



16-Speed Synchromesh Transmission Service Manual

Eaton 6-Speed Synchronesh Transmission



Truck Components Operations Europe
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Service Manual

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Main Section

Note: For fitment and servicing of power take off units, refer to the relevant power take off Service Manual.

Section 1 General

General

Letter and model designation

Example: RTSO-17316A

- R - Roadranger
- T - Twin countershaft
- S - Synchronised
- O - Overdrive
- 17 - Input torque code
- 3 - Design level
- 16 - Number of speeds
- A - Gear ratio

General

Technical data

Permissible torque:

RTS(O)-12316A 1750Nm

RTS(O)-14316A 1900Nm

RTS(O)-17316A 2375Nm

Weight:

289kg (without oil)

Length:

980mm from front face of clutch housing to rear face of flange (depending on flange fitted)

Oil capacity:

12.3litres

Power Take Off Openings:

A range of medium duty PTOs with single output and heavy duty PTOs with both single and dual outputs can be fitted to the lower left and upper right positions - flange and pump drives available

Side openings:

Right side opening, SAE standard 6 bolt

Bottom opening, SAE standard 8 bolt

Drive gear rotating at following ratios:

RTS

low split 0.63

RTSO

high split 0.92

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

Note: Low oil levels will damage the transmission.

Draining Oil

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

Refilling

Clean area round filler plug. Fill transmission to the level of the filler opening.

The exact amount of oil depends on the transmission inclination. In every instance, fill to the level of the filler opening. Do not overfill - this causes 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 the 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 32km/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.

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 8,000km	Change transmission oil on new units
Every 16,000km	Inspect oil level. Check for leaks
Every 80,000km	Change transmission oil.
Off highway use	
First 30 hours	Change transmission oil on new units.
Every 40 hours	Inspect oil level. Check for leaks.
Every 500 hours	Change transmission oil when severe dirt conditions exist.
Every 1000 hours	Change transmission oil (normal off highway use).
Clean drain plug gauze and oil filter (as required) at each oil change	

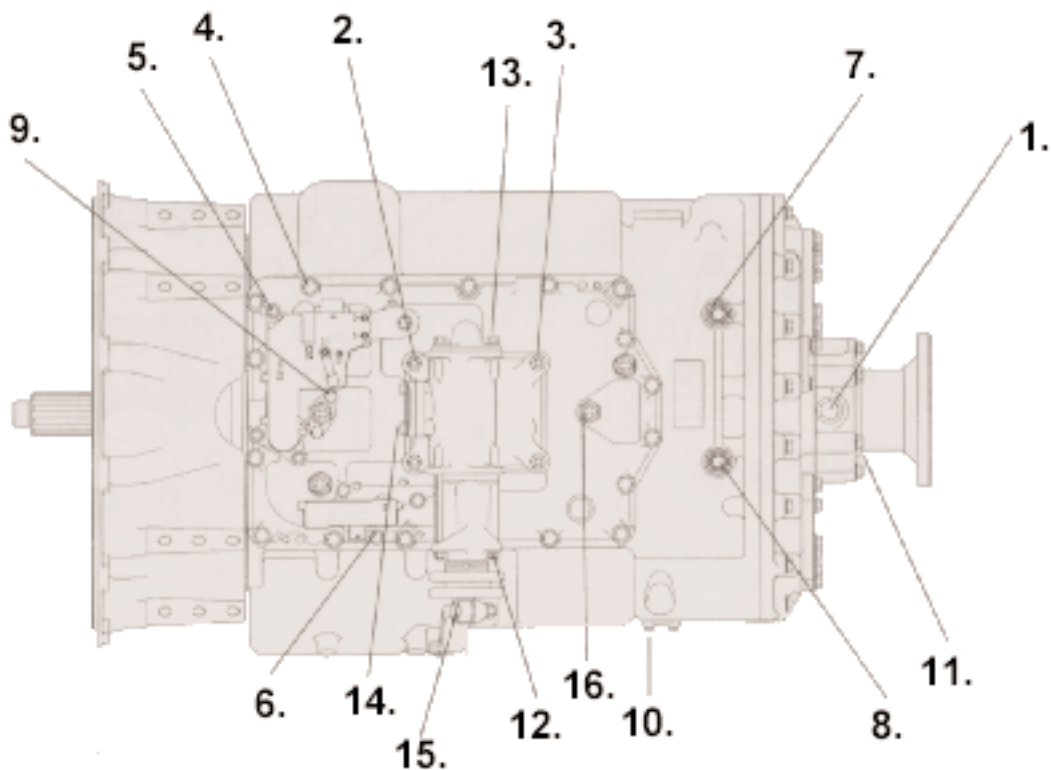
Type	Quality	Temperature
Heavy duty engine oil to specification MIL-L-2104C or MIL-L-46152 or API-SC or API-CC	SAE 50 SAE 40 SAE 30	over -12°C over -12°C under -12°C
Mineral gear oil to specification API-GL-1	SAE 90 SAE 80 W	over -12°C under -12°C
Mild EP gear oil* to specification MIL-L-2105 or API-GL-4	SAE 90 SAE 80 W	from -12°C to 38°C from -26°C to 21°C

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

Note: Synthetic oils are NOT recommended.

General

Torque tightening recommendations



1. Speedometer sender - M18
20 to 25Nm

2. Control housing stud - M10
11 to 16Nm

3. Control housing conical nuts - M10
50 to 75Nm
Control housing lock nuts - M10
30 to 40 Nm

4. Shift bar housing - M10
80 to 90Nm

5. Range change module - M8
30 to 35Nm

6. Splitter module - M8
30 to 35Nm

7. Support stud - M16
11 to 16Nm

8. Support stud nuts - M16
315 to 345Nm

9. Cover plate
20 to 25 Nm

10. Oil transfer plate - M6
15 to 20Nm

11. Speedometer housing - M10
85 to 95Nm

12. Remote control housing outer nuts - M8
27 to 32Nm

13. Remote control housing screws - M8
20 to 25Nm

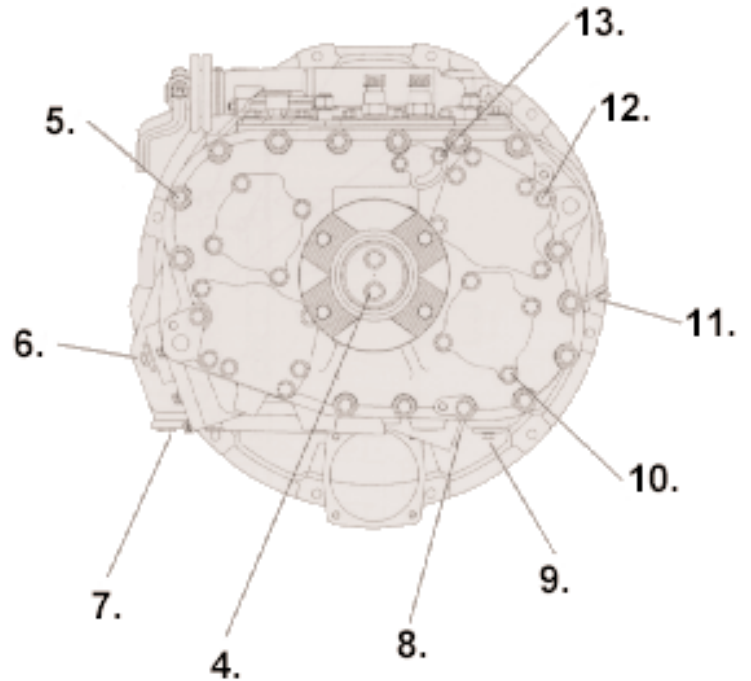
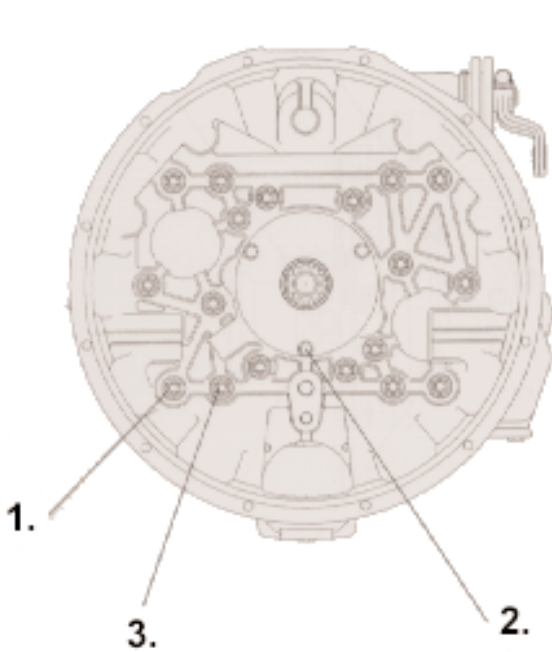
14. Detent cover screws - M8
20 to 25Nm

15. Shift lever - M10
45 to 55Nm

16. Switches - M16
20 to 25Nm

For additional torques for transmissions with Voith retarders.

General



1. Clutch housing nuts - M12
100 to 110Nm
2. Front bearing cover screws - M8
32 to 37Nm
3. Clutch housing studs
11 to 16Nm
4. Output shaft - M12
100 to 110Nm
5. Auxiliary housing - M10
85 to 95Nm
6. Oil filler plug - M24
32 to 37Nm
7. Bottom mounted power take off cover - M12
70 to 80Nm
8. Oil drain/strainer - M40
40 to 47Nm
9. Oil drain plug - M24
32 to 37Nm

10. Auxiliary countershaft rear bearing cover - M10
70 to 80Nm
11. Side mounted power take off cover - M10
45 to 70 Nm
12. Rear power take off cover - M10
85 to 95 Nm
13. Locking plate screws - M8
35 to 40 Nm

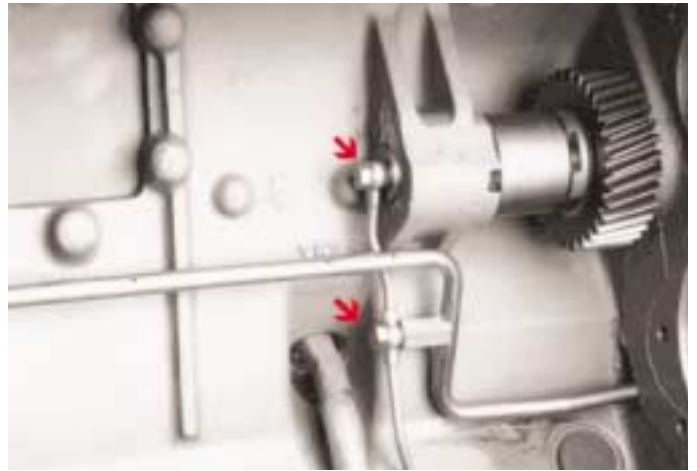
For additional torques for transmissions with Voith retarders

General

Internal parts



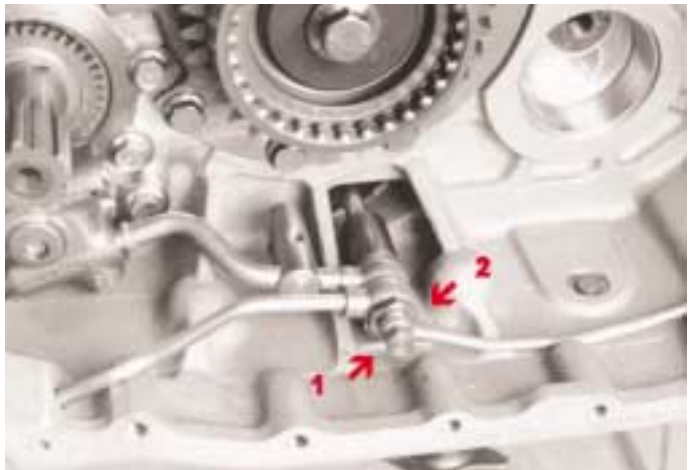
Countershaft bearing retainer - M10
70 to 80 Nm



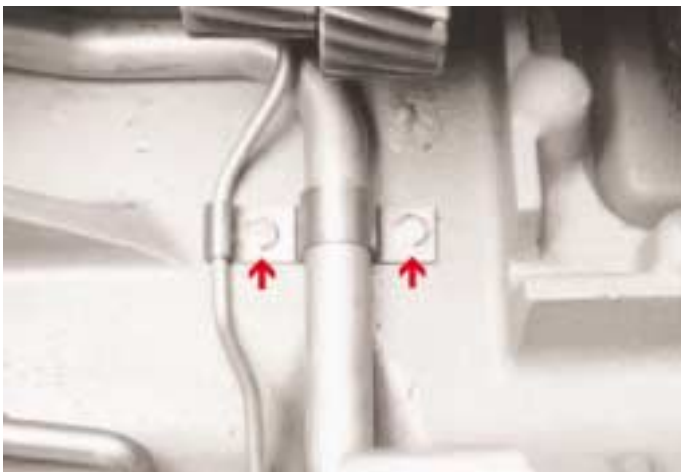
Oil pipe retaining screws - M10
20 to 25 Nm



Oil pump housing - M10
70 to 80 Nm

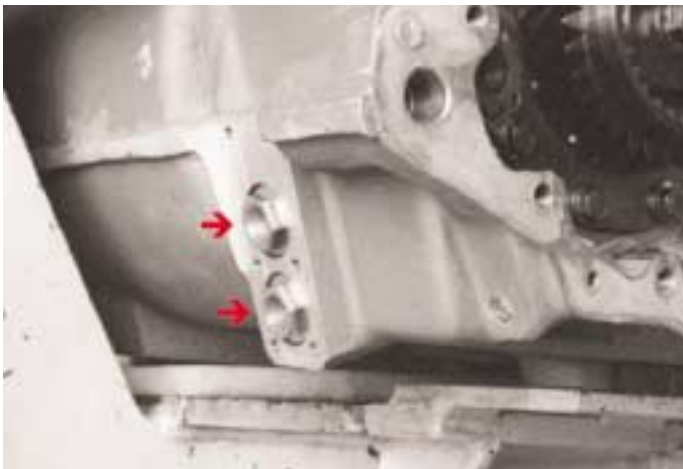


Oil pipe retaining screw
(1) 20 to 25 Nm - M10
(2) 55 to 75 Nm with Loctite 270 - M16

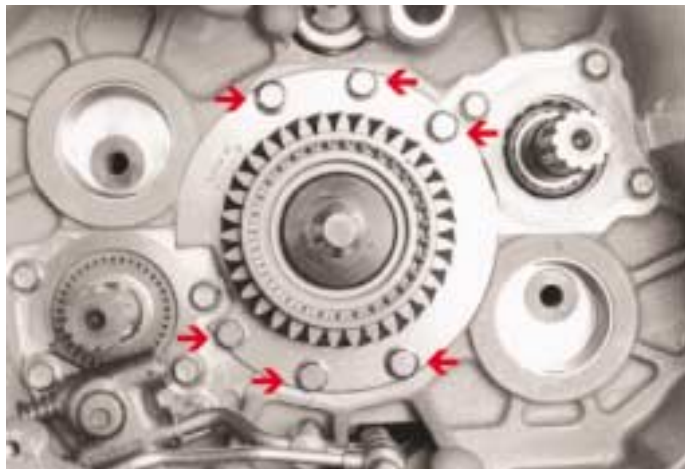


Oil pipe retaining screws - M6
11 to 16 Nm

General



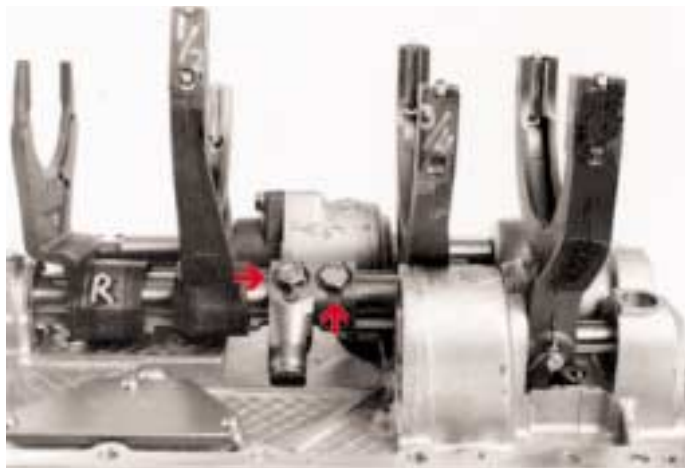
Oil port fitting assembly - M24
55 to 75 Nm



Mainshaft bearing retainer plate - M10
87 to 91 Nm



Mainshaft spindle - M22
285 to 315 Nm



Shift block fasteners - M10
33 to 38 Nm

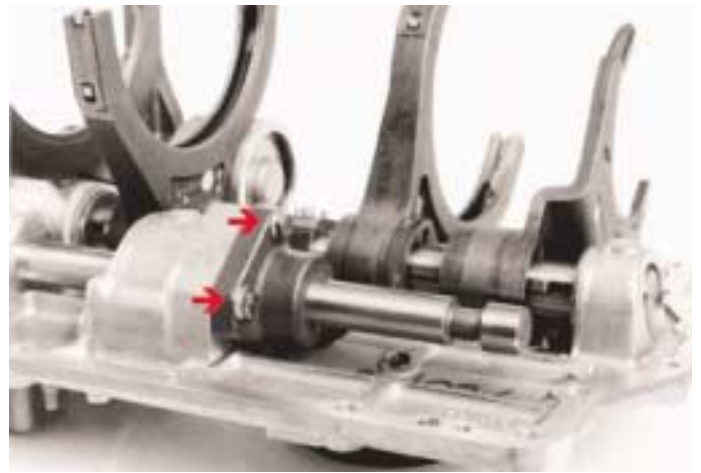


Mainshaft gear retainer - M16
230 to 250 Nm

General



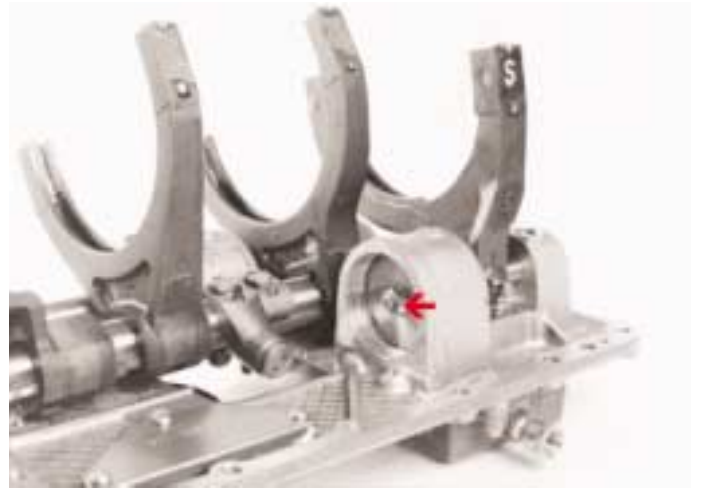
Remote control screw - M5
3.5 to 4 Nm



Range cylinder cover - M10
37 to 47 Nm



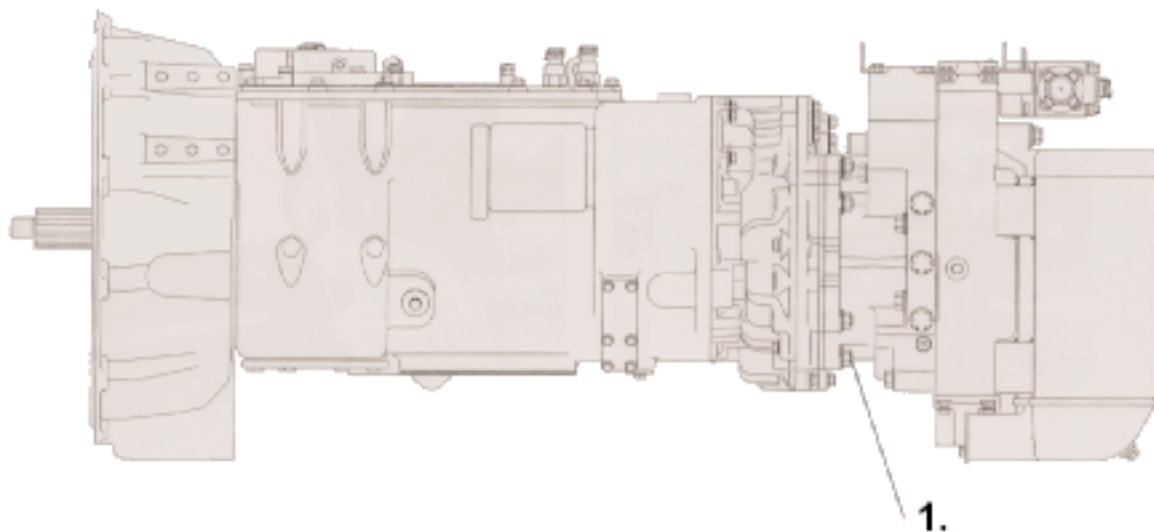
Splitter fork lockscrew - M10
10.5 to 12 Nm with Loctite 265



Splitter piston lock nut - M8
9 Nm with Loctite 648

General

These torques are additional torques for transmissions with Voith retarders



1. Retarder fixing nuts - M14
200 to 240 Nm

Internal parts



Adjuster screws
43 to 47 Nm

General

Gear end floats

Mainshaft

Gear	Minimum	Maximum
Reverse	0.22	0.69
1st	0.15	0.46
2nd	0.15	0.46
3rd	0.15	0.46
4th	0.018	0.15
Splitter	0.1	0.51
Auxiliary mainshaft reduction	0.076	0.25
Auxiliary drive gear	0.015	0.6

End float of the gears on the shaft is established in manufacture by machining the components to fine tolerances. Before disassembly of the mainshaft, the end floats should be checked to ascertain whether they are within the recommended limits.

Where end float is excessive, it is necessary to check the gears, mainshaft and thrust washers for wear and renew where necessary.

Countershafts

Bearing settings

Main section 0.10 to 0.15mm pre-load

Auxiliary section 0.03 to 0.13mm end float

These tolerances are maintained by use of graded spacers.

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 the 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, countershafts and shift bar housing, lay all parts on a clean bench in the same sequence as removed. This procedure simplifies reassembly and reduces the possibility of losing parts.

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

5. Input shaft - The drive gear or input shaft can be removed without removing the countershafts or mainshaft. Take care not to dislodge the splitter synchroniser assembly.

6. When Pressing - Apply force to shafts, housing etc. with restraint. Movement of some parts 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. The use of a questionable part may 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 spacer and gear hub for excessive wear.

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 0.76mm to 1mm.

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 idler gear and shaft for wear from action of roller bearings.

G. Grey Iron and Aluminium Parts

1. Check all parts for cracks and breaks. Renew or repair parts found to be damaged.

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 keys for wear at contact points. Renew worn parts.

2. Check yokes for alignment.

3. Check yokes and yoke inserts for excessive wear, renew worn yokes and inserts.

4. Check the lockscrew in the splitter yoke. Tighten if loose and renew lockwire. Lockscrews with worn tapers must be renewed.

5. Check condition and fit of selector key and interlock key in selector shaft. Worn or damaged keys must be renewed.

6. Check grooves of selector key for wear from detent plunger. Renew selector key if necessary.

7. Check shift bar housing bushes for wear. Renew as necessary.

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.

L. Oil Seals

1. Check oil seals in clutch housing, remote control housing and speedometer housing for damage and wear, renew if necessary.

M. Synchroniser Assemblies

1. Check that all splines are free from excessive wear.

2. Check that the engagement dog teeth on the sliding clutches and gears are free from chipping and burring.

3. Check that the synchroniser cones are not excessively worn or showing the effects of overheating.

4. Renew the springs and plungers.

5. Check synchroniser contact surfaces on the gears and cups for excessive wear. If burnt out contact surfaces are evident, gears or cups should be renewed.

6. Check blocker pin chamfer for excessive wear. Renew as necessary.

N. Splines

1. Check splines on all shafts for wear. Replace shafts if necessary.

O. O-Rings

1. Renew all O-rings if damaged. Apply silicone lubricant to O-rings.

P. Oil Pump

1. Check the oil pump rotors and covers for scoring and wear. The complete pump assembly must be renewed if scored or excessively worn, or its serviceability is suspect in any way.

Q. Shift Forks

1. Check all shift forks and inserts and clutch plates for extreme wear or discoloration 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.

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. Fasteners - To prevent oil leakage, use thread sealant on all capscrews. The serrations on the underside of the screwheads and nuts must be cleaned of debris prior to reassembly. The corresponding torque ratings are to be found in 'Torque Tightening Recommendations'.

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

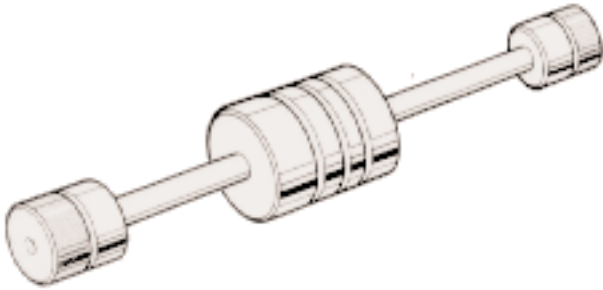
4. Bearings - Use of flange-end bearing drivers is recommended for the installation of bearings. These drivers apply equal force to both races of the bearing, preventing damage to balls and races and maintaining correct bearing alignment with shaft and bore. A tubular type driver, if used, will apply force only to the inner race.

5. Output Shaft Drive Flange - Tighten the screws to the correct torque.

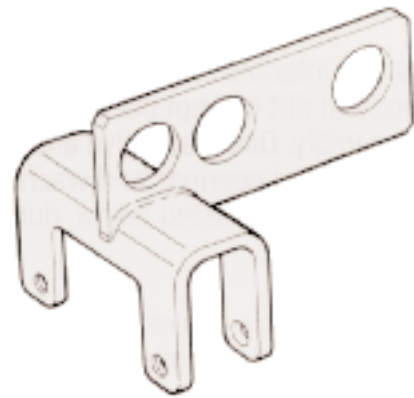
Do not under any circumstances use an impact wrench to tighten the screws. Use only a hand operated torque wrench or a stall torque motor. Failure to carry out these instructions can cause damage to the screws.

Special tools

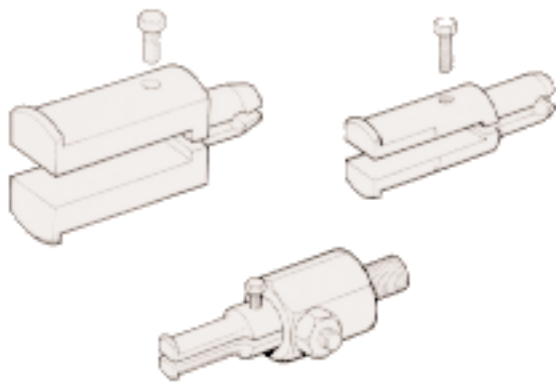
Some procedures in the Service Manual refer to special tools. These tools are recommended to make procedures faster and easier and prevent damage. The following tools are available from SPX UK (Ltd) Tel : +44 (0)1327 704461. For more information, contact your Eaton regional office.



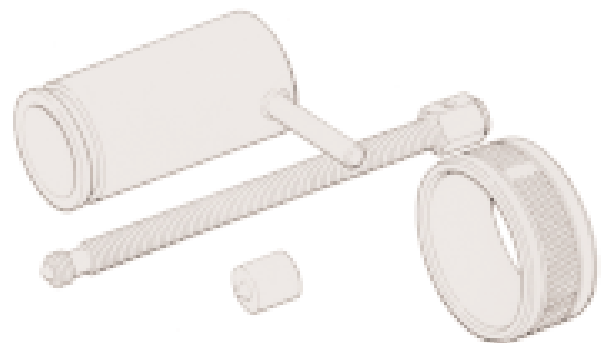
MS 284 Slide hammer



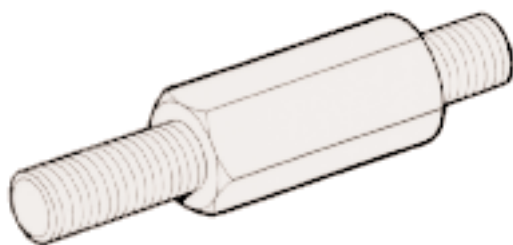
E 106-B Lifting bracket. Auxiliary section removal.



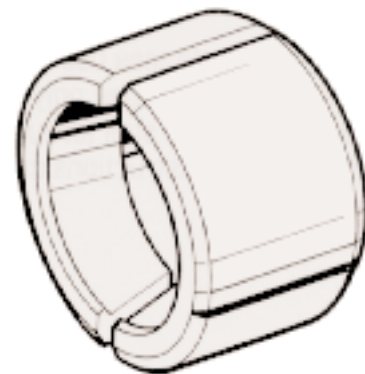
MS 284-1 Extractor set. Removal of input shaft bush.



LC 105A Puller for main bearing.

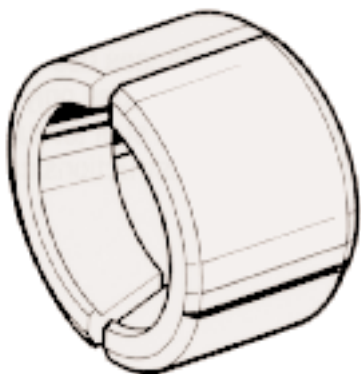


E 200 Adaptor Removal of idler shafts.

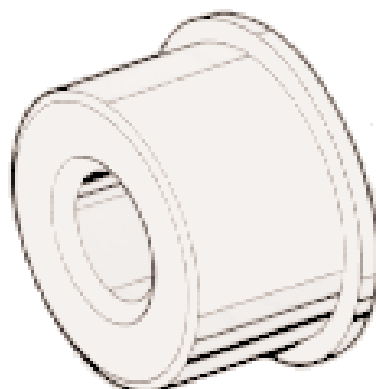


E 105-4 Removal of front countershaft bearing. Use with LC 105A.

Special tools



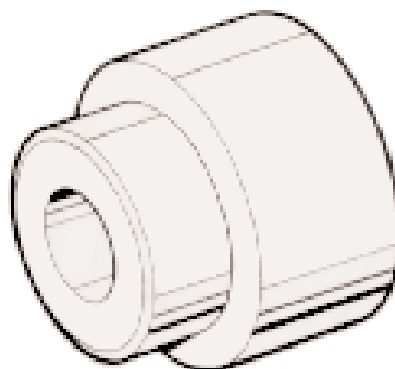
LC 105A-28 Removal of auxiliary countershaft bearing. Use with LC 105A.



E 109-14 Removal/fitment of shift bar housing selector rail bush. Used with E 109.



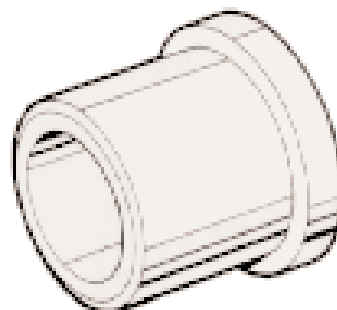
E 109 Driver.



E 109-15 Input shaft bush fitment. Used with E 109.

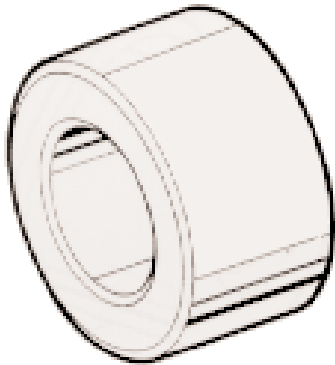


E 109-10 Driver extension. Use with E 109.

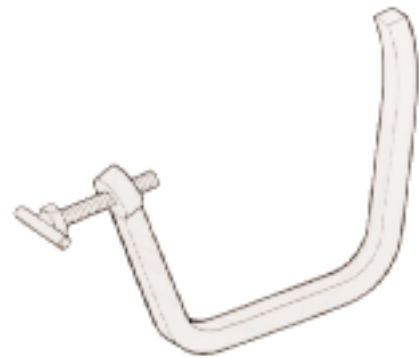


E 109-16 Remote control bush replacement. Use with E 109.

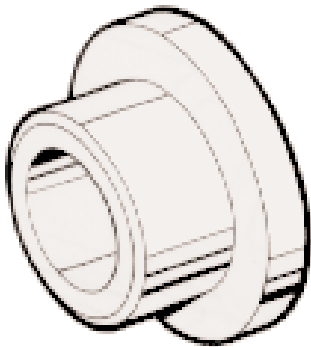
Special tools



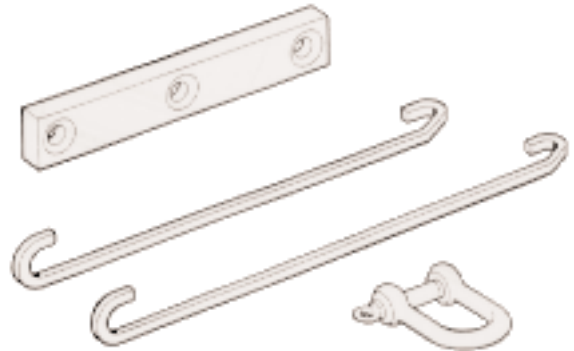
E 109-17 Remote control bush removal. Use with E 109.



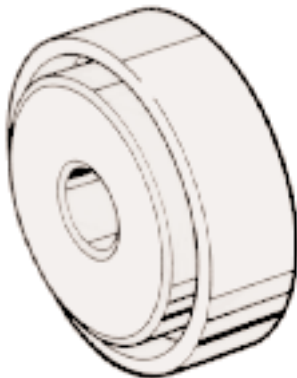
E 201 Countershaft retainer.



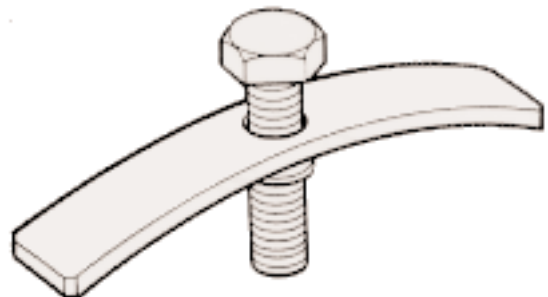
E 109-18 Remote control seal replacement. Use with E 109.



E 202 Mainshaft lifting tool.

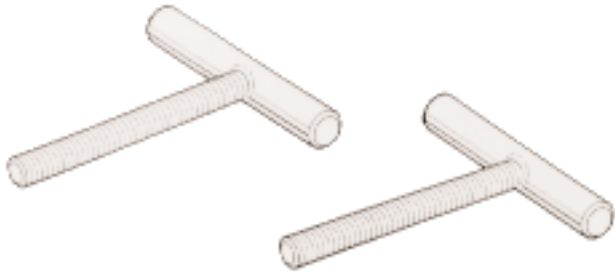


E 109-19 Removal/replacement of clutch housing seal. Use with E 109.

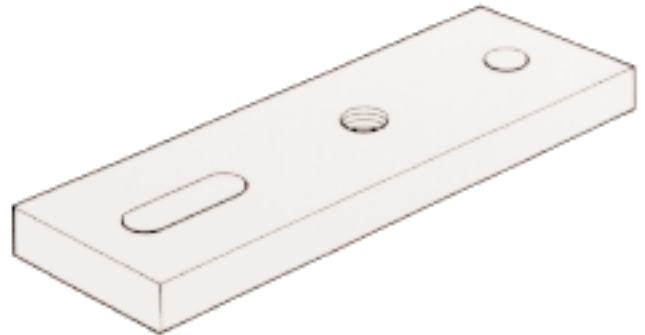


E 203 Splitter synchroniser retainer.

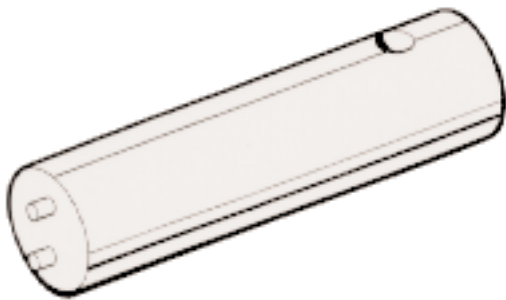
Special tools



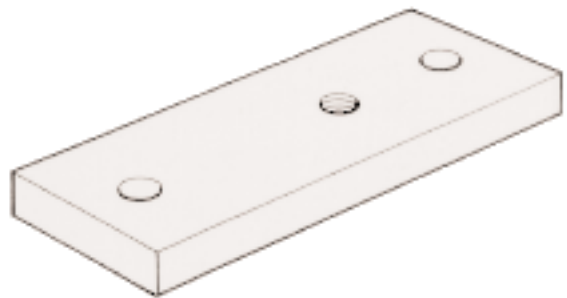
E 204 T bars. Removal/fitment of shift bar housing.



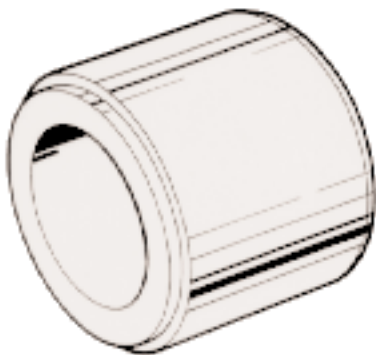
E 207 Front countershaft front bearing retainer.



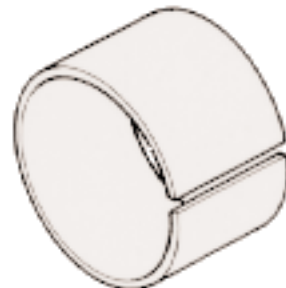
E 205 Neutral detent plug retainer.



E 208 Auxiliary countershaft bearing retainer.



E 206 Output seal fitting tool.



E 209 Range piston seal fitting tool.

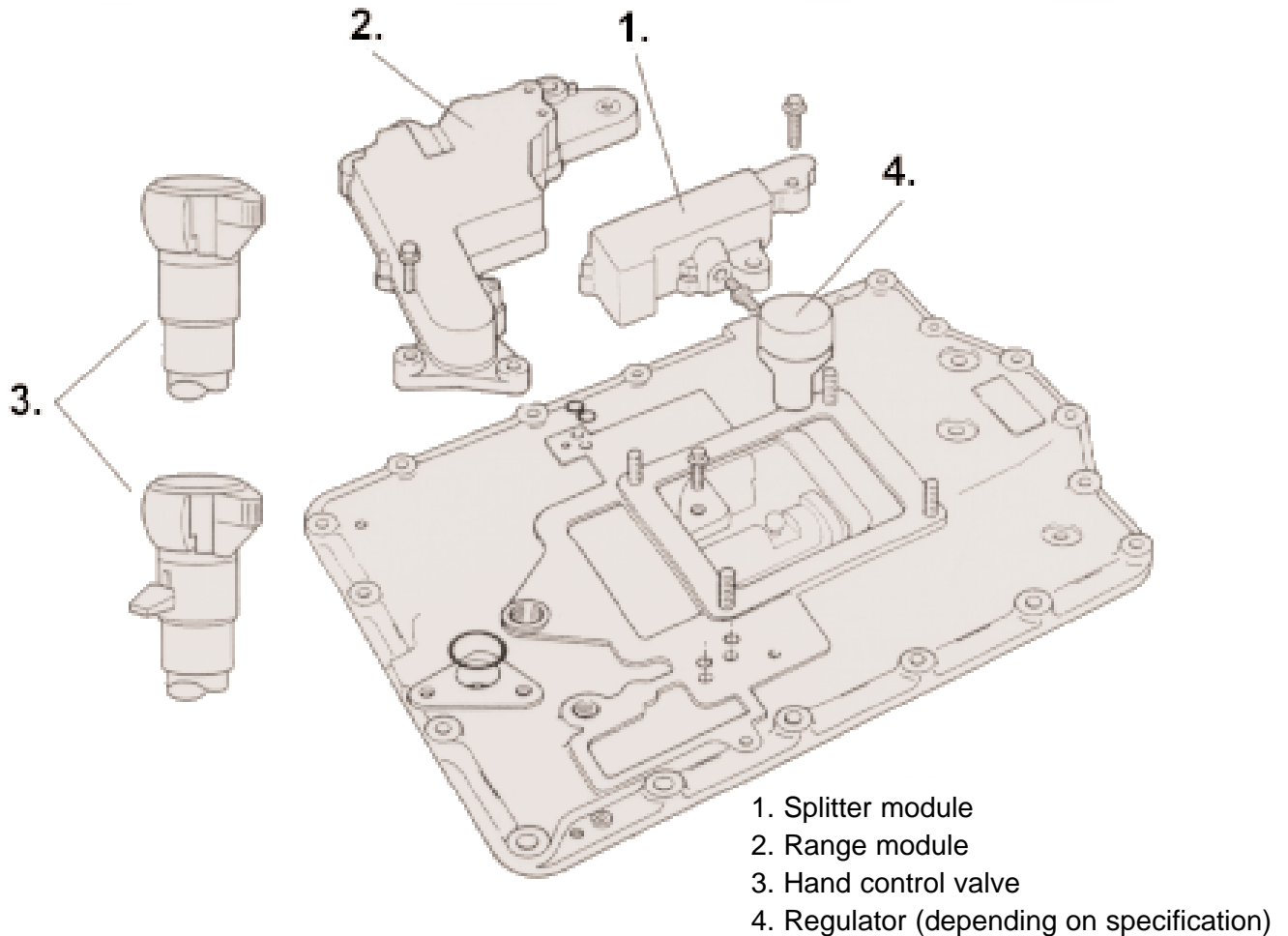
Section 2 Troubleshooting

Section 3 Air System

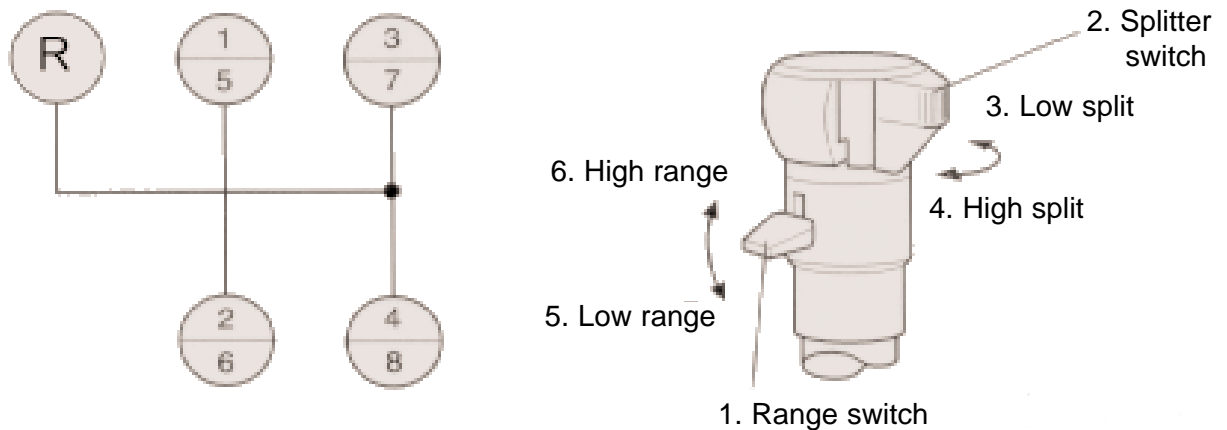
Air system

General description

The air system on the S-Series transmission is self contained within the shift bar housing assembly. This has the advantage that, apart from the vehicle supply lines to the range module and the splitter module and the signal feed pipes to and from the driver's hand control valve, there are no other external air pipes to the transmission.

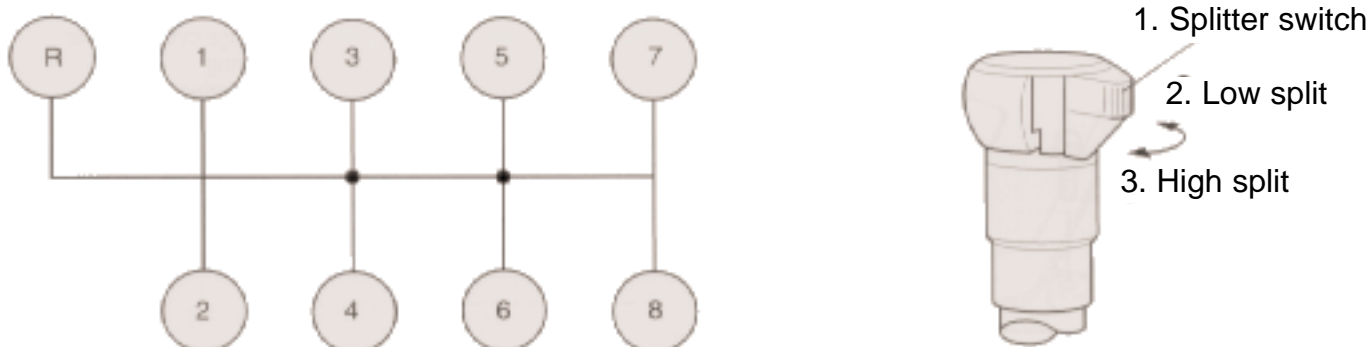


The air system has three major parts. The splitter module (1), the range module (2) and the hand control valve (3) of which two types are currently available.

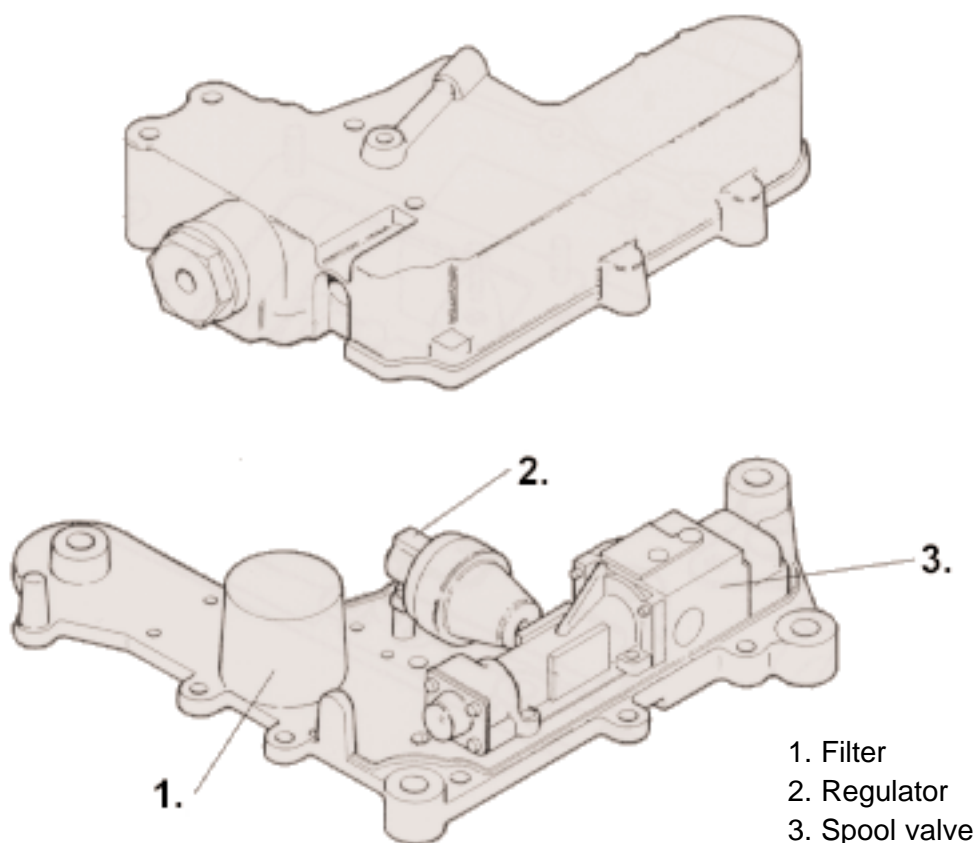


On single H transmissions the hand control valve has two switches, the range switch (1) and the splitter switch (2).

Air system



On double H transmissions the hand control valve has only one switch, the splitter switch (1).

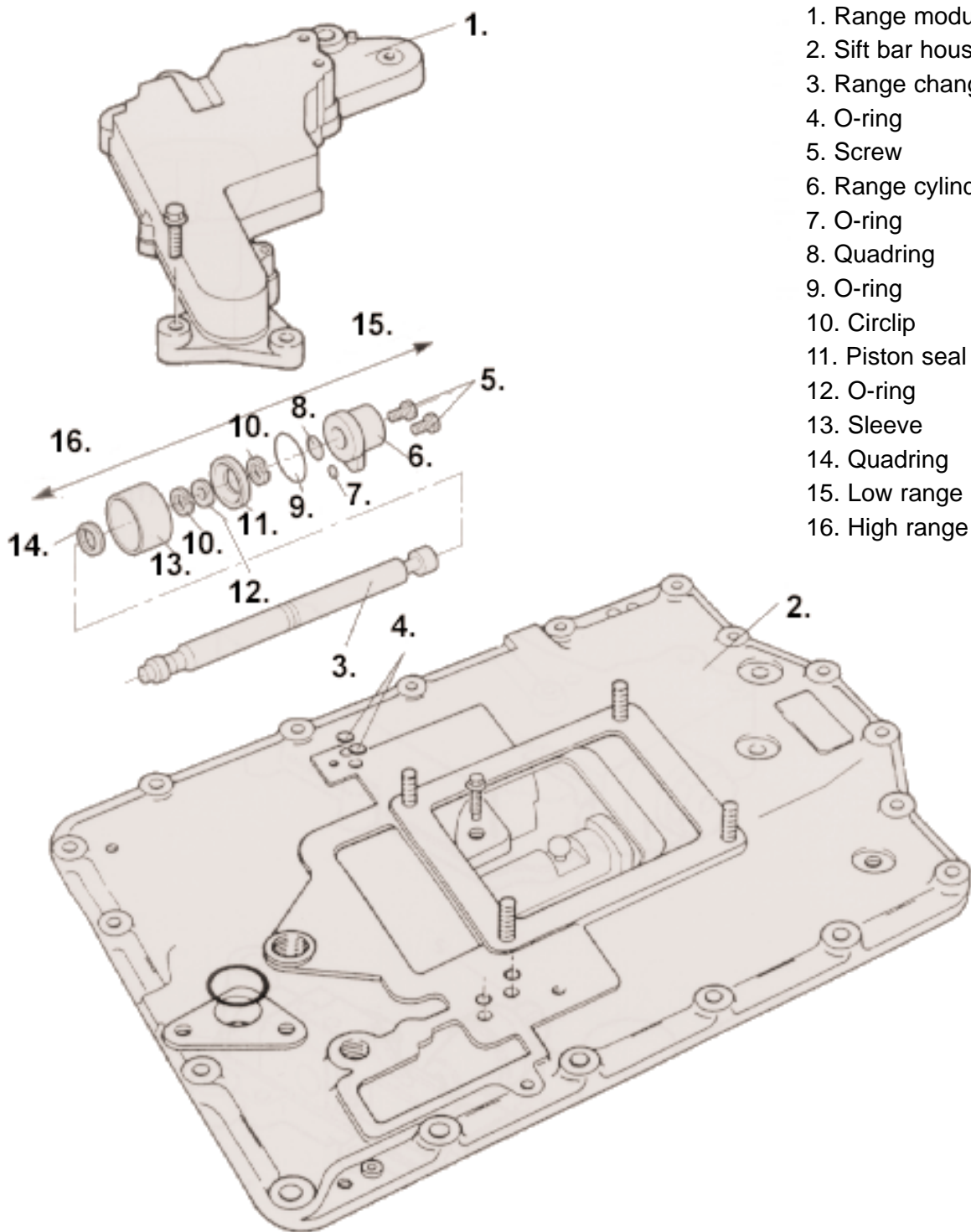


Within the range module are the filter (1), the regulator (2) and the range change spool valve (3).

Access to these components is gained by removing the countersunk screws from the base of the range module and then lifting the cover off.

Air System

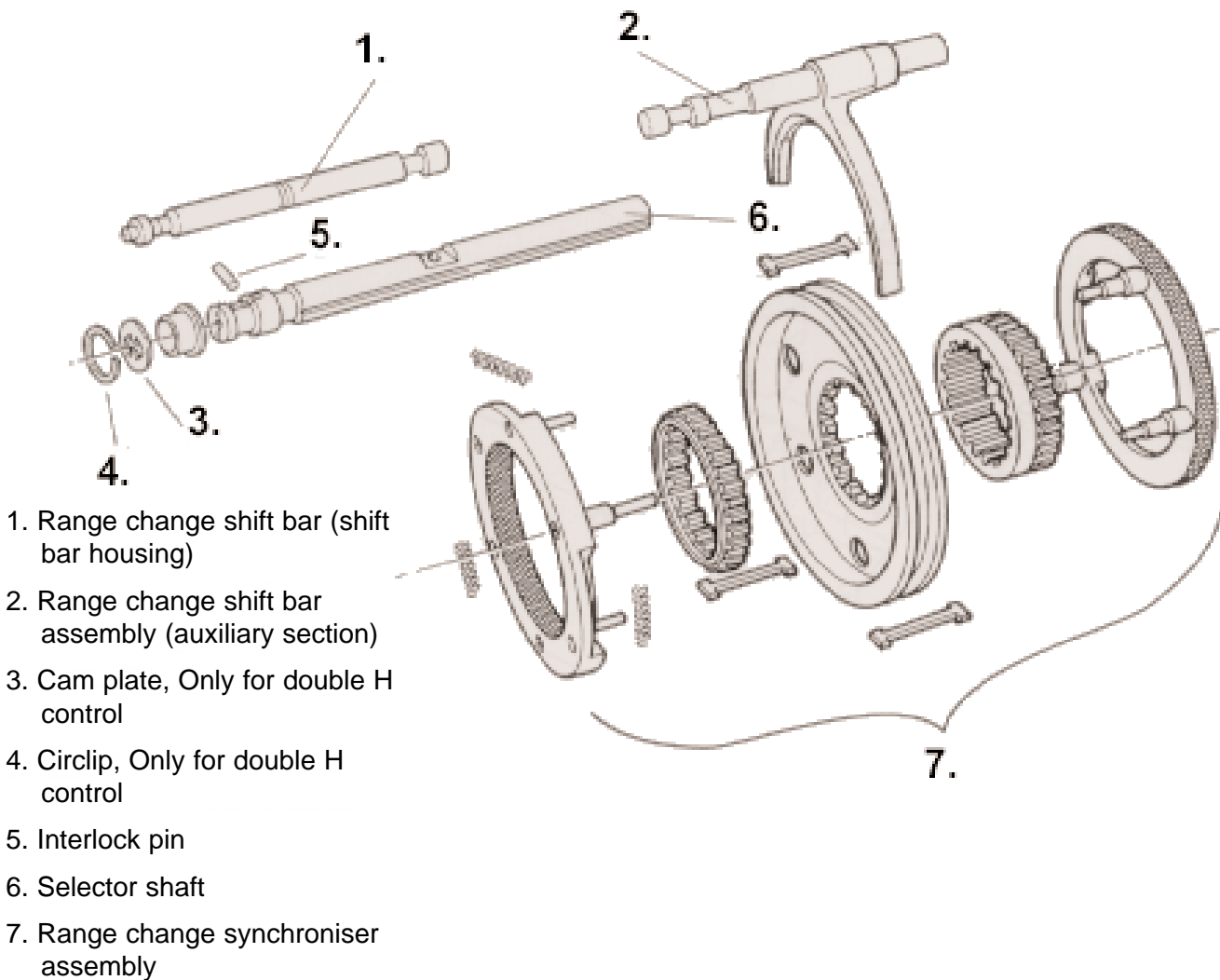
Range change control



The range module (1) feeds air directly into the range change cylinder through drillings in the shift bar housing (2). The range change spool valve in the range module determines whether the main supply of air goes into the low range or high range side of the cylinder.

When air is fed into the high range side of the cylinder the range change shift bar (3) will move forward. When air is fed into the low range side of the cylinder the range change shift bar will move rearward.

Air System



The position of the spool valve is controlled by a signal feed from the hand control valve to the range module on single H transmissions and by a cam plate (3) on the selector shaft (6) locating against a shift finger on the range module on double H transmissions.

The range change shift bar in the shift bar housing (1) is locked to the range change shift bar in the auxiliary housing (2) so that any movement of the range change shift bar in the shift bar housing causes the range change shift bar in the auxiliary housing to move in the same direction. As the range change shift bar in the auxiliary housing forms part of the range change synchroniser assembly, high range is selected on forward movement and low range on rearward movement.

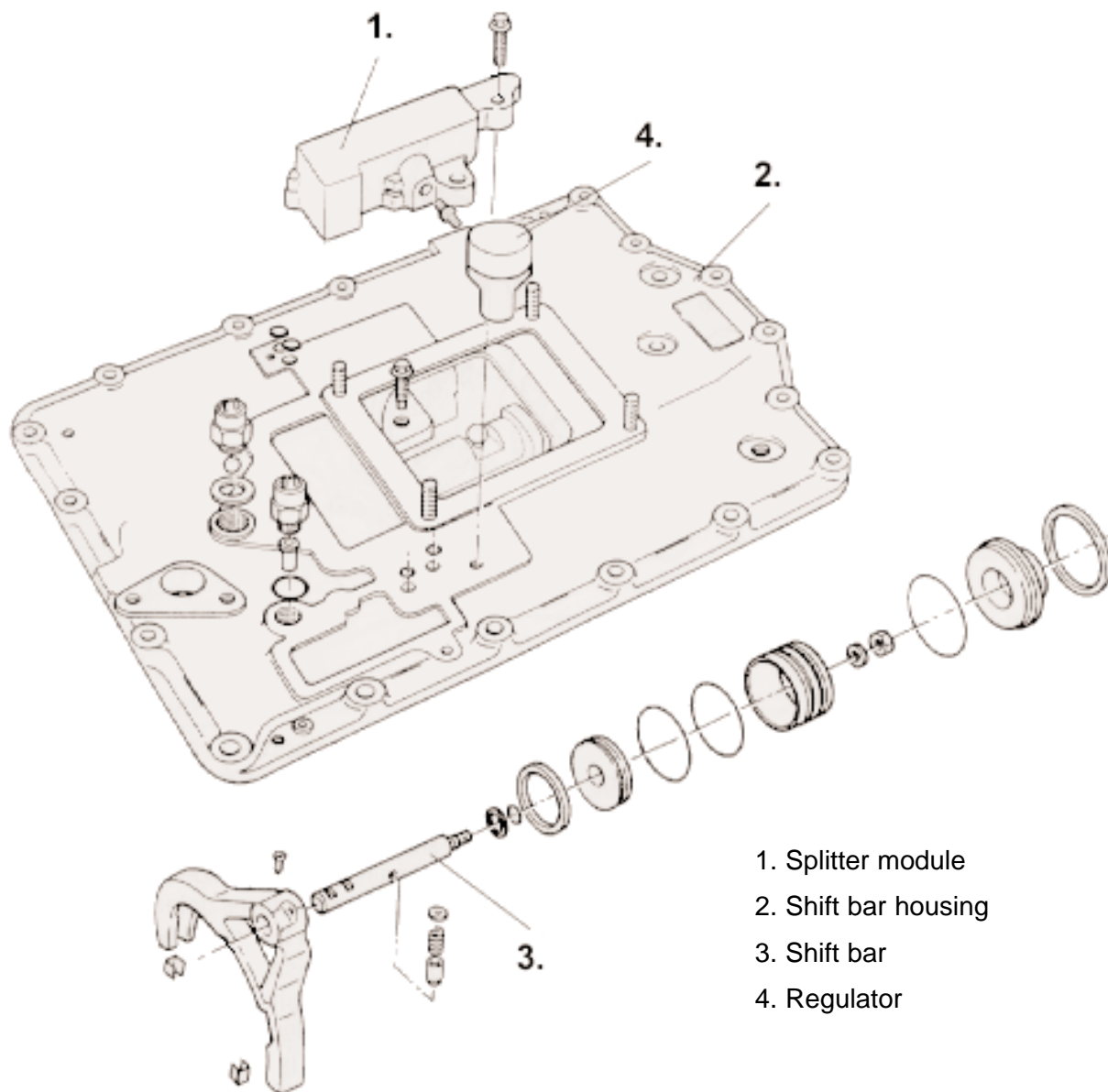
On double H transmissions a cam plate (3) and circlip (4) are fitted. The shift finger in the range module locates against this cam plate. When the selec-

tor shaft (6) is moved across gate the cam plate acts against the shift finger. The position to which the shift finger moves determines whether the transmission is in low range or high range.

On a single H transmission the required range is determined by the position of the hand control valve range range switch. To prevent range changing occurring before the gear lever is in neutral an interlock pin is fitted (5). This pin is fitted to all single H transmissions and is optional on double H transmissions.

Air System

Splitter control



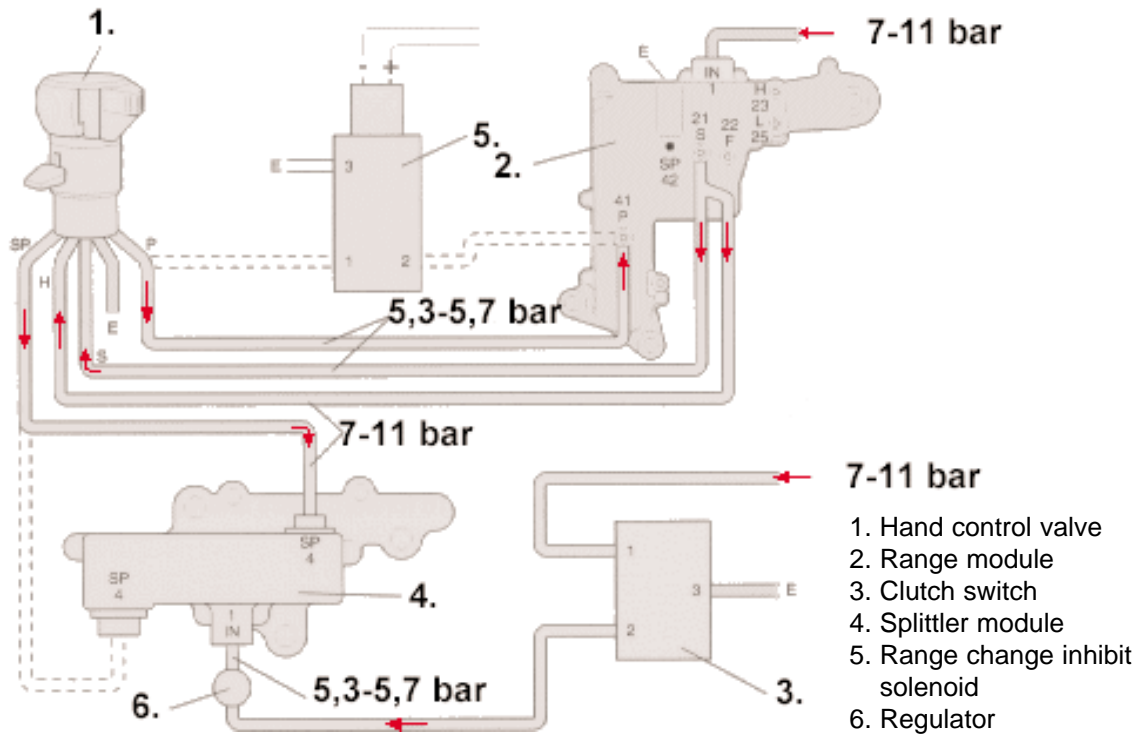
The splitter module (1) feeds air directly into the splitter cylinder through drillings in the shift bar housing (2). The position of the spool valve within the splitter module is determined by the signal feed pipe from the driver's hand control valve to port 4/SP on the splitter module. When this signal line from the hand control valve to the splitter module is pressurised the air supplied to port 1/IN flows into one side of the splitter cylinder. When the signal line from the hand control valve to the splitter module is exhausted the air supplied to port 1/IN flows into the other side of the splitter cylinder. It is important to understand that the air supply to port 1/IN on

the splitter module is fed through a valve under the driver's clutch pedal. This valve is opened by fully depressing the clutch pedal. Although the driver can preselect splitter gear shifts no splitter shifts occur until the clutch pedal is fully depressed.

On an overdrive transmission high split is selected when the splitter shift bar (3) moves forward. On a direct transmission low split is selected when the splitter shift bar moves forward.

Air System

Single H air system



The diagram shows the correct piping sequence for a single H transmission and includes the optional range change inhibit solenoid valve (5).

Two types of splitter module (4) are available, the correct type for the vehicle being predetermined by the vehicle manufacturer. Although provision for

porting at the front and rear has been made only one position is accessible.

The following table is a guide to the pressures that should be available when in low range or high range and in low split or high split gears

Single H control pressure chart

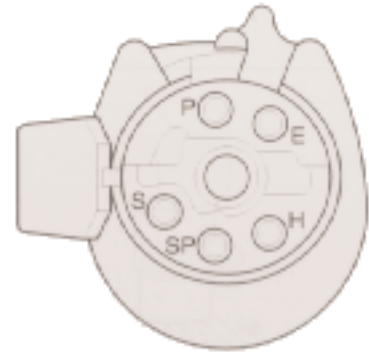
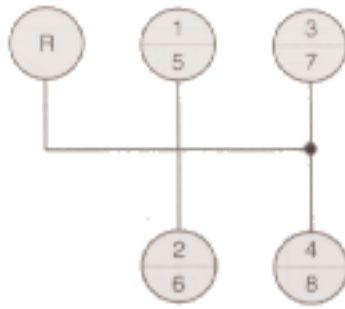
Vehicle Air Supply	Clutch Switch	Hand Control Valve	Range Module	Splitter Module	Pressure Reading
		S ←	21 S		5,3 - 5,7 bar
		H ←	21 S		5,3 - 5,7 bar
		P →	41 P		0 bar high range 5,3 - 5,7 bar low range
		SP →		4 SP	0 bar or 5,3 - 5,7 bar *
	2 →			1 IN	5,3 - 5,7 bar **
			1 IN		7 - 11 bar
	1 →				7 - 11 bar

* The pressure reading in this line should be zero with the hand control valve splitter switch in one position and 5,3 - 5,7bar with the splitter switch in the other position.

** The supply of air to the splitter module should be 5,3 - 5,7bar when the driver's clutch pedal is fully depressed. When the pedal is released the reading should be zero bar.

Air System

Hand control valve



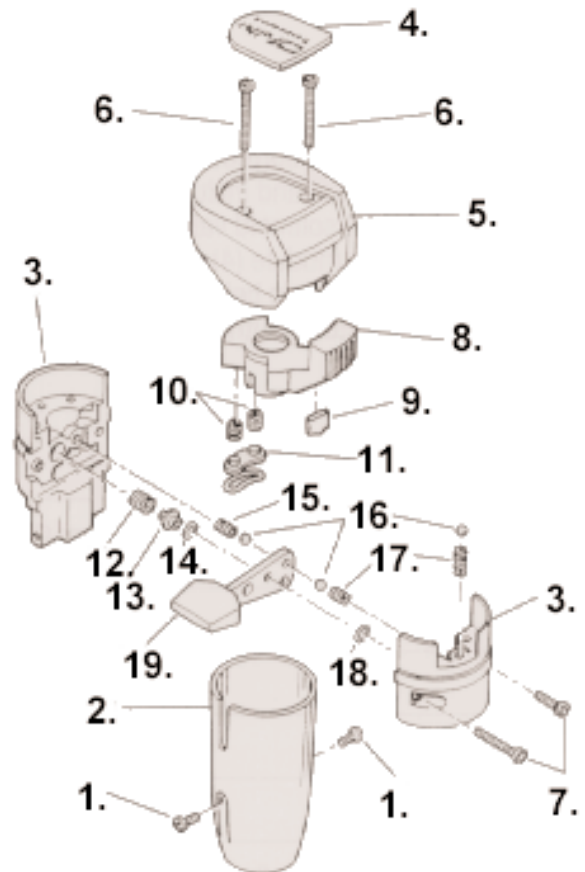
The driver's hand control valve on single H transmissions allows the driver to select the desired range and splitter gears.

When in low range, gears 1, 2, 3, 4 and low range reverse are available. When in high range, gears 5, 6, 7, 8 and high range reverse are available. As all these gears can be split there is a total of 16 forward gears and 4 reverse gears available.

- 1. Range change switch
- 2. Splitter switch
- 3. Low split
- 4. High split
- 5. Low range
- 6. High range

Removal and disassembly

1. Remove the two screws (1) holding the cover (2) to the control valve housing (3) and then slide the cover down the gear shift lever to expose the air line fittings. Identify and then disconnect the air lines.
2. Loosen the lock nut and unscrew the control valve from the gear shift lever.
3. Remove the plate (4) from the recess in the top cover (5).
4. Remove the two screws (6) and remove the top cover from the control valve housing.
5. Remove the two screws (7) from the side of the valve housing. The valve housing should now split into two parts.
6. Remove the range change lever, the position balls and the guide.
7. If necessary, remove the spring and O-ring from the valve housing.
8. If necessary, remove the springs, O-ring and sleeve from the valve housing.



Reassembly and installation

1. Refer to the drawing for proper assembly. Silicone lubricant should be applied to all O-rings and a small amount of grease applied to all relevant moving parts prior to reassembly.
2. Install the control valve on the gear shift lever. Retighten the locknut.
3. Attach the air lines and refit the cover.

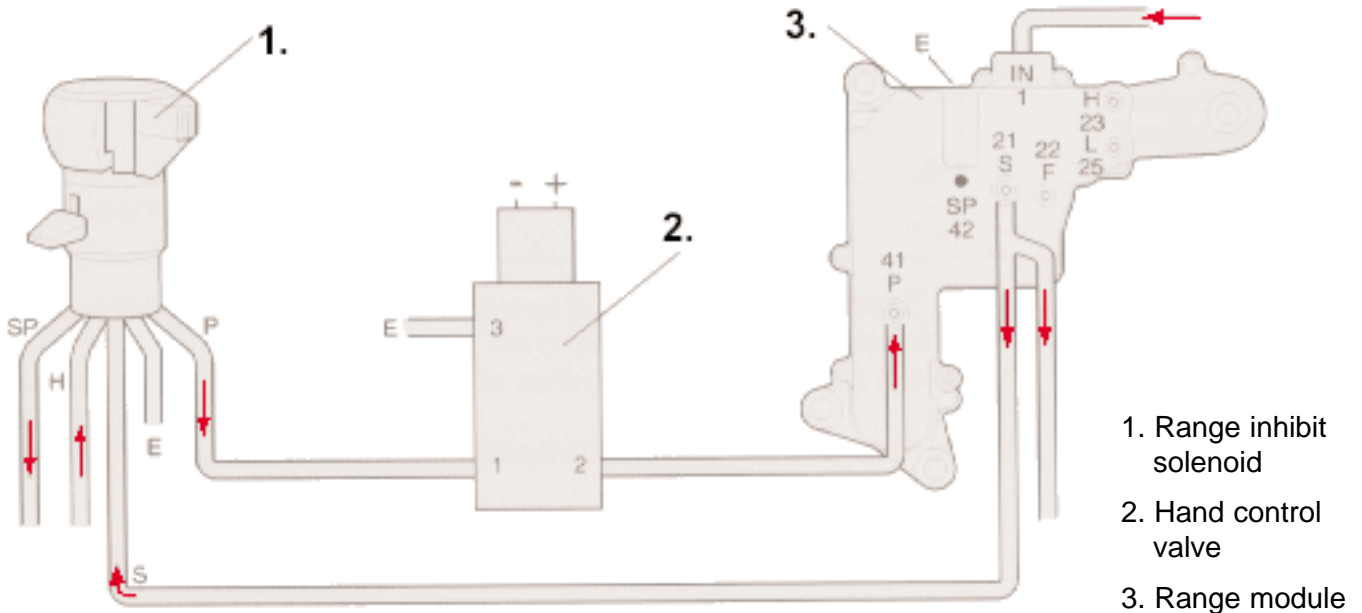
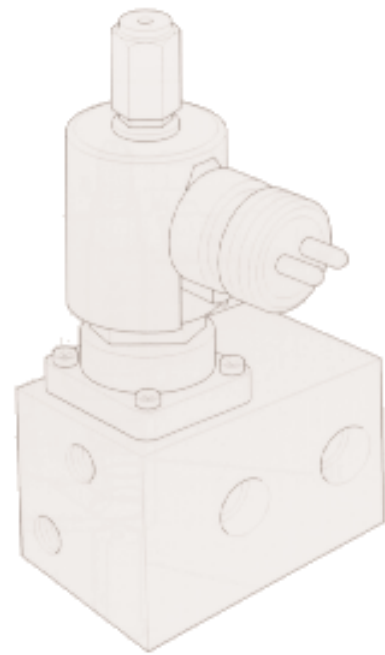
- | | | |
|--------------------------|--------------|------------|
| 1. Screw | 7. Screw | 14. O-ring |
| 2. Cover | 8. Actuator | 15. Spring |
| 3. Control valve housing | 9. Detent | 16. Ball |
| 4. Plate | 10. Spring | 17. Spring |
| 5. Top cover | 11. Retainer | 18. O-ring |
| 6. Screw | 12. Spring | 19. Lever |
| | 13. Retainer | |

Air System

Range inhibitor solenoid

Where required the selection of low range can be inhibited above a predetermined road speed by use of an electrical solenoid valve. This solenoid, when fitted, can be found on the rear right-hand side of the maincase.

Low range gears are selected by pressurising the signal feed pipe from port P on the driver's hand control valve to port 41/P on the range module. High range gears are selected by exhausting this signal line. If air in this signal pipe is prevented from reaching the range module the transmission defaults to high range.

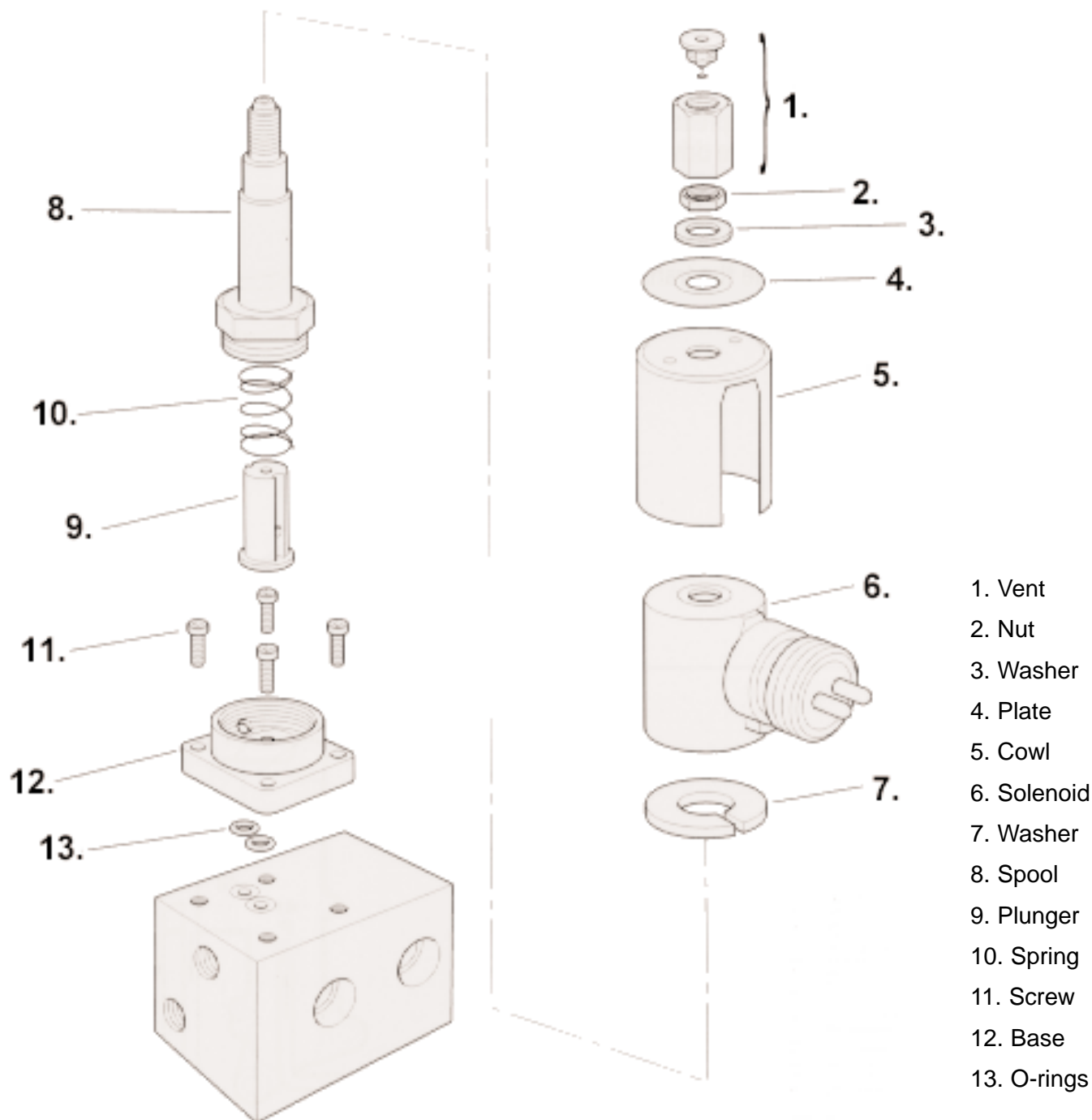


The range inhibit solenoid (1) is fitted in the signal line between the driver's hand control valve port P (2) and the range module port 41/P (3). This solenoid valve receives a 24 volt signal from the vehicle wiring system when the road speed is within the acceptable speed band for low range gears. This opens the solenoid valve and allows air to pass down the signal line to the range module. When the vehicle is travelling too fast for low range gears the 24 volt supply to the solenoid valve is cut off. Without the 24 volt supply to the solenoid the valve

closes and shuts off the air supply to the range module from the hand control valve. With no signal air supply to the range module the transmission defaults to high range.

Note: If the vehicle ignition is switched off when the transmission is in low range the transmission defaults to high range. When the ignition is switched on again the transmission reverts back to low range.

Air System



Disassembly

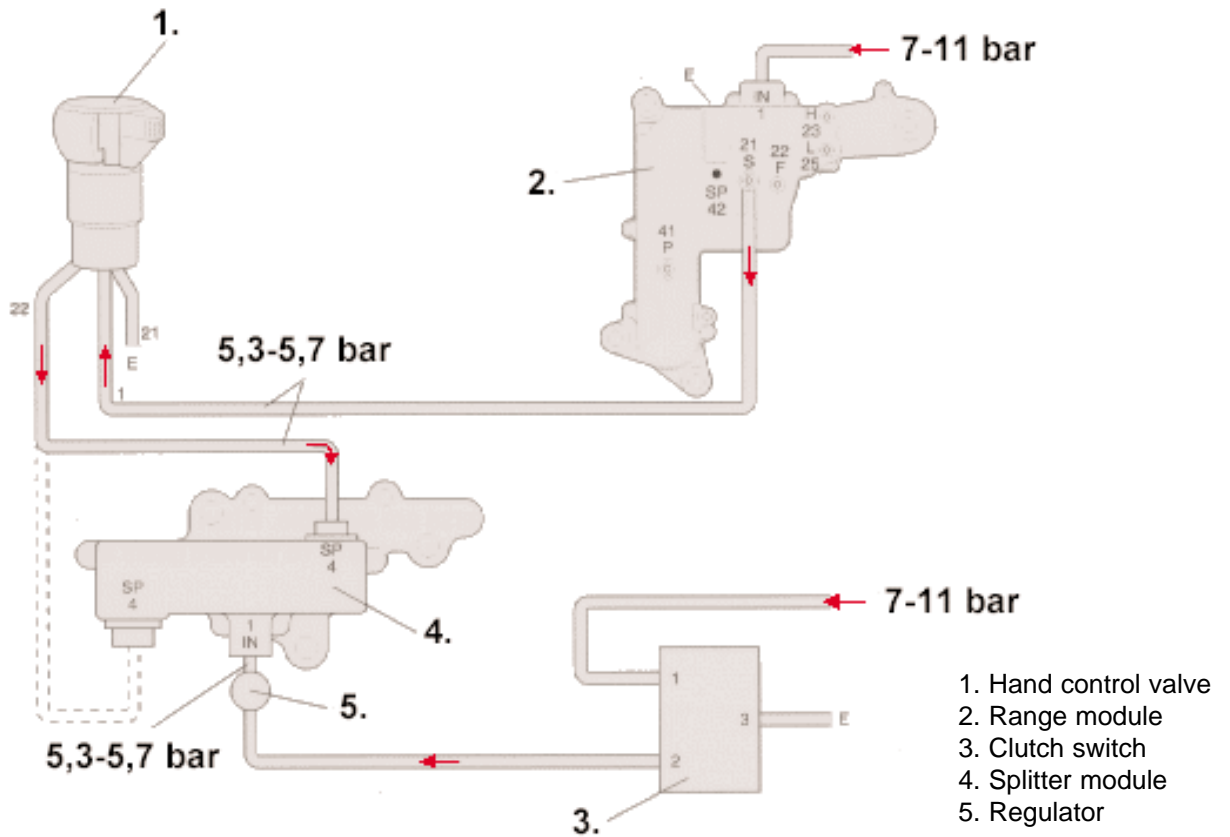
1. Identify and then remove the two air lines. Remove the solenoid valve from the transmission maincase.
2. Remove the vent (1) and nut (2).
3. Remove the washer, plate, cowl, solenoid and washer (3, 4, 5, 6, 7).
4. Remove the spool, plunger and spring (8, 9, 10).
5. To gain access to the O-rings (13) remove the screws and base plate (11, 12).

Assembly

1. Refer to the drawing for proper reassembly.
2. Apply silicone lubricant to the O-rings and lightly grease all moving parts.
3. Refit the solenoid to the transmission and refit the two air lines

Air system

Double H air system



The diagram shows the correct piping sequence for a double H transmission.

Two types of splitter module are available, the correct type for the vehicle being predetermined by the vehicle manufacturer. Although provision for porting

at the front and rear has been made only one position is accessible.

The following table is a guide to the pressures that should be available when low split or high split gears are selected.

Double H control pressure chart

Vehicle Air Supply	Clutch Switch	Hand Control Valve	Range Module	Splitter Module	Pressure Reading
		1 ←	21 S		5,3 - 5,7 bar
		22		→ 4 SP	0 bar or 5,3 - 5,7 bar *
	2			→ 1 IN	5,3 - 5,7 bar **
			→ 1 IN		7 - 11 bar
	→ 1				7 - 11 bar

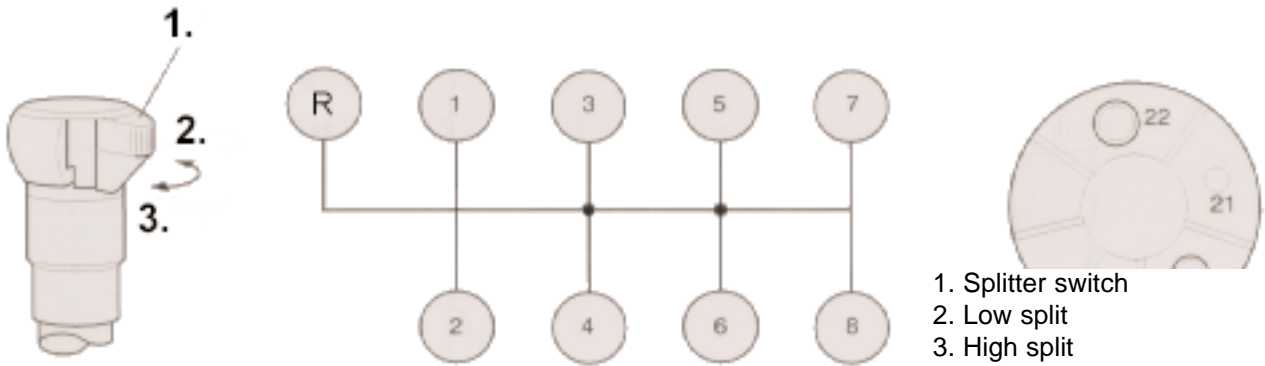
* The pressure reading in this line should be zero with the hand control valve splitter switch in one position and 5,3-5,7bar with the splitter switch in the other position.

** The supply of air to the splitter module should be 5,3-5,7bar when the driver's clutch pedal is fully depressed. When the pedal is released the reading should be zero bar.

Air System

Hand control valve

The driver's hand control valve on double H transmissions only allows the driver to select splitter gears. Low range and high range gears are selected by moving the gear lever across gate.



The hand control valve is a non serviceable item.

When in low range, gears 1, 2, 3, 4 and low range reverse are available. When in high range gears 5, 6, 7 and 8 are available. As all these gears can be split there is a total of 16 forward gears and 2 reverse gears.

Air System

Troubleshooting

Before carrying out any of the following checks ensure that the supply of air to the range module port 1/IN is constant and at the required pressure and also check the supply of air to the splitter module. Remember that the supply of air to the splitter module port 1/IN is controlled through a valve under the driver's clutch pedal. When the clutch pedal is fully depressed check that the air supplied to the splitter module is constant and at the correct pressure. When the clutch pedal is released this supply line should be exhausted.

Single H transmissions

No splitter shifts

1. Check that there is a constant feed of air, at the correct pressure, to the hand control valve port H from the range module port 21/S. If not then problems with the signal line and/or range module are suspected.
2. Check that there is a constant feed of air, at the correct pressure, to the splitter module port 4/SP from the hand control valve port SP when the splitter switch is in one position and that this air supply is exhausted when the splitter switch is moved to the alternate position. If not then problems with the signal line and/or hand control valve are suspected.
3. Taking care not to lose the O-rings lift the splitter module off the shift bar housing (do not disconnect any air lines). With the splitter switch in the low split position depress the clutch pedal and note from which port on the base of the splitter module air comes. Select high split and repeat the procedure. In high split air should be heard coming from the alternate port on the splitter module base. If not then the splitter module is suspect.

No range changes

1. If a range change inhibit solenoid is fitted check that the vehicle ignition is switched on and that the solenoid is receiving a 24 volt signal from the vehicle wiring system. If the range inhibit solenoid is not receiving a 24 volt signal, problems with the vehicle wiring or related components are suspected. If there is a 24 volt supply, the resistance of the solenoid coil should be checked. If the nominal reading is not 46 Ohms, the solenoid is suspect.
2. Check that there is a constant feed of air, at the correct pressure, to the hand control valve port S

from the range module port 21/S. If not, the signal feed pipe and/or range module are suspect.

3. Check that there is a constant supply of air, at the correct pressure, to port 41/P on the range module from the hand control valve port P in low range and that this signal line is exhausted in high range. If not then the signal feed pipe and/or hand control valve are suspect.
4. In low range remove the plug from port 23/H and fit a pressure gauge. The reading should be zero bar. Select high range. The pressure reading should be between 5.3 and 5.7bar. If not then the range module and/or sealing rings in the range change cylinder bore or piston are suspect. Select low range and then remove the pressure gauge and replace the plug.
5. In high range remove the plug from port 25/L and fit a pressure gauge. The reading should be zero bar. Select low range. The pressure reading should be between 5.3 and 5.7bar. If not then the range module and/or sealing rings in the range change cylinder bore or piston are suspect. Select high range and then remove the pressure gauge and replace the plug.

Double H transmissions

No splitter shifts

1. Check that there is a constant feed of air, at the correct pressure, to the hand control valve port 1 from the range module port 21/S. If not then problems with the signal line and/or range module are suspected.
2. Check that there is a constant feed of air, at the correct pressure, to the splitter module port 4/SP from the hand control valve port 22 when the splitter switch is in one position and that this air supply is exhausted when the splitter switch is moved to the alternate position. If not, problems with the signal line and/or hand control valve are suspected.
3. Taking care not to lose the O-rings lift the splitter module off the shift bar housing (do not disconnect any air lines). With the splitter switch in the low split position depress the clutch pedal and note from which port on the base of the splitter module air comes. Select high split and repeat this procedure. In high split air should be heard coming from the alternate port on the splitter module base. If not then the splitter module is suspect.

Air System

No range changes

1. In low range remove the plug from port 23/H and fit a pressure gauge. The reading should be zero bar. Select high range. The pressure reading should be between 5.3 and 5.7bar. If not then the range module, shift bar cam plate and/or sealing rings in the range change cylinder bore or piston are suspect. Select low range and then remove the pressure gauge and replace the plug.

2. In high range remove the plug from port 25/L and fit a pressure gauge. The reading should be zero bar. Select low range. The pressure reading should be between 5.3 and 5.7bar. If not then the range module, shift bar cam plate and/or sealing rings in the range change cylinder bore or piston are suspect. Select high range and then remove the pressure gauge and replace the plug.

Air leaks general

Hand control valve

- Range change spool valve seals/O-rings worn (single H only)

- Splitter spool valve seals/O-rings worn

- Hand control valve O-rings worn

Splitter module

- Spool valve seals/O-rings worn

- Splitter cylinder/piston sealing rings worn

Range module

- Range change spool valve seals/O-rings worn

- Range change cylinder/piston sealing rings worn

- Range change module gaskets/O-rings worn

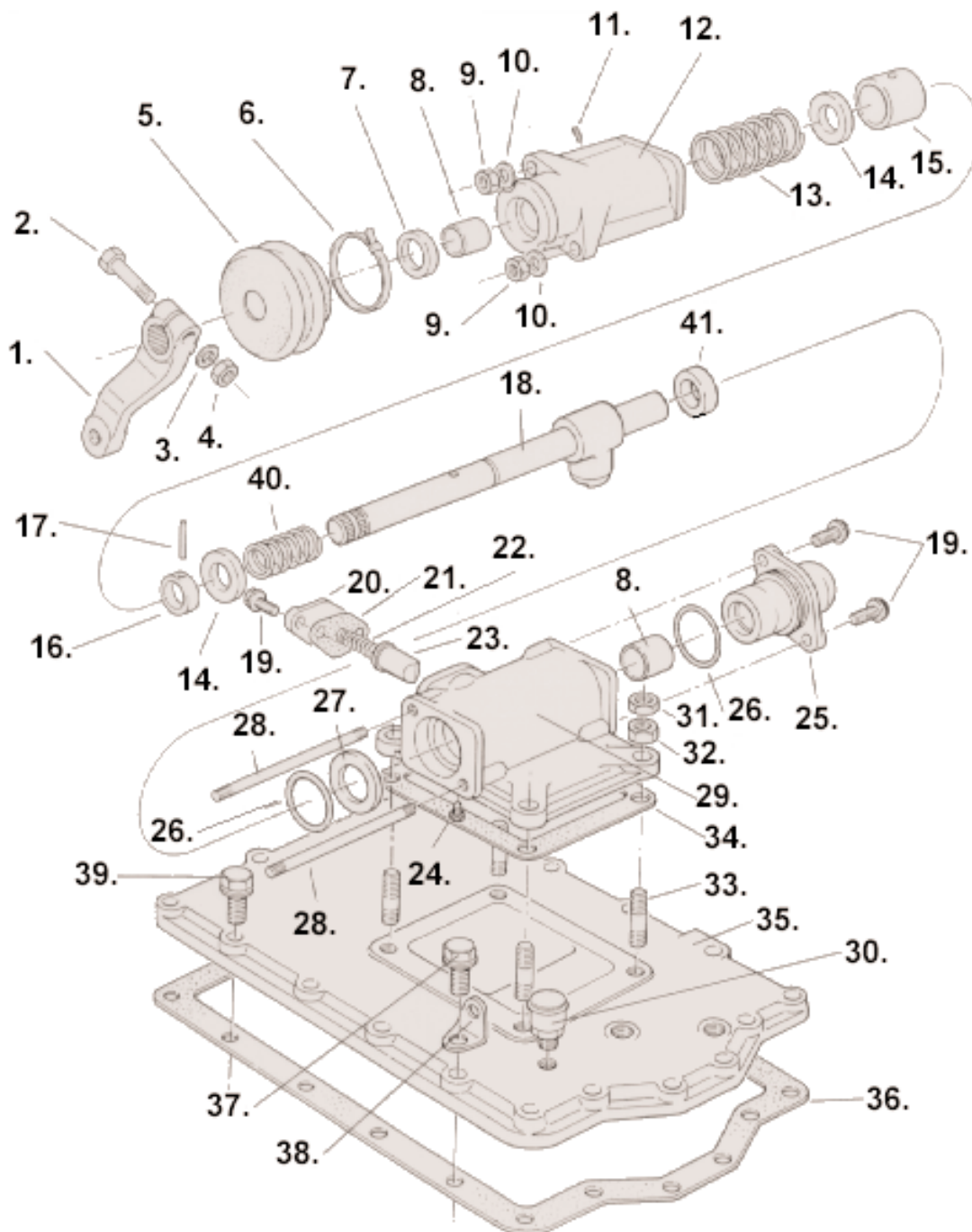
Range inhibit solenoid

- Solenoid plunger/seat worn

Section 4 Shifting Controls

Shifting controls

Remote control (LRC)



- | | | | |
|----------------|-----------------------------|-----------------|--|
| 1. Shift lever | 12. Front cover | 23. Plunger | 34. Gasket |
| 2. Bolt | 13. Spring | 24. Screw | 35. Shift bar housing |
| 3. Washer | 14. Thrust washer | 25. Rear cover | 36. Gasket |
| 4. Nut | 15. Stop sleeve | 26. O-ring | 37. Screw |
| 5. Boot | 16. Stop ring | 27. Washer | 38. Lifting eye |
| 6. Cable tie | 17. Locking pin | 28. Stud | 39. Screw |
| 7. Oil seal | 18. Selector shaft assembly | 29. Housing | 40. Spring |
| 8. Bush | 19. Screw | 30. Breather | 41. Spacer (Single H only) |
| 9. Nut | 20. Detent plate | 31. Nut | Note: This is replaced by a screw on the shift bar housing on later models. |
| 10. Washer | 21. Gasket | 32. Conical nut | |
| 11. Screw | 22. Spring | 33. Stud | |

Shifting controls

Remote Control Disassembly



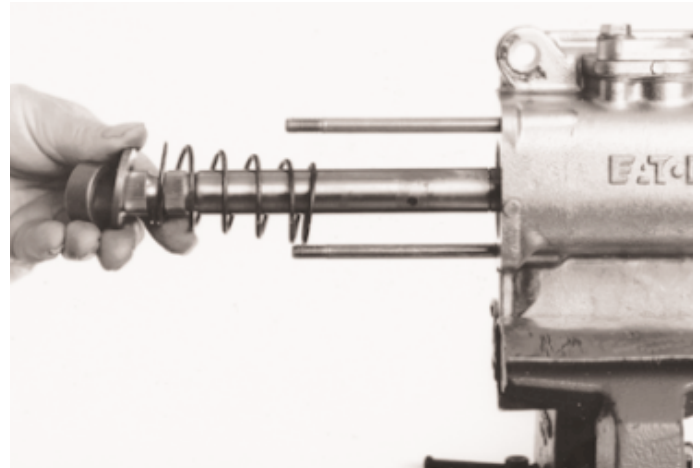
1. Remove the reaction rod and bracket. Remove the remote control and gasket from the shift bar housing.



4. Ensure spring is compressed. Drive out the locking pin from the stop ring.



2. Note the position of the shift lever. Remove the shift lever and the rubber boot from the housing front cover.



5. Remove the stop ring, washer and spring.



3. Remove the housing front cover.

Shifting controls



6. Remove O-ring and washer.



9. Single H (top photo).
Double H (bottom photo).

Manoeuvre the selector shaft assembly out of the housing. Note that the single H selector shaft may not have the spacer fitted as it may be replaced by a screw on the shift bar housing.



7. Remove detent plate, gasket, spring and plunger.



8. Remove the housing rear cover.

Shifting controls



10. Hold the stop sleeve in the front cover in position and loosen grub screw.



12. If necessary, renew the sliding bearings and seal in the front cover, (tools E 109, E 109-16, E 109-17 and E 109-18).



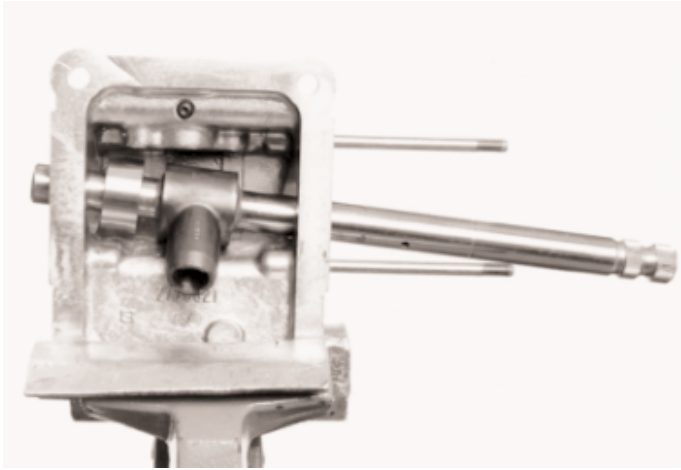
11. Remove stop sleeve, thrust washer and spring.



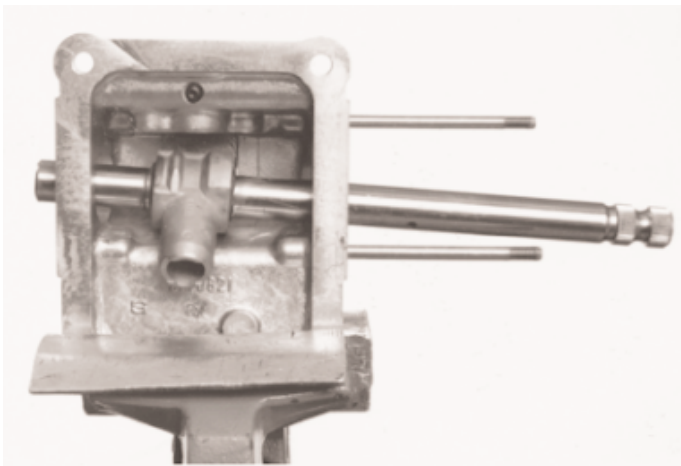
13. If necessary, renew bearing and O-ring in rear cover (tools E 109 and E 109-16).

Shifting controls

Remote control reassembly



3. Refit spring, thrust washer and stop sleeve into front cover. The grub screw in the front cover must locate in the hole in the stop sleeve.



4. Refit the washer and O-ring.

1. Single H (top photo).
Double H (bottom photo).

Fit selector shaft assembly. Note that if the single H selector shaft had a spacer, it must now be refitted.



2. Ensure O-ring is fitted in rear cover.
Refit rear cover.



5. Refit spring, washer and stop ring. Drive in a new locking pin.

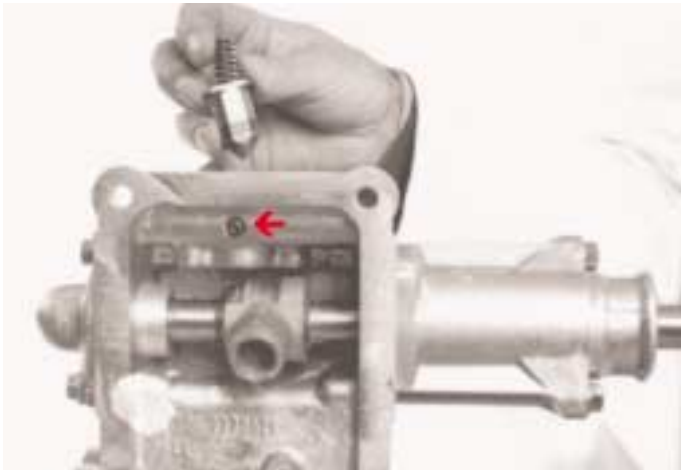
Shifting controls



6. Refit front cover.



8. Refit rubber boot with drain hole pointing down.



7. Refit plunger and spring. The flat face of the plunger must face the screw in the housing. Fit new gasket and detent cover.



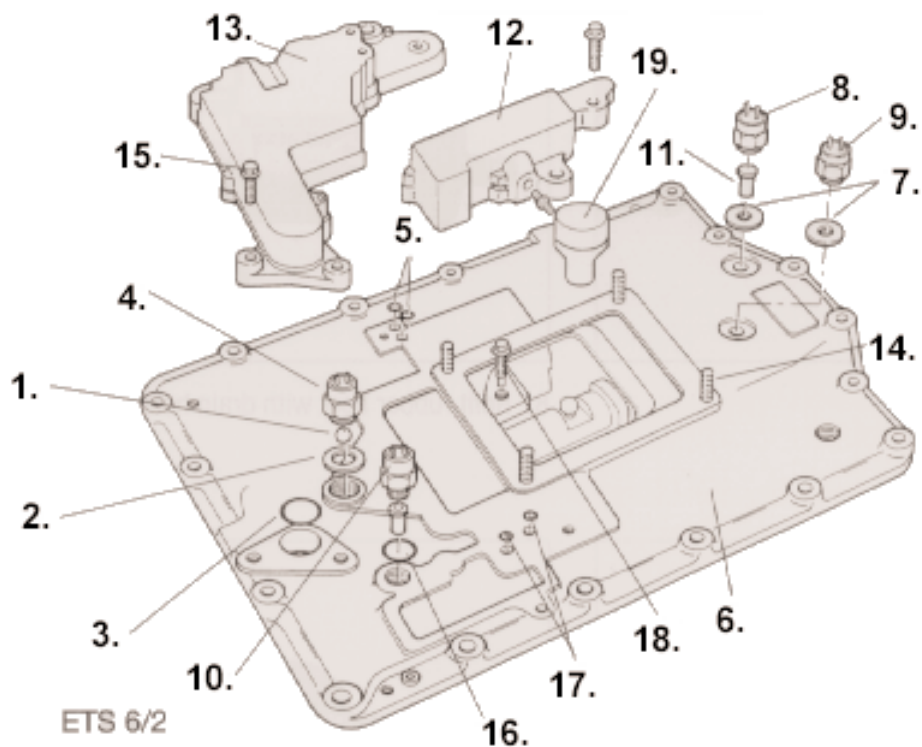
9. Refit shift lever.



10. Refit remote control to shift bar housing. Refit reaction rod and bracket.

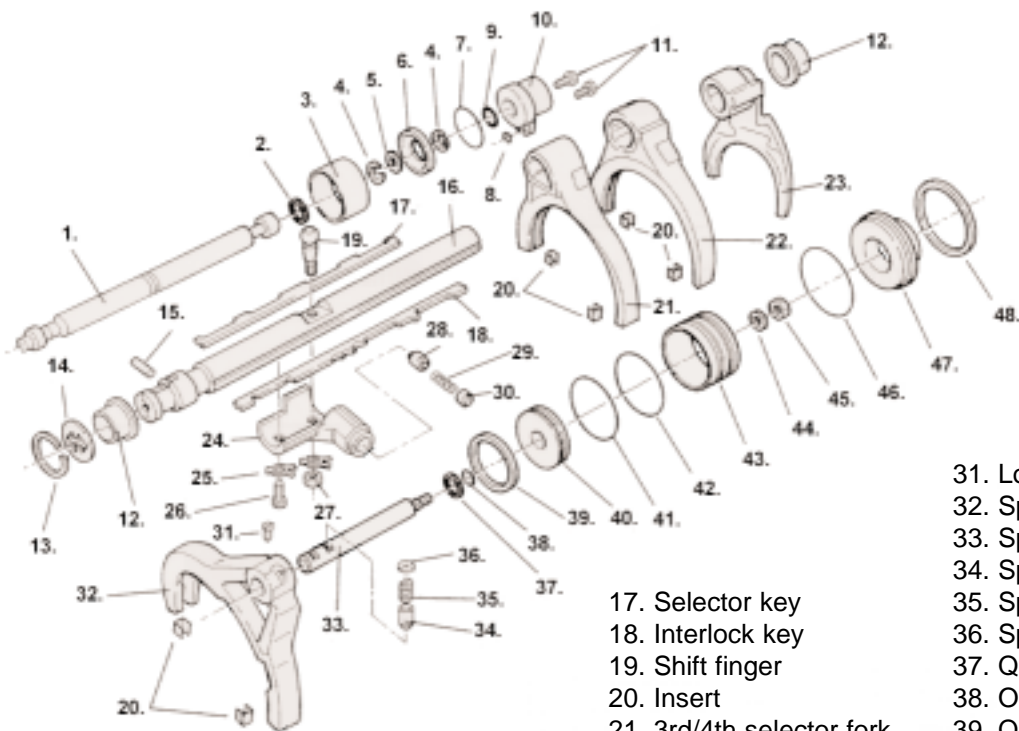
Shift bar housing

Exploded view



- 1. Ball
- 2. Gasket
- 3. O-ring
- 4. Neutral switch
- 5. O-ring
- 6. Shift bar housing
- 7. Gasket
- 8. Range switch
- 9. Reverse switch
- 10. Splitter switch
- 11. Pin
- 12. Splitter module
- 13. Range module
- 14. Stud
- 15. Screw
- 16. Gasket
- 17. O-ring
- 18. Screw
- 19. Regulator

ETS 6/2



- 1. Range change shift bar
- 2. Quadring
- 3. Sleeve
- 4. Circlip
- 5. O-ring
- 6. Piston seal
- 7. O-ring
- 8. O-ring

- 9. Quadring
- 10. Range cylinder cover
- 11. Screw
- 12. Bush
- 13. Circlip
- 14. Cam plate
- 15. Interlock pin
- 16. Selector shaft

- 17. Selector key
- 18. Interlock key
- 19. Shift finger
- 20. Insert
- 21. 3rd/4th selector fork
- 22. 1st/2nd selector fork
- 23. Reverse selector fork
- 24. Shift block
- 25. Tab washer
- 26. Screw
- 27. Nut
- 28. Plunger
- 29. Neutral detent spring
- 30. Plug

- 31. Lockscrew
- 32. Splitter fork
- 33. Splitter shift rail
- 34. Splitter detent plunger
- 35. Spring
- 36. Spring seat
- 37. Quadring
- 38. O-ring
- 39. Quadring
- 40. Piston
- 41. O-ring
- 42. O-ring
- 43. Sleeve
- 44. Washer
- 45. Nut
- 46. O-ring
- 47. Cover
- 48. Spiral clip

Shifting controls

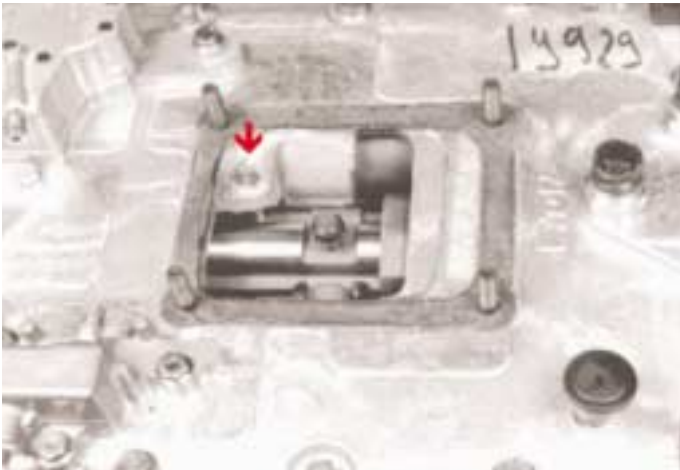
Selector Shaft Disassembly



1. Place the transmission in low range. Disconnect the air supply to the transmission. Remove the remote control assembly.



4. Place the shift bar housing on a bench. Where fitted, identify and remove the neutral and reverse switches and switch mechanisms.



2. The screw shown is used only on single H transmissions. This screw, when fitted, replaces the spacer that was previously used on the remote control.

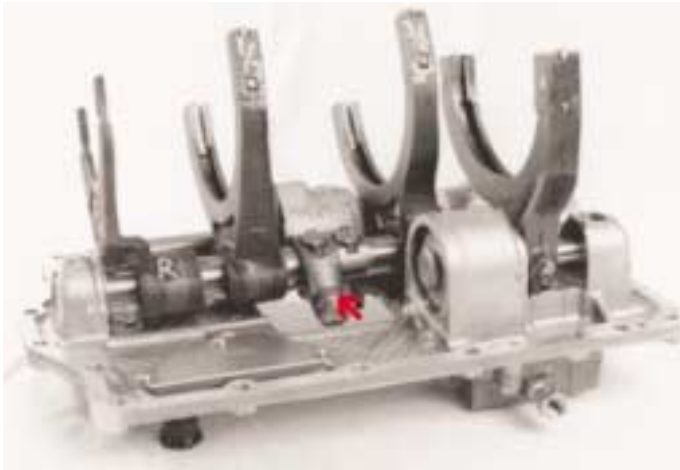


5. Remove range module and O-rings.

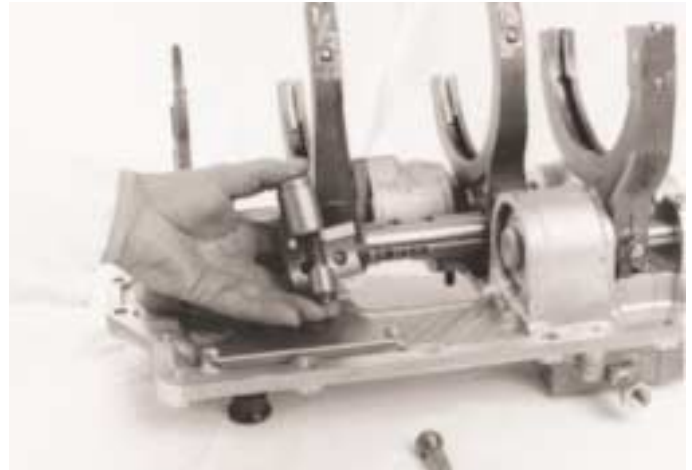


3. Using the tool E 204 in the two jacking points remove shift bar housing. Do not allow the two dowels to fall into the transmission. Remove the gasket.

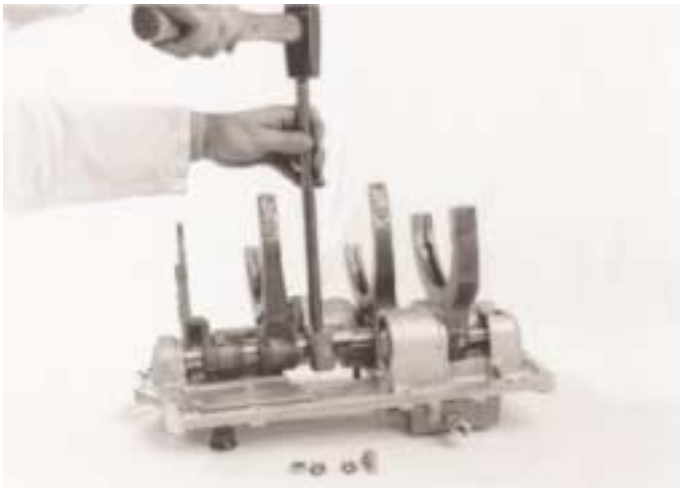
Shifting controls



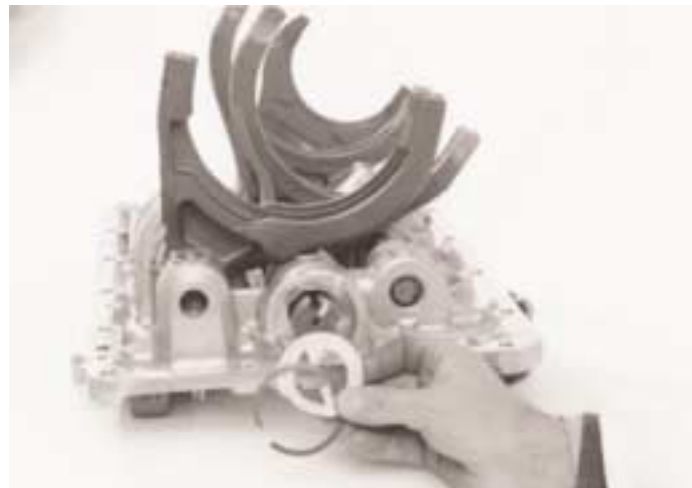
6. Turn shift bar housing over and identify the shift block and the neutral detent plug. Identify selector fork positions.



8. Remove the shift block and neutral detent spring and plunger.

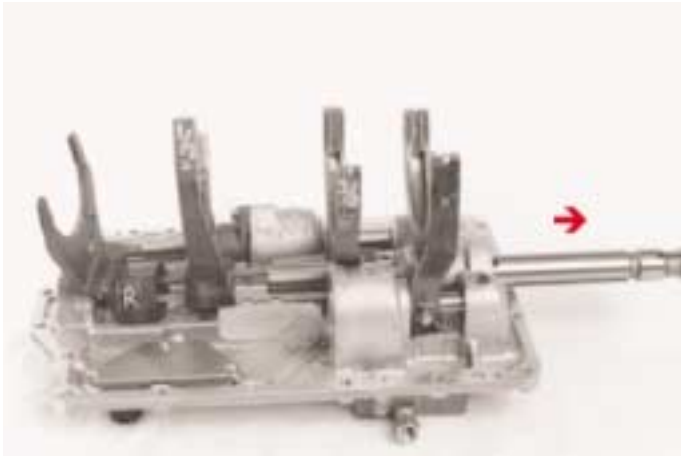


7. Unscrew the shift finger nut and the screw. Remove the tab washers and the shift finger.

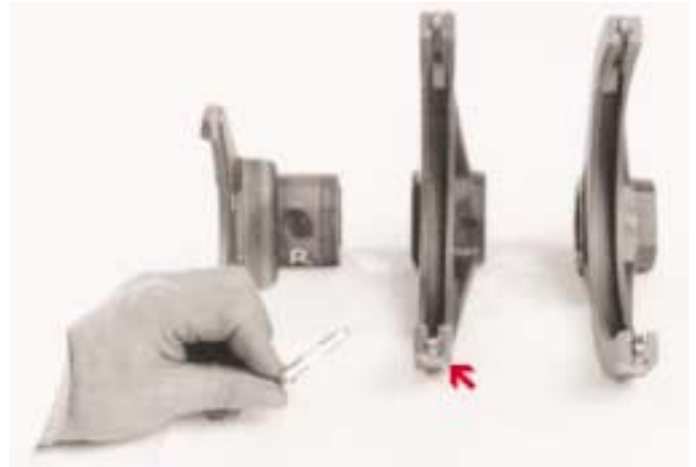


9. For a transmission fitted with a double H control there is a cam plate fitted to the selector shaft and a circlip fitted to the shift bar housing. Identify the orientation of the cam plate. Remove the circlip and cam plate

Shifting controls



10. Withdraw the selector shaft in the direction shown.



12. Remove the three forks. Check the inserts for wear and renew if necessary.



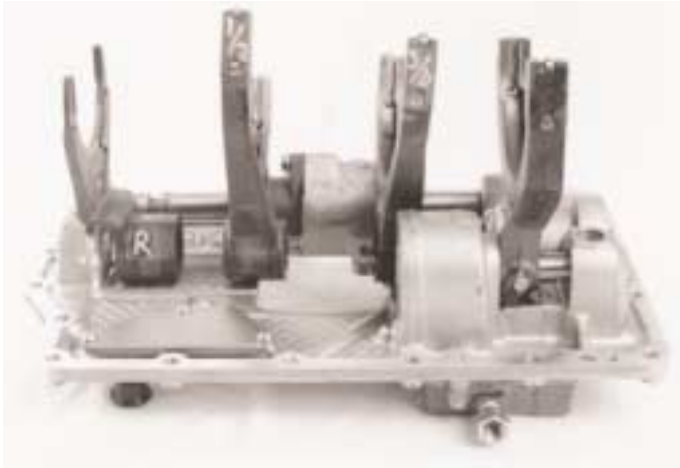
11. Note the positions of the selector key and the interlock key and then remove them.



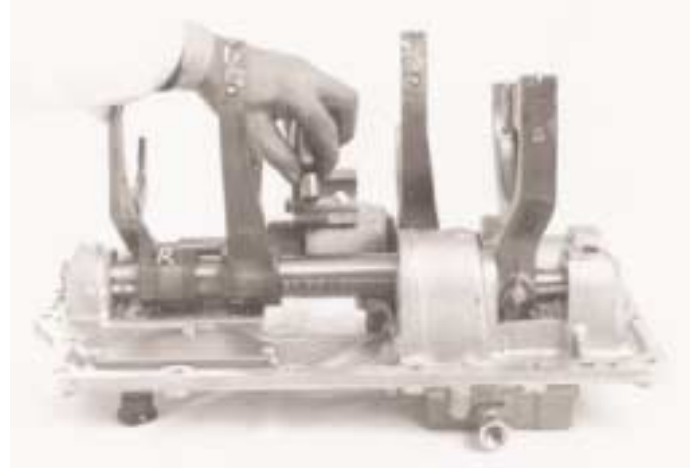
13. Replace bushes if necessary (tools E 109 and E 109-14).

Shifting controls

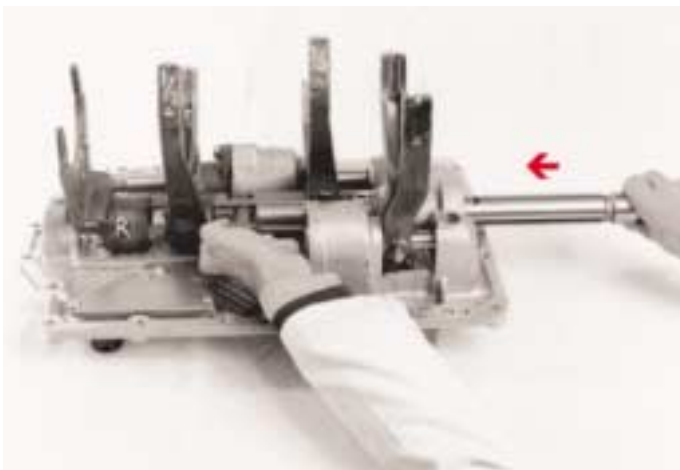
Selector shaft reassembly



1. Place the selector forks into position.



4. Ensure that the plug is fitted into the shift block. Refit neutral detent spring and plunger



2. Refit the selector key and interlock key. Note the position of the selector key slots. Hold the keys and forks in position and refit the selector shift rail in the direction shown.



5. Fit the shift block onto the selector shaft.

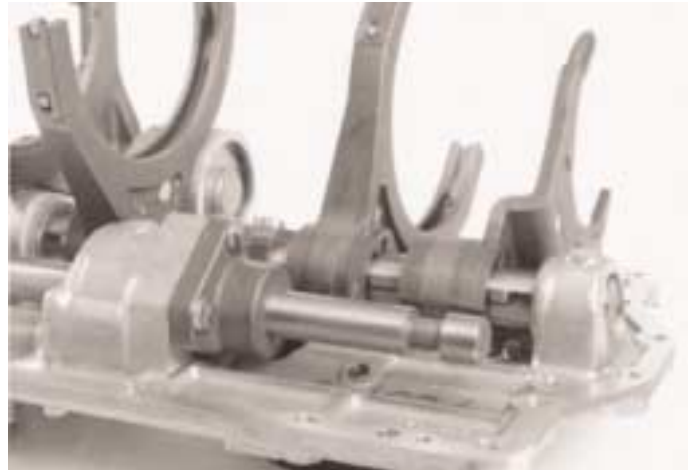


3. For a transmission fitted with a double H control, fit the cam plate and circlip to the selector shaft ensuring that the word FRONT on the cam plate is to the front.

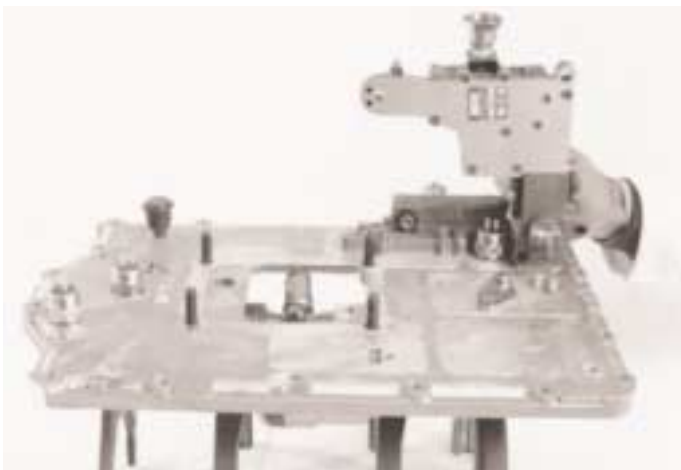
Shifting controls



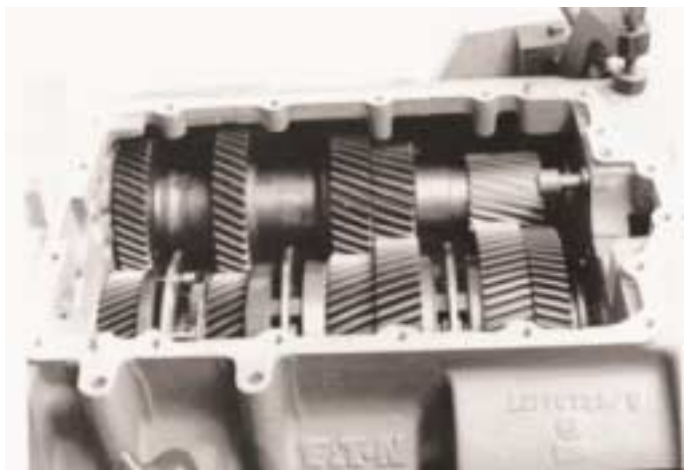
6. Refit the shift finger, tab washers, screw and nut.



8. Ensure that the selector forks are in the neutral position and that the range change shift bar is in the low range position, i.e. completely rearward.

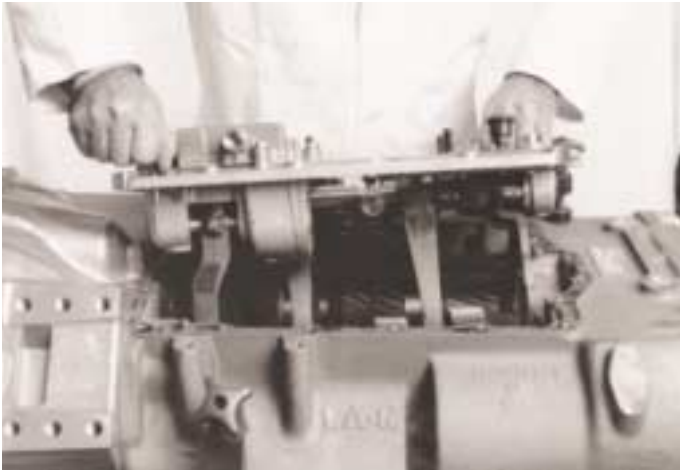


7. Refit the switch mechanisms, switches, O-rings and range module.

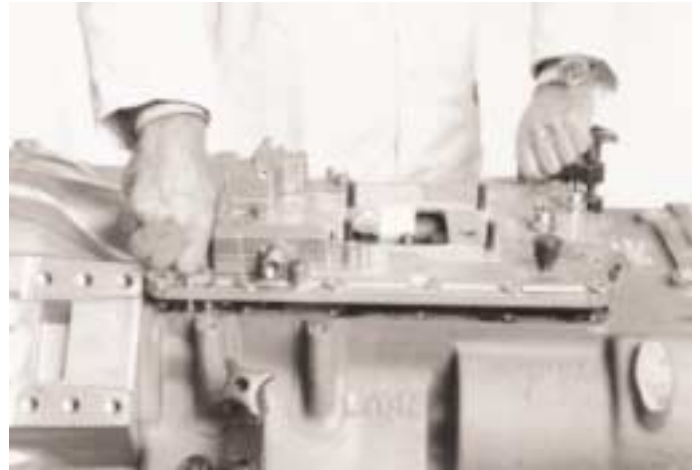


9. Ensure that the auxiliary range change shift bar is in the low position, i.e. completely rearward, and that the transmission is in neutral. Ensure that the two dowels are fitted.

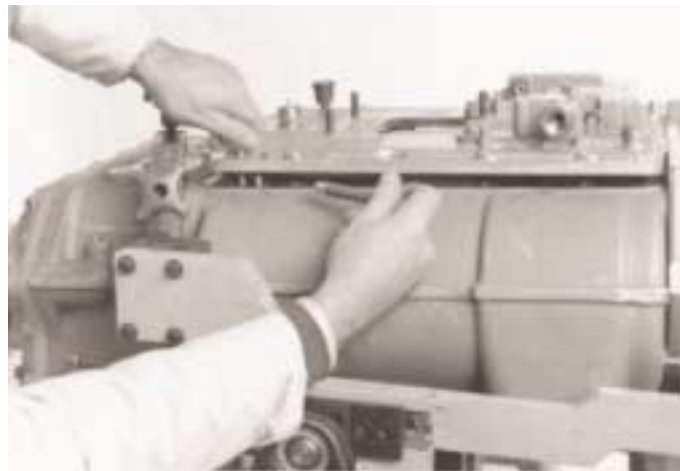
Shifting controls



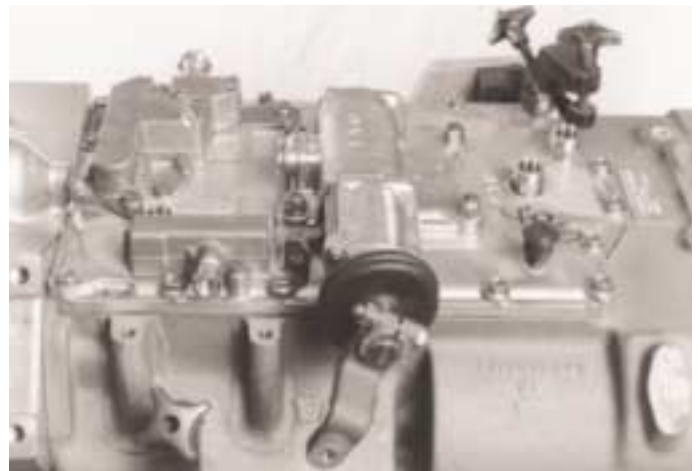
10. Screw in tool E 204 so that the threads protrude at least 15mm. Refit gasket and apply sealant. Carefully lower the shift bar housing into position.



12. Slowly remove the tool ensuring that the range change shift bars engage and that the shift bar housing locates on the dowels.



11. Using a torch if necessary, look through the gap at the rear of the shift bar housing and check that the two range change shift bars are correctly aligned. If necessary, adjust the position of the range change shift bar.



13. Refit gasket and remote control assembly.

Shifting controls

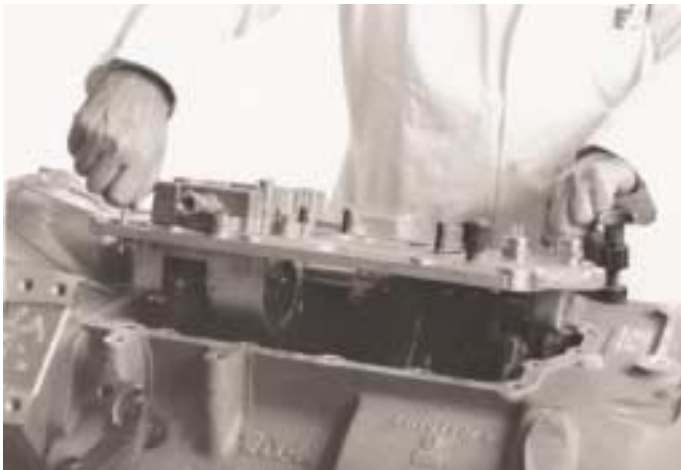
Range Change Shift Bar Disassembly



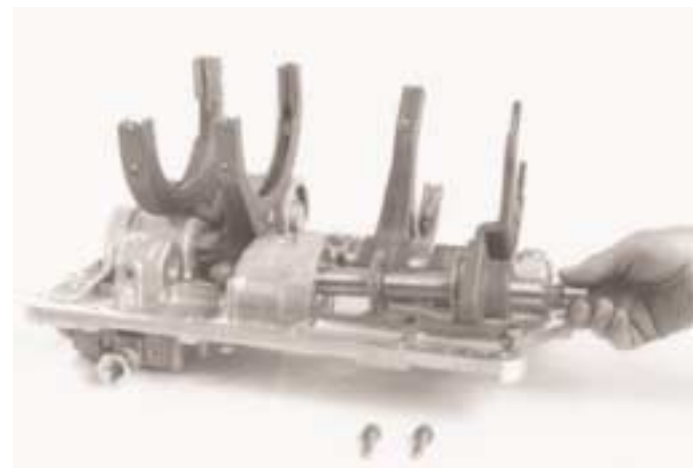
1. Place the transmission in low range. Disconnect the air supply to the transmission. Remove the remote control assembly and gasket.



4. To ease removal of range cylinder cover, remove the stud shown.



2. Using the tool E 204 in the two jacking points remove shift bar housing. Do not allow the two dowels to fall into the transmission. Remove the gasket.



5. Ensure that the selector shaft is in the neutral position. Remove the range cylinder cover and selector shaft assembly.



3. Remove range switch, gasket and plunger.

Shifting controls



6. If necessary, replace the O-ring in the cylinder face and the quadring in the cylinder bore.



8. Remove the cover from the range change shift bar. If necessary, replace the quadring in the bore and the outer O-ring.



7. Inspect the interlock pin for damage and replace if necessary. Grease the pin.



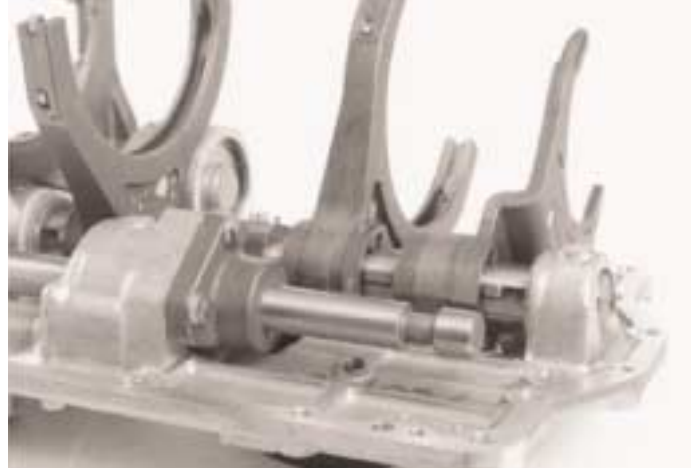
9. If necessary, replace the circlips, piston seal, O-ring and range change shift bar as required.

Shifting controls

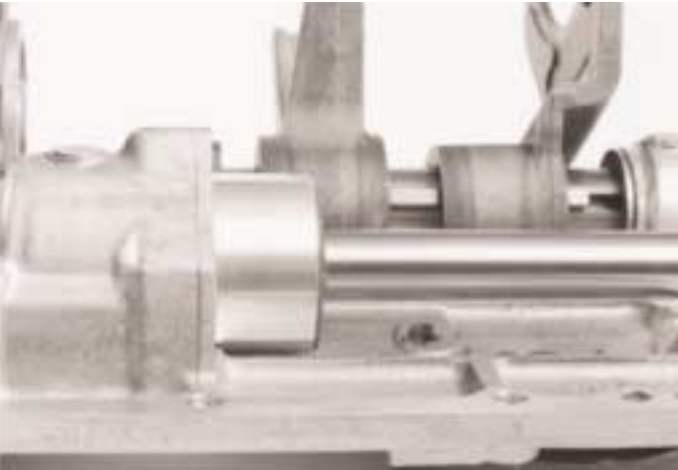
Range Change Shift Bar Reassembly



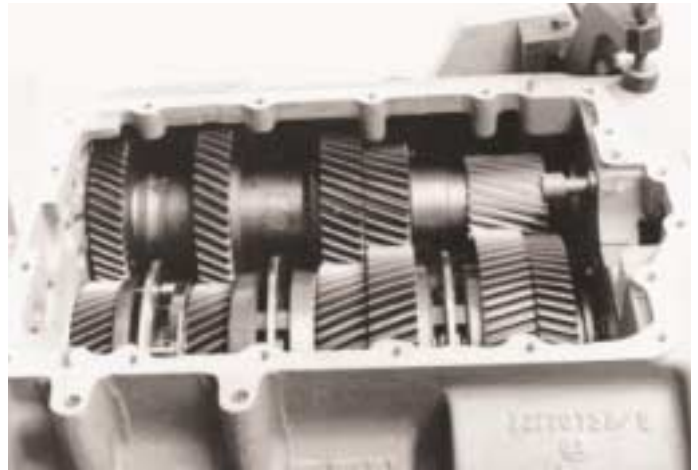
1. Place the shift forks in a neutral position. Grease and refit the interlock pin. The smaller end of the pin faces inwards. Partially refit range change shift bar assembly and range cylinder cover.



4. Ensure that the selector forks are in the neutral position and that the range change shift bar is in the low range position, i.e. completely rearward.



2. Use tool E 209 to guide the seal into the piston. Complete fitting the range change shift bar assembly and range cylinder cover.

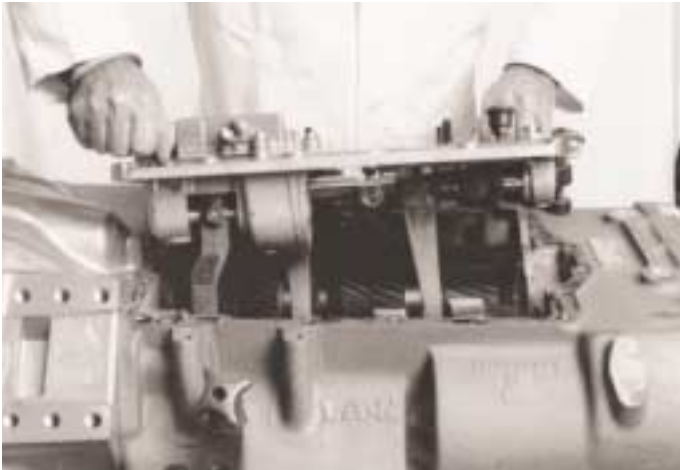


5. Ensure that the auxiliary range change shift bar is in the low position, i.e. completely rearward, and that the transmission is in neutral. Ensure that the two dowels are fitted.

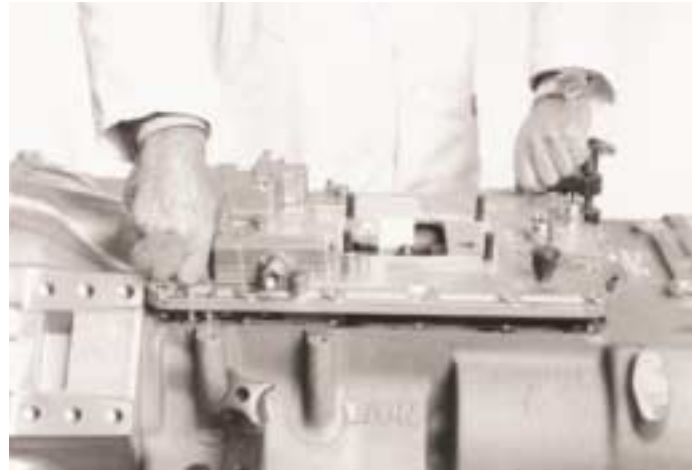


3. Refit stud, plunger, gasket and range switch.

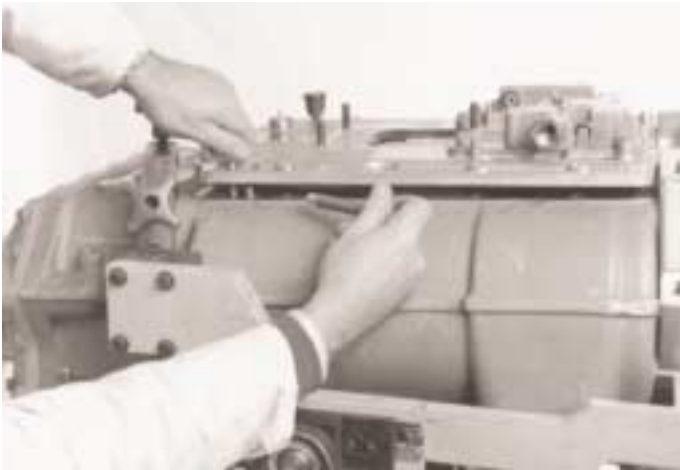
Shifting controls



6. Screw in tool E 204 so that the threads protrude at least 15mm. Refit gasket and apply sealant. Carefully lower the shift bar housing into position.



8. Slowly remove the tool ensuring that the range change shift bars engage and that the shift bar housing locates on the dowels.



7. Using a torch if necessary, look through the gap at the rear of the shift bar housing and check that the two range change shift bars are correctly aligned. If necessary, adjust the position of the range change shift bar.



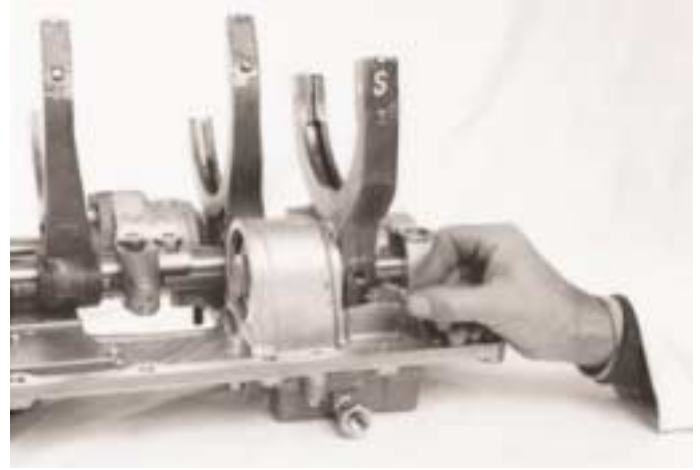
9. Refit gasket and remote control assembly.

Shifting controls

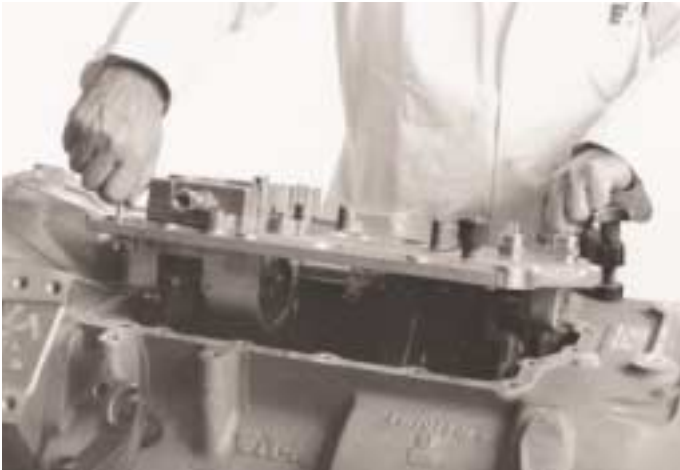
Splitter Shift Rail Disassembly



1. Place the transmission in low range. Disconnect the air supply to the transmission. Remove the remote control assembly and gasket.



4. Remove lockwire and splitter fork lock screw.



2. Using the tool E 204 in the two jacking points remove shift bar housing. Do not allow the two dowels to fall into the transmission. Remove the gasket.

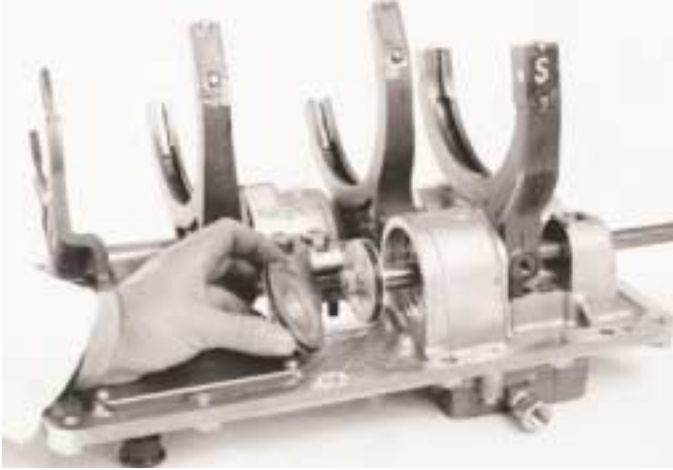


5. Remove spiral clip.



3. Remove the splitter switch, gasket and plunger.

Shifting controls



6. Tap out the splitter shaft rail. The O-ring and cover assembly also comes out. Replace O-ring if necessary.

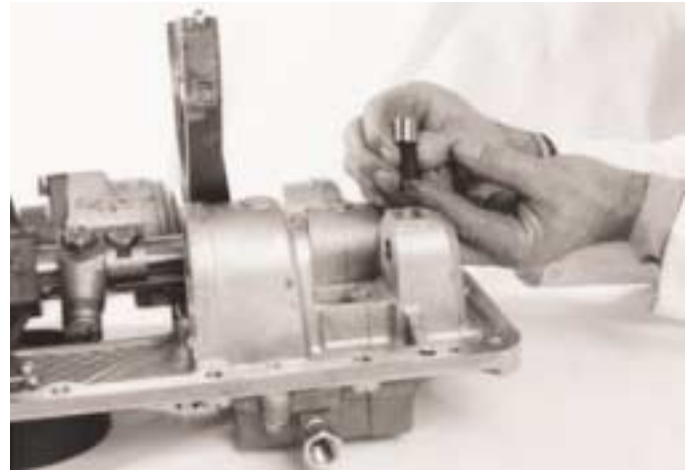


8. The splitter shift rail assembly can be disassembled if the O-rings need attention.

Note the position of the undercut in the piston.



7. Remove the splitter fork. If necessary, replace the quadring in the cylinder bore and the O-rings on the sleeve.



9. If necessary, the splitter detent plunger, spring and spring seat can be removed for maintenance.

Shifting controls

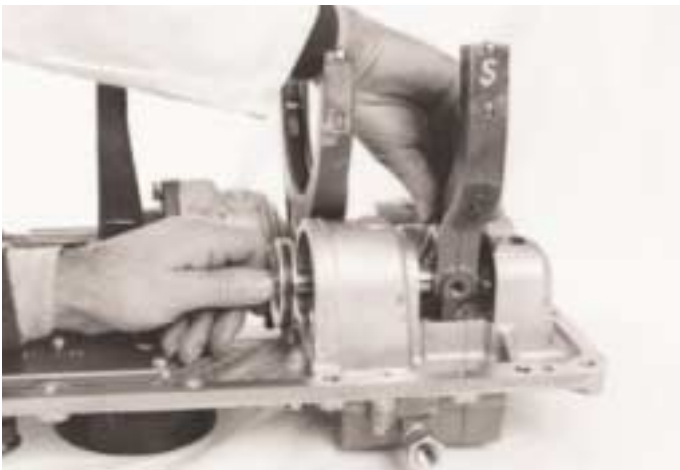
Splitter Shift Rail Reassembly



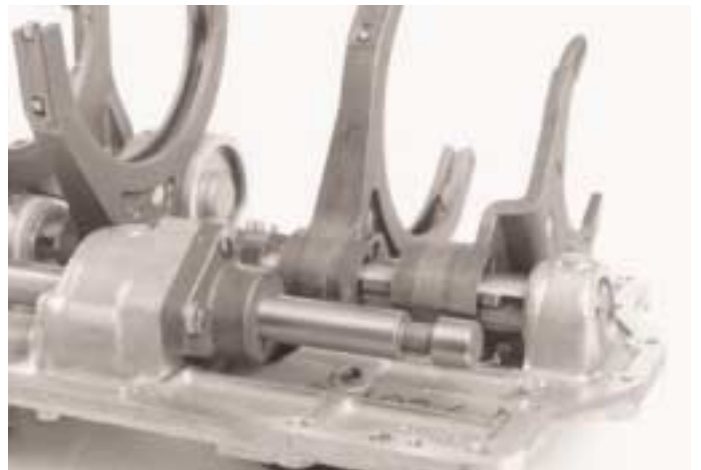
1. Reposition splitter shift rail. The boss on the splitter fork must be positioned as in the photograph.



4. Turn shift bar housing over. Refit plunger, gasket and splitter switch.



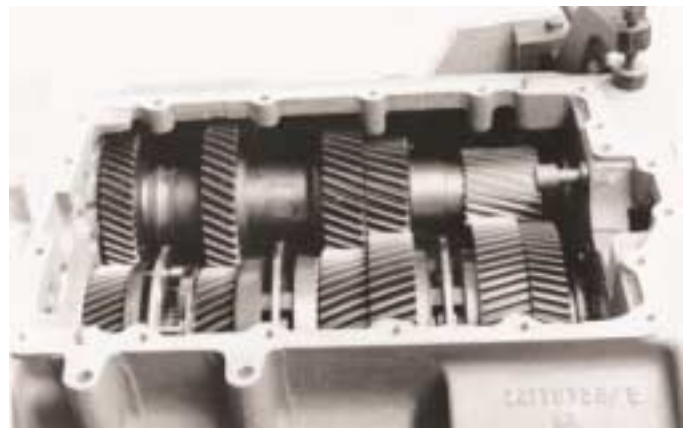
2. Refit splitter shift rail. Replace splitter fork lockscrew and lockwire.



5. Ensure that the selector forks are in the neutral position and that the range change shift bar is in the low range position, i.e. completely rearward.

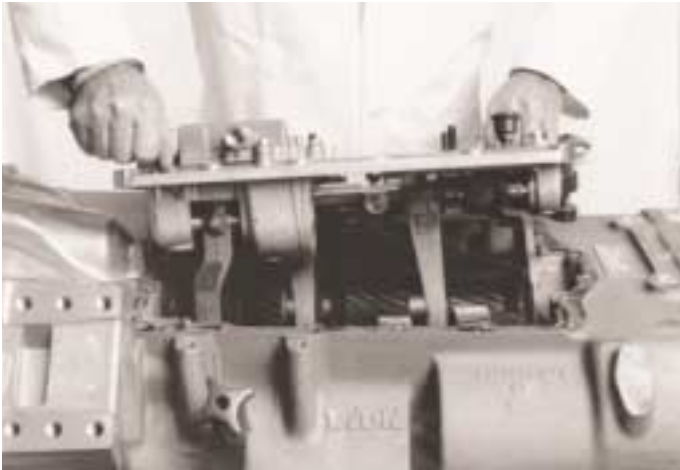


3. Refit cover and spiral clip.

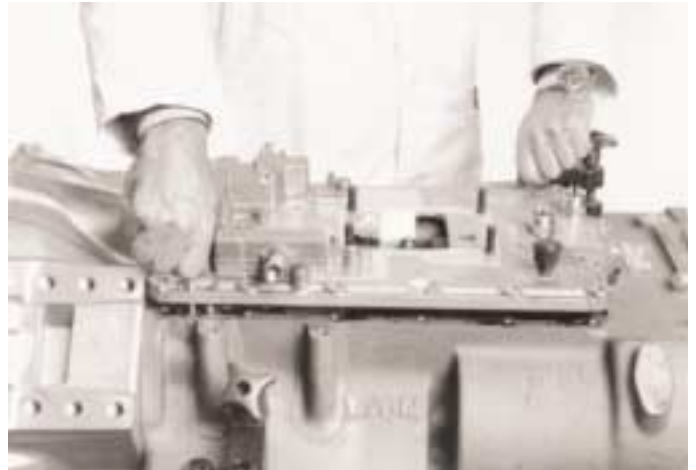


6. Ensure that the auxiliary range change shift bar is in the low position, i.e. completely rearward, and that the transmission is in neutral. Ensure that the two dowels are fitted.

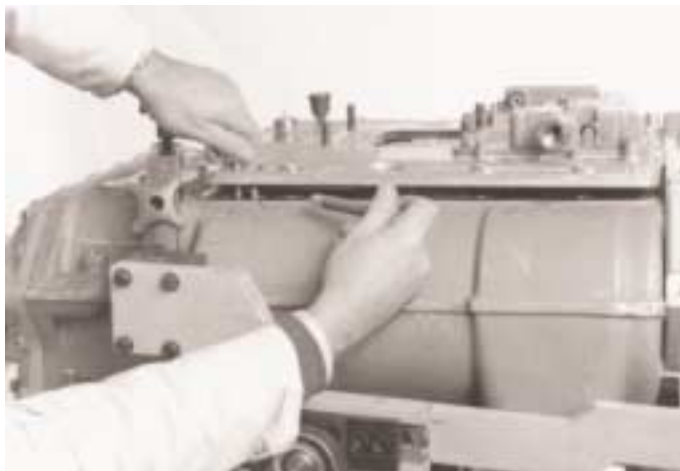
Shifting controls



7. Screw in tool E 204 so that the threads protrude at least 15mm. Refit gasket and apply sealant. Carefully lower the shift bar housing into position.



9. Slowly remove the tool ensuring that the range change shift bars engage and that the shift bar housing locates on the dowels.



8. Using a torch if necessary, look through the gap at the rear of the shift bar housing and check that the two range change shift bars are correctly aligned. If necessary, adjust the position of the range change shift bar.

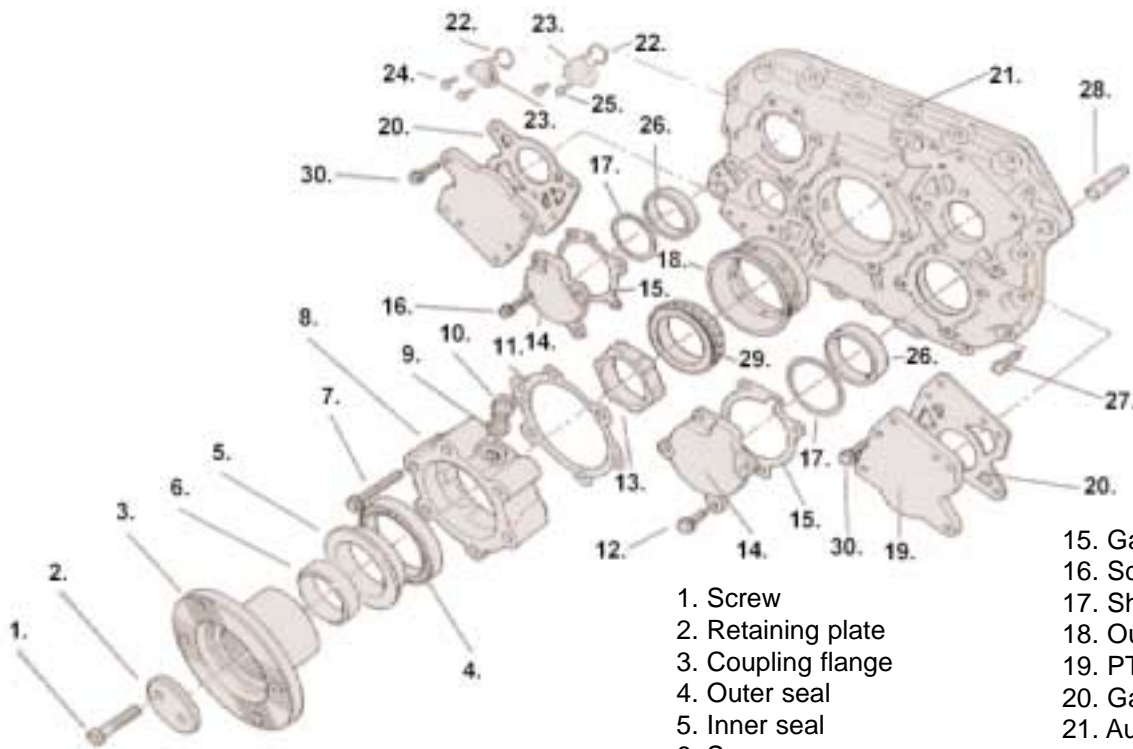


10. Refit gasket and remote control assembly.

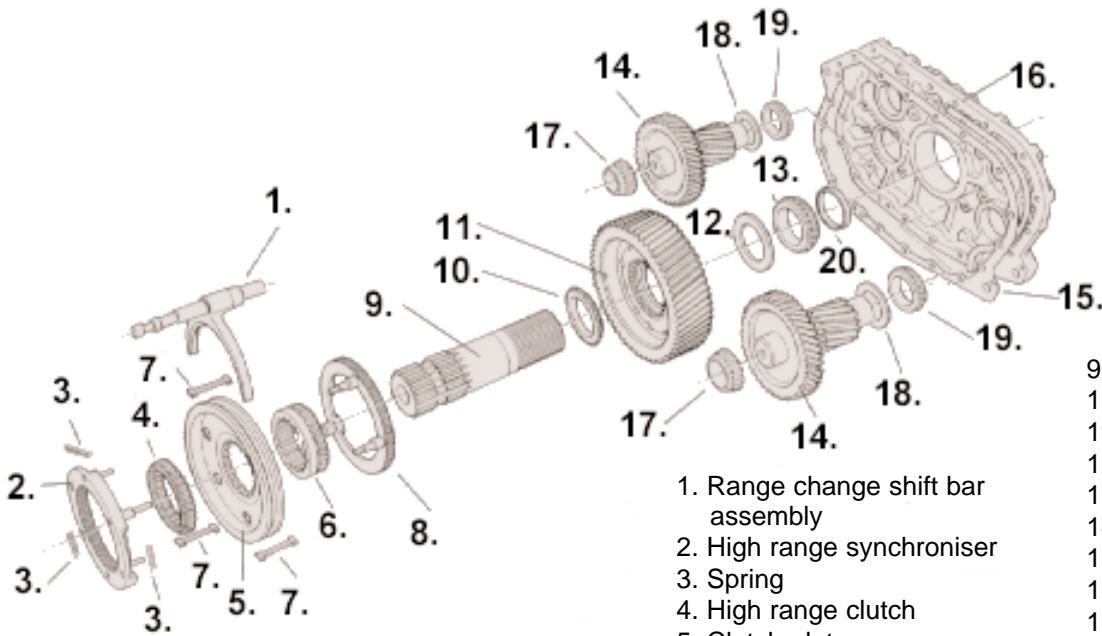
Section 5 Auxiliary Section

Auxiliary section

Exploded View (without a Voith retarder)



- 1. Screw
- 2. Retaining plate
- 3. Coupling flange
- 4. Outer seal
- 5. Inner seal
- 6. Spacer
- 7. Screw
- 8. Speedometer housing
- 9. Washer
- 10. Plug
- 11. Gasket
- 12. Screw
- 13. Speedometer rotor
- 14. Auxiliary countershaft bearing cover
- 15. Gasket
- 16. Screw
- 17. Shim
- 18. Output shaft bearing outer
- 19. PTO cover
- 20. Gasket
- 21. Auxiliary housing
- 22. O-ring
- 23. Locking plate
- 24. Screw
- 25. Screw
- 26. Bearing outer
- 27. Screw
- 28. Dowel
- 29. Bearing
- 30. Screw



- 1. Range change shift bar assembly
- 2. High range synchroniser
- 3. Spring
- 4. High range clutch
- 5. Clutch plate
- 6. Low range clutch
- 7. Key
- 8. Low range synchroniser
- 9. Output shaft
- 10. Splined washer
- 11. Low gear
- 12. Thrust washer
- 13. Output shaft bearing
- 14. Auxiliary countershaft
- 15. Gasket
- 16. Auxiliary housing
- 17. Bearing
- 18. Spacer
- 19. Bearing
- 20. Spacer

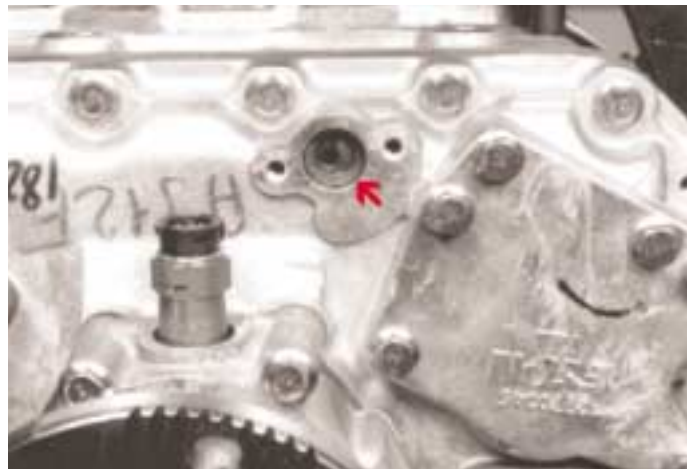
Auxiliary section

Disassembly (without a Voith retarder)

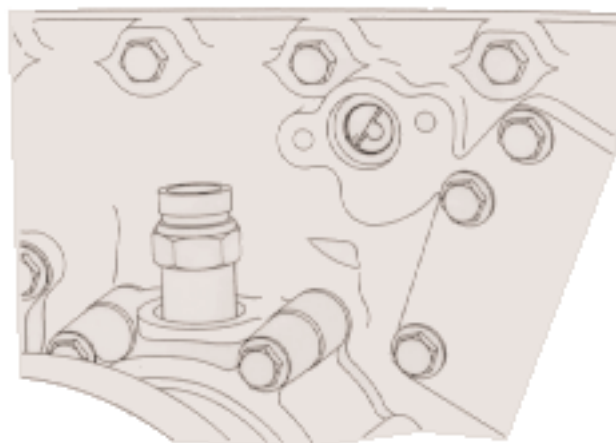
1. Place the transmission in low range. Disconnect the air supply to range module. Drain transmission oil.



2. When the transmission is fitted with a rotating locking plate, remove the left hand screw and loosen the right hand screw. Turn the locking plate anticlockwise as far as permissible. This action ensures that the auxiliary range change shift bar is unlocked from the shift bar housing assembly.

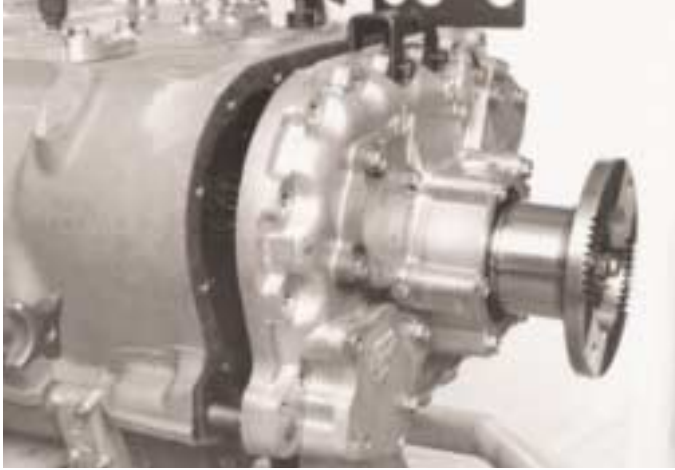


3. Where the transmission is fitted with a fixed locking plate, remove the plate to allow access to the range change shift bar.



4. Rotate the range change shift bar to the position shown. This action ensures that the auxiliary range change shift bar is unlocked from the shift bar housing assembly.

Auxiliary section



5. Loosen coupling flange screws. Remove auxiliary section screws. Support the weight of the auxiliary section assembly with tool E 106-B. Remove auxiliary section. If necessary use the three jacking points provided.



7. Remove speedometer housing assembly.



6. Place the auxiliary section on a bench so that the range change shift bar overhangs the edge of the bench. Remove the coupling flange screws, the retaining plate and coupling flange.



8. Remove speedometer rotor.

Auxiliary section



9. Carefully drive the output shaft down until the auxiliary housing can be lifted off.



12. Identify the left and right hand auxiliary countershafts. The two auxiliary countershafts and the output shaft can now be removed.



10. Remove the auxiliary housing.



13. The auxiliary countershafts are non-serviceable apart from the bearings and spacers.

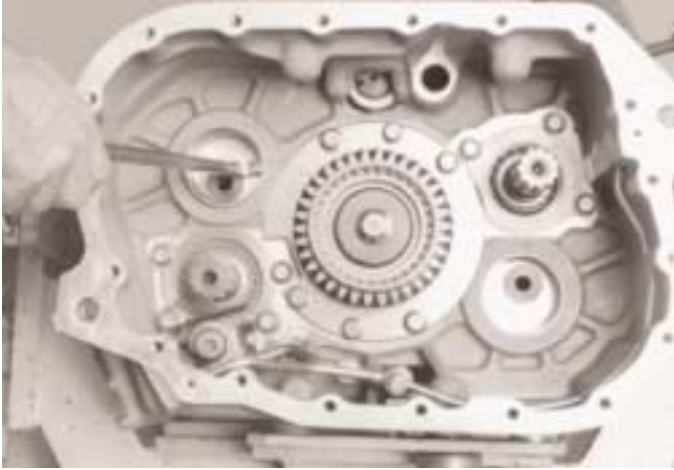


11. Remove range change shift bar and fork assembly.



14. Use tools LC 105A and LC 105A-28 to remove the bearings if they need replacing. If a bearing needs changing, the corresponding bearing outer should also be changed.

Auxiliary section



15. The bearing outers from the main case can be removed using a heel bar. When fitting replacement parts ensure that they are fully seated.



17. When replacing the bearings heat them to 120°C before fitting.



16. To change the bearing outers in the auxiliary housing remove the auxiliary countershaft bearing cover and gasket. Identify the position of the shims. Tap out the bearing outer from the auxiliary housing.



18. Remove locking plate. If necessary the output shaft bearing outer can be removed.

Auxiliary section



19. Remove the range change synchroniser assembly.



21. Remove the low gear and splined washer from the output shaft.



20. Remove the spacer. If necessary use a press or puller to remove bearing and thrust washer.

Auxiliary section



1. With the output shaft on the bench refit the splined washer.



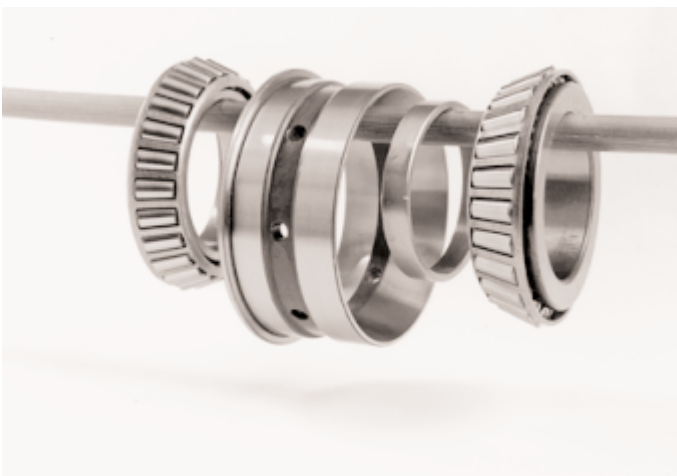
4. Take the wider of the two bearing inners and heat it to 120°C before refitting.



2. Refit the low gear, ensuring that it is correctly seated on the splined washer. Fit the thrust washer.



5. Allow the bearing to cool. Measure the gear end float to ensure it is within the specified limits.



3. The output shaft bearing consists of four parts.



6. Refit the bearing spacer.

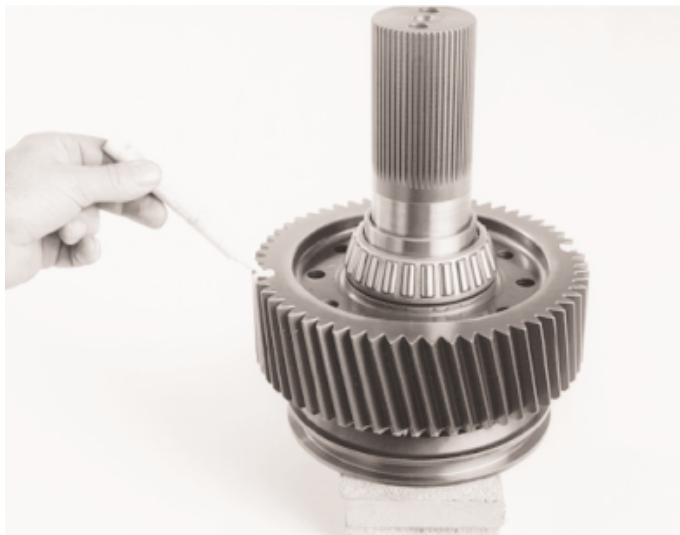
Auxiliary section



7. Place the range change synchroniser assembly on top of a block of wood 62mm high with the low range synchroniser uppermost near to the edge of the bench.



9. With the spacers and bearing fitted to the auxiliary countershafts find the two teeth with the letter 'O' stamped on them. (In the photo they are identified for easy recognition.) Highlight these teeth on both countershafts. These are the timing marks.



8. Ensuring that the three slots on the output shaft are in line with the three keys of the synchroniser assembly, fit the output shaft assembly to the synchroniser assembly. If not already identified, highlight any two adjacent teeth on the low gear. These are the timing marks that are used later.



10. Place the two auxiliary countershafts into mesh with the low gear. The timing marks on the low gear must be meshed with those on the auxiliary countershafts.

Auxiliary section



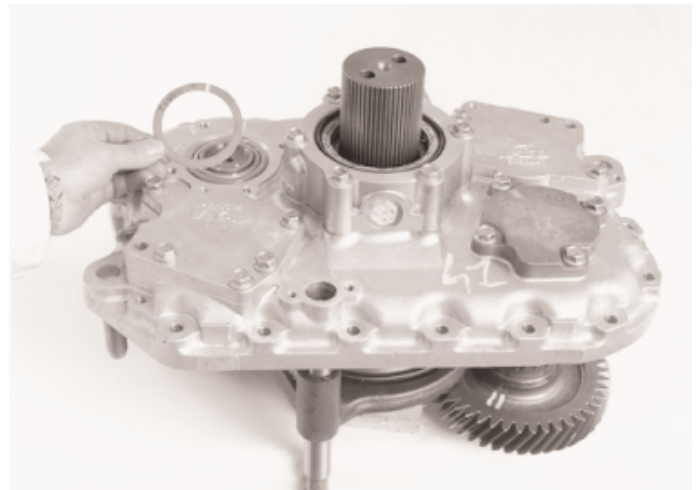
11. Refit the range change shift bar and fork assembly.



14. Refit the speedometer rotor.



12. Lower the auxiliary housing onto the components ensuring that the auxiliary countershafts and the range change shift bar are seated in their respective bores. Refit the bearing outer.



15. Refit speedometer housing assembly, auxiliary countershaft bearing outers, gaskets, shims and bearing covers.

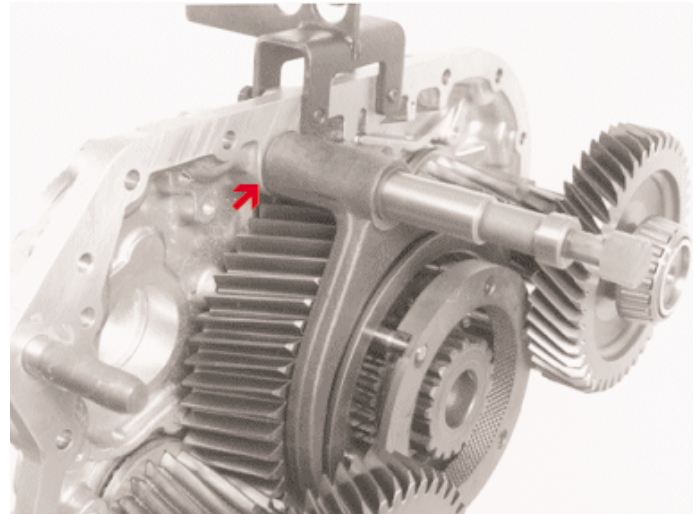


13. Heat the bearing to 120°C and refit to the output shaft.

Auxiliary section



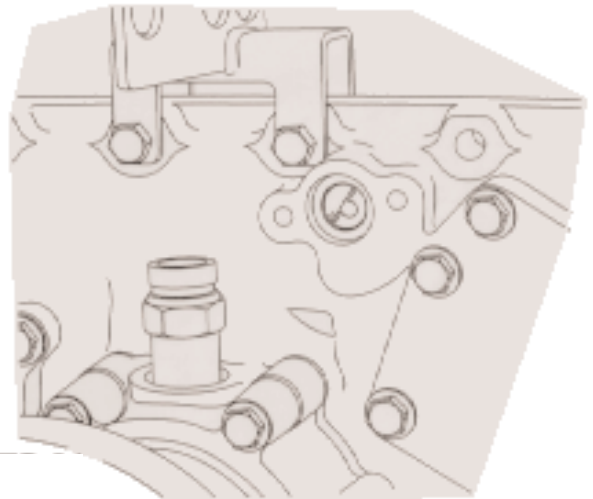
16. Refit the speedometer housing inner oil seal/spacer assembly.



18. Using the tool E 106B to support the weight, ensure that transmission is in low range. Low range is engaged when the fork is against the auxiliary housing.



17. Refit the coupling flange, retainer plate and screws.

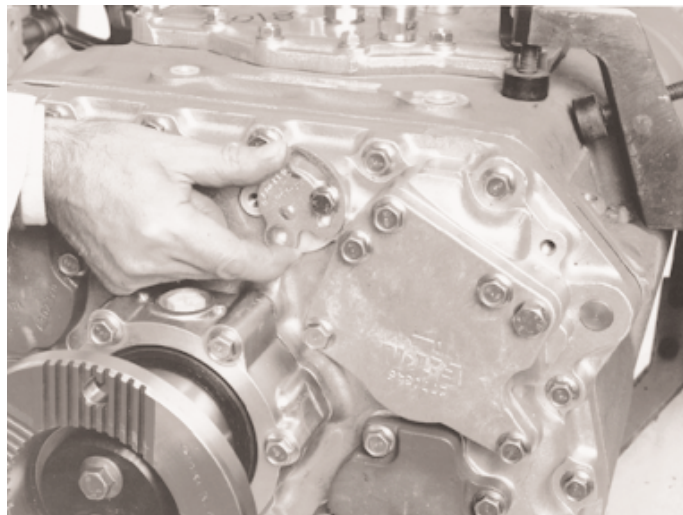


19. Where the transmission is fitted with fixed locking plate, rotate the range change shift bar as shown to ensure that it is in the unlocked position.

Auxiliary section



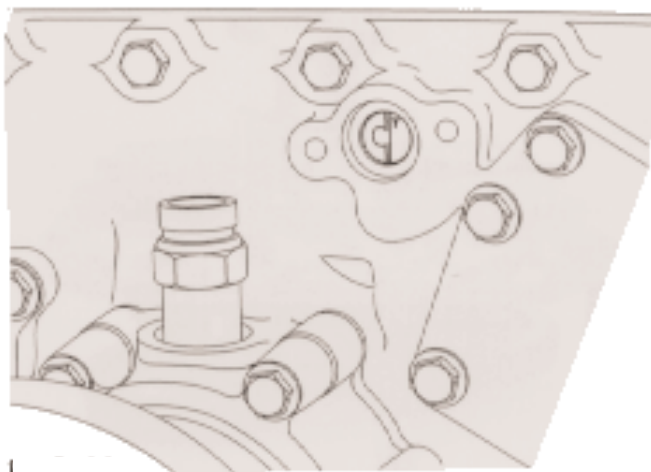
20. Where the transmission is fitted with a rotating locking plate, refit as shown to ensure the range change shift bar is in the unlocked position.



22. Where a rotating locking plate is used, turn it clockwise until the screw holes in the plate and auxiliary housing are in line. Refit the locking plate screws. This action locks the auxiliary section range change shift bar and the shift bar housing range change shift bar together.



21. Refit gasket and apply sealant. Grease the dowels. Refit the auxiliary section.



23. Where a fixed locking plate is used rotate the range change shift bar to position shown. This action locks the auxiliary section range change shift bar and the shift bar housing range change shift bar together. Refit locking plate ensuring that the word TOP is at the top.

Auxiliary section



24. Remove the bearing cover, gaskets and shims. Fasten the tool E 208 to the rear section. While rotating the auxiliary countershaft, tighten the centre screw to 33Nm to ensure that the auxiliary countershaft is fully seated. Back the screw off and then retighten until finger tight. Ensure the bearing outers are fully seated.

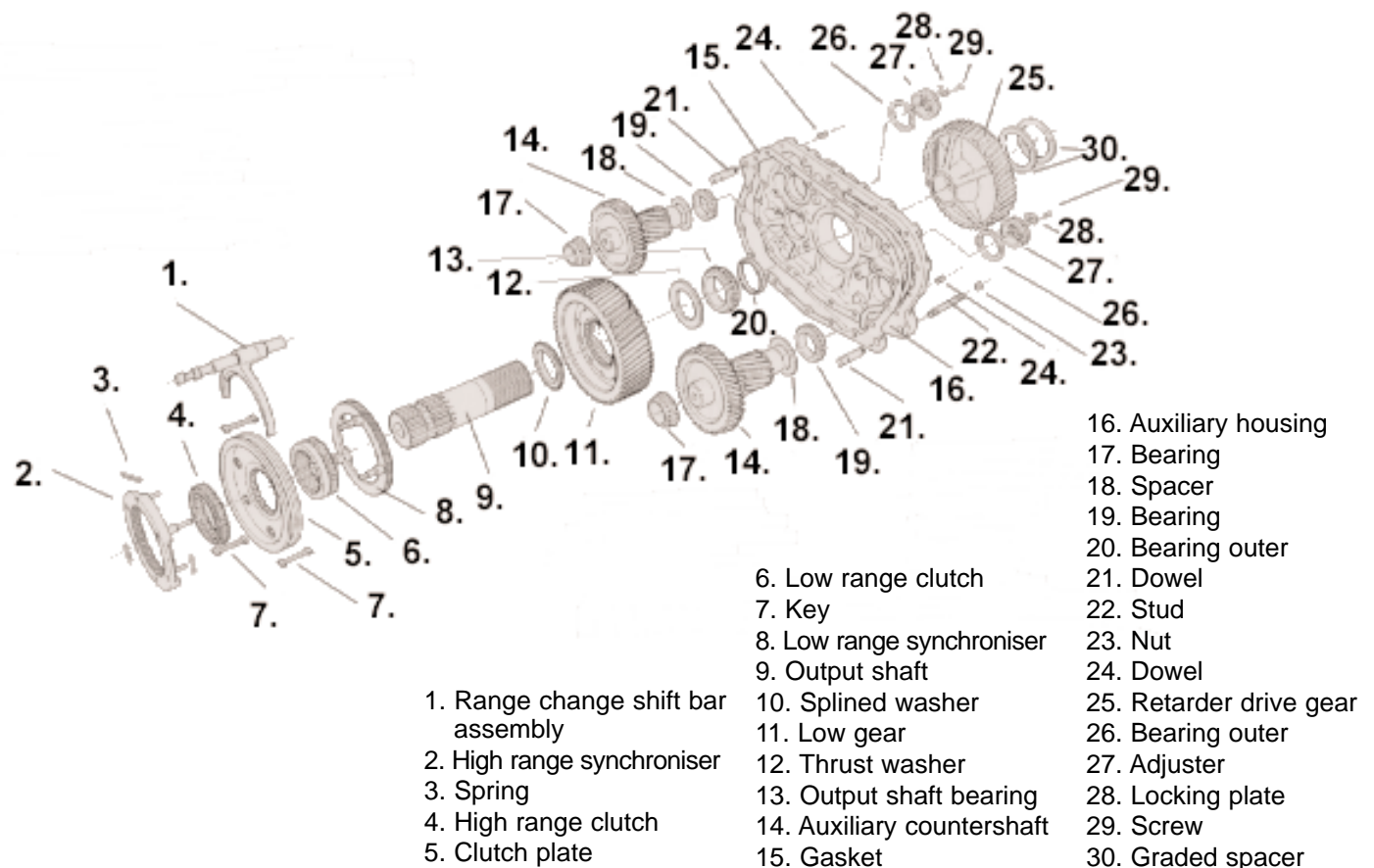
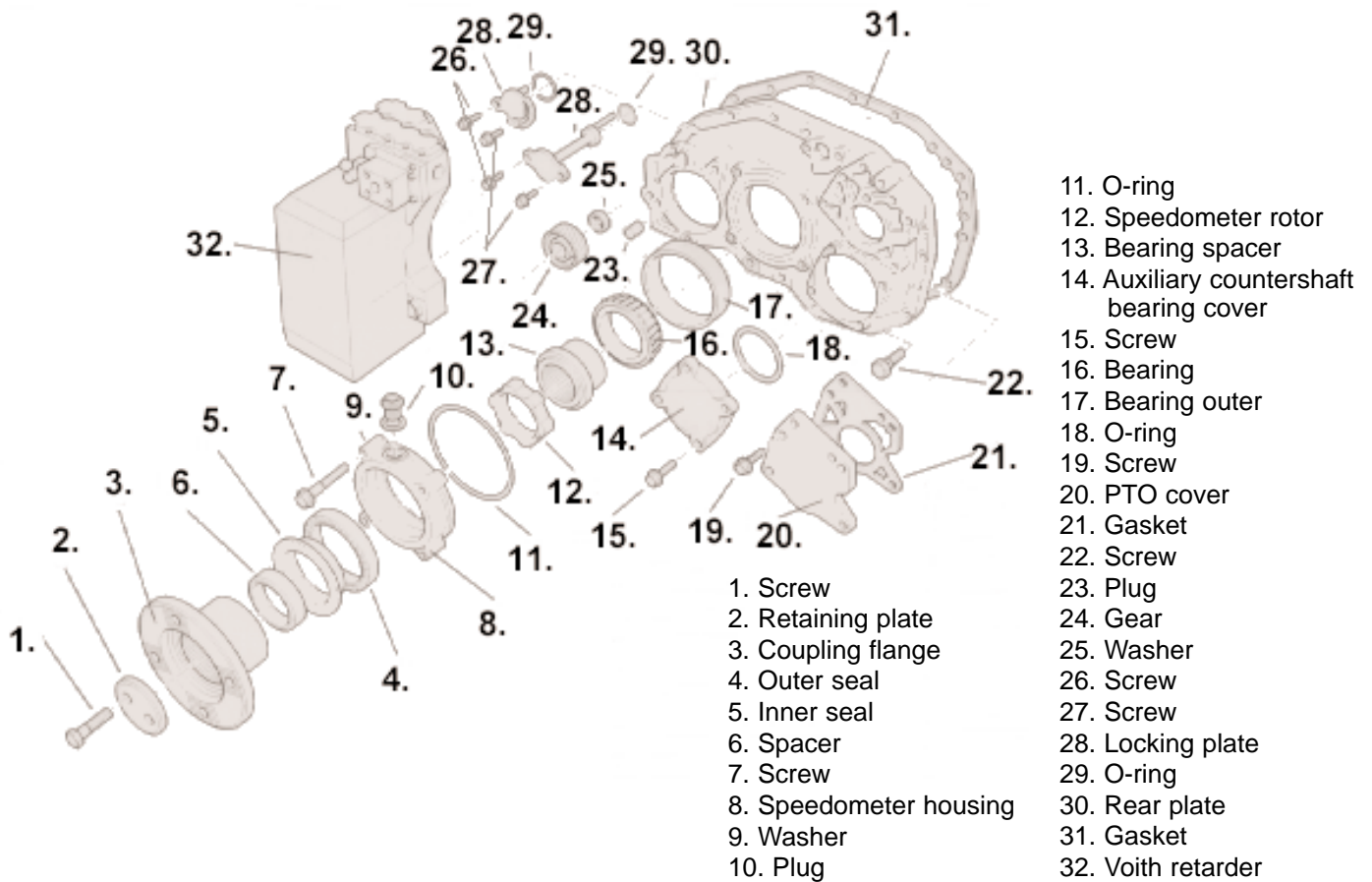


25. Measure the distance from the top of the bearing outer to the rear face. Use this measurement to determine the shim that gives the correct amount of endfloat. Allow 0.30mm for the gasket thickness. Refit the gaskets, shims and bearing covers.

Required shim thickness = Measured distance
+0.30 - specified end float.

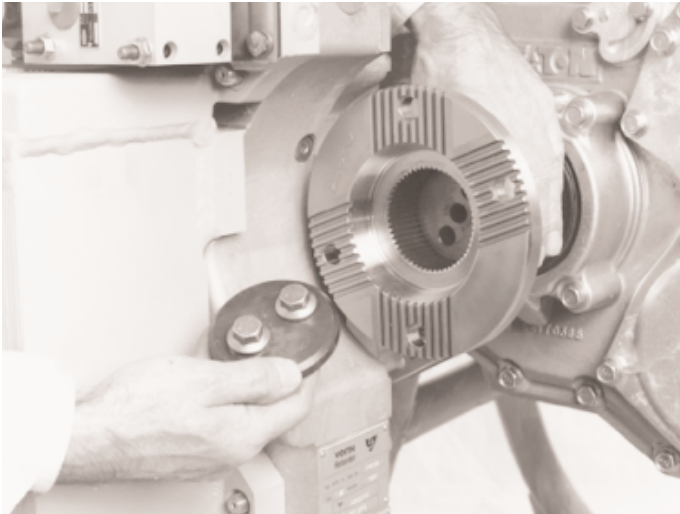
Auxiliary section

Exploded View (with a Voith retarder)

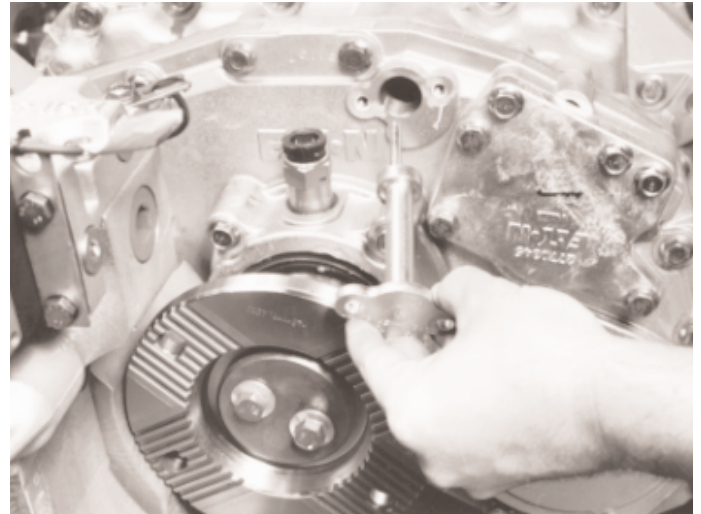


Auxiliary section

Disassembly (with a Voith retarder)

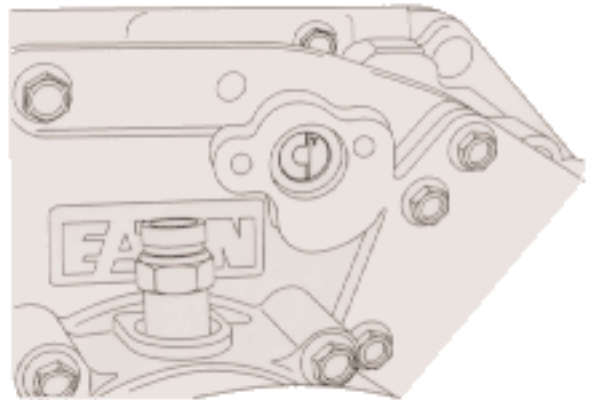


1. Place the transmission in low range. Disconnect air supply to range module. Drain the transmission oil and the Voith cooling system. Remove the coupling flange screws, retaining plate and coupling flange.

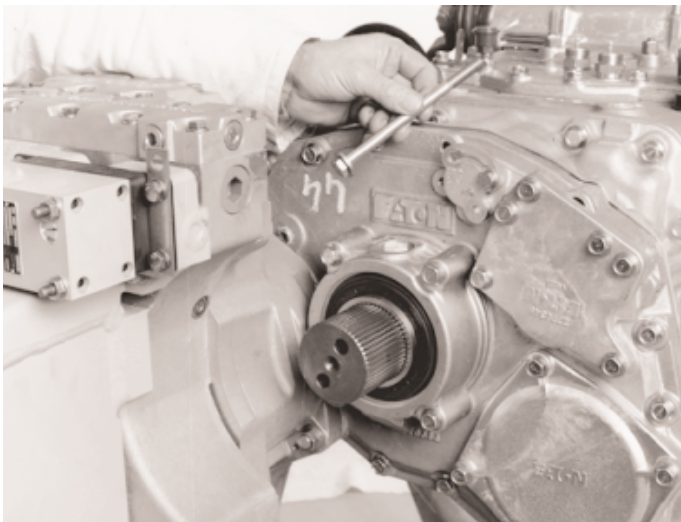
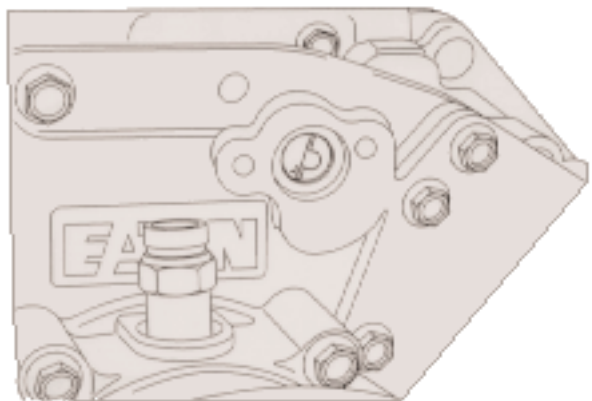


3. Where a fixed locking plate is used remove the screw shown in step 2 above. Remove the locking plate to allow access to the range change shift bar.

Locked position



Unlocked position



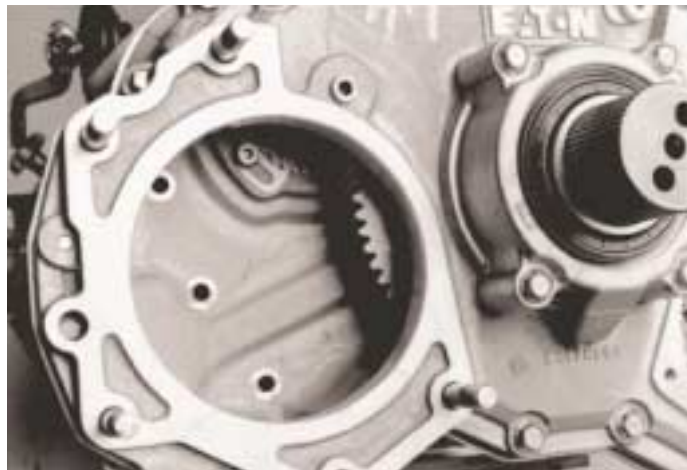
2. Remove the screw shown above. Where a rotating locking plate is used remove left hand screw from locking plate. Loosen the right hand screw. Turn the locking plate anticlockwise as far as permissible. This action ensures that the range change shift bar of the auxiliary section is unlocked from the shift bar housing assembly.

4. The range change shift bar must be rotated from the locked position to the unlocked position. This action ensures that the range change shift bar of the auxiliary section is unlocked from the shift bar housing assembly. The end of the range change shift bar is recessed into the housing approximately 100 mm.

Auxiliary section



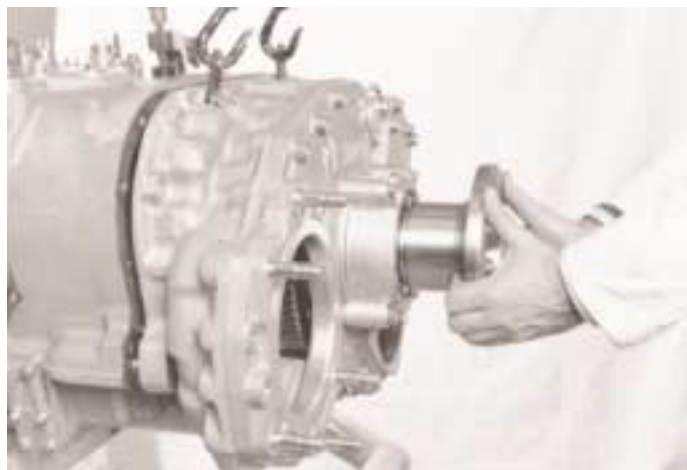
5. During removal of Voith retarder take care not to damage the cable shown.



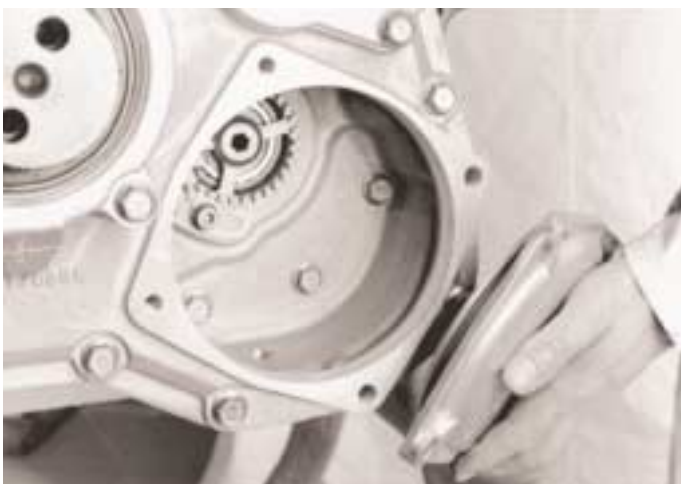
8. Remove the screws from inside the lower left hand opening. Remove remaining auxiliary section retaining screws



6. Support the weight of the retarder and remove the nuts. Remove the retarder.



9. Refit coupling flange, tight enough to prevent components falling off. Support the weight of the auxiliary section. Remove the auxiliary section.



7. Remove lower right hand cover to gain access to the interior screws. Remove the screws.



10. Place the auxiliary section on a bench so the range change shift bar overhangs the edge of the bench. Remove coupling flange screws, retaining plate and coupling flange.

Auxiliary section



11. Remove speedometer housing assembly.



14. Remove the graded spacers.



12. Remove the speedometer rotor and bearing/spacer assembly.



15. Remove screws and lift the rear plate off the locating dowels. Remove gasket. Remove locking plate.



13. The bearing can be pressed off the spacer if necessary. Heat the bearing to 120°C before refitting.

Auxiliary section



16. Remove the drive gear for the Voith retarder.



18. Remove the range change shift bar and fork assembly.



17. Remove the auxiliary housing.



19. Identify the left and right hand auxiliary countershafts. The two auxiliary countershafts and the output shaft assembly can now be removed.

Auxiliary section



20. The auxiliary countershafts are non-serviceable apart from the bearings and spacers.



22. The bearing outers from the main case can be removed using a heel bar. When fitting replacement parts ensure that they are fully seated.



21. Use tools LC 105A and LC 105A-28 to remove the bearings if they need replacing. If a bearing needs changing, the corresponding bearing outer should be changed



23. Remove the auxiliary countershaft bearing outer on the auxiliary housing by removing the screw and locking plate and winding the adjuster inwards. The bearing outer will be pushed out.

Auxiliary section



24. When replacing the bearings heat them to 120°C before fitting.



27. Remove the low gear and the splined washer from the output shaft.



25. Remove the range change synchroniser assembly.



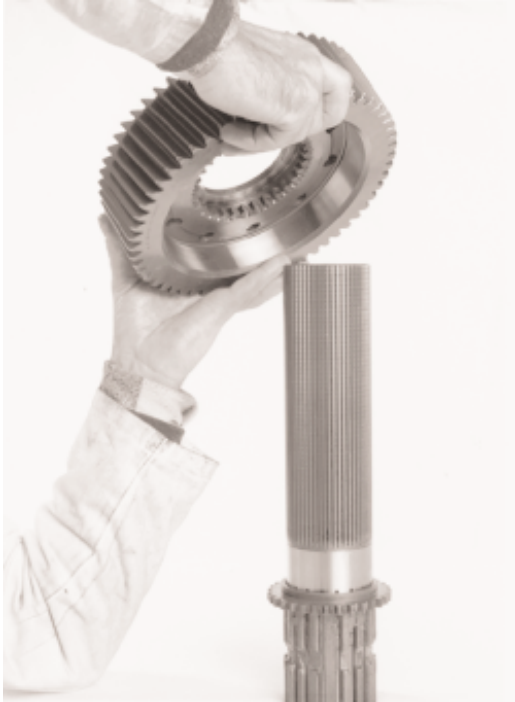
28. If either of the output shaft bearings need replacing, the corresponding outers must also be replaced. The outers can be tapped out from the auxiliary housing or rear plate.



26. Using a press or puller remove bearing and thrust washer.

Auxiliary section

Reassembly (with a Voith retarder)



1. Refit the splined washer onto the output shaft. Position low gear onto the shaft.



2. Place the thrust washer onto the output shaft. Heat the bearing to 120°C and fit to output shaft.



3. Allow the bearing to cool. Measure the gear end float to ensure it is within specified limits.



4. Place the range change synchroniser assembly on top of a block of wood 62mm high with the low range synchroniser uppermost near to the edge of the bench.



5. Ensuring that the three slots on the output shaft are in line with the three keys of the synchroniser assembly, fit the output shaft assembly to the synchroniser assembly. If not already identified, highlight any two adjacent teeth on the low gear. These are the timing marks.

Auxiliary section



6. With the spacers and bearings fitted to the auxiliary countershafts find the two teeth with the letter 'O' stamped on them. (In the photo they are identified for easy recognition.) Highlight these teeth on both countershafts. These are the timing marks.



8. Refit the range change shift bar and fork assembly.



7. Place the two auxiliary countershafts into mesh with the low gear. The timing marks on the low gear must be meshed with those on the auxiliary countershafts.



9. Lower the auxiliary housing onto the components ensuring that the auxiliary countershafts and the range change shift bar are seated in their respective bores.

Auxiliary section



10. Refit the drive gear, boss down.



13. Refit the bearing/spacer assembly.



11. Fit the two graded spacers. These are used to set the bearing end float.



14. Refit speedometer rotor. If the O-ring on the speedometer housing is damaged, replace it and refit speedometer housing.



12. Fit the gasket, apply sealant and fit the rear plate.

Auxiliary section



15. Refit coupling flange, retaining plate and screws. Torque the screws to the correct value. The taper bearings used on the output shaft must be assembled with end play. Measure the lift at the coupling flange. If the end play is not within 0.05 to 0.10mm, use a different combination of graded spacers (see para 11 above) to increase or decrease the amount of end play.



17. Remove the plug to gain access to the left hand adjuster.



16. The auxiliary countershaft bearing end play is set by using adjusters fitted into the auxiliary section housing. Remove the locking screw and plate and wind each adjuster two complete turns anti-clockwise.

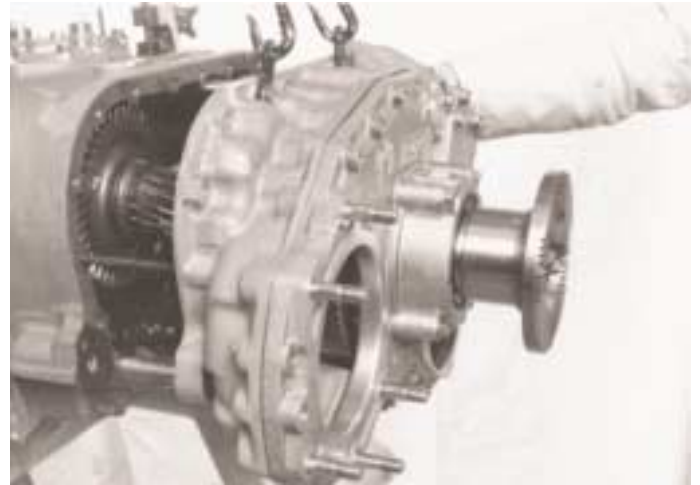


18. Support the weight of the auxiliary section and place it in low range. The range change shift bar should be pushed rearwards so that the shift fork is up against the face of the auxiliary housing.

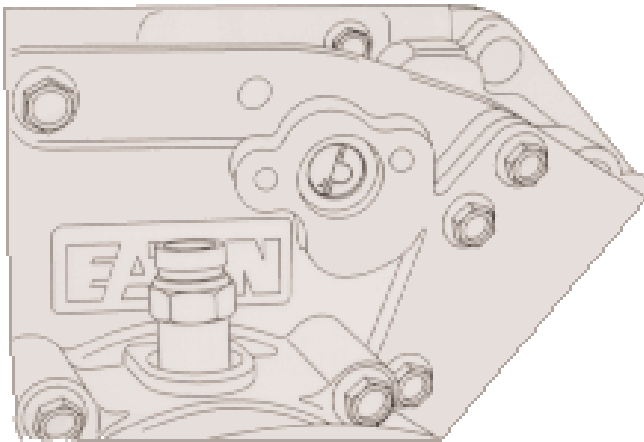
Auxiliary section



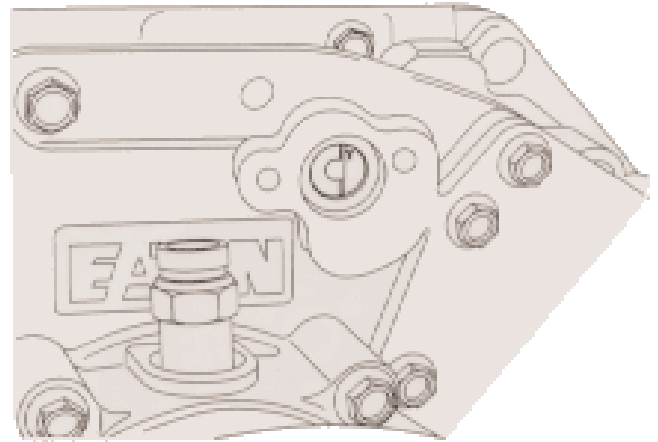
19. Where a rotating locking plate is fitted, refit the locking plate and rotate it until it is in the unlocked position. This ensures that the range change shift bar is in the unlocked position.



21. Where a rotating locking plate is used refit the gasket. Apply sealant and refit auxiliary section. To ease assembly grease the studs. Rotate the plate into the locked position. Refit the screws. This action locks the auxiliary section range change shift bar and the shift bar housing range change shift bar together.



20. Where a fixed locking plate is used rotate the range change shift bar to the position shown. This ensures that the range change shift bar is in the unlocked position. The end of the range change shift bar is recessed into the housing approximately 100 mm.



22. Where a fixed locking plate is used refit the gasket. Apply sealant and refit auxiliary section. To ease assembly grease the studs. Rotate the range change shift bar into the locked position. Refit locking plate ensuring the word TOP is to the top.

Auxiliary section



23. To set the auxiliary countershaft bearing end float tighten the adjusters to a torque of 33Nm. Back the adjusters off. Re-tighten the adjusters until they are just touching the bearing outers. Fit the locking plate so that the tapped hole appears just right of the centre line on the right hand adjuster and just below centre on the left hand adjuster slot. Fit the screws and tighten fingertight.



24. Rotate the adjusters anticlockwise until the edge of the slot hits against the screw. Tighten the screw. This procedure gives the required amount of bearing end play.



25. Check the O-ring in the right hand cover plate for damage and replace if necessary. Refit right hand cover plate. Remove screws, retaining plate and coupling flange.



26. Refit retarder.



27. Refit coupling flange, retaining plate and screws.

Auxiliary section

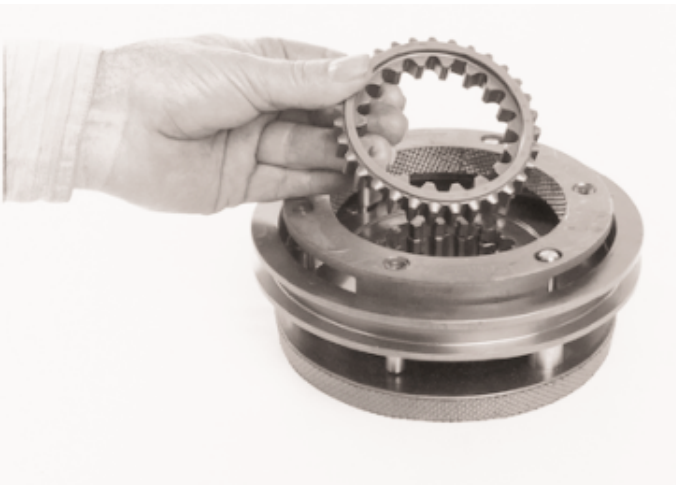
Synchroniser and range change shift bar disassembly



1. Place the synchroniser assembly on a bench with the high range synchroniser uppermost. Remove the three keys.



3. Lift the synchroniser assembly to reveal the low range clutch.



2. Remove the high range clutch.

Auxiliary section



4. To avoid losing the three springs, place the synchroniser assembly on the bench with the high range synchroniser downwards and the clutch plate pushed down. Remove the low range synchroniser.



6. If auxiliary drive gear is damaged, engage main section gear. Remove screw, retainer and auxiliary drive gear. Replace drive gear and refit components in reverse sequence.



5. Lift the clutch plate away to reveal the high range synchroniser and three springs.



7. Where the range change shift fork is retained by circlips it is possible to disassemble it. To remove the range change shift fork place the assembly in a soft jawed vice. Remove the circlip and lift the fork off the shaft.

Auxiliary section

Synchroniser and range change shift bar reassembly



1. If removed place the range change shift bar in a soft jawed vice with the circlip grooves uppermost. Fit the lower circlip. Fit the range change shift fork, boss up, to the shaft. Fit the upper circlip.



3. Grease and fit the three springs into the high range synchroniser.



2. Place the low range synchroniser on the bench. Fit the clutch plate, chamfered edge down. The pins locate in the holes whose chamfered edges face down.



4. Place the high range synchroniser onto the assembly and by simultaneously twisting anticlockwise and pushing engage the pins in the holes in the clutch plate.

Auxiliary section

Synchroniser and range change shift bar disassembly



5. Place the low range (wider) clutch onto the bench, clutching teeth down.



7. Place the high range clutch onto the assembly. Ensure that the three slots are in line. Here one of the slots is shown.



6. Place the synchroniser assembly, low range synchroniser downwards, onto the clutch making sure that the three broad slots on the clutch plate and clutch are in line. Here one of the slots is shown.



8. Refit the three keys.

Auxiliary section

Speedometer housing oil seal disassembly

The oil seal should only be changed when the auxiliary section is fitted



1. Remove the screw, retaining plate and coupling flange. Remove the spacer. This has the inner part of the cassette seal fitted onto it.



2. Remove the seal outer from the speedometer housing.

Speedometer housing oil seal reassembly



1. The speedometer housing seal consists of two parts.



2. Grease the outer diameter of the spacer. Fit the spacer onto the shaft.

Auxiliary section



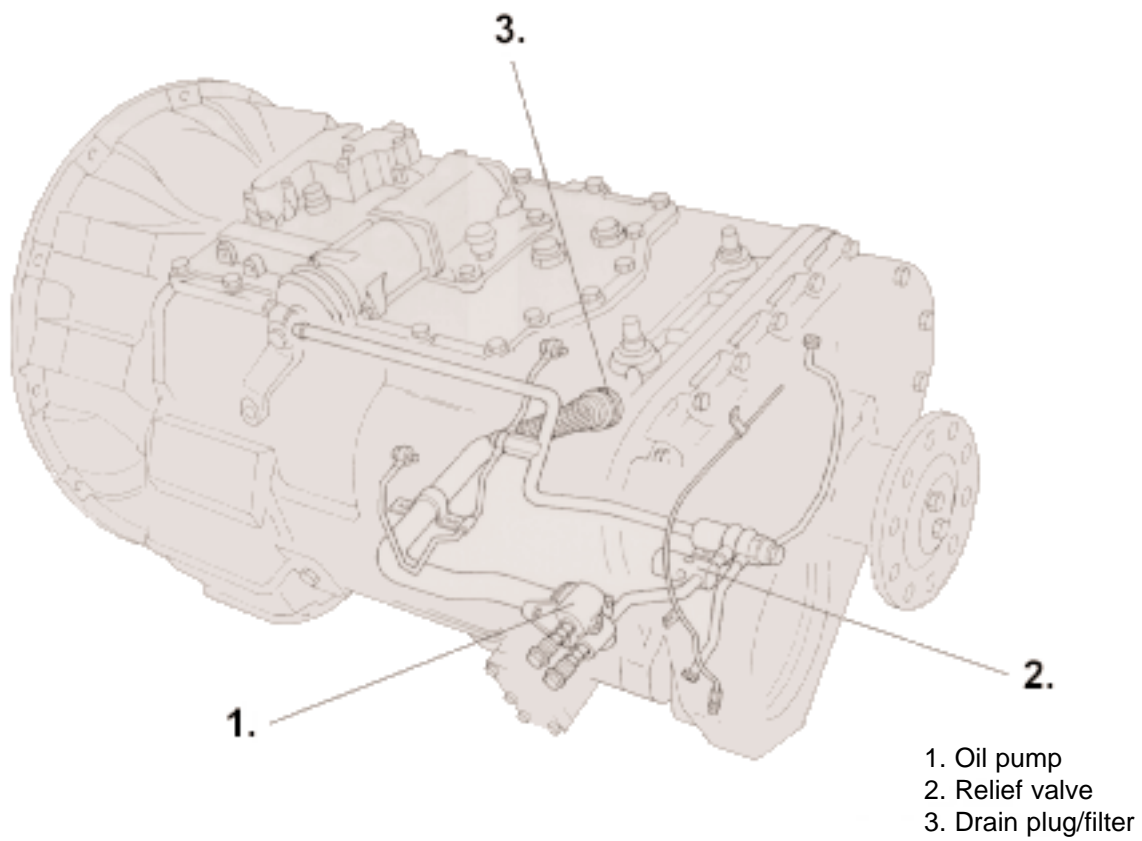
3. Using the tool E 206 drive the seal assembly onto the shaft until it is fully seated.



4. Refit coupling flange, retaining plate and screws.

Auxiliary section

Lubrication system



Auxiliary section

Oil pump disassembly



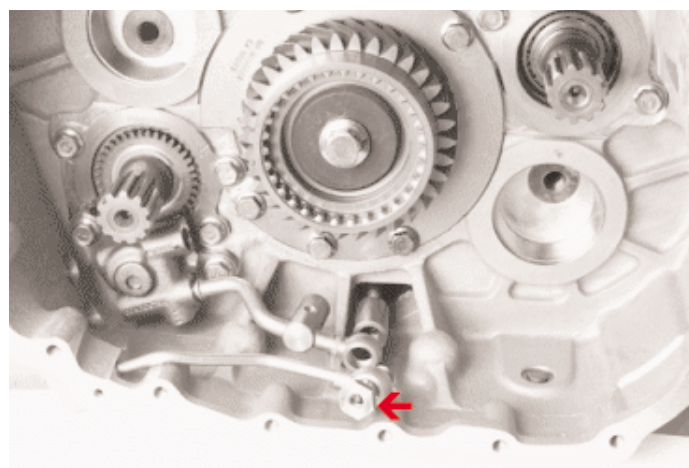
1. Remove oil transfer plate and gasket.



3. Remove oil feed screw and pipe.

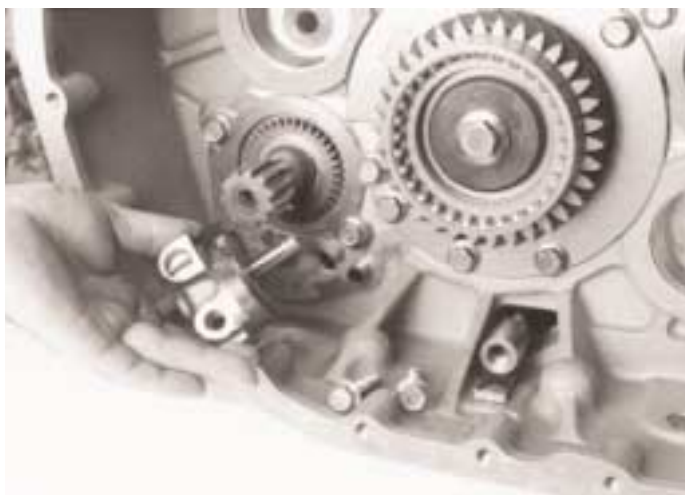


2. Remove oil feed pipe, washer, spring and washer from both positions.



4. Remove oil feed screw and pipes.

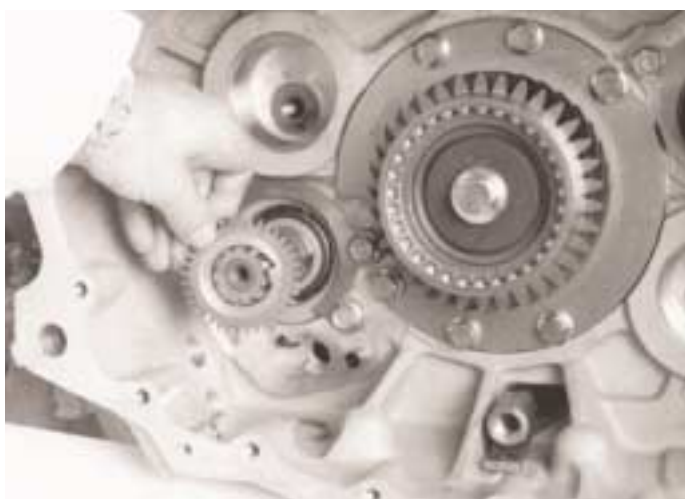
Auxiliary section



5. Remove oil pump retaining screws and oil pump.



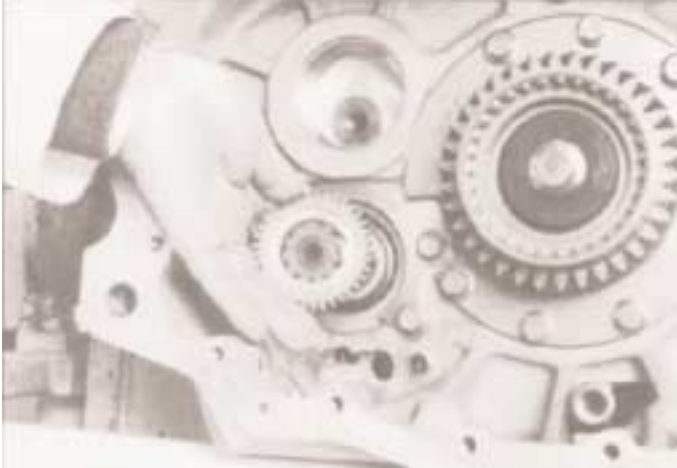
7. The oil pump consists of a gear and a rotor.



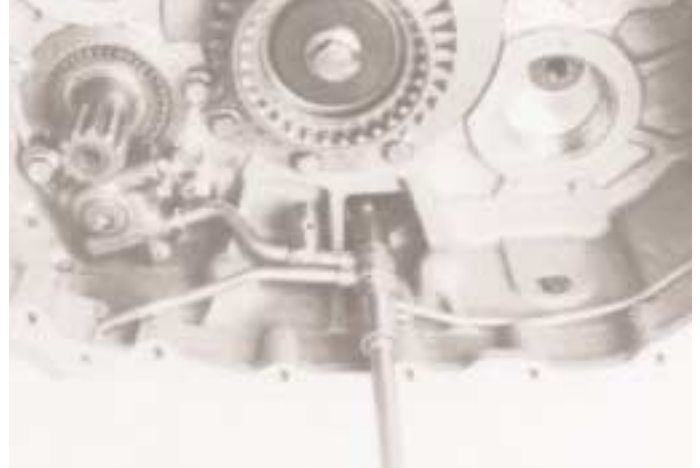
6. Remove snap ring from countershaft. Remove oil pump drive gear and spacer.

Auxiliary section

Oil pump reassembly



1. Refit the spacer. Refit the oil pump drive gear, boss forward, ensuring that the tab locates correctly on the countershaft. Refit the snap ring.



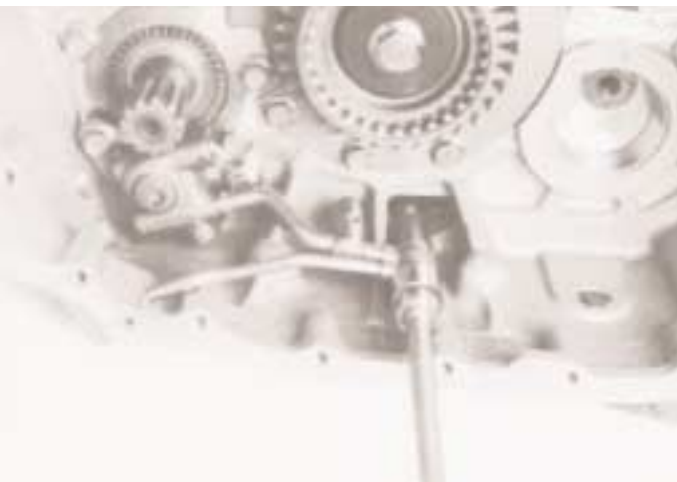
4. Refit the oil feed pipe and the screw.



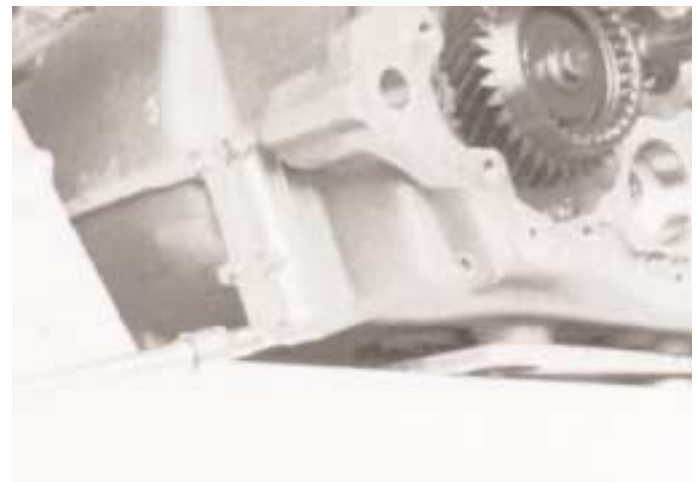
2. Refit the oil pump assembly. Ensure that the oil pump drive gear teeth engage correctly with the teeth on the oil pump. Refit the retaining screws.



5. Refit the washer, spring, washer and oil feed pipe to each position.



3. Refit the two oil feed pipes and screw.



6. Refit the gasket, apply sealant and refit the oil transfer plate.

Section 6 Clutch Housing

Clutch housing

Disassembly



1. Remove the clutch housing and gasket from transmission. Note the position of the shims which are behind the clutch housing gasket and then remove them.



3. Turn the clutch housing over. Remove the front cover.



2. Place the clutch housing on a bench, face down, and remove the clutch housing lubrication plate.



4. Drive out the oil seal if it needs replacing using tools E 109 and E109-19.

Clutch Housing

Reassembly



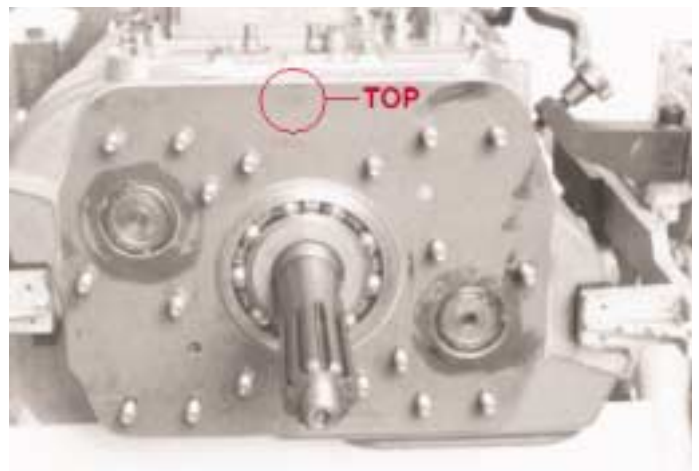
1. Place the clutch housing on a bench and refit the front cover.



3. Refit the lubrication plate ensuring that the dowel is correctly located in the hole in the clutch housing.



2. Turn the clutch housing over and use tools E 109 and E 109-19 to fit a new oil seal if necessary. The flat face of the seal must face the front cover. Drive the seal in until flush with the rear face.



4. Replace the shims and gasket. Note the word TOP on the gasket is at the top.

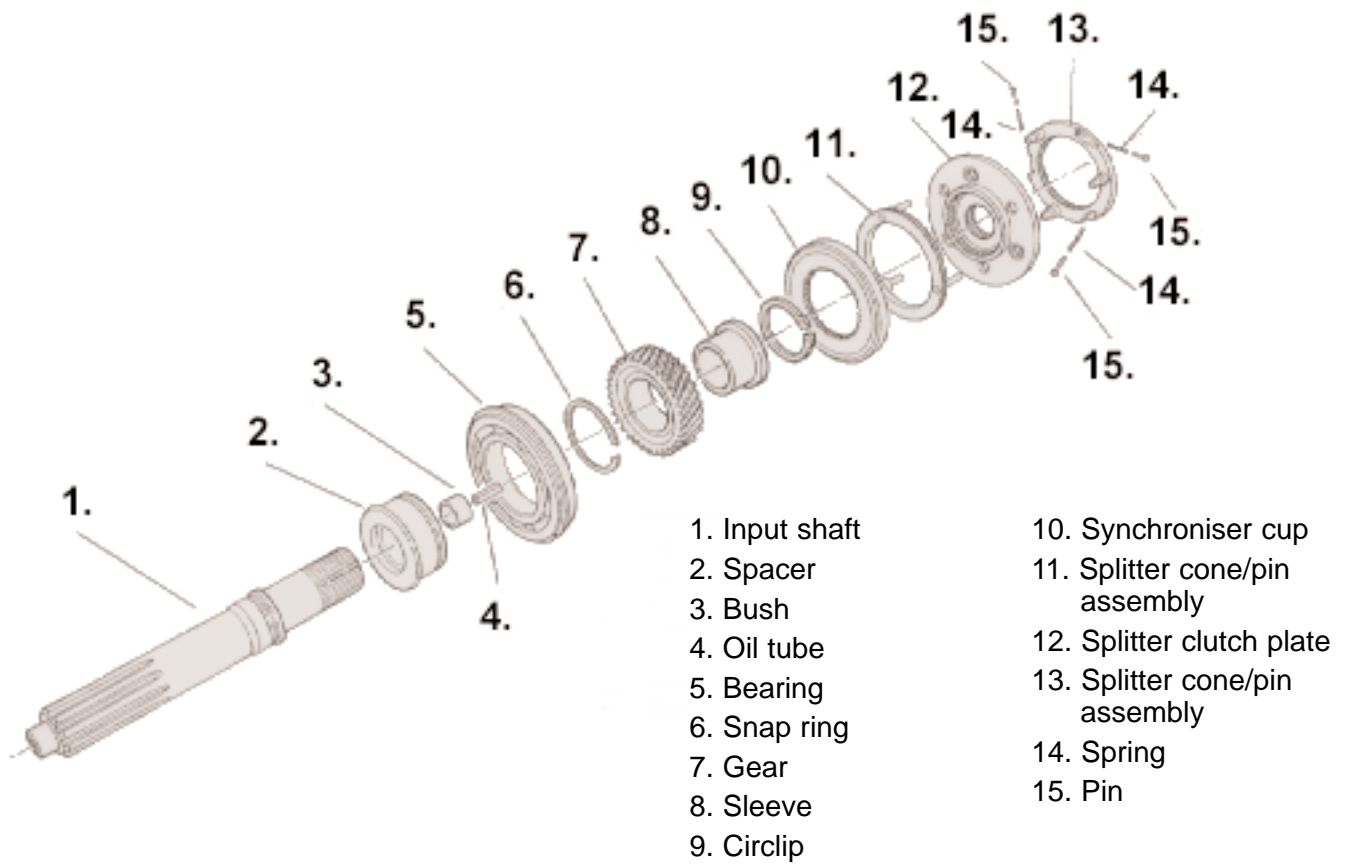


5. Replace clutch housing.

Section 7 Input Shaft

Input Shaft

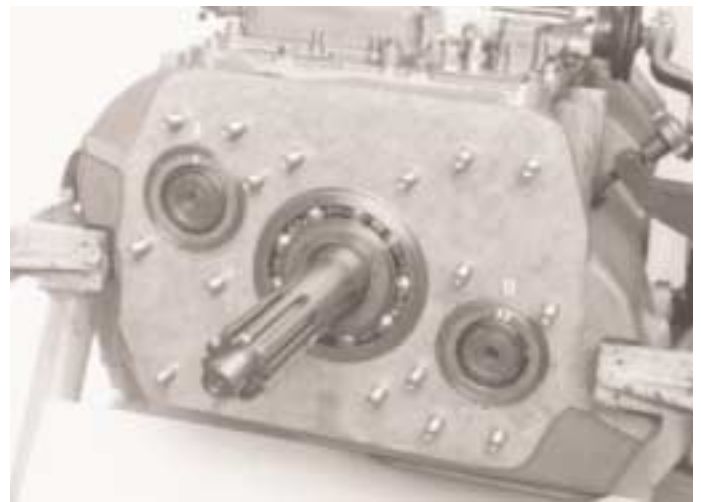
Exploded view



Disassembly



1. Remove the clutch housing.



2. Remove the clutch housing gasket. Identify the position of the shims and remove them.

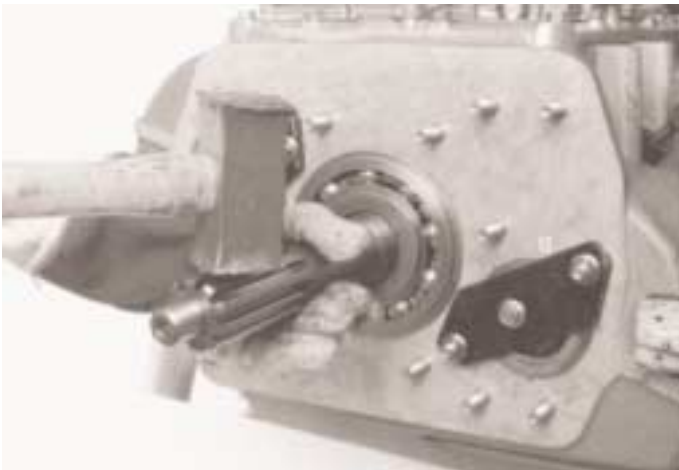
Input shaft



3. Fit tool E 207. Torque the centre screw on each retainer to 15-20Nm.



6. Taking care not to damage the shoulder of the input shaft, use a press or puller to remove the sleeve, gear and bearing sub-assembly.



4. Grasp the input shaft firmly and by a combination of tapping and pulling remove the input shaft assembly.



7. Sleeve, gear, bearing sub-assembly and input shaft.



5. Remove the snap ring.



8. The bearing sub-assembly can be disassembled by removing the snap ring and lifting the bearing off the sleeve.

Input shaft

Reassembly



1. Place the sleeve on the bench. Fit the bearing and the snap ring.



4. Allow the components to cool. Refit the snap ring and then check that the gear end float is within the specified limits.



2. Place the input shaft in a vice. Heat the bearing sub-assembly to 120°C and fit it onto the shaft.



5. If damaged, the input shaft bush can be removed using tools MS 284 and MS 284-1.



3. Place the gear on the input shaft, clutching teeth up. Heat the sleeve to 120°C. Fit the sleeve to the shaft.

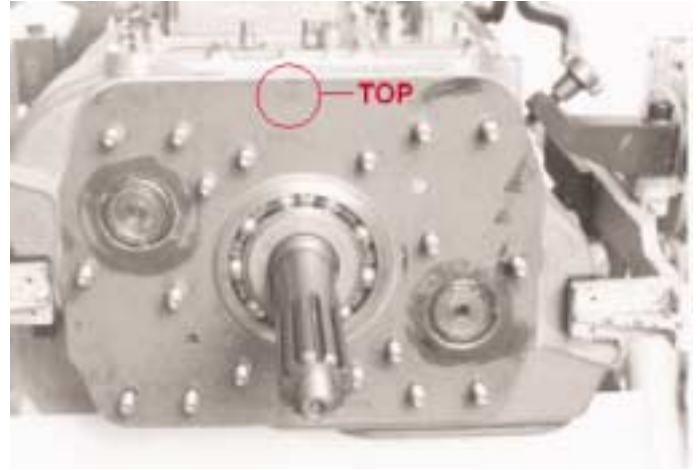


6. A new bush can then be fitted using tools E 109 and E 109-15.

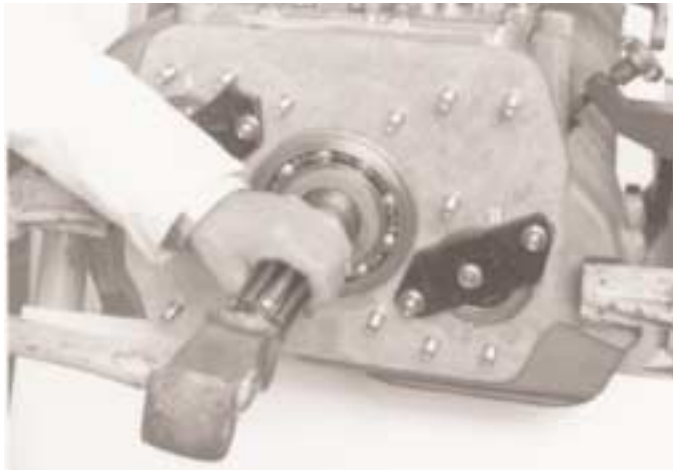
Input shaft



7. Refit the input shaft assembly to the transmission ensuring that the splines on the shaft and the splines on the gear engage in the corresponding component parts in the transmission.



9. Remove tool E 207. Replace the countershaft shims in the correct positions. Refit the gasket noting that the word TOP must be at the top.



8. Drive the input shaft assembly fully into position. If excessive resistance is felt, check that the parts are correctly aligned.



10. Refit the clutch housing.

Section 8

Main Section

Main Section

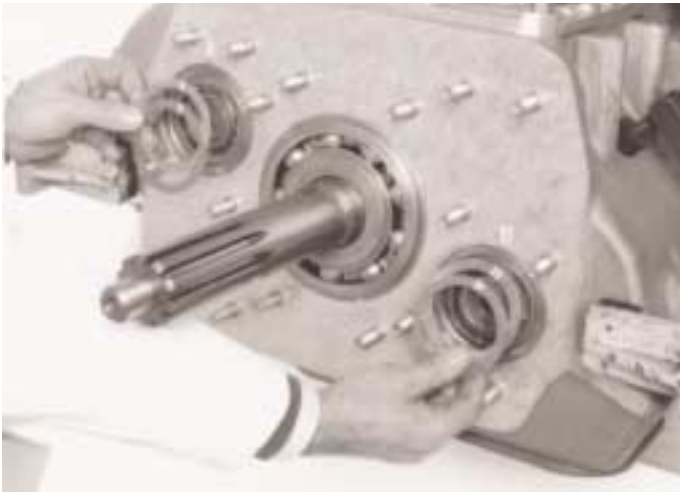
Disassembly



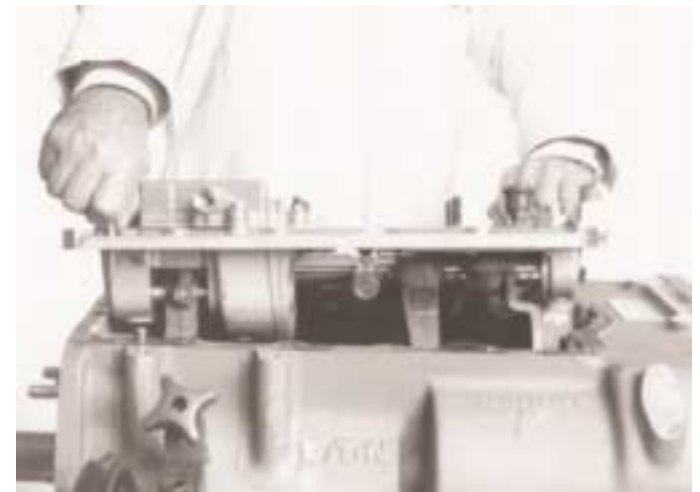
1. Place the transmission in low range. Disconnect the air supply to the range module. Drain the transmission oil. Remove the clutch housing.



3. Remove the remote control assembly and gasket.

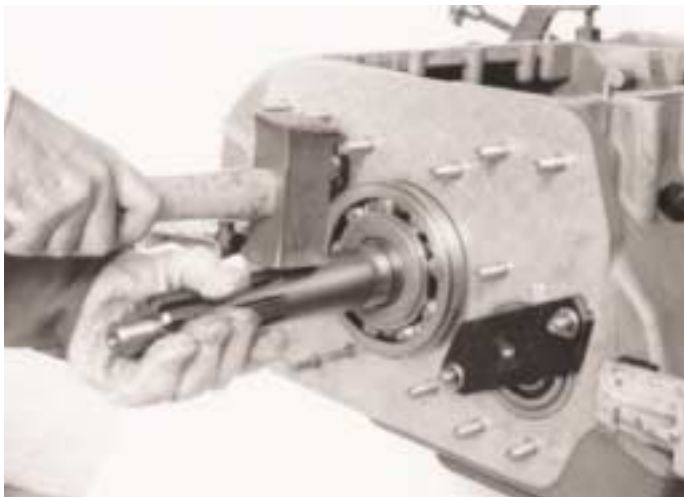


2. Remove the clutch housing gasket. Identify the position of the shims and remove them.



4. Using tool E 204 remove the shift bar housing and gasket. Do not allow the dowels to fall into the transmission.

Main section



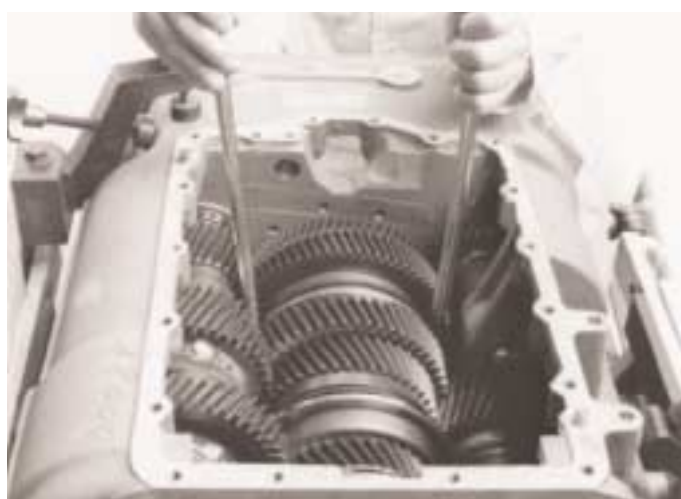
5. Fit the tool E 207. Torque the centre screw on the tool to 15-20Nm. Grasp the input shaft firmly and by a combination of tapping and pulling remove the input shaft assembly.



7. Remove auxiliary section screws. Support the weight of the auxiliary section with tool E 106B. Remove auxiliary section and gasket. If necessary use the three jacking points provided.



6. Use the tool E 203 to prevent the splitter synchroniser assembly coming apart.



8. Engage two mainshaft gears.

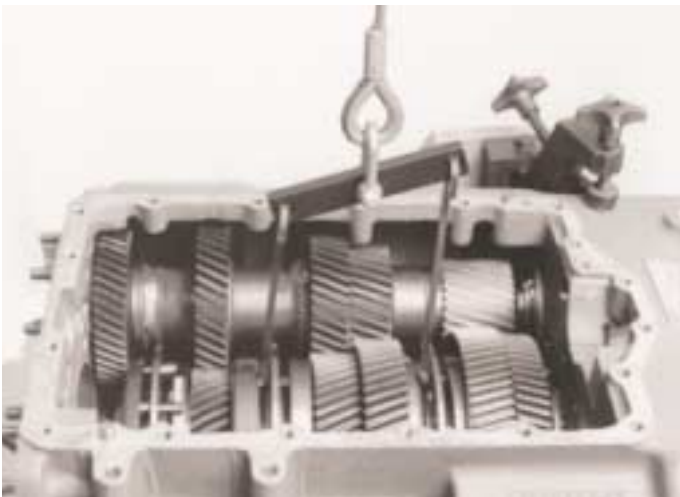
Main section



9. Remove the screw, retaining plate and auxiliary drive gear.



11. Remove the screws from the upper countershaft bearing support.

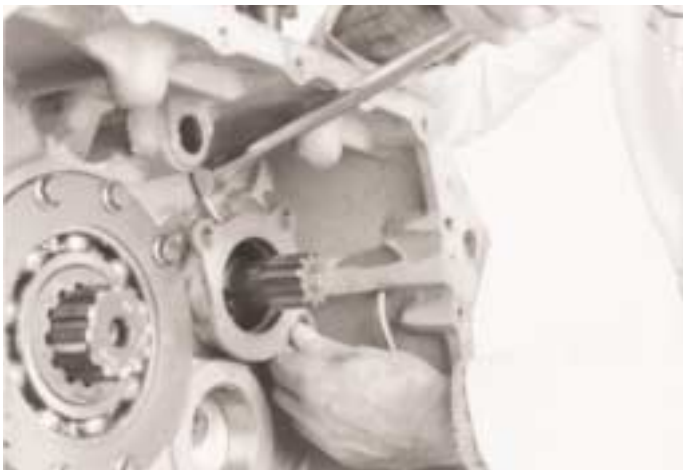


10. Place the transmission in neutral. Use the tool E 202 to support the weight of the mainshaft. The short leg locates in the 3rd/4th synchroniser plate. The longer leg locates in the 1st/2nd synchroniser plate.

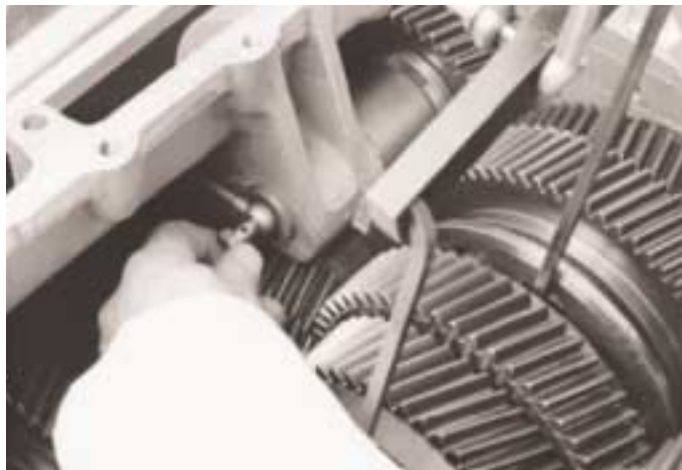


12. Mark the position of the taper bearing assemblies. Use the centre screw on the tool E 207 to push the upper countershaft rearwards approximately 5mm. This gives access to the rear bearing support.

Main section



13. Use a heel bar to remove the rear bearing support. Note: Do NOT apply force to any of the three tabs.



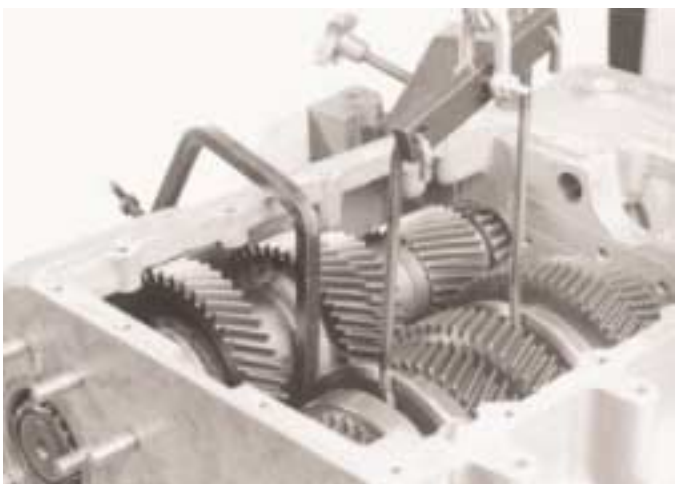
16. Remove the oil feed pipe retaining screw from the reverse idler shaft.



14. Remove the tool E 207 from the upper countershaft. Remove the bearing outer.

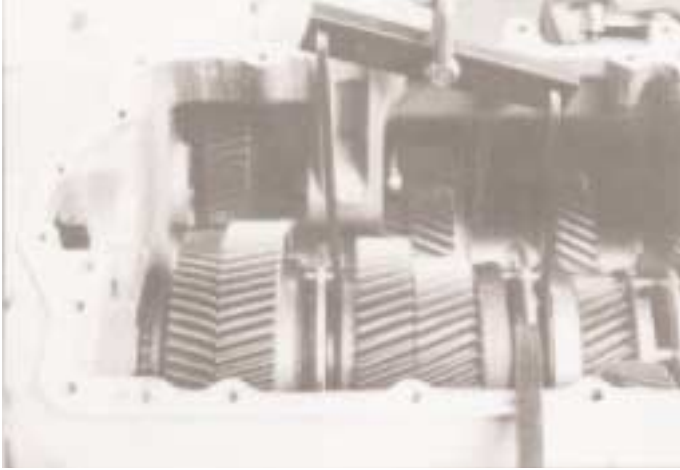


17. Remove the reverse idler shaft using tools MS 284 and E 200. The thrust washers and spacers on the idler shaft will drop into the main case.

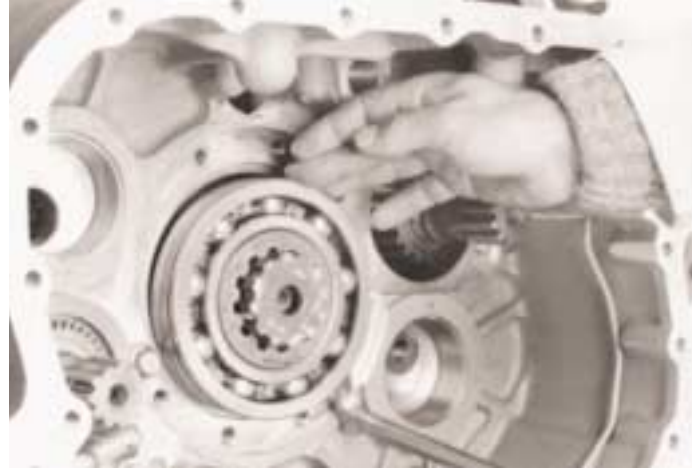


15. Use the tool E 201 to lift the upper countershaft away from the mainshaft.

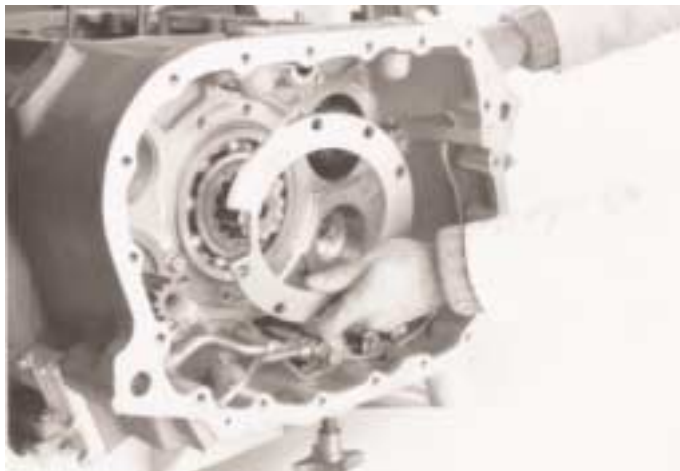
Main section



18. Roll the reverse idler gear away from the mainshaft.



21. Remove bearing and spacer assembly. Replace snap ring to avoid losing it.



19. Remove the mainshaft rear bearing retainer plate.

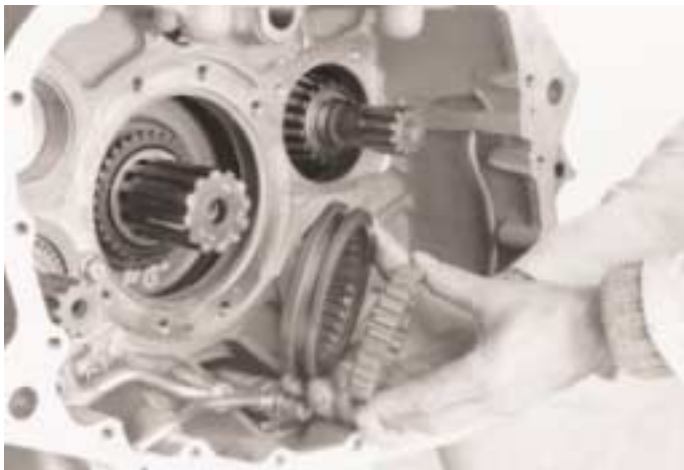


22. If necessary the bearing can be pressed off the spacer. If replacement is necessary, heat the bearing to 120°C before refitting.

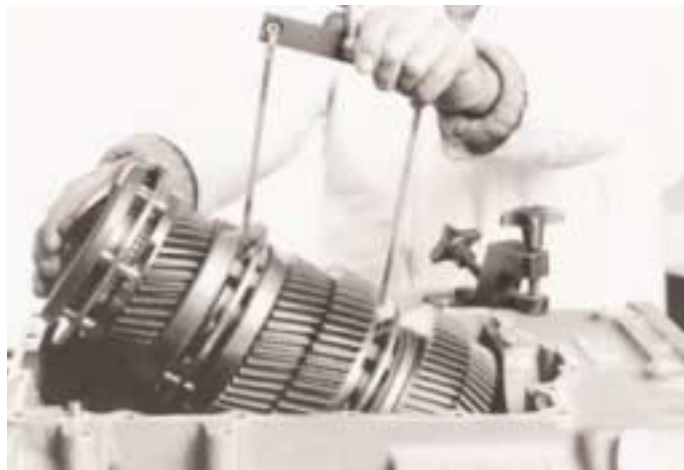


20. Pull the mainshaft rearwards to expose the bearing snap ring. Remove the snap ring.

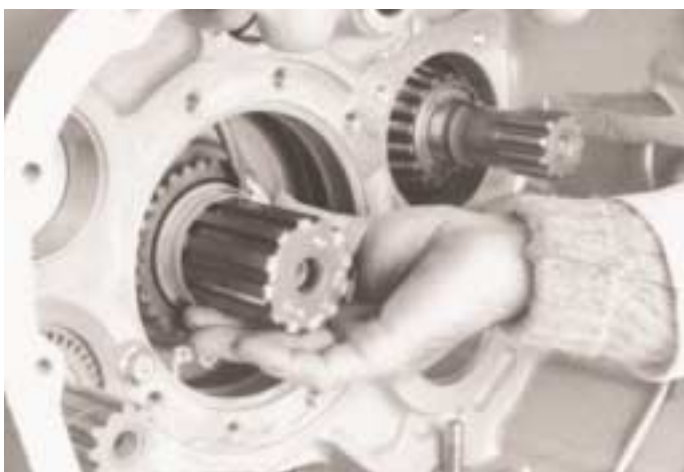
Main section



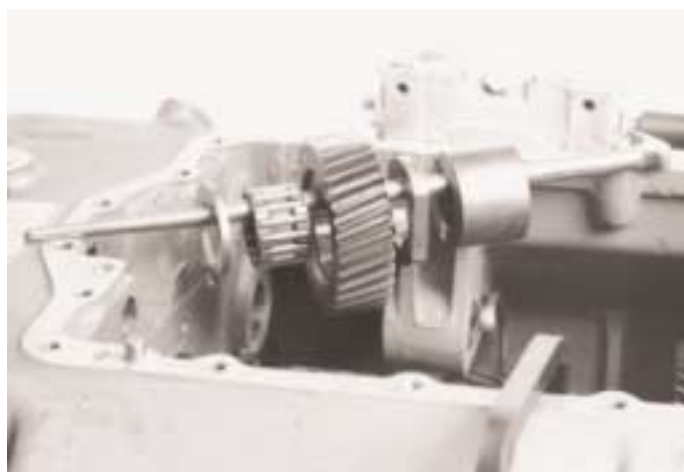
23. Remove reverse gear sliding clutch and hub.



25. Lift the mainshaft out of the transmission.



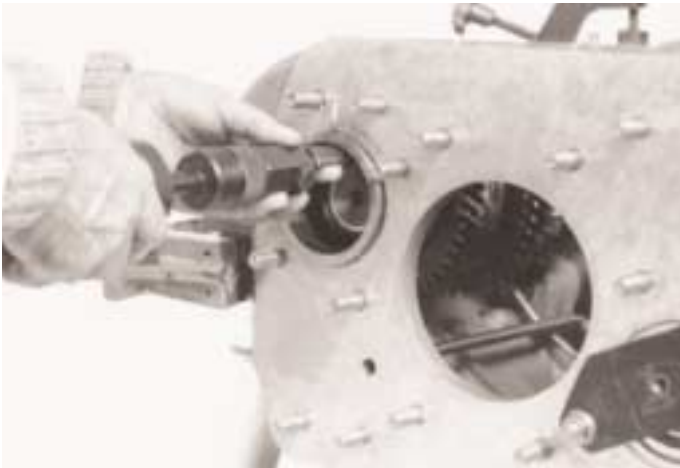
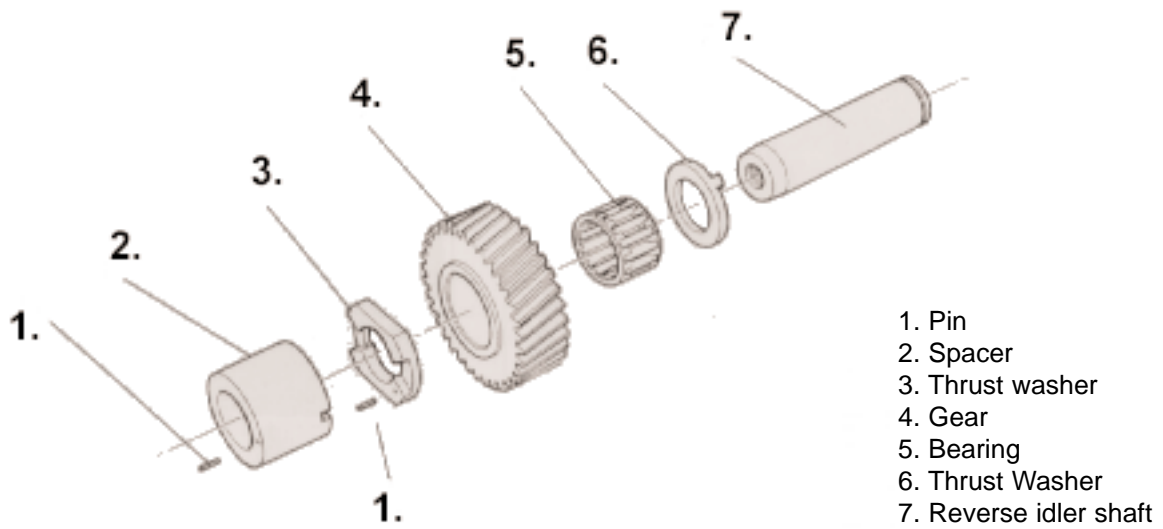
24. To prevent displacement of reverse thrust washer and the reverse gear when removing the mainshaft assembly, use a jubilee clip to retain these components in place.



26. Remove the reverse idler gear. Retrieve washers and spacers from inside the maincase.

Main section

Reverse Idler



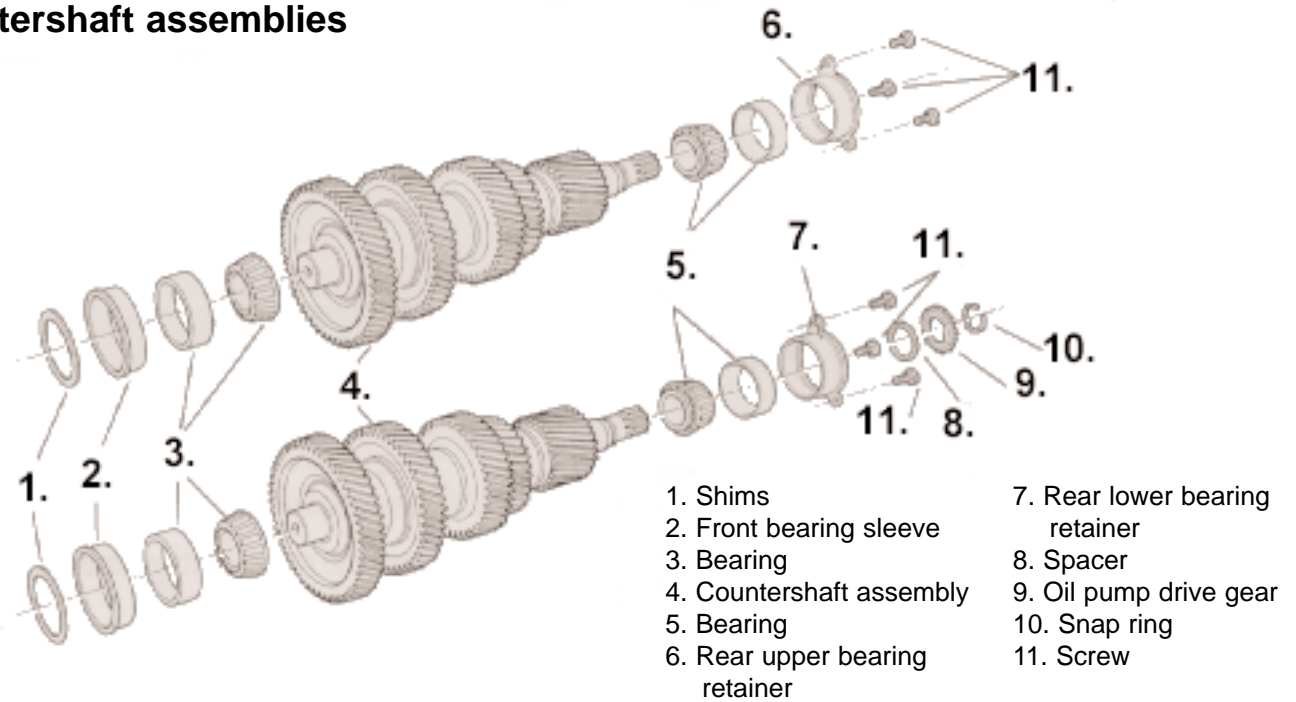
27. Remove the countershaft front bearing support using tools MS 284 and MS 284-1.



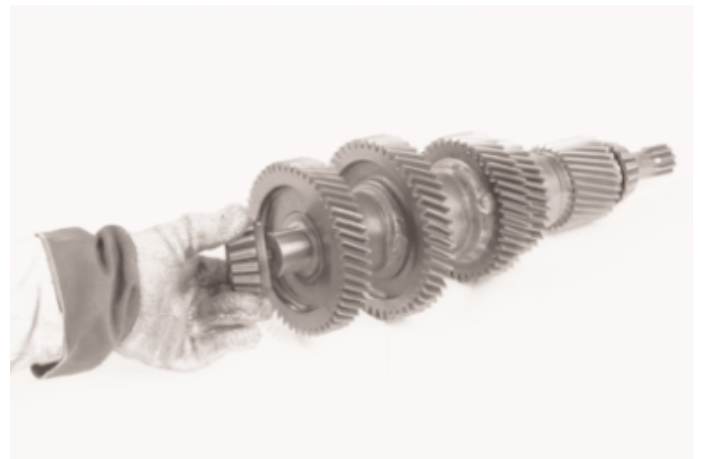
28. Remove the upper countershaft assembly. The countershaft assemblies are assembled and welded during production. Therefore apart from the bearings there are no serviceable parts.

Main section

Countershaft assemblies



29. The bearings can be removed from the countershaft using tools LC 105A and E 105-4. If the bearings are changed the corresponding outers must also be changed and vice versa.

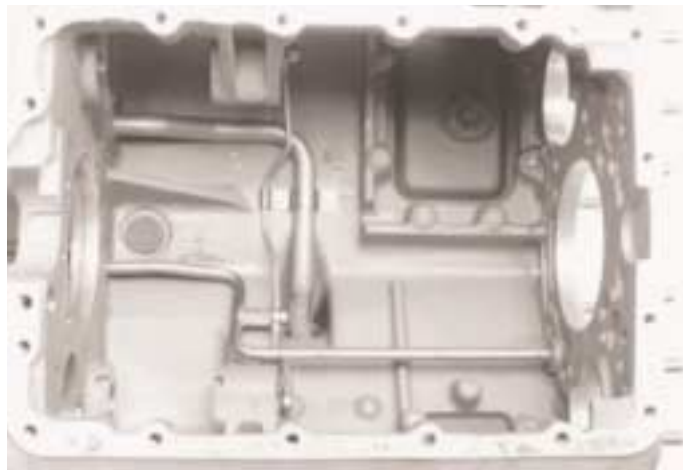


30. Heat a new bearing to 120°C before fitting.

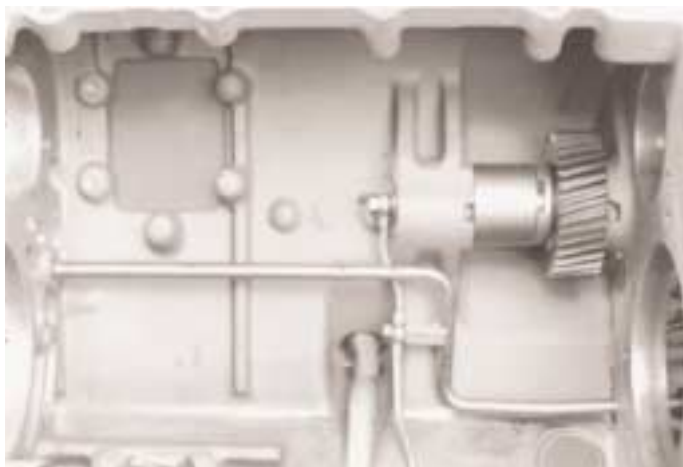
Main section



31. If the lower countershaft is to be removed the oil pump and oil pump drive gear must be removed first (refer to relevant section of this manual). The procedure for removing the lower countershaft is the same as for the upper.



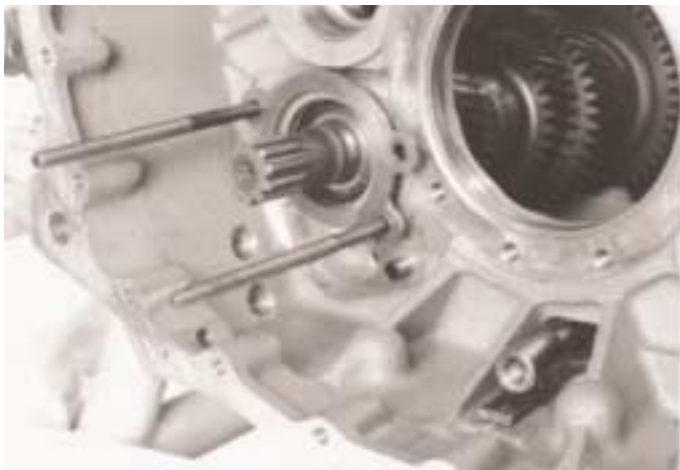
33. Inspect the oil lubrication pipework for damage etc and replace if necessary.



32. The lower reverse idler assembly is removed in a similar manner to the upper.

Main section

Reassembly



1. Ensure that the oil distribution piping is fitted. Place the lower countershaft into position. Fit the bearing outer into the lower countershaft rear bearing support. Refit this assembly. Studs can be used to aid alignment. Do NOT apply force to the tabs.



3. Support the washer on the idler shaft ensuring tab locates into the maincase.



2. Fit countershaft front bearing support and bearing outer. Note: the flat on the support must line up with the pin in the maincase. Use tool E 207 to prevent the bearing falling out.



4. Refit the reverse idler bearing into the idler gear. Fit this assembly onto the idler shaft, boss forward.

Main section



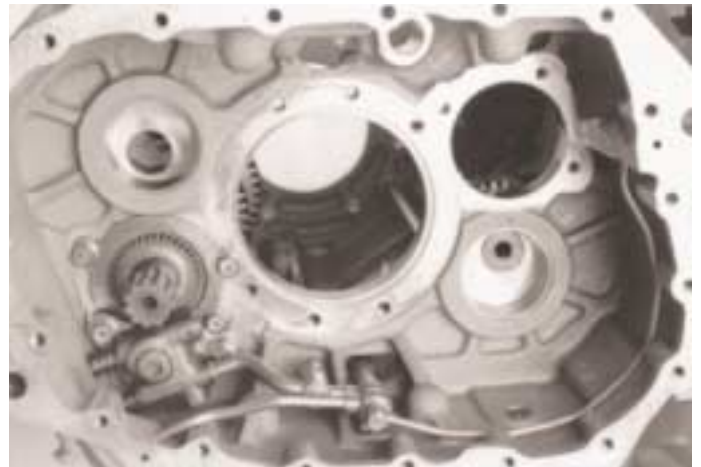
5. Fit the spacer and thrust washer. The pin on the thrust washer fits into the slot on the spacer; the pin on the spacer fits into the slot in the maincase.



7. On both countershafts there are timed teeth identified by an 'O'. Find and highlight these teeth on both countershafts. These are the timing marks used later.



6. Drive the idler shaft in until flush with transmission main case. Fit the oil feed pipe screw into the idler shaft.



8. Refer to 'Oil pump reassembly' and refit the oil pump assembly and pipework.

Main section



9. Place upper countershaft in position. Use tool E 201 to hold the countershaft up and away from the centre of the maincase.



11. With the bearing fitted, place the upper reverse idler gear, boss forward, into position. Roll the reverse idler gear away to the side. Support the thrust washer on the idler shaft. The tab on the washer locates into the maincase.



10. The timing marks on both countershafts must align with each other. Fit tool E 207 and tighten the centre screw to 30Nm. This prevents rotation of the lower countershaft.



12. With the splitter synchroniser assembly held onto the mainshaft with tool E 203 lower the mainshaft into position.

Main section



13. Mark any two adjacent teeth on the input shaft drive gear. These are the timing marks.



15. While holding the splitter synchroniser assembly, lightly tap the input shaft into the main case ensuring that the splines on the input shaft and input shaft gear align with the corresponding splines on the mainshaft component parts. Do NOT use excessive force.

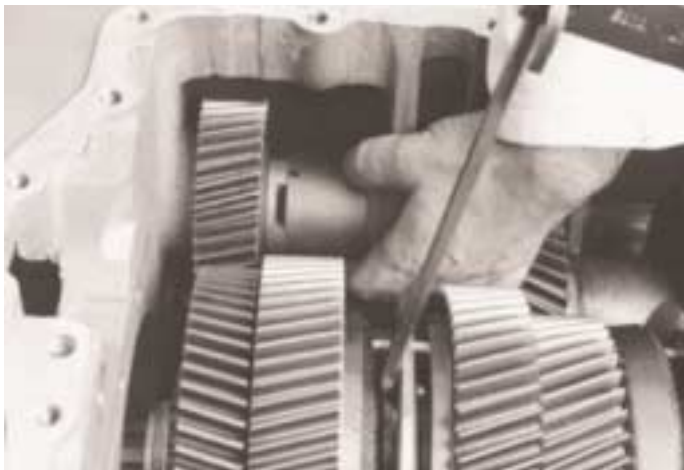


14. With the main shaft centralised, remove tool E 203 from front of mainshaft. Fit the input shaft, ensuring that one of the timing marks on the input shaft gear engages with the corresponding timing mark on the lower countershaft gear.



16. Slightly raise the rear of the mainshaft and roll the reverse gear into mesh. Support the reverse idler gear on the idler shaft.

Main section



17. Refit the mainshaft thrust washer and spacer. The pin on the thrust washer locates in the slot on the spacer; the pin on the spacer locates in the slot in the maincase.



19. Remove the jubilee clip.

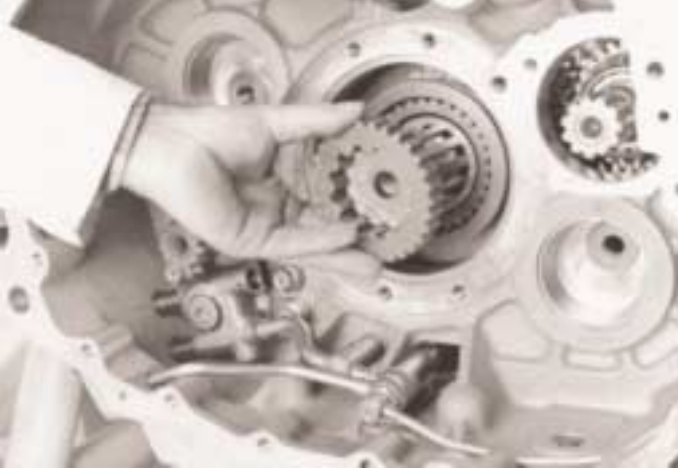


18. Drive the reverse idler shaft forwards until it is flush with the maincase face.

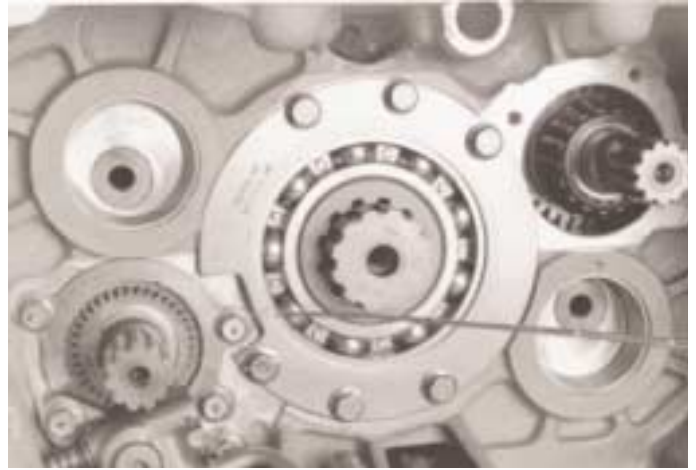


20. Refit the reverse gear sliding clutch, boss forward, onto reverse gear splines.

Main section



21. Refit reverse gear hub, chamfer forward.



23. Fit the mainshaft bearing retainer plate, counterbores facing forwards, with the slot in the position shown.



22. Refit mainshaft rear bearing and spacer assembly.



24. Remove the tool E 201 from the countershaft. Rotate the upper countershaft until the timed teeth of the input shaft gear and countershaft gear are in mesh.

Main section



25. With the bearing outer fitted into the rear bearing support fit the support. Dowels can be used to assist in alignment. Do NOT apply force to the tabs.



27. Tap the bearing outer into position until fully seated.



26. Stand the transmission upright. Refit the bearing support into the maincase. The slot on the support must line up with the pin in the maincase.

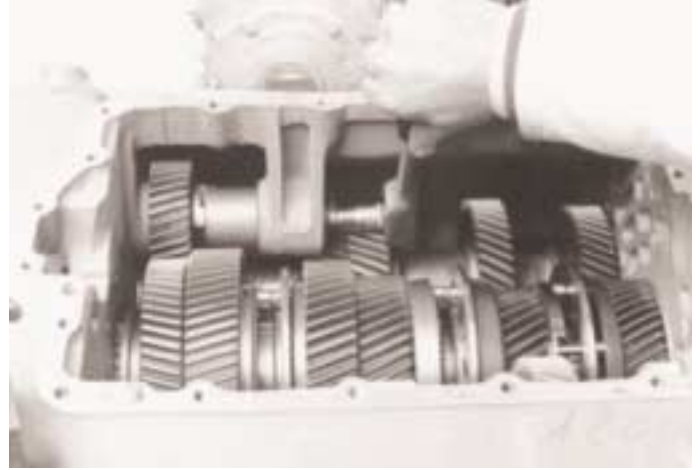


28. Using a dial test indicator measure the distance from the face of the bearing outer to the maincase front face.

Main section



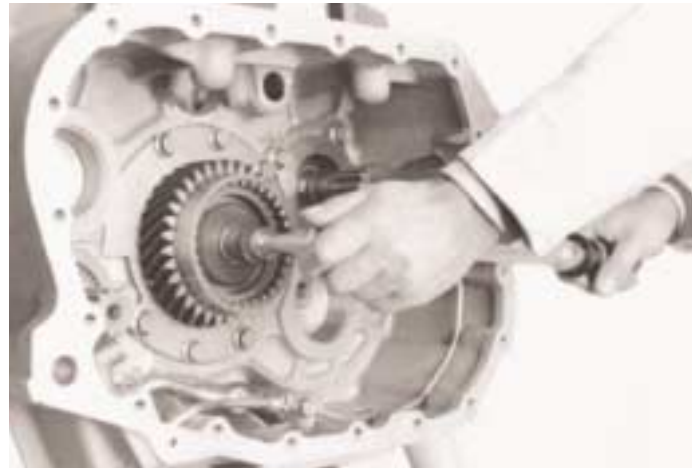
29. This measurement is used to determine the shims needed to give the correct amount of preload. Calculate and set the preload on the other countershaft in a similar manner. Measured dimension + specified preload = shim thickness.



31. Place the transmission in a horizontal position. Select two front section gears. Refit the oil feed pipe to the reverse idler shaft.

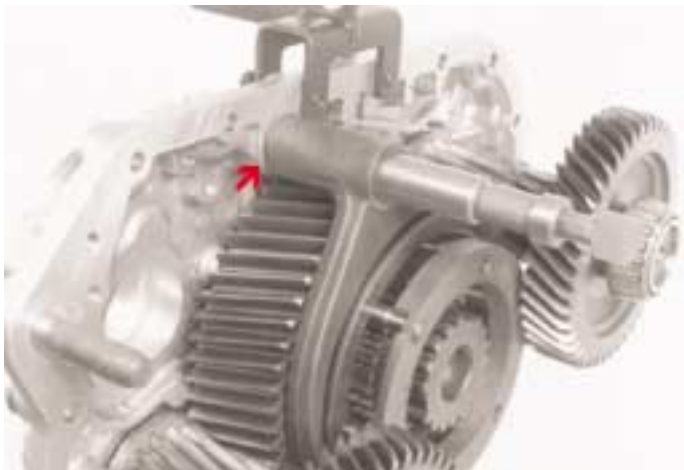


30. Refit the clutch housing gasket. Note the word TOP on the gasket is at the top and should face outwards. Replace clutch housing.

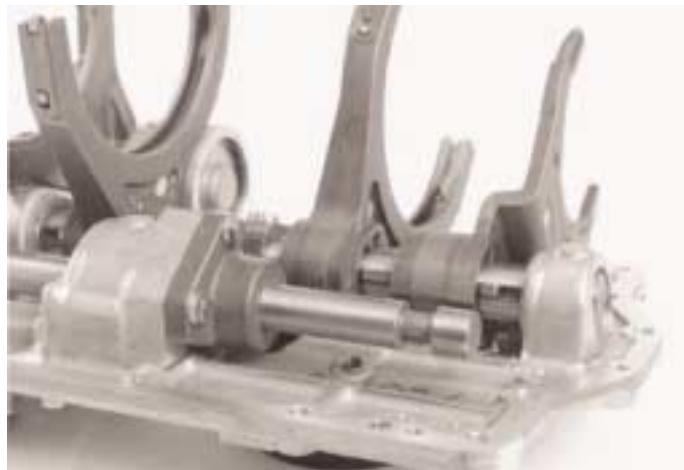


32. Refit the auxiliary drive gear, retaining plate and screw.

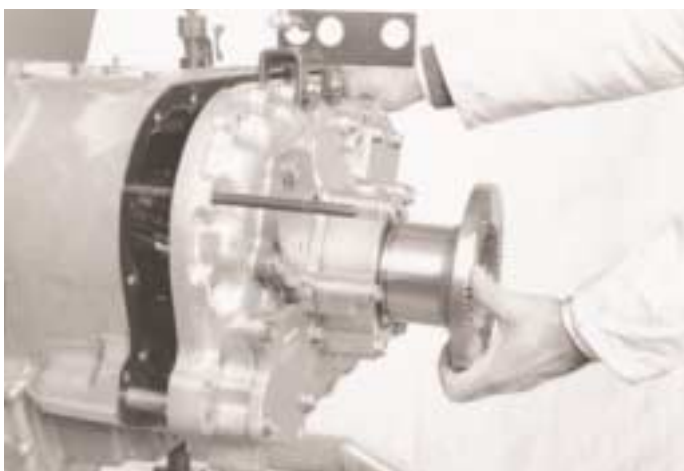
Main section



33. Place the auxiliary section in low range. Low range is engaged when the fork is against the auxiliary housing.



35. Ensure that the selector forks are in the neutral position and that the range change shift bar is in the low range position, i.e. completely rearward.

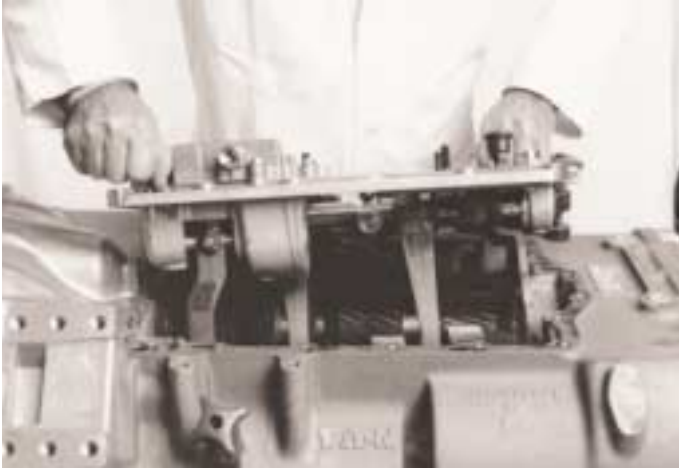


34. Refit gasket and apply sealant. Refit the auxiliary section to transmission. To ease assembly grease the studs. Dowels can be used to assist in alignment.



36. Ensure that the auxiliary range change shift bar is in the low position, i.e. completely rearward, and that the transmission is in neutral. Refit the two dowels.

Main section



37. Screw in tool E 204 so that the threads protrude at least 15mm. Refit the gasket and apply sealant. Carefully lower the shift bar housing into position.



39. Slowly remove the tool ensuring that the range change shift bars engage and that the shift bar housing locates on the dowels.



38. Using a torch if necessary, look through the gap at the rear of the shift bar housing and check that the two range change shift bars are correctly aligned. If necessary, adjust the position of the range change shift bar.



40. Refit the gasket and remote control.

Main section



41. Stand the transmission upright. Remove the bearing covers. Ensure that the bearings on both auxiliary countershafts are fully seated. Measure the distance from the bearing outers to the machined face.

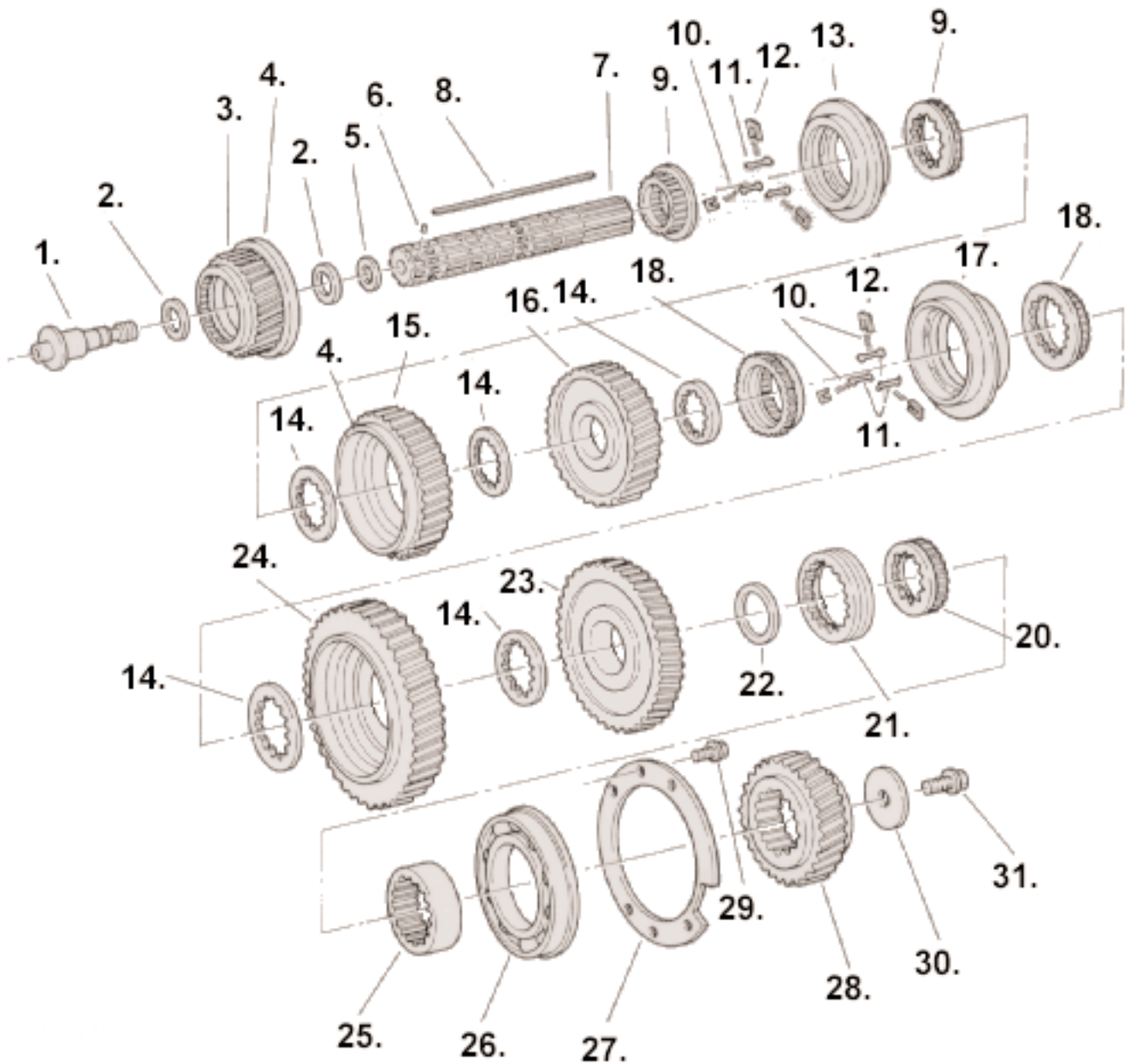


42. Use this measurement to determine the shim that gives the correct amount of endfloat. Allow 0.30mm for the gasket thickness. Refit the gaskets, graded spacer and bearing covers.

Required shim thickness = Measured distance
+0.3 - specified end float.

Main Section

Mainshaft Exploded view



- | | | |
|--------------------------------|--|---------------------------------|
| 1. Mainshaft spindle | 12. Plunger | 21. Reverse gear sliding clutch |
| 2. Thrust bearing | 13. 3rd/4th synchroniser cone assembly | 22. Thrust washer |
| 3. 4th gear | 14. Mainshaft thrust washer | 23. Reverse gear |
| 4. Synchroniser cup | 15. 3rd gear | 24. 1st gear |
| 5. Thrust washer | 16. 2nd gear | 25. Bearing spacer |
| 6. Pin | 17. 1st/2nd synchroniser cone assembly | 26. Bearing |
| 7. Mainshaft | 18. 1st/2nd gear sliding clutch | 27. Bearing retainer plate |
| 8. Key | 19. Retainer | 28. Auxiliary drive gear |
| 9. 3rd/4th gear sliding clutch | 20. Reverse gear hub | 29. Screw |
| 10. Spring | | 30. Retainer plate |
| 11. Retainer | | 31. Screw |

Main section

Disassembly



1. Place the splitter synchroniser assembly on a bench. Stand mainshaft on it. It is advisable to check that the gear end floats are within the specified limits during disassembly. Remove the jubilee clip previously fitted. Fit the reverse gear hub, bearing/spacer assembly, auxiliary drive gear, retaining plate and screw. Using a dial test indicator measure the auxiliary drive gear end float.



3. Remove screw, retainer plate, washer, auxiliary drive gear, mainshaft bearing assembly and reverse gear hub. The washer is no longer needed. Remove thrust washer and reverse gear.



2. Fit a washer under the retaining plate to prevent the auxiliary drive gear from moving. Measure the reverse gear end float.



4. Using feeler gauges measure first gear end float.

Main section



5. Identify position of mainshaft key and remove it.



7. 1st/2nd and 3rd/4th synchroniser assemblies are different and must not be confused. The orientation of the synchroniser assembly must not be changed. Therefore identify each one.

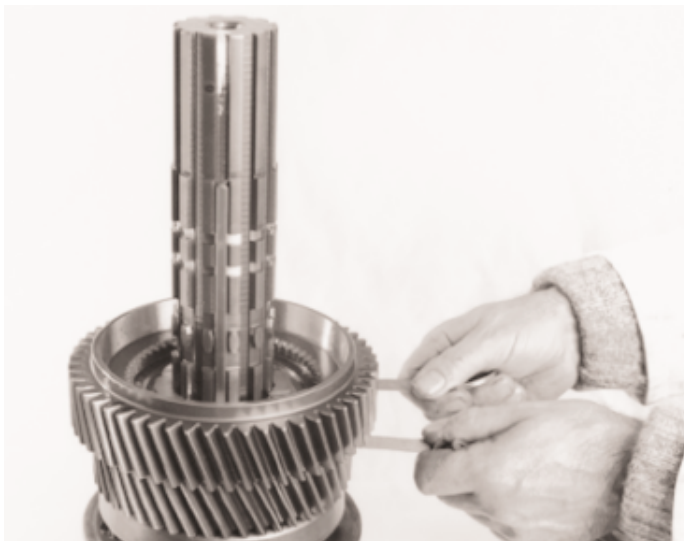


6. Remove the thrust washer and 1st speed gear.



8. Remove the thrust washer and 1st/2nd synchroniser assembly.

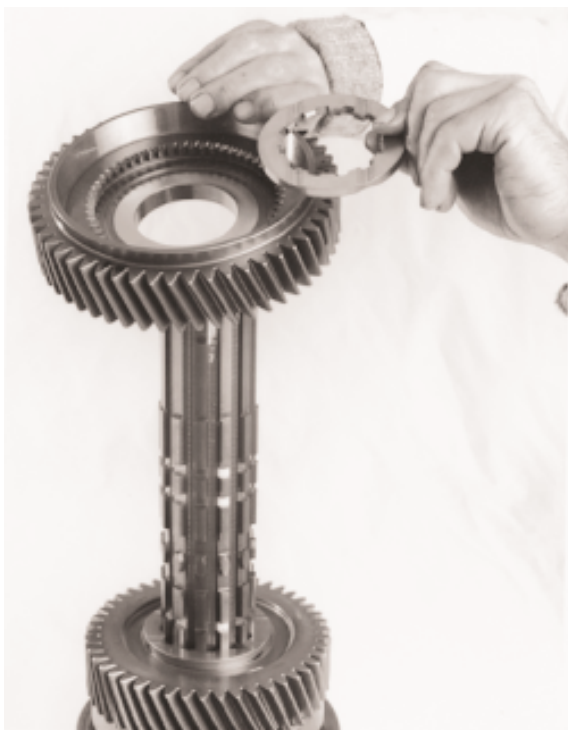
Main section



9. Refit mainshaft key. Using feeler gauges measure the 2nd speed gear end float.



11. Refit the mainshaft key. Using feeler gauges measure 3rd speed gear end float.



10. Remove mainshaft key, thrust washer and 2nd speed gear.



12. Remove mainshaft key, thrust washer and 3rd speed gear.

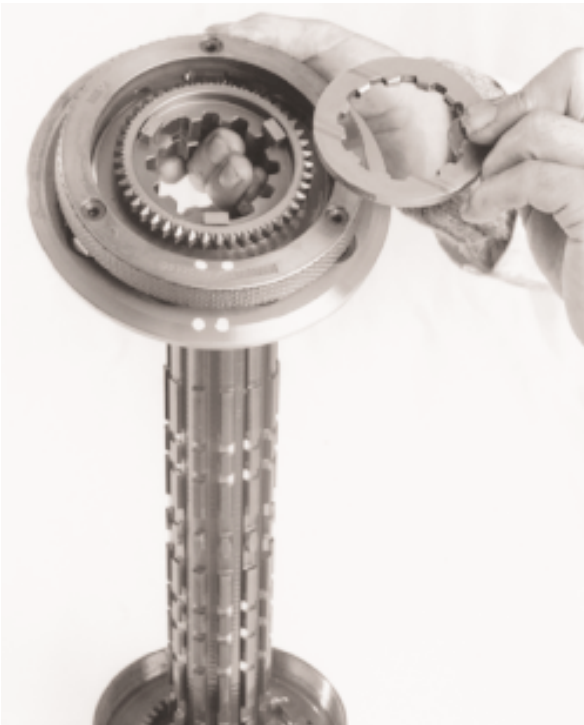
Main section



13. Identify 3rd/4th synchroniser assembly and orientation.



15. Place mainshaft in a soft jawed vice. Using a dial test indicator measure the 4th speed gear end float.



14. Remove thrust washer and synchroniser assembly.



16. Remove mainshaft spindle and bearing.



17. Remove 4th speed gear, bearing and thrust washer.

Main section

Reassembly



1. The synchroniser cups on 3rd and 4th gears can be replaced if they or the gears are damaged. Place the assembly as shown. Use a suitable tool to prise the cup loose. Prise the cup loose from opposite the tab of the synchroniser.



4. Place the synchroniser cup and gear face down on the bench. Push the gear towards the tab and, at the same time, tap the gear onto the synchroniser cup.



2. Slide the synchroniser away from the gear.



5. Hold the mainshaft spindle in a soft jawed vice by the spigot diameter so that there is a 12mm gap between the spindle and the top of the vice. Place the bearing onto the shaft. Lubricate the bearing.



3. Slide the tab of the synchroniser cup into the slot of the gear.

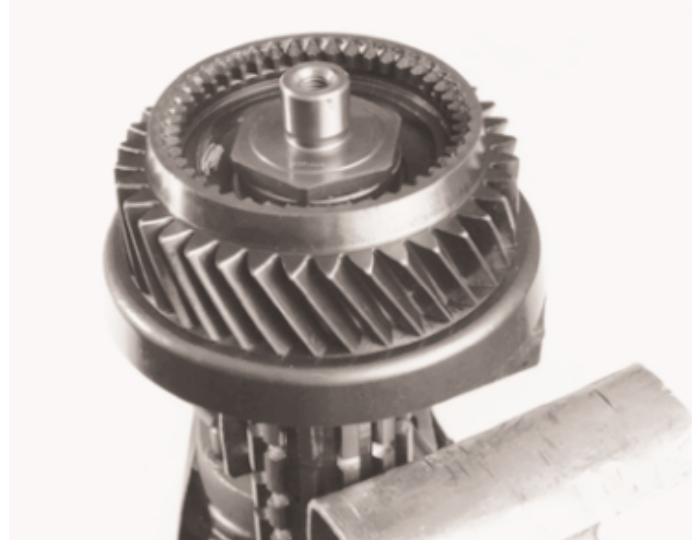


6. Place the 4th gear onto the shaft. Fit and lubricate the bearing.

Main section



7. Fit the thrust washer onto the shaft. If there is a flat edge on the thrust washer this must locate on the flat edge of the spindle.



9. Place the mainshaft upright in a soft jawed vice and tighten the mainshaft spindle to the correct torque.

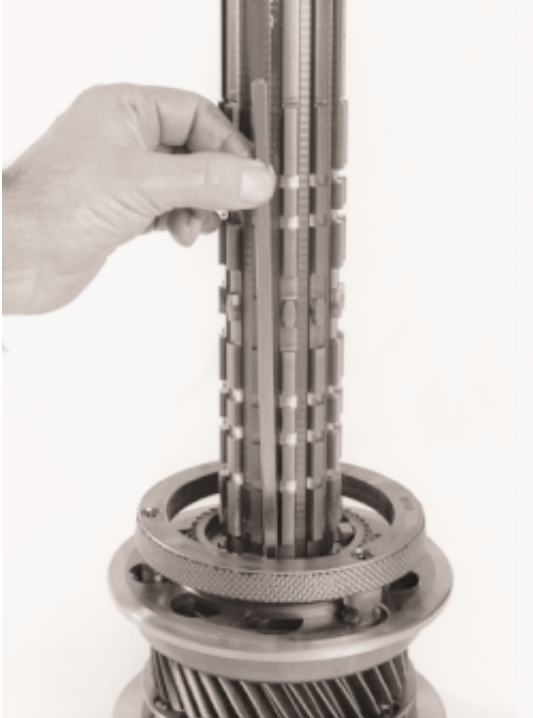


8. Hand tighten the mainshaft to this subassembly until the components cannot move axially.

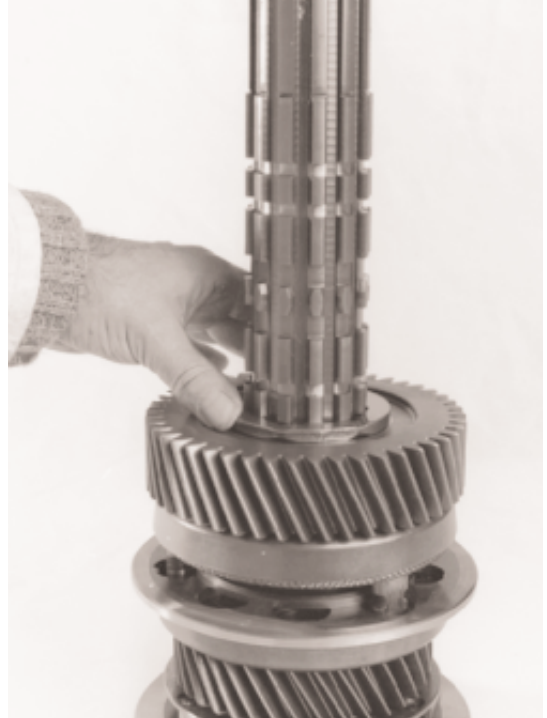


10. Place the splitter synchroniser assembly on the bench. Place the mainshaft on it. Find the groove in the mainshaft where the roll pin is fitted. Ensure the pin is fitted and identify this groove for the mainshaft key.

Main section



11. Lubricate the inside of the synchroniser cup. Fit 3rd/4th synchroniser assembly. Note: the slot on the assembly must line up with the highlighted groove for the key on the mainshaft. Ensure that the synchroniser assemblies are placed in the same orientation and position as when removed.



13. Lubricate the inside of the synchroniser cup. Fit the 3rd speed gear onto the mainshaft, cup down. Lubricate and fit the thrust washer.



12. Remove the mainshaft key. Lubricate and fit the thrust washer to the mainshaft. Index the washer round so that the splines are in line.



14. Fit the 2nd speed gear. Lubricate and fit the thrust washer.

Main section



15. Lubricate the inside of the synchroniser cup. Fit the 1st/2nd gear synchroniser assembly onto the mainshaft, again noting the position of the slot. Ensure correct orientation and position of the synchroniser assembly. Lubricate and fit the thrust washer.



17. Fit the reverse gear, clutching teeth up. Fit the mainshaft key.



18. Lubricate and fit the reverse gear thrust washer.



16. Lubricate the inside of the synchroniser cup. Fit the 1st speed gear onto the mainshaft, cup down. Lubricate and fit the thrust washer.



19. To assist in the assembly of the mainshaft to the transmission fit a jubilee clip to prevent the reverse gear components being displaced.

Main section

Mainshaft synchroniser disassembly

Although the service procedures for both synchroniser assemblies are the same, the clutches, retainers and synchroniser cone assemblies used in the 1st/2nd or 3rd/4th synchroniser assemblies are different and must not be used on the other assembly.

Before removing the synchroniser assemblies from the mainshaft check that the word FRONT is stamped on the synchroniser plate. The word FRONT must face towards the front of the transmission when the mainshaft assembly is refitted. If the word FRONT is not legible use some other method of identifying the orientation of the synchroniser to ensure that the synchroniser assemblies are correctly refitted.



1. To disassemble the mainshaft synchronisers place the assembly on a bench and remove the three keys.



3. Release the springs and plungers. Care should be taken at this stage to avoid the loss of these parts during removal.



2. Remove the clutch.



4. Lift the synchroniser cone assembly from the clutch.

Main section

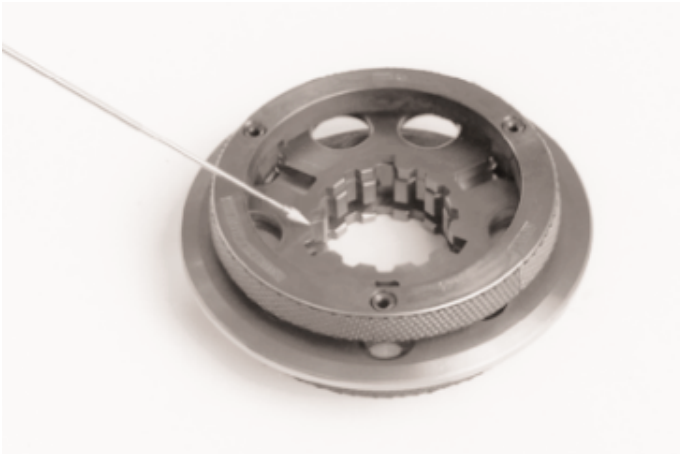
Mainshaft synchroniser reassembly



1. To reassemble a synchroniser assembly place the synchroniser clutch, teeth down, onto a bench. To ease reassembly of the 3rd/4th clutch place a mainshaft thrust washer under the clutch.



4. Fit the other synchroniser clutch, teeth up, onto the plate ensuring that all the wide slots are in line.



2. Place the synchroniser cone assembly onto the synchroniser clutch. Ensure that the wide slots of the plate and clutch are in line.



5. Refit the three keys to hold the assembly together.



3. Using a screwdriver, if necessary, fit the three springs and plungers into the plate.

Main section

Splitter synchroniser disassembly



1. Place the splitter synchroniser assembly on a bench. Lift off the synchroniser cup.



3. Lift the clutch plate from the synchroniser cone. Remove springs and pins.



2. Taking care not to lose the springs and pins, lift the synchroniser cone off the assembly.

Main section

Splitter synchroniser reassembly



1. Place the synchroniser cone having the longer pins on a bench.



3. Grease and fit the springs and pins into the synchroniser cone.



2. Place the clutch plate, external clutching teeth uppermost, onto the synchroniser cone. Note the relative position of the pins to the chamfers.



4. Place the synchroniser cone onto the assembly so that one of the pins/springs is located. While holding the synchroniser assembly re-locate the two other pins/springs using a screwdriver if necessary.