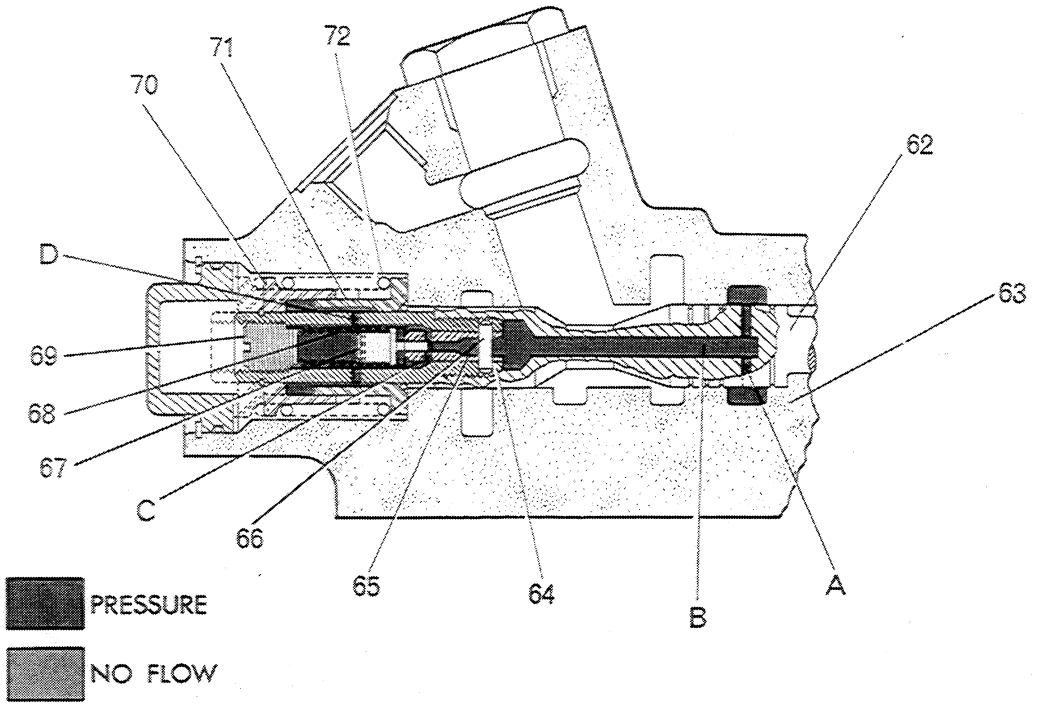
71
72
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D
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C
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B
A
PRESSURE
NO FLOW

FIG. 9

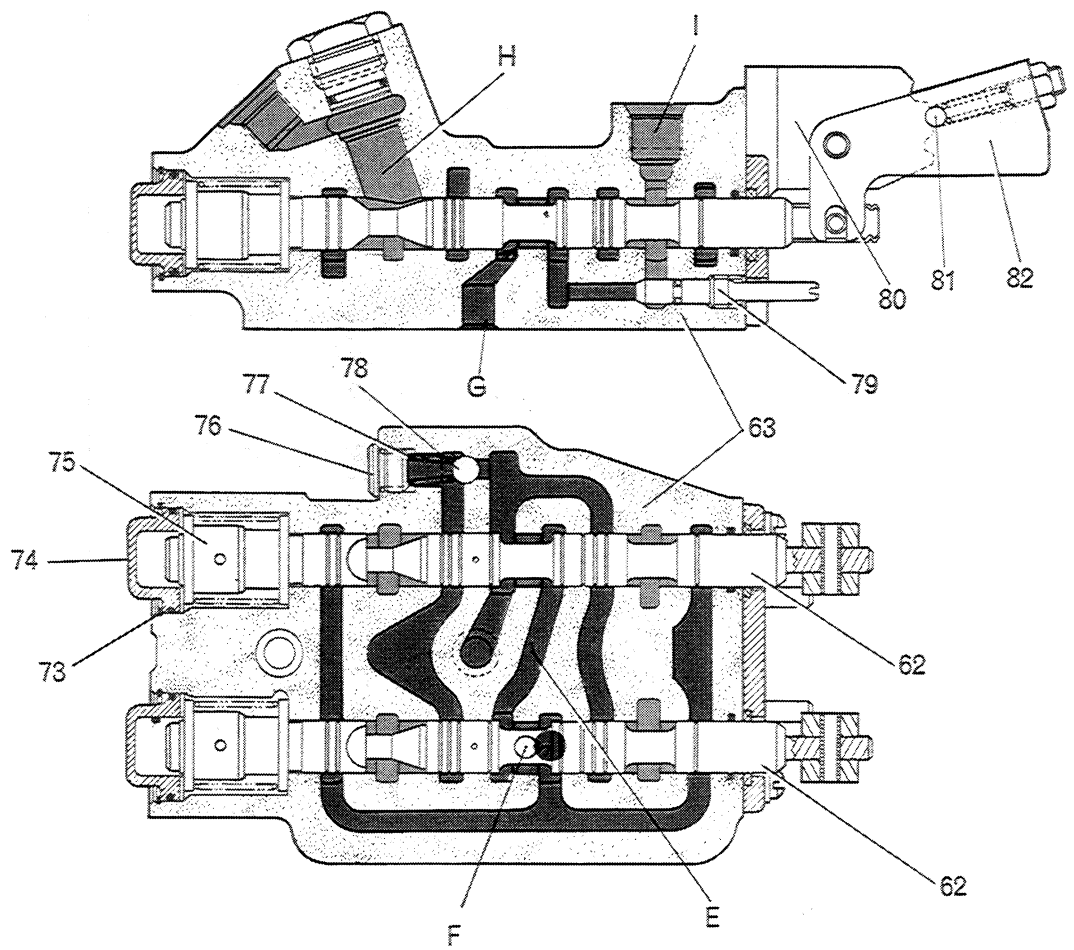
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FIG. 10

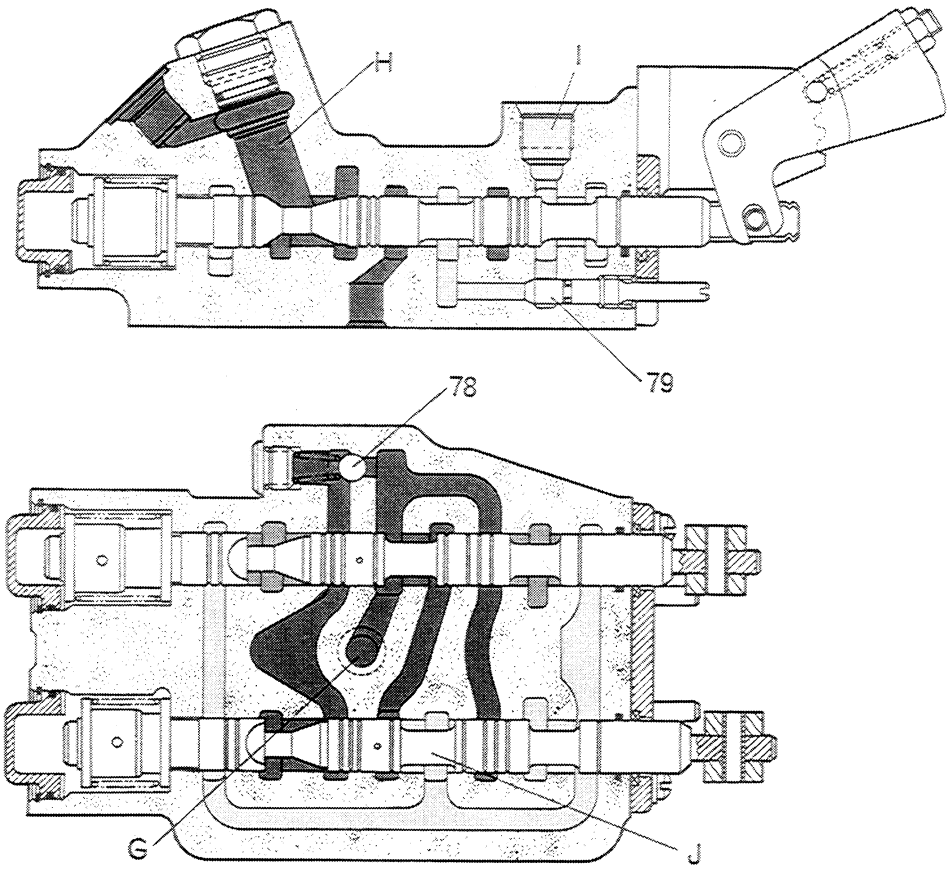


FIG. 11

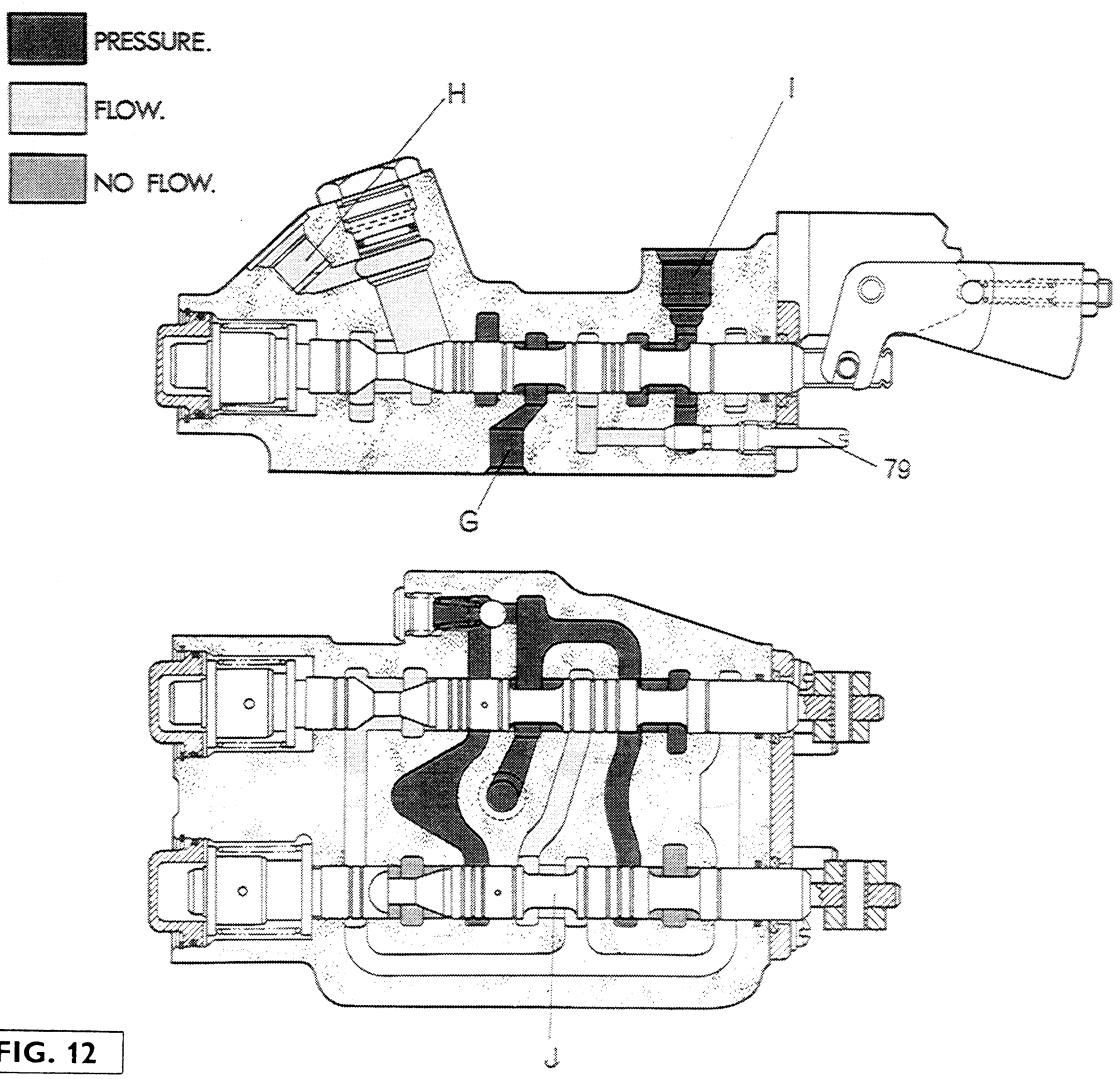


FIG. 12

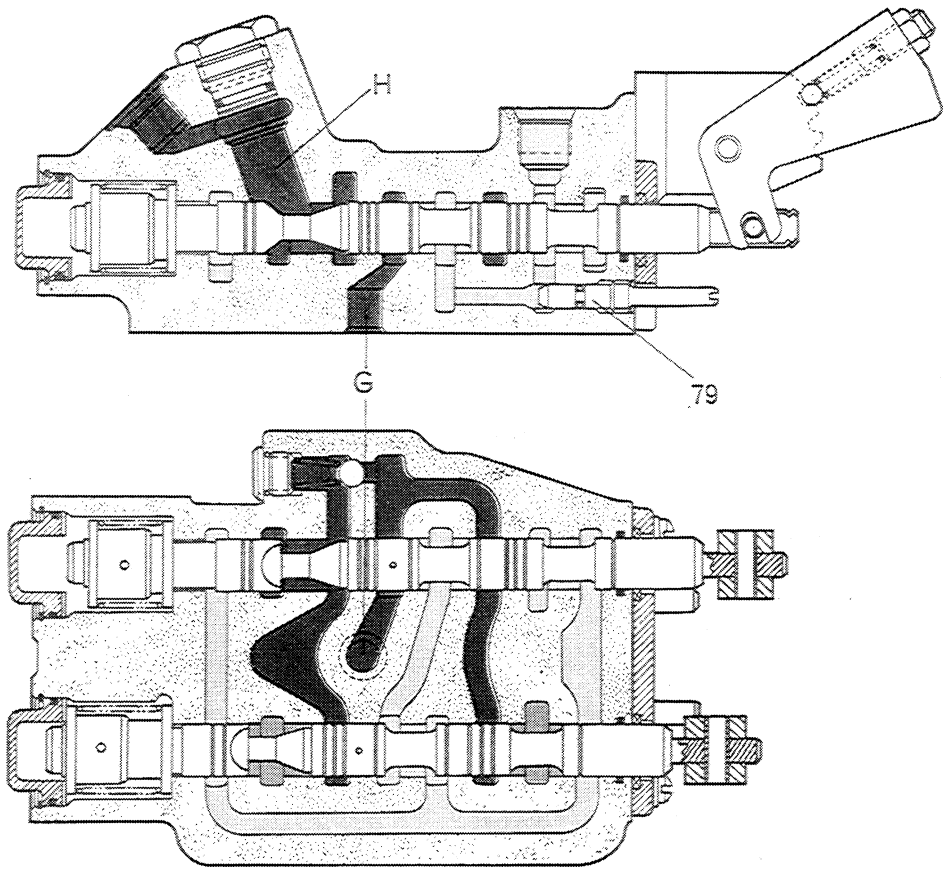


FIG. 13

PRESSURE

FLOW

NO FLOW

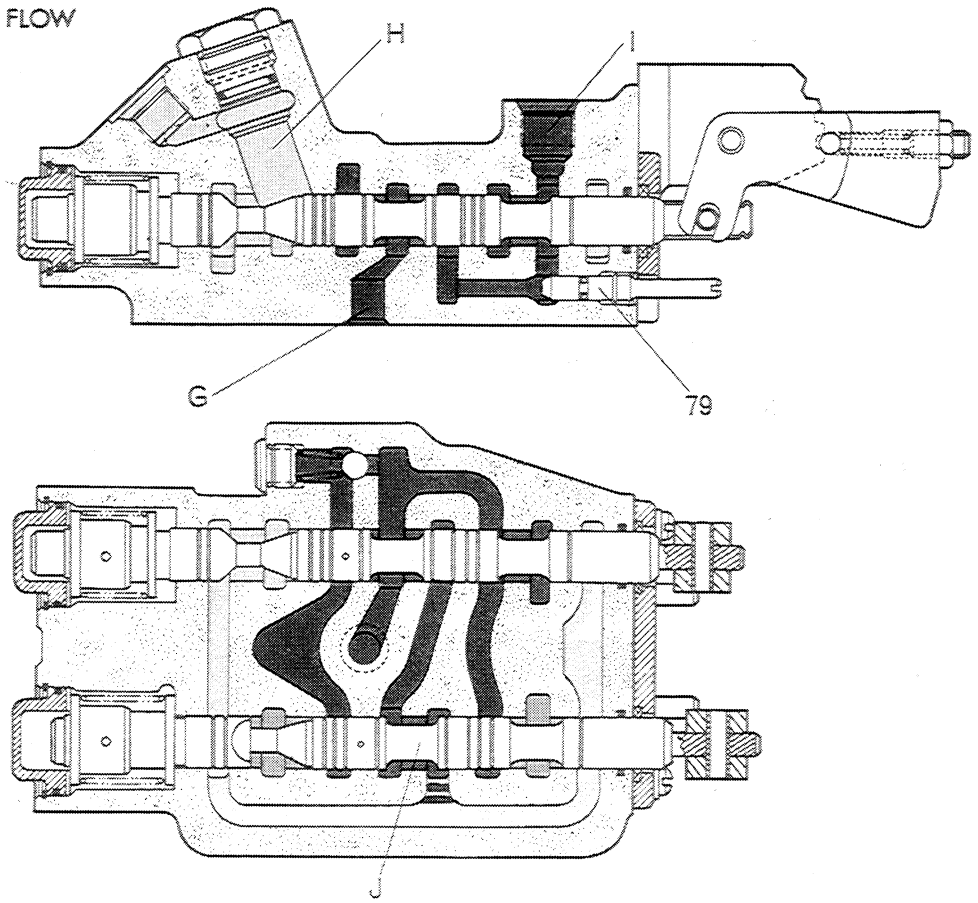
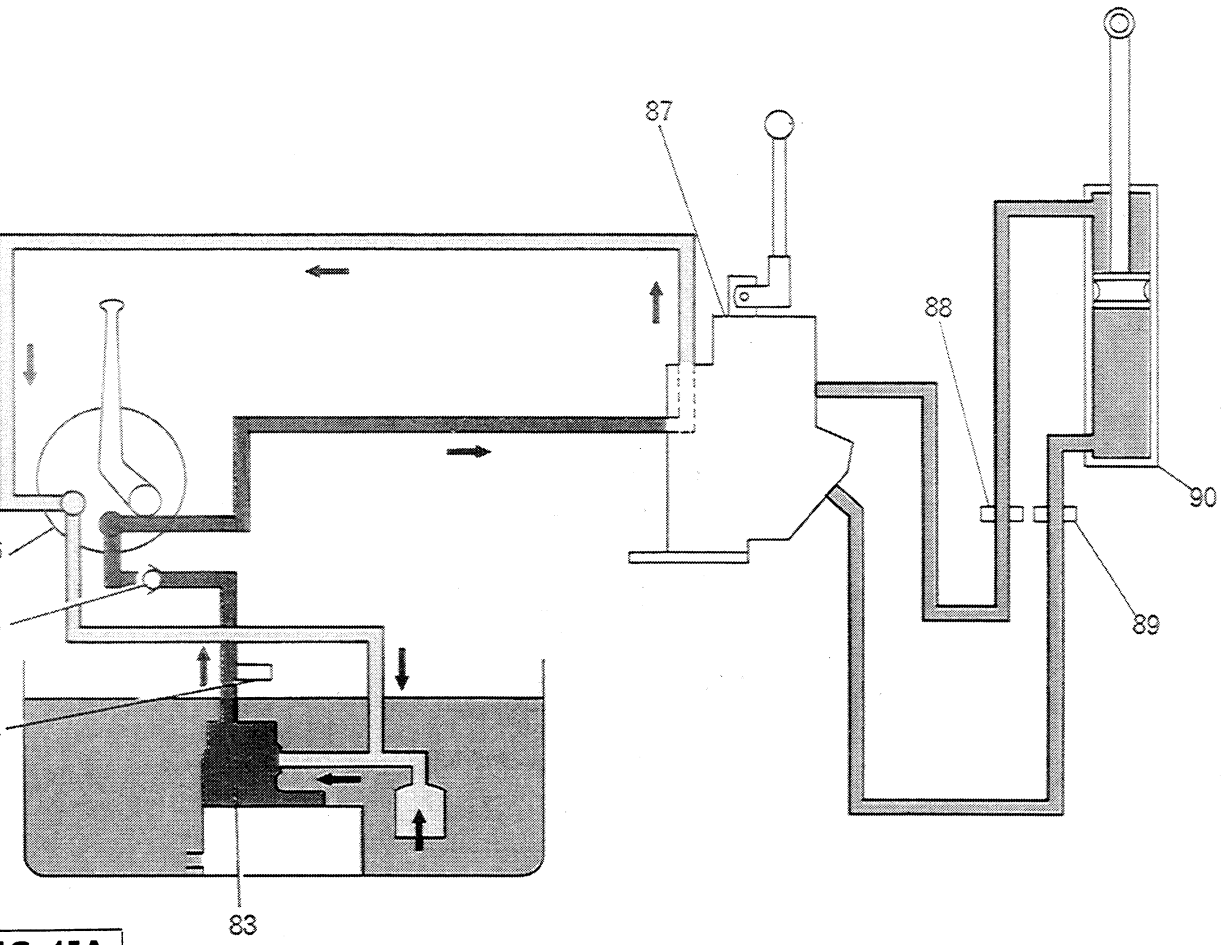
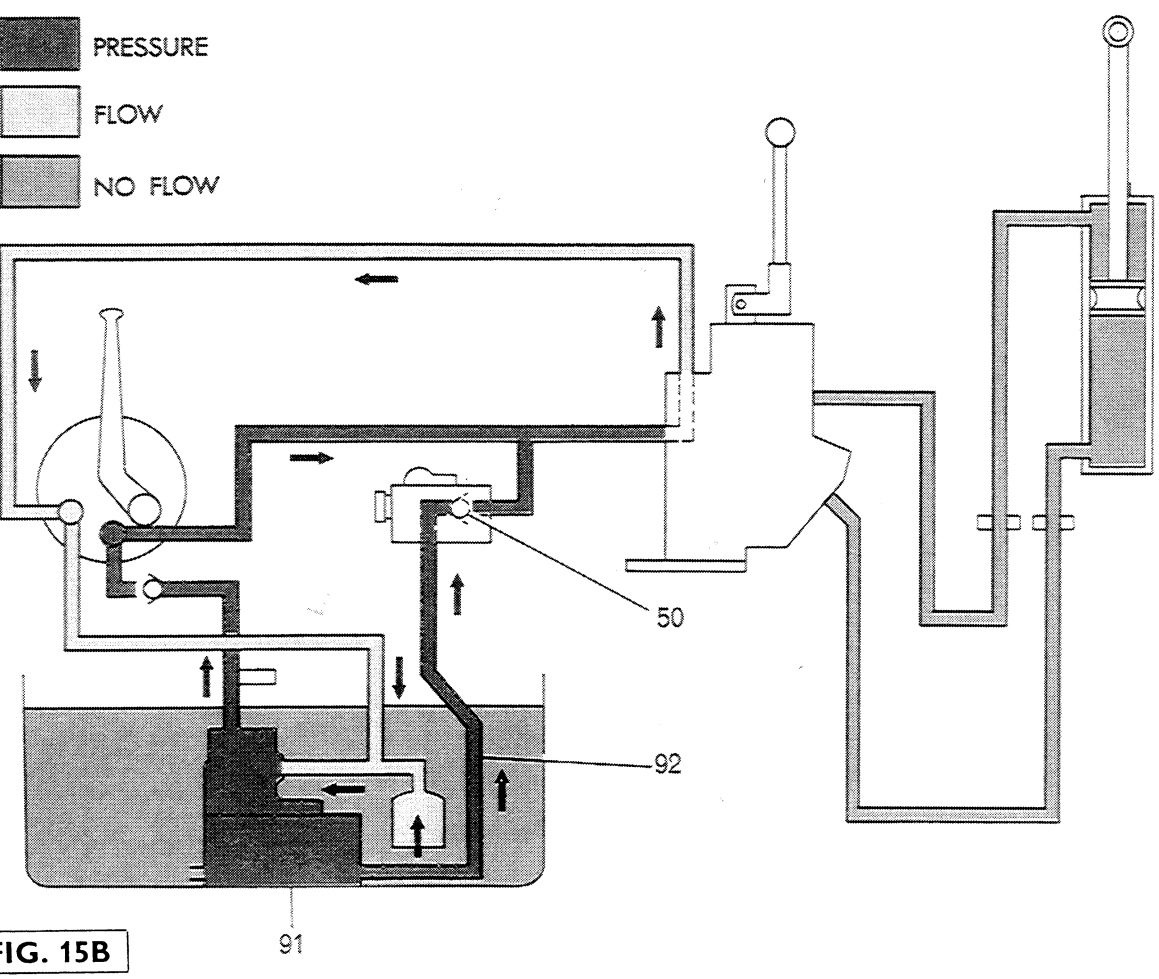


FIG. 14



IG. 15A



IG. 15B

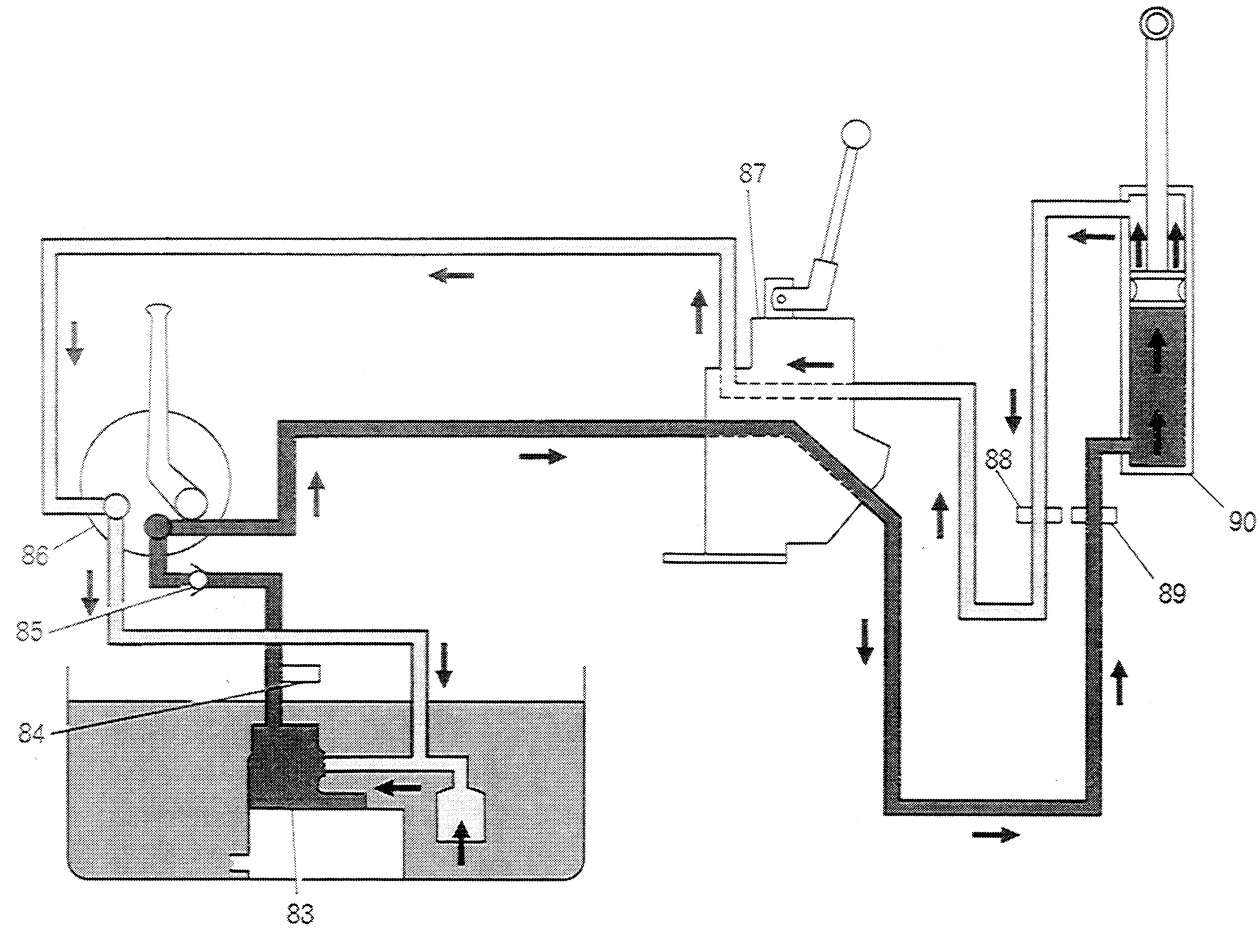


FIG. 16A

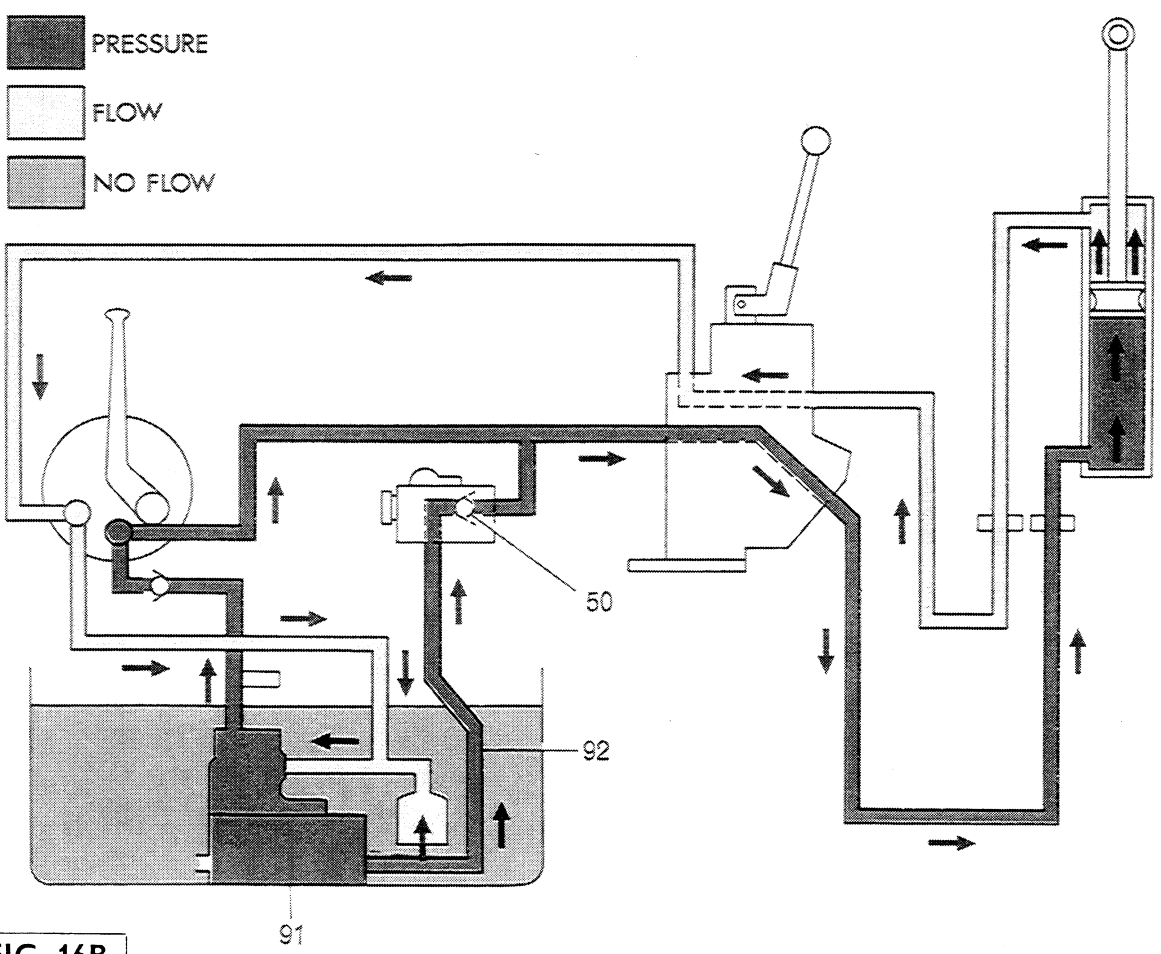


FIG. 16B

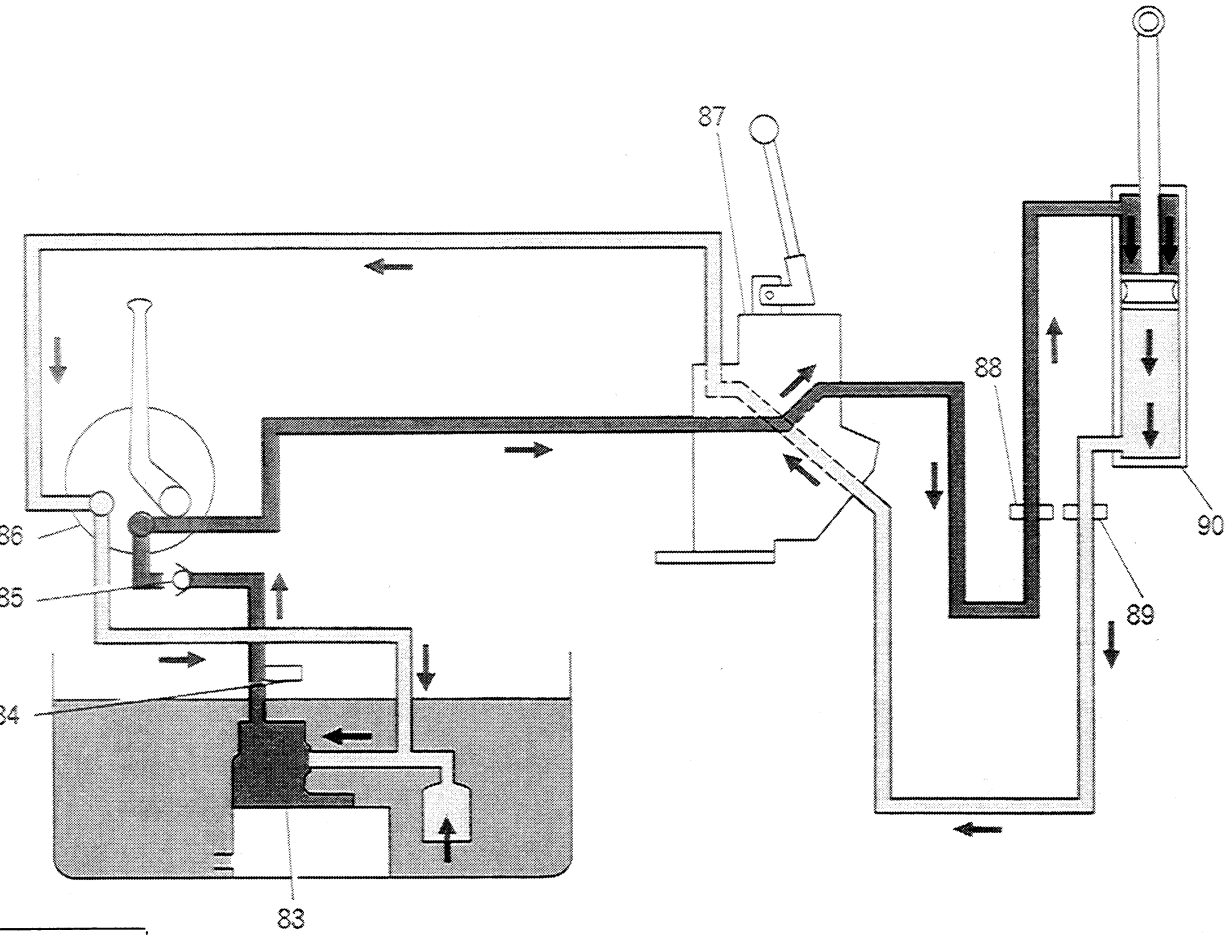


FIG. 17A

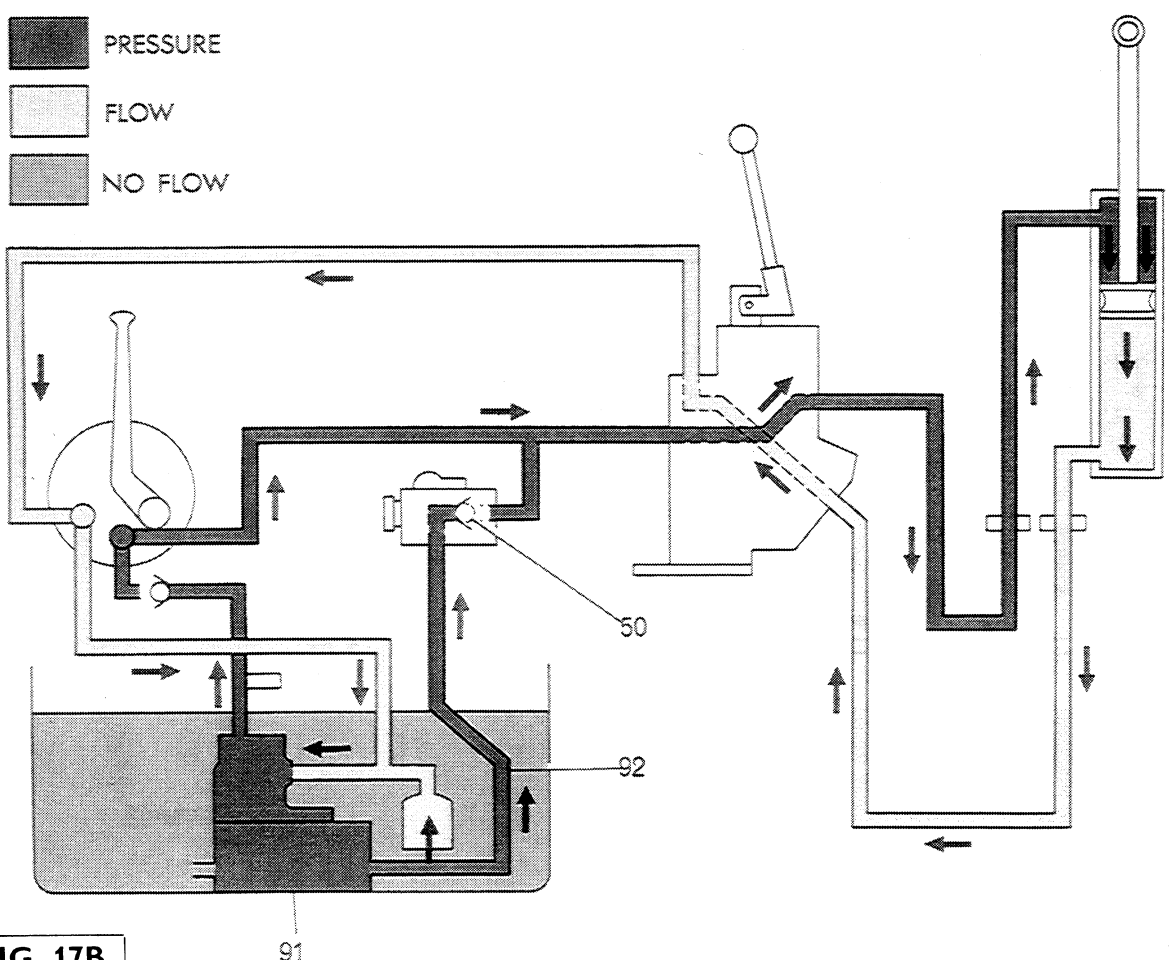


FIG. 17B

Double-Acting Lowering (Lever Forward) (Fig. 12)
When the lever is pushed forward, oil (red) is fed from the inlet port (G), out of the 'DROP' port (H) to the ram, thus expelling oil (yellow) from the opposite side of the ram back to the 'LIFT' port (I). The oil then flows along the return gallery to the exhaust port (J). The switch valve (79) must be fully closed, as shown for double-acting operation.

Single–Acting Neutral (Lever Central)(Not illustrated)
The neutral flow for single-acting is similar to that for double-acting except that the 'DROP' port (H Fig. 4) is blanked off by the self-sealing quick release hose coupling.

Single-Acting Raising (Lever Back) (Fig. 13)
For single-acting operation the switch valve (79) must be unscrewed five full turns from 'fully in' position. Oil (red) flows from the inlet port (G) into the spool bore. The oil is directed by the spool to the 'LIFT' port (H) where the oil then flows to the ram and extends it. As the 'DROP' port is blanked off, there is no flow from the ram back to the spool, and consequently, no flow back to pump from the valve. The oil (blue) in the return gallery, to all intents and purposes, does not flow.

Single–Acting Lowering (Lever Forward) (Fig. 14)
With the actuating lever placed in the forward position, the position of the spool is such that oil (red) enters the valve through the inlet port (G) and is directed by the spool to the 'DROP' port (I). As the 'DROP' port is blanked off, and the switch valve (79) is open, the oil returns straight into the exhaust port (J). Oil (yellow) is also flowing from the ram as it contracts, and enters through the 'LIFT' port (H). Due to the position of the spool, the oil is directed from the 'LIFT' port into the return gallery, where it flows into the exhaust port (J) and combines with the pump flow, to flow back to tank (shown as yellow).

CIRCUIT FLOWS

The following flows, although purely diagramatic, are intended as a guide to the correct methods of setting up hydraulic circuits on tractors fitted with the auxiliary pump. Each particular flow will have a two-part illustration; part A being for the auxiliary pump alone and part B for the combined auxiliary and linkage pumps, as the basic flow is similar once the flows have combined.

There are non-return valves incorporated in the circuit to prevent damage if one of the pumps malfunctions. The relief valve is fitted between the auxiliary pumps and non-return valve in the auxiliary pump circuit and thus allows the full 211 Kg/cm^2 (3000 lb/in^2) to be used for short periods. The non-return alve in the linkage pump circuit is in the combining valve.

Key to All Circuit Diagrams Fig. 15A to 21B

83 Auxiliary Hydraulic Pump
84 Pressure relief valve.
85 Non-return valve.
86 P.t.o. side cover
87 Wooster spool valve.
88 Upper 'Pioneer' coupler (yellow, or blue identification tag).
89 Lower 'Pioneer' coupler (red, or white identification tag).
90 Double-acting ram
91 Tractor linkage lift pump
92 Tractor standpipe
50 Combining valve
93 Single-acting ram
94 Special balance pipe
95 Hydraulic motor

Double–Acting Ram-Wooster Spool Valve Neutral (Lever Central) Fig. 15A and 15B
Oil (red) is drawin into the auxiliary pump through the filter and pumped, under pressure, to the manifold on the p.t.o. side cover. The oil is then piped into the Wooster spool valve inlet port, where, due to spool positioning, it flows straight out again through the exhaust port on the valve (see Fig. 12). The oil (now yellow) flows down the return pipe to the p.t.o. cover, where it is piped back into the hydraulic pump. As approximately 25% of the oil delivered by the pump is required to operate the Multi-power and does not return to the pump, the required quantity isdrawn through the filter.

When the combined pumps are employed as shown in Figure 5B oil (red) flows from the linkage lift pump, up the standpipe to the combining valve, which if open, will allow the oil to be piped to the tee-piece on the spool valve, and thus supplement the output of the auxiliary pump. When combined pumps are employed, the oil pumped by the tractor linkage pump will also be returned to the auxiliary pump. There will therefore, be very little intake through the filter into the auxiliary pump.

Double-Acting Ram-Wooster Spool Valve Raising (Lever Back) (Fig 16A and 16B)
Oil (red) is drawn into the pump(s) and is piped via either the p.t.o. side cover, or the combining valve to the tee-piece union on the spool valve. The oil, directed by the spool position, flows from the valve out of the 'LIFT' port to the quick release coupling hose which has either a white (L.H.) or red (R.H.) coloured identification tag. Connected to the quick release coupling is the ram hose, along which the oil flows to the ram. When the oil pressure exceeds the load, the ram extends. Oil (yellow) is forced from the opposite side of the ram and flows along the second ram hose, which is connected to the upper quick release coupling [yellow (L.H.) or blue (R.H.) identification tags]. The oil re-enters the spool valve through the 'DROP' port, and is routed through the valve, back through the p.t.o. side cover to the auxiliary pump.

Double-Acting Ram-Wooster Spool Valve Lowering (Lever Forward) Fig. 17A and 17B
Oil (red) is drawn into the pump(s) and is piped to the spool valve tee-piece union, via either the p.t.o. side cover or the combining valve. The oil is directed by the spool to the 'DROP' port on the valve, which is connected to another quick release coupling hose [yellow (L.H.) or blue (R.H.) identification tags].

The oil flows through the quick-release coupling, and along the ram hose to the ram which contracts. As the ram contracts, the oil (yellow) on the opposite side of the ram is forced back along the hose to the other quick release coupling hose [white (L.H.) or red (R.H.) identification tags] and into the valve through the 'LIFT' port. The oil then flows from the valve, through the p.t.o. side cover and into the pump, to be re-circulated.

Single–Acting Ram-Wooster Spool Valve
Neutral (Lever Central) Fig 18A and 18B
The neutral flow for single-acting rams is generally similar to that for double-acting, except that only one ram hose is employed. The self-sealing, quick release coupling prevents flow from the'DROP' port hose. The switch valve must be unscrewed five full turns from the 'fully in' position.

Single-Acting Ram-Wooster Spool Valve
Raising (Lever Back) Fig. 19A and 19B
Oil (red) is drawn into the pump(s) and is pumped, under pressure, to the spool valve, via either the tractor standpipe and combining valve, or the p.t.o. side cover. The oil is channelled through the valve to the 'LIFT' port. From the 'LIFT' port the oil flows along the quick release coupling hose, (white or red identification tag) to the ram hose and finally into the ram. The ram extends. The return pipe from the valve to the pump may contain some oil (blue), but as very little of this will be drawn back into the pump, a condition of 'no flow' may be considered to exist.

Single-Acting Ram-Wooster Spool Valve
Lowering (Lever Forward) Fig. 20A and 20B
When the valve actuating lever is placed in the forward position, filtered oil (red) is drawn from the pump(s) and is routed to the spool valve, via either the tractor standpipe and and combining valve, or the p.t.o. side cover. The oil flows into the valve and is routed to the 'DROP' port. As this is blanked off, but the switch valve is open, the oil flows to the return port. The oil (yellow) in the ram is forced out as the ram contracts, due to gravity or spring pressure, and the oil flows back along the quick release coupling hose to the 'LIFT' port. As the spool is in the lowering position, the oil flows into the return gallery and combines with the pump flow, to flow back to the auxiliary pump.

Hydraulic Motor (Single-Acting Operation)
(Lever Back) Fig. 21A and 21B
Oil (red) is drawn into the pump(s) and flows to the spool valve via either the p.t.o. side cover, or the tractor standpipe and combining valve. The oil flows from the 'LIFT' port on the valve, along the quick release coupling hose (white or red tag) to the motor hose. The oil flows into and drives the motor, the exhausted oil (yellow) flowing back to the upper quick release coupling hose (yellow or blue tag). The oil can either flow through the valve back to the return hose, or through the balance hose to the return pipe and then back to the pump. The by-pass hose is required to prevent burst seals when stopping the motor, i.e. when the valve is placed in the neutral position, the flow of oil to and from the motor, which is rotating at speed, will continue. Its momentum will allow it to carry on running for a short time, during which it will draw oil from the pressure side of the motor and attempt to transfer it to the non-pressure side. As the oil cannot escape, the seals in the circuit will fail. The balance pipe allows the oil to flow back to the pump without this pressure building up.

IMPLEMENTS WITH THEIR OWN SPOOL VALVES

When fitting machines with their own valves, certain precautions must be taken to ensure safe, efficient operation.

A pressure relief valve must be fitted.

If the machine is to be removed from the tractor, the p.t.o. side cover must be restored to its original condition. The manifold, banjo bolts, washers and gaskets (Figure 22) must be refitted.

NEVER UNDER ANY CIRCUMSTANCES, FIT BLANKING PLUGS IN PLACE OF THE MANIFOLD AND BANJO BOLTS

Operation
Precise instructions as to the correct operational technique cannot be given, due to the wide range of equipment and differing procedures. Manufacturers of such equipment usually provide more specialised instructions and should be consulted if these are not readily available.

WOOSTER SPOOL VALVE

Kit Fitment 7B-10-18

Auxiliary Hydraulic Tractors

Assembly
1. Remove the seat.
2. Remove the top bolts and nut securing each trumpet housing to the centre housing.
3. Place the 'Draft Control' lever in the 'DOWN' position.
4. Fig. 35. Remove the two bolts (47) securing the transfer cap (48) then carefully ease off the transfer cap, ensuring that the standpipe is not displaced from its location in the hydraulic pump.
5. Fit the combining valve, as stated in operation 7B-08-09
6. Drain the transmission oil to the 'MIN' mark on the dipstick.
7. Remove the two bolts securing the L.H. footplate to its rear support bracket.
8. Remove the UPPER bolt securing the L.H. footplate rear support bracket to the centre housing, then slacken the lower bolt and swing the bracket downwards to clear the side cover.
9. Remove the two banjo bolts and the manifold from the p.t.o. side cover.
10. Fig. 23. Fit the two unions (93 and 94) to the p.t.o. side cover, as shown.
11. Refit the footplate rear support bracket to the p.t.o. side cover, but do not refit the footplate to bracket bolts.

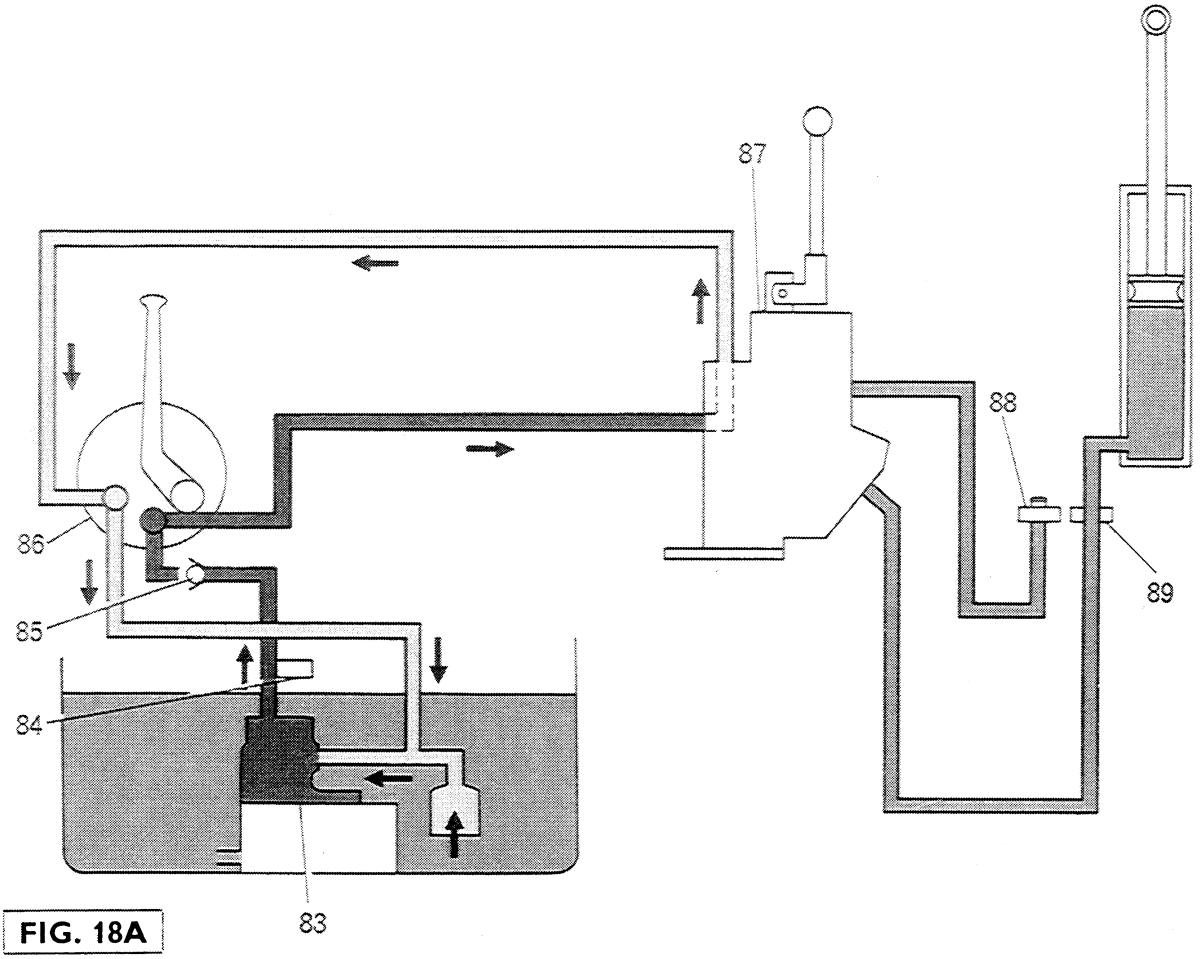


FIG. 18A

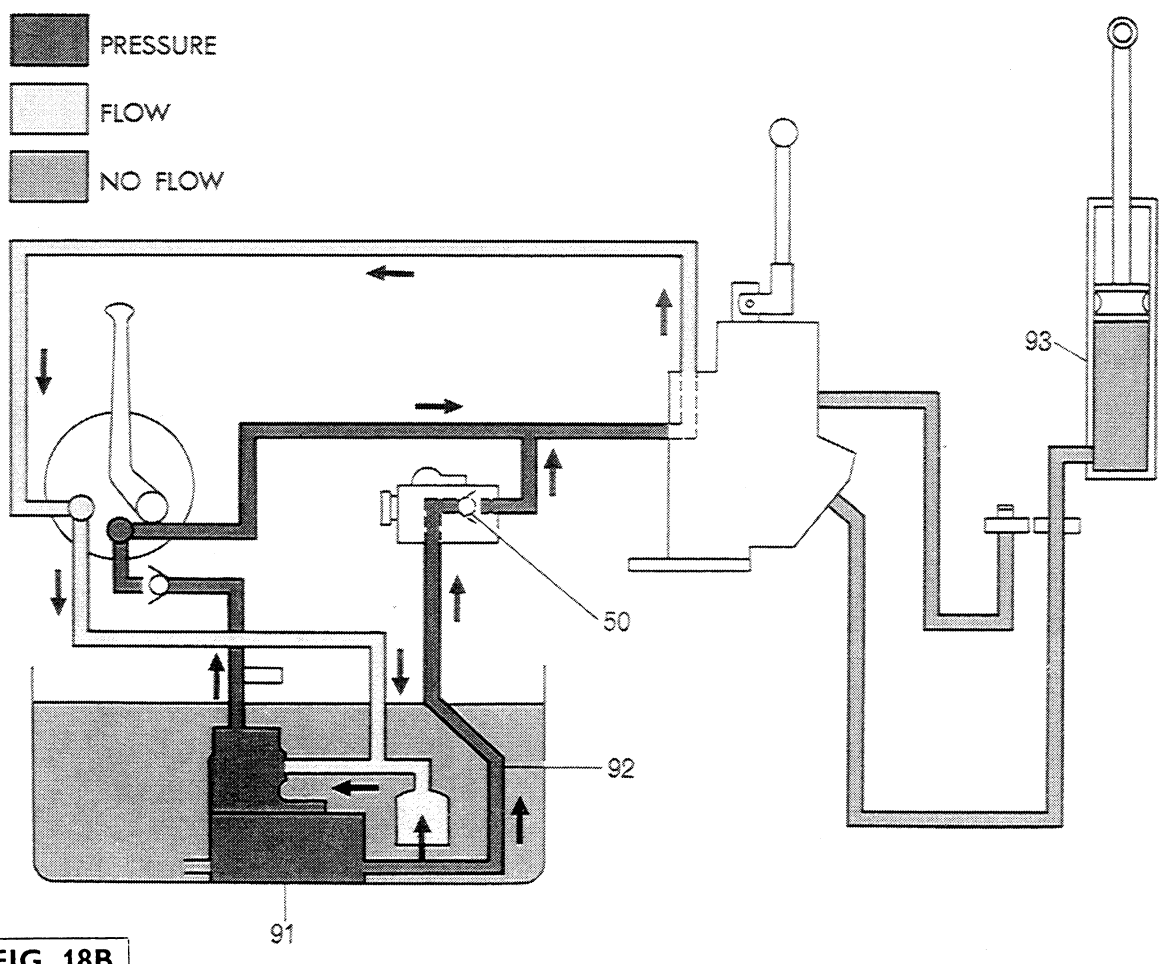


FIG. 18B

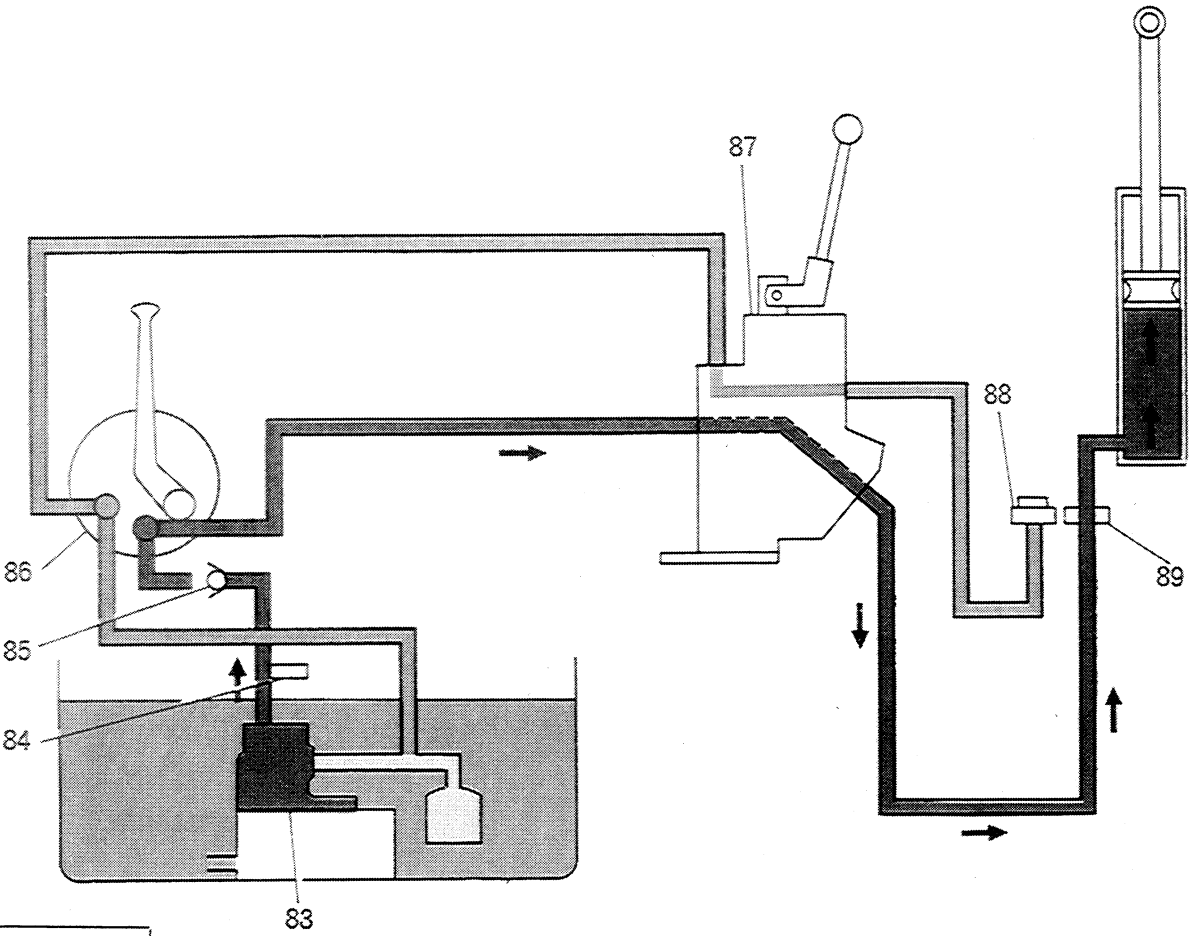


FIG. 19A

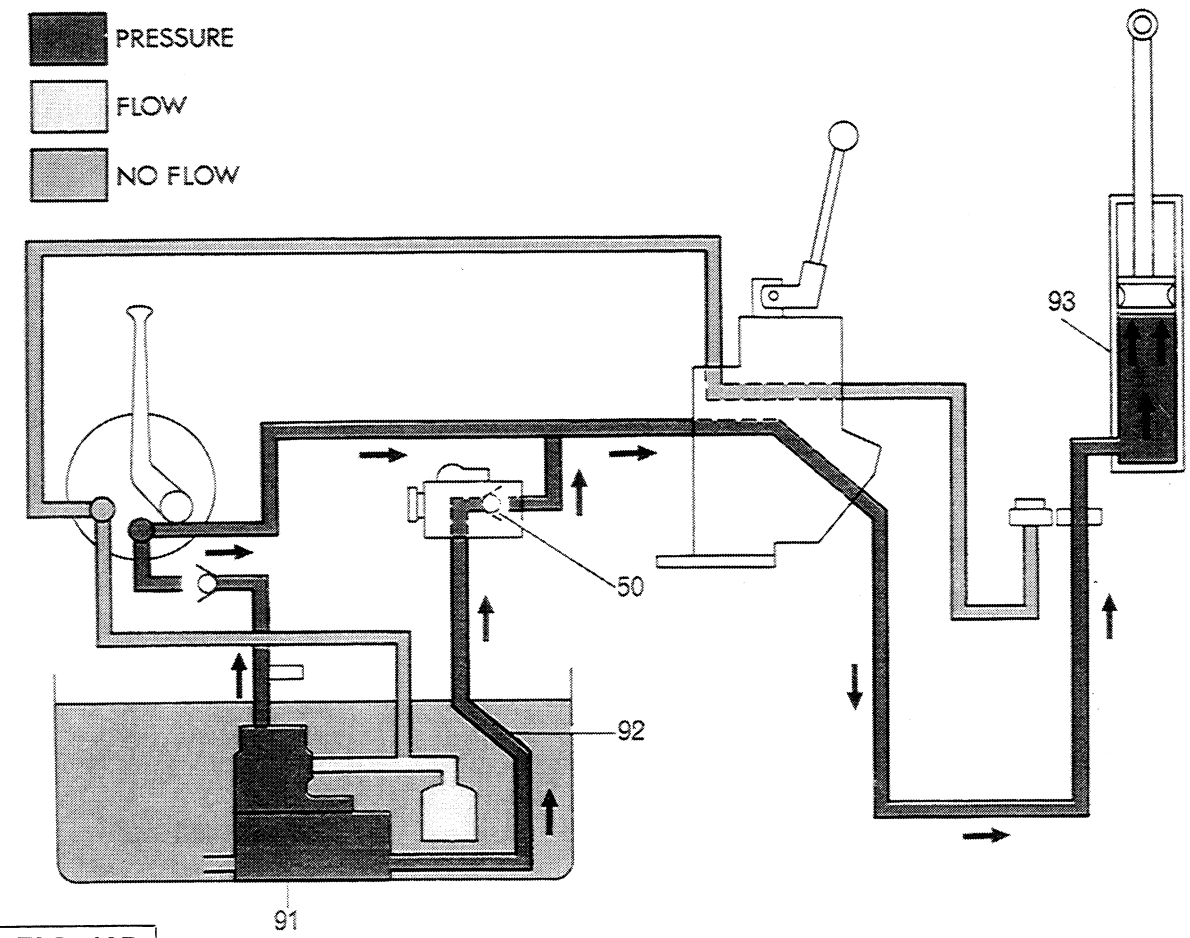


FIG. 19B

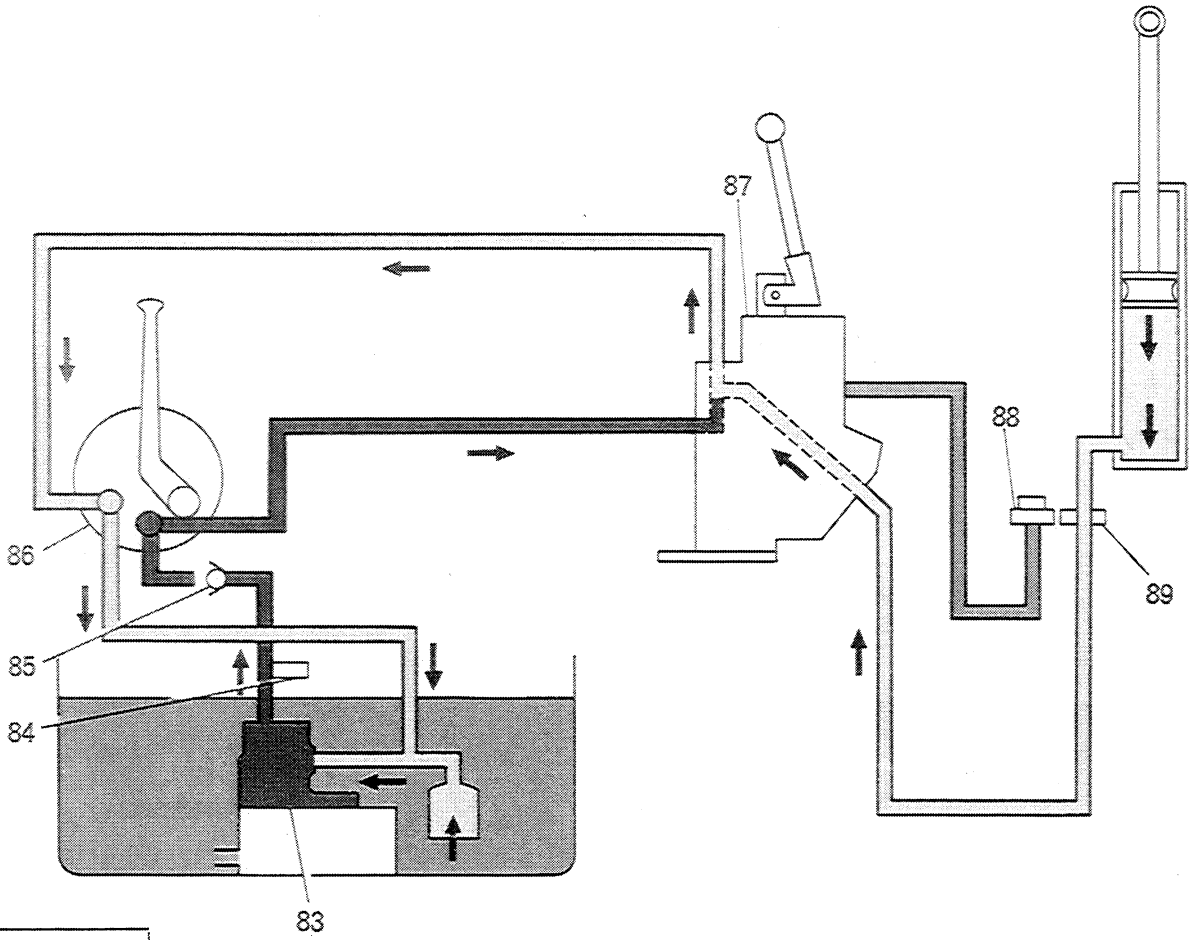


FIG. 20A

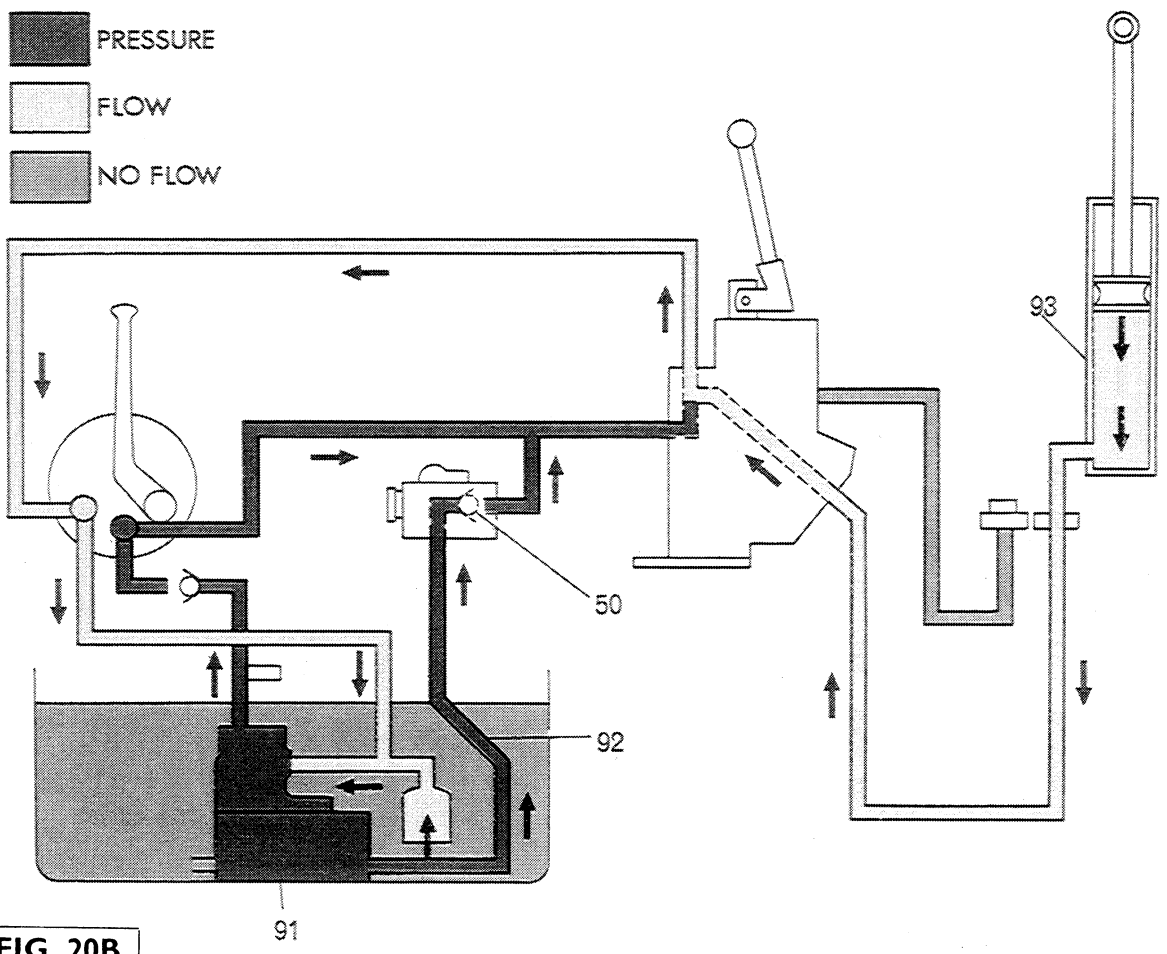


FIG. 20B

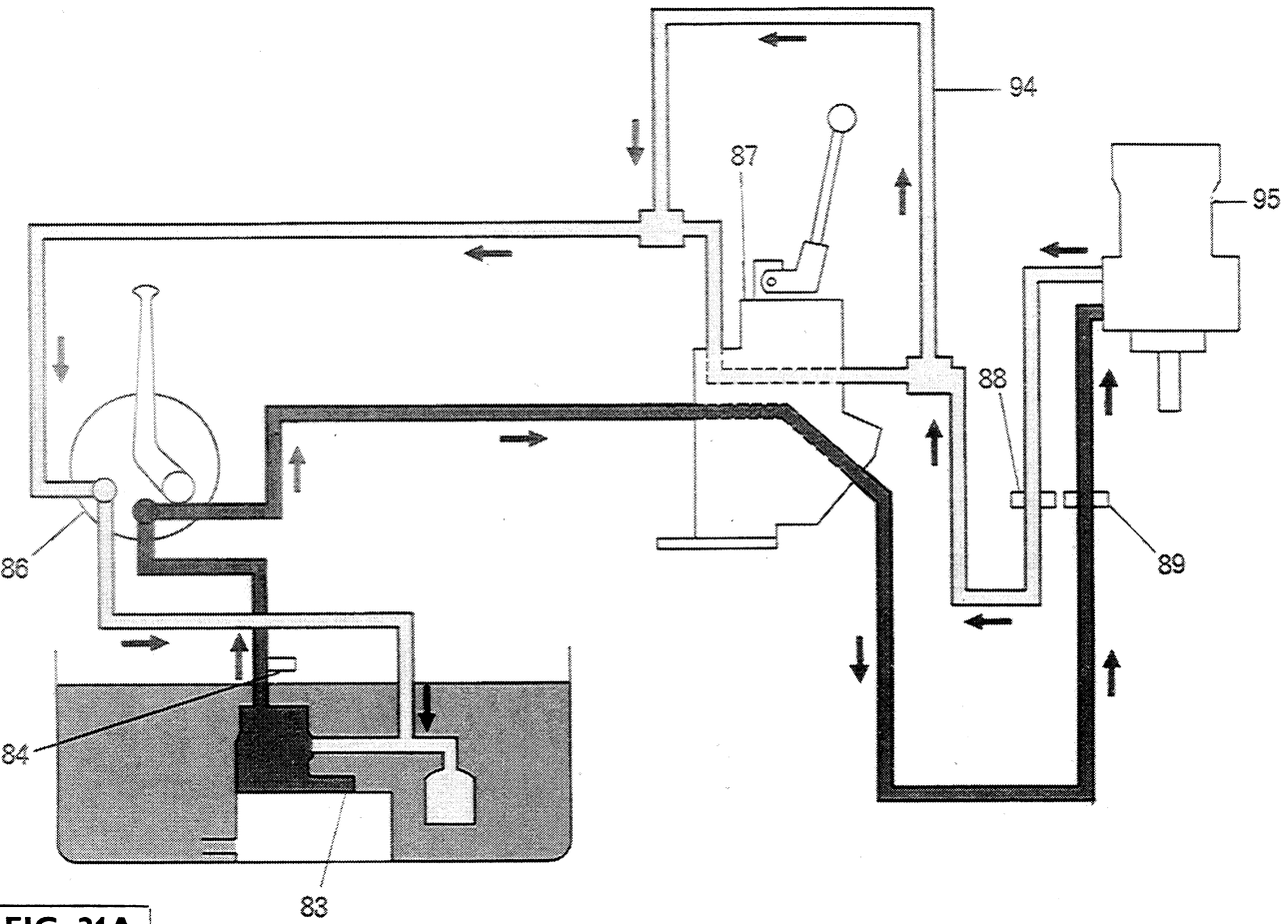


FIG. 21A

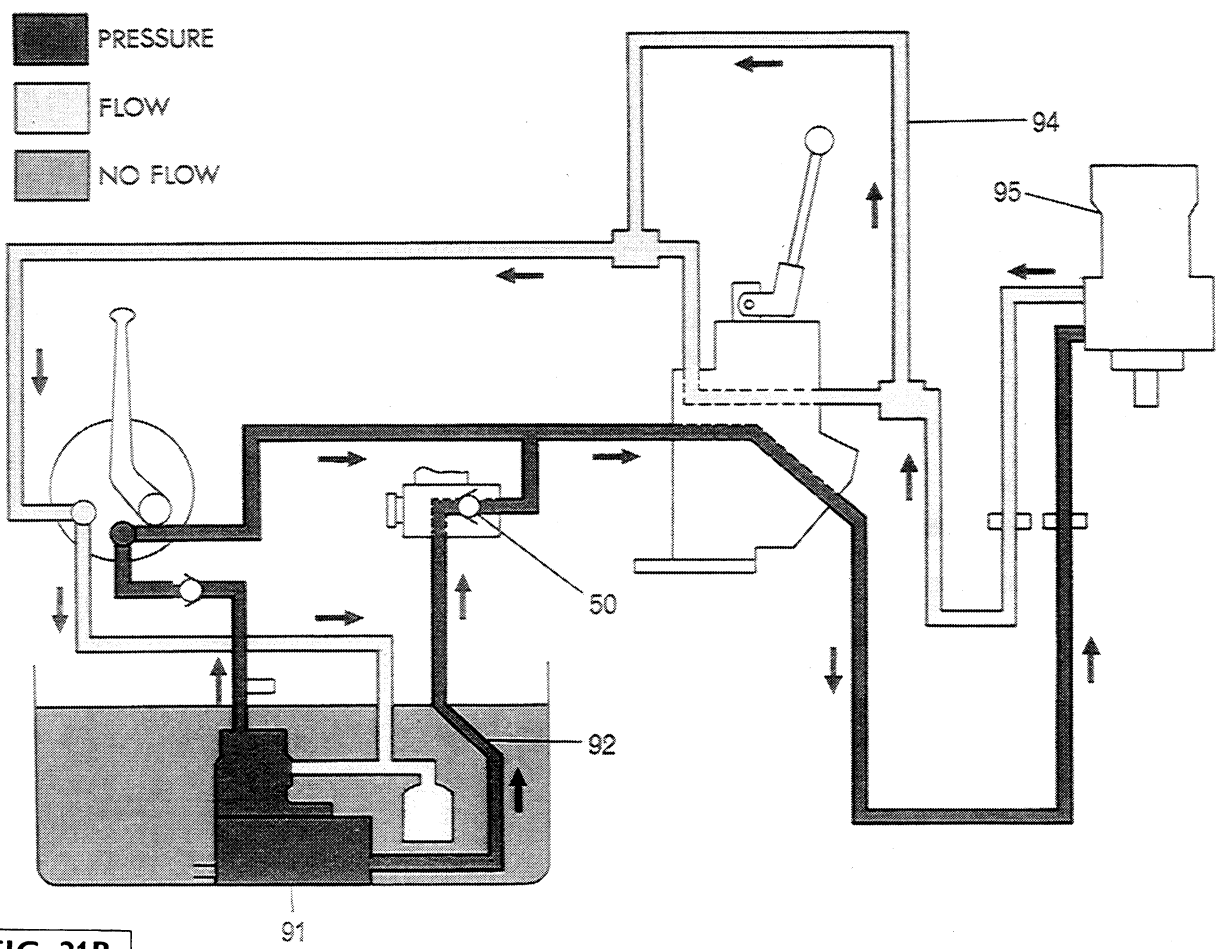


FIG. 21B

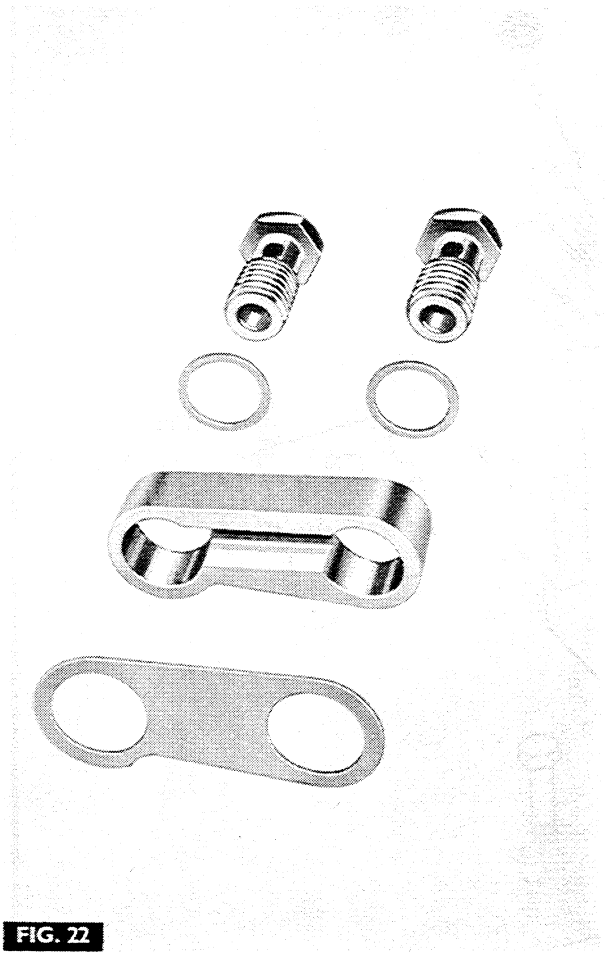


FIG. 22

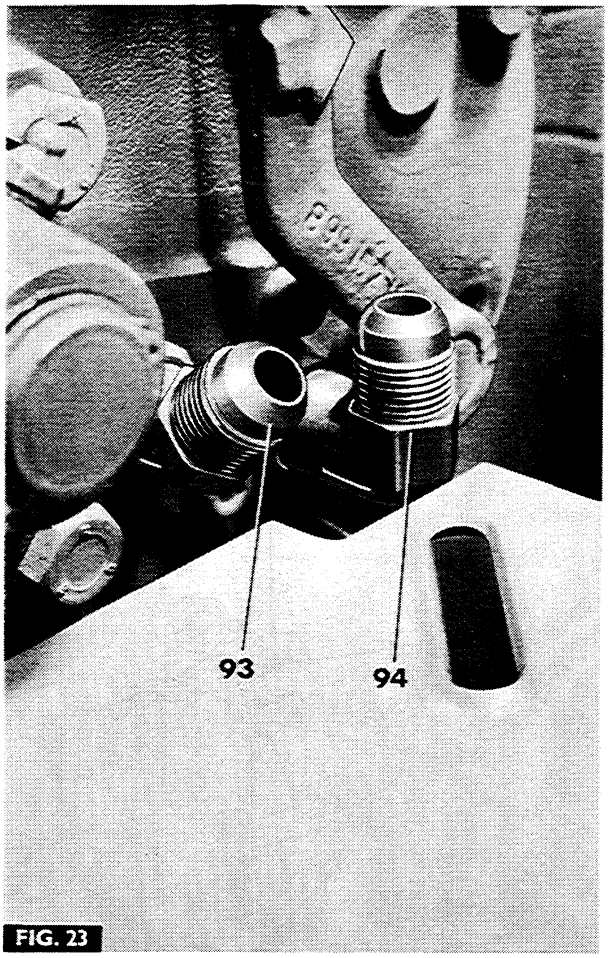


FIG. 23

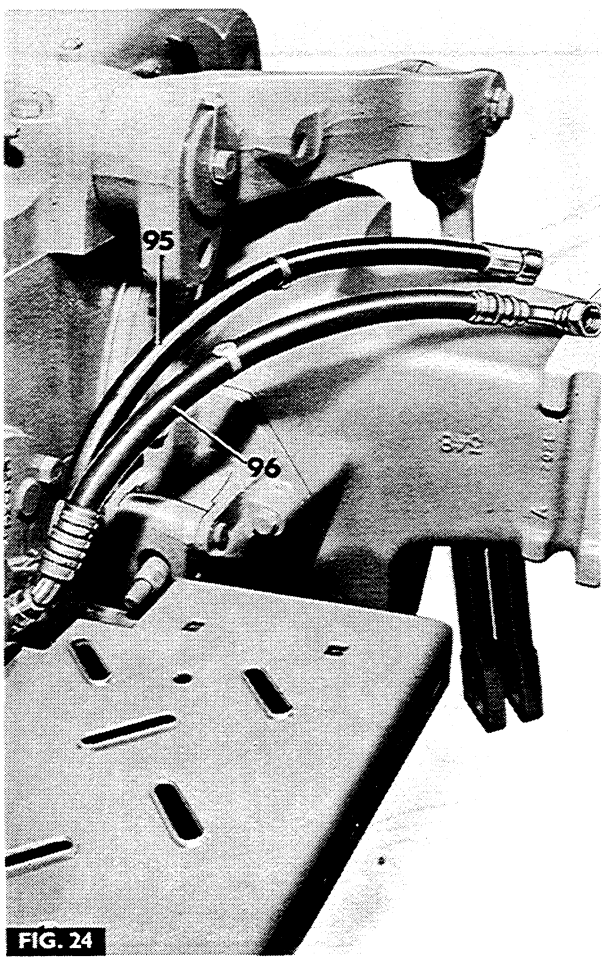


FIG. 24

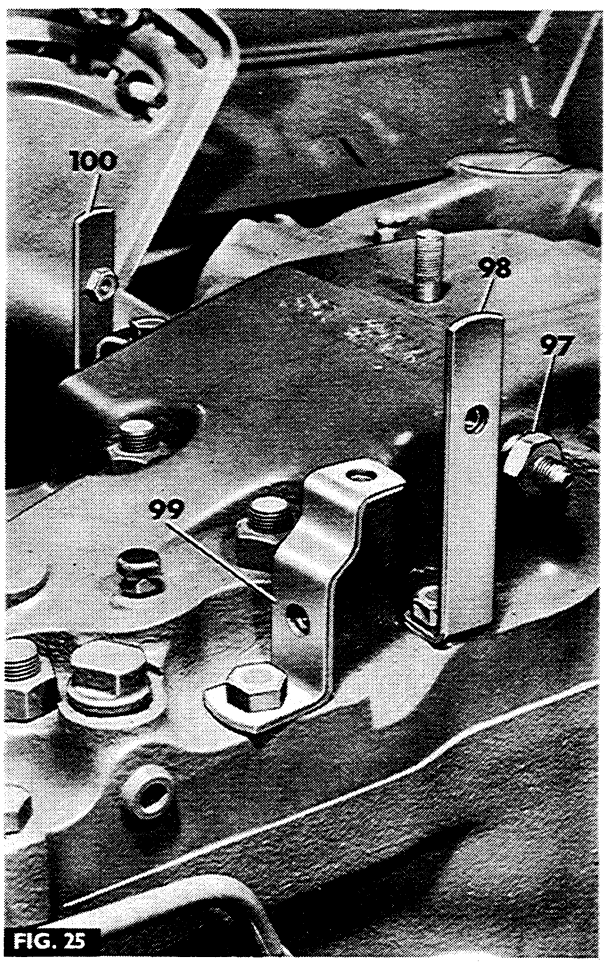


FIG. 25

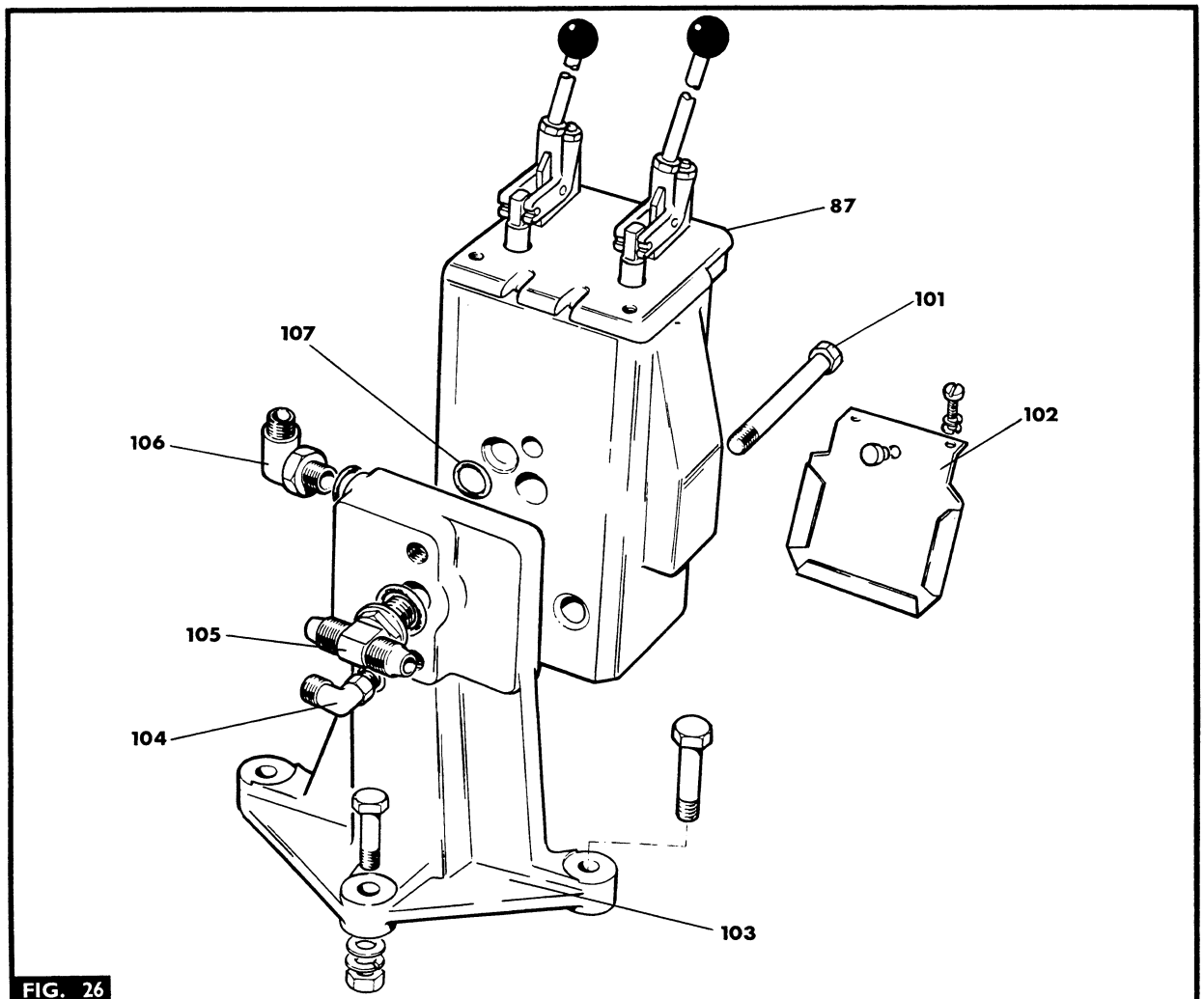

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FIG. 26

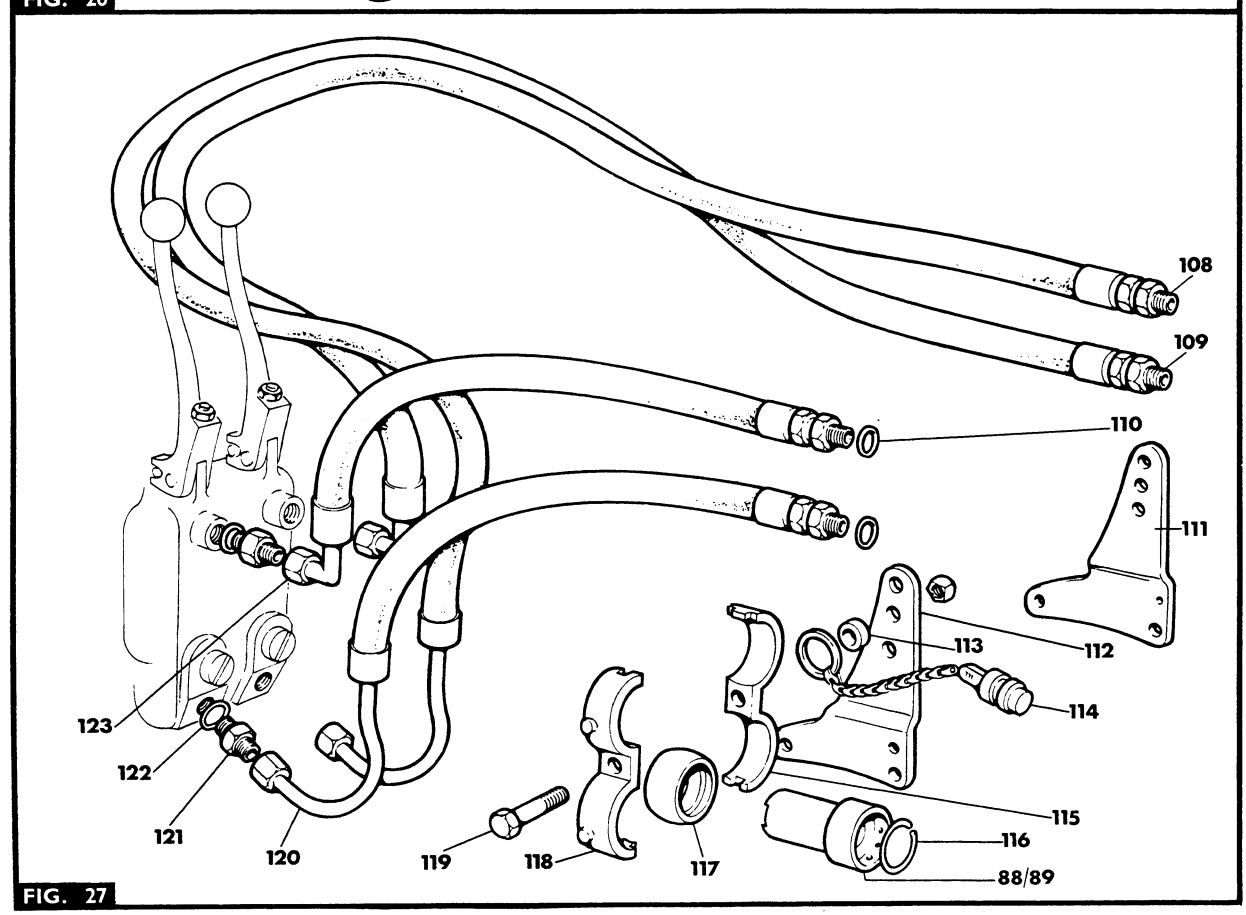
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FIG. 27

12. Fig. 24. Fit the feed and return hoses (95 and 96) to the two unions, as shown.
13. Fig. 25. Remove the Allen plug from the lift cover, just forward of the cross shaft, then fit the union (97) with an 'O' ring.
14. Remove the lift cover bolts shown, and fit the hose clamps (98, 99 and 100), securing them with three new bolts: two of 7/16UNC x 108 mm (4¼ in) and one of 7/16 UNC x 57 mm (2¼ in). Re-torque the lift cover bolts to 9,0 Kg-m (65 lb-ft).
15. Fig. 26. Clean the front face of spool valve (87) and the mating face of the manifold (103), then fit an 'O' ring (107) to each of the three ports on the valve body. Place the body and manifold together and fit the two Allen screws (101) to secure them.
16. Fit and 'O' ring to the tee-piece (105), then screw the tee-piece into the upper hole on the front of the manifold.
17. Fit an 'O' ring to the smaller 90° elbow (104) then screw the elbow into the lower hole in the front of the manifold.
18. Fit an 'O' ring to the larger 90° elbow (106), then screw the elbow into the side of the manifold.

NOTE – THE TEE-PIECE AND THE ELBOWS MUST, WHEN FULLY SCREWED IN, FACE IN THE DIRECTIONS SHOWN IN FIG. 26.

19. Fit the plate (102), securing it with two screws, plus flat and spring washers. Press in the rubber grommet.
20. Figs. 27 and 28. Place the spool valve, front face downwards on a bench, then fit the four adapters (121) using 'O' rings (122) to the four tapped ports in the valve body.
21. Fit the four hoses as follows: Short hose with 90° connector (123) to 'DROP No. 1', Long hose with 90° connector to (108) to 'DROP No.2'; Short hose with curved connector (120) to 'LIFT No.1'; and the long hose with the curved connector (109) to 'LIFT No. 2'.
22. Slide a 'Pioneer' coupler (88/89) into each gimbal ring (117) and secure them with the snap rings (116).
23. Using an 'O' ring (110) for each, screw the 'Pioneer' couplers on to the hoses.
24. Fig. 29. Assemble the 'Pioneer' couplers in pairs, with two clamps (115 and 118), a spacer (113) and a pair of plugs and chains (114) per side. Slide the bolt (119), through the clamps and spacer, then locate the plug chain rings over the spacer, before bolting the assembly to the brackets (111 and 112), through the middle hole in the bracket.

NOTE –THE BRACKETS (111 AND 112) ARE 'HANDED' (LEFT AND RIGHT) AND THE TWO SHORT HOSES MUST BE FITTED TO THE L.H. BRACKET (112). ALSO, THE HOSES WITH THE 90° CONNECTORS MUST BE PLACED IN THE UPPER CLAMP SOCKETS.

25. Fit a colour code tag to each hose as follows:

L.H.		R.H.	
Upper	Yellow	Upper	Blue
Lower	White	Lower	Red

26. Fig. 28. Fit the triangular plate (124) as shown, and secure it with a bolt (125) nut and spring washer through the R.H. hole in the base of the manifold.
27. Place the spool valve on the footplate and secure it with one bolt, flat washer, spring washer and nut. DO NOT yet fully tighten the nut.
28. Fig. 30. Fit the leak off pipe (126) to the union on the lift cover then connect it to the 90° elbow (104) on the front of the manifold.
29. Fit the feed pipe (127) connecting it to the union (54) on the combining valve and to the tee-piece (105) on the manifold.
30. Connect the feed pipe (95) (rear connector on side cover) to the tee-piece (105), as shown.
31. Connect the return pipe (96) to the 90° elbow (106) on the side of the manifold.
32. Fit the remaining two bolts, flat washers, spring washers and nuts to secure the manifold and valve to the footplate.

NOTE – DO NOT FORGET TO FIT THE FENDER WIRING TAG.

33. Fig. 29. Locate the 'Pioneer' coupler support brackets (111 and 112) on the studs on the trumpet housings, then refit the bolts and nuts.
34. Fig. 30. Fit the clamps to the components already fitted (98, 99 and 100) to secure the hoses to the lift cover.
35. Fig. 29. Fit the sealing plugs (114) to each of the 'Pioneer' couplers.
36. Refit the tractor seat.

Adjustment 7B-11-25

Fig. 30. To change from single acting, to double acting operation, screw the switch valve (A) fully in. To change to single-acting operation, screw the switch valve out five full turns.

WOOSTER SPOOL VALVE

Kit Fitment 7B-12-25

(Non-Auxiliary Hydraulic Tractors)

This operation is almost identical to operation 7B-10-18 except that the feed pipe (95 Fig. 30) is not used, its connections being blocked off by a banjo bolt at the p.t.o. side cover and by a cap on the tee-piece (105).

Selector Valve Fig. 31

The selector valve provides the facility to select any one service of three, leaving the remaining two isolated, and is of the six port, spring offset type.

The valve body (129), has cast-in galleries and is precision bored to accept the spool (131). The spool, has attached at one end, an operating lever, (132) secured by a roll pin (130). The external ports are EXT 1 (128), EXT 2 (134), and a port (R) (135) which must remain plugged. For convenience, EXT 1 port has twin outlet points to enable a pair of single acting services to operate simultaneously, as for example, with a front end, loader.

An instruction plate is affixed to the top of the valve by the two valve securing bolts (133) and plain washers.

OPERATION

Operation of the valve lever moves the spool (131) through an axial and fore and aft plane against the return spring, positioning of the spool also being governed by a cam formed on the front edge of the body.

Fig. 32. With the lever in the LINKAGE position (i.e. Vertical), oil flows from the hydraulic pump standpipe into the valve inlet port (K) and passes along the gallery into the linkage lift ram cylinder, through port (L). The tractor lower links can be operated in the normal manner. The other ports EXT 1 (128) and EXT 2 (134) are isolated.

Fig. 33. With the lever in EXT 1 (i.e. lever left) the oil flow is diverted by the spool (131) into the EXT 1 ports (128). The oil in the lift ram cylinder is "locked-in" by the spool. The lower links will be maintained in the fully raised position (i.e. Transport). EXT 2 port (134) is isolated. To prevent the lower links from dropping due to ram cylinder leakage (when EXT 1 is selected), a compensating valve, consisting of a ball (141) and spring (139) is incorporated between the EXT 1 port (128) and the ram cylinder port (L). When the ram cylinder pressure is less than in the EXT 1 port, the ball (141) will lift off its seat; oil will flow from the inlet port (K) through the cross drilling (M), past the ball and into the second cross drilling (N) to the lift ram chamber (L), thus maintaining ram cylinder pressure. When the pressure has equalised, the spring (139) will push the ball back on to its seat.

NOTE – THE COMPENSATING VALVE OPERATES ONLY WHEN EXT 1 IS SELECTED.

Fig. 34. Movement of the lever to the EXT 2 position (i.e. lever to the right) permits oil to flow from the inlet port (K) where the flow is diverted by the spool to the EXT 2 port (134). The flow to EXT 1 (128) and the ram cylinder is isolated.

To protect the ram cylinder from induced, high pressure from an outside source, when isolated (e.g. a heavy implement being transported on the three point linkage "bouncing" due to rough ground) a relief valve (144) is fitted. This relief valve opens at 225 Kg/cm^2 (3200 lb/in^2).

SELECTOR VALVE

Kit Fitment 7B-13-26

1. Place the 'Draft Control' lever in the 'Down' position.
2. Fig. 35. Remove the two bolts (47) and spring washers securing the transfer cap (48), then carefully ease off the transfer cap, ensuring that the standpipe is not displaced from its location in the hydraulic pump.
3. Fit a new back-up washer and 'O' ring to the top of the standpipe and an 'O' ring to the port.
4. Fig. 36. Fit an 'O' ring (145) to the lift ram cylinder port, as shown.
5. Place the selector valve gasket in position, ensuring that the oilways are clear, then carefully locate the selector valve on the standpipe, fit the instruction plate plain washers and special 7/16 UNC x 73 mm (2 7/8 in) bolts (133). Tighten the bolts to 5,5 Kg-m (40 lb-ft).

NOTE – OVERTIGHTENING OF THE BOLTS CAN CAUSE THE SPOOL TO STICK; ALSO LEAKAGE.

SELECTOR VALVE

Servicing 7B-14-26

Disassembly

1. Place the 'Draft Control' lever in the 'Down' position.
2. Disconnect any hoses, then plug or mask any ports and connections to prevent the ingress of dirt.
3. Fig. 31. Remove the bolts (133), plain washers and the instruction plate, then carefully remove the valve from the standpipe.
4. Drive out the roll pin (130) and remove the lever (132).
5. Fig. 32. Using a soft faced drift, gently tap the spool (131) towards the rear of the valve, to force out the welsh plug (136). Withdraw the spool from the valve body (129), complete with the return spring (138).
6. Remove the seals (142 and 143) from the body.
7. Remove the screw (137) and remove the spring (139) and ball (141).
8. Fig. 36. Ony if necessary, remove the relief vale plug (146).
9. Fig. 32. Remove the ball (150), poppet (151), spring (152) and second poppet (147).
10. If the relief valve has been removed, remove the valve seat (149), complete with its 'O' ring (148). This operation requires the use of a small wire extractor hook (see Fig. 37).

Examination

Check all components for wear or damage, paying particular attention to the spool and bore, also the relief valve poppet. Always fit new 'O' rings and seals.

Reassembly

1. Fig. 32. If necessary, fit a new 'O' ring (148) to the valve seat (149) then slide the valve seat into the body (129).

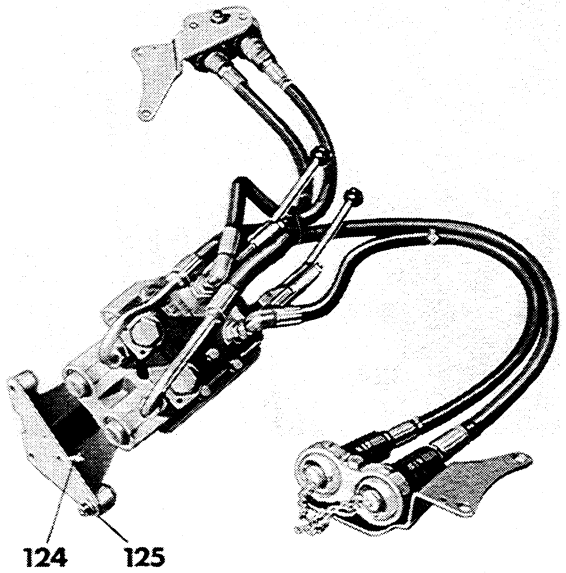

FIG. 28

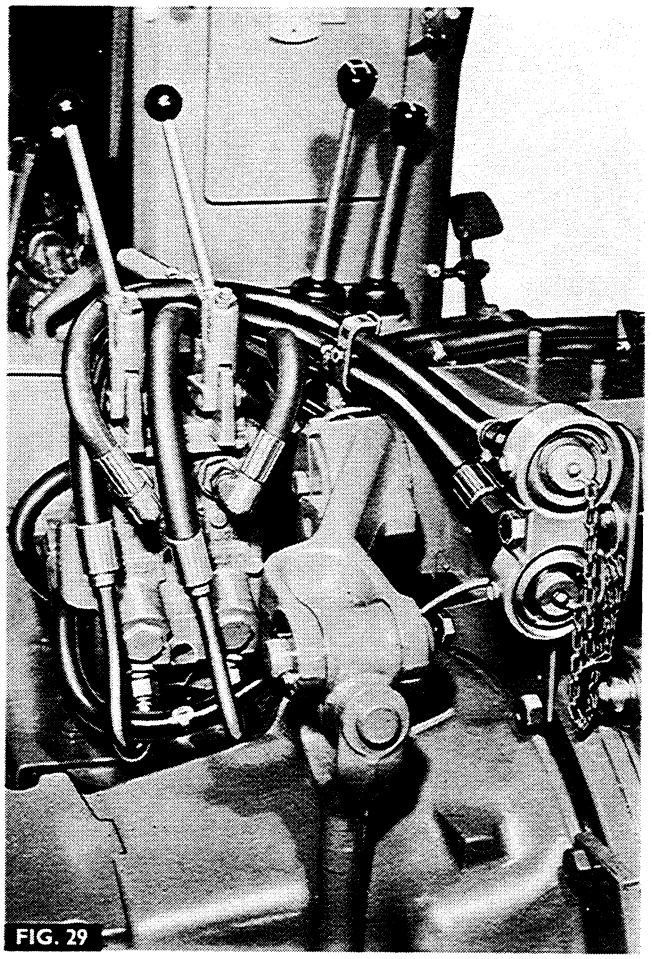

FIG. 29

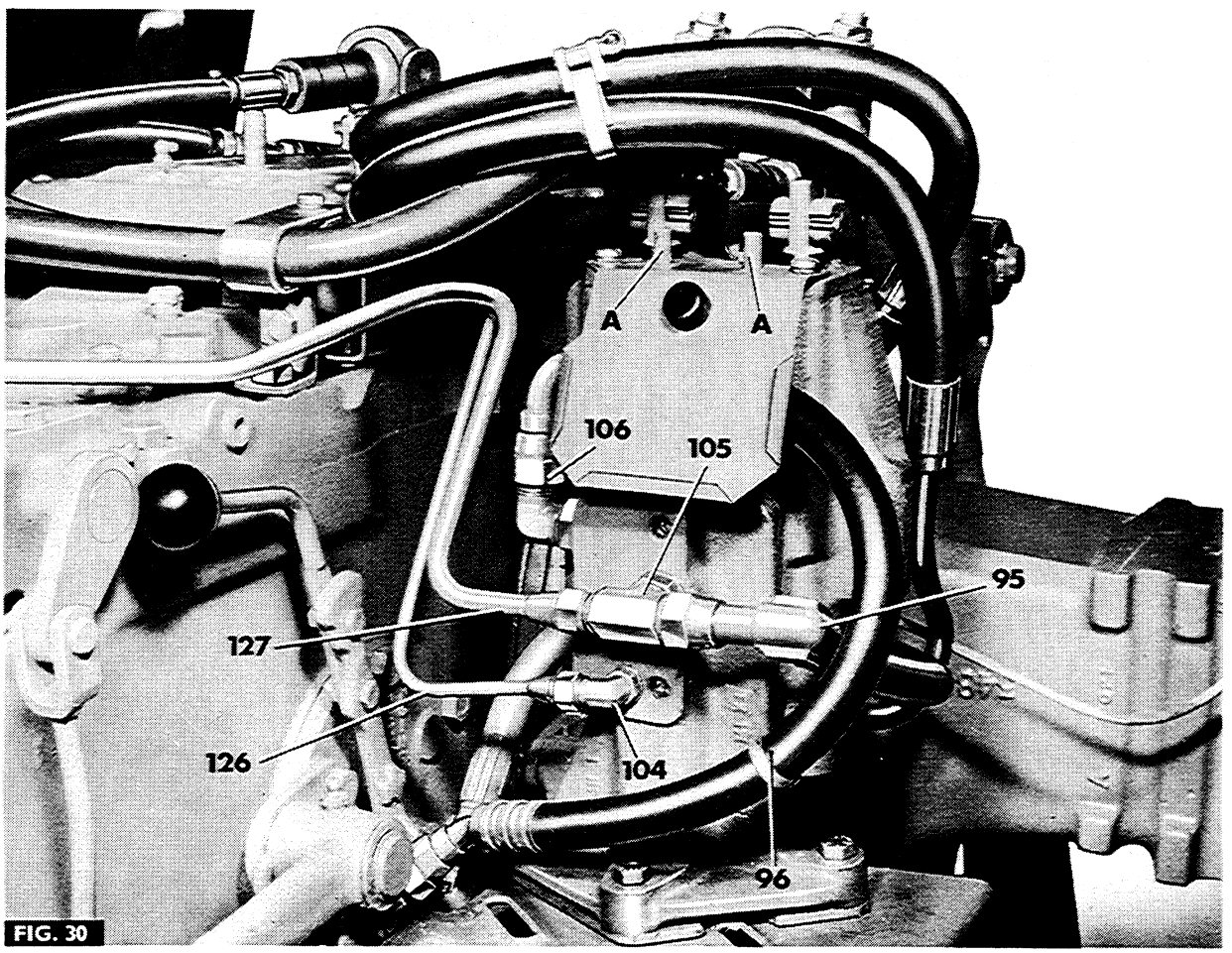

FIG. 30

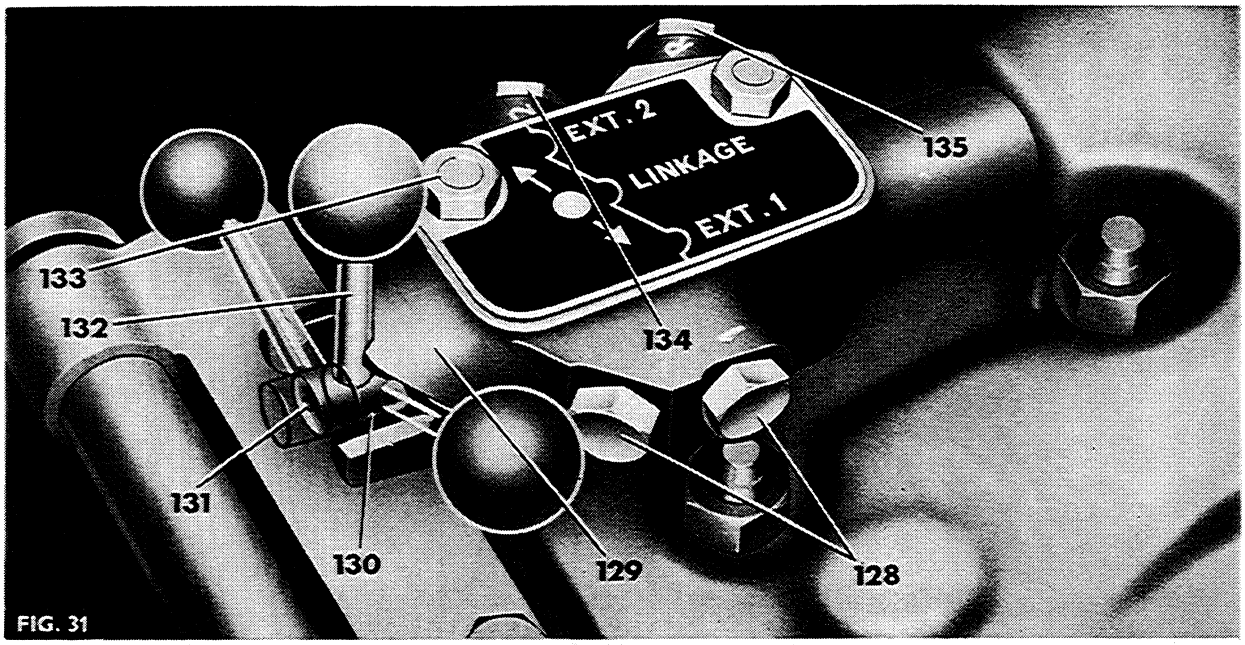

FIG. 31

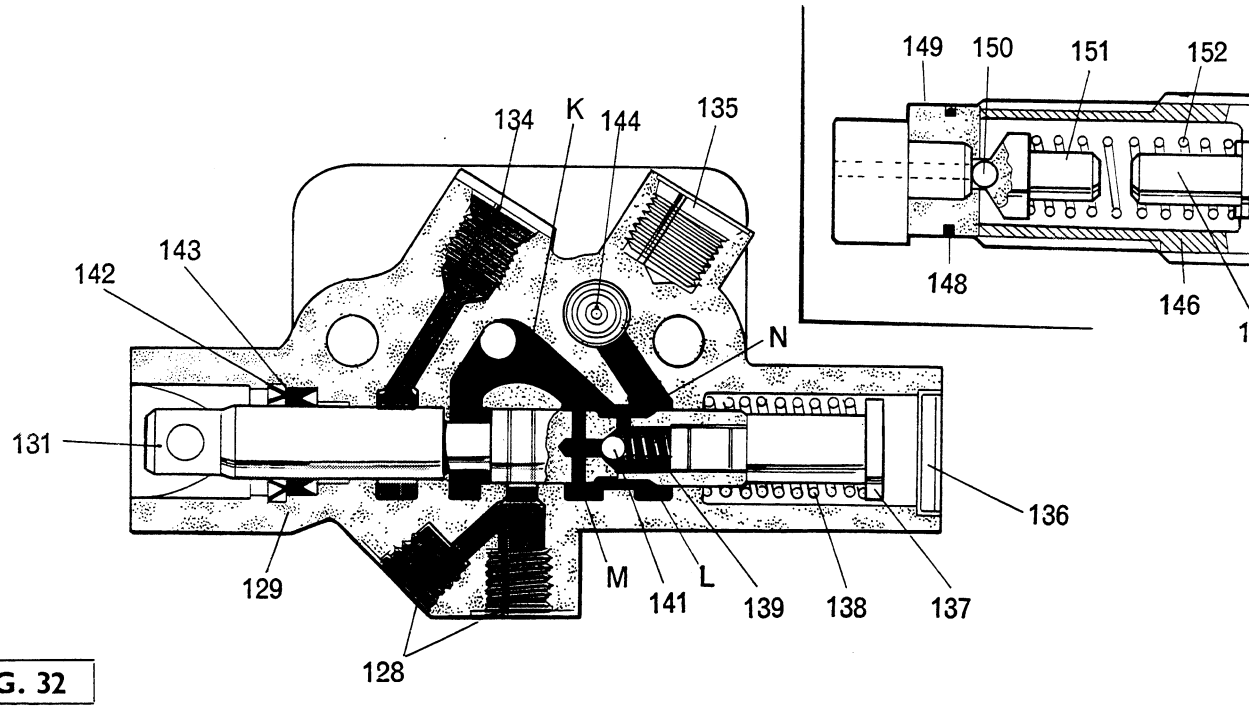

FIG. 32

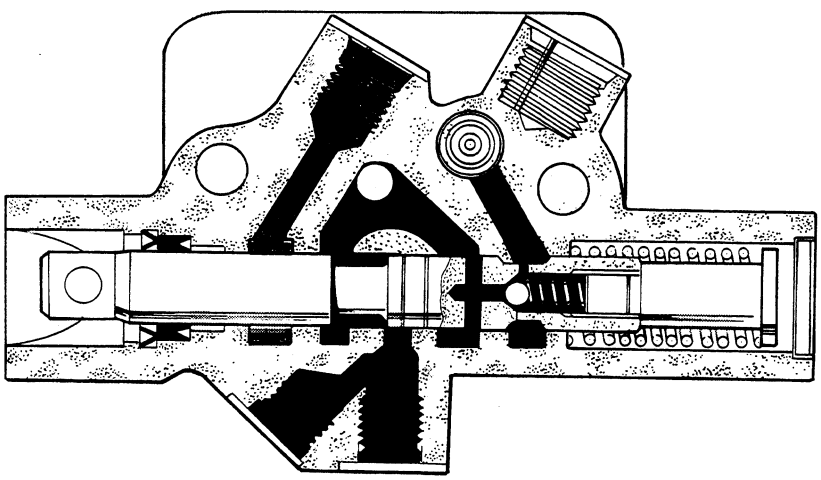

FIG. 33

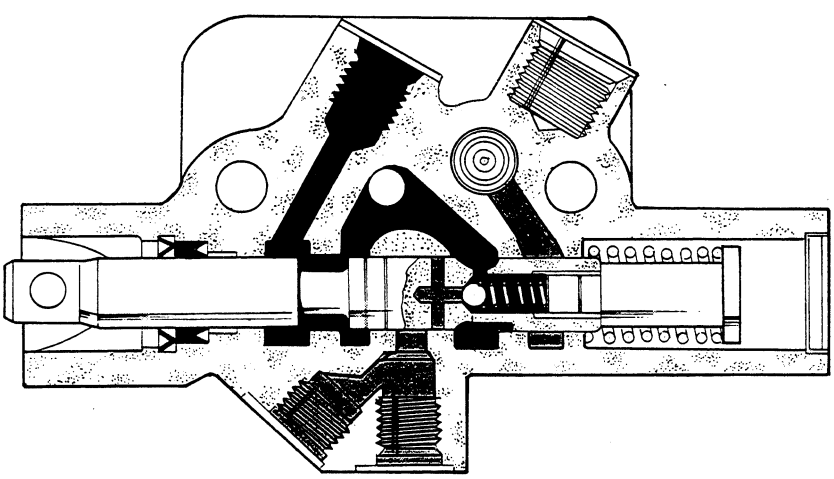

FIG. 34

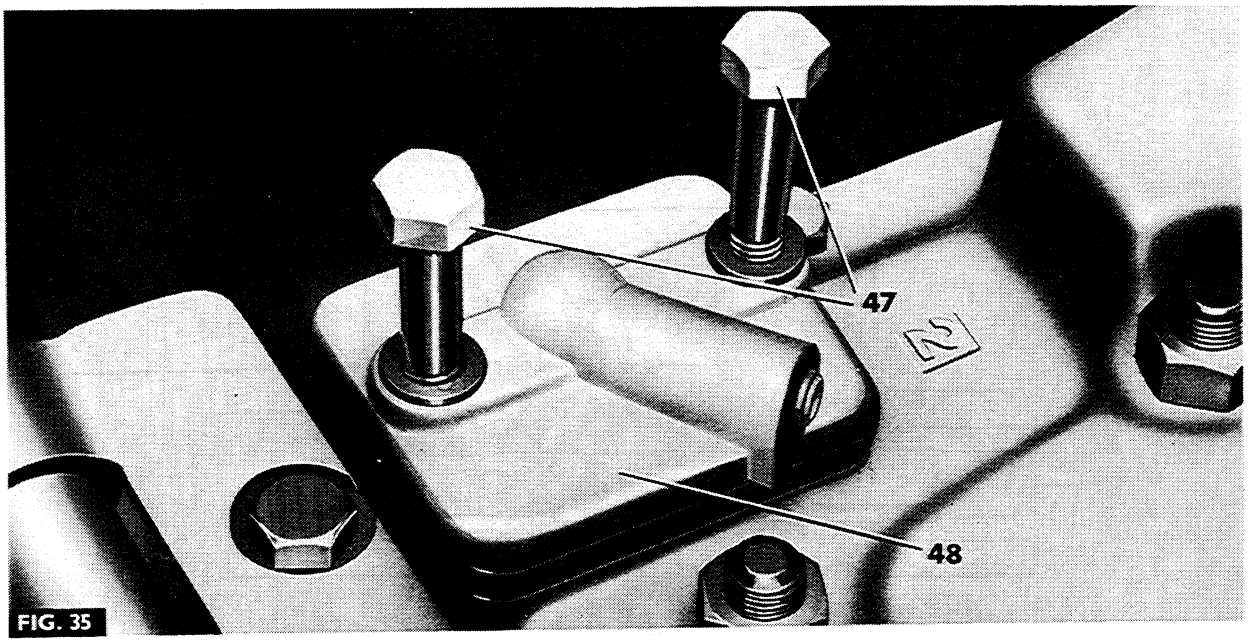

FIG. 35

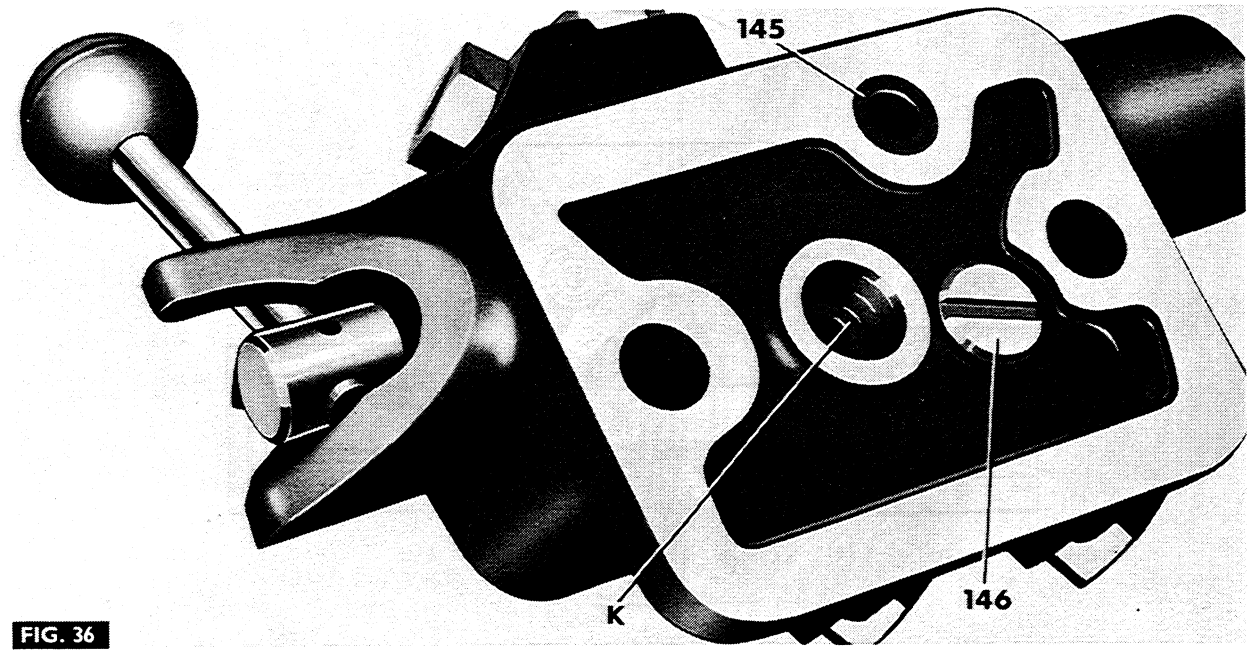

FIG. 36

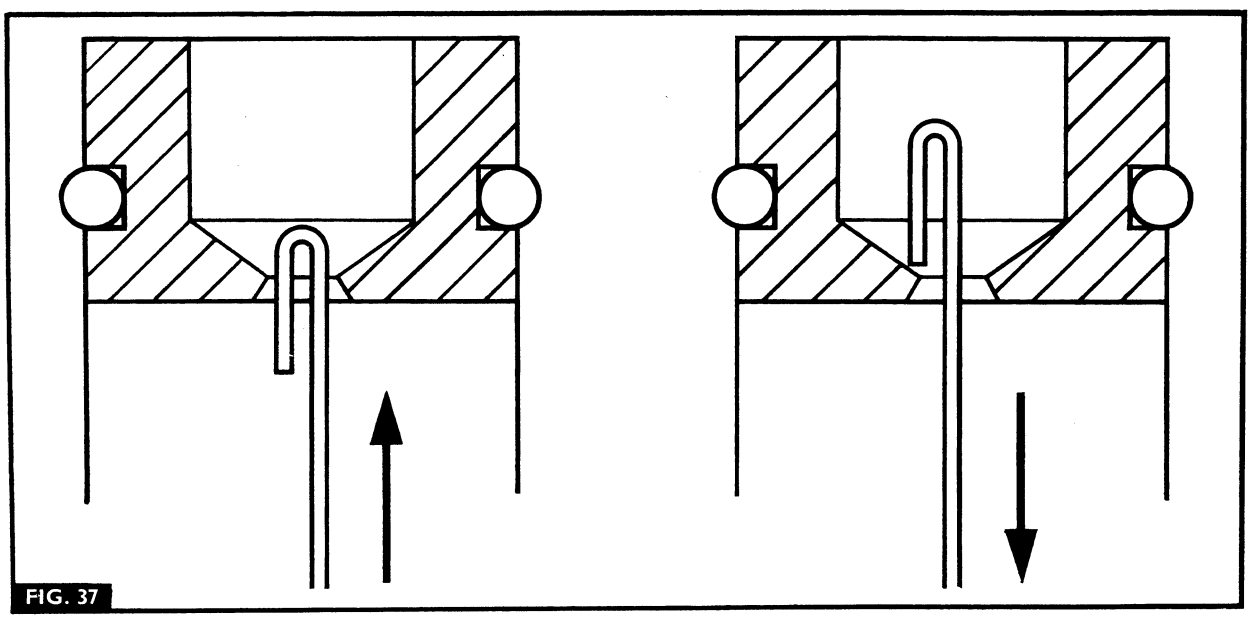
FIG. 37

2. Invert the body (129) and locate the ball (150) in the seat, then fit the poppet (151) spring (152), second poppet (147) and screw in the plug (146).
3. Refit the ball (141), spring (139) to the spool, and apply Loctite 'Hydraulic Seal' (grade brown) to the threads of the screw (137), then fit the screw to the spool.
4. Fit the distributor seal (143) into the valve body, with its flat face towards the front.
5. Place the spool return spring (138) in the rear of the valve body, then, insert the spool (131) through the spring (138) into the spool bore, taking care not to damage, or dislodge the seal (143).
6. Fit the wiper ring (142) to the valve with its flat face to the rear. This operation can be facilitated by the use of a piece of tube, approximately 20 mm (0.8 in) outside diameter, with a wall thickness of 1,2 mm (18 SWG) and radiused at one end to suit the ring. This tube can then be used to drive home the wiper ring against the distributor seal.
7. Push the spool (131) against the spring from the rear, taking care not to displace the seals, until the lever (132) can be inserted into the spool. Select EXT 2, the new roll pin (130) can then be easily driven into position to secure the lever.
8. Carefully tap a new welsh plug (136) into the rear of the spool bore.
9. Refit the selector valve to the tractor, as stated in operation 7B-13-00.

HYDRAULIC TESTS

When carrying out all pressure and flow tests, clean, fresh oil, of the recommended grade must be used and should be warmed to a temperature of 50°C (120°F) by running under load, before testing. The use of either excessively hot, or cold oil can seriously affect the instrument readings and pump performance.

Special Tools Required: See operation 7A-14-31
MF 260 Gauge
MF 810-4/1 Adapter
MF 260-4/1 Adapter
MF 260-4/1 Cap
Elbow Part No. 357 197 X 1

Relief Valve

1. Remove the lift cover, as stated in operation 7A-14-31.
2. Fig. 38 Disconnect the Multi-Power feed pipe from the union on the top front of the pump and fit the cap MF 260-4/4 in its place, as shown.
3. Remove the plug from the top of the pump and fit the elbow, Part No. 357 197 X 1, adapter MF 810-4/1 and the MF 148A gauge.
4. Start the tractor engine. With the oil at the correct temperature the gauge should indicate minimum pressures as follows:
   500 to 550 engine rev/min — 46 Kg/cm² (650 lb/in²)
   2000 engine rev/min — 53 Kg/cm² (750 lb/in²)
5. Switch off the tractor engine.

Multi-Power Operating Pressure

1. Carry out the relief valve test, as stated in previous column.
2. Remove the cap MF 260-4/4 from the outlet union on the pump and refit the Multi-Power feed pipe.
3. Fig. 39. Remove the MF 148A gauge and adapter MF 810-4/1 and fit in their place, adapter MF 260-4/1 and plug MF 260-4/4 as shown, then screw in the MF 260 gauge.
4. Start the tractor engine and select Multi-Power 'HIGH'. With the oil at the correct temperature, the gauge should indicate the following minimum pressure:
   2000 engine rev/min — 13 Kg/cm² (190 lb/in²).
5. Switch off the tractor engine.
6. Remove the MF 260 gauge, adapter MF 260-4/1, and elbow, Part No. 357 197 X1 from the pump then refit the plug and washer.
7. Refit the lift cover as stated in operation 7A-14-31.

High Capacity Pump — 7B-16-31

Special Tools Required: MF 260 Gauge
810 Test Kit
MF 148A Gauge
MF 260-4 Adapters and Plugs

Multi-Power Relief Valve

1. Fig. 40. Release the rear Multi-Power pipe as shown and fit adapter MF 810-4/1 and the MF 148A gauge, as shown.
2. Start the tractor engine. With the oil at the correct temperature, the gauge should indicate the following minima:
   500 to 550 engine rev/min — 46 Kg/cm² (650 lb/in²)
   2000 engine rev/min — 53 Kg/cm² (750 lb/in²)
3. Switch off the tractor engine, then remove the MF 148A gauge.

Multi-Power Flow Test

1. Carry out the Relief Valve test as stated above.
2. Release the clamp securing the two Multi-Power pipes to the steering box.
3. Fig. 41. Release the second Multi-Power pipe and fit another MF 810-4/1 adapter, then attach the 810 kit as shown (INLET hose to REAR pipe). Fit 70 Kg/cm² (1000 lb/in²) gauge to the 810 kit.
4. Start the engine and screw in the restrictor on the 810 kit until 21 Kg/cm² (300 lb/in²) is indicated on the gauge.
5. Press the diverter button and time the flow of 4,5 litres (1 Imp gal), into a suitable measure. Time taken should not exceed:
   72 seconds @ 500 t0 550 rev/min
   40 seconds @ 1000 rev/min
   Switch off the engine

Filter By-Pass Valve

1. Carry out the Relief Valve and Flow tests as stated on page 31.
2. Fig. 42. Remove the two pipes from the front of the filter and fit the two MF 260-4/4 caps, as shown.
3. Start the engine and select Multi-Power 'LOW'.
4. Fully unscrew the restrictor on the 810 kit. The pressure indicated should be between 6,3 and 8,4 Kg/cm^2 (90 to 120 lb/in^2) at 500 to 550 engine rev/min.
5. Stop the tractor engine.
6. Remove the MF 260-4/4 caps, the 810 kit and the MF 810-4/1 adapters from the tractor, then reconnect the relevant pipes and refit the pipe clamp.

Multi-Power Operating Pressure

1. Fig. 43. Disconnect a Multi-Power pipe, as shown then fit adapter MF 260-4/1 and the MF 260 gauge.
2. Start the tractor engine and select Multi-Power 'HIGH'. With the oil at the correct temperature, the gauge should indicate the following minimum pressures:

   2000 engine rev/min 13 Kg/cm^2 (190 lb/in^2).
3. Switch off the engine and remove the MF 260-4/4 adapter and the MF 260 gauge.
4. Reconnect the Multi-Power pipes.

By-Pass Test – MF 260 Gauge.

The by-pass valve can be tested using the MF 260 gauge, MF 260-4/1 adapter and MF 260-4/4 caps, as shown in fig 44 if required, or if the 810 kit is not available. Procedure and pressures are identical to those referred to when using the 810 kit .

Auxiliary Relief Valve.

1. Fit the 'Pioneer' adapters MF 810–1/1 to the 810 gauge.
2. Fig. 45. Attach both couplers to the quick couplers as shown (INLET hose to the LOWER quick coupler).
3. Screw the 280 Kg/cm^2 (4000 lb/in^2) gauge into the 810 kit then screw the restrictor knob fully in.
4. Start the tractor engine and run at 2000 rev/min.
5. Pull the spool valve lever rearwards and hold it there. The pressure should be 169 Kg/cm^2 (2400 lb/in^2).
6. Release the lever and unscrew the restrictor valve.

Flow Check

1. Screw in the combining valve knobs fully.
2. Pull the spool valve lever fully rearwards and adjust the restrictor until 70 Kg/cm^2 (1000 lb/in^2) is indicated.
3. Press the diverter button and time the flow of 4,5 litres (1 Imp gal) into a suitable measure, then release the diverter button. The flow at 2000 engine rev/min should not take longer the 10 seconds.

Spool Valve 'Kick-out'

1. Fully unscrew the restrictor knob.
2. Pull the spool valve lever rearwards.
3. Screw in the restrictor until the lever 'Kicks-out' and note the maximum pressure. The 'Kick-out' should operate at 112 to 127 Kg/cm^2 (1600 to 1800 lb/in^2).
4. The 'Kick-out' mechanism can be adjusted, if necessary, by screwing the grub screw (69 Fig. 9) in or out.
5. Remove the 810 kit from the tractor.

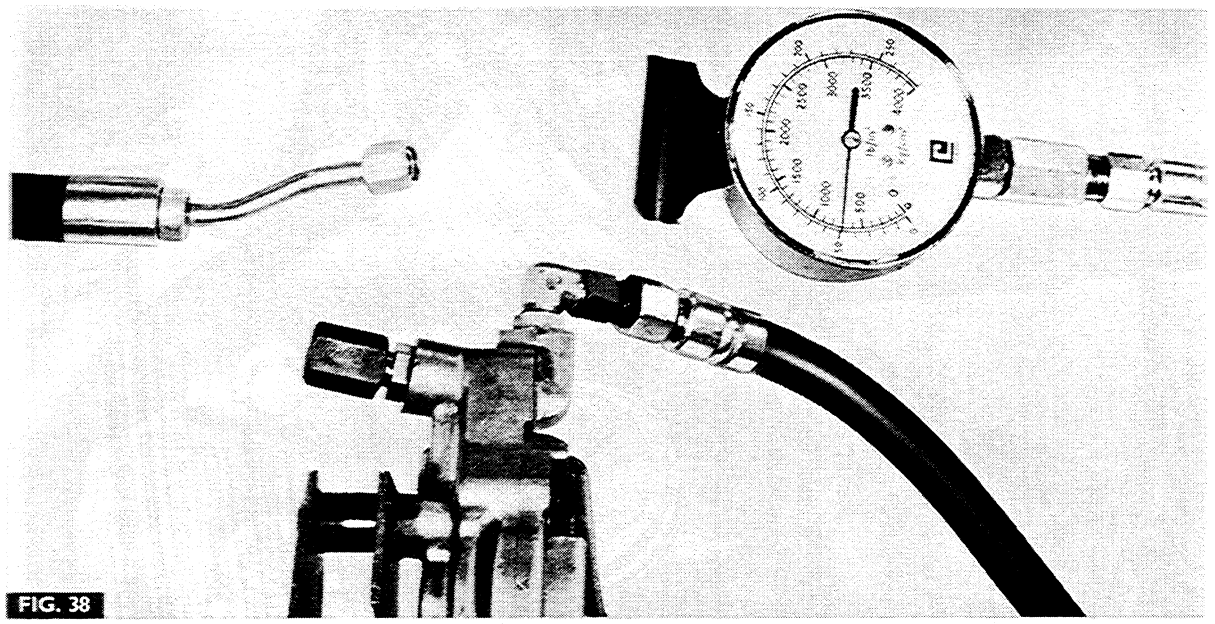

FIG. 38

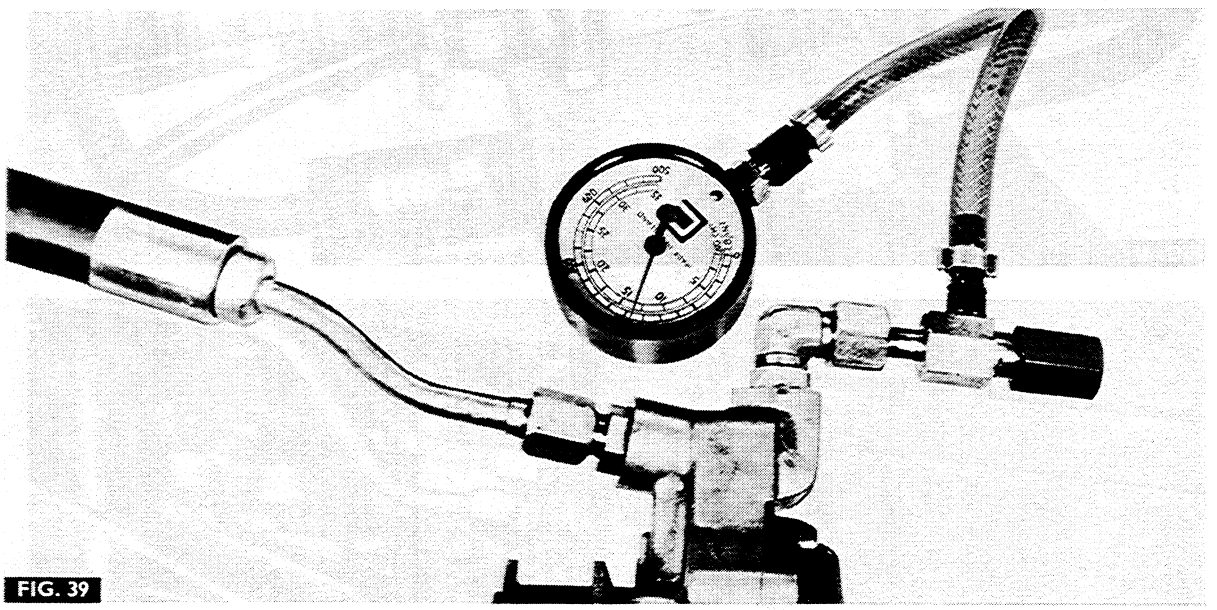

FIG. 39

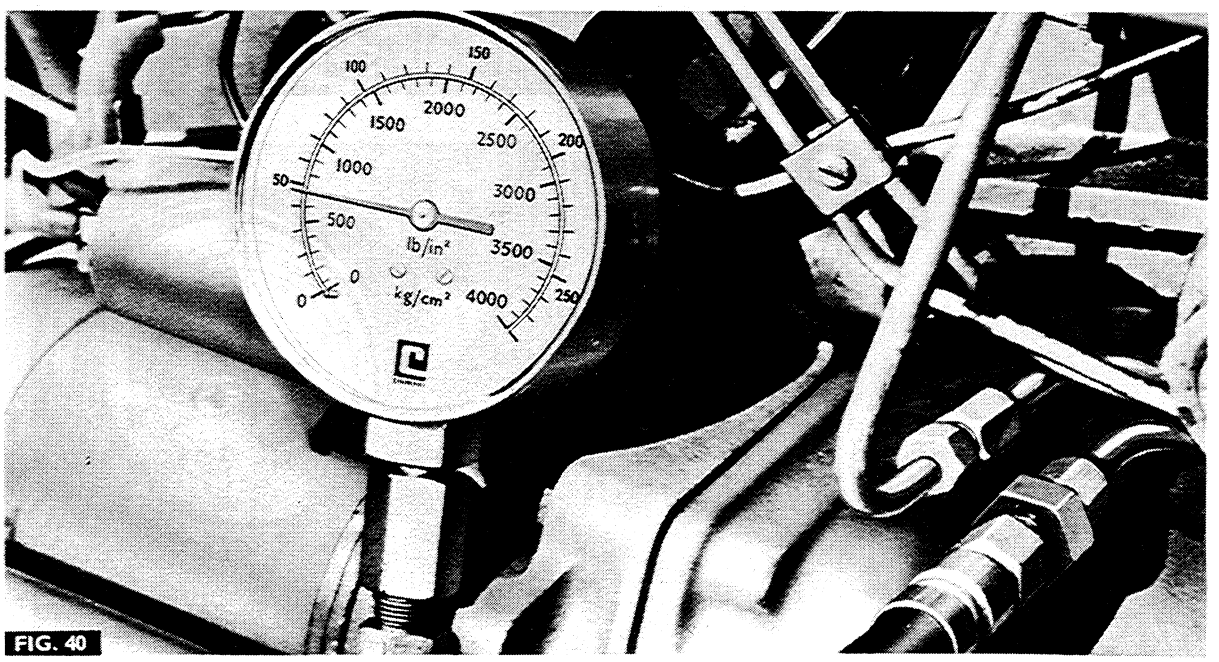

FIG. 40

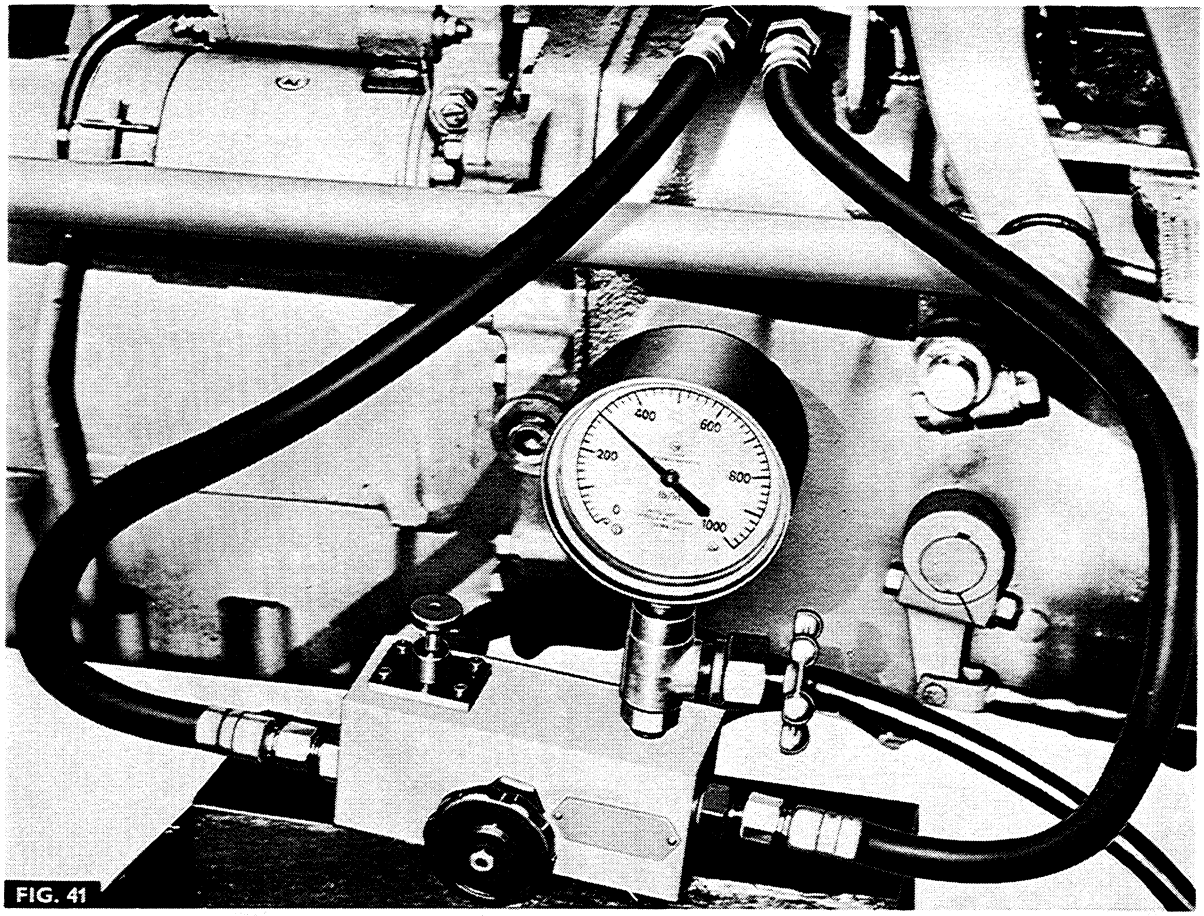

FIG. 41

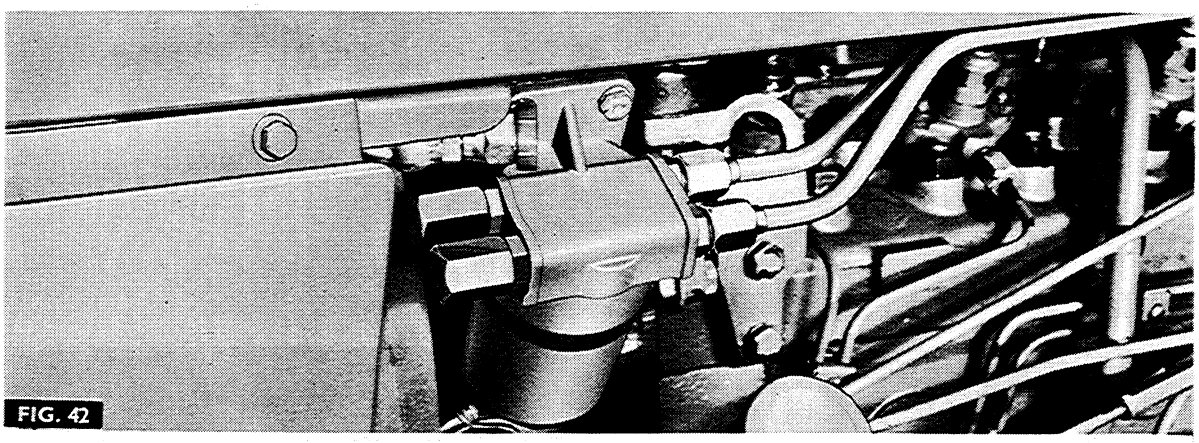

FIG. 42

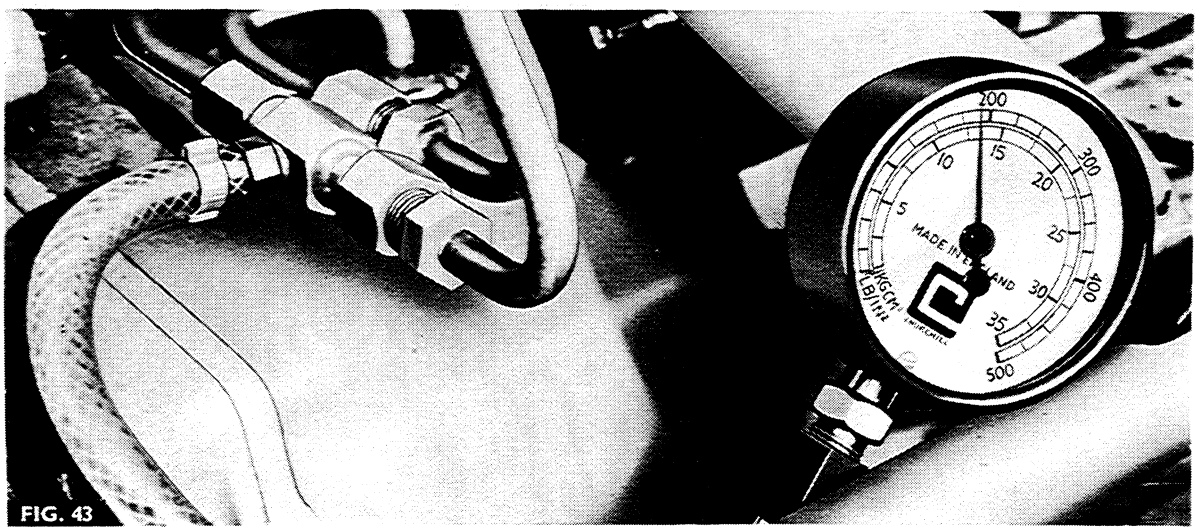

FIG. 43

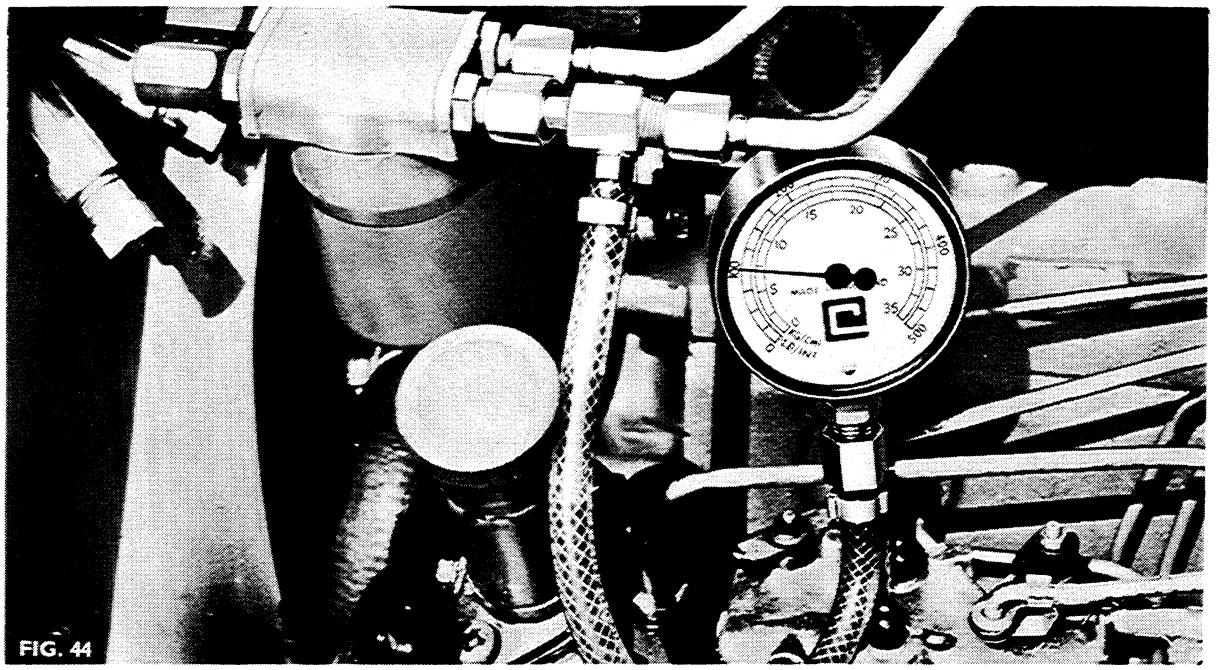

FIG. 44

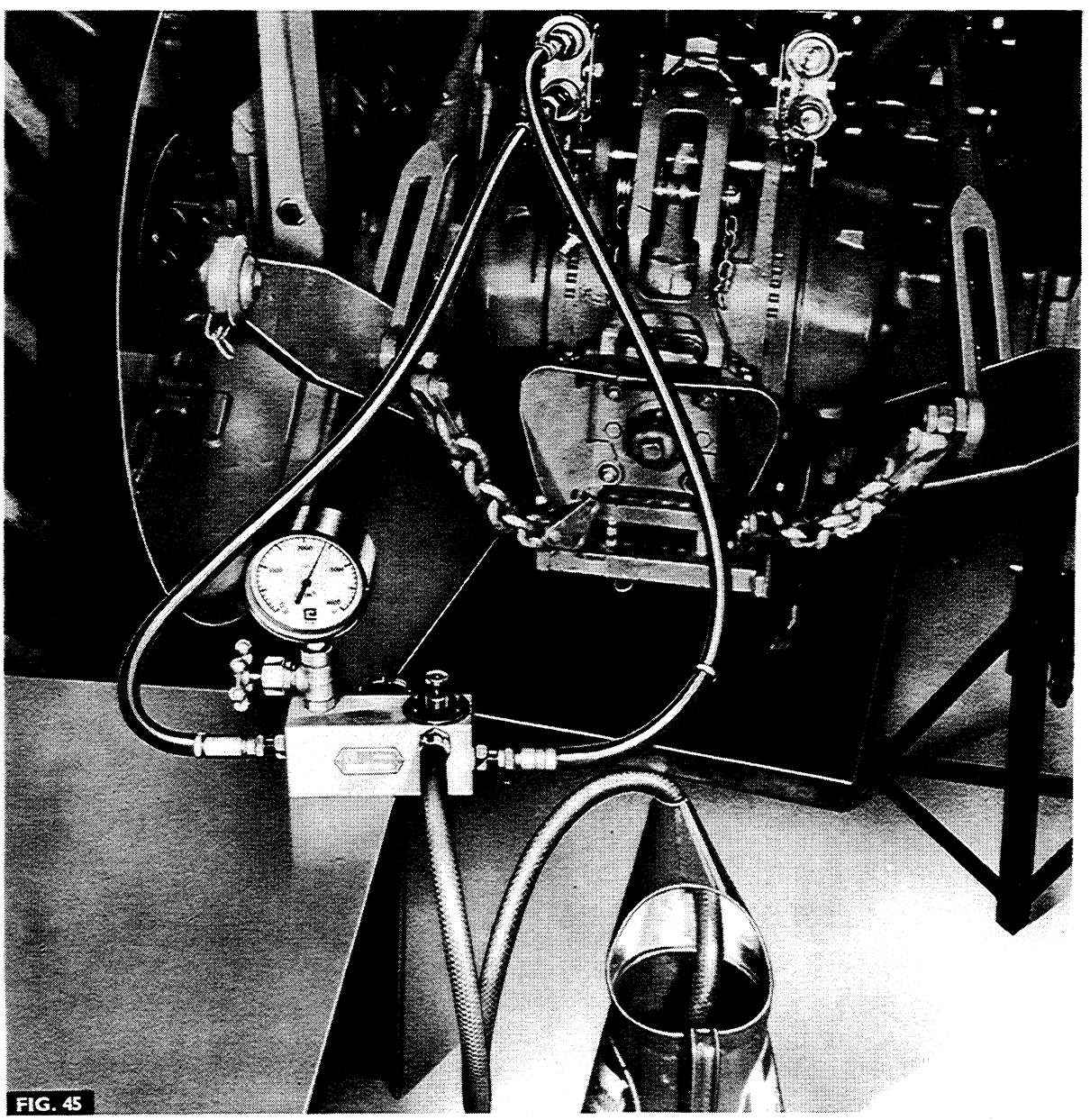

FIG. 45

KONTAK SPOOL VALVES

Part 7 Section B

KONTAK SPOOL VALVES

FUNCTION

The Kontak spool valve is capable of controlling the following services:–

1. Single Acting Rams.
2. Double Acting Rams.
3. Hydraulic Motors.

Single Acting Rams

To operate single acting rams, only the LOWER 'Pioneer' quick release couplers are used.
To extend the ram, pull the lever rearwards.
To lower the ram, push the lever forwards.
NOTE – TO SET THE VALVE FOR SINGLE ACTING OPERATION SEE ADJUSTMENTS.

Double Acting Rams

When operating double acting rams, the LOWER 'Pioneer' quick release coupler should be connected to the hose which feeds the side of the ram which causes it to EXTEND.
To extend the ram, pull the lever rearwards.
To lower the ram, push the lever forwards.

Hydraulic Motors

Although not specifically designed for use with hydraulic motors, these valves can be used satisfactorily, if the following points are observed:–

1. Always connect the motor feed to the LOWER coupler.
2. NEVER connect the motor return hose to the quick release couplers. Always connect the return hose directly to either the 'R' port on the selector valve (tractor working off linkage pump only) or to the FRONT port on the p.t.o. side cover (auxiliary pump, or combined flow applications.

** 3. Always contact your Distributor or Dealer when fitting hydraulic motors, to ensure that the hydraulic circuit is completely satisfactory.

NOTE – A SPECIAL SPOOL VALVE UNIT, FOR USE FOR REVERSIBLE HYDRAULIC MOTORS IS MANUFACTURED BY KONTAK LTD. FOR DETAILS OF THIS SPECIAL VALVE AND OTHER SPECIALISED APPLICATIONS (E.G. DETENTS, KICK-OUT ETC.,) PLEASE CONTACT KONTAK DIRECT.

ADJUSTMENTS

For Single Acting Operation

1. Fig. 1. Remove the special $\frac{7}{8}$ –14 UNF plug from the bottom of the spool valve.
2. From the spool valve kit, fit the standard $\frac{7}{8}$ – 14 UNF plug (2) (without a spigot) to the hole at the bottom of the spool valve.

NOTE – ENSURE THAT THE NEW PLUG HAS AN 'O' RING FITTED.

** 3. If the outlet hose kit is not being fitted, also fit the ¾–16 UNF plug (9) from the kit to the lower outlet port on the spool valve.

Do not lose, or discard the special $\frac{7}{8}$ –14 UNF plug (1), as this may be required at a later date for the valve to be used for double acting operation.

For Double Acting Operation

1. Fig. 1. If necessary, remove the standard $\frac{7}{8}$ – 14 UNF plug (2) (without a spigot) from the bottom of the spool valve.
2. Fit the special $\frac{7}{8}$ –14 UNF plug (1) (with a spigot and two 'O' rings) to the hole at the bottom of the spool valve.

** 3. If the outlet hose kit is to be fitted, if necessary, remove the ¾–16 UNF plug (9) from the lower outlet port on the spool valve.

WARNING – NEVER TRY TO OPERATE THE VALVE FOR DOUBLE ACTING OPERATION WITH THE PLUG (3) SCREWED INTO THE LOWER OUTLET PORT.

SPOOL VALVE FITTING INSTRUCTIONS 7B-17-38

1. Fig. 2. Thoroughly degrease the threads on the operating levers and the cranks, then apply two drops of Loctite Grade AV 'Stud Lock' (Red) to the threads before assembly. Screw the operating lever(s) (4) into the crank(s) on the spool assembly (5).
   Tighten the locknut (s) (6).
2. Locate the spool assembly (5) against the mounting bracket (7) and secure it with three $\frac{3}{8}$ UNF x 70 mm (2¾ in.) bolts (8), plus flat washers, lockwashers and nuts.
3. If necessary, fit the new p.t.o. handle and assemble the Auxiliary Hydraulic or Combined Flow feed and return hoses to the p.t.o. side cover, as stated in.the following specifications.
4. Locate the spool valve mounting bracket on the tractor footplate and secure it with one $\frac{3}{8}$ UNF x 32 mm (1½ in.) (9) through the front hole and two $\frac{3}{8}$ UNF x 38 mm (1½ in.) bolts (9A) through the rear holes.

NOTE – IF A HORIZONTAL EXHAUST IS FITTED, EQUAL PILES OF FLAT WASHERS SHOULD BE USED TO PACK THE BRACKET CLEAR OF THE SILENCER BOLT.

5. Adjust the position of the operating lever(s) (4) to clear the seat and to suit the operator.

HYDRAULIC SELECTOR VALVE

(This information supersedes that stated in Operation 7B-13-26).

FUNCTION

The hydraulic selector valve is used to feed oil to any one of three services, leaving the other two isolated. The three services are:–

Lever Position	Tractor Linkage	Port 1	Port 2
LINKAGE	Operates Normally	Isolated	Isolated
'EXT 1'	Links Fully Raised	Flow Available	Isolated
'EXT 2'	Links remain at Pre-set Height	Isolated	Flow Available

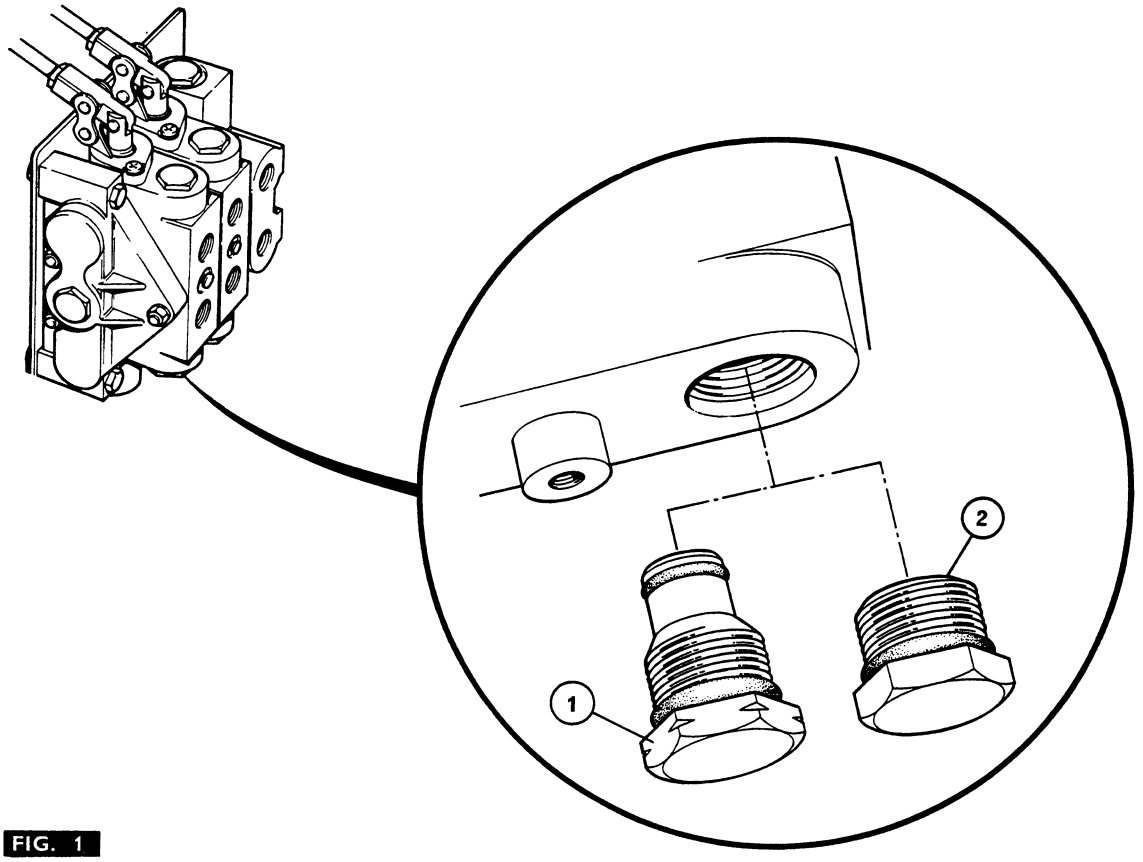

FIG. 1

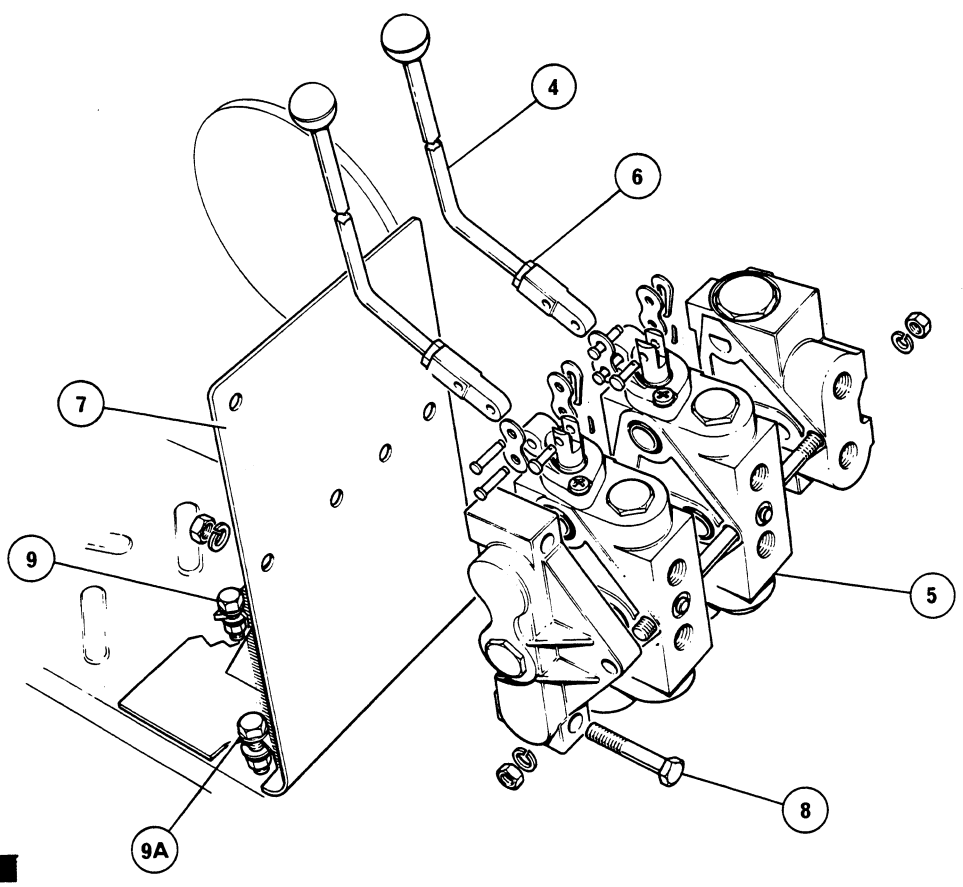

FIG. 2

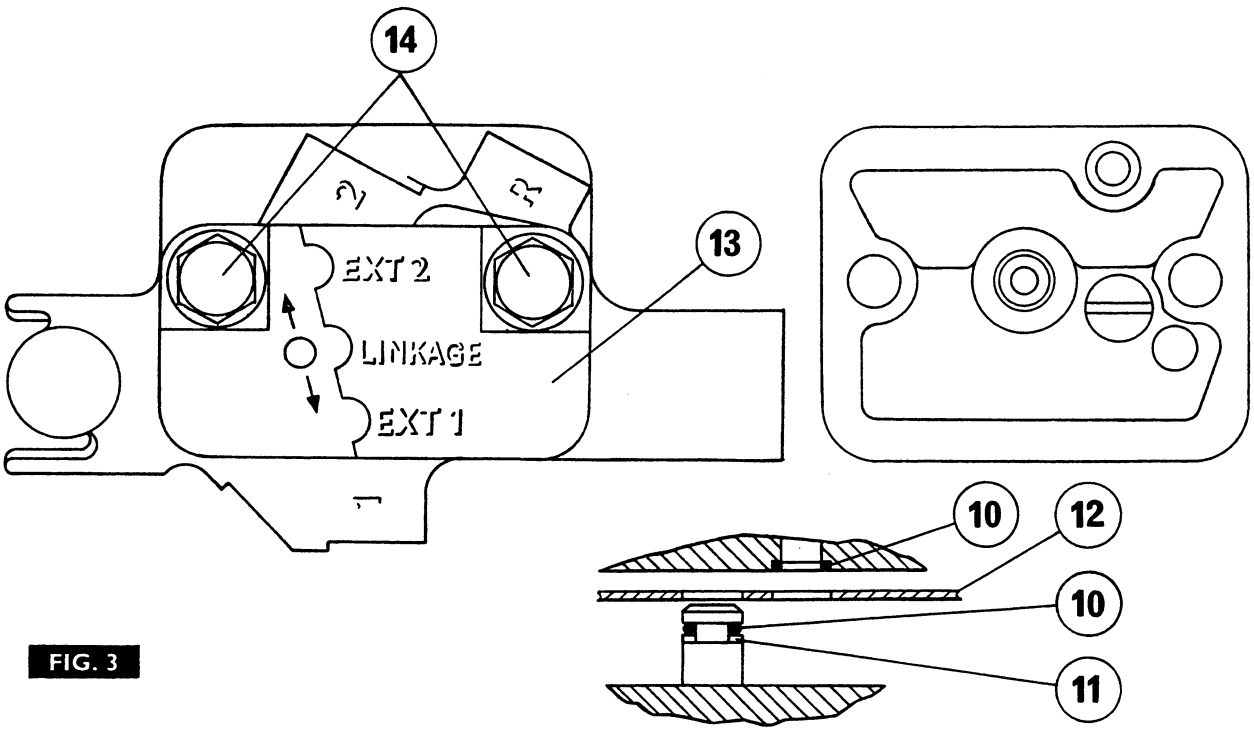

FIG. 3

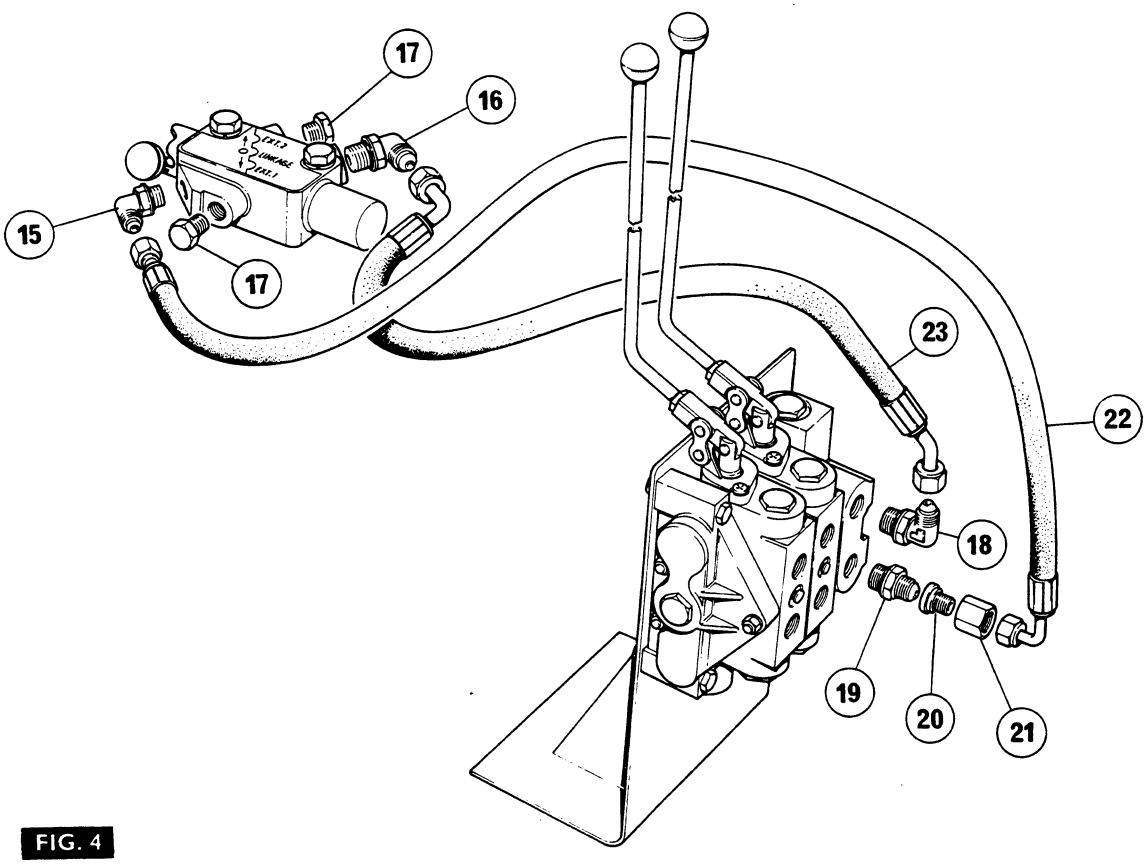

FIG. 4

Flow Available: 15 lit/min (3.3 Imp. gal/min or 3.9 U.S. gal/min).
Max. Pressure: 179,3 kg/cm^2 (2550 lb/in^2).
Hydraulic H.P.: 4.4 @ 140 kg/cm^2 (2000 lb/in^2).

FITTING INSTRUCTIONS 7B-18-41

1. Place the 'Draft Control' lever in the 'Down' position.
2. Remove the two bolts and spring washers securing the transfer cap to the lift cover, then carefully ease off the transfer cap, ensuring that the standpipe is not displaced from its location in the hydraulic pump.
3. Fig. 3. Remove the old 'O' ring and back-up washer (10 and 11 respectively), from the standpipe.
4. Fit a new 'O' ring (10) and back-up washer (11) to the standpipe.
5. Clean the bottom face of the selector valve, then fit an 'O' ring (10) to the shallow recess in the bottom face of the selector valve.
6. Place the selector valve gasket (12) in position, making sure that all of the holes are clear, then locate the selector valve on the standpipe.
7. Fit the instruction plate (13), then fit the two special $\frac{7}{16}$ UNC x 73 mm ($2\frac{7}{8}$ in.) bolts (14), with a flat washer and a lockwasher for each.
8. Carefully torque the bolts to 3,5 kg m (25 lb ft).

NOTE – DO NOT USE THE EXISTING TRANSFER CAP BOLTS. ALSO, DO NOT OVERTIGHTEN THE BOLTS, AS THIS CAN CAUSE LEAKAGE OF THE SELECTOR VALVE AND MAY CAUSE THE SPOOL TO STICK.

The various plugs, connectors and elbows should be fitted as stated in operations 7B-19-41, 7B-22-42, or 7B-23-45.

LINKAGE PUMP FEED HOSE KIT

FUNCTION

This feed hose kit supplies oil to the spool valve and permits oil to return to the 'R' Port on the selector valve.

ADJUSTMENT

If the tractor linkage has to be kept at a pre-set height above the ground, the following changes must be made to the arrangement of the supply hose kit:–

1. Fit the $\frac{9}{16}$–18 UNF plug (17) to front Port 1 in place of the $\frac{9}{16}$–18 UNF 90° elbow (15).
2. Fit the $\frac{9}{16}$–18 UNF 90° elbow (15) to Port 2.
3. In place of the feed hose (22) make up a longer hose, connecting it to the reducing adapter (20) at the lower R.H. port on the back of the spool valve and to the 90° elbow (15) at Port 2.

Flow Available: 15 lit/min (3.3 Imp. gal/min or 3.9 U.S. gal/min).
Max. Pressure: 179 kg/cm^2 (2550 lb/in^2).
Hydraulic H.P.: 4.4 @ 140 kg/cm^2 (2000 lb/in^2).

FITTING INSTRUCTIONS 7B-19-41

Fig. 4.

1. Assemble and fit the spool valve to the tractor, as stated in operation 7B-17-38.
2. Fit the hydraulic selector valve kit, as stated in operation 7B-18-41.
3. Screw the $\frac{9}{16}$–18 UNF 90° elbow (15) into front Port 1 on the selector valve. Lock the elbow (15) to face rearwards.
4. Screw the ¾–16 UNF 90° elbow (16) into the 'R' port on the selector valve. Lock this elbow also to face rearwards.
5. Fit a $\frac{9}{16}$–18 UNF blanking plug (17) to rear Port 1 and Port 2 of the selector valve.
6. Screw the ¾–16 UNF 90° elbow (18) into the upper R.H. port at the back of the spool valve. Lock the elbow to point vertically upwards.
7. Screw the ¾–16 UNF straight connector (19) into the lower R.H. port on the back of the spool valve.
8. Insert the reducing adaptor (20) into the tube nut (21), then screw the nut on to the straight connector (19).
9. Attach the selector valve feed hose (22) ($\frac{9}{16}$–18 UNF end fittings) with its straight end to the 90° elbow at Port 1 on the selector valve and its 90° end to the reducing adaptor (20).
10. Attach the return hose (23) (¾–16 UNF end fittings) with its 45° end to the 90° elbow (18) at the upper R.H. port of the spool valve and its 90° end to the 90° elbow (16) on the selector valve.

AUXILIARY HYDRAULIC FEED HOSE KIT

FUNCTION

This feed hose kit supplies oil to the spool valve and allows oil to return to the front port on the side cover.

Flow Available: 31,8 lit/min (7.0 Imp. gal/min or 8.4 U.S. gal/min).
Max. Pressure: 169 kg/cm^2 (2400 lb/in^2).
Hydraulic H.P.: 9.8 @ 140 kg/cm^2 (2000 lb/in^2).

Tractors with Early Type P.t.o. Side Cover

NOTE – THE P.T.O. SIDE COVER REFERRED TO IN THESE INSTRUCTIONS WAS FITTED TO ALL HIGH CAPACITY MULTI-POWER TRACTORS FROM 1965 ONWARDS UP TO THE CUT-IN OF INDEPENDENT P.T.O. IN DECEMBER 1971, WHEN ONLY NON-I.P.T.O. MULTI-POWER TRACTORS CONTINUED TO HAVE THIS TYPE OF SIDE COVER UNTIL THE FINAL CESSATION OF PRODUCTION IN MARCH 1972. THIS SIDE COVER IS IDENTIFIED BY HAVING THE FRONT PORT SLIGHTLY ABOVE THE REAR ONE. THE COVER IS MANUFACTURED FROM CAST IRON.

FITTING INSTRUCTIONS 7B-20-41

Fig. 5.

1. If necessary, fit the p.t.o. lever extension kit 884 391 M91 (24) (not supplied in the kit) to the p.t.o. lever.
2. Remove the manifold from the p.t.o. side cover.
3. Screw a ¾–16 UNF straight connector (19) into each port on the p.t.o. side cover.
4. Attach the feed hose (25) to the REAR port on the side cover.
5. Attach the straight end of the return hose (26) to the FRONT port on the side cover.
6. Assemble the spool valve unit and bolt it to the tractor footplate as stated in operation 7B-17-38.
7. Screw a ¾–16 UNF 90° elbow (18) into the two R.H. ports on the back of the spool valve. Lock the upper elbow to point vertically upwards. The lower elbow must be locked to point downwards at approx. 20° away from the tractor.

8. Route the feed hose round the front of the mounting bracket and connect it to the lower 90° elbow on the back of the valve.
9. Route the return hose across the front of the valve bracket, then over the top of the valve and couple its 90° end to the 90° elbow, at the upper R.H. port on the back of the spool valve.

AUXILIARY HYDRAULIC FEED HOSE KIT

Tractors with Later Type P.t.o. Side Cover

NOTE – THE P.T.O. SIDE COVER REFERRED TO IN THESE INSTRUCTIONS IS FITTED TO ALL TRACTORS WITH I.P.T.O. FROM FIRST PRODUCTION (DECEMBER 1971) AND TO ALL HIGH CAPACITY PUMP MULTI-POWER TRACTORS BUILT FROM MARCH 1972. THIS TYPE OF SIDE COVER IS IDENTIFIED BY HAVING THE FRONT PORT BELOW THE REAR ONE. THE COVER IS MANUFACTURED FROM LIGHT ALLOY AND A LONGER, CAST ALLOY, P.T.O. LEVER IS ALSO FITTED.

FITTING INSTRUCTIONS 7B-21-42

Fig. 6.

1. Drive out the roll pin securing the p.t.o. lever and remove the lever.
2. Fit the new, extended, p.t.o. lever (27), supplied in the kit and secure it with the new roll pin.
3. Remove the manifold from the p.t.o. side cover.
4. Thread a 1 in–12 UNF locknut (28) on to one of the manifold banjo bolts, then screw the manifold bolt into the FRONT port pipe.
5. Pull the snap ring off the front port pipe, then screw the locknut into position. Remove the manifold banjo bolt.
6. Remove the snap ring from the REAR port pipe, then fit a second locknut (28).
7. Screw a ¾–16 UNF straight connector (19) into each port on the p.t.o. side cover.
8. Attach the feed hose (25) to the REAR port on the side cover.
9. Attach the straight end of the return hose (26) to the FRONT port on the side cover.
10. Assemble the spool valve unit and bolt it to the tractor footplate, as stated in operation 7B-17-39.
11. Screw a ¾–16 UNF 90° elbow (18) into the two R.H. ports on the back of the spool valve. Lock the upper elbow to point vertically upwards. The lower elbow must point downwards and at approximately 20° away from the tractor.
12. Route the feed hose round the front of the mounting bracket and connect it to the lower 90° elbow on the back of the spool valve.
13. Route the return hose across the front of the valve bracket, then over the top of the valve. and couple its 90° end to the 90° elbow at the upper R.H. port on the back of the spool valve.

COMBINED FLOW FEED HOSE KIT

FUNCTION

The combined flow hose kit supplies oil to the spool valve from both the selector valve and the p.t.o. side cover. Oil is returned from the spool valve to the front port of the side cover.

ADJUSTMENT

If the tractor hydraulic linkage has to be kept at a preset height above the ground, the following changes must be made to the arrangement of the supply hose kit:–

1. Fit the $\frac{9}{16}$ –18 UNF plug (17), from the selector valve kit, to front Port 1, in place of the non-return valve (30) and 90° elbow (31).
2. Fit the non-return valve and 90° elbow (30 and 31) to Port 2 of the selector valve.
3. In place of the feed hose (22), make up a new, longer hose, connecting it to the reducing adapter (20) at the lower R.H. port on the back of the spool valve and to the $\frac{9}{16}$–18 UNF 90° elbow (31) at Port 2.

Flow Available: 46,7 lit/min (10.3 Imp. gal/min or 12.4 U.S. gal/min).
Max. Pressure: 179 kg/cm^2 (2550 lb/in^2) but with only 15 lit/min flow.
Hydraulic H.P.: 14.2 @ 140 kg/cm^2 (2000 lb/in^2).

Tractors with Early Type P.t.o. Side Cover

For details of types and tractor identification, see 'Auxiliary Hydraulic Feed Hose Kit' on page 7B-42.

FITTING INSTRUCTIONS 7B-22-42

Fig. 7.

1. If necessary, fit the p.t.o. lever extension kit 884 391 M91 (24) (not supplied in the kit) to the p.t.o. lever.
2. Remove the manifold from the p.t.o. side cover.
3. Screw a ¾–16 UNF straight connector (19) into the FRONT port on the side cover.
4. Screw the larger (¾–16 UNF) non-return valve (29) into the REAR port on the side cover.
5. Screw a ¾–16 UNF straight connector (19) into the non-return valve (29).
6. Attach the straight end of the return hose (26) to the straight connector (19) at the FRONT port on the side cover.
7. Attach the feed hose (25) to the straight connector (19) on the non-return valve (29) (REAR port on the side cover).
8. Fit the selector valve kit, as stated in operation 7B-18-40.
9. Assemble the spool valve unit and bolt it to the tractor footplate as stated in operation 7B-17-39.
10. Screw the smaller $\frac{9}{16}$–18 UNF non-return valve (30) into front Port 1 of the selector valve.
11. Screw the $\frac{9}{16}$–18 UNF 90° elbow (31) into the non-return valve (30).
12. Attach the straight end of the selector valve feed hose (22) ($\frac{9}{16}$–18 UNF end fittings) to the 90° elbow (31).
13. Fit a $\frac{9}{16}$ –18 UNF plug (17) to rear Port 1 and Port 2 of the selector valve.
14. Fit a ¾–16 UNF plug (9) to the 'R' port on the selector valve.
15. Screw the ¾–16 UNF tee-piece (32) into the lower, R.H. port on the back of the spool valve. Lock the tee-piece with its 90° angle union pointing downwards and approximately 20° away from the tractor.
16. Screw a ¾–16 UNF 90° elbow (18) into the upper R.H. port on the back of the selector valve. Lock the elbow to point vertically upwards.

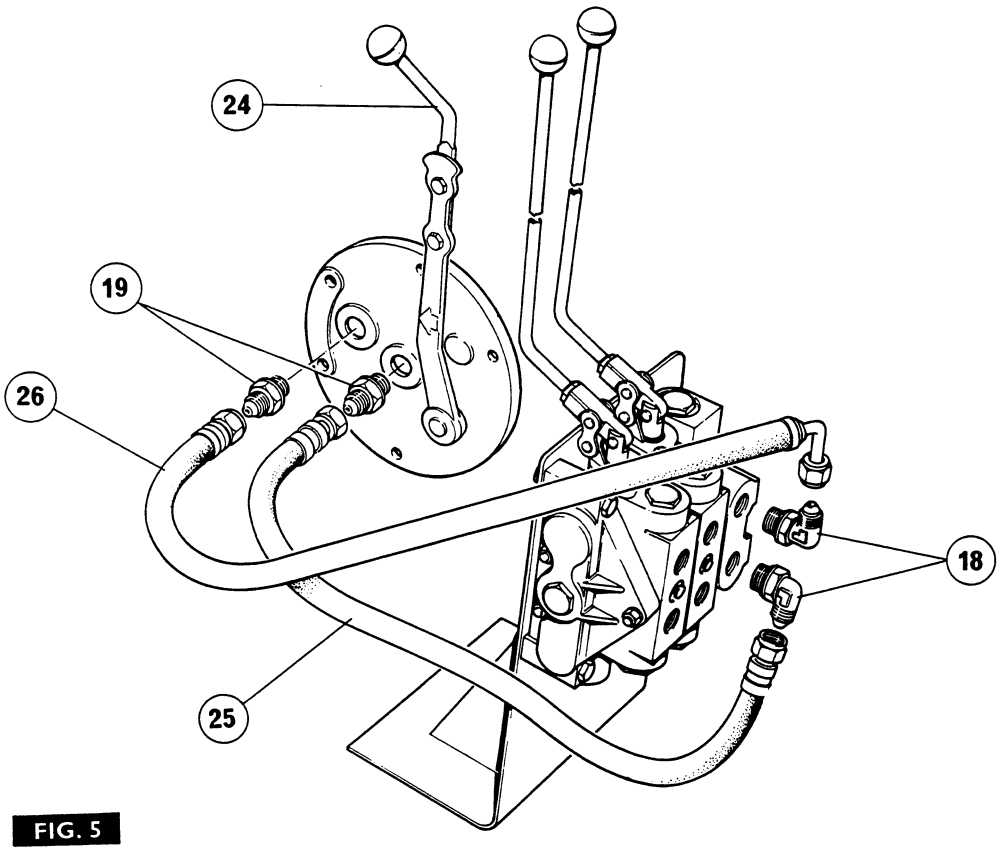

FIG. 5

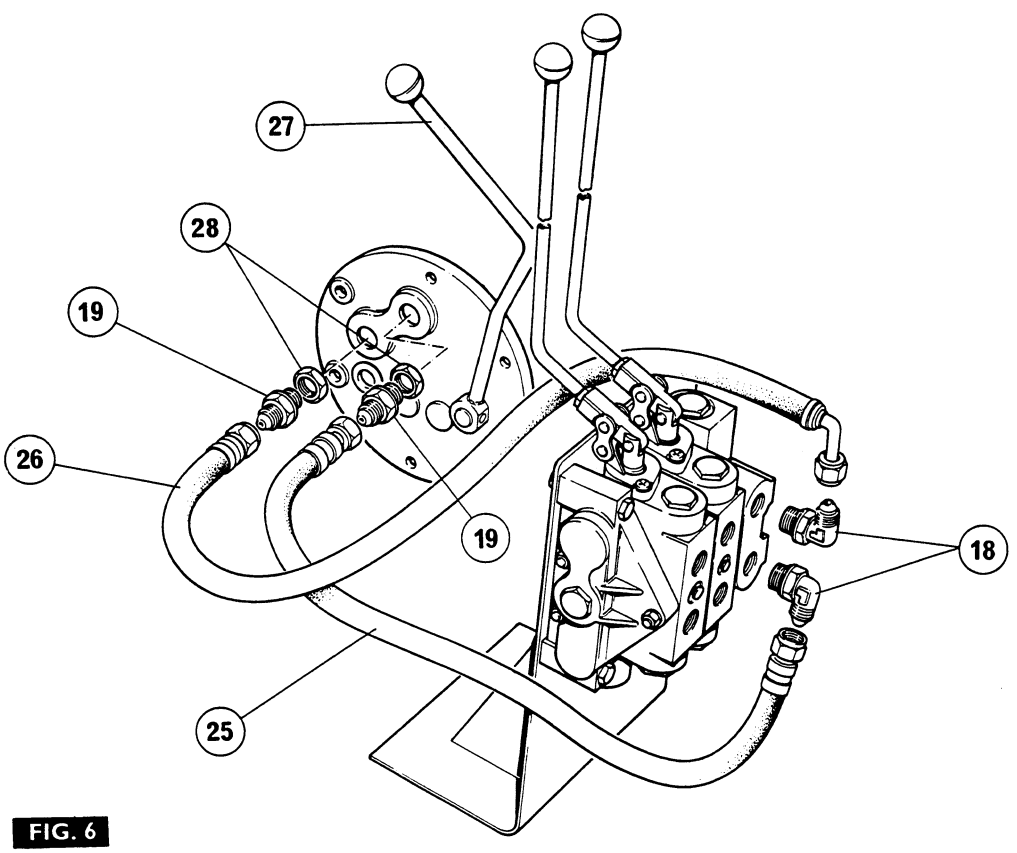

FIG. 6

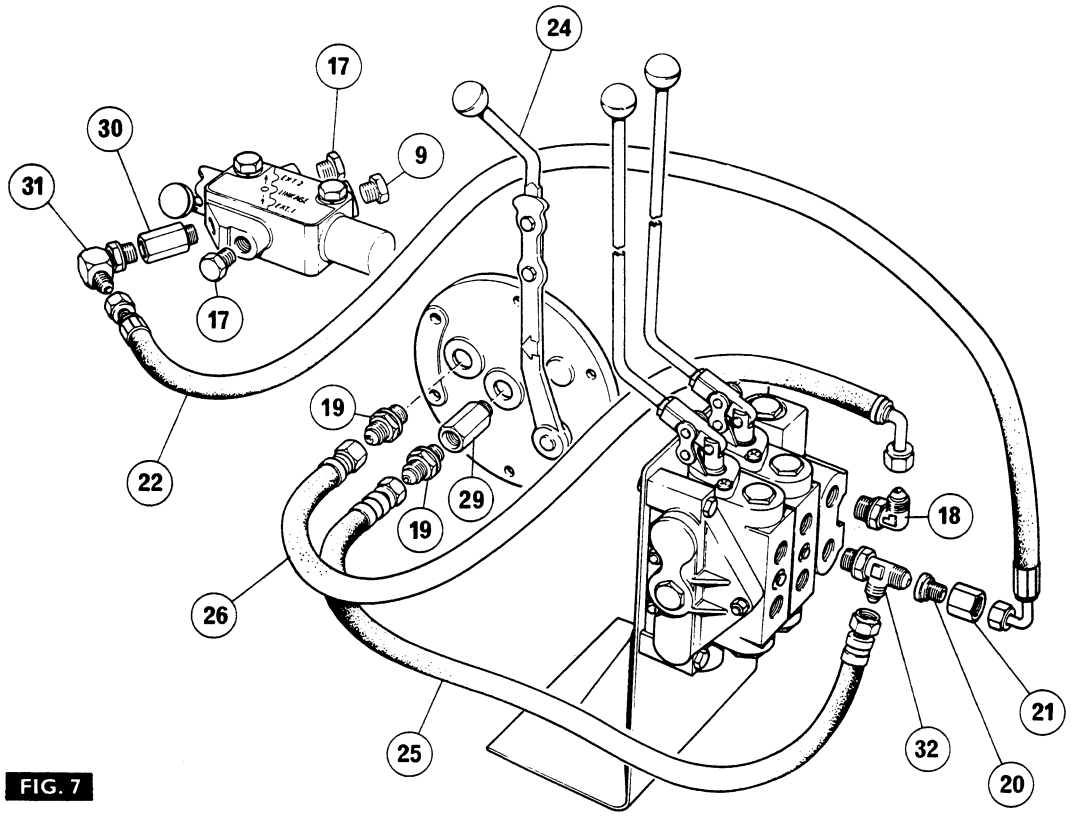
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FIG. 7

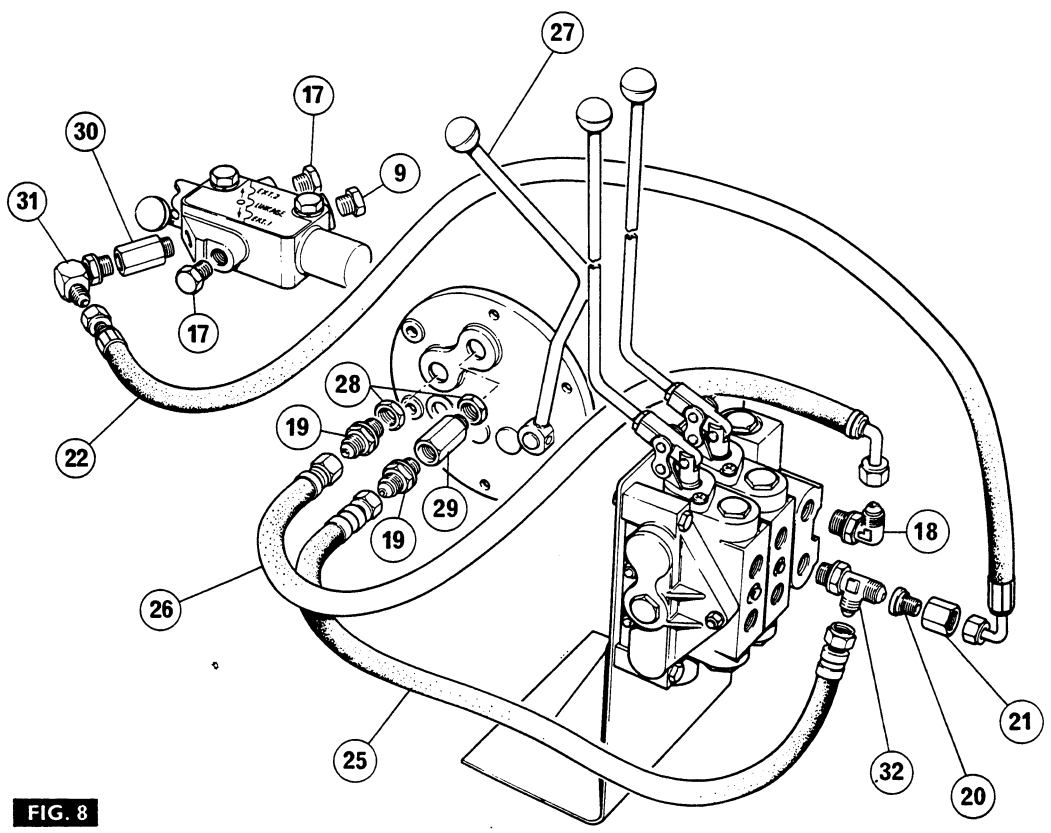
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FIG. 8

17. Insert the reducing adapter (20) through the tube nut (21), then screw the nut on to the horizontal portion of the tee-piece (32).
18. Route the side cover feed hose (25) across the footplate and attach it to the vertical portion of the tee-piece (32).
19. Route the return hose (26) across the front of the spool valve mounting bracket, then over the spool valve and attach its 90° end to the 90° elbow (18) at the upper R.H. port on the back of the spool valve.
20. Attach the 90° end of the selector valve feed hose (22) to the reducing adapter (20).

COMBINED FLOW FEED HOSE KIT

Tractors with Later Type P.t.o. Side Cover
For details of types of tractors and identification, see 'Auxiliary Hydraulic Feed Hose Kit' on page 7B-42.

FITTING INSTRUCTIONS 7B-23-45

Fig. 8.
1. Drive out the roll pin securing the p.t.o. lever and remove the lever.
2. Fit the new, extended, p.t.o. lever (27), supplied in the kit and secure it with the new roll pin.
3. Remove the manifold from the p.t.o. side cover.
4. Thread a 1 in–12 UNF locknut (28) on to one of the manifold banjo bolts, then screw the manifold banjo bolt into the FRONT port pipe on the p.t.o. side cover.
5. Pull the snap ring off the front port pipe of the p.t.o. side cover, then screw the locknut (28) into position. Remove the manifold banjo bolt.
6. Remove the snap ring from the REAR port pipe, then fit a second locknut (28).
7. Screw a ¾–16 UNF straight connector (19) into the FRONT port on the p.t.o. side cover.
8. Screw the larger (¾–16 UNF) non-return valve (29) into the REAR port on the p.t.o. side cover.
9. Screw a ¾–16 UNF straight connector (19) into the non-return valve (29).
10. Attach the straight end of the return hose (26) to the straight connector (19) at the FRONT part of the p.t.o. side cover.
11. Attach the feed hose (25) to the straight connector (19) on the non-return valve (29), (REAR port).
12. Assemble the selector valve kit, as stated in operation 7B-18-41.
13. Assemble the spool valve unit and bolt it to the tractor footplate, as stated in operation 7B-17-38.
14. Screw the smaller ($\frac{9}{16}$–18 UNF) non-return valve (30) into front Port 1 of the selector valve.
15. Screw the $\frac{9}{16}$ –18 UNF 90° elbow (31) into the non-return valve (30).
16. Attach the straight end of the selector valve feed hose (22) ($\frac{9}{16}$–18 UNF end fittings) to the 90° elbow (31).
17. Fit a $\frac{9}{16}$ –18 UNF plug (17) to rear Port 1 and Port 2 of the selector valve.
18. Fit a ¾–16 UNF plug (9) to the 'R' port on the selector valve.
19. Screw the ¾–16 UNF tee-piece (32) into the lower, R.H. port on the back of the spool valve. Lock the tee-piece with its 90° angle union pointing downwards and approximately 20° away from the tractor.
20. Screw a ¾–16 UNF 90° elbow (18) into the upper R.H. port on the back of the spool valve. Lock the elbow to point vertically upwards.
21. Insert the reducing adapter (20) through the tube nut (21), then screw the nut on to the horizontal portion of the tee-piece (32).
22. Route the side cover feed hose (25) across the footplate and round the valve to connect to the 90° angle of the tee-piece (32).
23. Route the return hose (26) across the front of the spool valve mounting bracket, then over the spool valve and attach its 90° end to the 90° elbow (18) at the upper R.H. port on the back of the spool valve.
24. Attach the 90° end of the selector valve feed hose (22) to the reducing adapter (20).

OUTLET HOSE KIT

FUNCTION

Quick Release Pioneer Couplers
To fit an implement hose to a 'Pioneer' coupler, grasp the coupler, forward of the gimbal clamp and pull the coupler rearwards. Holding the coupler in this position, insert the implement hose end adapter. Release the coupler and check for correct engagement.

WARNING – KEEP THESE COUPLERS CLEAN AND PLUGGED, WHEN NOT IN USE.

FITTING INSTRUCTIONS 7B-24-45

Fig. 9.
1. Assemble the spool valve unit and feed hose kit, as stated previously.
2. Screw a ¾–16 UNF straight connector (19) into the upper port(s).
3. Screw the extended ¾–16 UNF straight connector (33) into the lower port(s).
4. Attach the 90° end(s) of the outlet 'feed' hose(s) (34 and 35) to the upper straight connector(s) (19) (These are the larger diameter hoses).
5. Attach the 90° end(s) of the outlet 'return' hose(s) (36 and 37) to the lower straight connector(s) (19 and 33). (These are the smaller diameter hoses).
6. Fig. 10. Remove the top two fixings from the L.H. trumpet housing, then locate the L.H. coupler mounting bracket (38) and refit the nut and bolt.

6A. Twin Spool Only:– Repeat operation (6) for the R.H. coupler mounting bracket.

7. Slide a 'Pioneer' coupler (39), through each gimbal ring (40) and secure each one with a retaining ring (41).
8. Fit an 'O' ring (42) to each outlet hose end, then screw a 'Pioneer' coupler assembly on to each hose.

9. Assemble the 'Pioneer' couplers in pairs, with two clamps (43), a spacer (44) and a pair of plugs (45). Slide a $\frac{7}{16}$ UNF x 75 mm (3 in), bolt (46) through the brackets and the spacer, then locate the loops of the plugs (45) over the spacer, before bolting the assembly to the mounting bracket (38) (centre hole).

9A. Twin Spool Only:– Repeat operation (9) for the R.H. pair of hoses.

NOTE – THE HOSE(S) FROM THE UPPER PORT(S) (34 OR 35) IS THE BOTTOM HOSE IN THE CLAMP(s).

10. Remove the lift cover bolt, just forward of the L.H. lift arm.

10A. Twin Spool Only:– Also remove the lift cover bolt, just forward of the R.H. lift arm.

11. Tractors with De Luxe Seat Only:– Modify the hose clamp bracket(s) (47) as shown in Fig. 11.

12. Fig. 10. Secure the hose clamp bracket(s) (47) to the lift cover with the $\frac{7}{16}$ UNC x 108 mm (4¼ in) bolt(s) (48). Torque the bolt(s) to 9,0 kg m (65 lb ft).

13. Secure the hoses in pairs to the clamp bracket(s) (47), using the 'U' clamp(s) (49), plus a ¼ UNF x 41 mm ($1\frac{5}{8}$ in) bolt (50) and a ¼ UNF locknut (tractors with spring suspension seat only).

NOTE – IF NECESSARY, BEND THE BRACKET(S) (47) TO ENSURE A STRAIGHT HOSE RUN BETWEEN THE CLAMP(S) AND THE COUPLERS. ALSO, DO NOT CLAMP THE HOSES TIGHTLY, AS THEY MUST BE FREE TO SLIDE IN THE CLAMPS TO PERMIT COUPLING AND UNCOUPLING.

13A. Fig. 12. De Luxe Seat Tractors Only:– Secure the hoses to the clamp bracket(s) with a plastic strap (51).

14. Twin Spool Only. Remove the tractor seat.

15. Fig. 9. Twin Spool Only. Fit the hose retainer plate (52) over the seat location studs, locating the two R.H. hoses between the bend in the end of the retainer plate and the front of the lift cover.

16. Refit tractor seat.

17. Fit the plastic plugs (45) into the 'Pioneer' couplers.

SPOOL VALVE UNIT REMOVAL AND REFITMENT 7B-25-46

Fig. 2.

Removal

1. Disconnect all of the feed, return and outlet hoses from the spool valve.
2. Remove the three bolts (8) and spring washers, then lift off the valve.

Refitment

1. Align the valve against the mounting bracket (7), then refit the three bolts (8), nuts and spring washers.
2. Reconnect all of the feed, return and outlet hoses.

SPOOL BLOCK REMOVAL AND REFITMENT 7B-26-46

Fig. 13.

Removal

1. Remove the spool valve from the tractor, as stated in operation 7B-25-46.
2. Remove the three nuts and studs (52) securing the spool valve assembly.
3. Part the end plates (53 and 54) from the spool blocks (55) and remove the 'O' rings (56 and 57).
4. Thoroughly clean the mating faces of the spool blocks and the end plates.

Refitment

1. Fit four new 'O' rings (56 and 57) to the recesses in the L.H. plate and the spool blocks.
2. Place the valve on a flat surface, with the feed ports uppermost, then align the valve sections and refit the three studs (52) nuts and lockwashers.
3. Torque the nuts to 2 kg m (15 lb ft). DO NOT OVERTIGHTEN THE NUTS AS THIS COULD CAUSE THE SPOOLS TO STICK.
4. Refit the spool valve to the tractor, as stated in operation 7B-25-46.

SPOOL BLOCK SERVICING 7B-27-46

Fig. 11.

Disassembly

1. Split the spool block from the main assembly, as stated in operation 7B-25-47.
2. Remove the upper plug (1) from the spool block.
3. If a double-acting plug (1) is fitted, remove both 'O' rings (58 and 59); or, conversely, if the single-acting plug (2) is fitted, remove the 'O' ring (58).
4. Remove the lower plug (1) and remove both 'O' rings (58 and 59).
5. Withdraw the check valve body (60) from the spool block, then remove the poppet (61) and spring (62). Remove the 'O' ring from the valve body (48).
6. Remove the centreing spring cover retaining screws (63), then lift off the cover (64).
7. Remove the retaining screw (65) spring guides (66) and spring (67).
8. Remove the upper cover screws (63) and remove the cover. Remove the seal (68). DO NOT MOVE THE SPOOL FROM ITS CENTRAL POSITION.
9. Gently rotate and pull the spool towards the pull rod (TOP) end of the spool block, until the lower 'O' ring (69) is uncovered. DO NOT COMPLETELY REMOVE THE SPOOL.
10. Remove the lower 'O' ring (69) from its groove in the spool block.

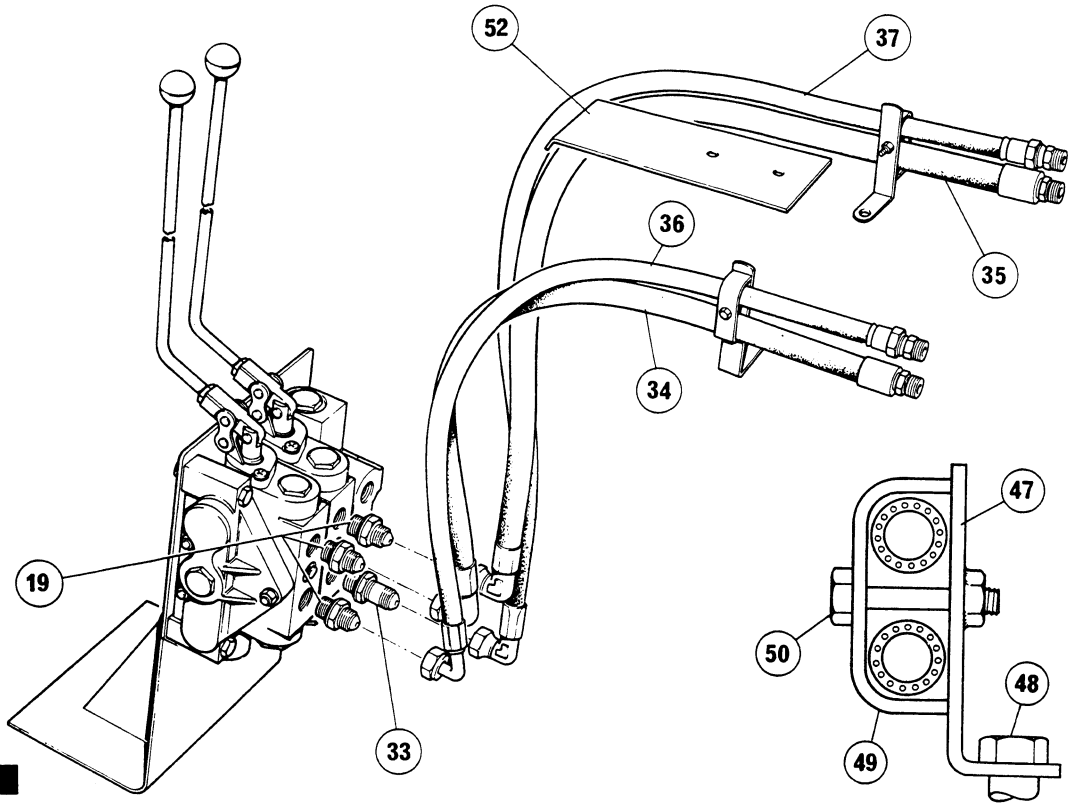

FIG. 9

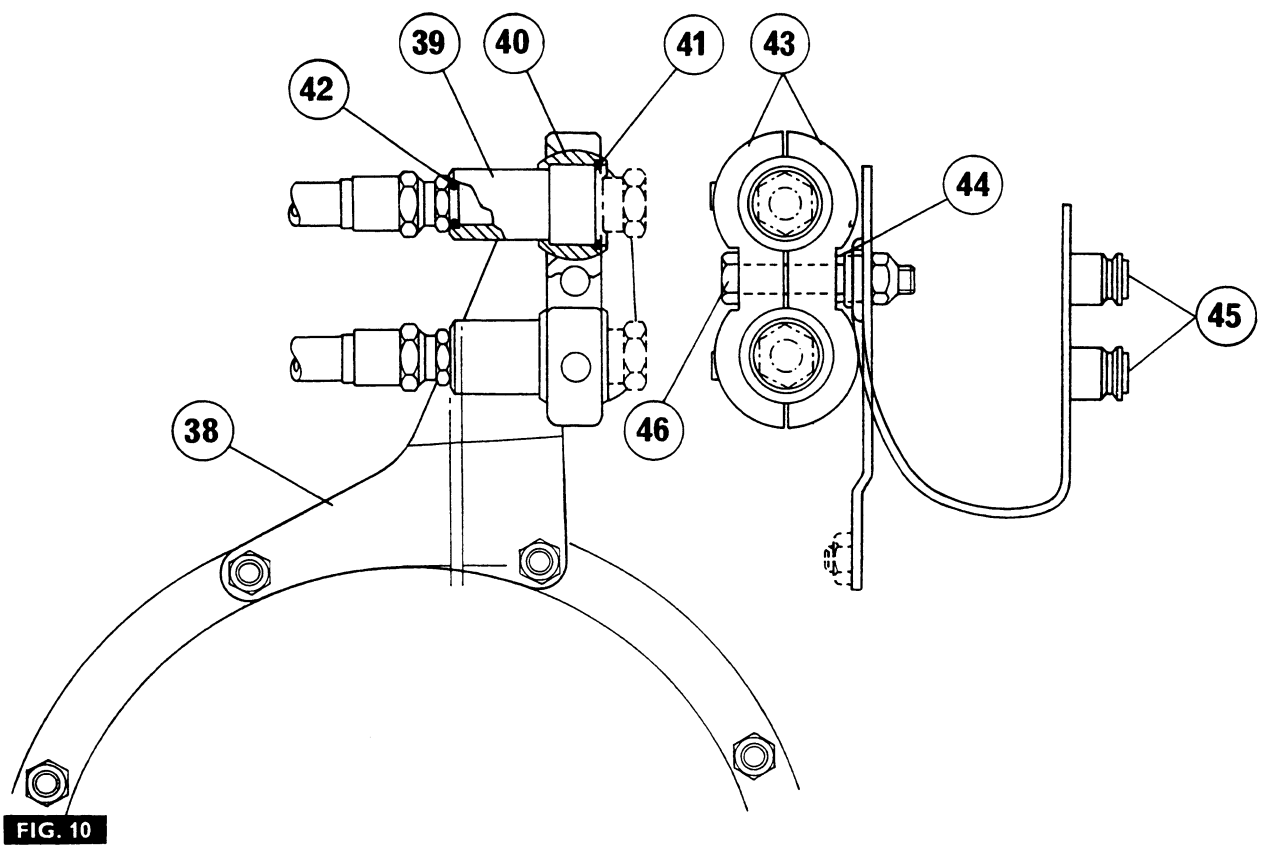

FIG. 10

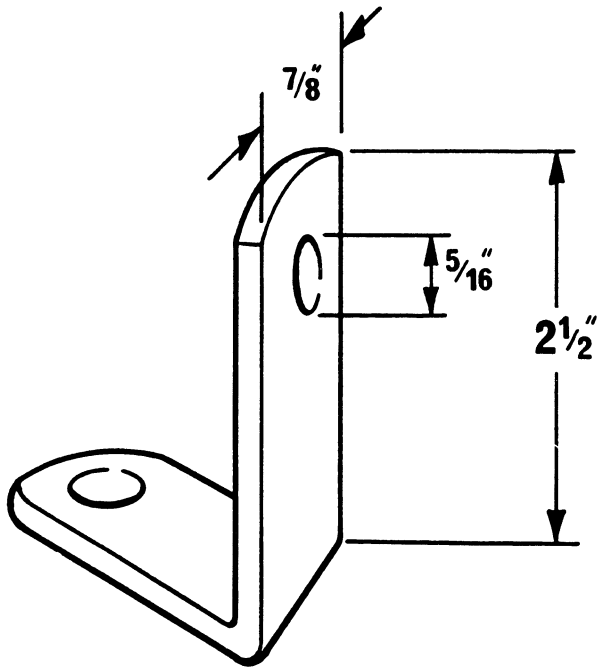

FIG. 11

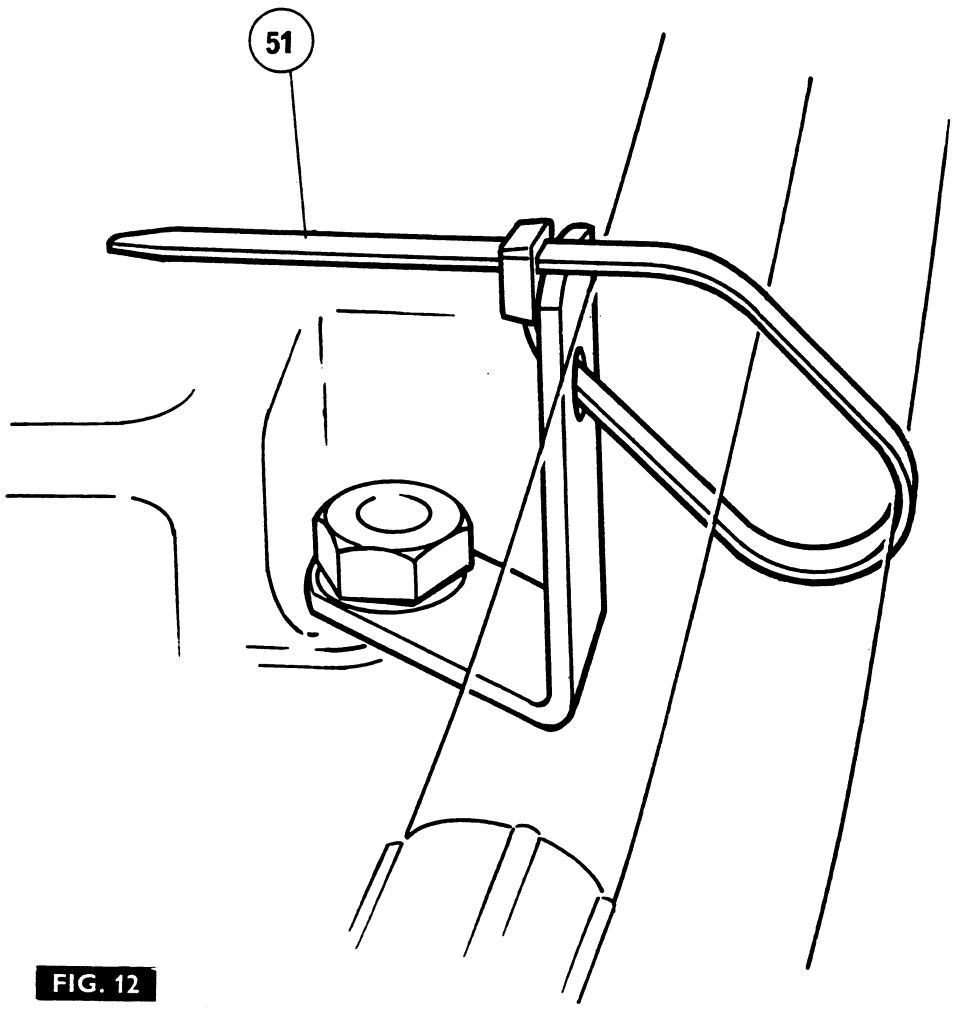

FIG. 12

11. Gently rotate and push the spool downwards, away from the pull rod end of the spool block, until the upper 'O' ring (69) is uncovered. DO NOT COMPLETELY REMOVE THE SPOOL.
12. Remove the upper 'O' ring from its groove.

Examination

Check the condition of the check valve poppet and its seat in the spool block. Poor seating of the poppet can result in jerky operation.

Check that the spool slides smoothly in the spool block but DO NOT REMOVE THE SPOOL COMPLETELY. Always fit new 'O' rings and a new seal (68).

Reassembly

1. Fit a new 'O' ring (69) into the upper groove, then very carefully rotate and push the spool upwards until the lower groove is exposed.
2. Fit a new 'O' ring (69) to the lower groove, then carefully centralise the spool.
3. Thoroughly degrease the threads in the end of the spool and the retaining screw (65).
4. Apply one drop of Loctite 'Hydraulic Seal' (Brown) to the threads of the retaining screw (65), then assemble the spring guides (66) and the spring (67) on to the screw (65) and refit the screw to the spool.
5. Refit the centreing spring cover (64) and screws (63).
6. Slide a new seal (68) on to the spool, then refit the upper cover.
7. Fit a new 'O' ring to the check valve body (60).
8. Fit the spring (62) and poppet (61) to the check valve body (60) then slide the body onto the spool block.
9. Fit new 'O' rings (58 and 59) to the lower plug (1) then refit the cover plug to the spool block.
10. Dependent upon whether a single acting plug (2), or a double-acting plug (1) is fitted, fit either one (58) or two (58 and 59) new 'O' rings, then refit the plug.
11. Reassemble the spool to the block, as stated in operation 7B-25-46.

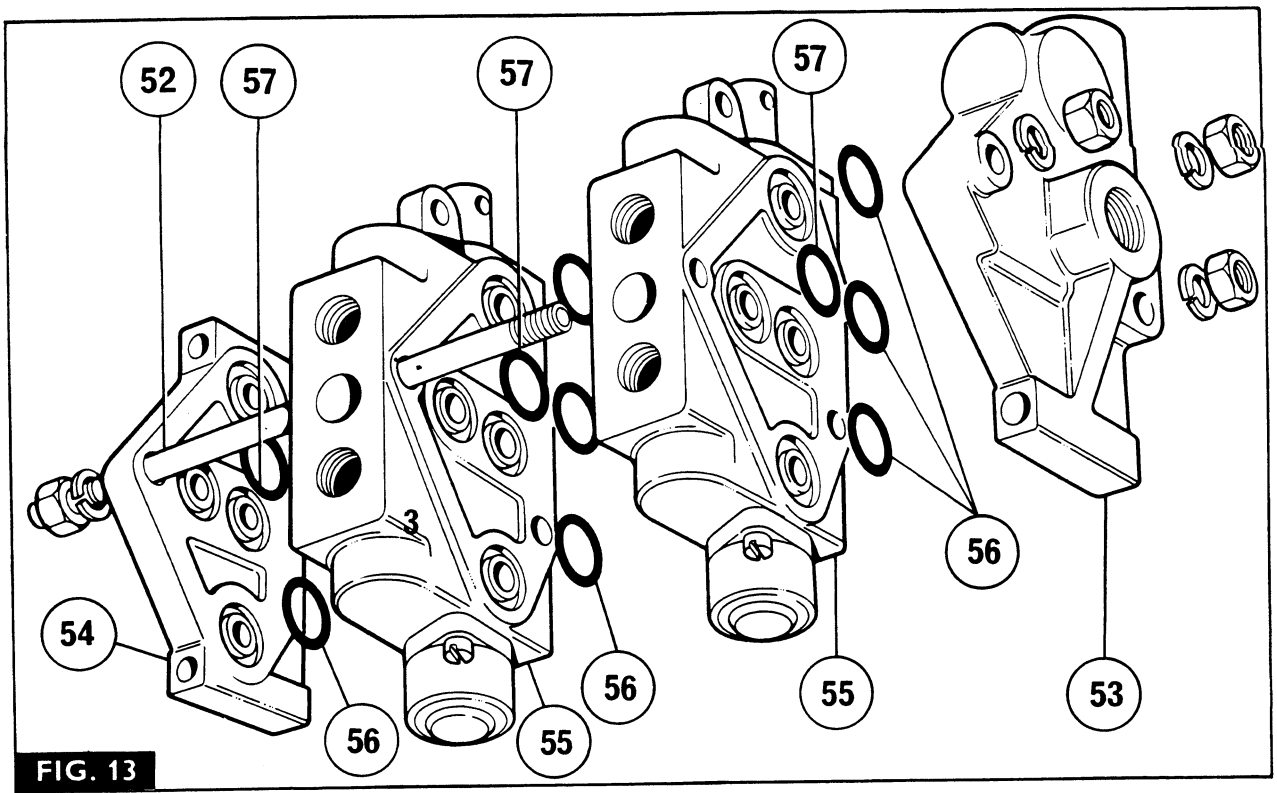
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FIG. 13

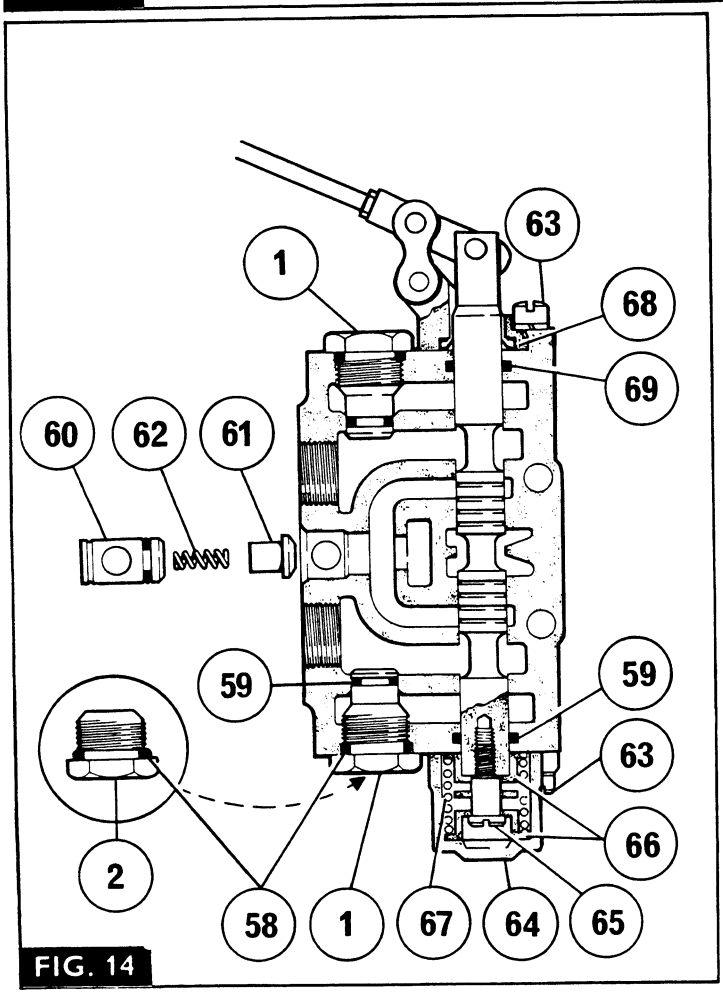
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FIG. 14

LINKAGE AND DRAWBARS

Part 7 Section C

LINKAGE AND DRAWBARS

GENERAL

Fig. 1. The three point linkage controls the movements of the mounted and semi-mounted implements. The linkage comprises five main components:– top link (1), lower links (3), lift rods (2), check chains (4) and control beam (5).

TOP LINK

Fig. 2. The top link is of the three-piece, barrel, turnbuckle type and is adjustable for length between the dimensions stated in the specification section.

Adjustment Procedure

1. Fig. 2. Release the locking clip (6).
2. Rotate the barrel (7) until the required length is achieved. Do not permit the ball ends to rotate.
3. Return the spring clip to the engaged position, to retain the ball ends in the correct plane.

LOWER LINKS

The lower links (3) carry the implement and are also used when attaching the Pressure Control coupler or the linkage drawbar. Vertical, but not lateral movement of the lower links determines the height of the implements from the ground, or its depth of penetration.
The lower links fitted to this tractor have provision for interchangeability of the ball ends.

Interchanging Ball Ends 7C-01-02

1. Fig. 3A. Pull the spring clip upwards, as shown.
2. Rotate the ball until the narrow portion aligns with the slot in the lower link, then remove the ball.
3. Fig. 3B. Fit the new ball by locating it with the narrow section in line with the slot, then refit the spring clip, as shown.

NOTE – FOR CATEGORY 1 IMPLEMENTS, THE CHECK CHAIN LENGTH MUST BE SET AS SHOWN IN FIG. 4A AND FOR CATEGORY 2 IMPLEMENTS, AS SHOWN IN FIG. 4B.

LIFT RODS

The lift rods (2) connect the lift arms to the lower links. The L.H. lift rod is normally set to its correct length on assembly and is not adjusted thereafter. The R.H. lift rod incorporates a bevel gear levelling box, which allows the upper portion of the rod to be screwed into, or out of, the lower portion of the lift rod, thus adjusting the height of the R.H. lower link in relation to the left.

NOTE – THE LIFT ROD BOLTS MUST ALWAYS BE FITTED TO THE FORWARD HOLE IN THE LOWER LINKS AND THE LOCKNUTS SHOULD BE ADJUSTED SO THAT THE LIFT ROD BOLTS CAN ROTATE.

L.H. Lift Rod **Fig. 5**

The L.H. Lift Rod should be adjusted for length on assembly with the punch work on the upper rod just beginning to show from the lower fork. At this setting the distance between the centres should be 612 mm (24⅛ in).
Other than daily greasing of the nipple on the lift rod, no other servicing is required.

R.H. Levelling Box and Lift Rod **Fig. 6**

The R.H. Lift Rod is adjustable for length to allow the implement to be levelled during, or after attachment. Adjustments are made by rotating the handle which drives through a bevel gearbox to the lift rod. The lift rod screws into, or out of the lower lift fork. The nominal length of the R.H. lift rod is 612 mm (24⅛ in) and the range of adjustment is ±38 mm (1½ in).

Levelling Box Servicing 7C-02-02

Disassembly

1. Fig. 7. Remove the complete levelling box from the tractor by removing the split pin and clevis pin from the knuckle on the levelling box.
2. Unscrew the levelling gear shaft (19) out of the lower fork.
3. Using a 5 mm (3/16 in) diameter drill, remove one head from the double countersunk rivet (14) which secures the bevel gear (12) to the handle spindle (13).
4. Withdraw the levelling handle (13) and bevel gear (12) from the levelling box (9).
5. Remove the split pin (21) and the clevis pin (10) from the levelling box and remove the knuckle (8).
6. Remove the circlip (18) and the thrust washer (17) from the gear shaft.
7. Using a soft faced mallet, tap the end of the gear shaft (19) to force the dished expansion plug (11) out of the levelling box.
8. Slide the gear shaft (19) out of the levelling box, then remove the bearing (16).

The spring (20) and the grease nipple need not be removed.

Examination

Examine all components and replace any which are worn, or damaged.
When reassembling, always fit a new rivet (14), dished expansion plug (11), bearing (16), thrust washer (17), circlip (18) and split pins (21).

Reassembly

1. Fit the new bearing (16) into the levelling box (9), then slide the gear shaft (19) into place, securing it with the new thrust washer (17) and circlip (18).
2. Drive a new dished expansion plug (11) into the levelling box, using a suitable drift.
3. Refit the levelling handle (13) to the levelling box, then refit the bevel gear (12) and secure it by fitting and peining the new rivet (14).
4. Refit the knuckle (8) securing it with the clevis pin (10) and a new split pin (21).
5. Charge the levelling box with a recommended grease, until grease exudes past the seals.
6. Screw the gear shaft into the lower fork and adjust for length, then refit the knuckle, clevis pin and a new split pin to the lift arms.

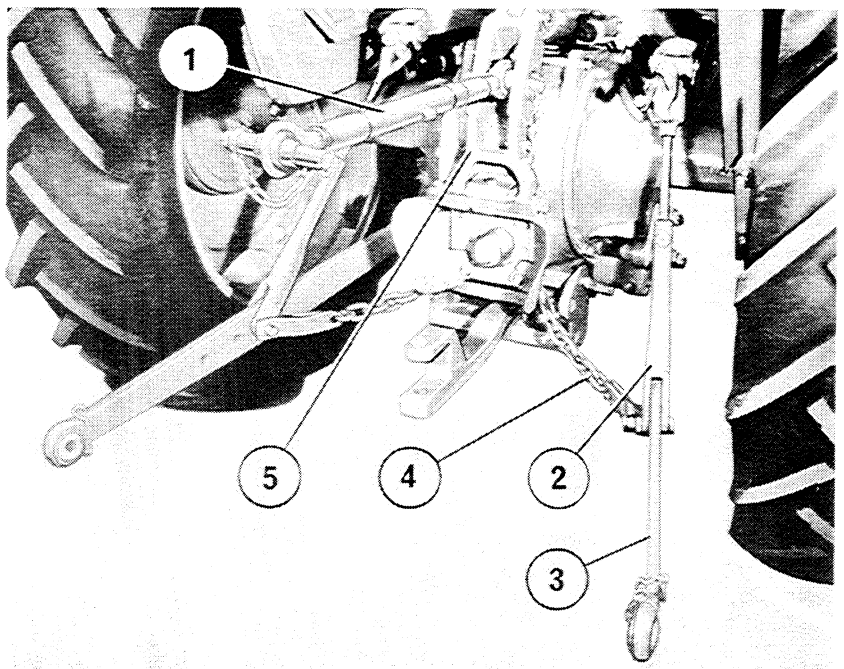


FIG. 1

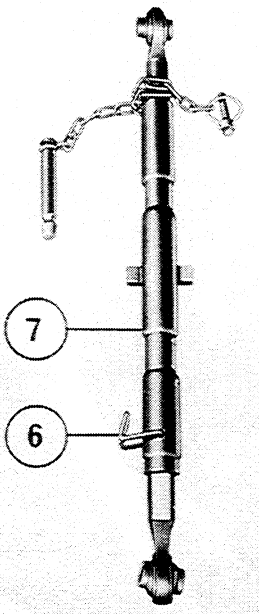


FIG. 2

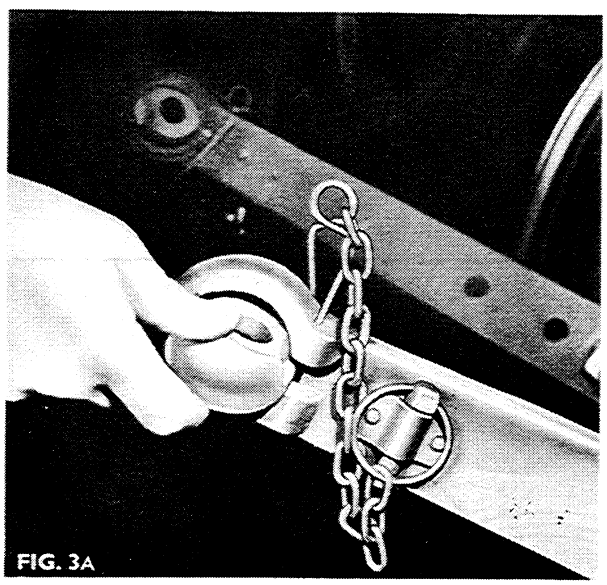


FIG. 3A

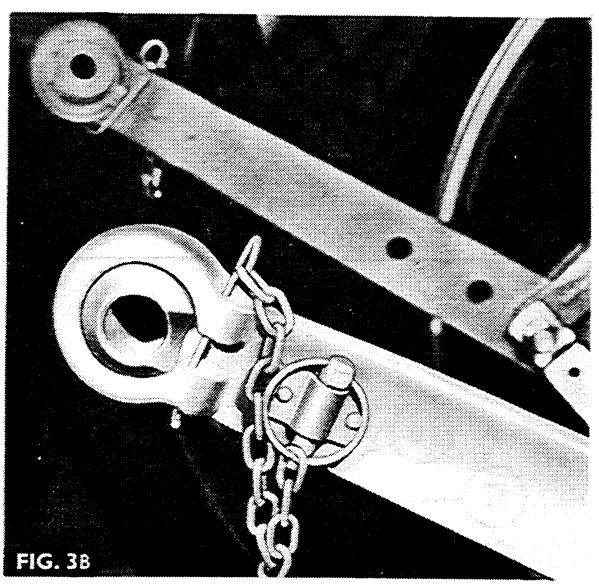


FIG. 3B

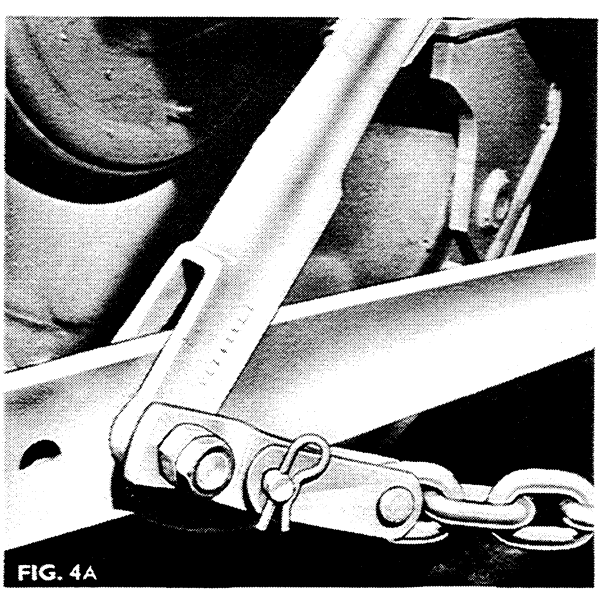


FIG. 4A

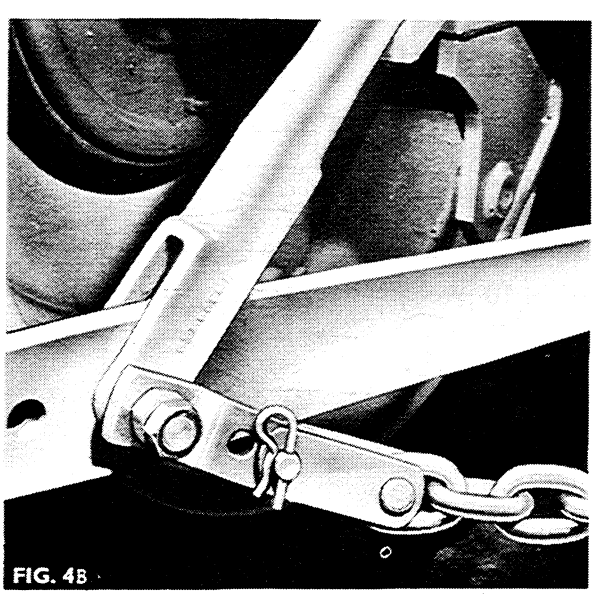


FIG. 4B

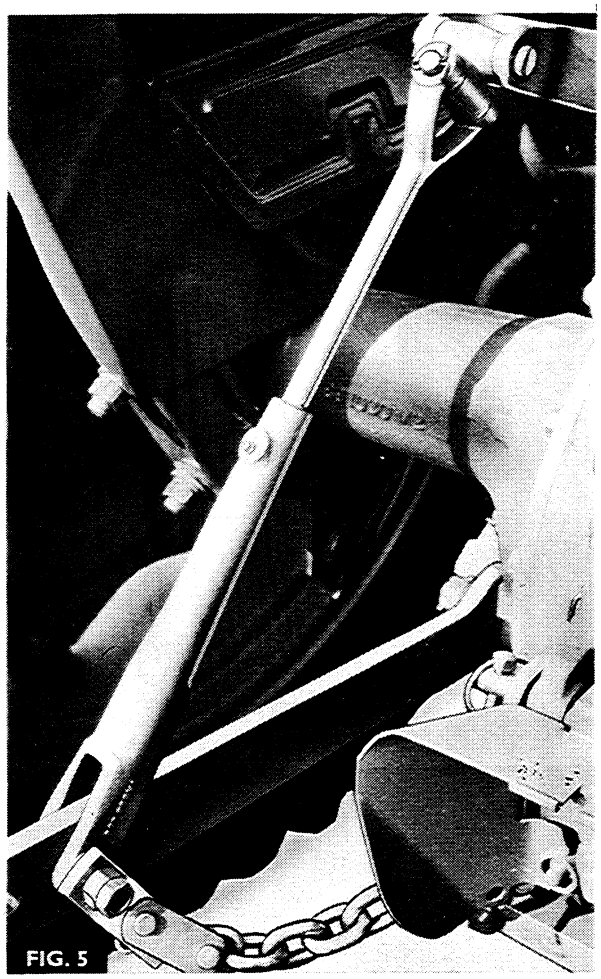


FIG. 5

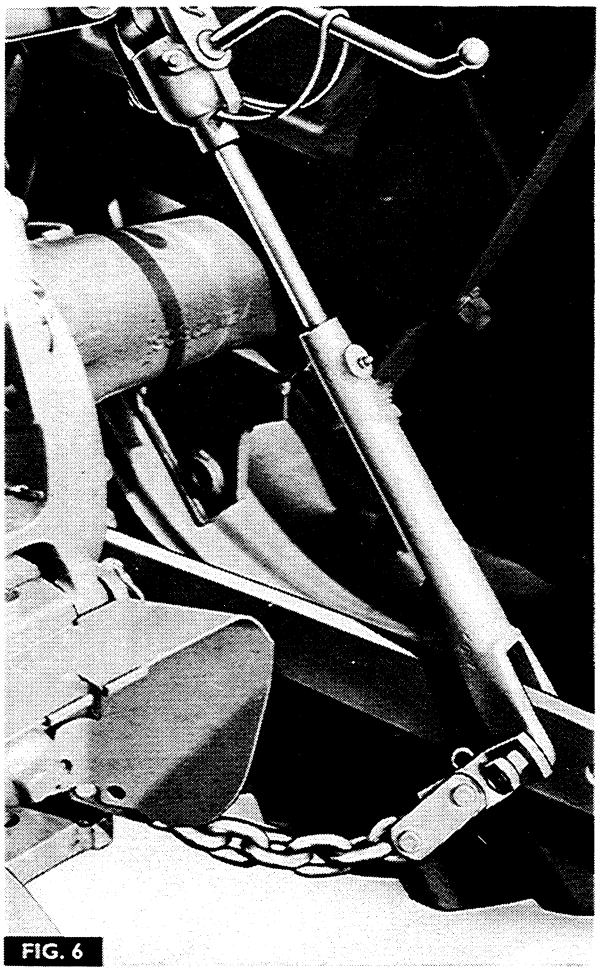


FIG. 6

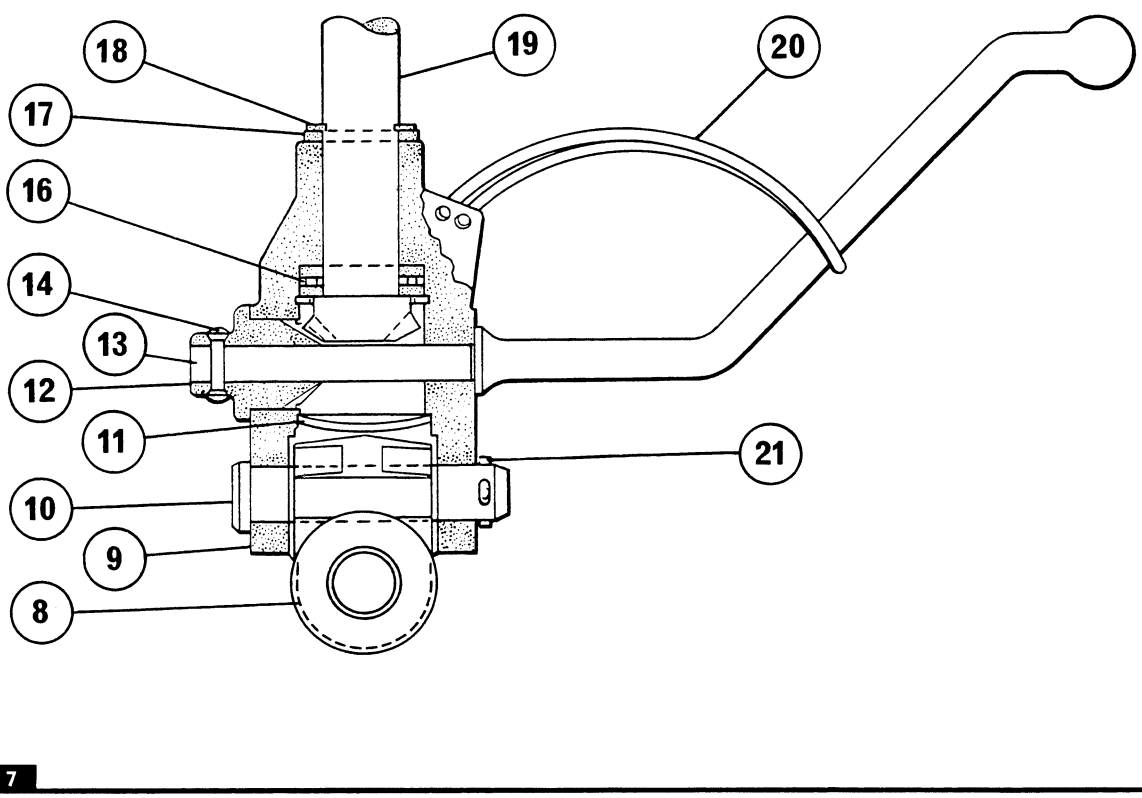


FIG. 7

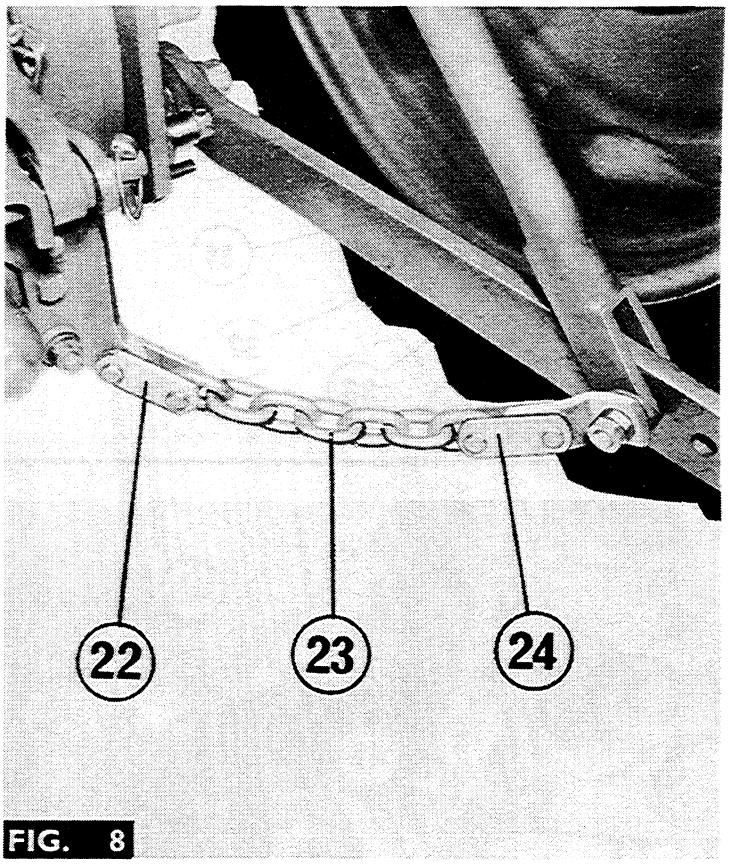


FIG. 8

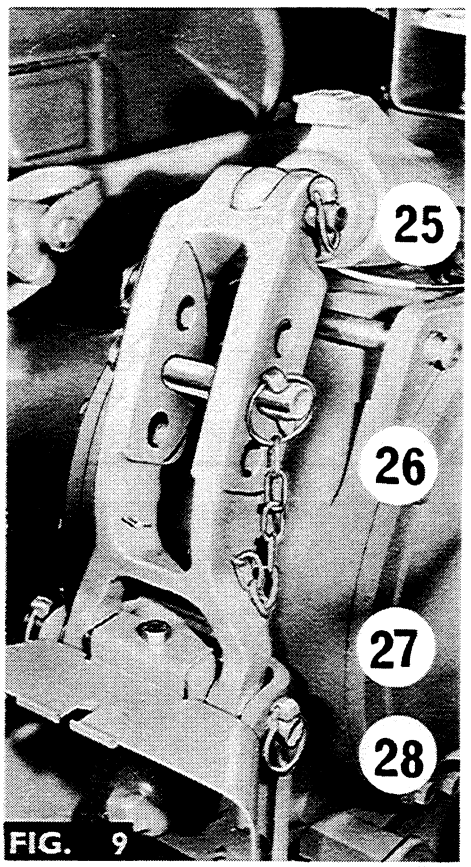


FIG. 9

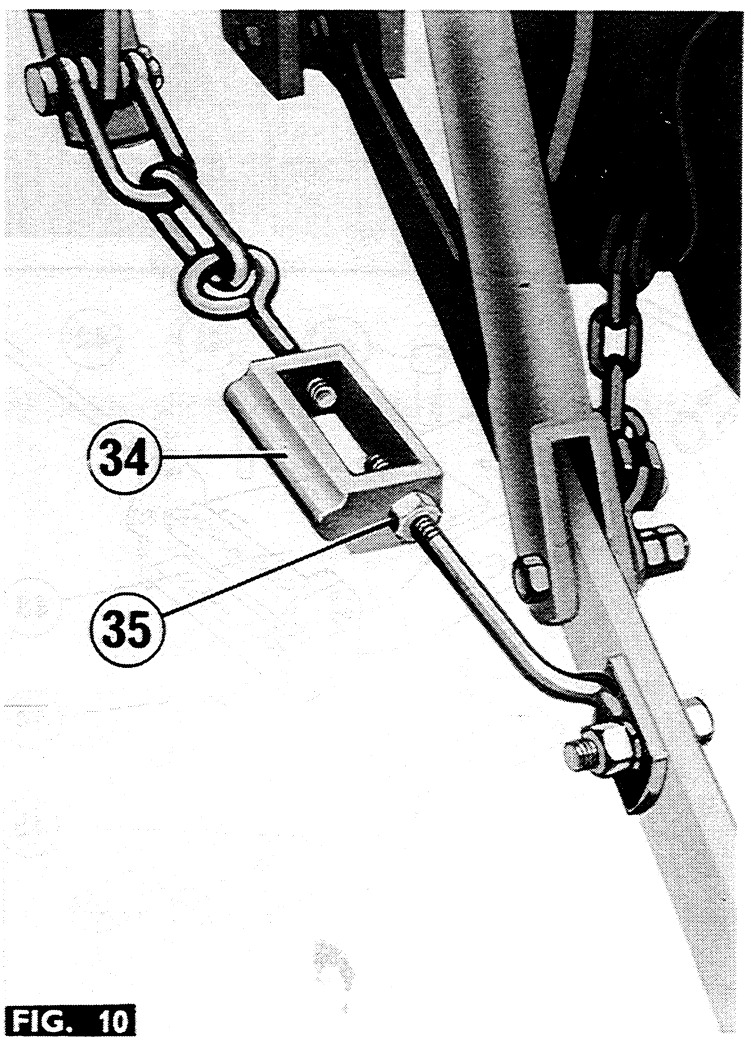


FIG. 10

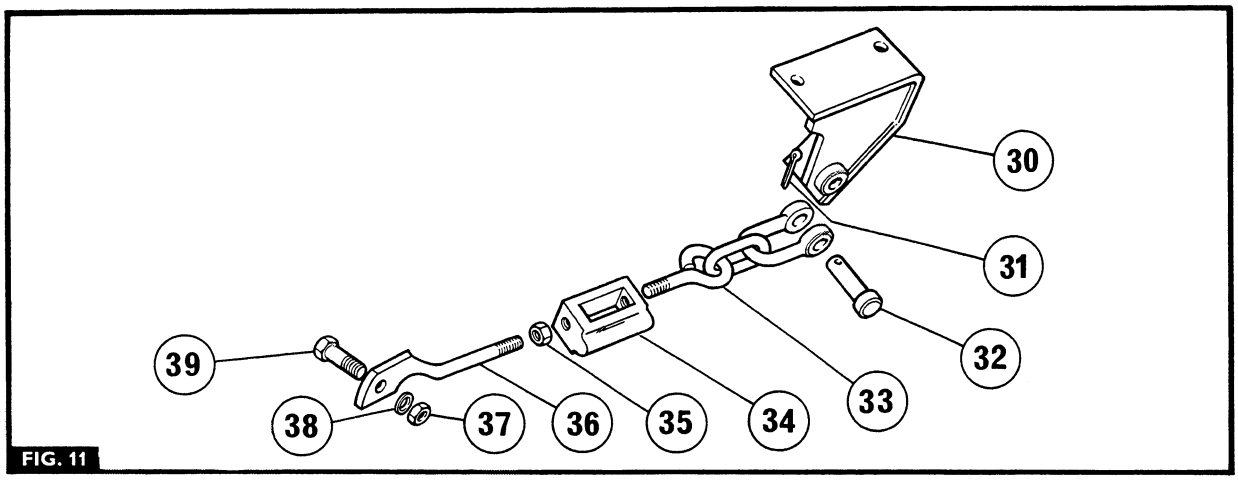


FIG. 11

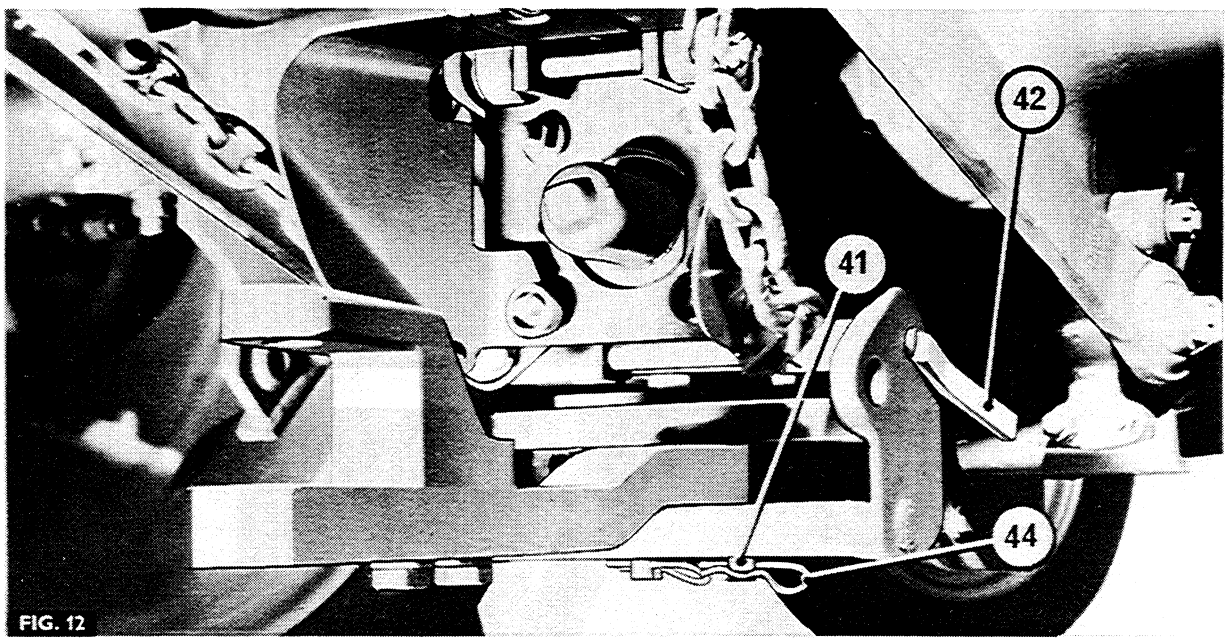


FIG. 12

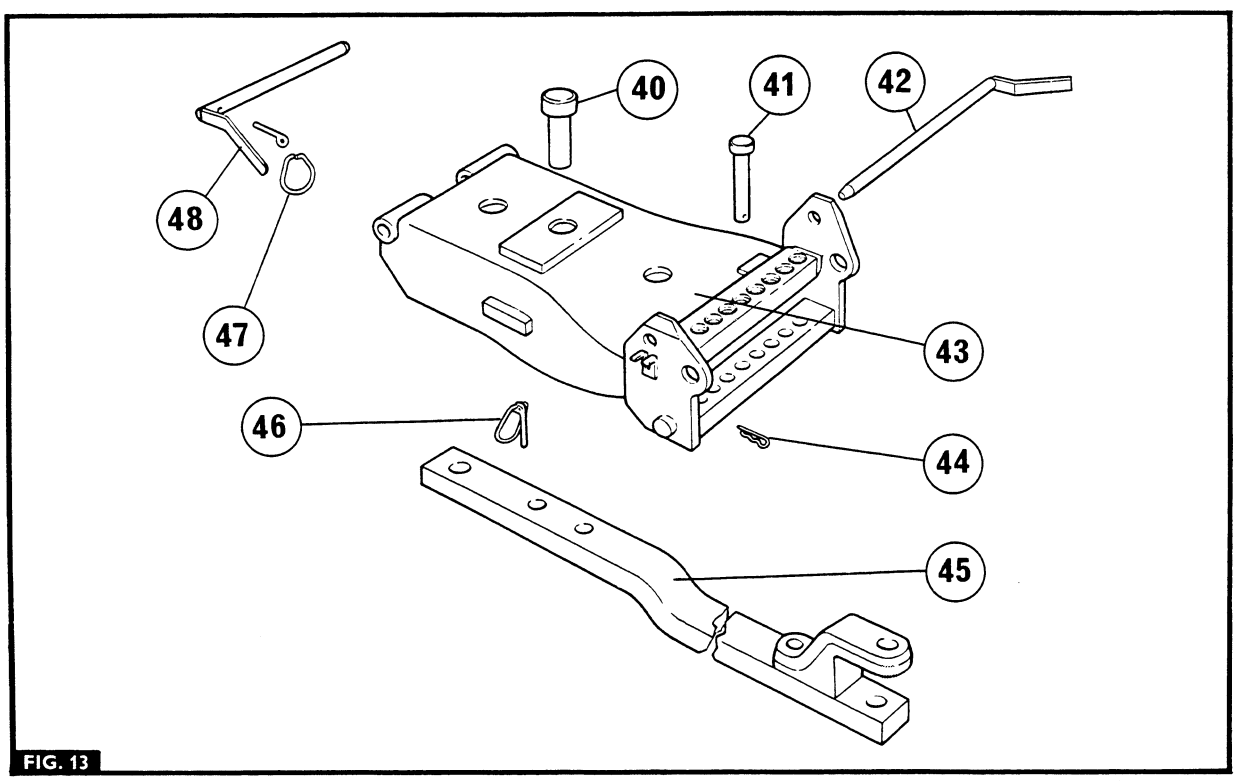


FIG. 13

CHECK CHAINS Fig. 8

The check chains restrict the movement of the lower links in a transverse plane, preventing the lower links or the implement they are carrying from striking the tractor's rear tyres. The check chains are attached to the rear of the tractor centre housing by the check chain anchor bracket and to the lower links by cranked brackets secured to the lower links by the lift rod retaining bolts.

The check chains comprise of the following components:–
Fig. 8. A pair of parallel side links (24) at the lower link end of the chain, seven plain chain links (23), and a pair of slightly shorter parallel side links (22) at the anchor bracket end.
According to the setting of the linkage for either Category 1 or Category 2 implement (See page 7C-02) the length of the chains are:–

Category 1 :– 308 mm (12⅛ in)
Category 2 :– 330 mm (13 in)

Check Chain Anchor Bracket

The one piece check chain anchor bracket with four stud, plus two bolt fixing is standard equipment The check chain anchor bracket also acts as the lower pivot point for the control beam.

CONTROL BEAM Fig. 9

The control beam connects the top link to the tractor hydraulic linkage when using Draft Control and thus governs the action of the implement.

Control Beam Removal and Refitment 7C-03-07

1. Fig. 9. Remove the linch pin (25) and withdraw the pin (26) securing the control beam to the control spring pull rod.
2. If necessary, remove one of the Auto-Hitch support brackets to permit removal of the lower pin.
3. Remove the linch pin (28) from the opposite end of the lower pivot pin (29) to that from which the Auto-Hitch support bracket has been removed, then withdraw the lower pin, complete with the other linch pin. Lift the control beam clear of the tractor.

STABILISERS Fig. 10

Stabilisers are fitted to prevent transverse movement of the lower links where an implement must be retained in a constant position relative to the tractor centre-line, to ensure accurate alignment, either with the crop rows, or the p.t.o. shaft. Adjustments are made by slackening the locknut (35) and rotating the turnbuckle (34) to give the required length, then retightening the locknut. Before working with soil engaging implements the chains should be adjusted to permit 50 mm (2 in) of sideways movement at the end of each lower link.

Stabiliser Kit Fitment

Two chain stabiliser kits are available for MF 148 tractors: A kit for tractors fitted with the U.K. safety frame and a seperate kit for tractors without the safety frame. Basic assembly for both kits is similar and is dealt with by one set of fitting instructions:–

1. Remove both nuts and washers from the fender attachment bolts.
2. Fig. 11. Locate the brackets (30) on the fender bolts and secure them with the washers and nuts tightened to a torque of 17 kg-m (125 lb-ft).

   NOTE – THE BRACKETS ARE MARKED 'L' AND 'R' TO INDICATE L.H. AND R.H. FITMENT
3. Assemble the chains (33) turnbuckle (34) locknut (35) and the link (36) together for each side of the tractor.
4. Align the rear links (36) with the holes in the lower links and secure them with the bolt (39), washer (38) and nut (37).
5. Align the shackles of the chains (33) with the holes in the bracket (30), then secure them with the clevis pins (32) and split pins (31).
6. Adjust the stabilisers for length, then liberally smear the threaded portions of the links and chains with grease to ensure ease of adjustment at a later date.

SWINGING DRAWBAR Fig. 12

The swinging drawbar conforms to British Standards, having a clevis hitch point at 356 mm (14 in) from the p.t.o. shaft. The maximum static load permissible at this setting is 765 kg (1700 lb). An alternative position, which places the drawbar clevis at 254 mm (10 in) from the p.t.o. shaft is provided. At this setting the maximum static load is 990 kg (2200 lb).

Swinging Drawbar Kit Fitment

1. Check the contents of the kit against the list provided.
2. Fig. 13. Slide the drawbar assembly (45) into the mounting frame (43) and fit the drawbar pin (40), then fit the two locating pins (41) securing them with the hairpins (44).
3. Place the mounting frame and drawbar assembly on a jack and raise it into position, secure it at the front with the support pin (48) and linch pin (47) and at the rear with the other support pin (42) and linch pin (46). Remove the jack.

Adjustments

Offset: Figs 12 and 14

1. Remove the linch pin and withdraw the support bar (42), thus freeing the drawbar frame.
2. Remove the two hairpins (44) from the locating pins (41) and remove the locating pins.
3. Reset the drawbar in the required position.
4. Refit the locating pins (41) and secure them with the hairpins (44).
5. Raise the drawbar frame and secure it with the support pin (42) and linch pin.

Length: Figs 12 and 13

1. Remove the linch pin and withdraw the support bar (42).
2. Push the drawbar pin (40) upwards, thus freeing the drawbar.
3. Adjust the drawbar for length and refit the drawbar pin (40).
4. Raise the drawbar frame and secure it with the support pin (42) and linch pin.

Height: Fig. 15

The drawbar can be adjusted for height. The procedure is similar to that for length adjustment. When inverting the drawbar the clevis adapter can be placed either on top, or underneath, as shown, but the bolts must be kept tight.

AUTO-HITCH Fig. 16

The Auto-Hitch is a supplementary lifting mechanism fitted to the swinging drawbar frame to enable implements fitted with a ring type drawbar attachment to be easily coupled to the tractor.
The hitch hook can, if required be replaced by the swinging drawbar by simply lowering the hitch, removing the pin and sliding out the hook, then replacing it by the drawbar.

Operation
Raising:– The quadrant control levers should be positioned as follows:–
'Draft Control' lever – 'Transport' i.e. fully back.
'Position Control' lever – Move to 'Transport' (adjacent to 'Constant Pumping'). The tractor lift arms will rise, lifting the hitch hook. When the 'Transport' position is reached, the latches will engage automatically, thus relieving the tractor linkage of weight.
Lowering:– Leave the 'Draft Control' lever in 'Transport'.
Move the 'Position Control' lever to 'Constant Pumping'; this will raise the hook frame clear of the latches. Pull the release lever rearwards to disengage the latch hooks, then, continuing to hold the release lever, move the 'Position Control' lever to 'Down'. the hitch will then lower.

Auto-Hitch Kit Fitment

1. Unpack the kit and check the contents against the packing list.
2. Fig. 13. Remove the linch pin and withdraw the support bar (42), thus freeing the drawbar frame (43).
3. Remove the three rearmost bolts securing each trumpet housing.
4. Fig. 17. Assemble one hook support bracket (49) to the centre housing, tightening the Allen screws to 11 kg-m (80 lb-ft).
5. Slide the cross shaft (51) through the bush in the hook support bracket already fitted, then fit the other hook support bracket.
6. Remove the masking tape from the spigots on the support brackets, then slide the latch hooks (50) on to the spigots. Secure each hook with a large washer and split pin.
7. Fig. 18. Assemble the cross shaft levers (54) on to the cross shaft (51) shimming them on each side with one thick washer and an equal number of thin washers.
8. Fit the ball (52) to the handle (53), then fit the handle to the R.H. cross shaft lever, securing it with a roll pin through either the centre hole (tractors with De Luxe seat) or the upper hole (tractors with Spring Suspension seat).
9. Secure the cross shaft levers (54) to the cross shaft (51) with a roll pin (55) on each side. Ensure that the cross shaft can rotate freely.
10. Assemble the springs (57) to the pull rods (58).
11. Locate the pull rods (58) in the support brackets (49), then fit the clevis pins (56) through the hooks (50) and the cross shaft levers (54) by compressing the springs. Secure the clevis pins with the four small split pins.
12. Fig. 19. Assemble the latches (62) and the support bar (61) to the drawbar frame, as shown, and secure the support bar with the two long, large split pins.
13. Remove the split pin and clevis pin securing each lift arm to the lift rod knuckle.

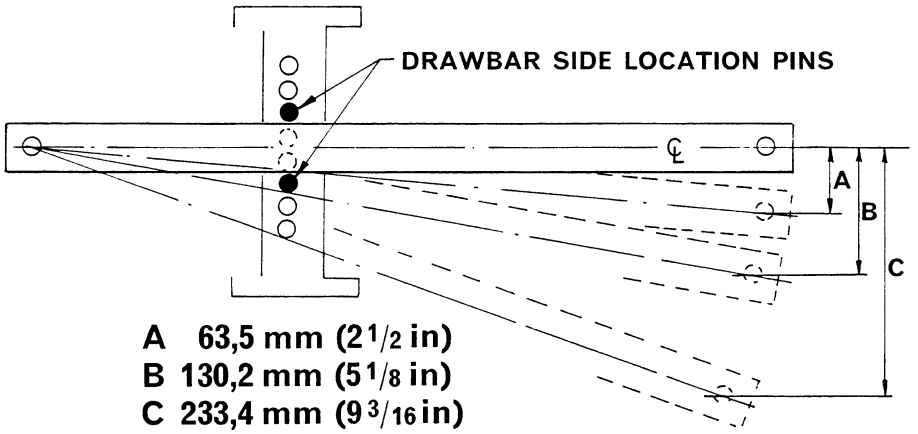
    WARNING – AS THE CLEVIS PIN IS REMOVED, THE LOWER LINK AND LIFT ROD WILL DROP.

14. Fig. 20. Locate the lift arm extension (65) against the lift arm, then loosely fit the two long bolts (63), plate (64), spring washers and nuts.
15. Raise the lower links and lift rods and fit the new, longer clevis pins (66), securing them with split pins.
16. Fully tighten the lift arm extension bolts (63).
17. Fig. 21. Screw a nut on to the threaded portion of each lift chain (68) then screw an eye (67) on to each chain.
18. Attach the chains to the lift arm extensions with clevis pins and secure with two split pins.
19. Place a strip of metal 1,5 mm x 25 mm x 150 mm ($\frac{1}{16}$ in x 1 in x 6 in) on top of the drawbar frame, above the locating pins (41, Fig. 22), then jack up the frame, as shown, until the strip of metal is trapped between the frame and the drawbar mounting bracket.
20. Start the tractor engine, select 'Constant Pumping' with the 'Position Control' lever and 'Transport' with the 'Draft Control' lever. The lower links will fully raise. Stop the engine.
21. Adjust the length of the lift chains (68) by screwing the eyes up or down, until the eyes will just slide on to the spigots on the latches (62, Fig. 19).

    NOTE – ENSURE THAT THE CHAINS ENGAGE THE LATCHES WITH EXACTLY EQUAL TENSION.

22. Remove the eyes from the spigots on the latches and SHORTEN the chains by screwing the eyes up a further FOUR turns, then fully tighten the nut on the threaded portion of the chains.
23. Lower the links slightly, refit the eyes and secure them with the medium size split pins.
24. Remove the jack, then lower the hitch by moving the lever (53) forwards, and moving the 'Position Control' lever to the 'Down' position.
25. Fig. 22. Remove the metal strip, then push out the drawbar pin (40) and withdraw the drawbar.
26. Fit the hitch hook (69), refitting the drawbar pin (40), then if necessary remove the hairpins (44) and locating pins (41) and refit them to centralise the hook.
27. Fig. 23. Remove the p.t.o. shield (if fitted) then remove the two nuts (71), spring washers and spacers securing the bottom of the check chain anchor bracket.
28. Fit the hook stop plate (70), spring washers and nuts (71), discarding the two spacers.
29. Fig. 24. Remove the long pin and fit the linkage check bracket (72) as shown.

Adjustment 7C-04-08
Every 500 hours, the adjustment should be checked. If the adjustment is incorrect, adjust as detailed in operations – 19 to 25.



A 63,5 mm (2 1/2 in)
B 130,2 mm (5 1/8 in)
C 233,4 mm (9 3/16 in)

FIG. 14

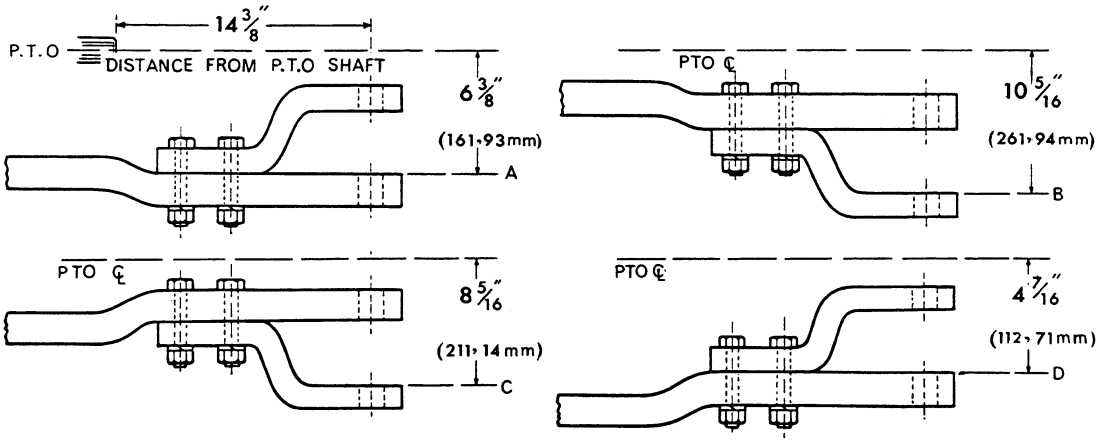


FIG. 15

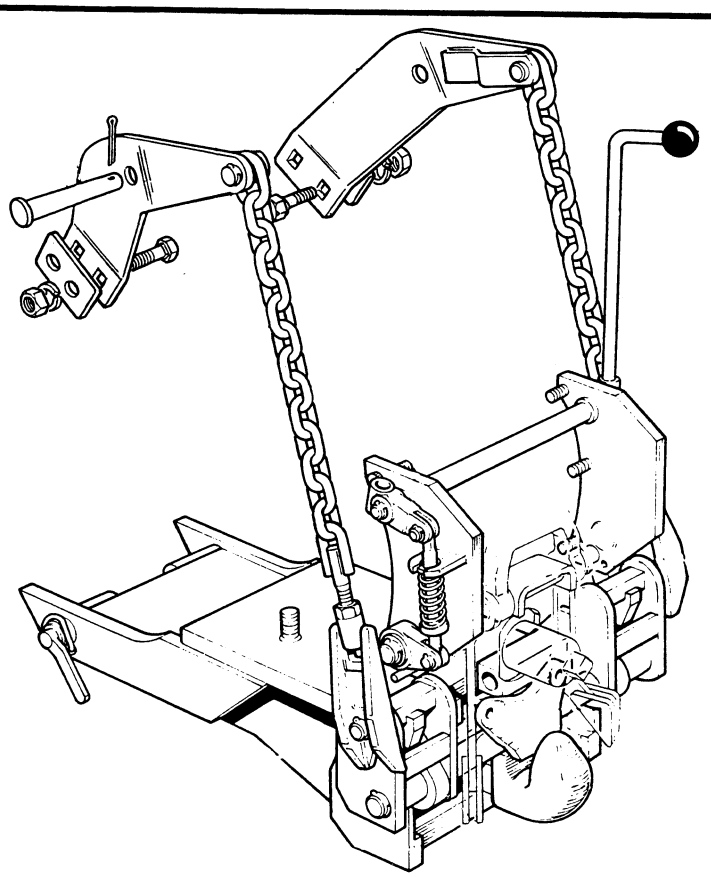


FIG. 16

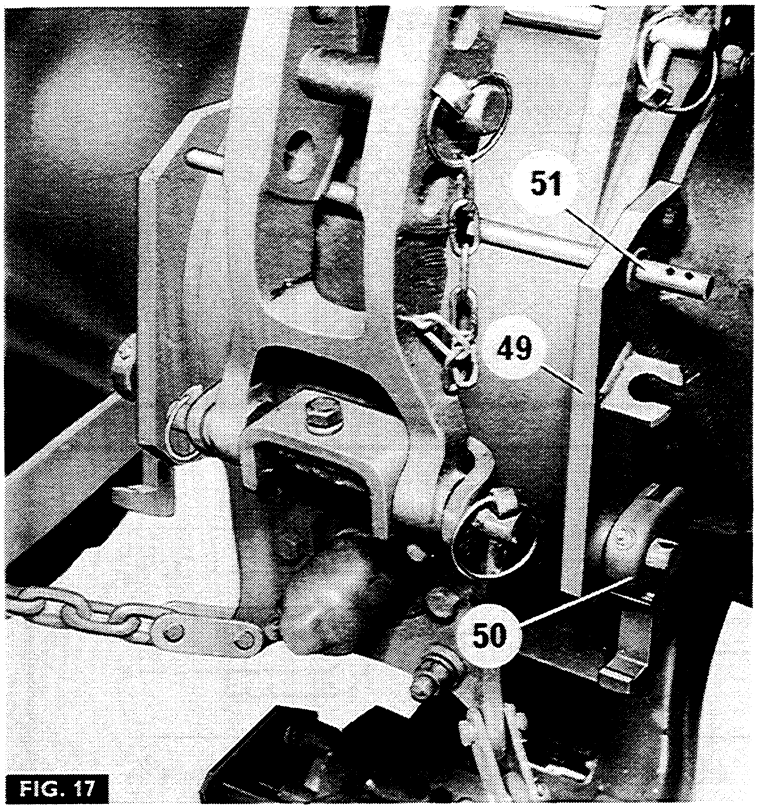


FIG. 17

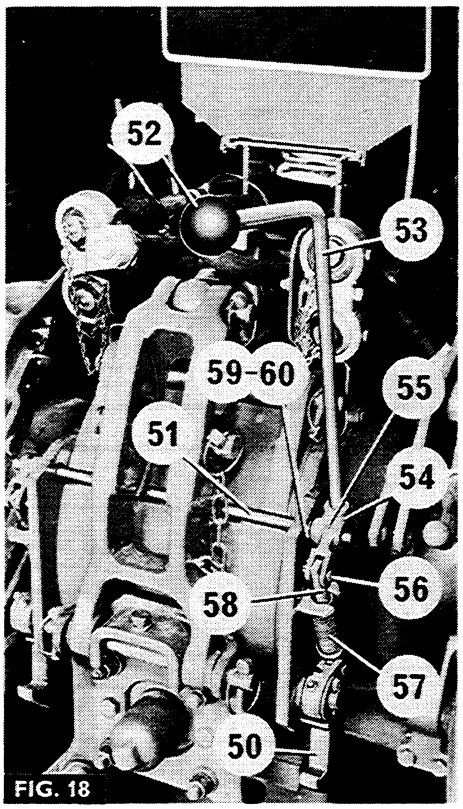


FIG. 18

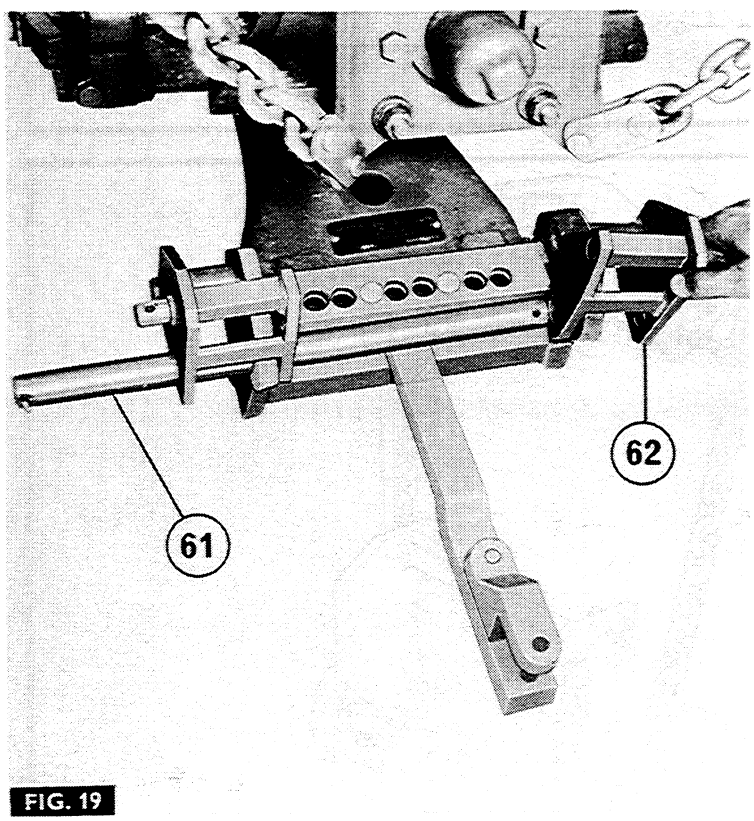


FIG. 19

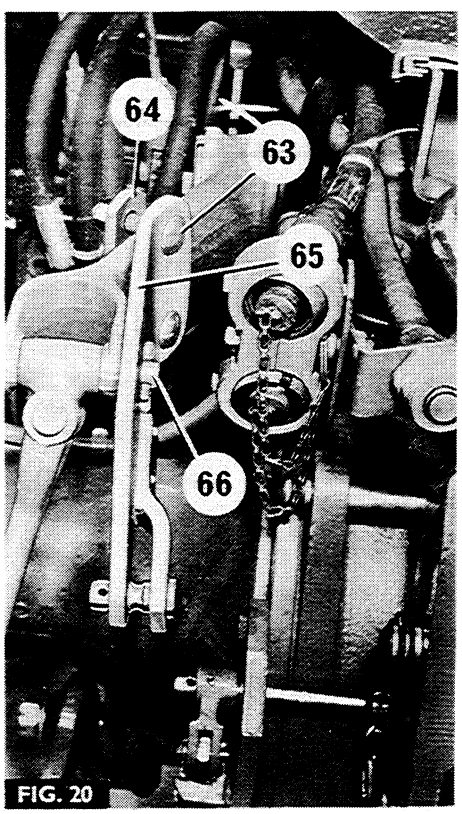


FIG. 20

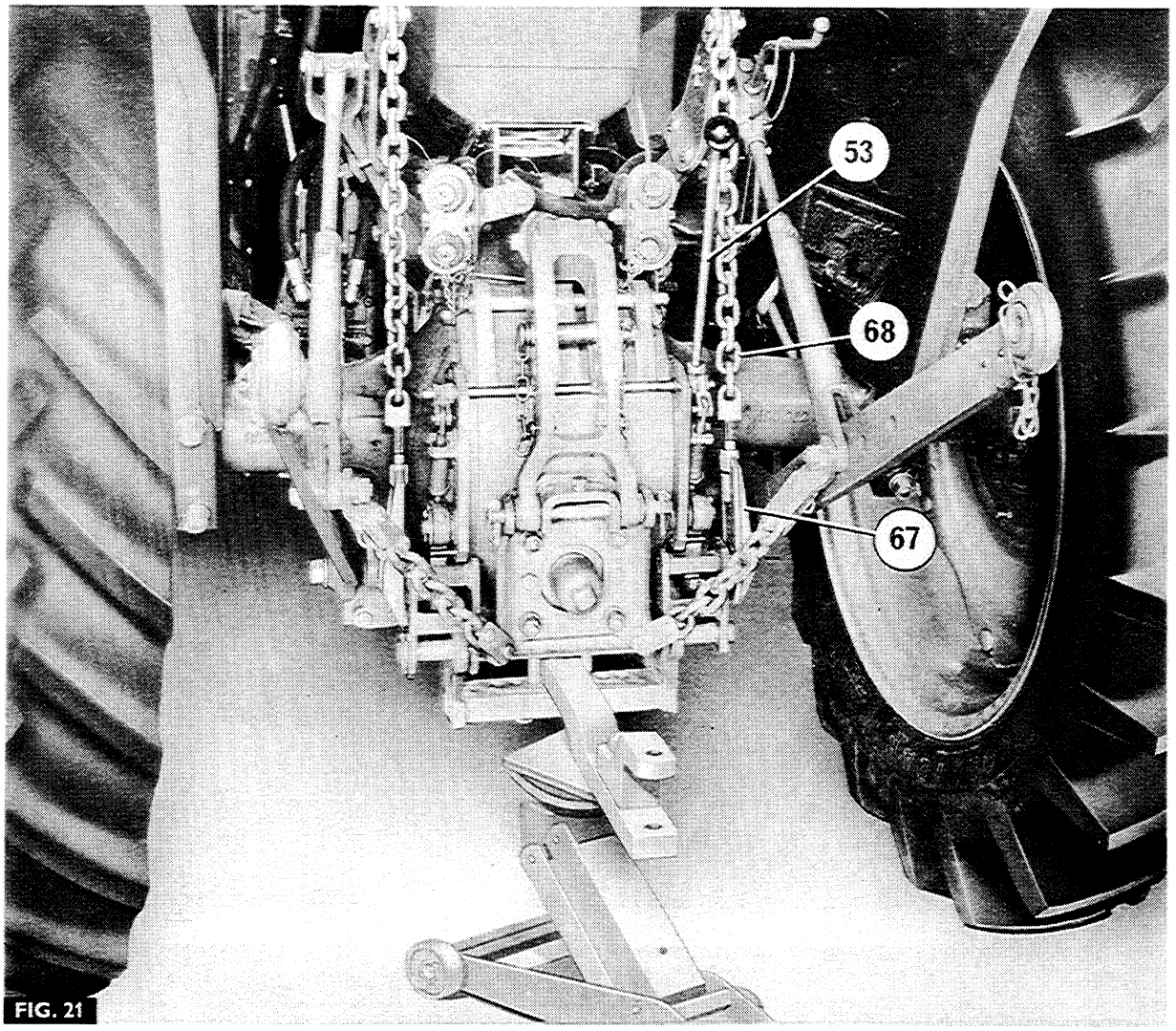


FIG. 21

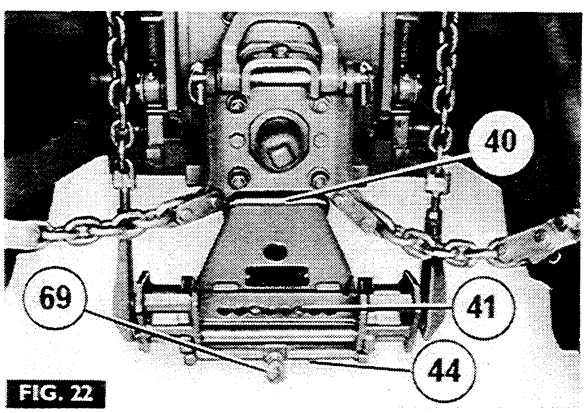


FIG. 22

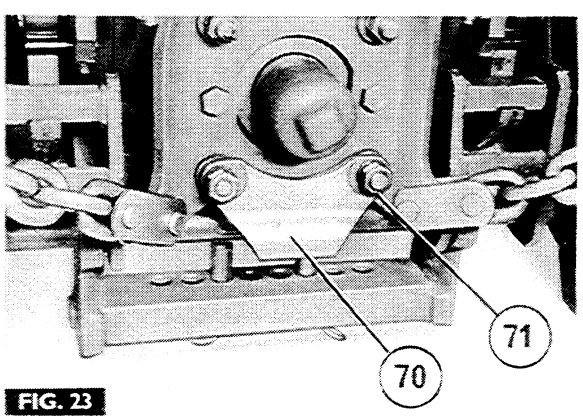


FIG. 23

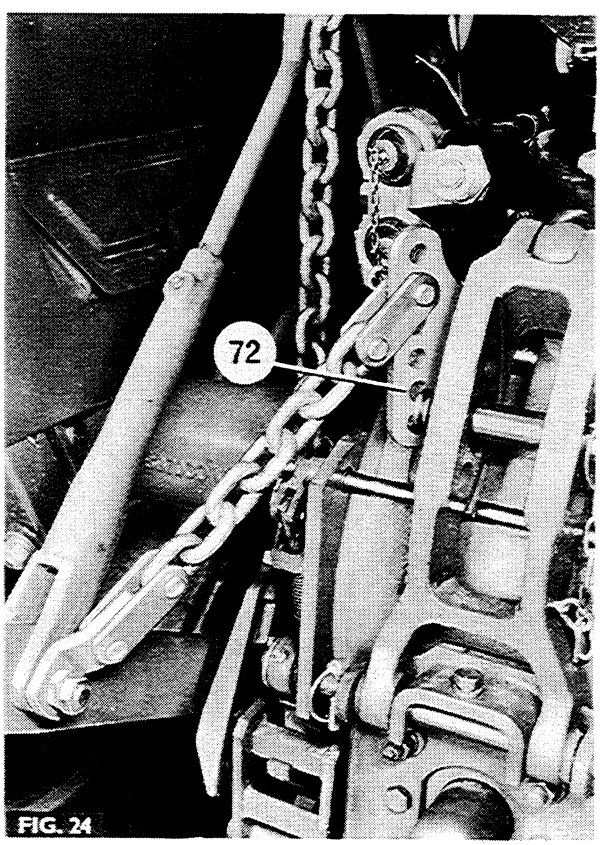


FIG. 24

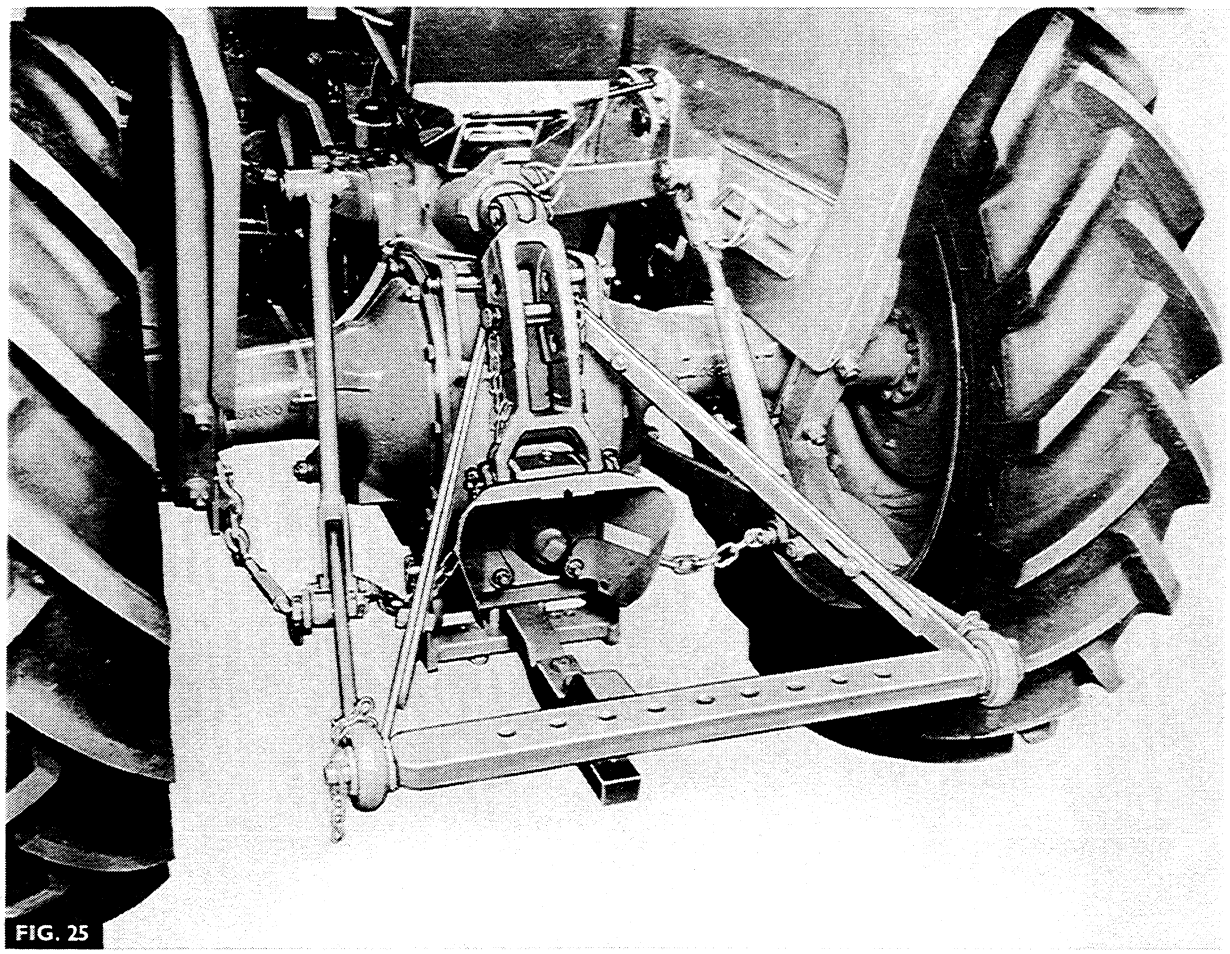


FIG. 25

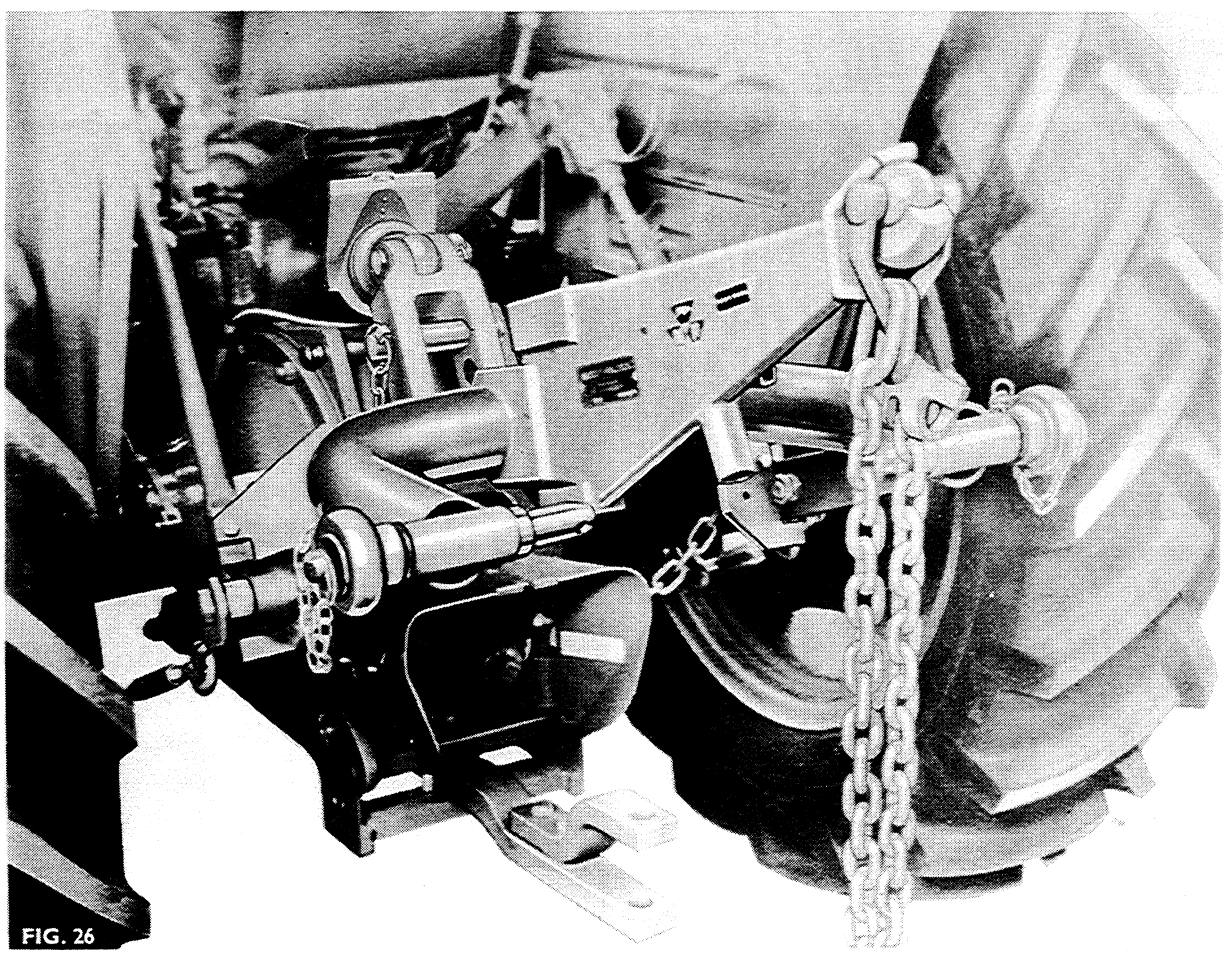


FIG. 26

Auto-Hitch used as a Swinging Drawbar
The Auto-Hitch can be converted to a swinging drawbar by substituting the drawbar for the hitch hook.
To remove the hook.
1. Lower the Auto-Hitch.
2. Remove the hitch hook securing pin and pull the hook rearwards and out of the mounting frame.
3. Remove the hairpins and locating pins at the rear of the mounting frame and slide the drawbar into the frame, refitting the securing pin. The drawbar can be positioned as shown in Fig. 14 and secured by refitting the locating pins and hairpins.

WARNING – DO NOT ATTEMPT TO LIFT THE AUTO-HITCH MECHANISM WITH THE DRAWBAR OFFSET AND A LOAD APPLIED.

Linkage Check Bracket **Fig. 24**

When a two-wheel trailer is used with the Auto-Hitch, the tractor lower links may foul the trailer drawbar when turning. To prevent such an occurrence, the linkage check bracket has been provided as part of the Auto-Hitch Kit.
After the trailer has been hitched, connect the check bracket by removing the hairpin and headed pin securing the L.H. check chain to the anchor bracket. Align the flat links in the end of the check chain with a convenient hole in the check bracket. Re-fit the headed pin and hairpin.

LINKAGE DRAWBAR Fig. 25

The linkage drawbar can be used when towing trailed implements with low weight transfer. To prevent excessive transverse movement, a pair of drawbar stays are fitted. These stays are adjustable for length to permit the height of the drawbar to be set as required and then locked in position.

WARNING – NEVER SET THE DRAWBAR ABOVE THE REAR AXLE CENTRE-LINE, OTHERWISE THE TRACTOR WILL BECOME EXTREMELY UNSTABLE WHEN TOWING.

Drawbar Fitment **Fig. 25**
1. Remove the long pin from the tractor centre housing.
2. Loosely assemble the pairs of stays, fitting the bolts only to the slotted holes.
3. Attach the stays to the centre housing as shown, securing them with the long pin and linch pin.
4. Fit the drawbar mounting pins to the holes in the stays, then into the lower link balls and secure them with linch pins.
5. Adjust the height of the drawbar using the tractor hydraulic lift system. When the notches in the stays are aligned, the drawbar will be at the normal working height of 500 mm (19½ in).
6. Finally tighten the outer bolts and fit the centre bolts to a pair of aligning holes.
7. Place both of the hydraulic control levers in the fully lowered position (i.e. 'Drop').

WARNING – IF THE LEVERS ARE PLACED IN THE RAISED POSITION, THE STAYS MAY BE BENT, OR BROKEN, WHEN THE TRACTOR ENGINE IS STARTED.

PRESSURE CONTROL COUPLER Fig. 26

The Pressure Control Coupler enables weight to be transferred to the tractor rear wheels when working with trailed implements, thus improving traction.
This additional weight transfer also gives improved braking performance by minimising wheel-locking and slewing when descending steep gradients.

Description
The coupler consists of a curved, tubular cross-member with fabricated location lugs and dual Category mounting pins, by means of which the beam is attached to the tractor lower links. Attached to the tubular member is a hinged hook, carrying the coupling chain, which is attached by the safety release ball and the adjusting claw.

Modification of Implement Drawbars
Before operating, certain modifications must be made to the implement drawbar to ensure adequate strength to attach the chain and where necessary to ensure that the coupler chain will clear the p.t.o. shaft, if used. As the Pressure Control coupler is used in conjunction with a variety of drawbar designs and applications, the following modifications are suggested:–
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 which may be of either of the above types.

Any of the above types of drawbars may need strengthening to withstand the lifting force applied by the coupler chain.
If the implement is powered by a p.t.o. driveshaft alterations must also be made to enable the coupler chain to clear the p.t.o. shaft.
Figures 27 to 30 show the recommended methods of modifying the implement drawbar for added strength and to give p.t.o. shaft clearance.
Strengthening can be achieved:–
a) By welding an angle-iron section on to the underside of a round tube drawbar.
b) By welding an identical angle-iron seciton 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 in relation to the boom and drawbar. When turning, the chain must slide freely through the anchor brackets, otherwise, rapid chain wear will occur. Square, or angle section drawbars may need chain guides to assist the chain in sliding. Various methods of keeping the chain clear of the p.t.o. shaft can be employed, according to the type of drawbar fitted.
MF machinery which is operated in conjunction with the Pressure Control coupler should be modified to allow chain attachment. Modification procedure for such machinery is detailed in the General Machines Workshop Service Manual, Publication No. 819 218 M1.

For implements other than those manufactured by MF the following principle modifications for the various drawbar types are as follows:–

Figure 27 'A' Frame type of round tube construction.

Figure 28 'A' Frame type of square tube, or angle iron construction.

Figure 29 'Pole' type, showing alternatives for round or square constructions.

Figure 30 'Pole' type, non-p.t.o., showing alternatives for round, or square sections.

NOTE – THE P.T.O. DRIVE SHAFT MUST HAVE A MINIMUM CLEARANCE FROM THE COUPLER CHAIN OF 25 MM (1 IN).

Adjustments

To allow one design of Pressure Control coupler to be fitted to MF135, 148, 165 and 168 tractors, the ball end mounting pins are reversible for Categories 1 and 2 and the lugs welded to the tubular cross member have adjustable adapter plates to compensate for the varying width of the lower links according to the particular tractor.

The adapter plates should be positioned as shown in Fig. 31. The reversible ball end mounting pins have alternative end diameters of 22,23 mm (⅞ in) and 28,58 mm (1⅛ in) to suit Category 1 and 2 ball ends respectively.

Coupler to Tractor Fitment

1. Ensure that the adapter plates are correctly adjusted as shown in Figure 31.
2. Check that the required ball end mounting pin faces outwards.
3. Place the coupler frame between the tractor lower links, then engage the ball end mounting pin and the frame bracket on the left lower link and then on the right lower link, secure the ball end mounting pins with the linch pins.

Coupler to Implement Attachment

1. Raise the coupler on the lower links, using 'Pressure Control'.
2. Attach the implement drawbar on to the tractor swinging drawbar.
3. Lower the coupler on the tractor using 'Position Control' until the tubular cross member is parallel to the ground.
4. Fig. 32. Loop the chain through the chain anchor bracket(s) and engage the nearest available chain link in the adjusting claw.
5. Tension the chain by moving the control quadrant lever to increase 'Pressure'.

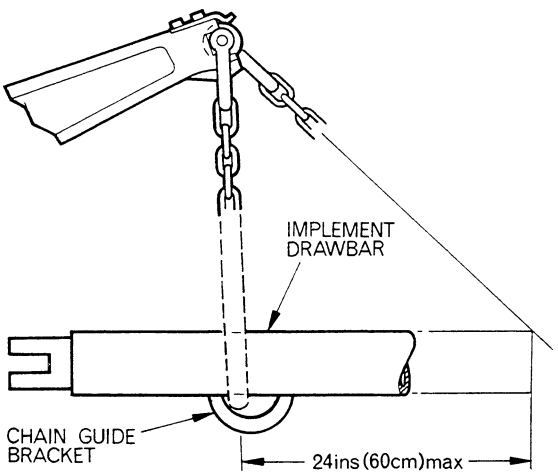
NOTE – THE MAXIMUM CHAIN ANGLE SHOULD NOT EXCEED 45° FIG. 33.

Operation

1. Attach the coupler to the tractor and implement.
2. Move the 'Draft Control' lever fully back.
3. Move the 'Position Control' lever into the black 'Pressure' sector of the inner quadrant to the 'LOW' position. Move the lever back just sufficiently to give adequate traction, then set the adjustable stop to align with the lever. If difficult conditions are encountered, increase the pressure by moving the lever towards 'High' until traction is obtained. Always return the lever to the set position when conditions improve.

Stowage for Transport

Fig. 34. If a tractor fitted with the Pressure Control coupler is to be driven without an implement attached, the boom should be stowed by slewing it to the right and engaging the spring clip (73).



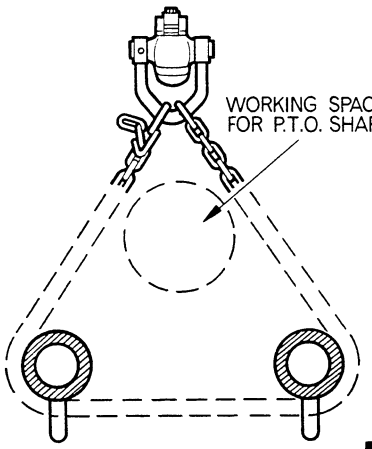
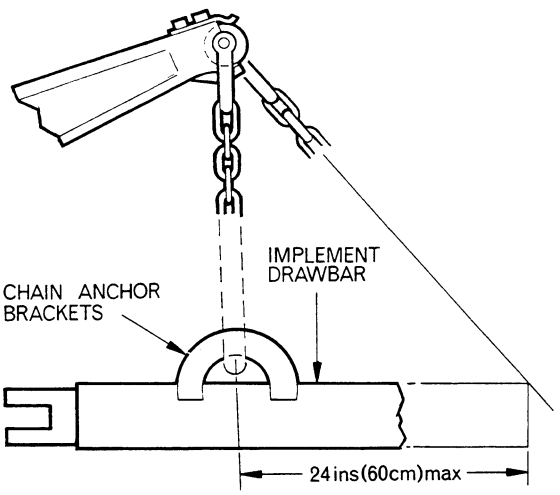


FIG. 27



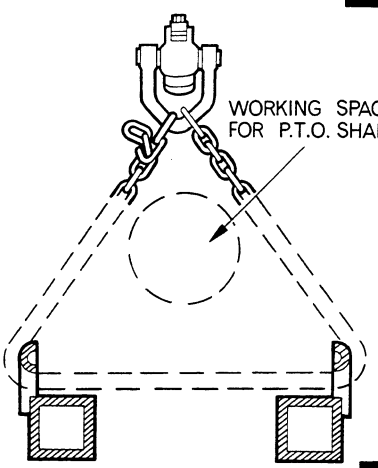
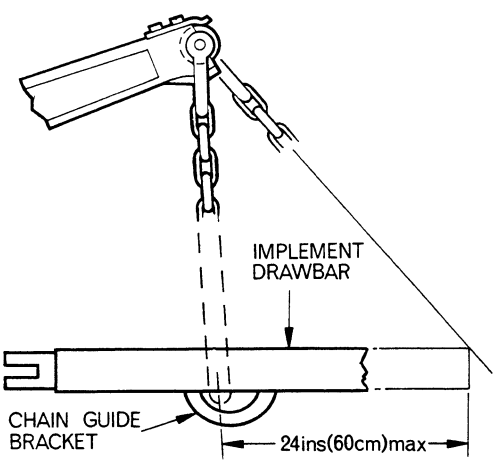


FIG. 28



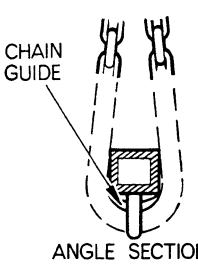
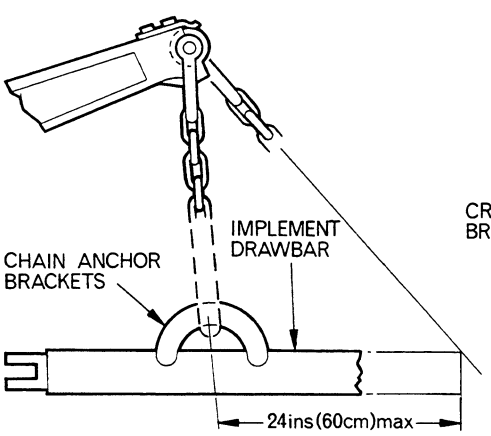
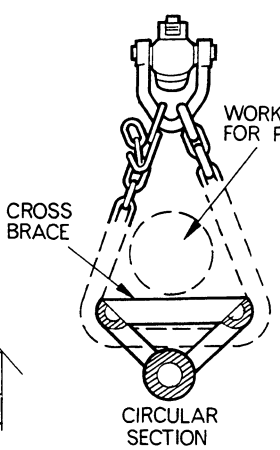


FIG. 29





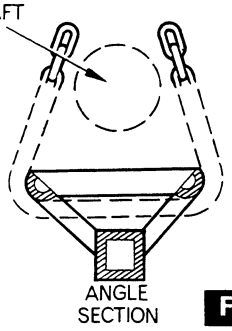


FIG. 30

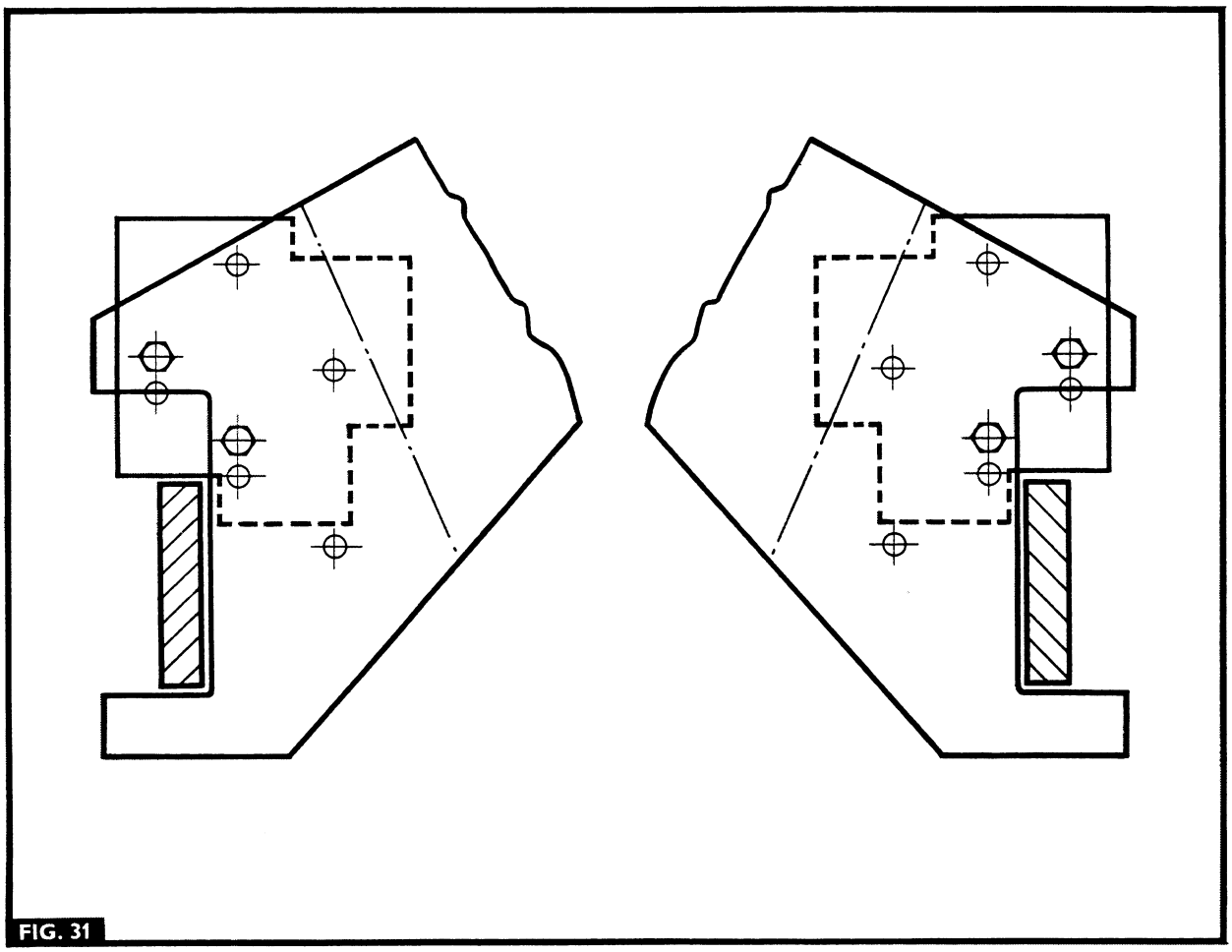


FIG. 31

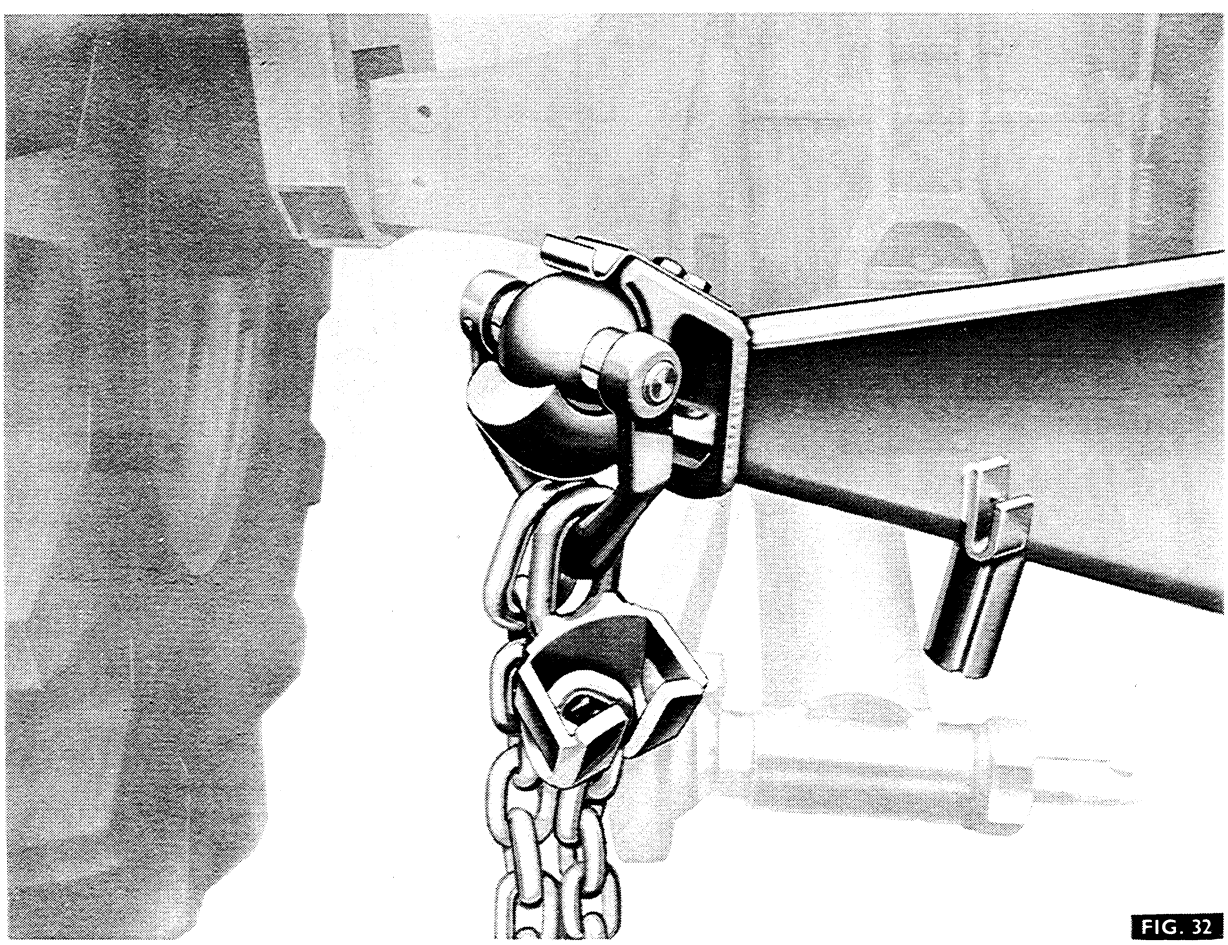


FIG. 32

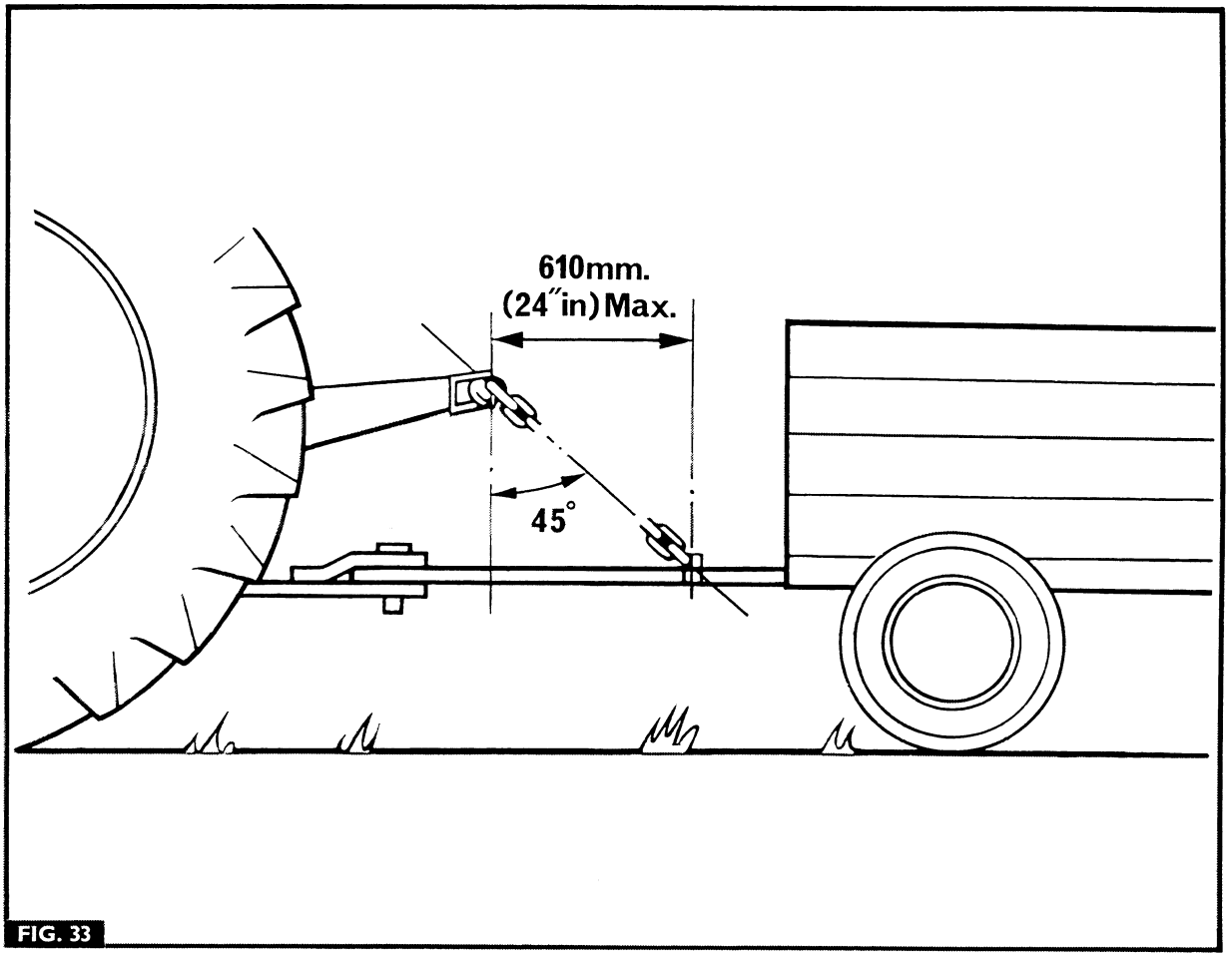


FIG. 33

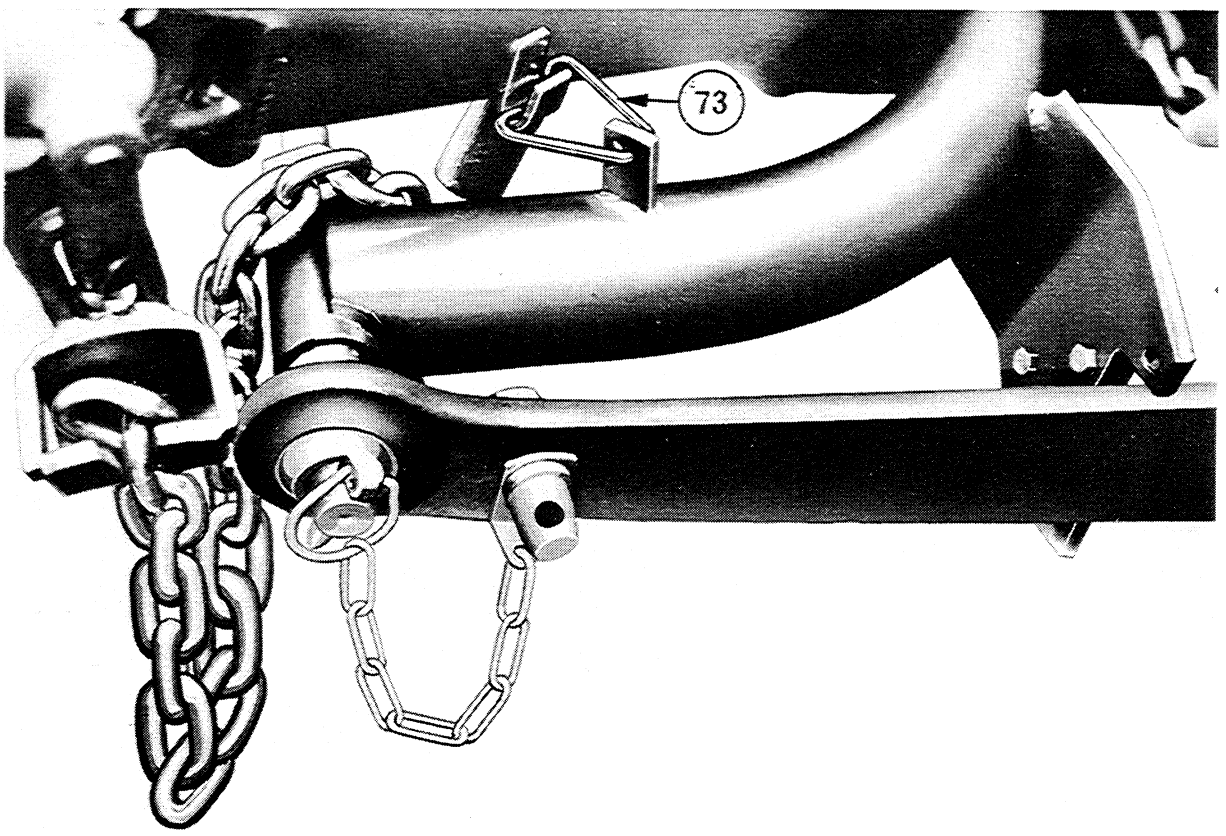


FIG. 34

LINKAGE AND DRAWBARS

Part 7 Section C

LINKAGE AND DRAWBARS

GENERAL

Fig. 1. The three point linkage controls the movements of the mounted and semi-mounted implements. The linkage comprises four main components:– top link (1), lower links (3), lift rods (2), checks chains (4).

TOP LINK

Fig. 2. The top link is of the three-piece, barrel, turnbuckle type and is adjustable for length between the dimensions stated in the specification section.

Adjustment Procedure 7C-01

1. Fig. 2. Release the locking clip (5).
2. Rotate the barrel (6) until the required length is achieved. Do not permit the ball ends to rotate.
3. Return the spring clip to the engaged position to retain the ball ends in the correct plane.

LOWER LINKS

The lower links (3) carry the implement and are also used when attaching the Pressure Control coupler or the linkage drawbar. Vertical but not lateral movement of the lower links determines the height of the implements from the ground, or its depth of penetration.
The lower links fitted to this tractor have provision for interchangeability of the ball ends.

Interchanging Ball Ends 7C-02

1. Fig. 3A. Pull the spring clip (7) upwards, as shown.
2. Rotate the ball until the narrow portion aligns with the slot in the lower link, then remove the ball.
3. Fig. 3B. Fit the new ball by locating it with the narrow section in line with the slot, then refit the spring clip, as shown.

NOTE – FOR CATEGORY 1 IMPLEMENTS, THE CHECK CHAIN LENGTH MUST BE SET AS SHOWN IN FIG. 4A AND FOR CATEGORY 2 IMPLEMENTS, AS SHOWN IN FIG. 4B.

LIFT RODS

The lift rods (2) connect the lift arms to the lower links. The L.H. lift rod is normally set to its correct length on assembly and is not adjusted thereafter. The R.H. lift rod incorporates a bevel gear levelling box, which allows the upper portion of the rod to be screwed into, or out of, the lower portion of the lift rod, thus adjusting the height of the R.H. lower link in relation to the left.

L.H. Lift Rod Fig 5.
The L.H. Lift rod should be adjusted for length on assembly with the centre punch mark on the upper rod just beginning to show from the lower fork. At this setting the distance between centres should be 515 mm (20¼ in) for standard tractors, or 556 mm (21¾ in) for tractors with 11-32 tyres. Other than daily greasing of the nipple on the lift rod, no other servicing is required.

R.H. Levelling Box and Lift Rod Fig 6.
The R.H. Lift rod is adjustable for length to allow the implement to be levelled during, or after attachment. Adjustments are made by rotating the handle (13) which drives through a bevel gearbox to the lift rod. The lift rod screws into, or out of the lower lift fork. The nominal length of the R.H. lift rod is 515 mm (20¼ in) for standard tractors and 556 mm (21¾ in) for tractors with 11-32 tyres and the range of adjustment is ± 38 mm (1½ in).

Levelling Box Servicing 7C-03

Disassembly

1. Fig 7. Remove the complete levelling box from the tractor by removing the split pin and clevis pin from the knuckle on the levelling box.
2. Unscrew the levelling gear shaft (19) out of the lower fork.
3. Using a 5 mm (3/16 in) diameter drill, remove one head from the double countersunk rivet (14) which secures the bevel gear (12) to the handle spindle (13).
4. Withdraw the levelling handle (13) and bevel gear (12) from the levelling box (9).
5. Remove the split pin (21) and the clevis pin (10) from the levelling box and remove the knuckle (8).
6. Remove the circlip (18) and the thrust washer (17) from the gear shaft.
7. Using a soft faced mallet, tap the end of the gear shaft (19) to force the dished expansion plug (11) out of the levelling box.
8. Slide the gear shaft (19) out of the levelling box, then remove the bearing (16).

The spring (20) and the grease nipple need not be removed.

Examination
Examine all components and replace any which are worn, or damaged.
When reassembling, always fit a new rivet (14), dished expansion plug (11), bearing (16), thrust washer (17) circlip (18) and split pins (21).

Reassembly

1. Fit the new bearing (16) into the levelling box (9), then slide the gear shaft (19) into place, securing it with the new thrust washer (17) and circlip (18).
2. Drive a new dished expansion plug (11) into the levelling box, using a suitable drift.
3. Refit the levelling handle (13) to the levelling box, then refit the bevel gear (12) and secure it by fitting and peining the new rivet (14).
4. Refit the knuckle (8) securing it with the clevis pin (10) and a new split pin (21).
5. Charge the levelling box with a recommended grease, until grease exudes past the seals.
6. Screw the gear shaft into the lower fork and adjust for length, then refit the knuckle, clevis pin and a new split pin to the lift arms.

CHECK CHAINS Fig 8.

The check chains restrict the movement of the lower links in a transverse plane, preventing the lower links or the implement they are carrying from striking

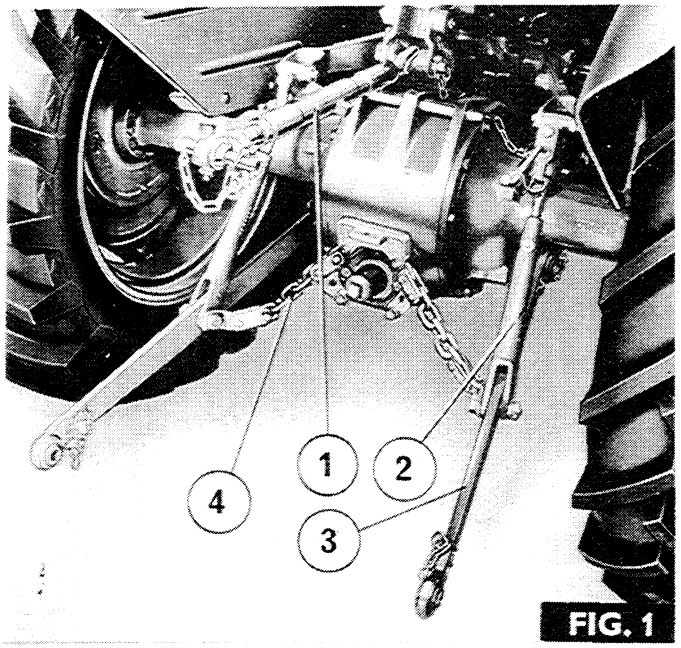


FIG. 1

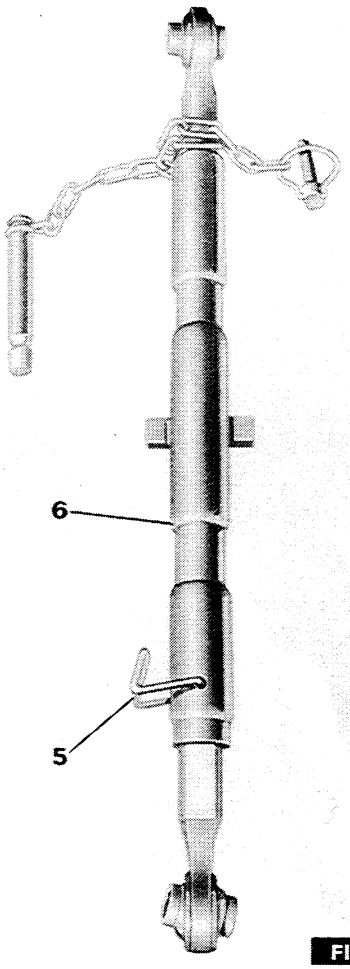


FIG. 2

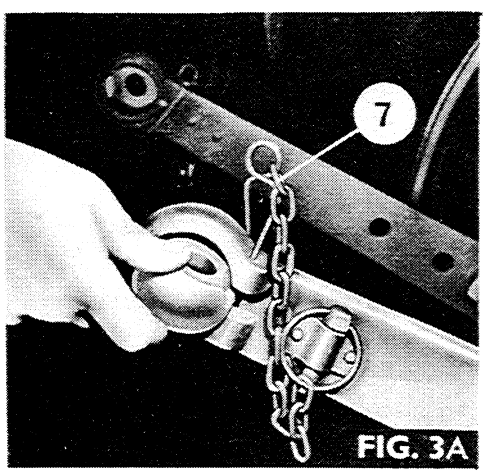


FIG. 3A

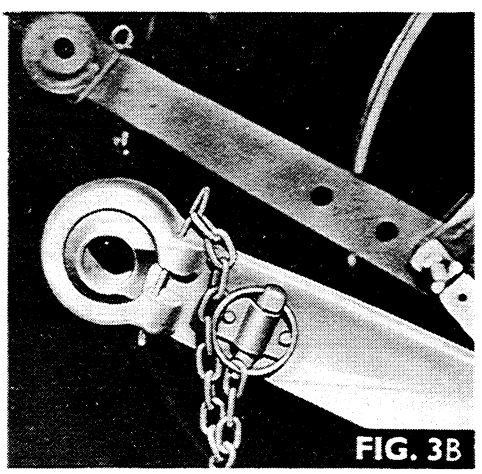


FIG. 3B

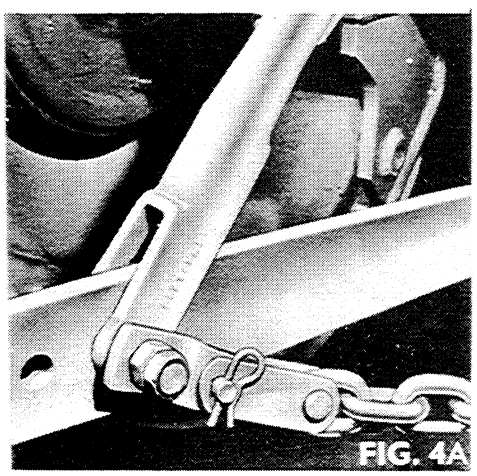


FIG. 4A

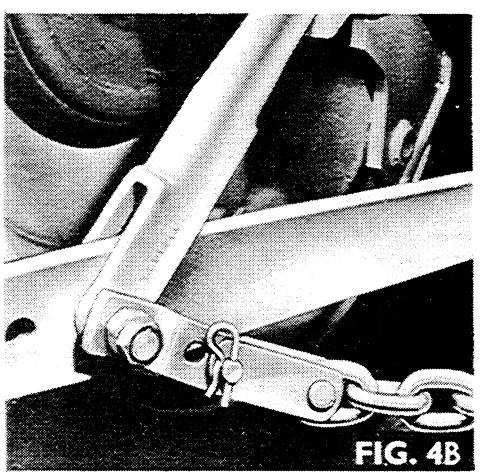


FIG. 4B

LINKAGE AND DRAWBARS

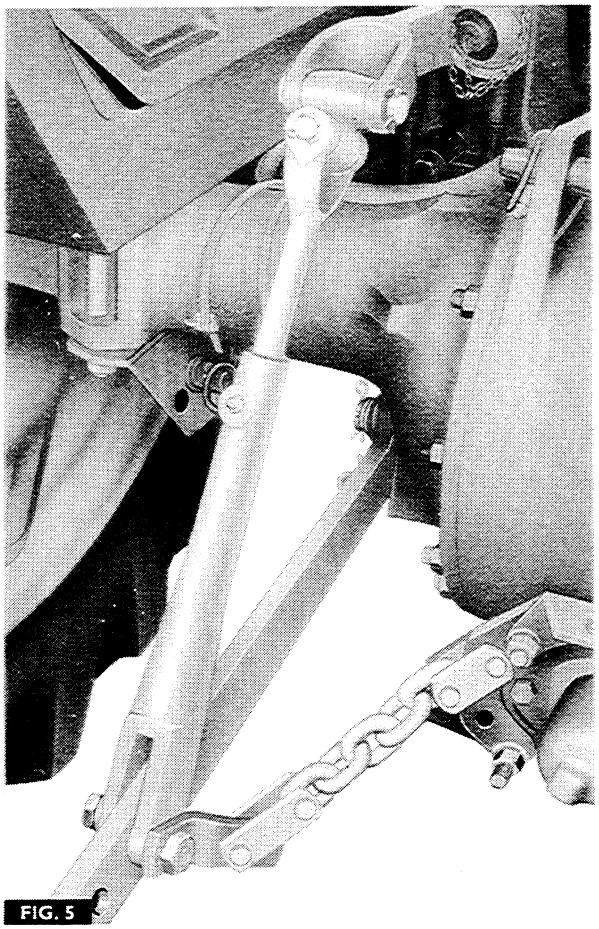


FIG. 5

FIG. 6

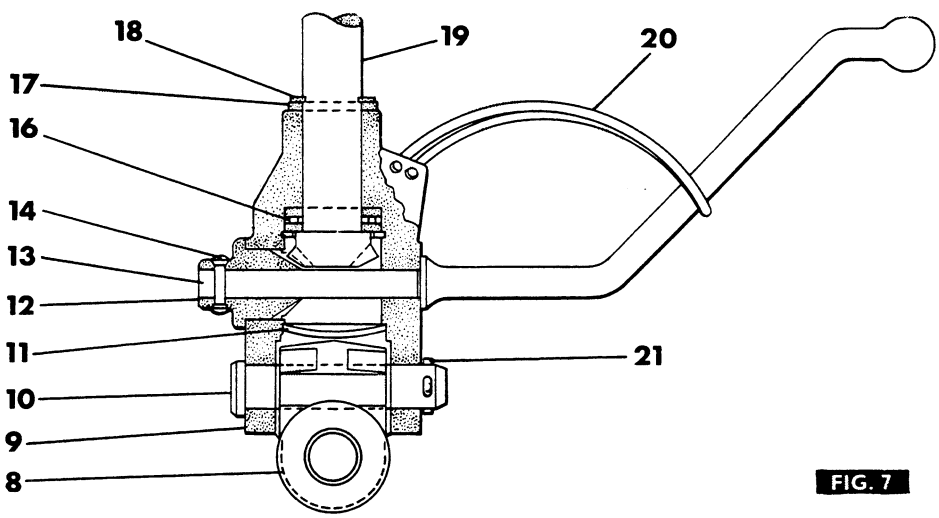


FIG. 7

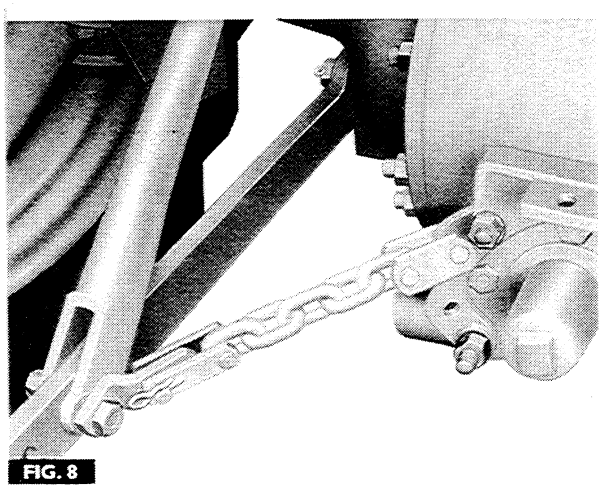


FIG. 8

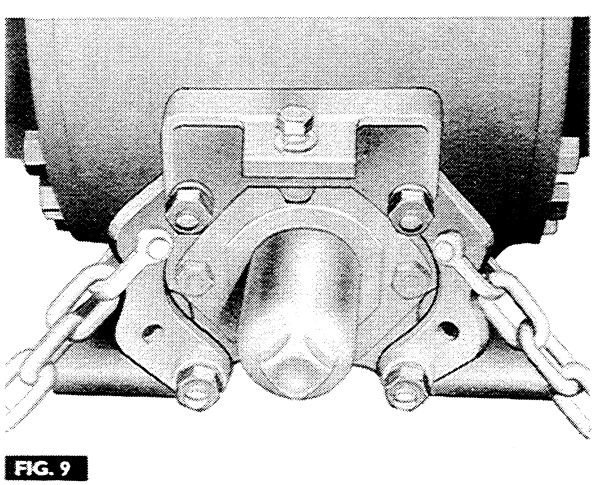


FIG. 9

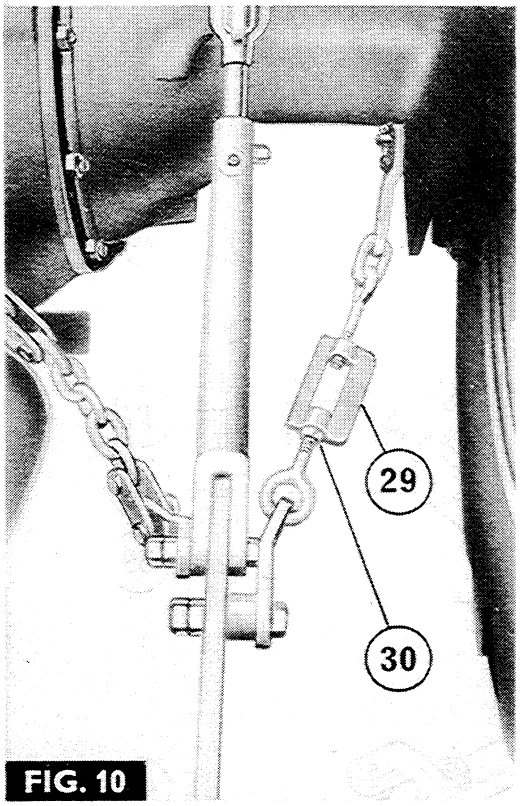


FIG. 10

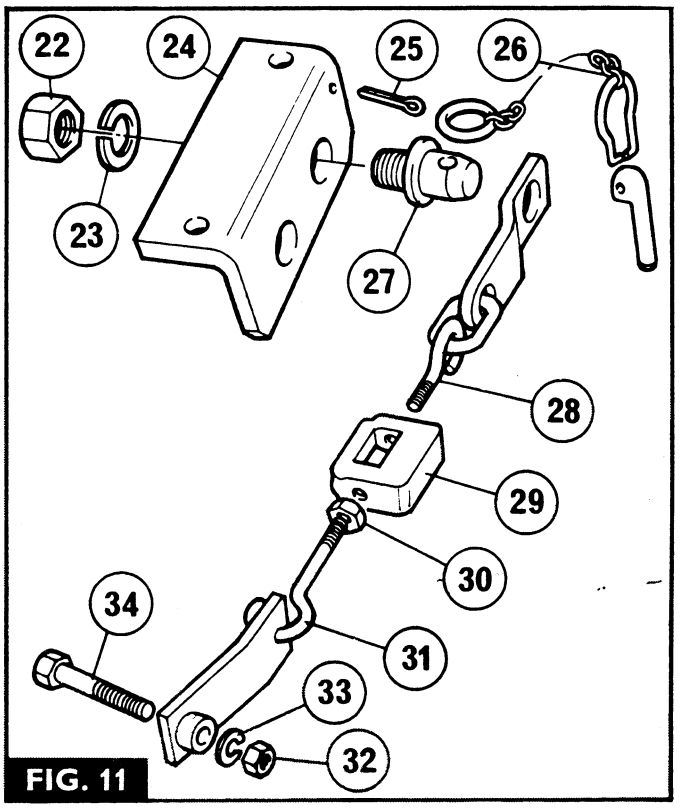


FIG. 11

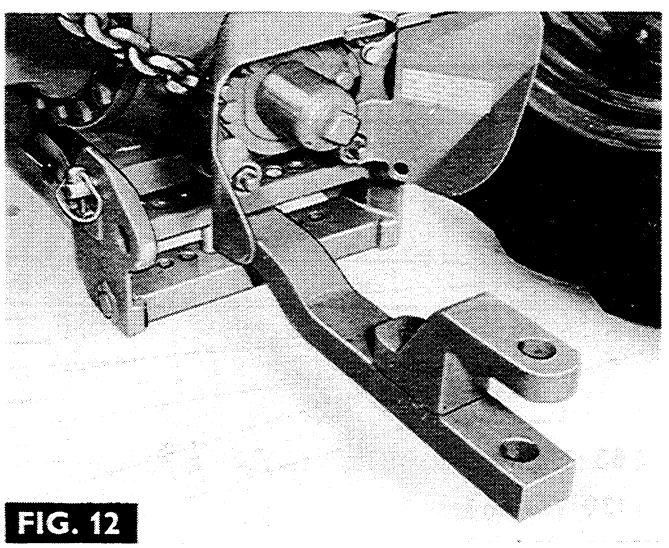


FIG. 12

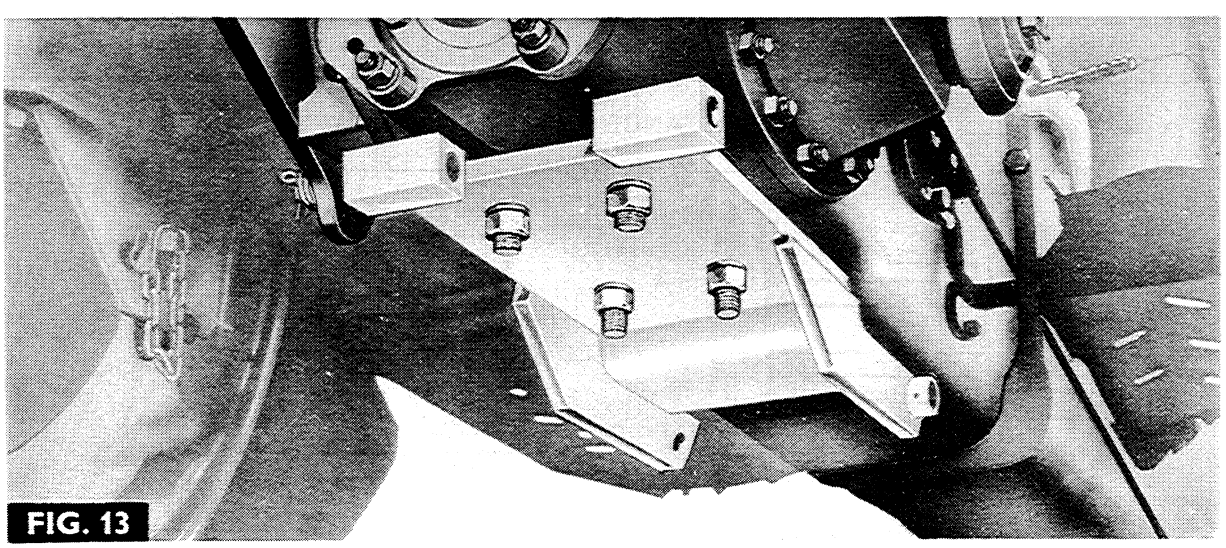


FIG. 13

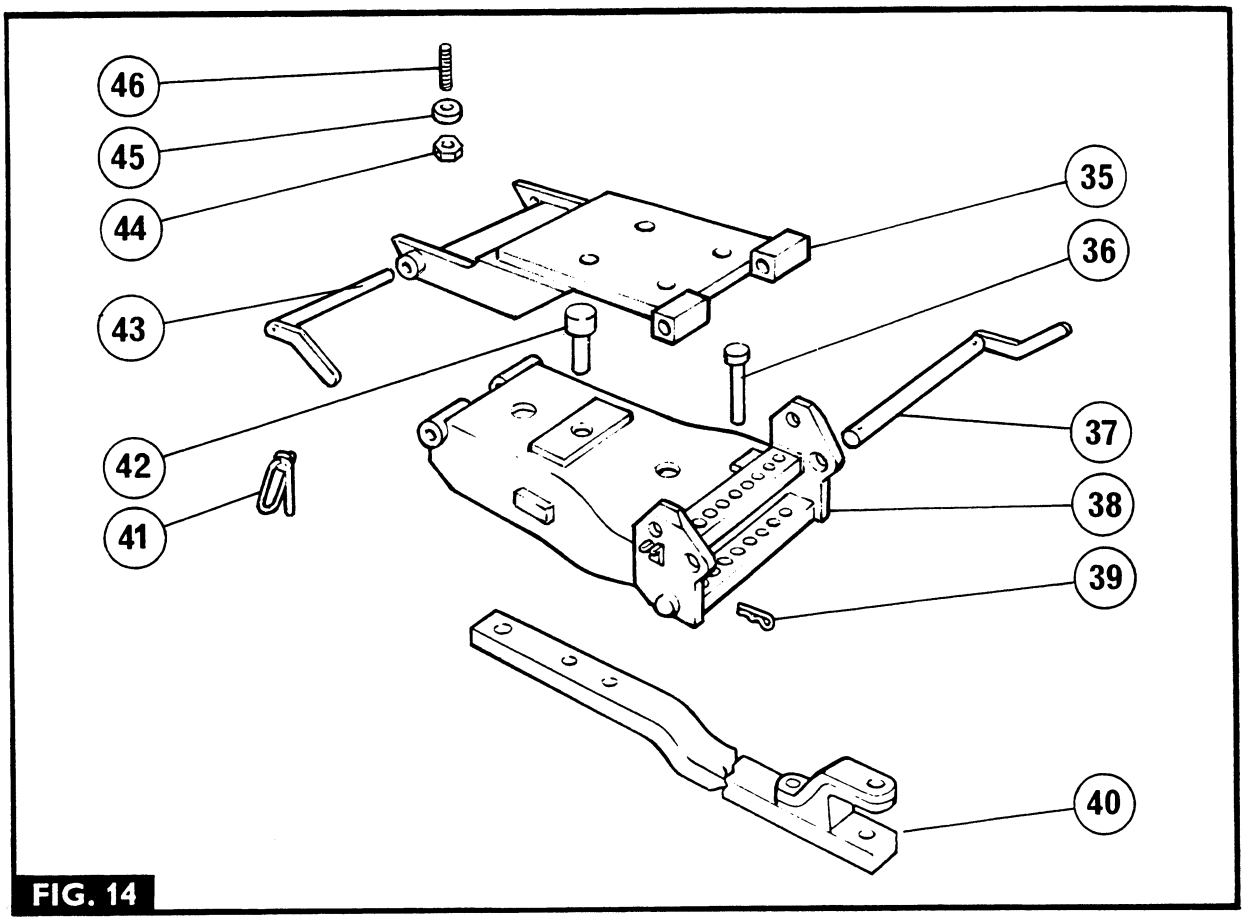


FIG. 14

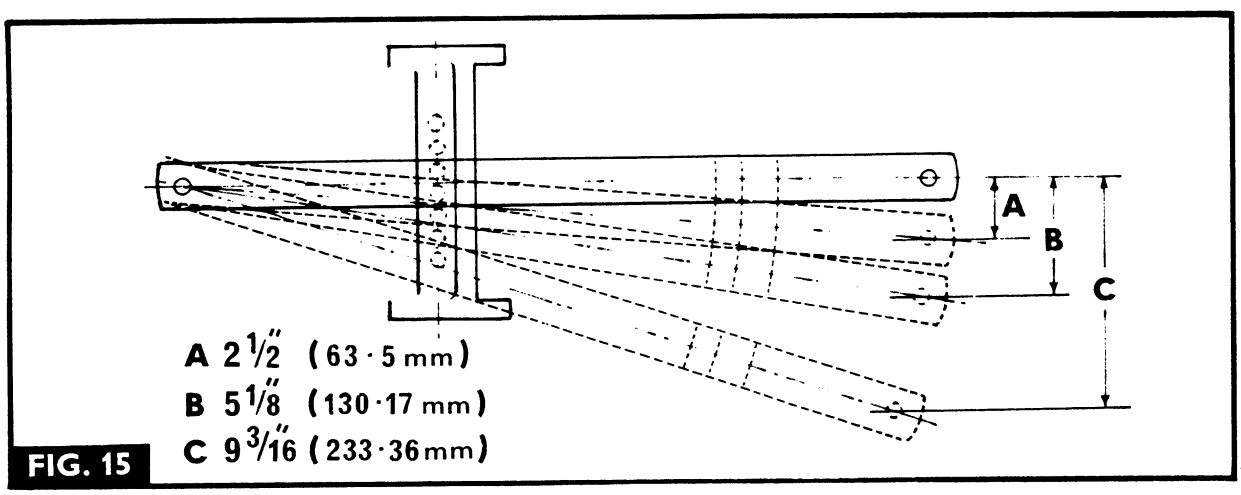


FIG. 15

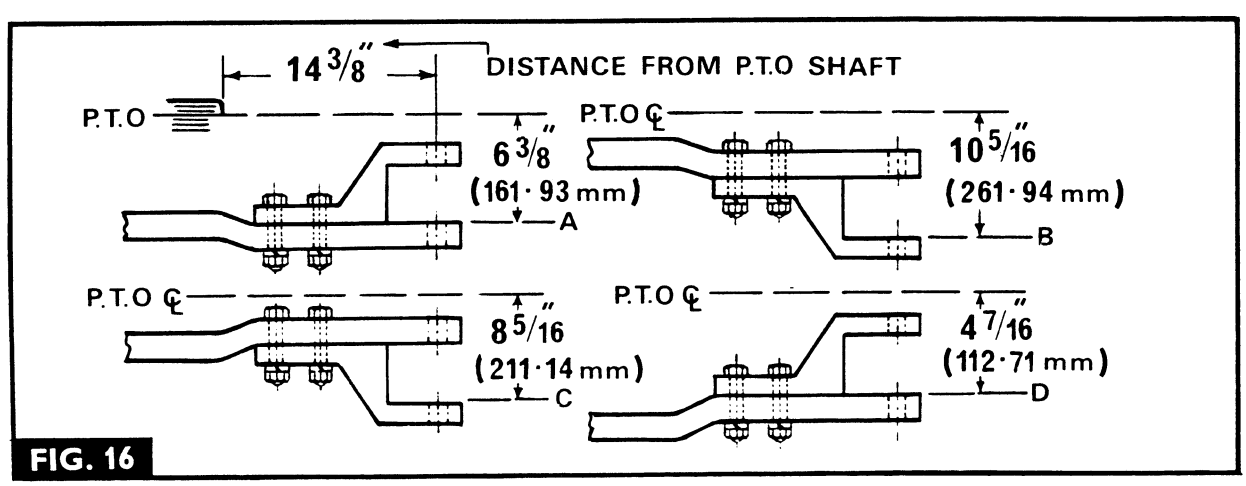


FIG. 16

the tractor's rear tyres. The check chains are attached to the rear of the tractor centre housing by the check chain anchor brackets and to the lower links by cranked brackets secured to the lower links by the lift rod retaining bolts.
According to the setting of the linkage for either Category 1 or Category 2 implements,

Category 1:– 187 mm (7 $\frac{3}{8}$ in) – standard
Category 2:– 209 mm (8¼ in) – standard
Category 1:– 270 mm (10 $\frac{5}{8}$ in) – 11-32 tyres
Category 2:– 292 mm (11¼ in) – 11-32 tyres

Check Chain Anchor Bracket Fig 9.
The check chain anchor brackets are bolted to the centre housing on either side of the p.t.o. shaft. The check chains must always be fitted to the upper holes on MF 135 tractors.

STABILISERS Fig 10.

Stabilisers are fitted to prevent transverse movement of the lower links where an implement must be retained in a constant position relative to the tractor centre-line, to ensure accurate alignment, either with the crop rows, or the p.t.o. shaft. Adjustments are made by slackening the locknut (30) and rotating the turnbuckle (29) to give the required length, then retightening the locknut. Before working with soil engaging implements the chains should be adjusted to permit 50 mm (2 in) of sideways movement at the end of each lower link.

Stabiliser Kit Fitment. Fig 11. 7C-04
Three chain stabiliser kits are available for MF 135 tractors:–

Standard tractors with U.K. safety frames.
Standard tractors without safety frames.
Tractors with 11-32 tyres and without safety frames.

NOTE – THERE ARE NO KITS FOR TRACTORS WITH 11-32 AND SAFETY FRAMES.

The under fender brackets differ for each kit and must be correctly identified, as the anchor pin centre-line must always align with the lower link pivot point.

NOTE – MF 135 TRACTORS BUILT BEFORE SERIAL NO. 35914 CANNOT BE FITTED WITH CHAIN STABILISERS AS THEY DO NOT HAVE THE THREE HOLES IN THE LOWER LINKS.

1. Remove the nuts and washers from the fender attachment bolts.
2. Locate the brackets (24) on the bolts with gussets facing outwards, then refit the nuts and washers. Re-tighten the nuts to a torque of 17 kg-m (125 lb-ft). This is most important if a safety frame is fitted.
3. Fit the anchor pins (27) to the forward holes in the brackets. The anchor pin nuts and washers (22 and 23) are fitted on the gusset side (outside) of the brackets.
4. Assemble the linch pin (26) and attach it to the forward end of the anchor bracket (21) using a split pin (25).
5. Assemble the chain components (28, 29, 30 and 31).
6. Attach the chain (28) to the anchor pin and insert a linch pin.
7. Attach the rear end of the chain (31) to the rearmost hole in the lower link using a bolt, nut and spring washer (32, 33 and 34).

NOTE–IF A FOUL CONDITION EXISTS BETWEEN BRACKET (31) AND THE BOLT THROUGH THE LIFT ROD FORK, AN ADDITIONAL SPACING WASHER MAY BE USED.

NORMAL DUTY SWINGING DRAWBAR Fig 12.

The swinging drawbar conforms to British Standards, having a clevis hitch point at 356 mm (14 in) from the p.t.o. shaft. The maximum static load permissible at this setting is 765 kg (1700 lb). An alternative position, which places the drawbar clevis at 254 mm (10 in) from the p.t.o. shaft is provided. At this setting the maximum static load is 990 kg (2200 lb).

Swinging Drawbar Kit Fitment 7C-05
1. Check the contents of the kit against the list provided.
2. Clean the base of the centre housing adjacent to the four ¾ UNC tapped holes and clean out the holes themselves.
3. Fig 14. Screw the ¾ UNC ends of the four studs (46) fully into the tapped holes in the centre housing.
4. Fig 13. Locate the mounting bracket (35) on the four studs, then secure it with the four nuts (44) and spring washers (45). Tighten the nuts to 27,5 kg-m (200 lb-ft).
   The use of a hydraulic jack to raise the mounting bracket, will facilitate this operation.
5. Fig 15. Slide the drawbar assembly (40) into the mounting frame (38), fitting the drawbar pin (42), the locating pins (36) and the hairpins (39).
6. Place the mounting frame and drawbar assembly on a jack and raise it into position secure it with the front support pin (43) and the rear pin (37), securing them with a linch pin (41).

Adjustments 7C-06
Offset: Fig. 14 and 15 Remove the linch pin (41) and withdraw the support bar (37), thus freeing the drawbar frame. Remove the two hairpins (39) and the locating pins (36) then reset the drawbar in the required position. Refit the locating pins (36), the hairpins (39) to secure the drawbar, then refit the rear pin (37) and the linch pin (41).
Length: Remove the linch pin (41) and the support bar (37). Push the drawbar anchor pin (42) upwards this freeing the drawbar. Adjust the drawbar for length, refit the anchor pin (42), raise the drawbar frame, then refit the rear pin (37) and the linch pin (41).
Height: Fig 16. The drawbar can be adjusted as shown, but the bolts must be kept tight.

AUTO-HITCH Fig 17.

The Auto-Hitch is a supplementary lifting mechanism fitted to the swinging drawbar frame to enable implements fitted with a ring type drawbar attach-

ment to be easily coupled to the tractor.
The hitch hook can, if required be replaced by the swinging drawbar by simply lowering the hitch, removing the pin and sliding out the hook, then replacing it by the drawbar.

Operations
Raising:– The quadrant control levers should be positioned as follows:–
'Draft Control' lever – 'Transport' i.e. fully back.
'Position Control' lever – Move to 'Transport' (adjacent to 'Constant Pumping'). The tractor lift arms will rise, lifting the hitch hook. When the 'Transport' position is reached, the latches will engage automatically, thus relieving the tractor linkage of weight.
Lowering :– Leave the 'Draft Control' lever in 'Transport'.
Move the 'Position Control' lever to 'Constant Pumping'; this will raise the hook frame clear of the latches. Pull the release lever rearwards to disengage the latch hooks, then, continuing to hold the release lever, move the 'Position Control' lever to 'Down'. The hitch will then lower.

Auto-Hitch Fitment 7C-07

1. Unpack the kit and check the contents against the packing list and figure 18.
2. Fig. 14. Place a hydraulic jack under the drawbar frame, then remove the linch pin (41) and the support bar (37), Lower the support bar to the ground.
3. Remove the three rearmost bolts from each side of the centre housing.
4. Fig. 19. Assemble one hook support bracket (52), to the centre housing, tightening the Allen screws (53) to 11 kg-m (80 lb-ft).
5. Slide the cross shaft (59) through the bush in the hook support bracket already fitted, then fit the other hook support bracket.
6. Remove the masking tape from the spigots on the support brackets, then slide the latch hooks (49) on to the spigots. Secure each hook with a large washer (68) and split pin.
7. Fig. 20. Assemble the cross shaft levers (58) on to the cross shaft (59) shimming them on each side with one thick washer (65) and an equal number of thin washers (66).
8. Fit the ball (60) to the handle (61), then fit the handle to the R.H. cross shaft lever, securing it with a roll pin (68) through either the centre hole (tractors with De Luxe seat) or the upper hole (tractors with the Spring Suspension seat).
9. Secure the cross shaft (59) to the cross shaft levers (58) with a roll pin (68) on each side. Ensure that the cross shaft can rotate freely.
10. Assemble the spings (54) to the pull rods (55).
11. Locate the pull rods (55) in the support brackets (52), then fit the clevis pins (69) through the hooks (49) and the cross shaft levers (58) by compressing the springs. Secure the clevis pins with the four small split pins.
12. Fig. 21. Fit a latch (72) to the drawbar frame.
13. Repeat operation 12 on the opposite side.
14. Centralise the support bar (56) and fit the two long, large split pins through the holes in the ends of the support bar.
15. Remove the split pin and clevis pin securing each lift arm to the lift rod knuckle.

WARNING. – AS THE CLEVIS PIN IS REMOVED, THE LOWER LINK AND LIFT ROD WILL DROP.

16. Fig. 22. Locate lift arm extension (62) against the lift arm, then loosely fit the bolts (64) and the plate (50) plus spring washers and nuts.
17. Raise the lower links and lift rods and fit the new, longer clevis pins (63), securing them with split pins.
18. Fully tighten the lift arm extension bolts (64).
19. Fig. 23. Screw a nut on to the threaded portion of each lift chain (47) then screw an eye (51) on to each chain.
20. Attach the chains to the lift arm extensions using the pins (57) and split pins.
21. Place a strip of metal 1 mm x 25 mm x 150 mm (1/16 in x 1 in x 6 in) on top of the drawbar frame, above the locating pins (36), then jack up the frame, as shown until the strip of metal is trapped between the frame and the drawbar mounting bracket.
22. Start the tractor engine, select 'Constant Pumping' with the 'Position Control' lever and 'Transport' with the 'Draft Control' lever. The lower links will fully raise.
23. Adjust the length of the lift chains (47) by screwing the eyes up, or down, until the eyes will just slide on to the spigots on the latches (72).

NOTE. ENSURE THAT THE CHAINS ENGAGE THE LATCHES WITH EXACTLY EQUAL TENSION.

24. Remove the eyes from the spigots on the latches and SHORTEN the chains by screwing the eyes up a further FOUR turns.
25. Lower the links slightly, refit the eyes and secure them with the medium size split pins.
26. Remove the jack, then lower the hitch by moving the lever (61) forwards, then moving the 'Position Control' lever to the 'Down' position.
27. Remove the metal strip, then push out the drawbar pin (42) and withdraw the draw bar (40).
28. Fig. 24. Fit the hitch hook (71), refitting the drawbar pin (42), then remove the hairpins (39) and locating pins (36) and refit them to centralise the hook.
29. Fig. 25. Remove the p.t.o. shield (if fitted) then remove the two nuts (73) spring washers and spacers securing the bottom of the check chain anchor bracket.
30. Fit the hook stop plate (70) and the nuts and spring washers, discarding the two spacers.
31. Fig. 26. Remove the long pin and fit the linkage check bracket (48) as shown.

Adjustment 7C-08
Every 500 hours, the adjustment should be checked. If the adjustment is incorrect, adjust as detailed in operations – 21 to 27.

Auto-Hitch used as a Swinging Drawbar
The Auto-Hitch can be converted to a swinging drawbar by substituting the drawbar for the hitch hook.
To remove the hook:–

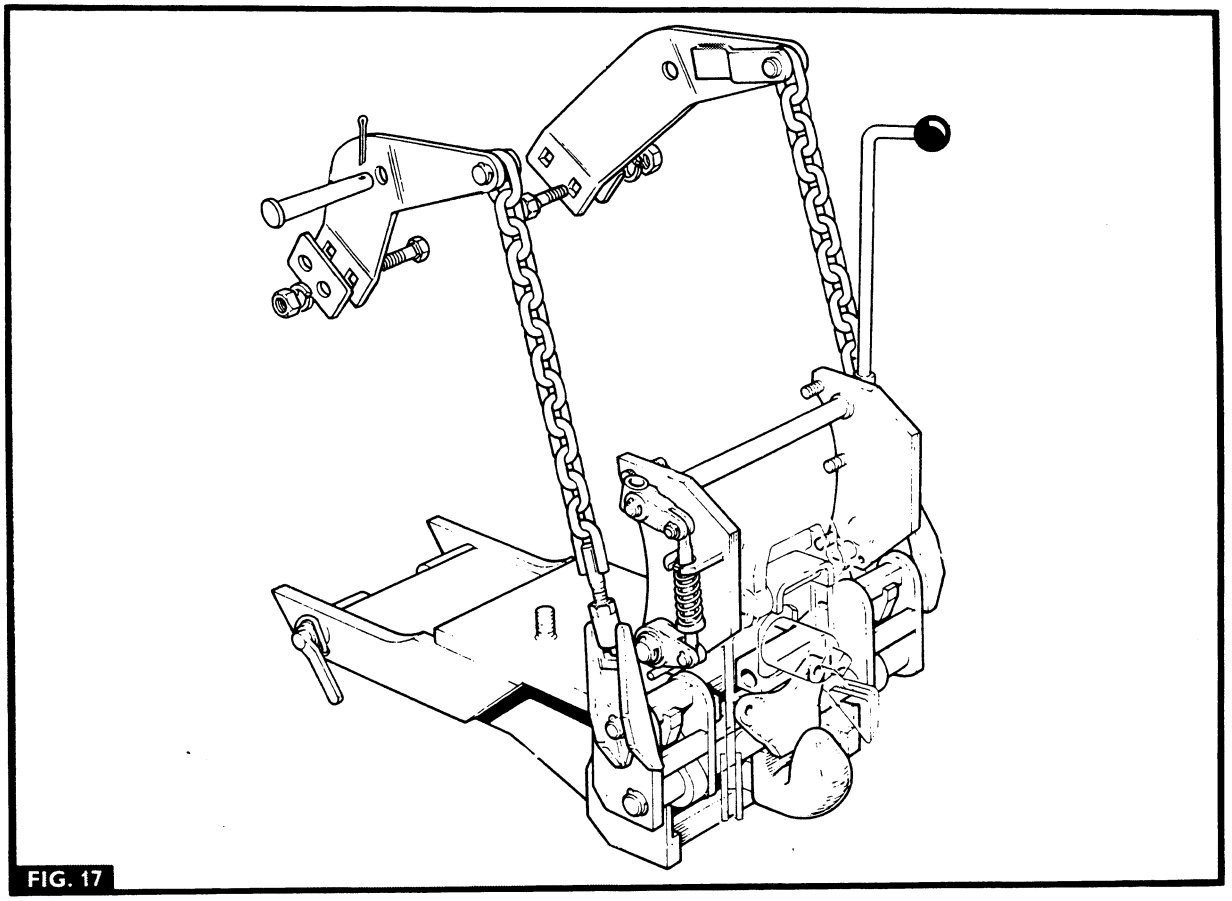


FIG. 17

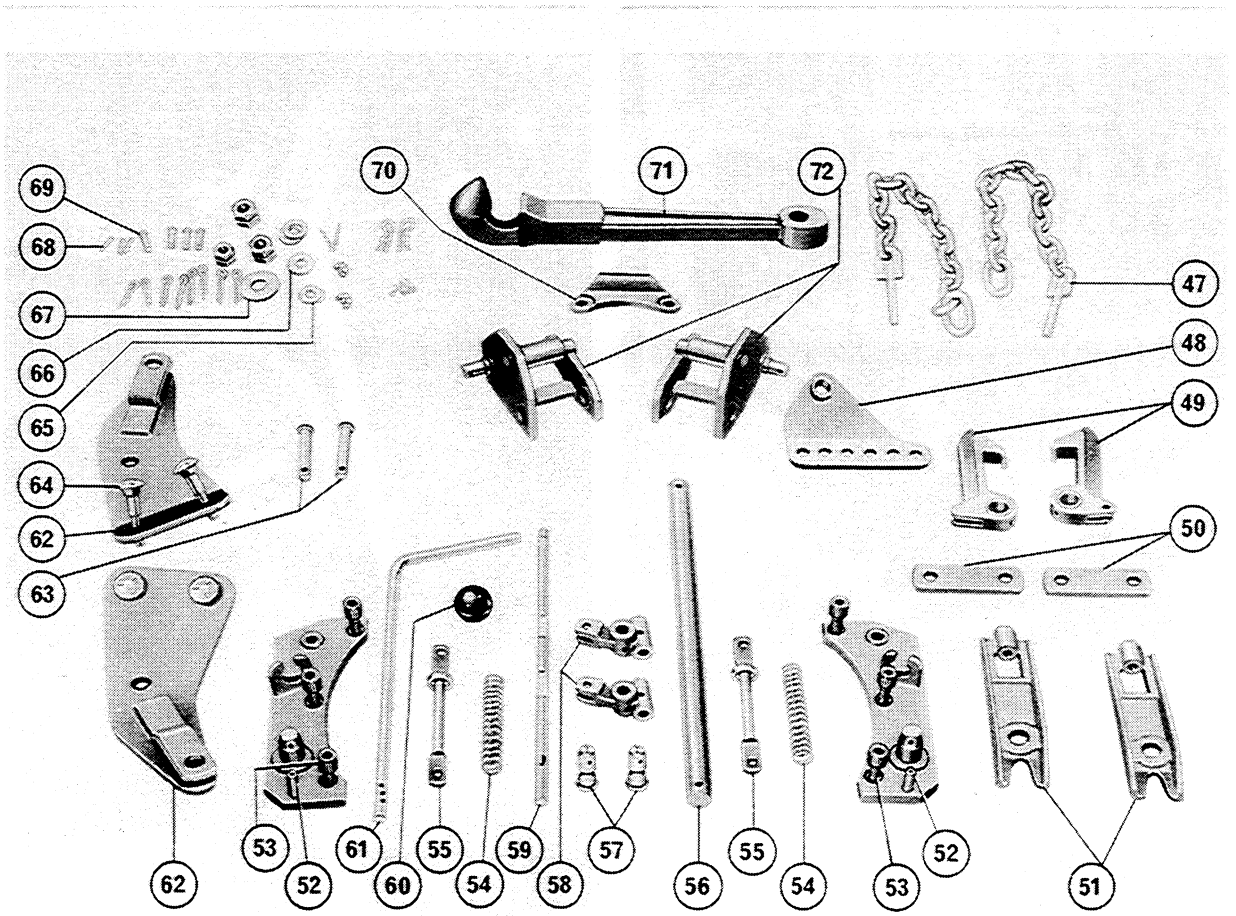

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FIG. 18

LINKAGE AND DRAWBARS

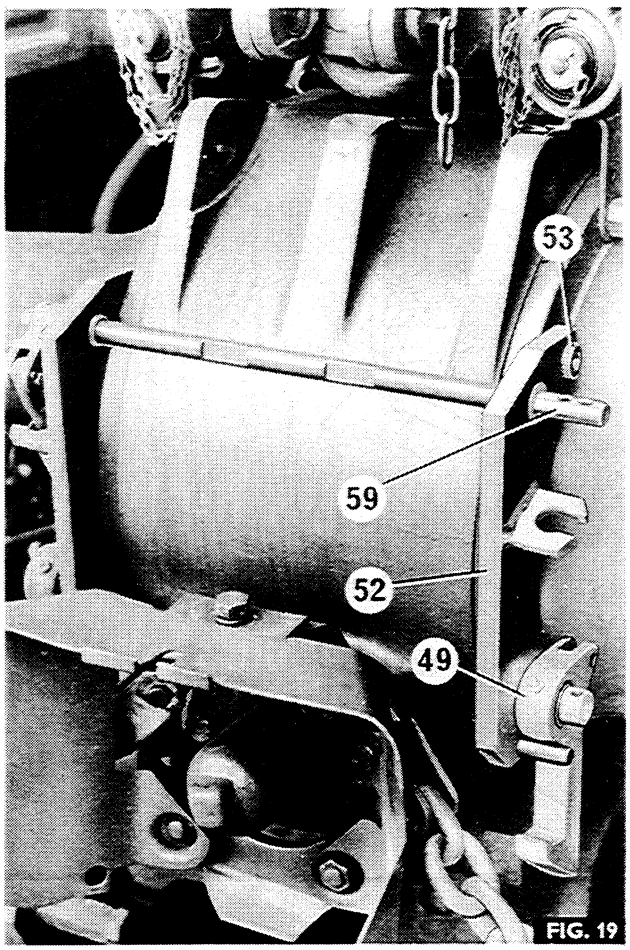


FIG. 19

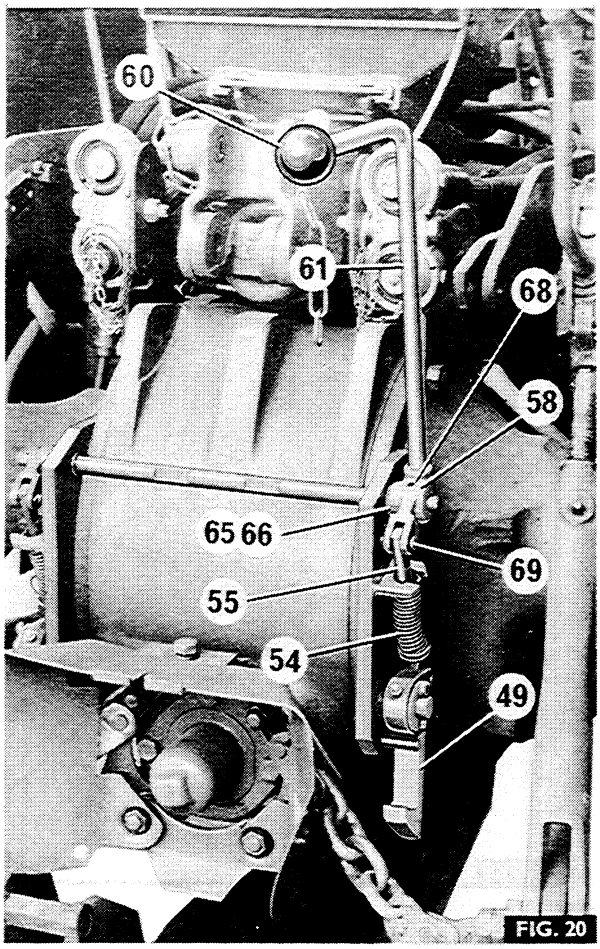


FIG. 20

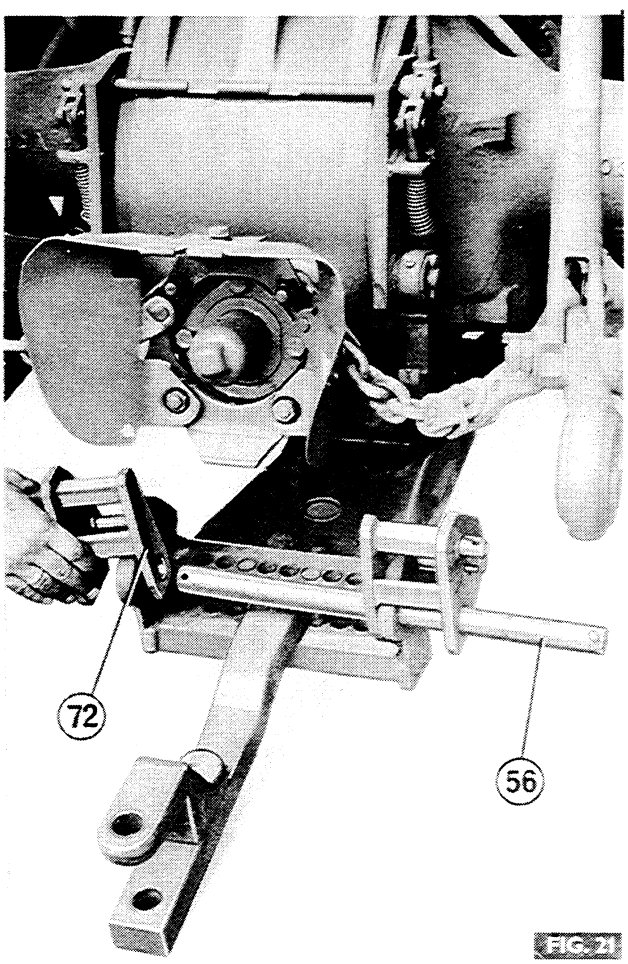


FIG. 21

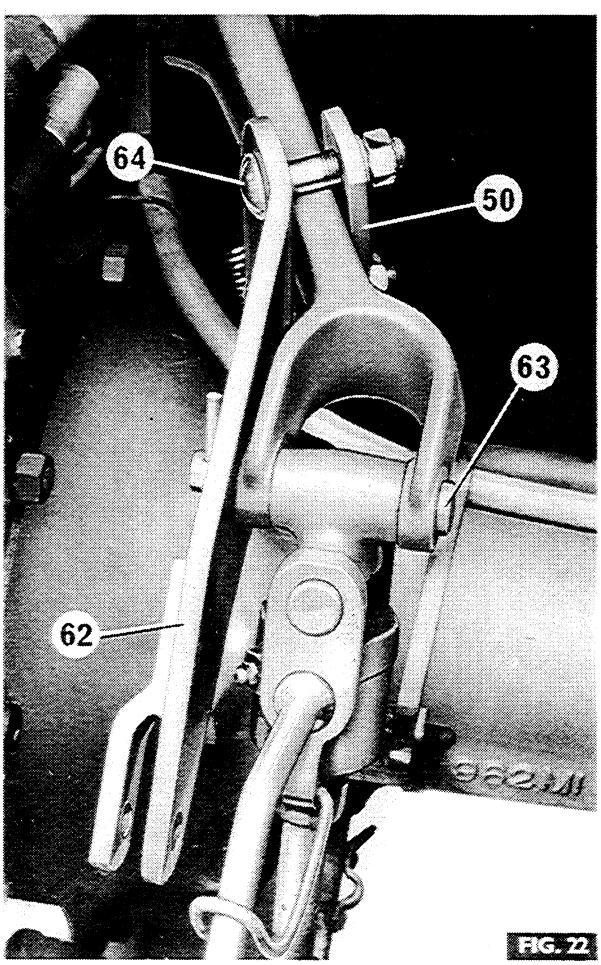


FIG. 22

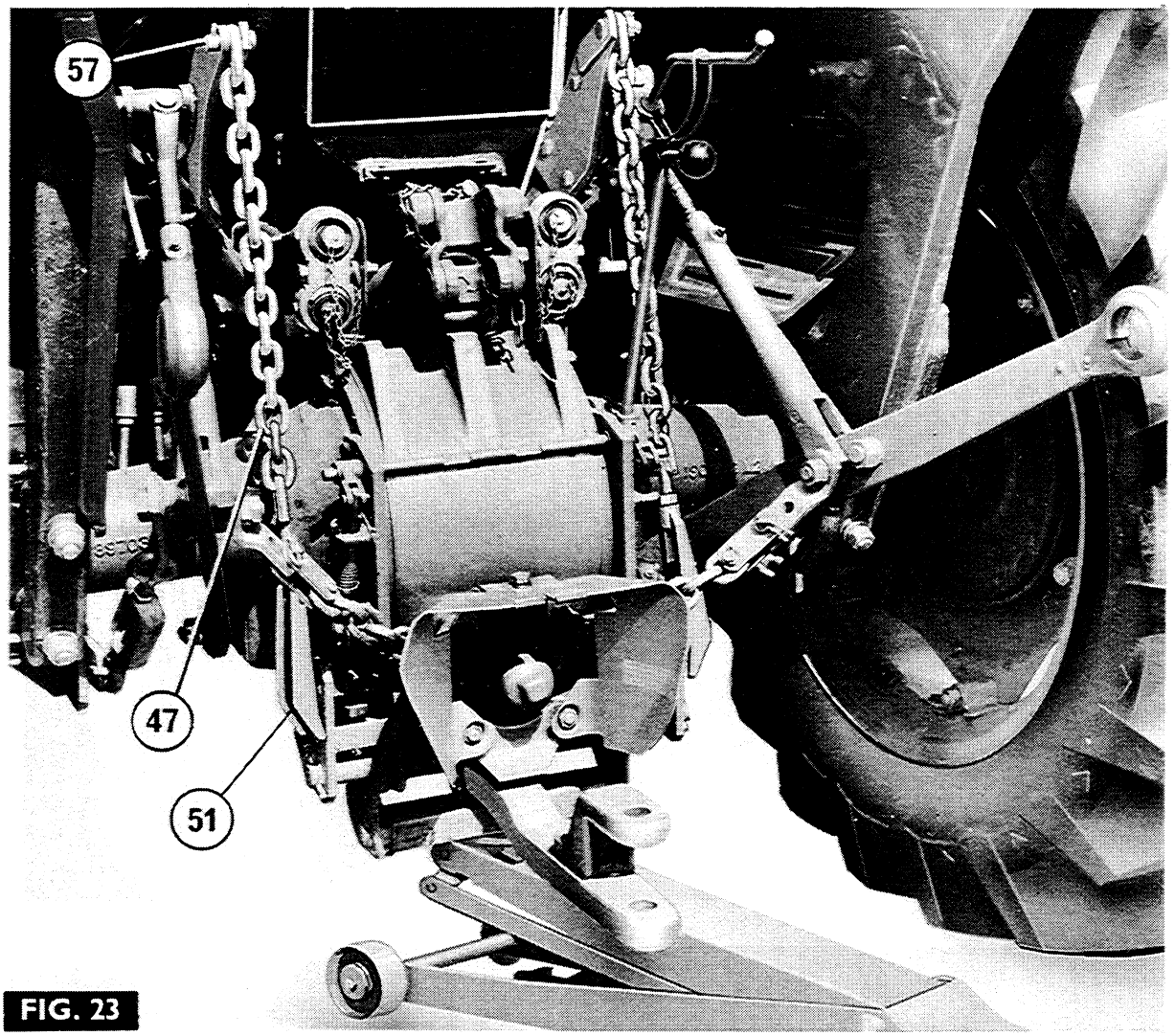


FIG. 23

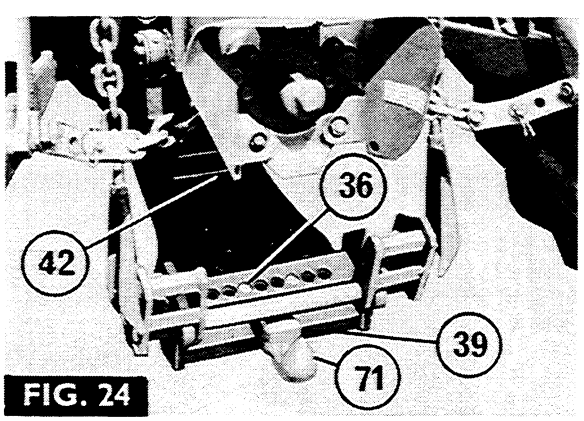


FIG. 24

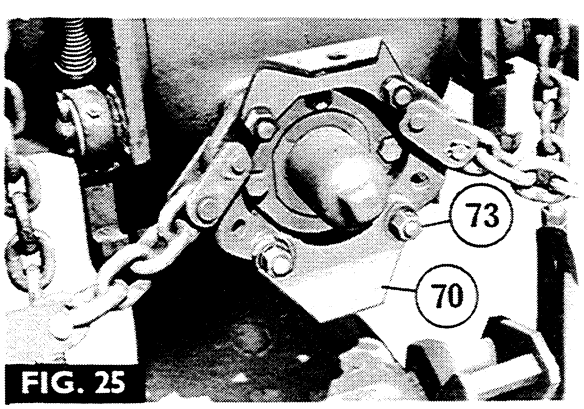


FIG. 25

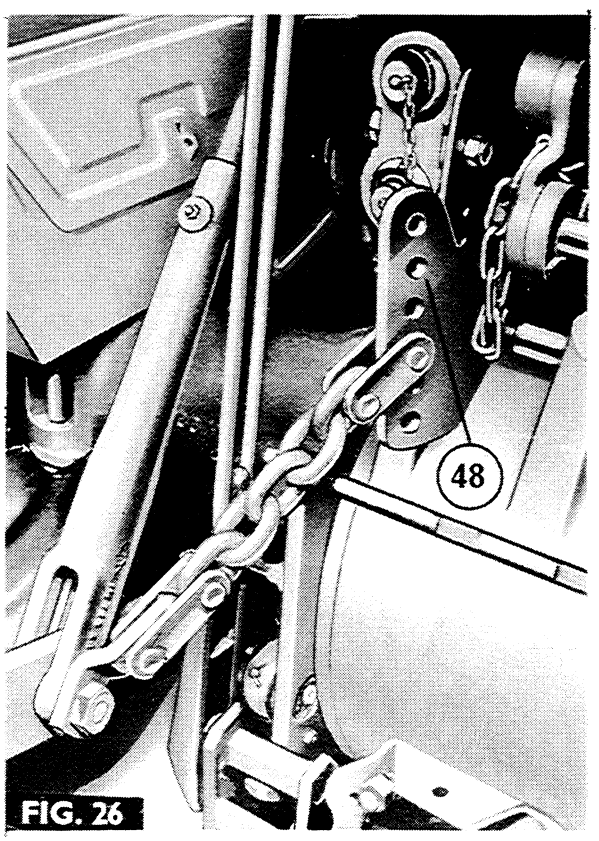


FIG. 26

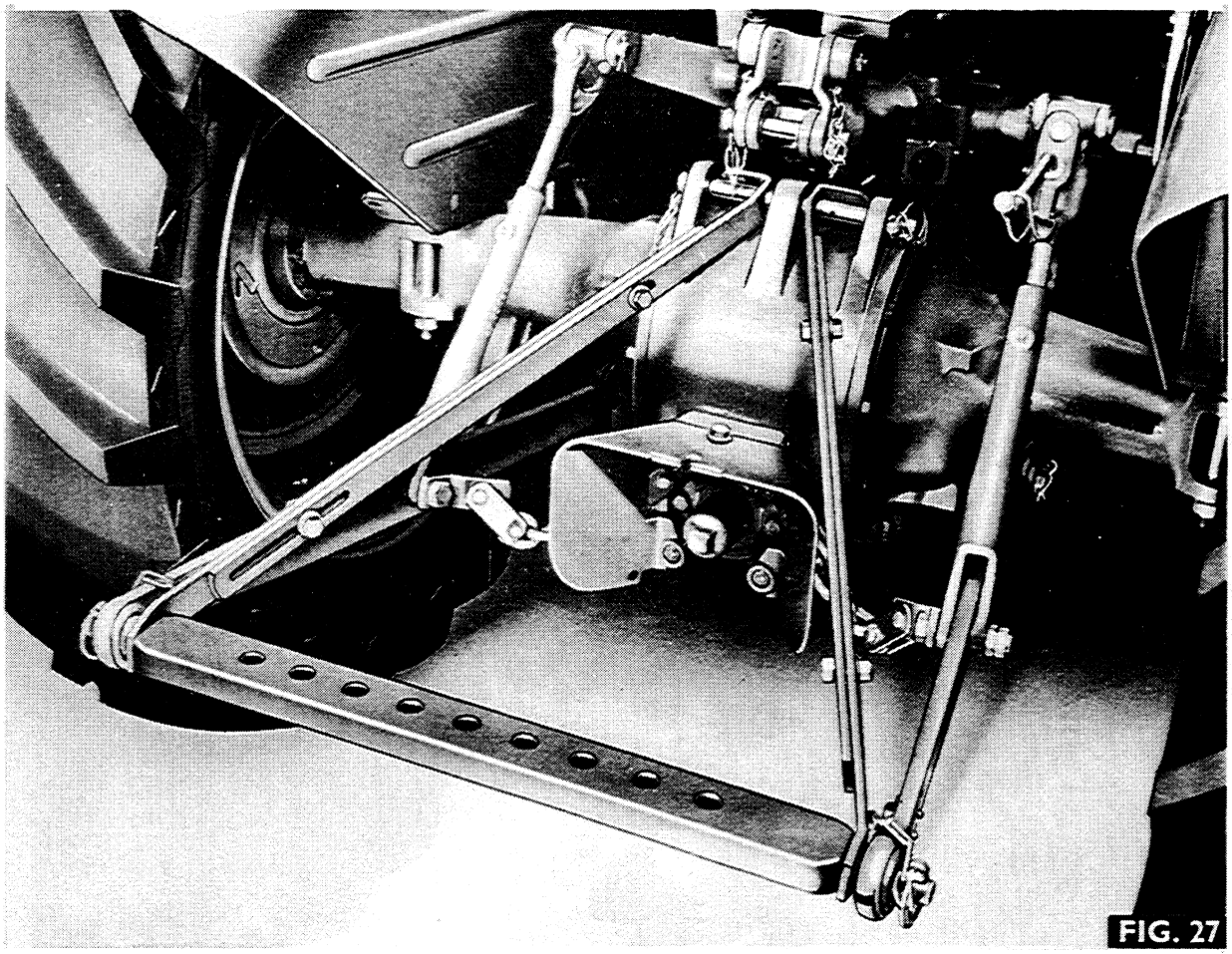


FIG. 27

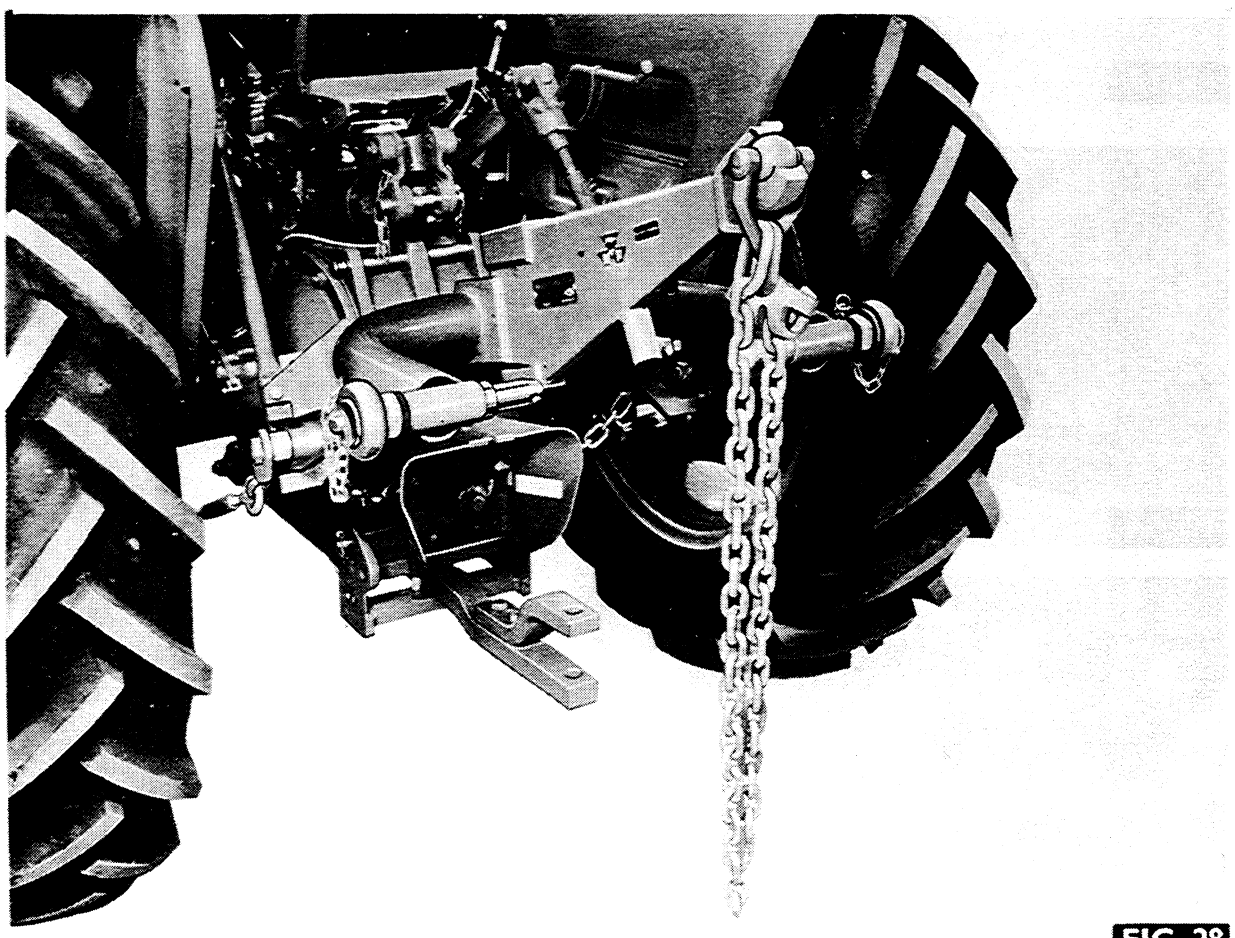


FIG. 28

1. Lower the automatic hitch.
2. Remove the hitch hook securing pin and pull the hook rearwards and out of the mounting frame.
3. Slide the drawbar between the headed pins at the rear of the mounting frame and re-fit the securing pin. The drawbar can be adjusted radially as stated. (see figure 15).

WARNING. – DO NOT ATTEMPT TO LIFT THE AUTO-HITCH MECHANISM WITH THE DRAW-BAR OFFSET AND A LOAD APPLIED.[

Linkage Check Bracket Fig 26.
When a two-wheel trailer is used with the Auto-Hitch, the tractor lower links may foul the trailer drawbar when turning. To prevent such an occurrence, the linkage check bracket has been provided as part of the Auto-Hitch Kit.
After the trailer has been hitched, connect the check bracket by removing the hairpin and headed pin securing the L.H. check chain to the anchor bracket. Align the flatlinks on the end of the check chain with a convenient hole in the check bracket. Re-fit the headed pin and hairpin.

LINKAGE DRAWBAR

The linkage drawbar can be used when towing trailed implements with low weight transfer. To prevent excessive transverse movement, a pair of drawbar stays are fitted. These stays are adjustable for length to permit the height of the drawbar to be set as required and then locked in position.

WARNING – NEVER SET THE DRAWBAR ABOVE THE REAR AXLE CENTRE-LINE, OTHERWISE THE TRACTOR WILL BECOME EXTREMELY UN-STABLE WHEN TOWING.

Drawbar Fitment. Fig 27. 7C-09
1. Remove the long pin from the tractor centre housing.
2. Loosely assemble the pairs of stays, fitting the bolts only to the slotted holes.
3. Attach the stays to the centre housing as shown, securing them with the long pin and linch pin.
4. Fit the drawbar mounting pins to the holes in the stays, then into the lower link balls and secure them with linch pins.
5. Adjust the height of the drawbar using the tractor hydraulic lift system. When the notches in the stays are aligned, the drawbar will be at the normal working height of 450 mm (17½ in).
6. Finally tighten the outer bolts and fit the centre bolts to a pair of aligning holes.
7. Place both of the hydraulic control levers in the fully lowered position, (i.e. 'Drop').

WARNING. – IF THE LEVERS ARE PLACED IN THE RAISED POSITION. THE STAYS MAY BE BENT, OR BROKEN, WHEN THE TRACTOR ENGINE IS STARTED.

PRESSURE CONTROL COUPLER Fig 28.

The Pressure Control Coupler enables weight to be transferred to the tractor rear wheels when working with trailed implements, thus improving traction. This additional weight transfer also gives improved braking performance by minimising wheel-locking and slewing when descending steep gradients.

Description
The coupler consists of a curved, tubular cross-member with fabricated location lugs and dual Category mounting pins, by means of which the beam is attached to the tractor lower links. Attached to the tubular member is a hinged hook, carrying the coupling chain, which is attached by the safety release ball and the adjusting claw.

Modification of Implement Drawbars 7C-10
Before operating, certain modifications must be made to the implement drawbar to ensure adequate strength to attach the chain and where necessary to ensure that the coupler chain will clear the p.t.o. shaft if used. As the Pressure Control coupler is used in conjunction with a variety of drawbar designs and applications, the following modifications are suggested:–
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 which may be of either of the above types.

Any of the above types of drawbars may need strengthening to withstand the lifting force applied by the coupler chain.
If the implement is powered by a p.t.o. driveshaft alterations must also be made to enable the coupler chain to clear the p.t.o. shaft.
Figures 29 to 32 show the recommended methods of modifying the implement drawbar for added strength and to give p.t.o. shaft clearance.
Strengthening can be achieved:–
a) By welding an angle-iron section on to the underside of a round tube drawbar.
b) By 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 in relation to the boom and drawbar. When turning, the chain must slide freely through the anchor brackets. otherwise, rapid chain wear will occur. Square, or angle section drawbars may need chain guides to assist the chain in sliding. Various methods of keeping the chain clear of the p.t.o. shaft can be employed, according to the type of drawbar fitted.
MF machinery which is operated in conjunction with the Pressure Control coupler should be modified to allow chain attachment. Modification procedure for such machinery is detailed in the General Machines Workshop Service Manual, Publication No. 819 218 M1.

LINKAGE AND DRAWBARS

For implements other than those manufactured by MF the following principle modifications for the various drawbar types are as follows:–

Figure 29 'A' Frame type of round tube construction
Figure 30 'A' Frame type of square tube, or angle iron construction
Figure 31 'Pole' type, showing alternatives for round or square constructions
Figure 32 'Pole' type, non-p.t.o., showing alternative for round, or square sections

NOTE. – THE P.T.O. DRIVE SHAFT MUST HAVE A MINIMUM CLEARANCE FROM THE COUPLER CHAIN OF 25 MM (1 IN).

Pressure Control Coupler Fitment 7C-11

1. Ensure that the adapter plates are correctly adjusted as shown in figure 33.
2. Check that the required ball end mounting pin faces outwards.
3. Place the coupler frame between the tractor lower links and engage the ball end mounting pin and extended bracket on the left lower link and secure with linch pin then on the right hand link and secure the ball end mounting pins with the linch pins.

Adjustments 7C-12

To allow one design of Pressure Control coupler to be fitted to MF135, 165 and 185 tractors, the ball end mounting pins are reversible for Categories 1 and 2 and the lugs welded to the tubular cross member have adjustable adapter brackets to compensate for the varying width of the lower links according to the particular tractor.

Fig. 33. The adapter bracket should be positioned as shown.

The reversible ball end mounting pins have alternative end diameters of 22,23 mm (7/8 in.) and 28,57 mm (1.1/8 in.) to suit Category 1 and 2 ball ends respectively.

Coupler to Implement Attachment

1. Raise the coupler on the lower links, using 'Position Control'.
2. Attach the implement drawbar on to the tractor swinging drawbar.
3. Lower the coupler on the tractor using 'Position Control' until the tubular cross member is parallel to the ground.
4. Fig. 34. Loop the chain through the chain anchor bracket(s) and engage the nearest available chain link in the adjusting claw.
5. Tension the chain by moving the control quadrant lever to increase 'Pressure'.

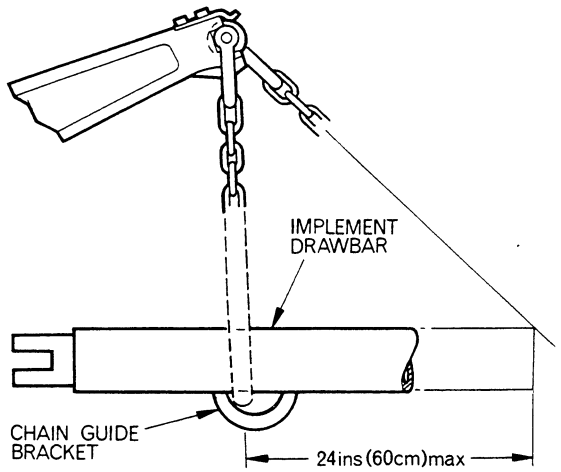
NOTE – THE MAXIMUM CHAIN ANGLE SHOULD NOT EXCEED 45° (Fig. 35).

Operation

1. Attach the coupler to the tractor and implement.
2. Move the 'Draft Control' lever fully back.
3. Move the 'Position Control' lever into the black 'Pressure' sector of the inner quadrant to the 'LOW' position. Move the lever back just sufficiently to give adequate traction, then set the adjustable stop to align with the lever. If difficult conditions are encountered, increase the pressure by moving the lever towards 'High' until traction is obtained. Always return the lever to the set position when conditions improve.

Stowage for Transport

Fig. 36. If a tractor fitted with the Pressure Control coupler is to be driven without an implement attached, the boom should be stowed by slewing it to the right and engaging the spring clip (74).



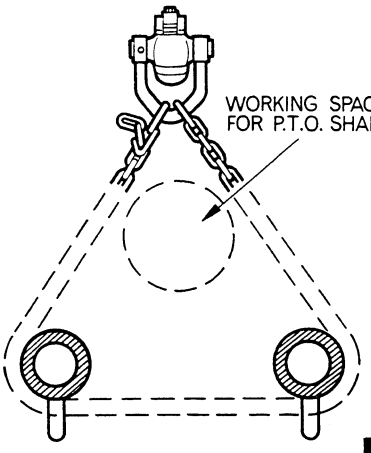
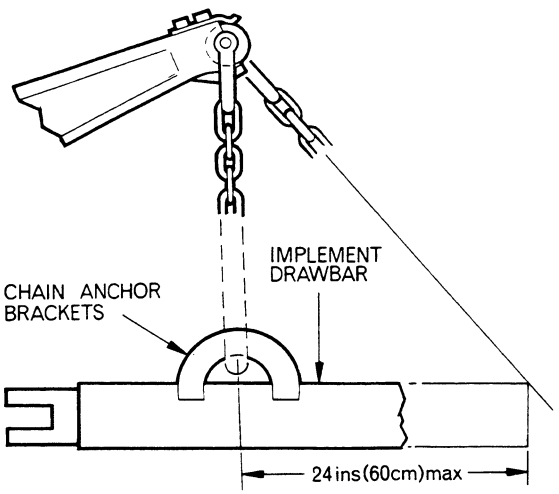


FIG. 29



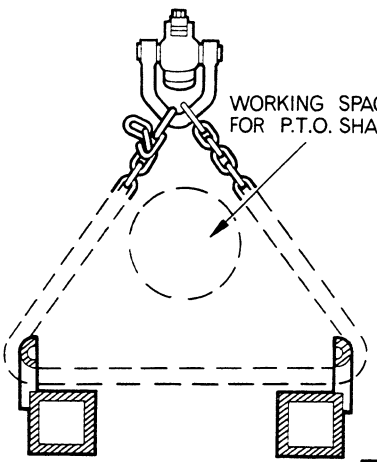
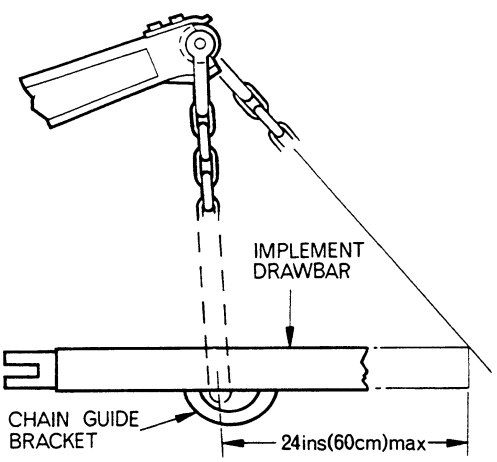


FIG. 30



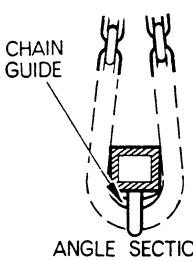
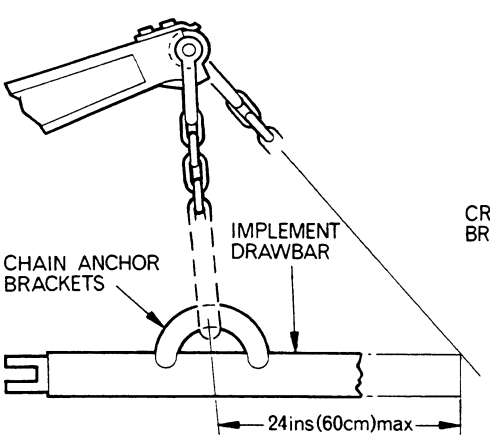
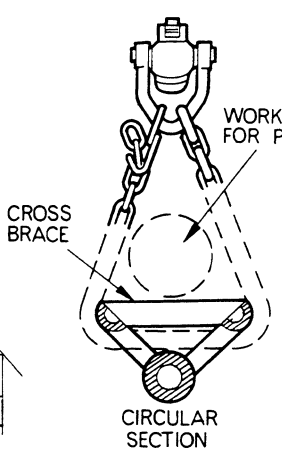


FIG. 31





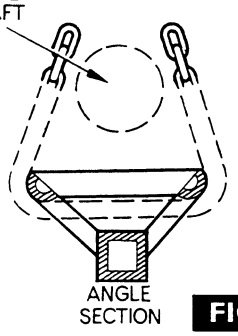


FIG. 32

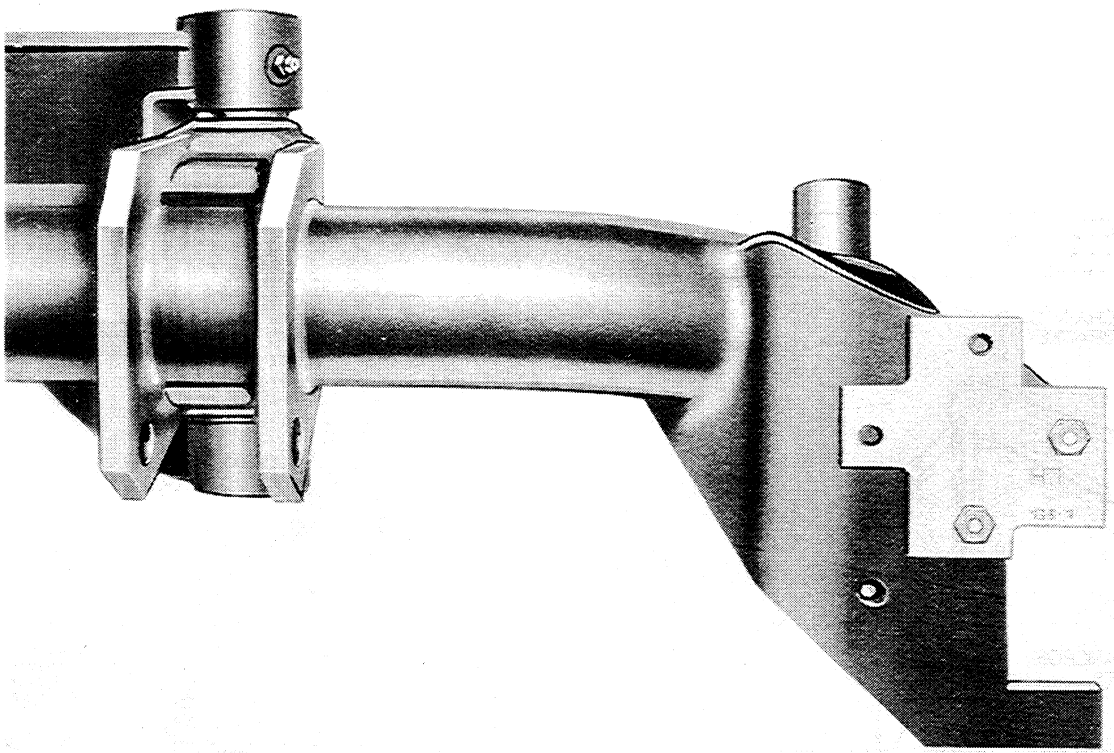


FIG. 33

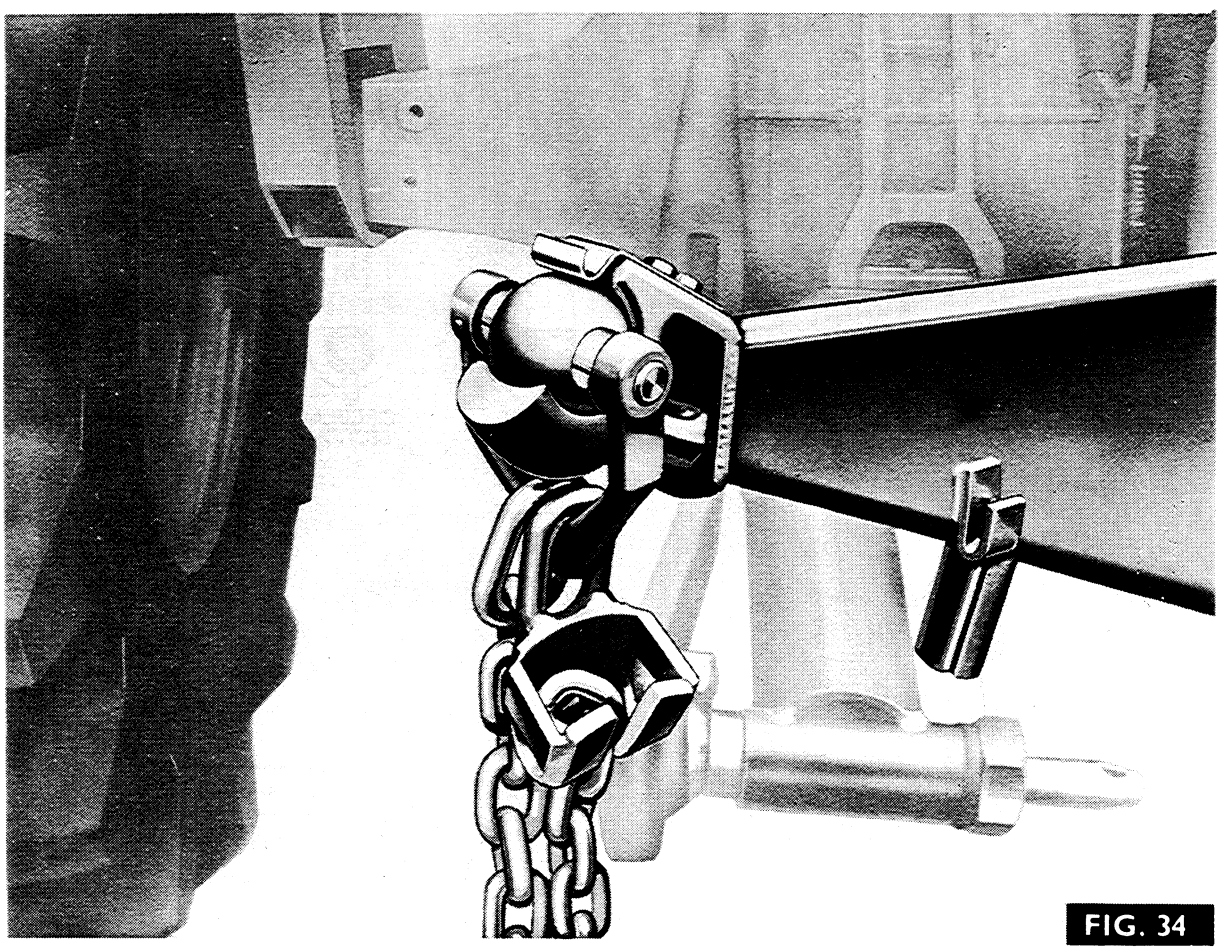


FIG. 34

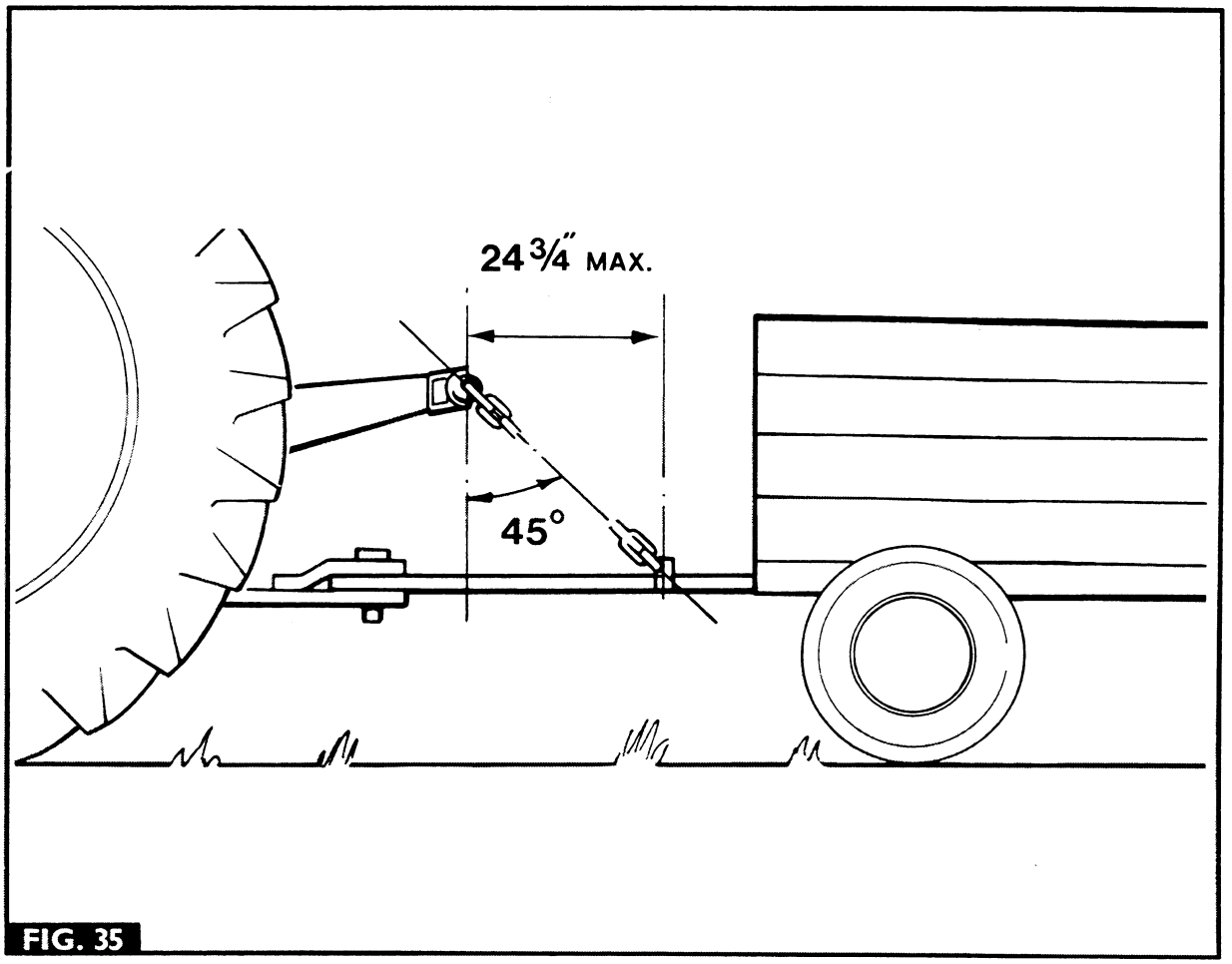


FIG. 35

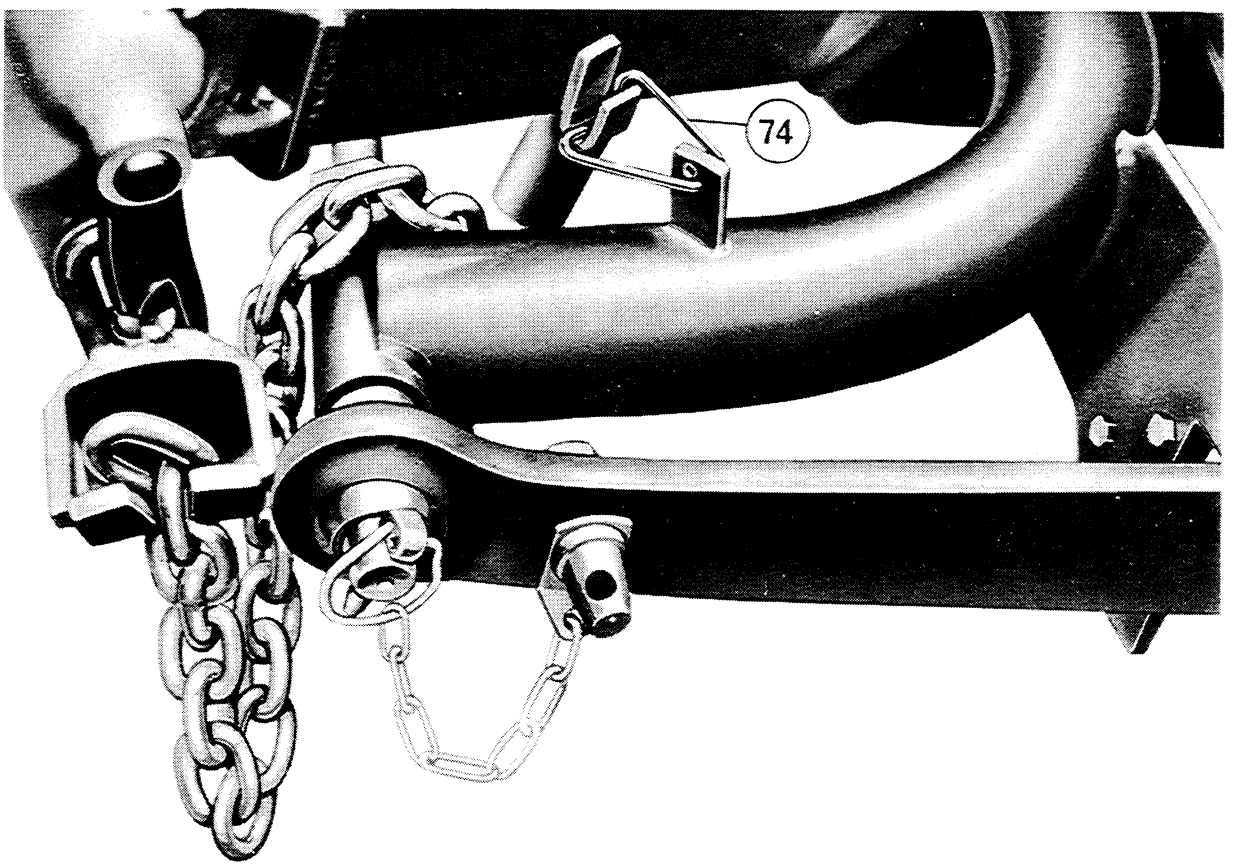


FIG. 36

ELECTRICAL SYSTEM

Part 8 Section A

GENERAL

The electrical system of this tractor is a 12 volt Negative earth system with compensated voltage control regulator. Fig. 1 shows the layout of all the electrical components and associated wiring.

The battery is mounted on a platform, at the rear of the fuel tank, and access is gained through a detachable panel on the tractor hood. The dynamo is mounted on the right hand side of the engine and is driven by an endless belt from the crankshaft pulley. The dynamo has adjustable mountings to enable the correct belt tension to be maintained. A voltage control regulator is mounted behind the engine bulkhead, beneath the instrument panel. The starter motor is bolted to the right hand side of the engine.

A neutral safety switch is fitted on top of the transmission case, which renders the starter motor inoperative until the Dual Range Selector Lever is in the Neutral Position.

The electrical equipment should be serviced at the times stated in the Operator Instruction Book, particular attention should be paid to the cleanliness and tightness of the battery terminals.

25 amp line fuses are fitted to protect the thermostart, cigarette lighter and lighting circuits. A blown fuse must always be replaced with one of the same capacity.

Before any operation is carried out on the electrical system, disconnect the battery terminals.

Key to Fig. 1

1. Thermostart
2. Dynamo
3. Wiring Harness
4. Starter Motor
5. Battery Lead
6. Battery Earth
7. Neutral Safety Switch
8. Battery
9. Control Box
10. Starter Switch
11. Cigarette Lighter

BATTERIES

Batteries are supplied either dry and uncharged or filled and charged or dry with their plates in a charged condition. Routine Maintenance is the same for all.

Battery Maintenance

Wipe away any foreign matter or moisture from the top of the battery, and ensure that the connections and the fixings are clean and tight. Every 100 hours, or more frequently in hot weather, examine the level of the electrolyte in the cells. If necessary, add distilled water to bring the level up to the top of the perforated separator guard.

The use of a Lucas Battery Filler will be found helpful in this topping up process as it ensures that the correct electrolyte level is obtained automatically and also prevents distilled water from being spilled over the battery top. Use only distilled water when topping up.

NOTE – NEVER USE A NAKED LIGHT WHEN EXAMING A BATTERY, AS THE MIXTURE OF OXYGEN AND HYDROGEN GIVEN OFF BY THE BATTERY WHEN ON CHARGE, AND TO LESSER EXTENT WHEN STANDING IDLE, CAN BE DANGEROUSLY EXPLOSIVE.

Battery Servicing

Vent Plugs

Ensure that the ventilating holes in each vent plug are clear.

Level of Electrolyte

The surface of the electrolyte should be level with the top of the perforated separator guard. If necessary, top-up with distilled water. Any loss of acid from spilling or spraying (as opposed to the normal loss of *water* by evaporation and electrolysis) should be made good by dilute acid of the same specific gravity as that already in the cell.

Cleanliness

Ensure that the top of the battery is free from dirt or moisture which might provide a discharge path. Ensure that the battery connections are clean and tight.

Hydrometer Tests

Measure the specific gravity of the acid in each cell, using a hydrometer. To avoid misleading readings, do not take hydrometer readings immediately after topping-up.

The readings given by each cell should be approximately the same. If one cell differs appreciably from the others, an internal fault in the cell is indicated.

The appearance of the electrolyte drawn into the hydrometer when taking a reading gives an indication of the state of the plates. If the electrolyte is very dirty, or contains small particles in suspension, it is possible that the plates are in bad condition.

The specific gravity of the electrolyte varies with the temperature, therefore for convenience in comparing specific gravities, this is always corrected to 15.5°C (60°F), which is adopted as a reference temperature. This method of correction is as follows:

For every 2.8°C (5°F) *below* 15.5°C *deduct* .002 from the observed reading to obtain the true specific gravity at 15.5°C (60°F).

For every 2.8°C (5°F) *above* 15.5°C *add* .002 to the observed reading to obtain the true specific gravity at 15.5°C. The temperature must be that indicated by a thermometer actually immersed in the electrolyte and not the air temperature.

Compare the specific gravity of the electrolyte with the values given in the chart below and so ascertain the state of charge of the battery. If the battery is in a discharged state, it should be re-charged, either on the vehicle by a period of daytime running or on the bench from an external supply.

Key to Fig. 2

1. Battery
2. Voltage Regulator
3. Dynamo
4. Fuel Gauge Sender Unit
5. Starting Aid
6. Fuse
7. Heat Start Switch
8. Fuel Gauge
9. Cigarette Lighter
10. Ammeter
11. Neutral Safety Switch
12. Starter Motor

Colour Code Fig. 2

B	Black	R	Red
G	Green	U	Blue
N	Brown	W	White
P	Purple	Y	Yellow
O	Orange	K	Pink
S	Slate	M	Maroon

State of Charge	Home and Climates ordinarily below 80°F (26.6°C): Specific Gravity of Electrolyte (Corrected to 60°F (15.5°C))	Climates frequently over 80°F (26.6°C): Specific Gravity of Electrolyte (Corrected to 60°F (15.5°C))
Fully charged	1.270 – 1.290	1.210 – 1.230
About half discharged	1.190 – 1.210	1.130 – 1.150
Completely discharged	1.110 – 1.130	1.050 – 1.070

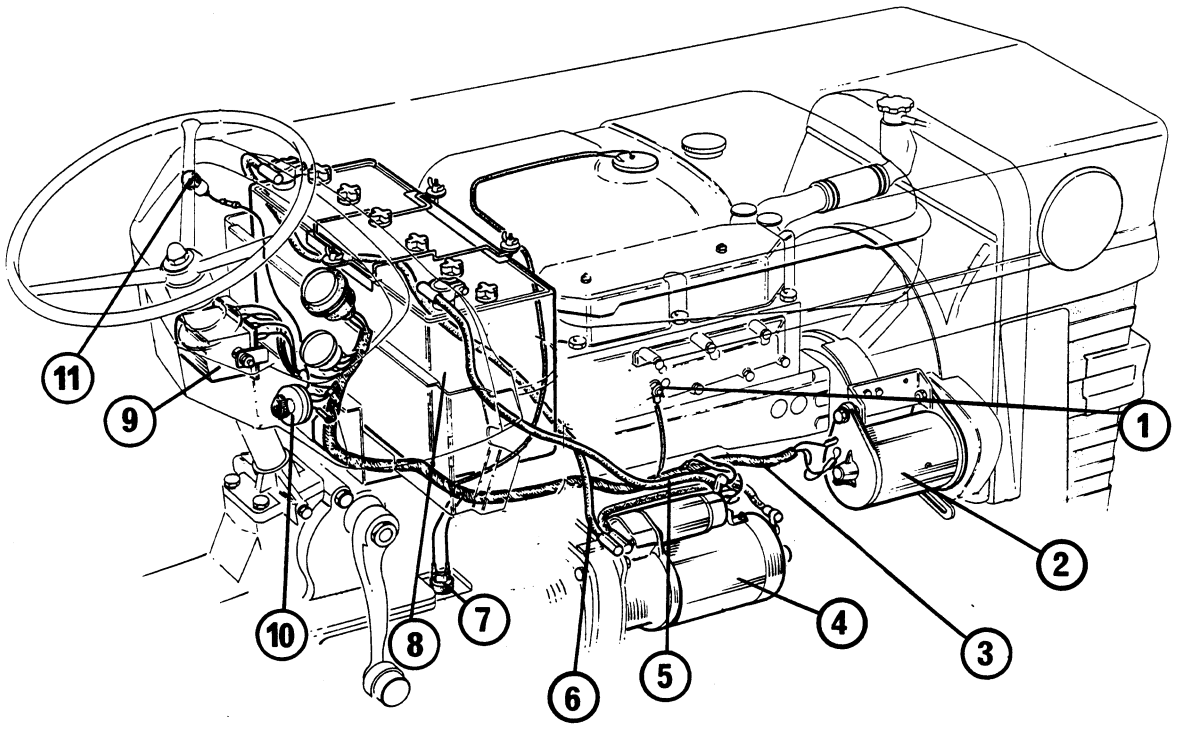

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FIG. 1

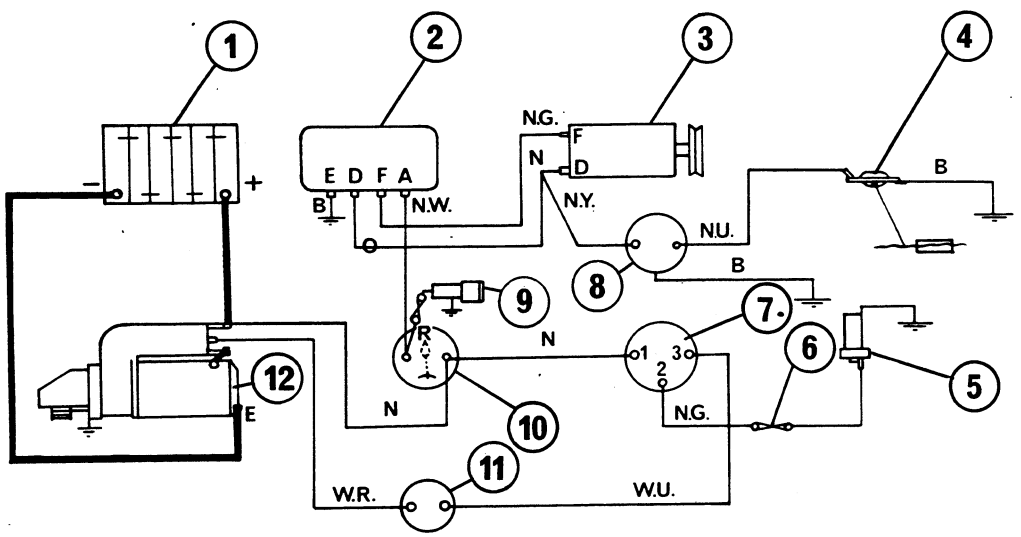
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FIG. 2

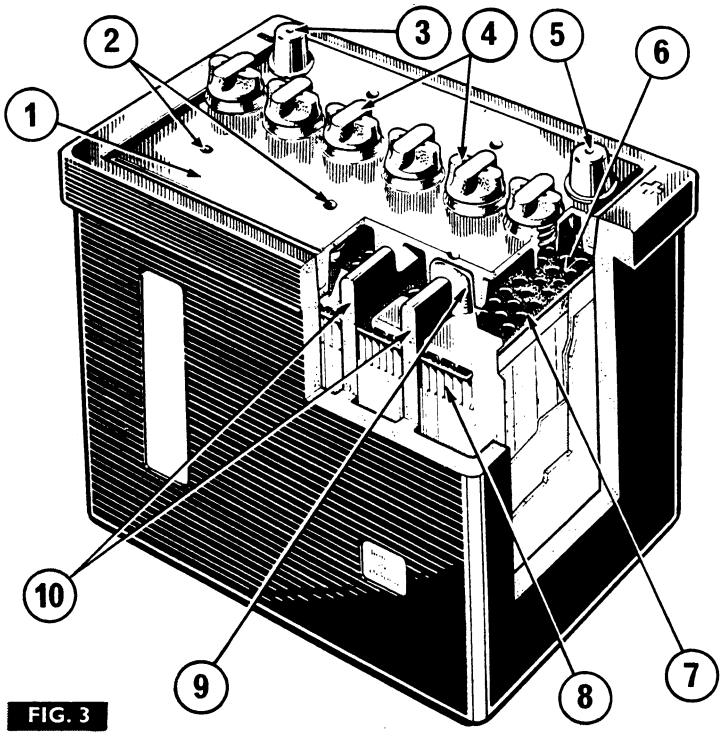


FIG. 3

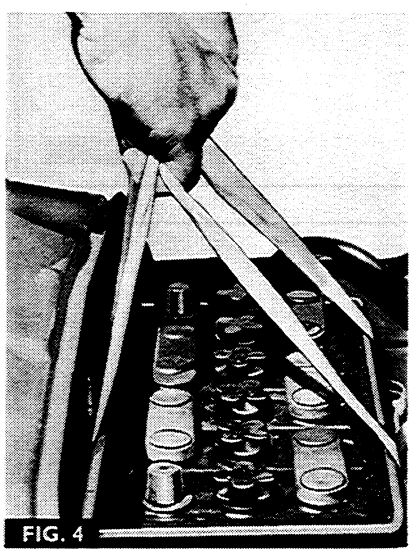


FIG. 4

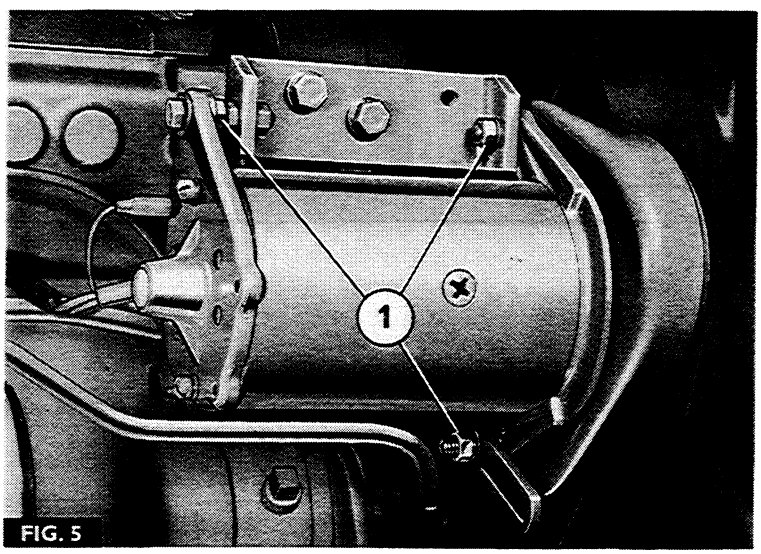


FIG. 5

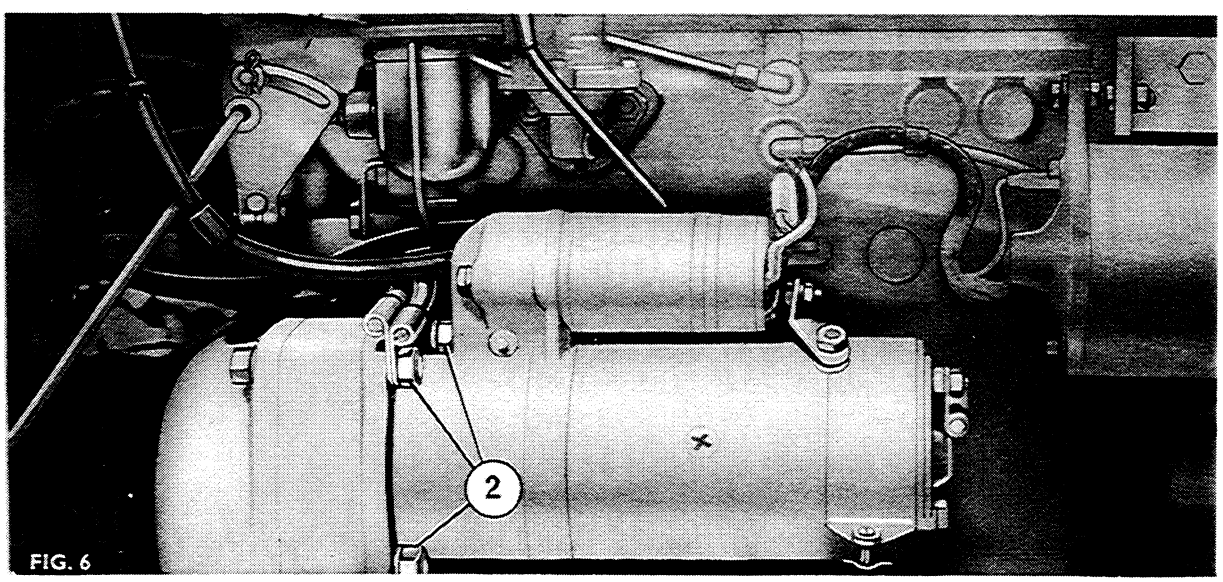


FIG. 6

Key to Fig. 3

1. Top Cover
2. Access Points to Cell Terminals
3. Terminal Post (Negative)
4. Filler Plugs
5. Terminal Post (Positive)
6. Splash Plate
7. Level of Electrolyte
8. Separators
9. Cell Terminals
10. Cell Wall

HIGH-RATE DISCHARGE TEST

The high-rate or heavy discharge test is a timed on-load voltage check applied separately to each cell of the battery. Before testing, a battery should have been off charge for at least some hours and each cell must be at least 70% charged, having a minimum electrolyte density of 1.230 S.G. in climates normally below 26.6°C (80°F) or 1.170 S.G. in hotter climates.

Use only a suitably rated tester, (300 ampere element). A cell in good condition will maintain a constant 1.2 – 1.5 volt reading on the test meter for 10 seconds when the prongs of the tester are passed on to adjacent interconnectors or terminals. A weak cell will show a rapidly falling voltage. If all the cells appear weak, this may indicate that the battery is merely discharged but otherwise healthly.

RECHARGING FROM AN EXTERNAL SUPPLY

If the above tests indicate that the battery is merely discharged and is otherwise in a good condition, it should be recharged, either on the tractor by a period of daytime running or on the bench from an external supply.

If the latter, the battery should be recharged at the rate given in the specification until the specific gravity and voltage show no increase over three successive hourly readings. During the charge the electrolyte must be kept level with the top of the separator guard by the addition of distilled water.

A battery that shows a general falling off in efficiency, common to all cells, will often respond to the process known as 'cycling'. This process consists of fully charging the battery, as described above, and then discharging it by connecting it to a lamp board, or other load, taking a current equal to the charging current. The battery should be capable of providing this current for at least 7 hours before it is fully discharged, as indicated by the voltage of each cell failing to 1.8. If the battery discharges in a shorter time, repeat the cycle of charge and discharge.

PREPARING NEW UNFILLED UNCHARGED BATTERIES

Preparation of Electrolyte

Batteries should not be filled with acid until required for initial charging.

Approximately:

790 cc (1 ⅜ pint) 96 amp/hr.
1220 cc (2 ⅛ pint) 125 amp/hr.

is needed for each 2-volt cell.

SPECIFIC GRAVITY OF ACID REQUIRED WHEN FILLING

Home and Climates ordinarily below 26.6°C (80°F): Specific Gravity of Acid (Corrected to 15.5°C (60°F) – 1.260.

Climates frequently over 26.6°C (80°F): Specific Gravity of Acid (Corrected to 15.5°C (60°F) – 1.210.

Electrolyte of the specific gravity required is prepared by mixing distilled water and concentrated sulphuric acid, usually of 1.840 S.G. The mixing must be carried out either in a lead-lined tank or in a suitable glass or earthenware vessel. Slowly add the acid to the water, stirring with a glass rod. *Never add the water to the acid,* as the resulting chemical reaction causes violent and dangerous spurting of the concentrated acid. The approximate proportion of acid and water are indicated in the following table:

To obtain 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, and the electrolyte should be allowed to cool before taking hydrometer readings and pouring the electrolyte into the battery.

Filling the Battery

The temperature of the acid, battery and filling-in room must not be below 0°C (32°F). Remove the vent plugs and half-fill each cell with electrolyte of the appropriate specific gravity. Allow the battery to stand for six to twelve hours (in order to dissipate the heat generated by the chemical action of the acid on the plates) before resuming the filling to the top surface of the separator guard. Allow to stand for a further two hours and then proceed with the initial charge.

Initial Charge

The initial charging rate is given in the specification. Charge at this rate until the voltage and specific gravity readings show no increase over five successive hourly readings. This will take from 48 to 80 hours, depending on the length of time the battery has been stored before charging. Some harmless frothing may occur during the first few hours. This can be minimised by reducing the charging current. Conversely, frothing will be increased if the specified charging rate is exceeded.

NOTE – BOTH 96 AMP AND 125 AMP BATTERIES MAY BE FILLED IN ONE STAGE TO THE SEPARATOR GUARD. THEY MUST THEN BE ALLOWED TO STAND FOR 12 HOURS BEFORE THE INITIAL CHARGE IS BEGUN. IF NECESSARY, ADD MORE ACID TO RESTORE ELECTROLYTE LEVELS TO THE SEPARATOR GUARDS.

MAXIMUM PERMISSIBLE ELECTROLYTE TEMPERATURE DURING CHARGE.

Home and Climates normally below 26.6°C (80°F):
37.7°C (100°F)
Climates frequently over 26.6°C (80°F):
48.8°C (120°F)

Keep the current constant by varying the series resistance of the circuit or the generator output. This charge should not be broken by long rest periods. If, however, the temperature of any cell rises above the permissible maximum, the charge must be interrupted until the temperature has fallen at least 5.5°C (10°F) below that figure. Throughout the charge, the electrolyte must be kept level with the top of the separator guard by the addition of acid solution of the same specific gravity as the original filling-in acid, until specific gravity and voltage readings have remained constant for five successive hourly readings.

If the charge is continued beyond that point, top up with distilled water.

At the end of the charge carefully check the specific gravity in each cell to ensure that, when corrected to 15.5° (60°F), it lies within the specified limits. If any cell requires adjustment, some of the electrolyte must be siphoned off and replaced, either by distilled water or by acid of the strength originally used for filling-in, depending on whether the specific gravity is too high or too low. Continue the charge for an hour or so to ensure adequate miximg of the electrolyte and again check the specific gravity readings. If necessary, repeat the adjustment process until the desired reading is obtained in each cell. Finally, allow the battery to cool, and siphon off any electrolyte above the top of the spearator guard.

PREPARING NEW DRY-CHARGED BATTERIES FOR SERVICE

SPECIFIC GRAVITY OF ACID REQUIRED WHEN FILLING

Home and Climates ordinarily below 26.6°C (80°F): Specific Gravity of Acid

(corrected to 15.5°C (60°F)

1.260

Climates frequently over 26.6°C (80°F): Specific Gravity of Acid

(corrected to 15.5°C (60°F)

1.210

Filling the Cells

Remove the sealing tape from the vent plugs (when applicable) and fill each cell with correct specific gravity acid to the top of the perforated separator guard in one operation. The Temperature of the filling room, battery and acid should be maintained at between 15.5°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.

Freshening Charge (When Necessary)

After filling, allow to stand for 20 minutes and then re-check the specific gravity and temperature of the electrolyte in each cell. The battery is then ready for service, unless the above checks show the electrolyte temperature to have risen by more than 5.5°C (10°F), or the specific gravity to have fallen by more than 10 points – 0.010 S.G. In this event, it will be necessary to recharge the battery at the appropriate recharge rate, see the specification, until the specific gravity values remain constant for three successive hourly readings and all cells are gassing freely. During charging, keep the electrolyte in each cell level with the separator guard by adding distilled water – NOT ACID.

Removal and Refitment 8A-01-06

1. Remove the battery access panel.
2. Disconnect both battery terminals.
3. Remove the three wing nuts and washers securing the battery retainer and remove the retainer.

4a. Fig. 4. If a battery harness is fitted lift out the battery.

4b. For batteries without a harness it is necessary to make a sling by using two pieces of rope positioned beneath the battery.

5. Replace the battery in reverse procedure, ensuring that the terminal posts are free from corrosion, and before replacing the terminals, smear the posts with petroleum jelly.

DYNAMO

The dynamo is a shunt-wound two-pole two-brush non-ventilated machine, arranged to work in conjunction with a Lucas regulator unit. The output of the dynamo is controlled by the regulator unit and is dependent on the state of charge of the battery and the loading of the electrical equipment in use. When the battery is in a low state of charge, the dynamo gives a high output, whereas if the battery is fully charged, the dynamo gives only sufficient output to keep the battery in good condition without any possibility of overcharging.

Dynamo Maintenance

Lubrication

Every 500 running hours or 6 months remove the neoprene plug and inject a few drops of high quality engine oil into the hole marked 'Oil' in the commutator-end bearing housing.

Inspection of Brushgear

At 1000 running hours or 1 year, the dynamo should be removed from the engine and the brushgear be inspected by a competent automobile electrican.

Belt Adjustment

Every 100 hours inspect the dynamo driving belt and, if necessary adjust to take up any undue slackness by turning the dynamo on its mounting. Care should be taken to avoid overtightening the belt, the tension needed being just enough to drive without slipping. See that the pulleys are properly aligned, otherwise undue strain will be thrown on the dynamo bearings.

To adjust the belt tension, slacken the bolts (1, Fig. 5) and swing the dynamo outward until there is 20 mm (¾ in) movement of the belt. Retighten the dynamo bolts (1).

Removal and Refitment 8A-02-06

Fig. 5

1. Remove the two wires from dynamo terminals.
2. Slacken the bolts (1) on the dynamo and swing the dynamo towards the engine.
3. Remove the fan belt.
4. Remove the bolts (1) and lift off the dynamo and the fan belt guard.
5. Replace in reverse sequence to above and adjust the fan belt to give a deflection of 20 mm (¾ in), midway between the fan pulley and the crankshaft pulley.

NOTE – SEE PERKINS WORKSHOP MANUAL FOR SERVICING DETAILS.

STARTER MOTOR

The starter motor is of similar construction to the dynamo except that heavier gauge conductors are used in the construction of the armature and field coils.

Removal and Refitment 8A-03-07

1. Fig. 6. Disconnect the wires at the starter motor relay, and the main lead to the battery.
2. Remove the bolts (2) securing the starter motor to the engine.
3. Pull the starter clear.
4. Replace in reverse sequence to above.

NOTE – SEE PERKINS WORKSHOP MANUAL FOR SERVICING DETAILS.

CONTROL BOX

All settings are accurately adjusted before control boxes leave the factory and must not be disturbed unnecessarily. Any subsequent attention that may be required after the period of warranty has expired should only be carried out by a qualified automobile electrician. The control box is a sealed unit but the cover is pierced with two 12.7 mm (½ in) dia. holes for permitting screwdriver access to the voltage regulator and cut-out relay adjusting screws. The holes are plugged with a pair of linked rubber blanks which can be withdrawn when making voltage measurements and adjustments.

The control box frame is at generator potential and so, also, are the adjusting screws, since these pass through tapped holes in the frame. It is therefore advisable before making an adjustment to select a small screwdriver having an adequately insulated blade, and thus obviate short-circuiting of the generator in the event of the control box cover becoming earthed. If necessary, a piece of insulating tubing of suitable length and bore can be sleeved on to an otherwise uninsulated screwdriver blade.

CONTROL BOX SERVICING

CHARGING CIRCUIT

Preliminary Checking

Before disturbing any electrical adjustments, examine as follows to ensure that the fault does not lie outside the control box:

1. Check the battery by substitution or with an hydrometer and a heavy discharge tester.
2. Inspect the dynamo driving belt. This should be just taut enough to drive without slipping.
3. Check the dynamo by substitution, or by disconnecting the dynamo cables and linking large terminal 'D' to small terminal 'F' and connecting a 0-20 first-grade moving-coil voltmeter between this link and earth, and then running the dynamo up to about 1,000 rev/min when a rising voltage should be shown. If satisfactory, restore the generator connections.
4. Inspect the wiring of the charging circuit and carry out continuity tests.
5. Check earth connections, particularly of the control box.
6. In the event of reported undercharging, ascertain that this is not due to little running of the tractor or continuous use at idling speed.

VOLTAGE REGULATOR ELECTRICAL SETTING

Checking and Adjustment

Fig. 7

Checking and adjusting of the open-circuit voltage setting should be completed as rapidly as possible so as to avoid errors resulting from heating of the voltage regulator shunt coil.

1. Disconnect the cable from control box terminal 'A'.

   WARNING – DO NOT ALLOW THE END OF THE CABLE REMOVED TO CONTACT ANY EARTHED PARTS OF THE TRACTOR.

2. Remove the linked rubber blanks (1) from the control box cover.
3. Start the engine and drive the generator at about 3000 rev/min.
4. Using test prods, (2 & 3), measure the voltage between the exposed head of one of the adjusting screws and a good earth. This should be between the following limits, according to the ambient temperature:

Ambient Temperature	*Open-circuit Generator Voltage*
10°C. (50°F.)	16.1 – 16.7
20°C. (68°F.)	16.0 – 16.6
30°C. (86°F.)	15.9 – 16.5
40°C. (104°F.)	15.8 – 16.4

An unsteady reading may be due to the voltage regulator contacts requiring cleaning, in which event, remove the cover and clean the contacts, preferably using silicon carbide paper, followed by methylated spirits (denatured alcohol). If the reading is steady but occurs outside the appropriate limits, the voltage regulator must be re-adjusted. In this event, proceed as follows otherwise stop the engine, restore the original connections and refit the rubber blanks.

NOTE – WHEN VIEWED FROM THE DOMED EMBOSSED END OF THE COVER WITH RUBBER BLANKS UPPERMOST, THE LEFT HAND HOLE GIVES ACCESS TO THE VOLTAGE REGULATOR ADJUSTING SCREW AND THE RIGHT HAND HOLE TO THE CUT-OUT RELAY ADJUSTING SCREW.

5. Clip one of the voltmeter leads (of appropriate polarity) to a good earthing point.
6. Using a test prod, contact the other voltmeter lead against the exposed head of the cut-out relay adjusting screw (2).
7. Turn the voltage regulator adjusting screw (clockwise to raise the setting or anti-clockwise to lower it) until the correct open circuit is obtained.
8. Check the setting by stopping the engine and then again raising the generator speed to 3000 rev/min.
9. Stop the engine, restore the original connections and refit the rubber blanks.

CUT-OUT RELAY ELECTRICAL SETTING

Checking and Adjustment

Checking and adjustment of the cut-in and drop-off voltage settings should be completed as rapidly as possible so as to avoid errors resulting from heating of the cut-out relay shunt coil. For this test remake the connection between control box terminal 'A' and its associated cable.

CUT-IN VOLTAGE

Testing

Figure 7

1. Disengage the linked rubber blanks from the control box cover.
2. Using test prods, measure the voltage between the exposed head of one of the adjusting screws and a good earth whilst the generator speed is slowly increased from zero.
3. Observe the voltmeter pointer, which should slowly rise and then drop back slightly at a reading between the limits 12.7 – 13.3 volts. The cut-in voltage is that reached immediately before the pointer drops back.
4. If the cut-in voltage occurs outside the limits 12.7 – 13.3 volts, adjust the cut-out relay in a manner similar to that described for adjusting the voltage regulator, turning the cut-out relay adjusting screw clockwise to raise the cut-in voltage, or anti-clockwise to lower it.
5. Re-check the setting by increasing the generator speed from zero.
6. Stop the engine, disconnect the voltmeter and refit the rubber blanks.

Key to Fig. 7

1. Linked Rubber Blanks
2. Screwdriver with Insulated Blade
3. Voltmeter Prod

Key to Fig. 8

1. Voltage Regulator Adjusting Screw
2. Cut-out Relay Adjusting Screw
3. Fixed Contact Blade
4. Cut-out Relay Armature

TESTING DROP-OFF VOLTAGE

1. Disconnect the cable from control box terminal 'A'.

   WARNING – DO NOT ALLOW THE END OF THE DISCONNECTED CABLE TO CONTACT ANY EARTHED PARTS OF THE TRACTOR.

2. Connect the voltmeter between control box terminal 'A' and a good earthing point.
3. Start the engine and drive the generator at about 3000 rev/min.
4. Observe the voltmeter pointer, while slowly decelerating the engine. Opening of the cut-out relay contacts, indicated by the voltmeter pointer dropping to zero, should occur between the limits 8.5 – 11.0 volts. If the drop-off voltage occurs outside these limits, remove the control box cover and adjust the contact pressure, otherwise, stop the engine and restore the original connections.
5. Stop the engine, remove and disconnect the control box.
6. Remove the control box cover, secured to the base by a rolled-over edge.
7. Bend carefully the fixed contact blade towards the cut-off relay armature to reduce the drop-off voltage or away from the armature to raise the voltage.
8. Re-check the setting and, if necessary, re-adjust until the correct drop-off voltage is obtained.
9. Refit the control box cover, bending back the rolled-over edge into its former position round the base.
10. Restore original connections.

CLEANING CUT-OUT RELAY CONTACTS

Only strips of fine glass paper must be used to clean the cut-out relay contacts. Carborundum stone, emery cloth or silicon carbide paper must never be used. The use of fine glass paper should be followed by methylated spirits (de-natured alcohol).

CONTROL BOX

Removal and Replacement 8A-04-08

1. Remove the lower instrument panel as stated in Part 2B.
2. Fig. 9. Disconnect the wire from the terminals.
3. Remove the two nuts securing the control box to the mounting bracket.
4. Remove the control box.
5. Assemble in the reverse sequence, connecting the wires as shown in Fig. 2.

STARTER SWITCH

The starter switch is actuated by a key and is only effective when the dual range gear is placed in the neutral "S" position. The switch has a spring-loaded action which holds the key in the "O" position normally. To start the tractor in normal conditions turn the key clockwise to the "S" position. In cold weather the key should be turned to the "H" and then the "HS" position to ensure easy starting. For detailed starting instructions, see the Operator Instruction Book.

STARTER SWITCH

Removal and Replacement 8A-05-08

1. Remove the nut and the instruction plate on the front of the starter switch.
2. Pull the switch through to the back of the instrument panel.
3. Disconnect the wires.
4. Replace in the reverse order, attaching the wires as shown in Fig. 2.

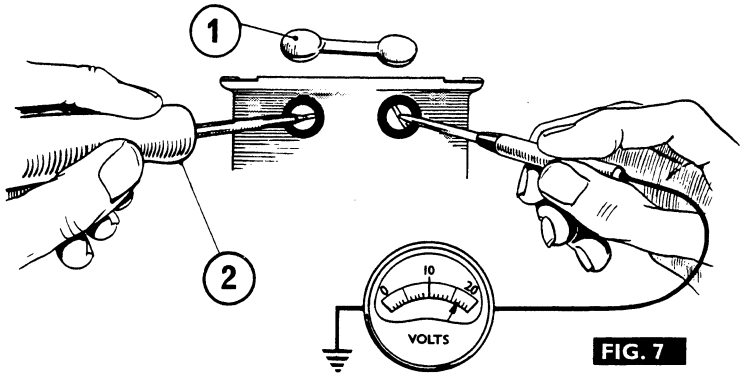


FIG. 7

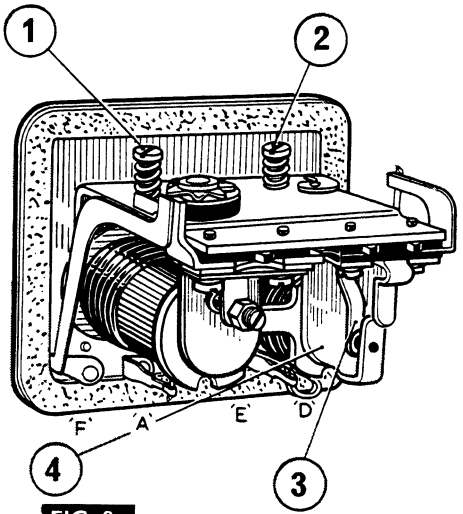


FIG. 8

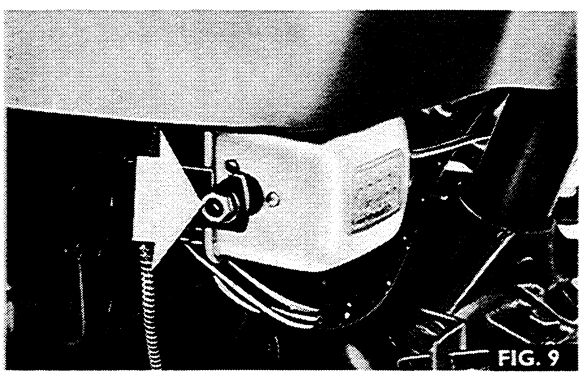


FIG. 9

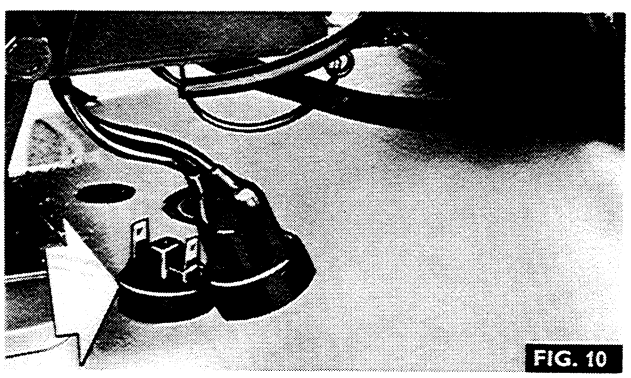


FIG. 10

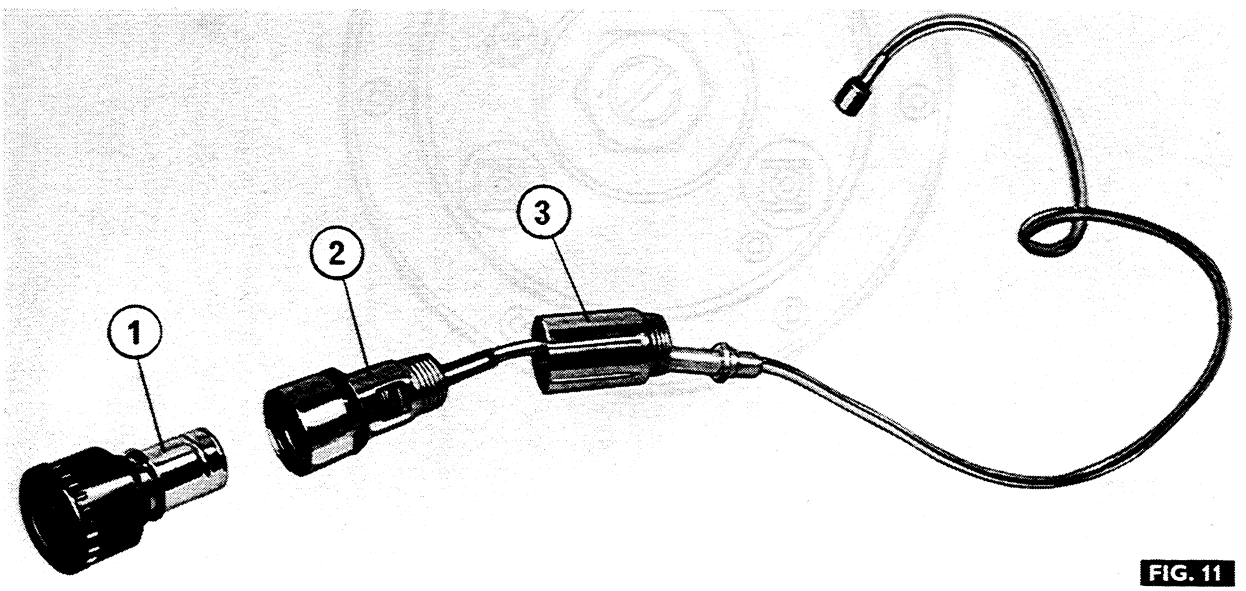


FIG. 11

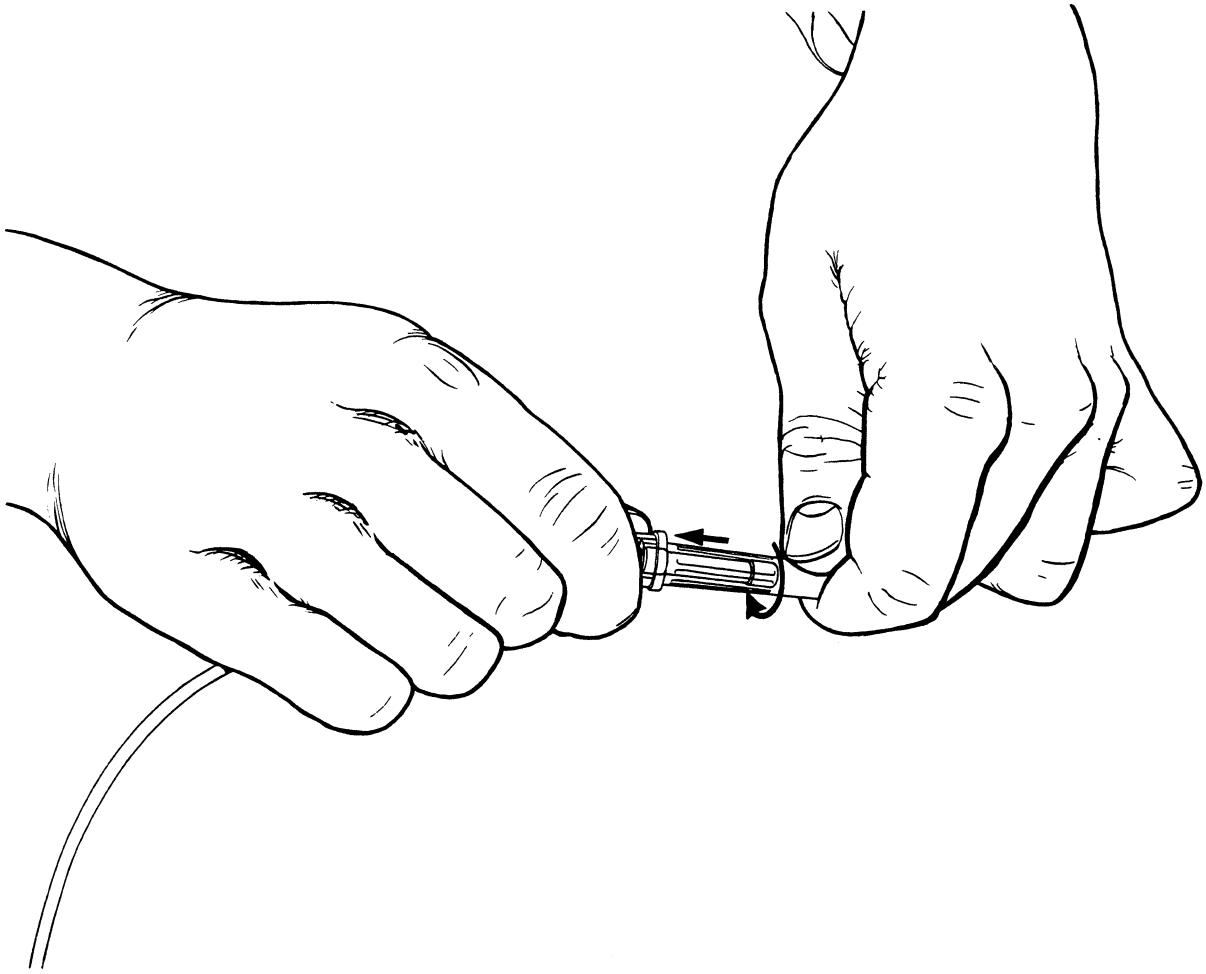


FIG. 12

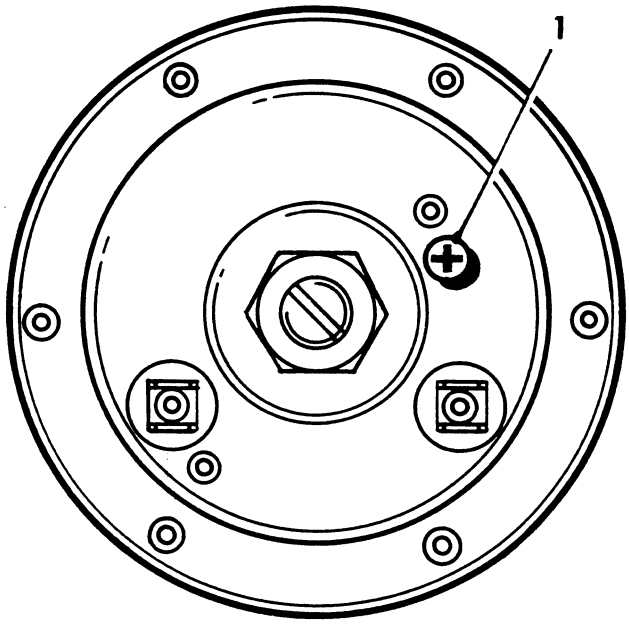


FIG. 13

NEUTRAL SAFETY START SWITCH

This switch prevents the tractor engine from being started when in gear. Engagement of either HIGH or LOW range breaks the starter switch circuit, thus preventing the starter solenoid becoming engaged.

NEUTAL SAFETY SWITCH

Removal and Replacement 8A-06-11

1. Fig. 10. Lift up the rubber cover and disconnect the two wires at the switch.
2. Unscrew the neutral safety switch.
3. Replace in the reverse sequence.

CIGARETTE LIGHTER (Optional Extra)

Fitting Instructions 8A-07-11

The cigarette lighter is available as an optional extra and is fitted as follows:

1. Remove the battery access panel.
2. Remove the rubber plug from the lighter hole.
3. Fig. 11. Pull the lighter unit (1) from the centre piece (2).
4. Unscrew the outer cover (3) from the lighter (2).
5. Place the centre of the lighter (2) through the hole in the instrument panel from the top.
6. Screw the outer cover (3) onto the centre piece (2) under the instrument panel
7. Connect up the wire to the live side of the ammeter on tractors without lights, and the feed terminal on the light switch for tractors with lights.

FUSES

Removal and Replacement 8A-08-11

Access to the fuses is gained by removing the battery access panel.

1. Remove the battery access panel.
2. Fig. 12. Holding both ends of the fuse casing, push the top of the fuse in and turn in an anti-clockwise direction as shown.
3. Pull the top of the casing clear and tip out the fuse.
4. Replace the new fuse, of the same capacity, in the reverse sequence to above.

WIRING HARNESS

Removal and Refitment 8A-09-11

1. Remove the battery access panel and disconnect the battery.
2. Disconnect the following wires:
   (a) Three at the fuel gauge
   (b) Four at the ammeter
   (c) Three at the starter switch
   (d) Four at the control box
   (e) Two at the neutral safety switch
   (f) Two at the starter motor
   (g) Two at the dynamo
   (h) One at the thermostart
   (j) Two at the fuel gauge sender unit
   (k) Two earth wires bolted to the battery carrier.
3. Remove the rubber clip securing the harness to the oil pipe adjacent to the dynamo.
4. Carefully pull the harness clear of the tractor.
5. Refit the harness to the tractor, threading it underneath the battery carrier and reconnect the wires as shown in Fig. 2.

HORN

Before being passed out of Works, every horn is adjusted to give its best performance. It should require no further attention until it has given a long period of service.

If the horn fails to sound or its performance becomes uncertain, the fault will not necessarily be in the horn. First see that the trouble is not due to such defects as a loose or broken connection in the wiring of the horn circuit or to a discharged battery. A short circuit in the horn wiring will cause the fuse (when fitted) to blow. In this event, examine the wiring for the fault and rectify accordingly, before renewing the fuse.

Poor performance can also be caused by loosening of the fixing bolts. Check and tighten as necessary.

If examination shows the above points to be in order the horn may need adjustment but this should not become necessary until the horn has been in service for a long period.

HORN ADJUSTMENT (Fig. 13)

Adjustment does not alter the pitch of the note but merely takes up wear of moving parts. While adjusting, short out the fuse (if fitted), otherwise it may blow. If the horn does not sound after making an adjustment, release the horn push instantly.

A small serrated adjustment screw is provided on that side of the horn at which the cables terminate. Turn this screw anti-clockwise until the horn just fails to sound, then turn it back for about one quarter of a turn.

WARNING – THE CENTRAL SLOTTED STEM AND LOCKING NUT MUST NOT BE DISTRUBED.

A model 6H horn in correct adjustment will pass 2.75 – 3.25 amperes (12 volt) – measured on a first grade moving coil 0-10A ammeter. If a suitable instrument is available, connect it in series with the horn and turn the adjustment screw clockwise to increase the current, or anti-clockwise to decrease it. (When adjusting the horn by the aid of an ammeter, the aim is to obtain the best performance with the lease current).

INSTRUMENTS AND INSTRUMENT PANEL

Part 8 Section B

GENERAL

Tractormeter (1, Fig. 1 and Fig. 2a and 2b)
The tractormeter is a multi-purpose instrument which indicates engine rev/min, miles or kilometres per hour and equivalent engine running hours on one dial. The layout of this dial is as follows:

1. The top outer set of figures and graduations indicate the engine speed in rev/min.
2. The top inner set of figures and graduations are sub-divided into bands and indicate the tractor ground speed in high range, 5th, 6th, 7th and 8th gear respectively (8 speed transmission Fig. 2a) or high range, high ratio 4th, 5th and 6th gear (Multi-Power transmission Fig. 2b), working form the inner band outwards.
3. The lower set of figures gives ground speeds for low range 1st, 2nd, 3rd and 4th gears respectively (8 speed transmission), or low range, high ratio, 1st, 2nd and 3rd gears respectively (Multi-Power transmission), working from the inner band outwards.
4. The rectangular aperture in the lower centre of the dial shows the readings on an odometer which is geared to register one unit for every hour of work that the tractor engine performs at approximately 1500 rev/min. If the engine speed is higher or lower, units will be registered more quickly or slowly respectively. This hour recorder gives a more accurate guide to tractor usage than would a mileage recorder, because some tractors supply power whilst stationary. The tractormeter also has markings to show normal speeds of belt pulley and p.t.o.

INSTRUMENTS AND INSTRUMENT PANEL

Ammeter (2, Fig. 1)
The ammeter indicates whether the battery is being charged, or is discharging. If a heavy discharge is indicated the battery will lose power and starting will become difficult, or impossible.

Fuel Gauge (3, Fig. 1)
The fuel gauge indicates the quantity of fuel in the tank as a fraction of the tank capacity, not in gallons, or litres.

Temperature Gauge (4, Fig. 1)
The temperature gauge indicates the temperature of the coolant in the radiator and engine. NOT the quantity of coolant in the system. GREEN indicates normal operating temperature.

Oil Pressure Gauge (5, Fig. 1)
This gauge indicates the state of the engine oil pressure, and does NOT give an indication of the quantity of oil in the engine. The normal operating pressure is in the GREEN sector of the dial.

Air Cleaner Service Indicator (6, Fig. 1)
This indicator shows RED when the dry air cleaner requires attention. To reset the indicator, press the button on the top of the body.

INSTRUMENT PANEL ASSEMBLY

Removal and Refitment 8B-01-02
Special Tools Required: MF 268 Steering Wheel Remover

Removal
1. Remove the three bolts each side securing the hood to the instrument panel and detach the lower instrument panel from the upper panel.
2. Remove the two bolts securing the instrument panel to the steering column.
3. Remove the battery access panel and disconnect the following wires;
   Two leads from the battery.
   Four wires from the starter switch.
   Two wires from the fuel gauge.
   Four wires from the light switch (if fitted).
   Two wires from the horn switch (if fitted).
4. Disconnect the oil pressure gauge pipe at the gauge.
5. Press the ammeter through the instrument panel.
6. Disconnect the tractormeter drive cable at the tractormeter.
7. Remove the temperature gauge bulb from the engine and release the tube back to the instrument panel.
8. Remove the steering wheel as stated in Part 6A and then remove the grease nipple, felt washer, cover and rubber collar from the steering column.
9. Remove the split pin and washer securing the Multi-Power control rod to the lever (if fitted).
10. Remove the clip securing the rod to the hand throttle lever, and then remove the two bolts, nuts and washers securing the hand throttle lever bracket to the battery carrier.
11. Figs. 3 and 4. Manoeuvre the instrument panel over the steering column and clear of the tractor, then if necessary, remove the hand throttle lever and the instruments.

Refitment
1. If necessary refit the instruments and the hand throttle lever to the instrument panel.
2. Place the instrument panel over the steering column and secure it to the steering column with the two bolts.
3. Secure the hand throttle lever bracket to the battery carrier with two bolts, washers and nuts and then reconnect the rod to the hand throttle lever and secure with the clip.
4. Reconnect the Multi-Power lever (if fitted) to its linkage using a new split pin.
5. Refit the rubber collar, cover, felt washer and grease nipple to the steering column, then refit the steering wheel as stated in Part 6A.
6. Reconnect the temperature gauge to the engine.
7. Reconnect the tractormeter drive cable to the tractormeter.
8. Reposition the ammeter in its rubber housing in the instrument panel
9. Reconnect the oil pressure gauge pipe to the gauge.
10. Reconnect the following wires;
    Two wires to the fuel gauge.
    Four wires to the starter switch.
    Four wires to the light switch (if fitted).
    Two wires to the horn switch (if fitted).
    Two leads to the battery.
11. Secure the instrument panel to the hood with three bolts each side and then refit the battery access panel.

TRACTORMETER

Removal and Replacement 8B-02-02

Removal
1. Remove the battery access panel.
2. Fig. 5. Disconnect the tractormeter drive cable from the back of the tractormeter.
3. Remove the two nuts and washers securing the tractormeter to the bracket beneath the instrument panel, then push the tractormeter upwards out of the panel.

Replacement
1. Fit the new tractormeter to the instrument panel and secure it with the two nuts, spring washers and bracket.
2. Reconnect the tractormeter drive cable to the tractormeter.
3. Refit the battery access panel.

Drive Cable Removal and Replacement 8B-03-02

Removal
1. Remove the battery access panel.
2. Disconnect the tractormeter drive cable from the rear end of the engine.
3. Disconnect the drive cable from the back of the tractormeter.
4. Withdraw the cable from the battery carrier.

Replacement
1. Feed the new cable through the battery carrier and connect it to the tractormeter.
2. Connect the drive cable to the engine.
3. Refit the battery access panel.

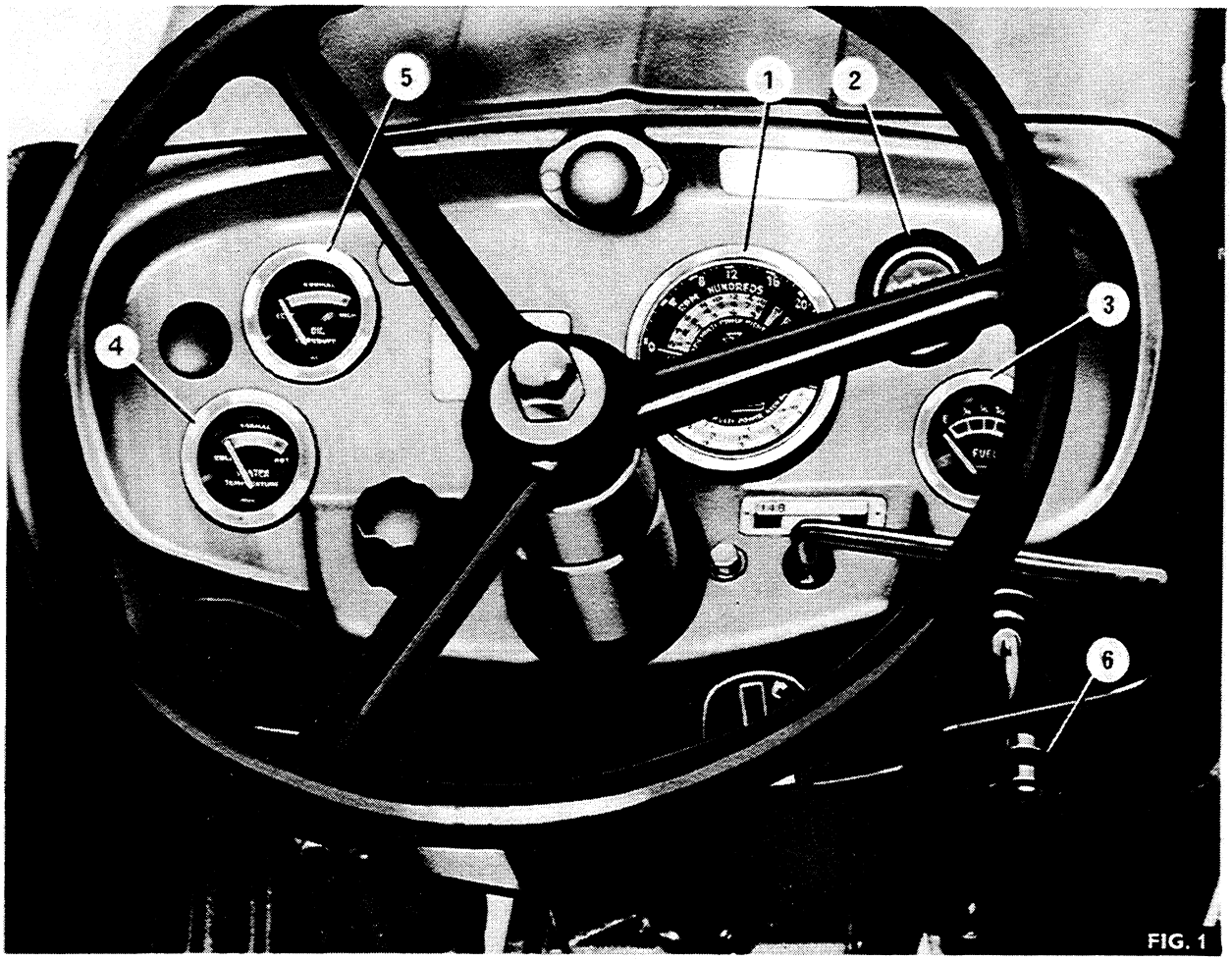


FIG. 1

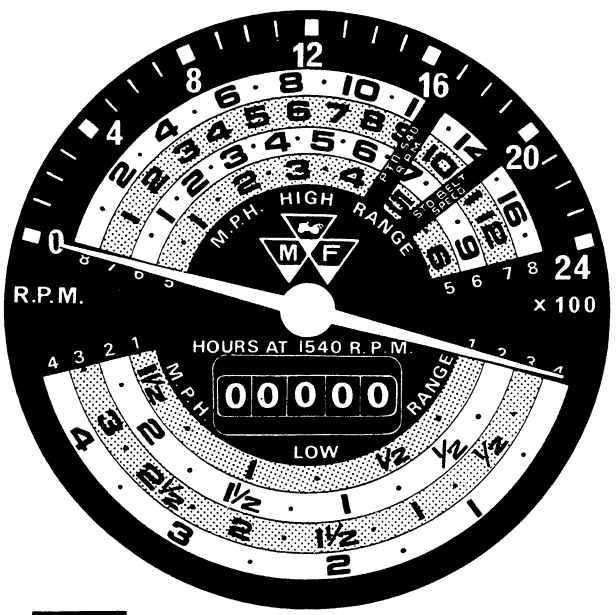


FIG. 2a

FIG. 2b

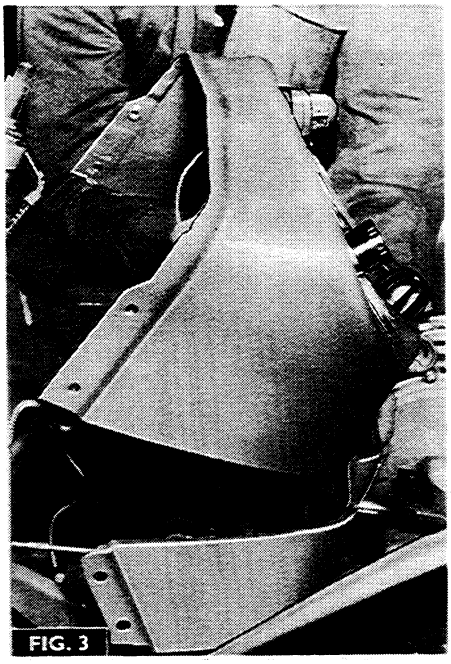


FIG. 3

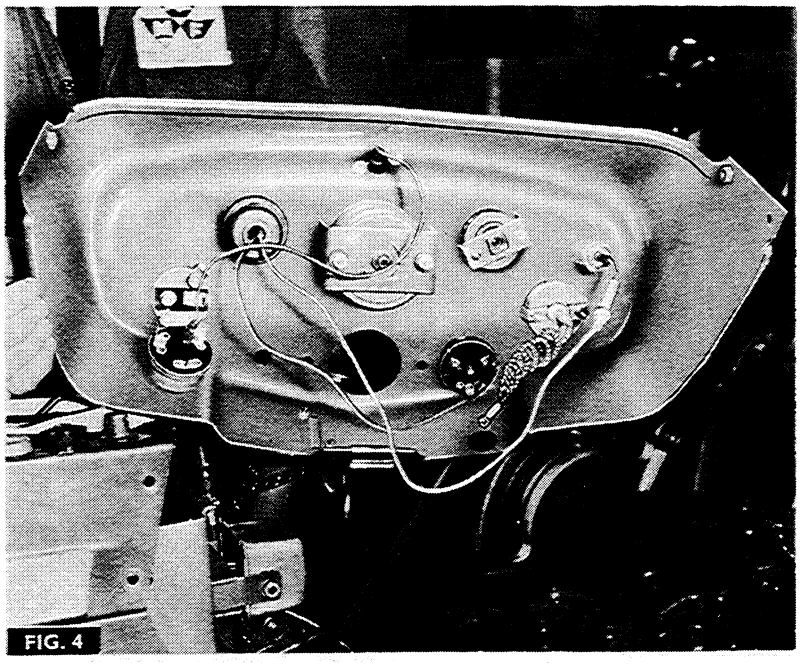


FIG. 4

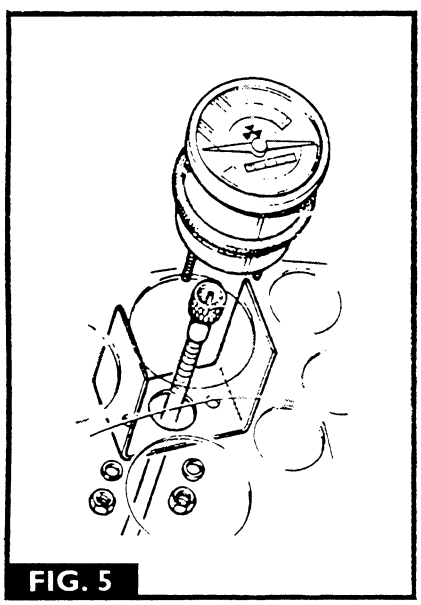


FIG. 5


FIG. 6

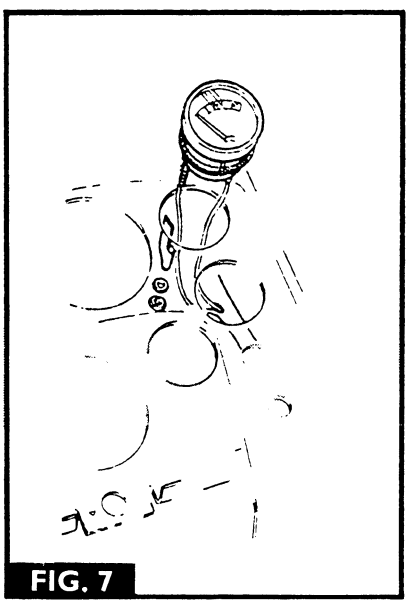


FIG. 7


FIG. 8

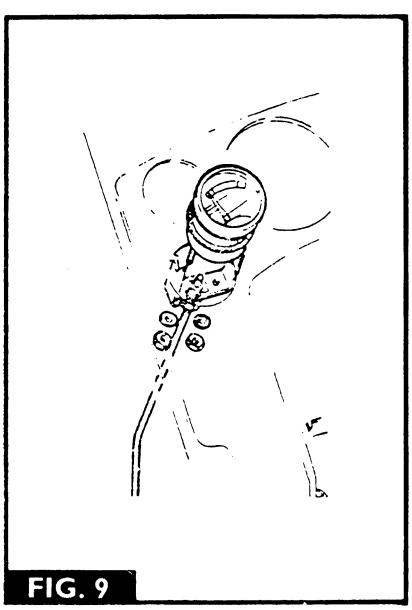


FIG. 9

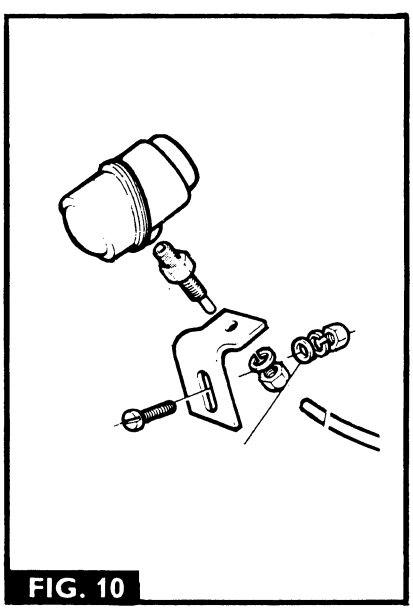


FIG. 10

AMMETER

Removal and Replacement 8B-04-05

Removal

1. Remove the battery access panel.
2. Fig. 6. Push the ammeter up through the instrument panel.
3. Roll back the rubber sleeve on the ammeter.
4. Disconnect the wires from the back of the ammeter.

Replacement

1. Connect the wiring to the new ammeter (see the wiring diagram in Part 8A).
2. Fit the ammeter into the rubber sleeve, then feed the sleeve into the instrument panel. Fully locate the sleeve in the instrument panel.
3. Refit the battery access panel.

FUEL GAUGE

Removal and Replacement 8B-05-05

Removal

1. Remove the battery access panel.
2. Fig. 7. Disconnect the two wires from the back of the fuel gauge.
3. Remove the two knurled nuts and washers securing the fuel gauge to the bracket and remove the bracket.
4. Push the fuel gauge upwards through the instrument panel.

Replacement

1. Push the fuel gauge downwards into the instrument panel.
2. Secure the gauge with the bracket, two spring washers and nuts.
3. Connect the two wires to the back of the fuel gauge.
4. Refit the battery access panel.

TEMPERATURE GAUGE

Removal and Replacement 8B-05-05

Removal

1. Remove the temperature gauge bulb from the engine and release the tube back to the instrument panel.
2. Remove the battery access panel.
3. Fig. 8. Remove the two nuts and spring washers securing the gauge to the bracket.
4. Push the gauge upwards through the instrument panel and remove complete with tube.

Replacement

1. Push the tube and gauge downwards into the instrument panel.
2. Secure the gauge with the bracket, two spring washers and nuts.
3. Connect the temperature gauge bulb to the engine.
4. Refit the battery access panel.

OIL PRESSURE GAUGE

Removal and Replacement 8B-07-05

Removal

1. Remove the battery access panel.
2. Fig. 9. Disconnect the oil pressure pipe from the rear of the gauge.
3. Remove the two nuts and spring washers securing the gauge to the bracket.
4. Push the gauge upwards through the instrument panel.

Replacement

1. Push the gauge downwards into the instrument panel.
2. Refit the two spring washers and nuts to secure the gauge to the bracket.
3. Reconnect the oil pressure pipe to the rear of the gauge.
4. Refit the battery access panel.

Pipe Removal and Replacement 8B-08-05

Removal

1. Remove the battery access panel.
2. Disconnect the oil pressure pipe from the rear of the gauge.
3. Disconnect the oil pressure pipe from the engine.
4. Pull the oil pressure pipe out through the battery carrier.

Replacement

1. Feed the new oil pressure pipe into position through the battery carrier.
2. Connect the oil pressure pipe to the engine.
3. Connect the oil pressure pipe to the rear of the gauge.
4. Refit the battery access panel.

AIR CLEANER INDICATOR

Removal and Replacement 8B-09-05

Removal

1. Remove the battery access panel.
2. Fig. 10. Disconnect the tube, from the air cleaner to the indicator, at the indicator adapter.
3. Remove the screw, nut and washers securing the indicator mounting bracket to the lower instrument panel and remove the indicator complete with the bracket.
4. Remove the nut and washer securing the adapter to the bracket and then remove the adapter from the indicator.

Replacement

1. Fit the adapter to the indicator and secure the adapter to the mounting bracket with the nut and spring washers.
2. Place the indicator in position on the lower instrument panel and secure with the screw, washer and nut.
3. Connect the tube to the indicator adapter and refit the battery access panel.

3-A-152 DIESEL ENGINE

No. of Cylinders	3.
Bore	3.6" (91.44 mm.)
Stroke	5" (127 mm.)
Cubic Capacity	152.7 cu. ins. (2,502 c.c.)
Compression Ratio	17.4 : 1.
Firing Order	1, 2, 3.
Brake H.P. (Bare Engine) ...	37. *
Belt H.P.	
Equivalent Crankshaft Torque ...	

*Subject to official confirmation

TIGHTENING TORQUES

Cylinder Head Nuts	55 - 60 lbs. ft. (7.60 - 8.29 Kg. m.)
Connecting Rod Nuts	70 - 80 lbs. ft. (9.68 -11.06 Kg. m.)
Main Bearing Setscrews	110 -120 lbs. ft. (15.21 -16.59 Kg. m.)
Flywheel Setscrews	75 lbs. ft. (10.37 Kg. m.)
Balance Weight Setscrews ...	50 - 55 lbs. ft. (6.91 - 7.60 Kg. m.)
Nozzle Cap Nuts	50 lbs. ft. (6.91 Kg. m.)

DIMENSIONS AND TOLERANCES

Component Details	Dimensions New Ins.	Dimensions New mm.	Clearances New Ins.	Clearances New mm.	Remarks
Main Bearings					
Housing Bores	2.9165	74.079			
	2.9175	74.104			
Main Bearing Bore	2.75126	69.8819			
(Ref. only)	2.75276	69.920			
Crankshaft Clearance ...			.00226	.05730	Measured assembled.
			.00426	.11810	
Crankshaft					
Main Journal Dia.	2.7490	69.824			
	2.7485	69.811			
Crankshaft Endfloat					
Rear Main Width	1.87725	47.682			
	1.87425	47.6059			
Crank Endfloat			.002	.0508	
			.011	.279	

Component Details	Dimensions New Ins.	mm.	Clearances New Ins.	mm.	Remarks
Thrust Washer Thickness ...	.123	3.124			
(Top and Bottom) ...	.125	3.175			
Thrust Washer Dia. ...	3.552	90.220			
(Top and Bottom) ...	3.562	90.475			
			.002	.0508	
			—.020	—.508	
Cylinder Block Recess for	3.572	90.729			
Thrust Washer	3.564	90.526			
Dowel—Main Bearing Cap	.750	19.050			
Diameter	.751	19.075			
			—.0015	—.038	
			÷.00075	—.019	
Cylinder Block Bore for	.75075	19.069			
Dowel	.7495	19.037			
Big End					
Crankpin Diameter	2.249	57.125			
	2.2485	57.112			
			.00325	.0825	
			.00175	.0444	
Bearing Bore	2.25175	57.1944			
	2.25075	57.1690			
Conn. Rod Bore	2.3955	60.846			
	2.3950	60.833			
Conn. Rod Big End Width ...	1.5525	39.434			
	1.5502	39.375			
Big End Endfloat			.0095	.2413	
			.0148	.3759	
Crankpin Width	1.565	39.751			
	1.562	39.674			
Small End					
Small End Bore	1.37475	34.918			
	1.37620	34.955			
			—.00525	—.1333	
			—.0023	—.0584	
Small End Bush	1.3785	35.014			
(External Dia.)	1.3800	35.052			
Small End Bush	1.2505	31.763			
(Internal Dia.)	1.2515	31.788			
			.0005	.0127	
			.00175	.0444	
Gudgeon Pin Dia.	1.250	31.75			
	1.24975	31.743			
			—.0005	—.0127	
			—.00025	—.0063	
Gudgeon Pin Holes in Piston	1.250	31.75			
	1.2495	31.737			

Component Details	Dimensions New Ins.	mm.	Clearances New Ins.	mm.	Remarks
Rod Alignment between Big and Small-end bores with small-end bush fitted.	At 5" Centres (127 mm.)		±.005" (.127 mm.)		Measured on each side of axis of rod on test mandrel.
Cylinder Block and Liners					
Cylinder Block Bore ...	3.6875	93.662			
	3.6885	93.687			
			+.001	+.0254	
			—.001	—.0254	
Liner	3.6885	93.687			
	3.6875	93.662			
Top Flange of Liner	.045	1.143			
(Thickness)	.040	1.016			
			.001	.0254	Below block top face.
			.009	.2286	
Recess for Top Flange of Liner	.046	1.1684			
	.049	1.2446			
Liner—Top Dia. (Flange) ...	3.810	96.774			
	3.805	96.647			
			.005	.127	
			.015	.381	
Cylinder Block—Top Bore for Liner	3.815	96.901			
	3.820	97.028			
Total Height of Cyl. Block ...	13.7445	349.110			
	13.7395	348.983			
Pistons and Sleeves					
Liner Bore	3.6015	91.478			
	3.6025	91.503			
Ring Groove Width ...	.0957	2.4307			Three compression and one scraper fitted above the gudgeon pin and one scraper fitted below.
(Top, 2nd and 3rd)	.0967	2.4561			
			.0019	.0482	
			.0039	.099	
Compression Ring Width ...	.0938	2.382			
(Top, 2nd and 3rd) ...	.0928	2.357			
Scraper Ring Groove Width	.252	6.400			
	.253	6.426			
			.002	.0508	
			.004	.1016	
Scraper Ring Width ...	.250	6.35			
	.249	6.324			
Fitted Gaps—Rings, Compression and Scraper ...	.009	.2286			
	.013	.3302			
Camshaft					
Journal Dia. (No. 1) Front ...	1.870	47.498			
	1.869	47.472			
			.004	.1016	
			.008	.2032	
Housing Bore (No. 1) Front	1.877	47.675			
	1.874	47.599			

Component Details	Dimensions New Ins.	mm.	Clearances New Ins.	mm.	Remarks
Journal Dia. (No. 2) Centre	1.860	47.244			
	1.859	47.218			
			.004	.1016	
			.008	.2032	
Housing Bore (No. 2) Centre	1.867	47.421			
	1.864	47.345			
Journal Dia. (No. 3) Rear ...	1.840	46.736			
	1.839	46.710			
			.004	.1016	
			.008	.2032	
Housing Bore (No. 3) Rear ...	1.847	46.913			
	1.844	46.837			
Camshaft Spigot Dia. ...	1.9995	50.787			
	1.9985	50.761			
			.0000	.0000	
			.0025	.0635	
Camshaft Gear Bore... ...	2.001	50.825			
	1.9995	50.787			
Camshaft Endfloat					Controlled by leaf spring affixed at rear of timing case front cover.
Cam Lift	.3085	7.836			
	.3165	8.039			
Tappets and Valves					
Bore in Head	.62575	15.894			
	.6245	15.862			
			.00075	.019	
			.0035	.088	
Tappet Stem Dia.	.62375	15.843			
	.62225	15.805			
Valve Tip Clearance					
Inlet (Cold)			.012	.3048	
Exhaust (Cold)			.012	.3048	
Valve Stem Dia.	.311	7.899			
(Inlet and Exhaust) ...	.312	7.924			
			.002	.0508	
			.0045	.1143	
Valve Guide Bore	.3155	8.013			
(Inlet and Exhaust) ...	.3140	7.975			
Valve Guide—Outside Dia....	.501	12.725			
	.5005	12.712			
			.0000	.0000	
			.0015	.0381	
Cylinder Head Hole for Guide	.5005	12.712			
	.4995	12.688			
Valve Head (Inlet and Exhaust) Clearance below Cylinder Head Face (New)	.070	1.778			Not to exceed .140" (3.556 mm.) after regrinding.

Component Details	Dimensions New Ins.	mm.	Clearances New Ins.	mm.	Remarks
Valve Head Dia.					
Inlet	1.536	39.014			
	1.532	38.913			
Exhaust	1.317	33.452			
	1.313	33.350			
Guide Projection above Spring Seat—					
Inlet	.59375	15.081			
Exhaust	.59275	15.056			
Valve Seating Angle on Valve Head	90° inclusive				
Valve Seat Angle on New Cylinder Head	88° inclusive				
Valve Springs					
Fitted Length: Inner ...	1.1875	30.162			Free Length: Inner 1.365" (34.671 mm.) 1.405" (35.687 mm.)
Outer ...	1.5	38.100			Outer 1.803" (45.796 mm.) 1.783" (45.289 mm.)
Fitted Load: Inner ...	8 lb. ± 1 lb.	3.629 ± .454 kg.			
Outer ...	22.75 ± 2 lb.	10.319 ± .907 kg.			
Full Lift Load:	Inlet				Outlet
Inner ...	23 ± 2 lb.	10.433 ± .907 kg.			23 ± 2 lb. 10.433 ± .907 kg.
Outer ...	50 ± 2 lb.	22.68 ± .907 kg.			50 ± 2 lb. 22.68 ± .907 kg.
Rocker Shaft Dia.	.62375	15.843			
	.62225	15.805			
			.00075	.019	
			.0035	.088	
Bush Rocker Lever Bore ...	.6245	15.862			
	.62575	15.894			
Timing Gear					
Crankshaft Dia. for Gear ...	1.5005	38.1127			
	1.500	38.100			
			—.001	—.0254	
			+.001	+.0254	
Crankshaft Gear Bore ...	1.501	38.1254			
	1.4995	38.087			
Crankshaft Dia. for Crank Pulley	1.5005	38.1127			
	1.500	38.100			
			.00025	.00635	
			.00175	.04445	
Crankshaft Pulley	1.50175	38.1444			
	1.50075	38.119			
Pulley—Crankshaft Seal Dia.	2.255	57.277			
	2.250	57.15			

Component Details	Dimensions New Ins.	mm.	Clearances New Ins.	mm.	Remarks
Crankshaft—Rear Seal Dia....	2.800	71.12			
	2.799	71.0946			
Idler Gear Hub Dia. ...	2.1238	53.944			
	2.123	53.924			
			.0012	.0304	
			.0036	.0913	
Idler Gear Bore	2.125	53.975			
	2.1266	54.016			
Idler Gear Hub Width ...	1.3275	33.718			
	1.3325	33.845			
Idler Gear Endfloat			.005	.127	
			.015	.381	
Idler Gear Width	1.3225	33.591			
	1.3175	33.464			
Idler Gear Hub Dia. ...	.8745	22.212			
	.8737	22.191			
			.000	.000	
			.002	.508	
Cylinder Block Bore ...	.87575	22.244			
	.8745	22.212			
Idler Retaining Plate Thick-	.140	3.556			
ness	.110	2.794			
Water Pump					
Shaft Diameter	.6267	15.918			
	.6262	15.905			
			—.0028	—.0711	
			—.0015	—.0381	
Pulley Bore	.6239	15.847			
	.6247	15.867			
Shaft Diameter	.6267	15.918			
	.6262	15.905			
			—.0017	—.0431	
			—.00045	—.0114	
Impeller	.62575	15.894			
	.6250	15.875			
Shaft Bearing Dia.	1.1811	29.999			
	1.1806	29.987			
			—.0011	—.02794	
			—.0001	—.00254	
Body-Bore for Bearing ...	1.1800	29.972			
	1.1805	29.984			
Fuel Pump Drive					
Gear Bore	1.750	44.45			
	1.751	44.475			
			.003	.0762	
			.0012	.0304	
Hub Gear Dia.	1.7488	44.419			
	1.7480	44.399			

Component Details	Dimensions New Ins.	mm.	Clearances New Ins.	mm.	Remarks
Lubricating Oil Pump					
Idler Gear Bore	.750	19.050			
	.751	19.075			
			—.0032	—.0762	
			—.0012	—.0304	
Idler Gear Bush—Outside Dia.	.7532	19.131			
	.7522	19.105			
Idler Gear Bush—Inside Dia.	.6572	16.692			
	.6562	16.667			
			.00085	.0215	
			.00245	.0622	
Shaft—Idler	.65535	16.645			
	.65475	16.630			
			—.00185	—.064	
			—.00025	—.00635	
Pump Body Bore	.6545	16.624			
	.6535	16.598			
Endfloat of Idler on Hub ...			.013	.330	
			.004	.1016	
Oil Pump Driver Gear Bore	.4964	12.608			
	.4972	12.628			
			—.0021	—.0533	
			—.0008	—.0203	
Oil Pump Drive Shaft ...	.4985	12.661			
	.4980	12.649			
			.003	.0762	
			.0015	.0381	
Housing Bore—Oil Pump ...	.501	12.725			
	.500	12.700			
Housing—Rotor Pocket	.751	19.075			
Depth	.750	19.050			
Housing—Rotor Pocket Dia.	1.603	40.716			
	1.604	40.741			
Driver Gear Boss Thickness	.515	13.081			
	.485	12.319			

3A-152 DIESEL ENGINE

THE 3A-152 ENGINE (Refer Figure 1)

The 3A-152 diesel engine is, as its numerical identification suggests, a 3-cylinder unit with a capacity of 152 cub. ins. (2·5 litres). This engine, by virtue of its combustion chamber design and nozzle location, combines the advantages of direct and indirect injection types.

This section is concerned with engine removal, overhaul and re-installation and, where applicable, includes reference to special toolage recommendations. Note that reference is made exclusively to the basic engine only, as the various components of the cooling, electrical and fuel systems are dealt with elsewhere in this Manual.

An important and often neglected aspect of engine reclamation work is the necessity for absolute cleanliness. Many cases of unsatisfactory performance and short engine life, following reconditioning, can be directly attributed to inadequate attention to cleanliness.

It is considered prudent to mention that the continued use of an engine due for overhaul can be neither satisfactory nor economic, and cannot justify the increasing risk of total failure and additional repair charges.

The repair instructions covered within this section assume that the engine has been removed from the tractor.

Reference to left and right hand should be interpreted as seen from the driving seat.

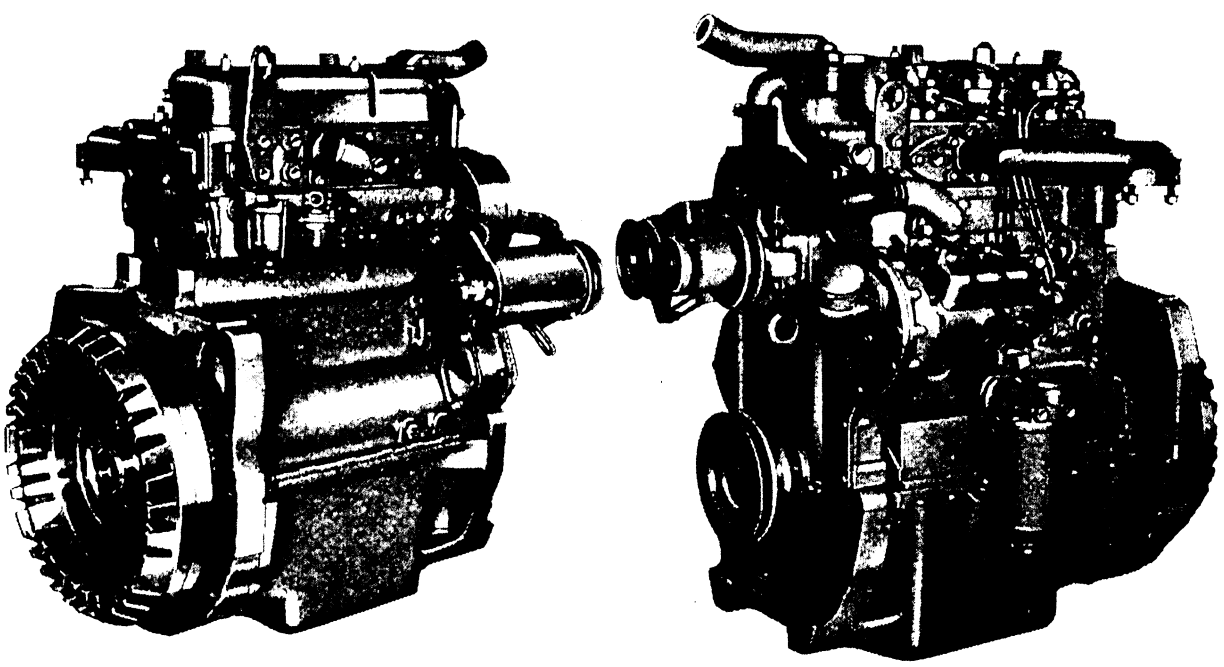


FIGURE 1
GENERAL VIEWS OF 3A-152 ENGINE

REMOVING THE ENGINE

Drain off water from radiator and cylinder block.

Remove hood and cowl assembly.

Disconnect and remove batteries.

Remove fuel tank.

Remove radiator.

Disconnect fuel supply lines to engine.

Disconnect throttle and stop control links.

Disconnect starter motor and generator connections.

Remove starter motor.

Disconnect steering drag links to left and right hand track arms.

Apply parking brake and chock rear wheels.

Support engine and gearbox.

Remove front axle assembly.

Remove nuts and bolts securing engine to transmission housing.

Using special engine removal rig or, alternatively, a block and tackle, separate engine from transmission housing.

Assemble in reverse order.

When offering up engine clutch centre plate to the gearbox primary shaft it may be found advantageous to turn the crankshaft to permit the primary shaft and centre plate splines to line up.

Note.—It will be necessary to bleed the fuel system before attempting to start the engine.

THE CYLINDER HEAD

REMOVING THE CYLINDER HEAD

(Refer Figures 1 and 2)

Release hose clip securing breather pipe to rocker cover, and slide connecting hose clear of rocker cover.

Release the two clips which attach breather pipe to engine, and remove breather pipe.

Slacken off hose clips connecting thermostat housing to water pump, and remove rubber hose.

Remove oil feed pipe connecting cylinder head to camshaft chamber.

Remove injector pipe clip.

Remove injector pipes and leak-off pipes, and seal off all fuel unions.

Remove the injectors.

Remove the rocker cover.

Remove the rocker shaft, ensuring that the middle two nuts are released first.

Slacken off and remove the cylinder head nuts in reverse sequence to that shown in Figure 2. Note that a plain washer is fitted to the waisted stud (No. 15).

Lift off the cylinder head and cylinder head gasket.

Remove the thermostat from the water outlet body.

Remove the inlet and exhaust manifolds. The cylinder head may be skimmed if required providing its thickness is not reduced below 2·98".

DISMANTLING THE ROCKER SHAFT ASSEMBLY (Refer Figure 3)

The removal of the retaining circlips at either end of the rocker shaft will enable the rockers, springs and pedestal brackets to be withdrawn.

Examine all components and renew as necessary.

If rocker tips are worn it is advisable to fit new rockers.

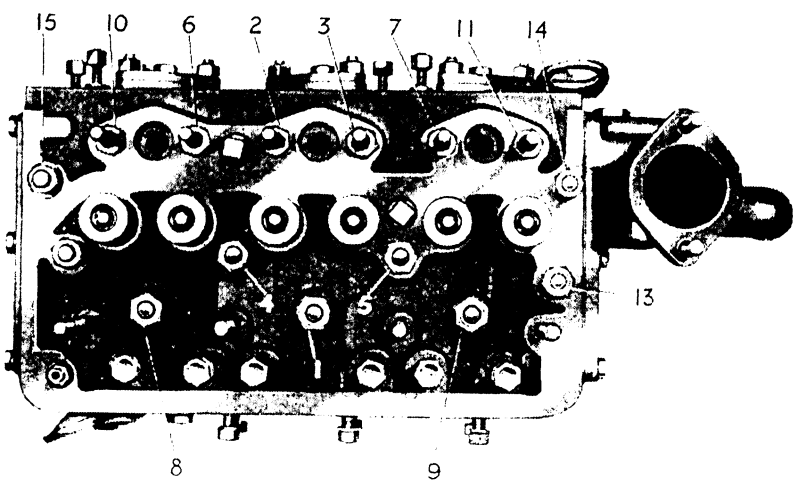


FIGURE 2
SEQUENCE OF TIGHTENING CYLINDER HEAD NUTS

FIRST ISSUE

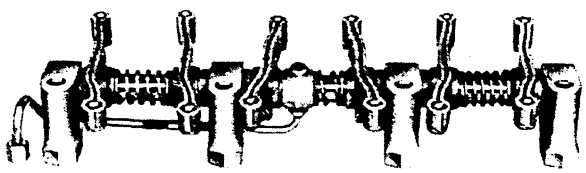


FIGURE 3
THE ROCKER SHAFT ASSEMBLY

REMOVING THE VALVES (Refer Figure 4)

Using a suitable Service Fixture or, alternatively, a valve spring compressor, remove valve cotters, valve caps, springs and valves.

Place valves and springs in a special stand or arrange them on the bench in the order in which they were dismantled. If the valves, after re-facing, are considered fit for further service, they must be returned to their original locations.

VALVE SPRINGS (Refer Figure 4)

Two coil springs are fitted to each valve. Inlet and exhaust springs are identical, and as no damper coils are incorporated they may be fitted either way up. Before re-use, however, all valve springs should be carefully examined, with particular regard to squareness of ends. The fitted length of the inner spring is 1·1875″ (30·16 mm.) developing a load of 8 lbs. (3·62 kgs.). The fitted length of the outer spring is 1·5″ (38·1 mm.) developing a load of 22·75 lbs. (10·31 kgs.).

The valve and spring assembly is illustrated in Figure 4.

VALVE GUIDES (Refer Figure 5)

The valve guides are a press fit in the cylinder head. Their location being determined by a machined step in their outer diameter.

REMOVING VALVE GUIDES (Refer Figure 5)

Valve guides can be removed and replaced using Service Tool P.D. 1A as illustrated in Figure 5.

When new valve guides are fitted the seats must be re-cut to ensure concentricity of the seat to the valve.

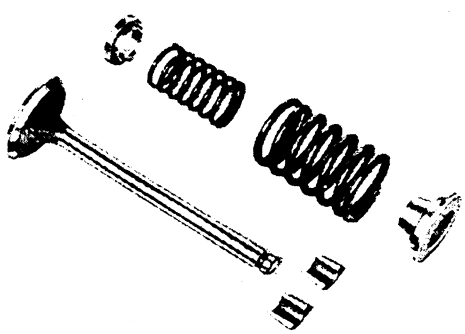
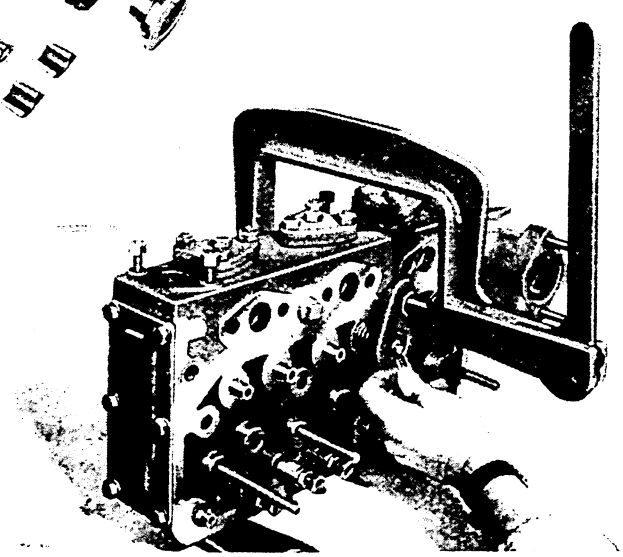


FIGURE 4
REMOVING THE VALVES



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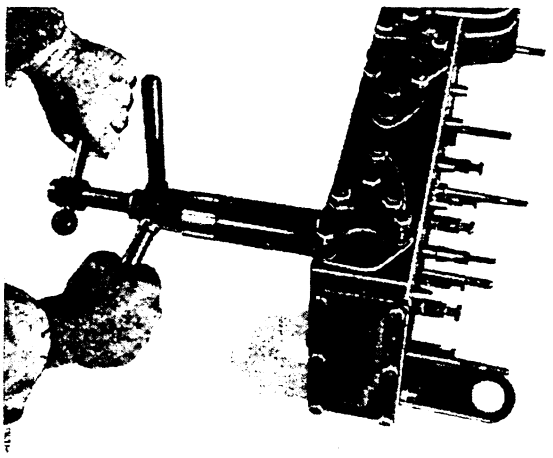

FIGURE 5
FITTING VALVE GUIDES

FIGURE 7
CHECKING VALVE HEAD DEPTH

VALVE SEATS (Refer Figures 6 and 7)

If the valve seats in the cylinder head show signs of pitting, burning or other evidence of leakage, they must be re-faced or re-ground according to their condition. Hand grinding is a finishing process and excessive grinding must be avoided, otherwise the seat angle may be altered and the seat width increased. Excessive grinding will result in "grooving" of the valve face.

Valve seat reconditioning may be carried out using a proprietary seat grinding machine with a 44° stoned face. Figure 6 shows a valve seat being re-faced by means of a hand cutter.

When stoning or re-cutting valve seats, the minimum of metal should be removed to ensure that the seating face width is maintained as near as possible to original design and not necessarily increased.

Note that the maximum clearance between the cylinder head face and the valve head must not exceed 0·140″ (3·556 mm.). This dimension can be checked using Service Tool P.D.17A as shown in Figure 7.

Valve seat inserts are not fitted to production engines. It is possible in most cases, however, to fit inserts to service engines where necessary, i.e., where the existing valve seat is worn or damaged to the point where re-cutting would place the relationship of the valve head to the cylinder head face beyond the service limits of ·066″-·140″ (1·676-3·556 mm.). This dimension applies equally to inlet and exhaust valves.

FIGURE 6
RE-CUTTING VALVE SEATS

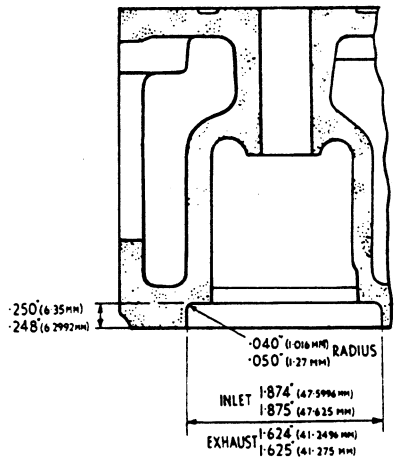

FIGURE 7A

MACHINING DIMENSIONS FOR VALVE SEAT INSERTS

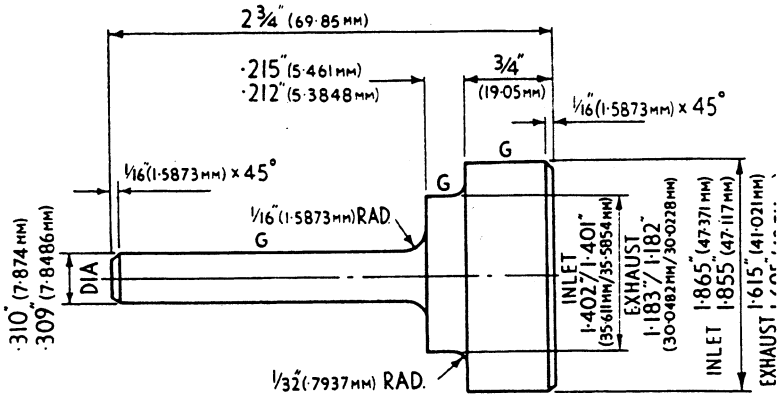

FIGURE 7B

TOOL FOR FITTING VALVE SEAT INSERTS

To fit valve seat inserts proceed as follows :—

(1) Withdraw valve guide and thoroughly clean valve guide bore in cylinder head.

(2) Press new valve guide into position.

(3) Using the new valve guide as a pilot, machine the recess in the cylinder head face to the dimensions given in Figure 7A.

(4) Remove all swarf and thoroughly clean the insert recess, taking care to ensure that all burrs are removed.

(5) With the insert and fitting tool assembled as shown in Figure 7C, press insert into position. Note that the insert must be pressed, and not hammered into place. Lubricant should not be employed.

(6) Visually inspect to ensure that the insert has been pressed in squarely and that it is in hard contact with the bottom of the recess.

(7) Cut or grind valve seat face on insert as normal procedure.

Note.—A valve head depth of ·140" (3·556 mm.) is outside the engine production limits, but it represents the maximum permitted depth on service engines. When cutting insert face, it is therefore policy to work as closely as possible to the minimum figure of ·066" (1·676 mm.) in order to permit further re-cutting during subsequent overhauls.

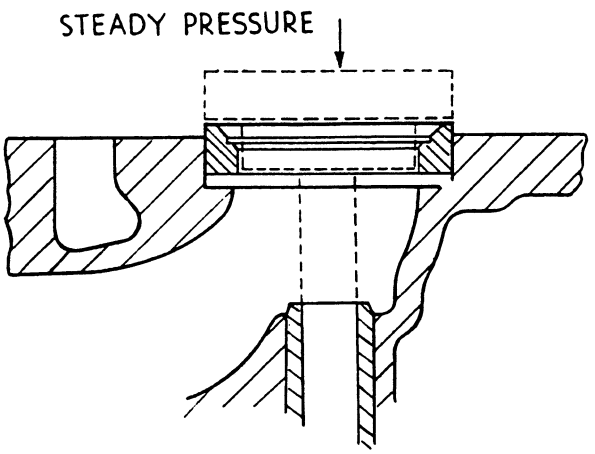

FIGURE 7C

FITTING VALVE SEAT INSERTS

VALVE GRINDING AND RE-FACING

If the valve faces are found to be unduly pitted they should be re-faced on a suitable valve re-facing machine set to 45°.

The re-facing should continue until the face is true, and free from pitting. Excessive grinding will thin the edge of the valve head and render the valve unfit for service, or will unduly lower the valve in its seating, and pocketing will result. If a valve tends towards thinness at the edges, it must be discarded. Valves which are badly burred, burnt, distorted or which have previously been ground to their limits must never be reclaimed.
Always hand grind valves before assembly.

HAND GRINDING

With the valves removed apply a small quantity of medium or fine grinding paste (depending on condition of valve and seat faces) to the valve face and insert valve into guide.

Using a suitable suction tool, rotate valve alternately in clockwise and anti-clockwise directions, occasionally raising the valve off its seat and revolving it a quarter turn before lowering it again. A light spring of suitable length, inserted between the valve head and guide will facilitate this operation.

Add more grinding paste as necessary, and continue as described above until an even, clean, matt-grey finish is obtained on a seating between $\frac{1}{16}$"-$\frac{3}{32}$" (1·58-2·38 mm.) in width. If such a condition cannot be obtained, it will be necessary to re-face or re-cut the valve and/or seat.

After grinding in the valves carefully, remove all traces of grinding paste.

TAPPETS (Refer Figure 7)

The tappets are of the mushroom foot type and operate directly in the cylinder head. With the cylinder head removed, it is necessary to remove the tappet adjusting screw and locknut before the tappets can be withdrawn. Note that the tappets must be free to rotate and capable of sliding in the cylinder head under their own weight. Tappet faces must not be re-ground. Damaged faces will necessitate the fitting of new tappets.

COMBUSTION CHAMBER CAPS (Refer Figure 1)

The removal of the combustion chamber caps and the cleaning of the throat passages should be undertaken as a matter of course when cylinder head overhaul is carried out.

Care must be taken on replacing these caps to ensure that they are tightened up evenly. Where possible, new gaskets should be employed. The old gaskets, however, may be used, providing they are first annealed.

DECARBONISING

It is difficult to state a specific period at which decarbonising would be desirable. Provided the fuel system and injection equipment are properly maintained and a reputable grade of fuel is used, it is difficult to imagine the cylinder head being lifted purely for this purpose. Generally the need for decarbonising will not arise before the valves require attention.

To decarbonise the engine, proceed as follows :—

Remove cylinder head as previously described. The valves, guides, rockers, etc., must be cleaned, examined and serviced as required.

Absolute cleanliness must be observed if particles of carbon, etc., are to be prevented from scoring cylinder walls, pistons, bearings, etc.

Carefully clean all carbon from the cylinder head and cylinder block faces and all cylinder head valve parts, ensuring that no burrs exist or are made on the machined faces.

With No. 1 piston midway down its bore, apply a smear of grease inside the top of No. 1 cylinder, and rotate crankshaft until No. 1 piston is at T.D.C. The grease serves as a seal between the piston crown and cylinder walls and prevents carbon becoming trapped between the piston and cylinder.

Cover No. 2 and 3 bores, and all water and oilways.

Using a suitable scraper, remove carbon from No. 1 piston crown, taking care not to scratch the piston and ensuring that a ring of carbon is left round the periphery of the piston crown.

Repeat the above operation for the remaining two pistons.

Clean all piston crowns and cylinder bores with a non-fluffy rag moistened in kerosene.

Lubricate piston crowns and bores and assemble cylinder head.

ASSEMBLING THE CYLINDER HEAD (Refer Figures 2 and 8)

Thoroughly clean cylinder head and all components.

Lubricate valves, guides and tappets and assemble in head.

Refit induction and exhaust manifolds using new gaskets.

Lightly smear both faces of new cylinder head gasket with a suitable jointing compound.

Place gasket over cylinder head studs, noting that it is marked "Top front".

Fit and tighten cylinder head nuts in recommended sequence (Figure 2), ensuring that a plain washer is fitted to waisted stud No. 15.

Cylinder head nuts should be tightened to a torque of 55/60 lbs./ft. and rechecked after the engine has been run.

Replace the rocker assembly, ensuring that the slot at the rear end of the rocker shaft is in line with the punch mark on the rear pedestal bracket (Figure 8). The relationship of this slot to the

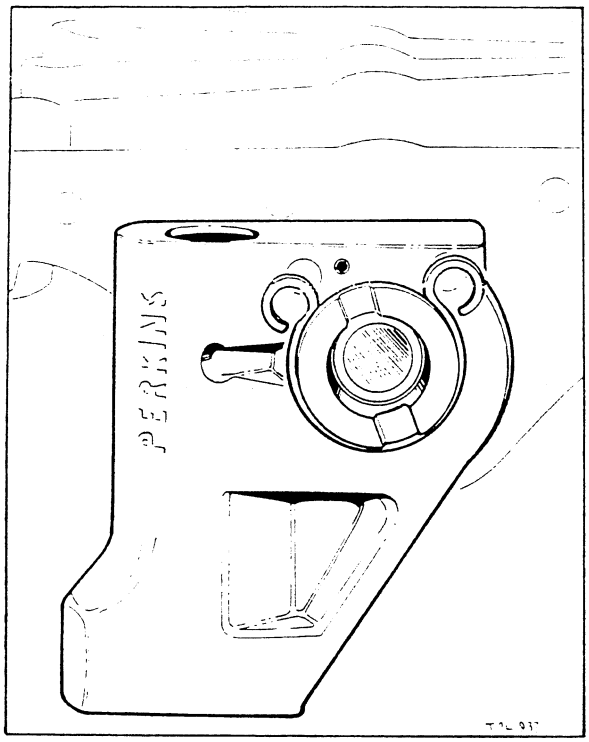

FIGURE 8
ROCKER SHAFT LOCATION MARK

punch mark determines the quantity of oil delivered to the rockers and bearings. Oil flow may be increased or decreased by rotating the shaft in a clockwise or anti-clockwise direction as required. It will generally be found that with the shaft slot and punch mark aligned the oil supply is most satisfactory.

Adjust valve clearances to 0·012″ (0·305 mm.) inlet and exhaust.

Refit oil feed pipe between cylinder head and camshaft housing.

Replace injectors, using new washers, and connect up injector pipes and leak-off pipes.

Tighten injectors evenly.

Fit rocker cover and joint.

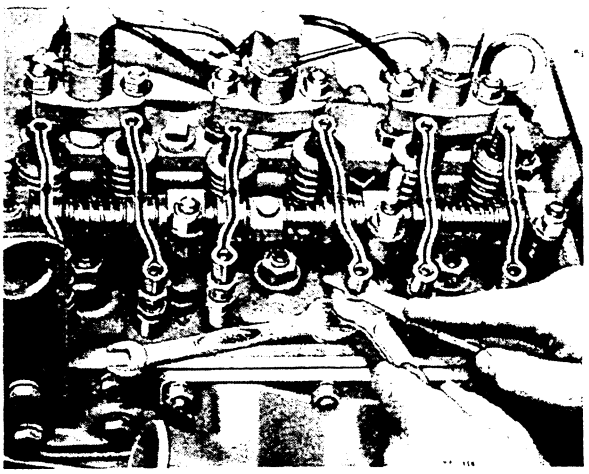

FIGURE 9
ADJUSTING TAPPETS

ADJUSTING VALVE CLEARANCE

(Refer Figure 9)

The three throw 120° crankshaft makes it necessary to adopt a slightly different sequence for tappet adjustment to the normal accepted procedure for four and six cylinder engines.

To adjust tappets proceed as follows :—

Remove the rubber plug in the inspection hole in the left front side of the transmission housing adaptor plate.

Rotate crankshaft until the T.D.C. line on the flywheel is in the centre of the inspection hole and No. 1 piston is on compression stroke (both valves fully closed).

Check and adjust clearances as necessary on Nos. 1, 2, 3 and 5 valves (Figure 9).

Turn crankshaft one revolution (360°) and repeat for Nos. 4 and 6 valves. (T.D.C. mark visible through inspection hole).

Replace rubber plug in adaptor plate.

Valve clearances for both inlet and exhaust should be set to 0·010″ (0·254 mm.) hot, and 0·012″ (0·305 mm.) cold.

THE LUBRICATING SYSTEM

The lubricating system is of the force feed type, the oil being circulated under pressure by a rotor type pump bolted to the front main bearing cap and driven via an idler gear by the crankshaft gear. Oil is drawn through a sump filter screen and a suction pipe before entering the oil pump, from whence it is pumped through a delivery pipe to a drilling in the cylinder block and to a full flow filter in the left hand side of the engine.

A plunger type relief valve is incorporated in the oil pump body. This relief valve is set to 50-65 p.s.i.

From the full flow filter the oil passes into the main oil gallery in the cylinder block. Passages in the main bearing webs of the crankcase carry the oil from the oil gallery to the main bearings.

The cylinder bores and gudgeon pins are splash lubricated. A transverse drilling at the front of the cylinder block feeds oil from the main oil gallery to an external pipe on the right hand side of the engine. This pipe feeds the centre camshaft bearing. Another external feed pipe connects the camshaft to the rocker assembly.

The camshaft is lubricated by oil draining from the rocker assembly through two oil-ways situated on either side of the centre camshaft bearing. A drilling connects the two chambers. The oil level is controlled by a weir in the front chamber.

Above No. 1 camshaft bearing there is a drilling which serves as a breather to the camshaft chamber and permits a free flow of oil passing over the weir. A drilling under the rear bearing of the camshaft prevents pressure build up between the rear camshaft journal and the tachometer housing seal.

The overflow from the camshaft weir is directed to lubricate the timing gears.

The flow of oil to the rocker assembly can be regulated by rotating the rocker shaft to align or restrict the oil feed passages.

LUBRICATING OIL FILTERS

The oil filters consist of : oil filler strainer, oil sump strainer, and main full flow oil filter.

THE OIL FILLER STRAINER (Refer Figure 10)

This is a coarse wide mesh strainer situated at the base of the oil filler tube.

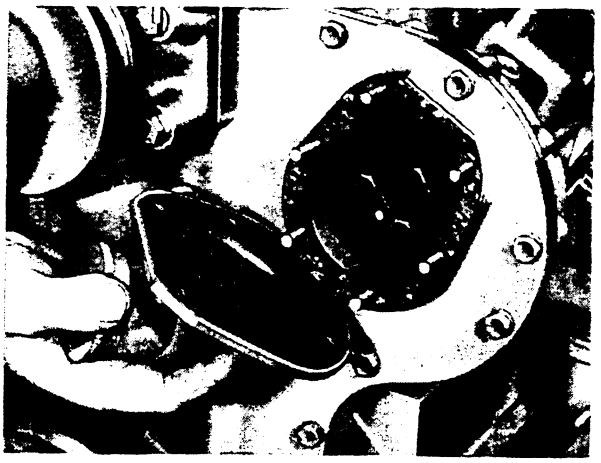

FIGURE 10
THE OIL FILLER STRAINER

THE SUMP STRAINER (Refer Figure 11)

The sump strainer consists of a perforated gauze wire strainer welded to the pressed steel cover at the bottom of the sump.

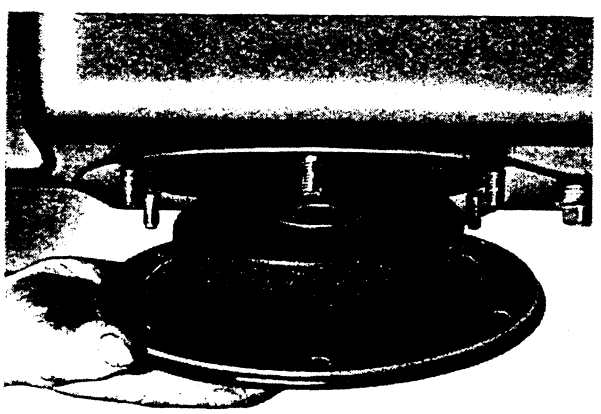

FIGURE 11
THE SUMP STRAINER

THE MAIN FULL FLOW FILTER

The main full flow filter is mounted on the left hand side of the engine crankcase. A replaceable type element is employed to extract foreign bodies from the circulating oil.

FIRST ISSUE

OPERATION

The inlet side of the filter body connects to the outside of the filter element. Oil pumped under pressure is forced through the element. Foreign bodies, grit, etc., are removed from the oil as it passes through the filter. The inside of the element connects to the engine and the filtered oil is thus recirculated through the engine.

Should the element become clogged and the passage of oil severely restricted, pressure will build up in the inlet port and will open the spring loaded ball valve in the by-pass assembly, and permit unfiltered oil to reach the engine. Regular oil changing and attention to filter maintenance and element renewal periods will prevent this occurring.

The spring loaded ball valve opens when the difference between inlet and outlet pressures exceeds 13-17 p.s.i.

DISMANTLING THE MAIN FILTER ASSEMBLY (Refer Figure 12)

Unscrew the centre bolt at the bottom of the filter bowl and lower bowl and centre bolt together. The bolt cannot be withdrawn completely, nor can the seal retainer and spring located over the bolt inside the bowl be removed from the bolt.

Remove the two sealing rings from the recess in the filter head. Release and remove the by-pass plug, washer, spring and ball from the head.

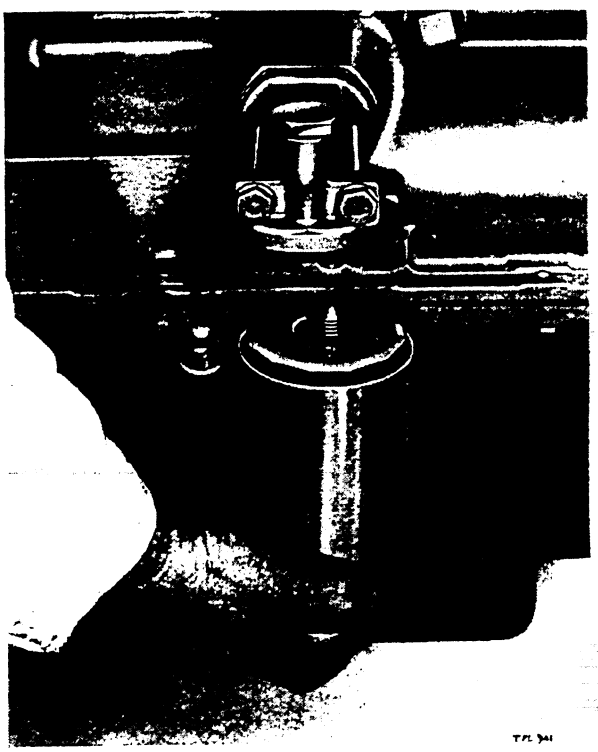

FIGURE 12
DISMANTLING MAIN OIL FILTER ASSEMBLY

ASSEMBLING THE MAIN FILTER

Replace the ball and spring in the by-pass passage and secure with the plug and fibre washer. Locate the large ring seal and the smaller inner seal in the head. Place the filter element over the centre bowl and offer up the bowl assembly to the head, ensuring that the bowl seats properly within the head recess. Tighten the centre bolt to a torque of 10 lb./ft.

THE ENGINE SUMP

The engine sump is of high duty cast iron, has a capacity of 10·5 Imperial pints, and is fitted with a drain plug and dipstick.

A pressed steel cover containing the sump strainer is fitted to the bottom of the sump. This cover enables the strainer to be cleaned without removing the sump.

REMOVING THE SUMP

To remove the sump it is necessary to support the engine, using either an overhead block and tackle or an engine stand. With the engine supported, release the front of the sump from the bolster bracket by removing three setscrews and three nuts and bolts. Release the rear of the sump from the transmission housing adaptor plate by removing the six bolts which secure the sump, adaptor plate, and transmission housing.

The sump can now be removed as follows :—

Remove the two nuts and spring washers from the studs at the front of the sump. These studs go through the sump into the bottom of the timing case.

Remove the two long setscrews and copper washers from the rear of the sump.

The twelve setscrews which hold the sump may now be removed from the cylinder block.

Remove the sump.

Remove the pressed steel cover from the bottom of the sump.

REPLACING THE SUMP

When replacing the sump new joints should be used throughout, *i.e.* between the sump and crankcase flanges and the cork seals at the front and rear of the sump.

Offer up the sump to the crankcase and refit setscrews and nuts. The two long setscrews at the rear of the sump should be fitted with new copper washers.

Tighten the securing bolts by working from the centre to front and rear.

Refit the pressed steel cover, ensuring that the oil pump suction pipe is properly locating in the strainer mesh.

Affix the bolster bracket and transmission housing adaptor plate.

THE OIL PUMP (Refer Figure 13)

The oil pump is secured to the front main bearing cap by three thin-headed setscrews, a protrusion of the idler gear shaft locating in a hole in the bearing cap for positive location.

A bushed idler gear, which is free to rotate on a shaft, and is retained in position by a circlip, transmits the drive from the crankshaft to the oil pump.

The oil pump drive gear is keyed and pressed on to the pump drive shaft. At the other end of the pump drive shaft a four lobed rotor is fitted. This rotor meshes with a five lobed rotor which is free to rotate inside the oil pump body.

As the rotors rotate, the pockets formed between the lobes increase and decrease in volume, causing oil to be transferred from the suction to the pressure side of the pump.

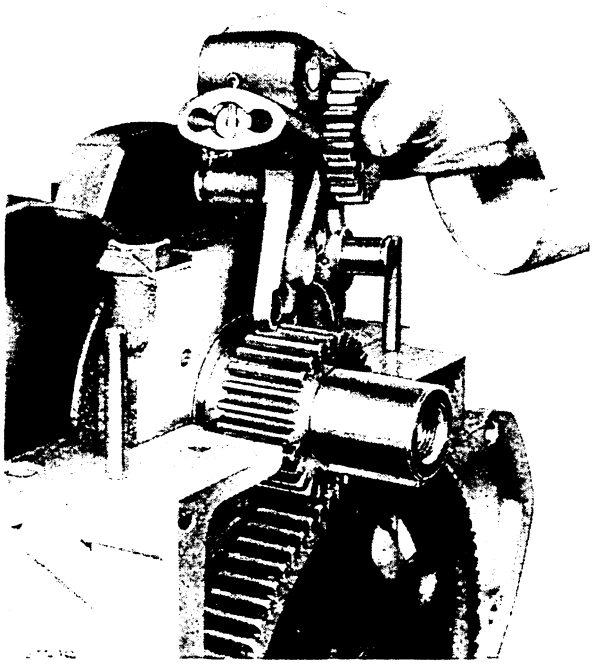

FIGURE 13
THE OIL PUMP

A pressure relief valve mounted on the delivery side of the pump body controls the maximum oil pressure to within 50-65 p.s.i.

The oil pump delivers 5·35 gallons per minute at an engine speed of 2,000 r.p.m.

REMOVING THE OIL PUMP (Refer Figure 13)

Remove the sump.

Remove the two setscrews securing the bridge piece to the block.

Remove the three setscrews securing the bridge piece to the front cover.

Remove the bridge piece.

Remove oil pump idler gear circlip and slide idler gear forward.

Remove the three setscrews securing oil pump and withdraw oil pump.

Assemble in reverse order.

DISMANTLING THE OIL PUMP (Refer Figures 14 and 15)

With the oil pump suitably held in a vice, remove the pump drive gear using Service Tool P.D.155 (Figure 14).

Remove the key from the keyway of the drive shaft.

Remove the three screws attaching end plate to pump body and withdraw end plate.

Carefully remove the drive and driven rotor from the pump body.

Dismantle the relief valve by removing the split pin and shims where fitted, the spring retaining cap, spring and plunger.

Remove the 'O' sealing ring from the pump body (Figure 15).

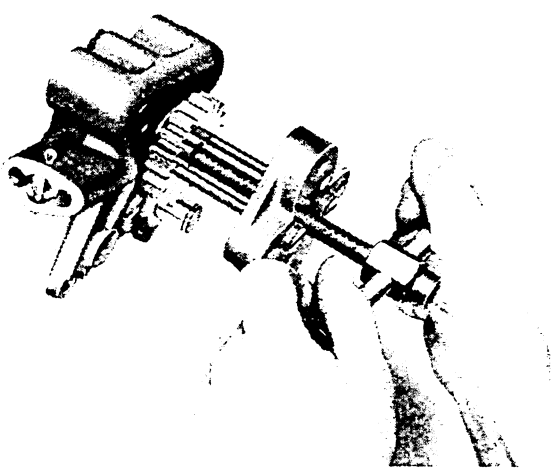

FIGURE 14
REMOVING OIL PUMP DRIVE GEAR

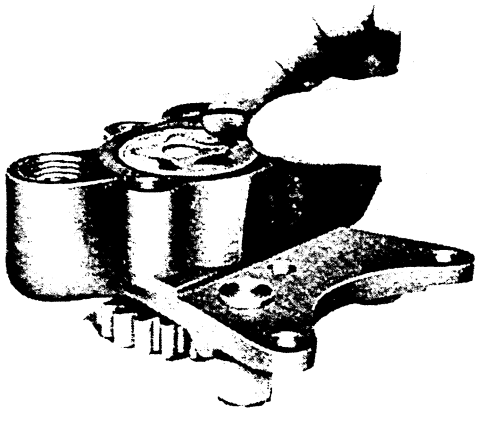

FIGURE 15
REMOVING OIL PUMP 'O' SEALING RING

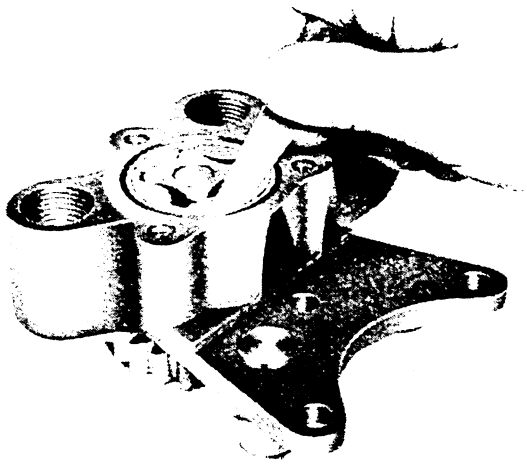

FIGURE 17
CHECKING CLEARANCE BETWEEN OUTER ROTOR AND OIL PUMP BODY

INSPECTION (Refer Figures 16-18)

Thoroughly clean all components.

Examine rotors for cracks or scoring.

Install the drive and driven rotors in the pump body, ensuring that the chamfered edge of the outer rotor enters the pump body first.

Check the clearance between the maximum diameter of the inner rotor and the minimum diameter of the outer, or driven rotor at all points (Figure 16).

If this clearance exceeds 0·006" (0·1524 mm.) a new oil pump should be fitted.

FIGURE 16
CHECKING CLEARANCE BETWEEN DRIVING AND DRIVEN ROTOR

The clearance between the driven rotor and the pump body (Figure 17) must not exceed 0·010" (0·254 mm.). The clearance between the top of the rotors and the surface of the pump body (Figure 18) must not exceed 0·003" (0·0762 mm.).

Note.—If the pump is considered faulty it must be replaced by a complete unit. Component parts are not available as spares.

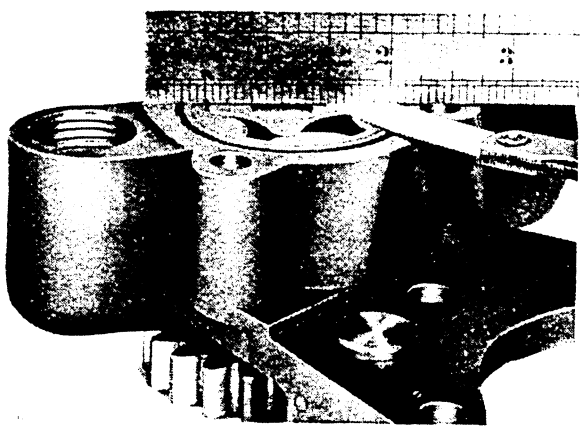

FIGURE 18
CHECKING CLEARANCE BETWEEN ROTOR FACES AND PUMP BODY

ASSEMBLING THE OIL PUMP

Fit the drive and driven rotors in the body, entering the chamfered end of the outer rotor to the body first and replace the 'O' sealing ring and end plate. Replace the three "Philips" screws.

Replace the key in the keyway of the drive shaft, and refit the drive gear, with its flat face outwards. This face should be flush with the end of the drive shaft.

Replace the relief valve and component parts and check that the relief valve lifts at 50-65 p.s.i. This may be checked using suitable hydraulic test equipment or by utilising compressed air.

TIMING CASE COVER AND CRANKSHAFT FRONT OIL SEAL

REMOVING TIMING CASE COVER

Using Service Tool P.D.46B, remove starter dog and washer.

Remove fan belt and generator.

Remove crankshaft pulley.

Remove breather pipe.

Remove generator brackets and adjustable linkage.

Slacken off hose clips connecting water pump to engine.

Remove setscrews securing timing cover.

Two long bolts pass through the timing case to secure a cover at the rear of the timing case, blanking off the power take off bore. In addition to the two long bolts passing through the timing case to secure the generator brackets, a long bolt is also fitted above the position of the generator brackets. The bottom setscrew below the front oil seal is fitted with a copper washer.

Withdraw timing case cover, taking care not to damage the front oil seal located in the timing case cover.

RENEWING CRANKSHAFT FRONT O L SEAL

Carefully prise out old seal from timing case cover. Locate new seal in position, ensuring that lip of seal is adjacent to inner face of timing case.

Using a suitable dolly, carefully tap new seal into position, ensuring that seal is square in timing cover bore.

ASSEMBLING TIMING CASE COVER

Clean mating faces of timing cover and timing case.

Fit new joint and offer up timing cover to engine, taking care not to damage the oil seal as it passes over the crankshaft.

Centralize timing cover using crankshaft pulley, and clamp timing cover in position.

Remove crankshaft pulley and fit and tighten the remaining timing cover setscrews.

Fit breather pipe.

Fit crankshaft pulley and secure in position with washer and starter dog.

Refit water pump hoses to engine and tighten hose clips.

Replace generator bracket, generator, and fan belt.

FIGURE 19
TIMING GEAR AND MARKING

TIMING GEARS (Refer Figure 19)

The camshaft and fuel pump gears are driven by the crankshaft gear through an idler gear. All gears are suitably marked during production to facilitate re-timing, the marks being in line when No. 1 piston is at top dead centre (T.D.C.) on its compression stroke, as illustrated in Figure 19. It will be appreciated that these markings will not align at every rotation of the crankshaft where No. 1 piston is at T.D.C. on its compression stroke.

CHECKING TIMING GEAR BACKLASH (Refer Figure 20)

Remove timing case cover as previously described. Using a feeler gauge, check backlash. Idler gear backlash between camshaft, crankshaft and fuel pump gears should be within 0·003″-0·006″ (0·076-0·152 mm.) (Figure 20). Backlash between crankshaft and oil pump idler gear should be 0·012″-0·018″ (0·305-0·457 mm.).

Excessive backlash can only be corrected by fitting new gears. Replacement gears are marked on production.

FIRST ISSUE

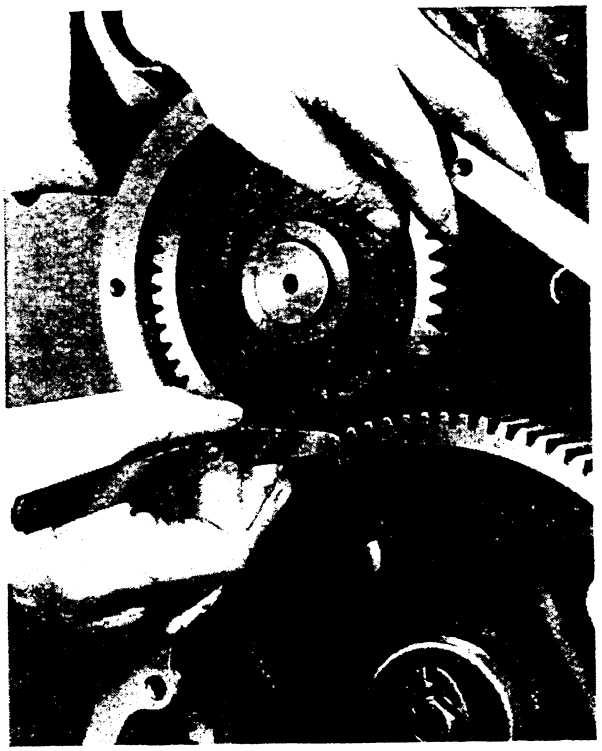

FIGURE 20
CHECKING CAMSHAFT AND IDLER GEAR BACKLASH

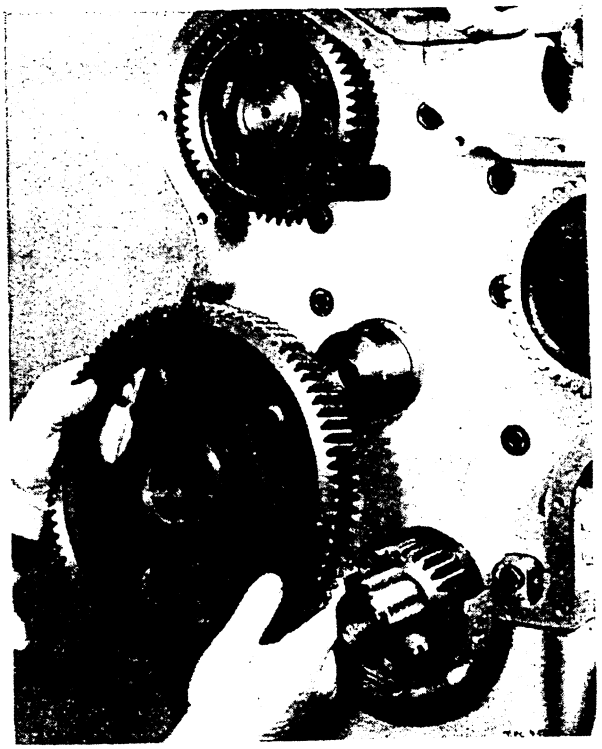

FIGURE 21
REMOVING IDLER GEAR FROM SPIGOT

REMOVING IDLER GEAR AND SPIGOT
(Refer Figures 21 and 22)

Remove timing case cover.

Straighten out lock washer on setscrew, securing idler gear.

Remove setscrew, locking washer and idler gear retaining plate.

Remove idler gear from spigot (Figure 21).

Remove idler gear spigot (Figure 22).

REPLACING IDLER GEAR AND SPIGOT
(Refer Figures 21 and 22)

Place idler gear spigot in position, ensuring that the small locating peg is entered into the through drilling in the spigot (Figure 22). When correctly in position, the spigot flange should be flush with the timing case.

Fit idler gear to spigot, ensuring that timing marks align (Figure 21).

Fit idler gear retaining plate, locking washer, and setscrew.

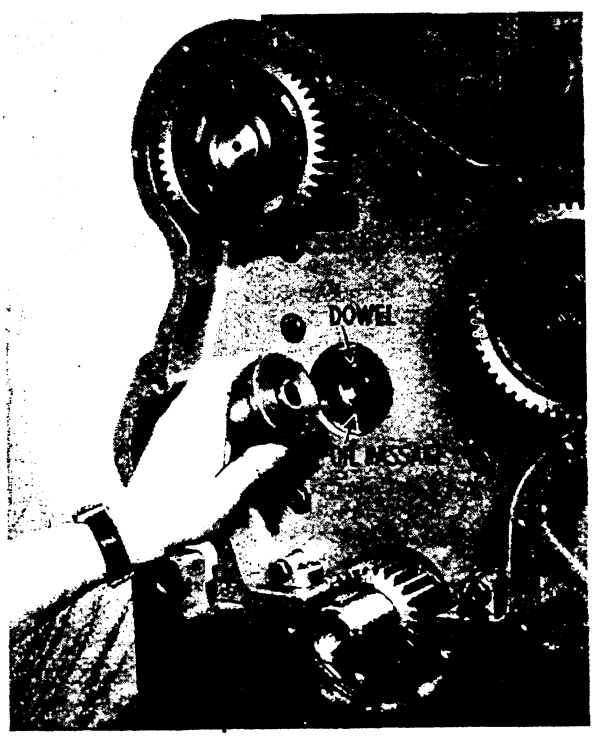

FIGURE 22
REMOVING IDLER GEAR SPIGOT

FIRST ISSUE

Tighten setscrew and bend lock washer into position.

Idler gear end float should be within 0·005"-0·015" (0·127-0·381 mm.).

REMOVING CAMSHAFT GEAR
(Refer Figure 23)

Remove the three setscrews and washers securing gear to camshaft.

Withdraw camshaft gear (Figure 23).

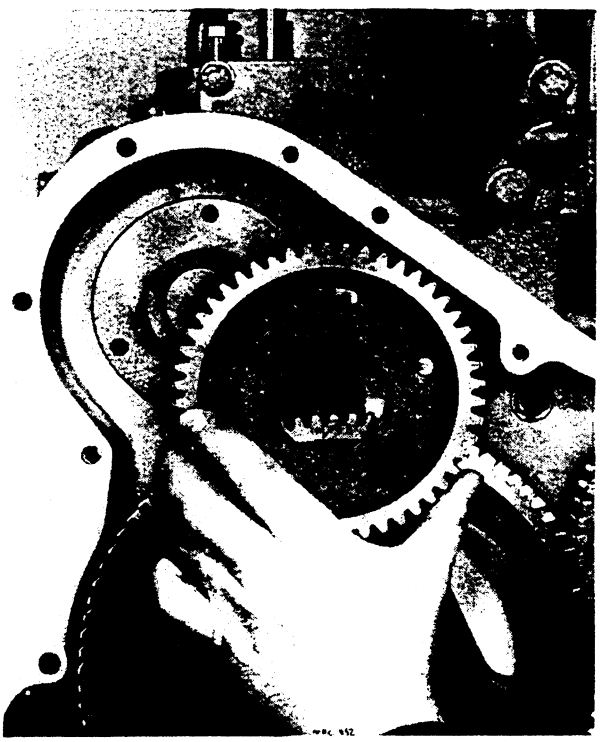

FIGURE 23
REMOVING CAMSHAFT GEAR

FITTING CAMSHAFT GEAR (Refer Figure 23)

Remove idler gear.

Release rocker assembly to facilitate turning of camshaft.

On the hub of the camshaft and the camshaft gear will be seen the letter 'D' stamped adjacent to a fixing hole (Figure 23).

Offer up camshaft gear to camshaft, ensuring that the holes adjacent to the letter 'D' are aligned. On no account must the slotted holes be used to attach the gear to the camshaft.

Fit and tighten the three setscrews and washers.

Fit idler gear and align all timing marks.

Replace rocker assembly and adjust tappets.

REMOVING FUEL PUMP GEAR
(Refer Figure 24)

Rotate crankshaft until timing marks align.

Remove idler gear.

Remove setscrews securing fuel pump gear.

Remove fuel pump gear, taking care not to damage the locating dowel (Figure 24).

Assemble in reverse order, ensuring timing marks align.

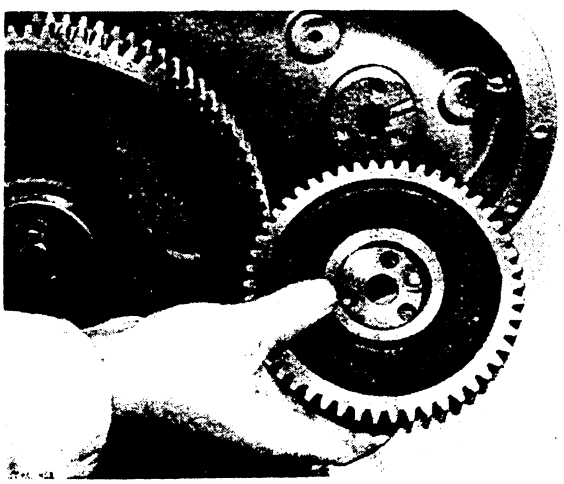

FIGURE 24
REMOVING FUEL PUMP GEAR

REMOVING THE CAMSHAFT
(Refer Figure 25)

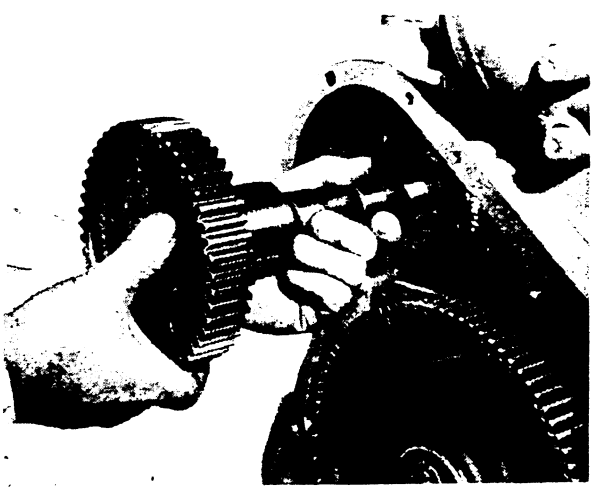

FIGURE 25
REMOVING THE CAMSHAFT

Remove rocker shaft assembly.

Remove timing case cover.

Remove fuel lift pump.

Remove idler gear.

Raise tappets and carefully withdraw camshaft (Figure 25) continually turning the shaft.

Assemble in reverse order, ensuring that timing marks are correctly aligned.

Note.—Camshaft end float is controlled by a spring riveted to the timing case cover.

REMOVING THE TIMING CASE

Remove rocker shaft assembly.

Remove timing case cover.

Remove idler gear and spigot.

Remove fuel lift pump.

Remove camshaft.

Remove fuel pump driving gear.

Remove all links and pipes from fuel injection pump.

Remove the three nuts, spring washers and plain washers securing fuel pump flange to timing case.

Withdraw fuel injection pump. Ensure that all fuel line connections and pipes are effectively sealed.

Remove sump.

Remove setscrews and shakeproof washers securing timing case to engine block.

Withdraw timing case.

REPLACING TIMING CASE (Refer Figure 26)

To ensure correct location of the timing case, it is advisable to fit and fully locate the idler gear hub to the cylinder block.

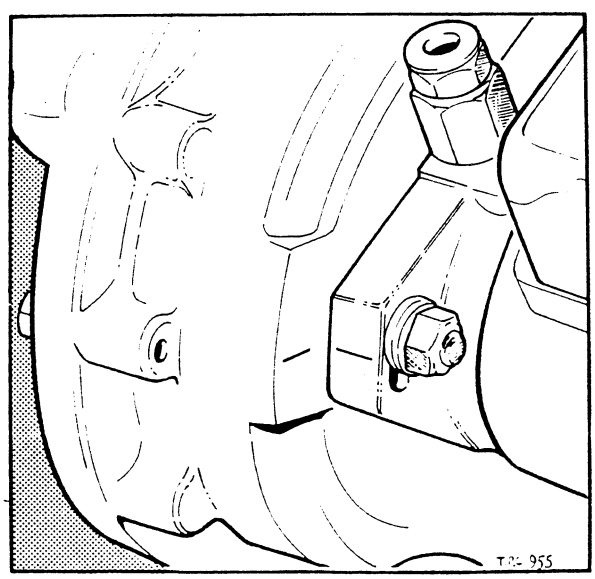

FIGURE 26
TIMING MARKS ON FUEL INJECTION PUMP AND TIMING CASE

Fit new joint and offer up timing case to engine block.

Fit and tighten timing case setscrews.

Fit fuel injection pump to timing case, ensuring scribed lines on pump flange and timing case are in line (Figure 26).

Rotate crankshaft until No. 1 piston is at T.D.C. (Key on crankshaft at T.D.C.).

Fit fuel pump gear to fuel pump, ensuring dowel is properly located.

Raise tappets and carefully insert camshaft.

Fit idler gear to spigot (long tapered flange of gear towards cylinder block and timing marks on crankshaft gear, fuel pump gear, camshaft gear and idler gear in line).

Fit sump.

Fit all fuel pipes and links to fuel injection pump.

REMOVING CRANKSHAFT REAR OIL SEAL

Remove flywheel.

Remove adaptor plate from rear of cylinder block and sump.

Remove the two long bolts and self-locking nuts clamping the oil seal housing halves together.

Unscrew the three setscrews securing each half housing, and withdraw housings.

FITTING NEW ROPE TYPE SEALS

Replacement seals should be soaked in clean engine oil for an hour before fitting.

Hand press seals into their respective grooves in housings, leaving 0·010"-0·020" (0·254-0·508 mm.) projecting above each end of groove. This projection serves to ensure intimate contact between the ends of the seals when the housing halves are clamped together. Any gap existing between the mating faces of seal ends will defeat the purpose of the oil seal. A projection exceeding that recommended must be avoided, as excessive overlap may spread and prevent the housing halves from seating properly.

Each rope type seal is of the correct length and must not be trimmed.

A round bar may be employed with advantage to bed the seal into position.

FITTING THE SEAL HOUSINGS

Remove all traces of the old joint between the top half of the housings and the cylinder block, and between the bottom half of the housings and the rear main bearing cap. Smear the exposed inside surfaces of the asbestos seals with a graphited grease and lightly coat the housing abutment faces with jointing compound.

Using new joints, fit the half housings to the cylinder block and rear main bearing cap. Locate, but do not tighten the six securing screws.

Fit and tighten the two long clamping bolts, using new self-locking nuts.

Tighten the housing securing screws.
Fit the transmission adaptor plate to rear of cylinder block, ensuring dowels are correctly located.
Fit flywheel and check for "run-out" and concentricity.

FLYWHEEL AND RING GEAR

REMOVING THE FLYWHEEL

Straighten out tabs on flywheel lock plates.

Remove the six setscrews securing flywheel to crankshaft flange.

Withdraw flywheel.

The pilot bearing can be removed by gently tapping it from the crankshaft flange side.

REMOVING STARTER RING GEAR

The starter ring gear is shrunk onto the flywheel. To remove it, partly cut through the gear with a hacksaw, taking care not to mark the flywheel, and split the ring gear with a chisel.

FITTING STARTER RING GEAR

Thoroughly clean ring gear location on flywheel.

Evenly heat new ring gear to an approximate temperature of 475°F.

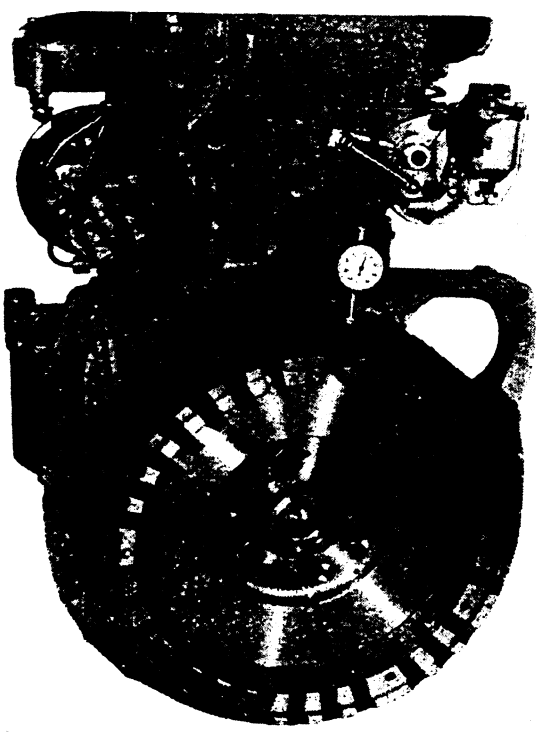

FIGURE 27
CHECKING FLYWHEEL FOR CONCENTRICITY

FIGURE 28
CHECKING FLYWHEEL FOR RUN-OUT

Gently lay ring gear in position on flywheel and allow to cool.

Note.—Leading edge of gear teeth must face towards engine.

REPLACING THE FLYWHEEL

(Refer Figures 27 and 28)

It is essential that the crankshaft flange and flywheel mounting faces are scrupulously clean and devoid of burrs.

There are six tapped holes in the crankshaft flange and one untapped hole. This untapped hole must coincide with the staggered hole in the flywheel. This ensures that the flywheel timing marks are correctly related to the crankshaft.

Fit new locking plates and evenly tighten the six setscrews to a torque of 75 lbs. ft. Do not bend over lockplates at this stage.

Using a dial indicator (Figure 27) carefully check the flywheel for concentricity. The total indicator reading should not exceed 0·008" (0·2032 mm.).

Using dial indicator (Figure 28), check flywheel for run-out. This should not exceed 0·001" (0·0254 mm.) per radius inch (25·4 mm.) from flywheel centre to dial indicator stylus.

Tighten securing screws and re-check torque to 75 lbs./ft.

Bend over tabs of locking plates.

Before fitting clutch assembly check that flywheel pilot bearing is a clearance fit on gearbox primary shaft.

Pack bearing with H.M.P. grease.

Note.—When checking "run-out" it is advisable to apply thrust to the centre of the flywheel to prevent false readings, due to crankshaft end float.

PISTONS AND CONNECTING RODS

In factory built engines, pistons and connecting rods are numbered to correspond to the cylinders to which they are fitted. When dismantling an engine, it is advisable to ensure that an unmarked component has not been substituted during service.

Connecting rods, in addition to being marked for their respective cylinders, are also marked to indicate their weight grading. Should it be necessary to fit a new connecting rod, it must carry the same etched marking as the old rod. The etched number on the displaced rod must be quoted when ordering a replacement (Figure 30).

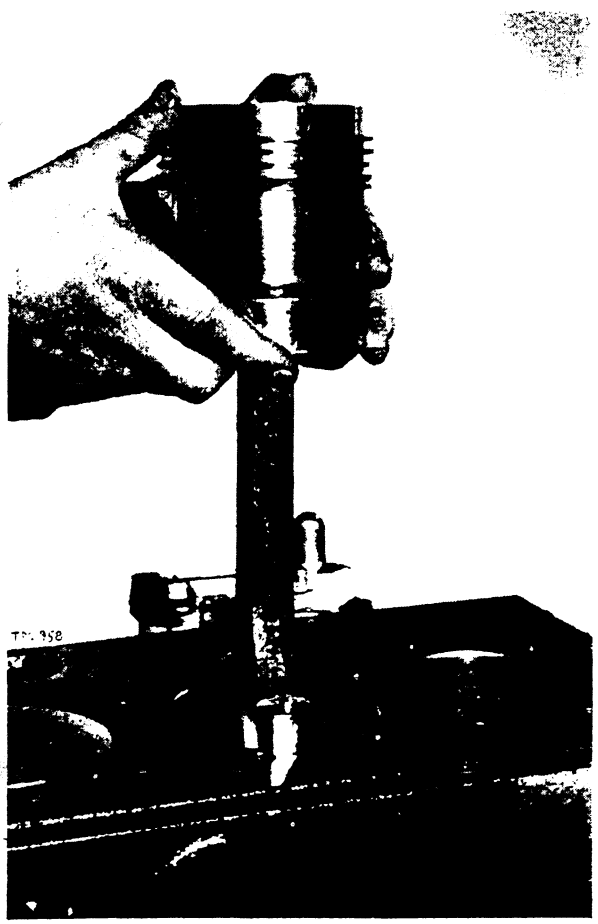

FIGURE 29
REMOVING PISTON AND CONNECTING ROD

REMOVING CONNECTING RODS AND PISTON ASSEMBLIES (Refer Figure 29)

Remove cylinder head and sump.

Rotate crankshaft until piston selected for removal is at the bottom of its stroke. If necessary, remove oil pump inlet and delivery pipes.

Carefully remove any carbon that may have built up round the top of the cylinder bore.

Remove the self-locking nuts from big end bolts and withdraw bearing cap, lower bearing half and the big end bolts.

Turn crankshaft to bring piston to top of its stroke.

Raise connecting rod clear of crankshaft and remove upper bearing half.

Withdraw piston and connecting rod from cylinder (Figure 29).

Fit bearing shells, cap, bolts and nuts to connecting rod.

Repeat above procedure for the remaining two pistons.

REMOVING PISTON FROM CONNECTING ROD

Remove piston and connecting rod from engine.

Thoroughly clean piston and connecting rod and check that they are correctly numbered for their relevant position in the engine.

Remove the two gudgeon pin circlips.

Immerse piston in warm oil or water and push gudgeon pin clear of connecting rod bush.

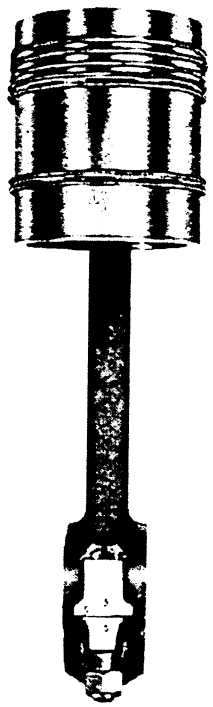

FIGURE 30
PISTON AND CONNECTING ROD

PISTON RINGS

Three compression rings and two oil control rings are fitted to each piston, as follows :—

Top Compression : Cast Iron. Parallel faced.

Second Compression : Cast Iron. Taper faced. Marked 'T' for 'Top'.

Third Compression : Cast Iron. Taper faced. Marked 'T' for 'Top'

First oil control (above gudgeon pin) : Cast iron scraper.

Second oil control (below gudgeon pin) : Cast iron scraper.

When fitting new piston rings into new cylinder liners the ring gap for compression and oil control should be within 0·009″-0·013″ (0·229-0·33 mm.) measured in a ring gauge of 3·6″ diameter.

ALIGNING CONNECTING RODS

(Refer Figure 31)

Connecting rods must always be checked for truth before re-assembly or before attempting to ream a small end bush.

Large and small end connecting rod bores must be square and parallel with each other within the limits of plus or minus 0·005″ (0·127 mm.) measured 5″ (127 mm.) each side of the axis of the rod on test mandrel as shown in Figure 31. When checking alignment with gudgeon pin bush fitted the limit plus or minus 0·005″ (0·127 mm.) is reduced to plus or minus 0·0015″ (0·0381 mm.).

When fitting and reaming connecting rod small end bushes, a reaming fixture must be employed. Service Tools 6200A and P.D.39A are recommended for this purpose.

Note.—Misaligned connecting rods must be discarded and a new one of similar weight group fitted.

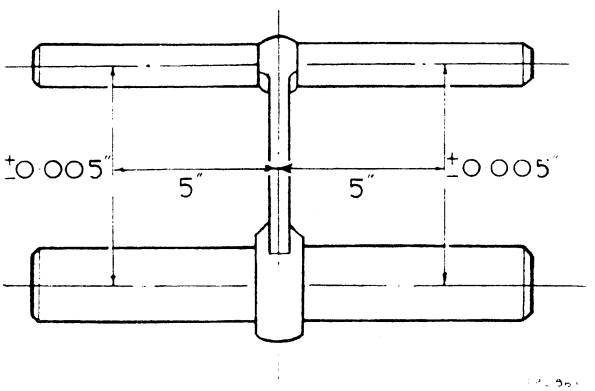

FIGURE 31
CHECKING CONNECTING ROD ALIGNMENT

ASSEMBLING PISTONS TO CONNECTING RODS

If the original pistons are being used they must be assembled to the same connecting rods in their original positions.

Thoroughly clean piston and connecting rod.

Fit one circlip in position to facilitate gudgeon pin location.

FIRST ISSUE

Immerse piston in clean hot oil or water to permit easy entry of the gudgeon pin.

Insert connecting rod between piston bosses, ensuring that piston and connecting rod markings are correctly related.

Insert gudgeon pin in position and fit the second circlip.

Ensure that both circlips are properly located in their respective grooves.

Fit piston rings.

FITTING PISTONS AND CONNECTING RODS (Refer Figures 32 and 33)

Thoroughly clean out cylinder bore and apply a generous coating of clean engine oil.

Lubricate piston.

Locate piston rings so that ring gaps are staggered and evenly spaced.

Fit piston assembly ring, Service Tool P.D.107, to piston, entering it from underside of piston with chamfered edge towards piston crown.

Remove bearing cap, big end bolts and bearing shells. If the old shells are to be re-used, they must not be interchanged.

FIGURE 32
FITTING PISTON TO ENGINE

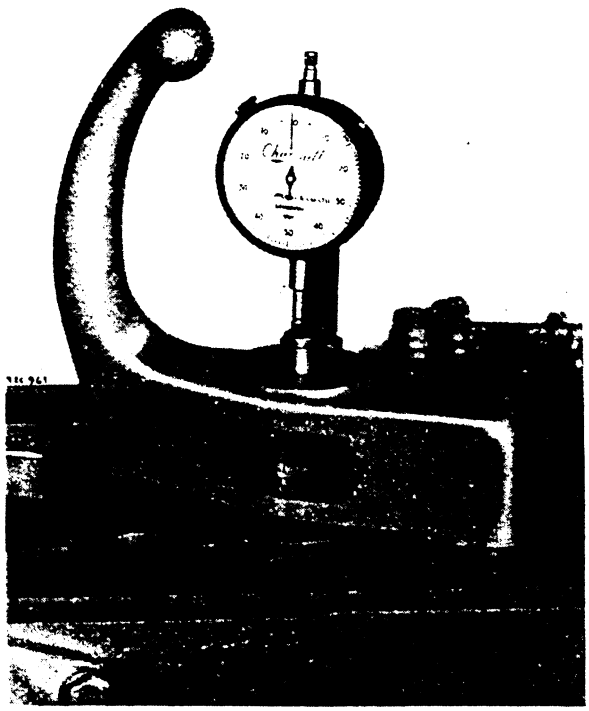

FIGURE 33
CHECKING PISTON HEIGHT

Check that number on connecting rod is to fuel pump side of engine.

Insert connecting rod and piston into cylinder bore.

Gently press piston through assembly ring into cylinder bore (Figure 32).

Turn crankshaft until appropriate crankpin is at B.D.C.

Fit big end bolts and upper bearing half, ensuring that tongue is correctly located.

Lubricate top bearing half and crankpin.

Draw connecting rod into position on crankpin.

Place bottom bearing half in bearing cap.

Lubricate bearing and fit cap to connecting rod, taking care that the position of the connecting rod bolts is not disturbed and that the cap marking coincides with the connecting rod.

Fit new self-locking nuts and evenly tighten to a torque of 70-80 lbs./ft.

With the crankshaft at T.D.C. the proximity of the piston crown to the cylinder block face should be within zero to — 0·005". Pre-top pistons should be within — 0·010" to + 0·004" (Figure 33).

CYLINDER LINERS

REMOVING CYLINDER LINERS
(Refer Figure 34)

Remove the cylinder head and sump.

Remove pistons and crankshaft.

Remove cylinder head studs.

Using Service Tool No. P.D.50C and adaptor P.D.50C-3, withdraw cylinder liners (Figure 34).

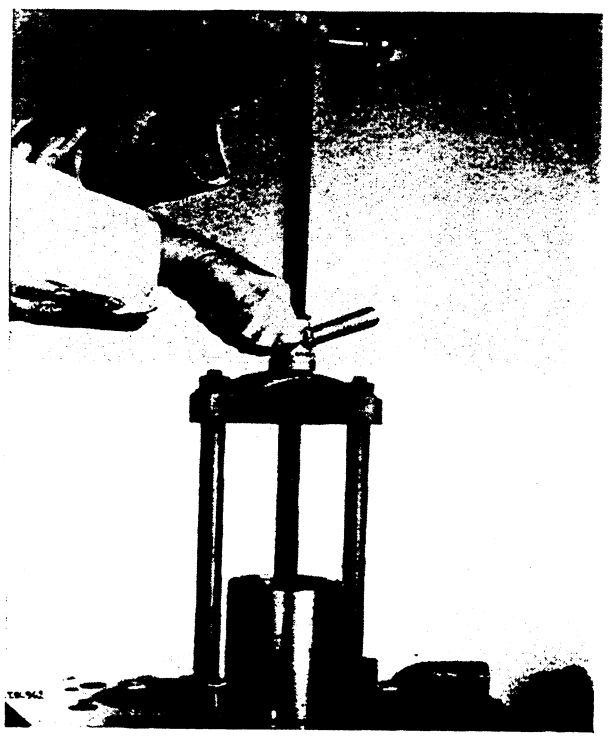

FIGURE 34
REMOVING CYLINDER LINERS

FITTING CYLINDER LINERS
(Refer Figure 35)

Using clean engine oil, lubricate the cylinder bore and the external surfaces of the cylinder liner. This oil should be applied with a pressure gun, or by hand. A brush or cloth must not be used for this purpose.

FIGURE 35
FITTING CYLINDER LINERS

PREPARATION FOR FITTING NEW LINERS

Care must be taken in the handling, transit, and storage of cylinder liners, as the slightest damage or burr can cause considerable distortion when the liner is pressed into position.

After removing the old liner, the parent bore must be thoroughly cleaned, and particular attention given to the top recess for the liner flange.

Ensure that the new liner is thoroughly cleaned. If kerosene has been used for this purpose, the liner must be dried before fitting.

Press or draw cylinder liner into position. Figure 35 shows Service Tool No. P.D.50C being used for this purpose.

It is advisable to allow a settling in period to elapse before checking the fitted internal bore of the liner. The acceptable limits are 3·6015″-3·6025″ (91·48-91·504 mm.).

Each liner should be checked in three positions—top, centre and bottom.

When fully in position, the top face of the liner flange should be 0·001″-0·009″ (0·0254-0·2286 mm.) below the top face of the cylinder block.

FIRST ISSUE

CRANKSHAFT & MAIN BEARINGS

MAIN BEARING CAPS (Refer Figure 36)

The main bearing caps are of high duty cast iron, and are located on ring dowels in the cylinder block. Two high tensile setscrews are fitted per cap and are locked by tab washers. The tab washers should be used once only.

In production, the main bearing parent bores are machined with the caps in position. If, therefore, a main bearing cap becomes damaged for any reason, it will be necessary to replace the complete cylinder block.

All bearings caps are numbered and must be returned to their original positions.

Main bearing and connecting rod bearings are supplied in undersizes of 0·010″ (0·254 mm.), 0·020″ (0·508 mm.) and 0·030″ (0·762 mm.).

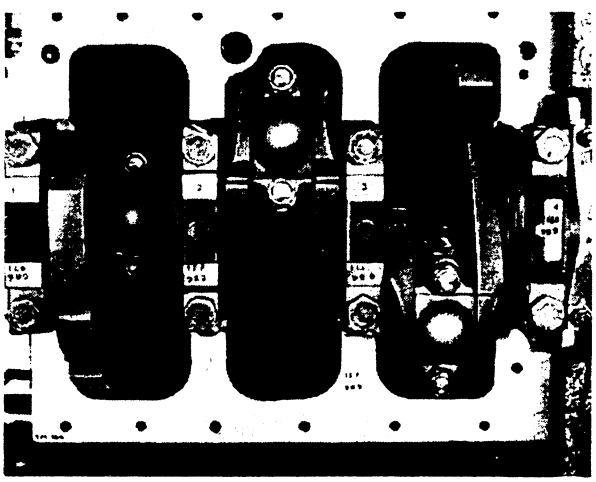

FIGURE 36
THE CRANKSHAFT AND BEARINGS

THE CRANKSHAFT

The crankshaft is forged from chrome molybdenum steel, and is fitted with two cast iron balance weights. These balance weights are matched as a pair and secured in position by two setscrews held in position by tab washers. The setscrews are tightened to a torque of 50-55 lbs./ft.

The rear of the crankshaft is machined to provide an oil thrower and an oil return scroll formed by single right hand helix machined to a depth of 0·004″-0·008″ (0·1016-0·2032 mm.).

REMOVING THE CRANKSHAFT
(Refer Figures 36 and 37)

Remove flywheel, transmission housing adaptor plate, sump and timing case cover.

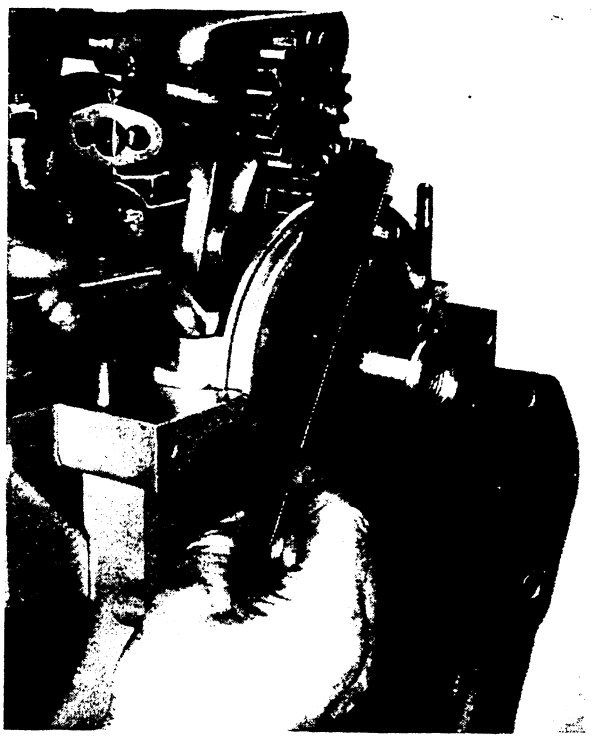

FIGURE 37
FITTING TIMING CASE BOTTOM COVER

Remove lubricating oil pump and idler gear.

Remove timing case bottom cover (Figure 37).

Remove bolts and self-locking nuts clamping the rear main oil seal housings.

Remove connecting rod caps and big end bearings.

Straighten out tabs on main bearing lockplates, and remove bearing cap setscrews.

Withdraw main bearing caps complete with lower bearing shells.

Remove crankshaft thrust washers.

Ensure that bearings—unless renewal is intended—are all identified with their location in the cylinder block and their respective bearing cap.

REPLACING THE CRANKSHAFT
(Refer Figure 36)

Locate upper, main bearing halves in their block positions.

Ensure all oilways and passages are clear and lubricate bearings.

Place thrust washers in position in block, oil grooves facing outwards. A light smear of grease will help retain them in position.

Carefully lower crankshaft into position.

Fit lower bearing halves to main bearing caps.

Fit lower thrust washers to rear main bearing cap.

Place main bearing caps in position, ensuring they are correctly located (Figure 36).

Evenly tighten main bearing caps to a torque of 110-120 lbs./ft.

Secure setscrews by bending over new tab washers.

Fit rear main bearing oil seal housings complete with new oil seals.

Fit timing case bottom cover.

CRANKSHAFT MAIN JOURNAL DIA.

Standard	2·7485″-2·7490″
Undersizes	—0·010″, —0·020″, —0·030″
Width of Nos. 2 and 3 Journals	1·21475″-1·22275″
Width of No. 4 Journal	1·87425″ to 1·87725″
Max. permissible width of No. 4 Journal	1·89125″
Radius on all Journals (must be maintained)	0·09375″-0·109375″

CRANKPIN DIA.

Standard	2·2485″-2·2490″
Undersizes	—0·010″, —0·020″, —0·030″
Width of Crankpin	1·565″-1·5620″
Max. permissible width of crankpin after grinding	1·5785″
Radius of Crankpin	0·1563″-0·1719″

The surface finish on all surfaces must not exceed 16 micro-inches as measured by a profilometer. Radii on journals and crankpins must be maintained as quoted, otherwise fatigue fracture is likely to occur. After grinding, the sharp corners on the oil holes must be removed, and the shaft crack detected and demagnetised.

DATA

Bore	3·6″ (91·44 mm.).
Stroke	5″ (127 mm.).
Number of Cylinders	3.
Cubic Capacity	152·7 cu. ins. (2·5 litres).
Combustion System	Swirl Chamber.
Compression Ratio	17·4 : 1.
Firing Order	1, 2, 3.
Location of No. 1 Cylinder	Front of Engine.
Cylinder Liners	Chrome Plated.
Fuel Pump Static Timing	18° B.T.D.C.
Letter on Fuel Pump Rotor	E.
Letter on Hydraulic Head No. 1 Deliver Port	W.
Inlet Valve Opens	13° B.T.D.C.
Exhaust Valve Closes	10° A.T.D.C.
Valve Overlap	23°.
Valve Lift	0·36″ (9·14 mm.)
Tappet Setting (Hot)	0·010″ (·254 mm.)
Tappet Setting (Cold)	0·012″ (·305 mm.)

TORQUE TIGHTENING FIGURES

Cylinder Head Nuts	55-60 lbs./ft.
Con. Rod Nuts	70-80 lbs./ft.
Main Bearing Setscrews	110-120 lbs./ft.
Flywheel Setscrews	75 lbs./ft.
Balance Weight Setscrews	50-55 lbs./ft.
Flywheel Diameter	14·75″ (374·65 mm.)
Flywheel Run-out, Clutch Face	·001″ per inch radius from flywheel centre to the dial indicator.
Flywheel Run-out, Periphery	·008″.
Number of Teeth on Starter Ring Gear	115.
One Inch on Flywheel Rim equals	7·773°.
One Degree on Flywheel Rim equals	·1287″ (3·269 mm.)
Starter Ring Gear Retention	Shrunk on.
Fuel Injection Pump	C.A.V.
Pressure Setting	120 Atmospheres.
Sprays of Atomiser	Twin Spray at 30° and 80° from the Vertical.
Fuel Lift Pump	A.C. Delco Diaphragm Type.
Fuel Filters	Purolator and C.A.V.
Lubricating Oil Pump	Rotor Type.
Pumping Capacity	Approximately 4·5 galls./min. at 2,000 r.p.m. Engine Speed.
Operating Oil Pressure	25-30 p.s.i. or more at Normal Speeds.
Relief Valve Setting	50-65 p.s.i.
Sump Capacity	10½ pints.
Lubricating Oil Filter Type	Tecalemit Full Flow.
Filter By-pass Valve Opens	13-17 p.s.i.
Thermostat Type	A.C. Delco 1572233.
Thermostat Opening Temperature	176°F.
Backlash in Timing Gears	·003″/·006″ (·0762-·1524 mm.)
Backlash, Lubricating Oil Pump Gears	·012″/·018″ (·305-·4572 mm.)

FIRST ISSUE