**75% Filling**

1. Using a jack capable of lifting 3000 kg (3 tons) raise the rear wheels just clear of the ground.
2. Ensure that the tyre valve is secured to the rim, either by a mounting cone or valve nut. If so deflate the tyre.
3. Check that an air-water type valve core is fitted to the valve.
4. Position the valve by turning the wheel until the valve is at '12 o'clock' (i.e. vertical at the top).
5. Connect the water adapter to the valve and place the solution suction tube in the tank of solution.
6. Pump the solution into the tyre until a steady stream of solution pours from the breather hole. This indicates that the tyre has been filled up to the level of the valve, which is approximately 75% of the tyre's capacity.
7. Disconnect the water adapter.
8. Using a special air-water gauge, adjust the air pressure in the tyre to that recommended for the load being carried by the rear of the tractor.

**Essential Facts when Liquid Ballasting**

Always use a proper air-water pressure gauge, as a normal air type gauge will be rapidly corroded by calcium chloride solution.

Never attempt to inflate the tyre with the wheel resting on the ground.

Always use an open topped container when mixing calcium chloride solution.

Never pour water on calcium chloride.

**LIQUID BALLAST TABLE 75% FILLING**

| | | 1 | | 2 | | 3 | | 4 | | 5 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Tyre Size** | **Rim Size** | **Weight of Calcium Chloride Required** | | **Volume of Water to Mix with Calcium Chloride** | | **Volume of Water Required to Finally Fill the Tyre** | | **Actual Weight Added to Tyre** | | **Volume of Plain Water Which must be Drained from Tyre if Anti-Freeze is to be added** | |
| | | **kg.** | **lb.** | **Lit.** | **Gal.** | **Lit.** | **Gal.** | **kg.** | **lb.** | **Lit.** | **Gal.** |
| **11 – 32** | **W10 x 32** | **13,8** | **30.5** | **17,0** | **3.75** | **112,6** | **24.75** | **143** | **315** | **25,5** | **5.75** |

**BOLT-ON BALLAST WEIGHTS**

The main advantage of bolt-on weights is that they can be removed easily when not required; thus relieving the tractor of unnecessary weight. This should, over a long period, give the tractor better fuel consumption than a tractor with liquid ballast, which cannot easily be removed.

These are cast iron weights, having various tapped and plain holes which are necessary for attaching the weight to the wheel and subsequent weights.

**FITTING WHEEL WEIGHTS**

Two separate types of weight are used on this tractor, i.e. an inner adapter weight and a second weight.

The adapter weights are fitted first, with the slot in the weight aligned with the tyre valve, thus rendering it accessible.

The second weight has semi-circular cut-outs, which must align with the tyre valve, to allow the valve to be still accessible.

Fitting procedure is as follows:

1. Position the tractor on level ground with the tyre valve in the '12 o'clock' position.
2. Ensure the tractor is in gear with the parking brake engaged.
3. Place the adapter weight in position with the cut-outs aligned with the tyre valve.
4. Fig. 13. Fit the four bolts, spring washers and nuts.
5. Fig. 14. Fit second and subsequent weights with four bolts and spring washers for each weight.

NOTE – NOT MORE THAN FOUR WEIGHTS CAN BE FITTED TO EACH WHEEL.

NOTE – IN ALL CASES AN EQUAL AMOUNT OF WEIGHT MUST BE FITTED TO BOTH SIDES OF THE TRACTOR. TYRE PRESSURES MUST BE RAISED TO SUIT THE AMOUNT OF WEIGHT ACTING ON THE TYRES.

## TRACTION AIDS

**Cage Wheels (Fig. 15)**
Cage Wheels are circular frames which attach to the sides of the existing tractor wheels to increase flotation and traction. There are numerous types available with either straight, angled or chevron type tread bars.

Due to the large number of differing designs available, pedantic instructions for fitting and removal cannot be given.

**Girdles (Fig. 16)**
These are chains made of steel strip which are fitted around the periphery of the wheel to give better traction when hauling timber and in similar conditions.

**Half-Tracks (Fig. 17)**
Half-Tracks are ideal for work in deep snow where as much flotation as possible is required.

**Strakes (Fig. 18)**
Strakes are retractable, radially mounted metal bars, with spade lug-ends which can give increased traction in heavy clay and similar soils.

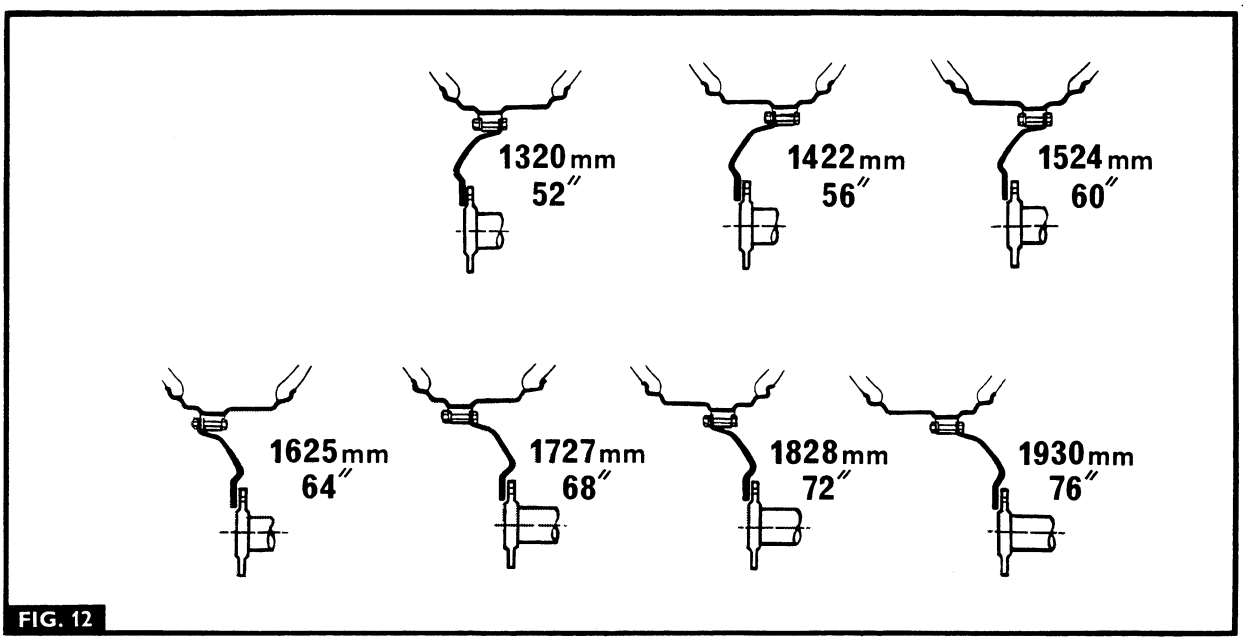


FIG. 12

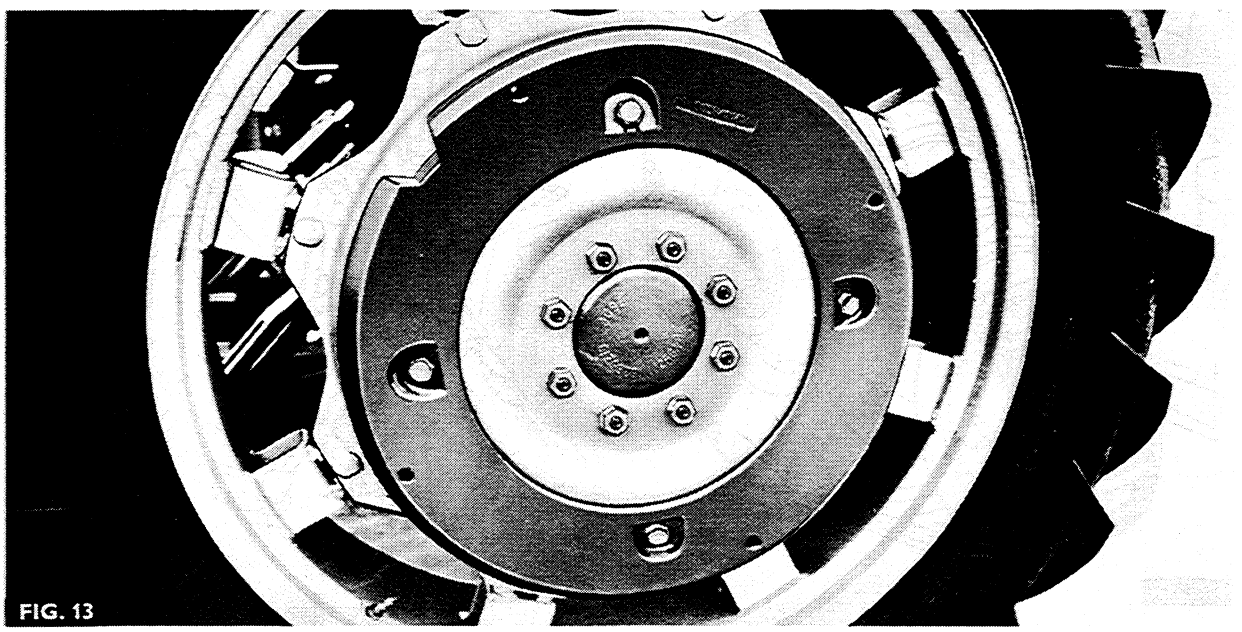


FIG. 13

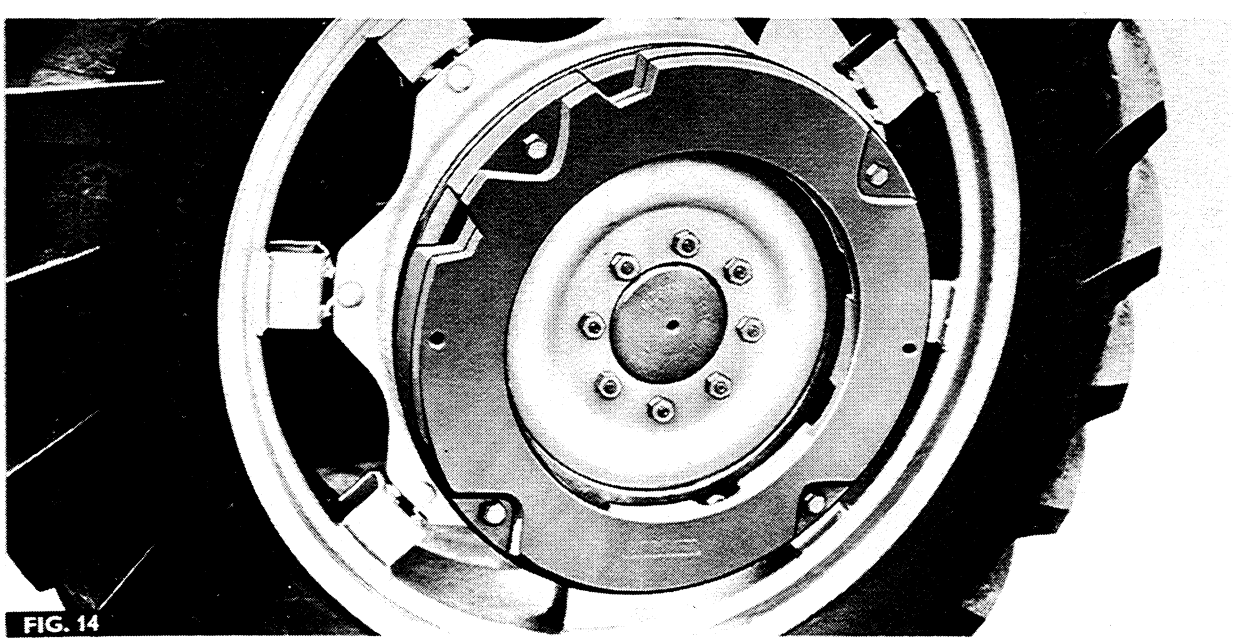


FIG. 14

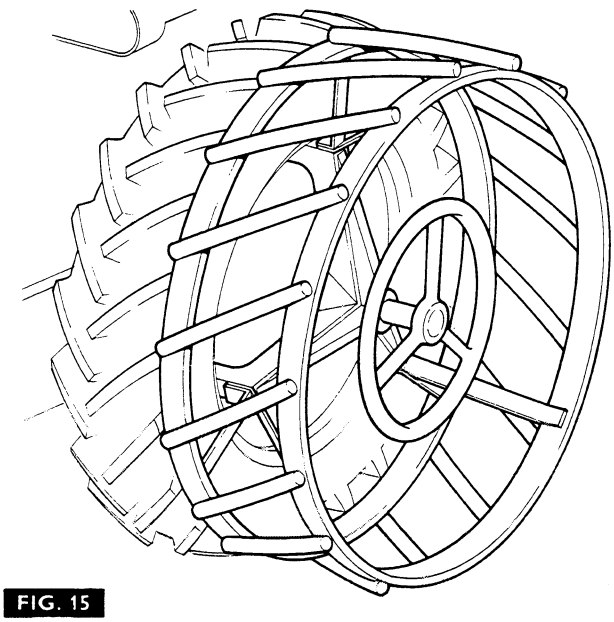


FIG. 15

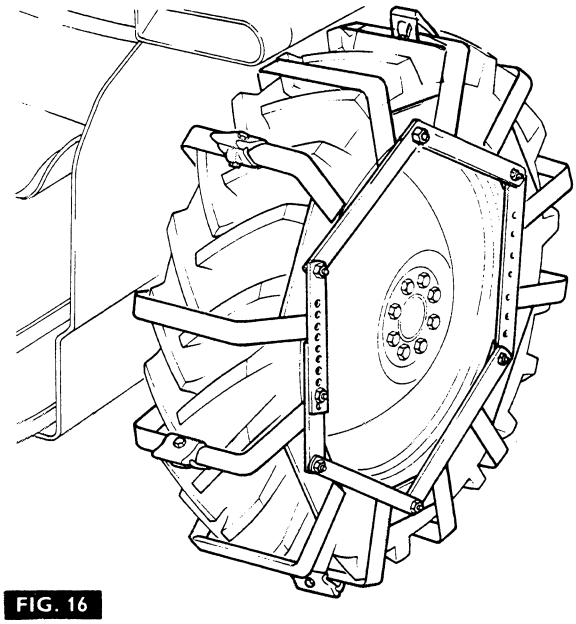


FIG. 16

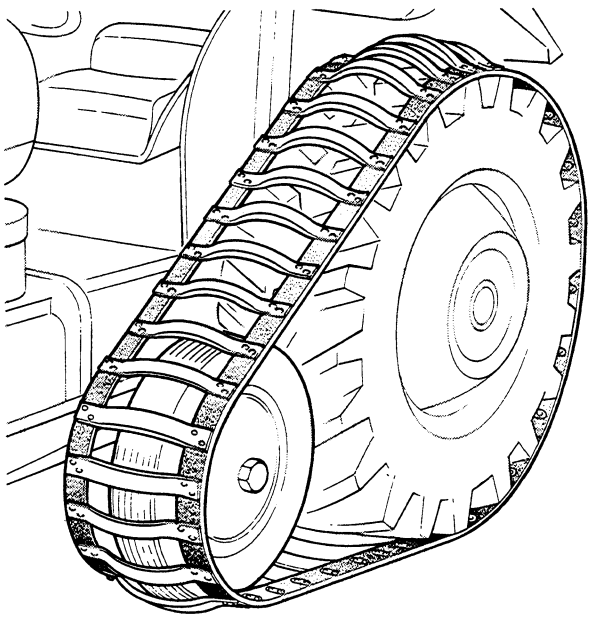


FIG. 17

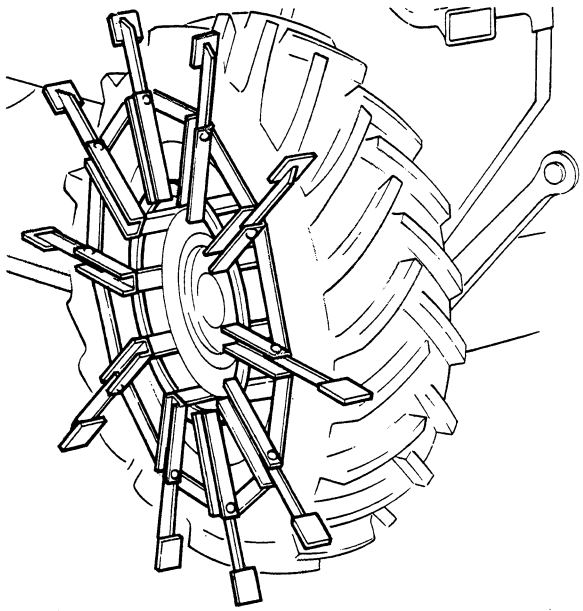


FIG. 18

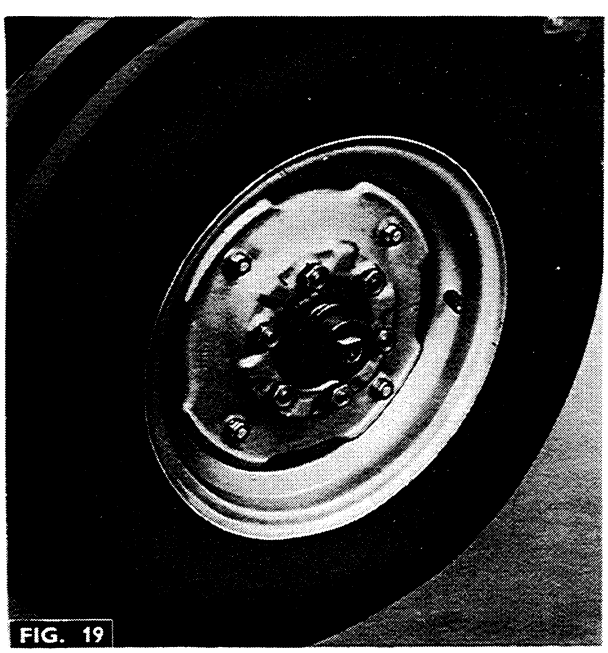


FIG. 19

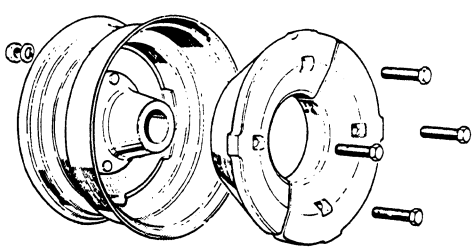


FIG. 20

## TYRE FAULT FINDING CHART

| Symptom | Possible Cause | Suggested Cure |
|---|---|---|
| Wheelspin | Too low gear | Use the highest gear that the tractor will pull without labouring |
| Wheelspin due to tyres loading with soil | Tyre pressures excessive | Adjust the pressures to the manufacturer's recommended minimum |
| | Inadequate tyre pressures | Raise the tyre pressures to that correct for the load on the rear end of the tractor |
| | Insufficient weight acting of the rear end of the tractor | 1) Fit wheel weights<br>2) Water ballast tyres<br>3) Increase 'Pressure Control' pressure if fitted.<br>4) Try narrower section tyres |
| Wheelspin<br>The tyre retains its self-cleaning action and sinks into the ground | Inadequate weight on the front end of the tractor | Fit weight frame and front-end weights |
| | Too narrow section tyre for the weight being carried by the rear end of the tractor | 1) Fit wider section tyres<br>2) Reduce the weight on the rear end of the tractor |
| | Lug-bar type tyres being used in sand | Use either grassland/sand type tyres, or heavily worn lug-bar type tyres |
| Tractor slews from side to side when being driven on hard ground (e.g. road) | Tyre squirms due to excessively low pressures | Raise the tyre pressures.<br>This complaint can cause rapid tyre wall wear and consequent failure |
| Tyre tread worn unevenly when used for long periods on the road | 1) Too low pressure<br>2) Overloading | Raise pressure –<br>This complaint is indicated by wear on the leading and trailing edges of the lug-bar |
| Uneven tread wear | Over inflation | Adjust pressures to those recommended by tyre manufacturers. This problem is indicated by wear to the centre of the tread only |
| | Wheels running out of true | 1) Jack up axle to relieve wheel of weight slacken and re-tighten wheel nuts.<br>2) Check that the tyre is located accurately on the rim. |
| Tyre creep | Too low tyre pressure | 1) Increase tyre pressure<br>2) Check the condition of both the rim and bead and replace as necessary<br>Certain sizes of wheel are available with knurled rims. |
| Split sidewall | Under-inflated tyre striking a sharp object | Minor splits are repairable. In cases of severe damage the tyre must be replaced. |

## FRONT WHEELS AND TYRES

**General (Fig. 19)**
One type of front wheel is fitted to this tractor. This is a W4.50 x 19 Pressed Steel Rim and Disc fitted with a 6.00–19 tyre.

**Tyre Pressures**
The tyre pressure are shown in the Specification Section. However, if a very heavy front end weight is fitted, such as a loader, the pressure should be raised to 2,81 to 3,09 kg/cm$^2$ (40 – 44 lb/in$^2$).

**Liquid Ballast**
Liquid ballasting is not normal procedure, but it can be used if required. The procedure is similar to that used for rear tyres. Ensure the correct type of valve is fitted to the tyre.

**Bolt-On Ballast Weights (Fig. 20)**
Two piece inner wheel weights can be fitted to this tractor. The weights are attached by four bolts per wheel.

Fitting procedure as follows:
1. Position the tractor on level ground.
2. Ensure that the tractor is in gear with the parking brake engaged.
3. Using a jack, raise the front wheels just clear of the ground.
4. Remove the wheel.
5. Place the two pieces of the weight on the inside of the wheel and secure with the four bolts, nuts and spring washers.
6. Refit the wheel to the tractor and secure it with the wheel nuts tightened to a torque of 8,3 kg-m (60 lb-ft).
7. Lower the tractor to the ground and remove the jack.
8. Repeat this procedure for the other side.

**NOTE** – NEVER OPERATE THE TRACTOR WITH UNEVEN WEIGHTS (E.G. L.H. WHEEL WEIGHTED, R.H. WHEEL WITHOUT WEIGHTS).

**Inner Tube Removal and Refitment** 6B-03-12
See operation 6B-01-03

**Tyre Removal and Refitment** 6B-04-12
See operation 6B-02-04

# WHEELS AND TYRES

## Part 6 Section B

## REAR TYRES

### General

The tyres fitted to M.F. Farm Machinery tractors can be divided fairly easily into three separate categories:

1. Field (Dunlop RT40, Goodyear Traction Sure Grip or Firestone F151).
2. Universal Field and Road (Goodyear Sure Grip All Service, Firestone F151 or Dunlop RT35).
3. Grassland, Sand or Hard Surfaces (Firestone A.N.S. or Goodyear All Weather).

Each of the above types of tyre has been designed especially to give the best grip and wear characteristics obtainable in the specified conditions. On grassland, such as parks and golf courses, worn field or universal type tyres can also be used successfully.

### Traction

Very few tractors are used to their fullest capacity, mainly due to inability of the driver to control excessive wheelspin.

If a tractor (or any other wheel driven machine) is being driven along a smooth flat surface, the tyre tread will grip the road provided that the torque applied to the wheel is not in excess of the coefficient of friction between the tyre and the road. When the tyre grips the road without slipping, the condition is one of 100% traction.

Unfortunately, due to tread design and other factors, the maximum rate of traction normally obtainable in the most favourable conditions (i.e. smooth concrete) is approximately 90%, i.e. the tractor will pull a load of 90% of the weight acting on its rear wheels, e.g. a tractor working on smooth dry concrete, with a weight of 5000kg acting on its rear wheels. Allowing for a coefficient of traction of 90%, the tractor will be capable of pulling a load of approximately:

$$\frac{5000}{1} \times \frac{90}{100} = 4500 \text{ kg}$$

When ploughing or performing similar operations in the field, the coefficient of traction is reduced to around 45 to 50%. This is the reason for ballasting the rear end of the tractor, thereby increasing the weight acting on the rear axle and thus increasing the tractive effort of the tractor.

The coefficients of traction mentioned can only be achieved by ensuring that all of the factors which affect the tractor performance are adjusted to suit the ground condition.

Some of the factors are:

1. Tyre Pressures — must be set at the lowest pressure permissible for the load being carried and the size and the ply-rating of tyre being used.
2. Tyre Tread — the tyre tread should not be more than 1/3 to ½ worn for efficient ploughing. The lug-bars must face in the correct direction (most tyres have arrows on the sidewalls to indicate the correct direction of rotation).
3. The correct section and size of tyre should be used for certain ground conditions. Some examples are:
   a. Clay — Large diameter, narrow section tyres. These tyres have a small contact area and will concentrate a larger amount of weight on the contact area than would a wide section tyre, thus helping the lug-bars to 'bite' into the soil and give traction.
   b. Very light sandy soil — or peat. Any wide section tyre will allow the weight acting on the rear end of the tractor to be spread over a larger area than with a narrow tyre, thus preventing sinkage and crushing of the furrow.
   c. Stony Ground — Large diameter, wide section tyres will spread the wear out over a large area of tread and give good flotation.
   d. Sand — Sand requires an entirely different type of tyre, for if ordinary lug-bar type tyres are used, they will greatly disturb the surface of the sand and rapidly dig themselves into an ever increasing depth. In these conditions, a smooth tread pattern on as wide a tyres as possible is required, to disturb the surface as little as possible and give good flotation.

## CORRECT TYRE USAGE FOR ECONOMICAL LIFE

### Pressures

Tyre pressure must be maintained at the manufacturers' recommended minimum to give the best possible performance. This minimum is determined by the weight acting on the rear end of the tractor and can be calculated from the table given in the Specification Section.

Incorrect inflation of tyres has the following effects:

### Over-Inflation

Excessive tyre pressure deprives the tyre of its self-cleaning properties. This causes wheelspin, which in turn causes sinkage, thus increasing the rolling resistance of the tyre and lowering the power available for traction.

Frequent and prolonged bouts of wheelspin cause rapid tyre wear. Another effect of over-inflation is that the casing of the tyre is very susceptible to damage from sharp rocks or similar objects due to the inability of the casing to 'give' on contact.

### Under-Inflation

If a tyre has insufficient pressure to support the casing, this may be deflected to such an extent that the plies may become separated. Such damage is irrepairable and the tyre must be replaced. Excessive deflection allied to a high drawbar pull can cause wrinkling of the tyre sidewalls which, if allowed to occur continually can cause the tyre to 'creep' on the rim and tear out the valve.

A visible warning of under-inflation is uneven wear of the lug-bars, indicated by 'gouging' of the centre of the bars.

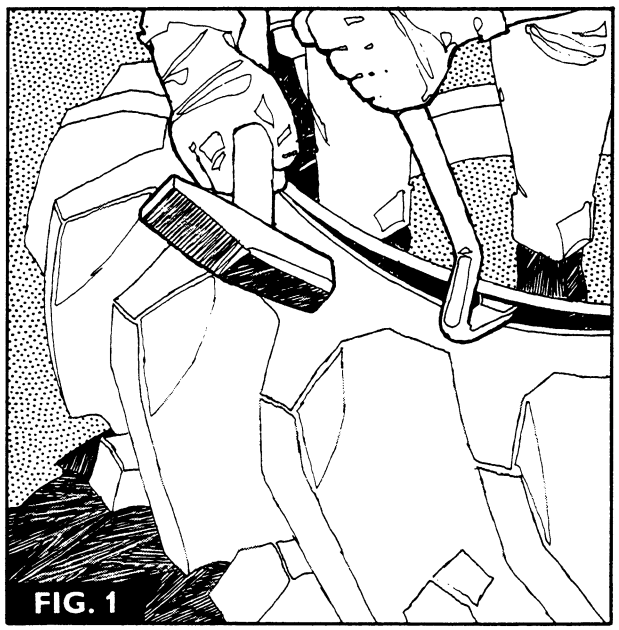


FIG. 1

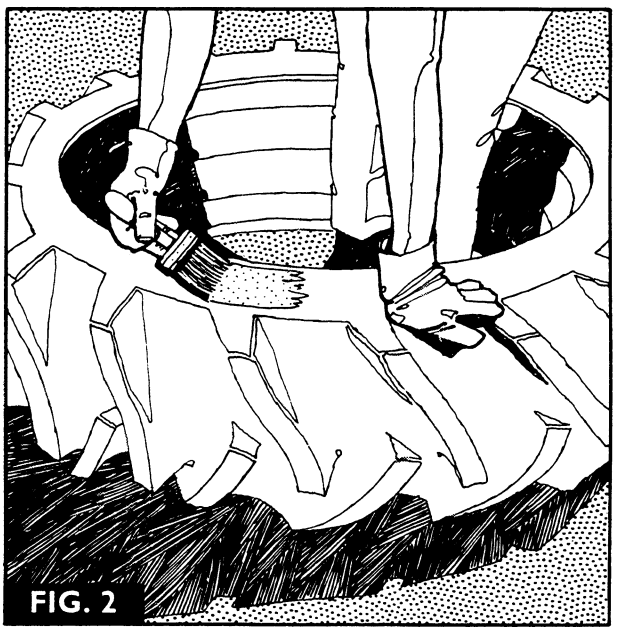


FIG. 2

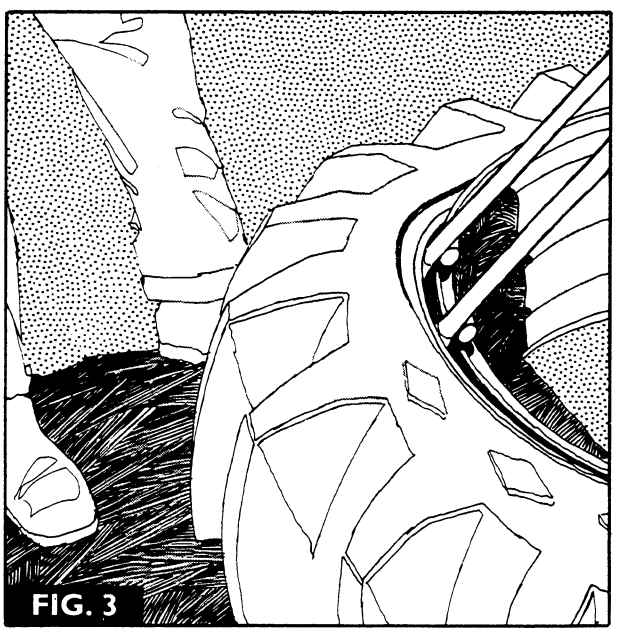


FIG. 3

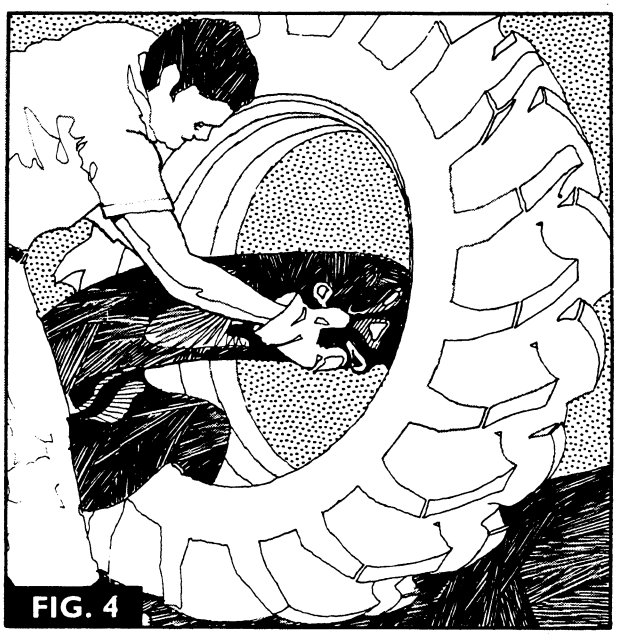


FIG. 4

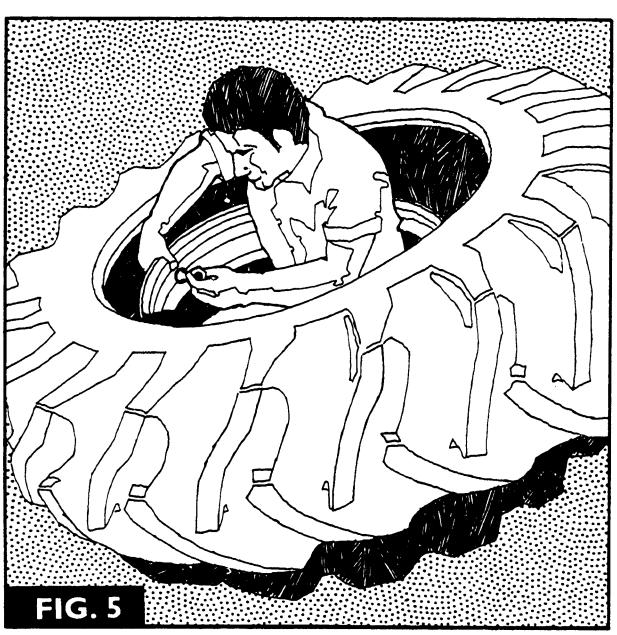


FIG. 5

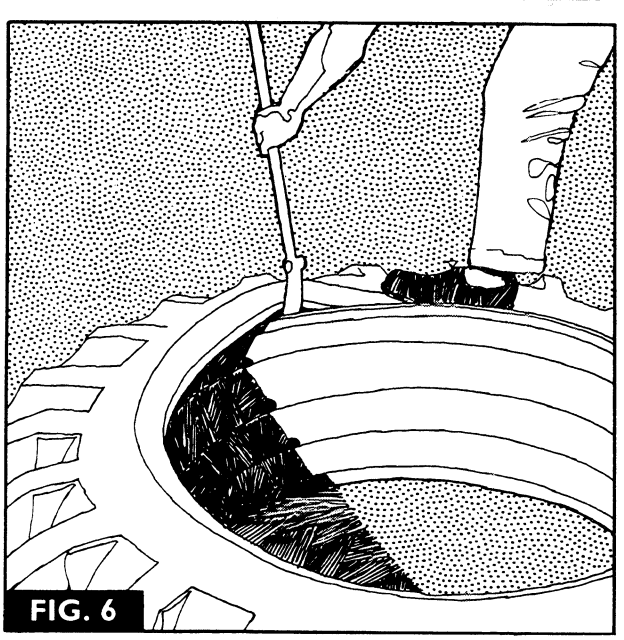


FIG. 6

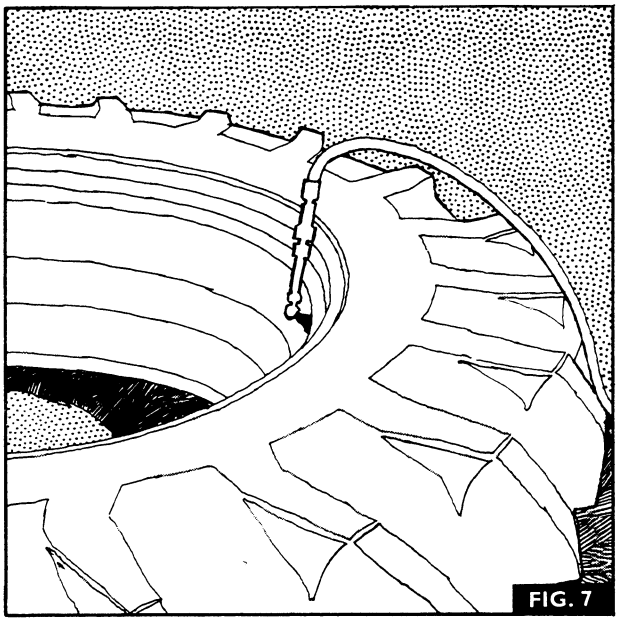


FIG. 7

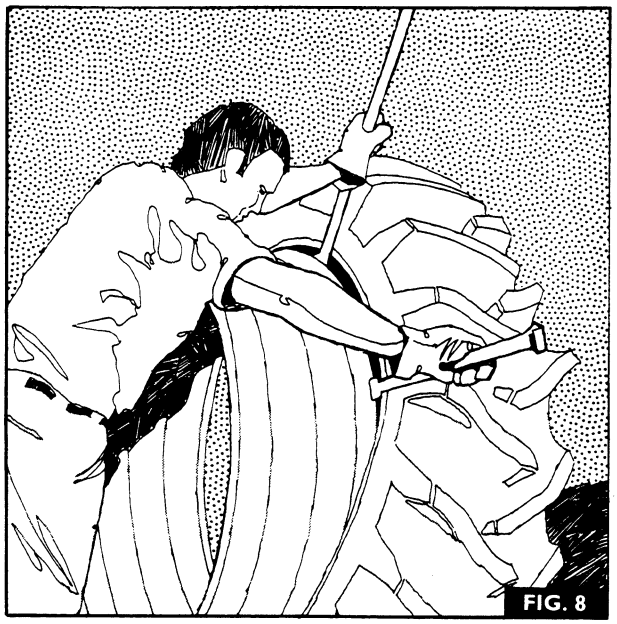


FIG. 8

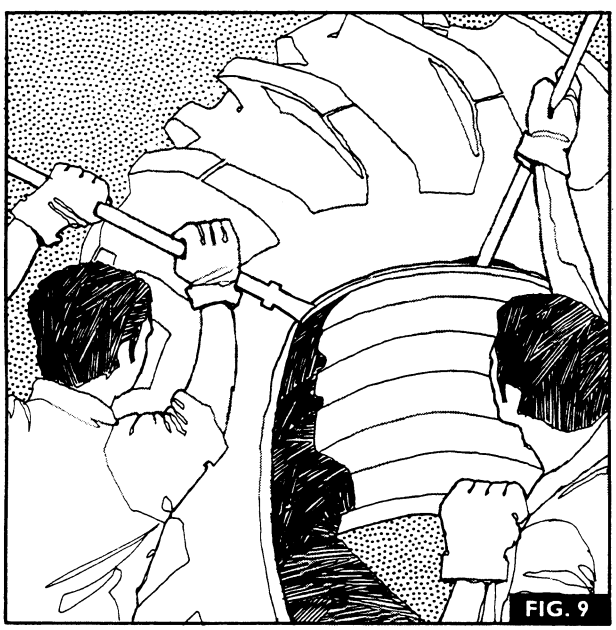


FIG. 9

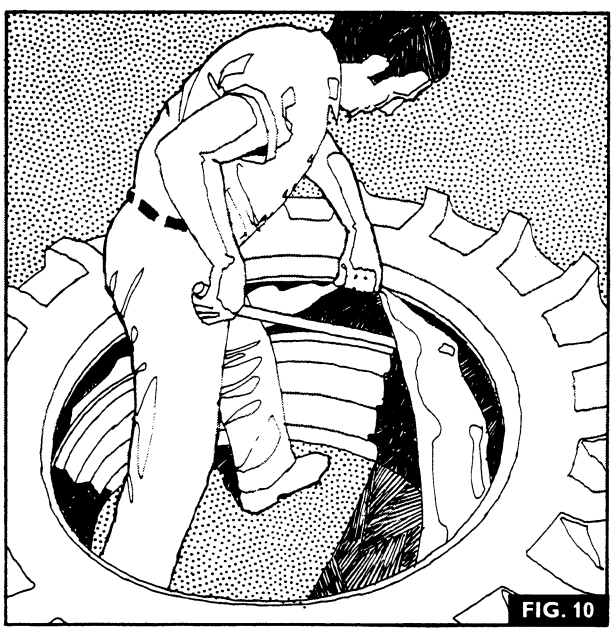


FIG. 10

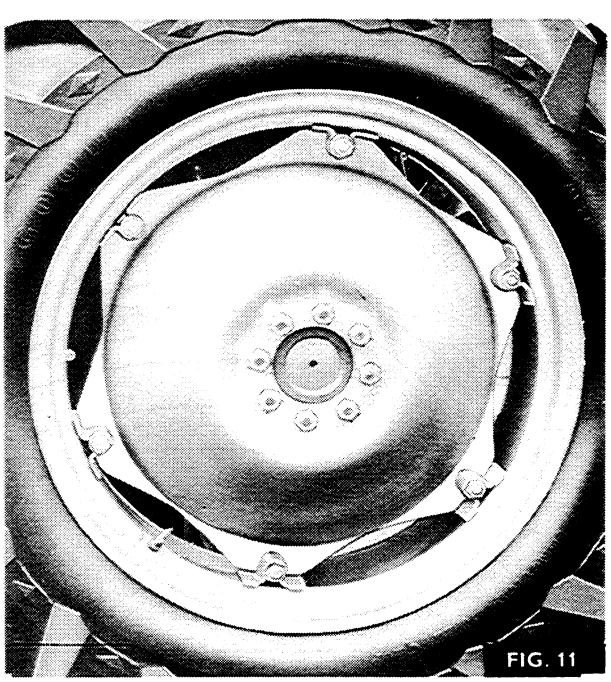


FIG. 11

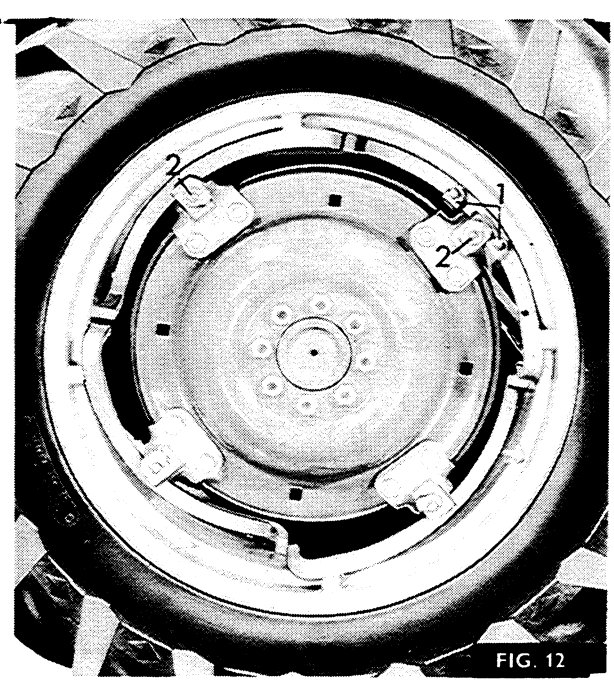


FIG. 12

**Cleanliness**
Certain liquids can cause considerable harm to tyres, if they are not quickly removed. Some of the worst offenders are oil, grease and some crop sprays which can contain considerable quantities of acid or alkali. If any of the above penetrate into the plies through small holes or splits, rapid deterioration will result.

**Effective Tyre Pressures**
Details of the maximum pressures usable with the various sizes and ply-ratings of tyres fitted are given in the Specification Section. These maxima are only used when very heavy loading of the tractor is required.
Under normal conditions the following pressures can be used, but must be increased if extra loading is involved.

Ploughing: 0,84 kg/cm² (12 lb/in²)

If bolt-on ballast weights are used, the pressure must be raised accordingly. When working on a hillside pressure should be raised by 0,14 kg/cm² (2 lb/in²) in both tyres, because as each tyre alternately takes most of the load when it is on the side of the tractor nearest the bottom of the slope, the pressure must be raised accordingly to cope.
When using a non-reversible plough the pressure of the landside tyre may be reduced by 0,14kg/cm² (2lb/in²) although the differential lock should be used to compensate for wheelspin by one wheel only.

**Road Work**
When driving a tractor on the road, higher speeds can be used than in the field. In such conditions the pressure can be raised by 0,28kg/cm² (4lb/in²) (not Firestone F151) to prevent squirming and gouging of the lug-bars.
If a two wheel trailer, or manure spreader is used, the weight exerted on the tractor drawbar should be determined and the pressure adjusted to suit.

**Using a Front End Loader**
If a loader is fitted to the tractor, a counter-weight is frequently fitted to the tractor rear linkage as a safety precaution. If a counter-weight is to be fitted the tyre pressure should be raised to compensate.

## INNER TUBE

**Removal and Refitment** 6B-01

Special tools required: 'Bead-breaking' tool
3lb. Hammer
Tyre levers

**Removal**
1. Lay the wheel on the ground with the valve uppermost.
2. Deflate the tyre by removing the valve core. Remove the valve retaining nut.
3. Fig 1. Drive the 'bead-breaking' tool between the tyre and rim, taking care not to damage the rim or the tyre.
4. After the bead has been released from the rim, invert the wheel and repeat Item 3.
5. Fig 2. Lubricate the rim, tyre and base of the tube with a solution of soap and water or similar rubber lubricant.

NOTE – NEVER USE PETROLEUM O R SILICONE BASE GREASES.

6. Fig 3. Starting at the valve location, pry the tyre off the rim, taking small bites with tyre levers, and ensuring that the bead on the opposite side is fully located in the mounting well.
7. Fig 4. With the wheel in a vertical position, pull the tyre forwards and remove the tube.

Examine the bead seating area of the rim. Remove any build-up of rust, corrosion or old rubber. Inspect inside the tyre casing for foreign matter or damage.

**Refitment**
1. Fig 5. Inflate the tube until 'rounded out'. Place the tube in the tyre with the valve located in the valve hole. Refit the valve retaining nut finger tight.
2. Fig 6. Refit the tyre, starting opposite the valve location taking small bites with long tyre levers and keeping the fixed part of the bead fully located in the well.

A solution of soap and water, or similar rubber lubricant, brushed on to the rim and bead will help fitment.

NOTE – CARE MUST BE TAKEN NOT TO PINCH THE TUBE WHEN FITTING.

3. Fig 7. Centre the tyre on the rim and inflate to approx. 2,5kg/cm² (35lb/in²).

NOTE – NEVER STAND OVER THE ASSEMBLY WHEN INFLATING, REMOTE CONTROL INFLATION EQUIPMENT SHOULD BE USED.

4. Remove the valve core and completely deflate the tyre.
5. Refit the valve core and inflate to recommended pressure.

NOTE – IF BEADS FAIL TO SEAT AT 2,5kg/cm² (35lb/in²) THE TUBE MAY BE PINCHED, DO NOT INCREASE THE PRESSURE BUT REMOVE THE VALVE CORE AND RELEASE TYRE FROM RIM. LUBRICATE TYRE, BEAD AND RIM AND REINFLATE TO 2,5kg/cm² (35lb/in²). REPEAT PROCESS UNTIL BOTH BEADS ARE PROPERLY SEATED.

## TYRE

**Removal and Refitment** 6B-02
Special tools required: 'Bead-breaking' tool
3lb Hammer
Tyre levers

**Removal**
1. Remove inner tube as stated in operation 6B-01
2. Figs 8 & 9. With the wheel in a vertical position pry off the tyre taking small bites with the tyre levers. The use of rubber lubricant will help removal.

**Refitment**
1. Place the rim on the ground, lubricate the bead and rim and place the tyre on rim.
2. Fig 10. Refit the tyre to rim, using long tyre levers.
3. Refit the inner tube as stated in operation 6B-01

## REAR WHEELS
**General**
The following types of wheels are available for MF 135 Tractors:
Pressed Steel Single Disc Wheels (Fig 1).
Pressed Steel Power Adjusted Variable Track (P.A.V.T.) wheels (Fig 12).

Both types of wheel can be reversed to give extra wide track settings, except when fitted to tractors with sealed brakes.
A general rule governing rim size in relation to tyre size is that the rim will be 25,4 mm (1 inch) narrower than the tyre fitted to it: e.g.
W12 x 24 rims are fitted with 13-24 tyres.
However, this rule does not always apply and in certain instances the rim may be 50,8 mm (2ins) narrower, or the same nominal width as the tyre: e.g.
W9 x 28 rims fitted with 11-28 tyres.
W14 x 30 rims fitted with 14-30 tyres.
Any tractor fitted with dual brakes will have track settings wider than standard.
The following wheel sizes are standard equipment on current MF 135 tractors.

## TRACK SETTINGS
**W9 x 28 and W10 x 32 Wheels**
Track settings can be varied from 1219 to 1524 mm (48 to 60 in) in 101,6 mm (4 in) increments with the wheels set normally on tractors fitted with shell type safety fenders, and from 1320 to 1524 mm (52 to 60 in) in 101,6 mm (4 in) increments on tractors fitted with flat-top fenders.
The rims and discs can be reversed to give track settings from 1625 to 1930 mm (64 to 76 in). See figure 13.

**W12 x 24 Wheels**
The minimum track setting for these wheels is 1422 mm (56 in) because if a narrower setting is attempted, the wheels and tyres will foul the tool box and strengthening ribs on the fenders. All other track settings are as for W9 x 28 and W10 x 32 rims. (Fig 13).

**W9 x 28 P.A.V.T. Wheels**
P.A.V.T. wheels have a range of track settings from 1333 mm (52. 1/2 in) to 1524 mm (60 in) with the wheels set normally and from 1625 mm (64 in) to 1929 mm (76 in) with the wheels reversed.

**Tractor with Sealed Brakes (Export Only)**
MF 135 tractors fitted with sealed brakes have their track increased by 172,45 mm (6¾ in) from the normal setting. Sealed brake tractors are fitted either with W9 x 28 or W12 x 24 pressed steel wheels. The discs cannot be reversed.

## TRACK ADJUSTMENT PROCEDURE

**Tractors with Pressed Steel Wheels**
1. Select the required track setting.
2. Slightly slacken either the wheel to axle, or rim to disc nuts, or both, according to requirements.
3. Using a jack capable of lifting 3000 kg (3 tons) raise the rear wheels just clear of the ground.
4. Remove the rim from the disc, or the complete wheel, or both, and re-assemble them with the rim and disc in their new position. Tighten the nuts to a torque of 14 kg-m (100 lb-ft).

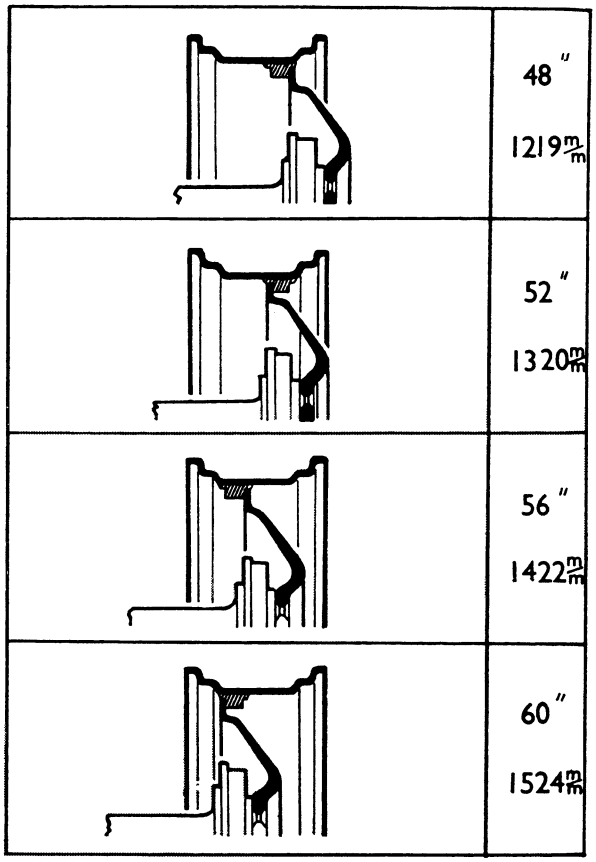
If the wheels are to be reversed, they have to be transferred to the opposite side of the tractor.
5. Refit the wheel and tighten the wheel nuts progressively to a torque of 27,5 kg-m (200 lb-ft).
6. Lower the tractor to the ground and remove the jack.

**P.A.V.T. Wheel Track Adjustment** **Fig 12.**
1) Remove the two rim stop pins (1) from the rim stops which position each wheel disc to the rim and remove the stops.
2) Replace one stop on each rim rail at the track limiting position and secure each with a rim stop pin.
3) Loosen the four eccentric pins (2) on each wheel disc lug.
4) Drive the tractor either forwards or backwards to helically rotate the discs in relation to the rails on the rims until the wheel disc lugs engage the stops on the rails.
5) Secure the position of the discs in relation to the rims by fitting the remaining stops and pins to the holes immediately adjacent to the disc lugs.
6) Re-tighten the four eccentric stop pins (2).

**Dual Rear Wheels**
Conversion kits which allow the fitting of an extra pair of rear wheels are available for MF 135 tractors. These extra wheels can be fitted to all types of wheel except the P.A.V.T. type.

**Note**
The supplementary wheels must be of exactly the same type and size as those already fitted.

**Fitting Procedure** Fig 14.
1) Adjust the track of the existing wheels to the narrowest available.
2) Remove one wheel nut at a time and replace it with one of the special adapter studs (3). Secure the studs.
3) Fit the location ring (4) over the studs.
4) Locate the wheel on the studs and refit the wheel nuts. Tighten the nuts to 27,7 kg-m (200 lb-ft).


48 "
1219 mm
52 "
1320 mm
56 "
1422 mm
60 "
1524 mm

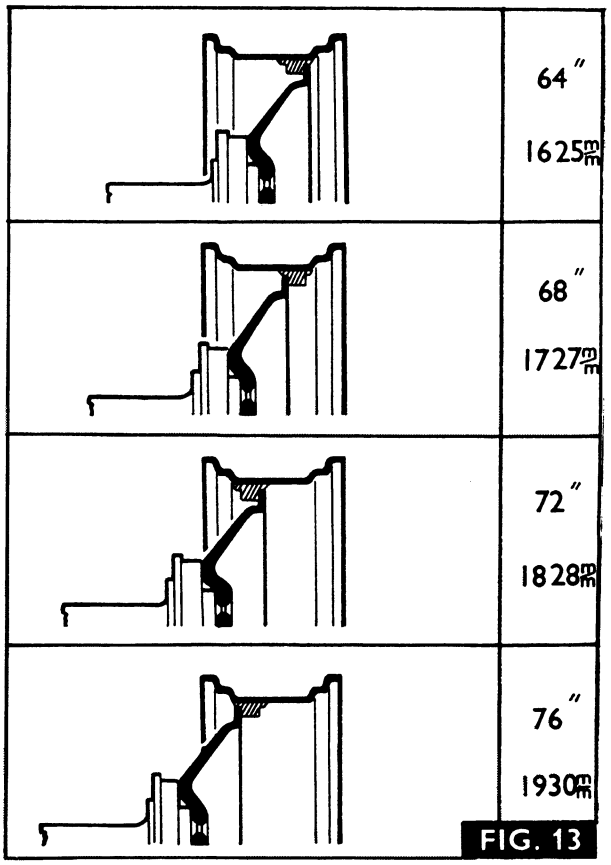

64 "
1625 mm
68 "
1727 mm
72 "
1828 mm
76 "
1930 mm

FIG. 13

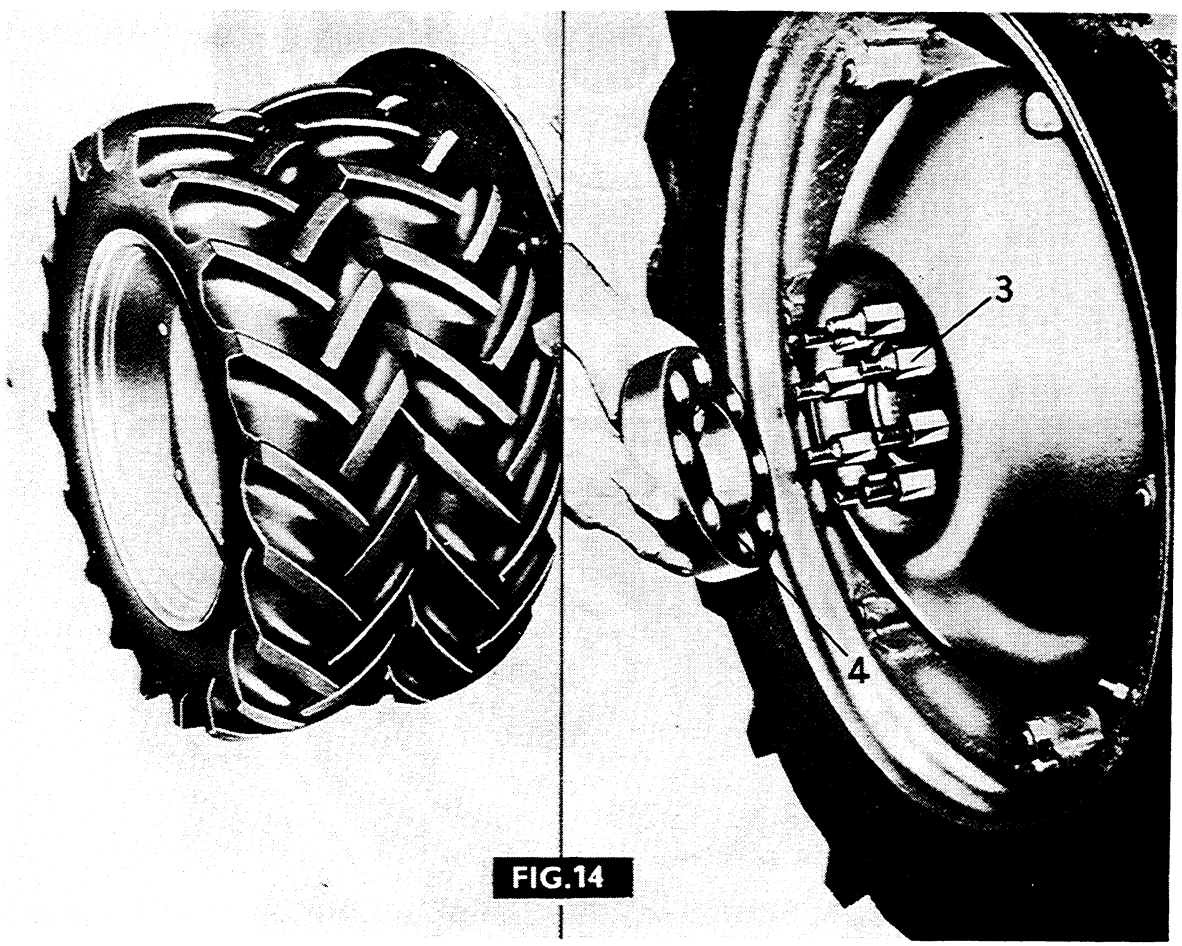

3
4

FIG.14

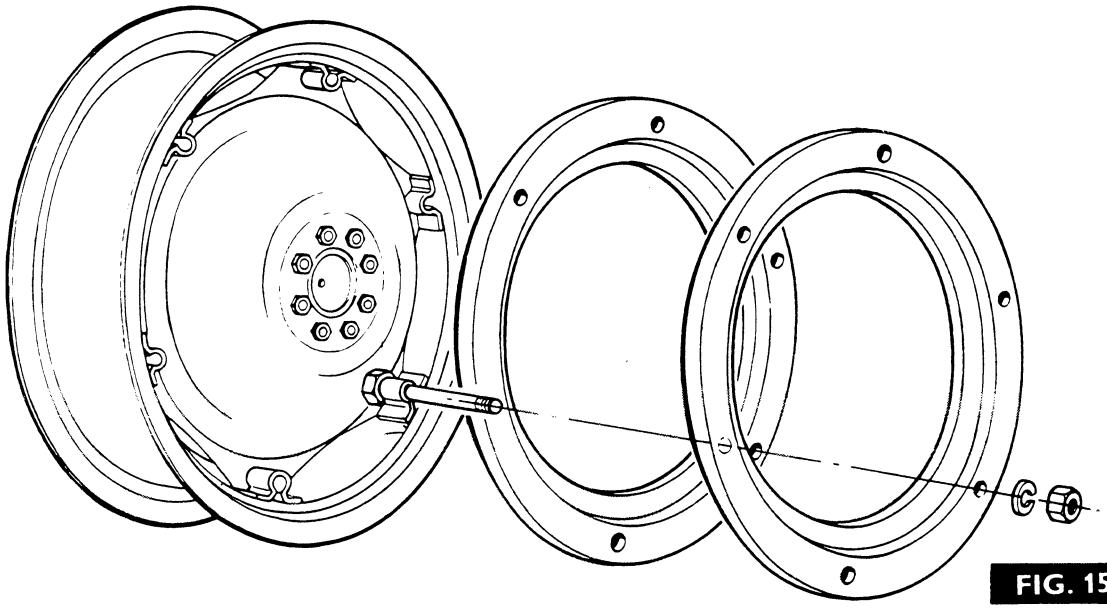


FIG. 15

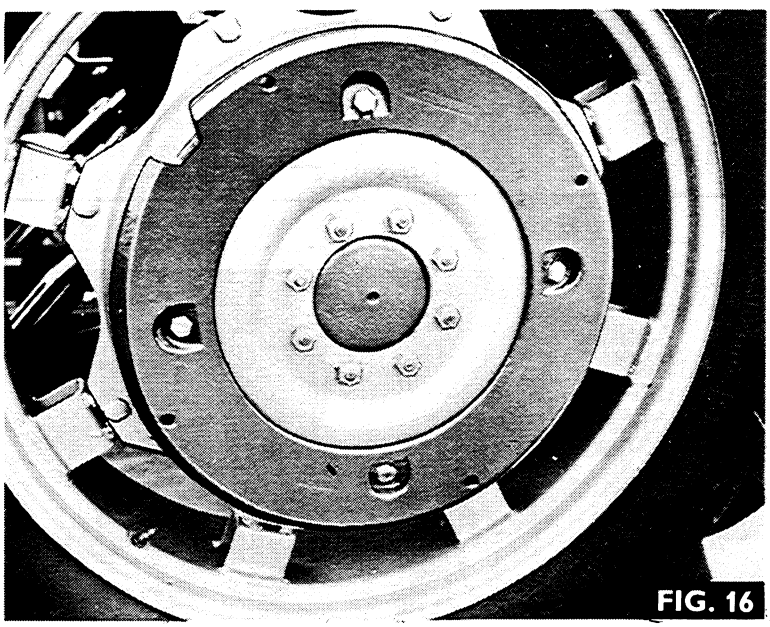


FIG. 16

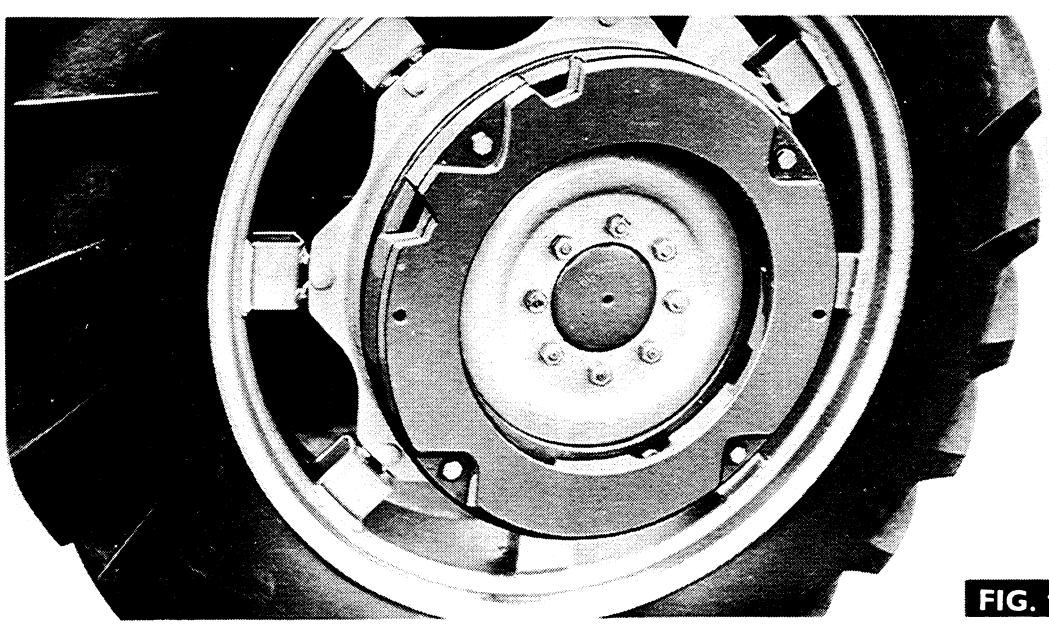


FIG. 17

## BALLASTING

### General

To impart extra weight on the rear wheels of a tractor, several methods may be employed:

1. Pressure Control or Draft Control
2. Liquid Ballast
3. Bolt-on Weights

Each of these methods has advantages and disadvantages, but all work well in practice and any two, or even all three may be combined for absolute efficiency.

## PRESSURE CONTROL AND DRAFT CONTROL

This feature, exclusive to Massey-Ferguson tractors, is described in detail in Part 7A of this Manual.

## LIQUID BALLAST

Liquid filling of the tyres is a well known and widely used method of weighting the rear of a tractor. To prevent damage by frost, calcium chloride should be dissolved in the water used to fill the tyres, thus forming an anti-freeze solution. The calcium chloride used should be 'Commercial Grade 70 to 72% $Ca.Cl_2$'.

The following table and actual filling method is based on data supplied by the Dunlop, Goodyear and Firestone Tyre Companies. This table is, of necessity, a compromise, because tyres of the same nominal size manufactured by different companies differ slightly in internal dimensions, which may alter the degree of filling by a small percentage, but this will not affect the actual performance of the tyre.

## MIXING THE CALCIUM CHLORIDE WATER SOLUTION

WARNING – NEVER POUR THE WATER ON TO CALCIUM CHLORIDE. ALWAYS ADD CALCIUM CHLORIDE TO WATER.

Procedure is as follows:

1. Consult the chart and locate the size of tyre to be filled.
2. Weigh out the correct quantity of calcium chloride (column 1), but do not put it in the mixing tank.
3. Measure the volume of water shown in column 2 and put it into the tank.
4. Add the calcium chloride to the water slowly.

NOTE – WHEN CALCIUM CHLORIDE AND WATER ARE MIXED A CHEMICAL REACTION CAUSES GREAT QUANTITIES OF HEAT TO BE PRODUCED. THE HOT SOLUTION MUST NOT BE USED – WAIT UNTIL IT HAS COOLED.

5. Add the remaining volume of water indicated in column 3 to the solution.

## TYRES FILLED WITH WATER

If a tyre has been previously filled with water and calcium chloride anti-freeze is to be added, drain off the amount indicated in column 5 of the table.

Mix a solution from the quantities shown in columns 1 and 2 and allow to cool.

Re-fill the tyre with this solution to make up the correct filling.

WARNING – NEVER ATTEMPT TO ADD PURE CALCIUM CHLORIDE TO A TYRE FILLED WITH WATER, AS THE RESULTANT HEAT AND EXPANSION CAN CAUSE TYRE DAMAGE.

### Ballasting Procedure

There are two methods of liquid ballasting tractor tyres, 75% filling and 100% filling. The 75% filling method is the most common, and is easier to achieve than 100% filling, not requiring a motorised pump.

The 100% filling increases casing vulnerability to impact damage and accordingly 75% filling is recommended by Tyre Manufacturers.

### LIQUID BALLAST TABLE 75% FILLING

| | | 1 | | 2 | | 3 | | 4 | | 5 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Tyre Size** | **Rim Size** | **Weight of Calcium Chloride Required** | | **Volume of Water to Mix with Calcium Chloride** | | **Volume of Water Required for Final Filling of Tyre** | | **Actual Weight Added to Tyre** | | **Volume of Plain Water which must be Drained from Tyre if Anti-Freeze is to be added** | |
| | | **lb.** | **kg.** | **Gal.** | **Lit.** | **Gal.** | **Lit.** | **lb.** | **kg.** | **Gal.** | **Lit.** |
| 10 – 28 | W9 x 28 | 20.0 | 9,07 | 2.5 | 11,36 | 16.25 | 73,85 | 207.5 | 94,12 | 3.75 | 17,05 |
| 11 – 28 | W9 x 28 | 27.5 | 12,47 | 3.5 | 15,92 | 22.25 | 101,2 | 285.0 | 192,28 | 5.25 | 23,92 |
| 11 – 32 | W10 x 32 | 30.5 | 13,83 | 3.75 | 17,05 | 24.75 | 112,6 | 315.5 | 143,09 | 5.75 | 25,55 |
| 13 – 24 | W12 x 24 | 38.5 | 17,46 | 5.0 | 22,74 | 31.0 | 140,9 | 398.5 | 180,76 | 7.5 | 34,1 |

**75% Ballasting**

1. Using a jack capable of lifting 5000 kg. (5 tons) raise the rear wheels just clear of the ground.
2. Ensure that the tyre valve is secured to the rim, either by a mounting cone or valve nut. If so, deflate the tyre.
3. Check that an air-water type valve core is fitted to the valve.
4. Position the valve by turning the wheel until the valve is at '12 o'clock' (i.e. vertical and at the top).
5. Connect the water adapter to the valve and place the solution suction tube in the tank of solution.
6. Pump the solution into the tyre until a steady stream of solution pours from the breather hole. This indicates that the tyre has been filled up to the level of the valve, which is approximately 75% of the tyre's capacity.
7. Disconnect the water adapter.
8. Using a special air-water gauge, adjust the air pressure in the tyre to that recommended for the load being carried by the rear of the tractor.

**Essential Facts when Liquid Ballasting**

Always use a proper air-water pressure gauge, as a normal air type gauge will be rapidly corroded by calcium chloride solution.

Never attempt to inflate the tyre with the wheel resting on the ground.

Always use an open topped container when mixing calcium chloride solution.

Never pour water on calcium chloride.

## BOLT-ON BALLAST WEIGHTS

The main advantage of bolt-on weights is that they can be removed easily when not required; thus relieving the tractor of unnecessary weight. This should, over a long period, give the tractor better fuel consumption than a tractor with liquid ballast, which cannot easily be removed.

These are cast iron weights, having various tapped and plain holes which are necessary for attaching the weight to the wheel and subsequent weights.

## FITTING WHEEL WEIGHTS

Wheel weights for MF 135 tractors are secured to the rim lugs by extension bolts which replace the standard bolts, as shown in Figure 15.

Procedure is as follows:

1) Jack up the rear of the tractor to relieve the rear wheels of weight.
2) Remove the six rim to disc securing bolts from one wheel.
3) Fit the extension bolts, as shown in Figure 15.
4) Secure the weight(s) with six nuts and spring washers.
5) Repeat the above procedure for the opposite wheel.

Removal is the reverse of fitting procedure.

**Tractor with 11-32 Wheels**

Two separate types of weight are used on this tractor, i.e. an inner adapter weight and a second weight.

The adapter weights are fitted first, with the slot in the weight aligned with the tyre valve, thus rendering it accessible.

The second weight has semi-circular cut-outs which must align with the tyre valve, to allow the valve to be still accessible.

Fitting procedure is as follows:

1. Position the tractor on level ground with the tyre valve in the '12 o'clock' position.
2. Ensure the tractor is in gear with the parking brake engaged.
3. Place the adapter weight in position with the cut-outs aligned with the tyre valve.
4. Fig. 16. Fit the four bolts, spring washers and nuts.
5. Fig. 17. Fit second and subsequent weights with four bolts and spring washers for each weight.

NOTE – NOT MORE THAN FOUR WEIGHTS CAN BE FITTED TO EACH WHEEL.

NOTE – IN ALL CASES AN EQUAL AMOUNT OF WEIGHT MUST BE FITTED TO BOTH SIDES OF THE TRACTOR. TYRE PRESSURES MUST BE RAISED TO SUIT THE AMOUNT OF WEIGHT ACTING ON THE TYRES.

**Tractors fitted with P.A.V.T. Wheels**

Wheel weights are not available for P.A.V.T. wheels.

## TRACTION AIDS

**Cage Wheels (Fig. 18)**

Cage Wheels are circular frames which attach to the sides of the existing tractor wheels to increase flotation and traction. There are numerous types available with either straight, angled or chevron type tread bars.

Due to the large number of differing designs available, pedantic instructions for fitting and removal cannot be given.

**Girdles (Fig. 19)**

These are chains made of steel strip which are fitted around the periphery of the wheel to give better traction when hauling timber and in similar conditions.

**Half-Tracks (Fig. 20)**

Half-Tracks are ideal for work in deep snow where as much flotation as possible is required.

**Strakes (Fig 21)**

Strakes are retractable, radially mounted metal bars, with spade lug-ends which can give increased traction in heavy clay and similar soils.

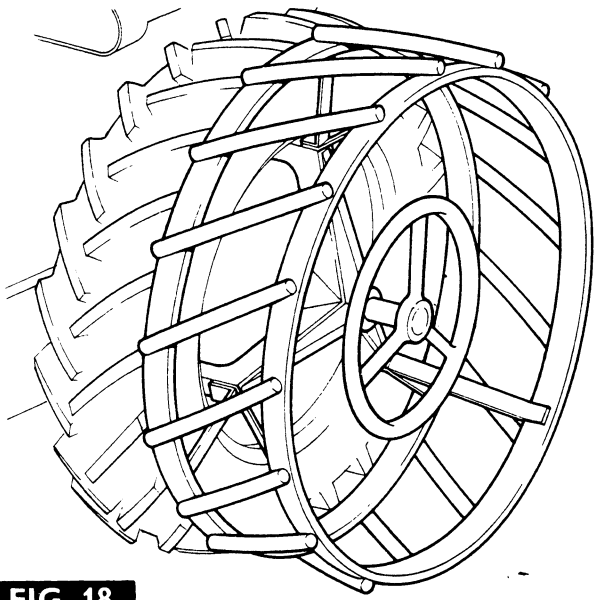


FIG. 18

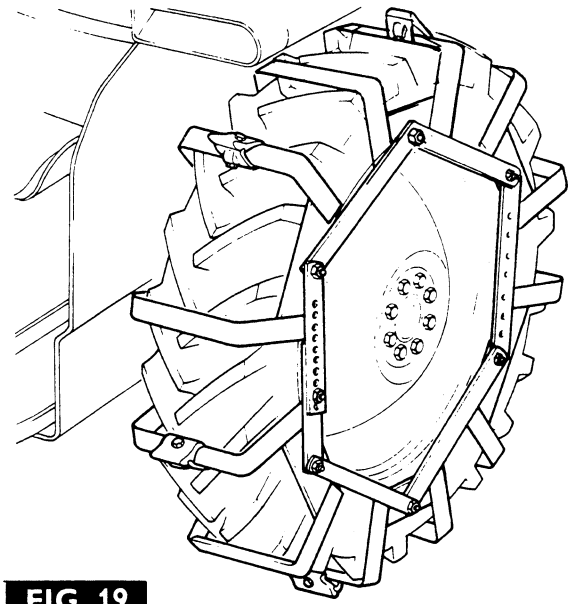


FIG. 19

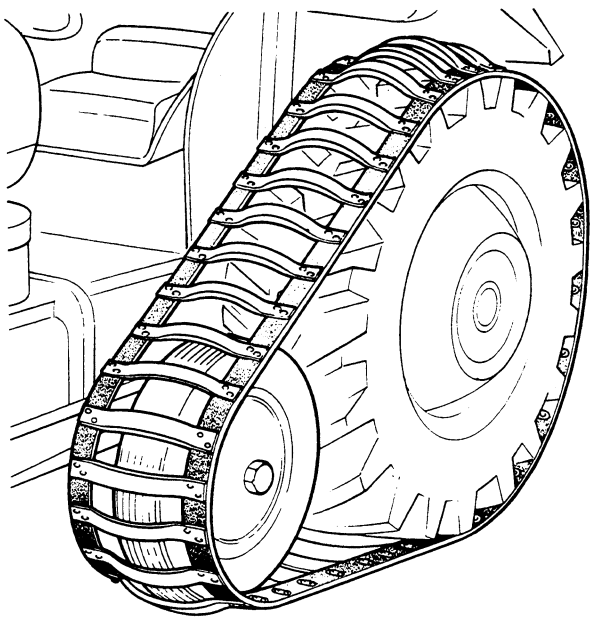


FIG. 20

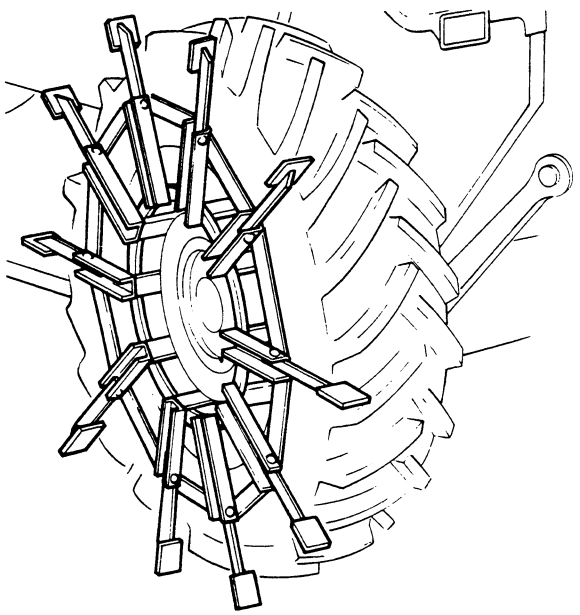


FIG. 21

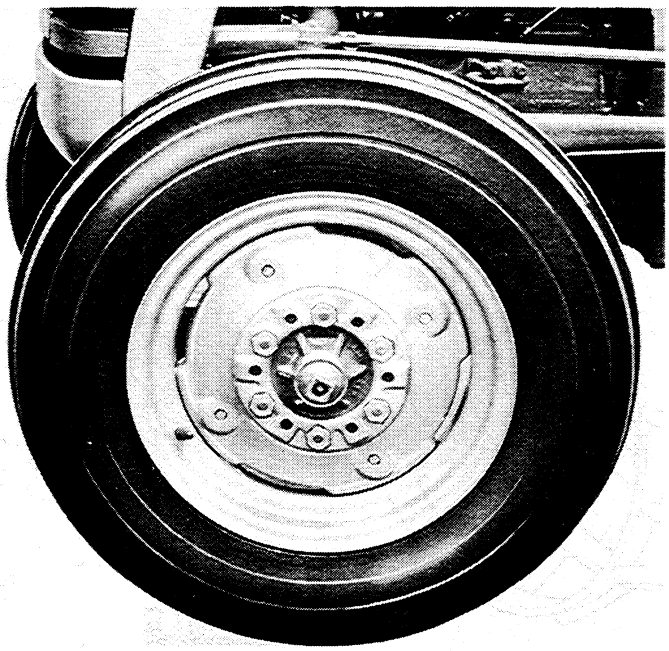


FIG. 22

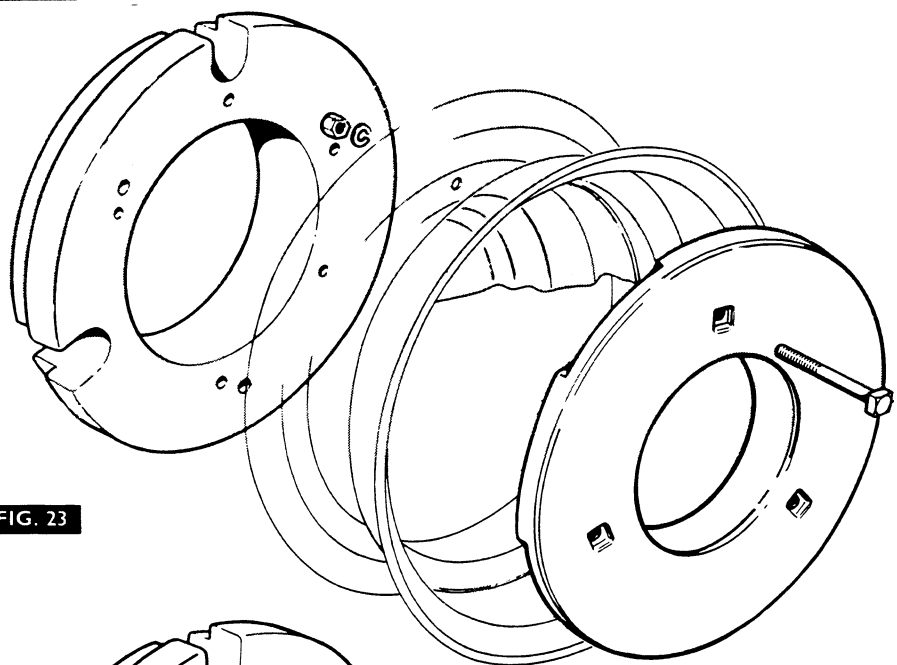


FIG. 23

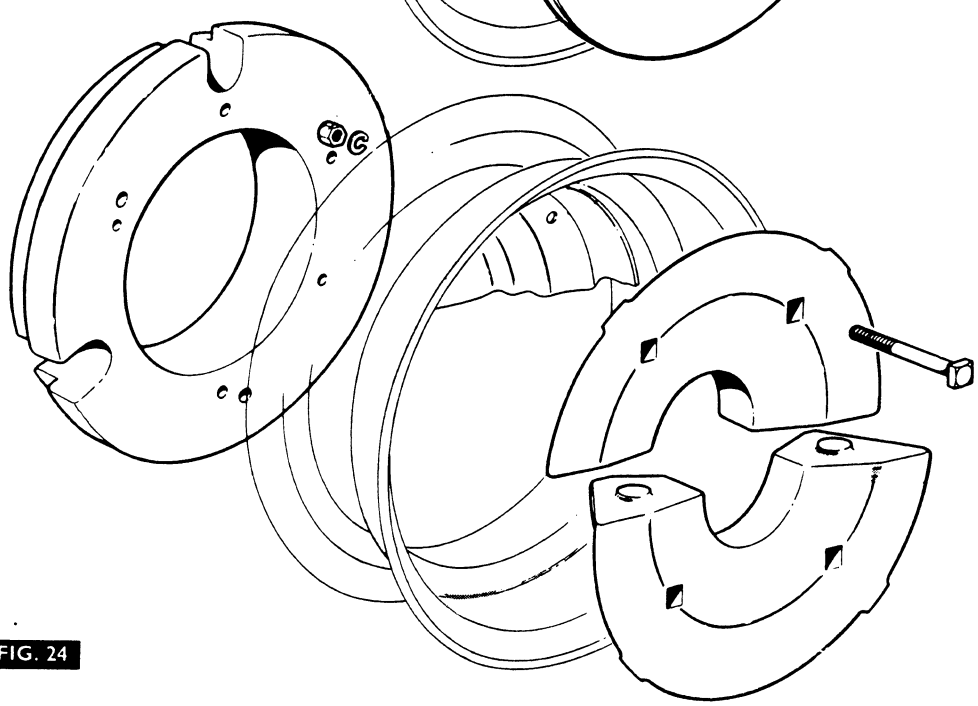


FIG. 24

## TYRE FAULT FINDING CHART

| Symptom | Possible Cause | Suggested Cure |
|---|---|---|
| Wheelspin | Too low gear | Use the highest gear that the tractor will pull without labouring |
| Wheelspin due to tyres loading with soil | Tyre pressures excessive | Adjust the pressures to the manufacturer's recommended minimum |
| | Inadequate tyre pressures | Raise the tyre pressures to that correct for the load on the rear end of the tractor |
| | Insufficient weight on the rear end of tractor | 1) Fit wheel weights<br>2) Water ballast tyres<br>3) Increase 'Pressure Control' pressure if fitted<br>4) Try narrower section tyres |
| | Inadequate weight on the front end of tractor | Fit weight frame and front-end weights |
| Wheelspin<br>The tyre retains its self-cleaning action and sinks into the ground | Too narrow section tyre for the weights being carried by the rear end of the tractor | 1) Fit wider section tyres<br>2) Reduce the weight on the rear end of the tractor |
| | Lug-bar type tyres being used in sand | Use either grassland/sand type tyres, or heavily worn lug-bar type tyres |
| Tractor slews from side to side when being driven on hard ground (e.g. road) | Tyre squirms due to excessively low pressures | Raise the tyre pressures.<br>This complaint can cause rapid tyre wall wear and consequent failure |
| Tyre tread worn unevenly when used for long periods on the road | 1) Too low pressure<br>2) Overloading | Raise pressure –<br>This complaint is indicated by wear on the leading and trailing edges of the lug-bar |
| Uneven tread wear | Over-inflation | Adjust pressures to those recommended by tyre manufacturers. This porblem is indicated by wear to the centre of the tread only |
| | Wheels running out of true (especially P.A.V.T. type) | 1) Jack up axle to relieve wheel of weight slacken and re-tighten wheel nuts.<br>2) Check that the tyre is located accurately on the rim. |
| Tyre creep | Too low tyre pressure | 1) Increase tyre pressure<br>2) Check the condition of both the rim and bead and replace as necessary<br>Certain sizes of wheel are available with knurled rims. |
| Split sidewall | Under-inflated tyre striking a sharp object | Minor splits are repairable. In cases of severe damage the tyre must be replaced. |

# WHEELS AND TYRES

## FRONT WHEELS AND TYRES

### GENERAL

MF 135 tractors have all pressed steel rims and discs (Figure 22) of three sizes:

W3 x 19 rims fitted with 4.00-19, four-ply rating tyres.

W4.50 x 16 rims, fitted with 6.00-16 four or six-ply tyres.

W4.50 x 19 rims fitted with 6.00-19 four or six-ply tyres.

The tyres can be of the triple rib or multi-rib type.

**Tyre Pressures**

The tyre pressures are shown in the Specification Section. However, if a very heavy front end weight is fitted, such as a loader, the pressure should be raised to 2,81 to 3,09 kg/cm² (40 – 44 lb/in²).

**Liquid Ballast**

Liquid ballasting is not normal procedure, but it can be used if required. The procedure is similar to that used for rear tyres. Ensure the correct type of valve is fitted to the tyre.

**Bolt-On Ballast Weights (Fig. 23 and 24)**

Two types of weight can be fitted to this tractor; an inner weight and an outer weight.

The inner weight is fitted first and is secured by four bolts, nuts and spring washers.

The outer weight (optional extra) has semi-circular cut-outs which must align with the tyre valve, to render the valve accessible.

Fitting procedure as follows:

1. Position the tractor on level ground.
2. Ensure that tractor is in gear with the parking brake engaged.
3. Using a jack, raise the front wheels just clear of the ground.
4. Remove the wheel.
5. Place the inner weight on the inside of the wheel and secure with the four bolts, nuts and spring washers, making sure the head of the bolts faces inwards.
6. Refit the wheel to tractor and secure it with the wheel nuts tightened to a torque of 8,3 kg-m (60 lb-ft).
7. Place the outer weight over the protruding bolts making sure the semi-circular cut-outs align with the valve. Secure the weight with four nuts and spring washers.
8. Lower tractor to ground and remove the jack.
9. Repeat this procedure for the other side.

NOTE – NEVER OPERATE THE TRACTOR WITH ENEVEN WEIGHTS (E.G. LH WHEEL WEIGHTED, RH WHEEL WITHOUT WEIGHTS).

**Inner Tube Removal and Refitment** 6B-03

See operation 6B-01

**Tyre Removal and Refitment** 6B-04

See operation 6B-02

# STEERING SYSTEM

## Part 6 Section C

# STEERING SYSTEM

## GENERAL (Figs. 1 and 2)

The steering box is a screw and recirculating ball type unit, mounted above the transmission casing. Drop arms, splined to the outer ends of two rocker shafts, control the front wheels by means of drag links.

The power assisted steering system comprises of a gear pump attached to the rear of the timing case, having a spur gear driven by the timing idler gear. The pump has a integral oil reservoir and supplies oil under pressure to a spool valve mounted on the outer tube of the steering column. A control link, attached to the spool valve, is actuated upon initial movement of the steering wheel, causing relative movement of the spool, which allows oil under pressure to flow through hoses to two double acting rams.

Each ram cylinder is mounted on a reaction bracket bolted to the centre axle beam and each ram piston rod is attached to a bell crank lever, keyed to the top of each front axle spindle.

Rotation of the steering wheel causes movement of the spool to allow oil to flow under pressure to the appropriate side of each ram piston. Oil from the opposite side is exhausted through the spool valve back to the pump reservoir. A filter element is located within the reservoir.

When the wheels have pivoted sufficiently around the axle spindle housings and effort is removed from the steering wheel, a return spring within the spool valve unit, returns the spool to the neutral position.

A by-pass valve is incorporated in the spool valve unit to allow the tractor to be steered with the engine stopped. The by-pass valve permits desplaced oil to flow from the exhaust side of the ram piston back to the pump reservoir.

## STEERING BOX

**Removal and Refitment** 6C-01-02

Special Tools Required: MF 268 Steering Wheel Remover
P1007C Steering Drop Arm Remover

**Removal**

1. Fig. 3. Remove the nut and washer securing the steering wheel and pull off the wheel using the special tool MF 268 as shown. Remove the key.
2. Remove the instrument panel as stated in Part 8B.
3. Fig. 5. Remove the nuts (14) and washers securing the drop arms (15) to the rocker shafts, then using the puller P1007C remove each drop arm and felt-seal (16) from the rocker shafts.
4. Remove the bolt and washer securing the fuel cut-off rod mounting bracket to the steering box.
5. Remove one bolt and washer each side securing the steering box to the battery carrier.
6. Disconnect the power steering pipes from the control valve on the steering column (Power Steering Tractors only).
7. Remove the bolt and washer securing the rear light wiring clip to the steering column (if fitted).
8. Remove the eight bolts and washers securing the steering box to the transmission housing.
9. Fig. 4. Lift and manoeuvre the steering box complete with gear levers clear of the tractor and place on a suitable surface taking care not to damage the gear selector levers.
10. Remove the gasket from the transmission housing.

**Refitment**

1. Ensuring that all the gears and levers are in the neutral position, place the steering box with a new gasket onto the transmission housing and secure with the eight bolts and washers.

   NOTE – DO NOT FORGET TO REFIT THE WIRING CLIP (IF FITTED) TO THE BOLT ADJACENT TO THE HIGH/LOW GEAR LEVER.

2. Reconnect the power steering pipes to the control valve on the steering column (Power Steering Tractors only).
3. Refit the bolt, washer and wiring clip to the steering column (if fitted).
4. Refit the bolt and washer securing the Multi-Power pivot (if fitted) and the steering box to the battery carrier and the bolt and washer securing the oil pressure gauge pipe clip and the steering box to the other side of the battery carrier.
5. Refit the bolt and washer securing the fuel cut-off rod mounting bracket to the steering column.
6. Fig. 5. Fit a new felt washer (16) to each rocker shaft, then refit the drop arms (15) aligning the master splines, and secure the drop arms with the two nuts (14) and washers tightened to a torque of 34,5 kg-m (250 lb-ft).
7. Refit the instrument panel as stated in Part 8B.
8. Refit the steering wheel with a new key and secure the wheel with the nut and washer tightened to a torque of 4,8 kg-m (35 lb-ft)
9. Refill the power steering reservoir (if fitted) as stated in operation 6C-08-10.

**Servicing** 6C-02-02

Special Tools Required: MF 268 Steering Wheel Remover
P1007C Steering Drop Arm Remover
MF 263 Bush Remover
MF 263-1 Adapter
550 Handle
MF 19A Bush Reamer
7066 Circlip Pliers (Power Steering Tractors only).

**Disassembly**

1. Remove the steering box as stated in operation 6C-01-02.

*Power Steering Tractors only*

2a. Fig. 16. Remove the hairpin (64) and washer (65) securing the valve linkage (67) and release the linkage from the pin (66).

2b. Remove the three bolts and washers securing the control valve to the steering column and remove the valve.

2c. Remove the two 'O' rings from the steering column valve face.

2d. Fig. 5. Remove the screw (36) and washer securing the retainer (35) to the outer ball race (39) and slide the retainer and the felt seal (37) on to the tube (10).

2e. Using the circlip pliers 7066 remove the circlip (38) from the outer ball race (39).

3. Fig. 5. Remove the plug (12) and drain off the oil.

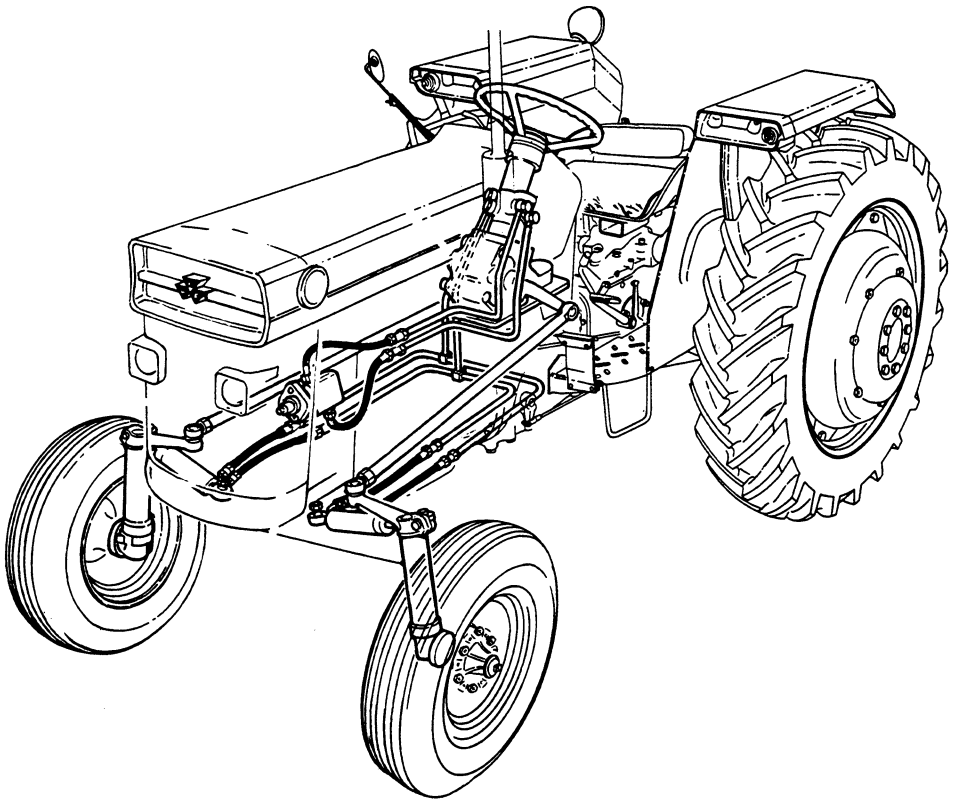


FIG. 1

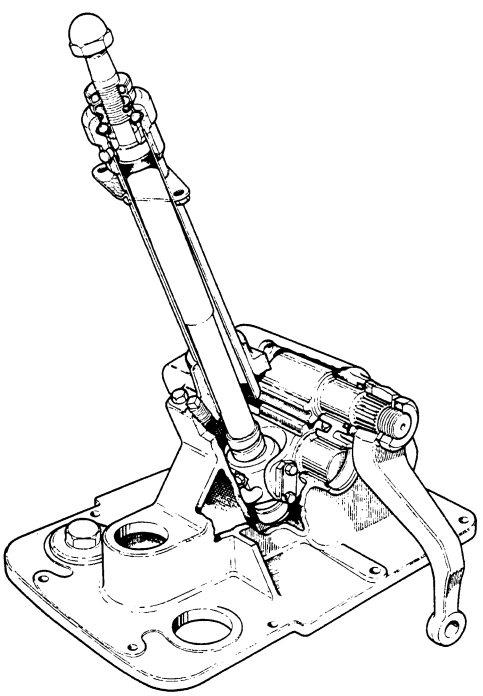


FIG. 2

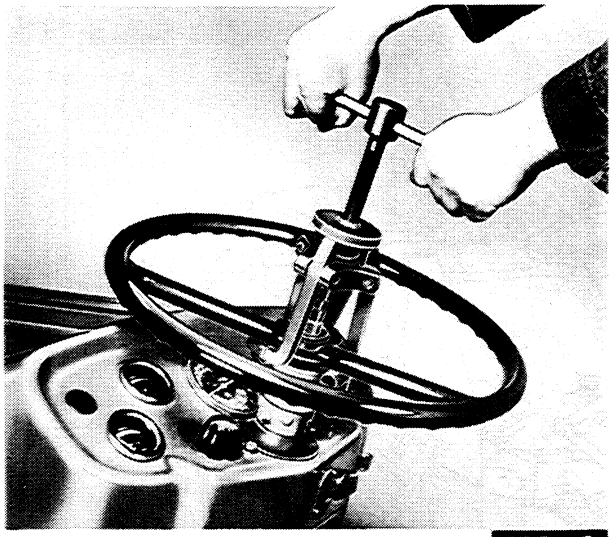


FIG. 3

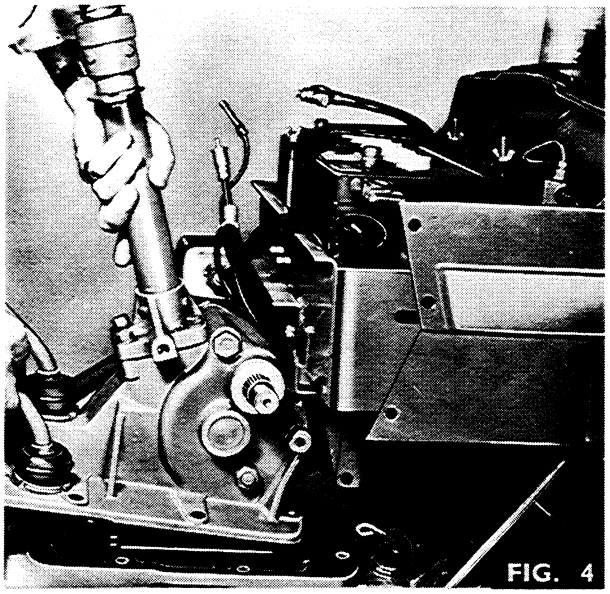


FIG. 4

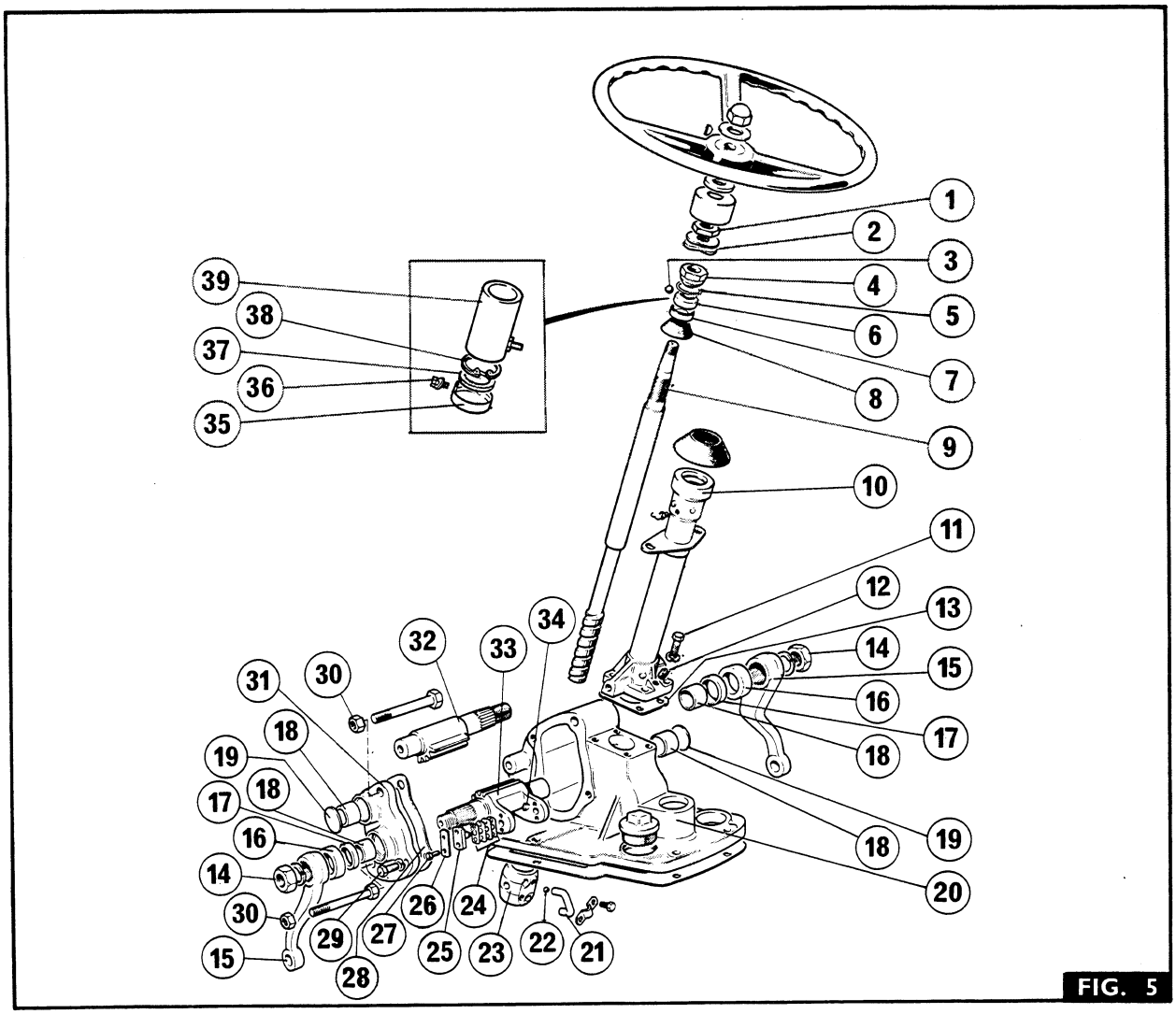



FIG. 5

4. Remove the two bolts (29) and washers and the two nuts (30) securing the cover plate (31) and remove the cover plate with its gasket (28).
5. Remove the secondary rocker shaft (32) from the steering box.
6. Release the tabwasher (26) locking the ball peg securing bolts (27), then remove the bolts, tabwasher, ball peg (25) and shims (24).
7. Remove the four bolts (11) and washers securing the steering column tube (10) to the steering box (20), then remove the tube, gasket (13) and the steering column (9) complete with main nut (23) and steel balls (22).
8. Remove the primary rocker shaft (33) and the steel ball (34) from the steering box (20).
9. Unscrew the main nut (23) off the column and collect 28 steel balls (22).
10. Release the tabwasher (2), then remove the locknut (1), tabwasher, adjustable race (4) and seal (5) from the column (9).

*Manual Steering Tractors only*

11a. Withdraw the column (9) out of the tube (10), then remove the ball race (6), ball ring (7) and seal (8) from the column.
11b. Remove the 12 steel balls (3) from the tube (10).

*Power Steering Tractors only*

12a. Carefully lift the outer ball race (39) off the tube (10) and collect the 12 steel balls (3).
12b. Withdraw the column (9) out of the tube (10), then remove the ball race (6), ball ring (7) and seal (8) from the column.
12c. Remove the circlip (38), felt seal (37) and the retainer (35) from the tube (10).

13. Remove the two dished washers (19) and the two oil seals (17) from the steering box and the cover plate.
14. Fig. 6. Using special tool MF 263 and adapter MF 263-1, as shown, cut a thread into a bush (18) by turning the outer handle, then pull out the bush by rotating the inner handle.
15. Repeat operation 14 for the retaining three bushes.

**Examination**

Check the condition of all components for wear or damage and replace any parts which are unfit for further service. Thoroughly clean all components of the steering box, removing any pieces of old gasket from the joint faces of the steering box and cover plate.

**Reassembly**

1. Fig. 7. Position a bush (18) squarely over its hole and drive in the bush using the adapter MF 263-1 and the 550 handle, as shown.
2. Repeat operation 1 for the remaining three bushes.
3. Secure the cover plate (31) to the steering box and ream through each pair of bushes using the reamer MF 19A.
4. Remove the cover plate and thoroughly clean out all the swarf from the steering box (20).
5. Fig. 5. Fit a new seal (8), ball ring (7) and ball race (6) onto the column (9).

*Manual Steering Tractors only*

6. Position the 12 balls (3) in the tube (10), using grease to retain them, then lower the tube onto the column, taking care not to dislodge any of the balls.

*Power Steering Tractors only*

7a. Place on the tube (10) the retainer (35), a new felt seal (37) and a new circlip (38).
7b. Lower the tube (10) onto the column, then position the 12 balls (3) in the outer ball race (39), using grease to retain them, and slide the outer ball race over the column, taking care not to dislodge any of the balls and locate the ball race on the tube.

8. Fit a new seal (5) to the adjustable race (4) then fit the adjustable race to the column. Tighten the adjustable race to 1,4 kg-m (10 lb-ft), then slacken off one flat to bring a flat adjacent to the tabwasher keyway.

NOTE – ACCURATE ADJUSTMENT OF THE ADJUSTABLE RACE IS ESSENTIAL. IF THE ADJUSTMENT IS INCORRECT, THE SHAFT MAY BE PREVENTED FROM OSCILLATING, RESULTING IN BENDING STRESSES AND FAILURE OCCURING, WITH DANGEROUS CONSEQUENSES.

9. Fit a new tabwasher (2) and the locknut (1) and secure the adjustable race (4) and the locknut with the tabwasher.
10. Place the main nut (23) onto the column and assemble the 28 balls (22) into the main nut channel. Turn the main nut to house the balls as they are assembled.
11. Fit new oil seals (17) and dished washers (19) to the steering box (20) and cover plate (31).
12. Slide the primary rocker shaft (33) into its bore in the steering box (20), then refit the ball (34) to the shaft, using grease to retain it.
13. Screw the main nut (23) to the top of its thread on the column, then locate a new gasket (13) onto the steering box (20) and enter the column assembly into the box, still retaining the main nut at the top of its thread.
14. As the column is lowered into the box, turn the primary rocker shaft (33) until the ball (34) locates in its seating in the main nut (23).

NOTE – THE BALL TRANSFER TUBE (21) ON THE MAIN NUT MUST BE FACING AWAY FROM THE ROCKER SHAFT (33).

Hold the assembly in this position and secure the tube (10) to the steering box (20) with the four bolts (11) and washers.

15. Refit the ball peg (25) and more shims (24) then will be necessary and temporarily secure them with the two bolts (27).
16. Turn the column until the main nut is half way along its thread on the column, then remove shims until there is no end float with the main nut rotating freely. When correctly adjusted, secure the ball peg (25) and shims (24) with the two bolts (27) and tabwasher (26).
17. Taking care not to damage the oil seal (17), refit the secondary rocker shaft (32) so that the two centre teeth of each rocker shaft are in mesh.
18. Refit the cover plate (31) with a new gasket (28) taking care not to damage the oil seal (17) and secure the cover plate with the two bolts (29) and washers and the two nuts (30).
19. Fill the steering box with recommended oil to the plug level and refit the plug (12).

*Power Steering Tractors only*

20a. Refit the circlip (38) to the outer ball race (39) using the 7066 circlip pliers.

20b. Fit the new felt seal (37) against the circlip (38) and secure the retainers (35) to the outer ball race (39) with the screw (36) and washer.

20c. Fit two new 'O' rings to the steering column valve face and refit the valve, securing it to the steering column with the three bolts and washers.

20d. Fig. 16. Refit the linkage (67) to the pin (66) and secure it with the washer (65) and hairpin (64).

21. Refit the steering box as stated in operation 6C-01-01 and adjust the control valve as stated in operation 6C-11-13.

**Steering Box Gasket Removal and Replacement** 6C-03-06

Special Tools Required: P1007C Steering Drop Arm Remover

**Removal**

1. Remove the bolt securing the oil pressure pipe clip and the L.H. side of the battery carrier to the steering box.
2. Fig. 5. Remove the nut (14) and washer securing the L.H. drop arm (15) to its rocker shaft (33), then using the puller P1007C remove the drop arm, and the felt seal (16).
3. Remove the bolt and washer securing the fuel cut-off rod mounting bracket to the steering box.
4. Remove the lower instrument panel and disconnect the two power steering pipes from the valve (Power Steering Tractors only).
5. Place a suitable container beneath the cover plate (31) and remove the two bolts (29) and washers and the two nuts (30) securing the cover plate to the steering box.
6. Remove the cover plate and the gasket (28) from the steering box, taking care not to damage the oil seal (17).

Examine the joint faces on the steering box and the cover plate for damage and distortion. Clean both faces, removing any pieces of old gasket. Always fit a new gasket.

**Replacement**

1. Fit a new gasket (28) to the steering box, and taking care not to damage the oil seal (17) refit the cover plate to the steering box and secure it with the two nuts (30) and the two bolts (29) and washers.
2. Fit a new felt seal (16) to the rocker shaft (33), then refit the drop arm (15) aligning the master splines, and secure with the nut (14) and washer tightened to a torque of 34,5 kg-m (250 lb-ft)
3. Reconnect the two power steering pipes to the valve and refit the lower instrument panel. (Power Steering Tractors only).
4. Refit the bolt and washer securing the fuel cut-off rod mounting bracket to the steering box.
5. Refit the bolt securing the oil pressure pipe clip and the L.H. side of the battery carrier to the steering box.
6. Remove the filler plug (12) and refill the steering box with recommended oil to the plug level and refit the plug (12).
7. Refill the power steering reservoir (if fitted) as stated in operation 6C-08-10

## DRAG LINK

**Removal and Refitment** 6C-04-06

**Removal**

1. Remove the nuts securing the drag link balls ends to the drop arm and the spindle arm.
2. Release the ball ends by hitting the side of the spindle arm or drop arm smartly whilst supporting the other side of the spindle arm or drop arm with a block of metal.
3. Fig. 8. If necessary slacken the bolt (42) and locknut (43) securing the front ball end (41) and withdraw the ball end.

   NOTE – DO NOT SLACKEN THE PINCH BOLT (44) OR UNSCREW THE BALL END (40) UNLESS THE BALL END IS TO BE REPLACED.

   Check the ball ends (40 and 41) for wear, replacing any defective components and fitting new rubber boots and garter springs.

**Refitment**

1. If necessary, refit the front ball end (41) into the drag link and secure with the bolt (42) and locknut (43). Ensure that the bolt is located in the seating groove in the ball end.
2. If necessary, screw the ball end (40) into the drag link. Screw the end in or out until the length of the drag link (at 1320 mm (52 in) track setting) is 1052,6 mm (41,44 in) from the centres of the ball ends. Retighten the pinch bolt (44) to a torque of 4,8 kg-m (35 lb-ft).

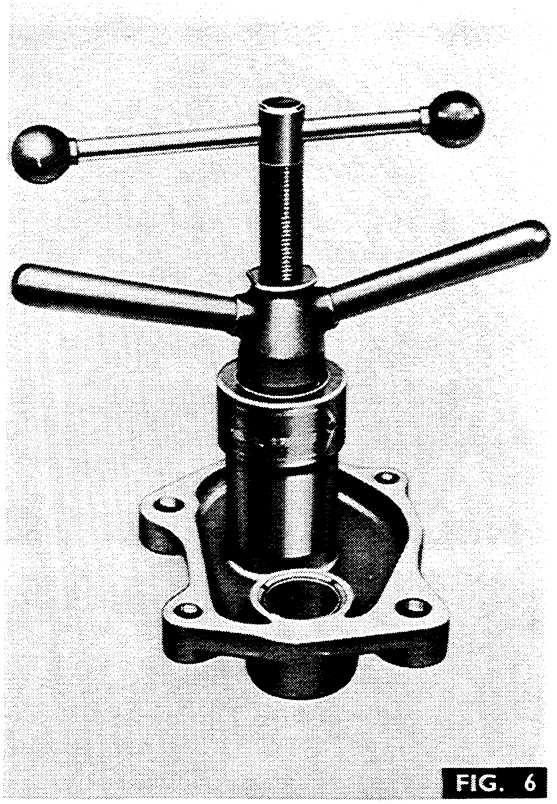


FIG. 6

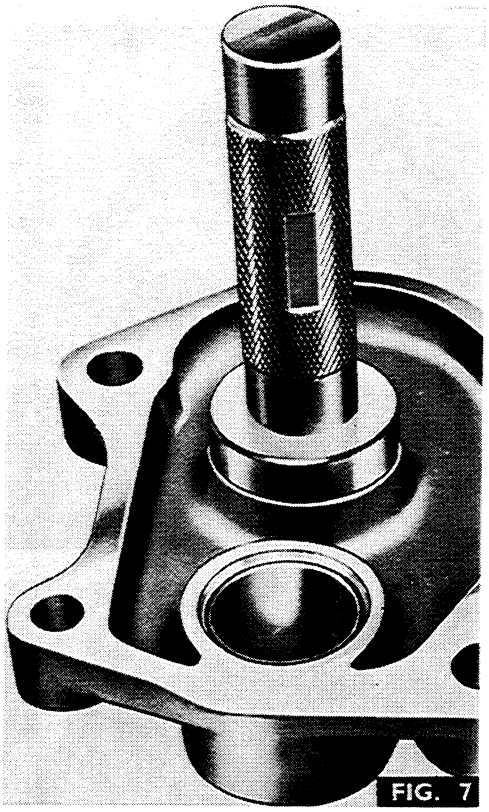


FIG. 7

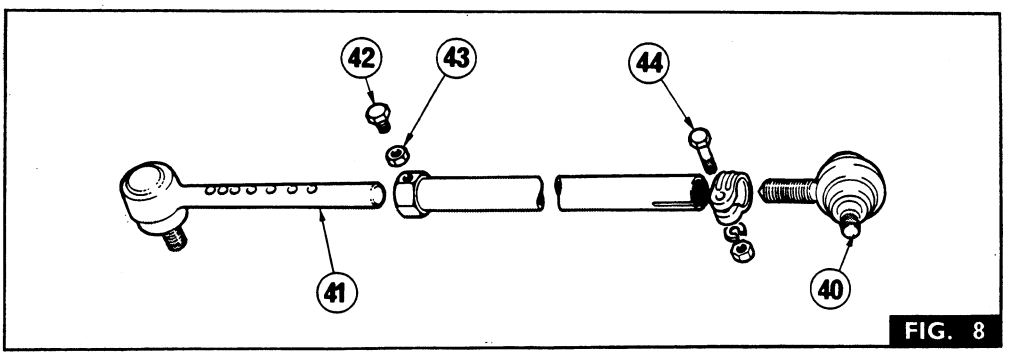



FIG. 8

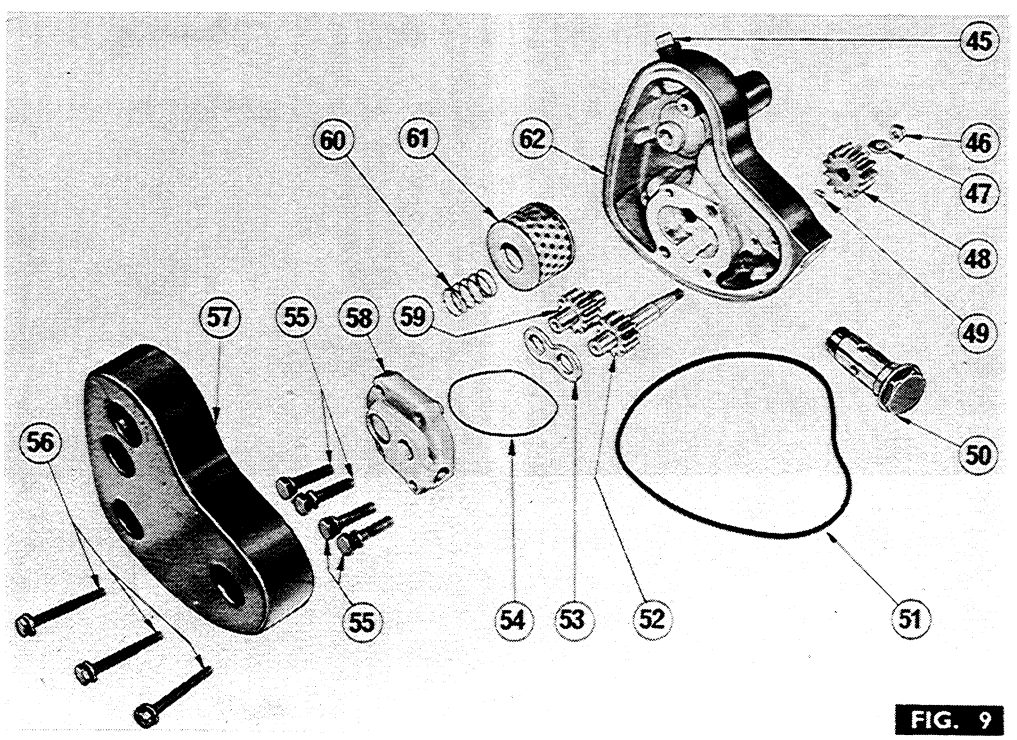



FIG. 9

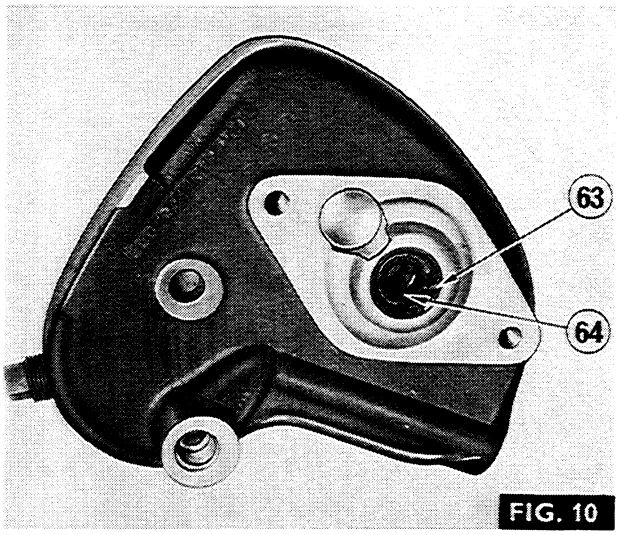


FIG. 10

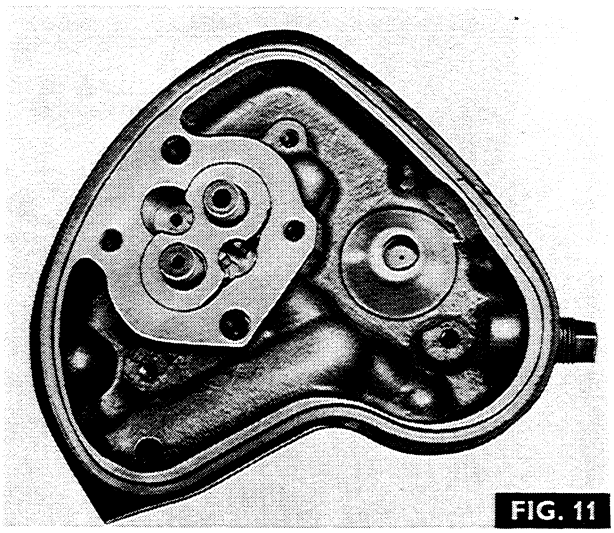


FIG. 11

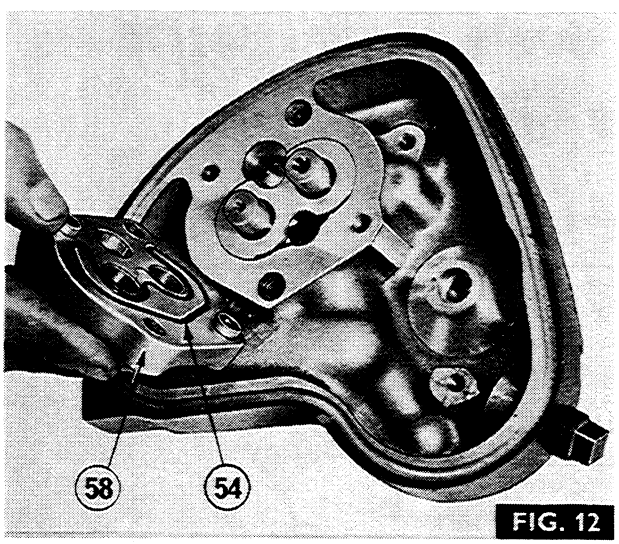


FIG. 12

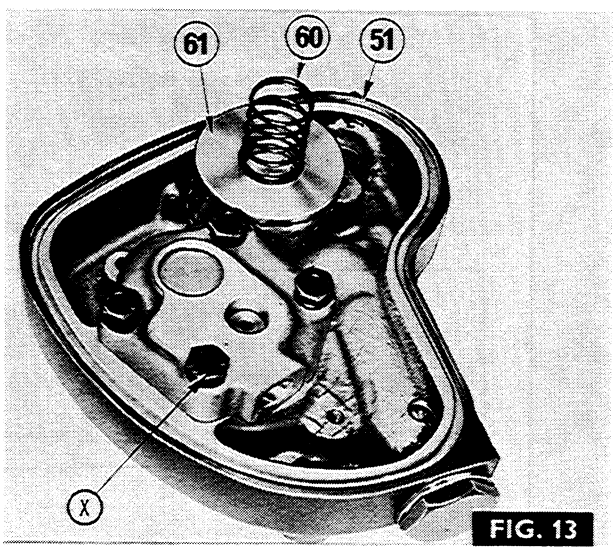


FIG. 13

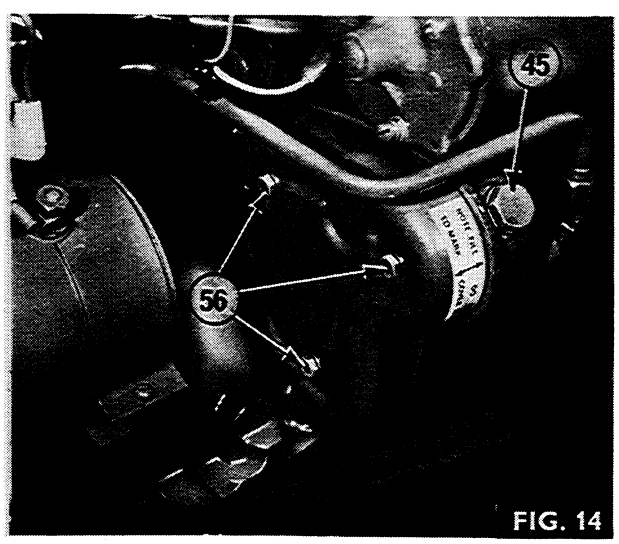


FIG. 14

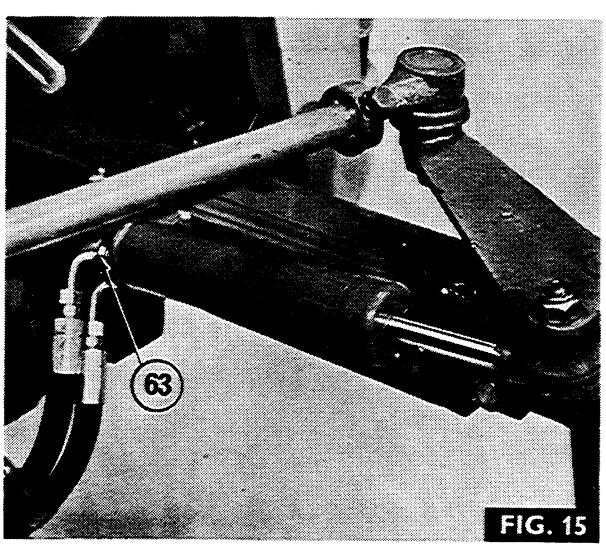


FIG. 15

NOTE – BEFORE RETIGHTENING THE BOLT (44) ENSURE THAT THE BOLT RUNS DIRECTLY ACROSS THE SLOT IN THE DRAG LINK.

3. Refit the drag link to the spindle arm and the drop arm and secure with the two nuts tightened to a torque of 12,5 kg-m (90 lb-ft).
4. Check the front wheel toe-in as stated in Part 6A.

## POWER STEERING PUMP

**Removal and Refitment** 6C-05-09

**Removal**

1. Disconnect the two pipes from the power steering pump.
2. Remove the two bolts and washers securing the pump to the engine timing case and remove the pump.

**Refitment**

1. Position the pump in place on the timing cover and secure it with the two bolts and washers.
2. Reconnect the two pipes and refill the reservoir as stated in operation 6C-08-10

**Servicing** 6C-06-09

Special Tools Required: 7066 Circlip Pliers

**Disassembly**

1. Remove the pump as stated in operation 6C-05-09.
2. Fig. 9. Remove the reservoir filler plug (45) and drain the pump of oil.
3. Release the tabwasher (47) and remove the nut (46) and tabwasher securing the gear to the spindle.
4. Remove the gear (48) and the key (49) from the spindle.
5. Remove the three bolts (56) and washers securing the reservoir cover (57) to the pump body (62), then remove the cover, together with the filter element (61) and the spring (60).
6. Remove the four bolts (55) and washers securing the gear cover (58) to the pump body, then remove the cover and the sealing ring (54).
7. Remove the pressure plate (53) and withdraw the drive gear (52) and the driven gear (59) from the pump body.
8. Remove the reservoir sealing ring (51) from the pump body.
9. Fig. 10. Using the circlip pliers 7066 remove the circlip (63) and then the seal (64) from the front of the pump body.
10. Fig. 9. If necessary, remove the relief valve (50) and washer.

**Examination**

Examine all parts for wear, scoring or damage and replace any defective components. Always fit new 'O' rings and seals.

**Reassembly**

1. If necessary, fit the relief valve (50) with a new washer and tighten it to a torque of 5,5 kg-m (40 lb-ft).
2. Fig. 10. Fit a new seal (64) into position in the pump body and secure it with a new circlip (63) using the circlip pliers 7066. Pack the cavity between the seal and the pump body with petroleum jelly.
3. Fig. 9. Fit the drive gear (52) into the pump body taking care not to damage the seal.
4. Fit a new key (49) and the gear (48) to the spindle (52) and secure the gear with a new tabwasher (47) and nut (46).
5. Fit the driven gear (59), with the shorter spindle in the bush in the pump body.
6. Fig. 11. Fit the pressure plate (53) on top of the gears, with the oil recesses against the gears and the relieved radii to the outlet side of the pump, as shown.
7. Fig. 12. Fit a new sealing ring (54) to the gear cover (58) and place the cover into position. Secure the cover with the four bolts (55, Fig. 9) and washers tightened to a torque of 2,0 kg-m (15 lb-ft).

   NOTE – THE LONGER BOLT IS FITTED AT "X" AS SHOWN IN FIG. 13.

8. Fig. 13. Lightly coat the outside edge of a new sealing ring (51) with petroleum jelly, then fit the ring into the recess around the outer edge of the pump body.
9. Fit a new filter element (61) with the oil inlet over the boss in the inlet port in the pump body.
10. Locate the filter element spring (60) in the recess on top of the element.
11. Fig. 9. Fit the reservoir cover (57), then, compressing the spring (60) tighten the securing bolts (56) and washers until the cover is maintained in contact with the sealing ring, then tighten the bolts a further complete turn.
12. Refit the pump to the timing cover as stated in operation 6C-05-09

**Filter Removal and Replacement** 6C-07-09

**Removal**

1. Fig. 14. Place a suitable container beneath the pump body and remove the three bolts (56) and washers securing the reservoir cover to the pump body.
2. Remove the reservoir cover complete with the filter element and spring.
3. Remove the sealing ring from the pump body.

**Replacement**

1. Fig. 13. Lightly coat the outside edge of a new sealing ring (51) with petroleum jelly, then fit the ring into the recess around the outer edge of the pump body.
2. Fit the new filter element (61) with the oil inlet over the boss on the inlet port in the pump body.
3. Locate the filter element spring (60) in the recess on top of the element.
4. Fig. 14. Fit the reservoir cover, then, compressing the spring tighten the securing bolts (56)and washers until the cover is maintained in contact with the sealing ring, then tighten the bolts a further complete turn.
5. Refill the reservoir as stated in operation 6C-08-10

**Filling the Reservoir** 6C-08-10

**Procedure is as follows**

1. Fig. 14. Remove the filter plug (45) and fill the reservoir with a recommended fluid.
2. With the engine STOP control fully out, operate the engine starter motor to actuate the pump. Fluid will be pumped to the control valve, emptying the reservoir.
3. Immediately, refill the reservoir to avoid damage to the pump.
4. Fig. 15. Refit the filler plug, then loosen the steel pipe (63) connected to a steering ram hose.
5. Start the engine and run at idling speed. Turn the steering wheel from lock to lock several times to expel air from the system.
6. Remove the filler plug and when fluid can be seen through the filler hole, to be returning to the reservoir free of air bubbles, retighten the steel pipe (63).
7. Stop the engine, top up the reservoir and refit the filler plug.

NOTE – NEVER RUN THE ENGINE UNLESS THERE IS SUFFICIENT FLUID IN THE PUMP RESERVOIR.

## CONTROL VALVE

**Removal and Refitment** 6C-09-10

**Removal**

1. Remove the lower instrument panel and the battery access panel.
2. Disconnect the feed and return pipes from the control valve.
3. Fig. 16. Remove the split pins (70) securing the valve pin (71) and remove the pin.
4. Remove the three bolts and washers securing the control valve to the steering column and remove the valve.
5. Remove the two 'O' rings from the steering column valve face.

**Refitment**

1. Fit two new 'O' rings to the steering column valve face, then refit the valve to the steering column and secure it with the three bolts and washers.
2. Reconnect the feed and return pipes to the valve.
3. Adjust the linkage as stated in items 3 to 8 of operation 6C-11-13

**Servicing** 6C-10-10

Special Tools Required: 7066 Circlip Pliers

**Disassembly**

1. Remove the control valve as stated in operation 6C-09-10.
2. Throroughly clean the valve housing.
3. Fig. 17. Using the 7066 Circlip Pliers remove the circlip (91) at the end of the valve, then remove the two washers (89) and the felt seal (90).
4. Remove the two bolts (73) and washers securing the end cover (74) and withdraw the spool complete with yoke, end cover, springs, washers and seals.
5. Detach the yoke (72) from the spool, then remove the end cover (74), reaction ring (76), springs (78 and 79) and washer (80) from the spool.
6. Remove the 'O' rings (75 and 77) from the reaction ring (76).
7. Remove the 'O' ring (88) from the valve body (87).
8. Invert the valve body and tap out the plug (83), ball (85) and spring (86).
9. Remove the 'O' rings (82 and 84) from the plug (83).
10. If necessary, remove the relief valve plug (95), washer (94), ball (92) and spring (93).

**Examination**

Thoroughly clean all components and check for wear or damage, replace any parts which are defective. Always fit new 'O' rings and seals.

NOTE – IF THE SPOOL OR BODY IS DAMAGED, BOTH PARTS MUST BE REPLACED AS THEY ARE ONLY SUPPLIED IN MATCHED SETS.

**Reassembly**

1. If necessary, refit the ball (92), spring (93), washer (94) and the relief valve plug (95).
2. Fit a new 'O' ring (88) to the valve body (87).
3. Fit new 'O' rings (82 and 84) to the plug (83), then fit the spring (86), ball (85) and plug (83) to the valve.
4. Fit new 'O' rings (75 and 77) to the reaction ring (76), then fit the washer (80), two springs (78 and 79), reaction ring (76) and the end cover (74) to the spool (81) and secure with the yoke (72).
5. Lubricate the spool and body with clean hydraulic fluid and slide the spool into the valve and secure the end cover (74) with the two bolts (73) and washers.
6. Fit a new felt seal (90) and the two washers (89) to the valve body and secure with a new circlip (91) using the circlip pliers 7066.
7. Refit the valve to the steering column as stated in operation 6C-09-10

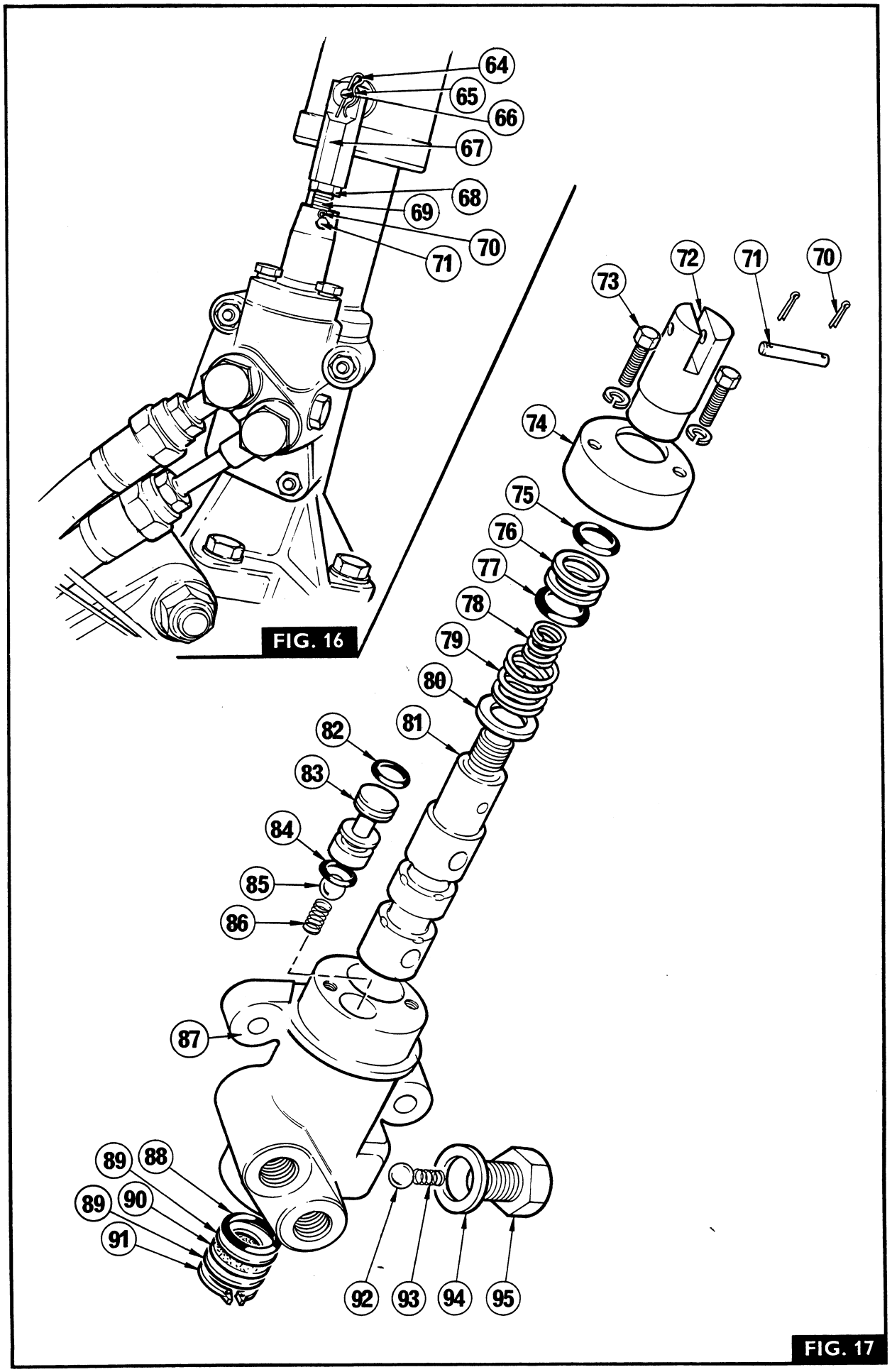

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FIG. 16

FIG. 17

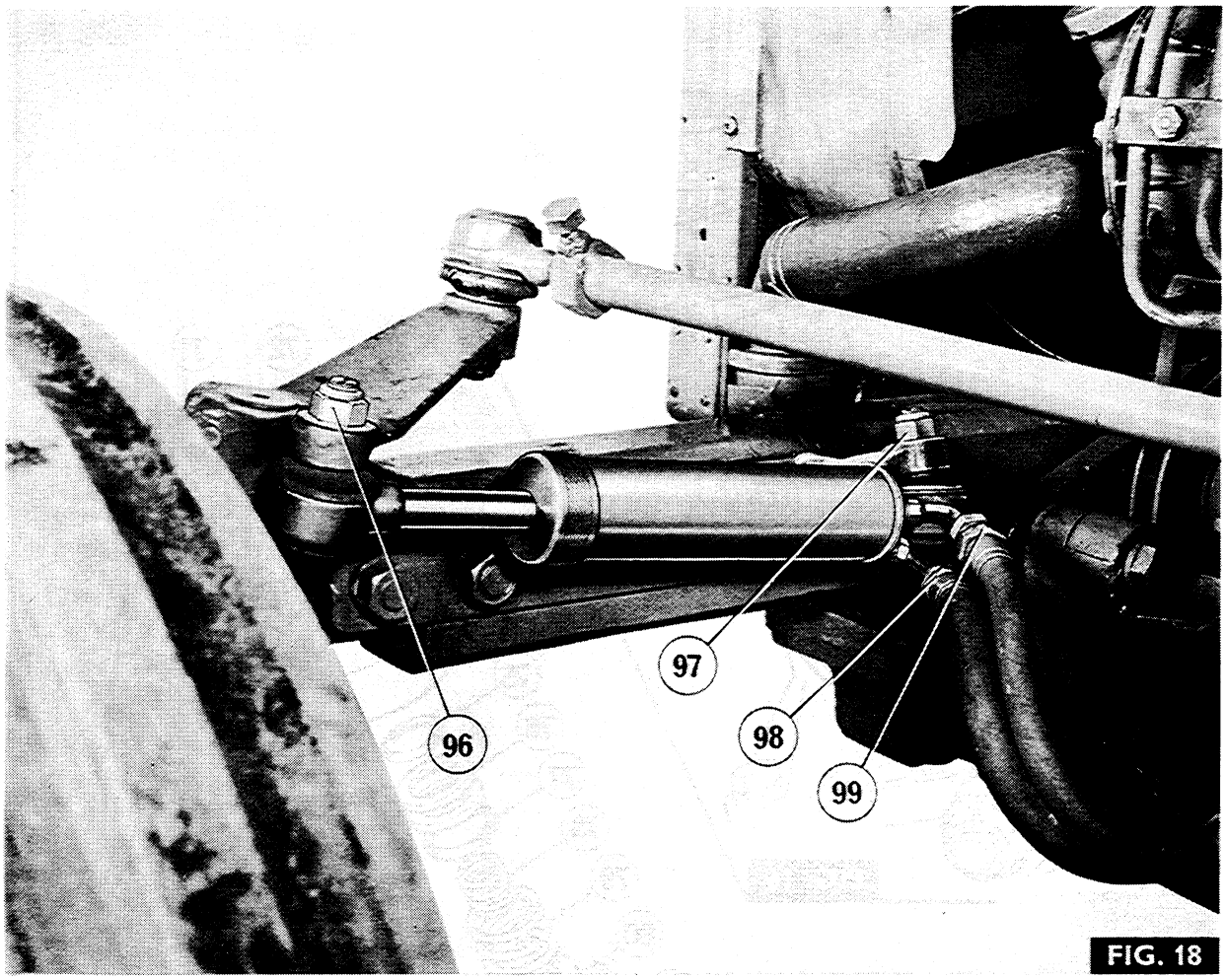



FIG. 18

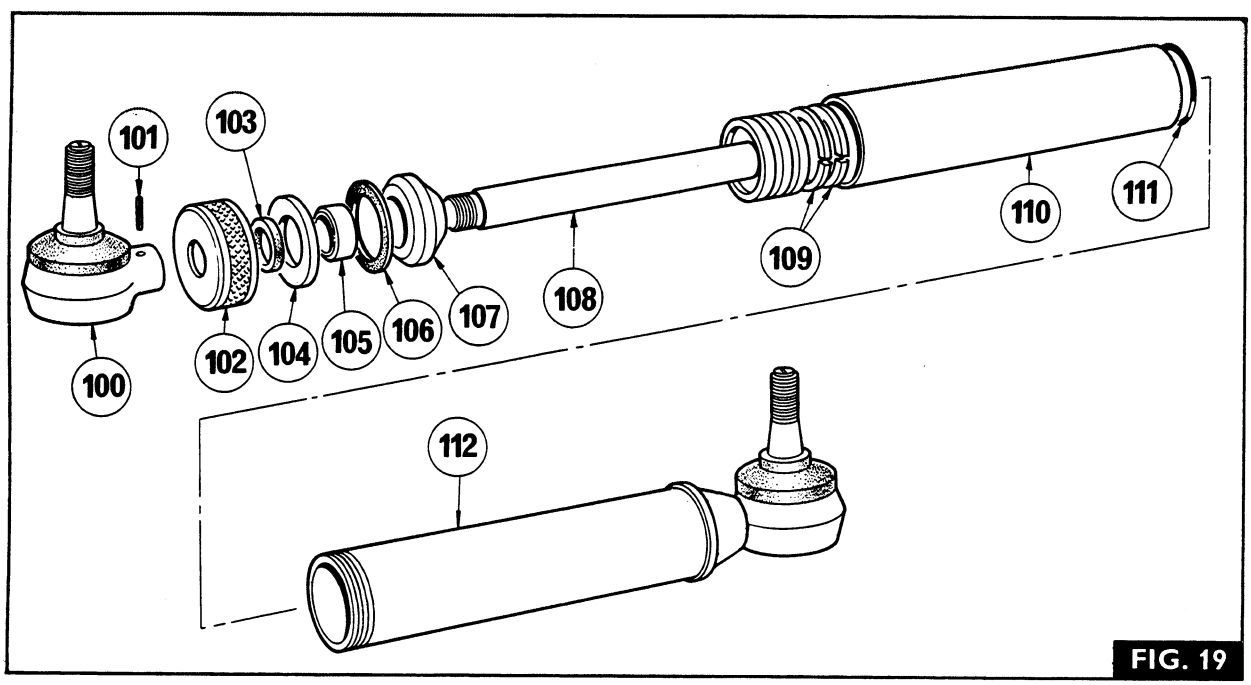



FIG. 19

**Adjustment** 6C-11-13

1. Remove the battery access panel and the lower instrument panel.
2. Fig. 16. Remove the split pins (70) securing the valve pin (71) and remove the pin.
3. Set the wheels in the straight ahead position.
4. Turn the steering wheel to the right until all free travel is taken up.
5. With the steering wheel in this position, adjust the linkage to enable the valve pin (71) to be fitted. The control valve yoke may be turned to facilitate fitment.
6. Remove the valve pin (71), then increase the length of the linkage 1,4 mm (0.055 in) by screwing out the link end (69) one complete turn, then secure with the locknut (68).
7. Turn the steering wheel to the left until the valve pin (71) can be refitted. Secure the pin with two new split pins (70).

   NOTE – DO NOT CHANGE THE POSITION OF THE CONTROL VALVE YOKE WHEN REFITTING THE LINKAGE.

8. Refit the battery access panel and the lower instrument panel.

## STEERING RAM

**Removal and Refitment** 6C-12-13

**Removal**

1. Fig. 18. Disconnect the two hoses (98 and 99) from the ram assembly.
2. Remove the nut (96) securing the ram piston to the spindle arm and the other nut (97) securing the ram cylinder to the bracket.
3. Release the two ball ends and remove the ram assembly.

**Refitment**

1. Refit the ram assembly, as shown, and secure it with the two nuts (96 and 97).
2. Reconnect the two hoses (98 and 99) to the ram cylinder and refill the reservoir as stated in operation 6C-08-10

**Servicing** 6C-13-13

**Disassembly**

1. Remove the steering ram as stated in operation 6C-12-13.
2. Thoroughly clean the outside of the steering ram.
3. Fig. 19. Unscrew the gland nut (102) and withdraw the piston assembly (108) together with the inner tube (110) from the cylinder assembly (112).
4. Remove the copper washer (111) from the cylinder assembly (112).
5. Withdraw the piston assembly (108) from the inner tube (110).
6. Remove the roll pin (101) and unscrew the ball end (100) from the piston assembly (108).
7. Remove the gland nut (102), seal (103), washer (104), 'O' ring (106), seal (105) and rod guide (107) from the piston (108).
8. If necessary, remove the piston rings (109) from the piston.

**Examination**

Examine all components for signs of wear, scoring or damage and replace any defective parts. When reassembling always fit new seals, 'O' rings and a new roll pin.

**Reassembly**

1. If necessary, fit new piston rings (109) to the piston.
2. Fit the rod guide (107), a new seal (105), 'O' ring (106) washer (104), seal (103), and the gland nut (102) to the piston assembly.
3. Screw the ball end (100) on to the piston assembly (108) and secure with a new roll pin (101).
4. Slide the piston assembly into the inner tube (110).
5. Place a new copper washer (111) in the cylinder assembly, then slide the inner tube and piston assembly into the cylinder assembly and secure with the gland nut (102).
6. Refit the steering ram as stated in operation 6C-12-13

# HYDRAULIC SYSTEM

## Part 7 Section A

## GENERAL

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

A connecting rod (4), from the cylinder piston engages the ram arm (5) on the lift shaft, which projects from the lift cover. Lift arms (6) are splined to each end of the lift shaft.

When oil, under pressure from the pump, is delivered to the closed end of the cylinder, the piston inside the cylinder is forced rearwards and pushes the ram arm upwards, causing the lift shaft to rotate and raise the lift arms.

Conversely, when the oil is allowed to drain back from the system, the piston moves back along its cylinder under the load of the lift arms.

### Hydraulic Pump

The pump is driven by the front p.t.o. drive shaft. Dowel pins, fitted through each side of the centre housing, prevent the pump from rotating.

Fig. 2. The pump consists of two piston yokes which ride on cam blocks over eccentrics on a camshaft. The pistons, two on each yoke, reciprocate in two opposed valve chambers, each chamber housing two inlet and outlet valves, and springs. A sealing plug and snap ring close the valve bores in the valve chambers. Front and rear castings incorporate the oil galleries connecting the two valve chambers, and house the control valve at the rear, and support the oscillator body and oil strainer.

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

### Control Valve

Fig. 3 The control valve slides inside the lower part of the pump rear casting on three hardened steel washers, which are separated by spacing sleeves, dividing the bore inside the casting into two compartments.

These two compartments provide inlet and outlet chambers for the pump which are opened and closed by the inlet and outlet slots at opposite ends of the control valve. The suction side of the pump or intake passage connects with the rear or outer compartment, and similarly the inner compartment lies at the bottom of the high pressure side of the system. The outer ends of the high pressure chamber are sealed by 'O' rings and the assembly is held in place by a cover plate bolted to the rear casting.

### Intake Position

When the valve slides forward, its inlet slots pass within the suction chamber so that the constant running pump may draw on the oil supply and deliver it to the lift cylinder to raise the lower links. In this position the valve keeps the discharge chamber closed so that oil cannot escape back to the sump.

### Neutral Position

With the valve positioned centrally, both the inlet and outlet slots are outside their respective chambers, the oil is therefore locked in the system and the lift piston and lower links remain stationary.

### Discharge Position

When the valve slides rearwards, the suction chamber remains closed, but the outlet slots are brought within the discharge chamber, permitting oil to drain into the sump from the lift cylinder, and the lower links fall.

The rate at which the oil drains away is, of course, proportional to the area of the slot within the chamber, which is dependant on the amount the valve is withdrawn.

## OPERATION

### Draft Control – Implement Lowering (Fig. 4)

The position control lever must be in the transport position when operating the draft control.

To lower the implement, move the draft control lever downwards through the quadrant. This action presses the eccentric roller. (7), on the end of the draft control lever shaft, down onto the upper cam face of the draft control cam (8), causing the lower face of cam (8) to be forced downwards into contact with roller (9) on the draft control linkage. Cam (8) is then moved rearwards causing the vertical lever (10) to pivot about its fulcrum and move the pump control valve lever (11) into the discharge position against the influence of the pump control valve spring. The draft control linkage will move because the force from the pump control valve is less than the breakout spring force from (12).

### Draft Control – Compression Force in Top Link (Fig. 5)

When the vertical lever (10) has moved the control valve to full discharge, the lever (10) will also have forced the dashpot piston to the end of its stroke. Therefore, with further downward movement of the draft control lever, the eccentric roller (7) acting on the upper cam face of the draft control cam (8), forces the lower cam face of the draft control cam (8) to move roller (9) forwards. Forward movement of the roller (9) leaves a gap between the draft control rod (15) and the draft control spring plunger (14), and simultaneously compresses the spring on the guide rod (12).

Forward movement of the tractor will cause an implement to gain depth (as the control valve is in the discharge position), until the resultant implement draft reaction compression forces applied through the top link deflect the control spring and cause the draft control spring plunger (14) to contact the draft control rod (15), and move the draft control linkage forwards. This permits the draft control cam (8) to move forward, acting under the influence of the pump control valve spring and limited by the position of roller (9), until the control valve reaches the neutral position.

### Draft Control – Tension Force in Top Link (Fig. 6)

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

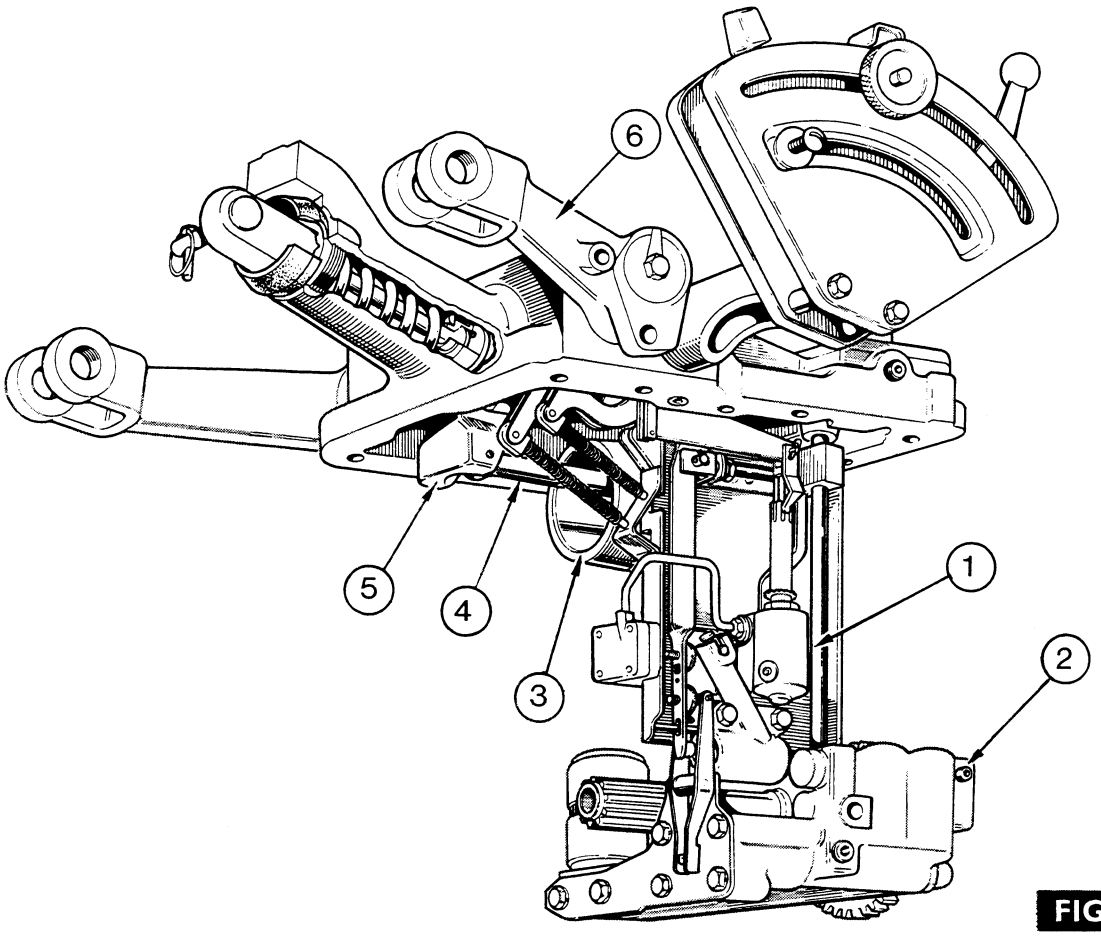



FIG. 1

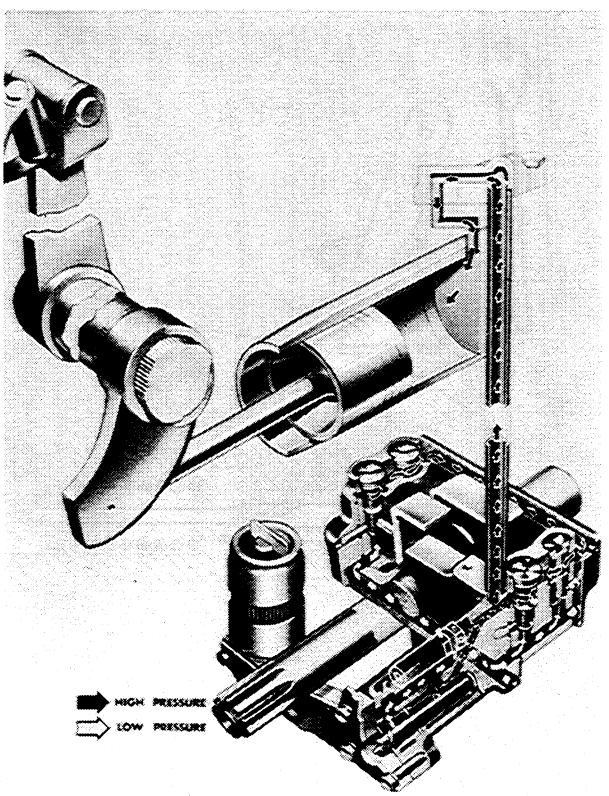
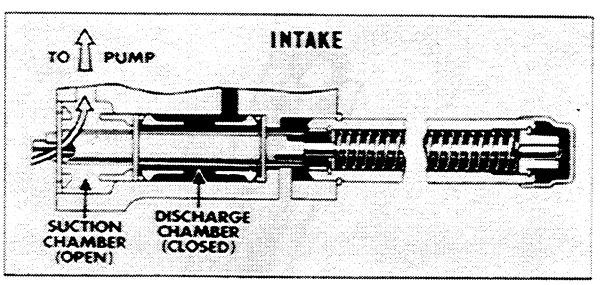
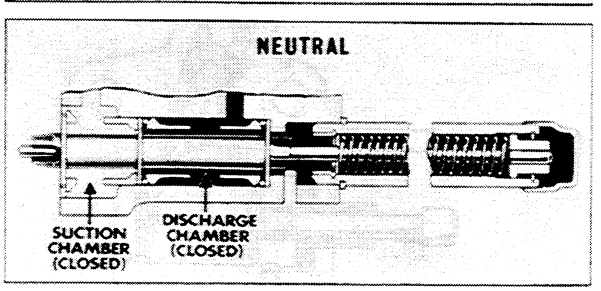



FIG. 2



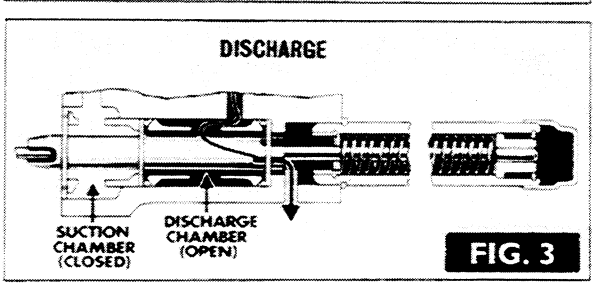




FIG. 3

DRAFT CONTROL – IMPLEMENT LOWERING

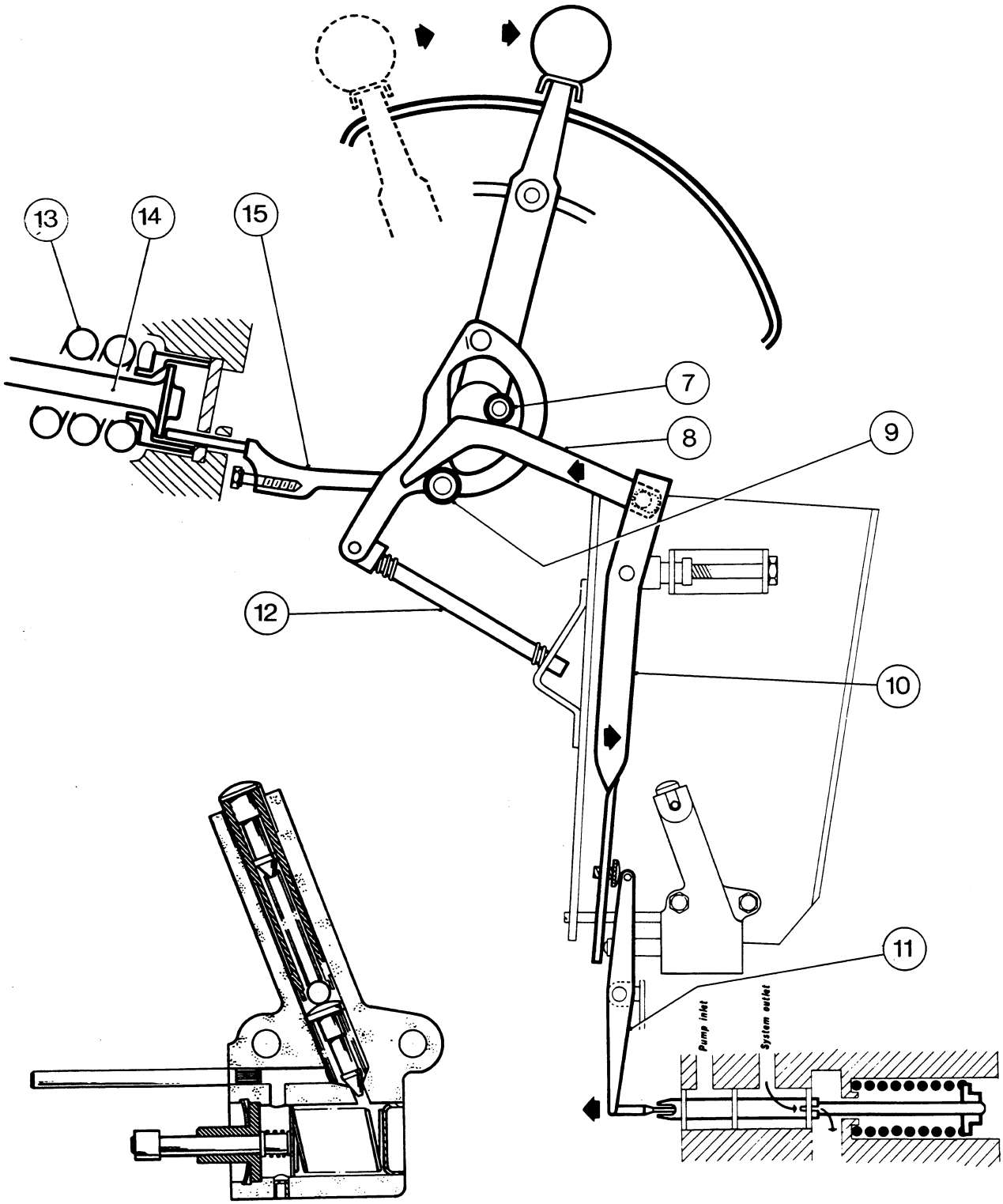



FIG. 4

DRAFT CONTROL - COMPRESSION FORCE IN TOP LINK

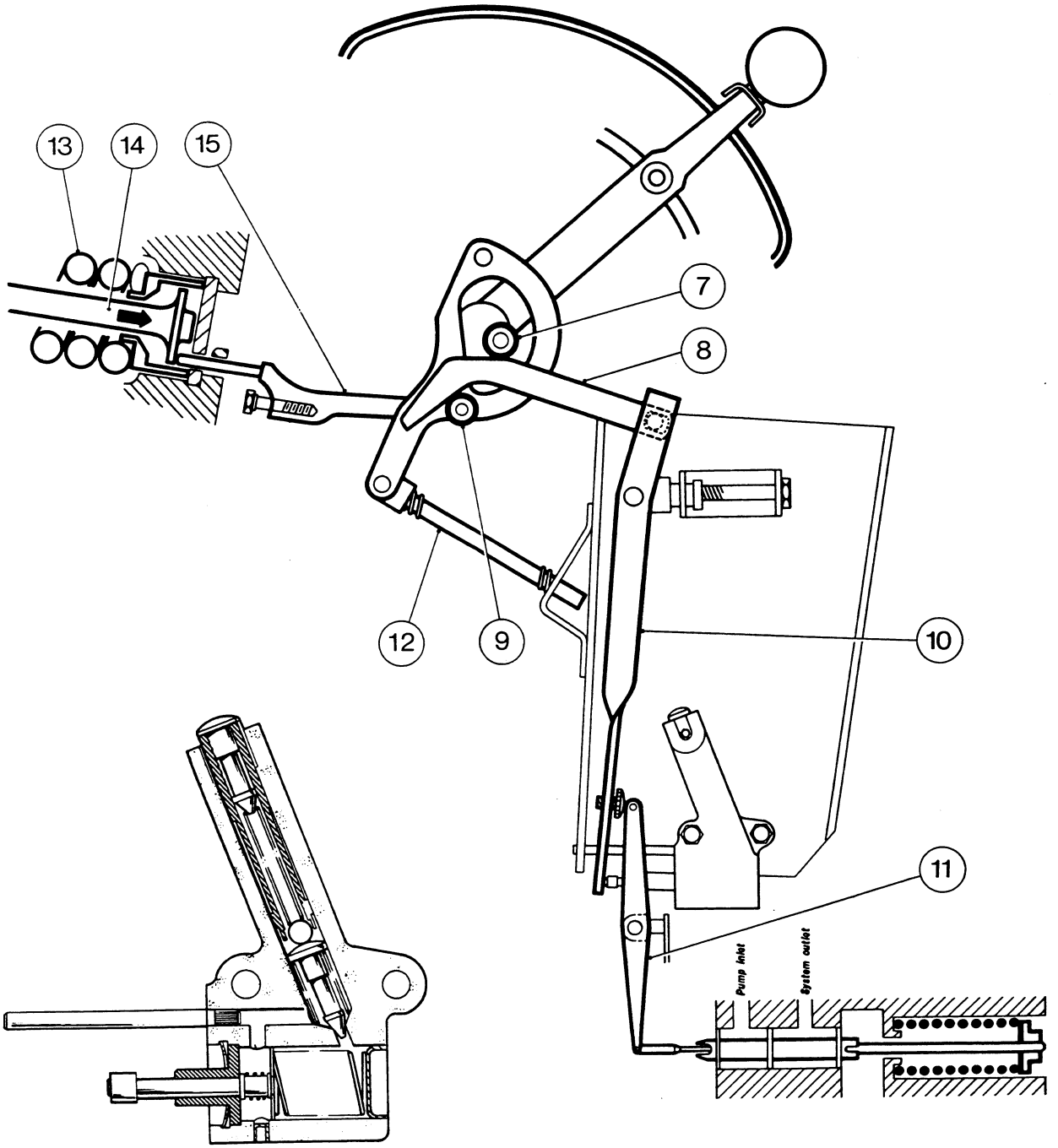



FIG. 5

DRAFT CONTROL – TENSION FORCE IN TOP LINK

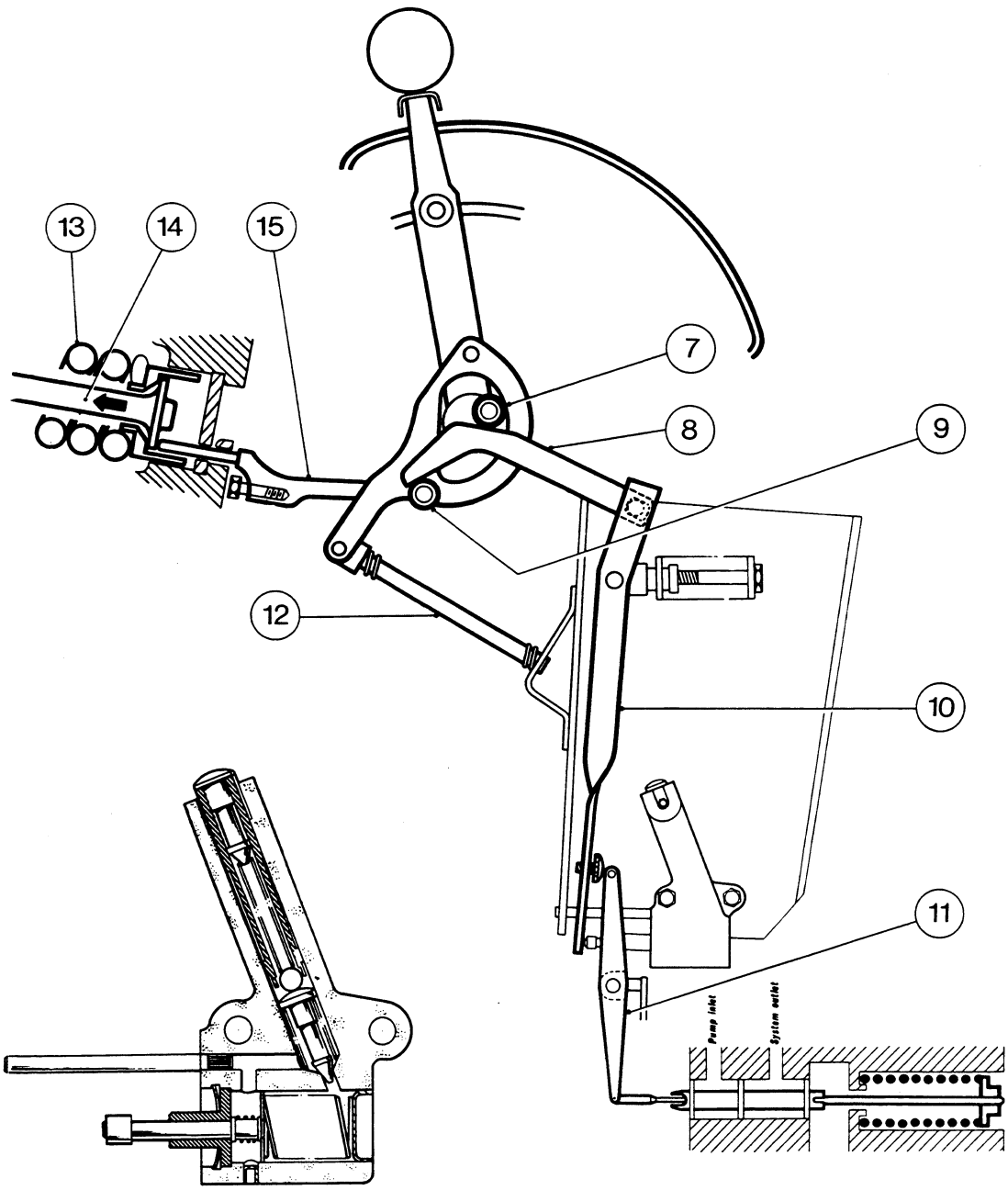



FIG. 6

**POSITION CONTROL – TRANSPORT POSITION**

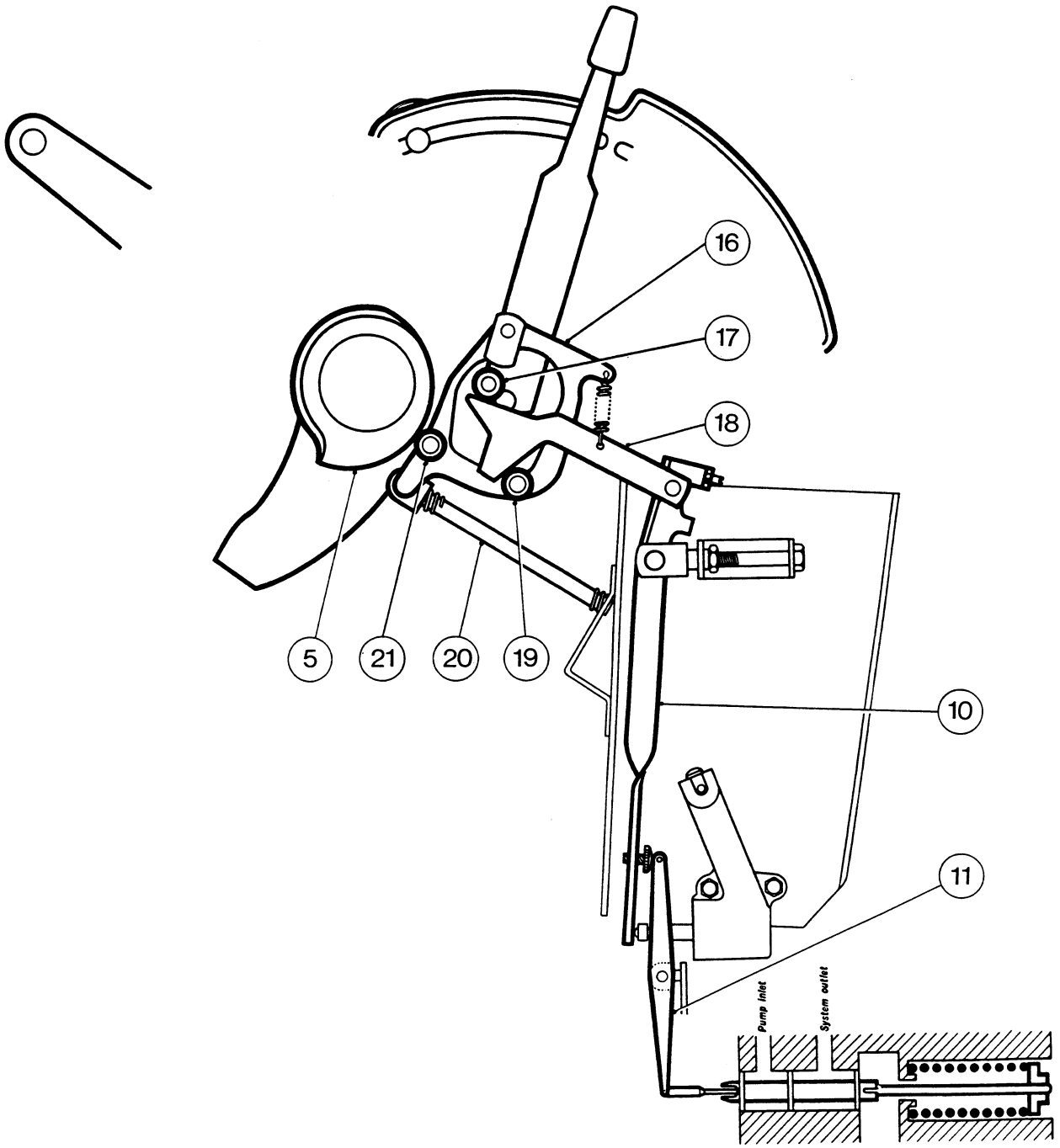



**FIG. 7**

POSITION CONTROL – IMPLEMENT LOWERING

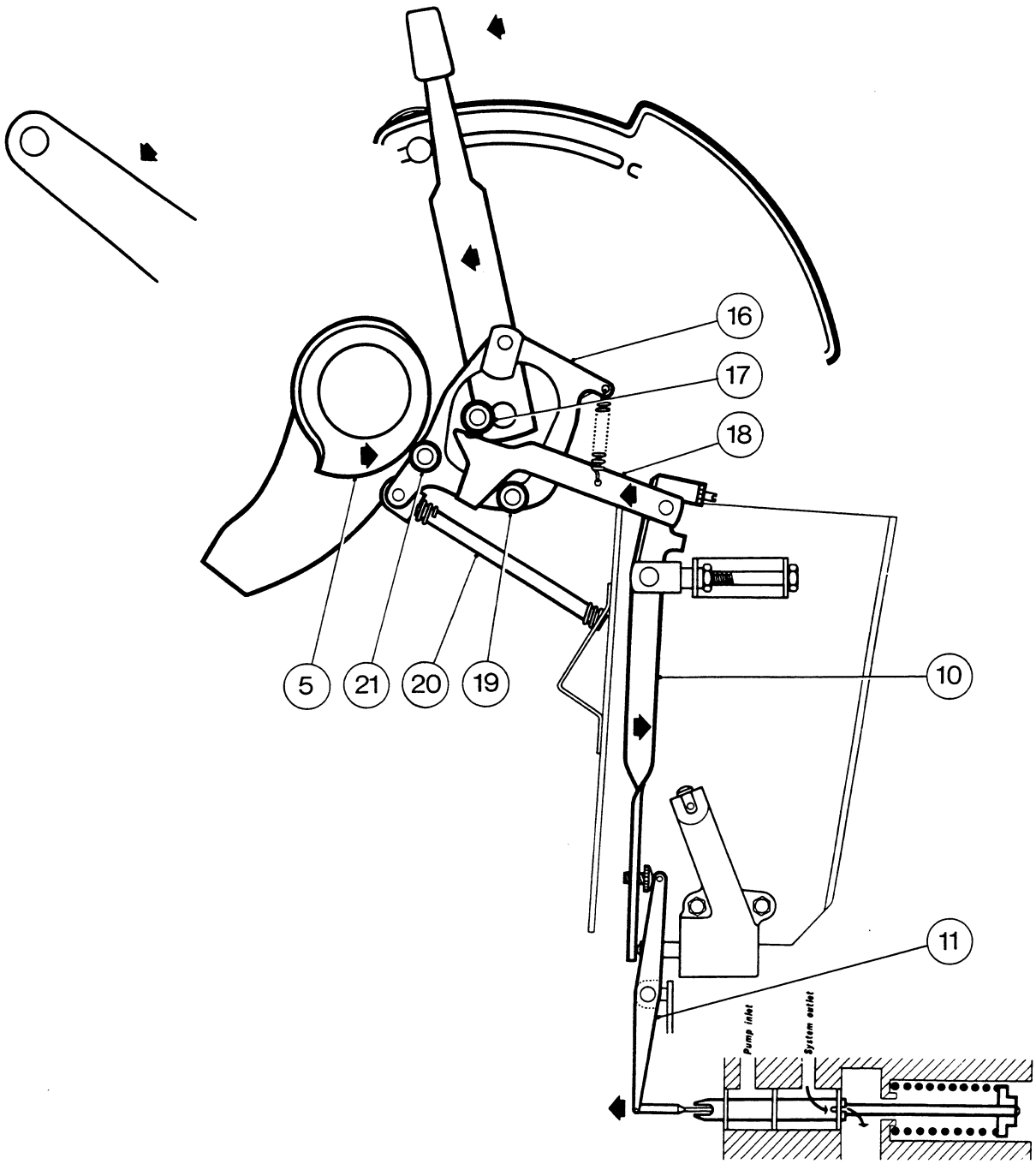



FIG. 8

**POSITION CONTROL – IMPLEMENT RAISING**

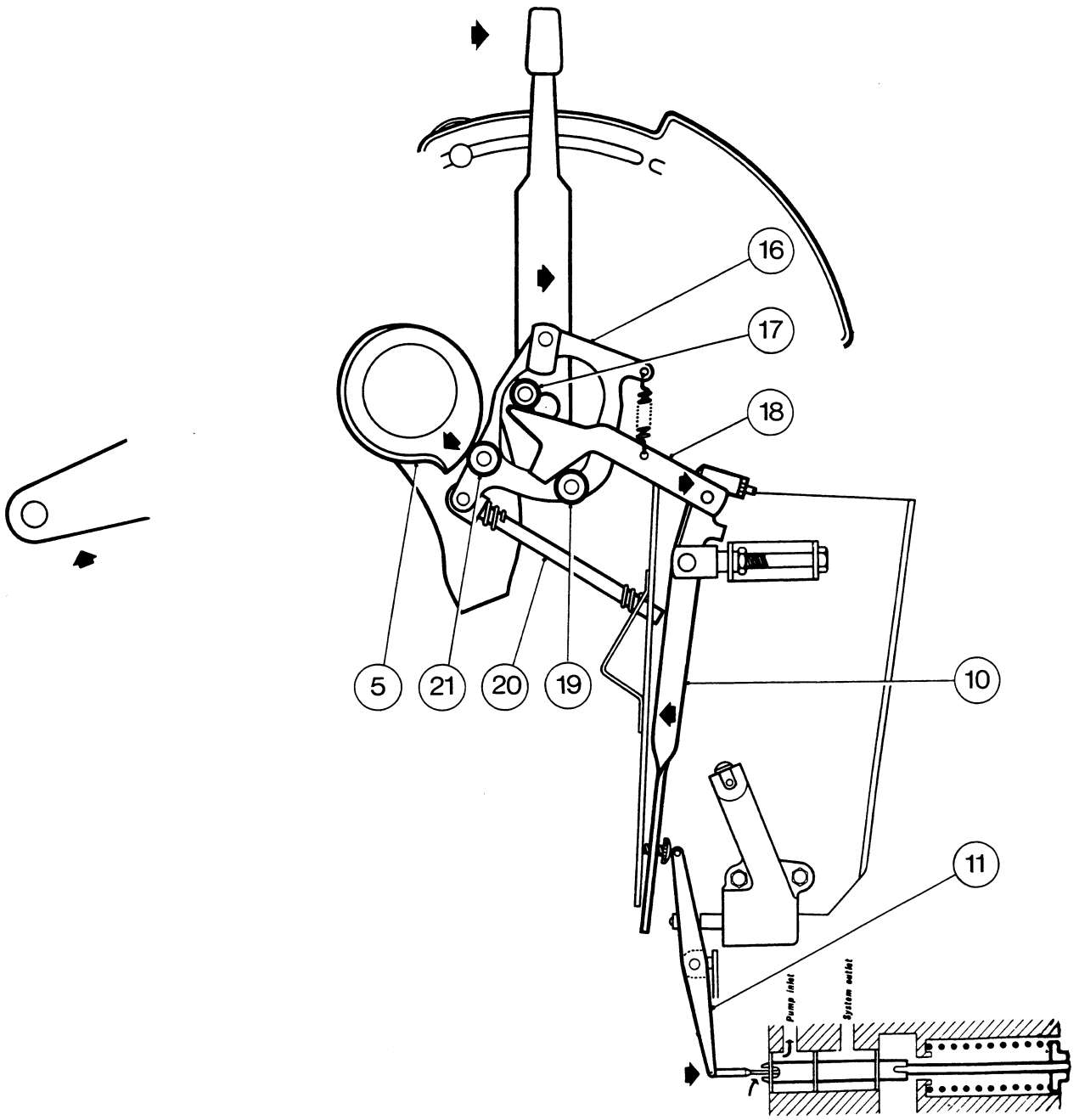
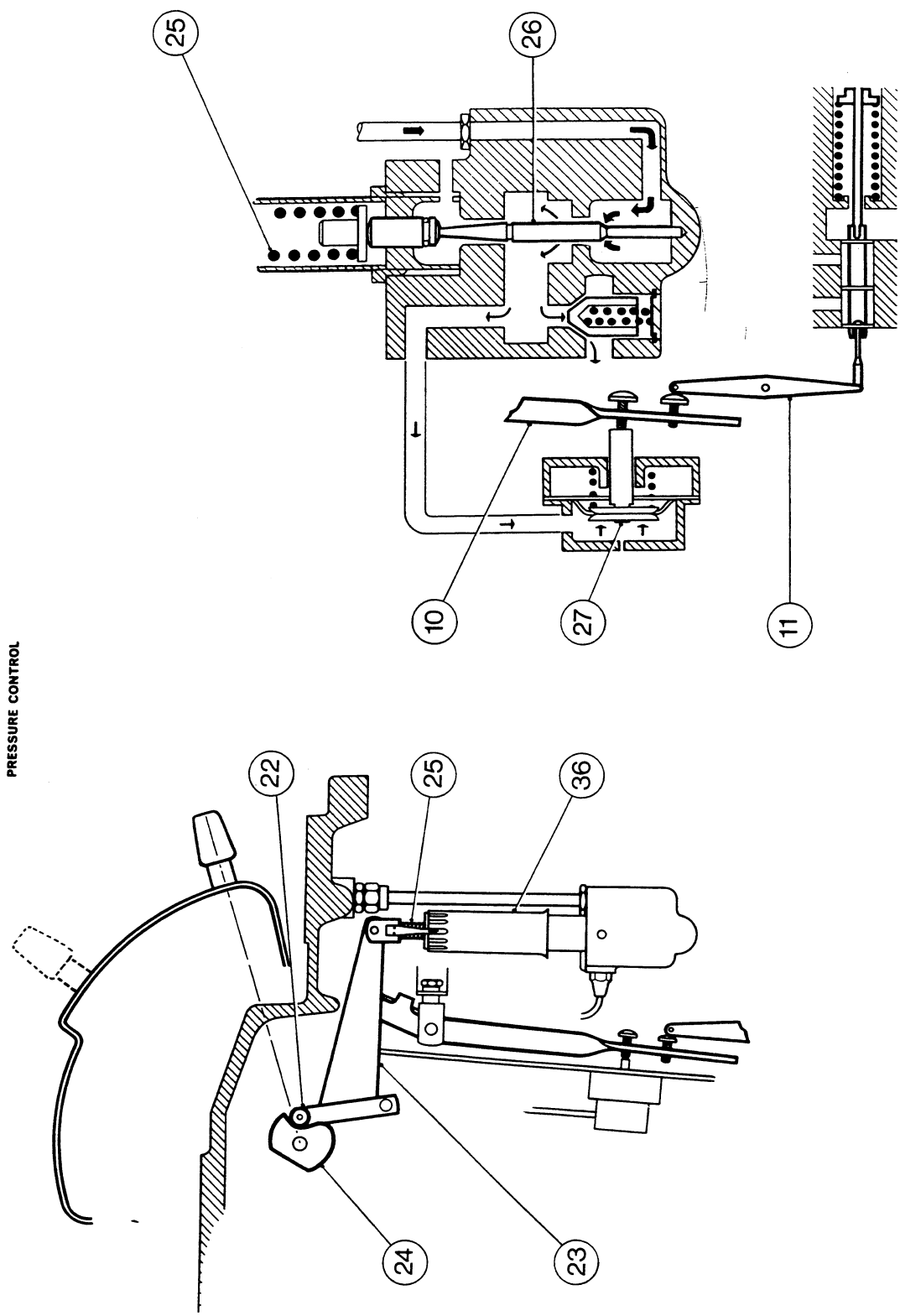



**FIG. 9**

FIG. 10



The draft control linkage follows the control spring plunger (14) under the influence of the spring on guide rod (12), and moves the draft control link rearwards. Lever (10) again pivots and causes the pump control valve lever (11) to push the pump control valve towards discharge. When correct depth is gained, the valve is restored to neutral. An increase of draft force in the top link will have an opposite effect.

**Position Control – Transport Position (Fig. 7)**
The position control lever shaft carries an eccentric roller (17) which contacts the upper cam face of the position control cam (18). The position control link (16) is pivoted at the top and carries two rollers (19) and (21). The front roller (19) contacts the lower cam face of the position control cam (18). The rear roller (21) is held in contact with the cam on the ram arm (5) by the spring on the guide rod (20). The front end of the position control cam (18) is connected to the vertical lever (10), which is in contact with the control valve lever (11).

**Position Control – Implement Lowering (Fig. 8)**
Downward movement of the position control lever causes the eccentric roller (17) to force the cam (18) downwards. The breakout spring pushes the position control link (16) to maintain contact between the roller (21) and the ram arm (5), and the front roller (19) moves the cam (18) rearwards, thus moving the pump control valve into discharge.

**Position Control – Implement Raising (Fig. 9)**
Release of oil from the ram cylinder allows the ram arm (5) to rotate and force the rear roller (21), mounted on position control link (16), forward. This action allows the pump control valve spring to move the position control cam (18), which is in contact with the front roller (19), forward, until the control valve reaches the neutral position, which has been determined by the position control lever.

**Response Control**
Response control governs the rate of movement of the pump control valve towards discharge, in the discharge range. In this way, the rate of drop of implements is controlled, thus ensuring smooth draft control operation.

The response control unit is bolted to the base of the lever support bracket. The unit is submerged in oil and is self-priming, and comprises a horizontal dashpot to which is fitted a spring loaded plunger with a spring loaded piston, and a vertical plunger with a spring loaded needle valve. Holes in the dashpot housing enable oil to enter either side of the piston.

The dashpot is only effective when the vertical lever moves forwards from the neutral position, i.e. control valve moving towards discharge. This action pushes the plunger and the piston forwards along the dashpot bore, oil is then forced past the needle valve to the other side of the piston and to the sump. Rearward movement of the vertical lever, i.e. control valve moving towards inlet, allows the plunger spring to lift the plunger clear of the piston, exposing a hole in the piston centre. Oil pressure then equalises on either side of piston as it is forced rearwards by the return spring.

Rate of oil escape from the dashpot is controlled by the size of the orifice between the needle valve and its seat. Movement of the response control lever (situated on the R.H. centre housing inspection cover, will adjust the orifice size due to the cam on the end of the lever acting against the needle valve plunger. The spring holding the needle valve clear of its seat also holds the valve and plunger up against the cam.

Movement of the response control lever rearwards, i.e. towards SLOW Response causes the cam to force the plunger and needle valve closer to the seat against spring pressure. This reduces the orifice size, so restricting oil flow past the valve. The damping action of the dashpot is thereby increased, thus slowing the vertical lever and pump control valve movement.

Conversely, movement of the response control lever forwards, i.e. towards FAST Response, rotates its cam, permitting the plunger and needle valve to lift away from the valve seat. The size of the orifice and oil flow past the valve thus increases. Damping effect of the plunger is reduced and faster movement of the vertical lever and pump control is allowed.

**Pressure Control (Fig. 10)**
The pressure control system enables the pressure in the ram cylinder to be regulated from 10,5 to 211 kg/cm$^2$ (150 to 3000 lb/in$^2$). One of the uses for this system is with semi-trailed implements fitted with depth control wheels. By suitable adjustment of the pressure control lever, part of the weight of the implement is supported by the tractor linkage, thus obtaining weight transfer to the tractor rear wheels and increasing traction.

The cam (24), fixed to the pressure control shaft, contacts the roller (22), mounted on the pressure control lever (23). This lever pivots at its rear lower end on the support bracket assembly.

The front end of the pressure control lever (23), carries an adjustable rod assembly which screws into an adjustment tube fitted to the control valve assembly. The control spring (25), fitted inside the adjustment tube locates at its lower end onto a guide, this guide contacts the servo valve plunger which in turn contacts the servo valve piston (26). A pin, fitted into the control valve body below and in line with the piston, controls maximum piston travel.

The piston runs in a sleeve assembly which embodies three compartments, the lower (pressure) compartment, central compartment and exhaust compartment. The central compartment is connected, by drillings in the sleeve and the valve body, and a pipe, to a diaphragm assembly (27). The diaphragm plunger acts on vertical lever (10).

When the pressure control lever is moved to its lowest position on the quadrant, the roller (22) on the internal pressure control lever (23) moves to the lowest position on the cam (24), allowing the lever (23), to exert minimum compression force on the control spring.

Oil entering the lower compartment, exerts pressure on the lower face of the piston and moves it against spring pressure. This allows the slot in the piston to pass through the lower sleeve and form a passage between the pressure and central compartments. Oil then flows into the diaphragm unit (27), which causes the plunger to move the vertical lever (10), and the pump control valve lever (11), and the pump control valve towards neutral. Maintaining system pressure at

a selected value, slight oil flow past the piston slot maintains pressure at the diaphragm face, under the influence of a 1.6 kg/cm$^2$ (23 lb/in$^2$) valve which allows flow back to the sump. A small hole in the rear diaphragm housing allows a continuous oil leakage.

As the quadrant lever is moved rearwards towards the high pressure position, the load on the control spring increases, so that a greater system pressure will be required to move the piston and allow oil through to the central compartment to extend the diaphragm plunger.

When the spring force on the piston exceeds the opposing pressure force, the piston will move down to the stop pin, cutting off oil supply to the central compartment and so to the diaphragm, thus allowing oil to exhaust from the diaphragm unit past the taper on the upper half of the piston. The diaphragm plunger is thus allowed to move rearwards, allowing the pump control valve under the influence of its spring to move into the lift position.

## CONTROLS

The Hydraulic Control Quadrants are located on the right hand side of the seat within easy reach of the operator. The two control levers, Draft (outer) and Position (inner), operate as follows:–

**Draft Control Lever (Fig. 11)**
The Draft Control Lever is the outer lever, and operates on the Draft (Yellow) range of the quadrant. A knurled nut locks the adjustable stop in place to indicate when the desired working depth is reached. The further the lever is moved towards the 'Down' position, the deeper the implement will tend to penetrate the ground, and conversely the nearer the lever is to the 'Up' mark, the shallower the implement will tend to work.

**Position Control Lever (Fig. 11)**
The Position Control Lever is the inner lever and operates on the Pressure (Black), Constant Pumping (Blue), and Position (Red) ranges of the quadrant. There are two knurled nuts which enable the adjustable stops to be locked in the required position. In the Position (Red) sector of the quadrant, the lever is used for lifting and lowering the tractor linkage, and carrying an implement at varying fixed heights above the ground. When the lever is in the Constant Pumping (Blue) sector, the tractor's hydraulic power is transmitted to external control rams or hydraulic motors. With the lever in the Pressure (Black) sector of the quadrant, a variable pressure in the system can be obtained which is determined by the position of the lever. The pressure can vary from 10,5 kg/cm$^2$ (150 lb/in$^2$) with the lever in 'Low', to 211 kg/cm$^2$ (3000 lb/in$^2$) with the lever in 'High', and enables part of the weight of a trailed implement (with pressure control coupler), or semi-mounted implement to be transferred to the tractor rear wheels for adhesion. The lower the lever in the quadrant the less weight is transferred, and conversely, the higher the lever in the quadrant the more weight is transferred.

**Response Control Quadrant (Fig. 12)**
The response quadrant is positioned on the right-hand side cover of the centre housing, which incorporates the transmission oil level dipstick. The quadrant is marked FAST and SLOW with an arrow on the lever knob to indicate the position. When the arrow is in the FAST position, an implement will drop in work fast, and conversely in the SLOW position, will drop in work slowly. Therefore, when ploughing, for example, over undulating ground, the plough will re-enter and follow the ground contours more accurately with the response lever towards the FAST position. The normal working position for the response lever should be just on the SLOW side of the centre position.

## EXAMPLES OF CONTROL LEVER SETTINGS

**Draft Control (Fig. 13)**

| | |
|---|---|
| Type of Work: | Ploughing, subsoiling and heavy cultivation.<br>For Draft Control, use the outer lever (yellow quadrant). |
| Transport Position: | Lever fully back (A). |
| Entering Work: | Push the lever forward until the implement reaches the required depth (B).<br>Set the adjustable stop in line with the lever.<br>Set the Response Control lever as shown. |
| Working: | The Draft Control lever can be moved slightly to suit varying soil conditions.<br>If an even depth cannot be maintained on undulating ground, move the Response lever towards FAST.<br>If the implement 'bobs', move the Response lever towards 'SLOW'. |
| Leaving Work: | Pull the Draft lever back to position 'A'. |

**Position Control (Fig. 14)**

| | |
|---|---|
| Type of Work: | Mowing, grading, harrowing and broadcasting.<br>For Position Control, use the inner lever in the rear sector (red quadrant). |
| Transport: | Push the lever to line up with the 'TRANSPORT' mark (A). |
| Entering Work: | Move the lever rearwards until the required implement position is obtained (B).<br>Set the adjustable stop in line with the lever.<br>Set the Response Control lever centrally as shown. |
| Working: | No further adjusting is necessary. |

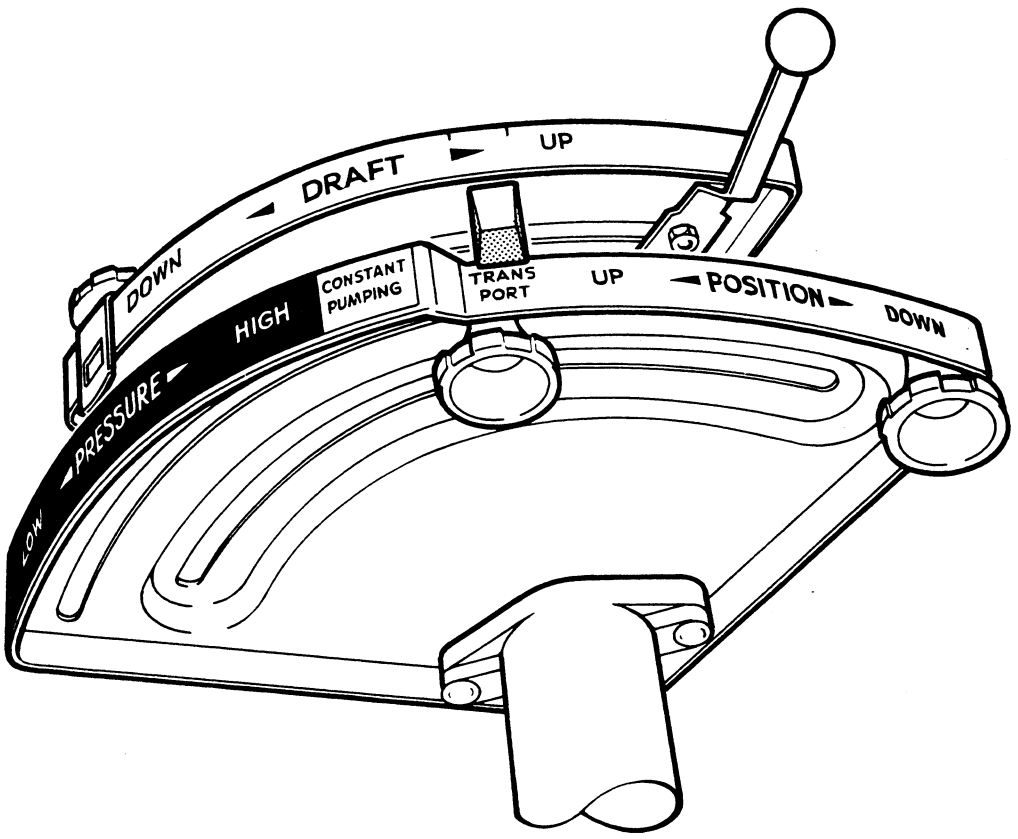

DRAFT
UP
DOWN
CONSTANT PUMPING
HIGH
PRESSURE
LOW
TRANS PORT
UP
POSITION
DOWN

FIG. 11

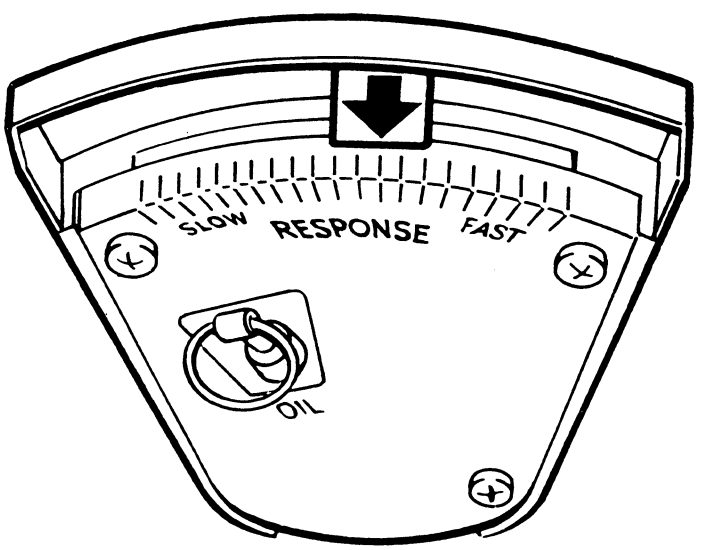

SLOW
RESPONSE
FAST
OIL

FIG. 12

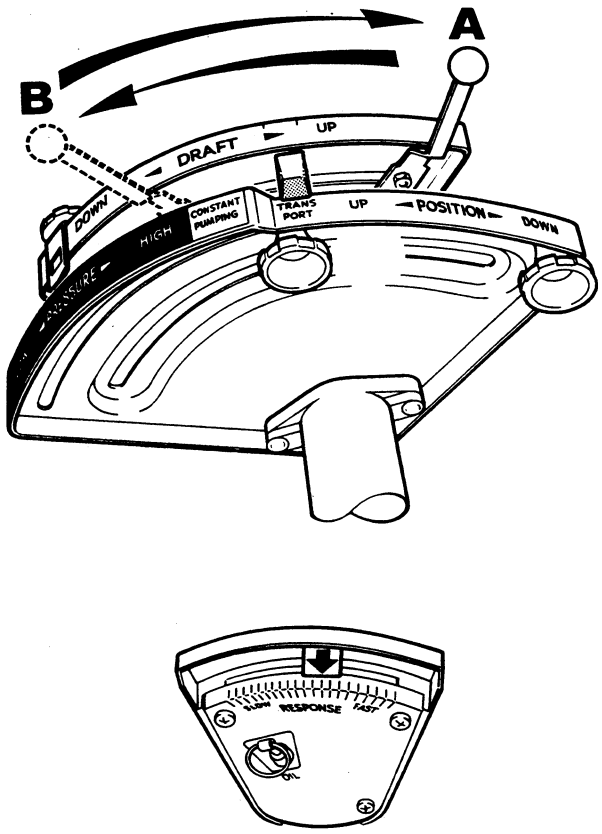



FIG. 13

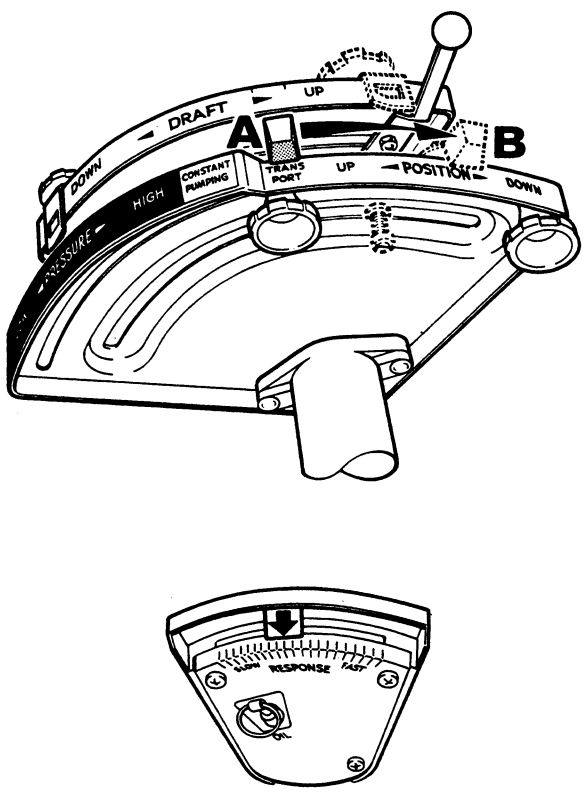



FIG. 14

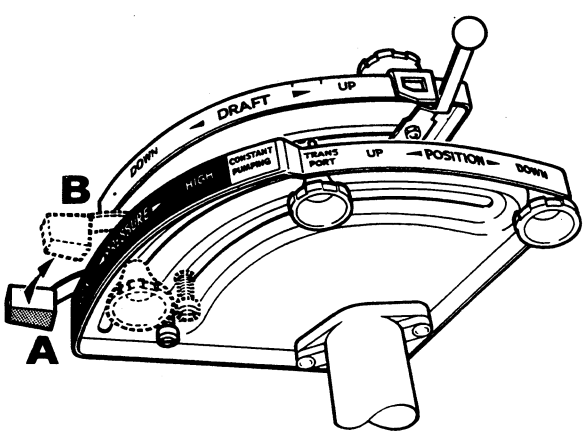



FIG. 15

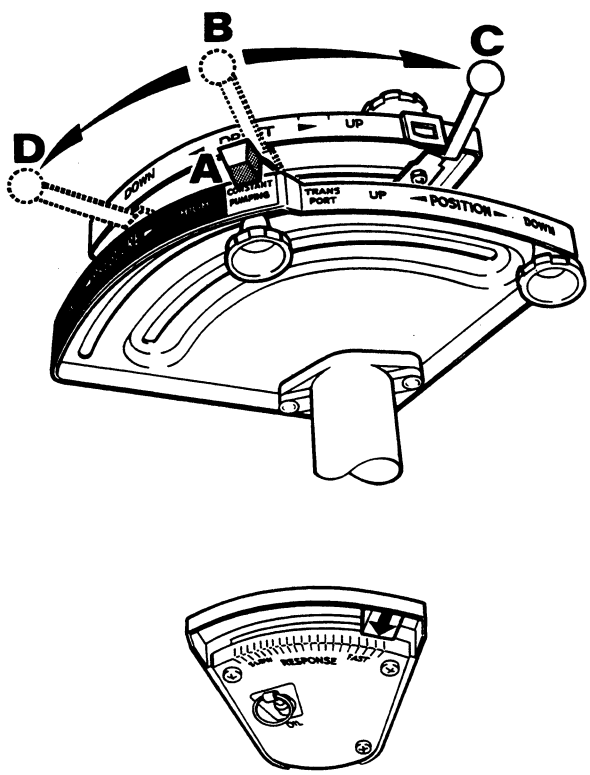



FIG. 16

Leaving Work: Move the lever forward to the 'TRANSPORT' position.

**Pressure Control (Fig. 15)**

Type of Work: Towing four-wheel trailers, disc harrows, seed drills, balers or manure spreaders.
Pressure control can only be used with the additional coupler.
For Pressure Control, use the inner lever in the front sector (black quadrant).

Operating: If wheelspin occurs, pull the lever rearwards from 'A' until traction is obtained (B).
Set the adjustable stop in line with the lever.

NOTE – USE OF EXTREME PRESSURE (IN EXCESS OF NORMAL REQUIREMENTS) CAN CAUSE FRONT END INSTABILITY.

When operating, the pressure may need to be increased slightly to improve traction, but the lever should be returned to position 'B' as soon as possible.

**Control of Hydraulic Equipment (Fig. 16)**

Type of Work: Single-acting hydraulic ram and low input hydraulic motors.

Rams: Move the inner lever to 'CONSTANT PUMPING' ('A', blue sector), then move the outer lever to approx. position 'B' to establish the point at which the ram neither extends, nor retracts.
Set the adjustable stop in line with the outer lever.
Set the Response Control lever to FAST.

Operation: To extend the ram, move the lever to 'C'.
To retract the ram, move the lever to 'D'.

**IMPORTANT** – WHEN THE RAM IS FULLY EXTENDED, RETURN THE LEVER TO 'B' TO PREVENT THE INTERNAL PRESSURE RELIEF VALVE FROM DISCHARGING CONTINUOUSLY.

Hydraulic Motors: Move the inner lever to 'CONSTANT PUMPING' ('A'). Move the outer lever to 'D'.

Operation: Move the outer lever to 'C' to engage the hydraulic drive and to 'D' to disengage the drive.
Response Control is not used.

## OPERATION OF EXTERNAL HYDRAULIC EQUIPMENT

There are four external tapping points (Fig. 17) in the left cover for use with implements which incorporate remote pressure operated hydraulic systems, such as loaders and tipping trailers. Various spool valves and hydraulic pipes can be fitted to this tractor.

For tapping points data see the Specification Section.

NOTE – IF A QUANTITY OF OIL IN EXCESS OF 7 LIT. (1½ IMP. GAL) IS REQUIRED FOR EXTERNAL USE, ADDITIONAL OIL CAN BE ADDED TO THE "HIGH" MARK ON THE DIPSTICK.

## CONTROL SPRING

**Removal and Refitment** 7A-01-15

Special Tools Required: MF 163 Wrench
Torque Wrench

**Removal**

1. Remove the control beam assembly.
2. Fig. 18. Slacken the socket screw (28).
3. Pull back the rubber boot (29).
4. Using tool MF 163, unscrew the retainer (30) out of the lift cover.
5. Fig. 19. Withdraw the control spring.

**Refitment**

1. Fig. 19. Refit the control spring assembly into the lift cover.
2. Place the draft control lever in the fully lowered position.
3. Fig. 18. Tighten the retainer (30) using tool MF 163 until all the end float is eliminated. Do not overtighten or end float will re-occur.
4. Refit the rubber boot (29).
5. Fit a new nylon locking plug then tighten the socket screw (28), to a torque of 0,70 kg-m (5 lb-ft).
6. Refit the control beam assembly.

## CONTROL SPRING ASSEMBLY SERVICING

7A-02-15

Special Tools Required: MF 163 Wrench
Torque Wrench

**Disassembly**

1. Remove the control spring assembly as stated in operation 7A-01-15.
2. Fig. 20. Drive out the pin (33) and detach the head (31).
3. Remove the retainer (30), control spring (13) and spring seat (32) from the plunger (14).

**Reassembly**

1. Fig. 20. Refit the spring seat (32), spring (13) and retainer (30) to the plunger (14).
2. Screw the plunger into the head (31), until all the end float is eliminated and the spring is tight to turn by hand.
3. Fit a new securing pin (33).
4. Refit the control spring assembly as stated in operation 7A-01-15.

# HYDRAULIC SYSTEM

## HYDRAULIC LIFT COVER

**Removal and Refitment** 7A-03-16

Special Tools Required: MF 163 Wrench
MF 271 Draft Control Rod Gauge
MF 148A Pressure Test Kit
MF 166 Adapter
MF 226A Lift Cover Remover and Replacer
MF 226A-3 Lift Cover Adapter
MF 269 Wrench
MF 270B Dashpot Piston Wedge
MF 271 Roller Tool
MF 272 Ram Arm Fixture
MF 273 Hydraulic Setting Fixture
1,36 kg (3 lb) weight
Torque Wrench
Feeler Gauge
Rule

**Removal**

1. Remove the seat.
2. Disconnect the wiring to the number plate light at the connection box attached to the lift cover.
3. Remove the split pins and pivot pins securing the lift rods to the lift arms.
4. Remove the control beam assembly.
5. Disconnect the Auto-Hitch (if fitted) at the lift arms.
6. Fig. 21. Remove the two bolts and spring washers securing the stand pipe cap (34) to the lift cover and remove the cap.
7. Disconnect the stand pipe (1) from the hydraulic pump by lifting the stand pipe slightly.
8. Remove the R.H. footplate, and drain the oil to the low mark on the dipstick.
9. Fig. 22. Remove the four screws (63) securing the response control cover plate (64), and remove the plate.
10. Remove the five bolts (61) and the screw (59) securing the inspection cover (60) to the centre housing and remove the cover.
11. Fig. 23. Remove the valve actuating roller using tool MF 271 as shown.
12. Fig. 22. Suitably retain the dashpot plunger (49) to prevent it from dropping out when the lift cover is removed.
13. Remove the 14 bolts securing the lift cover to the centre housing.
14. Place the parking brake clear of the lift cover.
15. Fig. 24. Fit tool MF 226A and adapter MF226A-3 to the lift cover as shown.
16. Fig. 25. Taking care not to damage the control valve vertical lever (10, Fig. 10), detach the lift cover from the centre housing as shown, and place the support leg on the ground.

**Refitment**

NOTE – BEFORE REFITMENT OF THE LIFT COVER THE EXTERNAL ADJUSTMENTS AS STATED IN OPERATION 7A-12-27 MUST BE CARRIED OUT.

1. Fig. 26. Fit the two special studs to the centre housing as shown.
2. Fit a new lift cover gasket.
3. Place the lift arms in the down position.
4. Set the shear tube split pin in the vertical position.
5. Fig. 25. Taking care not to damage any parts, manoeuvre the lift cover assembly into position, over the two special studs onto the centre housing.
6. Remove the two special studs, tool MF 226A and adapter MF 226A-3.
7. Fig. 23. Refit the valve actuating roller using tool MF 271 as shown.
8. Fig. 21. Centralise and locate the stand pipe (1) in the pump assembly.
9. Secure the lift cover and parking brake to the centre housing and tighten the bolts to a torque of 8,5 kg-m (65 lb-ft).
10. Fig. 21. Refit the stand pipe cap (34) with a new 'O' ring and secure with the two bolts and spring washers.
11. Refit the control beam assembly.
12. Secure the lift rods to the lift arms.
13. Reconnect the number plate light wiring at the connection box.
14. Refit the Auto-Hitch at the lift arms.
15. Carry out the internal adjustments as stated in operation 7A-12-27.
16. Refit the seat.

## HYDRAULIC LIFT COVER SERVICING 7A-04-16

Special Tools Required: MF 163 Wrench
MF 271 Draft Control Rod Gauge
MF 148A Pressure Test Kit
MF 166 Adapter
MF 226A Lift Cover Remover and Replacer
MF 226A-3 Lift Cover Adapter
MF 269 Wrench
MF 270B Dashpot Piston Wedge
MF 271 Roller Tool
MF 272 Ram Arm Fixture
MF 273 Hydraulic Setting Fixture
1,36 kg (3 lb) Hide Hammer
1,36 kg (3 lb) Weight
Torque Wrench
Feeler Gauge
Rule

**Disassembly**

1. Remove the lift cover as stated in operation 7A-03-16.
2. Fig. 10. Place the position and pressure control lever in the constant pumping position, remove the split pin retaining the pressure control linkage (23) to the support bracket (35, Fig. 27) then place the lever into the low range on the quadrant and remove the linkage complete with the adjustment tube (36), and spring (25) and spring guide.
3. Fig. 27. Remove the position control spring (37) as shown.
4. Disconnect the diaphragm pipe (38) at the pressure control valve (39).

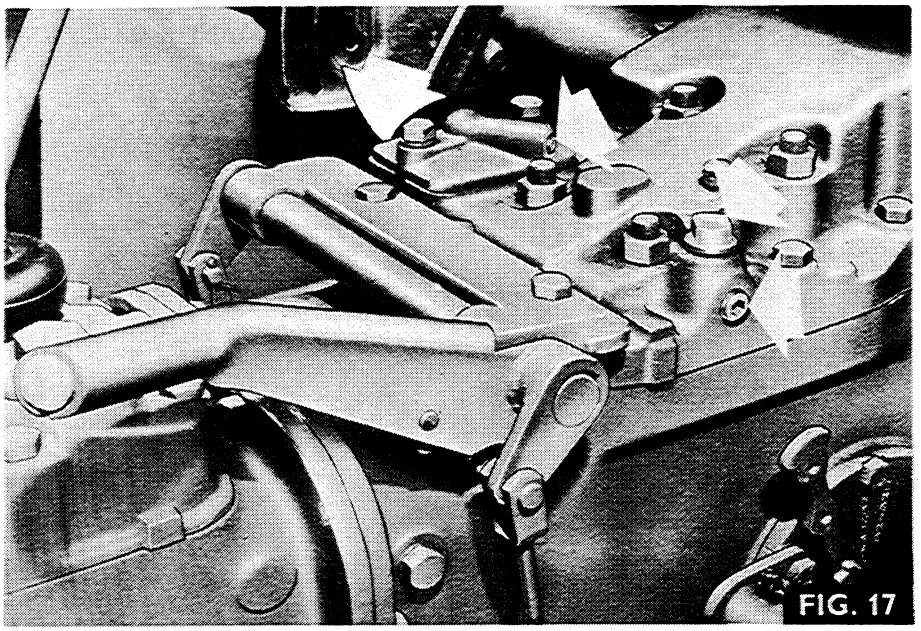


FIG. 17

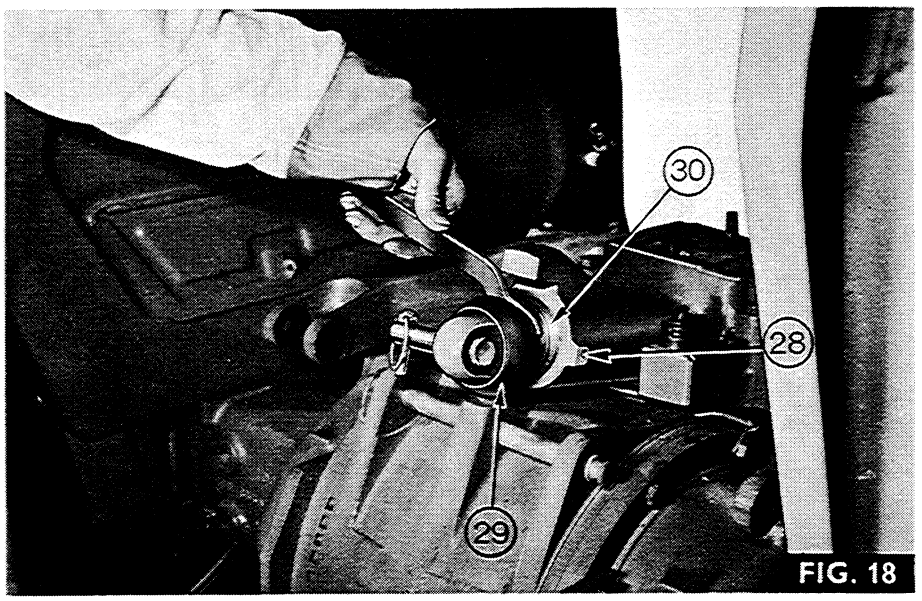


FIG. 18

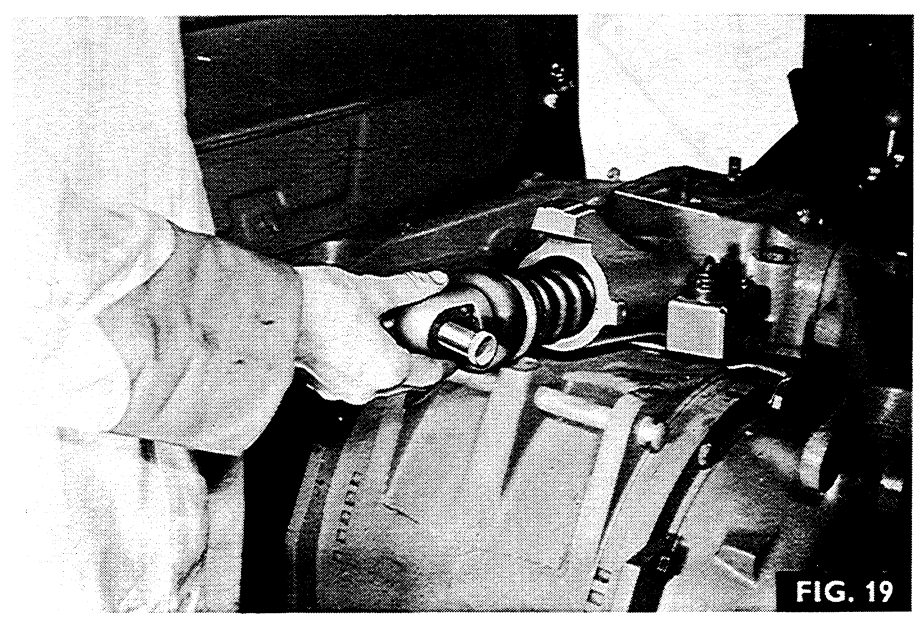


FIG. 19

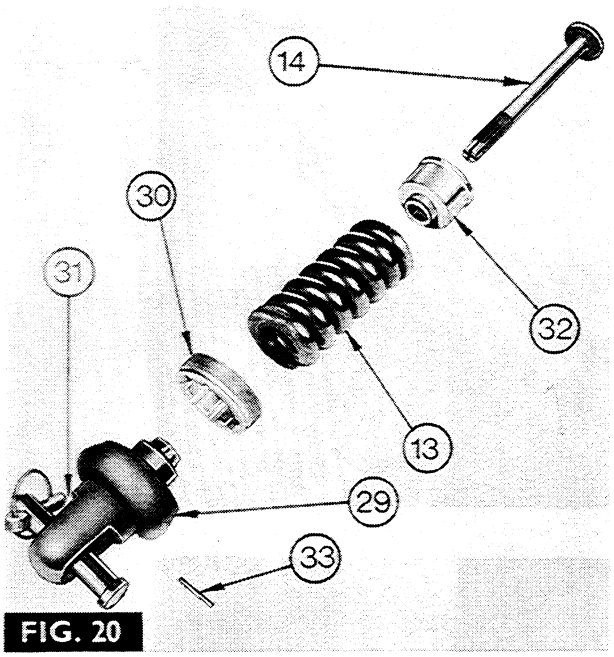



FIG. 20

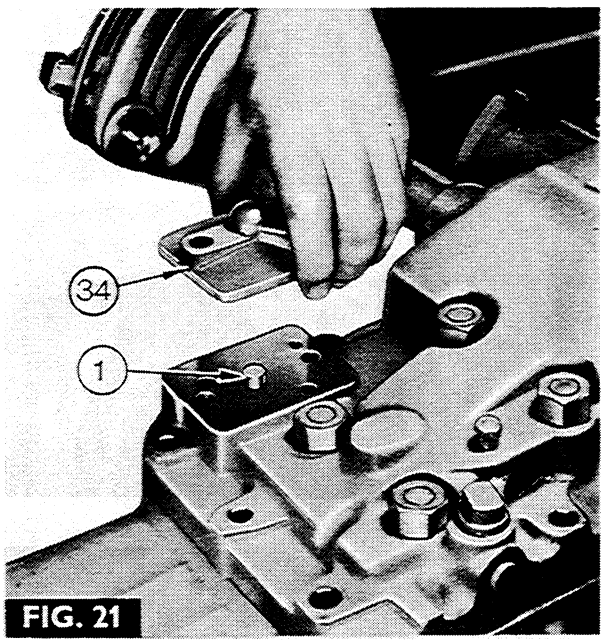



FIG. 21

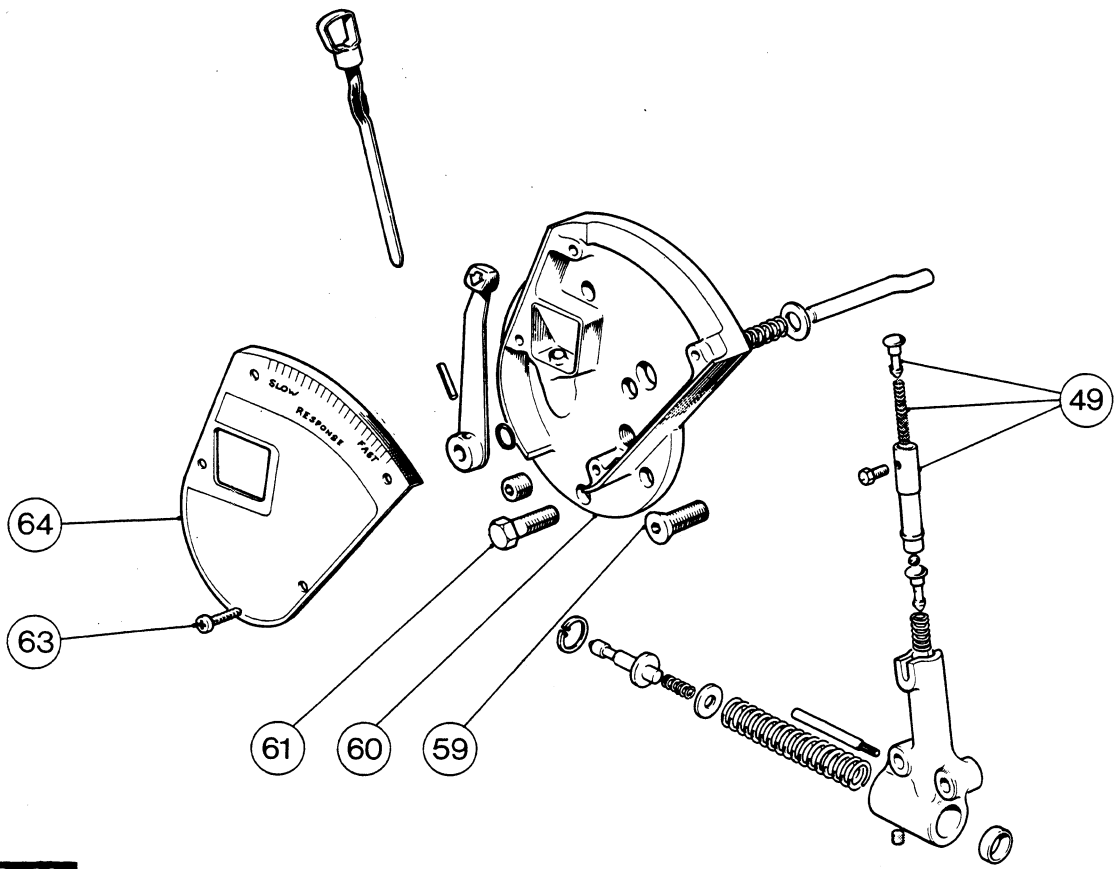



FIG. 22

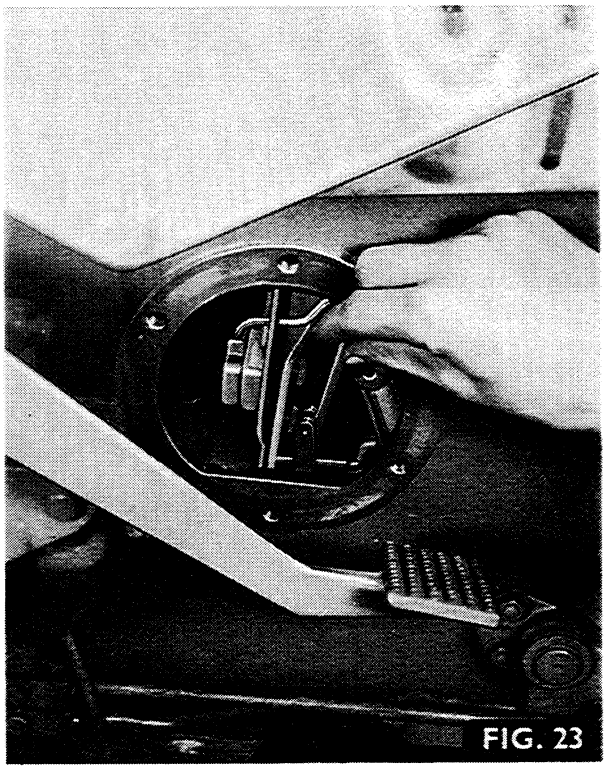


FIG. 23

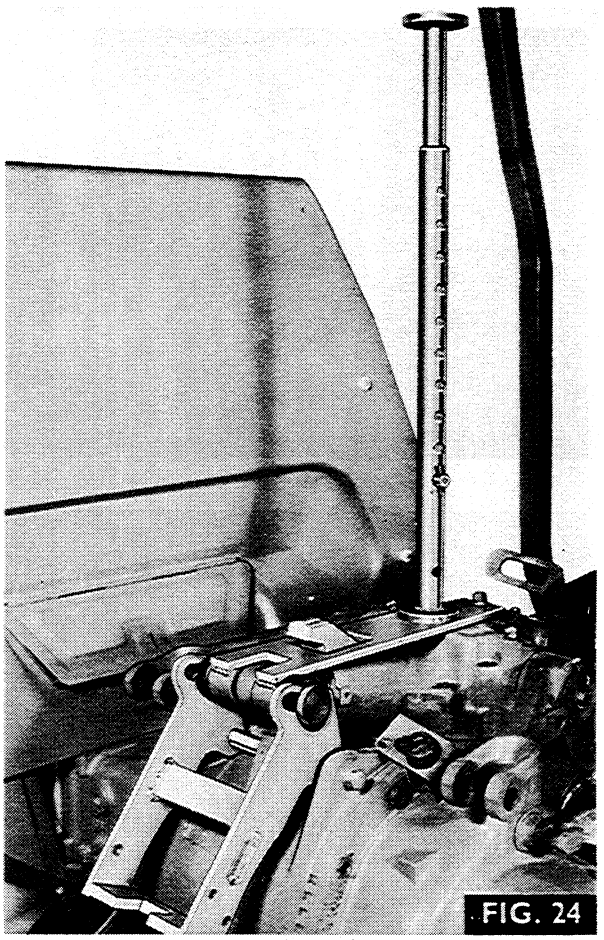


FIG. 24

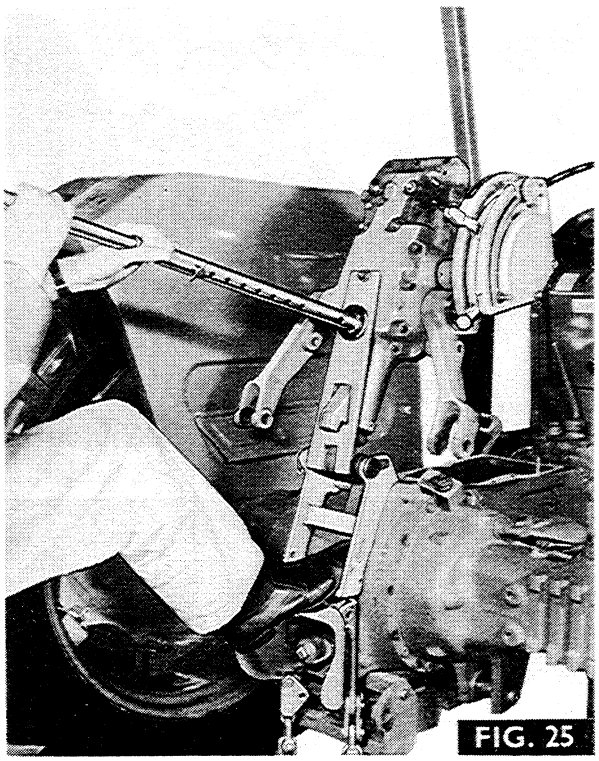


FIG. 25

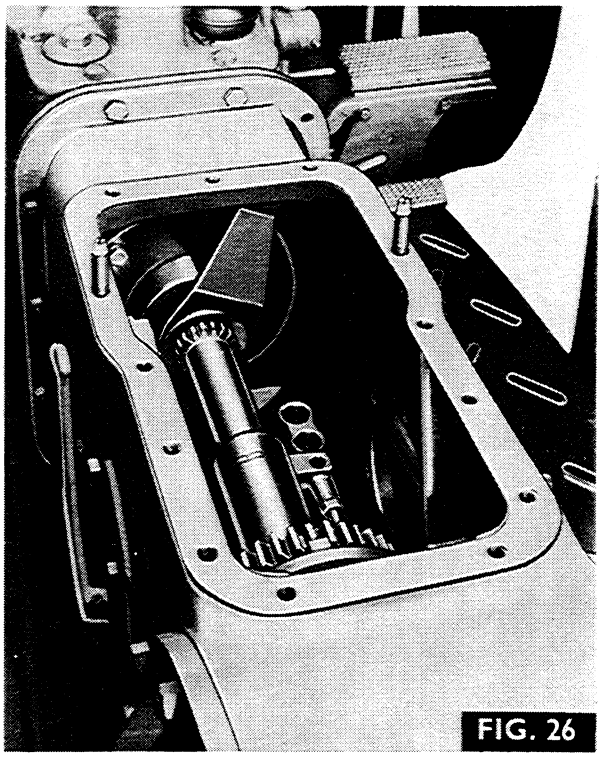


FIG. 26

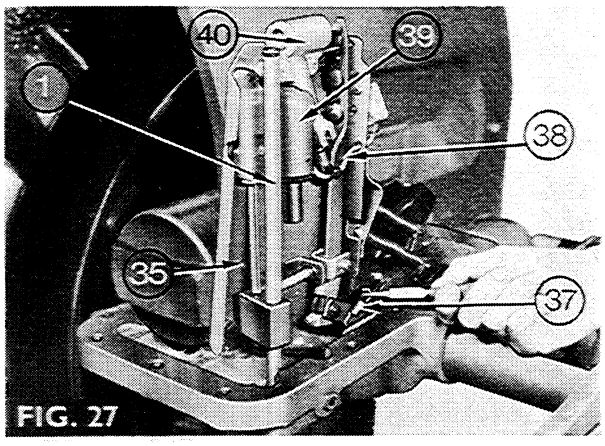


FIG. 27

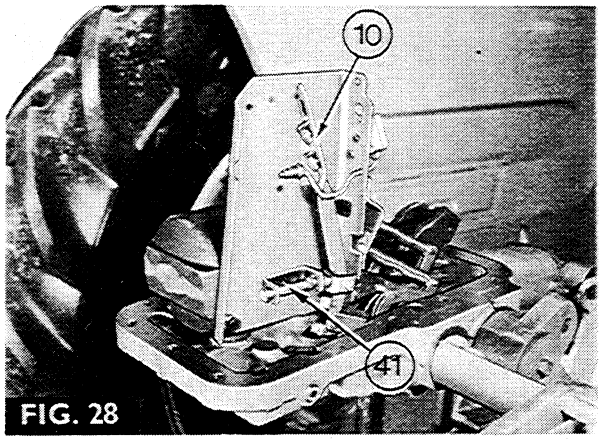


FIG. 28

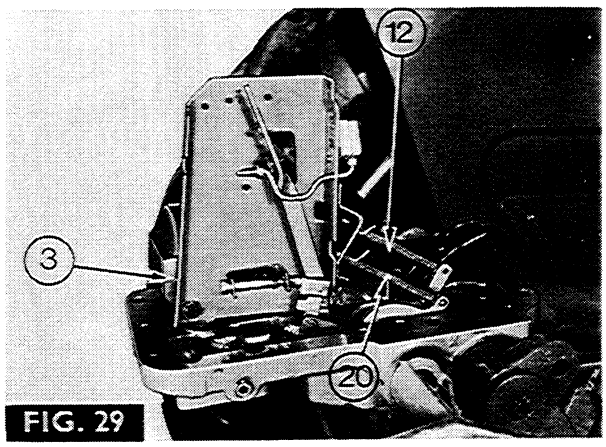


FIG. 29

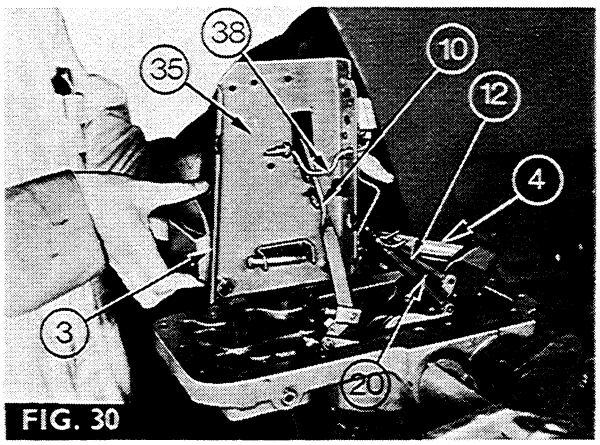


FIG. 30

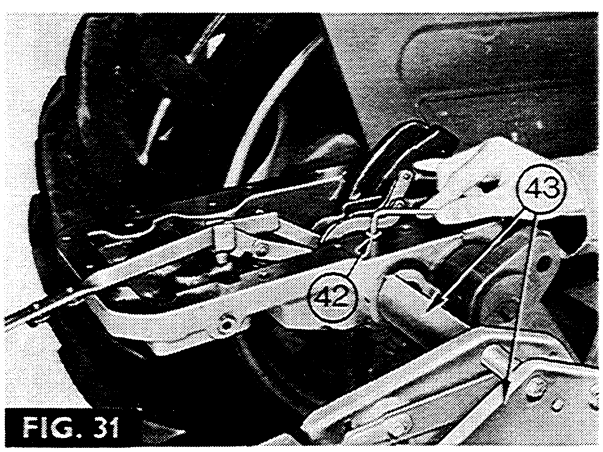


FIG. 31

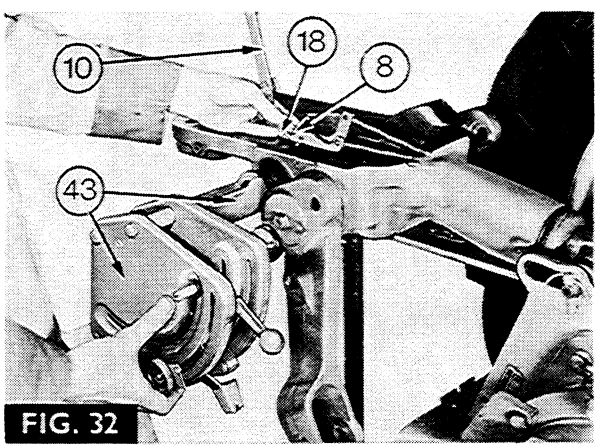


FIG. 32

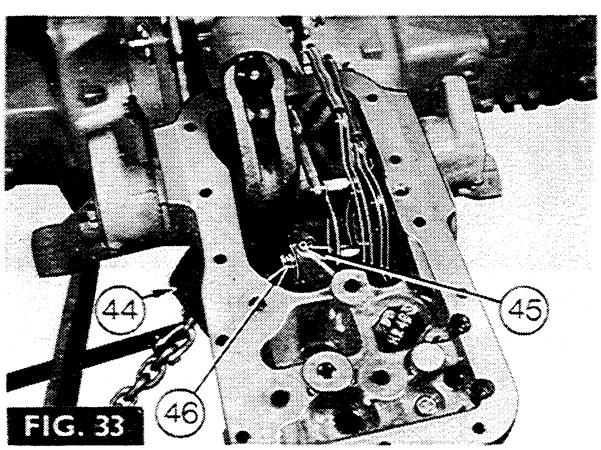


FIG. 33

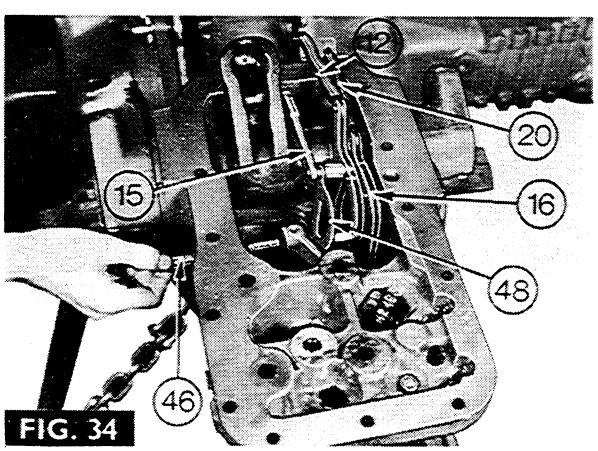


FIG. 34

5. Remove the two bolts and washers securing the pressure control valve to the support bracket and remove the valve (39) complete with the stand pipe (1).
6. Remove the two bolts and washers securing the response control dashpot (40) to the support bracket (35) and remove the response control dashpot.
7. Fig. 28. Loosen the locknut on the fulcrum bolt (41) and release the vertical lever (10).
8. Fig. 29. Fit a suitable retaining pin to the lower guide rod (20) to prevent the spring from being ejected.
9. Remove the four nuts securing the ram cylinder (3) to the lift cover.
10. Lift the cylinder slightly and fit a suitable retaining pin to the upper guide rod (12) to prevent the spring from being ejected.
11. Fig. 30. Lift the cylinder (3) and support bracket (35) clear of the lift cover, taking care not to damage the vertical lever (10) or the diaphragm pipe (38).
12. Remove the connecting rod (4).
13. Fig. 31. Remove the Allen screw (42) retaining the quadrant (43) in the lift cover.
14. Fig. 32. Withdraw the quadrant (43) from the lift cover simultaneously removing the vertical lever (10) and cams (8 and 18).
15. Fig. 33. Remove the plug (44) on the L.H. side of the lift cover to enable the linkage pivot shaft (46) to be removed.
16. Remove the Allen Screw (45).
17. Fig. 34. Withdraw the linkage pivot shaft (46) as shown and remove the remaining links (12, 15 and 48, then 20 and 16).
18. Release the tab washer and remove the bolt and washer securing the R.H. lift arm (6, Fig. 1) to the lift shaft (47) and remove the arm.
19. Fig. 35. Drive the remaining lift arm and shaft (47) out of the lift cover and remove the ram arm (5).

**Reassembly**

1. Fig. 35. Position the ram arm (5) in the lift cover.
2. Slide the lift arm and shaft (47), with a new 'O' ring into the lift cover and ram arm (5), aligning the master spines on the shaft and ram arm.
3. Refit the remaining lift arm, with a new 'O' ring. aligning the master splines.
4. Release the tabwasher on the L.H. lift arm and slacken the securing bolt.
5. Refit the washer and securing bolt to the R.H. lift arm and fully tighten, then secure it with new tabwasher.
6. Tighten the L.H. bolt so that the lift arms just move freely through their travel with no lift shaft (47) end float, and secure it with a new tabwasher.
7. Fig. 34. Refit the position control linkage (16 and 20), the draft control linkage (48, 15 and 12) then refit the linkage pivot shaft (46) as shown.
8. Fig. 32. Refit the vertical lever (10) and cams (8 and 18) simultaneously refitting the quadrant (43) into the lift cover.
9. Fig. 31. Secure the quadrant in the lift cover with the Allen Screw (42).
10. Fig. 33. Making sure that the linkage pivot pin (46) is hard against the lift cover, secure the pin (46) with the Allen screw (45).
11. Refit the plug in the L.H. side of the lift cover.
12. Refit the connecting rod (4) into the ram arm (5). Apply Loctite Grade 'AV' or Casco 'Metalok ML15' to the Allen Screw. Fit the screw, screw it in fully, then back off ¼ turn.

**NOTE – THOROUGHLY DEGREASE THE RAM ARM THREADS.**

13. Fig. 30. Place the cylinder (3) and support bracket (35) assembly on the lift cover using new 'O' rings simultaneously locating the two guide rods (12 and 20) into their holes, the vertical link (10) upright as shown and relocate the connecting rod (4).
14. Fig. 29. Remove the upper guide rod (12) spring retaining pin.
15. Secure the cylinder assembly (3) to the lift cover with the four nuts tightened to a torque of 16,0 kg-m (120 lb-ft).
16. Remove the lower guide rod (20) spring retaining pin.
17. Fig. 27. Refit the response control dashpot (40) and secure it with the two bolts and washers.
18. Refit the pressure control valve assembly (39) complete with the stand pipe (1) using new 'O' rings and washer and secure the valve with the two bolts and washers.
19. Reconnect the diaphragm pipe (38) to the pressure control valve (39).
20. Refit the position control spring (37).
21. Refit the lift cover as stated in operation 7A-03-16

## RESPONSE CONTROL DASHPOT

**Removal and Refitment** 7A-05-21

Special Tools Required: MF 163 Wrench
MF 271 Draft Control Rod Gauge
MF 148A Pressure Test Kit
MF 166 Adapter
MF 226A Lift Cover Remover and Replacer
MF 226A-3 Lift Cover Adapter
MF 269 Wrench
MF 270B Dashpot Piston Wedge
MF 271 Roller Tool
MF 272 Ram Arm Fixture
MF 273 Hydraulic Setting Fixture
1,36 kg (3 lb) Weight
Torque Wrench
Feeler Gauge
Rule

**Removal**

1. Remove the lift cover as stated in operation 7A-03-16.
2. Fig. 27. Remove the two bolts and washers securing the response control dashpot (40) to the support bracket (35) and remove the dashpot (40)

**Refitment**

1. Refit the response control dashpot (40) to the support bracket and secure with the two bolts and washers.
2. Refit the lift cover as stated in operation 7A-03-16.

## RESPONSE CONTROL DASHPOT SERVICING

7A-06-22

Special Tools Required: MF 163 Wrench
MF 271 Draft Control Rod Gauge
MF 148A Pressure Test Kit.
MF 166 Adapter
MF 226A Lift Cover Remover and Replacer
MF 226A-3 Lift Cover Adapter
MF 269 Wrench
MF 270B Dashpot Piston Wedge
MF 271 Roller Tool
MF 272 Ram Arm Fixture
MF 273 Hydraulic Setting Fixture
1,36 kg (3 lb) Weight
Torque Wrench
Feeler Gauge
Rule

**Disassembly**

1. Remove the responce control dashpot as stated in operation 7A-05-21.
2. Fig. 36. Slacken the setscrew (50) and remove the plunger assembly (49), needle valve (51) and spring (52).
3. Remove the retaining ring (58), rod (57), guide (56), spring (55), piston (54) and spring (53).

Examine all the components for signs of wear, damage, scoring or pitting and replace if necessary.

**Reassembly**

1. Refit the spring (53), piston (54), spring (55), guide (56), rod (57), and secure with new retaining ring (58).
2. Refit the spring (52), needle valve (57) and plunger assembly (49) and secure with the setscrew (50).
3. Refit the response control dashpot as stated in operation 7A-05-21.

## PRESSURE CONTROL VALVE

**Removal and Refitment** 7A-07-22

Special Tools required: MF 163 Wrench
MF 271 Draft Control Rod Gauge
MF 148A Pressure Test Kit
MF 166 Adapter
MF 226A Lift Cover Remover and Replacer
MF 226A-3 Lift Cover Adapter
MF 269 Wrench
MF 270B Dashpot Piston Wedge
MF 271 Roller Tool
MF 272 Ram Arm Fixture
MF 273 Hydraulic Setting Fixture
1,36 Kg (3 lb) Weight
Torque Wrench
Feeler Gauge
Rule

**Removal**

1. Remove the lift cover as stated in operation 7A-03-16.
2. Fig. 10. Place the position control lever in the 'Constant Pumping' position
remove the split pin, retaining the pressure control linkage (23) to the support bracket then place the lever in the low range on the quadrant and remove the linkage complete with the adjustment tube (36), spring (25), and spring guide.
3. Fig. 27. Disconnect the diaphragm pipe (38) at the pressure control valve.
4. Remove the two bolts and washers securing the pressure control valve (39) to the support bracket (35) and remove the valve complete with the stand pipe (1).
5. Remove the stand pipe (1) from the valve (39) at the stand pipe block.

**Refitment**

1. Refit the stand pipe (1), with a new 'O' ring, to the valve (39).
2. Refit the valve, complete with the stand pipe, to the support bracket and secure with the two bolts and washers.
3. Reconnect the diaphragm pipe (38) to the valve (39).
4. Refit the lift cover as stated in operation 7A-03-16

## PRESSURE CONTROL VALVE SERVICING

7A-08-22

Special Tools required: MF 163 Wrench
MF 271 Draft Control Rod Gauge
MF 148A Pressure Test Kit
MF 166 Adapter
MF 226A Lift Cover Remover and Replacer
MF 226A-3 Lift Cover Adapter
MF 269 Wrench
MF 270B Dashpot Piston Wedge
MF 271 Roller Tool
MF 272 Ram Arm Fixture
MF 273 Hydraulic Setting Fixture
1,36 Kg (3 lb) Weight
Torque Wrench
Feeler Gauge
Rule

**Disassembly**

1. Remove the pressure control valve as stated in operation 7A-07-22.
2. Fig. 37. Remove the pilot assembly (65), and withdraw the plunger (67).
3. Withdraw the sleeve assembly (68), piston (26) and pin (69).
4. Remove the retaining ring (73), washer (72), spring (71) and relief valve (70).

Examine all the components for signs of wear, damage, scoring or pitting and replace if necessary.

**Reassembly**

1. Refit the relief valve (70), spring (71), washer (72), and secure with a new retaining ring (73).
2. Fit two new 'O' rings (74), and one washer (75) to the sleeve assembly (68).

3. Check that the diametral clearance between the piston (26) and the insert inside the sleeve is 0,0051 to 0,0102 mm (0.0002 to 0.0004 in).
4. Locate the pin (69) into the valve body (39) and refit the sleeve assembly (68) and piston (26).
5. Locate the plunger (67) into the pilot assembly (65) and secure the pilot assembly (65) to the valve body (39) tightening to a torque of 3,5 kg-m (25 lb-ft).
6. Refit the pressure control as stated in operation 7A-07-22

## DIAPHRAGM

**Removal and Replacement** 7A-09-23

Special Tools required: MF 163 Wrench
MF 271 Draft Control Rod Gauge
MF 148A Pressure Test Kit.
MF 166 Adapter
MF 226A Lift Cover Remover and Replacer
MF 226A-3 Lift Cover Adapter
MF 269 Wrench
MF 270B Dashpot Piston Wedge
MF 271 Roller Tool
MF 272 Ram Arm Fixture
MF 273 Hydraulic Setting Fixture
1,36 Kg (3 lb) Weight
Torque Wrench
Feeler Gauge
Rule

**Removal**

1. Remove the pressure control valve as stated in operation 7A-07-22.
2. Remove the response control dashpot as stated in operation 7A-05-21.
3. Fig. 28. Loosen the locknut on the fulcrum bolt (41) and release the vertical lever (10).
4. Fig. 37. Remove the two screws (76) securing the diaphram assembly to the support bracket.
5. Disconnect the diaphragm pipe (38) from the diaphragm assembly and remove the pipe and the diaphragm assembly from the support bracket.
6. Disassemble the diaphragm assembly by removing the remaining two screws (76), rear housing (79), diaphragm (27), spring (78), and front housing (77).

Examine the diaphragm (27) for wear or damage and replace if necessary.

**Replacement**

1. Reassemble the spring (78), and the diaphragm (27) to the front housing (77) and secure the rear housing (79) to the front housing (77) with the two short screws (76).
2. Fig. 28. Position the diaphragm assembly in place on the support bracket and refit the diaphragm pipe (38) with a new 'O' ring, and secure the diaphragm assembly with the two screws as shown.
3. Refit the response control dashpot as stated in operation 7A-05-21.
4. Refit the pressure control valve as stated in operation 7A-07-22.

## CYLINDER, PISTON AND RAM ARM

**Removal and Refitment** 7A-10-23

Special Tools required: MF 163 Wrench
MF 271 Draft Control Rod Gauge
MF 148A Pressure Test Kit
MF 166 Adapter
MF 226A Lift Cover Remover and Replacer
MF 226A-3 Lift Cover Adapter
MF 269 Wrench
MF 270B Dashpot Piston Wedge
MF 271 Roller Tool
MF 272 Ram Arm Fixture
MF 273 Hydraulic Setting Fixture
MF 283 Ram Piston Assembly Ring
1,36 kg (3 lb) Hide Hammer
1,36 kg (3 lb) Weight
Torque Wrench
Feeler Gauge
Rule

**Removal**

1. Remove the lift cover as stated in operation 7A-03-16.
2. Remove the response control dashpot as stated in operation 7A-05-21.
3. Remove the pressure control valve as stated in operation 7A-07-22.
4. Fig. 27. Remove the position control spring (37) as shown.
5. Loosen the locknut on the vertical lever and release the lever.
6. Fig. 29. Fit a suitable retaining pin to the lower guide rod (20) to prevent the spring from being ejected
7. Remove the four nuts securing the ram cylinder (3) to the lift cover.
8. Lift the cylinder slightly and fit a suitable retaining pin to the upper guide rod (12) to prevent the spring from being ejected.
9. Fig. 30. Lift the cylinder (3) and support bracket (35) clear of the lift cover, taking care not to damage the vertical lever (10) or the diaphragm pipe (38).
10. Remove the connecting rod (4).
11. Fig. 34. Remove the retaining spring clip on the draft rod (15) pivot pin and remove the rod.
12. Release the tabwasher and remove the bolt and washer securing the R.H. lift arm (6, Fig. 1) to the lift shaft (47)and remove the arm.
13. Fig. 35. Drive the remaining lift arm and shaft (47) out of the lift cover and remove the ram arm (5).
14. Remove the two bolts and washers securing the support bracket to the cylinder.
15. Withdraw the piston, from the cylinder.

**Refitment**

1. If necessary replace the piston rings then reassemble the piston into the cylinder using tool MF 283.
2. Position the support bracket in place on the cylinder and secure it with the two bolts and washers.
3. Fig. 35. Position the ram arm (5) in the lift cover, apply Locktite Type AV or Casco Metalock ML15 to the threads, and screw the setscrew into the ram arm until engagement is made with the connecting rod, then slacken off the setscrew ¼ of a turn.
4. Slide the lift arm and shaft (47) with a new 'O' ring into the lift cover and ram arm (5), aligning the master spines on the shaft and ram arm.
5. Refit the remaining lift arm, with a new 'O' ring. aligning the master spline.
6. Release the tabwasher on the L.H. lift arm and slacken the securing bolt.
7. Refit the washer and securing bolt to the R.H. lift arm and fully tighten it, secure with a new tabwasher.
8. Tighten the L.H. bolt so that the lift arms just move freely through their travel with no lift shaft (47) end float, and secure with a new tabwasher.
9. Fig. 34. Refit the draft rod (15) securing it with a new spring retaining clip.
10. Fig. 30. Place the cylinder (3) and support bracket (35) assembly on the lift cover simultaneously locating the two guide rods (12 and 20) into their holes, the vertical link (10) upright as shown and relocate the connecting rod (4).
11. Fig. 29. Remove the upper guide rod (12) spring retaining pin.
12. Secure the cylinder assembly (3) to the lift cover with the four nuts tightened to a torque of 16,0 kg-m (120 lb-ft).
13. Remove the lower guide rod (20) spring retaining pin
14. Refit the pressure control valve as stated in operation 7A-07-22.
15. Refit the response control dashpot as stated in operation 7A-05-21.
16. Fig. 27. Refit the position control spring (37).
17. Refit the lift cover as stated in operation 7A-03-16.

## LINKAGE

**Removal and Refitment** 7A-11-24

Special Tools required:
MF 163 Wrench
MF 271 Draft Control Rod Gauge
MF 148A Pressure Test Kit
MF 166 Adapter
MF 226A Lift Cover Remover and Replacer
MF 226A-3 Lift Cover Adapter
MF 269 Wrench
MF 270B Dashpot Piston Wedge
MF 271 Roller Tool
MF 272 Ram Arm Fixture
MF 273 Hydraulic Setting Fixture
1,36 Kg (3 lb) Weight
Torque Wrench
Feeler Gauge
Rule

**Removal.**

1. Remove the lift cover as stated in operation 7A-03-16
2. Remove the pressure control valve as stated in operation 7A-07-22
3. Remove the response control valve as stated in operation 7A-05-21
4. Fig 27 Remove the position control spring (37) as shown.
5. Fig 29 Fit a suitable retaining pin to the lower guide rod (20) to prevent the spring from being ejected.
6. Remove the four nuts securing the ram cylinder (3) to the lift cover
7. Lift the cylinder slightly and fit a suitable retaining pin to the upper guide rod (12) to prevent the spring from being ejected.
8. Fig 30. Lift the cylinder (3) and support bracket (35) clear of the lift cover, taking care not to damage the vertical lever (10) or the diaphrapm pipe (38).
9. Fig 31. Remove the Allen screw (42) retaining the quadrant (43) in the lift cover.
10. Fig 32. Withdraw the quadrant (43) from the lift cover simultaneously removing the vertical lever (10) and cams (8 and 18).
11. Fig. 33 Remove the plug (44) in the L.H. side of the lift cover to enable the linkage pivot shaft (46) to be removed.
12. Remove the Allen screw (45).
13. Fig 34. Withdraw the linkage pivot shaft (46) as shown and remove the remaining links (12, 15 and 18, then 20 and 16).

**Refitment**

1. Refit the position control linkage (16 and 20), the draft control linkage (48, 15 and 12), then refit the linkage pivot shaft (46) as shown.
2. Fig 32. Refit the vertical lever (10) and cams (8 and 18) simultaneously refitting the quadrant (43) into the lift cover.
3. Fig 31. Secure the quadrant in the lift cover with the Allen Screw (42).
4. Fig 33. Making sure that the linkage pivot pin (46) is hard against the lift cover, secure the pin (46) with the Allen screw (45).
5. Refit the plug in the L.H. side of the lift cover.
6. Fig 30. Place the cylinder (3) and support bracket (35) assembly on the lift cover simultaneously locating, the two guide rods (12 & 20) into their holes, the vertical link (10) upright as shown and relocate the connecting rod (4).

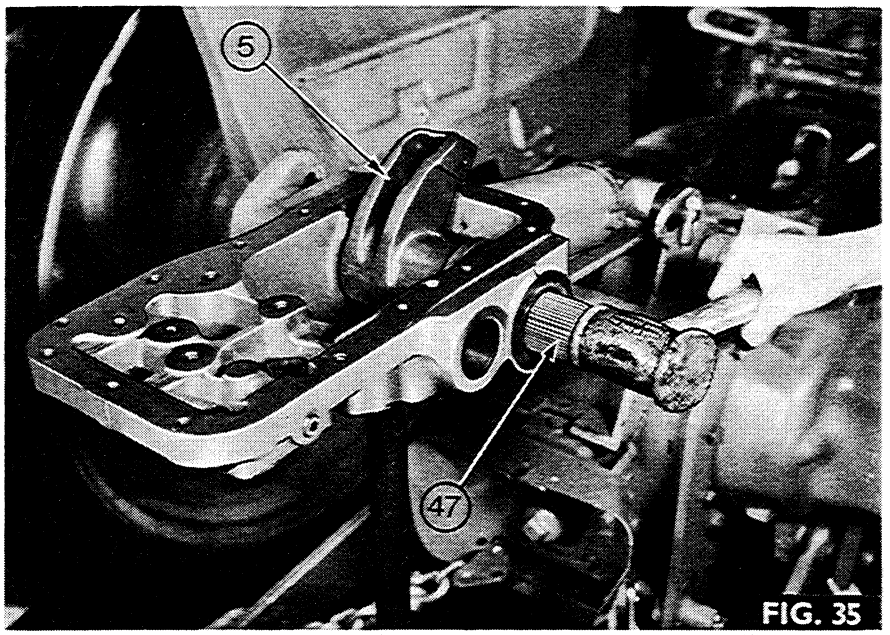


FIG. 35

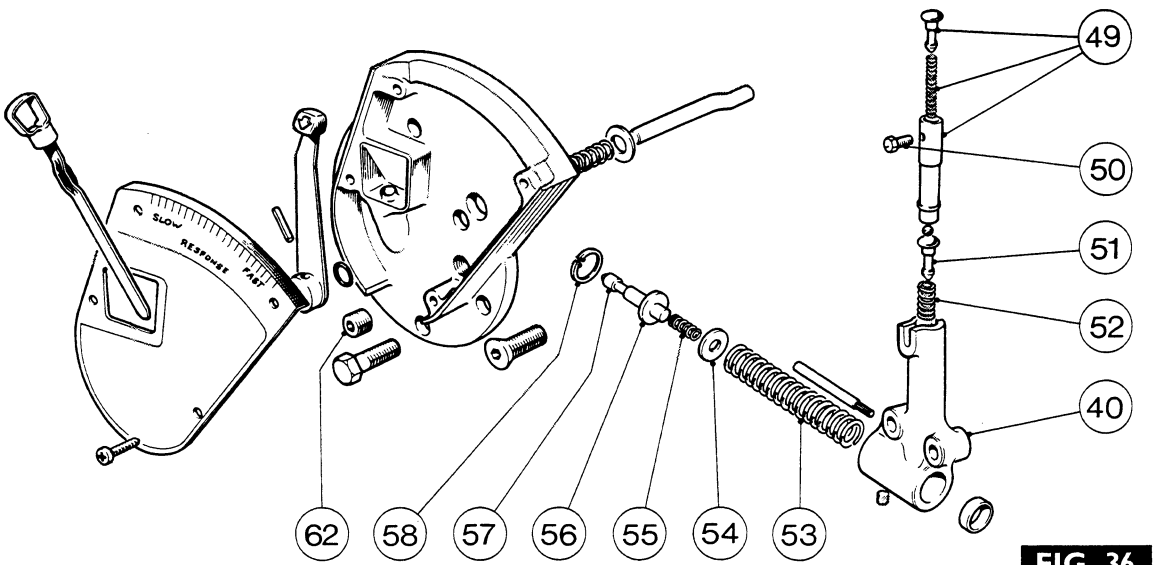


FIG. 36

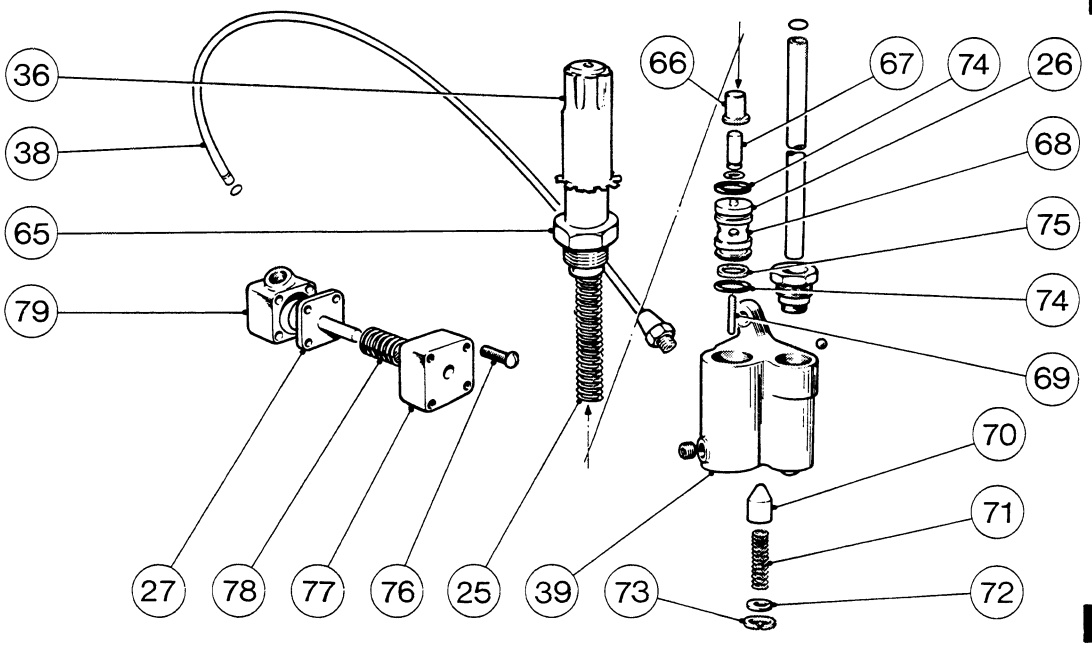


FIG. 37

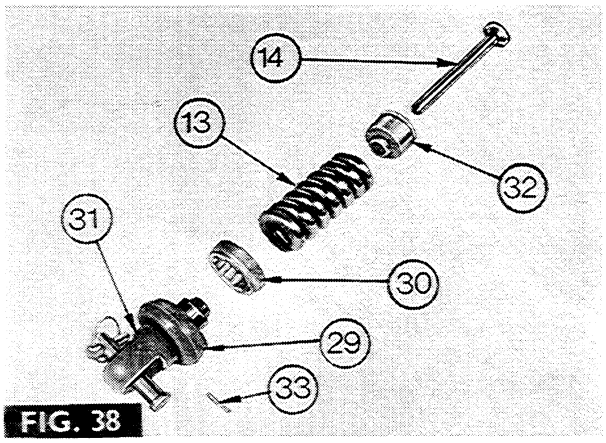


FIG. 38

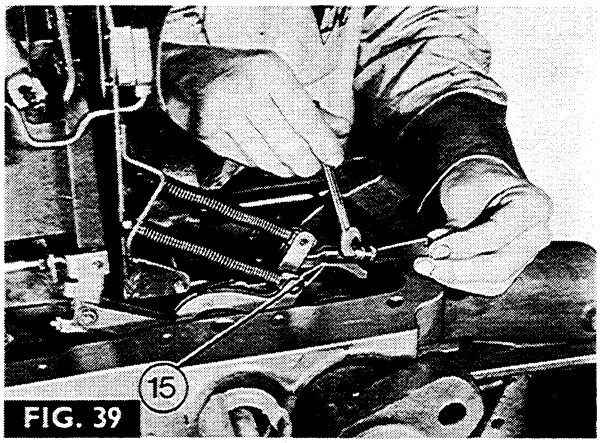


FIG. 39

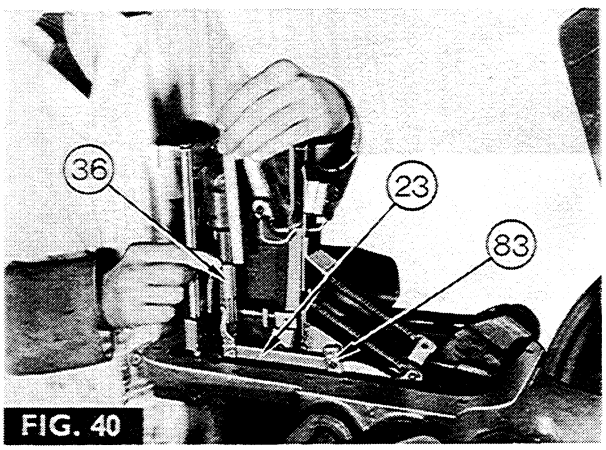


FIG. 40

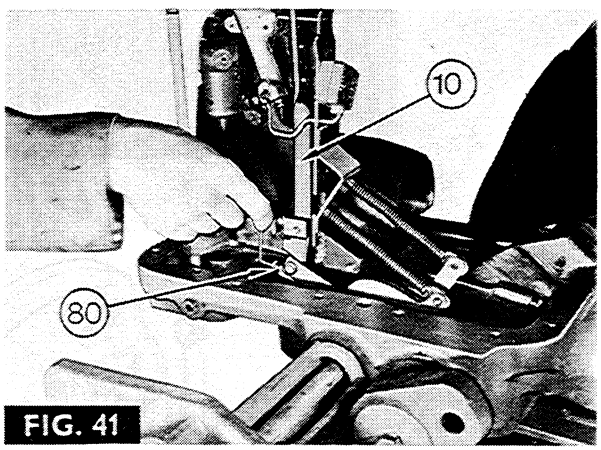


FIG. 41

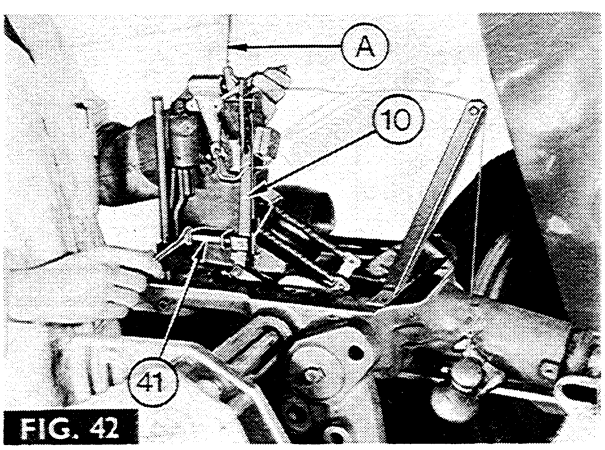


FIG. 42

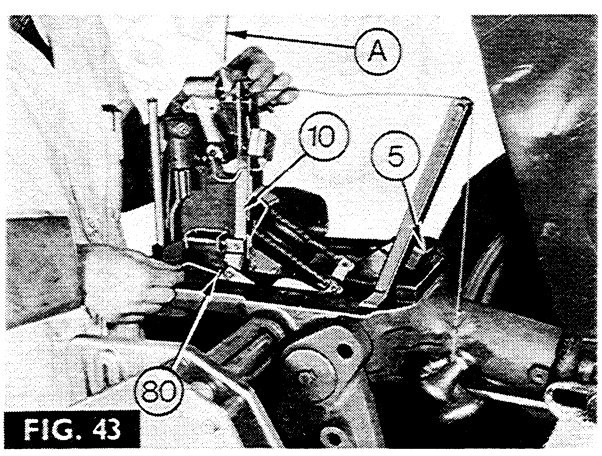


FIG. 43

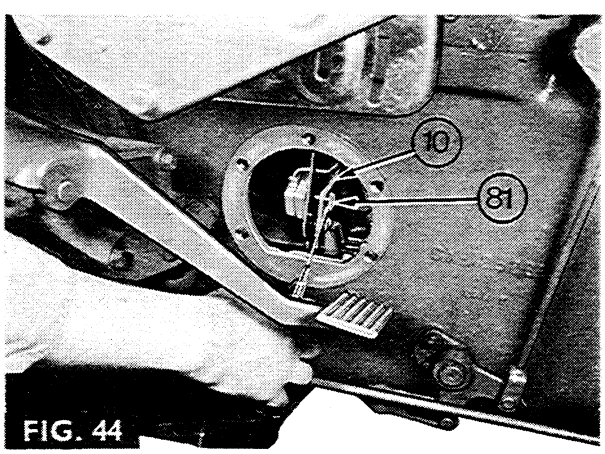


FIG. 44

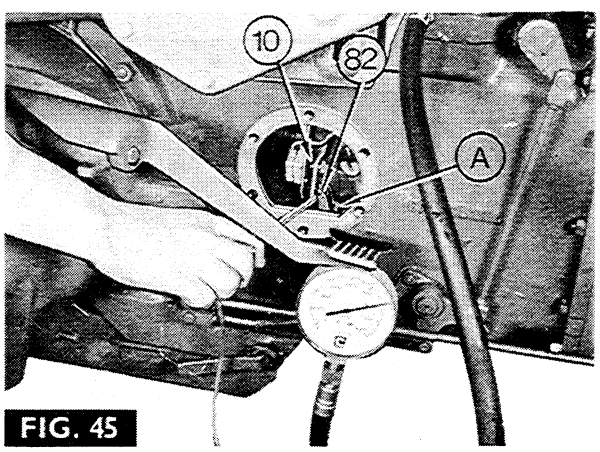


FIG. 45

7. Fig 29. Remove the upper guide rod (12) spring retaining pin.
8. Secure the cylinder assembly (3) to the lift cover with the four nuts tightened to a torque of 16,0 kg-m. (120 lb-ft).
9. Remove the lower guide rod (20) spring retaining pin.
10. Refit the response control dashpot as stated in operation 7A-05-21.
11. Refit the pressure control valve as stated in operation 7A-07-22.
12. Fig 27. Refit the position control spring (37) as shown.
13. Refit the lift cover as stated in operation 7A-03-16

## HYDRAULIC ADJUSTMENTS

**External and Internal** 7A-12-27

Special Tools required:
MF 163 Wrench
MF 271 Draft Control Rod Gauge
MF 148A Pressure Test Kit
MF 166 Adapter
MF 226A Lift Cover Remover and Replacer
MF 226A-3 Lift Cover Adapter
MF 269 Wrench
MF 270B Dashpot Piston Wedge
MF 271 Roller Tool
MF 272 Ram Arm Fixture
MF 273 Hydraulic Setting Fixture
1,36 Kg (3 lb) Weight
Torque Wrench
Feeler Gauge
Rule

**External Adjustments**

*Control Spring Internal and External End Float*

1 Remove the control spring as stated in operation 7A-01-15.
2 Fig 38. Drive out the pin (33) and screw the plunger (14) into the head (31) until all the end float is eliminated and the spring (13) is tight to turn by hand.
3. Fit new securing pin (33), and refit the Control Spring Assembly as stated in operatin 7A-01-15.

*Lift Arm End Float.*

1. Release the L.H. lift arm tabwasher and slacken the retaining bolt.
2. Fully tighten the R.H. lift arm retaining bolt and secure with a new tabwasher.
3. Tighten the L.H. retaining bolt, so that the lift arms just move freely through their travel with no lift shaft end float, and secure with a new tabwasher.

*Quadrant Location.*

1. Slacken the two bolts securing the quadrant to the support.
2. Turn the position and pressure control quadrant to the central position of the bolt holes and retighten the two bolts.

*Draft Control Rod.*

1. Remove the lift cover as stated in operation 7A-03-16.
2. Place the draft control lever in the fully raised position.
3. Fig 39. With the draft control rod held against the control spring plunger by the linkage retain spring, adjust the setscrew on the draft control rod assembly (15), using tool MF 333 as shown, so that the clearance between the setscrew head and the lift cover casting is 5,8 mm (0.230 in).

*Draft Control*

1. Place the position control lever in the fully lowered position.
2. Figs. 37 and 40. Remove the split pin (83) retaining the pressure control linkage (23) to the support bracket, and remove the linkage complete with adjustment tube (36) spring (25) and spring guide (66).
3. Fig 41. Slacken the locknut and unscrew the socket screw (80) on the vertical link (10) to the end of its thread as shown.
4. Place the draft control lever between the two sector marks on the quadrant.
5. Place the position control lever in the Transport position, making sure the stop is at the end of its travel.
6. Fig 42. Fit wedge tool MF270B (A) to the dashpot piston rod.
7. Position the weight frame tool MF 273 and apply a load of 1,36 Kg (3 lb) to the end of the vertical lever (10) as shown.
8. Adjust the lever fulcrum clevis bolt (41) until the gap between the end of the lever (10) and the dashpot piston rod is 0,051 to 0,102 mm (0.002 to 0.004 in).
9. Tighten the clevis bolt locknut and check the gap.

*Position Control.*

1. Place the draft control lever in the fully raised position.
2. Place the position and pressure control lever in the Transport position.
3. Fig 43. Fit wedge tool MF270B (A) to the dashpot piston rod.
4. Position tool MF 272 into the lift cover as shown, then locate the ram arm (5) onto the tool.
5. Position weight frame tool MF 273 and apply a load of 1,36 kg (3 lb) to the end of the vertical lever (10) as shown.
6. Adjust the socket screw (80) on the vertical lever (10) until the gap between the lever and the dashpot piston rod is 0,051 to 0,102 mm (0.002 to 0.004 in).
7. Tighten the locknut and check the gap.

*Pressure Control Spring.*

1. Fig 37. Refit the pressure control linkage complete with adjustment tube (36), spring (25) and spring guide (66) and secure with a new split pin (83 Fig 40).
2. Place the draft control lever in the fully raised position
3. Place the position and pressure control lever right down to the forward (low) end of the pressure range on the quadrant.
4. Fig 40. Hold the adjustment tube and pressure control lever assembly against the cam to remove end play, then turn the adjustment tube (36) until the distance between the bottom of the tube and the control valve body is 33,4 mm ($1\frac{5}{16}$ in).

**Internal Adjustments.**

1. Refit the lift cover as stated in operation 7A-03-16.
2. Fill the transmission with recommended oil to the level of the inspection aperure in the centre housing.
3. Attach a weight of 400 kg (900lb) to the lower links.
4. Fig 44. Slacken the upper knurled adjusting screw (81), on the vertical lever (10), right out of contact with the diaphragm plunger.
5. Place the draft control lever in the fully raised position.
6. Set the engine at 400-600 rpm and operate the position control lever through the quadrant range to expel all the air from the system.

*Valve Blow off Position and Drop Rate.*

1. Place the position and pressure control lever in the transport position.
2. Fig 45. Fit Wedge tool MF 270B (A) over the dashpot piston rod through the R.H. inspection aperture in the centre housing.

NOTE: – THE WEDGE TOOL MUST BE HELD FIRMLY IN POSITION WHEN MAKING ADJUSTMENTS.

3. Place the draft control lever in the fully lowered position.
4. Connect the pressure gauge MF 148A and adapter MF 166 to the tapped port.
5. Start the engine and set the engine speed at 400 to 600 rpm.
6. Screw in the lower knurled adjustment screw (82) on the vertical lever (10) as shown, until the weighted lower links have risen fully and pressure control valve starts to blow off and a gauge reading of approximately 208 to 218 kg/cm$^2$ (2950 to 3100 lb/in$^2$) is obtained.
7. Fig 46. Scribe a line (A) on the lift cover and lift arm, to indicate the start of valve blow off.
8. Scribe two more lines (B) on the lift cover 3,2 mm ( in) apart, and about 12,7 mm (½ in) back from the line (A) as shown.
9. Turn the lower adjustment screw (82) out until the time taken for the scribe line (A) on the lift arm to pass between the two scribe lines (B) on the lift cover is five seconds. (This is equivalent to a rate of drop of 25,4 mm (1 in) per five seconds at the ends of the lower links).
10. Fully raise the draft control lever and remove the wedge tool MF 270B (A).

*Transport Limit Stop.*

1. Place the transport limit stop on the quadrant at the end of its travel.
2. Move the position and pressure control lever up against the stop.
3. Slacken the two bolts securing the quadrant to the support.
4. Turn the position and pressure control quadrant, NOT the draft control quadrant, until the lines (A) are 1,6 to 3,2 mm(1/16 to 1/8 in) apart.
5. Retighten the quadrant bolts.

*Pressure Control Final Adjustments.*

1. Place the position and pressure control lever in the Constant pump position.
2. Fig 47. Screw in the upper knurled adjustment screw (81) on the vertical lever (10) as shown, until the lever (10) moves rapidly from side to side and the needle on the gauge MF 148A begins to fluctuate excessively.
3. Turn out the screw (81) until, the lever (10) is steady, the least amount of fluctuation is shown by the gauge needle, and as little oil as possible comes from the pressure control valve.
4. If the pressure reading on the guage is not within 208 to 218 kg/cm$^2$ (2950 to 3100 lb/in$^2$); place the position and pressure control lever in the low end of the pressure range on the quadrant.
5. Adjust the pressure control spring tube (up to decrease and down to increase the pressure), until the correct gauge reading is obtained in constant pumping.
6. Recheck the vertical lever (10). See items 2 and 3.
7. Remove the gauge MF 148A and adapter MF 166 and refit the plug.

*Response Control*

1. Fig 48. Compress the cap into the plunger and using tool MF 269 tighten the setscrew to a torque of 0,28 to 0,42 kg m (2 to 3 lb-ft) as shown.
2. Fig 49. Refit the response control plate (60) with a new gasket and secure with the five bolts (61) and one screw (59).
3. Remove the plug (62) from the plate as shown.
4. Fig 50. Using tool MF 269 as shown, slaken the setscrew to allow the spring to force the plunger head upwards.
5. Place the response lever 6 mm (¼in) from the 'slow' position and retighten the setscrew to a torque of 0,28 to 0,42 kg m (2 to 3 lb-ft).
6. Refit the plug and the response cover plate.
7. Refit the R.H. footplate.
8. Add oil to the transmission until the required level is reached
9. Carry out Hydraulic Test Procedure as stated in operation 7A-13-28.

## HYDRAULIC TEST PROCEDURE 7A-13-28

The following test procedure is used for checking the accuracy of the adjustments previously carried out in operation 7A-12-27, with the tractor completely assembled.

Special Tools required: MF 148A Pressure Test Kit
MF 166 Adapter.
Rule.

1. Attach a weight of 400 kg (900 lb) to the lower links.
2. Connect the pressure gauge MF 148A and adapter MF 166 to one of the tapped ports on the lift cover.
3. Start the engine and set the engine speed at 400 to 600 rpm.
4. Place the response control lever in the FAST position.
5. Place the draft control lever in the fully raised position.
6. Place the position control lever in the transport position.
7. Rapidly raise and lower the weight several times using the position control lever, to expel air from the system.

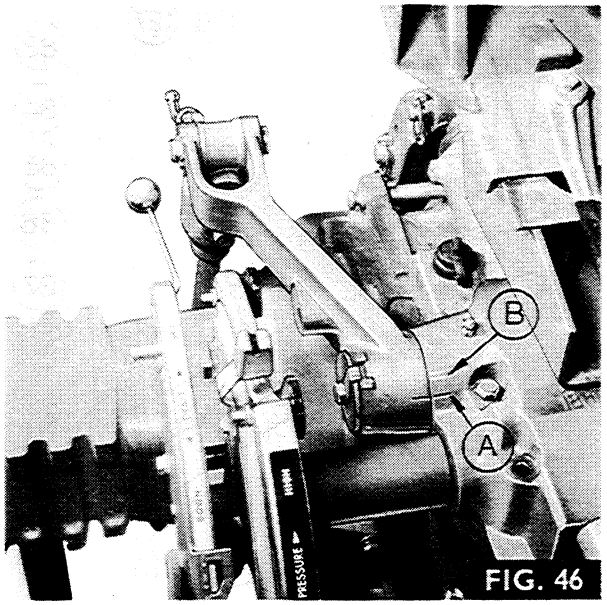


FIG. 46

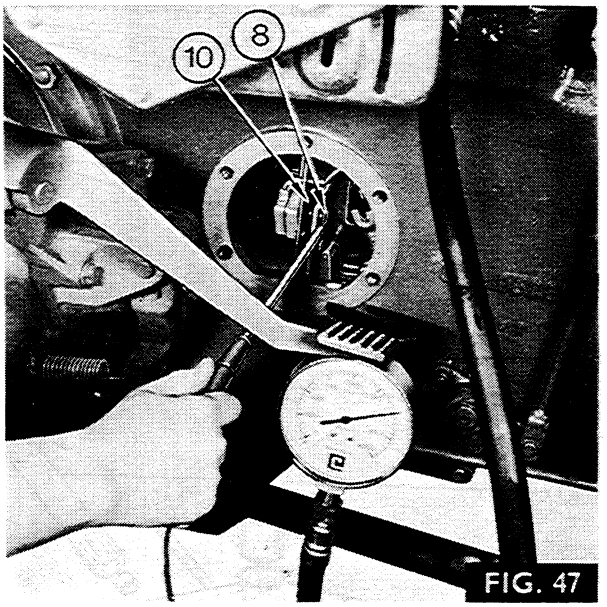


FIG. 47

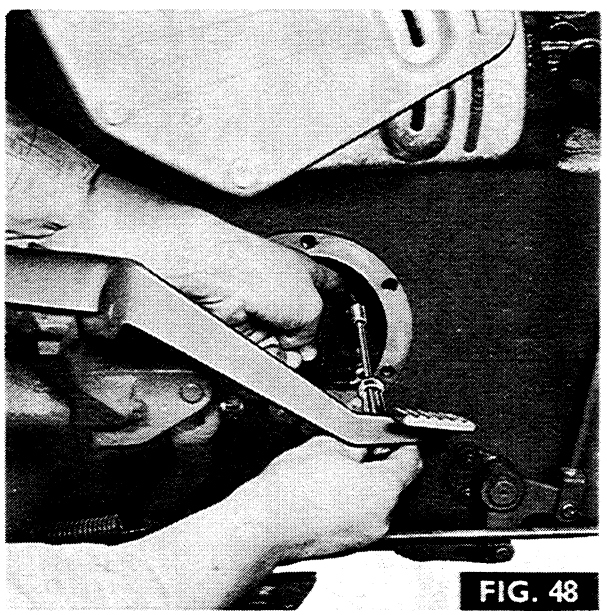


FIG. 48

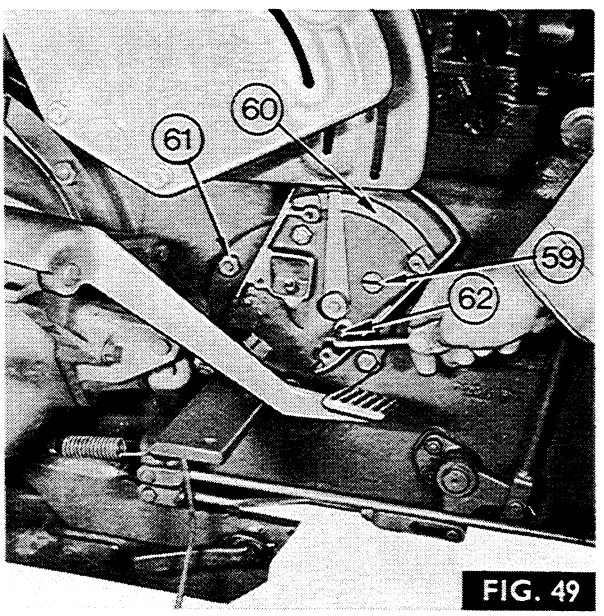


FIG. 49

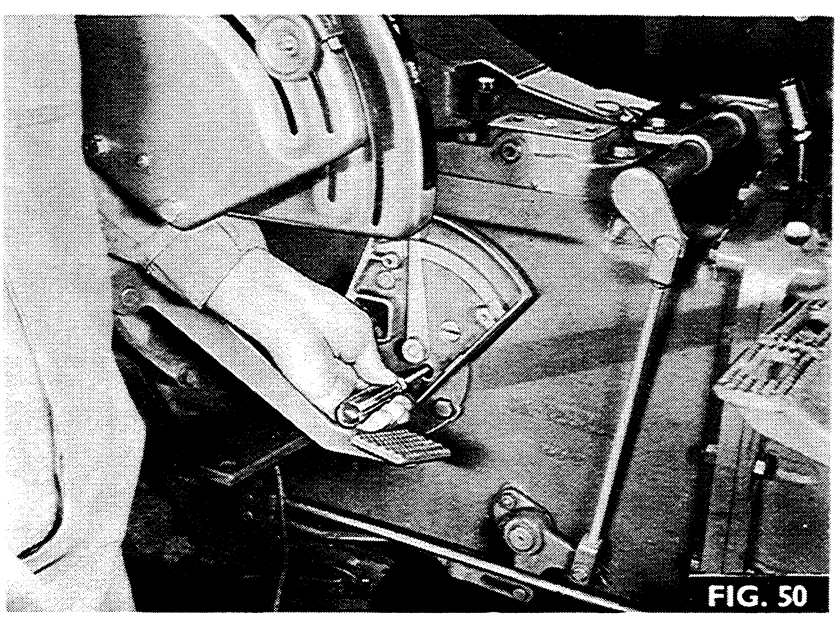


FIG. 50

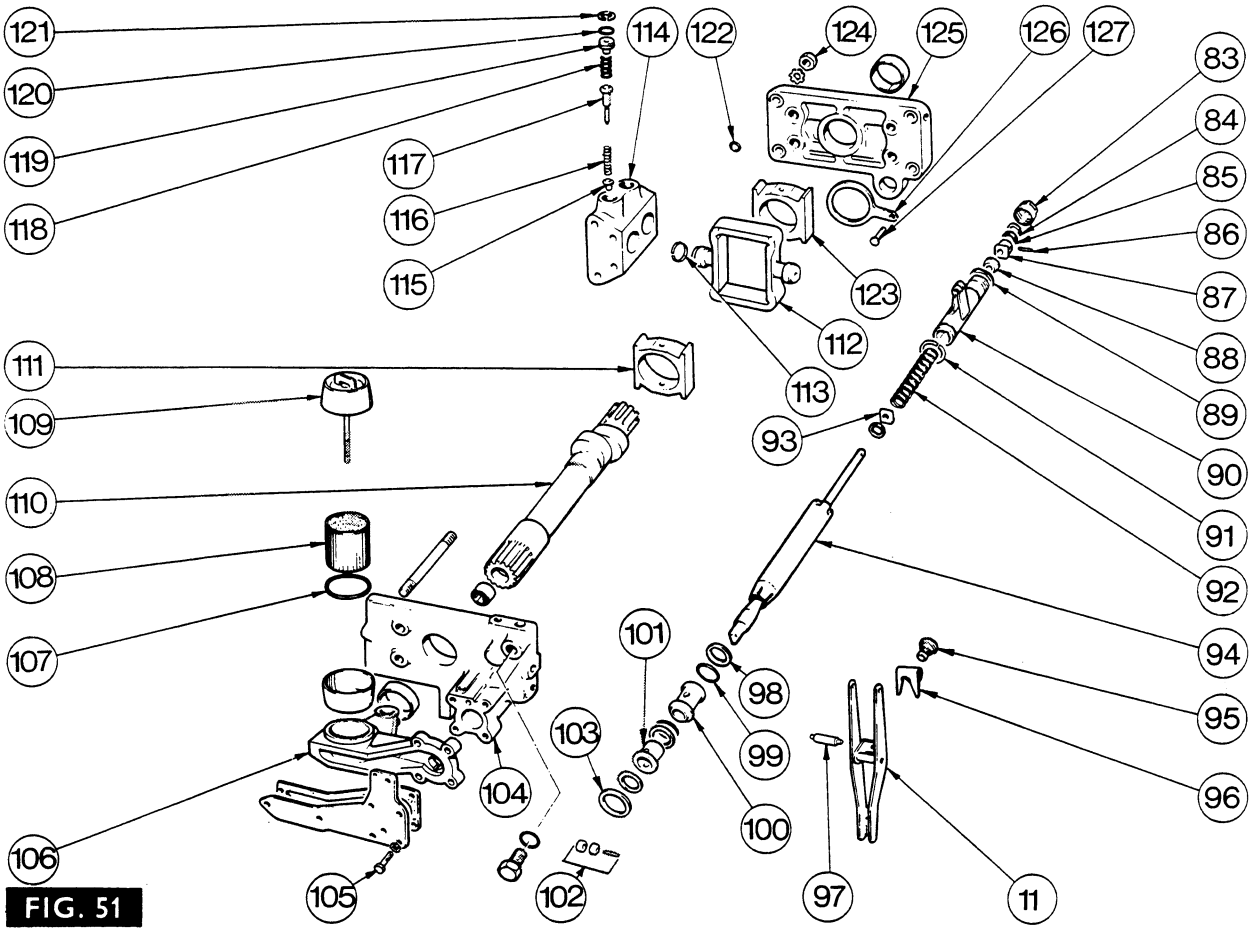



FIG. 51

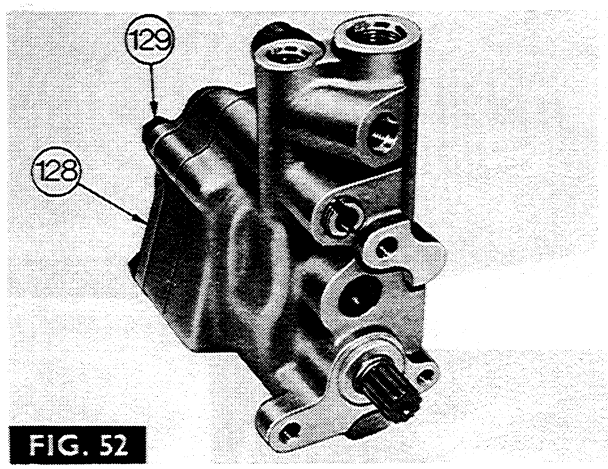



FIG. 52

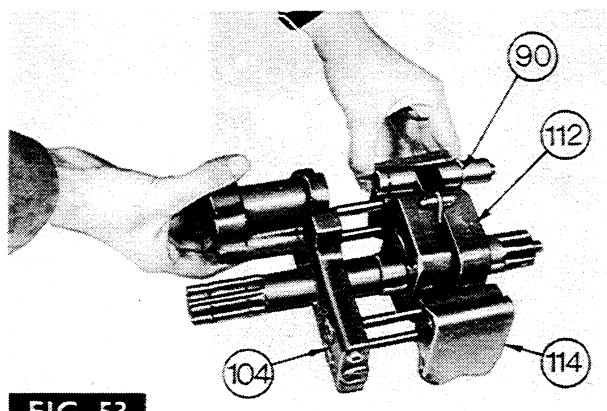



FIG. 53

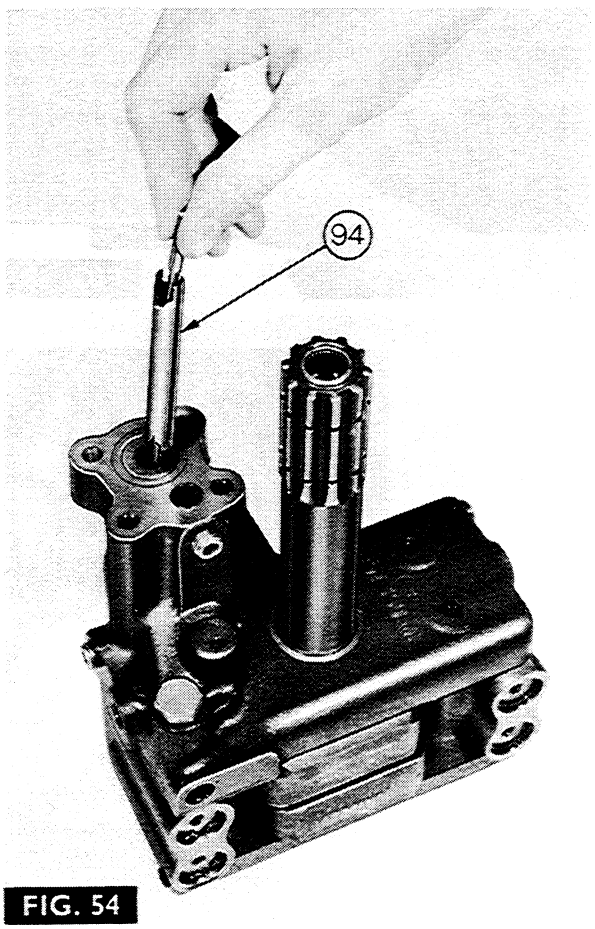



FIG. 54

*Position Control Test.*

1. Move the position and pressure control lever into the constant pumping sector on the quadrant, a gauge reading of 208 to 218 kg/cm$^2$ (2950 to 3100 lb/in$^2$) should be obtained.
2. Move the lever past the transport position to lower the weight, then return the lever to the transport position against the stop, the scribe lines (A) (Fig. 46) should be 1,6 to 3,2 mm (1/16 to 1/8 in) apart.
3. With the response control lever at FAST and then at SLOW, it must be possible, using the position control lever, to raise, lower and hold the weight at any pre-selected height throughout the full range of lower link travel. Any tendency to creep beyond a pre-selected height indicates internal friction or a sticking control valve.
4. Place the response control lever at 'SLOW'.
5. Place the position control lever in transport.
6. Check that the lower links rise to the correct height, scribe lines separated 1,6 to 3,2 mm (1/16 to 1/8 in). Any tendency to creep up beyond this point indicates that the dashpot is preventing the pump from shutting off and the vertical lever assembly is mis-adjusted.

*Draft Control Test.*

1. Place the position control lever in transport.
2. Check that the weight can be raised and lowered with the draft control lever.
3. Place the response control lever at SLOW, then fully raise the draft control lever.
4. Check that the lower links rise to the correct height, scribe lines separated 1,6 to 3,2 mm (1/16 to 1/8 in), without creeping up beyond this point.
5. With the weight fully supported on the lower links, move the draft control lever and find the position at which the lower links neither raise nor lower. At this point, the draft control lever must be between the sector marks in the quadrant within 6,4 mm (1/4 in).

*Response Control Test*

1. Place the response control lever at 'SLOW'
2. Place the draft control lever in the fully raised position.
3. Rapidly lower the draft control lever and note the time taken for the weighted lower links to fall from the fully raised position to the horizontal position. The drop times must be:

| Oil Temperature | Minimum Drop Time In Seconds |
|---|---|
| 16°C ( 60°F) | 6 |
| 27°C (80°F) | 4 |
| 38°C (100°F) | 3 |
| 49°C (120°F) | 2,5 |

4. Moving the response control lever progressively from SLOW to FAST, should result in a corresponding increase in the drop rate of the weighted lever links when the draft control lever is rapidly lowered. With the response control lever at FAST, the maximum drop time should be one second at an oil temperature of 49°C (120°F).

*Linkage Radial Drop Test.*

1. Fully raise the weighted lower links by placing the position control lever at transport.
2. Stop the engine.
3. Check that the lift arms continue to support the weight, and that after three minutes the lift arms do not fall more than 8 mm (5/16 in), measured between the scribe times (A Fig 46) using recommended oil at 38°C (100°F) minimum.

## HYDRAULIC PUMP

**Removal and Refitment** 7A-14-31

Special Tools required:
MF 163 Wrench
MF 271 Draft Control Rod Gauge
MF 148A Pressure Test Kit
MF 166 Adapter
MF 226A Lift Cover Remover and Replacer
MF 226A-3 Lift Cover Adapter
MF 269 Wrench
MF 270B Dashpot Piston Wedge
MF 271 Roller Tool
MF 272 Ram Arm Fixture
MF 273 Hydraulic Setting Fixture
1,36 Kg (3 lb) Weight
Torque Wrench
Feeler Gauge
Rule

**Removal**

1. Remove the lift cover as stated in operation 7A-03-16.
2. Remove the p.t.o. shaft as stated in Part 5.
3. Remove the L.H. footplate.
4. Remove the L.H. side cover plate as stated in Part 5.
5. Fig 51. Release the locking wire on the stainer head (109) and remove the head, filter (108) and sealing ring (107).
6. Remove the split pin from the shear tube, remove the tube and the rear drive shaft.
7. Disconnect the L.H. and R.H. brake rods at the front clevis pins.
8. Disconnect the L.H. and R.H parking brake rods at the cross shaft
9. Remove the two nuts each side securing the two dowel pins and remove the pins
10. Fig 52. Remove the four bolts (129) and spring washers securing the end plate (128) to the auxilary pump (if fitted).
11. Remove the end plate (128) and then the feed pipe.

## HYDRAULIC SYSTEM

NOTE: – DO NOT USE A SCREWDRIVER OR ANY SHARP OBJECT TO PRISE THE END PLATE OFF THE PUMP AS DAMAGE WILL OCCUR.

12. Disconnect the multi-power feed pipe at the auxiliary pump (if fitted).
13. Move the hydraulic pump rearwards and manoeuvre the auxiliary pump (if fitted) complete with the plated drive out of the housing.
14. Manoeuvre the hydraulic pump, tailshaft first, out of the housing.

**Refitment**

1. Place the hydraulic pump in the rear of the centre housing

NOTE: – BEFORE REFITTING THE AUXILIARY PUMP (IF FITTED) AND END PLATE ENSURE THAT THE END PLATE IS NOT SCORED OR DAMAGED, AND REPLACE IF NECESSARY.

2. Place the auxiliary pump (if fitted) into the centre housing and position it in place on the hydraulic pump.
3. Refit the feed pipe, with a new 'O' ring
4. Fig 52. Refit the end plate (128), with a new seal, and secure with the four bolts (129) and spring washers.
5. Slide both pumps rearwards to enable the end plate securing bolts to be tightened to a torque of 5,5 kg m (40 lb-ft).
6. Refit both pumps into position.
7. Place the p.t.o. gear into position and refit the p.t.o. shaft as stated in Part 5.
8. Refit the two dowel pins with new 'O' rings and secure with the two nuts each side.
9. Refit the parking brake rods and secure with the clevis pins and new split pins.
10. Refit the L.H. and R.H. brake rods and secure with the clevis pins and new split pin.
11. Fig 51. Fit a new sealing ring (107) and filter (108) and refit the strainer head (109), securing it with locking wire.
12. Refit the p.t.o. side cover as stated in Part 5, also refit the clutch pedal and the L.H. footplate to the side cover.
13. Reconnect the multi-power feed pipe to the auxiliary pump (if fitted).
14. Refit the rear drive shaft and shear tube and locate the split pin to give 0,38 to 2,54 mm (0.015 to 0.100 in) end float.
15. Refit the lift cover as stated in operation 7A-03-16.

**HYDRAULIC PUMP SERVICING** 7A-15-32

Special Tools required:
MF 163 Wrench
MF 271 Draft Control Rod Gauge
MF 148A Pressure Test Kit
MF 166 Adapter
MF 226A Lift Cover Remover and Replacer
MF 226A-3 Lift Cover Adapter
MF 196B Valve Seat Cutter Tool
MF 269 Wrench
MF 270B Dashpot Piston Wedge
MF 271 Roller Tool
MF 272 Ram Arm Fixture
MF 273 Hydraulic Setting Fixture
1,36 Kg (3 lb) Weight
Torque Wrench
Feeler Gauge
Rule

**Disassembly.**

1. Remove the hydraulic pump as stated in operation 7A-14-31.
2. Remove the control valve as stated in operation 7A-16-33.
3. Fig 51. Remove the four nuts (124) and washers and detach the front body assembly (125).
4. Fig 53. Withdraw the two valve chambers (114), from the rear body assembly (104), complete with the front cam block (123), pistons (112), cam follower (126) and oscillator assembly (90) and rear cam block (111) as shown.
5. Fig 51. Separate the valve chabers (114) from the pistons (112) and remove the cam blocks (111 and 123) from the pistons.
6. Withdraw the camshaft (110) from the rear body assembly (104).
7. Dismantle the oscillator assembly (90) by removing the snap ring (84), collar (87), guide (88), spring (92), and retainer disc (93).
8. If necessary remove the split pin and clevis pin (127) retaining the cam follower (126) to the oscillator assembly.
9. Dismantle each valve chamber by removing the retaining ring (121) 'O' ring (120) plug (119), outlet valve spring (118) outlet valve (117) inlet valve spring (116) and inlet valve (115).

Examine all parts for wear; damage, scoring or pitting and replace if necessary.

**Reassembly.**

1. Recut the valve seats in the valve chambers (114) if necessary, using tool MF 196B.
2. Refit the inlet valve (115), inlet valve spring (116), outlet valve (117), outlet valve spring (118), plug (119), 'O' ring (120) and secure with a new retaining ring (121).
3. Refit the retainer disc (93), spring (92), guide (88) and roller (87) with the oscillator and secure with a new snap ring (84).
4. Secure the cam follower to the oscillator with the clevis pin (127) and a new split pin.
5. Fit new 'O' rings (122) into place on the front and rear bodies (104 and 125)
6. Refit the valve chambers (114) onto the pistons, with new piston rings (113) if necessary.
7. Place the cam follower (126) between the pistons.
8. Place the camshaft (110), with the front and rear cam blocks (111 and 123) into the pistons.
9. Refit the rear body (104) making sure the oscilator housing aligns with the aperature in the rear body.
10. Refit the front body (125) and secure it with the four nuts (124) and washers, tightened to a torque of 4,8 kg m (35 lb-ft).
11. Refit the control valve as stated in operation 7A-16-33.
12. Refit the hydraulic pump as stated in operation 7A-14-31.

## CONTROL VALVE

**Removal and Refitment** 7A-16-33

Special Tools required: MF 163 Wrench
MF 271 Draft Control Rod Gauge
MF 148A Pressure Test Kit
MF 166 Adapter
MF 226A Lift Cover Remover and Replacer
MF 226A-3 Lift Cover Adapter
MF 269 Wrench
MF 270B Dashpot Piston Wedge
MF 271 Roller Tool
MF 272 Ram Arm Fixture
MF 273 Hydraulic Setting Fixture
1,36 Kg (3 lb) Weight
Torque Wrench
Feeler Gauge
Rule

**Removal.**

1. Remove the hydraulic pump as stated in operation 7A-14-31.
2. Fig 51. Remove the clip (96) and stud (95), lever (11) and the two rollers and pin (102).
3. Remove the four bolts (105) and washer securing the oil strainer housing (106) to the pump, and detach the housing.
4. Remove the oscillator body cap (83) and retaining ring (85).
5. Extract the pin (86) from the collar (87) and the oscillator drive rod in the control valve (94).
6. Fig. 54. Withdraw the control valve (94) from the pump as shown.
7. Fig. 51. Remove the spacer washer (103), washer (98), intake chamber (101), washer (98), 'O' ring (99), discharge chamber (100), 'O' ring (99) and washer (98) from the pump.

*Examination*

Fit the three washers (98) to the control valve (94) and check that the diametral clearance between each washer and the valve is 0,0051 to 0,0102 mm (0.0002 to 0.0004 in), then remove the washers from the valve.

**NOTE** – ANY PARTS WHICH SHOW SIGNS OF WEAR, SCORING OR PITTING MUST BE REPLACED.

**Refitment.**

1. Refit the following parts into the rear body of the pump in this order. Washer (98), 'O' ring (99), discharge chamber (100), 'O' ring (99), washer (98), intake chamber (101), washer (98), spacer washer (103).
2. Insert the valve assembly (94) into the pump, centralising the valve into the three washers (98). Operate the valve to ensure centralisation.
3. Refit the pin (86) to the collar (87) and oscillator drive rod in the control valve.
4. Secure the pin (86) with the retaining ring (85) fitted to the groove in the collar (87).
5. Refit the oscillator body cap (83).
6. Refit the oil strainer housing (106) to the pump and secure with the four bolts (105) and washers.
7. Refit the lever (11) and secure it to the control valve with the two rollers and pin (102).
8. Refit the stud (95) and clip (96).
9. Fit a new sealing ring (107) and filter (108), refit the strainer head (109) and secure with locking wire.
10. Refit the hydraulic pump as stated in operation 7A-14-31.

# HYDRAULIC SYSTEM (MARK III PUMP)

## PART 7 SECTION A

## HYDRAULIC SYSTEM (MARK III PUMP)

### GENERAL

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

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

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

The hydraulic pump is driven by the p.t.o. drive from the p.t.o. clutch plate, via the gearbox constant mesh gears and the p.t.o. drive shaft whose splines engage in the front end of the pump.

Dowel pegs, fitted through each side of the centre housing, prevent the pump from rotating.

Mounted on the right hand rear end of the pump is a control valve (9), which meters the quantity of oil being fed to the pump pistons and also allows oil to return from the ram cylinder. An oscillator, attached to the pump camshaft partially rotates the control valve to prevent it from sticking in its sleeve.

When using Draft Control, movement of the lever down the quadrant actuates the internal linkage which moves the control valve to the discharge position. As the implement enters the ground a force down the top link actuates the internal linkage which moves the control valve to the neutral position. Any variation in the force down the top link moves the control valve to the intake and the discharge positions, maintaining the implement at the pre-set depth. When the lever is fully raised the control valve moves to the full intake position, and when the lift arms reach their transport position, the Position Control linkage moves the valve to the neutral position.

When using Position Control, movement of the lever down the quadrant actuates the internal linkage which moves the control valve to the discharge position. As the lift arms lower, the cam on the ram arm actuates the internal linkage which moves the control valve to the neutral position. When the TRANSPORT position is selected the control valve moves to the full intake position, and when the lift arms reach their transport position, the cam actuates the internal linkage which moves the control valve to the neutral position.

Response Control, incorporated in the pump, regulates the speed that the control valve moves to the discharge position, and therefore can control the initial rate of flow from the ram cylinder and the speed of drop of an implement. Movement of the Response Control lever actuates an internal slide valve (11), which varies the size of an orifice in the intake gallery, from which oil can escape. When the control valve moves to the discharge position, oil has to be displaced from the intake gallery. The oil is prevented from returning through the strainer by a non-return valve (8), therefore it must pass through the inlet gallery orifice. The slide valve (11) controls the size of the orifice and therefore the speed of movement of the control valve.

The Pressure Control system enables the pressure in the ram cylinder to be regulated from 7 to 179 kg/cm$^2$ (100 to 2550 lb/ft$^2$)—MF 148 Tractor and 7 to 211 kg/cm$^2$ (100 to 3000 lb/in$^2$)—MF 165, 168, 185 and 188 Tractors. One of the uses for this system is with semi-trailed implements fitted with depth control wheels. By suitable adjustment of the Pressure Control lever, part of the weight of the implement is supported by the tractor linkage, thus obtaining weight transfer to the tractor rear wheels and increasing traction.

The Pressure Control valve (12) consists of a ball valve, held on a seat by a spring, a secondary relief valve and a diaphragm.

Setting the Pressure Control lever in the LOW position moves the control valve, under the influence of its spring, to the intake position. The pump supplies oil to the ram cylinder, and the lower links rise until the Pressure Control Coupler chain becomes tight. As the chain prevents the lower links from lifting any higher a pressure is created in the system, which moves the control valve towards neutral to reduce the flow. The excess oil escapes through the secondary relief valve.

Moving the Pressure Control lever towards the HIGH position, for more weight transfer, increases the pressure on the spring which seats the ball. Oil in the diaphragm escapes through the secondary relief valve and the diaphragm allows the control valve to move to the full intake position. The pump provides the increase in pressure until the ball valve is lifted. When the desired increase in pressure is achieved, oil enters the diaphragm which moves the control valve to a reduced flow situation.

As the tractor travels over undulations the lower links will rise and fall. When the lower links are pulled down, the excess oil is expelled through the secondary relief valve. When the Pressure Control Coupler Chain goes slack, the pressure in the system drops. Oil escapes from the diaphragm through the secondary relief valve and the control valve moves to the intake position. The lower links quickly rise and re-tension the chain, which again builds up the pressure and lifts the ball valve, and the diaphragm moves the control valve to reduce the flow.

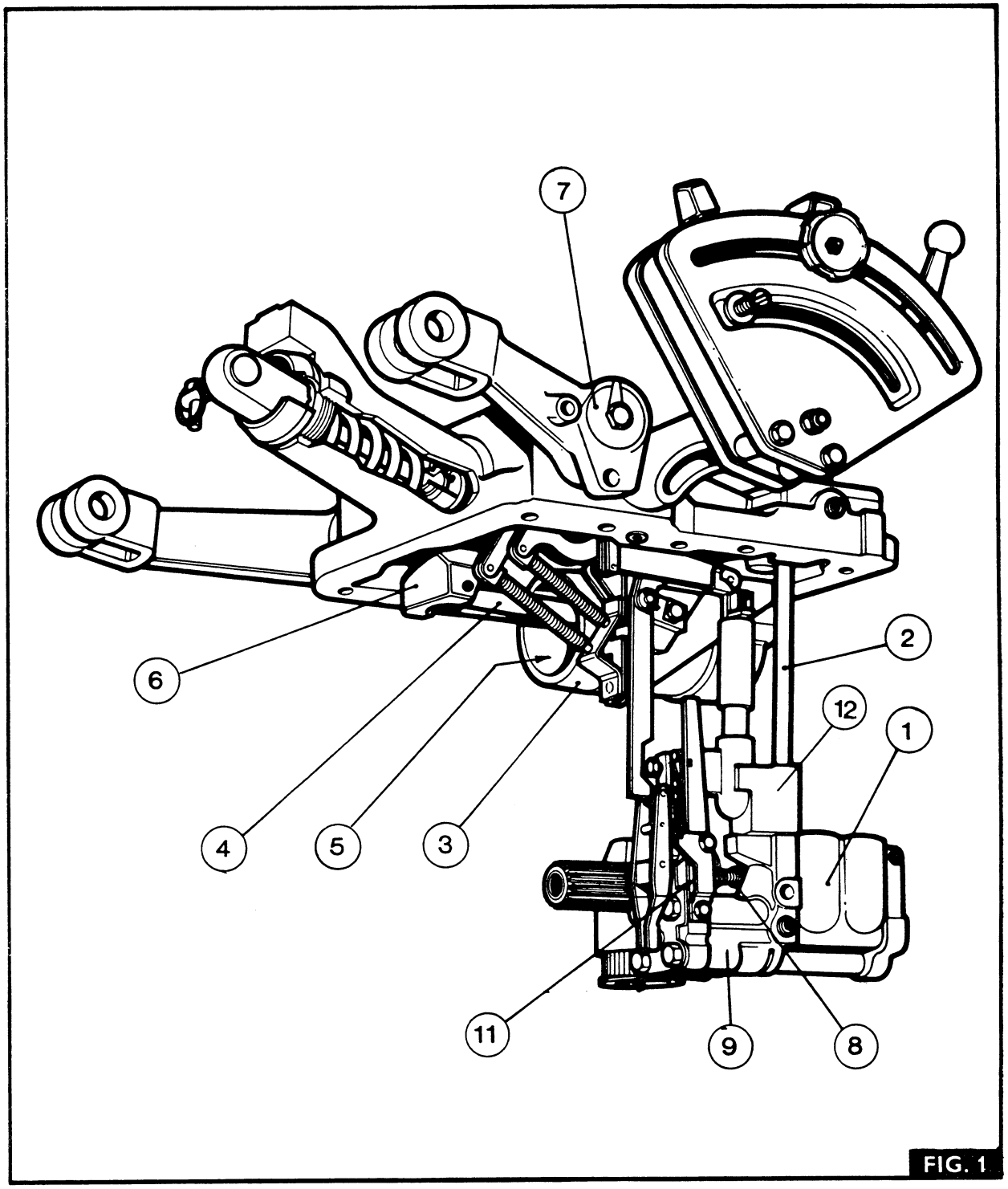



FIG. 1

## CONTROL SPRING ASSEMBLY

**Removal and Refitment** 7A—01—38

Special tools required:— MF 163 Wrench.
Torque Wrench.

**Figs. 2 and 3**

**Removal**

1. Remove the control beam.
2. Fig. 2. Remove the Allen screw (14).
3. Pull back the rubber boot (15).
4. Using MF 163, unscrew the retainer (13) from the lift cover.
5. Fig. 3. Withdraw the control spring assembly from the lift cover, as shown.
6. Remove the nylon plug.

**Refitment**

1. Fig. 3. Slide the control spring assembly into the lift cover.
2. Place the Draft Control lever in the fully DOWN position.
3. Fig. 2. Tighten the retainer (13), using MF 163, until all the end float is eliminated. Do not overtighten the retainer, otherwise the end float will reappear.
4. Refit the rubber boot (15).
5. Fit a new nylon plug, then refit and tighten the Allen screw (14) to a torque of 0,7 kg m (5 lbf ft).
6. Refit the control beam.

## CONTROL SPRING ASSEMBLY

**Servicing** 7A—02—38

Special tools required:— MF 163 Wrench.
Torque Wrench.

**Figs. 4 and 5**

**Disassembly**

1. Remove the control spring assembly as stated in operation 7A—01—38.
2. Fig. 4. Drive out the pin (17) and detach the head (18).
3. Remove the retainer (13), control spring (10) and spring seat (19) from the plunger (16).

**Reassembly**

1. Fig. 4. Refit the spring seat (19), spring (10) and retainer (13) to the plunger (16).
2. Fig. 5. Screw the plunger into the head, until all the end float is eliminated and the spring is tight to turn, by hand.
3. Fig. 4. Fit a new securing pin (17).
4. Refit the control spring assembly as stated in operation 7A—01—38.

## HYDRAULIC LIFT COVER

**Removal and Refitment** 7A—03—38

Special tools required:— MF 163 Wrench.
MF 148A Pressure Test Kit.
MF 166 Adapter.
MF 226A Lift Cover Remover and Replacer.
MF 226A-3 Lift Cover Adapter.
MF 272 Ram Arm Fixture.
MF 273 Hydraulic Setting Fixture.
MF 333 Draft Control Rod Gauge.
MF 356 Position and Draft Control Setting Gauge.
MF 357 Screwdriver Adjuster.
MF 359 Pressure Control Bleed Pipe.
1,4 kg (3 lb) weight.
Torque Wrench.
Rule.

**Figs. 6 to 11**

**Removal**

1. Remove the seat.
2. Disconnect the lift rods from the lift arms.
3. Remove the control beam.
4. Disconnect the Auto-Hitch (if fitted) at the lift arms.
5. Fig. 6. Fully lower the links, then remove the two bolts and spring washers securing the standpipe cap (20), then remove the cap, withdrawing the standpipe (2).
6. Remove the bolts securing the lift cover to the centre housing.
7. Place the parking brake clear of the lift cover ('5' line tractors only).
8. Fig. 7. Fit MF 226A and MF 226A—3 to the lift cover, as shown.
9. Place the Draft Control lever in the fully UP position and the Position Control lever in the TRANSPORT position.
10. Fig. 8. Taking care not to damage any parts, detach the lift cover from the centre housing as shown, and place the support leg on the ground.
11. Drain the oil to the LOW mark on the dip-stick.
12. Fig. 9. Remove the four screws (24) securing the Response Control cover plate (25) and remove the plate.
13. Remove the five bolts (23) and the screw (22) securing the side cover (21) to the centre housing, then remove the cover. (To facilitate side cover removal, it may be necessary to remove the rear footstep bracket).

**Refitment**

NOTE—BEFORE REFITTING THE LIFT COVER THE EXTERNAL ADJUSTMENTS SPECIFIED IN OPERATION 7A—09—45 MUST BE CARRIED OUT.

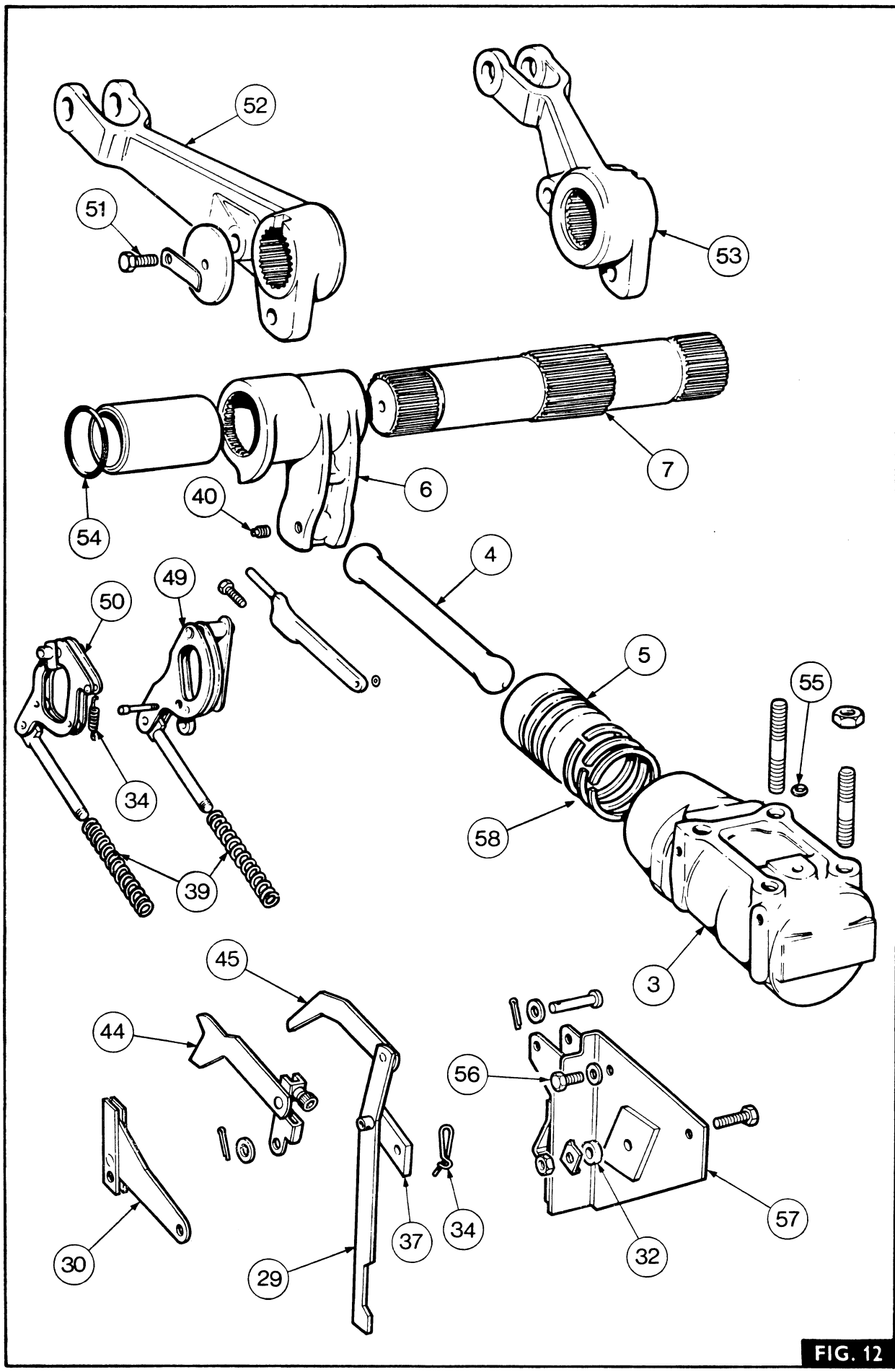



FIG. 12

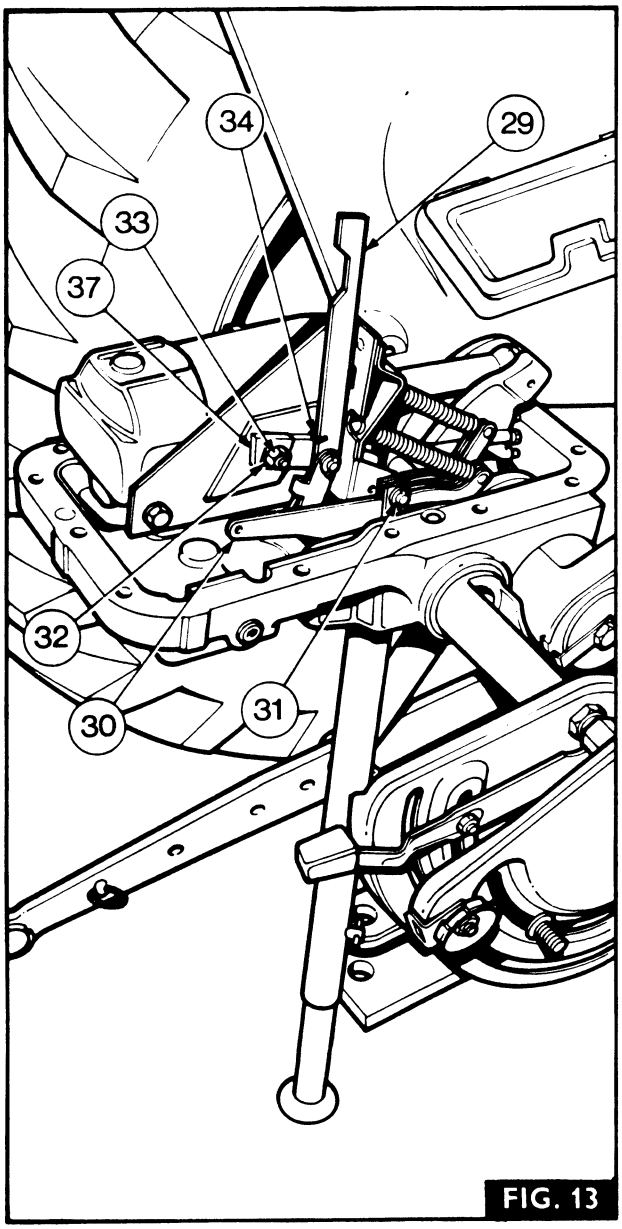


FIG. 13

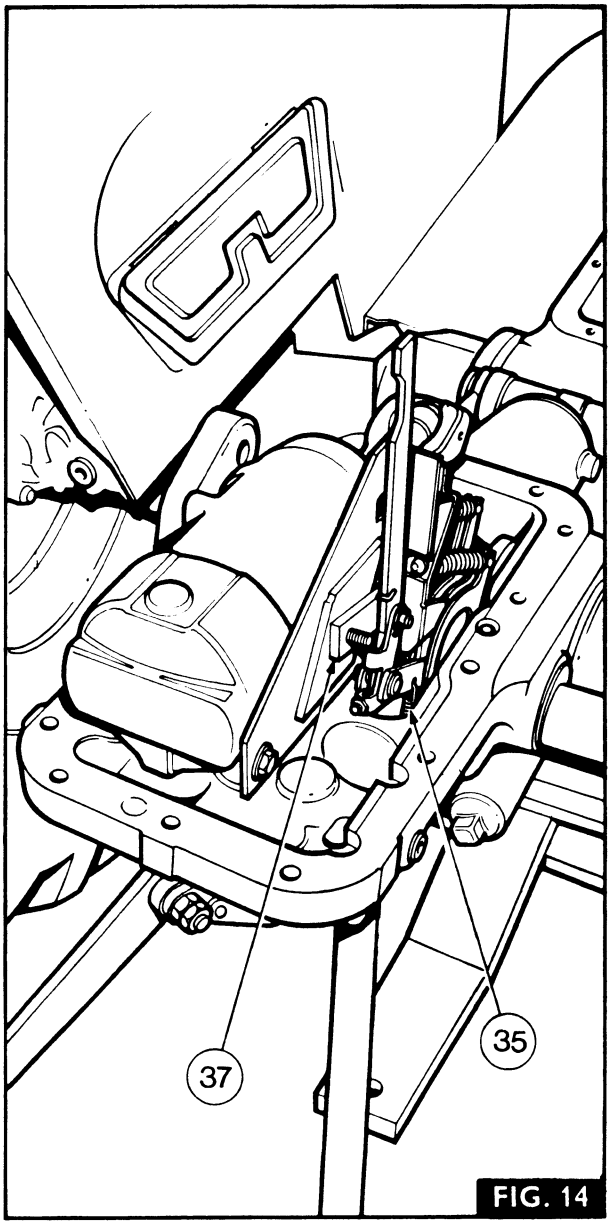


FIG. 14

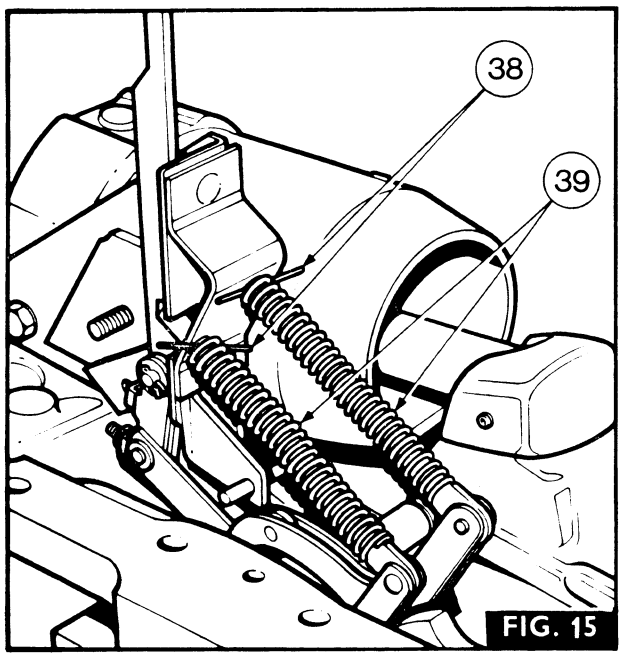


FIG. 15

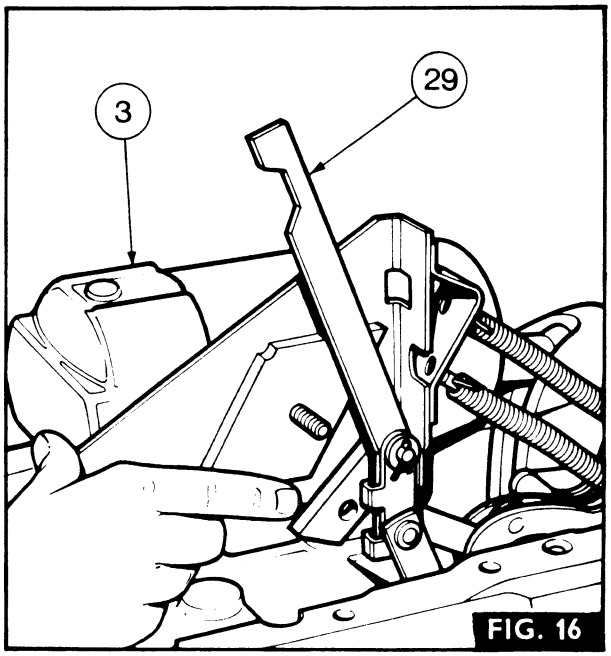


FIG. 16

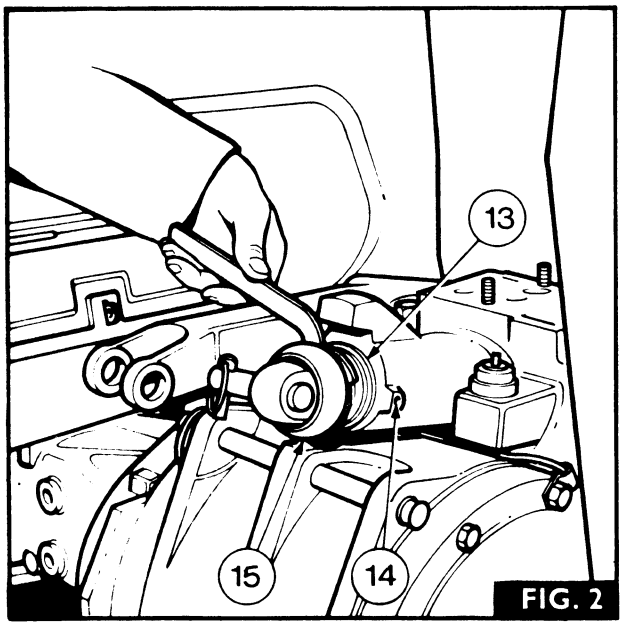


FIG. 2

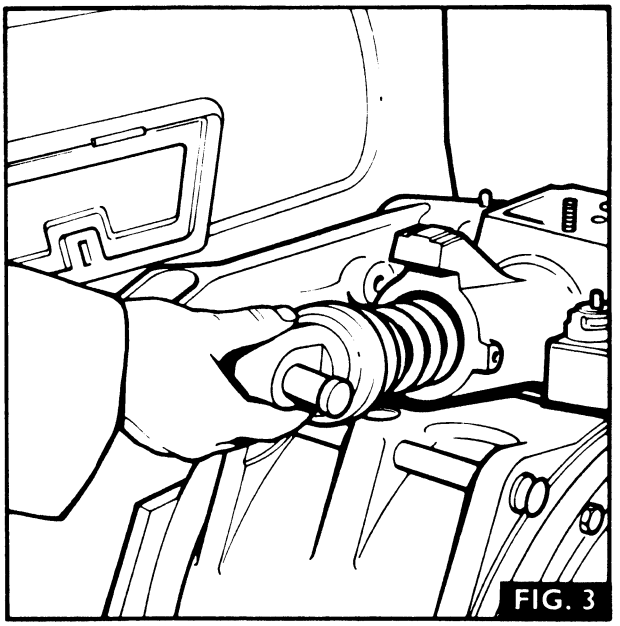


FIG. 3

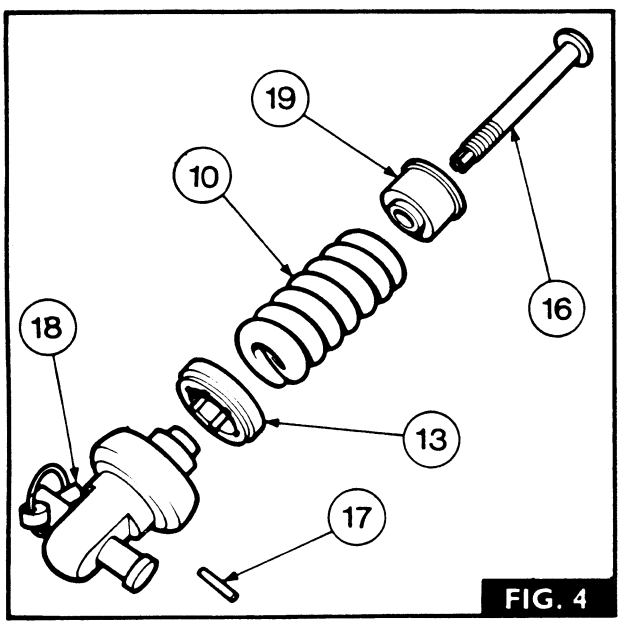


FIG. 4

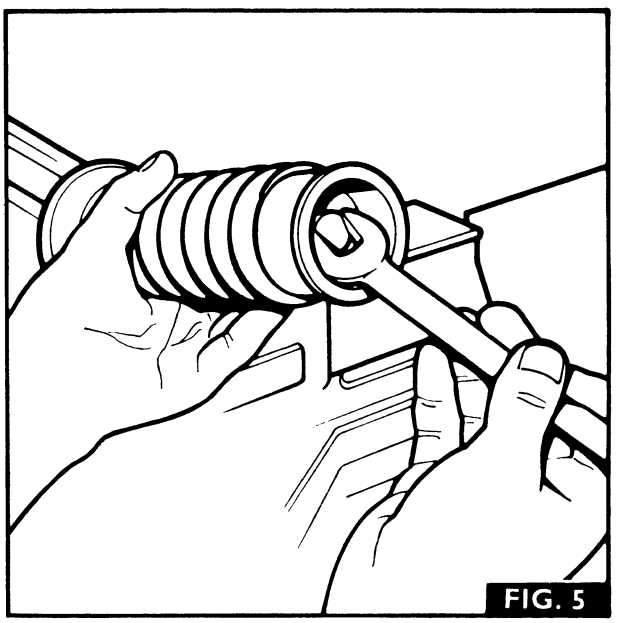


FIG. 5

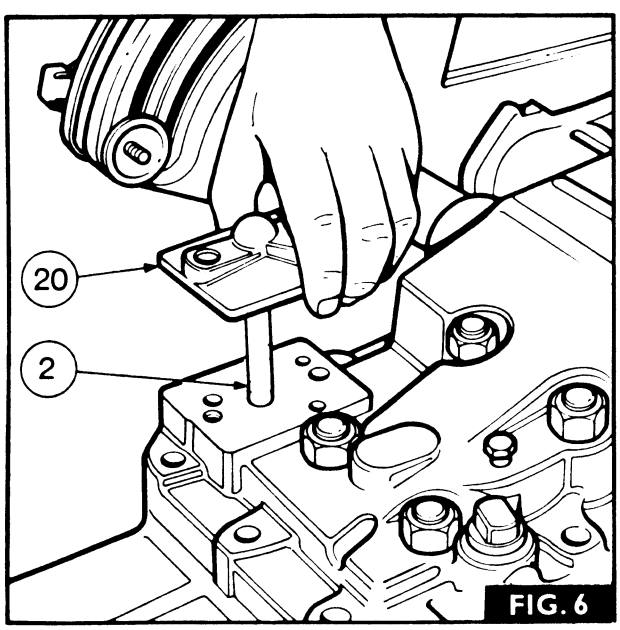


FIG. 6

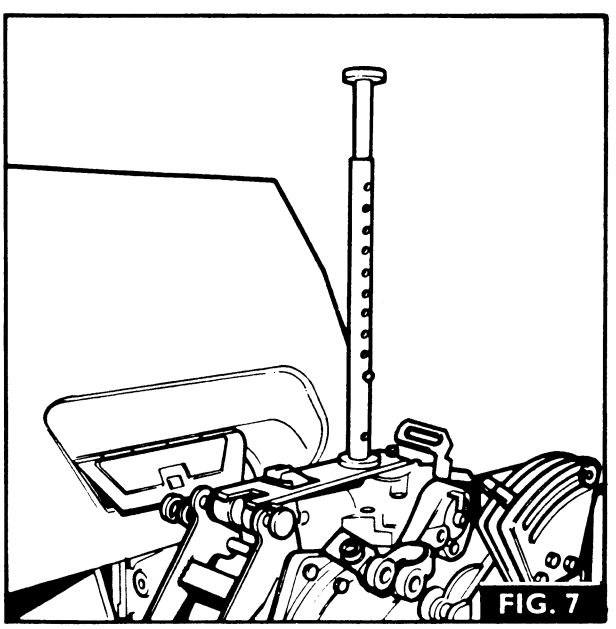


FIG. 7

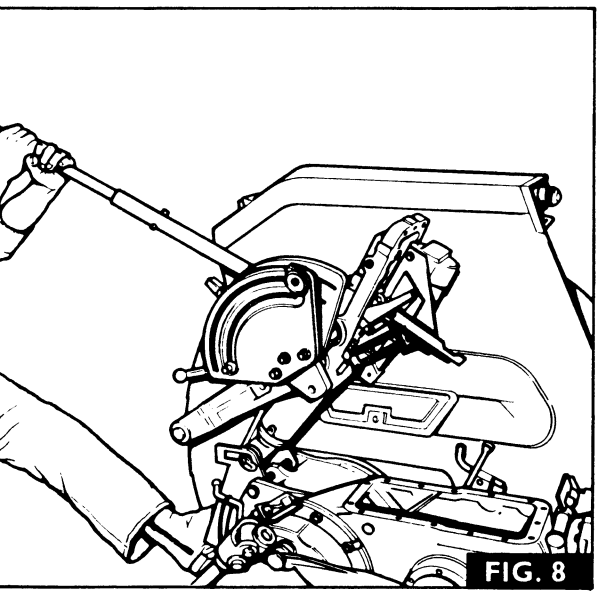


FIG. 8

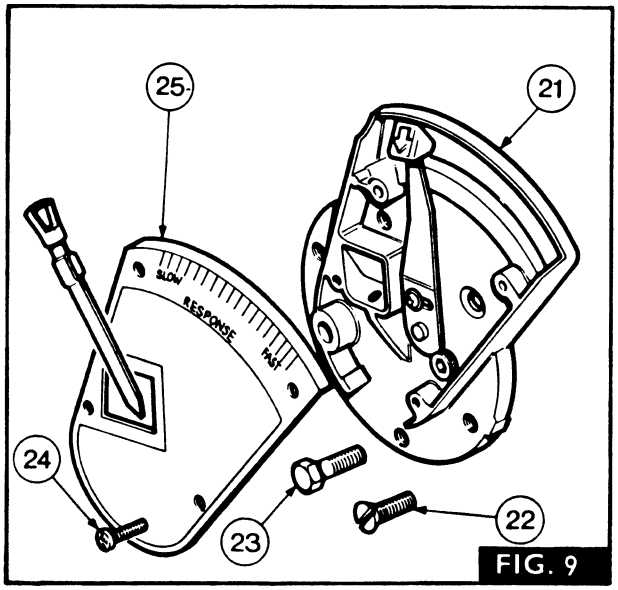


FIG. 9

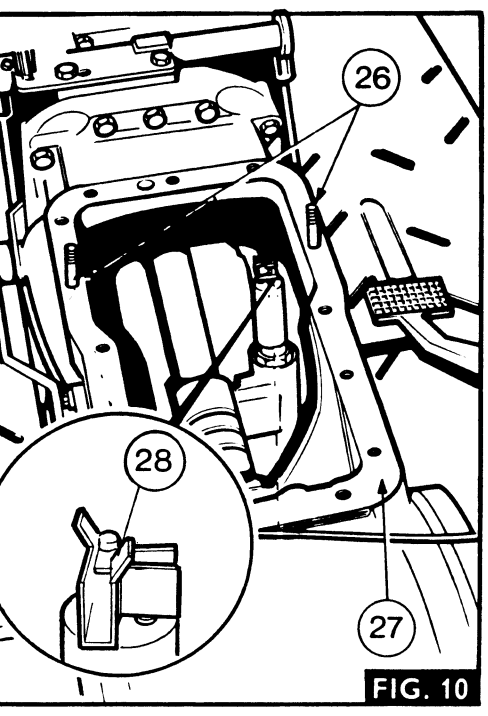


FIG. 10

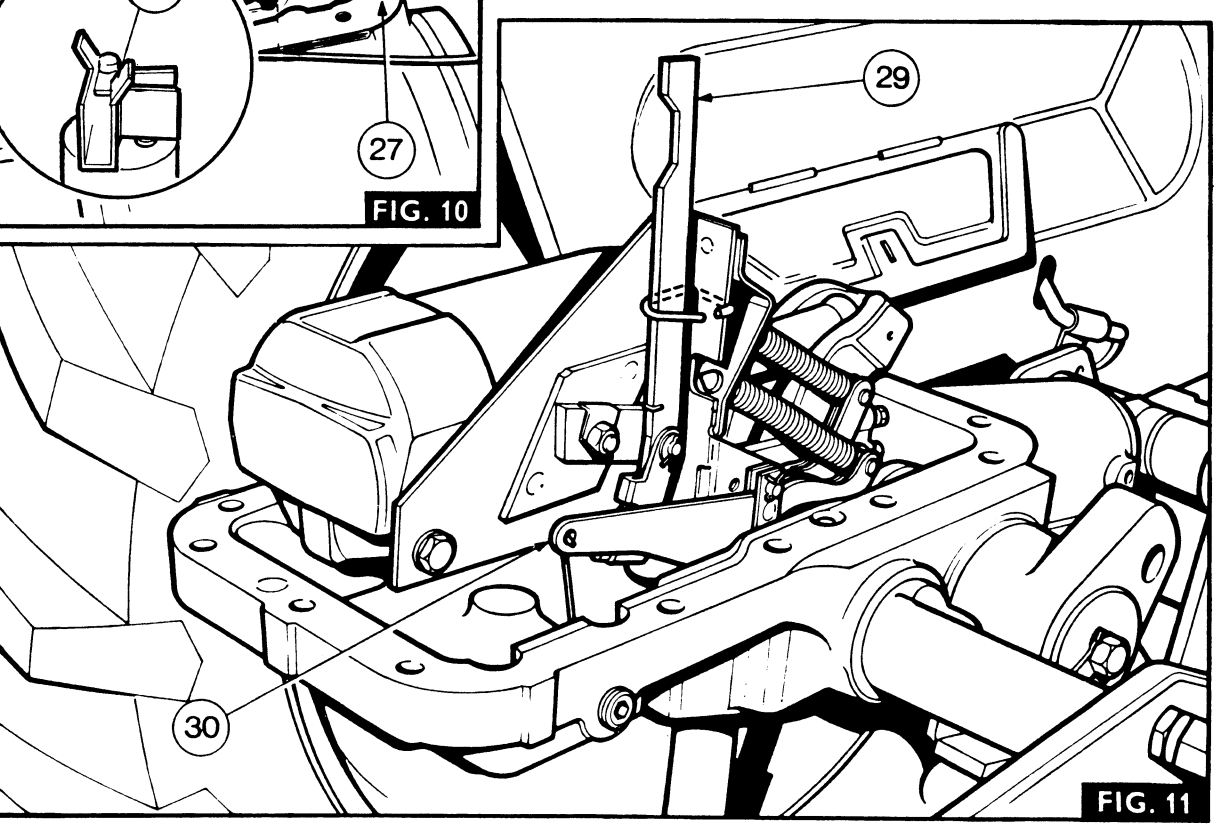


FIG. 11

1. Fig. 10. Fit the two guide studs (26) to the centre housing, as shown.
2. Fit a new lift cover gasket (27).
3. Position the Pressure Control adjuster assembly (28), as shown.
4. Place the lift arms in the down position.
5. Fig. 11. Using suitable pieces of wire retain the vertical lever (29) and the Pressure Control link (30), as shown.
6. Fig. 8. Taking care not to damage any parts, manoeuvre the lift cover assembly into position, over the guide studs, onto the centre housing, ensuring that the Pressure Control link locates in the Pressure Control adjuster assembly.
7. Remove the two guide studs, MF 226A, MF 226A—3 and the two pieces of wire retaining the vertical lever and Pressure Control link.
8. Fig. 6. Carefully locate the standpipe (2) through the lift cover and into the bore in the hydraulic pump.
9. Refit the standpipe cap (20) and secure it with the two bolts and spring washers.
10. Secure the lift cover and the parking brake ('5' line tractors only) to the centre housing and tighten the bolts to a torque of 9 kg m (65 lbf ft).
11. Refit the control beam.
12. Secure the lift rods to the lift arms.
13. Refit the Auto-Hitch (if fitted) to the lift arms.
14. Carry out the internal adjustments, as stated in operation 7A—10—46.
15. Refit the seat.

## HYDRAULIC LIFT COVER

**Servicing** 7A—04—41

Special tools required:— See operation 7A—03—38.

**Figs. 12 to 22**

**Disassembly**

1. Remove the lift cover as stated in operation 7A—03—38.
2. Fig. 13. Remove the split pin (31) and the washer retaining the Pressure Control link (30), and remove the link.
3. Release the tabwasher, then remove the nut (33), tabwasher and spacer (32) on the slide pivot (37).
4. Release the spring (34) on the vertical lever (29).
5. Fig. 14. Remove the Position Control spring (35).
6. Release the slide pivot (37) from the bolt.
7. Fig. 15. Fit a pair of pins (38) to retain the springs (39) on their rods.
8. Fig. 16. Remove the four nuts securing the ram cylinder (3) to the lift cover, then lift off the ram cylinder, taking care not to damage the vertical lever (29).
9. Fig. 17. Remove the connecting rod (4) and the Allen screw (40).
10. Using a No. 10 32 UNF × 11 mm ($\frac{7}{16}$ in) bolt remove the pin (41), securing the quadrant support (42) to the lift cover, as shown.
11. Fig. 18. Withdraw the quadrant support (42) and the Belleville spring (43) and shim, simultaneously lifting out the vertical lever (29) and the cams (44 and 45).
12. Fig. 19. Remove the Allen plug (46) in the left hand side of the lift cover, then remove the linkage pivot shaft retaining screw (47).
13. Fig. 20. Withdraw the linkage pivot shaft (48) as shown, then lift out the links (49 and 50).
14. Fig. 12. Remove the bolt (51) and tabwasher, then slide off the right hand lift arm (52).
15. Figs. 12 and 21. Drive the lift shaft (7) and the remaining lift arm (53) out of the lift cover, then remove the ram arm (6). Remove the 'O' rings (54).

**Reassembly**

1. Fig. 12. Place the ram arm (6) in the lift cover, then slide the lift shaft (7), complete with a new 'O' ring (54) into the lift cover and through the ram arm (6), aligning the master splines.
2. Refit the right hand lift arm (52), plus a new 'O' ring (54) aligning the master spline.
3. Refit the bolt (51) and the tabwasher.
4. Fig. 20. Place the Position Control link (50) and the Draft Control link (49) in position, then slide in the linkage pivot shaft (48).
5. Fig. 18. Refit the vertical lever (29) and the cams (44 and 45), simultaneously sliding the quadrant support (42), complete with the shim and the Belleville spring (43)—concave towards the lift cover, into position.
6. Fig. 22. Secure the quadrant support (42) to the lift cover by compressing the Belleville spring and driving in the pin (41).
7. Fig. 19. Ensuring that the linkage pivot shaft (48) is fully located against the side of the lift cover, retighten the Allen screw (47), then refit the plug (46) to the left hand side of the lift cover.
8. Degrease the threads of the Allen screw (40) and the threads in the ram arm (6), then locate the connecting rod (4) in its socket.
9. Apply one drop of Loctite 270 'Stud Lock' to the threads of the Allen screw (40). Screw the Allen screw into the ram arm until it bottoms on the annular groove in the connecting rod, then back it off $\frac{1}{4}$ turn.
10. Fit a new 'O' ring (55) to the ram cylinder feed port.
11. Fig. 16. Refit the ram cylinder and support bracket assembly to the lift cover, relocating the connecting rod in the piston and the two rods in the holes in the support bracket.
12. Refit the four ram cylinder securing nuts and tighten them to a torque of 16 kg m (120 lbf ft).
13. Fig. 15. Remove the guide rod spring retaining pins (38).
14. Fig. 14. Refit the position Control spring (35).
15. Fig. 13. Locate the spring (34) on the vertical lever (29) and on the slide pivot (37).
16. Fig. 12. Locate the slide pivot (37) on the bolt, then refit the spacer (32), tab washer and the nut (33).
17. Refit the Pressure Control link (30) and secure it with the washer and the split pin (31).
18. Refit the lift cover as stated in operation 7A—03—38.

## RAM CYLINDER

**Servicing** 7A—05—42

Special tools required:— See operation 7A—03—38.

**Figs. 12 to 16**

**Disassembly**

1. Remove the ram cylinder, as stated in items 1 to 8 of operation 7A—04—41.
2. Fig. 12. Remove the bolts (56) securing the support bracket (57) to the ram cylinder (3).
3. Withdraw the piston (5) from the ram cylinder, then if necessary, remove the piston rings (58).

Examine all components for wear, or damage, replacing any defective components. Details of dimensions and tolerances of the ram cylinder are given in the specification.

**Reassembly**

1. If necessary, fit the piston rings (58) to the piston (5).
2. Refit the piston to the ram cylinder (3).
3. Bolt the support bracket (57) to ram cylinder (3) with the bolts (56).
4. Refit the ram cylinder, as stated in items 10 to 18 of operation 7A—04—41.

## HYDRAULIC LINKAGE

**Removal and Refitment** 7A—06—42

Special tools required:— See operation 7A—03—38.

**Figs 12 to 20 and 22.**

**Removal**

1. Remove the linkage as stated in items 1 to 8, and 10 to 13 of operation 7A—04—41.

**Refitment**

1. Refit the linkage, as stated in items 4 to 7, and 10 to 18 of operation 7A—04—41.

## QUADRANT AND SUPPORT ASSEMBLY

**Removal and Refitment** 7A—07—42

Special tools required:— See operation 7A—03—38.

**Figs. 12 to 18 and 22.**

**Removal**

1. Remove the quadrant and support assembly as stated in items 1 to 8, 10 and 11 of operation 7A—04—41.

**Refitment**

1. Refit the quadrant and support assembly, as stated in items 5 to 7 and 10 to 18 of operation 7A—04—41.

## QUADRANT AND SUPPORT ASSEMBLY

**Servicing** 7A—08—42

Special tools required:— See operation 7A—03—38.

**Fig. 23.**

**Disassembly**

1. Remove the quadrant and support assembly, as stated in operation 7A—07—42.
2. Fig. 23. Remove the two bolts (59) and washers securing the outer quadrant (61).
3. Remove the nut (60) securing the lever (64) to the Draft Control shaft (67), and remove the outer quadrant, complete with the lever.
4. Remove the two spacer bolts (74) securing the inner quadrant (66) to the support (42).
5. Drive out the pin (68), and remove the inner quadrant (66), complete with the lever (65).
6. If necessary, remove the levers (64 and 65) and the stop knobs (63) from the quadrants.
7. Withdraw the Draft Control shaft (67) from the support (42).
8. Remove the circlip (70), and withdraw the Position Control shaft (71) from the support.
9. Remove the 'O' rings (72) and the bush (69).

**Reassembly**

1. Fit new 'O' rings (72) to the shafts and the support.
2. Slide the Position Control shaft (71) into the support (42) and refit the circlip (70).
3. Fit the bush (69) into the Pressure Control shaft, then slide the Draft Control shaft (67) into the Pressure Control shaft.
4. If necessary, refit the levers (64 and 65) and the stop knobs (63) to the quadrants. Assemble the friction washers, as shown, in the following order:— steel washer (75), polyurethane washer (76), with the shiny side against the quadrant (61 and 66), nylon washer (77), steel washer (75), and then tighten the screw (62), to give a clearance of approximately 20 mm (0.75 in) between the screw head and the steel washer.
5. Refit the inner quadrant (66), locating the lever on its shaft (71), and secure the quadrant to the support with the two spacer bolts (74).
6. Fit a new pin (68), as shown.
7. Refit the outer quadrant (61), locating the lever (64) on its shaft (67) and secure the quadrant with two bolts (59) and washers.
8. Secure the Draft Control lever (64) to its shaft (67) with the nut (60). Do not overtighten the nut (60) as the pin (68) will shear and the roller (73) will not turn freely.
9. Refit the quadrant and support assembly, as stated in operation 7A—07—42.

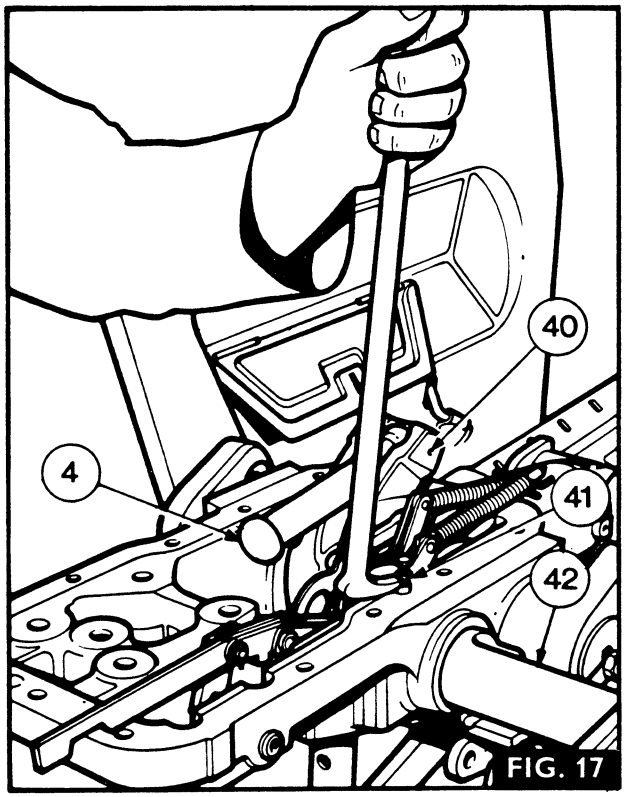


FIG. 17

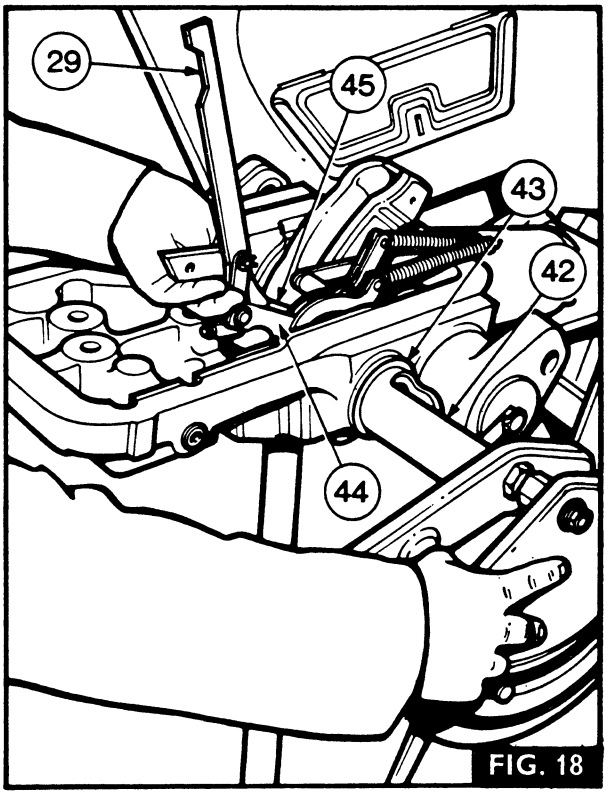


FIG. 18

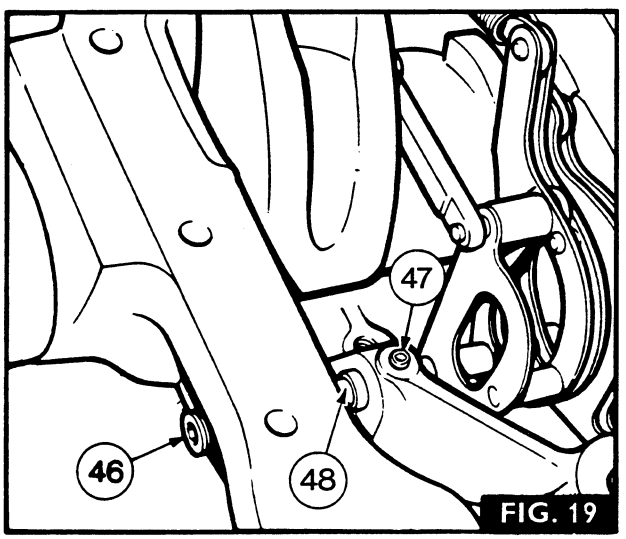


FIG. 19

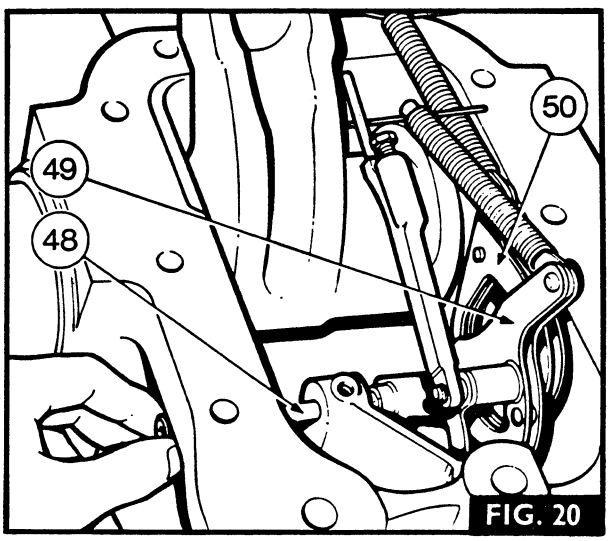


FIG. 20

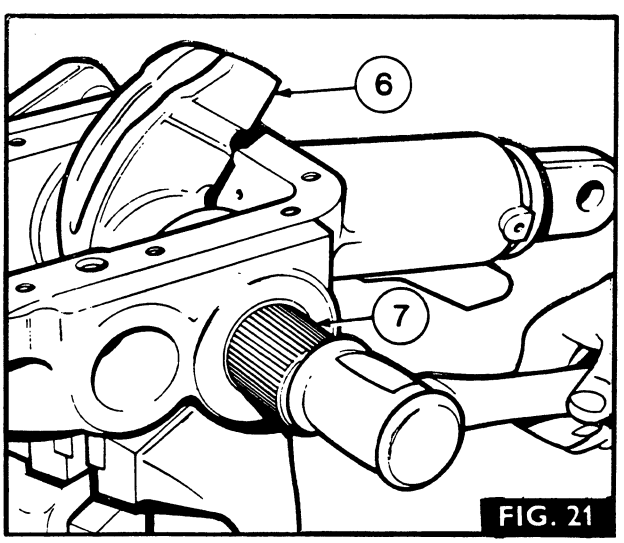


FIG. 21

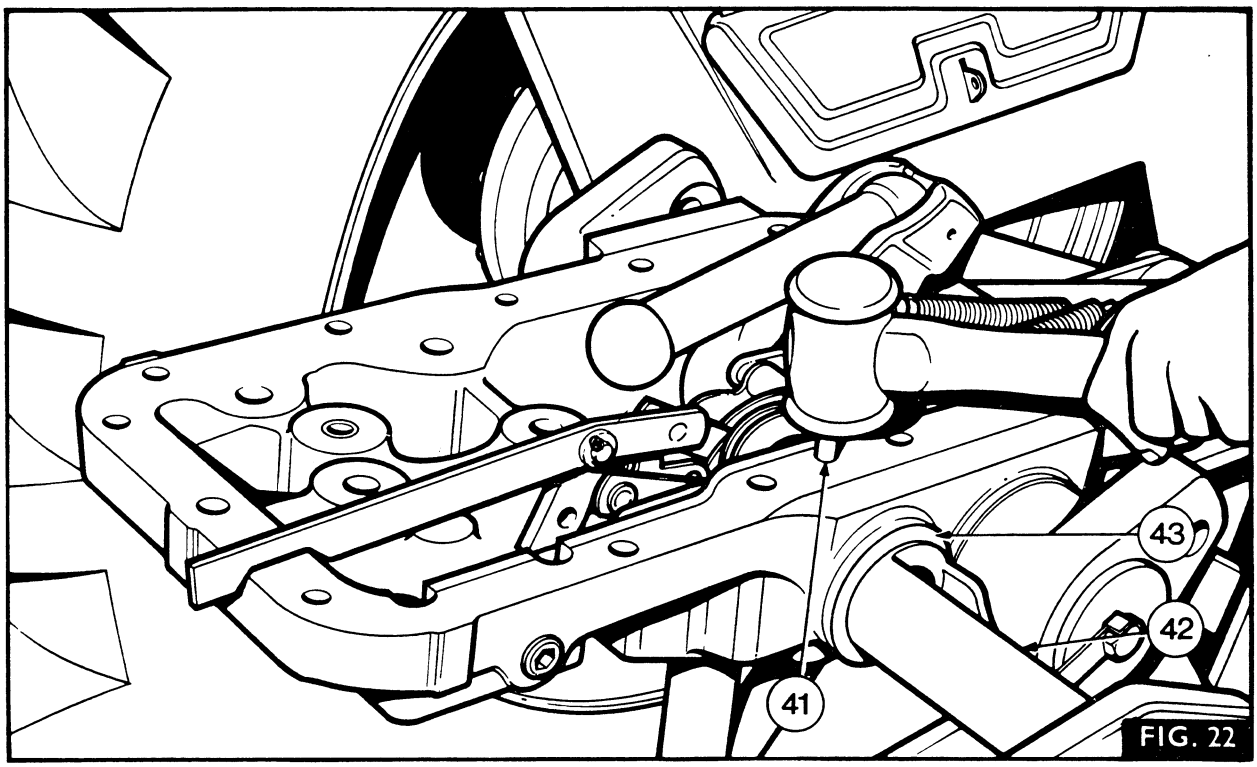

43
42
41

FIG. 22

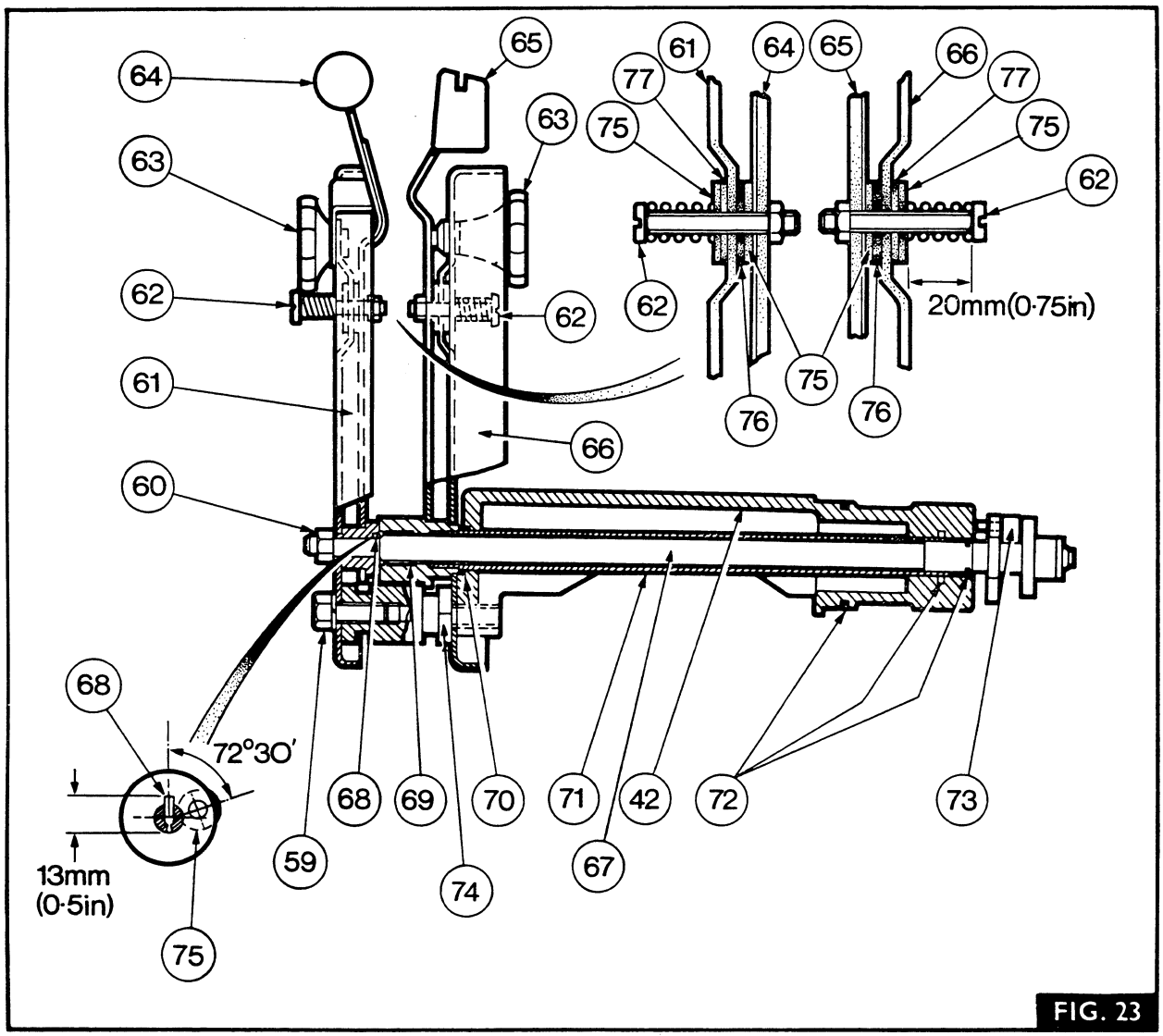

64
65
61
64
65
66
77
77
75
75
63
63
62
62
62
62
20mm(0·75in)
61
75
76
76
66
60
68
72°30'
68
69
70
71
42
72
73
59
74
67
13mm
(0·5in)
75

FIG. 23

## HYDRAULIC ADJUSTMENTS

**External Adjustments** 7A—09—45

Special tools required:— See operation 7A—03—38

**Figs. 12 and 23 to 29**

**Procedure:—**

1. Remove the lift cover, as stated in operation 7A—03—38

**Control Spring Internal and External End Float**

1. Fig. 24. Remove the Allen screw (14).
2. Pull back the rubber boot (15).
3. Using MF 163, unscrew the retainer (13) from the lift cover.
4. Withdraw the control spring assembly from the lift cover.
5. Remove the nylon plug.
6. Fig. 25. Drive out the pin (17) and screw the plunger (16) into the head (18) until all the end float is eliminated and the spring (10) is tight to turn, by hand.
7. Fit a new securing pin (17).
8. Slide the control spring assembly into the lift cover.
9. Fig. 24. Place the Draft Control lever in the fully DOWN position, and using a suitable wedge (36), ensure that the draft rod (79) is not touching the control spring plunger.
10. Tighten the retainer (13) using MF 163 until all the end float is eliminated. Do not overtighten the retainer, otherwise the end float will reappear.
11. Refit the rubber boot (15).
12. Fit a new nylon plug, then refit and tighten the Allen screw (14) to a torque of 0,7 kg m (5 lbf ft).
13. Remove the wedge (36).

**Lift Arm End Float**

1. Fig. 12. Release the tabwasher securing the bolt in the left hand arm (53), then slacken the bolt (51).
2. Fully tighten the right hand lift arm retaining bolt and secure with the tabwasher.
3. Tighten the left hand retaining bolt (51) until the lift arms will move freely throughout their range, but without any end float.
4. Secure the bolt with the tabwasher.

**Quadrant Location**

1. Fig. 23. Slacken the two bolts (59) and the spacer bolts (74) securing the quadrants to the support.
2. Locate the inner quadrant (66) in the centre of the elongated holes and secure it with the two spacer bolts (74), then locate the outer quadrant (61) in the centre of the elongated holes and secure it with the two bolts (59).

**Draft Control Rod**

1. Place the Draft Control lever in the fully UP position.
2. Fig. 26. Using MF 333, adjust the setscrew on the Draft Control rod (79) to give a clearance of 5,8 mm (0·230 in) between the setscrew head and the lift cover casting, as shown.

**Draft Control**

1. Fig. 27. Slacken the locknut and unscrew the Allen screw (78), on the vertical lever (29), to the end of the thread.
2. Release the tabwasher and slacken the nut (33) on the vertical lever slide pivot (37).
3. Place the Draft Control lever between the sector marks on the quadrant.
4. Place the Position Control lever in the TRANSPORT position.
5. Position MF 273 (A) on the lift cover and apply a load of 1,4 kg (3 lb) to the end of the vertical lever as shown.
6. Locate MF 356 (B) on the lift cover as shown.
7. Adjust the vertical lever slide pivot (37) until the vertical lever (29) just contacts the pin on MF 356.
8. Tighten the slide pivot nut (33), recheck the vertical lever (29) position and secure the nut with the tabwasher.

**Position Control**

1. Place the Draft Control lever in the fully UP position.
2. Place the Position Control lever in the TRANSPORT position.
3. Fig. 28. Position MF 272 (C) onto the lift cover as shown, then locate the ram arm onto the tool.
4. Position MF 273 (A) on the lift cover and apply a load of 1,4 kg (3 lb) to the end of the vertical lever as shown.
5. Locate MF 356 (B) on the lift cover as shown.
6. Adjust the Allen screw (78) on the vertical lever (29) until the vertical lever just contacts the pin on MF 356.
7. Tighten the locknut and check the position of the vertical lever.

**Pressure Control**

1. Fig. 29. Set the Pressure Control adjuster (28) so that the adjusting screw (30) is in the middle of its travel.
2. Set the diaphragm adjusting setscrew (81) to an initial setting of 14 mm ($\frac{9}{16}$ in), taken between the lever and the outside head of the setscrew, as shown.
3. Refit the lift cover, as stated in operation 7A—03—38.

## HYDRAULIC ADJUSTMENTS

**Internal Adjustments** 7A—10—46

Special tools required:— MF 148A Pressure Test Kit.
MF 166 Adapter.
MF 357 Screwdriver Adjuster.
MF 359 Pressure Control Bleed Pipe.
Rule.

**Figs. 29 and 30 to 34**

**Preparation for Internal Adjustments**

1. Attach a weight of 400 kg (900 lb) to the lower links.
2. Place the Draft Control lever in the fully DOWN position.
3. Connect the pressure test kit MF 148A and adapter MF 166 to the tapped port in the lift cover.
4. Remove the side cover as stated in items 11 to 13 of operation 7A—03—38, then locate MF 359 in the orifice in the Pressure Control valve body (as shown in Fig.31) and place the other end in the side cover aperture, so that the oil is returned to sump.
5. Place the Draft Control lever in the fully UP position.
6. Start the engine and set the engine speed at 'tick-over', then operate the Position Control lever through the quadrant range to expel all the air from the system.
   Warm up the oil in the transmission to a temperature of 50 to 70°c (120 to 169° F).

**Pressure Control Maximum Setting**

1. Place the Draft Control lever in the fully DOWN position.
2. Fig. 30. Remove the rear bolt from the stand pipe cap and fit MF 357.
3. Place the Draft Control lever in the fully UP position.
4. Place the Position Control lever in the CONSTANT PUMPING position.
5. Start the engine and set the engine speed at 1200 rev/min.
6. Using MF 357 adjust the Pressure Control adjusting screw (80, Fig. 29) to give:—
   MF 148 Tractor— 179 kg/cm² (2550 lbf/in²)
   MF 165, 168, 185 and 188 Tractors— 211 kg/cm² (3000 lbf/in²)
7. Fully lower the links and stop the engine, then remove MF 357 and refit the existing bolt.

**Pressure Control Final Adjustment**

1. Fig. 31. Remove the tube, of MF 359, from the side cover aperture and place it in a five litre (one gallon) container.
2. Start the engine and set the engine speed at 1200 rev/min.
3. Place the Draft Control lever in the fully UP position.
4. Place the Position Control lever in the CONSTANT PUMPING position.

**5. Adjust the diaphragm setscrew (81, Fig. 29) until a flow of 5 litre/40s (1 Imp. gal/35s) is obtained.

6. Stop the engine, and place the tube, of MF 359, in the side cover aperture, so that the oil is returned to sump.

NOTE—THE FOLLOWING METHOD CAN BE USED AS AN ALTERNATIVE, BUT IT MUST BE EMPHASISED THAT IT IS AN APPROXIMATE SETTING AND THE FIRST METHOD SHOULD BE CARRIED OUT AS SOON AS THE OPPORTUNITY ARISES.

1. Start the engine and set the engine speed at 1200 rev/min.
2. Place the Draft Control lever in the fully UP position.
3. Place the Position Control lever in the CONSTANT PUMPING position.
4. Fig. 29. Screw the diaphragm setscrew (81) in until the needle on the gauge begins to fluctuate.

**5. Screw the setscrew out until the fluctuations cease, then unscrew a further EIGHT flats.

6. Stop the engine.

**Position Control Setting**

1. Place the Draft Control lever in the fully UP position.
2. Place the Position Control lever in the CONSTANT PUMPING position.
3. Start the engine and set the engine speed at 1200 rev/min.
4. Fig. 32. When the links are fully raised, scribe a line (A) across the top cover casting and the lift arm.
5. Place the Position Control lever in the TRANSPORT position.
6. The links should drop until the scribe lines are 1,6 to 4,7 mm ($\frac{1}{16}$ to $\frac{3}{16}$ in) apart.
7. If the distance is incorrect, slacken the bolts (59) and spacer bolts (74) securing the quadrants and rotate the inner quadrant (66) and lever until the setting is correct.
8. Tighten the quadrant spacer bolts (74) and recheck the setting.

**Draft Control Setting**

1. Place the Position Control lever in the TRANSPORT position.
2. Start the engine, and set the engine speed at 1200 rev/min.
3. Using the Draft Control lever set the lower links in the horizontal position.
4. Fig. 33. The Draft Control lever should be in the sector marks on the quadrant, if not, slacken the bolts (59) securing the outer quadrant (61) and rotate the quadrant until the links remain stationary in the horizontal position with the lever in the sector marks.
5. Tighten the quadrant bolts (59) and recheck the setting.
6. Stop the engine and fully lower the links, then remove MF 359, MF 148A and MF 166.

**Response Control**

1. Fig. 34. Refit the Response Control side cover (21), with a new gasket and secure it with the five bolts (23) and the screw (22).
2. Release the locking screw (82) and place the Response Control lever (83), 6 mm ($\frac{1}{4}$ in) from the SLOW position.
3. Rotate the inner adjusting lever (84), until the cam just contacts the Response Control lever on the pump, and tighten the screw (82).
4. Refit the Response Control cover plate and secure it with the four screws.
5. Add approved oil to the transmission until the required level is reached.

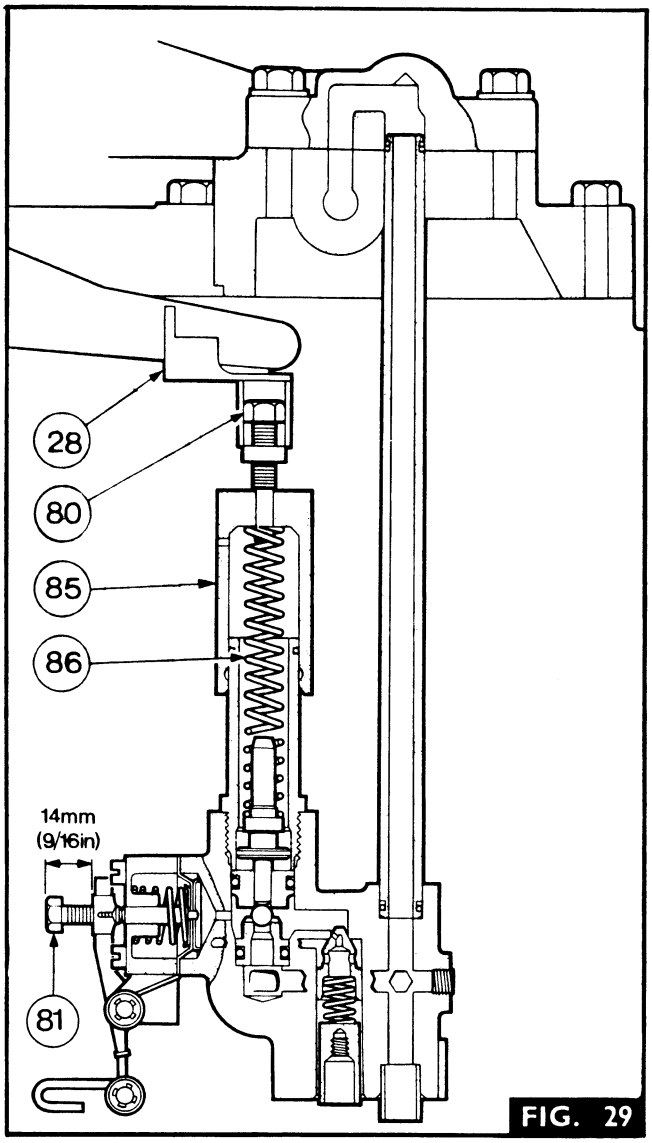



FIG. 29

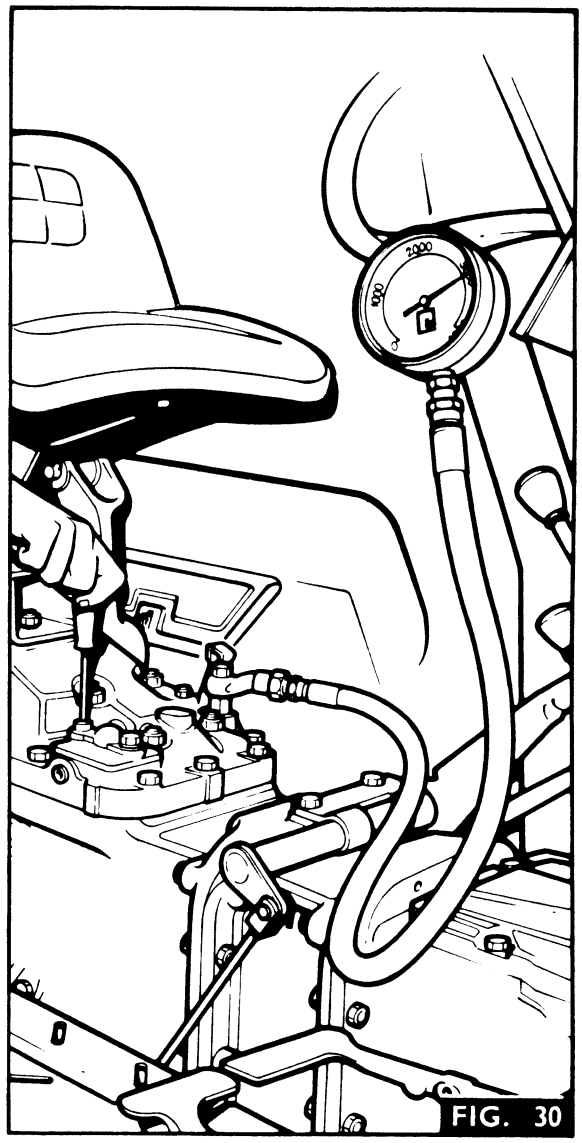


FIG. 30

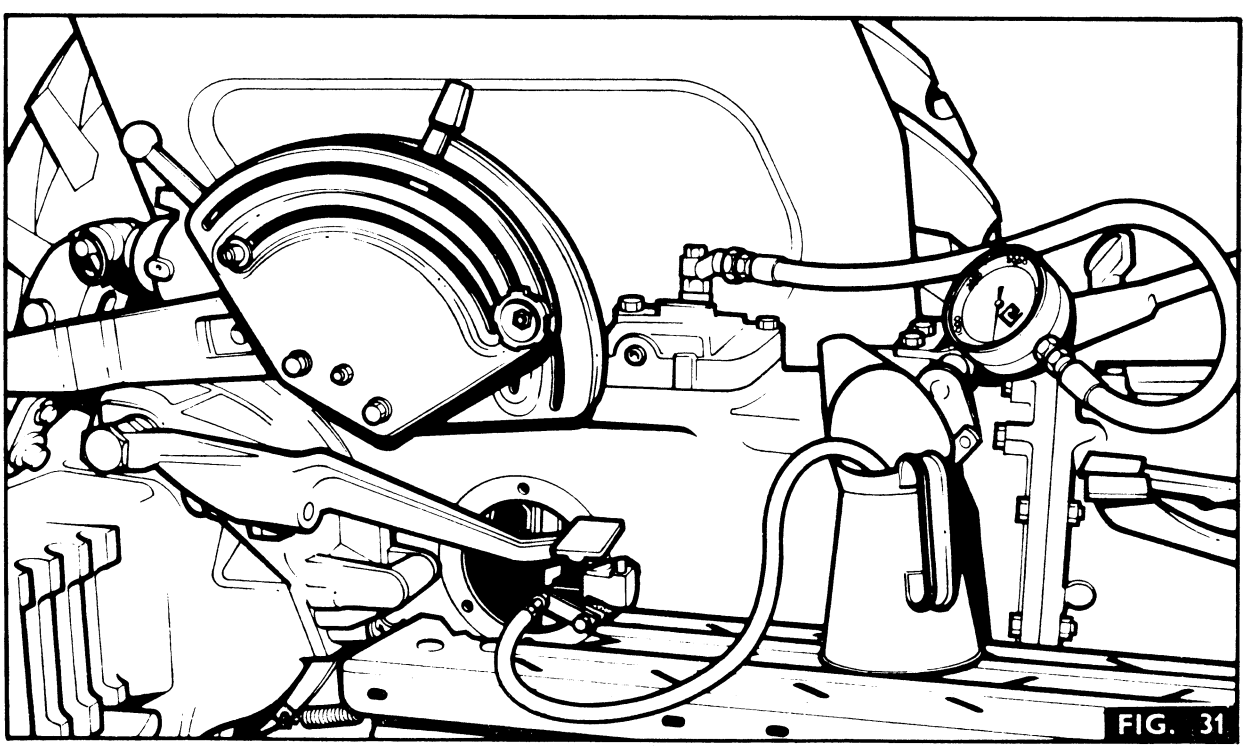


FIG. 31

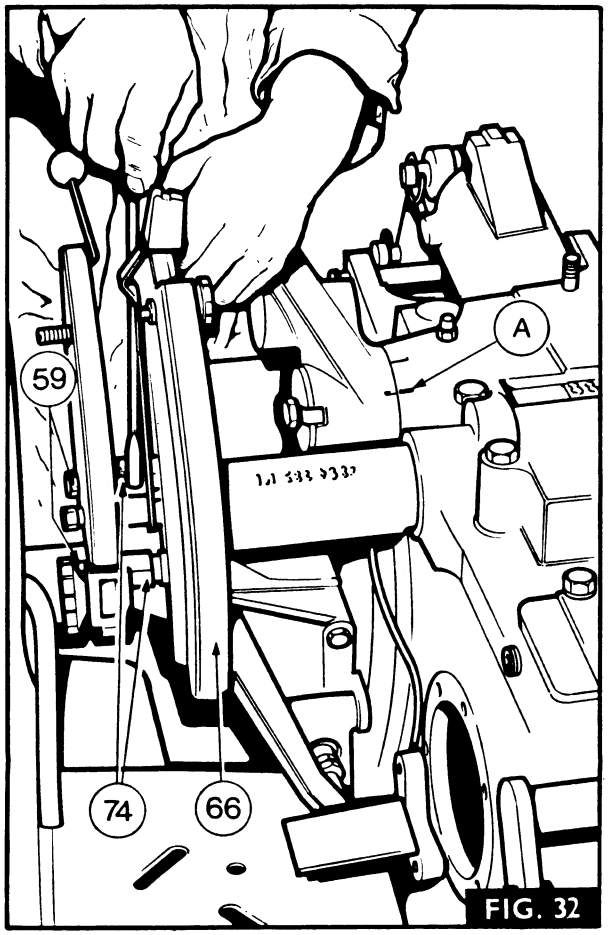


FIG. 32

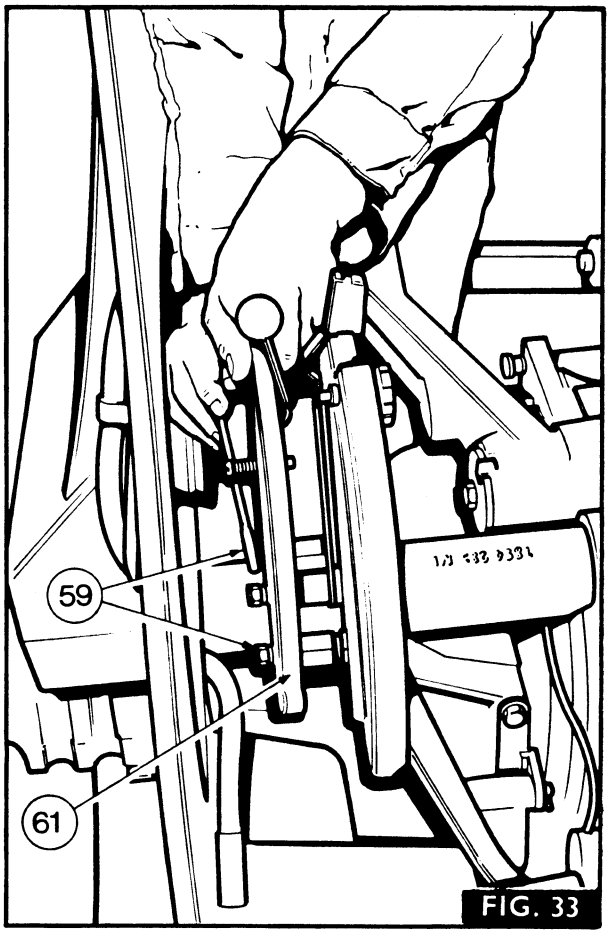


FIG. 33

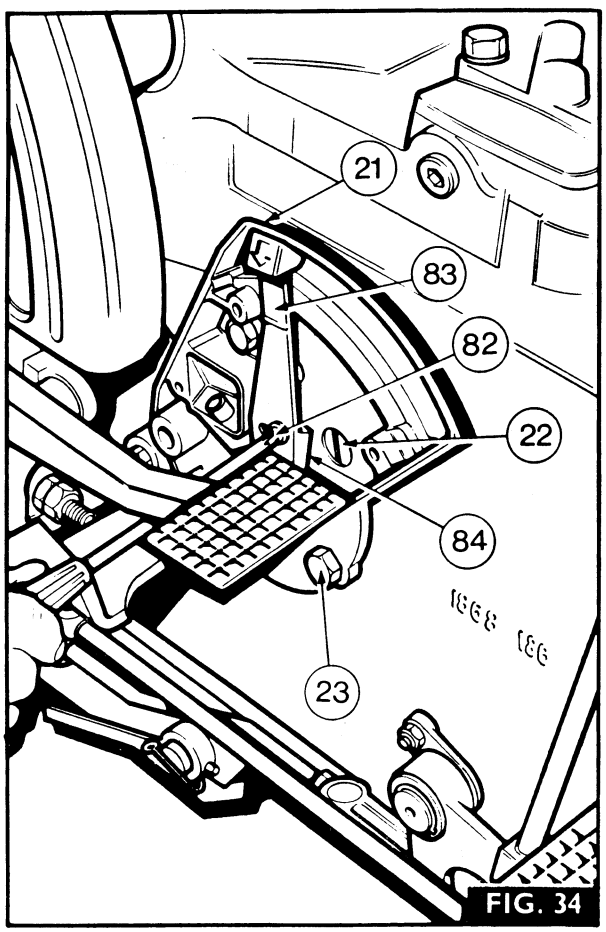


FIG. 34

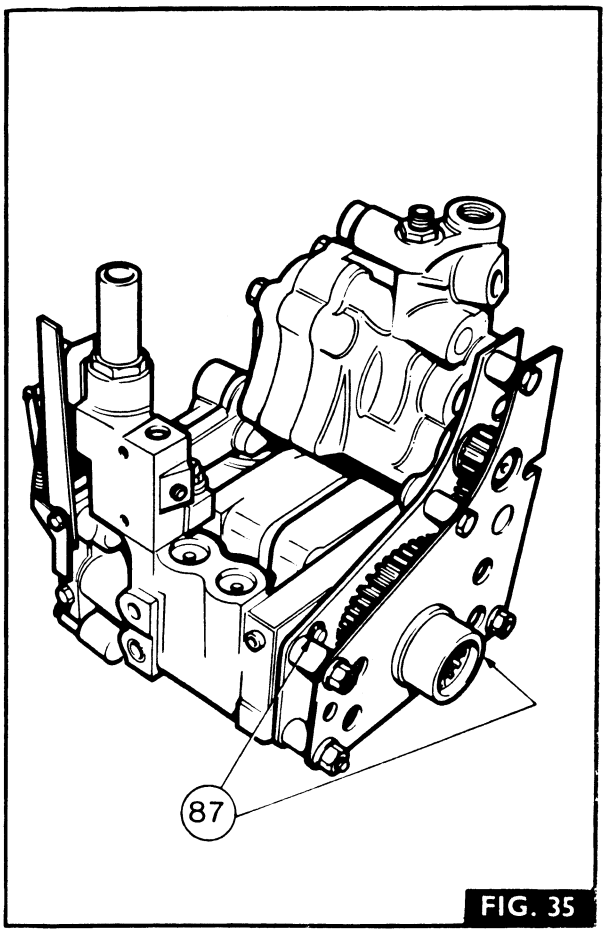


FIG. 35

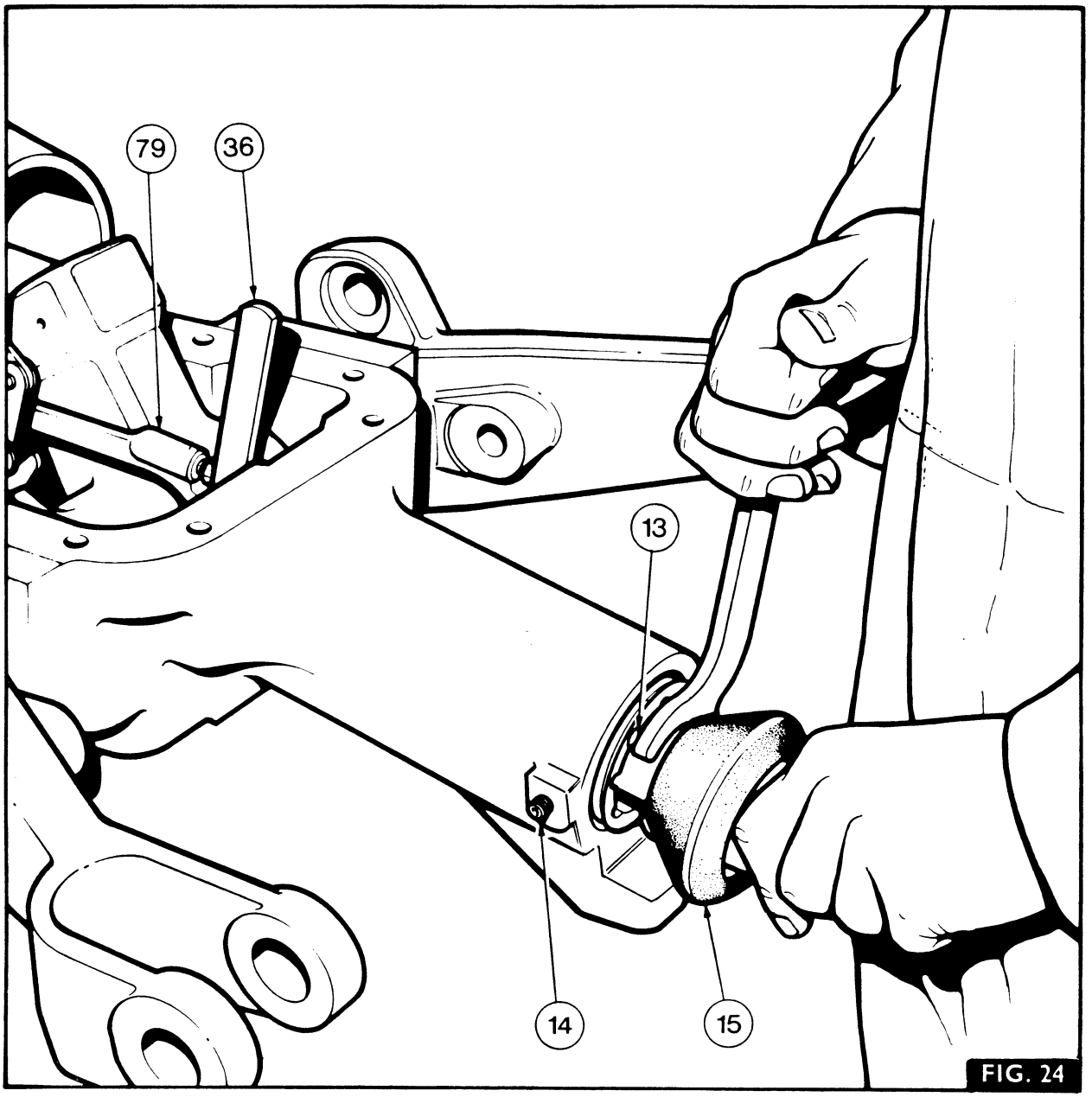


FIG. 24

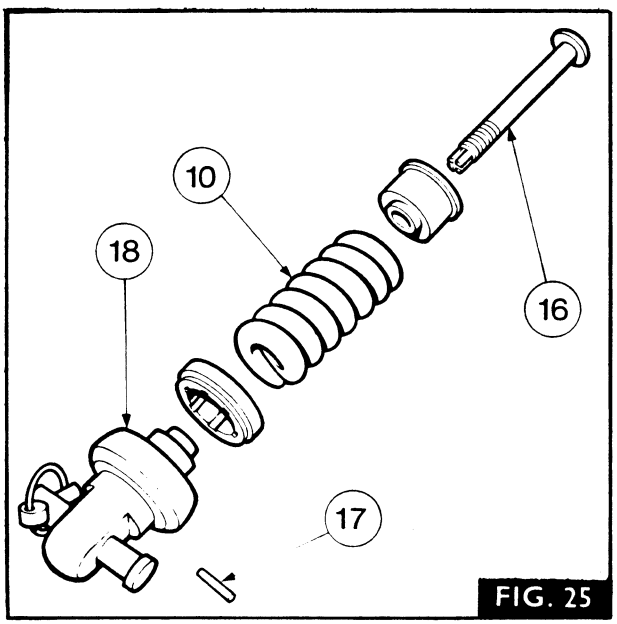


FIG. 25

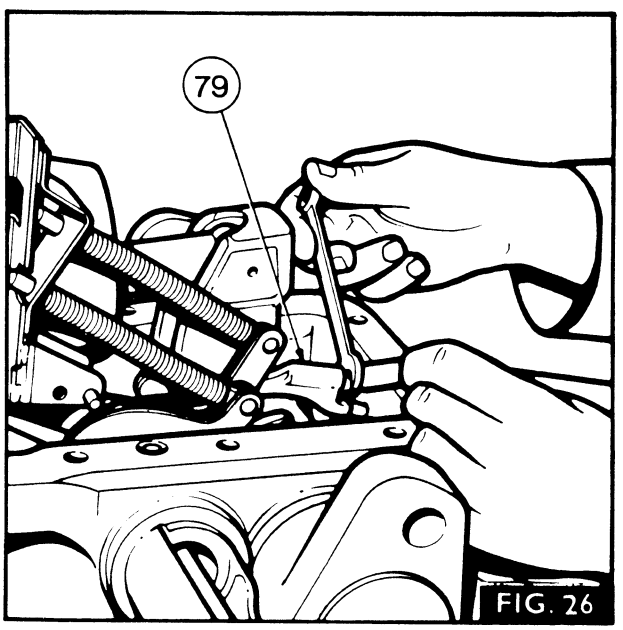


FIG. 26

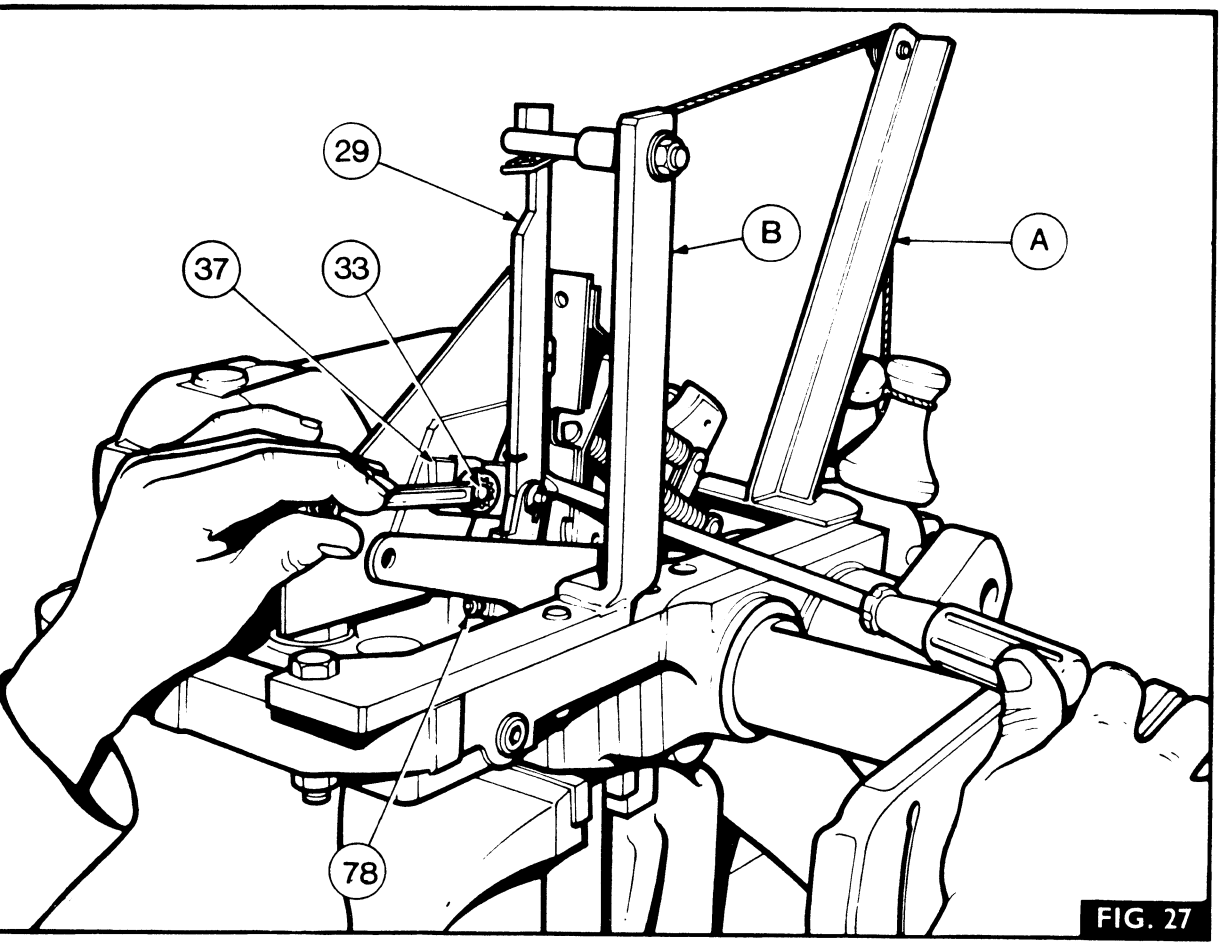



FIG. 27

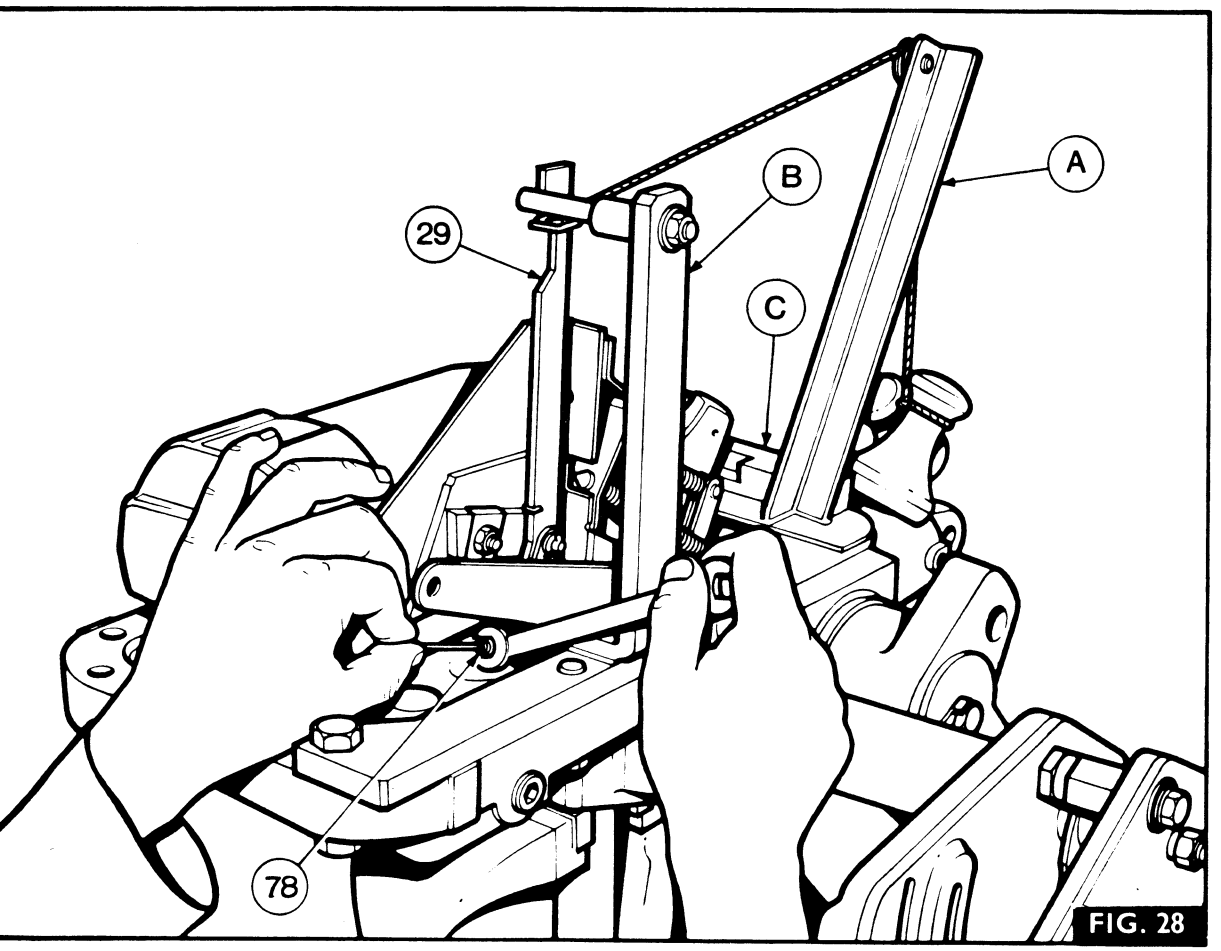



FIG. 28

## HYDRAULIC PUMP

**Removal and Refitment** 7A—11—49

Special tools required:— See operation 7A—03—38

**Fig. 29 and 35**

**Removal**

*Tractors not fitted with a Multi-Power/Auxiliary Pump*

1. Remove the lift cover, as stated in operation 7A-03-38.
2. Fig. 29. Remove the Pressure Control adjuster (28), tube (85) and spring (86).
3. Remove the split pin from the shear tube and remove the tube and the rear drive shaft.
4. Remove the p.t.o. side cover, as stated in Part 5.
5. Remove the p.t.o. shaft, as stated in Part 5.
6. Remove the two nuts securing each dowel pin and remove the pins.
7. Manoeuvre the hydraulic pump out of the top of the centre housing.
8. Remove the split pin and the coupler from the front of the camshaft.

*Tractors fitted with a Multi-Power/Auxiliary Pump*

1. Remove the lift cover, as stated in operation 7A—03—38.
2. Fig. 29. Remove the Pressure Control adjuster (28), tube (85) and spring (86).
3. Remove the split pin from the shear tube and remove the tube and the rear drive shaft.
4. Remove the p.t.o. side cover, as stated in Part 5.
5. Split the tractor between the centre housing and the gearbox/spacer housing, as stated in Part 3.
6. Remove the auxiliary feed pipe from the auxiliary pump (auxiliary pump tractors only).
7. Remove the two nuts securing each dowel pin and remove the pins.
8. When i.p.t.o. is fitted, move the hydraulic pump, auxiliary pump and the i.p.t.o. unit forwards.
9. Withdraw the hydraulic pump and the Multi-Power/auxiliary pump, as a complete assembly, from the front of the centre housing.
10. Fig. 35. Remove the two 'C' clips (87), and withdraw the Multi-Power/auxiliary pump from the hydraulic pump.

**Refitment**

*Tractors not fitted with a Multi-Power/Auxiliary Pump*

1. Refit the coupler to the front of the camshaft and secure it with a new split pin.
2. Position the hydraulic pump in the centre housing, locating the pump on the p.t.o. drive shaft.
3. Place the p.t.o. gear in position and refit the p.t.o. shaft, as stated in Part 5.
4. Refit the dowel pins, with new 'O' rings, then locate the dowel pins in the hydraulic pump and secure with two nuts each side.
5. Refit the p.t.o. side cover, as stated in Part 5.
6. Refit the rear drive shaft and shear tube and locate the split pin to give 0,83 to 2,54 mm (0·015 to 0·100 in) end float.
7. Fig. 29. Refit the Pressure Control spring (86), tube (85) and adjuster (28).
8. Refit the lift cover, as stated in operation 7A—03—38.

*Tractors fitted with a Multi-Power/Auxiliary Pump*

1. Fig. 35. Locate the Multi-Power/auxiliary pump on the hydraulic pump and secure it in place with the two 'C' clips (87).
2. When i.p.t.o. is fitted, locate the i.p.t.o. unit on the p.t.o. shaft splines.
3. Position the hydraulic pump and the Multi-Power/auxiliary pump in the centre housing, locating the camshaft splines in the i.p.t.o. unit.
4. Refit the dowel pins, with new 'O' rings, then locate the dowel pins in the hydraulic pump and secure with two nuts each side.
5. Refit the feed pipe to the auxiliary pump (auxiliary pump tractors only).
6. Refit the p.t.o. side cover, as stated in Part 5.
7. Reconnect the centre housing to the gearbox/spacer housing, as stated in Part 3.
8. Refit the rear drive shaft and shear tube and locate the split pin to give 0,38 to 2,54 mm (0·015 to 0·100 in) end float.
9. Fig. 29. Refit the Pressure Control spring (86), tube (85) and adjuster (28).
10. Refit the lift cover as stated in operation 7A—03—38.

## HYDRAULIC PUMP

**Servicing** 7A—12—49

Special tools required:— See Operation 7A—03—38, and
MF 349 Valve Seat Forming Tool.
MF 350 Valve Circlip Replacer.
MF 351 Valve Plug Remover and Replacer.
MF 352 Control Valve Spring Retainer.
MF 353 Control Valve Body 'O' Ring Guide.
MF 354 Control Valve Body Replacer.

**Figs 36 to 41.**

**Disassembly**

1. Remove the hydraulic pump, as stated in operation 7A—11—49.
2. Fig. 36. Remove the clip (139) and the pin retaining the link (140), and detach the link from the lever (125).
3. Remove the clip (124), lever (125) and the two rollers (122) and the pin (123).
4. Remove the four bolts (121) and washers securing the strainer housing (132) to the rear body (99) and remove the strainer housing, complete with the strainer and the Response Control unit.
5. Remove the two bolts (126) and washers securing the end plate (127), and remove the end plate and the gasket (129).
6. Disassemble the strainer assembly by removing the clip (115), nut (116), spring (117), washer (118), 'O' ring (119), strainer (120), cover (130) and the 'O' ring (131).
7. Release the spring (110) from the Response Control lever (108), then remove the two bolts (105 and 106) and washers, and remove the lever (108), retainer (107), bush (104) and the washer (109).
8. Remove the bush (112), spring (113) and the ball (114) from the strainer housing (132).

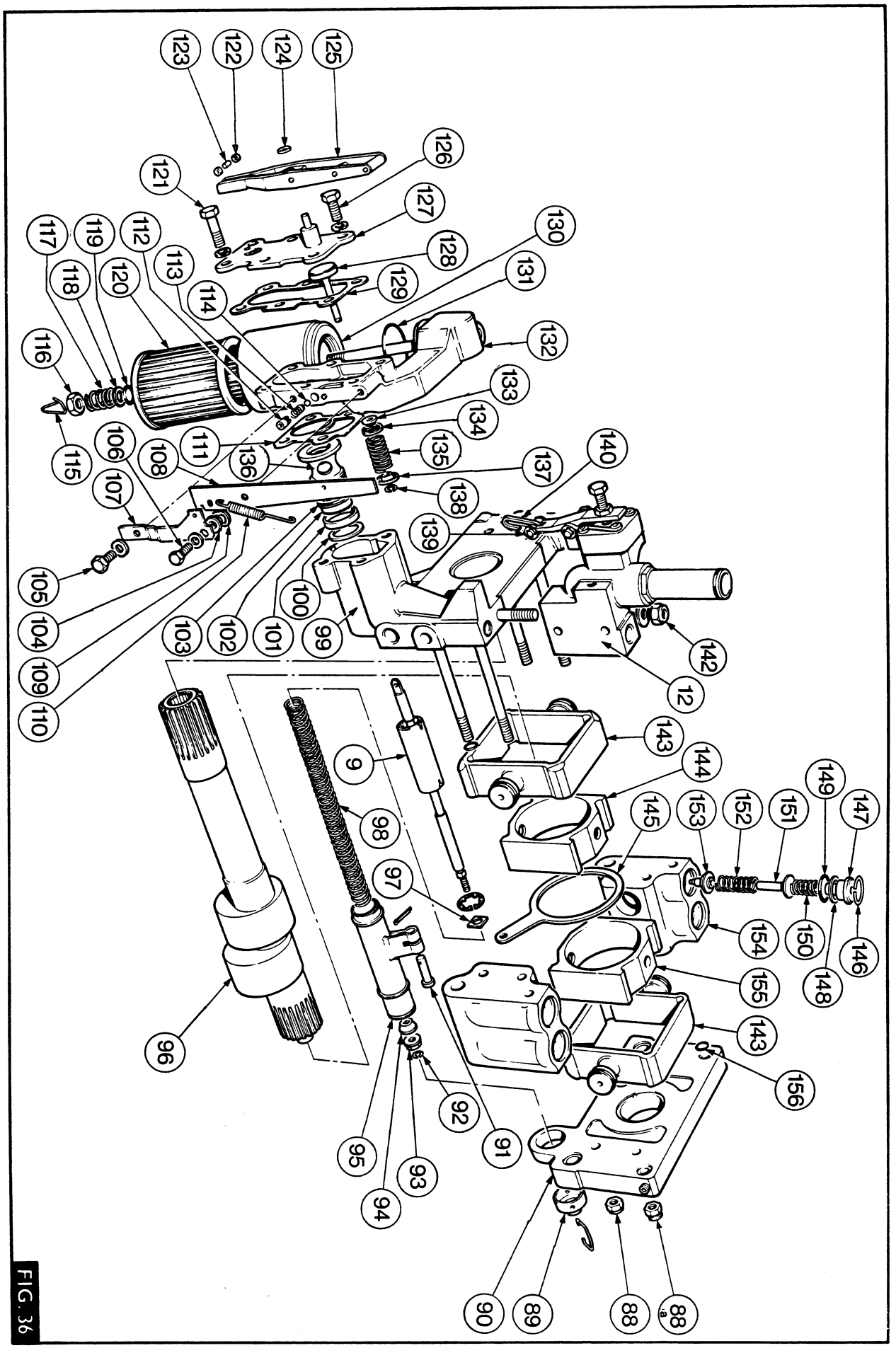
9. If necessary, disassemble the non-return valve by removing the circlip (138), cap (137), spring (135), retainer (134) and the seal (133) and withdraw the valve (128) from the housing (132).
10. Remove the nut (142) and washer securing the Pressure Control valve (12), and carefully remove the valve.
11. Remove the oscillator end cap (89).
12. Fig. 36 and 37. Using MF 352, compress the collar (93) and remove the retaining ring (92).
13. Fig. 36. Withdraw the control valve (9) from the rear body (99).
14. Taking care that the spring (98) is not ejected, remove MF 352, then remove the collar (93) guide (94), spring (98) and the disc (97).
15. Remove the four nuts (88 and 88a) and detach the front body (90).
16. Withdraw the two valve chambers (154) from the rear body (99), complete with the front cam block (155), pistons (143), cam follower (145), oscillator tube (95) and the rear cam block (144).
17. Separate the valve chambers (154) from the pistons (143) and remove the cam blocks (144 and 155) from the pistons.
18. Withdraw the camshaft (96) from the rear body (99).
19. If necessary, remove the split pin and the clevis pin (91) retaining the cam follower (145) to the oscillator tube (95).
20. Taking care not to damage the rear body (99) and the control valve body (136), drive out the body (136), then remove the 'O' ring (103) back-up washer (102), sleeve (101) and the washer (100). Remove the 'O' ring and the back-up washer from the control valve body.
21. Fig. 36 and 38. Remove the circlip (146), retaining the valve chamber plug (147) then using MF 351, remove the plug as shown.
22. Fig. 36. Remove the back-up washer (148), 'O' ring (149), outlet valve spring (150), outlet valve (151), inlet valve spring (152) and the inlet valve (153) from the valve chamber (154).
23. Repeat items 21 and 22 for the other three valves.

**Examination**

Check the condition of all components for wear, or damage, replacing any defective components. Always replace 'O' rings, back-up washers, gaskets and circlips. Lubricate the 'O' rings with an approved oil before fitting.

**Reassembly**

1. If necessary, form new valve seats, using MF 349 as follows:—
   Cut out the old top seat, then the bottom seat using the refacing tool. Using the seat forming tool, form a new top seat by tapping the tool with a hammer, invert the tool and form a new bottom seat in the same manner. Thoroughly clean the valve chambers.
2. Refit the inlet valve (153), inlet valve spring (152), outlet valve (151) and the outlet valve spring (150).
3. Fig. 36 and 38. Assemble a new back-up washer (148) and a new 'O' ring (149) to the plug (147), then using MF 351, push the plug into the valve chamber until the circlip groove can just be seen.
4. Fig. 36 and 39. Position a new circlip (146) in MF 350, then using the tool as shown, secure the plug (147) in the valve chamber with the circlip.
5. Using MF 351, pull the plug up against the circlip.
6. Repeat items 2 to 5 for the other three valves.
7. Fig. 40. Using MF 353, fit a new back-up washer (158) and a new 'O' ring (157) to the control valve body (136), as shown.
8. Fig. 37. Locate the washer (100) and the sleeve (101) in the rear body (99).
9. Fig. 36 and 41. Assemble a new 'O' ring (103) and a new back-up washer (102) to the end of the control valve body (136), then using MF 354, carefully drive the body (136) into the front body (99), aligning the pin at six o'clock.
10. Fig. 36. If necessary, secure the cam follower (145) to the oscillator tube (95) with the clevis pin (91) and a new split pin.
11. Fit new 'O' rings (156) into place on the front and rear bodies (90 and 99).
12. Refit the valve chambers (154) onto the pistons (143), with new piston rings, if necessary.
13. Place the cam follower (145) between the pistons.
14. Place the camshaft (96), with the front and rear cam blocks (155 and 144), into the pistons.
15. Refit the rear body (99), making sure the oscillator tube (95) aligns with the aperture in the rear body.
16. Refit the front body (90), then lubricate the threads of the studs with an approved oil, and secure the front body with the four nuts (88 and 88a) tightened to a torque of 4 kg m (30 lbf ft), ensuring at all times that the pistons move freely.
    NOTE—THE SPECIAL NUTS (88a) MUST BE FITTED TO THE TOP RIGHT HAND AND THE BOTTOM LEFT HAND STUDS.
17. Lubricate the control valve (9) with an approved oil, then slide it into the rear body (99).
18. Refit the disc (97), spring (98), guide (94) and the collar (93) into the oscillator tube (95) and retain them in position with MF 352.
19. Secure the collar (93) with a new retaining ring (92) and then remove MF 352.
20. Refit the oscillator end cap (89).
21. Refit the Pressure Control valve (12) and secure it with the washer and the nut (142) tightened to a torque of 4 kg m (30 lbf ft).
22. If necessary, reassemble the non-return valve by locating the valve (128) in the housing (132) and refitting the seal (133), retainer (134), spring (135), cap (137) and the circlip (138).
23. Locate the ball (114), spring (113) and the bush (112) in the strainer housing (132).
24. Locate the lever (108) in position, then fit the washer (109), bush (104) and the retainer (107) and secure them with the washer and the bolt (106) tightened to a torque of 1 kg m (10 lbf ft).
    NOTE—COAT THE BOLT THREADS WITH HYLOMAR SQ 32M SEALING COMPOUND.
25. Refit the washer and bolt (105) to secure the retainer (107).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88a

FIG. 36

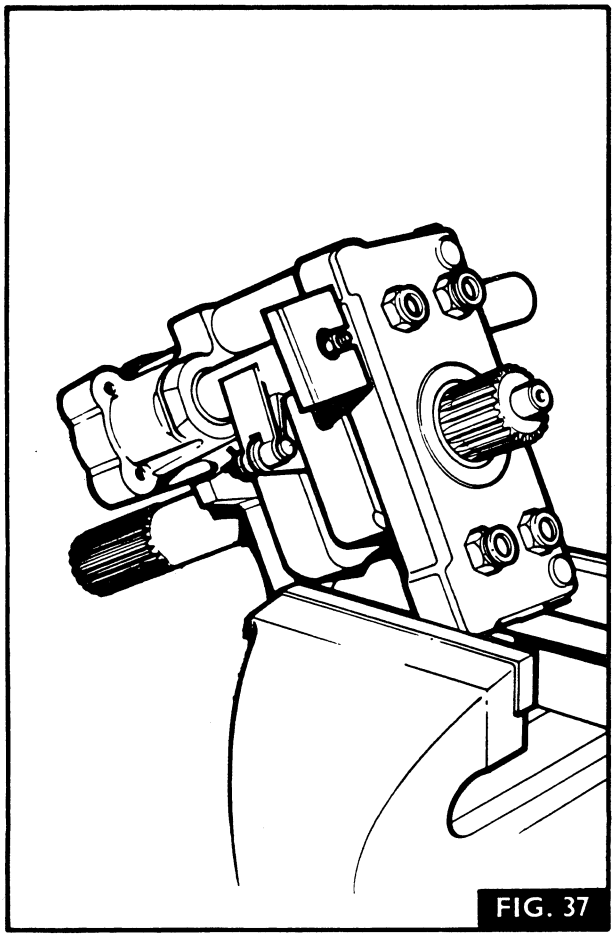

FIG. 37

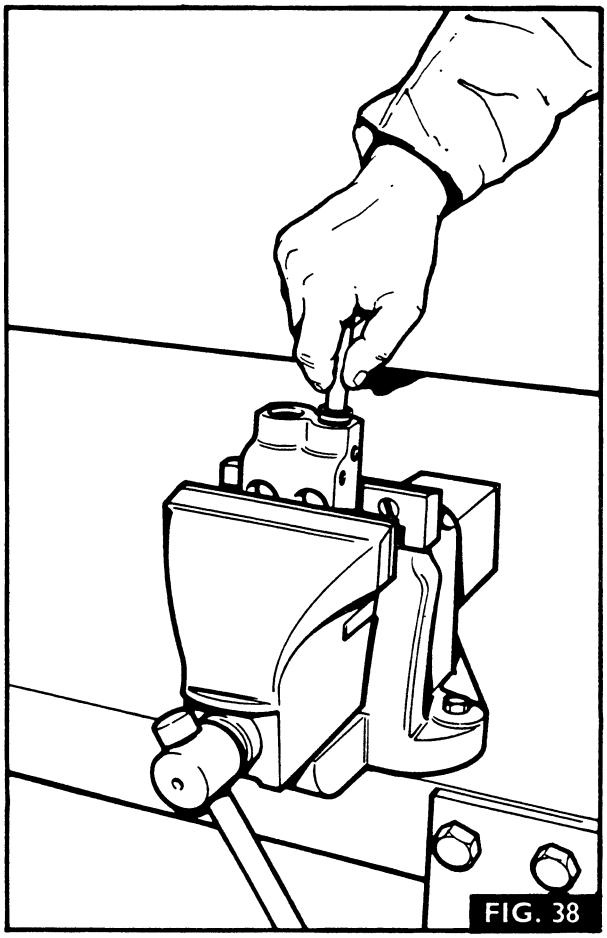

FIG. 38

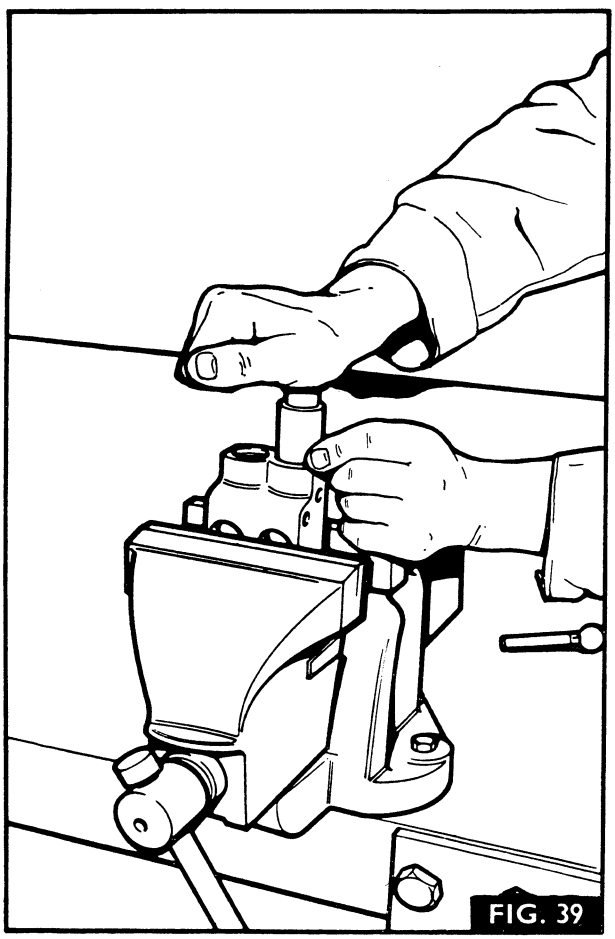

FIG. 39

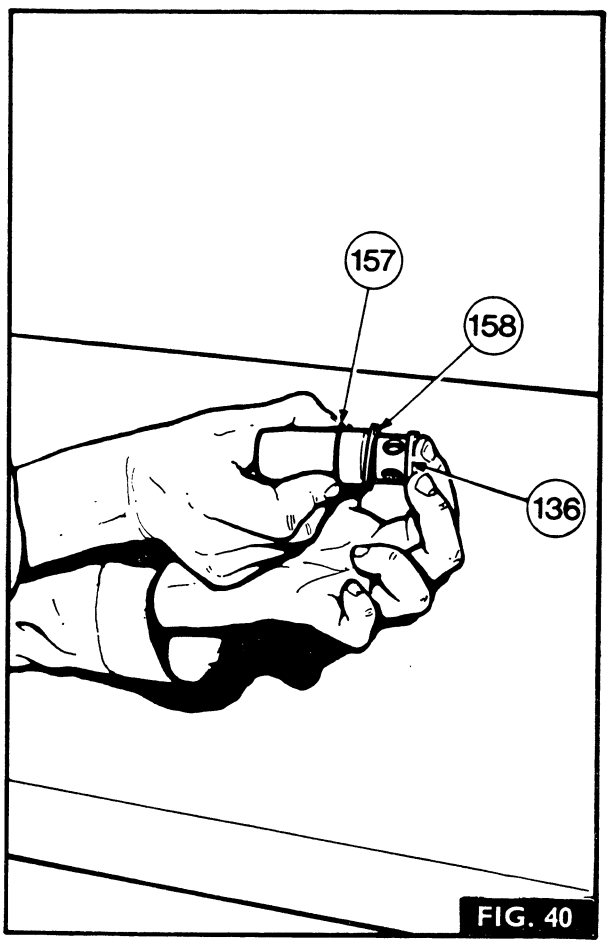


FIG. 40

26. Reassemble the strainer housing by locating a new 'O' ring (131) on the strainer housing (132) and refitting the cover (130), strainer (120), a new 'O' ring (119), washer (118), spring (117), nut (116) and the clip (115).
27. Refit the end plate (127), with a new gasket (129) and secure it in position with the two washers and bolts (126). Do not fully tighten the bolts at this stage.
    NOTE—COAT THE BOLT THREADS WITH HYLOMAR SQ 32M SEALING COMPOUND.
28. Refit the strainer housing (132), with a new gasket (111), making sure that the pin on the control valve body (136) locates in the strainer housing correctly.
29. Secure the strainer housing to the rear body with the four washers and bolts (121). Torque the bolts (121 and 126) to 2 kg m (15 lbf ft), checking at all times that the control valve continues to slide freely.
    NOTE—COAT THE BOLT THREADS WITH HYLOMAR SQ 32M SEALING COMPOUND.
30. Refit the lever (125), two rollers (122) and the pin (123), then refit the clip (124).
31. Attach the link (140) to the lever (126) and secure the outer end with the pin and the two clips (139).
32. Refit the hydraulic pump, as stated in operation 7A—11—49.

## HYDRAULIC PUMP

**Control Valve Removal and Refitment** 7A—13—53

Special tools required:— See operation 7A—03—38, and
MF 352 Control Valve Spring Retainer.
MF 353 Control Valve Body 'O' Ring Guide.
MF 354 Control Valve Body Replacer.

**Figs. 36, 39, 40 and 41.**

**Removal**

1. Remove the control valve, as stated in items 1 to 4, 11 to 15 of operation 7A—12—49.
2. Fig. 36. Remove the split pin and the clevis pin (91) securing the oscillator tube (95) and remove the tube.
3. Remove the control valve body, as stated in item 20 of operation 7A—12—49.

**Examination**

Check the condition of all components for wear, or damage, replacing any defective parts. Always replace back-up washers, 'O' rings, gaskets and circlips. Lubricate the 'O' rings with an approved oil before fitting.

**Refitment**

1. Refit the control valve, as stated in items 7 to 9, of operation 7A—12—49.
2. Fig. 36. Refit the oscillator tube (95) to the rear body and secure it to the cam follower (145) with the clevis pin (91) and a new split pin.
3. Refit the control valve as stated in items 16 to 20 and 28 to 32 of operation 7A—12—49.

## PRESSURE CONTROL VALVE

**Removal and Refitment** 7A—14—53

Special tools required:— See operation 7A—03—38.

**Fig. 36**

**Removal**

1. Remove the hydraulic pump, as stated in operation 7A—11—49.
2. Fig. 36. Remove the clip (139) and the pin retaining the link (140) and detach the link from the lever (125).
3. Remove the nut (142) and the washer securing the Pressure Control valve (12) and carefully remove the valve.

**Refitment**

1. Refit the Pressure Control valve (12) and secure it with the washer and the nut (142) tightened to a torque of 4 kg m (30 lbf ft).
2. Attach the link (140) to the lever (125) and secure the other end with the pin and the two clips (139).
3. Refit the hydraulic pump, as stated in operation 7A—11—49.

## PRESSURE CONTROL VALVE

**Servicing** 7A—15—53

Special tools required:— See operation 7A—03—38.

**Fig. 42**

**Disassembly**

1. Remove the Pressure Control valve, as stated in operation 7A—14—53.
2. Fig. 42. Remove the four screws (170) and the springs (169) securing the diaphragm body (166), then remove the body, spring (167) and the diaphragm (168).
3. If necessary, remove the lever (171) and the spring (165) from the diaphragm body (166).
4. Remove the distance piece (162), spring (161) and the valve (160).
5. Unscrew the guide (175), then remove the spring support (174), plunger (176) and the ball (177).
6. Taking care not to damage the valve body, withdraw the guide (173) and the 'O' ring (172), then withdraw the seat (163), back-up washer (159) and the 'O' ring (164).

**Examination**

Examine all the components for signs of wear, damage, scoring or pitting and replace if necessary.

**Reassembly**

1. Fit a new 'O' ring (164) and a new back-up washer (159) to the seat (163), then locate the seat (163) in position.
2. Fit a new 'O' ring (172) to the guide (173), then locate the guide in position.
3. Refit the ball (177), plunger (176), with the tappered end towards the ball, and the spring support (174).
4. Degrease the threads of the guide (173) and the threads in the valve body, then screw the guide into the valve body by half a thread.

5. Apply three equally spaced drops of Loctite 270 'Stud Lock' to the threads of the guide, then tighten the guide to a torque of 4 kg m (30 lbf ft).
6. Refit the valve (160), and the spring (161), then refit the distance piece (162) so that it is flush with the face of the valve body.
7. Assemble the diaphragm (168), spring (167) and the diaphragm body (166) to the valve body and secure them with the springs (169) and the four screws (170).
8. If necessary, refit the lever (171) and the spring (165) to the diaphragm body (166).
9. Refit the Pressure Control valve, as stated in operation 7A—14—53.

## STRAINER HOUSING AND RESPONSE CONTROL

**Removal and Refitment** 7A—16—54

Special tools required:— See operation 7A—03—38

**Fig. 36**

**Removal**

1. Remove the strainer housing as stated in items 1 to 4 of operation 7A—12—49.

**Refitment**

1. Refit the strainer housing as stated in items 28 to 32 of operation 7A—12—49.

## STRAINER HOUSING AND RESPONSE CONTROL

**Servicing** 7A—17—54

Special tools required:— See operation 7A—03—38.

**Fig. 36**

**Disassembly**

1. Remove the strainer housing, as stated in operation 7A—16—54.
2. Disassemble the strainer housing and the Response Control, as stated in items 5 to 9 of operation 7A—12—49.

**Examination**

Check the condition of all components for wear or damage, replacing any defective components. Always replace 'O' rings and gaskets.

**Reassembly**

1. Reassemble the strainer housing and the Response Control, as stated in items 22 to 27 of operation 7A—12—49.
2. Refit the strainer housing, as stated in operation 7A—16—54.

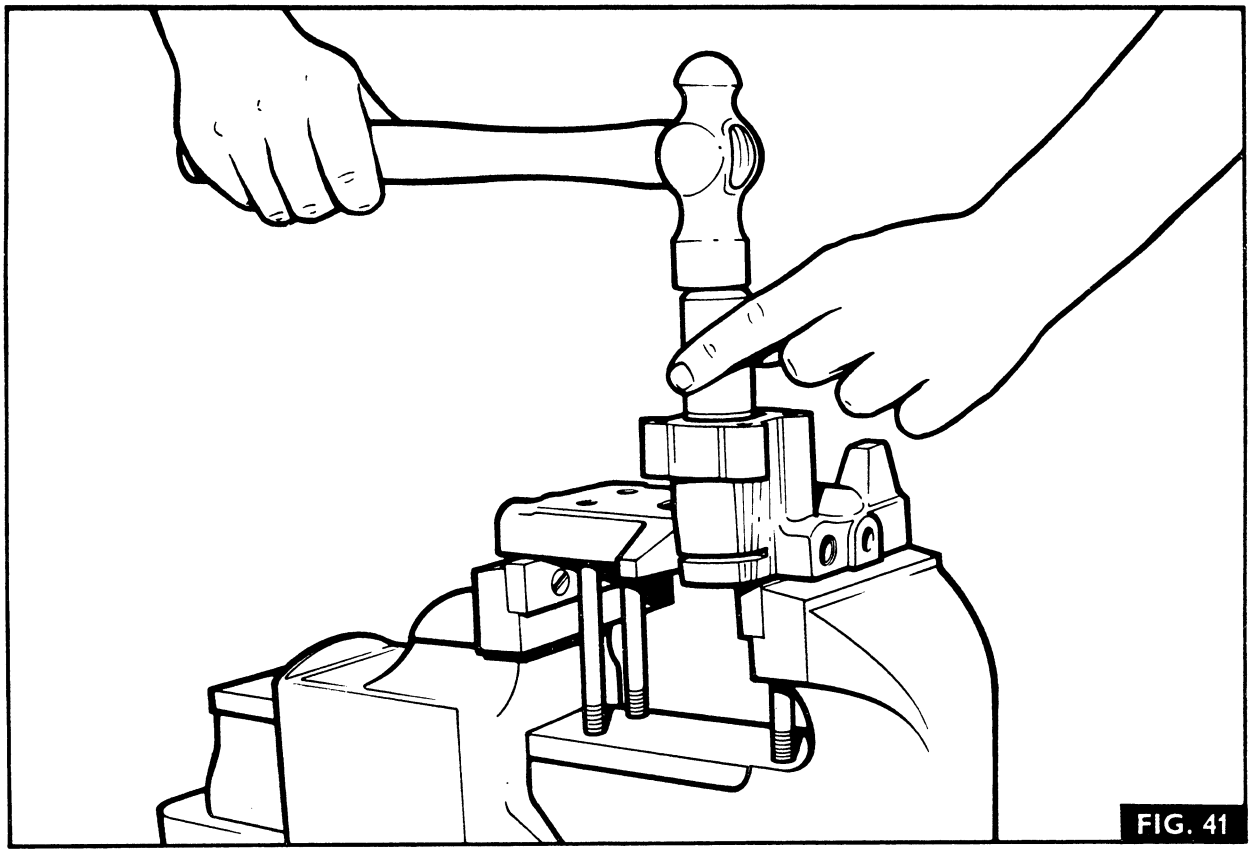

FIG. 41

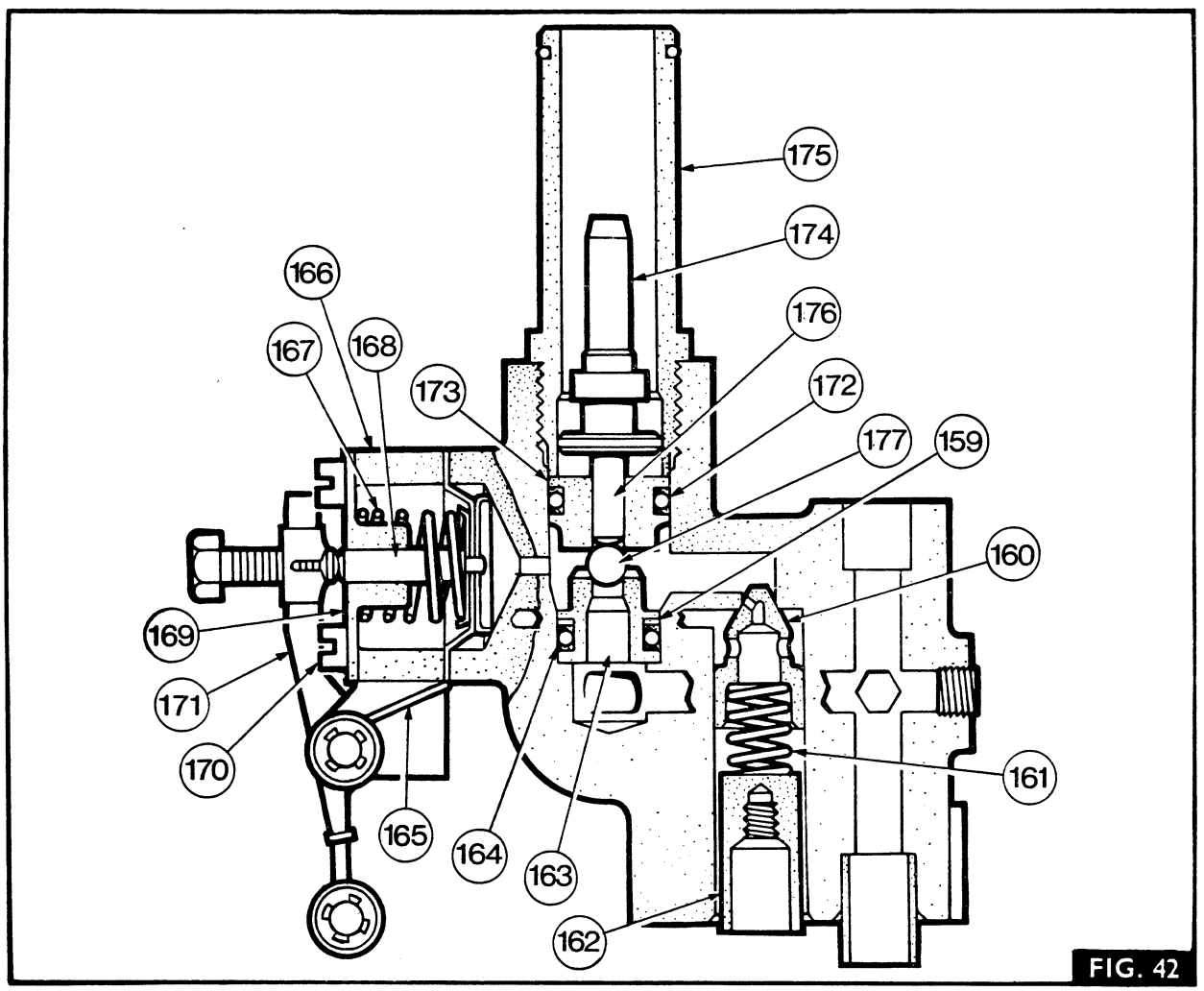
175
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FIG. 42

# AUXILIARY HYDRAULICS

## Part 7 Section B

# AUXILIARY HYDRAULICS

## GENERAL

The auxiliary hydraulic system is available for all Multi-Power tractors. The auxiliary hydraulic pump provides oil for up to three services :– Multi-Power, Independent p.t.o. and Auxiliary (external) services.

A single, or two spool control valve is available for use with auxiliary hydraulic tractors and can be used for both single-acting and double-acting hydraulic services.

Auxiliary hydraulic tractors are normally fitted with a filter as standard equipment and oil cooler is fitted to tractors with spool valves. Some tractors are fitted with the low output (Multi-Power only) type of pump and are not fitted with either a cooler, or a filter.

A combining valve can be fitted, to supplement the output of the auxiliary pump 28,6 lit/min (6.3 Imp gal/min), with the output of the tractor linkage pump of 14,1 lit/min (3.1 Imp gal/min) to give a total output of 42,7 lit/min (9.4 Imp gal/min) at 2000 engine rev/min. The linkage pump output is made available for external services, by screwing the combining valve knob fully out. When using combined flow, the 'Position Control' lever must be placed in the 'Constant Pumping' and the 'Draft Control' lever at the fully raised position. The rear linkage must not be used when the combining valve is open.

The combined flow of both pumps is available to external service provided that the pressure required is not in excess of 169 Kg/cm$^2$ (2400 lb/in$^2$) with the combining valve closed, or 211 Kg/cm$^2$ (3000 lb/in$^2$) with the combining valve open.

## OIL COOLER

**Removal and Refitment** 7B-01-02

**Removal**

1. Remove the grille door.
2. Fig. 1. Slacken the two wingnuts (1) and pull the oil cooler forwards.
3. Disconnect the two hoses (2) at the top of the cooler.
4. Mask off the hose connections using suitable plugs or masking tape to prevent the ingress of dirt.
4. Lift the cooler clear of the tractor.

**Refitment**

1. Place the oil cooler in position over the bottom retaining pins.
2. Fig. 1. Reconnect the two pipes (2) to the oil cooler.
3. Push the oil cooler into place and secure it with the two wing nuts (1).
4. Refit the grille door.

## AUXILIARY OIL FILTER UNIT

**Removal and Refitment** 7B-02-02

**Removal**

1. Fig. 2. Mark one of the metal pipes (3) and its mating union on the filter head,(5), then disconnect both metal pipes (3).
2. Disconnect both hoses (2) at the filter head.
3. Mask off all open connections using suitable plugs and caps, or masking tape.
4. Remove the two nuts, bolts and spring washers (4) securing the filter head (5) to its bracket.

**Refitment**

1. Place the filter unit in position, then secure it with the nuts, bolts and spring washers.

NOTE – PLACE SPRING WASHERS UNDER THE BOLT HEADS.

2. Reconnect the two hoses (2) to the front end of the filter.
3. Refit the two metal pipes (3), aligning the two identification marks.

## AUXILIARY OIL FILTER

**Servicing** 7B-03-02

**Disassembly**

1. Fig. 3. Unscrew the filter housing (10) from the filter head (5).
2. Remove the element (8) sealing rings (7 and 9) and the 'O' ring (6). Thoroughly clean all components with paraffin, then examine the filter head and housing for cracks, or damage. Always fit a new element and seals.

**Reassembly**

1. Fit a new sealing ring (9) to the base of the body, then fit a new element (8).
2. Locate the upper sealing ring (7) in the top of the element.
3. Fit a new 'O' ring (6) to the filter head (5), then screw the body and element assembly on to the head.

## AUXILIARY OR MULTI-POWER PUMP UNIT

**Removal and Refitment** 7B-04-02

Special Tools Required: See operation 7A-14-31

**Removal**

1. Remove the hydraulic pumps, as stated in operation 7A-14-31.
2. Fig. 5. Remove the circlip (23) securing the pump driven gear (36) to the pump drive shaft.
3. Remove the two special bolts (24), spacers (33) and the Allen screw (22) securing the pump drive assembly to the pump.
4. Slide the pump out of the plated drive unit, removing the driven gear (36).

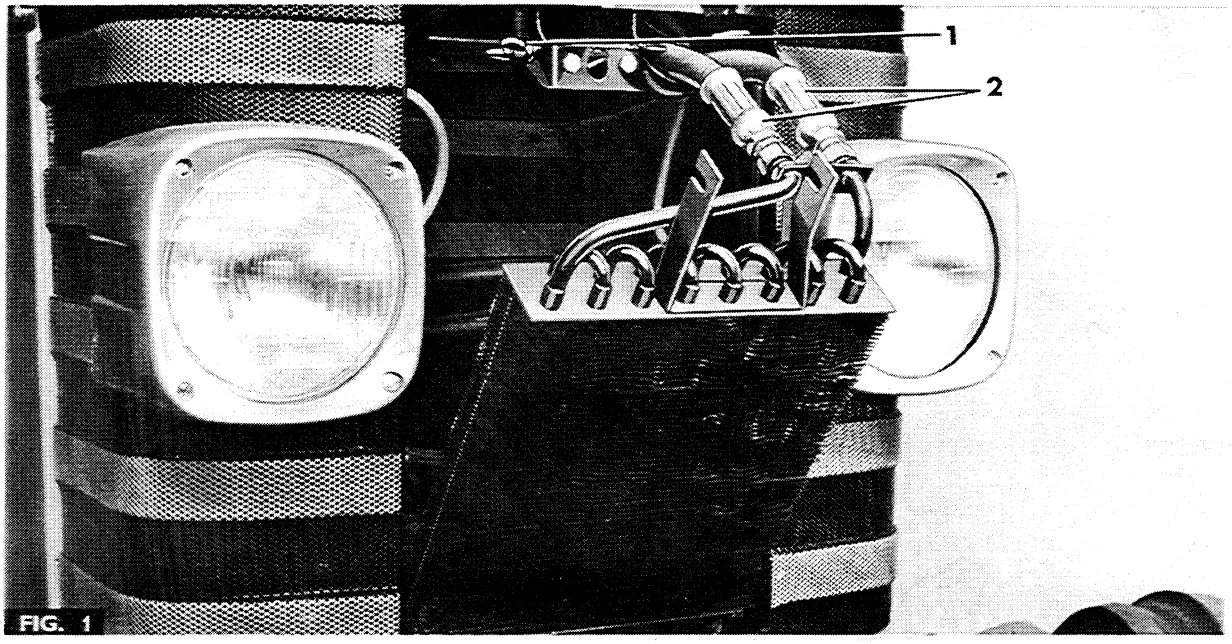


FIG. 1

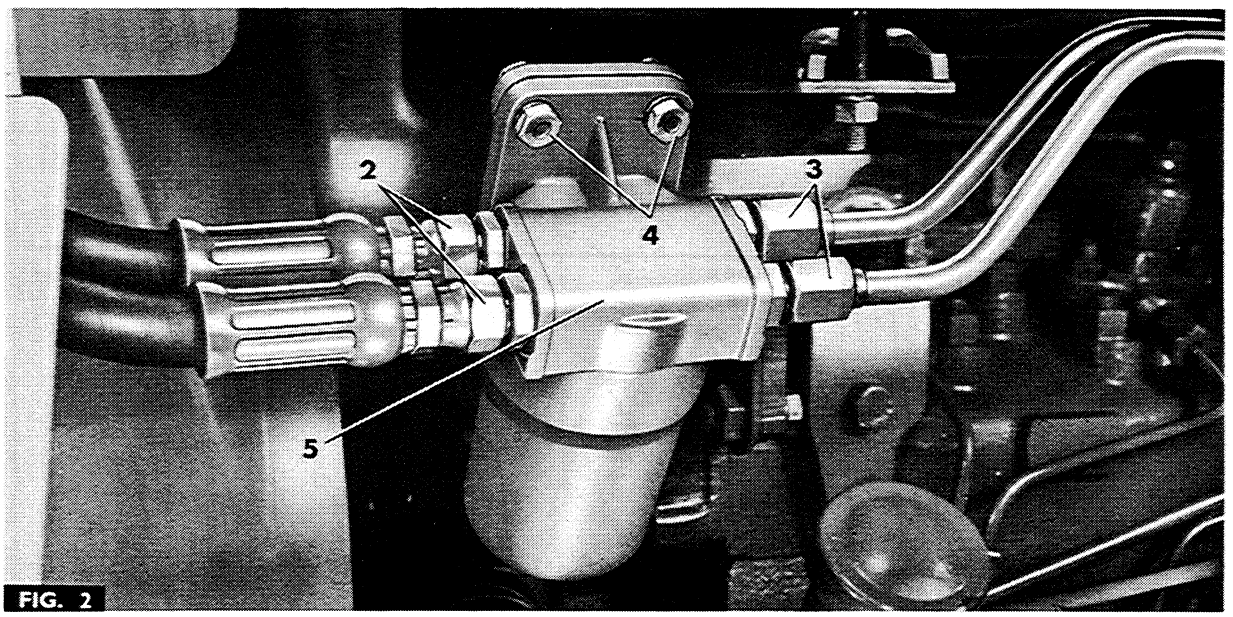


FIG. 2

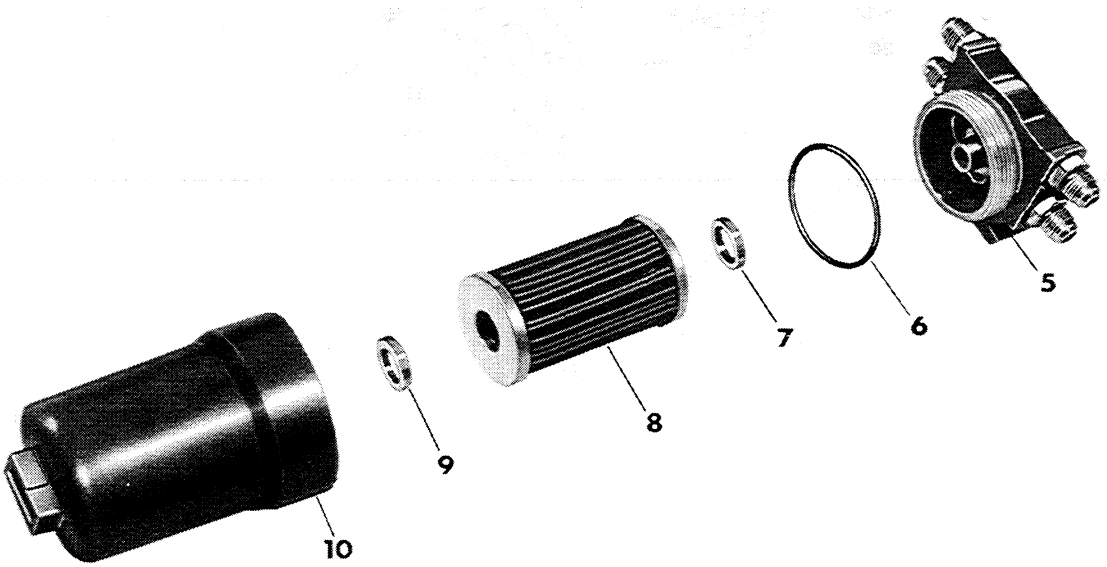


FIG. 3

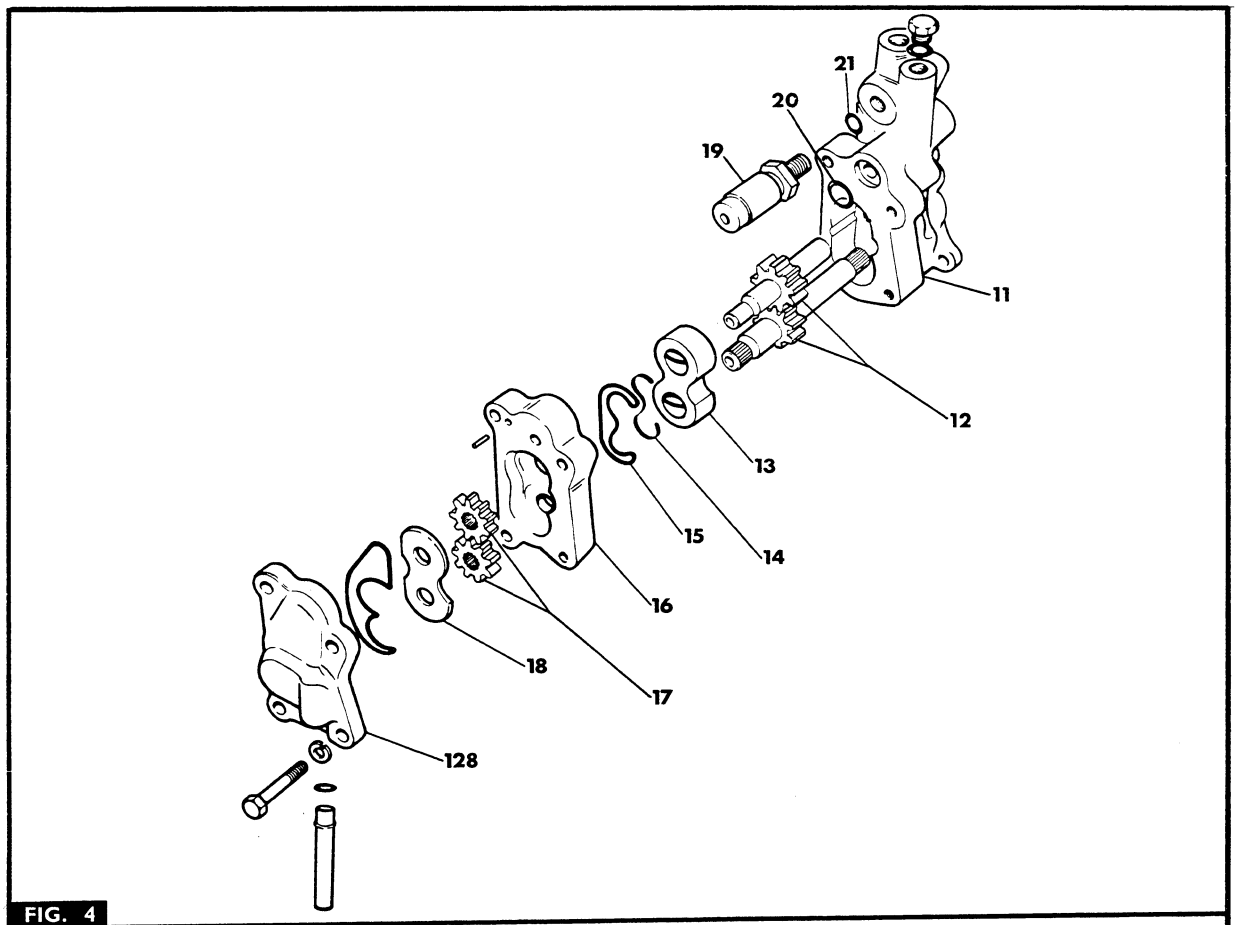


FIG. 4

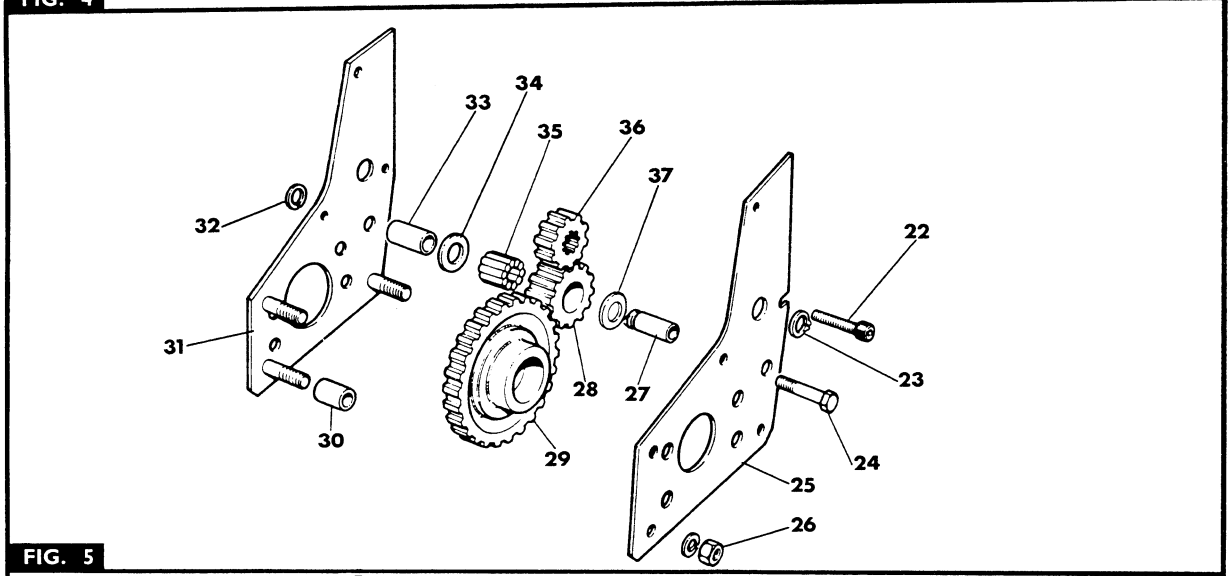


FIG. 5

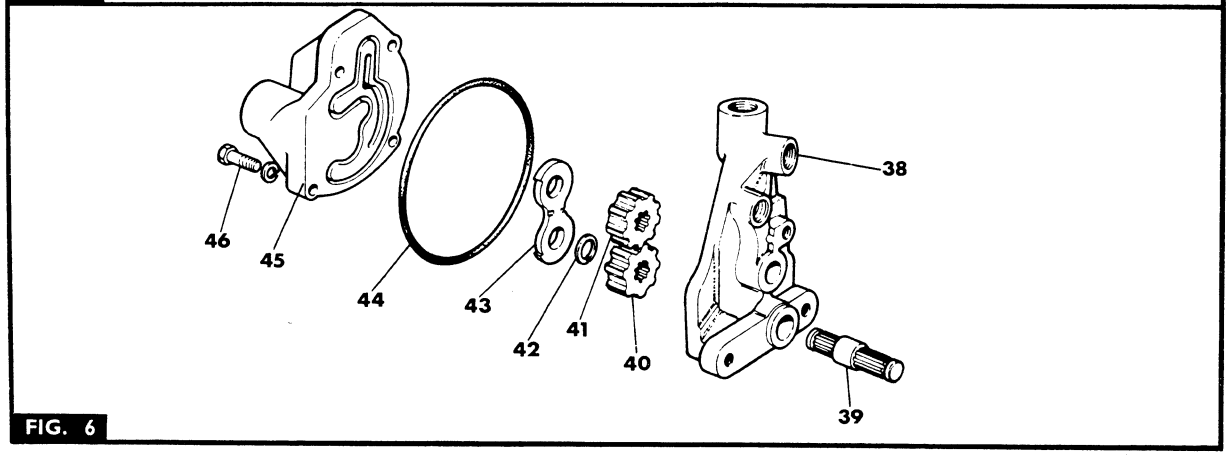


FIG. 6

**Refitment**

1. Position the plated drive unit on the auxiliary pump, ensuring that the flat machined on the idler gear shaft (27) abuts against the pump and that the driven gear (36) is correctly mounted on the pump driveshaft.
2. Refit the circlip (23) to the pump driveshaft to secure the driven gear (36).
3. Refit the two special bolts (24), spacers (33) and the Allen screw (22).
4. Tighten the two bolts (24) to a torque of 3,0 Kg-m (22 lb-ft) and the Allen screw (22) to a torque of 2,7 Kg-m (20 lb-ft), then check the backlash between any of the gears. The total backlash between the three gears (two measurements) must be between 0,050 to 0,406 mm (0.002 to 0.016 in).
5. Refit the hydraulic pump as stated in operation 7A-14-31.

## AUXILIARY PUMP

**Servicing** 7B-05-05

Special tools Required: See operation 7A-14-31

**Disassembly**

1. Remove the auxiliary pump, as stated in operation 7B-04-02.
2. Fig. 4. Remove the bearing plate (18).
3. Suitably mark each gear in relation to its shaft.
4. Remove the body (16), complete with the gears (17) rubber seal (15) and P.T.F.E seal (14).
5. Remove the 'O' ring (20).
6. Remove the floating bearing (13) and the gears (12) from the body (11).
7. If necessary, remove the main relief valve (19) and the 'O' ring (21).

**Examination:**

**Bearings**: Examine the bearings (13 and 18) for wear on their faces and in their bores. Pay particular attention to the lubricating scrolls. Score marks, between the bearing bores can cause high leakage losses. During major overhaul the bearings should be renewed, but if not badly worn, they can be salvaged, by polishing as follows:

Place a sheet of 'O' grade emery paper, lubricated with paraffin on a true, flat surface (e.g. a surface plate, or sheet of plate glass), then polish the bearing face, using a light, rotary motion.

Outer diameters of the bearings can be lightly polished to obtain free movement in the body.

**Bodies**: Inspect the bodies (11 and 16) for external damage and cracks. Examine bores for wear and damage. The gears always cut a light track on the inlet side of the body bores. The depth of this track must not exceed 0,010 mm (0.004 in). Examine the bearing face in the pump body for wear and damage, as this can cause high leakage losses.

Examine the bearing bores for wear. If they are worn excessively, the pump body must be replaced.

**Gears**: Examine the gears (12 and 17) for scored or worn faces or journals, damaged teeth and surface cracks.

Slight wear or scoring on the journals can be removed by polishing between lathe centres, using 'O' grade emery paper lubricated with paraffin. Check the widths of the drive and driven gears. Their actual width is relatively unimportant, provided that each pair are within 0,005 mm (0.0002 in) of each other and that the journals are within 0,013 mm (0.0005 in) of one another. Spare gears are only available as matched pairs.

Check the gear faces for flatness by smearing a bearing face with engineer's "blue" and rotating the gear against it. This will also reveal any sharp edges on the teeth which can be removed with a fine needle or by stoning.

Under working conditions, hydraulic pressure within the pump loads the gears towards the inlet side of the body, thus cutting the running track. If the bearings, or gear journals wear, the gears move over and deepen the running track. Therefore, if the running track is worn past, or to the limit, for re-use, the fitting of a new floating bearing (13) may not improve the pump efficiency, as the new bearing will hold the gears and prevent them from bottoming in the running track.

Always fit a set of new seals and 'O' rings on reassembly.

**Reassembly**

1. Lightly lubricate the faces and bores of all bearings and gears with clean hydraulic oil.
2. Fig. 4. Fit the gears (12) in the pump body (11).
3. Fit a new 'O' ring (20) to the pump body (11).
4. Fit the floating bearing (13) with its machined recess adjacent to the gears and the relieved radii on the outlet side of the pump. Check that the floating bearing is 0,05 to 0,13 mm (0.002 to 0.0055 in) below the face of the pump body.
5. Fit a new seal (15) to the centre body (16), then fit the new P.T.F.E. seal (14) between the OUTER edge of the rubber seal and the pump body.
6. Refit the centre body to the pump, taking care not to displace the seals.
7. Refit the gears (17) on the shafts, aligning the marks on the shaft.
8. Refit the bearing plate (18) ensuring that the machined recess is adjacent to the gears. Check that bearing plate is 0,05 to 0,18 mm (0.002 to 0.007 in) below the face of the centre body.
9. Refit the pressure relief valve (19) using a new 'O' ring (21).
10. Refit the auxiliary pump, as stated in operation 7B-04-02
11. Carry out hydraulics test as stated in operation 7B-16-31

## MULTI-POWER PUMP

**Servicing** 7B-06-06

Special Tools Required: See operation 7A-14-31

**Disassembly**

1. Remove the Multi-Power pump as stated in operation 7B-04-02.
2. Fig. 6. Remove the four bolts (46) from the end plate, then remove the end plate (45) and seal (44).
3. Remove the pressure plate (43) from the body (38).
4. Remove the gears (40 and 41) from the body, then remove the circlip (42) and slide the drive gear (40) off the shaft (39).

**Examination**

Examine the pressure plate (43) for wear on the faces and bores. Score marks between the bearing bores can cause high leakage losses. During major overhaul, the pressure plate (43) should be renewed, but if not badly worn, it can be salvaged, by polishing, as follows:

Place a sheet of 'O' grade emery paper, lubricated with paraffin, on a true, flat surface (e.g. a surface plate, or sheet of plate glass), then polish the bearing plate, using a light, rotary motion.

Outer diameters of the pressure plate can be lightly polished to obtain free movement in the body.

Inspect the body (38) for external damage or cracks and examine the bores for wear, or damage. The gears always cut a light track on the inlet side of the body bores. The depth of this track must not exceed 0,10 mm (0.004 in). Examine the bearing face in the pump body for wear or damage, as this can also cause high leakage losses.

Examine the diameter of the driven gear spigot for wear. This will normally show up as a step on the diameter and if wear has taken place, the running track wear in the body bore will be excessive, necessitating replacement of the body.

Inspect the gears (40 and 41) for scored or worn faces, damaged teeth, or surface cracks. Slight wear or scoring on the gear faces can be polished in a similar manner to that of the bearing plate. Check the width of the gears. Their actual width is relatively unimportant, provided that they are within 0,005 mm (0.0002 in) of each other.

Visually inspect the sealing face of the end plate (45) for damage, cracks, or scoring and check the flatness with a straight edge.

Replace any defective components and fit a new seal (44) and circlip (42).

**Reassembly**

1. Lightly lubricate the faces and bores of the bearings and gears with clean hydraulic oil.
2. Refit the drive gear (40) to the shaft (39), securing it with a new circlip (42).
3. Carefully slide the gears (40 and 41) into the pump body (38).
4. Fit the bearing plate (43) with the relieved edge and recessed face on the outlet side of pump. Check that the bearing plate is 0,05 to 0,18 mm (0.002 to 0.007 in) below the body face.
5. Fit a new seal (44) into the end plate (45), locate the end plate in position and fit the four bolts, tightening them to a torque of 2,75 Kg-m (20 lb-ft).
6. Refit the Multi-Power pump, as stated in operation 7B-04-02 carrying out the hydraulic tests as stated in operation 7B-15-31 before refitting the lift cover.

## PLATED DRIVE UNIT

**Servicing** 7B-07-06

Special Tools Required: See operation 7A-14-31

**Disassembly**

1. Remove the auxiliary, or Multi-Power pump, as stated in operation 7B-04-02
2. Fig. 5. Remove the three nuts (26) and spring washers, then remove the plate (25), and the spacers (30).
3. Lift out the drive gear (29), then remove the thrust washer (37) idler gear (28) complete with needle rollers (35) and second thrust washer (34).
4. Push the idler shaft (27) complete with its circlip (32) out of the side plate (31).

**Examination**

Check the gear teeth for wear, chipping, or other damage. Examine the bores of the gears and the needle rollers for wear. Check the idler shaft and thrust washers for wear, scoring, or pitting.

Replace any defective components.

**Reassembly**

1. Refit the idler shaft (27) to the side plate (31).
2. Fit a thrust washer (34) to the idler shaft.
3. Fit the idler gear (28), needle rollers (35) and the second thrust washer (37).

NOTE – PETROLEUM JELLY CAN BE USED TO FACILITATE FITMENT OF THE NEEDLE ROLLERS.

4. Refit the drive gear (29).
5. Refit the three spacers (30) then refit the drive plate (25) and secure it with the three nuts (26) and spring washers. Tighten the nuts progressively and evenly to a torque of 3 Kg-m (22 lb-ft).
6. Refit the auxiliary, or Multi-Power pump, as stated in operation 7B-04-02

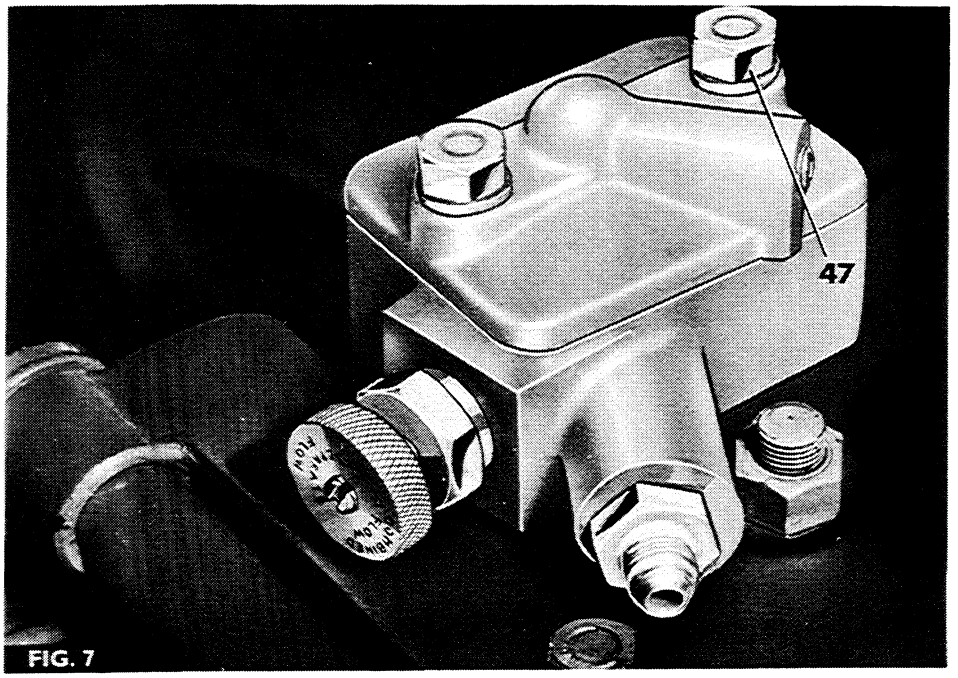


FIG. 7

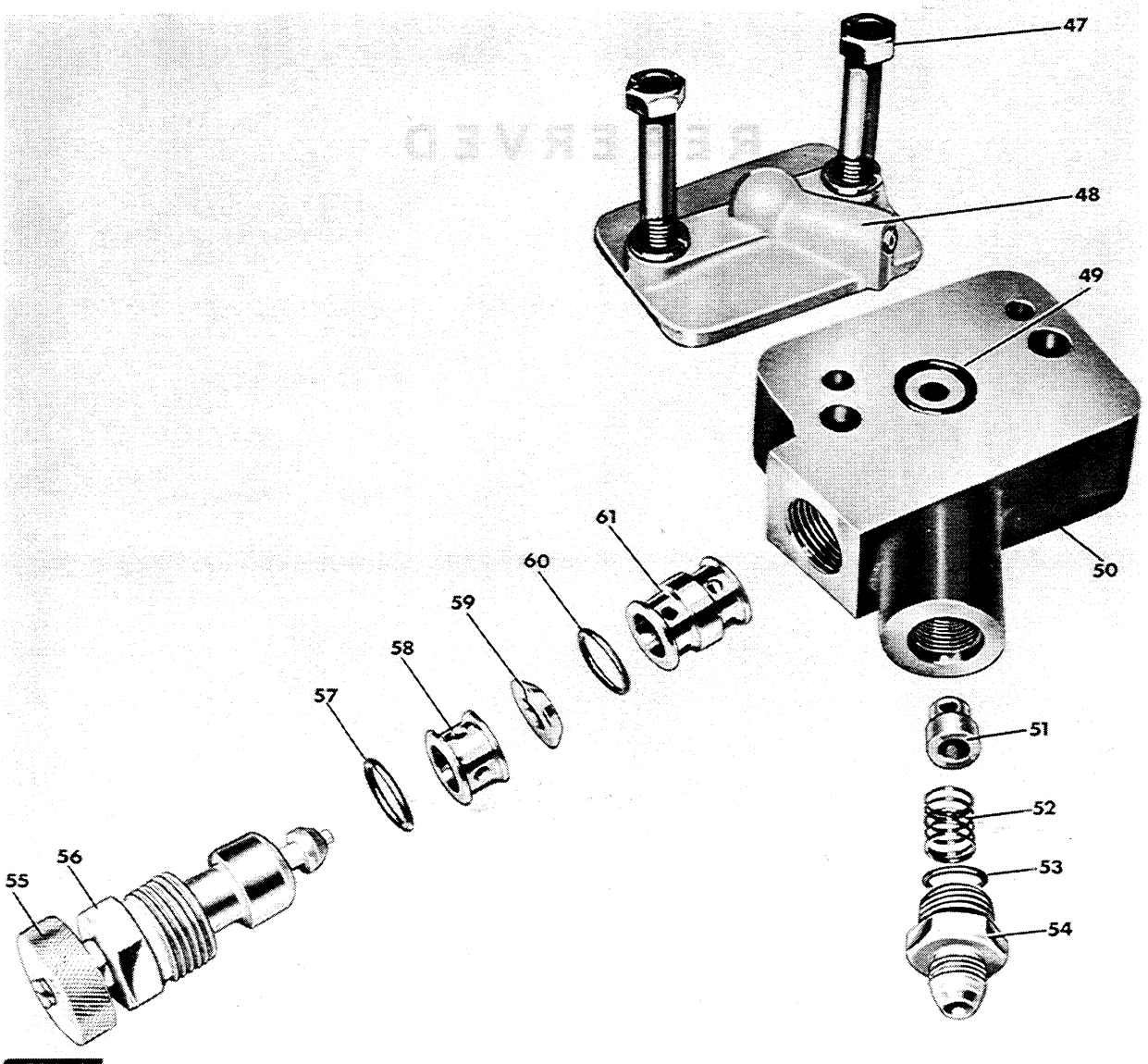


FIG. 8

## COMBINING VALVE

**Removal and Refitment** 7B-08-09

**Removal**

1. Place the 'Draft Control' lever in the 'Down' position and the spool valve lever in 'Drop' to relieve the hydraulic system of pressure.
2. Disconnect the feed pipe from the combining valve.
3. Fig. 7. Remove the two bolts (47) and spring washers securing the combining valve and transfer cap to the lift cover.
4. Remove the transfer cap.
5. Carefully ease the combining valve off the hydraulic standpipe, taking care not to disengage the standpipe from the hydraulic pump.

**Refitment**

1. Fit a new 'O' ring to the standpipe and clean the joint face.
2. Fit a new 'O' ring (49) to the top of the combining valve.
3. Carefully locate the combining valve on the standpipe, ensuring that the standpipe is properly located in the combining valve and in the lift pump.
4. Clean both the top face of the combining valve and the transfer cap, then locate the transfer cap on the combining valve and refit the bolts (47) and spring washers.

## COMBINING VALVE

**Servicing** 7B-09-09

**Disassembly**

1. Remove the combining valve, as stated in operation 7B-08-09.
2. Fig. 8. Remove the connector (54) 'O' ring (53), spring (52) and check valve (51) from the combining valve body (50).
3. Slacken the union nut (56), then remove the knob and guide assembly (55), 'O' ring (57) spacer (58) seat (59) 'O' ring (60) and distance piece (61).

**Examination**

Examine all components for wear, or damage and replace any defective components. Always fit new 'O' rings.

**Reassembly**

1. Refit the distance piece (61) new 'O' ring (60) seat (59) spacer (58) second new 'O' ring (57), then screw in the knob and guide assembly with the nut (55 and 56).
2. Refit the check valve (51) and spring (52). Replace the connector (54) with a new 'O' ring (53).
3. Refit the combining valve, as stated in operation 7B-08-09.

## WOOSTER SPOOL VALVE

Fig. 10. The spool valve is available in two forms; single or twin spool. The design of both valves is basically similar, and performance characteristics are identical; the valve being capable of controlling double-acting rams, single-acting rams, or hydraulic motors, if modified slightly.

The valve body (63) is a cast-iron casting, with cast-in galleries and is bored to accept precision ground spools (62).

The spools protrude from one end of the valve body and engage a bell-crank lever (82), movement of which determines the positioning of the spools and thus the flow of oil. The position of the bell-crank lever is maintained by a spring loaded ball (81) which engages one of the three slots in the radial selector plate (80).

The opposite end of the spool bore is enlarged to house the kick-out mechanism (75). The open ends of the spool bores are sealed by plugs (74) retained by circlips (73). The ball and spring valve (77 and 78), retained by the screwed plug (76) prevents unequal pressure in the hydraulic circuit thereby preventing jerky operation.

**Kick-out Mechanism**

Fig. 9. To prevent excessive exhausting of the circuit pressure relief valve, the Wooster spool valve incorporates a mechanism which returns the spool and actuating lever to the neutral position when a pressure of 140,5 Kg/cm$^2$ (2000 lb/in$^2$) is reached. The mechanism is as follows:–

The main spool (62) which slides in the valve body (63) is cross-drilled (A) and bored (B). Screwed into the end of the spool is a tubular spool extension (64) which houses a poppet valve (67) and valve guide (65) which is retained by a pin (66).

The valve guide is cross-drilled (C) to allow oil to flow into the chamber formed by the spool extension (64), but this cross-drilling is blocked off by a spigot on the poppet valve. The poppet valve is held against the end of the valve guide (position shown dotted) by the inner helical spring (68), whose pressure can be adjusted by the screwed plug (69). The tubular spool extension is also cross drilled (D) to allow oil to flow into an annular cavity formed between the two telescopic sleeves (70 and 71). When the spool is in the neutral position, both sleeves are fully extended (right hand sleeves as shown, left hand sleeve shown dotted) and are retained in this position by the outer spring (72).

**Operation of the Kick-out Mechanism**

Fig. 9. When the spool actuating lever is moved from the neutral position to either the raising or lowering position, oil is directed by the spool to various parts and galleries within the valve which determine whether lifting or lowering will occur. When the spool is moved the cross drilling (A) will always align with the port receiving oil from the hydraulic pump(s). Oil flows down the cross-drilling (A) along the spool centre bore (B) and into the valve guide (65). If the pressure is sufficient, it will lift the poppet valve (67) off its seat, against the pressure spring (68) and allow the oil to flow through the cross-drilling (D) into the annular chamber between the sleeves (70 and 71) where it can go no further. The pressure of oil will now continue to increase until the combined force of the oil pressure and the outer spring (72) force the left hand sleeve (70) back into the extended position (shown dotted) thus moving the spool and actuating lever back into the neutral position.

Figure 9 shows the spool set in the raising position. The action when lowering is generally similar, except that the left hand sleeve remains in its original position, and the right hand sleeve moves with the spool.

The kick-out mechanism will operate in all cases except when lowering a single acting ram, where no pressure is created in the system.

## GENERAL NOTES WHEN FITTING AND OPERATING AUXILIARY HYDRAULICS

1. All hydraulic systems must have a correctly adjusted pressure relief valve. Adjusting relief valves to open at a higher pressure than is normally recommended is dangerous and can also cause extensive damage to components within the system.
2. All components which come into contact with the hydraulic fluid must be kept scrupulously clean. Even minute particles of dirt or grit can cause extensive damage to pumps, seals, rams and motors.
3. The pressure relief valve should not be allowed to blow continuously, as this can cause overheating and frothing of the hydraulic fluid, thus reducing the lubricational properties of the oil, allowing air bubbles to enter the system and may cause the oil to become so thin that it can aggravate leaks past seals.
4. Always ensure that the hydraulic system contains sufficient fluid to supply the whole system. Lack of oil will result in vapour locks and jerky operation.
5. All unions must be kept tight and all seals must be effective, for the system to work efficiently.
6. If any of the services fail to function, never remove a hose to see whether fluid is flowing. Switch off the tractor engine first, fit a pressure gauge and check the flow.
7. When fitting hydraulic hoses, always route them in such a manner that no kinking or twisting of the hose occurs. Kinking and twisting of hoses restricts flow, reduces efficiency and in extreme cases, can cause over-heating of the hydraulic fluid.

## WOOSTER SPOOL VALVE OPERATION

The following set of flow diagrams are intended as a guide to the correct methods of arranging auxiliary hydraulic equipment to give the best performance in the field. Every possible variation of machine and flow cannot be shown in this publication. Indeed, if they were, they would serve only to confuse rather than clarify.

All equipment described in the following diagrams is of the type described in section seven of this manual, except where stated.

**Flow within the Wooster Spool Valve**

The following description of flows within the valve is intended as a guide which should enable fitters to trace a fault within the valve by checking for flow at various lever positions.

In all of the following illustrations, up to three different colours are used, and illustrate the condition of the hydraulic oil as follows :

RED – Oil under pressure
YELLOW – Oil flowing back to pump or sump
BLUE – No flow (hydraulic lock)

In some cases, the point at which pressurised flow ends and free flow begins is obscure. Under these circumstances, pressurised flow is shown all through the valve (e.g. neutral). In some cases, flow back to pump and pressurised flow combine to flow back to pump. In these cases, only YELLOW will be shown from where the flows combine (e.g. single-acting lowering).

**Neutral (Fig. 10)**

When the actuating lever on the spool valve is in the Neutral (central) position, oil (red) flows into the spool valve through the inlet port (G). Due to the positioning of the spool(s) the oil then flows straight through the cross-porting (E) into the exhaust port (F) and then back to the pump. When the spool is in neutral position, the port(s) connecting the ram or motor (H and I) are cut off from the oil flow and can neither lift nor lower. Even though there is a direct flow from the inlet to the exhaust port, there will be a certain amount of back-pressure within the system which will lift the ball valve (78) and allow oil to completely fill the valve. The position of the switch valve (79) is not important.

**Double–Acting Raising (Lever Back) (Fig. 11)**

Oil (red) is fed from the inlet port (G) into the spool bore. As one spool is in the neutral position, no oil is fed into either of its ports. The oil pressure then lifts the ball valve (78) and oil flows along the cross-drilling to the 'LIFT' port (H). The oil then flows into the ram and extends it. As the ram extends, oil (yellow) is forced from the opposite side of the ram and is fed back into the valve through the DROP port (I). Spool positioning is such that the oil flows along the return gallery to the exhaust port (J). The switch valve (79) must be fully closed, as shown.