases in service it may be necessary to renew or replace the input shaft due either to wear on the splines caused by the clutch or for reasons of implementing a change in clutch type or clutch hub diameter.

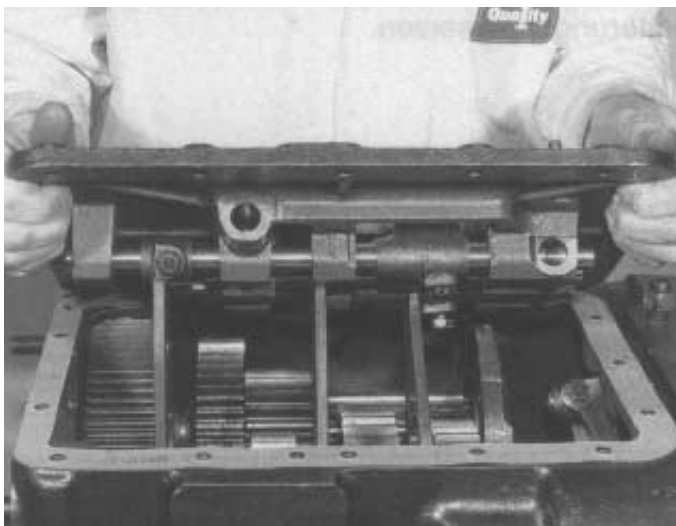
In these instances the input shaft can be renewed without disassembling the transmission other than the removal of the clutch housing and shift bar housing, by carrying out the following detailed procedure:



2. Remove the front bearing cover.

**Note:** There are two types of cover fitted depending on whether a push or pull action clutch release bearing is installed, Note the position of the two special capscrews when a push action clutch is fitted.

## Input Shaft Disassembly



1. Remove the gear shift remote control housing and shift bar housing from the transmission.



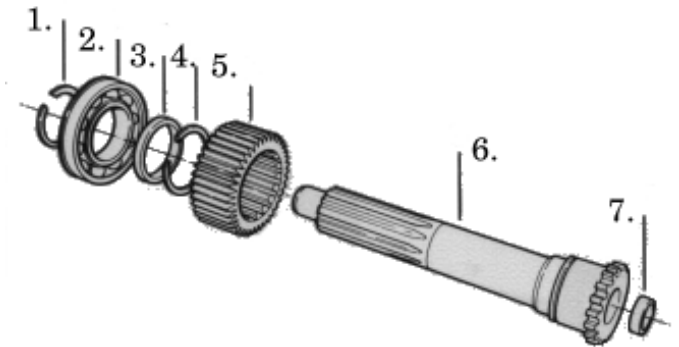
3. Grasp the input shaft firmly and joggle the shaft, gear and bearing out of the housing. Retain the parts in order for reassembly.

## Changing the Input Shaft



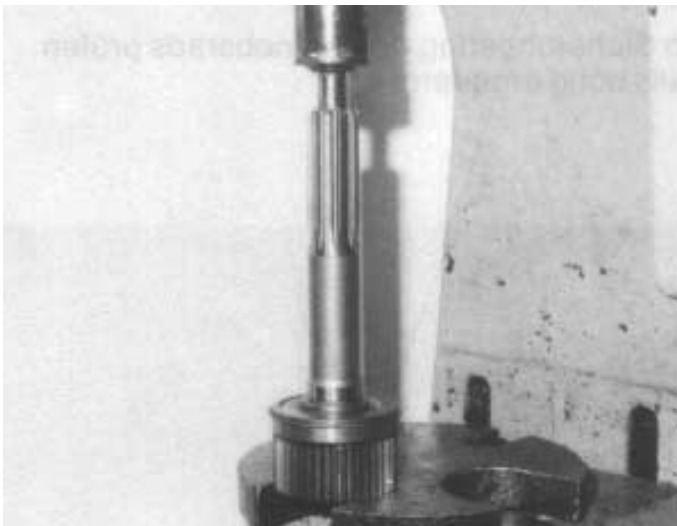
4. Remove the mainshaft thrust washers and the 3rd/4th gear sliding clutch from the mainshaft..

## Input Shaft Reassembly

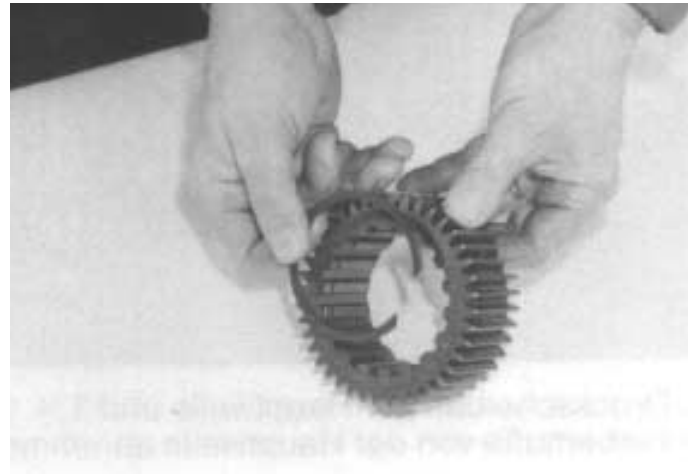


Input Shaft - Exploded View

- |                      |                |
|----------------------|----------------|
| 1. Bearing snap ring | 5. Input gear  |
| 2. Bearing assembly  | 6. Input shaft |
| 3. Spacer            | 7. Spigot bush |
| 4. Gear snap ring    |                |



5. Support the gear, remove the bearing snap ring and press or drive the shaft through the gear and off the bearing. Remove the spacer from the gear.



1. Check the input gear snap ring, renew if necessary.

## Changing the Input Shaft



2. Secure the input shaft in a vice and install the spigot bush using a suitable driver.



4. Install the sliding clutch into the drive gear and stand the assembly on the bench on the sliding clutch. Fit the spacer over the input shaft.



3. Assemble the new input shaft into the drive gear against the snap ring.



5. Drive the bearing, shrouded face upward, onto the shaft using a suitable driver.

## Changing the Input Shaft

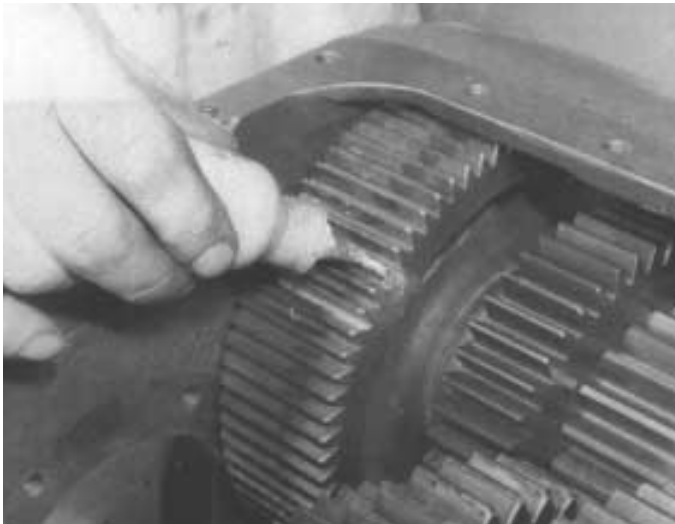


6. Fit the snap ring.

**Note:** The ends of the snap ring are angled slightly to ease removal. Ensure snap ring is correctly fitted.



8. Paint timing marks on any two adjacent gear teeth on the drive gear and the two teeth exactly opposite the first two.

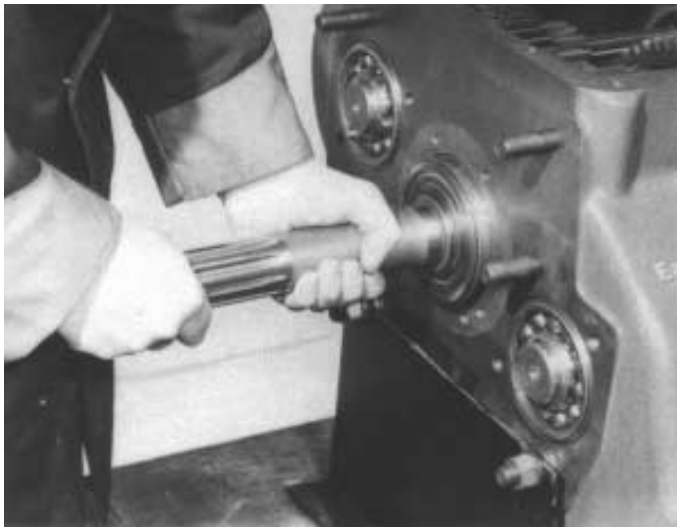


7. Locate the timing marks on the two countershaft input drive gears (marked O) and paint the tooth at both ends and along its length.

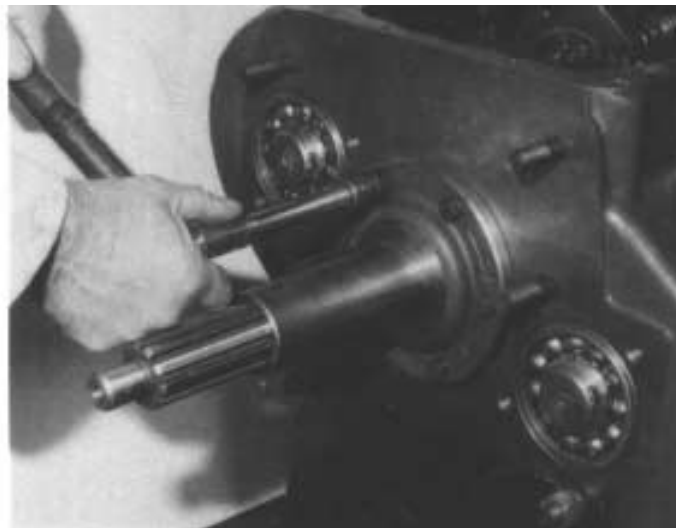


9. Place the mainshaft thrust race pack onto the mainshaft spigot, steel thrust washer against the shaft. Retain in place with petroleum jelly.

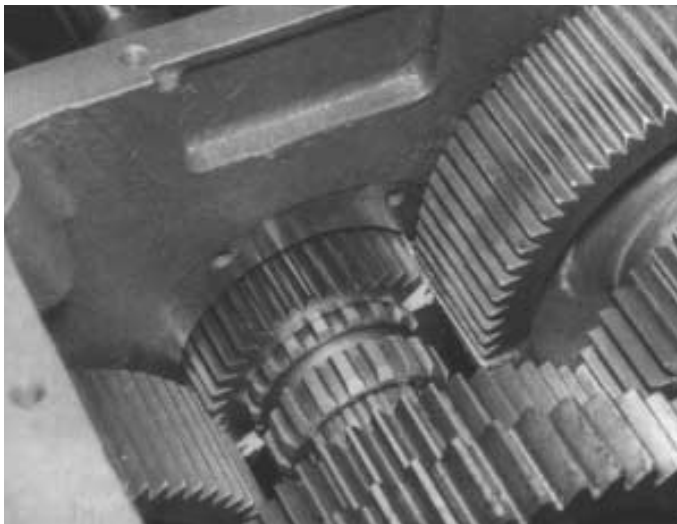
## Changing the Input Shaft



10. Install the 3rd/4th sliding clutch into the input shaft, align the timing marks and gently push the input shaft and bearing into the transmission housing. Lift the mainshaft slightly to aid installation, Do not drift the shaft in or the thrust race pack may be dislodged or damaged.



12. Install the front bearing cover. When a push type clutch release is fitted the two capscrews with the drilled heads are fitted into the uppermost two holes. Tighten the capscrews to the correct torque.



11. Ensure the timing marks are still aligned.



13. Reinstall the shift bar housing and remote control housing.



## Section 6      Upshift Brake

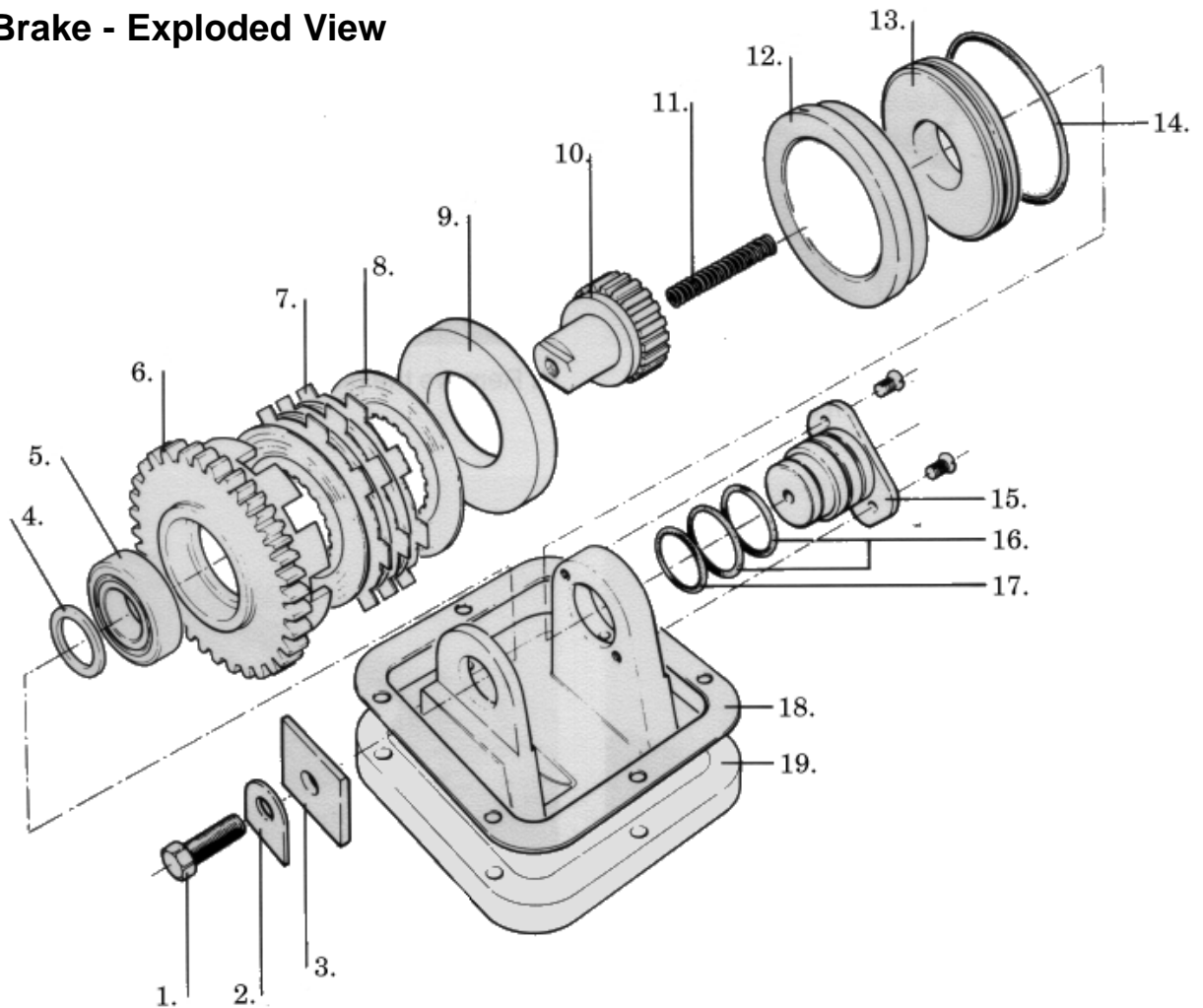




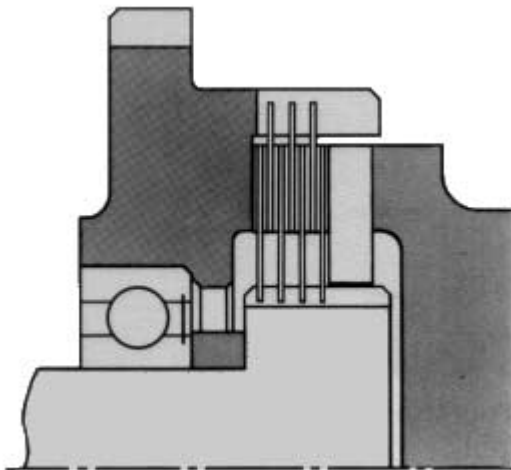
# Upshift Brake

Serial Numbers upto and including N 533586.

## Upshift Brake - Exploded View



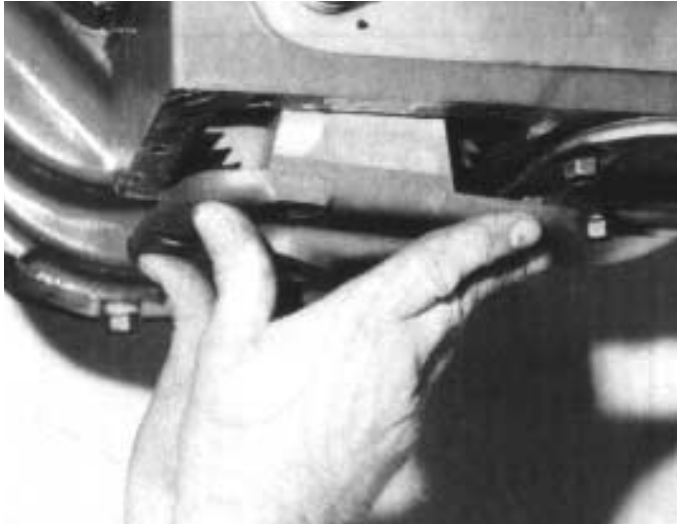
- |               |                                |                          |             |
|---------------|--------------------------------|--------------------------|-------------|
| 1. Capscrew   | 6. Spacer                      | 11. Compression spring   | 16. O-ring  |
| 2. Tab washer | 7. Gear                        | 12. Pressure plate       | 17. O-ring  |
| 3. Keep plate | 8. Friction disc outer (3 off) | 13. Piston               | 18. Gasket  |
| 4. Spacer     | 9. Friction disc inner (4 off) | 14. O-ring               | 19. Housing |
| 5. Bearing    | 10. Hub shaft                  | 15. Piston support shaft |             |



Upshift Brake - Sectional View

## Upshift Brake

### Upshift Brake Removal and Disassembly



1. Disconnect the air hose from the upshift brake, drain the transmission oil and remove the upshift brake.



3. Straighten the tab washer. Remove the keep plate retaining screw and keep plate. Support the pressure plate and piston assembly.

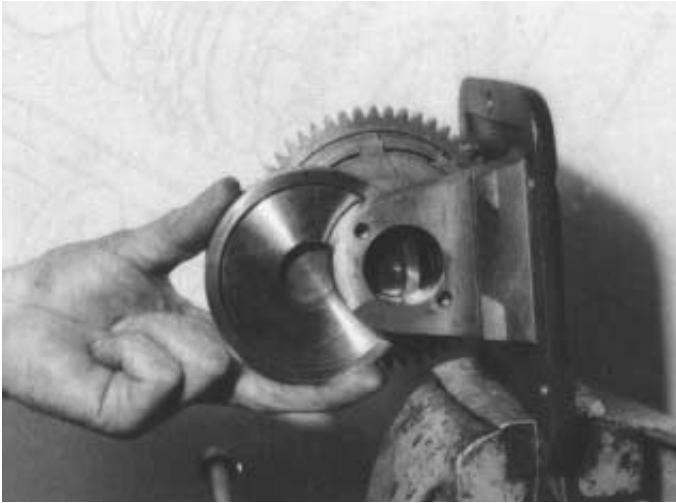


2. Mount the assembly in a soft jawed vice and remove the elbow connector. Remove the two countersunk head retaining screws. Remove the piston support shaft.



4. Remove the piston return spring.

## Upshift Brake



5. Remove the pressure plate and piston assembly.



8. Remove the spacer rings and hub from the gear and if the bearing is to be renewed, drive the bearing out of the gear.



6. Lift out the gear, hub and brake disc assembly.



9. Separate the piston from the pressure plate.  
Reassembly and Installation



7. Remove the lined and unlined brake discs from the splined hub and gear.

## Upshift Brake

### Reassembly and Installation



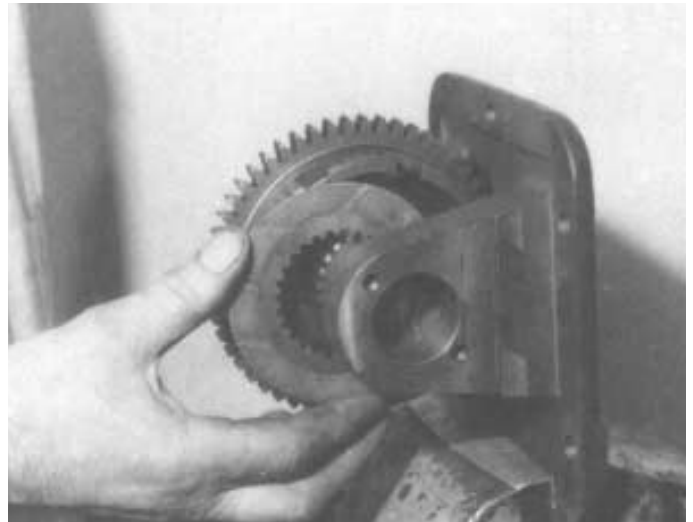
1. Clean and examine all parts, renew as necessary. Renew all O rings. Use silicone lubricant when assembling the O rings. If removed install a new bearing with shield towards brake plate into the gear using a suitable flanged driver.



3. Install the thinner spacer ring over the hub and install the hub and gear into the housing.



2. Install the hub into the gear bearing, tapping the hub lightly with a soft faced hammer if necessary, until fully home.



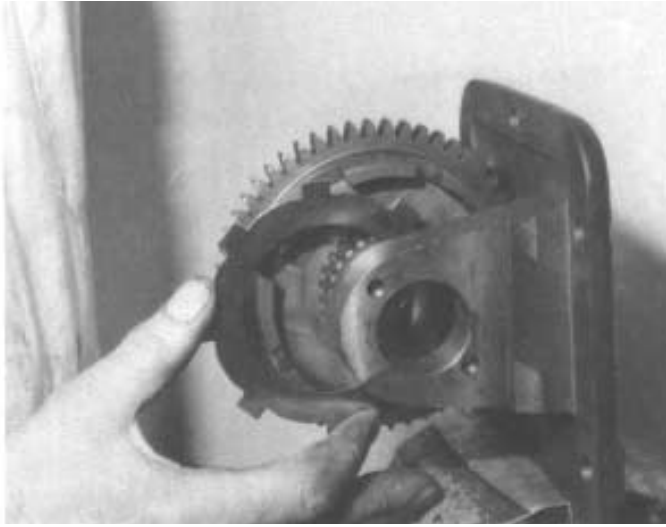
4. Install the four lined and three unlined brake discs over the hub and into the gear in alternate sequence.

**Note:** The first and last plates will be lined plates when correctly installed.

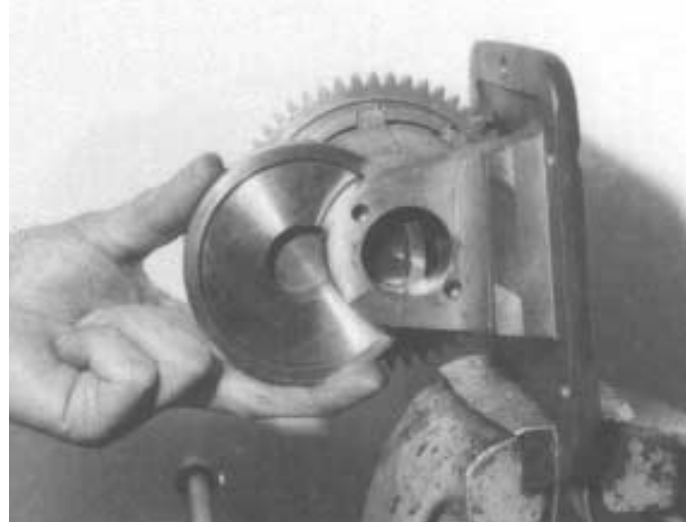
**Note:** SAMT transmissions only have three lined and two unlined plates.



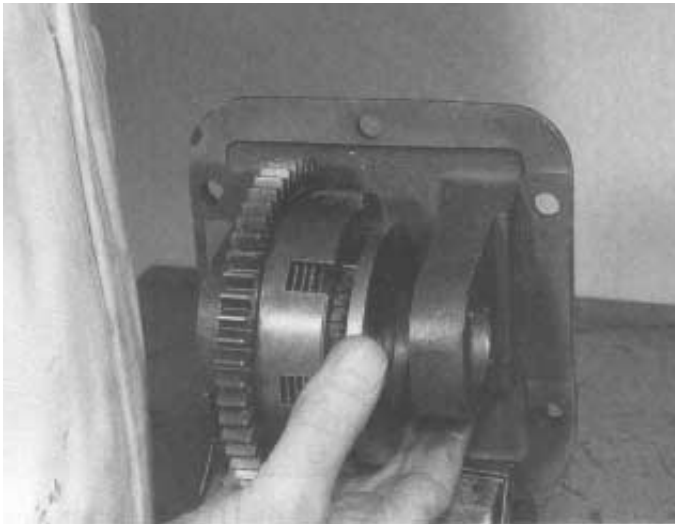
## Upshift Brake



5. Ensure that the lined plates slide easily over the splines on the hub and the unlined plates in the slots in the gear.



7. Install the piston and pressure plate assembly, pressure plate against the top, lined, plate.



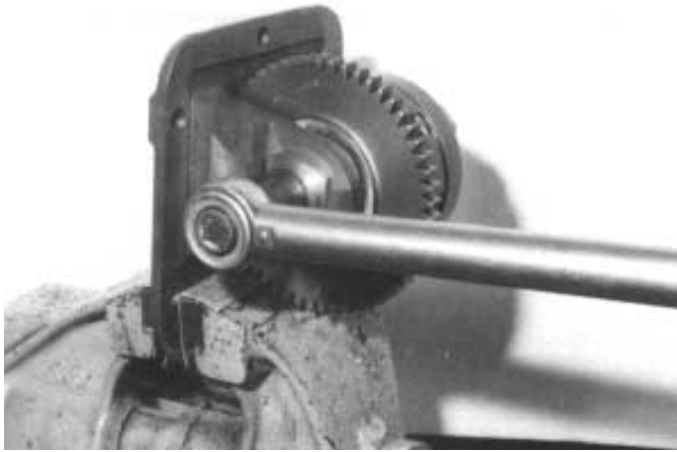
6. Install the spacer inside the gear.



8. Refit the piston support shaft and secure with two new patch locked countersunk headed screws. Tighten to the correct torque.

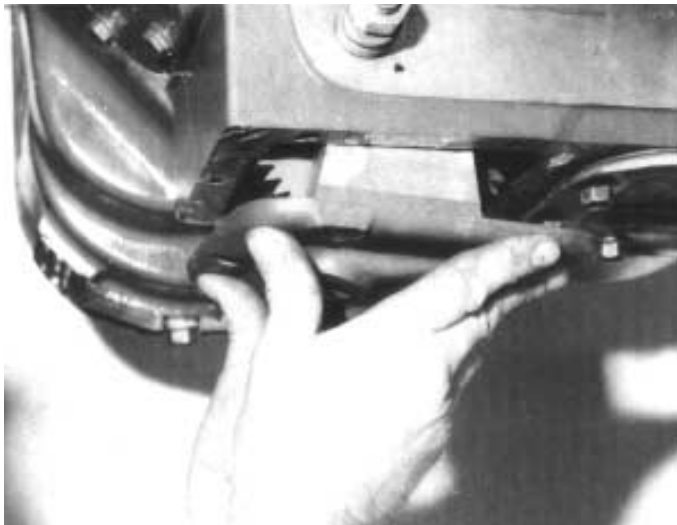
**Note:** Loctite sealer may be used where new screws are not available.

## Upshift Brake



9. Install the piston return spring and keep plate. Fit a new patch lock capscrew, tab washer and tighten to the correct torque. Ensure the assembly rotates freely.

**Note:** Loctite sealer may be used where a new patchlock capscrew is not available.

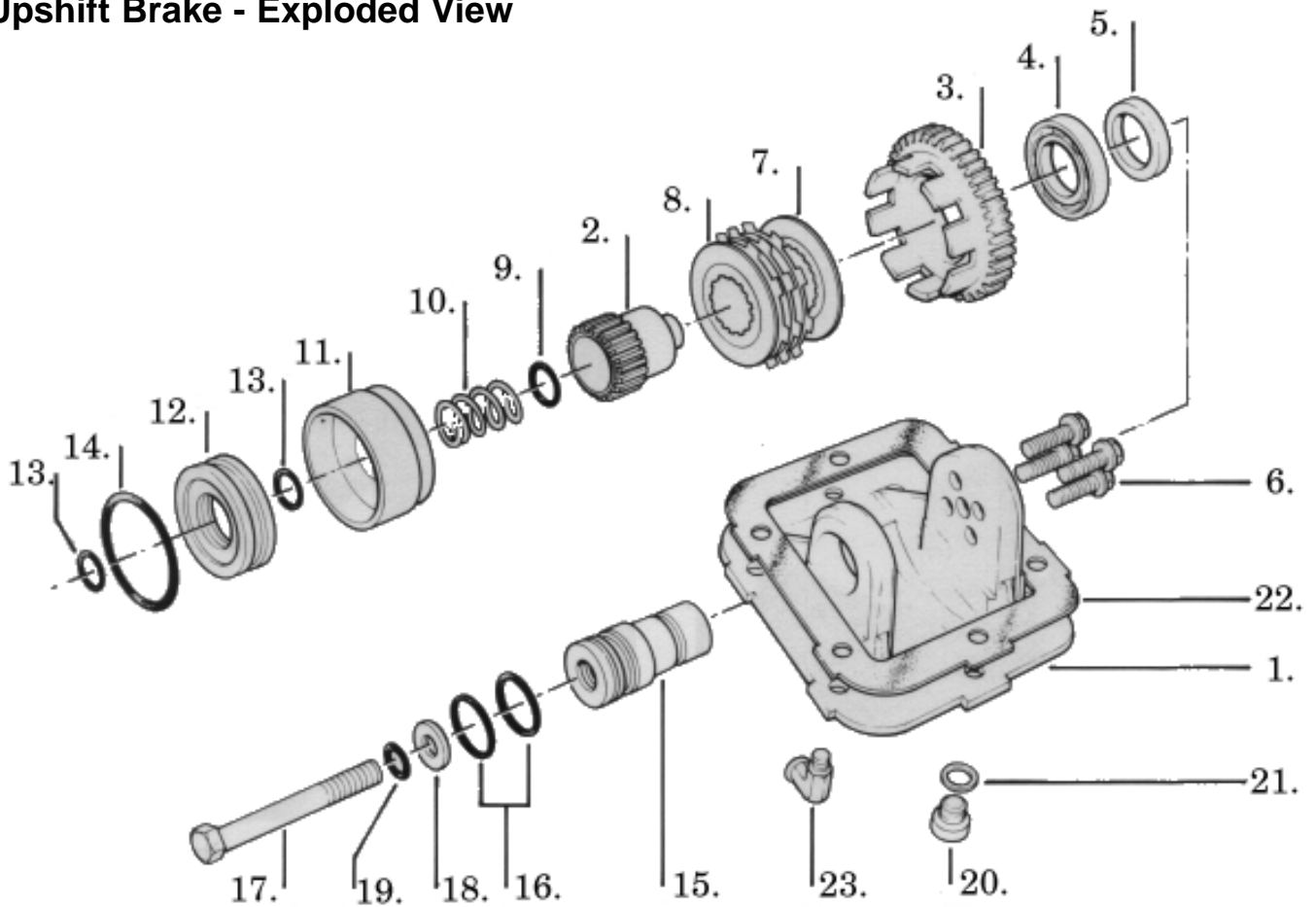


10. Using PTFE tape or suitable sealer, install the air connection elbow to the upshift brake. Install the upshift brake assembly to the transmission housing using a new gasket. Tighten the capscrews to the correct torque. Reconnect the air feed from the pulse unit.

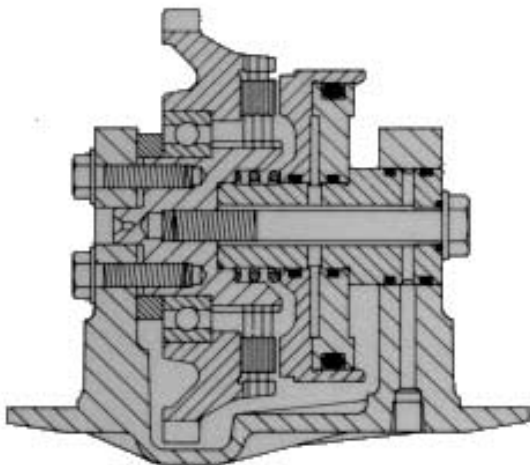
11. Check the backlash through the hole in the bottom of the housing. The correct backlash is 0,15 to 0,45 mm . Fit a thicker or a thinner gasket to increase or decrease the backlash if necessary.

Serial Numbers N 533587 and above.

## Upshift Brake - Exploded View



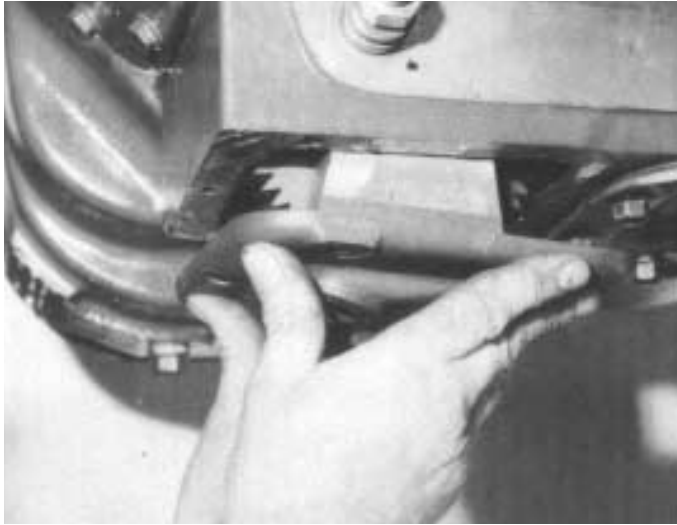
- |                  |                          |            |                |
|------------------|--------------------------|------------|----------------|
| 1. Housing       | 7. Friction disc - inner | 13. O-ring | 19. O-ring     |
| 2. Splined shaft | 8. Friction disc - outer | 14. O-ring | 20. Drain plug |
| 3. Gear          | 9. O-ring                | 15. Shaft  | 21. Washer     |
| 4. Bearing       | 10. Spring               | 16. O-ring | 22. Gasket     |
| 5. Spacer        | 11. Pressure plate       | 17. Bolt   | 23. Elbow      |
| 6. Bolt          | 12. Piston               | 18. Washer |                |



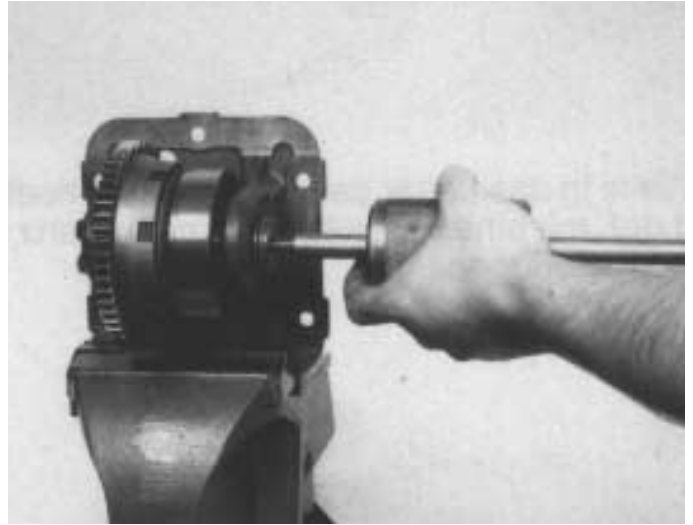
### Upshift Brake - Sectional View

## Upshift Brake

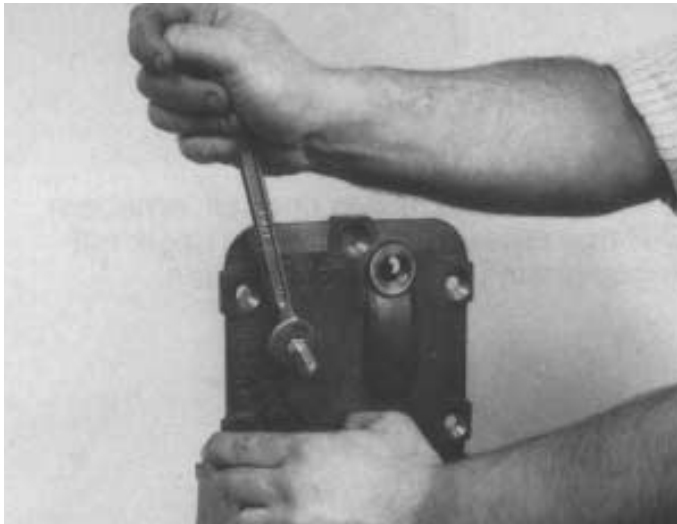
### Removal and Disassembly



1. Disconnect the air hose from the upshift brake, drain the transmission oil and remove the upshift brake.



3. Remove the bolt (note the washer and O-ring). Remove the piston support shaft.

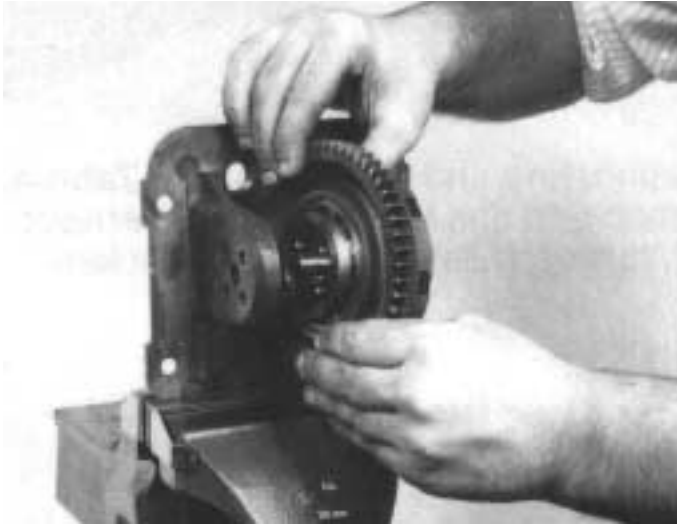


2. Mount the assembly in a soft jawed vice and remove the elbow connector.



4. Remove the pressure plate and piston assembly. Remove the spring.

## Upshift Brake



5. Remove the four bolts securing the splined shaft and lift out the gear, splined shaft and brake disc assembly from the housing.



7. Remove the spacer ring and shaft from the gear and if the bearing is to be renewed, drive the bearing out of the gear.



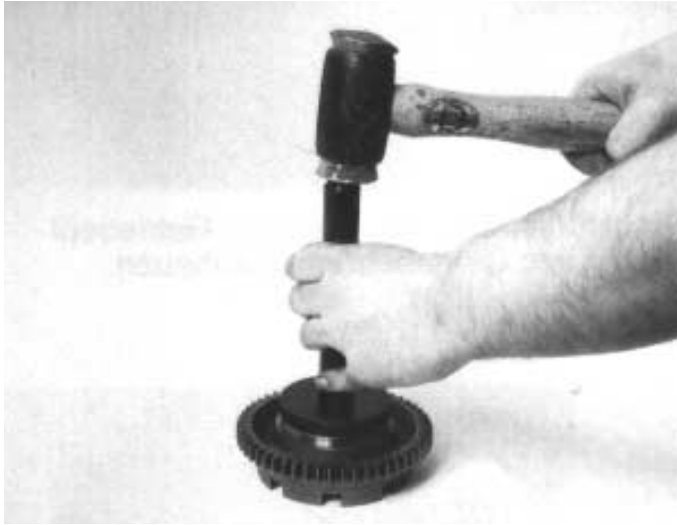
6. Remove the lined and unlined brake discs from the splined shaft and gear.



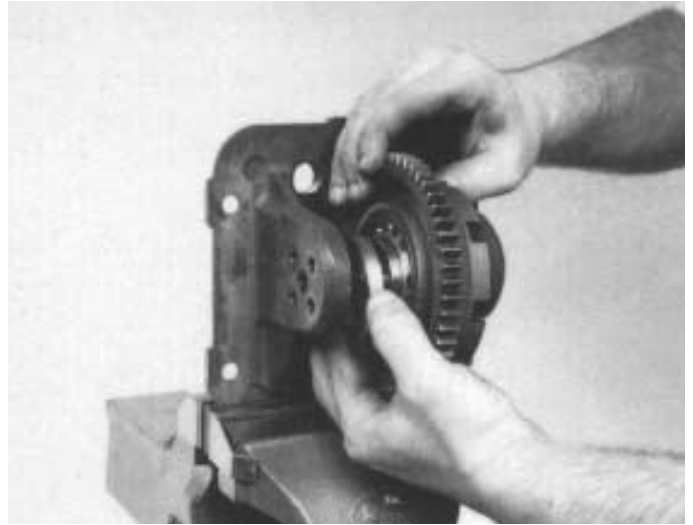
8. Separate the piston from the pressure plate.

## Upshift Brake

### Reassembly and Installation



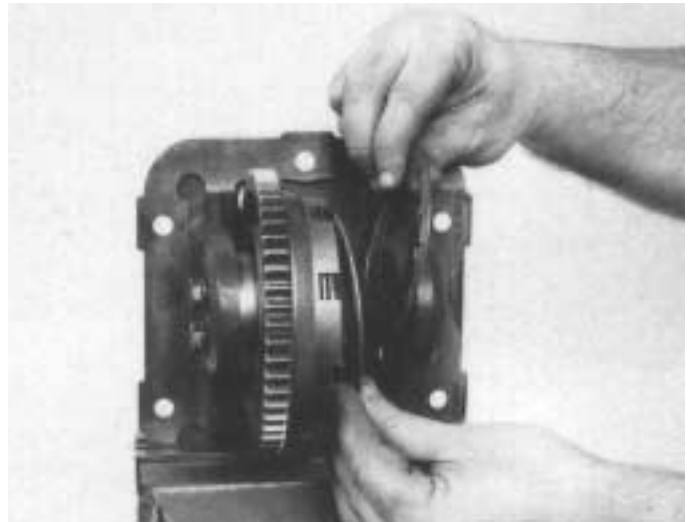
1. Clean and examine all parts, renew as necessary. Renew all O-rings. If removed install a new bearing into the gear using a suitable flanged driver.



3. Install the spacer ring over the shaft and install the shaft and gear into the housing. Install the four bolts and tighten to the correct torque (40 - 50 Nm).



2. Install the shaft into the gear bearing, tapping the shaft lightly with a soft faced hammer if necessary, until fully home.

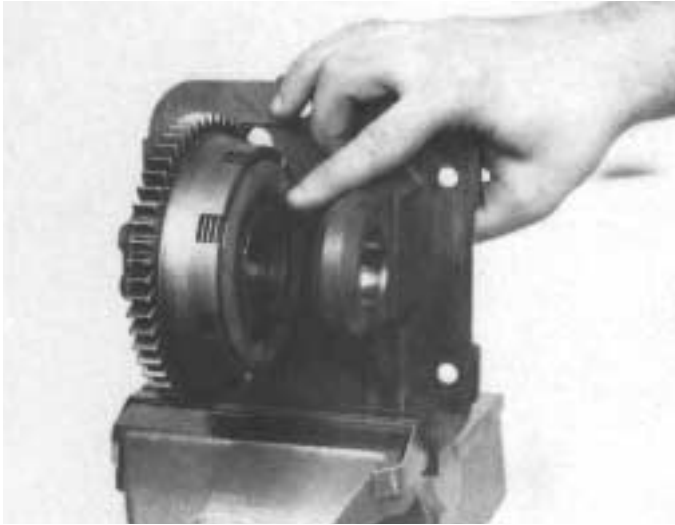


4. Install the four lined and three unlined brake discs over the shaft into the gear in alternate sequence.

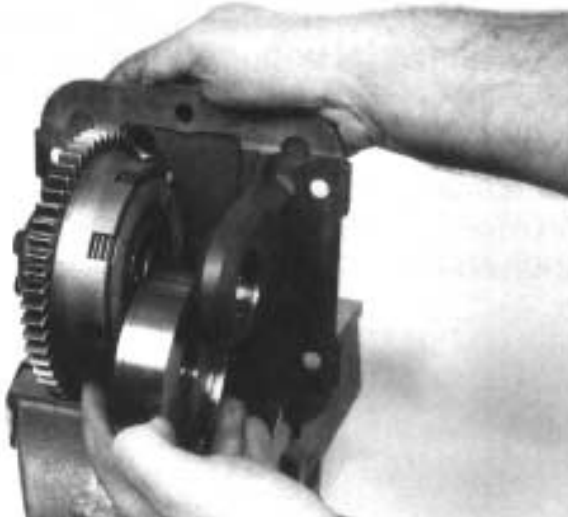
**Note:** The first and last plates will be lined plates when correctly installed.



## Upshift Brake



5. Ensure that the lined plates slide easily over the splines on the shaft and the unlined plates in the slots in the gear.



6. Install the O-ring, spring and pressure plate assembly, pressure plate against the top lined plate.



7. Refit the piston support shaft and secure with the appropriate bolt (not forgetting the O-ring and washer). Tighten to the correct torque (46 - 60 Nm).



8. Using PTFE tape or suitable sealer, install the air connection elbow to the upshift brake. Install the upshift brake assembly to the transmission housing using a new gasket. Tighten the socket headed countersunk screws to the correct torque. Reconnect the air feed from the pulse unit.

9. Check the backlash through the hole in the bottom of the housing. The correct backlash is 0.15 to 0.45 mm. If there is insufficient backlash use multiple gaskets to obtain the correct amount.

Refit the drain plug and washer. Tighten to the correct torque (41 - 47 Nm).



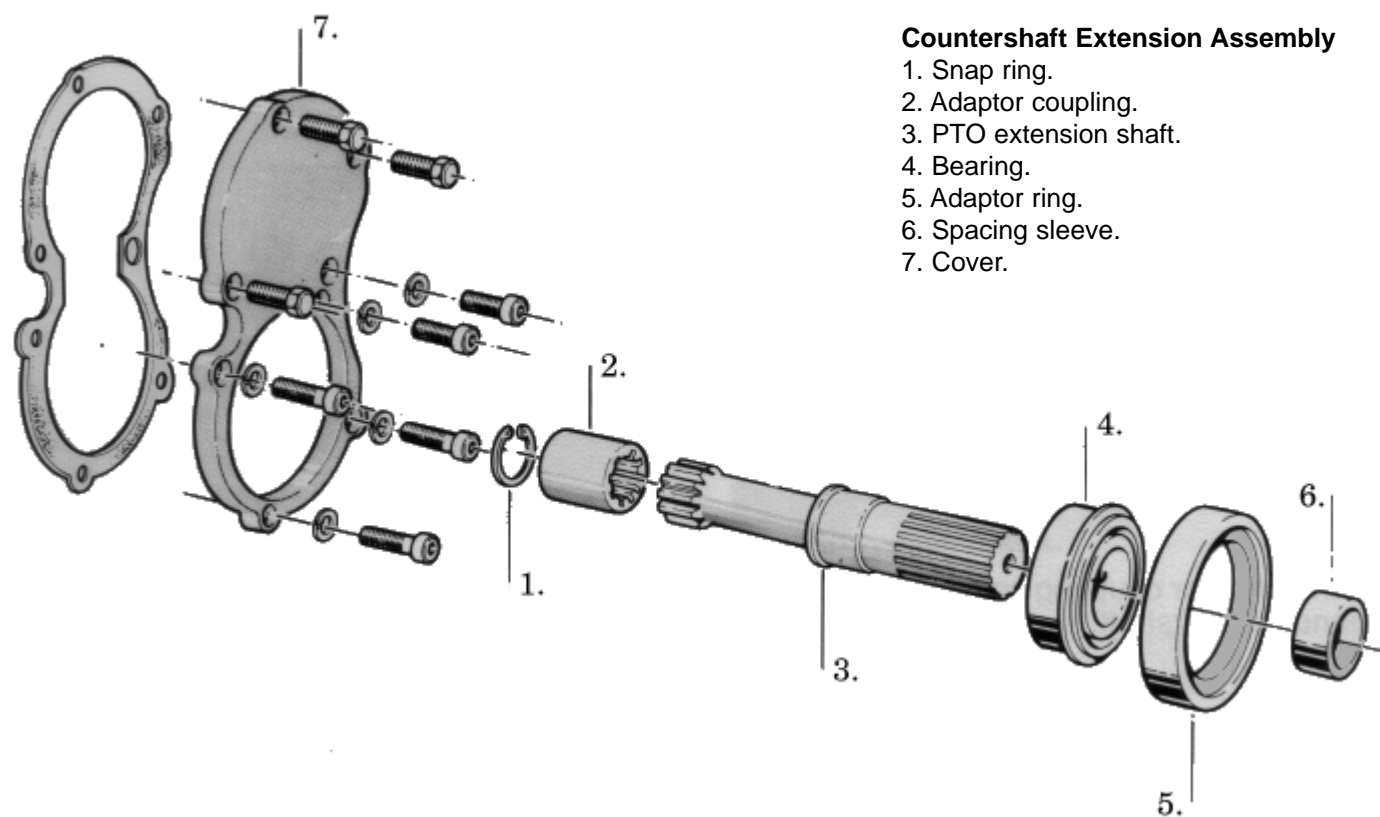
## Section 7      PTO Installation





# PTO Installation

## Fitting Extended Countershaft



### Countershaft Extension Assembly

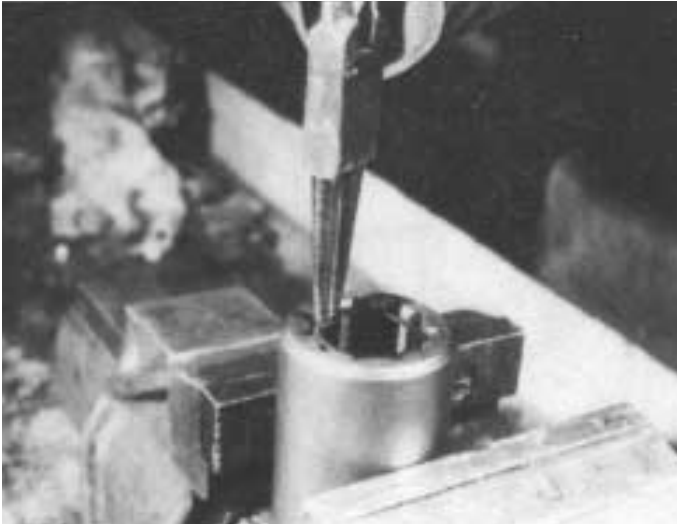
1. Snap ring.
2. Adaptor coupling.
3. PTO extension shaft.
4. Bearing.
5. Adaptor ring.
6. Spacing sleeve.
7. Cover.



1. Remove left-hand coverplate (7 bolts).

## PTO Installation

### Assembly of Extended Countershaft



1. Insert the snap ring into the adaptor coupling.



3. Fit the bearing on to the shaft with the radius of the inner bearing ring to the shaft collar.



2. Fit the adaptor coupling onto the rear of the left-hand countershaft.



4. Fit the spacer sleeve.



## PTO Installation



5. Insert the shaft assembly into the adaptor coupling. Use a suitable soft drift against the bearing outer ring to drive it into the housing.



7. Fit the cover. Tighten the three capscrews to the correct torque.

Additional screws as required supplied with PTO kit.

Refer to PTO Fitting Instructions to fit PTO.



6. Fit the adaptor ring onto the bearing.