
SECTION 5

Gearbox

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12 x 12 Shuttle Gearbox

12 x 12 Shuttle Gearbox Section 5 - Part A

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12 x 12 Shuttle Gearbox

SPECIFICATION

Model	12 x 12 Shuttle gearbox.
Number of gears forward.....	12.
Number of gears reverse.....	12.
Synchromesh type	Strut type.
Settings required:	
Main shaft end float.	0,08-0,03 mm (0.003-0.012 in).
Type of adjustment..	Variable thickness thrust washer.
Synchromesh ring to coupler clearance - installed	0,8 mm (0.030 in).
Synchromesh ring to coupler clearance - removed	0,5 mm (0.020 in).
Synchromesh neutral setting.....	See procedure 5A-05.
Input shaft bearing dimension (oil cooled clutch)	179,70 - 179,60 mm (7.080 - 7.076 in).

Special Tools:

MF.177A.....	Input shaft oil seal protector.
MF.218B.....	PTO Bearing housing replacer.
MF.255B.....	PTO input shaft oil seal replacer.
MF.315A.....	Needle roller bearing remover/replacer.
MF.367B.....	Transmission torque wrench.
MF.414	Synchromesh setting pin.
MF.421	Needle roller bearing and seal replacer.
MF.422A.....	Bearing, sleeve and oil seal remover.
MF.3008	Circlip plier set.

Bolt Torques:

Gear lever 12 point cap screws.....	60 Nm (45 lbf ft).
Gearbox top cover	115 Nm (85 lbf ft).
Shifter fork locking screws.....	43 Nm (32 lbf ft).
Rear gear shift selector bracket.....	58 Nm (43 lbf ft).
Input shaft housing to gearbox.....	40 Nm (30 lbf ft).
PTO drive bearing housing.....	58 Nm (43 lbf ft).
Gearbox to range gearbox.....	102 Nm (75 lbf ft).
Input housing to gearbox - countersunk screw.....	40 Nm (30 lbf ft).
Scavenge pump housing.....	40 Nm (30 lbf ft).

GENERAL DESCRIPTION

The 12 x 12 shuttle gearbox has twelve forward and twelve reverse gears; the forward reverse selection being controlled by a lever on the instrument panel adjacent to the steering wheel. All speed gears are controlled by a single gear lever to the right of the driver. Full engine braking is provided on over-run and the tractor can be towed to start the engine.

Drive Arrangements

From the constructional view point the gearbox has three sections. The front section consists of the forward and reverse gears with a synchromesh coupler.

The centre section comprises constant mesh gear sets giving four basic forward and one reverse speed. The rear section consists of a three speed range gearbox offering an alternative low range, medium range and high range. Synchromesh engagement is provided on all gears.

The four basic forward and reverse speeds are tripled by the ability of the range gearbox to provide the additional ratios. This feature, gives the gearbox the total of twelve forward speeds and twelve reverse.

The gearbox layshaft is located below the mainshaft which is of hollow construction to accept the Power Take-off (PTO) drive shaft which runs within it. Drive from the engine enters the gearbox through the input shaft which is spigot mounted into the front end of the mainshaft.

The forward and reverse gears are splined to the input shaft and are in constant mesh with corresponding free-running gears on the front of the layshaft. The front or reverse gears drive through an idler gear to give the reverse motion. Drive through either of these free-running gears occurs when the one selected is engaged with the layshaft by the sliding coupler of the synchromesh mechanism.

There are two types of reverse idler fitted, the single gear type or a double idler gear type depending on the ratio and size of the rear tyre.

The PTO drive enters the gearbox through a hollow shaft revolving on the outside of the gearbox input shaft. A spur gear at the rear of the hollow PTO input shaft is permanently engaged with the gear splined to the PTO drive shaft.

12 x 12 Shuttle Gearbox

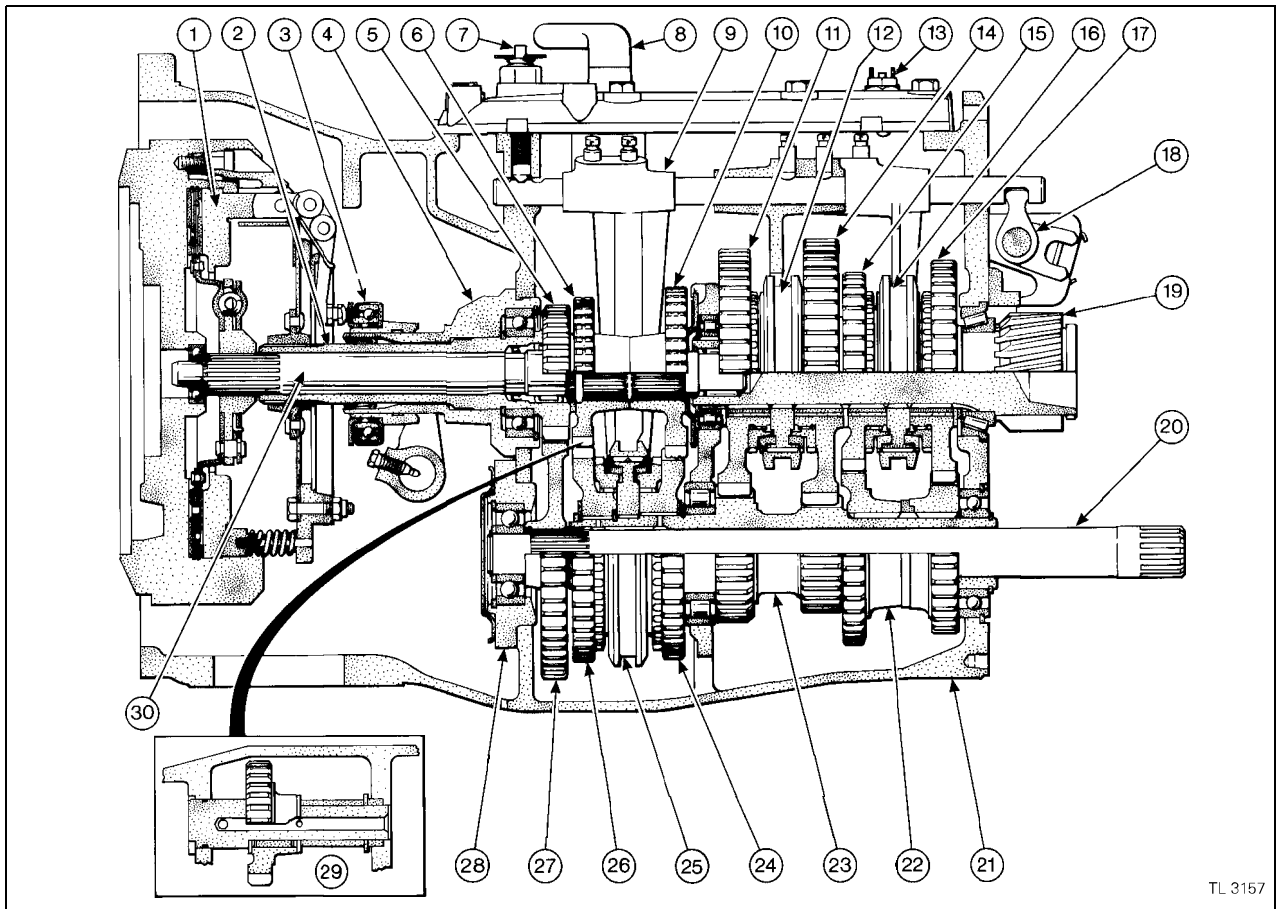


Fig.1

12 x 12 Shuttle Gearbox

Key to Fig.1

- | | |
|--|---|
| 1. Main split-torque transmission clutch | 16. 3rd/4th synchromesh coupler |
| 2. PTO input shaft | 17. 3rd gear |
| 3. Clutch release mechanism | 18. Selector mechanism |
| 4. Input housing | 19. Mainshaft |
| 5. PTO drive gear | 20. PTO drive shaft |
| 6. Reverse constant mesh gear | 21. Gearbox case |
| 7. Safety start switch | 22. 3rd/4th gear |
| 8. Shift mechanism | 23. Layshaft |
| 9. Selector rails and forks | 24. Forward constant mesh gear - layshaft |
| 10. Forward constant mesh gears | 25. Forward/reverse synchromesh coupler |
| 11. 2nd gear | 26. Reverse constant mesh gear - layshaft |
| 12. 1st/2nd synchromesh coupler | 27. PTO constant mesh gear - layshaft |
| 13. Switch - reverse bleeper | 28. PTO front bearing housing |
| 14. 1st gear | 29. Reverse idler gear |
| 15. 4th gear | 30. Transmission input shaft |

12 x 12 Shuttle Gearbox

The mainshaft carries four free-running gears, all of which are constant mesh with corresponding fixed gears on the layshaft to give the basic 1st, 2nd, 3rd and 4th ratios.

All the gear sets are of the straight cut spur type, 1st and 2nd being wider than 3rd and 4th to cope with the higher torque that has to be transmitted.

Drive through the 1st, 2nd, 3rd and 4th ratio gears takes place when the selected gear is engaged with the mainshaft by a sliding coupler. The coupler located between the pairs of gears forms part of the synchromesh engagement mechanism. Roller and taper roller bearings are used to support the mainshaft and layshaft.

Gearbox Driveline

The order of drive through the gearbox, with the gears selected is as follows:

From the input shaft through the forward or reverse gear set to the layshaft.

From the layshaft to the selected free-running gear on the mainshaft.

From the free-running gear to the coupler.

From the coupler to the mainshaft via the coupler hub which is splined to the mainshaft.

From the mainshaft to the tractor's final drive arrangements via the range gearbox.

Synchromesh Mechanism

The synchromesh mechanism synchronises (equalises) the speed of the selected free-running gear with the appropriate driven shaft before drive engagement. This is of great benefit to the drive by preventing potential gear damage and allowing fast, easy gear changes to be made on the move without the need to stop the tractor. Engaging gear with the tractor stationary is also easier.

Range Gearbox

The range gearbox is bolted directly to the rear of the main gearbox and forms an integral part of the main transmission assembly. Bolted to the right-hand side of the casing is the main gear shift lever, this single lever operates both sections of the gearbox excluding the forward/reverse mechanism which is operated from the lever adjacent to the steering wheel.

Gear Selection

The forward/reverse lever (1 Fig.2) is simple in operation, depress the clutch and move the lever forward to go forward, back for reverse from the central neutral position.

This operates the forward/reverse selector fork and coupler in the front of the gearbox. The lever can only be moved when the clutch is fully depressed and must be in the central neutral position to start the engine. A safety start switch prevents starting the engine if the lever is engaged.

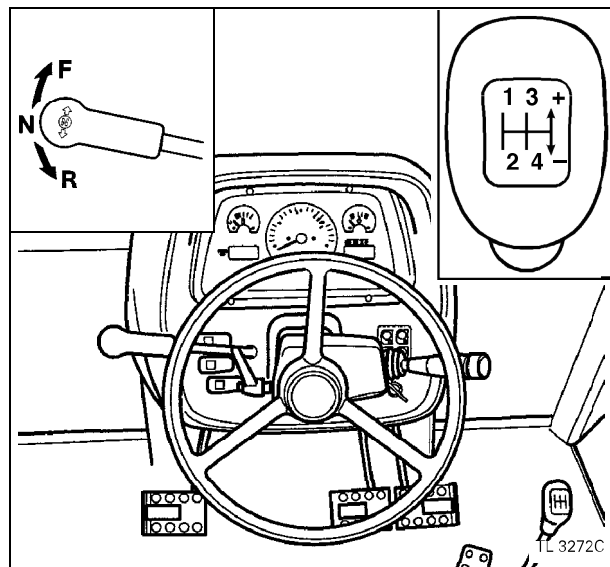


Fig.2 Gear shift positions

The 12 speeds are selected by a single lever (2 Fig.2), this lever operates the two sections of the gearbox. The first section contains four gears, 1st, 2nd, 3rd and 4th working in a gate as in any conventional gearbox, the lever is spring loaded when in neutral to be opposite 3rd and 4th gears. On the end of the gear lever cross shaft is a vertical lever which engages either of the two selector rails moving the selector fork and coupler.

The three speed range section is arranged in sequence from low (L) to medium (M) and high (H), and back through the range. The range selected is indicated by the appropriate indicator light on the instrument panel.

The range shift works on a ratchet system, moving the lever forward will select the next higher range and the lever will then return to the central position for selection of main gears, leaving the range selected.

Moving the lever back will select the next lower range and the lever will again return to the centre. If a double shift is required the lever must be moved in the appropriate direction twice.

The range gear is selected by moving the main gear lever fully to the right of the gate and moving it either forwards or backwards to its limit, depending whether a change up or down is being made. One movement of the lever changes one range.

After selection of the range gear the main gear lever is then used to select the required main gear.

12 x 12 Shuttle Gearbox

GEARBOX

Removal and Refitment

1-5A

Special Tools:

MF.367B Transmission Torque Wrench

Removal

IMPORTANT: The main gearbox and range gearbox must be removed and replaced in the tractor as one unit. DO NOT split between the gearbox and range gearbox.

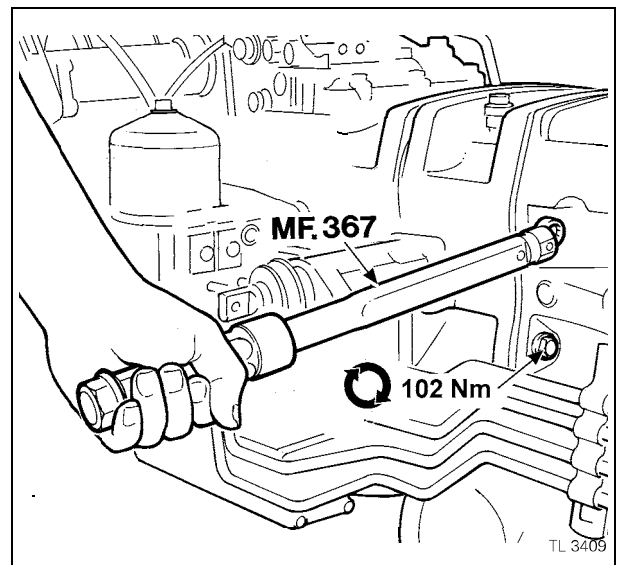
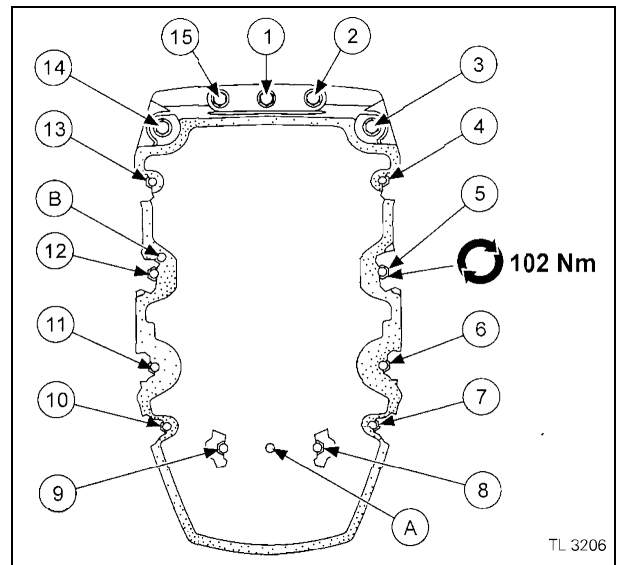
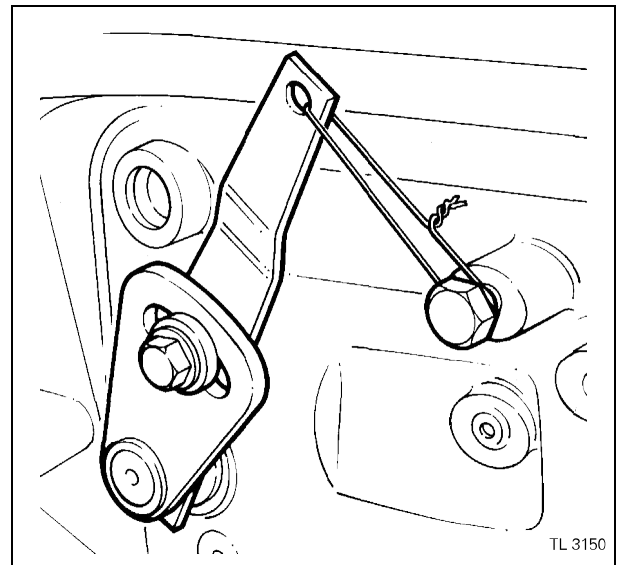
1. Split the tractor between the range gearbox and the rear axle (see operation 3-2A) in Section 2A Splitting the Tractor.
2. When the engine and gearbox assembly has been removed ensure that the engine is securely supported under the sump so that it does not fall over when the gearbox is removed.
3. With the aid of a hoist or small crane support the weight of the range gearbox.
4. Remove all the bolts around the casing and lift clear.
5. Tie the clutch operating lever back with a piece of wire to retain the clutch release bearing.
6. Support the weight of the main gearbox on the hoist or crane. Position the crane so that the input shafts can be withdrawn out of the clutch.
7. Remove all the bolts around the clutch housing and remove the gearbox taking care not to damage any of the clutch components.
8. Place the gearbox on a suitable bench so that the repair work can be carried out.

Refitment

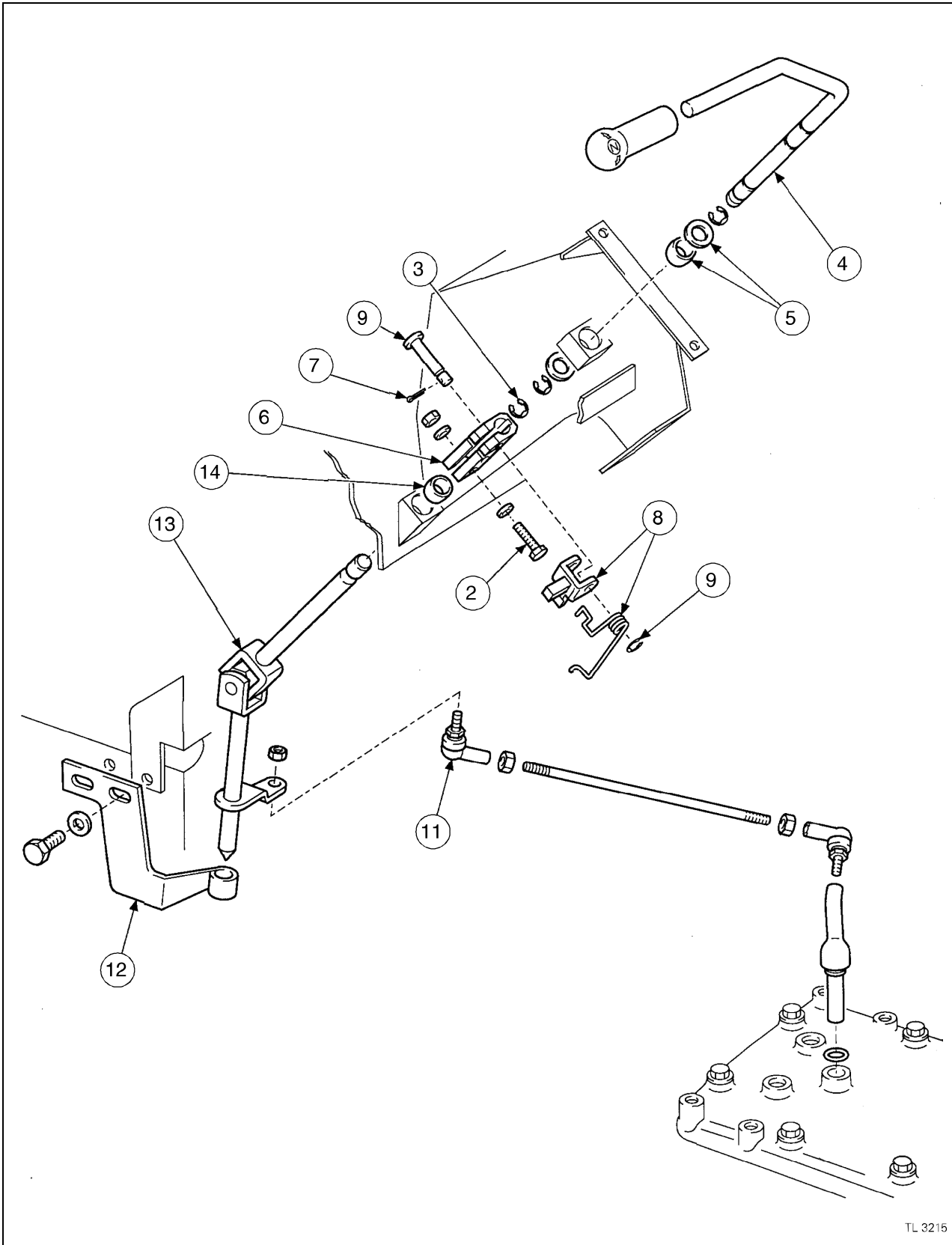
9. After repair, stand the gearbox vertically on the clutch housing face. Ensure that all gears are in neutral.
10. Ensure that the two dowels on the bottom and side of the range gearbox are in place.
11. Place a new gasket on the mounting face of the main gearbox.
12. Lower the range gearbox into position on the main gearbox. Check that range selector fork engages correctly with the rollers in the back of the cam plate. Lightly tap the gearbox with a copper faced hammer to ensure that the dowels 'A' and 'B' have located through the gasket into the main gearbox.

IMPORTANT: To prevent damage to the transmission the securing bolts must be tightened using the following procedure.

13. Apply Hylomar to the bottom two casing bolts. These are the two short bolts.



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14. Refit all the transmission case bolts (dry) and tighten to an initial torque to 50 Nm (35 lbf ft) working in sequence around the box as shown in the illustration. Use special tool MF.367B, Transmission Torque Wrench using the 14 mm socket.
15. Tighten all the bolts to a torque of 102 Nm (75 lbf ft). Finally, re-tighten the first bolt to ensure that the torque is correct.
16. Set the main shaft bearing pre-load, (*see operation 3-5D*).
17. Refit the gearbox assembly to the engine. Tighten the bolts around the clutch housing to a torque of 120 Nm (90 lbf ft).
18. Re-install the engine/gearbox assembly into the tractor.

FORWARD/REVERSE CONTROL LEVER

Overhaul

2-5A

Dis-assembly

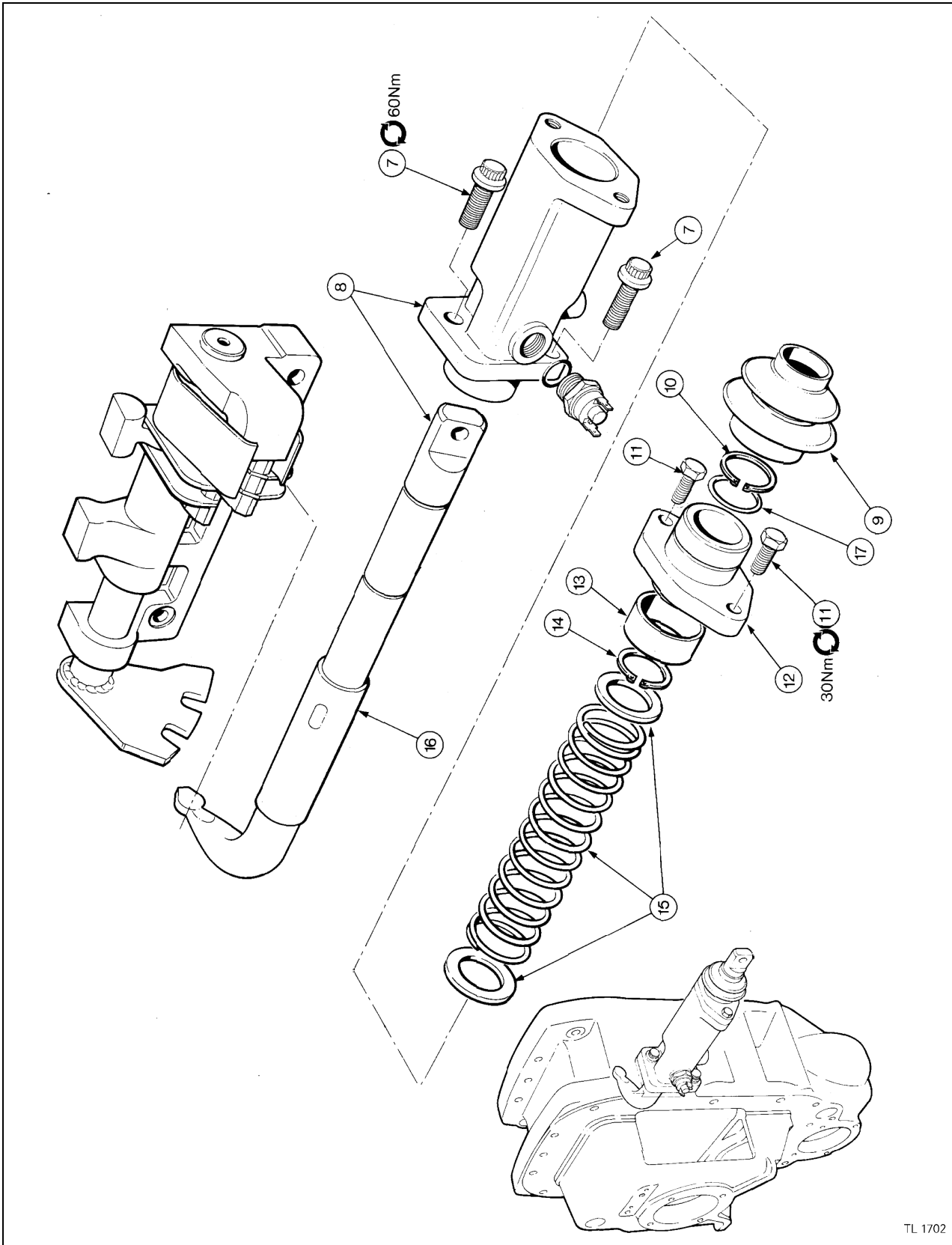
NOTE: *The lower part of the shaft with the universal joint can only be removed when the tractor is split between the engine and clutch.*

1. Remove the lower panel under the instrument panel to gain access to the control mechanism.
2. Slacken the coupling bolts.
3. Remove the three 'C' clips on the upper part of the hand lever.
4. Withdraw the hand lever up out of the instrument panel.
5. Remove the washers and spherical bearing.
6. Remove the coupling complete with the clutch interlock.
7. Remove the split pin.
8. Remove the spring and interlock lever.
9. Remove the 'C' clip and pivot pin.
10. If removal of the lower part of the shaft is required, split the tractor between the engine and clutch, sufficiently to enable the shaft to be removed from the lower bearing and to clear the back of the cylinder block.
11. Disconnect the control rod ball joint.
12. Remove the lower bracket.
13. Remove the lower shaft and universal joint.
14. Remove the lower spherical bearing.

Re-assembly

15. Reverse procedures 1 to 14 except:
 - a. Adjust the length of the control rod so that the interlock engages with the clutch pedal when the pedal is in its normal position.
 - b. Lightly lubricate the spherical bearings.
 - c. Set the hand lever to a nine o'clock position before tightening the coupling bolts.

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12 x 12 Shuttle Gearbox

MAIN GEAR SHIFT LEVER

Removal and Refitment

3-5A

Removal

1. Remove the three bolts and the gear lever cover (tractors with single fuel tank only).
2. Remove the cab floor to release the cover around the gear lever.
3. Disconnect the bottom strut from the gear lever.
4. Remove the gear lever pivot roll pin.
5. Withdraw the gear lever up through the cab floor.
6. If necessary, remove the bottom strut.
7. Remove the three 12 point cap screws holding the lever assembly to the range gearbox.
8. Remove the lever assembly.
9. Remove the rubber boot.
10. Remove the circlip.
11. Unscrew the two bolts holding the end cover in place.
12. Remove the end cover.
13. Remove the spacer.

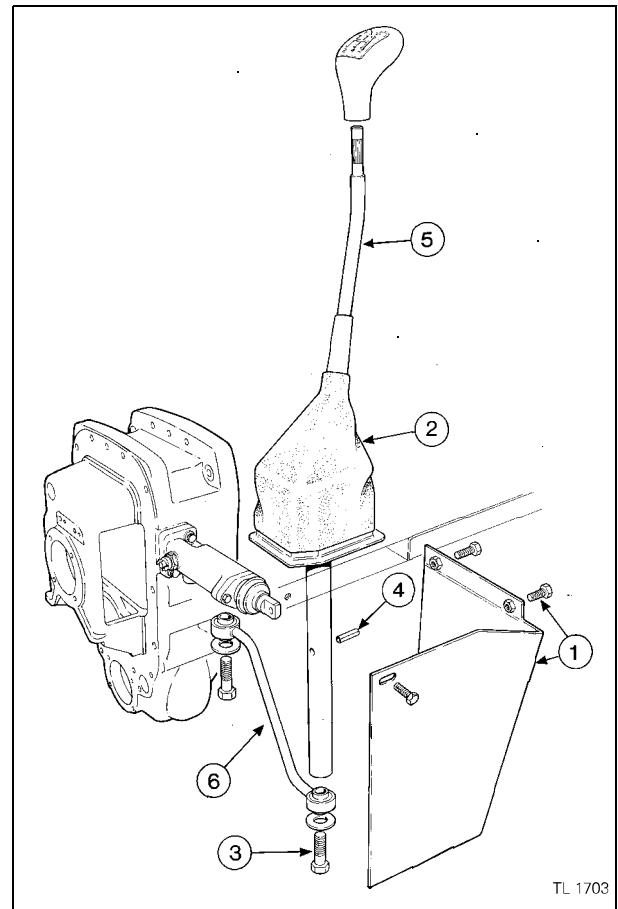


WARNING: Spring under compression.

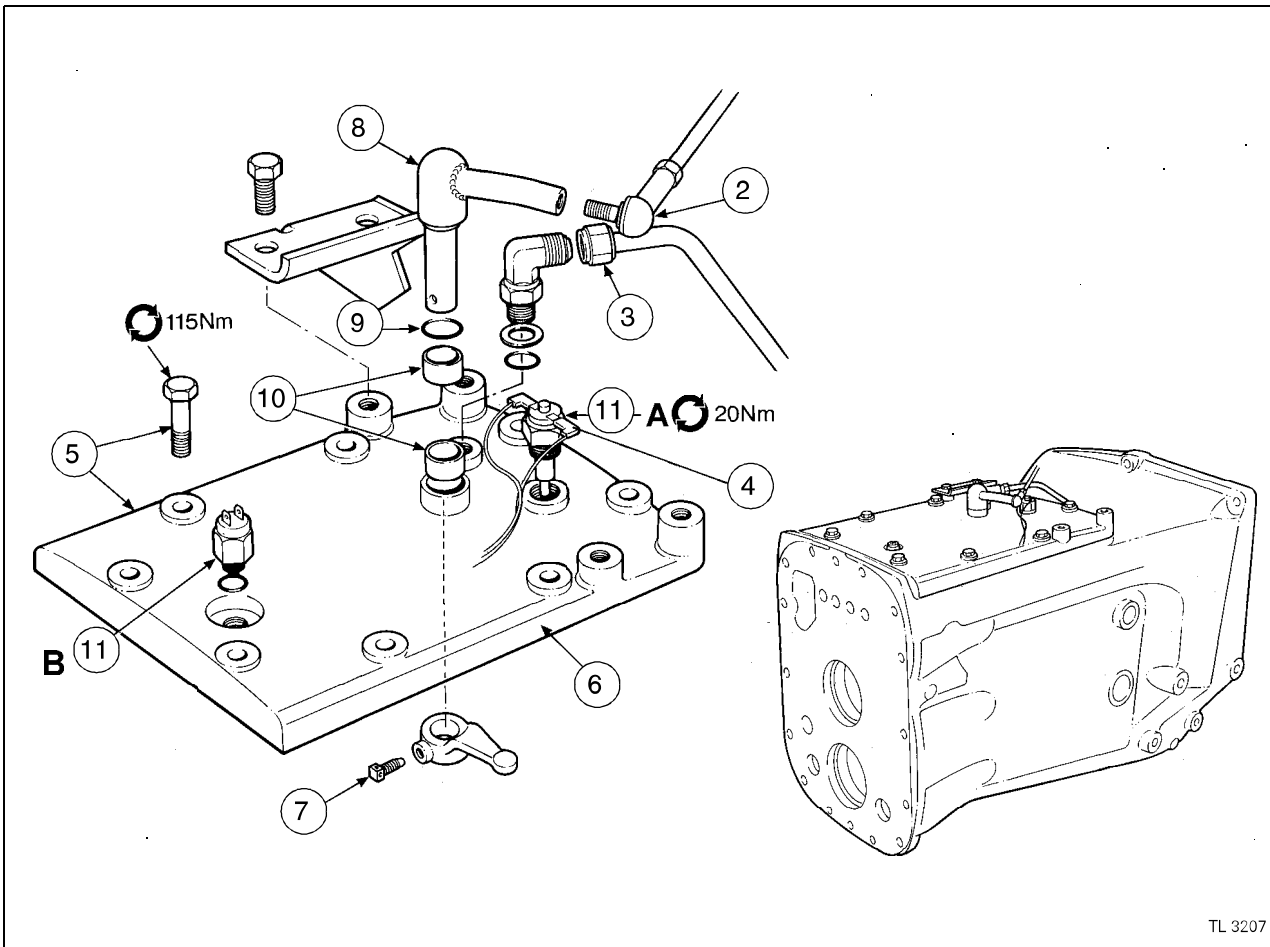
14. Remove the circlip.
15. Remove the two spacers and spring.
16. Remove the selector shaft from the housing.
17. Remove the 'O' ring.

Refitment

18. Reverse procedure 1 to 14, except:
 - a. Replace the 'O' ring in the end cover.
 - b. Replace all circlips.
 - c. Lubricate the component parts during assembly with transmission oil.
 - d. Ensure that the end of the selector shaft engages correctly in the jaws of the selector mechanism.
 - e. Apply Massey Ferguson Studlock (Loctite 270) to the two M8 bolts and tighten to a torque of 30 Nm (25 lbf ft).
 - f. Apply Massey Ferguson Multi-Gasket (Loctite 573) to the face of the end cap and housing. Tighten the 12 point cap screws to a torque of 60 Nm (45 lbf ft).



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GEARBOX TOP COVER

Removal and Refitment

4-5A

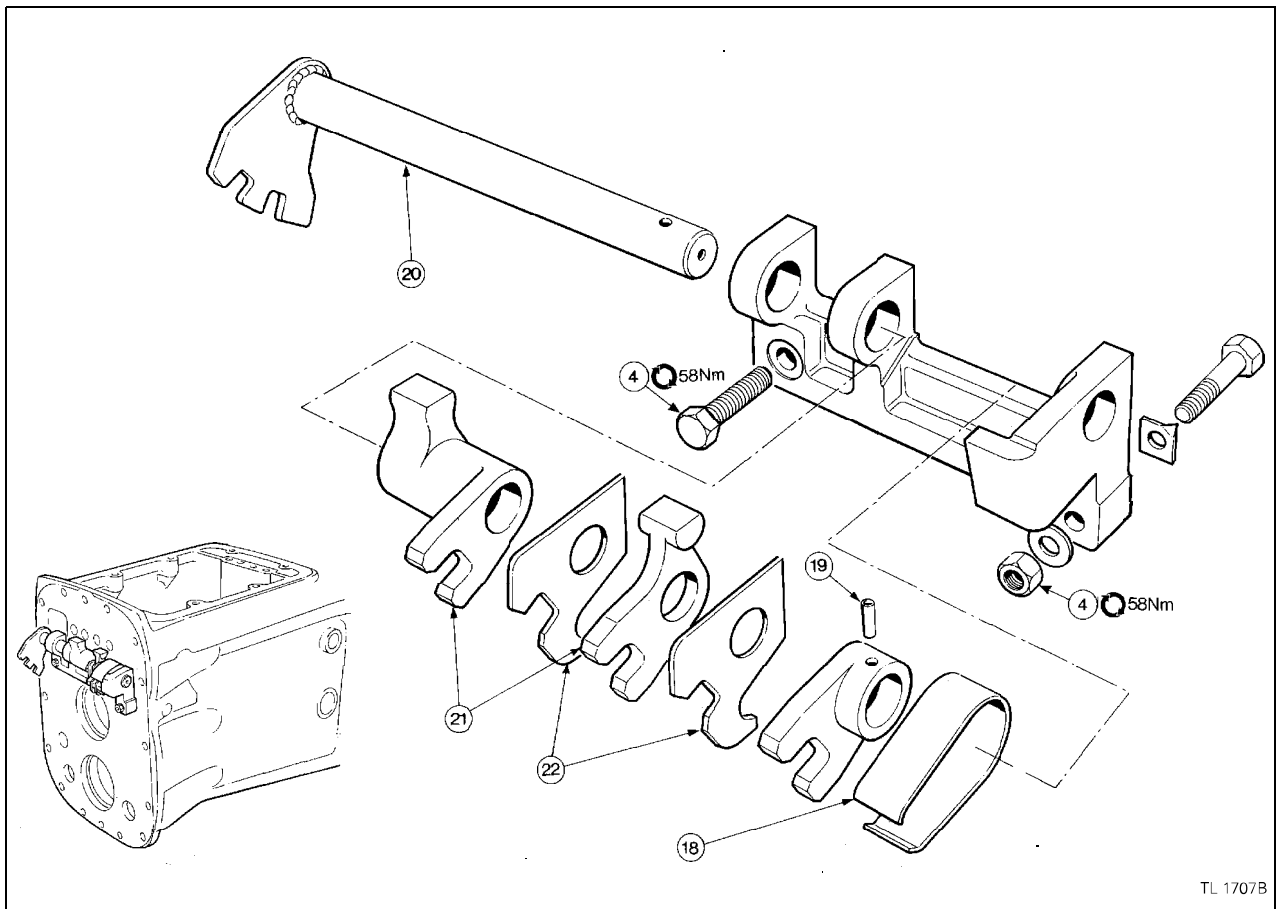
Removal

1. Remove the cab floor or footplates.
2. Disconnect the forward/reverse lever linkage.
3. Disconnect the lubrication oil pipe.
4. Disconnect the wires to the switches 'A' and 'B'.
5. Remove the bolts and clutch cable bracket.
6. Remove the top cover.
7. Unscrew the locking bolt in the selector lever and remove the lever from the shaft.
8. Withdraw the shaft from the cover.
9. Remove and discard the 'O' ring seal.
10. If necessary, remove and replace the bushes in the top cover.
11. Remove the safety start switch 'A', reverse bleeper switch 'B' to prevent damage to the switches.
12. Clean all components and remove dried gasket material from the machined faces.

Refitment

13. Reverse procedures except:
 - a. Replace the shaft 'O' ring.
 - b. Apply Massey Ferguson Studlock (Loctite 270) to the lever locking bolt (7).
 - c. Lubricate the safety start switch with a small quantity of transmission oil or petroleum jelly before installation.
 - d. Apply Massey Ferguson Multi-Gasket (Loctite 573) to the underside of the top cover and tighten the bolts to a torque of 115 Nm (85 lbf ft).

12 x 12 Shuttle Gearbox



SELECTOR RAILS AND FORKS

Removal and Refitment

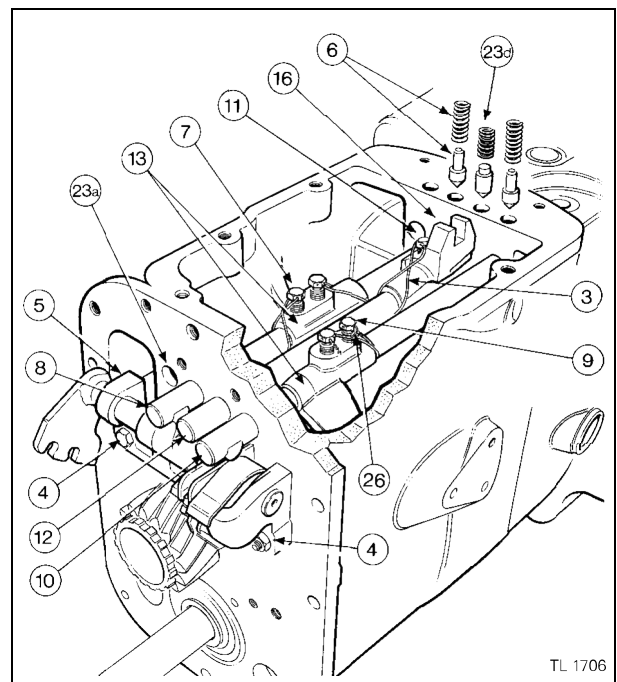
5-5A

Special Tools:

MF.414 Synchronmesh Setting Pin

Removal

1. Remove the gearbox assembly from the tractor, ([see operation 1-5A](#)).
2. Remove the gearbox top cover, ([see operation 4-5A](#)).
3. Release the locking wires.
4. Remove the bolt and nut from the rear selector mechanism.
5. Remove the selector mechanism assembly.
6. Lift out the detent springs and plungers.
7. Loosen the two locking screws.
8. Slide the 1st/2nd rail rearwards out of the housing.
9. Loosen the two locking screws.
10. Slide out the 3rd/4th rail rearwards out of the housing.
11. Loosen the two locking screws.



12. Slide the forward/reverse rail rearwards out of the housing.

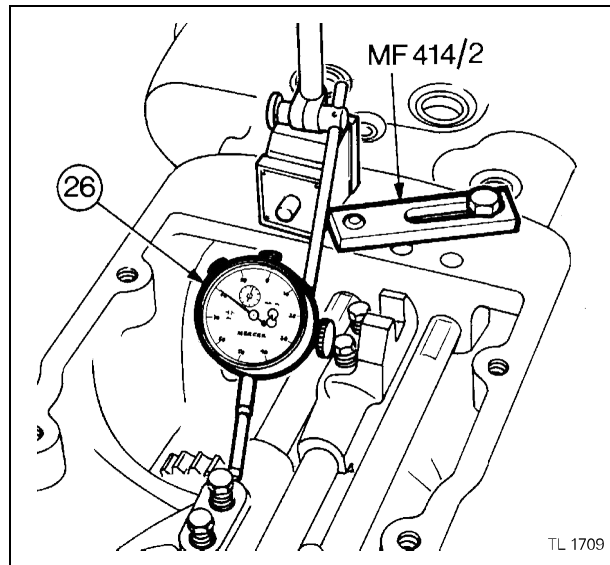
12 x 12 Shuttle Gearbox

13. Remove 1st/2nd and 3rd/4th selector forks.

NOTE: The forward/reverse selector fork can only be removed after removal of the input shaft and housing, and the reverse idler gear assembly.

To remove the forward/reverse selector fork:

14. Remove the main input shaft, (see operation 6-5A).
15. Remove the reverse idler assembly, (see operation 8-5A).
16. Remove the forward/reverse synchromesh selector fork.
17. If necessary, dismantle the selector mechanism proceed as follows:
18. Remove the selector return spring.
19. Drive out the roll pin.
20. Withdraw the range selector shaft.
21. Remove the selector levers.
22. Remove the spacer plates.



Refitment

23. Reverse procedures 1 to 22 except:
 - a. The first selector shaft hole, working from left to right, in the gearbox casing is not used.
 - b. Tighten the selector mechanism bolt and nut to a torque of 58 Nm (43 lbf ft).
 - c. Apply a few drops of oil to the selector rails before refitment.
 - d. When refitting the detent springs and plungers, the light spring and special plunger is fitted to the central forward/reverse rail.

NOTE: The selector fork adjustment can not be carried out until the range gearbox is bolted to the rear of the gearbox.

24. Set each synchromesh selector fork and rail to the neutral position. Lock the selector rails in place during the setting procedure using the plate and bolt MF.414/2 (part of tool MF.414 Synchromesh Setting Pin).
25. Set up magnetic base and dial indicator, as illustrated, with plunger located against the selector fork. With fingers pressure only slide the selector fork to the rear taking up any clearance. DO NOT engage gear. Zero the indicator gauge; slide the selector fork fully forward, taking up any clearance again and note the reading on the dial indicator. Halve the reading obtained and progressively lock up the two security screws on the selector fork to a torque of 43 Nm (32 lbf ft) ensuring that the selector fork is positioned to give the halve reading on the dial indicator. The setting must be within 0,25 mm (0.010 in).
26. Wire lock all the security screws.
27. Re-assemble the gearbox.

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PTO DRIVE SHAFT FRONT BEARING

Removal and Refitment

6-5A

Special Tools:

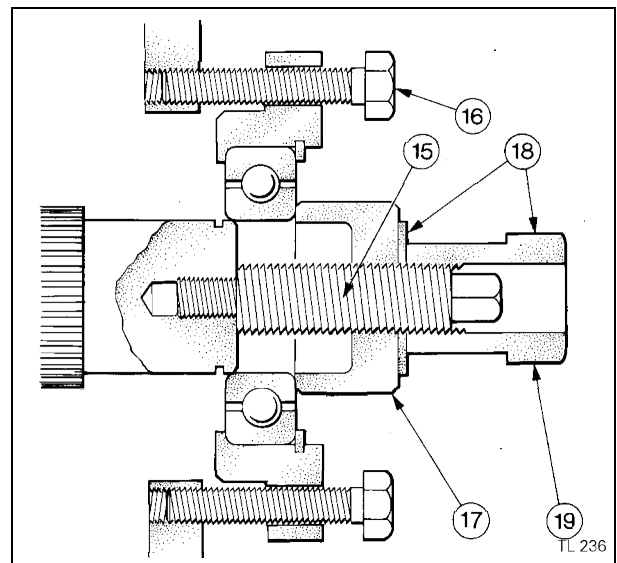
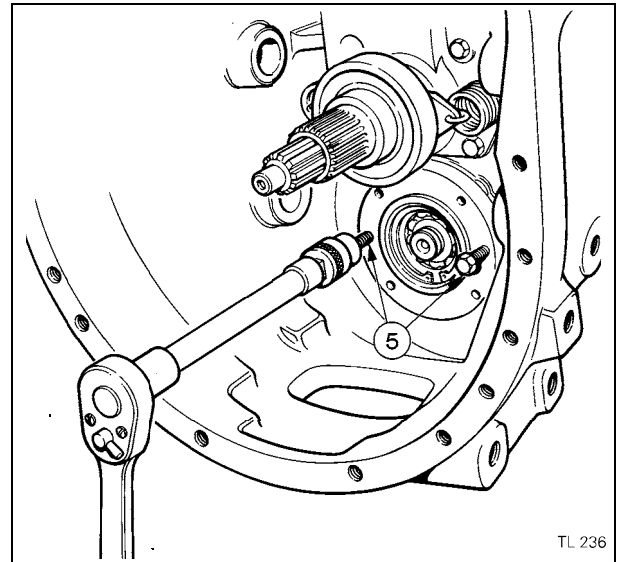
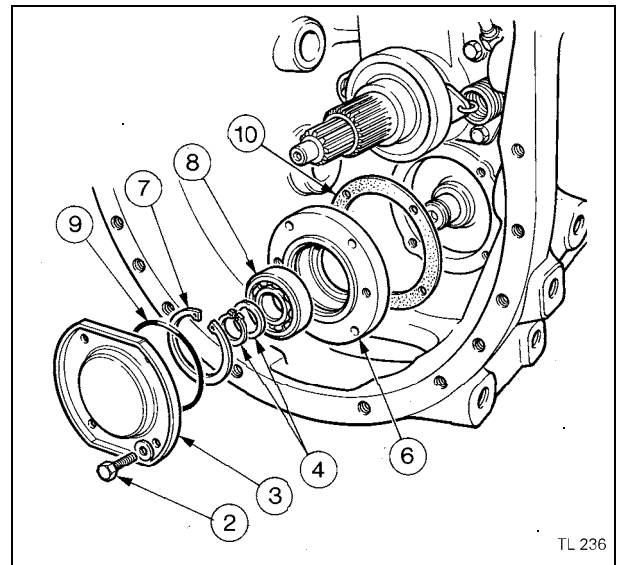
MF.218B PTO Bearing Housing Replacer

Removal

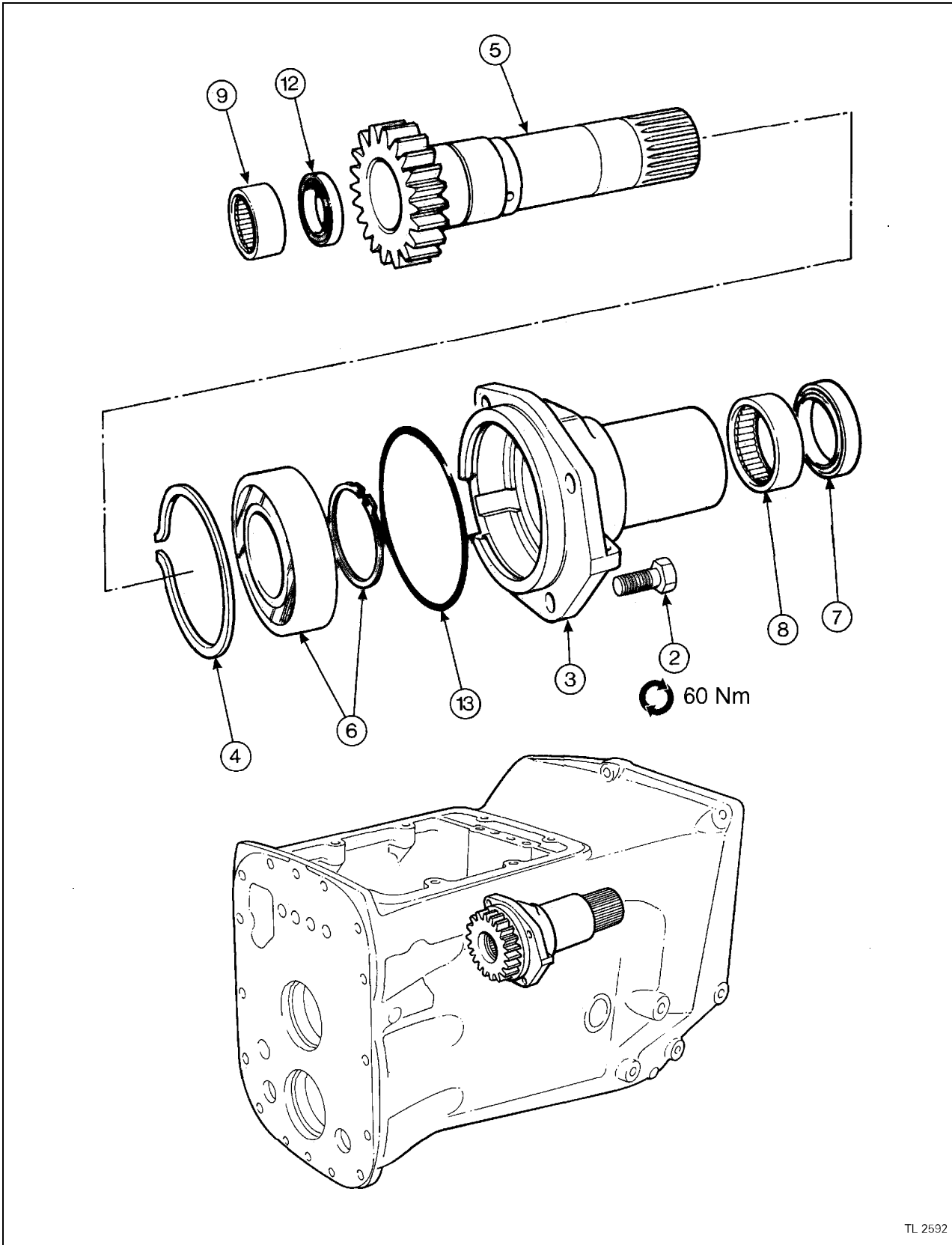
1. Remove the clutch cross-shaft and lever, (*see operation 4-4A*).
2. Remove the four bolts and washers.
3. Remove the cover plate.
4. Remove the external circlip and washer.
5. Screw two 3/8 UNC x (75 mm) 3 inch bolts (part of special tool MF.218B) into the bearing housing and tighten them evenly to draw the housing from the case and shaft.
6. Remove the housing.
7. Remove and discard the circlip.
8. Press out the bearing.
9. Discard the 'O' ring.
10. Discard the gasket.
11. If the gearbox has been removed and it is necessary to remove the PTO shaft, insert a 7/16 inch UNF bolt approximately 75-100 mm (3-4 inch long) into the shaft to protect it, and drive the shaft out of the PTO constant mesh gear.

Refitment

12. Lightly coat the new gasket with Hylomar sealant.
13. Using MF.218B, PTO Bearing Housing Replacer, refit the bearing and housing assembly.
14. Check that the PTO drive shaft splines locate with those in the PTO constant mesh gear, if the shaft has been removed.
15. Screw the centre screw into the end of the PTO shaft with the aid of a 9/16 inch across flats spanner.
16. Locate the bearing and housing assembly on the end of the PTO shaft and to the housing with the two long bolts provided with MF.218B through the unthreaded holes.
17. Place the adaptor onto the centre screw with the hollow face against the bearing.
18. Place the washer on the centre screw and put on the nut.
19. Tighten the nut with a 1 1/8 inch across flats spanner until the housing is pushed home and the PTO shaft is drawn through the ball bearing sufficiently to enable the washer and circlip to be fitted.
20. Fit a new circlip and washer.
21. Replace the cover ensuring that a new 'O' ring is fitted.
22. Lightly coat the securing bolt threads with Hylomar sealant.
23. Tighten the bolts to a torque of 58 Nm (43 lbf ft).



12 x 12 Shuttle Gearbox



TL 2592

12 x 12 Shuttle Gearbox

INPUT SHAFTS AND HOUSING

Removal and Refitment

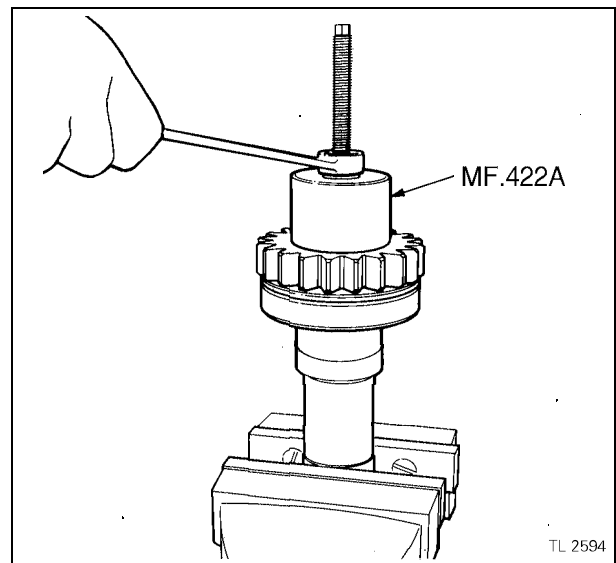
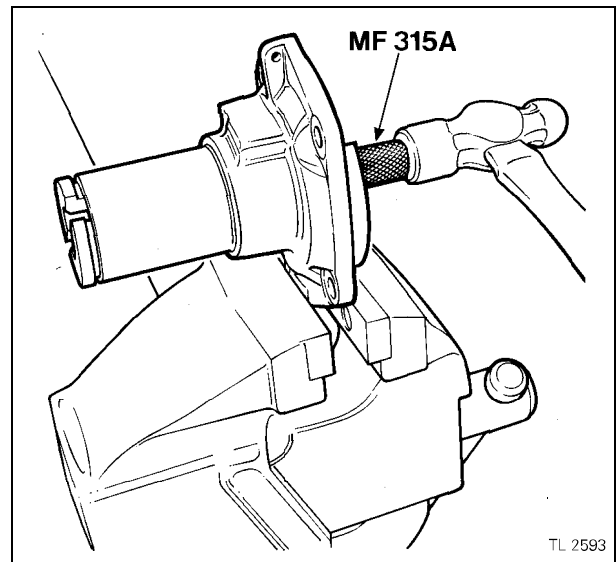
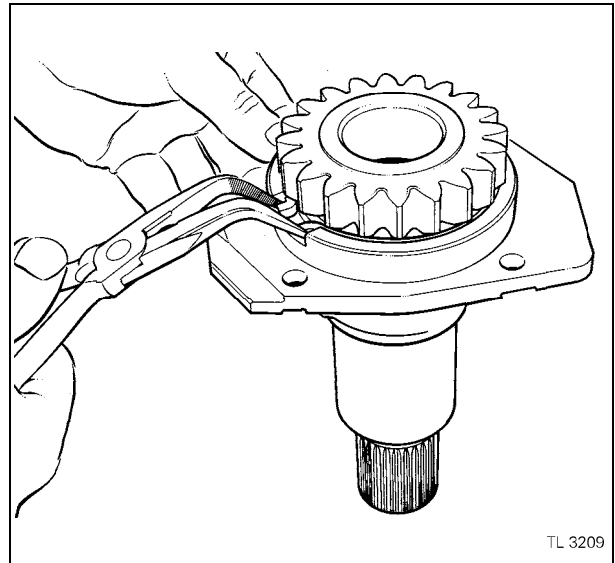
7-5A

Special Tools:

- MF.177A Input Shaft Oil Seal Protector
- MF.255B PTO Input Shaft Oil Seal Replacer
- MF.315A Needle Roller Bearing Remover/Replacer
- MF.421 Needle Roller Bearing And Seal Replacer
- MF.422A Bearing, Sleeve And Oil Seal Remover

Removal

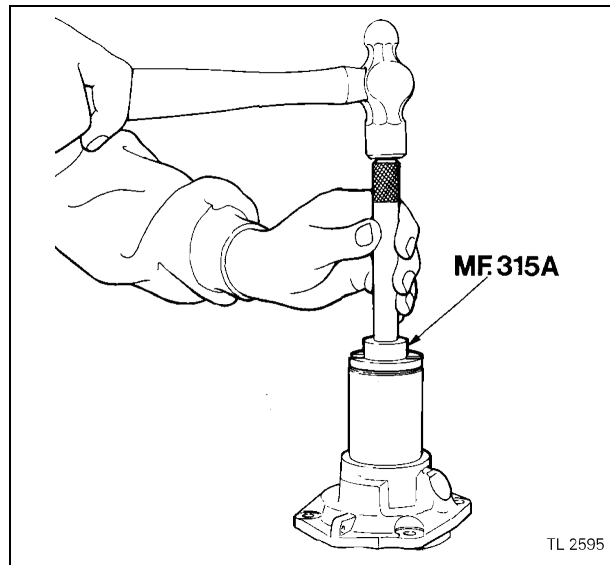
1. Remove the clutch mechanism, (*see operation 3-4A*).
2. Remove the four bolts.
3. Withdraw the input housing complete leaving the main input shaft in position.
4. Open up the large circlip in its groove so that it is clear of the bearing.
5. Push the PTO input shaft, complete with ball-bearing, rearwards out of the housing.
6. If necessary, remove the circlip and ball-bearing after first removing the split ring seals.
7. Lever the seal out of the front of the housing.
8. Using special tool MF.315A, Needle Roller Bearing Remover/Replacer, drive the needle roller bearing out of the housing.
9. Using special tool MF.422A, Bearing Sleeve and Oil Seal Remover, remove the rear needle roller bearing. Carefully assemble the collets so that the step is located behind the bearing. Screw up the tapered nut so that the collets are held tight inside the bearing.
10. Fit the cap, lubricate the screw thread, fit the washer and nut.
11. Tighten the nut withdrawing the bearing from the shaft.
12. Repeat the operation using tool MF.422A to extract the oil seal. The step on the collets must be located fully behind the seal.
13. Remove and discard the 'O' ring.



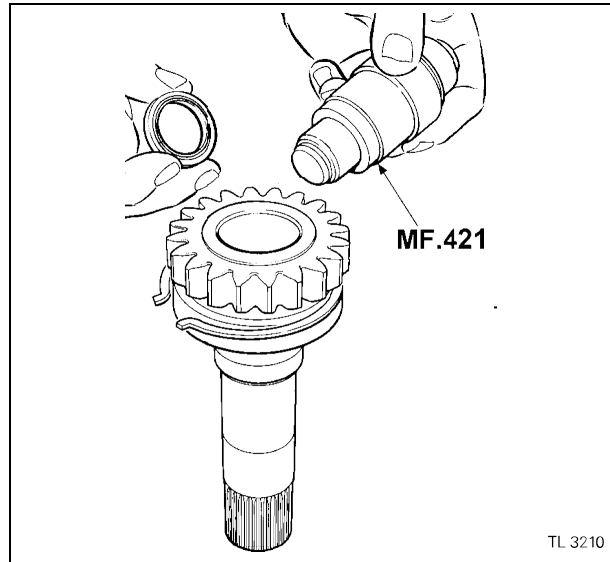
12 x 12 Shuttle Gearbox

Re-assembly

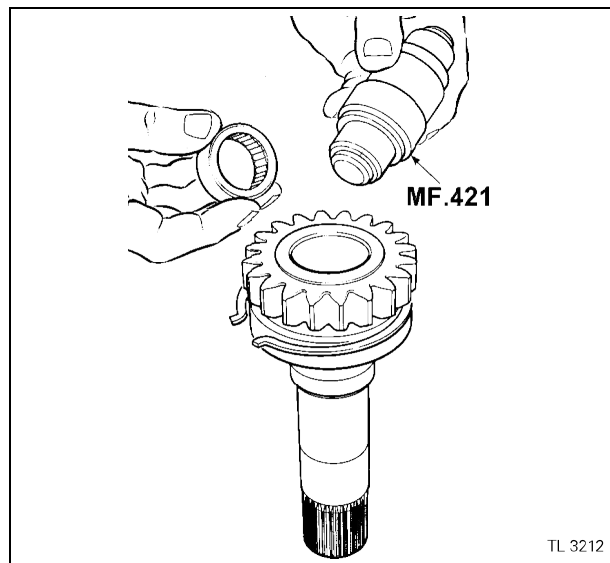
14. If the ball bearing has been removed from the PTO shaft, refit the bearing using a new circlip.
15. Using special tool MF.315A, Needle Roller Bearing Remover/Replacer, press a new needle roller bearing into the input housing. The needle roller bearing must be installed with the tool pressing on the face which is engraved with the maker's name. This end of the bearing is designed to take the pressing forces.



16. Pack the cavity of the small input shaft seal with petroleum jelly.
17. Using special tool MF.421, Needle Roller Bearing and Seal Replacer, place the seal on the tool as shown in the illustration and press it into the PTO shaft until the flange on the tool touches the face of the gear.

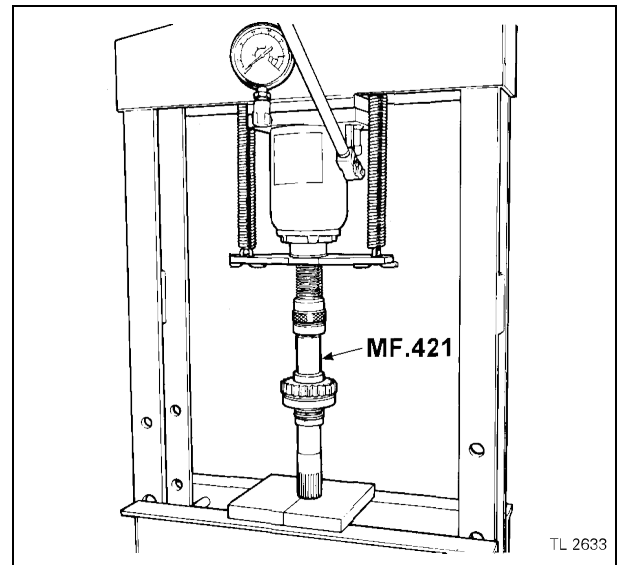


18. Place the needle roller bearing on the other end of the tool. The needle roller bearing must be installed with the tool pressing on the face which is engraved with the maker's name.

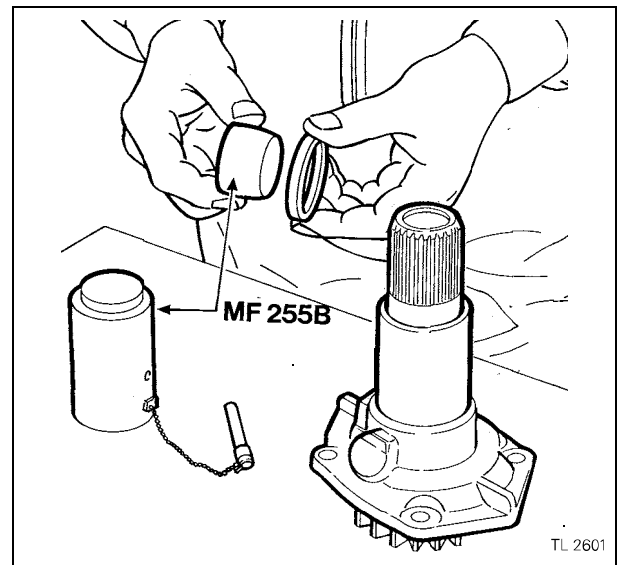


12 x 12 Shuttle Gearbox

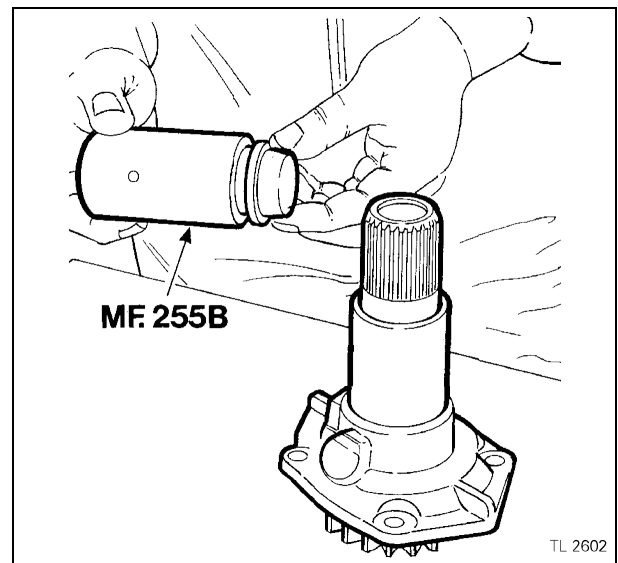
19. Press the bearing into position up to the flange on the tool.
20. Place the large circlip into the groove in the housing.
21. Open up the circlip with one hand, and install the PTO shaft and bearing with the other. Push the shaft into the housing until the circlip locates in the groove in the bearing.



22. Pack the cavity of the large PTO shaft oil seal with petroleum jelly.
23. Install the seal using special tool MF.255B, PTO Input Shaft Oil Seal Replacer, to prevent damage and oil leaks. Place the seal onto the cone adaptor with the seal lip facing away from the tool.



24. Fit the cone adaptor to the main body of the tool, slide the oil seal onto the tool. Remove the cone adaptor.



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