

MF 200 SERIES TRACTOR WORKSHOP SERVICE MANUAL

SUPPLEMENT A6/1856 072 M1

To keep your MF 200 Series Tractor Workshop Service Manual No. 1856 072 M1 up dated you should file the following pages in their appropriate place immediately and destroy the previous pages of the same number.

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**FUSE BOX COVER AND PANEL (MF 260, 265,
275, 285 and 290 Tractors)****Removal and Refitment**

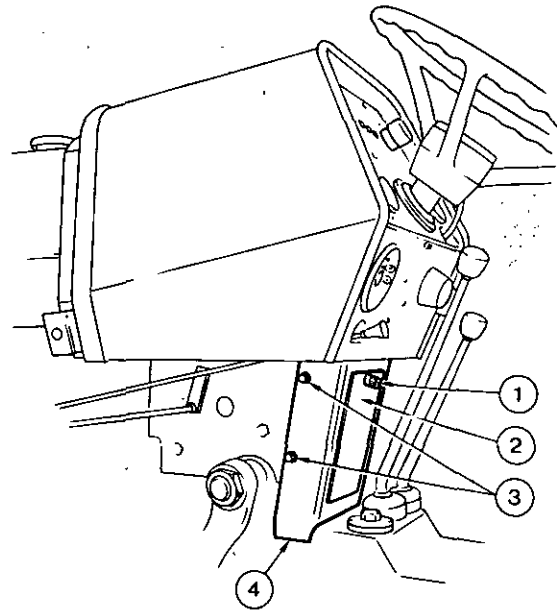
2A-28-15

Removal

1. Release the knurled screw beneath the instrument panel.
2. Lift out the fuse box cover.
3. Remove the four bolts, manual steering; six bolts, power steering.
4. Remove the fuse box cover.

Refitment

5. Reverse procedures 1 to 4, except:
(a) The welded nut is fitted at the top.
(b) The clip of the flexible conduit is fitted under the bottom right hand bolt.



SHEET METAL**SPRING SUSPENSION SEAT****GENERAL**

The seat is of the spring suspension type and is adjustable to suit heavy or light-weight operators by applying or releasing the spring tension through the screwed knob mounted on top of the seat pillar. The seat has a pressed steel pan with a bonded rubber cushion having a waterproof air valve which permits the cushion to breathe. The seat also has drains.

A plate, bolted to the back of the seat, is a sliding fit in the channel section plate, thus the seat can be lifted from the seat pillar. The front of the seat hinges on two nylon bearings onto the 'U' shaped swing arm which in turn is mounted on two nylon bearings and its rear ends are bolted to the bottom of the seat pillar and thus provides the tilting forward of the seat when the tractor is parked out in the open.

The channel section plate, on which the seat is mounted, is supported on two nylon rollers running in vertical tracks welded within the seat pillar and permits the channel section plate to travel up or down, according to the setting of the spring suspension and the weight of the operator.

The spring suspension is governed by the tension applied to the two coil springs situated vertically within the seat pillar between the adjuster beam and the bottom end of the channel section plate.

The spring tension can be altered by a knob and screwed rod connected to the adjuster beam and clockwise or counter clockwise rotation of the knob will cause the adjuster beam to move up or down to increase or decrease the tension and harden or soften the suspension.

A hydraulic damper is fitted between the seat pillar and the channel section plate to smooth out any seat oscillations when travelling over rough ground. A rubber stop is fitted at the limit of channel section plate travel to absorb any shock should the suspension inadvertently bottom owing to maladjustment.

The seat and pillar assembly is mounted on runners with nylon inserts between, to the inclined plate of the seat riser by a quick thread bolt and locking lever. The seat riser is fitted to the centre housing lift cover by two studs and nuts.

SEAT ADJUSTMENT

Adjustment of the seat, for both reach and height is effected by the seat riser. Reach adjustment by the fore and aft movement afforded by the two slots in the flat base of the seat riser and the mounting studs in the hydraulic lift cover and for height by a single slot in the inclined face of the seat riser and held in position by a quick thread bolt. A locking handle is fitted to this quick thread bolt to facilitate adjustment and locking.

The seat is of the spring suspension type and is adjustable to suit heavy or lightweight operators.

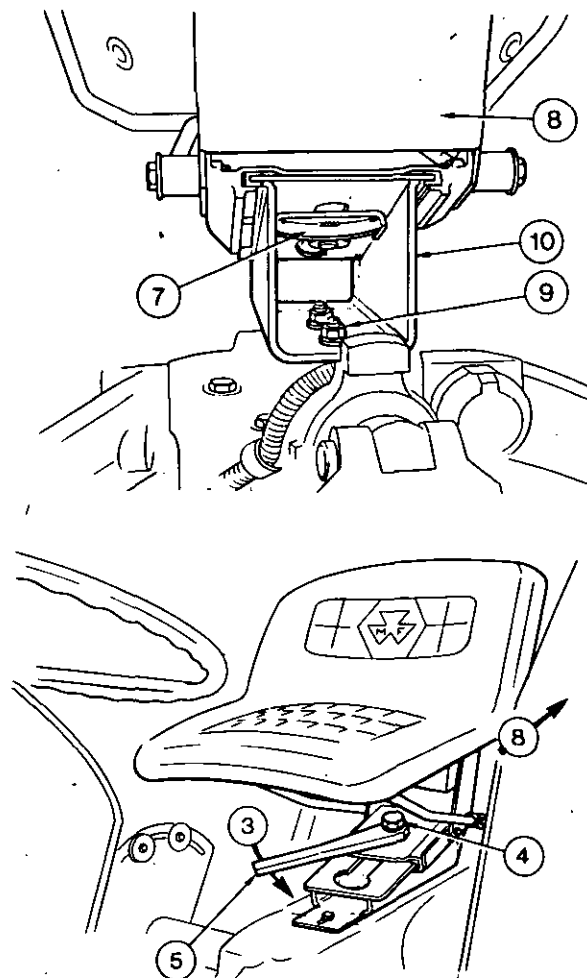
Adjustment of the seat suspension is effected with the weight of the operator on the seat and by rotating the adjustment knob clockwise or anti-clockwise to align the seat pointer with that on the seat pillar.

SPRING SUSPENSION SEAT AND RISER**Removal and Replacement 2A-29-17****Removal**

1. Remove the two number plate illumination lamp nuts and washers.
2. Remove the wiring harness bolt and washer.
3. Move the seat locking lever to the left.
4. Remove the bolt and washers.
5. Remove the seat locking lever.
6. Unscrew and remove the quick thread bolt and washers.
7. Remove the clamp/slide.
8. Slide the seat upward and rearward.
9. Remove the two nuts and washers.
10. Remove the seat riser.

Refitment

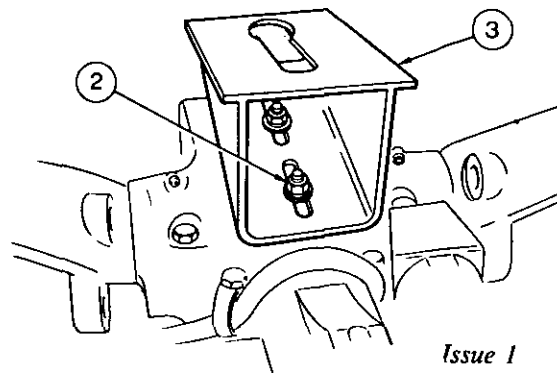
11. Reverse procedures 1 to 9, except:
 - (a) Ensure that the non-metallic runners are located by the raised lugs on their bottom faces and that they are held tight within the seat slide.
 - (b) The flat face of the clamp is positioned uppermost and so that the welded reinforcement curves rearward.
 - (c) The quick thread bolt is tightened to hold the seat firm and the locking handle is fitted so it points to the right.
 - (d) Set the height of the seat before adjusting the reach.

**SEAT RISER****Removal and Replacement 2A-30-17****Removal**

1. Remove the seat, operation 2A-29-17.
2. Identify the position of the seat riser and remove two nuts and washers.
3. Remove the seat riser.

Replacement

4. Reverse procedures 1 to 3, except:
 - (a) The seat riser is positioned "sharper" end to the front of the tractor.



SHEET METAL**SPRING SUSPENSION SEAT****Servicing** 2A-31-18**Dismantling**

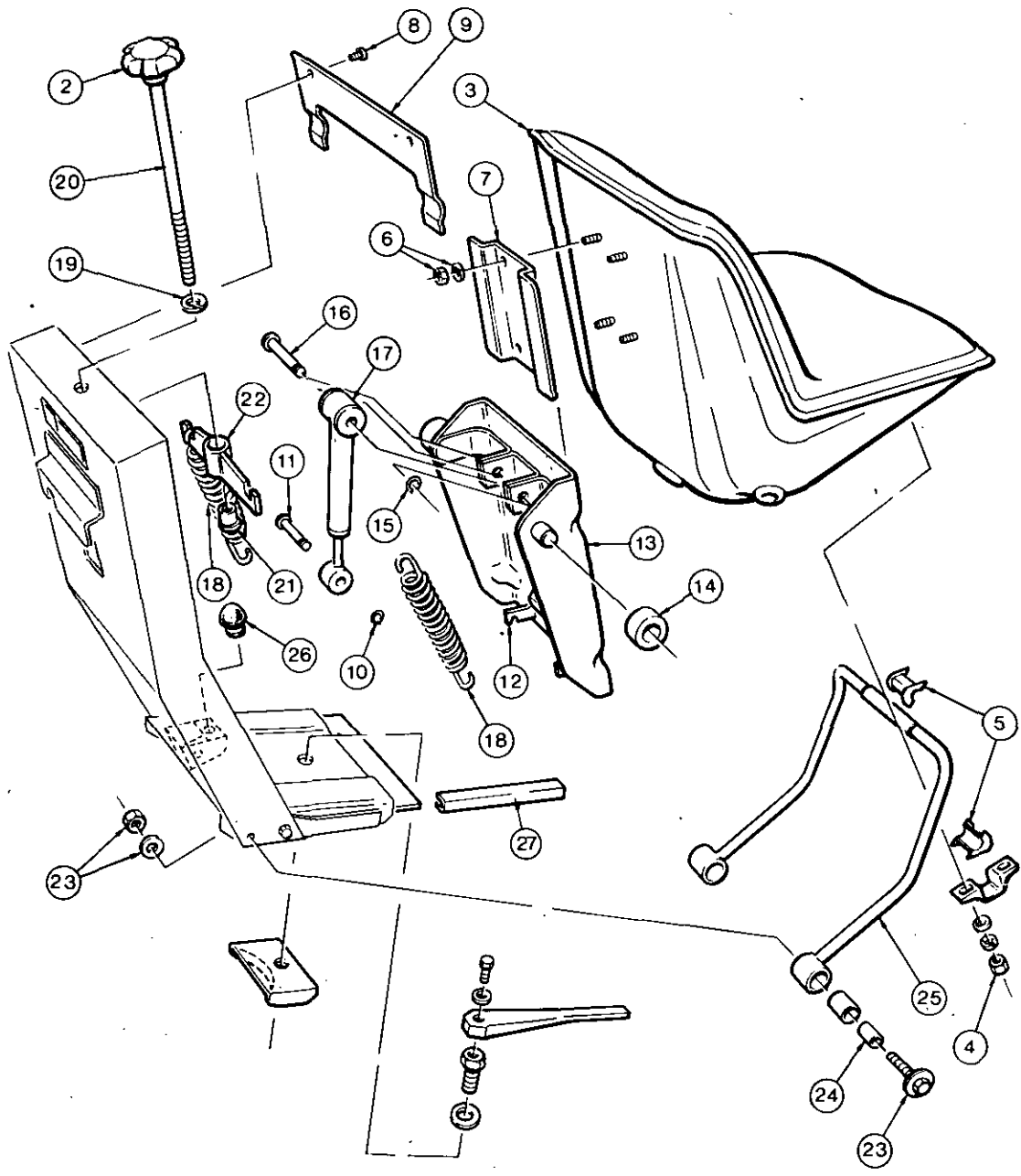
1. Remove the seat, operation 2A-29-17.
2. Slacken off the adjuster knob to fully lower the seat.
3. Lift the seat from the channel section plate and fold forward.
4. Remove the four nuts and washers.
5. Remove the two bearing housings and the split bearings.
6. Remove the four nuts and washers.
7. Remove the seat slide.
8. Remove the two screws.
9. Remove the top front cover.
10. Remove the circlip.
11. Eject the bottom shock absorber pin.
12. Detach the bottom ends of the two springs.
13. Remove the channel section plate upward.
14. Remove the two rollers from the channel section plate lugs.
15. Remove the circlip.
16. Eject the top shock absorber pin.
17. Remove the shock absorber.
18. Remove the two springs.
19. Remove the circlip.
20. Unscrew and remove the adjuster rod and washer.
21. Remove the flanged threaded bush.
22. Remove the adjuster beam.
23. Remove the two nuts, washers and bolts.
24. Remove the metal bushes.
25. Remove the swing arm.
26. Remove the rubber stop.
27. Depress the keys to remove the seat runners.

Re-assembling

28. Reverse procedures 1 to 26, except:
 - (a) Ensure that the rubber stop, swing arm, bushes, seat bearings, seat runners, seat cushion and channel section plate rollers are in good condition.
 - (b) Fit the rubber stop to the flatter side of the seat pillar bracket.
 - (c) Tighten the two swing arm bolts until they bottom.
 - (d) Fit the flange of the threaded bush to the straight side of the adjuster beam.
 - (e) Fit the adjuster beam so the straight edge is at the bottom.
 - (f) Fit the adjuster rod through the top of the seat pillar, the non-flanged end of the threaded bush and the welded bracket.
 - (g) Ensure that the circlips locate the bottom of their grooves.
 - (h) Fit the shock absorber, body end, to the channel section plate.
 - (i) Fit the tops of the two springs to the adjuster beam before fitting the channel section plate.
 - (j) Tension the two springs by rotating the adjuster knob clockwise.

KEY TO SPRING SUSPENSION SEAT

2. Adjuster knob
3. Seat
4. Bearing housing nuts and washers
5. Split bearings and housings
6. Seat slide nuts and washers
7. Seat slide
8. Cover screws
9. Top front cover
10. Circlip
11. Shock absorber bottom pin
12. Hooks for springs
13. Channel section plate
14. Rollers
15. Circlip
16. Shock absorber top pin
17. Shock absorber
18. Spring
19. Adjuster rod circlip
20. Adjuster rod
21. Flanged threaded bush
22. Adjuster beam
23. Swing arm nuts, washers and bolts
24. Swing arm metal bushes
25. Swing arm
26. Rubber stop
27. Seat runners.



MK II—ZF—8 SPEED SYNCHROMESH TRANSMISSION**GENERAL**

The transmission has four forward gears and one reverse gear which are doubled by a planetary unit to give eight forward and two reverse gears.

All gear teeth are of involute, straight cut spur type, designed to run in constant mesh, except for first gear which is now introduced with an increased width gears of constant mesh design, with a helical gear tooth form.

Where movement of the gears is required to change ratio, synchromesh engagement is used on the top two gears, which allows a heavy load to be accelerated in a lower gear and then allow the higher gears to be engaged on the move; it also allows a change down from top gear for hill climbing with a heavy load, or to increase engine braking down hill.

Thus the 8 speed synchromesh gearbox has eight speeds of the same ratio as on the non-synchromesh 8 speed gearbox but with synchromesh on 3rd, 4th, 7th and 8th gears.

Principle of Operation

Refer to figures 1, 2 and 3.

The Transmission

The tractor engine drives a clutch with divided drive, each plate being splined onto a separate gearbox shaft.

Drive is transmitted to:

- (a) The p.t.o. shaft (14), which is hollow and has gear teeth on its rear end.
- (b) The main drive shaft (17), (which runs inside the p.t.o. shaft) has gear teeth on its rear end and is spigot located in the front end of the mainshaft.

Layshaft and P.t.o. Shaft

Rotation of the p.t.o. input shaft (14) drives the p.t.o. constant mesh gear (109) which is splined onto the p.t.o. drive shaft (82). When the main input shaft (17) rotates, the drive is transmitted to the constant mesh gear (111), which is splined onto the layshaft (85). The layshaft, which is hollow and externally splined, has 14 gear teeth machined on its outside diameter to provide the first gear layshaft pinion.

It is supported by a roller bearing (84) located in the centre web and a ball race (86) located in the rear wall of the transmission case. Mounted on the layshaft (85) are three other gears, which are second (23 teeth) (112), fourth (33 teeth) (114) and third (28 teeth) (115) gears respectively. None of the layshaft gears are free to move along the shaft, being retained, either by abutment with other gears, bearings or snap rings.

Mainshaft

The mainshaft (62) has 31 shallow splines on its external surface, has gear teeth at its rear end and has a bore at its front end to accept the spigot on the main input shaft. It is supported by a roller bearing (95) located in the centre web and a ball race (59) located in the rear wall of the transmission case.

Mounted on the mainshaft are five sets of gears 3 of which are in constant mesh with the layshaft gears, when viewed from the front of the gearbox these gears are second (46 teeth) (93), first (42 teeth) (97), reverse (44 teeth) (100), fourth (36 teeth) (106) and third (41 teeth) (105).

The mainshaft gears are mounted on bushes which run on a sleeve, splined onto the mainshaft. When a gear is required, the sliding coupler (99) or (103) which

is splined to the mainshaft, is slid along by the selector to engage with dog teeth formed on the gear. This has the effect of locking the gearwheel to the shaft. The sliding couplers are used to engage and disengage, first, reverse, fourth and third gears, whilst second gear is moved into and out of mesh by a selector fork sliding the gear on the mainshaft splines.

SYNCHROMESH MECHANISM

The 8 speed ZF transmission has one synchromesh engagement situated between third and fourth gear, which operates on the following principal.

The synchromesh drive hub is splined to the shaft and the sliding coupler is mounted on the hub. The three pressure blocks are held out against the coupler by means of springs and plungers the synchronizer rings and each have three small lugs which fit into corresponding slots in the sliding coupler.

The inner spacers of the synchronizer rings are cone shaped and match the conical shape of the driven gear shoulders which they contact. These cone shaped surfaces provide the friction force to synchronize the speed of the shaft and gear.

During synchronization, the sliding coupler is moved towards the selected gear, pushing the synchronizer ring. The ring contacts the shoulder of the driven gear and begins to synchronize the speed of the two parts. To complete the shift, the sliding coupler teeth pass through the synchronizer ring teeth (because both are now rotating at the same speed), and mesh with the teeth on the driven gear.

Reverse Gear Cluster

The compound gear cluster (122) has 14/21 teeth respectively. The 21 tooth portion of the gear is in constant mesh with the fourth gear pinion (33 teeth) (114) on the layshaft. The 14 tooth portion is in constant mesh with the reverse gear pinion (44 teeth) (100) on the mainshaft.

Reverse gear engagement is made by a dog clutch (sliding coupler) (99), engaging with the reverse gear pinion (100) on the mainshaft. The reverse gear, acting as an idler gear between the layshaft and the mainshaft drive, reverses the rotation of the mainshaft, epicyclic unit and the final drive.

Epicyclic Unit

The basic four forward and one reverse gears are doubled by the epicyclic unit (Heavy Duty) mounted on the rear end of the transmission case. The epicyclic unit comprises a ring gear (66), inside which run three planetary pinions mounted in a carrier (70). The planetary pinions are driven by gear teeth on the end of the mainshaft (62) which acts as the sun gear.

When the mainshaft rotates, the planetary pinions also rotate, but being meshed with the teeth on the inside of the ring gear the rotational speed of the carrier is reduced by a ratio of 4:1.

To transmit the drive from the epicyclic unit to the rear axle, a driveshaft is connected by the coupler (81), either directly to the gearbox mainshaft (HIGH range), or to the planetary pinion carrier (70) (LOW range).

Movement of the dual range selector lever actuates the rod attached to the selector fork (50) which moves the coupler (81) into, or out of mesh with either the end of the mainshaft (62) or the planetary pinion carrier (70).

Between the two engaged (HIGH or LOW range) positions, there is a neutral position, where the coupler splines are disengaged from both the mainshaft and the planetary pinion carrier.

MK II-ZF-8 SPEED SYNCHROMESH TRANSMISSION

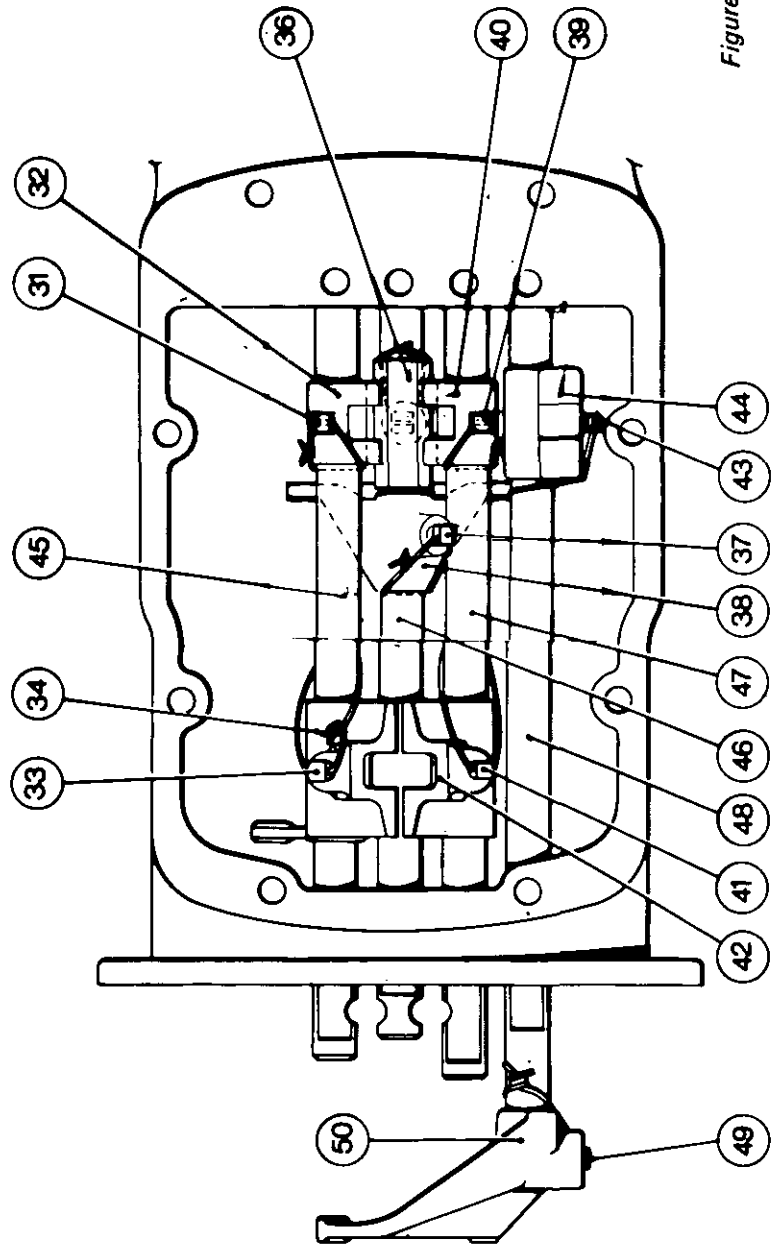


Figure 1

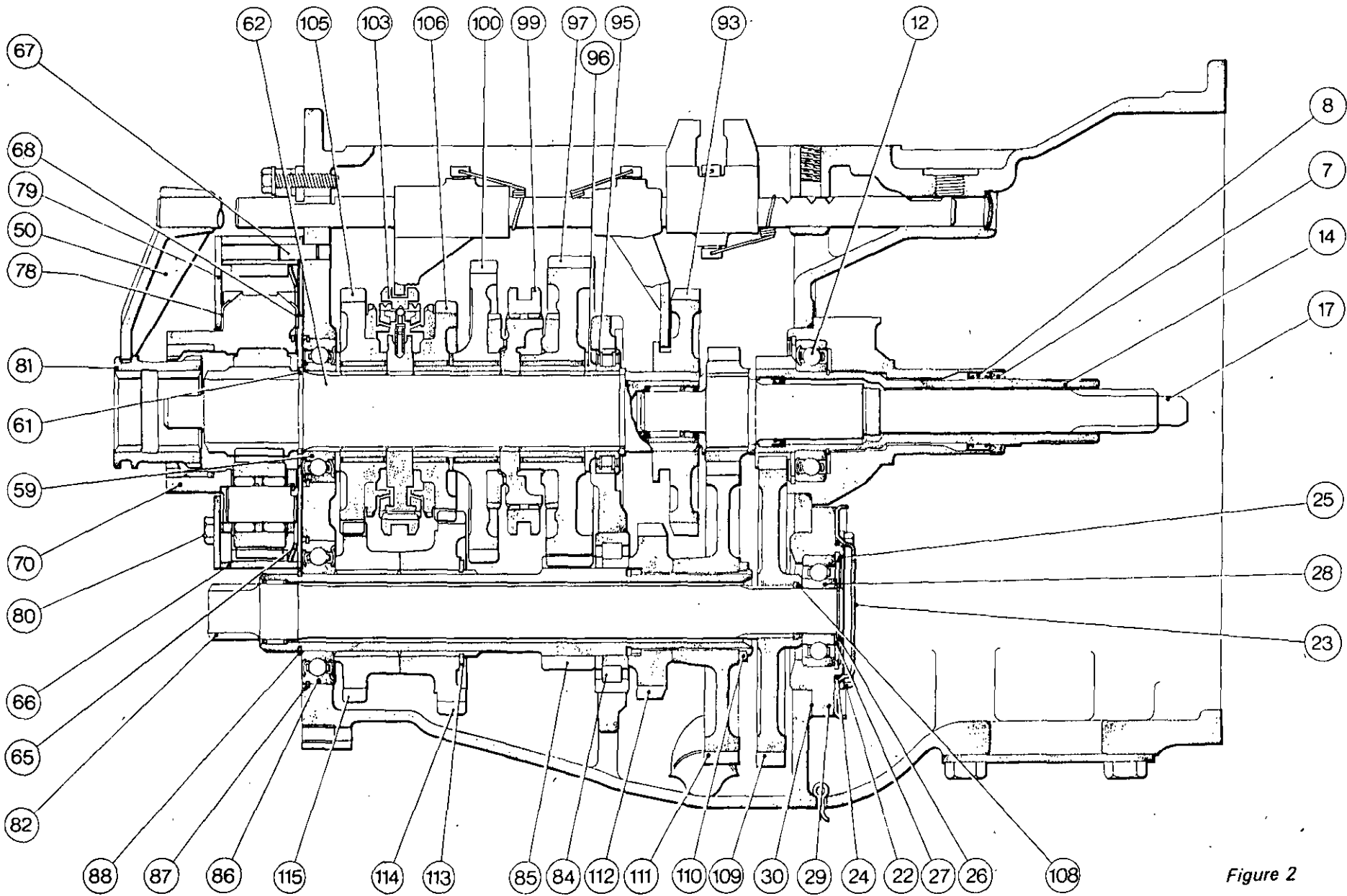


Figure 2

MK II—ZF—8 SPEED SYNCHROMESH TRANSMISSION

KEY TO FIGURES 1, 2 and 3

- | | | | |
|----|---|-----|---|
| 1 | Clutch release bearing | 68 | Epicyclic front thrust ring |
| 2 | Clutch release bearing carrier | 69 | Epicyclic planetary pinion shaft securing circlip |
| 3 | Clutch release fork locking peg | 70 | Epicyclic planetary pinion carrier |
| 4 | Clutch release fork | 71 | Epicyclic planetary pinion shaft |
| 5 | Clutch release bearing return spring | 72 | Planetary pinion front thrust washer |
| 6 | Input housing securing bolts | 73 | Planetary front roller set |
| 7 | P.t.o. input shaft seal | 74 | Planetary pinion |
| 8 | P.t.o. input shaft needle roller bearing | 75 | Planetary roller spacer |
| 9 | Input housing | 76 | Planetary rear roller set |
| 10 | P.t.o. input shaft bearing securing external circlip | 77 | Planetary pinion rear thrust washer |
| 11 | Input housing 'O' ring | 78 | Epicyclic rear thrust ring |
| 12 | P.t.o. input shaft bearing | 79 | Epicyclic cover plate |
| 13 | P.t.o. input shaft securing internal circlip | 80 | Epicyclic securing bolts |
| 14 | P.t.o. input shaft | 81 | High/Low shift coupler |
| 15 | Main drive input shaft seal | 82 | P.t.o. drive shaft |
| 16 | Main drive input shaft front bush | 83 | Layshaft rear needle roller bearing |
| 17 | Main drive input shaft | 84 | Layshaft front bearing |
| 18 | Main drive input shaft rear bush | 85 | Layshaft |
| 19 | Main shaft needle roller bearing front spacer | 86 | Layshaft rear bearing |
| 20 | Main shaft needle roller bearing | 87 | Layshaft rear bearing location snap ring |
| 21 | Main shaft needle roller bearing rear spacer | 88 | Layshaft rear bearing securing snap ring |
| 22 | P.t.o. front bearing cover securing bolts | 89 | Reverse gear cluster shaft |
| 23 | P.t.o. front bearing cover | 90 | Reverse gear cluster shaft retaining plate |
| 24 | P.t.o. front bearing cover 'O' ring | 91 | Tab washer |
| 25 | P.t.o. front bearing securing circlip | 92 | Reverse gear cluster shaft securing bolt |
| 26 | P.t.o. shaft securing circlip | 93 | Second gear (Mainshaft) |
| 27 | P.t.o. shaft spacer washer | 94 | Mainshaft front bearing front securing snap ring |
| 28 | P.t.o. shaft front bearing | 95 | Mainshaft front bearing |
| 29 | P.t.o. front bearing housing | 96 | Mainshaft front bearing thrust washer |
| 30 | P.t.o. front bearing housing gasket | 97 | First gear (mainshaft) |
| 31 | Third and fourth gear lever engagement dog locking peg | 98 | Splined sleeve (first gear) |
| 32 | Third and fourth gear lever engagement dog | 99 | First/Reverse sliding coupler |
| 33 | Third and fourth selector fork locking peg | 100 | Reverse gear (mainshaft) |
| 34 | Third and fourth selector fork | 101 | Thrust washer—reverse/fourth gear |
| 35 | Second gear lever engagement dog locking peg | 102 | Splined sleeve—reverse/fourth gear |
| 36 | Second gear lever engagement dog | 103 | 3rd/4th synchromesh unit |
| 37 | Second gear selector fork locking peg | 104 | Splined sleeve—third gear |
| 38 | Second selector fork | 105 | Third gear (mainshaft) |
| 39 | First and reverse gear lever engagement dog locking peg | 106 | Fourth gear (mainshaft) |
| 40 | First and reverse gear lever engagement dog | 107 | Mainshaft rear bearing thrust washer |
| 41 | First and reverse selector fork locking peg | 108 | P.t.o. constant mesh gear location circlip |
| 42 | First and reverse selector fork | 109 | P.t.o. constant mesh gear |
| 43 | High/Low gear lever engagement dog locking peg | 110 | Main drive constant mesh gear securing circlip |
| 44 | High/Low gear lever engagement dog | 111 | Main drive constant mesh gear |
| 45 | Third and fourth selector rail | 112 | Second gear (layshaft) |
| 46 | Second selector rail | 113 | Fourth gear (layshaft) securing snap ring |
| 47 | First and reverse selector rail | 114 | Fourth gear (layshaft) |
| 48 | High/Low selector rail | 115 | Third gear (layshaft) |
| 49 | High/Low selector fork locking peg | 116 | Reverse gear front thrust washer |
| 50 | High/Low selector fork | 117 | Needle roller front retaining ring |
| 51 | Interlock stop plate | 118 | Front needle roller set |
| 52 | Interlock plain plate | 119 | Needle roller spacer |
| 53 | Interlock ball | 120 | Rear needle roller set |
| 54 | Interlock cross peg | 121 | Needle roller rear retaining ring |
| 55 | Interlock ball carrier | 122 | Reverse gear cluster |
| 56 | Interlock mechanism securing bolts | 123 | Reverse gear rear thrust washer |
| 57 | Detent springs | 124 | Gearbox case |
| 58 | Detent plungers | | |
| 59 | Mainshaft rear bearing | | |
| 60 | Mainshaft bearing locating snap ring | | |
| 61 | Mainshaft rear bearing rear securing snap ring | | |
| 62 | Mainshaft | | |
| 63 | Epicyclic shim | | |
| 64 | Epicyclic front plate | | |
| 65 | Epicyclic Belleville spring disc | | |
| 66 | Epicyclic ring gear | | |
| 67 | Epicyclic ring gear dowel | | |

MK II-ZF-8 SPEED SYNCHROMESH TRANSMISSION**SELECTOR RAIL MECHANISM****Removal and Refitment**

5J-01-06

Special Tools: 2700 Rail Trolley
 MF414/1 Centralizing Pin
 MF414/2 Clamp Bolt
 MF414/3 Locating Peg

Removal

NOTE: Beware of the sharp edges around the top of the gearbox case.

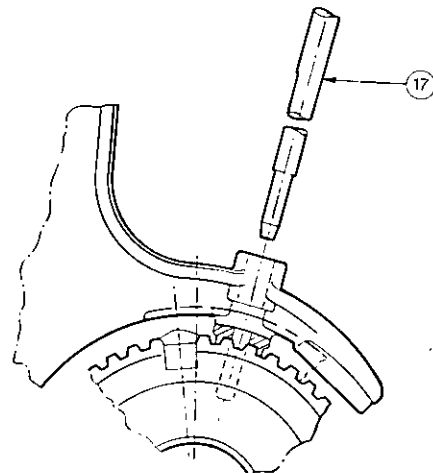
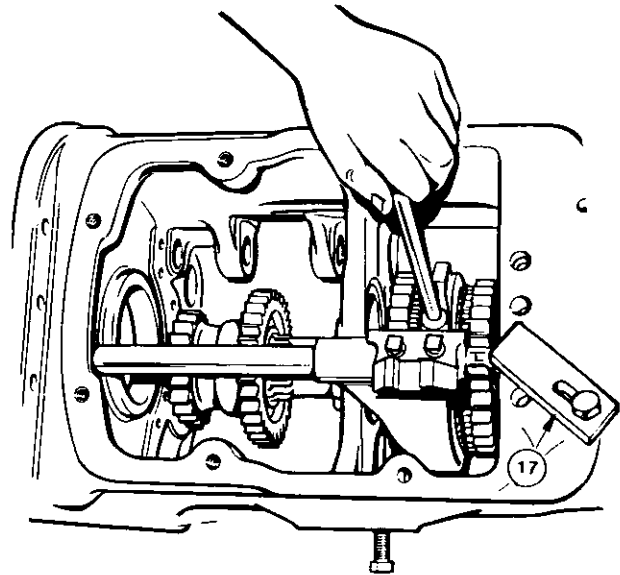
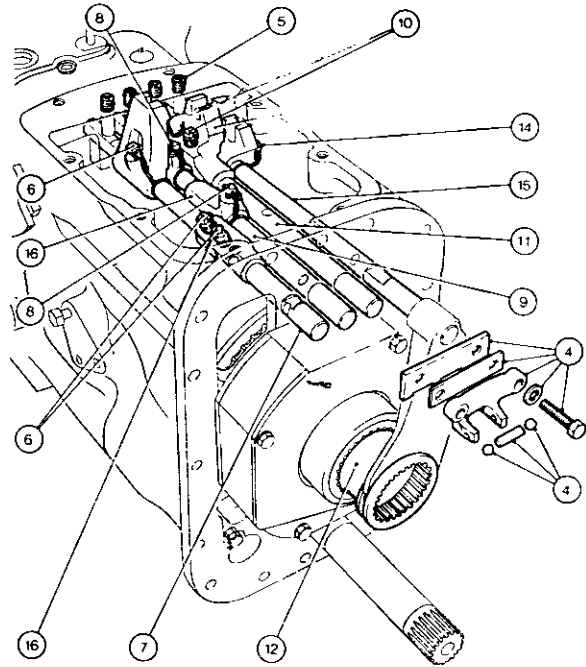
1. Split the tractor between the spacer housing and the centre housing and remove the transmission Part 3A.
2. Remove the gearbox top cover and gasket, and spacer and gasket.
3. Release the locking wires.
4. Remove the bolts, fork, balls, peg, stop plate and plain plate.
5. Lift out the springs and plungers.
6. Remove the locking pegs.
7. Slide the rail rearwards out of the housing.

NOTE: When removing the selector rails, retain the gear lever engagement dogs.

8. Remove the locking pegs.
9. Slide the rail rearwards out of the housing.
10. Remove the locking peg.
11. Slide rail rearwards out of the housing.
12. Slide the high/low rail rearwards and remove the coupling.
13. Rotate the high/low rail through 90°.
14. Remove the locking peg.
15. Slide rail rearwards out of the casting.
16. Remove first/reverse and third/fourth and second selector forks.

Refitment

17. Reverse procedures 1 to 16 except:
 - (a) Set the synchromesh selector fork to the neutral position by locating the selector rail with locating peg MF414/3 clamped with bolt MF414/2 inserting centralizing pin, MF414/1 into the hole on the top of the selector fork, lining it up with the corresponding hole in the sliding coupler, inserting the two locking pegs, and making sure the selector rail is stationary tighten the locking pegs equally.
 - (b) Apply a few drops of oil to the selector rails before refitment.
 - (c) Tighten the locking mechanism retaining bolts to a torque of 47 Nm (35 lbf ft).
 - (d) On completion of the refitting procedure, place all the gear lever engagement dogs in the neutral position.



MK II-ZF-8 SPEED SYNCHROMESH TRANSMISSION

GEARBOX EPICYCLIC**Removal and Refitment**

5J-02-07

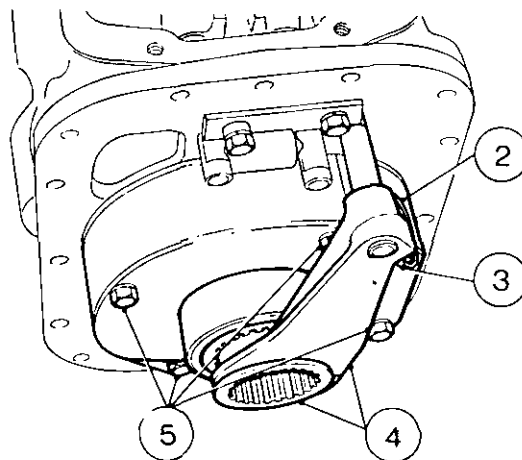
Special Tools: 2700 Rail Trolley

Removal

1. Split the tractor between the spacer housing, and remove the transmission, Part 3A.
2. Remove the locking wire.
3. Remove the locking peg.
4. Remove the selector fork and coupling.
5. Remove the bolts.
6. Remove the complete assembly.

Refitment

7. Reverse the procedures 1 to 6, except:
 - (a) Ensure that the front and rear thrust rings are correctly located before refitment.
 - (b) Ensure that the epicyclic dowels are correctly located in the gearbox casing.
 - (c) Locate the cover plate with the cut out in the bottom left hand corner.
 - (d) Do not fit a lock washer to the lower left hand retaining bolt.
 - (e) Tighten the retaining bolts progressively and evenly to a torque of 47 Nm (35 lbf ft).

**GEARBOX EPICYCLIC****Servicing**

5J-03-07

Special Tool: See operation 5J-02-07

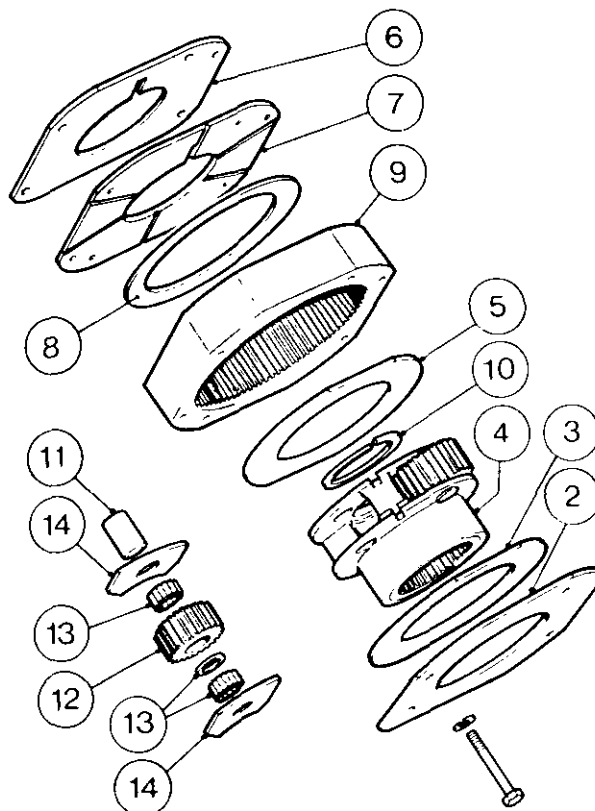
Disassembly

1. Remove the gearbox epicyclic, operation 5J-02-07.
2. Remove the cover plate.
3. Remove the rear thrust ring.
4. Remove the planetary pinion carrier.
5. Remove the front thrust ring.
6. Remove the shim.
7. Remove the front plate.
8. Remove the spring Belleville disc.
9. If necessary, remove the dowel pins from the planetary ring gear.
10. Remove the external snap ring.
11. Gently tap out the three pinion shafts towards the front.
12. Remove the planetary pinions.
13. Remove the two sets of rollers and spacer from each pinion.
14. Remove the wear plates from each side of each pinion.

Reassembly

15. Reverse procedures 1 to 14, except:
 - (a) When replacing the rollers in the pinions, a smear of petroleum jelly (not grease) will help retain them. Do not omit the spacer from between the two runs of rollers. Each run consists of 16 rollers.
 - (b) Ensure the Belleville spring disc is located correctly in the epicyclic ring gear with the concave face rearwards.
 - (c) The front plate and the cover plate must be positioned with the oil grooves towards the pinion carrier.
 - (d) Ensure that the pinion wear plates are refitted with the flats positioned innermost to the centre of the pinion carrier.
 - (e) Ensure the gap of snap ring is located midway between the planetary pinion shafts.

- (f) Always fit the same thickness of shims as those removed.
- (g) To facilitate fitment of the front and rear thrust rings on the pinion carrier, smear with petroleum jelly (not grease). Ensure that the tabs on the thrust rings locate in the pinion carrier cut-outs, and that the brass faces are away from the pinion carrier.



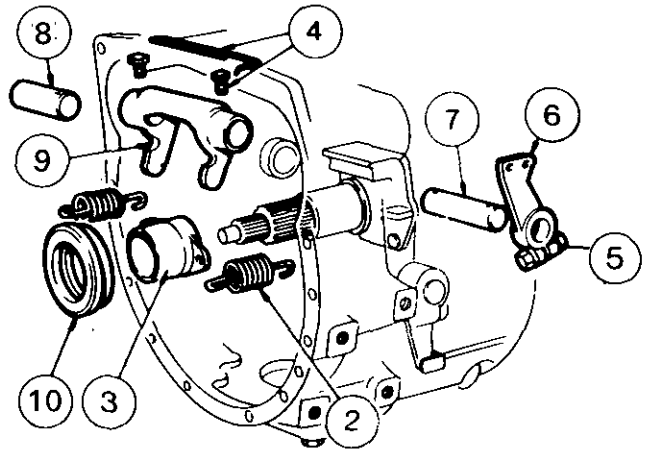
MK II-ZF-8 SPEED SYNCHROMESH TRANSMISSION**CLUTCH RELEASE MECHANISM****Removal and Refitment**

5J-04-08

Special Tool: 2700 Rail Trolley

Removal

1. Split the tractor between the engine and the transmission Part 3A.
2. Remove the two springs.
3. Slide the carrier and release bearing off the input housing.
4. Remove the locking wire and two locking pegs from the release fork.
5. Slacken off the clamp bolt on the clutch pedal lever.
6. Remove the clutch pedal lever.
7. Withdraw the left hand clutch half shaft from the gearbox casing.
8. Position a suitable drift, through the left hand clutch shaft bore and carefully drive out the right hand clutch half shaft.
9. Remove the clutch release fork.
10. Press the release bearing off the carrier.

**Refitment**

11. Reverse procedures 1 to 10, except:
 - (a) Lightly lubricate the input shaft splines and the release bearing carrier bore, with special grease, Mobilgrease Super.
 - (b) Ensure that the locking pegs locate in the holes in the shafts.
 - (c) Adjust the clutch pedal clearance, operation 5A-02-05.

MK II-ZF-8 SPEED SYNCHROMESH TRANSMISSION

INPUT SHAFT HOUSING AND P.T.O. INPUT SHAFT

Removal and Refitment 5J-05-09

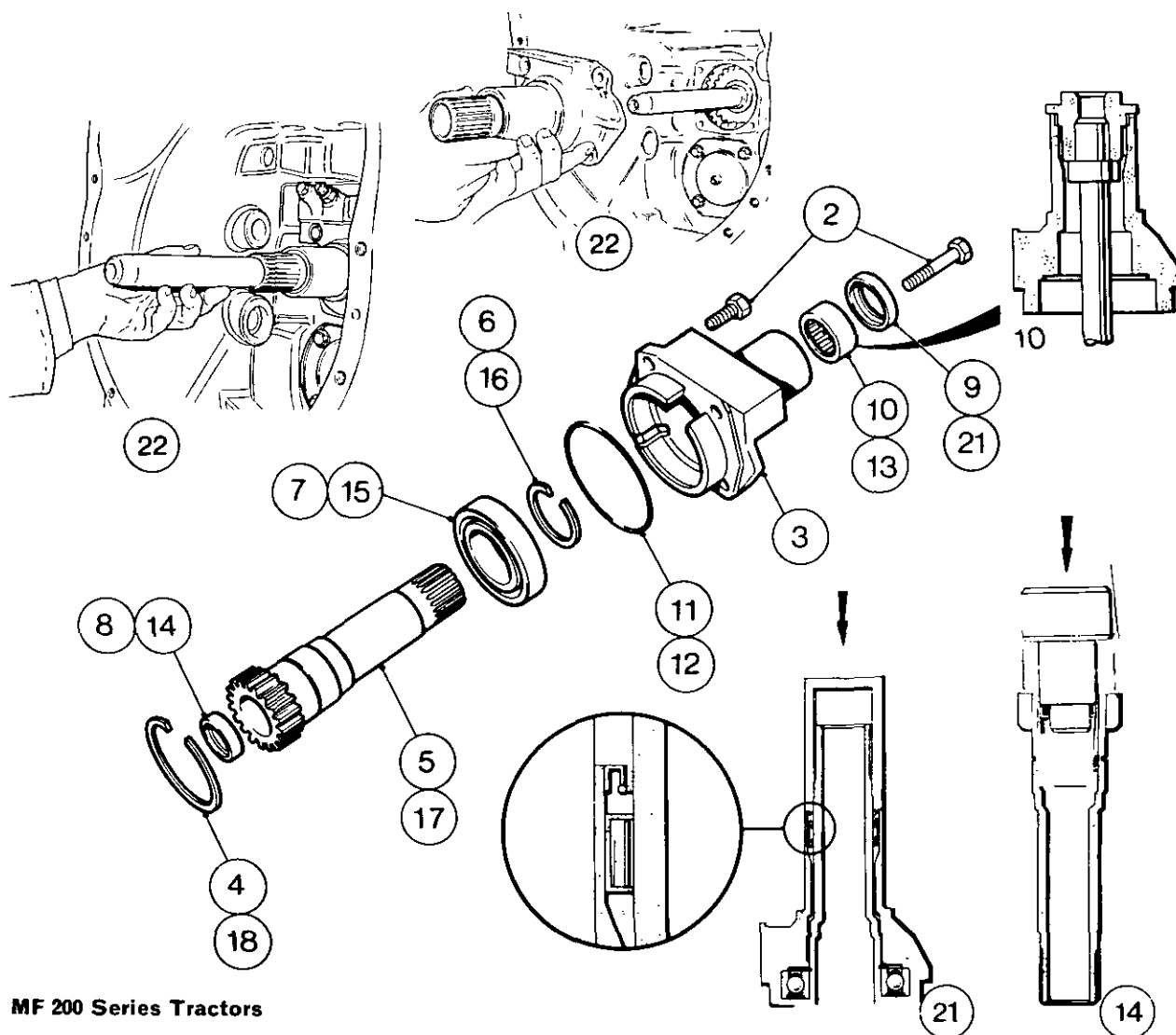
Special Tools: 2700 Rail Trolley
 KMF 1004/1 Protector Sleeve
 MF 255 B Oil Seal Replacer
 MF 255 B-2 Cone
 MF 331 Oil Seal Replacer
 MF 315 Needle Roller Bearing
 Removal/Replacer Tool

Removal

1. Remove the clutch release mechanism, operation 5J-04-08.
2. Remove the four bolts.
3. Withdraw the input housing complete with the p.t.o. input shaft.
4. Remove the large internal circlip.
5. Push the p.t.o. input shaft complete with bearing rearwards out of the housing.
6. If necessary remove the circlip.
7. If necessary press the bearing off.
8. Lever the seal out.
9. Lever the seal out.
10. Using MF 315, remove the needle roller bearing.
11. Remove the 'O' ring (p.t.o. input shaft housing).

Refitment

12. Fit a new 'O' ring (p.t.o. input shaft).
13. Using MF 315 replace the needle roller bearing.
14. Using MF 331, fit a new seal, with the toe of the seal facing the tool.
15. Refit the bearing with the shield towards the gear teeth.
16. Refit the circlip (check that it is properly seated).
17. Refit the p.t.o. input shaft and bearing into the input housing.
18. Refit the circlip (check that it is properly seated).
19. Place the cone adaptor MF 255B-2 on to seal replacer MF 255 B.
20. Place the seal over the cone and on to the tool with the seal toe facing away from the tool and remove the cone.
21. Place the tool over the p.t.o. input shaft and tap the seal into place.
22. Place the tool KMF 1004/1 over the splines of the main input shaft. Reverse procedures 2 and 3. Remove tool.
23. Reverse procedure 1.
 - (a) Use petroleum jelly (not grease) to lubricate all seals and the needle roller bearing when refitting.
 - (b) Lightly coat the bolt threads in recommended sealant 'B' when refitting, and tighten the bolts to a torque of 60 Nm (45 lbf ft).



MK II-ZF-8 SPEED SYNCHROMESH TRANSMISSION**P.T.O. DRIVESHAFT FRONT BEARING****Removal and Refitment**

5J-06-10

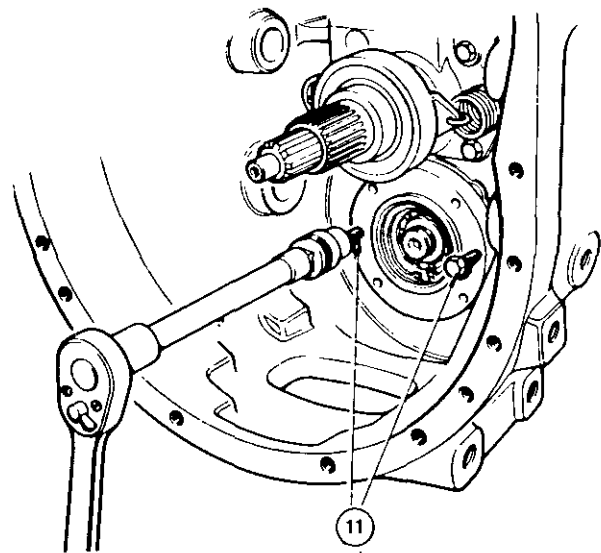
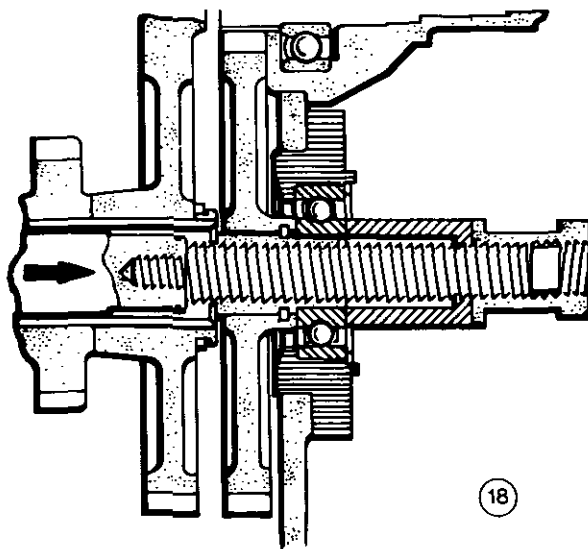
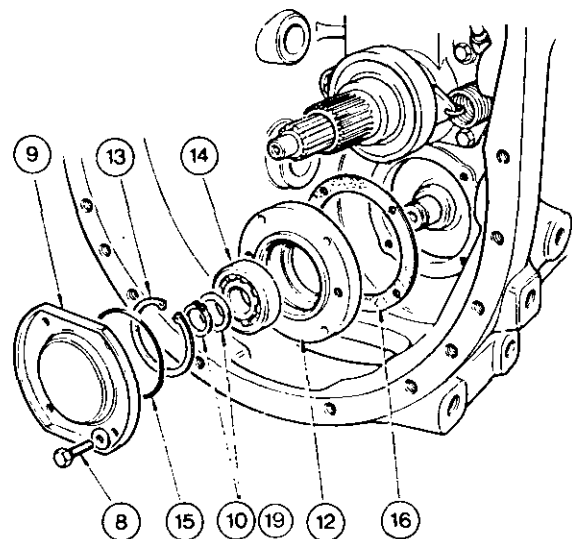
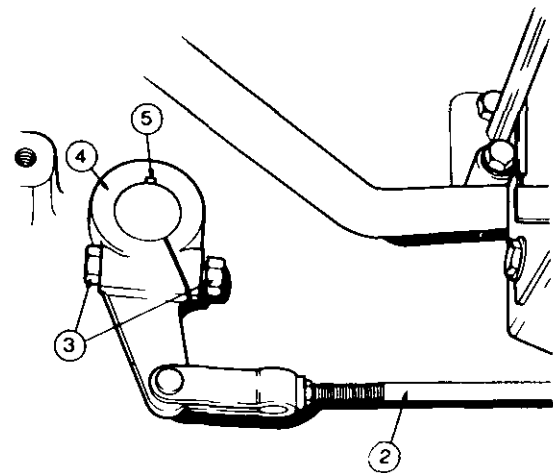
Special Tools: 2700 Rail Trolley
 MF 218A P.t.o. Drive Shaft Puller
 MF 218A-2 Adaptor

Removal

1. Split the tractor between the engine and the transmission, Part 3A.
2. Disconnect both footbrake operating rods.
3. Remove the bolt, nut and lockwasher securing the left hand footbrake cross shaft lever.
4. Remove the cross shaft lever.
5. Remove the key from the keyway.
6. Withdraw the shaft, complete with pedals from the right hand side of the transmission housing.
7. If fitted remove hydraulic pipe from centre of plate.
8. Remove the four bolts and washers.
9. Remove the plate.
10. Remove the external circlip and washer.
11. Screw two $\frac{3}{8}$ UNC \times 75 mm (3 in) bolts into the bearing housing and tighten them evenly.
12. Remove the housing.
13. Remove the circlip.
14. Press out the bearing.
15. Discard the 'O' ring.
16. Discard the gasket.

Refitment

17. Reverse procedures 13 to 16 except:
 - (a) Fit a new 'O' ring, gasket and circlip.
 - (b) Lightly coat the gasket with recommended sealant 'A'.
18. Using MF 218A and MF 218A-2, refit the bearing and housing assembly on the front end of the p.t.o. drive shaft ensuring that the splines on the shaft locate with those in the p.t.o. constant mesh gear.
19. Fit a new circlip and washer.
20. Reverse procedures 1 to 8, except:
 - (a) Lightly coat the securing bolt threads with recommended sealant 'B'.
 - (b) Tighten the bolts to a torque of 60 Nm (45 lbf ft).



MK II-ZF-8 SPEED SYNCHROMESH TRANSMISSION**SECOND GEAR (MAINSHAFT)****Removal and Refitment** 5J-07-11

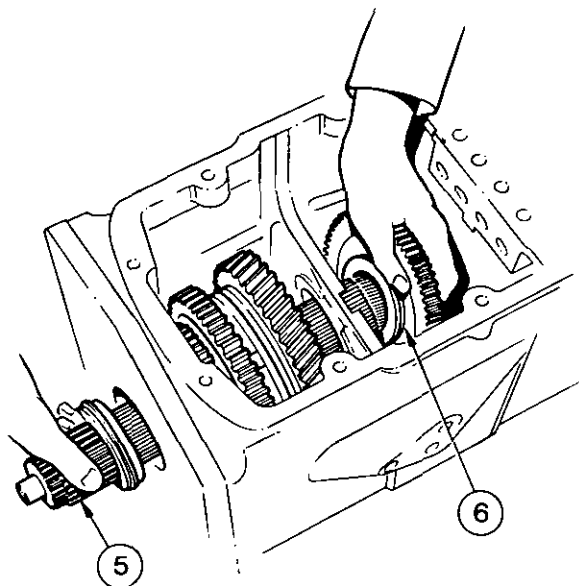
Special Tools: 2700 Rail Trolley

Removal

1. Split the tractor between the spacer housing and the centre housing and remove the transmission Part 3A.
2. Remove the selector rail mechanism, operation 5J-01-06.
3. Remove the gearbox epicyclic unit, operation 5J-02-07.
4. Release the snap ring and manoeuvre it towards the front of the mainshaft.
5. Using a soft faced mallet, drive the input shaft and mainshaft rearwards until it is clear of the second gear, and the rear bearing is no longer located in the gearbox casing.
6. Withdraw the second gear pinion.

Refitment

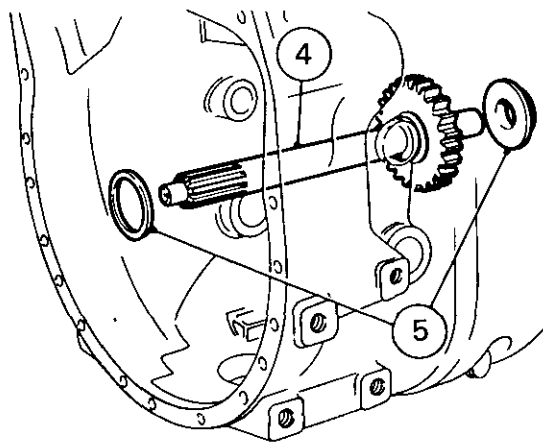
7. Reverse procedures 1 to 6.

**MAIN INPUT SHAFT—70 H.P. TRACTORS AND ABOVE****Removal and Refitment** 5J-08-11Special Tools: 2700 Rail Trolley
KMF 1004/1 Seal Protector Sleeve**Removal**

1. Split the tractor between the spacer housing and the centre housing. Remove transmission Part 3A.
2. Remove the input housing and p.t.o. input shaft, operation 5J-05-09 procedures 1 to 3.
3. Remove second gear, operation 5J-07-11 procedures 2-6
4. From the rear remove the main input shaft, complete with the two thrust washers.
5. Remove the thrust washers.

Refitment

7. Reverse procedures 1 to 5 except:
 - (a) Ensure that the thrust washer, with oil grooves, is placed on the rear of the main input shaft, with the oil grooves facing the rear of the gearbox, and that it is lightly oiled.
 - (b) Before refitting the input housing and p.t.o. input shaft, place tool KMF 1004/1 over the splines of the main input shaft, to protect the seal.



MK II-ZF-8 SPEED SYNCHROMESH TRANSMISSION**MAIN INPUT SHAFT—TRACTORS BELOW
70 H.P.****Removal and Refitment** 5J-09-12

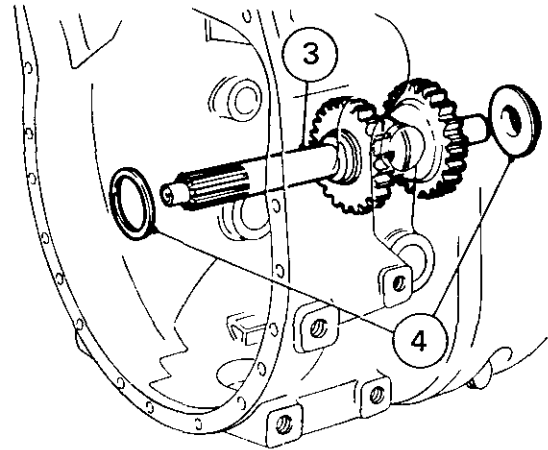
Special Tools: 2700 Rail Trolley
KMF 1004/1 Seal Protector Sleeve.

Removal

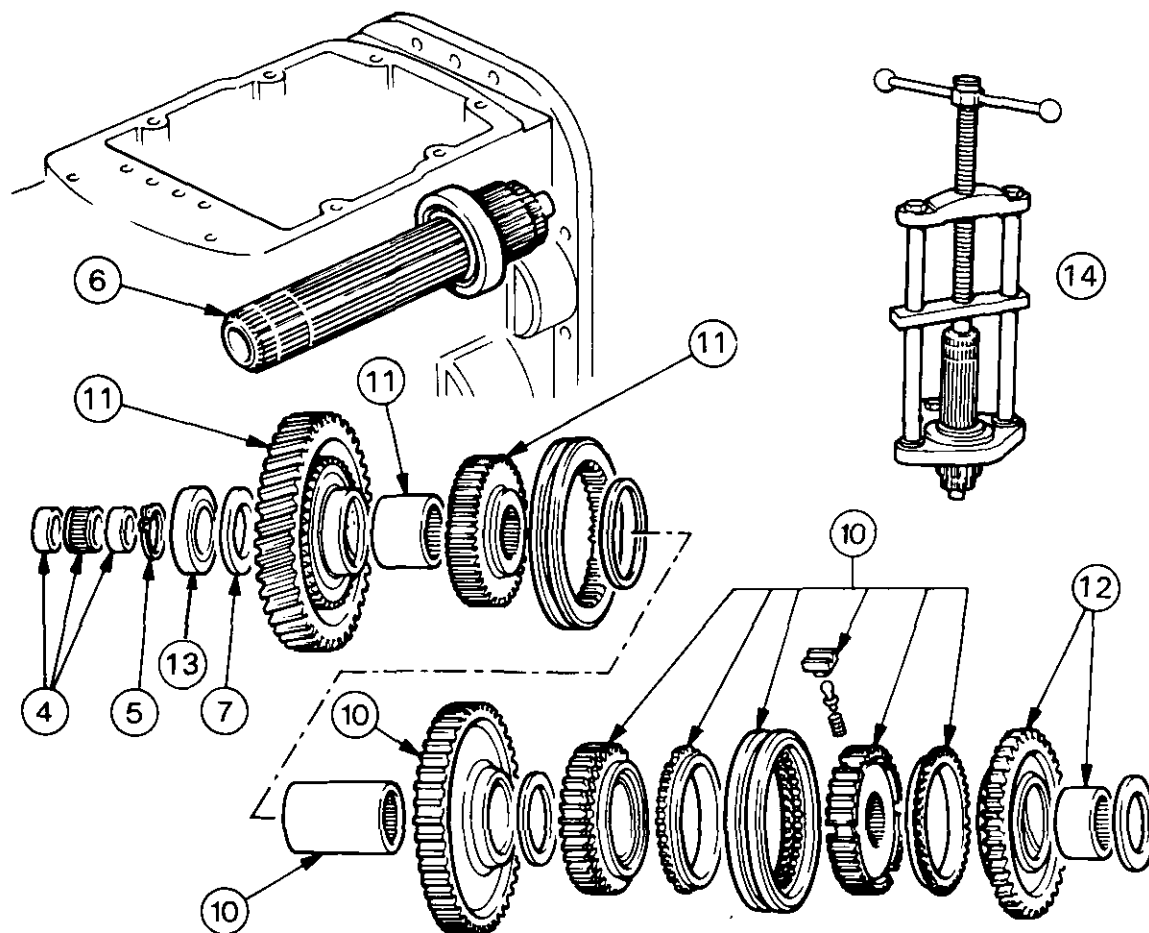
1. Split the tractor between the engine and the transmission part 3A.
2. Remove the input housing and p.t.o. input shaft. operation 5J-05-09, procedures 1 to 3.
FROM THE FRONT
3. Remove the main input shaft, complete with the two thrust washers.
4. Remove the thrust washers.

Refitment

5. Reverse procedures 1 to 4 except:
 - (a) Ensure that the thrust washer, with oil grooves, is placed on the rear of the main input shaft, with the oil grooves facing the rear of the gearbox, and that it is lightly oiled.
 - (b) Before refitting the input housing and p.t.o. input shaft, place tool KMF 1004/1 over the splines of the main input shaft, to protect the seal.



MK II-ZF-8 SPEED SYNCHROMESH TRANSMISSION

**MAINSHAFT, FIRST, REVERSE, THIRD AND FOURTH GEARS****Removal and Refitment** 5J-10-13

Special Tools: See operations
5J-01-06 and 5J-08-11
MF 200 Hand Press
MF 200-25 Adaptor

Removal

1. Remove selector rail mechanism, operation 5J-01-06.
2. Remove gearbox epicyclic unit, operation 5J-02-07
3. Remove the main input shaft, operation 5J-08-11
4. Using feeler gauges, measure the gap between the front thrust washer and the front bearing. If it exceeds 0,30 mm (0-012") record the dimension for later use.
5. Remove the spigot roller bearing and two spacers.
6. Remove the snap ring from off the front of the mainshaft.
7. Withdraw the mainshaft rearwards out of the gearbox casting.
8. Remove the thrust washer from between the front bearing and first gear.
9. Engage sliding coupler with first gear.
10. Engage sliding coupler with third gear.
11. Withdraw reverse and fourth gears, twisting them slightly to clear the edges of the gearbox case.
12. Remove first gear and the sliding coupler.
13. Remove third gear and the sliding coupler.
14. Remove the bearing from the centre web of the gearbox casing.
15. If necessary, press the bearing off the FRONT end of the mainshaft using MF 200 and MF 200-25.
16. If necessary, remove the circlip from the bearing.

Refitment

17. Reverse procedures 1-14 except:—
 - (a) If gap between the front thrust washer and the front bearing exceeded 0,30 mm (0-012") it must be replaced with one from the following chart, to give a gap of 0,08 mm (0-003") minimum, 0,30 mm (0-012") maximum. It must be fitted with the shoulder towards the bearing.
 - (b) Ensure that snap rings are correctly located in their grooves.

THRUST WASHER CHART

MF Part No.	Thickness mm	Thickness ins
1671-892-M2	6,35/6,40	.250/.252
1671-893-M2	6,58/6,63	.259/.261
1671-894-M2	6,80/6,85	.268/.270
1671-895-M2	7,03/7,08	.277/.279

MK II—ZF—8 SPEED SYNCHROMESH TRANSMISSION

SYNCHROMESH ASSEMBLY (THIRD AND FOURTH)

Servicing

5J-11-14

Special Tools: See Operation

5J-01-06 and 5J-08-11

MF 415/1 Synchro hub assembly ring

MF 415/2 Synchro hub assembly plate

MF 550 Drive handle

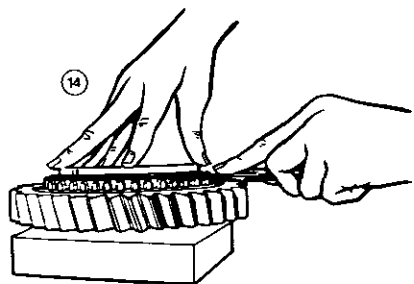
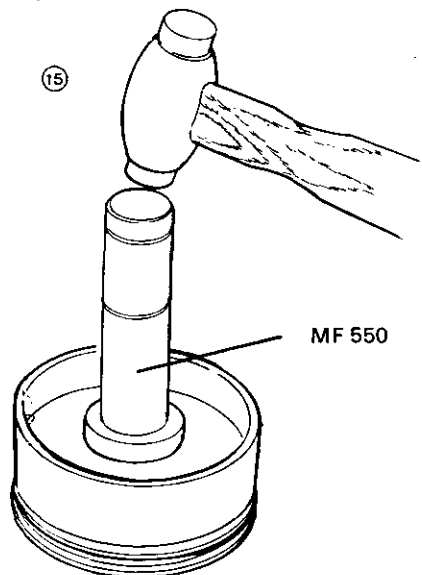
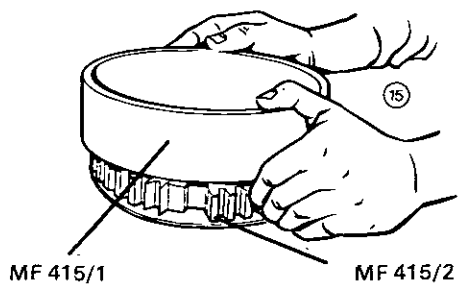
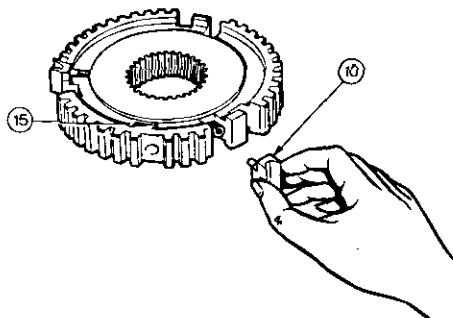
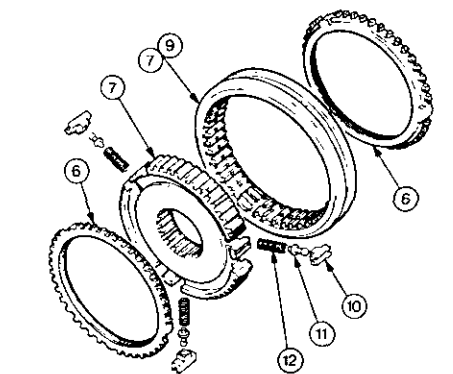
Disassembly

1. Split the tractor between the engine and transmission and the transmission and centre housing, Part 3A.
2. Remove the gear selector mechanism, operation 5J-01-06
3. Remove the gearbox epicyclic, operation 5J-02-07.
4. Remove the main input shaft, operation 5J-08-11.
5. Remove the mainshaft and gears, operation 5J-10-13. Procedures 4 to 12.
6. Remove the two synchronizer rings.
7. Remove the drive hub complete with the sliding coupler.
8. Wrap the hub and coupler in a cloth.
9. Remove the sliding coupler, taking care not to lose pressure springs, plungers and blocks.
10. Remove the three pressure blocks.
11. Remove the three pressure plungers.
12. Remove the three pressure springs.
13. Thoroughly clean all the components and check their condition.
14. Using a feeler gauge, measure the clearance between the synchronizer ring and the coupler on the gear at several points. The synchronizer ring must be correctly positioned on the tapered part of the coupler. If the clearance is less than 0.5 mm (0.02 in) replace the synchronizer ring. When working in the gearbox, replace the synchronizer ring if the clearance is found to be less than 0.8 mm (0.03 in).

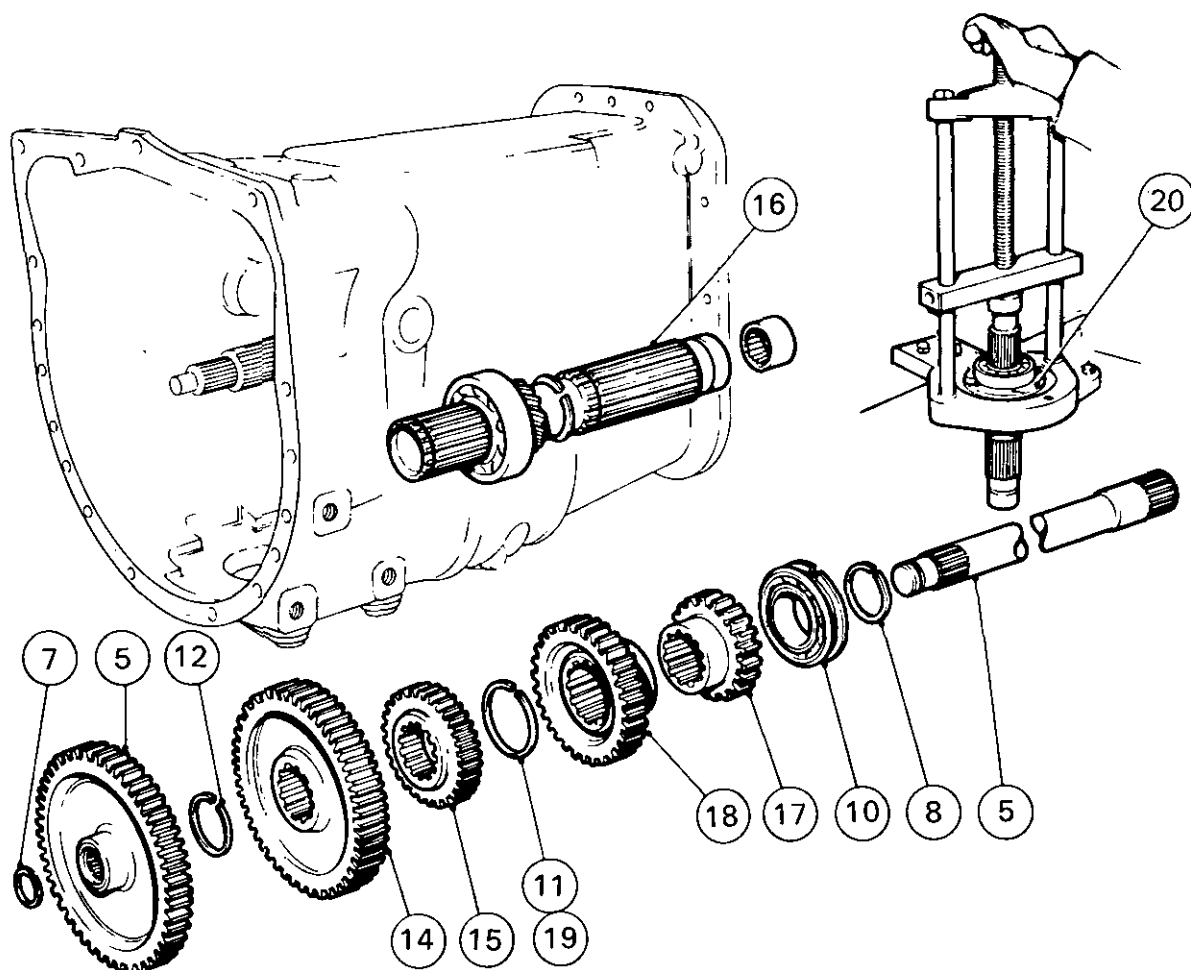
Reassembly

15. Reverse procedures 1 to 12, except: On replacing pressure springs, plungers and blocks special service tool MF 415 should be used to locate the hub back in the sliding coupler.

NOTE: Ensure that the centralization holes in the hub and coupler are aligned.



MK II-ZF-8 SPEED SYNCHROMESH TRANSMISSION

**LAYSHAFT AND GEARS, P.T.O. SHAFT AND GEAR****Removal and Refitment** 5J-12-15

Special Tools: See operation 5J-10-13

Removal

1. Remove the second gear pinion, operation 5J-07-11.
2. Remove the main input shaft, operation 5J-08-11.
3. Remove the mainshaft and gears, operation 5J-10-13.
4. Remove the p.t.o. drive shaft front bearing operation 5J-06-10.
5. Withdraw the p.t.o. driveshaft rearwards out of the gearbox casing.
6. Withdraw the p.t.o. constant mesh gear.
7. Remove the small internal snap ring, (only if necessary).
8. Remove the snap ring from the rear of the layshaft.
9. Tap the layshaft forwards.
10. Remove the rear bearing.
11. Expose the snap ring, open it and slide it forwards onto the unsplined portion of the shaft.
12. Remove the snap ring from the front of the layshaft.
13. Relocate the front bearing in its web and tap the layshaft rearwards.
14. Remove the constant mesh gear.
15. Remove the second gear pinion.
16. Manoeuvre the layshaft forwards out of the gearbox.
17. Remove the third gear pinion.
18. Remove the fourth gear pinion.
19. Remove the snap ring.
20. Using MF 200 and MF 200-25, press the bearing off the front end of the layshaft.

Refitment

21. Reverse procedures 1 to 20 except; Ensure that all snap rings are correctly located in their grooves.

MK II—ZF—8 SPEED SYNCHROMESH TRANSMISSION**Reverse Gear Cluster****Removal and Refitment 5J—13—16**

Special Tools: See operation 5J—10—13 and
55 × 25 mm (2 $\frac{1}{8}$ × 1 in) dia. Mild Steel
Dummy Shaft

Removal

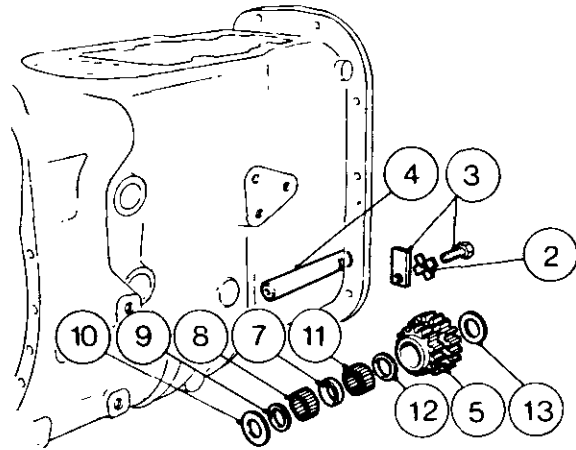
1. Remove the mainshaft and gears, operation 5J—10—13 procedures 1 to 12.
2. Release the tabwasher.
3. Remove the bolt and locating tab.
4. Slide the dummy shaft from the front of the reverse gear shaft towards the rear. This will push out the reverse gear shaft, and prevent the needle rollers from dropping into the transmission case.
5. Remove the idler gear cluster complete with all parts and the dummy shaft.
6. Withdraw the dummy shaft from the idler gears, and allow all parts to drop out, onto a clean work surface.

Refitment

7. Fit the spacer in the reverse gear cluster.
8. Refit the first set of rollers. Each run consists of 28 rollers.

NOTE: Smear the rollers in petroleum jelly (not grease) to facilitate reassembly.

9. Refit the retaining ring.
10. Refit the thrust washer.
11. Refit the second set of rollers.
12. Refit the retaining ring.
13. Refit the thrust washer.
14. Slide the dummy shaft into the reverse gear cluster rollers.
15. Reverse procedures 1 to 5.



MK II-ZF-8 SPEED SYNCHROMESH TRANSMISSION**TRANSMISSION CASE REMOVAL AND
REFITMENT OR COMPLETE GEARBOX OVER-
HAUL**

5J-14-17

Special Tools: KMF 1004/1 Protector Sleeve
 MF 200 Hand Press
 MF 200-25 Adaptor
 MF 218A P.t.o. Shaft Puller
 MF 218A-2 Adaptor
 MF 255B Oil Seal Replacer
 2700 Rail Trolley
 MF 315 Needle Roller Bearing
 Removal/Replacer Tool
 MF 331 Oil Seal Replacer
 V.L. Churchill 50 ton Hydraulic Press
 (alternative to MF 200)
 55 mm x 25 mm ($2\frac{1}{8}$ x 1 in) dia
 Mild Steel Dummy Shaft
 MF 414/1 Centralizing Pin
 MF 414/2 Clamp Bolt
 MF 414/3 Locating Peg
 MF 415/1 Synchro Hub Assembly
 Ring
 MF 415/2 Synchro Hub Assembly
 Plate
 MF 550 Drive Handle

Disassembly

1. Remove the selector rail mechanism, operation 5J-01-06.
2. Remove the gearbox epicyclic unit, operation 5J-02-07.
3. Disassemble the gearbox epicyclic unit, operation 5J-03-07.
4. Remove the clutch release mechanism, operation 5J-04-08.
5. Remove and dismantle the input housing and p.t.o. input shaft, operation 5J-05-09.
6. Remove the p.t.o. drive shaft front bearing, operation 5J-06-10.
7. Remove the second gear (mainshaft), operation 5J-07-11.
8. Remove the main input shaft 70 h.p. tractors and above. Operation 5J-08-11.
9. Remove the main input shaft tractors under 70 h.p. Operation 5J-09-12.
10. Remove the mainshaft, first, reverse, fourth and third gears, operation 5J-10-13.
11. Remove the synchromesh cone assembly operation 5J-11-14.
12. Remove the layshaft and gears and p.t.o. shaft and gear, operation 5J-12-15.
13. Remove the reverse gear cluster, operation 5J-13-16.

Examination

After disassembly of the transmission, examine all the components for scoring, wear or chipping. Pay particular attention to the gear teeth, bearings, needle rollers, gear sliding couplers, gear selector forks, also splines and main shaft gear bushes and sleeves. Check end float between main shaft bearings of 2nd, 3rd, 4th and reverse gear assembly. Replace thrust washer if necessary. See operation 5J-10-13. It is absolutely essential that tool KMF 1004/1 is used when replacing the input shaft housing, see operation 5J-05-09 centralising pin and locating

peg MF 414 must also be used to align selector fork, selector rail and synchro hub assembly. See operation 5J-01-06. All bearings should be washed in clean paraffin, blown dry, inspected for wear or scoring on the outer circumference and measured for fit in transmission case webs. Maximum acceptable clearance is 0,033 mm (0.013 in). Where the clearance between bearing and bore exceeds this figure, recommended sealant 'C' may be used to refit the bearings into the transmission case. After inspection, lubricate bearings with clean transmission oil. Any worn or damaged components should be replaced; also, a complete set of new gaskets, 'O' rings and a new tab washer must be fitted.

Reassembly

13. Reverse procedures 1 to 13, except;
 - (a) Use only petroleum jelly for reassembly purposes—Never Grease.
 - (b) Ensure all snap ring are correctly located in their grooves.
 - (c) Lightly oil all bushes, bearings and splines prior to reassembly.

MK II-ZF-8 SPEED SYNCHROMESH TRANSMISSION**GEAR SHIFT LEVER****Removal and Refitment** 5J-15-18**Removal**

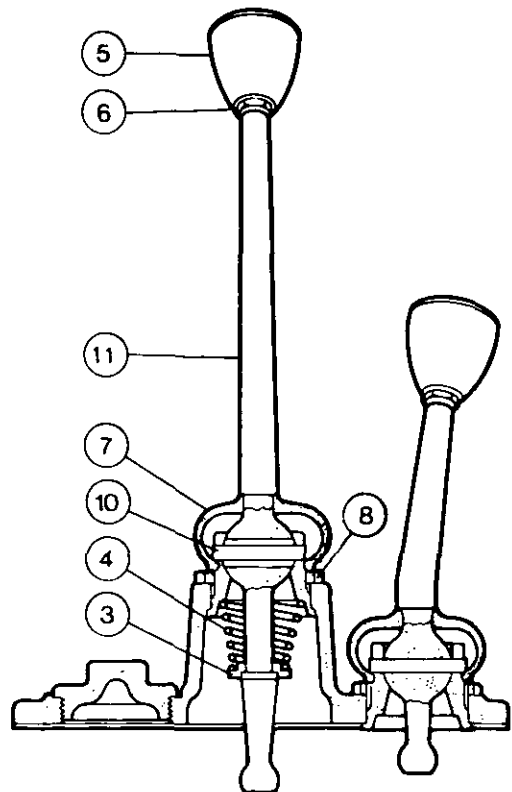
1. Remove the steering box and gearbox top cover assembly and gasket, Part 7B.
2. Support the top cover in a vice.
3. Press the spring retaining washer towards the spring, and slide sideways and remove. This will release the spring.

WARNING: When removing the spring retaining washer, care must be taken to prevent the spring from flying out and causing possible injury or damage.

4. Remove the seat and spring.
5. Remove the gear knob.
6. Remove the nut.
7. Remove the rubber dust cover.
8. Unscrew the locking ring.
9. Remove the locking ring.
10. Drive out the pin.
11. Remove the gear lever.
12. Drive the cup downwards out of the housing.

Refitment

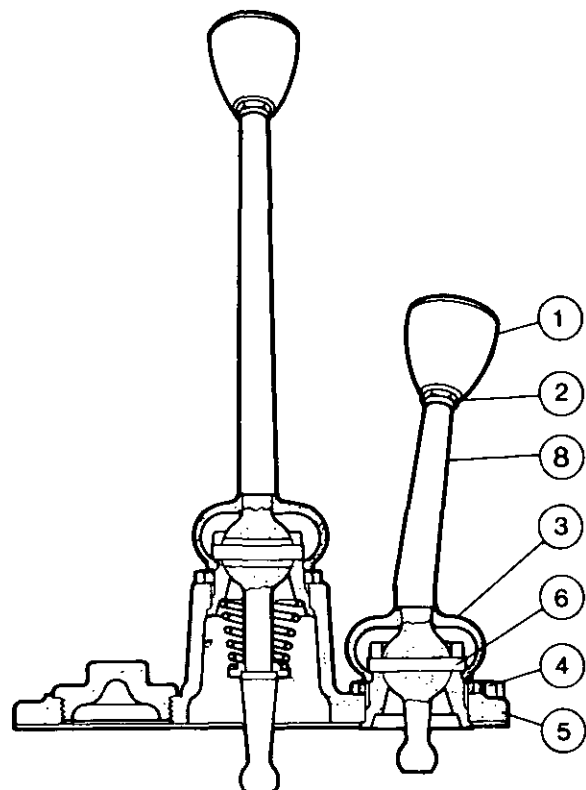
13. Reverse procedures 1 to 12.

**HIGH/LOW SHIFT LEVER****Removal and Refitment** 5J-16-19**Removal**

1. Remove the gear knob.
2. Remove the nut.
3. Remove the rubber dust cap.
4. Unscrew the locking ring.
5. Remove the locking ring.
6. Turn the lever and cup until the pin securing the lever can be removed.
7. Drive out the pin.
8. Remove the gear lever.
9. Drive the cup downwards out of the housing.

Refitment

10. Reverse procedures 1 to 9.



MK II-ZF CONSTANT MESH MULTI-POWER TRANSMISSION**GENERAL**

Refer to Figures 1, 2, 3 and 4

Multi-Power transmission provides twelve forward gears and four reverse gears. This is achieved by combining with the standard transmission, low driving (109) and driven (132) constant mesh gears, operated by a free wheel coupler (131), and high driving (107), and driven (129) constant mesh gears operated by a multi-plate hydraulic clutch (98). By driving the layshaft (88) with either of these two pairs of gears, an alternative speed for each gear becomes available. To provide Multi-Power, the following components are added to the standard transmission; a pair of constant mesh gears, free wheel unit (131), multi-plate clutch unit (98), oil pump, oil control valve and shift mechanism (147). The high driving gear (107), runs on a bush on the main input shaft (60), next to the low driving gear (109). The front end of the high driving gear (107) is splined to engage the clutch disc splines. The three clutch discs, plates, piston and return springs are held into the clutch housing (98) by a retainer plate and snap ring. The three clutch plates are splined into the clutch housing, and the housing is splined to the main input shaft (60).

The high driven gear (129) is splined to the lay shaft (88) and is retained by a snap ring. The low driven gear (132) runs on a bush on the layshaft, next to the high driven gear (129). A spring loaded coupler (131) is fitted between the driven gears and operates on a helical spline on the layshaft (88). The coupler is spring loaded towards the low driven gear (132), and the teeth on the rear face of the coupler engage similar teeth on the front face of the low driven gear (132).

The oil pump supplies oil to the control valve for operation of the clutch unit (98). The control valve is fitted to the input housing (9) and directs oil to the clutch or returns oil into the transmission housing. The Multi-Power shift lever is fitted to the instrument panel and a mechanical linkage connects the shift lever to the oil control valve.

Multi-Power high or low can be selected whilst the tractor is moving and is engaged in any gear.

Mounted on the mainshaft are four sets of gears, which are in constant mesh with the layshaft gears, and when viewed from the front of the gearbox these gears are, first (42 teeth) (114), reverse (44 teeth) (118) third (36 teeth) (121) and second (40 teeth) (124).

The gear levers, reduction unit and sliding couplers are identical to those used for the eight speed transmission.

The input shaft (60) has been redesigned to simplify assembly, which also allows a larger needle roller bearing (61) to be fitted.

Mounted on the layshaft are three gears, first (14 teeth) (88), third (33 teeth) (135) and second (20 teeth) (136).

Reverse gear layout and operation is identical to the eight speed transmission, except that the 21 tooth portion of the compound reverse gear runs in constant mesh with the third gear pinion (33 teeth) (135) on the layshaft.

Operation**Shift Lever in Low**

Oil is pumped through the control valve and back into the transmission housing. The drive is transmitted to the layshaft (88) through the low constant mesh gears (109, 132) and the free wheel coupler (131). The coupler is forced into engagement with the low driven gear (132) by its spring and the thrust exerted by the helical splines. When the coupler is in this engaged (low) position, no engine braking is available. If engine braking is required, move the Multi-Power shift lever to high.

Shift Lever in High

Oil is pumped to the control valve and is then directed through drillings to the clutch unit (98) which engages the high driving gear (107). The higher ratio of the high gears increases the speed of the layshaft (88). This speed increase, exerts an opposite thrust on the helical splines of the coupler (131), which overcomes the spring pressure and disengages the coupler from the low driven gear (132), so allowing the low driven gear to free wheel.

MK II-ZF CONSTANT MESH MULTI-POWER TRANSMISSION

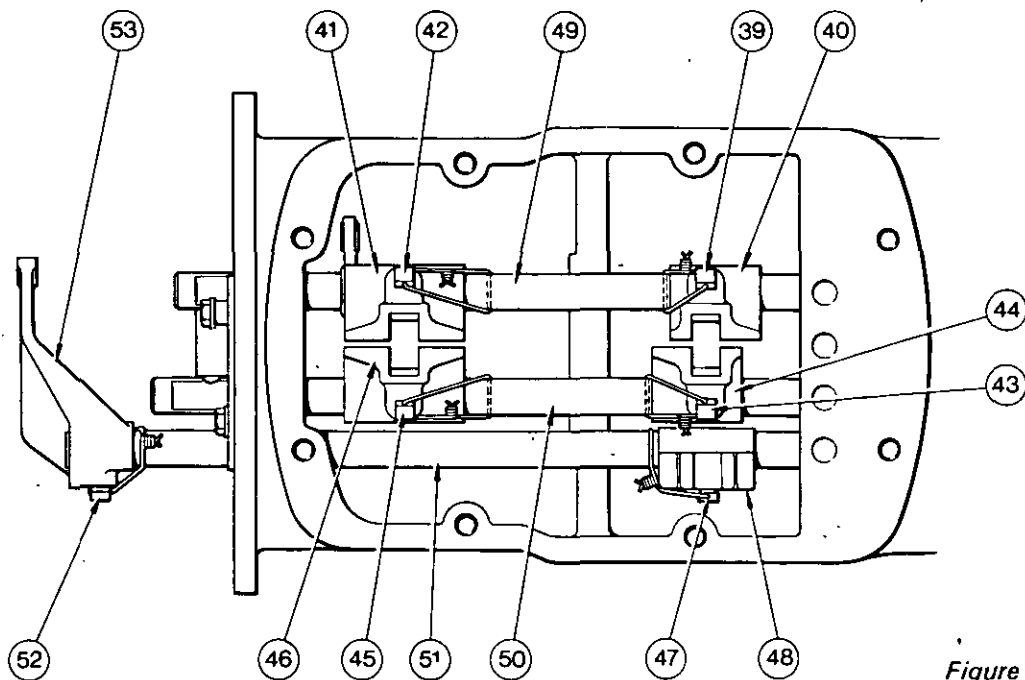


Figure 1

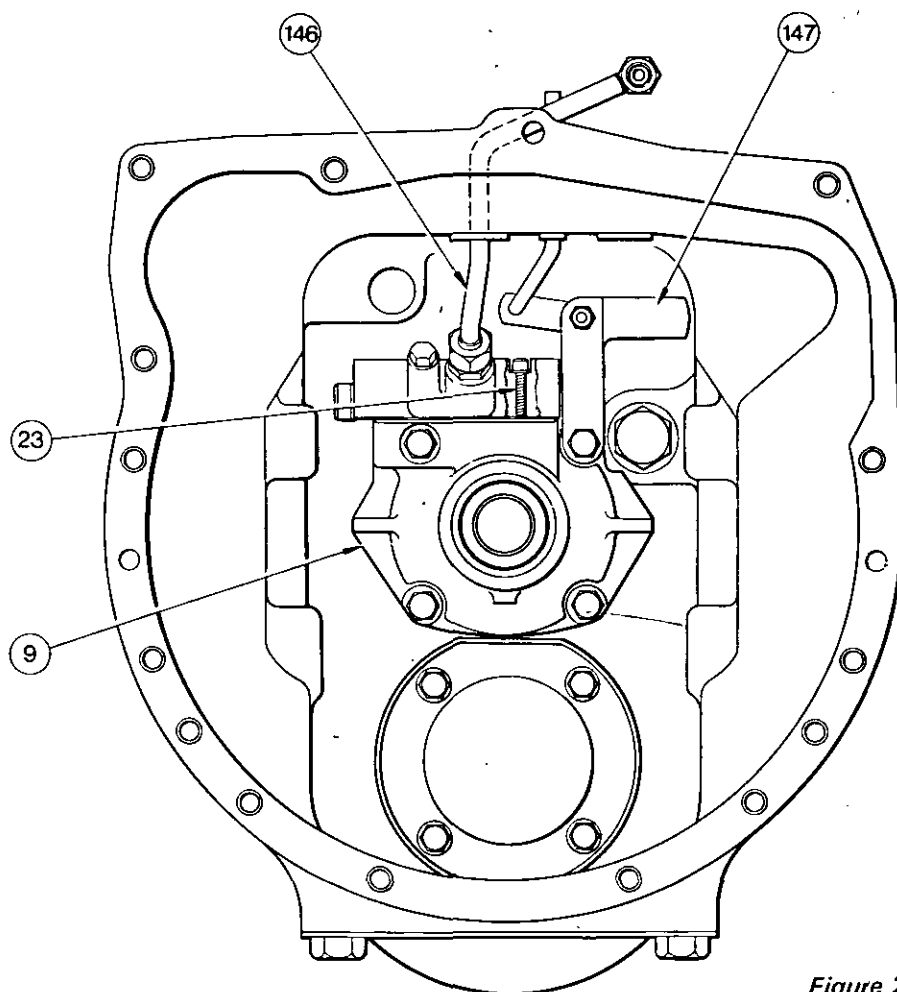


Figure 2

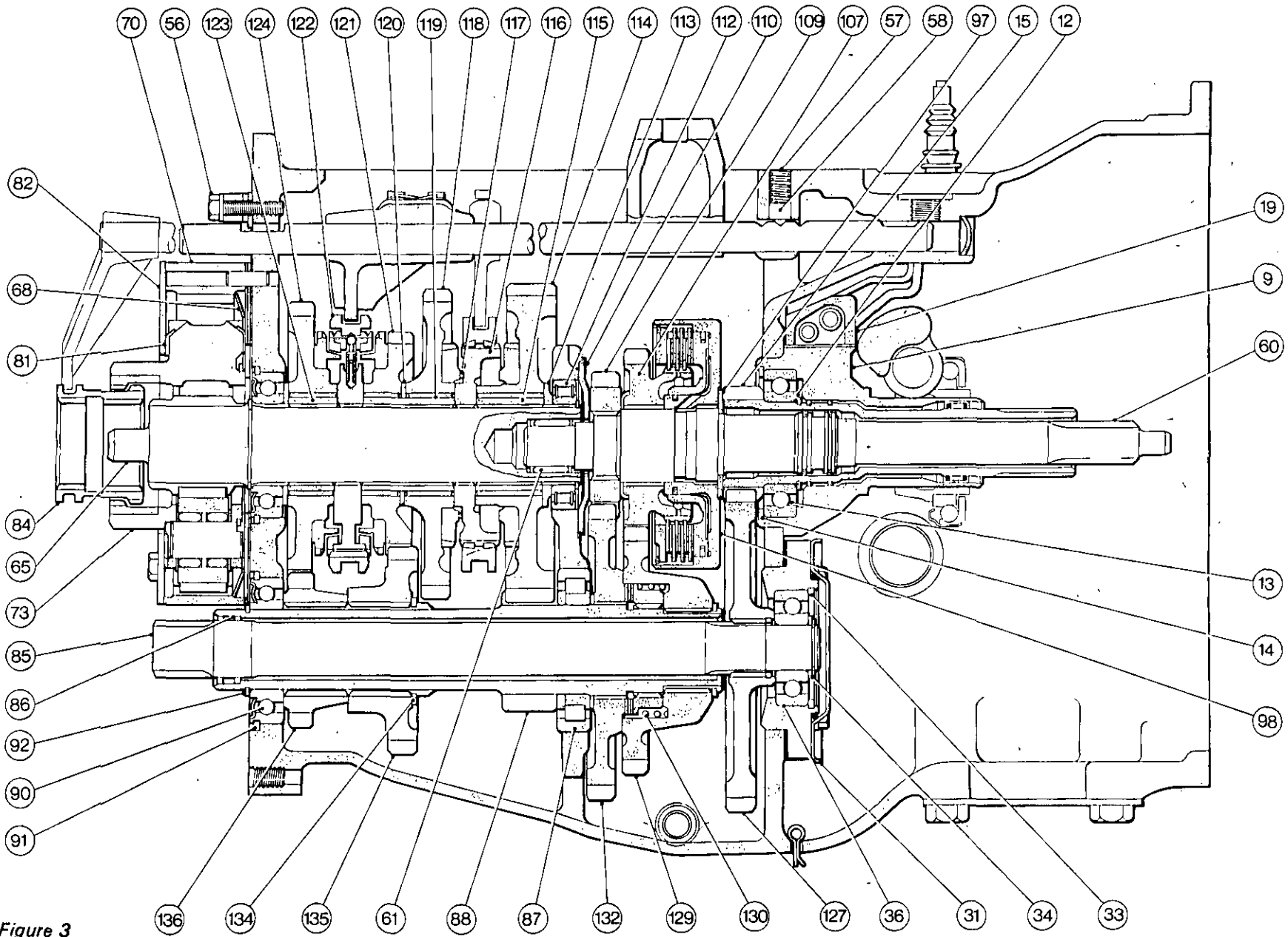


Figure 3

MK II—ZF CONSTANT MESH MULTI-POWER TRANSMISSION

KEY TO FIGS. 1, 2 and 3

1. Clutch release bearing
2. Clutch release bearing carrier
3. Clutch release fork locking peg
4. Clutch release fork
5. Clutch release bearing return spring
6. Input housing securing bolts
7. P.t.o. input shaft seal
8. P.t.o. input shaft needle roller bearing
9. Input housing
10. Input housing 'O' ring
11. P.t.o. input shaft cast iron sealing rings
12. P.t.o. input shaft securing external circlip
13. P.t.o. input shaft bearing
14. P.t.o. input shaft securing internal circlip
15. P.t.o. input shaft
16. Main drive input shaft seal
17. Multi-Power spool valve 'O' ring
18. Multi-Power spool valve
19. Multi-Power spool block
20. Multi-Power detent ball
21. Multi-Power detent spring
22. Multi-Power spool detent spring securing plug
23. Multi-Power spool block securing bolts
24. Anti-transient spring
25. Anti-transient ball
26. Multi-Power spool block pressure regulating valve
27. Multi-Power pressure regulating valve spring
28. Multi-Power pressure regulating valve spring retaining plug and washer
29. Multi-Power spool block gasket
30. P.t.o. front bearing cover securing bolts
31. P.t.o. front bearing cover
32. P.t.o. front bearing cover 'O' ring
33. P.t.o. front bearing securing circlip
34. P.t.o. shaft securing circlip
35. P.t.o. shaft spacer washer.
36. P.t.o. shaft front bearing
37. P.t.o. front bearing housing
38. P.t.o. front bearing housing gasket
39. Second and third gear lever engagement dog locking peg.
40. Second and third gear lever engagement dog
41. Second and third selector fork.
42. Second and third selector fork locking peg
43. First and reverse gear lever engagement dog locking peg.
44. First and reverse gear lever engagement dog
45. First and reverse selector fork locking peg
46. First and reverse selector fork
47. High/Low gear lever engagement dog locking peg
48. High/Low gear engagement dog
49. Second and third gear selector rail
50. First and reverse gear selector rail
51. High/Low gear selector rail
52. High/Low selector fork locking peg
53. High/Low selector fork
54. Interlock stop plate
55. Interlock plunger
56. Inetrlock mechanism securing bolt and washer
57. Detent springs
58. Detent plungers
59. Main input shaft cast iron sealing rings
60. Main input shaft
61. Mainshaft needle roller bearing
62. Mainshaft rear bearing
63. Mainshaft rear bearing locating snap ring
64. Mainshaft rear bearing rear securing snap ring
65. Mainshaft
66. Epicyclic shim
67. Epicyclic front plate
68. Epicyclic Belleville spring disc
69. Epicyclic ring gear dowel
70. Epicyclic ring gear
71. Epicyclic front thrust ring
72. Epicyclic planetary pinion shaft securing circlip
73. Epicyclic planetary pinion carrier
74. Epicyclic planetary pinion shaft
75. Planetary pinion front thrust washer
76. Planetary front roller set
77. Planetary pinion
78. Planetary roller spacer
79. Planetary rear roller set
80. Planetary pinion rear thrust washer
81. Epicyclic rear thrust ring
82. Epicyclic cover plate
83. Epicyclic securing bolts
84. High/Low shift coupler
85. P.t.o. drive shaft
86. Layshaft rear needle roller bearing
87. Layshaft front bearing
88. Layshaft
89. Layshaft front bearing spacer washer
90. Layshaft rear bearing
91. Layshaft rear bearing location snap ring
92. Layshaft rear bearing securing snap ring
93. Reverse gear cluster shaft
94. Reverse gear cluster shaft retaining plate
95. Tab washer
96. Reverse gear cluster shaft securing bolt
97. Multi-Power clutch front thrust washer
98. Multi-Power clutch unit housing
99. Multi-Power clutch unit housing cast iron sealing rings.
100. Multi-Power clutch unit piston ring
101. Multi-Power clutch unit piston
102. Multi-Power clutch unit interplates
103. Multi-Power clutch unit friction discs
104. Multi-Power clutch piston return springs
105. Multi-Power friction disc retainer plate
106. Multi-Power retainer plate securing circlip
107. Main input overdrive pinion
108. Multi-Power clutch unit rear thrust washer
109. Main drive pinion
110. Tab located spacer
111. Mainshaft front bearing securing circlip
112. Mainshaft front bearing
113. Mainshaft front bearing thrust washer
114. First gear (mainshaft)
115. First gear sleeve
116. First/Reverse gear sliding coupler
117. Needle bearing-thrust washer
118. Reverse gear (Main shaft)
119. Reverse/third gear sleeve
120. Reverse/third gear thrust washer
121. Third gear (Mainshaft)
122. Second/third synchromesh unit
123. Second gear sleeve
124. Second gear (Mainshaft)
125. Second gear thrust washer
126. P.t.o. constant mesh gear internal circlip
127. P.t.o. constant mesh gear
128. Layshaft front snap ring
129. Overdrive layshaft gear
130. Coupler spring
131. Coupler
132. Main drive layshaft gear
133. Main drive layshaft gear thrustwasher
134. Third gear layshaft securing snap ring
135. Third gear (layshaft)
136. Second gear (layshaft)

MK II-ZF CONSTANT MESH MULTI-POWER TRANSMISSION

KEY TO FIGURES 1, 2 and 3 Contd.

- 137. Reverse gear front thrust washer
- 138. Needle roller front retaining ring
- 139. Front needle roller set
- 140. Needle roller spacer
- 141. Rear needle roller set
- 142. Needle roller rear retaining ring
- 143. Reverse gear cluster
- 144. Reverse gear rear thrust washer
- 145. Gear box case
- 146. Multi-Power pipe
- 147. Multi-Power internal linkage and washer

SELECTOR RAIL MECHANISM

Removal and Replacement 5K-01-06

Special Tools: 2700 Rail Trolley
 MF 414/1 Centralizing Pin
 MF 414/2 Clamping Bolt
 MF 414/3 Locating Peg

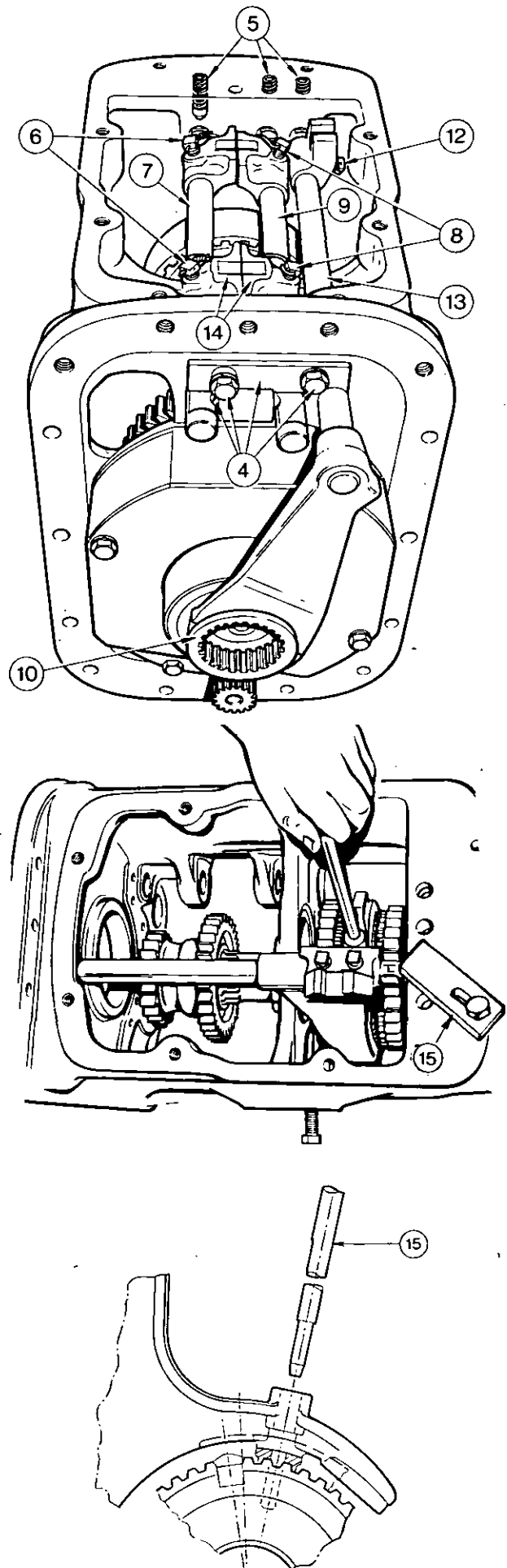
Removal

NOTE: Beware of the sharp edges around the top of the gearbox case.

1. Split the tractor between the transmission and the centre housing, Part 3A.
 2. Remove the gearbox top cover and gasket.
 3. Release the locking wires.
 4. Remove the bolts, stop plate and peg.
 5. Lift out the springs and plungers.
 6. Remove the locking pegs.
 7. Slide the rail rearwards out of the housing.
- NOTE: When removing the selector rails, retain the gear lever engagement dogs.**
8. Remove the locking pegs.
 9. Slide the rail rearwards out of the housing.
 10. Slide the High/Low rail rearwards and remove the coupling.
 11. Rotate the High/Low rail through 90°.
 12. Remove the locking peg.
 13. Slide the rail rearwards out of the housing.
 14. Remove the selector forks from the gearbox.

Refitment

15. Reverse procedures 1 to 14 except:
 - (a) Set the synchromesh selector fork to the neutral position by locating the selector rail with locating peg MF 414/3 clamped with bolt MF 414/2 inserting centralizing pin, MF 414/1 into the hole on the top of the selector fork, lining it up with the corresponding hole in the sliding coupler, inserting the two locking pegs, and making sure the selector rail is stationary tighten the locking pegs equally.
 - (b) Apply a few drops of oil to the selector rails before refitment.
 - (c) Tighten the locking mechanism retaining bolts to a torque of 47 Nm (35 lbf ft).
 - (d) On completion of the refitting procedure, place all the gear lever engagement dogs in the neutral position.



MK II-ZF CONSTANT MESH MULTI-POWER TRANSMISSION

CLUTCH RELEASE MECHANISM

Removal and Refitment

5K-02-07

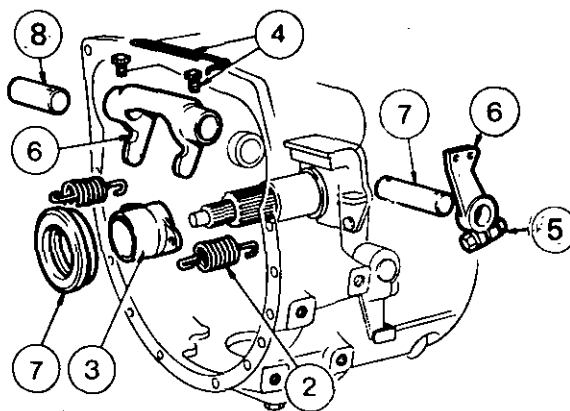
Special Tool: 2700 Rail Trolley

Removal

1. Split the tractor between the engine and the transmission Part 3A.
2. Remove the two springs.
3. Slide the carrier and release bearing off the input housing.
4. Remove the locking wire and two locking pegs from the release fork.
5. Slacken off the clamp bolt on the clutch pedal lever.
6. Remove the clutch pedal lever.
7. Withdraw the left hand clutch half shaft from the gearbox casing.
8. Position a suitable drift, through the left hand clutch shaft bore and carefully drive out the right hand clutch half shaft.
9. Remove the clutch release fork.
10. Press the release bearing off the carrier.

Refitment

11. Reverse procedures 1 to 10, except:
 - (a) Lightly lubricate the input shaft splines and the release bearing carrier bore, with special grease, Mobilgrease Super.
 - (b) Ensure that the locking pegs locate in the holes in the shafts.
 - (c) Adjust the clutch pedal clearance, operation 5A-02-05.



MK II—ZF CONSTANT MESH MULTI-POWER TRANSMISSION**EPICYCLIC UNIT****Removal and Refitment**

5K—03—08

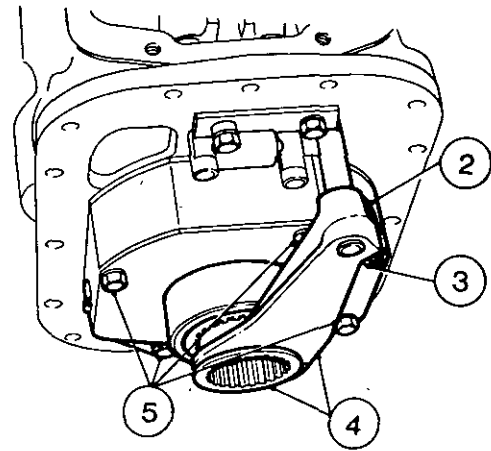
Special Tools: 2700 Rail Trolley

Removal

1. Split the tractor between the transmission and the centre housing, Part 3A.
2. Remove the locking wire.
3. Remove the locking peg.
4. Remove the selector fork and coupling.
5. Remove the bolts.
6. Remove the complete assembly.

Refitment

7. Reverse procedures 1 to 6, except:
 - (a) Ensure that the front and rear thrust rings are correctly located before refitment.
 - (b) Ensure that the epicyclic dowels are correctly located in the gearbox casing.
 - (c) Locate the cover plate with the cut out in the bottom left hand corner.
 - (d) Do not fit a lockwasher to the lower left hand retaining bolt.
 - (e) Tighten the retaining bolts progressively and evenly to a torque of 47 Nm (35 lbf ft).

**EPICYCLIC UNIT****Servicing**

5K—04—08

Special Tools: See operation 5K—03—08

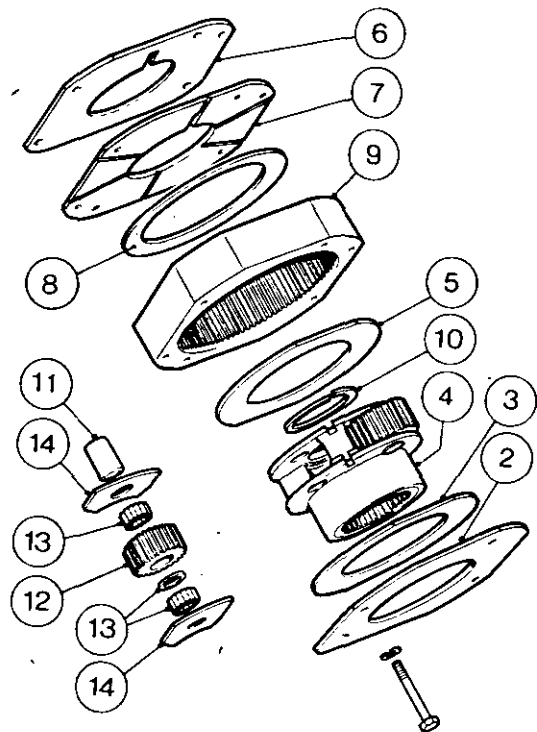
Disassembly

1. Remove the gearbox epicyclic unit, operation 5K—03—08.
2. Remove the cover plate.
3. Remove the rear thrust ring.
4. Remove the planetary pinion carrier.
5. Remove the front thrust ring.
6. Remove the shim.
7. Remove the front plate.
8. Remove the Belleville spring disc.
9. If necessary, remove the dowel pins from the planetary ring gear.
10. Remove the external snap ring.
11. Gently tap out the three pinion shafts towards the front.
12. Remove the planetary pinions.
13. Remove the two sets of rollers and the spacer from each pinion.
14. Remove the wear plates from each pinion.

Reassembly

15. Reverse procedure 1 to 14, except:
 - (a) When replacing the rollers in the pinions, a smear of petroleum jelly (not grease) will help retain them. Do not omit the spacer from between the two runs of rollers. Each run consists of 16 rollers.
 - (b) Ensure the Belleville spring disc is located correctly in the epicyclic ring gear with the concave face rearwards.
 - (c) The front plate and the cover plate must be positioned with the oil grooves towards the pinion carrier.
 - (d) Ensure that pinion wear plates are refitted with the flats innermost to the centre of the pinion carrier.
 - (e) Ensure the gap of snap ring is located mid-way between planetary pinion shafts.

- (f) Always fit the same thickness of shims as those removed.
- (g) To facilitate fitment of the front and rear thrust rings on the pinion carrier, smear with petroleum jelly (not grease). Ensure that the tabs on the thrust rings locate in the pinion carrier cut-outs, and that the brass faces are away from the pinion carrier.



MK II-ZF CONSTANT MESH MULTI-POWER TRANSMISSION

P.T.O. DRIVESHAFT FRONT BEARING

Removal and Refitment

5K-05-09

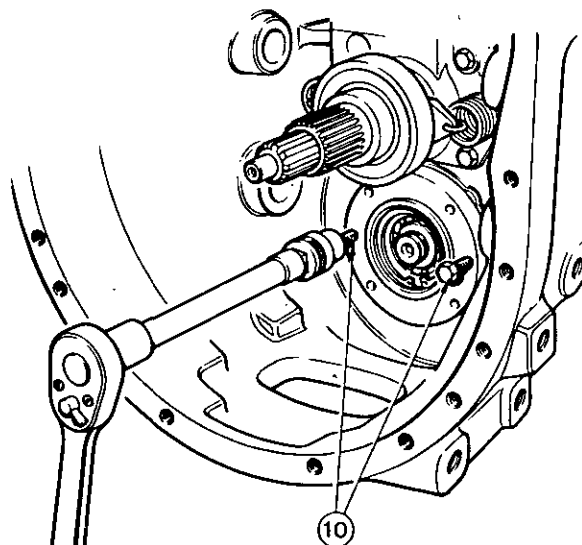
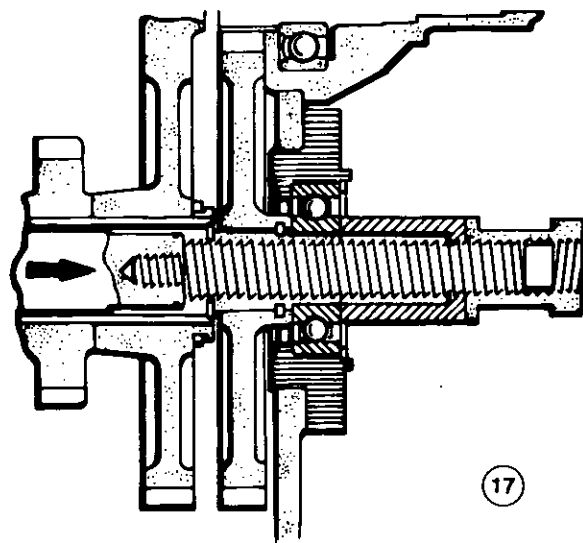
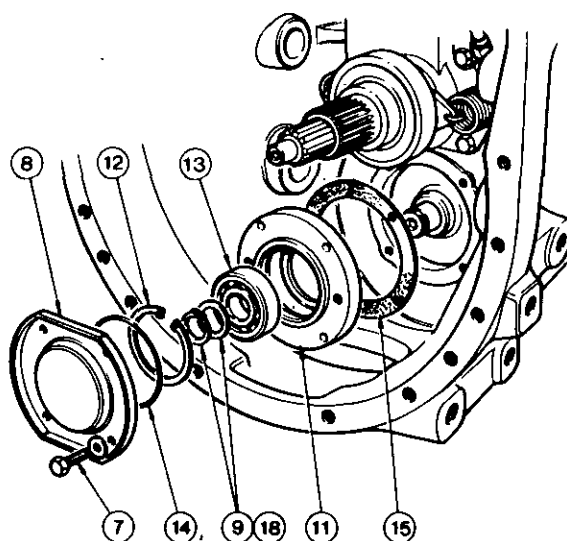
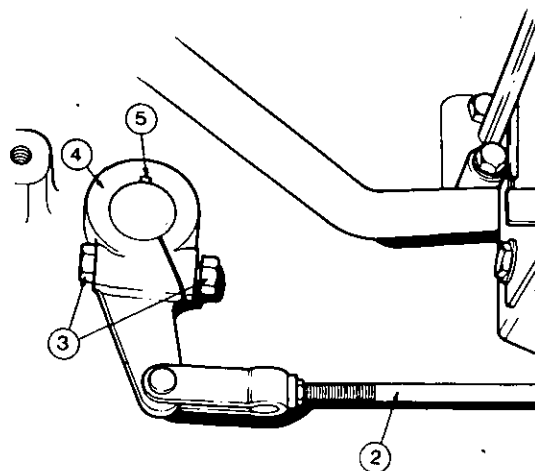
Special Tools: 2700 Rail Trolley
MF 218A P.t.o. Drive Shaft Puller
MF 218A-2 Adaptor

Removal

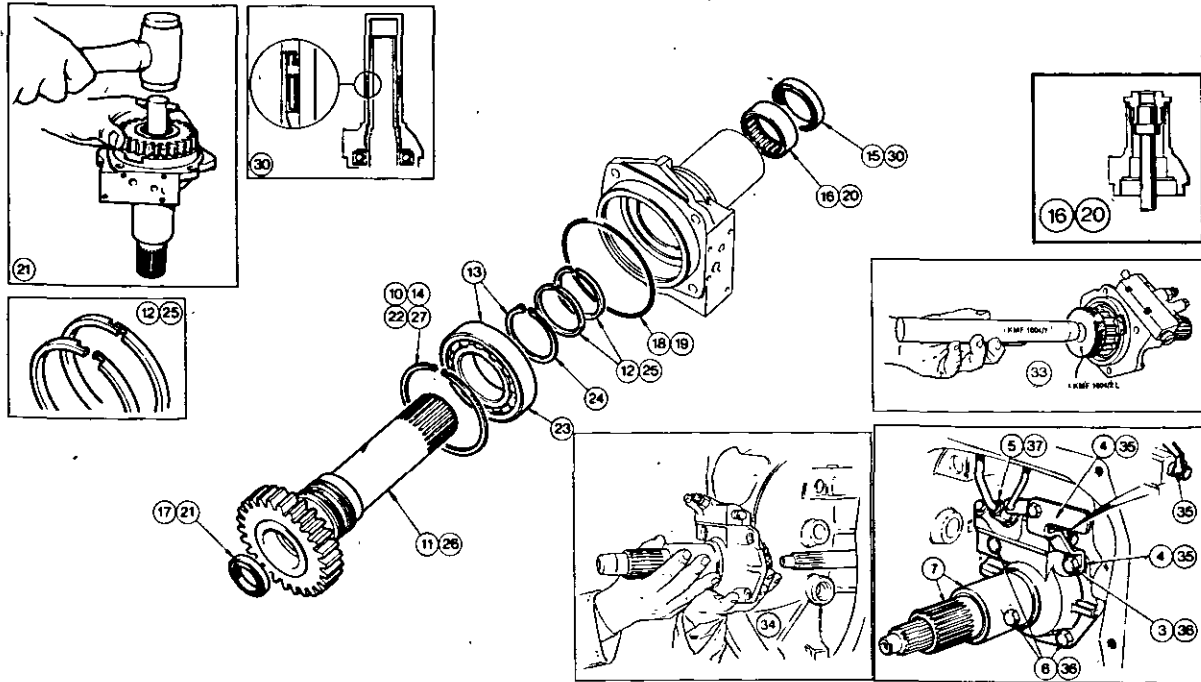
1. Split the tractor between the engine and the transmission, Part 3A.
2. Disconnect both footbrake operating rods.
3. Remove the bolt, nut and lockwasher securing the left hand footbrake cross shaft lever.
4. Remove the cross shaft lever.
5. Remove the key from the keyway.
6. Withdraw the shaft, complete with pedals from the right hand side of the transmission housing.
7. Remove the four bolts and washers.
8. Remove the plate.
9. Remove the external circlip and washer.
10. Screw two $\frac{3}{8}$ UNC x 75 mm (3 in) bolts into the bearing housing and tighten them evenly.
11. Remove the housing.
12. Remove the circlip.
13. Press out the bearing.
14. Discard the 'O' ring.
15. Discard the gasket.

Refitment

16. Reverse procedures 12 to 15, except:
 - (a) Fit a new 'O' ring, gasket and circlip.
 - (b) Lightly coat the gasket with recommended sealant 'A'.
17. Using MF 218A and MF 218A-2, refit the bearing and housing assembly on the front end of the p.t.o. drive shaft ensuring that the splines on the shaft locate with those in the p.t.o. constant mesh gear.
18. Fit a new circlip and washer.
19. Reverse procedures 1 to 8, except:
 - (a) Lightly coat the securing bolt threads with recommended sealant 'B'.
 - (b) Tighten the bolts to a torque of 60 Nm (45 lbf ft).



MK II-ZF CONSTANT MESH MULTI-POWER TRANSMISSION



INPUT SHAFT HOUSING AND P.T.O. INPUT SHAFT

Servicing

5K-06-10

Special Tools: 2700 Rail Trolley
 KMF 1004/1 Protector Sleeve
 KMF 1004/2 Guide
 MF 255 B-1 Oil Seal Replacer
 MF 255 B-2 Cone
 MF 256 A Oil Seal Replacer
 MF 315 Needle Bearing Removal/
 Replacer Tool

Disassembly

1. Remove the clutch release mechanism, operation 5K-02-07.
2. Disconnect the Multi-Power linkage on the top of the transmission case.
3. Remove the R. H. upper bolt.
4. Remove the internal Multi-Power linkage and washer.
5. Disconnect the pipe.
6. Remove the remaining three bolts.
7. Withdraw the input housing complete with the p.t.o. shaft.
8. Remove the four Allen screws securing the spool valve to the input housing.
9. Remove the spool valve and gasket.
10. Dislocate the large internal circlip from the input housing groove.
11. Push the p.t.o. shaft complete with bearing rearwards out of the housing.
12. Unclip and remove the two sealing rings.
13. If necessary, remove the circlip and press the bearing off the front of the shaft.
14. Remove the circlip.
15. Lever the seal out.
16. Using MF 315, remove the needle roller bearing.
17. Remove the seal.
18. Remove the 'O' ring (input shaft housing).

Examine the bore of the p.t.o. input shaft and the input housing for grooves, where the sealing rings locate. If any of the above parts show signs of wear or damage, they must be replaced. Check (and if necessary, replace) the ball and needle roller bearings for wear.

Lubricate all new seals with petroleum jelly (not grease) when reassembling.

Reassembly

19. Fit a new 'O' ring (input shaft housing).
20. Using MF 315 replace the needle roller bearing.
21. Using MF 256A, fit a new seal, with the toe of the seal facing the tool.
22. Refit the circlip on the shaft.
23. Refit the bearing with the shield towards the gear teeth.
24. Refit the circlip (check that it is properly seated).
25. Fit two new cast iron sealing rings on the p.t.o. input shaft and ensure that they are correctly clipped, then lubricate the shaft with clean transmission oil.
26. Carefully refit the p.t.o. input shaft and bearing into the input housing, ensuring that the cast rings are not damaged.
27. Re-locate the circlip in the input housing (check that it is properly seated).
28. Place the cone adaptor MF 255B/2 onto seal replacer MF 255B/1.
29. Place a new seal over the cone and onto the tool, with the toe of the seal facing away from the tool and remove the cone.
30. Place the tool over the p.t.o. shaft and tap the seal into place.
31. Refit the spool valve and a new gasket (fitted dry) and tighten the Allen screws evenly.
32. Fit two new cast iron sealing rings on the main input shaft.
33. Carefully push guide KMF 1004/2 into the rear end of the P.t.o. input shaft, carefully insert tapered end of protector sleeve KMF 1004/1 through guide. Remove the guide leaving the sleeve in position.
34. Carefully refit the input housing, and withdraw the protector sleeve.
35. Refit the washer and Multi-Power linkage, ensuring that the actuator locates in the slot in the spool.
36. Lightly coat the bolt threads in a recommended sealant 'B', refit and tighten them to a torque of 60 Nm (45 lbf ft).
37. Refit the pipe.
38. Refit the external Multi-Power linkage.
39. Refit the clutch release mechanism, operation 5K-02-07.

MK II—ZF CONSTANT MESH MULTI-POWER TRANSMISSION

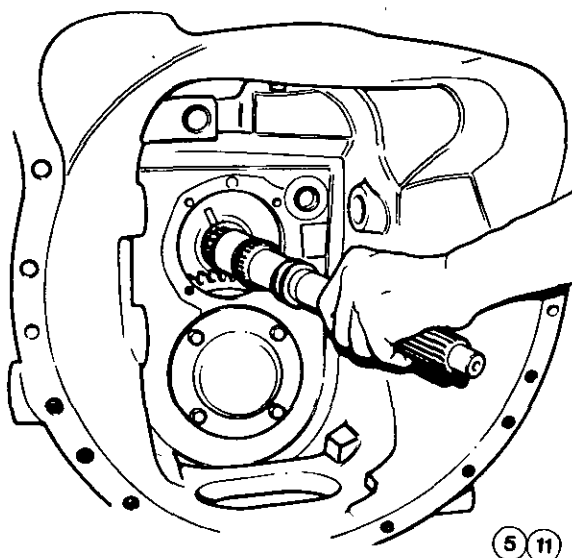
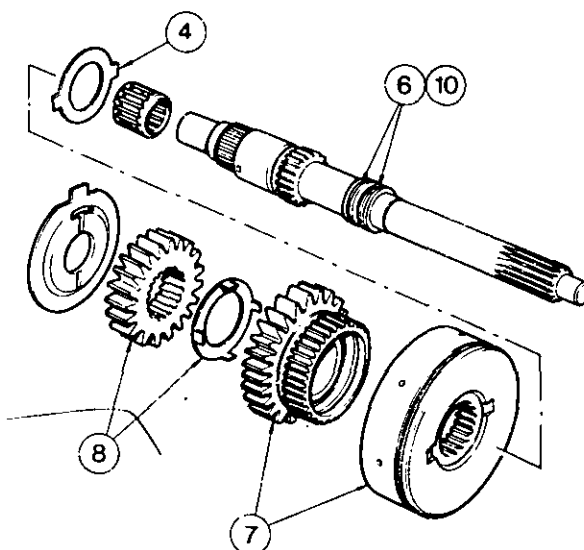
Main Input Shaft and Multi-Power Clutch Unit Removal and Refitment

5E-07-11

Special Tools: See operation 5E-06-10.

Removal

1. Split the tractor between the engine and transmission, and the transmission and centre housing, Part 3A.
2. Remove the gear selector mechanism, operation 5K-01-06, procedures 2 to 9.
3. Using feeler gauges, measure the gap between the front thrust washer and the p.t.o. input shaft pinion. If it exceeds 1,65 mm (0.065") record the dimension for later use.
4. Remove the input shaft housing and p.t.o. input shaft, operation 5K-06-10, procedures 1 to 7.
5. Remove the Multi-Power clutch front thrust washer.
6. Withdraw the main input shaft forwards out of the transmission casing and simultaneously steady the Multi-Power clutch unit, main input overdrive pinion and the main drive pinion whilst the splines are disengaged.
NOTE: Ensure that the Multi-Power clutch rear thrust washer does not fall into the bottom of the transmission casing.
7. Unclip and remove the cast iron sealing rings.
8. Remove the clutch unit and main input overdrive pinion.
9. Remove the Multi-Power clutch rear thrust washer and the main drive pinion. Examine the bore of the input p.t.o. shaft for grooves where the sealing rings locate and replace the shaft if any scoring or grooves are found. If excessive wear or scoring is found, the input housing and p.t.o. input shaft must be serviced as in operation 5K-06-10, procedures 8 to 31.



MAIN INPUT SHAFT AND MULTI-POWER CLUTCH UNIT

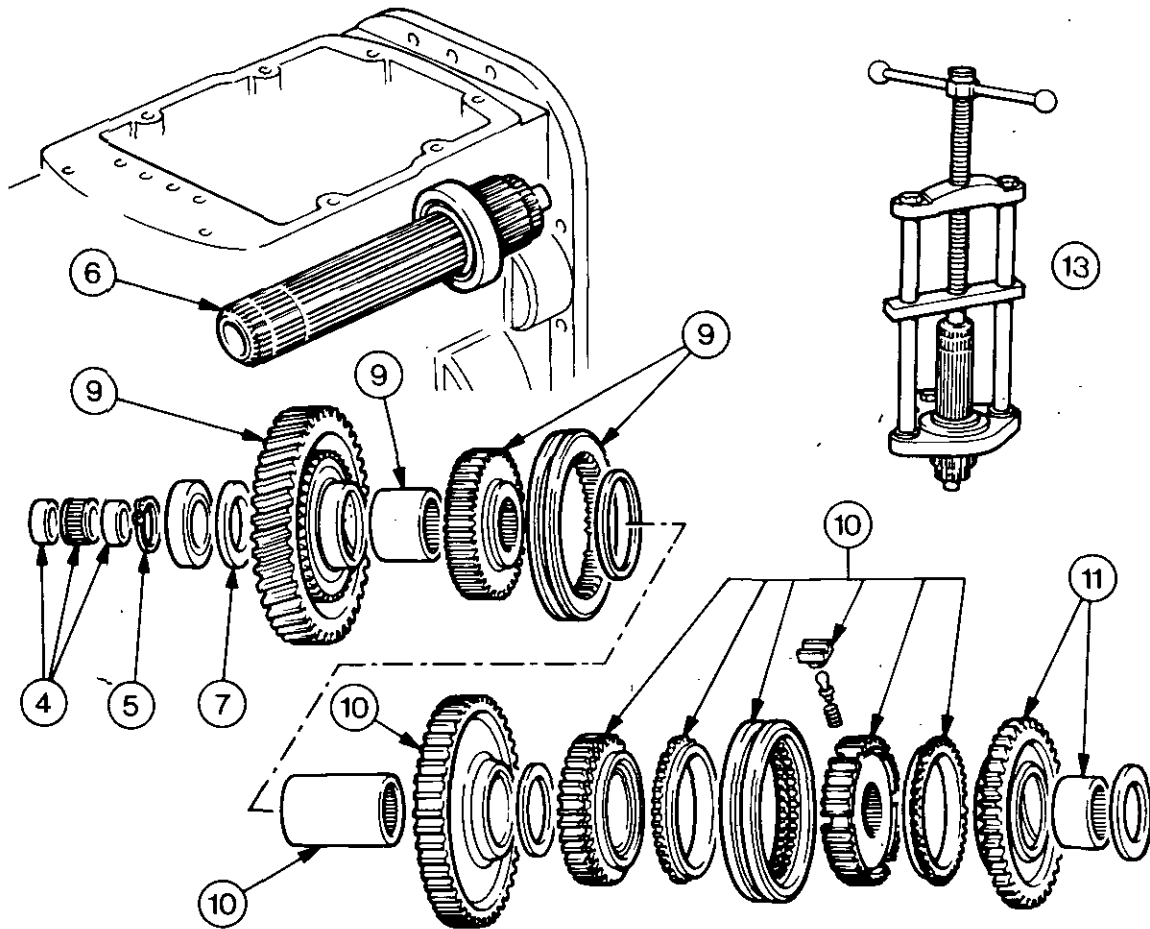
Refitment

10. Place the Multi-Power clutch unit, main input overdrive pinion, rear thrust washer and the main drive pinion forward of the centre web in the transmission casing, locating the gears with the overdrive and main drive layshaft gears.
NOTE: Lightly smear the rear thrust washer with petroleum jelly (to help refitment) and fit the tabs facing forwards and located correctly on the rear boss of the main input overdrive pinion.
11. Fit two new cast iron sealing rings to the main input shaft and ensure they are properly clipped.
12. Carefully push the shaft rearwards into the front of the Multi-Power clutch unit and on into mesh with the main drive pinion. Ensure that the Multi-Power clutch unit and the main drive pinion are both located on the main input shaft splines and that the main input shaft is correctly located in the mainshaft needle roller bearing.
13. If the gap between the front thrust washer and the p.t.o. input shaft pinion exceeded 1,65 mm (0.065") it must be replaced with one from the following chart to give a gap of 0,63 mm (0.025") minimum 1,65 mm (0.065") maximum.

THRUST WASHER CHART		
<i>MF Part No.</i>	<i>Thickness mm</i>	<i>Thickness ins.</i>
1661-951-M1	2,36/2,29	.093/.090
1667-607-M1	3,00/2,92	.118/.115
1667-608-M1	3,50/3,43	.138/.135

- Refit the thrust washer and ensure the two tabs are correctly located in the cut-outs on the clutch unit.
14. Lubricate the main input shaft with clean transmission oil and refit the input shaft housing and p.t.o. input shaft, operation 5K-06-10, procedures 33 to 39.
 15. Reverse procedures 1 and 2.

MK II-ZF CONSTANT MESH MULTI-POWER TRANSMISSION

**MAINSHAFT, FIRST, REVERSE, THIRD AND SECOND GEARS****Removal and Refitment**

5K-08-12

Special Tools: See Operation 5K-01-06 and
MF 200 Hand Press
MF 200-25 Adaptor

Removal

1. Remove selector rail mechanism, operation 5K-01-06.
2. Remove gearbox epicyclic unit, operation 5K-03-08.
3. Remove the main input shaft, operation 5K-07-11.
4. Using feeler gauges, measure the gap between the front thrust washer and the front bearing. If it exceeds 0,30 mm (0.012") record the dimension for later use.
5. Remove the spigot roller bearing and two spacers.
6. Remove the snap ring from off the front of the mainshaft.
7. Withdraw the mainshaft rearwards out of the gearbox casting.
8. Remove the thrust washer from between the front bearing, and the first gear.
9. Engage sliding coupler with first gear.
10. Withdraw first gear and the sliding coupler.
11. Withdraw reverse and third gear with synchromesh assembly.
12. Withdraw second gear.
13. Remove the bearing from the centre web of the gearbox casting.
14. If necessary, press the bearing off the front end of the mainshaft, using MF 200 and MF 200-25.
15. If necessary, remove the circlip from the bearing.

Refitment

16. Reverse procedures 1-13 except:—

- (a) If gap between the front thrust washer and the front bearing exceeded 0,30 mm (0.012") it must be replaced with one from the following chart, to give a gap of 0,08 mm (0.003") minimum, 0,30mm (0.012") maximum. It must be fitted with the shoulder towards the bearing.
- (b) Ensure that snap rings are correctly located in their grooves.

THRUST WASHER CHART

MF Part No.	Thickness mm	Thickness ins.
1671-888-M2	4,14/4,19	.163/.165
1671-889-M1	4,39/4,44	.173/.175
1671-890-M2	4,62/4,67	.182/.184
1671-891-M2	4,85/4,90	.191/.193

MK II-ZF CONSTANT MESH MULTI-POWER TRANSMISSION

SYNCHROMESH ASSEMBLY (SECOND AND THIRD)

Servicing

5K-09-13

Special Tools: See Operation 5K-01-06 and 5K-06-10
 MF 415/1 Synchro hub assembly tool
 MF 415/2 Synchro Hub Assembly Plate
 MF 550 Drive handle

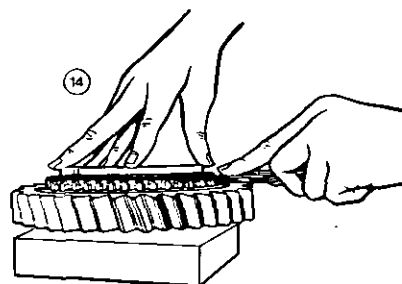
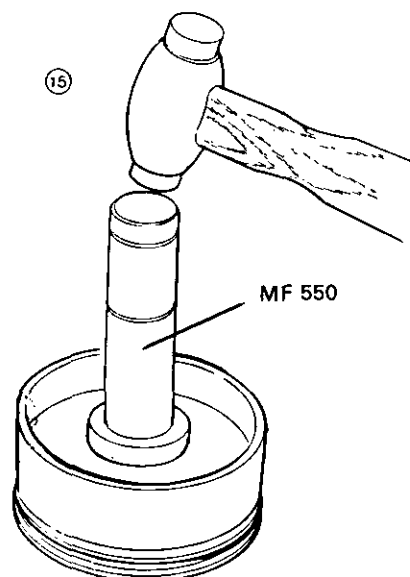
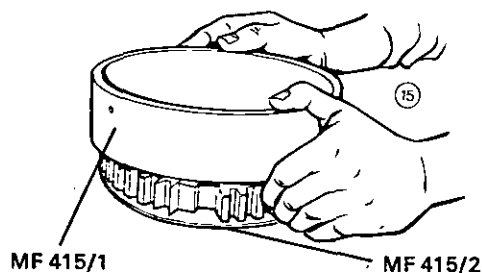
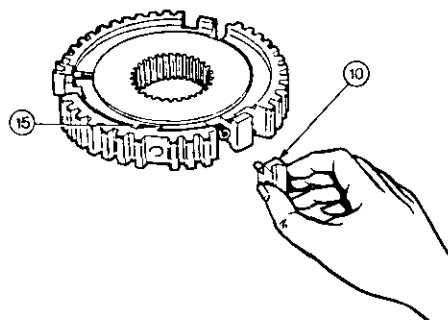
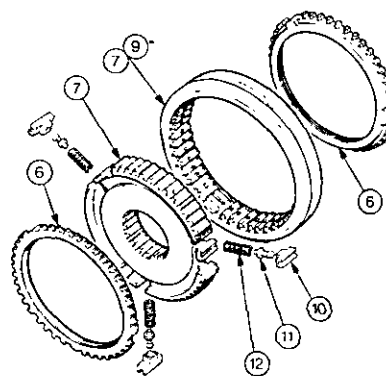
Disassembly

1. Split the tractor between the engine and transmission and the transmission and centre housing, Part 3A.
2. Remove the gear selector mechanism, operation 5K-01-06.
3. Remove the gearbox epicyclic, operation 5K-03-08.
4. Remove the main input shaft, operation 5K-07-11. Procedures 3 to 8.
5. Remove the mainshaft and gears, operation 5K-08-12. Procedures 5 to 12.
6. Remove the two synchronizer rings.
7. Remove the drive hub complete with the sliding coupler.
8. Wrap the hub and coupler in a cloth.
9. Remove the sliding coupler, taking care not to lose pressure springs, plungers and blocks.
10. Remove the three pressure blocks.
11. Remove the three pressure plungers.
12. Remove the three pressure springs.
13. Thoroughly clean all the components and check their condition.
14. Using a feeler gauge, measure the clearance between the synchronizer ring and the coupler on the gear at several points. The synchronizer ring must be correctly positioned on the tapered part of the coupler. If the clearance is less than 0.5 mm (0.02 in) replace the synchronizer ring. When working in the gearbox, replace the synchronizer ring if the clearance is found to be less than 0.8 mm (0.03 in).

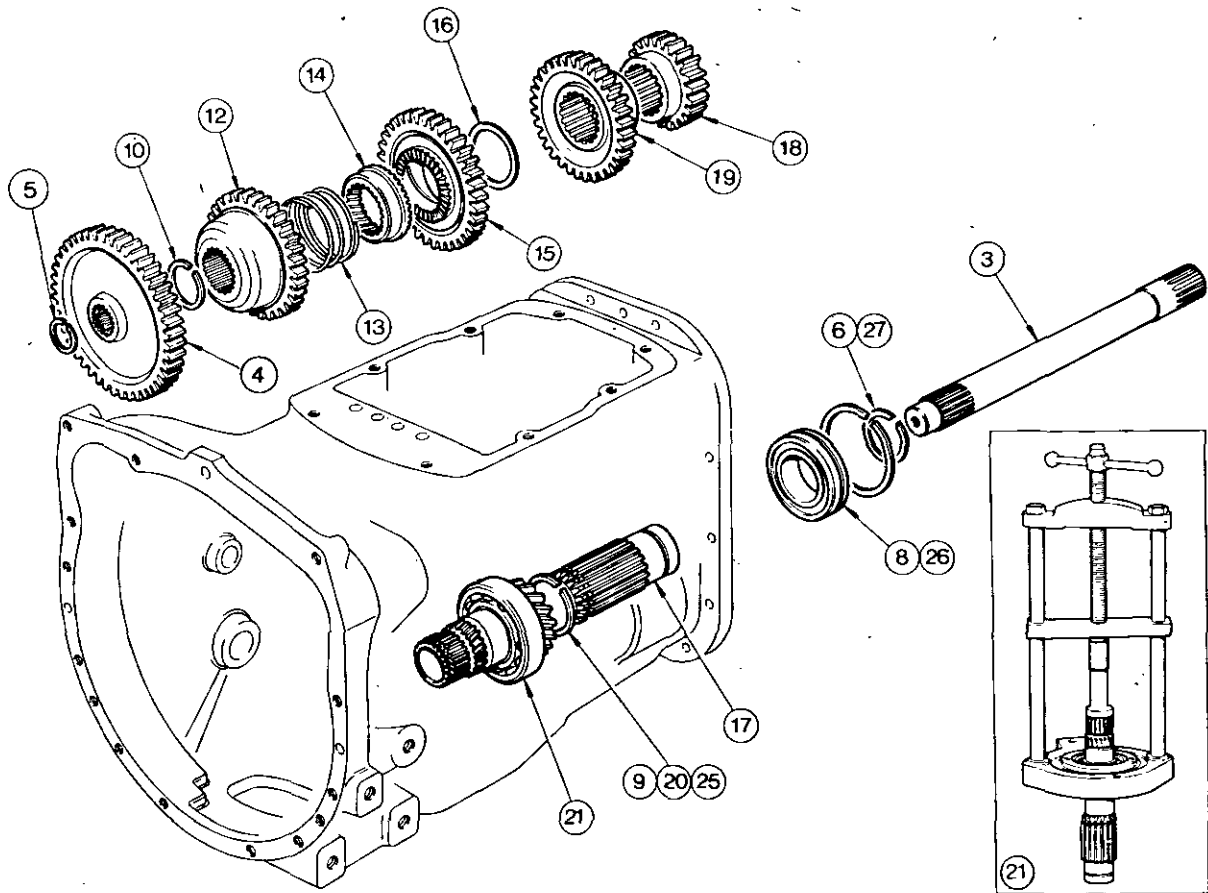
Reassembly

15. Reverse procedures 1 to 12, except: On replacing pressure springs, plungers and blocks special service tool MF 415 should be used to locate the hub back in the sliding coupler.

NOTE: Ensure that the centralization holes in the hub and coupler are aligned.



MK II-ZF CONSTANT MESH MULTI-POWER TRANSMISSION



LAYSHAFT AND GEARS, P.T.O. SHAFT AND GEAR

Removal and Refitment

5K-10-14

Special Tools: See operations 5K-05-09 and 5K-08-12

Removal

1. Remove the mainshaft and gears, operation 5K-08-12. Procedures 1 to 13.
2. Remove the p.t.o. driveshaft front bearing, operation 5K-05-09.
3. Withdraw the p.t.o. drive shaft rearwards out of the transmission casing.
4. Remove the p.t.o. constant mesh gear.
5. Remove the small internal snap ring (only if necessary).
6. Remove the snap ring from the rear of the layshaft.
7. Tap the layshaft forwards.
8. Remove the rear bearing.
9. Expose the snap ring, open it and slide it forwards onto the unsplined portion of the shaft.
10. Remove the snap ring from the front of the layshaft.
11. Relocate the front bearing in the centre web and tap the layshaft rearwards.
12. Remove the overdrive layshaft gear.
13. Remove the spring.
14. Remove the coupler.
15. Remove the main drive layshaft gear.
16. Remove the thrust washer.
17. Locate the front bearing in the centre web and gently drive the layshaft forwards out of the gearbox.

18. Remove the second gear from the gearbox.
19. Remove the third gear from the gearbox.
20. If necessary, remove the circlip.
21. If necessary, press the bearing of the FRONT end of the layshaft using MF 200 and MF 200-25.

Examination

Check all components for wear or damage, and if they are faulty, they must be replaced.

Check the coupler spring, which should have a free length of 47,5 mm (1.75 in), a compressed length of 16,5 mm (0.65 in) and a maximum load of 10,2 kg (22.5 lb) when compressed, if not, it must be replaced. When reassembling the layshaft, fit a new thrust washer and snap rings, and lubricate all parts with clean transmission oil.

Refitment

22. Reverse procedures 18 to 21.
23. Refit the layshaft, locating the third and second gears on the splines at the same time, push the layshaft rearwards enough to allow the components on its front end to be fitted.
24. Reverse procedures 10 to 16.
25. Push the layshaft forwards and second and third gears back far enough to allow the snap ring to be correctly refitted.
26. Refit the rear bearing in the gearbox.
27. Tap the layshaft rearwards (locating it correctly in the bearing) far enough to allow the snap ring to be replaced correctly.
28. Reverse procedures 1 to 5.

MK II-ZF CONSTANT MESH MULTI-POWER TRANSMISSION

REVERSE GEAR CLUSTER

Removal and Refitment 5K-11-15

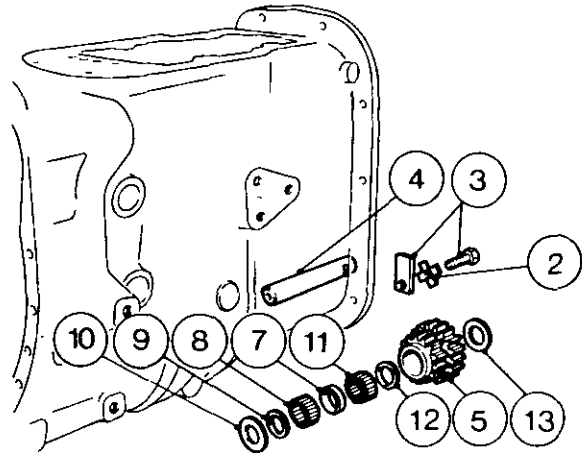
Special Tools: See operation 5K-08-12 and
55×25 mm (2 $\frac{1}{8}$ ×1 in) dia Mild Steel
Dummy Shaft

Removal

1. Remove the mainshaft and gears, operation 5K-08-12. Procedures 1 to 12.
2. Release the tabwasher.
3. Remove the bolt and locating tab.
4. Slide the dummy shaft from the front of the reverse gear shaft towards the rear. This will push out the reverse gear shaft, and prevent the needle rollers from dropping into the transmission case.
5. Remove the idler gear cluster complete with all parts and the dummy shaft.
6. Withdraw the dummy shaft from the idler gears, and allow parts to drop out, onto a clean work surface.

Refitment

7. Fit the spacer in the reverse gear cluster.
8. Refit the first set of rollers. Each run consists of 28 rollers.
NOTE: Smear the rollers in petroleum jelly (not grease) to help reassembly.
9. Refit the retaining ring.
10. Refit the thrust washer.
11. Refit the second set of rollers.
12. Refit the retaining ring.
13. Refit the thrust washer.
14. Slide the dummy shaft into the reverse gear cluster rollers.
15. Reverse procedures 1 to 5.

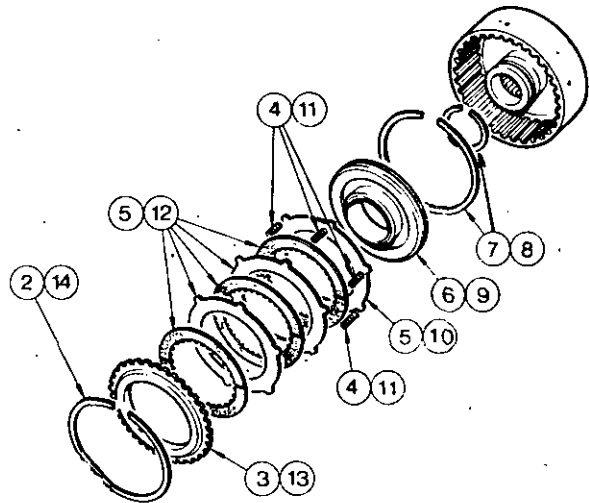


MK II—ZF CONSTANT MESH MULTI-POWER TRANSMISSION**MULTI-POWER CLUTCH UNIT 5K—12—16****Servicing**

Special Tools: See operation 5K—07—11.

Disassembly

1. Remove the multi-power clutch unit, operation 5K—07—11.
2. Place the clutch unit assembly on a flat surface, push down the retainer plate and remove the snap ring.
3. Remove the retainer plate.
4. Remove the six springs.
5. Remove the three interplates and the three friction discs.
6. Slide the piston out of the clutch housing.
7. If necessary, remove the piston rings.

**Examination**

Check the condition of all components for signs of wear, scoring, damage, distortion or overheating.

Check the friction plates for the following dimensional tolerances;

Thickness 2,41 to 2,59 mm (0.095 to 0.102 in).

Maximum Height (permissible distortion) 2,92 mm (0.115 in).

Groove Depth 0,38 to 0,63 mm (0.015 to 0.025 in).

Check the interplates as follows:

Thickness 1,67 to 1,75 mm (0.66 to 0.69 in).

Maximum Dish 0,25 mm (0.010 in).

Maximum Height (permissible distortion) 2,21 mm (0.0875 in).

Check the six coil springs as follows:

Free length 17,8 mm (0.70 in).

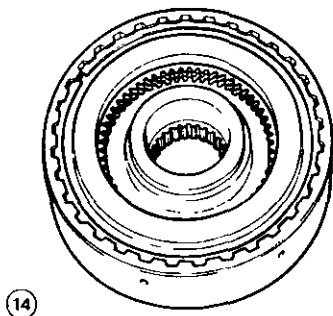
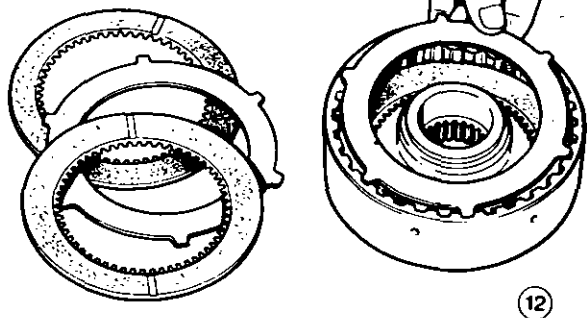
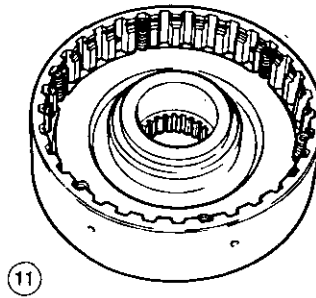
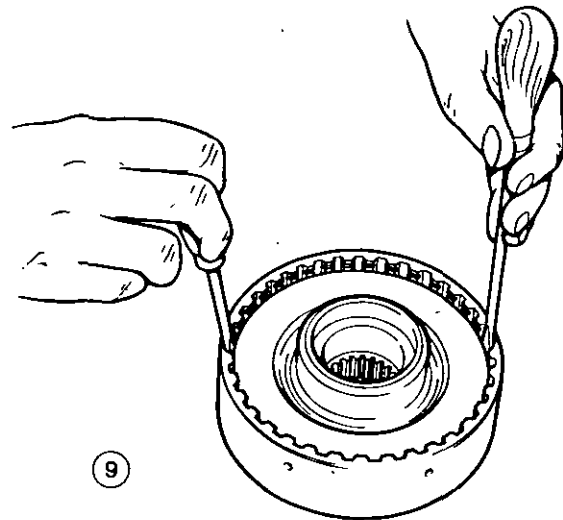
Working Length 12,7 mm (0.50 in).

Load at Working Length 2,98 to 3,64 kg (6.57 to 8.03 lb).

Replace any worn or damaged components, as required.

Reassembly

8. If necessary, refit the piston rings.
9. Compressing the piston ring, carefully refit the piston into the housing.
10. Fit one interplate to the clutch housing, with the lugs on the interplate located in the housing splines immediately to the right of the six holes in the housing.
11. Refit the six springs, placing one spring onto each lug of the first interplate.
12. Refit the three friction plates and the remaining two interplates alternately, locating the lugs on each interplate one spline further to the right of one previously fitted.
13. Refit the retainer plate.
14. Refit the snap ring, and ensure it is located correctly.
15. Refit the Multi-Power clutch unit and the Main Input Shaft as stated in operation 5K—07—11.



MK II-ZF CONSTANT MESH MULTI-POWER TRANSMISSION

MULTI-POWER SPOOL VALVE

Servicing 5K-13-17

Special Tools: operation 5K-06-10

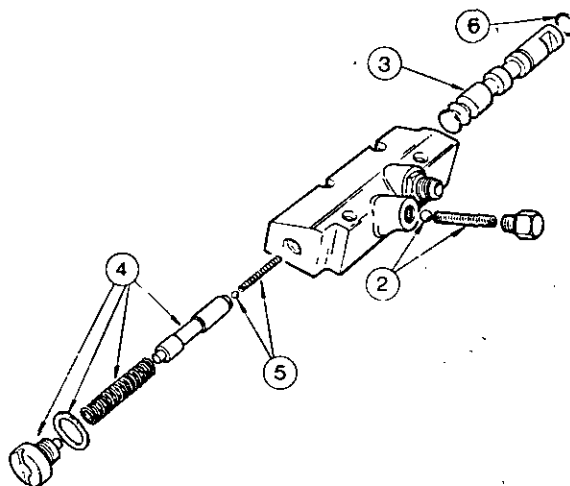
Disassembly

1. Remove the p.t.o. input housing, p.t.o. input shaft, and spool valve, operation 5K-06-10 procedures 1 to 9.
2. Remove the plug, spring and ball.
3. Withdraw the large spool.
4. Remove the plug, washer, spring and spool.
5. Remove the small ball and spring from the spool.

Reassembly

6. Fit a new 'O' ring to the large spool.
7. Slide the spool into the spool block.
8. Refit the ball, spring and plug.
9. Refit the small ball and spring into the spool.
10. Refit the small spool, spring, new washer and plug.
11. Tighten the plug to 27,11 Nm (20lbf ft).
12. Refit the spool valve, p.t.o. input shaft housing and p.t.o. input shaft, operation 5K-06-10 procedures 31 to 39.

NOTE: Ensure that all parts are scrupulously clean and are lubricated with clean transmission oil.



MK II—ZF CONSTANT MESH MULTI-POWER TRANSMISSION**TRANSMISSION CASE REMOVAL AND REPLACEMENT OR COMPLETE TRANSMISSION OVERHAUL** 5K—14—18

Special Tools: KMF 1004/1 Protector Sleeve
 KMF 1004/2 Guide
 MF 200 Hand Press
 MF 200-25 Adaptor
 MF 218 A P.t.o. Drive Shaft Puller
 MF 218 A-2 Adaptor
 MF 255 B-1 Oil Seal Replacer
 MF 255 B-2 Cone
 MF 256 A Oil Seal Replacer
 MF 2700 Rail Trolley
 MF 315 Needle Bearing Removal/ Replacer Tool
 MF 414/1 Centralizing Pin
 MF 414/2 Clamp Bolt
 MF 414/3 Locating Peg
 MF 415/1 Synchro Hub Assembly Ring
 MF 415/2 Synchro Hub Assembly Plate
 MF 550 Drive Handle
 V.L. Churchill 50 ton Hydraulic Press (alternative to MF 200)
 55 mm x 25 mm (2 $\frac{1}{4}$ in x 1 in) dia Mild Steel Dummy Shaft

Disassembly

1. Remove the selector rail mechanism, operation 5K—01—06.
2. Remove the clutch release mechanism, operation 5K—02—07.
3. Remove the gear box epicyclic unit, operation 5K—03—08.
4. Disassemble the transmission epicyclic unit, operation 5K—04—08.
5. Remove the p.t.o. driveshaft front bearing, operation 5K—05—09.
6. Remove and dismantle the input housing and p.t.o. shaft operation 5K—06—10.
7. Remove the main input shaft and multi-power clutch unit, operation 5K—07—11.
8. Remove first, reverse, second, third gears and mainshaft, operation 5K—08—12.
9. Remove the synchromesh cone assembly operation 5K—09—13.
10. Remove the layshaft and gears and p.t.o. shaft and gears operation 5K—10—14.
11. Remove the reverse gear cluster, operation 5K—11—15.
12. Dismantle the Multi-Power Clutch Unit, operation 5K—12—16.
13. Dismantle the Multi-Power Spool Valve, operation 5K—13—17.

Examination

After disassembly of the transmission, examine all the components for scoring, wear or chipping. Pay particular attention to the gear teeth, bearings, needle rollers, gear selector forks, gear selector couplers, multi-power clutch plates and spool valve.

Check end float between the Multi-Power Clutch Pack and the p.t.o. input shaft pinion. Replace thrust washer if necessary. See operation 5K—06—10. Check end float between mainshaft bearings of 1st, 2nd, 3rd and reverse gear assembly. Replace thrust washer if necessary. See operation 5K—08—12. It is absolutely essential that tool KMF 1004 is used when replacing the input shaft housing. See operation 5K—06—10. Centralising pin and locating peg MF 414 must also be used to align selector fork, selector rail and synchro hub assembly. See operation 5K—01—06.

All bearings should be washed in clean paraffin, blown dry, inspected for wear or scoring on the outer circumference and measured for fit in transmission case webs. Maximum acceptable clearance is 0.003 mm (0.0013 in). Where the clearance between bearing and bore exceeds this figure, recommended sealant 'C' may be used to refit the bearings into the transmission case. After inspection, lubricate bearings with clean transmission oil.

Any worn or damaged components should be replaced; also, a complete set of new gaskets, 'O' rings and a new tabwasher must be fitted.

Reassembly

13. Reverse procedures 1 to 13 except:
 - (a) Use only petroleum jelly for reassembly purposes—Never Grease.
 - (b) Ensure all snap rings are correctly located in their grooves.
 - (c) Lightly oil all bushes, bearings and splines prior to reassembly.

MK II-ZF CONSTANT MESH MULTI-POWER TRANSMISSION

GEAR SHIFT LEVER

Removal and Refitment

5K-15-19

Removal

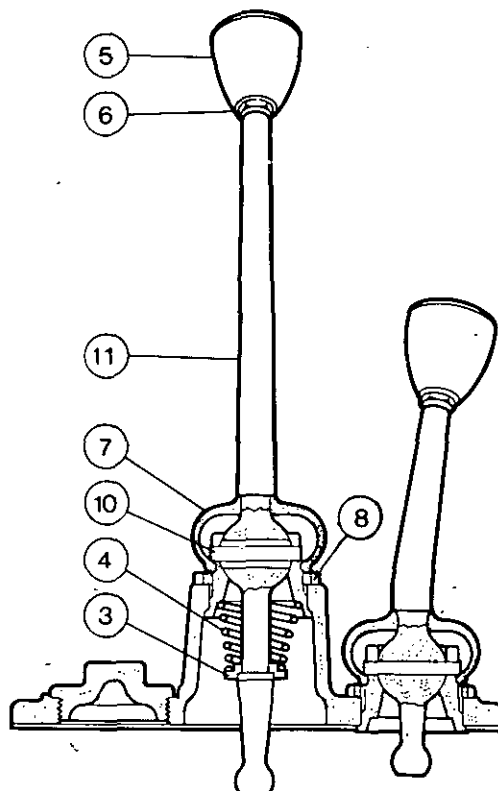
1. Remove the steering box and gearbox top cover assembly and gasket, Part 7B.
2. Support the top cover in a vice.
3. Press the spring retaining washer towards the spring, and slide sideways and remove. This will release the spring.

WARNING: When removing the spring retaining washer, care must be taken to prevent the spring from flying out and causing possible injury or damage.

4. Remove the seat and spring.
5. Remove the gear knob.
6. Remove the nut.
7. Remove the rubber dust cover.
8. Unscrew the locking ring.
9. Remove the locking ring.
10. Drive out the pin.
11. Remove the gear lever.
12. Drive the cup downwards out of the housing.

Refitment

13. Reverse procedures 1 to 12.



HIGH/LOW SHIFT LEVER

Removal and Refitment

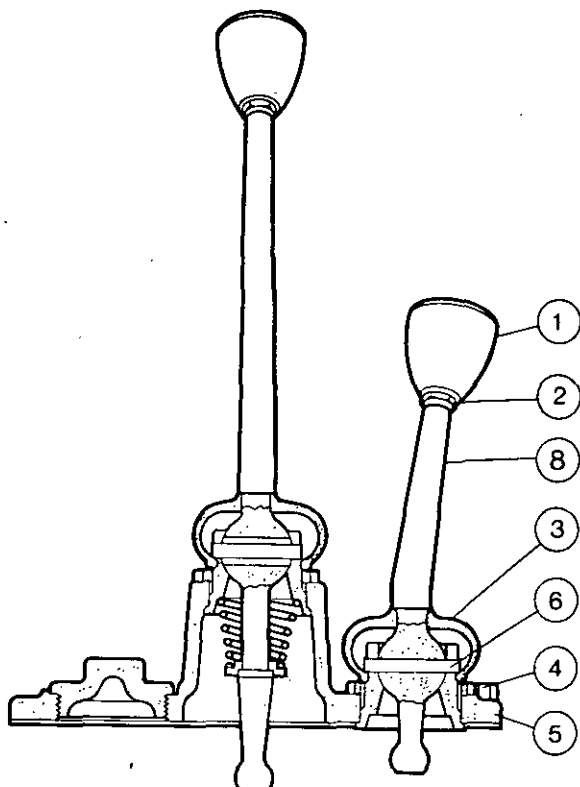
5K-16-19

Removal

1. Remove the gear knob.
2. Remove the nut.
3. Remove the rubber dust cap.
4. Unscrew the locking ring.
5. Remove the locking ring.
6. Turn the lever and cup until the pin securing the lever can be removed.
7. Drive out the pin.
8. Remove the gear lever.
9. Drive the cup downwards out of the housing.

Refitment

10. Reverse procedures 1 to 9.



HYDRAULIC SYSTEM

HYDRAULIC PUMP OIL STRAINER (All Early MF200 Tractors)

**** Servicing**

8A-18-20C

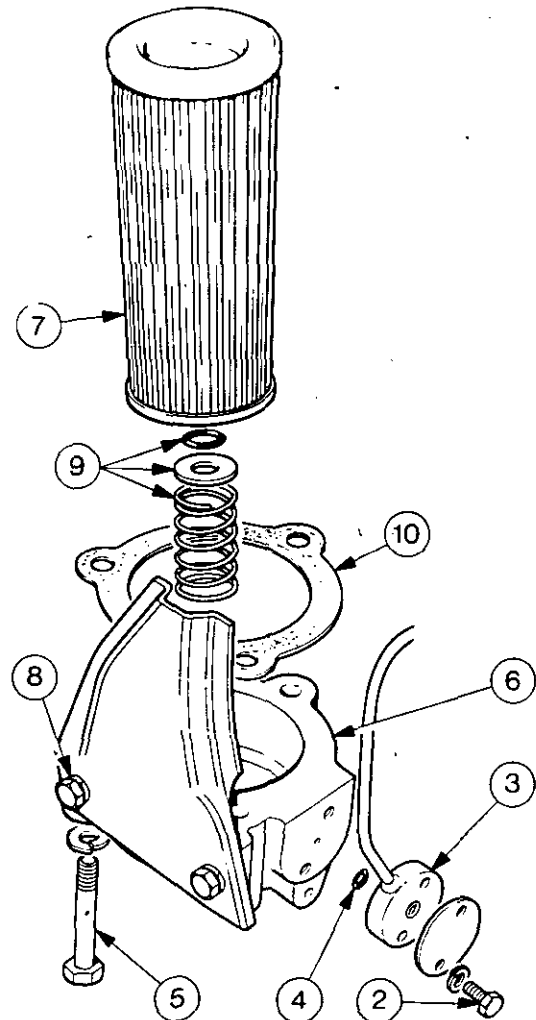
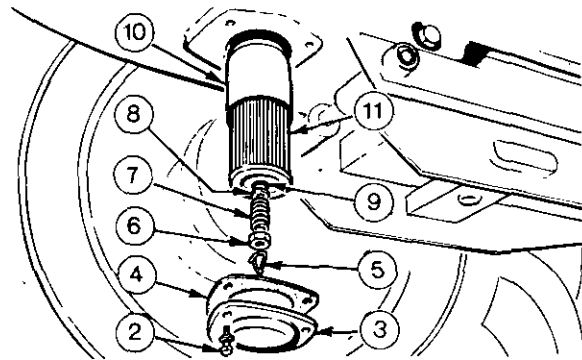
Disassembly

1. Drain the oil.
2. Remove the three bolts and washers securing the cover plate to the bottom of the centre housing.
3. Remove the cover plate.
4. Remove and discard the gasket.
5. Remove the clip.
6. Remove the nut.
7. Remove the spring.
8. Remove the washer.
9. Remove the "O" ring.
10. Pull out the strainer and the shroud.
11. Thoroughly clean the strainer, in paraffin.

Reassembly

12. Reverse procedures 1 to 9 except:
 - a. Fit new "O" ring.
 - b. Fit new cover plate gasket.

NOTE: Time should be allowed for the oil to settle in the transmission before rechecking the level.



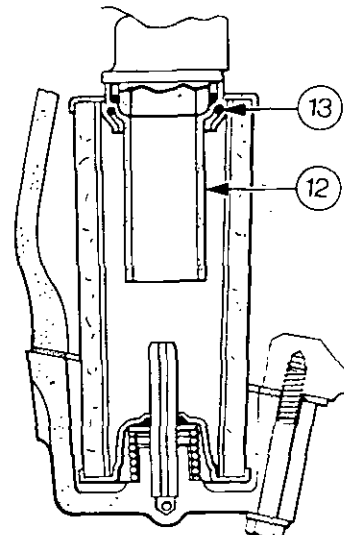
TRANSMISSION AND HYDRAULIC PUMP FILTER (All Late MF 200 Tractors)

**** Servicing**

8A-19-20C

Disassembly

1. Drain the oil.
2. Remove two bolts and plate from the vacuum tube connector.
3. Ease the connector away from the filter cover about 6 mm ($\frac{1}{4}$ in) to assist removal of the cover.
4. Remove connector "O" ring.
5. Remove three bolts and washers.
6. Remove the filter cover with the shield still attached.
7. Remove the filter element.
8. Remove the two bolts securing the shield to the cover and remove the shield.
9. Remove the spring, stop plate and "O" ring from the central post inside the filter cover.
10. Remove and discard the gasket.
11. To clean the filter element, first seal the open ends with either two suitable plugs or oil resistant adhesive tape, then swill the element in clean white spirit. Brush the mesh with a stiff bristle brush. Finally remove the plugs or tape, apply a compressed air line to the inside of the element to remove any remaining dirt particles.
12. Remove the suction tube by gently pulling it down from the pump manifold.
13. Remove two "O" rings—suction tube inner and outer.



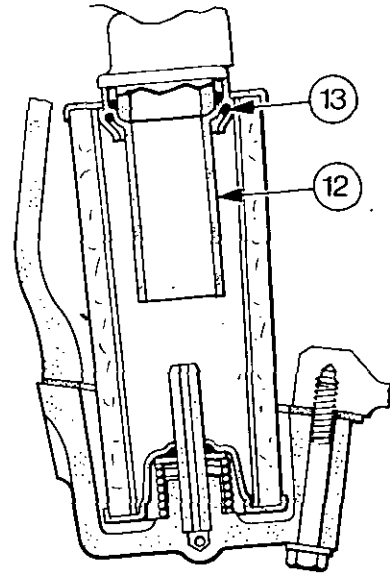
HYDRAULIC SYSTEM

** Reassembly

14. Place "O" ring inside suction tube.
15. Place "O" ring on the outside of the suction tube.
16. Push the suction tube onto the spigot of the pump manifold, where it will hold in position.
17. Fit new gasket to face of filter cover.
18. Fit spring, stop plate and "O" ring onto filter cover central post.
19. Place filter element in cover with the wider end uppermost.
20. Fit one bolt and washer to the filter cover.
21. Refit the filter and cover assembly to the centre housing by inserting the top of the filter element through the access hole until it passes over the suction tube and seats on the "O" ring.
22. Whilst holding the filter cover up to the centre housing engage one bolt and fully tighten, then fit and tighten the two remaining bolts.

NOTE: Do not attempt to pull the filter cover up to the centre housing using the securing bolts.

23. Refit the connector using a new "O" ring lightly oiled.
24. Refit the shield to the filter cover so that there is *maximum contact with the side of the centre housing*, and no gap at the top. The shield has slotted bolt holes to aid adjustment.

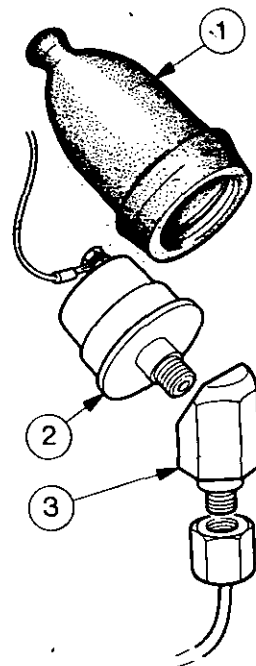


** VACUUM SWITCH (All late MF 200 Tractors) Removal and Replacement 8A-20-20D

1. Remove rubber cover.
2. Disconnect cable from switch terminal.
3. Unscrew switch from mounting block.

Replacement

4. Reverse procedures 1 to 3 except:
 - a. Apply a thin coat of Loctite 542 or equivalent to threads and shank of switch before screwing it into the mounting block.

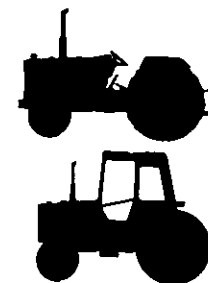


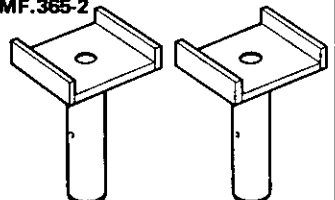
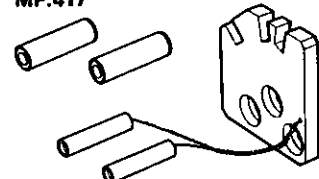
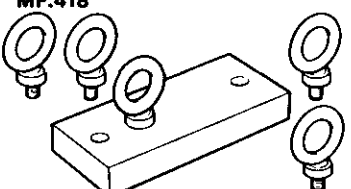
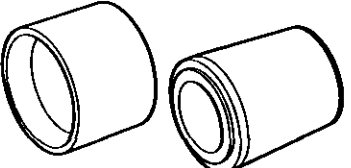
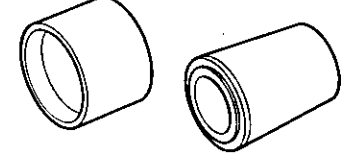
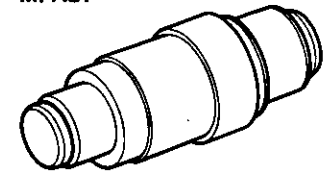
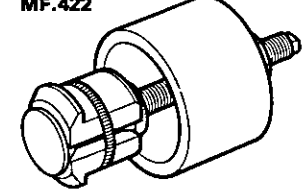
MF

Massey Ferguson

MF200

MF600



Tool No.	Description	Application
MF.365-2 	Cab Stand Adaptor Set Used with MF.365	600 Series Cab
MF.417 	Quadrant Lever Retaining Tool	600 Series Hydraulic System
MF.418 	Hydraulic Lift Cover Remover Replacer	600 Series Hydraulic System
MF.419 	Hydraulic Ram Piston Seal Replacer	600 Series 265 & 290 Upgrade. Hydraulic System with 85mm Piston
MF.420 	Hydraulic Ram Piston Seal Replacer	240 & 250 Upgrade Hydraulic System with 79mm Piston
MF.421 	Main Drive Shaft Pinion Oil Seal & Needle Bearing Replacer - 12 speed Gearbox	200 & 600 Series Transmission
MF.422 	Main Drive Shaft Pinion Needle Bearing Remover - 12 speed Gearbox	200 & 600 Series Transmission

 **V L CHURCHILL**

NEW SPECIAL TOOLS

**WARNING LIGHT BULB
(PANEL ASSEMBLY)****Removal and Replacement**

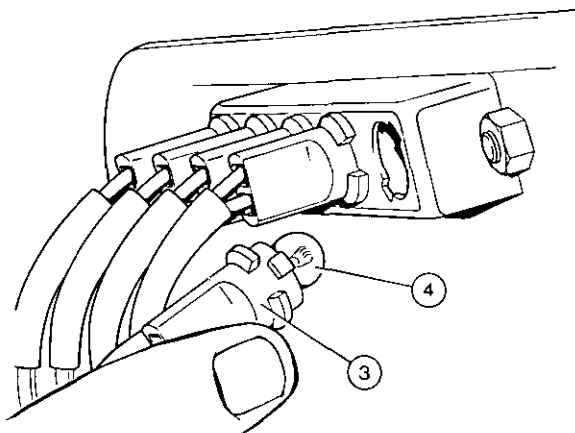
9A-37-29

Removal

1. Remove the instrument cowl, Part 2A.
2. MF 235, 245 and 255 Tractors:—
Disconnect the battery, removing first the earth (—) cable **IN THE INTERESTS OF SAFETY.***
MF 260, 265, 275 and 285 Tractors:—
Remove the front grille, Part 2A, and disconnect the battery, ***SEE ABOVE.**
3. Turn the holder of the failed bulb anti-clockwise and withdraw it from the light panel assembly.
4. Pull out the capless bulb.

Replacement

5. Reverse procedures 1 to 4: See **SERVICING THE ELECTRICAL SYSTEM**, Routine Maintenance, Section (d) for bulb table.

**INDICATOR WARNING LIGHT BULB****Removal and Replacement**

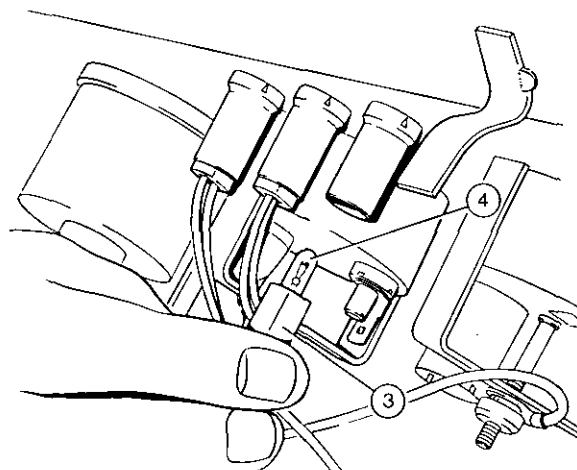
9A-38-29

Removal

1. Remove the instrument cowl, Part 2A.
2. MF 235, 245 and 255 Tractors:—
Disconnect the battery, removing first the earth (—) cable **IN THE INTERESTS OF SAFETY.***
MF 260, 265, 275 and 285 Tractors:—
Remove the front grille, Part 2A, and disconnect the battery, ***SEE ABOVE.**
3. Pull the holder of the failed bulb from its housing.
4. Pull out the bulb from the holder.

Replacement

5. Reverse procedures 1 to 4: See **SERVICING THE ELECTRICAL SYSTEM**, Routine Maintenance, Section (d) for bulb table.

**INSTRUMENT LIGHT BULB****Removal and Replacement**

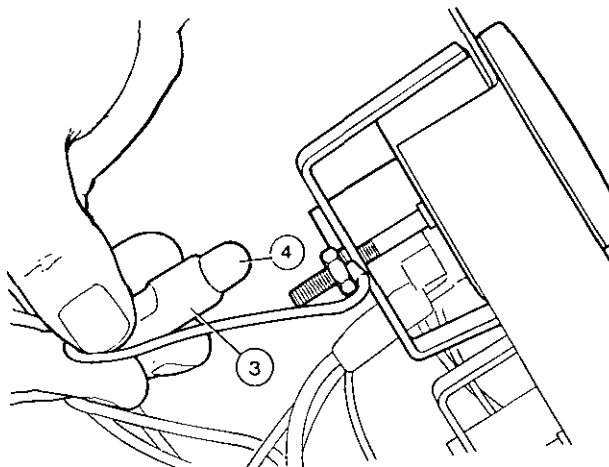
9A-39-29

Removal

1. Remove the instrument cowl, Part 2A.
2. MF 235, 245 and 255 Tractors:—
Disconnect the battery, removing first the earth (—) cable **IN THE INTERESTS OF SAFETY.***
MF 260, 265, 275 and 285 Tractors:—
Remove the front grille, Part 2A, and disconnect the battery ***SEE ABOVE.**
3. Pull the holder of the failed bulb from its housing in the instrument.
4. Pull out the capless bulb from the holder.

Replacement

5. Reverse procedures 1 to 4: See **SERVICING THE ELECTRICAL SYSTEM**, Routine Maintenance, Section (d) for bulb table.



ELECTRICAL SYSTEM**** HEADLIGHTS AND FRONT GRILLE ASSEMBLY****Removal and Refitment** 9A—40—30**Removal**

1. Pull the front grille release lever forward.
2. Pull the grille top forward and downward.

NOTE: The headlamp wiring will disconnect automatically as it is wired via the spring-loaded three pin plug and connector.

3. Lift the grille and headlamp assembly out of the nose.

Refitment

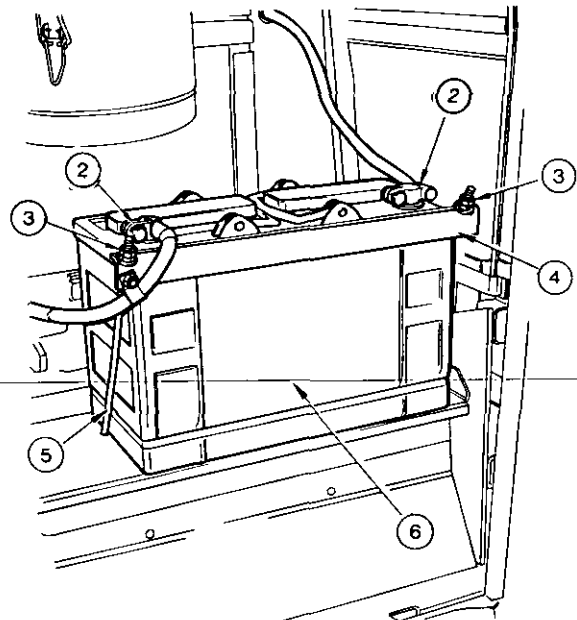
4. Reverse procedures 1 to 3 except:
5. Adjust the release lever latch plate as follows. Slacken the two bolts in the latch plate then refit the grille and close the latch. Push the grille in as far as possible to obtain an efficient seal around the periphery of the grille, then using a *thin spanner tighten the two bolts*.
6. Check the operation of the headlamps after refitting the grille.

BATTERY**Removal and Refitment** 9A—41—30**Removal**

- ** 1. Remove the front grille, operation 9A—40—30.
2. Disconnect the battery cables, removing the earth (—) cable first **IN THE INTERESTS OF SAFETY**.
3. Remove the wing nuts and washers.
4. Remove the battery stay.
5. Lift out the battery-stay rods.
6. Lift out the battery.

Refitment

7. Reverse procedures 1 to 6, except:
 - (a) Smear the battery terminals and stay-rod wing nuts with petroleum jelly.



**** HEADLIGHT BULB****Removal and Replacement**

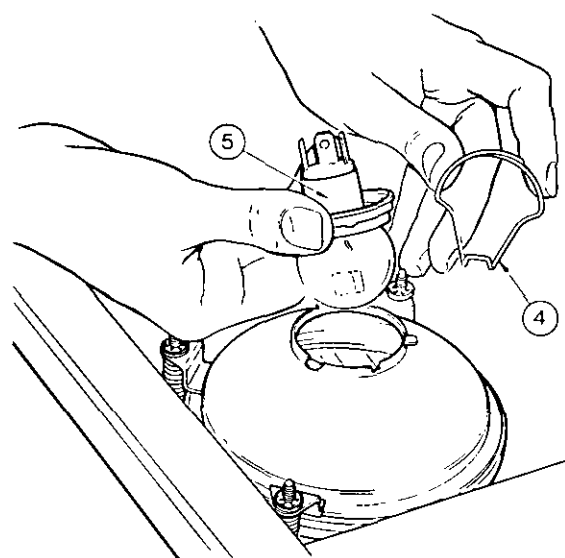
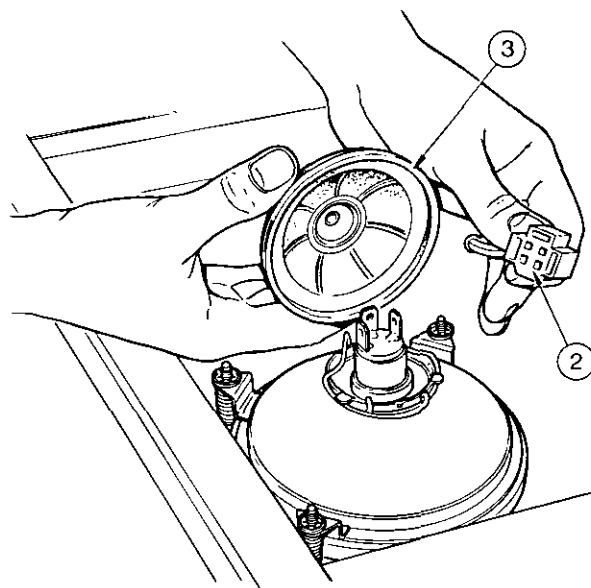
9A-42-31

Removal

1. Remove the front grille, operation 9A-40-30.
2. Remove the connector.
3. Remove the rubber surround.
4. Release the spring clip.
5. Remove the bulb.

Replacement

6. Reverse procedures 1 to 5: See **SERVICING THE ELECTRICAL SYSTEM**, Routine Maintenance, Section 9A-08 for bulb table.

**HEADLIGHTS****Removal and Refitment**

9A-43-31

Removal

1. Remove the front grille.
2. Remove the bulb, Operation 9A-42-31.
3. Remove the three headlight adjustment screws and springs.
4. Remove the headlight.

Replacement

5. Reverse procedures 1-4.

ELECTRICAL SYSTEM

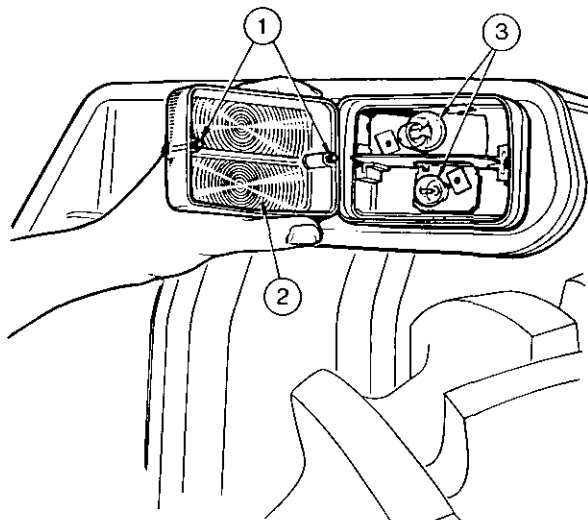
**** SIDE LIGHT/FLASHING INDICATOR BULB**

Removal and Replacement 9A-44-32

1. Slacken the two screws.
2. Remove the lens.
3. Remove the failed bulb.

Replacement

4. Reverse procedures 1 to 3: See **SERVICING THE ELECTRICAL SYSTEM**, Routine Maintenance, Section 9A-08 for bulb table.



TAIL/BRAKE LIGHT/FLASHING INDICATOR BULB

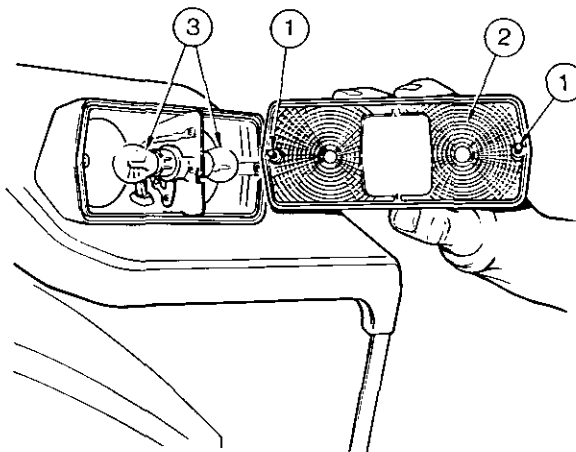
Removal and Replacement 9A-45-32

Removal

1. Slacken the two screws.
2. Remove the lens.
3. Remove the failed bulb from its bayonet fitting.

Replacement

4. Reverse procedures 1 to 3: See **SERVICING THE ELECTRICAL SYSTEM**, Routine Maintenance, Section 9A-08 for bulb table.



NUMBER PLATE LIGHT BULB

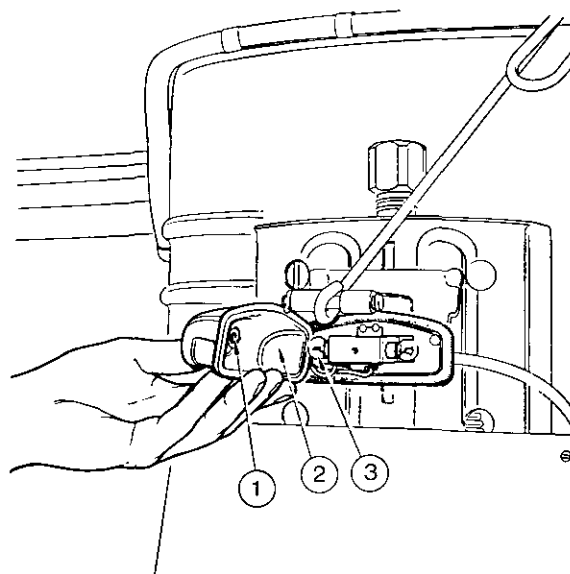
Removal and Replacement 9A-46-32

Removal

1. Slacken the screw or screws.
2. Remove the lens.
3. Remove the failed bulb from its fitting.

Replacement

4. Reverse procedures 1 to 3: See **SERVICING THE ELECTRICAL SYSTEM**, Routine Maintenance, Section 9A-08 for bulb table.



**** PLOUGH LIGHT BULB****Removal and Replacement**

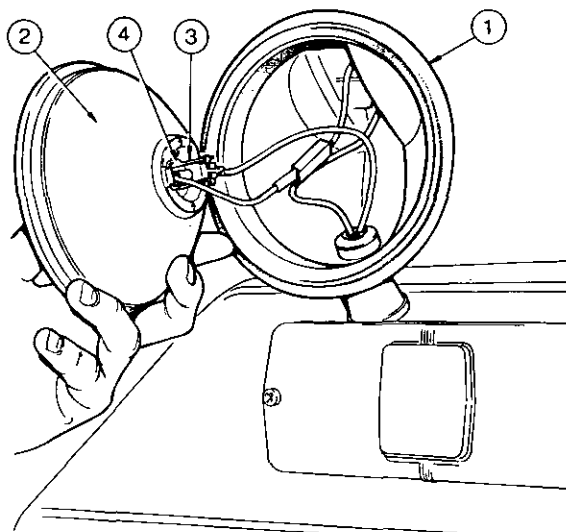
9A-47-33

Removal

1. Roll back the rubber surround from the face of the light.
2. Remove the light from the rubber surround.
3. Release the spring clip.
4. Remove the bulb.

Replacement

5. Reverse procedures 1-5: See **SERVICING THE ELECTRICAL SYSTEM**. Routine Maintenance, Section 9A-08 for bulb table.



ELECTRICAL SYSTEM**** SERVICING THE ELECTRICAL SYSTEM****Cable Continuity Test 9A-48-34**

Special Tools: 'CRYPTON' BA.402 Electrical Tester and Harness or alternatively—D.C. Voltmeter reading from 0 to 20V.

Method "A" using Crypton BA.402 Electrical Tester and Harness:

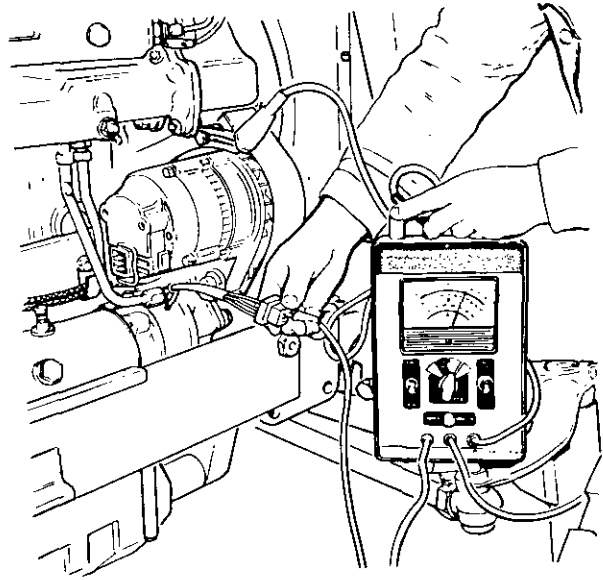
1. Turn the tractor starting switch to the 'ON' position checking that the indicator light illuminates.
2. Disconnect the non-reversible 'Lucar' connector from the back of the alternator.

NOTE: The alternator has two output 'Lucar' connector blades (large) and one indicator light 'Lucar' connector blade (small). The 'Lucar' connector pushes onto the blades and is non-reversible. The connector is secured by a wire spring clip.

3. Connect the two 'Lucar' Connector RED leads together and then connect them to the BLACK lead from the tester. Connect the YELLOW lead from the tester to earth.
4. Select 20 V. on the tester and the gauge should register the battery voltage.
5. Check the 'PURPLE' lead similarly.
6. If the reading is zero or low (below 9.6V.) and the battery is known to be serviceable a faulty connection or cable in the circuit is indicated.

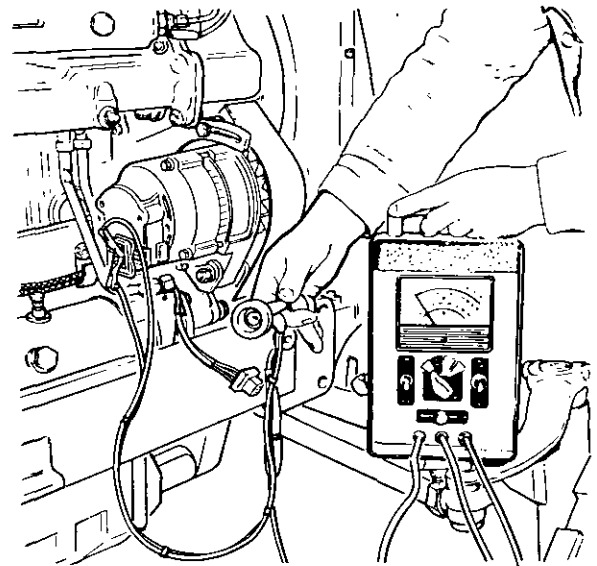
Method "B" using Voltmeter:

1. Turn the tractor starting switch to the 'ON' position, checking that the indicator light illuminates.
2. Disconnect the non reversible 'Lucar' plug from the back of the alternator.
3. Using a voltmeter check for battery voltage at the three contacts in the 'Lucar' connector.
4. If the reading is zero or low (below 9.6V.) and the battery is known to be serviceable a faulty connection or cable in the charging circuit is indicated.

**** SERVICING THE ELECTRICAL SYSTEM****Alternator Maximum Output Test 9A-49-34**

Special Tools: 'CRYPTON' BA.402 Electrical Tester and Harness.

1. Disconnect the 'Lucar' connector from the back of the alternator.
2. Connect the harness to the alternator connector blades as follows:
 - (a) The RED lead of the tester harness to the alternator output connector blades (two larger blades).
 - (a) The BLUE lead of the tester harness to the alternator indicator light connector blade (smaller).
3. With the BA.402 tester, connect the BLACK test clip to the battery positive (+) terminal and the YELLOW clip to the battery earth (-) terminal, then connect the RED clip to the remaining lead of the test harness and ensure that the test lamp illuminates.
4. Start the tractor and increase the engine speed above idling, when the test lamp should go out.
5. Run the engine at maximum rev./min., select 100 Amp on the tester, then push the test button for 10 seconds and note the alternator output on the gauge.



6. Compare the alternator output reading with the relevant minimum value. A very high or low output for the alternator indicates an internal fault. Before rejecting the alternator, ensure that the electrical circuit and battery are serviceable.
7. Remove the tester and refit the 'Lucar' connector to the back of the alternator. Secure with the spring clip.

NOTE: This test should be carried out with the alternator running at its normal operating temperature. The normal output of the alternator may be exceeded when running cold, which produces a misleading result.

** WIRING DIAGRAM (Fig. 7)

Key

- | | |
|---------------------------------------|--|
| 1. Headlights | 26. Flashing Indicator Switch |
| 2. Headlight Plug and Socket (Grille) | 27. Flashing Indicator Unit |
| 3. Horn | 28. Flashing Indicator Warning Lights |
| 4. Battery | 29. Engine Oil Pressure Warning Light |
| 5. Alternator | 30. Air Cleaner Warning Light |
| 6. Starter Motor | 31. Multi-Power Oil Pressure Warning Light |
| 7. Thermostart | 32. Alternator Charge Warning Light |
| 8. Temperature Sender Unit | 33. Headlight Main Beam Warning Light |
| 9. Multi-Power Oil Pressure Switch | 34. Brake Light Switch |
| 10. Engine Oil Pressure Switch | 35. RH Side Light |
| 11. Air Cleaner Indicator Switch | 36. RH Flashing Indicator (Front) |
| 12. Fuel Tank Sender Unit | 37. RH Flashing Indicator (Rear) |
| 13. Safety Start Switch | 38. RH Tail Light |
| 14. Starter Switch | 39. RH Brake Light |
| 15. Light Switch | 40. Plough Lamp |
| 16. Temperature Gauge | 41. Trailer Socket |
| 17. Fuel Gauge | 42. LH Side Light |
| *18. Battery Condition Indicator | 43. LH Flashing Indicator (Front) |
| 19. Tachometer Bulb | 44. LH Flashing Indicator (Rear) |
| 20. Temperature Gauge Bulb | 45. LH Tail Light |
| 21. Fuel Gauge Bulb | 46. LH Brake Light |
| 22. Battery Condition Gauge Bulb | 47. Number Plate Lamp |
| 23. Fuses | 48. Transmission/Hydraulic Oil Filter Switch |
| 24. Cigar Lighter | |
| 25. Hazard Warning Lights Switch | |
- *MF 240 Tractors only.

Wiring Colour Code

- | |
|-----------------|
| A — Red |
| B — Pink |
| C — Brown |
| D — Black |
| E — White |
| F — Green |
| G — Blue |
| H — Orange |
| I — Purple |
| J — Grey |
| K — Yellow |
| L — Light Green |
| M — Light Blue |
| N — White/Green |
| O — White/Blue |
| P — White/Red |
| Q — Red/Black |

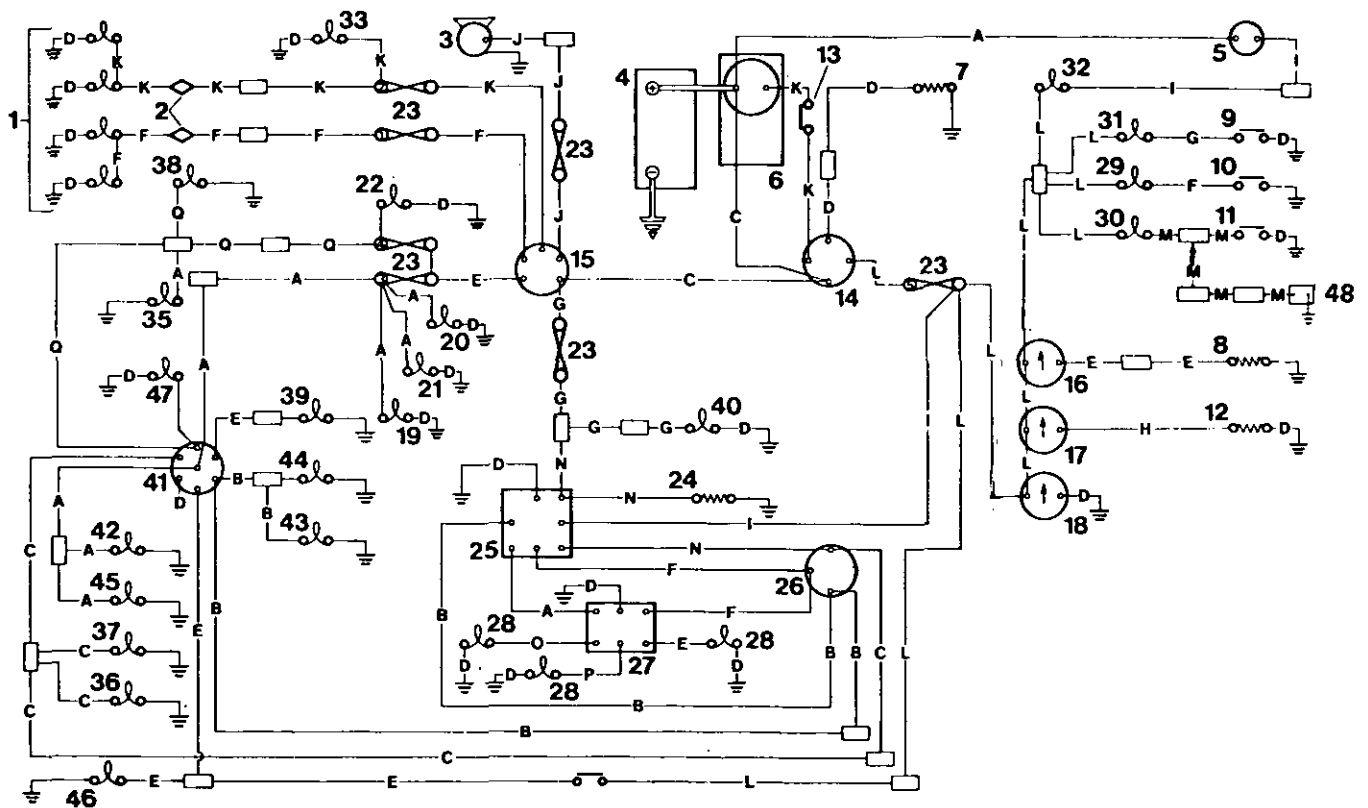


Fig. 7

SEALANTS

Sealants quoted in this Workshop Service Manual may be obtained from, as follows:

<i>Sealant</i>	<i>Description</i>	<i>Part No.</i>	<i>Size</i>	<i>Obtained from</i>	
A	HYLOMAR (PERKINS)	1861117	Tube	} Powerpart Product Central Parts Operation Urmston, Manchester	
	HYLOMAR (PERKINS)	1861152	Aerosol		
	HYLOSIL (PERKINS)	1861108	Tube		
	HYLOSIL (PERKINS)	1861151	Cartridge		
B	LOCK AND SEAL	3405 350 M1	10 ml		
	LOCK AND SEAL	3405 351 M1	50 ml		
C	STUDLOCK	3405 352 M1	10 ml		
	STUDLOCK	3405 353 M1	50 ml		
D	BOSTIK BLUE TACK	—	—		} Normal trade retail outlets
E	DUNLOP THIXOFIX	—	—		
F	LOCTITE SUPERFLEX RTV3	—	—		
G	INSTANT GASKET	3405 354 M1	6 ml	} Powerpart Product Central Parts Operation Urmston, Manchester	
	INSTANT GASKET	3405 355 M1	50 ml		

INTRODUCTION

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GENERAL INSTRUCTIONS	04
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INTRODUCTION

The purpose of this manual is to assist dealers and distributors in the efficient repair and maintenance of Massey-Ferguson farm machinery. Carrying out the procedures as detailed, together with the use of special tools where appropriate, will enable the operations to be completed within the time stated in the repair time schedule.

NOTE—To assist with locating information, each division of the manual is preceded by a contents page listing the operation in numerical order.

Each instruction within an operation has a sequence number, and to complete the operation in the minimum time it is essential that these instructions are performed in numerical sequence commencing at 1 unless otherwise stated. When applicable, these sequence numbers identify the components in the appropriate illustration. Where performance of an operation requires the use of a special tool, the tool number is quoted under the operation heading and is repeated in, or following, the instruction involving its use.

****INDEXING**

For convenience the manual is divided into parts and sections, each page bearing a part and section number. The sections are subdivided into numbered operations.

Example:—7A—01—15—would be—
Part 7 Section A Operation 01 Page 15

This simplifies cross referencing and enables the subject to be found easily.

SPECIAL TOOLS

Where the use of a special tool is specified in an operation the tool number will be shown under the operation heading and also following the instruction requiring its use.

The use of the special tools mentioned in the text contributes to a safe, efficient and profitable repair. Some operations are impracticable without their use, for example the assembly of the differential unit. Distributors are therefore urged to check their tools against the list provided. Where necessary tools may be ordered from: V. L. Churchill & Co. Ltd., London Road, Daventry, England. A special tool list is shown on Page 11.

REPAIRS AND REPLACEMENTS

When service parts are required it is essential that only genuine Massey-Ferguson replacements are used.

Attention is particularly drawn to the following points concerning repairs and the fitting of replacement parts and accessories.

Safety features embodied in the tractor may be impaired if other than genuine parts are fitted.

In certain territories, legislation prohibits the fitting of parts not to the tractor manufacturers specification. Torque wrench setting figures given in the Workshop Manual must be strictly adhered to. Locking devices where specified must be fitted. If the efficiency of a locking device is impaired during removal it must be renewed.

The tractor warranty may be invalidated by the fitting of other than genuine Massey-Ferguson parts. All Massey-Ferguson replacements have the full backing of the manufacturers warranty. Massey-Ferguson Distributors and Dealers are obliged to supply only genuine service parts.

INTRODUCTION

REPAIR TIME SCHEDULE

The operations listed in the Repair Time Schedule refer to those described in this manual. The time set against each operation in the schedule is established by performing the actual operations on standard machines using special tools where applicable. The Repair Time Schedule for use with this manual is issued as a separate publication.

NOTE—Repair Time Schedules are issued to Massey-Ferguson Distributors and Dealers only and are not for general publication.

AMENDMENTS

Under normal conditions revised pages are issued carrying the same number as the existing pages requiring amendment. The new pages are inserted in place of the existing ones. The old pages should then be discarded.

In some cases additional pages or completely new sections may be issued. These pages are to be inserted immediately following the page carrying the next lowest page number, or section number as appropriate.

Where new pages are required to be positioned between existing pages, the new page numbers will contain a suffix letter—

Example:—New page number 7A—16a.

This page is inserted after existing page number 7A—16 and before page number 7A—17. Correspondingly a further new page numbered 7A—16b would be positioned after 7A—16a but before 7A—17. To assist in identifying amendments on revised pages, two asterisks (**) will be inserted at the beginning and at the end of the amended paragraph, section, instruction or illustration.

To ensure that a record of amendments to this manual is readily available, the list of amendments will be re-issued with each set of revised pages, quoting the amendment number, date of issue, appropriate instructions and revised page numbers.

NOTE—Service Bulletins and Amendment Sheets are issued to the Massey-Ferguson Distributors and Dealers only and are not for general publication.

Amendment No.	Date	Page Issued

SHEET METAL

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2A-12-07	HOOD SUPPORT (REAR) (MF 260, 265, 275, 285 and 290 Tractors) Removal and Refitment	07
2A-13-08	RADIATOR TOP PANEL AND SUPPORT FRAME Removal and Refitment	08
2A-14-08	RADIATOR SIDE PANELS (MF 240 Tractor) Removal and Refitment	08
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SHEET METAL

Part 2—Section A

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GENERAL

The front grille, hood, front side and steering box panels, instrument panel cover, footsteps and fenders are all of sheet metal. They provide protection for the operator and the tractor but the tractor must not be operated with any of these sheet metal components removed.

To prevent corrosion, always keep the sheet metal components clean and respray the metal as soon as any becomes chipped.

FRONT SIDE PANEL**Removal and Refitment**

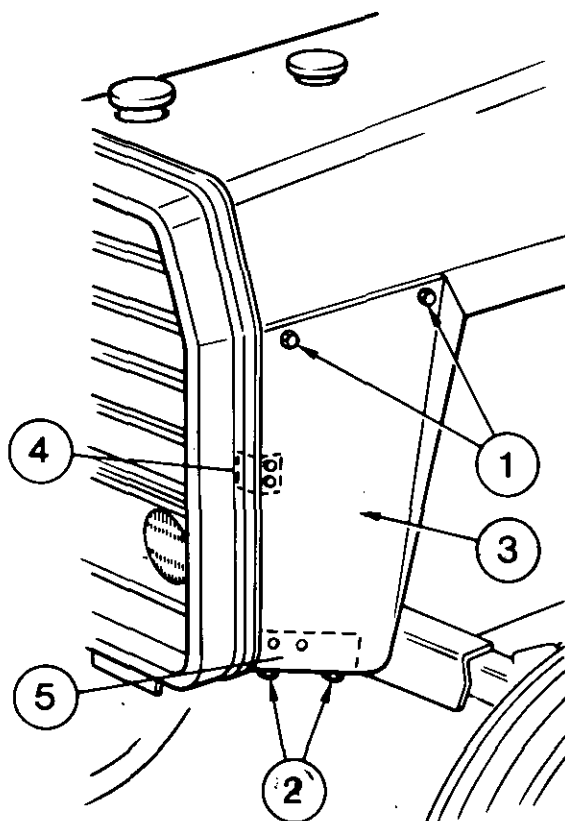
2A-01-03

Removal

1. Remove the two top bolts.
2. Slacken off or remove the two bottom bolts.
3. Remove the side panel, rear edge outward and pulled rearwards to withdraw the front clamp plate.
4. When necessary, remove the two bolts to remove the front clamp plate.
5. When necessary, remove the two bolts to remove the side panel support.

Refitment

6. Reverse procedures 1 to 5 except:
 - (a) The side panel support is positioned so the closer together holes are towards the front of the nose assembly.
 - (b) The clamp plate is positioned so the cranked end is forward and outward.
 - (c) The two bottom side panel bolt holes are slotted to facilitate the location of the clamp plate within the nose assembly.
 - (d) Tighten the four bolts to a torque of 20 Nm (15 lbf ft).

**FRONT SIDE PANEL (MF 240 Tractor)****Removal and Refitment**

2A-02-03

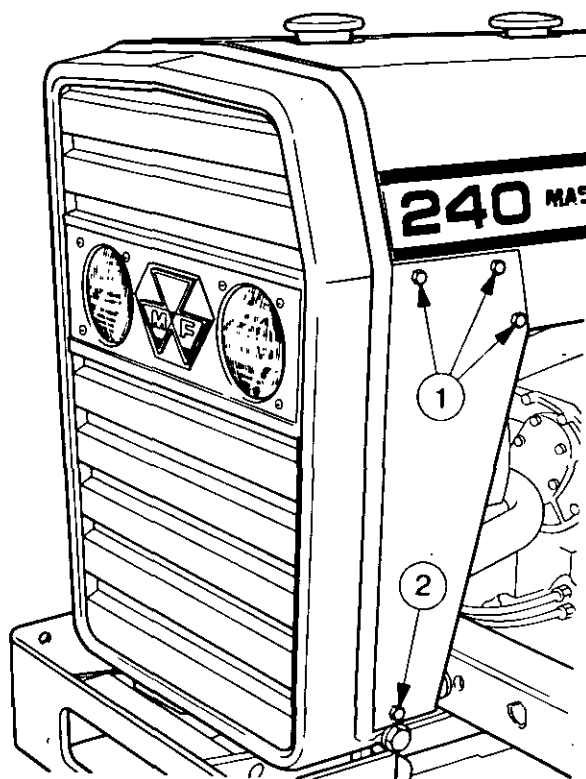
Removal

1. Remove the three top bolts.
2. Remove the bottom bolt.
3. Remove the side panel, withdrawing the front edge from the recess in the hood seal.

Refitment

Reverse procedures 1 to 3 except:

- (a) The bolt holes are slotted to aid attachment.



SHEET METAL**HOOD****Removal and Refitment**

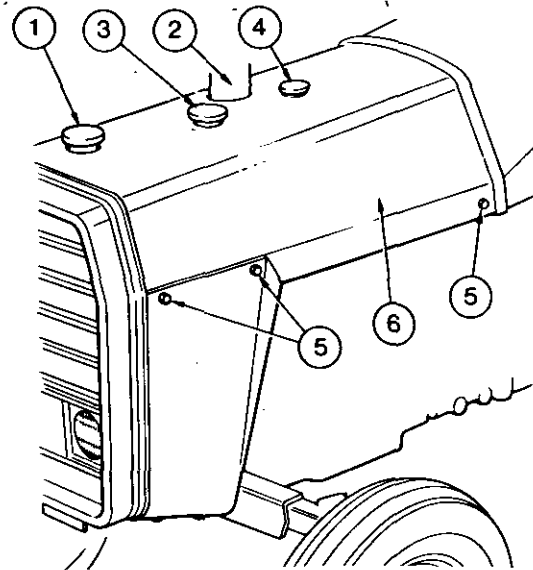
2A-03-04

Removal

1. MF 265, 275 and 285 tractors only, remove the air cleaner.
2. MF 265, 275 and 285 tractors only, remove the exhaust silencer.
3. Remove the radiator cap.
4. Remove the fuel filler cap.
5. Remove the four front bolts and two rear nuts and bolts.
6. Lift the front edge, pull forward to clear the seal to remove the hood.

Refitment

7. Reverse procedures 1 to 6 except:
 - (a) Ensure that the rear edge of the hood is located beneath the lip of the seal.
 - (b) Tighten the six bolts to a torque of 20 Nm (15 lbf ft).

**HOOD (MF 240 Tractor)****Removal and Refitment**

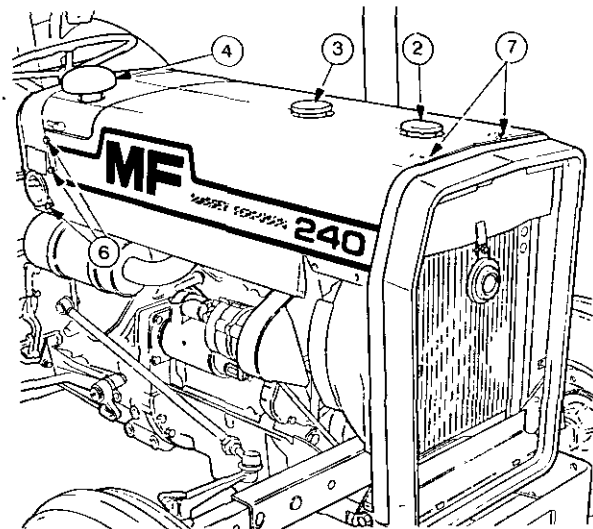
2A-04-04

Removal

1. Remove side panels, operation 2A-02-03.
2. Remove the radiator cap.
3. Remove the fuel filler cap.
4. Lift out the air cleaner intake and grommet from the battery cover panel.
5. Remove the battery cover panel.
6. Remove the six rear bolts.
7. Remove two bolts that secure the front underside of the hood to the top of the tractor nose.
8. Lift the hood up withdrawing the front edge from the hood seal and remove.

Refitment

9. Reverse procedures 1 to 8 except:
 - (a) Ensure that the front edge of the hood is located over the lip of the hood seal.
 - (b) Tighten the six bolts to a torque of 20Nm (15 lbf. ft.).



HOOD SEAL, FRONT**Removal and Replacement**

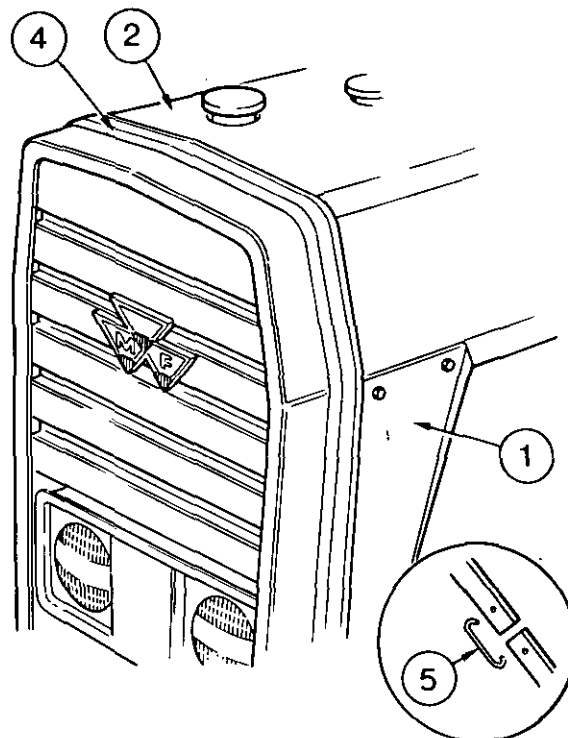
2A-05-05

Removal

1. Remove the two front side panels, operation 2A-01-03.
2. Remove the hood, operation 2A-03-04.
3. When necessary, remove the weight frame.
4. Mark the centre and peel the hood seal from the nose assembly.
5. When the hood seal is not continuous, remove the rod from the two ends.

Replacement

6. When the hood seal is continuous, loop it over the top of the nose assembly so its thinner edge is forward and fit by starting at the bottom and locate the recessed edge of the seal on the rear of the nose assembly.
7. When the hood seal has two ends, mark the centre point. Starting at the top centre, locate its recessed edge on the rear of the nose assembly and join the two ends with the rod, hooked ends upwards.
8. Reverse procedures 1 to 3.

**HOOD SEAL, FRONT (MF 240 Tractor)****Removal and Replacement**

2A-06-05

NOTE: The front hood seal is a one piece moulded rubber strip which is fixed to the tractor nose with a clear Bostik adhesive.

The tapered edge of the moulding faces towards the front of the tractor nose. The front edges of the hood and front side panels fit into the groove on the hood side of the moulding.

HOOD SEAL, REAR**Removal and Replacement**

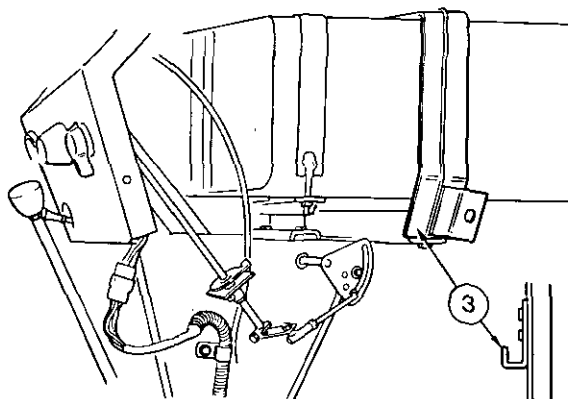
2A-07-05

Removal

1. Remove the hood, operation 2A-03-04.
2. Remove the instrument panel cover, operation 2A-15-08.
3. Unhook the two ends of the rear hood seal from the bottom of the hood support.

Replacement

4. Reverse procedures 1 to 3 except:
 - (a) The side of the hood seal having the deepest slot is positioned towards the instrument panel cover.



SHEET METAL**FRONT GRILLE****Removal and Refitment**

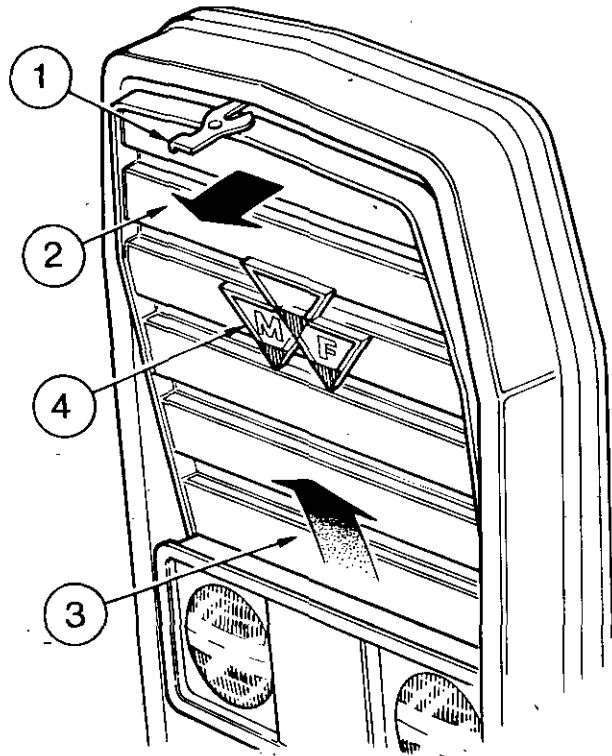
2A-08-06

Removal

1. Hinge the front grille release lever forward.
2. Pull the grille top forward and downward.
3. Lift the front grille upward and forward.
4. When necessary, remove two screws, plain and shakeproof to remove motif.

Refitment

5. Reverse procedures 1 to 4 except:
 - (a) When refitting the motif, the top of the two lower triangles are level with the bottom of the second recess from the top.
 - (b) Locate the bottom plate behind the headlamp assembly.
 - (c) Adjust the latch plate on the two studs within the nose assembly to obtain an efficient seal around the periphery of the front grille.

**FRONT GRILLE (MF 240 and late 265, 275, 285 and 290 Tractors)****Removal and Replacement**

2A-09-06

Removal

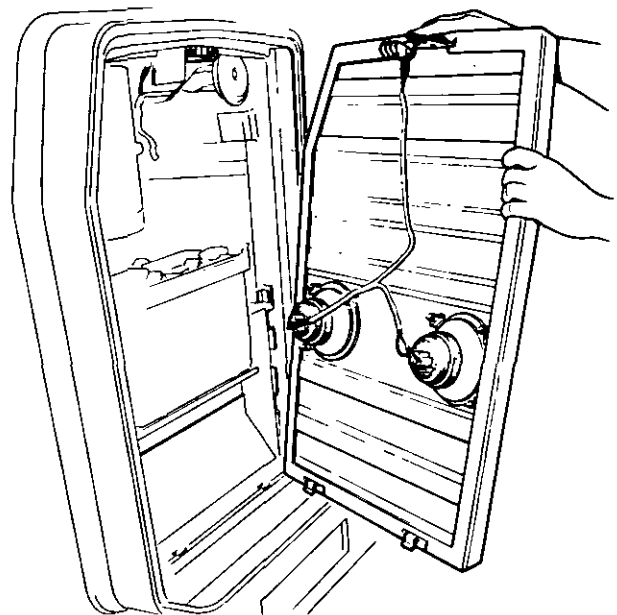
1. Pull the front grille release lever forward.
2. Pull the grille top forward and downward.

NOTE: The headlamp wiring will disconnect automatically as it is wired via the spring-loaded three pin plug and connector.

3. Lift the grille and headlamp assembly out of the nose.

Refitment

4. Reverse procedures 1 to 3 except:
5. Adjust the release lever latch plate as follows. Slacken the two bolts in the latch plate then refit the grille and close the latch. Push the grille in as far as possible to obtain an efficient seal around the periphery of the grille, then using a thin spanner tighten the two bolts.
6. Check the operation of the headlamps after refitting the grille.



FRONT LOWER PANEL**Removal and Refitment**

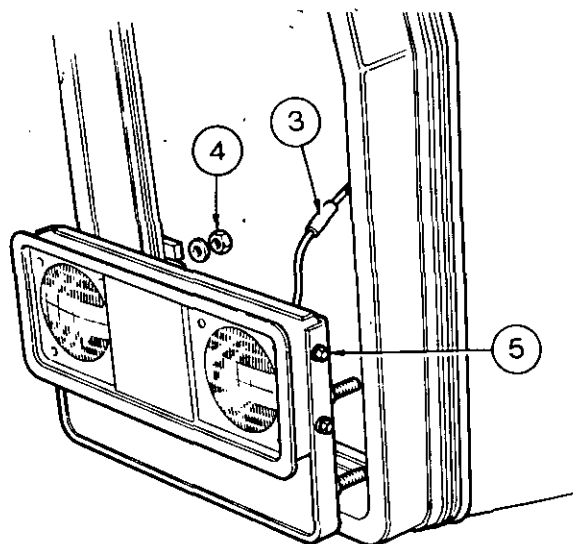
2A-10-07

Removal

1. Remove the front grille, operation 2A-08-06.
2. Disconnect the battery.
3. Identify and disconnect the headlamp harness.
4. Remove the four rear nuts, washers and identify the earth wire position to remove the front lower panel with headlamps.
5. Remove the four side bolts to remove the front lower panel from the headlamp assembly.

Refitment

6. Reverse procedures 1 to 5 except:
 - (a) Refit the headlamp assembly so that the two screws of each lamp are uppermost.
 - (b) Check the operation of the headlamps before refitting the grille.

**HOOD SUPPORT REAR (MF 235, 245 Tractors only)****Removal and Refitment**

2A-11-07

Removal

1. Remove the hood, operation 2A-03-04.
2. Remove the instrument panel cover, operation 2A-15-08.
3. Disconnect the battery positive (+) and negative (-) cables.
4. Remove battery.
5. Fit a suitable wooden wedge between the engine rocker cover and fuel tank. Take care not to damage the fuel tank.
6. Disconnect fuel tank rear support bracket bolts and battery carrier front and rear support bolts and front spacers.
7. Remove fuel tank rear support bracket.

Refitment

8. Reverse procedures 1 to 7.

HOOD SUPPORT (REAR)**Removal and Refitment**

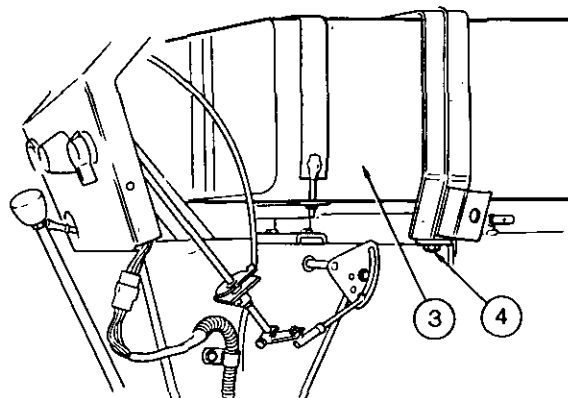
2A-12-07

Removal

1. Remove the hood, operation 2A-03-04.
2. Remove the instrument panel cover, operation 2A-15-08.
3. Remove the fuel tank, Part 4C.
4. Remove the two bolts from the underside to remove the hood support.
5. When necessary, the hood seal can be removed by unhooking the two ends.

Refitment

6. Reverse procedures 1 to 6 except:
 - (a) Refit the hood support so that it leans forward.
 - (b) Bleed the fuel system before starting the engine.

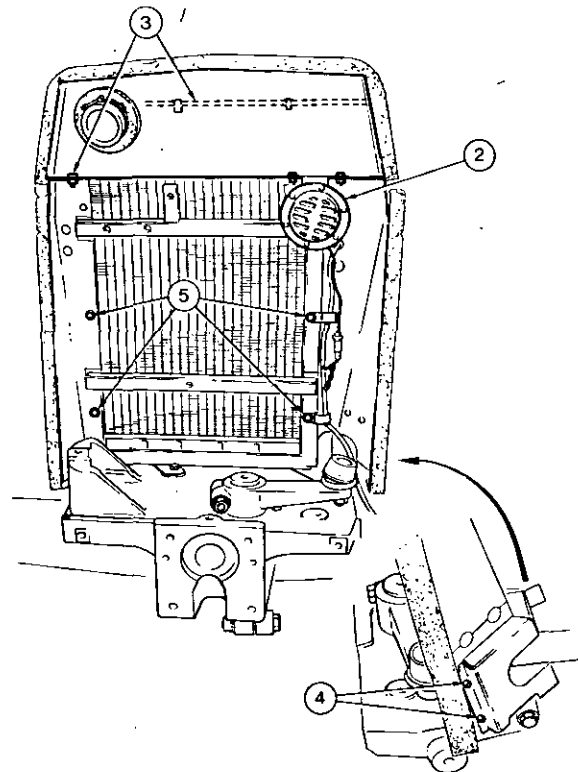


SHEET METAL**RADIATOR TOP PANEL AND SUPPORT FRAMES****Removal and Refitment** 2A-13-08**Removal**

1. Remove the nose assembly, operation 2A-17-09.
2. Remove one nut and two vertical bolts to remove the horn and bracket assembly.
3. Release the dry air cleaner warning device pipe from the rear face and remove the vertical bolt to remove the radiator top panel.
4. Remove the two self tapping screws and withdraw the locating tongue to remove the steering drag link seal housing, alternatively the front end of the drag link must be detached from the left hand steering lever.
5. Remove the five bolts, the sixth bolt secures the dry air cleaner, to remove the two radiator support frames.

Refitment

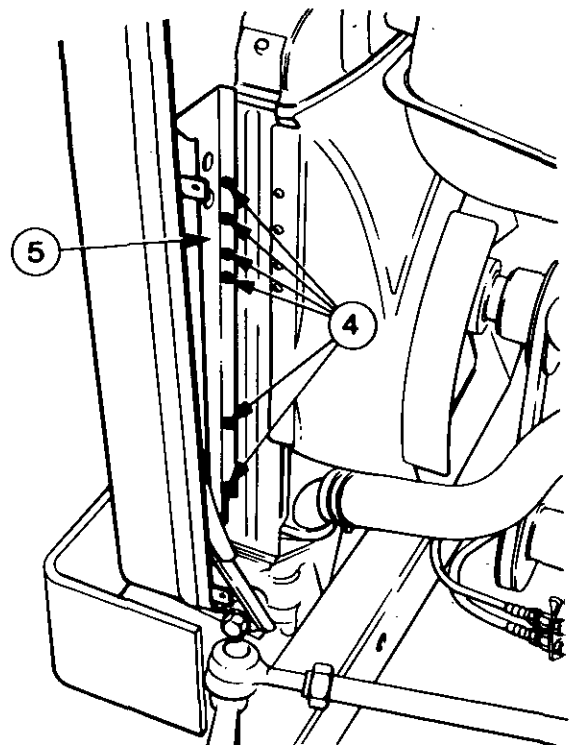
6. Reverse procedures 1 to 5 except:
 - (a) Ensure that the seals are in good condition.
 - (b) The two right hand bottom bolts accommodate the clips of the headlamp wiring harness.

**RADIATOR SIDE PANELS (MF 240 Tractor)****Removal and Refitment** 2A-14-08**Removal**

1. Remove side panels, operation 2A-02-03.
2. Remove hood, operation 2A-04-04.
3. Remove grille, operation 2A-09-06.
4. Remove six screws.
5. Remove outer side panel.
6. Remove four screws.
7. Remove inner side panel.

Refitment

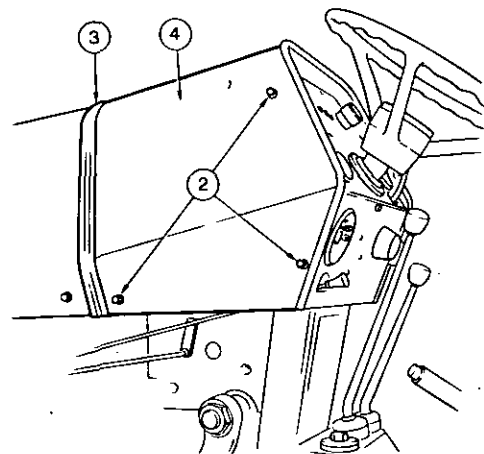
8. Reverse procedures 1 to 7.

**INSTRUMENT PANEL COVER****Removal and Refitment** 2A-15-08**Removal**

1. Disconnect the battery.
2. MF 245 Tractors only, remove the six bolts, three from each side.
MF 260, 265, 275, 285 and 290 Tractors only, remove the four bolts, two from each side.
3. Detach the instrument panel cover from the rear hood seal.
4. Spring open the bottom ends of the hood and lift off.
5. When necessary, remove the two bolts and washers to remove the rear view mirror.

Refitment

5. Reverse procedures 1 to 5 except:
 - (a) Ensure that the panel cover trim moulding and rear hood seal are in good condition.



INSTRUMENT PANEL — LOWER (MF 240 Tractor)

Removal and Refitment 2A-16-09

Removal

1. Remove battery cover panel.
2. Disconnect battery.
3. Disconnect fuse box wiring at multi plug.
4. Remove two bolts from each side of the hood.
5. The upper edge of the panel is secured in a spring clip, to release, pull the panel forward.

Refitment

6. Reverse procedures 1 to 6.

NOTE: For removal and refitment of Instrument Panel—Upper see Electrical System 9A.

NOSE ASSEMBLY

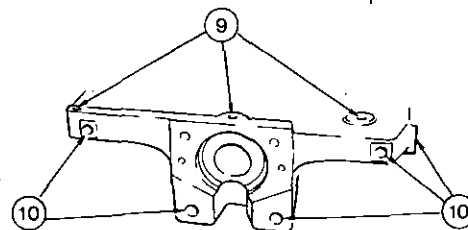
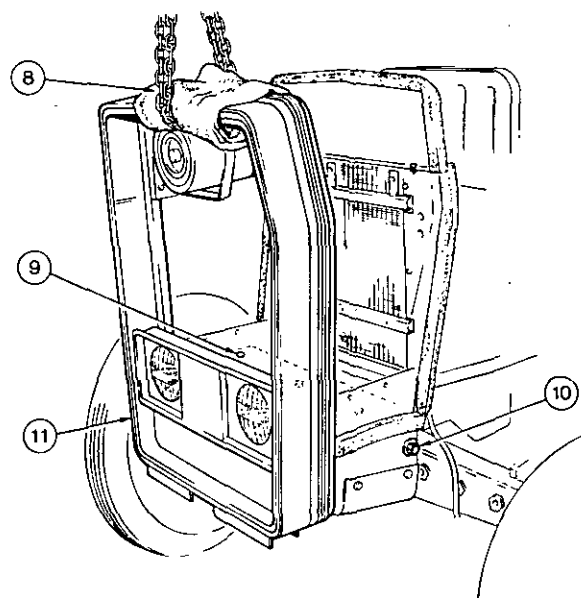
Removal and Refitment 2A-17-10

Removal

1. Disconnect the battery.
2. Remove the hood, operation 2A-03-04.
3. Remove the two front side panels, operation 2A-01-03.
4. Disconnect the headlamp wiring harness.
5. Disconnect the horn wiring harness.
6. MF 260, 265, 275, 285 and 290 tractors only, remove the battery.
7. MF 260, 265, 275, 285 and 290 tractors only, identify any battery or earth cable and remove four bolts to remove the battery tray.
8. Protecting the paintwork with suitable soft material, take the weight of the nose assembly with a jib crane and slings.
9. MF 260, 265, 275, 285 and 290 tractors only, remove the three vertical bolts inside the nose assembly.
10. Remove the two side bolts and four underside bolts (MF 235 and 245 tractors, the bottom two bolts have nuts) to detach the nose assembly from the front axle centre beam.
11. Move the jib crane and nose assembly from the front of the tractor.

Refitment

12. Reverse procedures 1 to 11, except:
 - (a) Ensure that all the sealing strips are in good condition.
 - (b) Tighten the two side and four nose assembly bolts to a torque of 224 Nm (165 lbf ft) but those of the MF 235 and 245 tractors which have a nut, torque tighten to 312 Nm (230 lbf ft).



SHEET METAL**NOSE ASSEMBLY (MF 240 Tractor)****Removal and Refitment**

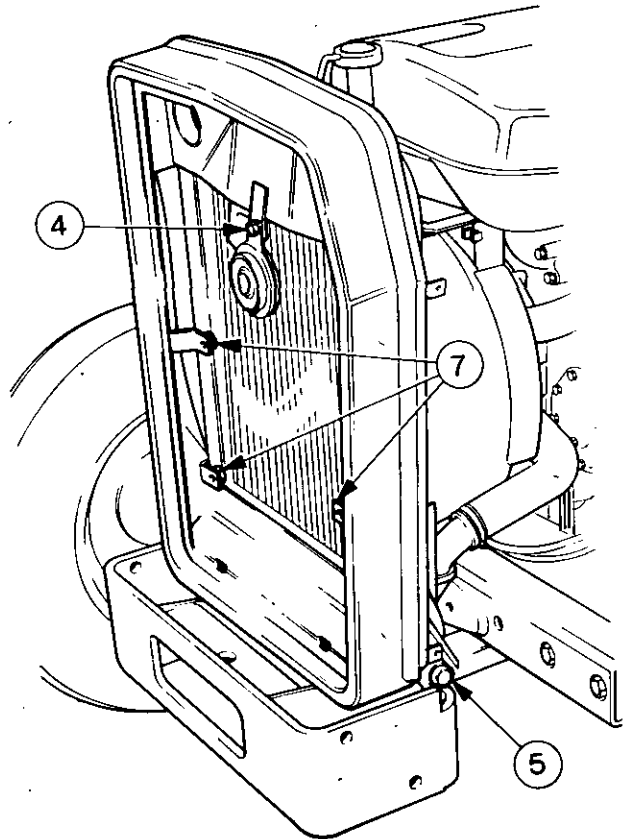
2A-18-10

Removal

1. Remove side panels, operation 2A-02-03.
2. Remove hood, operation 2A-04-04.
3. Remove grille, operation 2A-09-06.
4. Disconnect the horn wiring harness.
5. Remove the two side bolts and distance pieces whilst supporting the nose assembly.
6. Remove nose assembly.
7. The captive nuts on the lugs at the side of the nose are for fitting the multi-power oil cooler.

Refitment

8. Reverse procedures 1 to 7 except:
 - (a) Replace the distance pieces on the bolts so that they are positioned between the front support bracket and the nose assembly.
 - (b) Ensure that the sealing strips are in good condition.
 - (c) Tighten the two side bolts to a torque of 203 Nm (150 lbf ft).

**BATTERY SUPPORT****Removal and Refitment**

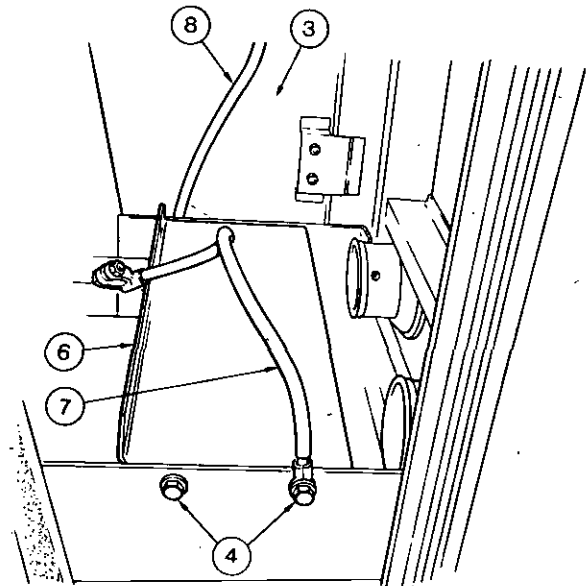
2A-19-10

Removal

1. Remove the front grille, operation 2A-08-10.
2. Disconnect and remove the battery.
3. Remove the two side panels, operation 2A-01-03.
4. Remove the four bolts to remove the battery tray.

Refitment

5. Reverse procedures 1 to 4.
6. The battery tray is positioned, lip to the rear.
7. Fit the negative (earth) cable to the front right hand bolt.
8. Clip the positive (starter motor) cable to the rear left hand bolt.

**BATTERY COMPARTMENT (MF 245 Tractor)****Removal and Refitment**

2A-20-10

Removal

1. Remove the instrument panel cover, operation.
2. Open the battery door.
3. Remove the three nuts, washers and bolts to remove the battery door.
4. Remove the two push nuts, and washer retainers to remove the closing screws.
5. Remove two horizontal and two vertical bolts to remove the battery support.

Replacement

6. Reverse procedures 1 to 5.

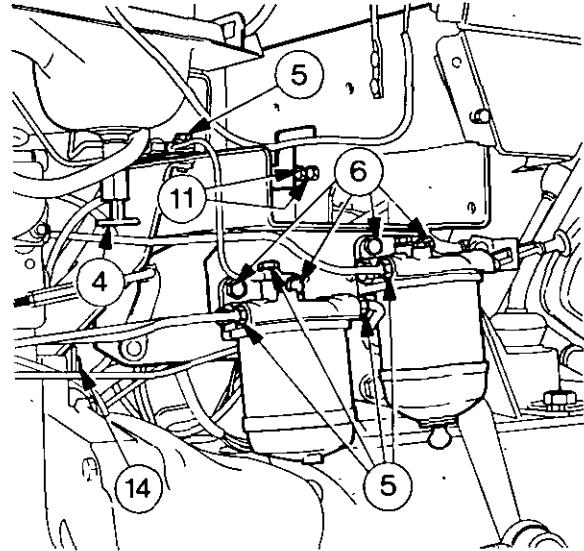
BATTERY PLATFORM AND SUPPORT ASSEMBLY (MF 240 Tractor)

Removal and Refitment 2A-21-11

Removal

WARNING: When opening up diesel fuel connections the hands should be coated with a protective cream.

1. Remove side panels, operation 2A-02-03.
2. Remove hood, operation 2A-04-04.
3. Remove instrument panel-lower, operation 2A-16-09.
4. Turn off the fuel at the fuel cut off tap.
5. Disconnect the fuel pipes from the two filters and blank off all open fuel connections with suitable caps or masking tape.
6. Remove the four nuts, bolts and washers securing the filters.
7. Remove filters.
8. Disconnect the throttle control rod left hand side at the battery platform end.
9. Disconnect foot throttle linkage at the cross-shaft.
10. Remove throttle control cross shaft.
11. Remove two nuts from throttle lever rod bracket.
12. Disconnect throttle lever rod split-pin.
13. Remove throttle lever bracket.
14. Remove bolts from top of clutch housing securing front of battery platform.
15. Remove two bolts from bottom flange of fuel tank support bracket.



Refitment

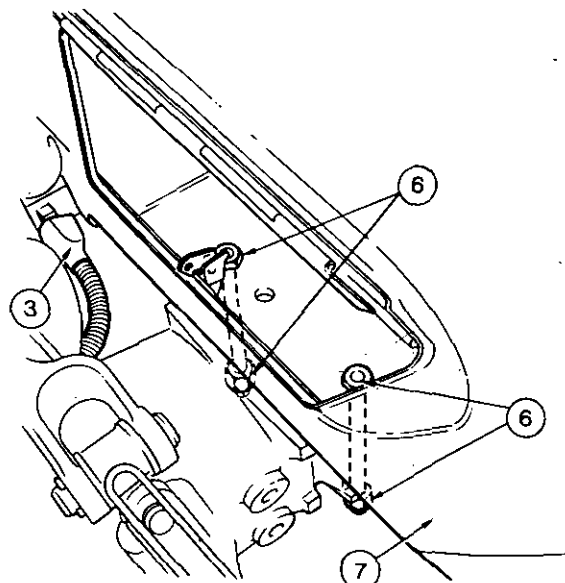
16. Reverse procedures 1 to 15 except:
 - (a) Adjust fuel control linkage, Part 4C.
 - (b) Renew split pins.
 - (c) Bleed the fuel system of air, Part 4C.

FENDER

Removal and Refitment 2A-22-11

Removal

1. Disconnect the battery.
2. MF 235 and 245 tractors. Disconnect the rear wiring harness at the junction box on the right hand side of the centre housing.
3. MF 260, 265, 275, 285 and 290 tractors. Disconnect the rear wiring harness at the plug situated on the bottom forward edge of the fender.
4. Protecting the paintwork with suitable soft material, take the weight of the fender with a jib crane and slings.
5. Remove the three side nuts, washers and bolts to detach the fender from the footstep.
6. Identify the plate/stabiliser bracket to the trumpet housing pad; remove the two nuts, washers and plate/stabiliser bracket and the two bolts through the fender tool box.
7. Lift the fender clear of the rear wheel and axle.



Refitment

8. Reverse procedures 1 to 7, except:
 - (a) The fender having the tool box with the folding lid is fitted to the right hand side.
 - (b) Tighten the two nuts to a torque of 169 Nm (125 lbf ft).

SHEET METAL**FENDER (MF 240 Tractor)****Removal and Refitment**

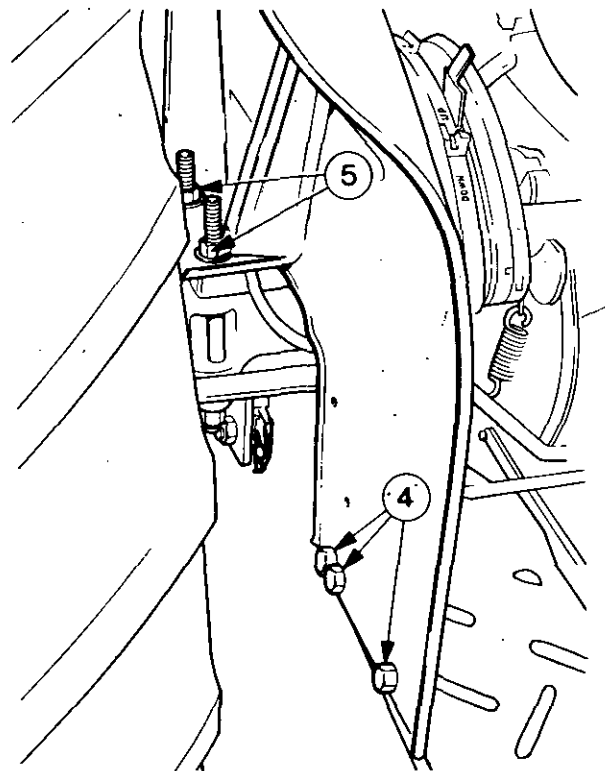
2A-23-12

Removal

1. Disconnect the battery.
2. Disconnect the fender wiring harness at the multi plug and the earth lead.
3. Protecting the paintwork with suitable soft material, take the weight of the fender with a jib crane and slings.
4. Remove the three bolts nuts and washers to detach the fender from the footplate.
5. Remove the nuts and washers from the two long bolts which secure the base of the fender to the trumpet housing.
6. Lift the fender clear of the rear wheel and axle.

Refitment

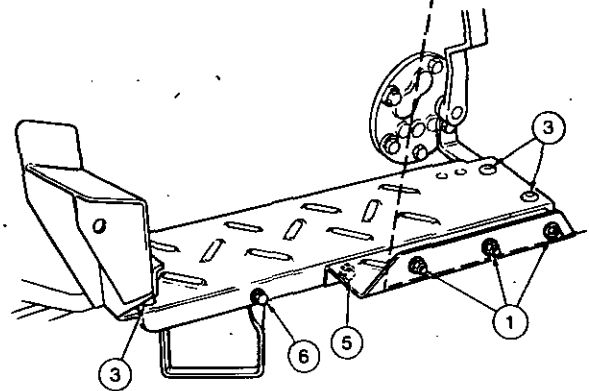
7. Reverse procedures 1 to 6, except:
 - (a) Tighten the two trumpet housing nuts and bolts to a torque of 169 Nm (125 lbf ft).

**FOOTSTEP****Removal and Refitment**

2A-24-12

Removal

1. Remove the three side nuts, washers and bolts to detach the fender.
2. Identify any footstep bolt that holds any wiring harness.
3. MF 235 and 245 tractors only, remove the four nuts, washers and square neck bolts to detach the footstep from the two brackets. MF 260, 265, 275, 285 and 290 tractors only, remove the six nuts, washers and square neck bolts to detach the footstep from the three brackets.
4. Manoeuvre the footstep from between the centre housing and fender.
5. MF 235 and 245 tractors only, remove the three nuts and bolts to split the footstep.
6. MF 260, 265, 275, 285 and 290 tractors only, remove the nut and bolt to remove the stirrup.

**Refitment**

8. Reverse procedures 1 to 6.

FOOTSTEP (MF 240 Tractor)**Removal and Refitment**

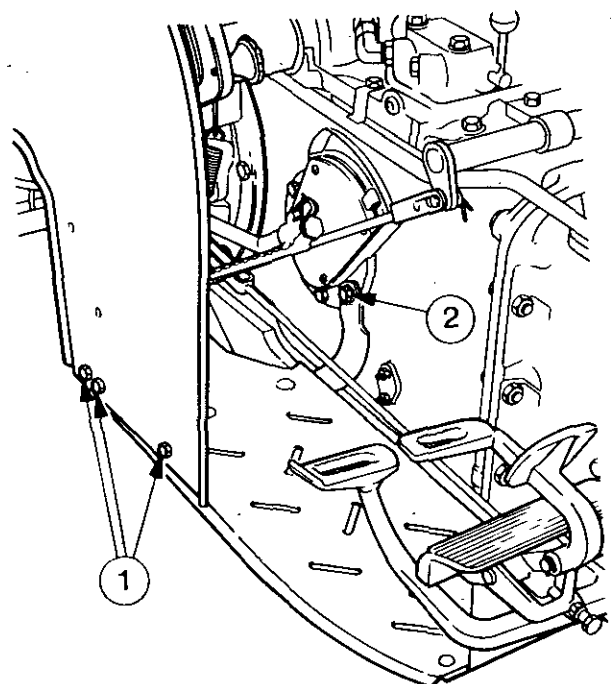
2A-25-12

Removal

1. Remove the three side nuts, washers and bolts to detach fender.
2. Remove the bolt attaching the footstep strut to the side cover.
3. Remove the four bolts attaching the footstep to the footrest.
4. Remove the footstep.

Refitment

5. Reverse procedures 1 to 4.



STEERING UNIT SIDE PLATES (MF 235, 245 and 255 Tractors)

Removal and Refitment 2A-26-13

Removal

1. Remove the hood, operation 2A-03-04.
2. Remove the instrument panel cover, operation 2A-15-08.
3. Disconnect and remove the battery.
4. Remove the two hood seal support frame bolts.
5. Remove the two battery support bolts.

Left Hand Plate

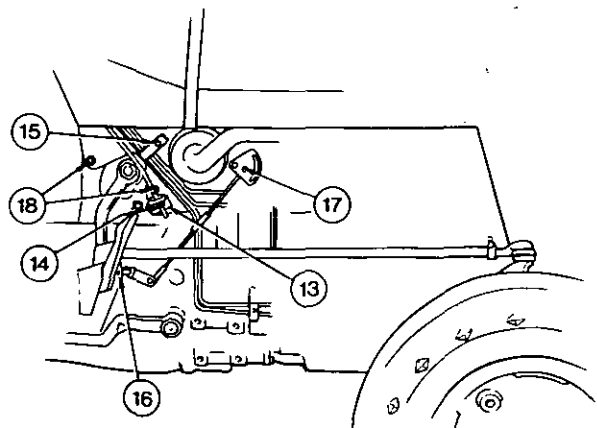
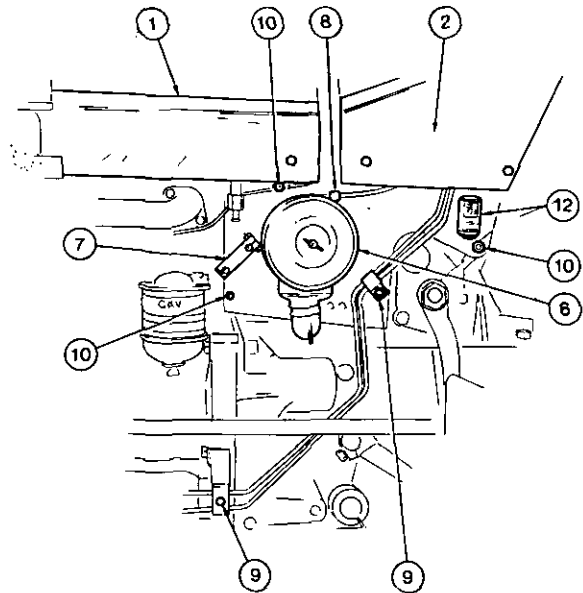
6. Remove the air cleaner, Part 4C.
7. Identify the split in the left hand throttle lever to the through spindle, release the pinch nut and bolt to remove the throttle lever.
8. Remove the left hand wiring harness bolt and clip.
9. Remove the bottom rear left hand bolt. When power assisted steering is fitted, this bolt also accommodates the ram feed and return pipe clip, the release of the engine/clutch housing clip will facilitate the movement of these pipes.
10. Remove the rear bottom instrument panel bolt and the three remaining bolts to remove the left hand steering unit side plate.
11. Detach the plastic pipe from the dry air cleaner warning indicator unit.
12. Release the adaptor to remove the dry air cleaner warning indicator unit.

Right Hand Plate

13. Identify the split in the right hand throttle lever to the hand throttle spindle, release the pinch nut and bolt to remove the throttle lever.
14. Remove the hand throttle spindle nut, washer, spring plate and two washers to withdraw the throttle spindle upwards.
15. Remove the tachometer drive cable clip bolt. When power steering is fitted, this bolt also accommodates the pump and ram feed and return pipe clip, the release of the engine/clutch housing clip will facilitate the movement of these pipes.
16. Identify the split in the right hand throttle lever to the foot pedal spindle, release the pinch nut and bolt to remove the throttle lever.
17. Withdraw the through spindle, hand and foot throttle operating rods from the steering unit side plate.
18. Remove the rear bottom instrument panel bolt and five bolts to remove the right hand steering unit side plate.

Refitment

19. Reverse procedures 1 to 18, except:
 - (a) Tighten the hand throttle spindle nut to give sufficient grip to hold the hand lever in a set position.
 - (b) Adjust the fuel control linkage, Part 4C.



SHEET METAL

STEERING UNIT SIDE PLATE ASSEMBLY
 (MF 260, 265, 275, 285 and 290 Tractors)

Removal and Refitment

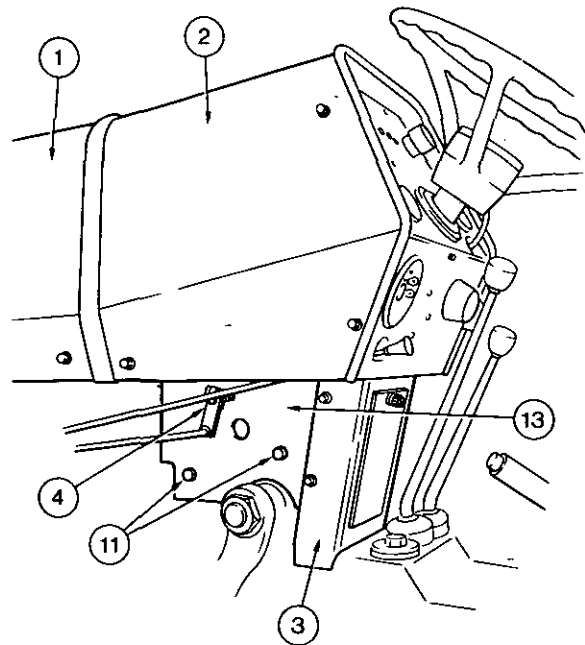
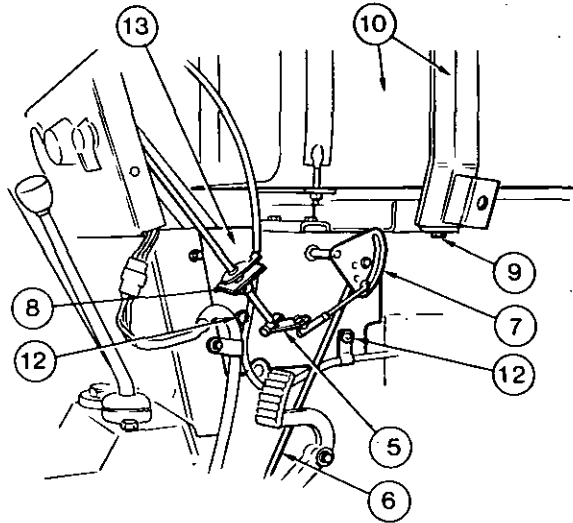
2A-27-14

Removal

1. Remove the hood, operation 2A-03-04.
2. Remove the instrument panel cowl, operation 2A-15-08.
3. Remove the fuse cover and panel, operation 2A-28-15.
4. Identify the split in the left hand throttle lever to the through spindle, release the pinch nut and bolt to remove the throttle.
5. Identify the split in the right hand throttle lever to the hand throttle spindle; release the pinch nut and bolt to remove the throttle lever.
6. Remove the split pin and washer at the foot throttle pedal to remove the throttle operating rod.
7. Withdraw the through spindle, hand and foot throttle operating rods from the right hand steering unit side plate.
8. Remove the handle throttle spindle nut, washer, spring plate and two washers to withdraw the throttle spindle upwards.
9. Remove the two vertical bolts to detach the rear hood support.
10. Turn off the fuel and remove the fuel tank and rear hood support, Part 4C.
11. Remove the two bottom left hand steering unit bolts to detach the side plate.
12. Remove the two bottom right hand steering unit bolts, the tachometer drive assembly clip is under the front bolt, to detach the side plate.
13. Lift off the steering unit side plate assembly.

Refitment

14. Reverse procedure 1 to 13, except:
 - (a) Locate the steering unit side plate assembly on the rear face of the engine cylinder block.
 - (b) Adjust the fuel control linkage, Part 4C.
 - (c) Renew the split pin.
 - (d) Bleed the fuel system of air, Part 4C.



SPINDLE HOUSING**Servicing**

7A-05-07

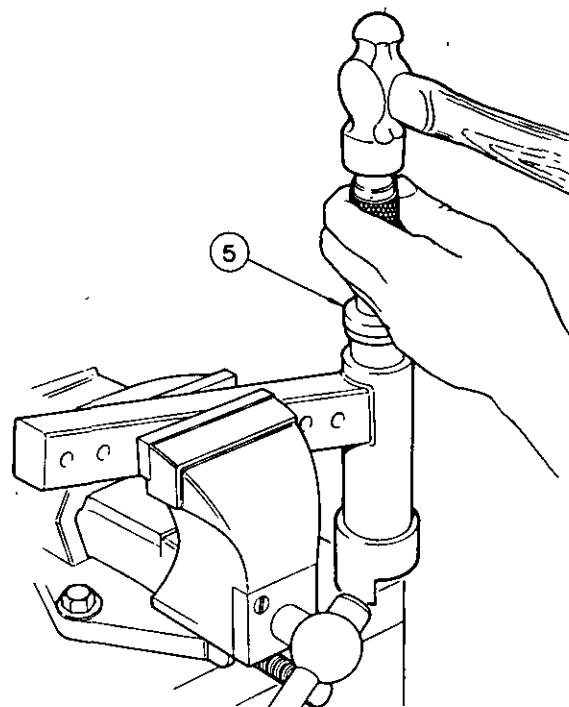
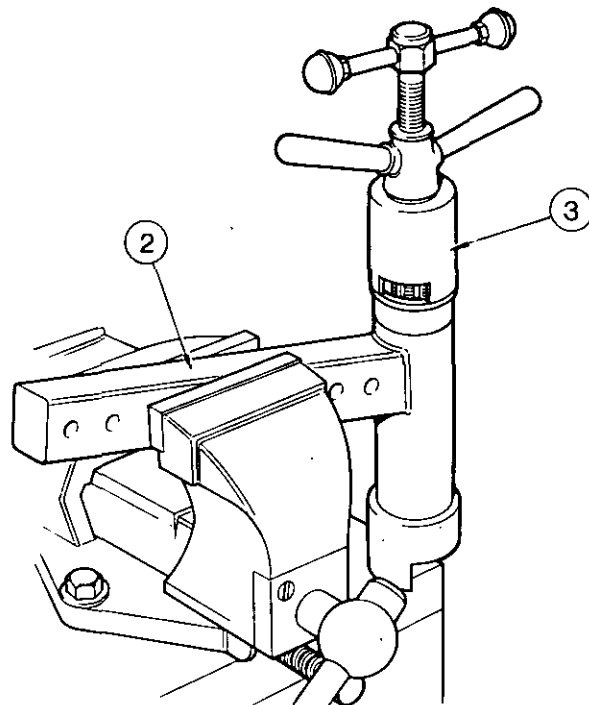
- ** Special Tools: MF 263A Bush Remover
 MF 263-1/1 Adaptor (Tap)
 MF 263-1/3 Adaptor (Collar)
 550 Universal Handle
 MF 263-1/2 Adaptor (Replacer)
 MF 19A Reamer

Disassembly

1. Remove the outer axle arm, operation 7A-06-07.
2. Secure the outer arm in a vice.
- ** 3. Fit the adaptor (collar) MF 263-1/3 over the bore.
- ** 4. Assemble the bush remover MF 263A and adaptor (tap) MF 263-1/1 as shown.
- ** 5. Enter the adaptor (tap) through the collar into the bush by turning the upper handle.
- ** 6. Extract the bush by turning the lower handle.
7. Invert the outer arm and similarly extract the other bush.

Reassembly

- ** 8. Using the 550 handle and MF 263-1/2, drive in a new bush, invert the outer axle and similarly drive in the other bush.
9. Using MF 19A, ream the upper and lower bushes to size.
10. Remove all swarf from the housing by washing the housing in clean paraffin and ensure that the grease nipple hole is clear.
11. Refit the outer axle arm, operation 7A-06-07.

**OUTER AXLE ARM****Removal and Refitment**

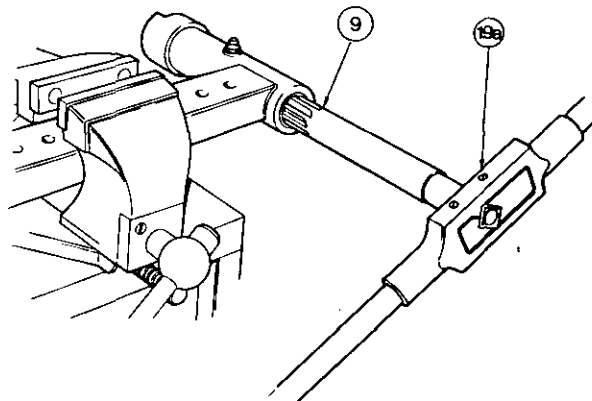
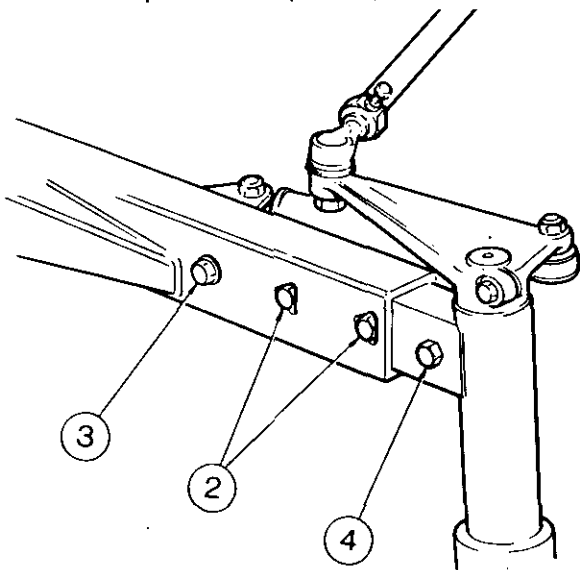
7A-06-07

Removal

1. Remove the spindle shaft, operation 7A-05-07.
2. Remove the two nuts and bolts.
3. Remove the nut, bolt and washer.
4. Remove the nut, bolt and washer.
5. Withdraw the axle arm.

Refitment

6. Reverse procedures 1 to 5 except:
 - (a) Tighten the axle to beam nuts to a torque of 215 Nm (160 lbf ft).
 - (b) Tighten the ram bracket to beam nuts to a torque of 65 Nm (50 lbf ft).



FRONT AXLE

BEAM ASSEMBLY

Removal and Refitment

7A-07-08

Removal

1. Remove the nose assembly, Part 2A.
2. Jack up the front of the tractor.
3. Remove both the outer axle arms, operation 7A-06-07 procedures 2, 3 and 5.
4. Remove the locking screw.
5. Remove the locking plate and washers.
6. Remove the special bolt.
7. Remove the circlip.
8. Remove the snap ring.
9. With one operator each side supporting the beam remove the pivot pin.
10. Remove the beam, thrust washer and shims.

Examination

Check the end faces of the centre beam journals, the pivot pin and thrust washer for wear.

Examine all bores and threads for wear or damage. In the event of accident damage, check the beam for bending or twisting. If the beam has been in any way deformed, it must be replaced, as steering characteristics and tyre wear can be severely affected. Also the beam may have been dangerously weakened due to straining of the welded seams.

Refitment

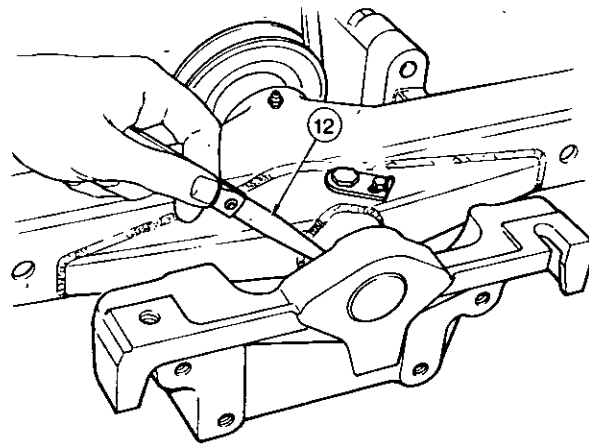
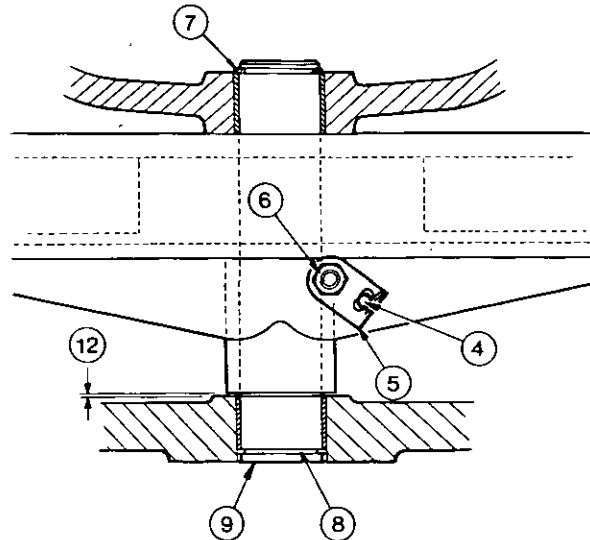
11. Place the beam in position on the axle support and fit the pivot pin—chamfer rearwards.
12. Push the beam fully rearwards, then measure the end float using feeler gauges. If new shims are to be fitted, select from the table below. Select shims to give 0,05 to 0,25 mm (0-002 to 0-010 in).

PART NUMBER	SHIM THICKNESS	
	mm	in
1660 607 M1	0,86 to 0,91	0-034 to 0-036
1660 459 M1	0,99 to 1,04	0-039 to 0-041
1660 460 M1	1,12 to 1,17	0-044 to 0-046

To fit Shims:

Remove the pivot pin, fit shim(s) then refit the pivot pin with the locking pin hole aligned with the hole in the casting.

13. Reverse procedure 1 to 10 except:
 - (a) Rotate the pin until the special bolt hole is aligned with the hole in the centre beam.
 - (b) Apply a few drops of recommended sealant 'B' to the special bolt threads.
 - (c) Fit and tighten the special bolt to a torque of 75 Nm (55 lbf ft).
 - (d) Use sufficient washers under the locking screw to centralise the locking plate on the special bolt.



SPINDLE HOUSING**Servicing**

7A-19-21

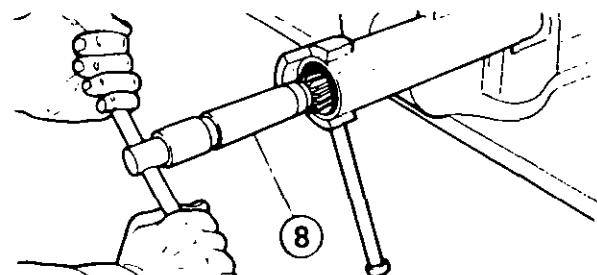
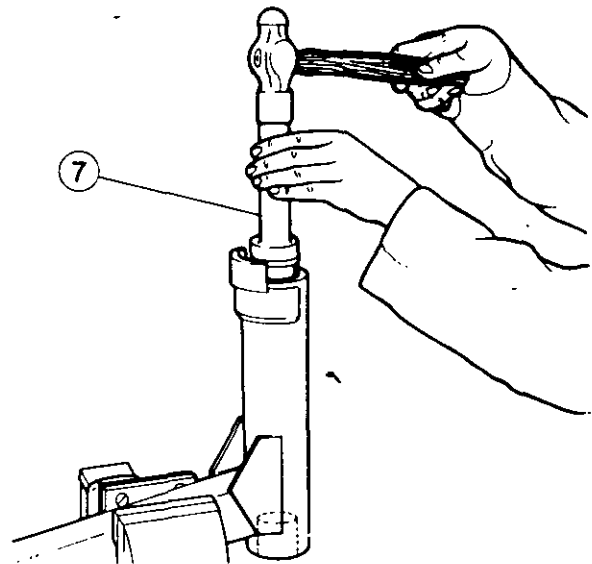
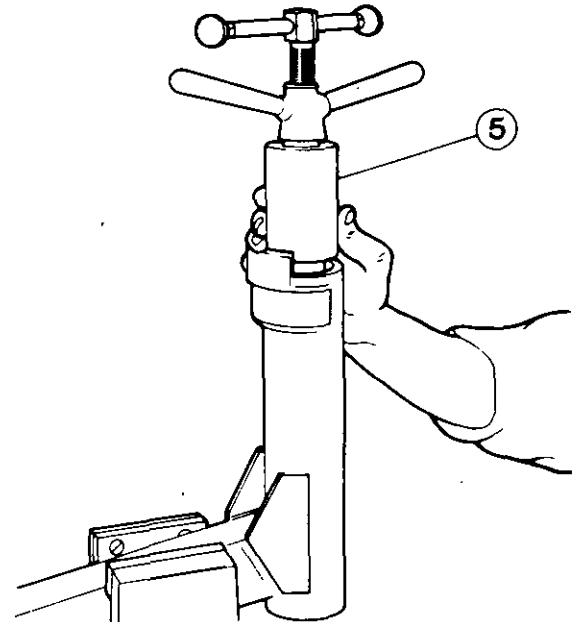
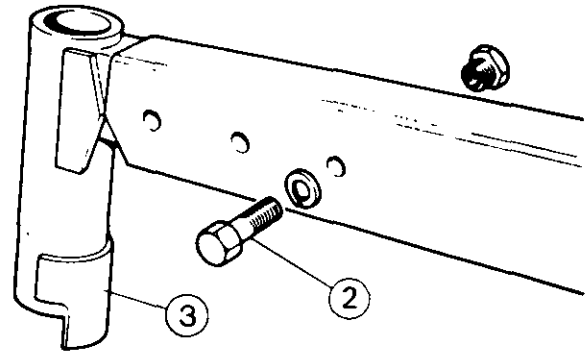
- **Special Tools: MF 263A Bush Remover
 MF 263-2/2 Adaptor
 MF 264 Reamer Handle
 MF 264-1/1 Reamer
 MF 264-1/2 Pilot
 MF 263-2/1 Bush Replacer
 550 Universal Handle

Disassembly

1. Remove items 1 to 6 as stated in operation 7A-18-20.
2. Remove jamb outer nuts and bolts.
3. Remove outer arm.
4. Secure the outer arm in a vice.
- ** 5. Using MF 263-A and MF 163-2/2 extract the bush by turning the lower handle.
6. Invert the outer arm and similarly extract the other bush.

Reassembly

- ** 7. Using the 550 handle and MF 263-2/1, drive in a new bush, invert the outer axle and similarly drive in the other new bush.
8. Using MF 264 Reamer Handle and MF 264-1/1 Reamer, ream the upper bush to size.
- ** 9. Fit the pilot MF 264-1/2 to the upper end of the reamer handle and the reamer MF 264-1/1 to the handle, then line ream the lower bush to size.
10. Remove all swarf from the housing by washing the housing in clean paraffin and ensure that the nipple hole is clear.
11. Reverse procedure 1-3.
 Noting: (a) obtain partial engagement of the jamb nuts and bolts, then tighten the jamb nuts to 245 Nm (180 lbf ft) and then the bolts to 245 Nm (180 lbf ft).
12. Refit wheels.

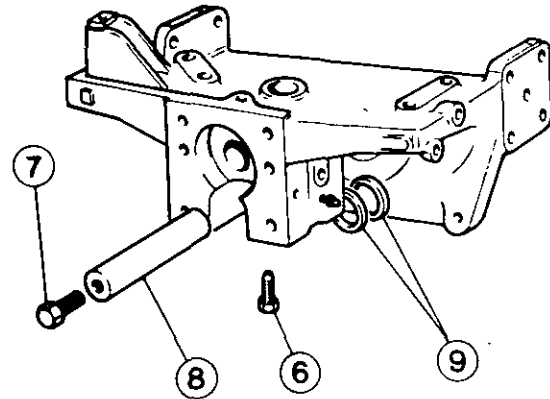


FRONT AXLE**BEAM ASSEMBLY****Removal and Refitment**

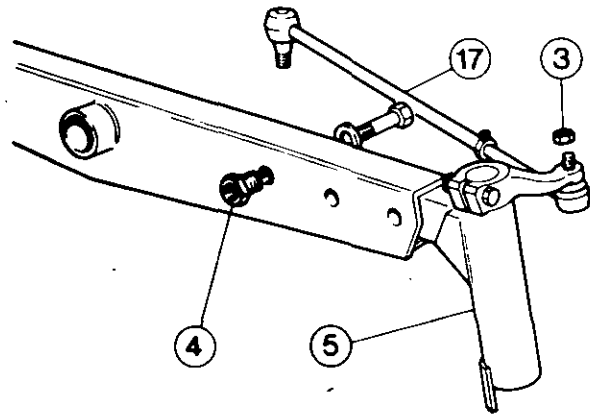
7A-20-22

Removal

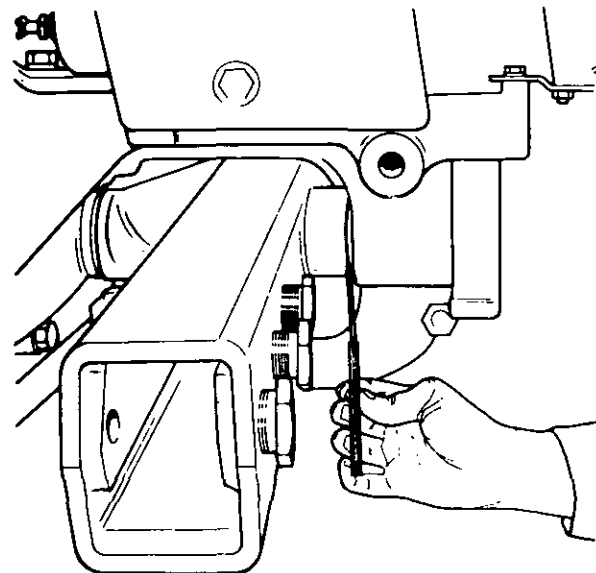
1. Remove the nose as stated in operation 2A-10-06.
2. Jack up the tractor under the sump.
3. Remove the nuts and release both tie rods.
4. Remove jamb nuts and bolts.
5. Withdraw the outer arm complete with wheel.
6. Remove the locknut and screw.
7. Fit a $\frac{7}{8}$ " UNC bolt into the pivot pin (to assist removal).
8. With one assistant each side supporting the beam, remove the pivot pin.
9. Remove the beam, thrust washer and shims.

**Examination**

10. Check the end faces of the centre beam journals, the pivot pin and thrust washer for wear. Examine all bores and threads for wear or damage. In the event of accident damage, check the beam for bending or twisting. If the beam has been in anyway deformed, it must be replaced, as steering characteristics and tyre wear can be severely affected. Also the beam may have been dangerously weakened due to straining of the welded seams.

**Refitment**

11. Push the beam fully rearwards, then measure the end float using feeler gauges. If new shims are to be fitted, select shims from the table below. Select shims to give 0.8 to 0.24 mm. To fit shims: Remove the pivot pin, fit shim(s) then refit the pivot pin with the locking screw hole aligned with the hole in the casting, and thrust washer, remove the $\frac{7}{8}$ UNC bolt from the pivot pin.
- **12. Thoroughly degrease the tapped hole, the locking screw and locknut. Apply a few drops of recommended sealant 'C' to the screw, then refit the locknut and lockscrew, tightening the screw to 75 Nm (55lbf ft) and locknut to 55 Nm (40 lbf ft).
13. Reverse procedure 1-5. Noting: (a) obtain partial engagement of the jamb nuts and bolts, then tighten the jamb nuts to 245 Nm (180 lbf ft) and then the bolts to 245 Nm (180 lbf ft).



PART NUMBER	SHIM THICKNESS	
	mm	in
898 018 M1	0,7 to 0,76	0-028 to 0-030
898 019 M1	0,86 to 0,91	0-034 to 0-036
898 020 M1	0,99 to 1,04	0-039 to 0-041
882 868 M1	1,12 to 1,17	0-044 to 0-046
882 869 M1	1,24 to 1,30	0-049 to 0-051

BEAM ASSEMBLY**Servicing**

7A-21-23

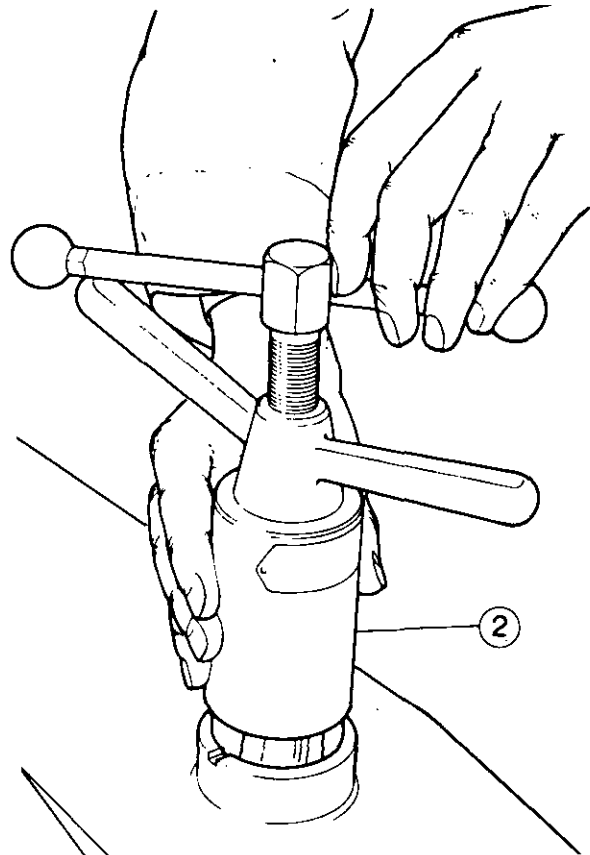
**Special Tools Required: MF 263A Bush Remover
MF 263-3/2 Adaptor
550 Universal Handle
MF 263-3/1 Bush Replacer

Disassembly

1. Remove the beam as stated in operation 7A-20-22.
- ** 2. Using MF 263A and MF 263-3/2 extract the bush by turning the lower handle.
3. Invert the beam and similarly extract the other bush.

Reassembly

- ** 4. Drive in the new bush with the cut out positioned vertically and facing the top tube, with the adaptor MF 263-3/1 and Universal Handle 550.
5. Invert the beam and similarly fit the other bush.
6. Refit the beam as stated in operation 7A-20-22.

**AXLE SUPPORT CASTING****Removal and Refitment**

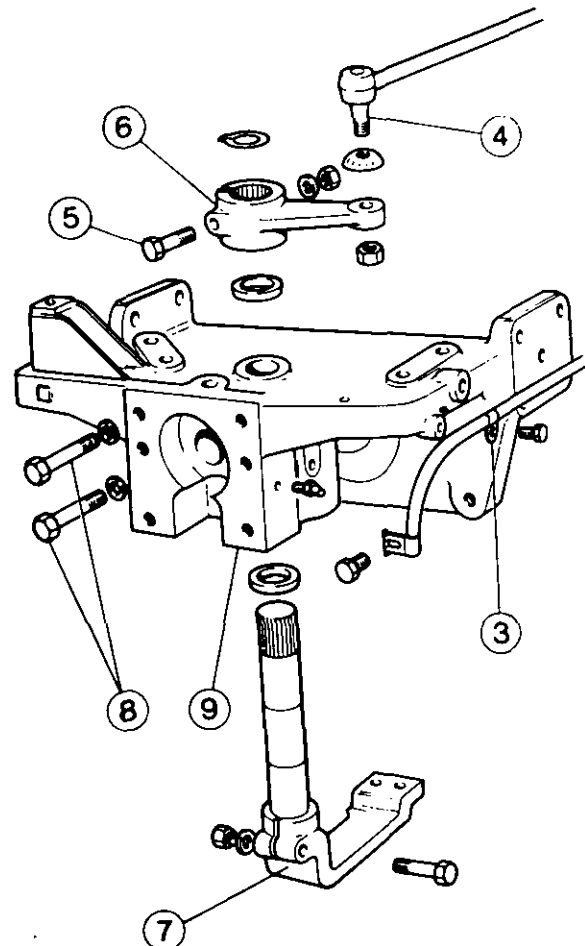
7A-22-23

Removal

1. Remove the beam as stated in operation 7A-20-22.
2. Remove the radiator as stated in operation 4B.
3. Remove the battery clip bolt.
4. Remove the nut and release the drag bar link.
5. Remove the bolt, nut and washer.
6. Remove the arm.
7. Withdraw the shaft and arm assembly complete with the tie rods.
8. Remove the nuts, bolts and washers.
9. Remove the axle support castings.

Refitment

10. Reverse procedure 1 to 9.
Noting. Axle support casting bolts to be torqued to 170 Nm (125 lbf ft). Steering linkage top arm bolt to be torqued to 120 Nm (90 lbf ft).



ELECTRICAL SYSTEM

Part 9—Section A

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9A-04-10	Voltage Drop Test	10
	BATTERY	11
9A-05-11	Preparation of Batteries for Service	11
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** The following pages cover details of improved Headlights and Front Grille assembly, Battery, General Light Fittings and Alternator. These improvements cut into production from Serial Nos.:-

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ELECTRICAL SYSTEM

** GENERAL

The electrical system of the 200 Series tractors comprises either a 90, 96, 120 or 125 ampere-hour, 12 volt negative earth system, charged by either a Lucas or Motorola 32 ampere alternator. Both makes of alternator have an integral rectifier and control box. On the MF 235, 245 and 255 tractors, the battery is contained in a compartment immediately ahead of the instrument panel, access being gained through a top mounted hinged flap. On the MF 240 tractor the battery is similarly positioned but access is gained through a lift off panel secured by two chromed locking levers. The remaining models in the series, the MF 260, 255, 275, 285 and 290, have the battery mounted in the nose of the tractor, and access is gained through the detachable front grille.

The alternator is mounted on the right hand side of the engine and is driven by a V-belt from the crankshaft pulley. Adjustment of the V-belt tension is provided for with a curved-slide alternator bracket and clamping bolt.

The starter motor is available in either standard or heavy duty form; the standard starter motor is either the Lucas M45G or the Paris Rhone D11E-137, and the heavy duty either the Lucas M50G or the Paris Rhone D11E-84. A neutral safety start switch fitted on the top of the transmission case renders the

starter motor inoperative until the dual range selector lever is in the neutral position.

Fuses are fitted to protect the lighting, cigar lighter, and horn circuits.

ENGINE WIRING DIAGRAM (Fig. 1)

- A. Battery
- B. Alternator
- C. Fuse Box
- D. Temperature Gauge Switch
- E. Thermostart
- F. Multi-Power Oil Pressure Switch
- G. Air Cleaner Warning Light
- H. Alternator Charge Warning Light
- I. Engine Oil Pressure Warning Light
- J. Multi-Power Oil Pressure Warning Light
- K. Cigar Lighter
- L. Water Temperature Gauge
- M. Safety Start Switch
- N. Fuel Gauge Sender Unit
- O. Air Cleaner Indicator Switch
- P. Engine Oil Pressure Switch
- Q. Starter Motor Solenoid
- R. Starter Motor
- S. Fuel Gauge
- T. Starter Switch
- U. Fusible Link

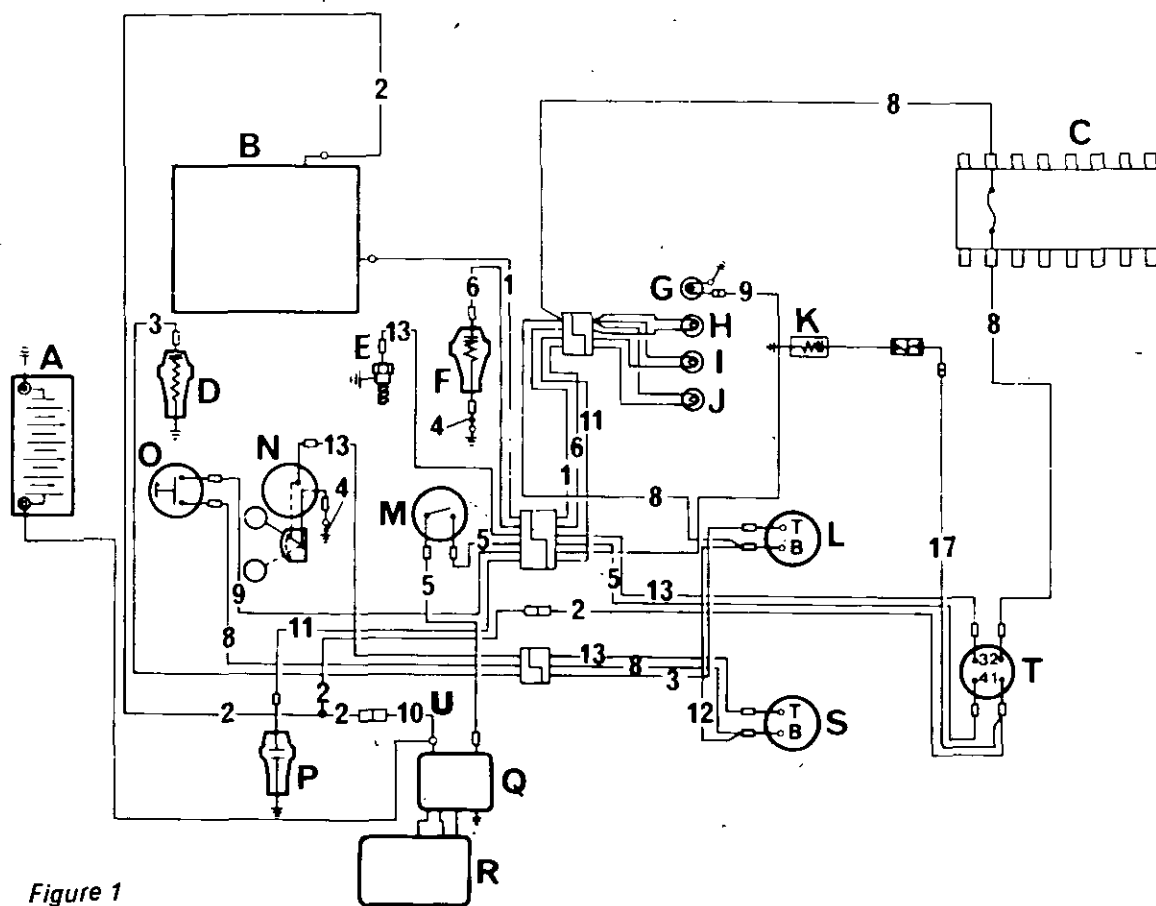


Figure 1

ELECTRICAL SYSTEM

**Colour Code
(All Wiring Diagrams)**

1. Purple
2. Red
3. White
4. Black
5. Yellow
6. Brown
7. Tan/Brown
8. Light Green
9. Light Blue
10. Brown
11. Green
12. Blue
13. Orange
14. Grey
15. Red/Black
16. Pink
17. Dark Green
18. White/Red
19. White/Blue
20. Brown/White

**LIGHTING WIRING DIAGRAMS
(Figs, 2, 3, 4, 5 and 6)**

- A. Flashing Indicator Light (Rear)
- B. Tail/Brake Light
- C. Plough Light
- D. Number Plate Light
- E. Trailer Socket
- F. Hazard Warning Lights Switch
- G. Flashing Indicator Relay
- H. Starter Switch
- I. Tachometer Bulb
- J. Brake Light Switch
- K. Flashing Indicator Switch
- L. Flashing Indicator Warning Lights
- M. Light Switch
- N. Fuse Box
- O. Temperature Gauge Bulb
- P. Fuel Gauge Bulb
- Q. Flashing Indicator Light (Front)
- R. Side Light (Front)
- S. Headlight Main Beam Warning Light
- T. Horn
- U. Headlight

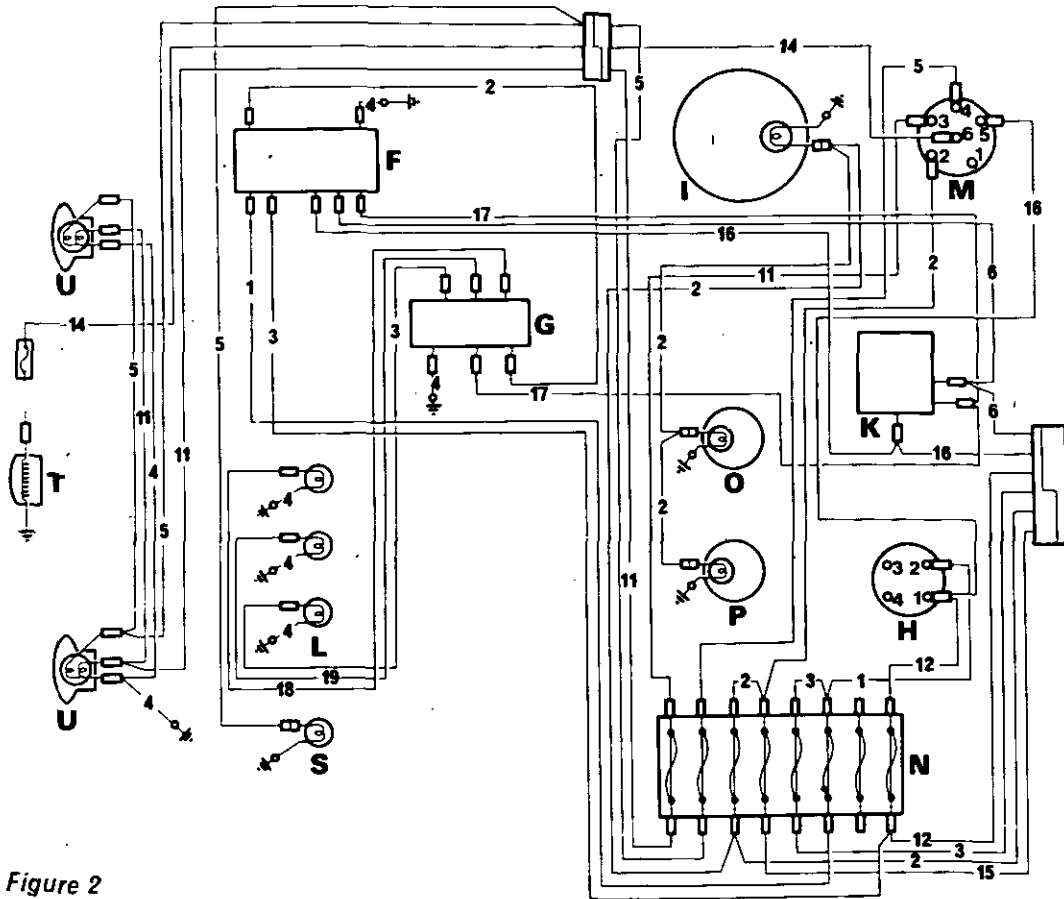


Figure 2

ELECTRICAL SYSTEM**SERVICING THE ELECTRICAL SYSTEM**

The electrical equipment should be serviced at the times stated in Part 1, Section B.

Precautions

**** IMPORTANT : Always disconnect the alternator wiring before removing the battery leads.**

1. Before any operation is carried out on the tractor electrical system, always disconnect the battery leads.
2. To prevent damage to the voltage regulator do not connect or disconnect any part of the charging circuit including the battery while the engine is running. (This action may damage the voltage regulator).
3. When connecting the alternator, slave battery or battery charger to the tractor always observe correct polarity, (positive to positive, negative to negative) or damage to the voltage regulator and rectifier may occur.

WARNING: If, at any time, it is necessary to remove the battery from the tractor, on refitment always ensure that the battery leads are reconnected correctly THE FIRST TIME, since even a momentary connection of the wrong lead, with the other lead already incorrectly connected, will cause serious damage to the alternator.

**** Battery lead connecting sequence:**

Connect the positive lead(+) to the terminal marked + (Red);

Connect the negative lead(-) to the terminal marked - (Black).

Preliminary Checks

If the charging circuit is faulty, indicated by a flat battery, frequent topping-up of the electrolyte or the warning light staying on throughout the engine speed range, check:—

- (a) That all cable connections are clean and tight.
- (b) That all components and wiring are without signs of overheating or damage.
- (c) That the alternator drive belt tension is correct and adjust as necessary.
- (d) That the battery is serviceable and the connections are in good condition.

For the complete list of electrical system faults, together with their symptoms and remedies, consult the fault finding table.

Routine Maintenance**(a) Battery**

Check the electrolyte level in the battery after every 100 hours of operation and top up with **DISTILLED WATER** as necessary. See operation 9A-07-14.

In an emergency, clean rainwater or melted snow can be used in place of distilled water. **NEVER USE** salt water, chlorinated water, chemically softened water, boiled water, or stagnant water.

Make sure that the filler plug or cover plate vent holes are kept open and free of dirt at all times.

The battery top should be kept clean, any moisture or dirt being wiped off at regular intervals. Dilute ammonia on a lint free cloth should be used for removing any traces of sulphation from the battery top or terminals.

Symptoms	Probable Fault		Test Procedure	Remedial Action
	Alternator	Circuit		
Indicator light stays OUT under all conditions	—	Blown filament	—	Renew filament
	Internal short circuit	—	Max Output (low reading)	Change alternator
	—	Bad connection or broken cable	Continuity Test	Renew connection/cable
Indicator light stays ON under all conditions (Dims at low rev/min)	High Output (internal short circuit)	—	Max Output Test Voltage Regulator Test	Change Alternator
Indicator light stays ON. Dims as rev/min increases: goes out at high rev/min	—	Short circuit to to earth	Continuity Test Voltage Drop Test	Renew connection/cable
	—	Fan Belt Adjustment	—	Adjust Fan Belt
	Output Low	—	Max Output Test	Change Alternator
Battery not charging	—	Battery in poor condition	Hydrometer Test Discharge Test	Change Battery
	Voltage control faulty	—	Voltage Regulator Test	Change Alternator
	—	High resistance (Bad Connection) Leak to earth	Voltage Drop Test Continuity Test	Renew or clean connection
Battery overcharging (Excessive use of electrolyte, filament bulbs blow after short period in service)	Voltage Control	—	Voltage Regulator Test	Change Alternator
Light ON when engine stationary. Dims at cut-in speed and remains dim at very high speeds	Internal Short Circuit	—	Max Output (Very Low)	Change Alternator

ELECTRICAL SYSTEM

The battery posts should be kept clean and the connections checked periodically for tightness. To maintain a dry, clean contact between the battery post and terminal clamp, the terminals should be smeared with grease.

(b) Alternator

Routine maintenance is limited to wiping away any oil or dirt which may have accumulated around the apertures on the alternator and ensuring that the drive belt is correctly tensioned. The alternator bearings are lubricated on initial assembly and no further lubrication is needed during service life.

(c) Fuses

In the case of a blown fuse, the cause must always be identified and rectified before replacement of the fuse. Only fuses of the same capacity may be used for replacement purposes. For the correct fuses, see the lists that follow.

FUSES

(MF 235, 245, 255, 260, 265, 275 and 285)

Dipped Headlights All models—20A.

Side Lights All models—2 fuses, each 5A.
Brake Lights All models—5A.
Instrument Power supply All models—15A.
Main Beam Headlights All models—25A.
Flashing Indicators All models—10A.
Plough Light All models—20A.
Horn All models—10A.
Cigar Lighter MF 245, 265 and 285 only—35A.
Overall Lighting—Certain Territories Only MF 245, 265 and 285 only—35 A.
Fusible Link (To starter solenoid) MF 235, 245 and 260—20 or 25A; MF 255, 265, 275 and 285—25A.

**** FUSES**

(MF 240 and MF 290)

Dipped Headlights 20A.
 Mainbeam Headlights 20A.
 LH side/Tail and instrument illumination 10A.
 RH side/Tail and Number Plate light 10A.
 Plough Light, Hazard and Cigar Lighter 25A.
 Brake Lights, Flashers and Instrument power supply 20A.
 Horn 10A.

(d) Bulbs

Bulb types and sizes for the lights and instruments of the different tractor models are as indicated in the chart below.

BULBS

** (MF 235, 240, 245, 255, 260, 265, 275, 285 and 290)

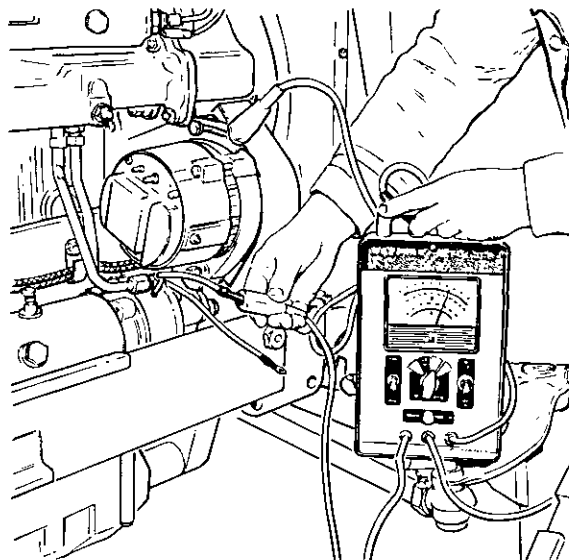
	Size	Fitting	Type
Headlights	36/36W or 45/40W ('E' Scheme)	Bayonet	Elongated Glass Round Glass
Front Sidelights	5W	Clamp	Festoon
Rear Sidelights Brake Lights	5W 21W	Bayonet	Pear Shaped Glass— Dual Filament
Flashing Indicator/ Hazard Warning Lights	21W	Bayonet	Pear Shaped Glass
Plough Light	36W	Bayonet	Round Glass
Panel Warning Lights	2-2W	Push-in (Capless)	Domed Glass
Indicator Warning Lights	2-2W	Push-in	Elongated Glass
Instrument Lights	2-2W	Push-in (Capless)	Elongated Glass
Number Plate Light	5W	Bayonet or Clamp	Round Glass Festoon
Certain Territories Only—Front/Rear Sidelights	5W	Bayonet	Round Glass

SERVICING THE ELECTRICAL SYSTEM**Cable Continuity Test 9A-01-09**

Special Tools: 'CRYPTON' BA.402 Electrical Tester and Harness or equivalent, or alternatively—

- D.C. Voltmeter reading from 0 to 20 V,
- D.C. Ammeter reading from 10 to 100A.

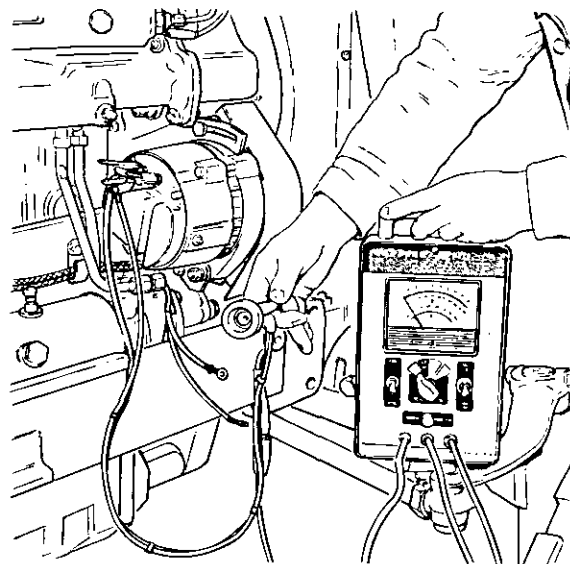
1. Turn the tractor starting switch to the 'ON' position, checking that the indicator light illuminates.
2. Disconnect the main output cable (RED) and the indicator light cable (PURPLE) at the terminals on the alternator.
DO NOT TOUCH THE CABLES TO EARTH.
3. With the BA.402 tester, connect the YELLOW lead to earth and the RED lead to each of the cable ends in turn.
4. Check the voltage shown by the tester. With the tester selected to 20 V, the gauge should register battery voltage.
5. Remove the tester and reconnect the alternator cables.
6. If the voltage reading is low (below 9.6 V), check the condition of the battery. See operation 9A-06-13. If the battery is serviceable, a faulty connection or cable in the charging circuit is indicated.

**SERVICING THE ELECTRICAL SYSTEM****Alternator Maximum Output Test 9A-02-09**

Special Tools: 'CRYPTON' BA.402 Electrical Tester and Harness

1. Disconnect the main output cable (RED) and the indicator light cable (PURPLE) at the terminals on the alternator.
2. Connect the test harness to the alternator terminals as follows:
 - (a) The RED lead of the harness to the alternator main output terminal;
 - (b) the BLUE lead of the harness to the alternator indicator light terminal.
3. With the BA.402 tester, connect the BLACK test clip to the battery positive (+) terminal and the YELLOW clip to the battery earth (-) terminal, then connect the RED clip to the remaining lead of the test harness and ensure that the test lamp illuminates.
4. Start the tractor and increase the engine speed above idling, when the test lamp should go out.
5. Run the engine at maximum rev./min., select 60 amp. on the tester, then push the test button for 10 seconds and note the alternator output on the gauge.
6. Compare the alternator output reading with the relevant minimum value. A very high or low output for the alternator indicates an internal fault in this. Before rejecting the alternator, ensure that the electrical circuit and battery are serviceable.
7. Remove the tester and reconnect the alternator cables.

NOTE: This test should be carried out with the alternator running at its normal operating temperature. The normal output of the alternator may be exceeded when running cold, which produces a misleading result.



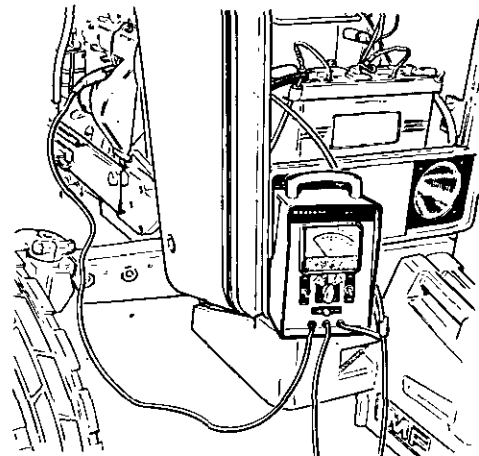
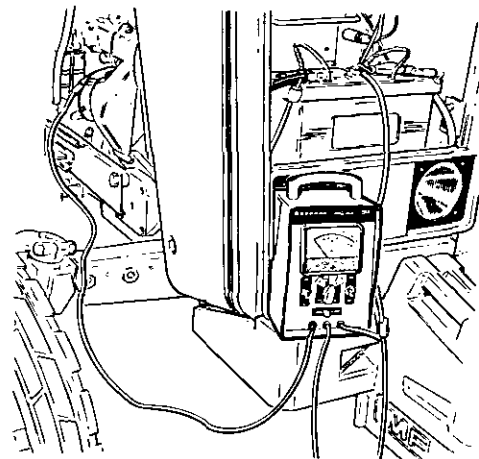
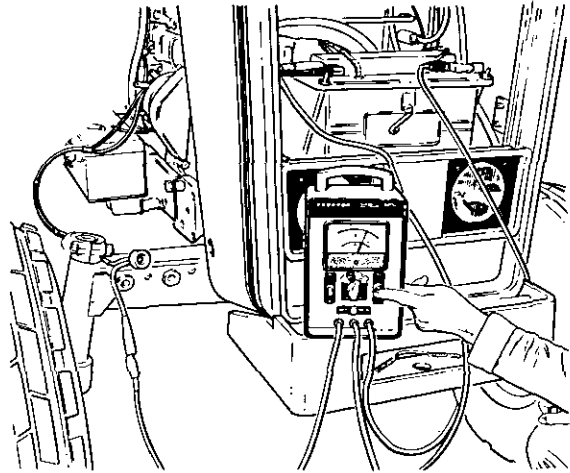
ELECTRICAL SYSTEM**** SERVICING THE ELECTRICAL SYSTEM**

Voltage Regulator Setting 9A-03-10
 Special Tools: 'CRYPTON' BA.402 Electrical Tester and Harness

NOTE: With later MF 200 Series tractors, with the exception of the MF 240 tractor, the front grille and headlight assembly is removed as one item giving access to the battery, operation 9A-40-30. With the MF 240 tractor the battery is housed behind the instrument panel and is accessible after removing the battery cover panel.

1. Carry out procedures 1 to 4 of operation 9A-02-09 or 9A-49-34 according to the type of alternator fitted.
2. Run the engine at maximum rev./min. and select 20 V. on the tester.
3. Move the test switch to RES. IN, whereupon the voltmeter reading should be 13.6 to 14.4 V.
4. Select the test switch to RES. OUT.
5. Remove the tester and reconnect the alternator cables.
6. If the voltage reading obtained is low, check the drive belt tension and the charging circuit for continuity before rejecting the alternator. If the voltage reading obtained is high, change the alternator.

NOTE: It is essential that the battery is in good condition when carrying out this test.

**SERVICING THE ELECTRICAL SYSTEM**

Voltage Drop Test 9A-04-10
 Special Tools: 'CRYPTON' BA.402 Electrical Tester

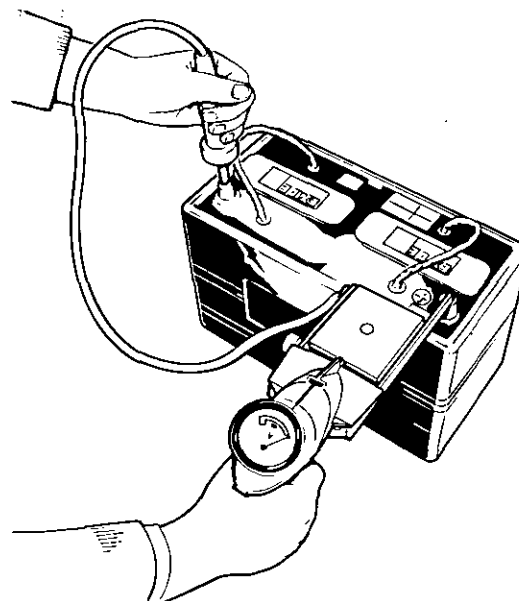
1. With the BA.402 tester, connect the RED clip of the tester to the alternator output terminal and the YELLOW clip to the battery positive (+) terminal.
2. Select the tester to 20 V. and run the tractor engine at maximum rev./min.
3. Switch on all the tractor lights, which should give a reading on the tester gauge of not more than 0.5 V.
4. Transfer the YELLOW clip to the battery earth (-) terminal and the RED clip to the alternator body (earth), whereupon the gauge reading should not exceed 0.25 V. If the limits are exceeded, a high resistance in the circuit is indicated.
5. Remove the tester.
6. Check that all connections are clean and tight, and change any cables that are suspect.

BATTERY**Capacitance Testing**

9A-06-13

Special Tools: 'Crypton' Battery Tester Model B51

1. The gases given off by the cells of a battery are explosive. Always use the battery tester in a well ventilated area.
2. Set the battery tester for:
 - (a) 12V operation, and
 - (b) a discharge rate of three times the battery amp-hr. capacity.
3. Connect the prod on the tester to the battery positive (+) terminal.
4. Connect the prod on the flexible cable to the battery negative (-) terminal.
5. Test the battery for 15 seconds only, whilst noting the voltmeter behaviour on the upper colour scale.
6. A reading in the Green zone indicates the battery to be in a satisfactory condition.
7. If the reading is in the YELLOW zone, charge the battery for 5 minutes at 30 Amps (or for the appropriate period indicated) and retest.



Charging Time in Minutes	Charging Amperage
5	30
10	15
20	10
30	5

8. If the meter reading is now in the GREEN zone, the battery is serviceable but needs further charging. A continuous reading in the YELLOW zone usually indicates a faulty battery.
9. When the meter reading falls progressively during the 15 seconds and ends in the RED zone, the battery needs replacing.

ELECTRICAL SYSTEM

**** BATTERY**

Electrolyte Replenishment

9A-01-14

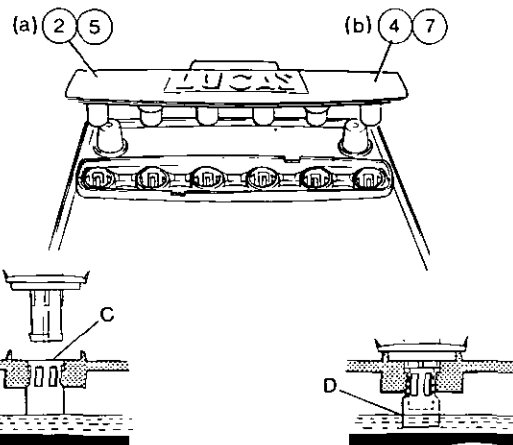
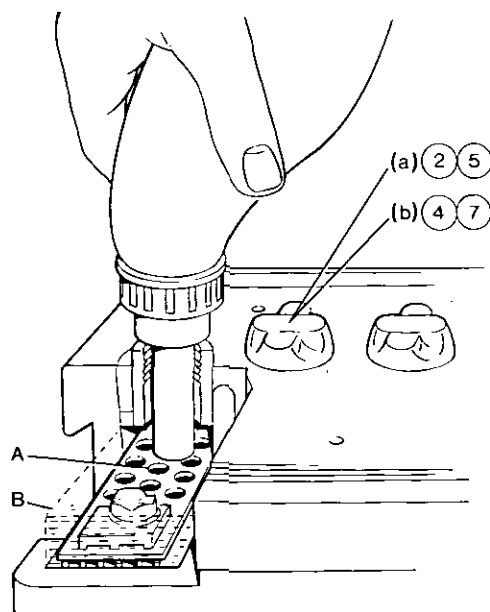
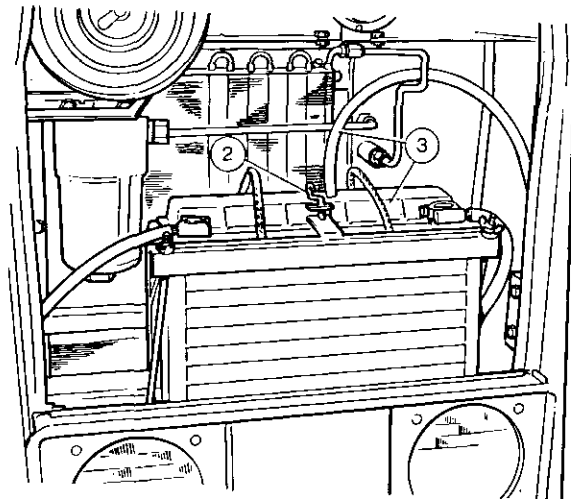
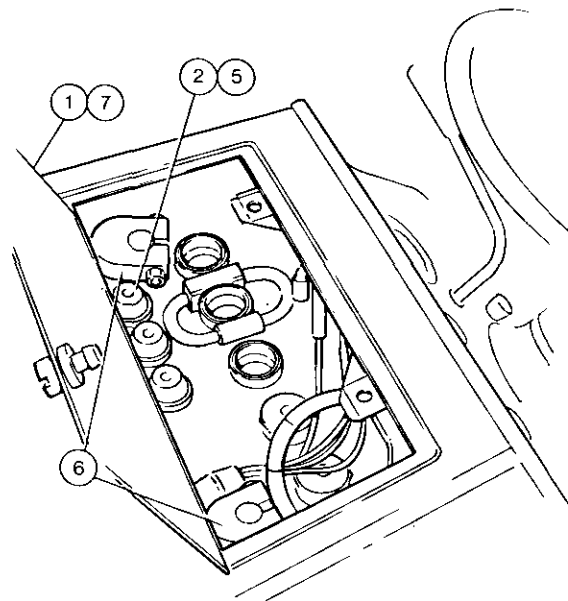
(a) MF 235, and 255 Tractors

1. Raised the hinged battery compartment lid, undoing the two knurled head screws.
2. Remove from the battery, according to type: The cover plates or filler plugs (Chloride Fulmen, Lucas Aqualok and Exide Auto-Fil), or the vent cover (Lucas and Exide Mono Lid).
3. Check that: with Chloride, Fulmen, Lucas and Exide Mono Lid batteries, the electrolyte just covers the battery plates or that, with Lucas Aqualok and Exide Auto-Fil batteries, the trough and cell filling tubes are completely filled with distilled water.
4. If any topping up is necessary, use **ONLY DISTILLED WATER**.
5. Refit the battery cover plates, filler plugs or vent cover.
6. Wipe the battery top and smear the terminals with petroleum jelly.
7. Screw down the battery compartment lid.

(b) MF 260, 265, 275, 285 and 290 Tractors

1. Remove the front grille, Part 2A.
2. Release the battery cover retainer.
3. Remove the battery cover and tube.
4. Remove from the battery according to type: the cover plates or filler plugs (Chloride, Fulmen, Lucas Aqualok, and Exide Auto-Fil), or the vent cover (Lucas and Exide Mono Lid).
5. Check that: with Chloride, Fulmen, Lucas and Exide Mono Lid batteries, the electrolyte just covers the battery plates or that, with Lucas Aqualok and Exide Auto-Fill batteries, the trough and cell filling tubes are completely filled with distilled water.
6. If any topping up is necessary, use **ONLY DISTILLED WATER**.
7. Refit the battery cover plates, filler plugs or vent cover.
8. Wipe the battery top and smear the terminals with petroleum jelly.
9. Reverse procedures 1 to 3.

NOTE: The Chloride battery is shown on Page 9A-30.



KEY:

- A—Separator Guard
- B—Electrolyte Level
- C—Valve Lifted, Air Lock Created, Filling Tubes Full
- D—Vent Cover Replaced, Air Lock Broken, Correct Level Indicated.

BATTERY**Recharging in Service**

9A-08-15

Hydrometer Test

The specific gravity of the electrolyte indicates the state of charge in the battery. Using a hydrometer, check the specific gravity of the electrolyte in each battery cell and compare the readings with those in the table below.

Electrolyte Temperature Correction

For every 2.8°C (5°F) **BELOW** 15.5°C (60°F), **DEDUCT** 0.002 from the S.G. reading to obtain the true S.G. at 15.5°C (60°F).

For every 2.8°C (5°F) **ABOVE** 15.5°C (60°F), **ADD** 0.002 to the S.G. reading, to obtain the true S.G. at 15.5°C (60°F).

If the specific gravity of individual cells varies by more than 0.040 the battery should be considered for replacement.

NOTE: Hydrometer readings should not be taken if the battery has just been topped up. Charge the battery for 1-2 hours before testing.

Recharging from an External Supply

If the battery is found to be less than 70% charged, it should be re-charged using an external source. The charging current should be one-tenth of the battery capacity. See Table: 9A-05-11.

Before re-charging, make sure that the battery filler plug or cover plate vent holes are open and free of dirt.

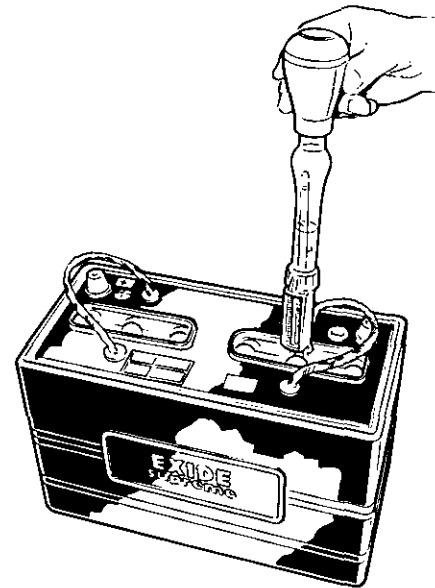
The battery is fully charged when the specific gravity of the electrolyte and voltage show no increase over three successive hourly readings. During the charge, the electrolyte level should be checked regularly and replenished as necessary with distilled water.

Boost Charging

Boost charging must be regarded as an **emergency measure only**.

Boost charging must be limited to a maximum period of one hour only, with a charge rate not greater than the ampere-hour capacity of the battery.

As the battery state-of-charge rises, the charging rate will fall, but must **NOT** be re-adjusted to the original state.



State of charge	Specific Gravity Readings	
	Climate Normally below 25°C (77°F)	Climate normally above 25°C (77°F)
Fully charged ..	1.260 — 1.280	1.210 — 1.230
70% charged ..	1.230 — 1.250	1.170 — 1.190
Discharged	1.110 — 1.130	1.050 — 1.070

ELECTRICAL SYSTEM**BATTERY**

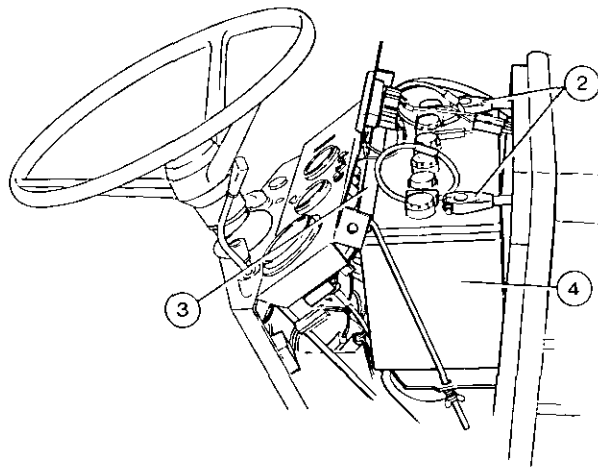
Removal and Refitment (MF 235, 245 and 255 Tractors) 9A-09-16

Removal

1. Remove the instrument cowl retaining bolts and then the cowl, Part 2A.
2. Disconnect the battery cables, removing the earth (—) cable first **IN THE INTERESTS OF SAFETY**.
3. Remove the battery stay by unscrewing the wing nuts securing the stay rods.
4. Lift the battery from its supporting plate, moving it sideways to avoid the warning light assembly and the wiring harness.

Refitment

5. Reverse procedures 1 to 4, except:
 - (a) Smear the battery terminals and stay-rod wing nuts with petroleum jelly.

**** BATTERY**

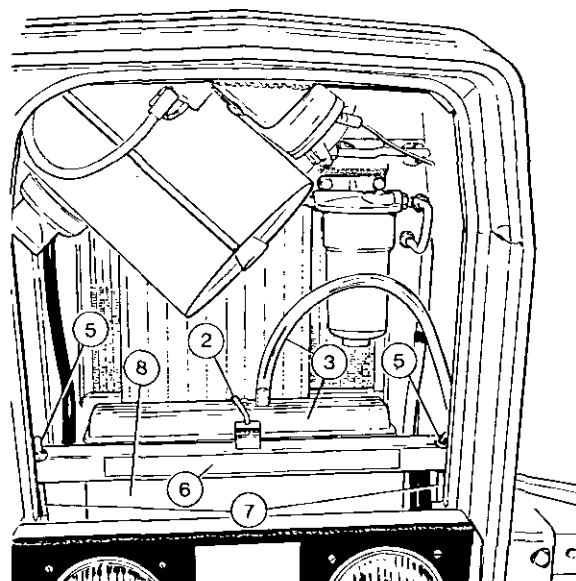
Removal and Refitment (MF 260, 265, 275, 285 and 290 Tractors) 9A-10-16

Removal

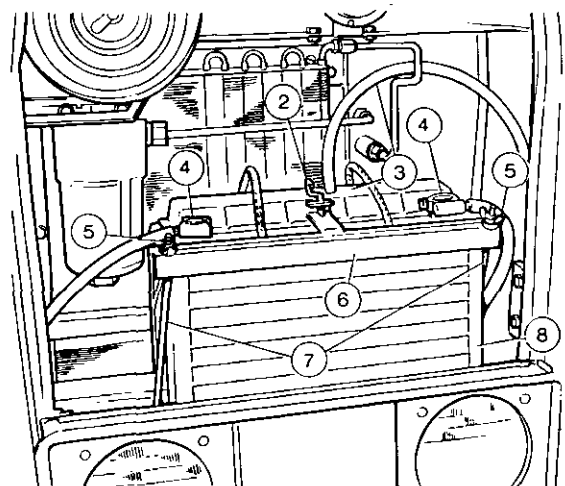
1. Remove the front grille, Part 2A.
2. Release the battery cover retainer.
3. Remove the battery cover and tube.
4. Disconnect the battery cables, removing the earth (—) cable first **IN THE INTERESTS OF SAFETY**.
5. Remove the wing nuts and washers.
6. Remove the battery stay.
7. Lift out the battery-stay rods.
8. Lift out the battery.

Refitment

9. Reverse procedures 1 to 8, except:
 - (a) Smear the battery terminals and stay-rod wing nuts with petroleum jelly.



- ** NOTE:** On the MF 240 Tractor the battery is housed in a compartment immediately ahead of the instrument panel, and is accessible after first removing the battery cover panel which is secured with two chromed locking levers.



SPECIAL TOOLS

Tool No.	Description	Tool No.	Description
ENGINE			
**PD.1D	Valve Guide Remover and Replacer (Main Tool)	MF.264	Front Axle and Steering Bush Reamer (Main Tool)
**PD.1D-1A	Adaptor for PD.1	**MF.264-2/1	Reamer and Pilot
**PD.1D-4	Adaptor for PD.1	**MF.264-2/2	Reamer and Pilot
** 4RL	Torque Wrench	MF.268A	Steering Wheel Remover
**No. 13	Torque Wrench	MF.322	Front Axle Pivot Pin Bush Remover and Replacer
**No. 8	Piston Ring Compressor	MF.332	Power Steering Pump Oil Seal Protector
PD.41B	Piston Height and Valve Depth Gauge	**MF.334	Steering Pivot Pin Bush Remover (Use with PD.1D)
**MS.73	Adjustable Valve Seat Cutter Kit	** 6312B	Steering Drop Arm Remover
**MS.76	Handle for 35° Valve Seat Cutters	MF.402	Steering Drop Arm Puller
**PD.137	Valve Guide Reamer (-.015" o/s)	REAR AXLE	
**PD.138	Valve Guide Reamer (-.030" o/s)	MF.9A	Differential Housing Holder
**PD.145	Crankshaft Rear Oil Seal Replacer	MF.10	Bench Plate
**PD.145-2	Oil Seal Pilot	MF.25A	Handle
**PD.150A	Cylinder Liner Remover and Replacer (Main Tool)	MF.26B	Axle Shaft Bearing Remover (Main Tool)
**PD.150-1B	Adaptors for PD.150A	MF.197	Wheel Axle Outer Bearing Cone and Differential Cone Replacer (Main Tool)
**PD.150-7A	Adaptors for PD.150A	MF.197-2	Differential Carrier-Plate Bearing Cone Replacer Adaptor
**MS.150-8	Pilot for 35° Valve Seat Cutter	MF.200-2	Drive Cover Assembly and Bearing Remover
PD.155B	Basic Puller	MF.200-3	Differential Carrier Plate Bearing Cone Remover Adaptor
**PD.155-1	Adaptor for PD.155B	MF.200-22	Differential Bearing Remover Adaptor
335	Con Rod Jig and Master Arbor	MF.200-23	Driving Pinion Bearing and Pilot Bearing Remover/Replacer Adaptor
**PD.336-102	Arbor Adaptor Used with 335	MF.200-24	Epicyclic Hub Inner Bearing Cone Remover Adaptor
** 102	Diesel Compression Tester	MF.202A	Rear Drive Shaft Needle Bearing Remover
** 109	Injector Extractor	MF.203A	Rear Drive Shaft Needle Bearing Replacer and P.t.o. Remover/Replacer
** 111	Injector Tester	MF.245D	Rear Axle Preload Gauge
6118B	Valve Spring Compressor	MF.245D-1	Straight Edge
PD.6118-3	Adaptor for 6118B	**MF.257A	Differential Bearing Cone Holder
**PD.6118-4	Adaptor for 6118B	MF.258	Differential Housing Holder
7600	Bearing Remover	MF.265A	Planetary Carrier Assembly Remover
7066	Circlip Pliers	MF.266B	Planetary Carrier Bush Inner Coil Seal Bearing Cone and Unit Replacer
MF.200-26	Water Pump Overhaul Kit	MF.267A	Epicyclic Hub Pre-load Gauge
**MS.690	Exhaust Valve Seat Cutter for 35° Seat	MF.295B	Wheel Guide Pilots
**MS.695	Inlet Valve Seat Cutter for 35° Seat	**MF.366	Wheel Guide Pilots
MS.67B	Static Timing Tool	MF.555-2A	Differential Coupling Bearing Cone Remover
PD.67B-1	Adaptor	MF.1105-2A	Differential Bearing Cup Remover/Replacer
FRONT AXLE AND STEERING			
**MF.19A	King Pin Bush Reamer	MF.1105-7A	Differential Bearing Cup Remover/Replacer Adaptor
**MS.62A/63	Danfoss Oil Seal and Spring Plate Kit	MF.1105-8	Epicyclic Hub Inner Bearing Cup Remover/Replacer Adaptor
MF.147-7	Power Steering Adaptor	MF.1105-11	Rear Axle Shaft Oil Seal Remover and Replacer
MF.195-4	Front Axle Pivot Pin Bush Remover/Replacer and P.t.o. Bush Remover/Replacer		
**MF.263A	Front Axle and Steering Bush Remover (Main Tool)		
**MF.263-1/1	Front Axle and Steering Bush Remover Adaptor (Tap-1¼ in)		
**MF.263-1/2	Front Axle and Steering Bush Replacer, Adaptor		
**MF.263-1/3	Front Axle and Steering Bush Remover, Adaptor (Collar)		
**MF.263-2/1	Front Axle and Steering Bush Replacer		
MF.263-2	Front Axle and Steering Bush Remover/Replacer Adaptors (1½ in)		
MF.263-3	Front Axle and Steering Bush Remover/Replacer Adaptors (1¾ in)		

SPECIAL TOOLS

Tool No.	Description	Tool No.	Description
CLUTCH & TRANSMISSION			
**MF.159B	Single-and Dual Clutch Centraliser and Sleeve	**MF.260-5	Multi-Power Pump Flow Adaptor
MF.178	P.t.o. Main Drive Shaft Pilot	**MF.269	Response Plunger Adjusting Wrench
**MF.179	Transmission and P.t.o. Pinion Oil Seal Replacer	**MF.270B	Dashpot Piston Wedge
MF.200-25	Multi-Purpose Bearing Remover	**MF.271B	Roller Assembly Tool and Draft Control Rod Gauge
MF.215	Secondary Clutch Setting Gauge	**MF.272	Ram Arm Gauge Fixture
MF.218A	Front P.t.o. Housing Replacer (Main Tool)	**MF.273	Hydraulic Control Lever Setting Fixture
MF.218A-2	Front P.t.o. Housing Replacer Adaptor	MF.333	Draft Control Rod Gauge (Increased Tension Range)
MF.255B	Multi-Power Pinion Oil Seal Replacer and Assembly Sleeve	**MF.355	Hydraulic Pump Overhaul Kit Comprising:— MF.349, 350, 351, 352, 353 and 354
MF.256A	Multi-Power Pinion Assembly Inner Oil Seal Replacer	MF.349	Valve Seal Forming Tool
MF.314	Lever Fulcrum Height Setting Gauge	MF.350	Valve Circlip Replacer
**MF.315A	Main Drive Shaft Retainer Needle Bearing and Seal Remover/Replacer	MF.351	Valve Plug Remover and Replacer
MF.331	Transmission Input Shaft Oil Seal Replacer	MF.352	Control Valve Spring Retainer
**MF.414/1	ZF. Synchromesh Hub Centralising Pin	MF.353	Control Valve Body 'O' Ring Guide
**MF.414/2	Clamp Bolt	MF.354	Control Valve Body Replacer
**MF.414/3	Locating Peg	**MF.360	Hydraulic Pump Adjusting Kit Comprising:— MF.356, 357A, 359
**MF.415	ZF. Synchromesh Hub Assembly Ring	MF.356	Position and Draft Control Setting Gauge
**MF.415/2	ZF. Synchromesh Hub Assembly Plate	MF.357A	Dummy Bolt and Screwdriver Adjuster
**KMF.1004	Mainshaft Oil Seal Protector Comprising:— KMF.1004/1 and KMF 1004/2	MF.359	Pressure Control Bleed Pipe
**KMF.1004/1	Sleeve	MF.363	Quadrant Lever Retaining Tool
**KMF.1004/2	Guide	MF.364	Oil Seal Replacer (P.t.o.)
MF.7600B	Flywheel Spigot Bearing Remover (Main Tool)	810	Hydraulic Pressure and Flow Test Fixture (Main Tool)
MF.7600-1	Flywheel Spigot Bearing Remover Adaptor	MF.810-1	Adaptor
P.T.O. & HYDRAULICS			
MF.163	Spring Retainer Nut Wrench	MF.810-4	Multi-Power Pump Flow Adaptor
MF.166	Hydraulic Adaptor for Lift Cover	MF.810-6	l.p.t.o. Pressure Gauge Adaptor
MF.167	P.t.o. Oil Seal Pilot	MULTI-PURPOSE & MISCELLANEOUS TOOLS	
**MF.168	P.t.o. Shaft Oil Seal Remover	** 13	Torque Wrench
**MF.195-5A	P.t.o. Needle Bearing Remover/Replacer	MF.148A	Hydraulic Pressure Test Equipment (Main Tool)
MF.195-6	Two Speed P.t.o. Shaft Needle Bearing Remover/Replacer	**MF.195A	Bearing Cups Remover/Replacer (Main Tool)
**MF.226B	Hydraulic Lift Cover Remover/Replacer	MF.200	Hand Press (Main Tool)
MF.226A-3	Lift Cover Cradle Adaptor Set	MF.260	Low Pressure Hydraulic Test Set (Main Tool)
**MF.260-1	Multi-Power Hydraulic Test Adaptor	**MF.278	Dial Test Indicator Gauge
**MF.260-3	Multi-Power Hydraulic Adaptor	**MS.2700	Tractor Splitting Kit
**MF.260-4	Multi-Power Pressure Test Adaptor	**MS.2700-1	Rails
		**MS.2700-2	Fixed Stand
		**MS.2700-3	Mobile Stand
		**MS.2700-4	Height Adjusting Handle
		550	Driver Handle (Main Tool)
		555	Three Leg Adjustable Puller (Main Tool)
		MF.1105	Bearing Remover (Main Tool)
		7065M	Heavy Duty Circlip Pliers
		** 7065MP	Circlip Plier Points
		7066	Circlip Pliers
		**MF.6312B	Universal Puller
		**T.4062A	Universal Pre-load Gauge

HYDRAULIC SYSTEM (MK III PUMP)

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HYDRAULIC SYSTEM

GENERAL

Fig. 1. The Ferguson hydraulic system comprises a four cylinder scotch yoke type pump (1) which delivers oil, through a vertical pipe (2) to the cylinder (3).

A connecting rod (4) from the cylinder piston (5) engages in the ram arm (6) which is splined on to the lift shaft (7) which carries the linkage lift arms.

When oil, under pressure from the pump, is delivered to the ram cylinder (3), the piston is forced rearwards and pushes the ram arm upwards, causing the lift shaft to rotate and raise the lift arms.

The hydraulic pump is driven by the p.t.o. drive from the p.t.o. clutch plate, via the gearbox constant mesh gears and the p.t.o. drive shaft.

Hydraulic Pump (Fig. 2)

The pump consists of two piston yokes (1) which ride on cam blocks over eccentrics on a camshaft (2). The pistons, reciprocate in two opposed valve chambers (3), each housing two inlet (4) and outlet valves (5) and springs. A sealing plug and snap ring secure the valves in the chambers.

Front and rear castings incorporate the oil galleries connecting the two valve chambers, and also house the control valve (6) and the oscillator (7).

Attached to the rear casting is the Response Control and strainer housing (9) and also the Pressure Control valve (8).

As each of the pump pistons moves down its cylinder it creates suction which lifts the inlet valve from its seat and draws in oil past the control valve (if open) along the intake gallery into the cylinder. During this inlet stroke the outlet valve is held closed by the spring acting on it. When the piston reaches the end of its inlet stroke, the suction ceases and the inlet valve is closed by the inlet valve spring. As the piston returns into the cylinder, the resultant pressure in the oil keeps the inlet valve closed and lifts the outlet valve. This pressure forces the oil past the outlet valve into the discharge passage.

Control Valve (Figs. 3, 4 and 5)

The control valve has intake and discharge slots at either end and is spring loaded to the intake position by the oscillator spring. The valve slides within a sleeve which has ports leading to both the intake and the pressure side of the pump.

With the valve held in the intake position (Fig. 3) by the oscillator spring, oil is drawn through the intake slots into the pump. In this position the lower links would raise.

With the valve in the neutral position (Fig. 4), both the intake and the discharge slots are outside the sleeve. In this position the lower links would be stationary.

With the valve in the discharge position (Fig. 5), the discharge slots are in the pressure chamber and oil can flow from the ram cylinder back to the sump. In this position the lower links would be lowering.

OPERATION

Draft Control—Implement Lowering (Fig. 6)

To lower the implement, place the Position Control lever in the TRANSPORT position, and move the Draft Control lever downwards through the quadrant. This action presses the eccentric roller (1), on the end of the Draft Control lever shaft, down onto the upper cam face of the Draft Control cam (2), causing the lower face of the cam (2) to be forced downwards into contact with the roller (3) on the Draft Control linkage. The cam (2) is then moved rearwards causing the vertical lever (4) to pivot and move the pump control valve, via the lever (5), into the discharge position against the influence of the control valve spring. The Draft Control linkage will move because the force from the control valve is less than the break-out spring (6) force.

Draft Control—Compression Force in the Top Link (Fig. 7)

When the control valve is in the fully discharge position, and with further downward movement of the Draft Control lever, the eccentric roller (3) acting on the upper cam face of the Draft Control cam (4), forces the lower cam face of the Draft Control cam (4) to move the roller (5) forwards. Forward movement of the roller (5) leaves a gap between the Draft Control rod (2) and the Draft Control spring plunger (1) and simultaneously compresses the spring on the guide rod (7).

Forward movement of the tractor will cause an implement to gain depth (as the control valve is in the discharge position), until resultant implement draft reaction compression forces, applied through the top link, deflect the control spring and cause the Draft Control spring plunger (1) to contact the Draft Control rod (2), and move the Draft Control linkage forwards. This permits the Draft Control cam (4) to move forwards, acting under the influence of the control valve spring and limited by the position of the roller (5), until the control valve reaches the neutral position.

Draft Control—Tension Force in the Top Link (Fig. 8)

Variations in ground conditions will cause fluctuations in the draft force in the top link. If the draft force decreases, the compression force in the control spring decreases.

The Draft Control linkage follows the control spring plunger (1) under the influence of the spring in the guide rod (7), and moves the Draft Control link rearwards. The vertical lever (4) pivots and moves the pump control valve, via the lever (5), towards discharge. When the correct depth is obtained, the valve is restored to neutral. An increase of draft force in the top link will have an opposite effect.

MF200 SERIES TRACTOR WORKSHOP SERVICE MANUAL

Publication No. 1856 072 M1

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†NOTE: For MF298 Tractor see Supplement A4 1851 072 M1.

Issue 5

SEALANTS

Sealants quoted in this Workshop Service Manual may be obtained from, as follows:

<i>Sealant</i>	<i>Description</i>	<i>Part No.</i>	<i>Size</i>	<i>Obtained from</i>
A	HYLOMAR (PERKINS)	1861117	Tube	} Powerpart Product Central Parts Operation Urmston, Manchester
	HYLOMAR (PERKINS)	1861152	Aerosol	
	HYLOSIL (PERKINS)	1861108	Tube	
	HYLOSIL (PERKINS)	1861151	Cartridge	
B	LOCK AND SEAL	3405 350 M1	10 ml	
	LOCK AND SEAL	3405 351 M1	50 ml	
C	STUDLOCK	3405 352 M1	10 ml	
	STUDLOCK	3405 353 M1	50 ml	
D	BOSTIK BLUE TACK	—	—	} Normal trade retail outlets
E	DUNLOP THIXOFIX	—	—	
F	LOCTITE SUPERFLEX RTV3	—	—	
G	INSTANT GASKET	3405 354 M1	6 ml	} Powerpart Product Central Parts Operation Urmston, Manchester
	INSTANT GASKET	3405 355 M1	50 ml	

MF600 SERIES TRACTOR WORKSHOP SERVICE MANUAL

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INTRODUCTION

The purpose of this manual is to assist dealers and distributors in the efficient repair and maintenance of Massey-Ferguson farm machinery. Carrying out the procedures as detailed, together with the use of special tools where appropriate, will enable the operations to be completed within the time stated in the repair time schedule.

NOTE—To assist with locating information, each division of the manual is preceded by a contents page listing the operation in numerical order.

Each instruction within an operation has a sequence number, and to complete the operation in the minimum time it is essential that these instructions are performed in numerical sequence commencing at 1 unless otherwise stated. When applicable, these sequence numbers identify the components in the appropriate illustration. Where performance of an operation requires the use of a special tool, the tool number is quoted under the operation heading and is repeated in, or following, the instruction involving its use.

INDEXING

For convenience the manual is divided into parts and sections, each page bearing a part and section number. The sections are subdivided into numbered operations.

Example:—7A—01—15—would be—
Part 7 Section A Operation 01 Page 15

This simplifies cross referencing and enables the subject to be found easily.

SPECIAL TOOLS

Where the use of a special tool is specified in an

operation the tool number will be shown under the operation heading and also following the instruction requiring its use.

The use of the special tools mentioned in the text contributes to a safe, efficient and profitable repair. Some operations are impracticable without their use, for example the assembly of the differential unit. Distributors are therefore urged to check their tools against the list provided. Where necessary, tools may be ordered from: V. L. Churchill & Co. Ltd., London Road, Daventry, England.

REPAIRS AND REPLACEMENTS

When service parts are required it is essential that only genuine Massey-Ferguson replacements are used.

Attention is particularly drawn to the following points concerning repairs and the fitting of replacement parts and accessories.

Safety features embodied in the tractor may be impaired if other than genuine parts are fitted.

In certain territories, legislation prohibits the fitting of parts not to the tractor manufacturers specification. Torque wrench setting figures given in the Workshop Manual must be strictly adhered to. Locking devices where specified must be fitted. If the efficiency of a locking device is impaired during removal it must be renewed.

The tractor warranty may be invalidated by the fitting of other than genuine Massey-Ferguson parts. All Massey-Ferguson replacements have the full backing of the manufacturers warranty. Massey-Ferguson Distributors and Dealers are obliged to supply only genuine service parts.

INTRODUCTION

REPAIR TIME SCHEDULE

The operations listed in the Repair Time Schedule refer to those described in this manual. The time set against each operation in the schedule is established by performing the actual operations on standard machines using special tools where applicable. The Repair Time Schedule for use with this manual is issued as a separate publication.

NOTE—Repair Time Schedules are issued to Massey-Ferguson Distributors and Dealers only and are not for general publication.

AMENDMENTS

Under normal conditions revised pages are issued carrying the same number as the existing pages requiring amendment. The new pages are inserted in place of the existing ones. The old pages should then be discarded.

In some cases additional pages or completely new sections may be issued. These pages are to be inserted immediately following the page carrying the next lowest page number, or section number as appropriate.

Where new pages are required to be positioned between existing pages, the new page numbers will contain a suffix letter—

Example:—New page number 7A—16a.

This page is inserted after existing page number 7A—16 and before page number 7A—17. Correspondingly a further new page numbered 7A—16b would be positioned after 7A—16a but before 7A—17. To assist in identifying amendments on revised pages, two asterisks (**) will be inserted at the beginning and at the end of the amended paragraph, section, instruction or illustration.

To ensure that a record of amendments to this manual is readily available, the list of amendments will be re-issued with each set of revised pages, quoting the amendment number, date of issue, appropriate instructions and revised page numbers.

NOTE—Service Bulletins and Amendment Sheets are issued to the Massey-Ferguson Distributors and Dealers only and are not for general publication.

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INTRODUCTION

Amendment No.	Date	Page Issued

INTRODUCTION

GENERAL INSTRUCTIONS

SAFETY

Your safety and that of others is always the first consideration when working around machines. Safety is a matter of thoroughly understanding the job to be done, the correct use of tools and equipment, and the application of good common sense.

SYSTEM FAULTS

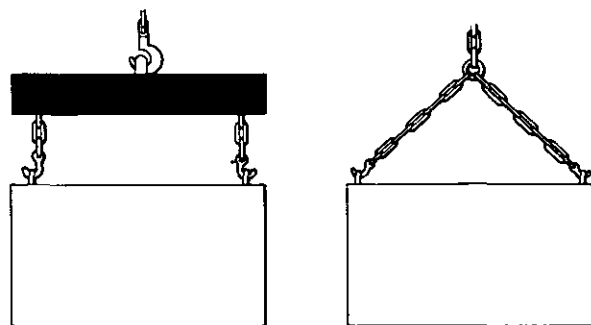
The following procedure combined with the information contained in the workshop manual will be helpful in tracing system faults accurately. It consists of following a number of logical steps to locate and correct the problem.

1. Determine the problem.
2. List possible causes.
3. Devise checks.
4. Conduct checks in logical order to determine cause.
5. Consider remaining service life against cost of parts and labour.
6. Make necessary repair.
7. Recheck.

HANDLING OF HEAVY COMPONENTS

Unless otherwise specified, all removals should be accomplished using an adjustable lifting beam and hoisting equipment. All supporting chains or cables should be parallel to each other and as near vertical as possible in relation to the object being lifted.

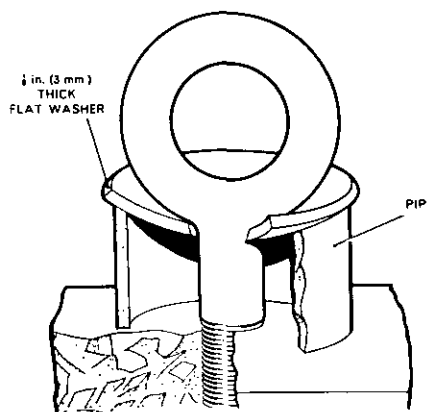
When removing a component on an angle remember that the capacity of an eyebolt diminishes as the angle between the supporting members and the object becomes less than 90° (Fig. 1).



Correct and incorrect method of lifting a component

Eyebolts and brackets should never be bent and should only have stress in tension. A length of pipe and a washer can be used to help relieve these stresses on eyebolts (Fig. 2). In some cases special lifting fixtures are available to obtain correct balance and provide for safe handling. If in doubt consult relevant section of workshop manual.

WARNING—If a part resists removal check to be certain all nuts and bolts have been removed and that an adjacent part is not interfering.



Forged eyebolt support

REMOVAL AND INSTALLATION OF COMPONENT PARTS

Cleanliness

The most important single item in preserving the long life of the machine is to keep dirt out of vital working parts. Precautions have been taken to safeguard against this. Enclosed compartments, seals and filters have been provided to keep the supply of air, fuel and lubricants clean. These safeguards must be maintained.

Whenever hydraulic, fuel, lubricating oil or air lines are disconnected, clean the point of disconnection as well as the adjacent area. As soon as the disconnection is made, cap, plug or tape the line or opening to prevent entry of foreign material. The same recommendations for cleaning and covering apply when access covers or inspection plates are removed.

Clean and inspect all parts. Be sure all passages and holes are open. Cover all parts to keep them clean. Be sure parts are clean when they are installed. Leave new parts in their containers until ready for assembly.

Assembly

When reassembling a machine, complete each step in turn. Do not partially assemble one part and start assembling some other part. Make all adjustments as recommended. Always check the job after it is completed to see nothing has been overlooked.

Recheck the various adjustments before returning the machine to the job.

NOTE—Clean the rust preventative compound from all machined surfaces of new parts before installing them.

Lubrication

Where applicable, fill the compartments of the components serviced with the amount, type and grade of lubricant recommended in the Regular Maintenance Section (1B) of this Manual.

Shims

When shims are removed, tie them together and identify them as to location. Keep shims clean and flat until they are reinstalled.

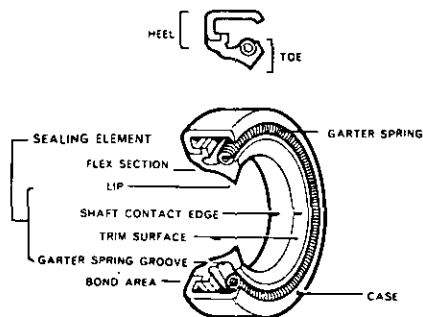
Gaskets

Be sure the holes in the gaskets correspond with the lubricant passages in the mating parts. If gaskets are to be made, select material of the proper type and thickness. Be sure to cut holes in the right places. Blank gaskets can cause serious damage.

Lip Type Rubber Seals

Lubricate the lips of lip-type rubber seals before installation. Use petroleum jelly. Do not grease on any seal except a grease seal.

The main parts of a lip-type seal are the case, sealing element, and garter spring. The picture below illustrates the construction of a simple lip-type seal. The cross section at the top shows the terms "heel" and "toe" used to identify the sides of a single element seal. With few exceptions, the toe of an oil seal with one lip is next to the lubricant that is sealed. Some seals have a second auxiliary lip, which does not carry a garter spring.



Lip-type seal construction

If, during installation, the seal lip must pass over a shaft that has splines, a keyway, rough surface or a sharp edge, the lip can be easily damaged. Always use a seal protector, when one is provided.

Cables and Wires

When removing or disconnecting a group of cables or wires, tag each one to assure proper assembly.

Bearing Bushes and Press Fits

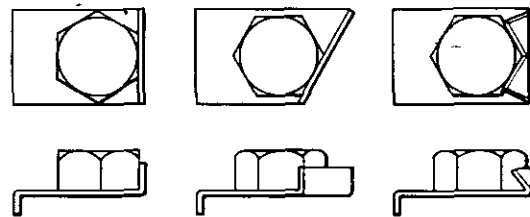
Do not install bearing bushes with a hammer. Use a press if possible and be sure to apply the pressure directly in line with the bore. If necessary, drive on a bearing using a bearing driver or a bar with a smooth flat end. If a sleeve bearing has an oil hole, align it with the oil hole in the mating part. When one part is pressed into another lubricate the mating surfaces.

Assemble tapered parts dry. Before assembling, be sure the tapers are clean, dry and free from burrs.

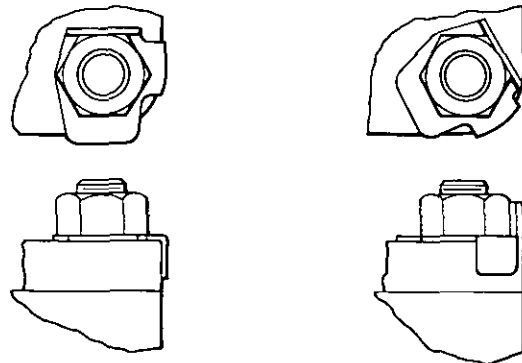
Use of Bolts in Blind Holes

Use bolts of the correct length. A bolt which is too long may "bottom" before the head is tight against the part it is to hold. The threads can be damaged when a "long" bolt is removed.

If a bolt is too short, there may not be enough threads engaged to hold the part securely.



Correct and incorrect methods of installing flat metal locks.



Correct and incorrect method for lock positioning and bending.

Locking Devices

Lockwashers, flat metal locks or cotter pins are used to lock nuts and bolts.

Flat metal locks must be installed properly to be effective. Bend one end of the lock around the edge of the part. Bend the other end against one flat surface of the nut or bolt head.

Always install new locks in compartments which house moving parts.

When installing lockwashers on housings made of aluminium, use a flat washer between the lockwasher and the housing.

INTRODUCTION**PRESSURE (KN/m² to lbf/m², lbf/in² to KN/m²)**

KN/m ²		lbf/in ²	KN/m ²		lbf/in ²	KN/m ²		lbf/in ²
6-8948	1	0-1450	234-423	34	4-9300	461-952	67	9-7150
13-7896	2	0-2900	241-318	35	5-0750	468-846	68	9-8600
20-6844	3	0-4350	248-213	36	5-2200	475-741	69	10-0050
27-5792	4	0-5800	255-108	37	5-3650	482-636	70	10-1500
34-4740	5	0-7250	262-002	38	5-5100	489-531	71	10-2950
41-3688	6	0-8700	268-898	39	5-6550	496-426	72	10-4400
48-2636	7	1-0150	275-792	40	5-8000	503-320	73	10-5850
55-1584	8	1-1600	282-687	41	5-9450	510-215	74	10-7300
62-0532	9	1-3050	289-582	42	6-0900	517-110	75	10-8750
68-9480	10	1-4500	296-476	43	6-2350	524-005	76	11-0200
75-8428	11	1-5950	303-371	44	6-3800	530-899	77	11-1650
82-7376	12	1-7400	310-266	45	6-5250	537-794	78	11-3100
89-6324	13	1-8850	317-161	46	6-6700	544-689	79	11-4550
96-5272	14	2-0300	324-056	47	6-8150	551-584	80	11-6000
103-422	15	2-1750	330-950	48	6-9600	558-479	81	11-7450
110-317	16	2-3200	337-845	49	7-1050	565-374	82	11-8900
117-212	17	2-4650	344-740	50	7-2500	572-268	83	12-0350
124-106	18	2-6100	351-635	51	7-3950	579-163	84	12-1800
131-001	19	2-7550	358-529	52	7-5400	586-058	85	12-3250
137-896	20	2-9000	365-424	53	7-6850	592-953	86	12-4700
144-791	21	3-0450	372-319	54	7-8300	599-848	87	12-6150
151-686	22	3-1900	379-214	55	7-9750	606-742	88	12-7600
158-580	23	3-3350	386-109	56	8-1200	613-637	89	12-9050
165-475	24	3-4800	393-004	57	8-2650	620-532	90	13-0500
172-370	25	3-6250	399-898	58	8-4100	627-427	91	13-1950
179-265	26	3-7700	406-793	59	8-5550	634-322	92	13-3400
186-159	27	3-9150	413-688	60	8-7000	641-216	93	13-4850
193-054	28	4-0600	420-583	61	8-8450	648-111	94	13-6300
199-949	29	4-2050	427-478	62	8-9900	655-006	95	13-7750
206-844	30	4-3500	434-372	63	9-1350	661-901	96	13-9200
213-739	31	4-4950	441-267	64	9-2800	668-796	97	14-0650
220-634	32	4-6400	448-162	65	9-4250	675-690	98	14-2100
227-528	33	4-7850	455-057	66	9-5700	682-585	99	14-3550

TORQUE (Nm to lbf/ft, lbf/ft to Nm)

Nm		lbf/ft	Nm		lbf/ft	Nm		lbf/ft
1-3558	1	0-7376	46-0972	34	25-0784	90-8386	67	49-4912
2-7116	2	1-4752	47-4530	35	25-8160	92-1944	68	50-1568
4-0674	3	2-2128	48-8088	36	26-5536	93-5502	69	50-8944
5-4232	4	2-9504	50-1646	37	27-2912	94-9060	70	51-6320
6-7790	5	3-6880	51-5204	38	28-0288	96-2618	71	52-3696
8-1348	6	4-4256	52-8762	39	28-7664	97-6176	72	53-1072
9-4906	7	5-1632	54-2320	40	29-5040	98-9734	73	53-8448
10-8464	8	5-9008	55-5878	41	30-2416	100-329	74	54-5824
12-2022	9	6-6384	56-9436	42	30-9792	101-685	75	55-3200
13-5580	10	7-3760	58-2994	43	31-7168	103-041	76	56-0576
14-9138	11	8-1136	59-6552	44	32-4544	104-397	77	56-7952
16-2696	12	8-8512	61-0110	45	33-1920	105-752	78	57-5328
17-6254	13	9-5888	62-3668	46	33-9296	107-108	79	58-2704
18-9812	14	10-3264	63-7226	47	34-6672	108-464	80	59-0080
20-3370	15	11-0640	65-0784	48	35-4048	109-820	81	59-7456
21-6928	16	11-8016	66-4342	49	36-1424	111-176	82	60-4832
23-0486	17	12-5392	67-7900	50	36-8800	112-531	83	61-2208
24-4044	18	13-2768	69-1458	51	37-6176	113-887	84	61-9584
25-7602	19	14-0144	70-5016	52	38-3552	115-243	85	62-6960
27-1160	20	14-7520	71-8574	53	39-0928	116-600	86	63-4336
28-4718	21	15-4896	73-2132	54	39-8304	117-955	87	64-1712
29-8276	22	16-2272	74-5690	55	40-5680	119-310	88	64-9088
31-1834	23	16-9648	75-9248	56	41-3056	120-666	89	65-6464
32-5392	24	17-7024	77-2806	57	42-0432	122-022	90	66-3840
33-8950	25	18-4400	78-6364	58	42-7808	123-378	91	67-1216
35-2508	26	19-1776	79-9922	59	43-5184	124-734	92	67-8592
36-6066	27	19-9152	81-3480	60	44-2560	126-089	93	68-5968
37-9624	28	20-6528	82-7038	61	44-9936	127-445	94	69-3344
39-3182	29	21-3904	84-0596	62	45-7312	128-801	95	70-0720
40-6740	30	22-1280	85-4154	63	46-4688	130-157	96	70-8096
42-0298	31	22-8656	86-7712	64	47-2064	131-513	97	71-5472
43-3856	32	23-6032	88-1270	65	47-9440	132-868	98	72-2848
44-7414	33	24-3408	89-4828	66	48-6816	134-224	99	73-0224

INTRODUCTION

CAPACITY (Imp. gall to litre, litre to Imp. gal)

Imp. gal		litre	Imp. gal		litre	Imp. gal		litre
0-2199	1	4-5459	7-4766	34	154-561	14-733	67	304-575
0-4398	2	9-0918	7-6965	35	159-107	14-9532	68	309-121
0-6597	3	13-6377	7-9164	36	163-652	15-1731	69	313-667
0-8796	4	18-1836	8-1363	37	168-198	15-393	70	318-213
1-0995	5	22-7295	8-3562	38	172-744	15-6129	71	322-759
1-3194	6	27-2754	8-5761	39	177-290	15-8328	72	327-305
1-5393	7	31-8213	8-7960	40	181-836	16-0527	73	331-851
1-7592	8	36-3672	9-0159	41	186-382	16-2726	74	336-397
1-9791	9	40-9131	9-2358	42	190-929	16-4925	75	340-943
2-1990	10	45-4590	9-4557	43	195-474	16-7124	76	345-488
2-4189	11	50-0049	9-6756	44	200-019	16-9323	77	350-034
2-6388	12	54-5508	9-8955	45	204-566	17-1522	78	354-580
2-8587	13	59-0967	10-1154	46	209-111	17-3721	79	359-126
3-0786	14	63-6426	10-3353	47	213-657	17-5920	80	363-672
3-2985	15	68-1885	10-5552	48	218-203	17-8119	81	368-218
3-5184	16	72-7344	10-7751	49	222-749	18-0318	82	372-764
3-7383	17	77-2803	10-995	50	227-295	18-2517	83	377-310
3-9582	18	81-8262	11-2149	51	231-841	18-4716	84	381-856
4-1781	19	86-3721	11-4348	52	236-387	18-6915	85	386-402
4-3980	20	90-9180	11-6547	53	240-933	18-9114	86	390-947
4-6179	21	95-4639	11-8746	54	245-479	19-1313	87	395-493
4-8378	22	100-009	12-0945	55	250-025	19-3512	88	400-039
5-0577	23	104-556	12-3144	56	254-570	19-5711	89	404-585
5-2776	24	109-102	12-5343	57	259-116	19-7910	90	409-131
5-4975	25	113-648	12-7542	58	263-662	20-0109	91	413-677
5-7174	26	118-193	12-9741	59	268-209	20-2308	92	418-223
5-9373	27	122-739	13-1940	60	272-754	20-4507	93	422-769
6-1572	28	127-285	13-4139	61	277-299	20-6706	94	427-315
6-3771	29	131-831	13-6338	62	281-846	20-8905	95	431-861
6-5970	30	136-377	13-8537	63	286-392	21-1104	96	436-406
6-8169	31	140-923	14-0736	64	290-938	21-3303	97	440-952
7-0368	32	145-469	14-2935	65	295-483	21-5502	98	445-498
7-2567	33	150-015	14-5134	66	300-029	21-7701	99	450-044

CAPACITY (Imp. pt. to litres, litres to Imp. pt.)

Imp. pt.		litres	Imp. pt.		litres	Imp. pt.		litres
1-7599	1	0-5682	59-8356	34	19-3188	117-913	67	38-0694
3-5198	2	1-1364	61-5965	35	19-8870	119-673	68	38-6376
5-2797	3	1-7046	63-3564	36	20-4552	121-433	69	39-2058
7-0396	4	2-2728	65-1163	37	21-0234	123-193	70	39-7740
8-7995	5	2-8400	66-8762	38	21-5916	124-953	71	40-3422
10-5594	6	3-4902	68-6361	39	22-1598	126-713	72	40-9104
12-3193	7	3-9774	70-3960	40	22-7280	128-473	73	41-4786
14-0792	8	4-5456	72-1559	41	23-2962	130-233	74	42-0468
15-8391	9	5-1138	73-9158	42	23-8644	131-993	75	42-6150
17-5990	10	5-6820	75-6757	43	24-4326	133-752	76	43-1832
19-3589	11	6-2502	77-4356	44	25-0008	135-512	77	43-7514
21-1188	12	6-8184	79-1955	45	25-5690	137-272	78	44-3196
22-8787	13	7-3866	80-9554	46	26-1372	139-032	79	44-8878
24-6386	14	7-9548	82-7153	47	26-7054	140-792	80	45-456
26-3985	15	8-5230	84-4752	48	27-2736	142-552	81	46-0242
28-1854	16	9-0912	86-2351	49	27-8418	144-312	82	46-5924
29-9183	17	9-6594	87-9950	50	28-4100	146-072	83	47-1606
31-6782	18	10-2276	89-7549	51	28-9782	147-832	84	47-7288
33-4381	19	10-7958	91-5148	52	29-5464	149-592	85	48-2970
35-1980	20	11-3640	93-2747	53	30-1146	151-351	86	48-8652
36-9579	21	11-9322	95-0346	54	30-6828	153-111	87	49-4334
38-7178	22	12-5004	96-7945	55	31-2510	154-871	88	50-0016
40-4777	23	13-0686	98-5544	56	31-8192	156-631	89	50-5698
42-2376	24	13-6368	100-314	57	32-3874	158-391	90	51-1380
43-9975	25	14-2050	102-074	58	32-9556	160-151	91	51-7062
45-7574	26	14-7732	103-834	59	33-5238	161-912	92	52-2744
47-5173	27	15-3414	105-594	60	34-0920	163-671	93	52-8426
49-2772	28	15-9096	107-354	61	34-6602	165-431	94	53-4108
51-0371	29	16-4778	109-114	62	35-2284	167-191	95	53-9790
52-7970	30	17-0460	110-874	63	35-7966	168-950	96	54-5472
54-5569	31	17-6142	112-634	64	36-3648	170-710	97	55-1154
56-3168	32	18-1824	114-394	65	36-9330	172-470	98	55-6836
58-0767	33	18-7506	116-153	66	37-5012	174-230	99	56-2518

INTRODUCTION**LENGTH (m to ft, ft to m)**

m		ft	m		ft	m		ft
0-3048	1	3-2808	10-3632	34	111-549	20-4216	67	219-816
0-6096	2	6-5617	10-6680	35	114-829	20-7264	68	223-097
0-9144	3	9-8425	10-9728	36	118-110	21-0312	69	226-378
1-2192	4	13-1234	11-2776	37	121-391	21-3360	70	229-659
1-5240	5	16-4042	11-5824	38	124-672	21-6408	71	232-940
1-8288	6	19-6850	11-8872	39	127-953	21-9456	72	236-220
2-1336	7	22-9659	12-1920	40	131-234	22-2504	73	239-501
2-4384	8	26-2467	12-4968	41	134-514	22-5552	74	242-782
2-7432	9	29-5276	12-8016	42	137-795	22-8600	75	246-063
3-0480	10	32-8084	13-1064	43	141-076	23-1648	76	249-344
3-3528	11	36-0892	13-4112	44	144-357	23-4696	77	252-625
3-6576	12	39-3701	13-7160	45	147-638	23-7744	78	255-906
3-9624	13	42-6509	14-0208	46	150-919	24-0792	79	259-186
4-2672	14	45-9318	14-3256	47	154-199	24-3840	80	262-467
4-5720	15	49-2126	14-6304	48	157-480	24-6888	81	265-748
4-8768	16	52-4934	14-9352	49	160-761	24-9936	82	269-029
5-1816	17	55-7743	15-2400	50	164-042	25-2984	83	272-310
5-4864	18	59-0551	15-5448	51	167-323	25-6032	84	275-591
5-7912	19	62-3360	15-8496	52	170-604	25-9080	85	278-871
6-0960	20	65-6168	16-1544	53	173-885	26-2128	86	282-152
6-4008	21	68-8976	16-4592	54	177-165	26-5176	87	285-433
6-7056	22	72-1785	16-7640	55	180-446	26-8224	88	288-714
7-0104	23	75-4593	17-0688	56	183-727	27-1272	89	291-995
7-3152	24	78-7402	17-3736	57	187-008	27-4320	90	295-276
7-6200	25	82-0210	17-6784	58	190-289	27-7368	91	298-556
7-9248	26	85-3018	17-9832	59	193-570	28-0416	92	301-837
8-2296	27	88-5827	18-2880	60	196-850	28-3464	93	305-118
8-5344	28	91-8635	18-5928	61	200-131	28-6512	94	308-399
8-8392	29	95-1444	18-8976	62	203-412	28-9560	95	311-680
9-1440	30	98-4252	19-2024	63	206-693	29-2608	96	314-961
9-4488	31	101-706	19-5072	64	209-974	29-5656	97	318-241
9-7536	32	104-987	19-8120	65	213-255	29-8704	98	321-522
10-0584	33	108-268	20-1168	66	216-535	30-1752	99	324-803

WEIGHT (Kg to lb, lb to Kg)

Kg		lb	Kg		lb	Kg		lb
0-4536	1	2-2046	15-4224	34	74-9564	30-3912	67	147-708
0-9072	2	4-4092	15-8760	35	77-1610	30-8448	68	149-913
1-3608	3	6-6138	16-3296	36	79-3656	31-2984	69	152-117
1-8144	4	8-8184	16-7832	37	81-5702	31-7520	70	154-322
2-2680	5	11-0230	17-2368	38	83-7748	32-2056	71	156-527
2-7216	6	13-2276	17-6904	39	85-9794	32-6592	72	158-731
3-1752	7	15-4322	18-1440	40	88-1840	33-1128	73	160-936
3-6288	8	17-6368	18-5976	41	90-3886	33-5664	74	163-140
4-0824	9	19-8414	19-0512	42	92-5932	34-0200	75	165-345
4-5360	10	22-046	19-5048	43	94-7978	34-4736	76	167-549
4-9896	11	24-2506	19-9584	44	97-0024	34-9272	77	169-754
5-4432	12	26-4552	20-4120	45	99-2070	35-3808	78	171-958
5-8968	13	28-6598	20-8656	46	101-412	35-8344	79	174-163
6-3504	14	30-8644	21-3192	47	103-616	36-2880	80	176-368
6-8040	15	33-0690	21-7728	48	105-821	36-7416	81	178-573
7-2576	16	35-2736	22-2264	49	108-025	37-1952	82	180-777
7-7112	17	37-4782	22-6800	50	110-230	37-6488	83	182-982
8-1648	18	39-6828	23-1336	51	112-435	38-1024	84	185-186
8-6184	19	41-8874	23-5872	52	114-639	38-5560	85	187-391
9-0720	20	44-0920	24-0408	53	116-844	39-0096	86	189-596
9-5256	21	46-2966	24-4944	54	119-048	39-4632	87	191-800
9-9792	22	48-5012	24-9480	55	121-253	39-9168	88	194-005
10-4328	23	50-7058	25-4016	56	123-458	40-3704	89	196-209
10-8864	24	52-9104	25-8552	57	125-662	40-8240	90	198-414
11-3400	25	55-115	26-3088	58	127-867	41-2776	91	200-619
11-7936	26	57-3196	26-7624	59	130-071	41-7312	92	202-823
12-2472	27	59-5242	27-2160	60	132-276	42-1848	93	205-028
12-7008	28	61-7288	27-6696	61	134-481	42-6384	94	207-232
13-1544	29	63-9334	28-1232	62	136-685	43-0920	95	209-437
13-6080	30	66-1380	28-5768	63	138-889	43-5456	96	211-642
14-0616	31	68-3426	29-0304	64	141-094	43-9992	97	213-846
14-5152	32	70-5472	29-4840	65	143-299	44-4528	98	216-051
14-9688	33	72-7518	29-9376	66	145-504	44-9064	99	218-255

INTRODUCTION

CONVERSION TABLES

Inches	Decimals	Milli- metres	Inches to Millimetres		Millimetres to Inches		Fahrenheit and Centigrade			
			Inches	Milli- metres	mm	inches	°F	°C	°C	°F
1/64	015625	3969			0.001	000039	-20	-28.9	-30	-22
1/32	03125	7937			0.002	000079	-15	-26.1	-28	-18.4
3/64	046875	11906			0.003	000118	-10	-23.3	-26	-14.8
1/16	0625	15875			0.004	000157	-5	-20.6	-24	-11.2
5/64	078125	19844			0.005	000197	0	-17.8	-22	-7.6
3/32	09375	23812			0.006	000236	1	-17.2	-20	-4
7/64	109375	27781			0.007	000276	2	-16.7	-18	-0.4
1/8	125	31750			0.008	000315	3	-16.1	-16	3.2
9/64	140625	35719			0.009	000354	4	-15.6	-14	6.8
5/32	15625	39687			0.01	00039	5	-15.0	-12	10.4
11/64	171875	43656			0.02	00079	10	-12.2	-10	14
3/16	1875	47625			0.03	00118	15	-9.4	-8	17.6
13/64	203125	51594			0.04	00157	20	-6.7	-6	21.2
7/32	21875	55562			0.05	00197	25	-3.9	-4	24.8
15/64	234375	59531			0.06	00236	30	-1.1	-2	28.4
1/4	25	63500			0.07	00276	35	1.7	0	32
17/64	265625	67469			0.08	00315	40	4.4	2	35.6
9/32	28125	71437			0.09	00354	45	7.2	4	39.2
19/64	296875	75406			0.1	00394	50	10.0	6	42.8
5/16	3125	79375			0.2	00787	55	12.8	8	46.4
21/64	328125	83344			0.3	01181	60	15.6	10	50
11/32	34375	87312			0.4	01575	65	18.3	12	53.6
23/64	359375	91281			0.5	01969	70	21.1	14	57.2
3/8	375	95250			0.6	02362	75	23.9	16	60.8
25/64	390625	99219			0.7	02756	80	26.7	18	64.4
13/32	40625	103187			0.8	03150	85	29.4	20	68
27/64	421875	107156			0.9	03543	90	32.2	22	71.6
7/16	4375	111125			1	03937	95	35.0	24	75.2
29/64	453125	115094			2	07874	100	37.8	26	78.8
15/32	46875	119062			3	11811	105	40.6	28	82.4
31/64	484375	123031			4	15748	110	43.3	30	86
1/2	5	127000			5	19685	115	46.1	32	89.6
33/64	515625	130969			6	23622	120	48.9	34	93.2
17/32	53125	134937			7	27559	125	51.7	36	96.8
35/64	546875	138906			8	31496	130	54.4	38	100.4
9/16	5625	142875			9	35433	135	57.2	40	104
37/64	578125	146844			10	39370	140	60.0	42	107.6
19/32	59375	150812			11	43307	145	62.8	44	112.2
39/64	609375	154781			12	47244	150	65.6	46	114.8
5/8	625	158750		1	13	51181	155	68.3	48	118.4
41/64	640625	162719		2	14	55118	160	71.1	50	122
21/32	65625	166687		3	15	59055	165	73.9	52	125.6
43/64	671875	170656		4	16	62992	170	76.7	54	129.2
11/16	6875	174625		5	17	66929	175	79.4	56	132.8
45/64	703125	178594		6	18	70866	180	82.2	58	136.4
23/32	71875	182562		7	19	74803	185	85.0	60	140
47/64	734375	186531		8	20	78740	190	87.8	62	143.6
3/4	75	190500		9	21	82677	195	90.6	64	147.2
49/64	765625	194469		10	22	86614	200	93.3	66	150.8
25/32	78125	198437		11	23	90551	205	96.1	68	154.4
51/64	796875	202406		12	24	94488	210	98.9	70	158
13/16	8125	206375		13	25	98425	212	100.0	75	167
53/64	828125	210344		14	26	102362	215	101.7	80	176
27/32	84375	214312		15	27	106299	220	104.4	85	185
55/64	859375	218281		16	28	110236	225	107.2	90	194
7/8	875	222250		17	29	114173	230	110.0	95	203
57/64	890625	226219		18	30	118110	235	112.8	100	212
29/32	90625	230187		19	31	122047	240	115.6	105	221
59/64	921875	234156		20	32	125984	245	118.3	110	230
15/16	9375	238125		21	33	129921	250	121.1	115	239
61/64	953125	242094		22	34	133858				
31/32	96875	246062		23	35	137795				
63/64	984375	250031		24	36	141732				
				25	37	145669				
				26	38	149606				
					39	153543				
					40	157480				

INTRODUCTION

Torque Loading

Apply proper torque values to all bolts and nuts when re-assembling equipment. When a specific value is required, the value is quoted in the text. All other nuts, bolts and taperlock studs should be tightened to the values detailed in the Standard Torque loading Chart.

NOMINAL SIZE (diameter)	WRENCH SETTING Nm (lbf-ft)	
	A	B
$\frac{1}{4}$ in	6.78 to 8.13 (5 to 6)	10.85 to 13.55 (8 to 10)
$\frac{3}{8}$ in	13.55 to 16.27 (10 to 12)	20.34 to 24.40 (15 to 18)
$\frac{1}{2}$ in	25.76 to 29.82 (19 to 22)	40.67 to 47.45 (30 to 35)
$\frac{3}{4}$ in	44.74 to 51.52 (33 to 38)	67.79 to 74.57 (50 to 55)
$\frac{1}{2}$ in	63.72 to 71.86 (47 to 53)	103.04 to 115.24 (76 to 85)
$\frac{3}{4}$ in	88.13 to 98.97 (65 to 73)	155.92 to 169.47 (115 to 125)
$\frac{1}{2}$ in	135.58 to 169.47 (100 to 125)	200.05 to 230.48 (155 to 170)
$\frac{3}{4}$ in	237.26 to 271.16 (175 to 200)	271.16 to 406.74 (270 to 300)

Standard Torque Loadings

COLUMN A

Non-Rigid Joints

Column "A" specifies the spanner torques to be used with non-rigid joints where extrusion, deformity or other damage would result when higher clamping forces are used.

Limited Strength Nuts

The torque values in column "A" are also the maximum recommended for weld nuts, slotted nuts or other limited strength nuts.

Standard Nuts with Lock Washers

When lock washers are used under the nut, the torque values in column "A" should be applied. Laboratory tests indicate that lock washers substantially reduce the friction under the nut. This is especially true if the bolt nut and lock washer are oiled. Due to this reduction in friction, proper bolt elongation is obtained by use of the torque in column "A". Column "B" torques may cause failure of the nut or bolt during assembly.

COLUMN B

Column "B" is the wrench torque to be used for assembly of rigid joints where extrusion, deformity or other damage will not result, and it is desirable to obtain more elastic elongation of the bolt or stud to ensure that it remains tight.

SPECIAL TOOLS

Tool No.	Description	Tool No.	Description
ENGINE			
PD.1D	Valve Guide Remover and Replacer (Main Tool)	MF.264	Front Axle and Steering Bush Reamer (Main Tool)
PD.1D-1A	Adaptor for PD.1	MF.264-2/1	Reamer and Pilot
PD.1D-4	Adaptor for PD.1	MF.264-2/2	Reamer and Pilot
4RL	Torque Wrench	MF.268A	Steering Wheel Remover
No. 13	Torque Wrench	MF.322	Front Axle Pivot Pin Bush Remover and Replacer
No. 8	Piston Ring Compressor	MF.332	Power Steering Pump
PD.41B	Piston Height and Valve Depth Gauge	MF.334	Oil Seal Protector
MS.73	Adjustable Valve Seat Cutter Kit	MF.334	Steering Pivot Pin Bush Remover (Use with PD.1D)
MS.76	Handle for 35° Valve Seat Cutters	6312B	Steering Drop Arm Remover
PD.137	Valve Guide Reamer (.015" o/s)	MF.402	Steering Drop Arm Puller
PD.138	Valve Guide Reamer (.030" o/s)	REAR AXLE	
PD.145	Crankshaft Rear Oil Seal Replacer	MF.9A	Differential Housing Holder
PD.145-2	Oil Seal Pilot	MF.10	Bench Plate
PD.150A	Cylinder Liner Remover and Replacer (Main Tool)	MF.26A	Handle
PD.150-1B	Adaptors for PD.150A	MF.26B	Axle Shaft Bearing Remover (Main Tool)
PD.150-7A	Adaptors for PD.150A	MF.197	Wheel Axle Outer Bearing Cone and Differential Cone Replacer (Main Tool)
MS.150-8	Pilot for 35° Valve Seat Cutter	MF.197-2	Differential Carrier-Plate Bearing Cone Replacer
PD.155B	Basic Puller	MF.200-2	Adaptor
PD.155-1	Adaptor for PD.155B	MF.200-3	Drive Cover Assembly and Bearing Remover
335	Con Rod Jig and Master Arbor	MF.200-22	Differential Carrier Plate Bearing Cone Remover Adaptor
PD.336-102	Arbor Adaptor Used with 335	MF.200-23	Differential Bearing Remover Adaptor
102	Diesel Compression Tester	MF.200-24	Driving Pinion Bearing and Pilot Bearing Remover/Replacer
109	Injector Extractor	MF.200-2A	Adaptor
111	Injector Tester	MF.200-24	Epicyclic Hub Inner Bearing Cone Remover Adaptor
6118B	Valve Spring Compressor	MF.202A	Rear Drive Shaft Needle Bearing Remover
PD.6118-3	Adaptor for 6118B	MF.203A	Rear Drive Shaft Needle Bearing Replacer and P.t.o. Remover/Replacer
PD.6118-4	Adaptor for 6118B	MF.245D	Rear Axle Preload Gauge
7600	Bearing Remover	MF.245D-1	Straight Edge
7066	Circlip Pliers	MF.257A	Differential Bearing Cone Holder
MF.200-26	Water Pump Overhaul Kit	MF.258	Differential Housing Holder
MS.690	Exhaust Valve Seat Cutter for 35° Seat	MF.265A	Planetary Carrier Assembly Remover
MS.695	Inlet Valve Seat Cutter for 35° Seat	MF.266B	Planetary Carrier Bush Inner Coil Seal Bearing Cone and Unit Replacer
MS.67B	Static Timing Tool	MF.267A	Epicyclic Hub Pre-load Gauge
PD.67B-1	Adaptor	MF.295B	Wheel Guide Pilots
FRONT AXLE AND STEERING			
MF.19A	King Pin Bush Reamer	MF.366	Wheel Guide Pilots
MS.62A/63	Danfoss Oil Seal and Spring Plate Kit	MF.555-2A	Differential Coupling Bearing Cone Remover
MF.147-7	Power Steering Adaptor	MF.1105-2A	Differential Bearing Cup Remover/Replacer
MF.195-4	Front Axle Pivot Pin Bush Remover/Replacer and P.t.o. Bush Remover/Replacer	MF.1105-7A	Differential Bearing Cup Remover/Replacer Adaptor
MF.263A	Front Axle and Steering Bush Remover (Main Tool)	MF.1105-8	Epicyclic Hub Inner Bearing Cup Remover/Replacer Adaptor
MF.263-1/1	Front Axle and Steering Bush Remover Adaptor (Tap-1½ in)	MF.1105-11	Rear Axle Shaft Oil Seal Remover and Replacer
MF.263-1/2	Front Axle and Steering Bush Replacer, Adaptor		
MF.263-1/3	Front Axle and Steering Bush Remover, Adaptor (Collar)		
MF.263-2/1	Front Axle and Steering Bush Replacer		
MF.263-2	Front Axle and Steering Bush Remover/Replacer Adaptors (1½ in)		
MF.263-3	Front Axle and Steering Bush Remover/Replacer Adaptors (1¾ in)		

SPECIAL TOOLS

Tool No.	Description	Tool No.	Description
CLUTCH & TRANSMISSION			
MF.159A	Single-and Dual Clutch Centraliser and Sleeve	MF.260-5	Multi-Power Pump Flow Adaptor
MF.178	P.t.o. Main Drive Shaft Pilot	MF.269	Response Plunger Adjusting Wrench
MF.179	Transmission and P.t.o. Pinion Oil Seal Replacer	MF.270B	Dashpot Piston Wedge
MF.200-25	Multi-Purpose Bearing Remover	MF.271B	Roller Assembly Tool and Draft Control Rod Gauge
MF.215	Secondary Clutch Setting Gauge	MF.272	Ram Arm Gauge Fixture
MF.218A	Front P.t.o. Housing Replacer (Main Tool)	MF.273	Hydraulic Control Lever Setting Fixture
MF.218A-2	Front P.t.o. Housing Replacer Adaptor	MF.333	Draft Control Rod Gauge (Increased Tension Range)
MF.255B	Multi-Power Pinion Oil Seal Replacer and Assembly Sleeve	MF.355	Hydraulic Pump Overhaul Kit Comprising:— MF.349, 350, 351, 352, 353 and 354
MF.256A	Multi-Power Pinion Assembly Inner Oil Seal Replacer	MF.349	Valve Seal Forming Tool
MF.314	Lever Fulcrum Height Setting Gauge	MF.350	Valve Circlip Replacer
MF.407	Lever Fulcrum Height-Setting Gauge	MF.351	Valve Plug Remover and Replacer
MF.315A	Main Drive Shaft Retainer Needle Bearing and Seal Remover/Replacer	MF.352	Control Valve Spring Retainer
MF.331	Transmission Input Shaft Oil Seal Replacer	MF.353	Control Valve Body 'O' Ring Guide
MF.414/1	ZF. Synchromesh Hub Centralising Pin	MF.354	Control Valve Body Replacer
MF.414/2	Clamp Bolt	MF.360	Hydraulic Pump Adjusting Kit Comprising:— MF.356, 357A, 359
MF.414/3	Locating Peg	MF.356	Position and Draft Control Setting Gauge
MF.415	ZF. Synchromesh Hub Assembly Ring	MF.357A	Dummy Bolt and Screwdriver Adjuster
MF.415/2	ZF. Synchromesh Hub Assembly Plate	MF.359	Pressure Control Bleed Pipe
KMF.1004/1	Mainshaft Oil Seal Protector Sleeve	MF.417	Quadrant Lever Retaining Tool
KMF.1004/2	Guide—Protector	MF.364	Oil Seal Replacer (P.t.o.)
KMF.1004/3	Guide—Protector	810	Hydraulic Pressure and Flow Test Fixture (Main Tool)
MF.421	Needle Roller Bearing and Seal Replacer	MF.810-1	Adaptor
MF.422	Needle Roller Bearing and Seal Remover	MF.810-4	Multi-Power Pump Flow Adaptor
7600B	Flywheel Spigot Bearing Remover (Main Tool)	MF.810-6	I.p.t.o. Pressure Gauge Adaptor
MF.7600-1	Flywheel Spigot Bearing Remover Adaptor		
P.T.O. & HYDRAULICS			
MF.163	Spring Retainer Nut Wrench	MULTI-PURPOSE & MISCELLANEOUS TOOLS	
MF.166	Hydraulic Adaptor for Lift Cover	13	Torque Wrench
MF.167	P.t.o. Oil Seal Pilot	MF.148A	Hydraulic Pressure Test Equipment (Main Tool)
MF.168	P.t.o. Shaft Oil Seal Remover	MF.195A	Bearing Cups Remover/Replacer (Main Tool)
MF.195-5A	P.t.o. Needle Bearing Remover/Replacer	MF.200	Hand Press (Main Tool)
MF.195-6	Two Speed P.t.o. Shaft Needle Bearing Remover/Replacer	MF.260	Low Pressure Hydraulic Test Set (Main Tool)
MF.418	Hydraulic Lift Cover Remover/Replacer	MF.278	Dial Test Indicator Gauge
MF.260-1	Multi-Power Hydraulic Test Adaptor	MS.2700	Tractor Splitting Kit
MF.260-3	Multi-Power Hydraulic Adaptor	MS.2700-1	Rails
MF.260-4	Multi-Power Pressure Test Adaptor	MS.2700-2	Fixed Stand
MF.419	Zero Leak Piston Seal Replacer	MS.2700-3	Mobile Stand
		MS.2700-4	Height Adjusting Handle
		550	Driver Handle (Main Tool)
		555	Three Leg Adjustable Puller (Main Tool)
		MF.1105	Bearing Remover (Main Tool)
		7065M	Heavy Duty Circlip Pliers
		7065MP	Circlip Plier Points
		7066	Circlip Pliers
		MF.6312B	Universal Puller
		T.4062A	Universal Pre-load Gauge
		MF.365	Cab Lifting Jack and Support Stand
		MF.365-2	Cab Stand Adaptors

**MF 600 SERIES TRACTOR
WORKSHOP SERVICE MANUAL**

PART 1

Publication No. 1856 274 M1

comprising

- A GENERAL SPECIFICATION
- B REGULAR MAINTENANCE
- C PRE-DELIVERY AND INSTALLATION

SPECIFICATION

Part 1 — Section A

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SPECIFICATION

ENGINE

Make: Perkins, to MF specification
Type and Model: Four-stroke, direct injection diesel A4.236
Number of Cylinders: Four
Bore: 98,4 mm (3.875 in)
Stroke: 127 mm (5 in)
Capacity: 3,86 litre (236 in³)
Compression Ratio: 16:1
Firing Order: 1, 3, 4, 2
Horsepower: 66 PS (48,5 kW) at 2000 rev/min. (DIN 70020)
 69 hp at 2000 rev/min (B.S. AU 141: 1967 Ambient Conditions)
Maximum Torque (at 1300 rev/min): 255 Nm (188 lbf ft) (DIN 70020)
Lubrication: Throwaway, cannister type full flow external filter
Valves: Overhead, pushrod operated
Valve Tip Clearance (Inlet and Exhaust): 0,30 mm (0.012 in) cold, 0,25 mm (0.010 in) hot

FUEL SYSTEM AND AIR CLEANER

Fuel Lift Pump: A.C. Delco with hand primer
Fuel Filter: C.A.V. filter, with transparent sediment bowl
Injection Pump: C.A.V. Distributor type, with mechanical governor
Engine Speeds (no load): Idling: 700 to 750 rev/min
 Maximum: 2160 rev/min
Injection Timing: 23° B.T.D.C.
Injectors: C.A.V. type nozzles and nozzle holders
 Initial setting pressure: 17,73 N/mm² (175 Atmosphere). Working Pressure: 17,23 N/mm² (170 Atmosphere)
Easy Starting Aid: C.A.V. Thermostat
Air Cleaner: Two stage, dry element, removable for cleaning with warning light or oil bath air cleaner

ELECTRICAL SYSTEM

Voltage: 12 volt. NEGATIVE EARTH
Battery: Normal Duty 96 Ah, Heavy Duty 125 Ah
Starter Motor: Lucas M50 with a solenoid engaged pinion. Safety device operated by the dual range selector.
Alternator: UK. Lucas 23 ACR or Motorola 55 Amp
 France: Motorola 55 Amp
Light Bulb Sizes:
 Headlights 45/40W
 Side Lights 5W
 Rear Lights 5W, 21W
 Brake Lights 21W
 Number Plate Lights 5W
 Plough Light Halogen 55W
 Panel Lights 2.2W
 Interior Light 5W

Fuses—Instrument Panel Fuse Box:

		Continuous Rate
Plough Light RH Side/Tail	20A	8A
Panel Illumination	20A	8A
Cigar Lighter Illumination		
LH Side/Tail		
Dip Beam Headlights	20A	8A
Main Beam Headlights	20A	8A
Stop Lights	20A	8A
Flashers	20A	8A

Air Cleaner Warning Light		
Gauges and Warning Lights	20A	8A
Cigar Lighter and Horn	20A	8A
Thermostat	40A	16A
Hazard Warning	40A	16A

Fuses—Cab Roof Fuse Box

Roof Work Lights	20A	8A
Radio	20A	8A
Interior Light	20A	8A
Wiper	20A	8A
Heater Control Illumination	20A	8A
Heater Blower	20A	8A

Trailer Socket 7 pin

Fresh Air Blower: Three speed blower drawing fresh air through a paper filter element

COOLING SYSTEM

Type: Thermostat controlled with centrifugal pump to assist circulation. Four bladed fan driven by a belt from the crankshaft.

Fan Belt Deflection (Total): 19 mm ($\frac{3}{4}$ in) midway between the fan pulley and the crankshaft pulley.

TRANSMISSION

Clutch: I.p.t.o. Tractors 305 mm (12 in) split torque Live P.t.o. and cold climate: 254x12 in) dual clutch

Twelve Speed Gear Box (Synchro 12): The twelve speed gearbox has twelve forward speeds and four reverse speeds. This is achieved by using a three forward speed and one reverse speed gear box with synchromesh on second and third gears. This is compounded by a High/Low manual shift range with synchromesh and a High/Low epicyclic range

Eight Speed Mk I Gear Box: The eight speed Mk I gear box has eight forward speeds and two reverse speeds. This is achieved by using a four forward and one reverse speed gearbox with synchromesh on third and fourth gear, compounded by an epicyclic unit.

Mk I or II Multi-Power Gearbox: The Multi-Power Gear Box has twelve forward speeds and four reverse speeds. This is achieved by using a three forward and one reverse speed gearbox with synchromesh on second and third gears. This is compounded by an epicyclic unit and an additional set of high ratio constant mesh gears actuated by a hydraulic clutch.

Gearbox Epicyclic Reduction: 4:1

Final Drive: Bevel drive with epicyclic final hub reduction giving an overall ratio of 3.14:1

POWER TAKE OFF

Live Power Take-off: Engine speed drive is engaged by a lever to the left of the operator's seat.

Independent Power Take-off: Engine speed i.p.t.o. is engaged by a lever to the left of the operator's seat. The i.p.t.o. clutch is a multi-plate, wet clutch.

Reduction Ratio: 540 rev/min 3.15:1 } High Flow
 1000 rev/min 1.69:1 } Pump

P.t.o. Speeds: 540 rev/min at 1688 engine rev/min
 1000 rev/min at 1690 engine rev/min

Power Take-off Shaft: Six spline (540 rev/min), 21 spline (1000 rev/min), 35 mm (1.38 in) diameter, with annular groove for securing p.t.o. couplings.

SPECIFICATION

HYDRAULIC SYSTEM

Ferguson Pump: Four cylinder, scotch yoke type pump driven from the forward end of the p.t.o. shaft, supplies oil, under pressure to the ram cylinder and four external take-off points.

Tapping Point Thread Sizes: Top: $\frac{3}{8}$ N.P.S.M.
Side $\frac{3}{8}$ N.P.T.F. (Two—one each side)

Pressure Control System: The Pressure Control system operates from 10.0 to 214 bar (145 to 3100 lbf/in)

Pump Maximum Output: 26.2

High Flow Pump: 26,2 litre min (5.76 Imp. gal/min) at 2200 engine rev/min

Standard Flow Pump: 15,10 litre/min (3.32 Imp. gal/min) at 2200 engine rev/min

Pump Maximum Pressure: 20,7 N/mm² (3000 lbf/in²)

Linkage: Heavy Duty Category II rear linkage with inter-changeable Cat. I and II ball ends

A barrel turnbuckle type adjustable top link is fitted, plus check chain

Position Control lever: A remote position control lever is provided, located externally on the right-hander fender valance.

Levelling Lever: An extension to the levelling lever is provided within the cab, so that linkage adjustments can be made from the tractor seat.

Maximum Lift Capacity (Lower Link ends—Links Horizontal): 1796 kg (3964 lb)
With assistor ram fitted 2688 kg (5933 lb)

AUXILIARY HYDRAULICS

Auxiliary Pump: Gear type pump with separate gear train and output for Multi-Power and i.p.t.o. supply

Pump Output: To auxiliaries 36.0 litre/min (7.92 Imp. gal/min)

To Multi-Power/i.p.t.o.: 19.0 litre/min (4.16 Imp. gal/min)

Relief Valve Pressure: Auxiliaries: 17.2 to 19,3 N/mm² (2500 to 2800 lbf/in²)
Multi-Power/i.p.t.o.: 4,8 to 6,9 N/mm² (700 to 1000 lbf/in²)

Multi-Power/i.p.t.o. Pump: Gear type pump

Pump Output: 19,0 litre/min (4.16 Imp. gal/min)

Relief Valve Pressure: 4,8 to 6,9 N/mm² (700 to 1000 lbf/in²)

Transmission, Auxiliary Hydraulic Pump and Multi-Power Pump Oil Filter: 40 Micron filter externally mounted under centre housing with woven stainless element which can be removed, washed and refitted

Standard Flow Ferguson Pump				
Applica- tion	Output at 2200 engine rev/min (664 p.t.o. rev/min)			
	litre/min	Imp. gal/min	Hydraulic PS	Hydraulic hp
Ferguson Pump Only	15,10	3.32	5,7	5.57
Auxiliary Pump Only	36,0	7.92	11,3	11.1
Combined Flow	51,0	11.25	15,9	15.75

High Flow Ferguson Pump				
Applica- tion	Output at 2200 engine rev/min (1157 p.t.o. rev/min)			
	litre/min	Imp. gal/min	Hydraulic PS	Hydraulic hp
Ferguson Pump Only	26,2	5.76	9,70	9.64
Auxiliary Pump Only	36,0	7.92	11,3	11.1
Combined Flow	62,20	13.66	19,2	19.16

BRAKES

Type: Hydraulically operated. Oil immersed 222,4 mm (8.75 in) five plate disc brakes, operated together or independently to assist steering.

Parking Brake: Operates on both rear brakes independently of foot brake.

Trailer Brakes: Hydraulically operated by the foot brake pedals

STEERING

Type: Orbital Hydrostatic, with a gear pump integral reservoir and filter

Toe-in: 6,35 mm ($\frac{1}{4}$ in)

Turns Lock to Lock: 4

FRONT AXLE

Type: Three section heavy duty adjustable for track width

Wheel Camber: 4°

Wheel Castor: H.D. 0
N.D. 4° 56'

TRACK ADJUSTMENTS

All adjustments are in 102 mm (4 in) increments.

Front Track:

	Normal duty std. clearance
7.50—16 Tyres	1245 to 1854 mm (49 to 73 in)
7.50—18 Tyres	1245 to 1854 mm (49 to 73 in)
6.00—19 Tyres	1219 to 1829 mm (48 to 72 in)
	Heavy duty high clearance
7.50—16 Tyres	1372 to 1778 mm (54 to 70 in)
7.50—18 Tyres	1346 to 1763 mm (53 to 69 in)
6.00—19 Tyres	1321 to 1727 mm (52 to 68 in)

Rear Track: 1524 to 2235 mm (60 to 88 in)

Seat: Gramner DS 85/H4

WHEELS AND TYRES

Front: 4.50×19 Wheels fitted with 6.00-19 4 or 6 ply tyres.

5.50×16 Wheels fitted with 7.50-18 6 or 8 ply tyres.

5.50×18 Wheels fitted with 7.50-18 6 ply tyres

Rear: 16×30 Pressed steel fitted with 14-30 6 ply tyres.

14×30 Pressed steel fitted with 14-30 6 ply tyres.

14×34 Pressed steel fitted with 14-34 6 ply tyres.

10×36 Pressed steel fitted with 11 or 12-36 6 ply tyres.

11×38 Pressed steel fitted with 12-38 6 ply tyres.

WHEEL WEIGHTS

Front: (Two half weights per wheel):

6.00-16 tyre each weight 21 kg (46 lb) Total 84 kg (185 lb)

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6.00-19 tyre, each weight 34 kg (75 lb) Total 136kg (300 lb)

(Inner and Outer wheel weights)

7.50-16 tyre, Outer 32,2 kg (71 lb)

Inner 32,7 kg (72 lb)

Total four weights 130 kg (286 lb)

Rear: First weight—43 kg (95 lb)

Three further weights per wheel of 54 kg (119 lb)

Total 411 kg (907 lb)

Water Ballasting: (Rear) Additional weight for each rear tyre:—

14-30 Tyres: 266 kg (587 lb)

14-34 Tyres: 308 kg (680 lb)

12-36 Tyres: 143 kg (315 lb)

12-38 Tyres: 222 kg (490 lb)

11-36 Tyres: 159 kg (351 lb)

CAPACITIES

Fuel Tank: 77,28 litre (135 Imp. pt)

Cooling System: 14,2 litre (25 Imp. pt) plus heater

Engine Sump (inc. filter): 7,1 litre (13 Imp. pt)

Transmission:

Twelve Speed 32,4 litre (57 Imp. pt)

Multi-Power 31,8 litre (56 Imp. pt)

Eight Speed 40 litre (70 Imp. pt)

Epicyclic Hubs: 1,71 litre (3 Imp. pt)

Power Steering Reservoir: 1,2 litre (2 Imp. pt)

P.t.o. Pulley (H.D.): 1.14 litre (2 Imp. pt)

GENERAL DIMENSIONS (Fig. 1)

A. Overall Height (over exhaust) 2720 mm (107 in)

Note: A1 When roof escape hatch is open in the ventilator position the overall height is increased to 2921 mm (115 in).

B. Overall Width: 1850 mm (73 in)

C. Overall Length: 3778 mm (149 in)

D. Wheelbase 2250 mm (89 in)

Ground Clearance:

E. Under Drawbar Frame: 394 mm (15 in)

F. Under Clutch Housing: 480 mm (19 in)

Turning Circle: 8357 mm (27 ft)

Weight (with fuel, oil and water) 2893 kg (6386 lb)

Total Possible maximum weight with Ballasted

Tyres—

Maximum recommended wheel weights and front weights—

Mounting Points (Fig 2)

1. 102 mm (4 in)

2. 102 mm (4 in)

3. 10 holes (5 each side) tap $\frac{3}{8}$ in 10 UNC 2B×32 mm (1 $\frac{1}{4}$ in)

4. 57 mm (2.25 in)

5. 73 mm (2.87 in)

6. 260 min (2.38 in)

7. 2052 mm (80.8 in)

8. 154 mm (10 in)

9. 184 mm (7.25 in)

10. 92 mm (3.62 in)

11. 4 holes tap $\frac{3}{8}$ in 11 UNC 3B×32 mm (1 $\frac{1}{4}$ in)

12. 102 mm (4 in)

13. 1243 mm (49 in)

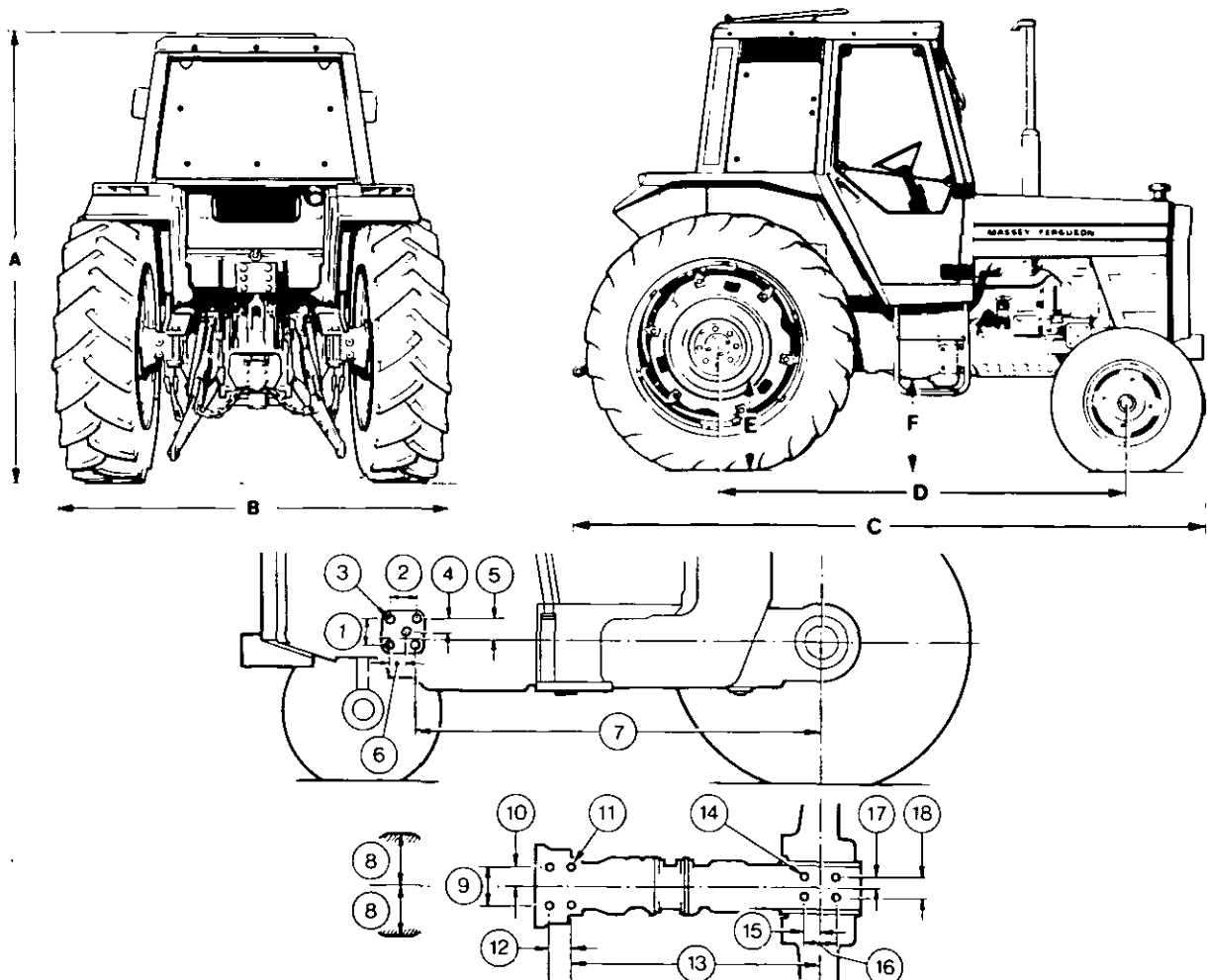
14. 4 holes tap $\frac{3}{8}$ in 10 UNC 3B×27 mm (1 $\frac{1}{8}$ in)

15. 76 mm (3 in)

16. 152 mm (6 in)

17. 43 mm (1.69 in)

18. 86 mm (3.38 in)



SPECIFICATION

ENGINE

Make: Perkins, to MF specification
Type and Model: Four-stroke, direct injection diesel A4.248

Number of Cylinders: Four

Bore: 100,96 mm (3-975 in)

Stroke: 127 mm (5 in)

Capacity: 4,06 litre (248 in³)

Compression Ratio: 16:1

Firing Order: 1, 3, 4, 2

Horsepower: 75 PS (56 kW) at 2200 rev/min (DIN 70020)

79 hp at 2200 rev/min (B.S. AU 141: 1967 Ambient Conditions)

Maximum Torque (at 1400 rev/min): 275 Nm (202.5 lbf ft) (DIN 70020)

287 Nm (212 lbf ft) (B.S. AU 141: 1967 Ambient Conditions)

Lubrication: Throwaway, cannister type full flow external filter

Valves: Overhead, pushrod operated

Valve Tip Clearance (Inlet and Exhaust): 0,30 mm (0-012 in) cold. 0,025 mm (0-010 in) hot

FUEL SYSTEM AND AIR CLEANER

Fuel Lift Pump: A.C. Delco, with hand primer

Fuel Filter: C.A.V. filter, with sediment bowl

Injection Pump: C.A.V. Distributor type, with mechanical governor

Engine Speeds (No load): Idling: 700 to 750 rev/min
 Maximum: 2350 rev/min

Injection Timing: 24° B.T.D.C.

Injectors: C.A.V. type nozzles and nozzle holders

Easy Starting Aid: C.A.V. Thermostart Mark III C

Air Cleaner: Two stage, dry element, removable for cleaning with warning light, or oil bath air cleaner

ELECTRICAL SYSTEM

Voltage: 12 volt. NEGATIVE EARTH

Battery: Normal Duty 96 Ah, Heavy Duty 125 Ah

Starter Motor: Lucas M50 with a solenoid engaged pinion. Safety device operated by the dual range selector.

Alternator: UK: Lucas 23 ACR or Motorola 55 Amp
 France: Motorola 55 Amp

Light Bulb Sizes:

Headlights 45/40W

Side Lights 5W

Rear Lights 5W, 21W

Brake Lights 21W

Number Plate Lights 5W

Plough Light Halogen 55W

Panel Lights 2-2W

Interior Light 5W

Fuses—Instrument Panel Fuse Box:

		Continuous Rate
Plough Light RH Side/Tail	20A	8A
Panel Illumination	20A	8A
Cigar Lighter Illumination LH Side/Tail		
Dip Beam Headlights	20A	8A
Main Beam Headlights	20A	8A
Stop Lights	20A	8A
Flashers		
Air Cleaner Warning Light		
Gauges and Warning Lights	20A	8A
Cigar Lighter and Horn	20A	8A

Thermostart	40A	16A
Hazard Warning	40A	16A

Fuses—Cab Roof Fuse Box

Roof Work Lights	20A	8A
Radio	20A	8A
Interior Light	20A	8A
Wiper	20A	8A
Heater Control Illumination	20A	8A
Heater Blower	20A	8A

Trailer Socket: 7 pin

Fresh Air Blower: Three speed blower drawing fresh air through a paper filter element.

COOLING SYSTEM

Type: Thermostat controlled with centrifugal pump to assist circulation. Six bladed fan driven by a belt from the crankshaft.

Fan Belt Deflection (Total): 19 mm ($\frac{3}{4}$ in) midway between the fan pulley and the crankshaft pulley.

TRANSMISSION

Clutch l.p.t.o. Tractors: 305 mm (12 in) split torque.
 Live P.t.o. and cold climate: 254x305 mm (10x12 in) dual clutch

Twelve Speed Gearbox (Synchro 12): The twelve speed gear box has twelve forward speeds and four reverse speeds. This is achieved by using a three forward speed and one reverse speed gear box with synchromesh on second and third gears. This is compounded by a High/Low manual shift range with synchromesh and a High/Low epicyclic range.

Eight Speed Mk II Gear Box: The eight speed Mk II gear box has eight forward speeds and two reverse speeds. This is achieved by using a four forward and one reverse speed gearbox with synchromesh on third and fourth gear, compounded by an epicyclic unit.

Multi-Power Mk II Gearbox: The Multi-Power Mk II gear box has twelve forward speeds and four reverse speeds. This is achieved by using a three forward and one reverse speed gearbox with synchromesh on second and third gears. This is compounded by an epicyclic unit and an additional set of high ratio constant mesh gears actuated by a hydraulic clutch.

Gearbox Epicyclic Reduction: 4:1

Final Drive: Bevel drive with epicyclic final hub reduction giving an overall ratio of 4-24:1

POWER TAKE OFF

Live Power Take-off: Engine speed drive is engaged by a lever to the left of the operator's seat.

Independent Power Take-off: Engine speed i.p.t.o. is engaged by a lever to the left of the operator's seat. The i.p.t.o. clutch is a multi-plate, wet clutch.

Reduction Ratio:

540 rev/min	3-3125:1	Standard pump
1000 rev/min	1-9:1	High flow pump

P.t.o. Speeds: High flow pump, 540 rev/min at 1893 engine rev/min. Standard pump 540 rev/min at 1789 engine rev/min.
 1000 rev/min at 1900 engine rev/min.

Power Take-off Shaft: Six spline (540 rev/min), 21 spline (1000 rev/min), 35 mm (1-38 in) diameter, with an annular groove for securing p.t.o. couplings.

SPECIFICATION

HYDRAULIC SYSTEM

Ferguson Pump: Four cylinder, scotch yoke type pump driven from the forward end of the p.t.o. shaft, supplies oil, under pressure to the ram cylinder and four external take-off points

Tapping Point Thread Sizes: Top $\frac{3}{8}$ N.P.S.M.
Side: $\frac{3}{8}$ N.P.T.F. (Two—One each side)

Pressure Control System: The Pressure Control system operates from 0.35 to 21.4 N/mm² (200 to 3100 lbf/in²)

Pump Maximum Output: High flow pump, 25.9 litre/min (5.7 Imp. gal/min) at 2200 engine rev/min.
Standard flow pump, 16 litre/min (3.5 Imp. gal/min) at 2200 engine rev/min

Pump Maximum Pressure: 20.7 N/mm² (3000 lbf/in²)

Linkage: Heavy Duty Category II rear linkage with hook type quick release inter-changeable Cat. I and II ball ends is fitted and is equipped with one assistor ram

A barrel turnbuckle type adjustable top link is fitted, plus check chains.

Position Control Lever: A remote position control lever is provided, located externally on the right-hand fender valance.

Levelling Lever: An extension to the levelling lever is provided within the cab, so that linkage adjustments can be made from the tractor seat.

Maximum Lift Capacity (Lower Link ends—Links Horizontal): with 1 Assistor Ram—2227kg (4916lb)

AUXILIARY HYDRAULICS

Auxiliary Pump: Gear type pump with separate gear train and output for Multi-Power and i.p.t.o. supply.

Pump Output: To auxiliaries 35.1 litre/min (7.72 Imp. gal/min)
To Multi-Power/i.p.t.o.: 19.0 litre/min (4.16 Imp. gal/min)

Relief Valve Pressure: Auxiliaries 17.3 to 19.3 N/mm² (2500 to 2800 lbf/in²)
Multi-Power/i.p.t.o.: 4.8 to 6.9 N/mm² (700 to 1000 lbf/in²)

Multi-Power/ I.p.t.o. Pump: Gear Type pump

Pump Output: 19.0 litre/min (4.16 Imp. gal/min)

Relief Valve Pressure: 4.8 to 6.9 N/mm² (700 to 1000 lbf/in²)

Transmission, Auxiliary Hydraulic Pump and Multi-Power Pump Oil Filter: 40 Micron filter externally mounted under centre housing with woven stainless steel element which can be removed, washed and refitted

Standard Flow Ferguson Pump				
Applica- tion	Output at 2200 engine rev/min (664 p.t.o. rev/min)			
	litre/min	Imp. gal/min	Hydraulic PS	Hydraulic hp
Ferguson Pump Only	14,36	3-16	4,7	5-77
Auxiliary Pump Only	39,0	8-58	12,0	11-66
Combined Flow	54,5	12-0	17,0	16-32

High Flow Ferguson Pump				
Applica- tion	Output at 2200 engine rev/min (1157 p.t.o. rev/min)			
	litre/min	Imp. gal/min	Hydraulic PS	Hydraulic hp
Ferguson Pump Only	25,9	5-7	9,6	9-63
Auxiliary Pump Only	35,1	7-72	11,0	10-8
Combined Flow	60,5	13-33	18,9	18-6

BRAKES:

Type: Oil immersed 222,4 mm (8.75 in) hydraulically operated five plate disc-brakes, operated together or independently to assist steering.

Parking Brake: Operates on both rear brakes independently of foot brake.

Trailer Brakes: Hydraulically operated by the foot brake pedals.

STEERING

Type: Orbital Hydrostatic, with a gear pump integral reservoir and filter.

Toe-in: 6,35 mm ($\frac{1}{4}$ in)

Turns Lock to Lock: 3-3

FRONT AXLE..

Type: Three section heavy duty adjustable for track width.

Wheel Camber 3° 30'

Wheel Castor 0°

TRACK ADJUSTMENTS

All adjustments are in 102 mm (4 in) increments.

Front Track:

7.50—13 Tyres 1346 to 1753 mm (53 to 69 in)

7.50—16 Tyres 1372 to 1778 mm (54 to 70 in)

Rear Track:

P.A.V.T. 1422 to 2388 mm (56 to 94 in)

Pressed steel wheels 1524 to 2388 mm (60 to 94 in)

Seat: Gramner DS 85/H4

WHEELS AND TYRES

Front: 5.50×18 Wheels fitted with 7.50-18 8 ply tyres.
5.50×16 Wheels fitted with 7.50-16 8 ply or 6 ply.

Rear: 14×30 P.A.V.T. cast centre wheels fitted with 14.30 or 15.30 6 ply tyres. 12×38 pressed steel or P.A.V.T. cast centre wheels fitted with 12.38 or 14.38 6 ply tyres.

14×34 pressed steel or P.A.V.T. cast centre wheels fitted with 14.34 or 15.34 6 ply tyres.

WHEEL WEIGHTS

Front: 2 outer weights 32.2 kg (71 lb). 2 Inner weights 32,7 kg (72 lb). Total 130 kg (286 lb)

Rear: Up to 4 weights per side, each weight 54 kg (119 lb) Total 453 kg (953 lb)

Water Ballasting (100%) Additional weight for each rear tyre:—

12-38 Tyres: 266 kg (587 lb)

14-34 Tyres: 352 kg (777 lb)

14-30 Tyres: 339 kg (748 lb)

15-34 Tyres: 430 kg (949 lb)

15-30 Tyres: 408 kg (900 lb)

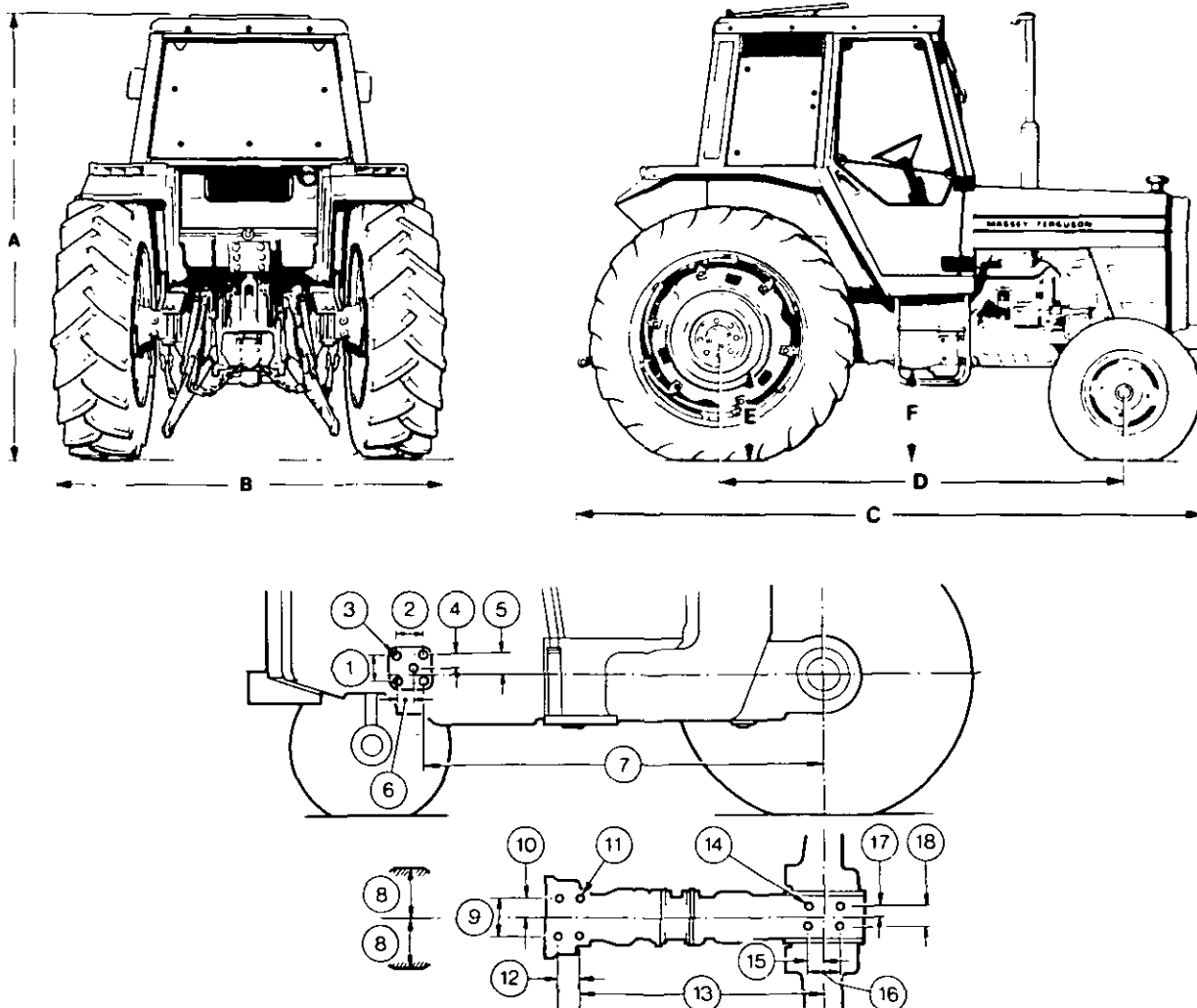
CAPACITIES**Fuel Tanks:** 145 litre (32 Imp. gal)**Cooling System:** 14,2 litre (25 Imp. pt.) Plus heater**Engine Sump (inc. filter):** 8 litre (14 Imp. pt)**Transmissions**

Twelve Speed: 39 litre (69 Imp. pt)

Multi-Power: 39 litre (69 Imp. pt)

Epicyclic Hubs: 3,1 litre (5.4 Imp. pt)**Power Steering Reservoir:** 1,2 litre (2 Imp. pt)**P.t.o. Pully (H.D.)** 1,14 litres (2 Imp. pt)**GENERAL DIMENSIONS (Fig. 1)****A.** Overall Height (over exhaust) 2720 mm (107 in)**Note:** A1 When roof escape hatch is open in the ventilator position the overall height is increased to 2921mm (115 in).**B.** Overall Width 2050 mm (81 in)**C.** Overall Length 3750 mm (148 in)**D.** Wheelbase 2286 mm (90 in)**Ground Clearance:****E.** Under Drawbar Frame 390 mm (154 in)**F.** Under Clutch Housing 510 mm (20 in)**Turning Circle:** 8,36 m (27.4 ft)**Weight** (with fuel, oil and water) 3515 kg (7760 lb)**Note:** The above dimensions are for a tractor fitted with 7.50-18 8 ply front tyres and 12-38 Rear. Front track setting 1422 mm (56 in).**Mounting Points (Fig. 2)**

1. 102 mm (4 in)
2. 102 mm (4 in)
3. 10 holes (5 each side) tap $\frac{3}{8}$ in 10 UNC 2B \times 32 mm (1 $\frac{1}{2}$ in)
4. 57 mm (2.25 in)
5. 73 mm (2.87 in)
6. 60 mm (2.38 in)
7. 2052 mm (80.8 in)
8. 254 mm (10 in)
9. 184 mm (7.25 in)
10. 92 mm (3.62 in)
11. 4 holes tap $\frac{3}{8}$ in 11 UNC 3B \times 32 mm (1 $\frac{1}{4}$ in)
12. 102 mm (4 in)
13. 1243 mm (49 in)
13. 4 holes tap $\frac{3}{8}$ in 10 UNC 3B \times 27 mm (1 $\frac{1}{8}$ in)
15. 76 mm (3 in)
16. 152 mm (6 in)
17. 43 mm (1.69 in)
18. 86 mm (3.38 in)



SPECIFICATION

ENGINE

Make: Perkins, to MF specification
Type and Model: Four-stroke, direct injection diesel A4.318.2 (Revised)
Number of Cylinders: Four
Bore: 114 mm (4.5 in)
Stroke: 127 mm (5 in)
Capacity: 5.21 litres (318 in³)
Compression Ratio: 16.5:1
Firing Order: 1, 3, 4, 2
Horsepower: 88 hp (67.7 kw) at 2000 rev/min.
Maximum Torque (at 1300 rev/min): 340 Nm (254 lbf ft)
Lubrication: Throwaway, cannister type full flow external filter
Valves: Overhead—Pushrod operated
Valve Tip Clearance (Inlet and Exhaust): 0.30 mm (0.012 in) cold, 0.25 mm (0.010 in) hot

FUEL SYSTEM AND AIR CLEANER

Fuel Lift Pump: C.A.V.
Fuel Filter: C.A.V. filter, with twin elements
Injection Pump: C.A.V. Distributor type, with mechanical governor
Engine Speeds (no load): Idling 700 to 750 rev/min
 Maximum: 2000 rev/min
Injection Timing: 28° B.T.D.C.
Injectors C.A.V. type nozzles and nozzle holders
 Initial setting pressure: 18,74 N/mm² (185 Atmosphere). Working pressure: 17,23 N/mm² (170 Atmosphere)
Easy Starting Aid: C.A.V. Thermostart Mark III C
Air Cleaner: A.C. Delco. Two stage, dry element, removable for cleaning with warning light.

COOLING SYSTEM

Type: Thermostat controlled with centrifugal pump to assist circulation. Five bladed fan driven by a belt from the crankshaft.
Fan Belt Deflection (Total): 19 mm ($\frac{3}{4}$ in) midway between the fan pulley and the crankshaft pulley.

ELECTRICAL SYSTEM

Voltage: 12 volt. NEGATIVE EARTH.
Battery: Normal Duty 125 Ah, Heavy Duty 180 Ah
Starter Motor: Lucas with a solenoid engaged pinion. Safety device operated by the dual range selector.
Alternator: UK: Lucas or Motorola 55 Amp
 France: Motorola 55 Amp
Light Bulb Sizes
 Headlights 45/50W
 Side Lights 5W
 Rear Lights 5W, 21W
 Brake Lights 21W
 Number Plate Lights 5W
 Plough Light Halogen 55W
 Panel Lights 2-2W
 Interior Light 5W

Fuses—Instrument Panel Fuse Box:

		Continuous Rate
Plough Light RH Side/Tail	20A	8A
Panel Illumination	20A	8A
Cigar Lighter LH Side/Tail		
Dip Beam Headlights	20A	8A
Main Beam Headlights	20A	8A
Stop Lights	20A	8A
Flashers		
Air Cleaner Warning Light		
Gauges and Warning Lights	20A	8A
Cigar Lighter and Horn	20A	8A
Thermostart	40A	16A
Hazard Warning	40A	16A

Fuses—Cab Roof Fuse Box

Roof Work Lights	20A	8A
Radio	20A	8A
Interior Light	20A	8A
Wiper	20A	8A
Heater Control Illumination	20A	8A
Heater Blower	20A	8A

Trailer Socket: 7 pin

Fresh Air Blower: Three speed blower drawing fresh air through a paper filter element

Eight Speed Mk II Gearbox: The eight speed Mk II gearbox has eight forward speeds and two reverse speeds. This is achieved by using a four forward and one reverse speed gearbox with synchromesh on third and fourth gear, compounded by an epicyclic unit

Multi-Power Mk II Gearbox The Multi-Power Mk II Gearbox has twelve forward speeds and four reverse speeds. This achieved by using a three forward and one reverse speed gearbox with synchromesh on second and third gears. This is compounded by an epicyclic unit and an additional set of high ratio constant mesh gears actuated by a hydraulic clutch

TRANSMISSION

Clutch: 330 mm (13 in) split torque

Twelve Speed Gearbox (Synchro 12): The twelve speed gearbox has twelve forward speeds and four reverse speeds. This is achieved by using a three forward speed and one reverse speed gear box with synchromesh on second and third gears. This is compounded by a High/Low manual shift range with synchromesh and a High/Low epicyclic range.

Gearbox Epicyclic Reduction: 4:1

Final Drive: Bevel drive with epicyclic final hub reduction giving an overall ratio of 4:24:1.

POWER TAKE OFF

Independent Power Take-off: Engine speed i.p.t.o. is engaged by a lever to the left of the operator's seat. The i.p.t.o. clutch is a multi-plate wet clutch.

Reduction Ratio: 540 rev/min 3.5:1
 1000 rev/min 1.69

P.t.o. Speeds: 540 rev/min at 1700 engine rev/min.
 1000 rev/min at 1690 engine rev/min.

Power Take-off Shaft: Six spline (540 rev/min), 21 spline (1000 rev/min), 35 mm (1.38 in) diameter, with annular groove for securing p.t.o. couplings.

SPECIFICATION

HYDRAULIC SYSTEM

Ferguson Pump: Four cylinder, scotch yoke type pump driven from the forward end of the p.t.o. shaft, supplies oil, under pressure to the ram cylinder and four external take-off points.

Tapping Point Thread Sizes: Top: $\frac{3}{8}$ N.P.S.M. Side: $\frac{3}{8}$ N.P.T.F. (Two—One each side)

Pressure Control System: The Pressure Control system operates from 0.35 to 21.4 Nm² (200 to 3100 lbf/in²)

Pump Maximum Output: 26.2 litre/min (5.76 Imp. gal/min) at 1183 engine rev/min.

Pump Maximum Pressure: 20,7 N/mm² (3000 lbf/in²)

Linkage: Heavy Duty Category II rear linkage with hook type quick release inter-changeable Cat. I and II ball ends is fitted and is equipped with one or two assistor rams.

A barrel turnbuckle type adjustable top link is fitted, plus check chains

Position Control Lever: A remote position control lever is provided, located externally on the right-hand fender valance.

Levelling Lever: An extension to the levelling lever is provided within the cab, so that linkage adjustments can be made from the tractor seat.

Maximum Lift Capacity (Lower Link ends— Links Horizontal): with 1 Assistor Ram— 2781 kg (6130 lb) with 2 Assistor Rams— 3275 kg (7220 lb)

AUXILIARY HYDRAULICS

Auxiliary Pump: Gear type pump with separate gear train and output for Multi-Power and i.p.t.o. supply.

Pump Output: To auxiliaries: 36 litre/min (8 Imp. gal/min). To Multi-Power/i.p.t.o.: 21.3 litre/min (4.7 Imp. gal/min)

Relief Valve Pressure: Auxiliaries: 17,3 to 19,3 N/mm² (2500 to 2800 lbf/in²). Multi-Power/i.p.t.o.: 4,8 to 6,9 N/mm² (700 to 1000 lbf/in²)

Multi-Power/i.p.t.o. Pump: Gear type pump.

Pump Output: 19,0 litre/min (4.1 Imp. gal/min)

Relief Valve Pressure: 4,8 to 6,9 N/mm² (700 to 1000 lbf/in²)

Transmission, Auxiliary Hydraulic Pump and Multi-Power Pump Oil Filter: 40 Micron filter externally mounted under centre housing with woven stainless steel element which can be removed, washed and refitted.

Application	Output at 1183 engine rev/min (1000 p.t.o. rev/min)			
	litre/min	Imp. gal/min	Hydraulic PS	Hydraulic hp
Ferguson Pump Only	26,2	5.76	9,3	9.21
Auxiliary Pump Only	36,0	7.92	11,0	10.8
Combined Flow	60,5	13.33	19,9	19.6

BRAKES

Type: Oil immersed 222,4 mm (8.75 in) hydraulically operated five plate disc brakes, operated together or independently to assist steering.

Parking Brake: Operates on both brakes independently of foot brake.

Trailer Brakes: Hydraulically operated by the foot brake pedals

FRONT AXLE

Type: Three section, adjustable heavy duty for track width

Wheel Camber: 5° 20'

Wheel-Castor: 0°

STEERING

Type: Orbitrol hydrostatic, with a gear pump and integral reservoir and filter

Toe-in: 6,35 mm ($\frac{1}{4}$ in)

Turns Lock to Lock: 3.3

TRACK ADJUSTMENTS

All adjustments are in 102 mm (4 in) increments

Front Track:

7.50—18 Tyres 1406—1914 mm (55 to 75 in)

7.50—20 Tyres 1400—1908 mm (55 to 75 in)

9.00—16 Tyres 1454—1962 mm (57 to 78 in)

10.00—16 Tyres

11.00—16 Tyres 1483—1990 mm (58 to 78 in)

Rear Track:

P.A.V.T. Wheels 1420—2440 mm (56 to 96 in)

Pressed Steel Wheels 1626—2362 mm (64 to 93 in)

Seat: Grammer DS 85/H4

WHEELS AND TYRES

Front: 5.50×18 Wheels fitted with 7.50-18 8 ply tyres.

5.50×20 Wheels fitted with 7.50-20 8 ply tyres.

8.00×16 heavy duty fitted with 9.00-16 10 ply tyres.

10.00-16 8 ply tyres for 1.00-16 8 ply tyres.

Rear: 11×38 P.A.V.T. Wheels fitted with 12-38 8 ply tyres.

12×38 pressed steel wheels fitted with 12-38 8 ply tyres.

14×38 pressed steel or P.A.V.T. wheels fitted with 14-38 8 ply tyres or 15-34 8 ply tyres.

WHEEL WEIGHTS

Front: 2 Outerweights 45 kg (99 lb) 2 Inner weights 45 kg (99 lb). Total 180 kg (396 lb)

Rear: Up to 4 weights per side, each weight 32.5 kg (72 lb) Total 260 kg (574 lb)

Water Ballasting (100%) Additional weight for each rear tyre:—

12-38 Tyres: 326 kg (720 lb)

14-34 Tyres 434 kg. (958 lb)

14-38 Tyres: 481 kg (1061 lb)

15-34 Tyres: 486 kg (1072 lb)

CAPACITIES

Fuel Tank: 145 litre (32 Imp. gal)

Cooling System: 15,9 litre (28 Imp pt) Plus heater

Engine Sump (in. filter): 9,7 litre (17 Imp pt)

Transmissions

Twelve Speed 36 litre (63 Imp pt)

Eight Speed 40 litre (70 Imp pt)

Multi-Power 36 litre (63 Imp. pt)

Epicyclic Hubs: 3.1 litre (5.4 Imp. pt)

Power Steering Reservoir: 2.8 litre (5 Imp. pt)

P.t.o. Pulley (H.D.): 1,14 litres (2 Imp. pt)

SPECIFICATION

GENERAL DIMENSIONS (Fig. 1)

A. Overall Height (over exhaust) 2769 mm (109 in)
Note: When the roof escape hatch is open in the ventilator position the overall height is increased to 2872 mm (117 in)

B. Overall Width: 2016 mm (80 in)

C. Overall Length: 4077 mm (160 in)

D. Wheelbase: 2432 mm (96 in)

Ground Clearance:

E. Under Drawbar Frame: 432 mm (17 in)

F. Under Clutch Housing: 476 mm (19 in)

Turning Circle: 7,96 mm (26 ft)

Weight (with fuel oil and water) 3787 kg (8359 lb)

Total possible maximum weight with

Ballasted Tyres—

Maximum recommended wheel weights—

Front weights and swinging drawbar— 5940 kg (258 c.w.t)

MOUNTING POINTS (Fig. 2)

1. 102 mm (4 in)

2. 102 mm (4 in)

3. 10 holes (5 each side) tap $\frac{3}{8}$ in 10 UNC 2B \times 32 mm (1 $\frac{1}{2}$ in)

4. 57 mm (2.25 in)

5. 73 mm (2.87 in)

6. 60 mm (2.38 in)

7. 2052 mm (80.8 in)

8. 254 mm (10 in)

9. 184 mm (7.25 in)

10. 92 mm (3.62 in)

11. 4 holes tap $\frac{3}{8}$ in 11 UNC 3B \times 32 mm (1 $\frac{1}{2}$ in)

12. 102 mm (4 in)

13. 1243 mm (49 in)

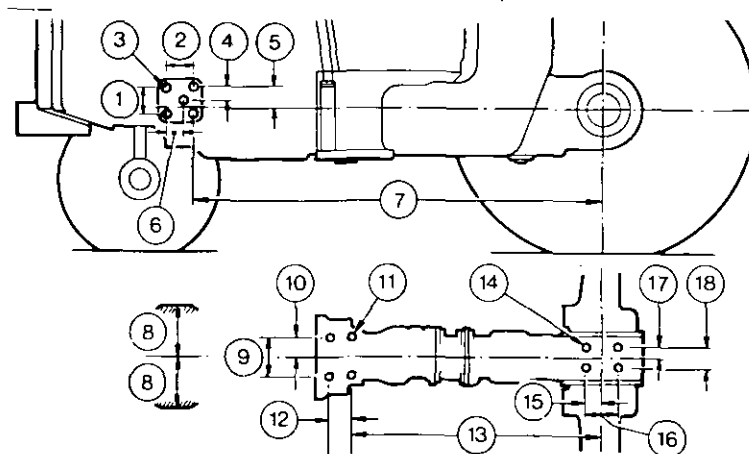
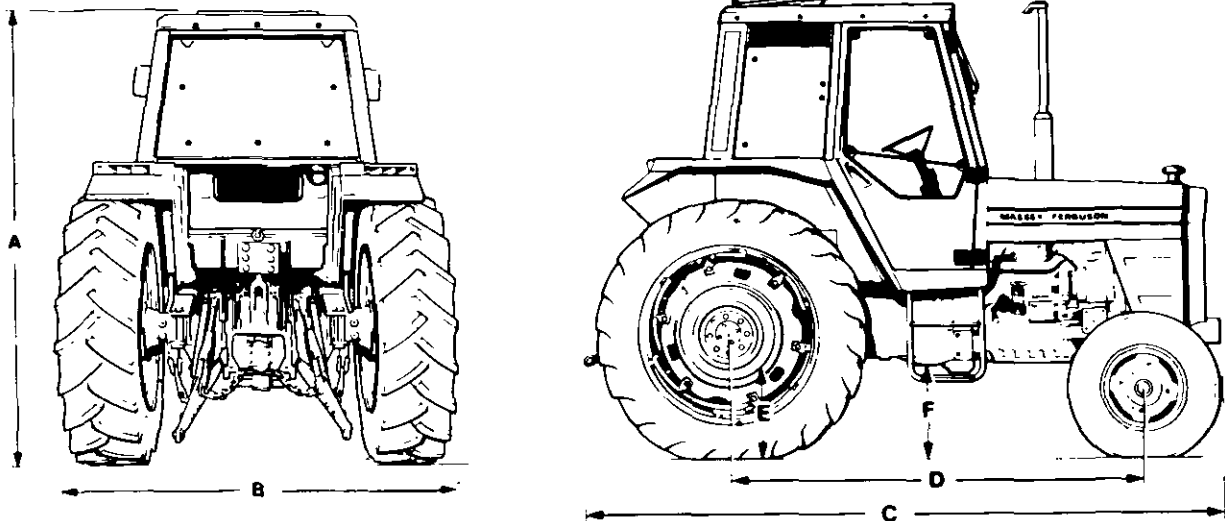
14. 4 holes tap $\frac{3}{8}$ in 10 UNC 3B \times 27 mm (1 $\frac{1}{8}$ in)

15. 76 mm (3 in)

16. 152 mm (6 in)

17. 43 mm (1.69 in)

18. 86 mm (3.38 in)



MAINTENANCE**Part 1—Section B**

Table of Contents	Page Number
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50 HOUR FREE SERVICE	02
250 HOUR FREE SERVICE	02
MAINTENANCE PERIODS	03

GENERAL

This section has been compiled to enable the reader to ascertain quickly what action is necessary at any maintenance period. Also detailed is the 'Running-in' procedure and the obligatory maintenance specified in the 50 and 250 Hour Free Service Vouchers. These recommended services will safeguard the life of the tractor when properly carried out.

RUNNING-IN

The following precautions should be taken during the running in period:

1. Diesel engines require a different type of running in from petrol engines. Experience has shown that usage of the tractor, during its first 50 hours of operation, can have a marked difference on the performance and life of the engine. From new the tractor should be engaged in work which will load the engine as near to full conditions as possible.
2. Use a low gear when pulling heavy loads.
3. During the running in period, check frequently the tightness of all screws, bolts, nuts, etc.
4. To ensure proper clutch life, care must be taken to bed-in the friction plates properly.
During the first 15 hours of the tractor's life, frequently, but carefully engage and disengage the clutch(es). During the first 50 hours a careful watch must be kept on the clutch pedal free travel, which should be adjusted as soon as the pedal travel increases.
5. Do not forget your free service entitlement, which entails changing oil and filters.

MAINTENANCE**50 HOUR FREE SERVICE**

To be carried out after 50 hours running

Engine

Change the engine oil.
Change the engine oil filter.
Check and adjust the engine slow running speed.

Fuel System and Air Cleaner

Change the primary fuel filter element.
Check the dry air cleaner hoses and unloader valve.

Cooling System

Check the radiator coolant level and replenish if necessary.
Check the alternator/fan belt tension and adjust if necessary.

Electrical System

Check the battery electrolyte level and replenish if necessary.
Wipe the battery top and smear the terminals with petroleum jelly.
Check the alternator/fan belt tension and adjust if necessary.
Check the tightness of all cable clips and terminals and check all wiring for chafing.
Check the safety start switch for correct operation.
Check all lights for operation.

Steering

Check the front hub adjustment and adjust if necessary.
Check the power steering oil level and replenish if necessary.
Change the power steering pump filter element.
Change the power steering oil.

Transmission and Hydraulics

Change the transmission oil.
Clean the hydraulic pump oil strainer.
Change the transmission oil filter element.
Check the oil level in the epicyclic hubs and replenish if necessary.
Check the operation of all hydraulics.

Clutch and Brakes

Check the clutch pedal free travel and adjust if necessary.
Check the live p.t.o. clutch setting and adjust if necessary.
Check the brakes and adjust if necessary.

Cab

Check the screenwasher bottle level and replenish if necessary.
Clean the cab air filter.
Check the torque of the cab securing bolts and tighten if necessary.

Miscellaneous

Check the torque of the wheel nuts and tighten if necessary.
Check the tyre pressures and adjust if necessary.
Lubricate all points with grease or oil where necessary.
Examine for external leaks, generally check all other nuts, bolts, clips and hoses for tightness.
Road test the tractor, checking the instruments and services for correct functioning.

250 HOUR FREE SERVICE

To be carried out before 250 hours of running

Engine

Change the engine oil.
Change the engine oil filter.
Check and adjust the engine slow running speed.

Fuel System and Air cleaner

Change the primary fuel filter element.
Check the dry air cleaner hoses and unloader valve.

Cooling System

Check the radiator coolant level and replenish if necessary.
Check the alternator/fan belt tension and adjust if necessary.

Electrical System

Check the battery electrolyte level and replenish if necessary.
Wipe the battery top and smear the terminals with petroleum jelly.
Check the alternator/fan belt tension and adjust if necessary.
Check the safety start switch for correct operation.
Check all lights for operation.

Steering

Check the front hub adjustment and adjust if necessary.
Check the power steering oil level and replenish if necessary.

Transmission and Hydraulics

Check the transmission oil level and replenish if necessary.
Change the transmission oil filter element.
Check the oil level in the epicyclic hubs and replenish if necessary. Not MF 550 tractors.
Check the operation of all hydraulics.

Clutch and Brakes

Check the clutch pedal free travel and adjust if necessary.
Check the live p.t.o. clutch setting and adjust if necessary.
Check the brakes and adjust if necessary.
Check the brake fluid reservoir and replenish if necessary.

Cab

Check the screenwasher bottle level and replenish if necessary.
Clean the cab air filter.
Check the torque of the cab securing bolts and tighten if necessary.

Miscellaneous

Check the torque of the wheel nuts and tighten if necessary.
Check the tyre pressures and adjust if necessary.
Lubricate all points with grease or oil where necessary.
Examine for external leaks, generally check all other nuts, bolts, clips and hoses for tightness.
Road test the tractor, checking the instruments and services for correct functioning.

MAINTENANCE PERIODS

Carry out operation below when Tachometer reads—	10	100	200	250	300	400	500	600	700	750	800	900	1000
GREASING	O	O	O	O	O	O	O	O	O	O	O	O	O
ENGINE Check the engine oil level and replenish if necessary Change the engine oil—See note 2 Change the engine oil filter—See note 2 Check the tappets and adjust if necessary Clean the engine breather pipe	O	O	O	O O O	O	O	O O O X X	O	O	O	O O O	O	O O O X X
FUEL SYSTEM AND AIR CLEANER Inspect the fuel filter glass bowl and drain off any water Renew the fuel filter element Service the injectors Drain clean and refill the fuel tank Check the dry air cleaner hoses and unloader valve Replace the dry air cleaner elements—See note 3	O	O	O	O	O	O	O O X	O	O	O	O	O	O O X O O
COOLING SYSTEM Check the radiator coolant level and replenish if necessary Clean the radiator and oil cooler fins Drain flush and refill the cooling system	O	O	O O	O	O	O	O O O	O	O	O	O	O	O O O
ELECTRICAL SYSTEM Check the battery electrolyte level and replenish if necessary Wipe the battery top and smear the terminals with petroleum jelly Check the alternator fan belt tension and adjust if necessary Examine the alternator		O	O O	O	O	O	O O O	O	O	O	O	O	O O O X
STEERING Check the power steering oil level and replenish if necessary Change the power steering pump filter element Check the front hub adjustment and adjust if necessary Check the front wheel alignment and adjust if necessary		O	O	O	O	O	O O X	O	O	O	O	O	O O O X
TRANSMISSION AND HYDRAULICS Check the transmission oil level and replenish if necessary Change the transmission oil Clean the transmission and hydraulic pump filter Change the transmission oil filter element Check the oil level in the epicyclic hubs and replenish if necessary Change the oil in the epicyclic hubs		O	O	O	O	O	O O O O	O	O	O	O	O	O O O O O
CLUTCH AND BRAKES Check the clutch pedal free travel and adjust if necessary* Check the brake fluid reservoir and replenish if necessary Check the brakes and adjust if necessary* *See note 4		O	O O	O	O	O	O O O	O	O	O	O	O	O O O
SAFETY CAB Check the screenwasher bottle level and replenish if necessary Clean the cab air filter Replace the cab air filter Check the torque of the cab securing bolts and tighten in necessary	O O	O O	O O	O O	O O	O O	O O X	O	O	O	O	O	O O O X
MISCELLANEOUS Check the differential lock and adjust if necessary Check the torque of the wheel nuts, bolts and tighten if necessary Check the tyre pressures and adjust if necessary	O	O	O	O	O	O	O O	O	O	O	O	O	O O O

NOTES

- All operations marked X are to be carried out by your Massey-Ferguson Distributor or Dealer.
- The oil change period at 250 hours assumes proper maintenance of the engine and auxiliaries (i.e. air cleaner and lubrication filter) and that the fuel and oil used have been of the approved type and specification. If inadequate maintenance, or inferior oils have been used, engine oil changes must be more frequent.
- The dry air cleaner elements must be renewed every 1000 hours, or yearly or after a maximum of ten washings of the main element.
- If heavy work is involved the clutch and brake adjustments must be made more frequently.

PRE-DELIVERY AND INSTALLATION**Part 1—Section C**

Table of Contents	Page Number
GENERAL	01
PRE-DELIVERY CHECK	01
TRACTOR INSTALLATION	02
TRACTOR STORAGE	02
PREPARING THE TRACTOR PRIOR TO RETURN TO WORK	03
TRACTOR WATERPROOFING	04

GENERAL

To ensure the regular maintenance of the tractor during the 12 month Warranty period, two free services must be carried out by the supplying Distributor or Dealer.

The two Free Service Vouchers, detailing the servicing to be carried out, cover the first 50 and 250 hours running of the tractor.

The timing of these two services has been calculated to provide maximum tractor efficiency throughout the Warranty period thus safeguarding the subsequent life of the tractor.

PRE-DELIVERY CHECK

The following items must be checked by the Distributor before delivery to a Dealer and by the Dealer before delivery to an Owner or Operator.

1. Check and replenish the battery electrolyte level. Clean the battery top and smear the terminals with petroleum jelly. Charge the battery if necessary.
2. Check all electrical connections, cable clips and lights.
3. Check and replenish the levels in the following:
 - Hydro-Static steering reservoir
 - Engine sump
 - Centre housing
 - Epicyclic hubs.
4. Lubricate all greasing points.
5. Check and adjust the alternator/fan belt tension.

6. Except when an anti-freeze solution is provided, flush the cooling system and refill with soft water.
7. Remove the clutch pedal keeper and check the clutch adjustment.
8. Check that the correct fuel is in the tank and the content is sufficient.
9. Check the torque of the cylinder head, inlet and exhaust manifold nuts and bolts.
10. Check and adjust the tappets and inspect the valve springs.
11. Check the injectors, de-aerate the fuel system and tighten all fuel pipe connections.
12. Check the security of the engine air cleaner hoses.
13. Fit the lower and top links and free the linkage joints.
14. Start the engine.
15. Check the instruments and warning lights for efficient operation.
16. Check the engine governor with the foot and hand linkage and the tachometer.
17. Attach an implement and check the tractor hydraulics for efficient operation.
18. Check and adjust the tyre pressures.
19. Check the security of all nuts, bolts, plugs, unions and clips.
20. Check all hoses for chafing and leaks.
21. Check the headlamp alignment.
22. Road test the tractor, checking the brakes, instruments and services for efficient operation.

PRE-DELIVERY AND INSTALLATION

TRACTOR INSTALLATION

Instructions are to be given to the Owner or Operator on the items listed below:

1. Safety Precautions.
2. Location and Significance of Tractor and Engine Serial Numbers.
3. Instruments and Controls.
4. Running In.
5. Starting and Stopping Procedures.
6. Gear Selection and danger of changing gear on the move.
7. Coasting and Towing.
8. Use of Multi-Power.
9. Use and Adjustment of Brakes and Interlock Latch.
10. Use and Adjustment of Clutch.
11. Use and Adjustment of Differential Lock.
12. P.t.o. Speed and Usage.
13. Operation of Hydraulic Lift System.
14. Attaching and Detaching Implements. (Danger of towing from Top Link).
15. Lubrication and Grease Points.
16. Changing of Factory Fill Oils.
17. Engine and Transmission Filter Replacements.
18. Operation of Fuel System. De-aeration and Air Cleaner.
19. Cooling System, Frost Precautions and Alternator/Fan Belt Adjustment.
20. Maintenance of Electrical Equipment. Negative Earth System.
21. Power Steering.
22. Wheel Track Settings.
23. Tyre Pressures.
24. Security of all Nuts and Bolts.
25. Fuel Handling and Storage.
26. Use and Attachment of Auxiliary Hydraulic Equipment.
27. Fill in the Serial No. etc., details in the Operator Instruction Book.

TRACTOR STORAGE

General

When preparing a tractor for storage, comply with the following recommendations to ensure that the tractor is in good condition when required for use. Thoroughly clean the tractor, giving particular attention to the greasing points and oil filler plugs. Park the tractor in a dry, level and covered area away from the weather and livestock with easy exit in case of fire.

When the tractor has to be stored in the open air, park it on level ground in the shelter of a building or wall and completely cover it with a good tarpaulin.

Tyres

1. Jack up the tractor and position wooden blocks under the axles to relieve the tyres of all weight.
2. Inflate the tyres a little above the normal pressure and chalk that pressure on the tyre wall. Protect the tyres from direct sunlight.
3. When ballasted tyres are not filled with calcium chloride, deflate the tyres, empty out the water and re-inflate with air.
4. When wheel weights are fitted, remove, clean and paint any bare metal and refit.

Hydraulic Lift System

1. Check and replenish the transmission oil level in the centre housing to the high mark on the response cover dipstick.
2. Using the tractor hydraulics, with the response control in "FAST", raise and lower the linkage several times.
3. Engage the p.t.o. for a short period to obtain the maximum circulation of transmission oil around the centre housing.
4. Raise the linkage to the "Transport" position and support the two lift arms in this position with wooden props.
5. Leave the two quadrant levers in the 'Transport' position i.e., the "Draft" control (outer) lever past the "UP" and the "Position" control (inner) lever in "TRANSPORT". Do NOT MOVE the quadrant control levers from these positions.

Hydro-Static Steering

1. Remove the filler plug from the reservoir and add the approved oil to the bottom of the oil filler plug hole. Refit the filler plug.
2. Clean and coat the exposed steering rams with grease.

Engine

1. Drain the engine sump, when hot if possible.
2. Change the filter element.
3. Refill the engine sump with an approved grade of oil.
4. Seal the crankcase breather, exhaust and air cleaner pipes with adhesive tape.
5. Clean the dry air cleaner unit.

Cooling System

1. Drain the radiator and cylinder block, when hot if possible and leave the taps in the open position.
2. Rest the radiator cap on the filler neck.

Fuel System

1. Clean the fuel filler bowls, renew the elements and drain the fuel tank.
2. Adding a rust inhibitor, refill the fuel tank and bleed the fuel system of air.
3. Start the engine and run at half speed for 15 minutes to circulate the fuel through the lift and distributor pumps, filters, pipework and ejectors.
4. Top-up the fuel tank completely to prevent condensation forming on the unfilled portion of the tank thus resulting in rust and water contaminating the fuel. Rust if permitted to form in any large quantity can cause filter blockage.
5. Seal the gap between the sides of the fuel filler cap and pipe.
6. Remove the injectors and spray approximately 18 ccs (1/32 pt) of engine oil into each cylinder bore. Using new joint washers, refit the injectors and slowly rotate the crankshaft one complete revolution. Do *not* bleed the fuel system of air.
7. Lubricate the foot and hand throttle control linkage.

PRE-DELIVERY AND INSTALLATION**Clutch**

Fully depress the clutch pedal and hold down with a wooden keeper or wedge. The clutch friction plates (main and p.t.o.) will not then bond themselves to the flywheel or pressure plates.

Battery

1. Remove the battery from the tractor.
2. Check the electrolyte level and top up as necessary.
3. Clean the battery top and coat the terminals with petroleum jelly.
4. Fully charge the battery from an external source.
5. Repeat the external charge every month during the storage period and top up the electrolyte as necessary.
6. Store the battery in a cool, dry, dust free location but not directly on a concrete or metal surface. There must be no possibility of freezing.

Alternator and Starter Motor

1. Smear the alternator terminals with petroleum jelly.
2. Smear the starter motor and solenoid terminals with petroleum jelly.

Sheet Metal, Exposed Castings and Bright Metal Components

1. All rusty, scratched or bare patches of castings and/or sheet metal must be cleaned with abrasive papers and repainted. Matching colours are available for all M.F. Tractors.
2. The bright metal components and surfaces must be cleaned and/or degreased and the protectives sprayed or brushed on.

Cab

1. Empty the windscreen washer bottle.
2. Remove and exclude the windscreen wiper blade from daylight.
3. Remove and store the rear view mirrors, free and lubricate all hinges and locking devices.
4. Close the cab side and rear windows.
5. Wash and dry the inside and outsides of the cab windscreen, side and rear windows with soap and water.
9. Cover the windscreen, side and rear windows.
7. Lock the cab door, note the number of the door key. Store the key in a known spot in case of fire.

PREPARING THE TRACTOR PRIOR TO RETURN TO WORK**Cab**

1. Remove the covers and wash the cab windscreen, side and rear windows.
2. Refit the windscreen wiper blade.
3. Refit the rear view mirrors.
4. Fill the windscreen washer bottle.

Sheet Metal and Bright Metal Components

1. Clean off the protective from the bright metal parts and surrounding sheet metal.
2. Wash the sheet metal.

Alternator and Starter Motor

1. Clean the petroleum jelly from the alternator terminals.
2. Clean the petroleum jelly from the starter motor and solenoid terminals.

Battery

1. Check that the battery is fully charged. Do not check the electrolyte strength immediately after adding distilled water.
2. Check that the electrolyte is at the correct level.
3. Clean the battery top and smear the terminals with petroleum jelly.
4. Refit the battery to the tractor.

Clutch

Remove the wooden keeper or wedge from the clutch pedal linkage.

Fuel System

1. Remove the adhesive tape seal from the fuel filler cap and pipe.
2. Check the level in the fuel tank: investigate any loss and eliminate the cause.
3. Bleed the fuel system of air.

Cooling System

1. Close the taps in the cylinder block and radiator.
2. Refill the cooling system slowly with clean rain or soft water.
3. In winter, refill the cooling system with an anti-freeze solution.
4. Check all connections and joints for leaks.
5. After the engine has been run for fifteen minutes, see 'Starting the Engine', permit the radiator to cool, check the coolant level and replenish as necessary.

Engine

1. Remove the adhesive tape seals from the crankcase breather, exhaust and air cleaner pipes.
2. Check the engine oil level, investigate any loss and eliminate the cause.

Hydro-static Steering

1. Check the hydro-static steering reservoir oil level, investigate any loss and eliminate the cause.
2. Clean the steering rams of grease and leave clean and dry.

Hydraulic Lift System

1. Check the centre housing transmission oil level, investigate any loss and eliminate the cause.
2. Remove the two wooden props from the lift arms.

Tyres

1. Check the tyre pressures, investigate any loss and eliminate the cause.
2. Adjust the tyre pressures or deflate the tyres, replace the ballast as before and re-inflate as necessary.
3. Jack up the axles and remove the wooden blocks,

Fuel Gauge and Warning Lights

Turn the starter key to '+' and check that the fuel gauge begins to register and all warning lights glow. Investigate any mal-function and eliminate the cause.

Starting the Engine

1. Start the engine and run on a light load.
2. Check that the tachometer and fuel gauge register and all warning lights become extinguished. Investigate any mal-function and eliminate the cause.
3. Continue to run the engine for no more than 15 minutes, check all system for correct function. Investigate any mal-function and eliminate the cause.

PRE-DELIVERY AND INSTALLATION

TRACTOR WATERPROOFING

General

Before working in water, such as in Paddy Fields or flooded areas, certain waterproofing modifications must be made to the tractor.

Ideally, only tractors with disc brakes should be used in water as little can be done to ensure the efficiency of drum brakes when the water depth exceeds 600 mm (24 in).

In addition, two extra maintenance services are required.

ELECTRICAL EQUIPMENT

'VYPATCH' Putty and 'VYCOAT'

The 'VYPATCH' Putty and 'VYCOAT' recommended for sealing the starter motor and solenoid assembly is available from:

Products Division,
Plastic Coatings Ltd.
Trading Estate,
Farnham,
Surrey,
England.

Starter Motor and Solenoid Assembly

1. Remove the starter motor and solenoid assembly.
2. Thoroughly clean the exterior of the starter motor and solenoid assembly.
3. Blank off the drive end bracket.
4. Seal all the openings in the starter motor and solenoid assembly with 'VYPATCH'.
5. Apply a thick coating of grease to the starter motor and solenoid terminals and ensure that the drive end bracket is blanked off.
6. Spray the exterior of the starter motor and solenoid assembly with a thick coat of 'VYCOAT'.
7. Dry for at least 10 minutes and spray the exterior of the starter motor and solenoid assembly with a second thick coat of 'VYCOAT'.
8. Let the 'VYCOAT' harden and clean the grease coating from the starter motor and solenoid terminals and remove the blank from the drive end bracket.
9. Refit the starter motor and solenoid assembly to the engine.
10. Reconnect the wiring harness.

Battery

Clean the battery top and smear the battery terminals with petroleum jelly.

Engine

Engine Breather Pipe

NOTE: The engine breather pipe is of a critical length and after modification it can be longer but **NEVER** shorter. When refitted it must point generally in a downward direction without 'U' bends or restrictions to trap liquid or dirt.

1. Shorten the existing breather pipe by approximately 200 mm (8 in).
2. Attach a 225 mm (9in) length of rubber piping to the shortened engine breather pipe.
3. Route the rubber piping to the front of the engine and secure it to one of the timing case bolts with a suitable clip.

Engine Dipstick

1. Remove the engine dipstick and store in the tool box.
2. Fit a tapered rubber plug to the engine dipstick tube.

Transmission

Clutch Housing Drain Hole

1. Discard the split pin in the drain hole in the clutch housing.
2. Enlarge the drain hole, tap and fit a screwed plug.

Clutch Housing Cover Plate Gasket

1. Remove the four bolts and the cover plate beneath the clutch housing.
2. Refit the cover plate to the clutch housing with the gasket (part No. 180 481 M1) between and the four original bolts.

Clutch Pedal Cross-shaft

1. Drill and tap the two bosses from which the pedal cross-shaft protrudes.
2. Fit two grease nipples to the tappings. Should the grease nipples foul the pedal cross-shaft, fit small fibre washers to the threaded shank.
3. Grease the cross-shaft until the grease just exudes from around the pedal cross-shaft but do not over grease.

P.T.O. Shaft Cap

1. Remove the p.t.o. cap.
2. Grease both threads.
3. Refit the p.t.o. cap and screw it fully home.

Centre Housing Dipstick

1. Remove the centre housing dipstick from the response control cover and store in the dipstick.
2. Fit a tapered rubber plug to the response control cover.

Brakes

Pedal Cross-shaft

1. Drill and tap the two bosses from which the pedal and cross-shaft protrudes.
2. Fit two grease nipples to the tappings. Should the grease nipples foul the pedal cross shaft, fit small fibre washers to the threaded shanks.
3. Grease the two nipples until the grease just exudes from around the pedal cross shaft.

Extra Maintenance

Every 10 hours or Daily

Charge all grease points with an approved grease until it exudes from the seals or shafts.

Every 50 hours or Weekly

1. Remove the clutch housing, drain plug, permit any water to drain away and refit the drain plug.
2. Ensure that the engine breather pipe is unobstructed.

**MF 600 SERIES TRACTOR
WORKSHOP SERVICE MANUAL
PART 2**

Publication No. 1856 274 M1

comprising

- A SHEET METAL
- B CAB AND FITTINGS

SHEET METAL

Part 2—Section A

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SHEET METAL**GENERAL**

The hood, grille and front side panels are shown. The sheet metal components are easily removed and refitted, and provide protection for the tractor.

The tractor must not be operated with any of these panels removed, except for the power take off guard, which has to be removed when certain implements are used.

To prevent corrosion, always keep the sheet metal clean, respraying the metal as soon as possible when any parts become chipped.

FRONT GRILLE**Removal and Refitment**

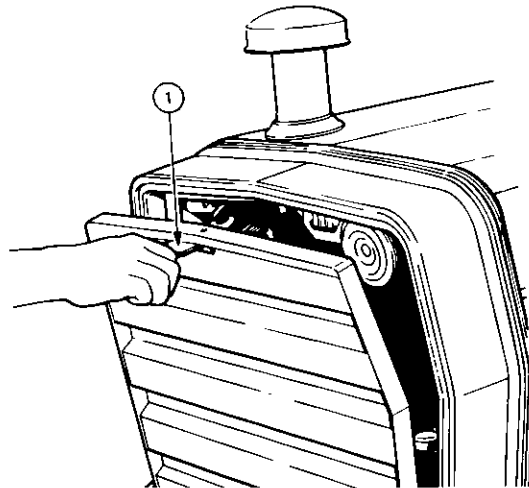
2A-01-02

Removal

1. Pull the front grille release catch forward.
2. Pull the grille forward.
3. Remove the grille lifting it upward.

Refitment

4. Reverse procedures 1 to 3.

**HOOD****Removal and Refitment**

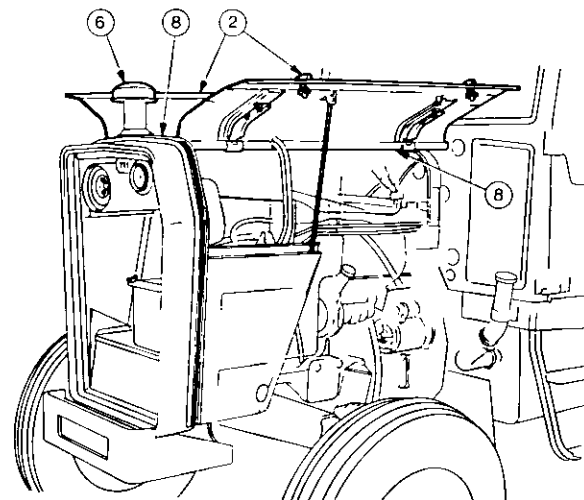
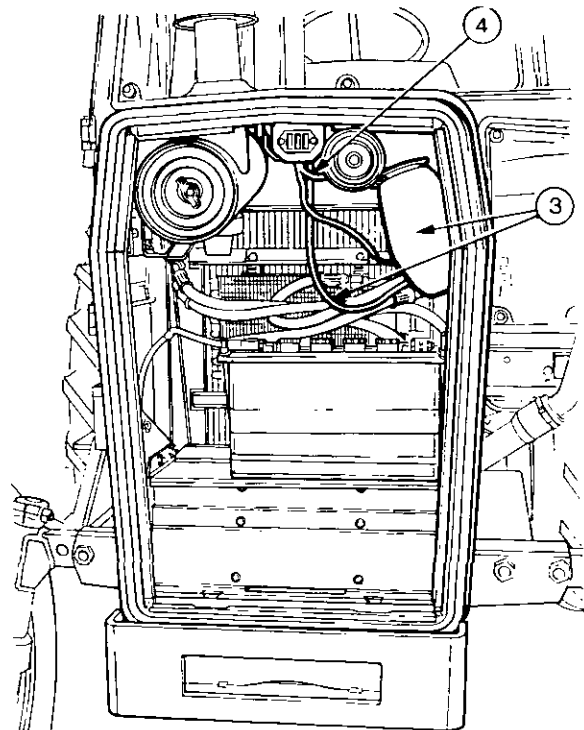
2A-02-02

Removal

1. Remove the front grille. Operation 2A-01-02.
2. Undo hand clamps, raise each side of hood and support in the open position using the props attached to the inside of hood.
3. Remove the wires attached to the screen washer bottle, situated on the inside of nose. Remove tube and lift out washer bottle.
4. Remove wires from the horn and headlight contact switch.
5. Pull harness rearward through hood inner panel.
6. Remove the air cleaner pre-cleaner from front end of hood.
7. Slacken two clamp nuts on the exhaust silencer and remove the silencer.
8. From the underside of hood, remove the two bolts at the front and the two at the rear. Lift the hood clear.

Refitment

9. Reverse procedures 1 to 8 ensuring the hood seats correctly on the front rubber seal when clamped in position.

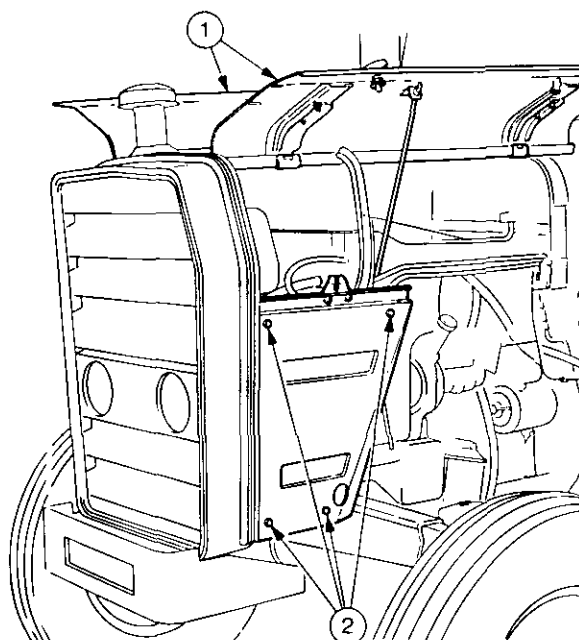


SIDE PANEL**Removal and Refitment** 2A-03-03**Removal**

1. Undo the hand clamp, raise the hood and support in the open position using the prop attached to the inside of hood, but do not use hole in the top of side panel for location.
2. Remove the four bolts.
3. Lift panel clear.

Refitment

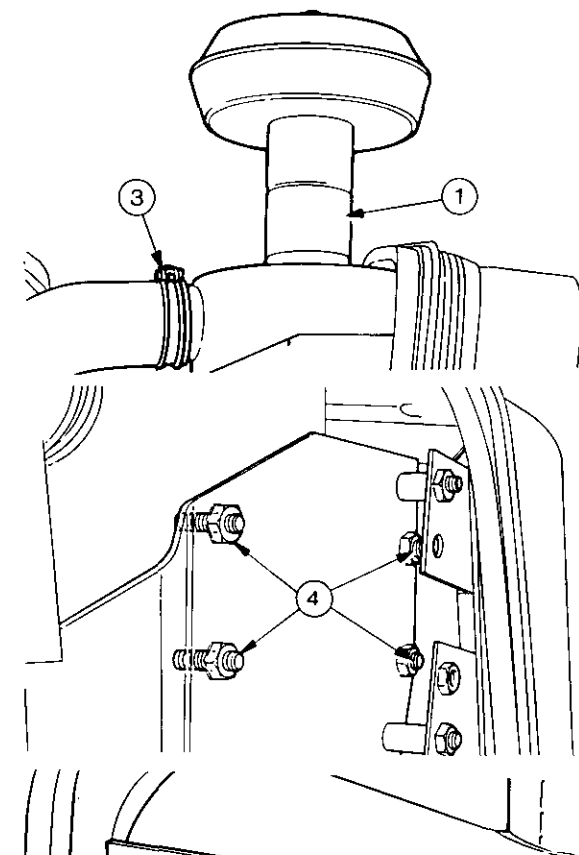
4. Reverse procedures 1 and 2 tightening the bolts to a torque of 20 Nm (15lbf ft).

**AIR CLEANER (DRY)****Removal and Refitment** 2A-04-03**Removal**

1. Remove the pre-cleaner from the top of the air cleaner.
2. Undo the hand clamps, raise the right hand side of the hood and support in the open position using the prop attached to the inside of the hood.
3. Undo the hose clip.
4. Remove the four bolts securing it to the side panel and lift it clear.

Refitment

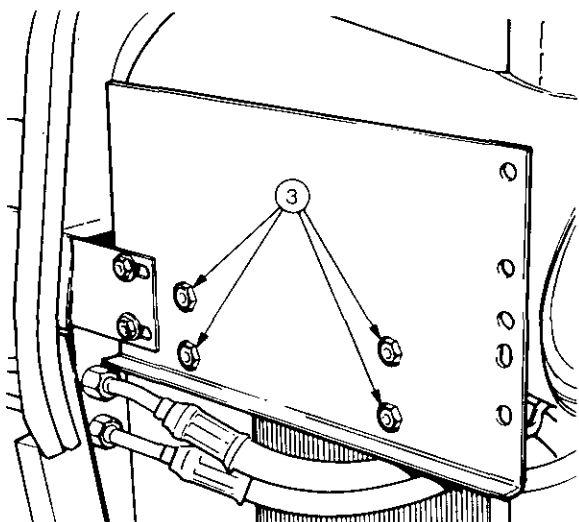
5. Reverse procedures 1 to 4.

**AIR CLEANER (OIL BATH)****Removal and Refitment** 2A-05-03**Removal**

1. Remove the pre-cleaner from the top of the air cleaner.
2. Undo the hand clamps, raise the right hand side of the hood and support in the open position using the prop attached to the inside of the hood.
3. Undo the hose clip.
4. Remove the four bolts securing it to the side panel and lift it clear.

Refitment

5. Reverse procedures 1 to 3.



SHEET METAL**STONE GUARD—LOWER****Removal and Refitment**

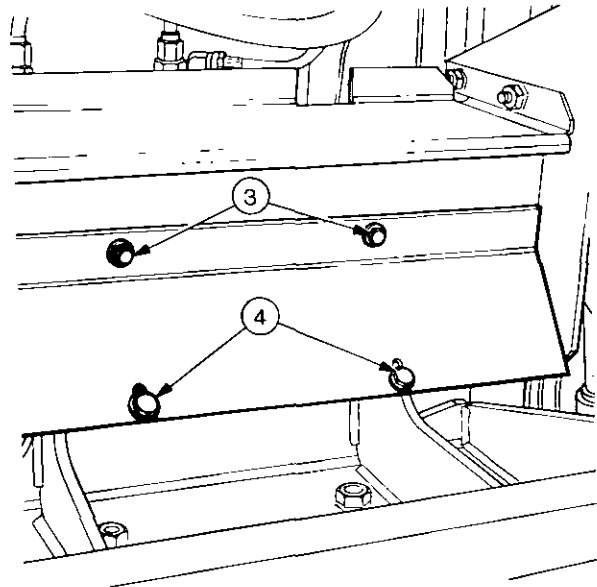
2A-06-04

Removal

1. Remove front grille. Operation 2A-01-02.
2. Remove the battery. Operation 9A-02-05.
3. Remove the two bolts securing it to the battery tray.
4. Remove the two bolts securing it to the bottom of the nose.
5. Lift guard clear.

Refitment

6. Reverse procedures 1 to 5.

**NOSE****Removal and Refitment**

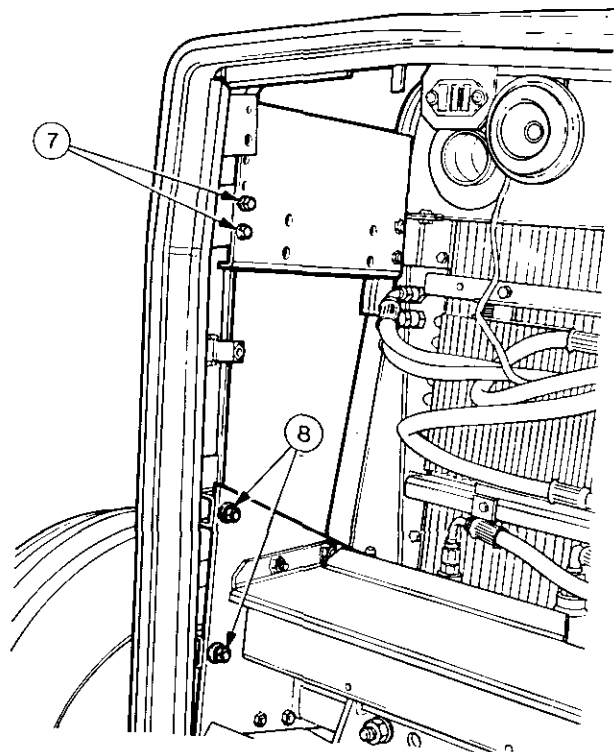
2A-07-04

Removal

1. Remove the front grille. Operation 2A-01-02.
2. Remove the hood. Operation 2A-02-02.
3. Remove the side panels. Operation 2A-03-03.
4. Remove the air cleaner. Operation 2A-04-03 or operation 2A-05-03.
5. Remove the battery. Operation 9A-02-05.
6. Remove the lower stoneguard. Operation 2A-06-04.
7. Remove the two bolts securing the air-cleaner side plate to the top of the nose.
8. Remove the two bolts from each side of the nose, which secure it to the two lower side plates.
9. Lift the nose clear.

Refitment

10. Reverse procedures 1 to 9 tightening the four lower bolts.



BATTERY TRAY**Removal and Refitment**

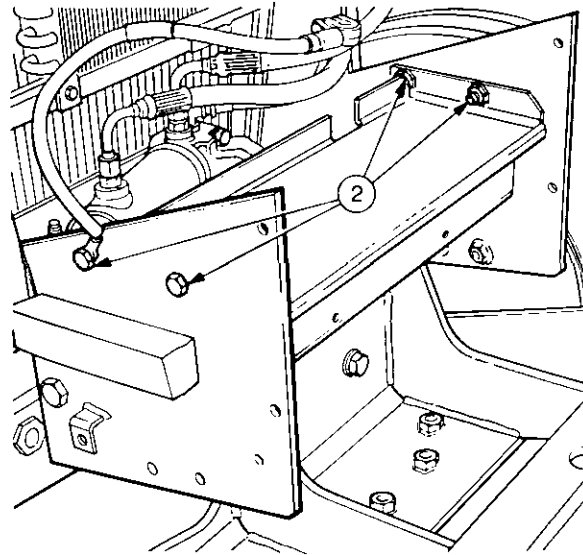
2A-08-05

Removal

1. Remove the stone guard lower. Operation 2A-06-04.
2. Remove the four bolts securing it to each of the two side panels.
3. Lift the tray clear, together with the negative battery cable attached to one of the R.H. bolts.

Refitment

4. Reverse procedures 1 to 3.

**STONE GUARD-UPPER****Removal and Refitment**

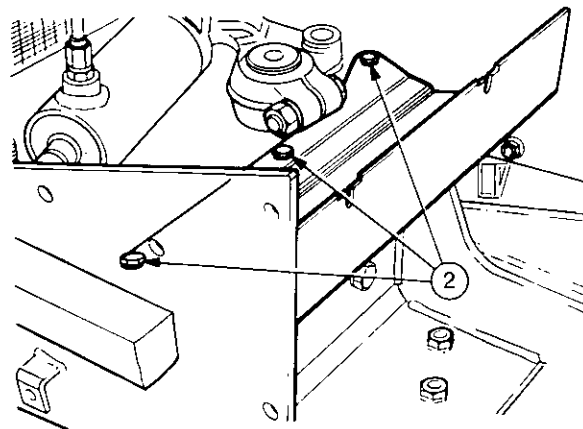
2A-09-05

Removal

1. Remove the battery tray. Operation 2A-08-05.
2. Remove the three bolts securing it to the top face of the front support.
3. Lift guard clear.

Refitment

4. Reverse procedures 1 to 3.

**AIR CLEANER SIDE PLATE****Removal and Refitment**

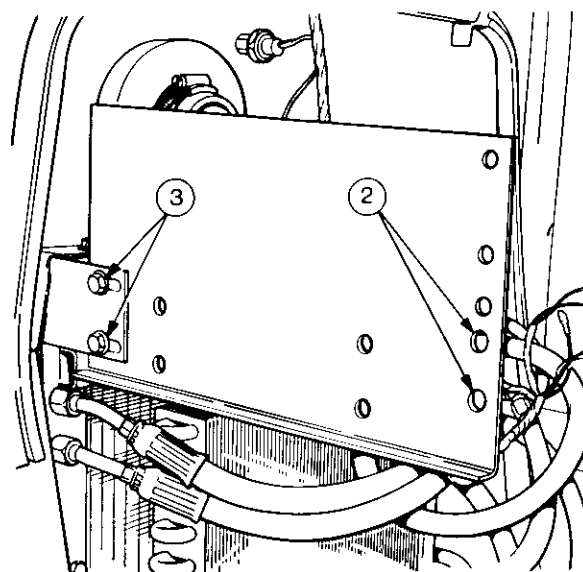
2A-10-05

Removal

1. Remove the air cleaner. Operation 2A-04-03 or 2A-05-03.
2. Remove the two bolts securing it to the top right hand side of the nose.
3. Remove the two bolts securing it to the bracket attached to the top right hand side of the radiator side panel.
4. Lift the plate clear.

Refitment

5. Reverse procedures 1 to 4.



NOSE SUPPORT BRACKET AND WEIGHT FRAME

Removal and Refitment

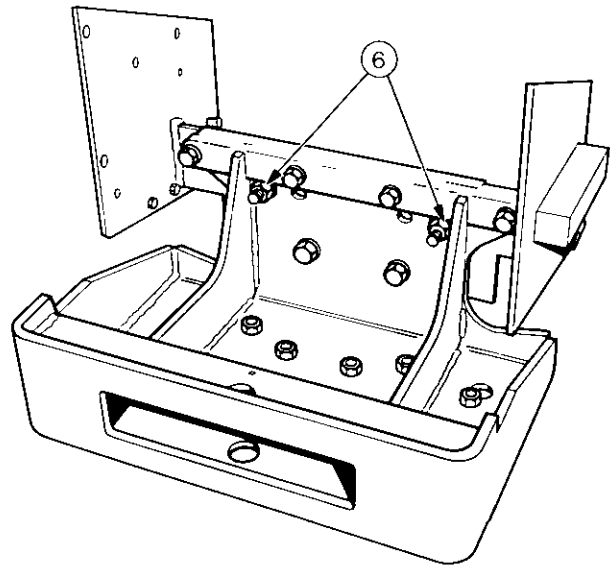
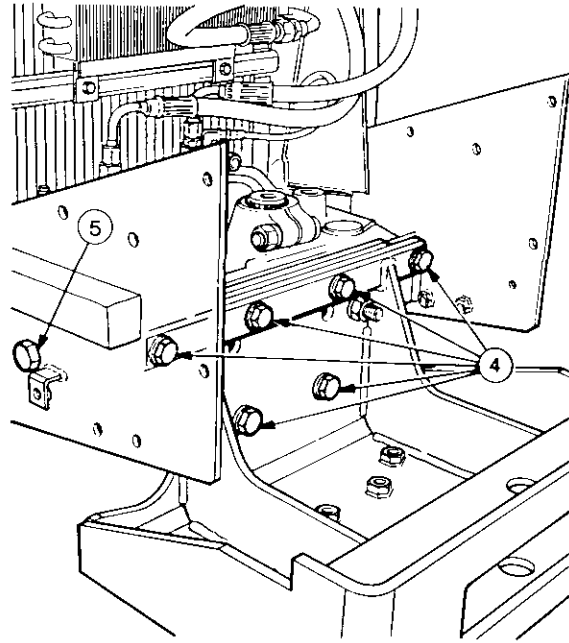
2A—11—06

Removal

1. Remove the nose. Operation 2A—07—04
2. Remove the stone guard upper. Operation 2A—09—06.
3. Suitably support the weight frame from underneath.
4. Remove the six bolts securing the weight frame and nose support bracket to the front support.
5. Remove the bolt from each side that secures the assembly to the side of the front support and lift the assembly clear.
6. Remove the two nuts and bolts that secure the weight frame and support bracket together.

Refitment

7. Reverse procedures 1 to 6 tightening all the bolts



RADIATOR SUPPORT FRAME, TOP PANEL AND SIDE PANEL

Removal and Refitment

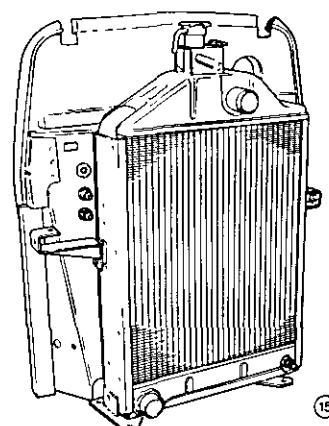
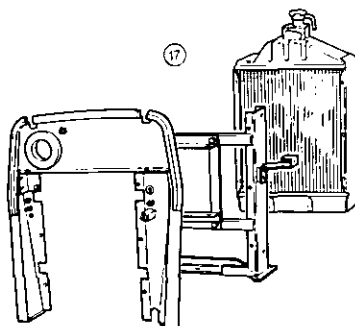
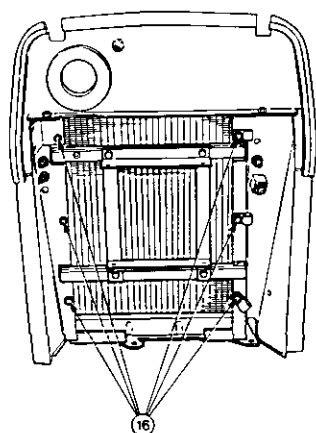
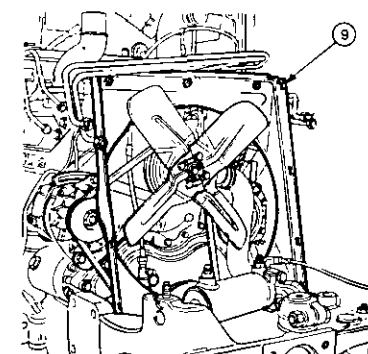
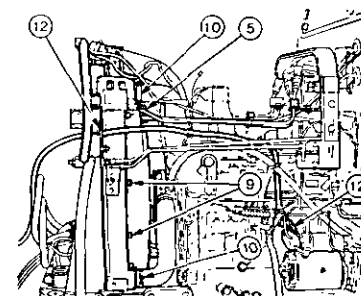
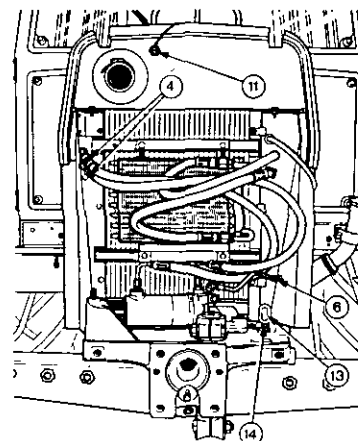
2A-12-07

Removal

1. Remove the nose assembly. Operation 2A-07-04.
2. Drain the radiator.
3. Disconnect the transmission oil cooler hoses and bundy pipes from the two connectors on the left hand side panel. Remove the oil cooler by lifting it against its springs, and prising forward.
4. Disconnect the two power steering ram hoses and the bundy pipes from the two connectors on the right hand side panel.
5. Remove the bundy pipe clamp from the radiator top panel.
6. Disconnect the power steering ram grease pipe from the connector on the bottom of left hand side panel.
7. Remove the alternator guard from the right hand side of radiator frame.
8. Remove the fan guard from the left hand side of radiator frame.
9. Remove the screws securing the fan cowl to each side of the radiator frame and push cowl backwards over fan.
10. Disconnect the radiator inlet and outlet hoses.
11. Disconnect the wire from the air cleaner sensor fitted to the top panel.
12. Disconnect the positive battery lead from the starter motor and pull it forwards through the grommet in the left hand side panel.
13. Remove the grommet in the bottom of the left hand side panel.
14. Remove the four bolts that secure the radiator frame to the front support.
15. Lift the radiator complete with the support frame, side and top panels, clear of the tractor.
16. Remove the six bolts securing the side and top panels to the radiator frame and lift them away from the radiator and frame.
17. Lift the radiator upwards clear of the frame.

Refitment

18. Reverse procedures 1 to 7.



SHEET METAL

REAR HOOD SUPPORT

Removal and Refitment

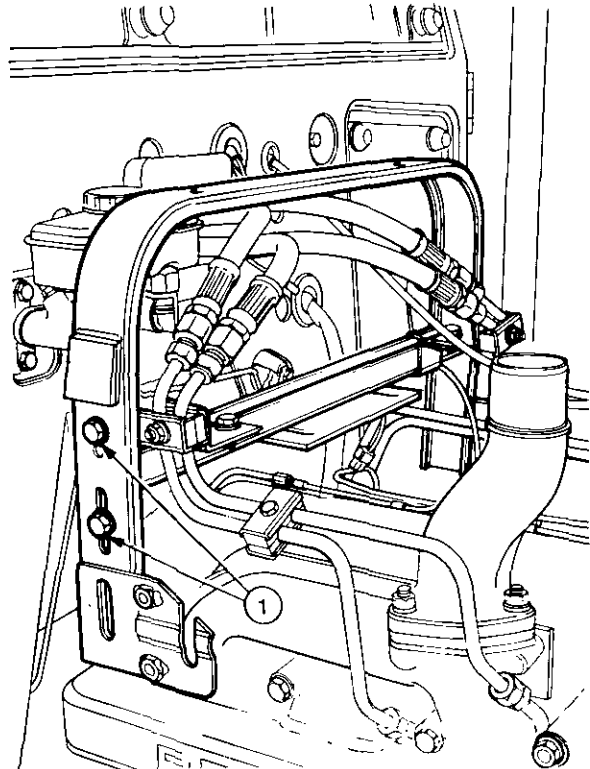
2A-13-08

Removal

1. Remove the two bolts each side that secure the support to the cross member.
2. Lift the support clear.

Refitment

3. Reverse procedures 1 and 2.



REAR HOOD SUPPORT CROSS MEMBER

Removal and Refitment

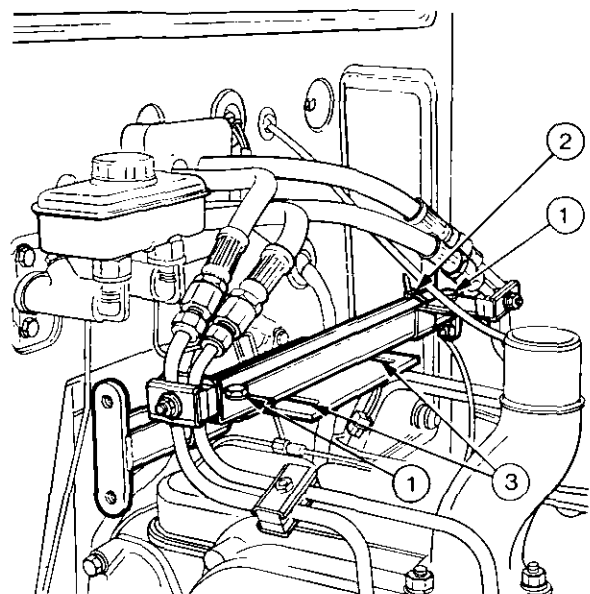
2A-14-08

Removal

1. Remove the bolt securing each of the two brackets supporting the power steering bundy pipes to the cross member.
2. Undo tie securing the fuel cut off cable.
3. Remove the two bolts securing the cross member to the bracket bolted to the rear of engine.
4. Lift the cross member clear.

Refitment

5. Reverse procedures 1 to 5.



REAR NUMBER PLATE ASSEMBLY**Removal and Refitment**

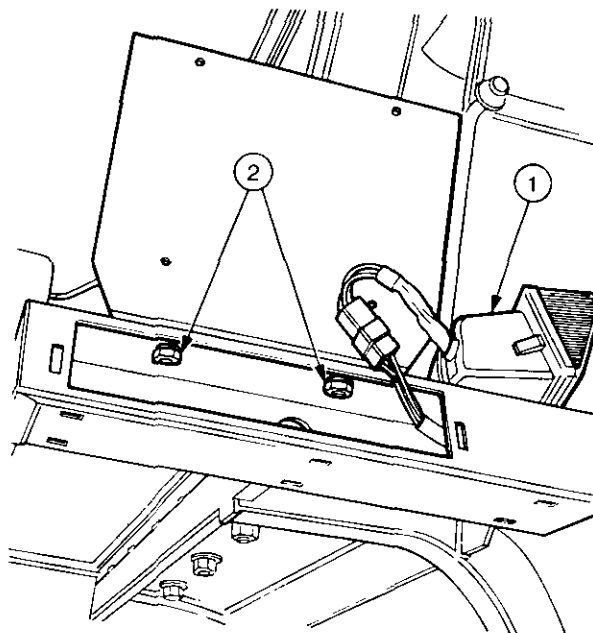
2A-15-09

Removal

1. Prise the rear lamp cluster out of the aperture in the left hand fender.
2. From inside the exposed aperture, remove the two nuts securing the number plate to the fender.

Refitment

3. Reverse procedures 1 and 2.

**REAR CENTRE PANEL****Removal and Refitment**

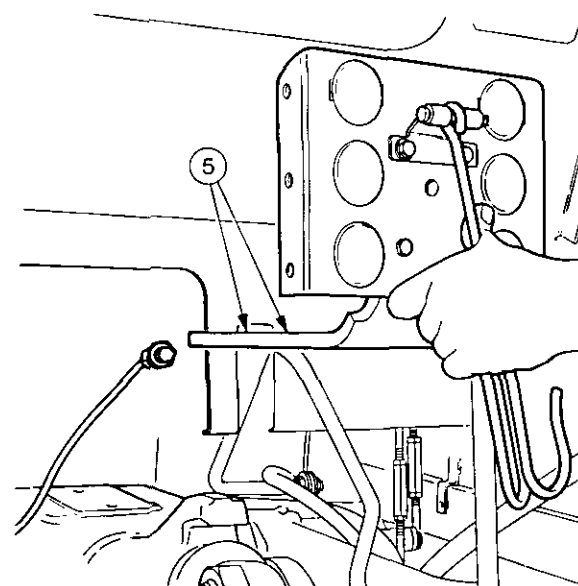
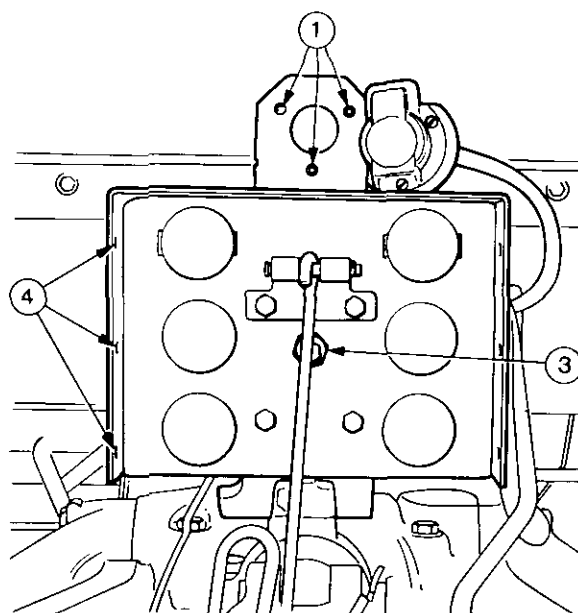
2A-16-09

Removal

1. Remove the three screws securing the trailer socket to the rear panel.
2. If spool valves are fitted remove the circlips securing them to the centre panel.
3. Remove the plug from end of l.p.t.o. pipe followed by the lock washer. Pull pipe clear of the centre panel.
4. Remove the three bolts each side securing the surround to the centre panel and lift it clear.
5. Remove the bolts securing the centre panel to the top of the lift cover.
6. Lift the centre panel surround complete with bracket, away from the tractor.

Refitment

7. Reverse procedures 1 to 5.



SHEET METAL

REAR FILLER PANEL

Removal and Refitment

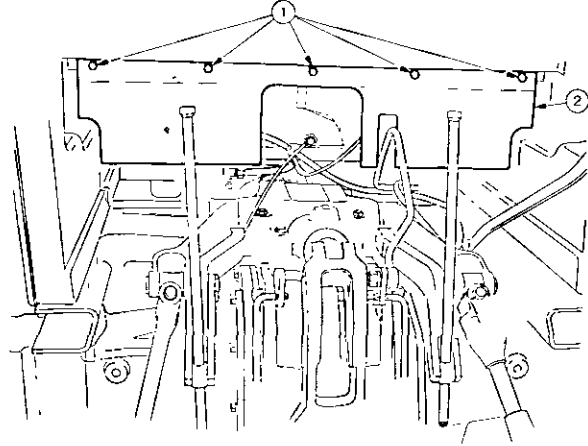
2A—17—10

Removal

1. Slacken the five bolts securing the filler panel to the back of cab.
2. Slide the panel down and away from the tractor.

Refitment

3. Reverse procedures 1 and 2.



SEAT

Removal and Refitment

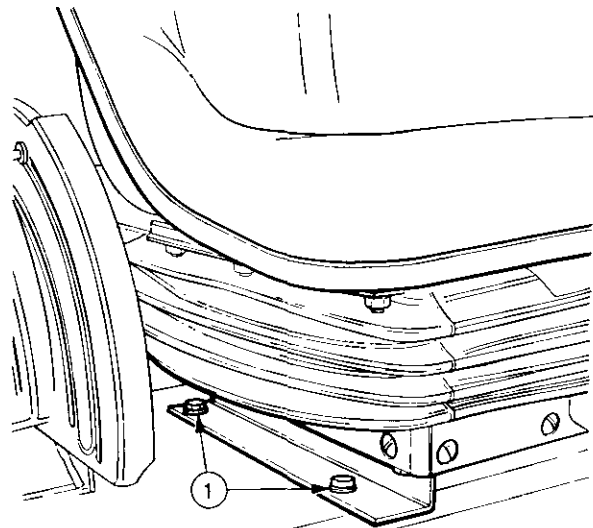
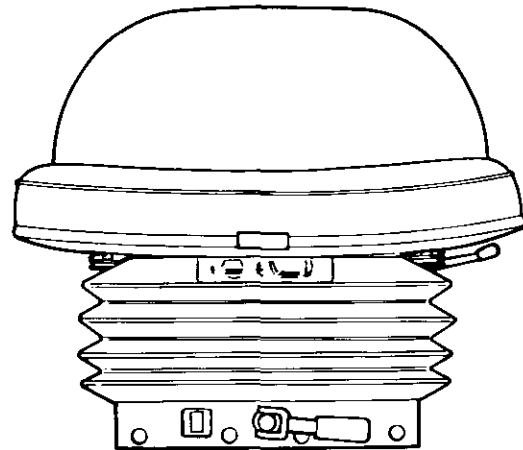
Removal

2A—18—10

1. Remove the four nuts, bolts and washers, securing the seat to the cab floor.
2. Lift the seat clear.

Refitment

3. Reverse procedures 1 and 2.



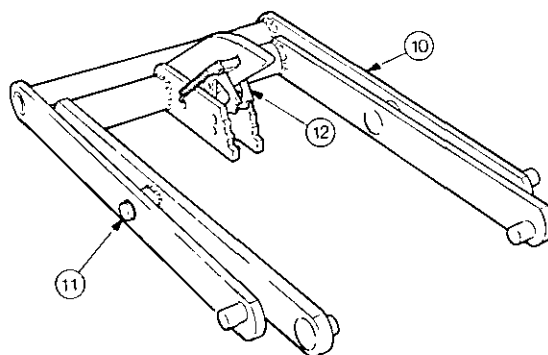
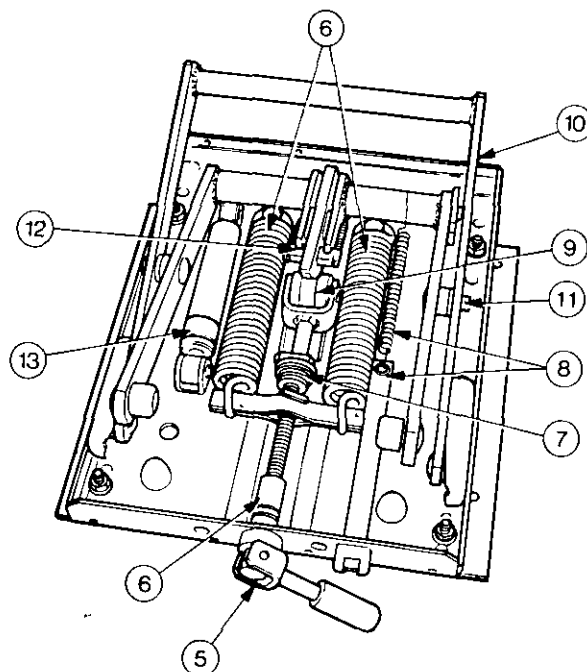
SEAT WEIGHT ADJUSTING MECHANISM**Servicing**

2A-19-11

1. Remove the complete seat from the cab operation 2A-18-10.
2. Remove the five nuts, washers and screws from lower seat tracking. This will separate the spring mechanism from the seat.
3. Remove the four bolts so as to separate upper tracking from seat.
4. Pull out studs on rubber seat cover and remove from seat mechanism.
5. Wind down the weight adjuster to the point of least tension and remove pin from handle.
6. Remove the weight adjusting rod by first withdrawing the small pin rod. The two springs can now be removed.
7. Prise out the four washers, thrust race, retaining clip and bar from position.
8. Remove weight adjustment tape and spring. Withdraw retaining bolt.
9. Remove the roller from its holder.
10. Remove the two pins so as to disassemble the seat brace.
11. This can be further separated by removing the two circlips and washers.
12. Separate the height adjuster by removing two springs, metal bar hexagonal roller and two metal pieces.
13. Remove two pins and circlips and remove gas strut. This will separate the two plates of the seat weight adjuster.

Reassembly

14. Check condition of components and replace as necessary.
15. Reverse procedure 1-13.



CAB AND FITTINGS

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CAB AND FITTINGS**Part 2—Section B**

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CAB AND FITTINGS

Part 2—Section B

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CAB AND FITTINGS

DOOR GLASS**Removal and Refitment**

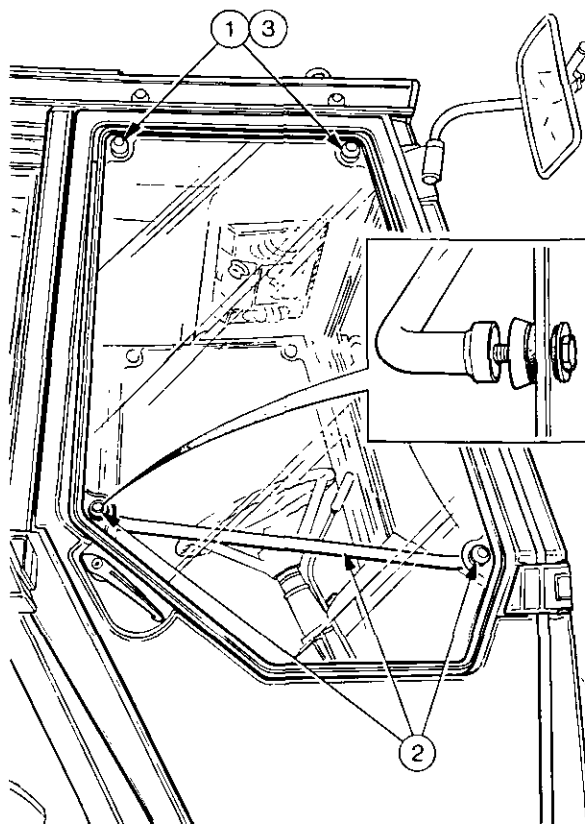
2B-01-05

Removal

1. Remove the four plastic caps from the bolt heads on outside, and the nuts on the inside of the upper two.
2. Remove the two lower bolts together with the grab handle.
3. Remove the two upper nuts and bolts.
4. Remove the glass from the door.

Refitment

5. Reverse procedures 1 to 4.

**FRONT SCREEN GLASS****Removal and Refitment**

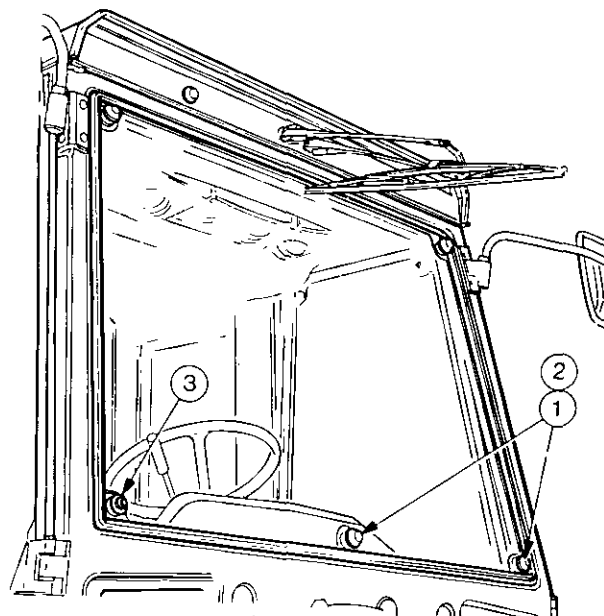
2B-02-05

Removal

1. Remove the five plastic caps from the nuts on the outside.
2. Remove the five plastic caps from the bolt heads on the inside.
3. Remove the five nuts and bolts.
4. Carefully remove the screen complete with sealing rubber.

Refitment

5. Reverse procedures 1 to 4.

**SIDE GLASS****Removal and Refitment**

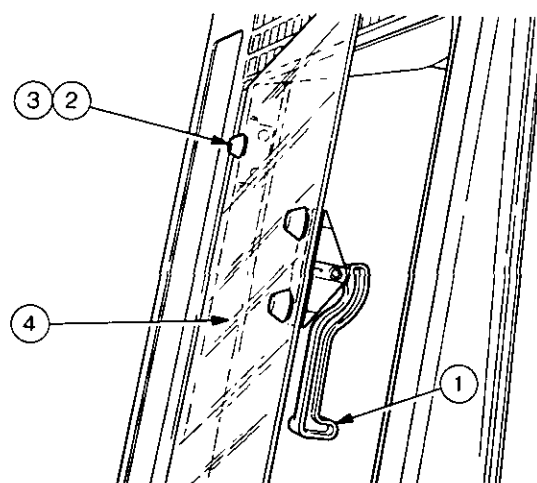
2B-03-05

Removal

1. Pull window catch clear of retainer pin.
2. Remove the two plastic caps from the nuts on the outside.
3. Remove the two nuts and bolts.
4. Carefully remove the side glass.

Refitment

5. Reverse procedures 1 to 4.



CAB AND FITTINGS**FRONT LOWER BULKHEAD GLASS****Removal and Refitment**

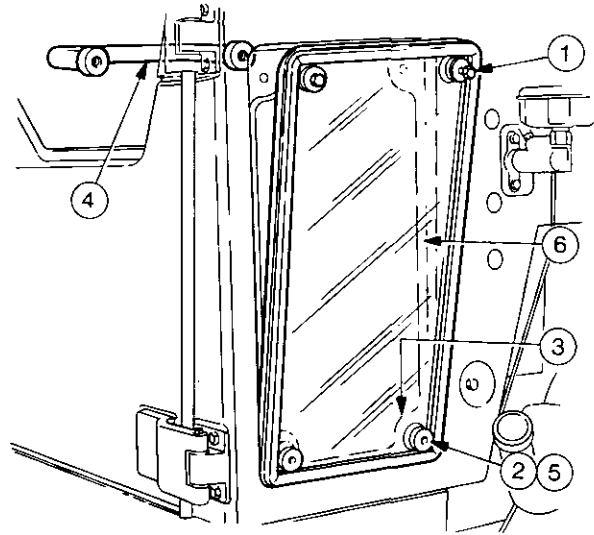
2B-04-06

Removal

1. Remove the two plastic caps from the two upper bolt heads on the outside.
2. Remove the two plastic caps from the two lower nuts on the outside.
3. Remove the two plastic caps from the two lower bolt heads on the inside.
4. Remove the two upper bolts together with the grab handle.
5. Remove the two lower nuts and bolts.
6. Carefully remove the glass together with the sealing rubber.

Refitment

7. Reverse procedures 1 to 6.

**REAR WINDOW GLASS****Removal and Refitment**

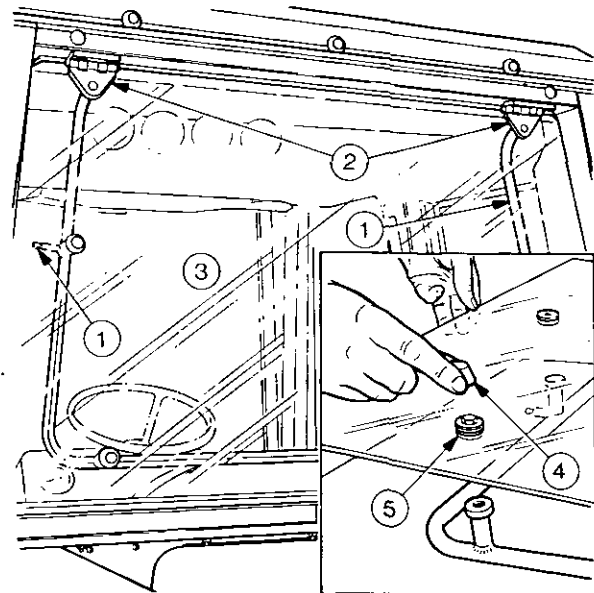
2B-05-06

Removal

1. Prise the two gas strut ends off the pivots attached to each side grab handle and to each pillar.
2. Remove the two bolts securing the hinges to the top of the glass.
3. Carefully lift the glass clear, complete with the grab handle.
4. Place glass on bench, remove the five plastic caps from bolt heads.
5. Remove the five bolts securing glass to the grab handle.

Refitment

6. Reverse procedures 1 to 5.

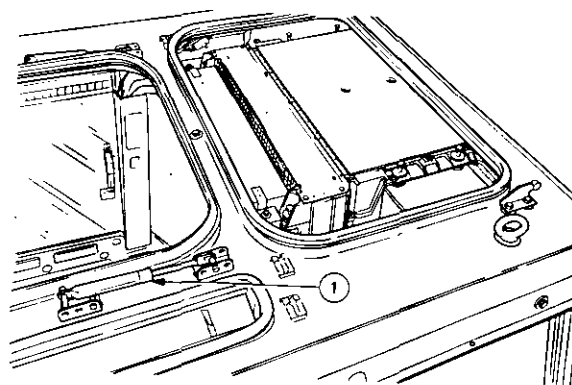


ESCAPE HATCH**Removal and Refitment** 2B-06-07**Removal**

1. Release the two gas struts from the plastic pivot blocks on the hatch.
2. Remove the two bolts from one of the hinge brackets attached to the roof.
3. Lift the escape hatch clear.

Refitment

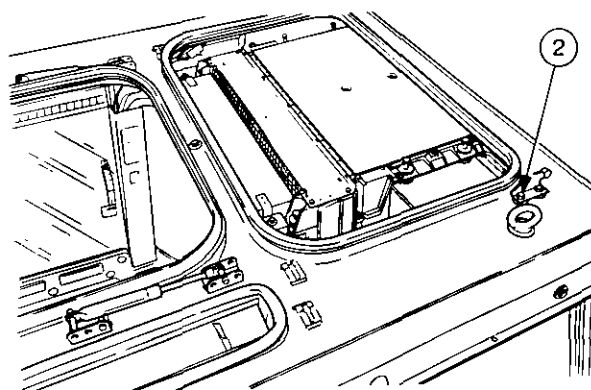
4. Reverse procedures 1 to 3.

**HEATER ACCESS DOOR****Removal and Refitment** 2B-07-07**Removal**

1. Undo the two quick release catches securing the door to the top of roof.
2. Remove the two bolts from one of the hinge brackets attached to the door.
3. Lift the door clear.

Refitment

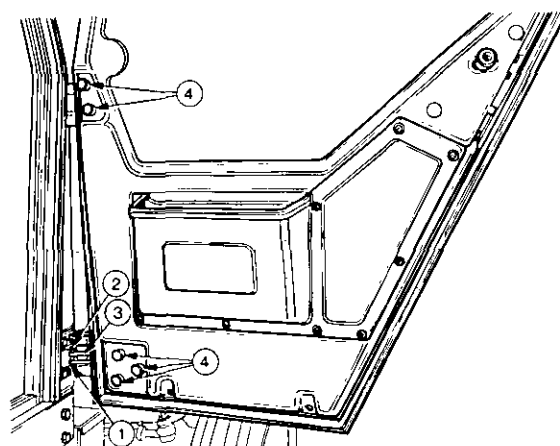
4. Reverse procedures 1 to 3.

**DOOR****Removal and Refitment** 2B-08-07**Removal**

1. Remove the split pin from the check strap pivot pin at the bottom of the door.
2. Remove the pivot pin.
3. Slide the check strap off.
4. Remove the five plastic caps from the hinge bolt head on the inside of door.
5. Remove the five bolts.
6. Lift the door clear of tractor.

Refitment

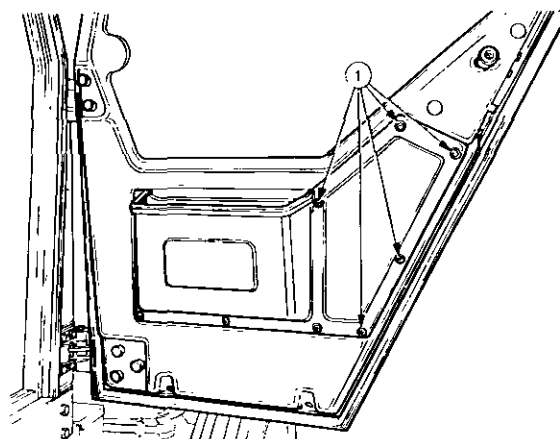
7. Reverse procedures 1 to 6.

**DOOR POCKETS****Removal and Refitment** 2B-09-07**Removal**

1. Remove the nine screws securing the pocket to the inside of door.
2. Lift pocket clear.

Refitment

3. Reverse procedures 1 and 2.



CAB AND FITTINGS**DOOR HANDLES****Removal and Refitment**

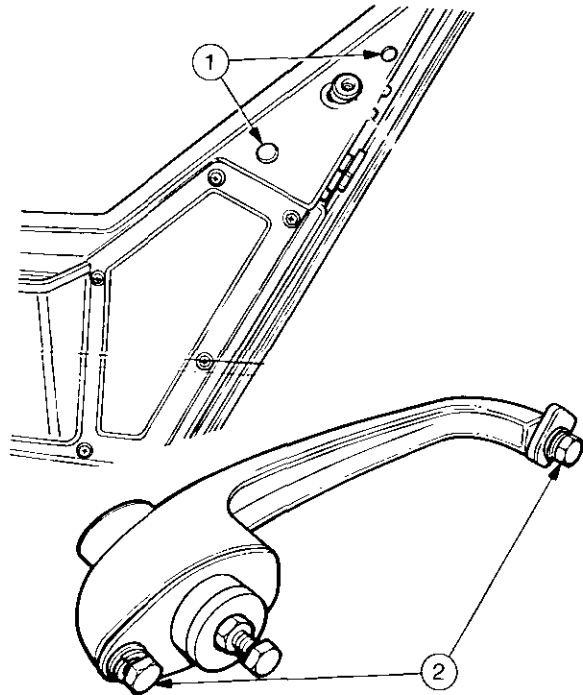
2B-10-08

Removal

1. Remove the two rubber grommets on the inside of door, one each side of catch release knob.
2. Using two holes exposed by the removal of the grommets, for access, remove the two screws securing the door handle to door.

Refitment

3. Reverse procedures 1 and 2.

**DOOR CATCH****Removal and Refitment**

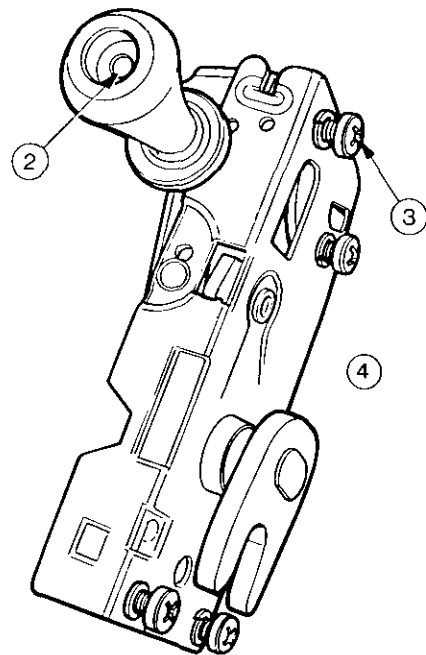
2B-11-08

Removal

1. Remove the door pocket operation.
2. Remove the screw securing the door release catch knob to the mechanism.
3. Remove the four screws securing the catch to the inside of door.
4. Using the large access exposed in the inner door panel by the removal of pocket, pull the door catch clear from the inside.

Refitment

5. Reverse procedures 1 to 4.

**DOOR MIRROR****Removal and Refitment**

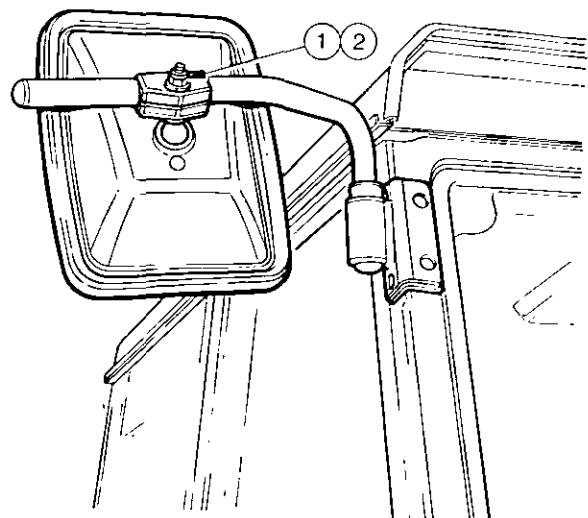
2B-12-08

Removal

1. Slacken clamp nut.
2. Slide mirror off arm.

Refitment

3. Reverse procedures 1 and 2.

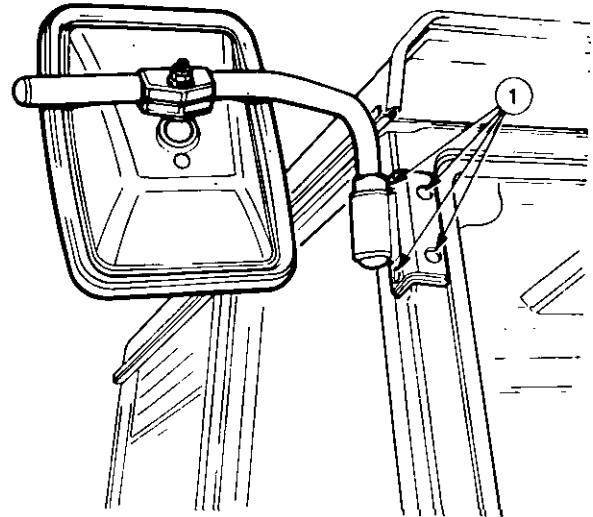


DOOR MIRROR MOUNTING BRACKET**Removal and Refitment** 2B-13-09**Removal**

1. Remove the four screws securing the bracket to 'A' post.
2. Lift bracket clear.

Refitment

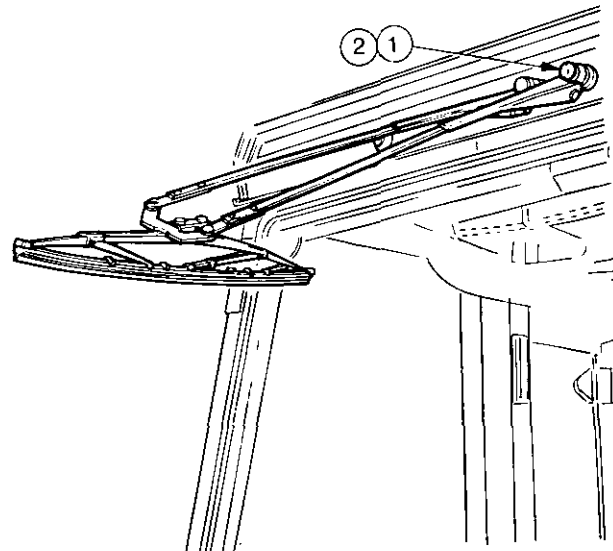
3. Reverse procedures 1 and 2.

**SCREEN WIPER ARMS****Removal and Refitment** 2B-14-09**Removal**

1. Remove the two plastic caps from the retaining nuts.
2. Remove the two nuts.
3. Prise the arms off the tapered splined lugs.

Refitment

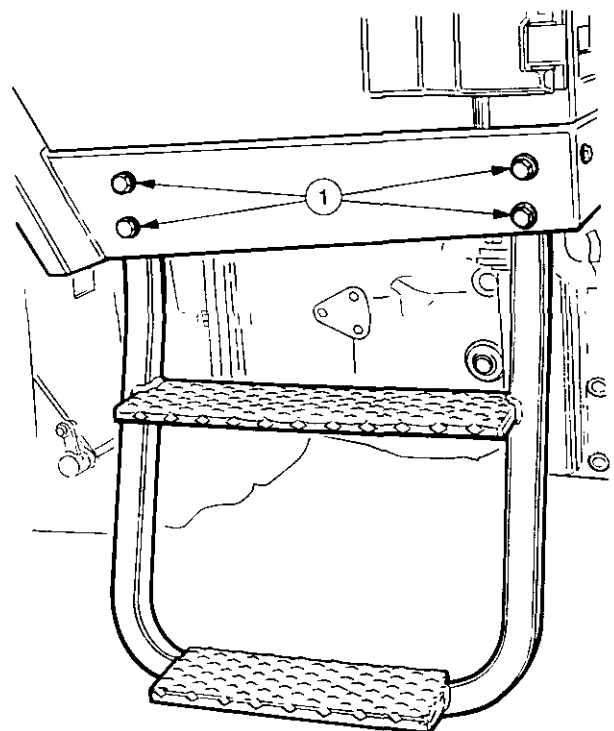
4. Reverse procedures 1 to 3.

**FOOTSTEPS****Removal and Refitment** 2B-15-09**Removal**

1. Remove the four nuts and bolts securing footstep to the cab chassis below the door.
2. Lift footstep clear.

Refitment

3. Reverse procedures 1 and 2.



CAB AND FITTINGS**PIN BOX****Removal and Refitment**

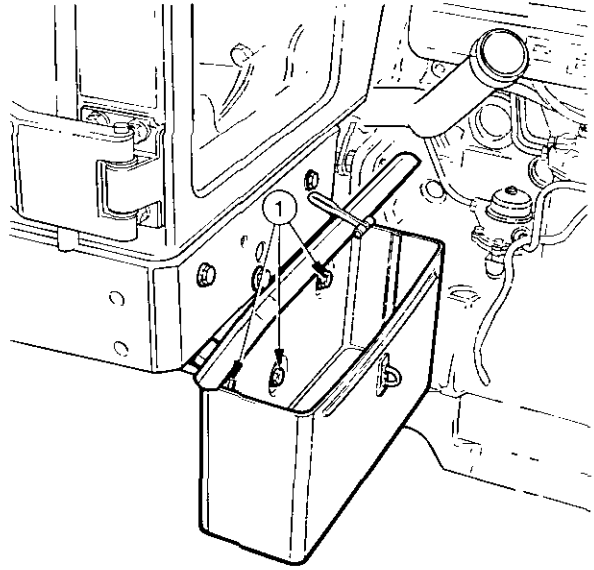
2B-16-10

Removal

1. Open lid of box and from inside remove the three bolts securing it to the three brackets fitted to bottom of right hand side, bulkhead.
2. Lift box clear.

Refitment

3. Reverse procedures 1 and 2 ensuring that the three washers are fitted between the box and the brackets.

**PIN BOX BRACKETS****Removal and Refitment**

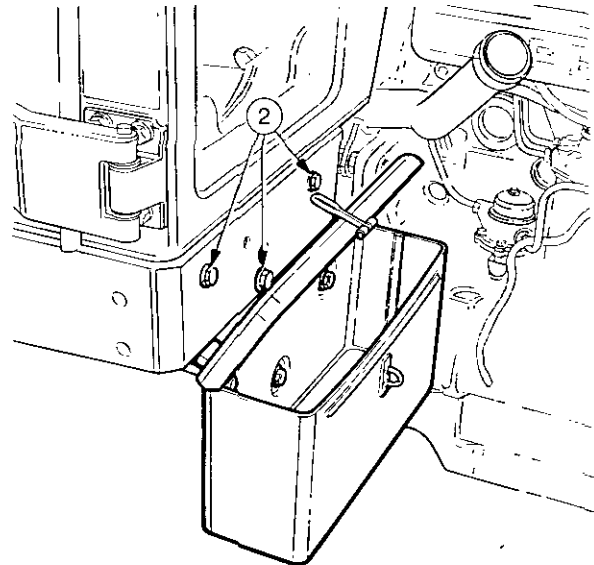
2B-17-10

Removal

1. Remove pin box operation 2B-16-10.
2. Remove the bolt securing each of the three brackets to the bottom of right hand side bulkhead.

Refitment

3. Reverse procedures 1 and 2.

**WORK LAMP****Removal and Refitment**

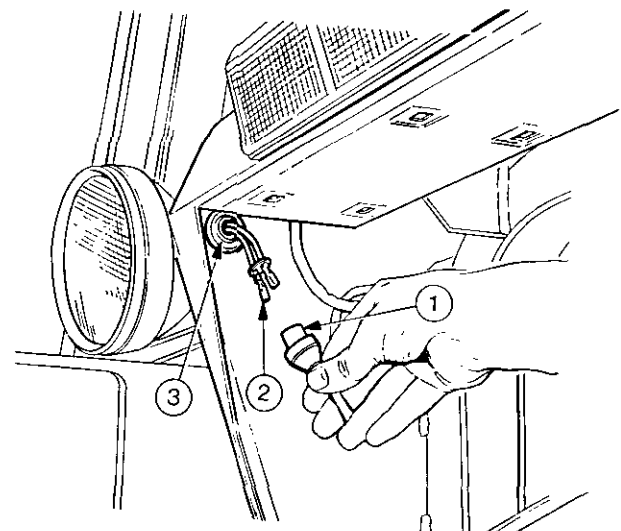
2B-18-10

Removal

1. Pull the rubber plug out of the end of the lamp from under the right hand fender.
2. Disconnect the two bullets.
3. Remove the large plastic nut from under fender.
4. Pull the lamp clear.

Refitment

5. Reverse procedures 1 to 4.



WHEEL ARCH FILLER PANEL**Removal and Refitment**

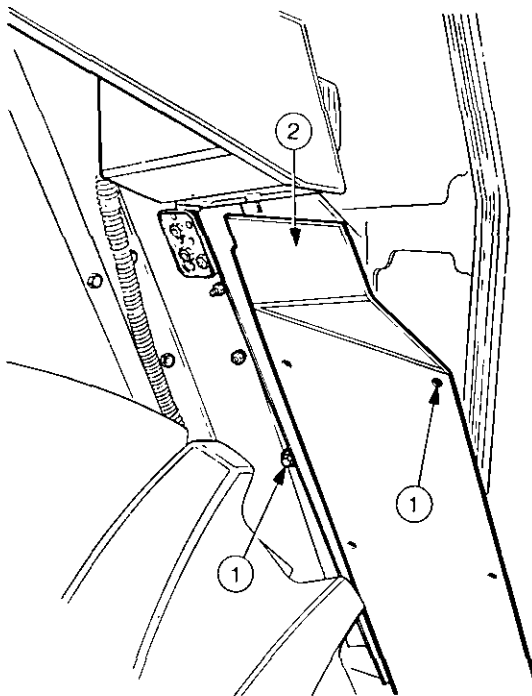
2B-19-11

Removal

1. From the underside of the wheel arch, remove the six screws and washers.
2. Pull panel away from the arch.

Refitment

3. Reverse procedures 1 and 2.

**DOOR LATCH**

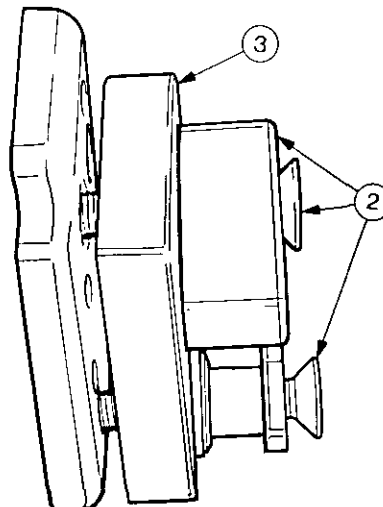
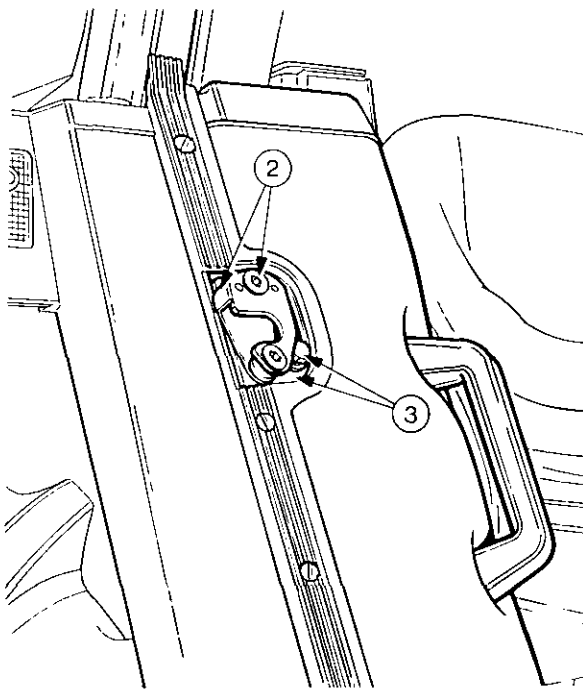
2B-20-11

Removal and Refitment**Removal**

1. Remove the wheel arch filler panel operation 2B-19-11.
2. Remove the two securing bolts from the top of the latch plate and remove it together with plastic spacer.
3. Remove the hex headed bolt together with the plastic back plate and the tapped clamp plate from rear of wheel arch.

Refitment

4. Reverse procedures 1 to 3 lightly clamping the latch.
5. Shut door firmly to obtain a good seal all round.
6. Open door and finally tighten both latch bolts, and hexagon headed bolt.

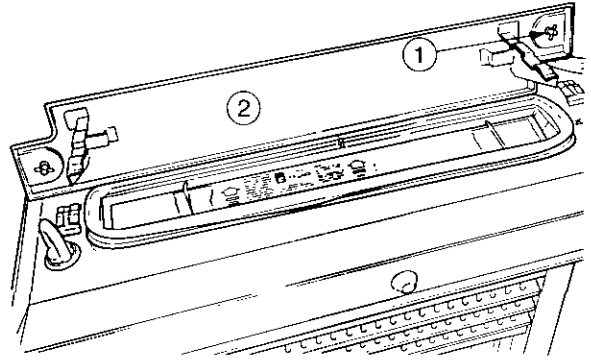


CAB AND FITTINGS**AIR CONDITIONING FILTER****Removal and Refitment** 2B-21-12**Removal**

1. Release the two quick release catches from top cover on R.H.S. top of cab roof.
2. Lift panel clear.
3. Withdraw the filter.

Refitment

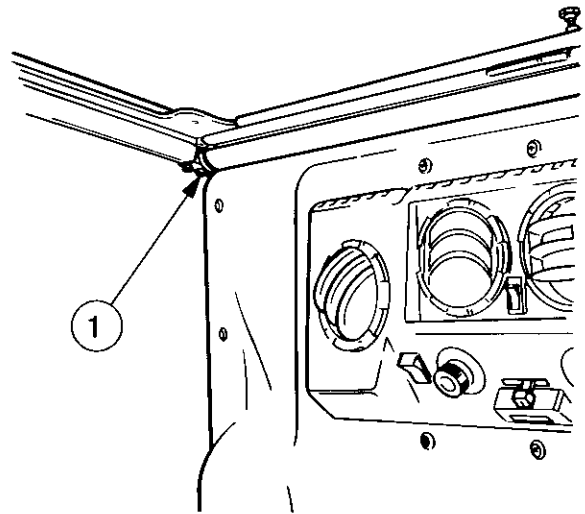
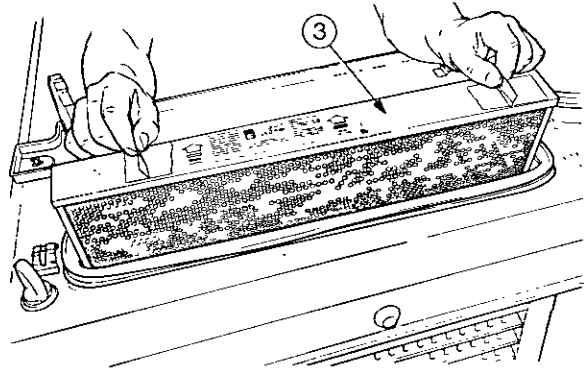
4. Clean filter by tapping gently on a flat surface, metal screen down, pass compressed air (100 psi—7 kg km² max) through panel opposite to the airflow direction.
5. Reverse procedures 1 to 3 with metal screen to the outside edge of the roof.

**SUN BLIND****Removal and Refitment** 2B-22-12**Removal**

1. Remove the two brackets from the top of the 'A' post.
2. Remove the two lower stay support brackets from 'A' post.
3. Lift the roller blind clear.

Refitment

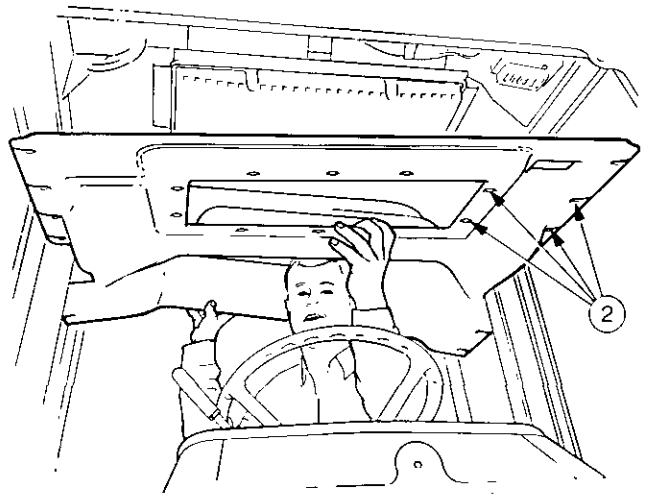
4. Reverse procedures 1 to 3.

**HEAD-LINING****Removal and Refitment** 2B-23-12**Removal**

1. Remove the sun blind, operation 2B-22-12.
2. Remove the twenty-four self tapping screws from around the head-lining periphery.
3. Lift the head-lining clear.

Refitment

4. Reverse procedures 1 to 3.



HEATER**Removal and Refitment**

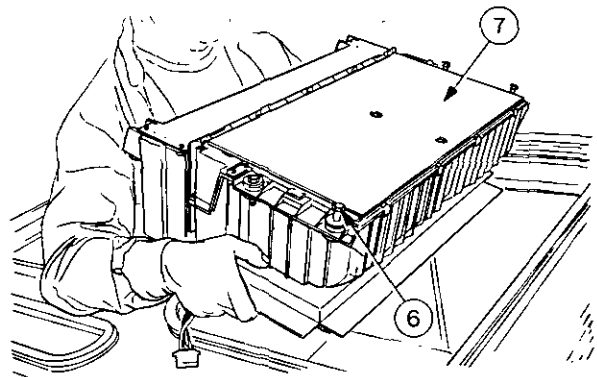
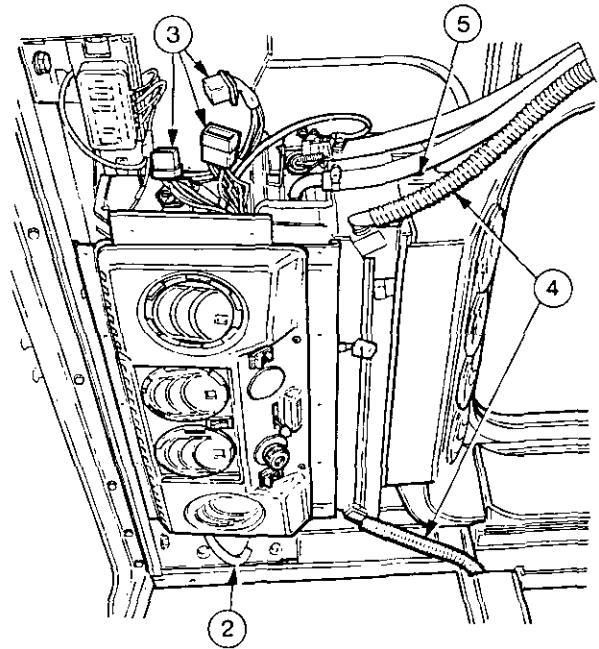
2B-24-13

Removal

1. Undo the two quick release catches securing the door to the front topside of roof, and open the door.
2. Disconnect the multi-plug connector on the right hand side of the heater.
3. Disconnect the multi-plug connectors on the left hand side of the heater.
4. Pull the air intake hose off the intake pipe on each side of heater.
5. Remove the nut and washer on each side of the air duct on rear of heater. Pull the air ducting clear.
6. Remove the three bolts and washer along each side of the heater.
7. Pull the complete heater unit clear.

Refitment

8. Reverse procedures 1-7.



CAB AND FITTINGS**'B' POST TRIM****Removal and Refitment**

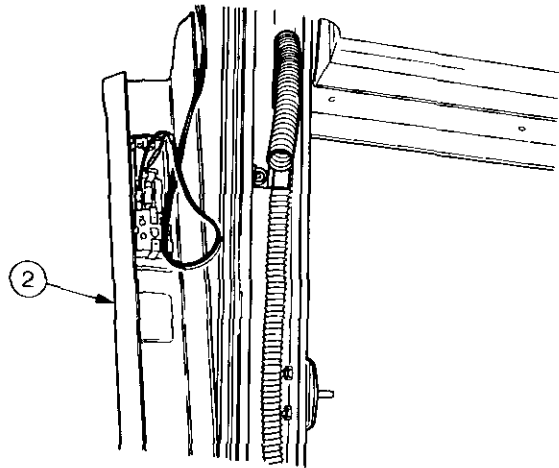
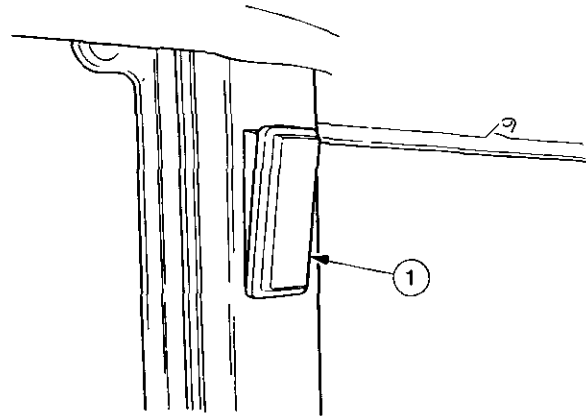
2B-25-14

Removal

1. Remove the interior lamp (left hand side only).
2. Pull complete trim panel off the post, out of the retaining channels.

Refitment

3. Reverse procedures 1 and 2.

**FLOOR MAT****Removal and Refitment**

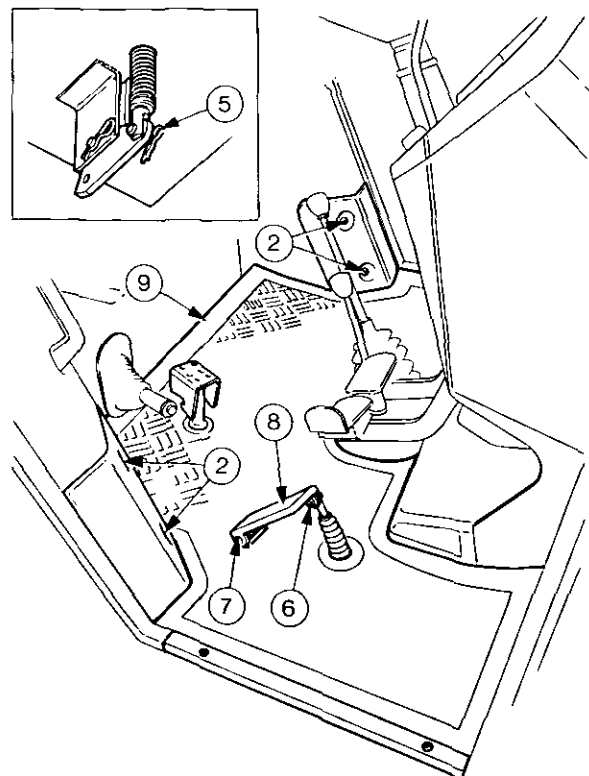
2B-26-14

Removal

1. Remove the two screws securing the plastic retainer strip along the bottom of each door aperture.
2. Lift both strips clear.
3. Remove the two screws from each of the two plastic trim gaiters at the bottom of the 'B' post.
4. Lift both gaiters clear.
5. From underneath the cab floor, remove the hair pin from the diff-lock clevis pin. From inside the cab, pull the diff-lock pedal clear, taking care not to dislodge the spring underneath the cab.
6. Remove the nut and washer from the foot throttle rod.
7. Remove the circlip from the foot throttle pedal and pull out the pivot pin.
8. Lift the pedal clear.
9. Pull the floor mat over the brackets.

Refitment

10. Reverse procedures 1 to 9.



INSTRUMENT PANEL**Removal and Refitment**

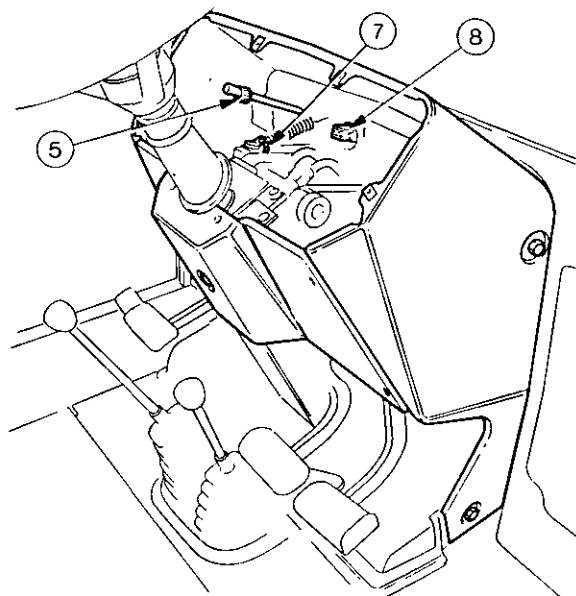
2B-27-15

Removal

1. Disconnect the hand throttle lever by slackening the two nuts and bolts on the clamp, positioned at the bottom of the bulkhead.
2. Pull the throttle lever clear through the centre of the steering wheel.
3. Remove the six screws securing the instrument panel to the bulkhead.
4. Carefully ease the panel forward to allow access to the rear harness connections.
5. Disconnect the tachometer cable.
6. Remove the bezel nuts from the cigar lighter, ignition switch and indicator switch and pull them rearwards clear of the panel.
7. Remove the screw and washer securing the white earth wires to the top of the steering column surround.
8. Disconnect all the multi-plugs.
9. Pull the instrument panel clear.

Refitment

10. Reverse procedures 1 to 9.



CAB AND FITTINGS**SWITCH PANEL****Removal and Refitment**

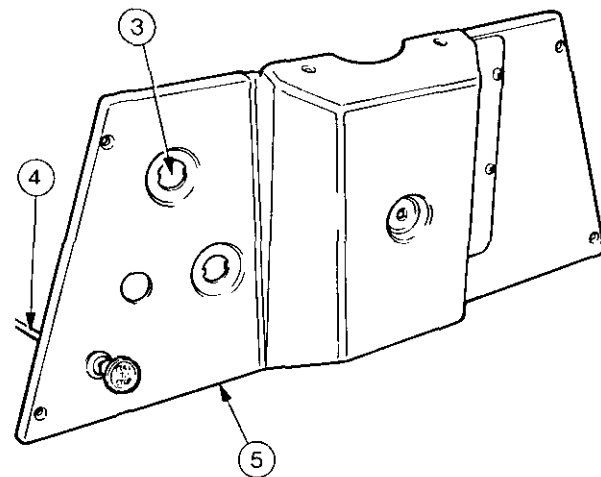
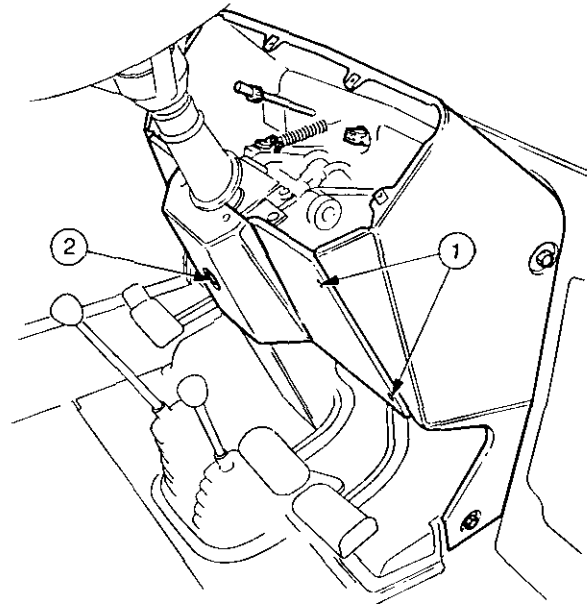
2B-28-16

Removal

1. Remove the four screws securing the panel to the column surround.
2. Remove the bolt from the centre of the panel that secures it to the steering column.
3. Remove the bezel nuts from the cigar lighter, ignition switch and indicator switch, and pull them rearwards clear of the panel.
4. Disconnect the fuel cut-off cable at the fuel pump.
5. Pull the panel clear together with the cable.

Refitment

6. Reverse procedures 1 to 5.

**INSTRUMENT PANEL SURROUND****Removal and Refitment**

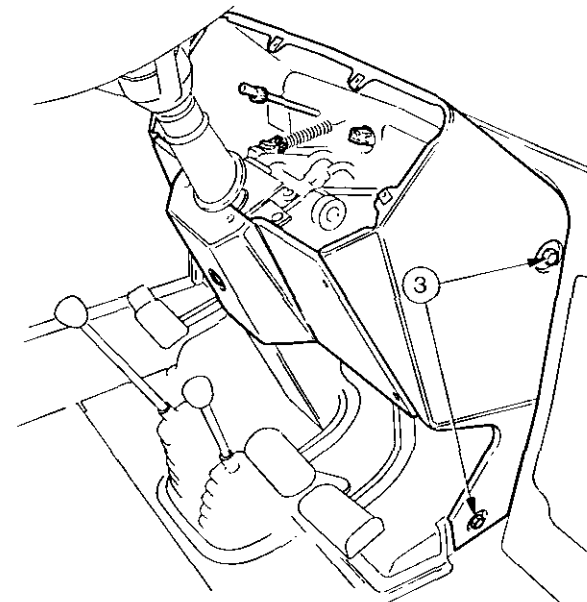
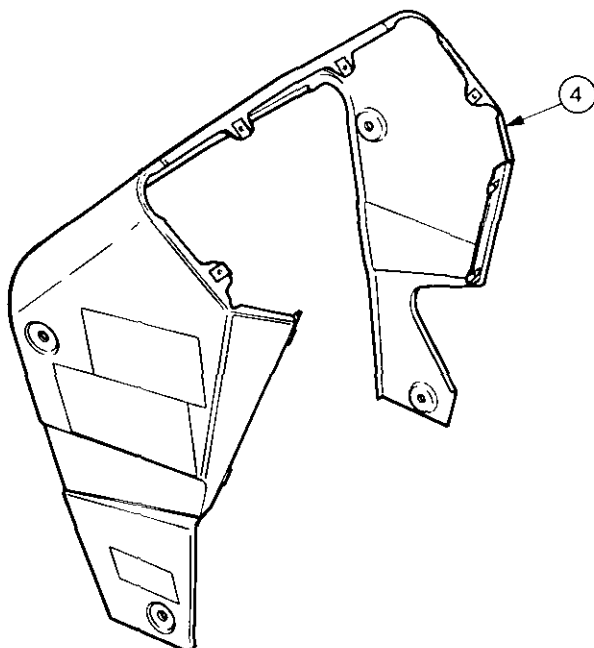
2B-29-16

Removal

1. Remove the instrument panel. Operation 2B-27-15.
2. Remove the switch panel. Operation 2B-28-16.
3. Remove the two upper and two lower nuts, bolts and washers securing the surround at each side to the bulkhead.
4. Pull the surround clear.

Refitment

5. Reverse procedures 1 to 4.



GEAR LEVER GAITER**Removal and Refitment**

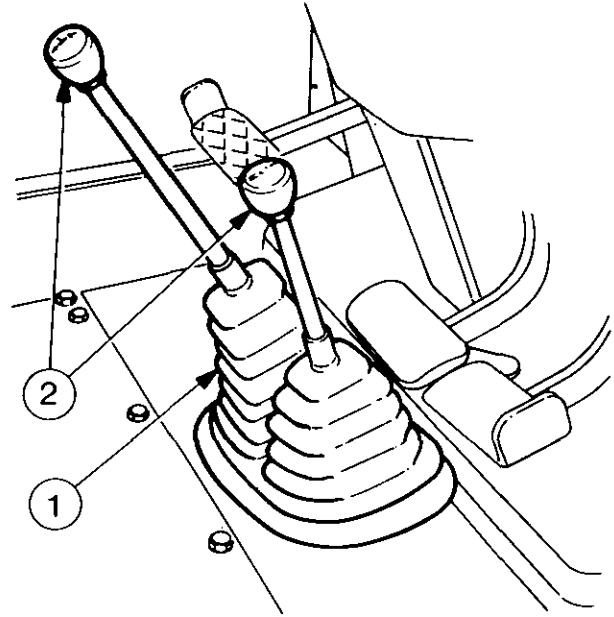
2B-30-17

Removal

1. Remove the gear lever knobs by releasing the jamb nuts and unscrewing the knobs from the levers.
2. Slide the gaiter up the levers.

Refitment

3. Reverse procedures 1 and 2.



CAB AND FITTINGS**FLOOR PANEL****Removal and Refitment**

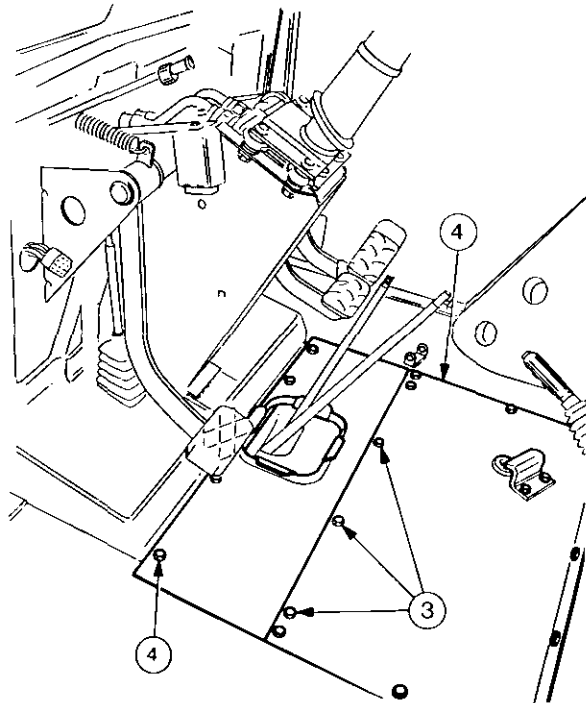
2B—31—18

Removal

1. Remove the floor mat. Operation 2B—26—14.
2. On the underside of tractor, remove the hair pin from the diff-lock operating rod and pull rod clear of the pivot plate.
3. Remove the thirteen bolts from around the periphery of the rear panel.
4. Remove the four bolts from the front panel and lift it clear.

Refitment

5. Reverse procedures 1 to 4.

**HEATER HOSES****Removal and Refitment**

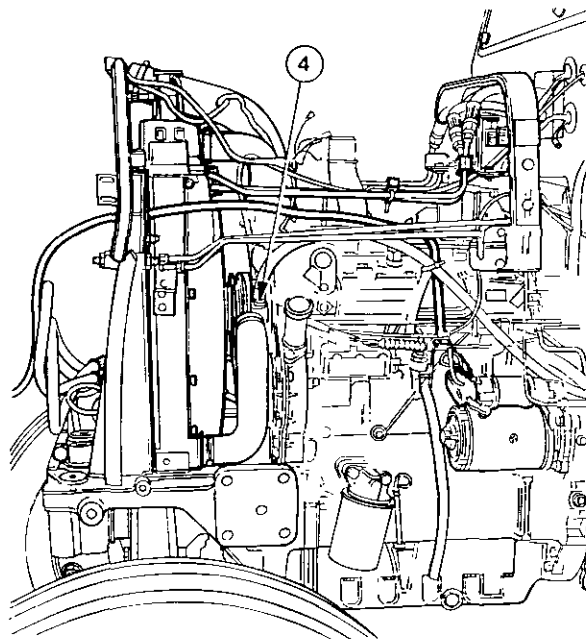
26—32—18

Removal

1. Remove the trim from the left hand side 'B' post. Operation 2B—25—14.
2. Undo the two hose clamp bolts inside the 'B' post and turn them through 90° to clear the hoses.
3. Pull the hoses out of the clamp fitted to the under side floor, below the door.
4. Slacken the hose clamps on the engine.
5. Pull the hoses clear.

Refitment

6. Reverse procedures 1 to 5.



AIR DUCT HOSES**Removal and Refitment** 2B-33-19**Removal**

1. Remove the 'B' post trim both sides. Operation 2B-26-14
2. Undo the two hose clamp bolts inside the 'B' post and turn them through 90° to clear the hose.
3. Pull the hose clear.

Refitment

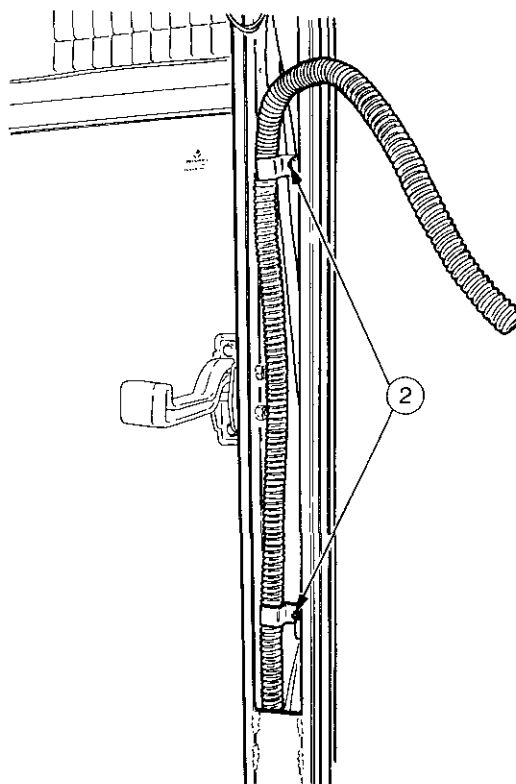
4. Reverse procedures 1 to 3.

AIR FILTER INLET DUCTING**Removal and Refitment** 2B-34-19**Removal**

1. Remove the two bolts, nuts and washers securing the ducting to the two brackets fitted to the right hand side of cab roof, above the side window.
2. Pull the duct clear.

Refitment

3. Reverse procedures 1 and 2.

**AIR DUCT GRILLE****Removal and Refitment** 2B-35-19

1. Remove the five screws securing the grille to the top of the side window frame.
2. Carefully pull the grille off the sealing rubber that is adhered to it.

Refitment

3. Reverse procedure 1.
4. Apply the recommended adhesive along the bottom edge of the grille and firmly press the seal onto it until adequately held.

CAB AND FITTINGS**HEAT EXCHANGER****Removal and Refitment**

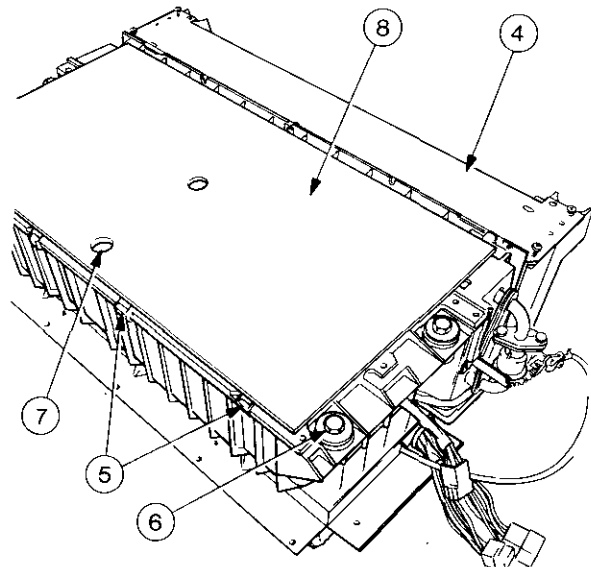
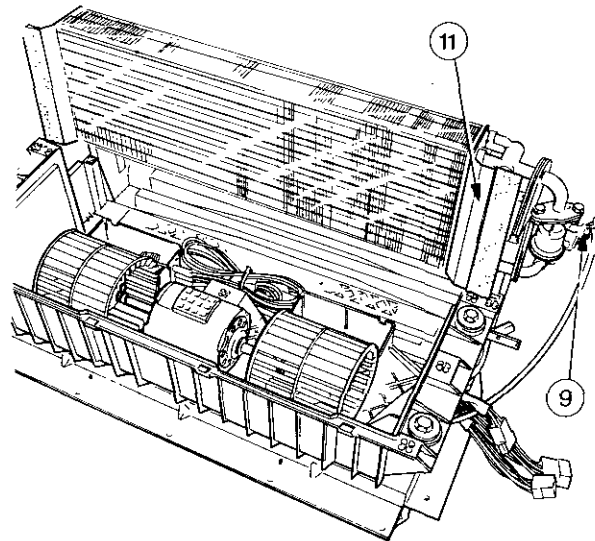
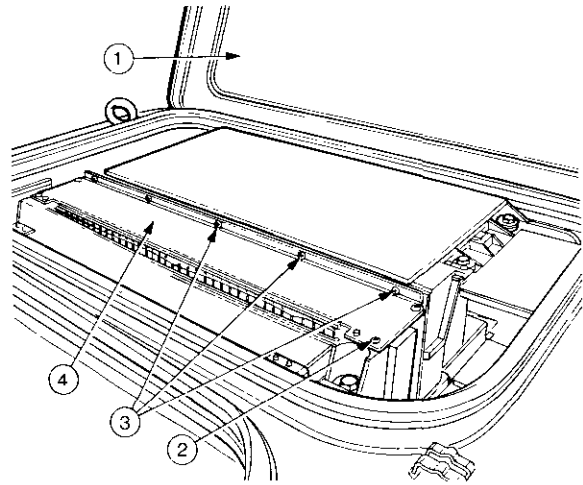
2B—36—20

Removal

1. Open the heater access hatch in the front of the cab roof.
2. Remove the two screws each end of the metal cover plate.
3. Loosen the five screws and five spire nuts securing the metal cover plate to the plastic cover.
4. Remove the metal cover plate.
5. Flick the four metal clips off the front edge of the plastic top cover.
6. Remove the four screws from each end of the cover.
7. Using the two holes in top of cover for access remove the two screws.
8. Prise off the top cover.
9. Release the heater control valve cable.
10. Remove the inlet and return hoses from the control valve.
11. Lift the heat exchanger clear of the casing.

Refitment

12. Reverse procedures 1 to 11.

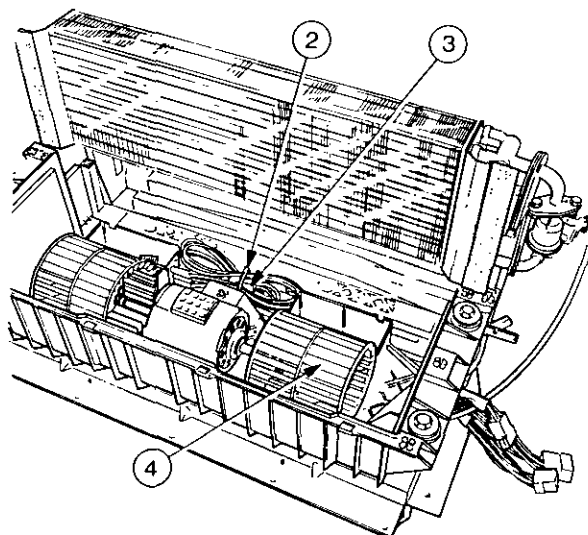


BLOWER MOTOR ASSEMBLY**Removal and Refitment** 2B-37-21**Removal**

1. Remove the heater top cover. Operation 2B-36-20 procedures 1 to 8.
2. Remove the cable tie.
3. Unplug the red and black wire connector.
4. Lift the blower motor complete with the impellor, clear of the casing.

Refitment

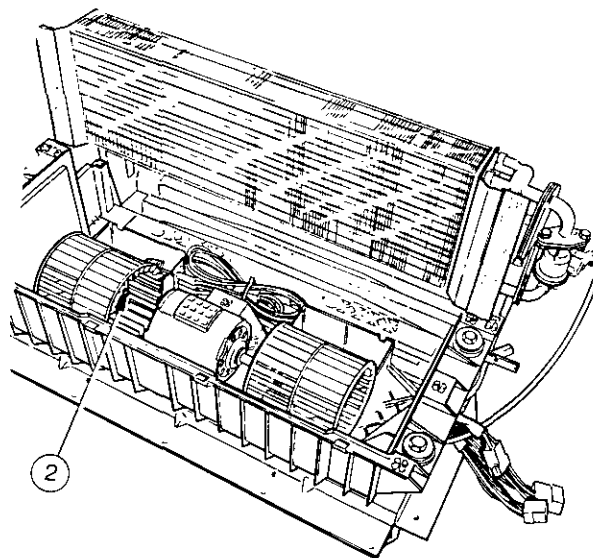
5. Reverse procedures 1 to 4.

**BLOWER IMPELLORS****Removal and Refitment** 2B-38-21**Removal**

1. Remove the blower motor assembly. Operation 2B-36-20.
2. Squeeze the retaining clip ears on the impellor spigot, together and pull the impellor off the shaft.

Refitment

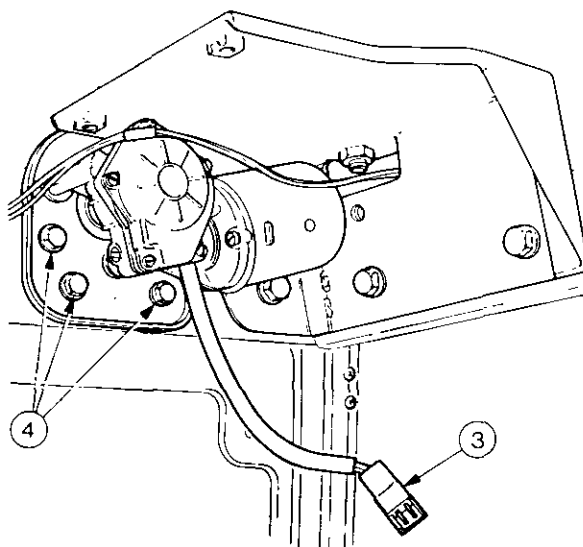
3. Reverse procedures 1 and 2.

**WIPER MOTOR****Removal and Refitment** 2B-39-21**Removal**

1. Remove the heater unit. Operation 2B-25-
2. Remove the clip and washer from the actuator arm pivot.
3. Disconnect the wiring plug.
4. Remove the 3 bolts securing the wiper motor to the front cross member.
5. Lift the motor clear.

Refitment

6. Reverse procedures 1 to 5.

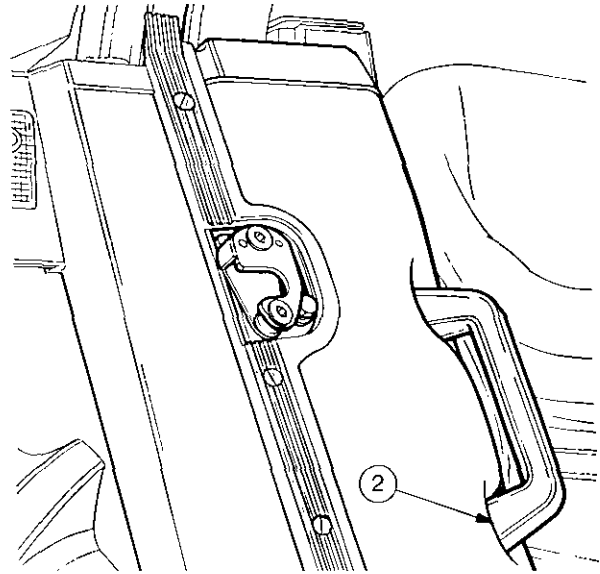


CAB AND FITTINGS**GRAB HANDLE****Removal and Refitment** 2B-40-22**Removal**

1. Remove the wheel arch filler panel. Operation 2B-19-11.
2. Remove the two bolts with washers from the underside that secure the handle to the 'B' post.

Refitment

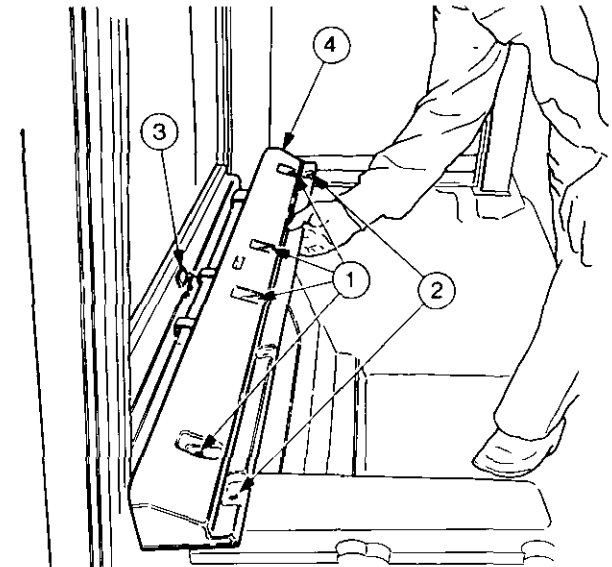
3. Reverse procedures 1 and 2.

**REAR TRIM PANEL****Removal and Refitment** 2B-41-22**Removal**

1. Remove the four self tapping screws with washers.
2. Remove the two bolts with nuts and washers.
3. Remove the two bolts with washers, securing the rear window latch.
4. Lift the panel clear.

Refitment

5. Reverse procedures 1 to 4.

**'D' POST TRIM****Removal and Refitment** 2B-42-22**Removal**

1. Remove the rear trim panel. Operation 2B-41-22.
2. Pull the complete trim off the post out of the retaining channels.

Refitment

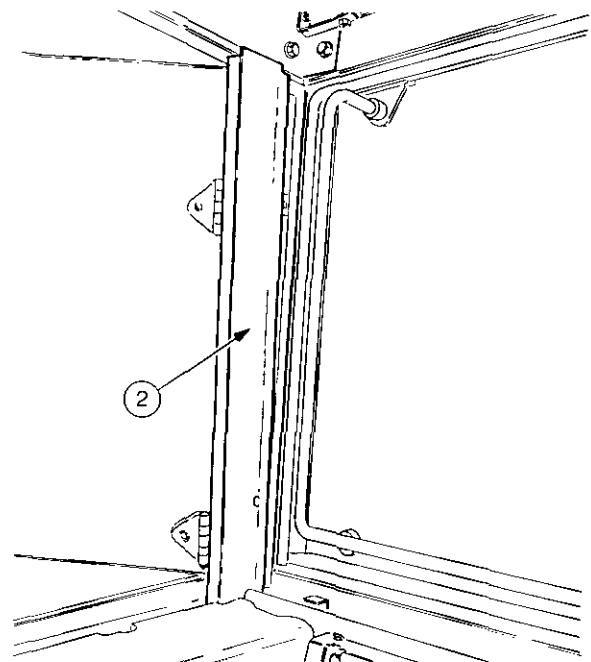
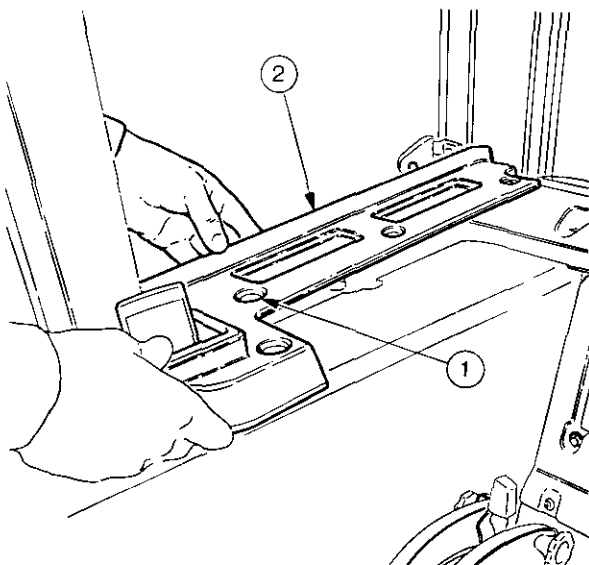
3. Reverse procedures 1 and 2.

WHEEL ARCH TRIM**Removal and Refitment** 2B-43-22**Removal**

1. Remove the self tapping screws with washers, securing the panel and ashtray to the top of the wheel arch.
2. Lift the panel clear.

Refitment

3. Reverse procedures 1 and 2.



REAR LOWER TRIM PANEL AND WINDOW**Removal and Refitment**

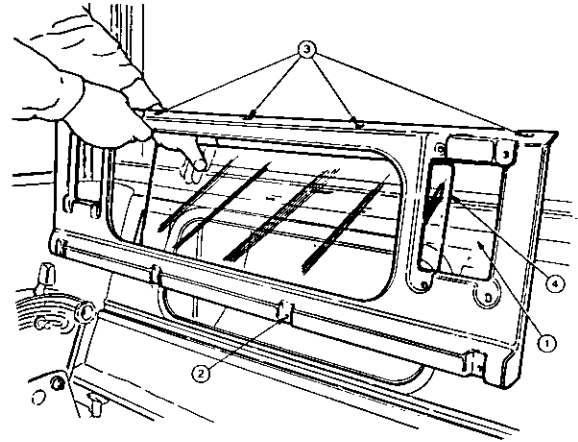
2B—44—23

Removal

1. Remove the two access panels.
2. Remove the four self tapping screws from along the bottom edge of the plastic trim panel.
3. Remove the five bolts, nuts and washers from along the top edge.
4. Carefully lift off the trim panel complete with the glass.

Refitment

5. Reverse procedures 1 to 4.

**HEATER CONTROL VALVE**

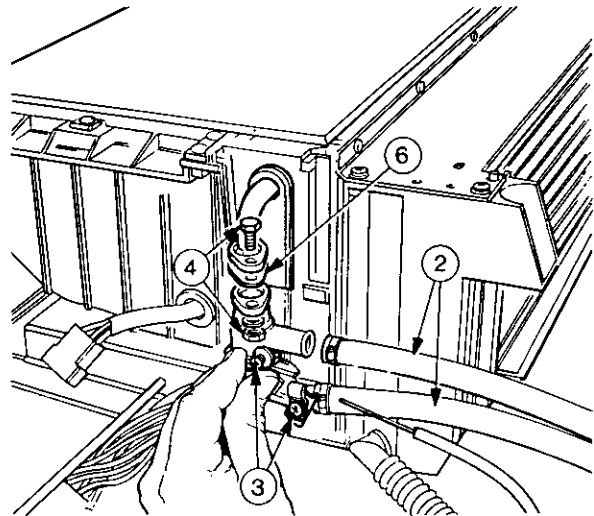
2B—45—23

Removal and Refitment.**Removal**

1. Open the heater access hatch in the front of the cab roof.
2. Disconnect the 2 hoses.
3. Loosen the two cable clamp screws.
4. Remove the two nuts and washers securing the valve to the pipe flange.
5. Lift the valve clear.

Refitment

6. Reverse procedures 1 to 5, ensuring the rubber seal between the joint, is in good condition, if not, it must be replaced.



CAB AND FITTINGS**HEATER AND SCREEN WIPER SWITCHES****Removal and Refitment**

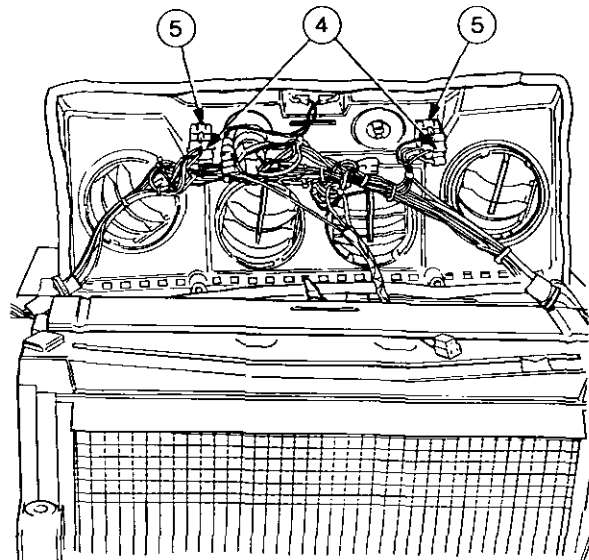
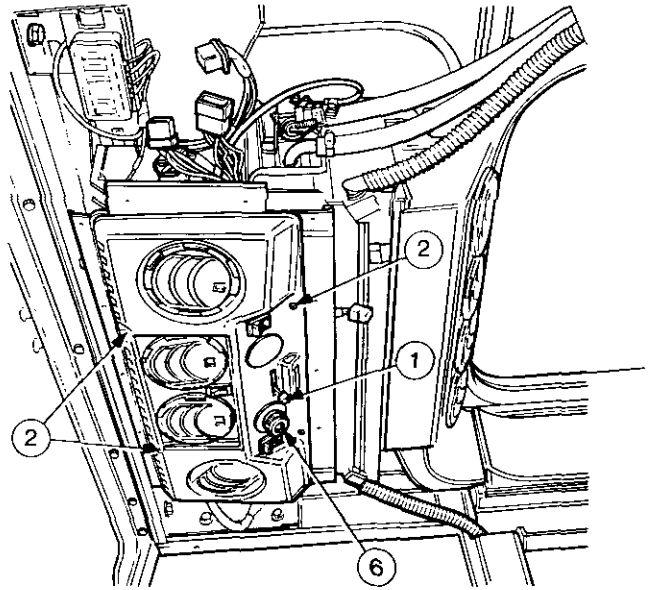
2B—46—24

Removal

1. Pull the heater control knob off the lever protruding from the overhead control panel.
2. Remove the four self tapping screws and washers.
3. Pull the control panel away from the heater unit, to gain access to the rear.
4. Remove the multi plug connectors from the switches.
5. Press the two tangs on the switches, inwards and push switches forward out of the front of the panel.
6. To remove the thermostat knob, slacken the Allen grub screw positioned in the side of the knob and pull it off the spindle.

Refitment

Reverse procedures 1 to 6.

**AIR-FLOW VENTS****Removal and Refitment**

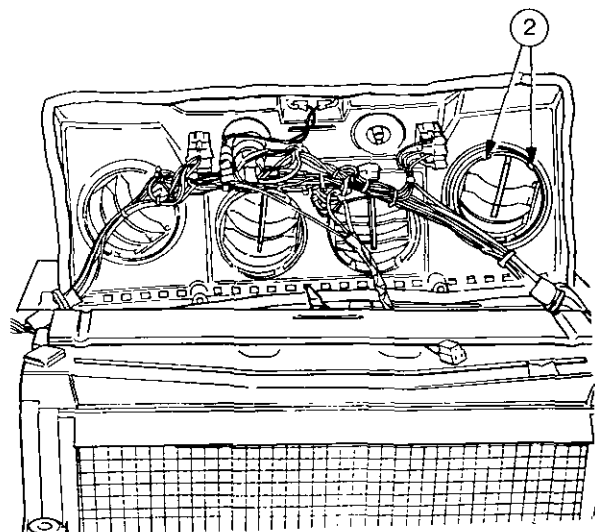
2B—47—24

Removal

1. Remove the overhead control panel. Operation 2B—45—23 procedures 1 to 3.
2. Press the tangs of the air-vent inwards and push it out of the front panel.

Refitment

3. Reverse procedures 1 and 2.



CAB ROOF PANEL**Removal and Refitment**

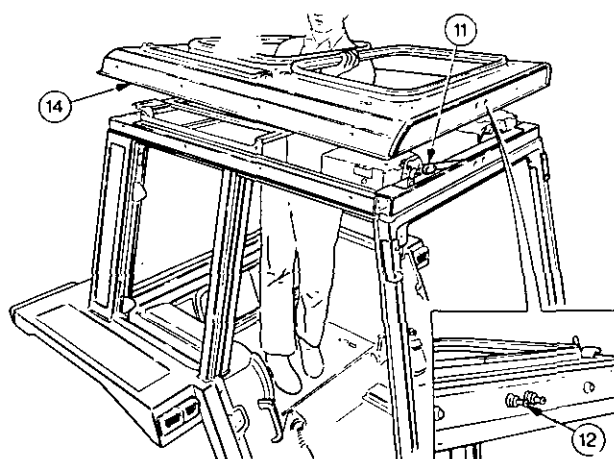
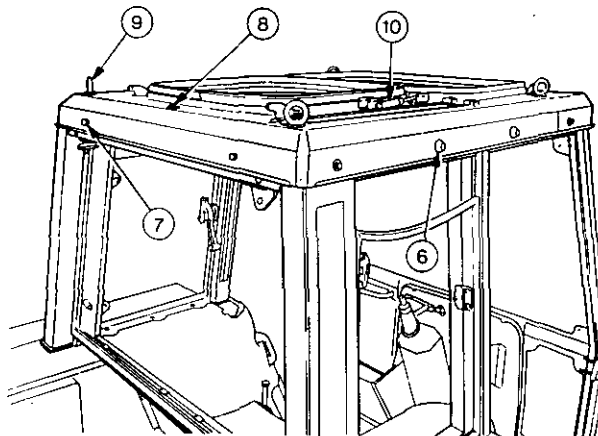
2B-48-25

Removal

1. Remove the escape hatch. Operation 2B-06-07.
2. Remove the heater access door. Operation 2B-07-07.
3. Remove the screen wiper arms. Operation 2B-14-09.
4. Remove the heater. Operation 2B-24-13.
5. Remove the air conditioning filter. Operation 2B-21-12.
6. Remove the plastic caps from the heads of the thirteen bolts around the periphery of the roof panel.
7. Remove the thirteen bolts and washers.
8. Remove the three centre bolts and washers from the top of the roof.
9. Remove the lifting eyes of the four corners of the roof.
10. Remove the bolts securing the gas strut hinge brackets and the escape hatch and heater access door hinge brackets.
11. Disconnect the wiper operating rod from the actuating lever.
12. Remove the two nuts from the two wiper spindles.
13. Remove the wiper actuating mechanism complete.
14. Lift the roof panel clear.

Refitment

15. Reverse procedures 1 to 14.



CAB AND FITTINGS

ROOF PANEL SUPPORT BRACKET

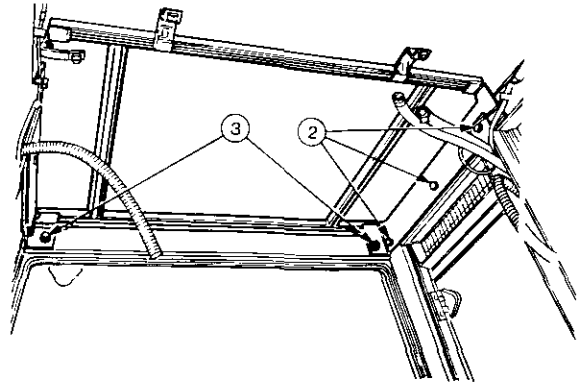
Removal and Refitment 2B-49-26

Removal

1. Remove the cab roof. Operation 2B-48-25.
2. Remove the three bolts each side securing the bracket to the side members.
3. Remove the two bolts securing it to the rear cross member.
4. Lift the support bracket clear.

Refitment

5. Reverse procedures 1 to 4.



HEATER SUPPORT BRACKETS

Removal and Refitment 2B-50-26

Removal

1. Remove the heater. Operation 2B-24-13.
2. Remove the wiper motor on right hand side.
3. Remove the fuse box from the left hand side.
4. Remove the fuse box mounting bracket.
5. Remove the remaining two bolts that secure each bracket.
6. Lift bracket clear.

Refitment

7. Reverse procedures 1 to 6.

FRONT SCREEN FRAME**Removal and Refitment**

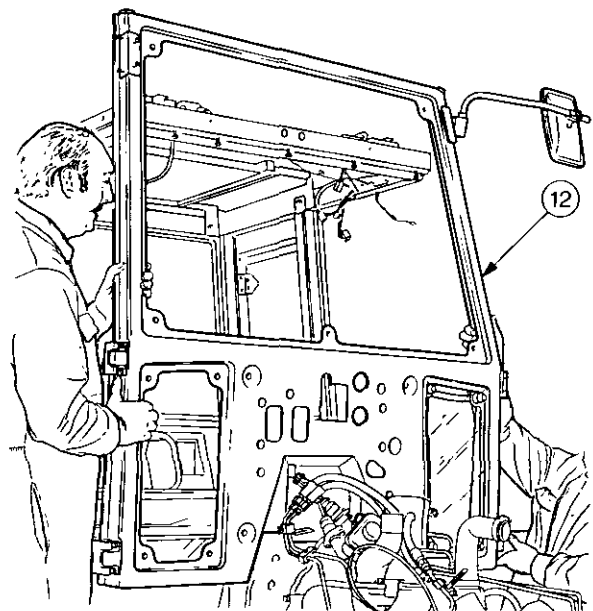
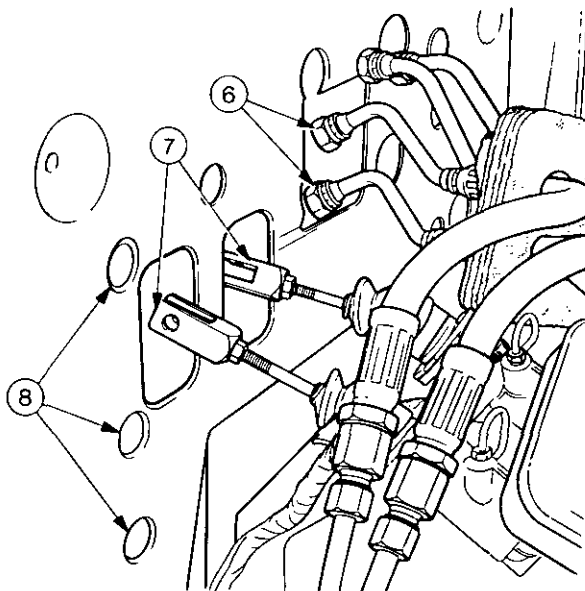
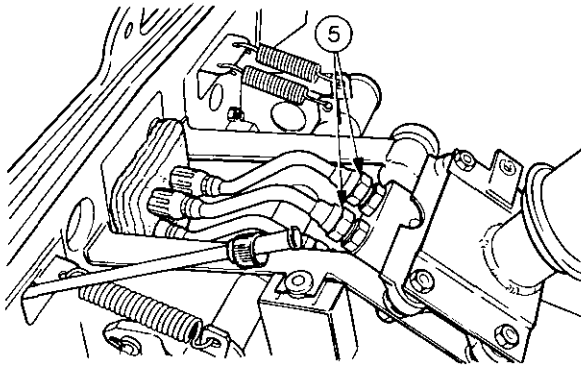
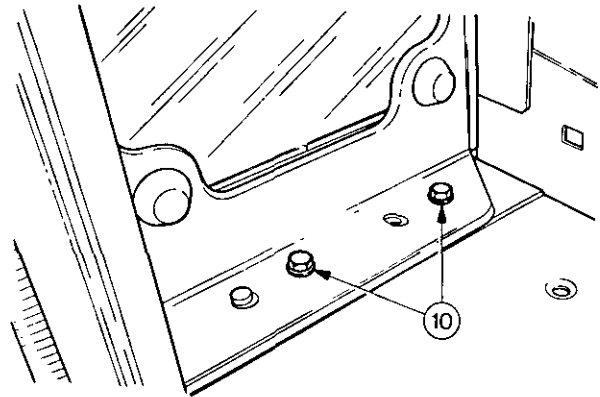
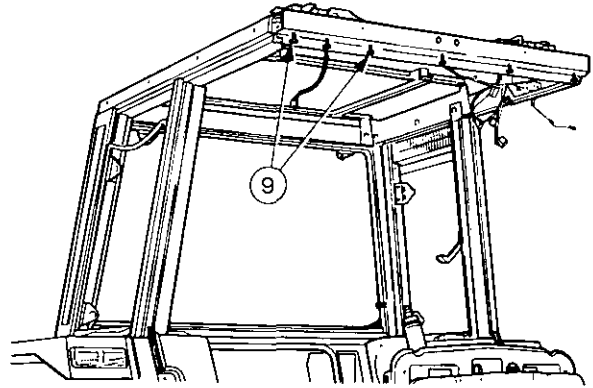
2B-51-27

Removal

1. Remove the headlining. Operation 2B-23-12.
2. Remove the front screen glass. Operation 2B-02-05.
3. Remove the doors. Operation 2B-08-07.
4. Remove the instrument panel surround. Operation 2B-29-16.
5. Remove the four power steering hoses from the orbital pump. Marking them for identification to assist in re-assembly.
6. Pull the hoses forwards through the front of the bulkhead.
7. Uncouple the two brake master cylinder push rods from the pedal and pull them forwards through the front of the bulkhead.
8. Remove the four bolts and washers from the front of the frame that secure it to the bulkhead panel.
9. Remove the six bolts and washers that secure the top of the frame to the roof front cross member.
10. From underneath the front of the cab floor each side, remove the two bolts and washers from the bottom of the frame.
11. From underneath the front of the cab floor each side, remove the two bolts and washers that fit inside the frame door panels.
12. Prise the screen frame clear.

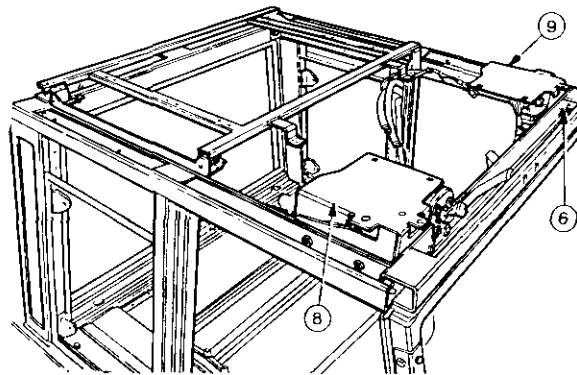
Refitment

13. Reverse procedures 1 to 12.



CAB AND FITTINGS**ROOF FRAME FRONT CROSS MEMBER****Removal and Refitment** 2B—51—28**Removal**

1. Remove the roof panel. Operation 2B—24—13.
2. Remove the head lining. Operation 2B—23—12.
3. Remove the heater. Operation 2B—23—12.
4. Remove the screen wiper arms and actuating mechanism.
5. Remove the five bolts and washers securing the top of the front screen frame to the cross member.
6. Remove the two bolts and washers each side securing the cross member to the side members.
7. Prise the cross member clear complete with the wiper motor and fuse box assembly.
8. Remove the wiper motor complete with mounting bracket.
9. Remove the fuse box complete with mounting bracket.

**Refitment**

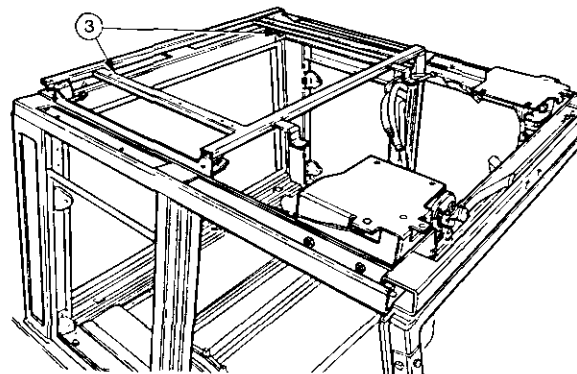
Reverse procedures 1 to 9.

ROOF FRAME REAR CROSS MEMBER**Removal and Refitment** 2B—52—28**Removal**

1. Remove the roof panel. Operation 2B—48—25.
2. Remove the rear window glass. Operation 2B—05—06.
3. Remove the two bolts and washers securing the rear roof support bracket to the cross member.
4. Remove the two bolts and washers each side that secure the cross member to the rear pillars.
5. Prise the cross member clear.

Refitment

6. Reverse procedures 1 to 5.

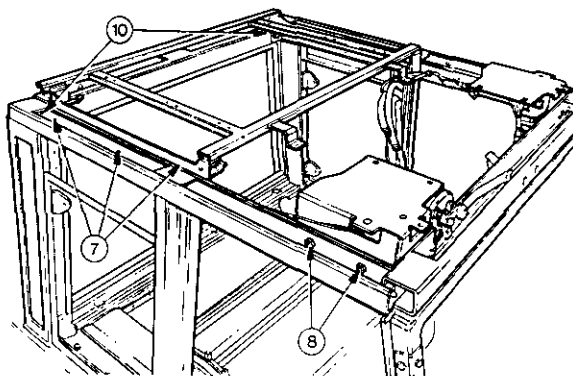


ROOF FRAME SIDE MEMBER**Removal and Refitment**

2B-53-29

Removal

1. Remove the roof panel. Operation 2B-48-25.
2. Remove the head lining. Operation 2B-23-12.
3. Remove the 'D' post trim. Operation 2B-42-22.
4. Remove the 'B' post trim. Operation 2B-25-14.
5. Remove the bolts and washers from inside the 'B' and 'D' posts.
6. Remove the three bolts and washers from the inside of the rear roof panel support bracket.
7. Remove the two bolts and washers from the heater support bracket.
8. Remove the two bolts and washers from the front inside of the side member that secure it to the front cross member.
9. Remove the two bolts and washers from the inside of the rear cross member.
10. Prise the side member clear.

**Refitment**

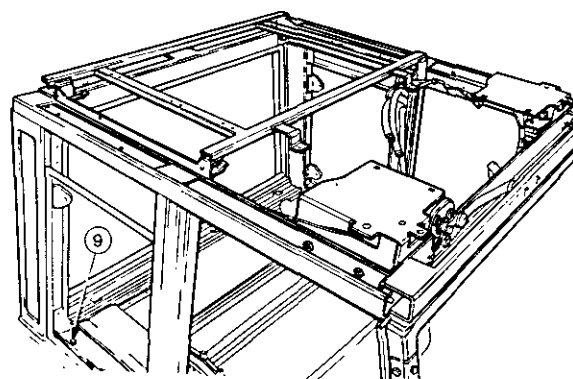
11. Reverse procedures 1 to 10.

SIDE WINDOW FRAME**Renewal and Refitment**

2B-54-29

Removal

1. Remove the head lining. Operation 2B-48-25.
2. Remove the 'B' post trim. Operation 2B-23-12.
3. Remove the 'D' post trim. Operation 2B-25-14.
4. Remove the front and rear bolt and washer from the side of the rear roof panel support bracket.
5. Remove the air duct grille. Operation 2B-35-19.
6. Remove the side glass. Operation 2B-03-05.
7. Remove the wheel arch trim. Operation 2B-43-22.
8. Remove the rear trim panel. Operation 2B-41-22.
9. Remove the three bolts, nuts and washers securing it to the wheel arch.
10. From underneath the wheel arch remove the four bolts and washers from the 'B' post and the 'D' post.
11. Prise the frame clear.

**Refitment**

12. Reverse procedures 1 to 11.

CAB AND FITTINGS

REAR WINDOW FRAME LOWER CROSS MEMBER

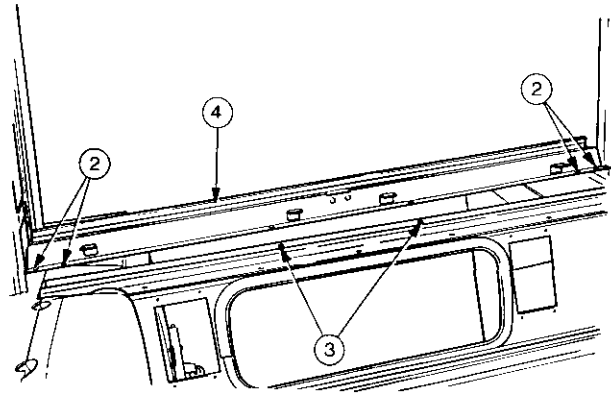
Removal and Refitment 2B—55—30

Removal

1. Remove the rear trim panel. Operation 2B—41—22.
2. Remove the two bolts, nuts and washers each side that secure it to the wheel arches.
3. Remove the two nuts and washers from the two studs securing it to the cross brace.
4. Lift the cross member clear.

Refitment

5. Reverse procedures 1 to 4.



REAR LOWER WINDOW PANEL

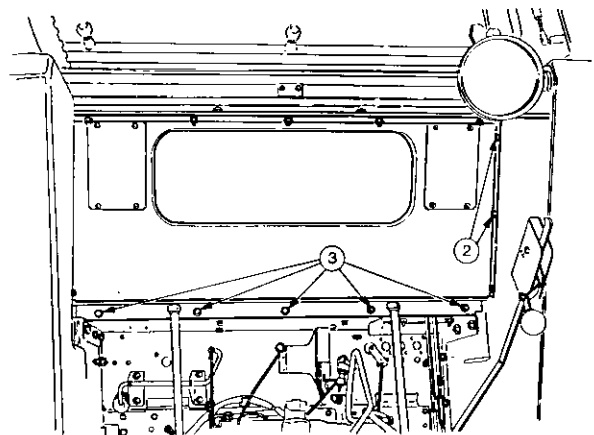
Removal and Refitment 2B—56—30

Removal

1. Remove the rear trim panel. Operation 2B—41—22.
2. Remove the three bolts, nuts and washers from each side that secure it to the wheel arches.
3. Remove the five bolts and washers that secure it to the upper cross brace.
4. Prise the panel clear, complete with window and trim.

Refitment

5. Reverse procedures 1 to 4.



**MF 600 SERIES TRACTOR
WORKSHOP SERVICE MANUAL**

PART 3

Publication No. 1856 274 M1

PART 3

comprising

A SPLITTING THE TRACTOR

SPLITTING THE TRACTOR**Part 3 — Section A**

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3A—02—03	SPLITTING THE TRACTOR BETWEEN THE ENGINE AND THE TRANSMISSION Splitting Procedure	03
3A—03—05	SPLITTING THE TRACTOR BETWEEN THE SPACER HOUSING AND THE CENTRE HOUSING AND WITHDRAWING THE ENGINE AND TRANS- MISSION FORWARDS Splitting Procedure	05
3A—04—07	SPLITTING THE TRACTOR BETWEEN THE SPACER HOUSING AND THE CENTRE HOUSING AND WITHDRAWING THE CENTRE HOUSING AND REAR AXLE REARWARDS Splitting Procedure	07

GENERAL

This section gives the procedures for splitting the tractor at four main points allowing access to the four major mechanical assemblies of the tractor.

SPLITTING THE TRACTOR

SPLITTING THE TRACTOR BETWEEN THE FRONT AXLE AND ENGINE

Splitting Procedure

3A-01-02

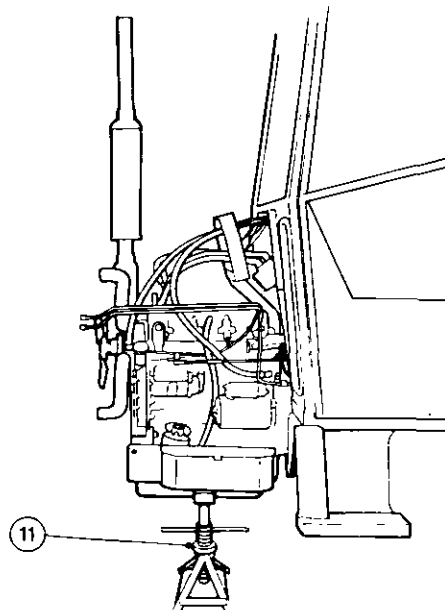
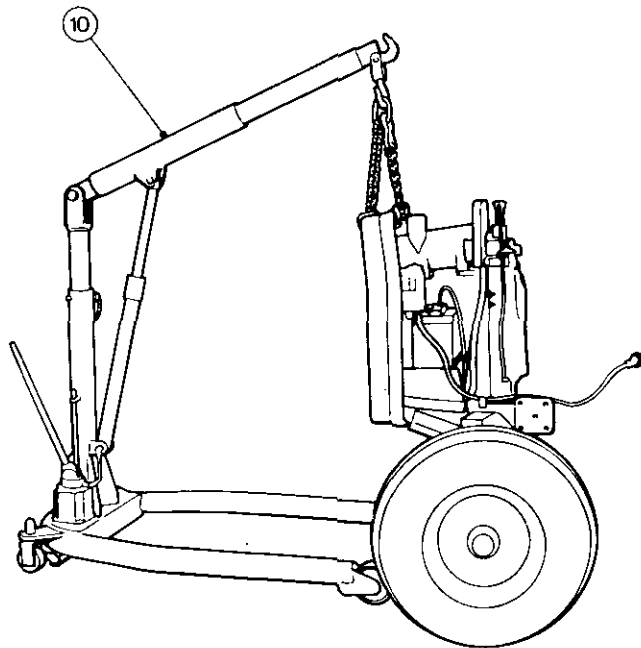
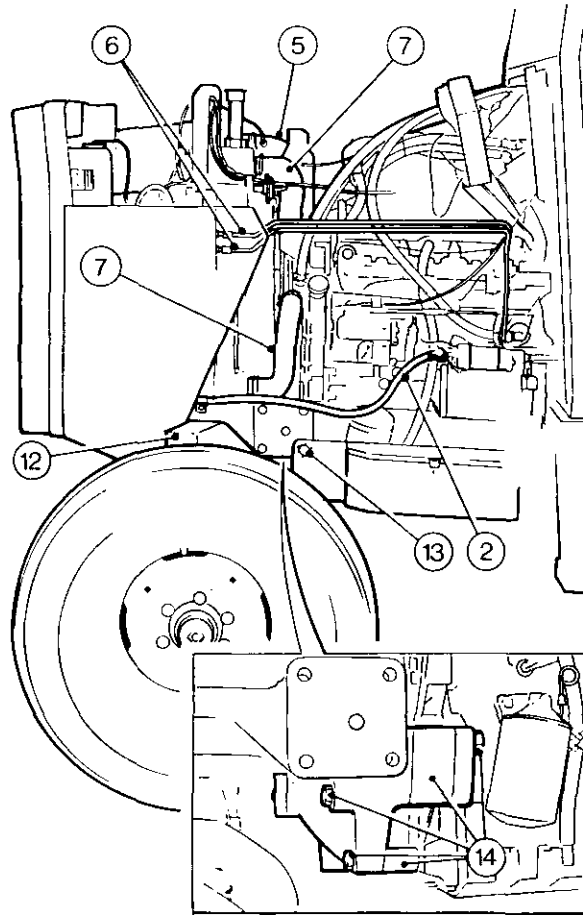
Disassembly

1. Remove the radiator cap and drain the cooling system via the drain taps on the radiator and cylinder block.
2. Disconnect the battery negative cable at the battery, and the positive cable at the starter solenoid.
3. Remove the hood, Part 2A.
4. Disconnect the steering pipes from right hand side.
5. Remove the air cleaner pipe.
6. Disconnect the oil pipes (if fitted). Left hand side.
7. Disconnect the radiator top and bottom hoses.
8. Remove the fan guards.
9. Apply the tractor hand brake.
10. Support the nose assembly using a jib crane and chain.
11. Support the tractor under the sump using a suitable jack stand.
12. Fit hard wood wedges in between the front axle casting and axle beam on both sides to prevent the beam from pivoting.
13. Remove the bolt.
14. Remove the four bolts, two nuts, washers, shims and spacers (if fitted).
15. Carefully wheel the two front wheels, front axle and jib crane forwards away from the engine.

WARNING: Take care to keep the front axle assembly level once it has been withdrawn from the engine, otherwise it could overbalance and cause injury.

Re-assembly

16. Reverse procedures 1 to 15 except: Tighten the front axle retaining nuts and bolts to a torque of 270 Nm (200 lbf ft).



SPLITTING THE TRACTOR BETWEEN THE ENGINE AND THE TRANSMISSION

Splitting Procedure

3A-02-03

Special Tool: MS 2700 Rail Trolley.

Disassembly

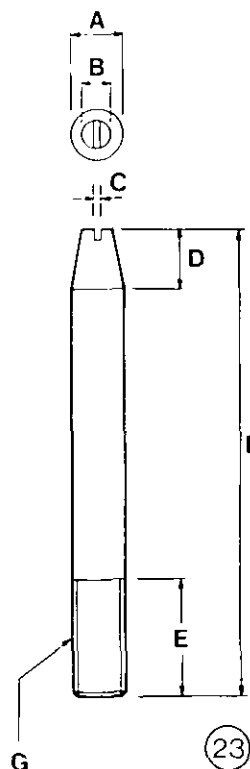
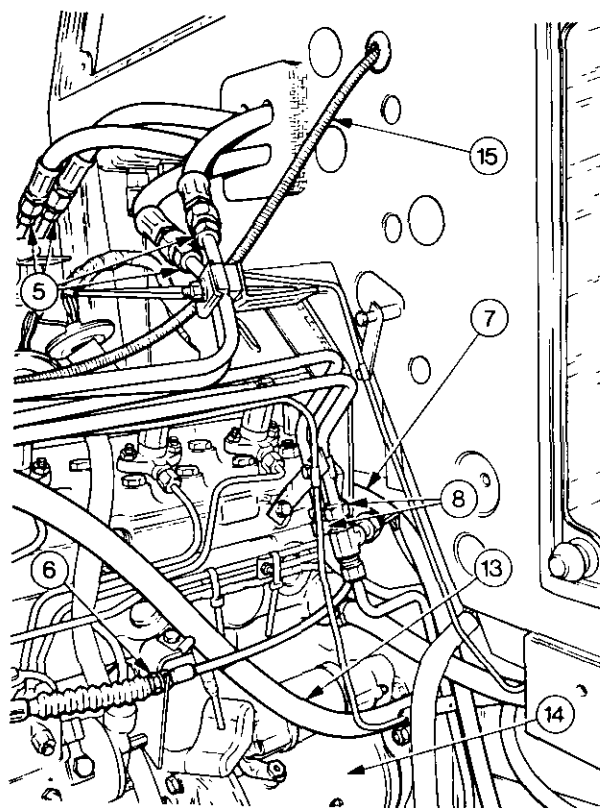
1. Apply the tractor hand brake.
2. Remove the radiator cap and drain the cooling system via the drain taps on the radiator and engine block.
3. Remove the hood, Part 2A.
4. Disconnect the battery.
5. Remove the orbital steering pump hoses.
6. Release the spring and disconnect the throttle cable from pump.
7. Disconnect the fuel pipe and return pipes.
8. Disconnect the oil pipes (if fitted).
9. Disconnect the wire connectors and wire from the left hand connector block.
10. Disconnect the headlight wire connector from the right hand connector block.
11. Disconnect the fuel gauge sender wire.
12. Disconnect the safety start wires.
13. Disconnect the heater hoses.
14. Remove the starter motor, Part 9A.
15. Disconnect the tachometer drive cable (and unclip it) from the front of the engine.
16. Disconnect the stop control cable.
17. Place hardwood wedges between the front axle support casting, and the front axle beam on both sides, to prevent the beam from pivoting.
18. Using MS 2700 support the tractor under the transmission with the fixed stand, and under the engine sump with rails and trolley.
19. Remove the fourteen bolts and one nut.
20. Withdraw the engine and front axle forwards.

Reassembly

21. Align the engine with the transmission, (two guide studs made to the given dimensions and fitted in each side of the gearbox flange, will assist in alignment).
22. Remove the plug.
23. Using a suitable lever turn the flywheel, and at the same time push the engine and front axle towards the transmission. Turning the flywheel aligns the clutch plate splines with the gearbox main and p.t.o. input shaft splines. Continue pushing and turning until the engine and transmission flanges meet.

NOTE: Do not fit any of the bolts until the two flanges meet, or serious damage may occur to the transmission and clutch.

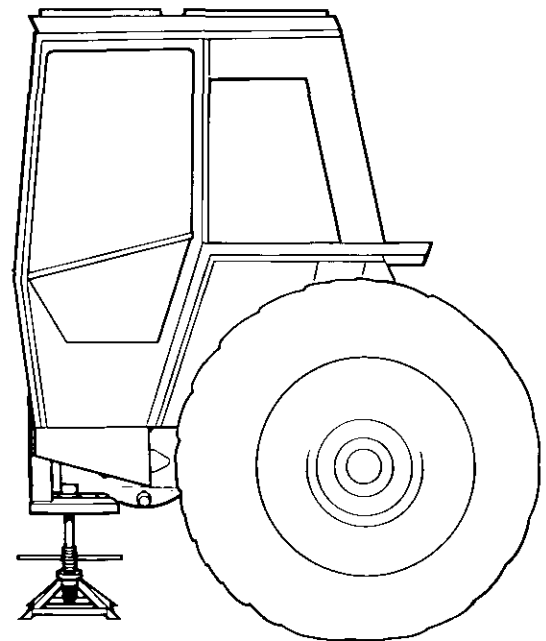
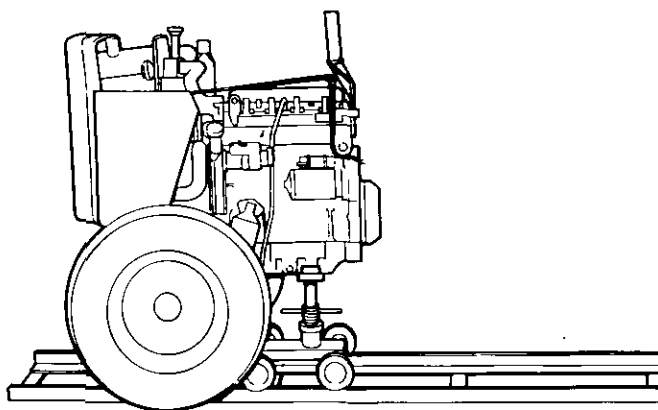
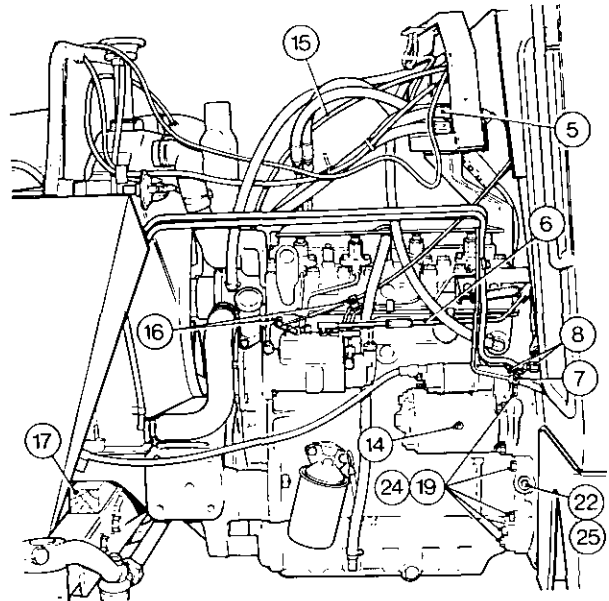
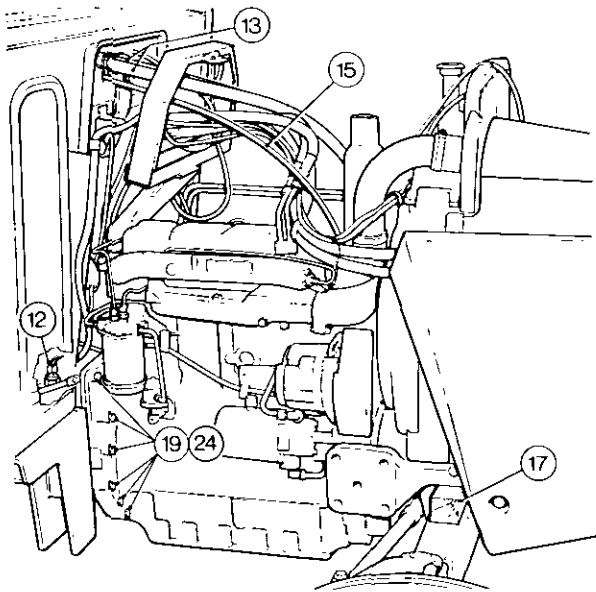
24. Fit some of the bolts, remove the guide studs, fit the remainder of the bolts and nut, and tighten them to a torque of 75 Nm (55 lbf ft).
25. Refit the plug.
26. Reverse procedures 2 to 18.
27. Adjust the clutch linkage, Part 5A.



KEY

- | | |
|---------------------------------------|--------------------------------|
| A. 11,1 mm ($\frac{7}{16}$ in) | D. 12,7 mm ($\frac{1}{2}$ in) |
| B. 6,4 mm ($\frac{1}{4}$ in) | E. 25 mm (1 in) |
| C. 3,2 mm ($\frac{1}{8}$ in) | F. 100 mm (4 in) |
| G. $\frac{7}{16}$ in—14 UNC—2A THREAD | |

SPLITTING THE TRACTOR



(20)

SPLITTING THE TRACTOR BETWEEN THE SPACER HOUSING AND THE CENTRE HOUSING AND WITHDRAWING THE ENGINE AND TRANSMISSION FORWARDS

3A—03—05

Special Tools: MS 2700 Rail Trolley
MF 365-1A Plates
MF 365-4 Long Support Bars
MF 365-6 Bar Pins
MF 367-7 Tommy Bar
MF 365-8 Stands
MF 367 Wrench Set.

Disassembly

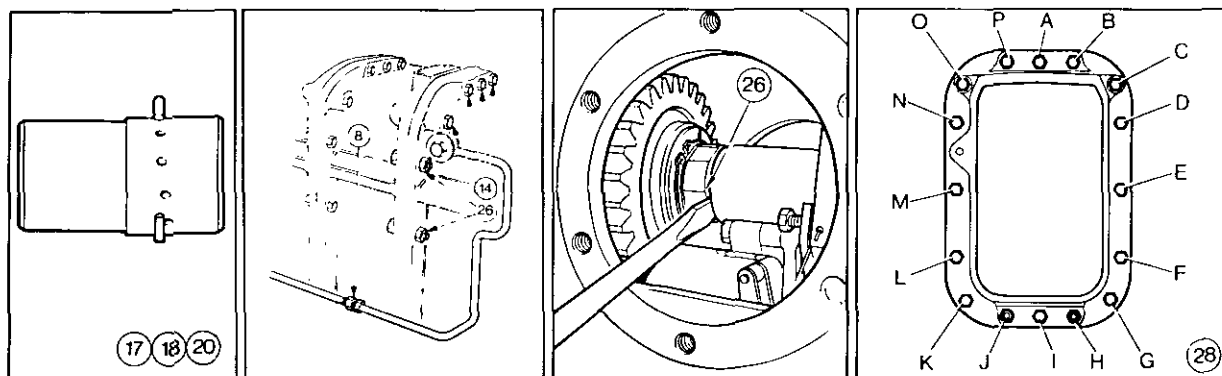
1. Split the tractor between the engine and transmission, operation 3A—02—03, procedures 1 to 13 and 15 to 17.
2. Remove the fuel tank, Part 4C.
3. Drain the transmission oil via the drain plugs on the transmission case and centre housing.
4. Remove the Multi-Power rod (if fitted).
5. Remove both floor access panels Part 2B.
6. Remove the gear levers, Part 5B.
7. Slacken the turnbuckle, and disconnect the rod from the clutch arm.
8. Disconnect the oil pipe (if fitted).
9. Disconnect the hydraulic brake flexible hose, both sides, collecting the fluid in a suitable receptacle.
10. Remove the bolt, washer and rubber mounting block from under each side of front of cab.
11. Using MF 365-1, 4, 6, 7 and 8 raise the cab approximately 50 mm (2 in) at the front.
12. Using MS 2700 support under the centre housing with the stand, and under the spacer with the trolley and rails.
13. Disconnect the cab earth strap.
14. Remove the 16 bolts and nine nuts securing the spacer and centre housing flanges.
15. Withdraw the front axle, engine, transmission and spacer forwards.
16. Discard the gasket.
17. Remove the split pin from the shear tube only if absolutely necessary.

Re-assembly

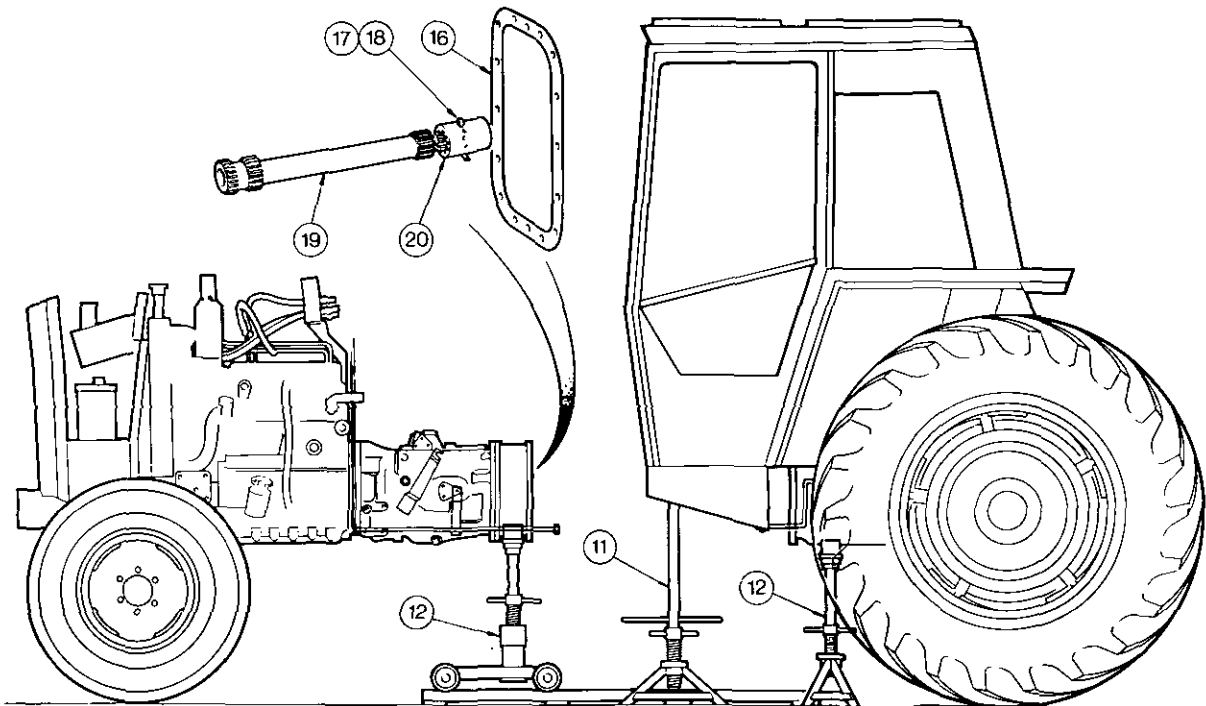
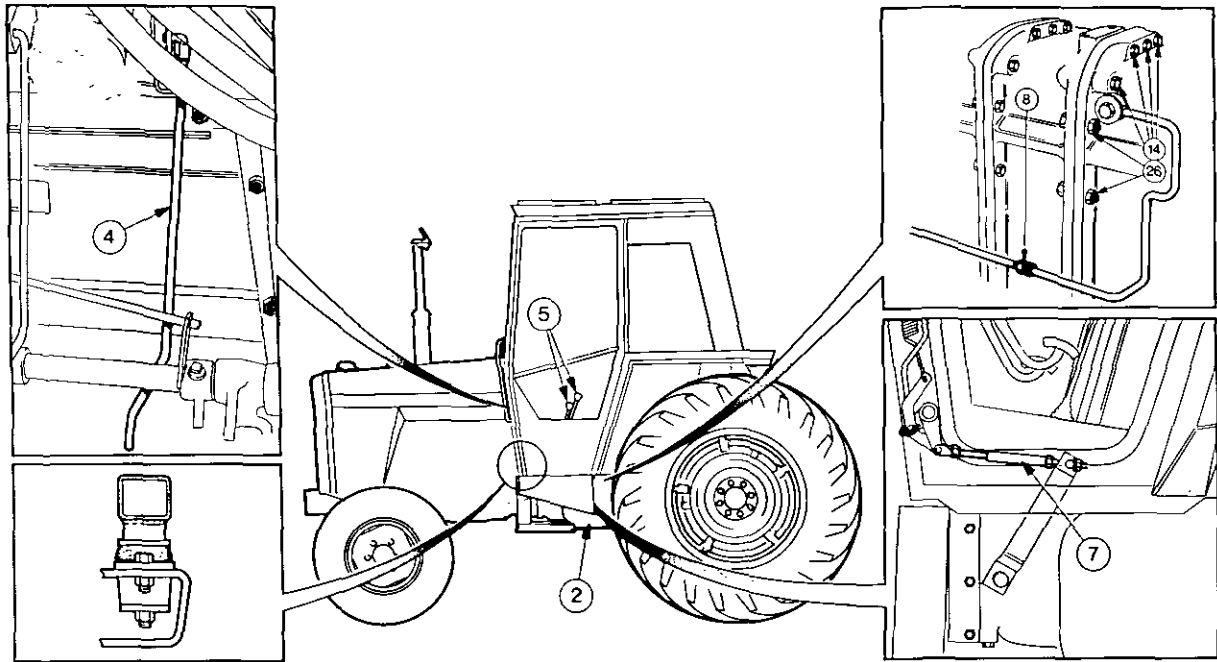
18. If the split pin has been removed, refit it in the centre of the five pairs of holes in the shear tube.
19. Fit the rear drive shaft into the epicyclic high/low coupler, with the high/low gear lever in low gear, and the main gear lever in the third gear position.
20. Fit the shear tube on to the pinion with the holes around the tube towards the front.
21. Fit two guide studs (see operation 3A—02—03 Fig. 23), in to the top left and right hand sides of the spacer rear flange, using them to support a new, dry gasket.
22. Remove the plug and, using a suitable lever, turn the flywheel.
23. Push the front axle, engine, transmission and spacer towards the centre housing, aligning the guide studs in the spacer with the corresponding holes in the centre housing. Continue turning and pushing until the two flanges meet.

NOTE: Do not fit and tighten any of the bolts until the two flanges meet, or serious damage may occur to the p.t.o. and main drive components. To facilitate easy re-assembly, the spacer and centre housing flanges must be aligned as near as possible.

24. Secure the two flanges with a nut and bolt on each side.
25. Remove the Response Control side cover.
26. Push the shear tube forwards (which will push the rear drive shaft against a spring, continue pushing until the spring is fully compressed) and measure the distance between the shear tube and locking collar. This measurement should be 0,4 to 2,5 mm (0.015 to 0.100 in).
27. If the end float is not within the specified limits, separate the spacer and centre housing. Remove the split pin and reposition it nearer the front of the shear tube if the measurement is too large, or nearer the rear of the shear tube if the measurement is too small. Repeat procedures 21 to 24 and 26, until the end float obtained is within the specified limits.
28. Remove the guide studs, fit the nuts and bolts, and tighten them to a torque of 105 Nm (75 lbf ft) starting at bolt 'A' and working in a clockwise direction (viewing the tractor from the rear) to bolt 'P', two rotations around the flange are to be completed, and finish by tightening bolts 'A' and 'B' a third time using the MF 367 wrench set and a torque wrench.
29. Refit the response control side cover.
30. Reverse procedures 1 to 13, except:
 - (a) Apply a few drops of recommended sealant to the mounting bolt threads and tighten until the rubber mounting is compressed to a thickness of 25,4 mm (1 in).
 - (b) Adjust the linkage. Part 5A.
 - (c) Check the Multi-Power for correct operation.
 - (d) Fill the transmission with an approved oil to the required level.
31. Bleed the hydraulic brakes, operation 6A—29—29.



SPLITTING THE TRACTOR



SPLITTING THE TRACTOR**SPLITTING THE TRACTOR BETWEEN THE SPACER HOUSING AND THE CENTRE HOUSING AND WITHDRAWING THE CENTRE HOUSING AND REAR AXLE REARWARDS****Splitting Procedure**

3A-04-07

Special Tools: See Operation 3A-03-05

Disassembly

NOTE: Ensure that there is a minimum distance of 1143 (45 in) between the inside edges of the rear wheels.

1. Remove the fuel tanks Part 4C.
2. Drain the transmission oil via the drain plugs on the transmission case and centre housing.
3. Disconnect the response control rods including the remote.
4. Disconnect the differential lock rod.
5. Remove the handbrake rods.
6. Disconnect the hydraulic brake flexible hose both sides, collecting the fluid in a suitable receptacle.
7. Remove the lower rear panel.
8. Disconnect the auxiliary feed and return hoses (if fitted).
9. Disconnect the p.t.o. rod.
10. Disconnect the levelling box operating rod.
11. Disconnect the oil pipe (if fitted)
12. Disconnect the hydraulic quadrant rods.
13. Remove the four rear mounting bolts and stabiliser chain brackets securing the cab risers to the trumpet housing.
14. Using MF 365-1, 4, 6, 7 and 8, raise the cab approximately 50 mm (2 in) at the rear.

15. Using MS 2700 support under the spacer with the stand and under the centre housing with the trolley and rails.
16. Remove the 16 bolts and 9 nuts securing the spacer and centre housing flanges.
17. Withdraw the rear axle and centre housing rearwards.
18. Discard the gasket.
19. Remove the split pin from the shear tube only if absolutely necessary.

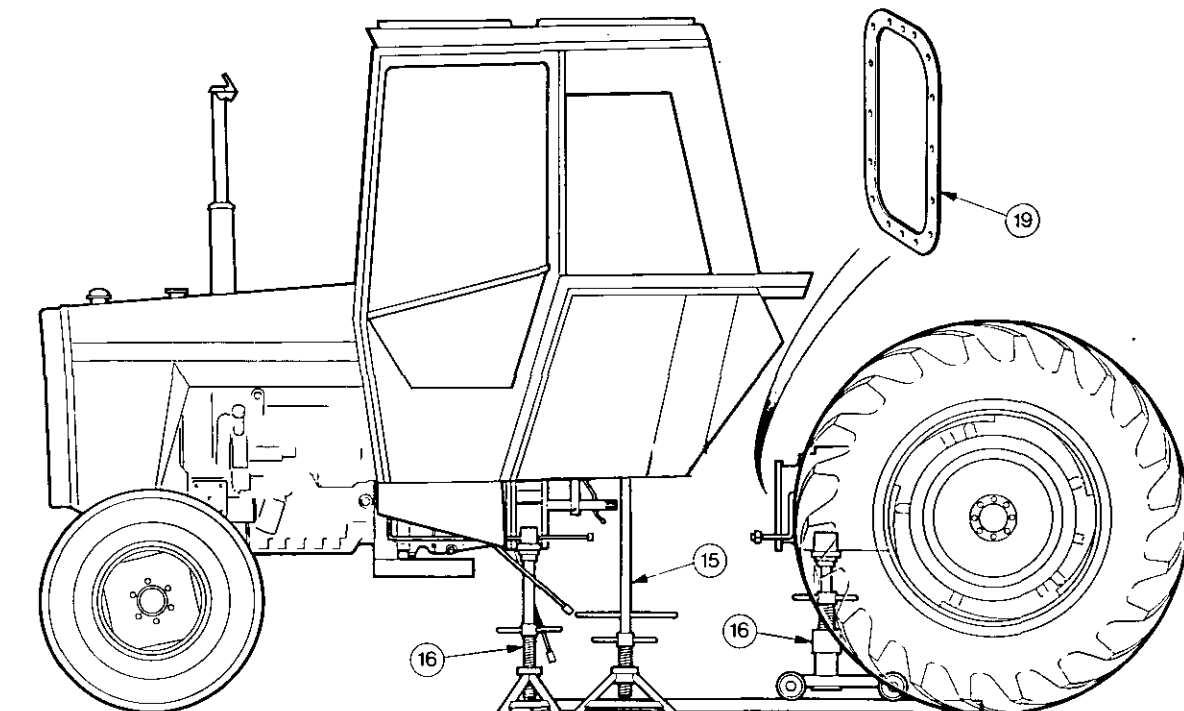
Re-assembly

20. Carry out operation 3A-03-05, procedures 18 to 22.
21. Push the rear axle and centre housing towards the spacer, aligning the guide studs in the spacer with the corresponding holes in the centre housing. Continue turning and pushing until the two flanges meet.

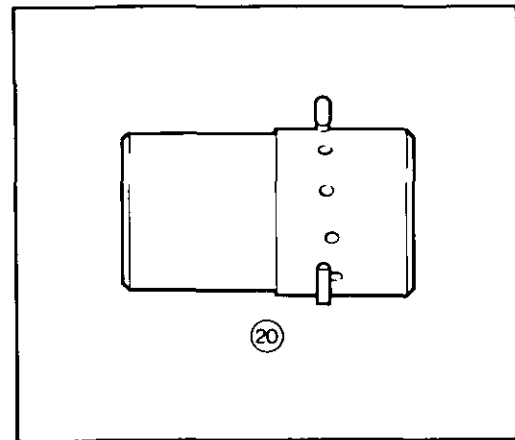
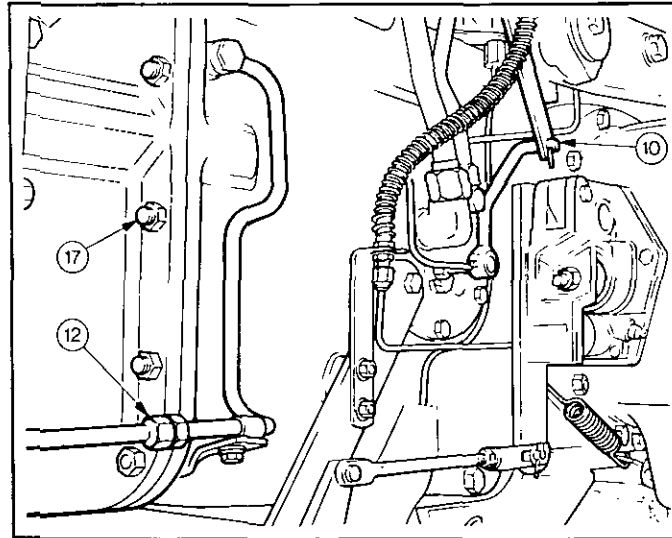
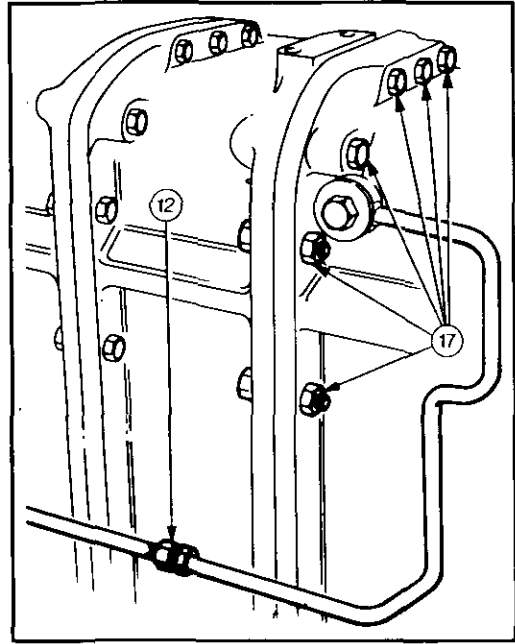
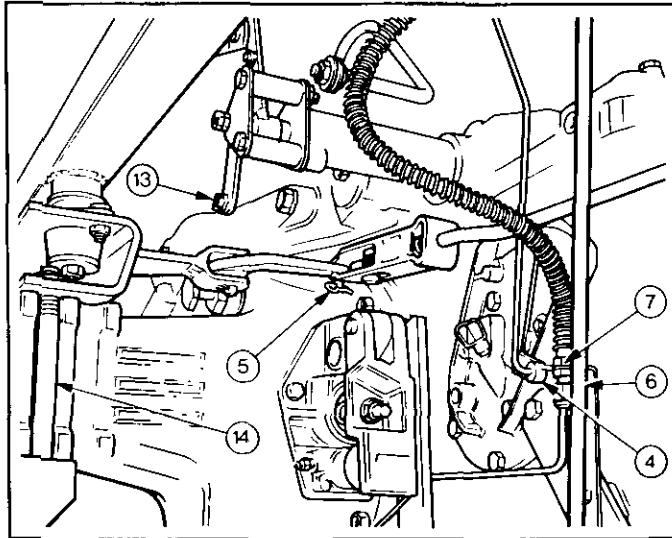
NOTE: Do not fit and tighten any of the bolts until the two flanges meet, or serious damage may occur to the p.t.o. and main drive components.

To facilitate easy re-assembly, the spacer and centre housing flanges must be aligned as near as possible.

22. Carry out operation 3A-03-05 procedures 24 to 29.
23. Reverse procedures 1 to 15, except:
 - (a) Apply a few drops of recommended sealant to the threads of the cab riser/stabiliser mounting bracket bolts, and tighten them to a torque of 230 Nm (170 lbf ft).
 - (b) Bleed the hydraulic brakes. Operation 6A-29-29.
 - (c) Fill the transmission with an approved oil to the required level.



SPLITTING THE TRACTOR



**MF 600 SERIES TRACTOR
WORKSHOP SERVICE MANUAL**

PART 4

Publication No. 1856 274 M1

comprising

- A ENGINE
- B COOLING SYSTEM
- C FUEL SYSTEM AND AIR CLEANER

A4. 236 and A4. 248 ENGINES

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ENGINE**GENERAL**

The Perkins A4. 236 engine and the A4. 248 engine are four cylinder water cooled, direct injection diesel units. The A4. 236 has a stroke of 127 mm (5.0 in) and a nominal bore diameter of 98,42 mm (3.875 in). The A4. 248 has a stroke of 127 mm (5.0 in) and a nominal bore diameter of 101 mm (3.98 in).

Both types of engines incorporate overhead valves mounted vertically in the cylinder head. A gear driven camshaft located in the right hand side of the cylinder block operates the valves via tappets, push rods and a series of rocker levers located on a shaft mounted on top of the cylinder head. Valves with oversize stems are available if excessive wear should occur in the cylinder head.

The cylinder block and crankcase form an integral casting and are fitted with full length replaceable flanged cast iron liners.

The aluminium pistons have a toroidal cavity in the head and are fitted with four piston rings on A4. 248 engines, and five piston rings on A4. 236 engines. The pistons are attached to their connecting rods by fully floating gudgeon pins retained by circlips. The big end bearings are replaceable and consist of a thin steel-shell lined with an aluminium-tin alloy.

The engine is lubricated by force feed. The oil is drawn from the sump via a strainer, by a rotary pump

driven by the crankshaft via the balancer unit. The oil passes through a filter before being circulated under pressure around the engine.

The crankshaft is mounted in five replaceable aluminium-tin alloy lined bearings held in position by cast iron bearing caps. Thrust is absorbed by four washers located on both sides of the centre main bearing cap and cylinder block.

A balancer unit is fitted to the cylinder block and driven via gears by the crankshaft. The oil pump is mounted on the rear of this unit inside the lubricating oil sump.

Maximum Engine Power at 2 000 rev/min

A4. 236 engine

MF 675	69 hp	(BS. AU 141 Ambient Conditions)
	66 PS	(DIN 70020)

Maximum Engine Power at 2 200 rev/min

A4. 248 engine

MF 690	79 hp	(BS. AU 141 Ambient Conditions)
	75 PS	(DIN 70020)

FAULT DIAGNOSIS

FAULT FINDING CHART

FAULT	POSSIBLE CAUSE
Low cranking speed	1, 2, 3, 4
Will not start	5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20, 22, 31, 32, 33
Difficult starting	5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 21, 22, 24, 29, 31, 32, 33
Lack of power	8, 9, 10, 11, 12, 13, 14, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 31, 32, 33
Misfiring	8, 9, 10, 12, 13, 14, 16, 18, 19, 20, 25, 26, 28, 29, 30, 32
Excessive fuel consumption	11, 13, 14, 16, 18, 19, 20, 22, 23, 24, 25, 27, 28, 29, 31, 32, 33
Black exhaust	11, 13, 14, 16, 18, 19, 20, 22, 24, 25, 27, 28, 29, 31, 32, 33
Blue/White exhaust	4, 16, 18, 19, 20, 25, 27, 31, 33, 34, 35, 45, 56,
Low oil pressure	4, 36, 37, 39, 40, 42, 43, 44
Knocking	9, 14, 16, 18, 19, 22, 26, 28, 29, 31, 33, 35, 36, 45, 46, 48
Erratic running	7, 8, 9, 10, 11, 12, 13, 14, 16, 20, 21, 23, 26, 28, 29, 30, 33, 35, 45, 48
Vibration	13, 14, 20, 23, 25, 26, 29, 30, 33, 45, 47, 49
High oil pressure	4, 38, 41
Overheating	11, 13, 14, 16, 18, 19, 24, 25, 45, 50, 51, 52, 53, 54, 57
Excessive crankcase pressure	25, 31, 33, 34, 45, 55
Poor compression	11, 19, 25, 28, 29, 31, 32, 33, 34, 46, 48
Starts and stops	10, 11 12

Key to Fault Finding Chart

1. Battery capacity low.
2. Bad electrical connection.
3. Faulty starter motor.
4. Incorrect grade of lubricating oil.
5. Low cranking speed.
6. Fuel tank empty.
7. Faulty stop control operation.
8. Blocked fuel feed pipe.
9. Faulty fuel lift pump.
10. Choked fuel filter.
11. Restriction in air cleaner.
12. Air in fuel system.
13. Faulty fuel injection pump.
14. Faulty atomisers or incorrect type.
15. Incorrect use of cold start equipment.
16. Faulty cold starting equipment.
17. Broken fuel injection pump drive.
18. Incorrect fuel pump timing.
19. Incorrect valve timing.
20. Poor compression.
21. Blocked fuel tank vent.
22. Incorrect type or grade of fuel.
23. Sticking throttle or restricted movement.
24. Exhaust pipe restriction.
25. Cylinder head gasket leaking.
26. Overheating.
27. Cold running.
28. Incorrect tappet adjustment.
29. Sticking valves.
30. Incorrect high pressure pipes.
31. Worn cylinder bores.
32. Pitted valves and seats.
33. Broken, worn or sticking piston rings.
34. Worn valve stems and guides.
35. Overfull oil bath air cleaner or incorrect grade of oil.
36. Worn or damaged bearings.
37. Insufficient oil in sump.
38. Blocked sump strainer.
39. Oil pump worn.
40. Pressure relief valve sticking open.
41. Pressure relief valve sticking closed.
42. Broken relief valve spring.
43. Faulty suction pipe.
44. Choked oil filter
45. Piston seizure/pick up.
46. Incorrect piston height.
47. Damaged fan.
48. Broken valve spring.
49. Incorrectly aligned flywheel.
50. Faulty thermostat.
51. Restriction in water jacket.
52. Loose fan belt.
53. Choked radiator.
54. Faulty water pump.
55. Choked breather pipe.
56. Damaged valve stem oil deflectors (if fitted).
57. Coolant level too low.

ENGINE**ROCKER COVER****Removal and Refitment**

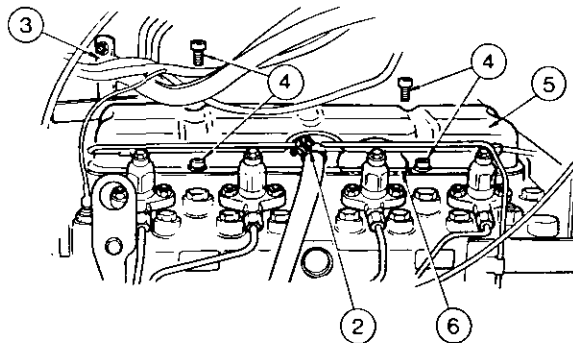
4A-01-04

Removal

1. Prop the hood in the open position both sides.
2. Disconnect the hose.
3. Remove the four Allen bolts.
4. Remove the rocker cover.
5. Discard the gasket.

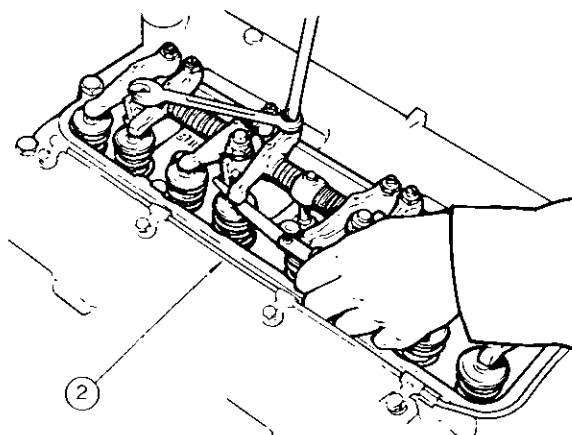
Refitment

6. Reverse procedures 1 to 5, except:
Fit a new gasket, dry.

**VALVE TIP CLEARANCE****Adjustment**

4A-02-04

1. Remove the rocker cover, operation 4A-01-04.
2. Set the valve clearance to 0,30 mm (0.012 in) cold. The clearance is measured between the rocker lever and the top of the valve stem. The sequence for adjusting the clearance is as follows:—
Valve No. 8. Fully open (fully compressed) set No. 1. valve clearance.
Valve No. 7. Fully open (fully compressed) set No. 2. valve clearance.
Valve No. 6. Fully open (fully compressed) set No. 3. valve clearance.
Valve No. 5. Fully open (fully compressed) set No. 4. valve clearance.
Valve No. 4. Fully open (fully compressed) set No. 5. valve clearance.
Valve No. 3. Fully open (fully compressed) set No. 6. valve clearance.
Valve No. 2. Fully open (fully compressed) set No. 7. valve clearance.
Valve No. 1. Fully open (fully compressed) set No. 8. valve clearance.
3. Refit the rocker cover, operation 4A-40-42.



ROCKER ASSEMBLY**Removal and Refitment**

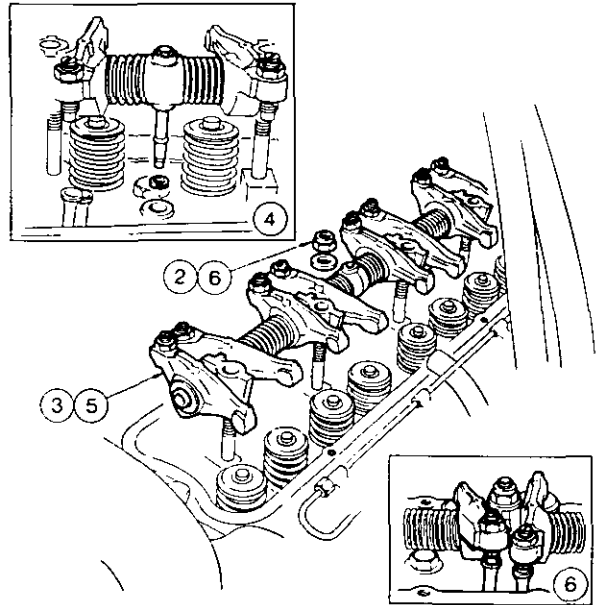
4A-03-05

Removal

1. Remove the rocker cover, operation 4A-01-04.
2. Remove the four nuts and washers.
3. Remove the rocker assembly.

Refitment

4. Fit a new oil feed connection seal into the recess in the cylinder head.
5. Refit the rocker assembly.
6. Refit the four nuts and washers, ensuring that the push rods are correctly located in the rocker levers.
7. Adjust the valve tip clearances, operation 4A-02-04.

**ROCKER ASSEMBLY****Servicing**

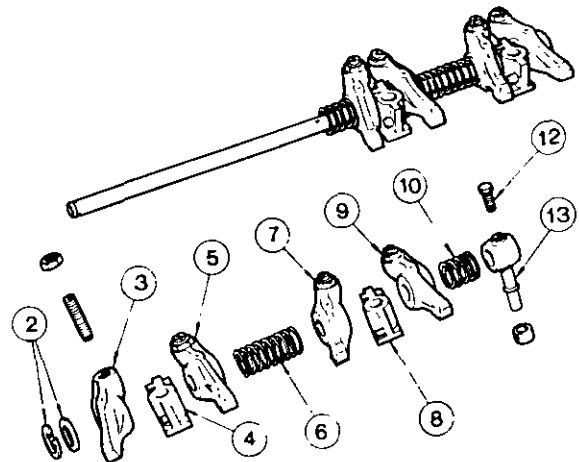
4A-04-05

Disassembly

1. Remove the rocker assembly, operation 4A-04-05.
2. Remove the circlip and washer from the front end of rocker shaft.
3. Slide No. 1 valve rocker lever clear of the shaft.
4. Slide the support bracket clear of the shaft.
5. Slide No. 2 valve rocker lever clear of the shaft.
6. Slide the long spring clear of the shaft.
7. Slide No. 3 valve rocker lever clear of the shaft.
8. Slide the support bracket clear of the shaft.
9. Slide No. 4 valve rocker lever clear of the shaft.
10. Slide the short spring clear of the shaft.
11. Repeat procedures 4 to 12 for the other end of the rocker shaft, which is identical.
12. Remove the bolt from the oil feed connection.
13. Slide the oil feed connection clear of the shaft. Examine the rocker lever bores and rocker shaft for wear. The rockers should be an easy fit on the shaft without excessive side play.

Reassembly

14. Reverse procedures 1 to 13 except:—
 - (a) The support brackets are interchangeable and when refitting them, ensure that the securing stud holes are to the right when viewing the shaft from the front end, with each pair of rockers inclined away from each other on the valve side.
 - (b) Lubricate all parts with clean engine oil prior to reassembly.

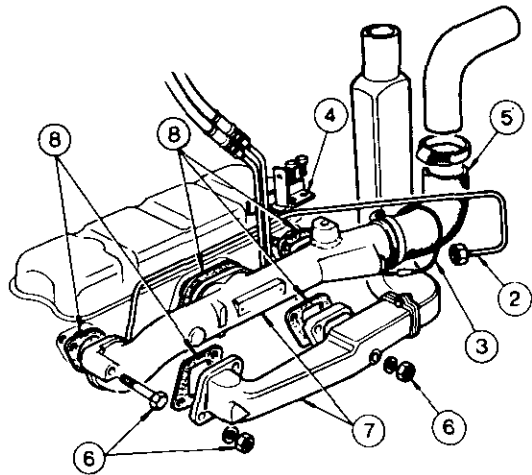


ENGINE**INLET AND EXHAUST MANIFOLDS****Removal and Refitment 4A-05-06****Removal**

1. Remove the hood, Part 2A.
2. Disconnect the thermostart fuel pipe.
3. Disconnect the cable.
4. Remove the steering hose bracket.
5. Remove the rubber inlet hose.
6. Remove the five bolts, nuts and washers.
7. Remove the manifolds.
8. Discard the gaskets.

Refitment

9. Reverse procedures 1 to 8, except:
 - (a) Fit new gaskets.
 - (b) The manifolds must be fitted simultaneously and not one at a time.
 - (c) Bleed the thermostart fuel pipe, Part 4C.

**VALVE SPRINGS****Removal and Refitment 4A-06-06**
(Cylinder Head Fitted)

Special Tools: 6118-B Valve Spring Compressor
PD 6118-4 Adaptor

Removal and Refitment

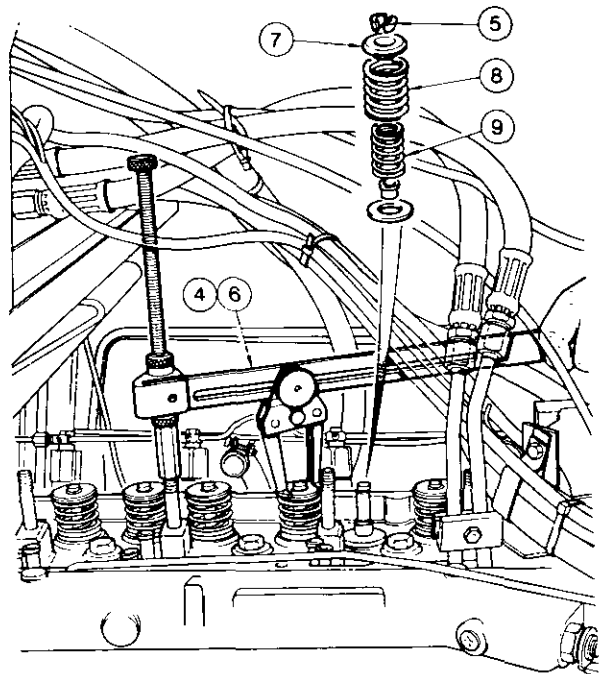
1. Remove the rocker assembly, operation 4A-04-05.
2. Turn the crankshaft to T.D.C. Nos. 1 and 4 cylinders.
3. Remove the hood support frame as described in MF 675 and MF 690, cab removal and refitment, Part 3A.
4. Using 6118-B and PD 6118-4, compress the valve springs on Nos. 1 and 4 cylinders.
5. Remove the collets.
6. Release 6118-B and PD 6118-4 slowly.
7. Remove the spring cap.
8. Remove the spring.
9. On A4. 248 engines only, remove the spring.

NOTES: (a) Do not turn the crankshaft again, until the valve springs have been refitted, and secured with the collets.

(b) Double valve springs are fitted to A4. 248 engines only.

(c) If valve springs are being replaced, a complete new set should be fitted.

10. Reverse procedures 4 to 9, ensuring that the damper coils of the springs are fitted nearest to the cylinder head.
11. Turn the crankshaft to T.D.C. Nos. 2 and 3 cylinders.
12. Repeat procedures 4 to 9 for the valves on Nos. 2 and 3 cylinders.
13. Reverse procedures 1, and 3 to 9.

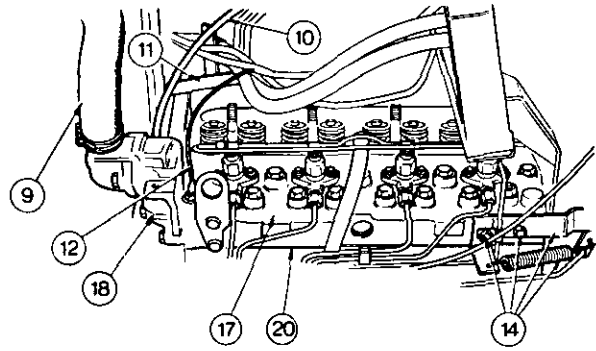


CYLINDER HEAD**Removal and Refitment**

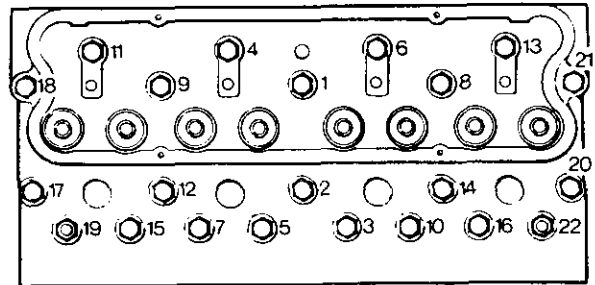
4A-07-07

Removal

1. Remove the hood, operation 2A-02-02.
2. Remove the left and right hand fanguards.
3. Disconnect the battery cables.
4. Drain the cooling system.
5. Disconnect the power steering hoses from the bundy pipes.
6. Remove the power steering bundy pipe clamp from the radiator fan cowl, and disconnect the pipes from the pump and the unions on the right hand side of the radiator frame.
7. Disconnect the tachometer drive cable from the timing case cover.
8. Remove the two bolts securing the rear hood support to the mounting bracket and lift clear together with the power steering bundy pipes.
9. Remove the inlet and exhaust manifolds. Operation 4A-05-06.
10. Remove the injectors part 4C.
11. Remove the high pressure fuel pipes.
12. Disconnect the radiator top hose.
13. Disconnect the water temperature sensor cable.
14. Remove the pipe support bracket from the left hand side of the cylinder head.
15. Remove the heat start fuel pipe.
16. Remove the push rods and retain them in the order in which they were removed.
17. Remove the bolts and nuts in the reverse order of their tightening sequence.
18. Remove the cylinder head.
19. Remove the cylinder head gasket.
20. If necessary, remove the thermostat housing. Operation 4B-07. Procedures 9 to 11.
21. If necessary, remove the rear cover and gasket.

**Refitment**

21. Ensure that all parts are thoroughly clean and that all joint faces are de-greased.
22. Reverse procedures 1 to 22, except:
 - (a) Fit a new cylinder head gasket, dry.
 - (b) The cylinder head securing nuts and bolts must be tightened in the correct sequence, in three equal stages to a torque of 122Nm (90 lbf ft).
 - (c) Lightly coat the rear cover gasket and securing bolts, and the thermostat housing gasket in recommended sealant 'A'.
23. Adjust the valve tip clearance 4A-02-04, but do not refit the hood.
24. Bleed the fuel system, Part 4C.
25. Start the engine and run it at a fast idle speed for approximately ten minutes, until the normal operating temperature is reached, and stop the engine.
26. Remove the rocker assembly, operation 4A-03-05.
27. Re-tighten the cylinder head securing nuts and bolts in the correct sequence to a torque of 122Nm (90 lbf ft).
28. Refit the rocker assembly, operation 4A-03-05.
29. Start the engine and check for any leaks.



ENGINE

CYLINDER HEAD

Servicing

4A-08-08

Special Tools: PD 137 Valve Guide Reamer 0,381 mm (0.015 in) oversize
 PD 138 Valve Guide Reamer 0,762 mm (0.030 in) oversize
 316 x Valve Seat Cutter Handle
 316-12 Normal Pilot
 316-125 Pilot, 0,381 mm (0.015 in) oversize
 316-13 Pilot, 0,762 mm (0.030 in) oversize
 PD 317-22 Valve Seat Cutter (Exhaust)
 317-30 Valve Seat Cutter (Inlet)
 317G-22 Valve Seat Glazebreaker (Exhaust)
 317G-30 Valve Seat Glazebreaker (Inlet)
 6118 B Valve Spring Compressor
 PD 6118-4 Adaptor
 PD 41 B Valve Depth Gauge

Disassembly and Reassembly

1. Remove the cylinder head, operation 4A-07-07.
2. Using 6118 B and PD 6118-4, compress the spring(s).
3. Remove the collets.
4. Release and remove the 6118B and PD 6118-4.
5. Remove the valve spring cap.
6. Remove the spring(s).

NOTE: Only A4. 248 engines are fitted with double valve springs.

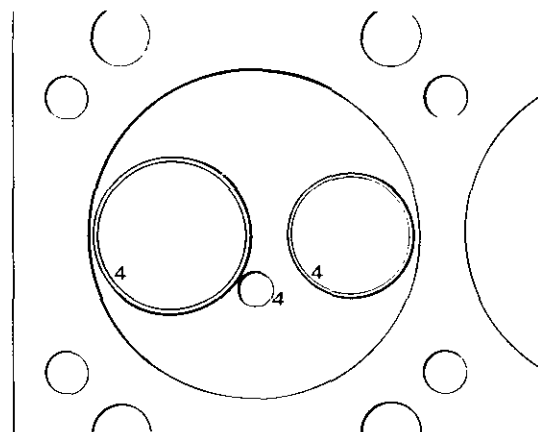
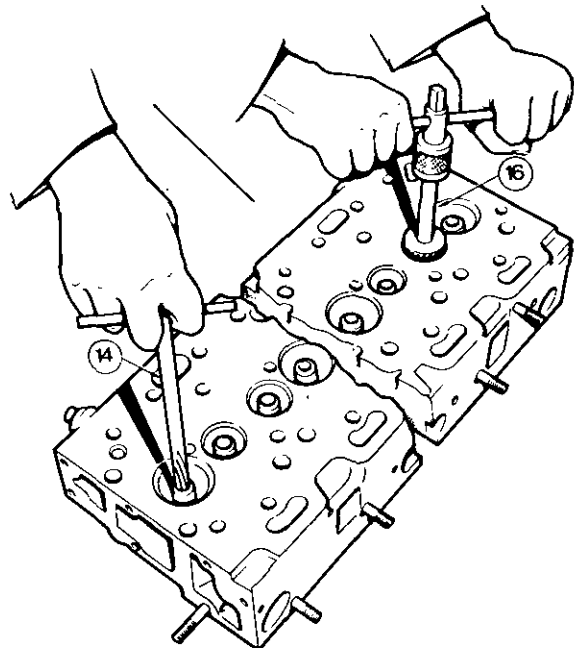
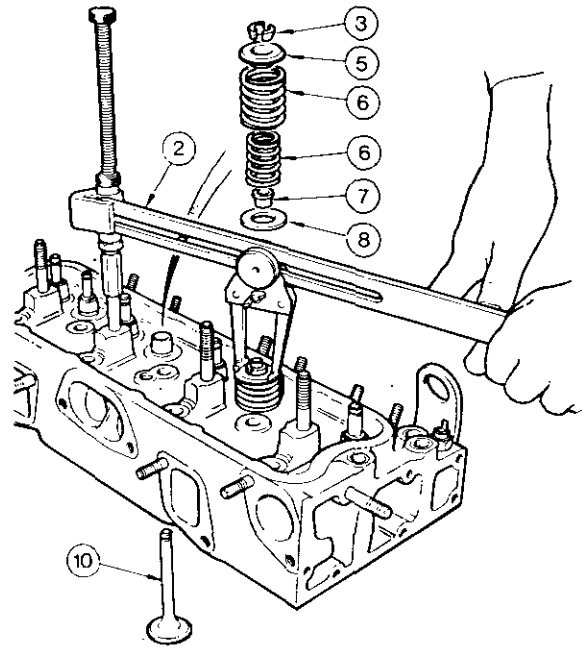
7. Remove the valve stem oil seal.
8. Remove the spring seat.
9. Repeat procedures 2 to 8 for the remaining valves.
10. Invert the cylinder head and remove the valves.

NOTE: The valves are numbered 1, 1:2, 2:3, 3:4, 4 from the front of the engine with the corresponding numbers adjacent to each valve seat to facilitate correct refitment.

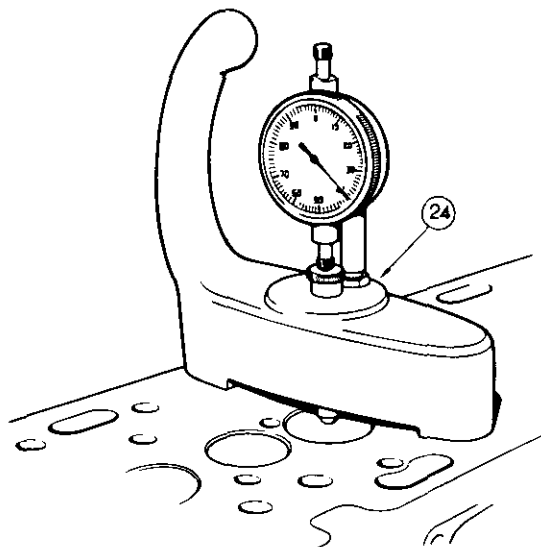
11. Clean all ports free of any carbon or other deposits.
12. If the water jacket of the cylinder head shows signs of excessive scale, a proprietary brand of de-scaling solution should be used.
13. Check the valve guide bores for wear.
14. If necessary, ream the bores to 0,381 mm (0.015 in) or 0,762 mm (0.030 in) oversize as required, using PD 137, or PD 138.

NOTE: When the valve guides have been reamed out, new valves with corresponding larger diameter stems must be fitted, and must have corresponding larger stem seals. The new valves should be numbered to correspond with the old valves.

15. Check the valve seats for excessive pitting or wear.
16. If necessary, recut the valve seats using the appropriate combination of cutter handle, pilot and valve seat cutter. Remove the minimum amount of metal consistent with giving a good smooth, gas tight seal.
17. Thoroughly clean all the valves and examine them for pitting, wear and burning.
18. If necessary, machine grind the valve jointing flange to an angle of 45°, removing the minimum amount of metal consistent with a good smooth finish.



19. Thoroughly clean the valves.
20. Lubricate the valve stems with clean engine oil.
21. Hand grind the valves and their respective valve seats until all pitting is removed and a good seal is produced.
22. Wash the cylinder head and valves thoroughly with clean paraffin and dry.
23. Lightly oil the valve stems and insert the valves in the cylinder head.
24. Using PD 41B, check the valve head depths relative to the cylinder head face, these should be between 0,74 and 1,4 mm (0-029 and 0-055 in) exhaust valves, and 0,89 and 1,55 mm (0-035 and 0-061 in) inlet valves.
25. If these limits are exceeded; the offending valve must be discarded, and a new one fitted in its place, again the valve head depth must be measured, and if it is still not within these limits, a new valve seat insert must be fitted (exhaust valves only), operation 4A-09-10. If the offending valve is an inlet, and still not within the limits after fitting a new valve, the cylinder head must be discarded and a new replacement fitted.
26. Check the flatness of the cylinder head face and if necessary, skim the face to a maximum of 0,30 mm (0-012 in) providing the injector nozzle protrusion is not greater than 4,44 mm (0-175 in). This figure must not be obtained by fitting additional injector sealing washers.
27. Thoroughly clean the cylinder head.
28. Reverse procedures 1 to 9 except:
 - (a) When refitting the valve springs, ensure that the damper coils of the springs are nearest the cylinder head.
 - (b) Refit the valves in the same order in which they were removed.



ENGINE

VALVE SEAT INSERTS

Fitting Procedure

4A-09-10

Special Tools: See Operation 4A-47-46 and Valve Seat Inserting Tool (see procedure 4).

Valve seat inserts can only be fitted on EXHAUST valve applications, and then only as a last resort to Cylinder Head Servicing, operation 4A-08-08. The fitting of inserts is a precision operation, and therefore should only be undertaken by a competent, skilled machinist.

1. Service the cylinder head, operation 4A-08-08.
2. Using the valve guide bore, machine the recess in the cylinder head face, to the dimensions given.

NOTE: Work as closely as possible to the minimum machining dimensions to allow for a possible re-seating at a later date.

3. Remove all machining swarf and clean the insert recess.
4. Using the valve guide bore as a pilot, press the insert home using an inserting tool made to the given dimensions.

NOTE: The insert must not be hammered in or lubricated.

5. Check that the insert is pressed fully home and is flush with the bottom of the recess.
6. Using the valve guide as a pilot, machine the 'flare' to the dimensions given.
7. Remove all machining swarf and burrs.
8. Re-cut the valve seat at an included angle of 90° so that the valve head depth below the cylinder head face is within the production limits of 0,74 and 0,99 mm (0-029 and 0-039 in) for exhaust valves.

KEY TO FIG. 2

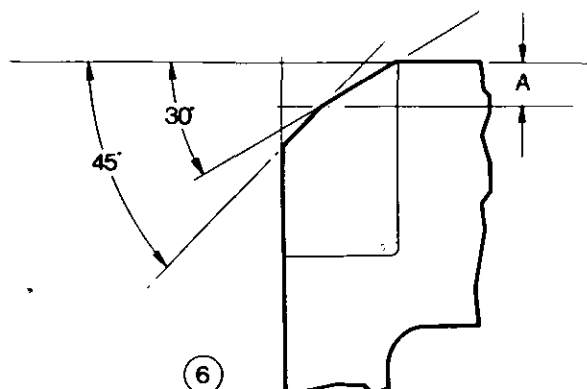
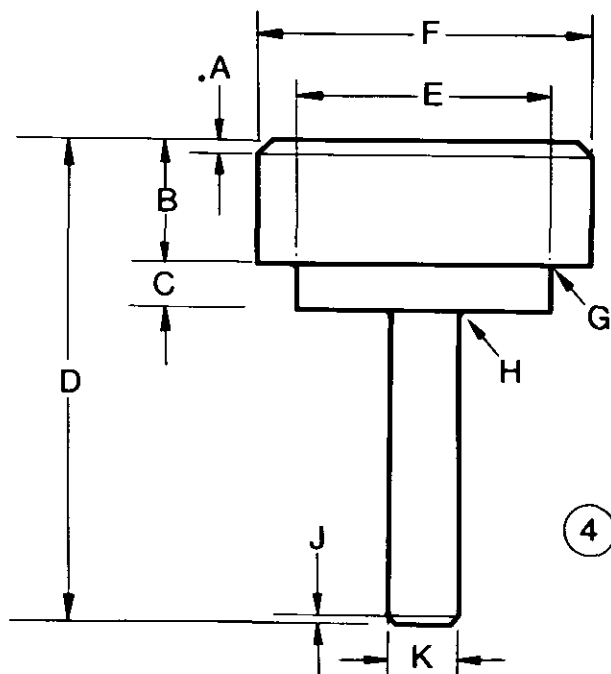
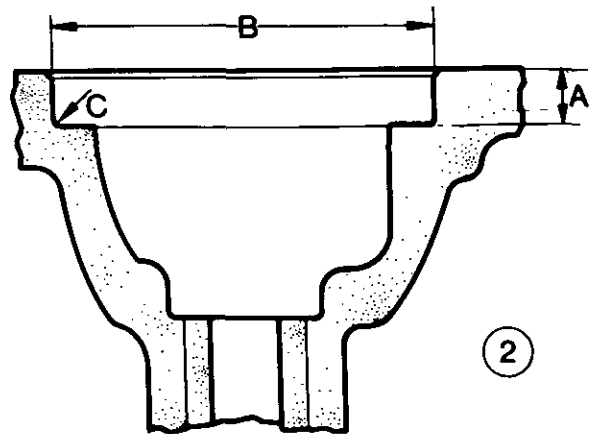
- A. 9,52 to 9,65 mm (0-375 to 0-380 in).
 B. 42,62 to 42,64 mm (1-678 to 1-679 in).
 C. 0,38 mm (0-015 in) maximum radius.

KEY TO FIG. 4

- A. 1,59 mm (0-63 in) at 45°.
 B. 19,05 mm (0-75 in).
 C. 7,92 mm (0-312 in).
 D. 76,20 mm (3 in).
 E. 31,70 to 31,72 mm (1-248 to 1-249 in).
 F. 43,42 to 43,67 mm (1-670 to 1-680 in).
 G. 0,79 mm (0-031 in) radius.
 H. 1,59 mm (0-063 in) radius.
 J. 1,59 mm (0-063 in) at 45°.
 K. 9,45 to 9,47 mm (0-372 to 0-373 in).

KEY TO FIG. 6

- A. 2,39 to 2,51 mm (0-094 to 0-099 in).
 Flare cut to 30°.



TIMING CASE COVER**Removal Refitment**

4A-10-11

Removal

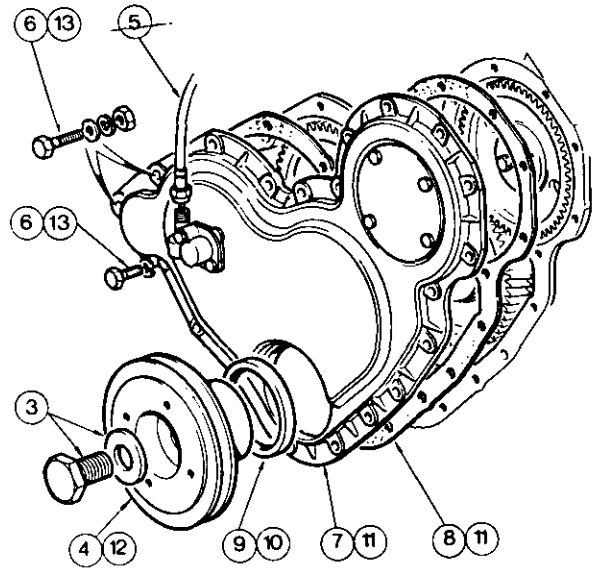
1. Split the tractor between the engine and the front axle, Part 3A.
2. Remove the fan belt.
3. Remove the crankshaft pulley securing bolt and washer.
4. Remove the crankshaft pulley.
5. Disconnect the tachometer drive cable.
6. Remove the 20 bolts and washers and the two nuts securing the timing case cover.
7. Remove the timing case cover.
8. Remove and discard the gasket.
9. Remove the oil seal.

Refitment

10. Fit a new oil seal, with the toe of the seal towards the engine.
11. Place the timing case cover and a new gasket in position.

NOTE: Lightly coat the gasket in recommended sealant 'A'.

12. Slide the crankshaft pulley into position on the crankshaft to centralize the timing case cover.
13. Fit and tighten some of the bolts and washers to secure the timing case cover.
14. Remove the crankshaft pulley.
15. Fit and tighten the remainder of the bolts, washers and nuts.
16. Reverse procedures 1 to 5, except:
Tighten the crankshaft pulley securing bolt to a torque of 400 Nm (300 lbf ft).



ENGINE

TIMING GEARS

Idler Gear Removal and Refitment 4A-11-12

Special Tool: Dial Test Indicator Gauge.

Removal

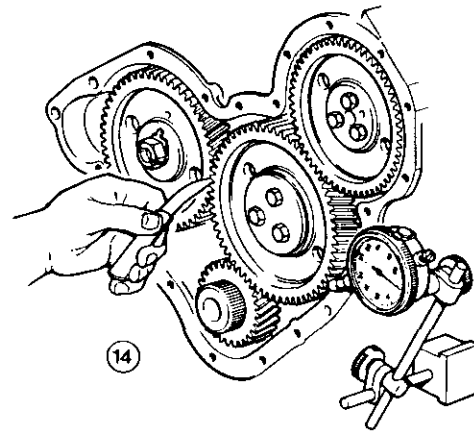
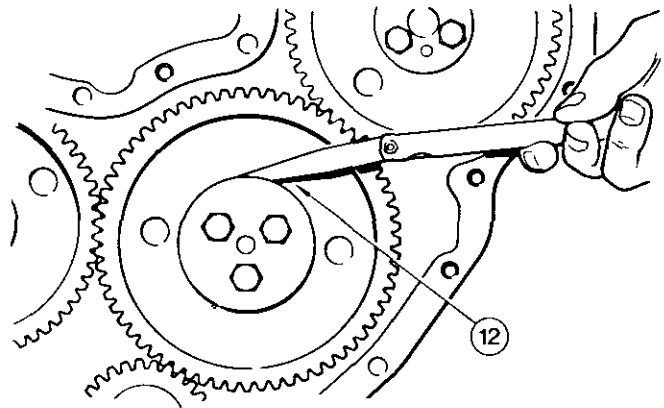
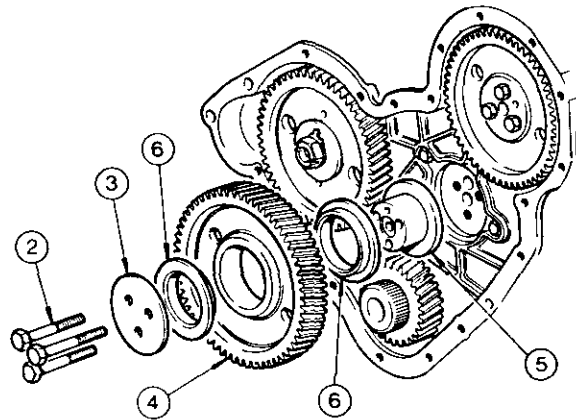
1. Remove the timing case cover, operation 4A-10-11.
2. Remove the bolts.
3. Remove the retaining plate.
4. Remove the gear.
5. Withdraw the hub.
6. If necessary, remove the bushes.

Refitment

7. Remove the rocker assembly, operation 4A-03-05.
8. Turn the crankshaft to T.D.C. Nos. 1 and 4 cylinders. (i.e. with the crankshaft gear keyway at the top of its periphery).
9. Reverse procedures 5 and 6, except:
 - (a) If new bushes are fitted, they must be bored to finished size after fitting.
 - (b) When refitting the hub, ensure that the oilway in the hub is aligned with the oilway in the cylinder block.
 - (c) Lubricate the hub and bushes with clean engine oil.
10. Refit the gear, aligning the timing marks on the crankshaft, camshaft, fuel pump and idler gears.
11. Reverse procedures 2 and 3, except: Tighten the bolts to a torque of 33 Nm (24 lbf ft).
12. Check the idler gear end float which should be between 0,10 and 0,20 mm (0-004 and 0-008 in).
13. Refit the rocker assembly, operation 4A-03-05, procedures 4, 5 and 6.
14. Check the timing gear backlash using either a dial test indicator gauge or feeler gauges. The backlash should be 0,076 mm (0-003 in) minimum, between any two meshed gears. Check all points of mesh.

NOTE: Should the backlash obtained not be within the prescribed limits, replace the affected timing gears.

15. Refit the timing case cover, operation 4A-10-11.



TIMING GEARS**Camshaft Drive Gear Removal and Refitment**
4A-12-13

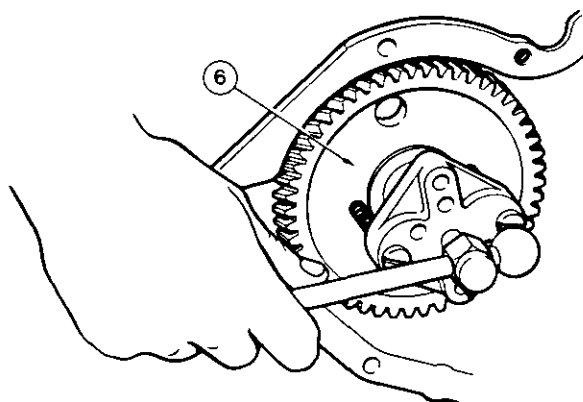
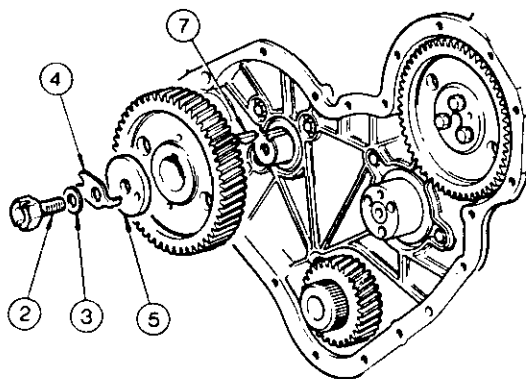
Special Tools: See Operation 4A-11-12, and
PD 155B Puller.
PD 155-1 Adaptor.

Removal

1. Remove the idler gear, operation 4A-11-12 procedures 1 to 5.
2. Remove the bolt.
3. Remove the washer.
4. Remove the tab washer.
5. Remove the retaining plate.
6. Using PD 155B and PD 155-1, remove the gear.
7. Remove the key.

Refitment

8. Reverse procedures 2 to 7, except:
 - (a) Ensure that the camshaft key is in good condition.
 - (b) Fit a new tab washer and bolt.
 - (c) Tighten the camshaft bolt to a torque of 68 Nm (50 lbf ft).
9. Refit the idler gear, operation 4A-11-12 procedures 7, 8 and 10 to 15.



ENGINE**TIMING GEARS****Fuel Pump Drive Gear Removal and Refitment**
4A-52-52

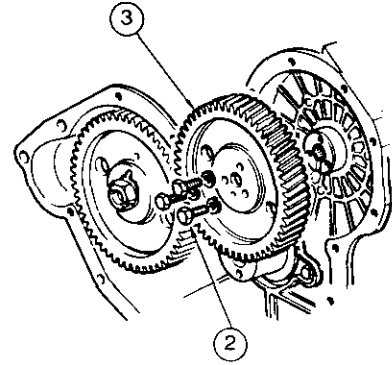
Special Tools: See Operation 4A-11-12.

Removal

1. Remove the idler gear, operation 4A-11-12 procedures 1 to 5.
2. Remove the bolts and the spring washers.
3. Remove the gear.

Refitment

4. Reverse procedures 2 and 3, except:
Ensure that the dowel in the gear locates in the corresponding slot in the pump drive flange.
5. Refit the idler gear, operation 4A-11-12 procedures 7, 8 and 10 to 15.

**TIMING GEARS****Crankshaft Gear Removal and Refitment**
4A-14-14

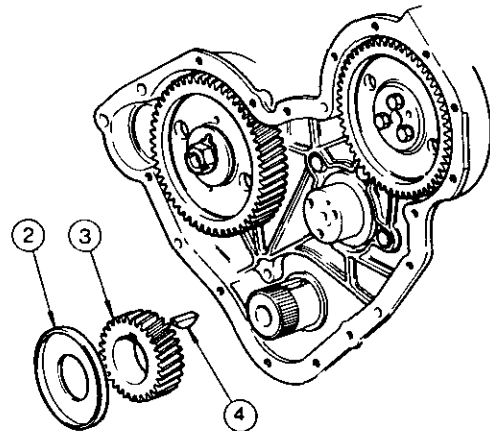
Special Tools: See Operation 4A-11-12.

Removal

1. Remove the idler gear, operation 4A-11-12, procedures 1 to 5.
2. Remove the oil thrower.
3. Withdraw the gear.
4. Remove the key.

Refitment

5. Reverse procedures 3 and 4.
6. Remove and refit the balancer unit, operation 4A-61-58 procedures 1 to 3, and 7 to 13.
7. Refit the idler gear, operation 4A-11-12.



TIMING CASE**Removal and Refitment**

4A-15-15

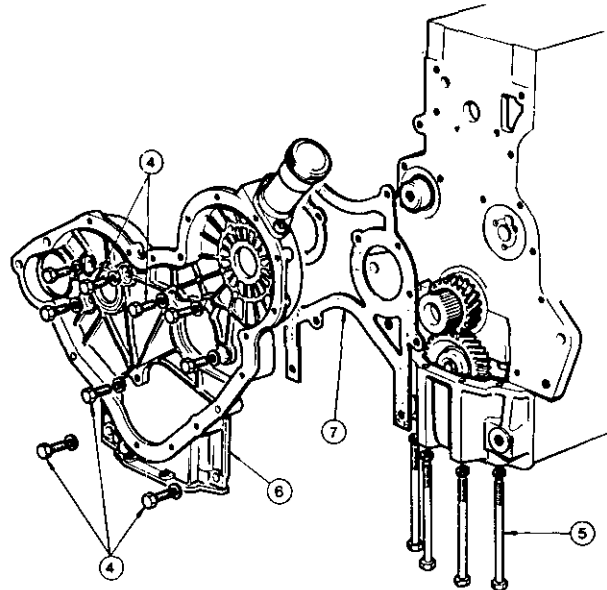
Special Tools: PD 155D Puller
Dial Test Indicator Gauge

Removal

1. Remove the camshaft drive gear, operation 4A-12-13.
2. Remove the fuel pump drive gear, operation 4A-13-14, procedures 2 and 3.
3. Remove the fuel injection pump, Part 4C.
4. Remove the nine bolts and washers securing the timing case to the cylinder block.
5. Remove the four bolts and washers securing the timing case to the engine sump.
6. Remove the timing case.
7. Remove the gasket.
8. Remove the idler gear hub from the cylinder block.

Refitment

9. Reverse procedures 3 to 8, except: Fit a new gasket lightly coated in recommended sealant 'A'.
10. Refit the fuel pump drive gear, operation 4A-13-14, procedure 4.
11. Refit the camshaft drive gear, operation 4A-12-13, procedures 8 and 9.



ENGINE

FLYWHEEL

Removal and Refitment

4A-16-16

Special Tools: See Part 5A, and
Dial Test Indicator Gauge.

Removal

1. Remove the clutch, Part 5A.
2. Remove the six bolts and tab washers.
3. Remove the flywheel.
4. If necessary, remove the pilot bearing.

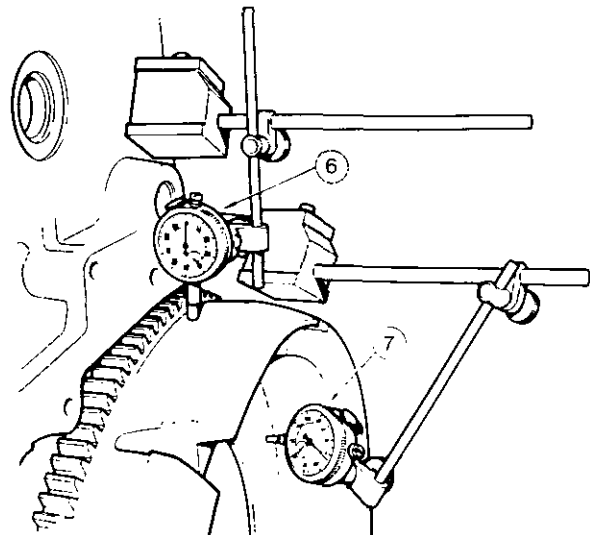
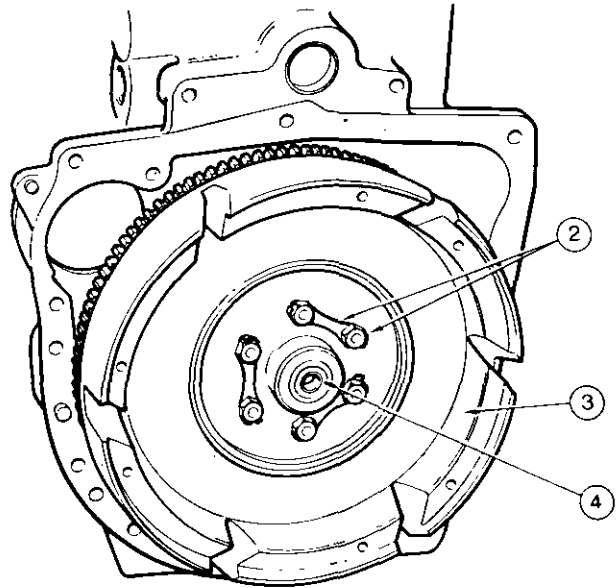
Refitment

5. Reverse procedures 2 to 4, except:
 - (a) Locate the flywheel on the crankshaft flange so that the untapped hole in the flange is in line with the unused hole in the flywheel.
 - (b) Tighten the flywheel bolts to a torque of 100 Nm (75 lbf ft) and secure with new tabwashers.
6. Using a dial test indicator gauge, adjust the dial so that the stylus is contacting the flywheel periphery. Turn the crankshaft and check the total reading. The flywheel should run true within 0,30 mm (0-012 in) total indicator reading.
7. Adjust the dial test indicator so that the stylus rests on the clutch face of the flywheel, parallel to the crankshaft at the outermost point of the face.

Press the crankshaft forwards to take up the end float, and turn the flywheel. The run out on the flywheel face should be within 0,025 mm (0-001 in) per 25 mm (1 in) of flywheel radius, measured from the crankshaft axis to the stylus of the dial test indicator gauge. If the run out is excessive, remove the flywheel, check and remove any burrs or foreign matter.

NOTE: If the flywheel is removed, procedures 5, 6 and 7 must be repeated.

8. Refit the clutch, Part 5A.



FLYWHEEL**Ring Gear Removal and Replacement 4A-17-17**

Special Tools: See Operation 4A-16-16

Removal

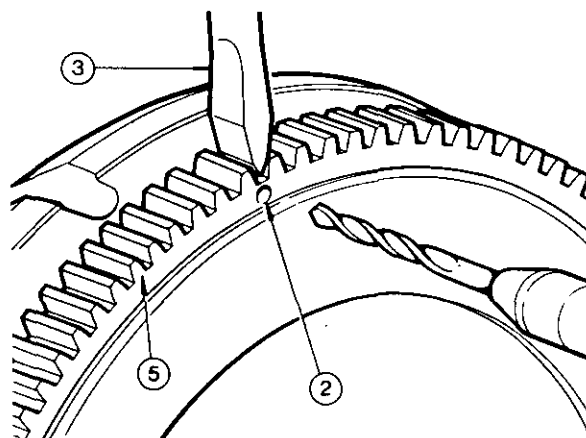
1. Remove the flywheel, operation 4A-16-16
2. Drill a 5 mm ($\frac{3}{16}$ in) diameter hole axially midway between the inside diameter of the ring gear, and the root of any tooth, to a depth of 16 mm ($\frac{5}{8}$ in) only, (otherwise damage to the flywheel will ensue).
3. Place a chisel in the root above the drilled hole.
4. Cover the flywheel and chisel point in a heavy cloth to protect the operator and others against flying fragments.

WARNING: Take precautions against flying fragments as the starter ring gear may disintegrate when struck.

5. Support the flywheel and strike the chisel sharply, and the ring gear should split.

Replacement

6. Heat the new ring gear to a temperature of 245°C (475°F) approximately, using an oven, NOT A NAKED FLAME.
7. Fit the gear ring over the flywheel with the 'lead in' on the teeth facing towards the front of the flywheel, push the ring gear fully home and allow to cool slowly.
8. Refit the flywheel, operation 4A-16-16.



ENGINE**CRANKSHAFT REAR MAIN OIL SEAL****Removal and Replacement 4A-18-18**

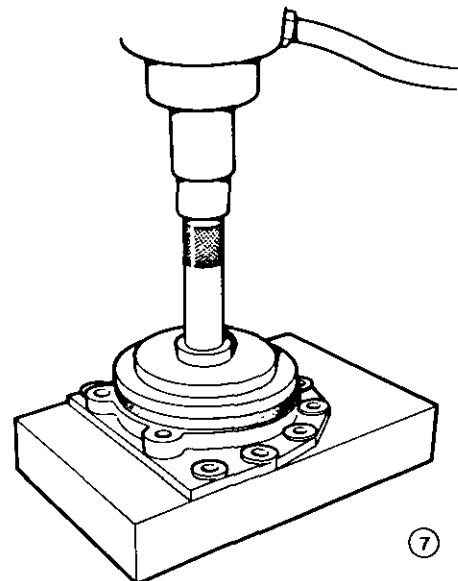
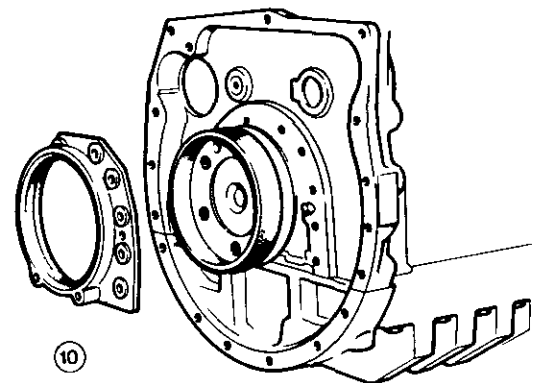
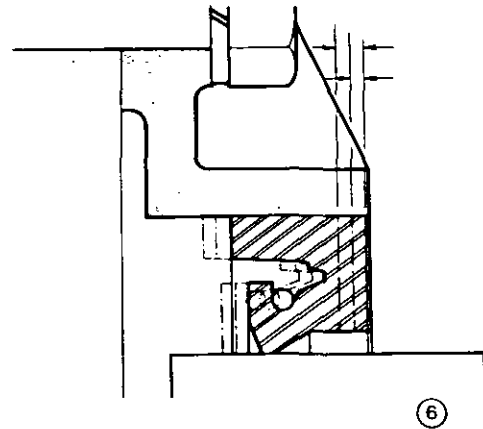
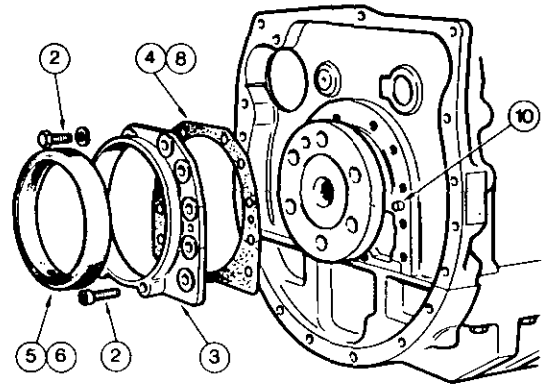
Special Tools: See Operation 4A-55-54 and
 PD 145-1 Oil Seal Replacer
 PD 145-2 Oil Seal Pilot

Removal

1. Remove the flywheel, operation 4A-16-16.
2. Remove the bolts, Allen screws and washers from the seal housing.
3. Remove the seal housing complete with oil seal.
4. Remove the gasket.
5. Remove the seal.

Replacement

6. On production, the lip seal is fitted with its rear face flush with the rear face of the seal housing. Examine the crankshaft flange and if it is found to be grooved the new seal should be pressed further into the housing in the first instance to 3,2 mm (0.125 in) and if required, a further equal distance resulting in a total of 6.4 mm (0.25 in). If all three positions have been used, the worn sealing area of the crankshaft may be machined. (See Operation 4A-29-27, procedure 14).
7. Lubricate the seal and the housing with clean engine oil, then using PD 145-1, press the seal into the housing to the required depth.
8. Fit a new gasket lightly coated in recommended sealant 'A'.
9. Lubricate the seal, the crankshaft flange and PD145-2.
10. Using PD 145-2, fit the seal and housing assembly, ensuring that the housing is correctly located on the dowels in the cylinder block.
11. Remove PD 145-2.
12. Reverse procedures 1 and 2.



ENGINE SUMP**Removal and Refitment**

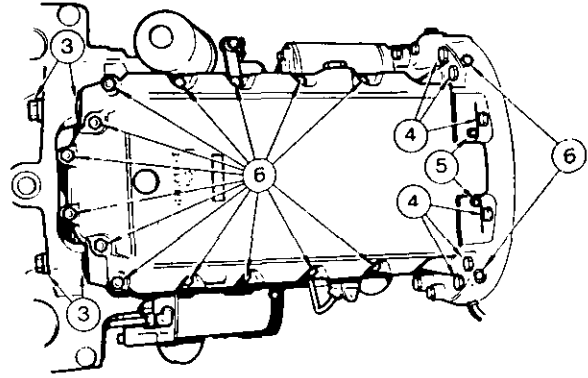
4A-19-19

Removal

1. Drain the engine oil.
2. Lightly support the centre of the sump with a trolley jack.
3. Remove the bolts, washers and shims.
4. Remove the bolts and washers.
5. Remove the nuts and washers.
6. Remove the bolts and washers.
7. Lower the jack and remove the sump.
8. Remove the old gasket.

Refitment

9. Reverse procedures 1 to 8 except:
 - (a) Use a new gasket lightly coated with recommended sealant 'A'.
 - (b) Ensure that the two shims are correctly located between the front axle casting and the engine sump casting.
 - (c) Tighten the sump to transmission casing bolts to a torque of 75 Nm (55 lbf ft).
 - (d) Tighten the front axle to sump bolts to a torque of 270 Nm (200 lbf ft).

**OIL PUMP****Removal and Refitment**

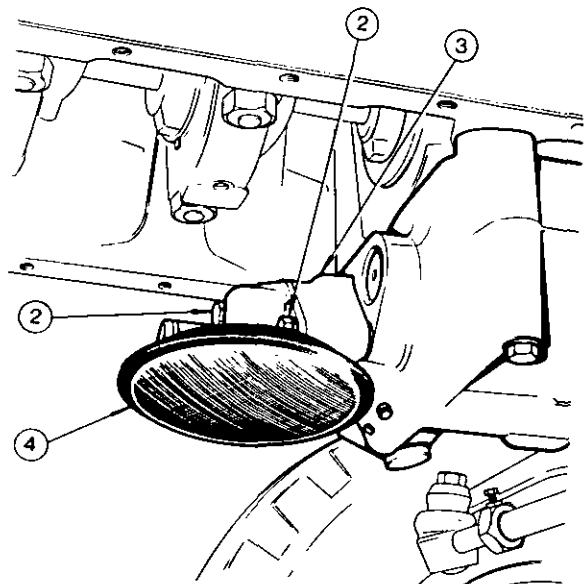
4A-20-19

Removal

1. Remove the sump operation 4A-19-19.
2. Remove the seven bolts.
3. Remove the pump.
4. Remove the strainer.

Refitment

5. Reverse procedures 1 to 4, except:
 - Tighten the oil pump securing bolts to a torque of 28 Nm (21 lbf ft).



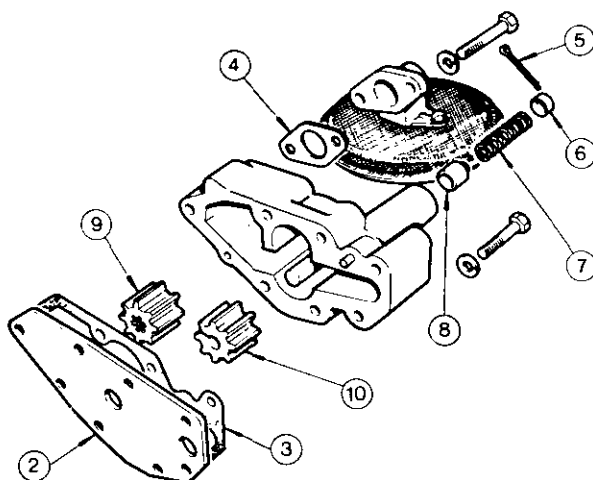
ENGINE**OIL PUMP****Servicing**

4A-21-20

Disassembly

NOTE: The balancer unit drive and driven shafts, needle roller bearings, keys and oil pump gears must be changed after 5 000 hours work.

1. Remove the oil pump operation 4A-20-19
 2. Remove the back plate.
 3. Remove the gasket.
 4. Remove the gasket.
 5. Remove the split pin.
 6. Remove the cap.
 7. Remove the relief valve spring.
 8. Remove the relief valve plunger.
 9. Remove the driving gear.
 10. Remove the driven gear.
- Examine all parts for wear, replace any parts whose condition is suspect.
New drive and driven gears must only be replaced in pairs.

**Reassembly**

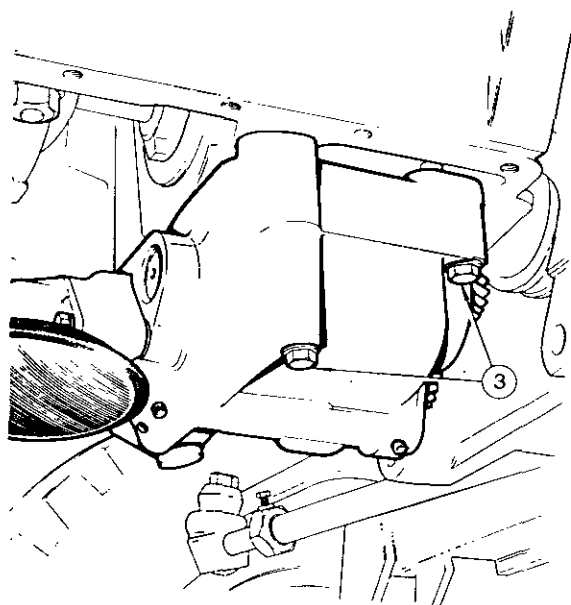
11. Reverse procedures 1 to 10.

ENGINE BALANCER UNIT**Removal and Refitment**

4A-22-20

Removal

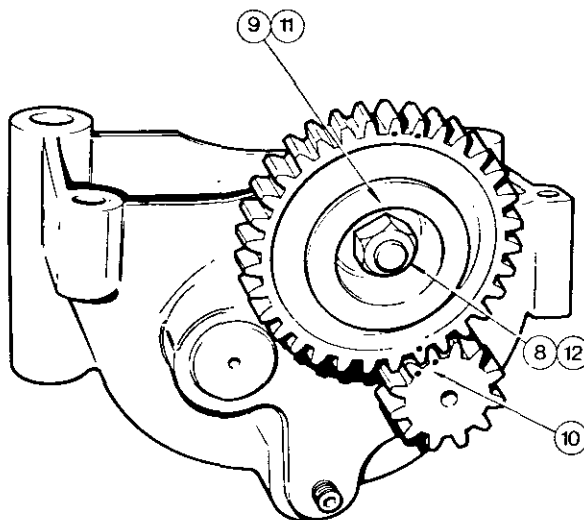
1. Remove the sump, operation 4A-19-19.
2. Support the balancer unit.
3. Remove the four bolts and washers, and remove the balancer unit.
4. Remove the oil pump, operation 4A-19-19, procedures 2 and 3.

**Refitment**

5. Refit the oil pump, operation 4A-20-19, except do not refit the sump.
6. Remove the timing case cover, operation 4A-10-11.
7. Turn the crankshaft to T.D.C. Nos. 1 and 4 cylinders, (i.e. with the crankshaft gear keyway at the top of its periphery).
8. Remove the nut.
9. Remove the idler gear hub.
10. Align the single mark on the idler gear between the double marks on the driven gear.
11. Refit the idler gear hub.

NOTE: Ensure that the dowel on the idler gear hub, locates through the thrust plate and into the corresponding hole in the balancer casing.

12. Refit the nut and tighten it to a torque of 55 Nm (40 lbf ft).
13. Ensure that the two thimbles on the rear upper face of the balancer casing are correctly located. Refit the balancer unit ensuring that the timing marks on the balancer unit driven gear, and idler gear, and idler gear and crankshaft gear are all aligned.
14. Refit the timing case cover, operation 4A-10-11.



ENGINE BALANCER UNIT**Servicing**

4A-23-21

Special Tool: 50 ton Hydraulic Press

Disassembly

NOTE: The balancer drive and driven shafts, needle roller bearings, keys and oil pump gears must be changed after 5 000 hours work.

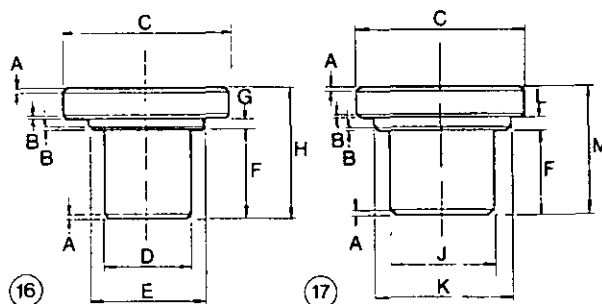
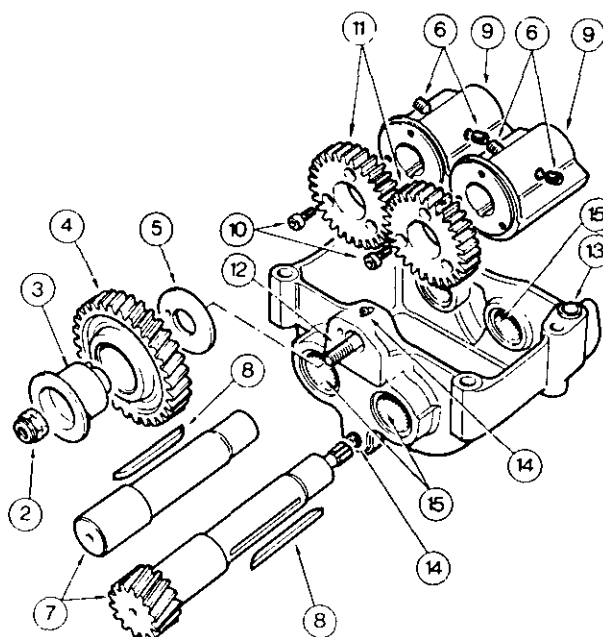
1. Remove the balancer unit, operation 4A-22-20.
2. Remove the nut.
3. Remove the idler gear hub.
4. Remove the idler gear.
5. Remove the idler gear thrust plate.
6. Remove the grub screws.
7. Using the 50 ton hydraulic press, press the shafts forwards out of the housing taking care that the keys do not damage the needle roller bearings.
8. Remove the keys.
9. Remove the balance weights complete with the drive gears.
10. If necessary, remove the Allen screws from each weight.
11. Remove the drive gears.
12. Remove the idler gear hub stud.
13. Remove the oilway thimbles.
14. Remove the seven oilway blanking plugs and flush the oilways clean.
15. If necessary, press out the needle roller bearings.

Reassembly

16. Press new small needle roller bearings into the rear end of the balancer unit, (ensuring that the writing on the rim of the bearing faces away from the balancer frame) using a tool made to the given dimensions and the 50 ton Hydraulic Press.
17. Press new large needle roller bearings into the front end of the balancer unit (ensuring that the writing on the rim of the bearing faces away from the balancer frame) using a tool made to the given dimensions, and the 50 ton Hydraulic Press.
18. Reverse procedures 1 to 14, except:
 - (a) Thoroughly degrease all male and female threads and apply a few drops of recommended sealant 'C' to the threads prior to reassembly.
 - (b) Tighten the six Allen screws, securing the gears to the balance weights, to a torque of 15 Nm (11 lbf ft).
 - (c) When refitting the two shafts, ensure that the balancer drive gears are enmeshed so that both keyways are at either T.D.C. or B.D.C.
 - (d) Extreme care must be taken when pressing in the shafts to ensure fouling of the keys and needle roller bearings does not occur.
 - (e) Tighten the two balance weight grub screws to a torque of 10 Nm (7 lbf ft).
 - (f) Ensure that the dowel on the idler gear hub locates in the corresponding hole in the balancer frame.
 - (g) Tighten the idler hub securing nut to a torque of 55 Nm (40 lbf ft).

Key to Figs 16 and 17

- A. 1,6 mm (0.63 in) \times 45° CHAMFER
- B. 0,8 mm (0.31 in) \times 45° CHAMFER
- C. 51 mm (2 in) dia.
- D. 25,298 mm (0.996 in) dia.
- E. 32,944 mm (1.297 in) dia.
- F. 25,4 mm (1 in)
- G. 2,769 mm (0.109 in)
- H. 37,719 mm (1.485 in)
- J. 31,648 mm (1.246 in) dia.
- K. 40,869 mm (1.609 in) dia.
- L. 3,572 mm (0.141 in)
- M. 38,506 mm (1.516 in)



ENGINE**CONNECTING ROD BIG END BEARING****Removal and Refitment**

4A-24-22

Removal

1. Remove the balancer unit, operation 4A-22-20, procedures 1 to 3.
2. Rotate the crankshaft until the required bearing is at B.D.C.
3. Remove the two nuts from the big end bolts.
4. Remove the big end cap complete with the shell bearing, and then remove the bearing from the big end cap.
5. Remove the big end bolts.
6. Rotate the crankshaft until the shell bearing can be removed from the connecting rod.
7. Repeat procedures 2 to 6 for the remaining big end bearings.

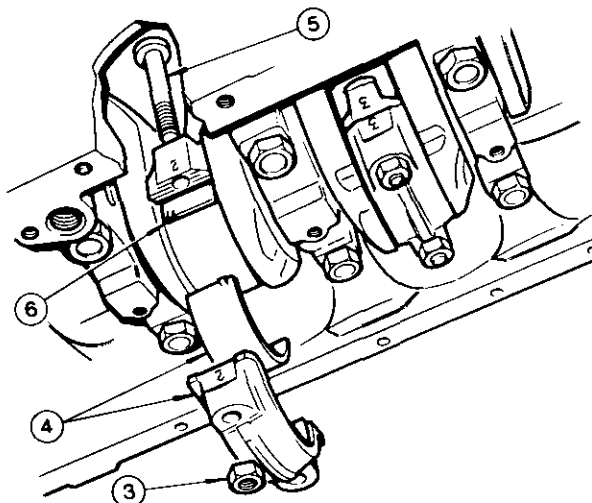
Examine the shell bearings for wear and scoring. If any bearing is found to be suspect, replace the complete set.

Check the crankpins for wear and ovality using a micrometer. Check the diameter of the crankpins in the horizontal plane and the vertical plane at each end of the crankpin.

Crankpin wear and ovality should not exceed 0,0381 mm (0.0015 in). The crankshaft should be re-ground or replaced if these limits are exceeded.

Refitment

8. Reverse procedures 1 to 7, except:
 - (a) Ensure that all components are scrupulously clean and lubricated with clean engine oil.
 - (b) Ensure that the steps on the shell bearing halves fit into the slots on the connecting rods and that the bearings are re-fitted in their original positions and are properly seated.
 - (c) Ensure that the flats on the connecting rod bolts are located against the shoulders on the connecting rods.
 - (d) Ensure that the connecting rod and the end cap are refitted with the identification marks together and are on the left hand side of the engine.
 - (e) Tighten the big end nuts to a torque of 95 Nm (70 lbf ft).
 - (f) The connecting rod big end cap attachment bolts are special bolts and should they require replacement, only bolts supplied by the manufacturer should be used.



PISTONS AND CONNECTING RODS**Removal and Refitment 4A-25-23**

Special Tools: 38 U3 Piston Ring Compressor
PD 41B Piston Height Gauge

Removal

1. Remove the cylinder head, operation 4A-07-07.
2. Remove the connecting rod big end bearings, operation 4A-24-22.
3. Push the pistons and connecting rods out of the top of the cylinders.

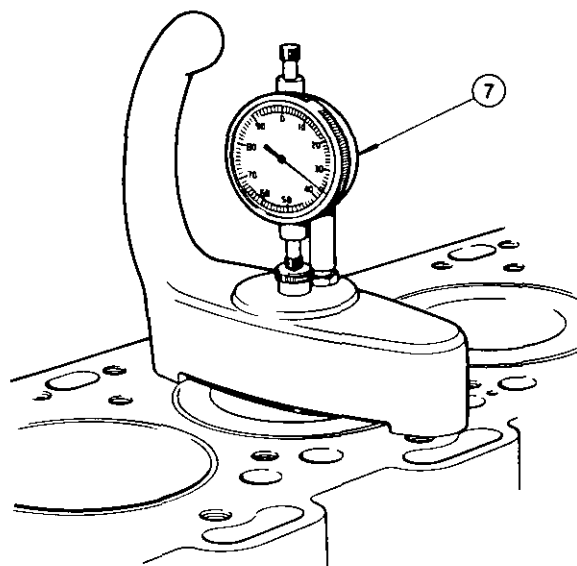
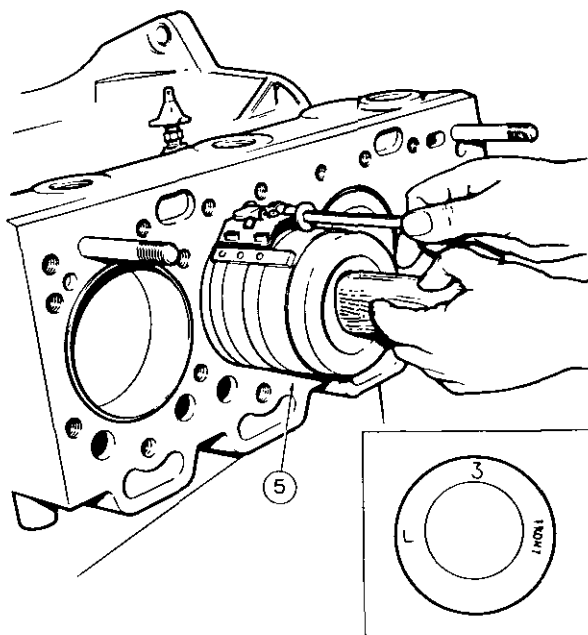
Refitment

Check the condition of the pistons, piston rings and cylinder liners, and if any doubt as to their serviceability, replace them.

4. Clean all parts thoroughly, and freely lubricate with clean engine oil.

NOTE: Position the piston rings on the pistons so that the ring gap on each piston ring is 180° from the gap in the previous piston ring.

5. Using 36 U3 and a suitable piece of hardwood, insert the piston and connecting rod assemblies into the top of their respective cylinder bores, ensuring that the word "front" on the piston crown is towards the front of the engine.
6. Refit the connecting rod big end bearings, operation 4A-24-22, except, do not refit the balancer unit and sump.
7. Using PD 41B, check the piston height. The piston should be 0,41 to 0,62 mm (0.016 to 0.024 in) on 4-236 engines and 0,08 to 0,25 mm (0.003 to 0.010 in) on 4-248 engines above the top face of the cylinder block.
8. Refit the balancer unit, operation 4A-22-20, except do not refit the front axle.
9. Refit the cylinder head, operation 4A-07-07.



ENGINE

PISTONS AND CONNECTING RODS

Servicing

4A-26-24

Special Tools: See Operation 4A-63-60
335 Connecting Rod Alignment Jig
336.102 Arbor Adaptor

Disassembly

1. Remove the pistons and connecting rods, operation 4A-24-22.
2. Remove the rings from each piston.
3. Remove the circlips.
4. Warm the piston in clean liquid to a temperature of 38 to 50°C (100 to 120°F).
5. Carefully withdraw the gudgeon pins.
6. Remove all traces of carbon deposits from the pistons with particular attention to the ring grooves.
7. Check the vertical groove clearance with a new ring fitted. The piston should be replaced if the limits are exceeded.
8. Examine the pistons for signs of scoring.
9. Check the gap of the piston rings when they are fitted in the unworn portion at the top of the cylinder bore.
10. Check the fit of the gudgeon pins in the piston bores and small end bearings.
11. If necessary, press out the small end bushes from the connecting rods.

Reassembly

12. If necessary, press new small end bushes into the connecting rod aligning the oil hole in the bush with the hole in the top of the connecting rod.

NOTE: The reaming of the small end bush is a precision task and should only be undertaken by a skilled machinist.

13. Using 335, check the connecting rod for parallelism and squareness, if any distortion is found, the connecting rod must be replaced.
14. Warm the piston in clean liquid, assemble the pistons to their corresponding connecting rods and insert the gudgeon pins.

NOTE: The cavity in the piston crown is off-set towards one side of the piston. Assemble the pistons to the connecting rods with the cavity towards the side of the connecting rod which carries the connecting rod and big end cap identification.

15. Fit two new circlips.
16. Fit the piston rings in the following order:

A4.236 Engines:

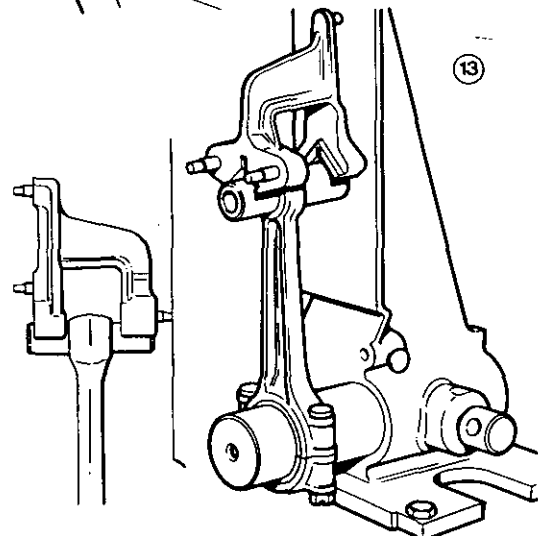
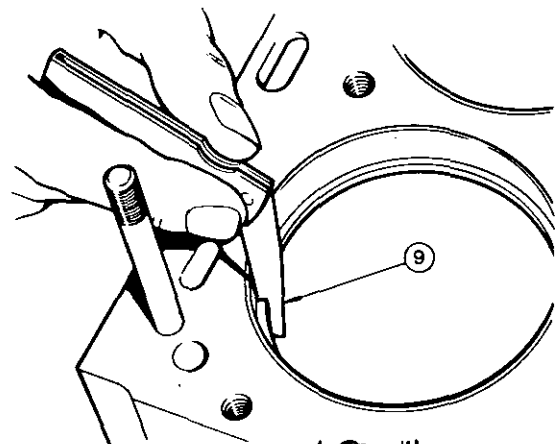
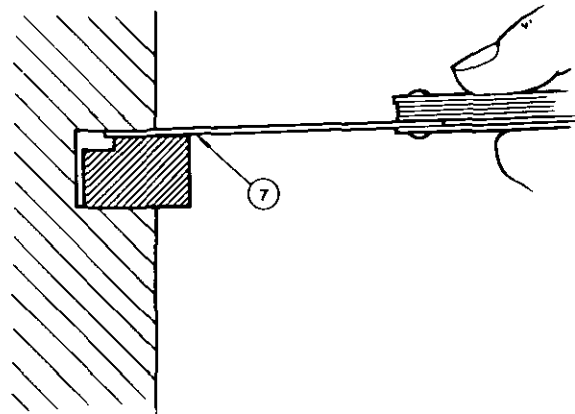
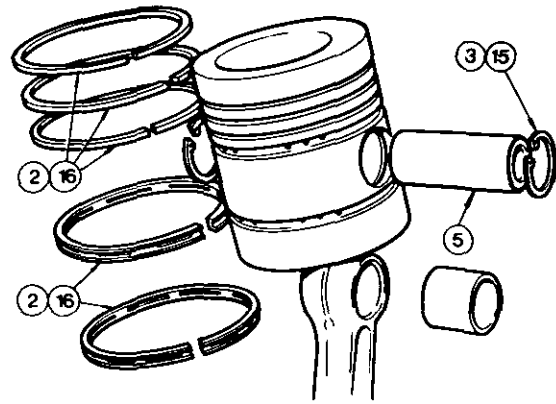
 - (a) Slotted scraper—below gudgeon pin.
 - (b) Slotted scraper—above gudgeon pin.
 - (c) Internally stepped compression—third groove.
 - (d) Internally stepped compression—second groove.
 - (e) Parallel chrome plated compression—top groove.

A4.248 Engines:

 - (a) Spring loaded scraper—above gudgeon pin.
 - (b) Internally stepped compression—third groove.
 - (c) Internally stepped compression—third groove.
 - ** (d) Barrel Face chrome plated compression—top groove.

NOTE: The internally stepped compression rings must be fitted with the step towards the piston crown.

17. Refit the pistons and connecting rods, operation 4A-24-22.



CYLINDER LINERS**Removal and Refitment**

4A-27-25

Special Tools: See Operation 4A-25-23, and
 PD 150 Liner Remover and Replacer
 PD 150-1B Adaptors (A4. 236
 Engine)
 PD 150-7A Adaptors (A4. 248
 Engine)
 30 ton Hollow Hydraulic Ram

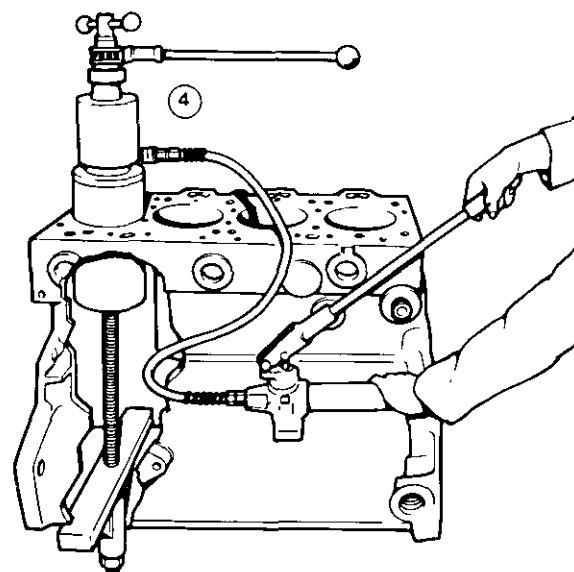
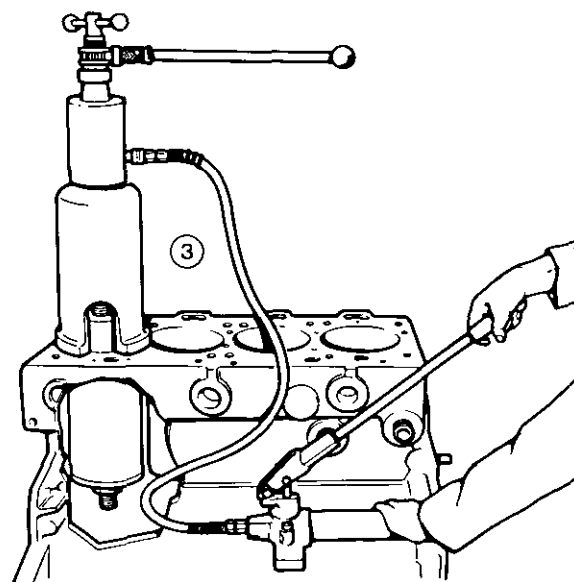
Removal

1. Remove the pistons and connecting rods, operation 4A-25-23.
2. Remove the studs from the cylinder block face.
3. Using PD 150, the appropriate adaptors and a 30 ton hollow hydraulic ram, withdraw the cylinder liners through the top of the cylinder block.

NOTE: The PD 150 cylinder liner remover and replacer tool, is designed for the field service of single liners. Should the tool be required for general workshop overhaul duties, it is advisable to use it in conjunction with a 30 ton hollow hydraulic ram, (Suitable examples are Epco P382 or Pickavant LRH 30), with a hand, or electrically operated hydraulic pump.

Replacement

4. Reverse procedures 1 to 3, except:
 - (a) Care must be taken in the handling and storage of cylinder liners. The slightest burr or damage will cause considerable distortion when the liner is put into the cylinder block.
 - (b) Flanged cast iron liners must not be rebored, but must be replaced with new pre-finished service liners.
 - (c) Prior to pressing in the new liner, the cylinder block parent bore and the new liner must be thoroughly cleaned, in particular the recess for the liner flange in the top of the parent bore.
 - (d) Liberally lubricate all parts with clean engine oil before refitment.
 - (e) Ensure that the liner flange does not foul the counter bore at the top of the parent bore.
 - (f) The top face of the liner should be between 0,01 and 0,25 mm (0.004 and 0.010 in) on the 4.236 engine and + 0,05 to - 0,102 mm (+ 0.002 to - 0.004 in) on the 4.248 engine below the top face of the cylinder block, when fully home.
 - (g) Check the condition of the piston rings, if in any doubt as to their serviceability, replace them.
 - (h) Allow a settling period to elapse before checking the fitted internal bore diameters of the liners.
 - (i) Each liner should be checked in three positions, top, centre and bottom, and the readings being taken transversely and parallel to the centre of the cylinder block.



ENGINE

CRANKSHAFT

Thrust Washers Removal and Replacement

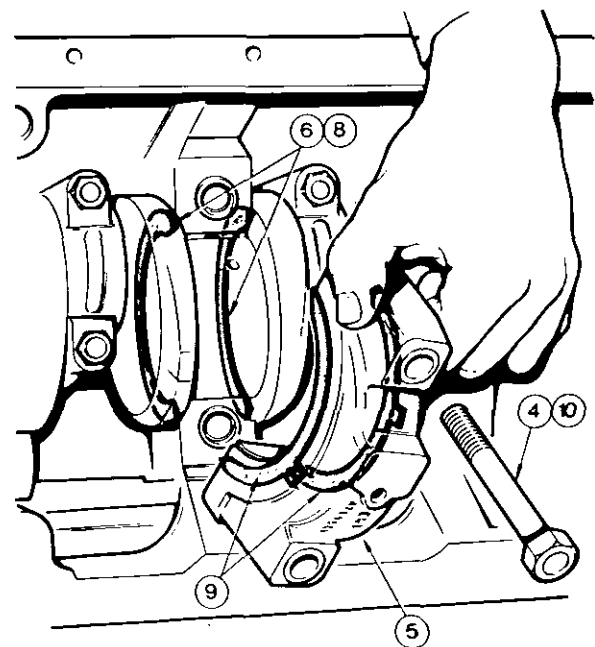
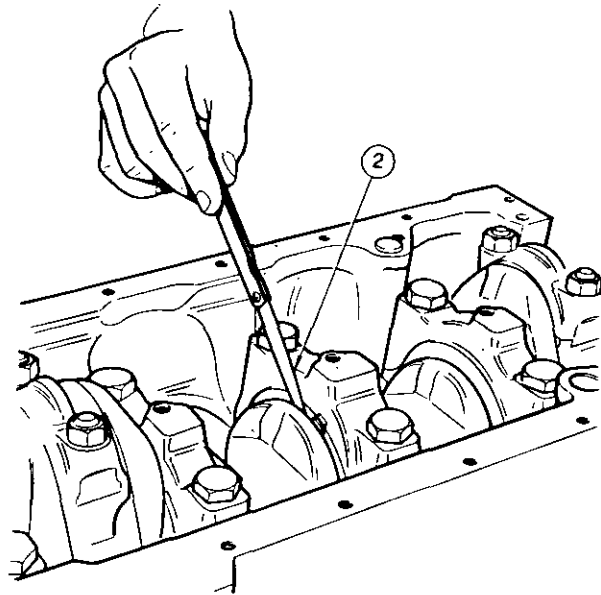
4A-28-26

Removal and Replacement

1. Remove the oil pump, operation 4A-20-19.
2. Push the crankshaft rearwards, and check the crankshaft end float between the rear thrust bearing and the crankshaft. The clearance obtained should be between 0,01 and 0,38 mm (0.004 and 0.015 in).
3. If the end float is not within these limits, proceed as follows:
 4. Remove the two bolts.
 5. Remove the centre main bearing cap, complete with the two bottom half thrust washers.
 6. Push the two top half thrust washers around the crankshaft journal with a piece of wire, until they can be removed.
 7. Lubricate all components before refitting.
 8. Slide two new top half thrust washers, with the steel side towards the bearing housing, into position.
 9. Locate the two new bottom half thrust washers on the centre main bearing cap, and refit the bearing cap.
 10. Refit the bolts, and tighten them to a torque of 203 Nm (150 lbf ft).
 11. Repeat procedure 2.
 12. If the end float is still not correct, oversize thrust washers can be fitted, repeat procedures 3 to 10.

NOTE: The top and bottom thrust washer halves must be the same thickness.

13. Refit the oil pump, operation 4A-20-19.



CRANKSHAFT**Removal and Refitment**

4A-29-27

Special Tools: See Part 5A
 PD 145-1 Oil Seal Replacer
 PD 145-2 Oil Seal Pilot
 PD 155B Puller
 550 Universal Handle
 Dial Test Indicator Gauge

Removal

1. Drain the engine oil.
2. Split the tractor between the front axle and the engine and between the engine and the transmission, Part 3A.
3. Mount the engine on a suitable stand.
4. Remove the crankshaft rear main oil seal, operation 4A-18-19.
5. Remove the timing case, operation 4A-15-15.
6. Remove the connecting rod big end bearings, operation 4A-24-22.
7. Remove the crankshaft thrust washers, operation 4A-28-24, procedures 4 to 6.
8. Remove the rear main bearing bridge piece and seals.
9. Remove the crankshaft gear and key.
10. Remove the eight bolts securing the remainder of the crankshaft main bearing caps.
11. Remove the four remaining main bearing caps complete with the half shell bearings.
12. Lift out the crankshaft.
13. Remove the five half shell bearings from the engine casing.
14. Thoroughly clean all parts.

Check the crankpins and journals for wear and ovality, using a micrometer. The diameter of the crankpins and journals must be checked in the vertical and horizontal planes at both ends of the crankpins and journals. The wear and ovality must not exceed 0,0361mm (0-0015 in).

Crack detect and de-magnetize the crankshaft.

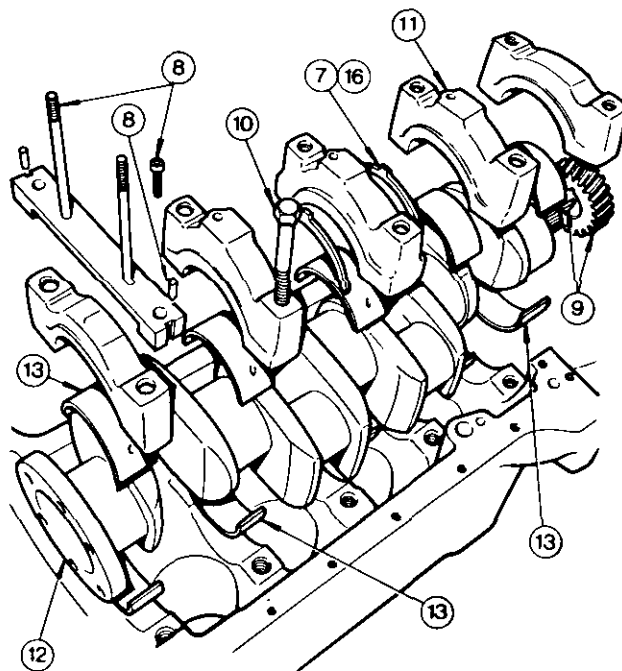
The main journals and crankpin diameters can be re-ground to the following sizes:—

- (a) 0,254 mm (0-010 in)
- (b) 0,508 mm (0-020 in)
- (c) 0,762 mm (0-030 in)

If the crankshaft needs to be re-ground below 0,762 mm (0-030 in), a new crankshaft must be fitted. Crankpin width may increase with regrinding, but must not exceed 40,55 mm (1-5965 in). It is important that the radii on the main and crankpin journals are maintained. After regrinding, the sharp corners on the oil holes must be removed.

Tufftrided crankshafts must be re-Tufftrided after re-grinding. If Tufftriding facilities are not available, a new crankshaft must be fitted.

If all three positions for the rear main oil seal have been used, the sealing area of the crankshaft flange must be re-ground. Only the minimum amount of metal should be ground off to ensure removal of the seal wear grooves. The oil seal flange must not be machined below 113,17 mm (5-243 in) minimum diameter. It is not necessary to re-Tufftride the flange. Crack test and de-magnetize the crankshaft.

**Refitment**

15. Reverse procedures 8 to 14, except:
 - (a) Ensure that the oilways in the cylinder block and crankshaft are free from obstruction.
 - (b) Check the main bearing cap attachment bolts for stretch. Only bolts supplied by the engine manufacturer should be used, as they are special bolts.
 - (c) Ensure all components are scrupulously clean and freely lubricated with clean engine oil.
 - (d) The main bearing caps are numbered, No. 1 commencing at the front of the engine. Each cap is also marked with a serial number as stamped on the cylinder block bottom face. These should read in line.
 - (e) Tighten the main bearing bolts to a torque of 203 Nm (150 lbf ft).
 - (f) The rear face of the bridge piece must be flush with the rear face of the block.
16. Refit the crankshaft thrust washers, operation 4A-28-26, procedures 7 to 12.
17. Refit the connecting rod big end bearings, operation 4A-24-22.
18. Refit the timing case, operation 4A-15-15.
19. Refit the crankshaft rear main oil seal, operation 4A-18-19.
20. Refit the engine, Part 3A.
21. Refill the engine with an approved oil.

ENGINE**CAMSHAFT AND TAPPETS****Removal and Refitment**

4A-30-28

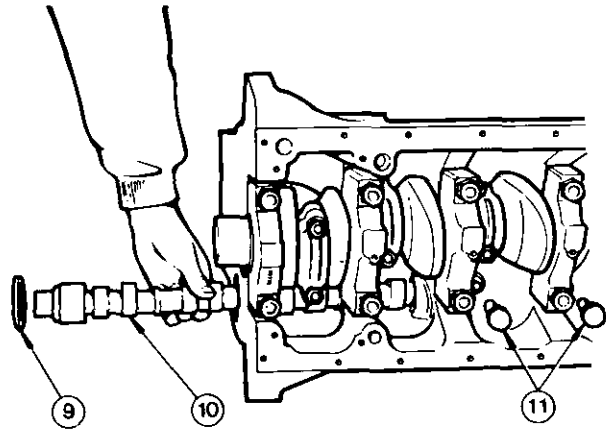
Special Tools: See Part 3A
PD 155-B Puller.

Removal

1. Drain the engine oil.
2. Split the tractor between the front axle and the engine, and between the engine and the transmission.
3. Remove the rocker assembly, operation 4A-03-05.
4. Remove the timing case, operation 4A-15-15.
5. Remove the pushrods.
6. Remove the fuel lift pump, Part 4C.
7. Invert the engine on a suitable stand.
8. Remove the balancer unit, operation 4A-22-20.
9. Withdraw the camshaft thrust washer.
10. Withdraw the camshaft.
11. Remove the tappets and retain them in the order in which they were removed.

Refitment

12. Reverse procedures 1 to 11, except:
 - (a) Clean and freely lubricate all parts prior to reassembly.
 - (b) Ensure when refitting the camshaft thrust plate, that the hole in the plate locates correctly over the dowel protruding from the engine block.
 - (c) Check the protrusion of the camshaft thrust washer above the face of the cylinder block, this should be between 0,10 and 0,41 mm (0.004 and 0.016 in).



A-4 318 ENGINE

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GENERAL

The Perkins A4 318 engine is a four cylinder, water cooled, direct injection diesel unit. It has a stroke of 127 mm (5.0 in) and a nominal bore diameter of 114 mm (4.5 in).

The engine has overhead valves mounted vertically in the cylinder head. A gear driven camshaft located in the right hand side of the cylinder block operates the valves via tappets, push rods and a series of rocker levers located on a shaft mounted on top of the cylinder head. Replacement valve guides are available in the case of wear.

The cylinder block and crankcase form an integral casting and are fitted with full length, replaceable, flanged cast iron liners.

The aluminium pistons have a toroidal cavity in the head and are fitted with four piston rings. The pistons are attached to their connecting rods by fully floating gudgeon pins retained by snaprings. The big end bearings are replaceable and consist of a thin steel shell lined with an aluminium-tin alloy.

The engine is lubricated by force feed. The oil is drawn from the sump, via a strainer, by a rotary pump driven by the crankshaft via the balancer unit. The oil passes through a filter before being circulated under pressure around the engine.

The crankshaft is mounted in five replaceable aluminium-tin alloy lined bearings held in position by cast iron bearing caps. Thrust is absorbed by four washers located on both sides of the centre main bearing cap and cylinder block.

A balancer unit is fitted to the cylinder block and driven via gears by the crankshaft. The oil pump is mounted on the rear of this unit inside the lubricating oil sump.

Maximum Engine Power at 2000 rev/min.

- 88 p.s. (64.8 kW) Din 70020
- 91 h.p. (67.9 kW) B.S. AU 141

ENGINE**GENERAL SPECIFICATIONS**

Model	Perkins A4.318
Bore	114 mm 4.5 inches
Stroke	127 mm 5 inches
Number of Cylinders	4
Firing Order	1-3-4-2
Direction of Engine Rotation (Viewing Crankshaft Pulley End)	Clockwise
Total Piston Displacement	5.211 litres 318 cubic inches
Compression Ratio	17.5 to 1
Combustion System	Direct injection
Engine Brake Horsepower (Mfg. Rating with Accessories)	84 BHP minimum at 2000 rpm
Maximum Engine Torque	334 Nm 245 ft.-lbs. @ 1300 rpm
Low Idle Speed	825-875 rpm
Maximum Engine Speed (No-Load)	2170-2220 rpm
Valve Tappet Clearance:	
Intake and Exhaust	0.25 mm "hot"—0.30 mm "cold" 0.010 inch "hot"—0.012 inch "cold"

***TORQUE TENSION SPECIFICATIONS**

Cylinder Head	136 Nm	100 ft.-lbs.
Connecting Rods	142 Nm	105 ft.-lbs.
Main Bearings	200 Nm	150 ft.-lbs.
Flywheel	110 Nm	80 ft.-lbs.
Crankshaft Pulley	410 Nm	300 ft.-lbs.
Engine Balancer:		
Weight Frame to Cylinder Block	50 Nm	36 ft.-lbs.
Balancer Weights to Shafts	8 Nm	6 ft.-lbs.
Balancer Weight Gears	34 Nm	25 ft.-lbs.
Rocker Shaft Brackets	33 Nm	24 ft.-lbs.
Intake and Exhaust Manifolds	20 Nm	15 ft.-lbs.
Injection Pump Drive Gear	28 Nm	21 ft.-lbs.
Camshaft Gear	60 Nm	45 ft.-lbs.
Idle Gear Hub	33 Nm	24 ft.-lbs.
Oil Pan:		
Oil Pan to Cylinder Block	28 Nm	21 ft.-lbs.
Oil Pan to Timing Gear Housing	20 Nm	15 ft.-lbs.
Oil Pan to Rear Bridge Piece	13.5 Nm	10 ft.-lbs.
Injector Hold-Down Nuts	16 Nm	12 ft.-lbs.
Oil Filter to Cylinder Block	41 Nm	30 ft.-lbs.
Oil Pump (Pump to Balancer Frame)	27 Nm	20 ft.-lbs.
Rear Oil Seal Retainer to Cylinder Block and Bridge Piece	16 Nm	12 ft.-lbs.

*THESE TORQUES APPLY WITH THE THREADS CLEAN AND LIGHTLY OILED. DO NOT EXCEED THESE VALUES AS DAMAGE COULD OCCUR.

ENGINE OVERHAUL SPECIFICATIONS**Pistons:**

Piston Diameter (Measured at Right Angles from Piston Pin Holes):

Top Piston Skirt Diameter (Just Below Bottom Ring Groove) 114.07—114.10 mm 4.4911—4.4921 inches

Bottom Piston Skirt Diameter (Just Above Bottom of Piston) 114.14—114.16 mm 4.4936—4.4946 inches

Piston Ring Land Diameter

(All Ring Lands Between Top and Bottom Ring Grooves) 113.69—113.77 mm 4.476—4.479 inches

Piston Pin Bore Diameter 36.51—36.52 mm 1.4376—1.4379 inches

Piston Height at T.D.C. Relative to Top Face of Block

From 0.08 mm (0.003 inch) BELOW to 0.25 mm (0.010 inch) ABOVE

Piston Clearance in Cylinder Liner 0.18-0.28 mm 0.007-0.011 inch

Cylinder Liners:

Type	Dry, shouldered, cast iron
Inside Diameter of Liner:	
Production Liner:	
Before Finishing	113.46—113.56 mm 4.467—4.471 inches
After Finishing	114.36—114.39 mm 4.5025—4.5035 inches
Service Liner	114.39—114.41 mm 4.5035—4.5045 inches
Outside Diameter of Liner:	
Production Liner	117.93—117.96 mm 4.643—4.644 inches
Service Liner	117.88—117.91 mm 4.641—4.642 inches
Cylinder Block Bore	117.88—117.91 mm 4.641—4.642 inches
Liner Fit in Block:	
Production Liner	0.03—0.08 mm (0.001—0.003 inch) interference
Service Liner	0.03 mm (0.001 inch) clearance to 0.03 mm (0.001 inch) interference
Location of Liner Above Top Face of Block	0.635—0.79 mm 0.025—0.031 inch

Piston Pins:

Pin Diameter	36.51—36.52 mm 1.4375—1.4378 inches
Clearance in Connecting Rod Bushing	0.01—0.04 mm 0.0004—0.0017 inch
Fit in Piston Pin Bore	From 0.005 mm (0.0002 inch) interference to 0.01 mm (0.0004 inch) clearance

Piston Rings:

Ring Side Clearance:	
Top Compression Ring	0.064—0.114 mm 0.0025—0.0045 inch
Other Compression Rings	0.038—0.089 mm 0.0015—0.0035 inch
Oil Control Ring	0.064—0.114 mm 0.0025—0.0045 inch
Ring End Gap (Measured in 4.500 Inch Bore) 114 mm:	
Top Compression Ring	0.46—0.64 mm 0.018—0.025 inch
Other Compression Rings	0.36—0.53 mm 0.014—0.021 inch
Oil Control Ring	0.46—0.64 mm 0.018—0.025 inch
Ring Width:	
All Compression Rings	2.38—2.38 mm 0.0928—0.0938 inch
Oil Control Ring	6.32—6.35 mm 0.249—0.250 inch

Connecting Rods:

Connecting Rod Bore Diameter—Bushings End	40.18—40.22 mm 1.582—1.5835 inches
Inside Bushing Diameter (Finished)	36.53—36.56 mm 1.4382—1.43925 inches
Connecting Rod Bore Diameter—Bearing End	74.07—74.09 mm 2.916—2.917 inches
Rod Bearing Inside Diameter (Standard Size)	69.87—69.91 mm 2.751—2.7525 inches
Crankpin Journal Diameter	69.81—69.82 mm 2.7483—2.749 inches
Bearing Clearance	0.05—0.11 mm 0.002—0.0042 inch
Rod Side-Play	0.02—0.43 mm 0.008—0.017 inch

Crankshaft and Main Bearings:

Crankpin Journal Diameter	69.81—69.82 mm 2.7483—2.749 inches
Main Bearing Bore in Block and Cap	80.42—80.44 mm 3.166—3.167 inches
Main Bearing Inside Diameter (Standard Size)	76.24—76.28 mm 3.0015—3.003 inches
Main Bearing Journal Diameter	76.16—76.17 mm 2.9985—2.999 inches
Main Bearing Clearance	0.064—0.114 mm 0.0025—0.0045 inch
Crankshaft End-Play	0.127—0.406 mm 0.005—0.016 inch
Crankshaft Flywheel Flange Diameter	133.30—133.35 mm 5.248—5.250 inches
Crankshaft Fillet Radii:	
Crankpin Journal Fillet Radii	4.78—5.16 mm 0.188—0.203 inch
Main Bearing Journal Fillet Radii	3.68—4.06 mm 0.145—0.160 inch

Valves:

Valve Clearance (Intake and Exhaust)

0.25 mm "hot"—0.30 mm "cold" 0.010 inch "hot"—0.012 inch "cold"

Valve Head Location—Relative to Face of Cylinder Head:

Production:

Intake	1.45—1.80 mm 0.057—0.071 inch below
Exhaust	1.32—1.65 mm 0.052—0.065 inch below

Service limits:

Intake	1.45 mm (0.057 inch) minimum, to 3.56 mm (0.140 inch) maximum depth below face of head
Exhaust	1.32 mm (0.052 inch) minimum, to 3.56 mm (0.140 inch) maximum depth below face of head

ENGINE

Valve Head Diameter:		
Intake	46.84—46.94 mm	1.844—1.848 inches
Exhaust	40.36—40.61 mm	1.589—1.599 inches
Valve Stem Diameter:		
Intake	9.46—9.49 mm	0.3725—0.3735 inch
Exhaust	9.45—9.47 mm	0.372—0.373 inch
Valve Face Angles .. .. .	.. .. .	45°
Valve Seats:		
Valve Seat Angle .. .. .	.. .. .	45°
Desired Seat Contact Width:		
Intake	1.59—2.38 mm	1/16—3/32 inch
Exhaust	2.38—2.78 mm	3/32—7/64 inch
Maximum Seat Run-Out .. .. .	.. .. .	0.051 mm 0.002 inch
Valve Guides:		
Type .. .. .	.. .. .	Replaceable, cast iron
Valve Guide Location .. .. .	.. .. .	Located by shoulder
Inside Diameter	9.52—9.55 mm	0.375—0.376 inch
Valve Guide Clearance:		
Intake	0.038—0.089 mm	0.0015—0.0035 inch
Exhaust	0.051—0.102 mm	0.002—0.004 inch
Valve Springs:		
Position of Spring Damper Coils (Closely Wound Coils) .. .. .	.. .. .	Toward cylinder head
Outer Springs:		
Spring Pressure @ 1-25/32 inches Length (Valve Closed) .. .. .	.. .. .	17.24-19.05 kg 38-42 lbs.
Spring Pressure @ 1-23/64 inches Length (Valve Open)	32.70 ± 1.63 kg	72.1 ± 3.6 lbs.
Inner Springs:		
Spring Pressure @ 1-9/16 inches Length (Valve Closed)	6.99 ± 0.35 kg	15.4 ± 0.77 lbs.
Spring Pressure @ 1-9/64 inches Length (Valve Open)	15.20 ± 0.76 kg	33.5 ± 1.67 lbs.
Valve Lifters (Tappets):		
Stem Diameter	18.99—19.02 mm	0.7475—0.7485 inch
Valve Lifter Bore in Block	19.04—19.07 mm	0.7495—0.7508 inch
Clearance Limits	0.025—0.084 mm	0.001—0.0033 inch
Rocker Arm Shaft Assembly:		
Rocker Arm Shaft Diameter	19.02—19.04 mm	0.7485—0.7495 inch
Inside Bushing Diameter	19.06—19.10 mm	0.7505—0.752 inch
Bushing Clearance	0.025—0.089 mm	0.001—0.0035 inch
Valve Timing (Theoretical-Crankshaft Degrees):		
Intake Valve Opens .. .. .	.. .. .	9° B.T.D.C.
Intake Valve Closes .. .. .	.. .. .	41° A.B.D.C.
Exhaust Valve Opens .. .. .	.. .. .	42° B.B.D.C.
Exhaust Valve Closes .. .. .	.. .. .	8° A.T.D.C.
Timing Gears:		
Timing Gear Backlash (All Except Balancer Idler Gear and Balancer Drive Shaft Gear)	0.076—0.152 mm	0.003—0.006 inch
Engine Idler Gear and Hub:		
Hub Diameter	50.75—50.77 mm	1.9981—1.9988 inch
Idler Gear Bushing Bore Diameter (Finished)	50.80—50.85 mm	2.0000—2.0019 inches
Clearance Limits	0.03—0.07 mm	0.0012—0.0028 inch
Idler Gear End-Play	0.076—0.178 mm	0.003—0.007 inch
Balancer Idler Gear and Hub:		
Inside Bushing Diameter (Finished)	38.10—38.14 mm	1.500—1.5016 inches
Hub Diameter	38.06—38.07 mm	1.4984—1.4990 inches
Bushing Clearance	0.025—0.081 mm	0.001—0.0032 inch
Idler Gear End-Play	0.051—0.127 mm	0.002—0.005 inch
Backlash Between Idler Gear and Crankshaft Gear	0.142—0.218 mm	0.0056—0.0086 inch
Backlash Between Idler Gear and Balancer Drive Shaft Gear	0.152—0.229 mm	0.006—0.009 inch

Engine Balancer Assembly:

Front Bearings:

Shaft Diameters (Drive and Driven)	33.30—33.31 mm	1.3109—1.3115 inches
Inside Bushing Diameters (After Line Boring)	33.39—33.43 mm	1.3145—1.3161 inches
Bushing Running Clearance	0.076—0.132 mm	0.003—0.0052 inch

Rear Bearings:

Shaft Diameters (Drive and Driven)	27.75—27.76 mm	1.0924—1.0929 inches
Inside Bushing Diameters (After Line Boring)	27.83—27.86 mm	1.0957—1.0969 inches
Bushing Running Clearance	0.071—0.114 mm	0.0028—0.0045 inch

Camshaft:

Cam Lift—Tappets	7.72—8.08 mm	0.304—0.318 inch
Cam Lift—Fuel Lift Pump	2.74—2.82 mm	0.108—0.111 inch
Camshaft End-Play	0.178—0.406 mm	0.007—0.016 inch

Front Bearing:

Front Journal Diameter	52.24—52.26 mm	2.0565—2.0575 inches
Front Bearing Bore Diameter	52.31—52.36 mm	2.0595—2.0615 inches
Clearance Limits	0.051—0.127 mm	0.002—0.005 inch

Centre Bearing:

Centre Journal Diameter	49.94—49.96 mm	1.966—1.967 inches
Centre Bearing Bore Diameter	50.01—50.06 mm	1.969—1.971 inches
Clearance Limits	0.051—0.127 mm	0.002—0.005 inch

Rear Bearing:

Rear Journal Diameter	48.39—48.41 mm	1.905—1.906 inches
Rear Bearing Bore Diameter	48.51—48.56 mm	1.910—1.912 inches
Clearance Limits	0.102—0.178 mm	0.004—0.007 inch

LUBRICATION SYSTEM SPECIFICATIONS

Engine Oil:

Recommended Type:

Massey-Ferguson Multiguard[®] Engine Oil or equivalent which meets or exceeds following requirements: MIL-L-2104C (supersedes MIL-L-45199B and MIL-L-2104B), MIL-L-46152, thus qualified for API Service Classification "CD" or "CC" (Diesel—former API "DS", "DM") and "SE" (Gasoline—former API "MS").

Recommended Viscosity:

Above 32.2°C Above 90°F	SAE 30
From 0°C to 32.2°C From 32°F to 90°F	SAE 20
Below 0°C Below 32°F	SAE 10

Recommended Change Interval:

Engine Oil	100 hours
Engine Oil Filter	200 hours

Engine Oil Pressure 40-50 psi at normal operating speeds and working temperature

Crankcase Capacity:

Without Filter Change	8.55 litres	Approx. 9 U.S., 7.5 Imp. qts.
With Installation of New Filter Element	9.45 litres	Approx. 10 U.S., 8.3 Imp. qts.

Oil Filter By-Pass Valve Opens 8-12 lbf/in²

Oil Pump:

Maximum Theoretical Capacity	60-45 litres pm	Approximately 16 U.S., 13.3 Imp. gpm at 2200 engine rpm (4400 rpm oil pump)
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Pump Clearances:

Inner Rotor to Outer Rotor	0.064—0.114 mm	0.0025—0.0045 inch
Outer Rotor to Pump Body	0.254—0.305 mm	0.010—0.012 inch
Top of Rotors to Surface of Pump Body	0.025—0.076 mm	(0.001—0.003 inch) for outer rotor
	0.038—0.089 mm	(0.0015—0.0035 inch) for inner rotor

Oil Pressure Relief Valve:

Relief Valve Opens at 50—65 lbf/in²

Relief Valve Spring:

Free Length	39.70 mm	Approx. 1.9/16 inches
Spring Pressure at 1-9/32 inches length	3.63 ± 0.113 kg	Approx. 8 lbs ± 4 ozs.
Spring Pressure at 1 inch length	7.26 ± 0.227 kg	Approx. 16 lbs. ± 8 ozs.

ENGINE**FUEL SYSTEM SPECIFICATIONS**

Fuel Injection Pump:

Type	CAV, DPA distributor type with mechanical governor
CAV Specification Number	3249F242
Service Setting Code	SD 90/600/5/2200
Injection Timing (Static Timing Angle)	20° B.T.D.C.
Timing Letter on Injection Pump Rotor for Start of Injection to No. 1 Cylinder	"E"
No. 1 Cylinder High Pressure Fuel Line Outlet Marking	Letter "X"

Fuel Injectors:

Type	CAV multi-hole, long stem nozzle
CAV Holder No.	BKBL 67S5172
CAV Nozzle No.	BDLL 150S6599
Identification Code Letters	"ED"
Nozzle Opening Pressure:	
Working Pressure (Injector with more than 25 hours operation)	2570 lbf/in ² (175 ATS)
Setting Pressure (New Injector or Used Injector with New Spring)	2650 lbf/in ² (180 ATS)
Spray Hole Orifice	0-300-0-320 mm 0-0118-0-0126 inch

Fuel Lift Pump:

Make	AC Delco
Operating Pressure	5-8 lbf/in ²
Method of Drive	Eccentric on camshaft

Recommended Diesel Fuel Oil (American Society of Testing Materials Specifications)

ASTM/D975-66T—Nos. 1D (Winter) or 2D (Summer)

Fuel Tank Capacity	86-36 litres	Approx. 23 U.S., 19 Imp. gals.
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COOLING SYSTEM SPECIFICATIONS

Water Pump:

Water Pump Impeller Clearance:	
Rebuild Clearance Setting	0-686-0-889 mm 0-027-0-035 inch
Normal Operating Clearance (Includes End-Play)	0-279-0-889 mm 0-011-0-035 inch
Pulley Fit on Water Pump Shaft	0-033-0-071 mm 0-0013-0-0028 inch interference
Impeller Fit on Water Pump Shaft	0-013-0-046 mm 0-0005-0-0018 inch interference

Thermostat:

Type	Wax pellet type
Normal Opening Temperature	80-6°-83-9°C 177°-183°F
Fully Open Temperature	97-8°C 208°F.
Minimum Valve Travel	8-89 mm 0-350 inch

Recommended Coolant	Water and ethylene-glycol anti-freeze mixture	
Cooling System Capacity	15-68 litres	Approx. 16-5 U.S., 13-8 Imp. qts.
Radiator Pressure Cap	7 lbf/in ²	
Fan Belt Deflection	Adjust to provide 12-7 mm (1/2 inch) to 19 mm (3/4 inch) deflection when depressed with 6-8 kg. (15 lbs.) load midway on longest span between pulleys	

FAULT FINDING CHART

Fault	Possible Cause
Low cranking speed	1, 2, 3, 4.
Will not start	5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20, 22, 31, 32, 33.
Difficult starting	5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 21, 22, 24, 29, 31, 32, 33.
Lack of power	8, 9, 10, 11, 12, 13, 14, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 31, 32, 33.
Misfiring	8, 9, 10, 12, 13, 14, 16, 18, 19, 20, 25, 26, 28, 29, 30, 32.
Excessive fuel consumption	11, 13, 14, 16, 18, 19, 20, 22, 23, 24, 25, 27, 28, 29, 31, 32, 33.
Black Exhaust	11, 13, 14, 16, 18, 19, 20, 22, 24, 25, 27, 28, 29, 31, 32, 33.
Blue/white exhaust	4, 16, 18, 19, 20, 25, 27, 31, 33, 34, 35, 45, 56.
Low oil pressure	4, 36, 37, 38, 39, 40, 42, 43, 44.
Knocking	9, 14, 16, 18, 19, 22, 26, 28, 29, 31, 33, 35, 36, 45, 46, 48.
Erratic running	7, 8, 9, 10, 11, 12, 13, 14, 16, 20, 21, 23, 26, 28, 29, 30, 33, 35, 45, 48.
Vibration	13, 14, 20, 23, 25, 26, 29, 30, 33, 45, 47, 49.
High oil pressure	4, 41.
Overheating	11, 13, 14, 16, 18, 19, 24, 25, 45, 50, 51, 52, 53, 54, 57.
Excessive crankcase pressure	25, 31, 33, 34, 45, 55.
Poor compression	11, 19, 25, 28, 29, 31, 32, 33, 34, 46, 48.
Starts and stops	10, 11, 12.

Key to Fault Finding Chart

- | | |
|---|--|
| 1. Battery capacity low. | 30. Incorrect high pressure pipes. |
| 2. Bad electrical connection. | 31. Worn cylinder bores. |
| 3. Faulty starter motor. | 32. Pitted valves and seats. |
| 4. Incorrect grade of lubricating oil. | 33. Broken, worn or sticking piston ring/s. |
| 5. Low cranking speed. | 34. Worn valve stems and guides. |
| 6. Fuel tank empty. | 35. Overfull oil bath air cleaner or incorrect grade of oil. |
| 7. Faulty stop control operation. | 36. Worn or damaged bearings. |
| 8. Blocked fuel feed pipe. | 37. Insufficient oil in sump. |
| 9. Faulty fuel lift pump. | 38. Blocked sump strainer. |
| 10. Choked fuel filter. | 39. Oil pump worn. |
| 11. Restriction in air cleaner. | 40. Pressure relief valve sticking open. |
| 12. Air in fuel system. | 41. Pressure relief valve sticking closed. |
| 13. Faulty fuel injection pump. | 42. Broken relief valve spring. |
| 14. Faulty atomisers or incorrect type. | 43. Faulty suction pipe. |
| 15. Incorrect use of cold start equipment. | 44. Choked oil filter. |
| 16. Faulty cold start equipment. | 45. Piston seizure/pick up. |
| 17. Broken fuel injection pump drive. | 46. Incorrect piston height. |
| 18. Incorrect fuel pump timing. | 47. Damaged fan. |
| 19. Incorrect valve timing. | 48. Broken valve spring. |
| 20. Poor compression. | 49. Incorrect aligned flywheel. |
| 21. Blocked fuel tank vent. | 50. Faulty thermostat. |
| 22. Incorrect type or grade of fuel. | 51. Restriction in water jacket. |
| 23. Sticking throttle or restricted movement. | 52. Loose fan belt. |
| 24. Exhaust pipe restriction. | 53. Choked radiator. |
| 25. Cylinder head gasket leaking. | 54. Faulty water pump. |
| 26. Overheating. | 55. Choked breather pipe. |
| 27. Cold running. | 56. Damaged valve stem oil seals. |
| 28. Incorrect tappet adjustment. | 57. Coolant level too low. |
| 29. Sticking valves. | |

ENGINE**ROCKER COVER****Removal and Refitment**

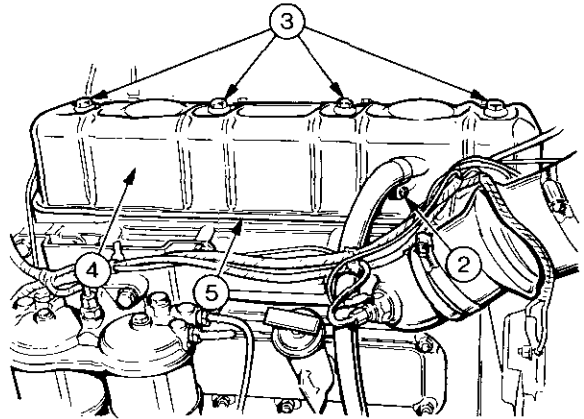
4A-31-40

Removal

1. Remove the hood 2A-02-02.
2. Disconnect the breather pipe.
3. Remove the four securing bolts, washers and rubber seals.
4. Remove the rocker cover.
5. Remove and discard the gasket.

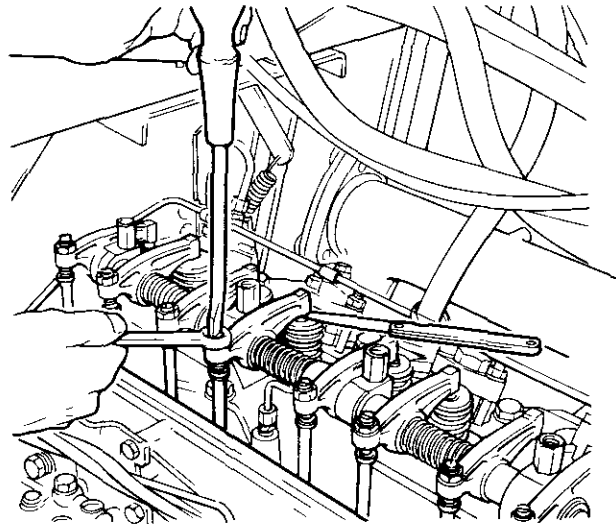
Refitment

6. Fit a new gasket, dry.
7. Reverse procedures 1 to 4.

**VALVE TIP CLEARANCE****Adjustment**

4A-32-40

1. Remove the rocker cover 4A-31-40
2. Rotate the crankshaft pulley, until the T.D.C. mark is aligned with the indicator and number one piston is on the compression stroke (both valves fully closed).
3. Loosen number one rocker arm lock nut and turn adjusting screw to correct clearance.
Engine cold — 0.30 mm clearance (0.012").
Engine hot — 0.25 mm clearance (0.010").
4. Tighten the lock nut and re-check the clearance.
5. Adjust the remaining valve clearances, in the order of 3-4-2, by rotating the crankshaft pulley half a turn each time.
6. Refit the rocker cover.



ROCKER ASSEMBLY**Removal and Refitment**

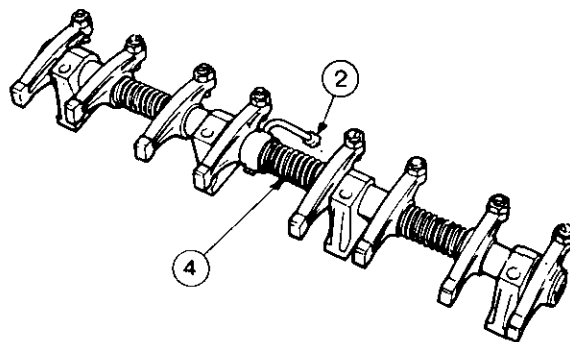
4A-23-41

Removal

1. Remove the rocker cover 4A-32-40.
2. Disconnect the oil feed pipe.
3. Remove the four securing nuts.
4. Remove the rocker assembly.

Refitment

5. Reverse procedures 2 to 4.
6. Adjust the valve tip clearances.
7. Refit the rocker cover.

**ROCKER ASSEMBLY****Servicing**

4A-34-41

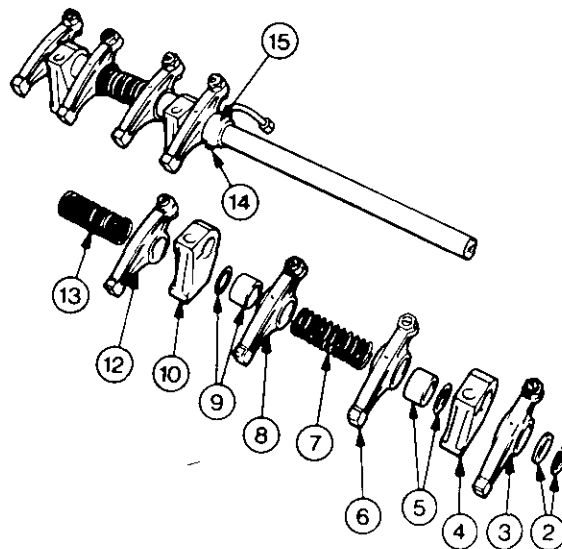
Disassembly

1. Remove the rocker assembly 4A-33-41.
2. Remove the circlip and washer from the front end of the shaft.
3. Slide off No. 1 rocker.
4. Slide off support bracket.
5. Slide off washer and spacer.
6. Slide off No. 2 rocker.
7. Slide off the spring.
8. Slide off No. 3 rocker.
9. Slide off spacer and washer.
10. Slide off support bracket.
11. Slide off No. 4 rocker.
12. Repeat procedures 2 to 11, for the other end of the rocker assembly, removing rocker arms 8, 7, 6 and 5.
13. Slide off the spring between No. 5 rocker and the oil feed.
14. Remove the bolt from the oil feed.
15. Slide the oil feed connection and pipe off the rocker shaft.

Examine the rocker lever bores and the rocker shaft for wear. The rockers should be an easy fit on the shaft without excessive side play.

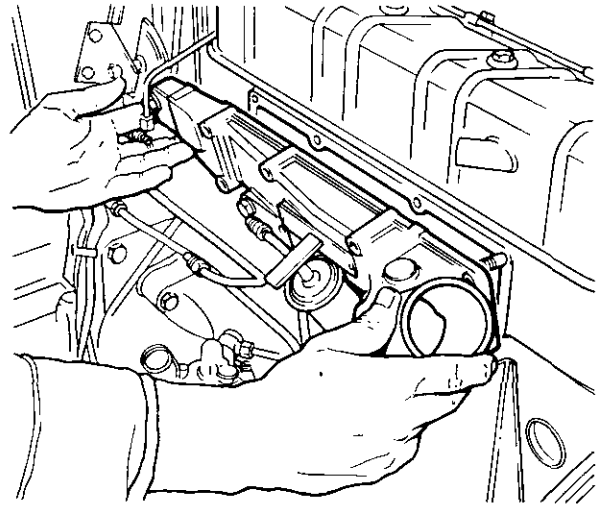
Reassembly

16. Lubricate all the parts, with clean engine oil, prior to reassembly.
17. Reverse procedures 1 to 15.
18. Adjust the valve tip clearance.



ENGINE**INLET MANIFOLD****Removal and Refitment** 4A-35-42**Removal**

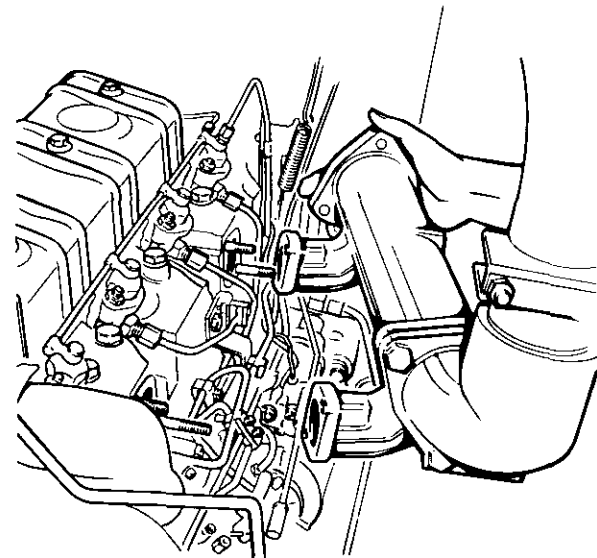
1. Remove the hood 2A-02-02.
2. Disconnect five fuel pipes from the two fuel filters.
3. Remove three bolts from the fuel filters mounting bracket.
4. Remove the fuel filters complete on the mounting bracket.
5. Disconnect the thermostart cable.
6. Disconnect the thermostart fuel pipe.
7. Slacken the clip on the rubber inlet hose.
8. Remove the five bolts remaining and one nut with washer from the manifold.
9. Remove the manifold from the side of the engine at the same time removing it from the rubber air-inlet hose.
10. Remove and discard the gasket.

**Refitment**

11. Fit a new gasket.
12. Reverse procedures 1 to 9.

EXHAUST MANIFOLD**Removal and Refitment** 4A-36-42**Removal**

1. Remove the hood 2A-02-02.
2. Disconnect the fuel pipe to No. 1 injector.
3. Remove four nuts with washers.
4. Remove the exhaust manifold.
5. Remove and discard the gaskets.

**Refitment**

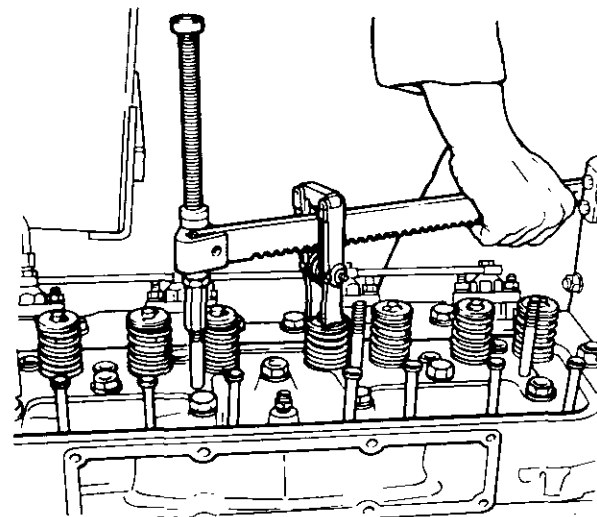
1. Fit new gaskets.
2. Reverse procedures 1 to 4.

VALVE SPRINGS**Removal and Refitment** 4A-37-42
(Cylinder head in situ)

Special tools required: PD 6118-B
PD 6118-3

Removal

1. Remove the rocker assembly 4A-34-41.
2. Turn the crankshaft to T.D.C. for cylinders Nos. 1 and 4.
3. Using PD 6118-B and PD 6118-3 compress the valve springs, one by one, on cylinders Nos. 1 and 4.
4. Holding the spring down remove its collet.
5. Release PD 6118-B and PD 6118-3 slowly.
6. Remove the spring cap.
7. Remove the inner and outer springs.
Do not attempt to remove (or fit) valve springs unless the respective cylinder is at T.D.C.

**Refitment**

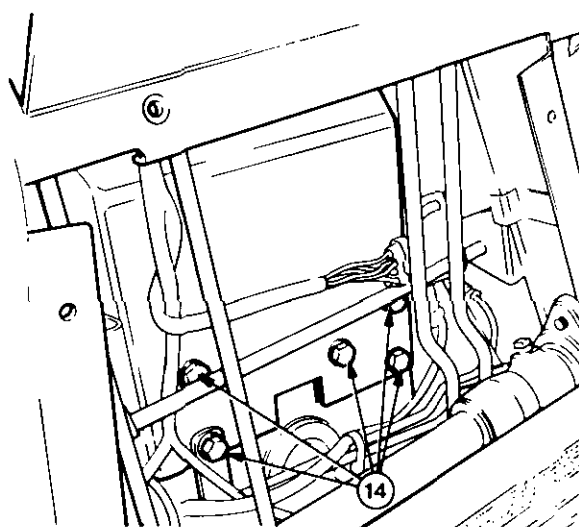
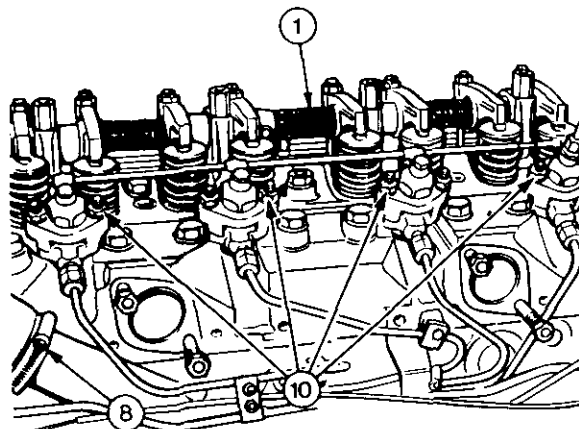
8. Refit the inner and outer valve springs with the damper coils down.
9. Reverse procedures 3 to 6.
If valve springs are being replaced a complete new set should be fitted.
10. Turn crankshaft to T.D.C. for cylinders Nos. 2 and 3.
11. Repeat procedures 3 to 9 for the valves on cylinders Nos. 2 and 3.
12. Refit the rocker assembly.

CYLINDER HEAD**Removal and Refitment**

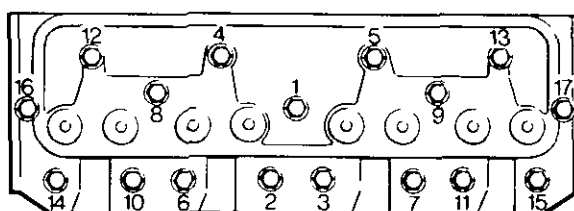
4A-38-43

Removal

1. Remove the rocker assembly 4A-33-41
2. Disconnect the battery cables.
3. Drain the radiator and engine block of the coolant.
4. Remove the inlet manifold 4A-35-42.
5. Remove the exhaust manifold 4A-36-42.
6. Disconnect the heater hoses.
7. Disconnect the power steering pipes.
8. Remove the three cooling hoses from the water pump.
9. Remove the fan belt.
10. Remove the injectors and the sealing washers.
11. Disconnect tachometer drive cable from the timing case cover.
12. Disconnect wires to the water temperature gauge, thermostart and alternator.
13. Remove the interior panel from the cab front.
14. Remove five bolts from the bracket behind the interior panel.
15. Remove the pushrods and retain them in the order of removal.
16. Progressively remove the seventeen nuts and washers in the reverse order of their tightening sequence.
17. Remove the cylinder head.
18. Remove and discard the cylinder head gasket.
19. If necessary remove water pump and fan, held on to head by four bolts.

**Refitment**

20. Refit water pump on to the front of the cylinder head, using a new gasket with recommended sealant. Install engine lift bracket and belt adjusting bracket on to right hand pump mounting studs.
21. Ensure both joining faces are thoroughly clean and de-greased.
22. Fit a new cylinder head gasket, dry.
23. Refit the cylinder head.
24. Lubricate the stud and nut threads with a light oil.
25. Tighten the seventeen cylinder head securing nuts, in the correct sequence, in three equal stages to a torque of 149 Nm (110 lbf ft).
26. Reverse procedures 1 to 15.
27. Adjust the valve tip clearance.
28. Bleed the fuel system.
29. Start the engine and run it up to operating temperature (min 77°C, 170°F), then stop engine.
30. Remove rocker assembly and re-tighten the head nuts again, in correct sequence, to a torque of 149 Nm (110 lbf ft).
31. Having re-torqued all the nuts it is important to re-check that the first ten positions still satisfy the quoted torque value.
32. Refit the rocker assembly.
33. Start the engine and check for leaks.



30

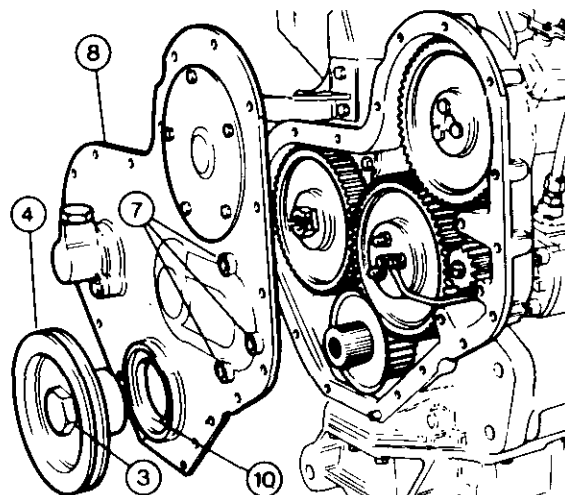
RESERVED

TIMING CASE COVER**Removal and Refitment****4A-41-47****Removal**

1. Split the tractor between the engine and the front axle 3A-01-02.
2. Remove the fan belt.
3. Remove the crankshaft securing bolt and washer.
4. Remove the crankshaft pulley.
5. Disconnect the tachometer drive cable.
6. Remove the eighteen bolts and one nut with washer from around the timing case cover.
7. Remove the three bolts going into the steering pump.
8. Remove the timing case cover.
9. Remove and discard the gasket.
10. Remove and discard the oil seal.

Refitment

11. Fit a new oil seal, with the lip towards the engine.
12. Coat the new gasket in the recommended sealant.
13. Fit the gasket and the timing case cover into position.
14. Slide the crankshaft pulley on to the crankshaft and centralise the timing case cover.
15. Fit and tighten some of the bolts to secure the cover.
16. Remove the pulley and fit the remainder of the bolts.
17. Reverse procedures 1 to 7.
Tighten the crankshaft pulley securing bolt to a torque of 386-414 Nm (280 lbf ft-300 lbf ft).

**CRANKSHAFT OIL SEAL****Replacement****4A-42-47**

1. Remove timing case cover 4A-41-47.
2. Press or tap the seal out of the cover. To pry old seal out may damage the aluminium cover.
3. Loosely bolt the timing case cover into place with new gasket fitted.
4. Install the crankshaft pulley and centralise the cover.
5. Tighten cap screws and remove the pulley.
6. Lightly coat bore with recommended sealing compound.
7. Lubricate the lip of the new seal with oil and place it on to the wide stepped side of the tool. Lip of the new seal must be towards the engine (Special Tool MF 317A).
8. Slide the tool and seal on to the crankshaft and push the oil seal into the bore of the cover using the pulley securing bolt and washer. When the tool contacts the cover front face the seal is then correctly located, 9.1-9.4 mm (0.360"-0.370"), inside the front face of the cover.

ENGINE

IDLER GEAR

Removal and Refitment

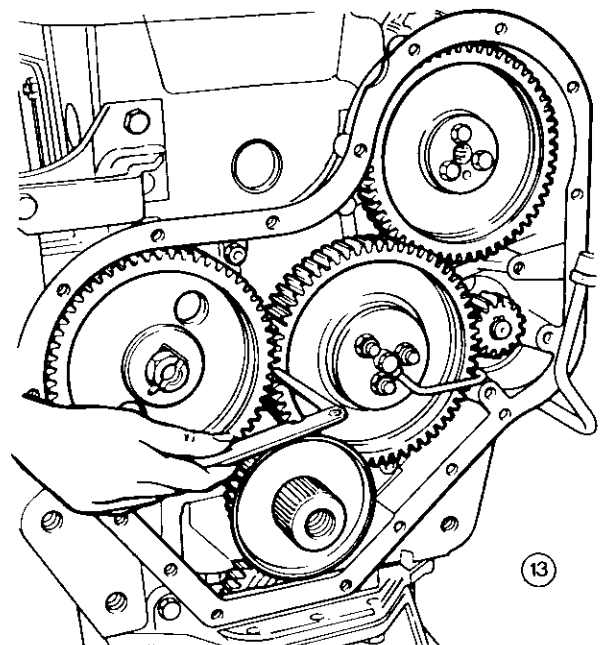
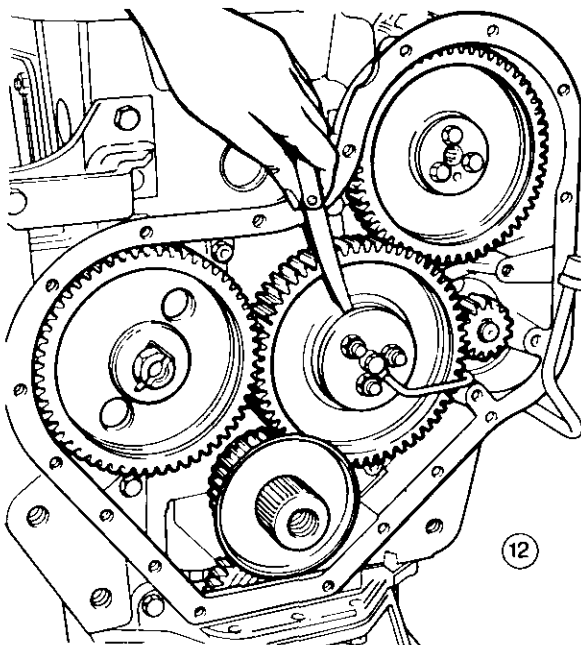
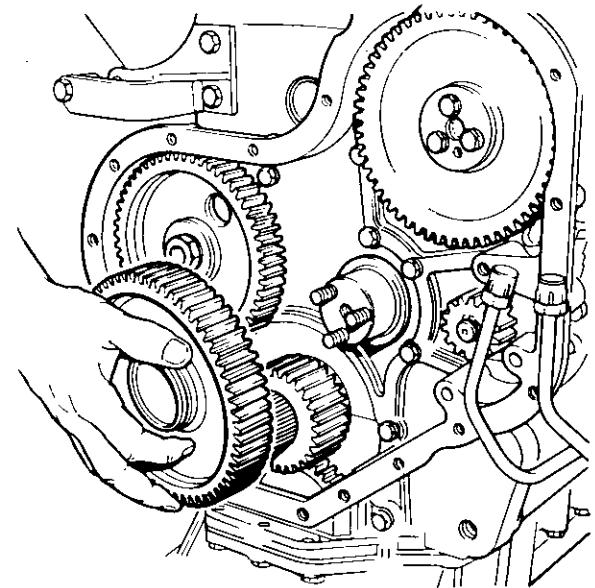
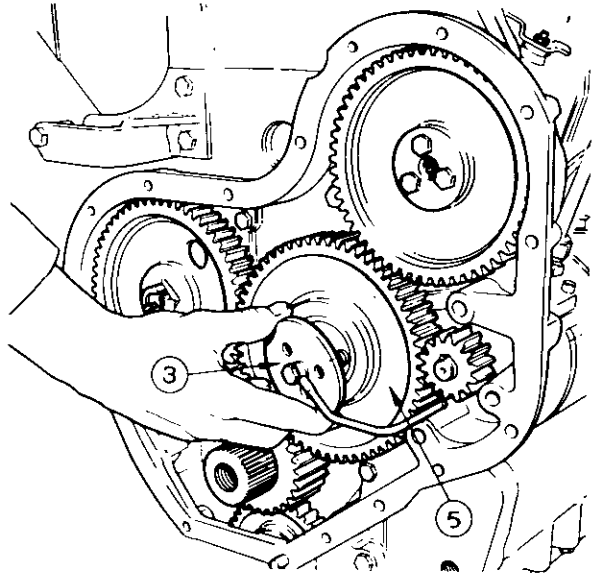
4A-43-48

Removal

1. Remove the timing case cover 4A-40-46.
2. Remove the three self locking nuts.
3. Remove the retainer plate complete with the drip feed oil pipe.
4. Remove the oil thrower from the crankshaft.
5. Remove the gear, if necessary remove the bush inside the gear and the idler hub.

Refitment

6. Turn the crankshaft to 45° B.T.D.C. for cylinders Nos. 1 and 4. (The crankshaft gear keyway will be at 45° before the top of its periphery). Do not force the crankshaft to turn if the valves foul on the pistons. Instead turn the camshaft until the crankshaft is free to turn again.
7. The camshaft gear timing mark should be pointed towards the centre of the idling hub.
8. Turn the crankshaft back to T.D.C. (The gear keyway at the top of its periphery).
9. The fuel pump drive gear timing mark should be pointed towards the centre of the idling hub.
10. Refit the idler gear, aligning the timing marks to those on the fuel pump gear, crankshaft gear and the camshaft gear.
11. Reverse procedures 2 and 3 and tighten the nuts to a torque of 29-32 Nm (21-24 lbf ft). Use new self locking nuts.
12. Check the idler gear end float which should be 0.07-0.17 mm (0.003"-0.007"). Replace thrust washers and other worn parts if play is excessive.
13. Check the timing gear backlash using either a dial test indicator gauge or feeler gauges. Check all points of mesh, backlash should be 0.076-0.15 mm (0.003"-0.006"). Replace the affected gears if the backlash is not within the prescribed limits.
14. Refit the oil thrower on to crankshaft gear.
15. Refit the timing case cover.
It is most important that the balancer unit is timed correctly to the crankshaft gear.



FUEL PUMP DRIVE GEAR**Removal and Refitment**

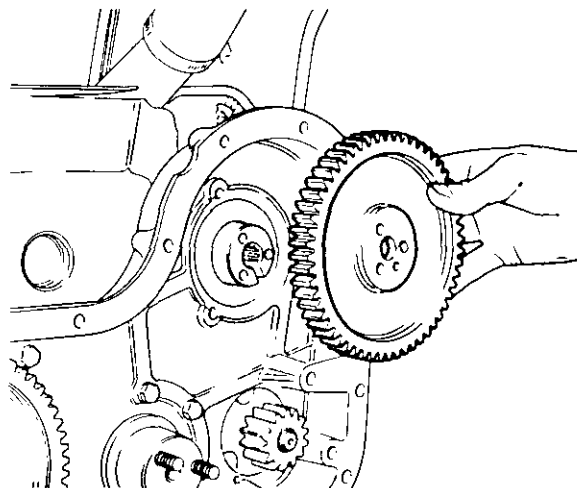
4A-44-49

Removal

1. Remove the idler gear 4A-43-48.
2. Remove the three bolts and spring washers from the fuel pump drive gear.
3. Remove the gear.

Refitment

4. Refit the fuel pump drive gear ensuring that the dowel in the gear locates in the slot of the D.P.A. pump flange.
5. Refit the bolts and washers.
6. Torque the bolts to 28 Nm (21 lbf ft).
7. Refit the idler gear 4A-43-48.

**CAMSHAFT GEAR****Removal and Refitment**

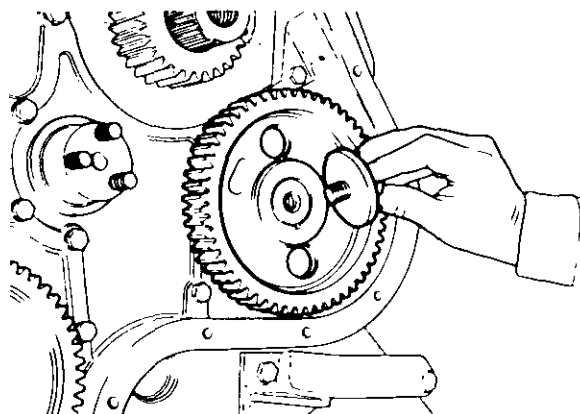
4A-45-49

Removal

1. Remove the idler gear 4A-43-48.
2. Remove the camshaft gear retainer bolt.
3. Remove the tab washer.
4. Remove the retainer plate.
5. Using a suitable puller remove the gear.
6. Remove the key.

Refitment

7. Ensure camshaft key is in good condition and refit.
8. Using a puller refit the gear. Do not attempt to drive camshaft gear on.
9. Refit the retainer plate.
10. Fit new tab washer.
11. Refit the retaining bolt and torque up to 56-62 Nm (41 lbf ft-45 lbf ft).
12. Refit the idler gear 4A-43-48.

**CAMSHAFT****Removal and Refitment**

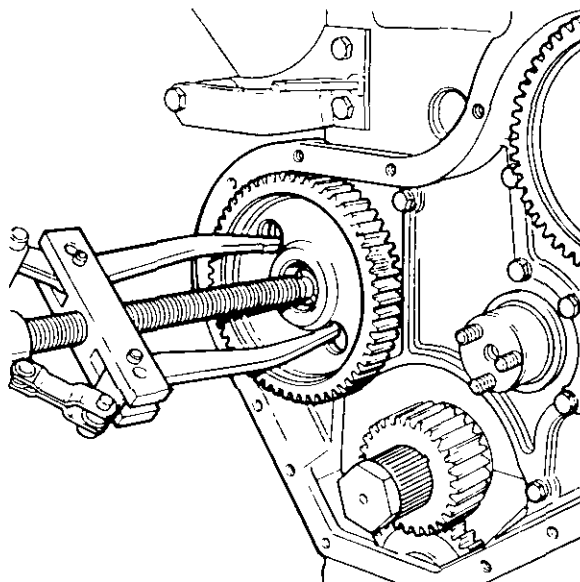
4A-46-49

Removal

1. Remove the rocker assembly and the push-rods.
2. Remove the fuel lift pump.
3. Remove the engine idler gear 4A-43-48.
4. Raise the tappets or else turn the engine upside down.
5. Remove the retaining bolts, securing the camshaft thrust plate, through the holes in the camshaft gear.
6. Remove the camshaft, complete with the gear, from the engine. Take care not to damage the bearing journals or the cam lobes when withdrawing the camshaft.

Refitment

7. Lubricate the bearing journals and the cam lobes with oil.
8. Reverse procedures 1 to 6.



ENGINE**CAMSHAFT****Servicing 4A-47-50**

1. Clean the camshaft and inspect for wear or damage. If worn or damaged replace the camshaft.
2. Measure the camshaft bearing bores in the engine block and compare each bore diameter to its mating journal diameter. Correct clearance is 0.05—0.12 mm (0.002"—0.005") for No. 1 and No. 2. No. 3 camshaft journal should have 0.10—0.17 mm (0.004"—0.007") clearance.
3. With the camshaft gear and thrust plate installed on to camshaft measure the clearance of the thrust plate, it should be 0.17 mm—0.41 mm. Replace the thrust plate if the clearance exceeds 0.41 mm (0.016").

TAPPETS**Servicing 4A-48-50**

Tappets can only be removed and refitted with the oil sump off and camshaft out, and should be retained in the order in which they were removed.

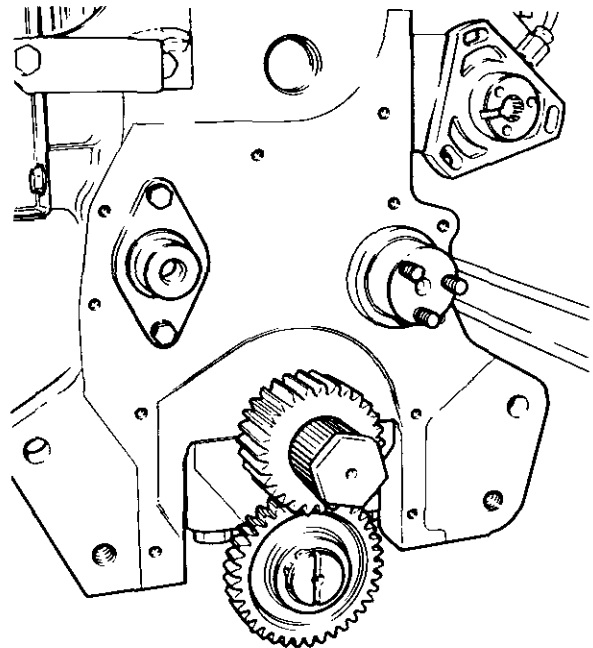
1. Replace tappets with badly worn faces. Do not attempt to reclaim them by re-grinding.
2. New tappets should be installed when replacing an old camshaft with a new one.

TIMING CASE**Removal and Refitment 4A-49-50****Removal**

1. Remove the idler gear 4A-43-48.
2. Remove the camshaft gear 4A-43-49.
3. Remove the fuel pump drive gear 4A-44-49.
4. Remove the fuel pump and the power steering reservoir.
5. Remove nine bolts and washers from the inside of the timing case securing it to the engine block.
6. Remove two bolts and washers from the outside of the case.
7. Remove three bolts securing the case to the sump.
8. Remove the timing case.
9. Remove and discard the gasket.
10. If necessary remove the idler gear hub.

Refitment

11. Fit a new gasket lightly coated in a recommended sealant.
12. Reverse procedures 1 to 10.



FLYWHEEL**Removal and Refitment**

4A-50-51

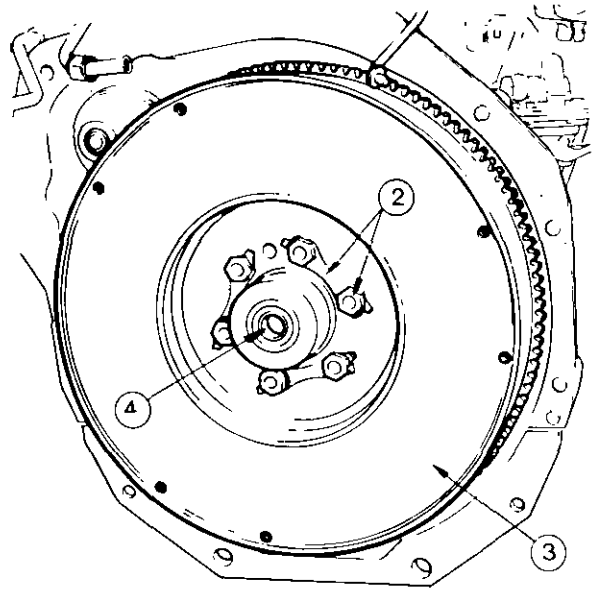
Removal

1. Remove the clutch 5A-04-04.
2. Undo the tabs and remove the six bolts with three tab washers.
3. Remove the flywheel.
4. Remove pilot bearing if necessary.

Refitment

5. Inspect flywheel and pilot bearing.
6. Locate the flywheel aligning the untapped hole in the flange to the unused hole in the flywheel.
7. Fit new tab washers and torque the flywheel bolts to 100-110 Nm (74-80 lbf ft).
8. Fold over tabs to secure the bolts.
9. Check the flywheel run-out with a dial test indicator gauge. Flywheel friction face run-out should not exceed 0.025 mm (0.001") for each 25 mm (1.000") of radius from the flywheel centre to the point of measurement. The flywheel outside periphery run-out should not exceed 0.30 mm (0.012").
10. If the run-out is excessive remove the fly-wheel, check and remove any foreign matter.
11. Repeat procedures 6 to 9.
12. Refit the clutch.

NOTE: If the tractor flywheel is scored, skimming is possible in 0.254 mm (0.010 in) increments up to a maximum 1.00 mm (0.040 in). The shoulder to which the clutch assembly is bolted must also be skimmed by the same amount.



CRANKSHAFT REAR OIL SEAL**Removal and Replacement**

4A-52-53

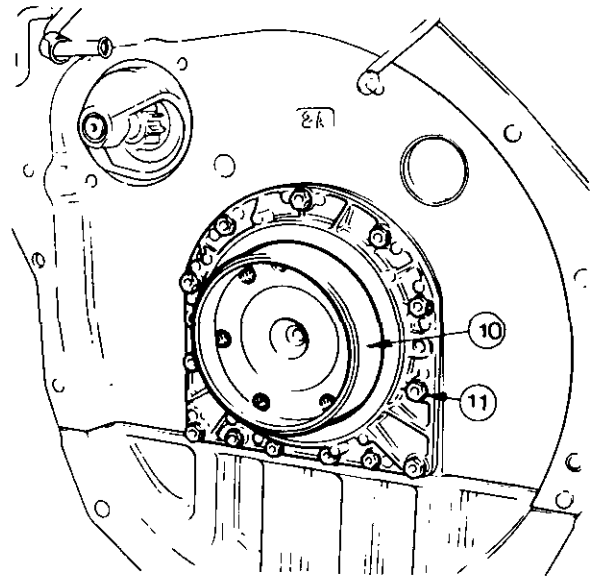
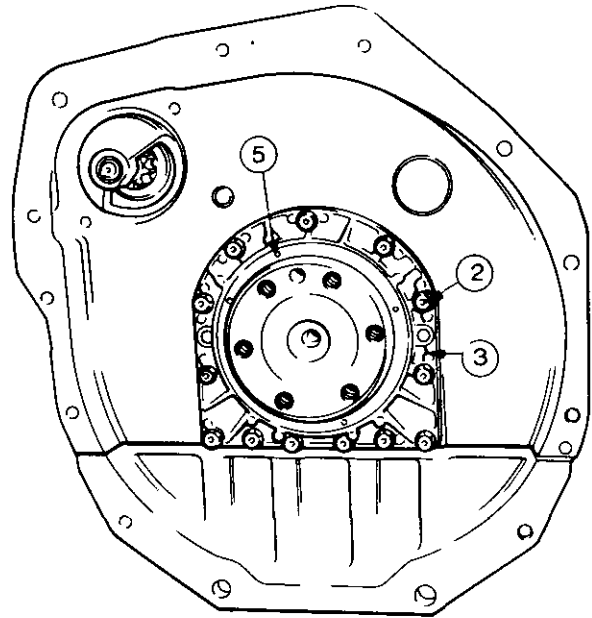
Removal

1. Remove the flywheel 4A-50-51.
2. Remove thirteen retainer bolts.
3. Remove the seal retainer.
4. Remove and discard the gasket.
5. Press the old seal out of the retainer.

Replacement

6. Lubricate the new seal and the housing with clean engine oil.
7. Using PD 145-1 press the new seal into the retainer to the required depth. The seal can be fitted in three positions, flush as on production, an eighth of an inch in if replaced and a quarter of an inch in if replaced a second time. If all three positions have been used replace the retainer and fit the seal flush.
8. Fit a new gasket coated with recommended sealant.
9. Lubricate the seal, crankshaft flange and PD 145-2.
10. Using PD 145-2 slide the seal over the flange locating the seal retainer on to the dowels on the cylinder block.
11. Refit the thirteen bolts and torque up to 16 Nm (12 lbf ft).
12. Refit the flywheel.

NOTE: If all three positions for the rear main oil seal have been used, the sealing area of the crankshaft flange must be re-ground. Only the minimum amount of metal should be ground off to ensure the removal of the seal wear grooves. The oil seal flange must not be machined below 113.17 mm (5.243 in) minimum diameter. It is not necessary to re-Tufftride the flange. Crack test and demagnetize the crankshaft.



ENGINE**ENGINE SUMP****Removal and Refitment**

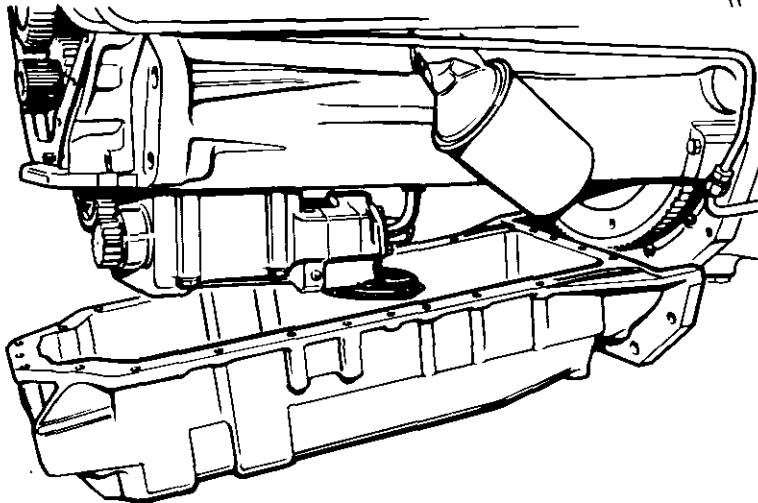
4A-53-54

Removal

1. Drain the engine oil.
2. Support the sump with a trolley jack.
3. Remove three bolts at the front going into timing case.
4. Remove two long bolts going into the front corners of the engine block.
5. Remove the four bolts going into clutch housing.
6. Remove four bolts going into the back of the engine block.
7. Remove sixteen bolts from along the two sides.
8. Lower the jack and remove the sump.
9. Remove and discard the gasket.

Refitment

10. Thoroughly clean both faces and fit a new gasket using a recommended sealant.
11. Reverse procedures 1 to 8 and use the following torques: Oil sump to rear bridge piece 14 Nm (10 lbf ft).
Oil sump to timing gear case 16-20 Nm (12-15 lbf ft).
Oil sump to engine block 26-29 Nm (19-21 lbf ft).

**OIL PUMP****Removal and Refitment**

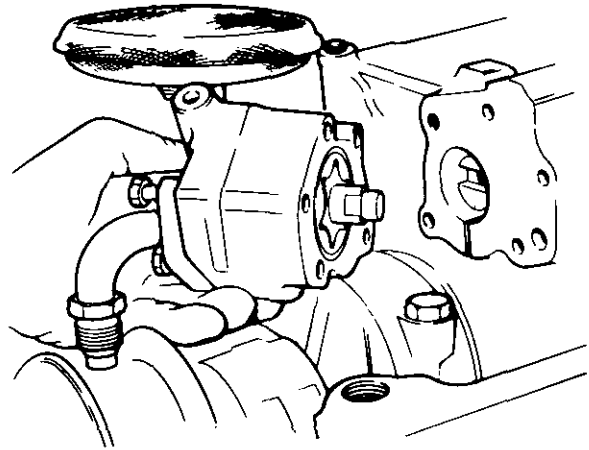
4A-54-54

Removal

1. Remove the sump 4A-53-54.
2. Disconnect the oil delivery connection.
3. Remove the four securing bolts.
4. Remove the pump and discard the gasket.

Refitment

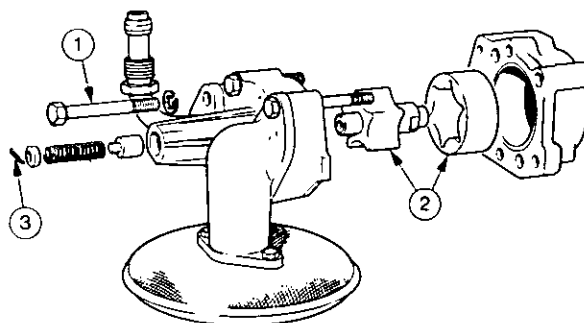
5. Reverse procedures 1 to 4.



OIL PUMP**Servicing**

4A-55-55

1. Remove two bolts securing oil pump cover to pump body and carefully separate the two castings.
2. Slide inner and outer rotors out of the pump body.
3. Remove the cotter pin from the end of the pump cover and withdraw the relief valve cap, spring and plunger.
4. Make sure the oil pump passages, that supply filtered oil to the balancer drive shaft, are fully cleaned and open.
5. Install the inner and outer rotors into the body and check their clearances. The parts should be dipped in oil before reassembly and outer rotor should have the chamfered edge inside the pump body.
6. Check the tension of the relief valve spring. A relief valve may be replaced but a worn rotor will require a replacement pump body and rear cover.
7. With 'O' rings in place join the dowelled pump body and pump cover.
8. Refit the two securing bolts.
9. Refit the relief valve plunger, spring and cap and secure with a new cotter pin.
10. Fit new gasket on to the oil suction and delivery pipes, using recommended sealant.
11. Slide in the four securing bolts into the oil pump.
12. Using a new gasket refit the pump to the balancer unit.

**ENGINE BALANCER UNIT****Removal and Refitment**

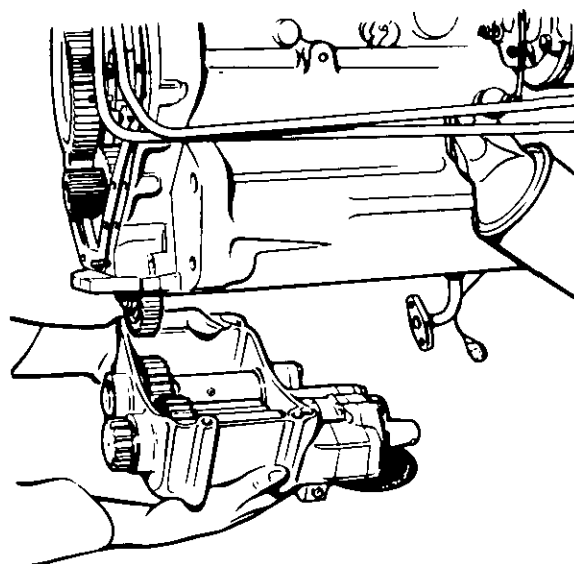
4A-56-55

Removal

1. Remove the sump 4A-53-54.
2. Disconnect the oil delivery line from the cylinder block.
3. Support the balancer unit.
4. Remove the four retaining bolts.
5. Remove the balancer complete with the oil pump and the strainer. The balancer idler is not a part of the assembly, it should be removed separately in order to time the unit to the engine.

Refitment

1. Remove the balancer idler gear and the timing case cover.
 2. Turn the crankshaft until the keyway is at the top of its periphery. Cylinders Nos. 1 and 4 will be at T.D.C.
 3. Refit the balancer idler gear so that the single timing mark is located between the two timing marks on the crankshaft gear.
 4. Refit the balancer unit in place with the single timing mark on the balancer drive gear located between the two marks on the idler.
 5. Refit the four bolts and torque to 44-48 Nm (32-36 lbf ft).
 6. Reconnect the oil delivery line.
 7. Refit the sump.
- It is most important that the unit is correctly timed to the engine as above.



CONNECTING ROD BIG END BEARINGS**Removal and Refitment**

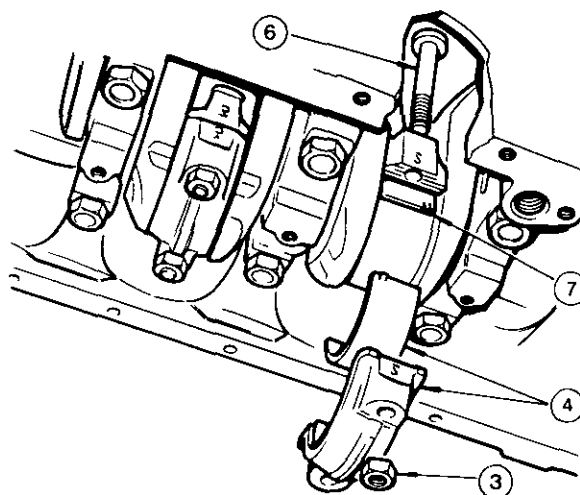
4A-59-57

Removal

1. Remove the balancer unit 4A-56-55.
2. Rotate the crankshaft until the required bearing is at B.D.C.
3. Remove the two nuts from the big end bolts.
4. Remove the big end cap complete with the shell bearing.
5. Remove the bearing from the big end cap.
6. Remove the two big end bolts.
7. Rotate the crankshaft until the shell bearing can be removed from the connecting rod.
8. Repeat procedures 2 to 7 for the remaining big end bearings.
9. Examine the shell bearings for wear and scoring. If any bearing is suspect, replace the entire set.
10. Using a micrometer, check the crankpins for wear and ovality at each end and in both, vertical and horizontal, planes. The crankshaft should be re-ground or replaced if the wear exceeds 0.0381 mm (0.0015").

Refitment

11. Ensure that all components are thoroughly cleaned and lubricated with clean engine oil.
12. Refit the bearings, one at a time, in their original positions. Ensure that the steps on the bearings fit into the slots on the connecting rods.
13. Refit the two bolts ensuring that the flats are located against the shoulders on the connecting rods.
14. Refit the big end caps. The identification marks must be together and Nos. 1 to 4, from the front of the engine, along the camshaft side.
15. Ensure all is properly located and tighten the bolts to 193-207 Nm (140-150 lbf ft).
16. Refit the balancer unit.



ENGINE

PISTONS AND CONNECTING RODS**Removal and Refitment** **4A-60-58****Removal**

1. Remove the cylinder head. 4A-38-43.
2. Remove the connecting rod big end bearings 4A-59-57.
3. Push the pistons and connecting rods out of the top of the cylinders.

Refitment

4. Check the condition of the pistons, piston rings and the cylinder liners. If there is any doubt to their serviceability, replace them.
5. Thoroughly clean all parts and lubricate them with clean oil.
6. Stagger the piston ring gaps around the piston.
7. Using Special Tool No. 8 Piston Ring Clamp and a suitable piece of hardwood, insert the piston and connecting rod assemblies into the top of their original cylinder bores. The word "Front" in the piston crown must face the front of the engine.
8. Refit the big end bearings.
9. Check the piston height using gauge PD 41-B. At T.D.C. the piston should be within the limits 0.08 mm (0.003") below and 0.25 mm (0.010") above the engine block face.
10. Refit the balancer unit.
11. Refit the cylinder head.

PISTONS AND CONNECTING RODS

Servicing

4A-61-59

Disassembly

1. Remove the pistons and the connecting rods.
2. Remove the rings from each piston.
3. Remove the snaprings from the piston pins.
4. Heat the pistons in warm oil (38 to 50°C, 100—120°F) and then push the piston pins out by hand.
5. Remove all traces of carbon deposits from the pistons with particular attention to the ring grooves.
6. Inspect for worn ring grooves and replace the piston if the limits are exceeded. With new rings fitted the groove clearance should be 0.06—0.11 mm (0.0025"—0.0045") on the top and bottom grooves and 0.04—0.09 mm (0.0015"—0.0035") on grooves 2 and 3.
7. Examine the pistons for signs of scoring.
8. Check the piston ring gaps by fitting the ring in the unworn portion, at the top, of the cylinder bore. Gaps should be 0.45—0.63 mm (0.018"—0.025") for top and bottom rings and 0.35—0.53 mm (0.014"—0.021") for 2 and 3.
9. Press out the small end bushes if they are worn.

Reassembly

10. If replacing the small end bushing, press it into place making sure the oil hole in the bushing aligns with the oil hole in the connecting rod.
11. The new bushing should be honed to an inside diameter of 36.52—36.55 mm (1.4382"—1.43925"). Proper clearance between piston pin and bushing is 0.01—0.04 mm (0.0004"—0.0017").
12. Using 335 Aligning Jig, check the connecting rods for parallelism and squareness. If any distortion is found replace the connecting rod.
13. Heat the piston in clean oil, assemble the pistons to their corresponding connecting rods and insert the piston pins. When assembled, the cavity in the piston crown must be off-set on the other side from the big end cap identification numbers.
14. Fit new snaprings, to retain the piston pins.
15. Fit the piston rings in the following order:
 - No. 1 (Top) Compression Ring—Barrel faced chrome-plated, cast iron ring, may be installed either side up.
 - Nos. 2 and 3 Compression Rings—Parallel faced, internally stepped, cast iron rings, must be installed in the second and third grooves with the step towards the piston crown.
 - No. 4 Oil Control Ring—Chrome-plated, cast iron ring with an integral spring expander, may be installed either side up.
16. Refit the pistons and connecting rods, so that the cavity in the piston crown faces the D.P.A. pump side and the identification numbers face the camshaft side of the engine.

ENGINE

CYLINDER LINERS

Removal and Refitment

4A-62-60

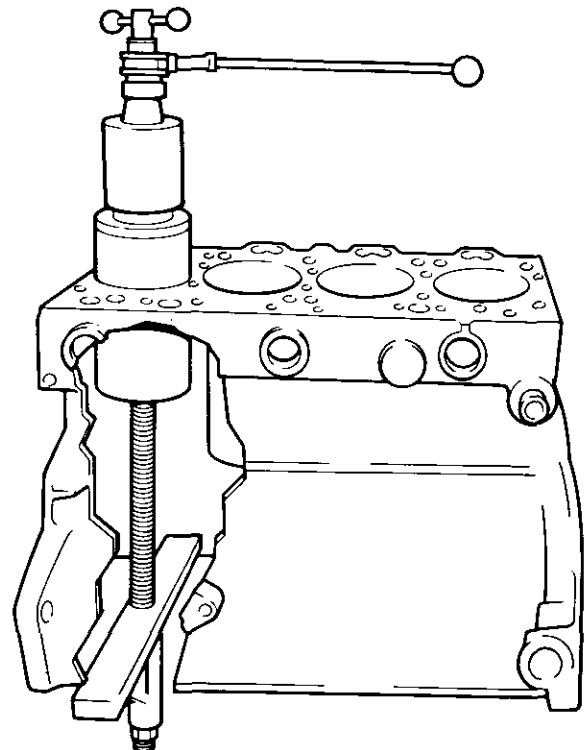
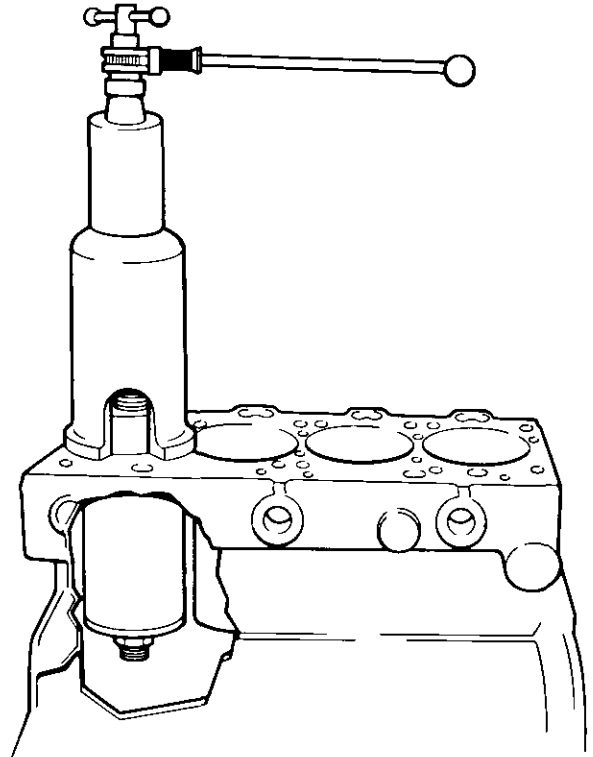
Removal

1. Remove the pistons and the connecting rods.
2. Remove the studs from the cylinder block face.
3. Using PD 150-B and appropriate adaptor with-draw the cylinder liner through the top of the cylinder block, being careful not to damage the cylinder block bore.

NOTE: Production type liners are an interference fit and require machining after installation. Service replacement liners are a transitional fit and, being prefinished, should require no further machining after installation. A liner should be replaced in the case of wear or damage. If the bore wear is less than 0.15 mm (0.006") and the liner is serviceable do not remove it. Carefully remove any cylinder ridge present and deglaze the liner.

Refitment

4. Thoroughly clean the cylinder block bore, in particular the top recess for the shoulder of the liner. Make sure the bores are free from burrs or damage.
5. Carefully clean the new liner.
6. Lubricate the outside of the liner and the cylinder block bores.
7. Using PD 150-B, press the liner fully into the cylinder block.
8. When correctly installed, the top of the liner should be 0.6—0.8 mm (0.025"—0.031") above the top of the cylinder block face. Use MF 403.
9. Make sure the liners are fully seated and allow a period of time for "settling in". Then, measure the inside diameter of the liner for distortion. Maximum cylinder distortion must not exceed 0.04 mm (0.0025"). Check the inside diameter in two directions (at right angles) at the top, centre and bottom of the liner.
10. Check the condition of the piston rings and replace them if necessary.
11. Refit the studs in the cylinder block face.
12. Refit the pistons and the connecting rods.



CRANKSHAFT THRUST WASHERS**Removal and Replacement 4A-63-61****Removal**

1. Remove the balancer unit and oil pump.
2. Force the crankshaft either forwards or backwards as far as it will go.
3. Measure the gap between the machined shoulder on the crankshaft web and the crankshaft thrust washer.
4. If the end float is not within 0.12—0.40 mm (0.005"—0.016") the thrust washers should be replaced, as below.
5. Remove the centre main bearing cap complete with the two bottom half thrust washers.
6. Rotate the two top half thrust washers until they can be removed.

Replacement

7. Lubricate all the parts before fitting.
8. Slide the two new upper halves into place, with the vertical grooves facing outwards towards the crankshaft.
9. Remove the old lower halves from the bearing cap and install new ones with the vertical grooves facing outwards.
10. Refit the centre main bearing cap.
11. Refit the two big end bolts and torque to 193—207 Nm (140—150 lbf ft).
12. Recheck the end play. If still not correct oversize thrust washers can be fitted. A combination of oversize and standard thrust washers may be fitted, but the top and bottom halves must be the same thickness.
13. Refit the balancer unit and the oil pump.

ENGINE

CRANKSHAFT**Removal and Refitment****4A-64-62****Removal**

1. Drain the engine oil.
2. Split the tractor between the front axle and the engine, also between the engine and the transmission 3A-02-04.
3. *Mount the engine on a suitable stand.*
4. Remove the crankshaft rear main oil seal.
5. Remove the timing case.
6. Remove the connecting rod big end bearings.
7. Remove the crankshaft thrust washers.
8. Remove the rear main bearing bridge piece and seals.
9. Remove the eight bolts securing the remainder of the crankshaft main bearing caps.
10. Remove the four remaining main bearing caps complete with the half shell bearings.
11. Lift out the crankshaft.
12. Remove the five half shell bearings from the engine casing.
13. Remove the crankshaft gear and key.
14. Thoroughly clean all parts.

Refitment

15. Ensure that components are scrupulously clean and freely lubricated with clean oil.
16. Refit the crankshaft gear and key.
17. Refit the five half shell bearings, if serviceable, in their original locations. In the case of a re-ground crankshaft new undersize bearings must be fitted.
18. Install the crankshaft, ensuring that the oil-ways in the engine block and the crankshaft are free from blockage.
19. Refit the main bearing caps complete with the half shell bearings. The main bearing caps are numbered from the front of the engine.
20. Tighten the main bearing bolts to a torque of 193-207 Nm (140-150 lbf ft). Check for "stretch" before fitting.
21. Refit the rear main bearing bridge so that the rear face is flush with the rear face of the engine block.
22. Refit the crankshaft thrust washers and check the end float.
23. Reverse procedures 1 to 6.

CRANKSHAFT**Servicing****4A-65-63**

1. Thoroughly clean and inspect all parts. Ensure that all the oil passages are clean and blown out with compressed air.
2. Check the crankpins and journals in the vertical and horizontal planes, at both ends, for wear and ovality.
3. If any journals are worn more than 0.025 mm (0.001") beyond the minimum diameter, 0.04 mm (0.0015") or more out of round, or tapered 0.025 mm (0.001") or more, then the crankshaft should be re-ground or replaced.
4. Crankpin journal diameter should be 69.80 mm—69.82 mm (2.7483"—2.749") or can be 0.25 mm, 0.50 mm or 0.76 mm (0.010", 0.020" or 0.030") undersize. Main bearing journal diameter is 76.15 mm—76.17 mm (2.9985"—2.999") or can be 0.25 mm, 0.50 mm or 0.76 mm (0.010", 0.020" or 0.030") undersize.
5. Inspect the crankshaft for cracks and demagnetize it.
6. Determine the nearest size it can be re-ground to and fitted with undersize bearing inserts. If it has to be re-ground below 0.76 mm (0.030") a new crankshaft must be fitted.
7. After re-grinding remove all sharp corners on the oilways.
8. The crankshaft must be re-Tufftrided after re-grinding.
9. Crankshaft must again be checked for cracks and demagnetised.

NOTE: If all three positions for the rear main oil seal have been used, the sealing area of the crankshaft flange must be re-ground. Only the minimum amount of metal should be ground off to ensure the removal of the seal wear grooves. The oil seal flange must not be machined below 113.17 mm (5.243") minimum diameter. It is not necessary to re-Tufftride the flange. Crack test and demagnetize the crankshaft.

COOLING SYSTEM

Part 4 - Section B

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GENERAL

The coolant is circulated by thermo-syphon action assisted by a centrifugal type pump. The system is controlled by a thermostat which prevents the coolant from flowing through the radiator until the correct working temperature has been achieved, and a pressure-sensitive radiator cap, which, by allowing the radiator to pressurise, raises the temperature at which the coolant will boil. A fan attached to the front of the engine assists cooling by drawing air through the radiator.

The water pump and cooling fan are driven by a belt, which is driven by a pulley splined to the front of the crankshaft.

COOLING SYSTEM

FAULT	POSSIBLE CAUSE	SUGGESTED REMEDY
OVERHEATING	Engine racing or pulling hard	Select the correct gear to suit conditions.
	Radiator water level	Fill to the correct level, check for leaks at joints and hoses, rectify as necessary.
	Loose fan belt	Adjust the fan belt tension, Part 9A.
	Radiator cap leaking or valve spring defective	Replace the radiator cap.
	Radiator matrix blocked	Clean the radiator using a reverse flow of air or water.
	Water flow restricted	Check the thermostat operation and replace if necessary, operation 4B-09-08 (A4. 236/A4. 248 Engine)
	Water flow restricted	Reverse flush the cooling system
ENGINE RUNS COOL	Water flow restricted	Service or renew the water pump, 4B-11-08 (A4. 236/A4. 248 Engine)
	Operating conditions (i.e. Cold head winds)	Blank off a portion of the radiator.
	Thermostat stuck open	Replace the thermostat, operation 4B-04-04 (A4. 236/A4. 248 Engine)

FAULT DIAGNOSIS

The faults listed are cooling system faults only and do not cover engine defects which may contribute towards overheating.

FROST PRECAUTIONS

There are three main methods of protecting the cooling system during frost conditions.

1. Draining the cooling system after each day's work.
This method leaves the system unprotected in the idle periods during the day, and in extreme conditions the cooling system may freeze while the engine is running. Erosion of the water pump impeller may be accelerated in hard water conditions due to the frequent draining and refilling of the system.
2. Use of heated premises, engine or sump heaters.
This method also leaves the engine unprotected during the idle periods in the day and in extremely cold conditions.

3. Anti-Freeze Solutions.

Generally the most efficient method of protecting cooling systems, but due to the penetrating properties of the solution, all hoses and joints should be in good condition. A cooling system which is normally free of leaks may well develop them when filled with an Anti-freeze solution. Leakage may not occur immediately after initial filling of the system, but may develop shortly afterwards. This should be considered and the necessary checks carried out.

NOTE: Only the Anti-freeze solutions listed in the Specification section should be used. The use of inferior grades of Anti-freeze (including some solutions conforming to BS 3151) can cause severe damage to the cooling system.

RADIATOR (A4. 236 and A4. 248 Engines)**Removal and Refitment**

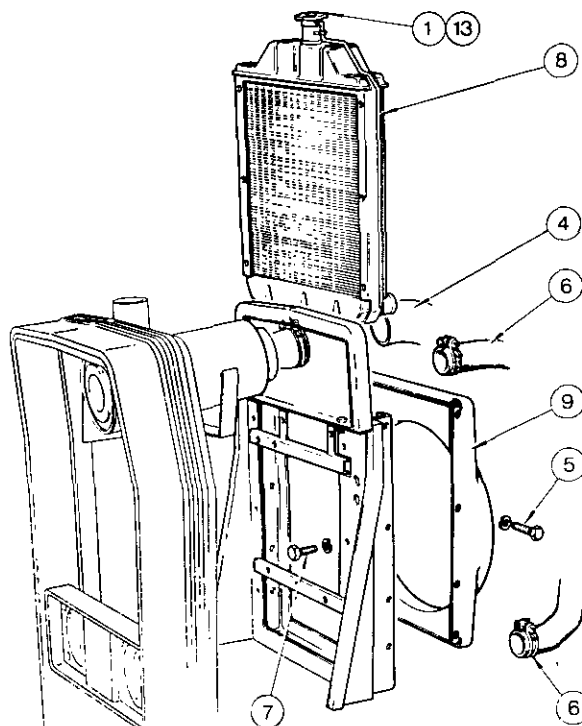
4B-01-03

Removal

1. Remove the radiator cap and drain the cooling system via the drain taps on the radiator and the engine block.
2. Remove the hood, Part 2A.
3. Remove the front grille.
4. Disconnect the hose at the rear of the air cleaner.
5. Remove the eight bolts securing the fan shroud to the radiator.
6. Disconnect the radiator top and bottom hoses.
7. Remove the six bolts securing the radiator to the front bulkhead.
8. Manoeuvre the radiator upwards clear of the engine.
9. Remove the fan shroud (if necessary).

Refitment

10. Reverse procedures 2 to 9.
11. Close the radiator and engine drain taps.
12. Fill the radiator with an approved coolant.
13. Refit the radiator cap.
14. Run the engine until the normal operating temperature is reached, and check the coolant level again.

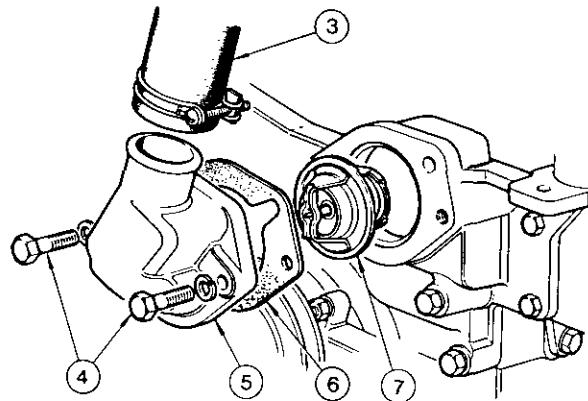


COOLING SYSTEM**THERMOSTAT (A4. 236 and A4. 248 Engines)****Removal and Refitment 4B-02-04****Removal**

1. Remove the radiator cap and drain the cooling system via the drain taps on the radiator and the engine block.
2. Remove the hood, Part 2A.
3. Remove the radiator top hose.
4. Remove the two bolts and spring washers.
5. Remove the thermostat cover.
6. Remove and discard the gasket.
7. Withdraw the thermostat.

Refitment

8. Reverse procedures 1 to 7, except:
 - (a) Fit a new gasket lightly coated with recommended sealant 'A'.

**THERMOSTAT****Servicing 4B-03-04**

Special Tool: Thermometer

Servicing

Thermostats are not repairable and, if faulty, should be replaced.

1. Remove the thermostat, operation 4B-04-04 (A4. 236 and A4. 248 engines)
2. Check the operating temperature of the thermostat, which is stamped on the top face of the thermostat next to the valve seat.

NOTE: Ensure that the thermometer has a range of 0° to 110°C (32° to 230° F).

3. Immerse the thermostat and the thermometer in water.
4. Gradually heat the water.
5. Monitor the reading on the thermometer and check the temperature at which the thermostat starts to open.
6. Refit or replace the thermostat as required, operation 4B-04-04 (A4. 236 and A4. 248 engines)

THERMOSTAT HOUSING (A4. 236 and A4. 248 Engines)

Removal and Refitment

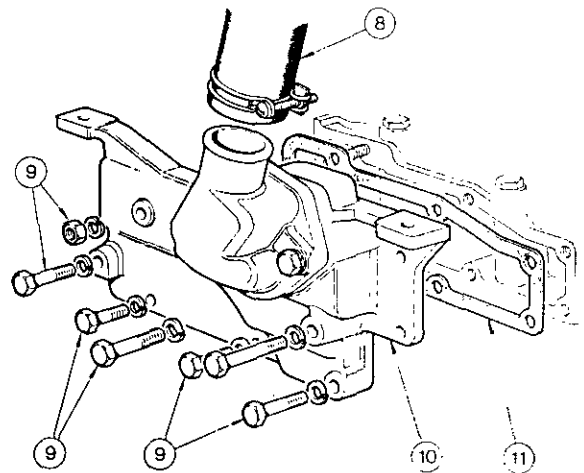
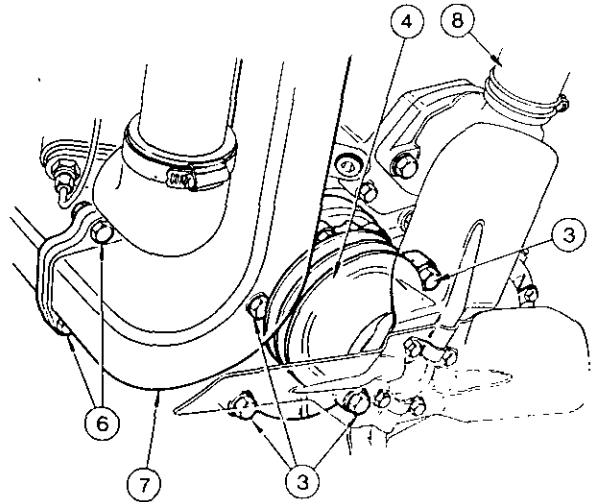
4B-04-05

Removal

1. Split the tractor between the engine and the front axle, Part 3A.
2. Remove the alternator, Part 9A.
3. Remove the four bolts and washers.
4. Remove the water pump complete with rear body.
5. Remove and discard the gasket.
6. Remove the three nuts and bolts.
7. Remove the front section of the exhaust manifold.
8. Disconnect the radiator top hose.
9. Remove the six bolts and one nut complete with washers.
10. Remove the thermostat housing.
11. Remove and discard the gasket.

Refitment

12. Reverse procedures 1 to 11, except:
 - (a) Fit new gaskets lightly coated with recommended sealant 'A'.



COOLING SYSTEM**WATER PUMP (A4. 236 and A4. 248 Engines)****Removal and Refitment**

4B-05-06

Special Tools: PD 155B Puller

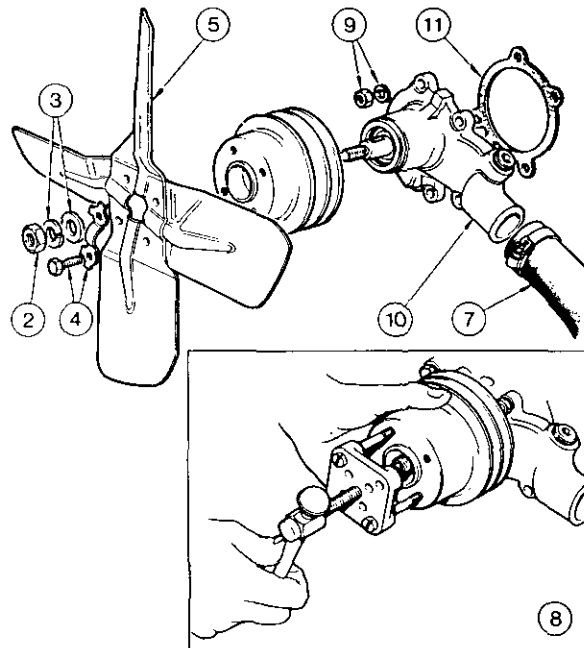
PD 155-1 Adaptors

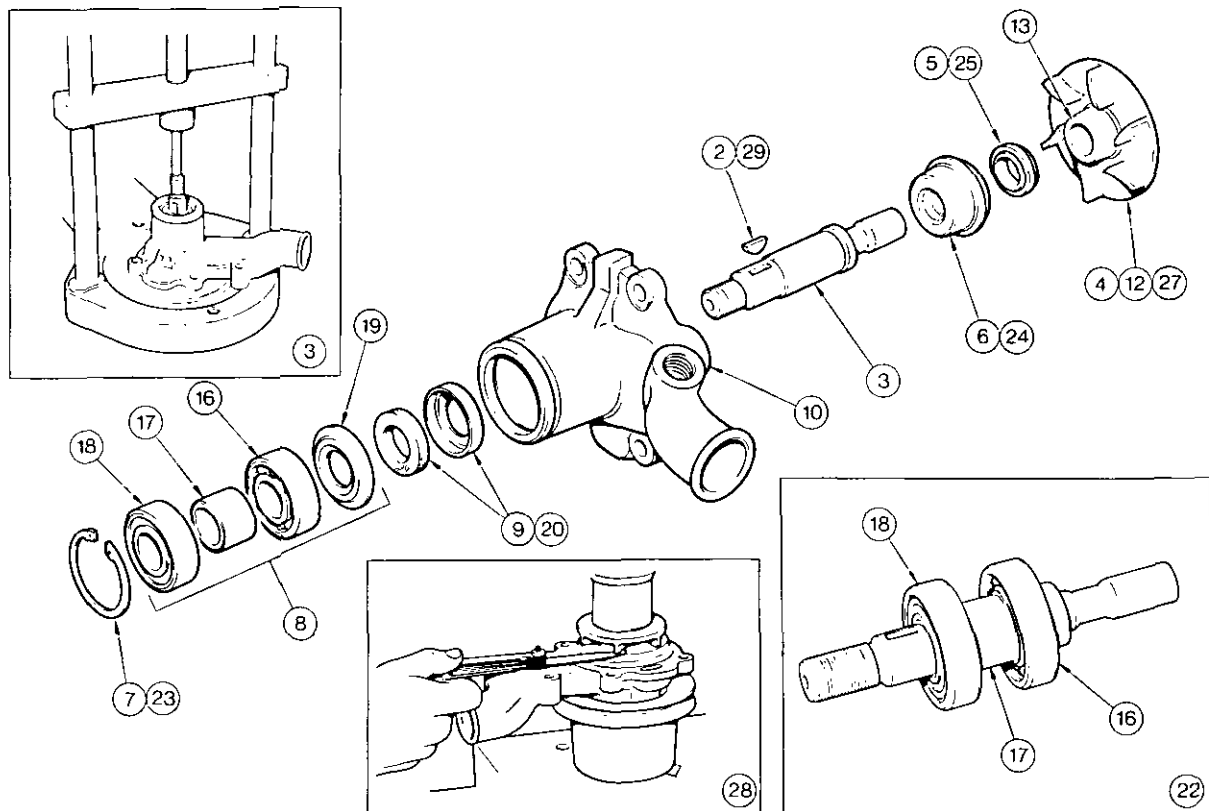
Removal

1. Split the tractor between the engine and the front axle, Part 3A.
2. Remove the nut.
3. Remove the spring washer and the plain washer.
4. Remove the bolts and tab washers.
5. Remove the fan blades.
6. Slacken the alternator mounting bolts and remove the fan belt.
7. Disconnect the radiator bottom hose.
8. Using PD 155B and PD 155-1, remove the pulley.
9. Remove the four nuts and washers.
10. Separate the water pump from the water pump rear body.
11. Remove and discard the gasket.

Refitment

12. Reverse procedures 1 to 10 except:
 - (a) Fit a new gasket lightly coated with recommended sealant 'A'.
 - (b) PD 155B and PD 155-1 are not required for refitting the pulley.
 - (c) When refitting the fan blades, use new tab washers.
 - (d) Tighten the pulley retaining nut to a torque of 80 Nm (60 lbf ft).
 - (e) Adjust the fan belt tension, Part 9A.





WATER PUMP (A4. 236 and A4. 248 Engines)

Servicing 4B-06-07

Special Tools: MF 200 Handpress
 MF 200-26A Water Pump Overhaul Kit
 MF 200-25 Multi-Purpose Bearing Remover.

Disassembly

1. Remove the water pump, operation 4B-09-06.
2. Tap out the key.
3. Using MF 200 and MF 200-26A, press the shaft complete with the impeller out of the housing.
4. Using MF 200 and MF 200-26A, press the drive shaft out of the impeller.
5. Remove the ceramic faced seal.
6. Remove the spring loaded seal.
7. Remove the circlip.
8. Using MF 200, MF 200-26A and MF 200-25 press the two bearings out of the housing complete with the spacer and retaining plate.
9. Remove the felt seal and retainer housing.
10. Examine the pump body for cracks, damage or corrosion.
11. Examine the drive shaft for wear, ensure that the bearings are a transition fit on the shaft. If the inner races of the bearings rotate on the shaft, the shaft must be renewed.
12. Remove any rust and scale from the impeller and inspect the impeller for cracks or damage.
13. Examine the impeller hub sealing face for excessive wear or scoring.
14. Inspect the bearings for pitting, corrosion or wear.
15. Replace all seals.

Reassembly

16. Press the rear bearing onto the shaft with the shielded face towards the rear of the shaft.
17. Fit the spacer.
18. Press the front bearing onto the shaft with the shielded face towards the front of the shaft.
19. Fit the retaining plate into the housing with the 'dished' portion towards the rear of the housing.
20. Fit the felt seal and retainer housing into the pump housing with the felt seal against the retaining plate.
21. Half fill the space between the bearings on the shaft with high melting point grease.
22. Press the complete bearing and shaft assembly into the housing from the front end.
23. Fit the circlip.
24. Fit the spring loaded seal.
25. Fit the ceramic faced seal with the ceramic face to the rear.
26. Spin the shaft assembly to ensure freedom of rotation.
27. Press the impeller onto the shaft.
28. Check the clearance between the impeller vanes and the pump body, this should be between 0,03 and 0,81 mm (0.012 and 0.032 in).
29. Refit the key.
30. Refit the water pump, operation 4B-09-06.

COOLING SYSTEM

Part 4 — Section B
(A4 318 Engine)

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GENERAL

The coolant is circulated by thermo-syphon action assisted by an impeller type water pump. The system is controlled by a thermostat which prevents the coolant from flowing through the radiator until the correct working temperature has been achieved, and a pressure sensitive radiator cap, which, by allowing the radiator to pressurise, raises the temperature at which the coolant will boil. A fan attached to the front of the engine assists cooling by drawing air through the radiator.

The water pump and cooling fan are driven by a belt, which is driven by a pulley splined to the front of the crankshaft.

COOLING SYSTEM

FAULT	POSSIBLE CAUSE	SUGGESTED REMEDY
OVERHEATING	Engine racing or pulling hard	Select the correct gear to suit conditions.
	Radiator water level	Fill to the correct level, check for leaks at joints and hoses, rectify as necessary.
	Loose fan belt	Adjust the fan belt tension.
	Radiator cap leaking or valve spring defective	Replace the radiator cap.
	Radiator matrix blocked	Clean the radiator using a reverse flow of air or water.
	Water flow restricted	Check the thermostat operation and replace if necessary.
	Water flow restricted	Reverse flush the cooling system.
ENGINE RUNS COOL	Water flow restricted	Service or renew the water pump.
	Operating conditions (i.e. Cold head winds)	Blank off a portion of the radiator.
	Thermostat stuck open	Replace the thermostat.

FAULT DIAGNOSIS

The faults listed are cooling system faults only and do not cover *engine* defects which may contribute towards overheating.

FROST PRECAUTIONS

There are three main methods of protecting the cooling system during frost conditions.

1. Draining the cooling system after each day's work.
This method leaves the system unprotected in the idle periods during the day, and in extreme conditions the cooling system may freeze while the engine is running. Erosion of the water pump impeller may be accelerated in hard water conditions due to the frequent draining and refilling of the system.
2. Use of heated premises, engine or sump heaters.
This method also leaves the engine unprotected during the idle periods in the day and in extremely cold conditions.

3. Anti-Freeze Solutions.

Generally the most efficient method of protecting cooling systems, but due to the penetrating properties of the solution, all hoses and joints should be in good condition. A cooling system which is normally free of leaks may well develop them when filled with an Anti-freeze solution. Leakage may not occur immediately after initial filling of the system, but may develop shortly afterwards. This should be considered and the necessary checks carried out.

NOTE: Only the Anti-freeze solutions listed in the Specification section should be used. The use of inferior grades of Anti-freeze (including some solutions conforming to BS 3151) can cause severe damage to the cooling system.

RADIATOR**Removal and Refitment**

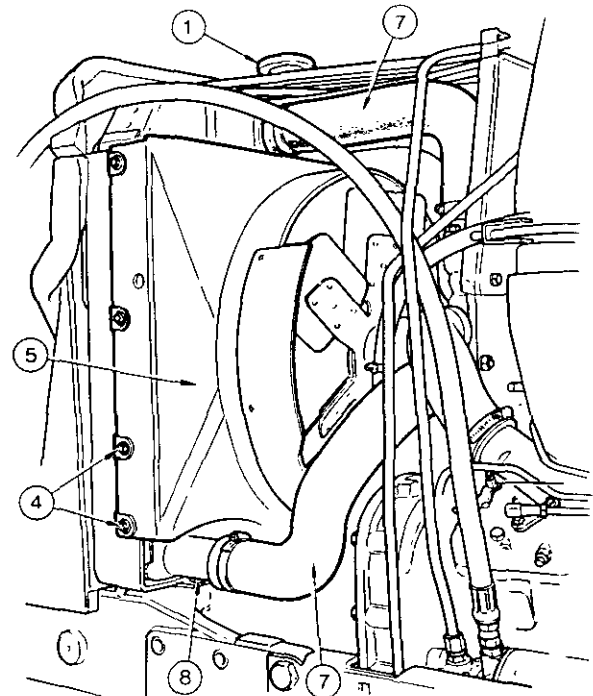
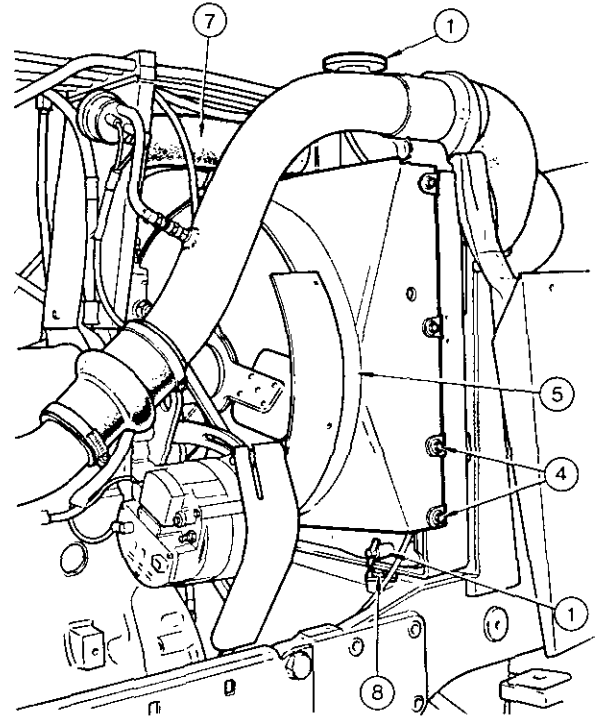
4B-13-13

Removal

1. Remove the radiator cap and drain the cooling system via the drain taps on the radiator and the engine block.
2. Remove the hood.
3. Remove the side panels.
4. Remove the eight screws securing the fan shroud to the radiator.
5. Move the fan shroud rearwards.
6. Remove the screws securing the radiator to the bulkhead.
7. Disconnect the radiator top and bottom hoses.
8. Remove two bolts (front and back) from both the lower securing brackets.
9. Manoeuvre the radiator sideways clear of the engine and power steering pipes. Remove the fan shroud if necessary.

Refitment

10. Reverse procedures 2 to 9.
11. Shut the radiator and engine drain taps.
12. Fill the radiator with an approved coolant.
13. Refit the radiator cap.
14. Run the engine until the normal operating temperature is reached and check the coolant level again.



COOLING SYSTEM**THERMOSTAT****Removal and Refitment**

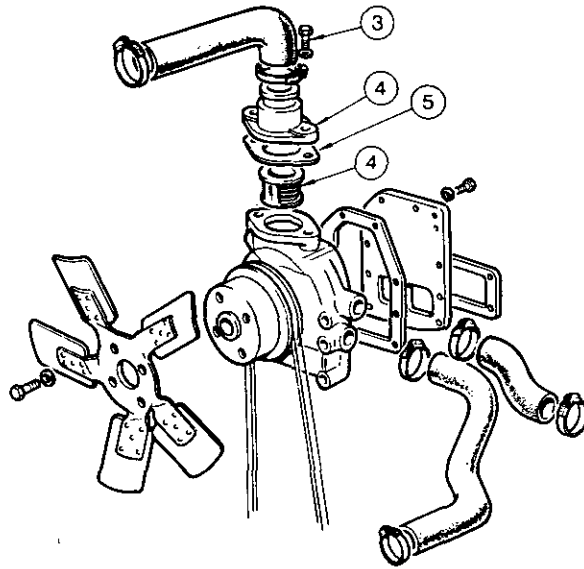
4B-14-14

Removal

1. Remove the radiator cap and drain the cooling system via the drain taps.
2. Remove the hood.
3. Remove the two capscrews securing the water outlet connection to the water pump body.
4. Separate connection from the body and remove the thermostat.
5. Remove the gasket and clean the gasket surfaces.

Refitment

6. Install the new thermostat into the water pump with the large wound spring towards the pump body.
7. Use a new gasket with recommended sealing compound.
8. Reverse procedures 1 to 4.

**THERMOSTAT****Servicing**

4B-15-14

Special Tools: Thermometer

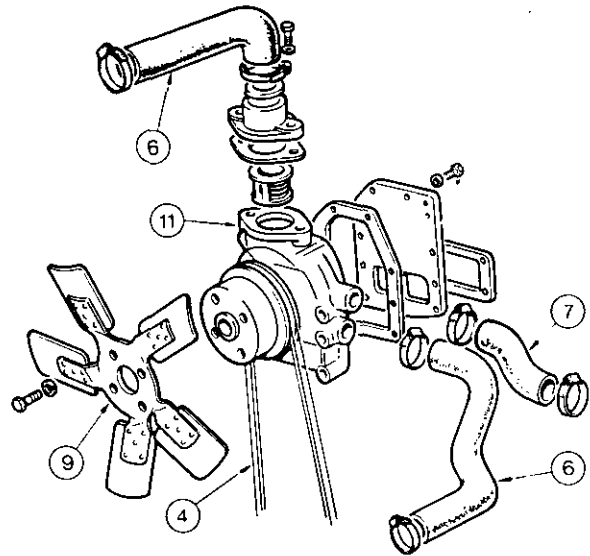
Thermostats are not repairable and if faulty should be replaced.

1. Remove the thermostat.
2. Check the operating temperature, as stamped on the thermostat.
3. Immerse the thermostat and a thermometer into water.
4. Gradually heat the water.
5. Check the temperature at which the thermostat valve begins to open.
6. If the thermostat does not function within the specified temperature range, or open fully, it should be replaced.
7. Refit or replace thermostat as required.

WATER PUMP**Removal and Refitment****Removal**

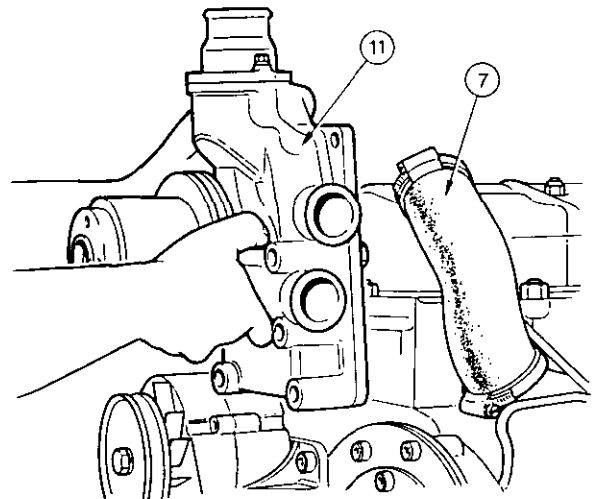
4B-16-15

1. Drain the cooling system.
2. Remove the hood.
3. Remove the alternator adjusting bracket and the engine lift eye.
4. Remove the fan belt.
5. Remove the temperature indicator sending unit wire.
6. Disconnect upper and lower radiator hoses from the water pump.
7. Disconnect the cylinder block inlet hose.
8. Remove the four bolts and tab washers on the fan.
9. Remove the fan blades.
10. Remove the four retaining bolts fixing the water pump to the cylinder head.
11. Remove the water pump.

**Refitment**

12. Refit the water pump on to the front of the cylinder head, using a new gasket with recommended sealant.
13. Refit the fan blades using new tab washers.
14. Reverse procedures 1 to 7.

NOTE: Ensure the fan belt tension is correctly adjusted to provide 12.70 mm—19.05 mm ($\frac{1}{2}$ in— $\frac{3}{4}$ in) deflection when depressed with 6.8 kg (15 lbs) midway on the longest span between pulleys.



COOLING SYSTEM

WATER PUMP

Servicing

4B-17-16

Special Tools: PD 155B Puller
 PD 155-1 Adaptors
 MF 200 Hand Press
 MF 200-26A Water Pump Overhaul Kit
 MF 200-25 Multi Purpose Bearing Remover

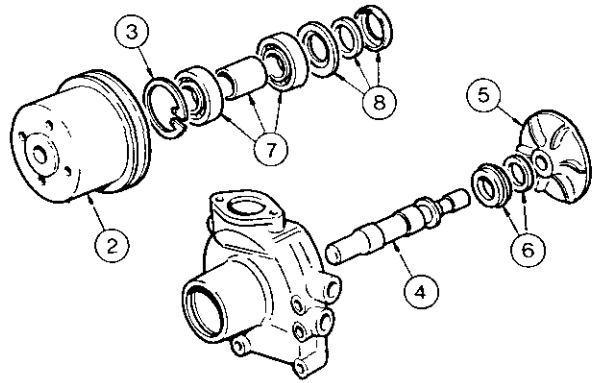
Disassembly

1. Remove the back plate from the rear of the pump body.
2. Using PD 155B and PD 155-1, remove the pulley from the water pump.
3. Remove the bearing retaining snap ring from the front end of the water pump.
4. Using MF 200 and MF 200-26A, press the shaft, complete with impeller, rearwards out of the housing.
5. Using MF 200 and MF 200-26A, press the drive shaft out of the impeller.
6. Remove the ceramic counterface and rear seal from the shaft.
7. Using MF 200, MF 200-26A and MF 200-25, press the two bearings and spacer out the front end of the pump body.
8. Remove the front seal, seal retainer and the flange.
9. Examine the pump body for cracks, damage or corrosion.
10. Examine the drive shaft for wear, ensure that the bearings are a transition fit on the shaft. If the inner races of the bearing rotate on the shaft, the shaft must be renewed.
11. Remove any rust and scale from the impeller and inspect the impeller for cracks or damage.
12. Examine the impeller hub sealing face for excessive wear or scoring.
13. Inspect the bearings for pitting, corrosion or wear.
14. Replace all the seals.

Reassembly

15. Press the rear bearing on to the shaft with the shielded face towards the rear of the shaft.
16. Fit the spacer.
17. Press the front bearing on to the shaft with the shielded face towards the front of the shaft.
18. Install the grease seal flange in position against the back face of the rear bearing so that the centre part dishes away from the bearing.
19. Install the felt seal and seal retainer so the seal bears on the flange.
20. Smear the bearings, and half fill the space between them, with high melting point grease.
21. Press the complete bearing and shaft assembly into the pump body from the front end.
22. Insert a new snap ring.
23. Press the pulley on to the shaft until it bottoms against the inner race on the front bearing.
24. Lightly coat the outside brass portion of the rear seal with sealing compound and push it fully into place with the carbon face towards the rear. Fit the ceramic counter face on to the shaft, so the ceramic side will contact the seal.

25. Rotate the shaft to make sure that it turns freely.
26. Press the impeller on to the shaft.
27. Check the clearance between the impeller blades and the pump body. This should be 0.6 mm—0.9 mm (0.027 in—0.035 in).
NOTE: 0.6 mm—0.9 mm (0.027 in—0.035 in) is a checking clearance. Normal running clearance, including end play, is 0.3 mm—0.9 mm (0.011 in—0.035 in).
28. Use a new gasket with sealing compound and refit the back plate.



FUEL SYSTEM AND AIR CLEANER**DRY ELEMENT AIR CLEANER ASSEMBLY****Removal and Refitment** 4C-01-02**Removal**

1. Prop the right hand side of the hood open.
2. Remove the front grille.
3. Disconnect the pre-cleaner.
4. Disconnect the pipe.
5. Remove the four bolts and spring washers.
6. Remove the air-cleaner assembly.

Refitment

7. Reverse procedures 1 to 6.

FUEL TANK STONE GUARD**Removal and Refitment** 4C-02-02**Removal**

1. Remove the two bolts and washers that secure the guard to the footstep support bracket.
2. Remove the bolt washer and spacer that secures the guard to the underside of the transmission.

Refitment

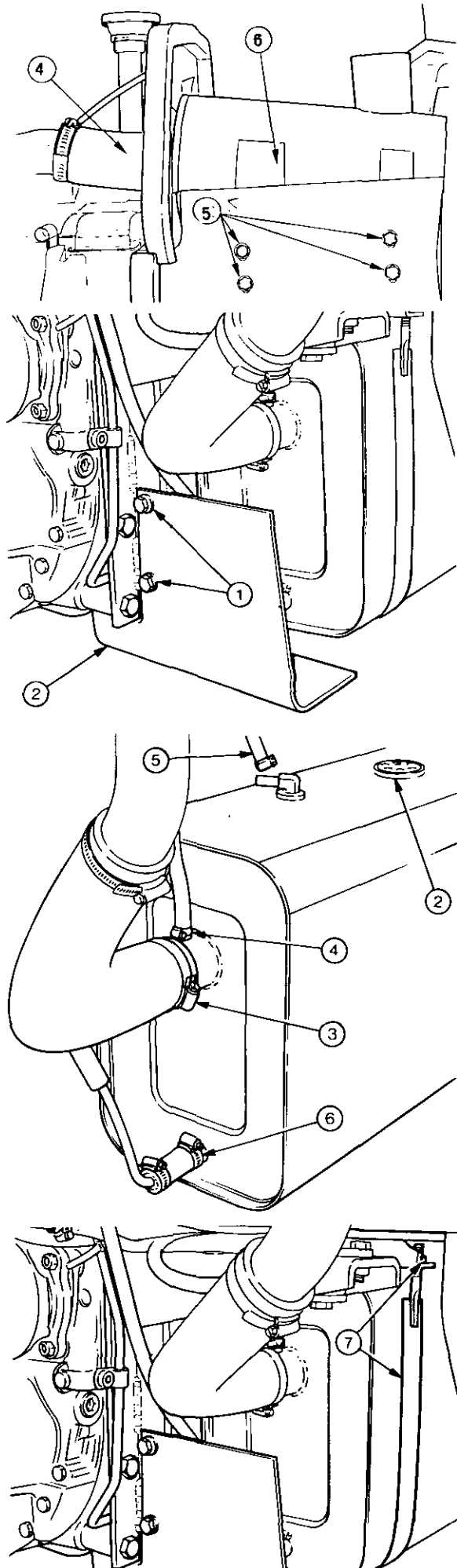
3. Reverse procedures 1 and 2.

SINGLE FUEL TANK**Removal and Refitment** 4C-03-02**Removal**

1. Drain the fuel tank using the drain plug in the bottom of tank.
2. Disconnect the sender gauge wires on top of the tank.
3. Slacken the clip on the filler hose at the tank end and pull the hose off the inlet pipe.
4. Slacken the clip on the breather hose attached to the small pipe on top of the large inlet pipe, and pull hose off.
5. Slacken the clip on the return hose attached to the small pipe protruding from the top of the tank, and pull the hose off.
6. Slacken the clip on the feed hose attached to the small pipe on the bottom of the tank and pull the hose off.
7. Remove the nut and washer from the two fuel tank strap studs and remove the straps.
8. Lift the tank clear.

Refitment

9. Reverse procedures 2 to 8.
10. Refit the drain plug after coating the threads with the recommended sealant, tighten the plug to a torque of 54-81 Nm (40-60 lbf ft).

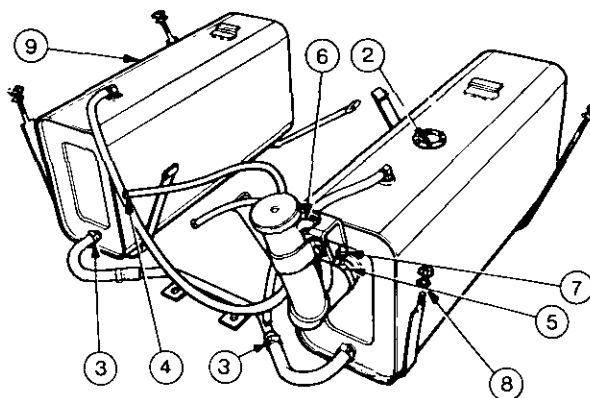


FUEL SYSTEM AND AIR CLEANER**DUAL FUEL TANK (MF 690, 698)****Removal and Refitment**

4C-04-03

Removal

1. Drain both fuel tanks using the drain plug in the bottom of the tanks.
2. Disconnect the sender gauge wires on top of the left hand tank.
3. Slacken the clip on the flexible hose at the bottom of each tank from the connecting tube bolted to the underside of the gearbox casting, and pull hose off.
4. Slacken the clip on the flexible hose on the bundy pipe at the lift pump and pull the hose off.
5. Slacken the clip on the filler hose at the tank end and pull the hose off the inlet pipe.
6. Slacken the clip on the breather hoses attached to the small pipes on top of the large inlet pipe and pull the hoses off.
7. Slacken the clip on the return hose attached to the small pipe protruding from the top of the inlet pipe and pull the hose off.
8. Remove the nut and washer from the two left-hand fuel tank strap studs and lift the tank clear.
9. Repeat procedure for the right hand fuel tank.

**Refitment**

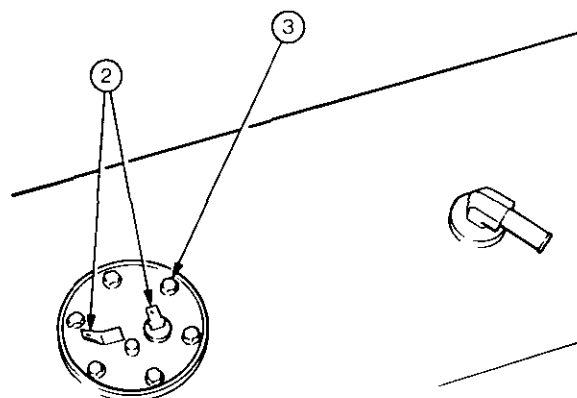
10. Reverse procedures 2 to 9.
11. Refit the drain plug after coating the threads with the recommended sealant, tightening the plug to a torque of 54-81 Nm (40-60 lbf ft).

FUEL GAUGE SENDER UNIT**Removal and Refitment**

4C-05-03

Removal

1. Drain the fuel tank via the drain plug.
2. Disconnect the wires to the sender unit.
3. Remove the six screws and washers.
4. Manoeuvre the sender unit out through the aperture in the tank.
5. Remove the sealant or the gasket.

**Refitment**

6. Replace the sealant (SILASTIC 732 RTV) or gasket.
7. Reverse procedures 2 to 4.
8. Refit the drain plug, the thread being coated with hydraulic sealant, and tighten to a torque of 54-81 Nm (40-60 lbf ft.)

THERMOSTART**Removal and Refitment**

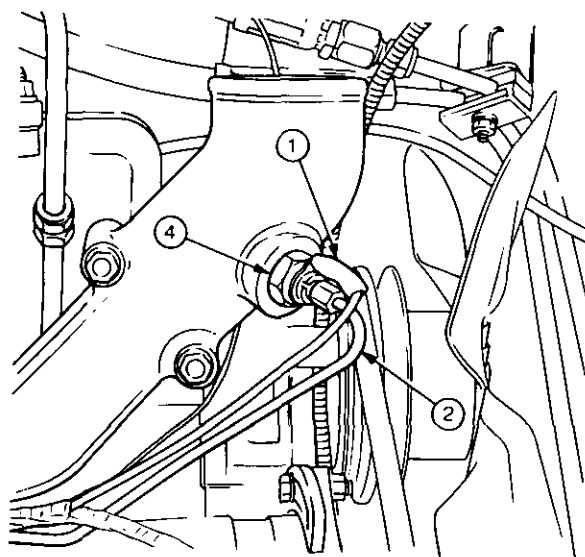
4C-06-03

Removal

1. Disconnect the electrical wire.
2. Disconnect the fuel pipe.
3. Blank off the open end of the fuel pipe.
4. Unscrew the unit from the manifold.

Refitment

5. Reverse procedures 3 and 4.
6. Refit the fuel pipe, but leave the union loose.
7. Operate the lift pump priming lever until air in the fuel pipe to the unit is eliminated.
8. Tighten the fuel pipe union.
9. Refit the electrical wire.



FUEL SYSTEM AND AIR CLEANER**FUEL LIFT PUMP****Removal and Refitment**

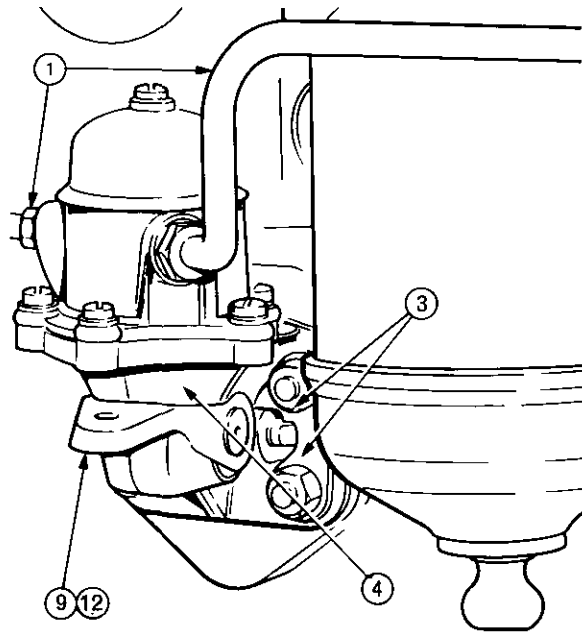
4C-07-04

Removal

1. Disconnect the two fuel pipes at the pump.
2. Blank off the open ends of the fuel pipes.
3. Remove the nuts and keeper plates securing the pump to the crankcase.
4. Remove the pump, manoeuvring the rocker arm through the aperture in the crankcase.
5. Remove the sealing gasket between the pump and the engine crankcase.

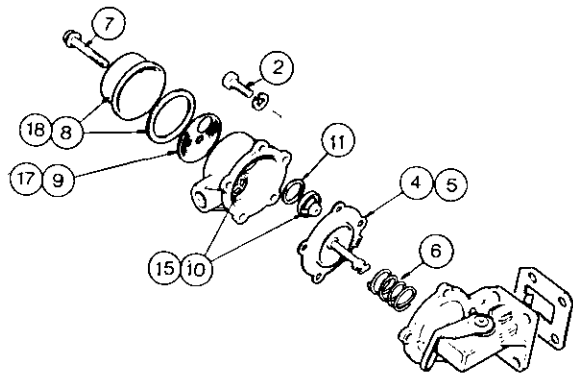
Refitment

6. Fit a new sealing gasket coated with Hylomar SQ 32M.
7. Reverse procedures 1 to 4.
8. Loosen the leak back union on the filter.
9. Operate the lift pump priming lever until air is eliminated.
10. Retighten the leak back union.
11. Loosen the thermostart fuel union.
12. Operate the lift pump priming lever until air is eliminated.
13. Retighten the thermostart fuel union.

**FUEL LIFT PUMP****Servicing**

4C-08-04

1. Make a file mark across the two flanges for guidance in re-assembly of the pump.
2. Remove the six screws and spring washers.
3. Separate the two halves of the pump.
4. Release the diaphragm by pushing it into the pump body and then turning it through 90 degrees.
5. Remove the diaphragm.
6. Withdraw the diaphragm spring.
7. Remove the pump cover retaining screw.
8. Remove the pump cover and seal.
9. Remove the gauze strainer, clean thoroughly in engine fuel, and then dry with compressed air.
10. Lever the two valves from their seats.
11. Remove the valve gaskets.
12. Examine the diaphragm spring, and replace if corroded or distorted.
13. Examine the flanges of the two pump halves for distortion and, if necessary, lightly linish to restore flatness.
14. Thoroughly clean the valve seats in the pump body and ensure that all previous stopping marks are removed.
15. Fit two new valves together with new gaskets to the valve body. The inlet valve must be fitted so that it opens to admit fuel to the pump chamber. The outlet valve must be fitted the opposite way round to the inlet valve.
16. Lock the valves in position by staking in six places with a suitable punch.
17. Refit the gauze strainer.
18. Refit the pump cover, together with a new sealing ring, and secure with the retaining screw.
19. Reverse procedures 2 to 6.



FUEL FILTER**Removal and Refitment**

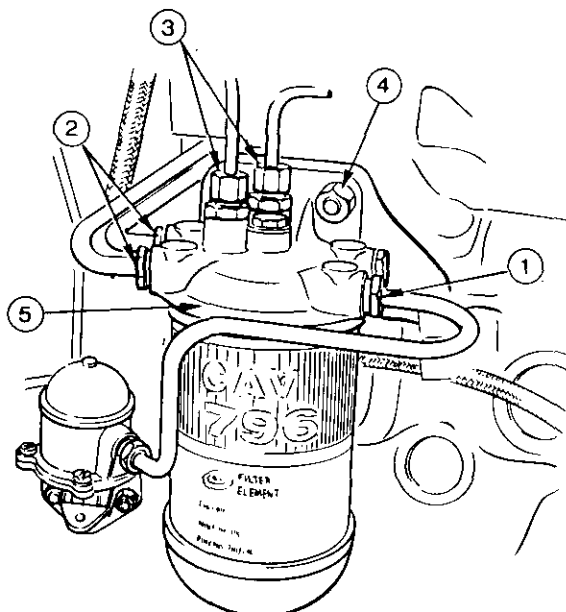
4C-09-05

Removal

1. Disconnect the lift pump input to the filter and blank off the open union.
2. Disconnect the two pipes to the fuel injection pump and blank off the open unions.
3. Disconnect the two pipes serving the injector leak-back system and the thermostart unit and blank off the open unions.
4. Remove the two nuts and the two washers.
5. Remove the filter unit.

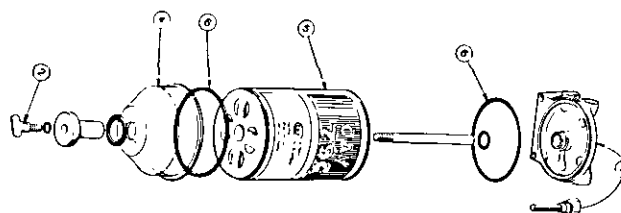
Refitment

6. Reverse procedures 1 to 5.
7. Bleed the fuel system, 4C-13-08.

**FUEL FILTER****Servicing**

4C-10-05

1. Clean the outside of the filter unit.
2. Drain the filter via the drain tap.
3. Remove the centre bolt.
4. Remove the bowl and carefully clean it.
5. Remove the filter element and discard it.
6. Check the condition of the seals.
7. Reassemble the filter unit with a new filter element, reversing procedures 3 to 5.
8. Bleed the fuel system, 4C-13-08.



FUEL SYSTEM AND AIR CLEANER

FUEL INJECTION PUMP

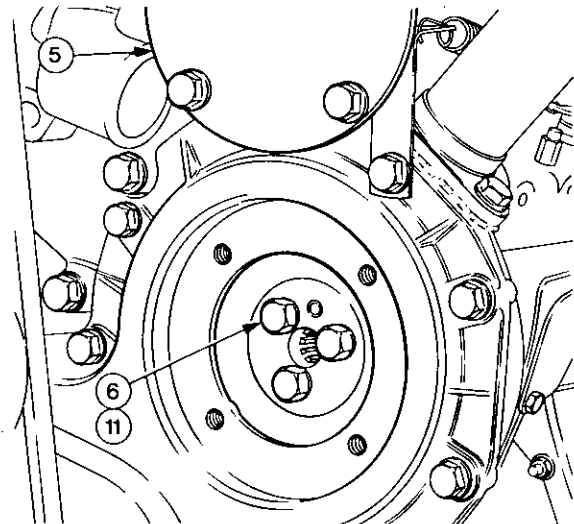
Removal and Refitment

4C-11-06

Removal

- NOTE:** (a) Unless the necessary equipment and experienced personnel are available, dismantling of the fuel injection pump must not be attempted.
- (b) Blank off the open ends of fuel pipes and unions with correctly fitted blanks.
- (c) Thoroughly clean all parts prior to dismantling.
- (d) To facilitate refitment of the fuel injection pump, a line should be scribed across the edge of the pump flange and on to the timing case.

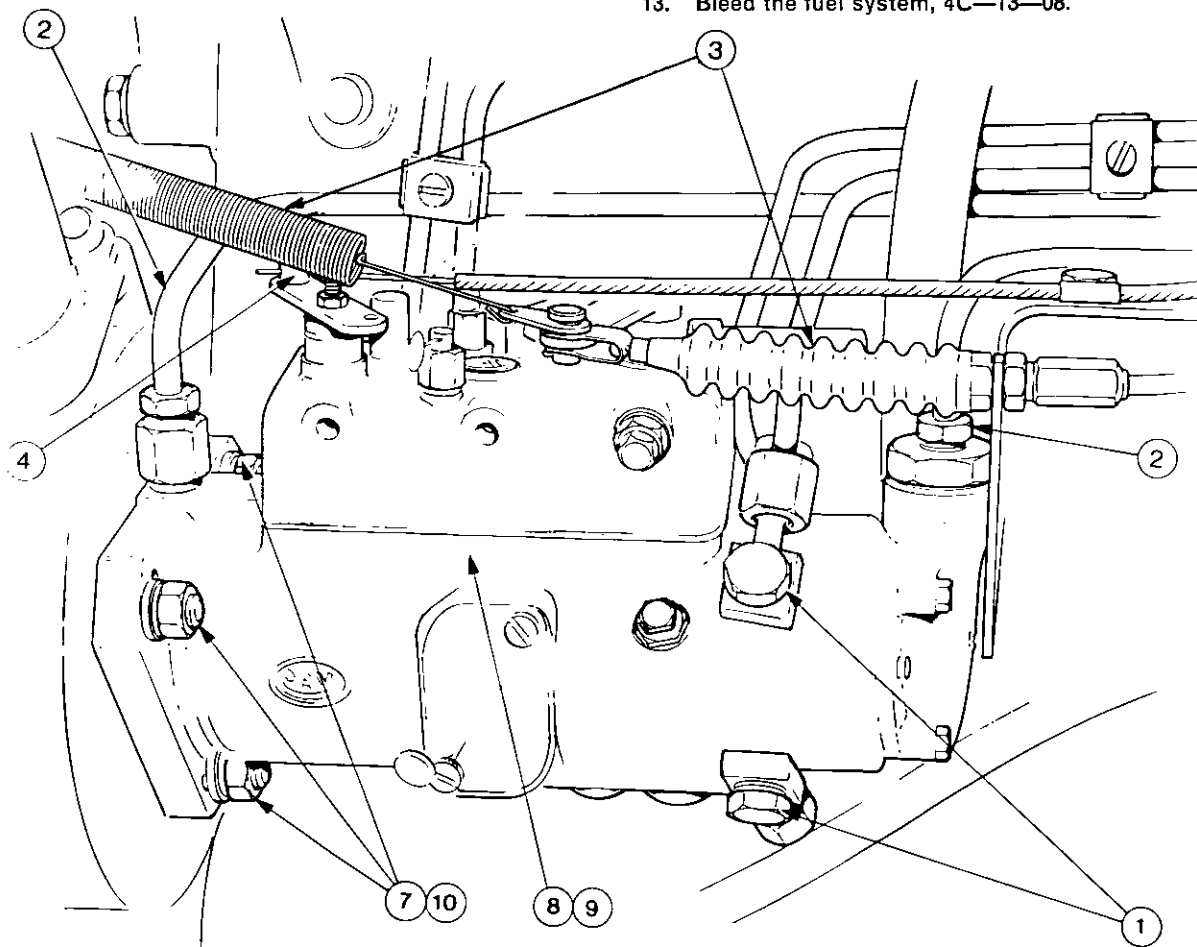
1. Remove the high-pressure fuel pipes.
2. Disconnect the two low-pressure fuel pipes.
3. Disconnect the throttle control cable and return spring.
4. Disconnect the fuel cut-off cable.
5. Remove the timing case front cover inspection plate.
6. Remove the three bolts and spring washers securing the fuel pump to the drive gear.
7. Remove the three nuts and spring washers securing the pump to the timing case.
8. Withdraw the fuel pump.



Refitment

- NOTE:** When fitting a new pump, it may be necessary to adjust the maximum and idling speeds.

9. Replace the fuel pump, ensuring that the slot in the pump hub is aligned with the dowel in the drive gear.
10. Position the pump so that the scribed line on the pump flange aligns with the mark on the timing case and secure with the three nuts and spring washers.
11. Secure the drive gear to the pump shaft with the three bolts and spring washers, ensuring that the dowel is properly located in its slot.
12. Reverse operations 1 to 5.
13. Bleed the fuel system, 4C-13-08.



FUEL INJECTORS**Removal and Refitment**

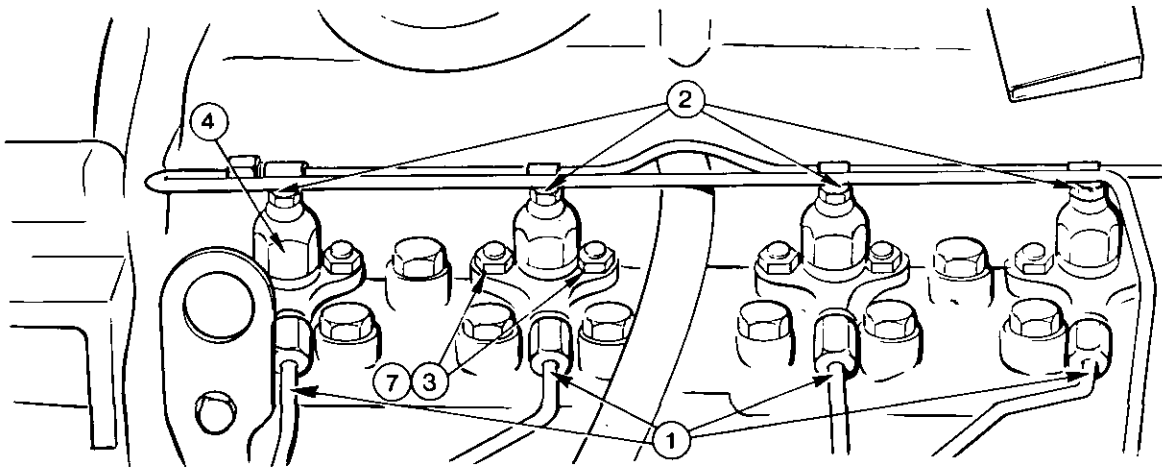
4C-12-07

Removal

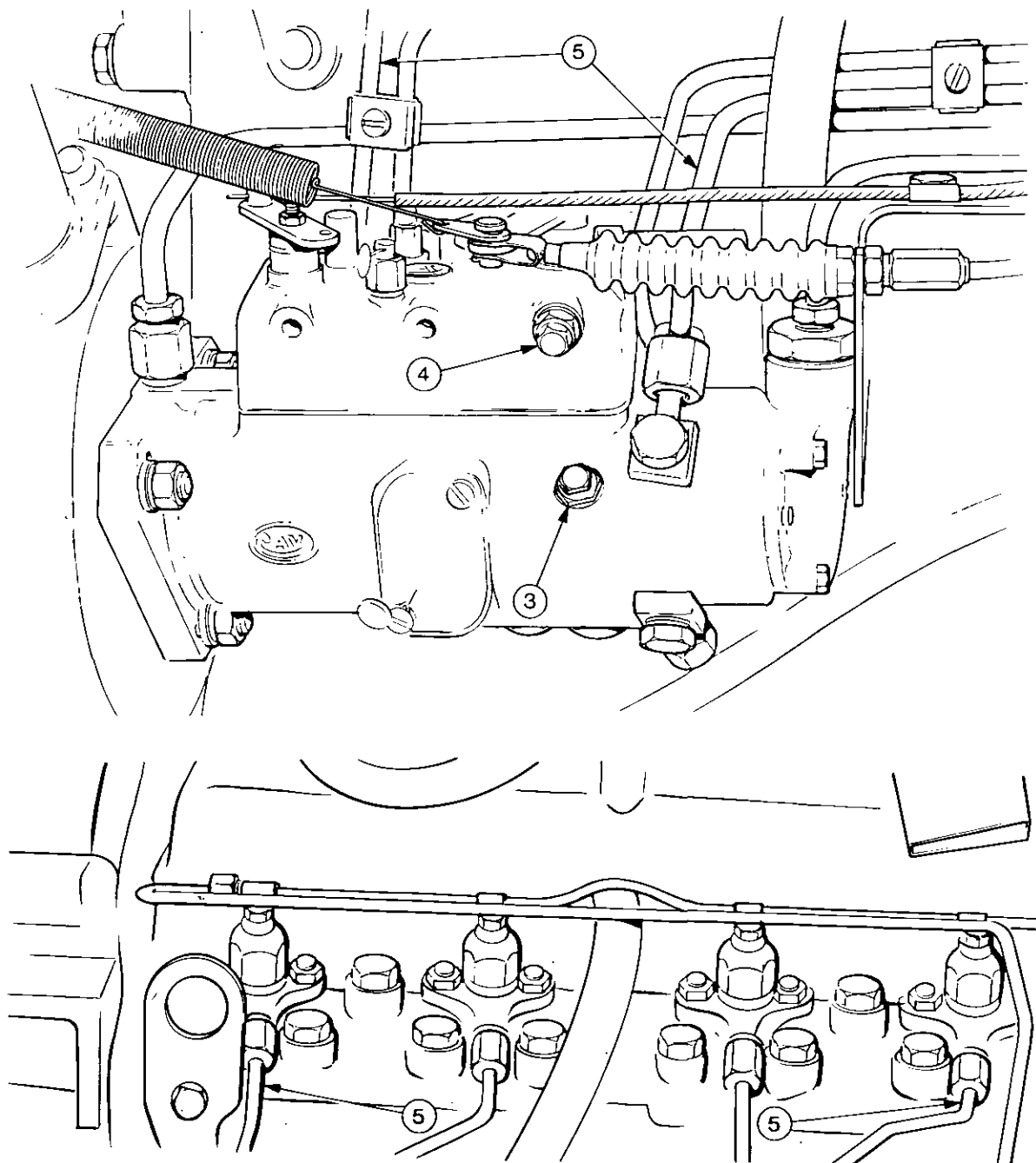
1. Disconnect the high-pressure fuel pipes at the injector unions and blank off the open ends.
2. Disconnect the leak-back system union at the head of each injector.
3. Remove the two nuts.
4. Withdraw the injector.

Refitment

5. Replace the copper seating washer at each injector.
6. Reverse procedures 3 and 4.
7. Tighten the two nuts to a torque of 16 Nm (12 lbf ft) in three equal stages.
8. Reverse procedures 1 and 2, but leave the unions for the high-pressure fuel pipes to No's. 1 and 4 injectors loose.
9. Bleed the high-pressure fuel pipes to the injectors by opening the throttle fully, ensuring that the fuel cut-off knob is pushed fully in and, then, turning the engine over with the starter until it begins to fire.
10. Retighten the unions at No's. 1 and 4 injectors as the case may be.



FUEL SYSTEM AND AIR CLEANER



FUEL SYSTEM DE-AERATION 4C-13-08

NOTE: (a) No attempt must be made to start the engine until the injection pump has been filled with fuel and the air removed, as serious damage can be caused to the pump due to lack of lubrication.

(b) The method detailed for the removal of air ensures that only fuel which has passed through the filter can reach the interior of the pump.

1. Slacken the outlet union on the fuel filter.
2. Operate the hand priming lever on the fuel lift pump until fuel, free of air bubbles, issues from the union, then retighten the union.
3. Slacken the lower vent plug on the fuel injection pump and operate the fuel lift pump until fuel, free of air bubbles, issues from the vent, then retighten the vent plug.
4. Slacken the upper vent plug on the fuel injection pump and operate the fuel lift pump until fuel, free of air bubbles, issues from the vent, then retighten the vent plug.
5. Slacken the unions at No's. one and four injectors.
6. Disconnect the thermostart fuel feed pipe at the thermostart and operate the fuel lift pump until fuel, free of air bubbles, issues from the pipe, then, reconnect the pipe.
7. Set the throttle fully open and ensure that the fuel cut-off knob is pushed fully in, then turn the engine over with the starter until the engine begins to start. Retighten the unions.

STATIC FUEL INJECTION PUMP TIMING**Adjustment Procedure** 4C—14—09
(Engines Fitted with Dowelled Pump Drive)

Special Tools: MS 67B Static Fuel Pump Timing Tool
PD 67B- Adaptor

Procedure

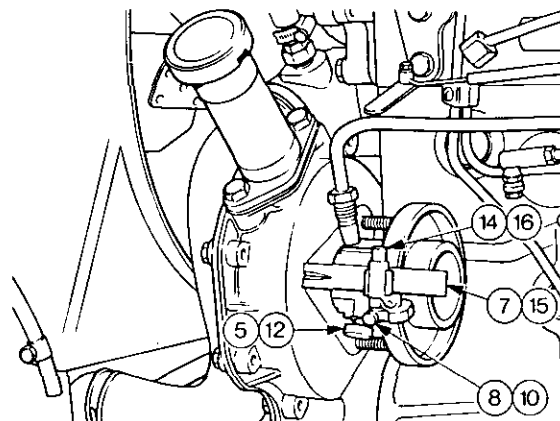
1. Rotate the engine crankshaft until the T.D.C. line on the flywheel is in line with the inspection hole, and No. 1 piston is at T.D.C. on the compression stroke (both valves fully closed).
2. Remove the fuel injection pump, operation 4C—11—06.
3. Fit adaptor PD 67B-1 to the fuel pump gear, locating the dowel in the slot and with the adaptor shaft facing rearwards.
4. Fit and tighten three set screws.
5. Slacken the screw on the timing tool, MS 67B.
6. Remove the splined shaft.
7. Check that the slotted pointer is positioned with slot at the front of the tool and the chamfered sides of the slot are facing outwards.
8. Slacken the bracket screw.
9. Set the bracket with the chamfered edge in line with the relevant engine checking angle. Refer to the chart on page 4C—14.
10. Retighten the bracket screw.
11. Push the fuel pump gear and adaptor rearwards, locating the splined shaft into the timing tool.

NOTE: It may be necessary to turn the timing tool to engage the master spline.

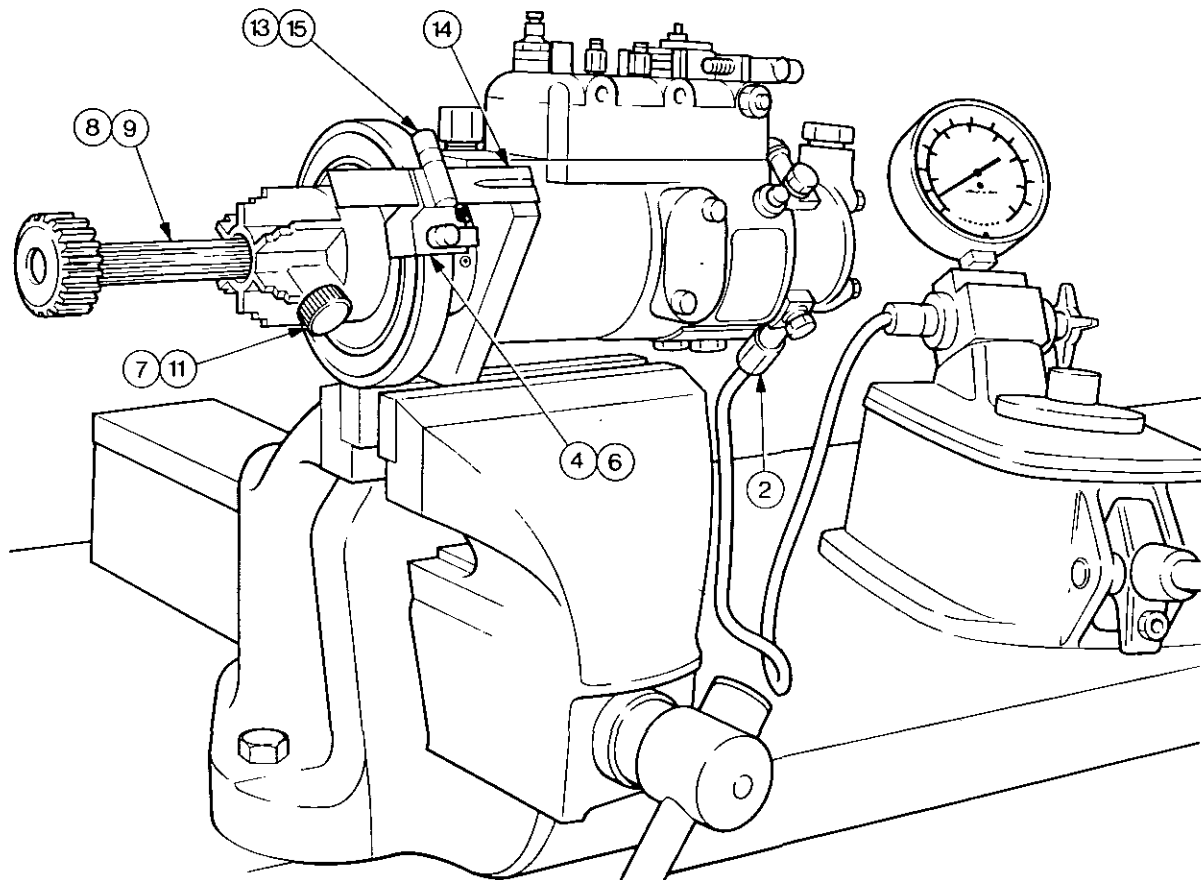
12. Tighten the screw on the timing tool.
13. Move the timing tool and gear forwards until the tool is located in the pump aperture of the timing case.
14. Slacken the screw.
15. Slide the slotted pointer forward until it abuts the rear face of the timing case.
16. Re-tighten the screw.
17. Take up any backlash, by turning the timing tool against the normal direction of pump rotation (shown on the pump nameplate).

NOTE: If the pointer is 180° from the timing mark, the engine is probably on the wrong stroke, remove the tool and reset the engine on the correct stroke.

18. Check that the timing mark is central in the slot of the pointer, if no mark exists scribe a radial line on the rear face of the timing case, outwards from the centre of the slot.
19. When the timing is correct, remove the tool.
20. Refit the fuel injection pump operation 4C—11—06.



FUEL SYSTEM AND AIR CLEANER



TO CHECK THE MARKING ANGLE OF FUEL INJECTION PUMP

Adjustment Procedure (Dowelled Fuel Pump Drive)

4C—15—10

Special Tool: MS67B Static Fuel Pump Timing Tool

Procedure

1. Remove the fuel injection pump, operation 4C—11—06.
2. Connect the No. 1 outlet of the fuel injection pump to an atomizer test rig and pump up to a maximum pressure of 30 atmospheres, 3,04 N/mm² (440 lbf/in²).

NOTE: Remove the pressurising valve, if fitted.

3. Check that the slotted pointer is positioned with the slot at the rear of the tool and the chamfered sides of the slot are facing outwards.
4. Slacken the bracket screw.
5. Set the bracket with the chamfered edge in line with the relevant marking angle. Refer to the chart on page 4C—13.

6. Re-tighten the bracket screw.
7. Slacken the screw on the timing tool, MS 67B.
8. Insert the splined shaft into the front of the timing tool.
9. Locate the end of the splined shaft into the hub of the fuel injection pump.
10. Slide the timing tool towards the pump until it abuts against the end of the hub.
11. Tighten the screw on the timing tool.
12. Turn the pump drive, in the normal direction of rotation until the pump locks.
13. Slacken the screw.
14. Slide the pointer rearward until it is halfway over the pump flange.
15. Tighten the screw.
16. Check that the timing mark is central with the slot in the pointer.

NOTE: If the original mark is not in line with the pointer, scribe a new line outwards from the centre of the slot.

17. Remove the timing tool from the pump.
18. Disconnect the pump from the atomizer.
19. Refit the fuel injection pump, operation 4C—11—06.

FOOT THROTTLE CABLE**Removal and Refitment**

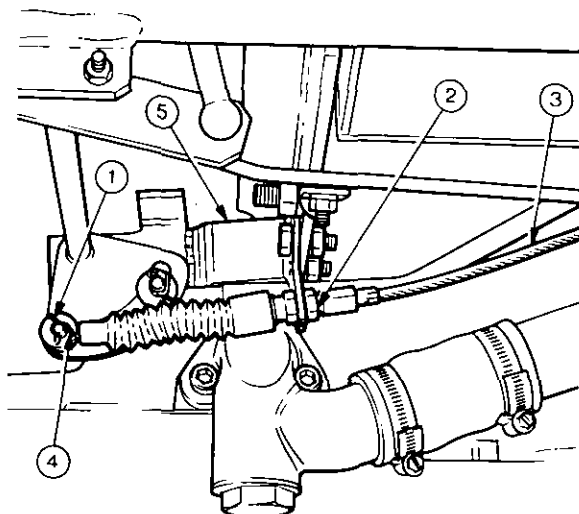
4C-16-11

Removal

1. From under the front right hand side of the cab floor, remove the split pin from the throttle cable pivot pin. Remove the washer, pivot pin and cable trunnion.
2. Slacken the cable locknut and remove the cable from slot in the bracket.
3. Pull the cable across to the left hand side of the engine from behind the engine.
4. Remove the split pin from the pivot pin on the injector pump operating lever. Remove the pivot pin taking care not to lose the lever return spring also fitted to the pivot pin.

Refitment

5. Reverse procedures 1 to 4.

**HAND THROTTLE LEVER AND LINKAGE****Removal and Refitment**

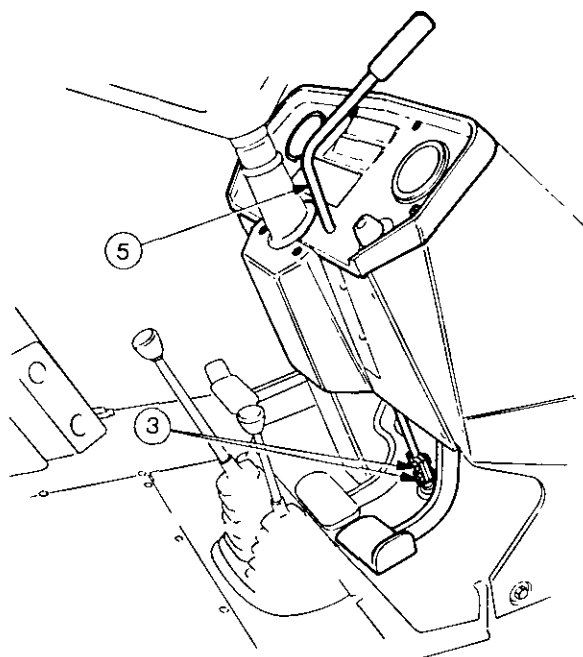
4C-17-11

Removal

1. From under the front right hand side of the cab floor, remove the split pin and washer from the end of the hand throttle connecting rod.
2. Peel back the toe board mat and remove the two nuts, bolts and washers securing the pivot bracket to the underside of the bulkhead.
3. Slacken the clamp bolts on the rod connector inside the cab.
4. Lift the bracket clear complete with linkage.
5. Pull the hand throttle lever through the steering wheel.

Refitment

6. Reverse procedures 1 to 5.



FUEL SYSTEM AND AIR CLEANER**THROTTLE CROSS-SHAFT AND BRACKETS****Removal and Refitment 4C—18—12****Removal**

1. Remove the foot throttle cable. Operation 4C—16—11 procedures 1 to 4.
2. Remove the hand throttle connecting rod. Operation 4C—17—11 procedure 1.
3. From under the front right hand side of the cab floor, remove the two bolts, nuts and washers that secure the pivot bracket to the underside of the cab floor.
4. Remove the nut and washer securing the operating rod from the foot throttle lever, to the cross shaft lever. Pull the rod clear.
5. Remove the two nuts and washers securing the cross shaft bracket to the cab floor right hand longitudinal member.
6. Remove the cross-shaft brackets complete.

Refitment

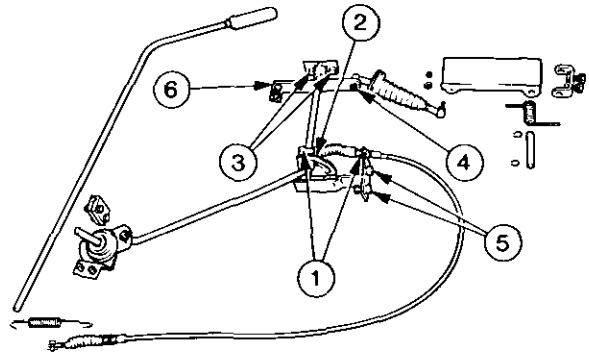
7. Reverse procedures 1 to 6.

FUEL CUT-OFF CABLE**Removal and Refitment 4C—19—12****Removal**

1. Loosen cable clamp screw on fuel cut-off lever on top of the inspection pump.
2. Loosen jam nut that locks the cable outer sleeve to the bracket fitted on the rear of the injection pump.
3. Remove the switch panel inside the cab.
4. Remove the jam nut from the rear of the "Pull to Stop" knob.
5. From inside the cab, pull the cable through, taking care not to lose the wedge shaped spacers, washers and nut.

Refitment

6. Reverse procedures 1 to 5.



FOOT THROTTLE PEDAL**Removal and Refitment**

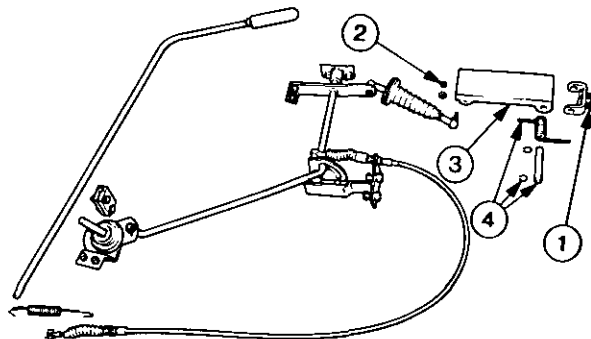
4C-20-13

Removal

1. From underneath the front of the cab floor, remove the two nuts and washers securing the pivot bracket to the floor.
2. At the front of the pedal remove the nut and washer from the end of the connecting rod.
3. Lift the pedal clear.
4. Remove the circlip from the end of the pivot pin and push pin through the spring.

Refitment

5. Reverse procedures 1 to 4.



FUEL SYSTEM AND AIR CLEANER

ENGINE CHECKING AND FUEL PUMP MARKING ANGLES

The angles at which the engine timing marks are set or checked and the fuel pump flanges are marked can be found by reference to the setting code on the fuel pump and tables given below. In most cases, the first two letters and figures of the code are sufficient, but, where necessary, the full code is given.

ENGINE TYPE	FUEL PUMP SETTING CODE	ENGINE CHECKING ANGLE (Degrees)	FUEL PUMP MARKING ANGLE (Degrees)
4. 236	AS 62	279	292
	BS 44	281	296
	BS 49	281	292
	BS 54	281	292
	BS 62	281	292
	BS 64	281	292
	LS 43	284½	296
	LS 44	281	296
	LS 45	284½	296
	LS 49	284½	296
	LS 50	284½	296
	LS 52	284½	296
	LS 55	284½	296
	LS 57 (rated below 2160 rev/min)	284½	296
	LS 57 (rated above 2160 rev/min)	238½	296
	LS 61	284½	296
	LS 62	283½	296
	LS 63	284½	296
	LS 66	281	292
	LS 67	284½	296
	MS 67	279	292
	PS 45	281	292
	PS 48	281	292
	PS 51	281	292
	PS 54	281	292
	PS 55	283	292
	PS 61 (exceptions below)	281	292
	PS 61/850/4/3120	280½	292
	PS 61/850/7/3120	280½	292
	PS 61/850/9/2400	280½	292
	PS 62	281	292
	PS 66	281	292
	WS 62	280	292
	WS 66	280	292
4. 248	SS 64	285	297
	SS 66	285	297
	SS 68	285	297
	TS 59	281	292
	TS 65	281	292
	TS 67 (exceptions below)	281	292
	TS 67/850/2/2480	285	292
	TS 67/850/6/2700	285	292
	TS 72	281	292
	XS 60E	281	293
4. 318.2	SD 90	13	21

**MF 600 SERIES TRACTOR
WORKSHOP SERVICE MANUAL**

PART 5

Publication No. 1856 274 M1

comprising

- A CLUTCH (DUAL AND SPLIT TORQUE)
- B TRANSMISSIONS

DUAL CLUTCH (12 in 305 mm)**Part 5 - Section A**

Operation Number	Table of Contents	Page Number
	GENERAL	01
	Operation	02
	FAULT FINDING	03
	MAIN FRICTION DISC OR CLUTCH ASSEMBLY	04
5A-01-04	Removal and Refitment	
	CLUTCH PEDAL	
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	CLUTCH ASSEMBLY	06
5A-03-06	Servicing	
	CLUTCH RELEASE BEARING	07
5A-04-07	Removal and Replacement	

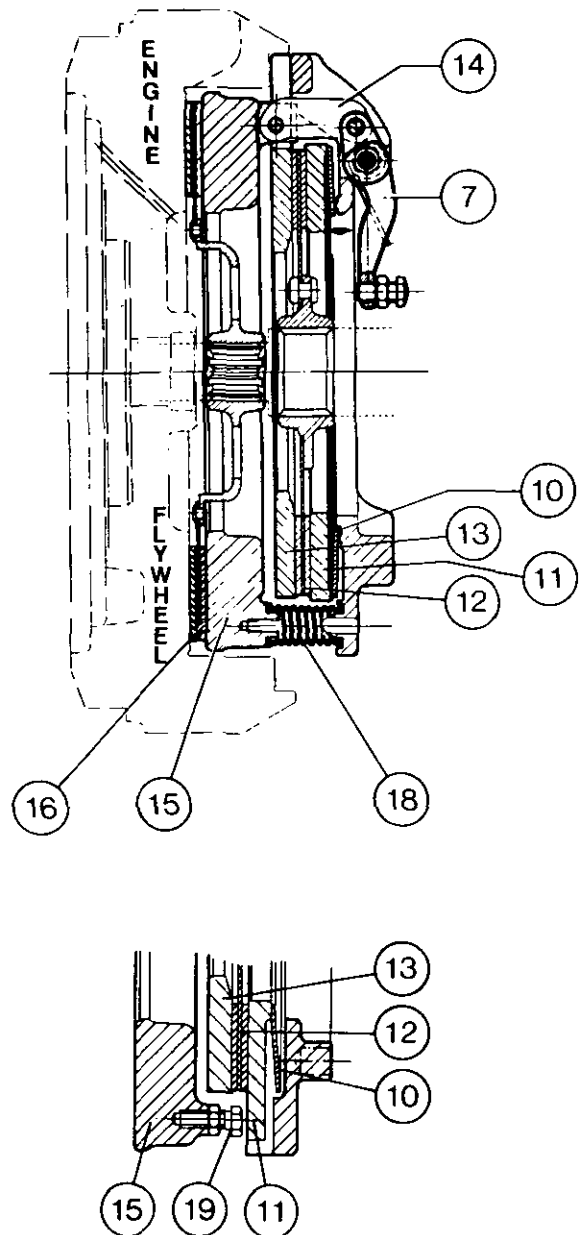
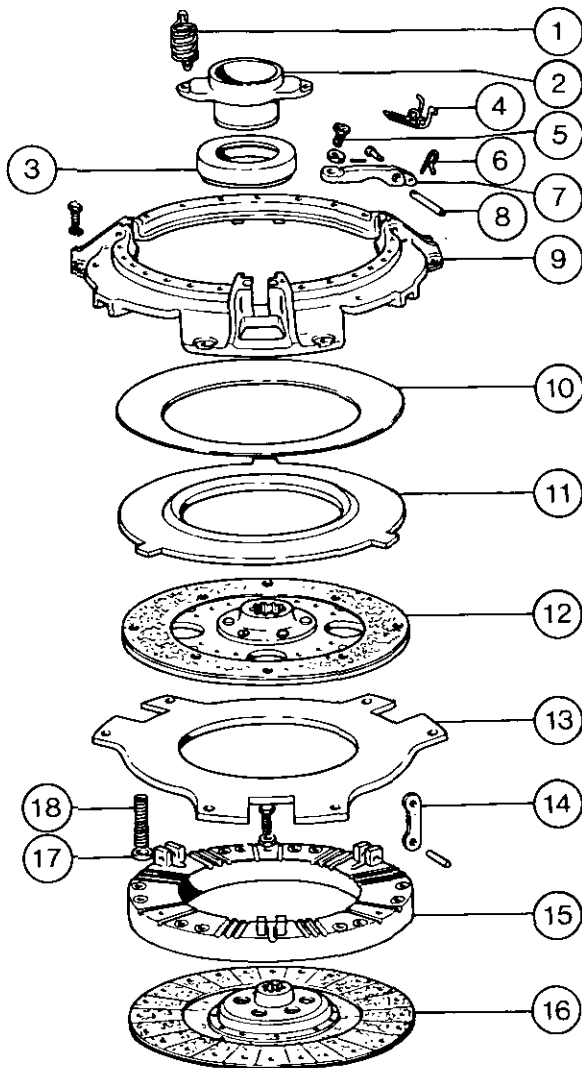
GENERAL

The Dual Clutch assembly consists of a main 305 mm (12 in) friction disc driving the main transmission input shaft, and a p.t.o. 245 mm (10 in) friction disc driving the p.t.o. input shaft. This allows the main transmission drive to be disconnected without interrupting the drive to the p.t.o. and hydraulic pump. The clutch is operated by a single pedal having two stages of operation.

DUAL CLUTCH

KEY TO FIGURES 1 and 2

1 Spring	10 Belleville Spring Disc
2 Carrier	11 P.t.o. Pressure Plate
3 Bearing	12 P.t.o. Friction Disc
4 Spring	13 False Flywheel
5 Setscrew	14 Connecting Links
6 Clip	15 Main Pressure Plate
7 Release Levers	16 Main Friction Disc
8 Pin	17 Washer
9 Cover Plate	18 Springs

**Operation**

During operation the main friction disc (16) is held against the engine flywheel by the main pressure plate (15) under the influence of twelve coil springs (18). The p.t.o. friction disc (12) is held against a false flywheel (13) by the p.t.o. pressure plate (11) under the influence of a belleville spring disc (10).

Initial movement of the clutch pedal rotates a cross-shaft which slides a release bearing into contact with three release levers (7). The release levers (7) pivot on the cover plate (9) and via connecting links (14) withdraw the main pressure plate (15) rearwards compressing the coil springs (18). This action releases the main friction disc (16).

Further downward movement of the clutch pedal will continue to withdraw the main pressure plate (15) still further until the three setscrews (19) attached to the main pressure plate (15) contact the p.t.o. pressure plate (11). The belleville spring (10) is then compressed by the action of the p.t.o. pressure plate (11) which releases the p.t.o. friction disc (12). When the clutch pedal is released the pressure plates return under the action of their respective spring mechanisms.

FAULT FINDING

<i>Sympton</i>	<i>Cause</i>	<i>Remedy</i>
Clutch will not release	Oil or grease on friction plate	Install new friction plate.
	Improper pedal adjustment	Adjust clutch pedal free travel and linkage.
	Damaged pressure plate on clutch cover	Replace defective part.
	Friction plate hub binding on splined drive pinion	Clean up splines and smear with small quantity of Mobilgrease Super
	Distorted friction plate Broken facings on friction plate	Install new friction plate
	Dirt or foreign matter in the clutch	Remove clutch from flywheel and clean with dry rag. See that all working parts are free.
Clutch slip	Oil or grease on friction plate	Install new friction plate.
	Weak or soft pressure springs	Install new set of pressure springs
	Binding of clutch pedal mechanism preventing its full return to stop	Free bearings. (NOTE: The clutch shaft bearings in the transmission case are self-lubricating. Oil or grease should not be applied).
	Improper pedal adjustment preventing full engagement	Correct pedal adjustment
	Clutch facing worn	Install new friction plate.

DUAL CLUTCH**MAIN FRICTION DISC OR CLUTCH ASSEMBLY****Removal and Refitment**

5A-01-04

Special Tools: MF 159A Clutch Centraliser
 MF 215 P.t.o. Clutch Setting Gauge
 MF 314 Lever Height Setting Gauge

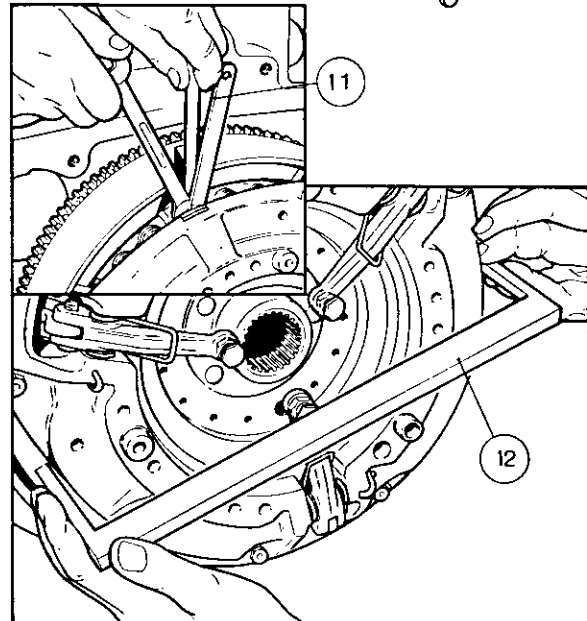
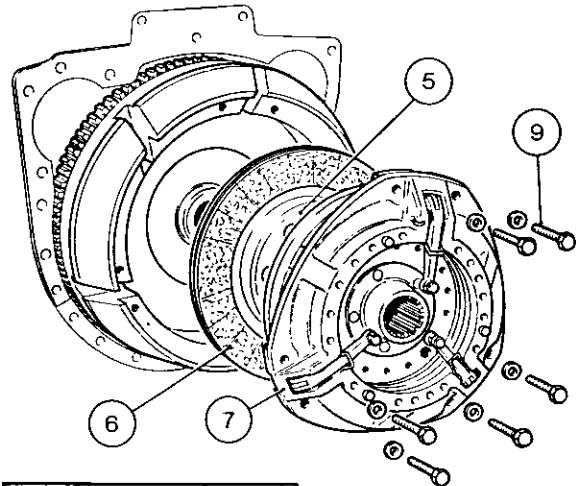
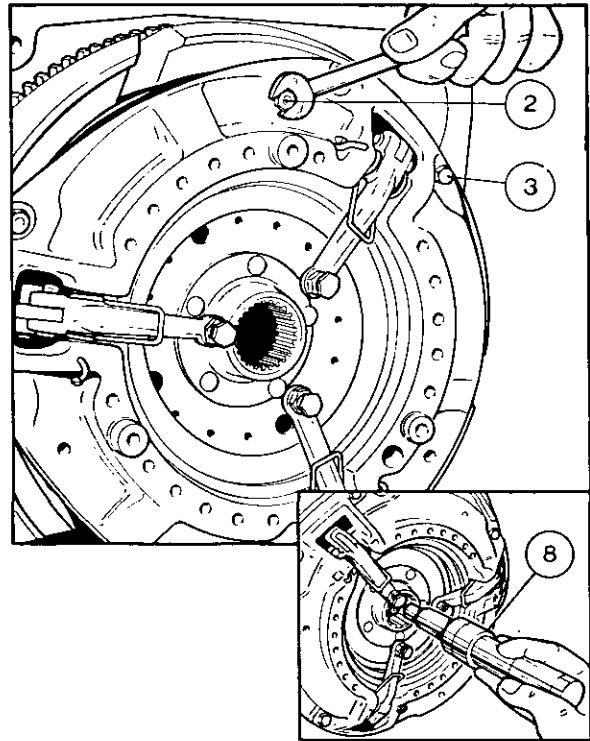
WARNING: The following sequence of instructions must be followed carefully, as spring pressure will cause the clutch cover to fly apart if pressure is not released slowly and evenly.

Removal

1. Split the tractor between the engine and the transmission, Part 3A.
2. Fit three slave bolts $\frac{1}{4}$ in UNC \times 54 mm ($2\frac{1}{8}$ in) to the three equi-spaced holes in the clutch cover.
3. Progressively slacken and remove the six bolts and washers.
4. Lift the clutch assembly clear of the flywheel. The main friction disc will remain separate from the clutch assembly.

Refitment

5. Lightly lubricate the splines of the friction disc with Mobilgrease Super.
6. Fit the main friction disc onto the flywheel.
7. Position the clutch assembly onto the flywheel.
8. Using MF 159A, centralise the clutch and the main friction disc.
9. Refit the six bolts and washers.
10. Remove the three slave bolts and then remove MF 159A.
11. Using MF 215, check the clearance between the p.t.o. clutch adjusting setscrew and the p.t.o. pressure plate. Adjust the setscrews as required. Re-tighten the locknuts.
12. Using MF 314, check the adjustment of each release lever. The domed end of the release lever setscrew must be just touching the gauge. Adjust the setscrews as required and re-tighten the locknuts.
13. Connect the engine to the rear half of the tractor, Part 4A.
14. Adjust the clutch pedal free travel, operation 5A-02-05 or 5A-03-05 or 5A-04-06.

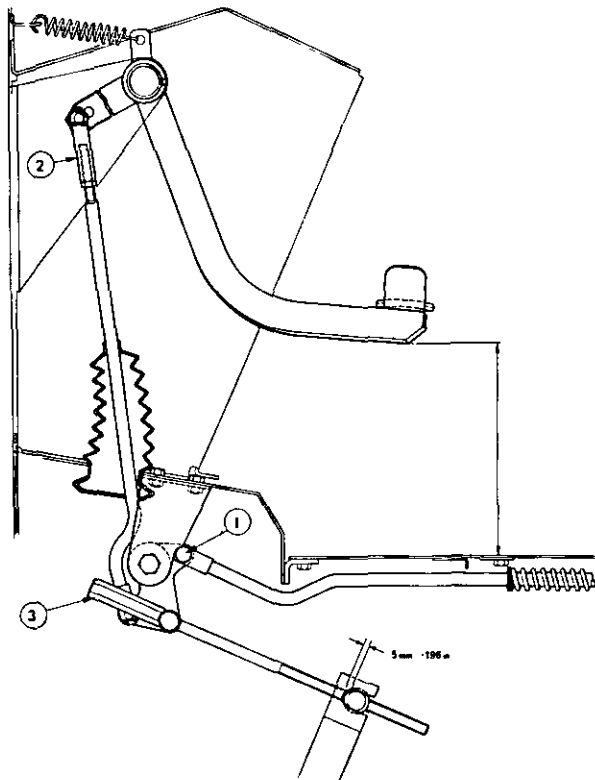


CLUTCH PEDAL**(Height and release bearing free play)****Adjustment****5A-02-05**

1. Ensure that the stop pin is in contact with the bell crank lever support bracket.
2. Adjust clevis until 210 mm (8¼ in) is obtained.

NOTE: Dimension is measured from the underside of the pedal to the cab floor

3. Adjust the screw rod until there is 5 mm (.196 in) free play.
4. Press the clutch pedal down through to full travel five times, recheck if necessary.



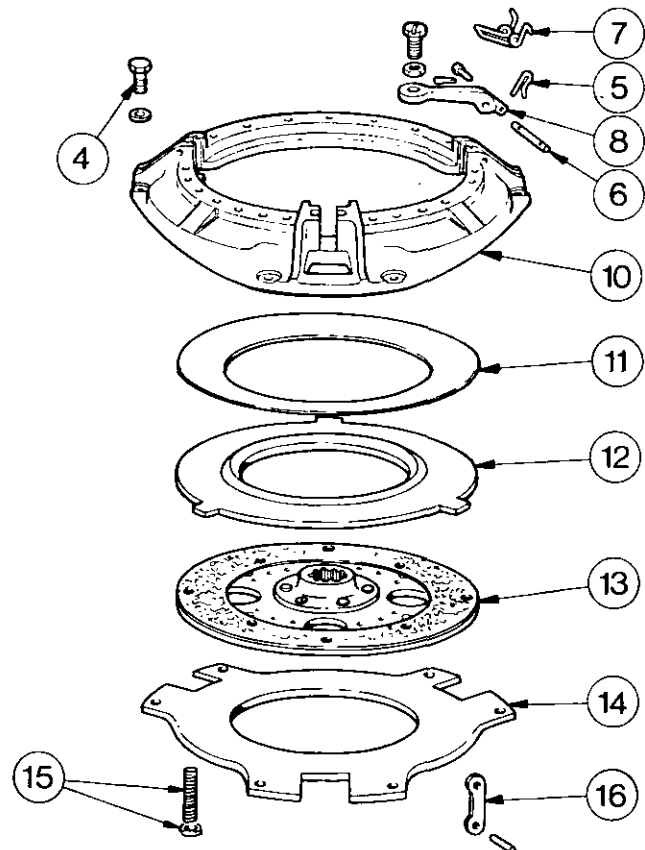
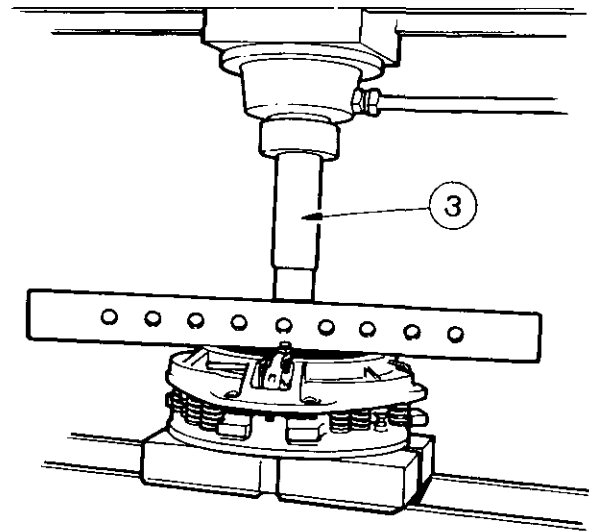
DUAL CLUTCH**CLUTCH ASSEMBLY****Servicing**

5A-03-06

Special Tools: MF 159A Clutch Centraliser
 MF 215 P.t.o. Clutch Setting Gauge
 MF 314 Lever Height Setting Gauge
 Hydraulic Press

Disassembly

1. Remove the clutch assembly, operation 5A-01-04.
2. Mark all following components to permit their refitment in the same relative positions:
 - Cover plate
 - P.t.o. pressure plate
 - False flywheel
 - Main pressure plate
3. Place the clutch assembly on the hydraulic press and locate a suitable bar.
4. Apply pressure until the three $\frac{1}{2}$ in slave bolts can be easily removed.
5. Remove the retaining clips.
6. Remove the pivot pins.
7. Remove the lever springs.
8. Disconnect the release levers from the links.
9. Slowly release the pressure from the press until the springs are out of compression.
10. Lift off the cover plate.
11. Lift off the belleville spring.
12. Lift off the p.t.o. pressure plate.
13. Lift off the p.t.o. friction disc.
14. Lift off the false flywheel.
15. Remove the 12 springs and the fibre washers.
16. Remove the links.

**EXAMINATION**

Inspect all components for wear, scoring, cracks, distortion or signs of overheating. Check the coil springs and the belleville spring for correct loading and pressures as given in the Specification Section. If the tractor flywheel is scored, skimming is permissible in 0,254 mm (0.010 in) increments up to a maximum of 1,00 mm (0,040 in).

The ledge to which the clutchcover is bolted must be skimmed by the same amount to maintain the distance from the clutch face to 39,75 to 39,62 mm (1.565 to 1.560 in).

WARNING: Never under any circumstances, skim either the false flywheel or the pressure plates as this will severely impair their heat dissipation characteristics.

Reassembly

17. Reverse procedures 1 to 16 except:
 - Fit new friction discs and 12 fibre washers.

CLUTCH RELEASE BEARING**Removal and Replacement**

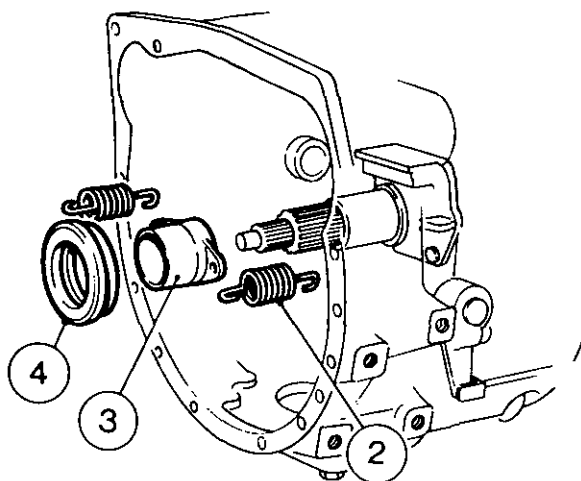
5A-04-07

Removal

1. Split the tractor between the engine and the transmission, Part 4A.
2. Release the two springs.
3. Remove the bearing and carrier assembly.
4. Drive out the carrier from the bearing.

Replacement

5. Reverse procedures 1 to 4 except:
 - (a) Press a new bearing onto the carrier.
 - (b) Lightly lubricate the splines of the carrier with Mobilgrease Special.



SPLIT TORQUE CLUTCH 12 in (305 mm)**Part 5 — Section A**

Operation Number	Table of Contents	Page Number
	GENERAL	12
	Operation	12
	FAULT FINDING	13
	FRICTION DISC OR CLUTCH ASSEMBLY	14
5A-11-14	Removal and Refitment	
	CLUTCH PEDAL	
5A-12-15	Adjustment (MF 675/690 Tractors)	15
	CLUTCH ASSEMBLY	16
5A-13-16	Servicing	
	CLUTCH RELEASE BEARING	17
5A-14-17	Removal and Replacement	

SPLIT TORQUE CLUTCH**GENERAL**

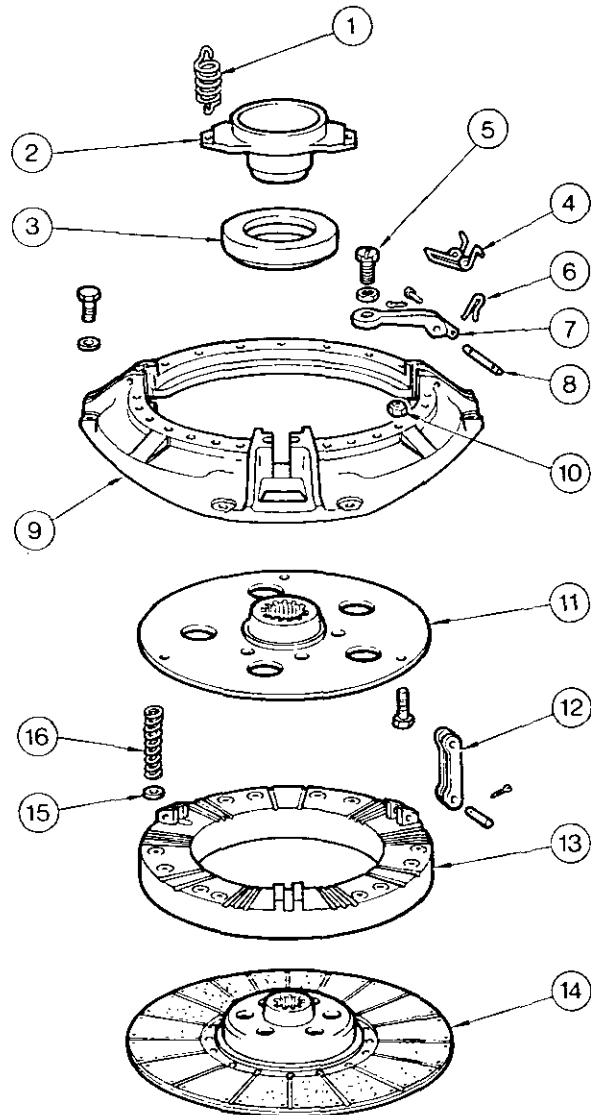
The Split Torque Clutch consists of a 305 mm (12 in) friction disc driving the transmission main input shaft and a plate having a splined boss which engages the p.t.o. input shaft. This allows the main transmission drive to be disconnected without interrupting the drive to the hydraulic pumps and p.t.o. shaft. When the main transmission drive is stopped, driven implements can still be operated and; raised and lowered by the hydraulic system

Operation

The friction disc (14) is operated by the pressure plate (13) against the flywheel. Pressure plate movement is obtained by three release levers (7), pivoted on the clutch cover plate (9). Release lever movement operating against the twelve coil springs (16), moves the pressure plate (13), rearwards and releases the friction disc (14). The clutch release levers (7) are operated by a release bearing (3) which is moved by the clutch pedal.

KEY TO FIGURE 1

- | | |
|------------------|-------------------|
| 1 Spring | 9 Cover Plate |
| 2 Carrier | 30 Nut |
| 3 Bearing | 11 P.t.o. plate |
| 4 Spring | 12 Link |
| 5 Screw | 13 Pressure Plate |
| 6 Retaining Clip | 14 Friction Disc |
| 7 Levers | 15 Washer |
| 8 Pin | 16 Springs |



SPLIT TORQUE CLUTCH**FAULT FINDING**

<i>Symptom</i>	<i>Cause</i>	<i>Remedy</i>
Clutch will not release	Oil or grease on friction plate	Install new friction plate.
	Improper pedal adjustment	Adjust clutch pedal free travel and linkage.
	Damaged pressure plate on clutch cover	Replace defective part.
	Friction plate hub binding on splined drive pinion	Clean up splines and smear with small quantity of Mobilgrease Super
	Distorted friction plate Broken facings on friction plate	Install new friction plate
	Dirt or foreign matter in the clutch	Remove clutch from flywheel and clean with dry rag. See that all working parts are free.
Clutch slip	Oil or grease on friction plate	Install new friction plate
	Weak or soft pressure springs	Install new set of pressure springs
	Binding of clutch pedal mechanism preventing its full return to stop.	Free bearings. (NOTE: The clutch shaft bearings in the transmission case are self-lubricating. Oil or grease should not be applied).
	Improper pedal adjustment preventing full engagement	Correct pedal adjustment
	Clutch facing worn	Install new friction plate

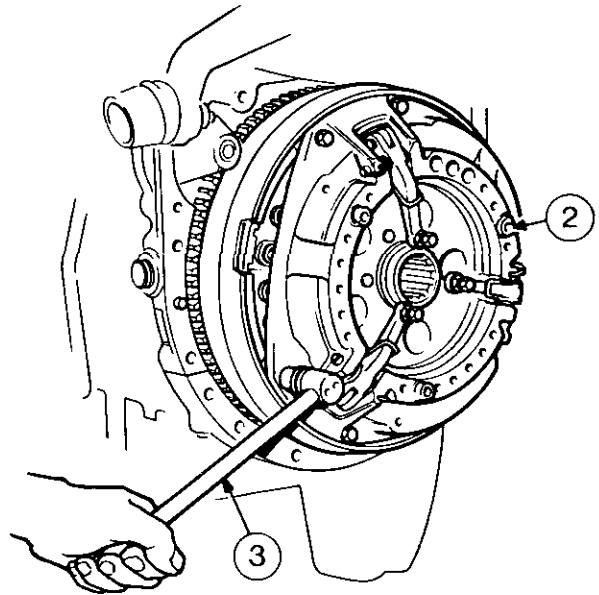
SPLIT TORQUE CLUTCH**FRICITION DISC OR CLUTCH ASSEMBLY****Removal and Refitment** 5A-11-14

Special Tools: MF 159A Clutch Centraliser
MF 314 Lever Height Setting Gauge

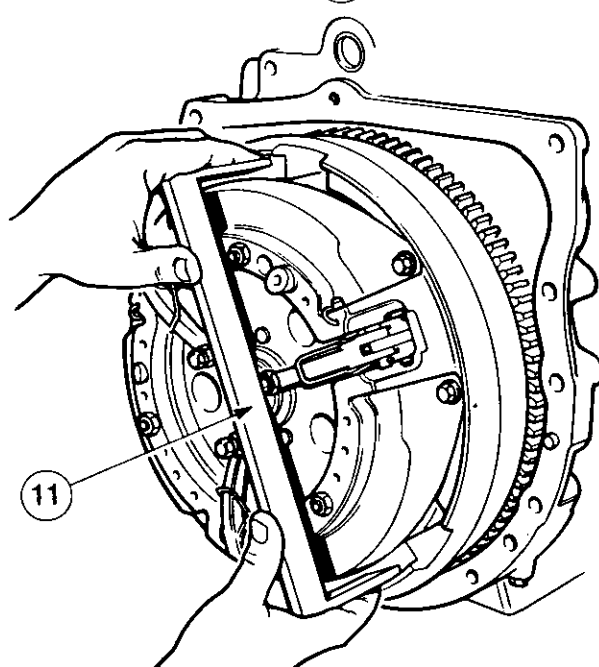
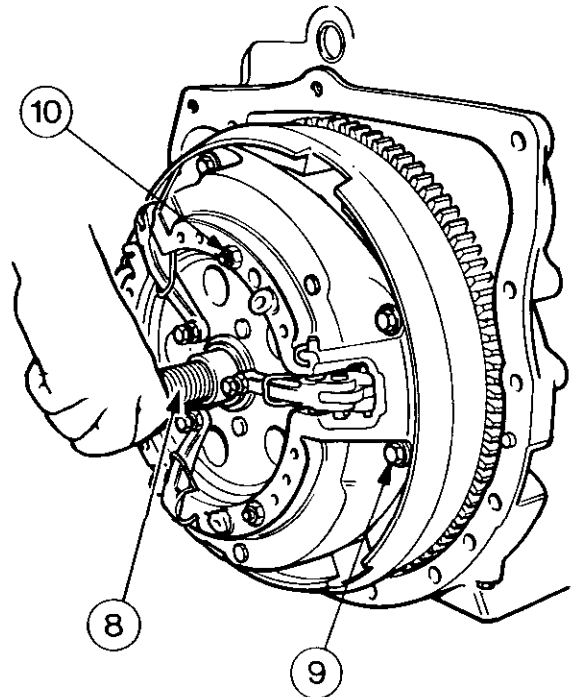
WARNING: The following sequence of instructions must be followed carefully, as spring pressure will cause the clutch cover to fly apart if pressure is not released slowly and evenly.

Removal

1. Split the tractor between the engine and the transmission, Part 3A.
2. Fit three slave bolts $\frac{1}{2}$ in UNC \times 54 mm ($2\frac{1}{8}$ in) to the three equi-spaced holes in the clutch cover.
3. Progressively slacken and remove the six bolts and washers.
4. Lift the clutch assembly clear of the flywheel. The friction disc will remain separate from the clutch assembly.

**Refitment**

5. Lightly lubricate the splines of the friction disc with Mobilgrease Super.
6. Fit the friction disc onto the flywheel.
7. Position the clutch assembly onto the flywheel.
8. Using MF 159A, centralise the clutch assembly and the friction disc.
9. Refit the six bolts and washers.
10. Remove the three slave bolts and then remove MF 159A.
11. Using MF 314, check the adjustment of each release lever. The domed end of the release lever set screw must be just touching the gauge. Adjust the setscrews as required and retighten the locknut.
12. Connect the engine to the rear half of the tractor, Part 4A.
13. Adjust the clutch pedal free travel, operation 5A-12-15 or 5A-13-15 or 5A-14-16.

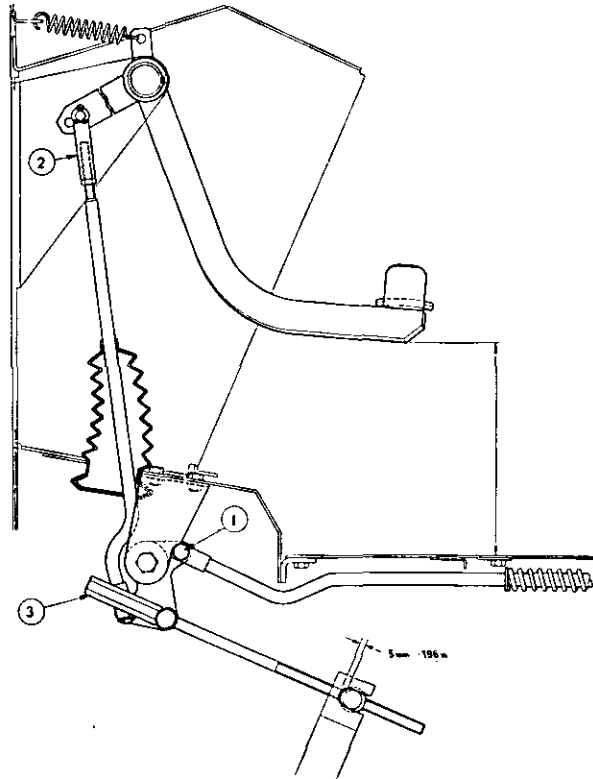


CLUTCH PEDAL**(Height and release bearing free play)****Adjustment****5A-12-15**

1. Ensure that the stop pin is in contact with the bell crank lever support bracket.
2. Adjust the clevis until 160 mm (6- $\frac{3}{8}$ in) is obtained

NOTE: Dimension is measured from the underside of the pedal to the cab floor.

3. Adjust the screw rod until there is 5 mm (.196 in) free play.
4. Press the clutch pedal down through its full travel five times, recheck if necessary.



SPLIT TORQUE CLUTCH**CLUTCH ASSEMBLY****Servicing**

5A-13-16

Special Tools: MF 159A Clutch Centraliser
MF 314 Level Height Setting Gauge
Hydraulic Press

Disassembly

1. Remove the clutch assembly, operation 5A-11-14.
2. Place the clutch assembly on the hydraulic press and locate a suitable bar.
3. Apply pressure until the three $\frac{1}{4}$ in slave bolts can be easily removed.
4. Removing the retaining clips.
5. Remove the pivot pins.
6. Remove the lever springs.
7. Disconnect the release levers from the links.
8. Slowly release the pressure from the press until the springs are out of compression.
9. Lift off the cover plate assembly.
10. Remove the 12 springs and the fibre washers.
11. Remove the links.
12. Remove the three bolts and nuts.
13. Remove the p.t.o. plate.

Examination

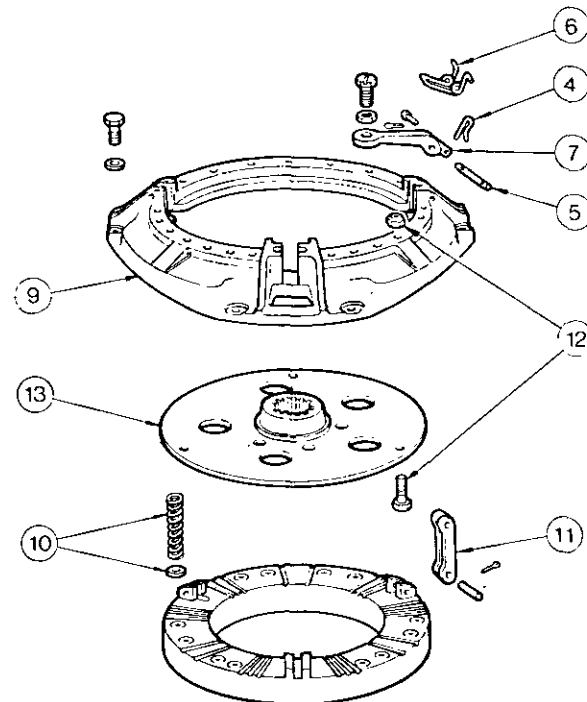
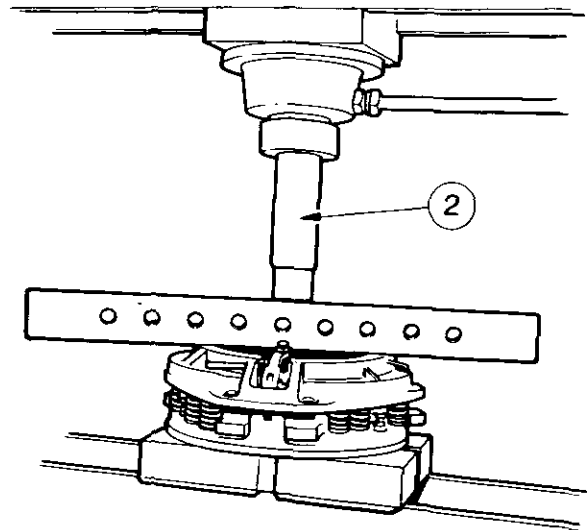
Inspect all components for wear, scoring, cracks, distortion or signs of overheating. Check the coil springs for correct loading and pressures as given in the Specification Section.

If the tractor flywheel is scored, skimming is possible in 0,254 mm (0.010 in) increments up to a maximum of 1,00 mm (0.040 in). The ledge to which the clutch cover is bolted must be skimmed by the same amount to maintain the distance from the clutch face to 39,75 to 39,62 mm (1.565 to 1.560 in).

Warning: Never under any circumstances, skim the pressure plate as this will severely impair its heat dissipation characteristics.

Reassembly

14. Reverse procedures 1 to 13 except:
Fit a new friction disc and 12 fibre washers.



CLUTCH RELEASE BEARING**Removal and Replacement**

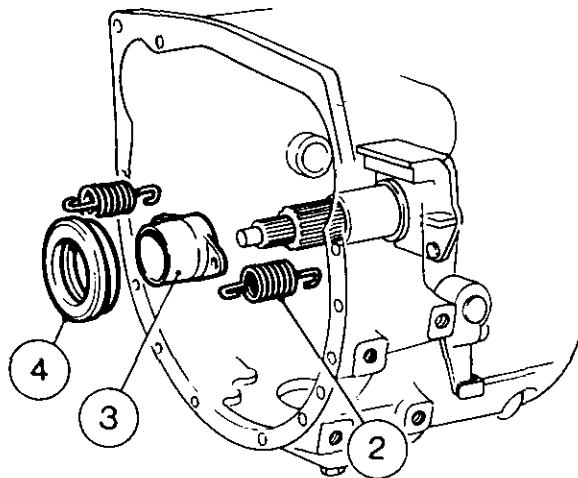
5A-14-17

Removal

1. Split the tractor between the engine and the transmission, Part 4A.
2. Release the two springs.
3. Remove the bearing and carrier assembly.
4. Drive out the carrier from the bearing.

Replacement

5. Reverse procedures 1 to 4 except:
 - (a) Press a new bearing onto the carrier.
 - (b) Lightly lubricate the spline of the carrier with Mobilgrease Special.



SPLIT TORQUE CLUTCH (13 in 330 mm)**Part 5 — Section A**

Operation Number	Table of Contents	Page Number
	GENERAL	22
	Operation	22
	FAULT FINDING	23
	FRICTION DISC OR CLUTCH ASSEMBLY	24
5A—01—24	Removal and Refitment	.
	CLUTCH ASSEMBLY	25
5A—02—25	Servicing	
	CLUTCH PEDAL	26
5A—03—26	Adjustment (MF 698 Tractors)	
	CLUTCH RELEASE BEARING	27
5A—04—27	Removal and Replacement	

SPLIT TORQUE CLUTCH**GENERAL**

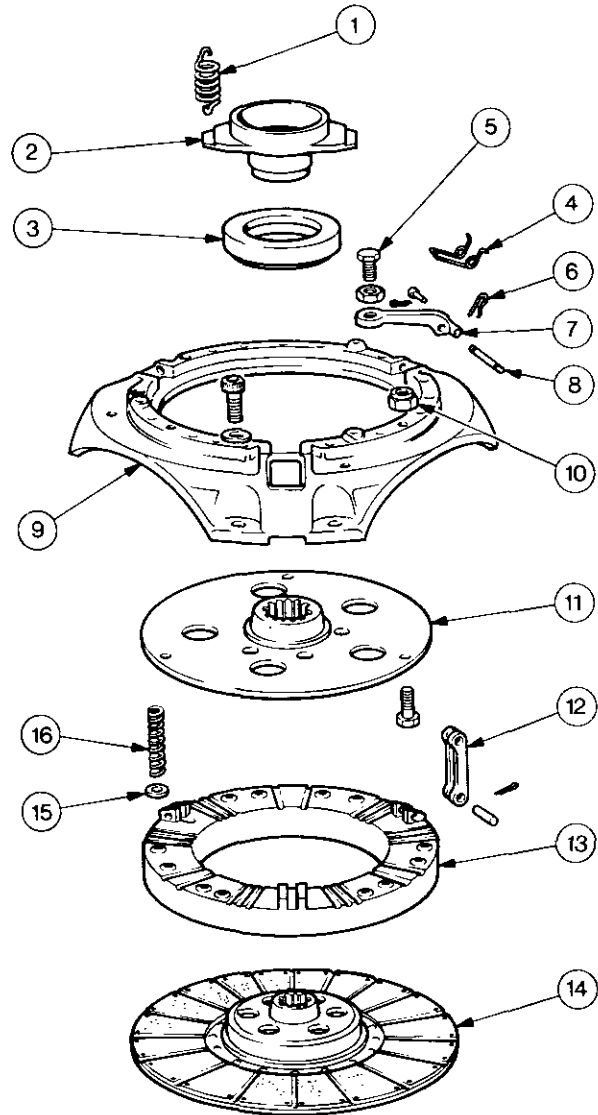
The Split Torque Clutch consists of a 330 mm (13 in) friction disc driving the transmission main input shaft and a plate having a splined boss which engages the p.t.o. input shaft. This allows the main transmission drive to be disconnected without interrupting the drive to the hydraulic pumps and p.t.o. shaft. When the main transmission drive is stopped, driven implements can still be operated and raised and lowered by the hydraulic system.

Operation

The friction disc (14) is operated by the pressure plate (13) against the flywheel. Pressure plate movement is obtained by three release levers (7), pivoted on the clutch cover plate (9). Release lever movement operating against the twelve coil springs (16), moves the pressure plate (13), rearwards and releases the friction disc (14). The clutch release levers (7) are operated by a release bearing (3) which is moved by the clutch pedal.

KEY TO FIGURE 1

1 Spring	9 Cover Plate
2 Carrier	10 Nut
3 Bearing	11 P.t.o. plate
4 Spring	12 Link
5 Screw	13 Pressure Plate
6 Retaining Clip	14 Friction Disc
7 Levers	15 Washer
8 Pin	16 Springs



SPLIT TORQUE CLUTCH**FAULT FINDING**

<i>Symptom</i>	<i>Cause</i>	<i>Remedy</i>
Clutch will not release	Oil or grease on friction plate	Install new friction plate
	Improper pedal adjustment	Adjust clutch pedal free travel and linkage
	Damaged pressure plate on clutch cover	Replace defective part
	Friction plate hub binding on splined drive pinion	Clean up splines and smear with small quantity of Mobilgrease Super
	Distorted friction plate Broken facings on friction plate	Install new friction plate
	Dirt or foreign matter in the clutch	Remove clutch from flywheel and clean with dry rag. See that all working parts are free
Clutch slip	Oil or grease on friction plate	Install new friction plate
	Weak or soft pressure springs	Install new set of pressure springs
	Binding of clutch pedal mechanism preventing its full return to stop	Free bearings. (NOTE: The clutch shaft bearings in the transmission case are self-lubricating. Oil or grease should not be applied)
	Improper pedal adjustment preventing full engagement	Correct pedal adjustment
	Clutch facing worn	Install new friction plate

SPLIT TORQUE CLUTCH**FRICITION DISC OR CLUTCH ASSEMBLY****Removal and Refitment**

5A-01-24

Special Tools: MF 159A Clutch Centraliser
MF 407 Lever Height Setting Gauge

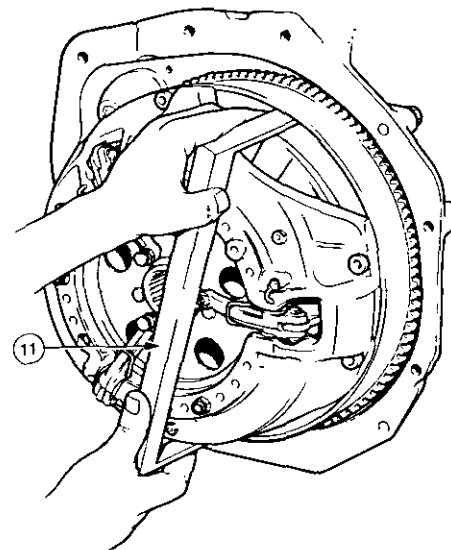
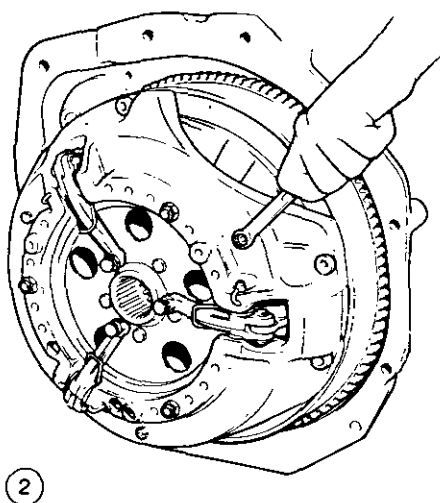
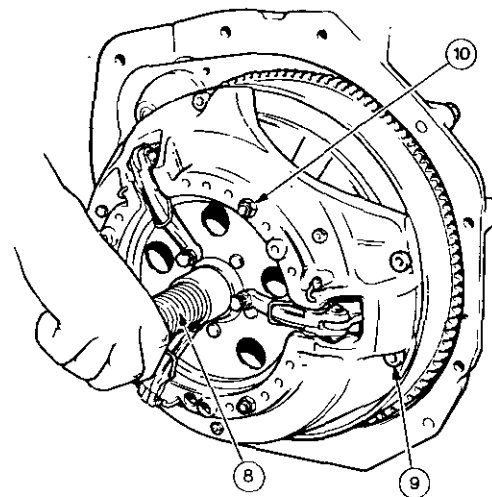
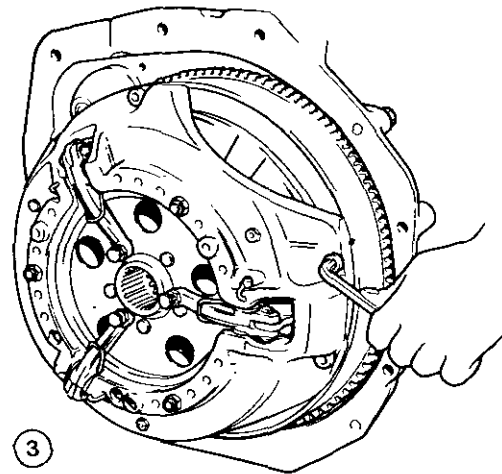
WARNING: The following sequence of instructions must be followed carefully, as spring pressure will cause the clutch cover to fly apart, if pressure is not released slowly and evenly.

Removal

1. Split the tractor between the engine and the transmission. Operation 3A-04-08.
2. Fit three slave bolts 1/4 in UNC x 54 mm (2 1/8 in) to the three equi-spaced holes in the clutch cover.
3. Progressively slacken and remove the six Allen headed bolts and washers.
4. Lift the clutch assembly clear of the flywheel. The friction disc will remain separate from the clutch assembly.

Refitment

5. Lightly lubricate the splines of the friction disc with Mobilgrease Super or Mobilex 47.
6. Fit the friction disc on to the flywheel.
7. Position the clutch assembly on to the flywheel.
8. Using MF 159A, centralise the clutch assembly and the friction disc.
9. Refit the six bolts and washers.
10. Remove the three slave bolts and then remove MF 159A.
11. Using MF 407, check the adjustment of each release lever. The domed end of the release lever set screw must be just touching the gauge. Adjust the setscrews as required and retighten the locknut.
12. Reassemble the tractor.
13. Adjust the clutch pedal free travel.



SPLIT TORQUE CLUTCH

CLUTCH ASSEMBLY

Servicing

5A—02—25

Special Tools: MF 159A Clutch Centraliser
MF 407 Lever Height Setting Gauge
Hydraulic Press.

Disassembly

1. Remove the clutch assembly.
2. Place the clutch assembly on a hydraulic press and locate a suitable bar. Apply pressure until the three $\frac{1}{2}$ in slave bolts can be removed.
3. As an alternative to 2, use three long slave bolts with nuts wound right the way up. Space the bolts, with nuts fitted, evenly around three of the six holes provided for fitting the clutch to the flywheel. Screw the slave bolts into a flywheel (not fitted on to a tractor) and then clamp the clutch assembly to the flywheel by progressively winding down the nuts. Remove the three $\frac{1}{2}$ in slave bolts.
4. Remove the retaining clips.
5. Remove the pivot pins.
6. Remove the lever springs.
7. Disconnect the release levers from the links.
8. Slowly release the pressure from the press or progressively wind the nuts back up the slave bolts, until the pressure springs are out of compression. Remove the assembly from the press or remove the slave bolts with nuts.
9. Lift off the clutch cover plate.
10. Remove the twelve springs and the fibre washers.
11. Remove the links.
12. Remove the three bolts and nuts fixing the p.t.o. plate.
13. Remove the p.t.o. plate.

Examination

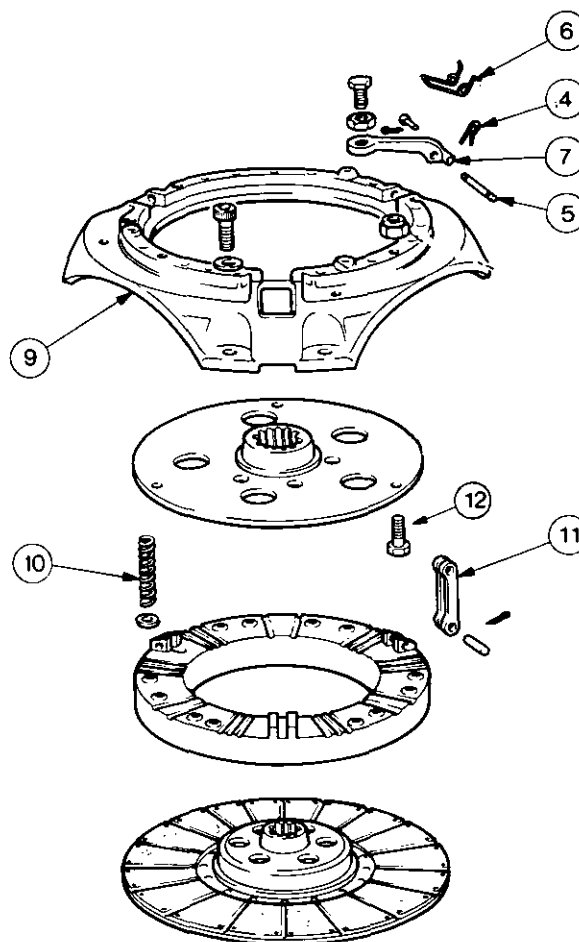
Inspect all components for wear, scoring, cracks or signs of overheating. Check the coil springs for correct loading and pressures. Clamp load should be 998 kg (2200 lb).

If the tractor flywheel is scored, skimming is possible in 0.254 mm (0.010 in) increments up to a maximum 1.00 mm (0.040 in). The shoulder to which the clutch assembly is bolted must also be skimmed by the same amount.

WARNING: Never skim the pressure plate as this will severely impair its heat dissipation characteristics. In the case of bad scoring, replace the pressure plate.

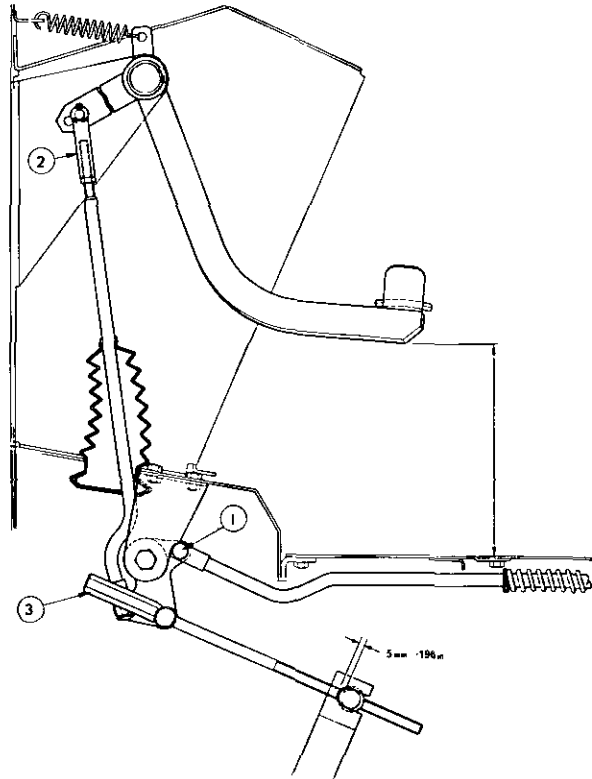
Reassembly

14. Reverse procedures 1 to 13, except: Fit a new friction disc and fit twelve new fibre washers.



SPLIT TORQUE CLUTCH**CLUTCH PEDAL****(Height and release bearing free play)****Adjustment****5A-12-15**

1. Ensure that the stop pin is in contact with the bell crank lever support bracket.
 2. Adjust the clevis unit 160 mm ($5\frac{7}{8}$ in) is obtained
- NOTE: Dimension is measured from the underside of the pedal.**
3. Adjust the screw rod until there is 5 mm (.196 in) free play.
 4. Press the clutch pedal down through its full travel five times, recheck if necessary.

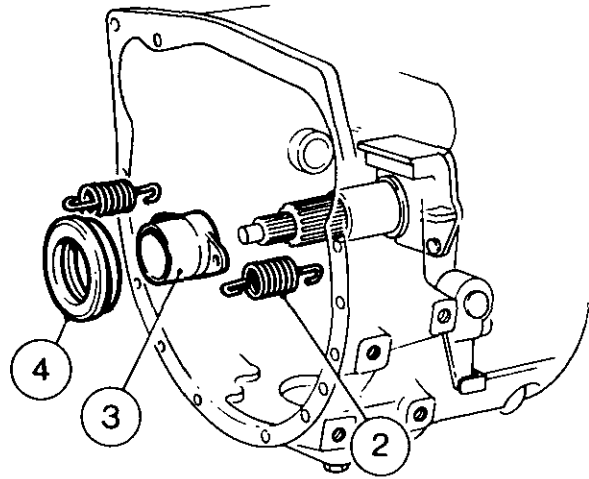


CLUTCH RELEASE BEARING**Removal and Replacement** 5A-04-27**Removal**

1. Split the tractor between the engine and the transmission, Part 4A.
2. Release the two springs.
3. Remove the bearing and carrier assembly.
4. Drive out the carrier from the bearing.

Replacement

5. Reverse procedures 1 to 4 except:
 - (a) Press a new bearing on to the carrier.
 - (b) Lightly lubricate the spline of the carrier with Mobilgrease Special.



TRANSMISSIONS

Part 5—Section B

The following types of gearboxes are available on certain MF 600 Series Tractors.

Ref.	ZF Gearbox Type	Gear Engagement			
		Rev.	1st	2nd	3rd	4th
A	Mk I 8 Speed Synchromesh	Sliding Gears			Synchromesh
B	Mk II 8 Speed Synchromesh	Constant Mesh	Sliding Gear	Synchromesh	
C	Mk I Multi-Power	Sliding Gears	Synchromesh		—
D	Mk II Multi-Power	Constant Mesh	Synchromesh		—
E	Mk II 12 Speed Manual	Constant Mesh	Synchromesh	Hi/Low Shift	

Gearbox Identification: Mk I Gearboxes have a spur type 1st gear. MK II Gearboxes have a helical type 1st gear. They can be viewed by removing the oil filler plug.

Operation No.	Operation Description	Gearbox Type										Page No.
		A	B	C	D	E						
5B-01-09	Selector Rail Mechanism Removal and Refitment	★	★	★	★	★						09
5B-02-10	Heavy Duty Epicyclic Unit Removal and Refitment	★	★	★	★	★						10
5B-03-10	Heavy Duty Epicyclic Unit Servicing	★	★	★	★	★						10
5B-04-11	Clutch Release Mechanism Removal and Refitment	★	★	★	★	★						11
5B-05-12	Input Shaft Housing and P.T.O. Input Shaft Removal and Refitment	★	★	—	—	—						12
5B-06-13	Input Shaft Housing and P.T.O. Input Shaft Removal and Refitment	—	—	★	★	—						13
5B-07-14	Input Shaft Housing and P.T.O. Input Shaft Removal and Refitment	—	—	—	—	★						14
5B-08-15	P.T.O. Drive Shaft Front Bearing Removal and Refitment	★	★	★	★	★						15
5B-09-16	Second Gear—Mainshaft Removal and Refitment	★	★	—	—	—						16
5B-10-17	Main Input Shaft Removal and Refitment	★	★	—	—	—						17
5B-11-18 5B-11A-18A	Main Input Shaft and Multi-Power Clutch Unit Removal and Refitment	—	—	—	★	—						18 18A
5B-12-19	Main Input Shaft Removal and Refitment	—	—	—	—	★						19
5B-13-20	Mainshaft and Gears Removal and Refitment	★	—	★	—	—						20
5B-14-21	Mainshaft and Gears Removal and Refitment	—	★	—	★	★						21

TRANSMISSIONS

Operation No.	Operation Number	Gearbox Type (See page 5B-01 for Ref.)										Page No.
		A	B	C	D	E						
5B-15-22	Layshaft and Gears, P.T.O. Shaft and Gear Removal and Refitment	★	★	—	—	—						22
5B-16-23	Layshaft and Gears, P.T.O. Shaft and Gear Removal and Refitment	—	—	★	★	—						23
5B-17-24	Layshaft and Gears, P.T.O. Shaft and Gear Removal and Refitment	—	—	—	—	★						24
5B-18-25	Mainshaft Synchromesh Unit Servicing	★	★	★	★	★						25
5B-19-25	Layshaft Synchromesh Unit Servicing	—	—	—	—	★						25
5B-20-26	Multi-Power Clutch Unit Servicing	—	—	★	★	—						26
5B-21-27	Multi-Power Spool Valve Servicing	—	—	★	★	—						27
5B-22-28	Reverse Gear Cluster Removal and Refitment	★	★	★	★	★						28
5B-23-29	Gearshift Lever Removal and Refitment	★	★	★	★	—						29
5B-24-29	High/Low Shift Lever Removal and Refitment	★	★	★	★	—						29
5B-25-30	Gear Shift Lever Removal and Refitment	—	—	—	—	★						30
5B-26-30	High/Low Shift and Synchromesh Lever Removal and Refitment	—	—	—	—	★						30
5B-27-31	Transmission Case Removal and Refitment or Complete Overhaul	★	★	—	—	—						31
5B-28-32	Transmission Case Removal and Refitment or Complete Overhaul	—	—	★	★	—						32
5B-29-33	Transmission Case Removal and Refitment or Complete Overhaul	—	—	—	—	★						33

**GENERAL GEARBOX DESCRIPTIONS
8 SPEED**

These gearboxes have four forward gears and one reverse. They are engaged by operating a shift lever situated on top of the gearbox. A second lever adjacent to it, is used to operate an epicyclic reduction unit mounted on the rear of the gearbox. This has the effect of doubling the available gears to eight forward and two reverse.

MULTI-POWER

These gearboxes have three forward gears and one reverse. A choice of 2 input shaft gears are provided. These can be selected by a shift lever mounted on the

instrument panel, which operates a clutch housed in front of the gearbox, this has the effect of doubling the available gears to six forward and two reverse. these are again doubled by the use of an epicyclic reduction unit, resulting in twelve forward and four reverse gears.

12 SPEED MANUAL

This gearbox is similar to the Multi-Power except the two input shaft gears are selected by a third change lever situated between the forward/reverse lever and the epicyclic change lever on top of the gearbox. A synchronising unit fitted to the layshaft, is used instead of the clutch pack, to assist gear change on the move.

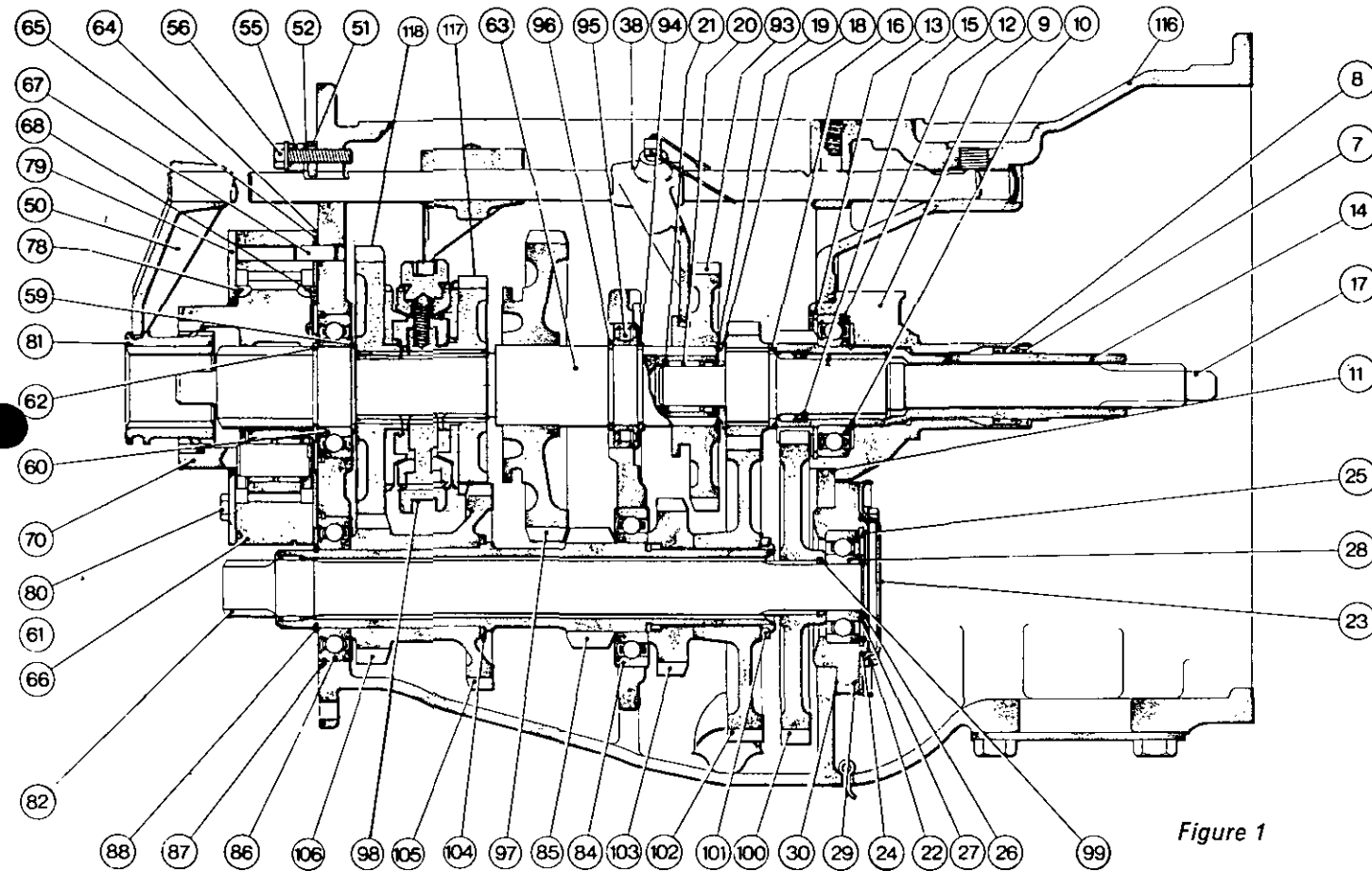


Figure 1

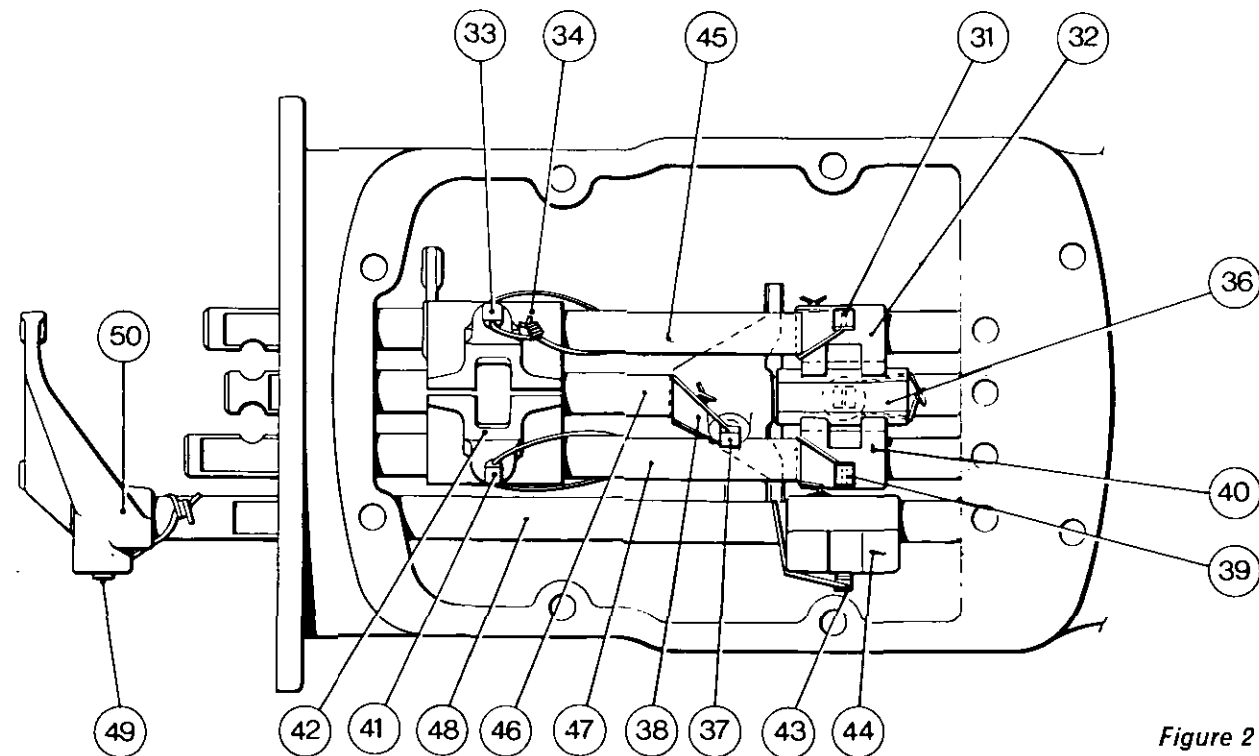


Figure 2

KEY TO FIGURES 1 and 2

MKI 8 Speed Synchronmesh Transmission (Ref. A)

- * 1 Clutch release bearing
- * 2 Clutch release bearing carrier
- * 3 Clutch release fork locking peg
- * 4 Clutch release fork
- * 5 Clutch release bearing return spring
- * 6 Input housing securing bolts
- 7 P.t.o. input shaft seal
- 8 P.t.o. input shaft needle roller bearing
- 9 Input housing
- 10 P.t.o. input shaft bearing securing external circlip
- 11 Input housing 'O' ring
- 12 P.t.o. input shaft bearing
- 13 P.t.o. input shaft securing internal circlip
- 14 P.t.o. input shaft
- 15 Main drive input shaft seal
- 16 Main drive input shaft front bush
- 17 Main drive input shaft
- 18 Main drive input shaft rear bush
- 19 Mainshaft needle roller bearing front spacer
- 20 Mainshaft needle roller bearing
- 21 Mainshaft needle roller bearing rear spacer
- 22 P.t.o. front bearing cover securing bolts
- 23 P.t.o. front bearing cover
- 24 P.t.o. front bearing cover 'O' ring
- 25 P.t.o. front bearing securing circlip
- 26 P.t.o. shaft securing circlip
- 27 P.t.o. shaft spacer washer
- 28 P.t.o. shaft front bearing
- 29 P.t.o. front bearing housing
- 30 P.t.o. front bearing housing gasket
- 31 Second and fourth gear lever engagement dog locking peg
- 32 Second and fourth gear lever engagement dog
- 33 Second and fourth selector fork locking peg
- 34 Second and fourth selector fork
- * 35 Third gear lever engagement dog locking peg
- 36 Third gear lever engagement dog
- 37 Third gear selector fork locking peg
- 38 Third selector fork
- 39 First and reverse gear lever engagement dog locking peg
- 40 First and reverse gear lever engagement dog
- 41 First and reverse selector fork locking peg
- 42 First and reverse selector fork
- 43 High/low gear lever engagement dog locking peg
- 44 High/low gear lever engagement dog
- 45 Third and fourth selector rail
- 46 Third selector rail
- 47 First and reverse selector rail
- 48 High/low selector rail
- 49 High/low selector fork locking peg
- 50 High/low selector fork
- 51 Interlock stop plate
- 52 Interlock plain plate
- * 53 Interlock ball
- * 54 Interlock cross peg
- 55 Interlock ball carrier
- 56 Interlock mechanism securing bolt
- * 57 Detent springs
- * 58 Detent plungers
- 59 Mainshaft rear bearing front securing snap ring
- 60 Mainshaft rear bearing
- 61 Mainshaft rear bearing locating snap ring
- 62 Mainshaft rear bearing rear securing snap ring
- 63 Mainshaft
- 64 Epicyclic shim
- 65 Epicyclic front plate
- 66 Epicyclic ring gear
- 67 Epicyclic ring gear dowel
- 68 Epicyclic front thrust ring
- * 69 Epicyclic planetary pinion shaft securing circlip
- 70 Epicyclic planetary pinion carrier
- * 71 Epicyclic planetary pinion shaft
- * 72 Planetary pinion front thrust washer
- * 73 Planetary front roller set
- * 74 Planetary pinion
- * 75 Planetary roller spacer
- * 76 Planetary rear roller set
- * 77 Planetary pinion rear thrust washer
- 78 Epicyclic rear thrust ring
- 79 Epicyclic cover plate
- 80 Epicyclic securing bolt
- 81 High/low shift coupler
- 82 P.t.o. drive shaft
- * 83 Layshaft front needle roller bearing
- 84 Layshaft front bearing
- 85 Layshaft
- 86 Layshaft rear bearing
- 87 Layshaft rear bearing location snap ring
- 88 Layshaft rear bearing securing snap ring
- * 89 Reverse gear cluster shaft
- * 90 Reverse gear cluster shaft retaining plate
- * 91 Tab washer
- * 92 Reverse gear cluster shaft securing bolt
- 93 Second gear (mainshaft)
- 94 Mainshaft front bearing front securing snap ring
- 95 Mainshaft front bearing
- 96 Mainshaft front bearing rear securing snap ring
- 97 First/reverse gear (mainshaft)
- 98 Third/fourth Synchronmesh Unit
- 99 P.t.o. constant mesh gear location circlip
- 100 P.t.o. constant mesh gear
- 101 Main drive constant mesh gear securing circlip
- 102 Main drive constant mesh gear
- 103 Third gear (layshaft)
- 104 Fourth gear (layshaft) securing snap ring
- 105 Fourth gear (layshaft)
- 106 Third gear (layshaft)
- * 107 Reverse gear front thrust washer
- * 108 Needle roller front retaining ring
- * 109 Front needle roller set
- * 110 Needle roller spacer
- * 110 Needle roller spacer
- * 111 Rear needle roller set
- * 112 Needle roller rear retaining ring
- * 113 Reverse gear cluster
- * 114 Reverse gear rear thrust washer
- * 115 Reverse gear cluster spacer
- 116 Gearbox case
- 117 Fourth gear (mainshaft)
- 118 Third gear (mainshaft)

*Not annotated on illustrations.

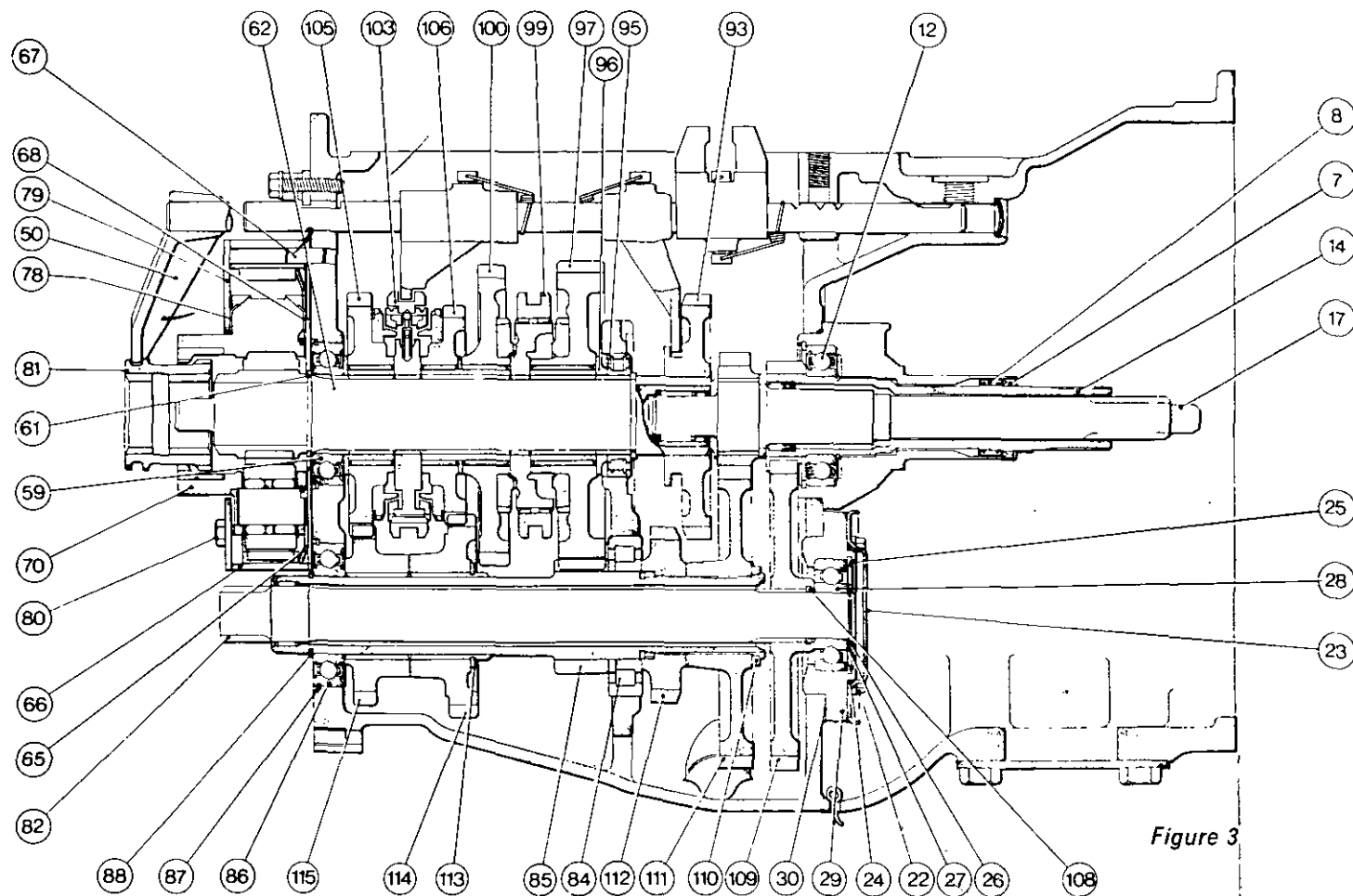


Figure 3

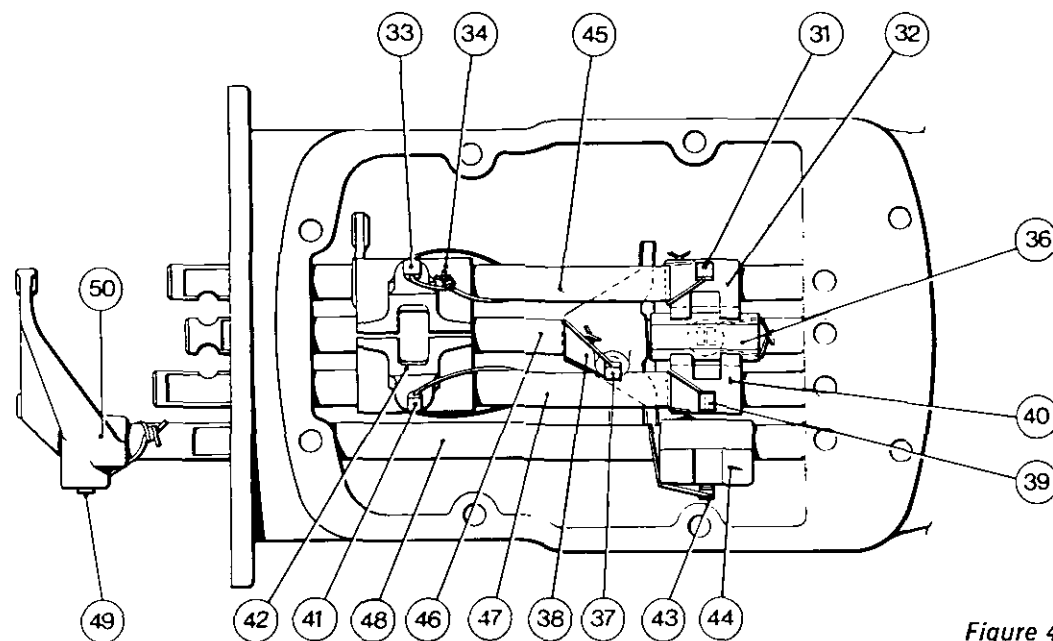


Figure 4

KEY TO FIGURES 3 and 4

MK II 8 Speed Synchronmesh Transmission (Ref. B)

- * 1 Clutch release bearing
- * 2 Clutch release bearing carrier
- * 3 Clutch release fork locking peg
- * 4 Clutch release fork
- * 5 Clutch release bearing return spring
- * 6 Input housing securing bolts
- 7 P.t.o. input shaft seal
- 8 P.t.o. input shaft needle roller bearing
- * 9 Input housing
- * 10 P.t.o. input shaft bearing securing external circlip
- * 11 Input housing 'O' ring
- 12 P.t.o. input shaft bearing
- * 13 P.t.o. input shaft securing internal circlip
- 14 P.t.o. input shaft
- * 15 Main drive input shaft seal
- * 16 Main drive input shaft front bush
- 17 Main drive input shaft
- * 18 Main drive input shaft rear bush
- * 19 Main shaft needle bearing front spacer
- * 20 Main shaft needle roller bearing
- * 21 Main shaft needle roller bearing rear spacer
- 22 P.t.o. front bearing cover securing bolts
- 23 P.t.o. front bearing cover
- 24 P.t.o. front bearing cover 'O' ring
- 25 P.t.o. front bearing securing circlip
- 26 P.t.o. shaft securing circlip
- 27 P.t.o. shaft spacer washer
- 28 P.t.o. shaft front bearing
- 29 P.t.o. front bearing housing
- 30 P.t.o. front bearing housing gasket
- 31 Third and fourth gear lever engagement dog locking peg
- 32 Third and fourth gear lever engagement dog
- 33 Third and fourth selector fork locking peg
- 34 Third and fourth selector fork
- * 35 Second gear lever engagement dog locking peg
- 36 Second gear lever engagement dog
- 37 Second gear selector fork locking peg
- 38 Second selector fork
- 39 First and reverse gear lever engagement dog locking peg
- 40 First and reverse gear lever engagement dog
- 41 First and reverse selector fork locking peg
- 42 First and reverse selector fork
- 43 High/Low gear lever engagement dog locking peg
- 44 High/Low gear lever engagement dog
- 45 Third and fourth selector rail
- 46 Second selector rail
- 47 First and reverse selector rail
- 48 High/Low selector rail
- 49 High/Low selector fork locking peg
- 50 High/Low selector fork
- * 51 Interlock stop plate
- * 52 Interlock plain plate
- * 53 Interlock ball
- * 54 Interlock cross peg
- * 55 Interlock ball carrier
- * 56 Interlock mechanism securing bolts
- * 57 Detent springs
- * 58 Detent plungers
- 59 Mainshaft rear bearing
- * 60 Mainshaft bearing locating snap ring
- 61 Mainshaft rear bearing rear securing snap ring
- * 62 Mainshaft
- * 63 Epicyclic shim
- * 64 Epicyclic front plate
- 65 Epicyclic Belleville spring disc
- 66 Epicyclic ring gear
- 67 Epicyclic ring gear dowel
- 68 Epicyclic front thrust ring
- * 69 Epicyclic planetary pinion shaft securing circlip
- 70 Epicyclic planetary pinion carrier
- * 71 Epicyclic planetary pinion shaft
- * 72 Planetary pinion front thrust washer
- * 73 Planetary front roller set
- * 74 Planetary pinion
- * 75 Planetary roller spacer
- * 76 Planetary rear roller set
- * 77 Planetary pinion rear thrust washer
- 78 Epicyclic rear thrust ring
- 79 Epicyclic cover plate
- 80 Epicyclic securing bolts
- 81 High/Low shift coupler
- 82 P.t.o. drive shaft
- * 83 Layshaft rear needle roller bearing
- 84 Layshaft front bearing
- 85 Layshaft
- 86 Layshaft rear bearing
- 87 Layshaft rear bearing location snap ring
- 88 Layshaft rear bearing securing snap ring
- * 89 Reverse gear cluster shaft
- * 90 Reverse gear cluster shaft stop
- * 91 Tab washer
- * 92 Reverse gear cluster shaft securing bolt
- 93 Second gear (mainshaft)
- * 94 Mainshaft front bearing front securing snap ring
- 95 Mainshaft front bearing
- 96 Mainshaft front bearing thrust washer
- 97 First gear (mainshaft)
- * 98 Splined sleeve (first gear)
- 99 First/reverse sliding coupler
- 100 Reverse gear (mainshaft)
- * 101 Thrust washer—reverse/fourth gear
- * 102 Splined sleeve—reverse/fourth gear
- 103 3rd/4th Synchronmesh unit
- * 104 Splined sleeve—third gear
- 105 Third gear (mainshaft)
- 106 Fourth gear (mainshaft)
- * 107 Mainshaft rear bearing thrust washer
- 108 P.t.o. constant mesh gear location circlip
- 109 P.t.o. constant mesh gear
- * 110 Main drive constant mesh gear securing circlip
- 111 Main drive constant mesh gear
- 112 Second gear (layshaft)
- 113 Fourth gear (layshaft) securing snap ring
- 114 Fourth gear (layshaft)
- 115 Third gear (layshaft)
- * 116 Reverse gear front thrust washer
- * 117 Needle roller front retaining ring
- * 118 Front roller set
- * 119 Needle roller spacer
- * 120 Rear needle roller set
- * 121 Needle roller rear retaining ring
- * 122 Reverse gear cluster
- * 123 Reverse gear rear thrust washer
- * 124 Gearbox case

*Not annotated on illustrations.

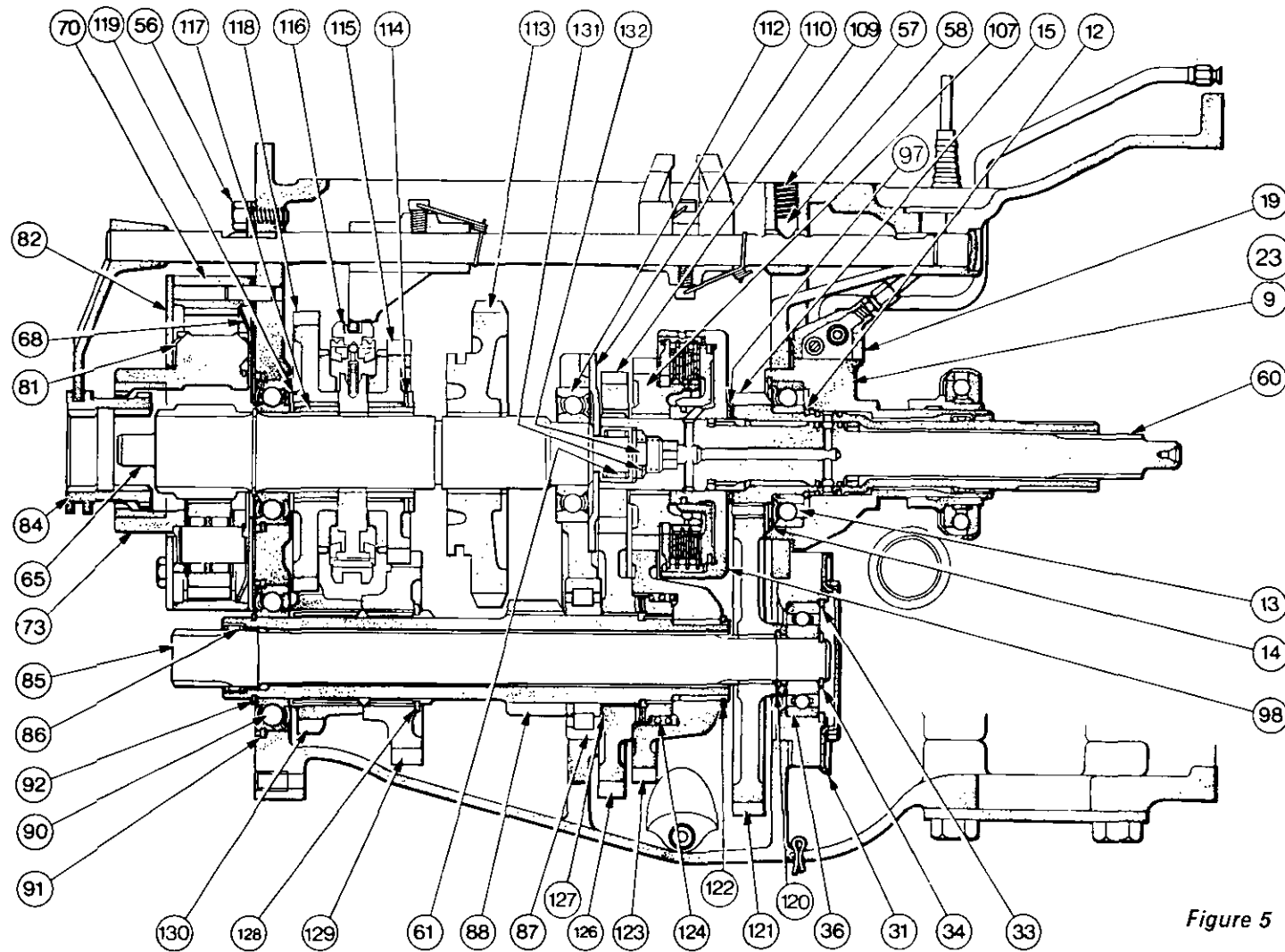


Figure 5

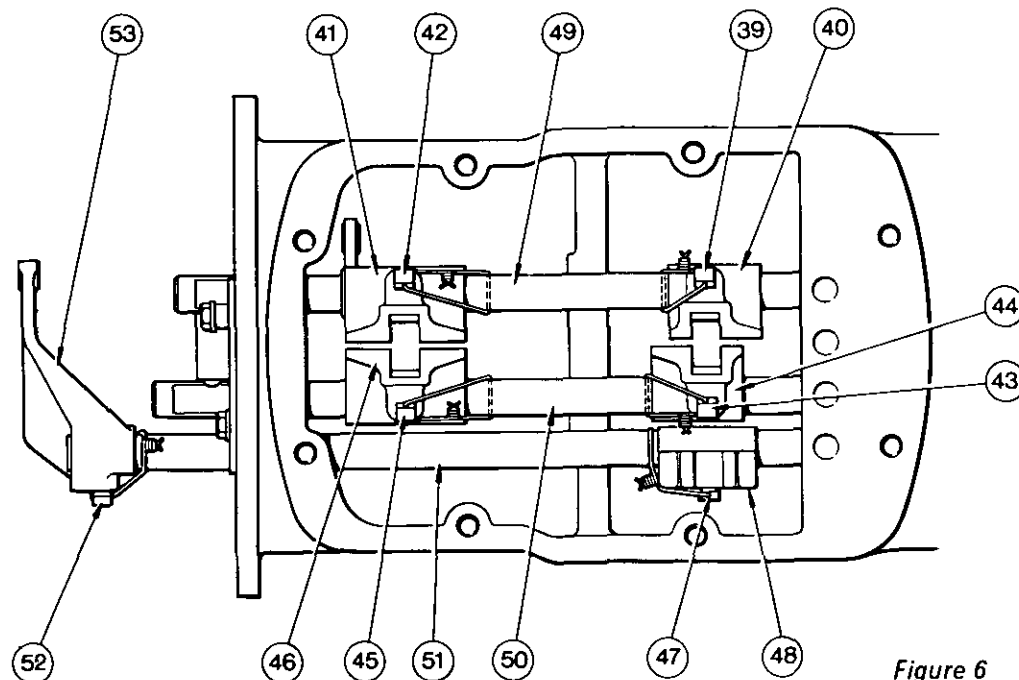


Figure 6

KEY TO FIGURES 5 and 6

MKI Multi-Power Transmission (Ref. C)

- * 1 Clutch release bearing.
- * 2 Clutch release bearing carrier
- * 3 Clutch release fork locking peg
- * 4 Clutch release fork
- * 5 Clutch release bearing return spring
- * 6 Input housing securing bolts
- * 7 P.t.o. input shaft seat
- * 8 P.t.o. input shaft needle roller bearing
- * 9 Input housing
- * 10 Input housing 'O' ring
- * 11 P.t.o. input shaft cast iron sealing rings
- * 12 P.t.o. input shaft securing external circlip
- * 13 P.t.o. input shaft bearing
- * 14 P.t.o. input shaft securing internal circlip
- * 15 P.t.o. input shaft
- * 16 Main drive input shaft seal
- * 17 Multi-Power spool valve 'O' ring
- * 18 Multi-Power spool valve
- * 19 Multi-Power spool block
- * 20 Multi-Power detent ball
- * 21 Multi-Power detent spring
- * 22 Multi-Power spool detent spring securing plug
- * 23 Multi-Power spool block securing bolts
- * 24 Anti-transient spring
- * 25 Anti-transient ball
- * 26 Multi-Power spool block pressure regulating valve
- * 27 Multi-Power pressure regulating valve spring
- * 28 Multi-Power pressure regulating valve spring retaining plug and washer
- * 29 Multi-Power spool block gasket
- * 30 P.t.o. front bearing cover securing bolts
- * 31 P.t.o. front bearing cover
- * 32 P.t.o. front bearing cover 'O' ring
- * 33 P.t.o. front bearing securing circlip
- * 34 P.t.o. shaft securing circlip
- * 35 P.t.o. shaft spacer washer
- * 36 P.t.o. shaft front bearing
- * 37 P.t.o. front bearing housing
- * 38 P.t.o. front bearing housing gasket
- * 39 Second and third gear lever engagement dog locking peg
- * 40 Second and third gear lever engagement dog
- * 41 Second and third selector fork
- * 42 Second and third selector fork locking peg
- * 43 First and reverse gear lever engagement dog locking peg
- * 44 First and reverse gear lever engagement dog
- * 45 First and reverse selector fork locking peg
- * 46 First and reverse selector fork
- * 47 High/Low gear lever engagement dog locking peg
- * 48 High/Low gear engagement dog
- * 49 Second and third gear selector rail
- * 50 First and reverse gear selector rail
- * 51 High/Low gear selector rail
- * 52 High/Low selector fork locking peg
- * 53 High/Low selector fork
- * 54 Interlock stop plate
- * 55 Interlock plunger
- * 56 Interlock mechanism securing bolt and washer
- * 57 Detent springs
- * 58 Detent plungers
- * 59 Main input shaft cast iron sealing rings
- * 60 Main input shaft
- * 61 Mainshaft needle roller bearing
- * 62 Mainshaft rear bearing
- * 63 Mainshaft rear bearing locating snap ring
- * 64 Mainshaft rear bearing rear securing snap ring
- * 65 Mainshaft
- * 66 Epicyclic shim
- * 67 Epicyclic front plate
- * 68 Epicyclic Belleville spring disc
- * 69 Epicyclic ring gear dowel
- * 70 Epicyclic ring gear
- * 71 Epicyclic front thrust ring
- * 72 Epicyclic planetary pinion shaft securing circlip
- * 73 Epicyclic planetary pinion carrier
- * 74 Epicyclic planetary pinion shaft
- * 75 Planetary pinion front thrust washer
- * 76 Planetary front roller set
- * 77 Planetary pinion
- * 78 Planetary roller spacer
- * 79 Planetary rear roller set
- * 80 Planetary pinion rear thrust washer
- * 81 Epicyclic rear thrust ring
- * 82 Epicyclic cover plate
- * 83 Epicyclic securing bolts
- * 84 High/Low shift coupler
- * 85 P.t.o. drive shaft
- * 86 Layshaft rear needle roller bearing
- * 87 Layshaft front bearing
- * 88 Layshaft
- * 89 Layshaft front bearing spacer washer
- * 90 Layshaft rear bearing
- * 91 Layshaft rear bearing location snap ring
- * 92 Layshaft rear bearing securing snap ring
- * 93 Reverse gear cluster shaft
- * 94 Reverse gear cluster shaft retaining plate
- * 95 Tab washer
- * 96 Reverse gear cluster shaft securing bolt
- * 97 Multi-Power clutch front thrust washer
- * 98 Multi-Power clutch unit housing
- * 99 Multi-Power clutch unit housing cast iron sealing rings
- * 100 Multi-Power clutch unit piston ring
- * 101 Multi-Power clutch unit piston
- * 102 Multi-Power clutch unit interplates
- * 103 Multi-Power clutch unit friction discs
- * 104 Multi-Power clutch piston return springs
- * 105 Multi-Power friction disc retainer plate
- * 106 Multi-Power retainer plate securing circlip
- * 107 Main input overdrive pinion
- * 108 Multi-Power clutch unit rear thrust washer
- * 109 Main drive pinion
- * 110 Tab located spacer
- * 111 Mainshaft front bearing securing circlip
- * 112 Mainshaft front bearing
- * 113 First/reverse gear
- * 114 Reverse/third gear thrust washer
- * 115 Third gear (mainshaft)
- * 116 Second/third synchromesh unit
- * 117 Second gear sleeve
- * 118 Second gear (mainshaft)
- * 119 Second gear thrust washer
- * 120 P.t.o. constant mesh gear internal circlip
- * 121 P.t.o. constant mesh gear
- * 122 Layshaft front snap ring
- * 123 Overdrive layshaft gear
- * 124 Coupler spring
- * 125 Coupler
- * 126 Main drive layshaft gear
- * 127 Main drive layshaft gear thrust washer
- * 128 Third gear layshaft securing snap ring
- * 129 Third gear (layshaft)
- * 130 Second gear (layshaft)
- * 131 Mainshaft/input shaft separator spring
- * 132 Mainshaft/input shaft separator abutment

*Not annotated on illustrations.

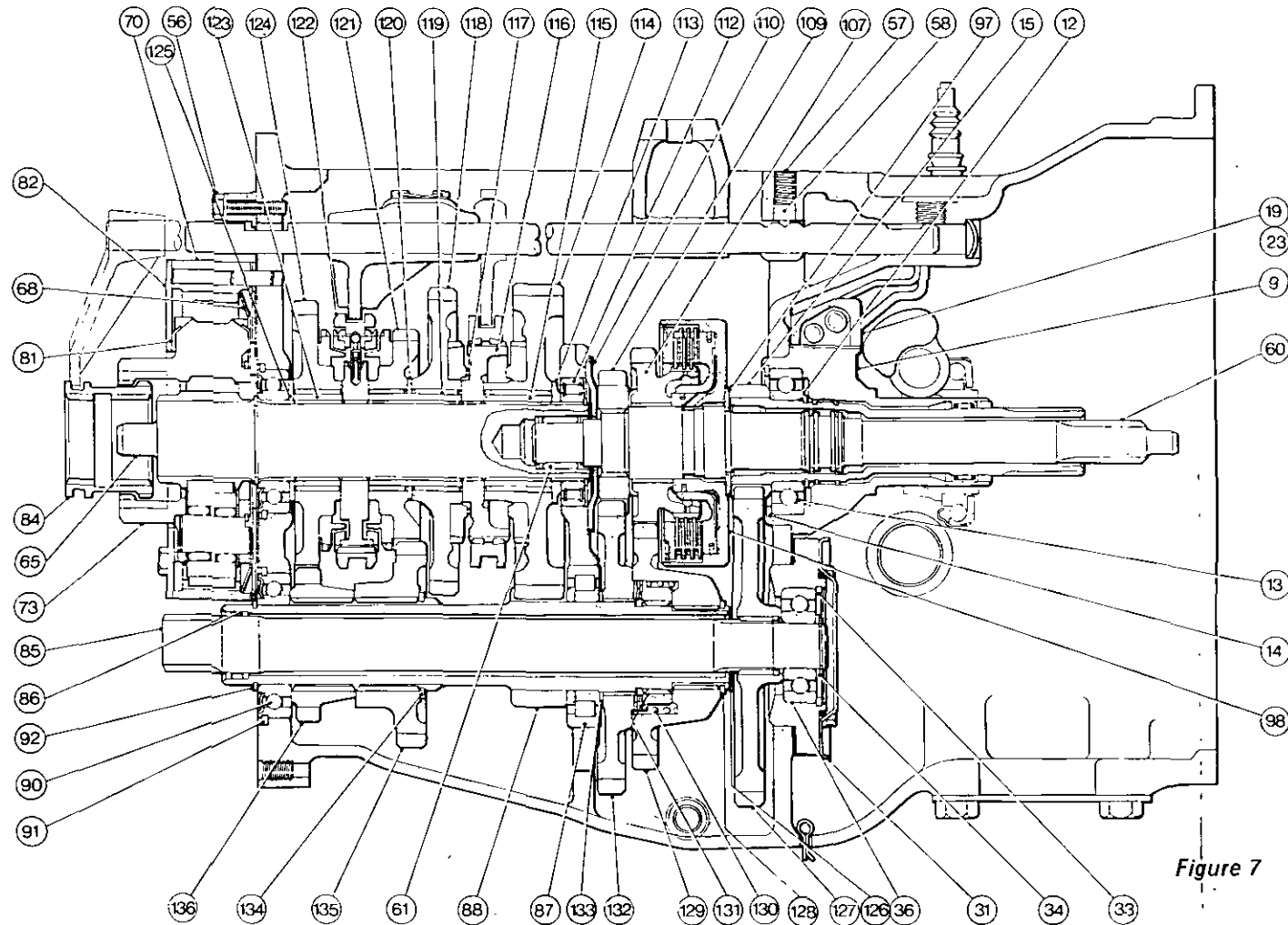


Figure 7

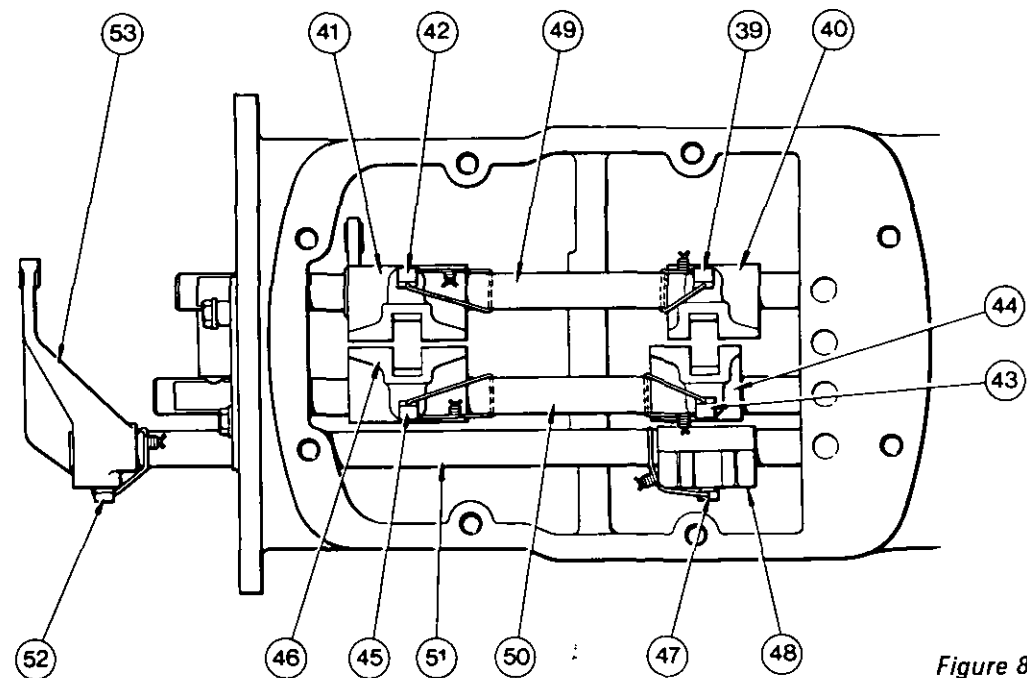


Figure 8

KEY TO FIGURES 7 and 8

MK II Multi-Power Transmission (Ref. D)

- * 1 Clutch release bearing
- * 2 Clutch release bearing carrier
- * 3 Clutch release fork locking peg
- * 4 Clutch release fork
- * 5 Clutch release bearing return spring
- * 6 Input housing securing bolts
- * 7 P.t.o. input shaft seal
- * 8 P.t.o. input shaft needle roller bearing
- 9 Input housing
- * 10 Input housing 'O' ring
- * 11 P.t.o. input shaft cast iron sealing rings
- 12 P.t.o. input shaft securing external circlip
- 13 P.t.o. input shaft bearing
- 14 P.t.o. input shaft securing internal circlip
- 15 P.t.o. input shaft
- * 16 Main drive input shaft seal
- * 17 Multi-Power spool valve 'O' ring
- * 18 Multi-Power spool valve
- 19 Multi-Power spool block
- * 20 Multi-Power detent ball
- * 21 Multi-Power detent spring
- * 22 Multi-Power spool detent spring securing plug
- 23 Multi-Power spool block securing bolts
- * 24 Anti-transient spring
- * 25 Anti-transient ball
- * 26 Multi-Power spool block pressure regulating valve
- * 27 Multi-Power pressure regulating valve spring
- * 28 Multi-Power pressure regulating valve spring retaining plug and washer
- * 29 Multi-Power spool block gasket
- * 30 P.t.o. front bearing cover securing bolts
- 31 P.t.o. front bearing cover
- * 32 P.t.o. front bearing cover 'O' ring
- 33 P.t.o. front bearing securing circlip
- 34 P.t.o. shaft securing circlip
- * 35 P.t.o. shaft spacer washer
- 36 P.t.o. shaft front bearing
- * 37 P.t.o. front bearing housing
- * 38 P.t.o. front bearing housing gasket
- 39 Second and third gear lever engagement dog locking peg
- 40 Second and third gear lever engagement dog
- 41 Second and third selector fork
- 42 Second and third selector fork locking peg
- 43 First and reverse gear lever engagement dog locking peg
- 44 First and reverse gear lever engagement dog
- 45 First and reverse selector fork locking peg
- 46 First and reverse selector fork
- 47 High/Low gear lever engagement dog locking peg
- 48 High/Low gear engagement dog
- 49 Second and third gear selector rail
- 50 First and reverse gear selector rail
- 51 High/Low gear selector rail
- 52 High/Low selector locking peg
- 53 High/Low selector fork
- * 54 Interlock stop plate
- * 55 Interlock plunger
- 56 Interlock mechanism securing bolt and washer
- 57 Detent springs
- 58 Detent plungers
- * 59 Main input shaft cast iron sealing rings
- 60 Main input shaft
- 61 Mainshaft needle roller bearing
- * 62 Mainshaft rear bearing
- * 63 Mainshaft rear bearing locating snap ring
- * 64 Mainshaft rear bearing rear securing snap ring
- 65 Mainshaft
- * 66 Epicyclic shim
- * 67 Epicyclic front plate
- 68 Epicyclic Belleville spring disc
- * 69 Epicyclic ring gear dowel
- 70 Epicyclic ring gear
- * 71 Epicyclic front thrust ring
- * 72 Epicyclic planetary pinion shaft securing circlip
- 73 Epicyclic planetary pinion carrier
- * 74 Epicyclic planetary pinion shaft
- * 75 Planetary pinion front thrust washer
- * 76 Planetary front roller set
- * 77 Planetary pinion
- * 78 Planetary roller spacer
- * 79 Planetary rear roller set
- * 80 Planetary pinion rear thrust washer
- 81 Epicyclic rear thrust ring
- 82 Epicyclic cover plate
- * 83 Epicyclic securing bolts
- 84 High/Low shift coupler
- 85 P.t.o. drive shaft
- 86 Layshaft rear needle roller bearing
- 87 Layshaft front bearing
- 88 Layshaft
- * 89 Layshaft front bearing spacer washer
- 90 Layshaft rear bearing
- 91 Layshaft rear bearing location snap ring
- 92 Layshaft rear bearing securing snap ring
- * 93 Reverse gear cluster shaft
- * 94 Reverse gear cluster shaft retaining plate
- * 95 Tab washer
- * 96 Reverse gear cluster shaft securing bolt
- 97 Multi-Power clutch front thrust washer
- 98 Multi-Power clutch unit housing
- * 99 Multi-Power clutch unit housing cast iron sealing rings
- * 100 Multi-Power clutch unit piston ring
- * 101 Multi-Power clutch unit piston
- * 102 Multi-Power clutch unit interplates
- * 103 Multi-Power clutch unit friction discs
- * 104 Multi-Power clutch piston return springs
- * 105 Multi-Power friction disc retainer plate
- * 106 Multi-Power retainer plate securing circlip
- 107 Main input overdrive pinion
- * 108 Multi-Power clutch unit rear thrust washer
- 109 Main drive pinion
- 110 Tab located spacer
- * 111 Mainshaft front bearing securing circlip
- 112 Mainshaft front bearing
- 113 Mainshaft front bearing thrust washer
- 114 First gear (mainshaft)
- 115 First gear sleeve
- 116 First/reverse gear sliding coupler
- 117 Needle bearing thrust washer
- 118 Reverse gear (mainshaft)
- 119 Reverse/third gear sleeve
- 120 Reverse/third gear thrust washer
- 121 Third gear (mainshaft)
- 122 Second/third synchronesh unit
- 123 Second gear sleeve
- 124 Second gear (mainshaft)
- 125 Second gear thrust washer
- 126 P.t.o. constant mesh gear internal circlip
- 127 P.t.o. constant mesh gear
- 128 Layshaft front snap ring
- 129 Overdrive layshaft gear
- 130 Coupler spring
- 131 Coupler
- 132 Main drive layshaft gear
- 133 Main drive layshaft gear thrust washer
- 134 Third gear layshaft securing snap ring
- 135 Third gear (layshaft)
- 136 Second gear (layshaft)

*Not annotated on illustrations.

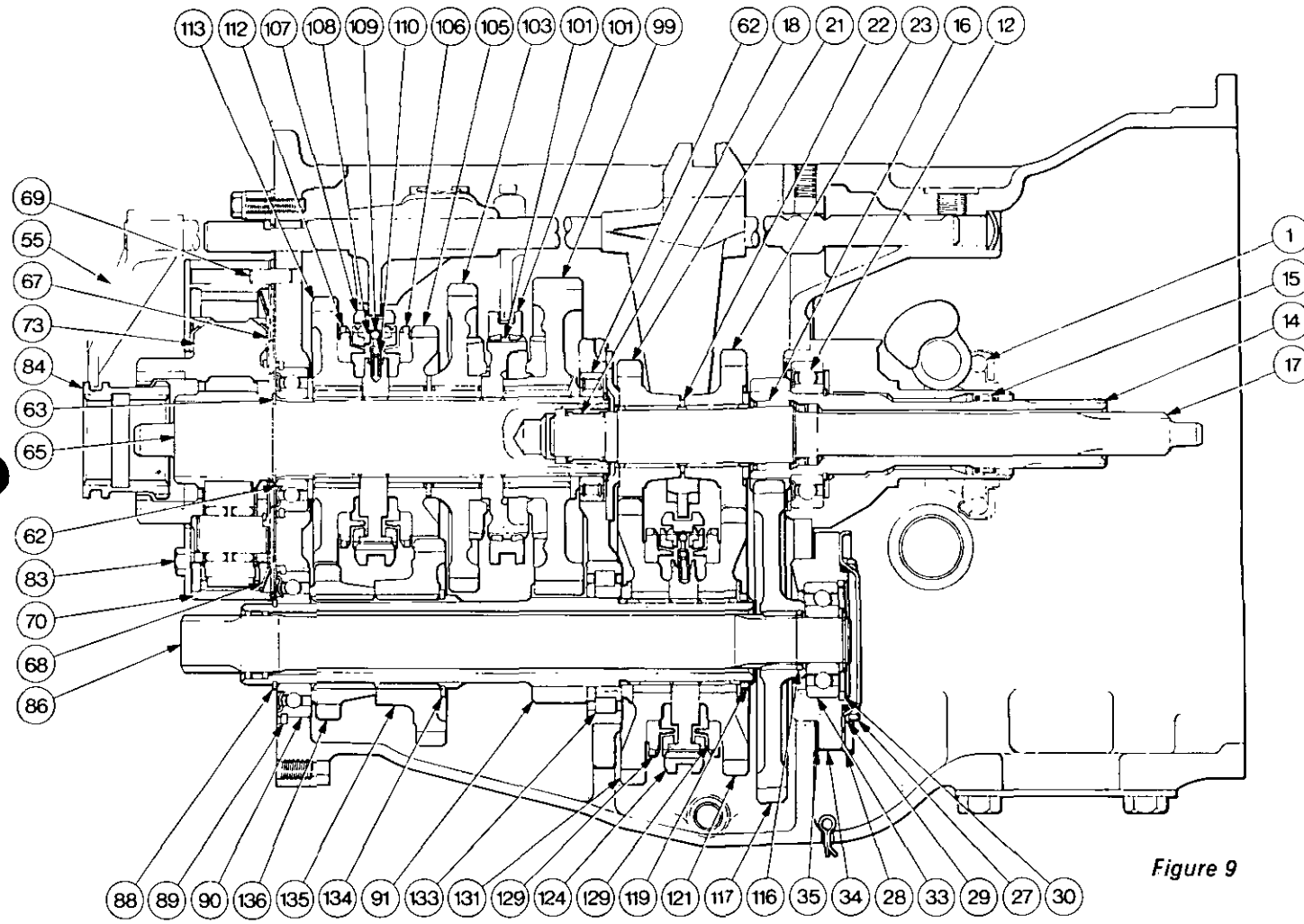


Figure 9

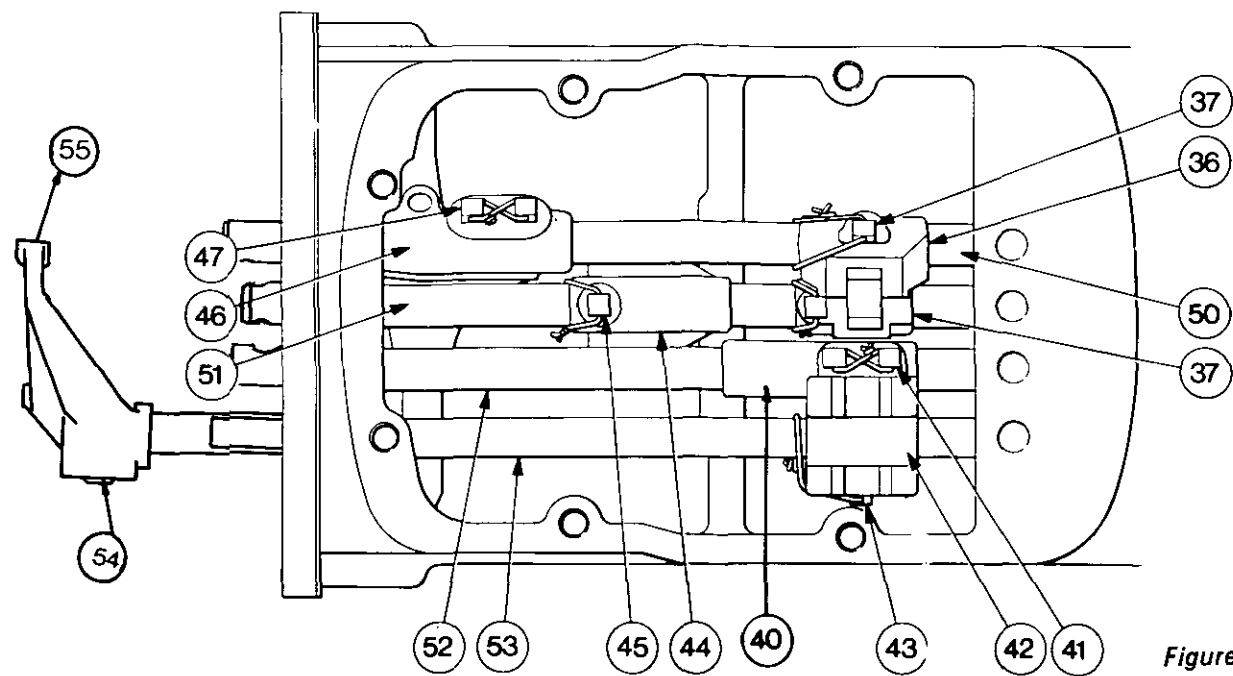


Figure 10

**KEY TO FIGURES 9 and 10
MK II 12 Speed Transmission (Ref. E)**

- 1 Clutch release bearing
- * 2 Clutch release bearing carrier
- * 3 Clutch release fork locking peg
- * 4 Clutch release fork
- * 5 Clutch release bearing return spring
- * 6 Input housing securing bolts
- * 7 P.t.o. input shaft seal
- * 8 P.t.o. input shaft needle roller bearing
- * 9 Input housing
- * 10 P.t.o. input shaft bearing securing external circlip
- * 11 Input housing 'O' ring
- 12 P.t.o. input shaft bearing
- * 13 P.t.o. input shaft securing internal circlip
- 14 P.t.o. input shaft
- 15 Main drive input shaft seal
- 16 Main drive input shaft front bush
- 17 Main drive input shaft
- 18 Mainshaft bush
- * 20 Main drive input gear thrust washer
- 21 Main drive input gear (high)
- 22 Main drive input gear spacer
- 23 Main drive input gear (low)
- * 24 Main drive input shaft spacer
- * 25 Mainshaft needle roller bearing
- 27 P.t.o. front bearing cover securing bolts
- 28 P.t.o. front bearing cover
- 29 P.t.o. front bearing cover 'O' ring
- 30 P.t.o. front bearing securing circlip
- * 31 P.t.o. shaft securing circlip
- * 32 P.t.o. shaft spacer washer
- 33 P.t.o. shaft front bearing
- 34 P.t.o. front bearing housing
- 35 P.t.o. front bearing housing gasket
- 36 Second and third engagement dog
- 37 Second and third engagement dog locking peg
- * 38 First and reverse engagement dog
- * 39 First and reverse engagement dog locking peg
- 40 High/Low synchronmesh selector fork
- 41 High/Low synchronmesh selector fork locking pegs
- 42 High/Low gear lever engagement dog
- 43 High/Low gear lever engagement dog locking peg
- 44 First and reverse selector fork
- 45 First and reverse selector fork locking peg
- 46 Second and third selector fork
- 47 Second and third selector fork locking pegs
- * 48 Detent springs
- * 49 Detent plungers
- 50 Second and third selector rail
- 51 First and reverse selector rail
- 52 High/Low synchronmesh selector rail
- 53 High/Low selector rail
- 54 High/Low selector fork locking peg
- 55 High/Low selector fork
- * 56 Internal stop plate
- * 57 Internal plain plate
- * 58 Internal ball
- * 59 Internal cross peg
- * 60 Internal ball carrier
- * 61 Internal mechanism securing bolts
- 62 Mainshaft rear bearing
- 63 Mainshaft bearing locating snap ring
- * 64 Mainshaft rear bearing rear securing snap ring
- 65 Mainshaft
- * 66 Epicyclic shim
- 67 Epicyclic front plate
- 68 Epicyclic Belleville
- 69 Epicyclic ring gear dowel
- 70 Epicyclic ring gear
- * 71 Epicyclic front thrust ring
- * 72 Epicyclic planetary pinion shaft securing circlip
- 73 Epicyclic planetary pinion carrier
- * 74 Epicyclic planetary pinion shaft
- * 75 Planetary pinion front thrust washer
- * 76 Planetary front roller set
- * 77 Planetary pinion
- * 78 Planetary roller spacer
- * 79 Planetary rear roller set
- * 80 Planetary pinion rear thrust washer
- * 81 Epicyclic rear thrust ring
- * 82 Epicyclic cover plate
- 83 Epicyclic securing bolts
- 84 High/Low shift coupler
- * 85 P.t.o. shaft rear oil seal
- 86 P.t.o. drive shaft
- * 87 Layshaft rear needle roller bearing
- 88 Layshaft rear bearing securing snap ring
- 89 Layshaft rear bearing location snap ring
- 90 Layshaft rear bearing
- 91 Layshaft
- * 92 Reverse gear cluster shaft
- * 93 Reverse gear cluster shaft retaining plate
- * 94 Tab washer
- * 95 Reverse gear cluster shaft securing bolt
- * 96 Mainshaft front bearing front securing snap ring
- * 97 Mainshaft front bearing
- * 98 Mainshaft front bearing thrust washer
- 99 First gear (mainshaft)
- * 100 Splined sleeve (first gear)
- 101 First and reverse sliding coupler
- * 102 Splined sleeve (reverse/third gear)
- 103 Reverse gear (mainshaft)
- * 104 Thrust washer (reverse/third gear)
- 105 Third gear (mainshaft)
- 106 Front synchronizer ring (second/third)
- 107 Synchronmesh sliding coupler (second/third)
- 108 Synchronmesh pressure block (second/third)
- 109 Synchronmesh pressure plunger (second/third)
- 110 Synchronmesh pressure spring (second/third)
- * 111 Synchronmesh drive hub (second/third)
- 112 Rear synchronizer ring (second/third)
- 113 Second gear (mainshaft)
- * 114 Splined sleeve (second gear)
- * 115 Mainshaft rear bearing thrust washer
- 116 P.t.o. constant mesh gear location circlip
- 117 P.t.o. constant mesh gear
- * 118 P.t.o. constant mesh gear securing circlip
- 119 Main drive constant mesh gear (high) thrust washer
- * 120 Splined coupler (main drive constant mesh gear high)
- 121 Main drive constant mesh gear (high)
- * 122 Front synchronizer ring (high/low)
- * 123 Synchronmesh drive hub retaining circlip
- 124 Synchronmesh sliding coupler (high/low)
- * 125 Synchronmesh pressure block (high/low)
- * 126 Synchronmesh pressure plunger (high/low)
- * 127 Synchronmesh pressure spring (high/low)
- * 128 Synchronmesh drive hub (high/low)
- 129 Rear synchronmesh ring (high/low)
- * 130 Splined coupler (main drive constant mesh gear low)
- 131 Main drive constant mesh gear (low)
- * 132 Main drive constant mesh gear (low) thrust washer
- 133 Layshaft front bearing
- 134 Third gear location circlip
- 135 Third gear (layshaft)
- 136 Second gear (layshaft)

*Not annotated on illustrations.

SELECTOR RAIL MECHANISM GEARBOX TYPES A, B, C, D, E

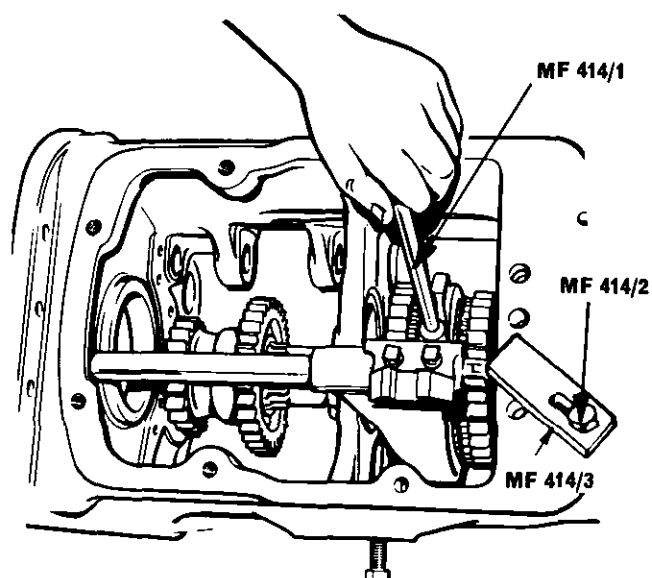
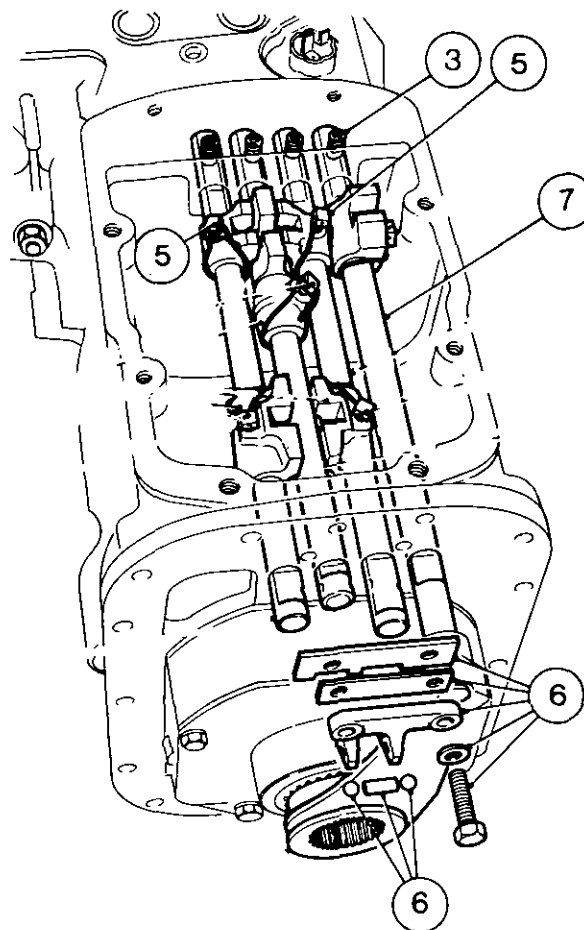
Special Tools: 2700 Rail Trolley
MF 414/1 Centralising Pin
MF 414/2 Clamp Bolt
MF 414/3 Locating Peg

Removal 5B-01-09

1. Split the tractor between the transmission and the centre housing, Part 3A.
2. Remove the gearbox top cover and gasket, Part 7B.
3. Lift out the springs and plungers.
4. Remove locking wires.
5. Loosen the locking pegs.
6. Remove the bolts, fork, balls, peg, stop plate and plain plate.
7. Slide rails rearwards out of the casting retaining the gear lever engagement dogs and selector forks on each rail.

Refitment

8. Reverse procedures 1 to 7 except:
 - (a) Apply a few drops of oil to the selector rails before refitment.
 - (b) Tighten stop plate bolts to a torque of 47 Nm (35 lbs ft).
 - (c) Tighten all locking pegs to a torque of 42 Nm (31 lbs ft).
 - (d) On completion of the refitting procedure, place all the gear lever engagement dogs in the neutral position.
 - (e) Set the synchromesh selector fork to the neutral position by locating the selector rail with locating peg MF 414/3 clamped to casting with bolt MF 414/2. Insert centralizing pin MF 414/1 into hole in top of the selector fork, lining it up with the hole in the sliding coupler. Tighten locking pegs to the correct torque and replace locking wire.
 - (f) **GEARBOX TYPE E ONLY**
Set the high and low synchromesh selector fork as described in (e).



TRANSMISSIONS

HEAVY DUTY EPICYCLIC UNIT GEAR BOX TYPES A, B, C, D, E

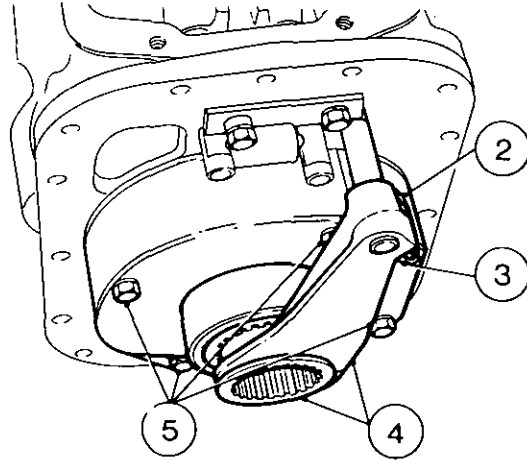
Special Tools: MS 2700 Rail Trolley

Removal 5B-02-10

1. Split the tractor between the transmission and the centre housing, Part 3A.
2. Remove the locking wire.
3. Remove the locking peg.
4. Remove the selector fork and coupling.
5. Remove the bolts.
6. Remove the complete assembly.

Refitment

7. Reverse the procedures 1 to 6, except:
 - (a) Ensure that the front and rear thrust rings are correctly located before refitment.
 - (b) Ensure that the epicyclic dowels are correctly located in the gearbox casing.
 - (c) Locate the cover plate with the cut out in the bottom left hand corner.
 - (d) Do not fit a lock washer to the lower left hand retaining bolt.
 - (e) *Tighten the retaining bolts progressively and evenly to a torque of 47 Nm (35 lbf ft).*



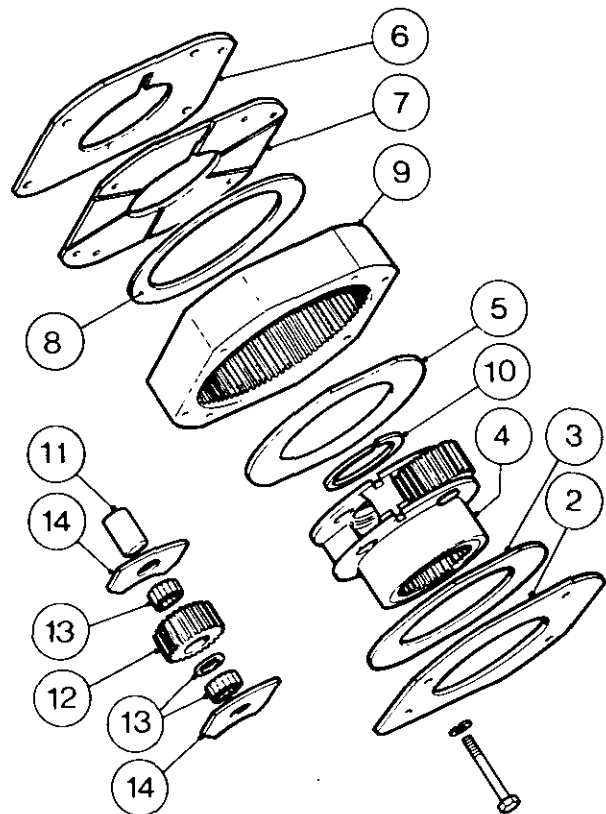
SERVICING THE HEAVY DUTY EPICYCLIC UNIT GEAR BOX TYPES A, B, C, D, E

Disassembly 5B-03-10

1. Remove the gearbox epicyclic, operation 5B-02-10.
2. Remove the cover plate.
3. Remove the rear thrust ring.
4. Remove the planetary pinion carrier.
5. Remove the front thrust ring.
6. Remove the shim.
7. Remove the front plate.
8. Remove the spring Belleville disc.
9. If necessary, remove the dowel pins from the planetary ring gear.
10. Remove the external snap ring.
11. Gently tap out the three pinion shafts towards the front.
12. Remove the planetary pinions.
13. Remove the two sets of rollers and spacer from each pinion.
14. Remove the wear plates from each side of each pinion.

Reassembly

15. Reverse procedures 1 to 14, except:
 - (a) When replacing the rollers in the pinions, a smear of petroleum jelly (not grease) will help retain them. Do not omit the spacer from between the two runs of rollers. Each run consists of 16 rollers.
 - (b) Ensure the Belleville spring disc is located correctly in the epicyclic ring gear with the concave face rearwards.
 - (c) The front plate and the cover plate must be positioned with the oil grooves towards the pinion carrier.
 - (d) Ensure that the pinion wear plates are refitted with the flats positioned innermost to the centre of the pinion-carrier.
 - (e) Ensure the gap of snap ring is located midway between the planetary pinion shafts.
 - (f) Always fit the same thickness of shims as those removed.



- (g) To facilitate fitment of the front and rear thrust rings on the pinion carrier, smear with petroleum jelly (not grease). Ensure that the tabs on the thrust rings locate in the pinion carrier cut-outs, and that the brass faces are away from the pinion carrier.

**CLUTCH RELEASE MECHANISM
GEARBOX TYPES A, B, C, D, E**

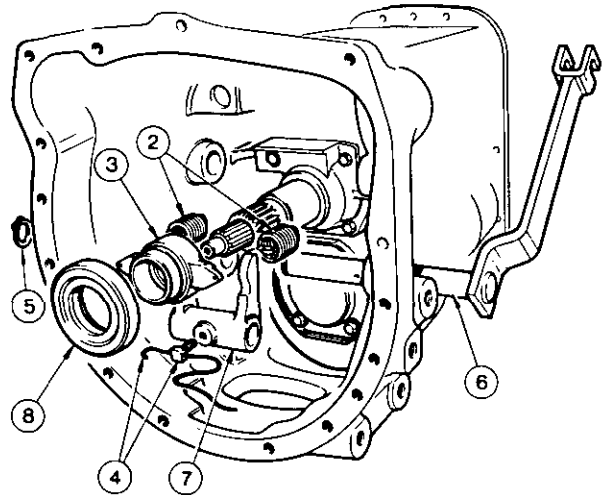
Special Tools: MS 2700 Rail Trolley

Removal 5B-04-11

1. Split the tractor between the engine and the transmission, Part 3A.
2. Remove the two springs.
3. Slide the carrier and release bearing off the input housing.
4. Remove the locking wire and locking peg.
5. Remove the circlip.
6. Remove the shaft.
7. Remove the clutch release fork.
8. Press the release bearing off the carrier.

Refitment

9. Reverse procedures 1 to 8, except:
 - (a) Lightly lubricate the input shaft splines and the release bearing carrier bore, with special grease Mobilgrease Super.
 - (b) Ensure that the locking peg locates in the hole in the shaft.



TRANSMISSIONS

INPUT SHAFT HOUSING AND P.T.O. INPUT SHAFT GEARBOX TYPES A, B

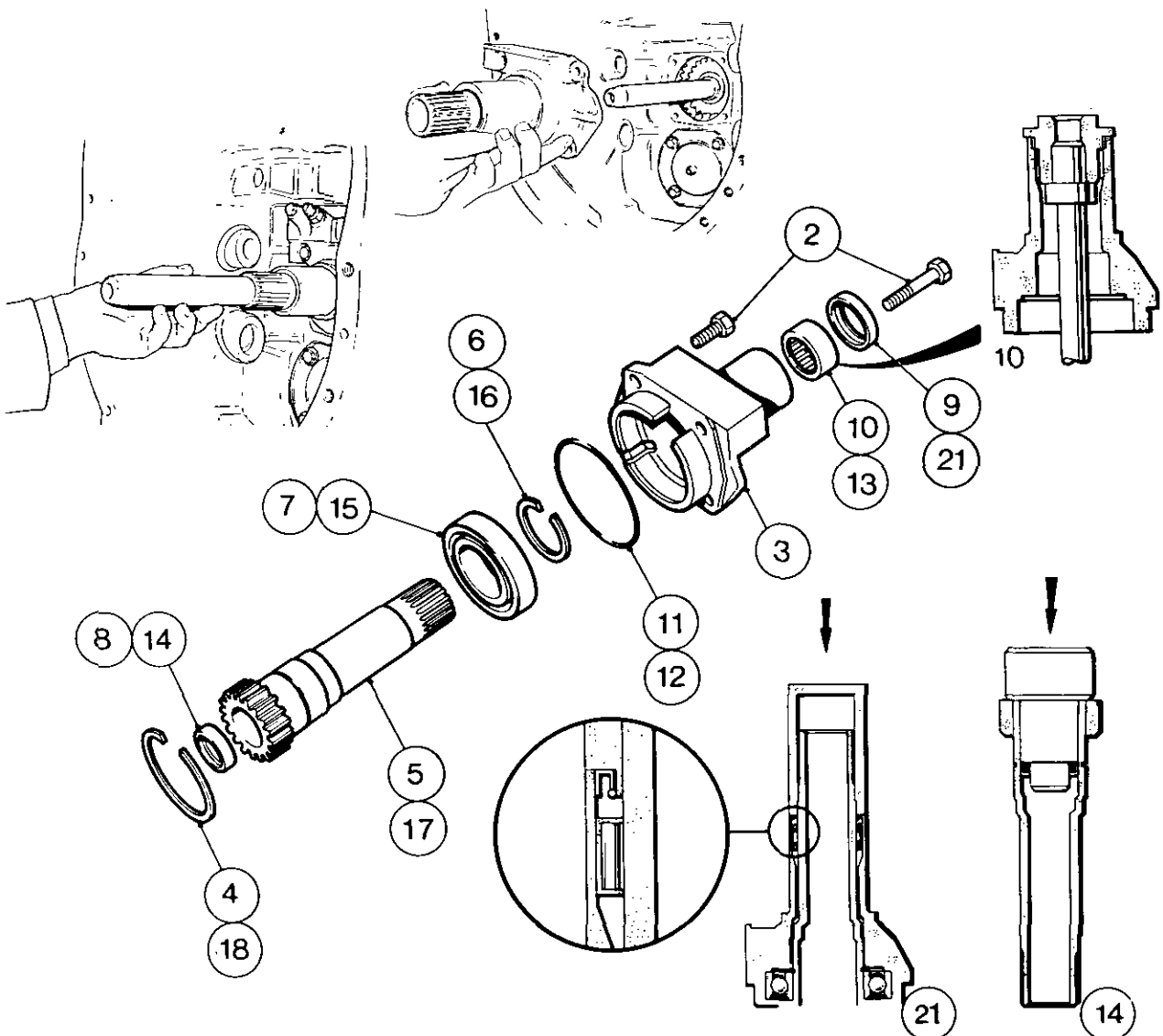
Special Tools: MS 2700 Rail Trolley
MF 315A Needle Roller Bearing and Seal Removal/Replacer Tool
MF 331 Oil Seal Replacer Tool
MF 255B/2 Cone
MF 255B/1 Oil Seal Replacer
KMF 1004/1 Protector Sleeve

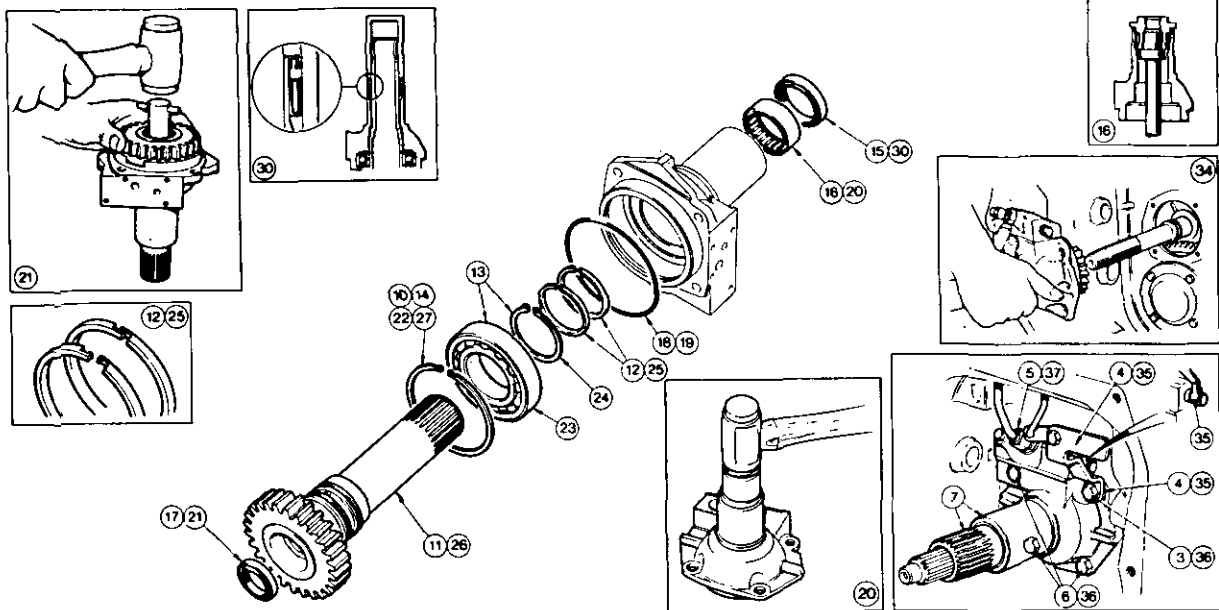
Removal 5B-05-12

1. Remove the clutch release mechanism, operation 5B-04-11.
2. Remove the four bolts.
3. Withdraw the input housing complete with the p.t.o. input shaft.
4. Remove the large internal circlip.
5. Push the p.t.o. input shaft complete with bearing rearwards out of the housing.
6. If necessary remove the circlip.
7. If necessary press the bearing off.
8. Lever the seal out.
9. Lever the seal out.
10. Using MF 315A, remove the needle roller bearing.
11. Remove the 'O' ring (p.t.o. input shaft housing).

Refitment

12. Fit a new 'O' ring (p.t.o. input shaft housing).
13. Using MF 315A replace the needle roller bearing.
14. Using MF 331 fit a new seal, with the toe of the seal facing the tool.
15. Refit the bearing with the shield towards the gear teeth.
16. Refit the circlip (check that it is properly seated).
17. Refit the p.t.o. input shaft and bearing into the input housing.
18. Refit the circlip (check that it is properly seated).
19. Place the cone adaptor MF 255B/2 on to seal replacer MF 255B/1.
20. Place the seal over the cone and onto the tool with the seal toe facing away from the tool and remove the cone.
21. Place the tool over the p.t.o. input shaft and tap the seal into place.
22. Place the KMF 1004/1 over the splines of the main input shaft. Reverse procedures 2 and 3. Remove tool.
23. Refit the clutch release mechanism, operation 5B-04-11. Procedure 9.





INPUT SHAFT HOUSING AND P.T.O. INPUT SHAFT GEARBOX TYPES C, D

Special Tools: MS 2700 Rail Trolley
 MF 315A Needle Roller Bearing and Seal Removal /Replacer Tool
 MF 256A Oil Seal Replacer
 MF 255B/2 Cone
 MF 255B/1 Oil Seal Replacer
 KMF 1004/1 Protector Sleeve
 KMF 1004/2 Guide

Removal 5B-06-13

1. Remove the clutch release mechanism, operation 5B-04-11.
2. Disconnect the Multi-Power linkage on the top of the transmission case.
2. Remove the R.H. upper bolt.
4. Remove the internal Multi-Power linkage and washer.
5. Disconnect the pipe.
6. Remove the remaining three bolts.
7. Withdraw the input housing complete with the p.t.o. shaft.
8. Remove the four Allen screws securing the spool valve to the input housing.
9. Remove the spool valve and gasket.
10. Dislocate the large internal circlip from the input housing groove.
11. Push the p.t.o. shaft complete with bearing rearwards out of the housing.
12. Unclip and remove the two sealing rings.
13. If necessary, remove the circlip and press the bearing off the front of the shaft.
14. Remove the circlip.
15. Lever the seal out.
16. Using MF 315A remove the needle roller bearing.
17. Remove the seal.
18. Remove the 'O' ring (input shaft housing).

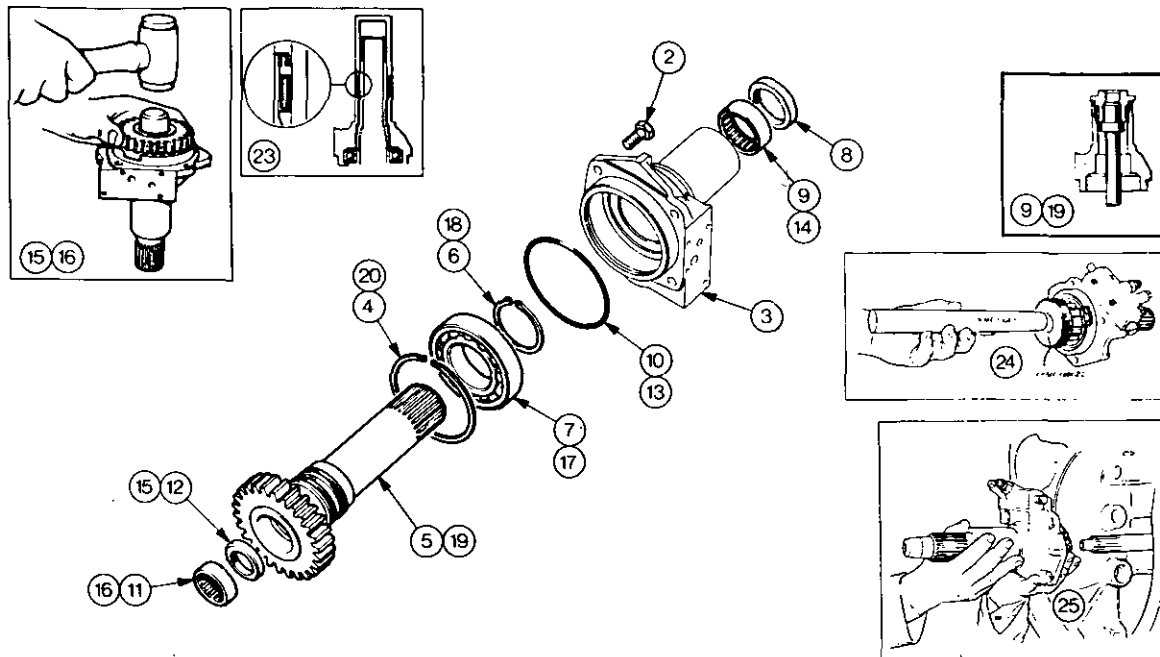
Examine the bore of the p.t.o. input shaft and the input housing for grooves, where the sealing rings locate. If any of the above parts show signs of wear or damage, they must be replaced. Check (and if necessary, replace) the ball and needle roller bearings

Refitment

- (a) Use petroleum jelly (not grease) to lubricate all seals and the needle roller bearing when refitting.

19. Fit a new 'O' ring (input shaft housing).
20. Using MF 315A replace the needle roller bearing.
21. Using MF 256A, fit a new seal, with the toe of the seal facing the tool.
22. Refit the circlip on the shaft.
23. Refit the bearing with the shield towards the gear teeth.
24. Refit the circlip (check that it is properly seated).
25. Fit two new cast iron sealing rings on the p.t.o. input shaft and ensure that they are correctly clipped, then lubricate the shaft with clean transmission oil.
26. Carefully refit the p.t.o. input shaft and bearing into the input housing, ensuring that the cast rings are not damaged.
27. Re-locate the circlip in the input housing (check that it is properly seated).
28. Place the cone adaptor MF 255B/2 onto seal replacer MF 255B/1.
29. Place a new seal over the cone and onto the tool, with the toe of the seal facing away from the tool and remove the cone.
30. Place the tool over the p.t.o. shaft and tap the seal into place.
31. Refit the spool valve and a new gasket (fitted dry) and tighten the Allen screws evenly.
32. Fit two new cast iron sealing rings on the main input shaft.
33. Carefully push guide KMF 1004/2 into the rear end of the p.t.o. input shaft. Carefully insert tapered end of protector sleeve KMF 1004/1 through guide. Remove the guide leaving the sleeve in position.
34. Carefully refit the input housing, and withdraw the protector sleeve.
35. Refit the washer and Multi-Power linkage, ensuring that the actuator locates in the slot in the spool.
36. Lightly coat the bolt threads in a recommended sealant 'B', refit and tighten them to a torque of 60 Nm (45 lbf ft).
37. Refit the pipe.
38. Refit the external Multi-Power linkage.
39. Refit the clutch release mechanism, operation 5B-04-11. Procedure 9.

TRANSMISSIONS



INPUT SHAFT HOUSING AND P.T.O. INPUT SHAFT GEARBOX TYPE 'E'

Special Tools: MS 2700 Rail Trolley
 No. 315A Needle Roller Bearing and Seal Removal/Replacer Tool
 MF 421 Needle Roller Bearing and Seal Replacer.
 MF 255B/2 Cone
 MF 255B/1 Oil Seal Replacer
 KMF 1004/1 Protector Sleeve
 KMF 1004/3 Protector Guide
 MF 422 Roller Bearing/Oil Seal Remover Tool

Removal 5B-07-14

- 1 Remove the clutch release mechanism. Operation 5B-04-11.
- 2 Remove the four bolts.
- 3 Withdraw the input housing complete with the p.t.o. input shaft.
- 4 Remove the large internal circlip.
- 5 Push the p.t.o. input shaft complete with bearing rearwards out of the housing.
- 6 If necessary, remove the circlip.
- 7 If necessary, press the bearing off.
- 8 Lever the seal out of the front of the housing.
- 9 Using MF 315A, remove the needle roller bearing from the front of the housing.
- 10 Remove the 'O' Ring from the housing.

Refitment

- 11 Using MF 422 carefully remove the needle roller bearing from the input shaft.
- 12 Using MF 422 remove the oil seal from the input shaft.

- 13 Fit a new 'O' ring into the housing.
- 14 Using MF 315A, replace the needle roller bearing in the housing.
- 15 Using MF 421 fit a new seal into the input shaft with the toe of the seal facing the tool.
- 16 Using MF 421 refit needle roller bearing into the input shaft with the *round* end of the cage to the bottom of the recess.
- 17 Refit the bearing onto the outside of the shaft with the shield towards the gear teeth.
- 18 Refit the circlip (check that it is properly seated).
- 19 Refit the p.t.o. input shaft and bearing into the input housing.
- 20 Refit the circlip (check that it is properly seated).
- 21 Place the cone adaptor MF 255B/2 on the seal replacer MF 255B/1.
- 22 Place the seal over the cone and onto the tool with the seal toe facing away from the tool and remove the cone.
- 23 Place the tool over the p.t.o. input shaft and tap the seal into place.
- 24 Carefully push guide KMF 1004/2 into the rear end of the p.t.o. input shaft. Carefully insert tapered end of protector sleeve KMF1004/1 through guide. Remove the guide leaving the sleeve in position.
- 25 Carefully refit the input housing, and withdraw the protector sleeve.
- 26 Refit the clutch release mechanism. Operation 5B-04-11, procedure 9.
 - (a) Use petroleum jelly (not grease) to lubricate all seats and the needle roller bearing when refitting.
 - (b) Lightly coat the bolt threads in recommended sealant 'B' when refitting, and tighten the bolts to a torque of 60 Nm (45 lbf ft).

P.T.O. DRIVESHAFT FRONT BEARING GEARBOX TYPES A, B, C, D, E

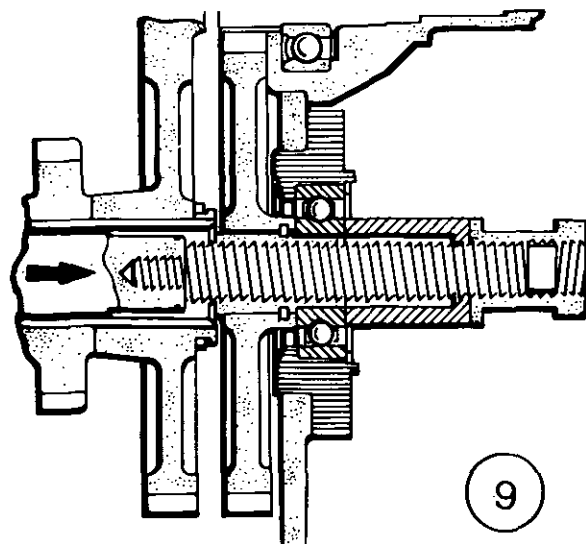
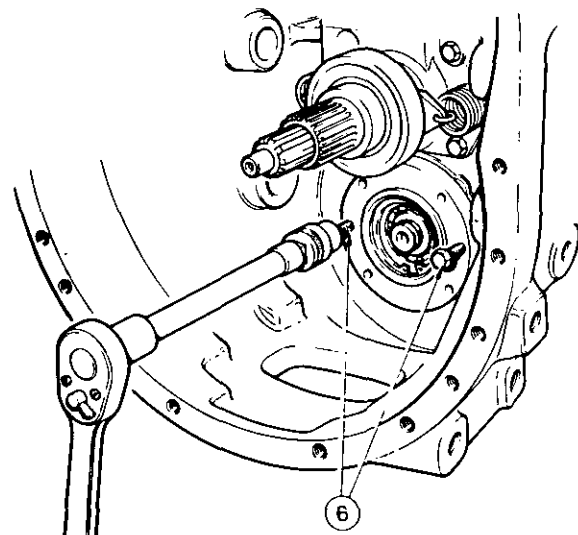
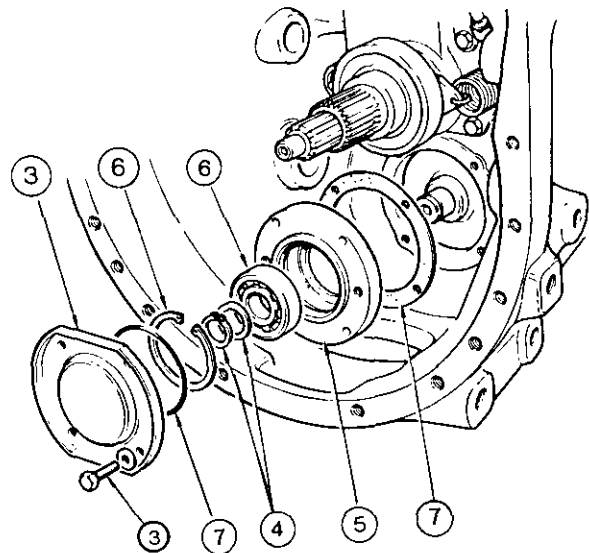
Special Tools: MS 2700 Rail Trolley
MF 218A P.t.o. Driveshaft Puller
MF 218A/2 Adaptor

Removal 5B-08-15

1. Remove the clutch release cross shaft, operation 5B-04-11. Procedures 1 to 7.
2. If fitted, remove hydraulic pipe from centre of cover plate.
3. Remove the bolts, washers and cover plate.
4. Remove circlip and washer from end of p.t.o. driveshaft.
5. Screw two $\frac{3}{8}$ UNC \times 75 mm (3 in) bolts into two diametrically opposite tapped holes in the bearing housing. Tighten evenly to remove the housing.
6. Remove the circlip from inside the housing and press out the bearing.
7. Discard the 'O' ring, gasket and circlip.

Refitment

8. Reverse procedures 6 and 7 except:
 - (a) Fit a new 'O' ring, gasket and circlip.
 - (b) Lightly coat the gasket with recommended sealant 'A'.
9. Using MF 218A and MF 218A/2, refit the bearing and housing assembly.
10. Fit new circlip and washer on end of p.t.o. driveshaft.
11. Reverse procedures 1-3 except:
 - (a) lightly coat the securing bolt threads with recommended sealant 'B'.
 - (b) Tighten bolts to a torque of 60 Nm (45 lbs ft).



TRANSMISSIONS

**SECOND GEAR—MAINSHAFT
GEARBOX TYPES A, B**

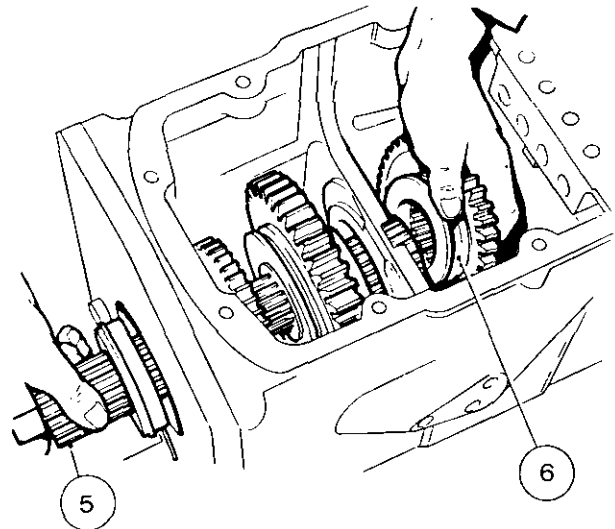
Special Tools: MS 2700 Rail Trolley
MF 414/1 Centralising Pin
MF 414/2 Clamp Bolt
MF 414/3 Locating Peg
KMF 1004/1 Protector Sleeve

Removal **5B-09-16**

1. Remove the input shaft housing and p.t.o. input shaft. Operation 5B-05-12. Procedures 1-3.
2. Remove the selector rail mechanism. Operation 5B-01-09. Procedures 1-7.
3. Remove the gearbox epicyclic unit. Operation 5B-02-10. Procedures 2-6.
4. Release snap ring on mainshaft and manoeuvre it towards the front of the mainshaft.
5. Withdraw mainshaft rearwards clear of gear.
6. Remove the gear.

Refitment

7. Reverse procedures 3 to 6.
8. Refit selector rails. Operation 5B-01-09. Procedure 8.
9. Refit input shaft housing and p.t.o. input shaft. Operation 5B-05-12. Procedures 22 and 23.



**MAIN INPUT SHAFT
GEARBOX TYPES A, B**

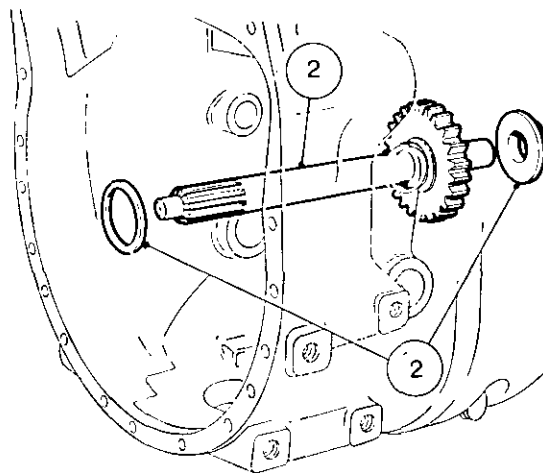
Special Tools: As Operation 5B-09-16

Removal **5B-10-17**

1. Remove second gear from the mainshaft. Operation 5B-09-16, procedures 1-6.
2. From the rear, remove the main input shaft together with the two thrust washers.

Refitment

3. Reverse procedure 2 except:
 - (a) Ensure that the thrust washer, with oil grooves, is placed on the rear of the main input shaft, with the oil grooves facing the rear of the gearbox, and that it is lightly oiled.
4. Refit the second gear. Operation 5B-09-16. Procedures 7-9.



TRANSMISSIONS

MAIN INPUT SHAFT AND MULTI-POWER CLUTCH UNIT GEARBOX TYPE D

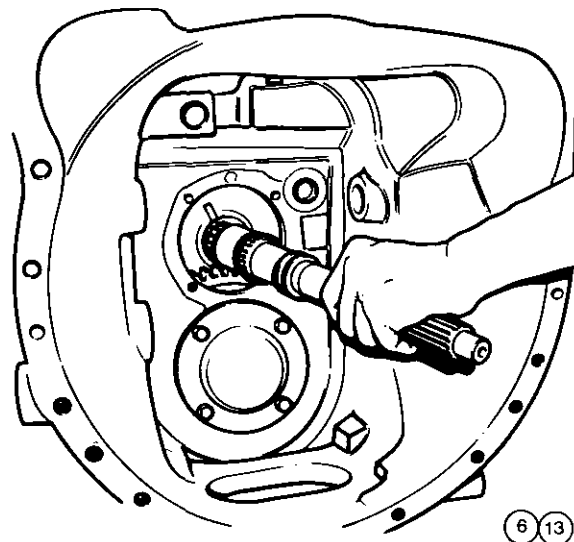
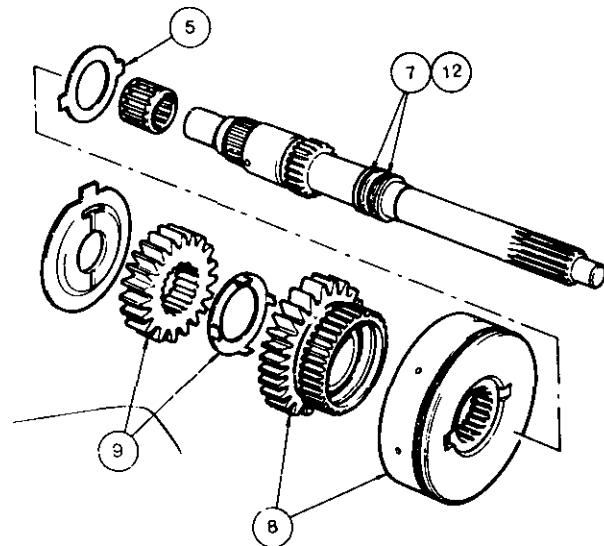
Special Tools: As Operation 5B-09-16 and KMF 1104/2 Guide

Removal 5B-11-18

1. Remove the selector rail mechanism.
Operation 5B-01-09. Procedures 1-7.
 2. Remove clutch release mechanism.
Operation 5B-04-11. Procedures 1-7.
 3. Using feeler gauge, measure the gap between the front thrust washer and the p.t.o. input shaft pinion. If it exceeds 1,65 mm (0.065 in) record the dimension for later use.
 4. Remove the input shaft housing and p.t.o. input shaft. Operation 5B-06-13. Procedures 2-7.
 5. Remove the Multi-Power clutch front thrust washer.
 6. Withdraw the main input shaft forwards out of the transmission casing and simultaneously steady the Multi-Power clutch unit, main input overdrive pinion and the main drive pinion whilst the splines are disengaged.
- NOTE: Ensure that the Multi-Power clutch rear thrust washer does not fall into the bottom of the transmission casing.**
7. Unclip and remove the sealing rings.
 8. Remove the clutch unit and main input overdrive pinion.
 9. Remove the Multi-Power clutch rear thrust washer and the main drive pinion.
 10. Examine the bore of the input p.t.o. shaft for grooves where the sealing rings locate and replace the shaft if any scoring or grooves are found. If excessive wear or scoring is found, the input housing and p.t.o. input shaft must be serviced as in operation 5B-06-13, procedures 8 to 31.

Refitment

11. Place the Multi-Power clutch unit, main input overdrive pinion, rear thrust washer and the main drive pinion forward of the centre web in the transmission casing, locating the gears with the overdrive and main drive layshaft gears.
- NOTE: Lightly smear the rear thrust washer with petroleum jelly (to help refitment) and fit the tabs facing forwards and located correctly on the rear boss of the main input overdrive pinion.**
12. Fit two new sealing rings to the main input shaft and ensure they are properly clipped.
 13. Carefully push the shaft rearwards into the front of the Multi-Power clutch unit and on into mesh with the main drive pinion. Ensure that the Multi-Power clutch unit and the main drive pinion are both located on the main input shaft splines and that the main input shaft is correctly located in the mainshaft needle roller bearing.
 14. If the gap between the front thrust washer and the p.t.o. input shaft pinion exceeded 1,65 mm (0.065 in) it must be replaced with one from the following chart, to give a gap of 0,63 mm (0.025 in)-minimum, 1,65 mm (0.065 in) maximum.



MF Part No.	Thickness m/m	Thickness ins
1661 951 M1	2,36/2,29	.093/.090
1667 607 M1	3,00/2,92	.118/.115
1667 608 M1	3,50/3,43	.138/.135

Refit the Multi-Power clutch unit front thrust washer and ensure the two tabs are correctly located in the cut-outs on the clutch unit.

15. Lubricate the main input shaft with clean transmission oil and refit the input shaft housing and p.t.o. input shaft, operation procedures 33 to 38.
16. Reverse procedures 1 and 2.

MAIN INPUT SHAFT AND MULTI-POWER CLUTCH UNIT GEARBOX TYPE 'C'

Removal and Refitment 5B-11A-18A

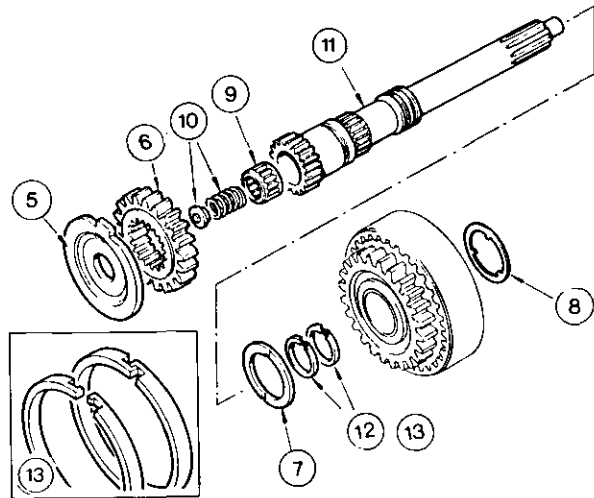
Special Tools: See Operation 5B-01-09 and
KMF 1004/1 Protector Sleeve
KMF 1004/2 Guide

Removal

1. Remove the selector rail mechanism. Operation 5B-01-09. Procedures 1-7.
2. Remove the input housing and p.t.o. input shaft. Operation 5B-06-13. Procedures 1-7.
3. Remove gearbox epicyclic unit. Operation 5B-02-10. Procedures 2-6.
4. Pull the mainshaft rearwards off the input shaft spigot.
5. Remove the tab located spacer.
6. Remove the main drive pinion.
7. Remove the thrust washer.
8. Remove the thrust washer.
9. Remove the roller bearing.
10. Remove the spring and abutment.
11. Push the shaft rearwards out of the gearbox.
12. Unclip and remove the cast iron sealing rings. Examine the bore of the input p.t.o. shaft for grooves where the sealing rings locate, and replace the shaft if any scoring or grooves are found. If excessive wear or scoring is found, the input housing and p.t.o. input shaft must be serviced as in operation 5B-06-13 procedures 8 to 32.

Refitment

13. Fit two new cast iron sealing rings to the main input shaft and ensure they are properly clipped. Lubricate the shaft with clean transmission oil.
14. Reverse procedures 1 to 11 except:
Ensure that the tab located washer is fitted with its convex side towards the Multi-Power clutch unit, and that the tab is correctly located.



MAINSHAFT AND GEARS GEARBOX TYPES A, C

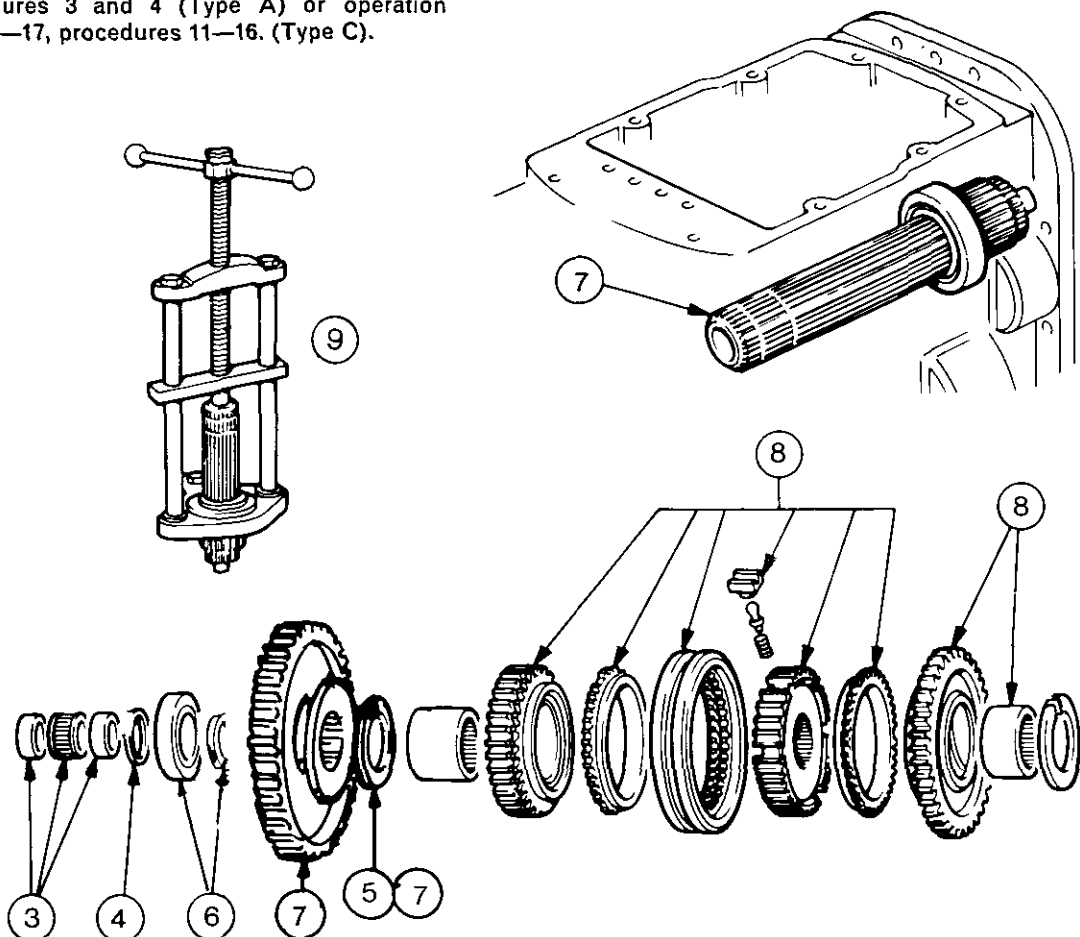
Special Tools: As operation 5B-10-17

Removal 5B-12-19

1. Remove main input shaft. Operation 5B-9-16, procedures 1 and 2. (Type A) or 5B-10-17, procedures 1-9 (Type C).
2. Remove gearbox epicyclic unit. Operation 5B-02-10. Procedures 2-6.
3. Remove the spigot roller bearings and two spacers.
4. Remove the snap ring from the front of the mainshaft.
5. Manoeuvre the snap ring out of groove in front of the third gear onto the shaft splines.
6. Slide the bearing forward out of the centre web and off the front of mainshaft together with snap ring.
7. Slide mainshaft rearward out of the gearbox casting at the same time moving the third snap ring forward, together with first/rev. sliding gear, and off the front end of the mainshaft.
8. Remove the gears and synchromesh unit.
9. If necessary remove snap ring and press the bearing off the front end of the mainshaft, using MF 200 and MF 200/25.
10. If necessary, remove the circlip from the bearing.

Refitment

11. Reverse procedures 3-8 except:
 - (a) ensure that all snap rings are correctly located in their grooves.
12. Refit gearbox epicyclic unit. Operation 5B-02-10, procedure 7.
13. Refit the main input shaft. Operation 5B-19-16, procedures 3 and 4 (Type A) or operation 5B-10-17, procedures 11-16. (Type C).



TRANSMISSIONS**MAINSHAFT AND GEARS
GEARBOX TYPES A, C**

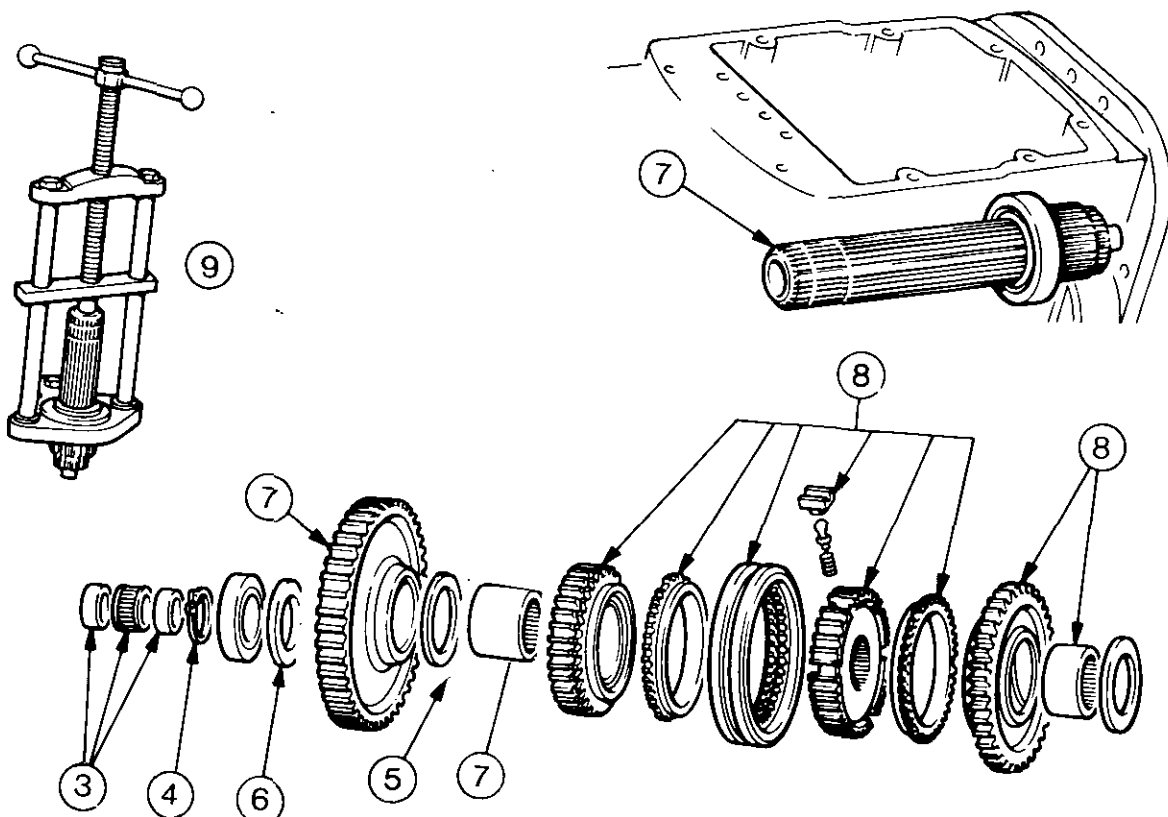
Special Tools: As Operation 5B-11-18

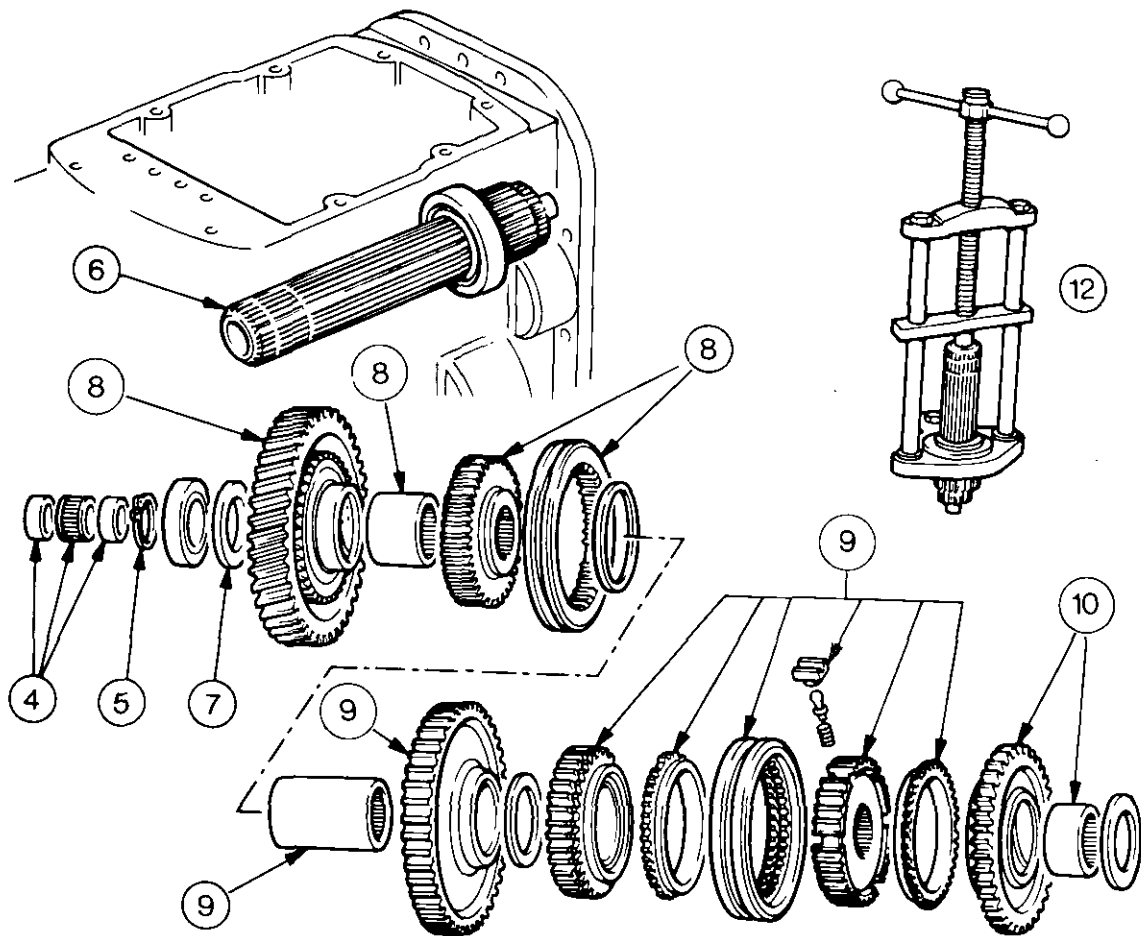
Removal**5B-13-20**

1. Remove main input shaft.
Operation 5B-10-17. Procedures 1 and 2.
(Type A) or 5B-11-18. Procedures 1-9
(Type C).
2. Remove gearbox epicyclic unit.
Operation 5B-02-10. Procedures 2-6.
3. Remove the spigot roller bearings and two spacers.
4. Remove the snap ring from the front of the mainshaft.
5. Manoeuvre the snap ring out of groove in front of the third gear onto the shaft splines.
6. Slide the bearing forward out of the centre web and off the front of mainshaft together with snap ring.
7. Slide mainshaft rearwards out of the gearbox casting at the same time moving the third snap ring forward, together with 1st/rev. sliding gear, and off the front end of the mainshaft.
8. Remove gears and synchromesh unit.
9. If necessary remove the snap ring and press the bearing off the front end of the mainshaft, using MF 200 and MF 200/25.
10. If necessary, remove the circlip from the bearing.

Refitment

11. Reverse procedures 3-8 except:
(a) Ensure that all snap rings are correctly located in their grooves.
12. Refit gearbox epicyclic unit.
Operation 5B-02-10. Procedure 7.
13. Refit the main input shaft.
Operation 5B-10-17. Procedures 3 and 4
(Type A) or Operation 5B-11-18. Procedures 11-16 (Type C).





MAINSHAFT AND GEARS GEARBOX TYPES B, D, E

Special Tools: As Operation 5B-11-18 and
MF 200 Hand Press
MF 200/25 Adaptor

Removal

5B-14-21

1. Remove main input shaft.
Operation 5B-10-17. Procedures 1 and 2 (Type B), 5B-11-18. Procedures 1-9 (Type D) or 5B-12-19. Procedures 1-7 (Type E).
2. Remove gearbox epicyclic unit.
Operation 5B-02-10. Procedures 2-6.
3. Using feeler gauges, measure the gap between the front thrust washer and the front bearing. If it exceeds 0,30 mm (0.012 in) record the dimension for later use.
4. Remove the spigot roller bearing (and two spacers on gearbox Type 'B' only).
5. Remove the snap ring from the front of the mainshaft.
6. Withdraw the mainshaft rearwards out of the gearbox casting.
7. Remove the front thrust washer.
8. Engage sliding coupler with first gear and remove together.
9. Engage synchromesh unit and remove together with reverse gear.
10. Remove remaining gear.
11. Remove the bearing from the centre web of the gearbox casting.
12. If necessary remove snap ring and press the bearing off the front end of the mainshaft, using MF 200 and MF 200/25.
13. If necessary, remove the circlip from the bearing.

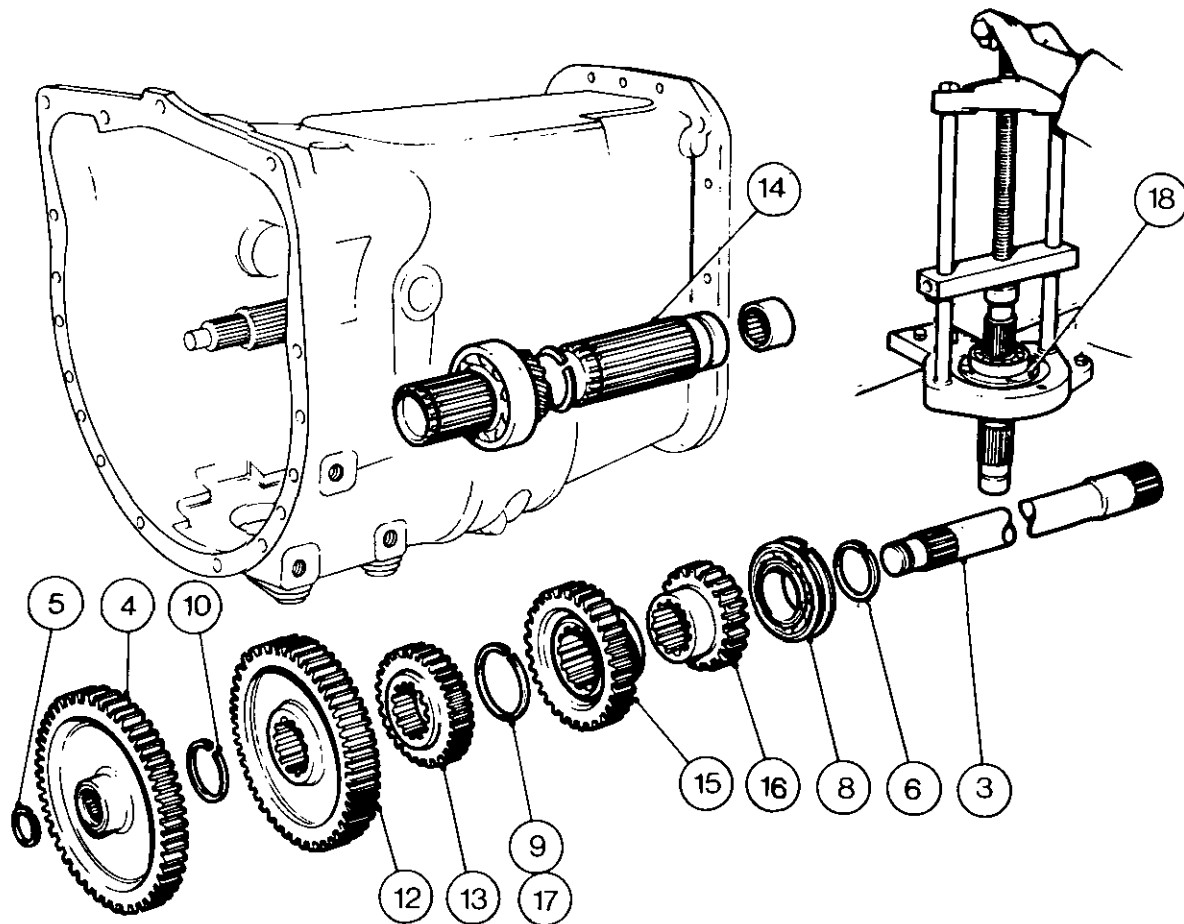
Refitment

14. Reverse procedures 4-11 except:
 - (a) If gap between the front thrust washer and the front bearing exceeded 0,30 mm (0.012 in) it must be replaced with one from the following chart to give a gap of 0,08 mm (0.003 in) minimum, 0,30 mm (0.012 in) maximum. It must be fitted with the shoulder towards the bearing.
 - (b) Ensure that snap rings are correctly located in their grooves.

THRUST WASHER CHART

MF Part No.	Thickness mm	Thickness ins
1671-888-M2	4,41 /4,19	.163/.165
1671-889-M1	4,39 /4,44	.173/.175
1671-890-M2	4,62 /4,67	.182/.184
1671-891-M2	4,85 /4,90	.191/.193
1671-892-M2	6,35 /6,40	.250/.252
1671-893-M2	6,58 /6,63	.259/.261
1671-894-M2	6,80 /6,85	.268/.270
1671-895-M2	7,03 /7,08	.277/.279

15. Refit gearbox epicyclic unit.
Operation 5B-02-10. Procedure 7.
16. Refit the main input shaft.
Operation 5B-10-17. Procedures 3 and 4 (Type B), Operation 5B-11-18. Procedures 11-16 (Type D) or Operation 5B-12-19. Procedures 8-10 (Type E).



LAYSHAFT AND GEARS, P.T.O. SHAFT AND GEAR GEARBOX TYPES A, B

Special Tools: As Operation 5B-14-21

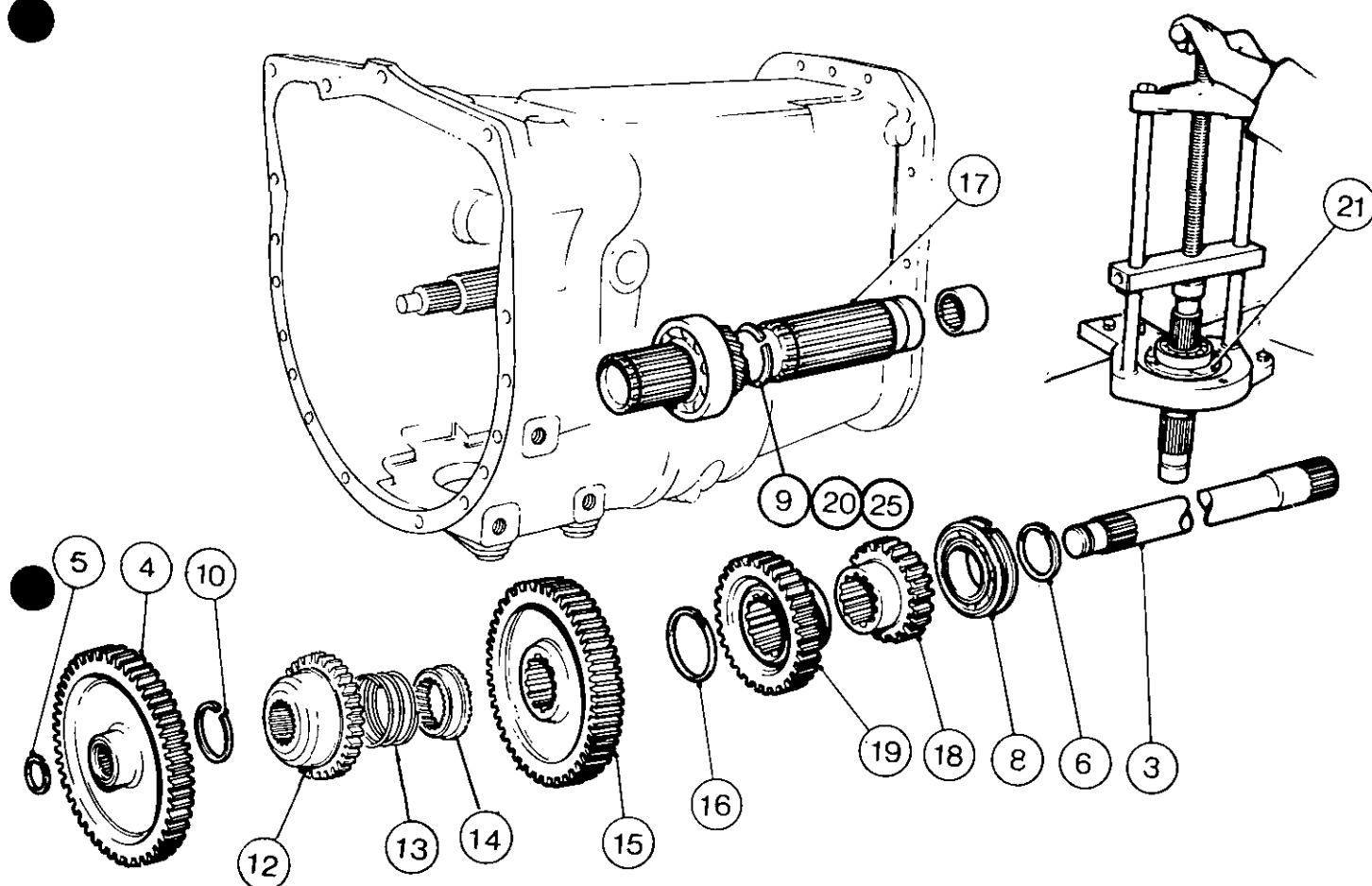
Removal

5B-15-22

1. Remove mainshaft and gears.
Operation 5B-13-20. Procedures 1-8 (Type A) or 5B-14-21. Procedures 1-11 (Type B).
2. Remove p.t.o. driveshaft front bearing.
Operation 5B-08-15. Procedures 2-5.
3. Withdraw the p.t.o. driveshaft rearwards out of the gearbox casing.
4. Withdraw the p.t.o. constant mesh gear.
5. Remove the small internal snap ring, (only if necessary).
6. Remove the snap ring from the rear of the layshaft.
7. Tap the layshaft forwards.
8. Remove the rear bearing.
9. Expose the snap ring, open it and slide it forwards onto the unsplined portion of the shaft.
10. Remove the snap ring from the front of the layshaft.
11. Relocate the front bearing in its web and tap the layshaft rearwards.
12. Remove the constant mesh gear.
13. Remove the second gear pinion.
14. Manoeuvre the layshaft forwards out of the gearbox.
15. Remove the third gear pinion.
16. Remove the fourth gear pinion.
17. Remove the snap ring.
18. Using MF 200 and MF 200/25, press the bearing off the front end of the layshaft.

Refitment

19. Reverse procedures 3 to 18 except:
Ensure that all snap rings are correctly located in their grooves.
20. Refit p.t.o. driveshaft front bearing.
Operation 5B-08-15. Procedures 8-11.
21. Refit mainshaft and gears.
Operation 5B-13-20. Procedures 11-13 (Type A) or Operation 5B-14-21. Procedures 14-16 (Type B).



LAYSHAFT AND GEARS, P.T.O. SHAFT AND GEAR GEARBOX TYPES C, D

Special Tools: As Operation 5B-14-21

Removal

5B-16-23

1. Remove mainshaft and gears. Operation 5B-13-20. Procedures 1-8 (Type C) or 5B-14-21. Procedures 1-11 (Type D).
2. Remove p.t.o. drive shaft front bearing. Operation 5B-08-15. Procedures 2-5.
3. Withdraw the p.t.o. drive shaft rearwards out of the transmission casing.
4. Remove the p.t.o. constant mesh gear.
5. Remove the small internal snap ring (only if necessary).
6. Remove the snap ring from the rear of the layshaft.
7. Tap the layshaft forwards.
8. Remove the rear bearing.
9. Expose the snap ring, open it and slide it forwards onto the unsplined portion of the shaft.
10. Remove the snap ring from the front of the layshaft.
11. Relocate the front bearing in the centre web and tap the layshaft rearwards.
12. Remove the overdrive layshaft gear.
13. Remove the spring.
14. Remove the coupler.
15. Remove the main drive layshaft gear.
16. Remove the thrust washer.
17. Locate the front bearing in the centre web and gently drive the layshaft forwards out of the gearbox.
18. Remove the second gear from the gearbox.
19. Remove the third gear from the gearbox.

20. If necessary, remove the circlip.
21. If necessary, press the bearing off the FRONT end of the layshaft using MF 200 and MF 200/25.

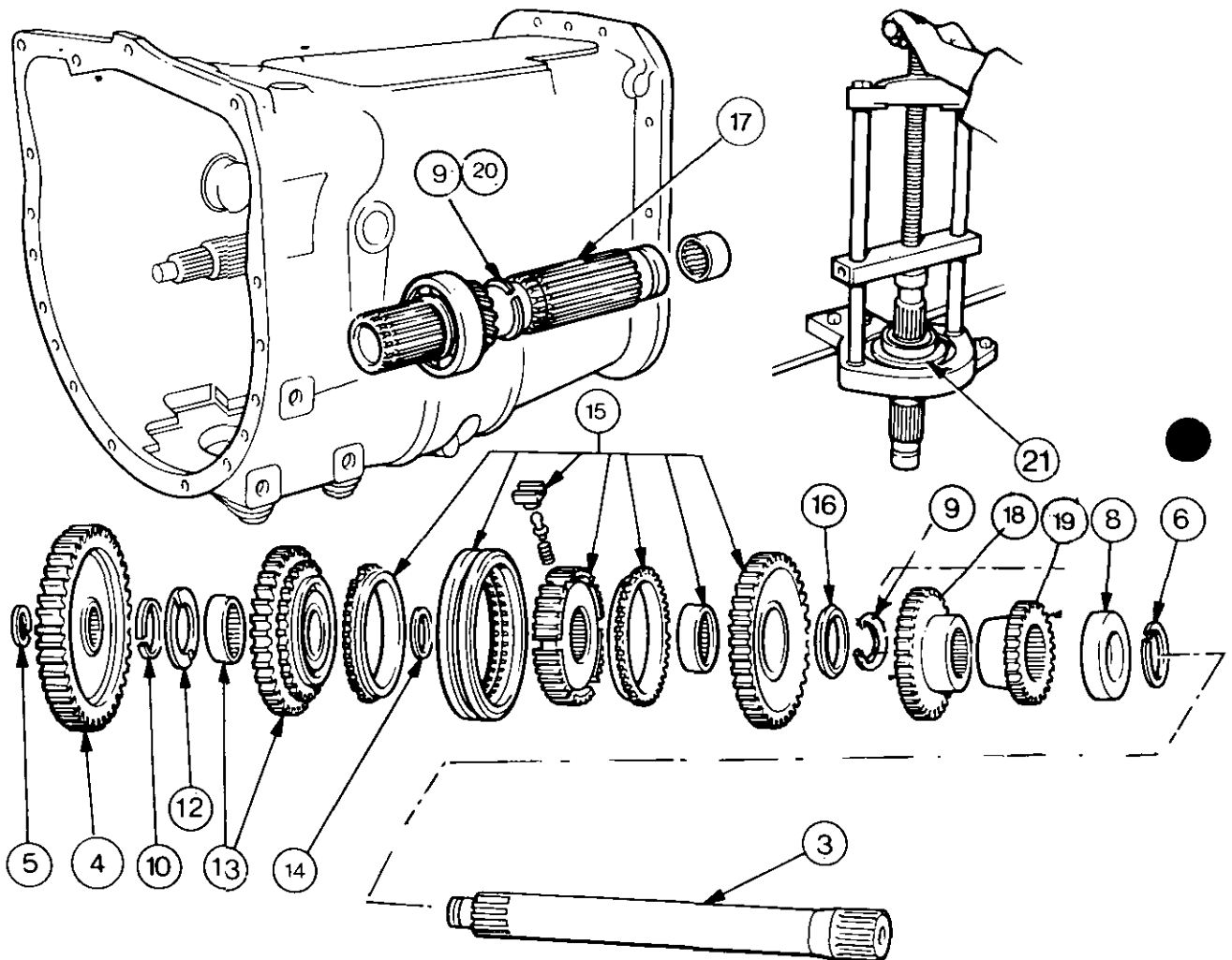
Examination

Check all components for wear or damage, and if they are faulty, they must be replaced.

Check the coupler spring, which should have a free length of 47,5 mm (1.75 in), a compressed length of 16,5 mm (0.65 in) and a minimum load of 10,2 kg (22.5 lb) when compressed, if not, it must be replaced. When reassembling the layshaft, fit a new thrust washer and snap rings, and lubricate all parts with clean transmission oil.

Refitment

22. Reverse procedures 18 to 21.
23. Refit the layshaft, locating the third and second gears on the splines at the same time, push the layshaft rearwards enough to allow the components on its front end to be fitted.
24. Reverse procedures 10 to 16.
25. Push the layshaft forwards and second and third gears back far enough to allow the snap ring to be correctly refitted.
26. Refit the rear bearing in the gearbox.
27. Tap the layshaft rearwards (locating it correctly in the bearing) far enough to allow the snap ring to be replaced correctly.
28. Reverse procedures 3 to 5.
29. Refit p.t.o. driveshaft front bearing. Operation 5B-08-15. Procedures 8-11.
30. Refit mainshaft and gears. Operation 5B-14-21. Procedures 14-16 (Type D) or Operation 5B-13-20. Procedures 11-13 (Type C).



LAYSHAFT AND GEARS, P.T.O. SHAFT AND GEAR GEARBOX TYPE E

Special Tools: As Operation 5B-14-21.

Removal

5B-17-24

1. Remove the mainshaft and gears. Operation 5B-14-21. Procedures 1-11.
2. Remove p.t.o. driveshaft front bearing. Operation 5B-08-15. Procedures 2-5.
3. Withdraw p.t.o. drive shaft rearwards out of the gearbox casting.
4. Withdraw the p.t.o. constant mesh gear.
5. Remove the small internal snap ring (only if necessary).
6. Remove the snap ring from the rear of the layshaft.
7. Tap the layshaft forwards.
8. Remove the rear bearing.
9. Expose the snap ring open it and slide it forwards on to the unsplined portion of the shaft.
10. Remove the snap ring from the front of the layshaft.
11. Relocate the front bearing in its web and tap the layshaft rearwards.
12. Remove front thrust washer.
13. Withdraw the constant mesh gear (high).
14. Remove circlip.
15. Withdraw synchromesh assembly and constant mesh gear (low).
16. Remove rear thrust washer.
17. Manoeuvre the layshaft forwards out of the gearbox.
18. Remove the third gear pinion.
19. Remove the second gear pinion.
20. Remove the snap ring.
21. Using MF 200 and MF 200/25, press the bearing off the front end of the layshaft.

Refitment

22. Reverse procedures 3 to 21 except:
 - (a) Ensure that all snap rings are correctly located in their grooves.
 - (b) Ensure that the front and rear thrust washers are correctly located with their shoulders facing away from the gears.
23. Refit p.t.o. driveshaft front bearing. Operation 5B-08-15. Procedures 8-11.
24. Refit mainshaft and gears. Operation 5B-14-21. Procedures 14-16.

THE MAINSHAFT SYNCHROMESH SERVICING GEARBOX TYPES A, B, C, D, E

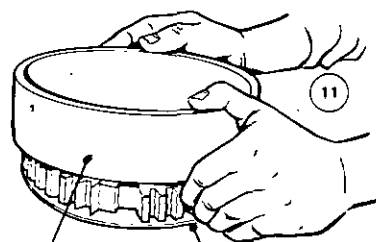
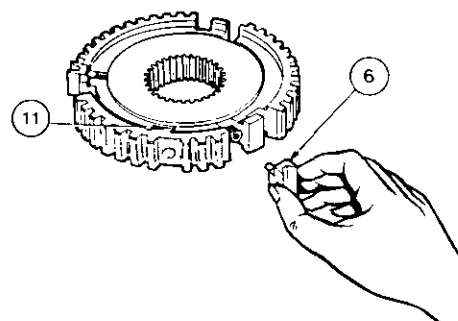
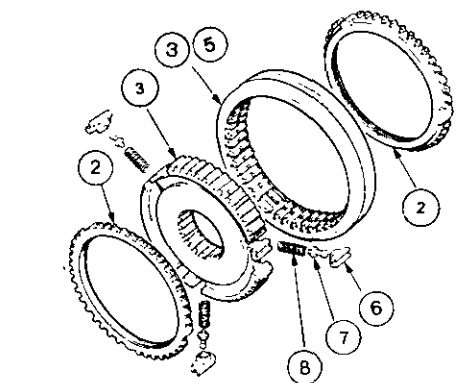
Special Tools: MF 415/1 Synchro Hub Assembly
Ring
MF 415/2 Synchro Hub Assembly
Plate
MF 550 Drive Handle

Disassembly 5B-18-25

1. Remove mainshaft and gears.
Operation 5B-13-20. Procedures 1-8 (Types A, C) or Operation 5B-14-21. Procedures 1-11 (Types B, D, E).
2. Remove the two synchronizer rings.
3. Remove the drive hub complete with the sliding coupler.
4. Wrap the hub and coupler in a cloth.
5. Remove the sliding coupler, taking care not to lose pressure springs, plungers and blocks.
6. Remove the three pressure blocks.
7. Remove the three pressure plungers.
8. Remove the three pressure springs.
9. Thoroughly clean all the components and check their condition.
10. Using a feeler gauge, measure the clearance between the synchronizer ring and the coupler on the gear at several points. The synchronizer ring must be correctly positioned on the tapered part of the coupler. If the clearance is less than 0,5 mm (0.02 in) replace the synchronizer ring. When working in the gearbox, replace the synchronizer ring if the clearance is found to be less than 0,8 mm (0.03 in).

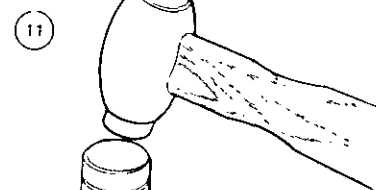
Reassembly

11. Reverse procedures 2 to 12 except:
On replacing pressure springs, plungers and blocks special service tool MF 415 should be used to locate the hub back in the sliding coupler.
NOTE: Ensure that the centralization holes in the hub and coupler are aligned.
12. Refit mainshaft and seals.
Operation 5B-13-20. Procedures 11-13 (Types A, C) or Operation 5B-14-21. Procedures 14-16 (Types B, D, E).

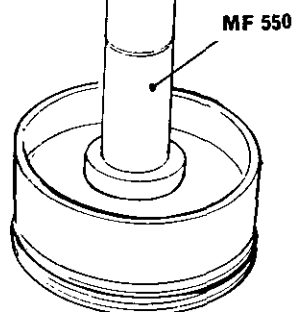


MF 415/1

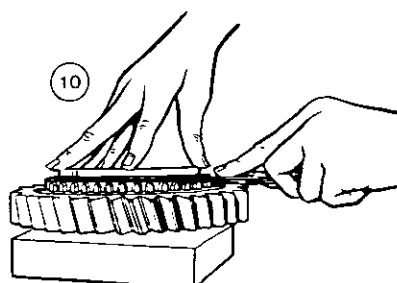
MF 415/2



11



MF 550



10

THE LAYSHAFT SYNCHROMESH UNIT SERVICING GEARBOX TYPE E

Special Tools: As Operation 5B-18-25

Disassembly 5B-19-25

1. Remove layshaft and gears.
Operation 5B-17-24. Procedures 1-20.
2. Service synchronismesh assembly.
Operation 5B-18-25. Procedures 2-10.

Reassembly

3. Reassemble as Operation 5B-18-25. Procedures 11 and 12.
4. Refit layshaft and gears.
Operation 5B-17-24. Procedures 22-24.

TRANSMISSIONS

THE MULTI-POWER CLUTCH UNIT
SERVICING

GEARBOX TYPES C, D

Special Tools: As Operation 5B-11-18

Disassembly 5B-20-26

1. Remove the multi-power clutch unit. Operation 5B-11-18. Procedures 1-8.
2. Place the clutch unit assembly on a flat surface, push down the retainer plate and remove the snap ring.
3. Remove the retainer plate.
4. Remove the six springs.
5. Remove the three interplates and the three friction discs.
6. Slide the piston out of the clutch housing.
7. If necessary, remove the piston rings.

Examination

Check the condition of all components for signs of wear, scoring, damage, distortion or overheating. Check the friction plates for the following dimensional tolerances;

Thickness 2,41 to 2,59 mm (0.095 to 0.102 in).

Maximum Height (permissible distortion) 2,92 mm (0.115 in).

Groove Depth 0,38 to 0,63 mm (0.015 to 0.025 in).

Check the interplates as follows:

Thickness 1,67 to 1,75 mm (0.66 to 0.69 in).

Maximum Dish 0,25 mm (0.010 in).

Maximum Height (permissible distortion) 2,21 mm (0.0875 in).

Check the six coil springs as follows:

Free length 17,8 mm (0.70 in).

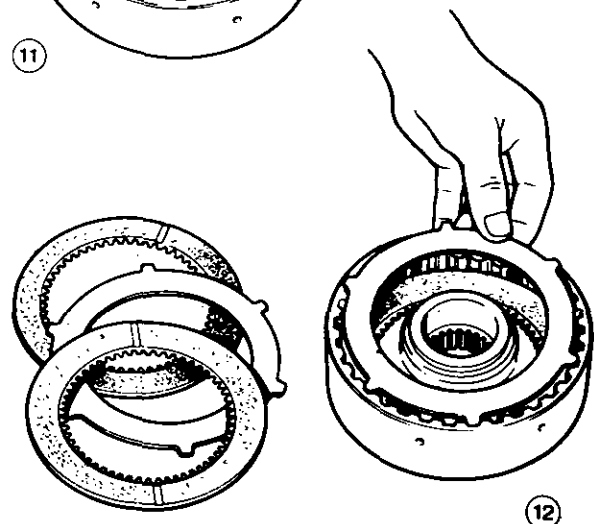
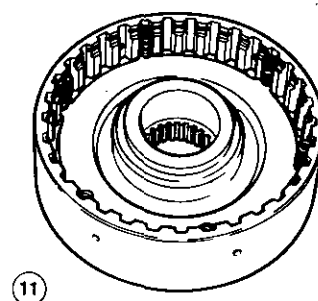
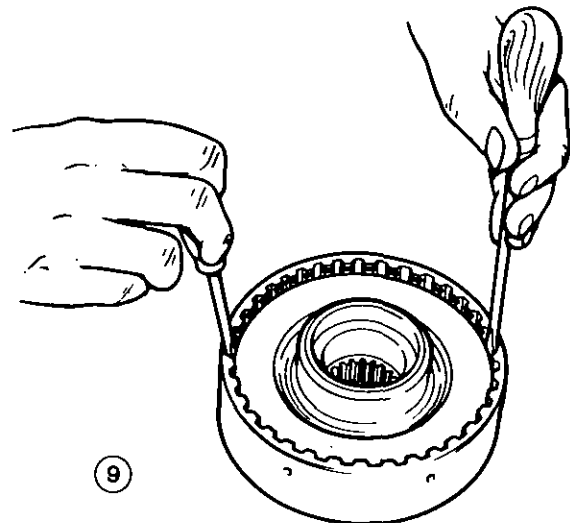
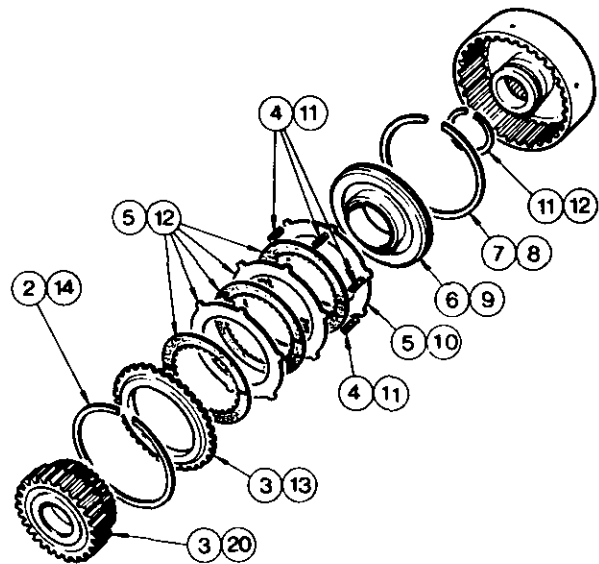
Working Length 12,7 mm (0.50 in).

Load at Working Length 2,98 to 3,64 kg (6.75 to 8.03 lb).

Replace any worn or damaged components, as required.

Reassembly

8. If necessary, refit the piston rings.
9. Compressing the piston ring, carefully refit the piston into the housing.
10. Fit one interplate to the clutch housing, with the lugs on the interplate located in the housing splines immediately to the right of the six holes in the housing.
11. Refit the six springs, placing one spring onto each lug of the first interplate.
12. Refit the three friction plates and the remaining two interplates alternately, locating the lugs on each interplate one spline further to the right of one previously fitted.
13. Refit the retainer plate.
14. Refit the snap ring, and ensure it is located correctly.
15. Refit the Multi-Power clutch unit. Operation 5B-11-18. Procedures 11-16.



THE MULTI-SPOOL VALVE SERVICING GEARBOX TYPES C, D

Special Tools: MS 2700 Rail-Trolley
KMF 1004/1 Protector Sleeve
KMF 1004/2 Guide

Disassembly 5B-21-27

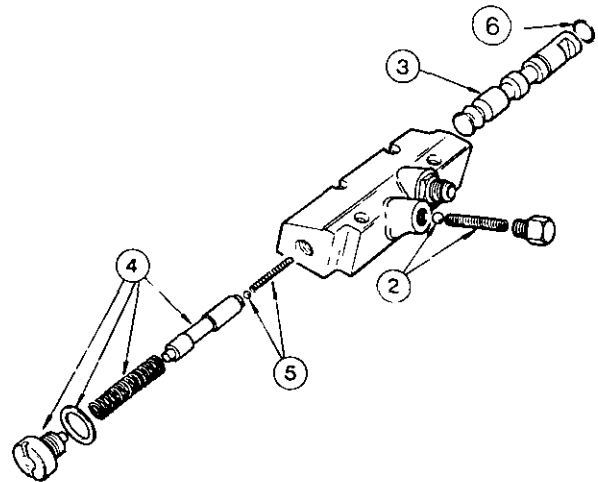
1. Remove the p.t.o. input housing, p.t.o. input shaft and spool valve.
Operation 5B-06-13. Procedures 1 to 9.
2. Remove the plug, spring and ball.
3. Withdraw the large spool.
4. Remove the plug, washer, spring and spool.
5. Remove the small ball and spring from the spool.

Reassembly

6. Fit a new 'O' ring to the large spool.
7. Slide the spool into the spool block.
8. Refit the ball, spring and plug.
9. Refit the small ball and spring into the spool.
10. Refit the small spool, spring, new washer and plug.
11. Tighten the plug to 27,11 Nm (20 lbf ft).
12. Refit the spool valve, p.t.o. input shaft housing and p.t.o. input shaft.

Operation 5B-06-13. Procedures 31 to 39.

NOTE: Ensure that all parts are scrupulously clean and are lubricated with clean transmission oil.



TRANSMISSIONS

REVERSE GEAR CLUSTER GEAR BOX TYPES A, B, C, D, E

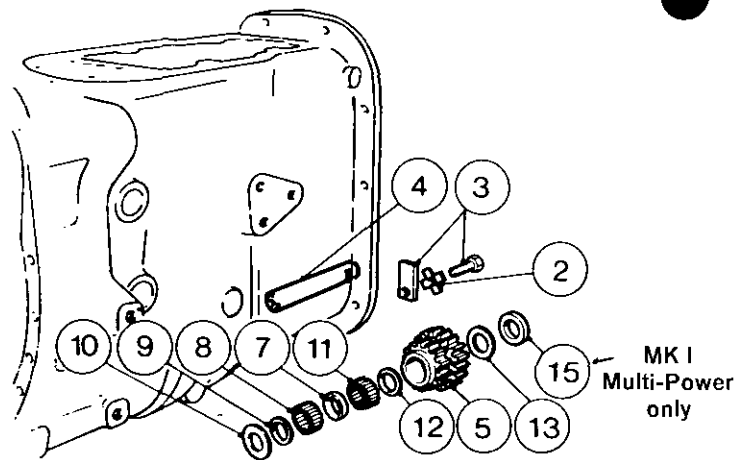
Special Tools: As Operation 5B-08-15
and Dummy shaft 55×25 mm
(2 $\frac{1}{8}$ in×1 in dia) mild steel

Removal 5B-22-28

1. Remove the mainshaft and gears, Operation 5B-13-20. Procedures 1 to 8 (Types A, C) or Operation 5B-14-21. Procedures 1-11 (Types B, D, E).
2. Release the tabwasher.
3. Remove the bolt and locating tab.
4. Slide the dummy shaft from the front of the reverse gear shaft towards the rear. This will push out the reverse gear shaft, and prevent the needle rollers from dropping into the transmission case.
5. Remove the idler gear cluster complete with all parts and the dummy shaft.
6. Withdraw the dummy shaft from the idler gears, and allow all parts to drop out, onto a clean work surface.

Refitment

7. Fit the spacer in the reverse gear cluster.
8. Refit the first set of rollers. Each run consists of 28 rollers.
NOTE: Smear the rollers in petroleum jelly (not grease) to help reassembly.
9. Refit the retaining ring.
10. Refit the thrust washer.
11. Refit the second set of rollers.
12. Refit the retaining ring.
13. Refit the thrust washer.
14. Slide the dummy shaft into the reverse gear cluster rollers.
15. Slide the distance piece over the dummy shaft on the rear end of the reverse gear cluster.
16. Reverse procedures 2 to 5.
17. Refit mainshaft and gears.
Operation 5B-13-20. Procedures 11-13 (Types A, C) or Operation 5B-14-21. Procedures 14-16 (Types B, D, E).



GEAR SHIFT LEVER GEARBOX TYPES A, B, C, D

Removal 5B-23-29

1. Remove the steering box and gearbox top cover assembly and gasket, Part 7B.
2. Support the top cover in a vice.
3. Press the spring retaining washer towards the spring, and slide sideways and remove. This will release the spring.

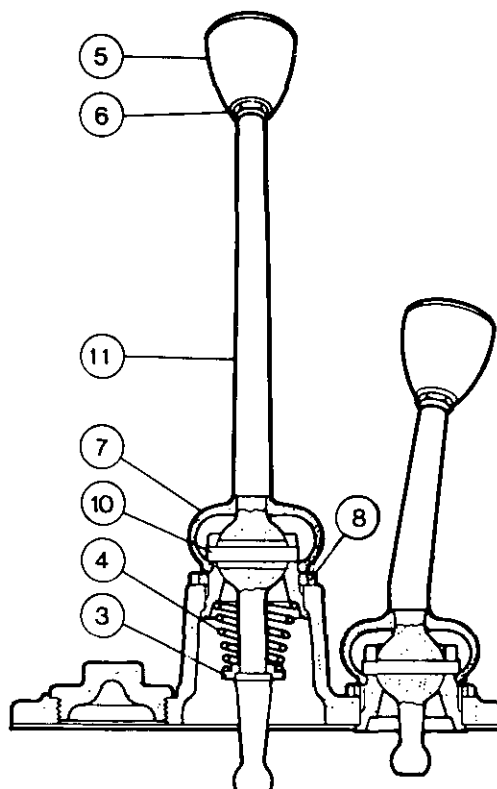


WARNING: When removing the spring retaining washer, care must be taken to prevent the spring from flying out and causing possible injury or damage.

4. Remove the seat and spring.
5. Remove the gear knob.
6. Remove the nut.
7. Remove the rubber dust cover.
8. Unscrew the locking ring.
9. Remove the locking ring.
10. Drive out the pin.
11. Remove the gear lever.
12. Drive the cup downwards out of the housing.

Refitment

13. Reverse procedures 1 to 12.



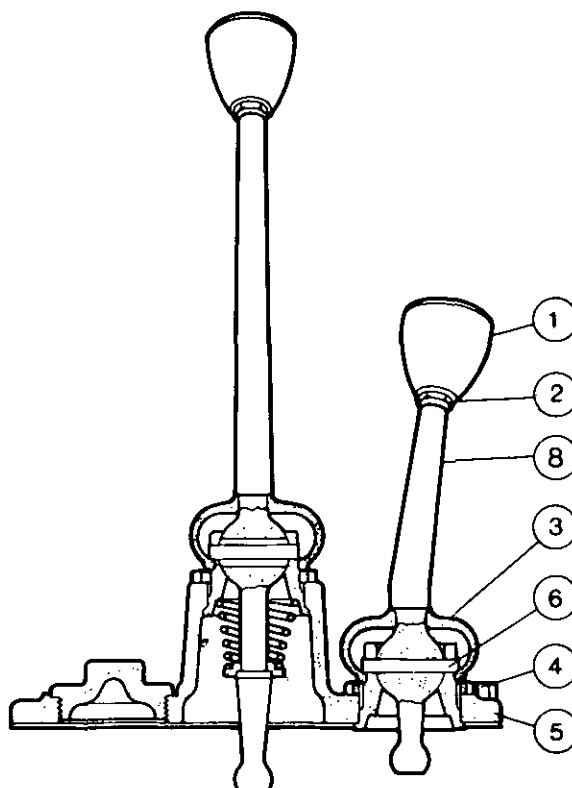
HIGH/LOW SHIFT LEVER GEARBOX TYPES A, B, C, D

Removal 5B-24-29

1. Remove the gear knob.
2. Remove the nut.
3. Remove the rubber dust cap.
4. Unscrew the locking ring.
5. Remove the locking ring.
6. Turn the lever and cup until the pin securing the lever can be removed.
7. Drive out the pin.
8. Remove the gear lever.
9. Drive the cup downwards out of the housing.

Refitment

10. Reverse procedures 1 to 9.



TRANSMISSIONS

GEAR SHIFT LEVER GEARBOX TYPE E

Removal

5B-25-30

1. Remove the steering box and gearbox top cover assembly and gasket, Part 7B.
2. Support the top cover in a vice.
3. Press the spring retaining washer towards the spring, and slide sideways and remove. This will release the spring.

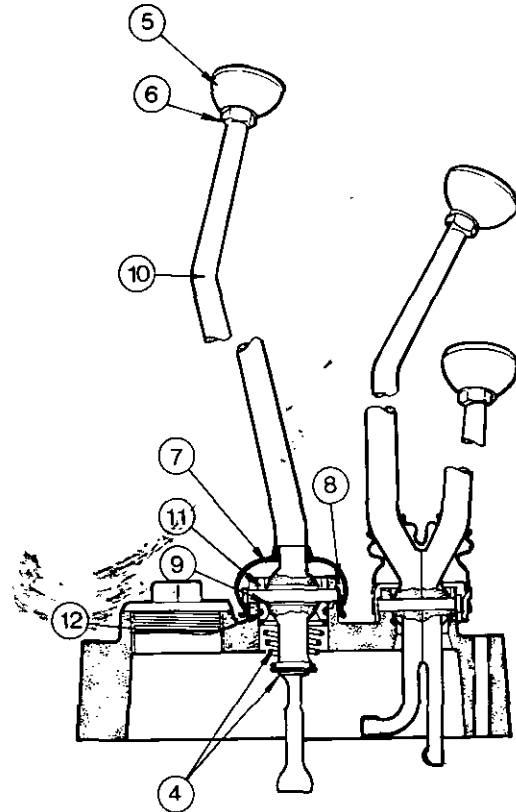


WARNING: When removing the spring retaining washer, care must be taken to prevent the spring from flying out and causing possible injury or damage.

4. Remove the seat and spring.
5. Remove the gear knob.
6. Remove the nut.
7. Remove the rubber dust cover.
8. Remove the circlip.
9. Drive out the pin.
10. Remove the gear lever.
11. Drive the cup downwards out of the housing.

Refitment

12. Reverse procedures 1 to 11 except renew the 'O' ring if necessary.



HIGH/LOW SHIFT AND SYNCHROMESH LEVER

GEARBOX TYPE E

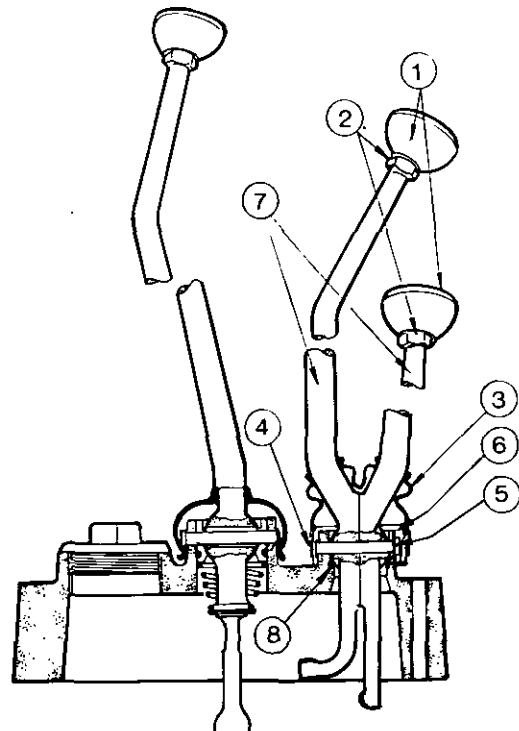
Removal

5B-26-30

1. Remove the gear knobs.
2. Remove the nuts.
3. Remove the rubber dust cap.
4. Remove the circlip.
5. Drive out the pin.
6. Remove the locking ring.
7. Withdraw the gear levers.

Refitment

8. Reverse procedures 1 to 7 except renew the 'O' ring if necessary.



TRANSMISSION CASE REMOVAL AND REPLACEMENT OR COMPLETE OVERHAUL GEARBOX TYPES A, B

Special Tools: MS 2700 Rail-Trolley
 MF 414/1 Centralizing Pin
 MF 414/2 Clamp Bolt
 MF 414/3 Locating Peg
 MF 315A Needle Roller Bearing and Seal Removal/Replacer Tool
 MF 331 Oil Seal Replacer Tool
 MF 255B/2 Cone
 MF 255B/1 Oil Seal Replacer
 MF 256A Oil Seal Replacer
 KMF 1004/1 Protector Sleeve
 KMF 1004/2 Guide
 MF 218A P.t.o. Drive Shaft Puller
 MF 218A/2 Adaptor
 MF 200 Hand Press
 MF 200/25 Adaptor
 MF 415/1 Synchro Hub Assembly Ring
 MF 415/2 Synchro Hub Assembly Plate
 MF 550 Drive Handle
 25 mm dia × 55 mm (1 in dia × 2 $\frac{3}{8}$ in) Mild Steel Dummy Shaft

Disassembly 5B-27-31

1. Remove the selector rail mechanism.
Operation 5B-01-09.
2. Remove the epicyclic unit.
Operation 5B-02-10.
3. Service the epicyclic unit.
Operation 5B-03-10.
4. Remove the clutch release mechanism.
Operation 5B-04-11.
5. Remove input shaft housing and p.t.o. input shaft.
Operation 5B-05-12.
6. Remove p.t.o. driveshaft front bearing.
Operation 5B-08-15.
7. Remove second gear mainshaft.
Operation 5B-09-16.
8. Remove main input shaft.
Operation 5B-10-17.
9. Remove mainshaft and gears.
Operation 5B-13-20 or 5B-14-21.
10. Remove layshaft and gears, p.t.o. shaft and gear.
Operation 5B-15-22.
11. Service the mainshaft synchromesh unit.
Operation 5B-18-25.
12. Remove the reverse gear cluster.
Operation 5B-22-28.

Examination

After disassembly of the transmission, examine all the components for scoring, wear or chipping. Pay particular attention to the gear teeth, bearings, needle rollers, gear sliding couplers, gear selector forks, also splines and main shaft gear bushes and sleeves. All bearings should be washed in clean paraffin, blown dry, inspected for wear or scoring on the outer circumference and measured for fit in transmission case webs. Maximum acceptable clearance is 0.033 mm (0.013 in). Where the clearance between bearing and bore exceeds this figure, recommended sealant 'C' may be used to refit the bearings into the transmission case. After inspection, lubricate bearings with clean transmission oil. Any worn or damaged components should be replaced; also, a complete set of new gaskets, 'O' rings and a new tab washer must be fitted.

Reassembly

13. Reverse procedures 1 to 12 except:
 - (a) Use only petroleum jelly for reassembly purposes—Never Grease.
 - (b) Ensure all snap rings are correctly located in their grooves.
 - (c) Lightly oil all bushes, bearings and splines prior to reassembly.
 - (d) It is absolutely essential that tool KMF 1004 is used when replacing the input shaft housing. See Operation 5H-05-12. Centralizing Pin and Locating Peg MF 414 must also be used to align selector fork, selector rail and synchro hub assembly.

TRANSMISSIONS**GEARBOX TYPES C, D**

Special Tools: MS 2700 Rail -Trolley
 MF 414/1 Centralizing Pin
 MF 414/2 Clamp Bolt
 MF 414/3 Locating Peg
 MF 315A Needle Roller Bearing and Seal Removal/Replacer Tool
 MF 331 Oil Seal Replacer Tool
 MF 255B/2 Cone
 MF 255B/1 Oil Seal Replacer
 MF 256A Oil Seal Replacer
 KMF 1004/1 Protector Sleeve
 KMF 1004/2 Guide
 MF 218A P.t.o. Drive Shaft Puller
 MF 218A/2 Adaptor
 MF 200 Hand Press
 MF 200/25 Adaptor
 MF 415/1 Synchro Hub Assembly Ring
 MF 415/2 Synchro Hub Assembly Plate
 MF 550 Drive Handle
 25 mm dia × 55 mm (1 in dia × 2 $\frac{1}{8}$ in)
 Mild Steel Dummy Shaft

Disassembly**5B—28—32**

1. Remove the selector rail mechanism.
Operation 5B—01—09.
2. Remove the epicyclic unit.
Operation 5B—02—10.
3. Service the epicyclic unit.
Operation 5B—03—10.
4. Remove the clutch release mechanism.
Operation 5B—04—11.
5. Remove input shaft housing and p.t.o. input shaft.
Operation 5B—06—13.
6. Remove p.t.o. Driveshaft front bearing.
Operation 5B—08—15.
7. Remove the main input shaft and multi-power clutch unit. Operation 5B—11—18.
8. Remove mainshaft and gears.
Operation 5B—13—20 or 5B—14—21.
9. Remove layshaft and gears, p.t.o. shaft and gear.
Operation 5B—16—23.
10. Service the mainshaft synchromesh unit.
Operation 5B—18—25.
11. Service the multi-power clutch unit.
Operation 5B—20—26.
12. Service the multi-power spool valve.
Operation 5B—21—27.
13. Remove the reverse gear cluster.
Operation 5B—22—28.

Examination

After disassembly of the transmission, examine all the components for scoring, wear or chipping. Pay particular attention to the gear teeth, bearings, needle rollers, gear sliding couplers, gear selector forks, also splines and main shaft gear bushes and sleeves. All bearings should be washed in clean paraffin, blown dry, inspected for wear or scoring on the outer circumference and measured for fit in transmission case webs. Maximum acceptable clearance is 0,033 mm (0.013 in). Where the clearance between bearing and bore exceeds this figure, recommended sealant 'C' may be used to refit the bearings into the transmission case. After inspection, lubricate bearings with clean transmission oil. Any worn or damaged components should be replaced; also, a complete set of new gaskets, 'O' rings and a new tab washer must be fitted.

Reassembly

13. Reverse procedures 1 to 12 except:
 - (a) Use only petroleum jelly for reassembly purposes—Never Grease.
 - (b) Ensure all snap rings are correctly located in their grooves.
 - (c) Lightly oil all bushes, bearings and splines prior to reassembly.
 - (d) It is absolutely essential that tool KMF 1004 is used when replacing the input shaft housing. See Operation 5B—06—13. Centralizing Pin and Locating Peg MF 414 must also be used to align selector fork, selector rail and synchro hub assembly.

TRANSMISSION CASE REMOVAL AND REPLACEMENT OR COMPLETE OVERHAUL GEARBOX TYPE E

Special Tools: MS 2700 Rail-Trolley
 MF 414/1 Centralizing Pin
 MF 414/2 Clamp Bolt
 MF 414/3 Locating Peg
 MF 315A Needle Roller Bearing and Seal Removal/Replacer Tool
 MF 421 Needle Roller Bearing and Seal Replacer
 MF 255B/2 Cone
 MF 255B/1 Oil Seal Replacer
 MF 422 Roller Bearing oil Seal Removal Tool
 KMF 1004/1 Protector Sleeve
 KMF 1004/3 Guide
 MF 218A P.t.o. Drive Shaft Puller
 MF 218A/2 Adaptor
 MF 200 Hand Press
 MF 200/25 Adaptor
 MF 415/1 Synchro Hub Assembly Ring
 MF 415/2 Synchro Hub Assembly Plate
 MF 550 Drive Handle
 25 mm dia x 55 mm (1 in x 2 $\frac{1}{8}$ in) Mild Steel Dummy Shaft

Disassembly

5B-29-33

1. Remove the selector rail mechanism.
Operation 5B-01-09.
2. Remove the epicyclic unit.
Operation 5B-02-10.
3. Service the epicyclic unit.
Operation 5B-03-10.
4. Remove the clutch release mechanism.
Operation 5B-04-11.
5. Remove input shaft housing and p.t.o. input shaft.
Operation 5B-07-14.
6. Remove p.t.o. driveshaft front bearing.
Operation 5B-08-15.
7. Remove main input shaft.
Operation 5B-12-19.
8. Remove mainshaft and gears.
Operation 5B-14-21.
9. Remove layshaft and gears, p.t.o. shaft and gear.
Operation 5B-17-24.
10. Service the mainshaft synchromesh unit.
Operation 5B-18-25.
11. Service the layshaft synchromesh unit.
Operation 5B-19-25.
12. Remove the reverse gear cluster.
Operation 5B-22-28.

Examination

After disassembly of the transmission, examine all the components for scoring, wear or chipping. Pay particular attention to the gear teeth, bearings, needle rollers, gear sliding couplers, gear selector forks, also splines and main shaft gear bushes and sleeves. All bearings should be washed in clean paraffin, blown dry, inspected for wear or scoring on the outer circumference and measured for fit in transmission case webs. Maximum acceptable clearance is 0,033 mm (0.013 in). Where the clearance between bearing and bore exceeds this figure, recommended sealant 'C' may be used to refit the bearings into the transmission case. After inspection, lubricate bearings with clean transmission oil. Any worn or damaged components should be replaced; also, a complete set of new gaskets, 'O' rings and a new tab washer must be fitted.

Reassembly

13. Reverse procedures 1 to 12 except:
 - (a) Use only petroleum jelly for reassembly purposes—Never Grease.
 - (b) Ensure all snap rings are correctly located in their grooves.
 - (c) Lightly oil all bushes, bearings and splines prior to reassembly.
 - (d) It is absolutely essential that tool KMF 1004 is used when replacing the input shaft housing. See Operation 5H-05-10. Centralizing Pin and Locating Peg MF 414 must also be used to align selector fork, selector rail and synchro hub assembly.

**MF 600 SERIES TRACTOR
WORKSHOP SERVICE MANUAL**

PART 6

Publication No. 1856 274 M1

comprising

- A REAR AXLE AND BRAKES
- B POWER TAKE-OFF

Part 6 — Section A

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REAR AXLE AND BRAKES

GENERAL

The drive from the transmission mainshaft is transmitted through the rear drive shaft and shear tube to a spiral bevel driving pinion and crown wheel, then through the axle shafts and epicyclic reduction units to the rear wheel axles.

The driving pinion is supported in the centre housing by a straight roller pilot bearing and a pre-loaded housing assembly carrying two tapered roller bearings.

The crownwheel is attached to the split differential case, which is supported each side by a tapered roller bearing. The differential pinions run on a cross joint and thrust is taken by thrust washers behind the pinions.

The axle shaft inner ends are splined into differential gears, and the outer ends which run on a bush in the epicyclic carrier (except MF 590 tractor) are splined into the sun gear in the epicyclic unit.

The wheel axles are splined into the epicyclic carrier which is driven by the sun gear and planetary pinions.

A differential lock is fitted to the R.H. axle housing. When the spring loaded pedal is pressed, a shaft engages a coupler with a coupling cap on the differential case, thus locking the differential.

This tractor is fitted with hydraulically operated multi-disc oil cooled brakes between the axle housings and the differential carrier plates adjacent to the centre housing.

The operation of the brake is effected by the transfer of oil pressure from two master cylinders adjacent to the pedals, to the brake slave cylinders mounted on the trumpet housings.

The right pedal operates the right hand brake and the left pedal operates the left hand brake, to assist turning.

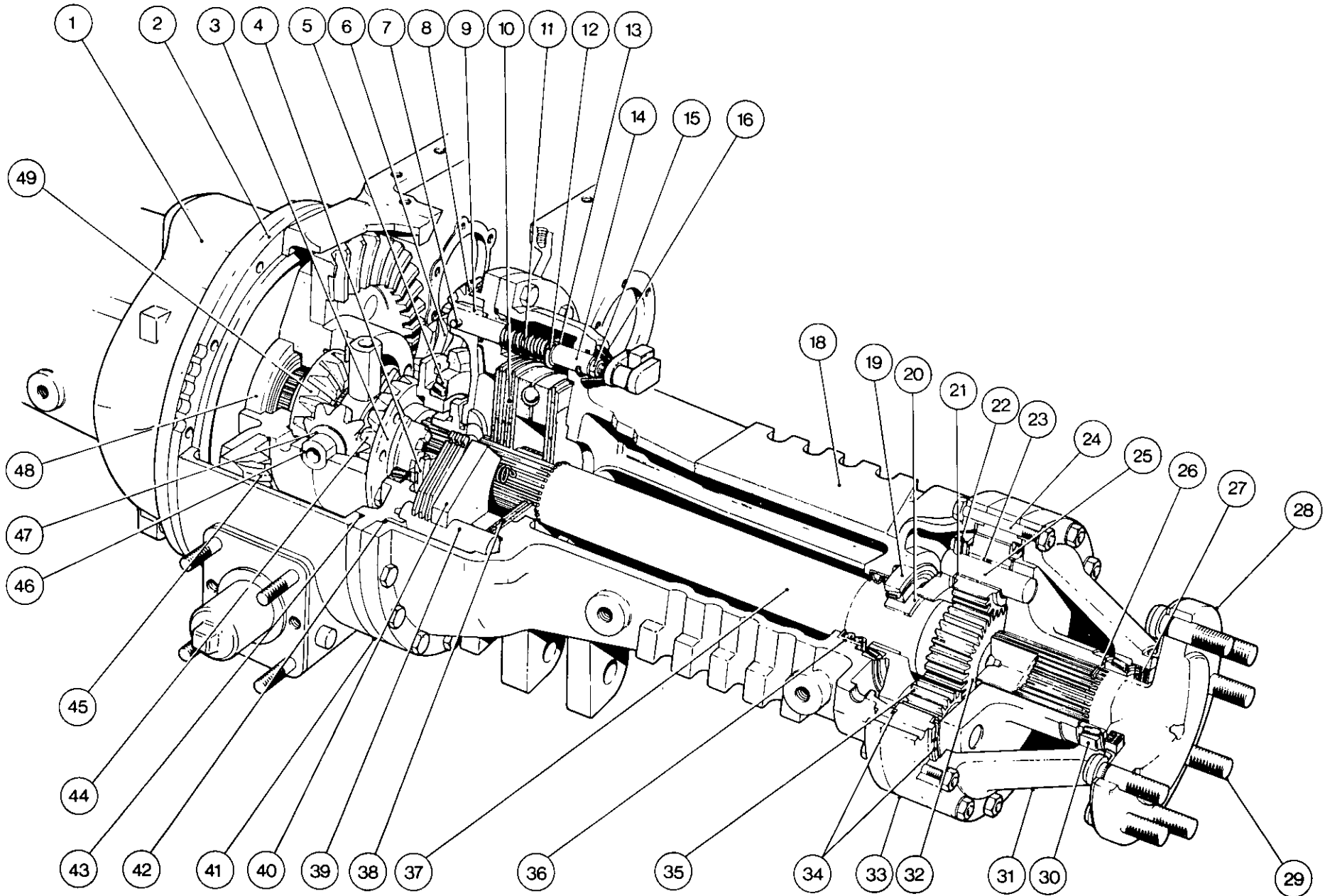
For highway use the brakes are used together by operating an interlocking latch which joins the two brake pedals.

Pressure on the brake pedal brings an actuating assembly in contact with two rotating middle (friction) discs splined to each axle shaft, these in turn contact fixed friction faces provided in the axle housing and in the differential carrier plate fitted between the centre and axle housings. The mechanism of each brake consists of two cast iron actuating discs, held together by tension springs and separated by steel balls located in inclined seats. Pressure on the brake pedal, by pulling on the operating rod, rotates one actuating disc relative to the other, and the steel balls ride up their inclined seats and so spread the actuating discs apart. These come into contact with the rotating (friction) discs, which are splined to the shaft being braked. The actuating assembly will move slightly in the direction of rotation until the torque ear of one actuating disc comes into contact with a shaft in the housing. The other actuating disc tends to rotate further, increasing the angular displacement between the discs, and assisting the braking action. When the operating pull is released, the tension springs cause the discs to return to their normal position.

A parking brake is installed, operated by a lever with a rack which engages with a cross shaft connected via two linkages to each brake operating assembly.

KEY TO FIGURE 1

1 Trumpet Housing—LH	18 Trumpet Housing—RH	34 Gasket
2 Carrier Plate—LH	19 Epicyclic Hub—Inner Bearing	35 Planet Gear
3 Differential Lock Coupler Cap	20 Epicyclic Hub—Bush	36 Inner Oil Seal
4 Differential Lock Coupler	21 Thrust Washer	37 Axle Shaft
5 RH Differential Bearing	22 Roll Pin (except 590)	38 Brake Friction Plate
6 Pinion Assembly	23 Needle Rollers	39 Brake Stop Rod
7 Roll Pin	24 Epicyclic Unit Securing Bolts	40 Actuator Unit
8 Ground Speed Gear	25 Planet Gear—Shaft	41 Carrier Plate—RH
9 Differential Lock Coupler Fork	26 Half Ring (Snap Ring, 590)	42 'O' Ring—Outer
10 Brake Interplate	27 Outer Oil Seal	43 'O' Ring—Inner
11 Differential Lock Return Spring	28 Stub Axle	44 Differential Gear—RH
12 Washer	29 Wheel Stud	45 Crownwheel
13 Circlip	30 Outer Bearing	46 Cross Shaft
14 Differential Lock Actuator Shaft	31 Outer Housing	47 Thrust Washer
15 Differential Lock Adjusting Nut	32 Sun Gear	48 Differential Bearing
16 Dust Cover	33 Ring Gear	49 Differential Gear—LH



REAR AXLE AND BRAKES

REAR WHEEL STUD

Removal and Replacement 6A-01-04

Special Tools: MF 295B Guide Pegs, (P.A.V.T. wheels only)

Removal

1. Jack up the tractor.
2. Remove the rear wheel.



NOTE: P.A.V.T. wheels are extremely heavy and should only be removed with the assistance of a crane.

3. Drive out the damaged stud. Examine the stud hole, the other studs and the wheel disc for signs of fretting or damage.

Replacement

4. Locate a new stud in the wheel axle.
5. Tap the stud gently to locate the splines.
6. Fit a new wheel nut, with the flat side against the axle to the stud and pull the stud through the axle to its correct position.
7. Remove the nut.
8. Fit a guide peg MF 295B to two of the wheel studs (P.A.V.T. wheels only).

9. Brush the wheel stud threads clean.
10. Refit the rear wheel and lightly oil the stud threads before fitting the wheel nuts.
11. **Tractors fitted with 15,8 mm ($\frac{5}{8}$ in) diameter studs.**
Tighten the nuts progressively and evenly to a torque of 270 Nm (200 lbf ft).
Tractors fitted with 17,5 mm ($\frac{11}{16}$ in) diameter studs.
Tighten the nuts progressively and evenly to a torque of 325 Nm (240 lbf ft).
12. Remove the jack.

EPICYCLIC UNIT OUTER HOUSING AND RING GEAR.

Removal and Refitment 6A-02-04

Removal

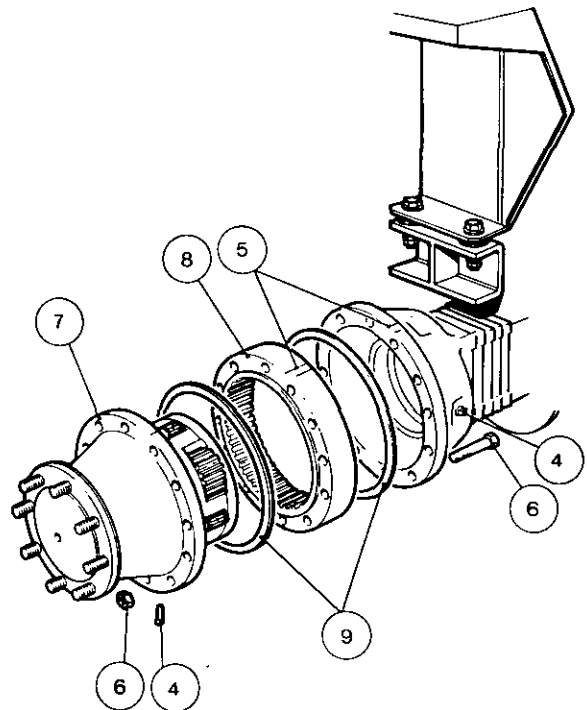
1. Apply the parking brake.
2. Jack up the tractor.
3. Remove the rear wheel.
4. Remove the drain and level plugs and drain the oil from the epicyclic unit.
5. Scribe a mark across the outer housing, ring gear, and trumpet housing to facilitate refitment. Also scribe a mark across the outer housing and ring gear only; this will ensure that the ring gear is replaced with the teeth in full engagement.
6. Remove the nuts and bolts.
7. Remove the outer housing and ring gear assembly.
8. Remove the ring gear.

NOTE: Do not withdraw the axle shaft.

9. Remove and discard the two cork gaskets. Clean the recesses in which the ring gear spigots are located and check that there is no burr or deformity which could cause leakage.

Refitment

10. Reverse procedures 1 to 9 except:
 - (a) Fit new cork gaskets.
 - (b) Ensure that the scribe marks are correctly aligned ensuring that the teeth of the ring gear are in full engagement **OTHERWISE SEVERE DAMAGE CAN OCCUR.**
 - (c) Tighten the nuts and bolts to a torque of 75 Nm (55 lbf ft).
 - (d) Brush the wheel stud threads clean.



- (e) Refit the rear wheel and lightly oil the stud threads before fitting the wheel nuts.
- (f) **Tractors fitted with 15,8 mm ($\frac{5}{8}$ in) diameter studs.**
Tighten the nuts progressively and evenly to a torque of 270 Nm (200 lbf ft).
Tractors fitted with 17,5 mm ($\frac{11}{16}$ in) diameter studs.
Tighten the nuts progressively and evenly to a torque of 325 Nm (240 lbf ft).
- (g) Refill to the correct level with an approved oil.

EPICYCLIC PLANET AND SUN GEAR— LIGHT DUTY

Servicing

6A-03-05

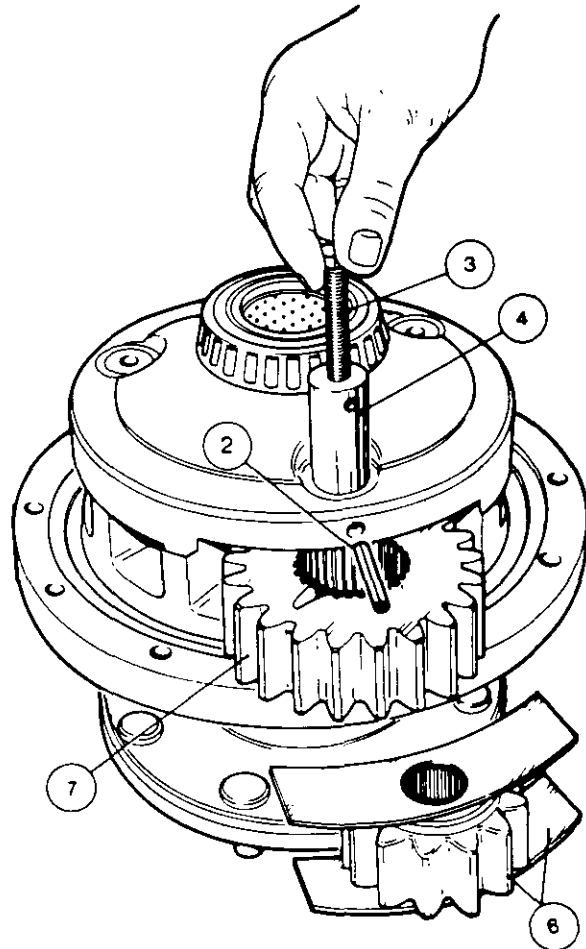
Special Tools: $\frac{3}{8}$ in UNF Bolt

Disassembly

1. Remove the outer housing assembly, operation 6A-02-04. To service the sun gear it is only necessary to remove one planet gear.
 2. Drive out and discard the roll pin.
 3. Fit the $\frac{3}{8}$ in bolt to the planet gear shaft.
 4. Withdraw the shaft trying not to dislodge the needle rollers.
 5. Remove the $\frac{3}{8}$ in bolt.
 6. Remove the thrust washers and the planet gear. Repeat operations 2 to 6 only if the epicyclic hub is to be completely overhauled.
 7. Withdraw the sun gear.
- Inspect all parts and replace any which show signs of undue wear or damage.

Reassembly

8. Reverse procedures 1 to 7 except:
 - (a) If the needle rollers were dislodged, refit them using petroleum jelly, not grease. There are 58 needle rollers per planet gear (two rows of 29, plus a spacer washer).
 - (b) Ensure that the holes in the casting and shaft are aligned.
 - (c) Fit a new roll pin.



EPICYCLIC PLANET AND SUN GEAR— HEAVY DUTY

Servicing

6A-03-05

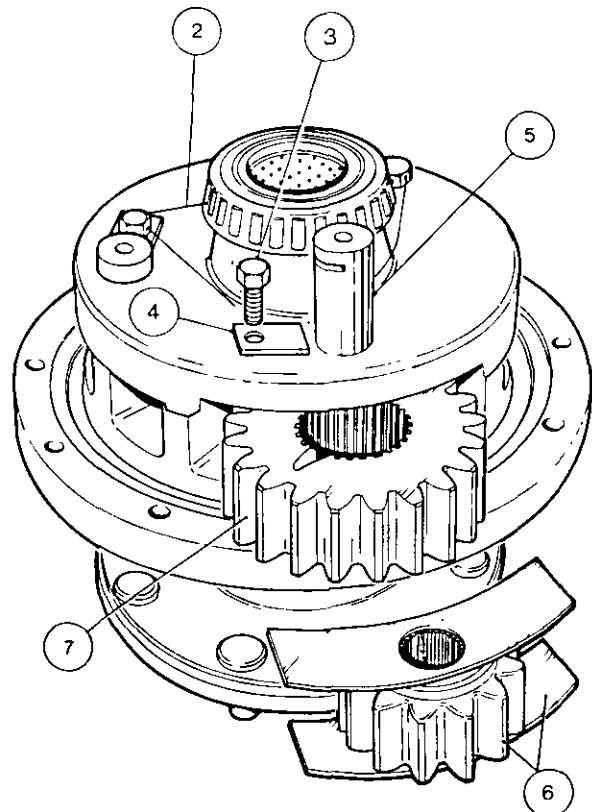
Disassembly

1. Remove the outer housing assembly, operation 6A-02-04. To service the sun gear it is only necessary to remove one planet gear.
2. Remove the locking wire.
3. Remove the setscrews.
4. Remove the retaining plates.
5. Withdraw the shaft, trying not to dislodge the needle rollers.
6. Remove the thrust washers and the planet gear. Repeat operations 3 to 6 only if the epicyclic hub is to be completely overhauled.
7. Withdraw the sun gear.

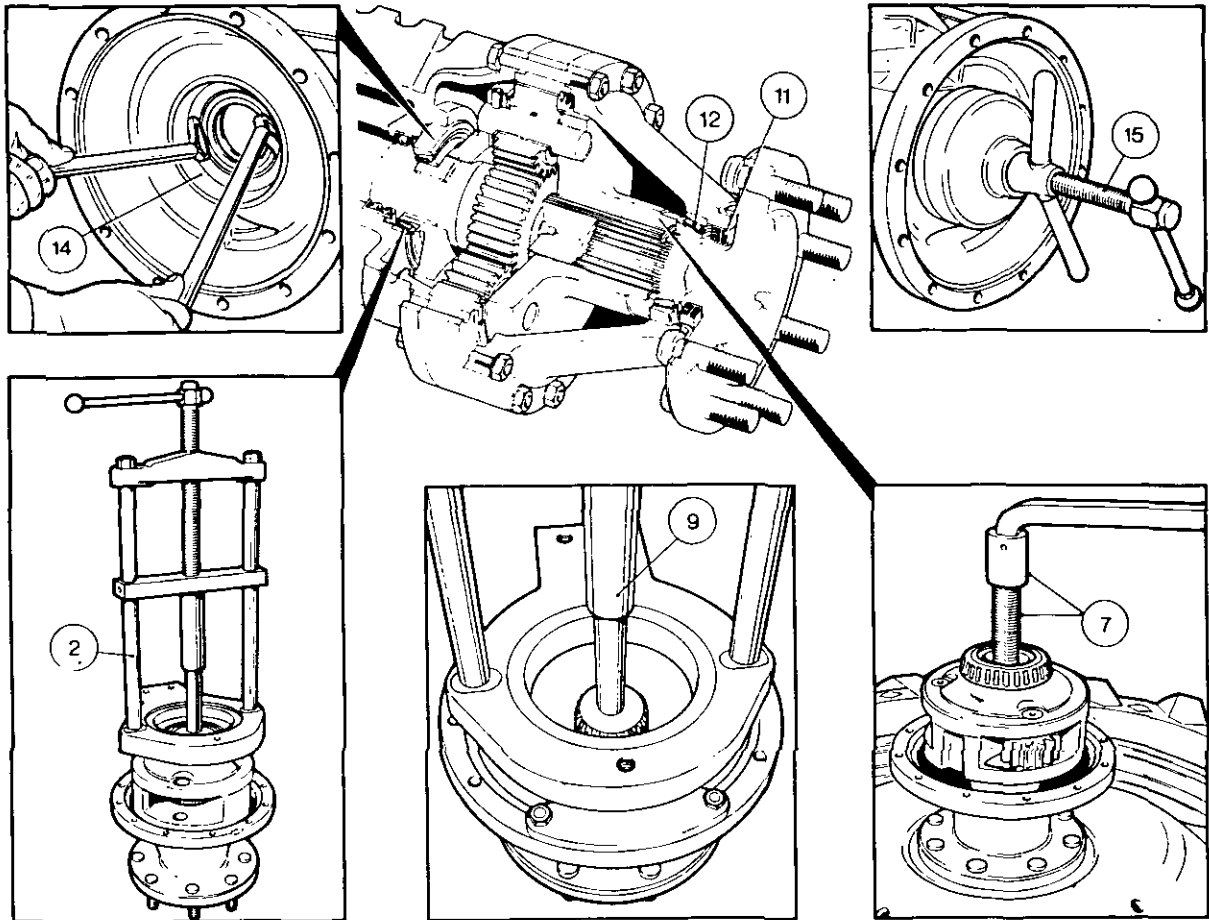
Inspect all parts, and replace any which show signs of undue wear or damage.

Reassembly

8. Reverse procedures 1 to 7 except:
 - (a) If the needle rollers were dislodged, refit them using petroleum jelly, not grease. There are 44 needle rollers per planet gear (two rows of 22, plus a spacer washer).
 - (b) Tighten the setscrews to a torque of 45 Nm (35 lbf ft).



REAR AXLE AND BRAKES



EPICYCLIC UNIT

Servicing

6A-04-06

Special Tools: MF 26A Wrench
 MF 200 Hand Press
 MF 200-2/1 Adaptor
 MF 200-3/3 Plug
 MF 200-24 Adaptor
 MF 265A Extractor
 MF 266B Wheel axle and Bearing Replacer
 MF 1105 Puller
 MF 1105-8 Adaptor
 MF 1105-11 Adaptor
 550 Universal Handle
 50 Ton Press

Disassembly

1. Remove the planet gear and sun gear, operation 6A-03-05.
2. Remove the bearing cone using MF 200 and MF 200-24.
3. MF 675-2WD Tractors.
Tap the bearing bush into the hub using MF 200-3/3.
4. MF 675-2WD Tractors.
Remove the bush and MF 200-3/3 from the hub.
5. Place the dismantled wheel on the workshop floor.
6. Fit the outer housing and hub assembly and secure with two wheel nuts.
7. Fit MF 265A and MF 26A and remove the hub from the housing.
8. Remove the two half rings. (Snap ring on heavy duty epicyclics).

9. Using MF 200 and MF 200-2/1 press out the wheel axle.
10. Lift out the bearing cone.
11. Tap out the outer seal.
12. Tap out the bearing cup.
13. Fully apply the parking brake and check that the transmission oil is no higher than the FULL mark on the dipstick. Remove the axle shaft.
14. On Light Duty Epicyclics.
Using MF 1105 and 1105-8 remove the inner bearing cup from the trumpet housing.
On Heavy Duty Epicyclics, lever the inner bearing cup out of the trumpet housing as shown in the illustration.
15. Using MF 1105 and MF 1105-11, pull the inner oil seal out of the trumpet housing.
Inspect all parts and replace any which show signs of undue wear or damage. Replace all seals and gaskets.

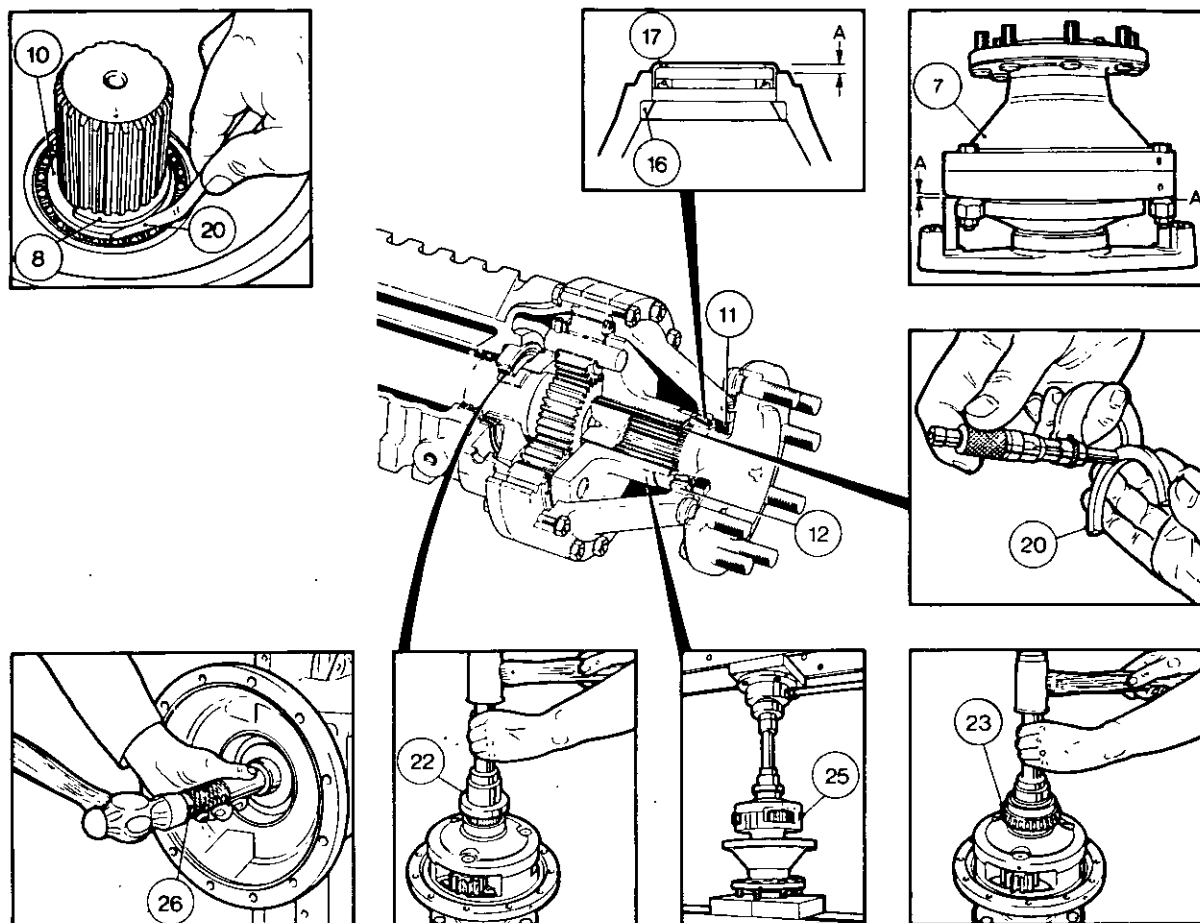
Reassembly

16. Refit the bearing cup, making sure it is fully seated.
17. Smear a new outer seal lightly with recommended sealant 'A', then drive it into the housing, metal face outwards, and 2 mm (0.080 in) proud of the housing (dimension A). Smear the lip, and fill the seal cavity with petroleum jelly.

NOTE: For the heavy duty epicyclics the seal must be driven flush with the outer housing.

18. Carefully, insert the wheel axle through the outer seal.
19. Drive the bearing cone fully onto the wheel axle, seating the rollers in the cup.

REAR AXLE AND BRAKES



20. Light Duty Epicyclics.

Using the number 0 half ring and feeler gauges measure the gap between the bearing cone and the half ring. If there is no clearance, the No. 0 half ring can be used. If the clearance is measurable, select a pair of half rings to give a clearance of 0,00 to 0,025 mm (0,00 to 0,001 in) by using the following procedure and the table below.

Half Ring + Feeler Gap mm in	Half Ring Thickness mm in	Part No.	Identifi- cation No.
5,92 0-233 5,94 0-234	5,84 0-230 5,89 0-232	882 601 M1	0
5,95 0-2341 5,99 0-236	5,90 0-2321 5,94 0-234	882 602 M1	1
6,00 0-2361 6,04 0-238	5,95 0-2341 5,99 0-236	882 603 M1	2
6,05 0-2381 6,09 0-240	6,00 0-2361 6,04 0-238	882 604 M1	3

- (a) Using a micrometer, measure the thickness of the No. 0 half ring.
- (b) Add the No. 0 half ring thickness to the feeler gauge measurement to give the thickness of the half rings required.

21. On Light Duty Epicyclics.

Fit the two half rings, ensuring that they seat fully in the groove.

On Heavy Duty Epicyclics.

Fit the snap ring, ensuring that it seats fully in the groove. Using a suitable puller, draw the outer housing assembly back tightly onto the snap ring.

22. On Light Duty Epicyclics.

Using the 550 handle and MF 266 B, fit a new bearing bush in the epicyclic hub.

23. Using the 550 handle and MF 266B, drive the bearing cone onto the spigot on the epicyclic hub.

24. Reassemble the planet gears and the sun gear in the epicyclic hub, operation 6A-04-05.

25. Using the 550 handle, MF 266B and a hydraulic press, drive the epicyclic hub onto the wheel axle.

26. Apply a thin coating of recommended sealant 'A' to the bore of the trumpet housing, then fit a new oil seal using MF 1105-11 and the 550 handle. Smear the lips of the seal with petroleum jelly.

27. Check the epicyclic preload, operation 6A-05-07.

28. Refit the inner bearing cup in the trumpet housing.

29. Refit the ring gear and outer housing assembly, operation 6A-02-04.

REAR AXLE AND BRAKES**EPICYCLIC PRE-LOAD**

6A-05-08

Special Tools: MF 267A Preload Checking Tool
MF 1105 Puller
MF 1105-8 Adaptor

Procedure

1. Remove the outer housing and ring gear, operation 6A-02-04.
2. Remove the two cork gaskets and thoroughly clean the mating faces of the ring gear and outer housing.
3. Bolt the ring gear to the outer housing using four bolts from the epicyclic unit with four wheel nuts as spacers. These bolts should be equally spaced around the ring gear.

NOTE: Ensure that the ring gear is correctly fitted i.e., with the teeth in full engagement.

4. Ensure that the oil level is no higher than the FULL mark on the dipstick, fully apply the handbrake and remove the half-shaft.
5. On Light Duty Epicyclics,
Using MF 1105 and 1105-8 remove the inner bearing cup from the trumpet housing.
On Heavy Duty Epicyclics,
Lever the inner bearing cup out of the trumpet housing.
6. Remove the old shims.
7. Place the bearing cup on the spigot in the centre of MF 267A. Do not fit the shims.
8. Place the epicyclic unit on MF 267A and measure the gap at points 'A' using two feeler gauges.
9. Note the clearance, which must be equal at both sides, then select a shim or shims from the table below.

Gap Measured by Feeler Gauges (Both Sides)		Shim Thickness Required	
mm	in	mm	in
0,025 to 0,13	0-001 to 0-005	0,76	0-030
0,15 to 0,25	0-006 to 0-010	0,64	0-025
0,28 to 0,38	0-011 to 0-015	0,51	0-020
0,41 to 0,51	0-016 to 0-020	0,38	0-015
0,53 to 0,64	0-021 to 0-025	0,25	0-010
0,66 to 0,76	0-026 to 0-030	0,13	0-005
0,79 to 0,89	0-031 to 0-035	0	0

The shims are available as follows:

Shim Thickness		Part No.
mm	in	
0,13	0-005	894 757 M1
0,25	0-001	894 758 M1
0,38	0-015	894 759 M1

10. Fit the shims to the trumpet housing.
11. Refit the inner bearing cup, ensuring that it is fully seated.
12. Refit the axle shaft.
13. Remove the four bolts and spacers securing the ring gear to the outer housing.
14. Using new cork gaskets, refit the ring gear and outer housing, operation 6A-02-04.

L.H. TRUMPET HOUSING**Removal and Refitment**

6A-06-09

Special Tools: MS 2700 Rail Trolley

Removal

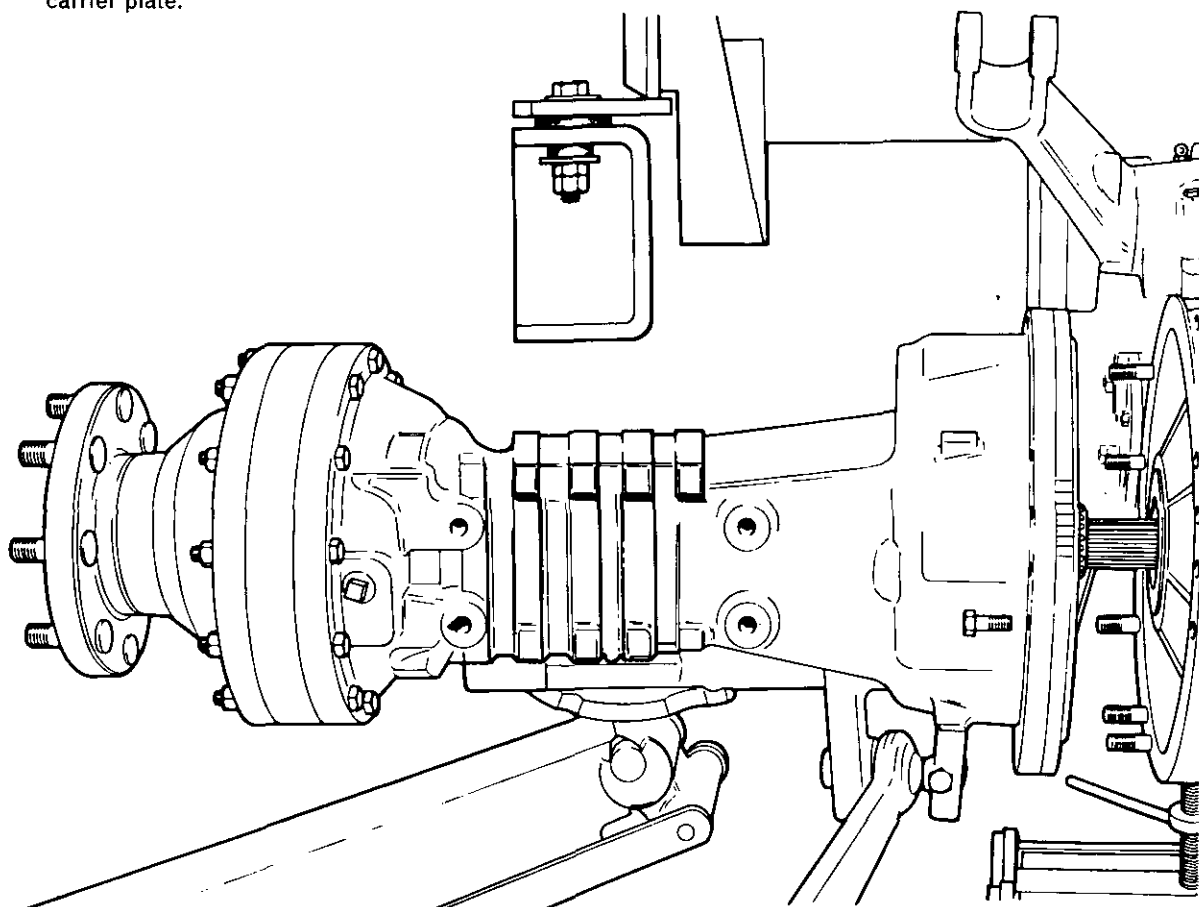
1. Drain the transmission oil.
2. Disconnect the bundy feed pipe from the flexible hose and drain the fluid into a clean receptacle.
3. Disconnect the trailer brake bundy pipe from the slave cylinder.
4. Release the lift rod at the knuckle.
5. Release the check chain at the check chain anchor bracket.
6. Release the stabiliser bracket underneath the trumpet housing.
7. Release the forward end of the lower link from the trumpet housing bracket.
8. Remove the lift arm and lower link assembly complete.
9. Release the brake pull rods and the return spring.
10. Jack up the tractor under the trumpet housing being serviced.
11. Remove the left hand rear wheel.
12. Place the MS 2700 rail trolley under the centre housing and lower the tractor until the trolley jack is just taking the trumpet housing weight.
13. Remove all of the nuts and bolts securing the trumpet housing to the centre housing.
14. Lower the trumpet housing slightly and withdraw it far enough to clear the half shaft from the differential splines.
15. Lower the trumpet housing further to clear the cab riser.
16. Withdraw the trumpet housing completely.
17. Remove the 'O' ring from the flange on the carrier plate.

Refitment

18. Reverse procedures 1 to 17 except:
 - (a) Fit a new 'O' ring, using petroleum jelly.
 - (b) When manoeuvring the trumpet housing assembly back into position, take care to align the axle shaft splines in the differential unit and the studs through their holes in the centre housing.
 - (c) Apply a few drops of recommended sealant 'C', then fit and tighten the cab riser/stabiliser mounting bolts to a torque of 230 Nm (170 lbf ft).
 - (d) Brush the wheel stud threads clean.
 - (e) Refit the rear wheel and lightly oil the stud threads before fitting the wheel nuts.
 - (f) **Tractors fitted with 15,8 mm ($\frac{5}{8}$ in) diameter studs.**
Tighten the nuts progressively and evenly to a torque of 270 Nm (200 lbf ft).
Tractors fitted with 17,5 mm ($\frac{11}{16}$ in) diameter studs.
Tighten the nuts progressively and evenly to a torque of 325 Nm (240 lbf ft).

NOTE: The full quantity of oil, as stated in the specification will not be required as approximately 2,5 litre (4 Imp. pt) will be trapped by the carrier plates in the trumpet housing.

19. Bleed the brake system in accordance with operation 6A-29-29.
20. Adjust and balance the brakes, operation 6A-30-29.



REAR AXLE AND BRAKES

R.H. TRUMPET HOUSING

Removal and Refitment

6A-07-10

Special Tools: MS 2700 Rail Trolley

Removal

1. Drain the transmission oil.
2. Disconnect the brake bundy feed pipe from the flexible hose, and drain the fluid into a clean receptacle.
3. Release the levelling box at the knuckle.
4. Release the check chain at the check chain anchor bracket.
5. Remove the stabiliser mounting bracket from underneath the trumpet housing.
6. Release the forward end of the lower link from the trumpet housing bracket.
7. Remove the lift arm and lower link assembly complete.
8. Release the brake pull rods and the return spring.
9. Release the differential lock pull rod.
10. Jack up the tractor under the trumpet housing being serviced.
11. Remove the right hand rear wheel.
12. Place the MS 2700 rail trolley under the centre housing and lower the tractor until the trolley jack is just taking the trumpet housing weight.
13. Remove all of the nuts and bolts securing the trumpet housing to the centre housing.
14. Lower the trumpet housing slightly and withdraw it far enough to clear the half shaft from the differential splines.
15. Lower the trumpet housing further to clear the cab riser.

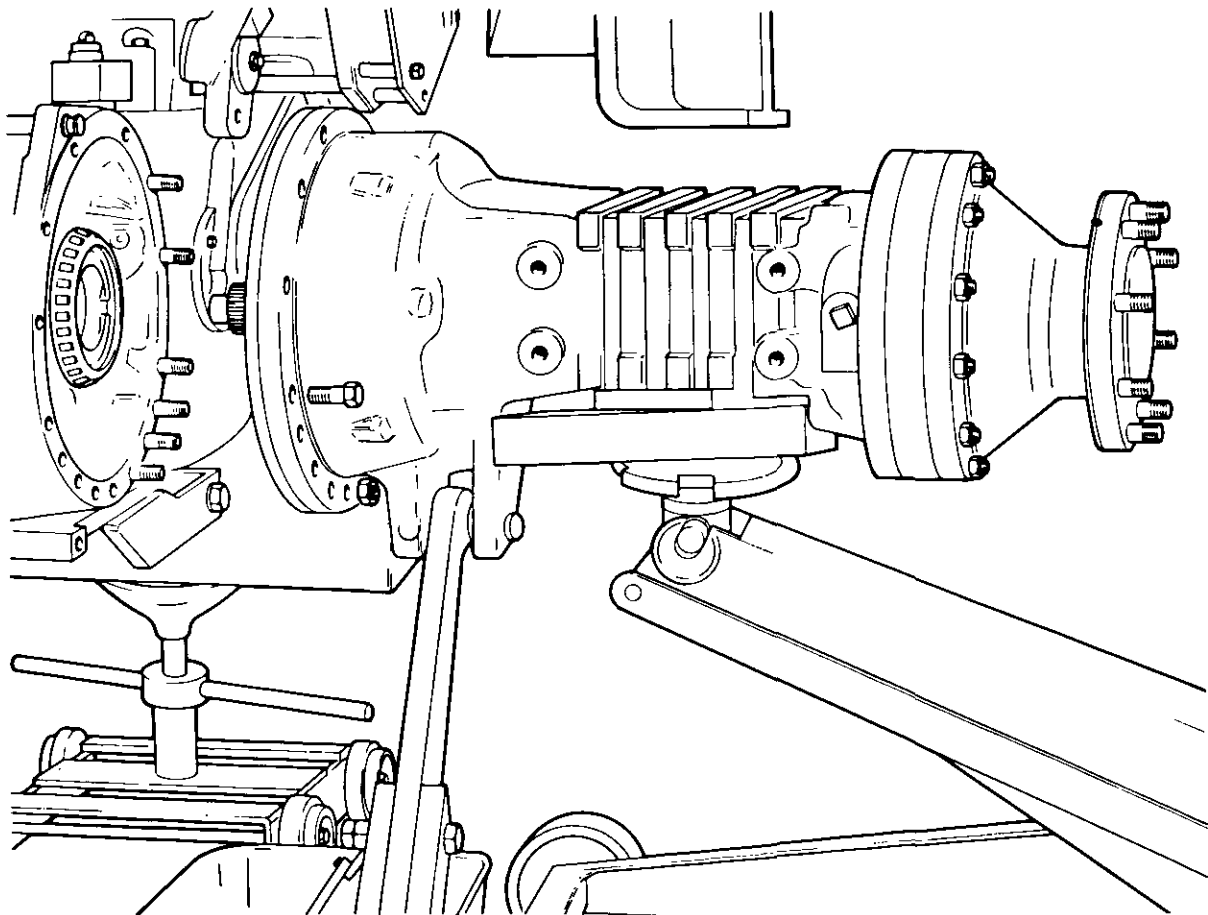
16. Withdraw the trumpet housing completely.
17. Remove the 'O' ring from the flange on the carrier plate.

Refitment

18. Reverse procedures 1 to 17 except:
 - (a) Fit a new 'O' ring using petroleum jelly.
 - (b) Carefully manoeuvre the trumpet housing into position, taking care to align the axle shaft splines in the differential unit and the studs through their holes in the centre housing.
 - (c) Apply a few drops of recommended sealant 'C', then fit and tighten the cab riser/stabiliser mounting bolts to a torque of 230 Nm (170 lbf ft).
 - (d) Brush the wheel stud threads clean.
 - (e) Refit the rear wheel and lightly oil the stud threads before fitting the wheel nuts.
 - (f) **Tractors fitted with 15,8 mm ($\frac{5}{8}$ in) diameter studs.**
Tighten the nuts progressively and evenly to a torque of 270 Nm (200 lbf ft).
Tractors fitted with 17,5 mm ($\frac{11}{16}$ in) diameter studs.
Tighten the nuts progressively and evenly to a torque of 325 Nm (240 lbf ft).

NOTE: The full quantity of oil, as stated in the specification will not be required, as approximately 2,5 litre (4 Imp. pt) will be trapped by the carrier plate in the trumpet housing.

19. Bleed the brake system in accordance with operation 6A-29-29.
20. Adjust and balance the brakes, operation 6A-30-29.



L.H. CARRIER PLATE**Removal and Refitment**

6A-08-11

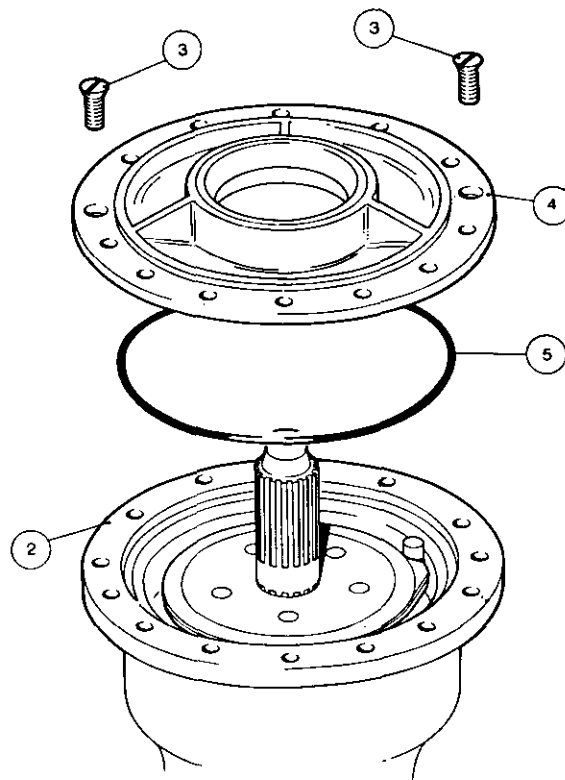
Special Tools: MS 2700 Rail Trolley

Removal

1. Remove the trumpet housing, operation 6A-06-09.
2. Manoeuvre the trumpet housing, off the trolley jack and stand it on end.
3. Remove the two countersunk screws.
4. Withdraw the carrier plate from the trumpet housing.
5. Remove and discard the inner 'O' ring.

Refitment

6. Reverse procedures 1 to 5, except:
 - (a) Place a new 'O' ring in the recess in the trumpet housing using a smear of petroleum jelly for location. DO NOT attempt to fit the 'O' ring to the carrier plate.
 - (b) Secure each countersunk screw with a centre punch mark.

**R.H. CARRIER PLATE****Removal and Refitment**

6A-09-11

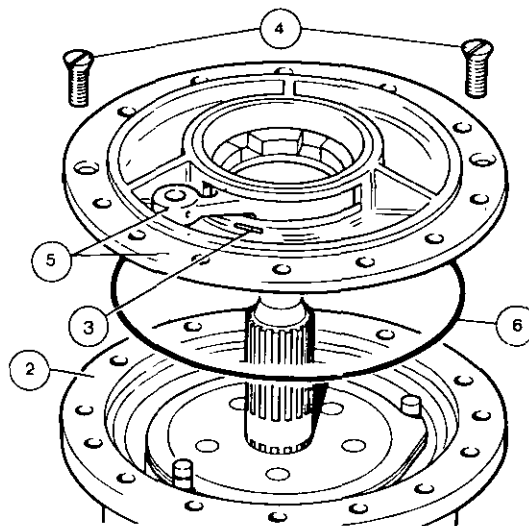
Special Tools: MS 2700 Rail Trolley

Removal

1. Remove the trumpet housing, operation 6A-07-10.
2. Manoeuvre the trumpet housing assembly off the trolley jack and stand it on end.
3. Remove, and discard the roll pin.
4. Remove the two countersunk screws.
5. Remove the carrier plate complete with the differential lock coupler fork and coupler.
6. Remove and discard the inner 'O' ring.
7. Remove the differential lock coupler fork and coupler.

Refitment

8. Reverse procedures 1 to 7, except:
 - (a) Fit a new 'O' ring to the recess in the trumpet housing using petroleum jelly. Do not attempt to fit the 'O' ring to the carrier plate.
 - (b) Assemble the differential lock coupler fork and coupler to the carrier plate, then refit the assembly, aligning the coupler splines on the axle shaft and the coupler fork on its shaft.
 - (c) Secure each countersunk screw with a centre punch mark.
 - (d) Fit a new roll pin.



REAR AXLE AND BRAKES**DIFFERENTIAL LOCK
ACTUATOR MECHANISM****Removal and Refitment**

6A-10-12

Removal

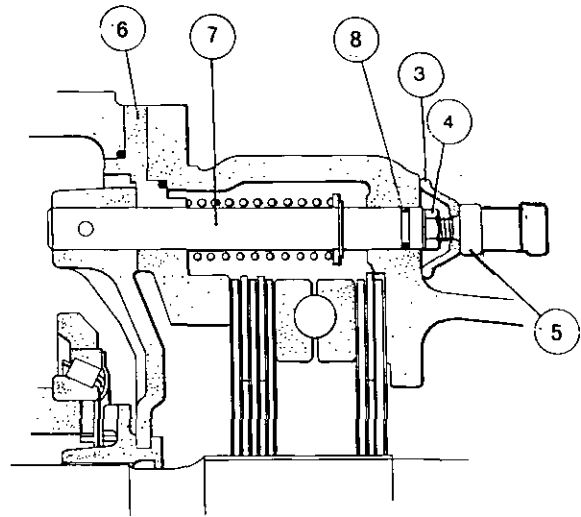
1. Remove the right hand trumpet housing, operation 6A-07-10.
2. Manoeuvre the trumpet housing assembly off the trolley jack and stand it on end.
3. Lift up the rubber seal.
4. Release the locknut.
5. Unscrew the fork from the shaft complete with its locknut and rubber seal.
6. Remove the carrier plate, operation 6A-09-11.
7. Remove the shaft, complete with the spring, washer, circlip and 'O' ring.

Examination

Examine the shaft for signs of wear or scoring. Clean and degrease the threads in the end of the shaft, and on the actuator fork.

Refitment

8. Fit a new 'O' ring to the shaft. If renewing the shaft, a new washer and circlip should be fitted.
9. Refit the shaft taking care not to damage the 'O' ring.
10. Refit the spring.
11. Refit the carrier plate, operation 6A-09-11.
12. Smear the threads of the actuator fork with recommended sealant 'B', then screw the fork fully into the shaft.
13. Unscrew the actuator fork until it will engage the differential lock operating lever in the horizontal position.
14. Tighten the locknut.
15. Push the rubber seal into position.



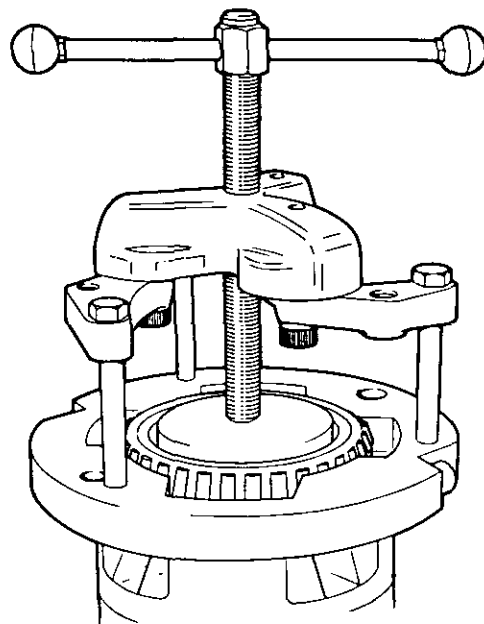
DIFFERENTIAL LOCK COUPLER CAP**Removal and Replacement** 6A-11-13

Special Tools: 555 Universal Pulley
MF 555-2A/1 Puller Adaptor
MF 257 Bearing Driver

Removal

1. Remove the right hand trumpet housing, operation 6A-07-10.
2. Remove the bearing cone using puller 555 and MF 555-2A/1.

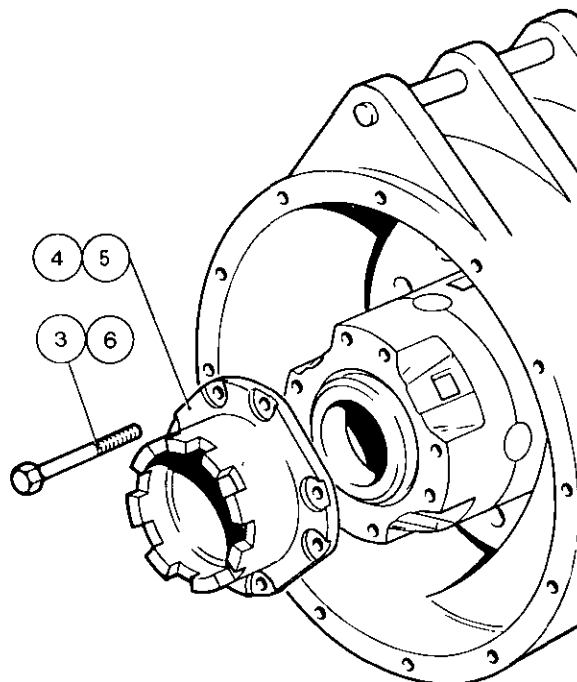
NOTE: For clarity, the illustration shows the differential removed. However for the actual operation this is not necessary.



3. Remove the eight bolts.
4. Prise off the cap taking care not to dislodge the case which would allow the differential gears to fall out.

Replacement

5. Fit the new coupler cap.
6. Insert and hand tighten the eight bolts.
7. Tighten the bolts progressively, and evenly to a torque of 108 Nm (80 lbf ft).
8. Refit the bearing cone using MF 257.
9. Refit the trumpet housing, operation 6A-07-10.



REAR AXLE AND BRAKES**DIFFERENTIAL****Pre-load Checking and Adjustment 6A-12-14**

Special Tools: MF 245D Pre-load Gauge

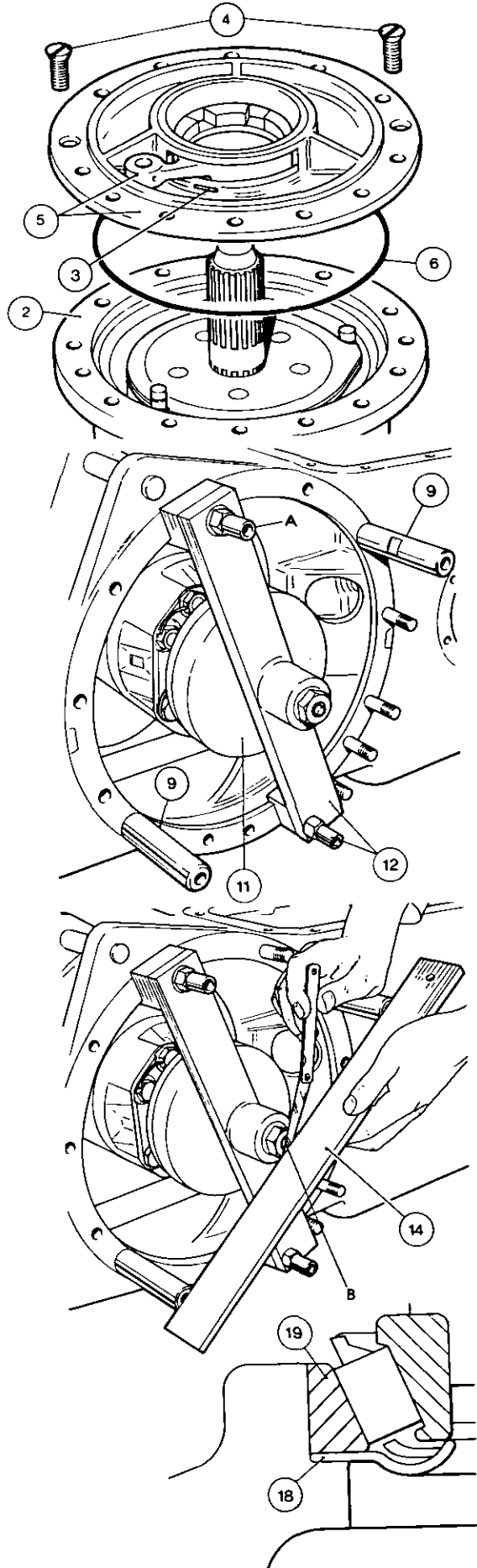
NOTE: This check must be carried out whenever the differential unit is disassembled, or if the bearings have been replaced.

Procedure is as follows:

1. Remove the right hand trumpet housing, operation 6A-07-10.
2. Manoeuvre the trumpet housing assembly off the trolley jack and stand it on end.
3. Drive out the roll pin securing the coupler fork to the shaft.
4. Remove the two countersunk screws.
5. Withdraw the carrier plate complete with the differential lock coupler fork and coupler.
6. Remove the inner 'O' Ring.
7. Drive the bearing cup out of the carrier plate.
8. Remove the chip shield.
9. Screw a setting block onto each of two diametrically opposed studs. Remove one stud from an adjacent location to fit the upper block.
10. Remove another stud from the centre housing and fit it in the tapped hole at position 'A'.
11. Place the bearing cup on the bearing cone and fit the centraliser.
12. Position the clamp bar and secure it with the two tube nuts.
13. Torque the clamp bar nut to 27 Nm (20 lbf ft) whilst using a lever to turn the differential unit. This will ensure correct seating and location of the bearings.
14. Place the straight edge in position, and measure the gap (B) using feeler gauges.
15. Use the table below to determine the correct chip shield.

Feeler Gap (Equals Shield Thickness)		Means of Identifi- cation	Part No.
mm	in		
0,74 to 0,79	0-029 to 0-031	NO DOTS	187 689 M1
0,86 to 0,91	0-034 to 0-036	ONE DOT	892 173 M1
0,99 to 1,04	0-039 to 0-041	TWO DOTS	892 172 M1
1,12 to 1,17	0-044 to 0-046	THREE DOTS	892 171 M1
1,25 to 1,30	0-049 to 0-051	FOUR DOTS	892 170 M1
1,37 to 1,42	0-054 to 0-056	FIVE DOTS	191 124 M1

16. Remove the tube nuts, clamp bar, centraliser and setting blocks.
17. Refit the two studs in their correct holes.
18. Place the new chip shield in the carrier plate, with the dished face towards the differential.
19. Refit the bearing cup, ensuring that it is fully seated.
20. Refit the carrier plate, operation 6A-09-11.

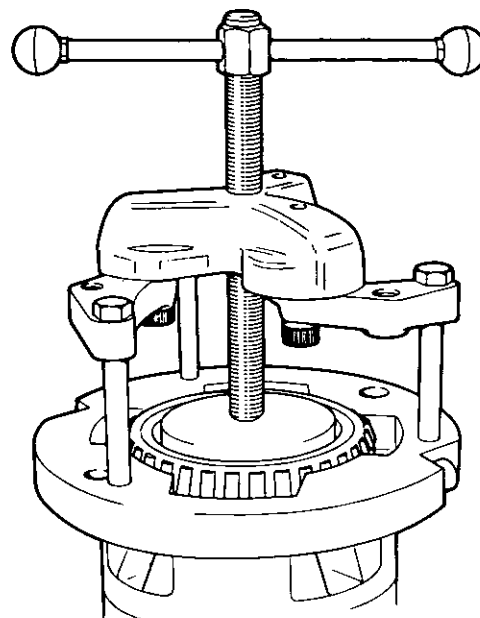


RH DIFFERENTIAL BEARING**Removal and Replacement 6A—13—15**

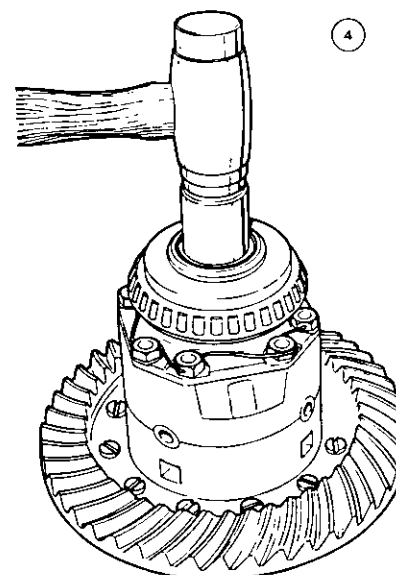
Special Tools Required: 555 Universal Puller
MF 555-2A/1 Puller Adaptor
MF 257 Bearing Driver

Removal

1. Remove the right hand trumpet housing, operation 6A—07—10.
2. Pull off the bearing cone using puller No. 555 and MF 555-2A/1.
3. Remove the carrier plate and drive out the bearing cup as stated in items 3 to 8 of Operation 6A—12—14.

**Replacement**

4. Drive the new bearing cone on to the differential lock coupler cap using MF 257.
5. Check the bearing pre-load, operation 6A—12—14 but using a new bearing cup.

**DIFFERENTIAL UNIT****Removal and Refitment 6A—14—15****Removal**

1. Remove the left hand trumpet housing, operation 6A—06—09.
2. Manoeuvre the differential assembly out of the centre housing.

WARNING: The differential unit is heavy and awkward to handle. Take care when both removing and refitting it.

Refitment

3. Manoeuvre the differential unit into the centre housing, engaging the splines in those of the RH axle shaft.

NOTE: If any of the differential components have been replaced, the pre-load should be checked, operation 6A—12—14.

4. Refit the left hand trumpet housing, operation 6A—06—09.

REAR AXLE AND BRAKES

DIFFERENTIAL LH BEARING

Removal and Replacement

6A-15-16

Special Tools: MF 300 Hand Press
 MF 200-3 Adaptor
 MF 197 Bearing Driver
 MF 197-2 Adaptor
 MF 1105 Universal Puller
 MF 1105-2A/1 Adaptor
 MF 1105-2A/4 Adaptor

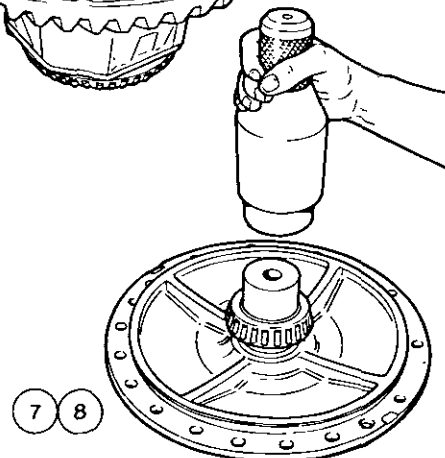
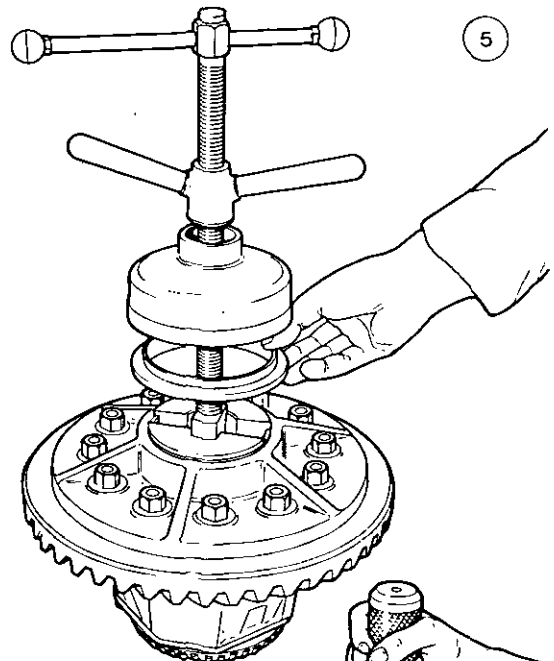
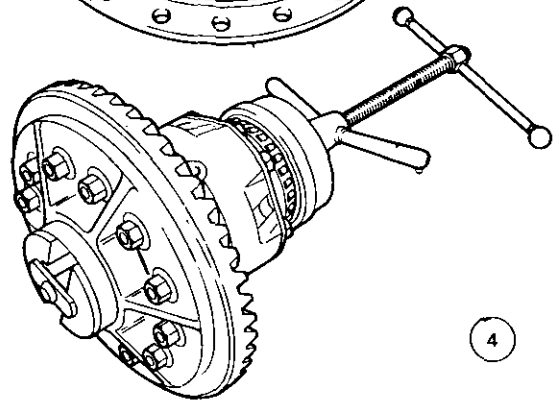
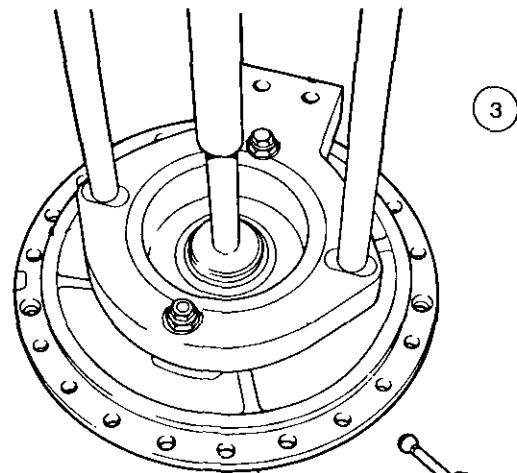
Removal

1. Remove the differential, operation 6A-14-15.
2. Remove the left hand carrier plate, operation 6A-08-11.
3. Assemble MF 200 with MF 200-3, then pull off the bearing cone.
4. Assemble MF 1105 with MF1105-2A/1 and MF 1105-2A/4, and pull out the bearing cup.

Replacement

5. Assemble MF 1105, MF 1105-2A/1 and MF 1105-2A/4 with a new bearing cup.
6. Pull the new cup into the differential unit.

7. Fit the MF 197-2 to the bore of the carrier plate.
8. Slide the new bearing cone on to MF 197-2, then drive it fully on to the carrier plate using a hammer and MF 197.
9. Refit the differential unit, operation 6A-14-15.
10. Check the differential pre-load, operation 6A-12-14.



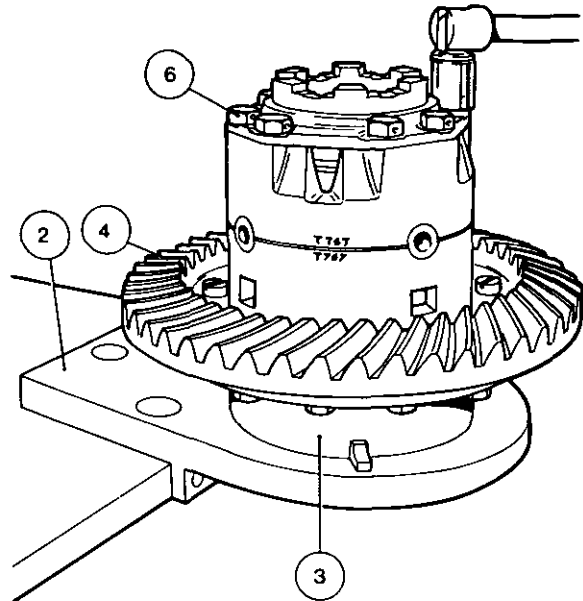
DIFFERENTIAL UNIT**Servicing**

6A-16-17

Special Tools: MF 9A Holder
 MF 10 Bench Adaptor
 MF 258 Holder
 555 Universal Puller
 MF 555-2A/1 Adaptor

Disassembly

1. Remove the differential unit, operation 6A-14-15.
2. Fit MF 10 to the bench.
3. Fit MF 9A to MF 10.
4. Place the differential on MF 10.
5. Remove the bearing cone using puller 555 and MF 555 2A/1 (See operation 6A-13-15).



6. Remove the eight bolts.
7. Remove the coupler cap and right hand case.
8. Remove the cross joint and pinions assembly with the thrust washers.
9. Remove the differential gears and their thrust washers.

Examination

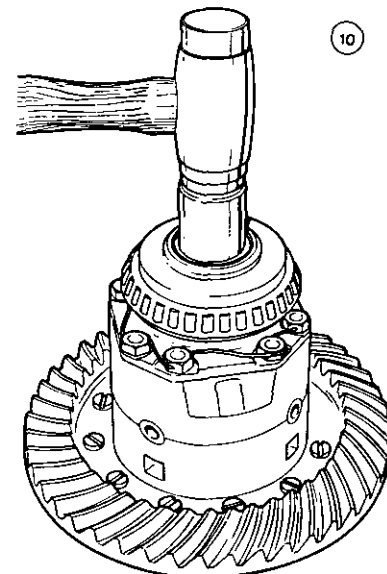
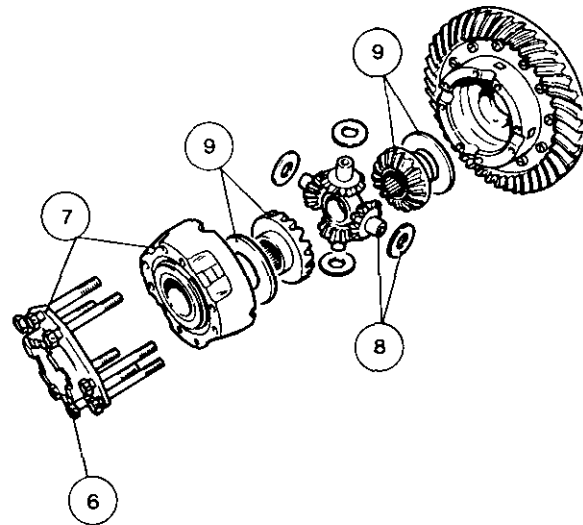
Examine all of the differential components and replace any that are worn or damaged.

NOTE: If any of the spider gears are worn, a full set of four new gears should be fitted. In such circumstances, differential gears may also need to be replaced.

Reassembly

Reverse procedures 2 to 9 except:

- (a) Refit the right hand differential case with the markings aligned.
 - (b) Tighten the eight bolts to a torque of 108 Nm (80 lbf ft).
 - (c) Refit the bearing cone using MF 257.
10. Refit the differential unit, operation 6A-14-15.



REAR AXLE AND BRAKES

CROWNWHEEL

Removal and Replacement

6A-17-18

Special Tools: MF 9A Holder
MF 10 Adaptor
MF 258 Holder
Epoxy Resin Bonding Kit
No. 1852 913 M91

Removal

1. Remove the differential gears, operation 6A-16-17.
2. Place the differential unit on a bench with the teeth facing downwards.
3. Centre punch each of the rivet heads centrally,
4. Using a 13 mm ($\frac{1}{2}$ in) drill, drill out each of the rivet heads until they become detached from their shanks.
5. Drive out the rivets.
6. Drive off the crownwheel.

NOTE: When fitting a new crownwheel, the pinion must also be replaced.

Replacement

7. Ensure that the mating faces of the differential case and the new crownwheel are perfectly flat.
8. Fit MF 9A and MF 10 to the bench.
9. Fit the left hand differential case, with the mating face upwards.
10. Degrease the crownwheel, left hand differential case, differential bolts and nuts with trichloroethylene.
11. Collect together all items necessary for speedy assembly.

These items are:

A torque wrench, the correct size socket and recommended sealant 'C'.

12. Open the epoxy resin kit 1852 913 M91. Its contents are:
One jar containing 10 ml of resin. (This jar is also used as a mixing vessel).
One jar containing 5 ml of hardener.
One glass stirring rod.
One brush.
13. Pour the hardener into the resin jar and mix thoroughly using the glass rod.
14. Apply an even coating of adhesive to both mating surfaces.
15. Fit the crownwheel to the differential case.

NOTE: These two components are an interference fit and must, therefore, have their bolt holes aligned accurately before being fitted together.

16. Fit the twelve bolts with their heads nearest the crownwheel teeth.
17. Apply two drops of recommended sealant 'C' to the first thread of each bolt.
18. Fit the nuts, and tighten them progressively and evenly to a torque of 160 Nm (120 lb ft).
19. Refit the differential components, operation 6A-16-17.

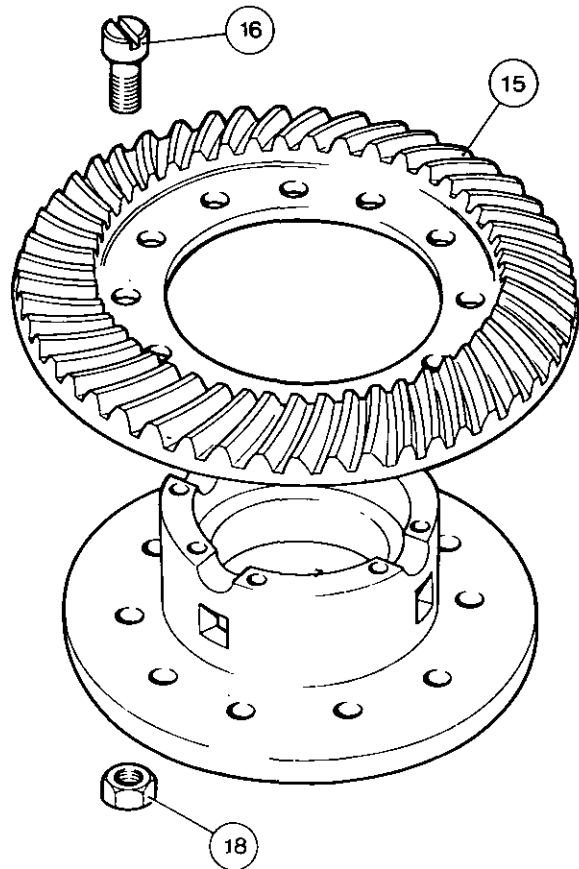
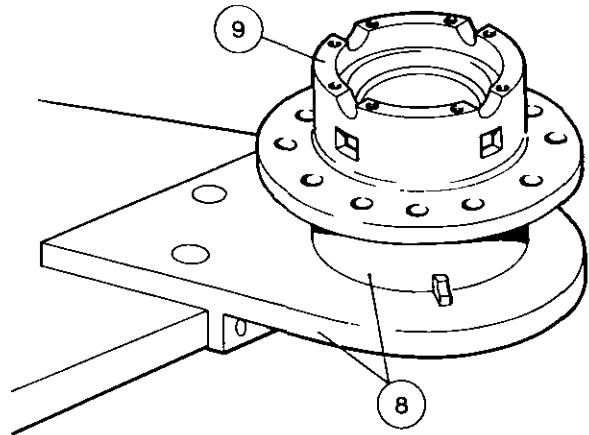
NOTE: Operations 14 to 18 must be completed within 30 minutes of mixing the resin and hardener.

20. Cure the resin bonding by subjecting the differential assembly to uniform heating as follows:—

120°C (248°F) for a minimum of 1 hour.
or 40°C (105°F) for a minimum of 12 hours.
or 30°C (86°F) for a minimum of 16 hours.
or 20°C (68°F) for a minimum of 24 hours.

21. Refit the differential unit, operation 6A-16-17.

Issue 1



PINION ASSEMBLY (STANDARD FLOW PUMP)

Removal and Refitment

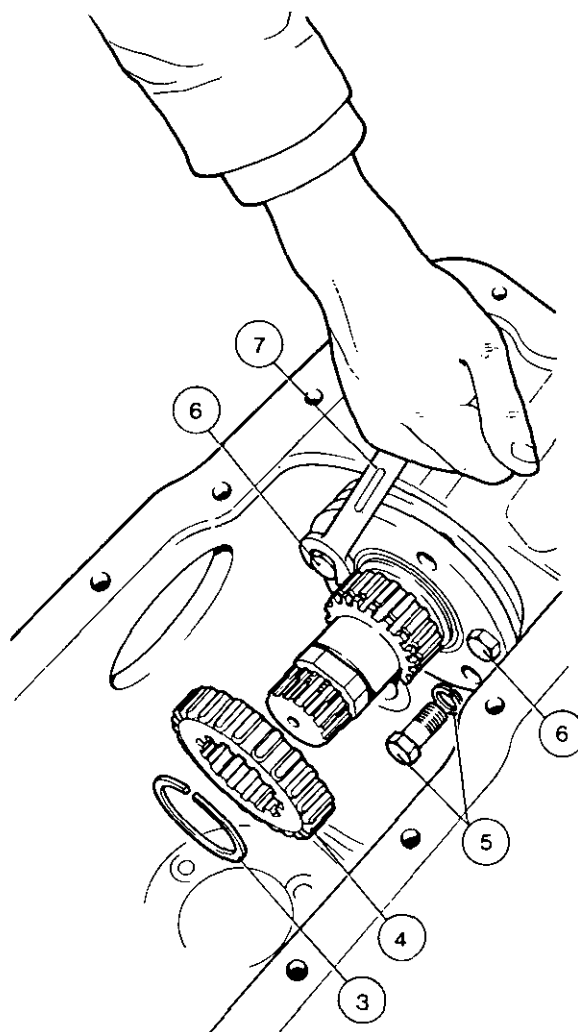
6A-18-19

Removal

1. Remove the lift cover and the hydraulic pump(s) as stated in Part 8A.
2. Remove the i.p.t.o. clutch pack (if fitted), Part 6B.
3. Release the snap ring.
4. Slide off the gear.
5. Remove the six bolts and spring washers.
6. Screw one of the bolts into each of the two tapped holes.
7. Tighten the bolts, thus withdrawing the pinion assembly.

Refitment

8. Reverse procedures 1 to 7 except:
 - (a) Ensure that the locating pin is aligned before pressing the housing into place.
 - (b) Tighten the six bolts to a torque of 108 Nm (80 lbf ft).
 - (c) Fit a new snap ring.



PINION ASSEMBLY (HIGH FLOW PUMP)

Removal and Refitment

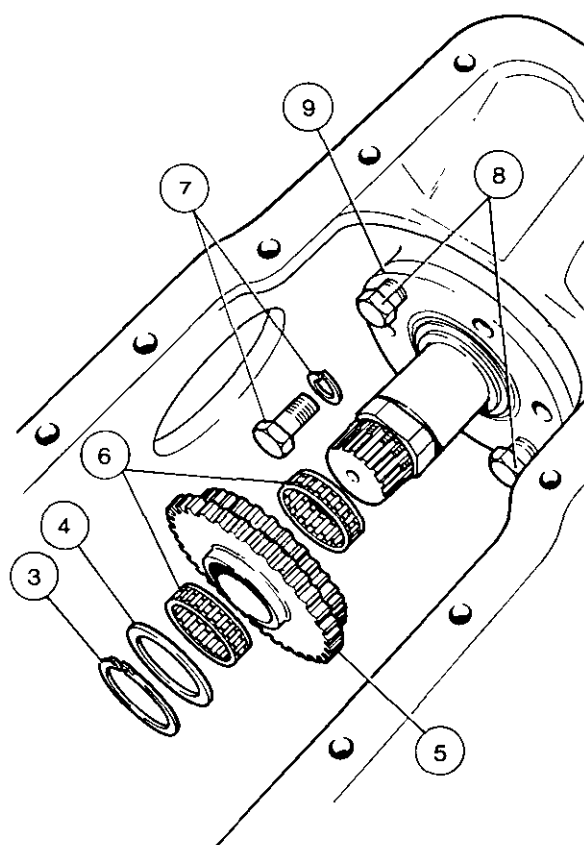
6A-19-19

Removal

1. Remove the lift cover and the hydraulic pump(s) as stated in Part 8A.
2. Remove the i.p.t.o. clutch pack (if fitted), Part 6B.
3. Release the circlip.
4. Remove the thrust washer.
5. Remove the gear cluster.
6. Slide the needle roller bearings off the bearing sleeve.
7. Remove the six bolts and spring washers.
8. Screw one of the bolts into each of the two tapped holes.
9. Tighten the bolts thus withdrawing the pinion assembly.

Refitment

10. Reverse procedures 1 to 9 except:
 - (a) Ensure that the locating pin is aligned before pressing the housing into place.
 - (b) Tighten the six bolts to a torque of 108 Nm (80 lbf ft).
 - (c) When the thrust washer shows signs of wear it should be renewed.
 - (d) Fit a new circlip.



REAR AXLE AND BRAKES

PINION ASSEMBLY

Servicing

6A-20-20

Special Tools: MF 200 Hand Press
MF 200-23 Adaptor
MF 200-25 Adaptor
Pre-load Gauge

Disassembly

1. Remove the pinion assembly, operation 6A-18-19 (Standard Flow Pump), 6A-19-19 (High Flow Pump).
2. Remove the locking ring as follows:
 - (a) Place the pinion in a soft faced vice with the jaws of the vice holding the flats, adjacent to the collar locking rollers.
 - (b) Using a cold chisel, cut one half to two thirds into the locking collar at points b and c.
 - (c) Reposition the pinion in the vice and chisel down the splines into the cuts made at points b and c. A few hefty blows will fracture the locking collar enabling it to be removed.

NOTE: Great care should be taken to avoid damaging the threads of the pinion.

3. Remove the sleeve and the splined hub (Standard Flow Pump) or the bearing sleeve, sleeve keeper and thrust washer (High Flow Pump).
4. Remove the housing, complete with the front bearing cone.
5. Fit the pinion to MF 200 with MF 200-23 and MF 200-25. Press off the bearing.
6. Remove the snap ring securing the pilot bearing to the pinion.
7. Fit the pinion to MF 200, using adaptor MF 200-23, then press off the pilot bearing.

Examination

Examine all components for signs of wear, scoring or pitting. Any faulty or worn parts must be replaced.

NOTES:

- (a) If the pinion is damaged the crownwheel must also be replaced as these are only supplied in matched sets.
- (b) The taper roller bearings are serviced as a pair, assembled with the housing.
- (c) New snap rings should always be fitted.

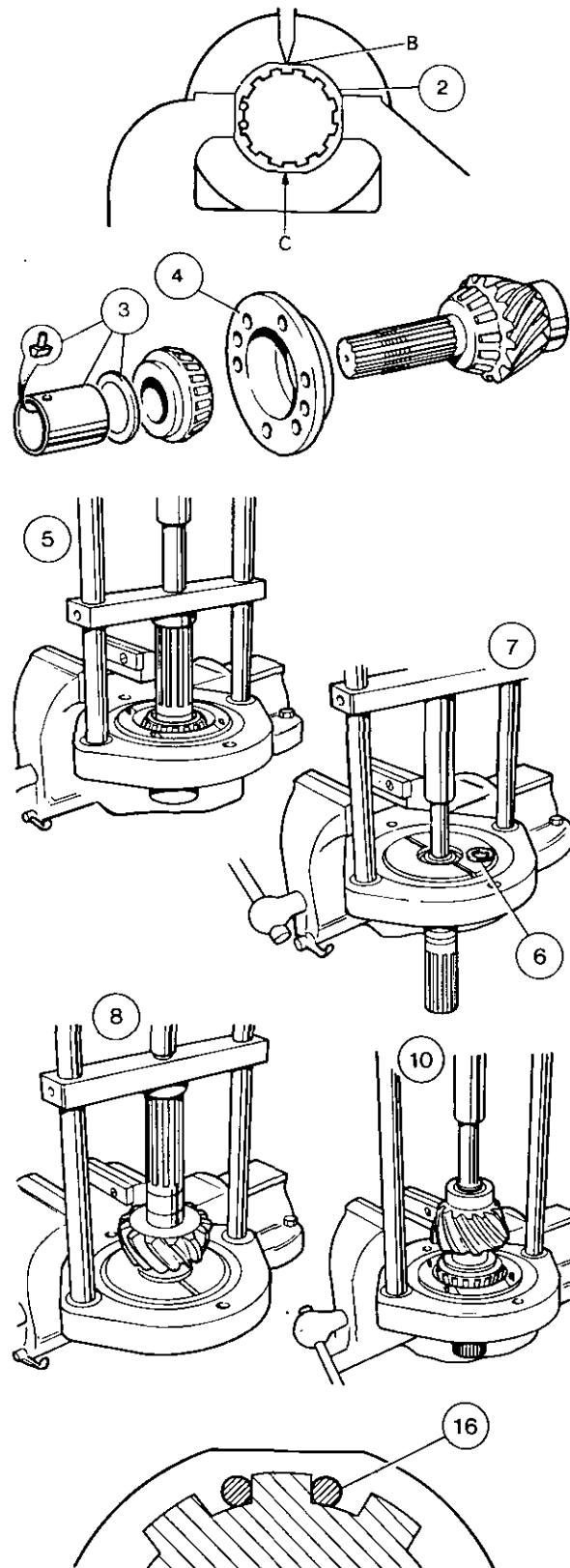
Reassembly

8. Using MF 200 and MF 200-23, press the pilot bearing on the pinion.
9. Secure the pilot bearing with a new snap ring.
10. Using MF 200 and MF 200-23 and MF 200-25 press the bearing onto the pinion.
11. Locate the pinion in its housing and fit the front bearing cone.
12. Refit the sleeve and the splined hub (Standard Flow Pump) or the thrust washer and bearing sleeve with the sleeve keeper (High Flow Pump) and a new locking ring, hand tightened.
13. Hold the housing in a soft faced vice.
14. Fit a suitable pre-load gauge to the pinion and tighten the locking ring to give a pre-load reading of 24 kg cm (20 lbf in).
15. Remove the gauge, tap the pinion firmly to centralise the bearings, then re-check the pre-load.
16. Secure the locking ring by tapping a locking roller down either side of one of the pinion splines.

NOTE: The needle rollers must be driven flush with the locking collar.

Before refitment, the pinion assembly should be freely lubricated with clean transmission oil.

17. Refit the pinion assembly, operation 6A-18-19. Standard Flow Pump), 6A-19-19 (High Flow Pump).



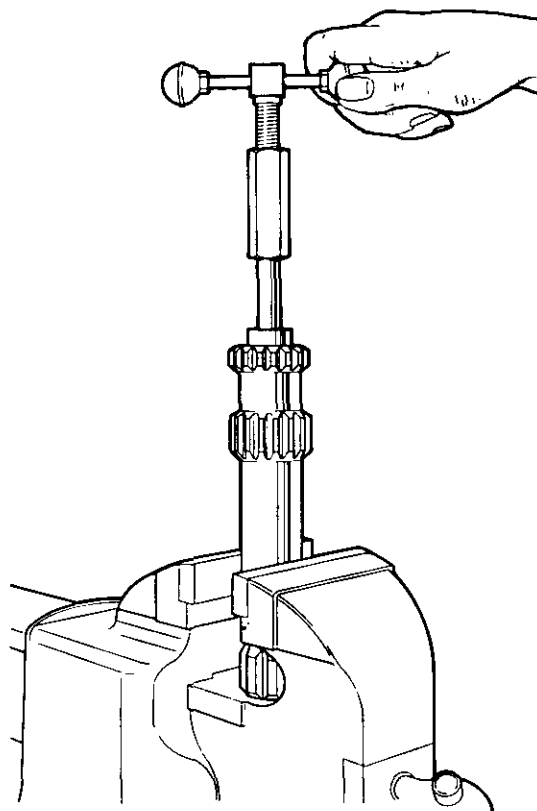
REAR DRIVE SHAFT**Servicing**

6A-21-21

Special Tools: MF 202A Needle Roller Bearing Puller
 MF 203A Needle Roller Bearing Driver
 550 Universal Handle

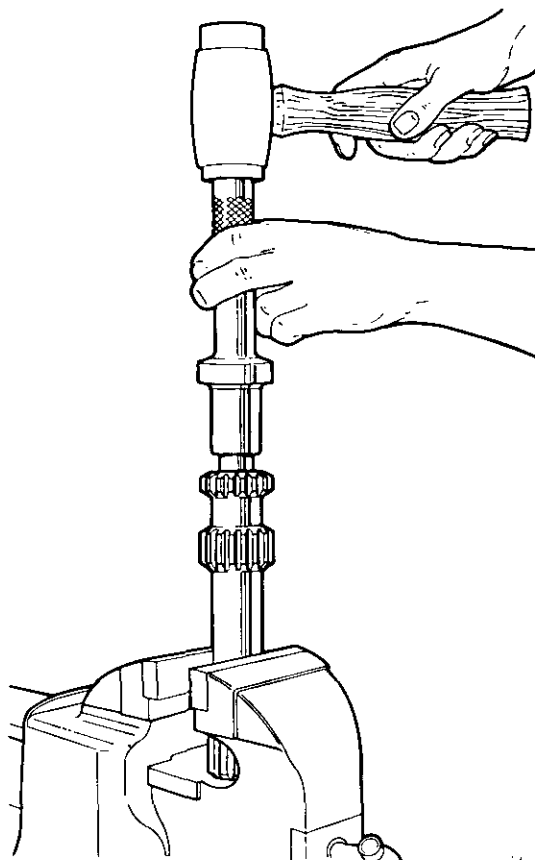
Disassembly

1. Remove the lift cover, Part 8A.
2. Remove the split pin from the shear tube.
3. Remove the shear tube.
4. Remove the rear drive shaft.
5. Locate the end of MF 202A underneath the bearing cage.
6. Extract the bearing.
7. Remove the plunger and spring.
 Examine the drive shaft for signs of wear, and fit a new needle roller bearing.

**Reassembly**

Reverse procedures 1 to 7 except:

- (a) Place the bearing depth control collar (part of 203A) on the end of the driveshaft over the new bearing. Drive the bearing into the drive shaft using MF 203A and the 550 handle until the tool contacts the depth control collar.
- (b) Fit a new split pin to give an end float of 0,40 to 2,50 mm (0-015 to 0-100 in).



REAR AXLE AND BRAKES**BRAKE ACTUATOR HOUSINGS****Servicing**

6A—22—22

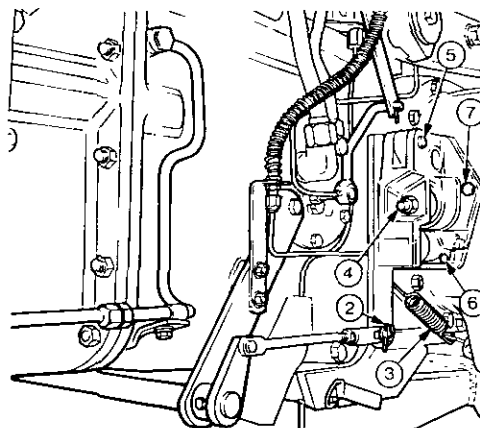
1. Drain the transmission oil to the min mark on the dipstick.
2. Disconnect the brake pull rod.
3. Remove the brake return spring.
4. Remove the two locknuts and the spherical seat.
5. Remove the split pin, pivot pin and actuating levers.
6. Remove the two nuts and bolts securing the slave cylinder to the actuator housing. To avoid having to bleed the brake system do not disconnect the bundy pipes.
7. Remove the two bolts and lockwashers securing the housing to the axle.
8. Move the slave cylinder to one side to reveal a countersunk screw behind it. Remove this screw using an Allen key.
9. Lift the actuator housing clear.
10. Remove and discard the gasket.
11. If damaged, tap out and discard the rubber boot.

Examination

Examine the mating faces of the actuator housing and the trumpet housing for damage. Clean both surfaces before reassembly.

Reassembly

12. Reverse procedures 1 to 9, except:
 - (a) If necessary fit a new rubber boot, preferably using a hydraulic press.
 - (b) Fit a new gasket.
 - (c) Before refitting the housing, smear the brake actuator rod with petroleum jelly. When refitting the housing take care to seat the lips of the rubber boot in the step on the actuator rod, without disturbing the garter spring.
- Adjust and balance the brakes, operation 6A—30—29.



RIGHT AND LEFT HAND BRAKES**Servicing**

6A-23-23

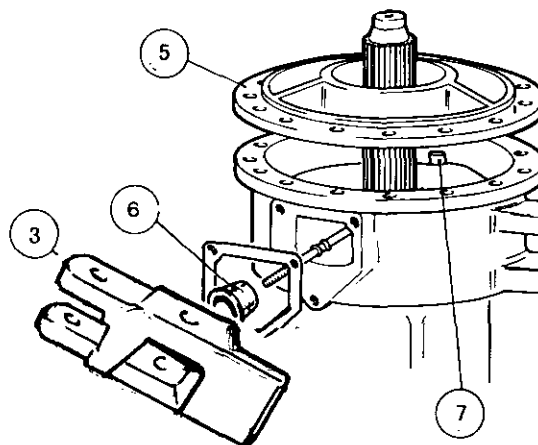
Special Tools: MS 2700 Rail Trolley

Disassembly

1. Remove the trumpet housing, operation 6A-06-09 or 6A-07-10.
2. Manoeuvre the trumpet housing assembly off the trolley jack and stand it on end.
3. Remove the actuator housing. Operation 6A-22-22 procedures 4 to 11.
4. Remove the carrier plate, operation 6A-08-11 or 6A-09-11.
5. Remove the brake components, turning each plate over and stacking in reverse order to ensure correct refitment.
6. If necessary, remove the brake stop rod from the housing.

Only if necessary dismantle the actuator unit as follows.

7. Release the four springs.
8. Remove the actuator rod and links and the ball bearings.

**Examination**

Friction plates: These have a minimum groove depth of 0,3 mm (0.12 in) when new. When worn to the extent that the grooves begin to disappear, the plates must be replaced.

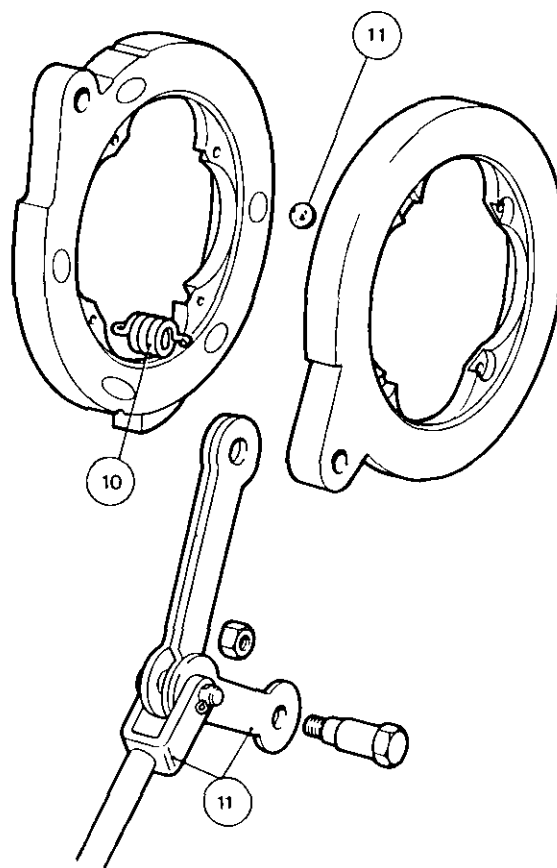
Interplates: The interplates can generally be refitted, but should be replaced either when badly scored or worn more than 0,13 mm (0.005 in) per face. The interplates should also be replaced when the friction plates are renewed.

Check all plates for signs of severe overheating or distortion.

NOTE: Never attempt to reclaim friction plates or interplates by lapping or grinding.

Actuator Plates: The actuator plates do not normally need replacing, but should be checked for severe scoring.

Thoroughly clean out the brake housing and remove any burrs or pieces of old gasket from the actuator and trumpet housings.

**Reassembly**

9. Reverse procedures 1 to 6 or 1 to 8 depending on the extent of disassembly, except:
 - (a) Dip each friction plate, interplate and the actuator unit in clean transmission oil before refitting them into the housing **THIS IS MOST IMPORTANT.** Refit all plates in the order in which they were originally assembled.
 - (b) Refit the carrier plate, operation 6A-08-11 or 6A-09-11.
 - (c) Fit a new rubber boot, preferably using a hydraulic press.
 - (d) Smear the actuator rod with petroleum jelly, then refit the actuator housing ensuring that the lip of the rubber boot seats correctly in the ridge on the actuator rod. **DO NOT DISPLACE THE GARTER SPRING.**
 - (e) The three bolts are of varying lengths according to their location in the actuator housing.
10. Adjust and balance the brakes, operation 6A-30-29.

REAR AXLE AND BRAKES**HANDBRAKE****Removal and Refitment**

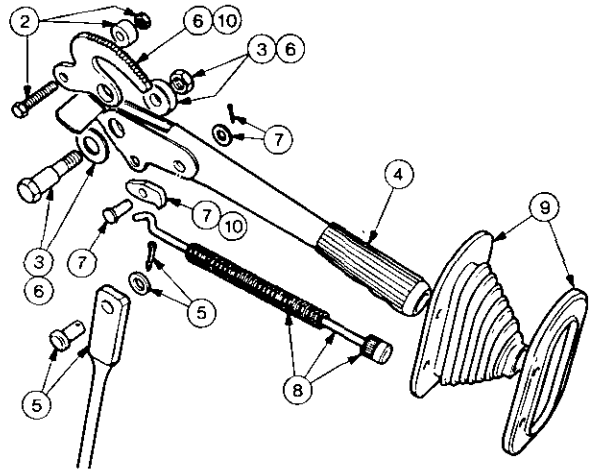
6A-24-24

Removal

1. Disconnect the handbrake rod from the lever mounted on the right hand side of the centre housing.
2. Remove the top bolt, nut, spacer and washer securing the handbrake to the bracket on the underside of the cab floor.
3. Remove the nut from the lower bolt and ease the handbrake away from the bracket. Replace the nut to hold the mechanism together.
4. Pull the handbrake rearwards out of the rubber gaiter.
5. Remove split pin, washer and pivot pin to release the operating rod.
6. Remove the nut special pivot bolt and washers to release the ratchet plate.
7. Remove the split pin, pivot pin and the ratchet catch.
8. Remove the centre plunger together with the spring.
9. If gaiter is damaged, remove the four screws from the plastic retainer inside the cab to release it.

Refitment

10. Check the condition of all components paying particular attention to the ratchet and catch. Replace if necessary.
11. Reverse procedures 1 to 7.

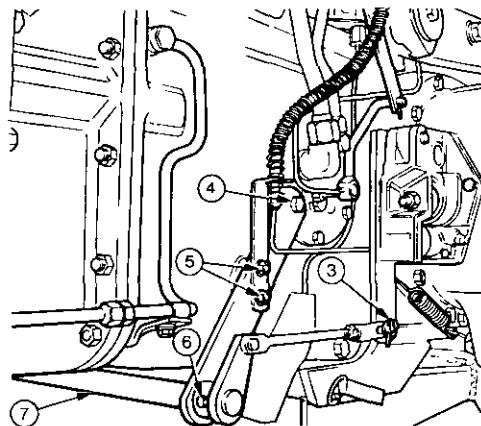
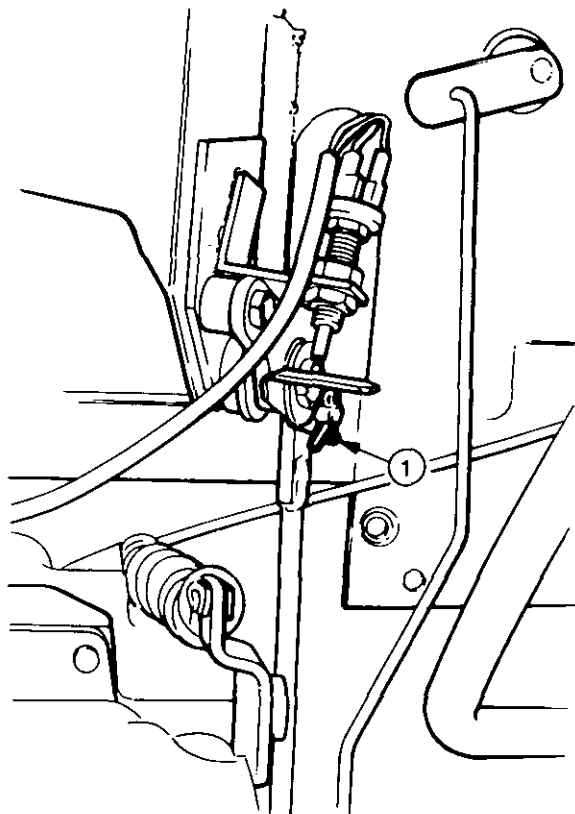


HANDBRAKE RODS**Removal and Refitment**

6A-25-25

Removal

1. Remove the split pin and pivot pin securing the vertical operating rod to the hand brake.
2. Remove the split pin from the pivot pin securing the vertical operating rod to the cross shaft lever below the front end of the rear axle. Remove the rod.
3. Remove the split pin, washer and pivot pin securing the horizontal operating rod to the lever on the actuating housing both sides.
4. Remove the bolt that secures the cross shaft brace to the response cover on one side and to the p.t.o. cover on the other side.
5. Remove the two nuts and washers securing the cross shaft brace and flexible brake hose bracket to the front end of the centre housing on both sides.
6. On the left hand side remove the nut and bolt from the cross shaft lever, remove the lever.
7. Lift the cross shaft and brace assembly clear, together with the horizontal operating rods.



REAR AXLE AND BRAKES**FOOT BRAKE CONTROLS****Removal and Refitment**

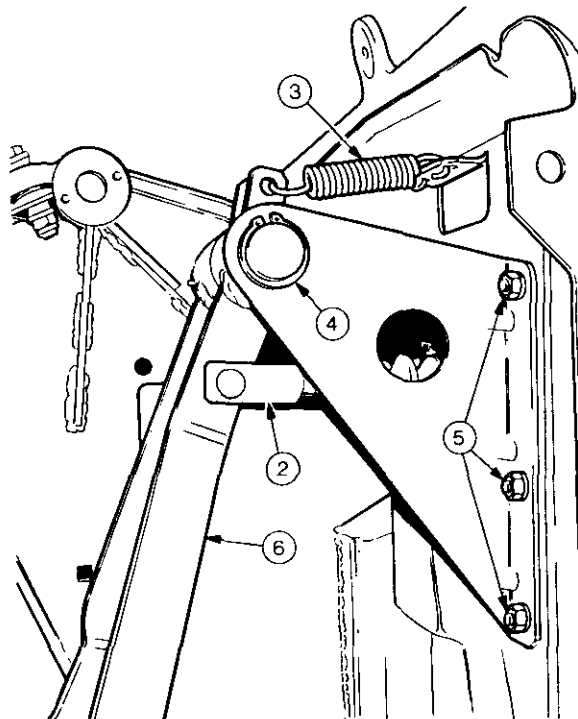
6A-26-26

Removal

1. Remove the switch panel.
2. Disconnect the master cylinder plunger from each of the two pedal levers.
3. Release the return spring from the top of each pedal lever.
4. Remove the circlip from the end of the pivot shaft.
5. Remove the three bolts, nuts and lockwashers from the pivot shaft support bracket and remove it.
6. Pull the two pedal levers off the pivot shaft.
7. Remove three plastic bearings from the bore of each pedal lever boss also the plastic spacer between the two bosses.

Refitment

8. Spray the pivot shaft with molybdenum disulphide.
9. Reverse procedures 1 to 7 ensuring that the plastic bearings are positioned correctly in the bores of the bosses and that the plastic spacer is positioned between the bosses.
10. The pedal free travel should be 13 to 25 mm measured at the end of the pedal or 1 to 2 mm between the bracket and the pedal.
11. If adjustment is necessary, slacken the locknut and turn the master cylinder control rod clockwise to increase the free travel.
12. Adjust the stop light switch so that the plunger travels 3.8 to 6.4 mm when the pedal is fully released.



MASTER CYLINDERS**Overhaul**

6A-27-27

Removal

1. From inside the cab remove the switch panel.
2. Disconnect the master cylinder plunger from each of the two brake pedal levers.
3. On the left hand plunger undo the locknut and remove the clevis and stop light switch actuator bracket.
4. Prop the right hand side of the hood in the open position.
5. Remove the flexible connecting hose from the left hand cylinder protruding from the bulkhead, insert the end into a clean receptacle and drain off the brake fluid.
6. Remove the bundy feed pipe from the end of each cylinder.
7. Remove the two nuts, bolts and lockwasher securing each cylinder to the bulkhead.
8. Pull the two cylinders clear.
9. Peel back the rubber dust cover and remove circlip.
10. Remove the plunger assembly.
11. Remove the piston and spring.

INSPECTION

Thoroughly clean and dismantle parts by washing them in methylated spirit and drying with compressed air. Inspect the inside of the master cylinders for any signs of scoring or abrasion.

Refitment

12. Lubricate the inside of the master cylinders with new oil of the recommended type.
13. Renew shim on the end of the piston covering the three holes in face.
14. Renew seal with the smaller hole with the flat face against the new shim.
15. Refit the nylon spring seat with the face with the three recesses against the previously fitted seal.
16. Refit the spring onto the nylon seat.
17. Fit the three legged nylon insert into the opposite end of the spring.
18. Ensure that the half circular band is in position in the recess of the nylon insert covering the side slot.
19. Renew the seal with the larger hole, on the opposite end of the piston between the two flanges with the flat face of the seal against the end flange.
20. Carefully insert the assembly into the cylinder, slide down the spherical seating washer and fit circlip into the groove inside the cylinder to retain the assembly.
21. Ensure rubber dust cover seats on the metal collar and slip it onto the outer diameter of the cylinder.
22. Reverse procedures 1 to 8.
23. Tighten the four bolts to a torque of 20.7-24.9 Nm (15.3-18.4 lbf ft).
24. Bleed the brake system in accordance with Operation 6A-29-29.
25. Adjust and balance the brakes in accordance with Operation 6A-30-29.

REAR AXLE AND BRAKES

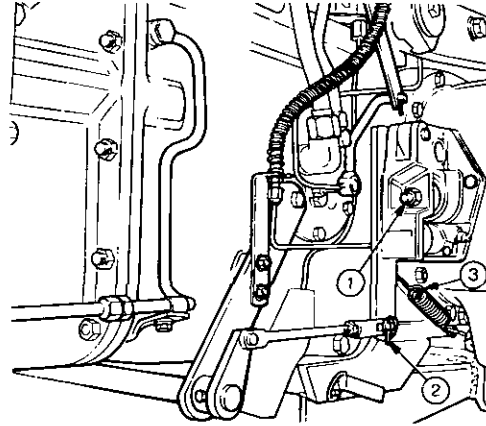
SLAVE CYLINDERS

Overhaul

6A-28-28

Removal

1. Remove the two locknuts and the spherical seat from the end of the brake actuating rod protruding from the actuating lever on the trumpet housing.
2. Remove the split pin, pivot pin and washer from the slot in the horizontal actuating rod.
3. Release the return spring from the trumpet housing.
4. Swivel the actuating lever upwards and remove the Bundy feed pipe from the cylinder, allow the fluid to drain into a clean receptacle.
5. On tractors fitted with a trailer brake pipe, the Bundy pipe will have to be disconnected from the left hand cylinder.
6. Remove the two nuts and bolts securing the cylinder to the actuator housing.
7. Remove the actuating plunger from the cylinder.
8. Remove the rubber dust cover.
9. Remove the spring clip.
10. Remove the piston complete with oil seal.

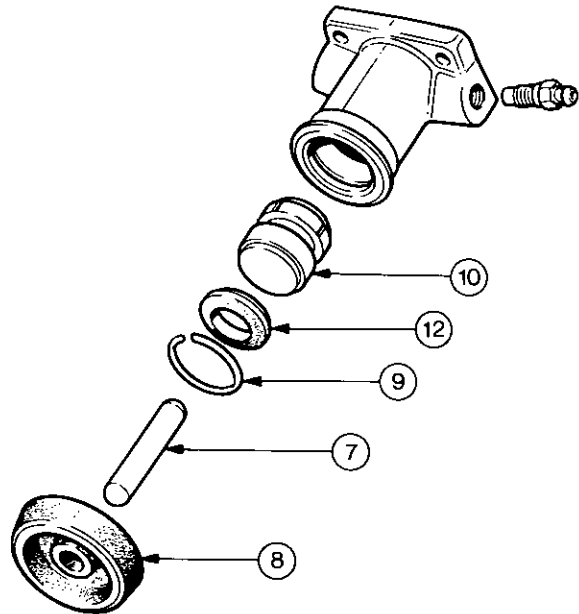


Inspection:

Thoroughly clean and dismantle parts by washing them in methylated spirit and drying with compressed air. Inspect the inside of the master cylinders for any signs of scoring or abrasion.

Refitment

11. Lubricate the inside of the master cylinders with new oil of the recommended type.
12. Renew the oil seal with the flat side against the face of the groove in the piston, nearest the plunger divot.
13. Reverse procedures 1 to 8 ensuring the plunger seats in the divot in the end of the piston. Tighten the two nuts to a torque of 8-13 Nm (6-10 lbf ft).
14. Bleed the system in accordance with operation 6A-29-29.
15. Adjust and balance the brakes in accordance with operation 6A-30-29.



BLEEDING THE BRAKING SYSTEM

Method

6A-29-29

NOTE: The braking system has two bleed screws. In the case of tractors less trailer brakes there is a bleed screw in each of the two slave cylinders. On tractors with trailer brakes one bleed screw is in the right hand slave cylinder and the other in the trailer brake valve on top of the lift cover. If the system is opened up for any reasons, eg. when components are removed or when parts such as unions or hoses fail, it is essential to completely bleed the system, once repairs have been made, in order to expel any air. This operation must be carried out in precise sequence, as follows:

1. Fill the brake fluid reservoir with fresh clean, approved brake fluid. **It must be kept topped up at all time during the bleeding process.**
2. Fit a suitable length of rubber pipe onto the bleed screw on the left hand slave cylinder (or on the valve on top of the lift cover on tractors with trailer brakes).
3. Insert free end of the rubber pipe into a clean, transparent receptacle.
4. Unlatch the brake pedals to enable them to be operated individually.
5. Undo the bleed screw and depress the left hand brake pedal for the full extent of its travel, allow it to return and repeat the process until air free fluid can be seen exuding from the rubber pipe. On a downward stroke lock the bleed screw.
6. Remove the pipe and repeat the process on the opposite cylinder.

BRAKE ADJUSTMENTS AND BALANCING

6A-30-29

Procedure is as follows:—

1. Jack up the tractor until both rear wheels are clear of the ground.
2. Disengage the brake return springs and release the parking brake.
3. Unlatch the brake pedals.
4. Measure the height of the right hand pedal from the cab floor.
5. Apply a light load to the brake pedal and re-measure the pedal height. The pedal free travel should be 25 mm (1 in).
6. If adjustment is required, slacken the locknut, turn the adjustment nut clockwise to reduce free travel and anti-clockwise to increase free travel; tighten the locknut.
7. Having adjusted the right hand pedal, adjust the left hand pedal to match for height so that the latch freely engages.
8. Re-connect the brake return springs.
9. Road test the tractor, checking for binding or pulling to one side. Any tendency to pull to one side should be counteracted by slackening the adjuster on the side to which pulling takes place.

POWER TAKE OFF

Part 6—Section B

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6B—04—06 6B—05—06	P.T.O. SHAFT REAR BEARING Removal and Replacement (Standard Flow Linkage Pump) Removal and Replacement (High Flow Linkage Pump)	06
6B—06—07	NEEDLE BEARING Removal and Replacement (Standard Flow Linkage Pump)	07
6B—07—08	GROUND SPEED GEAR, BUSH AND PINION SHAFT GEAR ASSEMBLY (Standard Flow Linkage Pump) Removal and Replacement	08
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6B—09—10 6B—10—10 6B—11—11 6B—12—11	P.T.O. SIDE COVER Removal and Refitment (Non Multi-Power/I.P.T.O. or Auxiliary Pump Tractors) Servicing (Non Multi-Power/I.P.T.O. or Auxiliary Pump Tractors) Removal and Refitment (Multi-Power/I.P.T.O. or Auxiliary Pump Tractors) Servicing (Multi-Power/I.P.T.O. or Auxiliary Pump Tractors)	10 10 11 11

GENERAL

The p.t.o. can be one of the following according to the specification and /or type of tractor:

- (i) Proportional ground speed p.t.o. and proportional engine speed p.t.o. with the standard flow linkage pump and a three-position control lever.
- (ii) Proportional engine speed p.t.o. with the high flow linkage pump, reduction gears and a two position control lever.
- (iii) Proportional engine two speed p.t.o. with the high flow linkage pump, reduction gears and the two-position control lever. The second speed being obtained by exchanging the p.t.o. shaft, 540 rev/min or 1000 rev/min.

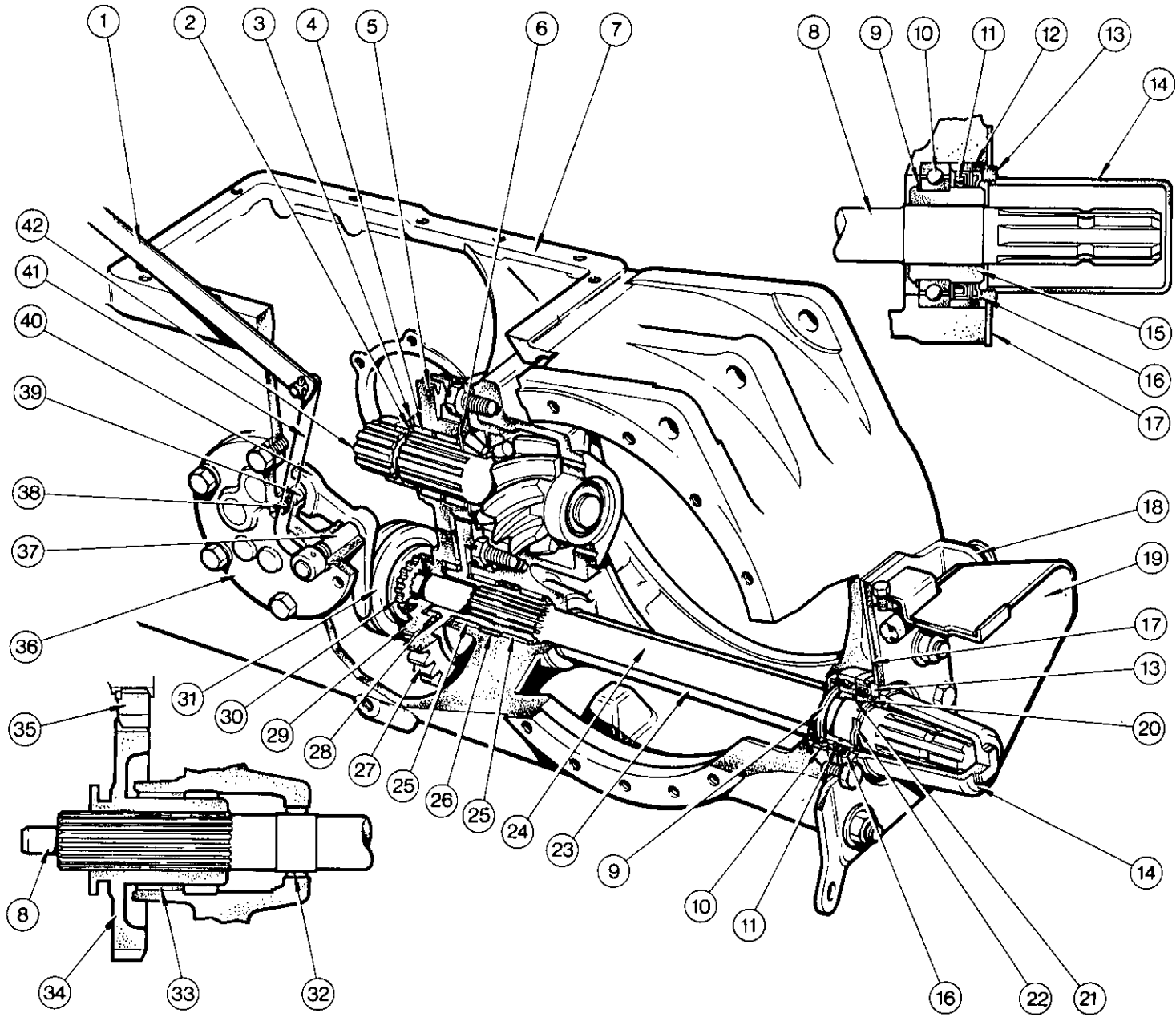
The p.t.o. shaft projects rearward from the lower section of the centre housing and when not in use a screwed cap is fitted.

The front end of each p.t.o. shaft is supported by a needle bearing in the rear end of the linkage pump camshaft but the p.t.o. shaft of (i) is also supported by a needle bearing in a centre housing web.

The driven ground speed p.t.o. gear of (i) which slides on the splines of the p.t.o. shaft, is supported by a bush bearing but the drive, compound reduction and driven gears of (ii) and (iii) are all supported on needle bearings.

The rear end of each p.t.o. shaft is supported by a ball bearing together with two seals; one of metal to exclude external dirt and a lip type seal to retain the transmission oil within the centre housing.

In the instance of (iii) a guide tube assembly is fitted within the centre housing, which prevents transmission oil running out when the 540 rev/min or 1000 rev/min p.t.o. shafts are exchanged.



6B-02
POWER TAKE OFF

KEY TO FIGURE 1

- | | |
|--|--|
| 1 P.t.o. shift link | 22 Snap ring |
| 2 Circlip | 23 P.t.o. shaft guide tube (Two speed p.t.o. only) |
| 3 Thrust washer | 24 Low speed p.t.o. shaft (Two speed p.t.o. only) |
| 4 Needle bearing | 25 Needle bearing |
| 5 Compound reduction gear | 26 Spacer |
| 6 Thrust washer | 27 P.t.o. driven gear |
| 7 Centre housing | 28 Needle bearing |
| 8 Ground speed/engine speed p.t.o. shaft | 29 P.t.o. drive gear |
| 9 Circlip | 30 Splined hub |
| 10 Ball bearing | 31 Shift collar |
| 11 Lip seal | 32 Needle bearing |
| 12 "O" Ring | 33 Bush bearing |
| 13 Seal housing | 34 Ground speed driven gear |
| 14 P.t.o. cap | 35 Ground speed drive gear |
| 15 Bearing collar | 36 Side cover |
| 16 Metal shield | 37 Shift lever shaft |
| 17 Seal housing plate | 38 Plunger spring |
| 18 Control beam bracket | 39 Plunger |
| 19 P.t.o. shield | 40 Shift lever |
| 20 Bearing sleeve | 41 P.t.o. lever |
| 21 "O" Ring | 42 Rear axle pinion shaft |

POWER TAKE OFF**P.T.O. SHAFT OIL SEAL (Standard and High Flow Linkage Pump)****Removal and Replacement** 6B—01—04

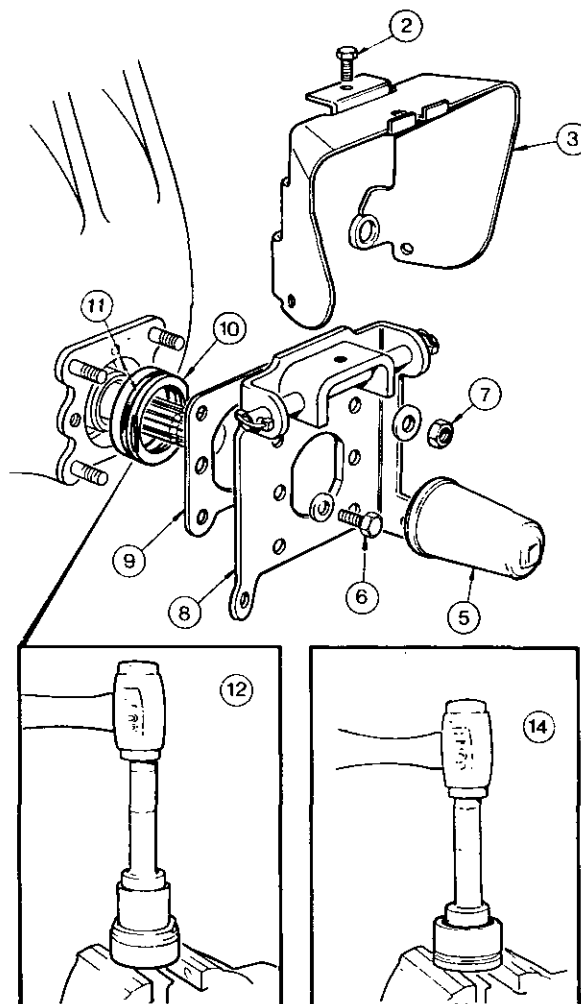
Special Tools: MF 168 Seal Remover
 MF 364 Seal Replacer
 550 Universal Handle

Removal

1. Drain the centre housing of transmission oil.
2. Remove the bolt.
3. Remove the p.t.o. shield.
4. Detach the top or bottom of the control beam.
5. Unscrew the p.t.o. cap.
6. Remove two bolts and washers.
7. Remove four nuts and washers.
8. Remove the control beam bracket.
9. Remove the seal housing plate.
10. Withdraw the oil seal housing.
11. Remove and discard the 'O' ring.
12. Using MF 168 and 550, remove and discard the lip seal and metal shield.

Replacement

13. Press in a new metal shield, lip curving upwards, to the full limit of its travel.
14. Using MF 364 press in the lip seal, lip curving upwards; this will ensure that the inner face of the seal is 1,78 mm (0.07 in) below the edge of the housing.
15. Fit a new 'O' ring.
16. Fit the oil seal housing so the two flats are vertical.
17. Reverse procedures 1 to 8.



P.T.O. SHAFT (Standard Flow Linkage Pump)

Removal and Refitment 6B—02—05

Removal

1. Remove the oil seal housing, operation 6B—01—04, procedures 1 to 10.
2. Withdraw the p.t.o. shaft.

Refitment

3. Slide in the p.t.o. shaft, taking care to align the internal splines and to keep it horizontal.
4. Refit the oil seal housing, operation 6B—01—04, procedures 16 and 17.

P.T.O. SHAFT (High Flow Linkage Pump)

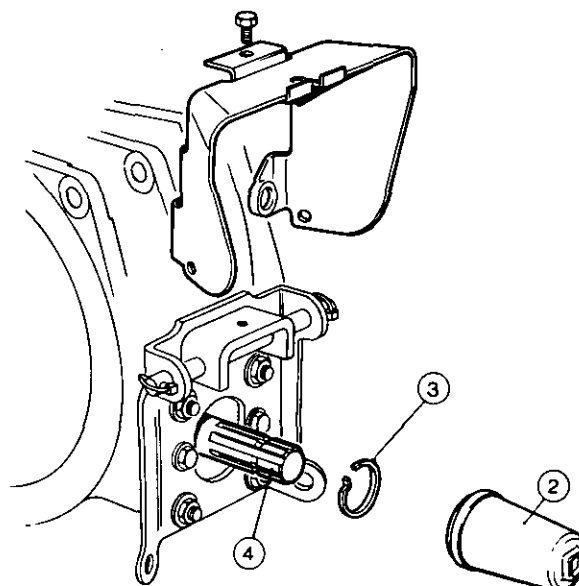
Removal and Refitment 6B—03—05

Removal

1. Drain the centre housing of transmission oil.
2. Unscrew the p.t.o. cap.
3. Remove the snap ring.
4. Remove the p.t.o. shaft.

Refitment

5. Reverse procedures 1 to 4 except:
 - (a) When refitting the p.t.o. shaft, take care to align the splines and keep the shaft horizontal.
 - (b) Ensure that the snap ring locates correctly in its groove.



POWER TAKE OFF**P.T.O. SHAFT REAR BEARING
(Standard Flow Linkage Pump)****Removal and Replacement**

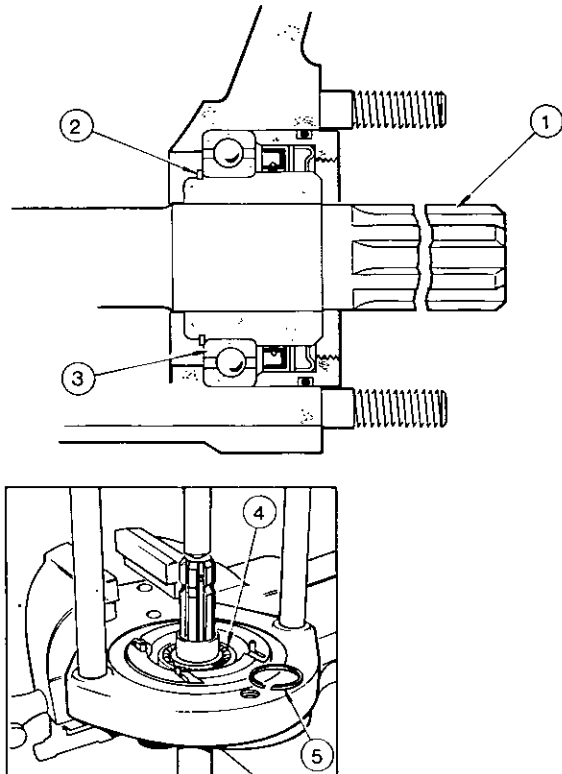
6B-04-06

Special Tools: MF 200 Hand Press
MF 200-25 Adaptor**Removal**

1. Remove the p.t.o. shaft operation 6B-02-05.
2. Remove the snap ring.
3. Using a length of 60 mm (2 $\frac{3}{8}$ in) internal diameter tube, drive the ball bearing off forwards.

Replacement

4. Using MF 200-25 and MF 200 press the new ball bearing onto the p.t.o. shaft.
5. Fit a new snap ring and ensure that it locates correctly in its groove.
6. Refit the p.t.o. shaft, operation 6B-02-05.

**P.T.O. SHAFT REAR BEARING
(High Flow Linkage Pump)****Removal and Replacement**

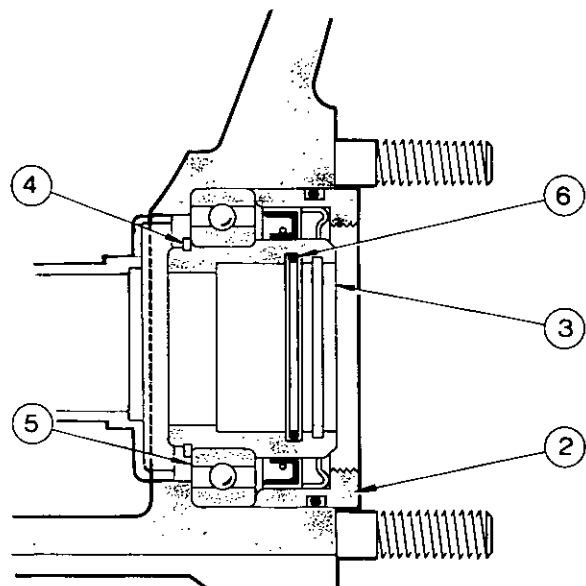
6B-05-06

Removal

1. Remove the p.t.o. shaft, operation 6B-03-05.
2. Remove the seal housing operation 6B-01-04.
3. Remove the ball bearing and sleeve.
4. Remove the snap ring.
5. Using a length of 60 mm (2 $\frac{3}{8}$ in) internal diameter tube, drive off the ball bearing.
6. Remove and discard the 'O' ring.

Replacement

7. Reverse procedures 1 to 6 except:
 - (a) Fit a new 'O' ring.
 - (b) Ensure that the snap ring locates correctly in its groove.
 - (c) Fit the ball bearing and sleeve assembly, snap ring end first.
 - (d) When feeding in the p.t.o. shaft, take care to align the splines and keep the shaft horizontal.



NEEDLE BEARING (Standard Flow Linkage Pump)**Removal and Replacement** 6B-06-07

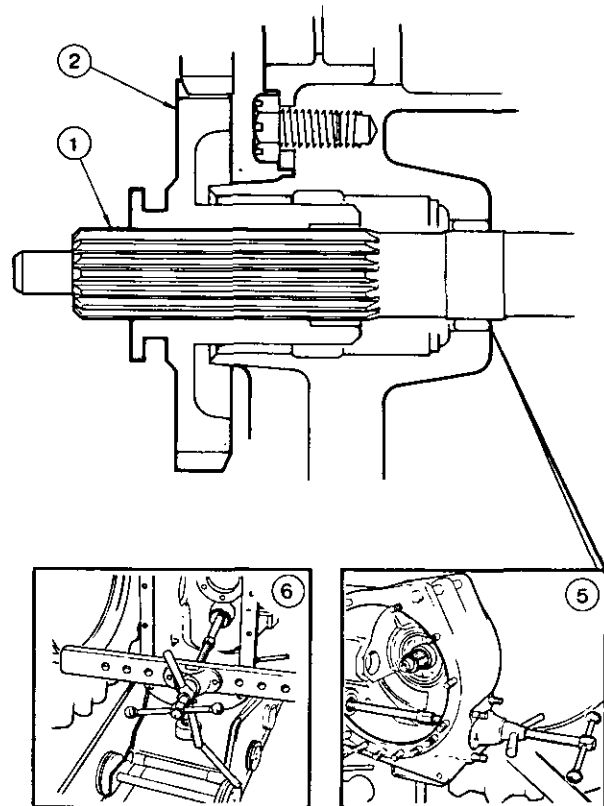
Special Tools: MF 195 Puller
MF 195-5-2 Adaptor
MF 195-5A Bar

Removal

1. Remove the p.t.o. shaft and the hydraulic pump(s), Part 8A.
Tractors without Multi-Power/i.p.t.o. or auxiliary pumps.
2. Remove the ground speed p.t.o. driven gear.
Tractors without Multi-Power/i.p.t.o. or auxiliary pumps.
3. Remove the i.p.t.o. clutch unit, operation 6B-13-15.
4. Remove the differential unit Part 6A.
5. Using MF 195, MF 195-2 and MF 195-5A, remove the needle bearing rearwards.

Replacement

6. Using MF 195, MF 195-5-2 and MF 195-5A, in conjunction with a linkage drawbar, pull the needle bearing into its bore until it is flush with the rear face.
7. Reverse procedures 1 to 4 except:
 - (a) When fitting the linkage pump, ensure that the needle bearing in the rear end of the camshaft, is in good condition.



POWER TAKE OFF

GROUND SPEED GEAR, BUSH AND PINION SHAFT GEAR ASSEMBLY (Standard Flow Linkage Pump)**Removal and Replacement** 6B-07-08

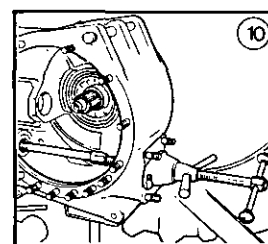
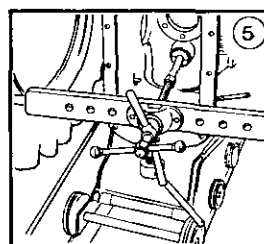
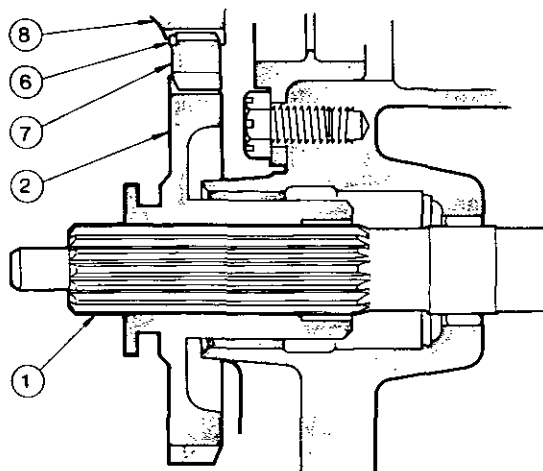
Special Tools: MF 195 Puller
 MF 195-5A Bar
 MF 195-6 Bush Remover
 MF 168 Bush Replacer

Removal

1. Remove the p.t.o. shaft and the hydraulic pump(s), Part 8A.
2. Remove the ground speed driven gear.
3. Remove the differential unit, Part 6A.
4. Using MF 195, MF 195-5A and MF 195-6 in conjunction with a linkage drawbar, pull the bush out.
5. Remove the retainer ring.
6. Remove the ground speed drive gear.
7. Renew the drive gear splined hub if necessary, Part 6A.

Replacement

8. Reverse procedures 5 to 7 except:
 - (a) Ensure that the retainer ring locates correctly in its groove.
9. Using MF 195, MF 195-5A and MF 168, pull the bush into its bore until it is flush with the inner end of the chamfer.
10. Reverse procedures 1 to 3 except:
 - (a) When fitting the linkage pump, ensure that the needle bearing in the rear of the camshaft is in good condition.



NEEDLE BEARINGS & REDUCTION GEARS (High Flow Linkage Pump)

Removal and Replacement

6B-08-09

Special Tools: MF 195 Puller

MF 195-5A Bar

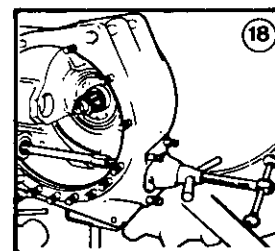
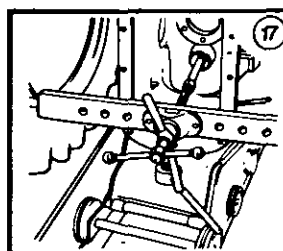
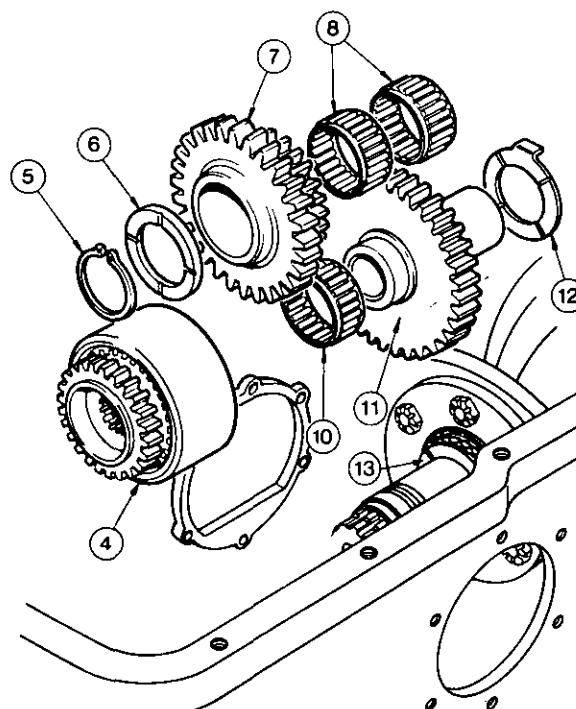
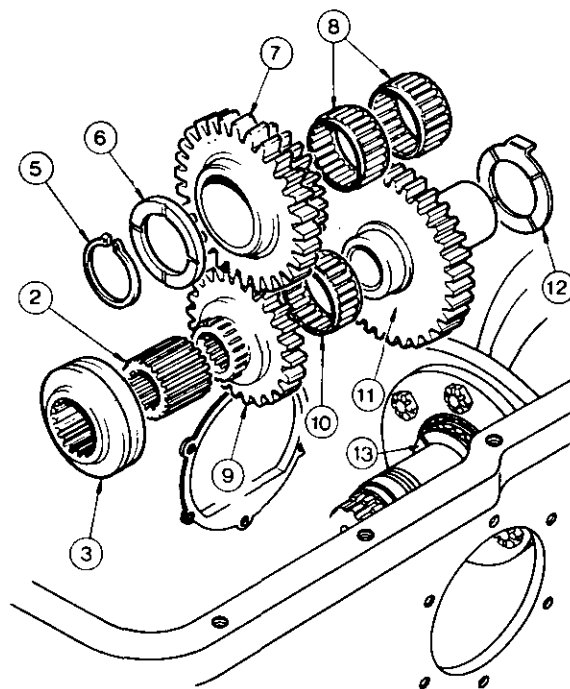
MF 195-6 Two Speed, p.t.o. Shaft
Needle Bearing, Remover
and Replacer

Removal

1. Remove the p.t.o. shaft and the hydraulic pump(s), Part 8A.
Tractors without Multi-Power/p.t.o. or auxiliary pumps.
2. Remove the splined hub.
3. Remove the shift collar.
Tractors with Multi-Power/p.t.o. or auxiliary pumps.
4. Remove the i.p.t.o. clutch unit, operation 6B-13-15.
All tractors.
5. Remove the pinion shaft retaining ring.
6. Remove the outer thrust washer.
7. Remove the compound reduction gear.
8. Remove the two caged needle bearings.
9. Remove the drive p.t.o. gear.
10. Remove the drive p.t.o. gear needle bearing.
11. Remove the driven p.t.o. gear.
12. Remove the tabbed thrust washer.
13. Remove the inner thrust washer if necessary, Part 6A.
14. Remove the shaft rear bearing, operation 6B-05-06.
15. Remove the differential unit, Part 6A.
Tractors fitted with two speed p.t.o.
16. Drive out the p.t.o. shaft guide tube.
17. Using MF 195, MF 195-5A and MF 195-6 in conjunction with a linkage drawbar, pull out the two needle bearings and spacer.

Replacement

18. Using MF 195, MF 195-5A and MF 195-6 (longer end from collar), pull in one needle bearing, NO PART NUMBER END first, up to the collar. Feed in the spacer. Reverse MF 195-6 (shorter end from collar) and pull in the second needle bearing; this will ensure a clearance of 0,25 mm (0.010 in) between the spacer and the two needle bearings.
Tractors fitted with two speed p.t.o.
19. Press in the p.t.o. shaft guide tube until its rear end is no more than 1.5 mm (0.060 in) past the shaft ball bearing recess.
20. Reverse procedures 1 to 15 except:
 - (a) Ensure that the retaining ring locates correctly in its groove.
 - (b) When fitting the linkage pump ensure that the needle bearing, in the rear end of the camshaft, is in good condition.



POWER TAKE OFF**P.T.O. SIDE COVER (Non Multi-Power/i.p.t.o. or Auxiliary Pump Tractors)****Removal and Refitment**

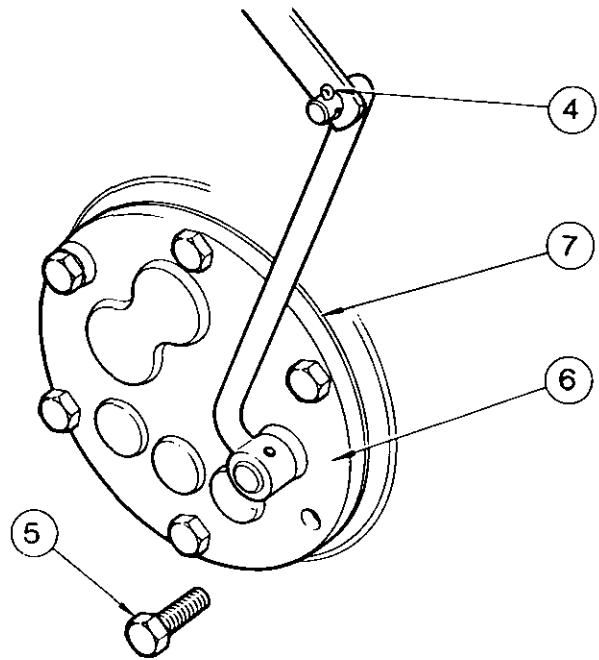
6B—09—10

Removal

1. Remove the fuel tank, Part 4C.
2. Drain the transmission oil to the LOW mark on the dipstick.
3. Remove the 2 nuts securing the brake flexible hose bracket and hand brake support bracket also the side cover bolt that secures the support bracket at the top, move the bracket clear of the side cover.
4. Remove and discard the split pin and disconnect the p.t.o. linkage at the side cover.
5. Remove the remaining five bolts from the cover.
6. Remove the side cover.
7. Remove and disconnect the gasket.

Refitment

8. Reverse procedures 1 to 7 except:
 - (a) Locate the shift lever in the annulus of the ground speed gear or shift collar.
 - (b) Fit a new gasket and split pins.

**P.T.O. SIDE COVER (Non Multi-Power/i.p.t.o. or Auxiliary Pump Tractors)****Servicing**

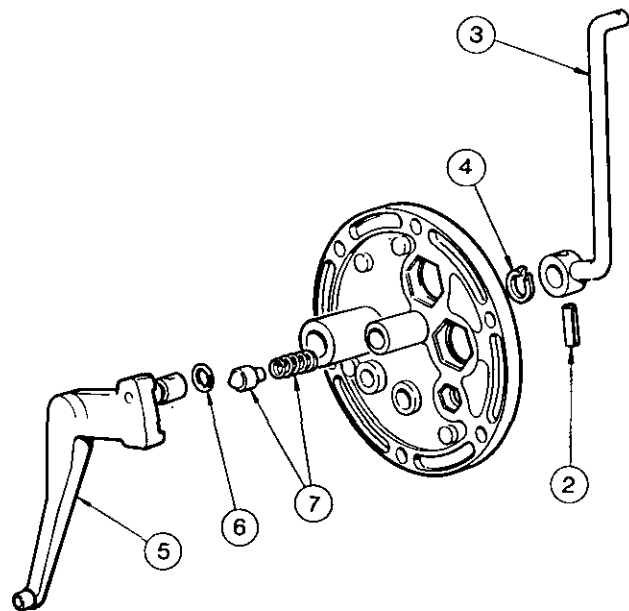
6B—10—10

Disassembly

1. Remove the side cover, operation 6B—09—10.
2. Drift out and discard the roll pin.
3. Remove the p.t.o. lever.
4. Remove the circlip.
5. Remove the shift lever.
6. Remove and discard the 'O' ring.
7. Remove the detent plunger and spring.

Reassembly

8. Reverse procedures 1 to 7 except:
 - (a) Fit a new 'O' ring.
 - (b) Fit a new roll pin.



P.T.O. SIDE COVER (Multi-Power/i.p.t.o. or Auxiliary Pump Tractors)

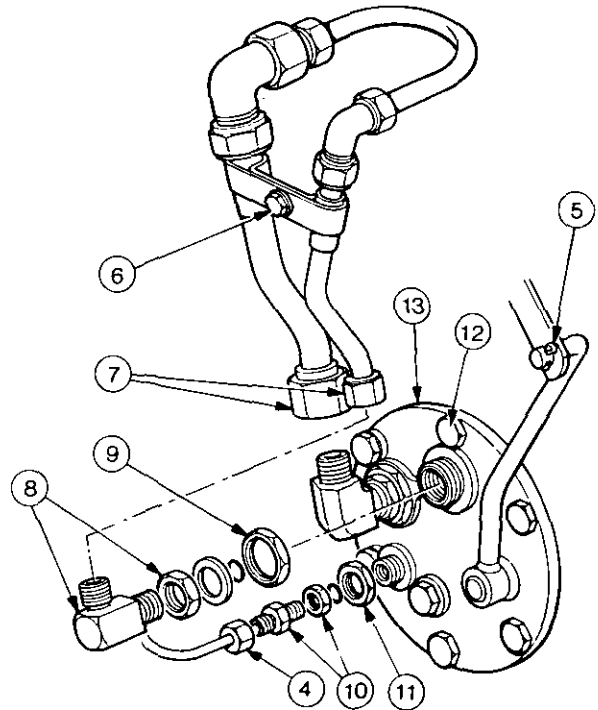
Removal and Refitment

6B-11-11

Removal

Multi-Power/i.p.t.o. and/or Auxiliary Pump Tractors Only.

1. Remove the fuel tank, Part 4C.
2. Drain the transmission oil to the LOW mark on the dipstick.
3. Remove the handbrake cross shaft support bracket, the lever and operating rod.
4. Disconnect the i.p.t.o. test Bundy pipe from the cover.
5. Remove the p.t.o. shift link then the operating shaft.
6. Remove the pipe clamp.
7. Release the two nuts and remove the 'U' pipe assembly or the spool valve feed and return pipes.
8. Remove the feed pipe elbow connector.
9. Remove the feed pipe locknut.
10. Remove the i.p.t.o. pressure test pipe connector.
11. Remove the i.p.t.o. pressure test pipe locknut.
12. Remove the remaining five bolts securing the side cover to the centre housing.
13. Remove the side cover and gasket.



Refitment

14. Reverse procedures 1 to 13 except:
 - (a) Fit a new gasket.
 - (b) Fit a new 'O' ring to each of the feed and return pipe elbow connectors and also the i.p.t.o. test pipe connector.

P.T.O. SIDE COVER (Multi-Power/i.p.t.o. or Auxiliary Pump Tractors).

Servicing

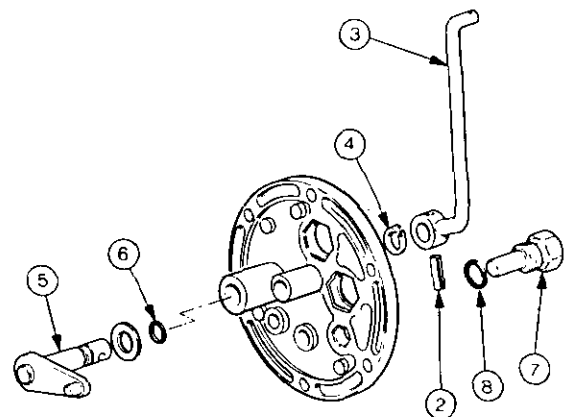
6B-12-11

Disassembly

1. Remove the side cover, operation 6B-11-11.
2. Drift out and discard the roll pin.
3. Remove the p.t.o. lever.
4. Remove the circlip.
5. Remove the i.p.t.o. clutch actuating lever.
6. Remove and discard the 'O' ring.
7. Remove the i.p.t.o. clutch control valve locating pin.
8. Remove and discard the 'O' ring.

Reassembly

9. Reverse procedures 1 to 8.
 - (a) Fit new 'O' rings.
 - (b) Tighten the i.p.t.o. clutch control valve locating pin to a torque of 16 Nm (12 lbf ft).
 - (c) Ensure that the circlip locates correctly in its groove.
 - (d) Fit a new roll pin.



	INDEPENDENT POWER TAKE OFF CLUTCH UNIT	
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	I.P.T.O. CLUTCH UNIT	15
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	I.P.T.O. CONTROL VALVE	16
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6B—16—16	Servicing	
	I.P.T.O. BRAKE UNIT	17
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INDEPENDENT POWER TAKE OFF CLUTCH UNIT

GENERAL

The independent power take off consists of a hydraulically actuated clutch unit whose engagement and disengagement is controlled by a two position spool type valve freely mounted on the spigotted front end of the clutch housing.

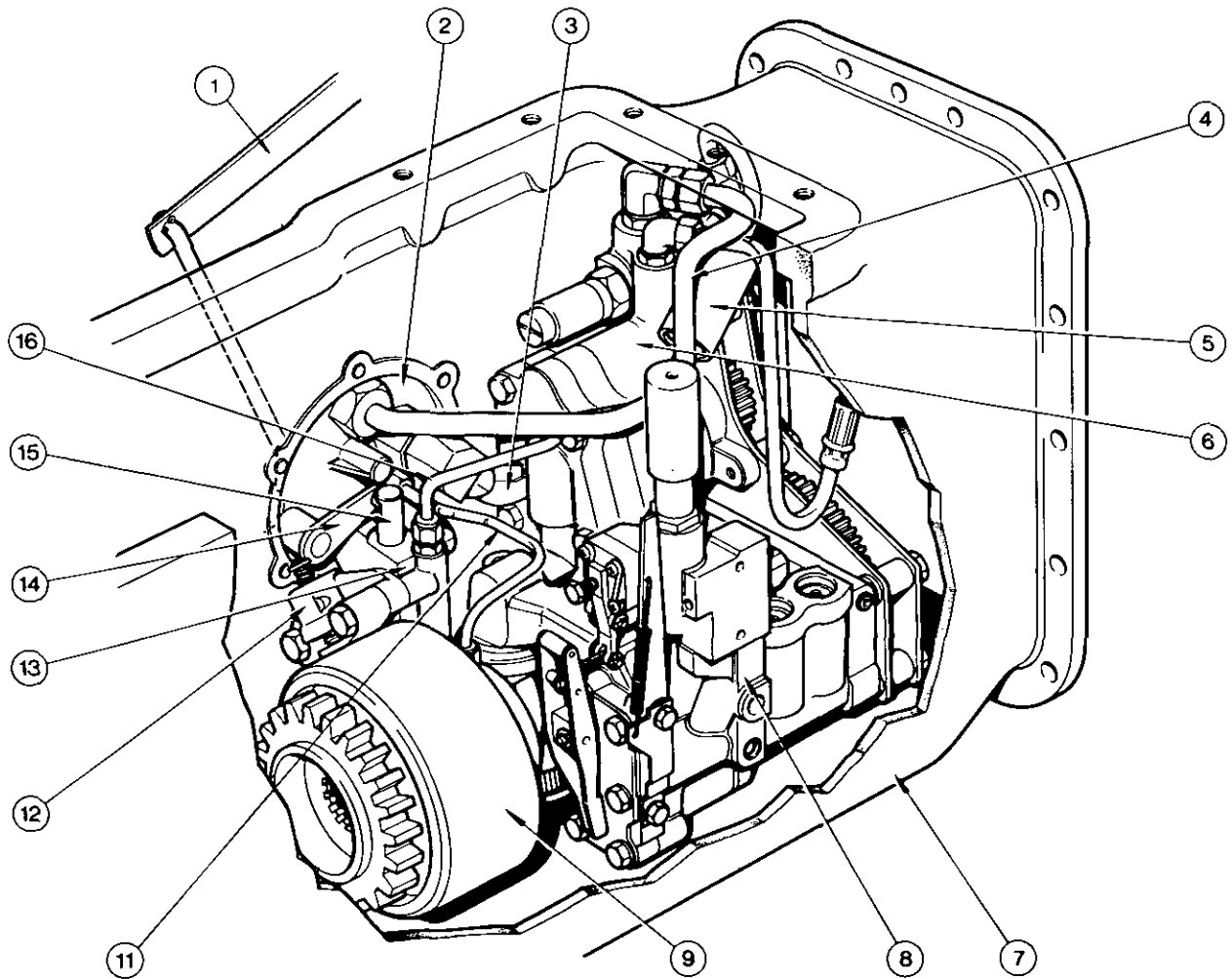
The drive hub of the clutch is splined to the rear end of the linkage pump camshaft, while the clutch housing is connected to the front end of the p.t.o. shaft or the drive gear of the reduction gear by the clutch plate retainer external splines and retaining ring. The friction discs are splined to the drive hub and the

clutch plates are splined to the clutch housing, which also accommodates the Belleville washer and piston assembly.

Hydraulic pressure applied to the piston assembly closes the clutch plates to the friction plates, thus transmitting the drive of the linkage pump to the p.t.o. shaft or drive gear of the reduction gearing.

When the hydraulic pressure is released, the wave springs, fitted outside the friction discs and between the outer peripheries of the clutch plates keep these components apart.

INDEPENDENT POWER TAKE OFF

**KEY**

- | | |
|-----------------------------------|---|
| 1 Shift link | 9 I.p.t.o. clutch unit |
| 2 Side cover | 10 P.t.o. shaft drive (Clutch plate retainer) |
| 3 Spool valve return pipe | 11 I.p.t.o. pressure test pipe |
| 4 Spool valve feed pipe | 12 Brake unit |
| 5 Oil filter (Integral with pipe) | 13 Control valve |
| 6 Auxiliary pump | 14 Control valve actuating lever |
| 7 Centre housing | 15 Control valve plunger |
| 8 Linkage pump | 16 Control valve feed pipe |
| | 17 P.t.o. lever |

I.P.T.O. CLUTCH UNIT**Removal and Refitment**

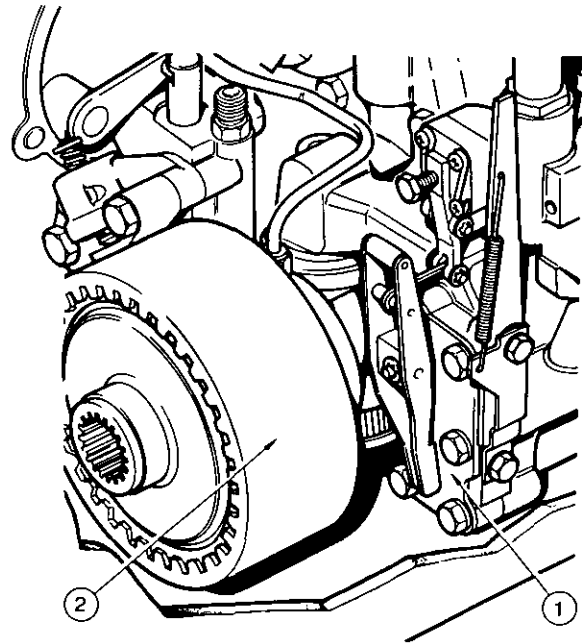
6B-13-15

Removal

1. Remove the p.t.o. shaft and the hydraulic pumps, Part 8A.
2. Remove the i.p.t.o. clutch unit.

Refitment

3. Reverse procedures 1 and 2.
 - (a) When fitting the linkage pump, ensure that the needle bearing, in the rear end of the camshaft, is in good condition.

**I.P.T.O. CLUTCH UNIT****Clutch Assembly Servicing**

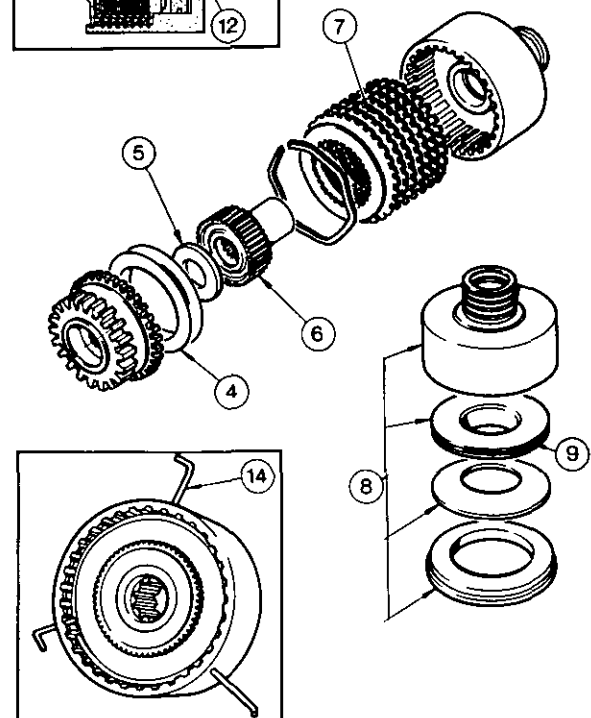
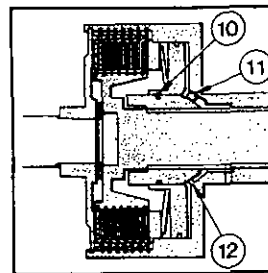
6B-14-15

Disassembly

1. Remove the control valve, operation 6B-15-16.
2. Remove the retaining ring.
3. Remove the retainer plate.
4. Remove the shims and retain for re-use, if fitted.
5. Remove the thrust washer.
6. Remove the clutch drive hub.
7. Remove and keep in order, the seven wave springs, friction discs and clutch plates.
8. Invert the clutch housing and tap out the piston front plate, Belleville washer and the clutch piston.
9. Remove and discard the large seal.
10. Remove and discard the small seal.
11. Press out the check valve, if necessary.
12. Press out the restrictor valve, if necessary.

Reassembly

13. Reverse procedures 7 to 12 except:
 - (a) Press in the restrictor valve (either end first) from the drive end of the housing.
 - (b) Press in the check valve (steeper conical end first) from the drive end of the housing.
 - (c) Fit new large and small seals.
 - (d) Fit the piston, flat face first.
 - (e) Fit the Belleville washer, convex face first.
 - (f) Fit the piston front plate, stepped edge first.
 - (g) Renew any clutch plate that is soft, blue or distorted and any friction disc when the friction material has lost its scrolling.
 - (h) With the wave spring installed, unloaded in a 137,41 mm (5-41 in) ring gauge, the gap must be 10,3 to 15,09 mm (0-4 to 0-6 in). With the wave spring laying flat on a surface plate, the free height should be 5,21 mm (0-205 in) and all waves must be within 0,51 mm (0-020 in) of the same height.
14. To facilitate the fitting of the clutch plates (external teeth), friction discs (internal teeth) and wave springs, insert 4,0 mm (0-16 in) diameter pins through the clutch housing vent holes.
15. Reverse procedures 1 to 6 except:
 - (a) Ensure that the retaining ring locates correctly in its groove.



INDEPENDENT POWER TAKE OFF**I.P.T.O. CONTROL VALVE****Removal and Refitment**

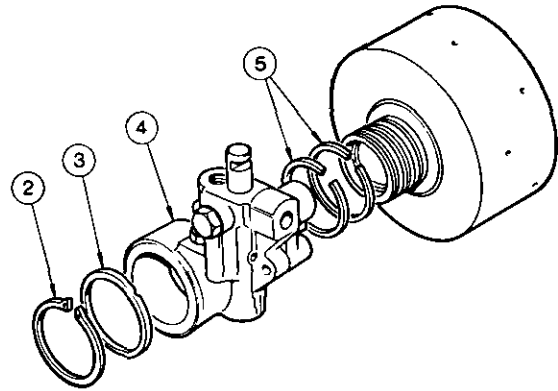
6B—15—16

Removal

1. Remove the i.p.t.o. clutch unit, operation 6B—13—15.
2. Remove the circlip.
3. Remove the thrust washer.
4. Remove the control valve and brake unit.
5. Remove the two cast iron piston rings.

Refitment

6. Fit new piston rings and ensure that there is a piston ring gap of 0,050 to 0,305 mm (0.002 to 0.012 in).
7. Reverse procedures 1 to 5 except:
 - (a) Ensure that the circlip locates correctly in its groove.

**I.P.T.O. CONTROL VALVE****Servicing**

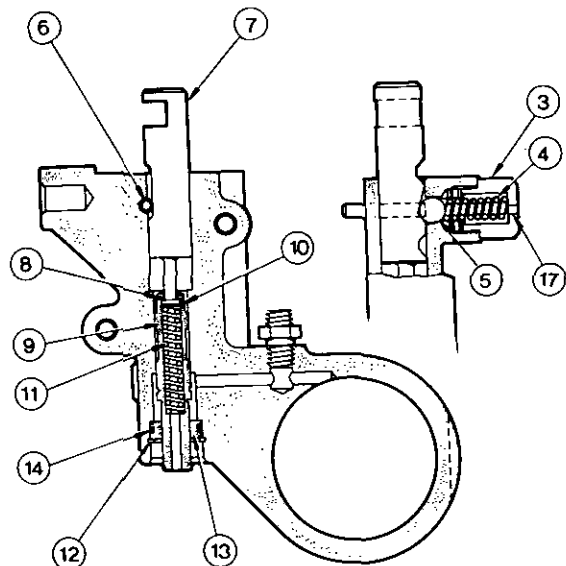
6B—16—16

Disassembly

1. Remove the control valve, operation 6B—15—16.
2. Remove the brake unit, operation 6B—17—17.
3. Remove the detent plug.
4. Remove the detent spring.
5. Remove the detent ball.
6. Drift out the roll pin.
7. Remove the plunger, spool and spring assembly.
8. Remove the circlip.
9. Remove the spool.
10. Remove and retain the shim pack for re-use.
11. Remove the spring.
12. Remove the circlip.
13. Remove the sleeve.
14. Remove and discard the 'O' ring.

Reassembly

15. Reverse procedures 1 to 14 except:
 - (a) Fit a new 'O' ring.
 - (b) Ensure that the circlip locates correctly in its groove.
16. Fit the shim pack above the plunger spring.
17. Ensure that the detent plug vent is unobstructed.
18. Reverse procedures 1 to 10 except:
 - (a) Ensure that the circlip locates correctly in its groove.
 - (b) Fit a new roll pin and position the split away from the plunger.
 - (c) Tighten the detent plug to a torque of 47 Nm (35 lbf ft).



I.P.T.O. BRAKE UNIT**Removal and Refitment**

6B-17-17

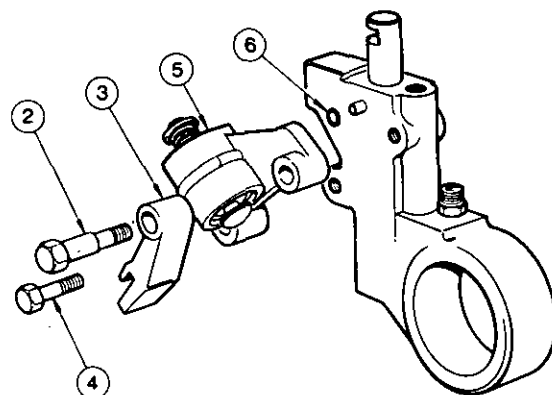
Removal

1. Remove the i.p.t.o. clutch unit, operation 6B-13-15.
2. Remove the shouldered brake pad bolt.
3. Remove the pad.
4. Remove the short bolt.
5. Remove the brake housing.
6. Remove and discard the 'O' ring.

Refitment

7. Reverse procedures 1 to 5 except:
 - (a) Fit a new 'O' ring.
 - (b) Fit a new shouldered brake pad bolt (888 738 M2) and a special washer (1671 886 M1).
 - (c) Tighten both bolts to a torque of 6,8 Nm (5 lbf ft).
 - (d) Ensure that the brake pad has complete freedom of movement.

If a new shouldered brake pad bolt is not available, the following procedure must be carried out.
8. Reverse procedures 4 to 6.
9. Smear the internal thread in the i.p.t.o. clutch unit with the recommended sealant 'C'.
10. Refit the brake pad.
11. Refit the shouldered brake pad bolt.
12. Tighten both bolts to a torque of 6,8 Nm (5 lb ft).
13. Ensure that the brake pad has complete freedom of movement.

**I.P.T.O. BRAKE UNIT****Servicing**

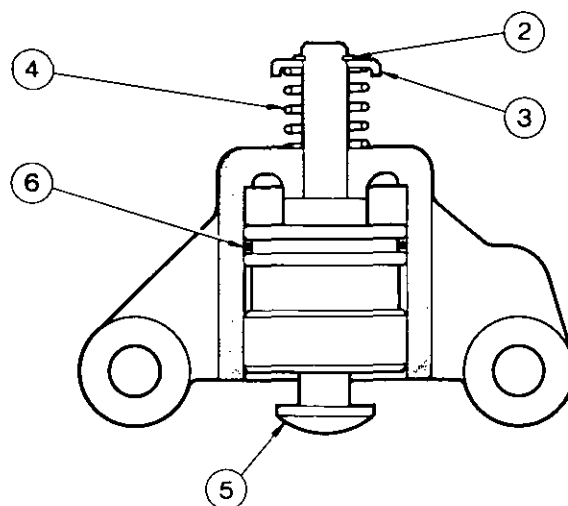
6B-18-17

Disassembly

1. Remove the brake unit, operation 6B-17-17.
2. Remove the circlip.
3. Remove the spring retainer.
4. Remove the return spring.
5. Withdraw the piston.
6. Remove and discard the 'O' ring.

Reassembly

7. Reverse procedures 1 to 6 except:
 - (a) Fit a new 'O' ring.
 - (b) Ensure that the circlip locates correctly in its groove.



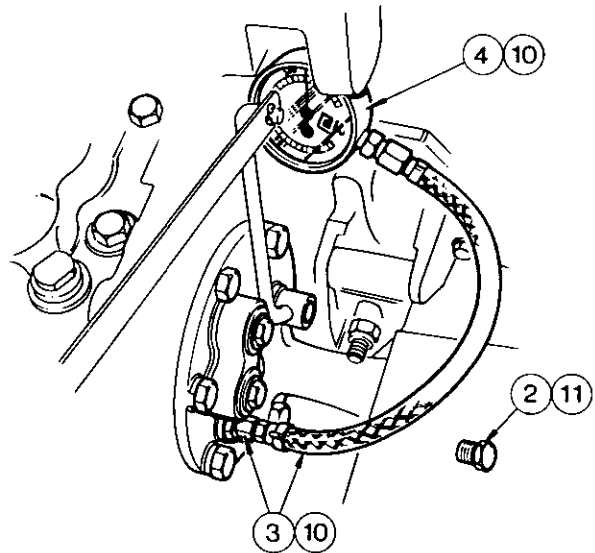
INDEPENDENT POWER TAKE OFF**I.P.T.O. HYDRAULIC TEST**

Before effecting a hydraulic test, clean fresh transmission oil of the approved grade must fill the centre housing and its temperature must be raised to 50° to 60°C (120° to 140°F) by running the hydraulic system under load; this is important as excessively cold or hot transmission oil can effect the pressure gauge readings.

Hydraulic Test Procedure 6B—19—18

Special Tools: MF 840 Pressure Gauge
MF 819-6 Adaptor

1. Remove the fuel tank, Part 4C and fit a slave tank to the fuel lift pump.
2. Remove the pressure test plug.
3. Fit MF 810-6 Adaptor and hose.
4. Fit MF 840 pressure gauge.
5. Start the engine and run to raise the transmission oil temperature.
6. Engage the p.t.o. and increase the engine speed to 2000 rev/min.
7. With the transmission oil at the specified temperature the pressure gauge should read:
1,38 to 1,73 N/mm² (200 to 250 lbf/in²).
8. Reduce engine speed to idling and disengage the p.t.o.
9. Stop the engine.
10. Remove MF 840 and MF 810-6.
11. Refit the pressure test plug.



MF 600 SERIES TRACTOR
WORKSHOP SERVICE MANUAL
PART 7

Publication No. 1856 274 M1

comprising

- A FRONT AXLE
- B STEERING
- C WHEELS AND TYRES

FRONT AXLE**Part 7 — Section A**

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GENERAL

The front axle assembly consists of a centre beam and two outer axles. The centre beam pivots on a pin which is secured to the axle support casting. The outer axles can be bolted to the centre beam in alternative positions to provide front wheel track adjustment. Fig. 1. shows the general arrangement of the front axle assembly.

1 Front Support
2 Centre Beam
3 Nut
4 Shims
5 Pivot Pin
6 Bolt—Wheel
7 Spindle Arm Assembly
8 Bolt
9 Stud
10 Bolt
11 Bolt
12 Bolt

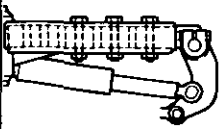
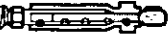
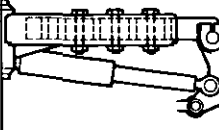

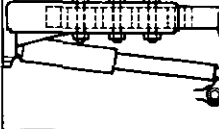

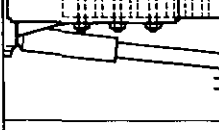



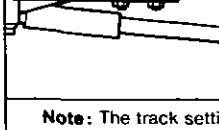
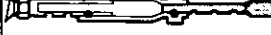
13 Thrust Washer
14 Bush
15 Bolt
16 Nut
17 Bolt
18 Tie Rod
19 Nut
20 Boot
21 Arm, Axle Spindle LH
22 Seal Dust
23 Bush
24 Nipple Straight

25 Arm
26 Bush
27 Thrust Bearing
28 Spacer
29 Spindle, LH
30 Shield
31 Seal
32 Bearing—Inner
33 Bearing Cup—Inner
34 Hub Assembly
35 Cup—Outer
36 Bearing Outer

37 Washer
38 Split Pin
39 Nut—Slotted
40 Hub Cap
41 Bolt

MF 698 FRONT AXLE 2 W.D.**FRONT TRACK**

The front track is adjustable in 102 mm (4 in) steps as shown.

Front Track Adjustments		
Axle Arm	Track Width	Tie Rod
	1406 mm 55 ³ / ₈ in	
	1508 mm 59 ³ / ₈ in	
	1610 mm 63 ³ / ₈ in	
	1711 mm 67 ³ / ₈ in	
	1813 mm 71 ³ / ₈ in	
	1914 mm 75 ³ / ₈ in	

Note: The track settings shown above are with 7.50 - 18 tyres fitted

FRONT TRACK**Adjustment Procedure**

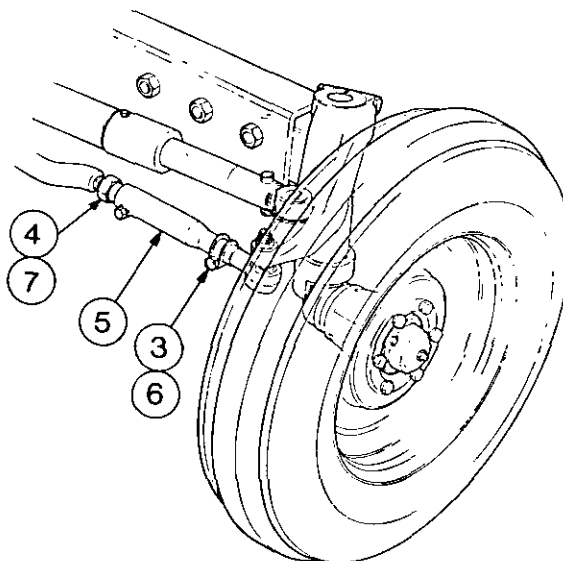
7A-01-04

1. Jack up front axle of tractor.
2. Remove the nuts and bolts securing each axle arm to the centre beam.
3. Remove the nuts, washers and bolts securing the ball joints to the power steering rams.
4. If either of the two widest tracks are required, both nuts and bolts must be removed from each tie rod. If not, only the outer nut and bolt need be removed from each.
5. Pull each axle arm out of the centre beam to give the required track setting. Replace the bolts, washers and nuts and tighten to a torque of 400—600 Nm (300—450 lbf ft).
6. Pull each ball joint out of the rams equally. Replace the bolts, washers and nuts and tighten to a torque of 43—60 Nm (32—44 lbf ft).
7. Pull each ball joint out of the tie rod equally. Replace the nuts and bolts and tighten to a torque of 68—81 Nm (50—60 lbf ft).

TOE-IN**Adjustment**

7A-02-05

1. Position the tractor on firm level ground. Place the front wheels in the "straight forward" position.
2. Using a suitable track gauge, check the toe-in which should be 6 mm ($\frac{1}{4}$ in).
3. If adjustment is necessary, remove the outer nut, washer and bolt from each tie rod.
4. Slacken off jam nut, from end of each tube.
5. Rotate the outer tube to increase or decrease the toe-in as required.
6. Align hole in outer tubes with groove in ball joint shafts.
Re-fit the bolts, washers and nuts.
Tighten nuts to a torque of 68—81 Nm (50—60 lbf ft).
7. Tighten jam nuts to a torque of 135—200 Nm (100—150 lbf ft).

**FRONT HUB****Servicing**

7A-03-05

Disassembly

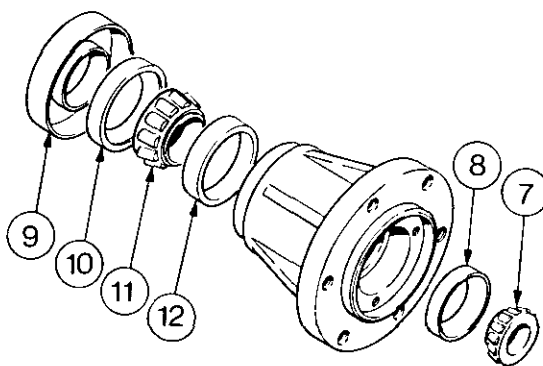
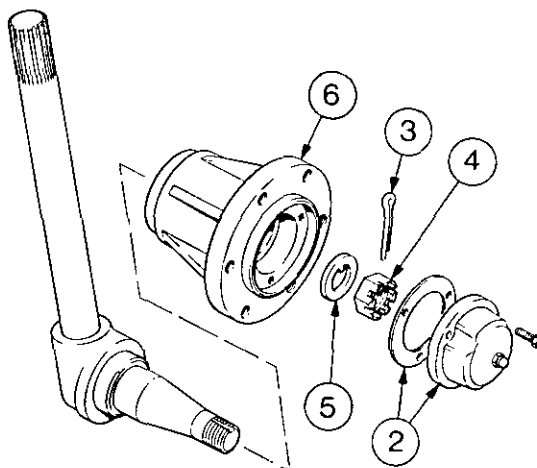
1. Jack up the front of the tractor and remove the wheel.
2. Remove the hub cap and the gasket.
3. Remove and discard the split pin.
4. Remove the castellated nut.
5. Remove the washer.
6. Lift the hub complete with bearings and seal from the axle spindle.
7. Remove the outer bearing cone.
8. Remove the outer bearing cup.
9. Remove the dust shield.
10. Remove the seal.
11. Remove the inner bearing cone.
12. Remove the inner bearing cup.

Examination

13. Thoroughly wash out old grease or dirt from the hub components using clean paraffin, check condition of hub, spindle and bearings.
Any worn or damaged components should be replaced.

Reassembly

14. Reverse procedures 1 to 12 except:
 - (a) Fit a new seal with the flat face towards the centre hub; and tap the seal right into the recess in the hub.
 - (b) Tighten the castellated nut to a torque of 80 Nm (60 lbf ft) then slacken it off two flats to give the correct hub float.
 - (c) Fit a new split pin.
 - (d) Fit a new gasket.
 - (e) Tighten hub cap bolts to a torque of 20—28 Nm (14—21 lbf ft).
 - (f) Tighten the wheel bolts to a torque of 135—200 Nm (100—150 lbf ft).



SPINDLE SHAFT**Removal and Refitment**

7A-04-06

Removal

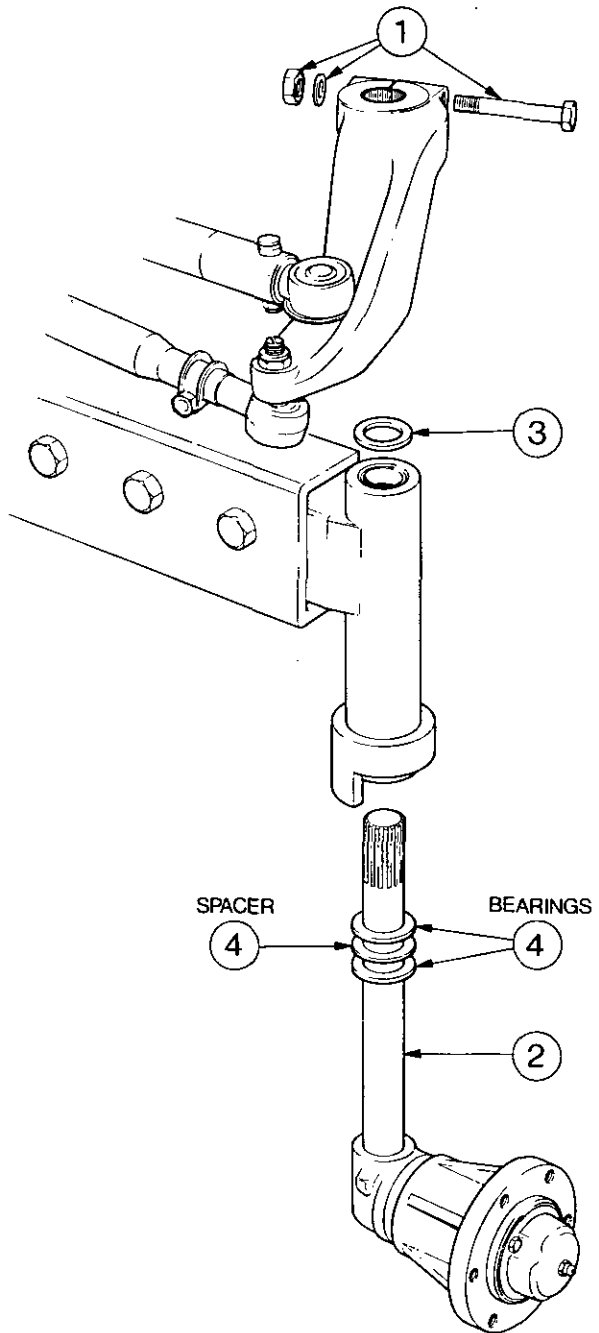
1. Remove nut, washer and bolt from the spindle arm.
2. Drive spindle out of the arm.
3. Remove dust seal from arm.
4. Remove 2 thrust bearings and spacer from the spindle.

EXAMINATION

Examine the spindle shaft thrust bearings for wear or damage. Replace if necessary.

Refitment

5. Reverse procedures 1 to 5 except:
 - (a) Renew dust seal.
 - (b) Liberally lubricate thrust bearings with suitable grease before assembly.
 - (c) Assemble bearings with radial faces against spacer.
 - (d) Tighten nut to a torque of 131—171 Nm (32—44 lbf ft).
 - (e) With the hub and spindle assembly held firmly against the thrust bearings, measure the gap between the spindle arm and the spindle housing, using feeler gauges. It must not exceed 0,10 mm (.004 ins).



SPINDLE HOUSING**Servicing**

7A-05-07

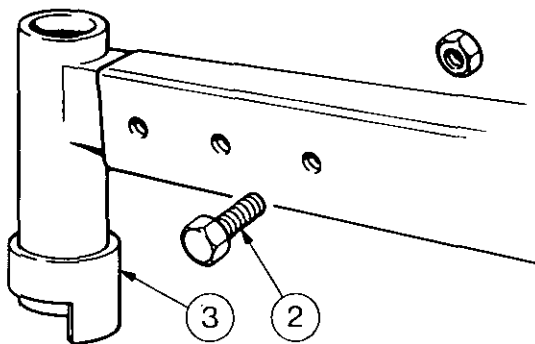
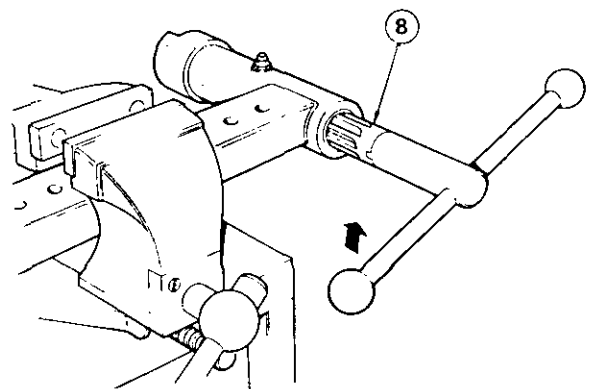
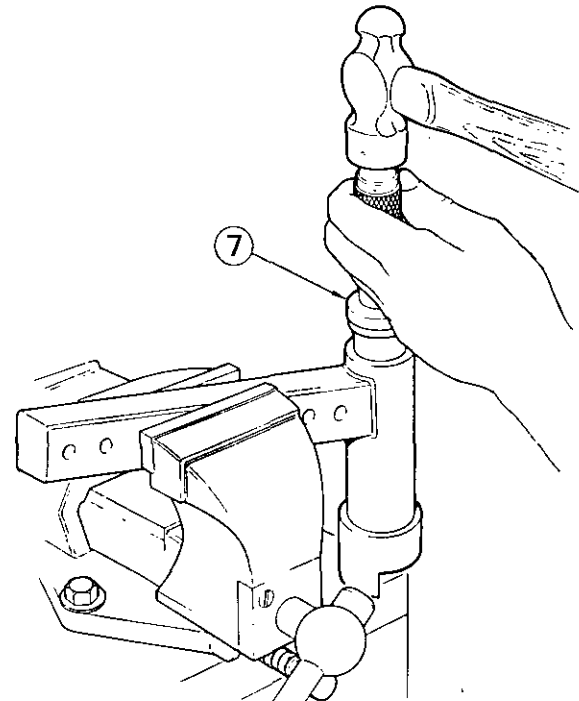
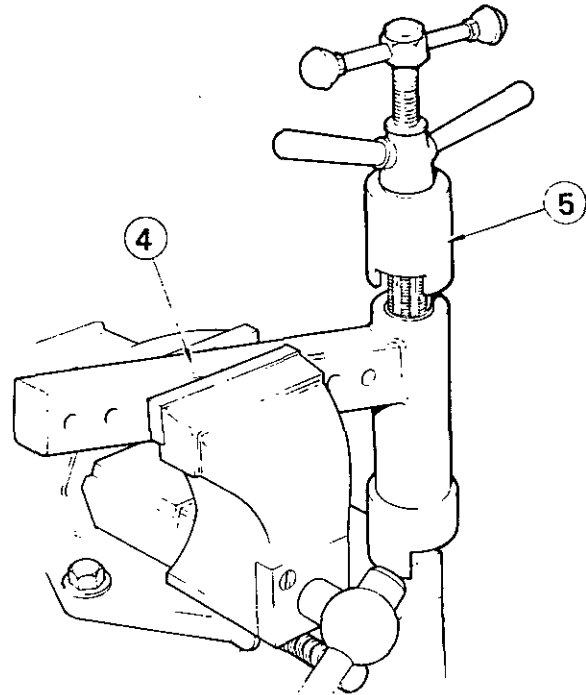
Special Tools Required: MF 263 Bush Remover
MF 263-2 Adaptor
MF 264 Reamer Handle
MF 264 Reamer
550 Universal Handle

Disassembly

1. Remove spindle shaft. Operation 7A-04-06 procedures 1 to 4
2. Remove the nuts and bolts.
3. Remove outer arm.
4. Secure the outer arm in a vice.
5. Using MF 236 and MF 263-2 extract the bush by turning the lower handle.
6. Invert the outer arm and similarly extract the other bush.

Reassembly

7. Using the 550 handle and MF 263-2 drive in a new bush, invert the outer axle and similarly drive in the other new bush.
8. Using MF 264 Reamer Handle and MF 264 Reamer, ream the upper bush to size.
9. Fit the pilot MF 264- $\frac{1}{2}$ to the upper end of the reamer handle and the reamer MF 264-1 to the handle, then line ream the lower bush to size.
10. Remove all swarf from the housing by washing the housing in clean paraffin and ensure that the nipple hole is clear.
11. Reverse procedures 2 and 3 tightening the nuts to a torque of 400-600 Nm (300-400 lbf ft).
12. Refit spindle shaft as operation 7A-04-06 procedure 6.
Refit wheels, tightening wheel bolts to a torque of 135-200 Nm (100-150 lbf ft).



BEAM ASSEMBLY**Removal and Refitment**

7A-06-08

Removal

1. Remove the nose as operation 00-00-00. procedures 00-00.
2. Jack up the tractor under the sump.
3. Remove the wheels.
4. Detach the power steering rams and each end of tie rod from the spindle arms.
5. Remove the nuts and bolts from the centre beam and slide the outer arms out.
6. Push centre beam hard back on its pivot pin against the thrust washer. Using feeler gauges, check the gap between the front boss on beam and the casting. If it exceeds 0,25 mm (.010 in) note the dimension for later use.
7. Remove locknut and screw.
8. With the centre beam supported on both sides, remove the pivot pin.
9. Remove the beam, thrust washer and shims.

Examination

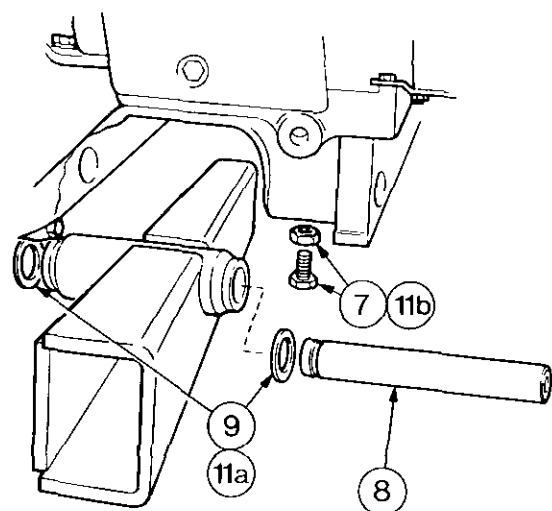
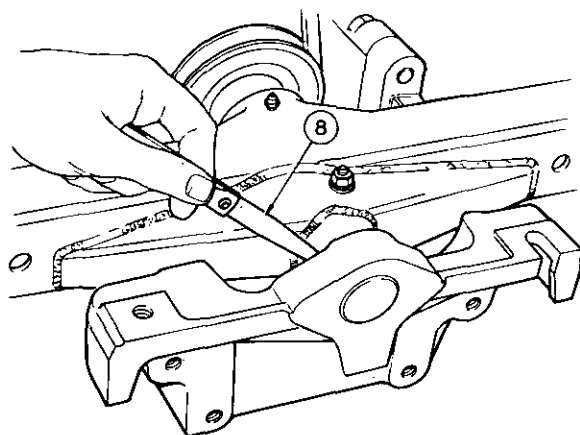
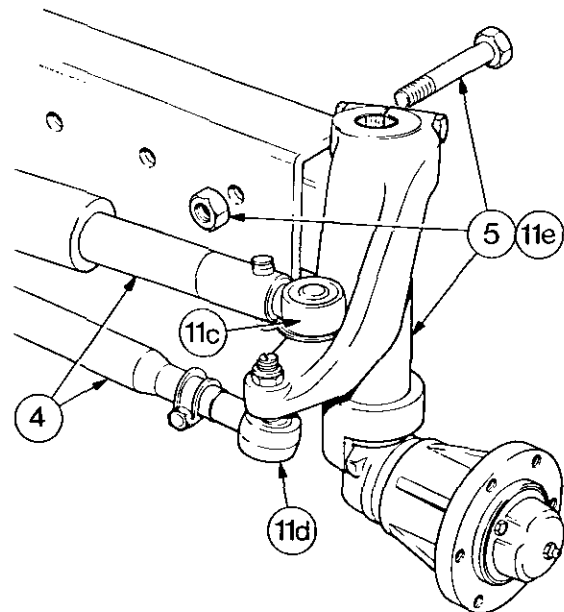
10. Check the end face of the centre beam boss, the pivot pin and thrust washer for wear. Examine all bores and threads for wear or damage. In the event of accident damage, check the beam for bending or twisting. If the beam has been in any way deformed, it must be replaced, as steering characteristics and tyre wear can be severely affected. Also the beam may have been dangerously weakened due to straining of the welded seams.
11. Reverse procedures 2-5 except:
 - (a) If gap between the front boss on beam and the casting, exceeds 0,25 mm (.010 ins), suitable shims from the following chart must be selected to give a gap of 0,08 mm (.003 ins) minimum to 0,25 mm (.010 ins) maximum. Shims must be fitted to front of the beam and the thrust washer to the rear

PART NUMBER	SHIM THICKNESS	
	mm	in
898-018-M1	0,7 to 0,76	0-028 to 0-030
898-019-M1	0,86 to 0,81	0-034 to 0-036
898-020-M1	0,99 to 1,04	0-039 to 0-041
882-868-M1	1,12 to 1,17	0-044 to 0-046
882-896-M1	1,24 to 1,30	0-049 to 0-051

- (b) Thoroughly degrease tapped hole, locknut and screw. Apply a few drops of recommended sealant (C) to the threads of screw. Ensure screw engages divot in pivot pin and tighten screw and locknut to a torque of 67-74 Nm (38-43 lbf ft).
- (c) Tighten nut securing ram to the spindle arm. to a torque of 43-60 Nm (32-44 lbs ft).

- (d) Tighten nut securing the tie rod to the spindle arm, to a torque of 108-122 Nm (80-90 lbf ft).
- (e) Tighten bolts securing outer arms into centre beam, to a torque of 400-600 Nm (300-400 lbf ft).

12. Refit the nose.



BEAM ASSEMBLY**Servicing**

7A-07-09

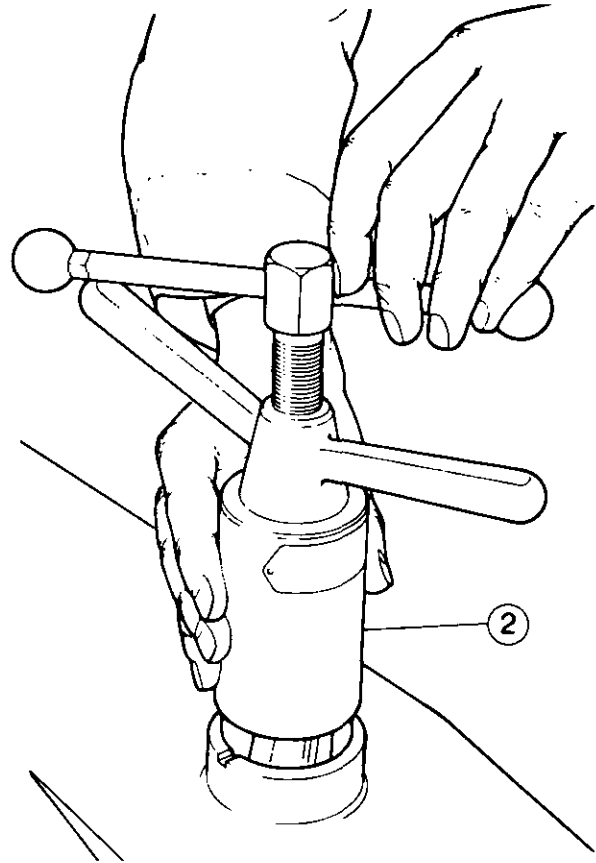
Special Tools Required: MF 263 Bush Remover
M 263-2 Adaptor
550 Universal Handle

Disassembly

1. Remove the beam as described in operation 7A-06-08 procedures 1-9.
2. Using MF 263 and MF 263-2, extract the bush by turning the lower handle.
3. Invert the beam and similarly extract the other bush.

Reassembly

4. Drive in the new bush with the cut out positioned vertically and facing the top tube, with the adaptor MF 263-2/2.
5. Invert the beam and similarly fit the other bush.
6. Refit the beam as described in operation 7A-06-08 procedures 11 and 12.

**AXLE SUPPORT CASTING****Removal and Refitment**

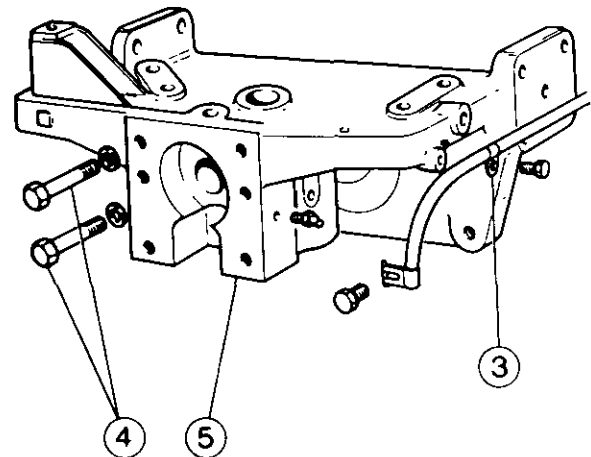
7A-08-09

Removal

1. Remove the beam as described in operation 7A-06-08 procedures 1-9.
2. Remove the radiator as described in operation 4B.
3. Remove the battery clip bolt.
4. Remove the nuts, bolts and washers.
5. Remove the axle support casting.

Refitment

6. Reverse procedures 3, 4, 5.
Noting. Axle support casting bolts to be torqued to 170 Nm (125 lbf ft).
7. Refit the radiator as described in operation 4B.
8. Refit the beam assembly as described in 7A-06-08 procedures 11 and 12.



FRONT AXLE**Part 7 — Section A**

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GENERAL

The front axle assembly consists of a centre beam and two outer axles. The centre beam pivots on a pin which is secured to the axle support casting. The outer axles can be bolted to the centre beam in alternative positions to provide front wheel track adjustment. Fig. 1. shows the general arrangement of the front axle assembly.

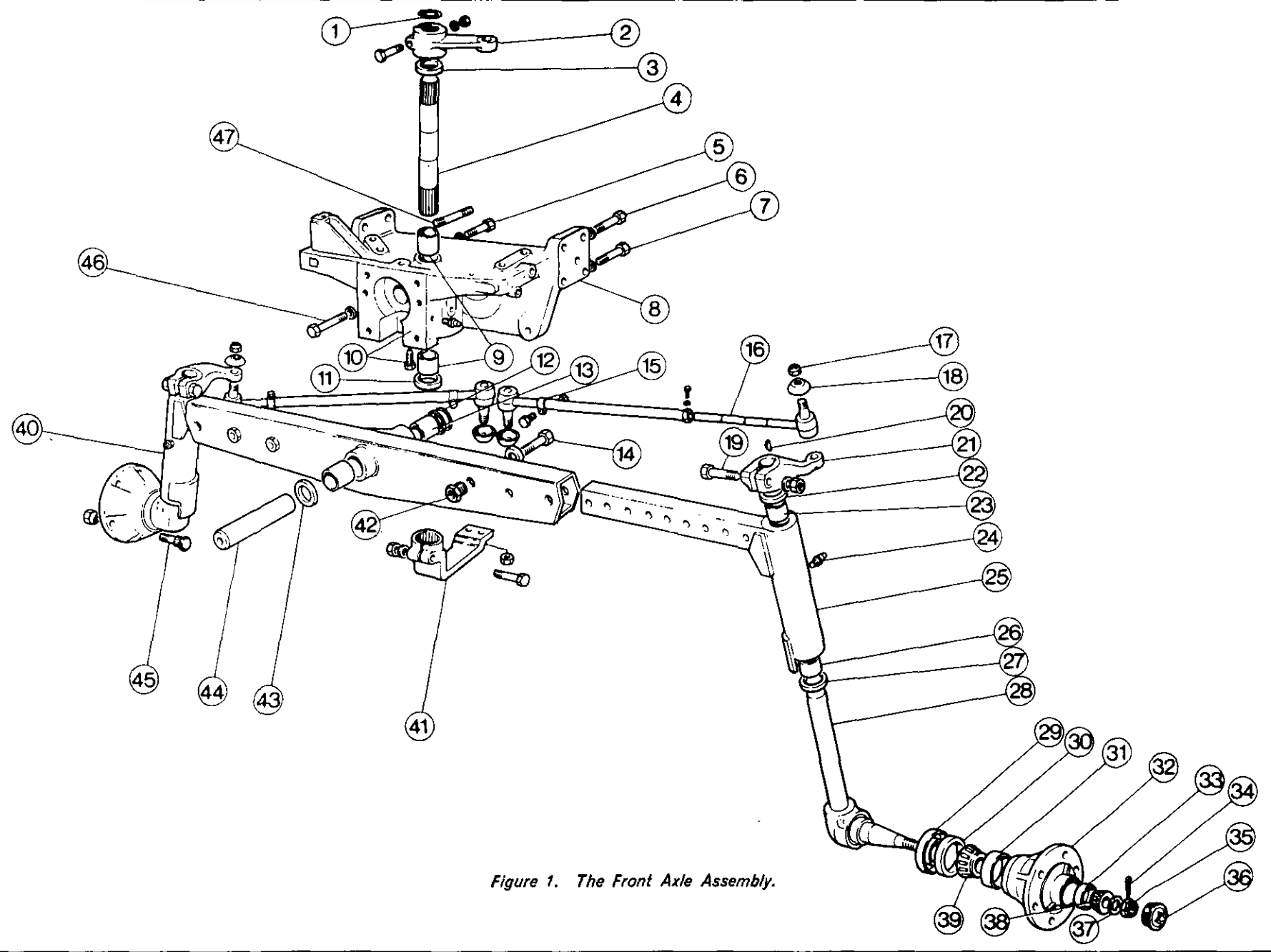


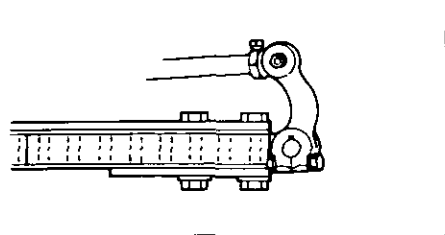
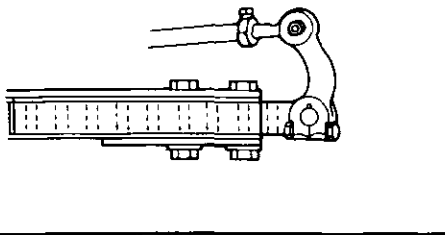
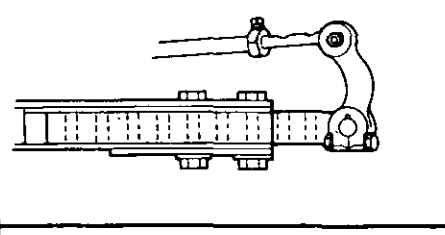
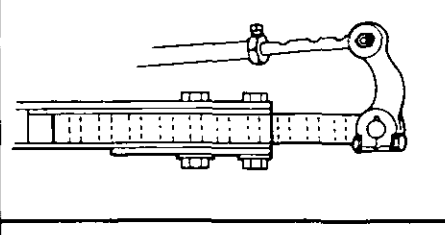
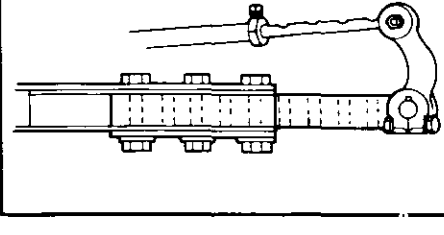
Figure 1. The Front Axle Assembly.

KEY TO FIGURE 1

1 Circlip	12 Shim .028"—.051"	24 Nipple, Straight	36 Hub Cap Assembly
2 Arm, Main Steering	13 Bush	25 Arm	37 Washer
3 Seal	14 Bolt	26 Bush	38 Bearing—Outer
4 Shaft, Main Steering	15 Adjuster	27 Thrust Bearing	39 Bearing—Inner
5 Bolt	16 Stem—Tie Rod	28 Spindle, LH	40 Drop Arm Assy. RH
6 Bolt	17 Nut—Nyloc	29 Shield	41 Arm
7 Bolt	18 Boot	30 Seal	42 Nut
8 Support Assembly— Front Axle	19 Bolt $\frac{3}{8}$ "—24 UNF x $4\frac{1}{2}$ "	31 Bearing Cup—Inner	43 Thrust Washer
9 Bush	20 Key, Woodruff	32 Hub Assembly	44 Pin—Front Axle
10 Screw	21 Arm, Axle Spindle LH	33 Cup—Outer	45 Stud
11 Seal	22 Seal Dust	34 Split Pin	46 Bolt
	23 Bush	35 Nut Slotted	47 Stud

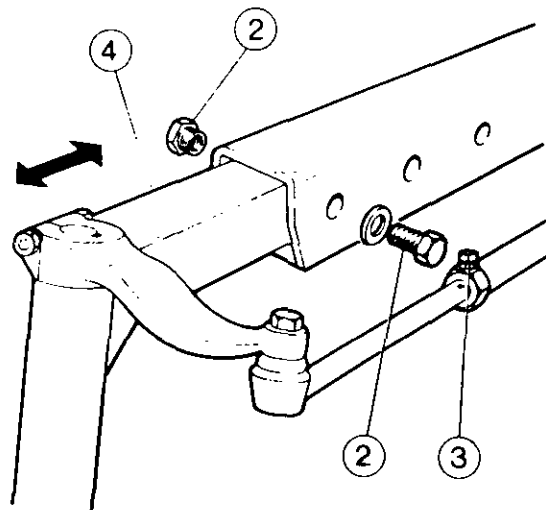
MF 675/690 FRONT AXLE 2 W.D.**FRONT TRACK**

The front track is adjustable in 102 mm (4 in) steps, as shown.

	53" 1346 mm.
	57" 1448 mm.
	61" 1550 mm.
	65" 1652 mm.
	69" 1754 mm.

ADJUSTMENT PROCEDURE 7A-15-18

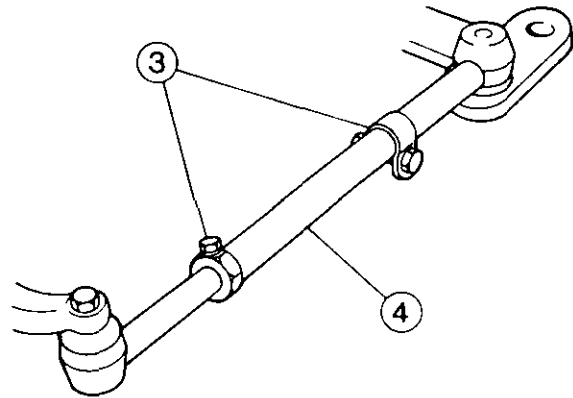
1. Jack up front axle of the tractor.
2. Remove the jamb nuts and bolts securing each front axle arm to centre member.
3. Remove bolt and nut.
4. Spread the outer axle arm and the telescopic tie rod to the required track setting.
5. Obtain partial engagement of the jamb nuts and bolts, then tighten the jamb nuts to 245 Nm (180 lbf ft) and then the bolts to 245 Nm (180 lbf ft).
6. Refit bolt and secure the lock nut, do not over tighten.



TOE-IN**Adjustment**

7A-10-15

1. Locate the tractor on firm level ground and place the front wheel in the "straight forward" position.
2. Using a suitable track gauge, check the toe-in which should be 3,2 mm ($\frac{1}{8}$ in).
3. If adjustment is necessary, slacken the bolt and nut.
4. Rotate the tie rod tube clockwise or anti-clockwise to increase or decrease the toe-in as required.
5. Retighten the nuts and bolts.

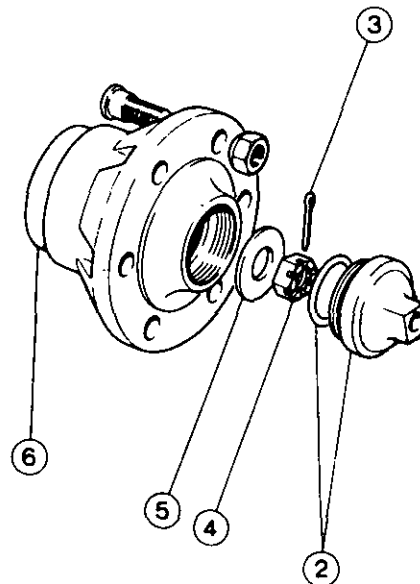
**FRONT HUB****Servicing**

7A-11-15

Special Tools Required: Torque wrench

Disassembly

1. Jack up front of the tractor and remove the wheel.
2. Remove the hub cap.
3. Remove and discard the split pin.
4. Remove the nut.
5. Remove the washer.
6. Lift the hub, complete with bearing and seal from the axle spindle.
7. Remove the outer bearing cone.
8. Tap out the outer bearing cup.
9. Remove the seal.
10. Remove the inner cone.
11. Drive out the bearing cup.
12. Remove the dust shield.

**Examination**

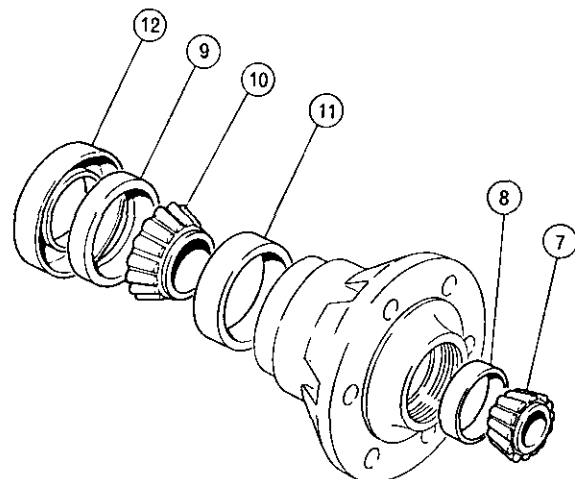
12. Thoroughly wash out the old grease or dirt from the hub components using clean paraffin, check conditions of the hub, spindle and bearings. Any worn or damaged components should be replaced. Always fit a new seal with flat face towards the centre hub and tap the seal right into the recess in the hub.

Fit a new split pin.

Resassembly

Reverse the procedure 1-11.

13. Tighten the nut to 80 Nm (60lbf ft) then slacken it off $1\frac{1}{2}$ flats to give correct hub float.



SPINDLE SHAFT**Removal and Refitment**

7A-12-16

Removal

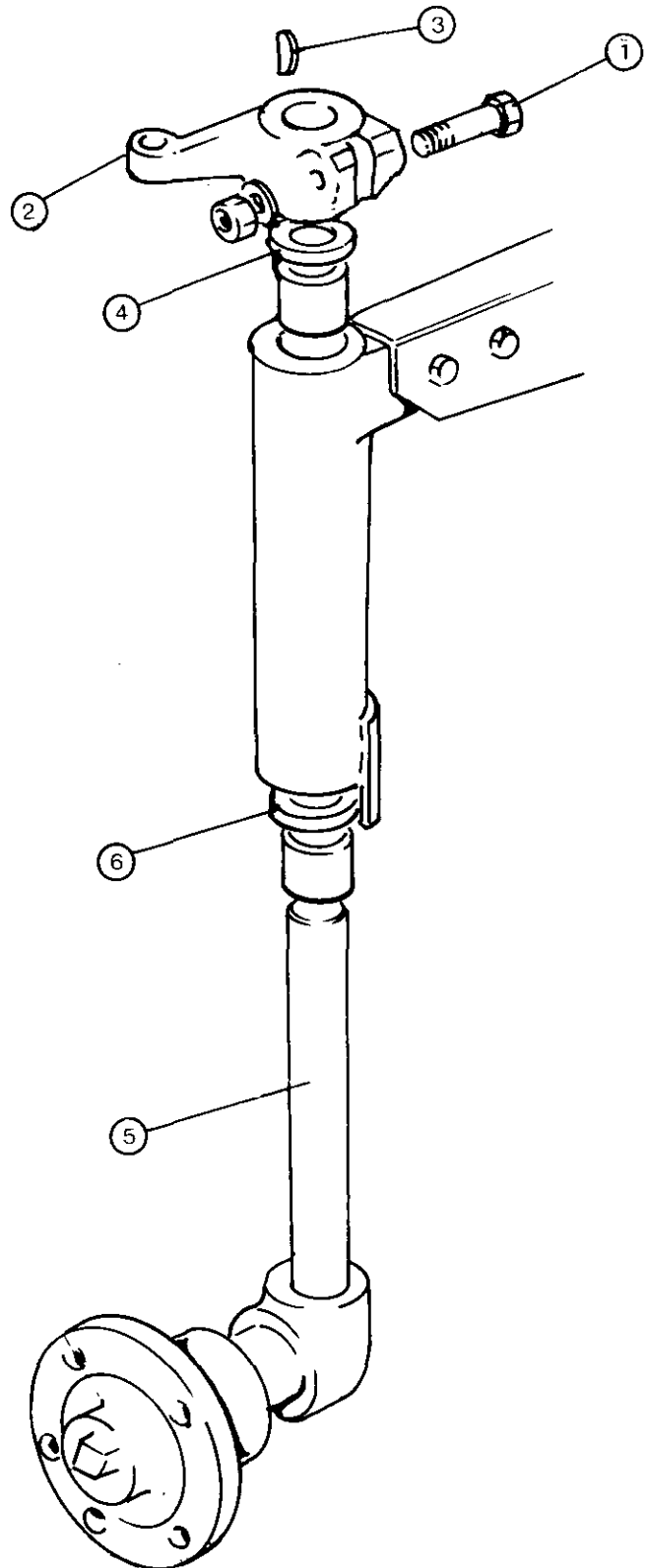
1. Remove the nut, washer and bolt.
2. Detach the arm.
3. Remove and discard the key.
4. Remove the seal.
5. Lower the spindle shaft from the housing.
6. Remove the bearing.

Examination

7. Examine the spindle shaft bearing for wear or damage. When reassembling, use a new seal and replace the bearing if necessary (with the thrust face downwards).

Refitment

8. Reverse the procedure 1 to 7.
 - (a) A new key must be fitted.



SPINDLE HOUSING**Servicing**

7A-13-17

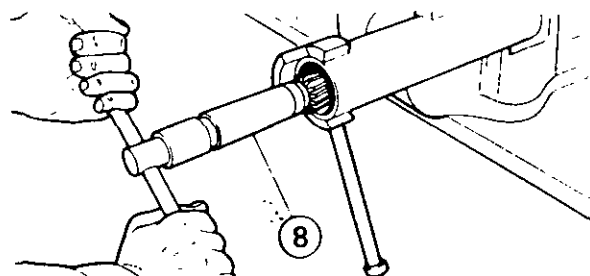
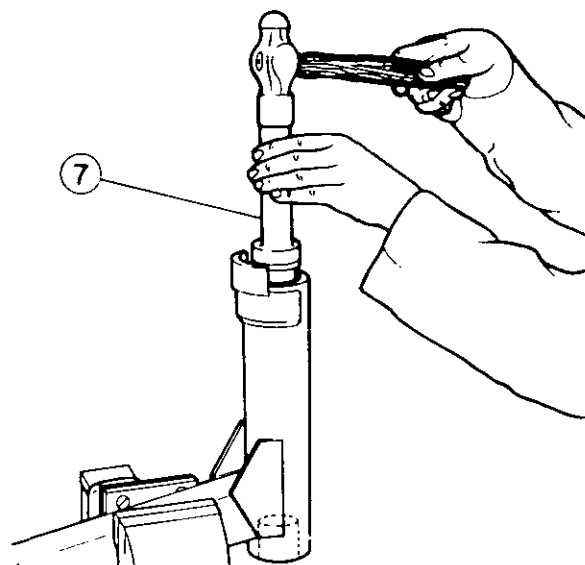
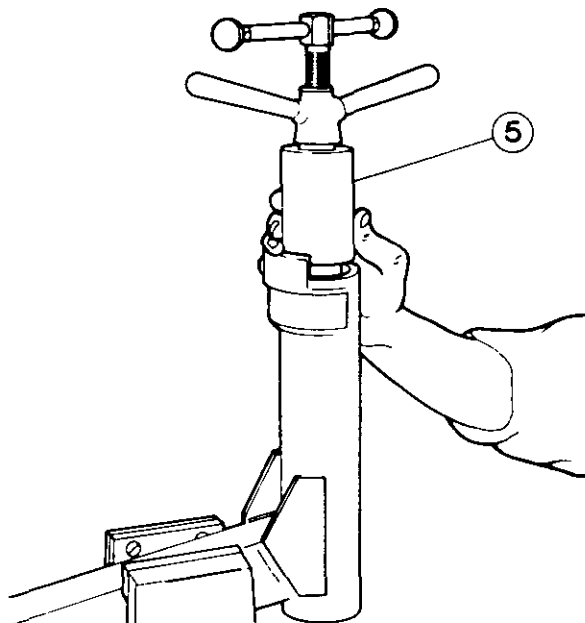
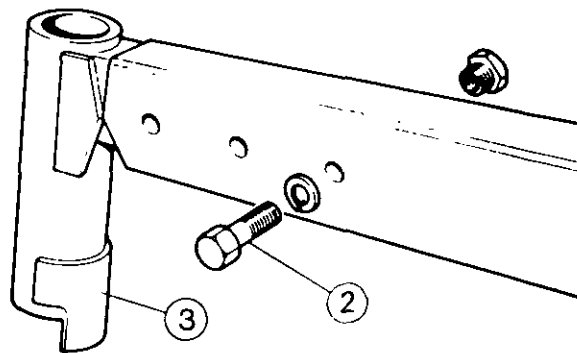
Special Tools Required: MF 263 Bush Remover
 MF 263-2 Adaptor
 MF 264 Reamer Handle
 MF 264 Reamer
 550 Universal Handle

Disassembly

1. Remove spindle shaft. Operation 7A-12-16, procedures 1 to 6.
2. Remove jamb outer nuts and bolts.
3. Remove outer arm.
4. Secure the outer arm in a vice.
5. Using MF 263 and MF 263-2 extract the bush by turning the lower handle.
6. Invert the outer arm and similarly extract the other bush.

Reassembly

7. Using the 550 handle and MF 263-2 drive in a new bush, invert the outer axle and similarly drive in the other new bush.
8. Using MF 264 Reamer Handle and MF 264 Reamer, ream the upper bush to size.
9. Fit the pilot MF 264- $\frac{1}{2}$ to the upper end of the reamer handle and the reamer MF 264-1 to the handle, then line ream the lower bush to size.
10. Remove all swarf from the housing by washing the housing in clean paraffin and ensure that the nipple hole is clear.
11. Reverse procedures 2 and 3 tightening the nuts to a torque of 400-600 Nm (300-400 lbf ft).
12. Refit spindle shaft as operation 7A-04-06 procedure 6.
 Refit wheels, tightening wheel bolts to a torque of 135-200 Nm (100-150 lbf ft).



BEAM ASSEMBLY**Removal and Refitment**

7A-20-22

Removal

1. Remove the nose as stated in operation
2. Jack up the tractor under the sump.
3. Remove the nuts and release both tie rods.
4. Remove jamb nuts and bolts.
5. Withdraw the outer arm complete with wheel.
6. Push centre beam hard back on its pivot pin against the thrust washer. Using feeler gauges, check the gap between the front boss on beam and the casting. If it exceeds 0,25 mm (.010 in) note the dimension for later use.
7. Remove locknut and screw.
8. With the centre beam supported on both sides, remove the pivot pin.
9. Remove the beam, thrust washer and shims.

Examination

10. Check the end face of the centre beam boss, the pivot pin and thrust washer for wear. Examine all bores and threads for wear or damage. In the event of accident damage, check the beam for bending or twisting. If the beam has been in any way deformed, it must be replaced, as steering characteristics and tyre wear can be severely affected. Also the beam may have been dangerously weakened due to straining of the welded seams.

BEAM ASSEMBLY**Removal and Refitment**

7A-06-08

Refitment

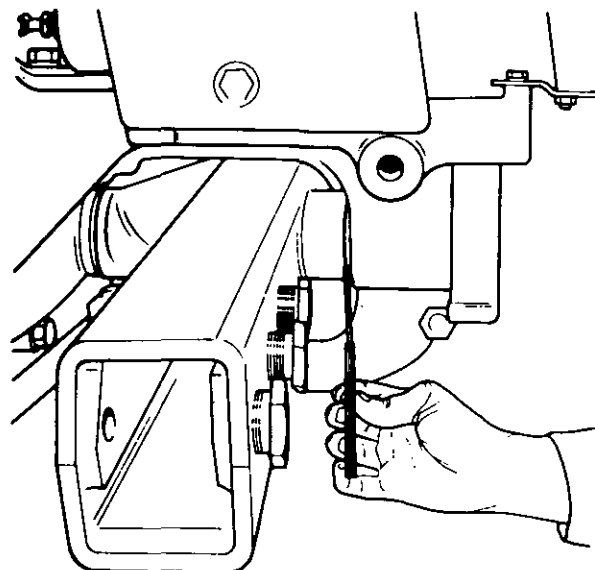
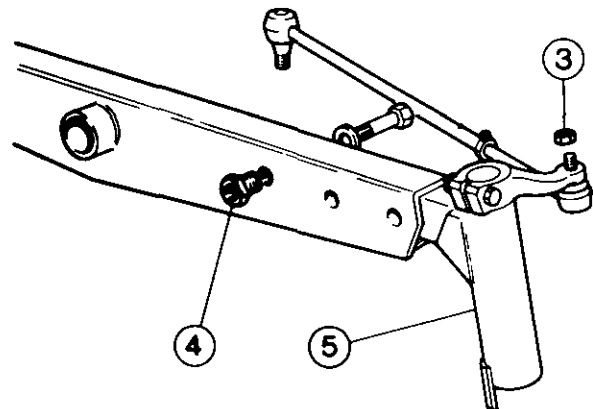
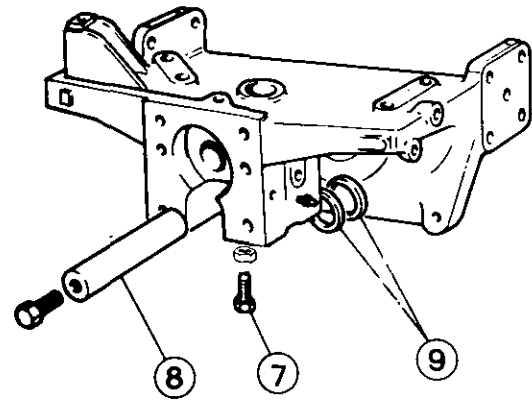
11. Reverse procedures 2-5 except:
 - (a) If gap between the front boss on beam and the casting, exceeds 0,25 mm (.010 ins), suitable shims from the following chart must be selected to give a gap of 0,08 mm (.003 ins) minimum to 0,25 mm (.010 ins) maximum. Shims must be fitted to front of the beam and the thrust washer to the rear

PART NUMBER	SHIM THICKNESS	
	mm	in
898-018-M1	0,7 to 0,76	0-028 to 0-030
898-019-M1	0,86 to 0,81	0-034 to 0-036
898-020-M1	0,99 to 1,04	0-039 to 0-041
882-868-M1	1,12 to 1,17	0-044 to 0-046
882-896-M1	1,24 to 1,30	0-049 to 0-051

- (b) Thoroughly degrease tapped hole, locknut and screw. Apply a few drops of recommended sealant (C) to the threads of screw. Ensure screw engages divot in pivot pin and tighten screw and locknut to a torque of 67-74 Nm (38-43 lbf ft).

- (c) Tighten nut securing ram to the spindle arm, to a torque of 43-60 Nm (32-44 lbs ft).
- (d) Tighten nut securing the tie rod to the spindle arm, to a torque of 108-122 Nm (80-90 lbf ft).
- (e) Tighten bolts securing outer arms into centre beam, to a torque of 400-600 Nm (300-400 lbf ft).

12. Refit the nose



BEAM ASSEMBLY

Servicing

7A-15-19

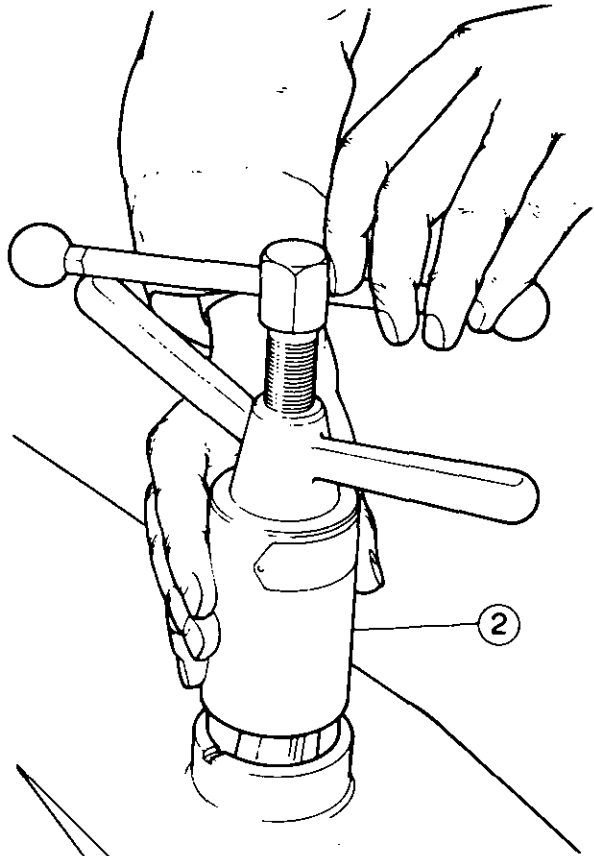
Special Tools Required: MF 263 Bush Remover
M 263-2 Adaptor
550 Universal Handle

Disassembly

1. Remove the beam as described in operation 7A-14-18, procedures 1 to 9.
2. Using MF 263 and MF 263-2, extract the bush by turning the lower handle.
3. Invert the beam and similarly extract the other bush.

Reassembly

4. Drive in the new bush with the cut out positioned vertically and facing the top tube, with the adaptor MF 263-2/2.
5. Invert the beam and similarly fit the other bush.
6. Refit the beam as described in operation 7A-14-18, procedures 11 and 12.

**AXLE SUPPORT CASTING**

Removal and Refitment

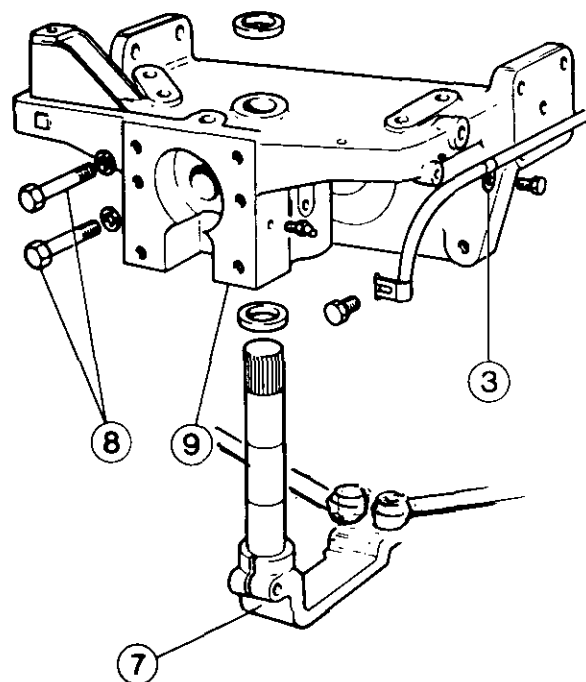
7A-16-19

Removal

1. Remove the beam as described in operation 7A-14-18, procedures 1 to 9.
2. Remove the radiator as stated in operation 4B.
3. Remove the battery clip bolt.
4. Remove the nut and release the drag bar link.
5. Remove the hydraulic steering cylinder together with the top arm. Operation 7B-12-08.
6. Withdraw the shaft and arm assembly complete with the tie rods.
7. Remove the nuts, bolts and washers.
8. Remove the axle support castings.

Refitment

9. Reverse procedure 1 to 9.
Noting. Axle support casting bolts to be torqued to 170 Nm (125 lbf ft). Steering linkage top arm bolt to be torqued to 120 Nm (90 lbf ft).



STEERING

Part 7—Section B

Operation Number	Table of Contents	Part Number
	GENERAL	01
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7B—08—05	Removal and Refitment	06/07
7B—09—06	Servicing	
	HYDROSTATIC STEERING CYLINDER	
7B—10—08	Removal and Refitment—MF 675, 690—2 W.D.	08
7B—11—08	Removal and Refitment—MF 698—2 W.D.	08
7B—12—08	Removal and Refitment—MF 675, 690, 698—4 W.D.	08
7B—13—09	Servicing	09

GENERAL (MF 675, 690)

The hydrostatic steering mechanism comprises a hydraulic ram, engine driven pump, reservoir, steering hand pump and piping.

The hydraulic ram cylinder assembly is bolted to the ram arm pivot pin, the ram arm being splined to the main steering shaft. The piston rod is retained in the R.H. side of the front axle support casting by a pin fitted into the R.H. side of the front axle support casting.

The gear type oil pump is bolted to the engine timing case and is driven from the timing gears. The reservoir contains a micronic filter and is attached to the rear of the pump.

The Danfoss orbitrol steering hand pump is splined onto the end of the steering column. Hydraulic pipe connects the orbitrol unit to the steering ram and gear pump.

Oil is pumped from the reservoir via the micronic filter to the steering hand pump. Oil from the steering hand pump is fed to the cylinder at the appropriate side of the ram, determined by the steering wheel movement, and hydraulic force turns the road wheels in the direction required. Excess oil from the steering hand pump is returned to the reservoir.

The tractor can be manually steered if the power steering mechanism fails, or if the tractor is being moved without the engine running.

GENERAL (MF 698 TRACTOR)

The hydrostatic steering system comprises a gear pump attached to the rear of the timing case, having a spur gear driven by the timing idler gear. The pump has an integral oil reservoir and supplies oil under pressure to an orbitrol steering hand pump mounted at the end of the steering column. Rotation of the steering wheel activates the spool valve contained within the orbitrol unit, allowing oil under pressure to flow through hoses to two double acting rams.

Each ram cylinder is mounted on a reaction bracket bolted to the centre axle beam.

The ram piston rod is attached to the steering arm keyed to the top of each axle spindle.

Rotation of the steering wheel causes movement of the spool valve to allow oil to flow under pressure to the appropriate side of each ram piston. Oil from the opposite side is expelled through the orbitrol pump back to the pump reservoir. A filter element is located within the reservoir.

STEERING**STEERING SYSTEM
(TRACTORS)****System Bleeding** 7B-01-02

1. Fill the reservoir on the rear of the steering pump with clean steering oil to the filler plug level.
2. Replace the plug.
3. Start the engine and run it at 900 rev/min for thirty seconds.
4. Rotate the steering wheel in one direction, then in the other until each time a full lock is obtained.
5. Switch off the engine and refill the reservoir to the filler plug level.
6. Restart the engine and run it at 1200 rev/min.
7. Repeat procedure 4.
8. The relief valve can be heard functioning when the steering is on full lock. Keep the relief valve operating for ten seconds with the steering wheel on full lock in each direction.
9. Repeat procedure 8, three times.
10. Switch off the engine, check all unions for leaks. If there are any leaks, tighten the unions and repeat procedures 1 to 9.

STEERING PUMP**Oil Level Checking** 7B-02-02**Procedure**

1. Start the tractor engine, turn the steering wheel one turn to left only.
2. Run the engine for thirty seconds before removing the filler plug and washer from reservoir. The oil level should be to the plug level.
3. If necessary, fill the reservoir with clean approved oil to the plug level.
4. Refit the plug. Restart the engine and run it for a further two or three minutes.
5. Remove the plug and recheck the oil level, adding more oil if necessary.
6. Tighten the plug to a torque of 12 Nm (9 lbf ft).

STEERING PUMP

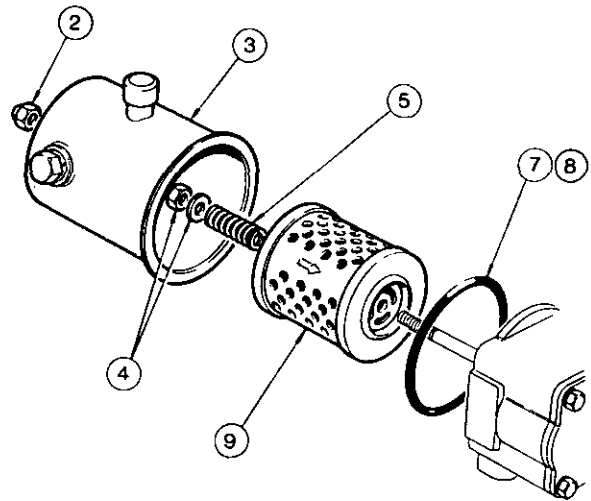
(Plessey type shown. The Aero-Quip is similar)

Element Removal and Replacement**Removal** 7B-03-02

1. Place a suitable drain tray below the filter.
2. Remove the nut.
3. Remove the seal.
4. Remove the canister.
5. Remove the nut.
6. Remove the spring.
7. Remove the washer.
8. Remove the seal.
9. Remove and discard the filter element, wash all components in clean paraffin and dry them with a fluff free cloth.
10. Remove the spacer. (Aero-Quip only).
11. Remove the sealing ring.

Replacement

12. Fit a new sealing ring if necessary.
13. Fit a new filter element with the arrows pointing towards the pump body.
14. Reverse procedures 1 to 8 except:
 - (a) Tighten the canister retaining nut to a torque of 27 Nm (20 lbf ft).
15. Check the steering system oil level, operation 7B-02-02.

**STEERING PUMP****Removal and Refitment** 7B-04-02

1. Disconnect the pipes from the pump.
2. Remove the two nuts, washers and bolts.
3. Remove the bolt.
4. Remove the pump.

Refitment

5. Reverse procedures 1 to 4 except:
 - (a) Tighten the nuts and bolt to a torque of 27 Nm (20 lbf ft).
6. Check the steering pump oil level, operation 7B-02-02.

STEERING PUMP

(Plessey type shown—The Aero-Quip is similar)

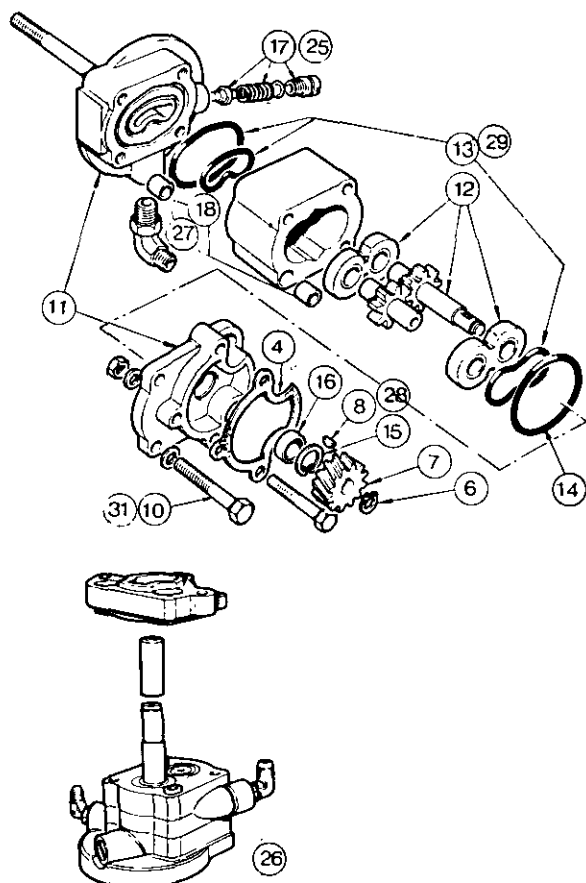
Servicing

7B-05-03

Special Tools: MF 148A Pressure Gauge
MF 148-11 Adaptor
MF 332 Seal Protector
MF 810-4 Adaptor

Removal

1. Thoroughly clean the pump exterior.
2. Remove the filter element, operation 7B-04-02 procedures 1-11.
3. Disconnect the pump feed and return pipes.
4. Remove the bolts securing the pump to the engine housing.
5. Remove the gasket.
6. Remove the circlip.
7. Remove the gear.
8. Remove the key.
9. Mark the pump body and end plates to facilitate their correct refitment.
10. Remove the four bolts and spring washers.
11. Separate the pump end plates from the body.
12. Remove the drive and driven gears, and the two floating bearings.
13. Remove the inner and outer seals.
14. Remove the 'O' ring.
15. Remove the circlip.
16. Drive out the lip seal.
17. Remove the plug sealing washer, spring relief valve.
18. If necessary, remove the dowels.

**Examination**

19. Check the floating bearings for wear, both on the faces and in the bores. Pay particular attention to the condition of the lubricating scrolls and the portion of the bearing between the bearing bores. Score marks or damage at this point can cause very high leakage losses.
20. During servicing, the floating bearings should normally be replaced. However, if new bearings are not available, the existing bearings can be salvaged (if only lightly marked) by polishing as follows:—
 - (a) Place a sheet of 'O' grade emery paper lubricated with paraffin on a truly flat surface (e.g., surface plate or a piece of plate glass), then polish the surface, using a light circular motion. Check that the bearings can move freely in the pump body, if necessary, polishing the outside diameters of the bearings to ensure free movement. After polishing, thoroughly wash the bearings in clean paraffin to remove all traces of aluminium dust.
21. Visually check the pump body and end plates for signs of cracks or damage. Check the bores for wear, cracks or scoring. Due to the action of the oil pressure, the gears normally cut a track on the inlet side of the pump body bores. The depth of this track must not exceed 0,01 mm (0.004 in), otherwise the body must be replaced. The only salvage work possible on the pump body is to very carefully remove the burrs from the edge of the track, using fine emery cloth.
22. Inspect the gear teeth for scored, or worn faces or journals, damaged teeth, or surface scratches. Slight wear or scoring of the journals can be removed by polishing between lathe centres, using grade 'O' emery cloth lubricated with paraffin. Slightly scored gear faces can be salvaged by sandwiching emery paper between the gear face and a scrap bearing. Also check that the gear widths of the drive and driven gears, are within 0,005 mm (0.0002 in) of each other. If the gears cannot be reclaimed by light polishing, as described above, a pair of gears (only matched sets are supplied) must be fitted.
23. Always check that the gear faces are flat. This can be checked by lightly smearing a bearing face with 'Engineering Blue' and rotating the gear against the face. This will reveal any sharp edges on the teeth which can be removed with a fine cut needle file. Check the diameter of the journal on each gear. These must be within 0,013 mm (0.0005 in) of each other (per gear) for efficient operation. Examine the reservoir for damage, particularly the retaining nut. Check that the 'O' ring sealing face is also undamaged.
24. Examine the relief valve and its seat for erosion, or damage. If necessary, lightly re-lap the seat using fine lapping paste; then thoroughly flush out the seat and circlip valve.

STEERING**Reassembly**

25. Refit the relief valve spring, sealing washer and plug.
26. Using MF 332 fit a new oil seal.
27. Slide the end plate into position, locating the dowels in their holes.
28. Fit the circlip.
29. Renew the inner and outer seals.
30. Assemble the drive and driven gears to the floating bearings with the relieved side of the floating bearings on the outlet side of the pump. To ensure correct sealing, measure the thickness of the assembled 'sandwich' of gears and bearings then measure the thickness of the pump body. The sandwich should be 0,01 to 0,20 mm (0-004 to 0-008 in) less than the body thickness.
31. Replace the four bolts and spring washers, remove MF 332.
32. Reverse procedures 1 to 6 omitting 3.
 - (a) Tighten the four bolts to a torque of 41 Nm (30 lbf ft).
 - (b) Lightly coat the gasket in recommended sealant A.
 - (c) Tighten the pump securing bolts to a torque of 38 Nm (28 lbf ft).
33. Turn the steering wheel one turn to the left, refill the reservoir to the base of the filler hole. Start the engine and recheck the level, adding oil as required.
34. Keep the engine running at 2000 rev/min and the steering on full lock until the oil temperature is 50°C (120°F). Switch off the engine.
35. Using MF 810-4 and MF 148-A, screw the adaptor to the outlet port of the pump. Start the engine. The relief valve will discharge and should indicate a pressure of 105 to 112 kg/cm² (1500 to 1600 lb/in²). If the pressure is incorrect, adjust by turning the regulator thus:—
 - Clockwise to increase pressure.
 - Anti-clockwise to decrease pressure.
36. ALTERNATIVELY fitting MF 148-11 and MF 148A to the front hose connection. Apply full lock (in either direction) with the engine running at 2000 rev/min. The gauge should indicate 105 to 112 kg/cm² (1500 to 1600 lb/in²). Adjust the regulator screw as necessary.
37. Stop the engine.
38. Disconnect MF 148A and MF 148-11 and re-connect the return pipe.
39. Check the oil level in the reservoir and replenish if necessary.

STEERING WHEEL**Removal and Refitment**

7B-06-04

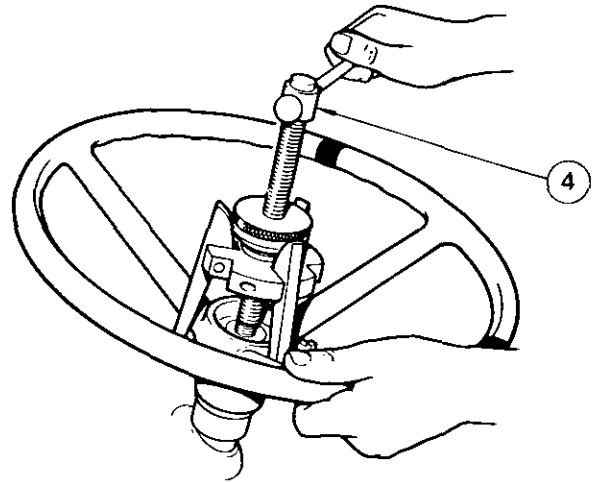
Special Tool: MF 268 Steering Wheel Remover

Removal

1. Ensure that the front wheels are set straight ahead.
2. Detach the motif cap from the centre of the steering wheel.
3. Remove the nut.
4. Using MF 268, detach the steering wheel.

Replacement

5. Reverse procedures 1 to 4 except:
 - (a) Ensure that the splines in the steering wheel, mesh correctly with those in the steering column.
 - (b) Tighten the nut to a torque of 58 Nm (43 lbf ft).



STEERING COLUMN**Removal and Refitment**

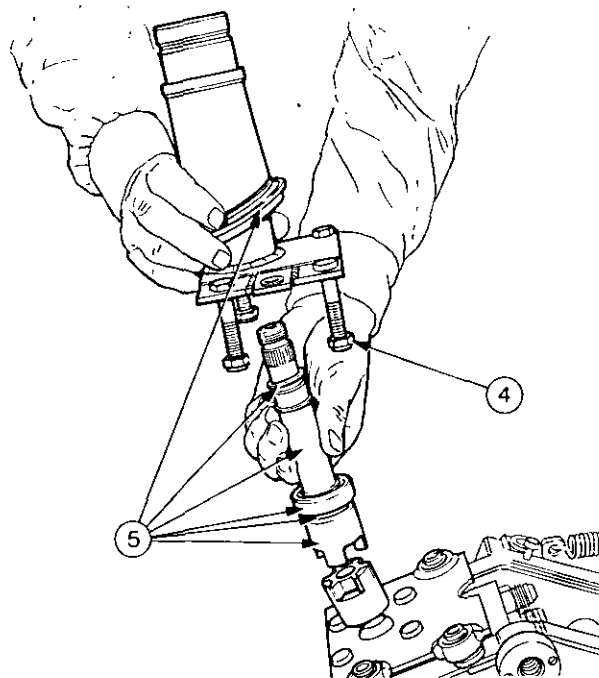
7B-07-05

Removal

1. Remove the steering wheel 7B-06-04.
2. Remove the instrument panel.
3. Remove the instrument panel switch support.
4. Remove four bolts and lock nuts.
5. Remove the steering column, complete with the steering shaft assembly.

Refitment

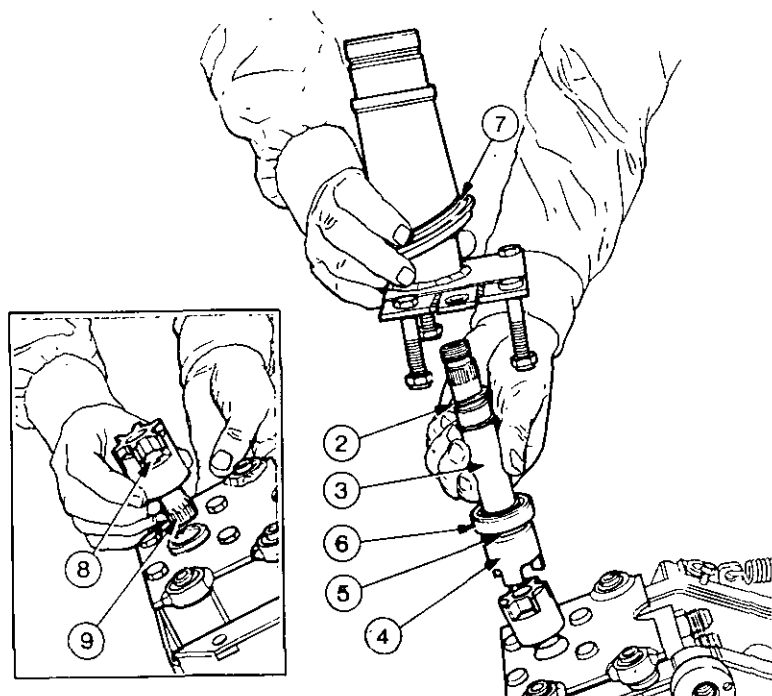
6. Coat splines of shaft with grease.
7. Reverse procedures 1 to 5.
8. Tighten the four bolts to a torque of 34-47 Nm (25-35 lbf ft).

**STEERING COLUMN****Servicing**

7B-08-05

1. Remove the steering column. Operation 7B-07-05.
2. Remove the circlip from the top of the shaft.
3. Press the shaft out of the top bearing.
4. Extract the coupling from the bottom of the shaft.
5. Remove the bottom circlip from the shaft.
6. Remove the bottom bearing.
7. Remove the rubber cover from the tube.
8. Remove the clip from the splined shaft in the coupler.
9. Press the splined drive shaft out of the coupler.

NOTE: The bottom bearing can be replaced if worn, the top bearing is swaged into the tube and if worn the tube assembly must be replaced.

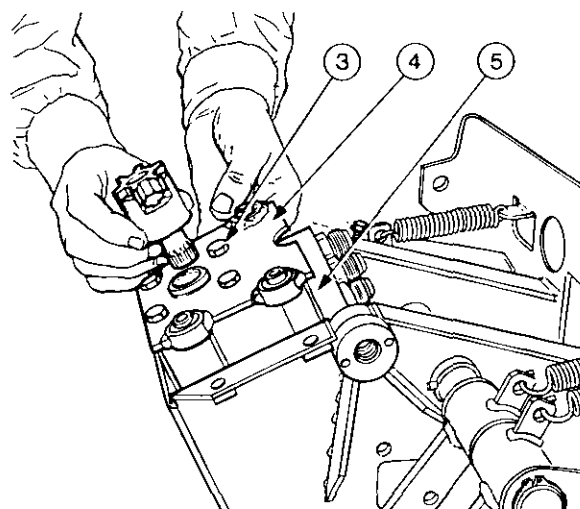
**HYDROSTATIC STEERING HAND PUMP****Removal and Refitment**

7B-09-05

1. Remove the steering column operation 7B-07-05 procedures 1-5.
2. Mark the four power steering hoses for ease of re-fitment and disconnect them from the pump.
3. Remove four set pins.
4. Remove the plate.
5. Lift out the steering hand pump.
6. Blank off the open ends of the hoses and elbows with suitable plugs.

Refitment

7. Reverse procedures 2 to 6.
8. Refit steering column, operation 7B-06-04 procedure 5.
9. Tighten the four bolts to a torque of 38 Nm (28 lbf ft).
10. Bleed the system as described in operation 7B-01-02 procedures 1-10.



STEERING**STEERING HAND PUMP****Servicing**

7B-10-06

Special Tools: MS 62A 'O' Ring and Kin Ring Fitting Tool
MS 63 Spring Fitting Tool

Disassembly

NOTE: This operation must be carried out in scrupulously clean conditions.

1. Remove the hand pump, operation 7B-09-05 procedures 1-5.
2. Mount the hand pump in a vice, then remove the seven bolts.
3. Lift off the end plate.
4. Remove the 'O' ring.
5. Lift off the rotor.
6. Lift off the stator.
7. Remove the 'O' ring.
8. Remove the spacer washer.
9. Lift off the valve plate.
10. Remove the 'O' ring.
11. Withdraw the drive shaft.
12. Remove the threaded insert.
13. Remove the ball.
14. Slide the spool and sleeve assembly out of the body.
15. Remove the 'O' ring from the valve body.
16. Remove the kin ring from the valve body.
17. Slide the outer thrust washer off the spool.
18. Remove the inner thrust washer.
19. Slide the needle bearing off the spool.
20. Slide the kin ring off the spool.
21. Press out the cross pin from the spool and sleeve.
22. Very carefully slide the spool out of the sleeve.
23. Push out the six plate springs from the cross slot in the spool.
24. Carefully lever out the upper seal from the top of the body.

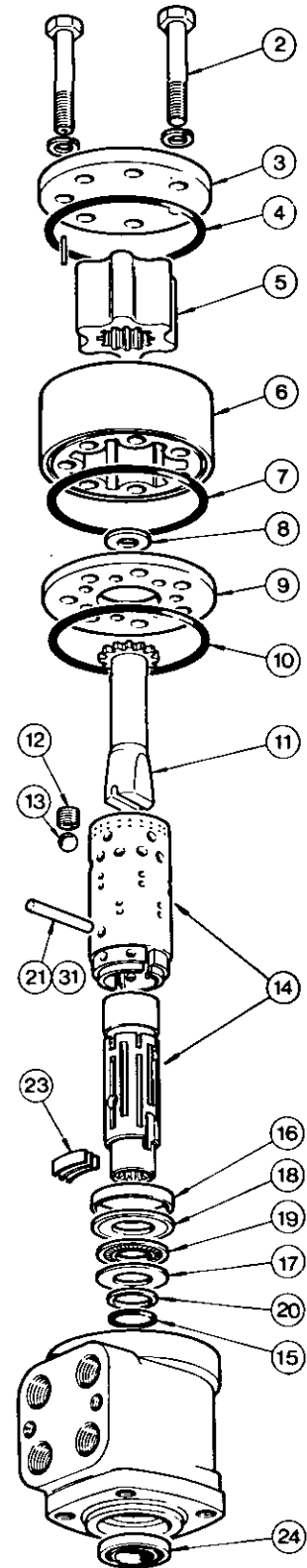
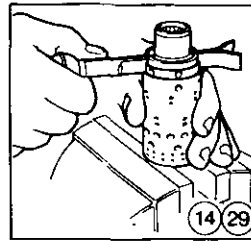
Examination

25. Carefully clean all components in a degreasing solvent, then examine all components for wear or damage.
26. If either the spool, sleeve or body is scored, the whole pump must be replaced. The only components which are serviced are the 'O' rings, kin ring and the upper seal.

Reassembly

27. Before reassembly, lubricate all components with clean steering oil.
28. Carefully slide the spool into the sleeve, with the centering spring slots aligned.
29. Push MS 63 through the centering spring slot, then fit the six centering springs to the slot in the end of MS 63.
30. Carefully push the springs into the slot in the spool and sleeve until they are central, then withdraw MS 63.
31. Refit the cross pin to the sleeve and spool assembly.
32. Reverse procedures 15 to 20.
33. Stand Special Tools MS 62A on the bench.
34. Remove the outer sleeve.
35. Fit the nylon spigot into the plunger.
36. Fit the 'O' ring (A) with the kin ring (B) over the nylon spigot (C).
37. Replace the outer sleeve over the plunger.

NOTE: DO not push the outer sleeve past the 'O' ring.



38. Place the pump body over the outer sleeve and push down until a firm resistance is felt.
39. Carefully slide the spool and sleeve assembly into the pump body and push out the nylon spigot.
40. Remove the tool MS 62A from the pump assembly.
41. Refit the ball to the bore of the body.
42. Refit the threaded insert.

NOTE: Assemble the driveshaft to the rotor with the slot in the end of the driveshaft aligned with a cut out in the rotor.

43. Using new 'O' rings, refit the valve plate.
44. Reverse procedure 1 to 9:
 - (a) Smear the inner 'O' ring with an approved grease.
 - (b) Tighten the seven bolts to a torque of 27 Nm (20 lbf ft).

STEERING**HYDROSTATIC STEERING CYLINDER****Removal and Refitment** 7B-11-08

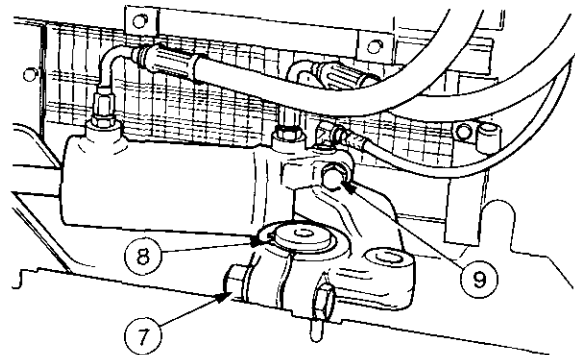
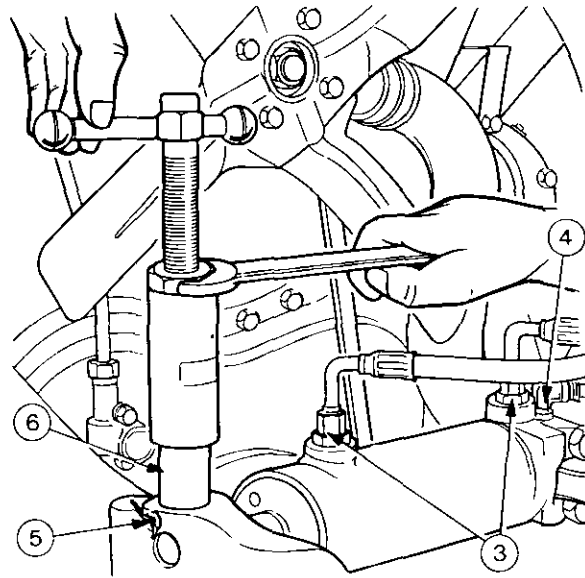
Special Tools: PD 1D Puller
MF 334 Adaptor

Removal—(MF 675, 690—2 W.D.)

1. Remove the front side panels Part 2B.
2. Remove the battery and shelf assembly Part 9A.
3. Remove the hoses from the cylinder and blank off the open ends and cylinder ports to prevent dirt ingress.
4. Remove the remote greasing tube from the top of the pivot pin.
5. Remove cotter pin and washer from the piston anchor pin.
6. Remove piston anchor pin using tools PD 10 and MF 334.
7. Loosen the clamp bolt on the upper steering arm.
8. Remove the circlip from the top of steering shaft and prise the arm off the shaft together with the steering hydraulic cylinder. Loosen the two clamp bolts securing the pivot pin and remove the pin and upper steering arm.
9. Thoroughly clean all components.

Refitment

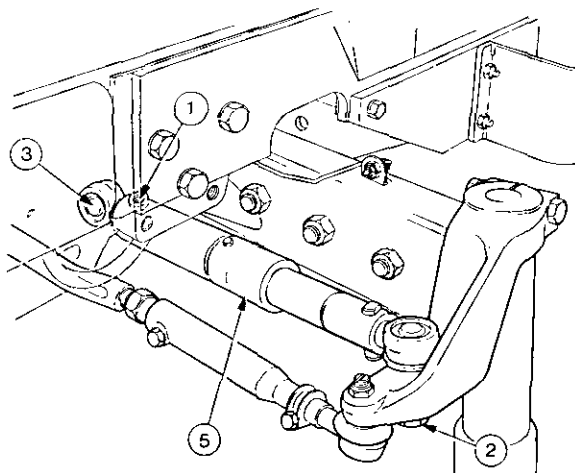
10. Reverse procedures 1—8 except:
 - (a) Tighten clamp bolt to a torque of 332—427 Nm (100—130 lbf ft).
 - (b) Tighten hose union to a torque of 21—61 Nm (16—45 lbf ft).
 - (c) Renew cotter pin in the pivot pin
 - (d) Bleed the system. Operation 7B-01-02.

**HYDROSTATIC STEERING CYLINDER****Removal and Refitment** 7B-12-08**Removal (MF 698—2 W.D.)**

1. Remove the hose from the cylinder and blank off the open end and cylinder port to prevent dirt ingress.
2. Remove the nut securing the ball joint to the spindle arm.
3. Remove the nut securing the ball joint to the centre bracket.
4. Drive out the ball joints.
5. Lift the cylinder clear.
6. Thoroughly clean all components.

Refitment

7. Reverse procedures 1—4 except:
 - (a) Tighten both ball joint nuts to a torque of 135—200 Nm (100—147 lbf ft).
 - (b) Tighten hose union to a torque of 21—61 Nm (16—45 lbf ft).
 - (c) Bleed the system. Operation 7B-01-02.

**HYDROSTATIC STEERING CYLINDER****Removal and Refitment** 7B-13-08**Removal—(MF 675, 690, 698—4 W.D.)**

1. Remove the hoses from the cylinder and blank off the open ends and cylinder ports to prevent dirt ingress.
2. Remove cotter pin and washer from the pivot pin.
3. Remove the pivot pin.
4. Remove the nut securing the ball joint to the spindle arm.
5. Drive out the ball joint.
6. Lift the cylinder clear.
7. Thoroughly clean all components.

Refitment

8. Reverse procedures 1—5 except:
 - (a) Tighten the ball joint nut to a torque of 135—200 Nm (100—147 lbf ft).
 - (b) Tighten the hose unions to a torque of 21—61 Nm (16—45 lbf ft).
 - (c) Bleed the system. Operation 7B-01-02.

HYDROSTATIC STEERING CYLINDER**Servicing** **7B-14-09**

1. Remove the cylinder, operation 7B-10-08, procedures 1-8, 7B-11-08 procedures 1-6 or 7B-12-08 procedures 1-6.
2. Remove piston assembly. Record the position of all parts, seals, friction rings, washers etc.
3. Thoroughly clean all components.
4. Check that there are no signs of scoring or seizure on the piston and in the cylinder bore.
5. Replace any worn parts and fit all new oil seals.
6. Oil all components with the recommended type.
7. Refit the piston assembly as it was removed, taking care not to damage any seals.

WHEELS AND TYRES

Part 7—Section C

Operation Number	Description	Page Number
7C-01-02	INNER TUBE Removal and Refitment	02
7C-02-04	TYRES Removal and Refitment	04
	FAULT FINDING CHART	05

WHEELS AND TYRES

INNER TUBE**Removal and Refitment**

7C-01-02

Special Tools: 'Bead-breaking' tool
3 lb Hammer
Tyre Levers

Removal

1. Lay the wheel on the ground with the valve uppermost.
2. Deflate the tyre by removing the valve core. Remove the valve retaining nut.
3. Drive the 'bead-breaking' tool between the tyre and rim, taking care not to damage the rim or the tyre.
4. After the bead has been released from the rim, invert the wheel and repeat Item 3.
5. Lubricate the rim, tyre and base of the tube with a solution of soap and water or similar rubber lubricant.

NOTE: Never use petroleum or silicone base greases.

6. Starting at the valve location, pry the tyre off the rim, taking small bites with tyre levers, and ensuring that the bead on the opposite side is fully located in the mounting well.
7. With the wheel in a vertical position, pull the tyre forwards and remove the tube.

Examine the bead seating area of the rim. Remove any build-up of rust, corrosion or old rubber. Inspect inside the tyre casing for foreign matter or damage.

Refitment

8. Inflate the tube until 'rounded out'. Place the tube in the tyre with the valve located in the valve hole. Refit the valve retaining nut finger tight.
9. Refit the tyre, starting opposite the valve location taking small bites with long tyre levers and keeping the fixed part of the bead fully located in the well.

A Solution of soap and water, or similar rubber lubricant, brushed on to the rim and bead will help fitment.

NOTE: Care must be taken not to pinch the tube when fitting.

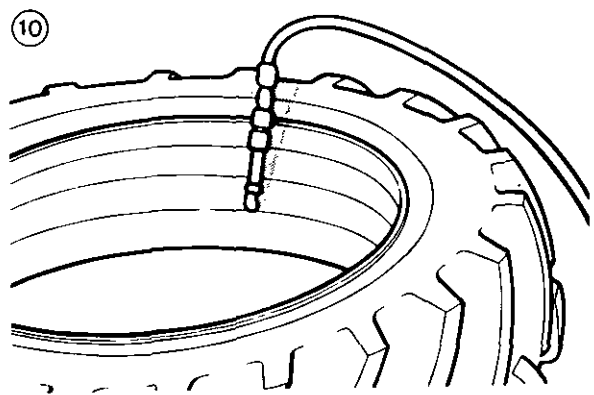
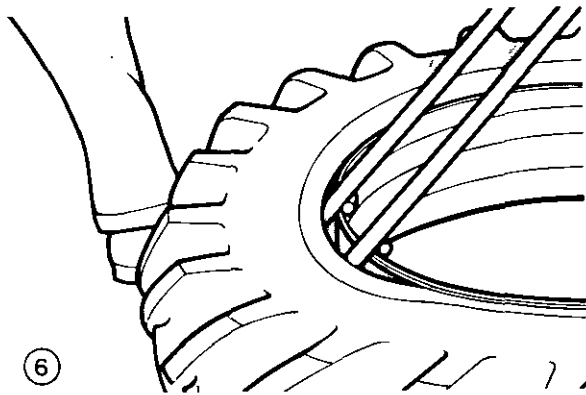
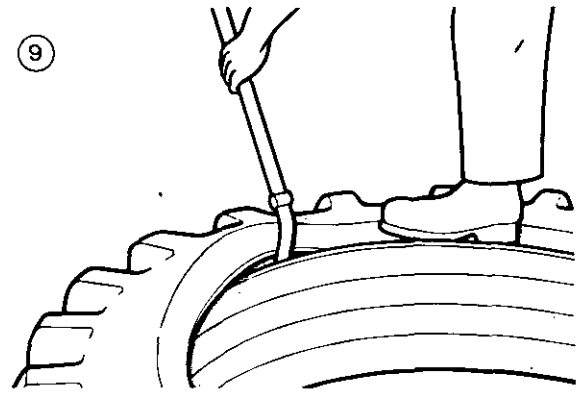
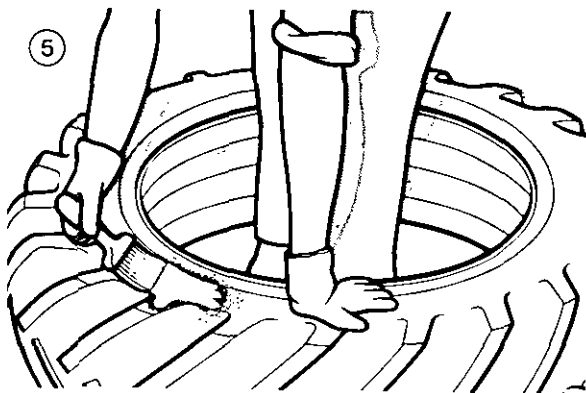
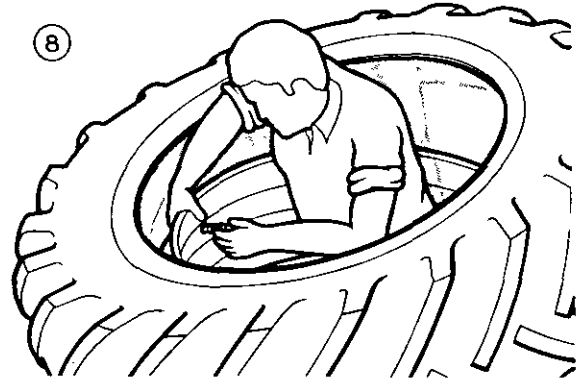
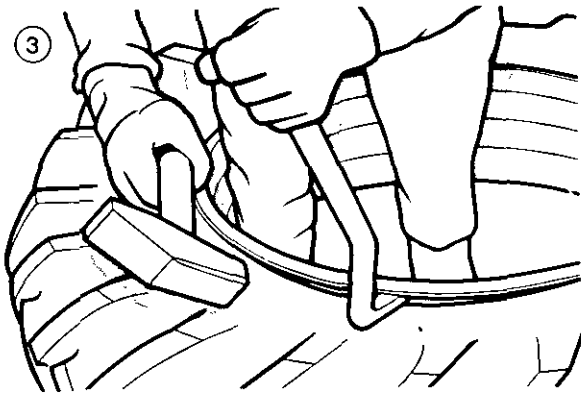
10. Centre the tyre on the rim and inflate to approx. 2,5 kg/cm² (35 lb/in²).

NOTE: Never stand over the assembly when inflating, remote control inflation equipment should be used.

11. Remove the valve core and completely deflate the tyre.
12. Refit the valve core and inflate to recommended pressure.

NOTE: If beads fail to seat at 2,5 kg/cm² (35 lb/in²) the tube may be pinched, do not increase the pressure but remove the valve core and release tyre from rim. Lubricate tyre, bead and rim and re-inflate to 2,5kg/cm² (35 lb/in²) repeat process until both beads are properly seated.

WHEELS AND TYRES



WHEELS AND TYRES**TYRE****Removal and Refitment**

7C-02-04

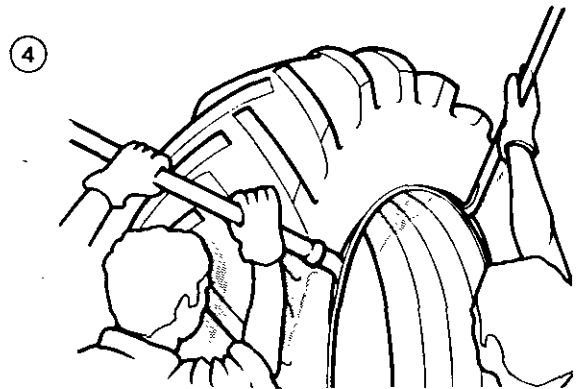
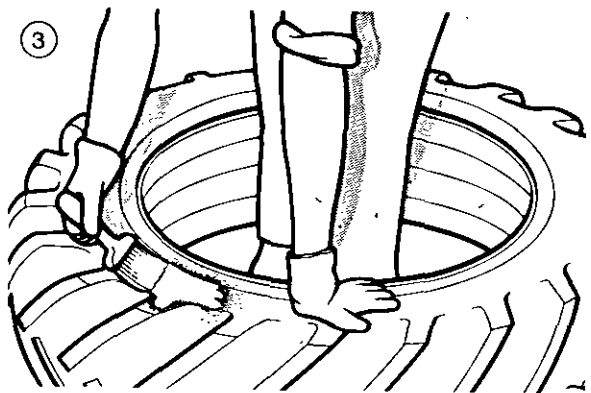
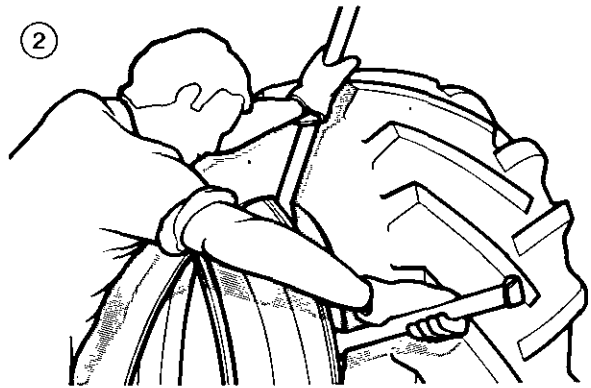
Special Tools: 'Bead-breaking' tool
3 lb Hammer
Tyre levers

Removal

1. Remove inner tube as stated in operation 7C-01-04.
2. With the wheel in a vertical position pry off the tyre taking small bites with the tyre levers. The use of rubber lubricant will help removal.

Refitment

3. Place the rim on the ground, lubricate the bead and rim and place the tyre on rim.
4. Refit the tyre to rim, using long tyre levers.
5. Refit the inner tube.

**FRONT WHEELS AND TYRES****Tyre Pressures**

The tyre pressures are shown in the Specification Section. However, if a very heavy front' end weight is fitted, such as a loader, the pressure should be raised to 2,81 to 3,09 kg/cm² (40-44 lb/in²).

Inner Tube Removal and Refitment 6B-03-04

See operation 6B-01-02

Tyre Removal and Refitment

6B-04-04

See operation 6B-02-04

WHEELS AND TYRES**FAULT FINDING CHART**

Symptom	Possible Cause	Suggested Cure
Wheelspin	Too low gear	Use the highest gear that the tractor will pull without labouring
Wheelspin due to tyres loading with soil	Tyre pressures excessive	Adjust the pressures to the manufacturer's recommended minimum
	Inadequate tyre pressures	Raise the tyre pressures to that correct for the load on the rear end of tractor
	Insufficient weight acting of the rear end of the tractor	<ol style="list-style-type: none"> 1. Fit wheel weights 2. Water ballast tyres 3. Increase 'Pressure Control' pressure if fitted 4. Try narrower section tyres
Wheelspin The tyre retains its self-cleaning action and sinks into the ground	Inadequate weight on the front end of the tractor	Fit weight frame and front-end weights
	Too narrow section tyre for the weight being carried by the rear end of the tractor	<ol style="list-style-type: none"> 1. Fit wider section tyres 2. Reduce the weight on the rear end of the tractor
	Lug-bar type tyres being used in sand	Use either grassland/sand type tyres, or heavily worn lug-bar type tyres
Tractor slews from side to side when being driven on hard ground (e.g. road)	Tyre squirms due to excessively low pressures	Raise the tyre pressures. This complaint can cause rapid tyre wall wear and consequent failure
Tyre tread worn unevenly when used for long periods on the road	<ol style="list-style-type: none"> 1. Too low pressure 2. Overloading 	Raise pressure— This complaint is indicated by wear on the leading and trailing edges of the lug-bar
Uneven tread wear	Over inflation	Adjust pressures to those recommended by tyre manufacturers. This problem is indicated by wear to the centre of the tread only
	Wheels running out of true	<ol style="list-style-type: none"> 1. Jack up the axle to relieve wheel of weight slacken and re-tighten wheel nuts 2. Check that the tyre is located accurately on the rim.
Tyre creep	Too low tyre pressure	<ol style="list-style-type: none"> 1. Increase tyre pressure 2. Check the condition of both the rim and bead and replace as necessary Certain sizes of wheel are available with knurled rims.
Split sidewall	Under-inflated tyre striking a sharp object	Minor splits are repairable. In cases of severe damage the tyre must be replaced

**MF 600 SERIES TRACTOR
WORKSHOP SERVICE MANUAL**

PART 8

Publication No. 1856 274 M1

comprising

- A HYDRAULIC SYSTEM
- B AUXILIARY HYDRAULICS
- C DRAWBAR AND LINKAGE

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HYDRAULIC SYSTEM

GENERAL

Fig. 1. The Ferguson hydraulic system comprises a four cylinder scotch yoke type pump (1) which delivers oil, through a vertical pipe (2) to the cylinder (3).

A connecting rod (4) from the cylinder piston (5) engages in the ram arm (6) which is splined on to the lift shafts (7) which carries the linkage lift arms.

When oil, under pressure from the pump, is delivered to the ram cylinder (3), the piston is forced rearwards and pushes the ram arm upwards, causing the lift shaft to rotate and raise the lift arms.

Conversely when oil is allowed out of the cylinder, the piston moves back under the load of the lift arms.

The hydraulic pump is driven by the p.t.o. drive from the p.t.o. clutch plate, via the gearbox constant mesh gears and the p.t.o. drive shaft. It is therefore rotating whenever the forward part of the p.t.o. system is being driven.

Oil flow from the pump is controlled by an integral control valve on the suction side.

The pump control valve is moved by the quadrant levers, forces down the top link, the cam on the cross shaft or the pressure control diaphragm.

The speed of movement of the valve into discharge is controlled by the response unit.

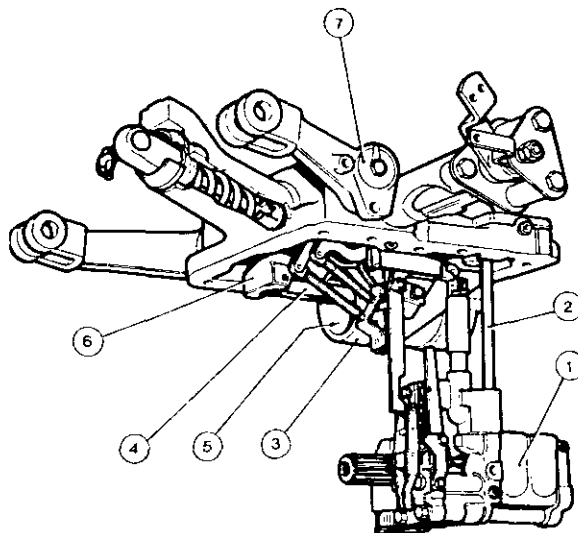


Fig.1

Hydraulic Pump (Fig. 2)

The pump consists of two piston yokes (1) which ride on cam blocks over eccentrics on a camshaft (2). The pistons, reciprocate in two opposed valve chambers (3), each housing two inlet (4) and outlet valves (5) and springs. A sealing plug and snap ring secure the valves in the chambers.

Front and rear castings incorporate the oil galleries connecting the two valve chambers, and also house the control valve (6) and the oscillator (7).

Attached to the rear casting is the Response Control and strainer housing (9) and also the Pressure Control valve (8).

Housed in the control valve is the main relief valve for the pump. There is also a secondary relief valve fitted in this unit as a precaution against a fault occurring with the main relief valve.

As each of the pump pistons moves down its cylinder it creates suction which lifts the inlet valve from its seat and draws in oil past the control valve (if open) along the intake gallery into the cylinder. During this inlet stroke the outlet valve is held closed by the spring acting on it. When the piston reaches the end of its inlet stroke, the suction ceases and the cylinder will be now full of oil and the inlet valve is closed by the inlet valve spring.

As the piston returns into the cylinder, the resultant pressure in the oil keeps the inlet valve closed and lifts the outlet valve. This pressure forces the oil past the outlet valve into the high pressure gallery and up the stand pipe to the ram cylinder.

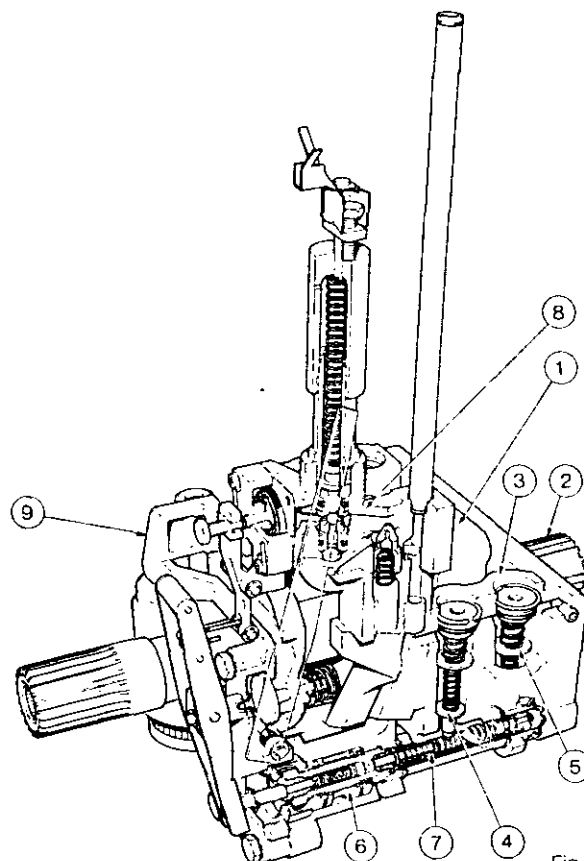


Fig.2

Pump Control Valve (Figs. 3, 4 and 5)

The control valve has intake and discharge slots at either end and is spring loaded to the intake position by the oscillator spring. The valve slides within a sleeve which has ports leading to both the intake and the pressure side of the pump.

With the valve held in the intake position (Fig. 3) by the oscillator spring, oil is drawn through the intake slots into the pump. In this position the lower links would raise.

With the valve in the neutral position (Fig. 4), both the intake and the discharge slots are outside the sleeve. In this position the lower links would be stationary.

With the valve in the discharge position (Fig. 5), the discharge slots are open allowing oil to flow from the ram cylinder back to the sump. In this position the lower links would be lowering.

Flow Control Valve (Fig. 6)

The flow from the linkage pump and auxiliary pump can be combined to give maximum flow and pressure for external hydraulic equipment. The valve is operated by a lever attached to the R.H. fender adjacent to the quadrant levers. With the lever in position 'A' combined flow is available at the spool valves, and the three point linkage hydraulics are locked in position. With the lever in position 'B' only flow from the auxiliary pump is available. The three point linkage may be operated.

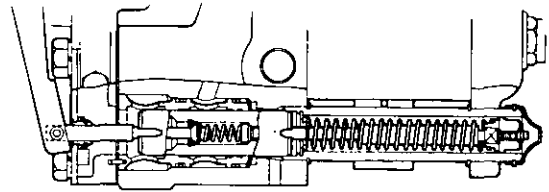


Fig.3

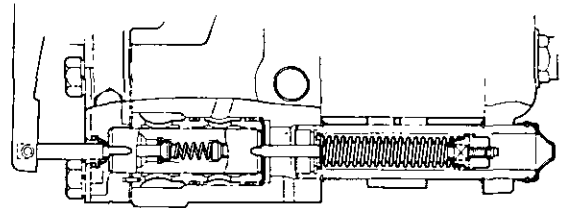


Fig.4

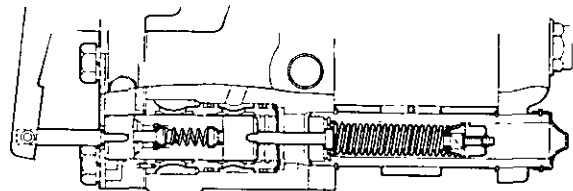


Fig.5

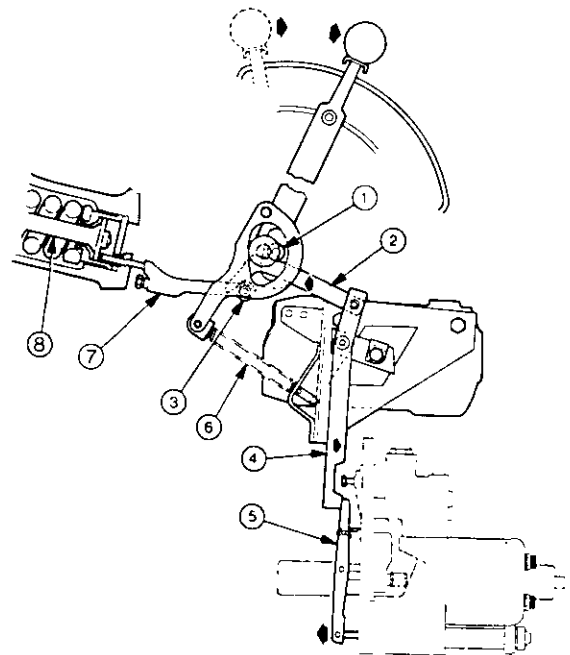


Fig. 6

HYDRAULIC SYSTEM**OPERATION****Draft Control—Implement Lowering (Fig. 7)**

To lower the implement, place the position control lever in the TRANSPORT position, and move the Draft Control lever downwards through the quadrant. This action presses the eccentric roller (1), on the end of the Draft Control lever shaft, down onto the upper cam face of the Draft Control cam (2), causing the lower face of the cam (2) to be forced downwards into contact with the roller (3) on the Draft Control linkage. The cam (2) is then moved rearwards causing the vertical lever (4) to pivot and move the pump control valve, via the lever (5), into the discharge position against the influence of the control valve spring. The Draft Control linkage will move because the force from the control valve is less than the break-out spring (6) force.

Draft Control—Tension Force in the Top Link (Fig. 7)

Variations in ground conditions will cause fluctuations in the draft force in the top link. If the draft force decreases, the compression force in the control spring decreases.

The Draft Control linkage follows the control spring plunger (8) under the influence of the spring in the guide rod (6), and moves the Draft Control link rearwards. The vertical lever (4) pivots and moves the pump control valve, via the lever (5), towards discharge. When the correct depth is obtained, the valve is restored to neutral. An increase of draft force in the top link will have an opposite effect.

Draft Control—Compression Force in the Top Link (Fig. 7)

When the control valve is in the fully discharge position, and with further downward movement of the Draft Control lever, the eccentric roller (1) acting on the upper cam face of the Draft Control cam (2), forces the lower cam face of the Draft Control cam (2) to move the roller (5) forwards. Forward movement of the roller (3) leaves a gap between the Draft Control rod (7) and the Draft Control spring plunger (8) and simultaneously compresses the spring on the guide rod.

Forward movement of the tractor will cause an implement to gain depth (as the control valve is in the discharge position), until resultant implement draft reaction compression forces, applied through the top link, deflect the control spring and cause the Draft Control spring plunger (8) to contact the Draft Control rod (7), and move the Draft Control linkage forwards. This permits the Draft Control cam (2) to move forwards, acting under the influence of the control valve spring and limited by the position of the roller (3), until the control valve reaches the neutral position.

Position Control—Implement Lowering (Fig. 8)

Downward movement of the Position Control lever causes the eccentric roller (2) to force the cam (3) downwards. The breakout spring pushes the Position Control link (1) to maintain contact between the roller (8) and the eccentric cam on the cross shaft (9), and the front roller (6) moves the cam (3) rearwards, causing the vertical lever (4) to pivot and move the pump control valve, via the lever (5) into the discharge position.

Position Control—Implement Raising (Fig. 9)

Release of oil from the ram cylinder allows the eccentric cam on the cross shaft (5) to rotate and force the rear roller (4), mounted on the Position Control link (1), forward. This action allows the pump control valve spring to move the Position Control cam (2), which is in contact with the front roller (3), forward, until the control valve reaches the neutral position, which has been determined by the Position Control lever.

For every position that the Position Control lever is moved to, there is a position where the cam moves the control valve to neutral.

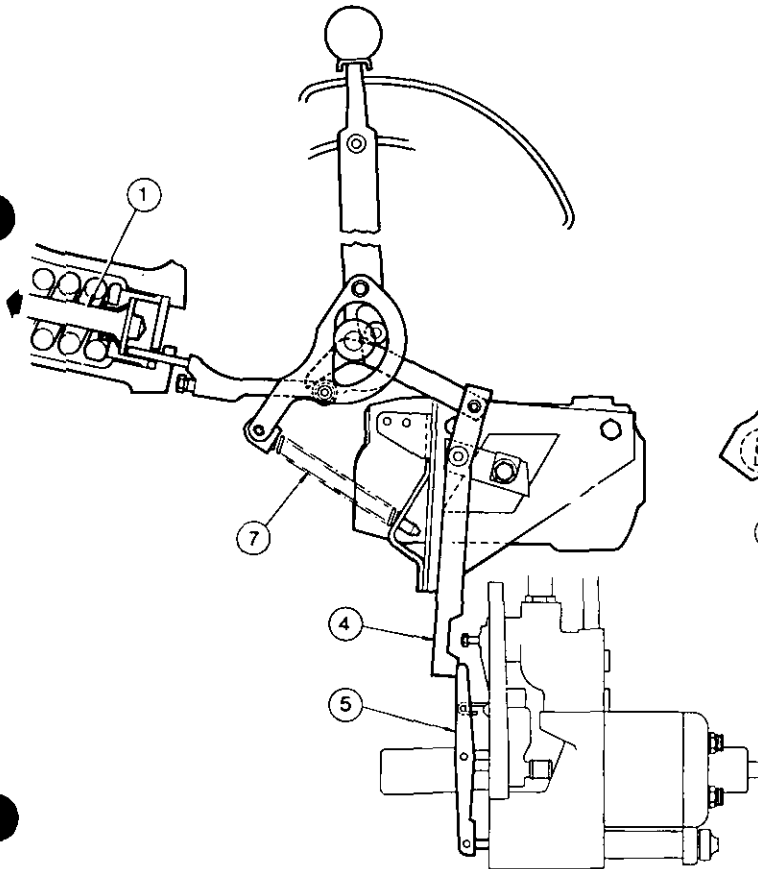


Fig. 8

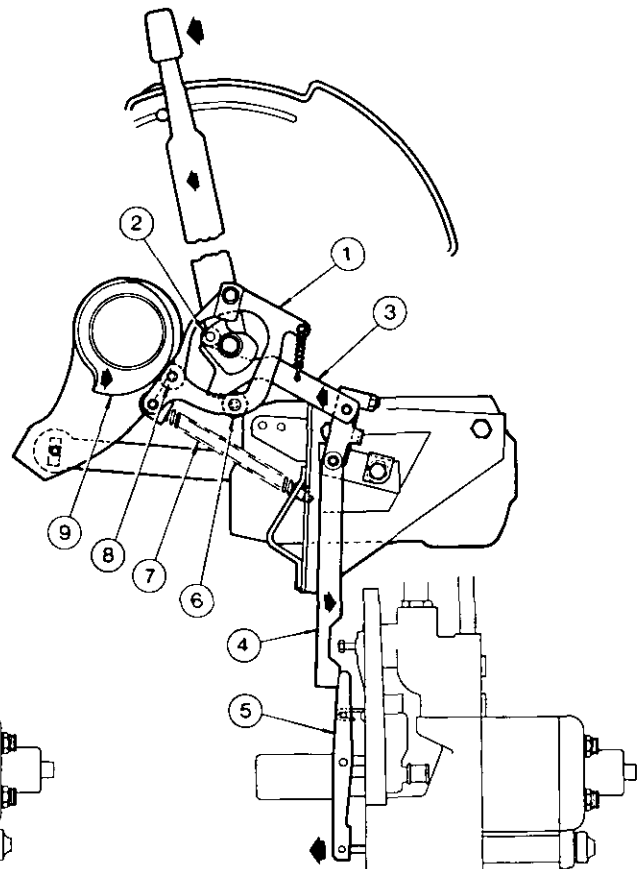


Fig. 9

HYDRAULIC SYSTEM

Response Control (Fig. 10)

Response Control, incorporated in the pump, regulates the speed that the control valve moves to the discharge position, and therefore can control the initial rate of flow from the cam cylinder and speed of drop of an implement.

Movement of the Response Control switch actuates an internal slide valve (1), which varies the size of an orifice (2), in the intake gallery, from which oil can escape. When the control valve moves to the discharge position, oil has to be displaced from the intake gallery. The oil is prevented from returning through the strainer by a non-return valve (3), therefore it passes through the outlet gallery orifice (2). The slide valve (1) controls the size of the orifice and therefore the speed of movement of the control valve.

Pressure Control (Fig. 11)

The relief valve for the hydraulic circuit is the Pressure Control valve. The valve consists of a main Pressure Control valve, a low pressure relief valve and a diaphragm actuator with a lever system connecting it to the pump control valve. The main Pressure Control valve comprises a ball valve which is loaded onto its seat by a spring. The Compression of the spring is regulated by the Pressure Control lever.

When the Pressure Control lever is moved to its lowest position on the quadrant, the roller (1) on the internal lever (3) moves to the lowest position on the cam (2), allowing the lever (3) to exert minimum pressure on the spring (4).

Pump pressure is fed to underside of the ball valve (5) and when the pressure acting on the ball valve exceeds the selected spring load, the ball lifts off its seat, allowing a flow to the chamber (6). As the pressure builds up the diaphragm (7) deflects, extending the plunger, which in the linkage (9) pushes the pump control valve lever (8) and the control valve to a reduced flow situation.

A relief valve (10) maintains a safe pressure at the diaphragm.

As the lever is moved towards the high pressure position, the load on the spring increases. Oil on the diaphragm escapes through the bleed hole (11) and the diaphragm (7) allows the control valve to move to the full intake position. When the desired increase in pressure is achieved, oil enters the diaphragm which moves the control valve to a reduced flow situation.

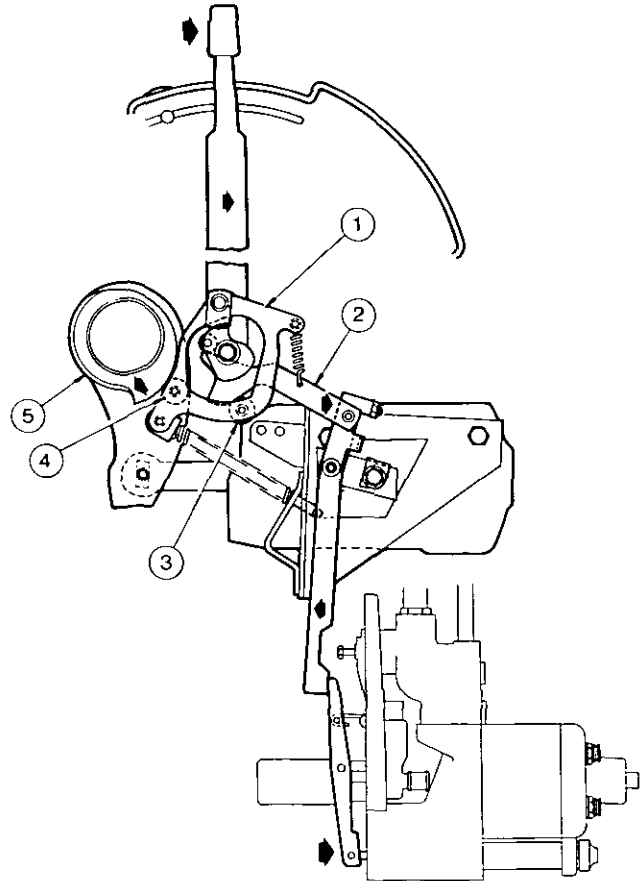


Fig.10

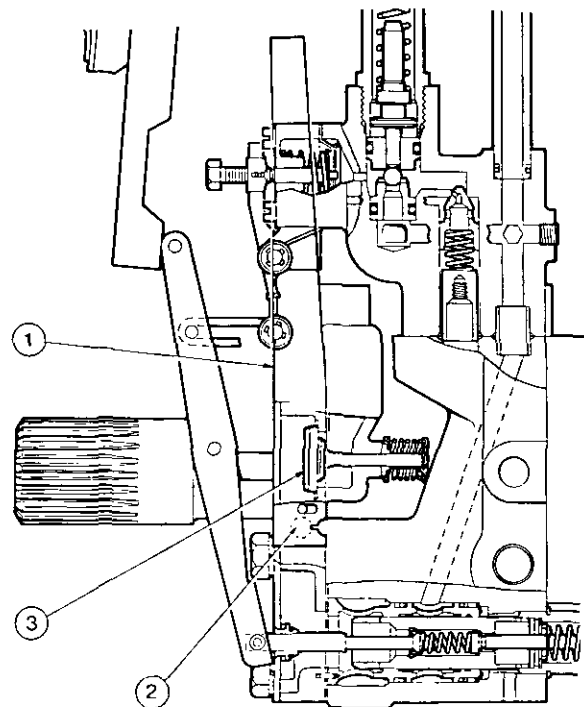


Fig.11

CONTROL SPRING ASSEMBLY**Removal and Refitment**

8A-01-07

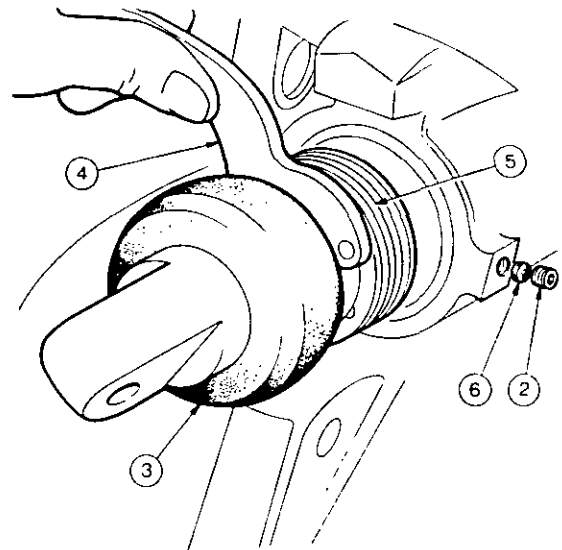
Special Tools: MF 163 Wrench

Removal

1. Remove the control beam.
2. Remove the Allen screw.
3. Pull back the rubber boot.
4. Using MF 163, unscrew the retainer from the lift cover.
5. Withdraw the control spring assembly from the lift cover.
6. Remove and discard the nylon plug.

Refitment

7. Reverse procedures 1 to 6, except:
 - (a) With the Draft Control lever in the fully DOWN position, tighten the retainer, until the end float is eliminated. Do not over-tighten otherwise the end float will re-appear.
 - (b) Fit a new nylon plug.
 - (c) Tighten the Allen screw to a torque of 7Nm (5lbf ft).

**CONTROL SPRING ASSEMBLY****Servicing**

8A-02-07

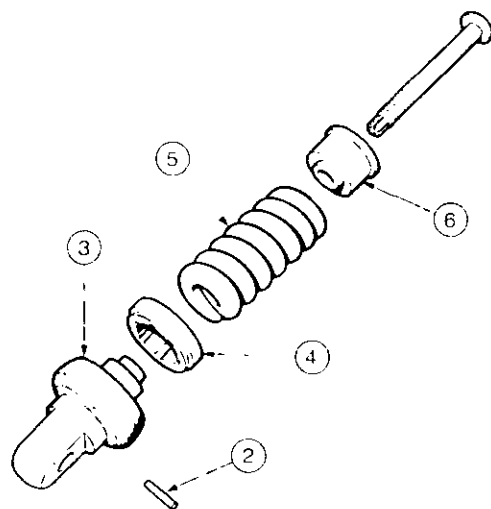
Special Tools: MF 163 Wrench

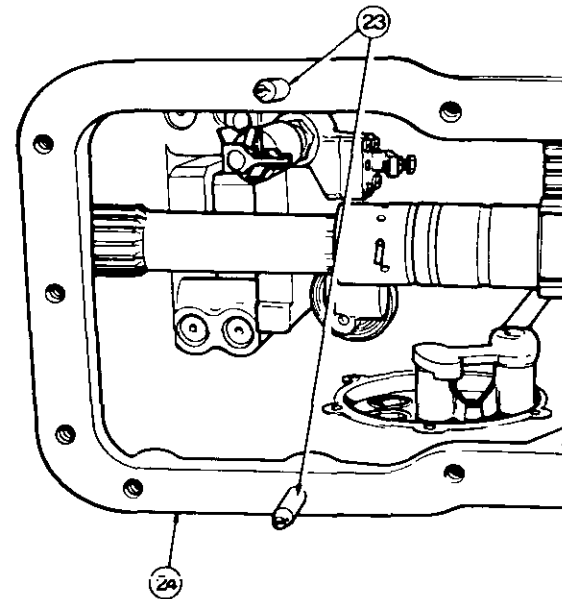
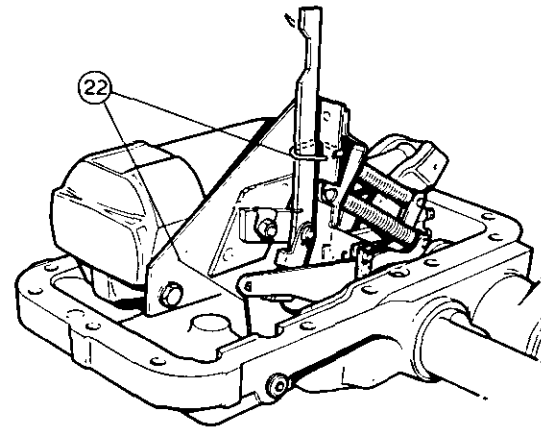
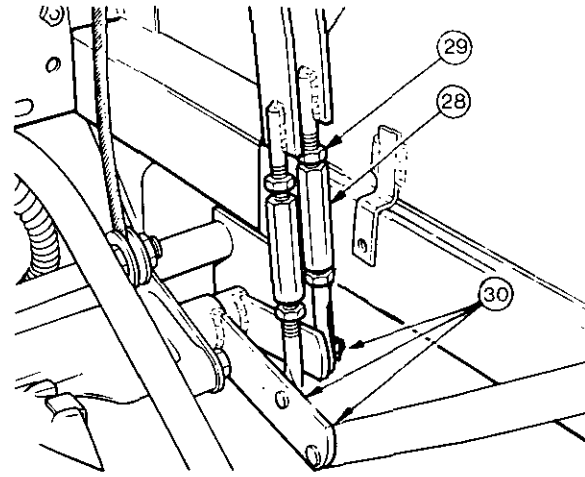
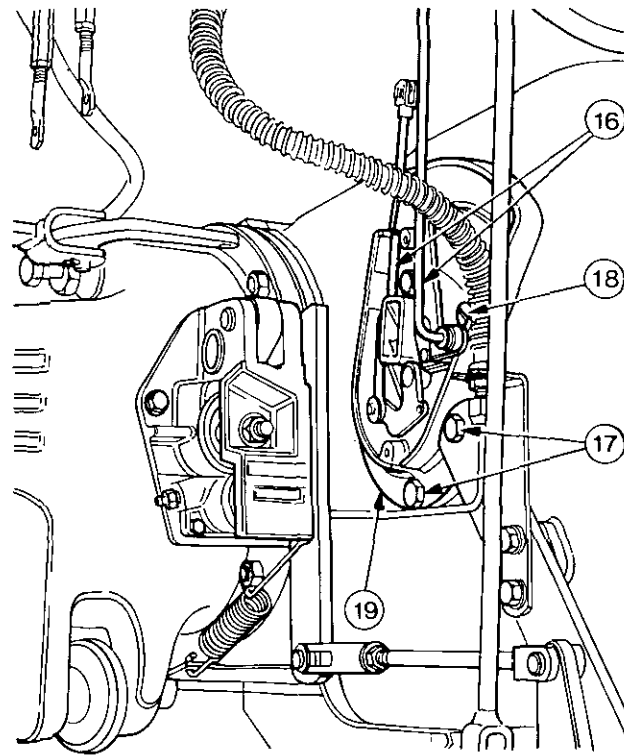
Disassembly

1. Remove the control spring assembly, operation 8A-01-07.
2. Drive out the pin.
3. Unscrew the head.
4. Remove the retainer.
5. Remove the spring.
6. Remove the spring seat.

Reassembly

7. Reverse procedures 1 to 6, except:
 - (a) Screw the plunger into the head until the end float is eliminated and the spring is tight to turn by hand.





HYDRAULIC LIFT COVER

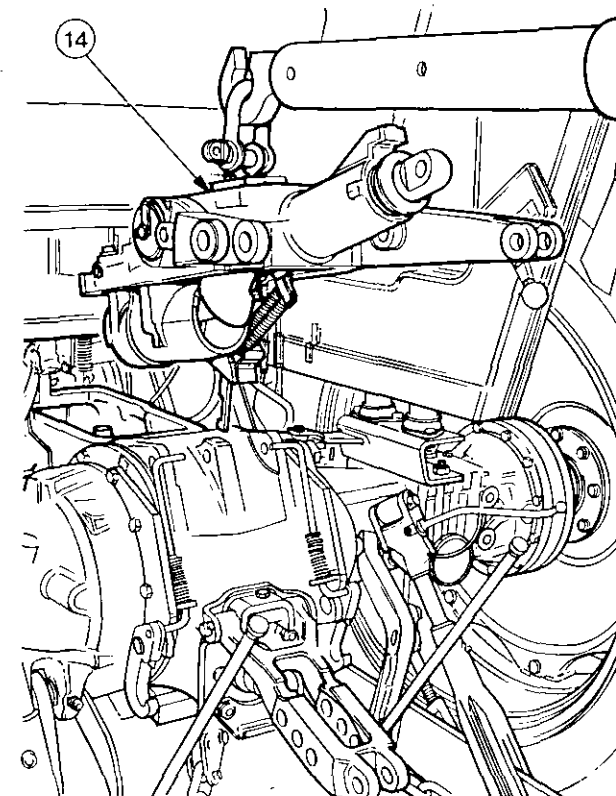
Removal and Refitment

8A-03-09

Special Tools: MF 148A Pressure Test Kit
 MF 163 Wrench
 MF 166 Adaptor
 MF 418 Lift Cover Remover and Replacer
 MF 272 Ram Arm Fixture
 MF 273 Hydraulic Setting Fixture
 MF 333 Draft Control Rod Gauge
 MF 356 Position and Draft Control Setting Gauge
 MF 357 Screwdriver Adjuster
 MF 359 Pressure Control Bleed Pipe
 MF 417 Quadrant Lever Retainer Tool
 1,4 kg (3 lb) weight

Removal

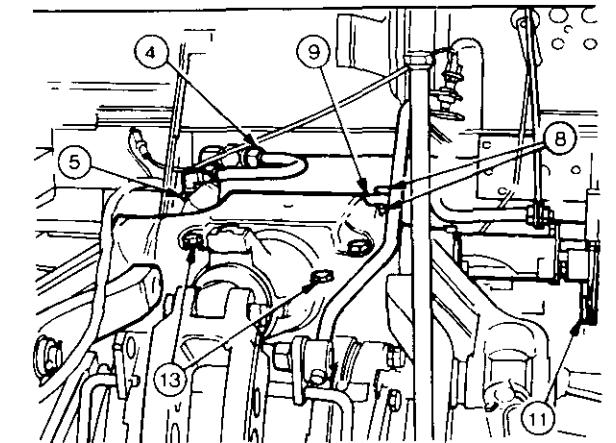
1. Remove the cab rear filler panel, operation 2A-17-10.
 2. Disconnect the lift rods from lift arms.
 3. Remove the control beam.
- Tractors fitted with an auxiliary pump, carry out procedures 4, 5, and 6.
4. Disconnect the 'U' pipe or the two hoses (tractors with spool valves) at the unions and remove the pipe or place the hoses clear of the lift cover.
 5. Remove the bracket securing the two pipes.
 6. Place the hoses and the rear panel (tractors with spool valves) clear of the lift cover.
 7. Place the Draft Control lever in the fully DOWN position.
 8. Remove the two bolts and washers.
 9. Remove the cap and the stand pipe, or auxiliary control valve if fitted.
 10. Place the Draft Control lever in the fully UP position and the Position Control lever in the TRANSPORT position.
 11. Disconnect the three rods at the quadrant support tube.



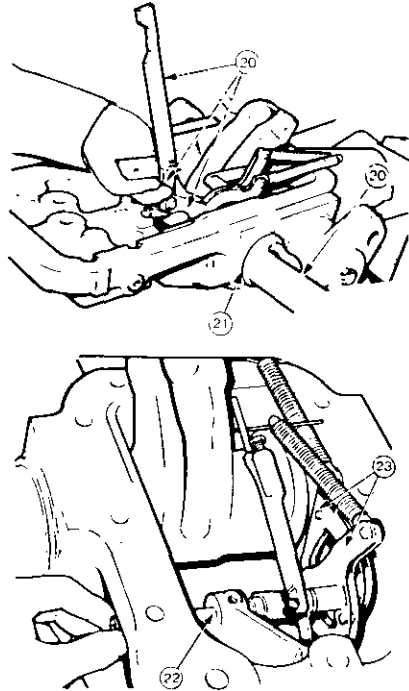
12. Disconnect the auxiliary pump control valve lever cable from the lever.
13. Remove the lift cover bolts.
14. Using the two removed bolts secure MF 418 to the top of the lift cover, using a portable swan neck crane linked to the eyebolt, carefully hoist the lift cover vertically and pull the crane rearwards.
15. Drain the oil to the LOW mark on the dipstick.
16. Disconnect the rods at the Response Control side cover.
17. Remove the five bolts.
18. Remove the screw.
19. Remove the side cover.
20. Remove and discard the side cover gasket.

Refitment

21. Carry out the external adjustments, operation 8A-11-13.
22. Using suitable pieces of wire retain the vertical lever and Pressure Control link.
23. Fit 2 guide studs.
24. Clean surfaces of centre housing and lift out and coat with recommended sealant.
25. Reverse procedures 13 and 14 except:
 - (a) Take care, when refitting the lift cover, that the vertical lever does not foul any internal components.
 - (b) Remove the two guide studs.
 - (c) Tighten the lift cover bolts to a torque of 88 Nm (65 lbf ft).
26. Place the Draft Control lever between the sector marks on the quadrant.
27. Place the Position Control lever in the TRANSPORT position.
28. Set the lengths of the rods, by adjusting the turnbuckles, so that the rods locate on the lever pivot pins.
29. Tighten the rod locknuts.
30. Connect the remote response lever rod and fit spring clip on each of the three lever pivot pins.
31. Reverse procedures 2 to 12. Carry out the internal adjustments, operation 8A-12-15.



HYDRAULIC SYSTEM



RAM CYLINDER

Servicing 8A-05-10

Special Tools: See Operation 8A-03-09
also MF 419
Also Guide MF 419/1
Sizing Ring MF 419/2

Disassembly

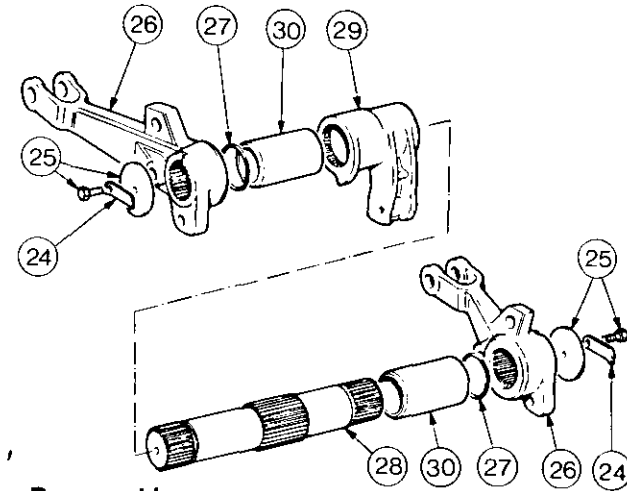
1. Remove the ram cylinder, operation 8A-04-09 procedures 1 to 14.
2. Remove the two bolts.
3. Remove the support bracket.
4. Withdraw the piston from the cylinder.
5. Remove the piston seals if necessary.

Examination

Examine all components for wear or damage replacing any defective components.

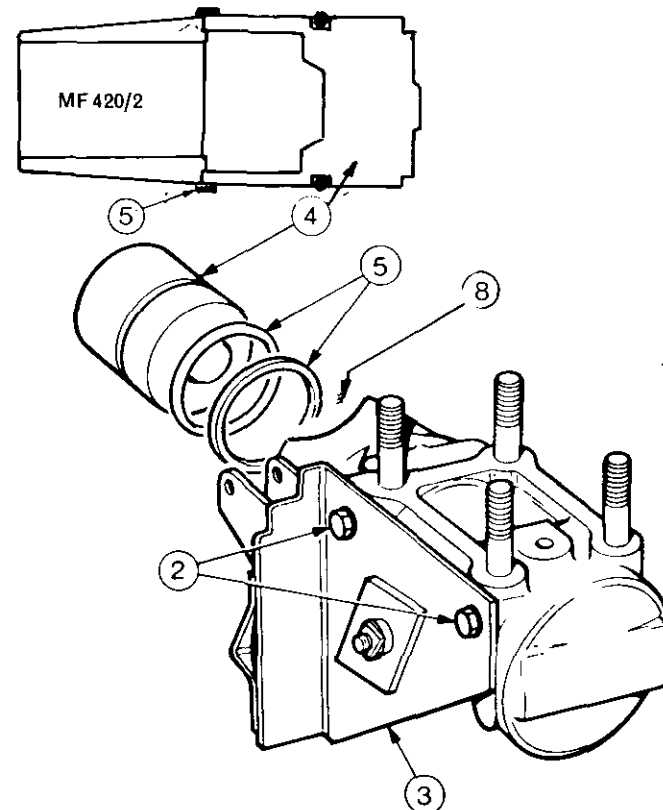
Reassembly

6. If piston seals have been removed apply mineral oil to 'O' ring part of seal and fit into the piston groove.
7. Lubricate the outside of the guide MF 419/1 with mineral oil. Place the guide on a firm flat surface. Locate the P.T.F.E. seal onto the guide using the narrow bore end of the sizing ring MF 419/2, carefully push the seal down the taper of the guide until it protrudes beyond the end. Locate the lip of the seal onto the piston at the open end, using the sizing ring, push the seal off the guide onto the piston and into the groove on top of the 'O' ring.
8. Ensure that the mouth of the cylinder is chamfered adequately to accept the P.T.F.E. seal, paying particular attention to the edge around the relieved portion.
9. Push the piston into the wide bore end of the sizing ring, push it through until it protrudes approximately 12 mm (0.5 in) from the end of the ring.
10. Lubricate the bore of the cylinder with mineral oil, locate the protruding portion of the piston in the mouth of the cylinder bore. Push the piston through the sizing ring and into the cylinder.
11. Reverse procedures 1 to 3.



Reassembly

31. Reverse procedures 1 to 35, except:
 - (a) Fit new bushes if necessary.
 - (b) Fit new 'O' rings and tabwashers.
 - (c) Align the master spline when refitting the shaft and the two lift arms.
 - (d) Fit the Belleville washer with the concave side towards the lift cover.
 - (e) Ensure that the pivot shaft is fully located against the side of the lift cover before tightening the Allen screw.
 - (f) When refitting the connecting rod Allen screw, apply a drop of recommended sealant 'C' to the threads, and screw the Allen screw into the ram arm until the screw bottoms on the annular groove in the connecting rod, then back it off 1/2 turn.
 - (g) When refitting the ram cylinder, locate the connecting rod in the piston and the two rods in the holes in the bracket.
 - (h) Tighten the ram cylinder retaining nuts to a torque of 160 Nm (120 lbf ft).

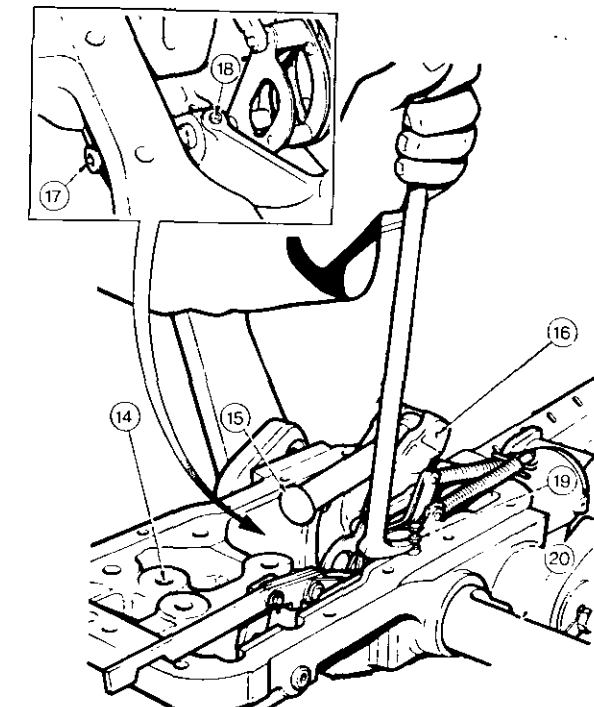
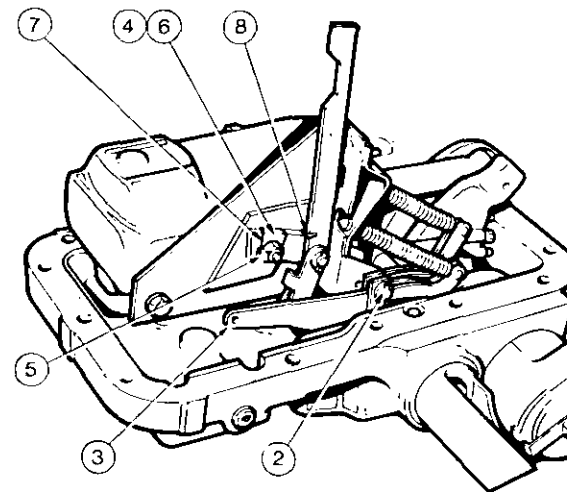
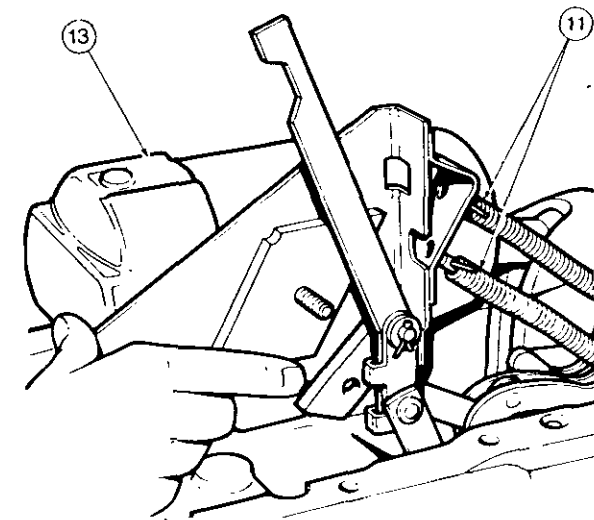
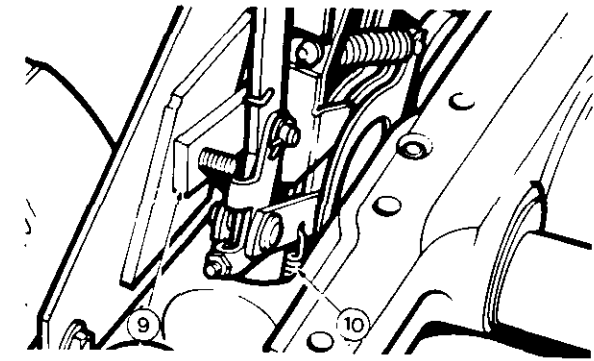


HYDRAULIC LIFT COVER

Servicing 8A-04-10
Special Tools: See Operation 8A-03-09

Disassembly

1. Remove the lift cover, operation 8A-03-09.
2. Remove the split pin and washer.
3. Remove the link.
4. Remove the tabwasher.
5. Remove the nut.
6. Remove the tabwasher.
7. Remove the spacer.
8. Release the spring.
9. Release the slide pivot from the bolt.
10. Remove the spring.
11. Fit a pair of pins to retain the springs.
12. Remove the four nuts securing the ram cylinder to the lift cover.
13. Lift off the ram cylinder.
14. Remove and discard the 'O' ring.
15. Remove the connecting rod.
16. Remove the Allen screw.
17. Remove the Allen plug.
18. Remove the screw.
19. Screw a No. 12 32 UNF bolt into the pin and remove the pin.
20. Withdraw the quadrant control support assembly, simultaneously lifting out the vertical lever and the cams.
21. Remove the Belleville washer.
22. Withdraw the pivot shaft.
23. Lift out the links.
24. Release the tabwashers.
25. Remove the bolts and washers.
26. Slide off the lift arms.
27. Remove and discard the 'O' rings.
28. Drive the lift shaft out of the lift cover.
29. Remove the ram arm.
30. Remove the two bushes.



HYDRAULIC LINKAGE**Removal and Replacement** 8A-06-11

Special Tools: See Operation 8A-03-09

Removal

1. Remove the linkage, operation 8A-04-10 procedures 1 to 14 and 17 to 23.

Refitment

2. Reverse procedure 1.

QUADRANT CONTROL SUPPORT**ASSEMBLY****Removal and Refitment** 8A-07-11

Special Tools: See Operation 8A-03-09

Removal

1. Remove the quadrant control support assembly, operation 8A-04-10 procedures 1 to 14 and 19 to 21.

Refitment

2. Reverse procedure 1.

QUADRANT CONTROL SUPPORT ASSEMBLY**Servicing** 8A-08-11

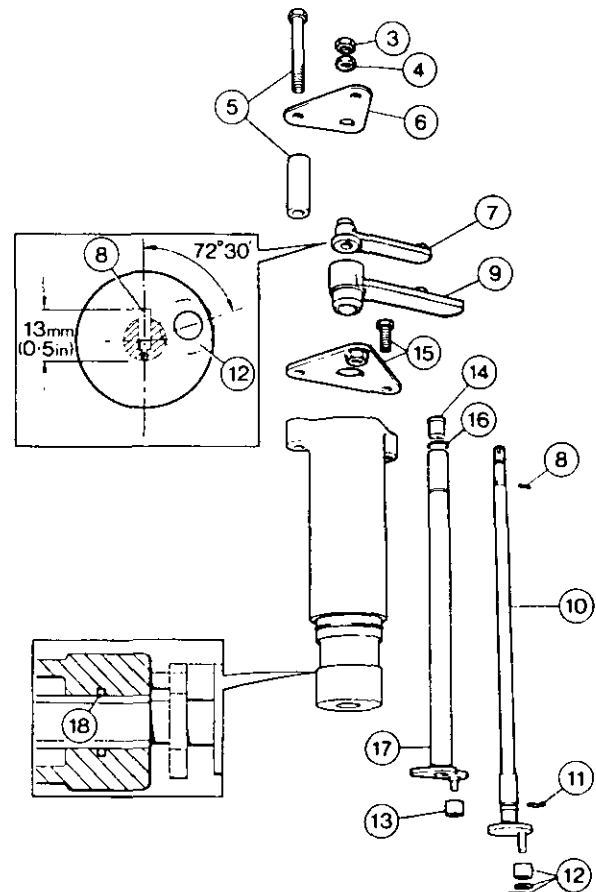
Special Tools: See Operation 8A-03-09

Disassembly

1. Remove the quadrant control support assembly, operation 8A-07-11.
2. Align the two rollers and scribe a line across the Draft and Position Control levers.
3. Remove the locknut.
4. Remove the nut.
5. Remove the two bolts and spacers.
6. Remove the plate.
7. Remove the Draft Control lever.
8. Drive out and discard the pin.
9. Remove the Position Control lever.
10. Withdraw the Draft Control Shaft.
11. Remove and discard the 'O' ring.
12. If necessary, remove the split pin, washer and roller.
13. Remove the roller.
14. Remove the bush.
15. Remove the bolt and the plate.
16. Remove the retaining ring.
17. Withdraw the Position Control Shaft.
18. Remove and discard the 'O' rings.

Reassembly

19. Reverse procedures 1 to 18, except:
 - (a) Fit the 'O' rings, split pin, pin and retaining ring.
 - (b) Do not overtighten the Draft Control shaft nut, as the roller will not turn freely.



HYDRAULIC SYSTEM**HYDRAULIC QUADRANT ASSEMBLY****Removal and Refitment**

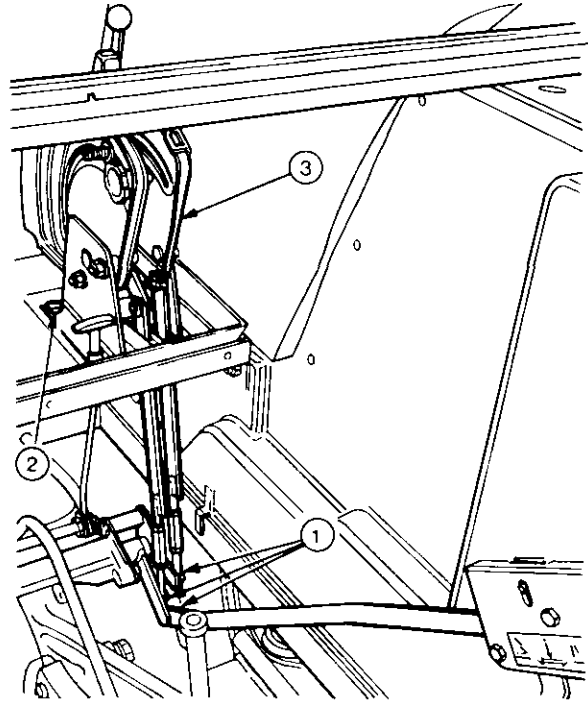
8A—09—12

Removal

1. Disconnect the three rods at the cross shaft levers.
2. Remove the four bolts securing quadrant to cab floor.
3. Remove the hydraulic quadrant assembly.

Refitment

4. Reverse procedures 2 and 3.
5. Re-connect the three rods and adjust lengths if necessary as described in operation 8A—03—09 procedures 26 to 30.
6. Carry out the internal adjustments, operation 8A—12—16.

**HYDRAULIC QUADRANT ASSEMBLY****Servicing**

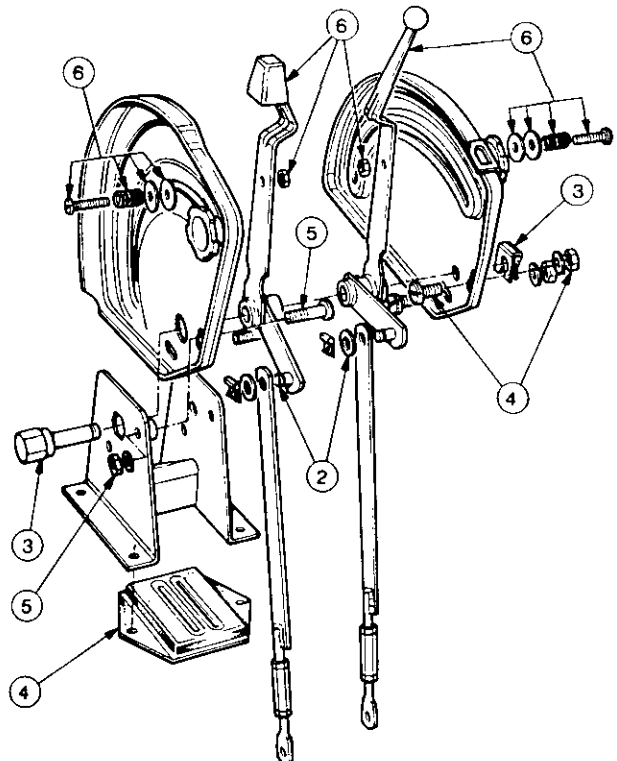
8A—10—12

Disassembly

1. Remove the hydraulic quadrant assembly, operation 8A—09—12.
2. Disconnect the two links from the quadrant.
3. Remove clip and lever pivot pin.
4. Remove the two bolts, washers and nuts securing the draft control quadrant to the base.
5. Remove the two bolts washers and nuts securing the pressure control quadrant to the base.
6. Remove the screws, springs, washers and nuts from the 'draft' and 'pressure' control arms and separate.

Reassembly

7. Reverse procedures 1 to 6 clamping the quadrants in the middle of their slots.



HYDRAULIC ADJUSTMENTS

External Adjustments

8A-11-13

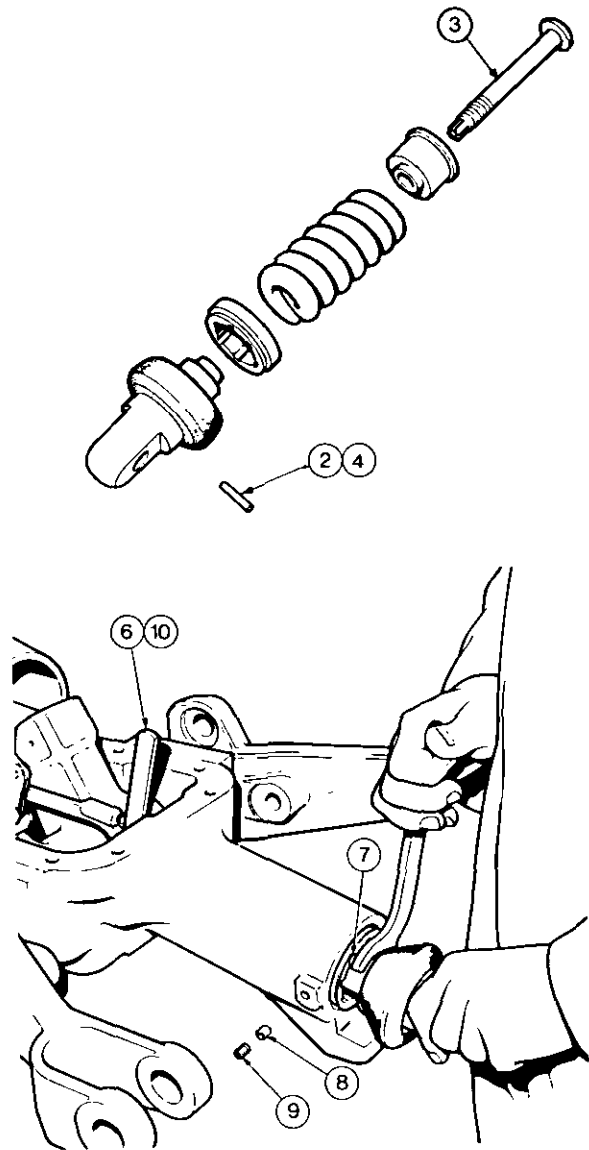
Special Tools: See Operation 8A-03-09

Procedure

1. Remove the lift cover, operation 8A-03-09

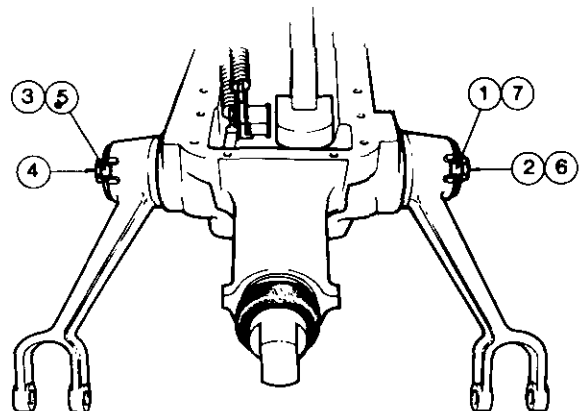
Control Spring Internal and External End Float

1. Remove the control spring assembly, operation 8A-01-07 procedures 2 to 6.
2. Drive out the pin.
3. Screw the plunger into the head until all the end float is eliminated and the spring is tight to turn by hand.
4. Fit a new pin.
5. Slide the control spring assembly into the lift cover.
6. Using a suitable wedge, ensure that the draft rod is not touching the control spring plunger.
7. Using MF 163, tighten the retainer until all the end float is eliminated. Do not overtighten the retainer otherwise the end float will reappear.
8. Fit a new nylon plug.
9. Tighten the Allen screw to a torque of 7 Nm (5 lbf ft).
10. Remove the wedge.



Lift Arm End float

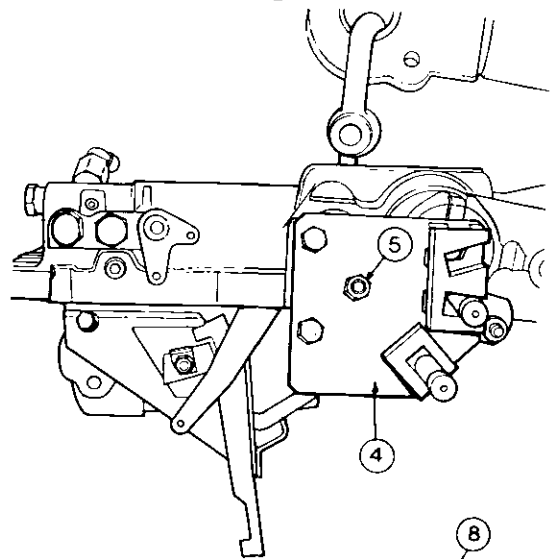
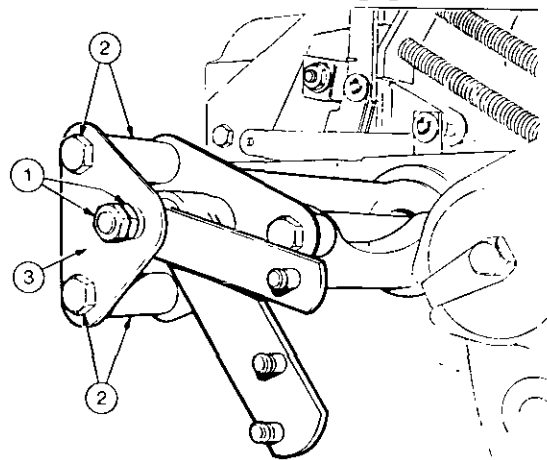
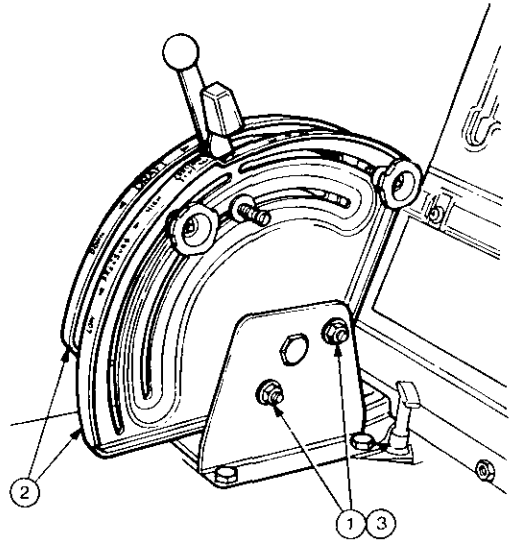
1. Release the tabwasher.
2. Slacken the bolt.
3. Release the tabwasher.
4. Fully tighten the bolt.
5. Secure the bolt with the tabwasher.
6. Tighten the bolt, until the lift arms will move freely throughout their range. but without any end float.
7. Secure the bolt with the tabwasher.



HYDRAULIC SYSTEM

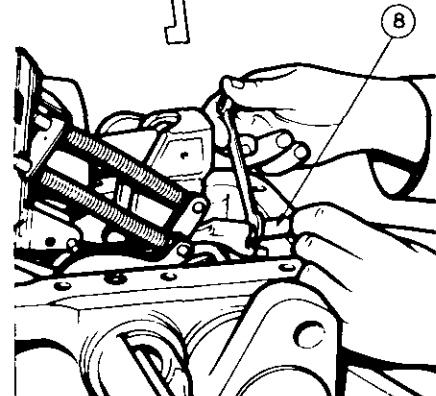
Quadrant Location

1. Slacken the two nuts on each of the two quadrants.
2. Locate the two quadrants in the centre of the elongated holes.
3. Tighten the four nuts.



Draft Control Rod

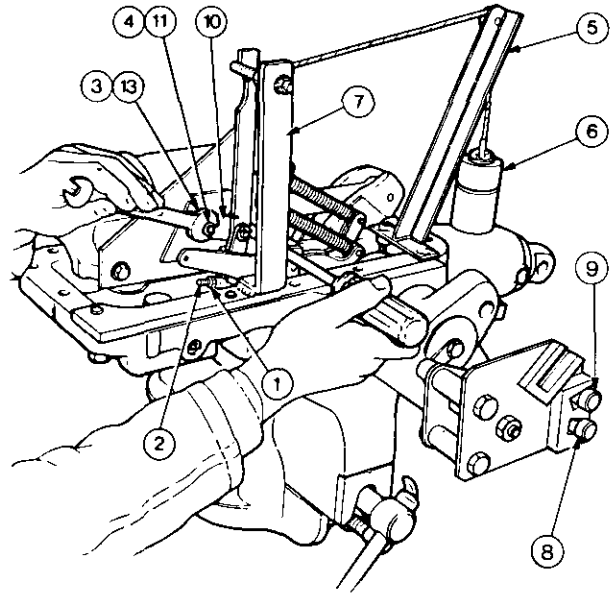
1. Remove the locknut and the nut
2. Remove the two bolts and the spacers.
3. Remove the plate.
4. Fit MF 417 to the quadrant control support assembly.
5. Refit and tighten the nut.
6. Place the 'Draft Control lever' in the 'up' position and secure it with the pin.
7. Place the 'Position Control lever' in the 'transport' position and secure it with the other pin.
8. Using MF 333, adjust the set screw to give a clearance of 5,8 mm (0.230 in) between the setscrew and the lift cover casting.



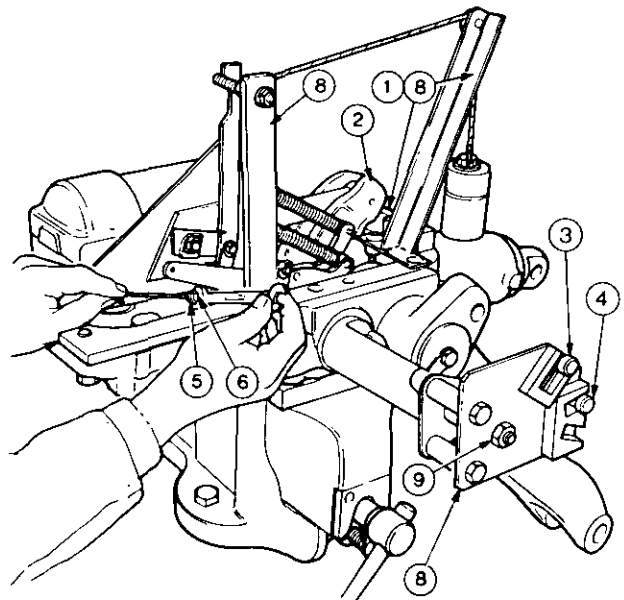
HYDRAULIC SYSTEM

Draft Control

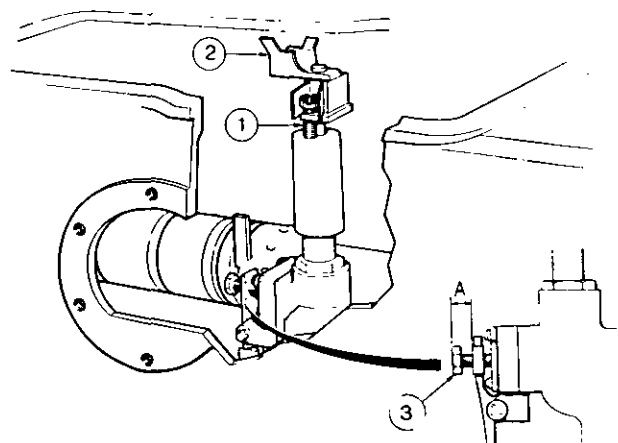
1. Slacken the locknut.
2. Unscrew the Allen screw to the end of its thread.
3. Release the tabwasher.
4. Slacken the nut.
5. Position MF 273 on the lift cover.
6. Apply a load of 1,4 kg (3 lb) to the end of the vertical lever.
7. Locate MF 356 on the lift cover.
8. Place the 'Draft Control lever' in the 'sector' position and secure it with the pin.
9. Place the 'Position Control lever' in the 'transport' position and secure it with the other pin.
10. Adjust the slide pivot, until the vertical lever just touches the pin on MF 356.
11. Tighten the nut.
12. Recheck the setting.
13. Secure the nut with the tabwasher.

**Position Control**

1. Position MF 272 on the lift cover.
2. Locate the ram arm on MF 272.
3. Place the 'Draft Control lever' in the 'up' position and secure it with the pin.
4. Place the 'Position Control lever' in the 'transport' position and secure it with other pin.
5. Adjust the Allen screw until the vertical lever just contacts the pin on MF 356.
6. Tighten the locknut.
7. Recheck the setting.
8. Remove MF 272, MF 273, MF 356 and MF
9. Refit the nut to retain the lever. DO NOT fit the plate, spacers and bolts at this stage.

**Pressure Control**

1. Set the setscrew in the middle of its travel.
2. Set the butterfly adjuster as shown, rearwards.
3. Set the setscrew to 14 mm (0.56 in) at 'A'.
4. Refit the lift cover, operation 8A-03-08.

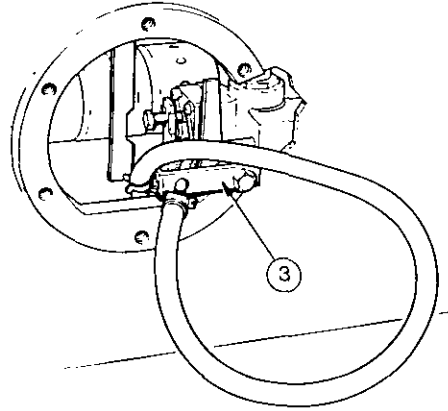


HYDRAULIC SYSTEM**HYDRAULIC ADJUSTMENTS****Internal Adjustments** 8A—12—16

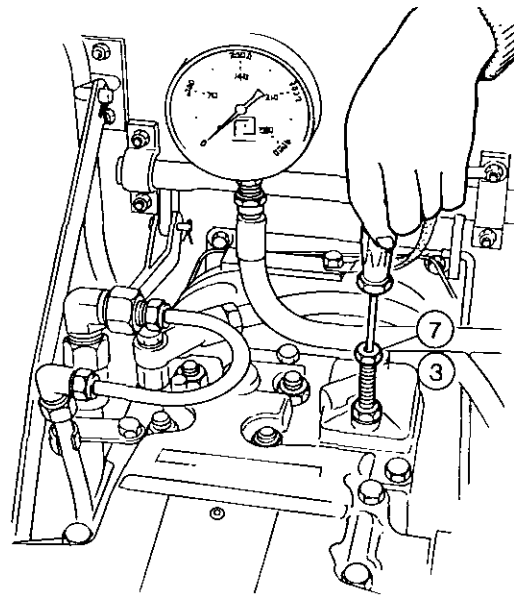
Special Tools: MF 148A Pressure Test Kit
 MF 166 Adaptor
 MF 357 Screwdriver Adjuster
 MF 359 Pressure Control Bleed Pipe

Preparation for Internal Adjustments

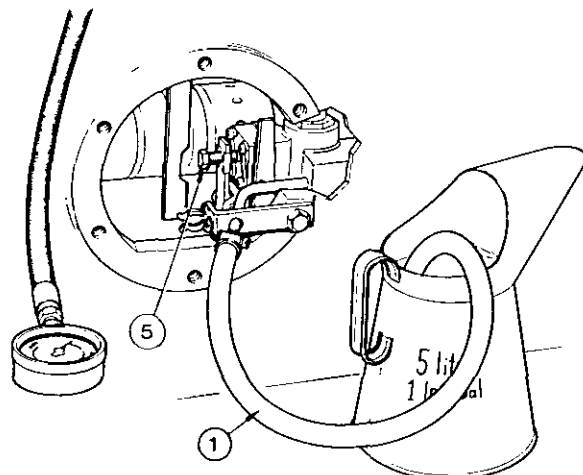
1. After ensuring that the oil level is to the bottom mark on the dipstick, remove the side cover, operation 8A—03—08, procedures 15 to 20.
2. Locate MF 359, in the Pressure Control valve body and place the other end in the side cover aperture.
3. Attach a weight of 400 kg (900 lb) to the lower links.
4. Place the Draft Control lever in the fully DOWN position.
5. Connect MF 148A and MF 166 to the tapped port in the lift cover.
6. Place the Draft Control lever in the fully UP position.
7. Start the engine and set the engine speed at 'tick-over', then operate the Position Control lever through the quadrant range to expel all the air from the system.
8. Warm up the oil in the transmission to a temperature of 50 to 70°C (120 to 160°F) and then stop the engine.

**Pressure Control Maximum Setting**

1. Place the Draft Control lever in the fully DOWN position.
2. Remove the bolt and washer.
3. Fit MF 356 to the stand pipe cap.
4. Start the engine, and set the engine speed at 1200 rev/min.
5. Place the Draft Control lever in the fully UP position.
6. Place the Position Control lever in the CONSTANT PUMPING position.
7. Using MF 357, adjust the screw to give a pressure on the gauge of:
 - MF 675, 690, 698 Tractors— 21 to 22 N/mm²
(3 100 to 3 250 lbf in²)
8. Fully lower the links and stop the engine.
9. Remove MF 357.
10. Remove the washer and bolt.

**Pressure Control Final Adjustment**

1. Remove the tube of MF 359, from the side cover aperture and place it in a five litre (one gallon) container.
2. Start the engine, and set the engine speed at 1200 rev/min.
3. Place the Draft Control lever in the fully UP position.
4. Place the Position Control lever in the CONSTANT PUMPING position.
5. Adjust the setscrew until a flow of 5 litre/40s (1 Imp. gal/35s) is obtained.
6. Stop the engine, and place the tube of MF 359 in the side cover aperture.



AUXILIARY PUMP-AIR EQUIPMENT (ALTERNATIVE)

Servicing

8B-09-09

Disassembly

1. Remove the Auxiliary pump, operation 8B-05-02.
2. Remove the four securing bolts and remove the end cover.

NOTE: The bolts are of varying length. Two are 85 mm ($3\frac{1}{2}$ in) long and the remainder 80 mm ($3\frac{3}{4}$ in) long.

3. Remove the 'O' ring.
4. Withdraw the centre body complete with gear wheels.
5. Remove the gear wheels from the body.
6. Remove the two 'O' ring seals.
7. Remove the centre body bearings together as follows; using a plastic mallet shock the centre body using a number of sharp blows to release their fit in the bores. Then very gently using THE FINGERS ONLY press out the bearings. If an even pressure is applied, the bearings will move easily without using excessive force. Under no circumstances should a drift and hammer be used to drive out the bearings.

NOTE: If the bearings are to be refitted identify the bores from which they were removed.

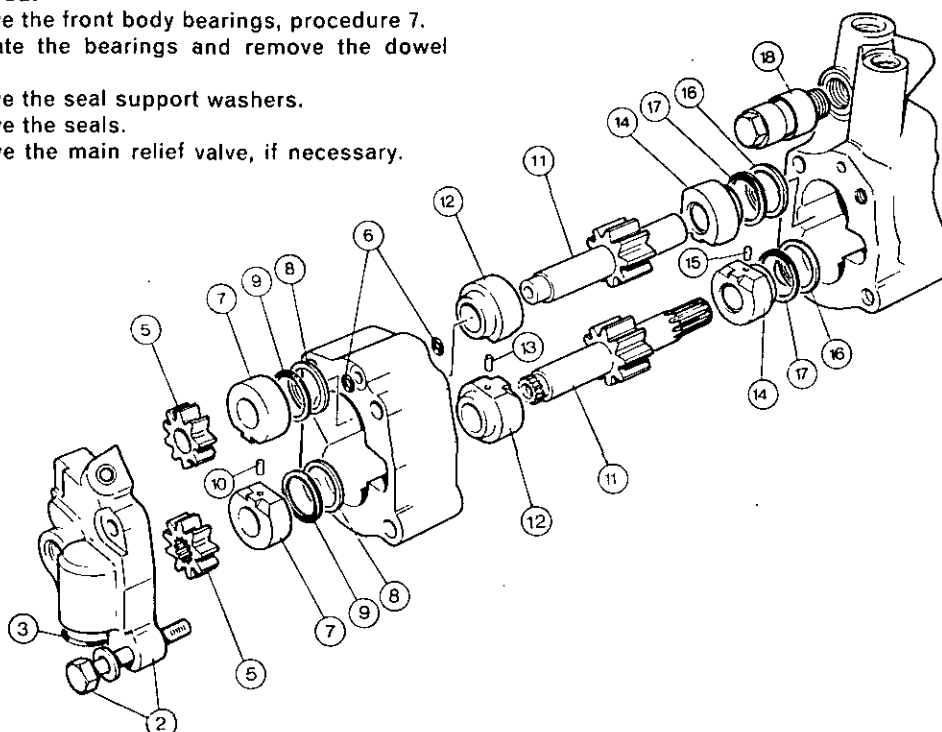
8. Remove the seal support washers.
9. Remove the seals.

WARNING: Take care not to damage the bearings when removing the seals as the material is very soft.

10. Separate the centre body bearings and remove the dowel pin.
11. Withdraw both shafts complete with the centre bearings from the front body. DO NOT use force or a hammer and drift to remove the shafts.
12. Remove the centre bearings from the shafts.
13. Separate the bearings and remove the dowel pin.

NOTE: If the bearings are to be refitted identify the bores from which they were removed.

14. Remove the front body bearings, procedure 7.
15. Separate the bearings and remove the dowel pin.
16. Remove the seal support washers.
17. Remove the seals.
18. Remove the main relief valve, if necessary.



Examination

Bearings

Examine the bearings for wear on their faces and in their bores. During a major overhaul the bearings should be renewed, but if not badly worn they can be salvaged as follows:

Place a sheet of 'O' grade emery paper, lubricated with paraffin on a true flat surface (e.g., a surface plate, or plate glass), then polish the bearing face, using a light rotary motion.

Bodies

Inspect the front and centre bodies for external damage and cracks. Examine the bores for wear and damage. The gears will always cut a light track on the inlet side of the body bores. The depth of this track must not exceed 0,005 mm (0.002 in). The depth of the track can be very difficult to measure with such accuracy. If in doubt replace the body.

Gears

Examine the gears for scored or worn faces or journals, damaged teeth and surface cracks. Always fit replacement gears as a pair and never individually. Under working conditions, hydraulic pressure within the pump loads the gears towards the inlet side of the body, thus cutting the running track. If the bearings or gear journals wear, the gears move over and deepen the running track. Therefore if the running track is worn past or to the limit for re-use, the fitting of new bearings may not improve the pump efficiency, as the new bearings will retain the gears and prevent them from bottoming in the running track.

Bearing Seals

Check the seals for any signs of cracking, damage or hardness due to the pump overheating.

'O' Rings

Always fit new 'O' ring seals on re-assembly.

AUXILIARY HYDRAULICS

Multi-Power/l.p.t.o. Relief Valve

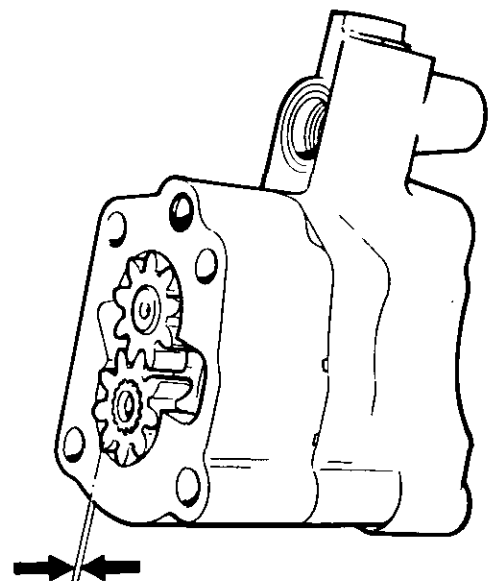
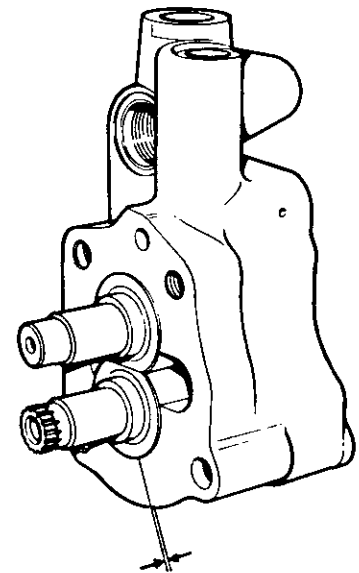
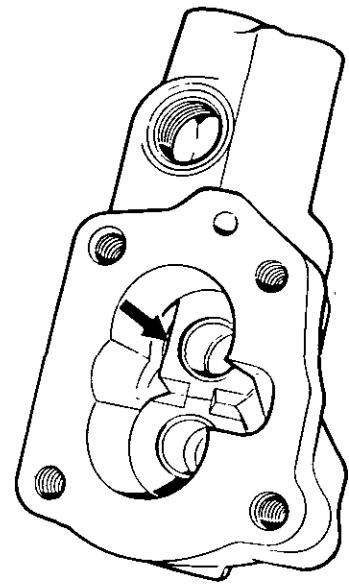
If the valve is suspect it is permissible to service the seat by removing the staking and unscrewing the end plug, withdrawing the spring and valve and removing the slotted seat with a screwdriver.

NOTE: If the seat has been replaced twice or more use a suitable loctite sealant on the threads.

Re-assemble the valve and set the spring tension at the correct relief pressure, operation 8B—16—12 and re-stake the end plug.

Reassembly

19. Reverse procedures 1 to 18 except:
 - (a) Retighten the main relief valve to a torque of 50 Nm (37 lbf ft).
 - (b) When replacing the front body and centre body bearings DO NOT use unnecessary force, e.g., a hammer and drift. Using hand pressure only gently ease the bearings into the bores until they have seated onto their seals.
 - (c) When replacing the front body bearings ensure that the uppermost bearing is fitted with its relieved face adjacent to the outlet port.
 - (d) Measure the protrusion of the bearings above the joint face of the front body and the protrusion of the gear wheels from the centre body face. This dimension must lie between 0 to 0,5 mm (0 to 0.019 in) **MAXIMUM**. If the dimension falls below zero and the bearings become recessed renew the seals. If this dimension is above 0,5 mm (0.019 in) then the bearings have not seated correctly because of a slight seizure in the bores.
 - (e) Retighten the end cover bolts to a torque of 45 Nm (33 lbf ft).
 - (f) The drive shaft will be difficult to turn by hand when the pump is reassembled. This condition is quite normal. Check for rotation by temporarily assembling a drive gear to the shaft and turn using a cloth wrapped around the gear.



AUXILIARY HYDRAULICS

PLATED DRIVE**Servicing**

8B-10-11

Special Tools: See Part 8A

Disassembly

1. Remove the pump. Operation 8B-05-02.
2. Remove the nuts and lockwashers.
3. Remove the plate and spacers.
4. Lift out the drive gear.
5. Remove the thrust washers, idler gear, and needle rollers.
6. Push the idler shaft out of the rear plate.

Examination

Check the gear teeth for wear, chipping, or other damage. Examine the bores of the gears the needle rollers for wear. Check the idler shaft and thrust washers for wear, scoring or pitting. Replace any defective components.

Reassembly

7. Refit the idler shaft to the rear plate.
8. Fit a thrust washer to the idler shaft.
9. Fit the idler gear, needle rollers and the second thrust washer.

NOTE: Use petroleum jelly to retain the needle rollers. NEVER USE GREASE.

10. Refit the drive gear.
11. Refit the spacers and the plate, then refit the nuts. Tighten the nuts progressively to 27 Nm (20 lbf ft).
12. Refit the pump, Operation 8B-05-02.

PRESSURE MAINTAINING VALVE (EIGHT SPEED I.P.T.O. Tractors Only)**Removal and Refitment**

8B-11-11

Removal

1. Remove the front grille.
2. Remove the hood, Part 2A.
3. Disconnect the inlet and outlet pipes from the valve. (The valve is situated in the line to the oil cooler and transmission oil filter, between the bulkhead and the radiator.)
4. Remove the valve assembly.

Refitment

5. Reverse procedures 1 to 4.

PRESSURE MAINTAINING VALVE**Servicing**

8B-12-11

1. Remove the valve. Operation 8B-11-11.
2. Unscrew the adaptor and remove the sleeve, spring and poppet.
3. Examine the poppet and its seat.

Reassembly

4. Reverse procedures 1 to 3 except:
 - (a) Refit the adaptor with a new 'O' ring.

HYDRAULIC TESTING**Auxiliary Relief Valve**

8B-13-11

Special Tools: 840 Test Kit

MF 810-1/1 'Pioneer' Adaptor—2 off

NOTE: Ensure the spool valve is adjusted for double acting operation.

1. Fit the MF 810-1/1 adapters to the hoses of the 840 Test Kit.
2. Fit the INLET hose adapter to the No. 1 coupler at the rear of the tractor.
3. Fit the outlet hose adapter to the No. 2 coupler at the rear of the tractor.
4. Start the tractor engine and warm up the oil to at least 50°C (120°F).
5. Fully unscrew the restrictor on the 840 Test Kit.
6. Move the R.H. spool valve lever rearwards.
7. Screw in the restrictor fully.

LOW CAPACITY (8÷4) PUMPS

8. At an engine speed of 2000 rev/min the pressure should be 141 kgf/cm² (2000 lbf/in²) minimum to 169 kgf/cm² (2400 lbf/in²) maximum.

HIGH CAPACITY (10÷4) PUMPS

9. At an engine speed of 1000 rev/min the pressure should read 176 kgf/cm² (2500 lbf/in²) minimum.
10. At an engine speed of 2000 rev/min the pressure should read 197 kgf/cm² (2800 lbf/in²) maximum.

HYDRAULIC TESTING**Auxiliary Pump Flow Test**

8B-14-11

1. See procedures 1 to 7, operation 8B-13-11.
2. Adjust the pressure with the restrictor until 127 kgf/cm² (1800 lbf/in²) is obtained.
3. Switch on the flow meter.

LOW CAPACITY (8÷4) PUMPS

The meter should read:

28,5 litre/min (6.3 Imp. gal/min) minimum at 2000 rev/min engine speed.

HIGH CAPACITY (10÷4) PUMPS

The meter should read:

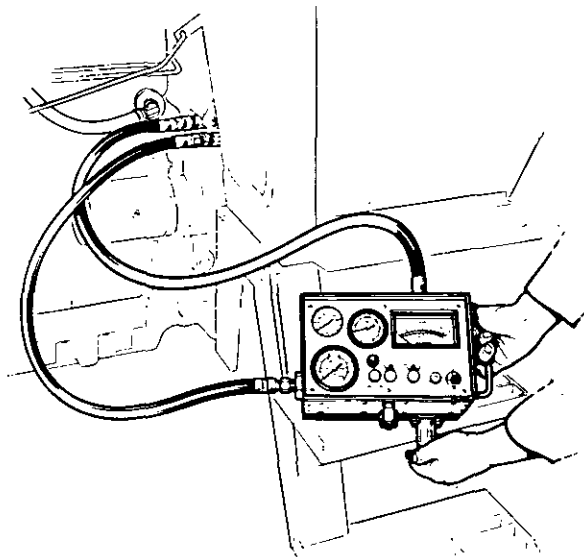
36 litre/min (7.9 Imp. gal/min) minimum at 2000 rev/min engine speed.

AUXILIARY HYDRAULICS**HYDRAULIC TESTING****Multi-Power Pressure Test 8B—15—12**

Special Tools: 840 Test Kit
Two off MF 810-1/4 Adaptors.

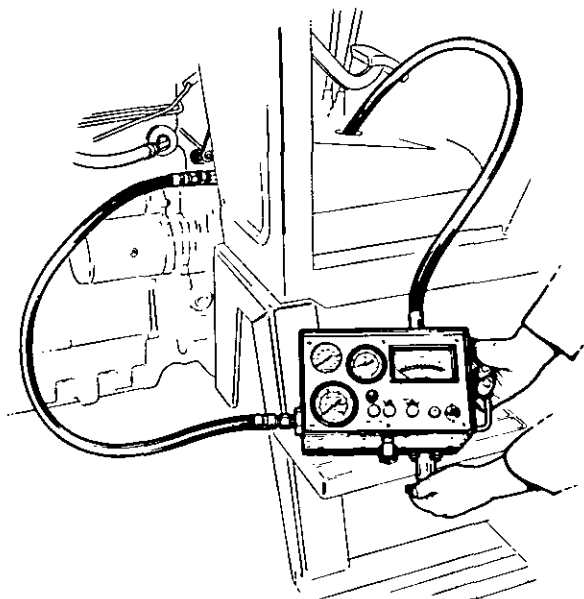
1. Remove the hood, Part 2A.
2. Disconnect the Multi-Power feed and return lines.
3. Fit the MF 8101/4 Adaptors.
4. Connect the INLET hose of the 840 Test Kit in the line to the oil cooler.
5. Connect the OUTLET hose of the 840 Test Kit in the line from the oil filter.
6. Fully unscrew the restrictor of 840.
7. In Multi-Power HIGH or LOW, the pressure should be:—

IDLING	14-16,2 kgf/cm ² (200-230 lbf/in ²)
2000 Engine rev/min	16,2-19 kgf/cm ² (230-270 lbf/in ²)
8. Fully close the restrictor.

**HYDRAULIC TESTING****Multi-Power Relief Valve Test 8B—16—12**

1. See Procedures 1 to 5 and 8, Operation 8B—15—12.
2. With the i.p.t.o. lever in the OFF position, the pressure should be:—

IDLING	49,2 kgf/cm ² (700 lbf/in ²)
	MINIMUM
2000 Engine rev/min	70,3 kgf/cm ² (1000 lbf/in ²)
	MAXIMUM
3. Stop the engine.

**HYDRAULIC TESTING****Multi-Power Flow Test 8B—17—12**

1. See Procedures 1 to 5, Operation 8B—15—12
2. Disconnect the OUTLET hose.
3. Route the hose into the gearbox filler hole.

WARNING: Do not insert the pipe into the gearbox filler hole otherwise serious damage may result. Only direct the return flow into the hole.

4. Start the engine. The flow should be 400—450 p.s.i. back pressure.

IDLING	5,5 litre/min (1.2 Imp. gal/min) MINIMUM.
2000 Engine rev/min	7,7 litre/min (1.7 Imp. gal/min) MINIMUM.

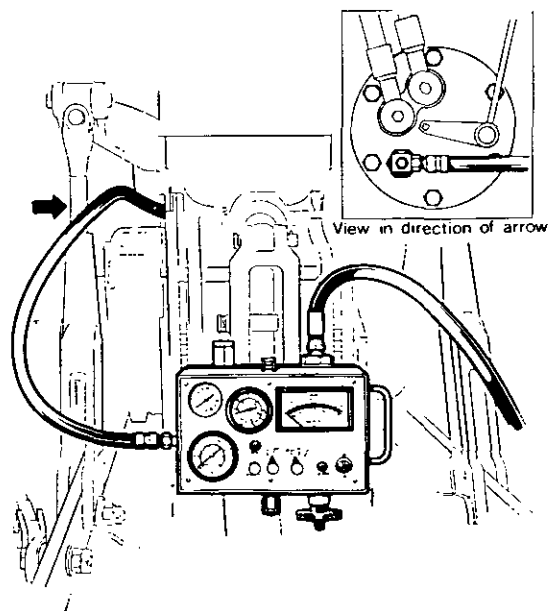
HYDRAULIC TESTING**I.p.t.o. Pressure Test 8B—18—12**

Special Tools: 840 Test Kit
MF 810-6 Adaptors

Procedure

1. Remove the plug from the p.t.o. side cover.
2. Fit MF 810-6 to the INLET hose of 840.
3. Fit MF 810-6 to the side cover.
4. Start the tractor engine.
5. At 2000 Engine rev/min the pressure should read:—

With the lever OFF	ZERO
With the lever ON	14 to 17,5 kgf/cm ² (200-250 lbf/in ²)



HYDRAULIC TESTING**Pressure Maintaining Valve Check 8B—19—13
(Eight Speed I.P.T.O. Tractor Only)**

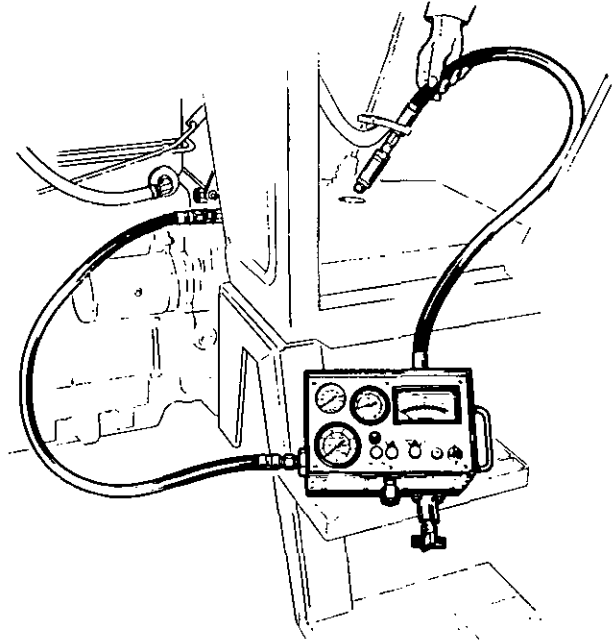
Special Tools: 840 Test kit
MF 810-1/4 Adaptors

Procedure

1. Disconnect the Multi-power feed line, (the outer pipe, nearest the cab step).
2. Fit the MF 810-1/4 adaptors.
3. Remove the pressure maintaining valve, operation 8B—11—11.
4. Connect the pressure maintaining valve to the end of the return pipe.
5. Place the end of pipe at the gearbox filler hole.

WARNING: Do not insert the pipe into the gearbox filler hole otherwise serious damage may result. Only direct the return flow into the hole.

6. Open the regulator valve and check the operating pressure which should be:
1000 rev/min
16,2-19 kgf/cm² (230-270 lbf/in²).



NOTE: The following can be used as an alternative. But it must be emphasised that it is an approximate setting and the first method should be carried out as soon as the opportunity arises.

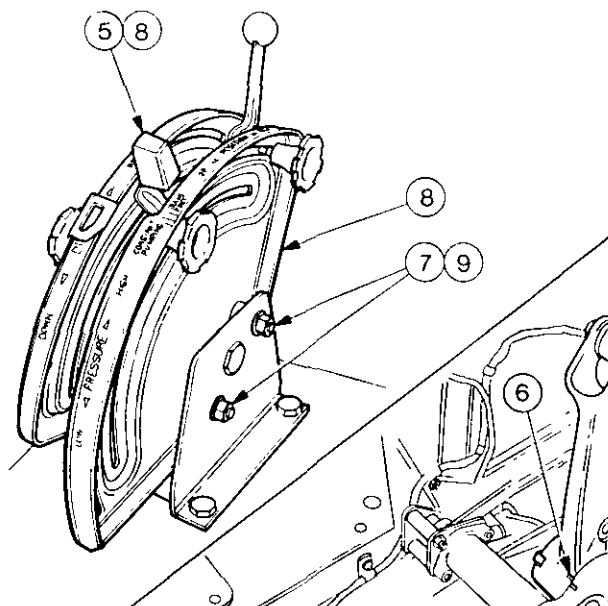
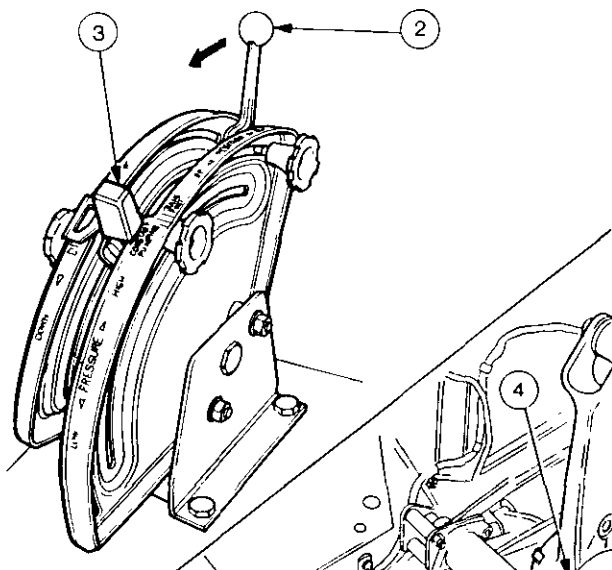
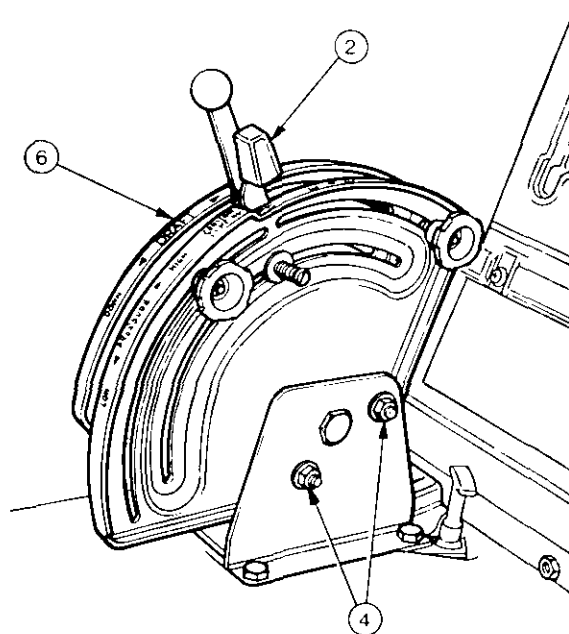
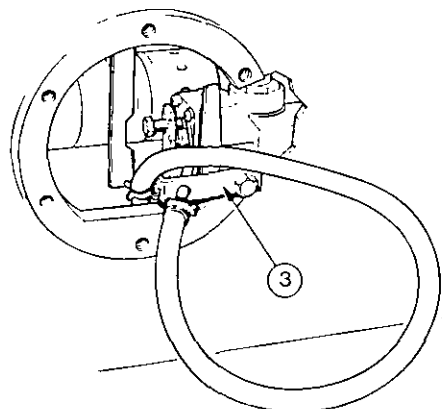
1. Start the engine, and set the engine speed at 1200 rev/min.
2. Place the Draft Control lever in the fully UP position.
3. Place the Position Control lever in the CONSTANT PUMPING position.
4. Screw the setscrew in until the needle of the gauge begins to fluctuate.
5. Screw the setscrew out until the fluctuating ceases, then unscrew a further **eight flats**.
6. Stop the engine.

Draft Control Setting

1. Start the engine, and set the engine speed at 1200 rev/min.
2. Place the Position Control lever in the TRANSPORT position.
3. Using the Draft Control lever, set the lower links in the horizontal position. The Draft Control lever should be in the sector marks on the quadrant, if not carry out procedures 4 to 7.
4. Slacken the two nuts.
5. Rotate the Draft Control quadrant and lever until the links remain stationary in the horizontal position.
6. Tighten the two nuts and recheck the setting.
7. Stop the engine.

Position Control Setting

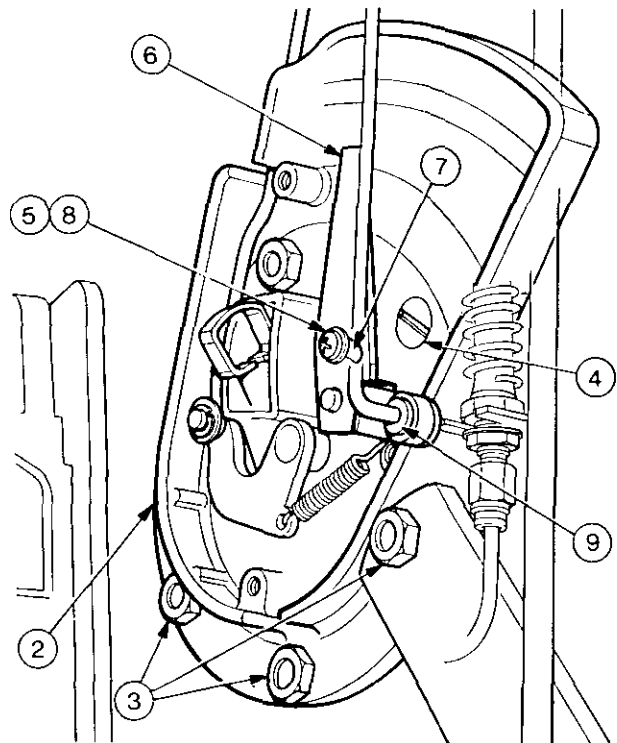
1. Start the engine, and set the engine speed at 1200 rev/min.
2. Place the Draft Control lever in the fully UP position.
3. Place the Position Control lever in the CONSTANT PUMPING position.
4. When the links are fully raised scribe a line across the top cover casting and lift arm.
5. Place the Position Control lever in the TRANSPORT position.
6. The links should drop until the scribe lines are 1,6 to 4,7 mm (0.06 to 0.19 in) apart, if the distance is incorrect carry out procedures 7 to 10.
7. Slacken the two nuts.
8. Rotate the Position Control quadrant and lever until the setting is correct.
9. Tighten the two nuts and recheck the setting.
10. Fully lower the links and stop the engine.
11. Remove MF 359, MF 148A and MF 166.



HYDRAULIC SYSTEM

Response Control

1. Fit a new gasket.
2. Refit the side cover.
3. Refit the five bolts.
4. Refit the screw.
5. Release the locking screw.
6. Place the Response Control lever 6 mm (0.25 in) from the rear end of its quadrant.
7. Rotate the inner lever, until the cam just contacts the vertical lever on the pump.
8. Tighten the screw.
9. Reconnect the rod.
10. Add approved oil to the transmission until the required level is reached.



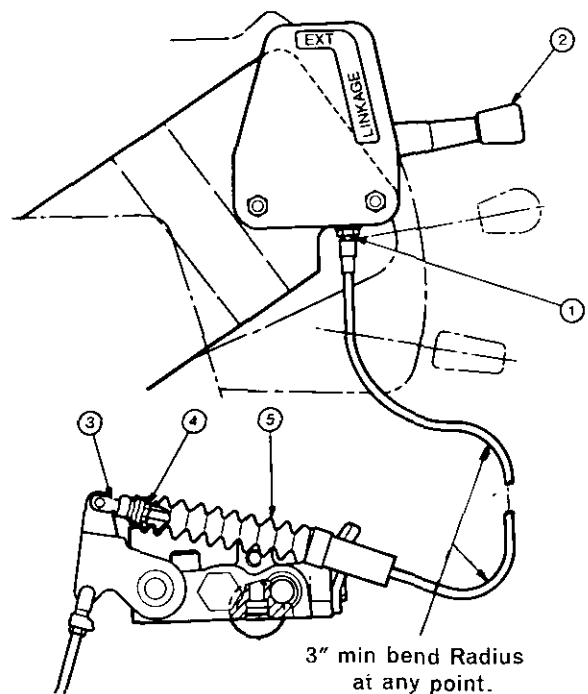
AUXILIARY PUMP CONTROL

Side Cover Rod and Clevis Adjustment

1. Ensure that both quadrant control levers are in the down position.
2. Rotate the side cover lever clockwise until internal resistance is felt.
3. Rotate the selector valve lever fully anti-clockwise to the linkage position.
4. Adjust the rod clevis until the pin fits freely.
5. Remove the pin and unscrew clevis one turn to lengthen the rod.
6. Refit pin and tighten locknut.

Cable Adjustment

1. Position the cable adjuster with the minimum amount of thread showing and tighten the locknut.
2. Ensure that the control lever and selector valve lever are in the linkage position.
3. With the cable held taut, adjust the clevis until the clevis pin fits freely.
4. Tighten the locknut.
5. Fit the bellows over the washers.



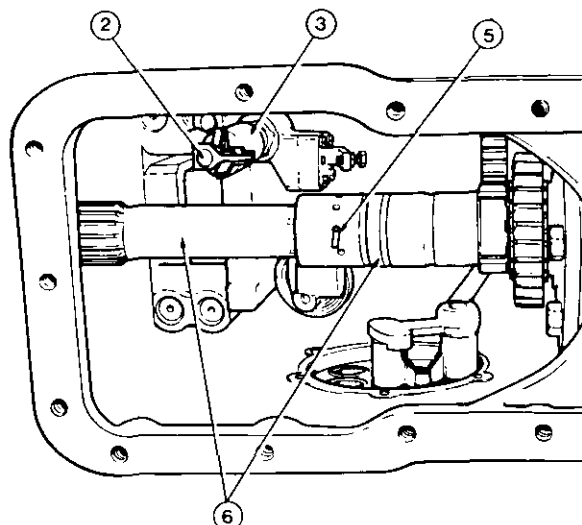
HYDRAULIC PUMP**Removal and Refitment**

8A—13—19

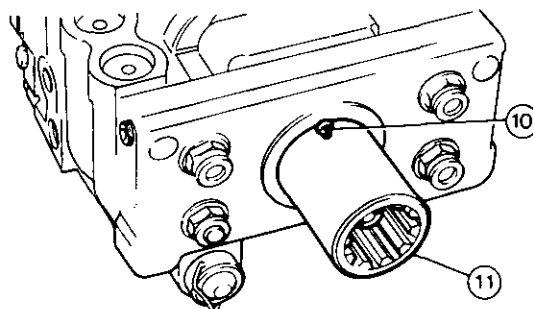
Special Tools: See Operation 8A—03—09.

Removal**Tractors not fitted with an i.p.t.o./Multi-Power or auxiliary pump.**

1. Remove the lift cover, operation 8A—03—09.
2. Remove the butterfly adjuster.
3. Remove the tube.
4. Remove the spring.
5. Remove and discard the split pin.
6. Remove the shear tube and the rear drive shaft.
7. Remove the p.t.o. shaft, Part 6B.
8. Remove the two nuts and the dowel pins each side.
9. Manoeuvre the hydraulic pump out of the top of the centre housing.
10. Remove and discard the split pin.
11. Remove the coupler.

**Tractors with live engine two speed p.t.o.**

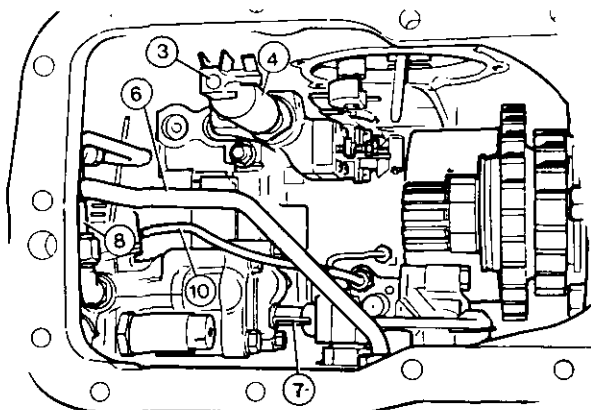
12. Remove the shift collar.
13. Remove the splined hub.
14. Remove the snap ring.

**Refitment**

15. Reverse procedures 1 to 14 except:
 - (a) Fit new split pins and 'O' rings.
 - (b) Fit the new shear tube split pin to give 0,38 to 2,54 mm (0.015 to 0.100 in) end float.

Removal**Tractors fitted with an i.p.to./Multi-Power or auxiliary pump.**

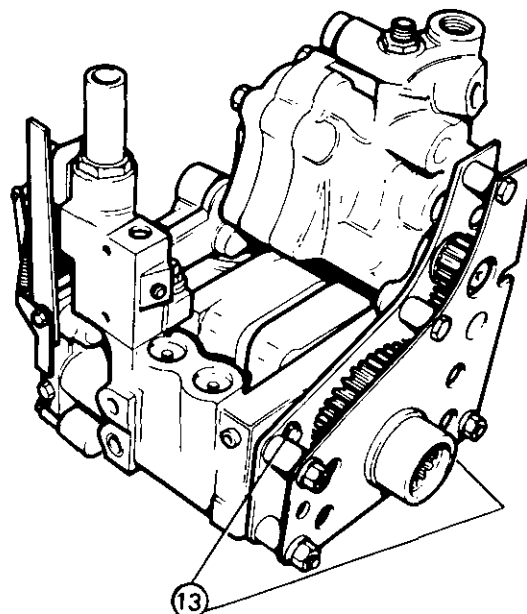
1. Remove the lift cover, operation 8A—03—09.
2. Split the tractor between the spacer housing and the centre housing and withdraw the rear axle assembly rearwards, Part 3A. Remove the spacer housing, Part 6B.
3. Remove the butterfly adjuster.
4. Remove the tube and the spring.
5. Remove the p.t.o. side cover, Part 6B.

**Tractors fitted with an auxiliary pump, carry out procedures 6 and 7.**

6. Disconnect the pipe.
7. Remove the pipe.
8. Remove the pipe.
9. Remove the two nuts and the dowel pin each side.

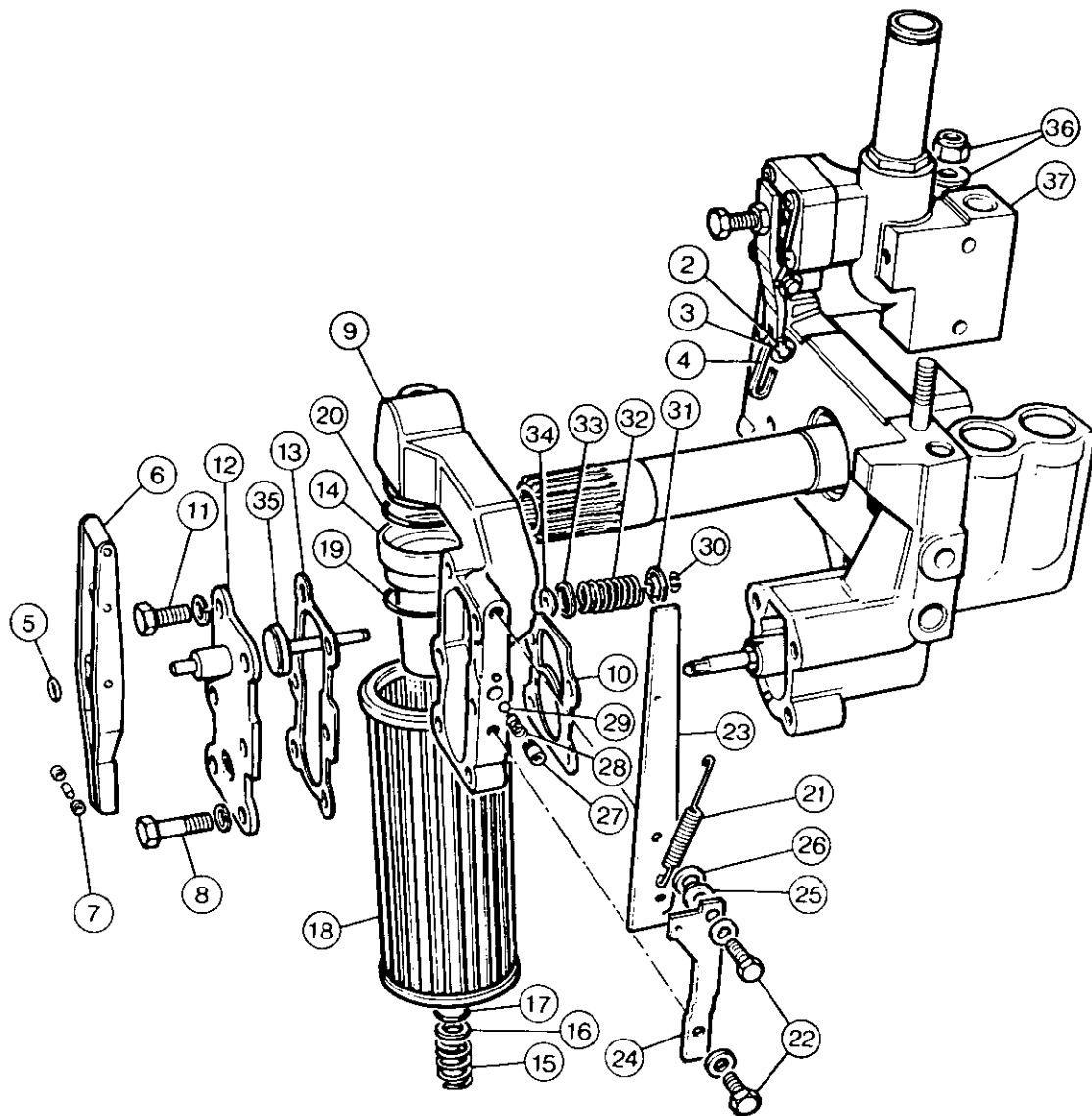
Tractors fitted with i.p.t.o., carry out procedures 10 and 11.

10. Disconnect the pipe at the i.p.t.o./Multi-Power pump.
11. Move the hydraulic pump, i.p.t.o./Multi-Power or auxiliary pump, and the i.p.t.o. unit forwards.
12. Withdraw the hydraulic pump and the p.t.o./Multi-Power or auxiliary pump, as a complete assembly from the front of the centre housing.
13. Remove the two 'C' clips.
14. Withdraw the i.p.t.o./Multi-Power or auxiliary pump from the hydraulic pump.

**Refitment**

15. Reverse procedures 1 to 14 except:
 - (a) Locate the i.p.t.o. unit (if fitted) on the p.t.o. splines and then locate the hydraulic pump camshaft in the i.p.t.o. unit.
 - (b) Fit new 'O' rings.

HYDRAULIC SYSTEM



HYDRAULIC PUMP

Servicing

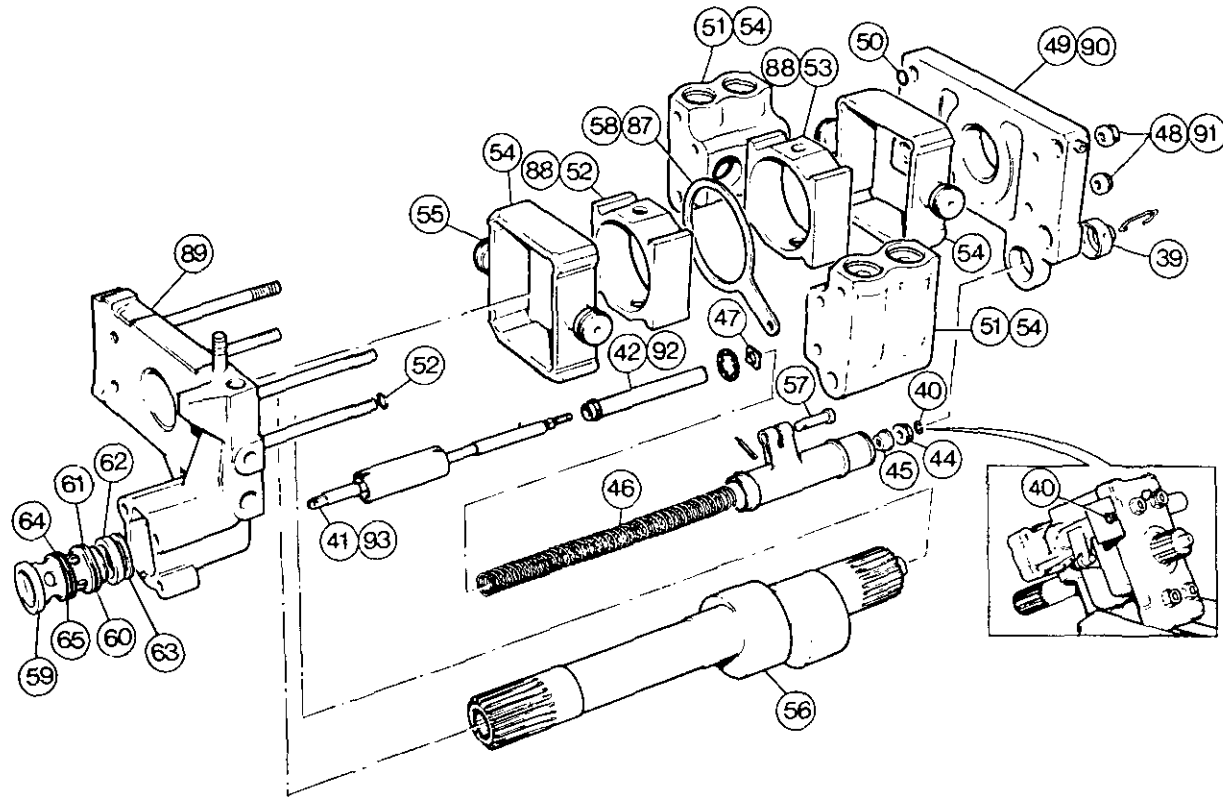
8A-14-20

Special Tools: See Operation 8A-03-09, and
 MF 349 Valve Seat Forming Tool
 MF 350 Valve Circlip Replacer
 MF 351 Valve Plug Remover and
 Replacer
 MF 352 Control Valve Spring
 Retainer
 MF 353 Control Valve Body 'O'
 Ring Guide
 MF 354 Control Valve Body Replacer

Disassembly

1. Remove the hydraulic pump, operation 8A-13-19.
- Remove the following:
2. Clip.
3. Pin.
4. Link.
5. Clip.
6. Lever.
7. Two rollers and the pin.
8. Four bolts and washers.
9. Strainer housing.
10. Gasket and discard it.

11. Two bolts and washers.
12. End plate.
13. Gasket and discard it.
14. Suction Tube.
15. Spring.
16. Washer
17. 'O' ring and discard it.
18. Strainer.
19. 'O' ring and discard it.
20. 'O' ring and discard it.
21. Spring.
22. Two bolts and washers.
23. Lever.
24. Retainer.
25. Bush.
26. Washer.
27. Bush.
28. Spring.
29. Ball.
30. Circlip.
31. Cap.
32. Spring.
33. Retainer.
34. Seal and discard it.
35. Valve.
36. Nut and washer.
37. Carefully remove the Pressure Control valve.
38. Deleted.



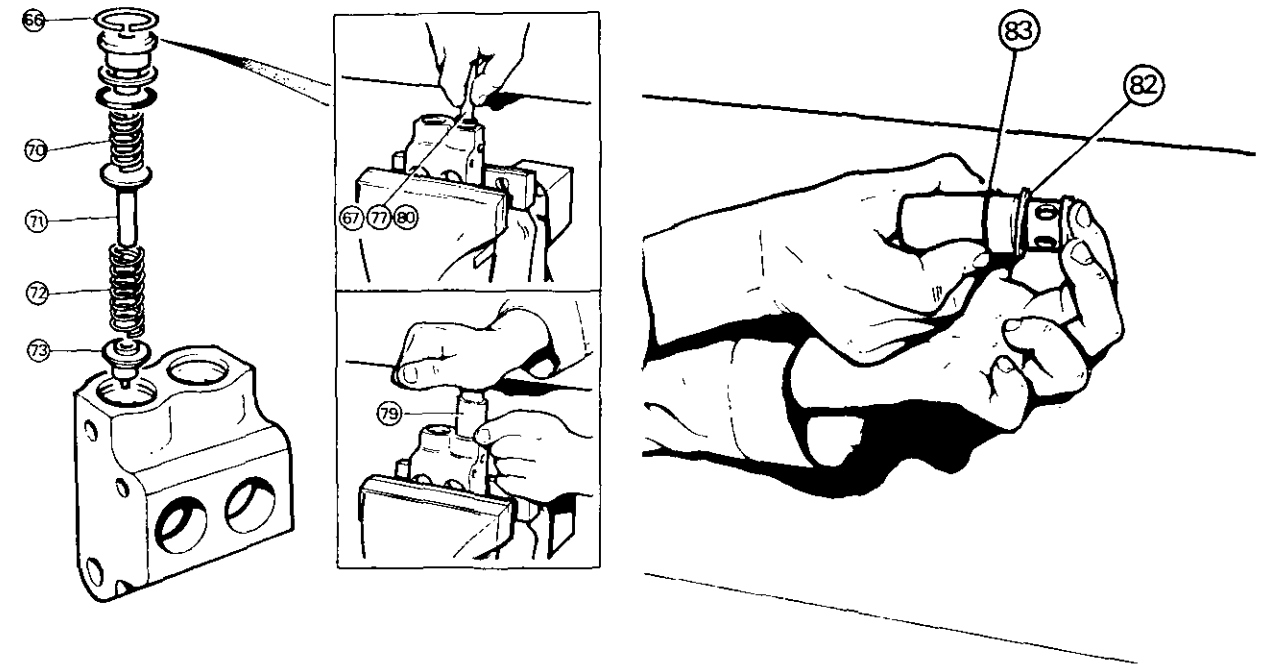
39. Remove the cap.
40. Using MF 352, remove and discard the retaining ring.
41. Withdraw the control valve.
42. Remove the balancer tube.
43. Taking care that the spring is not ejected, remove MF 352.
44. Remove the collar.
45. Remove the guide.
46. Remove the spring.
47. Remove the square disc.
48. Remove the four nuts.
49. Detach the front body.
50. Remove and discard the 'O' rings.
51. Withdraw the two valve chambers from the rear body, complete with the cam blocks, pistons, cam follower and oscillator tube as an assembly.
52. Remove and discard the 'O' rings.
53. Remove the cam blocks from the pistons.
54. Separate the valve chambers from the pistons.
55. Remove the piston rings, if necessary.
56. Withdraw the camshaft from the rear body.
57. Remove the split pin and the pin.
58. Remove the cam follower from the oscillator tube.
59. Carefully drive out the body.
60. Remove and discard the 'O' ring.
61. Remove and discard the back-up washer.
62. Remove the sleeve.
63. Remove the washer.
64. Remove and discard the 'O' ring.
65. Remove and discard the back-up washer.
66. Remove and discard the circlip.
67. Using MF 351, remove the plug.
68. Remove and discard the back-up washer.
69. Remove and discard the 'O' ring.
70. Remove the spring.
71. Remove the valve.
72. Remove the spring.
73. Remove the valve.
74. Repeat procedures 66 to 73 for the other three valves.

Examination

Check the condition of all components for wear or damage, replacing any defective components. Always replace 'O' rings, back-up washers, gaskets and circlips. Lubricate the 'O' rings with an approved oil before fitting.

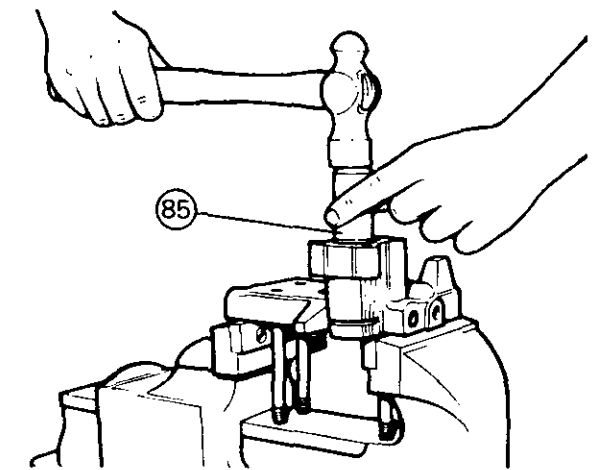
Reassembly

75. If necessary, form new valve seats, using MF 349 as follows:
Cut out the old top seat, then the bottom seat using the refacing tool. Using the seat forming tool, form a new bottom seat by tapping the tool with hammer, invert the tool and form a new top seat in the same manner. Thoroughly clean the valve chambers.
76. Reverse procedures 68 to 73.
77. Using MF 351, push the plug into the valve chamber until the circlip groove can just be seen.
78. Position a new circlip in MF 350.
79. Using MF 350, fit the circlip.
80. Using MF 351, pull the plug up against the circlip.
81. Repeat procedures 76 to 80 for the other three valves.
82. Using MF 353, fit a new back-up washer to the valve body.
83. Using MF 353, fit a new 'O' ring to the valve body.
84. Reverse procedures 60 and 63.
85. Using MF 354, carefully drive the body into the front body, aligning the pin at six o'clock.
86. Reverse procedures 52, 54, 55, 57 and 58.
87. Place the cam follower between the pistons.
88. Fit the two cam blocks to the camshaft.
89. Refit the rear body.
90. Refit the front body.
91. Lubricate the studs with an approved oil, and refit the four nuts and tighten them to a torque of 40 Nm (40 lbf ft) ensuring at all times that the pistons move freely.



NOTE: The special nuts must be fitted to the top right hand and the bottom left hand studs.

92. Refit the balancer tube to the control valve.
93. Lubricate the control valve with an approved oil and slide it into the rear body.
94. Reverse procedures 1 to 40 and 43 to 47 except:
 - (a) Tighten the Pressure Control valve nut to a torque of 40 Nm (30 lbf ft).
 - (b) Coat the vertical lever upper bolt with recommended sealant 'A' and tighten the bolts to a torque of 14 Nm (10 lbf ft).
 - (c) Coat the strainer end plate bolts with recommended sealant 'A' and tighten the bolts to a torque of 20 Nm (15 lbf ft) checking at all times that the control valve continues to move freely.



HYDRAULIC SYSTEM

HYDRAULIC PUMP

Control Valve Removal and Refitment

8A-15-22

Special Tools: See Operation 8A-03-09 and
MF 352 Control Valve Spring Retainer
MF 353 Control Valve Body 'O' Ring
Guide
MF 354 Control Valve Body Replacer

Removal

1. Remove the control valve, operation 8A-14-20 procedures 1 to 10 and 39 to 52.
2. Remove the control valve body, operation 8A-14-19, procedures 58 to 64.

Examination

Check all components for wear or damage, replacing any defective parts. Always replace back-up washers, 'O' rings, gaskets and circlips. Lubricate the 'O' rings with an approved oil before refitting.

Refitment

3. Reverse procedures 1 and 2.

PRESSURE CONTROL VALVE

Removal and Refitment

8A-16-22

Special Tools: Operation 8A-03-09

Removal

1. Remove the hydraulic pump, operation 8A-13-19.
2. Remove the clip.
3. Remove the pin.
4. Remove the link.
5. Remove the nut and washer.
6. Carefully remove the valve.

Refitment

2. Reverse procedures 1 to 6 except, tighten the nut to a torque of 40 Nm (30 lbf ft).

PRESSURE CONTROL VALVE

Servicing

8A-17-22

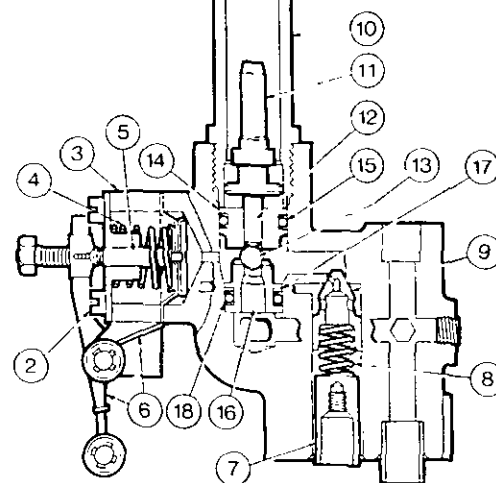
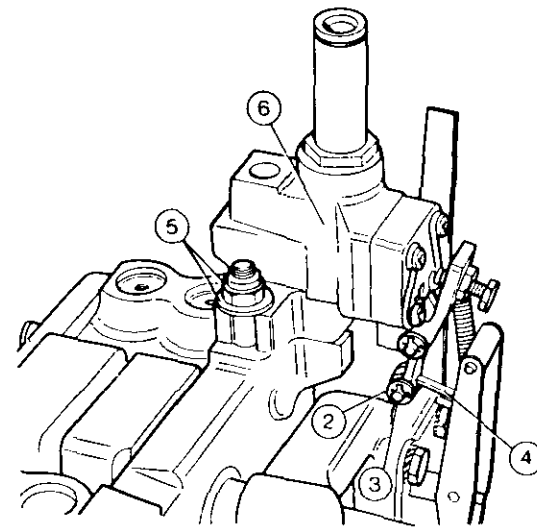
Special Tools: See Operation 8A-03-09

Disassembly

1. Remove the Pressure Control valve, operation 8A-16-22.
2. Remove the four screws and spring washers.
3. Remove the body.
4. Remove the spring.
5. Remove the diaphragm.
6. If necessary, remove the lever and the spring.
7. Remove the distance piece.
8. Remove the spring.
9. Remove the valve.
10. Unscrew the guide.
11. Remove the spring support.
12. Remove the plunger.
13. Remove the ball.
14. Taking care not to damage the valve body, withdraw the guide.
15. Remove and discard the 'O' ring.
16. Taking care not to damage the valve body, withdraw the seat.
17. Remove and discard the back-up washer.
18. Remove and discard the 'O' ring.

Examination

Examine all components for signs of wear, damage, scoring or pitting and replace if necessary. Always fit new 'O' rings and back-up washers.



Reassembly

19. Reverse procedures 1 to 18 except;
 - (a) Fit the plunger with the taper towards the ball.
 - (b) Lightly coat the threads of the guide with recommended sealant 'C' and tighten the guide to a torque of 40 Nm (30 lbf ft).
 - (c) Fit the distance piece so that it is flush with the face of the body.

TRANSMISSION AND HYDRAULIC PUMP FILTER

Servicing

8A-18-22

Disassembly

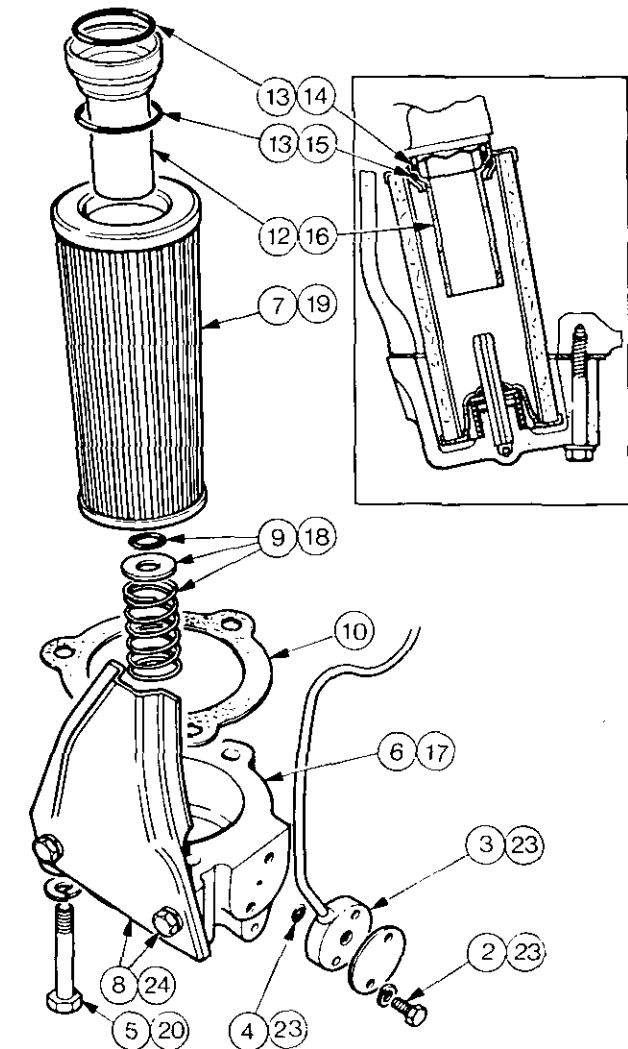
1. Drain the oil.
2. Remove two bolts and plate from the vacuum tube connector.
3. Ease the connector away from the filter cover about 6 mm (1/4 in) to assist removal of the cover.
4. Remove connector 'O' ring.
5. Remove three bolts and washers.
6. Remove the filter cover with the shield still attached.
7. Remove the filter element.
8. Remove the two bolts securing the shield to the cover and remove the shield.
9. Remove the spring, stop plate and 'O' ring from the central post inside the filter cover.
10. Remove and discard the gasket.
11. To clean the filter element, first seal the open ends with either two suitable plugs or oil resistant adhesive tape, then swill the element in clean white spirit. Brush the mesh with a stiff bristle brush. Finally remove the plugs or tape, apply a compressed air line to the inside of the element to remove any remaining dirt particles.
12. Remove the suction tube by gently pulling it down from the pump manifold.
13. Remove two 'O' rings—suction tube inner and outer.

Reassembly

14. Place 'O' ring inside suction tube.
15. Place 'O' ring on the outside of the suction tube.
16. Push the suction tube onto the spigot of the pump manifold, where it will hold in position.
17. Fit new gasket to face of filter cover.
18. Fit spring, stop plate and 'O' ring onto filter cover central post.
19. Place filter element in cover with the wider end uppermost.
20. Fit one bolt and washer to the filter cover.
21. Refit the filter and cover assembly to the centre housing by inserting the top of the filter element through the access hole until it passes over the suction tube and seats on the 'O' ring.
22. Whilst holding the filter cover up to the centre housing engage one bolt and fully tighten, then fit and tighten the two remaining bolts.

NOTE: Do not attempt to pull the filter cover up to the centre housing using the securing bolts.

23. Refit the connector using a new 'O' ring lightly oiled.
24. Refit the shield to the filter cover so that there is maximum contact with the side of the centre housing and no gap at the top. The shield has slotted bolt holes to aid adjustment.



STRAINER HOUSING AND RESPONSE CONTROL

Removal and Refitment 8A—19—23

Special Tools: See Operation 8A—03—09.

Removal

1. Remove the strainer housing, operation 8A—14—20, procedures 1 to 10.

Refitment

2. Reverse procedure 1.

STRAINER HOUSING AND RESPONSE CONTROL

Servicing 8A—20—23

Special Tools: See Operation 8A—03—09.

Disassembly

1. Remove the strainer housing, operation 8A—19—23.
2. Disassemble the strainer housing and the Response Control, operation 8A—14—20 procedures 11 to 36.

Examination

Check the condition of all components for wear or damage, replacing any defective components. Always replace 'O' rings and gaskets.

Reassembly

3. Reverse procedures 1 and 2.

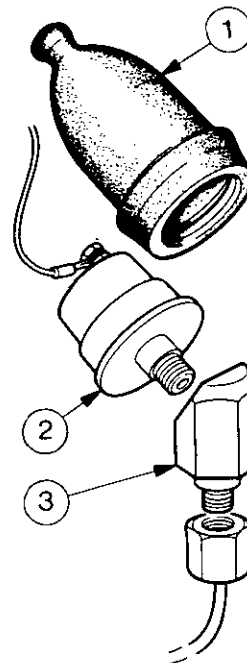
VACUUM SWITCH

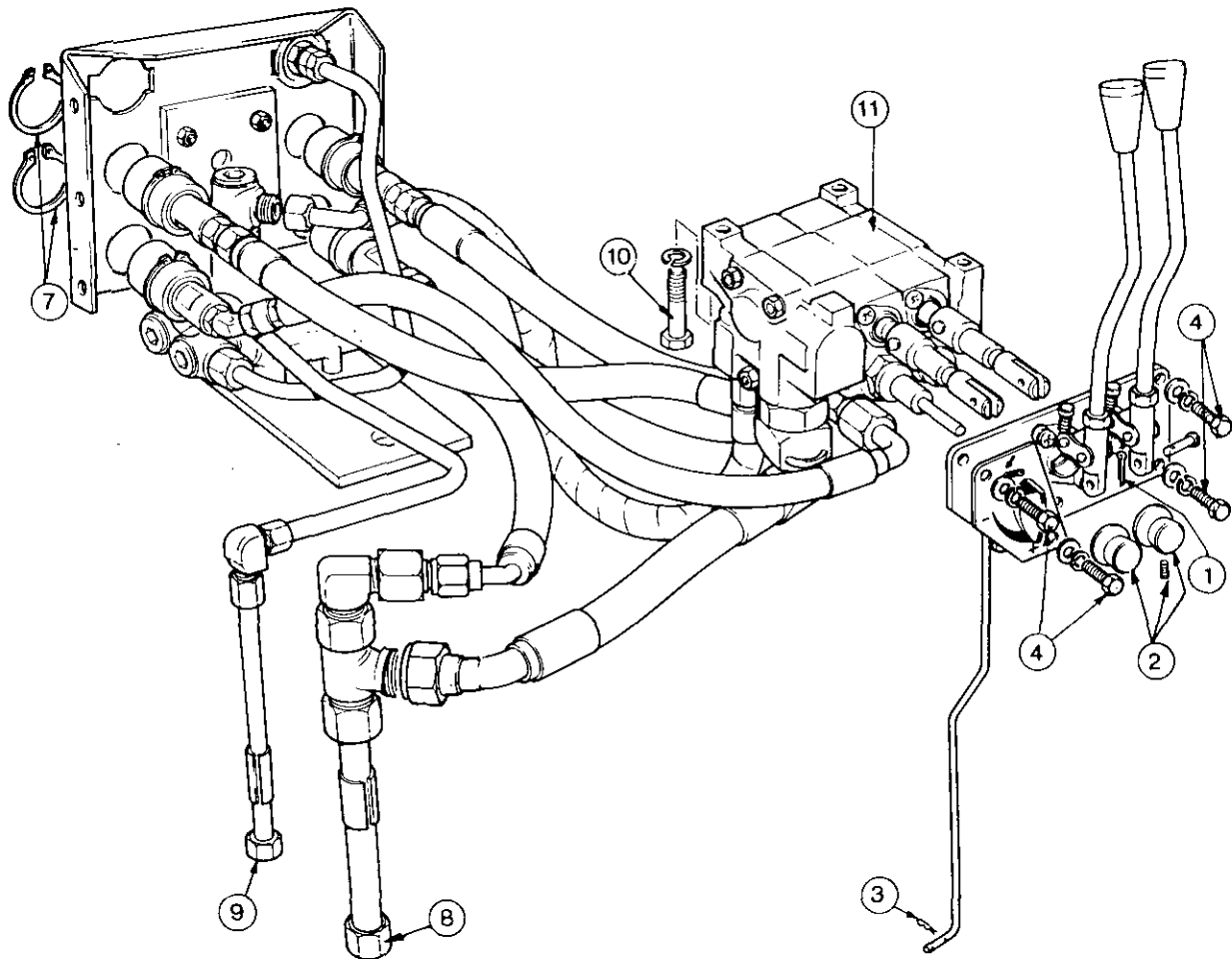
Removal and Replacement 8A—21—23

1. Remove rubber cover.
2. Disconnect cable from switch terminal.
3. Unscrew switch from mounting block.

Replacement

4. Reverse procedures 1 to 3 except:
 - (a) Apply a thin coat of Loctite 542 or equivalent to threads and shank of switch before screwing it into the mounting block.



HYDRAULIC SYSTEM**SPOOL VALVE UNIT****Removal and Refitment**

8A—22—24

1. From inside the cab, remove the split pin from each of the clevis pins securing the two levers to the two extension rods.
2. Loosen the grub screw in each of the two single/double acting control knobs and prise them off.
3. Remove the hair pin from the fast/slow response rod and detach rod from the side cover lever.
4. Remove the four bolts and washers securing the mounting plate to the front of the seat platform.
5. Loosen the five bolts and washers securing the lower panel to the rear of the tractor and remove the panel.
6. Remove the surround from the coupling mounting plate fitted to the lift cover.
7. Remove the circlip securing each of the four couplings to the mounting plate, and push them out of the holes.
8. Disconnect the large return hose from the side cover connector.
9. Disconnect the oil feed hose from the connector on the trailer braking valve attached to the lift cover.
10. Remove the three bolts and washers securing the selector valve to the underside of the seat platform.
11. Lift the selector valve clear together with the hoses.

12. Mask the open ends of the hoses and the connectors from which they were removed, to prevent dirt ingress.

Refitment

13. Reverse procedures 1 to 12.

SPOOL BLOCK**Removal and Refitment**

8A—23—24

Removal

1. Remove the spool valve unit, operation 8A—22—24 procedures 1 to 12.
2. Remove the three nuts and studs securing the spool valve assembly.
3. Remove the end plates.
4. Remove the 'O' rings.
5. Thoroughly clean the mating faces of the spool blocks and end plates.

Refitment

6. Fit new 'O' rings to the recesses in the spool blocks.
7. Place the spool blocks on a flat surface with the feed ports uppermost.
8. Align the valve sections and fit the nuts and lockwashers.
9. Re-tighten the nuts to a torque of 2 kg.m (15 lbf. ft).

NOTE: Do not overtighten the nuts as this could cause the spools to stick.

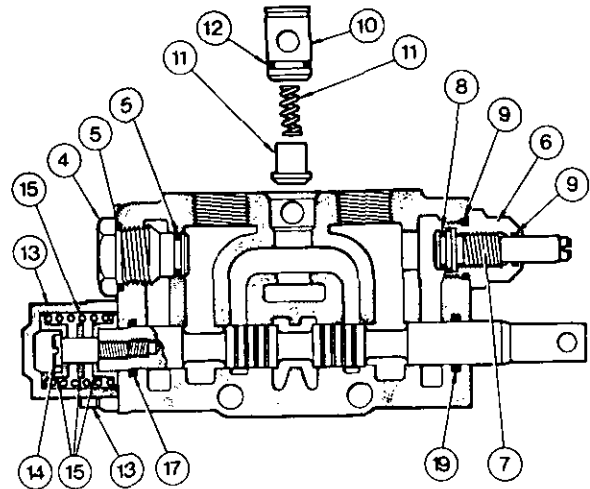
10. Refit the spool valve unit, operation 8A—22—24 procedure 13.

Spool Block Servicing

Disassembly

8A—24—25

1. Remove the spool block, operation 8A—23—24.
2. Remove the spring pin securing the single/double acting extension rod and withdraw the rod.
3. Remove the split pin and clevis pin securing the spool valve extension rod and withdraw the rod.
4. Remove the plug.
5. Remove both the 'O' rings from the plug.
6. Remove the single/double acting valve housing and withdraw complete with the valve.
7. Unscrew and remove the valve.
8. Remove the 'O' ring.
9. Remove the two 'O' rings from the valve housing.
10. Withdraw the check valve body from the spool block.
11. Remove the poppet and spring.
12. Remove the 'O' ring.
13. Remove the two screws and withdraw the centring spring cover.
14. Remove the retaining screw.
15. Remove the end plates, spring and washer.
16. Gently rotate and pull the spool forwards until the rear 'O' ring is exposed. **DO NOT COMPLETELY REMOVE THE SPOOL.**
17. Remove the exposed 'O' ring from the spool block.
18. Gently rotate and push the spool rearwards until the front 'O' ring is exposed. **DO NOT COMPLETELY REMOVE THE SPOOL.**
19. Remove the exposed 'O' ring from the spool block.



Examination

Check the condition of the check valve poppet and its seat in the spool valve block. Poor seating of the check valve can result in jerky operation.

Check that the spool slides freely in the block but **DO NOT REMOVE THE SPOOL COMPLETELY.**

Always fit new 'O' rings.

20. Reassembly

Reverse procedures 1 to 19 except:

- (a) Thoroughly degrease the tapped hole and the screw and apply one drop of Loctite Hydraulic Seal to the threads of the retaining screw, procedure 14.
- (b) With the spool pushed rearward, fit a new 'O' ring (19) at the front end.
- (c) Gently push the spool forward until the rear 'O' ring groove is *just* exposed. Fit a new rear 'O' ring (17).



Pushing the spool further forward will damage the 'O' ring (19) previously fitted at the front end.

- (d) Push the spool rearward into the neutral position, do not move the spool again until the centralizing spring cover (13) has been fitted and secured.

AUXILIARY HYDRAULICS

Part 8 — Section B

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AUXILIARY HYDRAULICS

GENERAL

The auxiliary hydraulic system provides oil under pressure for up to three services:— Multi-power, Independent P.T.O. and auxiliary (external) services. Spool control valves are available for use with auxiliary tractors (fitted with dual element pump) and can be used for both single-acting and double-acting hydraulic services.

Auxiliary hydraulic tractors are normally fitted with an oil cooler and micronic filter as standard equipment. The combined flow of both the auxiliary pump and linkage pump is available for external service provided that the pressure required is not in excess of 11,38 N/mm² (1650 lb/in²) and that a selector valve is fitted.

OIL COOLER

Removal and Refitment

8B—01—02

Removal

1. Remove the front grille.
2. Remove the battery, Part 9A.
3. Detach the windscreen washer bottle (if fitted).
4. *Disconnect the two pipe unions at the cooler.*
5. Mask off the hose connections with suitable plugs or masking tape to prevent the ingress of foreign matter.
6. Remove the four securing bolts.
7. Withdraw the oil cooler.

Refitment

8. Reverse procedures 1—7.

TRANSMISSION OIL FILTER

Maintenance

8B—02—02

Disassembly

1. Remove the front grille.
2. Unscrew the filter housing.
3. Remove the element.
4. Remove the spring from the base of the element.
5. Remove the 'O' ring from the filter head.
6. Clean all components with paraffin.
7. Examine the filter head and filter housing for cracks or leaks.
8. Always fit a new element and filter head 'O' ring.

Reassembly

9. Fit a new 'O' ring to the filter head.
10. Fit a new element with the spring.
11. Reverse procedures 1—2.

TRANSMISSION OIL FILTER

Removal and Refitment

8B—03—02

Removal

1. Remove the hood, Part 2A.
2. Remove the front grille.
3. Disconnect both pipe unions at the filter head.
4. Disconnect the horn circuit fuse (MF 550 only).
5. Remove the two securing bolts and washer retaining the filter unit.
6. Block off the pipes with suitable sealing caps or masking tape to prevent the ingress of dirt or foreign matter.

Refitment

7. Reverse procedures 1—6.

TRANSMISSION OIL FILTER

By-Pass Valve Servicing

8B—04—02

Disassembly

1. Remove the auxiliary oil filter unit, operation 8B—03—02.
 2. Unscrew the filter housing.
 3. Remove the inlet union.
 4. Remove the spring.
 5. Remove the ball valve.
 6. Clean all components in paraffin.
- Check all components for wear or damage.

Reassembly

8. Reverse procedures 1—6.

AUXILIARY OR MULTI-POWER/I.P.T.O. PUMP

Removal and Refitment

8B—05—02

Special Tools: See Part 8A

Removal

1. Remove the auxiliary pump, complete with the plated drive and separate this assembly from the hydraulic lift pump as stated in Part 8A.
2. Remove the circlip securing the drive gear.
3. Remove the bolts and the Allen screw securing the pump.
4. Withdraw the pump from the plated drive.
5. Remove the gear and the spacers if necessary.

Refitment

6. If necessary, refit the spacers and the gear to the plated drive.
7. Engage the splines of the pump shaft into the gear and refit the circlip.
NOTE: Ensure that the machined flat on the plated drive idler gear shaft engages against the bottom of the pump.
8. Refit the securing bolts and Allen screw. Tighten to a torque of 27 Nm (20 lbf ft).

9. Check the backlash between the plated drive gears. The total backlash between the three gears (two measurements) should be in the range 0,050 to 0,406 mm (0-002 to 0-016 in). If the backlash is incorrect, slacken the bolts and move the pump in relation to the plated drive, then retighten the bolts and recheck the backlash.
10. Reconnect the plated drive and pump assembly to the hydraulic lift pump, as stated in Part 8A.

AUXILIARY OR MULTI-POWER/I.P.T.O. PUMP UNIT

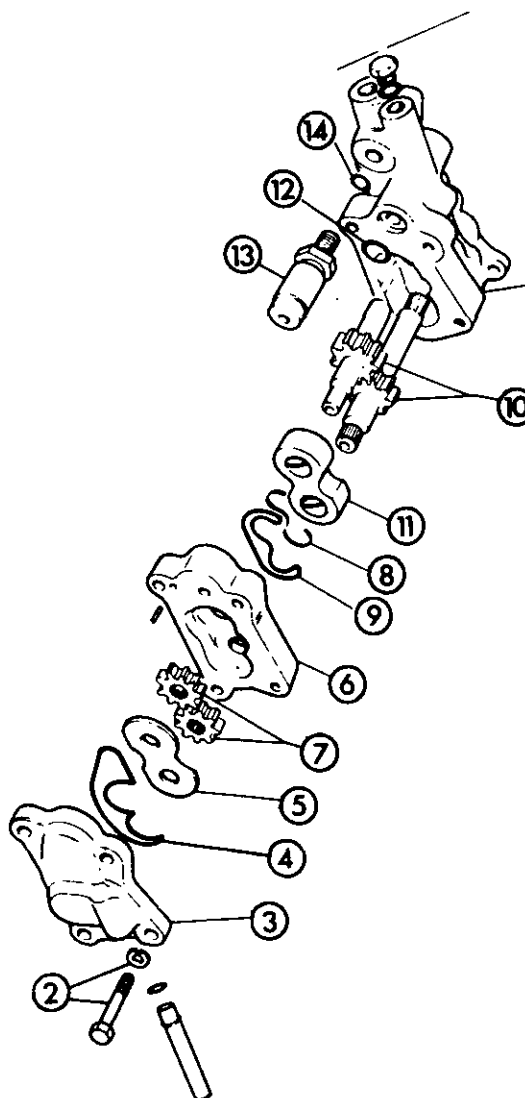
Auxiliary Pump Servicing

8B-06-03

Special Tools: See Part 8A

Disassembly

1. Remove the Auxiliary pump, Part 8A.
2. Remove the end cover securing bolts and locking washers.
3. Remove the end cover.
4. Remove the seal.
5. Remove the bearing plate.
6. Remove the centre body complete with the gears and seals.
7. Withdraw the gears.
8. Remove the P.T.F.E. seal (white).
9. Remove the centre body seal.
10. Withdraw the shafts complete with the bearing.
11. Remove the bearing.
12. Remove the 'O' ring.
13. If necessary remove the main relief valve.
14. If necessary remove the 'O' ring.
15. If necessary service the Multi-power/I.P.T.O. relief valve, operation 8B-08-06.



AUXILIARY HYDRAULICS**Examination****Bearings**

Examine the bearings for wear on their faces and in their bores. Pay particular attention to the lubricating scrolls. Score marks, between the bearing bores can cause high leakage losses. During major overhaul the bearings should be renewed, but if not badly worn, they can be salvaged, by polishing as follows:

Place a sheet of 'O' grade emery paper, lubricated with paraffin on a true, flat surface (e.g., a surface plate, or sheet of plate glass), then polish the bearing face, using a light rotary motion.

Outer diameters of the bearings can be lightly polished to obtain free movement in the body.

Bodies

Inspect the bodies for external damage and cracks. Examine bores for wear and damage. The gears always cut a light track on the inlet side of the body bores. The depth of this track must not exceed 0,10 mm (0-004 in). Examine the bearing face in the pump body for wear and damage, as this can cause high leakage losses.

Examine the bearing bores for wear. If they are worn excessively, the pump body must be replaced.

Gears

Examine the gears for scored or worn faces or journals, damaged teeth and surface cracks. Slight wear or scoring on the journals can be removed by polishing between lathe centres, using 'O' grade emery paper lubricated with paraffin. Check the widths of the drive and driven gears. Their actual width is relatively unimportant, provided that each pair are within 0,005 mm (0-002 in) of each other and that the journals are within 0,013 mm (0-005 in) of one another. Spare gears are only available as matched pairs.

Check the gear faces for flatness by smearing a bearing face with engineer's "blue" and rotating the gear against it. This will also reveal any sharp edges on the teeth which can be removed with a fine needle or by stoning.

Under working conditions, hydraulic pressure within the pump loads the gears towards the inlet side of the body, thus cutting the running track. If the bearings, or gear journals wear, the gears move over and deepen the running track. Therefore, if the running track is worn past, or to the limit, for re-use, the fitting of a new floating bearing may not improve the pump efficiency, as the new bearing will hold the gears and prevent them from bottoming in the running track.

Always fit a set of new seals and 'O' rings on reassembly.

Reassembly

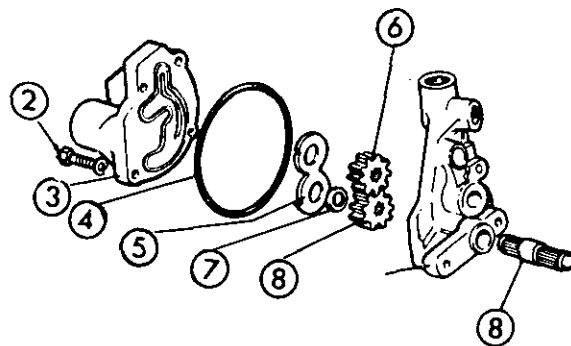
1. Reverse procedures 1 to 15 except:
 - (a) After checking that all parts are clean, lubricate all parts with a clean, approved oil.
 - (b) Fit the floating bearing with its machined recess adjacent to the gears and the relieved radii on the outlet side of the pump (i.e. the R.H. side of the pump, when viewed from the rear). Check that the floating bearing is 0,05 to 0,13 mm (0-002 to 0-0055 in) BELOW the face of the pump body.
 - (c) Fit a new seal to the centre body then fit the P.T.F.E. seal (white) between the OUTER edge of the rubber seal and the pump body.
 - (d) When refitting the centre body to the pump, DO NOT DISPLACE THE SEALS.
 - (e) Refit the rear bearing with the recess adjacent to the gears. Check that the face of the rear bearing is 0,05 to 0,18 mm (0-002 to 0-007 in) BELOW the face of the centre body. Fit a new seal to the rear cover, then fit the cover, plus the bolts and lockwasher. Tighten the bolts to 27 Nm (20 lbf ft).

AUXILIARY OR MULTI-POWER/I.P.T.O. PUMP**Multi-Power I.P.T.O. pump****8B—07—05****Servicing**

Special Tools: See Part 8A

Disassembly

1. Remove the pump, operation 8B—05—02.
2. Remove the securing bolts and locking washers.
3. Remove the end cover.
4. Remove the seal.
5. Remove the bearing plate.
6. Remove the idler gear.
7. Remove the circlip.
8. Slide out the shaft and gear.

**Examination**

Examine the pressure plate for wear on the faces and bores. Score marks between the bearing bores can cause high leakage losses. During major overhaul, the pressure plate can be renewed, but if not badly worn, it can be salvaged, by polishing, as follows:

Place a sheet of 'O' grade emery paper, lubricated with paraffin, on a true, flat surface (e.g. a surface plate, or sheet of plate glass). then polish the bearing plate, using a light, rotary motion.

Outer diameters of the pressure plate can be lightly polished to obtain free movement in the body.

Inspect the body for external damage or cracks and examine the bores for wear, or damage. The gears always cut a light track on the inlet side of the body bores. The depth of this track must not exceed 0,10 mm (0.004 in). Examine the bearing face in the pump body for wear or damage, as this can also cause high leakage losses.

Examine the diameter of the driven gear spigot for wear. This will normally show up as a step on the diameter and if wear has taken place, the running track wear in the body bore will be excessive, necessitating replacement of the body.

Inspect the gears for scored or worn faces, damaged teeth, or surface cracks. Slight wear or scoring on the gear faces can be polished in a similar manner to that of the bearing plate. Check the width of the gears. Their actual width is relatively unimportant, provided that they are within 0,005 mm (0.002 in) of each other.

Visually inspect the sealing face of the end plate for damage, cracks, or scoring and check the flatness with a straight edge.

Replace any defective components and fit a new seal and circlip.

Reassembly

1. Reverse procedures 1 to 8 except:
 - (a) Refit the floating bearing with the relieved edge and the recessed face to the outlet side of the pump.
 - (b) Check that the floating bearing is 0,05 to 0,18 mm (0.002 to 0.007 in) BELOW the body joint face.
 - (c) Re-tighten the end cover bolts to a torque of 27 Nm (20 lbf ft).

AUXILIARY HYDRAULICS

AUXILIARY OR MULTI-POWER/I.P.T.O. PUMP

Multi-power/I.p.t.o. relief valve Servicing

8B-08-06

Special Tools: 840 Test Kit
 MF 166, MF 810-1/4 and MF 260-4/4
 Adaptors
 357 197×91 90° Elbow
 Seat replacer, See page 8B-08
 Peening tool, See page 8B-08

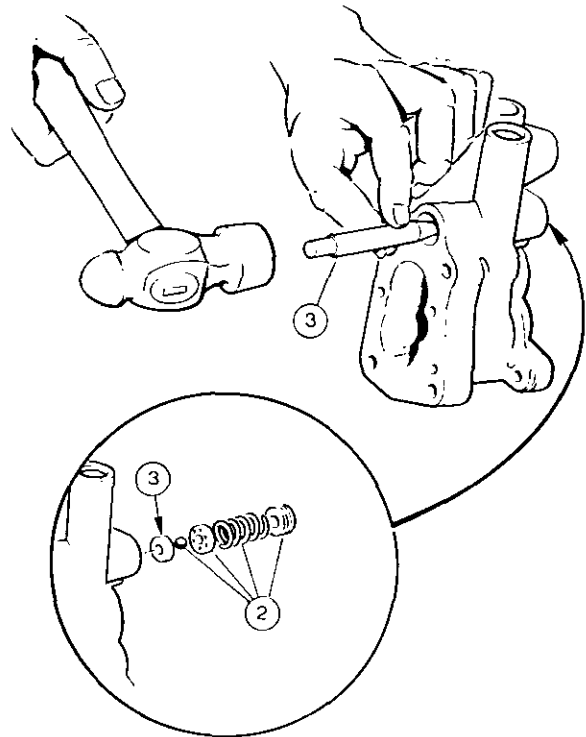
NOTE: The relief valve cannot be properly serviced without these tools.

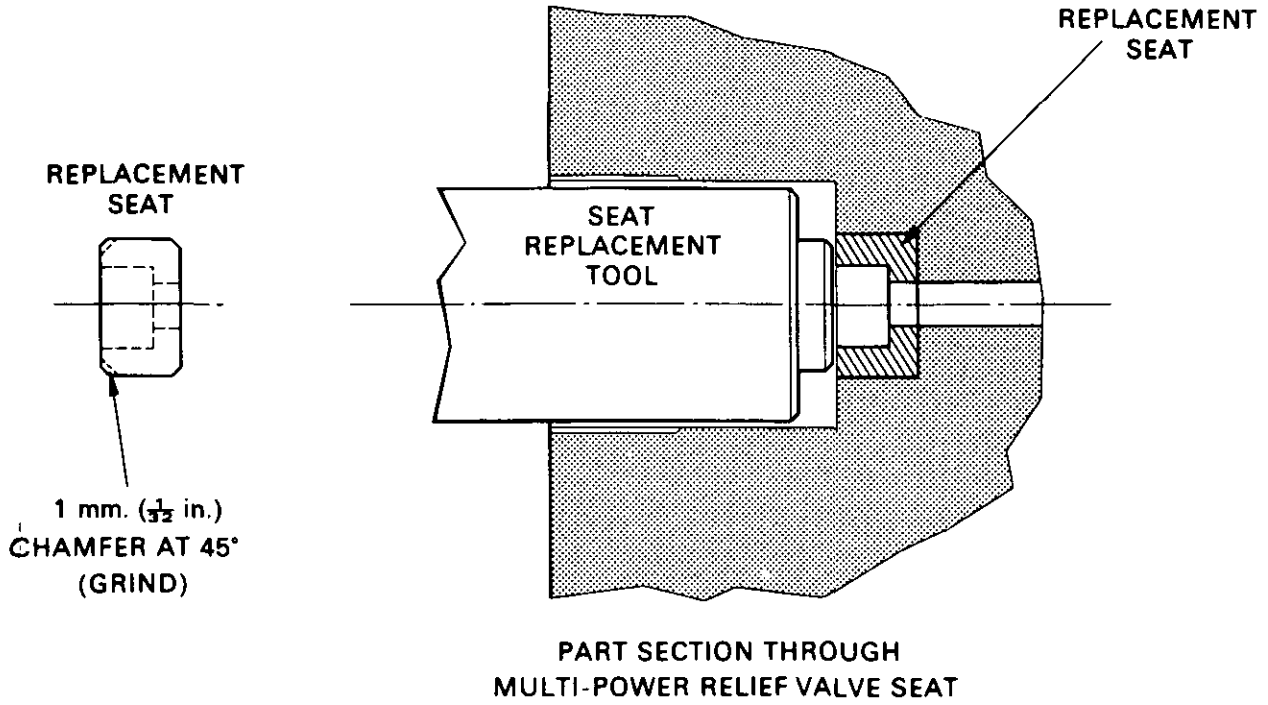
Procedure

1. Remove the pump. Operation 8B-05-02.
2. Unscrew the locking screw and remove the spring, guide and ball.
3. Drive out the seat.
4. Degrease the seating in the pump body.
5. Grind a chamfer on the new seat.
6. Apply two or three drops of Loctite Sealant (C) to the pump body seat.
7. Carefully drive the new seat into the body, using the seat replacing tool.

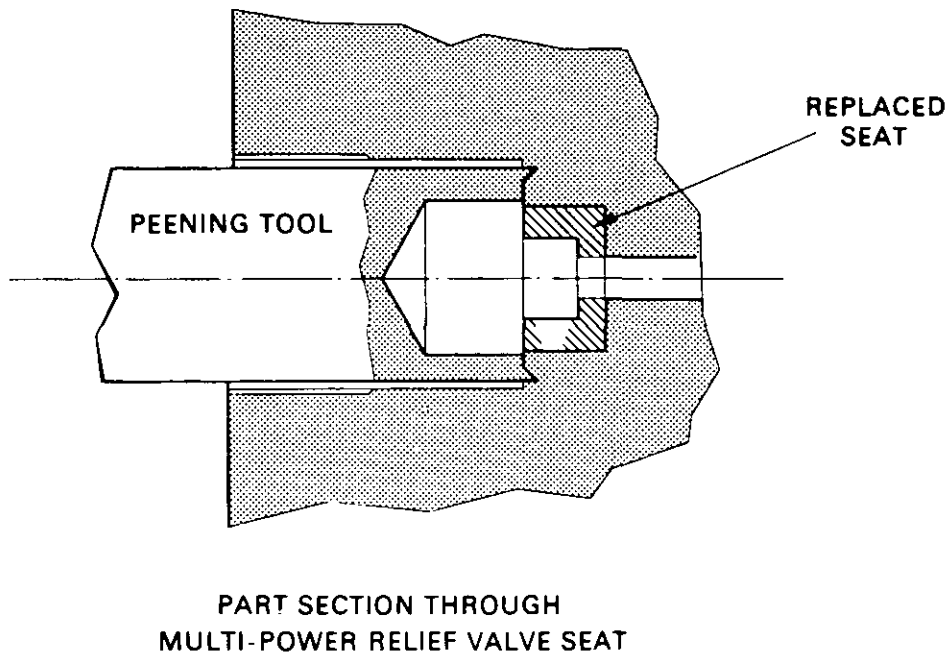
NOTE: Ensure that the seat is fully seated and squarely located in the pump body.

8. Using the peening tool, peen the seat into body. Rotate the tool between each hammer blow to ensure even displacement of the metal.
9. Fit a new tungsten carbide ball, the guide, spring and screw. **DO NOT FULLY SCREW IN THE ADJUSTING SCREW.**
10. Connect the outlet hose of the 840 Test Kit to one of the pump outlet ports, using the MF810-1/4 adapter.
11. Blank off the second pump outlet port with the MF 260-4/4 cap.
12. Fit the MF 148-A7 adapter to the port on the lift cover.
13. Connect the inlet hose of the 840 Test Kit to the MF148A-7 adapter.
14. Check that the transmission is filled to the 'H' mark on the dipstick.
15. Fully unscrew the restrictor valve on the 840 Test Kit.
16. Move the *Draft Control* lever of the tractor to the fully UP position and the *Position/Pressure Control* lever to the LOW end of the "Pressure" portion of the quadrant.
17. Suitably restrain the gears of the plated drive unit with a wedge of aluminium or brass, then start the tractor engine and run it at 2000 rev/min.
18. Move the *Position/Pressure Control* lever towards the HIGH end of the 'Pressure' range. until the pump relief valve blows. Check the blow off pressure on the 840 Test Kit, then, if necessary, adjust the pressure by screwing the relief valve in or out, until a pressure in the range of 63 to 70 kg/cm² (900 to 100 lb/in²) is required to blow the valve. Remove the wedge from the gears.
19. With the pressure correctly set, stake the adjuster screw in position with a centre punch. Recheck the pressure.
20. Stop the tractor engine.
21. Remove the adaptors and the 840 test kit.
22. Refit the pump. Operation 8B-05-02.



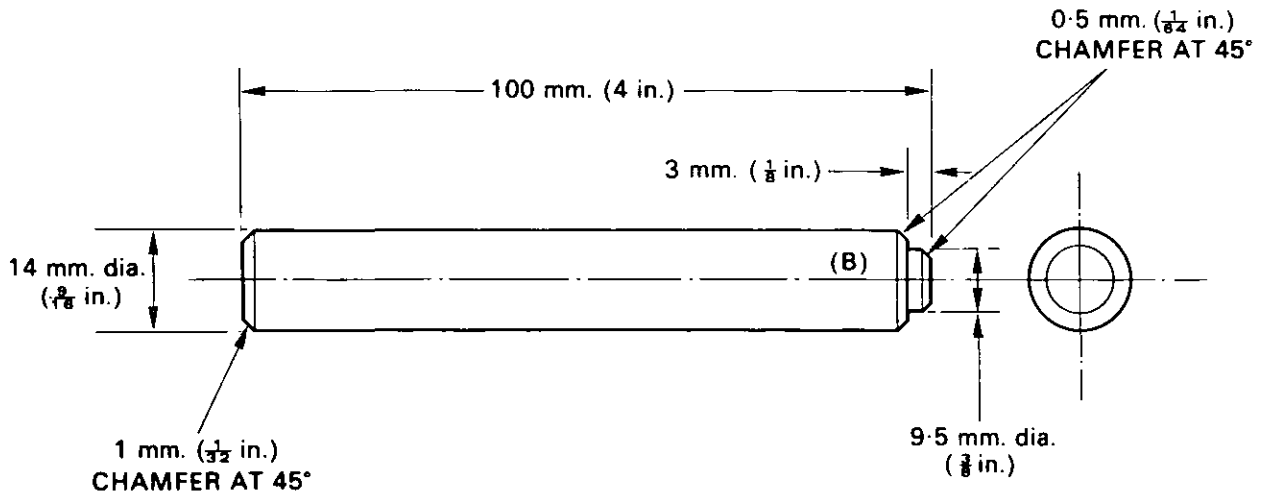


REPLACING THE SEAT



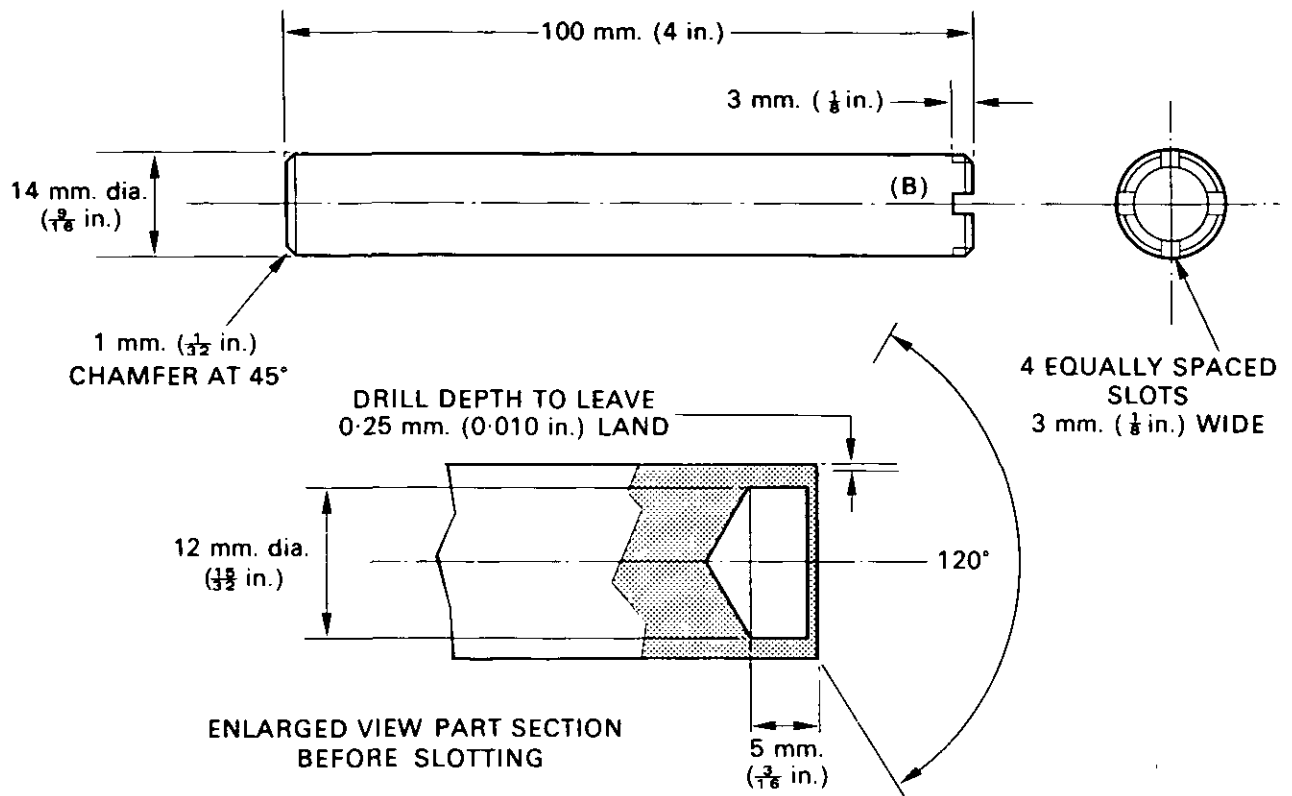
PEENING THE SEAT AFTER FITTING

AUXILIARY HYDRAULICS



MATERIAL: SILVER STEEL B.S. 1407 OR B.S. 970 EN 31
 TREATMENT: HARDEN & TEMPER AT APPROX. 260°C TO HRC 56-59 (END 'B' ONLY)

SEAT REPLACER



MATERIAL & TREATMENT: AS ABOVE

PEENING TOOL

DRAWBAR AND LINKAGE**Part 8—Section C**

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	LIFT RODS	02
	CONTROL BEAM	02
	HOOK-TYPE LOWER LINKS	02
	HOOK-TYPE TOP LINK	02

DRAWBAR AND LINKAGE

GENERAL

The three point linkage controls the vertical movement of the mounted and semi-mounted implements.

The linkage consists of:

- | | |
|-----------------------------|-------------------------|
| 1 Top link | 8 Hook-type lower links |
| 2 Two lower links | 9 Hook-type top link |
| 3 Two lift rods | |
| 4 Two check chains | |
| 5 Control beam | |
| 6 Interchangeable ball ends | |
| 7 Levelling lever | |

The linkage (9 hole) drawbar can be fitted to the two rear ends of the lower links together with a pair of adjustable stays, the upper ends of which are attached to the top of the centre housing by the long hitch pin. The height of the linkage drawbar is set and then locked in that position by tightening the bolts of the adjustable stays. The adjustable stays also arrest the excessive transverse movement of the two lower links.

TOP LINK

The top link transmits the draft reaction forces from the ground engaging implements to the control spring and plunger assembly in the lift cover.

The top link consists of three main components:

- Top ball end
- Turnbuckle barrel and spring locking clip
- Bottom ball end (Implement end)

The top link is adjustable for length, seven rings are machined on each ball and shank; the centre or wider marker ring indicates its normal length. The turnbuckle is prevented from rotating by the spring locking chip at its top end.

LOWER LINKS

General

The two lower links have interchangeable balls at their rear ends and normally Category 2 balls are fitted.

In the instance of the heavy duty tractors, the front ends, of the two lower links have alternative attachment holes, one vertically above the other and the size of the tyre governs the attachment hole in use. The two lift rods are fitted to the opposite hole to that of the lower link attachment hole.

The lower link check chains are always fitted to the lift rod bolts and the stabiliser chains (when fitted) are secured to the hole at the rear of the lift rod.

A spring clip is inserted into the lower link towards the implement end to accommodate the linch pin and ring assembly when it is not in use.

LIFT RODS

General

The two lift rods connect the lift arms to the lower links having a knuckle type joint at the top end with the link arms and a swivelling bolt at the bottom end with the lower links.

The left hand lift rod consists of three main components, knuckle joint, yoke section and lower fork. The lift rod is of a set length and the yoke section is "pop" marked as it enters the lower fork.

The right hand lift rod is similarly constructed but the yoke section incorporates a bevel gear levelling box, thus the length can be adjusted for attachment to the implement. By rotating the handle of the levelling box, the yoke shank is screwed out of or into the lower fork.

The lower fork section of both lift rods may have an alternative elongated lower link attachment hole, this will permit lift rod float when working with wide implements. In this instance the lift rods are detached from the lower links, rotated 180° and refitted using the elongated holes thus the lubricators will point downwards.

CHECK CHAINS

The two check chains restrict the movement of the lower links in the transverse plane thus preventing the lower links or implement fouling the inside walls of the rear tyres.

The check chains are fitted between the bottom end of the control beam bracket and the inner face of each lower link using the lift rod bolts.

The check chains are set longer for Category 2 implements.

CONTROL BEAM

The control beam connects the top link to the control spring rod of the tractor hydraulic system when the Draft control is in use and thus governs the action of the implement.

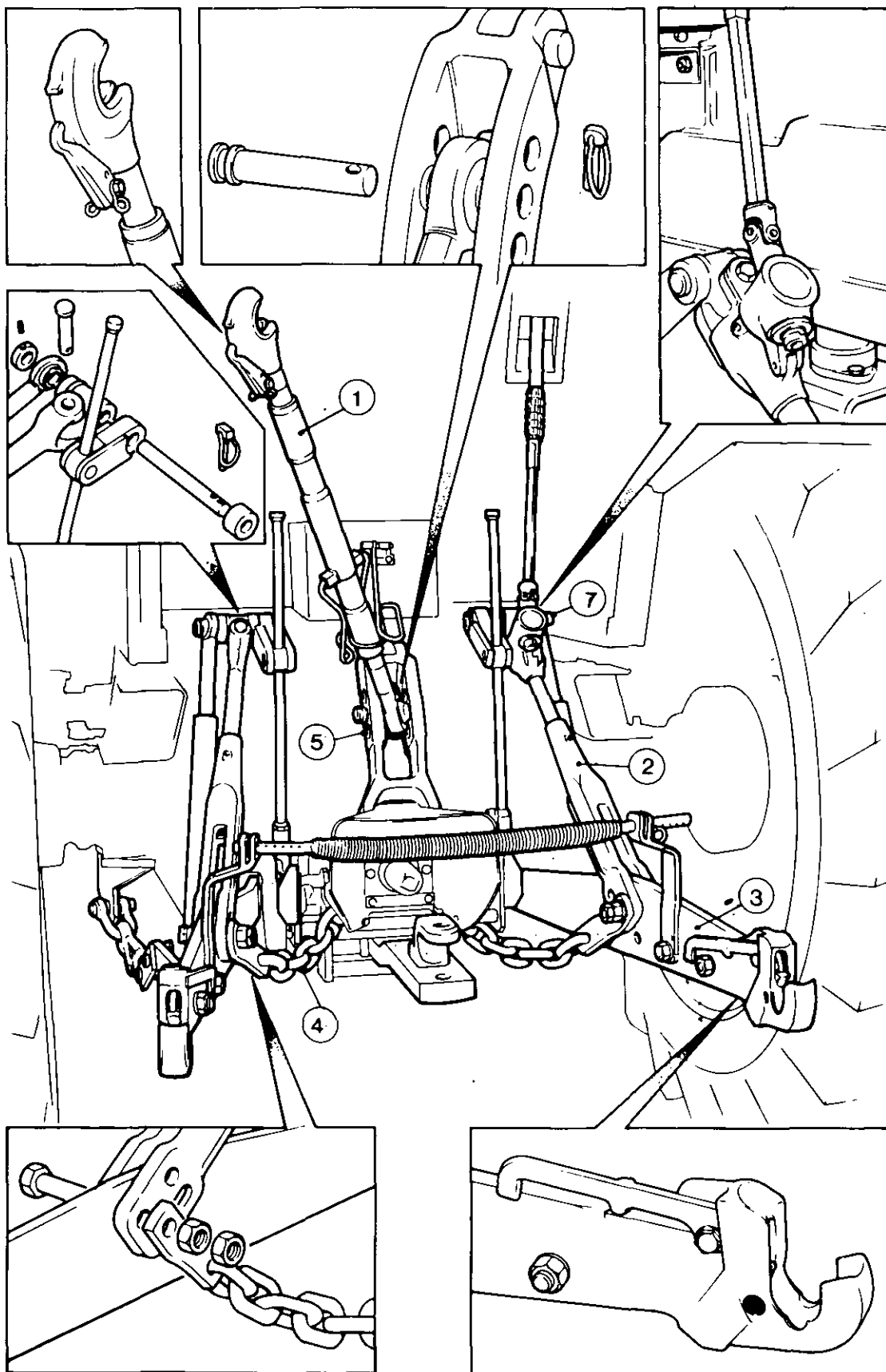
HOOK-TYPE LOWER LINKS

Hook-type lower links are constructed and operate in the same way as the normal ball-end lower links except that when attaching an implement the link balls are placed on the cross shaft of the implement, the tractor is then positioned so that when the lower links are raised the hook-ends snap into connection on the balls. When detaching, this can be done from the tractor seat using a rod to trigger the hook end latches.

HOOK-TYPE TOP LINK

The hook-type top link is constructed and operates in the same way as the normal top link except that it has a hook type connector at the implement end. This snaps into connection with the ball which is fitted to the top of the implement 'A' frame. When detaching, this can be done from the tractor seat using a rod to trigger the hook end latch.

DRAWBAR AND LINKAGE



**MF 600 SERIES TRACTOR
WORKSHOP SERVICE MANUAL**

PART 9

Publication No. 1856 274 M1

comprising

A ELECTRICAL SYSTEM AND EQUIPMENT

ELECTRICAL SYSTEM

PART 9 — Section A

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GENERAL

The electrical system of this tractor comprises either a 180 or 125 Ampere hour 12 Volt negative earth system, charged by either a Lucas or Motorola 55 Ampere alternator, both makes of alternator incorporate an integral rectifier and control box.

The battery is mounted in the front of the tractor, and access is gained through the detachable front grille panel.

The alternator is mounted on the right hand side of the engine and is driven by an endless belt from the crankshaft pulley. The alternator has adjustable mountings to enable the correct belt tension to be maintained.

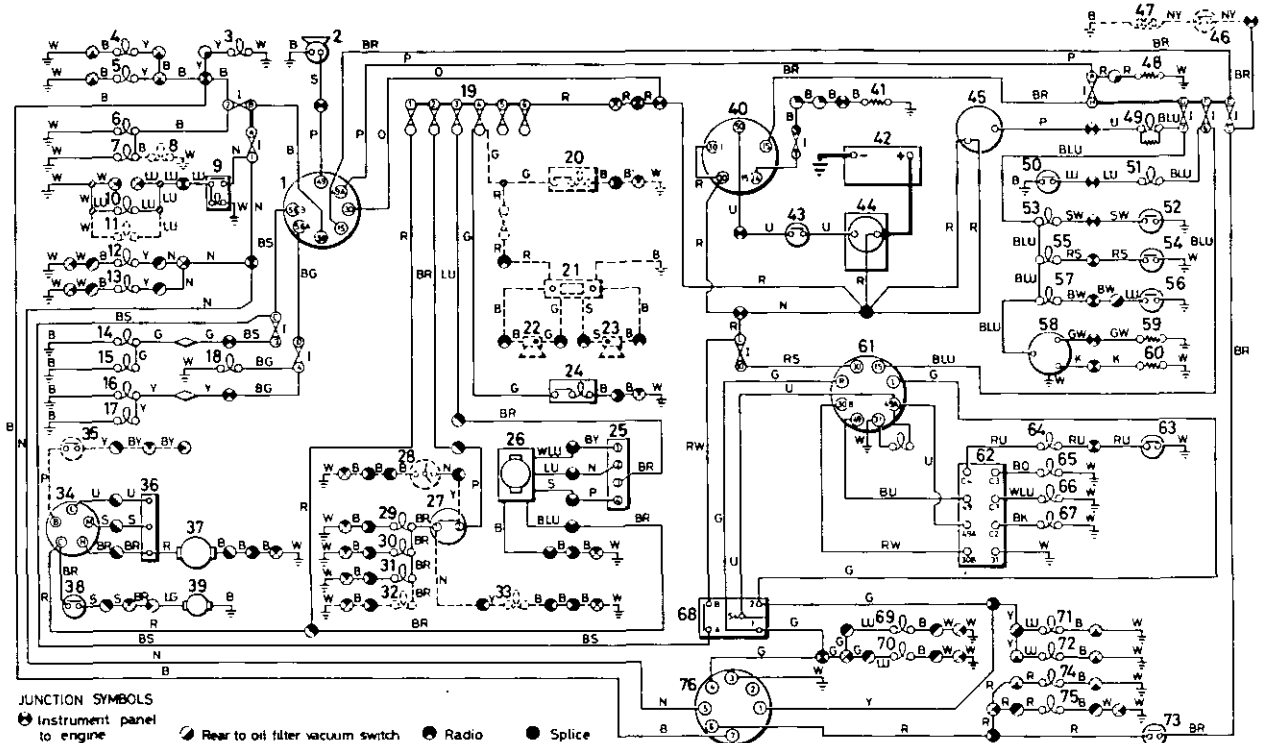
A Lucas or M50 starter motor is bolted to the left hand side of the engine. A neutral safety start switch is fitted on the top of the transmission case, which renders the starter motor inoperative until the dual range selector level is in the neutral position.

The electrical equipment should be serviced at the times stated in Part 1 Section B Maintenance Section with particular attention paid to the cleanliness and tightness of battery terminals.

Fuses are fitted to protect the lighting, fresh air blower, cigar lighter, wiper and horn circuits. A blown fuse must always be replaced with one of the same capacity.

Before any operation is carried out on the electrical system, always disconnect the battery terminals.

ELECTRICAL SYSTEM



JUNCTION SYMBOLS

- ⊕ Instrument panel to engine
- ⊗ Instrument panel to rear
- ⊙ Rear to roof
- ⊚ Rear to RH fender
- ⊛ Rear to LH lamps
- ⊜ Rear to engine
- ⊝ Rear to oil filter vacuum switch
- ⊞ RH fender to RH lamps
- ⊟ Roof harness to roof unit
- ⊠ Roof unit to blower motor
- ⊡ Roof unit to wiper motor
- ⊢ Roof unit to clock
- Radio
- ⊕ Earth route through a complex path in roof unit
- ◇ Headlamps
- ⊖ Ether start
- ⊙ Cigar lighter to instrument panel
- Single in line

OTHER SYMBOLS

- ⊞ Fuse box - instrument panel
- ⊞ Earth via fixings
- Optional circuits
- W or B Earth via cable

WIRING DIAGRAM

Key

1. Lights and Horn Switch
2. Horn
3. Cigar Lighter—Illumination
4. Left Hand Side Light
5. Left Hand Tail Light
6. Fuel/Temperature Gauge—Illumination
7. Tractometer—Illumination
8. Not applicable
9. Plough Light Switch and Illumination
10. Right Hand Plough Light
11. Right Hand Plough Light
12. Right Hand Side Light
13. Right Hand Tail Light
14. Right Hand Dipped Beam
15. Left Hand Dipped Beam
16. Right Hand Main Beam
17. Left Hand Main Beam
18. Main Beam Warning Light
19. Fuse Box—Roof
20. Not applicable
21. Radio
22. Left Hand Speaker
23. Right Hand Speaker
24. Interior Light and Switch
25. Wiper Switch
26. Wiper Motor
27. Roof Instrument Panel Illumination-Switch
28. Not applicable
29. Washer Switch—Illumination
30. Wiper Switch—Illumination
31. Heater Control—Illumination

32. Not applicable
33. Not applicable
34. Blower Switch
35. Not applicable
36. Blower—Resistance
37. Blower Motor
38. Windscreen Washer Switch
39. Windscreen Washer Motor
40. Ignition Switch
41. Thermostat
42. Battery
43. Neutral Safety Switch
44. Starter Motor
45. Alternator
46. Not applicable
47. Not applicable
48. Cigar Lighter
49. Alternator Warning Light and Resistor
50. Air Cleaner Vacuum Switch
51. Air Cleaner Warning Light
52. Engine Oil Pressure Switch
53. Oil Pressure Warning Light
54. Multi-Power Switch
55. Multi-Power Warning Light
56. Oil Filter Vacuum Switch
57. Oil Filter Warning Light
58. Fuel/Temperature Gauge
59. Water Temperature Sender Unit
60. Fuel Tank Sender Unit
61. Hazard Warning Lights Switch and Illumination
62. Flasher Unit
63. Parking Brake Switch
64. Parking Brake Warning Light
65. Trailer 2 Flashers Warning Light

66. Tractor Flashers Warning Light
67. Trailer 1 Flashers Warning Light
68. Flashers and Head Light Flash Switch
69. Right Hand Front Flasher
70. Right Hand Rear Flasher
71. Left Hand Front Flasher
72. Left Hand Rear Flasher
73. Brake Stop Switch
74. Left Hand Stop Light
75. Right Hand Stop Light
76. Trailer Socket. (See wiring details)

Wiring Colour Code

- B — Black
- G — Green
- K — Pink
- L — Light
- N — Brown
- O — Orange
- P — Purple
- R — Red
- S — Grey
- U — Blue
- W — White
- Y — Yellow

Trailer Socket Wiring

1. Left Hand Rear Flashers
2. Spare
3. Earth
4. Right Hand Rear Flashers
5. Right Hand Tail Light
6. Right Hand and Left Hand Brake Stop Lights
7. Left Hand Tail Light and Number Plate Light

ELECTRICAL SYSTEM

SERVICING THE ELECTRICAL SYSTEM

The electrical equipment should be serviced at the times stated in Part 1, Section B.

Precautions

IMPORTANT: Always disconnect the alternator wiring before removing the battery leads.

1. Before any operation is carried out on the tractor electrical system, always disconnect the battery leads.
2. To prevent damage to the voltage regulator do not connect or disconnect any part of the charging circuit including the battery while the engine is running. (This action may damage the voltage regulator).
3. When connecting the alternator, slave battery or battery charger to the tractor always observe correct polarity, (positive to positive, negative to negative) or damage to the voltage regulator and rectifier may occur.

WARNING: If, at any time, it is necessary to remove the battery from the tractor, on refitment always ensure that the battery leads are reconnected correctly THE FIRST TIME, since even a momentary connection of the wrong lead, with the other lead already incorrectly connected, will cause serious damage to the alternator.

Battery lead connecting sequence:
Connect the positive lead(+) to the terminal marked + (Red);
Connect the negative lead(-) to the terminal marked - (Black).

Preliminary Checks

If the charging circuit is faulty, indicated by a flat battery, frequent topping-up of the electrolyte or the warning light staying on throughout the engine speed range, check:—

- (a) That all cable connections are clean and tight.
- (b) That all components and wiring are without signs of overheating or damage.
- (c) That the alternator drive belt tension is correct and adjust as necessary.
- (d) That the battery is serviceable and the connections are in good condition.

For the complete list of electrical system faults, together with their symptoms and remedies, consult the fault finding table.

Routine Maintenance

(a) Battery

Check the electrolyte level in the battery after every 100 hours of operation and top up with DISTILLED WATER as necessary. See operation 9A—07—14.

In an emergency, clean rainwater or melted snow can be used in place of distilled water. NEVER USE salt water, chlorinated water, chemically softened water, boiled water, or stagnant water.

Make sure that the filler plug or cover plate vent holes are kept open and free of dirt at all times.

The battery top should be kept clean, any moisture or dirt being wiped off at regular intervals. Dilute ammonia on a lint free cloth should be used for removing any traces of sulphation from the battery top or terminals.

Symptoms	Probable Fault		Test Procedure	Remedial Action
	Alternator	Circuit		
Indicator light stays OUT under all conditions	—	Blown filament	—	Renew filament
	Internal short circuit	—	Max Output (low reading)	Change alternator
	—	Bad connection or broken cable	Continuity Test	Renew connection/cable
Indicator light stays ON under all conditions (Dims at low rev/min)	High Output (internal short circuit)	—	Max Output Test Voltage Regulator Test	Change Alternator
Indicator light stays ON. Dims as rev/min increases: goes out at high rev/min	—	Short circuit to to earth	Continuity Test Voltage Drop Test	Renew connection/cable
	—	Fan Belt Adjustment	—	Adjust Fan Belt
	Output Low	—	Max Output Test	Change Alternator
Battery not charging	—	Battery in poor condition	Hydrometer Test Discharge Test	Change Battery
	Voltage control faulty	—	Voltage Regulator Test	Change Alternator
	—	High resistance (Bad Connection) Leak to earth	Voltage Drop Test Continuity Test	Renew or clean connection
Battery overcharging (Excessive use of electrolyte, filament bulbs blow after short period in service)	Voltage Control	—	Voltage Regulator Test	Change Alternator
Light ON when engine stationary. Dims at cut-in speed and remains dim at very high speeds	Internal Short Circuit	—	Max Output (Very Low)	Change Alternator

ELECTRICAL SYSTEM

The battery posts should be kept clean and the connections checked periodically for tightness. To maintain a dry, clean contact between the battery post and terminal clamp, the terminals should be smeared with grease.

(b) Alternator

Routine maintenance is limited to wiping away any oil or dirt which may have accumulated around the apertures on the alternator and ensuring that the drive belt is correctly tensioned. The alternator bearings are lubricated on initial assembly and no further lubrication is needed during service life.

(c) Fuses

In the case of a blown fuse, the cause must always be identified and rectified before replacement of the fuse. Only fuses of the same capacity may be used for replacement purposes. For the correct fuses, see the lists that follow.

Fuses—Instrument Panel Fuse Box

		<i>Continuous Rate</i>
Plough Light	20A	8A
Right hand side/Tail		
Panel Illumination	20A	8A
Cigar Lighter illumination		
Left hand side/Tail		
Dip Beam Headlights	20A	8A
Main Beam Headlights	20A	8A
Stop Lights	20A	8A
Flashers		
Air Cleaner Warning Light		
Gauges and Warning Lights	20A	8A
Cigar Lighter and Horn	20A	8A
Thermostart	40A	16A
Hazard Warning	40A	16A

Fuses—Cab Roof Fuse Box

Roof Work Lights	20A	8A
Radio	20A	8A
Interior Light	20A	8A
Wiper	20A	8A
Heater Control Illumination	20A	8A
Heater Blower	20A	8A

BULBS

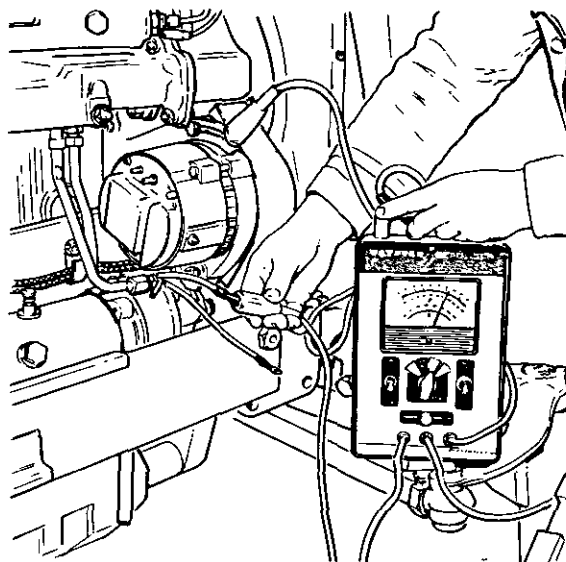
	Size	Fitting	Type
Headlights	45/40W	Bayonet	Round Glass
Front Sidelights	5W	Bayonet	Round Glass
Rear Sidelights Brake Lights	5W 21W	Bayonet	Round Glass— Dual Filament
Flashing Indicator/ Hazard Warning Lights	21W	Bayonet	Round Glass
Plough Light	55W Halogen	Bayonet	Round Glass
Panel Warning Lights	2.2W	Push-in	Domed Glass
Indicator Warning Lights	2.2W	Push-in	Elongated Glass
Instrument Lights	2.2W	Push-in	Elongated Glass
Number Plate Light	5W	Bayonet	Round Glass
Interior Light	5W	Bayonet	Round Glass

ELECTRICAL SYSTEM**SERVICING THE ELECTRICAL SYSTEM****Cable Continuity Test 9A-01-06**

Special Tools: 'CRYPTON' BA.402 Electrical Tester and Harness or equivalent, or alternatively—

- D.C. Voltmeter reading from 0 to 20 V,
- D.C. Ammeter reading from 10 to 100A.

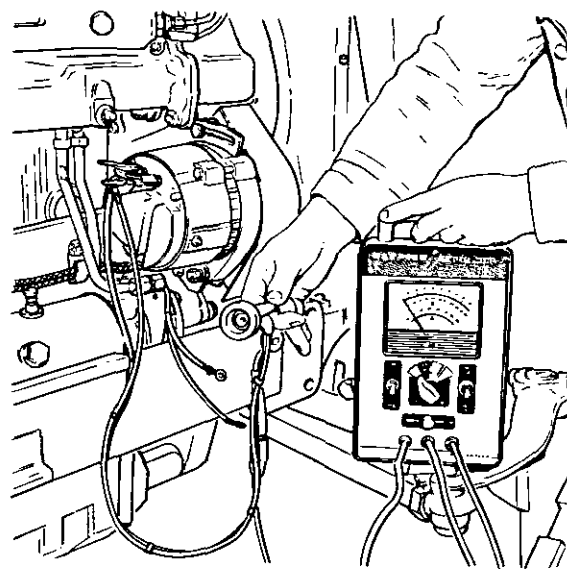
1. Turn the tractor starting switch to the 'ON' position, checking that the indicator light illuminates.
2. Disconnect the main output cable (RED) and the indicator light cable (PURPLE) at the terminals on the alternator.
DO NOT TOUCH THE CABLES TO EARTH.
3. With the BA.402 tester, connect the YELLOW lead to earth and the RED lead to each of the cable ends *in turn*.
4. Check the voltage shown by the tester. With the tester selected to 20 V, the gauge should register battery voltage.
5. Remove the tester and reconnect the alternator cables.
6. If the voltage reading is low (below 9.6 V), check the condition of the battery. See operation 9A-06-13. If the battery is serviceable, a faulty connection or cable in the charging circuit is indicated.

**SERVICING THE ELECTRICAL SYSTEM****Alternator Maximum Output Test 9A-02-06**

Special Tools: 'CRYPTON' BA.402 Electrical Tester and Harness

1. Disconnect the main output cable (RED) and the indicator light cable (PURPLE) at the terminals on the alternator.
2. Connect the test harness to the alternator terminals *as follows*:
 - (a) The RED lead of the harness to the alternator main output terminal;
 - (b) the BLUE lead of the harness to the alternator indicator light terminal.
3. With the BA.402 tester, connect the BLACK test clip to the battery positive (+) terminal and the YELLOW clip to the battery earth (-) terminal, *then connect the RED clip to the remaining lead of the test harness and ensure that the test lamp illuminates.*
4. Start the tractor and increase the engine speed above idling, when the test lamp should go out.
5. Run the engine at maximum rev./min., select 60 amp. on the tester, then push the test button for 10 seconds and note the alternator output on the gauge.
6. Compare the alternator output reading with the relevant minimum value. A very high or low output for the alternator indicates an internal fault in this. Before rejecting the alternator, ensure that the electrical circuit and battery are serviceable.
7. Remove the tester and reconnect the alternator cables.

NOTE: This test should be carried out with the alternator running at its normal operating temperature. The normal output of the alternator may be exceeded when running cold, which produces a misleading result.



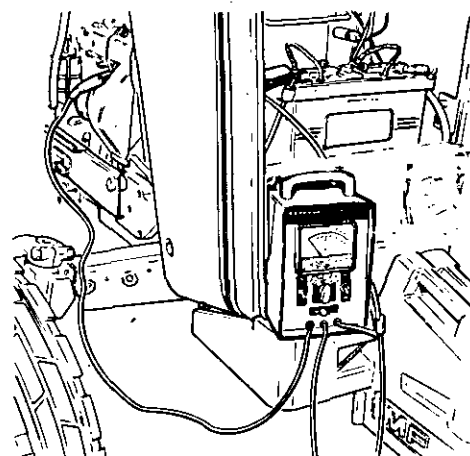
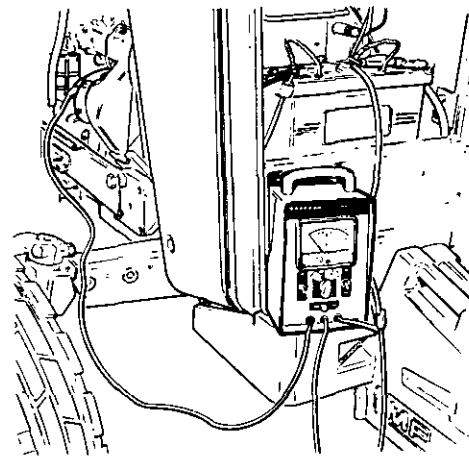
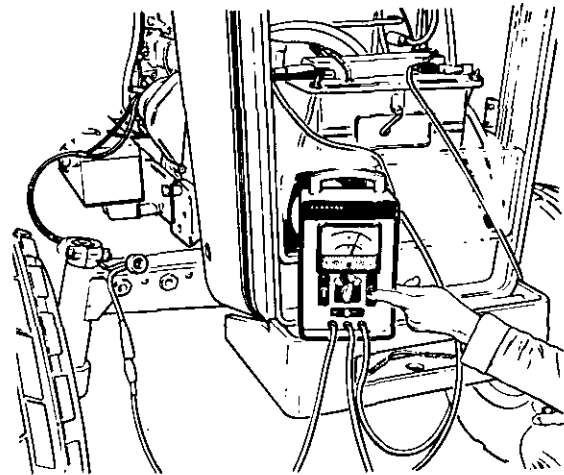
SERVICING THE ELECTRICAL SYSTEM

Voltage Regulator Setting 9A-03-07

Special Tools: 'CRYPTON' BA.402 Electrical Tester and Harness

1. Remove the front grille.
2. Carry out procedures 1 to 4 of operation 9A-07-10.
3. Run the engine at maximum rev./min. and select 20 V. on the tester.
4. Move the test switch to RES. IN, whereupon the voltmeter reading should be 13.6 to 14.4 V.
5. Select the test switch to RES. OUT.
6. Remove the tester and reconnect the alternator cables.
7. If the voltage reading obtained is low, check the drive belt tension and the charging circuit for continuity before rejecting the alternator.
if the voltage reading obtained is high, change the drive belt tension and the charging circuit for continuity before rejecting the alternator.
If the voltage reading obtained is high, change the alternator.

NOTE: It is essential that the battery is in good condition when carrying out this test.



SERVICING THE ELECTRICAL SYSTEM

Voltage Drop Test 9A-03-07

Special Tools: 'CRYPTON' BA.402 Electrical Tester

1. With the BA.402 tester, connect the RED clip of the tester to the alternator output terminal and the YELLOW clip to the battery positive (+) terminal.
2. Select the tester to 20 V. and run the tractor engine at maximum rev./min.
3. Switch on all the tractor lights, which should give a reading on the tester gauge of not more than 0.5 V.
4. Transfer the YELLOW clip to the battery earth (-) terminal and the RED clip to the alternator body (earth), whereupon the gauge reading should not exceed 0.25 V. If the limits are exceeded, a high resistance in the circuit is indicated.
5. Remove the tester.
6. Check that all connections are clean and tight, and change any cables that are suspect.

ELECTRICAL SYSTEM

BATTERY

Preparation of Batteries for Service 9A—05—08

Preparation of Dry-Charged Batteries

Batteries intended for export markets are supplied "dry-charged" and must be filled with electrolyte of the correct specific gravity (S.G.) according to the climate before being put into service.

Dry-charged batteries leave the manufacturer in a fully charged state but may slowly discharge whilst in storage.

Batteries should not be filled with electrolyte until required for service.

Initial charging after filling is not normally necessary; but a freshening charge for 4 hours at the rate specified in the Table below is extremely advantageous from the point of view of battery life.

Remove the filler plates or plugs and fill each cell with electrolyte of the correct S.G. to the top of the perforated separator guard in one operation.

The temperature of the charging room, battery and electrolyte should be maintained between 15.6°C and 37.7°C (60°F and 100°F). If the battery has been stored in a cool place, it should be allowed to warm up to room temperature before filling.

If, after a period of twenty minutes, the casing of the filled battery feels warm to the back of the hand, it should be assumed that the battery has become completely discharged during storage, and a charging process appropriate to a **DRY UNCHARGED BATTERY** should be applied.

Preparation of Dry Uncharged Batteries

When dry uncharged batteries are filled, heat is created from the mixing of the filling acid with moisture in the plates, and also as a result of chemical action on the negative plates.

With batteries in moulded containers this heat may crack the containers, therefore these batteries must be filled in two stages.

In the first stage the battery should be half filled and allowed to cool for 6 to 12 hours.

The battery should then be filled to the level of the separator guard and allowed to cool for a further 2 hours to complete the second stage.

Charge the battery at the rate specified in the Table below until the voltage and S.G. readings remain stable over 5 consecutive hourly readings.

The charging duration is from 48 to 80 hours, dependent upon the storage period of the battery.

Maximum permissible electrolyte temperature during charge is: Climates below 26.6°C (80°F): 37.7°C (100°F).

Climates over 26.6°C (80°F): 48.8°C (120°F).

If the temperature of any cell rises above the permissible maximum, the charge must be interrupted until the temperature has fallen to 5.5°C (10°F) below that figure.

During charging, ensure that the electrolyte is level with the top of the separator guard, by the addition of electrolyte of the same S.G. as that used in the initial filling of the battery.

Keep the current constant by varying the series resistance of the circuit. This charge should not be broken by long rest periods.

Electrolyte 'frothing' may occur during the first few hours of charging. This can be overcome by **REDUCING** the charging current.

On completion of charging, check the S.G. in each cell, to ensure that it is within the specified limits at 15.5°C (60°F).

If any cell requires adjustment, some of the electrolyte must be syphoned OFF and replaced, either by distilled water, or by electrolyte of the S.G. used originally in the filling of the battery, depending on whether the S.G. is too high or low.

NEVER TRANSFER ELECTROLYTE FROM ONE BATTERY OR CELL TO ANOTHER.

Continue the charging for an hour to ensure adequate mixing of the electrolyte, and again check the S.G. readings. If necessary, repeat the adjustment process until the desired S.G. reading is obtained in each cell. Allow the battery to cool and syphon off any electrolyte above the top of the separator guard.

Preparation of Electrolyte

Approximately 790 cc (1½ pint) of sulphuric acid is required for each 2 volt cell.

The specific gravity (S.G.) of the electrolyte required when filling is:

Climates normally below 26.6°C (80°F)—1.260 (corrected to 15.5°C (60°F)).

Climates normally above 26.6°C (80°F)—1.210 (corrected to 15.5°C (60°F)).

Electrolyte is prepared by mixing distilled water and concentrated sulphuric acid (usually S.G. 1.840) to the required S.G.

Type of Charge	Battery, Amp.-h.			
	90	96	120	125
Freshening Charge (Dry Charged Battery) ..	9 amps	9.5 amps	12 amps	12.5 amps
Initial Charge (Dry Uncharged Battery)	6 amps	6 amps	8 amps	8 amps
Recharging in Service	9 amps	9.5 amps	12 amps	12.5 amps

The mixing of the electrolyte must be carried out either in a lead lined tank or in a suitable glass or earthenware vessel.

SLOWLY add the acid to the distilled water. **NEVER ADD THE WATER TO THE ACID**, as the resultant chemical reaction causes violent spurting of the sulphuric acid.

The approximate proportion of sulphuric acid and distilled water is as follows:

To obtain a specific gravity (corrected to 15.5°C (60°F)) of:

1.260

1.210

Add 1 vol. of acid of 1.840 S.G. (corrected to 15.5°C (60°F)) to

3.2 volumes of water (1.260 S.G.)

4.3 volumes of water (1.210 S.G.)

Heat is produced by the mixture of acid and water, therefore the electrolyte should be allowed to cool before taking hydrometer readings and pouring the electrolyte into the battery.

Use diluted ammonia on a lint free cloth to neutralise acid spillage.

Hydrometer Tests

The specific gravity (S.G.) of acid is measured using a hydrometer. The readings given by each cell should be approximately the same. The electrolyte S.G. varies with temperature. All calculations are always corrected to 15.5°C (60°F). This is known as the reference temperature.

NOTE: The temperature must be that indicated by a thermometer actually immersed in the electrolyte and not the air temperature.

For every 2.8°C (5°F) **BELOW** 15.5°C (60°F), **DEDUCT** 0.002 from the S.G. reading to obtain the true S.G. at 15.5°C (60°F).

For every 2.8°C (5°F) **ABOVE** 15.5°C (60°F), **ADD** 0.002 to the S.G. reading to obtain the true S.G. at 15.5°C (60°F).

NOTE: Never use a naked light when examining a battery, as the mixture of oxygen and hydrogen given off by the battery on charge, and to a lesser extent when standing idle, can be dangerously explosive.

ELECTRICAL SYSTEM**HEADLIGHTS AND FRONT GRILLE ASSEMBLY****Removal and Refitment 9A—06—10****Removal**

1. Pull the front grille release lever forward.
2. Pull the grille top forward and downward.

NOTE: The headlamp wiring will disconnect automatically as it is wired via the spring-loaded three pin plug and connector.

3. Lift the grille and headlamp assembly out of the nose.

Refitment

4. Reverse procedures 1 to 3 except:
5. Adjust the release lever latch plate as follows. Slacken the two bolts on the latch plate then refit the grille and close the latch. Push the grille in as far as possible to obtain an efficient seal around the periphery of the grille, then using a thin spanner tighten the two bolts.
6. Check the operation of the headlamps after refitting the grille.

BATTERY

IMPORTANT: Always disconnect the alternator wiring before removing the battery leads.

NOTE: When reconnecting the battery leads: Connect the positive lead (+) to the terminal marked '+' (red).

Connect the negative lead (—) to the terminal marked '—' (black).

NOTE: The cover plates must be fitted at all times, except when checking the electrolyte level.

Wipe the battery top and smear the terminals with petroleum jelly.

Removal and Refitment 9A—07—10**Removal**

1. Remove the front grille, operation 9A—40—30.
2. Disconnect the battery cables, removing the earth (—) cable first **IN THE INTERESTS OF SAFETY.**
3. Remove the wing nuts and washers.
4. Remove the battery stay.
5. Lift out the battery-stay rods.
6. Lift out the battery.

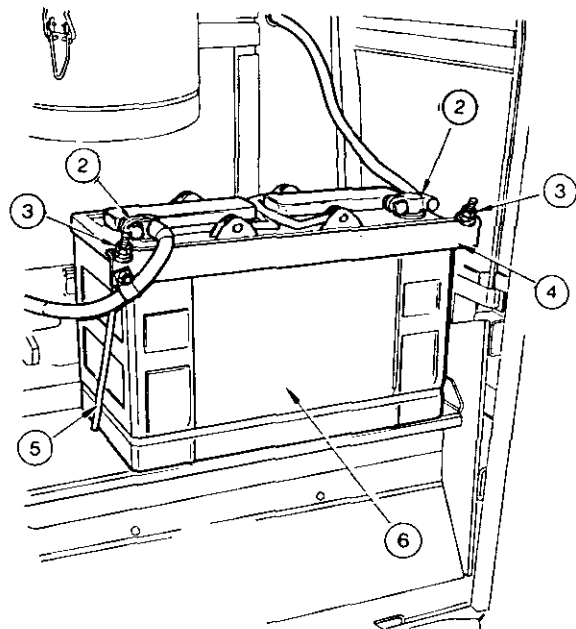
Refitment

7. Reverse procedures 1 to 6, except:
 - (a) Smear the battery terminals and stay-rod wing nuts with petroleum jelly.

Electrolyte Replenishment 9A—08—10

Check the Battery Electrolyte Level every 100 hours.

1. Remove the cover plates or plugs.
2. Check that the electrolyte level just covers the battery plates.
3. If the level is incorrect, top up each cell with distilled water to the correct level.
4. Refit the cover plates or plugs.



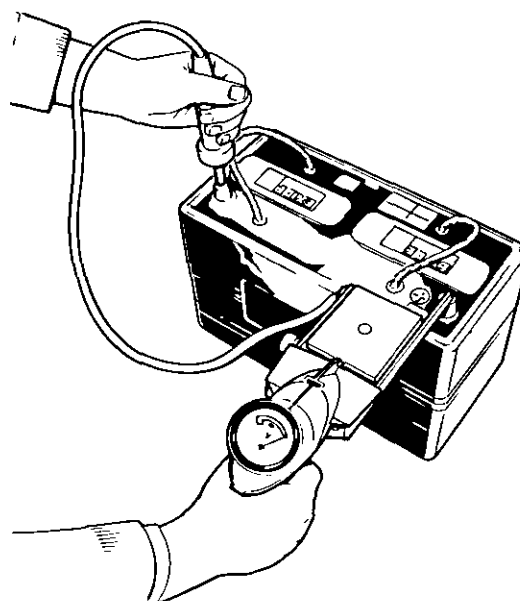
BATTERY**Capacitance Testing****9A—09—11**

Special Tools: 'Crypton' Battery Tester Model B51

1. The gases given off by the cells of a battery are explosive. Always use the battery tester in a well ventilated area.
2. Set the battery tester for:
 - (a) 12V operation, and
 - (b) a discharge rate of three times the battery amp-hr. capacity.
3. Connect the prod on the tester to the battery positive (+) terminal.
4. Connect the prod on the flexible cable to the battery negative (—) terminal.
5. Test the battery for 15 seconds only, whilst noting the voltmeter behaviour on the upper colour scale.
6. A reading in the Green zone indicates the battery to be in a satisfactory condition.
7. If the reading is in the YELLOW zone, charge the battery for 5 minutes at 30 Amps (or for the appropriate period indicated) and retest.

Charging Time in Minutes	Charging Amperage
5	30
10	15
20	10
30	5

8. If the meter reading is now in the GREEN zone, the battery is serviceable but needs further charging. A continuous reading in the YELLOW zone usually indicates a faulty battery.
9. When the meter reading falls progressively during the 15 seconds and ends in the RED zone, the battery needs replacing.



ELECTRICAL SYSTEM**BATTERY****Recharging in Service**

9A—10—12

Hydrometer Test

The specific gravity of the electrolyte indicates the state of charge in the battery. Using a hydrometer, check the specific gravity of the electrolyte in each battery cell and compare the readings with those in the table below.

Electrolyte Temperature Correction

For every 2.8°C (5°F) **BELOW** 15.5°C (60°F), **DEDUCT** 0.002 from the S.G. reading to obtain the true S.G. at 15.5°C (60°F).

For every 2.8°C (5°F) **ABOVE** 15.5°C (60°F), **ADD** 0.002 to the S.G. reading, to obtain the true S.G. at 15.5°C (60°F).

If the specific gravity of individual cells varies by more than 0.040 the battery should be considered for replacement.

NOTE: Hydrometer readings should not be taken if the battery has just been topped up. Charge the battery for 1—2 hours before testing.

Recharging from an External Supply

If the battery is found to be less than 70% charged, it should be re-charged using an external source. The charging current should be one-tenth of the battery capacity. See Table: 9A—05—11.

Before re-charging, make sure that the battery filler plug or cover plate vent holes are open and free of dirt.

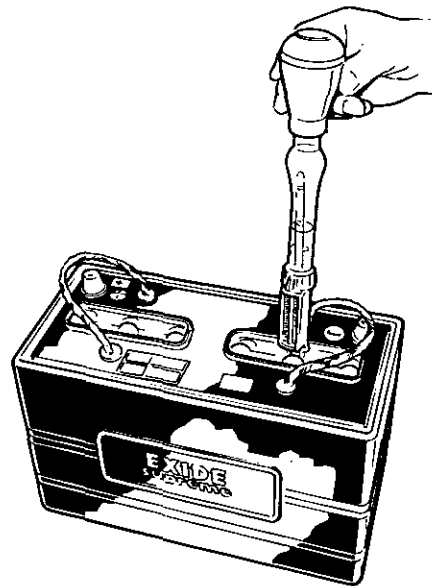
The battery is fully charged when the specific gravity of the electrolyte and voltage show no increase over three successive hourly readings. During the charge, the electrolyte level should be checked regularly and replenished as necessary with distilled water.

Boost Charging

Boost charging must be regarded as an **emergency measure only**.

Boost charging must be limited to a maximum period of one hour only, with a charge rate not greater than the ampere-hour capacity of the battery.

As the battery state-of-charge rises, the charging rate will fall, but must **NOT** be re-adjusted to the original state.



State of charge	Specific Gravity Readings	
	Climate Normally below 25°C (77°F)	Climate normally above 25°C (77°F)
Fully charged ..	1.260 — 1.280	1.210 — 1.230
70% charged ..	1.230 — 1.250	1.170 — 1.190
Discharged	1.110 — 1.130	1.050 — 1.070

ALTERNATOR**Removal and Refitment**

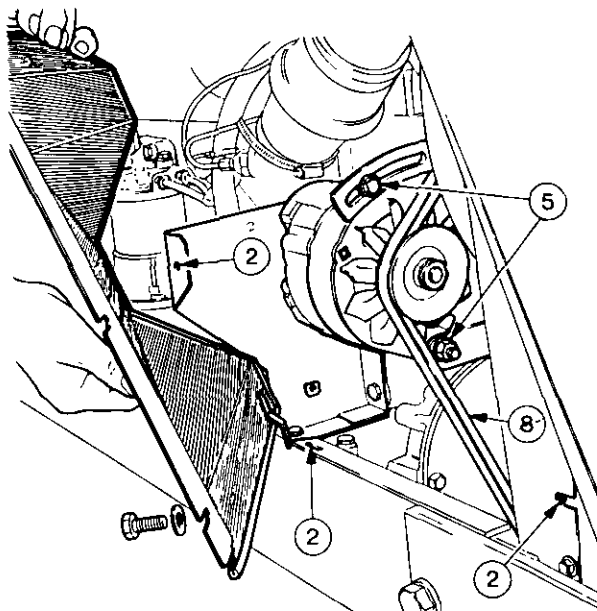
9A—11—13

Removal

1. Remove the front grille. Operation 9A—06—10.
2. Remove the guard.
3. Disconnect the battery.
4. Disconnect the Lucar Connector.
5. Slacken the bolts.
6. Remove the nut and washer.
7. Push the alternator towards the engine.
8. Remove the fan belt from the pulley.
9. Whilst supporting the alternator, remove the bolt.
10. Remove the alternator.

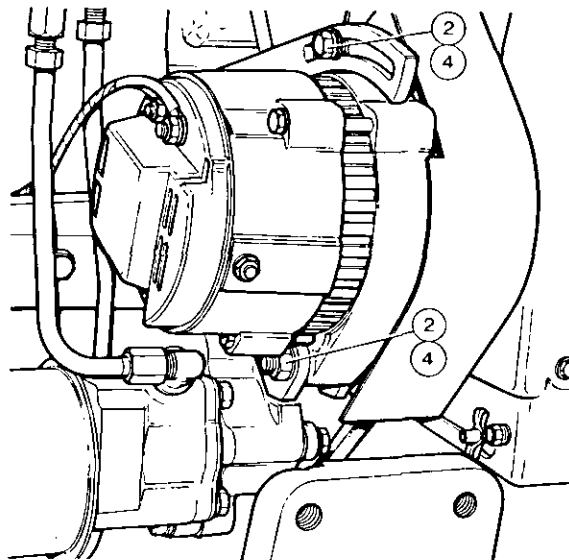
Refitment

11. Reverse procedures 1 to 10.
Adjust the belt tension, operation 9A—12—13.

**ALTERNATOR****Belt Tension**

9A—12—13

1. Check the belt tension at a point midway between the longest span. It should be 13 mm (0.5 in).
2. If the belt tension is incorrect, slacken the mounting bolts.
3. Adjust the tension to 19 mm (0.75 in).
4. Re-tighten the bolts and recheck the belt tension.



ELECTRICAL SYSTEM**STARTER MOTOR****Removal and Refitment**

9A—13—14

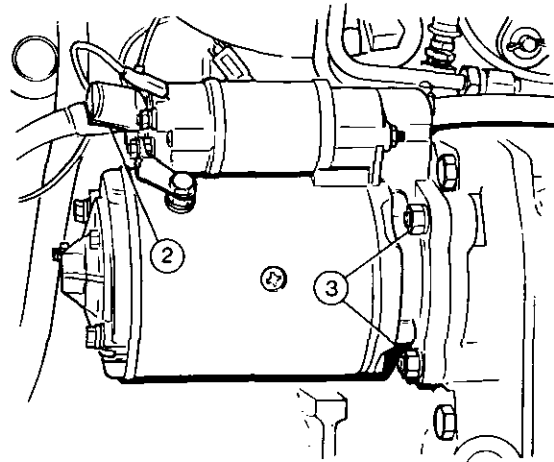
Removal

1. Remove the front grille. Operation 9A—06—10.
2. Disconnect the battery cables.
3. Disconnect the cables from the solenoid.
4. Remove the mounting bolts.
5. Withdraw the motor.

Refitment

6. Reverse procedures 1 to 5.

NOTE: On the MF 698 Tractor to remove the starter motor mounting bolts it is necessary to remove the rear bolts securing the side rail and two of the three front bolts and allow the rail to pivot downwards. Check that the power steering pipes are not attached to the rail.

**STARTER SWITCH****Removal and Replacement**

9A—14—14

Removal

1. Remove the front grille. Operation 9A—06—10.
2. Disconnect the battery cables.
3. Move the instrument lower panel forwards.
4. Remove the nut.
5. Withdraw the switch.
6. Label and disconnect the wires from the rear of the starter switch.
7. Remove the switch.

Replacement

8. Reverse procedures 1 to 7.

NOTE: When servicing switches or gauges on the instrument panel or lower panel, it is only necessary to unscrew the panels and tilt them forwards. Disconnecting the tractormeter drive will allow the instrument panel to move further forwards.

FUEL CUT-OFF CONTROL**Removal and Refitment**

9A—15—14

Removal

1. Move the instrument lower panel forwards.
2. Slacken the locknut behind the instrument panel.
3. Slacken the locknut and unscrew the knob.
4. Unscrew the milled edge securing ring.
5. Withdraw the cable from the panel.
6. Remove the nylon bush and the locknut.
7. Slacken the locking screw at the fuel pump, and disconnect the inner cable.
8. Slacken the screw and disconnect the outer cable from its clamp.
9. Feed the cable through the cab bulkhead and remove the cable from the tractor.

Refitment

10. Reverse procedures 1 to 9.

FLASHING INDICATOR AND HEADLIGHT FLASH SWITCH

NOTE: When servicing switches or gauges on the instrument panel or lower panel, it is only necessary to unscrew the panels and tilt them forward. Disconnecting the tractorometer drive will allow the instrument panel to move further forward.

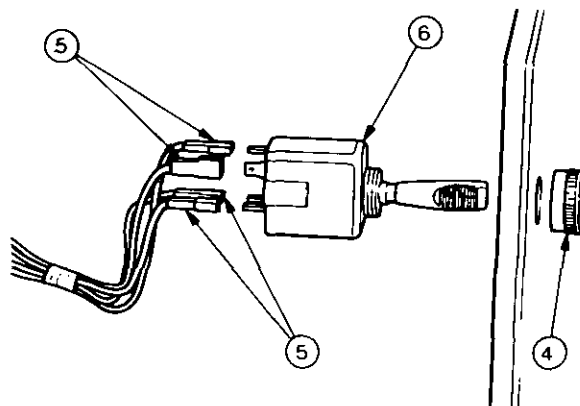
Removal and Replacement 9A-16-15

Removal

1. Remove the front grille. Operation 9A-06-10.
2. Disconnect the battery cables.
3. Move the instrument lower panel forward.
4. Unscrew the milled edge securing ring.
5. Label and disconnect the wires from the rear of the switch.
6. Remove the switch.

Replacement

7. Reverse procedures 1 to 6.



CIGAR LIGHTER

NOTE: When servicing switches or gauges on the instrument panel or lower panel, it is only necessary to unscrew the panels and tilt them forward. Disconnecting the tractorometer drive will allow the instrument panel to move further forward.

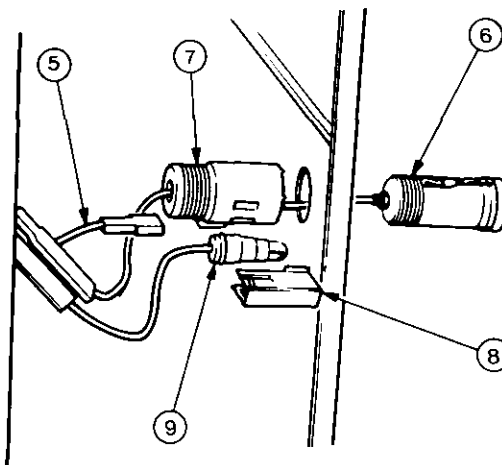
Removal and Replacement 9A-17-15

Removal

1. Remove the front grille. Operation 9A-06-10.
2. Disconnect the battery cables.
3. Move the instrument lower panel forward.
4. Remove the cigar lighter element.
5. Label and disconnect the wires from the rear of the unit.
6. Hold the rear part of the unit and unscrew the inner part and remove.
7. Remove the rear part of the unit.
8. Remove the bulb cover by squeezing gently to release the two lugs.
9. Remove the bulb and holder assembly.

Replacement

10. Reverse procedures 1 to 9.



ELECTRICAL SYSTEM**TRACTORMETER**

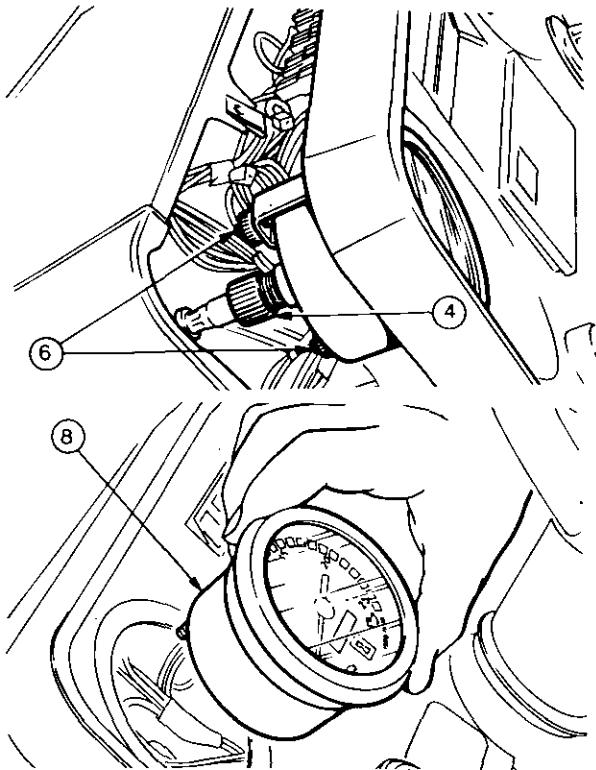
NOTE: When servicing switches or gauges on the instrument panel or lower panel, it is only necessary to unscrew the panels and tilt them forward. Disconnecting the tractorometer drive will allow the instrument panel to move further forward.

Removal and Replacement 9A-18-16**Removal**

1. Remove the front grille. Operation 9A-06-10.
2. Disconnect the battery cables.
3. Move the instrument panel forward.
4. Unscrew the drive cable securing ring.
5. Remove the drive cable.
6. Remove the two nuts securing the clamping brackets.
7. Remove the two brackets.
8. Remove the tractorometer.

Replacement

9. Reverse procedures 1 to 8.

**FUEL AND TEMPERATURE GAUGE**

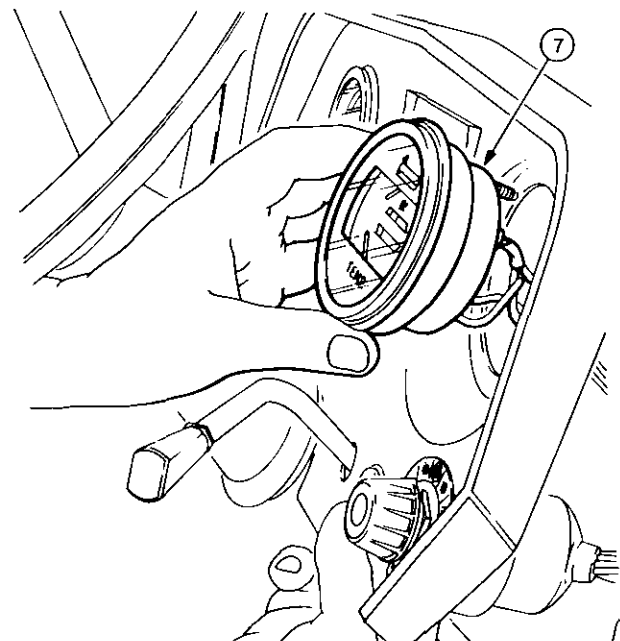
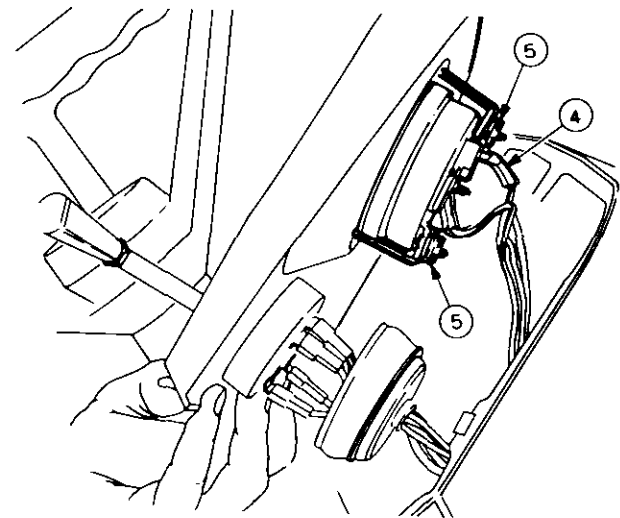
NOTE: When servicing switches or gauges on the instrument panel or lower panel, it is only necessary to unscrew the panels and tilt them forward. Disconnecting the tractorometer drive will allow the instrument panel to move further forward.

Removal and Replacement 9A-19-16**Removal**

1. Remove the front grille. Operation 9A-06-10.
2. Disconnect the battery cables.
3. Move the instrument panel forward.
4. Label and disconnect the wires from the rear of the gauge.
5. Remove the two nuts securing the clamping brackets.
6. Remove the two brackets.
7. Remove the gauge.

Replacement

8. Reverse procedures 1 to 7.



LIGHT SWITCH

NOTE: When servicing switches or gauges on the instrument panel or lower panel, it is only necessary to unscrew the panels and tilt them forward. Disconnecting the tractorometer drive will allow the instrument panel to move further forward.

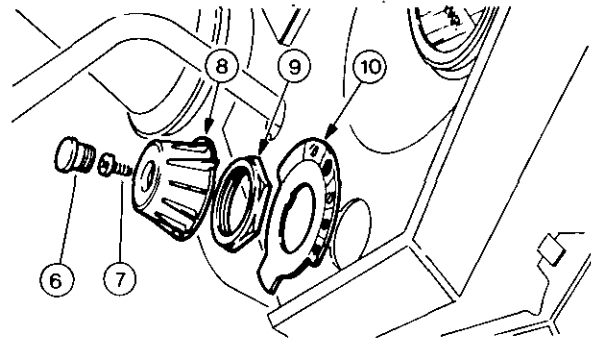
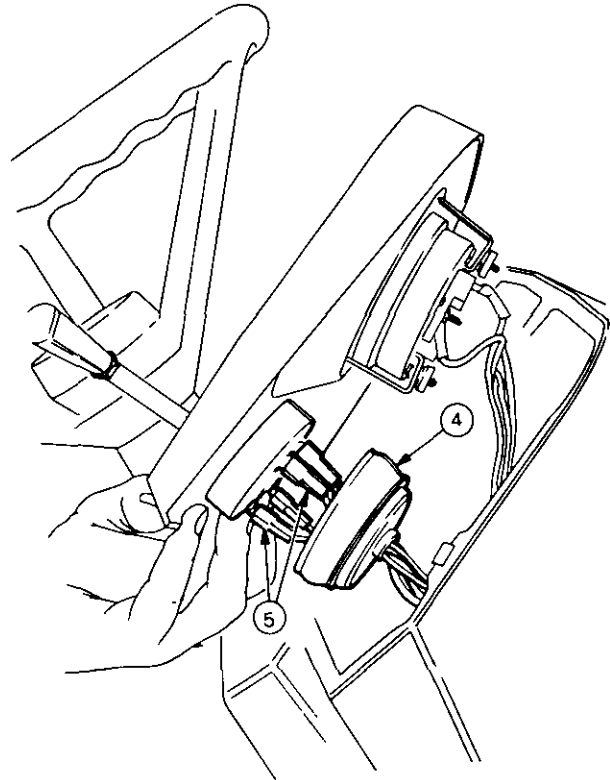
Removal and Replacement 9A-20-17

Removal

1. Remove the front grille. Operation 9A-06-10.
2. Disconnect the battery cables.
3. Move the instrument panel forward.
4. Peel back the rubber cover on the back at the light switch.
5. Label and disconnect the wires from the rear of the switch.
6. Remove the red plug from the switch knob.
7. Remove the screw from the centre of the switch knob.
8. Remove the switch knob.
9. Unscrew the hex retaining ring.
10. Remove the symbol plate.
11. Remove the light switch from the rear of the instrument panel.

Replacement

12. Reverse procedures 1 to 11.



WARNING LIGHT-BULBS

NOTE: When servicing switches or gauges on the instrument panel or lower panel, it is only necessary to unscrew the panels and tilt them forward. Disconnecting the tractorometer drive will allow the instrument panel to move further forward.

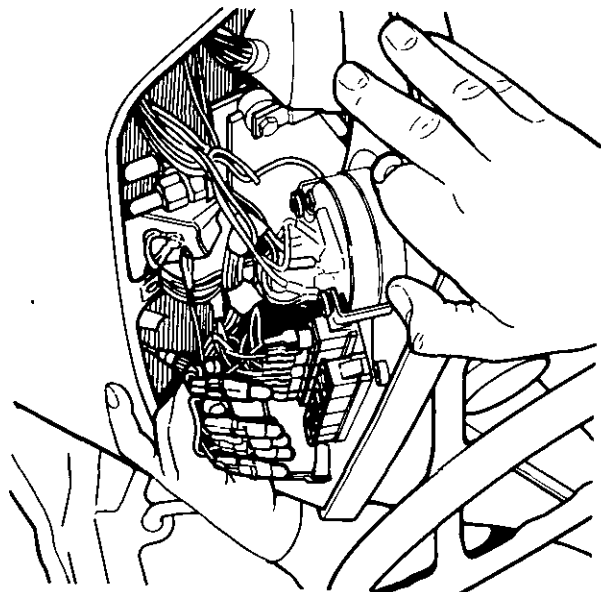
Removal and Replacement 9A-21-17

Removal

1. Remove the front grille. Operation 9A-06-10.
2. Disconnect the battery cables.
3. Move the instrument panel forward.
4. Pull the bulb holders out from the warning light lens unit.
5. Remove the failed bulbs as necessary.

Replacement

6. Reverse procedures 1 to 5.



ELECTRICAL SYSTEM**WARNING LIGHT LENS**

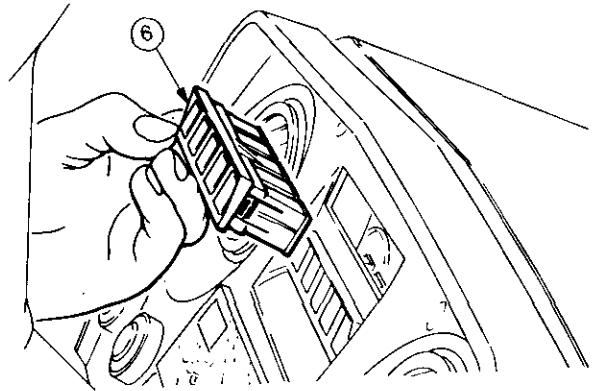
NOTE: When servicing switches or gauges on the instrument panel or lower panel, it is only necessary to unscrew the panels and tilt them forward. Disconnecting the tractorometer drive will allow the instrument panel to move further forward.

Removal and Replacement 9A—22—18**Removal**

1. Remove the front grille. Operation 9A—06—10.
2. Disconnect the battery cables.
3. Move the instrument panel forwards.
4. Pull the bulb holders out from the warning light lens unit. Operation 9A—21—17.
5. Press the retaining pieces in the sides of the warning light lens unit.
6. Remove the unit from the front of the instrument panel.

Replacement

7. Reverse procedures 1 to 6.

**HAZARD WARNING LIGHT SWITCH AND PLOUGH LIGHT SWITCH**

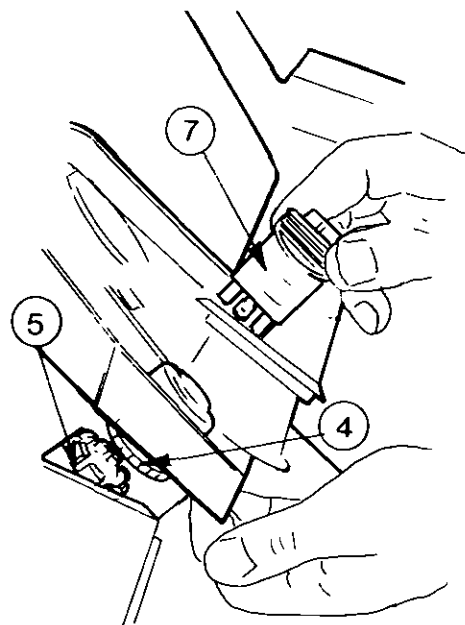
NOTE: When servicing switches or gauges on the instrument panel or lower panel, it is only necessary to unscrew the panels and tilt them forward. Disconnecting the tractorometer drive will allow the instrument panel to move further forward.

Removal and Replacement 9A—23—18**Removal**

1. Remove the front grille. Operation 9A—06—10.
2. Disconnect the battery cables.
3. Move the instrument panel forward.
4. Unscrew retainer from switch at rear of instrument panel.
5. Unplug switch unit from body.
6. Label and disconnect the wires from the rear of the body.
7. Remove the switch body.

Replacement

8. Reverse procedures 1 to 7.

**FUSE BOX—INSTRUMENTS**

NOTE: When servicing switches or gauges on the instrument panel or lower panel, it is only necessary to unscrew the panels and tilt them forward. Disconnecting the tractorometer drive will allow the instrument panel to move further forward.

Removal and Replacement 9A—24—18**Removal**

1. Remove the front grille. Operation 9A—06—10.
2. Disconnect the battery cables.
3. Move the instrument panel forward.
4. Remove clear plastic cover from front of fuse box.
5. Label and disconnect wires from rear of fuse box.
6. Remove fuse box.

Replacement

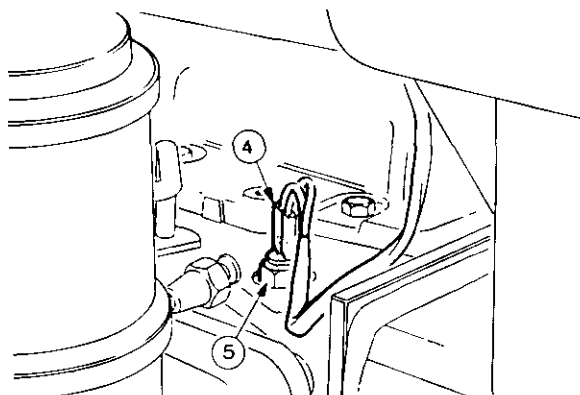
7. Reverse procedures 1 to 6.

NEUTRAL SAFETY START SWITCH**Removal and Replacement** 9A—25—19**Removal**

1. Remove the front grille. Operation 9A—06—10.
2. Disconnect the battery cables.
3. Remove the rubber cover.
4. Disconnect the two wires.
5. Unscrew the switch from the top of the gearbox.

Replacement

6. Reverse procedures 1 to 5.

**ENGINE OIL PRESSURE WARNING LIGHT SWITCH UNIT****Removal and Replacement** 9A—26—19**Removal**

1. Remove the front grille. Operation 9A—06—10.
2. Disconnect the battery cables.
3. Disconnect the Lucar connector.
4. Unscrew the switch unit from the cylinder block.

Replacement

5. Reverse procedures 1 to 4.

TEMPERATURE GAUGE SENDER UNIT**Removal and Replacement** 9A—27—19**Removal**

1. Remove the front grille. Operation 9A—06—10.
2. Remove the battery cables.
3. Drain the engine coolant to a level below that of the bulb, by opening the engine block drain tap.
4. Disconnect the sensor units electrical connector.
5. Unscrew the bulb from the cylinder block.

Replacement

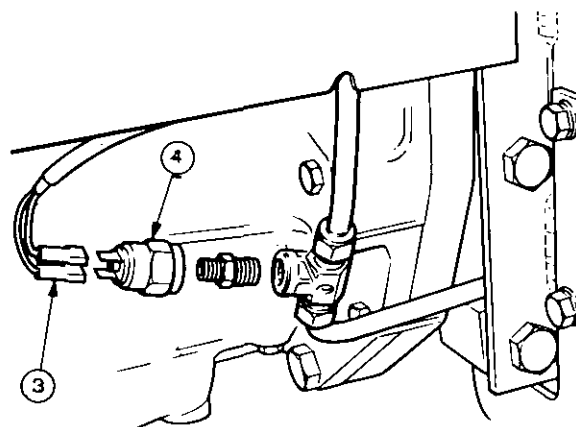
6. Reverse procedures 1 to 5.

MULTI-POWER OIL PRESSURE WARNING LIGHT SWITCH**Removal and Replacement** 9A—28—19**Removal**

1. Remove the front grille. Operation 9A—06—10.
2. Disconnect the battery cables.
3. Disconnect the two wires.
4. Unscrew the switch unit.

Replacement

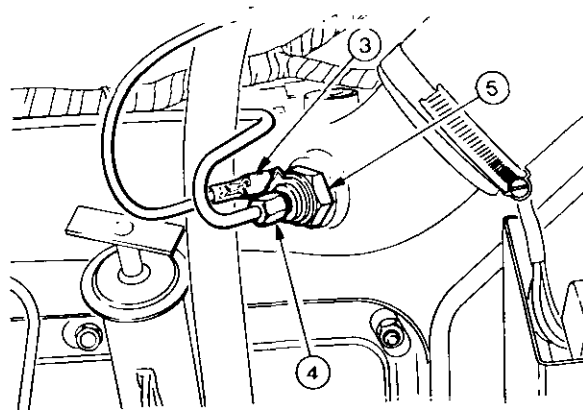
5. Reverse procedures 1 to 4.

**THERMOSTART****Removal and Replacement** 9A—29—19**Removal**

1. Remove the front grille. Operation 9A—06—10.
2. Disconnect the battery cables.
3. Disconnect the wire.
4. Disconnect the fuel pipe and plug the open end.
5. Unscrew the thermostart unit.

Replacement

6. Reverse procedures 1 to 5. Except that the fuel system must be bled.

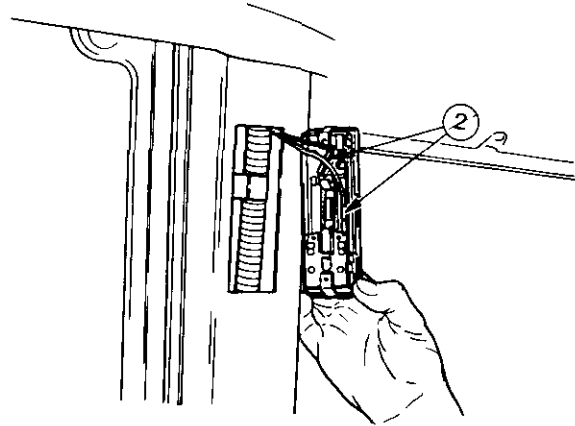


ELECTRICAL SYSTEM**INTERIOR LIGHT AND BULB****Removal and Replacement** 9A—30—20**Removal**

1. Remove the front grille. Operation 9A—06—10.
2. Disconnect the battery cables.
3. Prise the light unit out of the right-hand side door post.
4. Disconnect the two wires.

Replacement

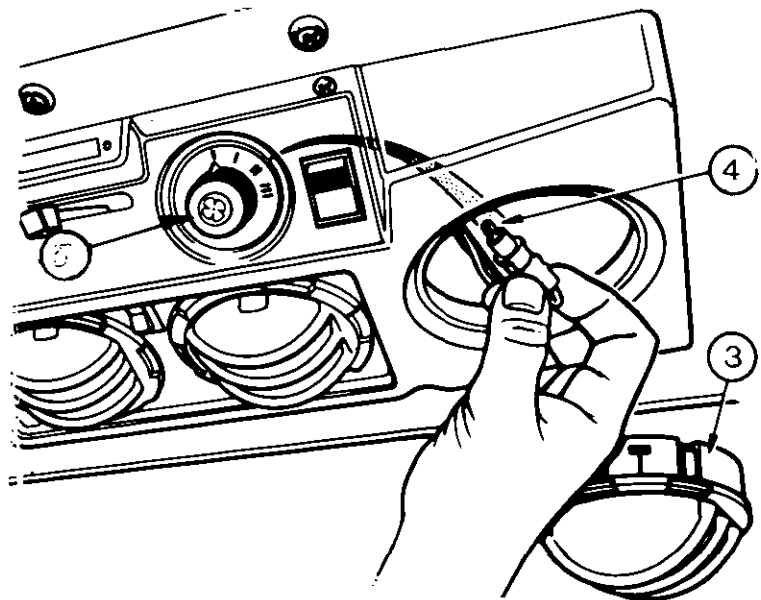
5. Reverse procedures 1 to 4.

**BLOWER SWITCH****Removal and Replacement** 9A—31—20**Removal**

1. Remove the front grille. Operation 9A—06—10.
2. Disconnect the battery cables.
3. Remove the first and second right hand air vent louvres.
4. Remove the bulb holder and bulb.
5. Unscrew the grub-screw in the side of the switch knob.
6. Remove the knob.
7. Label and disconnect the five wires from the rear of the switch.
8. Remove the switch from the rear of the panel.

Replacement

9. Reverse procedures 1 to 8.



WINDSCREEN WIPER SWITCH AND WIND-SCREEN WASHER SWITCH

Removal and Replacement 9A-32-21

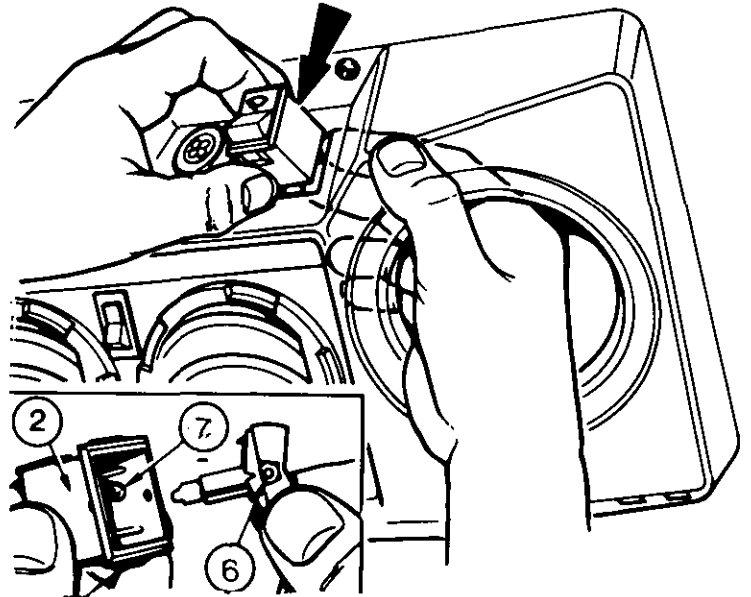
Removal

1. Remove the front grille. Operation 9A-06-10.
2. Disconnect the battery cables.
3. Remove the first and second right hand or left hand air vent louvre.
4. Label and disconnect the wires from the rear of the switch.
5. Ease the switch from the front of the panel.
6. Remove the rocker from the switch case.
7. Remove the bulb.

NOTE: If whilst removing and replacing the bulb, the rocker bars inside the switch are dislodged, the one with the contact joints must be fitted on the left hand side to match the contact points in the switch case.

Replacement

8. Reverse procedures 1 to 7.



HEADLIGHT BULB

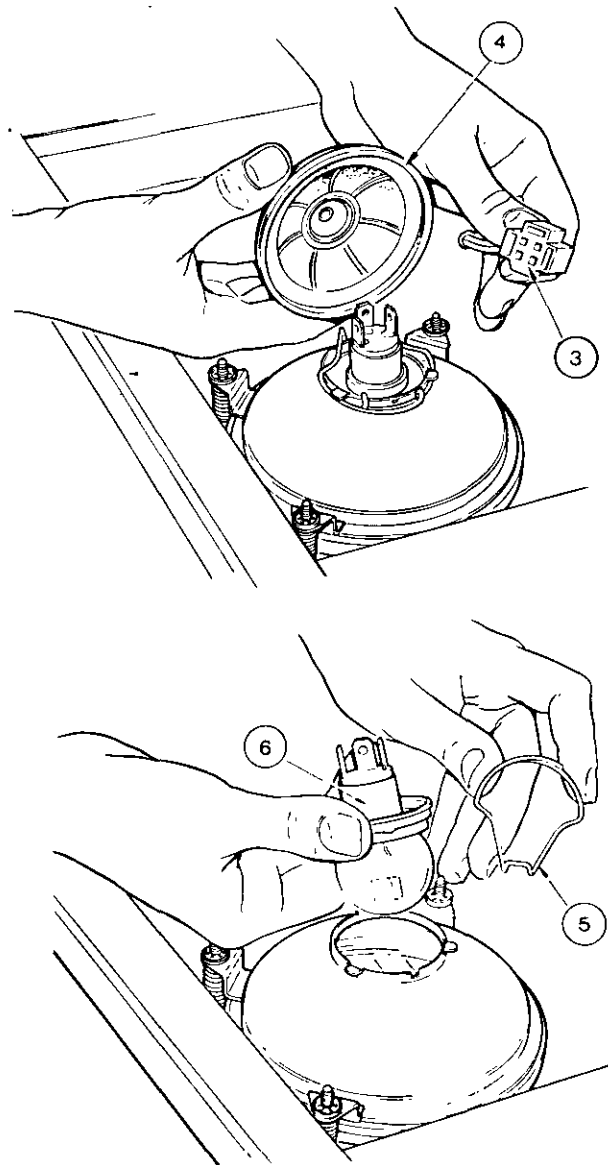
Removal and Replacement 9A-33-21

Removal

1. Remove the front grille. Operation 9A-06-10.
2. Disconnect the battery cables.
3. Remove the connector.
4. Remove the rubber surround.
5. Release the spring clip.
6. Remove the bulb.

Replacement

7. Reverse procedures 1 to 6.
See bulb table in Section 9A-05.

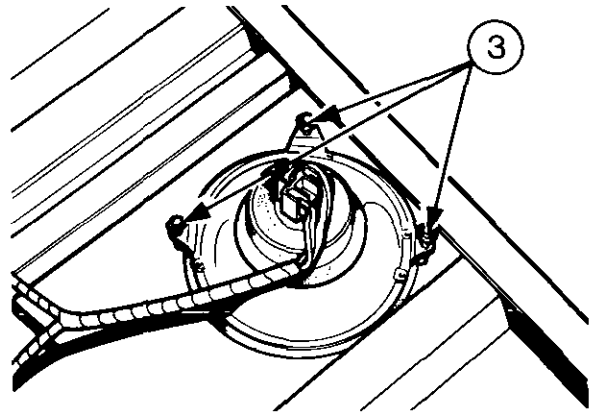


ELECTRICAL SYSTEM**HEADLIGHTS****Removal and Replacement** 9A—34—22**Removal**

1. Remove the front grille. Operation 9A—06—10.
2. Remove the bulb. Operation 9A—33—21.
3. Remove the three headlight adjustment screws and springs.
4. Remove the headlight.

Replacement

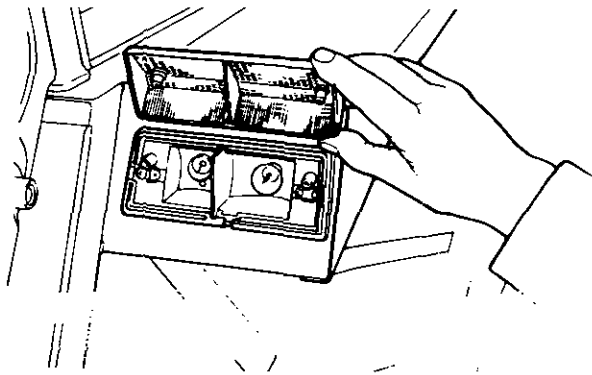
5. Reverse procedures 1—4.

**SIDE LIGHT/FLASHING INDICATOR BULB****Removal and Replacement** 9A—35—22**Removal**

1. Slacken the two screws.
2. Remove the lens.
3. Remove the failed bulb.

Replacement

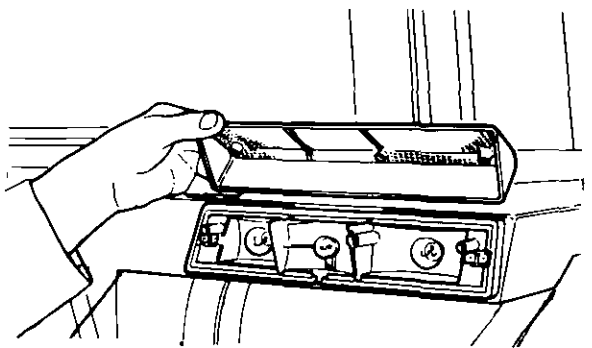
4. Reverse procedures 1 to 3: See bulb table in Section 9A—05.

**TAIL/BRAKE LIGHT/FLASHING INDICATOR BULB****Removal and Replacement** 9A—36—22**Removal**

1. Slacken the two screws.
2. Remove the lens.
3. Remove the failed bulb from its bayonet fitting.

Replacement

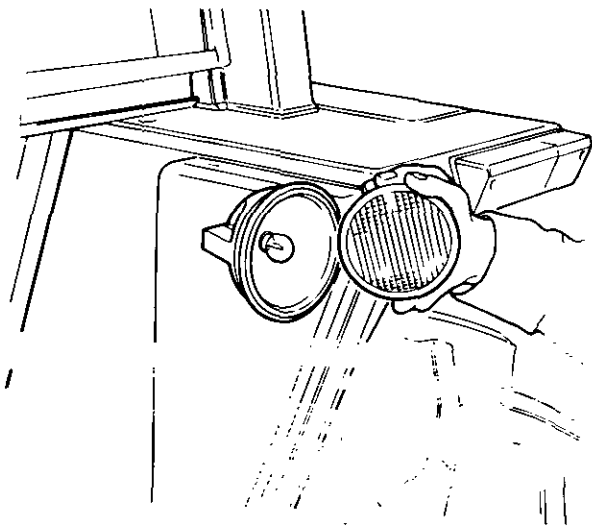
4. Reverse procedures 1 to 3: See bulb table in Section 9A—05.

**PLOUGH LIGHT BULB****Removal and Replacement** 9A—37—22**Removal**

1. Peel back the rubber surround.
2. Prise out the lens.
3. Remove the bulb.

Replacement

4. Reverse procedures 1 to 3: See bulb table in Section 9A—05

**BLOWER MOTOR****Removal and Replacement**
(See Cab and Fittings Section 2B)**WIPER MOTOR****Removal and Replacement**
(See Cab and Fittings Section 2B)

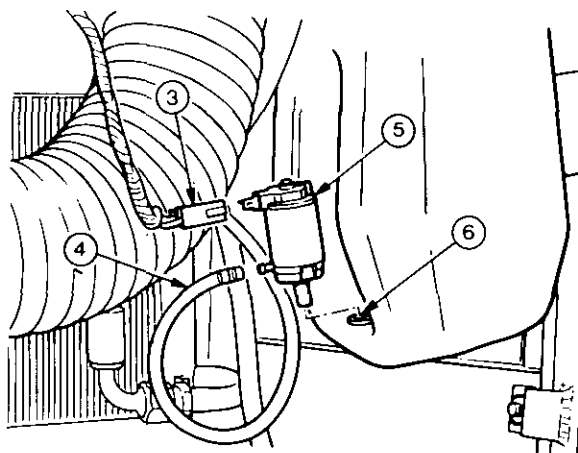
WINDSCREEN WASHER ELECTRIC PUMP**Removal and Replacement** 9A-38-23**Removal**

1. Remove the front grille. Operation 9A-06-10.
2. Disconnect the battery cables.
3. Disconnect the wire.
4. Disconnect the clear plastic water hose from the pump.
5. Remove pump by pulling upwards out of sealing plug in reservoir.
6. Leave sealing plug in reservoir unless damaged.

NOTE: Before replacement and re-assembly wash out reservoir with warm water and detergent. Rinse thoroughly in clean water.

Replacement

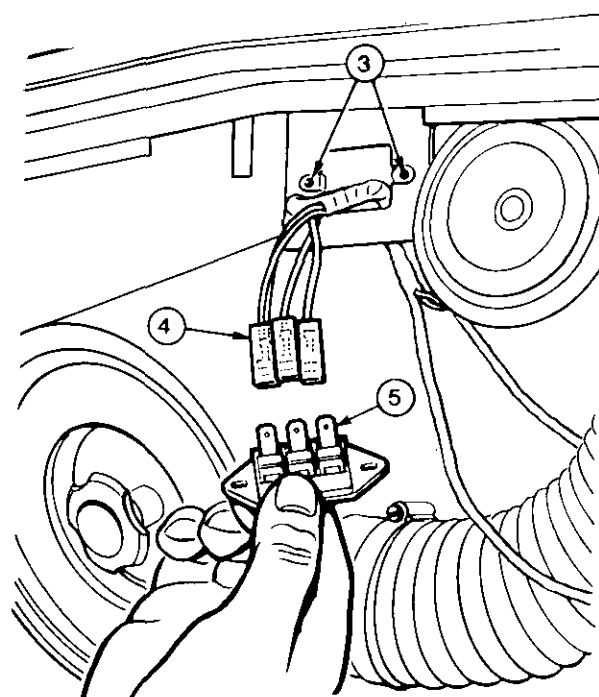
7. Reverse procedures 1 to 6.
(Refill reservoir).

**HEADLIGHT WIRING CONNECTOR—NOSE****Removal and Replacement** 9A-39-23**Removal**

1. Remove the front grille. Operation 9A-06-10.
2. Disconnect the battery cables.
3. Remove the two screws.
4. Disconnect the wiring from the three lugs.
5. Remove the connector.

Replacement

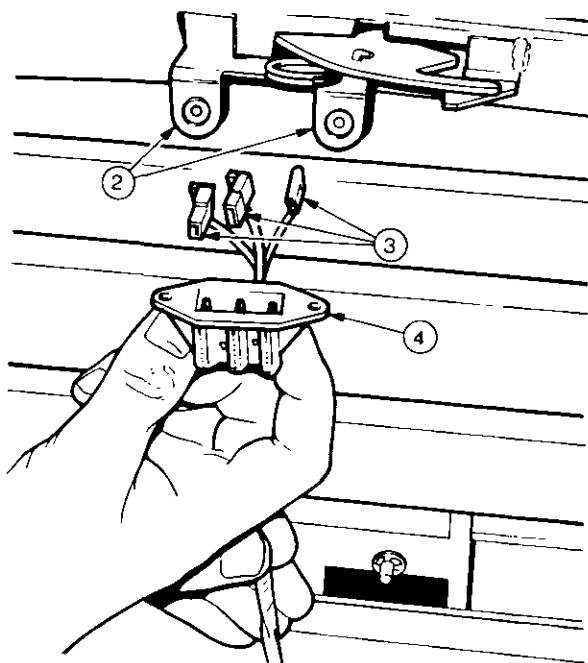
6. Reverse procedures 1 to 5.

**HEADLIGHT WIRING CONNECTOR—GRILLE****Removal and Replacement** 9A-40-23**Removal**

1. Remove the front grille. Operation 9A-06-10.
2. Remove the two screws.
3. Disconnect the wiring from the three spring contacts.
4. Remove the connector.

Replacement

5. Reverse procedures 1 to 4.



**MF 600 SERIES TRACTOR
WORKSHOP SERVICE MANUAL
PART 10**

Publication No. 1856 274 M1

comprising

A ACCESSORIES

ACCESSORIES

Part 10—Section A

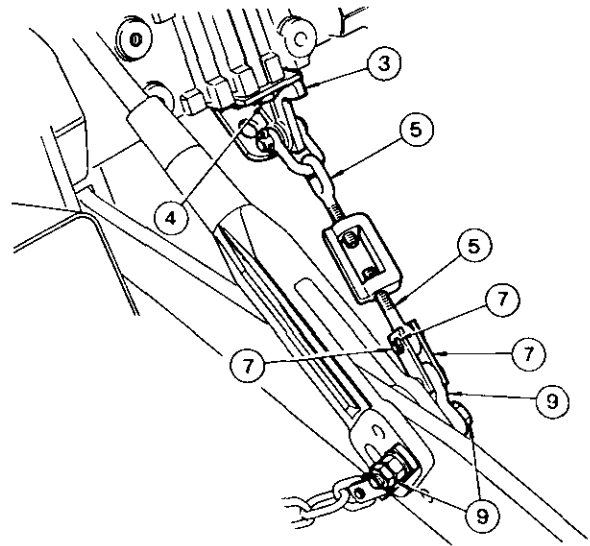
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10A—16—15	WHEEL BALLAST WEIGHTS General	15
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ACCESSORIES

STABILISERS

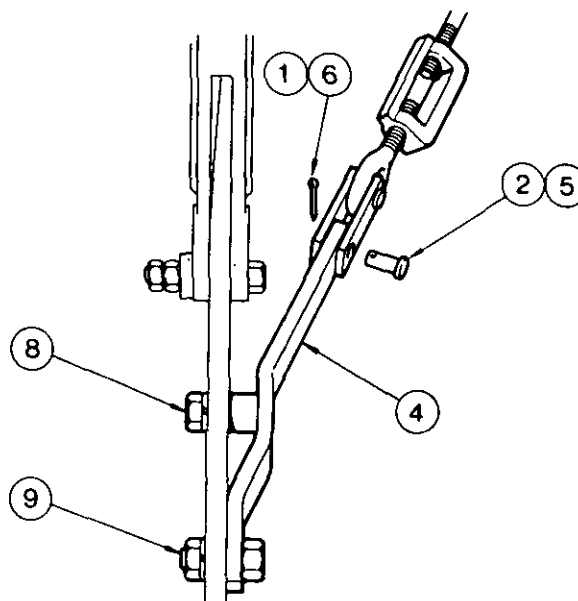
Kit Fitment MF 675, 690 Tractors) 10A—01—02

1. Remove the four nuts securing the two plates to the underside of the trumpet housing.
2. Remove and discard the two plates.
3. Fit the stabiliser mounting brackets with the bossed holes facing rearwards.
4. Apply a few drops of recommended sealant 'C' to the cab riser/stabiliser mounting bracket bolts, then refit and tighten the nuts to a torque of 230 Nm (170 lbf ft).
5. Screw two eyebolts into each turnbuckle approximately equal amounts.
6. Fit the 'U' shackles so that lettering on the turnbuckles will face inwards when the stabiliser assembly is fitted.
7. Assemble the four plates and two cranked brackets using the clevis pins and split pins.
8. Align the shackles with the holes in the stabiliser mounting brackets and fit the clevis pins and split pins.
9. MF 690 Tractor. Remove the locknut, nut and bolt securing the check chain and lift rod. Secure the stabiliser bracket, lift rod and check chain to the same hole in the lower link, using the special bolt provided in the kit. Refit the nut and locknut so that the check chain bracket is just free to rotate. Repeat for the other stabiliser.
MF 675 Tractors. Secure cranked stabiliser bracket to the second hole from the lift rod attachment point using the bolt (head outwards) spacer, washer nut and locknut. The nut must be tightened so that the stabiliser is just free to rotate. Repeat for the other stabiliser.
10. Liberally coat the eyebolt threads with grease to facilitate adjustment.
11. Adjust the turnbuckles to give approximately 50 mm (2 in) of sideways motion measured at the lower link ends.



STABILISER EXTENSION KIT**Kit Fitment MF 675, 690 Tractors) 10A-02-03**

1. Discard the two rear parallel link split pins or remove the hair pins.
2. Remove the clevis pins.
3. Remove the cranked brackets.
4. Fit the extensions brackets.
5. Fit the clevis pins.
6. Fit new split pins or refit the hair pins.
7. Remove the rear linch pins and stowage clips; store in tool box.
8. Fit the bolts and lockwashers to the last lift rod bolt hole in each lift rod and extension bracket boss.
9. Fit the bolts, lock washers and nuts to the second extension bracket holes and the linch pin stowage clip holes.

**HYDRAULIC ASSISTOR RAM****General**

The hydraulic assistor ram is a single acting hydraulic ram, which in conjunction with the standard tractor hydraulics, increases the lower link lift capacity from 2223 to 2667 kg (4900 to 5880 lb).

The assistor ram is fitted between the left hand lift arm and the underside of the left hand rear axle trumpet housing.

The hydraulic connection, half way down the ram cylinder, is connected by adaptors and a flexible hose to a tapping in the left hand side of the lift cover and then by internal drillings to the tractor hydraulic system.

A stabiliser extension kit must always be fitted:

- (a) To limit lower link sidesway and prevent contact between the lower link and the hydraulic cylinder.
- (b) To assist the check chains.

ACCESSORIES

HYDRAULIC ASSISTOR RAM

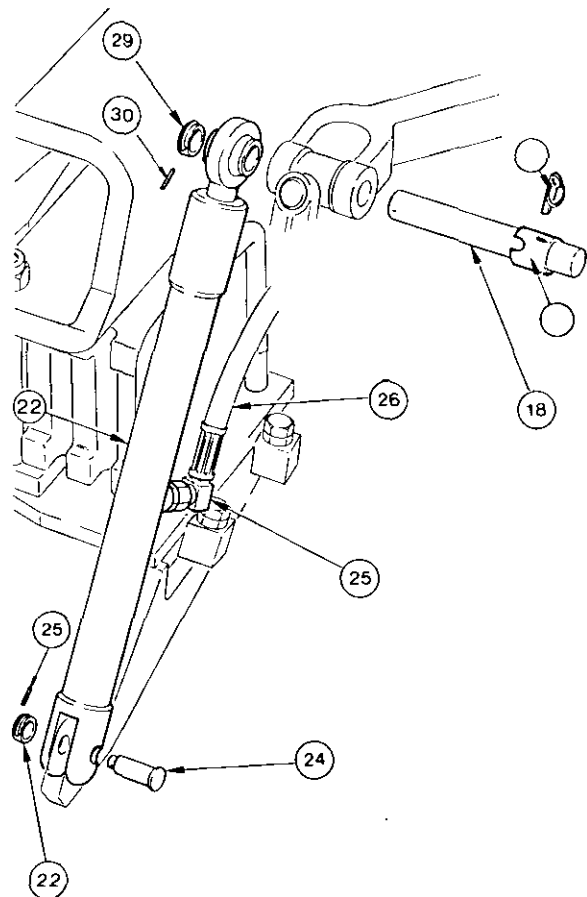
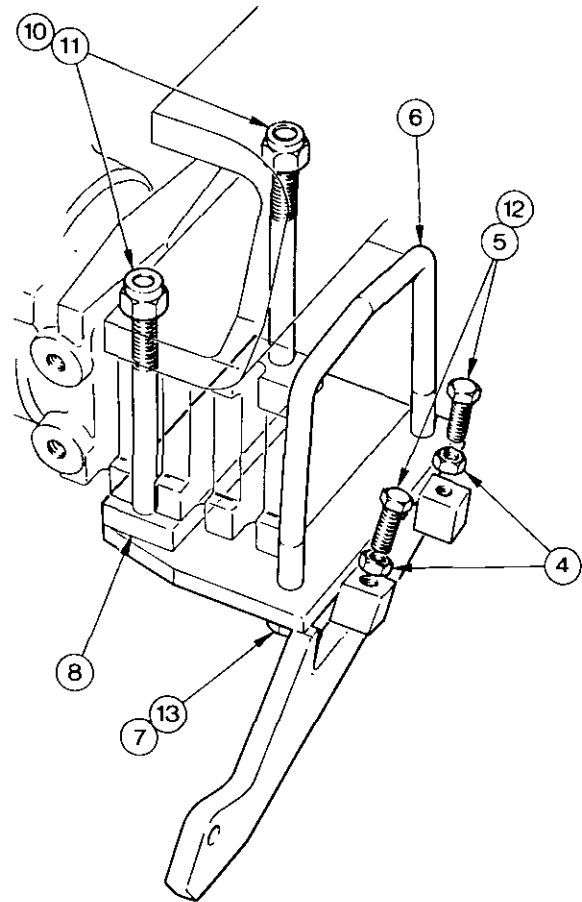
Kit Fitment

10A—03—04

1. Lower the tractor linkage.
2. Disconnect the left hand stabiliser at the mounting bracket below the trumpet housing.
3. Remove and discard the left hand stabiliser mounting bracket.
4. Fit the two locknuts to both setscrews.
5. Screw the two setscrews into the lugs on the ram support bracket.
6. Position the 'U' bolt over the left hand trumpet housing and locate the ram support bracket under the trumpet housing, with the lugs and setscrew heads uppermost and facing towards the right hand side of the tractor.
7. Fit and tighten finger tight two 15,87 mm ($\frac{5}{8}$ in) UNF locknuts to the 'U' bolt.

NOTE: When fitting ram assistor kits on early model tractors, it may be necessary to remove part of the upper and lower bosses, on the left hand trumpet housing to provide a clearance for the 'U' bolt and hydraulic ram. Check for a clearance between the hydraulic ram and the trumpet housing when the tractor linkage is raised by hand into the constant pumping position.

8. Position the spacer between the trumpet housing and the ram support bracket.
9. Degrease or dewax the threads of the two 15,87 mm ($\frac{5}{8}$ in) UNC bolts and lightly coat the threads with the recommended sealant 'C'.
10. On MF 675 and 690 Tractors:
Position the bolts upwards through the holes in the ram support bracket and spacer then tighten finger tight into the cab rear mounting support bracket.
11. Adjust the two setscrews until the heads touch the axle housing, then tighten the locknuts.
12. Tighten the two locknuts on the 'U' bolt and the two bolts (and nuts when fitted) to a torque of 237 Nm (175 lbf ft).
13. Using a new split pin, refit the left hand stabiliser to the ram support bracket.
14. Fit the stabiliser extension kit to the rear ends of both stabilisers, operation 10A—02—03.
15. Remove and discard the lift arm clevis pin and split pin.
16. Fit the new lift arm clevis pin from the left hand side.
17. Fit the spacer or the automatic-hitch extension arm (when fitted).
18. Fit the linch pin and ring assembly.
19. Support the left hand lower link.
20. Position the ram cylinder body on the ram support bracket and ensure that the hydraulic connection point faces the centre and front of the tractor.
21. Fit the ram pin from the right hand side with the head facing towards the centre of the tractor.
22. Fit the collar on the end of the ram pin and align the holes in the collar with the hole in the ram pin.
23. Fit the spiral pin into the hole in the collar.
24. Fit the connector and 'O' ring to the ram cylinder hydraulic connection point.



25. Fit the hose assembly to the connector on the ram cylinder.
26. Extend the ram and fit the ball end onto the lift arm clevis pin.

NOTE: Check for a clearance between the hydraulic ram and the trumpet housing when the tractor linkage is raised by hand into the constant pumping position.

27. Fit the collar to the left hand side of the lift arm clevis pin and align the holes in the collar with the hole in the clevis pin.
28. Fit the spiral pin into the hole in the collar.
29. Remove and discard the plug from the left hand side of the lift cover and fit the adaptor.
30. Connect the hose assembly to the adaptor.

NOTE: Ensure the hose is not twisted or fouls any moving parts on the tractor.

31. Remove the left hand trumpet housing top securing bolt.
32. Position the hose retaining bracket against the trumpet housing with the lug holding the hose.
33. Refit the trumpet housing bolt.
34. Start the tractor engine and operate the hydraulic lift system a few times, to bleed the assistor ram free of air.
35. Stop the engine and permit the transmission oil to settle, check the transmission oil level and top up, if necessary.

HYDRAULIC ASSISTOR RAM

Removal and Refitment

10A—04—05

Removal

1. Lower the tractor linkage.
2. Disconnect the hose assembly at the assistor ram. Seal both open ends to prevent any ingress of dirt, etc.
3. Remove the spiral pin from the left hand side of the lift arm clevis pin.
4. Remove the collar from the lift arm clevis pin.
5. Remove the spiral pin from the ram pin.
6. Remove the collar from the ram pin.
7. Remove the ram pin and support the assistor ram body.
8. Disconnect the assistor ram from the lift arm clevis pin.
9. Remove the assistor ram:

Refitment

10. Reverse procedures 2 to 9.
11. Start the tractor engine and operate the hydraulic lift system a few times, to bleed the assistor ram free of air.
12. Stop the engine and permit the transmission oil to settle, check the transmission oil level and top up, if necessary.

ACCESSORIES

HYDRAULIC ASSISTOR RAM

Servicing

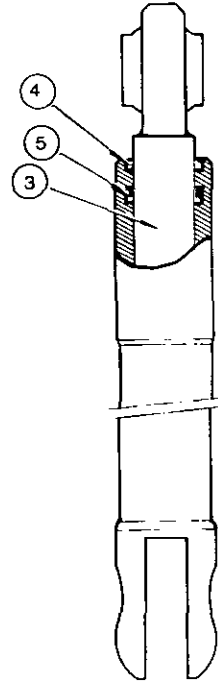
10A—05—06

Disassembly

1. Remove the hydraulic -assistor ram, operation 10A—04—05.
2. Drain the oil from the assistor ram and thoroughly clean the exterior.
3. Withdraw the piston rod from the barrel assembly.
4. Remove the wiper seal.
5. Carefully remove the bearing seal from the annular groove inside the barrel assembly.

Reassembly

6. Examine the piston rod for any signs of wear or scoring, and replace if necessary.
7. Reverse procedures 1 to 5, except:
 - (a) Fit new seals.
 - (b) Ensure the barrel seal is correctly located in the annular groove.
 - (c) Ensure the lip on the wiper seal faces outwards.



DRAWBAR AND STAYS

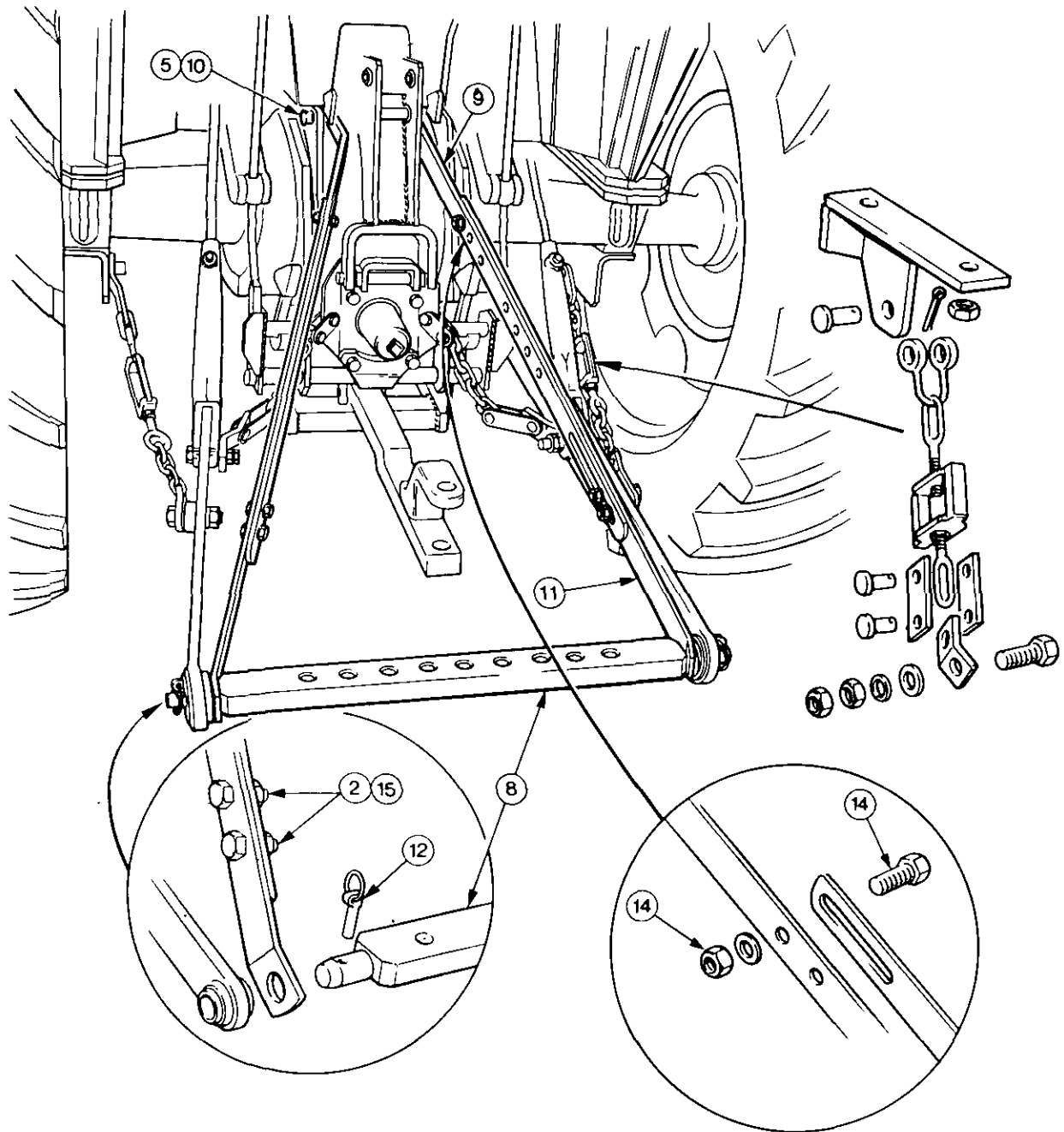
General

The linkage drawbar, fitted between the ball ends of the lower links, can be used when towing implements with a low weight transfer. Lateral adjustment of 433 mm (17 in) is provided by nine holes in the drawbar. To prevent excessive transverse movement, a pair of stays are fitted which permit a height adjustment of between 280 and 635 mm (11 and 25 in) above the ground.

Raising the drawbar increases traction with trailed machinery; lowering the drawbar will tend to keep the front of the tractor down, but with some loss of traction.

NOTE: Never use the linkage drawbar without the stays, and ensure the stays are locked in position.

Never set the drawbar above the rear axle centre line, otherwise the tractor will become unstable when towing.

**Kit Fitment**

10A-06-07

1. Place the drawbar on the ground.
2. Loosely assemble the pair of stays, fitting the four end nuts and bolts with washers to the slotted holes.

NOTE: The bolt heads must all face the same direction.

3. Attach the two straighter ends of the stay links to the drawbar ends and ensure they form a triangle.
4. Remove the tractor p.t.o. guard.
5. Remove the long hitch pin from the tractor centre housing.
6. Check that the correct ball ends are fitted to suit drawbar kit.
Category 2—MF 675, 690 tractors.
7. Lower the tractor links.
8. Rest the drawbar assembly on the lower links.

9. Locate the two stay links between the centre housing webs.
10. Fit the long hitch pin and secure it with the linch pin.
11. Locate the drawbar ends in the lower link ball ends.
12. Fit two linch pins to the drawbar ends.
13. Adjust the height of the drawbar by lengthening or shortening the stay links.
For normal working conditions, set drawbar at 470 mm (18.5 in).
14. Align the holes in the stay links, fit and tighten the centre nuts, bolts and washers.
15. Tighten the four stay link end nuts and bolts.

NOTE: When the drawbar is fitted, always operate the tractor with the Position and Draft Control levers in the DOWN position.

ACCESSORIES

PRESSURE CONTROL COUPLER**General**

The Pressure Control Coupler is used for transferring weight from trailed, drawbar pulled equipment to the tractor rear wheels. Full use can be made of the pressure control coupler with four wheel trailers, heavy discs, wheeled ploughs and p.t.o. driven equipment.

The Pressure Control Coupler comprises a tubular frame, boom assembly and chain assembly which incorporates a safety release device.

Reversible link pins for categories 1 and 2 are fitted, the ends not in use face inboard on the frame. The boom assembly can be locked in one position for transport or stowage.

To maintain the correct chain angle, one or two chain anchor brackets should be welded to the drawbar at a point between a vertical centre line through the boom end and 45° rearward along the drawbar. The drawbar may also need strengthening so that it can withstand the lift of the coupling chain.

Modification of Implement Drawbars 10A—07—08

As the pressure control coupler is used in conjunction with a variety of drawbars, modifications may be necessary to ensure the drawbar has adequate strength to attach the chain and where necessary to ensure that if the coupler chain will clear the p.t.o. shaft, if used.

Drawbars fitted to implements are of three basic types:—

1. 'A' frame (rigid) of tubular, or angle iron construction.
2. 'Pole' type (rigid) of round, or square tube construction.
3. 'Hinged' type (often fitted on four wheel trailers) which may be of either of the above types.

Any of the three types of drawbar may need strengthening to withstand the lifting force applied by the coupler chain. If the implement is powered by a p.t.o. drive shaft, alterations must also be made to enable the coupler chain to clear the p.t.o. shaft.

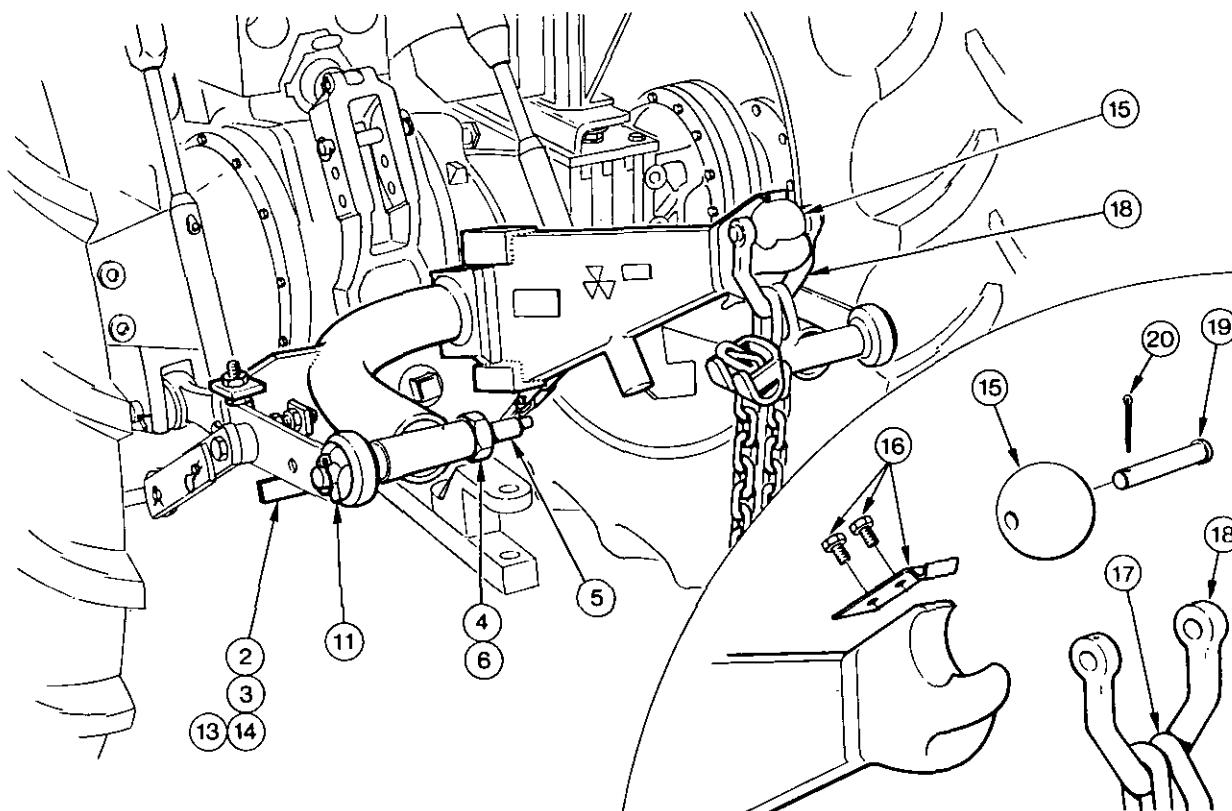
Strengthening of the drawbar can be achieved by:—

- (a) Welding a section of angle-iron on to the underside of a round tube drawbar.
- (b) Welding an identical angle-iron section to the existing angle-iron drawbar to form a square section tube.

All drawbars must have a chain anchor bracket welded on to retain the chain at its correct angle of 45° and a distance of 600 mm (24 in) relative to the boom and drawbar.

When turning, the chain must slide freely through the anchor brackets, otherwise, rapid chain wear will occur. Various methods of keeping the chain clear of the p.t.o. shaft can be employed, according to the type of drawbar fitted.

It is essential that a minimum clearance of 25 mm (1 in) must be maintained between the coupling chain and the p.t.o. shaft.



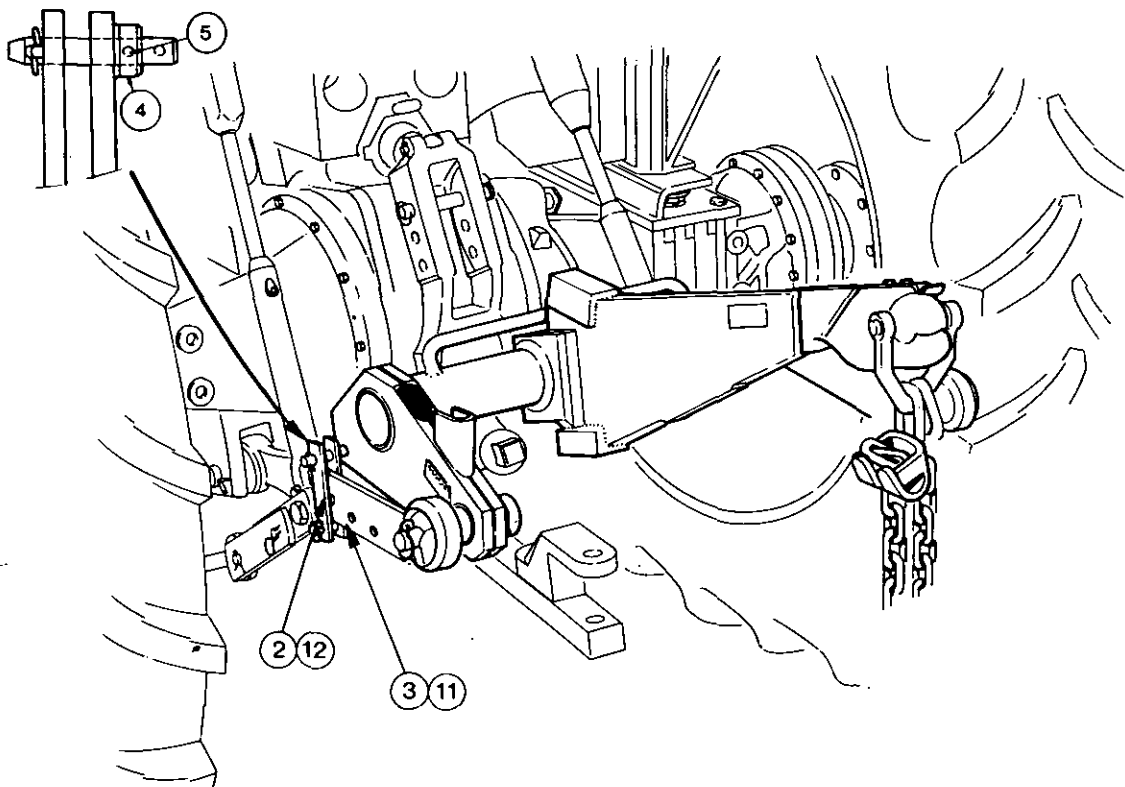
PRESSURE CONTROL COUPLER

Normal Duty Type

Kit Fitment

10A-08-09

1. Position the boom in the stowage position.
2. Slacken the four locknuts.
3. Slacken the four link bracket bolts.
4. Remove the two retaining nuts and washers.
5. Position the link pins to match the lower link ball ends (either category 1 or 2).
6. Refit the retaining nuts and washers.
7. Position the pressure control coupler with the boom pointing upwards and the link pins furthest from the tractor, on level ground.
8. Reverse the tractor over the coupler until the lower link ends are over the link pins.
9. Lower the tractor links.
10. Fit the link pins into the lower link ball ends, simultaneously guiding the frame link brackets around the lower links.
11. Fit two linch pins to secure the link pins.
12. Adjust the right hand lower link with the levelling box until both links are equally positioned vertically in the support notches.
13. Adjust the length of the four link bracket bolts until the bolt heads are positioned 1,5 mm ($\frac{1}{16}$ in) from the face of the lower links.
14. Tighten the four locknuts.
15. Press the safety ball into the spherical seat on the rear of the boom assembly.
16. Fit the retainer bracket and two bolts.
17. Fit the larger link of the coupling chain onto the stirrup, from the right hand side, then fit the ring of the claw onto the stirrup.
18. Position the stirrup and chain assembly around the safety ball.
19. Fit the locating pin ensuring the hole aligns with hole in the stirrup.
20. Carefully tap the spiral pin through the holes in the stirrup and locating pin.
21. Raise the tractor linkage and pressure control coupler.



PRESSURE CONTROL COUPLER

Heavy Duty Type

Kit Fitment

10A—09—10

1. Position the pressure control coupler with the boom pointing upwards and the link pins furthest from the tractor, on level ground.
2. Remove the linch pin from the right hand lower link locating pin.
3. Remove the right hand lower link locating pin.
4. Position the collar at the inner position on the pin.
5. Secure the collar with a spiral pin.
6. Repeat procedures 2 to 5 for the left hand lower link locating pin.
7. Reverse the tractor over the coupler until the lower link ends are above the link pins.
8. Lower the tractor lower links.
9. Fit the link pins into the lower link ball ends.
10. Position the lower links between the two locating links on each side of the coupler frame.
11. Fit the two locating pins from the inside of the frame.
12. Fit the two linch pins to the locating link pins.
13. Fit the two linch pins to the lower link pins.
14. Press the safety ball into the spherical seat on the rear of the boom assembly.
15. Fit the retainer bracket and two bolts.
16. Fit the larger link of the coupling chain onto the stirrup from the right hand side, then fit the ring of the claw onto the stirrup.
17. Position the stirrup and chain assembly around the safety ball.
18. Carefully tap the spiral pin through the holes in the stirrup and locating pin.
19. Raise the tractor linkage and pressure control coupler.

PRESSURE CONTROL COUPLER

Coupler to Implement Attachment 10A—10—08

1. Set the Draft Control lever in the 'UP' position.
2. Move the Position Control lever to the 'UP' position, which will raise the lower links/pressure control coupler.
3. Attach the implement drawbar to the tractor swinging drawbar.
4. Move the Position Control lever to the 'DOWN' position, to lower the links until the coupler frame is slightly below horizontal.
5. Release the boom from the stowage position.
6. Attach the boom chain to the implement drawbar chain brackets, ensuring that a minimum of slack in the chain is maintained. Secure the nearest link into the chain claw.

NOTE: The maximum coupling chain angle, between a vertical centre line through the safety release ball and the coupling chain must not exceed 45°. Also, the distance from the base of the vertical centre line and the implement drawbar chain brackets must not exceed 610 mm (24 in).

PRESSURE CONTROL COUPLER SAFETY RELEASE BALL

General

The safety release ball gives full protection in the rare event of the implement becoming detached from the tractor at the drawbar, when the implement chain would act as a towing link. In this instance, the safety release ball attached to the chain, is pulled out of the slot in the boom, so freeing the implement.

Safety Release Ball Refitment 10A-11-11

1. Position the coupling chain and claw assembly on the right hand side of the stirrup.
2. Press the safety release ball under the spring retainer and into the spherical seat on the rear of the boom assembly.
3. When the spring retainer becomes weak, remove the two bolts.
4. Remove the spring retainer.
5. Fit a new spring retainer with the curved end facing downwards.
6. Refit and tighten the two bolts.

P.T.O. BELT PULLEY ASSEMBLY**General**

The belt pulley is a self contained unit which is driven by the p.t.o. shaft and controlled by the p.t.o. lever. The belt pulley can be mounted in one of three positions, two horizontal and one vertical. The two horizontal positions provide alternative directions of rotation. The pulley must NEVER be fitted above the p.t.o. drive as, in this position, the drive unit bearings would not receive adequate lubrication.

P.T.O. BELT PULLEY**Kit Fitment and Removal 10A-12-11****Fitment**

1. Remove the bolt and washer.
2. Remove the p.t.o. guard and store in a safe place.
3. Remove the p.t.o. cap and stow in the tractor tool box.
4. Remove the swinging drawbar and store in a safe place.
5. Remove the four nuts and spring washers.
6. Fit the four adaptor studs.

NOTE: The four spacers supplied in the kit, are only required if the check chain anchor bracket is removed.

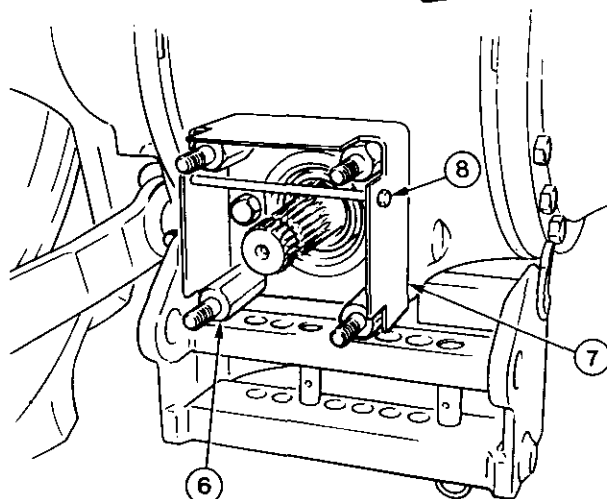
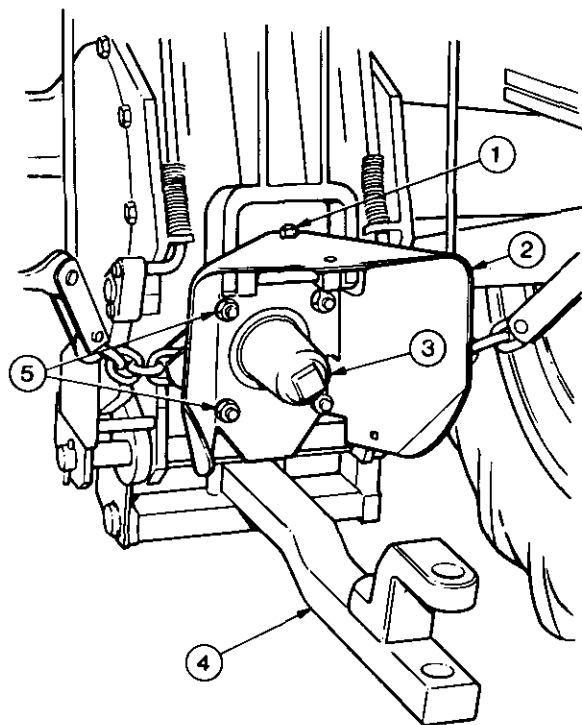
Forged type check chain brackets must be removed when fitting the pulley unit.

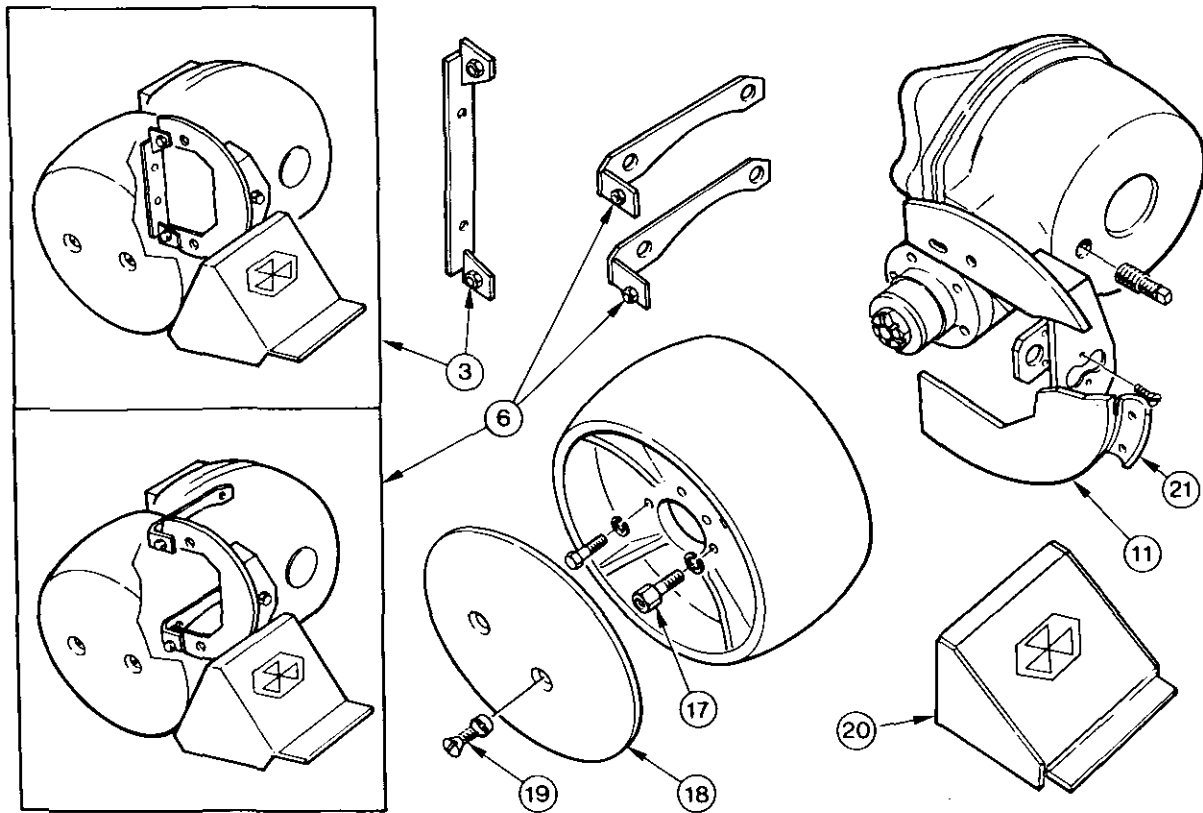
7. Fit the p.t.o. guard.
8. Fit and tighten the p.t.o. guard securing bolt.
9. Fit the p.t.o. pulley guard assembly, operation 10A-13-12.
10. Mount the pulley drive unit in the required position on the four adaptor studs and simultaneously engage the tractor p.t.o. shaft splines in the pulley drive gear.
11. The pulley unit can be fitted to the left, right or beneath the p.t.o. shaft but NEVER ABOVE.
12. Fit and secure the four nuts and washers to secure the pulley drive unit.

NOTE: The p.t.o. guard and the pulley guard must be fitted at all times.

Removal

13. Reverse procedures 1 to 12.



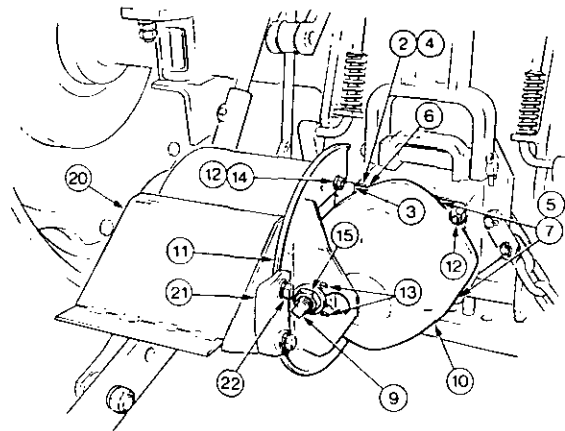


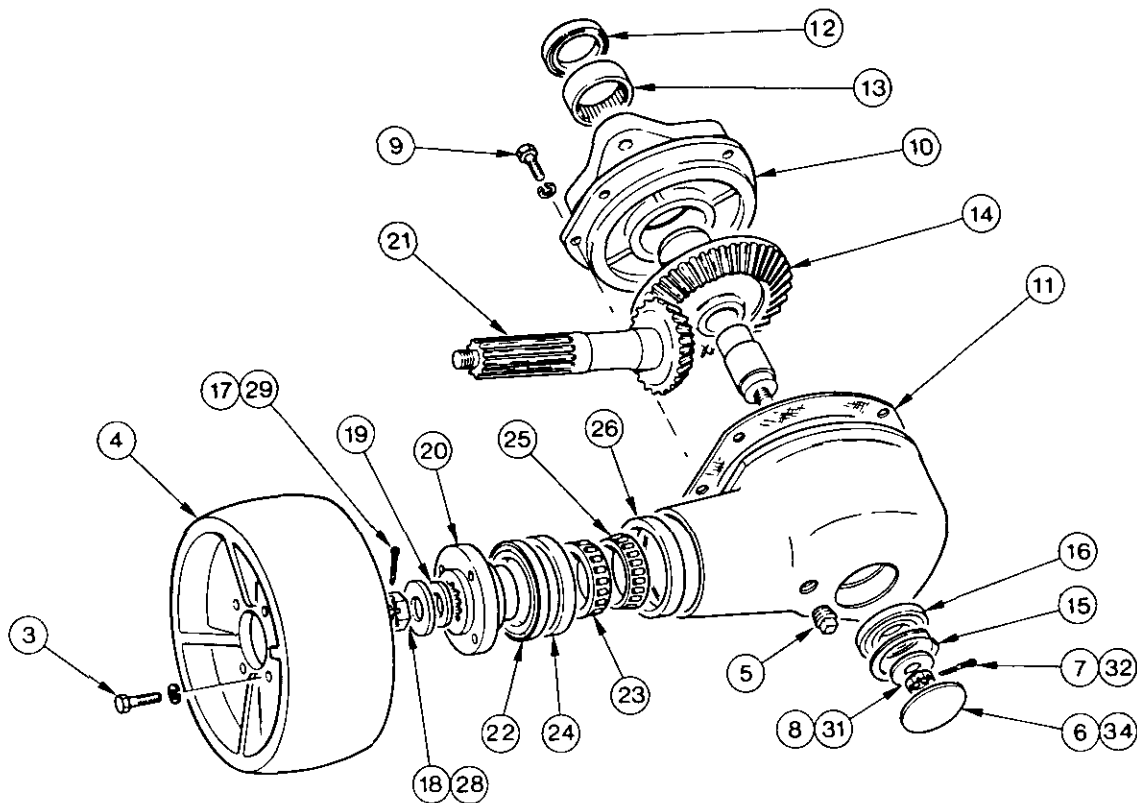
P.T.O. PULLEY GUARD ASSEMBLY

Kit Fitment

10A-13-12

1. Remove the p.t.o. Belt Pulley Unit from the tractor, operation 10A-12-11.
2. Normal Duty Units, remove the two bearing housing bolts adjacent to the pulley.
3. Fit the bracket assembly with the welded nuts facing the pulley.
4. Refit and tighten the two bolts.
5. Heavy Duty Units, remove four bearing housing bolts.
6. Fit the two brackets, with the lugs nearest to the pulley.
7. Refit and tighten the four bolts.
8. Remove and discard the oil filler plug.
9. Fit the special oil filler plug which is supplied in the kit.
10. Position the spacer over the oil filler plug.
11. Position the support plate on the belt pulley unit from the rear and locate the extended oil filler plug through the hole in the flange.
12. Fit finger tight the two bolts securing the support plate to the bracket assemblies.
13. Align the support plate with the pulley and fit the countersunk screws in the spacer.
14. Tighten the two support plate securing bolts.
15. Fit and tighten the nut and washer on the end of the oil filler plug.
16. Remove and discard the two bolts and washers from the pulley.
17. Fit the two adaptors.
18. Position the end cover and align the holes with the adaptors.
19. Fit and tighten two countersunk screws and lock washers.
20. Position the wedge assembly against the pulley with its fixing point nearest to the support plate.
21. Fit the fixing clamp over the rim of the support plate and align it with the holes in the wedge assembly.
22. Fit and tighten two bolts and spring washers.
23. Fit the p.t.o. belt pulley assembly on the tractor, operation 10-12-11.
24. Check that the belt clearance is kept to a minimum, to ensure effective guarding of the pulley is maintained. Adjustment of this clearance may be obtained by releasing the pressure from the clamp and pivoting the wedge about the pulley until the required clearance is obtained.





P.T.O. BELT PULLEY ASSEMBLY

Servicing

10A—14—13

Disassembly

1. Remove the p.t.o. belt pulley assembly.
2. Remove the p.t.o. guard kit.
3. Remove the pulley bolts and washers.
4. Remove the pulley.
5. Remove the oil filler plug and drain off the oil.
6. Remove the 'welch' washer.
7. Remove the split pin.
8. Remove the castellated nut and washer.
9. Remove the remaining three bolts and washers.
10. Remove the input bearing housing.
11. Remove and discard the gasket.
12. Remove the oil seal.
13. Remove the needle roller bearing.
14. Withdraw the input drive gear assembly from the housing.
15. Remove the snap ring.
16. Remove the ball bearing assembly.
17. Remove the split pin.
18. Remove the castellated nut and washer.
19. Remove the drive pinion oil seal.
20. Remove the pulley drive pinion hub.
21. Withdraw the pulley drive pinion from the housing.
22. Remove the oil seal.
23. Remove the outer bearing cone.
24. Remove the outer bearing cup.
25. Remove the inner bearing cone.
26. Remove the inner bearing cup.

Re-assembly

27. Reverse procedures 18 to 26, except:
 - (a) Ensure a new gasket and oil seals are fitted.
 - (b) The 'lip type' oil seals are fitted with the lips curve facing the bearing.
28. Tighten the castellated nut on the pulley drive pinion to obtain a preload of 0,35 Nm (3 lbf in), then back off the nut to the first castellation.
29. Fit a new split pin.
30. Reverse procedures 8 to 16.
31. Tighten the castellated nut until 0,15 mm (0.006 in) back lash between the gears is obtained, then back off the nut to the first castellation.
32. Fit a new split pin.
33. Lightly coat the edge of the 'welch' washer with a recommended sealant 'A'.
34. Fit the 'welch' washer, concave face first and using a large diameter drift, flatten the convex surface sufficiently for the 'welch' washer to grip the housing.
35. Fill the normal duty pulley housing with 0,85 litres (1½ pints) and the heavy duty housing with 1,14 litres (2 pints) of S.A.E. 30 oil.
36. Reverse procedures 1 to 5.

ACCESSORIES

FRONT MOUNTED WEIGHT FRAME

Kit Fitment

10A—15—14

NOTE: Care should be taken when handling weight frames.

1. Remove the front grille, operation 2A.
2. Remove both front side panels, operation 2A.
3. Remove the battery, operation 9A.
4. Remove the front lower panel, operation 2A.
5. Remove the battery platform complete with the negative cable and clips.
6. Position the weight frame beneath the nose assembly and support the front and rear ends.
7. **On Four Wheel Drive Tractors** position the weight frame beneath the nose assembly and *simultaneously hook the front upper lip onto the nose assembly and support the rear end.*
8. Fit four long bolts with spacers in the four upper holes.
9. Fit two short bolts in the two lower holes.
10. Tighten all the bolts to a torque of 135 Nm (100 lbf ft).
11. Reverse procedures 1 to 5.
12. Fit the hitch pin and secure with a linch pin.

WHEEL BALLAST WEIGHTS

General

The wheel ballast weights are fabricated from cast iron and are available for fitment to both front and rear wheels.

1. Front wheel weights can be bolted to either or both sides of the wheel and are known as inner and outer weights.
2. Rear wheel weights are bolted to the outside of the wheel. Additional weights can be bolted to the adaptor weights.

NOTE: Ensure that an equal amount of weights are fitted to each side of the tractor and the tyre pressures are increased to accommodate the additional weight.

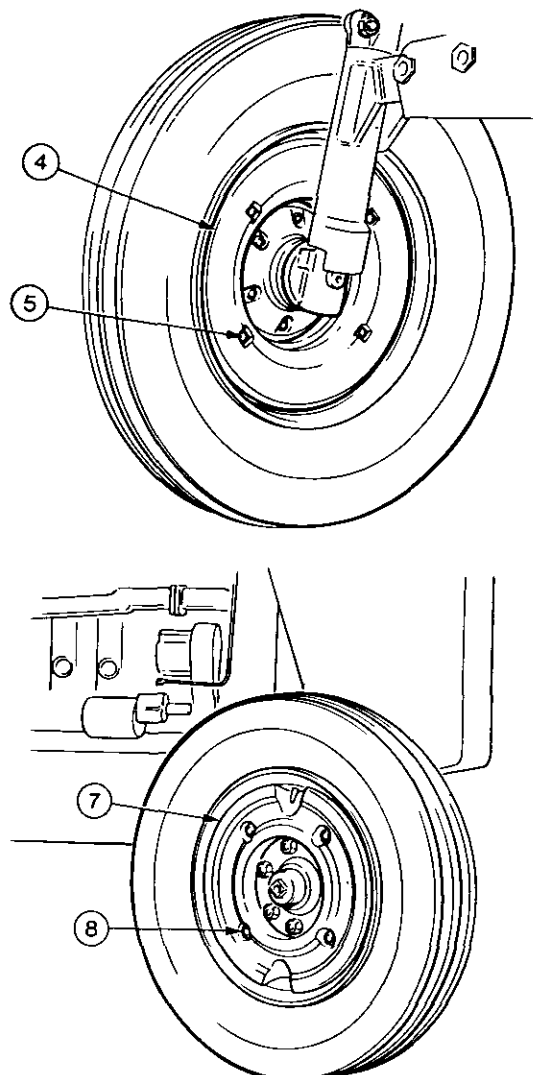
FRONT WHEEL WEIGHTS

Kit Fitment

10A—16—15

NOTE: Care should be taken when handling the weights.

1. Park the tractor on hard, level ground.
2. Apply the tractor handbrake.
3. Raise and remove one front wheel.
4. Position the inner weight on the inside edge of the wheel.
5. Fit the four square headed bolts from the inside edge. Use the short bolts when fitting inner weights **ONLY** and the long bolts when fitting outer weights.
6. Inner Weight Fitment only.
Position four special washers on the outside edge of the wheel with the chamfered face towards the wheel.
7. Outer Weight Fitment.
Position the weight on the outside edge of the wheel with the cut-out section by the tyre valve.
8. Fit and tighten four nuts and locking washers to the wheel weight securing bolts.
9. Refit the front wheel and torque the wheel securing bolts to 80 Nm (60 lbf ft).
10. Repeat procedures 2 to 8 for the other front wheel.



ACCESSORIES

REAR WHEEL WEIGHTS

Kit Fitment 10A—17—16

NOTE: Care should be taken when handling weights.

Round weight fitment (all tractors).

1. Park the tractor on hard, level ground and apply the hand brake.
2. Position the adaptor weight on the outside of the wheel with the cut-out by the tyre valve.
3. Fit and tighten four bolts and washers, or four nuts, bolts and washers.
4. Position the outer weight on the adaptor weight.
5. Fit and tighten four bolts and washers.
6. Repeat procedures 2 to 5 for the other rear wheel.

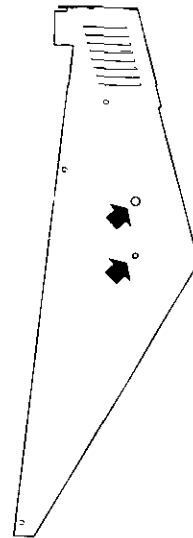
FIRE EXTINGUISHER MOUNTING POINT

10A—18—16

A fire extinguisher may be mounted on the rear section of the left hand fender panel. The two tapped holes (as shown) should be used rather than drilling any additional holes in to the cab, which would invalidate the O.E.C.D. approval.

Massey-Ferguson recommend the use of Fire Extinguishers filled with B.C.F. (Bromochloridifluoromethane) an efficient hlogenated carbon or vapourising liquid.

NOTE: A B.C.F. filled fire extinguisher should be used with care and confined spaces should be well ventilated after the fire is extinguished and before personnel re-enter.



MF 600 SERIES TRACTOR
WORKSHOP SERVICE MANUAL
PART 11

Publication No. 1856 274 M1

comprising

A SPECIAL MODELS

FOUR WHEEL DRIVE

Part 11—Section A

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FOUR WHEEL DRIVE

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GENERAL

Drive is taken from the gearbox epicyclic unit and is transmitted through a series of straight spur gears to a multi-plate hydraulic clutch which is actuated by a control knob mounted in the left-hand side rear corner of the tractor cab. When four wheel drive is engaged, torque is transmitted through the clutch and output shaft to an externally mounted transmission shaft which is connected to the intermediate housing and front axle rear support by two internally splined sliding sleeves. Housed in the front axle rear support is an input shaft which transmits the drive through two helical spur gears to a spiral bevel driving pinion and crownwheel. The crownwheel is bolted to the differential case containing the spider and differential gears into which the inner ends of the axle shafts are splined. Final drive is then transmitted through the epicyclic reduction units to the front wheels.

The axle is attached to the front of the tractor by means of the front and rear supports which house bearings to allow normal movement of the front axle. An anchor plate is welded to the rear of the axle on the right hand side of the Category III axle and on the left hand side of the Category II axle for the fitment of the hydraulic power steering ram.

The Category II axle can be identified by the small diameter, narrow hubs and cast construction, while the Category III axle is of a welded steel construction with large diameter protruding hubs.

PLANETARY CARRIER**Removal and Refitment**

11A-01-03

Removal

1. Apply the parking brake and chock the rear wheels.
2. Jack up the tractor under the axle being serviced.
3. Remove the wheel.
4. Rotate the hub until the plug is at the bottom, remove the plug and drain the oil from the hub.
5. Remove the three bolts, plain washers and spring washers.
6. Remove the guard.
7. Remove the eight bolts.
8. Withdraw the planetary carrier.
9. Remove and discard the gasket.

Refitment

10. Reverse procedures 1 to 9 except:
 - (a) Fit a new gasket.
 - (b) Tighten the planetary carrier securing bolts to a torque of 60 Nm (45 lbf ft).
 - (c) Rotate the wheel so that the filler plug is horizontal, then fill to this level with an approved oil and refit the plug.
 - (d) Tighten the wheel nuts to a torque of 270 Nm (200 lbf ft).

PLANETARY CARRIER**Servicing**

11A-02-03

Disassembly

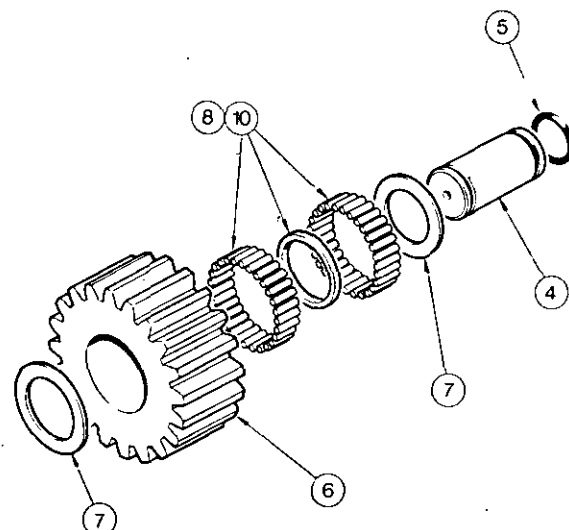
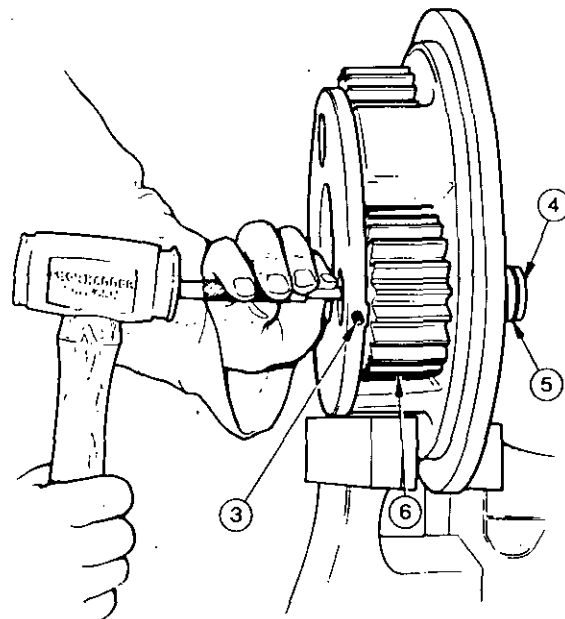
1. Remove the planetary carrier, operation 11A-01-03.
2. Place the planetary carrier in a vice.
3. Remove the grub screw.
4. Carefully tap out the planet gear shaft.
5. Remove the 'O' ring.
6. Remove the planet gear and the washers, taking care not to dislodge the needle rollers.
7. Remove the washers.
8. Remove the needle rollers and the spacer.
9. Repeat procedures 3 to 7 for the remaining two planetary gears. Thoroughly clean and inspect all components and replace any that are worn or damaged.

Reassembly

10. Using petroleum jelly, refit the needle rollers and the spacer.

NOTE: There are 40 needle rollers either side of the spacer in each planet gear.

11. Reverse procedures 1 to 9 except:
 - (a) Tighten the planet gear shaft retaining screws to 9 Nm (7 lbf ft).



FOUR WHEEL DRIVE

RING GEAR AND REDUCTION HUB

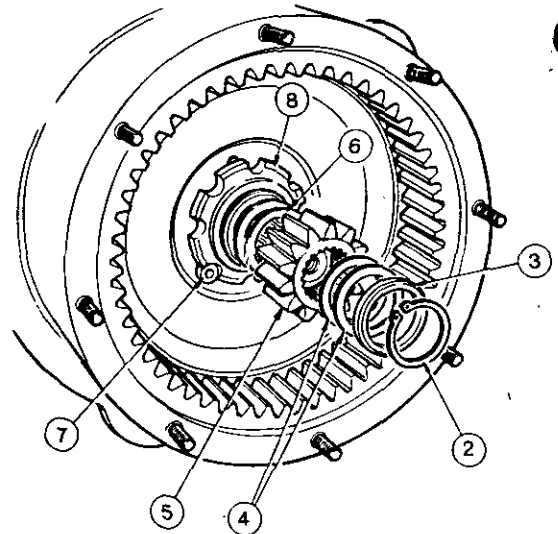
Removal and Refitment

11A-03-04

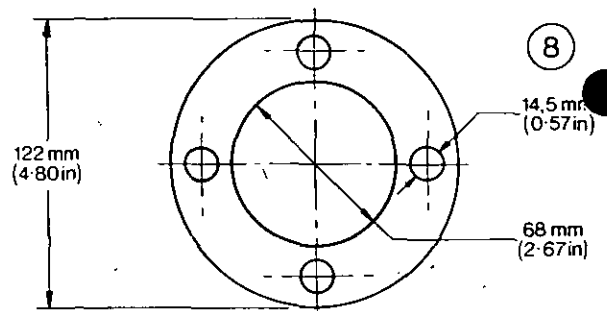
Special Tools: See item 8.

Removal

1. Remove the planetary carrier, operation 11A-01-03.
2. Remove the circlip.
3. Remove the washer.
4. Remove the shims.
5. Remove the sun gear.
6. Remove the thrust washers.
7. Remove the Allen bolt and washer.



8. Using a special spanner made in accordance with the drawing shown, remove the castellated nut.

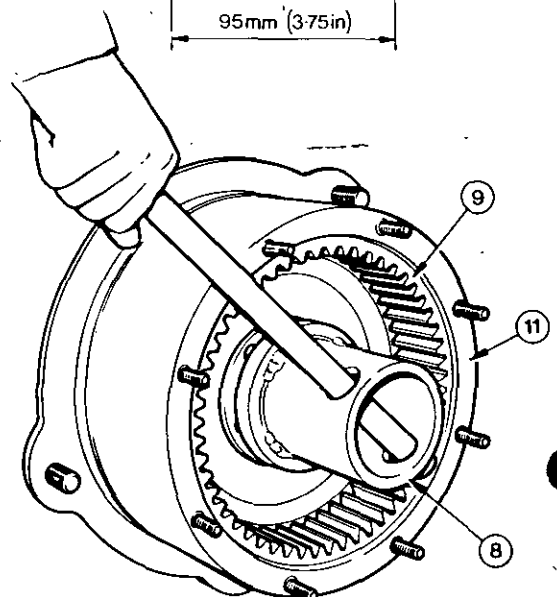
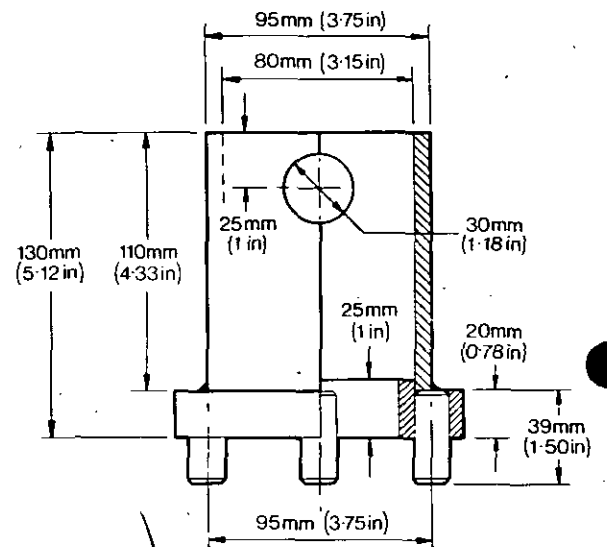


9. Remove the ring gear assembly.
10. Remove the rubber shroud from its seating on the universal joint housing.
11. Carefully withdraw the hub, taking care not to damage the lip seal.



WARNING: The hub is heavy and awkward to handle, take care when both removing and re-fitting it.

12. Remove the bearing cone which will have fallen into the hub.



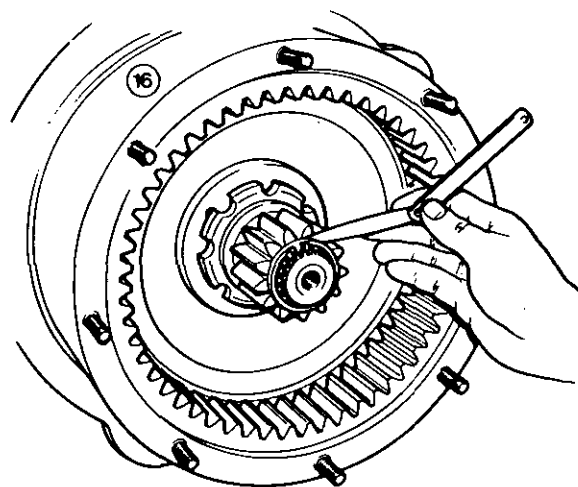
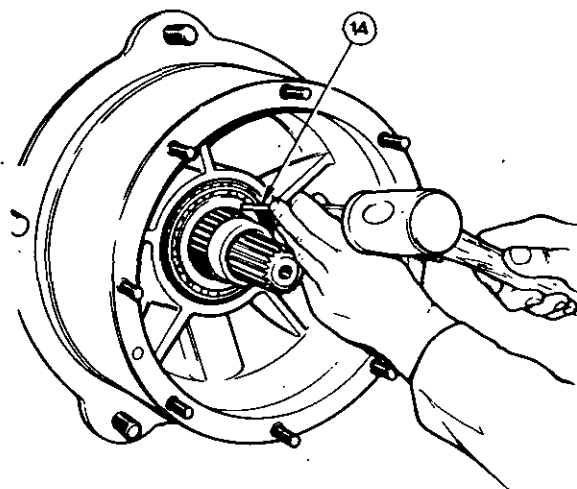
Refitment

13. Place the hub, complete with rubber shroud, in position on the wheel spindle.

14. Partially fit the bearing cone to the wheel spindle; this will centralise, and hold the reduction hub.
15. Reverse procedures 2 to 10 except:
 - (a) Tighten the castellated nut until the reduction hub can freely rotate without any end play.
 - (b) Tighten the Allen bolt to a torque of 30 Nm (28 lbf ft).
16. Using feeler gauges, measure the gap between the sun gear and the washer.
17. Add shims selected from the table below, to limit sun gear end float to 0,1 to 0,2 mm (0-004 to 0-008 in).

Part No.	mm	in
2714 113 M1	0,10	0-004
2714 114 M1	0,15	0-006
2714 115 M1.	0,30	0-012
2714 116 M1	0,50	0-020

18. Refit the planetary carrier, operation 11A-01-03



FOUR WHEEL DRIVE**RING GEAR AND REDUCTION HUB****Servicing** 11A-04-06

Special Tools: See item 8, operation 11A-03-04.

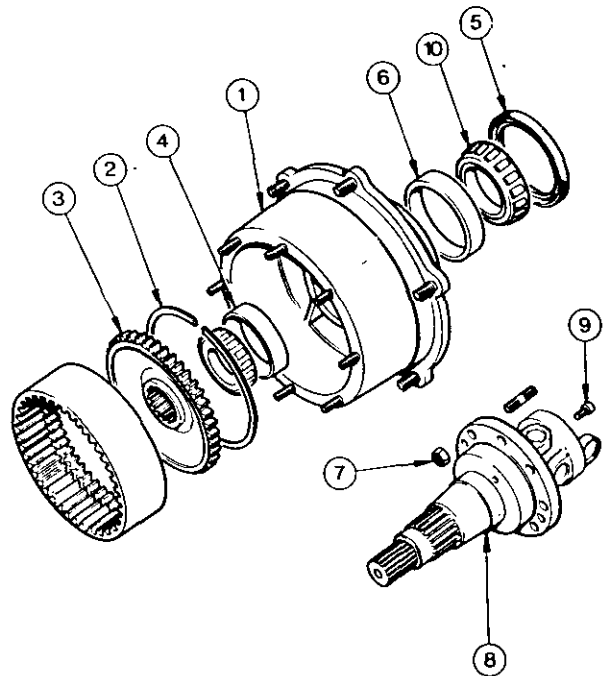
Disassembly

1. Remove the reduction hub, operation 11A-03-04.
2. Remove the circlip.
3. Remove the splined end cover.
4. Remove the bearing cup.
5. Remove the lip seal.
6. Remove the bearing cup.
Only if the inner bearing cone is damaged, continue as follows:—
7. Remove the eight self locking nuts.
8. Withdraw the wheel spindle and half shaft assembly.
9. Remove the two allen bolts.
10. Insert and tighten two bolts, thus removing the bearing cone.

Paying particular attention to the bearings and the ring gear teeth, inspect all components and replace any which show signs of wear or damage.

Reassembly

11. Reverse procedures 1 to 10 except:
 - (a) When refitting the wheel spindle and half shaft assembly, take care to avoid damaging the lip seal and ensure that the splines on the inner end of the half shaft engage correctly in the differential gear.
 - (b) Tighten the wheel spindle securing nuts to a torque of 40 Nm (30 lbf ft).
 - (c) Smear a new lip seal with recommended sealant 'A' then fit it to the reduction hub with the lip facing towards the reduction hub.

**WHEEL SPINDLE, HALF SHAFT AND UNIVERSAL JOINT ASSEMBLY****Removal and Refitment** 11A-05-06

Special Tools: See item 8, operation 11A-03-04.

Removal

1. Remove the reduction hub, operation 11A-03-04.
2. Remove the eight locking nuts.
3. Withdraw the wheel spindle and half shaft assembly.

Refitment

4. Reverse procedures 1 to 3 except:
 - (a) Tighten the locking nuts to a torque of 40 Nm (30 lbf ft).

WHEEL SPINDLE, HALF SHAFT AND UNIVERSAL JOINT ASSEMBLY

Servicing

11A-06-07

Special Tools: 7066 Circlip Pliers
MF 200 Hand Press
MF 200-25/1 and 25/2 Adaptors
Special Spanner—See item 8, operation 11A-03.

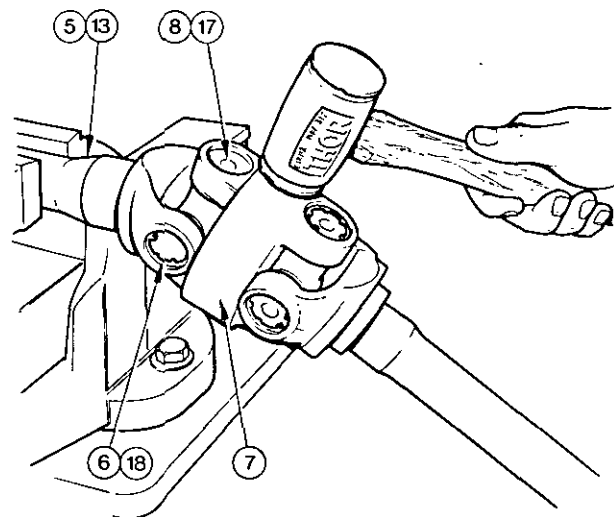
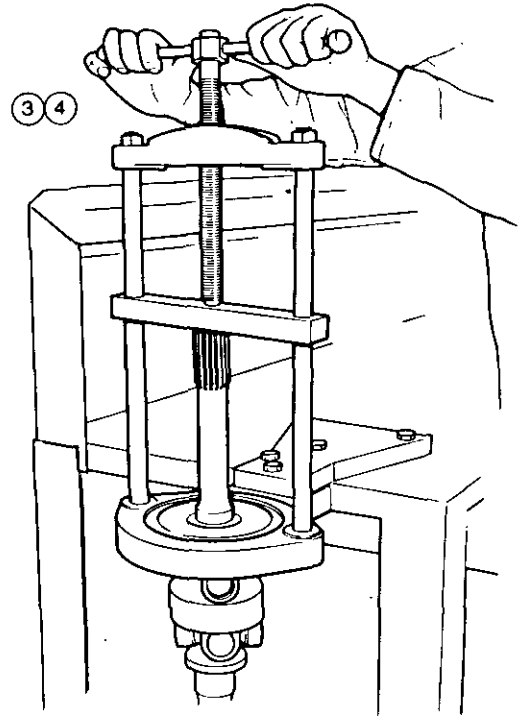
Disassembly

1. Remove the wheel spindle and half shaft assembly, operation 11A-05-06.
2. Remove the wheel spindle by holding the inner splined section of the half shaft, inverting the shaft and tapping the outer half shaft on a block of wood.
3. Using MF 200 fitted with MF 200-25, remove the bearing.
4. Using MF 200 fitted with MF 200-25 remove the seal.
5. Grip the inner section of the half shaft in a soft faced vice.
6. Remove the four circlips from the spider coupling, using 7066 circlip pliers.
7. Tap the spider housing with a soft faced hammer until it bottoms on the spider.
8. Remove the spider cap complete with the rubber seal and needle rollers.
9. Turn the half shaft assembly through 180° and repeat items 7 and 8.
10. Manoeuvre the spider housing clear of the journal.
11. Turn the half shaft assembly through 45° then repeat items 7 to 9 to free the spider from the yoke.
12. Grip the outer section of the half shaft in the vice and repeat items 7 to 11.

Paying particular attention to the axle shaft splines, inspect all components and replace any which show signs of wear or damage. On the universal joint, always replace spider couplings, end caps and circlips.

Reassembly

13. Grip the inner section of the half shaft in the vice.
14. Pack four new end caps with an approved molybdenum based grease.
15. Manoeuvre a new spider into position in the yoke.
16. Fit an end cap into position over the journal.
17. Using a suitable punch, tap the end cap into the yoke until the circlip groove is visible.
18. Fit a new circlip.
19. Turn the shaft through 180° and repeat items 16 to 18.
20. Manoeuvre the spider housing into position on the remaining journals.
21. Repeat items 16 to 18.
22. Grip the outer section of the half shaft in the vice.
23. Repeat items 15 to 21.
24. Refit the bearing in the wheel spindle.
25. Refit the seal in the wheel spindle with the lip towards the bearing.
26. Fit the outer half shaft into the wheel spindle.
27. Refit the wheel spindle and half shaft assembly operation 11A-05-06.



FOUR WHEEL DRIVE

FRONT AXLE PIVOT HOUSING

Servicing

11A-07-08

Special Tools: See item 6.

Universal Bearing Extractor

MF 195-4/1 Bearing Replacer

See item 8, operation 11A-03-04.

Disassembly

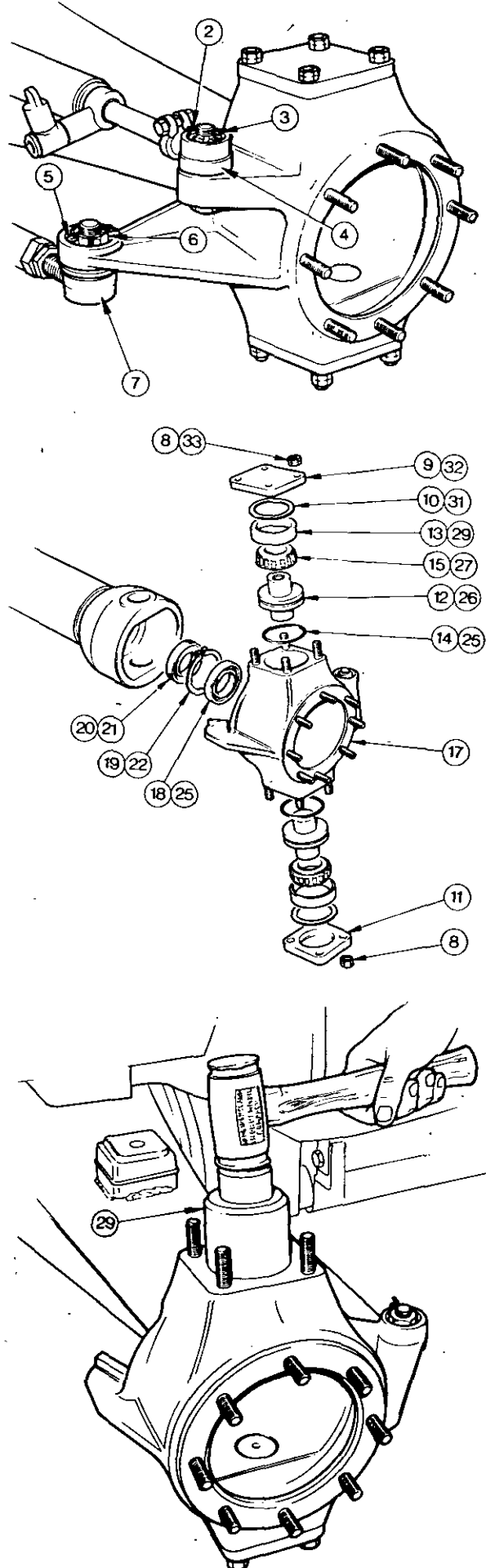
1. Remove the wheel spindle, half shaft and universal joint assembly, operation 11A-05-06. Right Hand Pivot Housing only, items 2 to 4.
2. Remove the split pin.
3. Remove the castellated nut.
4. Disconnect the piston rod ball joint.
5. Remove the split pin.
6. Remove the castellated nut.
7. Disconnect the tie rod ball joint.
8. Remove the eight nuts.
9. Remove the upper cover, taking care not to damage the shims.
10. Remove the shims.
11. Remove the lower cover.
12. Using an extractor, remove the upper pin.
13. Remove the bearing cap.
14. Remove the 'O' ring.
15. Remove the bearing cone.
16. Repeat items 12 to 15 for the lower pivot pin.
17. Remove the pivot housing.
18. Remove the seal.
19. Remove the circlip.
20. Remove the bearing.

Thoroughly clean and inspect all components, replacing any which show signs of wear or damage.

Reassembly

21. Refit the bearing, ensuring that it is fully seated.
22. Fit a new circlip.
23. Smear a new seal with recommended sealant 'A', then fit it with its lip towards the circlip.
24. Support the pivot housing in approximately its correct position.
25. Fit a new 'O' ring to the recess in the upper pivot pin flange.
26. Fit the upper pivot pin.
27. Fit the bearing cone.
28. Partially fill the bearing cavity with an approved grease.
29. Using MF 195-4/1, fit the bearing cup.
30. Pack the bearing with an approved grease.
31. Refit the shims.
32. Refit the upper cover.
33. Fit and tighten the 4 nuts to a torque of 40 Nm (30 lbf ft).
34. Repeat items 25 to 30 and 32 to 33 for the lower pivot pin.

Continued



35. Check that the housing pivots freely without any play. If play is encountered, remove the upper cover and ADD shims selected from the table below. If excessive binding is encountered, remove the upper cover and REMOVE shims.

Part Number	mm	in
2714 095 M1	0.10	0.004
2714 096 M1	0.15	0.006
2714 097 M1	0.30	0.012
2714 098 M1	0.50	0.020

36. Refit the upper cover and recheck the pivot housing movement.
37. Reverse procedures 1 to 7 except:
- Tighten the castellated nuts to a torque of 70 Nm (50 lbf ft).
 - Fit new split pins.

FRONT AXLE

Removal and Refitment

NOTE: The front axle can be removed in one of two ways, the choice of which is dictated by the work to be undertaken:—

Method 1. Work being carried out on the front axle front support, the input housing or the front axle rear support.

Method 2. Work being carried out on the crownwheel and pinion, the differential or complete front axle overhaul.

Method 1

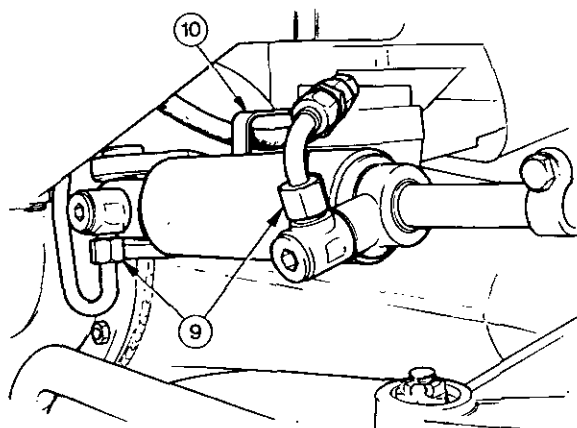
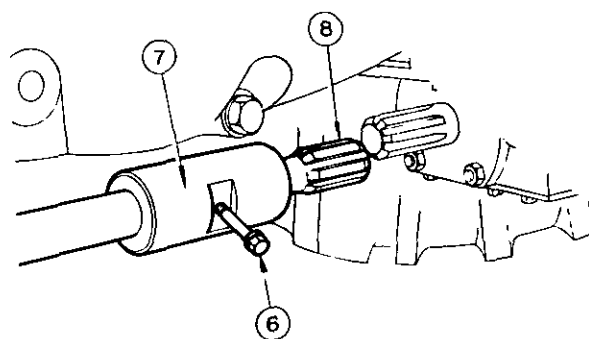
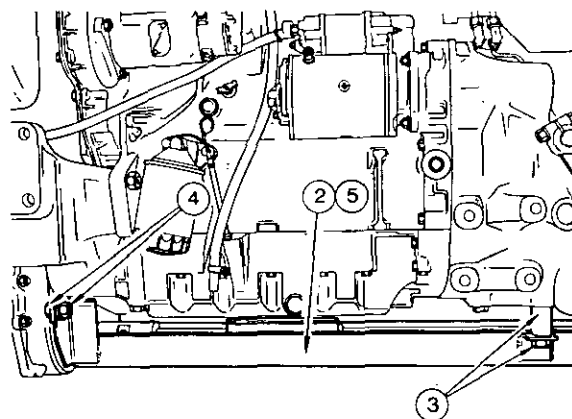
Removal and Refitment

11A-08-09

Special Tools: 270 Stand

Removal

- Check the tractor rear wheels and apply the parking brake.
- Support the transmission shaft shield.
- Remove the two bolts, washers and spacers.
- Remove the two nuts, washers and bolts.
- Remove the shield.
- Remove the bolt securing each sliding sleeve.
- Slide the sleeves inwards along the transmission shaft.
- Remove the transmission shaft.
- Disconnect the two steering ram hoses. Plug the hoses and the ram connections with plastic or wooden plugs to prevent dirt ingress.
- Feed the hose from the piston rod end of the cylinder through the bracket welded adjacent to the bump stop.
- Support the tractor under the engine sump with the 270 stand.



FOUR WHEEL DRIVE

12. Remove the four nuts and spring washers or four bolts securing the rear support.
13. Remove the four bolts and spring washers securing the front support.
14. Stabilise the front axle by supporting the tie rod with a suitable stand.
15. Place a trolley jack immediately behind the 270 stand and raise the nose of the tractor sufficiently to clear the front axle front support.
16. Extend the 270 stand to support the tractor.
17. Remove the trolley jack and re-position it under the front axle.
18. Remove the stand from underneath the tie rod.
19. Roll the front axle assembly clear of the tractor.

Refitment

20. Reverse procedures 1 to 19 except:
 - (a) When lowering the tractor onto the front and rear supports, ensure that the spacer studs and the bolt holes are correctly aligned.
 - (b) Tighten the front support bolts and the rear support nuts to a torque of 200 Nm (150 lbf ft).
21. Bleed the power steering system, Part 7B.

Method 2.**Removal and Refitment**

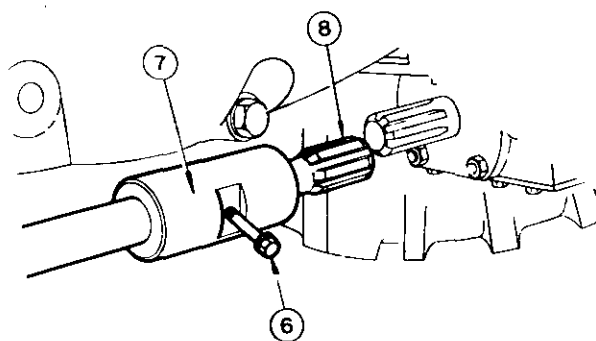
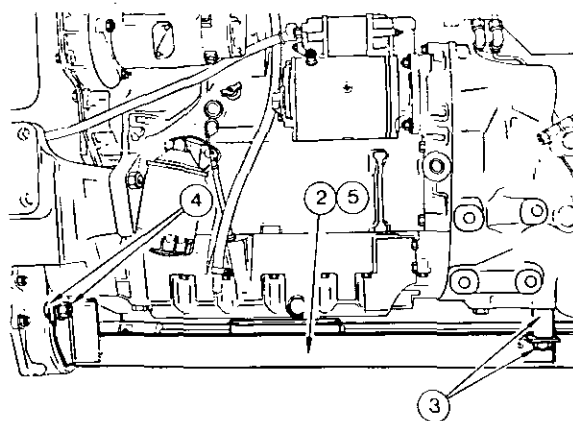
11A-09-10

Special Tools: 270 Stand

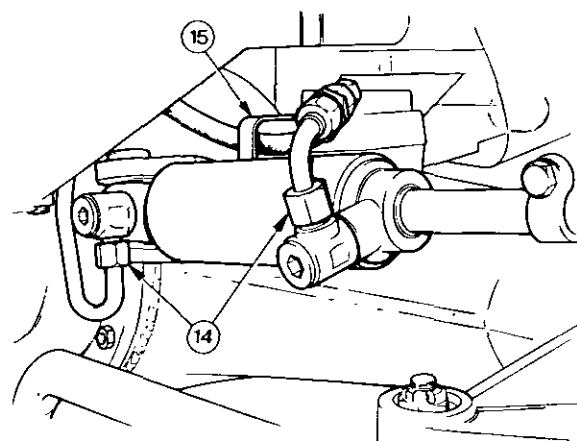
See item 16

Removal

1. Chock the tractor rear wheels and apply the parking brake.
2. Support the transmission shaft shield.
3. Remove the two bolts, washers and spacers.
4. Remove the two nuts, washers and bolts.
5. Remove the shield.
6. Remove the bolt securing each sliding sleeve.
7. Slide the sleeves inwards along the transmission shaft.
8. Remove the transmission shaft.



9. Slacken the wheel nuts.
10. Using a jack capable of lifting at least 5000-kg (5 ton), raise the tractor so that both front wheels are clear of the ground.
11. Using a 270 stand, support the tractor under the engine sump.
12. Remove the wheel nuts.
13. Remove the front wheels.
14. Disconnect the two steering ram hoses. Plug the hoses and the ram connections with plastic or wooden plugs to prevent dirt ingress.
15. Feed the hose from the piston rod end of the cylinder through the bracket welded adjacent to the bump stop.



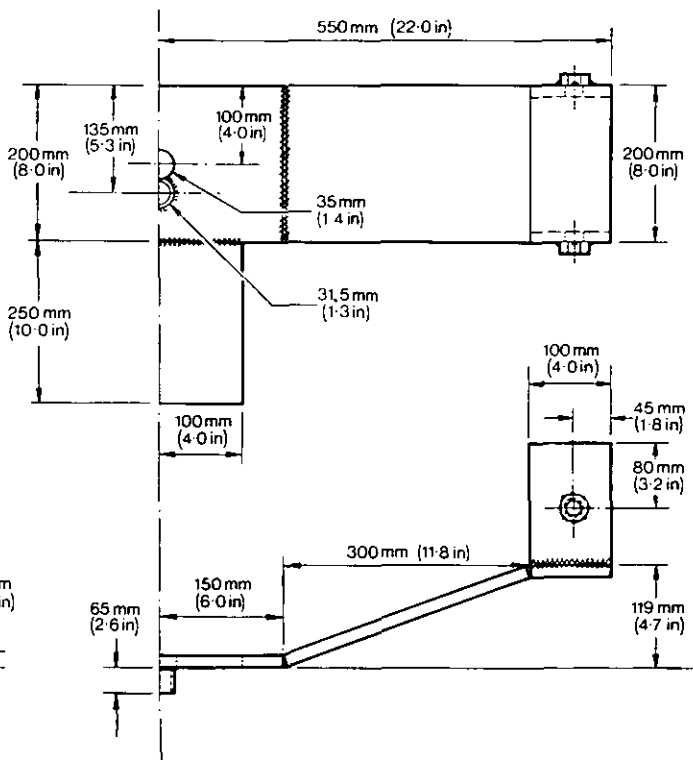
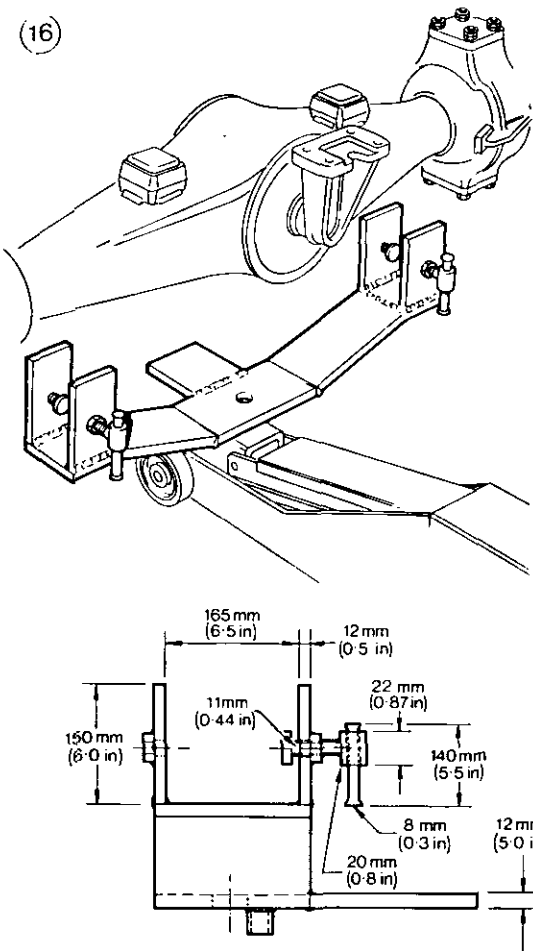
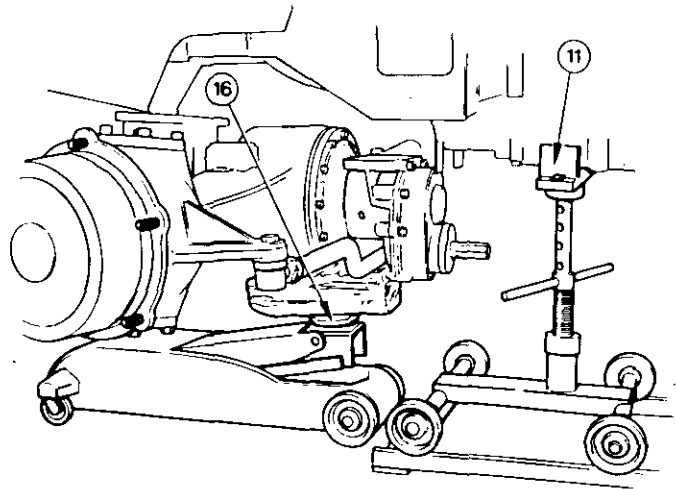
FOUR WHEEL DRIVE

16. Support the front axle with a trolley jack fitted with either the special support tool (made in accordance with the drawing given) or a suitable block of wood.
17. Remove the four nuts and spring washers or four bolts securing the rear support.
18. Remove the four bolts and spring washers securing the front support.
19. Lower the front axle assembly on the trolley jack sufficiently for the front axle front support to clear the nose of the tractor.
20. Withdraw the front axle assembly.

NOTE: If a block of wood is being used in preference to the special axle support tool, care must be taken to maintain correct balance of the front axle while manoeuvring it into the desired position.

Refitment

21. Reverse procedures 1 to 20 except:
 - (a) When raising the front axle into position, ensure that the spacer studs and the bolt holes are correctly aligned.
 - (b) Tighten the front support bolts and the rear support nuts to a torque of 200Nm (150 lbf ft).
 - (c) Tighten the wheel nuts to a torque of 270 Nm (200 lbf ft).
22. Bleed the power steering system, Part 7B.



FOUR WHEEL DRIVE**REAR SUPPORT SPACER**
(Category III axle only)**Removal and Replacement** 11A-10-12

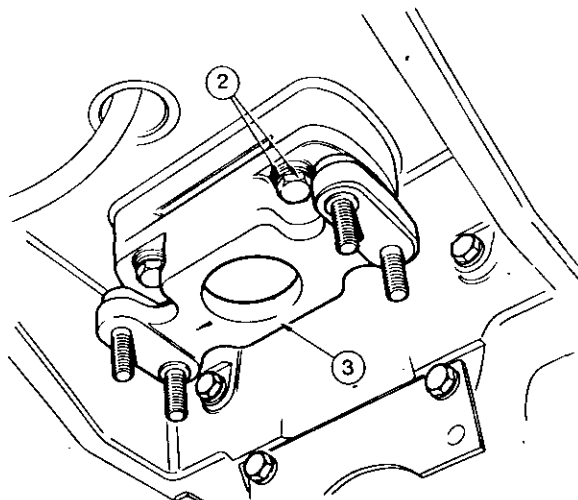
Special Tools: See operation 11A-08-09

Removal

1. Remove the front axle, operation 11A-08-09.
2. Remove the four bolts and spring washers.
3. Remove the spacer.

Refitment

4. Reverse procedure 1 to 3 except:
 - (a) Tighten the bolts to a torque of 200 Nm (150 lbf ft).

**FRONT SUPPORT****Removal and Refitment** 11A-11-12

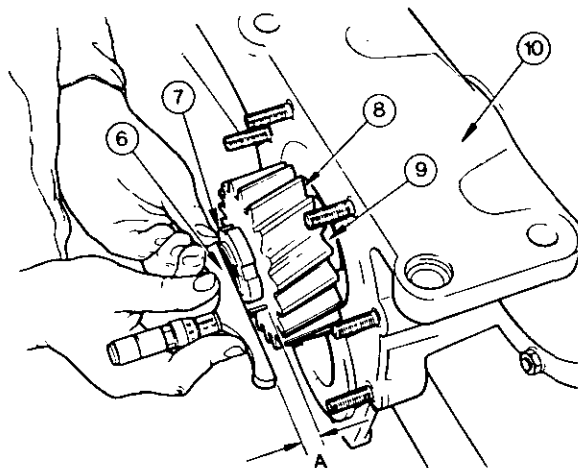
Special Tools: See operation 11A-08-09

Removal

1. Remove the front axle, operation 11A-08-09.
2. Remove the front support.
3. Remove the thrust washer. Clean and inspect the thrust washer and the bush.
4. If necessary, remove the bush using a suitable bush extractor. Ensure that the grease nipple is functioning correctly.

Refitment

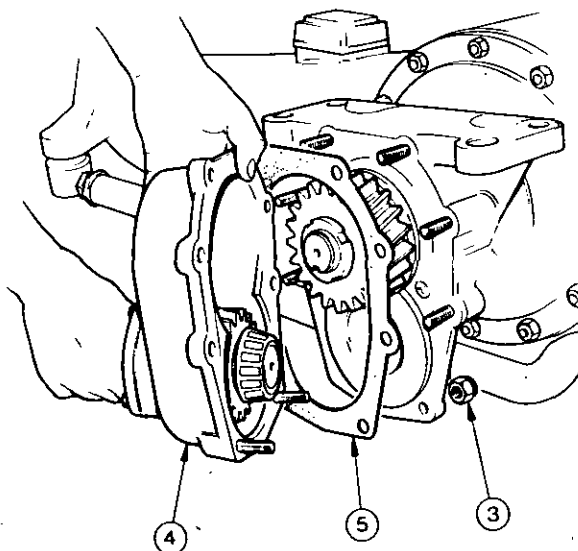
5. If necessary, fit a new bush using a suitable mandrel.
6. Reverse procedures 1 to 3.
7. Grease the front support until clean grease exudes past the thrust washer.

**REAR SUPPORT/INPUT HOUSING**
(Category III Axle)**Removal and Refitment** 11A-12-12Special Tools: Depth gauge—micrometer type
See operation 11A-08-09**Removal**

1. Remove the front axle, operation 11A-08-09
2. Place a drain tank of at least 12 litre (20 Imp. pt) capacity under the front axle and remove axle and input housing drain plugs.
3. Remove the eight self locking nuts.
4. Remove the cover and input shaft assembly.
5. Remove and discard the gasket.
6. Using a depth gauge measure dimension 'A'—record this reading.
7. Remove the locknut.
8. Remove the gear.
9. Remove the spacer.
10. Remove the rear support/input housing. Thoroughly clean the mating faces of the input housing and support casting. Clean the main pivot bush and thrust washer.

Refitment

11. Reverse procedures 1 to 10 except:
 - (a) Fit a new locknut, tightened to give the same reading of dimension 'A' as obtained in item 6. Secure the locknut.
 - (b) Fit a new gasket.
 - (c) Fill the front axle to the correct level with an approved oil.



REAR SUPPORT/INPUT HOUSING (Category III axle only)

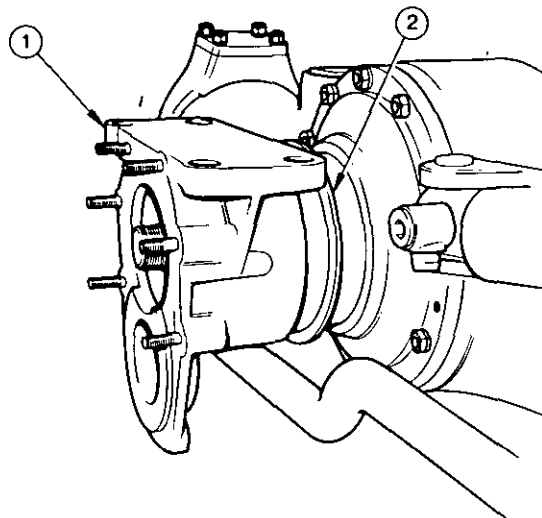
Servicing

11A-13-13

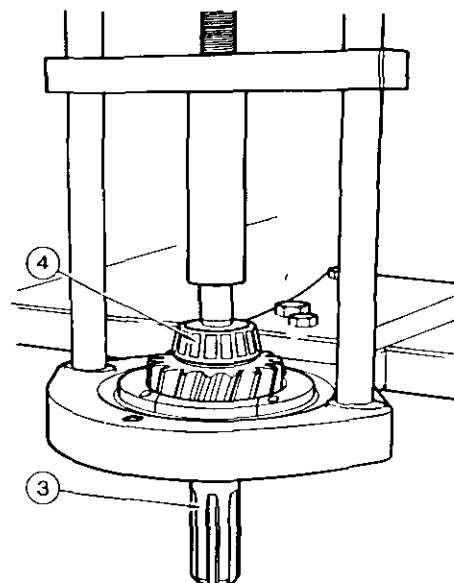
Special Tools: MF 200 Hand press
MF 200-25 Bearing remover
See operation 11A-12-12

Disassembly

1. Remove the rear support/input housing, operation 11A-12-12.
2. Remove the thrust washer.

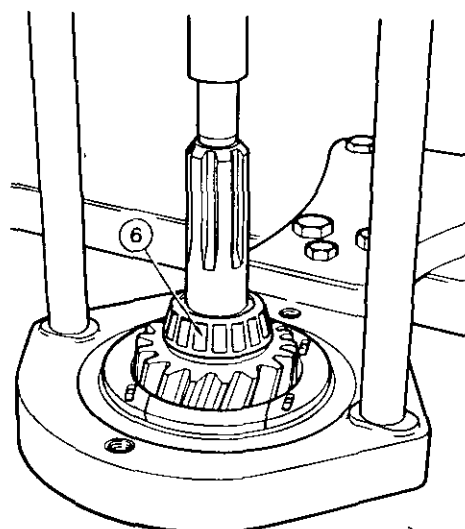


3. Remove the input shaft assembly.
4. Using MF 200 fitted with MF 200-25, press off the inner bearing cone.



5. Remove the thrust washer.
6. Refit the input shaft to MF 200 and press off the outer bearing cone.

Continued



FOUR WHEEL DRIVE

7. Remove the thrust washer.
8. Remove the gear.
9. Remove the three self locking nuts.
10. Remove the seal housing.
11. Remove the shims.
12. Remove and discard the seal.
13. Remove and discard the 'O' ring.
14. Tap out the outer bearing cup.
15. Using pry bars as shown, remove the inner bearing cup.
16. Only if necessary, press out the two bushes.
17. Only if necessary, remove the bush.
18. Remove and discard the 'O' ring.

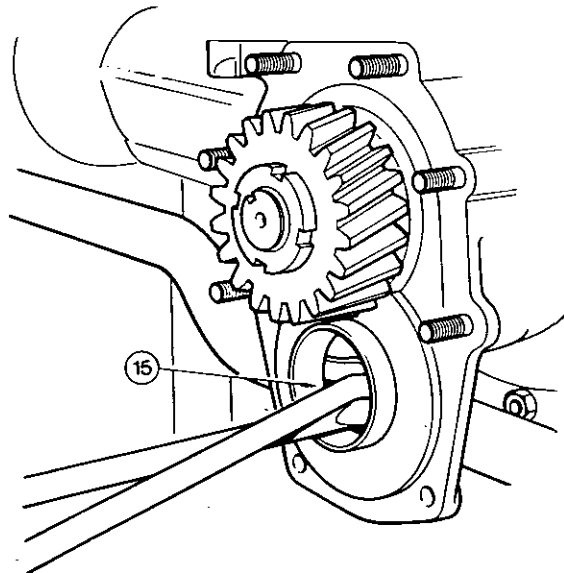
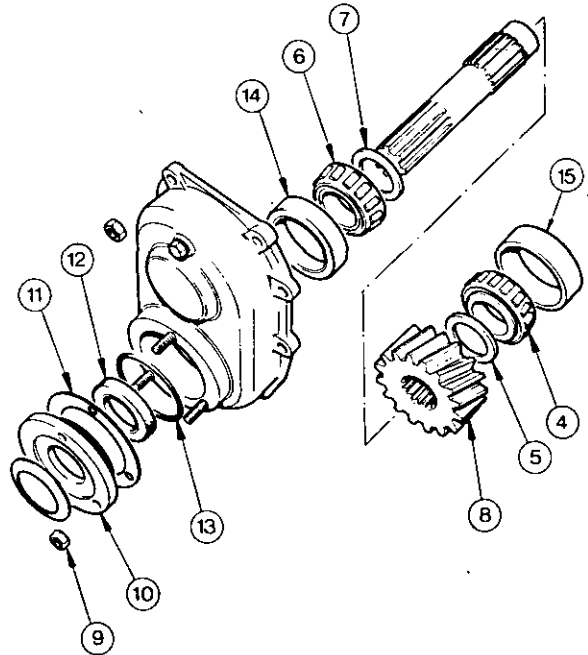
Thoroughly clean and inspect all components and replace any which show signs of wear or damage.

Reassembly

19. Reverse procedures 2 to 18 except:
 - (a) Fit a new 'O' ring.
 - (b) Ensure that the first bush is pressed FULLY into the rear support casting and that the second bush is pressed in until it is flush with the casting.
 - (c) Fit the bush (17) with the larger internal chamfer towards the differential housing.
 - (d) Fit a new 'O' ring (13).
 - (e) Fit a new lip seal with the lip facing towards the input housing. Smear the lip of the seal with petroleum jelly.
 - (f) Fit, and tighten the three locknuts.
 - (g) When fitting the input shaft assembly, take care not to damage the lip seal.
20. Reverse procedures 3 to 11 of operation 11A-12-12.
21. Using a suitable pre-load gauge and shims selected from the table below, set the input shaft pre-load to between 15 and 20 kg cm (12 and 16 lbf in). To increase the pre-load decrease total shim thickness and to decrease the pre-load increase total shim thickness.

Part Number	mm	in
2714 077	0,50	0-020
2174 078	0,30	0-012
2714 079	0,15	0-006
2714 080	0,10	0-004

22. Refill the front axle to the correct level with an approved oil.
23. Refit the front axle, operation 11A-08-09.



DIFFERENTIAL ASSEMBLY**Removal and Refitment** 11A-14-15

Special Tools: See operations 11A-09, 11A-12 and 11A-05

Removal

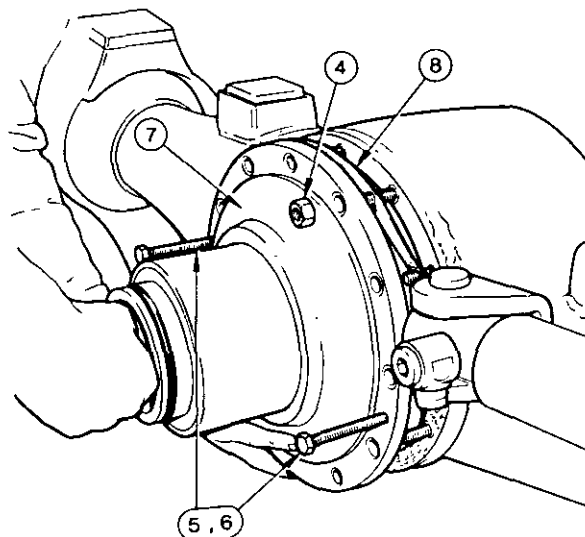
1. Remove the front axle, operation 11A-09-10.
2. Remove the rear support/input housing, operation 11A-12-12.
3. Remove the right and left hand wheel spindle, half shaft and universal joint assemblies, operation 11A-05-06.
4. Remove the twelve self locking nuts.
5. Fit a bolt to each of the two diametrically opposed tapped holes. Tighten the bolts to free the differential.
6. Remove the bolts.
7. Remove the differential assembly.

NOTE: The differential unit is heavy and awkward to handle, take care when both removing and refitting it.

8. Remove and discard the gasket.

Refitment

9. Reverse procedures 1 to 8 except:
 - (a) **IMPORTANT:** When refitting the differential assembly, the crownwheel must be to the **LEFT** of centre.
 - (b) Fit a new gasket.



FOUR WHEEL DRIVE**DIFFERENTIAL BEARINGS****Removal and Refitment**

11A-15-16

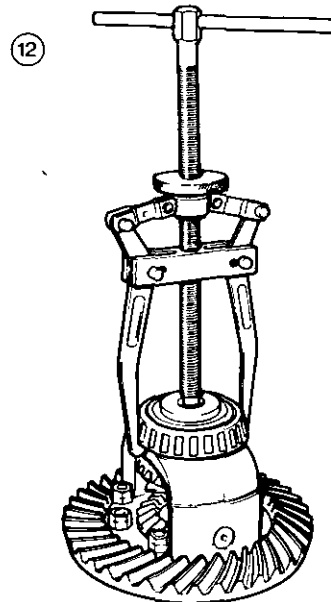
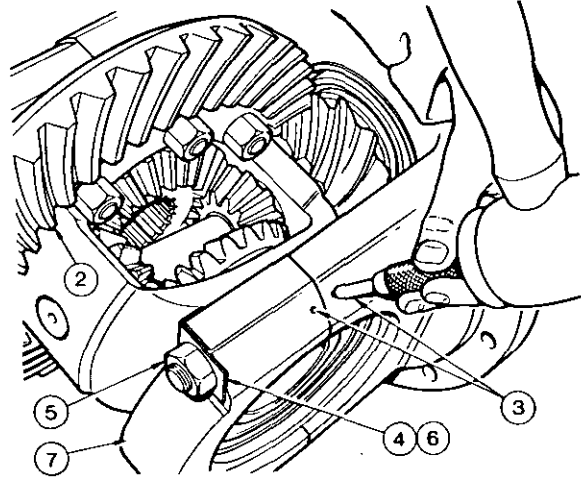
Special Tools: See operation 11A-14-15

Removal

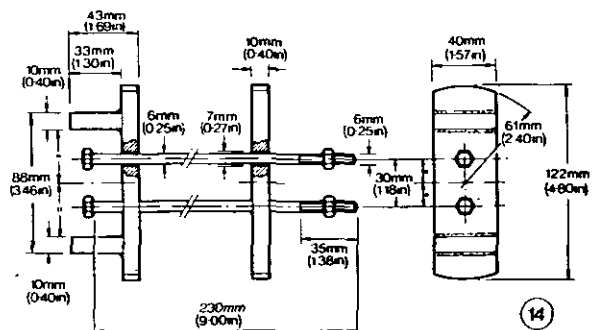
1. Remove the differential assembly, operation 11A-14-15.
2. Hold the differential in a soft faced vice.
3. Dot punch an end cap and the differential casting adjacent to it. Note which side the crownwheel is in relation to the dot punched end cap.
4. Flatten the four lockwasher tabs.
5. Remove the four nuts.
6. Remove the four lockwashers.
7. Remove the end caps.
8. Remove the differential unit complete with locating rings, shims and bearing cups.
9. Remove the locating rings.
10. Remove the shims.
11. Remove the bearing cups.

NOTE: Keep the two sets of locating rings, shims and bearing cups separately and identify them to ensure that they are refitted in their original positions.

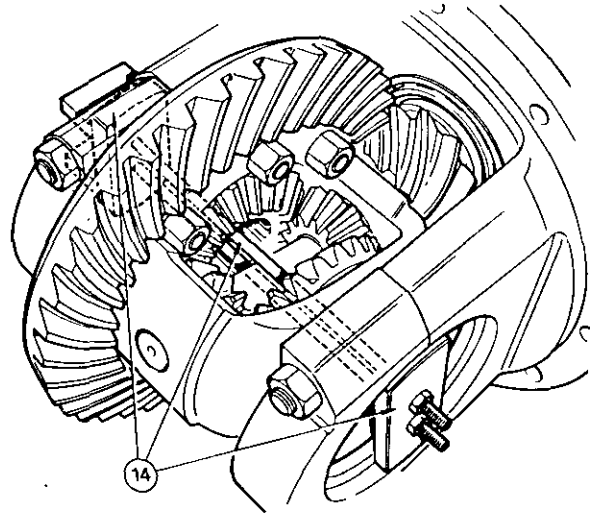
12. Using a universal extractor, remove the two bearing cones.

**Refitment**

13. Reverse procedures 9 to 12.
14. Using the special tool made in accordance with the drawing given, clamp the differential, shims, bearing cups and locating rings together.

Continued

15. Reverse procedures 3 to 8 except:
 - (a) Ensure that all parts are assembled in their original positions.
 - (b) Tighten the end cap nuts to a torque of 140 Nm (105 lbf ft).
16. Refit the differential assembly, operation 11A-14-15.
17. **NOTE:** If bearings, shims or locating rings have been replaced, or if shims have not been refitted in their original positions, the crownwheel and pinion backlash must be adjusted, operation 11A-17-18.



DIFFERENTIAL PRE-LOAD

Checking and Adjustment 11A-16-17

Service Tools: See operation 11A-14-15
Dial Test Indicator

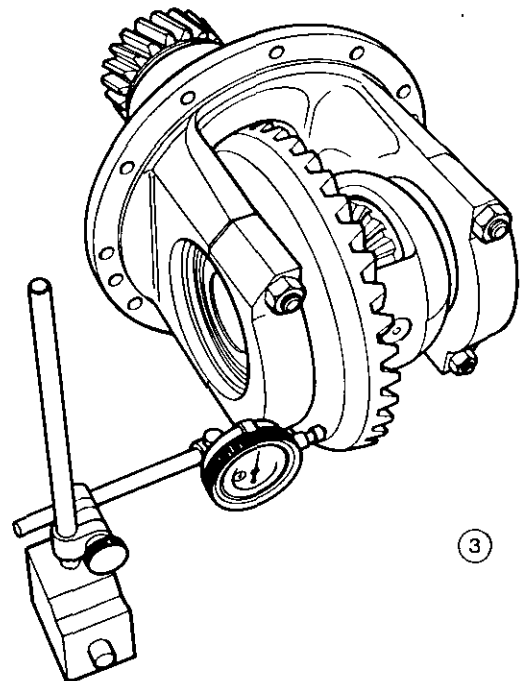
Procedure

1. Remove the differential assembly, operation 11A-14-15.
2. Hold the differential assembly in a soft faced vice.
3. Place a dial gauge so that its stylus is just touching, and at right angles to the rear face of the crownwheel.
4. Read off the total differential end float.
5. Remove the differential, items 3 to 10 operation 11A-15-16.
6. Measure the total shim thickness. The difference between this figure and the figure obtained in item 4 is the shim thickness which must be added to zero end float.
7. To introduce the correct bearing pre-load, add 0,15 mm (0-006 in) additional shim thickness to that obtained in item 13.

Select shims from the table below:

Part Number	mm	in
2712 993 M1	0,50	0-020
2712 994 M1	0,30	0.012
2712 995 M1	0,15	0-006
2712 996 M1	0,10	0-004

8. Place approximately half of the shims behind each bearing cup.
9. Using the clamping tool made in accordance with the drawing given, clamp the differential bearing cups, shims and locating rings together.
10. Check and adjust the crownwheel and pinion backlash, items 2 to 31 operation 11A-17-18.



FOUR WHEEL DRIVE

CROWNWHEEL AND PINION BACKLASH

Checking and Adjustment 11A-17-18

Special Tools: MF 200 Hand Press
 MF 200-25 and 23 adaptors.
 See items 5 and 10
 Hydraulic Press
 Pre-load gauge
 See operation 11A-16

Procedure

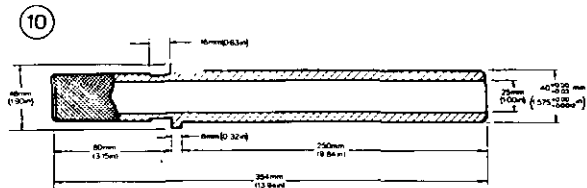
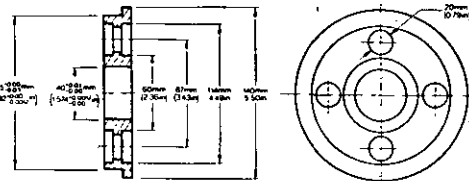
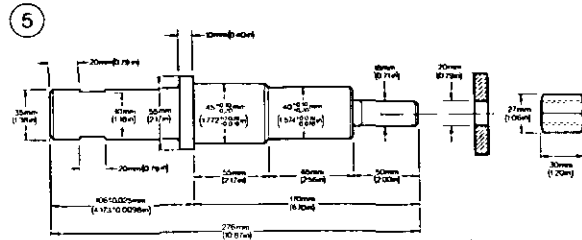
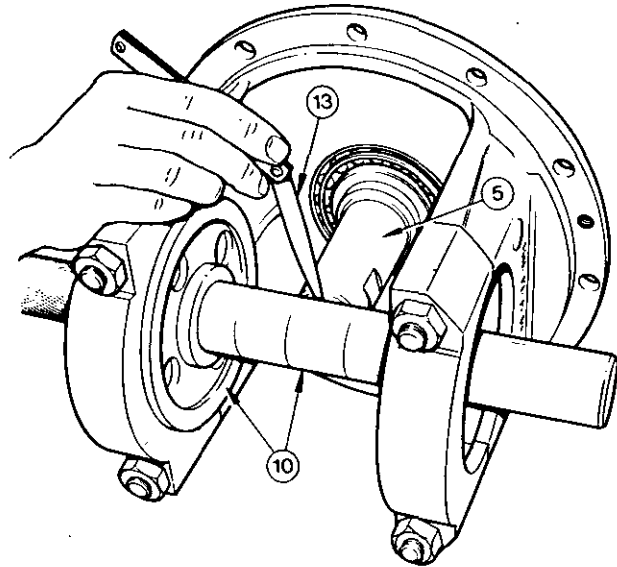
1. Adjust the differential pre-load, items 1 to 9 operation 11A-16-17.
2. Remove the bevel drive pinion, items 2 to 4 operation 11A-20-21
3. Tap out the inner bearing cup, taking care not to damage the shims.
4. Remove the shims.
5. Assemble the dummy pinion, machined in accordance with the drawing given, to the differential support complete with taper roller bearings but WITHOUT shims.
6. Fit the washer and nut.
7. Fit a suitable pre-load gauge to the dummy pinion.
8. Tighten the nut to give a pre-load of 35 kg cm (30 lbf in).
9. Remove the pre-load gauge.
10. Assemble the dummy bearings and crossshaft, machined in accordance with the drawings given, to the differential support.
11. Fit the end caps.
12. Fit and tighten the nuts to a torque of 140 Nm (105 lbf ft).
13. Using a feeler gauge, measure the gap between the end of the dummy pinion and the crossshaft.

If the gap is 1 mm (0.039 in), it will not be necessary to fit shims behind the inner bearing cup. If the gap is greater than 1mm (0.039 in) select shims from the table below to reduce the gap to the correct size.

Part Number	mm	in
2714 060 M1	0,10	0.004
2714 061 M1	0,15	0.006
2714 062 M1	0,30	0.012
2714 063 M1	0,50	0.020

14. Remove the end cap nuts, end caps, dummy bearings and crossshaft.
15. Remove the nut, washer and dummy pinion.
16. Remove the inner bearing cone from the dummy pinion.
17. Using MF 200 fitted with MF 200-23, refit the inner cone to the pinion—ensure that it is fully seated.
18. Fit the shims, as established in item 13, to the differential support.
19. Refit the inner bearing cup.
20. Refit the pinion to the differential support.

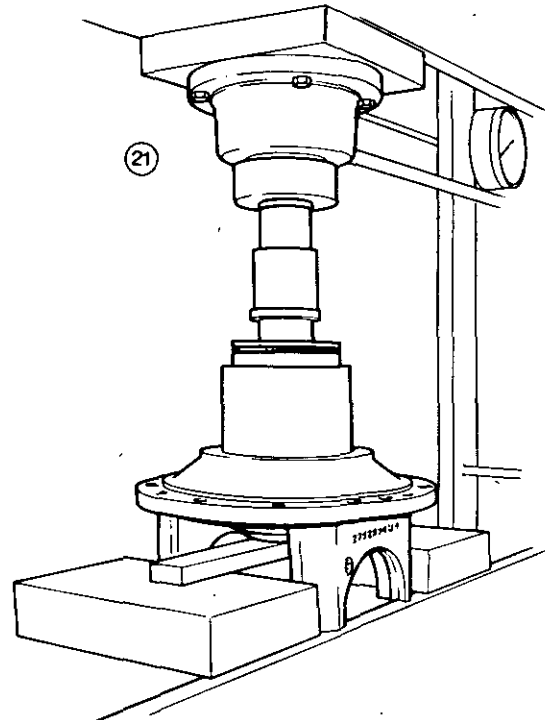
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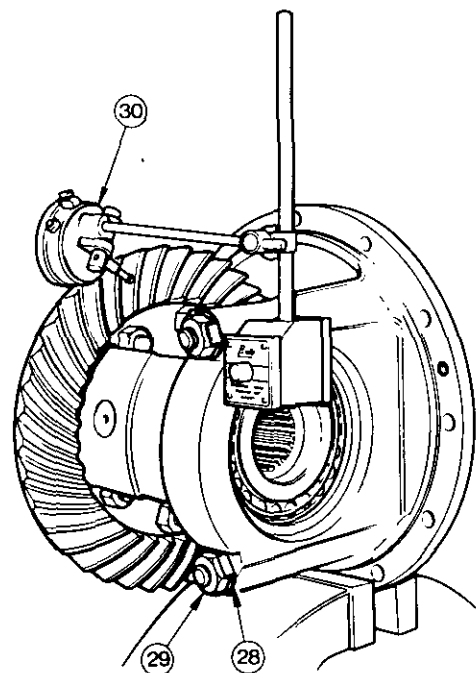
FOUR WHEEL DRIVE

21. Press the outer bearing cone into position on the pinion, preferably using a hydraulic press and
22. Fit the spacer.
23. Fit the drive gear.
24. Fit the nut.
25. Fit a suitable pre-load gauge to the pinion and, using a 'C' spanner, tighten the nut to give a pre-load of 35 kg cm (30 lbf in). Tap the pinion firmly then re-check the pre-load.
26. Fit the clamped differential assembly to the differential support.
27. Refit the end caps.

NOTE: Ensure that all parts are assembled in their original positions.



28. Refit the tab washers.
29. Refit the nuts and tighten them to a torque of 140 Nm (105 lbf ft).
30. Place a dial gauge so that its stylus is just touching, and perpendicular to the centre of one of the crownwheel teeth.
31. Whilst holding the pinion firmly, rotate the crownwheel—note the reading on the dial gauge. Take another reading at a point on the crownwheel diametrically opposite to the first, then average the two readings.
The backlash must be between 0,18 and 0,23 mm (0-007 and 0-009 in). The difference between the dial gauge reading and allowed backlash is the thickness of shims to be transferred from the non-crownwheel side to the crownwheel side of the differential.
32. Repeat items 30 and 31 until the correct backlash is obtained.
33. Remove the clamping tool.
34. Secure the tabs of the tabwashers.
35. Refit the differential assembly, operation 11A-14-15.



FOUR WHEEL DRIVE**DIFFERENTIAL****Servicing****11A-18-20**

Special Tools: See operations 11A-09, 11A-12 and 11A-05.

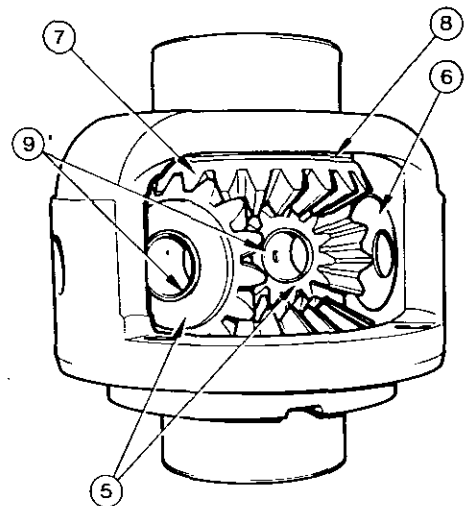
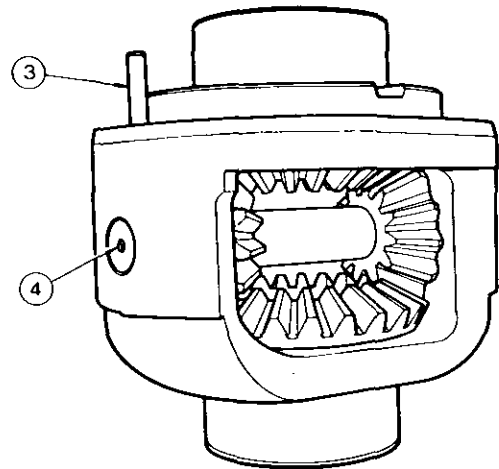
Disassembly

1. Remove the differential bearings, operation 11A-15-16.
2. Remove the crownwheel, operation 11A-19-19.
3. Tap out the planetary shaft locating pin.
4. Remove the planetary shaft.
5. Rotate the differential gears through 90° and remove the two planetary pinions.
6. Remove the planetary pinion thrust washers.
7. Remove the differential gears.
8. Remove the thrust washers.
9. If necessary, remove the planetary pinion bushes.

Thoroughly clean and inspect all components. Any showing signs of wear or damage must be replaced.

Reassembly

10. Reverse procedure 1 to 9 except:
 - (a) If the planetary pinion bushes are removed fit new ones using a suitable mandrel.
 - (b) Fit the thrust washers with their oil grooves towards the differential gears.
 - (c) Coat the planetary pinion thrust washers in petroleum jelly then locate them in their respective recesses in the differential case.
 - (d) Place the planetary pinions directly opposite to each other, then roll them into position on the thrust washers.
 - (e) Ensure that the hole in the planetary pinion shaft aligns with that of the differential case.

**CROWNWHEEL****Removal and Refitment****11A-19-20**

Special Tools: See operation 11A-15

Removal

1. Remove the differential bearings, items 1 to 8 operation 11A-15-16.
2. Remove the locating rings, shims and bearing cups.

Notes:

 - (a) If the crownwheel is to be refitted, mark it in relation to the differential carrier to facilitate correct fitment.
 - (b) If the crownwheel is damaged, the pinion must also be replaced as these are only sold in matched sets.
3. Remove the nuts.
4. Remove the bolts.
5. Remove the crownwheel.

Refitment

6. Reverse procedures 3 to 6 expect:
 - (a) Tighten the nuts to a torque of 95 Nm (70 lbf ft).
7. Adjust the crownwheel and pinion backlash, operation 11A-17-18.

BEVEL DRIVE PINION**Removal and Refitment** 11A-20-21

Special Tools; See operation 11A-17

Removal

1. Remove the differential bearings, items 1 to 11 operation 11A-15-16.
2. Press out the pinion complete with the inner bearing cone.

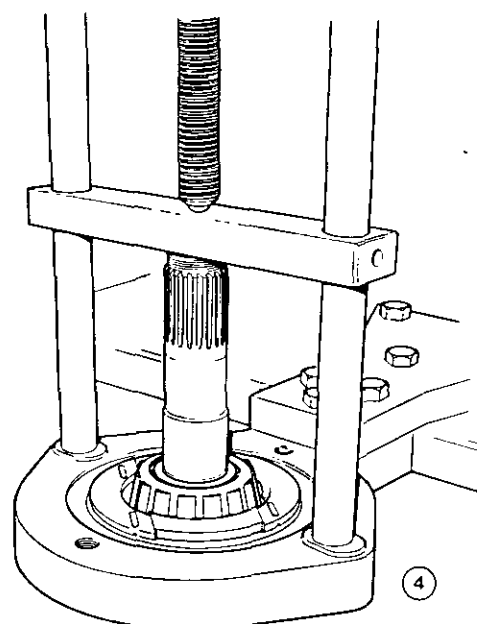
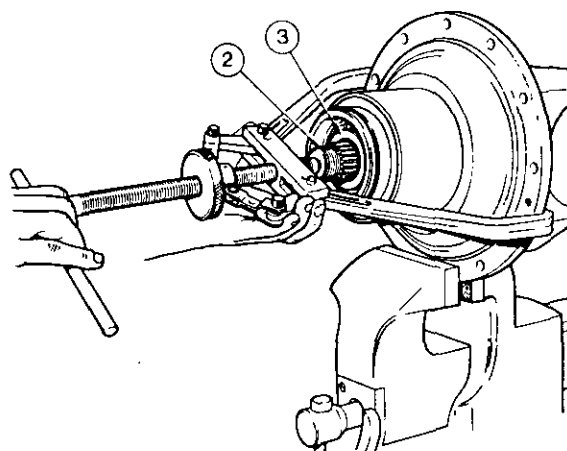
NOTE: When removing the pinion, take care to avoid the outer bearing cone being damaged as it will be free to fall from the bearing cup.

3. Remove the outer bearing cone.
4. Using MF 200 with MF 200-25, press off the inner bearing cone.

NOTE: If the pinion is damaged, the crownwheel must also be replaced as these are only sold in matched sets.

Refitment

5. Reverse procedures 2 to 4.
6. Check and adjust the crownwheel and pinion backlash, items 3 to 35, operation 11A-17-18.
7. Refit the differential bearings, operation 11A-15-16.

**BEVEL DRIVE PINION ASSEMBLY****Servicing** 11A-21-21

Special Tools: See operation 11A-17

Disassembly

1. Remove the pinion, operation 11A-20-21.
2. Tap out the inner bearing cup, taking care not to damage the shims.
3. Remove the shims.
4. Extract the outer bearing cup.

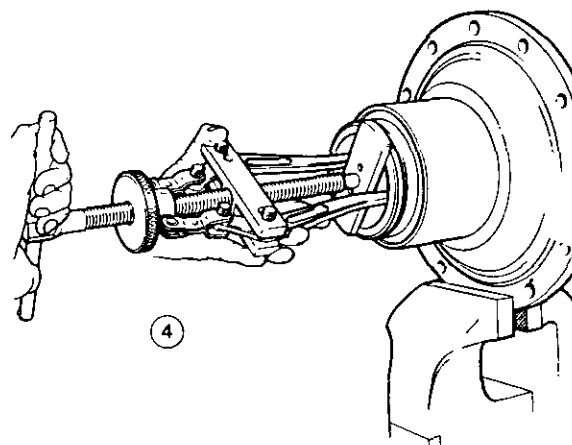
Examination

Inspect all parts and replace any which show signs of wear or damage.

NOTE: If the pinion is damaged, the crownwheel must also be replaced as these are only sold in matched sets.

Reassembly

5. Reverse procedures 1 to 4.



FOUR WHEEL DRIVE**TRANSFER GEARBOX****Removal and Refitment**

11A-22-22

Special Tools: 270 Rail Trolley
 MF 365—1 Plates
 MF 365—4 Long Support Bars
 MF 365—6 Bar Pins
 MF 365—7 Tommy Bar
 MF 365—8 Stand
 MF 367. Wrench Set

Removal

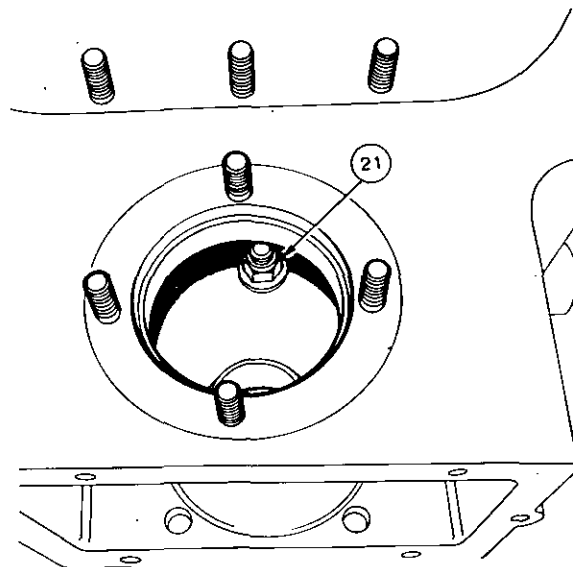
1. Chock the tractor rear wheels and apply the parking brake.
2. Support the transmission shaft shield.
3. Remove the two bolts, washers and spacers.
4. Remove the nuts, washers and two bolts.
5. Remove the shield.
6. Remove the bolt securing each sliding sleeve.
7. Slide the sleeves inwards along the transmission shaft.
8. Remove the transmission shaft.
9. Drain the transmission oil via the drain plugs on the gearbox, transfer gearbox and centre housing.
10. Remove the control valve, operation 11A-27-28.
11. Disconnect the hydraulic clutch feed pipe.
12. Split the tractor between the transfer gearbox and the centre housing, operation 3A-06-12 except:
 - (a) Position the rail trolley underneath the gearbox clutch housing.
 - (b) Where the tractor is fitted with an internal hydraulic feed hose, follow procedures 13 to 18 before splitting the tractor.

EARLY MODEL TRACTORS ONLY

13. Remove the floor inspection panel, Part 2B.
14. Remove the eight gearbox top cover bolts.
15. Remove the gearbox top cover, taking care not to disturb the detent springs.
16. Remove the three detent springs, to prevent them from falling into the gearbox.
17. Remove and discard the gasket.
18. Disconnect the internal feed hose.

ALL TRACTORS

19. Remove the hydraulic clutch, operation 11A-24-24.
20. Using either a jib crane or other suitable lifting gear, support the transfer gearbox.
21. Remove the internal nut.
22. Remove the nuts and bolts.
23. Remove the transfer gearbox.
24. Remove and discard the gasket.

**Refitment**

25. Reverse procedures 1 to 24, except:
 - (a) Fit new gaskets.
 - (b) Fit the gearbox and transfer gearbox securing nuts and bolts and tighten to a torque of 105 Nm (75 lbf ft).
 - (c) Tighten the four cab front mounting primary nuts and bolts until the distance between the top and bottom of the rubber mounting is 25,4 mm (1 in).
Apply a few drops of recommended sealant 'C' to the bolt threads protruding from the primary nuts. With a spanner securely retaining the primary nuts, fit and tighten the locknuts to a torque of 68 Nm (50 lbf ft).
 - (d) Adjust the clutch linkage.
 - (e) Fill the transmission with an approved oil to the required level.
 - (f) **EARLY MODEL TRACTORS ONLY.** To facilitate refitment of the gearbox top cover, cut the gasket away immediately above the detent springs.

TRANSFER GEARBOX**Servicing**

11A-23-23

Special Tools: See operation 11A-22-22 and

7065M Circlip Pliers

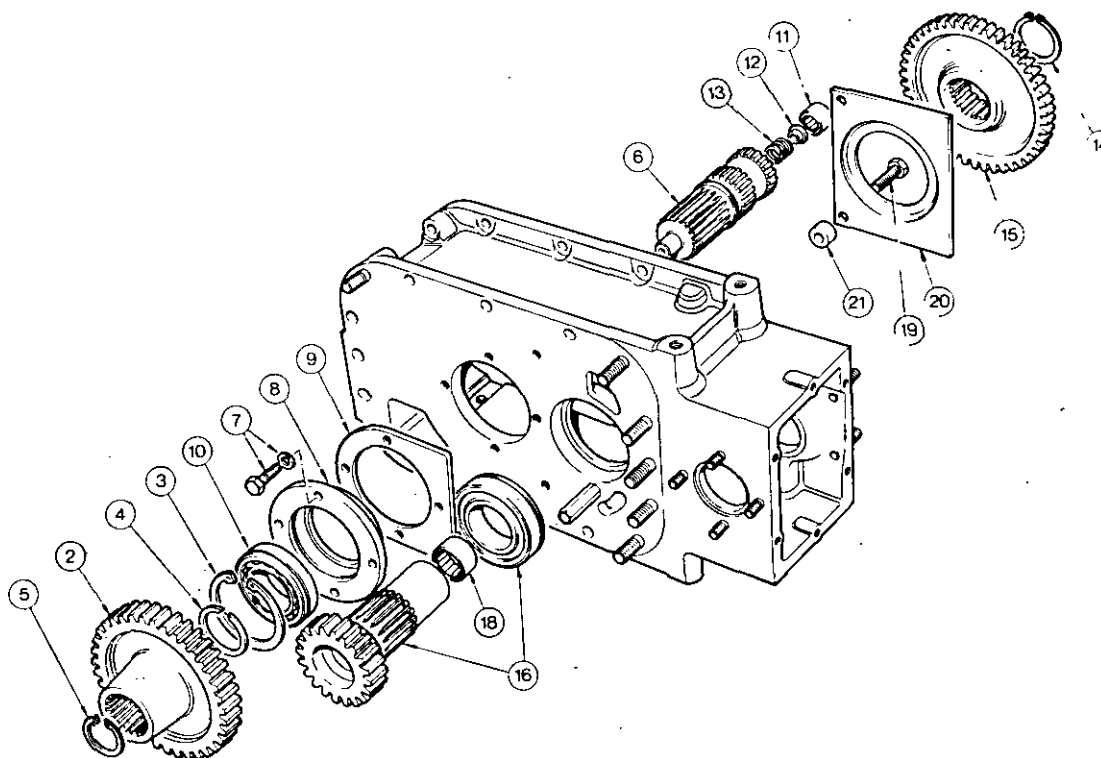
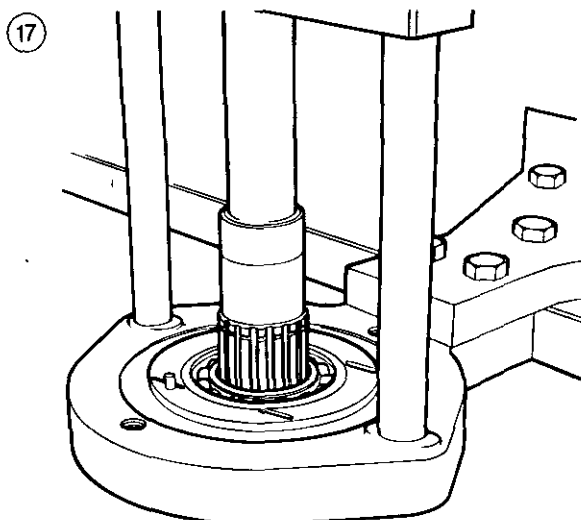
7066M Circlip Pliers

MF 200 Hand Press

MF 200-25 Bearing Remover

Disassembly

1. Remove the transfer gearbox, operation 11A-22-22.
2. Remove the drive gear.
3. If the bearing is to be removed from the bearing housing, remove the internal circlip using 7065M circlip pliers.
4. Using 7066M circlip pliers, remove the external circlip.
5. Using 7066M circlip pliers, remove the internal circlip from the drive gear.
6. Remove the intermediate shaft.
7. Remove the four bolts and lockwashers.
8. Remove the bearing housing complete with the bearing.
9. Remove the stop plate.
10. If necessary, remove the bearing. Check the condition of the needle roller bearing and the spring and plug operation—only if necessary, carry out items 11 to 13.
11. Remove the needle roller bearing.
12. Remove the plug.
13. Remove the spring.
14. Using 7066M circlip pliers, remove the circlip.
15. Remove the gear.
16. Tap out the layshaft and bearing assembly.
17. Using MF 200 hand press fitted with the MF200-25 bearing remover, press off the ball bearing.



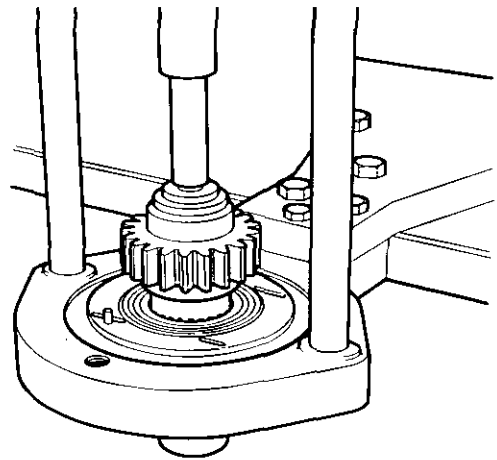
FOUR WHEEL DRIVE

18. Only if necessary, remove the needle roller bearing.
19. Remove the two bolts.
20. Remove the deflector.
21. Remove the two spacers.
Check all components and replace any showing signs of wear or damage.

Reassembly

22. Reverse procedures 1 to 21, except:
 - (a) Add a few drops of recommended sealant 'C' to the threads of the deflector attachment bolts before assembly.
 - (b) Fit the deflector with the concave side facing the casing.
 - (c) Press the bearing onto the layshaft using the MF 200 hand press fitted with the bearing remover MF 200-25. The chip shield must be fitted facing away from the shaft splines.
 - (d) Fit the gear (15) with the splined section of the bore facing the circlip.
 - (e) Fit the bearing (10), with the chip shield facing the bearing housing.

22c

**HYDRAULIC CLUTCH BEARINGS AND OUTPUT SHAFT****Removal and Refitment** 11A-24-24

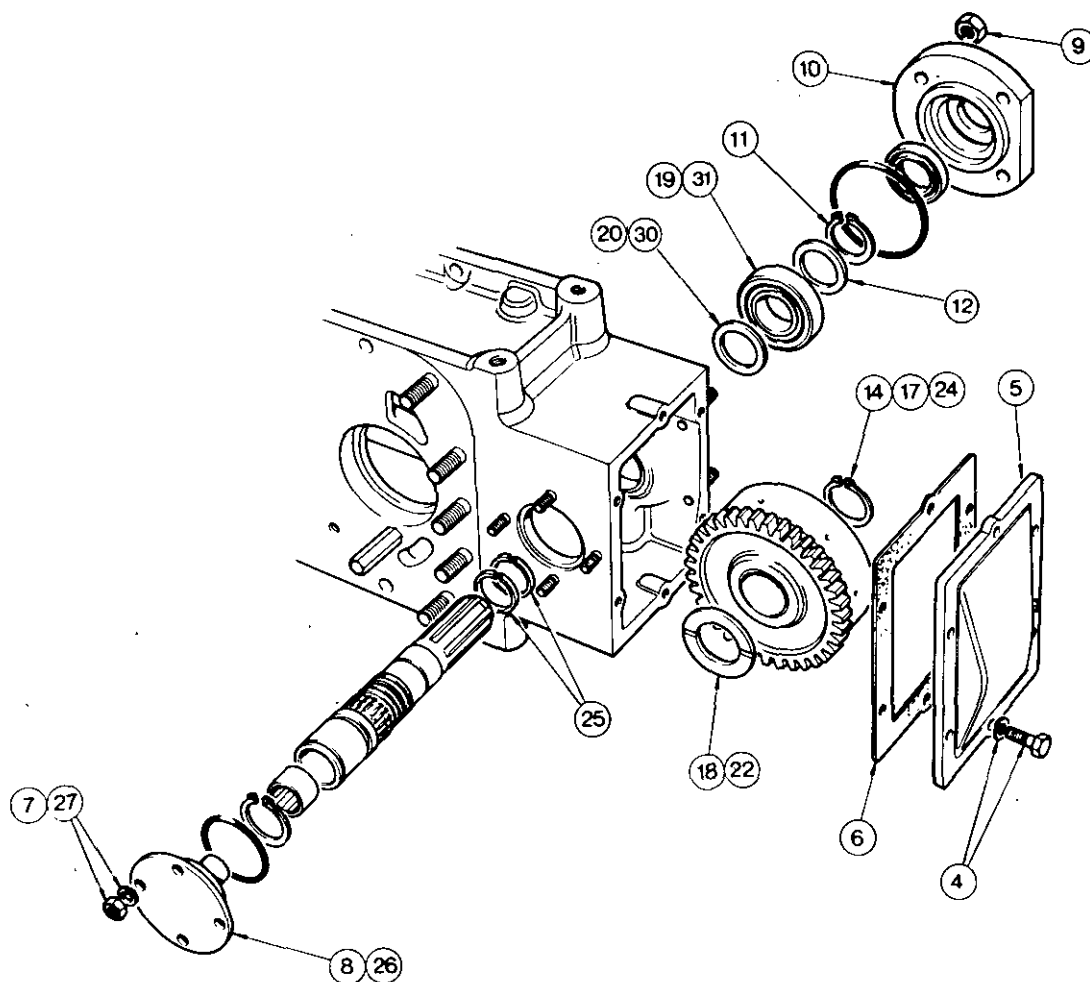
Special Tools: 7066M Circlip Pliers
Right-angled points for 7066M

Removal

1. Remove the transmission shaft, operation 11A-22-22 procedures 1 to 8.
2. Drain the transmission oil via the drain plugs on the gearbox, transfer gearbox and centre housing into a container of at least 40 litre (70 Imp Pts) capacity.
3. Refit the drain plugs.
4. Remove the six bolts and lockwashers.
5. Remove the cover.
6. Remove and discard the gasket.
7. Remove the four nuts and lockwashers.
8. Remove the rear plug.
9. Remove the four nuts.
10. Remove the output shaft cover—taking care not to damage the integral lip seal when passing the cover over the output shaft splines.
11. Using 7066M circlip pliers, remove the circlip.
12. Remove the thrust washer.
13. Push the output shaft as far rearwards as possible.
14. Using 7066M circlip pliers fitted with the right-angled points, release the circlip and slide it forwards along the output shaft.
15. Whilst supporting the gear and clutch from underneath, tap the output shaft rearwards.

NOTE: There are two cast iron piston rings fitted to the output shaft which must be guided through the loose circlip as the output shaft is tapped rearwards.

16. Remove the output shaft and the clutch and gear assembly.
17. Remove the circlip.
18. Remove the thrust washer.
19. Remove the bearing.
20. Remove the thrust washer.



Refitment

Ensure that the gear is correctly seated in the clutch pack and that the cast iron rings are correctly seated and interlocked on the output shaft. Lubricate the rings with clean transmission oil.

21. Support the gear and clutch assembly, with the gear in mesh with the transfer gear.
22. Hold the thrust washer in position behind the gear.
23. Insert the output shaft, splines first, through the rear of the housing until it protrudes from the clutch.
24. Place the circlip in position.
25. Push the shaft forwards, **TAKING CARE TO COMPRESS THE CAST IRON RINGS SO THAT THEY FIT CORRECTLY INTO THE BRONZE BUSH IN THE HOUSING.**
26. Fit the rear plug.
27. Fit and tighten the four lockwashers and nuts.
28. Push the clutch rearwards until the circlip groove is visible.
29. Using 7066M circlip pliers fitted with the right angled points, fit the circlip.
30. Refit the thrust washer.
31. Refit the bearing.
32. Reverse procedures 9 to 12.
33. Reverse procedures 1 to 2 and 4 to 6, except:
 - (a) Fit a new bottom cover gasket.

FOUR WHEEL DRIVE

HYDRAULIC CLUTCH, BEARINGS AND OUTPUT SHAFT

Servicing

11A-25-26

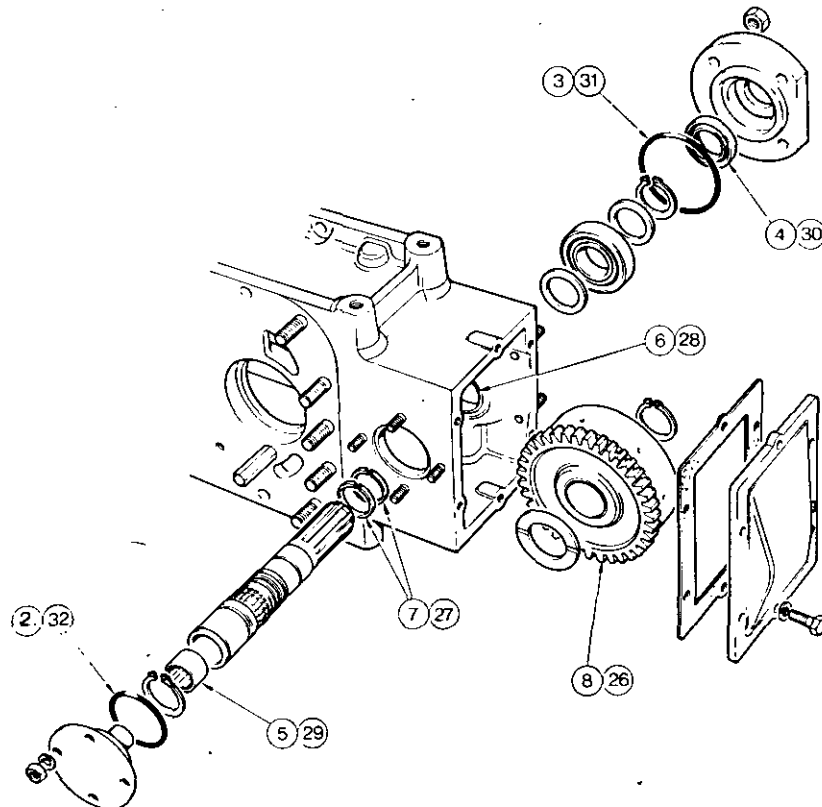
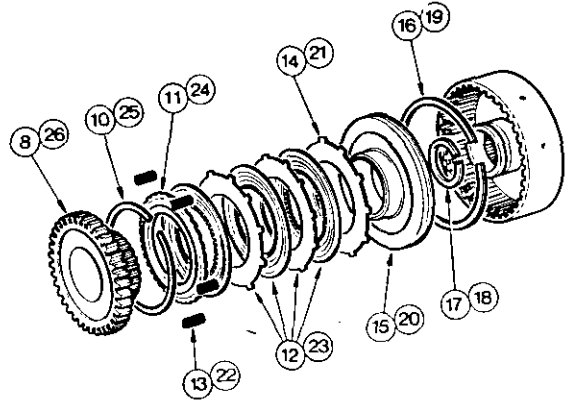
Special Tools: See operation 11A-24-24.

Disassembly

1. Remove the hydraulic clutch, operation 11A-24-24.
2. Remove and discard the 'O' ring.
3. Remove and discard the 'O' ring.
4. Remove and discard the lip seal.
5. Only if necessary, remove the needle bearing.
6. Check the condition of the bronze bush in the gearbox casing. Only if necessary, remove the bush using a suitable drift.
7. Remove and discard the two cast iron rings.
8. Remove the output gear.
9. Compress the retainer plate.
10. Remove the snap ring.
11. Remove the retainer plate.
12. Remove the three friction discs and two inter plates.
13. Remove the six springs.
14. Remove the remaining inter plate.

NOTE: Keep the friction discs and inter plates in their original order.

15. Remove the piston.
16. Remove the piston ring.
17. Remove the sealing ring.



Examination

Check the condition of all components for signs of wear, damage, distortion or overheating. Replace the friction discs when the friction material has lost its scrolling.

Check the inter plates for:

Maximum dish—0,25 mm (0.010 in)

Maximum permissible distortion—2,21mm (0.088 in)

Check the six coil springs for:

Free length—17,8 mm (0.70 in)

Working length—12,7 mm (0.05 in)

Load at working length—2,98 to 3,64 kg (6.57 to 8.03 lb).

Any components which are not within the above tolerances must be replaced.

Re-assembly

18. Fit a new sealing ring.
19. Fit a new piston ring.
20. Using two small screwdrivers to compress the piston ring, refit the piston.

NOTE: Ensure that the piston is fully seated.

21. Fit the first interplate to the clutch housing.
22. Fit the six coil springs in the sequence shown.
23. Refit the three friction plates and the remaining two interplates alternately, locating the lugs of the interplates one spline clockwise to the one previously fitted.

NOTE: The springs must only contact the first interplate.

24. Refit and compress the retainer plate.
25. Refit the snap ring.
26. Refit the output gear.
27. Fit two new cast iron rings.
28. If the bush was removed, using a suitable mandrel, fit a new bush.
29. If the needle roller bearing was removed, press in a new bearing.
30. Fit a new lip seal.
31. Fit a new 'O' ring.
32. Fit a new 'O' ring.
33. Refit the hydraulic clutch, operation 11A-24-24.

HYDRAULIC CLUTCH**Pressure Test**

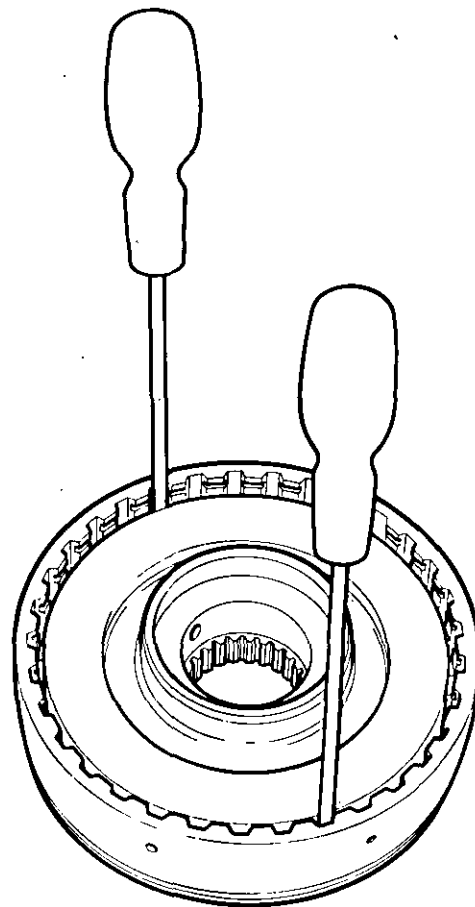
11A-26-27

Special Tools: Either—MF 260 Low Pressure Gauge
or—840 Hydraulic Test Kit

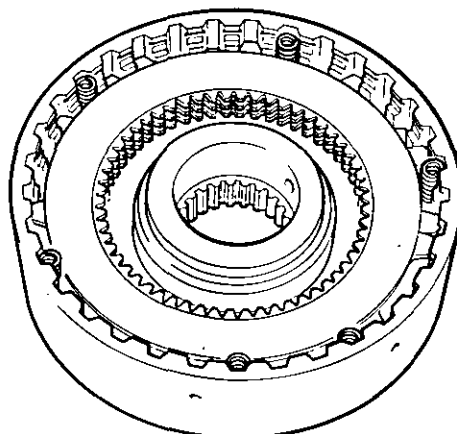
Test Procedure

1. Fill the transmission to the correct level with clean oil of the approved type.
2. Run the tractor under load until the transmission oil temperature reaches 50°C (120°F).
3. Disconnect the clutch feed union at the bottom of the transfer gearbox.
4. Remove the right-angled union.
5. Fit and tighten a 'T' connector.
6. Reconnect the clutch feed.
7. Connect either MF 260 or 840 to the free 'T' connection.
8. Run the engine at 1000 rev/min.
With the control knob in the disengaged position, the pressure must read zero.
With the clutch engaged the pressure should be 0,90 to 1,04 N/mm² (130 to 150 lbf/in²).
9. Reverse procedures 3 to 7.

20



22



FOUR WHEEL DRIVE**CONTROL VALVE****Removal and Refitment**

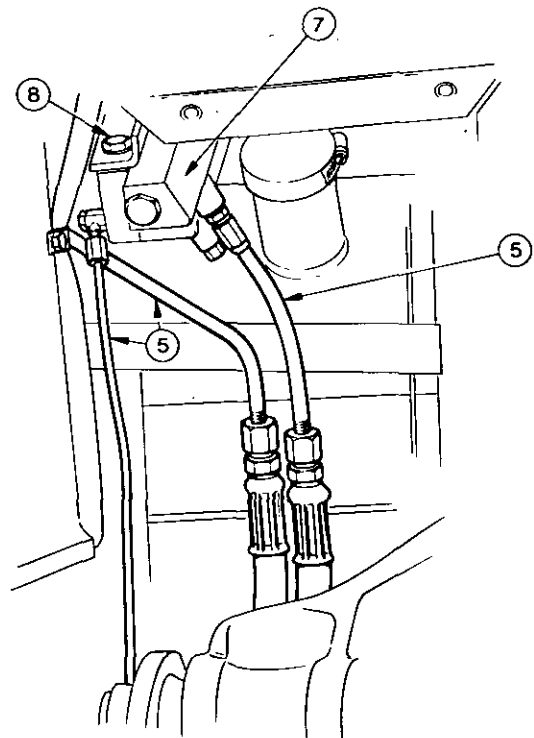
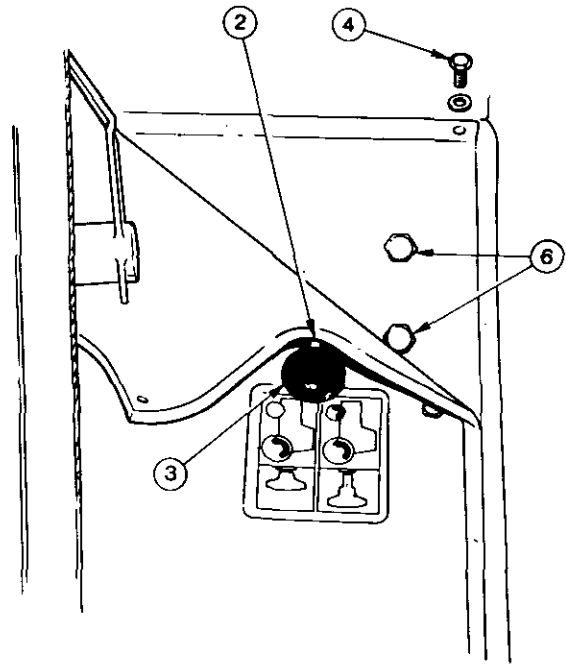
11A-27-28

Removal

1. Remove the L.H. rear trim panel, Part 2A.
2. Slacken the lock nut.
3. Remove the control knob.
4. Remove the nut and bolt.
5. Disconnect the three pipes. Plug the open unions to avoid dirt ingress.
6. Remove the two bolts and washers.
7. Remove the control valve and mounting bracket from the tractor.
8. Remove the two bolts and washers.
9. Remove the control valve from the mounting bracket.

Refitment

10. Reverse procedures 1 to 9.



CONTROL VALVE**Servicing**

11A—28—29

Disassembly

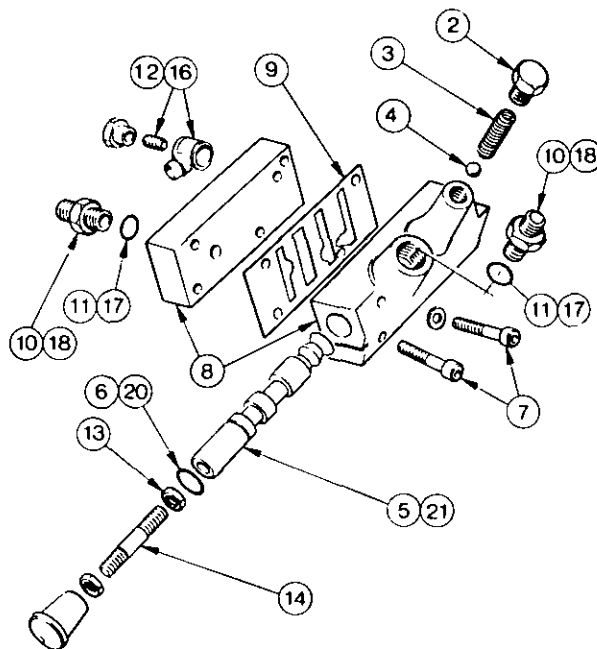
1. Remove the control valve, operation 11A—27—28.
2. Remove the plug.
3. Remove the spring.
4. Remove the steel ball.
5. Withdraw the spool.
6. Remove and discard the 'O' ring.
7. Remove the four allen screws, take care not to lose the copper washer.
8. Separate the valve body from the mounting block.
9. Remove and discard the gasket.
10. Remove the two straight adaptors.
11. Remove and discard the 'O' rings.
12. Remove the banjo union.
13. Slacken the locknut.
14. Remove the control rod.

Examination

Examine all parts and replace any showing signs of wear or damage. Thoroughly clean the spool, spool body and mounting block in white spirit. Fit new 'O' rings and a new gasket.

Reassembly

15. Reverse procedures 13 and 14.
16. Fit the banjo union but do not fully tighten at this stage.
17. Smear the new 'O' rings with clean oil and carefully fit to the straight adaptors.
18. Fit the straight adaptors and tighten to a torque of 16 Nm (12 lbf ft).
19. Reverse procedures 7 to 9 except:
 - (a) Ensure that the copper washer is fitted to the long allen screw, adjacent to the straight adaptor.
20. Smear a new 'O' ring with clean oil and carefully fit it to its groove in the spool.
21. Smear the spool with clean oil and fit it to the valve body.
22. Reverse procedures 1 to 4 except:
 - (b) Start the nuts of the feed and bleed tubes before fully tightening the banjo union.

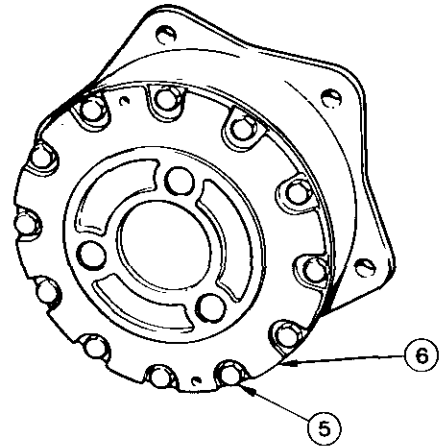


FOUR WHEEL DRIVE**CATEGORY II FRONT AXLE****PLANETARY CARRIER****Removal and Refitment**

11A—29—30

Removal

1. Apply the parking brake and chock the rear wheels.
2. Jack up the tractor under the axle being serviced.
3. Remove the wheel.
4. Rotate the hub until the plug is at the bottom, remove the plug and drain the oil from the hub.
5. Remove the twelve bolts.
6. Withdraw the planetary carrier.
7. Remove and discard the gasket.

**Refitment**

8. Reverse procedures 1 to 7 except:
 - (a) Fit a new gasket.
 - (b) Tighten the planetary carrier securing bolts to a torque of 60 Nm (45 lbf ft).
 - (c) Rotate the wheel so that the filler plug is horizontal, then fill to this level with an approved oil and refit the plug.
 - (d) Tighten the wheel bolts to a torque of 270 Nm (200 lbf ft).

Servicing

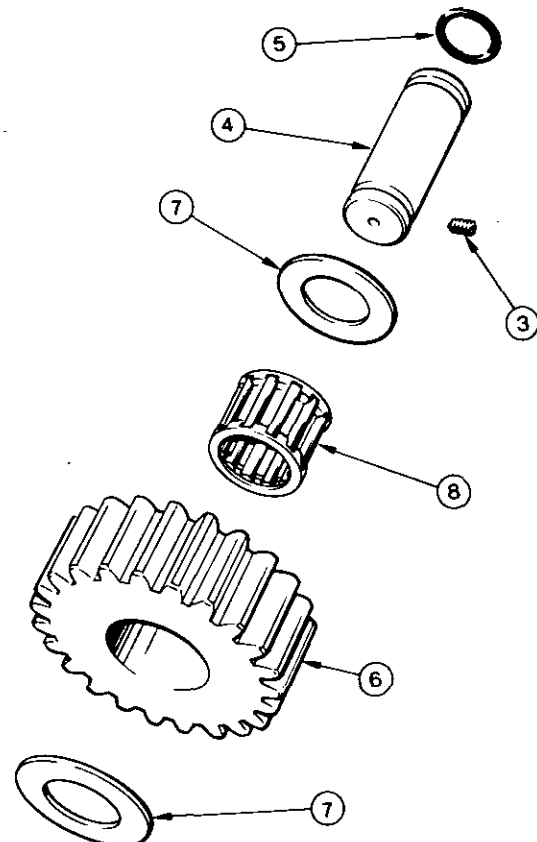
11A—30—30

Disassembly

1. Remove the planetary carrier, operation 11A—29—30.
2. Place the planetary carrier in a vice.
3. Remove the grub screw.
4. Carefully tap out the planet gear shaft.
5. Remove the 'O' ring.
6. Remove the planet gear and the washers.
7. Remove the washers.
8. Remove the caged needle roller bearing.
9. Repeat procedures 3 to 8 for the remaining two planetary gears. Thoroughly clean and inspect all components and replace any that are worn or damaged.

Reassembly

10. Reverse procedures 1 to 9 except:
 - (a) Tighten the planet gear shaft retaining screws to a torque of 9 Nm (7 lbf ft).



RING GEAR AND REDUCTION HUB**Removal and Refitment** 11A-31-31

Special Tools: See item 6.

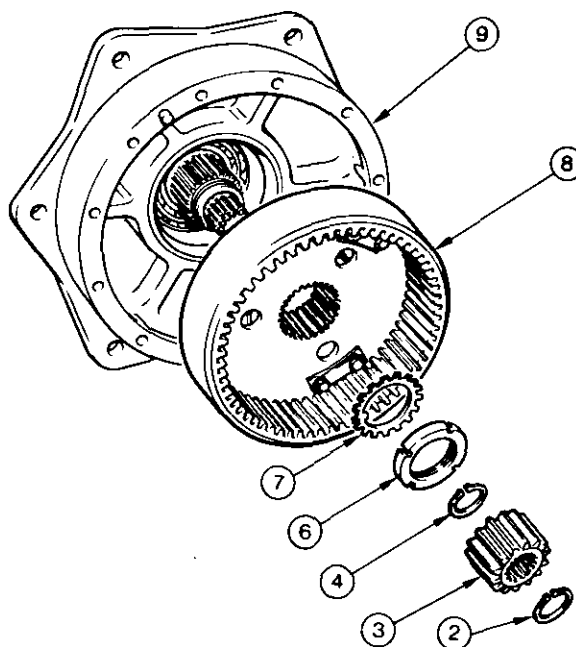
Removal

1. Remove the planetary carrier, operation 11A-29-30.
2. Remove the circlip.
3. Remove the sun gear.
4. Remove the circlip.
5. Release and flatten the lock washer tab.
6. Using a suitably modified 'C' type spanner, remove the special locking ring.
7. Remove the locking washer.
8. Remove the ring gear assembly.
9. Carefully withdraw the hub, taking care not to damage the lip seal.

WARNING: The hub is heavy and awkward to handle, take care when both removing and refitting it.

Refitment

10. Reverse procedures 1 to 9 except:
 - (a) Tighten the locking ring until the reduction hub can freely rotate without any end play and one of the slots is aligned with one of the tabs on the locking washer.
 - (b) Bend over the locking washer tab to secure the locking ring.

**RING GEAR AND REDUCTION HUB****Servicing** 11A-32-31

Special Tools: See item 8, operation 11A-31-31.

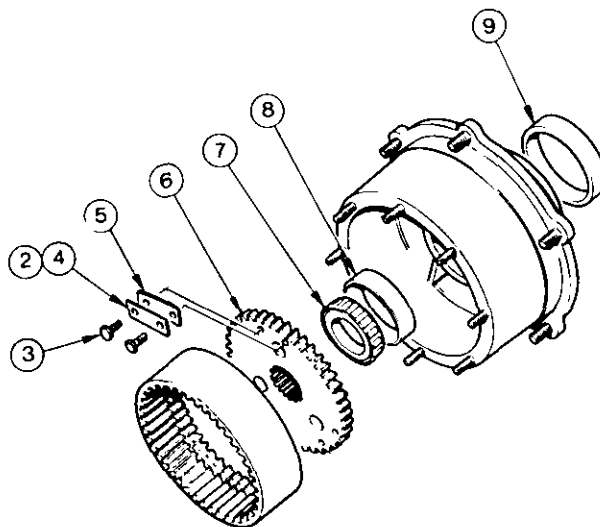
Disassembly

1. Remove the ring gear and reduction hub, operation 11A-31-31.
2. Release and flatten the tabs on the tab locking washers.
3. Remove the six bolts.
4. Remove the three tab locking washers.
5. Remove the three locking plates.
6. Remove the splined end cover.
7. Remove the bearing cone.
8. Remove the bearing cup.
9. Remove the bearing cup.

Paying particular attention to the ring gear teeth and the bearings, inspect all components and replace any which show signs of wear or damage.

Reassembly

10. Reverse procedures 1 to 9 except:
 - (a) Tighten the splined end cover securing bolts to a torque of 12 Nm (9 lbf ft).



FOUR WHEEL DRIVE**WHEEL SPINDLE, BEARING AND OIL SEALS****Servicing**

11A-33-32

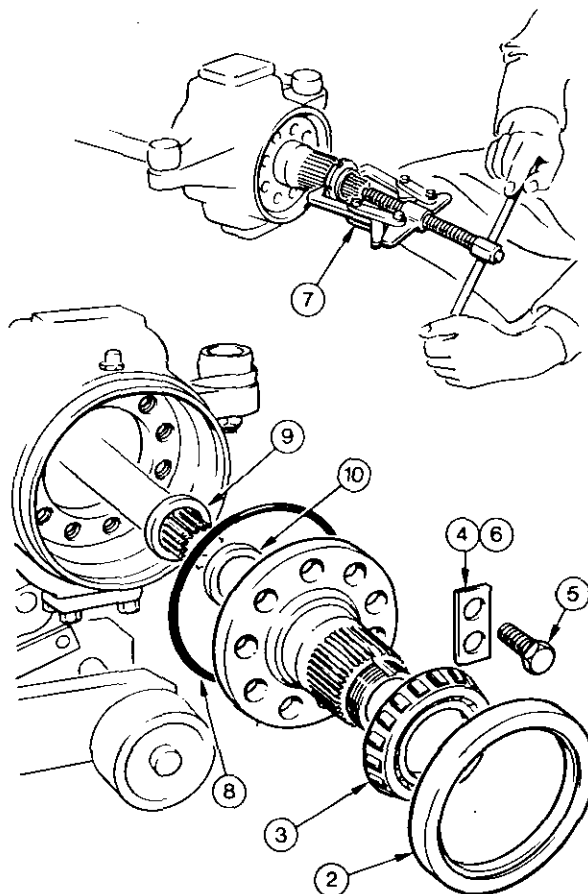
Special Tools; See item 8, operation 11A-31-31.
6312A Two Leg Pulling Tool

Disassembly

1. Remove the ring gear and reduction hub, operation 11A-31-31.
2. Remove and discard the oil seal.
3. Withdraw the bearing cone from the wheel spindle using a pulling tool or pry bars.
4. Release and flatten the tabs on the tab locking washers.
5. Remove the ten bolts.
6. Remove the five tab locking washers.
7. Run the locking ring on the wheel spindle threads and using special tool 6312A, withdraw the wheel spindle from the pivot housing.
8. Remove and discard the 'O' ring.
9. Remove the oil seal retaining ring.
10. Remove and discard the oil seal.

Reassembly

11. Reverse procedures 1 to 10 except:
 - (a) When refitting the wheel spindle assembly, take care to avoid damaging the lip seal.
 - (b) Tighten the wheel spindle securing nuts to a torque of 94 Nm (69 lbf ft).
 - (c) Fit new oil seals and an 'O' ring.



FRONT AXLE PIVOT HOUSING

Servicing

11A-34-33

Disassembly

1. Remove the wheel spindle, operation 11A-33-32.
2. Remove the self locking nut.
3. Disconnect the tie rod ball joint.
4. Left Hand Pivot Housing only, items 4 and 5.
5. Remove the self locking nut.
6. Disconnect the piston rod ball joint.
7. Remove the eight bolts and lock washers.
8. Remove the upper cover and pin assembly, taking care not to damage the shims.
9. Remove the shims.
10. Remove the lower cover and pin assembly.
11. Remove the pivot housing.
12. Remove the dust seal.
13. Remove the thrust washer.
14. Remove the bearing cone.
15. Repeat items 11 to 14 for the upper bearing assembly.

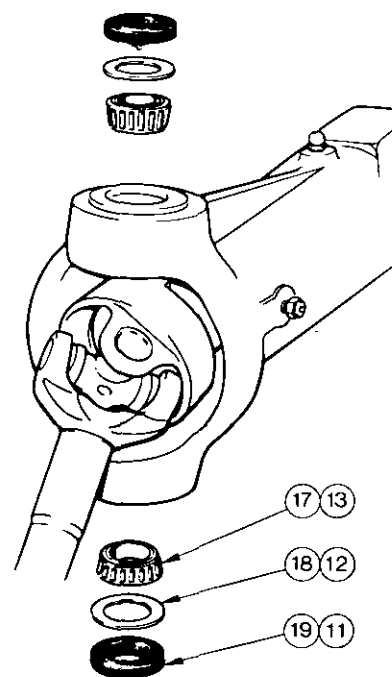
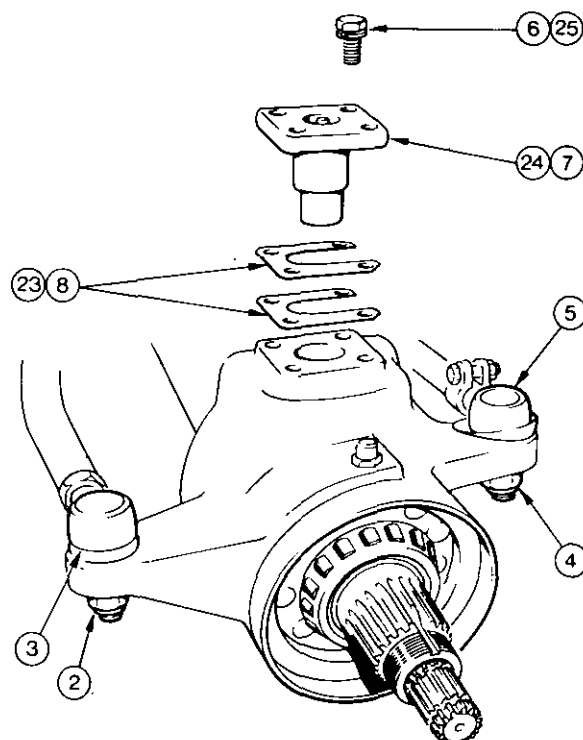
Thoroughly clean and inspect all components, replacing any which show signs of wear or damage.

Reassembly

16. Refit the bearing cup.
17. Refit the bearing, ensuring that it is fully seated.
18. Refit the thrust washer.
19. Fit a new dust seal.
20. Repeat procedures 16 to 19 for the upper bearing assembly
21. Carefully re-position the pivot housing, but ensure that the dust seals are not dislodged.
22. Refit the lower cover and pin assembly.
23. Refit the shims.
24. Refit the upper cover and pin assembly.
25. Fit and tighten the eight bolts to a torque of 94 Nm (69 lbf ft).
26. Grease the upper and lower grease nipples with an approved grease.
27. Check that the housing pivots freely without any play. If play is encountered, remove the upper cover and ADD shims selected from the table below. If excessive binding is encountered, remove the upper cover and REMOVE shims.

Part Number	mm	in
1823 592 M1	0,30	0-012
1823 593 M1	0,50	0-020
1823 594 M1	0,70	0-030

28. Refit the upper cover and recheck the pivot housing movement.
29. Reverse procedures 1 to 5 except:
 - (a) Tighten the self locking nuts to a torque of 70 Nm (50 lbf ft).



FOUR WHEEL DRIVE

HALF SHAFT AND UNIVERSAL JOINT ASSEMBLY

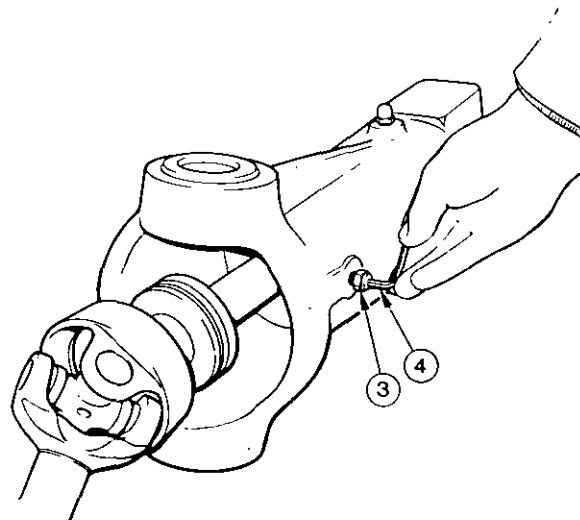
Removal and Refitment 11A-35-34

Removal

1. Remove the pivot housing, operation 11A-34-33 procedure 1 to 10.
2. Place a drain tank of at least 12 litre (20 Imp. Pts) capacity under the front axle and remove the axle drain plug. Drain sufficient oil to bring the level below the half shaft housing. Refit the drain plug.
3. Slacken the self locking nut.
4. Remove the allen head locking pin.
5. Using pry bars, remove the half shaft assembly.

Refitment

6. Reverse procedures 1 to 5 except.
 - (a) Ensure that the groove in the collar is aligned with the locking pin hole in the front axle housing.
 - (b) Refill the front axle to the correct level with an approved oil.



HALF SHAFT AND UNIVERSAL JOINT ASSEMBLY

Servicing

11A—36—35

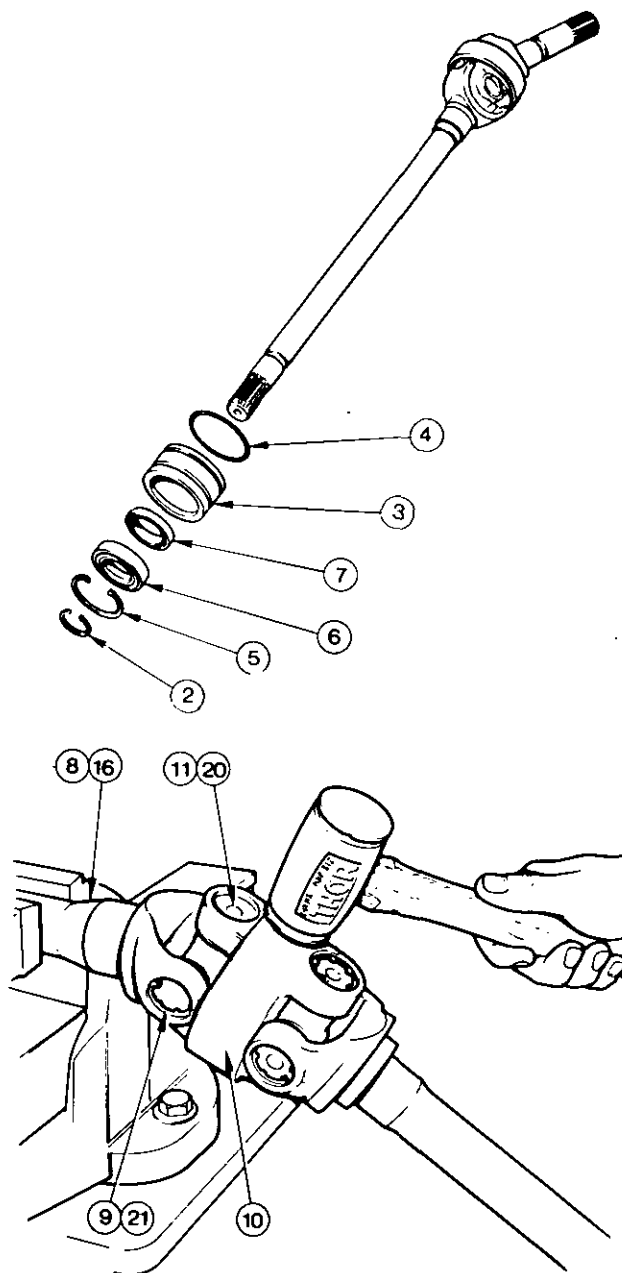
Special Tools: 7066 Circlip Pliers

Disassembly

1. Remove the half shaft assembly, operation 11A—35—34.
2. Remove the circlip.
3. Remove the collar and bearing assembly.
4. Remove and discard the 'O' ring.
5. Remove the circlip.
6. Remove the bearing.
7. Remove and discard the oil seal.
8. Grip the inner section of the half shaft in a soft faced vice.
9. Remove the four circlips from the spider coupling, using 7066 circlip pliers.
10. Tap the spider housing with a soft faced hammer until it bottoms on the spider.
11. Remove the spider cap complete with the rubber seal and needle rollers.
12. Turn the half shaft assembly through 180° and repeat items 10 and 11.
13. Manoeuvre the spider housing clear of the journal.
14. Turn the half shaft assembly through 45° then repeat items 10 to 12 to free the spider from the yoke.
15. Grip the outer section of the half shaft in the vice and repeat items 10 to 14. Paying particular attention to the axle shaft splines, inspect all components and replace any which show signs of wear or damage. On the universal joint, always replace spider couplings, and caps and circlips.

Reassembly

16. Grip the inner section of the half shaft in the vice.
17. Pack four new end caps with an approved molybdenum based grease.
18. Manoeuvre a new spider into position in the yoke.
19. Fit an end cap into position over the journal.
20. Using a suitable punch, tap the end cap into the yoke until the circlip groove is visible.
21. Fit a new circlip.
22. Turn the shaft through 180° and repeat items 19 to 21.
23. Manoeuvre the spider housing into position on the remaining journals.
24. Repeat procedures 19 to 21.
25. Grip the outer section of the half shaft in the vice.
26. Repeat procedures 18 to 24.
27. Reverse procedures 1 to 7 except:
 - (a) Fit a new oil seal and 'O' ring.



FOUR WHEEL DRIVE

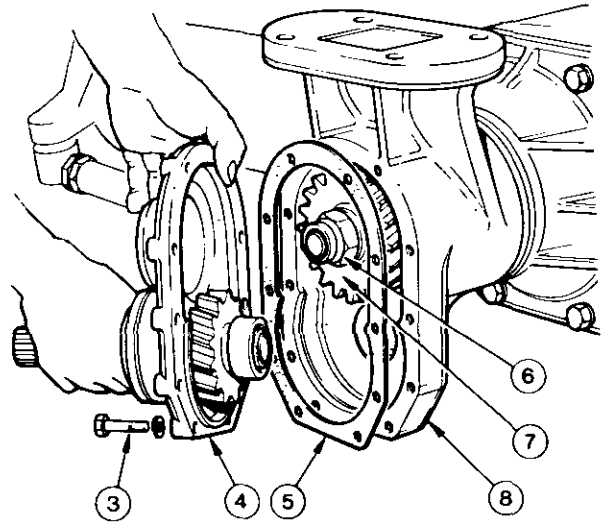
REAR SUPPORT/INPUT HOUSING

Removal and Refitment 11A-37-36

Special Tools: See operation 11A-08-09

Removal

1. Remove the front axle, operation 11A-08-09.
2. Place a drain tank of at least 12 Litre (20 Imp. pts) capacity under the front axle and remove the axle and input housing drain plugs.
3. Remove the ten bolts and locking washers.
4. Remove the cover and input shaft assembly.
5. Remove and discard the gasket.
6. Remove the self locking nut.
7. Remove the gear.
8. Remove the rear support/input housing. Thoroughly clean the mating faces of the input housing and support casting, clean the main pivot bush and thrust washer.



Refitment

9. Reverse procedures 1 to 8 except:
 - (a) Fit a new self locking nut, tightened to a torque of 12 Nm (9 lbf ft).
 - (b) Fit a new gasket.
 - (c) Tighten the bolts to a torque of 53 Nm (39 lbf ft).
 - (d) Fill the front axle to the correct level with an approved oil.

REAR SUPPORT/INPUT HOUSING

Servicing 11A-38-36

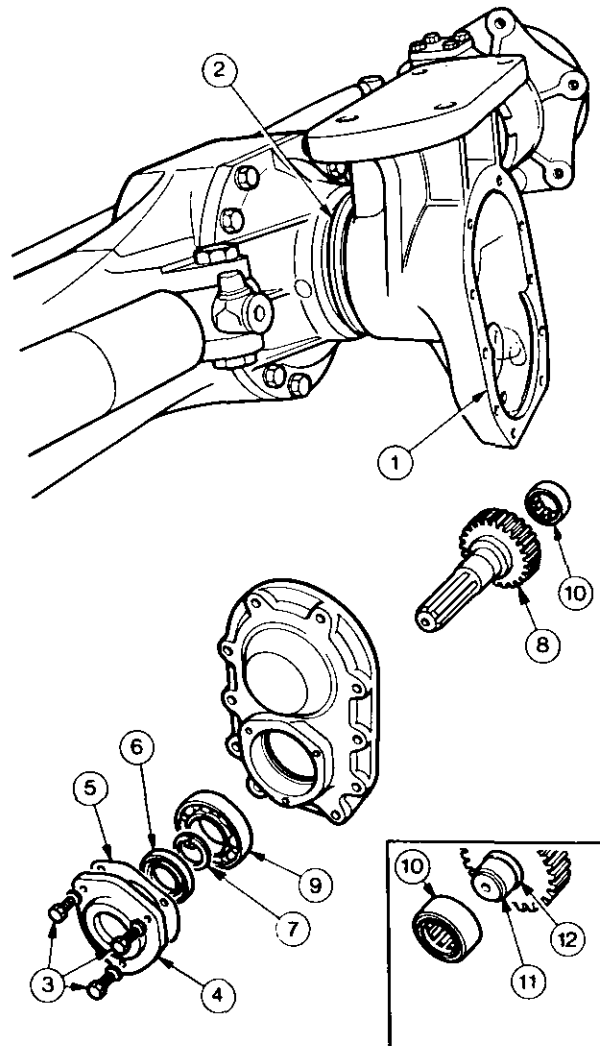
Disassembly

1. Remove the rear support/input housing, operation 11A-37-36.
2. Remove the thrust washer.
3. Remove the three bolts and locking washers.
4. Remove the seal housing/end cover.
5. Remove and discard the gasket.
6. Remove the oil seal.
7. Remove the circlip.
8. Using either a press or a copper faced hammer, press off the input shaft and gear assembly.
9. Remove the ball bearing.
10. Remove the needle roller bearing.
11. If necessary, remove the needle roller bearing inner race, using a suitable press.
12. Remove the spacer.
13. Only if necessary, remove the bush from the rear support.
14. Remove and discard the 'O' ring from the rear support.

Thoroughly clean and inspect all components and replace any which show signs of wear or damage.

Reassembly

15. Reverse procedures 1 to 14, except:
 - (a) Fit a new 'O' ring.
 - (b) Fit a new lip seal with the tip facing towards the input housing. Smear the tip of the seal with petroleum jelly.
 - (c) Fit and tighten the three bolts to a torque of 30 Nm (22 lbf ft).



DIFFERENTIAL ASSEMBLY**Removal and Refitment**

11A-39-37

Removal

1. Remove the front axle, operation 11A-09-10.
2. Remove the rear support/input housing, operation 11A-37-36.
3. Remove the right and left/hand half shaft assemblies, operation 11A-35-34.
4. Remove the fourteen bolts and locking washers.
5. Remove the differential assembly.

NOTE: The differential unit is heavy and awkward to handle, take care when both removing and refitting it.

6. Remove and discard the gasket.

Refitment

7. Reverse procedures 1 to 6 except:
 - (a) **IMPORTANT: When refitting the differential assembly, the crown wheel must be to the LEFT of centre.**
 - (b) Fit a new gasket.
 - (c) Tighten the bolts to a torque of 94 Nm (69 lbf ft).

DIFFERENTIAL BEARINGS**Removal and Refitment**

11A-40-37

Removal

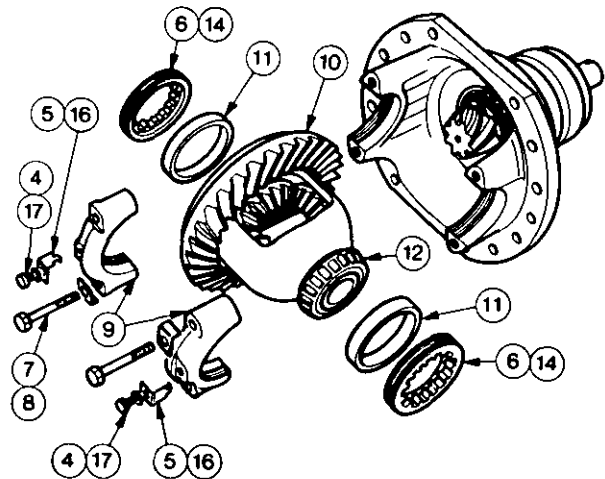
1. Remove the differential assembly, operation 11A-39-37.
2. Hold the differential in a soft faced vice.
3. Dot punch an end cap and the differential casting adjacent to it. Note which side the crownwheel is in relation to the dot punched end cap.
4. Remove the two bolts and locking washers.
5. Remove the two locking tabs.
6. Unscrew and remove the two bearing adjustment ring nuts.
7. Release the four tab locking washers.
8. Remove the four bolts.
9. Remove the end caps.
10. Remove the differential unit complete with the bearing cups.
11. Remove the bearing cups.

NOTE: Keep the two bearing cups separately and identify them to ensure that they are refitted in their original position.

12. Using a universal extractor, remove the two bearing cones.

Refitment

13. Reverse procedures 7 to 12, except:
 - (a) Tighten the four bolts to a torque of 94 Nm (69 lbf ft).
14. Fit and tighten the two bearing adjustment ring nuts **EVENLY**.
15. Adjust the crown wheel bearing adjustment and pinion teeth backlash, operation 11A-41-38, procedures 5 to 11.
16. Refit the two ring nut locking tabs.
17. Refit and tighten the two bolts and locking washers.
18. Refit the differential assembly, operation 11A-39-37.



FOUR WHEEL DRIVE

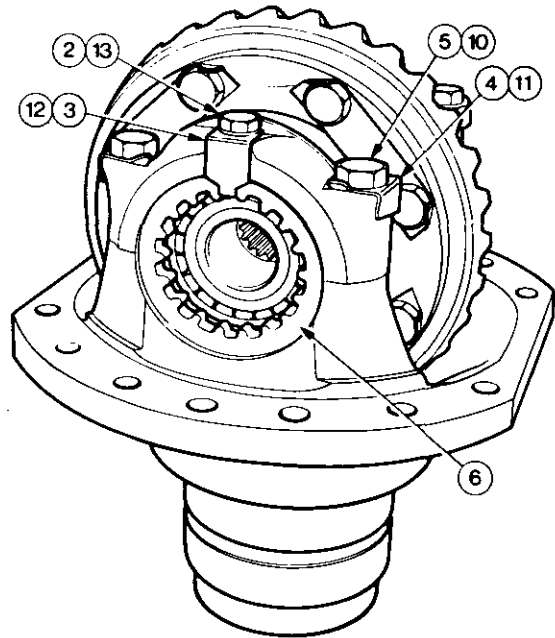
CROWN WHEEL BEARING ADJUSTMENT AND PINION TEETH BACKLASH

Adjustment Procedure 11A-41-38

1. Remove the differential assembly, operation 11A-39-37.
2. Remove the two bolts and locking washers.
3. Remove the two locking tabs.
4. Release the four tab locking washers.
5. Slacken the four bolts and retighten to a torque of 20,3 Nm (15 lbf ft).
6. Rotate the crownwheel and simultaneously tighten the L.H. ring nut until the backlash is taken up and a light pre-load is given to the bearings.
7. Check the backlash between the teeth of the crownwheel and pinion by positioning a dial gauge perpendicularly on a crownwheel tooth.
8. Take a new reading at a further two positions staggered at 120°. Take the mean of the readings which should be 0,18 to 0,23 mm (00.7 to 00.9 in).
9. Should the dial gauge readings not be within the required limits, adjust the ring nuts by slackening and tightening one and the other by the same amount of turns until the correct play is obtained.

NOTE: Ensure that the crownwheel bolt heads do not foul any other components when the crownwheel is turned.

10. Tighten the four bolts to a torque of 94 Nm (69 lbf ft).
11. Bend up the four lock tabs against the bolt heads.
12. Refit the two ring nut locking tabs.
13. Refit and tighten the two bolts and locking washers.
14. Refit the differential assembly, operation 11A-39-37.



DIFFERENTIAL

Servicing 11A-42-38

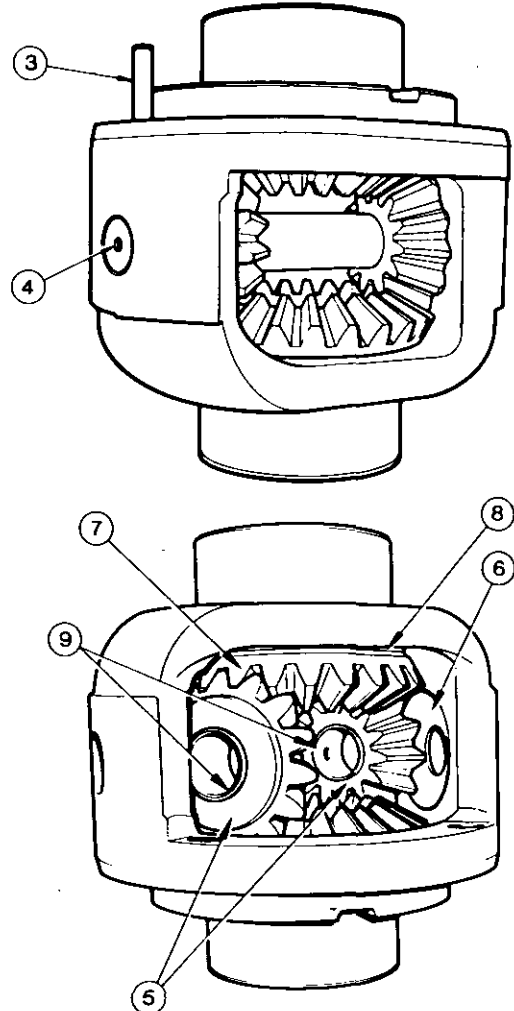
Disassembly

1. Remove the differential bearings, operation 11A-40-37.
2. Remove the crownwheel, operation 11A-43-39.
3. Tap out the planetary shaft locating pin.
4. Remove the planetary shaft.
5. Rotate the differential gears through 90° and remove the two planetary pinions.
6. Remove the planetary pinion thrust washers.
7. Remove the differential gears.
8. Remove the thrust washers.
9. If necessary, remove the planetary pinion bushes.

Thoroughly clean and inspect all components. Any showing signs of wear or damage must be replaced.

Reassembly

10. Reverse procedures 1 to 9 except:
 - (a) If the planetary pinion bushes are removed fit new ones using a mandrel.
 - (b) Fit the washers with their oil grooves towards the differential gears.
 - (c) Coat the planetary pinion thrust washers in petroleum jelly, then locate them in their respective recesses in the differential case.
 - (d) Place the planetary pinions directly opposite to each other, then roll them into position on the thrust washers.
 - (e) Ensure that the hole in the planetary pinion shaft aligns with that of the differential case.



**WHEEL
and Refitment**

11A-43-39

Remove the differential bearings, operation 11A-40-37.

2. Release the tab locking washers.
3. Remove the eight bolts and tab washers.
4. Remove the crownwheel.

NOTES:

- (a) If the crownwheel is to be refitted, mark it in relation to the differential carrier to facilitate correct fitment.
- (b) If the crownwheel is damaged, the pinion must also be replaced as these are only sold in matched sets.

Refitment

5. Reverse procedures 1 to 4 except:
 - (a) Tighten the bolts to a torque of 81,4 Nm (60 lbf ft).
6. Adjust the crownwheel and pinion backlash, operation 11A-41-38.

BEVEL DRIVE PINION ASSEMBLY**Removal and Refitment**

11A-44-39

Removal

1. Remove the differential bearings, operation 11A-40-37.
Press out the pinion complete with the inner bearing cone.

NOTE: When removing the pinion, take care to avoid the outer bearing cone being damaged as it will be free to fall from the bearing cup.

3. Remove the outer bearing cone.
4. Using MF 200 with MF 200-25, press off the inner bearing cone.

NOTE: If the pinion is damaged, the crownwheel must also be replaced as these are only sold in matched sets.

Refitment

5. Check and adjust the pinion axial position, operation 11A-46-40.
6. Reverse procedures 1 to 4.

FOUR WHEEL DRIVE

BEVEL DRIVE PINION ASSEMBLY

Servicing

11A-45-40

Disassembly

1. Remove the pinion operation 11A-44-39.
2. Tap out the inner bearing cup, taking care not to damage the shims.
3. Remove the shims.
4. Extract the outer bearing cup.

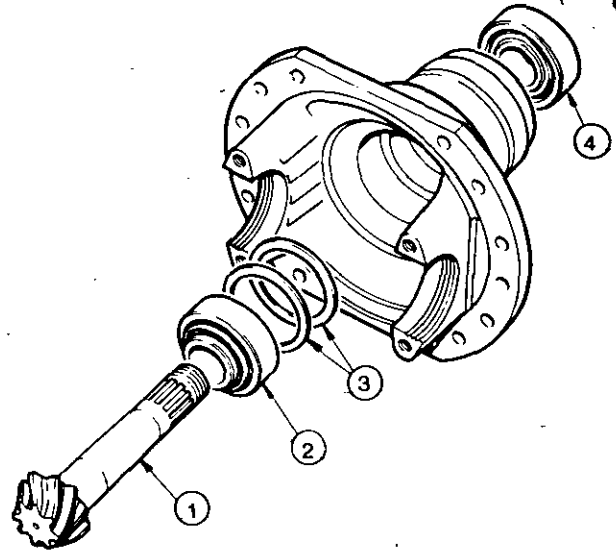
Examination

Inspect all parts and replace any which show signs of wear or damage.

NOTE: If the pinion is damaged, the crown-wheel must also be replaced as these are only sold in matched sets.

Reassembly

5. Reverse procedures 1 to 4.



BEVEL DRIVE PINION AXIAL POSITION

Adjustment Procedure

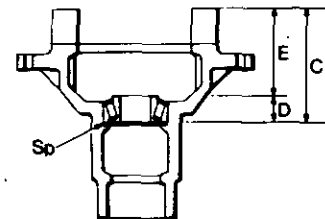
11A-46-40

1. Remove the pinion assembly, operation 11A-45-40.
2. Fit the inner bearing cup and bearing cone complete.
3. The thickness of adjusting shims is calculated by using a simple formulae $Sp = C - (D + E)$ where:
 - C = Distance from the pinion shaft support front bearing seat to the crownwheel axis.
 - D = Height of the pinion support front bearing.
 - E = Nominal distance from the crownwheel axis to the pinion base.
4. Once the thickness of adjusting shims has been determined (Sp), remove the bearing and fit the shims required.

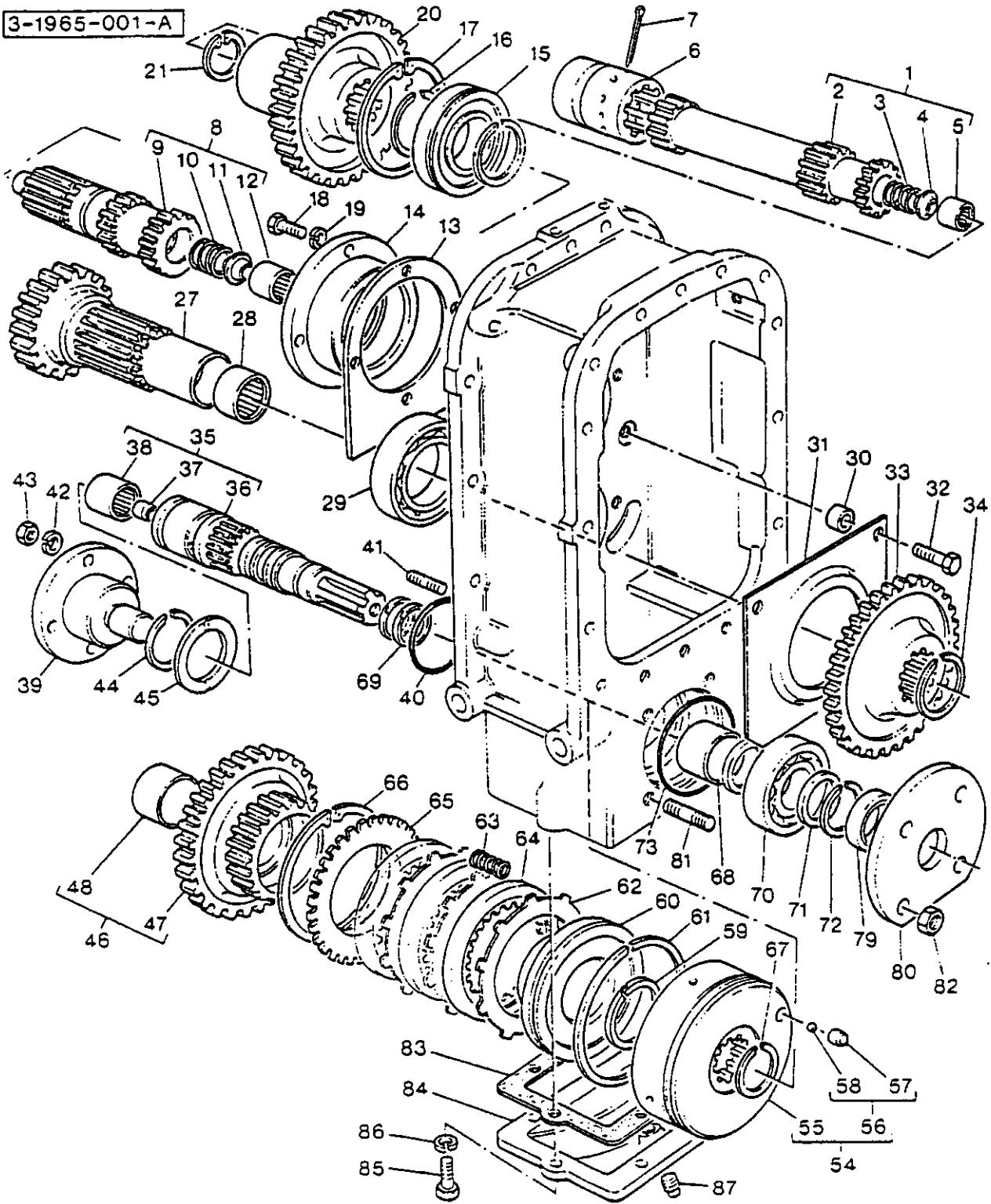
Select the shims from the table below:

Part Number	mm	in
1659 774 M1	0,15	0-006
1659 775 M1	0,30	0-012
1659 776 M1	0,50	0-020
1659 777 M1	0,70	0-028

5. Refit the inner bearing cup.
6. Refit the bevel drive pinion, operation 11A-44-39.



3-1965-001-A



AGCO Corporation
Parts List Report

Massey Ferguson (Europe)

MF 290 TRACTOR, [-> 387021

Page 494 - TRANSFER GEAR BOX-GEARS - UP TO SERIAL NO 392592

Item	Part Number	Qty	Part Description	Comments
				UP TO SERIAL NO 392592
1	886366M91	1	Shaft	
2		1	Shaft	(1) Not Serviced, Order REF 1
3	886352M1	1	Spring	(1)
4	886353M1	1	Abutment	(1)
5	195513M1	1	Bearing	(1)
6	1680189M1	1	Coupler	
7	354416X1	1	Pin	
8	1809849M92	1	Shaft	
9		1	Shaft	(8) Not Serviced, Order REF 8
10	886352M1	1	Spring	(8)
11	886353M1	1	Abutment	(8)
12	195513M1	1	Bearing	(8)
13	908975M1	1	Plate	
14	908974M1	1	Sleeve	
15	834303M1	1	Bearing	
16	195363M1	2	Circlip	
17	1440516X1	1	Circlip	
18	353681X1	4	Bolt Unc	
19	353446X1	4	Lock Washer	
20	908976M1	1	Gear	39T
21	355976X1	1	Circlip	
27	908970M1	1	Shaft	21T
28	195717M1	1	Needle	
29	831186M1	1	Bearing	
30	1809845M2	2	Spacer	
31	1809738M1	1	Deflector	
32	353680X1	2	Screw Unc	
33	908971M1	1	Gear	42T
34	339470X1	1	Circlip	
35	1809151M93	1	Shaft	
36		1	Shaft	(35) Not Serviced, Order REF 35
37	186573M1	1	Plug	(35)

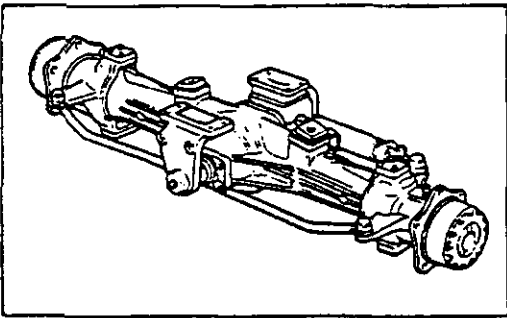
38	0050277	1	Bush	(35)
39	908960M1	1	Plug	
40	835130M1	1	Ring	
41	195569M1	4	Stud	
42	353446X1	4	Lock Washer	
43	353916X1	4	Nut Unf	
44	22608X	1	Circlip	
45	186567M1	1	Washer	
46	908967M91	1	Gear	
47		1	Gear	(46) Not Serviced, Order REF 46
48	188806M1	1	Bush	(46)
54	518508M93	1	Housing	
55		1	Housing	(54) Not Serviced, Order REF 54
56	1872134M92	1	Valve Check	(54)
57		1	Body	(56) Not Serviced, Order REF 56
58	357134X1	1	Ball	(56)
59	186580M1	1	Ring	
60	186531M2	1	Piston	Alternative 1661 952 M1
60	1661952M1	1	Piston	Alternative 186 531 M2
61	185425M1	1	Ring	
62	185464M1	3	Plate	
63	186519M1	6	Spring	
64	1870074M1	3	Disc	Alternative 1672 626 M1
64	1672626M1	3	Disc	Alternative 1870 074 M1
65	518507M1	1	Plate	Alternative 510 241 M1
65	510241M1	1	Plate	Alternative 518 507 M1
66	364689X1	1	Snapping	
67	850723M1	1	Circlip	
68	908959M1	1	Bush	
69	186581M1	2	Ring	
70	1440501X1	1	Bearing Assy	
71	908965M1	2	Washer	
72	339469X1	1	Segment	
73	1004633M1	1	O Ring	
79	1442346X1	1	Oil Seal	
80	1808471M1	1	Cover	
81	183267M1	4	Stud	
82	353437X1	4	Nut Unf	
83		1	Joint	(A)
84	908956M1	1	Cover	
85	353678X1	6	Screw Unc	

86	353446X1	6	Lock Washer
87	22769X	1	Plug

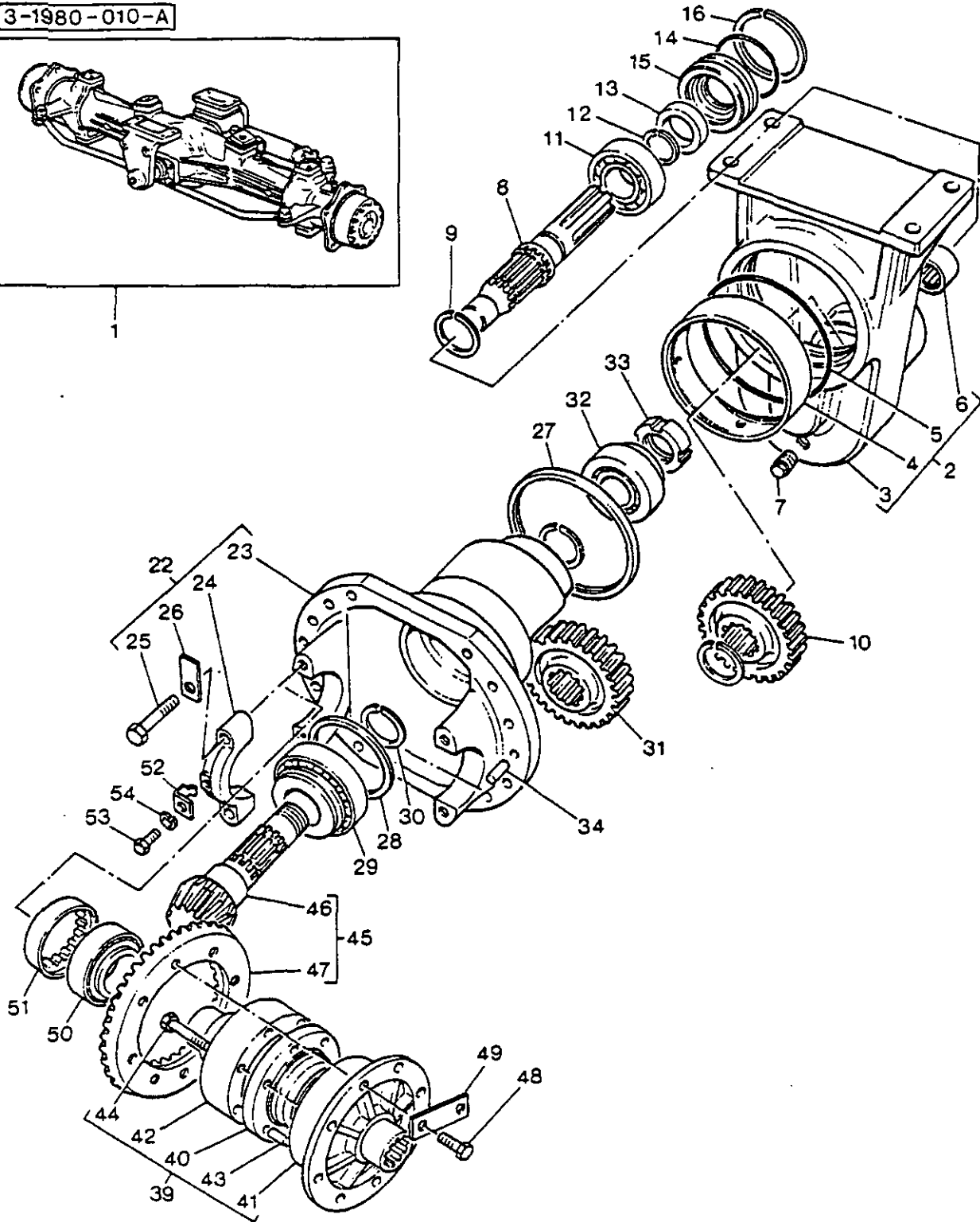
(A)

USE 'LOCTITE 515' SEALER

3-1980-010-A



1



AGCO Corporation
Parts List Report

Massey Ferguson (Europe)
MF 290 TRACTOR, |-> 387021
Page 508 - FRONT AXLE-DIFFERENTIAL-4 WHEEL DRIVE

Item	Part Number	Qty	Part Description	Comments
1		1	Axle	See Page/Reference Number 504/1
2	3224971M92	1	Support	(1)
3		1	Support	(2)
				Not Serviced, Order REF 2
4	3224973M1	1	Bush	(2)
5	359213X1	1	O Ring	(2)
6	1440627X1	1	Bearing	(2)
7	392735X1	1	Plug	(1)
8	3224999M2	1	Shaft	(1)
9	339820X1	2	Circlip	(1)
10	3426137M1	1	Gear	(1)
				22T
				"FNB"
10	3426333M1	1	Gear	26T
				"FND"
11	339856X1	1	Bearing Ball	(1)
12	339469X1	1	Segment	(1)
13	392108X1	1	Seal	(1)
14	392022X1	1	Seal	(1)
15	3224998M1	1	Ring	(1)
16	1440913X1	1	Segment	(1)
22	3426187M92	1	Support	(1)
23		1	Support	(22)
				Not Serviced, Order REF 22
24		2	Cap	(22)
				Not Serviced, Order REF 22
25	1441473X1	4	Bolt Metric	(22)
26	1442553X1	4	Plate	(22)
27	3224997M1	1	Ring	(1)
28	974765M1	X	Shim	(1)
				Thickness: 0.10MM
28	974766M1	X	Shim	(1)
				Thickness: 0.15MM
28	974767M1	X	Shim	(1)
				Thickness: 0.30MM
28	974765M1	X	Shim	(1)
				Thickness: 0.50MM

29	1440826X1	1	Bearing Assy	(1)
30	339820X1	2	Circlip	(1)
31	3426138M1	1	Gear	(1)
				29T
				"FNB"
31	3426333M1	1	Gear	26T
				"FND"
32	1442253X1	1	Bearing	(1)
33	2824178M1	1	Nut Special	(1)
34	393596X1	2	Centraliser	(1)
39	3426071M92	1	Kit,Differential	(1)
40	3426074M92	1	Differential	(39)
41	3426072M1	1	Housing	(39)
42	3426073M2	1	Housing	(39)
43	3426075M2	2	Pin	(39)
44	1442901X1	8	Screw	(39)
45	3426185M91	1	Kit, Crownwheel	(1)
46		1	Pinion	(45)
				Not Serviced, Order REF 45
47		1	Crownwheel	(45)
				Not Serviced, Order REF 45
48	1442557X1	8	Bolt Metric	(1)
49	1823590M1	4	Plate	(1)
50	330375X1	2	Bearing Assy	(1)
51	1823550M2	2	Nut	(1)
52	1823577M1	2	Plate	(1)
53	339124X1	2	Screw Metric	(1)
54	339374X1	2	Lock Washer	(1)