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DAVID BROWN

850 & 950 IMPLEMATIC
880 & 990 IMPLEMATIC

REPAIR MANUAL

DAVID BROWN TRACTORS LIMITED

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DAVID BROWN

REPAIR MANUAL

850 and 950 Series Tractors

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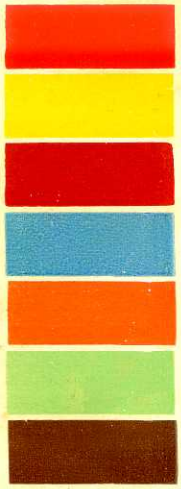
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DAVID BROWN TRACTORS LIMITED

TECHNICAL PUBLICATIONS . SERVICE DEPARTMENT

MELTHAM . HUDDERSFIELD . YORKSHIRE

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Introduction

This manual is issued to assist Distributors and Dealers in the repair and overhaul of the 850 and 950 series tractors. The knowledge of a competent engineering fitter is assumed and no instructions are given for normal operations, such as decarbonising, etc., which are common everyday jobs in your workshop. The recommended fuels and oils, and servicing instructions are given in the Instruction Book supplied with every tractor. Reference should also be made there for most items of the tractor specification, such as road speeds, capacities, weights and dimensions, valve clearances, valve timing, compression pressures, etc.

Information in this manual is confined to practical details as to the method of dismantling, including the necessary requirements for access. Where adjustments are provided for running clearances, etc., these are given under the heading for re-assembly. Together with the study of the illustrations and drawings provided, this work should be obvious. Unnecessary padding and description is purposely omitted in order to encourage the reading of the essential information. Only where the design is complex or peculiar to David Brown Tractors is explanation of working given.

It is hoped that this publication will prove a useful and helpful reference for the David Brown Serviceman.

KEY TO TRACTOR SERIES

Series	*Designation*	*Serial Number*	*Parts List Applicable*
DB 950	VAD/IU	57000 - 62500	DBT 440
950 Livedrive	VAD/IT		

Fitted with AD4/40T and U series engine. Dowty hydraulic lift pump positioned inside power take-off housing; single lever hydraulic lift control mounted on right-hand mudguard. Swinging drawbar giving towing and stowed positions only. Category I and II linkage.

Series	*Designation*	*Serial Number*	*Parts List Applicable*
950 Implematic	VAD/IW	63000 onwards	DBT 464
950 Implematic Livedrive	VAD/IV		

Engine, clutch and gearbox as T and U series. Differential fitted with lock operated by pedal mounted on right-hand platform. Hydraulic lift pump as T and U but valve chest modified to increase the flow of return oil into the pt-o housing. Single lift control lever mounted on front face of rear axle casing; response unit in top link with flexible cable to control valve giving automatic depth control of implement. Swinging drawbar with stowed, towing and pt-o driven implement positions. Dual category linkage.

Series	*Designation*	*Serial Number*	*Parts List Applicable*
850 Implematic	VAD/2B	300000 onward	DBT 471
850 Implematic Livedrive	VAD/2A		

Engine series AD4/36A and B; construction as T and U series engines but fitted with $3\frac{1}{2}$ in. (88·9 mm.) pistons and sleeves. Front axle trunnion brackets incorporated in front extension. Clutch, gearbox, differential lock and hydraulic lift system as 950 Implematic but fitted with category I linkage only. Reduction units as on 25 - 30 series tractors. Fixed or swinging drawbar with towing and pt-o driven implement positions.

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850, 880, 950 and 990

SERVICE INFORMATION

FILE WITH THE 850/950 REPAIR MANUAL—DBT 445

Issued by :

DAVID BROWN TRACTORS LIMITED

TECHNICAL PUBLICATIONS - SERVICE DEPARTMENT

MELTHAM · HUDDERSFIELD · YORKSHIRE

Publication No. DBT 499

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INTRODUCTION

This booklet should be used in conjunction with the 850/950 Repair Manual—DBT 445. The first part is devoted to an explanation of the design changes introduced with the 850 C & D and 950 3A and 3B tractors, and the technical descriptions of the new 880 and 990 tractors. The second part gives dimensional data relating to all the tractors detailed below. A useful comparative table of Specifications is included at the end.

The information contained herein, together with that in DBT 445, will enable a trained fitter to fully service the David Brown 850, 880, 950 and 990 model tractors.

990—950—880 and 850 MODELS—IMPLEMATIC TRACTORS

Tractor Model	Engine Model	Tractor Serial No.
990 Implematic Livedrive	AD4/47A	990/A/440,001 onward
990 Implematic	AD4/47B	990/B/440,001 onward
950 Implematic Livedrive	AD4/40T	950/3A/400,001 onward
950 Implematic	AD4/40U	950/3B/400,001 onward
880 Implematic Livedrive	AD4/40T	880/C/350,001 onward
880 Implematic	AD4/40U	880/D/350,001 onward
850 Implematic Livedrive	AD4/36A	850/C/310,001 onward
850 Implematic	AD4/36B	850/D/310,001 onward
880 Implematic Livedrive (Narrow)	AD4/40T	880/C/395,001/N onward
880 Implematic (Narrow)	AD4/40U	880/D/395,001/N onward
850 Implematic Livedrive (Narrow)	AD4/36A	850/C/390,001/N onward
850 Implematic (Narrow)	AD4/36B	850/D/390,001/N onward

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CONSTRUCTIONAL FEATURES

General

The main frame and rear axle case have been strengthened. 990 model tractors have a tapered distance piece between the gearbox top cover and clutch housing which, when bolted together gives a rigid assembly and increases the effective depth of the frame.

Unified threads are used on the chassis of all tractors and also on the 990 engine; other engines use B.S.F. threads as previously. Castings incorporating unified threads may be identified by the letter "U" cast near the part number.

Engine—990 Model

The AD4/47 engine is of completely new design and has few features and components in common with previous engines. An increase of stroke, from 4 in. to $4\frac{1}{2}$ in. (101·6 mm to 114·3 mm) gives increased power without appreciably increasing the length or width of the cylinder block.

The cylinder sleeves are very similar in appearance to 950 sleeves, the inner and outer diameters are identical. The overall length of $8\frac{1}{16}$ in. (20·48 cm) is $\frac{1}{2}$ in. (12·7 mm) longer than the 950 sleeves. The sleeves are fitted with two lower sealing rings but no upper seals are required; the machining limits on the block register and sleeve flange being so close as to ensure the correct amount of protrusion without the use of graded seals.

Pistons on the 990 engine are not interchangeable with 950 pistons. Whilst being similar in appearance and using the same rings, 990 pistons have a larger combustion chamber in the piston crown—$2\frac{1}{4}$ in. (57·15 mm) diameter.

The toughened steel crankshaft has increased diameter main and big-end journals and the front end of the shaft is splined for the fan pulley fitting. The rear main bearing oil seal is a separate split housing bolted to the cylinder block and bearing cap.

The intermediate timing gear and injection pump drive gear run direct on to their shafts and are pressure lubricated from the main oil gallery. As the camshaft is driven from the intermediate gear it rotates in the opposite direction to the 950 camshaft and the skew gear on the oil pump is therefore fitted with a locating sleeve to take the upward thrust.

The valve stems operate direct in micro-finished bores in the cylinder head (no separate guides). The exhaust valves are fitted with caps over the ends of the stems. These are so dimensioned that they allow the valve to be free of pressure for an instant at the beginning and end of the opening period. This allows the valve to rotate keeping it free of carbon and prolonging the seat life. Cooling water from the pump circulates through a right-angled port in the cylinder block into the cylinder head and then through the outlet pipe into the radiator. A thermostat, in the cylinder head outlet, controls the flow into the radiator and a by-pass connection, in the pump body, permits circulation through the engine only when the thermostat is closed.

Engine—950 and 880 Model Tractors

These engines are of the same series (AD4/40T and AD4/40U) as were fitted in the previous 950 model tractors and are fully covered in the engine section of the 950 service manual DBT.445. Minor changes recently incorporated in these engines include the fitting of the lubricating oil filter direct on to the cylinder block instead of on to a separate head; bowl-less type fuel filters; and gear teeth in the flywheel and on the periphery of the clutch separator plate.

Engine—850 Model Tractors

Differing only in bore diameter from the 950 engine, these engines are of the same series (AD4/36A and AD4/36B) as the engines fitted in the previous 850 model tractors.

Clutch—990 Livedrive

This is of similar construction to the 950 double clutch but is fitted with an 11 inch (28 cm) diameter transmission drive plate. The method of operation and adjustment are the same as described in the 950 service manual DBT.445, the only different setting is the release lever height, shown at "X" fig. 10, which is increased to 3·810–3·830 in. (96·77–97·28 mm) when four 0·349 in. (8·865 mm) thick spacers are fitted in place of the transmission plate and four spacers 0·310 in. (7·87 mm) thick are fitted in place of the PTO plate.

Clutch—990 Standard

Of the same construction as the single clutch fitted to the 950 tractor the only difference is that it has a larger diameter of 11 in. (28 cm). The method of dismantling is as described in the appropriate section of the 950 manual DBT.445, the setting of the release lever height should however be 1·955 in. (49·53 mm) from the flywheel face when the clutch is assembled with four 0·310 in. (7·87 mm) thick spacers in place of the driven plate.

Clutch—950, 880 and 850 Model Tractors

Unchanged from the clutches fitted to the previous 950 and 850 model tractors these clutches may be serviced by reference to appropriate section of the 950 service manual DBT.445.

Gearbox and Differential—All Models

The introduction of unified threads on the end plates has necessitated some part number changes but in operation and construction the gearbox is the same as the previous 950-850 gearbox which is described in service manual DBT.445.

Gear sizes and ratios are the same for all models but as the main drive gears on 990 tractors are of special material, these are not interchangeable with gears fitted to the other tractors.

Narrow model tractors have the same gearbox as the standard width tractors but, due to limitations in space, no differential lock is fitted.

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Reduction Units—990 and 950 Models

Of the same basic construction as the previous 950 V and W reductions, they are now fitted with taper roller bearings on the spur pinion shafts and $\frac{1}{2}$ UNC threads in the brake drum extraction holes. The extraction holes in the final drive shaft are however BSF as previously.

Reduction Units—880 and 850 Models

With $\frac{1}{2}$ UNC threads in the brake drum extraction holes but otherwise the same units as fitted to the previous 850 model tractors (TSB.589 refers), these units have ball races on the spur pinion and final drive shafts.

Front Axle—All Models

Of similar arrangement to the previous 950 Models but giving greater ground clearance, the axle trunnion pin fits directly into the front extension having no separate trunnion brackets. To remove the trunnion pin it is therefore necessary to remove the front extension and then draw the pin out by means of the $\frac{5}{8}$ UNC extraction hole in the rear end of the pin.

As the upper king pin bushes are used to locate the seal retainers, the bushes should protrude $\frac{3}{16}$ in. (4·76 mm) above the axle face.

The front hubs are fitted with taper roller bearings and a metal disc on the stud axle traps lubricant and forms a labyrinth to prevent dirt reaching the oil seal.

The re-circulating ball steering column operates in an oil bath that is filled during assembly and does not require periodical topping up, the filler plug having now been dispensed with.

Steering joints with nylon seats which do not require periodical lubrication are an alternative fitting and will be used when supplies permit.

Hydraulic Lift

The Implematic system is the same as on previous Implematic tractors with hydraulic pump and control valve. The re-designed ram cylinder is smaller in diameter and the piston is fitted with a rubber sealing ring. It operates at the same pressure as external equipment. Increased piston stroke gives the linkage a greater range of lift, approximately 20% greater than the previous system.

Brakes

Of similar arrangement to previous models but has a simplified hand brake linkage, and is fitted with cross-shaft bearings in the footplate flanges.

SERVICE DATA

ENGINE

Camshaft journal diameters

Front	1·872–1·870 in.	47·55–47·50 mm
Number 2	1·827–1·825 in.	46·41–46·35 mm
Numbers 3 and 4	1·811–1·810 in.	46·00–45·97 mm
Number 5	1·765–1·763 in.	44·83–44·78 mm
Number 6	1·749–1·747 in.	44·42–44·37 mm
Camshaft thrust washer thickness (990)	0·245–0·240 in.	6·223–6·096 mm
Camshaft thrust washer thickness (950–880–850)	0·185–0·184 in.	4·699–4·673 mm
Camshaft end float (990)	0·010–0·020 in.	0·254–0·508 mm
Camshaft end float (950–880–850)	0·012–0·025 in.	0·304–0·635 mm

Connecting rod alignment

Maximum out of parallel } per unit of	0·0005 in./in.	0·005 mm/cm
Maximum twist } mandrel length	0·0005 in./in.	0·005 mm/cm
Maximum weight variation in set of four rods	0·25 ozs	7 gm

Crankshaft (990)

Big-end journal diameter (standard)	2·2485–2·2480 in.	57·111–57·099 mm
Main bearing journal diameter (standard)	2·4995–2·4990 in.	63·487–63·474 mm
Bearing fillet radii	0·160–0·150 in.	4·064–3·81 mm
Centre journal width (standard)	2·126–2·124 in.	54·00–53·95 mm
Big-end bearing clearance (new)	0·0015–0·0025 in.	0·038–0·0635 mm
Main bearing clearance (new)	0·0015–0·004 in.	0·038–0·1016 mm
Thrust washer thickness (standard)	0·093–0·091 in.	2·362–2·311 mm
Crankshaft end float	0·002–0·010 in.	0·050–0·25 mm

Crankshaft (950—880—850)

Big-end journal diameter (standard)	2·1230–2·1225 in.	53·924–53·898 mm
Main bearing journal diameter (standard)	2·2485–2·248 in.	57·112–57·090 mm
Bearing fillet radii	0·160–0·150 in.	4·064–3·81 mm
Centre journal width (standard)	2·126–2·124 in.	54·00–53·95 mm
Big-end bearing clearance (new)	0·0025–0·003 in.	0·063–0·076 mm
Main bearing clearance (new)	0·0025–0·0045 in.	0·063–0·144 mm
Thrust washer thickness (standard)	0·092–0·091 in.	2·337–2·312 mm
Crankshaft end float	0·002–0·010 in.	0·050–0·254 mm

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Fuel System

Injector setting pressure	175 atm	1810 kg/cm²
Spill timing (static)	11° before top dead centre	

Spill timing mark.

When number one piston is on compression stroke and the indentation in the flywheel coincides with the peg aperture marked "SP", on left-hand side of the clutch housing, the line marked "C" on the injection pump rotor should be exactly in-line with the line through the eye of the body circlip.

Spill timing adjustment.

Elongated holes in the injection pump mounting flange permit the pump body to be rotated when the three securing nuts are released.

Injection pump fuel setting (990) (at 600 rev/min pump speed)	9·0–9·2 cc per line per 200 injections
Injection pump fuel setting (950–880) (at 600 rev/min pump speed)	7·3–7·5 cc per line per 200 injections
Injection pump fuel setting (850) (at 600 rev/min pump speed)	6·1–6·3 cc per line per 200 injections

Idling speed	700 rev/min	
Maximum no-load speed (990–950–880)	2 350 rev/min	
Maximum no-load speed (850)	2 160 rev/min	
Fuel feed pump pressure	2¾–4¼ lb/in²	193–310 gm/cm²

Lubricating System

Oil pump output (990)	19¼ pints/min	10·9 L/min
Oil pump output (950-880-850) at 780 rev/min and 20 lb/in² (1406 gm/cm²)	17¾ pints/min	9·9 L/min
Oil pressure (at 700 rev/min engine speed, when hot)	35 lb/in²	2·46 kg/cm²
Oil pump rotor width (990)	1·186–1·185 in.	30·13–30·11 mm
Oil pump rotor width (950–880–850)	1·096–1·095 in.	28·84–27·81 mm
Oil pump spindle diameter	0·490–0·489 in.	12·446–12·421 mm

Piston Dimensions (new)

Piston skirt diameter (990–950–880) (at right angles to gudgeon pin bore)	3·621–3·620 in.	91·98–91·96 mm
Piston skirt diameter (850) (at right angles to gudgeon pin bore)	3·497–3·495 in.	88·8–88·78 mm
Piston weight variation (maximum in one set)	½ oz	14 gm
Piston ring side clearance	0·002–0·0035 in.	0·050–0·088 mm
Piston ring gap	0·010–0·015 in.	0·254–0·374 mm
Gudgeon pin diameter	1·2503–1·250 in.	31·757–31·750 mm

(Push fit in connecting rod bush, light drive fit in piston)

Sleeve Dimensions (new)

Bore (990–950–880)	3·6255–3·6250 in.	92·088–92·076 mm
Bore (850)	3·5005–3·500 in.	88·913–88·90 mm
Taper (maximum)	0·0005 in.	0·0127 mm
Ovality (maximum)	0·0005 in.	0·0127 mm
Protrusion (excluding ridge)	0·002–0·005 in.	0·0508–0·127 mm

Timing Gears (990)

Intermediate gear bore	1·1887–1·1875 in.	30·193–30·162 mm
Intermediate gear shaft diameter	1·1870–1·1857 in.	30·150–30·117 mm
Intermediate gear end float	0·002–0·004 in.	0·050–0·102 mm
Injection pump gear bore	2·5012–2·500 in.	63·53–63·50 mm
Injection pump support diameter	2·499–2·498 in.	63·474–63·449 mm
Injection pump thrust washer thickness	0·125–0·124 in.	3·175–3·150 mm
Injection pump gear end float	0·002–0·005 in.	0·050–0·127 mm

Timing Gears (950—880—850)

Intermediate gear bore	1·125–1·124 in.	28·57–28·55 mm
Intermediate gear shaft diameter	1·123–1·122 in.	28·52–28·50 mm
Intermediate gear end float	0·002–0·003 in.	0·050–0·076 mm
Injection pump gear bearing adjustment	0·001 in. (0·025 mm) end float to 0·001 in. (0·025 mm) preload	

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Valve Mechanism

Firing order	1: 2: 4: 3
Valve Timing:	Inlet opens 8° before top dead centre Inlet closes 38° after bottom dead centre Exhaust opens 36° before bottom dead centre Exhaust closes 10° after top dead centre
Method of checking the valve timing.	When number one piston is at the top of a compression stroke the centre punch marks on the gears should be at the point of mesh; the single mark on one gear being between the two marks on the adjacent gear. Note.—When number one piston is at the top of a compression stroke the keyways in the camshaft and crankshaft are towards the bottom.

Valve Clearances (cold)

Inlet (all models)	0·015 in.	0·38 mm
Exhaust (950–880–850)	0·015 in.	0·38 mm
Exhaust (990)	0·012 in.	0·30 mm
Exhaust valve end float: stem end to cup—990 only	0·003 in.	0·076 mm
Valve seat angle	45°	45°
Valve stem diameter—inlet (990)	0·373–0·372 in.	9·474–9·448 mm
Valve stem diameter—inlet (950–880–850)	0·342–0·341 in.	8·686–8·661 mm
Valve stem diameter—exhaust (990)	0·373–0·372 in.	9·474–9·448 mm
Valve stem diameter—exhaust (950–880–850)	0·339–0·338 in.	8·61–8·585 mm
Valve stem bore (990)	0·3755–0·3745 in.	9·528–9·512 mm
Valve guide bore (950–880–850)	0·3443–0·3433 in.	8·745–8·720 mm
Valve guide protrusion (950–880–850)	0·750 in.	19·05 mm
Valve spring length: free (990)	1·920 in.	48·768 mm
Valve spring length: free (950–880–850)	2·320 in.	58·928 mm
Valve tappet diameter	0·624–0·623 in.	15·850–15·824 mm
Valve rocker shaft diameter	0·749–0·748 in.	19·022–18·999 mm
Valve rocker bush bore	0·7505–0·750 in.	19·060–19·050 mm

CLUTCH (990 Livedrive)

Clutch type	Borg and Beck BB.11/180	
Plate diameter (Transmission)	11 in.	27·94 cm
Plate facing material	Trist "Bimet"	
Plate thickness (new)	0·353 in.	8·966 mm
Plate diameter (Power take-off)	10 in.	25·4 cm
Plate facing material	Raybestos W.N.M.R.	
Plate thickness (new)	0·320 in.	8·128 mm
Number of springs (Transmission)	12	12
Spring colour (Inner-Trans.)	Brown	Brown
Spring pressure (at checking length)	70 lb	31·752 kg
Spring checking length	2·82 in.	71·622 mm
Spring colour (Outer-Trans.)	Brown	Brown
Spring pressure (at checking length)	112 lb	50·8 kg
Spring checking length	2·82 in.	71·622 mm
Number of springs (PTO)	6	6
Spring colour (PTO)	Buff	Buff
Spring pressure (at checking length)	85 lb.	38·556 kg
Spring checking length	2·37 in.	60·198 mm
Separator plate thickness	0·765–0·755 in.	19·531–19·177 mm
Pedal clearance	1–1¼ in.	25·40–31·75 mm
Cover adjusting screw clearance	0·058–0·062 in.	1·473–1·574 mm
Release lever height, i.e. distance from outer face of the separator plate to the outer face of the release lever plate; when the clutch is bolted to a flywheel and fitted with four 0·310 in. (7·874 mm) spacers in place of the PTO driven plate and four 0·349 (8·865 mm) spacers in place of the main drive plate.	3·810–3·830 in.	96·774–97·282 mm

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CLUTCH (990 Non-Livedrive)

Clutch type	Borg and Beck 11A6G	
Plate diameter	11 in.	27·94 cm
Plate facing material	Raybestos W.N.M.R.	
Plate thickness (new)	0·330 in.	8·382 mm
Number of springs	12	12
Spring colour	Yellow/Light Green	
Spring pressure (at checking length)	140 lb	63·4 kg
Spring checking length	1·688 in.	42·875 mm
Pedal clearance	1–1¼ in.	25·4–31·75 mm
Release lever height, i.e. distance from tips of the release levers to the flywheel face, when the clutch is assembled with four 0·310 in. (7·874 mm) thick spacers in place of the driven plate.	1·955 in.	49·53 mm

CLUTCH (950—880—850 Livedrive)

Clutch type	Borg and Beck BB.10/167	
Plate diameter (Transmission)	10 in.	25·4 cm
Plate facing material	Trist "Bimet"	
Plate thickness (new)	0·350 in.	8·890 mm
Plate diameter (PTO)	10 in.	25·4 cm
Plate facing material	Raybestos W.N.M.R.	
Plate thickness (new)	0·320 in.	8·128 mm
Number of springs (Transmission)	12	12
Spring colour (Inner-Trans.)	Brown	Brown
Spring pressure (at checking length)	70 lb	31·752 kg
Spring checking length	2·82 in.	71·622 mm
Spring colour (Outer-Trans.)	Brown	Brown
Spring pressure (at checking length)	112 lb	50·8 kg
Spring checking length	2·82 in.	71·622 mm
Number of springs (PTO)	6	6
Spring colour (PTO)	Buff	Buff
Spring pressure (at checking length)	85 lb	38·556 kg
Spring checking length	2·37 in.	60·198 mm
Separator plate thickness	0·705–0·695 in.	19·05–17·653 mm
Cover adjusting screw clearance	0·058–0·062 in.	1·473–1·574 mm
Pedal clearance	1–1¼ in.	25·40–31·75 mm
Release lever height, i.e. distance from outer face of the separator plate to the outer face of the release lever plate, when the clutch is bolted to a flywheel and fitted with four 0·310 in. (7·874 mm) thick spacers in place of the PTO drive plate and four 0·349 (8·865 mm) thick spacers in place of the main drive plate.	3·720 in.	94·488 mm

CLUTCH (950—880—850 Non-Livedrive)

Clutch type	Borg and Beck 10A6G	
Plate diameter	10 in.	25·4 cm
Plate facing material	Raybestos W.N.M.R.	
Plate thickness (new)	0·320 in.	8·128 mm
Number of springs	12	12
Spring colour	Light Green	Light Green
Spring pressure (at checking length)	110 lb	49·896 kg
Spring checking length	1·688 in.	42·875 kg
Pedal clearance	1–1¼ in.	25·4–31·75 mm
Release lever height, i.e. distance from tips of the release levers to the flywheel face, when the clutch is assembled with four 0·310 in. (7·874 mm) thick spacers in place of the driven plate.	1·955 in.	49·53 mm

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GEARBOX AND DIFFERENTIAL

Muff coupling end float	0·008–0·039 in.	0·203–0·990 mm
Driveshaft end float	0·006–0·010 in.	0·152–0·254 mm
Layshaft end float	0·010–0·015 in.	0·254–0·381 mm
Pinion shaft end float	0·001–0·003 in.	0·025–0·076 mm
Gearbox mounting clearance	0·012–0·016 in.	0·305–0·406 mm
Differential side bearing clearance	0·002–0·004 in.	0·051–0·102 mm
Crown wheel backlash	0·007–0·009 in.	0·178–0·229 mm

FINAL DRIVE REDUCTIONS (990—950)

Pinion shaft bearing setting	0·001 in. (0·0254 mm) preload to 0·002 in. (0·0508 mm) end float	
Final drive shaft bearing setting		
Final drive seal land diameter	3·252–3·248 in.	82·600–82·499 mm

FINAL DRIVE REDUCTIONS (880—850)

Pinion shaft bearing clearance	0·001–0·003 in.	0·025–0·076 mm
Final drive seal land diameter	3·252–3·248 in.	82·600–82·499 mm

HYDRAULIC LIFT

Pump pressure (maximum)	2 000–2 200 lb/in²	140–154 kg/cm²
Pump pressure (maximum with TCU)	670–720 lb/in²	47·1–50·6 kg/cm²
Pump output (at maximum pressure and rated engine speed)	5 gal/min	22·73 L/min
Lift at end of links (maximum)	1 800 lb	817 kg
Lift at end of links (max. with TCU)	940 lb	426 kg
Relief valve plunger diameter	0·4679–0·4668 in.	11·885–11·857 mm
Hold valve plunger diameter	0·4686–0·4675 in.	11·902–11·874 mm
Ram piston diameter	3·124–3·123 in.	79·350–79·324 mm
Ram cylinder bore	3·127–3·125 in.	79·426–79·375 mm
Locking catch needle roller protrusion (face of cover to end of needles)	0·728–0·718 in.	18·491–18·237 mm
Locking catch plunger setting (face of cover to face of plunger, when plunger is in disengaged position)	4·060–4·000 in.	103·124–101·60 mm
Top link compression spring length (free)	4·25 in.	107·95 mm
Top link compression spring rate	2 730 lb/in.	485·58 kg/cm

FRONT AXLE AND STEERING

Front wheel toe-in (at wheel rims)	$\frac{1}{16}$–$\frac{1}{8}$ in.	1·59–3·17 mm
Trunnion pin diameter	1·500–1·496 in.	38·1–37·998 mm
Trunnion pin bush bore	1·502–1·501 in.	38·15–38·125 mm
Trunnion pin pre-load	0·001–0·060 in.	0·025–1·524 mm
King pin diameter	1·374–1·373 in.	34·90–34·874 mm
King pin bush bore	1·376–1·375 in.	34·95–34·925 mm
King pin end float	0·001–0·020 in.	0·025–0·50 mm
Front hub bearing adjustment	0·002 in. (0·050 mm) pre-load to 0·003 in. (0·076 mm) clearance	
Drop arm shaft diameter (large)	1·252–1·251 in.	31·80–31·775 mm
Drop arm shaft diameter (small)	1·003–1·002 in.	25·476–25·450 mm
Drop arm shaft bush diameter (large)	1·255–1·252 in.	31·877–31·800 mm
Drop arm shaft bush diameter (small)	1·005–1·001 in.	25·527–25·425 mm
Rocker arm ball peg pre-load	0·001–0·003 in.	0·025–0·076 mm

BRAKES

Lining material	Ferodo AM2	
Drum diameter (new)	8·510–8·500 in.	21·615–21·59 cm
Drum diameter (maximum regrind)	8·685 in.	22·06 cm
Brake camshaft diameter	0·999–0·997 in.	25·374–25·324 mm
Camshaft bush bore	1·005–1·001 in.	25·527–25·425 mm

BELT PULLEY UNIT

Pulley shaft end float	0·004–0·006 in.	0·102–0·152 mm
Bevel gear backlash	0·005–0·007 in.	0·127–0·178 mm

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TIGHTENING TORQUES (In alphabetical order)

Location	Torque	
Belt pulley retaining nut	100 lb ft	13·83 kg metres
Big-end bearing nuts (990)	50 lb ft	6·925 kg metres
Big-end bearing nuts (except 990)	40 lb ft	5·532 kg metres
Breather filter cover (990)	10 lb ft	1·383 kg metres
Crown wheel bolts	45 lb ft	6·22 kg metres
Cylinder head nuts and bolts	90 lb ft	12·4 kg metres
Note.—The cylinder head nuts and bolts should be tightened in the order shown in the tractor instruction book and in stages of 30 (4·15), 60 (8·30) and 90 lb/ft (12·4 kg/metres).		
Cylinder head studs into block (990)	35 lb ft	4·84 kg metres
Cylinder head studs into block (except 990)	40 lb ft	5·532 kg metres
Depth control valve banjo bolt	100 lb ft	13·83 kg metres
Differential casing cover bolts	25 lb ft	3·46 kg metres
Differential side-bearing cap bolts	110 lb ft	15·2 kg metres
Front extension to main frame bolts	45 lb ft	6·22 kg metres
Flywheel nuts	50 lb ft	6·925 kg metres
Fuel injection pump.		
Governor housing nuts (Permanite gasket)	40 lb in.	0·46 kg metres
Governor housing nuts (Cork gasket)	30 lb in.	0·35 kg metres
Throttle and cut-off lever nuts	30 lb in.	0·35 kg metres
Inspection cover nuts	30 lb in.	0·35 kg metres
Head-side fixing bolts	170 lb in.	1·96 kg metres
Injection pipe banjo bolts	270 lb in.	3·11 kg metres
Manual lock fixing bolt	350 lb in.	4·02 kg metres
Automatic retard fixing bolt	120 lb in.	1·38 kg metres
Gearbox mounting bolts	100 lb ft	13·83 kg metres
Gearbox spacer bar nuts	70 lb ft	9·67 kg metres
Hydraulic lift filter cover bolts	15 lb ft	2·07 kg metres
Hydraulic pump body cover bolts	45 lb ft	6·22 kg metres
Main bearing bolts (990)	140 lb ft	19·3 kg metres
Main bearing bolts—$\frac{1}{2}$ in. } except 990	85 lb ft	11·755 kg metres
Main bearing bolts—$\frac{7}{16}$ in. } except 990	60 lb ft	8·298 kg metres
Main frame bolts (front to rear)	45 lb ft	6·22 kg metres
Oil filter bowl fixing bolt	10 lb ft	1·383 kg metres
Pinion thrust bearing housing bolts	25 lb ft	3·4575 kg metres
Ram cylinder bleeder bolt	8 lb ft	1·11 kg metres
Ram cylinder banjo bolt	60 lb ft	8·298 kg metres
Steering lever bolts	100 lb ft	13·83 kg metres
Steering wheel nut	20 lb ft	2·766 kg metres
Sump to front frame bolts	15 lb ft	2·07 kg metres
Wheel nuts (front and rear)	110 lb ft	15·2 kg metres

GENERAL TIGHTENING TORQUES FOR UNIFIED BOLTS AND NUTS

The following torque figures apply to bolts of standard material with either coarse (UNC) or fine (UNF) threads and may be used for all bolts and nuts not listed in the previous table.

Thread Diameter	Torque	
$\frac{1}{4}$ in.	7 lb ft	0·97 kg metres
$\frac{5}{16}$ in.	15 lb ft	2·07 kg metres
$\frac{3}{8}$ in.	25 lb ft	3·46 kg metres
$\frac{7}{16}$ in.	45 lb ft	6·22 kg metres
$\frac{1}{2}$ in.	65 lb ft	8·98 kg metres
$\frac{5}{8}$ in.	110 lb ft	15·2 kg metres
$\frac{3}{4}$ in.	140 lb ft	19·3 kg metres

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SPECIFICATION CHART

Model	990 Implematic	950 Implematic	880 Implematic	880 Narrow	850 Implematic	850 Narrow
Serial Numbers	990 A 440 001 990 B 440 001	950 3A 400 001 950 3B 400 001	880 C 350 001 880 D 350 001	880 C 395 001N 880 D 395 001N	850 C 310 001 850 D 310 001	850 C 390 001N 850 D 390 001N
Engine Bore	3⅝ in. (92·1 mm)	3⅝ in. (92·1 mm)	3⅝ in. (92·1 mm)	3⅝ in. (92·1 mm)	3½ in. (88·9 mm)	3½ in. (88·9 mm)
Engine Stroke	4½ in. (114·3 mm)	4 in. (101·6 mm)	4 in. (101·6 mm)	4 in. (101·6 mm)	4 in. (101·6 mm)	4 in. (101·6 mm)
Engine Capacity	185·3 in³ (3045 cm³)	165 in³ (2705 cm³)	165 in³ (2705 cm³)	165 in³ (2705 cm³)	154 in³ (2523 cm³)	154 in³ (2523 cm³)
Engine Maximum Power	52·0 BHP at 2200 rev/min	42·5 BHP at 2200 rev/min	42·5 BHP at 2200 rev/min	42·5 BHP at 2200 rev/min	35·0 BHP at 2000 rev/min	35·0 BHP at 2000 rev/min
Engine Speed Range	700 to 2200 rev/min	700 to 2200 rev/min	700 to 2200 rev/min	700 to 2200 rev/min	700 to 2000 rev/min	700 to 2000 rev/min
Engine Rated Speed	1800 rev/min	1800 rev/min	1800 rev/min	1800 rev/min	1800 rev/min	1800 rev/min
Engine Max. No Load Speed	2350 rev/min	2350 rev/min	2350 rev/min	2350 rev/min	2160 rev/min	2160 rev/min
Compression Ratio	17:1	17:1	17:1	17:1	17:1	17:1
Thermostat opens at	180°F (82°C)	180°F (82°C)	180°F (82°C)	180°F (82°C)	180°F (82°C)	180°F (82°C)
Tractor Max. Drawbar Power	43 HP at 2200 rev/min	36 HP at 2200 rev/min	36 HP at 2200 rev/min	36 HP at 2200 rev/min	30 HP at 2000 rev/min	30 HP at 2000 rev/min
Tractor Drawbar Power at 1800 rev/min	39 HP	31 HP	31 HP	31 HP	28·5 HP	28·5 HP
Tractor Max. Drawbar Pull (Ballasted on Tarmac)	7000 lb (3180 kg)	6500 lb (2940 kg)	6000 lb (2720 kg)	6000 lb (2720 kg)	5500 lb (2490 kg)	5500 lb (2490 kg)
Clutch Transmission PTO	 11 in. (27·9 cm) dia. 10 in. (25·4 cm) dia.	 10 in. (25·4 cm) dia. 10 in. (25·4 cm) dia.	 10 in. (25·4 cm) dia. 10 in. (25·4 cm) dia.	 10 in. (25·4 cm) dia. 10 in. (25·4 cm) dia.	 10 in. (25·4 cm) dia. 10 in. (25·4 cm) dia.	 10 in. (25·4 cm) dia. 10 in. (25·4 cm) dia.
Rear Wheel Track Widths Available	52 in. (132 cm) 56 in. (142 cm) 60 in. (152·5 cm) 64 in. (163·5 cm) 68 in. (173 cm) 72 in. (183 cm) 76 in. (193 cm)	52 in. (132 cm) 56 in. (142 cm) 60 in. (152·5 cm) 64 in. (163·5 cm) 68 in. (173 cm) 72 in. (183 cm) 76 in. (193 cm)	52 in. (132 cm) 56 in. (142 cm) 60 in. (152·5 cm) 64 in. (163·5 cm) 68 in. (173 cm) 72 in. (183 cm) 76 in. (193 cm)	37⅜ in. (96·6 cm) 47⅜ in. (120 cm) 51⅜ in. (130 cm) 55⅜ in. (141 cm) 59⅜ in. (151 cm)	52 in. (132 cm) 56 in. (142 cm) 60 in. (152·5 cm) 64 in. (163·5 cm) 68 in. (173 cm) 72 in. (183 cm) 76 in. (193 cm)	37⅜ in. (96·6 cm) 47⅜ in. (120 cm) 51⅜ in (130 cm) 55⅜ in. (141 cm) 59⅜ in. (151 cm)
Front Wheel Track Widths Available	52 in. (132 cm) 56 in. (142 cm) 60 in. (152·5 cm) 64 in. (163·5 cm) 68 in. (173 cm) 72 in. (183 cm) 76 in. (193 cm)	52 in. (132 cm) 56 in. (142 cm) 60 in. (152·5 cm) 64 in. (163·5 cm) 68 in. (173 cm) 72 in. (183 cm) 76 in. (193 cm)	52 in. (132 cm) 56 in. (142 cm) 60 in. (152·5 cm) 64 in. (163·5 cm) 68 in. (173 cm) 72 in. (183 cm) 76 in. (193 cm)	42 in. (106·5 cm) 48 in. (122 cm) 52 in. (132 cm) 56 in. (142 cm) 60 in. (152·5 cm) 64 in. (163·5 cm)	52 in. (132 cm) 56 in. (142 cm) 60 in. (152·5 cm) 64 in. (163·5 cm) 68 in. (173 cm) 72 in. (183 cm) 76 in. (193 cm)	42 in. (106·5 cm) 48 in. (122 cm) 52 in. (132 cm) 56 in. (142 cm) 60 in. (152·5 cm) 64 in. (163·5 cm)
Linkage System	British Standard Category I & II	British Standard Category I & II	British Standard Category I & II	British Standard Category I	British Standard Category I	British Standard Category I
Power Take-off (2 Speed)	Engine rev/min / PTO rev/min	Engine rev/min / PTO rev/min	Engine rev/min / PTO rev/min	Engine rev/min / PTO rev/min	Engine rev/min / PTO rev/min	Engine rev/min / PTO rev/min
Low Ratio	1800 / 532	1800 / 532	1800 / 532	1800 / 532	1800 / 532	1800 / 532
High Ratio	1100 / 550	1100 / 550	1100 / 550	1100 / 550	1100 / 550	1100 / 550
High Ratio	2000 / 1000	2000 / 1000	2000 / 1000	2000 / 1000	2000 / 1000	2000 / 1000
Height of Shaft (Std. Tyres)	25¼ in. (64·1 cm)	25¼ in. (64·1 cm)	23·4 in. (59·5 cm)	20·6 in. (52·5 cm)	22·4 in. (56·9 cm)	22·4 in. (56·9 cm)
Offset to Left Hand Side of centre line	¾ in. (9·5 mm)	¾ in. (9·5 mm)	¾ in. (9·5 mm)	¾ in. (9·5 mm)	¾ in. (9·5 mm)	¾ in. (9·5 mm)
Direction of Rotation	Clockwise	Clockwise	Clockwise	Clockwise	Clockwise	Clockwise

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SPECIFICATION CHART—continued

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Serial Numbers	990 A 440 001 990 B 440 001	950 3A 400 001 950 3B 400 001	880 C 350 001 880 D 350 001	880 C 395 001N 880 D 395 001N	850 C 310 001 850 D 310 001	850 C 390 001N 850 D 390 001N
Drawbar						
Type	Universal Swinging	Universal Swinging	Permanent	Permanent	None Fitted as Std.	Permanent
Height from Ground (Std. Tyres)	10¾ to 16 in. (27·3 to 40·6 cm)	10¾ to 16 in. (27·3 to 40·6 cm)	14¼ in. (38·8 cm)	13¾ in. (34·9 cm)	— —	13¾ in. (34·9 cm)
Lateral Swing	6 in. (15·2 cm) each side of centre line	6 in. (15·2 cm) each side of centre line	—	—	—	—
Adjustments	Stowed, Trailer position or Fully extended	Stowed, Trailer position or Fully extended	Trailer position or Fully extended	Trailer position or Fully extended	—	Trailer position or Fully extended
Dimensions						
Total Weight Livedrive Non-Livedrive	 4312 lb (1960 kg) 4272 lb (1940 kg)	 4230 lb (1920 kg) 4190 lb (1900 kg)	 4040 lb (1830 kg) 4000 lb (1815 kg)	 3620 lb (1642 kg) 3580 lb (1626 kg)	 3750 lb (1700 kg) 3710 lb (1680 kg)	 3620 lb (1642 kg) 3580 lb (1626 kg)
Rear Axle Weight Livedrive Non-Livedrive	 2716 lb (1232 kg) 2696 lb (1222 kg)	 2680 lb (1215 kg) 2660 lb (1205 kg)	 2470 lb (1120 kg) 2450 lb (1110 kg)	 2300 lb (1042 kg) 2280 lb (1035 kg)	 2350 lb (1065 kg) 2330 lb (1055 kg)	 2300 lb (1042 kg) 2280 lb (1035 kg)
Front Axle Weight Livedrive Non-Livedrive	 1596 lb (724 kg) 1576 lb (715 kg)	 1550 lb (705 kg) 1530 lb (695 kg)	 1570 lb (710 kg) 1550 lb (705 kg)	 1320 lb (600 kg) 1300 lb (591 kg)	 1400 lb (635 kg) 1380 lb (625 kg)	 1320 lb (600 kg) 1300 lb (591 kg)
Overall Length	118 in. (300 cm)	118 in. (300 cm)	115 in. (292 cm)	114 in. (289·5 cm)	113⅝ in. (288·6 cm)	114 in. (289·5 cm)
Height to Bonnet Top	56 in. (142 cm)	56 in. (142 cm)	52⅝ in. (134 cm)	47½ in. (120·6 cm)	51¾ in. (131 cm)	47½ in. (120·6 cm)
Overall Width (Minimum)	64 in. (163 cm)	64 in. (163 cm)	64 in. (163 cm)	48 in. (122 cm)	62¾ in. (159·3 cm)	48 in. (122 cm)
Wheel Base	76¾ in. (195 cm)	76¾ in. (195 cm)	75¼ in. (191 cm)	74 5/16 in. (190·2 cm)	75¼ in. (191 cm)	74 5/16 in. (190·2 cm)
Clearance under Front Axle	20 in. (51 cm)	20 in. (51 cm)	19½ in. (49·5 cm)	14 in. (35·6 cm)	18½ in. (47 cm)	14 in. (35·6 cm)
Capacities						
Cooling Water	3 gal (13·6 litres)	3 gal (13·6 litres)	3 gal (13·6 litres)	3 gal (13·6 litres)	3 gal (13·6 litres)	3 gal (13·6 litres)
Engine Oil	13 pt (7·4 litres)	* 13 pt (7·4 litres)	* 13 pt (7·4 litres)	* 13 pt (7·4 litres)	* 13 pt (7·4 litres)	* 13 pt (7·4 litres)
Transmission Oil	4½ gal (20·5 litres)	4½ gal (20·5 litres)	4½ gal (20·5 litres)	4½ gal (20·5 litres)	4½ gal (20·5 litres)	4½ gal (20·5 litres)
Final Drive Oil (each)	4 pt (2·3 litres)	4 pt (2·3 litres)	2 pt (1·1 litres)	2 pt (1·1 litres)	2 pt (1·1 litres)	2 pt (1·1 litres)
Fuel Tank	11½ gal (52 litres)	11½ gal (52 litres)	8¾ gal (40 litres)	8¾ gal (40 litres)	8¾ gal (40 litres)	8¾ gal (40 litres)
Air Cleaner Oil	1½ pt (0·85 litre)	1½ pt (0·85 litre)	1½ pt (0·85 litre)	1½ pt (0·85 litre)	1½ pt (0·85 litre)	1½ pt (0·85 litre)
Steering Box Oil	2 pt (1·1 litres)	2 pt (1·1 litres)	2 pt (1·1 litres)	2 pt (1·1 litres)	2 pt (1·1 litres)	2 pt (1·1 litres)

* 13 pt capacity with dipstick 908274 : 17 pt capacity with dipstick 905244.

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SPECIFICATION CHART—continued

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Serial Numbers	990 A 440 001 990 B 440 001			950 3A 400 001 950 3B 400 001			880 C 350 001 880 D 350 001			880 C 395 001N 880 D 395 001N			850 C 310 001 850 D 310 001			850 C 390 001N 850 D 390 001N		
Road Speed (on Std. Tyres)	Overall Ratio	mile/h	km/h	Overall Ratio	mile/h	km/h	Overall Ratio	mile/h	km/h	Overall Ratio	mile/h	km/h	Overall Ratio	mile/h	km/h	Overall Ratio	mile/h	km/h
Min. Speed (700 rev/min)																		
L1	168·83	0·61	0·98	168·83	0·61	0·98	124·9	0·76	1·22	124·9	0·73	1·17	124·9	0·73	1·17	124·9	0·73	1·17
540 PTO rev/min (1100 rev/min)																		
*LL1							318·5	0·47	0·76	318·5	0·45	0·73	318·5	0·45	0·73	318·5	0·45	0·73
L1	168·83	0·96	1·54	168·83	0·96	1·54	124·9	1·20	1·93	124·9	1·15	1·86	124·9	1·15	1·86	124·9	1·15	1·86
Rated Speed (1800 rev/min)																		
*LL1							318·5	0·77	1·23	318·5	0·74	1·19	318·5	0·74	1·19	318·5	0·74	1·19
*LL2							192·0	1·27	2·04	192·0	1·23	1·98	192·0	1·23	1·98	192·0	1·23	1·98
*LH1							142·4	1·71	2·76	142·4	1·65	2·66	142·4	1·65	2·66	142·4	1·65	2·66
L1	168·83	1·58	2·54	168·83	1·58	2·54	124·9	1·96	3·15	124·9	1·89	3·04	124·9	1·89	3·04	124·9	1·89	3·04
L2	101·77	2·62	4·22	101·77	2·62	4·22	75·31	3·24	5·21	75·31	3·13	5·04	75·31	3·13	5·04	75·31	3·13	5·04
H1	75·49	3·53	5·68	75·49	3·53	5·68	55·86	4·37	7·03	55·86	4·22	6·79	55·86	4·22	6·79	55·86	4·72	6·22
L3	55·70	4·79	7·71	55·70	4·79	7·71	41·21	5·93	9·54	41·21	5·72	9·20	41·21	5·72	9·20	41·21	5·72	9·20
H2	45·49	5·87	9·44	45·49	5·87	9·44	33·66	7·25	11·7	33·66	7·00	11·30	33·66	7·00	11·30	33·66	7·00	11·30
H3	24·88	10·7	17·2	24·88	10·7	17·2	18·41	13·3	21·4	18·41	12·8	20·6	18·41	12·8	20·6	18·41	12·8	20·6
LR	102·52	2·60	4·18	102·52	2·60	4·18	75·86	3·22	5·18	75·86	3·11	5·00	75·86	3·11	5·00	75·86	3·11	5·00
HR	45·83	5·82	9·36	45·83	5·82	9·36	33·92	7·20	11·6	33·92	6·94	11·2	33·92	6·94	11·2	33·92	6·94	11·2
Max. Full Power Speed 2200 rev/min																		
H3	24·88	13·1	21·1	24·88	13·1	21·1	18·41	16·3	26·2	18·41	15·6	25·3						
2000 rev/min																		
H3													18·41	14·2	22·8	18·41	14·2	22·8
Max. Light Load Speed 2350 rev/min																		
H3	24·88	14·0	22·6	24·88	14·0	22·6	18·41	17·4	28·0	18·41	16·8	27·0						
2160 rev/min																		
H3													18·41	15·3	24·6	18·41	15·3	24·6

* L Denotes creeper gear in low ratio.

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DAVID BROWN

CLUTCH

TRACTOR MODELS
900 — 950 — 990
850 — 880
Livedrive and Non-Livedrive Models

DAVID BROWN TRACTORS LIMITED
MELTHAM - HUDDERSFIELD - ENGLAND

DBT. 445

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SINGLE PLATE CLUTCH (Non-Livedrive Tractors)

Description (Fig. 1)

The clutch is of the dry plate type, and consists of a driven plate assembly, cover assembly and withdrawal mechanism.

The driven plate assembly B consists of a thin steel disc with a splined hub riveted to the centre, and woven asbestos facings riveted to each side of the outer edge. The cover assembly consists of a pressed steel cover L and a cast iron pressure plate C, loaded with thrust springs D. Mounted on the pressure plate are three release levers E, which pivot on floating pins retained in the eyebolts F and transmit movement to the pressure plate through the struts G.

The withdrawal mechanism consists of the clutch pedal M and cross shaft N which operate the carbon block H by means of the fork O.

Operation (Fig. 1)

Depressing the clutch pedal turns the cross shaft N which moves the carbon block H forward by means of the fork O. As the movement of the carbon block is transmitted to the release levers E by the lever plate P. The levers pivot on the pins Q and draw the pressure plate away from the flywheel by means of the struts G. Thus releasing the driven plate B and disengaging the drive.

Adjustment

The only adjustment required in service is the maintaining of 1 inch (2·5 cm) clutch pedal clearance.

To adjust the clutch pedal clearance, release nut J (Fig. 1) on the hand clutch rod then adjust bolt I until the pedal has 1 inch (2·5 cm) clearance (K). Lock bolt I by means of the lock nut, then reset nut J to give $\frac{1}{16}$ in. (1·5 mm) clearance of the hand clutch rod.

Clutch Removal

Before the clutch assembly can be removed access must first be obtained by removing the fuel tank and steering box, followed by the clutch and gearbox covers.

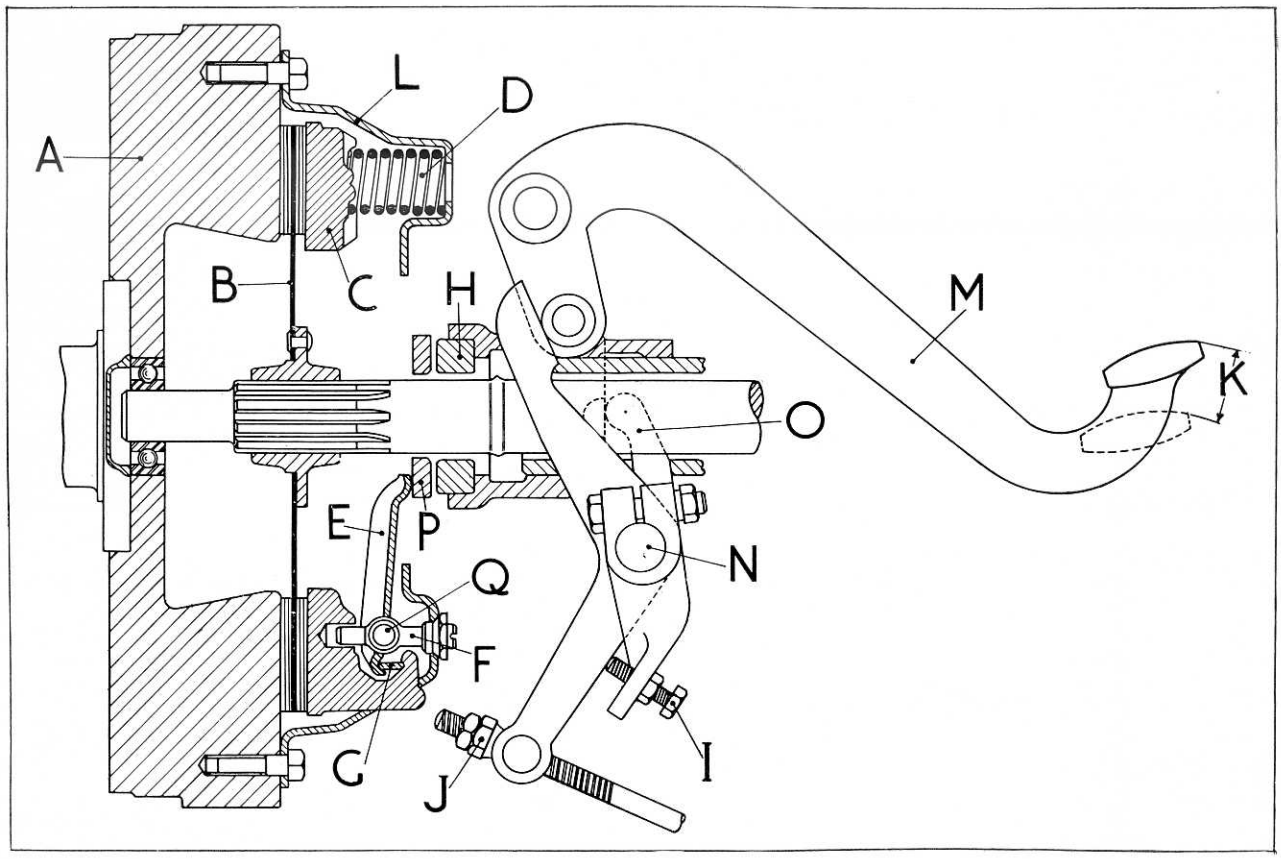


Fig. 1. DIAGRAM OF SINGLE PLATE CLUTCH

A. Flywheel
B. Driven Plate
C. Pressure Plate
D. Thrust Spring
E. Release Lever
F. Eyebolt
G. Lever Strut
H. Carbon Block
I. Pedal Adjustment
J. Hand Lever Adjustment
K. Pedal Clearance
L. Cover
M. Pedal Lever
N. Cross Shaft
O. Cross Shaft Fork
P. Lever Plate
Q. Pivot Pin

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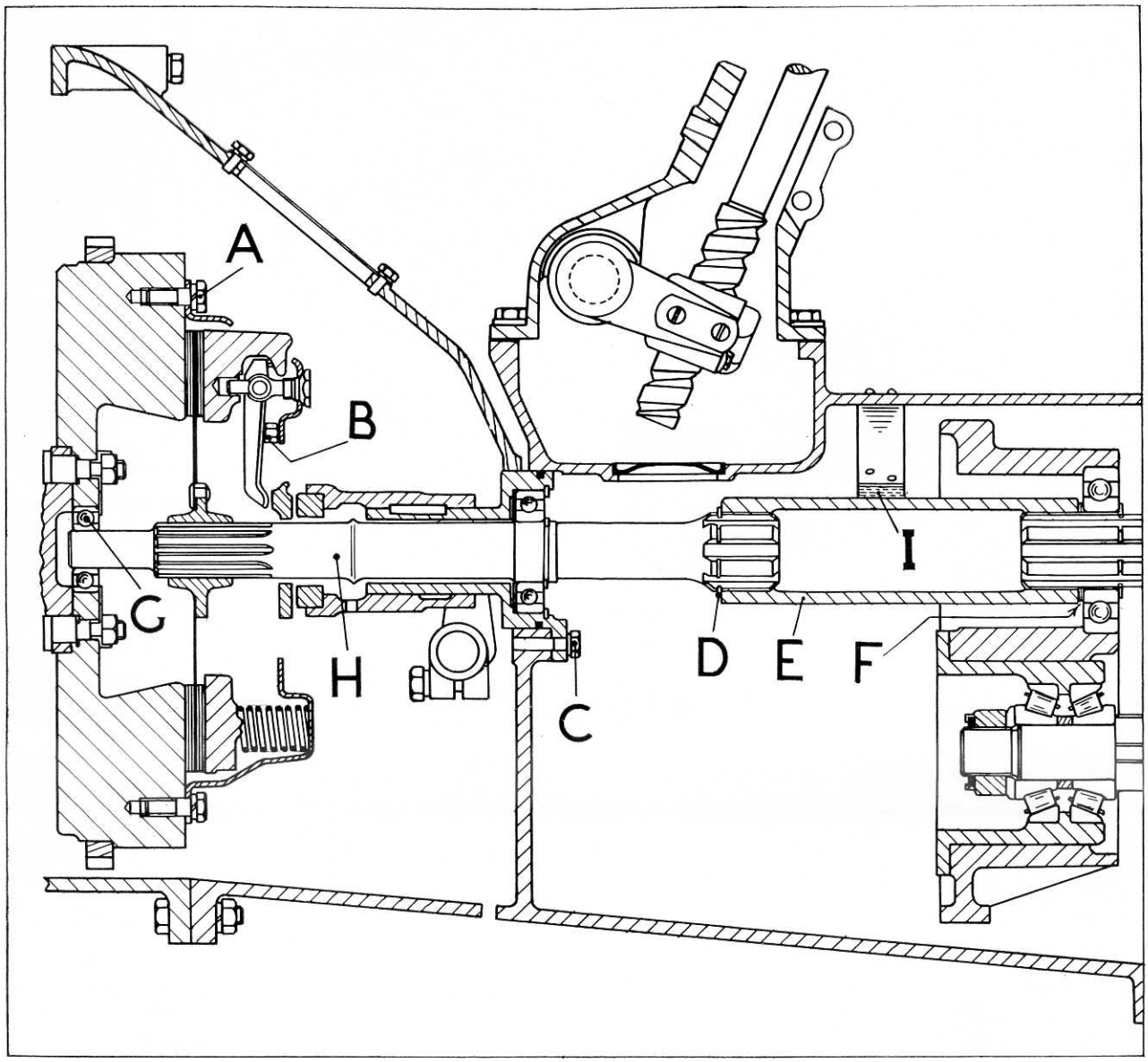


Fig. 2. SECTIONAL ARRANGEMENT OF SINGLE PLATE CLUTCH

A. Cover Bolt
B. Packing Nut
C. Support Housing Bolt
D. Circlip
E. Coupling
F. Shims
G. Spigot Bearing
H. Clutch Shaft
I. Clutch Shaft Stop

When these components have been removed remove the circlip D (Fig. 2) then slide the coupling E forward. Detach the support housing from the frame, by removing the bolts C and remove the two spring clips securing the cross shaft fork to the carbon block carrier.

Withdraw the support housing and the clutch shaft H away from the flywheel, until the clutch shaft is clear of the spigot bearing G, then remove the bolts A attaching the clutch cover to the flywheel. When removing the clutch cover bolts wedge a $\frac{3}{8}$ in. nut B, between each release lever and the inside of the cover. This will prevent the thrust springs from expanding too far and assist re-assembly.

The complete clutch assembly may now be removed by first lifting the rear until the coupling is clear of the gearbox end plate.

Clutch replacement should be carried out in the opposite sequence to removal, noting the following points.

Examine the flywheel spigot bearing and place a small quantity of high melting point grease in the cavity behind the bearing.

Check the fit of the drive plate on the clutch shaft. The plate should slide freely on the splines without excessive slackness.

Refit the clutch cover with the dowel holes in alignment with dowels in the flywheel. Tighten the bolts carefully and by diagonal selection to avoid distorting the cover.

After completing the assembly check the end float of the coupling E. This should be not less than 0·010 in. (0·25 mm). If necessary adjust by removing shims F between the coupling and the gearbox front bearing.

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Servicing the Clutch Unit

1. Mark the position of the release levers, cover plate, pressure plate and eyebolts so that these may be refitted in the same position should new parts be unnecessary.
2. Place the assembly on a press, as in Fig. 3, with a block under the pressure plate positioned so that the cover is free to move down. Place a block or bar across the top of the cover, resting on the spring bosses.

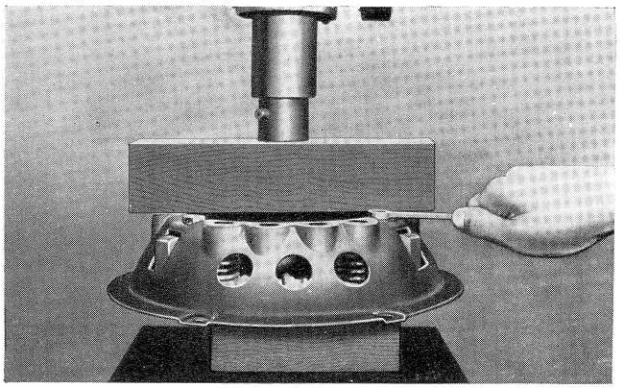


Fig. 3. DISMANTLING THE CLUTCH ASSEMBLY

3. Compress the cover against the pressure plate, unlock and remove the eye bolt nuts. Slowly release the pressure on the cover until the thrust springs are fully extended.
4. Lift off the cover, and remove the thrust springs. Remove the release levers, Fig. 4, clean and examine all parts.
5. To assemble the clutch, place the pressure plate on the block and replace the release levers and struts (Fig. 5). Taking note of the marks made during dismantling and applying a smear of grease to the pivot pins and struts.
6. Replace the thrust springs on the bosses on the pressure plate and place the cover in position on top of the springs, after ensuring that the three anti-rattle springs are in position on the cover and the marks made during dismantling are in alignment.

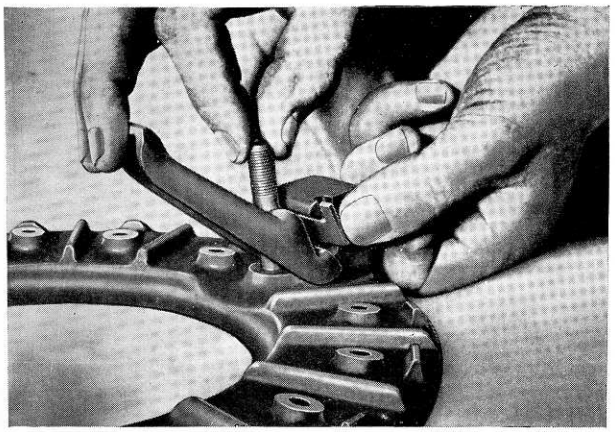


Fig. 4. REMOVING THE RELEASE LEVERS

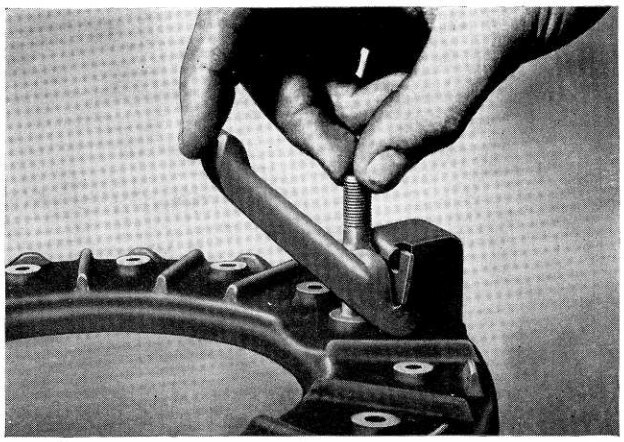


Fig. 5. REPLACING THE RELEASE LEVERS

7. With the second block placed across the cover, as in dismantling, compress the thrust springs until the eye bolt nuts can be replaced.
8. Remove the clutch assembly from the press and depress the release levers two or three times to settle the working parts.
9. Bolt the clutch to a flywheel, using a lever adjustment gauge, Part Number 20022, in lieu of the clutch driven plate. Before tightening the cover bolts ensure that the gauge is centred and the three machined lugs are positioned directly under the release levers.

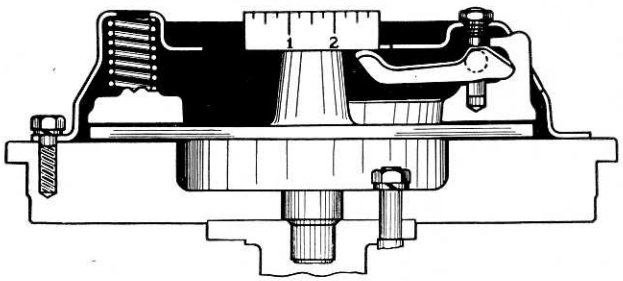


Fig. 6. SETTING THE RELEASE LEVERS

10. When the cover assembly has been bolted down place a short straight edge across the gauge boss and against the tip of a release lever (Fig. 6), turn the adjusting nut until the tip of the release lever just touches the straight edge, then repeat with the other two levers. When all three levers are set correctly lock the nuts by staking the nut rim into the slot in the eye bolt.
11. Fit the release lever plate to the inner ends of the release levers, secure by fitting the three retaining clips. Before removing the clutch from the flywheel, replace the three nuts, used as packing pieces, between the cover and release levers.

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DOUBLE CLUTCH (Livedrive Tractors)

Description (Fig. 7)

The double clutch is, in effect, two separate clutches mounted in tandem and controlled by a common pedal. The inner clutch (which is nearest the flywheel) transmits the drive to the hydraulic lift pump and power take-off and the outer clutch transmits the main drive to the gearbox. Disengagement of the main drive clutch does not, therefore, disengage the drive to the power take-off, which remains in operation until the second clutch is disengaged.

Operation (Fig. 7)

As the clutch pedal is depressed the pressure plate B is drawn rearwards by the action of the release levers R until the rear (main drive) plate S is free, and the clearance at C is reduced to 0·009/0·012 in. (0·23/0·31 mm). During this movement (L) of the pedal the roller G will have rolled along face F until it is also in contact with face E. Further movement of the clutch pedal will cause the roller to leave face F and roll along face E, which will draw the pressure plate B further to the rear. The additional movement of the pressure plate B will also move the inner cover M to the rear, due to the pressure plate contacting the adjusting screws D. As the withdrawal of the inner cover releases the pressure on the PTO pressure plate A, the springs T will then move the PTO pressure plate to the rear, thus disengaging the PTO clutch.

Adjustment

As the clutch linings wear during service the pressure plates A and B will move closer to the flywheel and reduce the amount of pedal free play. The pedal linkage should therefore be adjusted by releasing the nut Q on the hand clutch rod, and re-setting bolt P to give 1 in (2·5 cm) free pedal movement. The nut Q should then be tightened to give $\frac{1}{16}$ in. (1·5 mm) clearance of the hand clutch rod. Removal of the pedal return spring will assist in determining the pedal free play more accurately.

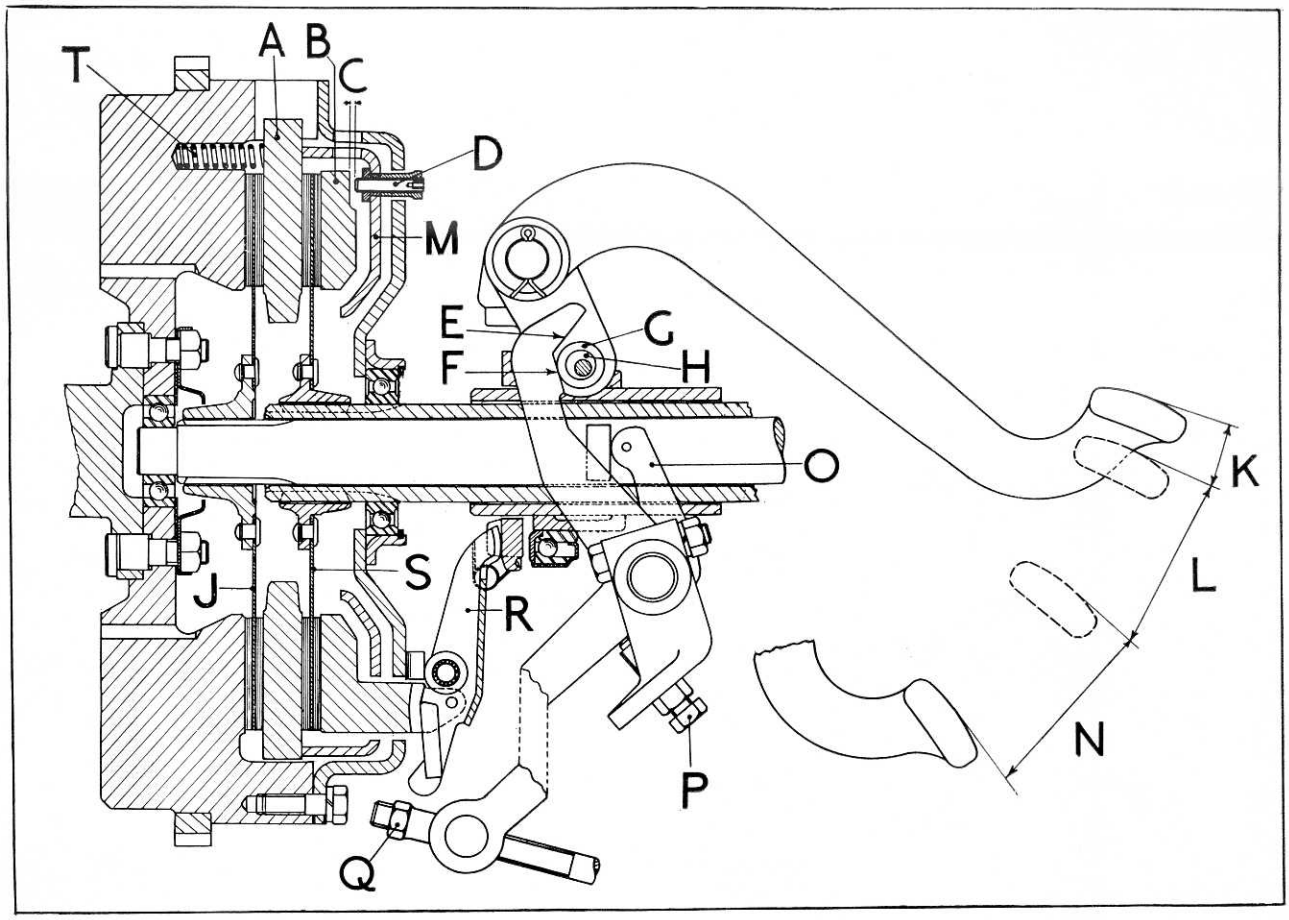


Fig. 7. DIAGRAM OF DOUBLE CLUTCH

A. PTO Pressure Plate
B. Pressure Plate
C. Clearance
D. Adjusting Screws
E. F. Lever Faces
G. Roller
H. Eccentric Pin
J. PTO Driven Plate
K. Pedal Free Play
L. Pedal Travel
M. PTO Cover
N. Pedal Travel
O. Clutch Fork
P. Adjusting Screw
Q. Hand Clutch Nut
R. Release Lever
S. Driven Plate

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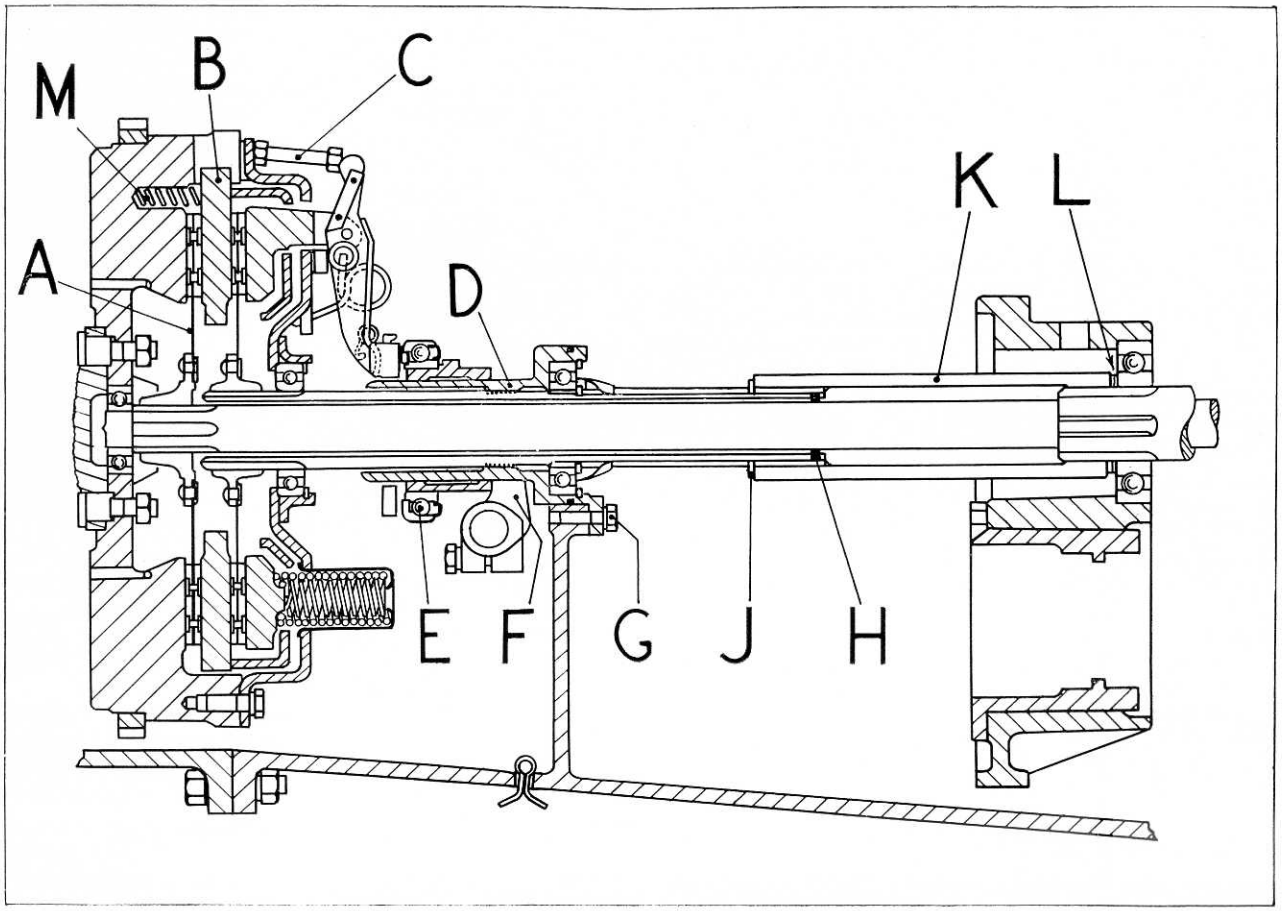


Fig. 8. SECTIONAL ARRANGEMENT OF DOUBLE CLUTCH

A. PTO Driven Plate	E. Release Bearing	J. Circlip
B. PTO Pressure Plate	F. Clutch Fork	K. Coupling
C. Packing Bolt	G. Housing Bolt	L. Shims
D. Support Housing	H. Seal	M. Spring

NOTE: The eccentric adjustment H should not normally be altered once it has been set during manufacture. Necessity for adjustment at this point should only arise if new parts have been fitted to the operating mechanism, or if these parts have become excessively worn.

If difficulty is experienced in freeing the power take-off clutch or if the clutch unit has been removed proceed as follows:—

1. Release nut Q and set the pedal clearance to 1 in. (2·5 cm) by means of the bolt P. With the clutch pedal in the fully "off" position set the clearance at C to 0·060 in. (1·52 mm) by means of the adjusting screw D. (The locknut is $\frac{7}{16}$ in. (1·1 mm) across flats and the adjusting screw requires an Allen key $\frac{1}{8}$ in. (3·17 mm) across flats.
2. Depress the clutch pedal until the roller G touches both faces E and F simultaneously then measure the clearance at C. If this is not within The limits 0·009/0·012 in. (0·23/0·31 mm) the eccentric adjustment H should be moved round to the next position. (Move clockwise to increase the clearance, anti-clockwise to decrease the clearance).
3. Check the pedal clearance, re-adjust if required and tighten nut Q to give $\frac{1}{16}$ in. (1·5 mm) clearance of the hand clutch rod.
4. Start the engine and depress the clutch pedal until the roller can be felt to contact face E. The main clutch should now be fully disengaged permitting clean gear engagement. Depressing the clutch pedal to its full extent should also disengage the inner clutch making the power take-off and hydraulic lift inoperative.

Clutch Removal

On twelve-speed tractors access to the clutch must be obtained by splitting the tractor main frame. As the engine and transmission units are heavy and require to be aligned carefully when being re-assembled, this operation should be carried out with the tractor standing on firm, level ground.

Place a jack under the front end of the rear main frame so that it can support the rear half of the tractor when the front main frame is withdrawn. Place a block of wood between the jack and main frame and extend the jack so that it takes weight but does not lift the tractor. Drive two suitable wooden wedges between each side of the front extension and axle

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beam, so that the engine unit will remain upright. Place a trolley jack under the flywheel housing, and after disconnecting the wiring, fuel pipes and controls, remove the main frame bolts so that the front main frame and engine unit can be drawn forwards until it is clear of the clutch driveshaft. To avoid damaging the clutch plates or driveshafts adjust the two jacks so that the front and rear main frames are withdrawn squarely away from each other.

On six-speed tractors access to the clutch may be obtained by splitting the main frame as on a twelve-speed tractor or if this is not convenient an alternative method is to remove the fuel tank and steering box followed by the clutch and gearbox covers. The power take-off unit must also be removed and the long drive shaft withdrawn. Remove the circlip from the front of the muff coupling and slide the coupling forward. Depress the clutch as far as possible, using a spanner on the lever, and insert a packing piece between each release lever and the clutch cover. Three 2 in. (5 cm) long bolts and nuts will make suitable packing pieces and will prevent the clutch springs from fully expanding when the cover is released from the flywheel.

Detach the bearing support housing from the frame by removing the three bolts and remove the two spring clips attaching the release bearing to the cross shaft fork. Suitably mark the relative positions of the clutch cover, separator plate and flywheel, then remove the bolts attaching the clutch cover to the flywheel.

Lift the complete clutch and driveshaft assembly from the tractor, leaving the separator plate and PTO driven plate in the flywheel. The rear of the clutch should be lifted until it is clear of the gearbox and then the whole assembly drawn upwards and rearwards.

Clutch Replacement

Replace the clutch in the reverse order of removal. Ensure that the inside of the flywheel is clean and place the PTO driven plate in position, hub towards the flywheel. Fit the three compression springs into the holes in the flywheel and fit the separator plate, with the marks made prior to dismantling in alignment.

If the clutch has been removed with the engine in situ, assemble the thrust bearing and support housing on to the clutch shaft and fit the clutch shaft into the cover. Place the transmission drive plate on the clutch shaft, hub towards the flywheel, and replace the complete assembly in the opposite way of removal. Bolt the clutch cover on to the flywheel, with the marks made prior to dismantling in alignment, and attach the support housing to the main frame. Push the muff coupling to the rear and slide the circlip into the groove. With the circlip in position the muff coupling should have 0·010 in. (0·25 mm) end float and if necessary this should be corrected by adding, or removing, shims between the coupling and gearbox front bearing. Fit the two spring clips to attach the release bearing to the cross shaft fork and replace the clutch housing and gearbox cover.

On 990 tractors the clutch housing and gearbox covers are bolted together to increase the effective depth of the main frame and to obtain a rigid attachment a taper wedge is fitted between the housing and cover faces. After firmly bolting the clutch housing and gearbox cover in position, place the wedge in the gap between the two faces and push the bolts through the holes in the gearbox cover. If the wedge is not tight in the gap when the bolts are screwed in loosely, push the wedge upwards and add as many shims as possible, so that when the bolts are tightened the housing and cover are bolted solidly together without being distorted.

When refitting the PTO cardan shaft care must be taken to ensure that the felt seal inside the clutch driveshaft is not displaced or damaged. The end of the shaft should be pushed carefully through the clutch shaft and not turned until the splines are clear of the seal.

Top up the oil bath before refitting the steering box and after completing the assembly adjust the clutch as indicated on page 6.

If the main frame has been split in order to remove the clutch a pilot, or spare clutch shaft, will be required to enable the transmission clutch plate to be centralised when assembling the clutch.

Place the three springs in the holes in the flywheel and fit the PTO driven plate, positioned with the hub against the flywheel. Fit the separator plate into the flywheel, noting that the marks made prior to dismantling are in alignment. Insert the spare clutch shaft, or pilot, through the bearing in the clutch cover and fit the transmission driven plate on to the shaft, positioned with the hub on the flywheel side of the plate. Bolt the cover and plate assembly on to the flywheel, placing the marks made during dismantling in alignment and tightening the bolts progressively and by diagonal selection to avoid distorting the cover, then remove the pilot shaft. Adjust the three PTO clearance adjustment screws in the clutch cover as these are more accessable whilst the tractor is split.

Check that the clutch release mechanism is in order and fully release the pedal adjustment. Ensure that the PTO cardan shaft is engaged on the splines of the PTO input shaft and is pushed fully to the rear. Clean both main frame faces and push the two halves of the tractor together. It is essential for the main frame faces to be parallel and in line and the front half should be raised until the clutch driveshaft enters the cover and then the engine turned to enable the driven plates to engage the driveshaft splines. When the two main frame faces are close together and entered on the dowels, fit the bolts and tighten progressively and by diagonal selection until they are all fully tightened. Replace the starter, reconnect the throttle and adjust the clutch pedal linkage.

Servicing the clutch unit

1. To ensure re-assembly of the parts in the same relative position, thereby preserving the balance and adjustment of the clutch, suitably mark the following parts:—
   (*a*) Main drive cover and power take-off cover.
   (*b*) Release levers and pressure plate lugs.

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(*c*) Relative position between the main drive cover and both pressure plates.

2. Remove the flywheel from the engine, or use a spare flywheel, and bolt the clutch unit to it, with the PTO pressure plate and both driven plates positioned correctly.

3. Disengage the release lever plate by removing the split pins and washers securing the retainer springs F to each release lever.

4. Remove the split pins from the release lever fulcrum pins, D, withdraw the pins and remove the release levers after removing the anti-rattle springs.

5. Extract the pin securing the roller bearing in each release lever; prepare to catch the 19 needle rollers as each pin is removed.

6. Remove the bolts securing the clutch cover to the flywheel, slowly and progressively to prevent the thrust springs from flying out. Separate the various parts of the clutch.

7. Thoroughly clean all parts and renew those that show appreciable wear. Examine the driven plate facings, renew if worn or contaminated with oil or grease. Check the thrust springs, if these have been overheated due to prolonged clutch slip their tension will be reduced and they will require replacement.

8. To re-assemble the clutch eight spacers will be required. These should be 1 in. (2·5 cm) diameter and either 0·310 in. (7·874 mm) or 0·349 in. (8·865 mm) as indicated on page 13. With the flywheel on the bench place four spacers, equal distance apart, in the place normally occupied by the PTO driven plate facings and place the PTO pressure plate on top of the spacers (Fig. 9).

9. Place the four remaining spacers on the PTO pressure plate, positioning these so that they will be directly under the release lever lugs on the pressure plate G. Before fitting the pressure plate place a straight edge across the centre of pressure plate A, to act as a datum line when measuring the height of the release levers.

10. Apply a slight smear of grease to the sides of the lugs on the pressure plates. Locate the six pairs of brown thrust springs on the pressure plate bosses and pass the cover B over the springs, ensuring that the marks made prior to dismantling are aligned.

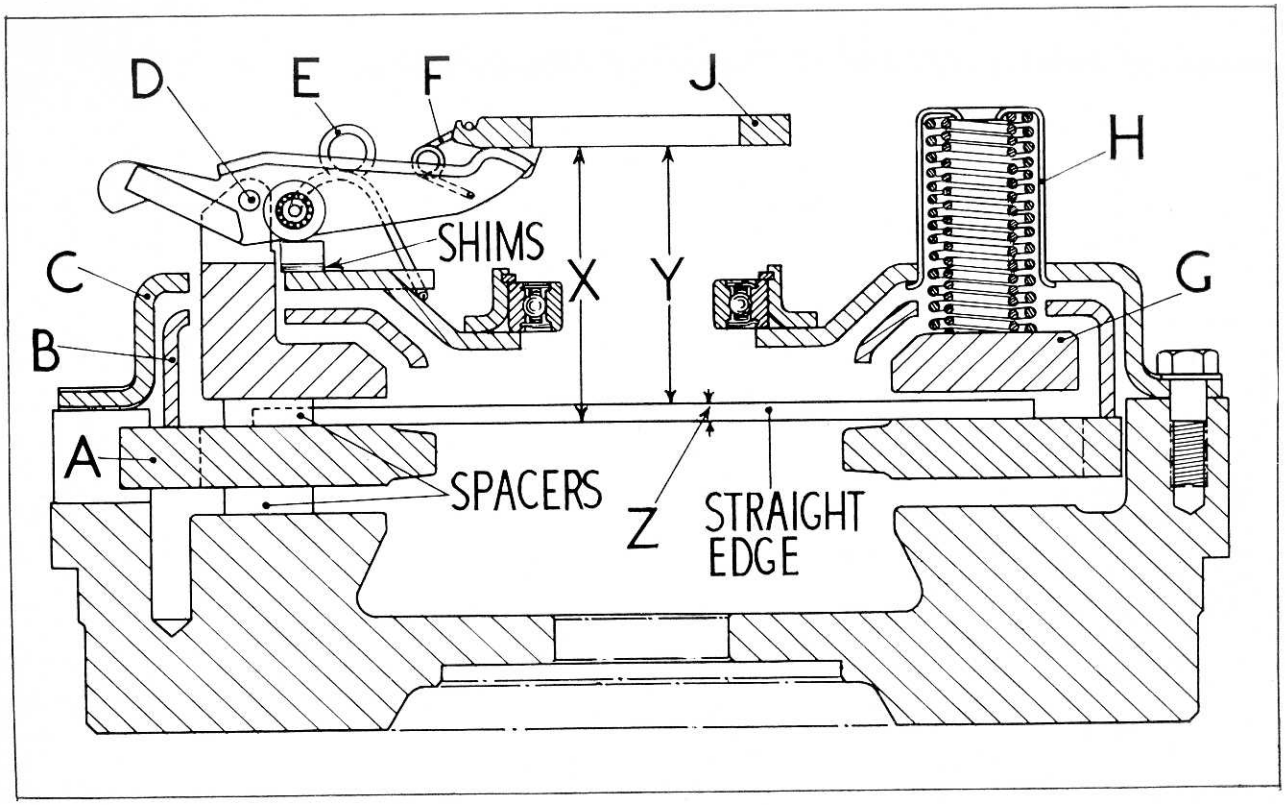


Fig. 9. ASSEMBLING THE CLUTCH

A. PTO Pressure Plate
B. PTO Cover
C. Main Cover
D. Pivot Pin
E. Anti Rattle Spring
F. Lever Spring
G. Main Pressure Plate
H. Spring Cup
J. Release Lever Plate
X. Setting Distance
Y. Distance Measured
Z. Thickness of Straight Edge

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11. Position the cups H over the springs and locate the six pink springs and cups on the bosses of cover B. Pass cover C over the lugs and spring cups, and bolt to the flywheel. Tighten the bolts a little at a time and by diagonal selection to avoid distorting the cover.

12. Pack the 19 needle rollers with grease and place inside the lever roller. Fit the rollers to the lever, securing the pin with circlips. Fit the release levers to the pressure plate, securing with pins D and split pins.

13. Engage the loop of the anti-rattle springs E behind the projection on the main drive cover C, and locate the ends of the springs in the holes in the lever rollers.

14. Operate the clutch several times, by depressing the tip of each release lever, to settlet he working parts.

15. Place a rule, or depth gauge, through the release lever plate J and measure the distance between the tips of the release levers and the straight edge. Adjust the height of the release levers, by removing or adding shims under the lever roller pads, until the distance between the upper face of the separator plate and the release levers (Fig. 9) is 3·445 in. (8·75 cm) on a BB11/180 clutch or 3·345 in. (8·531 cm) on a BB10/167 clutch.

    As it is not possible to measure directly to the upper face of the separator plate for which the dimension quoted is correct, it will be necessary to add the thickness of the straight edge (Z) to the measurement taken (Y) in order to obtain the correct dimension (X).

16. Replace the three adjuster studs and nuts and remove the clutch assembly from the flywheel.

TWIN PLATE CLUTCH (990 INDUSTRIAL TRACTORS)

The clutch fitted to 990 Industrial tractors is of the same basic construction as the 990 Livedrive clutch and for service purposes the clutch should be considered as a Livedrive unit.

The only difference in the clutch cover assembly is that the six buff springs on the inner pressure plate (the PTO clutch springs on a Livedrive clutch) are replaced by six lighter springs, Part No. 625149.

Both the 10 in. (25·4 cm) diameter inner and the 11 in. (27·94 cm) diameter outer driven plates are fitted with Bimet facings and both plates are mounted on a single driveshaft. The clutch, therefore, functions as a single clutch but the twin plates give twice the facing area of a single plate clutch.

Adjustment

Clutch pedal adjustment is by means of the adjusting screw shown at P, figure 7, and this should be adjusted to give 1—1¼ in. (25·40—31·75 mm) pedal 'free play'. As no intermediate stage is required, the pedal roller is not fitted with an eccentric adjustment and the cross shaft lever is not equipped with two angled faces.

The maintaining of the correct amount of pedal 'free play' is the only adjustment normally required during service, but if after considerable service the driven plates fail to stop when the clutch pedal is fully depressed this may be due to insufficient movement of the pressure plate, caused by excessive clearance between the adjusting screws and pressure plate. To set the adjusting screw clearance, remove the vent cover from the clutch compartment and turn the engine so that one of the screws is opposite the cover aperture. Release the locknut, insert a 0·050 in. (1·270 mm) feeler gauge between the pressure plate and screw end. After adjusting the screw so that it just holds the feeler gauge, firmly tighten the locknut and repeat the operation on the second and third screws. Ensure that the locknuts are firmly tightened before replacing the cover.

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REFACING DRIVEN PLATES

An examination of a driven plate will show that it consists of a series of segments set alternately concave and convex and that each rivet is attached to only one facing; the alternate hole in each facing being drilled to give access to the rivet securing the facing on the opposite side.

To remove the old facings drill out the rivets using a $\frac{5}{32}$ in. (4 mm) diameter drill inserted through the clearance hole in the opposite side facing. The open portion of the rivet readily centres the drill enabling a speedy and clear removal to be effected.

When the facings have been removed examine the plate carefully. If any signs of cracking are apparent, or if the hub is loose on the rivets or worn in the splines, a new plate complete with facings is required.

It should be noted that on later series Livedrive tractors the main drive plate is fitted with facings of Bimet material, and these should not be replaced with woven asbestos facings as fitted to the power take-off plate.

When refacing main drive plates from early series tractors Bimet facings should be used and not woven asbestos facings as were fitted originally.

Bimet facings may be identified by their dark appearance and the six ventilation slots moulded into the friction face.

Place one of the new facings in position on the disc, noting that the convex side of the plate segments are against the rivet holes in the facing.

Insert the rivets, with their heads in the counterbored holes in the facing, and roll the shanks securely against the plate disc. If a rolling tool is not available a blunt-ended punch will prove satisfactory.

Secure the opposite side facing in a similar manner, When it will be noted that the counterbored holes in one facing coincide with the clearance holes in the other facing.

After fitting the new facings, place the disc on a suitable mandrel between lathe centres and spin to check for runout. If this is more than ·015 in. (38 mm) straighten the disc as required.

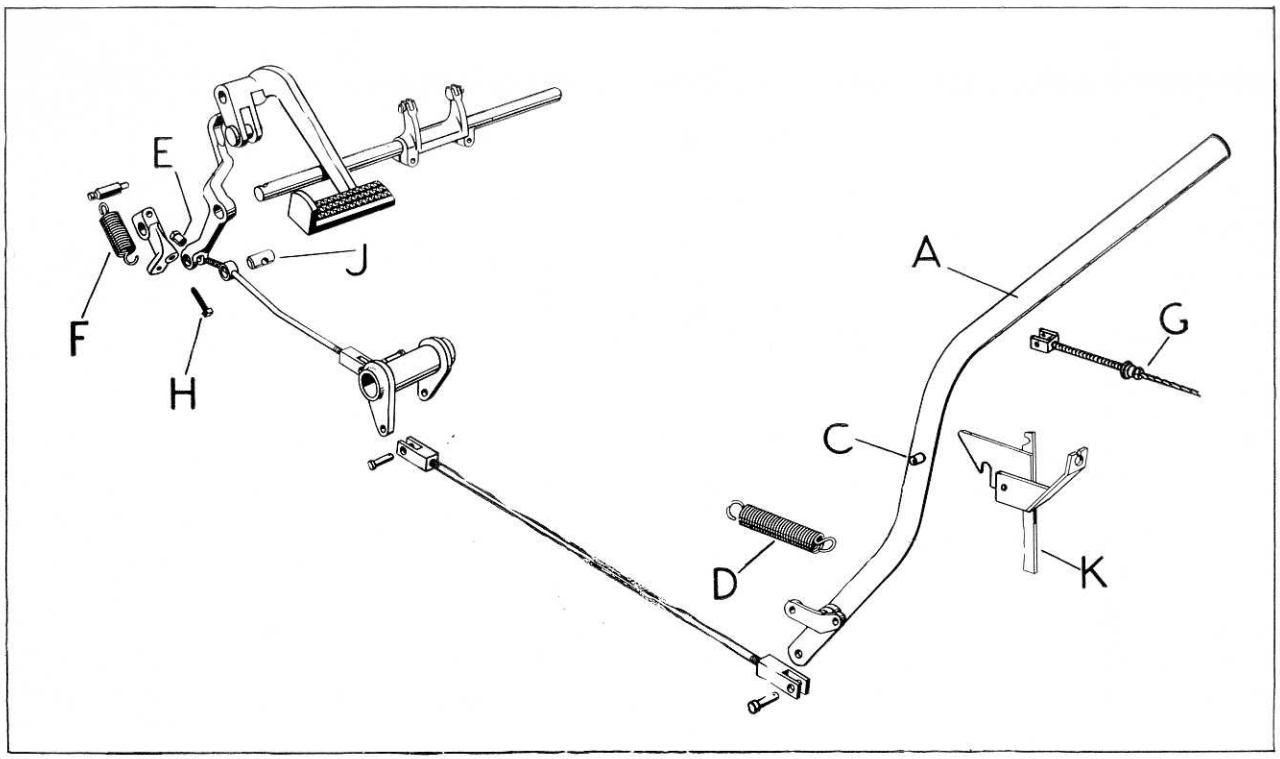


Fig. 10. CLUTCH WITHDRAWAL MECHANISM

A. Hand Clutch Lever
C. Lever Stud
D. Tension Spring
E. Adjusting Nut
F. Pedal Return Spring
G. Overload Release Cable
H. Adjusting Bolt
J. Linkage Pin.
K. Catch Lever

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CLUTCH WITHDRAWAL MECHANISM

Clutch Stop

To prevent rotation of the gearbox drive shaft when the clutch is dis-engaged, a clutch stop is fitted on the underside of the gearbox cover. This is in the form of a spring loaded friction pad which contacts the muff coupling (fig. 2) and acts as a brake.

The stop requires no maintenance or adjustment, other than inspection whenever the gearbox cover is removed. When the friction pad is worn a new assembly should be attached to the gearbox cover.

Operation of the Hand Clutch (Fig. 11)

The hand clutch lever is mounted on the left hand side of the rear axle casing, and is normally retained in the rear (engaged), position by means of the catch K engaging with the stud C.

When the catch lever is raised by the overload release cable G, or tripped by hand, the catch releases the lever and allows the tension spring D to draw the lever forward, thus disengaging the clutch.

On Livedrive tractors the hand clutch disengages the main drive clutch only, the power take-off and belt pulley remaining operative until disengaged by the clutch pedal.

Adjustment of the Hand Clutch

Resetting of the clutch pedal "free play" by means of the adjustment bolt H also resets the free play in the hand clutch linkage. The setting of the hand clutch rod adjusting nut E should however always be checked when the clutch is adjusted, to ensure that hand clutch linkage does not prevent the clutch pedal from returning to the fully engaged position. When the clutch pedal is against the stop on the clutch housing, and the hand clutch lever is locked in the engaged position, the nut E should be $\frac{1}{16}$in. (1·5 mm) clear of the pin J.

CLUTCH FAULT DIAGNOSIS

SYMPTOM	CAUSE
Difficulty in engaging gears due to driven plate revolving after clutch pedal is depressed	(*a*) Clutch not fully disengaged due to incorrect pedal adjustment. (*b*) Driven plate bonded to flywheel due to facings becoming contaminated with oil or grease. (*c*) Driven plate distorted. (*d*) Driven plate hub binding on clutch shaft splines. (*e*) Excessive wear in release mechanism.
Clutch slipping when under load	(*a*) Lack of clutch pedal "free-play." (*b*) Lack of clearance in hand clutch mechanism or swinging lever tight on the brake cross shaft. (*c*) Driven plate facings contaminated with oil or grease. (*d*) Driven plate facings worn. (*e*) Thrust springs weak, due to overheating caused by excessive slipping.
Clutch fails to take up the drive smoothly	(*a*) Driven plate facings contaminated with oil or grease. (*b*) Wear in release mechanism or incorrect adjustment of release levers. (*c*) Excessive wear in flywheel spigot bearing.
Clutch fails to drive when pedal is released	(*a*) Hand clutch lever in disengaged position. (*b*) Incorrect adjustment of release mechanism. (*c*) Fractured driven plate.

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DIMENSIONAL DATA

900—950—880—850 Non-Livedrive

Clutch type	Borg and Beck 10A6G	
Plate diameter	10 in.	25·4 cm
Plate facing material	Raybestos W.N.M.R.	
Plate thickness (new)	0·320 in.	8·128 mm
Number of springs	12	12
Spring colour	Light Green	Light Green
Spring pressure (at checking length)	110 lb	49·896 kg
Spring checking length	1·688 in.	42·875 kg
Pedal clearance	1–1¼ in.	25·4–31·75 mm
Release lever height, i.e. distance from the tips of the release levers to the flywheel face, when the clutch is assembled with four 0·310 in. (7·874 mm) thick spacers in place of the driven plate	1·955 in.	49·53 mm

900—950—880—850 Livedrive

Clutch type	Borg and Beck BB.10/167	
Plate diameter (Transmission)	10 in.	25·4 cm
Plate facing material	Bimet	
Plate thickness (new)	0·350 in.	8·890 mm
Plate diameter (PTO)	10 in.	25·4 cm
Plate facing material	Raybestos W.N.M.R.	
Plate thickness (new)	0·320 in.	8·128 mm
Number of springs (Transmission)	12	12
Spring colour (Inner-Trans.)	Brown	Brown
Spring pressure (at checking length)	70 lb	31·752 kg
Spring checking length	2·82 in.	71·622 mm
Spring colour (Outer-Trans.)	Brown	Brown
Spring pressure (at checking length)	112 lb	50·8 kg
Spring checking length	2·82 in.	71·622 mm
Number of springs (PTO)	6	6
Spring colour (PTO)	Buff	Buff
Spring pressure (at checking length)	85 lb	38·556 kg
Spring checking length	2·37 in.	60·198 mm
Separator plate thickness	0·705–0·695 in.	19·05–17·653 mm
Cover adjusting screw clearance	0·058–0·062 in.	1·473–1·574 mm
Pedal clearance	1–1¼ in.	25·40–31·75 mm
Release lever height, i.e. distance from outer face of the separator plate to the tips of the release levers, when the clutch is bolted to a flywheel and fitted with four 0·310 in. (7·874 mm) thick spacers in place of the PTO plate and four 0·349 in. (8·865 mm) thick spacers in place of the main drive plate.	3·345 in.	8·531 cm

990 Non-Livedrive

Clutch type	Borg and Beck 11A6G	
Plate diameter	11 in.	27·94 cm
Plate facing material	Raybestos W.N.M.R.	
Plate thickness (new)	0·330 in.	8·382 mm
Number of springs	12	12
Spring colour	Yellow/Light Green	
Spring pressure (at checking length)	140 lb	63·4 kg
Spring checking length	1·688 in.	42·875 mm
Pedal clearance	1–1¼ in.	25·4–31·75 mm
Release lever height, i.e. distance from the tips of the release levers to the flywheel face, when the clutch is assembled with four 0·310 in. (7.874 mm) thick spacers in place of the driven plate.	1·955 in.	49·53 mm

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990 Livedrive

Clutch type	Borg and Beck BB.11/180	
Plate diameter (Transmission)	11 in.	27·94 cm
Plate facing material	Bimet	
Plate thickness (new)	0·353 in.	8·966 mm
Plate diameter (Power take-off)	10 in.	25·4 cm
Plate facing material	Raybestos W.N.M.R.	
Plate thickness (new)	0·320 in.	8·128 mm
Number of springs (Transmission)	12	12
Spring colour (Inner-Trans.)	Brown	Brown
Spring pressure (at checking length)	70 lb	31·752 kg
Spring checking length	2·82 in.	71·622 mm
Spring colour (Outer-Trans.)	Brown	Brown
Spring pressure (at checking length)	112 lb	50·8 kg
Spring checking length	2·82 in.	71·622 mm
Number of springs (PTO)	6	6
Spring colour (PTO)	Buff	Buff
Spring pressure (at checking length)	85 lb	38·556 kg
Spring checking length	2·37 in.	60·198 mm
Separator plate thickness	0·765–0·755 in.	19·531–19·177 mm
Pedal clearance	1–1¼ in.	25·40–31·75 mm
Cover adjusting screw clearance	0·058–0·062 in.	1·473–1·574 mm
Release lever height, i.e. distance from outer face of the separator plate to the tips of the release levers, when the clutch is bolted to a flywheel and fitted with four 0·310 in. (7·874 mm) spacers in place of the PTO plate and four 0·349 in. (8·865 mm) spacers in place of the main drive plate.	3·445 in.	8·750 cm

990 Industrial

Clutch type	Special Twin Plate	
Plate diameter (Outer plate)	11 in.	27·94 cm
Plate facing material (Outer plate)	Bimet	
Plate thickness (new) (Outer plate)	0·353 in.	8·966 mm
Plate diameter (Inner plate)	10 in.	25·4 cm
Plate facing material (Inner plate)	Bimet	
Plate thickness (new) (Inner plate)	0·350 in.	8·890 mm
Number of springs	12	12
Spring colour (inner)	Brown	Brown
Spring pressure (at checking length)	70 lb	31·752 kg
Spring checking length	2·82 in.	71·622 mm
Spring colour (outer)	Brown	Brown
Spring pressure (at checking length)	112 lb	50·8 kg
Spring checking length	2·82 in.	71·622 mm
Separator plate thickness	0·765–0·755 in.	19·531–19·177 mm
Pedal clearance	1–1¼ in.	25·40–31·75 mm
Cover adjusting screw clearance	0·050 in.	1·270 mm
Release lever height, i.e. distance from outer face of the separator plate to the tips of the release levers, when the clutch is bolted to a flywheel and fitted with eight 0·349 in. (8·865 mm) thick spacers. Four in place of the inner plate and four in place of the outer plate.	3·445 in.	8·750 cm

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SUMMARY OF DESIGN CHANGES

Details of Change — **When introduced**

Method of locating the muff coupling (89329) changed from locking screws in the coupling to circlips on the clutch drive shaft.

New No.	Description	Superseded No.
12922	Circlip $\frac{3}{4}$ in. (19·05 mm)	—
901753	Muff Coupling	89329
901754	Clutch Driveshaft	89328
901758	Gearbox Driveshaft	88866
902106	Shim, $\frac{1}{32}$ in. (0·794 mm)	—
—	Locking screw	89330
—	Locking Ring	89331

Clutch driveshaft (901754) will service tractors prior to the change. In this case the original muff coupling can be used, the locking screws discarded and the coupling located by fitting two circlips; one in front of the muff coupling and one at the rear of the clutch shaft bearing. Sufficient shims (902106) should be fitted between the muff coupling and the front bearing on the gearbox driveshaft to reduce the end float of the coupling to 0·010 in. (0·254 mm). Muff coupling (901753) and gearbox driveshaft (901754) are not interchangeable with the original parts and cannot be fitted to tractors prior to the change unless a new clutch driveshaft (901758) is also fitted. . . — 900J/52103 (October 1958)

Spring loading of transmission clutch increased by fitting brown springs instead of the dark green springs fitted previously. To compensate for this increase the spring loading on the power take-off clutch has been decreased, by replacing the buff inner and outer springs with pink outer springs only.

New No.	Description	Superseded No.
902512 (Brown)	Spring—Outer	900259 (Dark Green)
902513 (Brown)	Spring—Inner	900260 (Dark Green)
902514 (Pink)	Spring (PTO)—Outer	900261 (Buff)
—	Spring (PTO)—Inner	900262 (Buff)

The part number of the clutch cover assembly (89324) is unchanged and the springs are interchangeable with the original springs if fitted in complete sets. . . . . — 900J/54855 (November 1958)

Three compression springs, part number 13226, fitted between the separator plate (89323) and flywheel. These springs improve the disengagement of the PTO clutch and are accommodated in holes in the flywheel. Tractors prior to the change may be modified by drilling three $1\frac{1}{4}$ in. (31·75 mm) deep holes, using locating jig part number 902182. . . . . — 900J/54855 (November 1958)

Ventilation of clutch compartment increased by fitting a spacer, part number 903489, on the lower bolt of the adjustment cover (89387). The spacer is fitted between the cover and clutch housing so that a gap is formed to allow air circulation. . . — 900J/59605 (April 1959)

Material of transmission drive plate facings (900249) changed to Bimet. The new facing, which has considerably improved wear resisting qualities over the woven asbestos facing, is obtainable under part number 904140 and should be used for refacing all Livedrive transmission plates. . . . . — 950T/62184 (January 1960)

Radial slots incorporated in the face of Livedrive clutch facings (904140) to assist heat dissipation. Part number of facings unchanged. . . . . — 950T/65266 (January 1960)

Clutch stop, part number 903870, consisting of a pad of friction material riveted to a spring steel strip, bolted on the underside of the gearbox cover. The stop is in permanent contact with the muff coupling and prevents the clutch shaft from rotating when the clutch pedal is depressed. . . . . — 900J/63007 (January 1960)

Needle roller bearings on the clutch withdrawal fork rollers replaced by bushes on Non-Livedrive models only.

New No.	Description	Superseded No.
902085	Roller	900348
—	Needle Roller Bearing	620260
902086	Bush	—

The new parts are interchangeable with the original parts if fitted in pairs. . — 900L/66446 (March 1960)

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Details of Change	When Introduced
Cored hole incorporated in the main frame clutch compartment directly below the clutch. Bosses cast on the clutch housing (89382) to raise the cover and dispense with the use of a spacer (903489).	850/302311 950/72145 (December 1961)
Power take-off thrust springs changed from pink to buff. Part number of springs changed from 902514 to 900261. Interchangeability is not affected if springs are fitted in sets.	950V/70570 850A/301593 (December 1960)
Separator plate located in flywheel by gear teeth on the periphery of the plate and inside the recess in the flywheel, instead of three lugs and slots as previously.	

New No.	Description	Superseded No.	
906200	Separator Plate	89323	
906567	Flywheel—Diesel	89319	950V/75889
906572	Flywheel—Gasoline	89793	850A/304187

The new parts are interchangeable with the previous parts if fitted in pairs. (April 1961)

Grease nipples fitted in main frame bosses, to lubricate clutch cross shaft bearings.	850/306078 950/80267 (September 1961)
Thickness of clutch stop spring (903870) increased from 0·048 in. (1·22 mm) to 0·056 in. (1·42 mm) and the stop contact area on the muff coupling (901753) ground to improve the surface finish. Part numbers unchanged.	850/310013 880/350686 950/400013 990/440242 (November 1961)
Cover, part number 9088838, fitted over the aperture in the clutch compartment of the main frame. The cover is provided with an air vent so that it prevents the ingress of dirt and water but allows air, which enters the compartment through the upper vent, to pass out through the lower vent. The cover may be fitted to all tractors incorporating the aperture in the main frame, by drilling and tapping the frame for the two attachment bolts (602733).	850/312229 850/N390175 880/352662 880/N395128 950/401042 990/447005 (August 1962)
Tension of anti-rattle springs (900263) increased. The new springs, which have two coils instead of a single coil as on the previous springs are interchangeable with the previous springs if fitted in sets.	

New No.	Description	Superseded No.	
910171	Clutch Cover Assembly	89324	850C/313773
910170	Clutch Cover Assembly	902788	880C/355216
961128	Anti-rattle spring	900263	990A/452359

(March 1963)

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DAVID BROWN

DIESEL ENGINE

REPAIR MANUAL

Engine Series	Tractor Model
AD4/40T	880 and 950 Livedrive
AD4/40U	880 and 950 Non-Livedrive
AD4/36A	850 Livedrive
AD4/36B	850 Non-Livedrive
ID4/40	Taskmaster Industrial Tractor
ID4/40T	Turbo Taskmaster Industrial Tractor
TD4/40	40TD Crawler Tractor

DAVID BROWN TRACTORS LIMITED
MELTHAM · HUDDERSFIELD · ENGLAND

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Introduction

The water pump, fuel injection pump and equipment, and the cylinder head may be removed without taking the engine out of the tractor. For access to the crankshaft, pistons, connecting rods and cylinder liners the engine must be removed as follows.

Removing the Engine from the Tractor

Before the engine can be lifted out of the frame the following procedure must be carried out.

Remove the silencer, bonnet top and air cleaner, unfastening the latter at its bracket from the main frame and pull it off the manifold. Disconnect and remove the wiring harness from the engine leaving the wires attached to the instrument panel. On V and W model tractors disconnect the harness at the 8-way connector under the instrument panel.

Remove the thermometer phial and capillary tube from the engine if fitted.

Disconnect the wire to the oil warning light pressure unit.

Unfasten the snap connectors for the starter solenoid and for the side lights. Disconnect the cable from the starter motor.

Remove the tractormeter drive cable.

Disconnect the fuel pipe at the lift pump and drain the fuel tank. Disconnect the pipe to the fuel tap.

Remove the hand throttle lever and rod.

Unfasten the strap holding the fuel tank (one nut and locknut each side) and lift the fuel tank off.

Remove the throttle and stop control rods.

Remove the Steering Column and Steering Box (see Steering and Front Axle Section). Remove the gearbox top, and flywheel cover complete with fuel tank support.

On Livedrive tractors remove the power take-off unit and withdraw the long driveshaft.

Unclip the circlip in front of the gearbox muff coupling and slide the coupling forward as far as possible. Remove the two spring securing clips from the clutch withdrawal yoke.

Remove the hose connections to the radiator.

Take out the sump bolts. Remove the engine breather and screw the engine lifting eye into the threaded socket in the cylinder head bolt exposed by removing the breather.

Lift the engine vertically until the oil pump is clear of the main frame.

Replacement. New cork packings should always be used for the front and rear main bearings to seat on. These should be fitted to the frame and glued in position with a gasket cement. Two half-discs of wood should be used to hold the cork in place until the cement has set. (Fig. 1.)

To guide the engine into place, screw two rods about $2\frac{1}{2}$ in. (64 mm) long, threaded $\frac{3}{8}$ in. B.S.F. at one end into the main frame in such a position that they could be easily removed when the engine has been lowered into position as shown in Fig. 1. When the engine is within 1 in. (2·5 cm) of the frame it should be *dropped* home to ensure a good seating on the cork seals. Fit the two dowels in the right-hand side flange and bolt down securely.

Turning the Engine Without Starting Handle

From tractor number 950/58641 onwards the decompressor lever and the hand starting dog, guide bracket and handle were discontinued. The engine can of course be turned by the fan if the injectors are removed, but the recommended method of turning the engine for servicing is to use the special box spanner and tommy bar on the crankshaft pulley nut. It is not necessary to remove the injectors using this method.

Engines prior to the following serial numbers are fitted with a 1·67 in. (42·42 mm.) across-flats crankshaft nut and require turning tool number 903221.

AD4/40T–15688	AD4/40U–10821
AD4/36A–4689	AD4/36B–3789
TD4/40–220	ID4/40–113
ID4/40T–280	

Commencing at the above serial numbers the size of the crankshaft nut was reduced to 1·50 in. (38·10 mm.) across-flats and turning tool 960995 is, therefore, required.

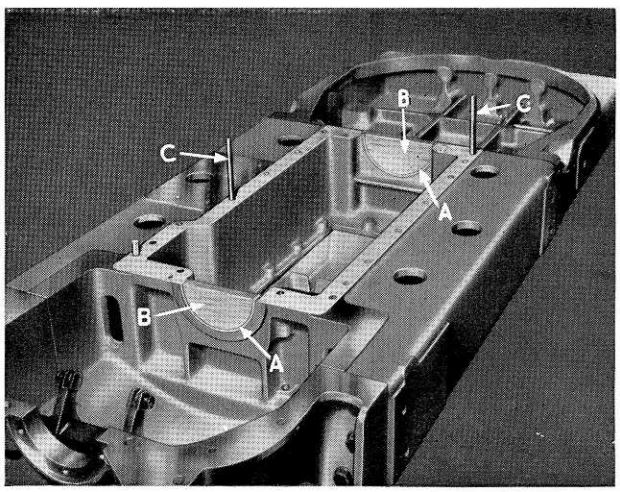


Fig. 1. ENGINE MOUNTING IN MAIN FRAME
A. Cork Seals at front and rear Main Bearing Caps
B. Dummy Bearing Caps
C. Guide Dowels

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Setting Valve Clearances

The valve clearances should be set when the engine is cold. If the clearances have been disturbed the valves should be set cold and the engine run up to working temperature and then reset after tightening down the cylinder head.

In order to reduce the engine turning to a minimum the following procedure is recommended:

Set Nos. 1 and 2 valves with Nos. 7 and 8 on the balance one opening the other closing, i.e. No. 4 cylinder on top dead centre. This can be found accurately by inserting the timing pointer in the flywheel cover marked TDC and turning until it is felt to fall into the dimple in the flywheel.

Turn the engine exactly half a turn until Nos. 5 and 6 valves are on the balance and set the clearance of Nos. 3 and 4.

Turn the engine another half turn (on to the TDC position) and adjust valves 7 and 8 while Nos. 1 and 2 are balanced.

A further half turn will bring valves 3 and 4 to the balanced position enabling Nos. 5 and 6 to be set.

Whenever the cylinder head bolts are tightened the valve clearances should be rechecked afterwards.

Air Cleaner

At the time of major overhaul the air cleaner should be removed complete from the tractor for thorough cleaning. Remove the oil bath and the pre-cleaner and wash the knitted wire element and the tubes with clean paraffin. Allow the element to dry and then re-soak in engine oil.

The pre-cleaner should be cleaned out and wiped dry. On diesel engines equipped with pneumatic governors the pre-cleaner was selected for use only with its own engine in order to maintain the correct maximum speed. With the introduction of the DPA pump with mechanical governor this does not apply. However, the pre-cleaner should be kept clean and free from obstructions.

Some difficulty may be experienced in advising users how often to change the oil in the cleaner bath. This is entirely governed by prevailing conditions. In a dry dusty atmosphere frequent changing will be required. In a clean damp atmosphere the oil will last a very considerable period, perhaps many weeks. This would apply in Great Britain under normal usage in the field. However, if the tractor is then put on belt pulley work in a dusty yard the oil will quickly become contaminated.

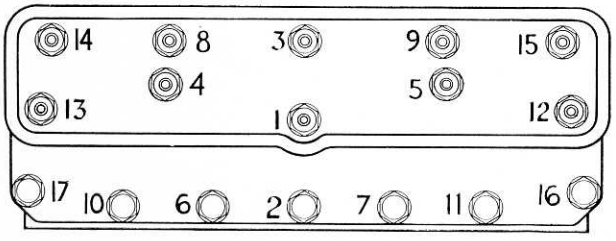


Fig. 3. HEAD TIGHTENING SEQUENCE

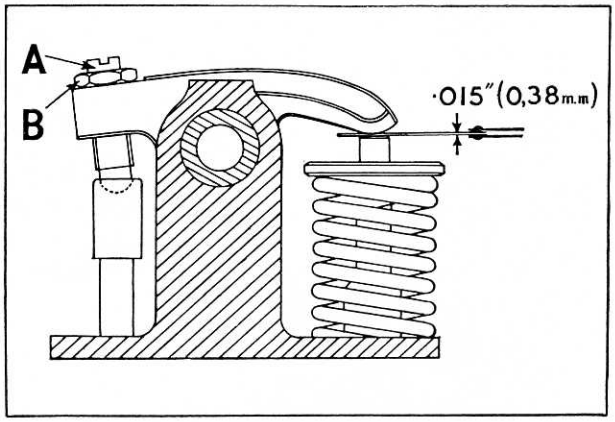


Fig. 2. VALVE CLEARANCE
A. Adjusting Screw B. Lock Nut

The best advice is to note the working conditions, and make a periodic inspection accordingly. If the oil has dirt on its surface or if the sediment in the bowl exceeds $\frac{1}{4}$ in. (6 mm) it should be changed. Should the conditions become more dusty than usual a more frequent inspection should be made. In very adverse conditions which occur overseas, inspection should be made as often as every five working hours.

Particularly bad conditions are those involving grass cutting or seeds which very quickly produce choking of the cleaner, pre-cleaner, and radiator. It is a wise precaution to remove debris from the radiator core periodically. Where the air flow is affected, overheating will occur and the radiator should be cleaned with an air jet from the rear. If this is not available a jet from a hose also from the rear is effective. This should be done while hot so that the water quickly dries off.

Cylinder Head

It is important that the cylinder head bolts are tightened in the sequence shown in Fig. 3, i.e. starting with the centre bolt. It is also important that no one bolt be tightened fully whilst the others are much slacker. It is strongly recommended that when the head has been completely slackened the following procedure be followed. Set the torque wrench to 30 lb ft (4·15 kgm) and tighten all the bolts to this in the correct sequence. Next set the torque wrench to 60 lb ft (8·3 kgm) and tighten to this figure in correct sequence. Finally set to 90 lb ft (12·45 kgm) and repeat. The valve clearances should be reset whenever the cylinder head has been tightened.

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A new gasket should be fitted each time the head has been removed. The correct gasket can be identified by the two extra stud holes which were not featured on earlier series engines. There are now 17 studs instead of 15. The gasket should also be of the cut-away type leaving only narrow sealing bands round combustion chambers, studs, and water passages. The new gasket should be coated both sides with "Wellseal" compound and hung up out of dust and dirt to dry for at least five minutes. After tightening the head, reset the tappets and run up to working temperature and retighten. The head bolts should be checked again after 15 to 20 hours' running.

Rocker Shaft and Rockers

The rocker shaft *could* be removed without removing the cylinder head if the radiator and water pump were first removed. The valve adjusting screws would have to be fully slackened to take all load off the rocker shaft and a suitable threaded tool made to draw the rocker shaft out of the head as access to the rear is not possible in the tractor. However, it is more normal to remove the rockers after the head has been lifted from the tractor.

The rocker shaft is secured by a grub screw in the rear support pillar, but before this is removed, the plug at the rear which forms the oil supply pipe connection should be slackened. After removing the retaining grub screw the shaft can be turned by the centre spill pipe and its locating screw removed.

The shaft may then be tapped forward with a soft drift, taking care not to damage the thread.

If it is expected that any of the rockers will be refitted it is recommended that they be marked before removal so that they can be replaced in the same position.

When fitting new bushes to the rockers ensure that the lubrication hole in the bush coincides with that in the rocker.

Re-assembly. The rockers are of two types left hand and right hand. One of each type is fitted adjacent to each support pedestal so that the tips of the arms operate squarely over the valve stems. The springs should be threaded into position in the same order as removal so that the rockers are pressed against the pedestals.

If the order of the springs has not been noted it should be as follows going by the free length. The $3\frac{1}{2}$ in. (8·7 cm) long springs should be fitted at the ends. The 3 in. (7·6 cm) springs between the end cylinders and the $1\frac{3}{4}$ in. (4·4 cm) springs either side of the centre leak-off elbow.

New washers should be fitted to the end plugs and both tightened evenly so as not to shear the retaining grub screw.

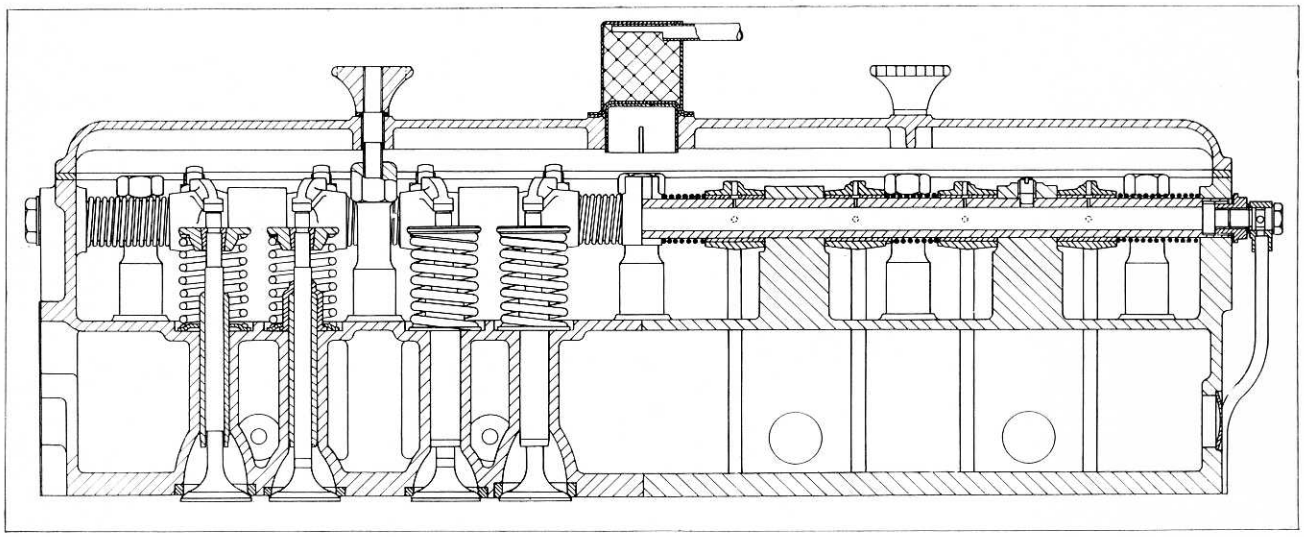


Fig. 4. SECTION THROUGH CYLINDER HEAD AND VALVES

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Valves and Guides

Should a valve spring break because of fatigue, it is recommended that a complete new set be fitted. The cylinder head should be removed. If not already marked, number the valves beginning with the front one, so that they can be replaced in their original positions. Use a valve spring compressor such as David Brown Part No. 900200 to release the cotters.

Some difficulty may be experienced in removing the exhaust valves because of the compacting of the carbon which occurs when the valve is opened beyond its normal working position. This should not be mistaken as meaning that the valve has been sticking in service. When tapping the valve out of the guide take care not to bend the stem or the head. It may be necessary to tap the valve to and fro once or twice to free it. Flushing the soft carbon away with paraffin may also help. When the valve has been removed and wiped dry it will be found to slide freely in the guide.

If there is an excessive amount of clearance between valve and guide the guides should be renewed. Press the old guide out using a suitable tool such as that shown in Fig. 5. The new guide should be fitted with the sharp chamfered edge uppermost. It is important that this edge is not chipped or blunted. The tool shown in Fig. 5 will protect the edge and control the projection to $\frac{3}{4}$ in. (19 mm) at the same time. The guide should be *pressed* in with the aid of this tool. The use of a hammer is not recommended.

If the guide is a slack fit in the head special guides are available 0·005 in. (0·13 mm) larger on the outside diameter which may be fitted instead of the normal replacement. See Parts List.

The valve seats and faces should be examined for pitting or burning. Slightly pitted seats may be relapped in the usual way, checking the final seat with engineer's blue. If too bad for treatment in this way the seat may be recut with a cutting tool and the valve ground on a valve grinding machine to 45°. However, the valve seat should not be greatly in excess of $\frac{1}{16}$ in. (1·6 mm) wide, after which a new insert should be fitted and cut to approx. $\frac{1}{32}$ in. (0·8 mm) wide. Before cutting the seat, the insert should be ground flush with the head face. Care should be taken when removing the old seat not to damage the cylinder head. A sharp blow from a chisel should fracture the seat after which it may be removed. If equipment is available it may be machined out. The new insert should be frozen in solid carbon-dioxide and hammered in immediately with a tool similar to that shown in Fig. 7. Do not touch the ice or cold seat with the bare hand or a blister will result.

Neoprene oil seals are fitted to the inlet valves and these should be examined to see that they are still a good fit on the valve stem and the top edge is sharp and unworn.

Valve guides are identical for inlet and exhaust but the valve stems are slightly different diameters to

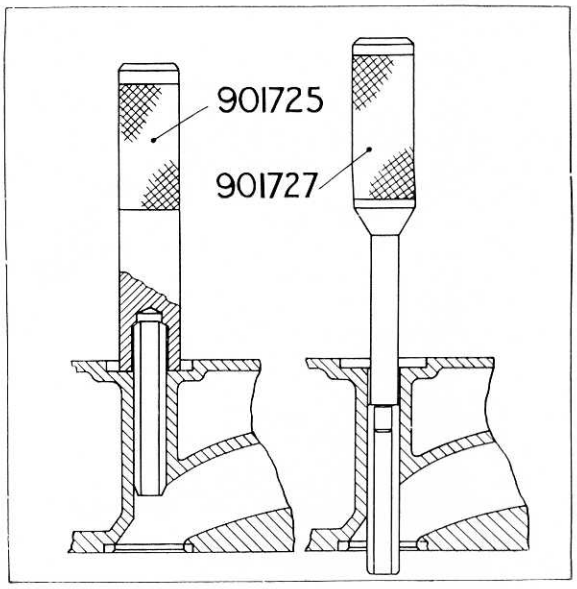


Fig. 5. VALVE GUIDE REMOVING AND INSERTING TOOLS

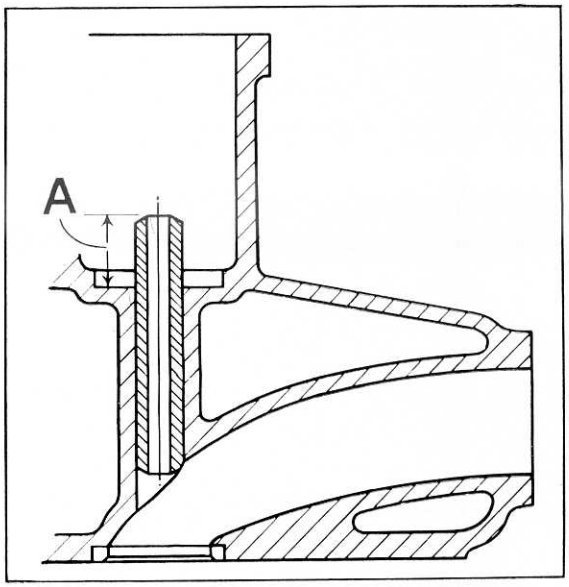


Fig. 6. CYLINDER HEAD AND VALVE GUIDE
Dimension A — $\frac{3}{4}$ in. (19 mm)

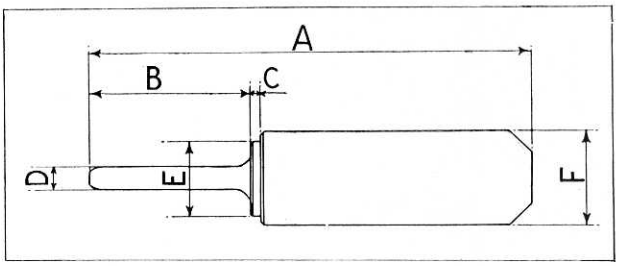


Fig. 7. VALVE SEAT INSERTING TOOL

A. 7 in. (178 mm)
B. $2\frac{5}{8}$ in. (66·6 mm)
C. $\frac{9}{64}$ in. (3·6 mm)
D. 0·3403/0·3383 in. (8·644/8·593 mm) dia.
E. $1\frac{3}{16}$ in. (30·22 mm)
F. $1\frac{1}{2}$ in. (38·1 mm) dia.

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obtain the correct clearances. The exhaust valves are also identifiable by the necked portion just above the head which is provided to obviate valve sticking due to carbon. See Fig. 8.

Water Distribution

The steel water distributor tube which has been a feature of David Brown cylinder heads on all previous models has now been discontinued in favour of cast water passages as shown in Fig. 9, drilled plugs are fitted to direct a jet of water on to the injectors. These are accessible through Welch plugs in the right-hand side of the cylinder head.

Injector Pockets

It will also be seen from Fig. 9 that loose copper sleeves for the injectors have been discontinued. It is therefore necessary to use the copper washer supplied with nozzles otherwise the nozzle tip will project too far into the cylinder and a gas-tight seat will be difficult to achieve. This washer should not be used on previous David Brown diesel engines fitted with the copper sleeve.

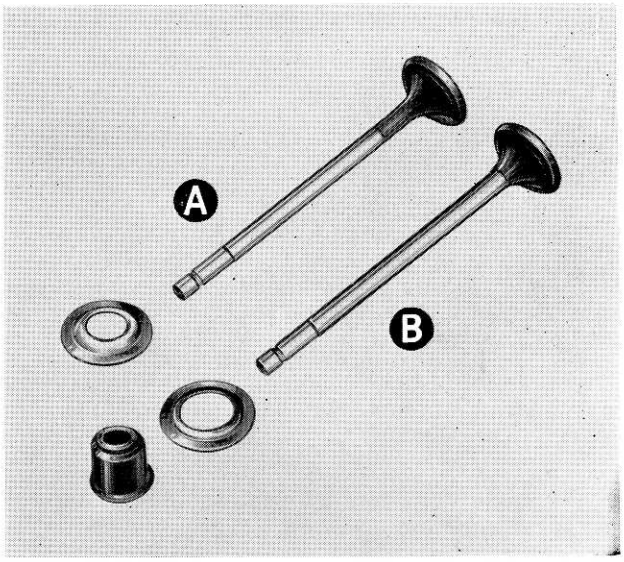


Fig. 8. INLET AND EXHAUST VALVE WITH SEALING CUP
A. " Necked " type Exhaust Valve
B. Inlet Valve and Rubber Seal

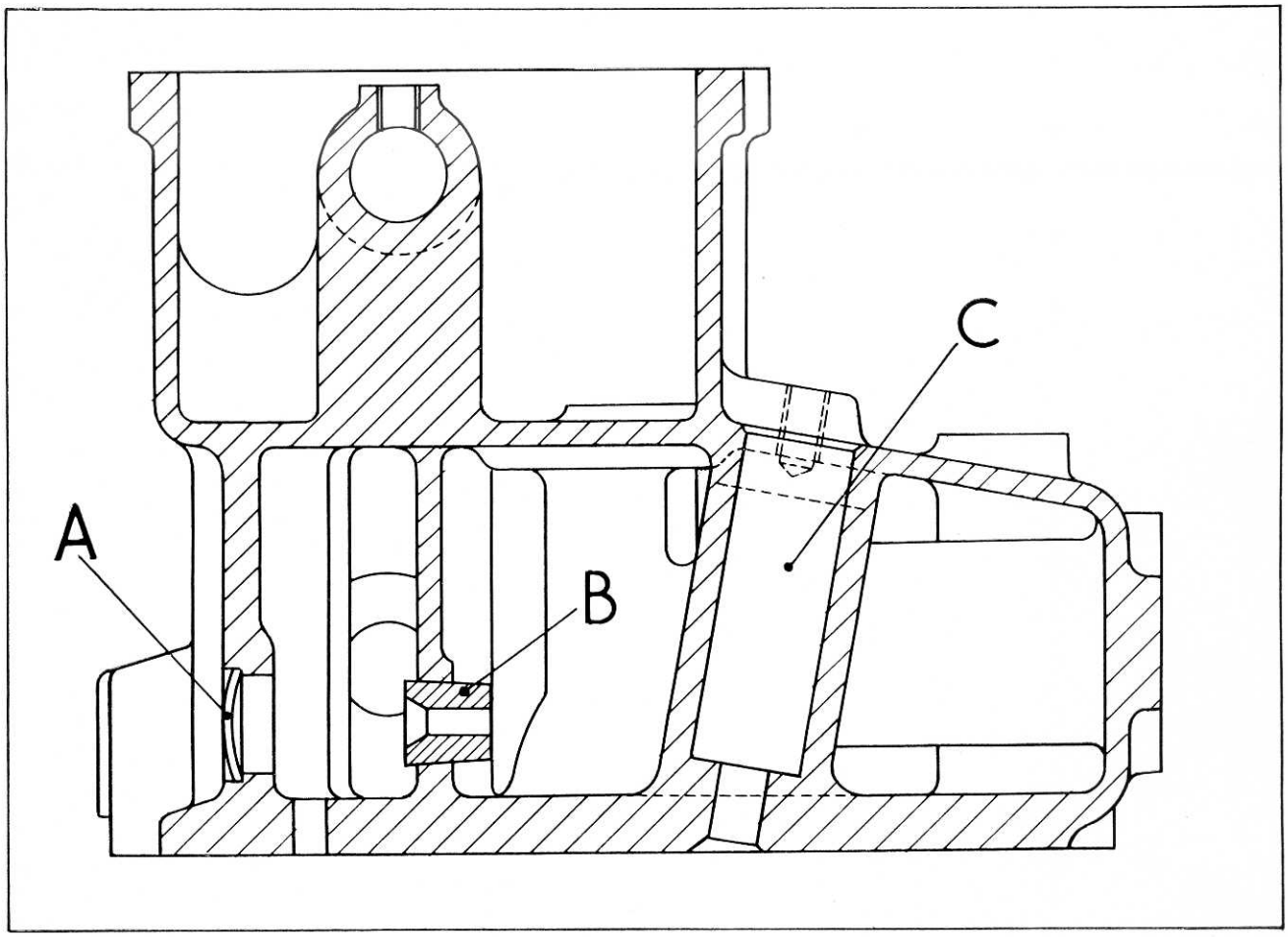


Fig. 9. SECTION THROUGH WATER JET AND INJECTOR POCKET
A. Core Plug B. Water Jet C. Injector Pocket

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Pistons and Connecting Rods

Pistons and connecting rods cannot be removed through the sump with the crankshaft in situ. However, if the cylinder head is removed and the big end bearing caps taken off, the connecting rod and piston can be withdrawn upwards through the bore. Note that the big end nuts are secured with tab washers which should be unbent before trying to slacken the nuts.

It is advisable to number the pistons and connecting rods when removing them so that they can be replaced in the same bore on reassembly.

Reassembly. The connecting rod and cap are machined as a pair and must be kept together. Identification numbers are stamped on the side of the bearing on rod and cap. These should be adjacent when the cap is fitted to the rod and are usually fitted to the camshaft side of the engine.

It is important to fit the piston the correct way round in the bore, i.e. with the recess for the valves towards the right-hand side of the engine, this will be the same side as the identification marks on the rods when assembling the piston to the connecting rod.

The piston should be examined for high spots and wear and if, from its appearance, the connecting rod is suspected of being out of line, the rod should be checked. A B.T.S. connecting rod aligner DB/39/GC251B shown in the Category "B" tool Leaflet 110 is advocated. If necessary straighten, using the twisting and bending tools DB/39/GC251D.

If the bearing surfaces are worn or breaking up, new shells should be fitted. No attempt should be made to take up wear as no provision is made for this. The replaceable type shells are machined to very close limits and must not be filed or scraped.

If bearing failure has taken place due to oil starvation the cause of this must be ascertained and rectified before replacement.

Before reassembly clean all parts, ensure that the oilway is clear of residue, especially metal bits from worn or failed bearings, and examine the crankshaft for scores and wear. Regrind if necessary.

When fitting the shells (see also under "Big End and Main Bearings") make sure that the housing and the back of the shells are perfectly clean. The importance of this is not often realised. A speck of dirt behind the bearing can cause a high spot which may result in failure. Apply a thin film of oil to the connecting rod, fit the shell, apply oil to the bearing surface and also liberally to the piston and rings. Enter the piston and connecting rod assembly from the top of the bore using a piston ring clamp to enter the rings, it is advisable to space the ring gaps round the piston so that no two are near together. Check that the valve recesses in the piston are at the camshaft side of the engine. Fit new tab washers to the big end bolts and tighten to the correct torque (see page 25).

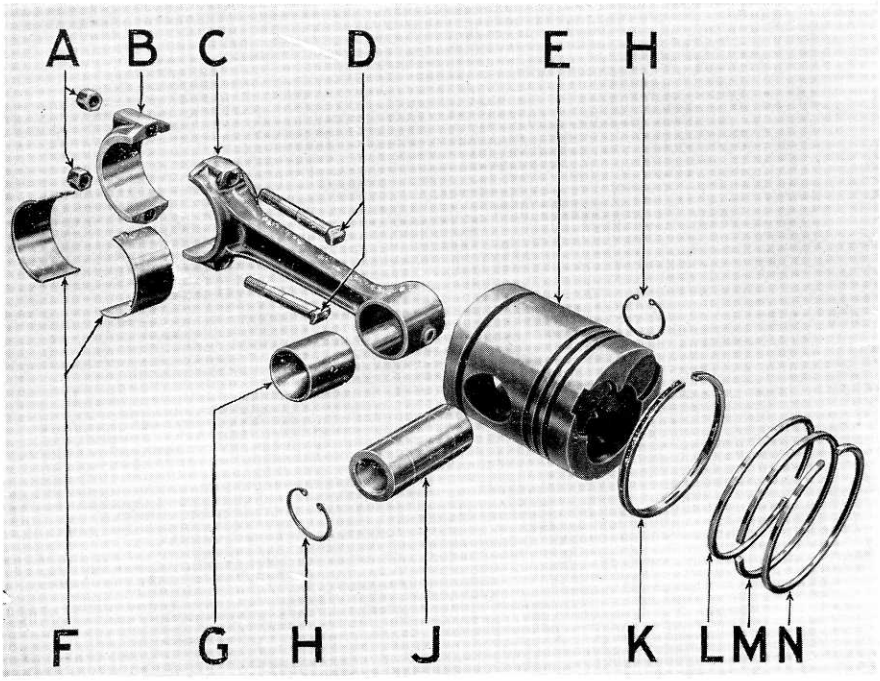


Fig. 10. PISTON AND CONNECTING ROD

A. Bearing Nuts
B. Bearing Cap
C. Connecting Rod
D. Bearing Bolts
E. Piston
F. Bearing Shells
G. Small End Bearing
H. Circlips
J. Gudgeon Pin
K. Oil Control Ring
L. Stepped Compression Ring
M. Stepped Compression Ring
N. Plain Compression Ring

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Detach the Piston from the Connecting Rod

The gudgeon pin is of the fully floating type, being retained by a circlip at each side of the piston. The pin is a push fit in the piston at working temperature and to remove it the piston should be immersed in hot oil. When the piston is removed the small end bush may be examined and renewed if necessary.

Piston Rings

The top ring is a plain compression ring. The next two rings are stepped internally and the cut away portion should be fitted uppermost. (See Fig. 11.) When the ring is compressed to fit in the bore the upper half of it being relieved is weaker and tends to take up a slightly smaller diameter than the lower half. The contact pressure on the cylinder wall is therefore concentrated at the bottom edge of the ring, this has the effect of helping to scrape the oil down the bore as the piston descends. The bottom ring, below the gudgeon pin, is a full scraper ring being slotted, and the piston is drilled behind the ring to allow the oil to drain back to the sump.

The ring gaps, clearances, and so forth are given in the table at the end of this section. The method of checking the ring gaps and ring clearances are shown in Figs. 12 and 13 respectively. If the ring gap exceeds 0·020 in. (0·5 mm) it is suggested that the bores be checked and if the wear at the highest point of travel of the top ring exceeds 0·005 in. (0·127 mm) new liners, pistons and rings should be fitted. If the bores are in good condition and little worn, a new set of piston rings should suffice. However, the real criterion of when an engine requires new rings is the oil consumption. If oil consumption is low it is preferable if at all possible to leave pistons and rings undisturbed.

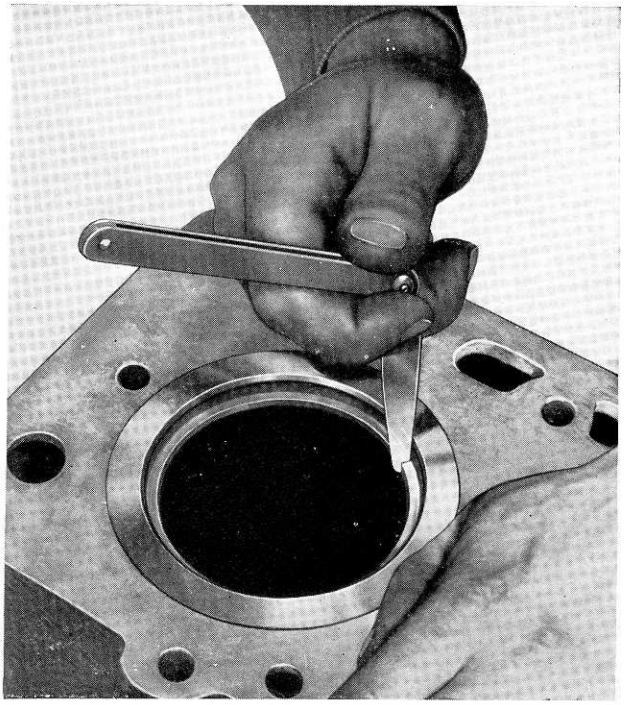


Fig. 12. PISTON RING GAP CLEARANCE

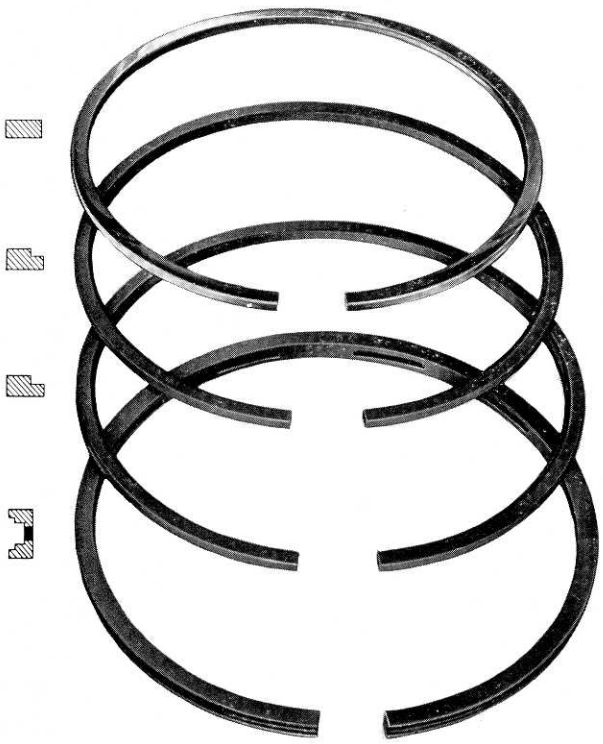


Fig. 11. PISTON RINGS AND CROSS SECTIONS



Fig. 13. PISTON RING GROOVE CLEARANCE
0·0015 in. to 0·0035 in.

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Big End and Main Bearings

Earlier engines were fitted with steel-backed copper lead bearing shells. Whilst these were able to stand the necessary load they had the disadvantage of wearing the crankshaft, thus necessitating a hardened shaft. In addition to the cost of having the crankshaft hardened, this reduced the fatigue life of the shaft. Recent developments in the process of applying reticular aluminium tin compounds on a steel backing, have brought an improvement in bearing conditions. These bearings are capable of carrying high loads with reduced shaft wear. It is therefore practical to use an unhardened crankshaft and therefore with the introduction of the AD4/40 engine the crankshaft is identical with the kerosene and gasoline engine crankshafts. It is therefore vitally important that the correct bearings are used in this engine. The big end has two aluminium tin bearing shells and the main bearings have one white metal shell in the cylinder block half and one aluminium tin bearing in the cap half. The bearing shell part numbers quoted in the Parts List are also stamped on the back of each half bearing shell.

Undersize bearing shells are available to suit re-ground crankshafts, see Parts List for details.

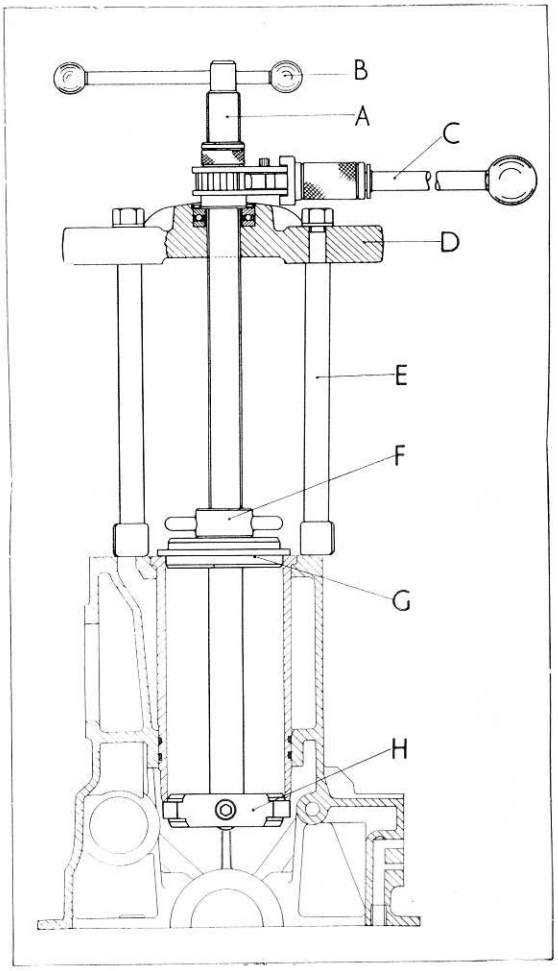


Fig. 14. CYLINDER LINER REMOVER

Cylinder Sleeves

To gain access remove the cylinder head, pistons and connecting rods.

Insert the cylinder liner remover Part No. 901729, Tool Leaflet 119, as follows. With the tool assembled as shown in Fig. 14 lower end H down the bore and manipulate so that it locates in the end of the sleeve with the $3\frac{5}{8}$ in. side uppermost. Hold H in position and slip the centralizer pad G into place the correct side downwards for $3\frac{5}{8}$ in. bore sleeves. Tighten the butterfly nut F to secure the liner between G and H. Lower the bridge piece D so that the side rods and feet E come into contact with the cylinder block. Run the ratchet handle C down by the knurled nut until it contacts D. Set the ratchet for tightening and holding handle B, tighten C to extract the cylinder liner. After the first inch or so has been withdrawn it should be possible to lift the liner out quite easily.

After removing the sleeve, clean all traces of deposit from the upper and lower cylinder lands. If the crankshaft has been left in situ it will be necessary to carefully clean off any dirt which falls on to it.

Replacement. New rubber sealing rings and copper sealing washers should always be used. The copper sealing washers are available in three thicknesses, 0·015 in., 0·017 in. and 0·020 in. (0·38 mm, 0·432 mm, and 0·508 mm). The thickness of washer should be chosen to give a sleeve protrusion above the top face of the cylinder block ignoring the ridge on the sleeve of 0·003 to 0·005 in. (0·076 to 0·127 mm). This is done by measuring the dimensions A and B, Fig. 15, for each sleeve and block recess and referring to the chart on page 27 for the correct sealing washer.

Fit the selected copper washer and the new rubber sealing rings to the liner, and apply an even coating of Pressoline No. 2 (Part No. 900185 for 1 lb tin), one part Pressoline to three parts water.

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Push the sleeve into the block as far as possible by hand. Make sure that the flats are correctly positioned. Fit the cylinder liner protrusion checking tool Part No. 902169 (Tool Leaflet 123) as follows:

Locate the replacing pad E, Fig. 16, in the bore of the sleeve with the two flats parallel to the flats on the liner. Two spigot diameters are provided on this pad, one each side marked with the appropriate bore diameter. Ensure that the correct side is used otherwise damage will occur to the ridge on the liner top.

Fit the three distance pieces A, two over the studs and the other in position to use bolt G supplied with the tool. Place the press body D over the studs, turn the centre screw down until the ball in the end rests in the centre dimple of the pad E. The body will then be centralized and can be secured using the three washers H and the two nuts B and bolt G. The counter bore in the nuts should be downwards.

Turn the centre screw and press the liner into the block until it is nearly in its final position. Place the socket F on the centre screw and apply a torque of 140 lb ft (19·4 kgm). This will give a total pressure of 2 tons.

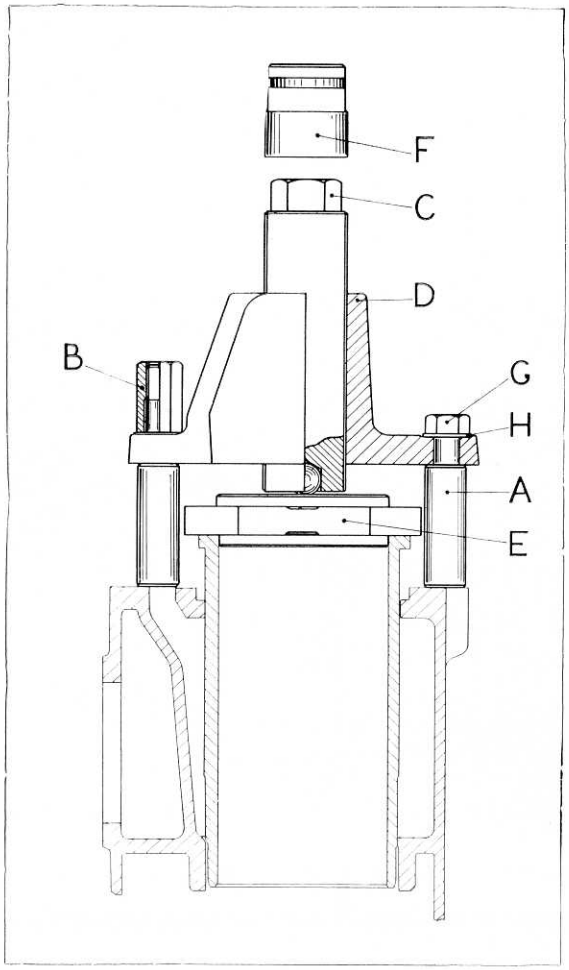


Fig. 16. LINER PRESS AND PROTRUSION CHECKING TOOL

A. Distance Pieces
B. Special Nuts
C. Centre Screw
D. Press Body
E. Replacer Pad
F. Socket
G. 4 in. Bolt
H. Washers

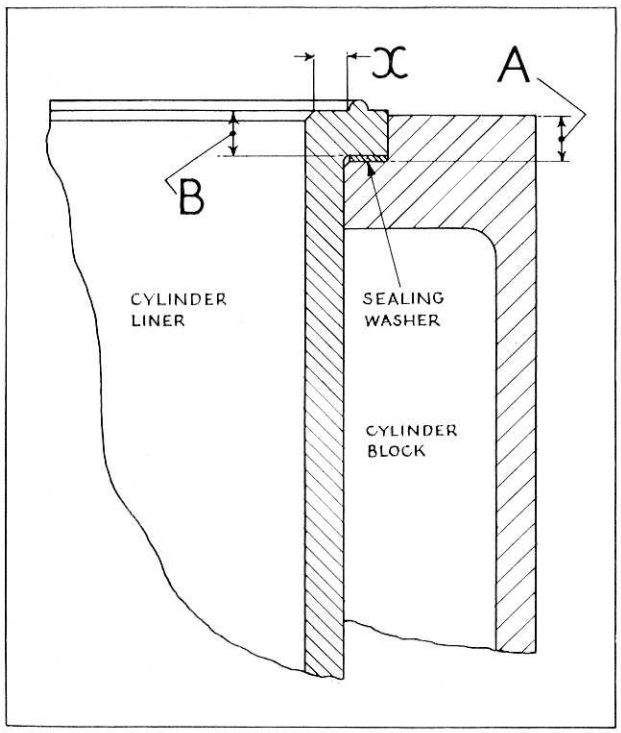


Fig. 15. MEASURING LINER PROTRUSION
(See table on page 27)

The protrusion should then be measured with feelers under the edge of the replacing pad E or by means of a dial gauge on top of the liner in the positions provided by the pad E. Measurements should be taken on two opposite sides. If the position is not between the correct limits the liner should be removed and a different thickness of sealing washer fitted as required.

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Timing Case

It is possible to remove the timing case cover with the engine in the tractor, but the camshaft could not be withdrawn unless the radiator is removed or the engine taken out of the tractor.

Before slackening the timing case cover unscrew the crankshaft nut and remove the pulley after slackening the dynamo and removing the drive belt. Remove the Woodruff Key. Remove the bolts securing the cover to the back plate. Withdraw the cover from the two dowels.

The crankshaft oil seal may be examined and if necessary extracted from the timing case. The oil scroll in the cover just behind the oil seal should be examined and the position of the oil flinger on the crankshaft should be checked.

Replacement. The intermediate timing gears run on a shaft, the front end of which is supported in a housing on the timing case cover. It is important that the dowels are correctly fitted in the back plate in order to locate the cover so that it centralizes over the crankshaft and intermediate gear shaft. When removing the crankcase cover there is no need to disturb the housing which supports the intermediate shaft. This housing, however, controls the end-float of the gears by the alternative thickness of shims under its flange. (For adjustment see **Intermediate Gear**.)

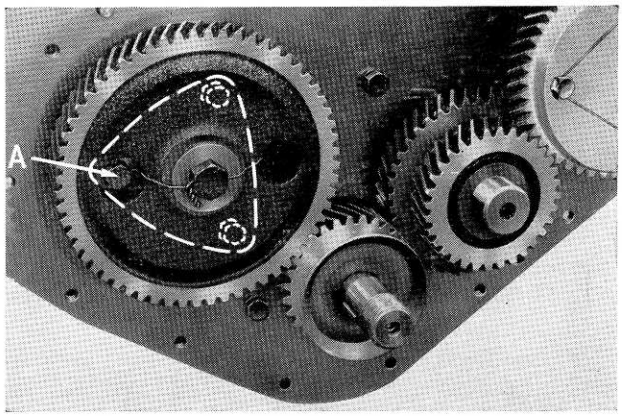


Fig. 17. TIMING GEARS
A. Camshaft Securing Nut

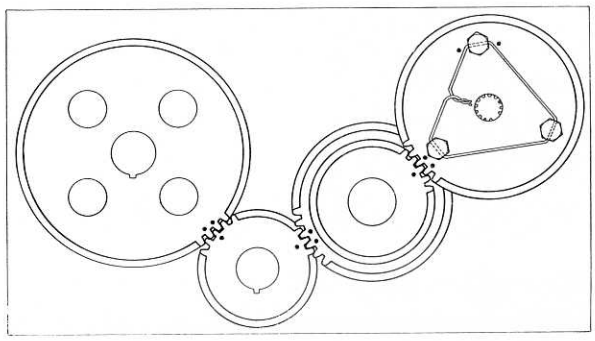


Fig. 18. TIMING MARKS

Camshaft

Remove the timing case cover, push rods and tappets and the lubricating oil pump.

Remove the locking wire and the end bolt and washer securing the gear. Draw the gear off the shaft. The thrust washer may then be examined. Remove the three set screws which secure the triangular retaining plate to the timing back plate. The camshaft may now be withdrawn from the block.

Examine the thrust washer and the retaining plate for wear. If the camshaft end-float exceeds 0·020 in. (0·51 mm) these components should be renewed.

Replacement. Care should be taken when fitting the thrust washer to make sure that it is the correct way round as shown in Fig. 19. It will also be necessary to time the engine. The crankshaft should be put in the top dead centre position No. 1 cylinder firing. The key in the crankshaft will then be vertically downwards and the timing centre punch marks on the intermediate gear and fuel pump drive gear should coincide. The camshaft should be turned so that its key is vertically downwards also and the gear then fitted so that its timing marks fall either side of the corresponding mark on the crankshaft gear. See Fig. 18.

Intermediate Gear

A section through the gear and support is shown in Fig. 20. This makes it clear how the oil is fed from the main oil gallery to the gear bearing surfaces. Before the intermediate gear can be removed the fuel pump drive gear must first be removed.

The end-float of the gear is adjusted by shims under the flange of the support in the timing case cover. If a new gear has been fitted, or if excessive end-float is suspected the following procedure should be followed

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to determine the correct thickness of shims to use. With the gear in position and the timing case cover fitted, remove the shaft support cap B and refit without the shim washers. Measure the clearance between the cap and timing case cover with feeler gauges and then fit shims to a thickness of 0·002 to 0·003 in. (0·050 to 0·076 mm) greater than this.

The support shaft may be removed for renewal when worn or if it is necessary to remove the timing case back plate. Slacken the grub screw A which serves to locate the shaft in the correct position for the oil supply holes and to prevent it turning in use. The shaft may be tapped forward using a soft drift through the crankcase.

Fuel Injection Pump Gear

Fig. 21 shows a section through the injection pump drive gear and its support bearings and bracket. The gear, bearings and support bracket should be removed as an assembly from the back plate. The gear and bearings may then be dismantled if necessary on the work-bench.

Firstly remove the injection pump as described under the appropriate heading. The gear assembly is then free and may be pulled forward off the mounting plate.

To remove the gear from the angle contact races, remove the circlip A and draw the gear off. The front race may remain on the shaft or in the gear. It can be drawn off the shaft and after removing circlips B the rear race may be drawn off the shaft. If the front race remains in the gear the front retaining plate C and drive plate D must be removed and the race tapped out of the gear. Before removing the drive plate ensure that the timing punches are visible so that it can be refitted in the same position.

Replacement. Fit the rear race in the gear and secure with circlip A. Next fit over the shaft and fit circlips B. Finally fit the front race. Ensure that the inner tracks are hard up against the circlips B by levering the gear forward and tapping the inner track of the front race backwards. Alternatively tighten up the end plate D without shims. Refit the drive plate and end plate with the centre punch marks in line with sufficient shims at E to give an end-float of 0·001 in. (0·025 mm) to 0·001 in. (0·025 mm) pre-load. This can be done by fitting excess shims and taking one out at a time until the end float is not more than 0·001 in. (0·025 mm) and yet the gear turns freely.

The assembly should be offered up to the back plate with the engine on top dead centre No. 1 cylinder firing and the timing marks on the gears all in mesh. See Fig. 18. The injection pump should then be replaced as described under D.P.A. Injection Pump, page 23.

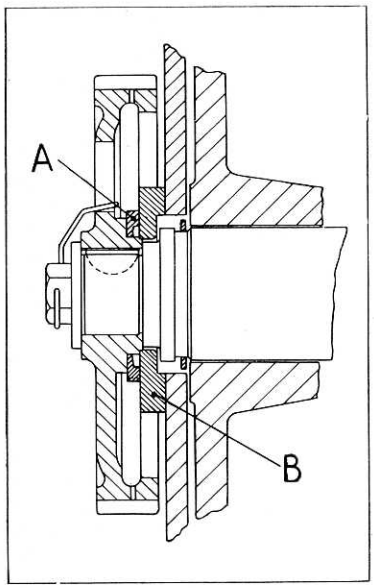


Fig. 19. SECTION OF CAMSHAFT GEAR
A. Camshaft Thrust Washer
B. Camshaft Thrust Plate

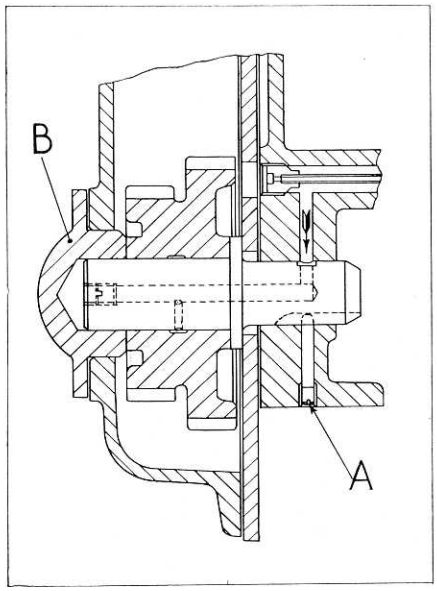


Fig. 20. SECTION OF INTERMEDIATE GEAR
A. Locating Dowel
B. Shaft Support Cap

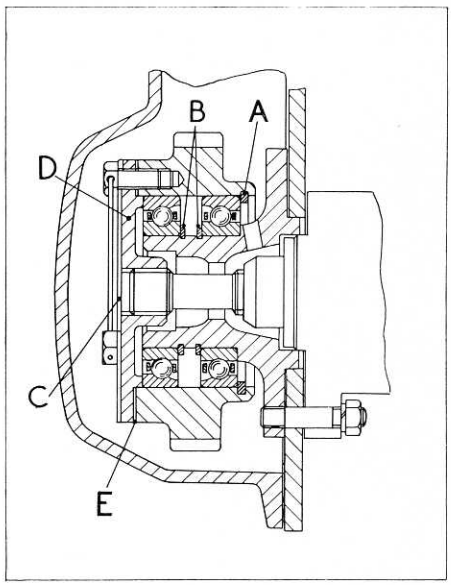


Fig. 21. SECTION OF FUEL INJECTION PUMP GEAR
A. Circlip
B. Circlips
C. Retaining Plate
D. Drive Plate
E. Shims

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LUBRICATION SYSTEM

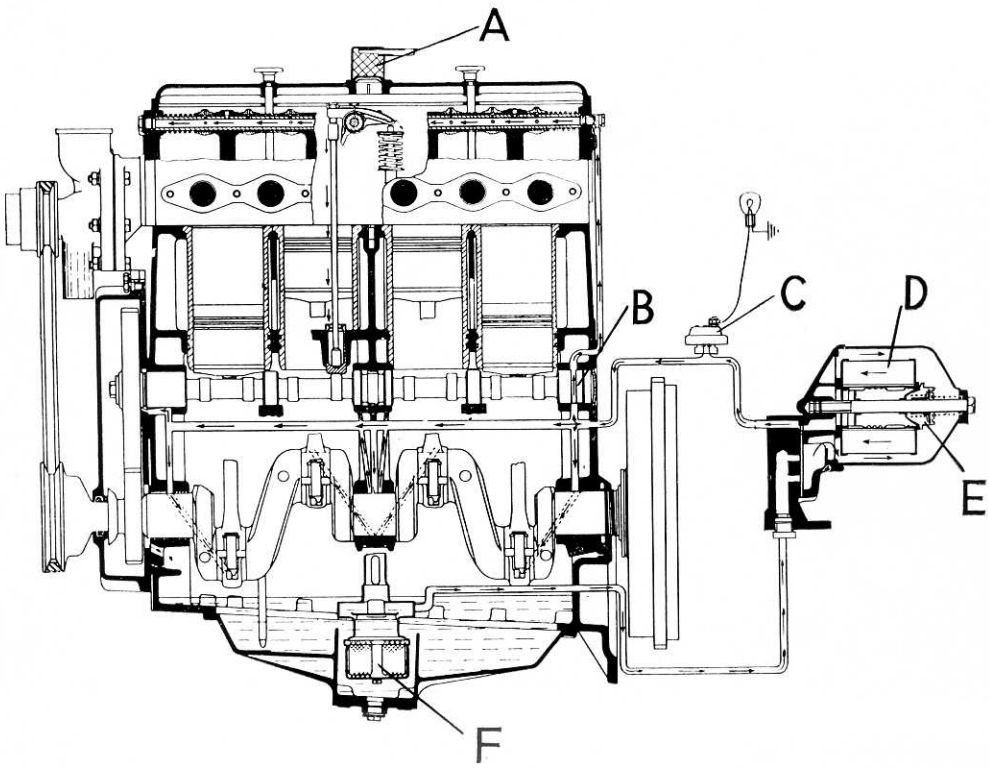


Fig. 22. DIAGRAM OF THE LUBRICATION SYSTEM

A. Breather
B. Intermittent Rocker Supply through Camshaft
C. Oil Pressure Unit
D. Oil Filter Element
E. By-pass Relief Valve
F. Oil Pump

Description

The lubrication system is shown in Fig. 22 from which it can be seen that the full flow from the pump is filtered except when the pressure drop across the filter exceeds 10 lb/in². Above this pressure unfiltered oil is progressively by-passed around the filter element to prevent the bearings being starved of oil. The importance of renewing the oil filter element at the recommended periods cannot therefore be emphasised too greatly.

The oil to the rockers is metered by passing through a hole drilled through the rear bearing of the camshaft as shown in Fig. 24. Because the hole is drilled to one side of the diameter it lines up only once each revolution of the camshaft.

The oil pump is totally submerged and contains its own relief valve.

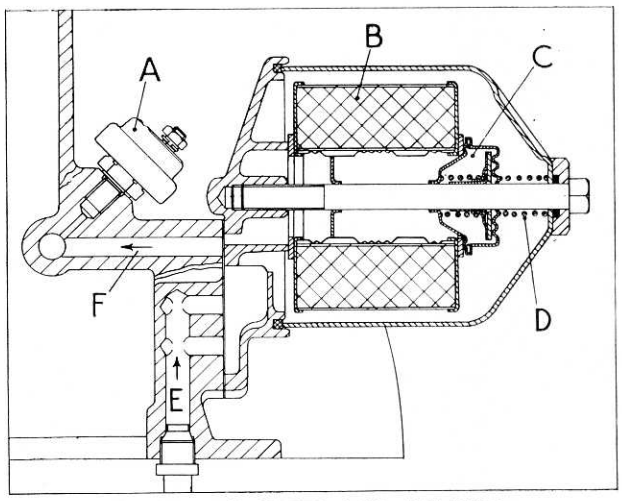


Fig. 23. OIL FILTER AND HOUSING

A. Pressure Unit
B. Filter Element (Paper)
C. By-Pass Valve Unit
D. Retaining Spring
E. Oil Supply from Pump
F. Oil Supply to the Gallery

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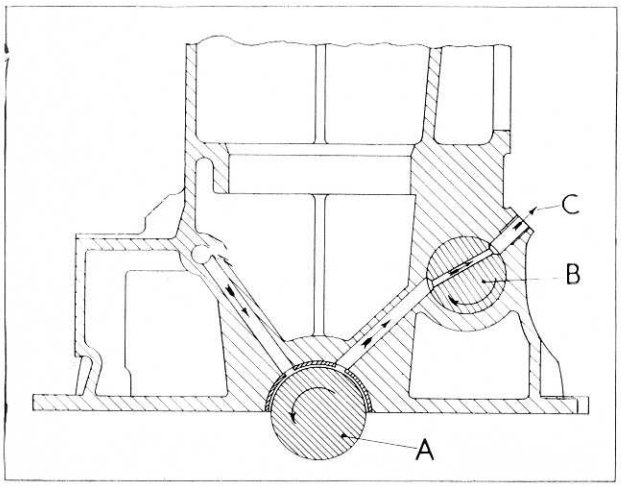


Fig. 24. ROCKER SHAFT OIL SUPPLY
A. Camshaft Rear Journal
B. Camshaft
C. Oil Supply to Rockers

On early engines the oil filter is mounted on a separate head bolted on to the side of the cylinder block but on later engines the filter mounting is cast integrally with the block and a separate mounting head is not therefore required.

Caution

If the oil filter mounting head is removed from the cylinder block ensure that when the filter-to-block gasket is replaced it is fitted so that the holes in the gasket are opposite the oil passages in the block. Otherwise the oil flow into the main gallery will be blanked off and the engine starved of oil.

Oil Pump

The hour counter or Tractormeter (whichever is fitted) is driven from the oil pump shaft and must be removed before the oil pump. This can be lifted out together with the drive spindle after releasing the retaining bolt A, Fig. 25.

Drain the sump and remove the cover, then remove the pipe from the pump and crankcase.

Slacken the locknut and unscrew the locating screw B, Fig. 27. Support the pump whilst doing this and withdraw the pump downwards when the screw is clear.

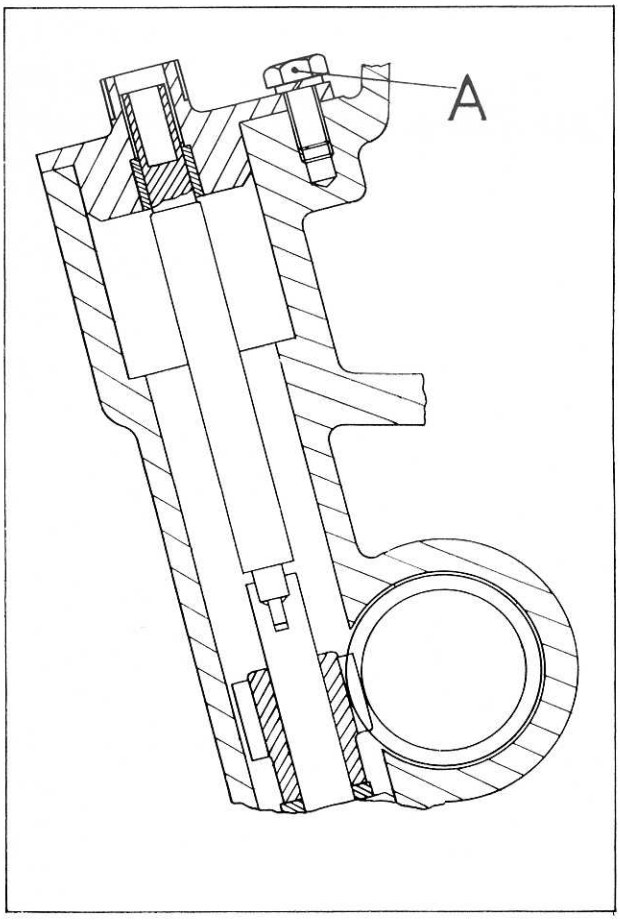


Fig. 25. TRACTORMETER DRIVE
A. Retaining Bolt

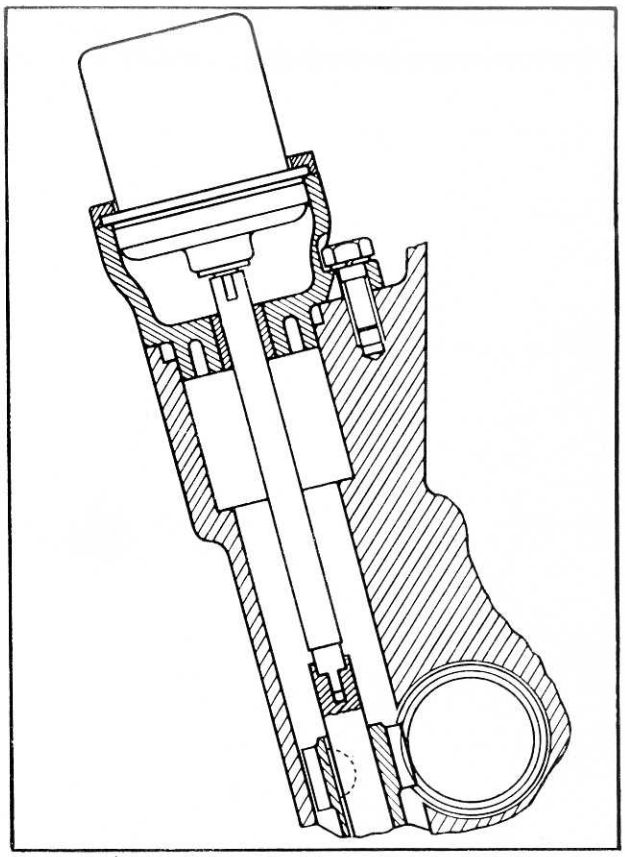


Fig. 26. ENGINE HOUR COUNTER

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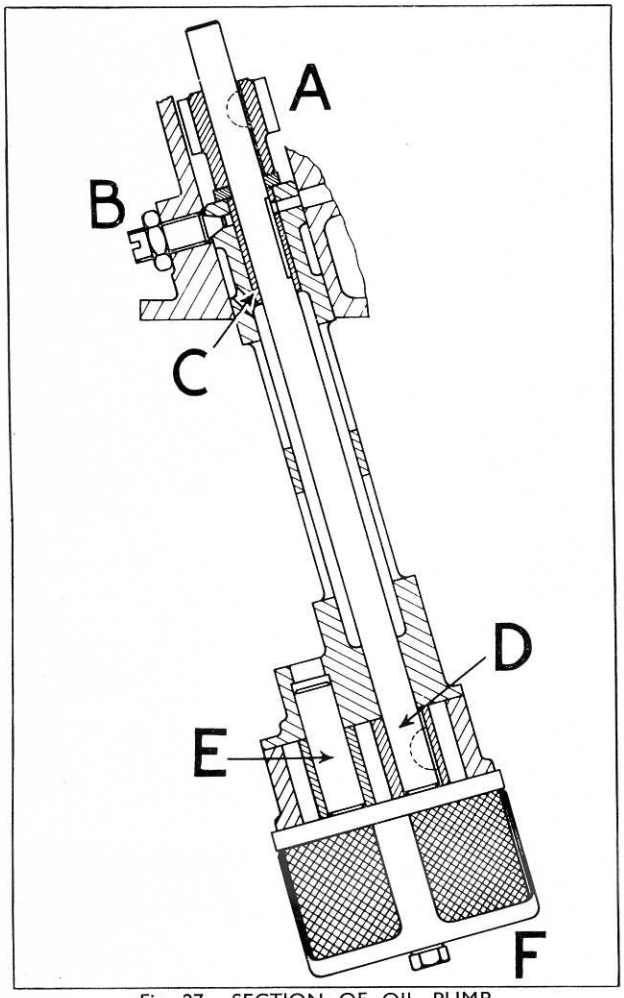


Fig. 27. SECTION OF OIL PUMP

A. Pump Gear
B. Dowel Screw
C. Upper Bearing
D. Drive Shaft
E. Fixed Shaft
F. Gauze Screen

If it is required to dismantle the pump, proceed as follows, referring to Fig. 28.

Remove the strainer C after taking out the securing screw B. The spiral drive gear may be drawn off with David Brown tool No. 900204 using the thrust pad and adaptor (see Tool Leaflet 103). Remove the Woodruff key and thrust washer.

Mark the pump top L, the pump body I and the base plate H in some way so that they can be replaced the same way round. Remove the four fitted bolts G, the base plate, gear J and gear Q with its drive shaft N. The gear may then be pressed off the shaft and the Woodruff key removed.

Reassembly. Examine the drive shaft top bearing and renew if worn using David Brown Tool No. 901701. To remove the bush refer to Fig. 29. Slip B through the slot in the pump bracket to locate in the bush. Stand the pump bracket on a hollow anvil or press base. Using drift A, drive or press the bush out.

To replace the new bush place the new bush on C and push the centralizer D over C and the new bush until the oil hole in the bush just shows at the bottom edge of the centralizer.

Start to press the new bush into the pump bracket ensuring that the oil hole is in line with the oil hole in the bracket. Slide the centralizer into contact with the pump bracket. Stand the pump bracket on a flat anvil or press base. Drive or press C until it butts firmly against D. After fitting the bush, the oil groove on top of the bracket face should be continued across the end of the bush with a file.

The driven gear shaft, if worn, can be removed with drift A in the direction of the arrow E in Fig. 29.

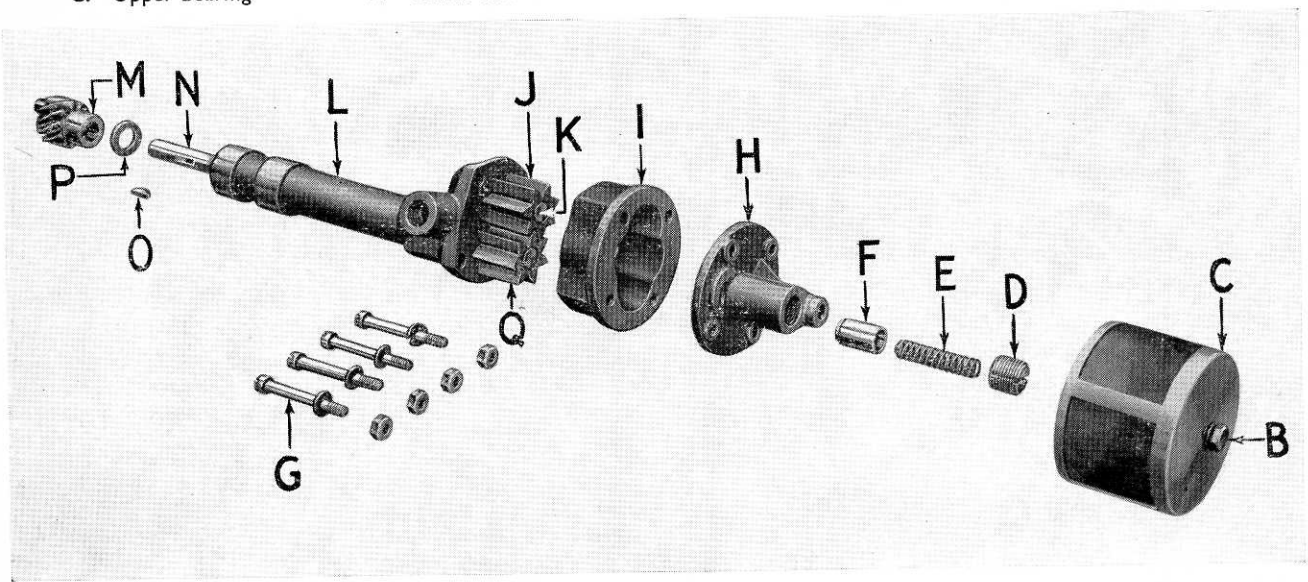


Fig. 28. OIL PUMP COMPONENTS

B. Bolt, Pump Filter
C. Strainer
D. Relief Valve Screw
E. Relief Valve Spring
F. Relief Valve Plunger
G. Dowel Bolts (Pump Body)
H. Base Plate
J. Driven Rotor
I. Pump Body
K. Rotor Spindle
L. Pump Top
M. Skew Gear
N. Drive Shaft
O. Dowel Screw
P. Thrust Washer
Q. Driving Rotor

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The pumping gears, if worn, should be replaced only in pairs. After assembling the pump check the drive shaft end-float. This should be a minimum without the gears binding. If the end-float is not sufficient to allow the gears to turn smoothly, adjustment should be made with paper packings between the body and the pump bracket. These are available as Part No. 12053.

Fig. 30 shows a section through the oil relief valve. The position of the pressure adjusting screw E should be noted before dismantling so that it can be replaced at the same setting. If a test rig is available this is the best way of setting the relief pressure. The test fluid should be Shell Fortisol 5W used at a room temperature of 20°C (68°F) giving a viscosity of 188 Redwood seconds. This is equivalent to Shell Rotella 20/20W oil at 46°C (115°F). Using an adjustable needle valve and pressure gauge in the delivery pipe the relief valve should be adjusted to open at 50 lb/in² (3·5 kg/cm²). Some means of driving the pump at between 350-780 rev/min should be satisfactory for this test. Below 50 lb/in² the valve should not leak and may be lightly lapped on to its seat if necessary to ensure this.

If a test rig is not available the valve should be set in approximately the same position as originally and the pump refitted to the engine.

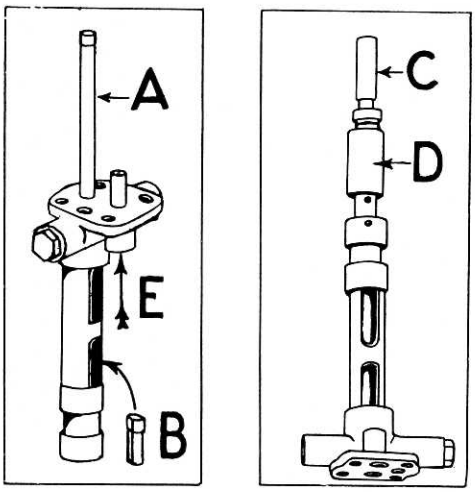


Fig. 29. PUMP BUSH REPLACEMENT
A. Long Drift
B. Pilot Bush
C. Replacer Drift
D. Centralizer Guide
E. Driven Rotor Shaft Removal

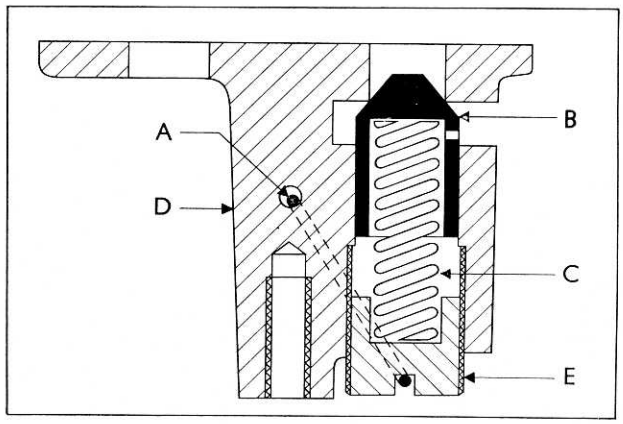


Fig. 30. OIL RELIEF VALVE
A. Lockwire
B. Valve
C. Spring
D. Base Plate
E. Adjusting Screw

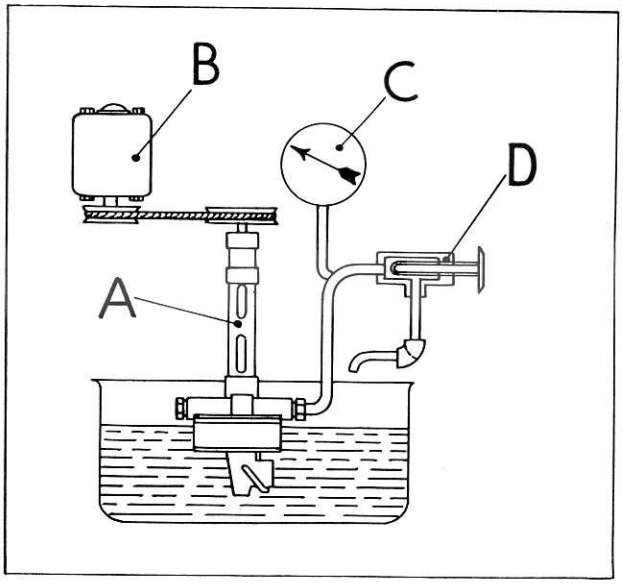


Fig. 31. OIL PUMP TEST RIG
A. Oil Pump
B. Drive Motor
C. Pressure Gauge
D. Outlet Restricting Valve

The oil pressure switch should be removed and an oil pressure gauge fitted in its place. When the oil is cold, 5-15°C (40-60°F) and the engine is run at 1 850 rev/min the oil pressure should not exceed 80 lb/in² (5·6 kg/cm²). When the oil is hot an oil pressure of 35-65 lb/in² (2·5-4·5 kg/cm²) should be obtained at working engine speeds. If these conditions are not fulfilled the sump should be removed and the pump adjusted. One complete turn of the valve makes a difference of approximately 4 lb/in² (0·28 kg/cm²).

After fitting the valve, fit the locking wire in the slot in the valve adjusting screw and through the hole in the base plate. Fit the gauze screen, renewing it if it is broken or damaged.

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COOLING SYSTEM

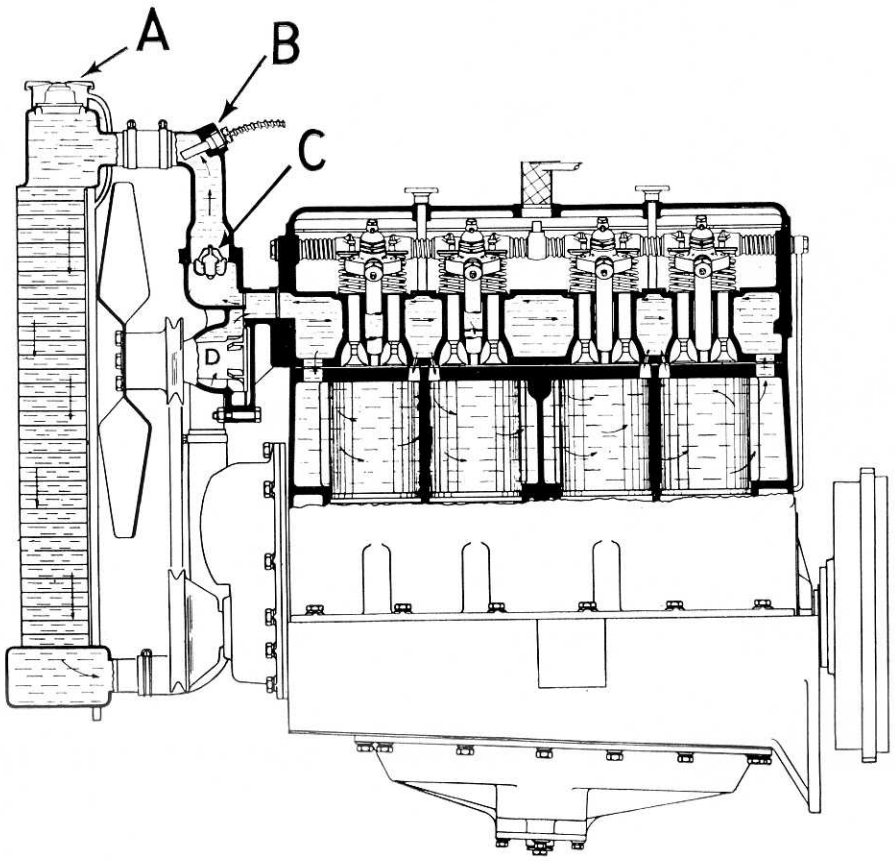


Fig. 32. DIAGRAM OF THE COOLING SYSTEM
A. Pressure Cap B. Thermometer Phial C. Thermostat

Description

Fig. 32 is a section of the engine showing the cooling system. It can be seen from this that water is pumped from the bottom of the radiator to a cast passage in the head which direct jets of cool water on to the injector bosses. From the head the water is pumped over a restriction type thermostat to the top of the radiator for re-cooling. Communicating passages allow water from the head to pass into the cylinder block and adequate cooling of the liners occurs by thermosyphon action. The system is pressurised by a spring-loaded capsule in the radiator filler cap which allows steam to escape through the overflow pipe when the pressure exceeds 4 lb/in² (0·28 kg/cm²).

Cooling air is drawn through the radiator by a two-bladed fan mounted on the same spindle as the water pump impellor. This is V-belt driven from the crankshaft at one and a half times engine speed.

Water Pump

The water pump may be removed without disturbing the radiator provided that the fan blades are first removed. Mark the blades and the pulley hub so that they may be refitted in the same position, and the correct way round, because the two are balanced during manufacture. Remove the four bolts on the front of the pulley hub and remove the blades.

Slacken the fan and dynamo belt adjustment and remove the fan belt. Remove the thermometer bulb (if fitted) from the water-pump housing. Slacken the clips at the inlet and outlet connections.

Remove the four bolts securing the water pump to the cylinder head. The gasket should always be renewed before replacing the pump.

Fitting a New Seal or Bearing. Remove the two bolts securing the backplate to the pump and remove

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the backplate and gasket. Using David Brown Tool Part No. 19899 withdraw the pulley from the spindle.

Remove the dowel screw B, Fig. 33, locating the spindle bearing. Place the pump, with suitable packing and the impeller facing uppermost, on the bed of a press. Carefully press the spindle and bearing assembly out, taking care not to damage the impeller or the pump housing.

When the spindle and bearing assembly is removed, the impeller may be lifted out and the seal prised out of the end of the impeller. If the seal is fit to be used again, it is advisable to leave it in situ as it is inevitable that it would be damaged trying to remove it. The seal is supplied as a self-contained assembly and no attempt should be made to dismantle it. A new seal should be carefully pressed into the rotor bore using a little Pressoline No. 2 compound (one part Pressoline to three parts water). Care should be taken not to cut or damage the seal and pressing should not be continued after its shoulder is up against the end of the rotor. The internal bore of the rotor should have a $\frac{1}{32}$in. (0·79 mm) chamfer at 45°. Engines made before April, 1959, do not incorporate this chamfer. If one of these is encountered the chamfer should be machined. Bulletin No. 524 gives details of this.

Reassembly. When fitting the spindle and bearing assembly ensure that the locating screw aligns with the hole in the bearing shell and is correctly fitted. The fan pulley and the pump impeller should be pressed on to the spindle, so that the ends of the spindle are flush with the ends of the appropriate bores in the pulley and impeller as shown at X in Fig. 33.

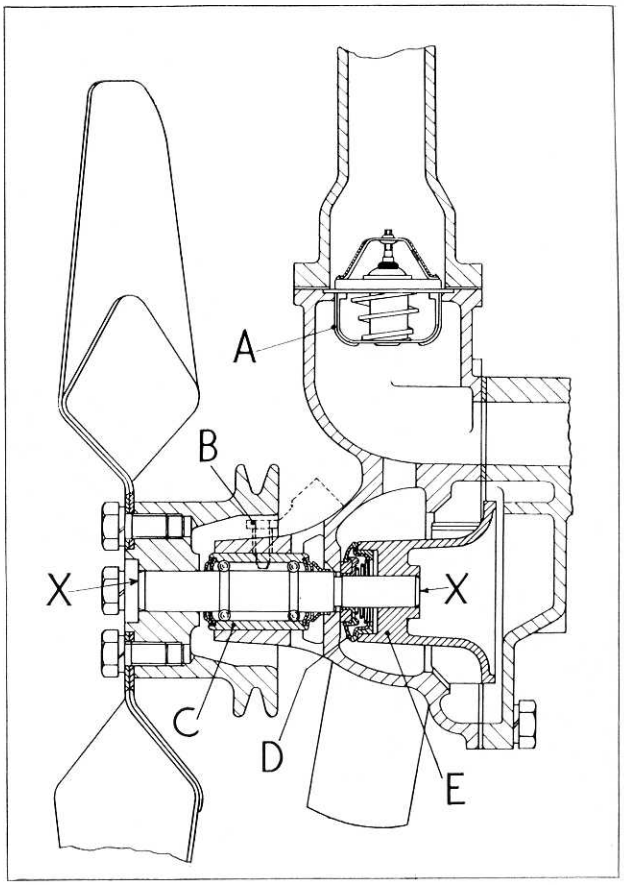


Fig. 33. SECTION OF WATER PUMP

A. Thermostat
B. Bearing Retaining Screw
C. Bearing
D. Gland Seal
E. Pump Impeller
X. Alignment faces of Impeller and Fan Pulley

Thermostat

The thermostat should be tested in hot water to ascertain that it opens correctly. If possible the thermostat should be immersed in cold water together with an accurate thermometer and the temperature gradually increased. The temperature at which the valve commences to open and also at which it is fully open should be noted. The valve should start to open at 174-183°F (79-84°C) and at 200°F (94°C) should be fully open. The thermostat is marked with its commence to open temperature, i.e. 180, on the base of the capsule.

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FUEL SYSTEM

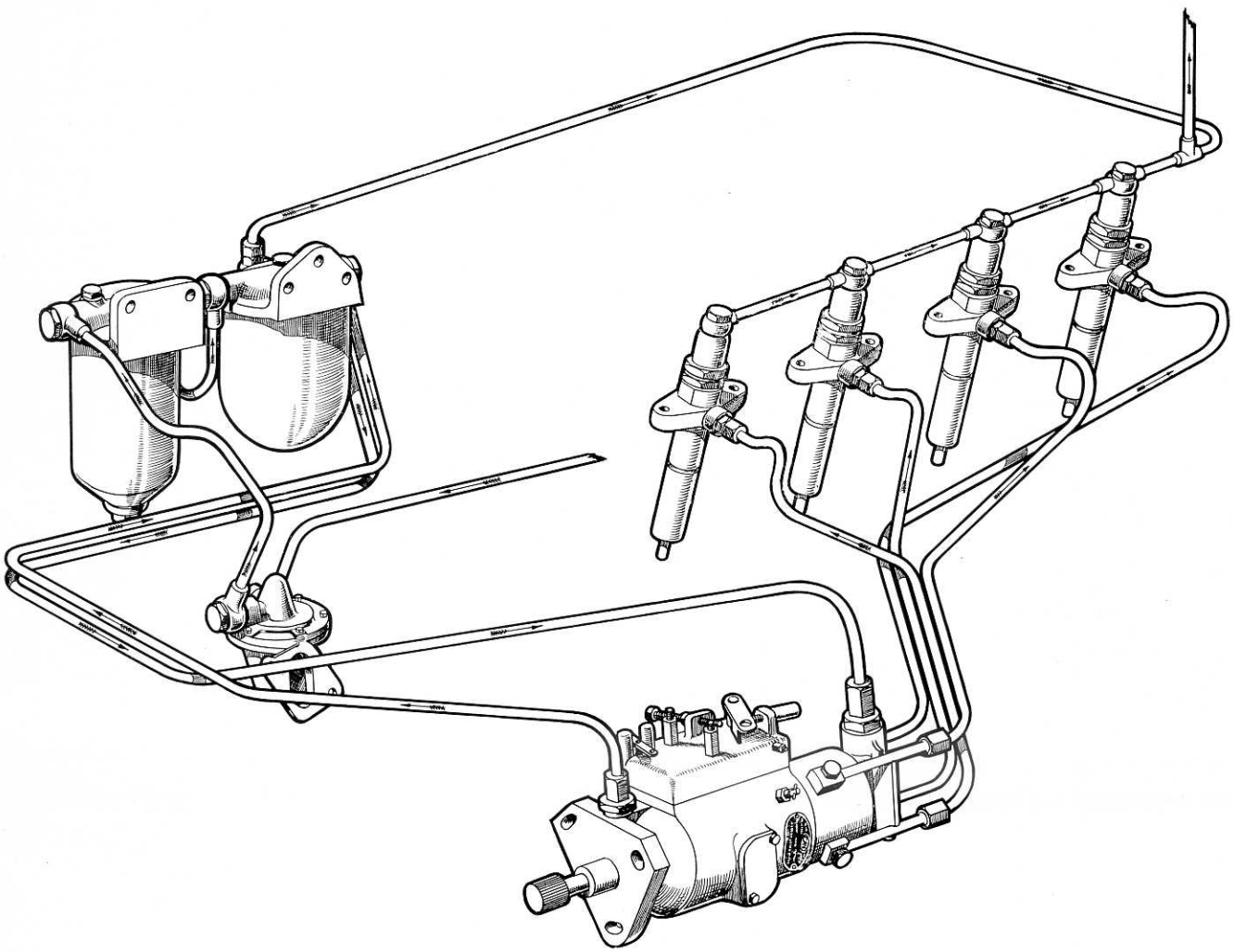


Fig. 34. DIAGRAM OF THE FUEL SYSTEM

Introduction

A thoroughly clean fuel system is essential. Too much emphasis cannot be made on this point and the necessity for correct storage of fuel, proper attention to filter renewal, cleaning of the exterior of the tractor before slackening any connections on the fuel system, and care when filling the fuel tank not to allow dirt to enter, **must** be impressed upon the user. Cotton waste or cloths must not in any circumstances be used in conjunction with fuel injection equipment.

Every care should also be exercised in the workshop. The bench to be used for the servicing of fuel equipment should be situated in a well lighted and separate part of the workshop. If it is possible an insulated dust-proof room should be provided in which the equipment can be permanently installed.

Some of the tools and test gear necessary for servicing injectors are shown in Tool Leaflet No. 112. The minimum essentials consist of the following: Two Safety Containers, one filled with petrol for soaking dirty nozzles and the other filled with fusus oil for assembly of the cleaned components. A nozzle bench plate should be screwed to the bench with the jig end overhanging so that an injector can be located on it while the dome nut and lockwasher are slackened or tightened. A Nozzle Setting Outfit should also be securely bolted to the bench with a suitable canister to collect the spray and protect the operator against accidental contact with the spray. For use in conjunction with the Nozzle Setting Outfit, the Flushing Device will be found very useful. The Nozzle Cleaning Kit B and C includes the probing tool. Probe needles of 0·20 mm should be obtained. The above items are an essential minimum for injector servicing. However, more complex apparatus or additional items are available where the volume of work make their purchase worth while.

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Injectors and Nozzles

Care should be taken in removing injectors from the engine not to damage or distort them. After disconnecting the leak-off pipe and high pressure supply pipe, the holding down nuts should be slackened a little at a time alternately. Lift out the injector carefully so as not to damage the tip of the nozzle. Seal all openings in the cylinder head, pipes, and injector to prevent the ingress of dirt.

Nozzle Testing. The hand tester shown in Fig. 35 and also on Service Tool Leaflet No. 112 is adequate for testing and pressure setting the injectors.

Attach the nozzle to the spray tester and place a canister round the nozzle to ensure that the spray does not contact the body. The force of the spray is such that it will easily penetrate the skin, even through clothing. The resultant oil under the skin is very difficult to treat and can be a very uncomfortable wound. The tin will help to condense the very fine spray which forms an objectionable atmosphere. If regular nozzle testing is contemplated a totally enclosed test chamber with exhauster is advocated.

Pressure Test. With the injector mounted in the test outfit, depress the hand lever several times to fill the injector and expel any air. Depressing the lever very slowly observe the highest pressure reading that is obtained before the needle on the pressure gauge flicks. This is the pressure at which injection takes place. The correct pressure for new injectors is 185 atmospheres, and for used injectors is 175 atmospheres.

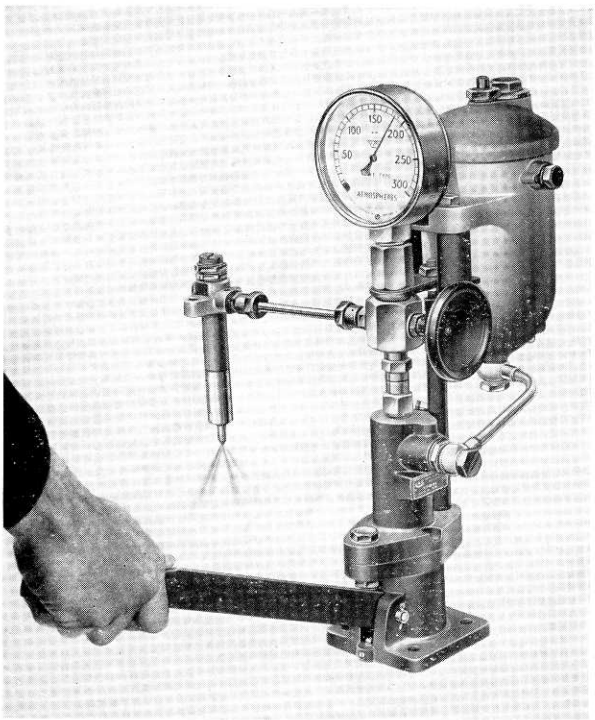
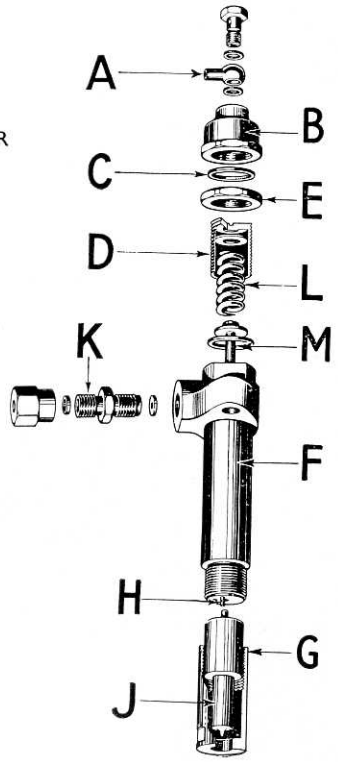


Fig. 35. TESTING THE INJECTOR SPRAY

Fig. 36 EXPLODED INJECTOR

A. Leak-off Union
B. Dome Nut
C. Sealing Washer
D. Pressure Adjusting Screw
E. Lock Nut
F. Nozzle Holder
G. Nozzle Nut
H. Locating Dowel
J. Nozzle
K. Pressure Union
L. Pressure Spring
M. Plunger Valve



If the pressure is incorrect but the nozzle is clean and otherwise satisfactory, it should be set to the correct figure as follows: Remove the dome cap and slacken the locknut, using a large screwdriver in the pressure adjusting screw D, Fig. 36, adjust the pressure. Only a very small movement will be required unless the nozzle has only just been assembled and the pressure not previously set. When the pressure is correct, tighten the locknut and recheck the pressure.

Back Leakage Test. Operate the hand pump until the pressure is about 170 atmospheres. Release the handle quickly and measure with a stop watch, the time taken between the pressure-gauge pointer, passing the 150 atmospheres and 100 atmospheres marks as it gradually falls. For a satisfactory nozzle the time taken should be between 6 and 25 seconds.

Dry Seat Test. Carefully wipe the nozzle dry. Build up the pressure to 10 atmospheres below the "breaking" (or injection) pressure. Examine the nozzle whilst under this pressure. It should be dry and free from leakage. If the nozzle is inadvertently caused to "break" the tip should be re-wiped dry and tested again.

Atomisation Test. Isolate the pressure gauge by closing the valve. Then apply eight quick jerks and examine the spray quality. The sprays should be free from coarse or solid streaks and the tip should remain dry. There should be four sprays equally spaced at an inclusive angle of 140°. They are offset 10° to allow for the tilt of the injector in the cylinder head.

Examine the injector for signs of leakage at the nozzle cap nut, the spring adjusting nut, and the copper sealing washers.

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Nozzle Cleaning. If the injector fails to pass any of the above tests it must be dismantled, cleaned and re-tested. Remove the nozzle cap G, Fig. 37, using a close-fitting spanner on the flats provided. Remove the nozzle noting that it will only fit in one position because of the locating dowels. Remove the needle valve and place in petrol to soften the carbon. Examine the nozzle and needle for damage, over-heating or scratch marks on the lapped working surfaces. If excessive overheating has occurred, denoted by a dark-blue colour of the needle, or if the seat or working surfaces are damaged, reconditioning will be required and a new nozzle should be fitted.

If the nozzle is not damaged it should be cleaned using the special tools provided in the nozzle cleaning kit shown in Fig. 38 and Tool Leaflet No. 112. Firstly clean the fuel oil channels and boring in the nozzle. Scrape the carbon from the valve seat with a brass scraper.

Using the special groove scraper clear the carbon deposits from the oil gallery. Clean the spray holes with the probing tool fitted with a probing wire of the correct diameter. Only nozzles type BDLL 140S6276 should be used with the AD4/40T, U, V and W engines. The hole diameter in these nozzles is 0·21-0·23 mm (0·008-0·009 in.). Some of the 0·2 mm cleaning wires are often undersize and it is necessary to select those which are a full 0·008 in. dia. The smaller ones are useful for the initial probing of holes which are severely blocked with carbon.

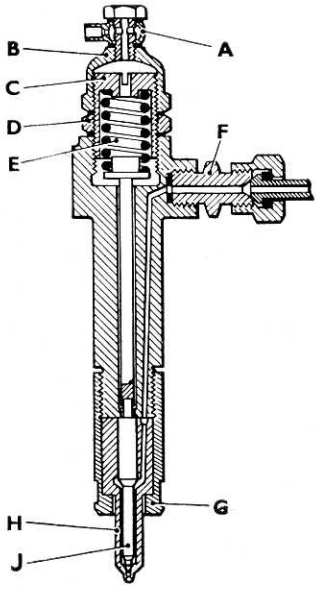


Fig. 37. SECTION OF THE INJECTOR

A. Leak-Off Banjo
B. Dome Nut
C. Adjusting Nut
D. Lock Nut
E. Plunger Valve Spring
F. Inlet Union
G. Nozzle Nut
H. Nozzle
J. Needle Valve

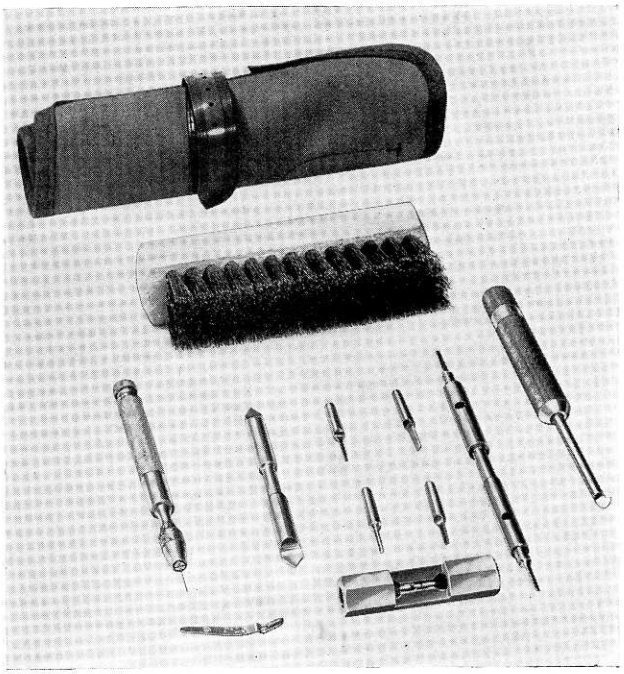


Fig. 38. NOZZLE CLEANING KIT

If a wire is broken off in the hole it is often impossible to remove it, and the nozzle is then useless. Great care should be exercised when using the probing wires. After clearing the holes scrape the carbon from the valve seat with the brass tool having a Vee tip. Next use the tool with the thin blade radiused at its tip to clean the carbon out of the sac. After cleaning with the tools, the nozzle should be thoroughly cleaned with fuel. This should be done by placing without needle, in the reverse flushing attachment and fixed to the nozzle pressure tester in place of the injector. Operation of the tester will then thoroughly flush all particles of loose carbon from the nozzle.

With the brass wire brush gently clean the needle valve, paying particular attention to the valve seat and needle tip. Brush the carbon from the nozzle stem and tip.

Reassembly. The needle valve should be fitted to the nozzle whilst both are under the surface of clean fuel oil or fusus oil. Only in this way can dust be excluded from assembly. The needle should slide smoothly in the nozzle and this should be tried several times whilst under the surface of the fluid. Needle and nozzle are assembled as a pair and under no account should they be interchanged.

The nozzle should then be assembled on to the injector body. In order to avoid distorting the needle or plunger the pressure on the pressure spring should be released. Remove the dome cap, slacken the lock-nut and slacken the pressure adjusting screw right back until there is no pressure on the spring. Make sure that the mating surfaces between nozzle and injector body are perfectly clean. Place the nozzle on the body with the dowel in correct engagement so

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hat the two faces are in perfect contact, i.e. not held apart by spring pressure. Place the cap over the nozzle and tighten adequately but not overtight. Retighten the pressure adjusting screw and reset the pressure on the spray tester. Test the spray, leak back, etc. If the injector is not required for immediate use it should be stored in a sealed plastic bag or similar container.

It is essential that the copper washer be used under the injector when refitting to the engine. Check that the seat in the head is clean and that an old washer has not been left in the recess. The use of two washers will raise the nozzle tip so that the sprays impinge on the cylinder head. This will cause loss of efficiency and a smokey exhaust.

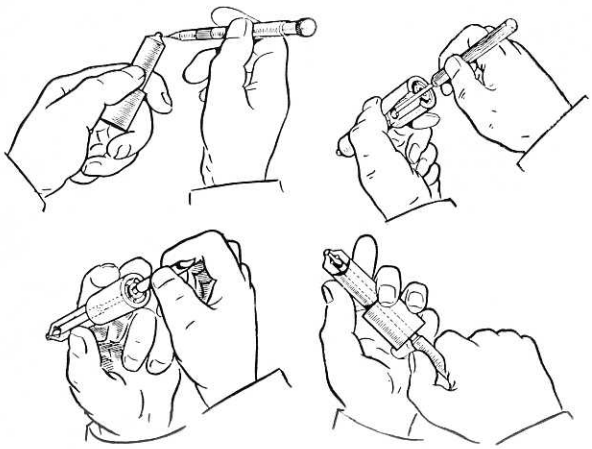


Fig. 39. CLEANING THE NOZZLE

D.P.A. Injection Pump

The injection pump is attached by three studs on the timing gear carrier plate and the pump mounting holes are slotted to permit the pump body to be turned for injection timing adjustment. To assist in obtaining the correct timing position the pump flange is marked with a groove and when the timing is set during assembly a mark is made on the carrier plate opposite the mark on the pump. Any pump can thus be fitted and the original timing obtained, by placing the two marks in alignment. (Fig. 40.)

Before removing the pump, check the carrier plate marking. A number of early engines were not marked and in these instances it will be necessary to make a chisel mark on the carrier plate, opposite the mark on the pump body.

When refitting the pump, note the position of the master spline in the drive gear and set the pump shaft into a corresponding position. Enter the pump shaft into the drive gear, rocking the pump body slightly until the shaft engages into the gear splines, then push the pump fully home. Set the pump and carrier plate marks in alignment before fitting the retaining nuts. Firmly tighten the retaining nuts, noting that flat washers should be fitted between the spring washers and the pump body.

As the correct timing of the pump depends on the gears being in their correct positions it is essential that the gears are meshed as shown in Fig. 18, otherwise correct injection timing cannot be obtained. If incorrect timing is suspected and the pump and gear markings are correctly aligned, the pump should be removed and returned to a C.A.V. agent for checking and resetting.

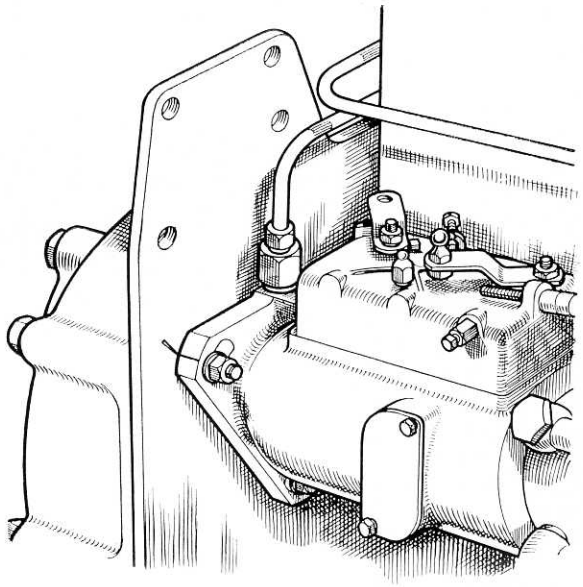


Fig. 40. TIMING MARKS ON PUMP AND BACKPLATE

Fuel Setting

Once this has been set for an engine it is most unlikely that it will require adjustment. If adjustment is required the pump should be removed from the engine and tested for delivery on a Hartridge Test Bench. There is no reliable way of judging the fuel delivery on the engine unless it can be tested on a dynamometer and consumption measured at full load. On the Hartridge Machine BDN 12 SD12 Type nozzles should be used and delivery measured for 200 revolutions at 600 rev/min. For the AD4/40 series engines used in tractors the delivery should be 7·3/7·5 cm^3. (Marine engines and $3\frac{1}{2}$ in. bore engines should have a delivery of 6·1–6·3 cm^3.)

Injection Pump Controls

The front lever on the D.P.A. pump operates the fuel cut-off to stop the tractor. The rear lever operates the governor to give the required engine speed and is fitted with two adjustable stops. The front one, for idling speed, should be set at 700 rev/min the rear one, for maximum speed, is set to 2 330 rev/min light load for tractor engines and 1 950 rev/min for Marine engines.

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Fuel Feed Pump

The fuel feed pump is mounted on the right-hand side of the engine crankcase and is actuated by a push rod from an eccentric formed on the camshaft. Some adjustment is obtainable by removing or fitting extra packings between the pump and mounting face.

To remove the fuel feed pump, disconnect the fuel pipes at the pump and release the two bolts securing the pump to the engine crankcase. When the pump is removed the push rod may be withdrawn from the crankcase.

Renewal of Diaphragm. Clean the exterior of the pump and mark the top and bottom halves so that they can be replaced in the same position. Remove the six cheese-headed screws securing the upper half of the pump to the base and lift off the pump top.

Remove the diaphragm complete with pull rod by turning these through an angle of 90° which should release the pull rod from the connecting link. Fit the new diaphragm and pull rod over the spring with the tab in the position shown in Fig. 41. Press the centre down until the "T" of the pull rod enters the slot in the connecting link and turn the diaphragm through 90° as shown in Fig. 41 so that they lock together. The upper housing may then be replaced. Press the priming lever and keep it pressed whilst the cheese-headed screws securing the housing are tightened. This ensures the diaphragm is not too taut.

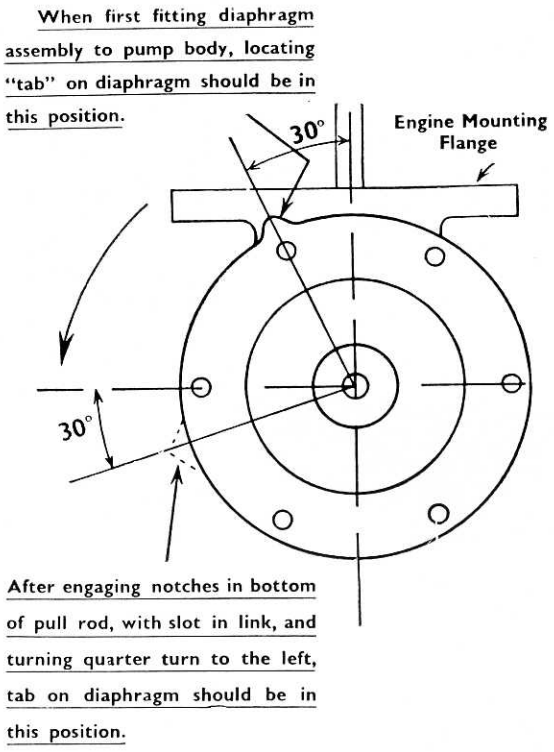


Fig. 41. FUEL PUMP DIAPHRAGM

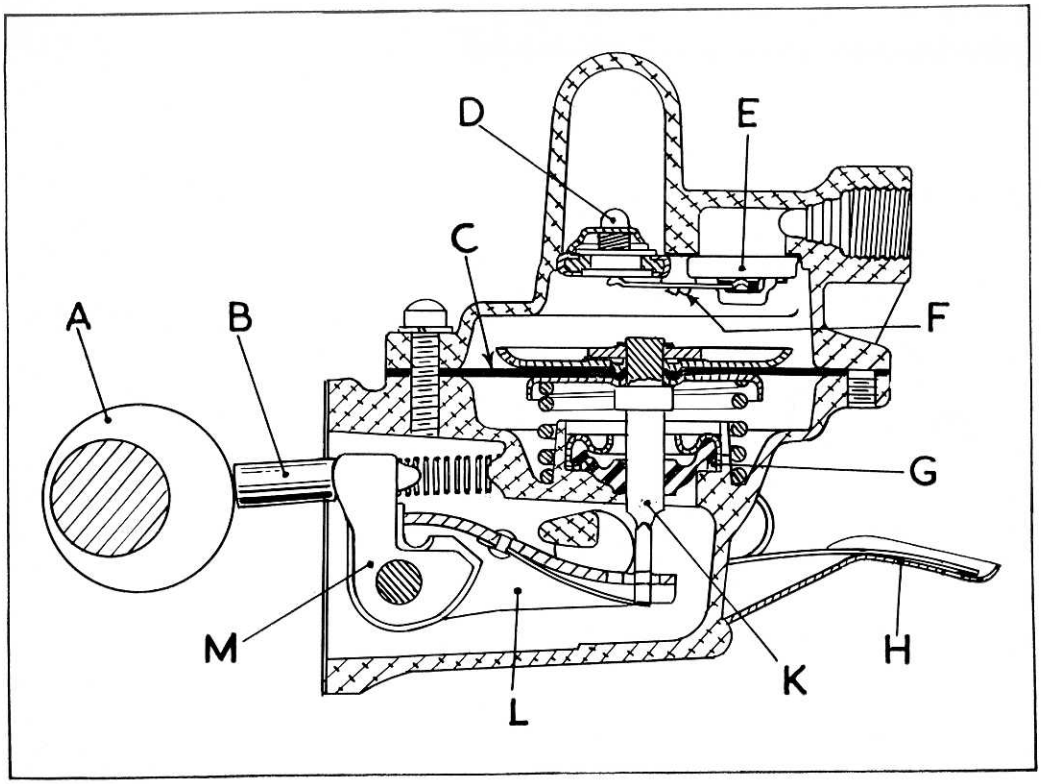


Fig. 42. SECTION THROUGH FUEL LIFT PUMP

A. Camshaft
B. Push Rod
C. Diaphragm
D. Delivery Valve
E. Suction Valve
F. Valve Retaining Screw
G. Gland
H. Priming Lever
K. Pull Rod
L. Connecting Link
M. Rocker Arm

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DIMENSIONAL DATA

Tightening Torques

Cylinder Head Bolts	90 lb ft	12·45 kgm
Cylinder Head Studs	40 lb ft	5·64 kgm
Main Bearing Bolts $\frac{7}{16}$ in.	60 lb ft	8·30 kgm
$\frac{1}{2}$ in.	85 lb ft	11·75 kgm
Camshaft Retaining Bolt	45 lb ft	6·22 kgm
Flywheel Retaining Bolts	50 lb ft	6·91 kgm
Connecting Rod Big End Bolts	40 lb ft	5·64 kgm

Valve Clearance

Inlet and Exhaust	0·015 in.	0·38 mm (Cold)

Rocker Shaft

Diameter	0·748 - 0·749 in.	18·99 - 19·02 mm
Bush Bore (Reamed in Position)	0·7500 - 0·7505 in.	19·05 - 19·06 mm

Valve Guides

Guide Bore	0·3443 - 0·3433 in.	8·74 - 8·72 mm
Valve Stem—Exhaust	0·339 - 0·338 in.	8·61 - 8·58 mm
—Inlet	0·342 - 0·341 in.	8·69 - 8·66 mm

Valve Timing

Inlet Opens	8° before top centre
Inlet Closes	38° after bottom centre
Exhaust Opens	36° before bottom centre
Exhaust Closes	10° after top centre

Valve Springs

Free Length	2·280 - 2·350 in.	57·91 - 59·69 mm
Length With Valve Closed	1·8 in.	45·7 mm
Load With Valve Closed	55 - 65 lb	24·9 - 28·5 kg

Pistons

Ring Side Clearance	0·002 - 0·0035 in.	0·05 - 0·09 mm
Ring Gaps	0·010 - 0·015 in.	0·25 - 0·38 mm
Gudgeon Pin Diameter (Push fit in small end. Light drive fit in piston.)	1·250 in.	31·75 mm

Connecting Rod Alignment

Maximum permissible error in alignment between small end and big end bores, i.e. parallelism and twist, measured per unit of mandrel length—0·0005 in./in. (0·005 mm/cm).

Cylinder Bores

Std. $3\frac{1}{2}$ in. bore	3·500 - 3·5005 in.	88·900-88·913 mm
+ 0·020 in.	3·520 - 3·5205 in.	89·408-89·421 mm
+ 0·040 in.	3·540 - 3·5405 in.	89·916-89·929 mm
Std. $3\frac{5}{8}$ in. bore	3·625 - 3·6255 in.	92·075-92·088 mm
+0·020 in.	3·645 - 3·6455 in.	92·582-92·596 mm
+0·040 in.	3·665 - 3·6655 in.	93·090-93·104 mm

Camshaft

Journal—Front	1·8707 - 1·8720 in.	47·516 - 47·549 mm
—Centre	1·8100 - 1·8113 in.	45·974 - 46·007 mm
—Rear	1·7475 - 1·7488 in.	44·387 - 44·420 mm
Bearing Bore—Front	1·8735 - 1·8742 in.	47·587 - 47·605 mm
—Centre	1·8129 - 1·8135 in.	46·048 - 46·063 mm
—Rear	1·7503 - 1·7510 in.	44·458 - 44·475 mm
End-float of Shaft	0·012 - 0·025 in.	0·305 - 0·635 mm

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Crankshaft

	Main Journal Diameter	Big-End Journal Diameter	Centre Journal Width
Standard Size	2·2485 - 2·248 in. 57·112 - 57·099 mm	2·123 - 2·122 in. 53·924 - 53·899 mm	2·126 - 2·124 in. 54·000 - 53·950 mm
0·010 in. Undersize .. .. 0·254 mm Undersize	2·2385 - 2·2380 in. 56·858 - 56·845 mm	2·113 - 2·112 in. 53·670 - 53·645 mm	— —
0·020 in. Undersize .. .. 0·508 mm Undersize	2·2285 - 2·2280 in. 56·604 - 56·591 mm	2·103 - 2·102 in. 53·416 - 53·391 mm	— —
0·030 in. Undersize .. .. 0·762 mm Undersize	2·2185 - 2·2180 in. 56·350 - 56·337 mm	2·093 - 2·092 in. 53·162 - 53·137 mm	— —
0·010 in. Oversize .. .. 0·254 mm Oversize	— —	— —	2·136 - 2·134 in. 54·254 - 54·204 mm
0·040. in Oversize .. .. 1·016 mm Oversize	— —	— —	2·166 - 2·164 in. 55·016 - 54·966 mm

Bearing Fillet Radius	0·160 - 0·150 in.	4·064 - 3·810 mm
Big-end Bearing Clearance (New)	0·0025 - 0·003 in.	0·063 - 0·076 mm
Main Bearing Clearance (New)	0·0025 - 0·0045 in.	0·063 - 0·144 mm
Crank Pin Length	1·5015 - 1·4995 in.	38·138 - 38·087 mm
Connecting Rod Side Clearance	0·008 - 0·012 in.	0·20 - 0·30 mm
End Float of Crankshaft	0·002 - 0·010 in.	0·05 - 0·25 mm
Thrust Washer Thickness, std.	0·091 - 0·092 in.	2·311 - 2·362 mm
+ 0·005 in.	0·096 - 0·098 in.	2·438 - 2·489 mm
+ 0·020 in.	0·111 - 0·113 in.	2·819 - 2·870 mm

Note

When regrinding crankshafts it is important that the original bearing fillet radius is maintained. It is also important that the surface of the radius is as smooth as the surface of the journal and that the radius is smoothly blended into both surfaces. A fillet that is incorrectly radiused, roughly finished or not smoothly blended, weakens a shaft and may cause fatigue failure during service.

Intermediate Gear

Shaft Diameter	1·1235 - 1·12275 in.	28·537 - 28·518 mm
Gear Bore	1·1260 - 1·1245 in.	28·600 - 28·562 mm
End-float	0·002 - 0·003 in.	0·050 - 0·076 mm

Oil Pump

Spindle Diameter	0·4895 - 0·4900 in.	12·433 - 12·446 mm
Spindle Bush Bore	0·4915 - 0·4935 in.	12·484 - 12·535 mm
Driven Gear Pin Diameter	0·4895 - 0·4900 in.	12·433 - 12·446 mm
Driven Gear Bore	0·4912 - 0·4920 in.	12·476 - 12·497 mm
Pumping Gear Width	1·0950 - 1·0960 in.	27·813 - 28·838 mm
Pump Gear Backlash	0·026 in.	0·660 mm

Maximum Fuel Setting

Measured on Hartridge Test Machine for 200 revolutions at 600 rev/min for AD4/40 series used in tractor—7·3 - 7·5 cm^3.
Marine engines and $3\frac{1}{2}$ in. bore tractor engines 6·1-6·3 cm^3.

Injector Pressure Setting

New Nozzles and Injectors—185 atmospheres.
After bedding in (10 hours' running) 175 atmospheres.

Fuel Lift Pump

Delivery Pressure—$2\frac{3}{4}$ - $4\frac{1}{4}$ lb/in^2 0·19 - 0·31 kg/cm^2

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TABLE OF CYLINDER BLOCK AND SLEEVE FITTING DIMENSIONS

(Dimensions refer to Fig. 15, Page 11)

Block Dimension "A"	Sleeve Dimension "B"	Difference in Dimensions	Thickness of sealing ring required	Amount of Protrusion
in.	in.	in.	in.	in.
0·310	0·297	0·013	0·017	0·004
0·311	0·297	0·014	0·017	0·003
0·312	0·297	0·015	0·020	0·005
0·313	0·297	0·016	0·020	0·004
0·314	0·297	0·017	0·020	0·003
0·310	0·298	0·012	0·015	0·003
0·311	0·298	0·013	0·017	0·004
0·312	0·298	0·014	0·017	0·003
0·313	0·298	0·015	0·020	0·005
0·314	0·298	0·016	0·020	0·004
0·315	0·298	0·017	0·020	0·003
0·310	0·299	0·011	0·015	0·004
0·311	0·299	0·012	0·015	0·003
0·312	0·299	0·013	0·017	0·004
0·313	0·299	0·014	0·017	0·003
0·314	0·299	0·015	0·020	0·005
0·315	0·299	0·016	0·020	0·004

Compression Pressures

Average pressure obtained when the engine is cranked, by means of the starter motor, with all injectors removed and at an ambient temperature of 20°C. (68°F.)

Cranking Speed	Pressure	
rev/min	lb/in²	kg/cm²
150	380–400	26·6–28·0
250	415–435	29·0–30·5

SUMMARY OF DESIGN CHANGES TO DATE

Details of Change	When Introduced
Cover plate (87081) for injection pump drive gear deleted from timing cover. Part number of timing cover (902116) unchanged.	AD4/40T/860 AD4/40U/345 (January 1959)
Inside of water pump impeller (902131) chamfered to facilitate fitting of gland seal.	AD4/40T/2123 AD4/40U/727 (April 1959)
Position of cylinder block drain tap moved 1¾ in. (44·45 mm) to rear. Part number of cylinder block (902190) unchanged.	AD4/40T/2249 AD4/40U/1115 (August 1959)
Fuel feed pump fitted with four-layer diaphragm. Part numbers of pump (902135) and diaphragm (12863) unchanged.	AD4/40T/4594 AD4/40U/2713 (October 1959)
Fuel feed pump banjo bolts changed from brass to steel. Part number of bolts (12723) unchanged.	AD4/40T/4799 AD4/40U/2943 (November 1959)
Injector leak-off connections changed from banjo type to union nuts and olives. Part number of injector changed from 902104 to 904442.	AD4/40T/5516 AD4/40U/3574 (January 1960)

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Details of Change	When Introduced
Sealing washer fitted to dipstick. Part number of dipstick changed from 902307 to 905244	AD4/40T/8147 AD4/40U/5425 (July 1960)
Thickness of mounting flange on oil cleaner head (902124) increased to reduce distortion	AD4/40T/8878 AD4/40U/6219 AD4/36A/1941 AD4/36B/1008 ID4/40/109 (September 1960)
Fuel filters changed to bowl-less type. Part numbers of filters changed from 903442 and 901382 to 905218	AD4/40T/9612 AD4/40U/6982 AD4/36A/2337 AD4/36B/1280 (November 1960)
Introduction of gear teeth on inside of flywheel to mesh with corresponding teeth on clutch separator plate. Part number of flywheel changed from 89319 to 906567	AD4/40T/11351 AD4/36A/3164 (March 1961)
Oil filter gasket material changed from Oakenstrong to cork/aluminium. Part number of gasket (62430) unchanged	AD4/40T/12265 AD4/40U/8208 AD4/36A/3374 AD4/36B/2286 ID4/40T/186 ID4/40/113 TD4/40/143 (April 1961)
Fuel feed pump diaphragm spring colour changed from blue to green, to reduce output pressure to $2\frac{3}{4}$–$4\frac{1}{4}$ lb/sq. in. (0·19–0·31 kg./sq. cm). Part number of spring changed to 960958	AD4/40T/12290 AD4/40U/8249 AD4/36A/3381 AD4/36B/2320 (April 1961)
Oil filter mounted directly on to cylinder block, filter head 902124 deleted. Part number of cylinder block (902190) unchanged	AD4/40T/14768 AD4/40U/10193 AD4/36A/4090 AD4/36B/3177 TD4/40/201 ID4/40/113 ID4/40T/237 (October 1961)
Dipstick 905244 replaced by dipstick 908274. Sump capacity reduced from 17 pints (9·6 litres) to 13 pints (7·4 litres) on wheeled tractors and from 25 pints (14·2 litres) to 20 pints (11·4 litres) on crawler tractors	AD4/40T/15688 AD4/40U/10795 AD4/36A/4642 AD4/36B/3774 TD4/40/208 ID4/40/113 ID4/40T/280 (March 1962)
Dimension of crankshaft nut (623300) reduced from 1·67 to 1·50 in. (42·42–38·10 mm) across-flats. Part number of nut unchanged	AD4/40T/15688 AD4/40U/10821 AD4/36A/4689 AD4/36B/3789 ID4/40/113 ID4/40T/280 TD4/40/220 (March 1962)

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DAVID BROWN

IMPLEMATIC

HYDRAULIC SYSTEM

FILE IN 850/950 REPAIR MANUAL FOLDER

DAVID BROWN TRACTORS LIMITED

TECHNICAL PUBLICATIONS SERVICE DEPARTMENT

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IMPLEMATIC HYDRAULIC SYSTEM

The hydraulic lift systems on all Implematic type tractors are of the same basic construction and operate in exactly the same manner. For servicing purposes however it is possible to separate the systems into two types according to the tractor model.

The first 850 and 950 series Implematic tractors have serial numbers in the following range.

Tractor Model	*Serial Number*
850 Implematic	2B/850/300 001 to 306 350
850 Implematic Livedrive	2A/850/30 001 to 306 350
950 Implematic	W/950/63 001 to 81 850
950 Implematic Livedrive	V/950/63 001 to 81 850

These tractors, which will be referred to as early model tractors, have a $3\frac{1}{2}$ in. (88·9 mm) diameter ram cylinder with a linkage locking bolt on the cylinder cover. As the hydraulic valve is set to deliver 2 000 lb/in² (140 kg/cm²), for operating external equipment, but the ram cylinder only requires 1 500 lb/in² (105·6 kg/cm²), a relief valve is fitted into the ram cylinder to prevent the linkage from being overloaded. BSF threads are used throughout and the appropriate parts catalogues are DBT471 (850) and DBT464 (950).

Tractors referred to as later model have serial numbers as follows:

Tractor Model	*Serial Number*
850 Implematic	850/D/310 001 onward
850 Implematic Livedrive	850/C/310 001 onward
880 Implematic	880/D/350 001 onward
880 Implematic Livedrive	880/C/350 001 onward
950 Implematic	950/3B/400 001 onward
950 Implematic Livedrive	950/3A/400 001 onward
990 Implematic	990/B/440 001 onward
990 Implematic Livedrive	990/A/440 001 onward

The hydraulic system on these tractors incorporates a $3\frac{1}{8}$ in. (79·37 mm) diameter ram cylinder with an automatic locking catch mounted in the cylinder cover. As the reduced diameter of the ram cylinder allows it to operate at full pump pressure of 2 000 lb/in² (140 kg/cm²) a relief valve is not required in the cylinder. The introduction of unified threads on these tractors has necessitated part number changes for parts which are otherwise unchanged, it should however be noted that the tapped holes in the hydraulic pump body are threaded BSF as on previous series. Parts catalogues for these tractors are DBT494 (990) and DBT.497 (850–880–950).

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OPERATION OF THE IMPLEMATIC SYSTEM

The Implematic system may be used to operate implements with, or without, depth control wheels. When used for traction depth control (Fig. 1) the implement is supported on the linkage and the operating depth controlled by raising, or lowering, the linkage. This is carried out automatically by the action of the top link, which telescopes against its spring according to the amount of implement draught.

Since the amount of draught varies with the depth of the implement, any change in implement depth will make a corresponding change in the length of the top link. This movement of the top link is then transmitted through the flexible cable J to the depth control valve F which raises, or lowers, the pressure against the ram piston K by decreasing, or increasing, the flow of oil to waste.

As the oil passing through the depth control valve F also passes through the traction control valve G before returning to waste, the oil pressure in the system cannot fall below the pressure setting of the traction control valve. Traction control is, therefore, always operative when using automatic depth control

To allow the operator to adjust the working depth of the implement, the depth control valve operating lever N is mounted on a floating pivot L. The position of the pivot can thus be changed by moving the control lever A. Moving the control lever forwards takes the pivot closer to the valve, so that greater compression of the top link, and therefore increased depth, is required before the valve commences to close.

Moving the control lever rearwards moves the pivot further away from the valve, so that less compression of the top link is required before the valve commences to close.

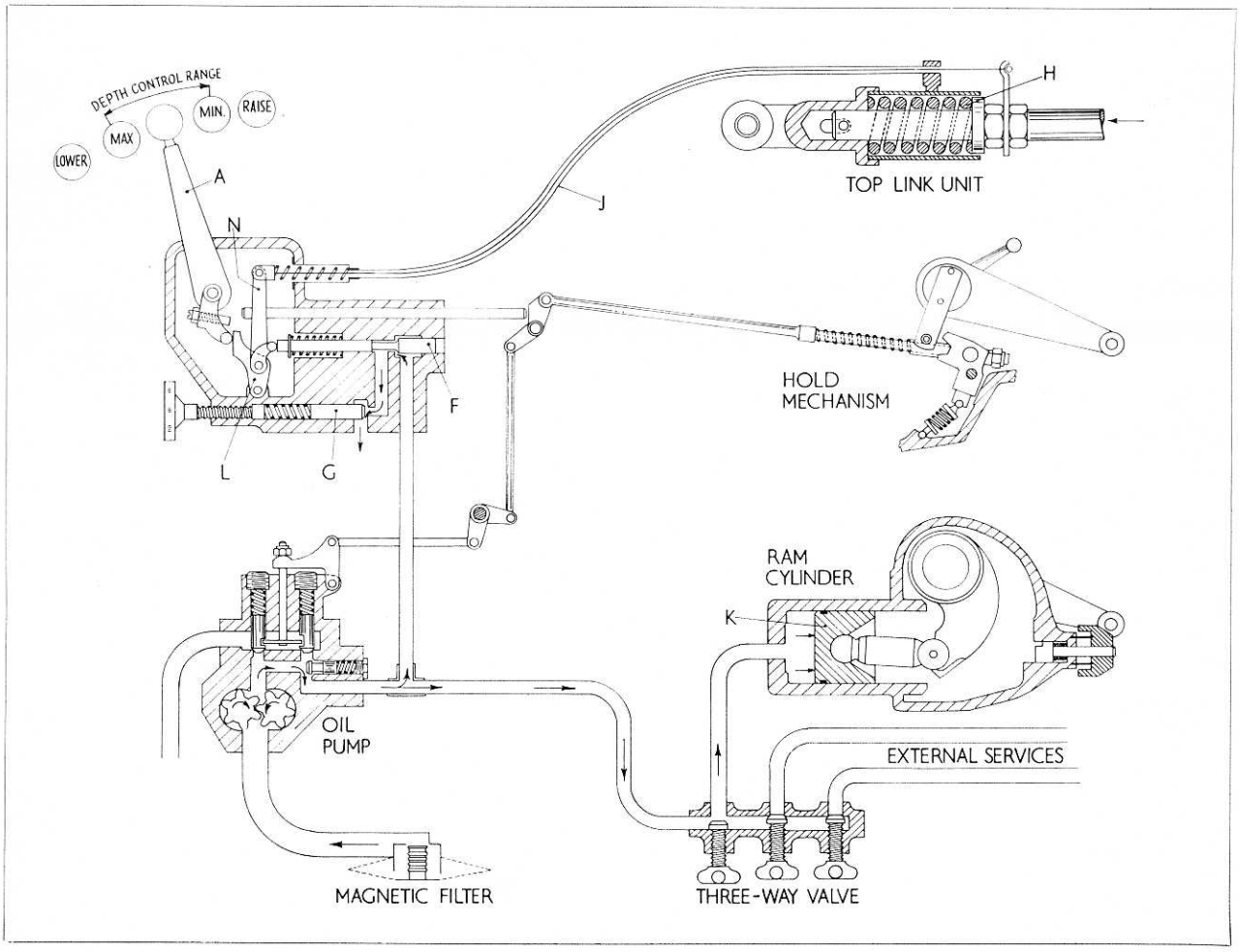


Fig. 1 OPERATION OF THE SYSTEM WHEN USING TRACTION DEPTH CONTROL
(Implements not equipped with depth wheels)

A. Control Lever
F. Depth Control Valve
G. Traction Control Valve
H. Compression Spring
J. Flexible Cable
K. Ram Piston
L. Floating Pivot
N. Valve Operating Lever

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When used with implements fitted with depth wheels the control lever is placed further forward than the depth control position (Fig. 2) and this holds the depth control valve F fully open irrespective of the position of the top link unit. The implement then rests on its own depth wheels and the pressure in the hydraulic system is controlled by the traction control valve G, which can be adjusted by means of the hand wheel M to provide the amount of traction control required.

Since the maximum pressure setting of the TCU valve G is insufficient to support the full weight of the implement, the ram piston K exerts a partial lifting effort which increases the adhesion of the rear wheels by transferring part of the implement weight onto the rear of the tractor.

When traction control is not required the control lever A is pushed fully forward, into the 'lower' position. The abutment screw B then contacts the push rod C and operates the linkage to open both pump valves D and E. Pressure in the system is then reduced to zero and pump output flows to waste, allowing the pump to idle and the implement to rest on its own depth wheel without any TCU pressure being applied.

Placing the control lever in the most rearward position (Fig. 3) moves the operating lever N clear of the valve F. The valve is then closed by its spring and the linkage raised.

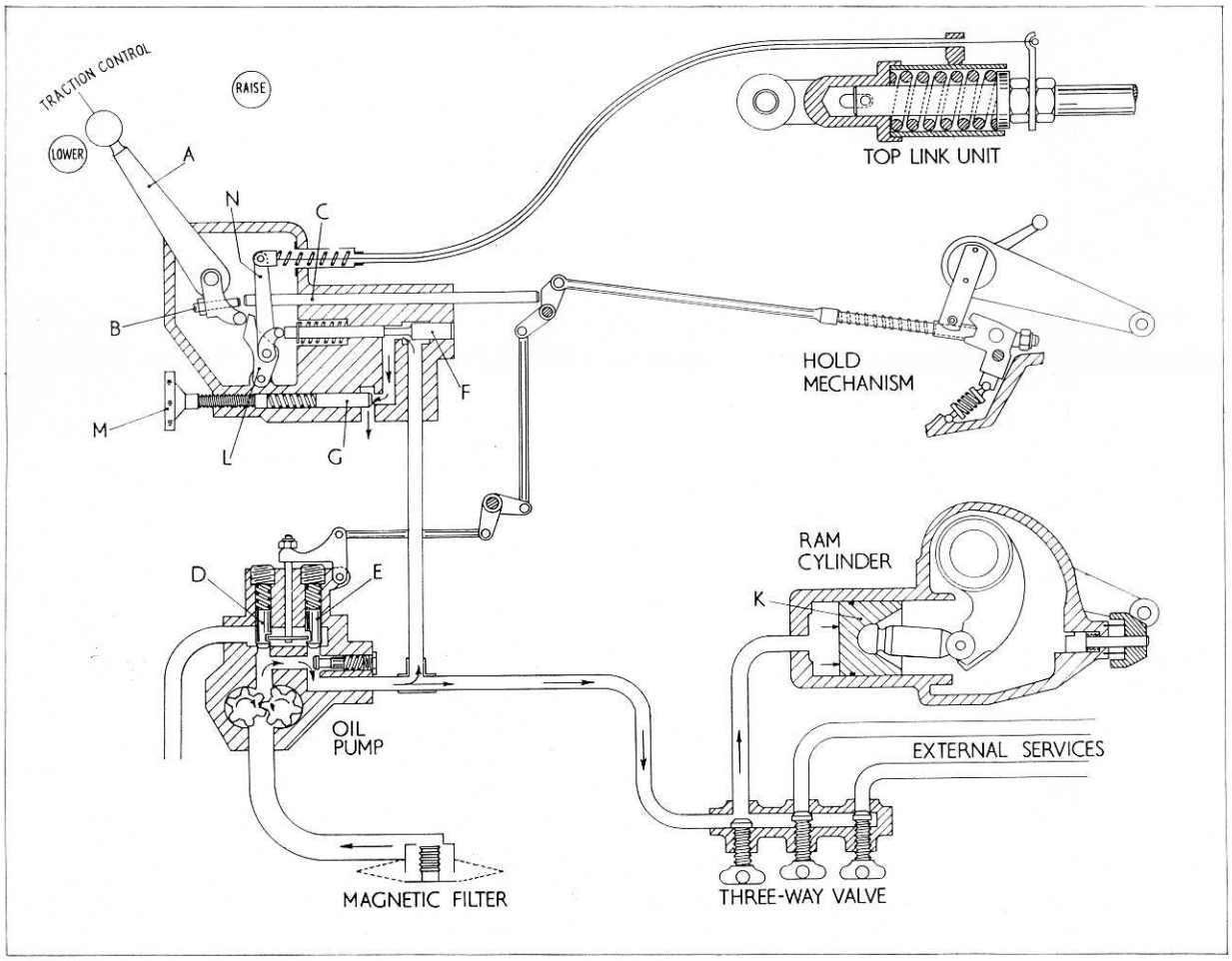


Fig. 2. OPERATION OF THE SYSTEM WHEN USING TRACTION CONTROL
(Implements equipped with depth wheels)

A. Control Lever
B. Abutment Screw
C. Push Rod
D. Pump Relief Valve
E. Pump Hold Valve
F. Depth Control Valve
G. Traction Control Valve
K. Ram Piston
L. Floating Pivot
M. Handwheel
N. Valve Operating Lever

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As the linkage is reaching the raised position the lever R on the right-hand end of the ramshaft contacts the trip lever S on the hold mechanism and turns the lever until the spring loaded toggle T snaps the mechanism over and opens the pump valve D. This removes the load from the pump by returning pump output to waste, but retains oil in the system due to the valves E and O remaining closed, so that the linkage is held stationary in the raised position.

Pushing the control lever fully forwards allows the abutment screw B to contact the push rod C which operates the pump valve linkage and opens both valves, thus lowering the linkage.

Since moving the control lever away from the 'raise' position opens the depth control valve F, which allows the linkage to lower, no 'hold' position is available on the control lever unless the top link cable J is disconnected.

On early model tractors a linkage locking bolt is fitted on the left-hand ramshaft bracket. When the hold mechanism has tripped into the 'hold' position the hole in the ramshaft arm should be in line with the bolt so that the bolt can be engaged when required.

On later model tractors an automatic linkage lock is incorporated in the ram cylinder cover. When the knob Z is turned into the 'engage' position the spring-loaded plunger W is released so that when the ramshaft arm X reaches its stop the plunger springs under the heel of the arm and locks the linkage. As the hold mechanism is set to operate just before the ramshaft arm reaches its stop the automatic lock cannot be engaged unless the override control is used to make the automatic hold mechanism inoperative.

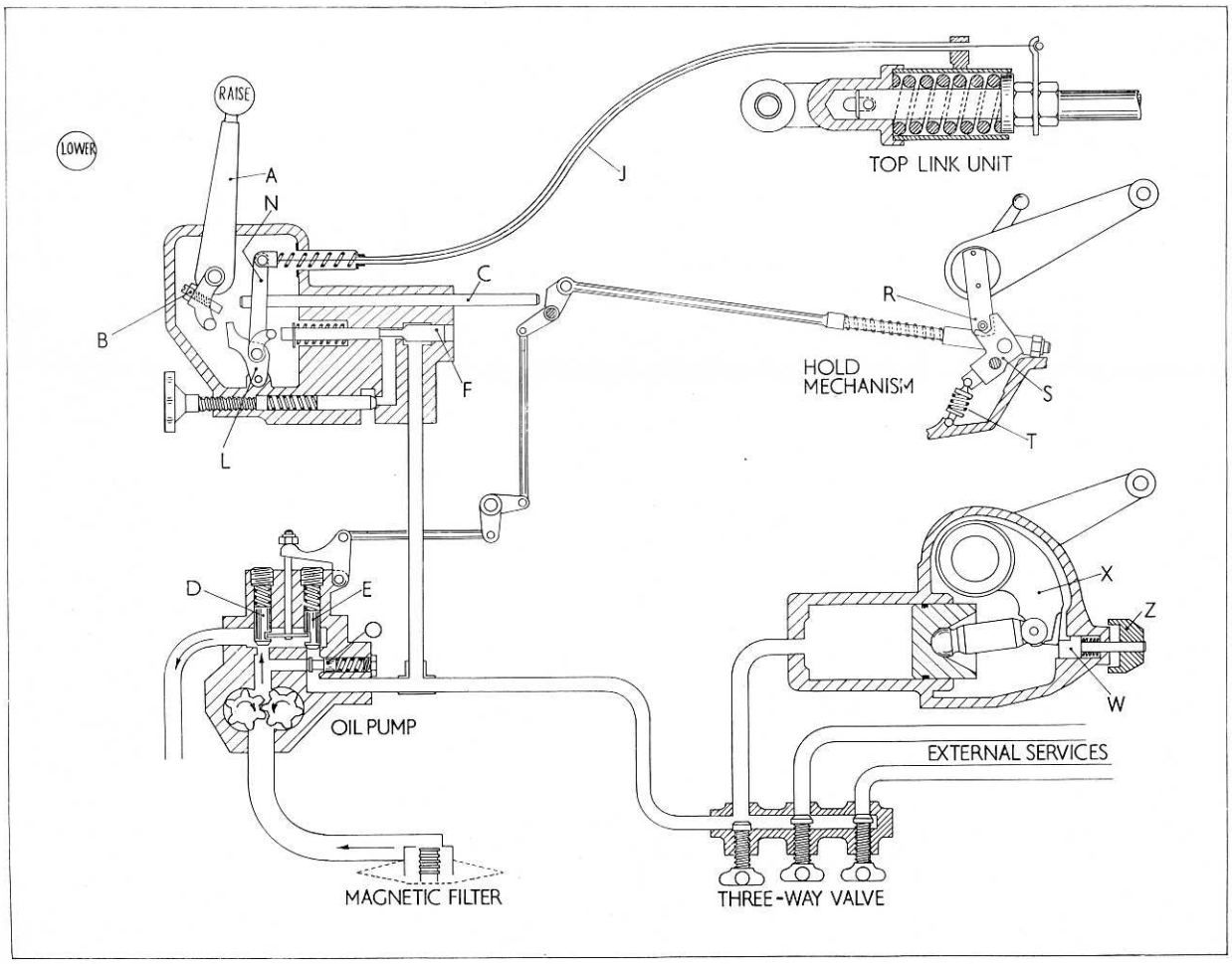


Fig. 3. OPERATION OF THE SYSTEM WHEN IN THE RAISED POSITION

A. Control Lever
B. Abutment Screw
C. Push Rod
D. Pump Relief Valve
E. Pump Hold Valve
F. Depth Control Valve
N. Valve Operating Lever
O. Non-return Valve
R. Striker Arm
S. Trip Lever
T. Spring Toggle
W. Locking Plunger
X. Ramshaft Arm
Z. Catch Knob

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When the system is required to operate external equipment (Fig. 4), the control cable J to the top link is disconnected and the oil supply through the three-way valve diverted from the ram cylinder to the external connection.

Disconnecting the top link cable J moves the operating lever N away from the depth control valve F so that the valve is permanently closed. Pushing the control lever fully forward will then open both pump valves so that the attachment will be lowered. Bringing the lever a short distance to the rear will close the hold valve E only and give a "hold" position. Moving the lever further to the rear will close both valves and the attachment will then rise.

To enable the linkage to be stowed in the raised position the automatic hold mechanism may be disconnected by means of the override control V. This disconnects the striker arm R from the ramshaft so that the lever S is not tripped over when the ramshaft turns into the raised position. If the locking catch control Z is in the 'engage' position the plunger W will then engage the ramshaft arm X and lock the linkage.

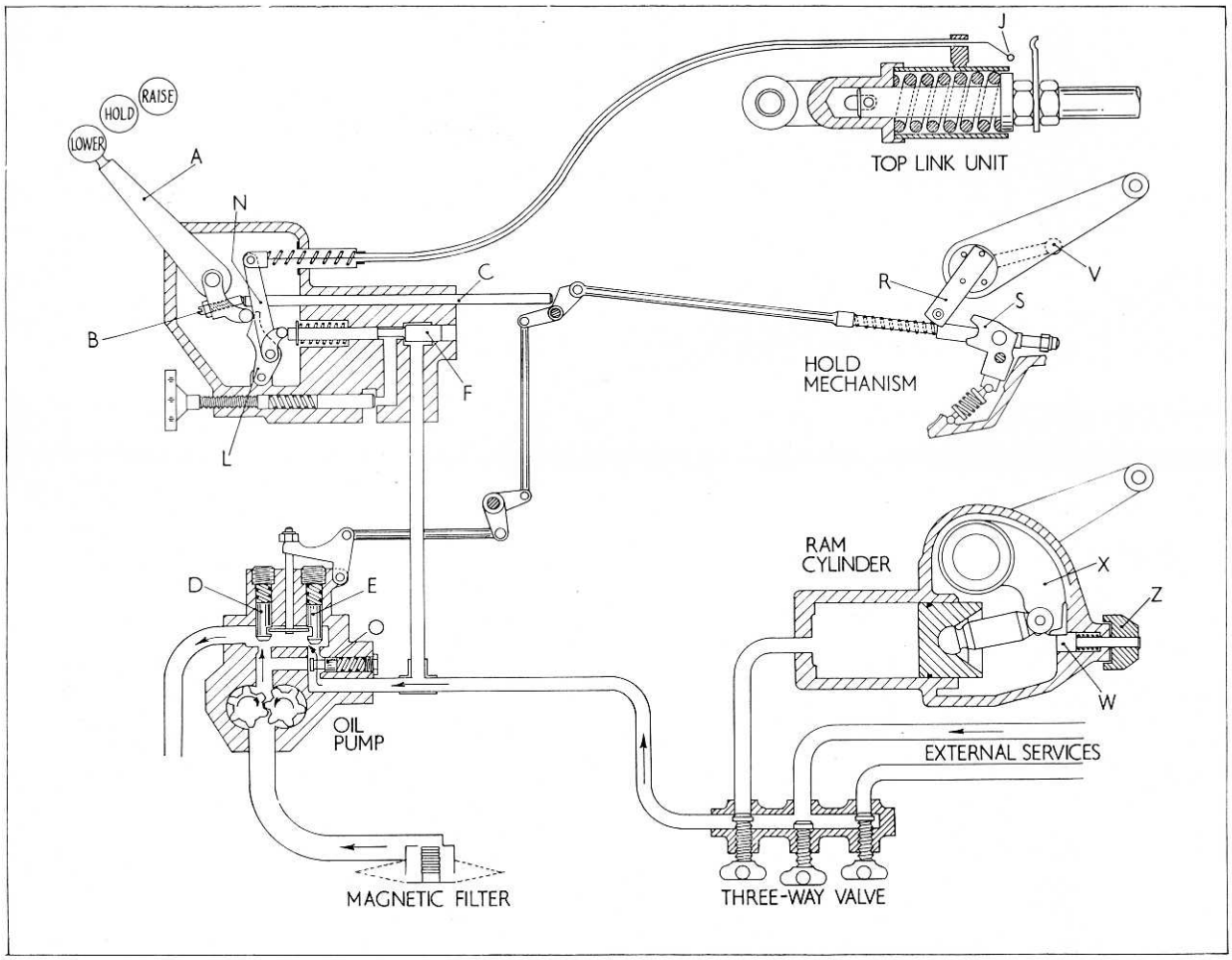


Fig. 4. OPERATION OF THE SYSTEM WHEN USING EXTERNAL HYDRAULIC EQUIPMENT

A. Control Lever
B. Abutment Screw
C. Push Rod
D. Pump Relief Valve
E. Pump Hold Valve
F. Depth Control Valve
J. Flexible Cable
L. Floating Pivot
N. Valve Operating Lever
O. Non-return Valve
R. Striker Arm
S. Trip Lever
V. Override Control
W. Locking Plunger
X. Ramshaft Arm
Z. Catch Knob

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CHECKING THE SYSTEM FOR FAULTS

Incorrect operation of the system may be due to any of a number of causes, and the exact cause of the faulty operation should first be located before any re-adjustments or dismantling are undertaken.

The following fault finding chart summarises the more common faults and indicates their probable cause. To locate the cause of faulty operation, refer to the symptom applicable then check each cause in turn. The causes are listed in order of probability and where a simple visual check can not be made a test is indicated. These tests are listed at the end of the chart and provide methods of checking adjustments and components with the minimum of dismantling.

Symptom	*Probable Cause*	*Action*
Lift fails to rise or rises very slowly	Override control disengaged and in "hold" position	Check
	Three-way valve closed to ram cylinder	Check
	Relief valve opening due to lift being overloaded	Reduce load
	Shortage of oil in transmission	Check
	Hydraulic pump inlet filter choked	Remove and check
	Incorrect adjustment of pump valve linkage	Test A
	Faulty ram cylinder relief valve	Test B
	Faulty depth control valve or incorrectly adjusted top link cable	Test C
	Leaking oil pipe or union	Test D
	Insufficient pump pressure due to worn pump components	Test D
Lift fails to hold in raised position	Control lever not fully into "raise" position	Check
	Incorrect adjustment of automatic hold mechanism	Test E
	Faulty ram cylinder relief valve	Test B
	Incorrect adjustment of top link cable or faulty depth control valve	Test C
	Oil leakage from faulty pipe or connection	Test D
	Faulty hydraulic pump valves	Test E
	Worn ram cylinder piston or rings	Test F
Lift fails to lower or lowers slowly	Three-way valve not fully open	Check
	Incorrect grade of oil (too heavy) in transmission	Check
	Incorrect adjustment of pump linkage	Re-adjust
Implement fails to operate at depth required	Insufficient tension in control lever pivot allowing lever to move from original setting.	Re-adjust (4a page 14)
	Implement failing to penetrate due to incorrect setting	Test H
	Incorrect adjustment of top link cable	Test H

Fault Diagnosis

After referring to the fault finding chart to find the possible cause, the next step is to locate the actual fault. The following tests will assist in this by providing a method of checking the operation of the various components.

Test A. To check the pump valve linkage.

Remove the inspection plug from the top of the power take-off housing and check that when the control lever is placed in the "raise" position, and the linkage is lowered, the flat washer on the pump valve spindle is clear of the Nyloc nut. If the washer is not free, the linkage should be re-adjusted (page 12).

Test B. To check the ram cylinder relief valve.

(Early model tractors only)

Remove the cover plate from the front left-hand side of the rear axle case, attach an implement to the linkage then place the control lever into the "raise" position, any leakage of oil from the ram cylinder relief valve can then be observed.

If the tractor is fitted with a three-way isolating valve, remove the union assembly from the front end of the ram cylinder, then temporarily attach the main oil pipe banjo directly to the ram cylinder, using banjo bolt part number 11765, and test as previously.

Test C. To check the depth control valve.

Remove the cover from the right-hand ramshaft bracket and attach an implement to the linkage. Place the control lever into the "raise" position then start the engine. Any discharge of oil from the oil jet on top of the valve body will then indicate that the depth control valve is not fully seated. If a discharge of oil takes place, allow the implement to lower then disconnect the top link cable and re-test. If no oil discharge occurs on the second test, the flexible cable is holding the valve off its seat and requires adjustment (page 14). If the oil discharge still takes place when the cable is disconnected, the valve is not seating and should be removed and examined.

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Test D. To check the system for leakage.

Remove the cover plate from the front left-hand side of the axle casing and remove the oil pipe banjo bolt. Temporarily connect the oil pipe to the ram cylinder with a banjo bolt that has been modified, by drilling and tapping $\frac{1}{4}$ in. BSP (Fig. 5). If the tractor is fitted with a three-way isolating valve, remove the banjo bolt on the end of the ram cylinder union and replace this with a bolt that has been modified by drilling and tapping $\frac{1}{4}$ in. BSP.

Connect a pressure gauge calibrated to 3000 lb/in.^{2} (210 kg/cm^2) to the banjo bolt, attach an implement to the linkage and place the control lever into the "raise" position. If the gauge shows a low pressure reading at all engine speeds, this indicates that the pump output is flowing to waste due to a leakage from the system. If the pressure rises slowly as the engine speed is increased, a worn hydraulic pump should be suspected.

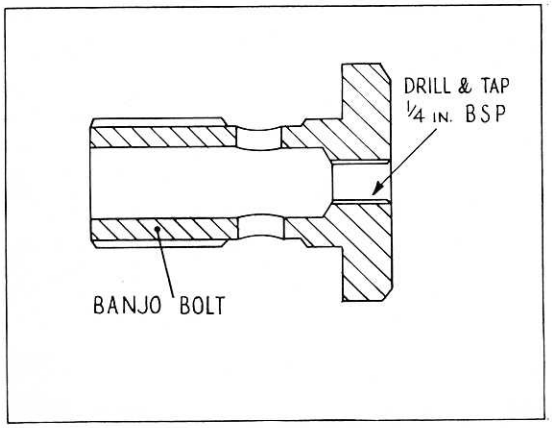


Fig. 5. MODIFICATION TO BANJO BOLT FOR CONNECTION TO PRESSURE GAUGE

Test E. To check the hold mechanism adjustment.

Disconnect the top link cable and disengage the override control. Place the control lever in the "raise" position and allow the implement to reach full height, then stop the engine. Observe that the implement does not creep down, then manually trip the override control into the hold position. If the implement commences to lower immediately the override control is tripped, adjust the hold mechanism, then re-test. If the linkage continues to fall when the hold mechanism is tripped on the second test, the non-return valve in the pump should be examined.

Test F. To check the ram piston for leakage.

If the tractor is fitted with a three-way valve, raise the implement then firmly close the left-hand control on the three-way valve. Closing this valve will prevent oil in the ram cylinder from returning into the system, if the implement, therefore, continues to fall when the valve is closed oil is leaking either through the ram cylinder relief valve or past the ram piston rings.

Remove the cover plate from the left-hand front of the axle case and remove the banjo bolt from the front end of the ram cylinder. If the tractor is fitted with a three-way valve, remove the union assembly from the front end of the ram cylinder. Temporarily attach the main oil pipe to the ram cylinder by means of a banjo bolt which has been modified by fitting a bolt through the centre (Fig. 6). Raise the implement

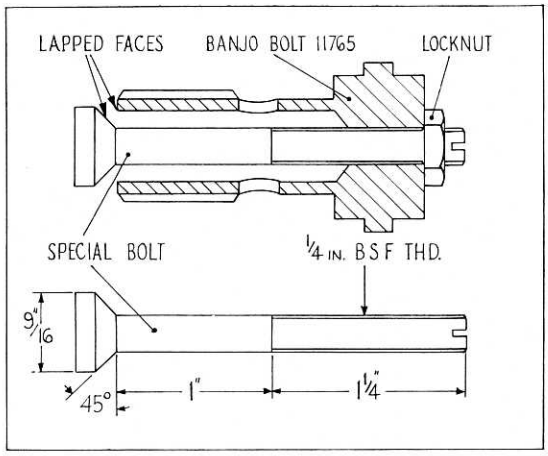


Fig. 6. MODIFICATION TO BANJO BOLT FOR CHECKING RAM CYLINDER

then firmly unscrew the bolt in the banjo bolt, to prevent oil in the ram cylinder from returning into the system, and place the control lever in the "lower" position. If the implement then creeps down and no oil can be observed leaking out of the cylinder relief valve, oil leakage is taking place past the piston rings.

Test G. To check the maximum hydraulic pressure.

If the tractor is not fitted with a three-way take-off valve remove the cover plate from the left-hand front of the rear axle case and connect a pressure gauge into the system by replacing the ram cylinder banjo bolt, part number 11765, with an adaptor (service tool 960620) or by modifying a banjo bolt as shown in Fig. 5.

Attach an implement to the linkage, start the engine and place the lift control lever in the 'raise' position. If a linkage locking bolt is fitted on the left-hand ramshaft bracket engage the bolt into the ramshaft arm when the linkage reaches the hold position ; this will prevent the piston from reaching the end of its stroke and uncovering the ram cylinder spill port. Tractors fitted with an automatic lift catch do not incorporate spill ports in the ram cylinder and this type of catch need not, therefore, be engaged. Operate the override control to trip the hold mechanism out of action, this will bring the pump into operation and enable a pressure reading to be taken. If the ram cylinder incorporates a relief valve this should open at 1 450–1 550 lb/in^2 (101–109 kg/mm^2) though when the engine is running at a fast speed the back pressure in the system may rise above this figure. If the ram cylinder does not incorporate a relief valve the pump relief valve should limit the pressure to 2 000–2 200 lb/in^2 (140–154 kg/cm^2).

If the tractor is fitted with a three-way hydraulic valve, remove the Exactor coupling from the rear of the seat support and connect a pressure gauge to the $\frac{1}{2}$ in. BSP pipe union, using service tool 960646 or any suitable adaptor.

Start the engine, close the ram cylinder oil-supply valve and open the rear take-off valve. Place the lift control lever in the 'raise' position and note the pressure gauge reading, the pump relief valve should limit the maximum pressure to 2 000–2 200 lb/in^2 (140–154 kg/cm^2). If the tractor is fitted with a relief valve in the ram cylinder, first check the pump

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pressure then open the ram cylinder valve. Engage the linkage locking bolt into the left-hand ramshaft arm when the implement reaches the hold position then operate the override control to trip the mechanism out of action and observe the gauge reading. The ram cylinder valve should open at 1 450–1 550 lb/in² (101–109 kg/cm²) though when the engine is running at a fast speed the back pressure in the system may rise above this figure.

Test H. To check the operation of the automatic depth control.

If the implement fails to operate at the depth required, and the control lever is in the maximum depth position, place the control lever into the "lower" position. The implement should then rapidly increase its operating depth, failure to do this indicating that the fault is in the setting of the implement and not in the tractor hydraulic system. Either the levelling levers are too short, preventing the implement from being fully lowered, or the top link is too long, giving insufficient pitch on the implement.

If the operating depth of the implement increases immediately the control lever is placed in the "lower" position, the hydraulic system is preventing the implement from attaining sufficient depth. This could be caused by excessive TCU pressure, or incorrect adjustment of the top link cable.

If the implement operates satisfactorily at full depth but will not maintain a consistent shallow depth, check that the compression in the top link is sufficient to operate the control unit. This may be checked by noting the position of the peg in the compression spring housing, if the peg does not move from the end of the slot when the implement is in work the control unit cannot operate correctly.

ADJUSTMENTS AND SETTING INSTRUCTIONS

Adjustment is available at the following points:—

1. Main relief valve pressure setting.
2. Ram cylinder relief valve pressure setting.
3. Pump valve operating rod.
4. Hold mechanism operating rod.
5. Hold mechanism striker arm.
6. Top link compression spring.
7. Top link flexible cable.
8. Control lever abutment screw.
9. Control lever pivot shaft.

The main relief valve (Fig. 13) is set to limit the maximum pump output pressure to 2000 lb/in² (140 kg/cm²) and may be adjusted by removing, or adding, shims between the cap and ball seat, see page 18.

As the pump relief valve is set to open at 2000 lb/in² (140 kg/cm²) for operating external equipment, 3½ in. (88·9 mm) diameter ram cylinders are fitted with a relief valve which opens at 1 500 lb/in² (105·6 kg/cm²)

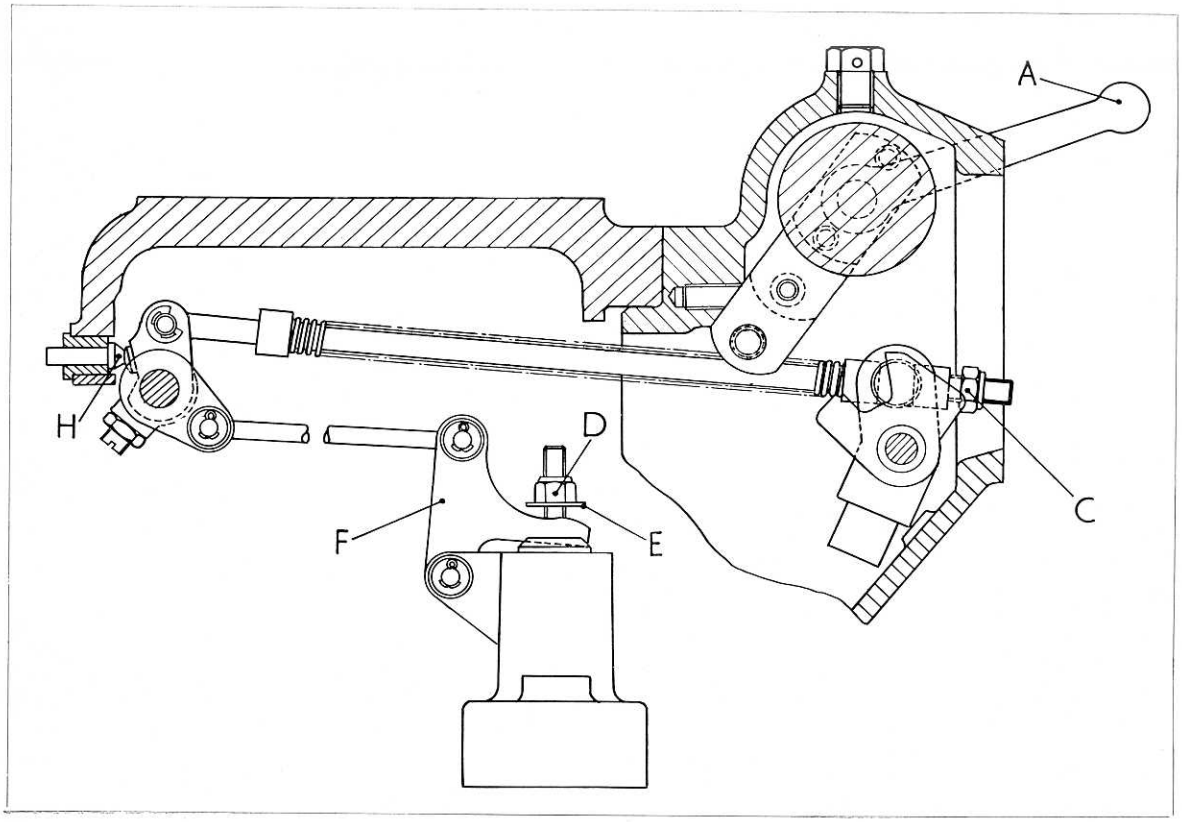


Fig. 7. PUMP LINKAGE ADJUSTMENT

A. Override Control
C. Linkage Nut
D. Pump Valve Rod Nut
E. Washer
F. Bell Crank Lever
H. Push Rod

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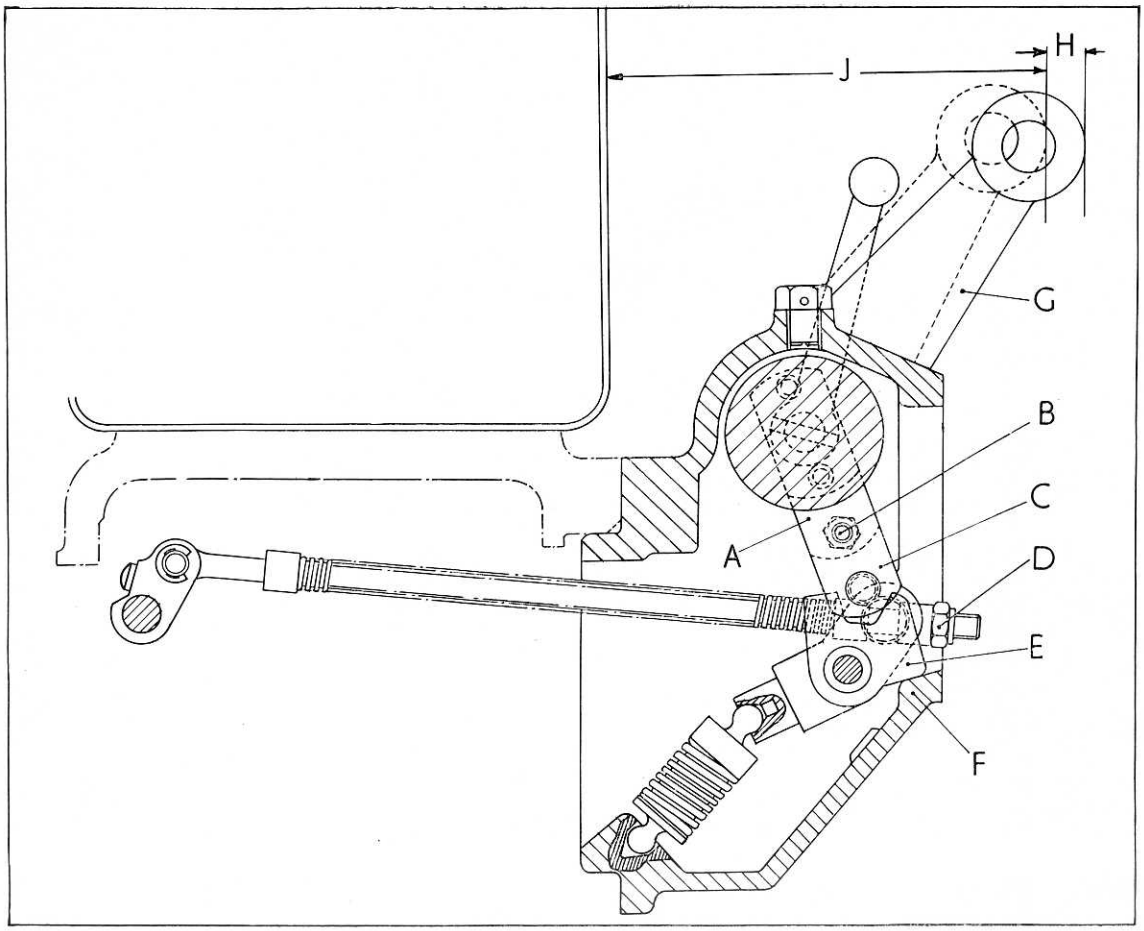


Fig. 8. HOLD MECHANISM ADJUSTMENT

A. Locating Plate
B. Adjusting Bolt
C. Striker Arm
D. Linkage Nut
E. Trip Lever
F. Stop
G. Ramshaft Arm
H. Setting Distance $\frac{1}{4}$-$\frac{3}{8}$ in. (6.35-9.52 mm)
J. Distance Measured (at full height)

and prevents the lift from being overloaded. $3\frac{1}{8}$ in. (79·37 mm) diameter ram cylinders are not fitted with a relief valve however as these operate at full pump pressure of 2 000 lb/in² (140 kg/cm²).

Re-adjustment of the main, or ram cylinder, relief is not normally required and should not be attempted unless a suitable pressure gauge is available, otherwise serious damage may result.

Adjusting the Linkage

If the system has been disturbed, or if incorrect adjustment is suspected, carry out the following procedure:—

1. Pump valve linkage adjustment. Fig. 7.

(a) Remove the cover plate from the right-hand ramshaft housing and remove the inspection plug from the top of the power take-off housing.

(b) With the override control A engaged and the linkage lowered, place the control lever into the "raise" position then check that the nut C on the hold mechanism is clear of its distance piece. If the distance piece cannot be turned quite freely, unscrew the nut a few turns to ensure that the linkage is in contact with the push rod H.

(c) Tighten the Nyloc nut D, on the pump valve rod, until it just holds the flat washer E against the bell crank lever F, then **unscrew** the nut D $2\frac{3}{4}$ turns on early series tractors (BSF thread) or 2 turns on later series tractors (UNC thread) and replace the inspection plug.

2. Hold mechanism adjustments. Fig. 8.

(a) Raise the linkage by hand until the hold mechanism trips, and engage the locking bolt, or catch, to lock the linkage in the raised position.

(b) With the control lever in the "raise" position tighten the Nyloc nut D until the heel of the rocker arm E commences to lift away from the casing F then **unscrew** the nut D four complete turns. Inserting a 0·002 in. (0·05 mm) feeler gauge between the rocker arm E and the casing F will assist in determining the point at which rocker arm commences to lift away from the casing. On some tractors it will be found that the rocker arm does not contact the casing when the nut D is fully unscrewed and in these instances the clearance between the rocker arm

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and casing should be measured, by inserting a suitable feeler gauge, and then the point at which the rocker arm commences to lift determined by inserting a feeler gauge 0·002 in. (0·05 mm) thicker than the measured clearance.

(c) Disengage the lift lock and operate the linkage by hand to check that the mechanism trips over quite freely then attach an implement and raise the linkage under power to check that the hold mechanism operates when the linkage is in the correct position.

On tractors fitted with a linkage locking bolt the mechanism should operate when the hole in the left-hand ramshaft arm is opposite the locking bolt. If the bolt cannot be engaged when the linkage has reached the hold position, lower the linkage, release the clamp bolt B and move the striker arm C forward, or backward, as required until the correct position is obtained.

On tractors fitted with an automatic linkage lock the hold mechanism should operate before the ramshaft reaches the point where the catch will engage and make it necessary for the override control to be operated in order to engage the catch. To check the mechanism for correct operation; disconnect the override control and raise the linkage to the maximum height position, then measure the distance from the rear face of the mudguard support to the end of the ramshaft arm G. Lower the linkage, engage the override control and place the lift control lever in the 'raise' position; allow the automatic hold mechanism to operate then take a second measurement from the same two points as taken previously. As the ramshaft arm should be $\frac{1}{4}$–$\frac{3}{8}$ in. (6·35–9·52 mm) from the maximum height position the second measurement should be this amount longer than the first measurement J. If the distance H is not within $\frac{1}{4}$–$\frac{3}{8}$ in. (6·35–9·52 mm) release the clamp bolt B and move the striker arm forward, or backward, as required to obtain the correct position.

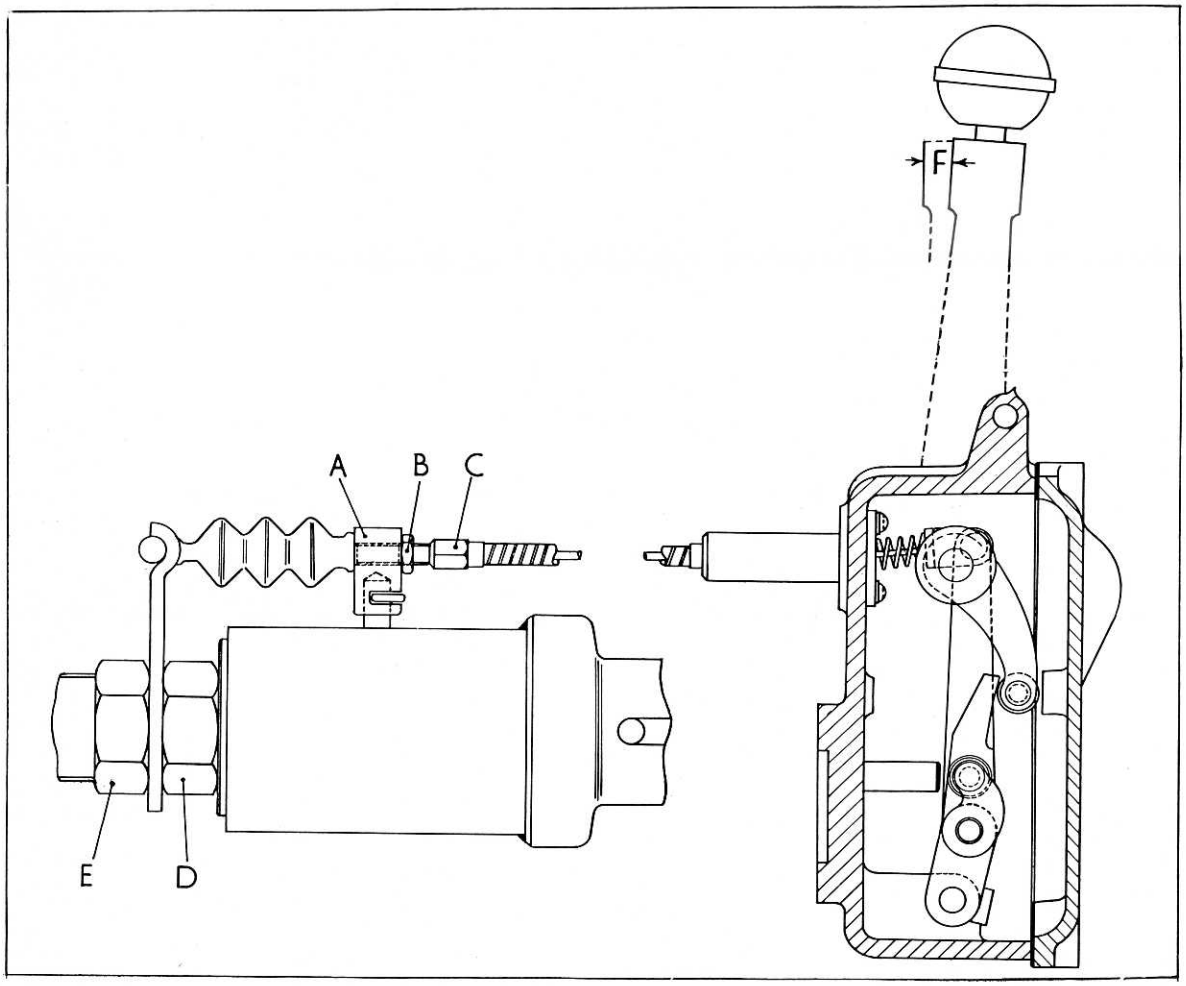


Fig. 9. TOP LINK CABLE ADJUSTMENT

A. Abutment Block
B. Locknut
C. Cable Adjuster
D. Inner Nut
E. Outer Nut
F. Setting Distance

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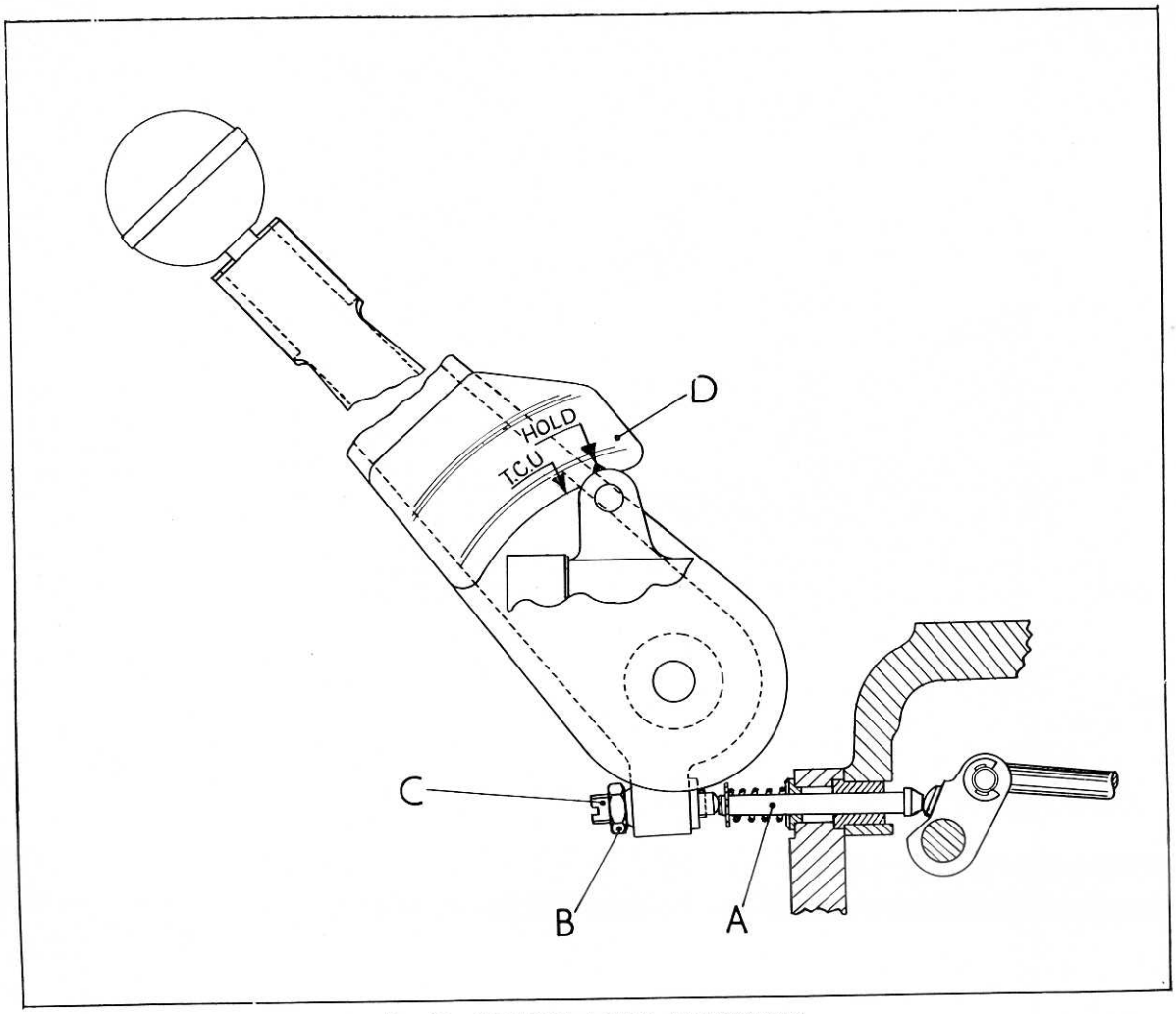


Fig. 10. CONTROL LEVER ADJUSTMENT

A. Push Rod
B. Lock Nut
C. Abutment Screw
D. Pre-set Guide

3. Top link and cable adjustment. Fig. 9.

(a) Release the outer nut E on the top link compression unit and adjust the inner nut D until any play is removed, but the spring is not compressed, then re-tighten the outer nut E.

(b) Attach an implement of approximately 800 lb (360 kg) weight on to the linkage then release the cable adjuster locknut B, and screw the cable adjuster fully into the abutment block A.

(c) Raise the implement to full height then stop the engine and move the control lever $\frac{1}{2}$ to $\frac{3}{4}$ in. (13 to 19 mm) forward from the fully rearwards position, as at F.

(d) Screw the top link cable adjuster C out of the abutment block until the implement commences to creep down, then screw the adjuster back into the block one full turn and tighten the locknut.

4. Control lever adjustment. Fig. 10.

(a) Place the control lever into the "lower" position and check that the lever has sufficient resistance to remain stationary. If the lever returns to the T.C.U. position when released, tighten the Nyloc nut on the control lever pivot shaft until the lever has sufficient resistance to remain in the "lower" position unaided.

(b) Disconnect the flexible cable from the top link, attach an implement of approximately 800 lb (360 kg) weight to the linkage then raise the implement to full height.

Caution—Do not attempt to disconnect the top link cable unless the implement is resting on the ground as disturbing the cable may lift the depth control valve off its seat and allow the linkage to fall.

Set the pre-set guide into the "hold" position then unscrew the control lever abutment screw C. Move the control lever into alignment with the gauge lever then slowly screw the abutment screw into the control lever. Continue screwing the abutment screw in until it contacts the push rod A and operates the valve linkage. Immediately the implement commences to creep down **unscrew** the abutment screw one full turn and tighten the locknut B.

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CONTROL VALVE ASSEMBLY

The control valve assembly consists of the depth control valve, traction control valve and operating linkage. No internal adjustments are required, and the mechanism is lubricated by the leak-off oil from the valves forming an oil bath in the housing.

Figure 11 shows a section through the valve assembly. The depth control valve E is operated by the roller H, which is connected to the top link cable and changes position according to the amount of compression in the top link. Since the entire pump output is flowing through the valve any change in the amount of opening of the valve will result in a change in back pressure in the ram cylinder. The change in back pressure thus counteracts the change in depth by raising, or lowering, the linkage as required.

The traction control valve O is a pressure balanced valve, whose operation is identical with the pressure balanced valves in the hydraulic pump. When the depth control valve is open oil flows into the port P, where it exerts pressure against the valve O. This pressure tends to lift the valve O off its seat but is balanced by the oil passing through an orifice in the valve and building up an equal pressure on the opposite side of the valve. The valve, therefore, remains seated until the pressure behind the valve is sufficient to lift the ball M off its seat. This allows surplus oil to flow to waste, thus preventing any further increase in pressure behind the valve, and any increase in pressure in port P will not then be accompanied by a corresponding increase in pressure behind the valve. The higher pressure in port P then opens the valve and allows a controlled flow of oil to waste.

From the above description, it will, therefore, be noted that whilst the main flow of oil from port P passes directly to waste, the maximum pressure in port P is determined by the opening pressure of the ball valve M. The handwheel thus controls the pressure setting of the traction control valve by adjusting the pressure of the ball valve spring L. The ball J locates on to the six flats machined on the handwheel spindle and gives six positive positions during each complete turn of the hand wheel.

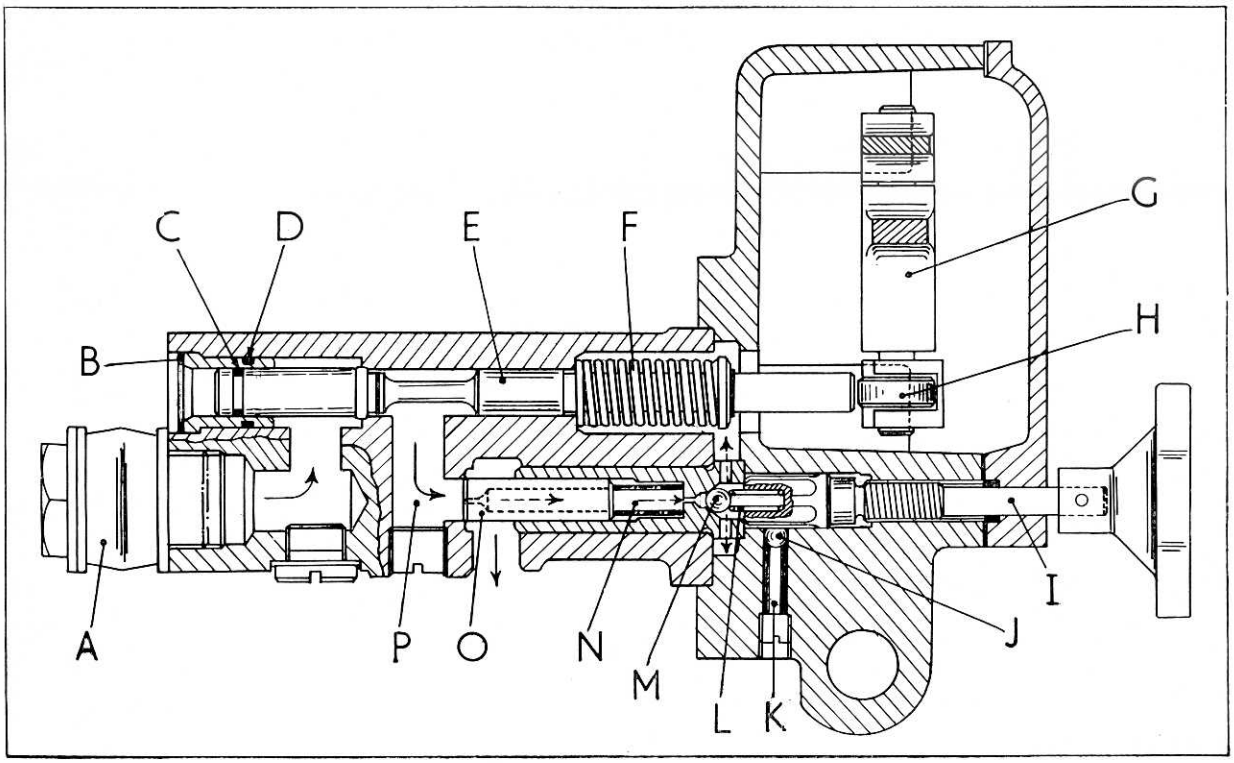


Fig. 11. SECTION THROUGH CONTROL VALVE

A. Inlet Union
B. Circlip
C. 'O' Ring
D. 'O' Ring
E. Depth Control Valve
F. Valve Spring
G. Floating Pivot
H. Roller
I. Handwheel Spindle
J. Detent Ball
K. Detent Spring
L. Ball Valve Spring
M. Ball Valve
N. Cavity
O. Traction Control Valve
P. Port

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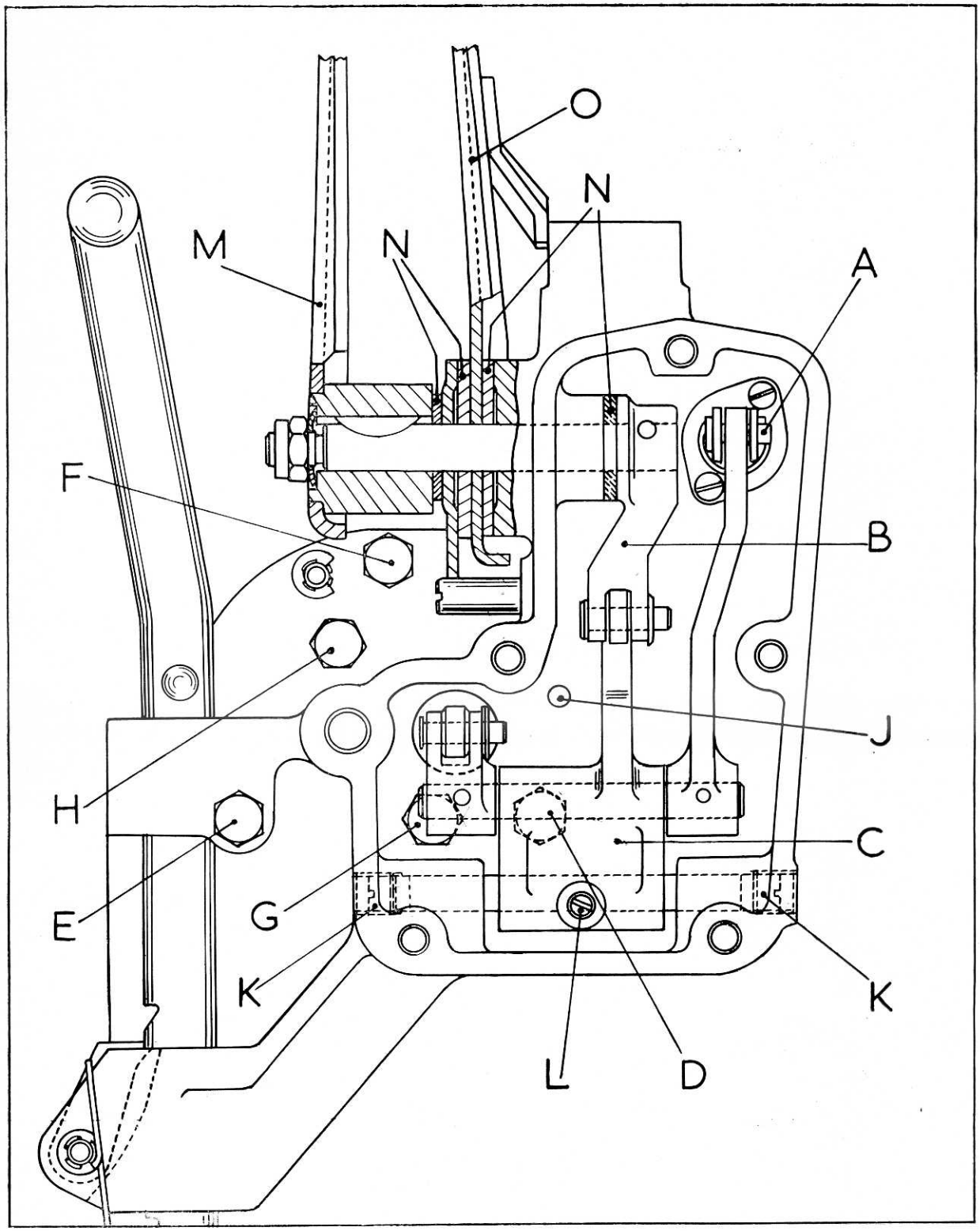


Fig. 12. CONTROL VALVE MECHANISM

A. Cable Attachment Pin	B. Operating Lever
C. Floating Pivot	D. Axle Case Bolt
E. Axle Case Bolt	F. Axle Case Bolt
G. Valve Body Bolt	H. Valve Body Bolt
J. Oil Level Hole	K. Shaft Plug
L. Locating Grub Screw	M. Control Lever
N. Friction Washers	O. Pre-set Guide

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Removing the Valve Assembly

Disconnect the linkage and remove the ramshaft complete with its right-hand housing. Remove the banjo bolt connecting the oil feed pipe to the rear of the valve housing, taking care of the two sealing washers. Disconnect the linkage from the lower end of the hand brake lever and remove the traction control handwheel, this is secured to the spindle with a Mills pin. Remove the five cap bolts attaching the cover to the housing then break the joint and withdraw the cover. A quantity of oil will be released when the cover is removed, but this will be replaced automatically when the system is in operation.

Remove the clevis pin (A, Fig. 12) connecting the flexible cable to the depth control valve operating lever and remove the nut from the control lever pivot shaft. Slide the control lever towards the end of the shaft, until it is clear of the key, this will enable the lever B to be pulled forward so that the floating pivot C can be swung downwards to expose the attachment bolt D. Remove the three attachment bolts D, E and F, then withdraw the complete assembly forward out of the axle case.

To replace the unit, reverse the removal procedure, ensuring that all gaskets, sealing washers, etc., are in good condition and taking special care to ensure that the housing to axle case gasket does not obstruct the oil drain hole J. This hole controls the housing oil level and if restricted will allow the housing to fill completely, resulting in oil leakage from the flexible cable aperture.

Before refitting the control lever, slide the pivot shaft into the housing and smear the shaft with anti-scuffing paste. If the shaft shows any tendency of being tight in the casing remove the shaft and clean with abrasive tape.

When refitting the Nyloc nut onto the control lever pivot shaft, ensure that the Belleville washer is first placed on the shaft and the nut then tightened sufficiently to allow the friction washers to hold the lever in any set position.

Dismantling the Valve Assembly

After removing the complete assembly from the tractor, remove the two bolts G and H (Fig. 12) and separate the valve body from the linkage housing, taking care of the ball M and spring L (Fig. 11) which will be displaced.

Remove the traction control valve plunger, complete with sleeve and spring, and remove the depth control valve spring F after removing the circlip from the valve spindle. Extract the circlip B from inside the valve body then push the valve spindle and sleeve out of the body.

The drilled plug screwed into the top of the valve body is an oil jet, which lubricates the automatic hold mechanism by spraying oil into the right hand ram-shaft bracket housing when the depth control valve is open.

Assembling the Valve Mechanism

After thoroughly cleaning all parts, carefully examine the valves for any sign of wear, paying particular attention to the valve seat faces. It is essential that the valves slide freely in their bores and special care should be taken during assembly to prevent the inclusion of any foreign matter which would affect the movement of the valves. Depth control valves and bodies are selectively paired during assembly and should not, therefore, be interchanged with similar components, from another valve.

TCU valves and sleeves are also selectively assembled and it should be noted that two assemblies are available. These assemblies are identical in appearance but as they give different maximum pressures assembly number 961028 should only be fitted to tractors with a $3\frac{1}{8}$ in. (79·4 mm) diameter ram cylinder and assembly number 88615 fitted to tractors with a $3\frac{1}{2}$ in. (88·9 mm) diameter ram cylinder.

When assembling the valve, replace the parts in the reverse order of dismantling, ensuring that all components are clean and lightly oiled. All gaskets and 'O' rings should be replaced regardless of condition. After assembling the depth control valve, check the valve for freedom of operation. When attaching the valve body to the linkage housing ensure that the traction control valve ball and spring are first placed in position.

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HYDRAULIC PUMP UNIT

Description

Figure 14 shows a section through the pump unit. Oil is drawn through the gauze and magnetic filter, situated in the base of the transmission case, into the inlet elbow A from where it is pumped by the rotors Q into the passage B. From there it passes through the non-return valve C into the delivery port D, which is connected to the ram cylinder supply pipe by means of a connector O mounted on the pump support plate P.

The valves E and F control the flow of oil into the port D and are operated by the stirrup G which is connected to the lift control lever. The stirrup has three positions, in the lower position both valves are seated and the oil from the rotors passes through the non-return valve C and into the system through the port D, thus raising the linkage. When the stirrup is in the mid-position valve E remains seated but valve F is opened, oil from the rotors, therefore, passes into the port H from where it is directed to waste. Oil is, however, retained in the system, due to the valve E and the non-return valve C remaining seated, which supports the linkage in the hold position. Further movement of the stirrup into the upper position also opens the valve E, so that oil in the ram cylinder returns into the port D and then passes into the waste port H, allowing the linkage to lower.

It will be noted that the valve F is open whenever the stirrup is in the mid (hold) or upper (lower) position. This allows the pump to idle since it is then only circulating oil into the waste port H, which is piped to the gearbox and power take-off unit for lubrication purposes.

The rotors Q are supported in bushes M which not only provide bearings for the rotor shafts but also seal the side faces of the rotors against leakage. Most of the internal leakage that occurs in gear type pumps is due to the fixed running clearance between the rotors and side-plates. The rotor bushes are therefore pressure loaded by allowing oil pressure from the pump pressure port B to be fed to an annular area outside the front rotor bushes. This area is sealed by means of a sealing ring J and is slightly greater than the pressure area on the gear side of the bush. The difference in pressure area results in the complete rotor and bush assembly being pressed against the pump housing end cover at all pump output pressures, and oil leakage between the rotor side faces is thus reduced to a minimum.

The valves E and F are pressure balanced valves, the oil pressure acting on both sides of the valve. Figure 13 shows a section through valve F. Oil pressure from the underside of the valve passes through the orifice A and into the cavity D. The pressure on the top of the valve is thus able to hold the valve seated against the equal pressure acting against the underside of the valve. The spring C does not therefore control the operation of the valve but only applies a light pressure to give the valve a bias towards its seat. When the pressure in the cavity D is sufficient to overcome the tension of the spring H the ball valve F is raised off its seat and allows oil to leak away faster than it can be replaced by the restricted flow through the orifice A. Any further increase in pressure against the underside of the valve is not then accompanied by a corresponding increase in the cavity D which results in the valve B being raised off its seat and allowing oil to flow to waste. The relief pressure of the valve is therefore controlled by the tension of the spring H which may be adjusted by removing, or adding, shims G between the cap and the valve seat. The operation of the valve E is the same as valve F except that no relief valve is incorporated in the end cap as no maximum pressure control is required.

The valve seats are loose inserts mounted on rubber sealing rings, thus permitting the seats to align themselves with the valves which are mounted in a detachable housing.

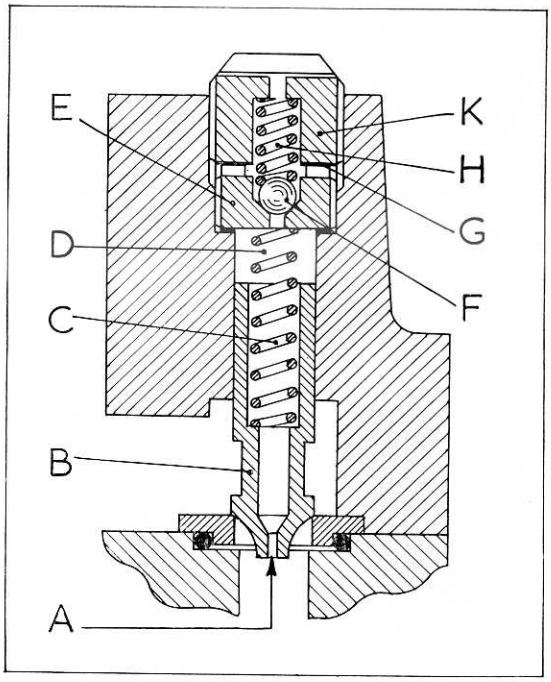


Fig. 13. SECTION THROUGH PUMP RELIEF VALVE

A. Orifice
B. Valve Plunger
C. Plunger Spring
D. Cavity
E. Ball Seat
F. Ball Valve
G. Adjustment Shim
H. Ball Spring
K. Plug

Removing the Pump Unit

Access to the pump unit is obtained by removing the power take-off and pulley unit after first draining the transmission oil.

The pump is driven from a gear on the power take-off shaft and this is removed with the P.T-O. unit. After removing the P.T-O. unit, remove the four set

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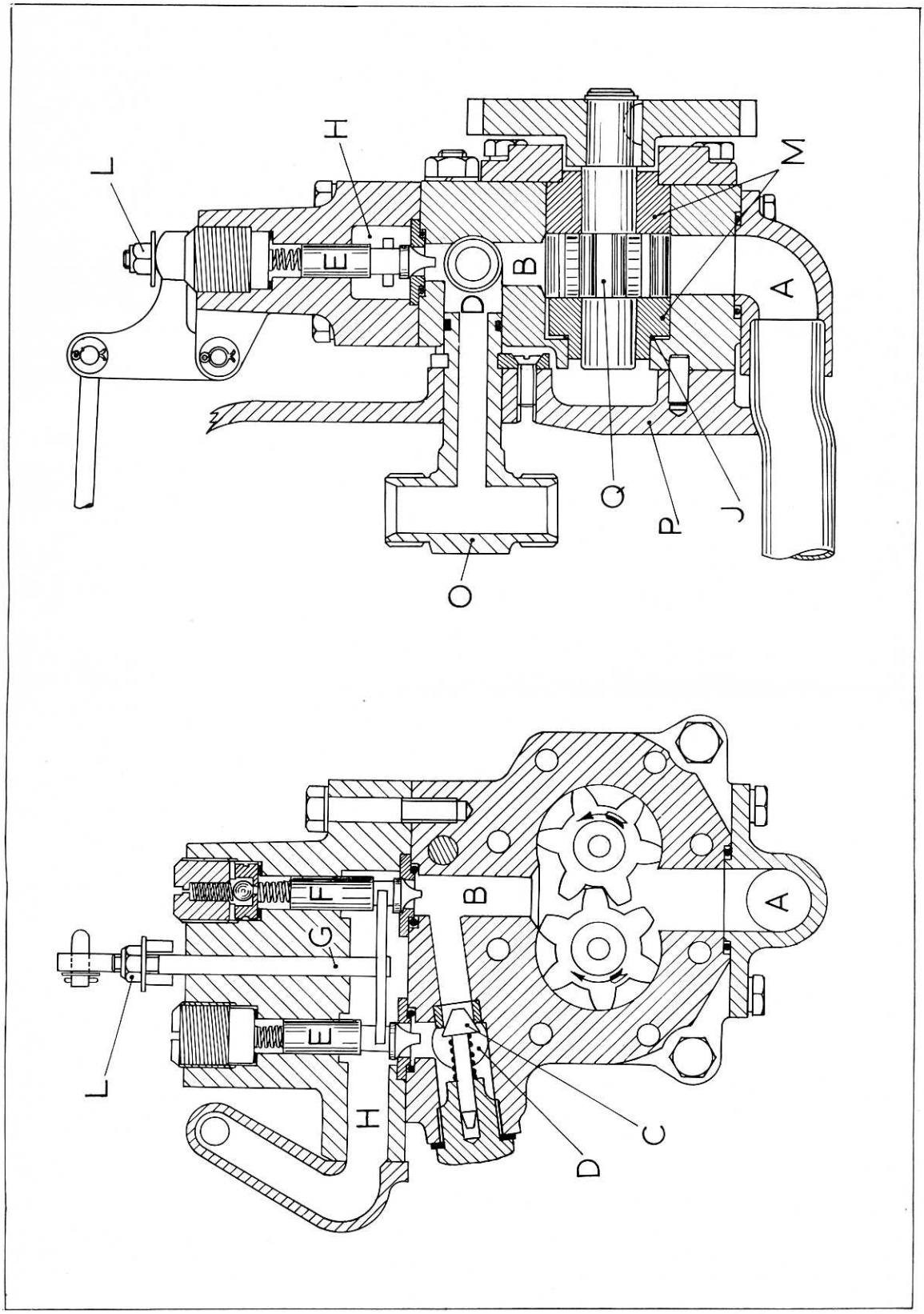


Fig. 14. SECTIONAL ARRANGEMENT OF HYDRAULIC PUMP

A. Inlet Elbow
B. Oil Passage
C. Non-return Valve
D. Outlet Port
E. Hold Valve
F. Main Relief Valve
G. Valve Stirrup
H. Waste Port
J. Sealing Ring
L. Adjusting Nut
M. Rotor Bushes
O. 'T' Connector
P. Backplate
Q. Rotor

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screws attaching the intake elbow to the base of the pump body and unscrew the union on the gearbox lubricating pipe. Disconnect the valve operating rod from the bell crank lever and remove the two lower attachment bolts. Remove the nut from the upper attachment stud and draw the pump rearwards. The pump outlet port is on the rear face of the pump housing and fits on to a connector mounted on the pump support plate.

Replacement of the pump unit is the reverse of removal. Special care being taken to ensure that the rubber sealing ring on the pump outlet connector is not displaced when the pump is pushed into position. When re-fitting the power take-off unit, ensure that the lubricating pipe from the pump enters the gear casing, otherwise the unit will be starved of oil. Turning the PTO shaft, with the unit in gear, will enable the drive shaft splines to line up with the coupling splines. The PTO shaft should also be turned to ensure meshing of the pump drive gears, on Livedrive tractors it will be necessary to hold the PTO clutch disengaged to enable the shaft to be turned.

Dismantling the Pump Unit

Remove the five bolts attaching the valve chest to the rotor housing and withdraw the valve chest. The valve seats will be released when the chest is removed and these should be identified so that they can be replaced in the same positions.

To remove the valve plungers, remove the nut from the top of the valve operating rod and withdraw the stirrup and valve plungers. Remove the plugs from the top of the valve bores, noting the number of shims fitted below the pressure relief valve plug. These shims adjust the pressure at which the valve operates and should be replaced as removed.

Remove the circlip securing the pump drive gear on to the rotor shaft then remove the gear using a suitable extractor. Do not remove the drive gear by

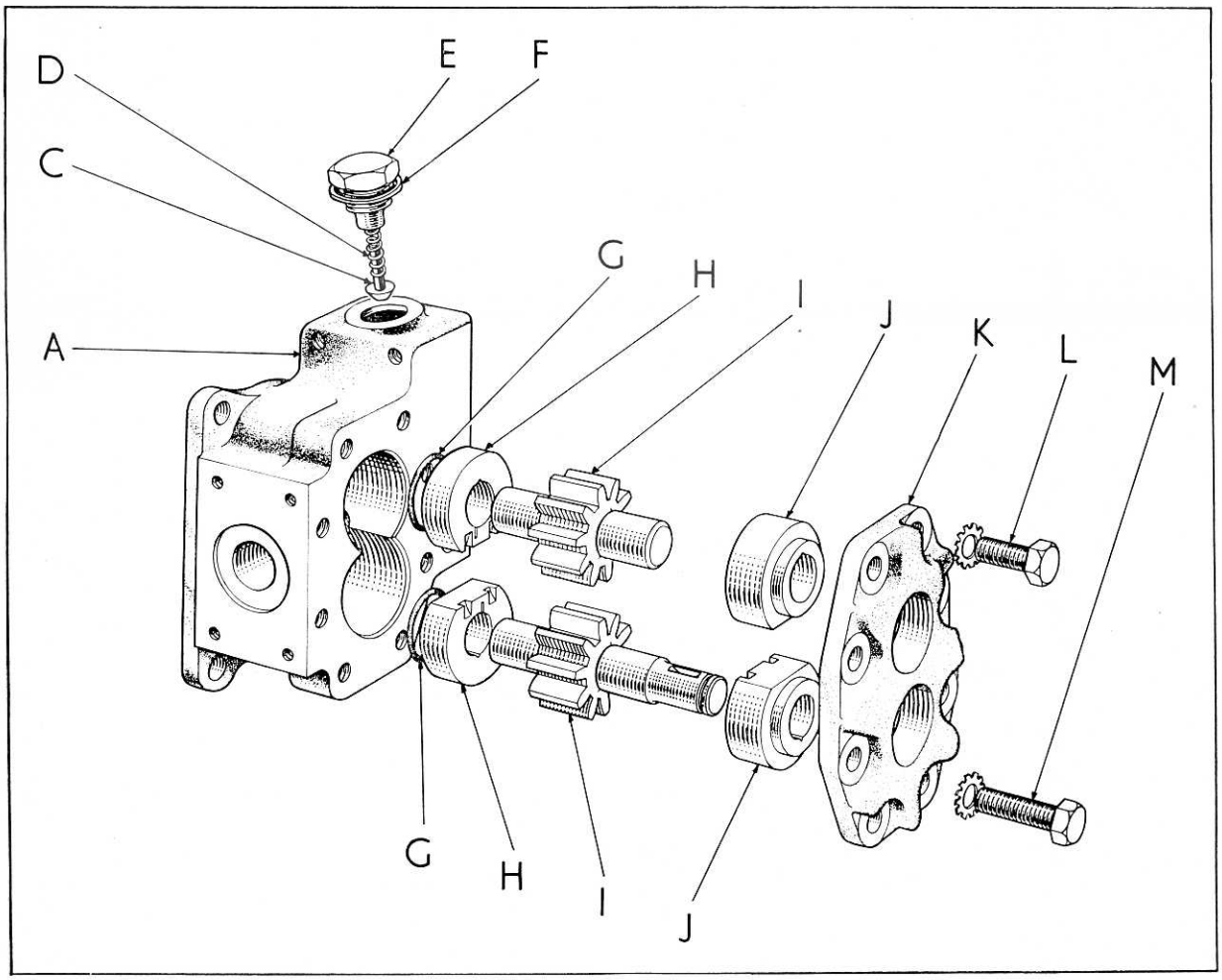


Fig. 15. ROTORS AND HOUSING

A. Pump Body
C. Non-return Valve
D. Valve Spring
E. Plug
F. Sealing Washer
G. 'O' Ring
H. Rotor Bushes
I. Rotors
J. Rotor Bushes
K. End Plate
L. Short Bolt
M. Long Bolt

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hammering the end of the rotor shaft as this will damage the rotor bushes.

Remove the eight bolts attaching the cover to the rotor housing. Remove the end cover and withdraw the rotors and bushes. The bushes should slide out of the housing. If there is a little stiffness the rotor pack may be shaken out by tapping the edge of the housing on a wooden block.

The non-return valve assembly may be removed by unscrewing the hexagon headed plug. The valve seat is a steel insert and should not be removed.

Except for the withdrawal of the drive gear, no special tools are required for stripping or re-assembly. Hammers or similar tools must not be used on the pump.

Assembling the Pump Unit (Fig. 15)

The pump components should be washed in clean paraffin and placed on a clean bench. If more than one pump is to be stripped at the same time, care should be taken to ensure that all components are segregated along with their housings and covers. The width of the rotors are paired to 0·0002 in. (0·005 mm) and the length of the major diameters of the bushes are also paired to the same limit. It is thus essential not to interchange pump components indiscriminately.

Smear the 'O' rings G with a good quality grease and fit them on to the tails of the bushes H. The tail diameters of the bushes H are smaller than the bushes J and the bushes are not, therefore, interchangeable.

With the 'O' rings fitted, slide the two bushes H down to the bottom of the pump bores. A little clean oil on the pump bores will assist this operation.

Apply a quantity of clean oil into the pump and slide the two rotors into their respective bores. Slide the two bushes J into the body with their slotted faces against the gears. Fit the cover K and replace the eight bolts, with shakeproof washers. Noting that two bolts are shorter than the others for use where the cover section is thinner. Tighten the bolts by diagonal selection, to 40-45 lbs ft (5·5-6·2 kgm)

Replace the non-return valve assembly after ensuring that the valve and seat are in good condition.

Re-fit the pump drive gear on to the rotor shaft. First fitting the driving key into the shaft and then pressing the gear on to the shaft until the retaining circlip can be fitted. When fitting the driving gear, special care should be taken to ensure that no end loading is taken by the rotors, as the rotor teeth will easily damage the comparatively soft bushes. When pressing the gear on to the shaft, support the opposite end of the shaft on a peg or stop, the pump housing is open at the end to allow this.

After fitting the drive gear check that the rotors can be turned by hand. Check the fit of the valve plungers in the housing bores. It is important that the valves are a close fit in their bores, as any oil leakage down the stem will affect the operation of the valves. Valves are graded, according to the sizes shown on the chart, and then selectively assembled to bores of the same grade. Replacement valves supplied as spares are all of blue grade and should be carefully lapped into the housing, using fine lapping compound, until only sufficient clearance exists to ensure freedom of operation. If the housing bores are worn to a greater diameter than 0·4692 in. (11·918 mm) the clearance will be excessive and a new housing, complete with matched valves, should be fitted.

The valve plunger seats and seat inserts should also be examined to ensure that they are in good condition. The valves should make a line contact with their seat and may be lightly lapped, with fine paste, if required.

Assemble the valves into the valve housing, fitting the relief ball and spring into the end cap on the main relief valve, and replacing the adjusting shims as removed.

Replace the valve seat inserts on to the pump body, positioning the sealing rings underneath the inserts, and fit the valve housing. Lightly tighten the housing bolts, then gently tap the housing on each side, to align the seats, before fully tightening the bolts.

Code Colour		Housing Bore	Leak-off Valve 903298	Control Valve 89236
Red	in.	0·4682/0·4685	0·4675/0·4679	0·4668/0·4672
	mm.	11·892/11·900	11·875/11·885	11·860/11·867
Yellow	in.	0·4685/0·4688	0·4679/0·4683	0·4672/0·4676
	mm.	11·900/11·908	11·885/11·895	11·867/11·877
Blue	in.	0·4688/0·4692	0·4683/0·4686	0·4676/0·4679
	mm.	11·908/11·918	11·895/11·902	11·877/11·885

CHART OF VALVE PLUNGER DIAMETERS AND BORE GRADES.

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TOP LINK UNIT AND CONTROL CABLE

Figure 16 shows a section through the top link unit. The screwed shaft is a sliding fit in the spring housing and is secured by means of a peg passing through the end of the shaft. The outer ends of the peg are located in slots in the spring housing so that when the linkage is raised and the link is in tension the link becomes solid due to the peg being at the end of the slot, but when the implement is in work and the link is in compression, the peg slides freely in the slot and allows the thrust to be taken by the compression spring.

Variations in the length of the compression spring, due to variations in the amount of thrust, are then transmitted to the flexible cable which is attached to the moving shaft (inner cable) and stationary housing (outer casing).

To remove the compression spring unscrew the locknut B then remove the cable bracket M. Remove the nut C and hold the housing vertical to allow the abutment washer and spring to fall out of the housing.

Whenever the unit is dismantled the spring dowel pin F should be removed, the shaft A withdrawn from the housing and lubricated with anti-scuffing paste before being assembled.

Replace the spring in the reverse order of removal, tightening the inner nut until there is no end play in the shaft but the spring is not compressed, then replace the cable bracket and outer nut. Overtightening the inner nut will pre-load the spring and affect the operation of the unit.

For satisfactory operation of the depth control valve it is essential that the flexible cable operates quite freely. The cable should be lubricated through the grease nipple at regular intervals and care should be taken to ensure that the outer casing is not damaged in any way.

To check the cable for freedom of operation. Lower the linkage and disconnect the cable from the top link, place the control lever into the "raise" position then pull the inner cable against the spring whilst holding the outer casing. If the spring tension does not return the inner cable back to its original position, the cable should be removed and freed or replaced.

To remove the flexible cable. Remove the traction control handwheel, this is secured to the shaft by means of a Mills Pin, then remove the control valve housing cover. A quantity of oil will be released when the cover is removed, this will, however, be replaced automatically when the system is in operation. Disconnect the cable from the top link and unscrew the abutment block off the cable adjuster. Remove the clevis pin attaching the cable to the depth control valve operating lever and remove the two screws attaching the cable casing H to the inside of the control valve housing. After removing the grease nipple from the centre of the cable casing, withdraw the complete cable assembly out of the control valve housing.

Refit the cable in the reverse order of removal, ensuring that the valve housing cover gasket is undamaged and finally adjusting the cable in accordance with the instructions on page 14.

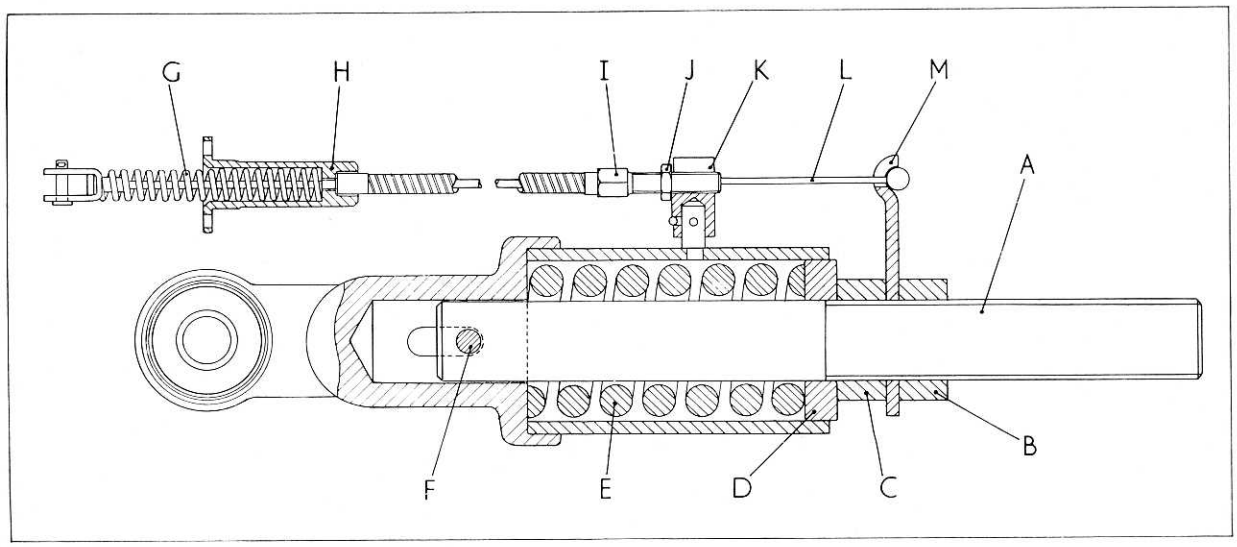


Fig. 16. TOP LINK COMPRESSION UNIT

A. Shaft
B. Outer Nut
C. Inner Nut
D. Abutment Washer
E. Compression Spring
F. Shaft Peg
G. Cable Spring
H. Cable Housing
I. Cable Adjuster
J. Locknut
K. Cable Abutment Block
L. Inner Cable
M. Cable Bracket

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RAM CYLINDER AND RAMSHAFT

To remove the Ramshaft

Remove the cover from the right-hand ramshaft bracket and remove the Nyloc Nut and distance piece from the end of the hold mechanism linkage rod. Remove the four bolts attaching the right-hand housing to the axle case, then remove the six ram cylinder cover bolts; the two centre cover bolts pass through the axle case and are fitted with nuts adjacent to the ram cylinder union cover plate.

Whilst supporting the weight of the ramshaft, remove the ram cylinder cover then remove the ramshaft complete with right-hand bracket.

To remove the right-hand bracket from the ramshaft remove the two countersunk screws, securing the override control in the housing, then withdraw the control assembly out of the housing (Fig. 20). Remove the circlip from the ramshaft extension and slide the housing off the shaft.

After removing the ramshaft, remove the cover plate from the front of the axle casing then disconnect the oil pipe banjo union and push the ram cylinder out of the axle case. If the tractor is fitted with a three-way valve, it will be necessary to remove the union assembly from the front end of the ram cylinder (see page 27) before removing the ram cylinder.

The ramshaft arms are keyed and shrunk on to the shaft and should therefore be regarded as an integral assembly. The ramshaft assembly on later series 850 tractors is dimensionally identical to the ramshaft on 880-950 and 990 model tractors but as the shafts are of different material assembly number 908036 must only be fitted to 850 model tractors; to assist identification these shafts are stamped '850' adjacent to the top link attachment.

To re-assemble, replace the components in the reverse order of removal, ensuring that the ramshaft bearing seals are positioned on the ramshaft before the ramshaft is placed in position.

To facilitate guiding the hold mechanism on to the linkage rod, the inner distance piece and rod are drilled to enable the compression spring on the rod to be held in the compressed position, by temporarily fitting a split pin through the distance piece and rod.

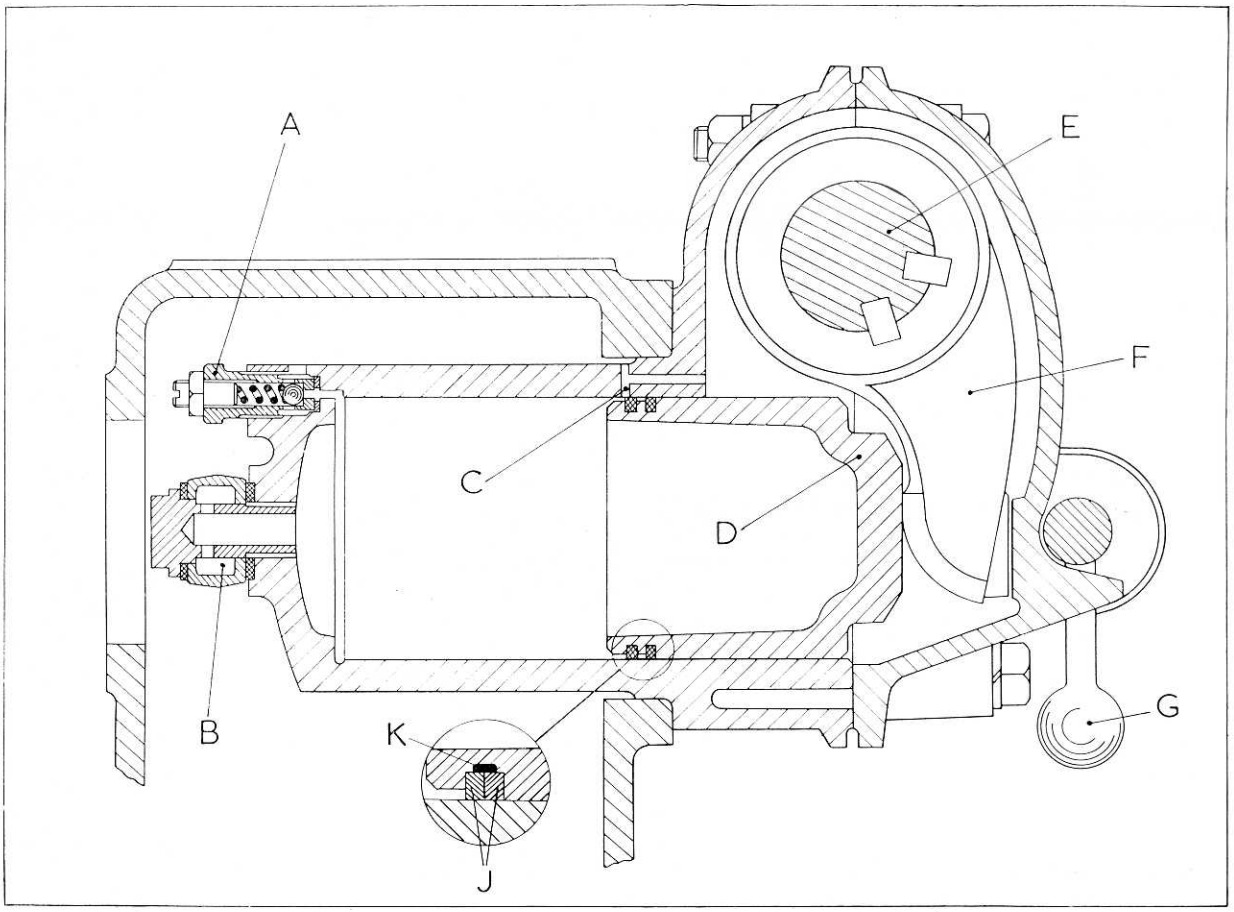


Fig. 17. SECTION THROUGH RAM CYLINDER (Early series tractors)

A. Pressure Relief Valve
B. Inlet Union
C. Spill Port
D. Ram Piston
E. Ramshaft
F. Ramshaft Arm
G. Lift Locking Bolt
J. Piston Rings
K. Rubber Seal

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The ram cylinder cover has a faced joint and requires no gasket, the faces must, however, be clean and smeared with jointing compound. After attaching the housings to the axle case, remove the split pin from the hold mechanism rod and fit the outer distance piece and Nyloc Nut. Adjust the nut in accordance with the instructions on page 12, then replace the cover.

Ram Cylinder—Early series tractors

Figure 17 shows a section through the ram cylinder. Oil from the hydraulic pump enters the cylinder through the banjo union B and exerts pressure against the piston D, which turns the ramshaft E by means of the arm F.

The valve A is a pressure relief valve and is set to open at 1 500 lb/in² in order to protect the linkage from damage due to overloading.

The bolt G engages the ramshaft arm and may be used to lock the linkage in the raised position.

When the piston reaches the end of its stroke the port C is uncovered and allows oil to spill from the cylinder; a cross drilling into the spill port feeding oil into the cylinder cover to lubricate the piston face.

On earlier production tractors the two cast-iron piston rings were fitted in separate grooves but on later series tractors this arrangement was changed by fitting both rings in a single double-width groove and fitting a thin rubber seal underneath the ring joint.

When refitting the piston into the cylinder ensure that the ring gaps are diametrically opposite and the piston and bore are clean. Smear the piston thrust face with anti-scuffing paste and replace the relief valve: do not overtighten the relief valve, a tightening torque of 20 lb ft (2·76 km g) is sufficient.

Ram Cylinder—Later model tractors

Figure 18 shows a section through the ram cylinder Oil from the hydraulic pump enters the cylinder through the banjo union and exerts pressure against the piston N, which turns the ramshaft C by means of the connecting rod M and Lever D.

The valve A is a bleeder valve for venting the system, to remove air left in the cylinder after assembly. The pipe B is connected to the gearbox lubrication pipe and feeds oil into the cylinder cover; a drain hole in the cylinder allowing surplus oil to return into the axle casing.

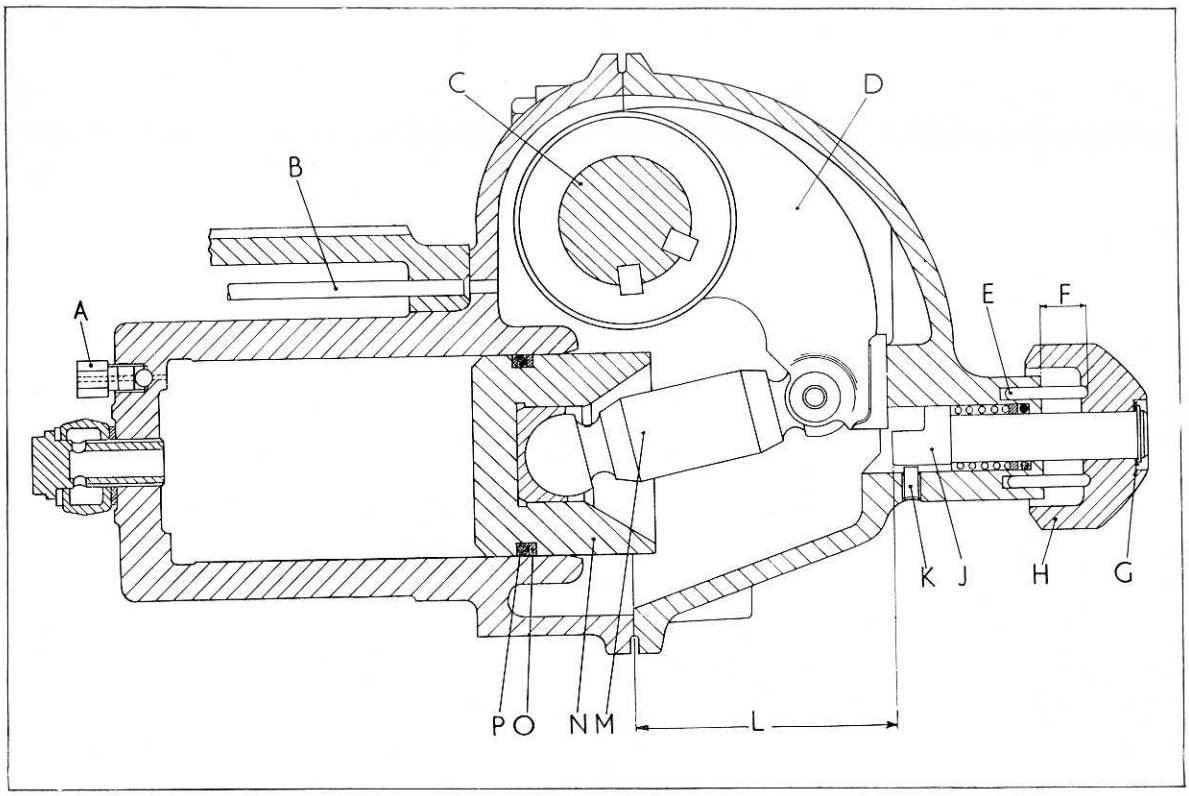


Fig. 18. SECTION THROUGH RAM CYLINDER (Later model tractors)

A. Bleeder Valve
B. Lubricating Oil Pipe
C. Ramshaft
D. Ramshaft Arm
E. Needle Roller
F. Setting Distance 0·718-0·728 in. (18·24-18 mm)
G. Shims
H. Catch Knob
J. Catch Plunger
K. Locating Screw
M. Connecting Rod
N. Piston
O. Anti-Extrusion Ring
P. 'O' Ring

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The plunger J is spring-loaded and may be used to lock the linkage in the raised position by turning the knob H, which releases the plunger and allows it to engage the ramshaft arm D when the lift reaches maximum height.

When assembling the cylinder, soak the leather anti-extrusion ring in light oil for 30 minutes before fitting the ring on to the piston. The ring should be fitted with the rough side towards the 'O' ring and special care should be taken not to stretch the ring when passing it over the piston crown. When the leather ring is correctly positioned in the groove fit the rubber 'O' ring, ensuring that this fits snugly alongside the leather ring and does not prevent the leather ring from standing proud of the piston.

Thoroughly clean the cylinder bore and piston then smear with oil before fitting the piston in to the cylinder. The end of the cylinder bore is chamfered to facilitate entering the sealing rings but care must be taken not to damage the rings as any damage, however slight, may allow leakage when under high pressure. If the ram cylinder is installed in the tractor, place the lift control lever into the "lower" position, to prevent air being trapped in the cylinder when inserting the piston. After fitting the piston smear the ends of the connecting rod with ant-scuffing paste and refit the ramshaft.

Before replacing the cover assembly check the setting of the locking plunger J, by turning the knob H into the 'disengage' position, placing a straight edge across the joint face and measuring the distance to the plunger end. This distance should be 4·00–4·06 in. (10·16–10·31 cm) and if not within this distance the knob H should be removed and shims G added, or removed, as required.

As the setting of the needle rollers E determines the position of the plunger J, when replacement needles are fitted these should be pressed into the cover until the protrusion F is 0·728–0·718 in. (18·49–18·24 mm) and then the catch assembled and the distance L checked. If the distance L is not within 4·00–4·06 in. (10·16–10·31 cm) the knob H should be removed and shims G added as required.

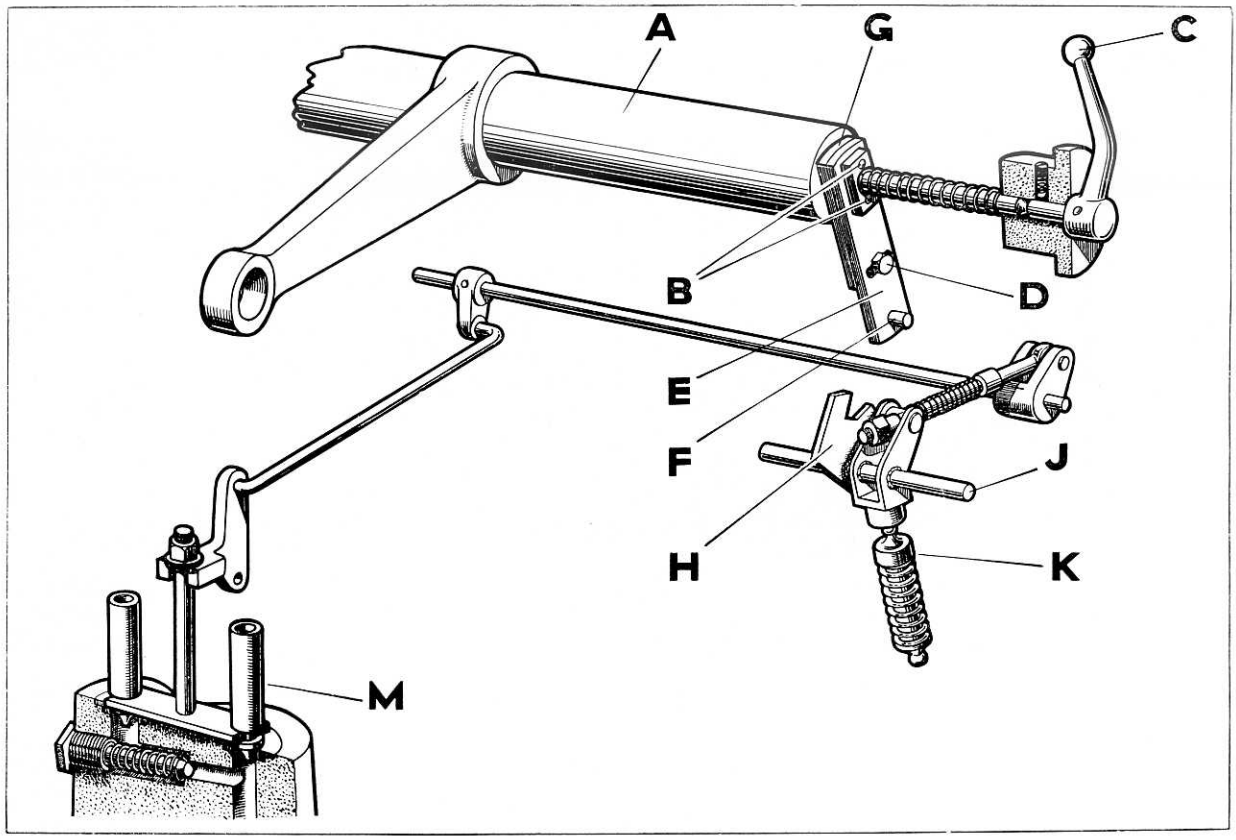


Fig. 19. AUTOMATIC HOLD MECHANISM

A. Ramshaft
B. Connecting Pegs
C. Override Control
D. Adjusting Bolt
E. Striker Arm
F. Striker Peg
G. Connecting Plate
H. Trip Lever
J. Pivot Shaft
K. Spring Toggle

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AUTOMATIC HOLD MECHANISM

The automatic hold mechanism is housed inside the right-hand ramshaft bracket and consists of a spring-loaded toggle mechanism operated by a striker arm connected to the ramshaft.

With reference to figure 19, as the ramshaft A turns into the raised position, the striker arm E is also turned by means of the two connecting pegs B. When the striker arm stud F contacts the jaw of the trip lever H this commences to pivot on its shaft J and compresses the spring toggle K. Immediately the spring toggle reaches an "over centre" position the trip lever H springs over and pulls the valve linkage rod a sufficient distance to open the pump valve M, pump output then flows to waste and no further lift takes place.

To enable the maximum lift of the linkage to be adjusted to coincide with the position of the linkage locking bolt, the striker arm E is attached to the plate G by means of a bolt D fitted through an elongated hole. This permits the position of the striker arm to be moved if required.

When the override control lever C is moved sideways, away from the ramshaft, the two connecting pegs B are withdrawn from the holes in the ramshaft, thus permitting the ramshaft to turn without operating the striker arm

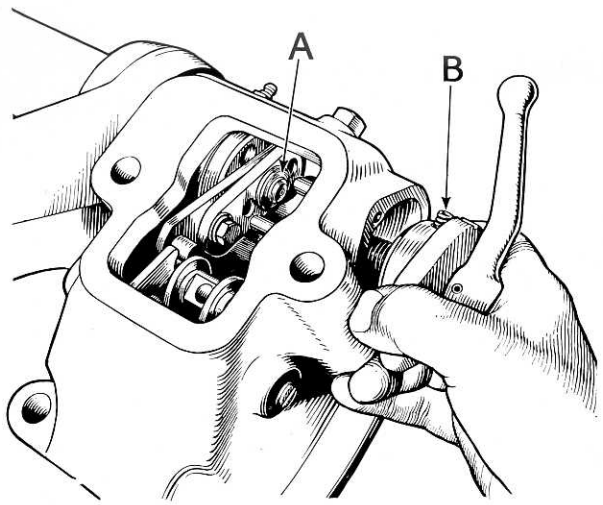


Fig. 20. REMOVING THE OVERRIDE CONTROL ASSEMBLY
A. Circlip B. Detent Spring

To remove the Automatic Hold Mechanism

Disconnect the flexible cable and remove the top link. Disconnect the lower links and remove the six ram cylinder cover bolts: the two centre bolts pass through the axle case and are fitted with nuts. Remove the right-hand ramshaft bracket cover and remove the Nyloc Nut and distance piece from the valve linkage rod. Remove the four bolts attaching the right-hand ramshaft bracket to the axle case, then break the joint on the ram cylinder cover and remove the ramshaft complete with right-hand housing.

Clamp the ramshaft in a vice, then remove the two countersunk screws from the housing end plate. Withdraw the end plate and override control, taking care of the detent spring and ball, which will be displaced when the assembly is withdrawn from the housing. To remove the striker arm from the ramshaft, remove the circlip (Fig. 20) from the ramshaft extension, then slide the housing off the ramshaft. The trip lever pivot shaft may be pushed out of the housing, after removing the two end plugs and the grub screw through the trip lever boss.

Re-assemble the mechanism in the reverse sequence to dismantling, ensuring that the ramshaft bearing seal is fitted in the recess in the housing and the ends of the spring toggle are correctly seated in their respective sockets. Before re-fitting the ramshaft on to the axle case, compress the spring on the pump valve operating rod and temporarily retain in this position by fitting a split pin through the distance piece and rod. This will facilitate guiding the rod into the trip lever when placing the ramshaft in position. After re-fitting the ramshaft, remove the split pin and fit the outer distance piece and nut, then adjust the pivot shaft end plugs so that the shaft has a slight end play with the trip lever positioned clear of the striker arm and in line with the valve operating rod.

After adjusting the mechanism in accordance with the instructions on page 12, lift the linkage several times by hand and check that the mechanism operates quite freely.

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THREE-WAY VALVE UNIT U279

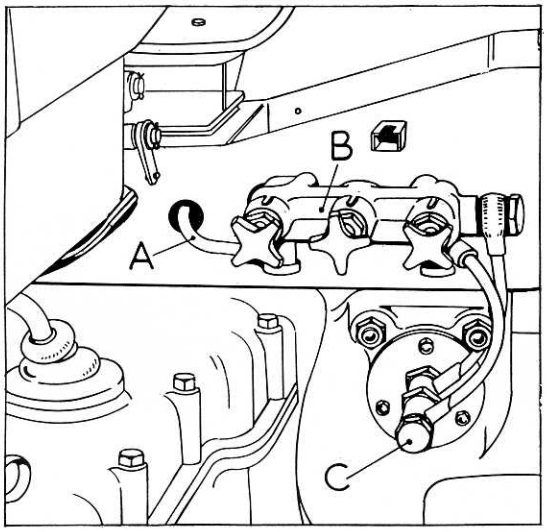


Fig. 21. THREE-WAY VALVE UNIT
A. External Connection B. Valve
C. Ram Cylinder Union

The three-way valve unit is mounted on the left-hand side of the seat support and contains three screw-in valves which may be operated to control the flow of oil to the tractor ram cylinder or the two external services as required. A permanent connection, from one of the external services, is made to an Exactor quick-release coupling which is mounted on the rear face of the tool compartment to provide a convenient connection for attachments positioned at the rear of the tractor.

Oil supply to the valve is by means of a four-way union fitted on the front end of the ram cylinder. Figure 22 shows a section through the union assembly. Oil from the main feed pipe banjo flows along the outer passage and then through the inner banjo union and pipe to the three-way valve. Oil flow from the valve then returns through the outer banjo and along the inside of the centre tube into the ram cylinder.

To remove the union assembly from the tractor, remove the two pipes connecting the union to the valve then remove the three screws attaching the circular cover plate to the axle case. Unscrew the union body from the ram cylinder taking care of the two banjo sealing washers.

When re-fitting the union, ensure that the sealing washer is positioned between the end of the ram cylinder and the pipe banjo then fit the other sealing washer, 'O' ring and cover plate on to the union body. Before screwing the extension on the union body, check that the sealing ring is positioned in the internal groove. Leakage past this seal will allow oil to pass into the ram cylinder when the three-way valve is closed.

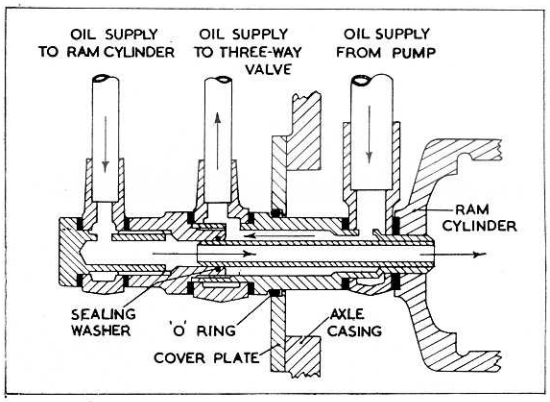


Fig. 22. SECTION THROUGH RAM CYLINDER UNION

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DIMENSIONAL DATA

Pump Relief Valve Pressure Setting		2 000 lb/in² (140 kg/cm²)
Maximum Lift at end of Links (total)		1 800 lb (187 kg)
Ram Cylinder Relief Valve Pressure Setting	Early model tractors	1 500 lb/in² (105·6 kg/cm²)
Pump Output (at maximum pressure and rated engine speed)	Early model tractors	6¼ gall/min (28 litres/min)
Maximum T.C.U. Pressure	Early model tractors	550–600 lb/in² (38·5–42 kg/cm²)
Maximum Lift at end of Links with T.C.U.	Early model tractors	840 lb (381 kg)
Ram Cylinder Diameter	Early model tractors	3·50–3·499 in (88·9–88·875 mm)
Ram Piston Diameter	Early model tractors	3·4985–3·498 in (88·86–88·85 mm)
Ram Piston Stroke	Early model tractors	3·562 in (9·05 cm)
Ram Piston Ring Gap	Early model tractors	0·003–0·007 in (0·08–0·18 mm)
Pump output (at maximum pressure and rated engine speed)	Later model tractors	5 gall/min (22·7 litres/min)
Maximum T.C.U. Pressure	Later model tractors	670–720 lb/in² (48·9–52·6 kg/cm²)
Maximum lift at end of links with T.C.U.	Later model tractors	896–980 lb (406–444 kg.)
Ram Cylinder Bore	Later model tractors	31·25–3·127 in (79·37–79·42 mm)
Ram Piston Diameter	Later model tractors	3·123–3·124 in (79·32–79·35 mm)
Ram Piston Stroke	Later model tractors	4·675 in (118·7 mm)
Locking Catch Needle Roller Protrusion	Later model tractors	0·718–0·728 in (18·24–18·49 mm)
Locking Plunger Setting Dimension	Later model tractors	4·000–4·060 in (101·6–103·12 mm)
Top Link Compression Spring Length (free)		4·25 in (10·79 cm)
Top Link Compression Spring Rate		2 730 lb/in (485·58 kg/cm)

TIGHTENING TORQUES

Location	Torque
Depth control valve banjo bolt	100 lb ft (13·83 kg metres)
Magnetic filter cover bolts	15 lb ft (2·07 kg metres)
Pump body cover bolts	45 lb ft (6·22 kg metres)
Ram cylinder bleeder bolt	8 lb ft (1·11 kg metres)
Ram cylinder relief valve	20 lb ft (2·76 kg metres)
Ram cylinder banjo bolt	60 lb ft (8·29 kg metres)

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DAVID BROWN

950 & 990

TRANSMISSION

DAVID BROWN TRACTORS LIMITED

MELTHAM · HUDDERSFIELD · ENGLAND

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GEARBOX AND DIFFERENTIAL

The gearbox is of open construction being formed by two cast iron end plates secured together by four steel spacer bars. The end plates house the bearings which in turn carry the shafts and gears. On Livedrive tractors the gearbox mainshaft is hollow, permitting the power take-off drive shaft to pass through the gearbox to the rear mounted power take-off and hydraulic lift pump.

The gears are straight tooth spur gears and are carried on splined shafts to permit movement for gear engagement. The crown wheel driving pinion is integral with gearbox output shaft and allows the bevel pinion type differential to be supported on the gearbox rear end plate. Thus forming a single compact unit which can be fully assembled before being mounted in the tractor frame.

On Implematic tractors the right-hand spur pinion shaft is fitted with a splined sleeve. This is connected to a foot pedal and when operated connects the pinion shaft directly to the differential case. Thus, locking the differential assembly and giving, in effect, a solid drive to both rear wheels.

The gearbox provides six forward speeds and is, in effect, two three-speed gearboxes; a high range gearbox and a low range gearbox. The selection of the range in use being determined by the position of the range gear lever, which causes the layshaft to be driven at high or low speed as required.

Three forward speeds, and one reverse, are provided in each range, the required speed being selected by means of the main gear lever which slides the gears on the mainshaft so that they engage with the required gear on the layshaft. Reverse gear is obtained by interposing an idler gear, positioned on the input shaft, between the mainshaft and layshaft, thus reversing the direction of rotation of the mainshaft. When either the main or range gear lever is in the neutral position the gears are not engaged and no drive is transmitted through the gearbox.

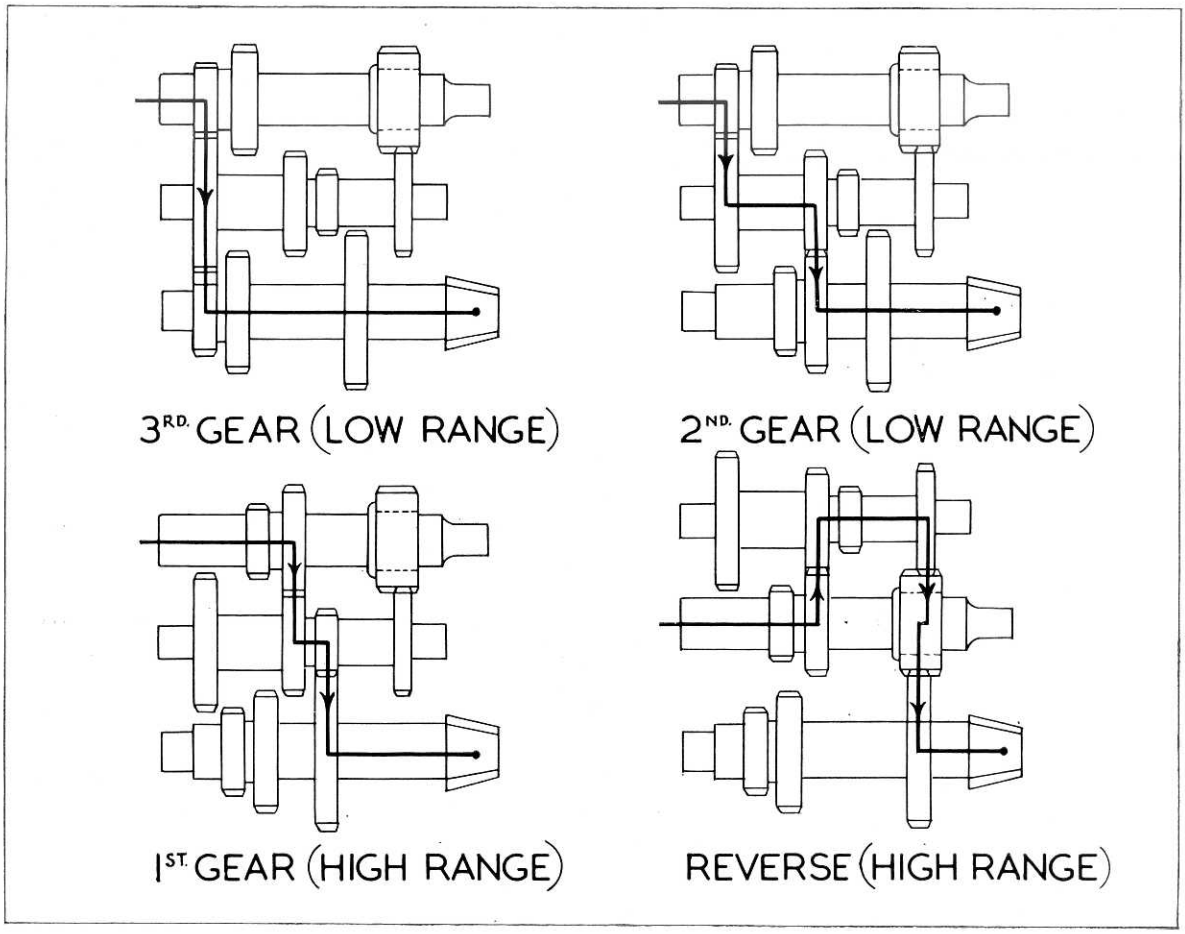


Fig. 1. OPERATION OF THE GEARBOX

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Removing the Gearbox Unit

The gearbox and differential can be removed as a complete unit and the most convenient way of doing this is to detach the rear axle case from the main frame. The hydraulic pump can then remain attached to the axle case and the lift controls need not be disturbed.

Drain the oil from the transmission, remove the lower links and levelling levers. Remove the drawbar frame and place a jack under the axle case. Place suitable packings under the rear end of the tractor main frame so that both rear wheels are supported just clear of the ground. Withdraw the jack and remove the wheels. Disconnect the two brake rods and remove both reduction units.

Remove the power-take-off unit and on Livedrive models withdraw the long PTO drive shaft. Remove the batteries from the seat support, disconnect the wiring and remove the seat support and mudguard assembly from the axle case.

Disconnect the throttle linkage from the hand lever and withdraw the hand lever through the instrument panel. Detach the drag link from the steering arm and remove the steering box. Remove the bolts attaching the gearbox cover to the main frame and axle case then remove the cover.

Disconnect the inlet pipe from the base of the hydraulic pump, by removing the four setscrews, and disconnect the lubrication pipes by removing the pump outlet elbow. If the tractor is fitted with a differential lock, remove the right-hand oil seal housing, to enable the hand to be inserted into the axle case and the sleeve and spring withdrawn clear of the differential.

Remove the bolts attaching the axle case to the main frame and tap the axle case off the dowels. Using a jack, or blocks of wood, to support the weight of the axle, tilt the top of the axle away from the frame until it has passed the crown wheel then move the axle clear of the tractor. Remove the gearbox mounting bolts and withdraw the gearbox rearwards out of the main frame.

Gearbox Replacement

The gearbox should be refitted in the reverse sequence to removal, paying special attention to the following points:—

1. If the gearbox is rigidly mounted, i.e. six mounting bolts without bushes, simply refit the mounting bolts and tighten to 100 lb ft (13·83 kgm).

2. If the gearbox is not rigidly mounted, i.e. four mounting bolts with bushes. Release the four Nyloc nuts on the front end of the spacer bars then temporarily fit the mounting bolts without their bushes. Fully tighten the mounting bolts, then retighten the space bar nuts to 70 lb ft (9·68 kgm). This will ensure that the spacer bars, which pass through clearance holes in the front end plate, hold the two end plates in correct alignment. After tightening the spacer bar nuts, remove the four mounting bolts and fit the bushes into the mounting holes, replace the mounting bolts and tighten to 100 lb ft (13·83 kgm). The mounting bolts should not be fitted with washers and in instances where washers were fitted on production these should be discarded when removed.

3. After bolting the axle case to the main frame refit the differential lock sleeve and hold the lock pedal in the engaged position by placing a bolt between the operating lever and footplate.

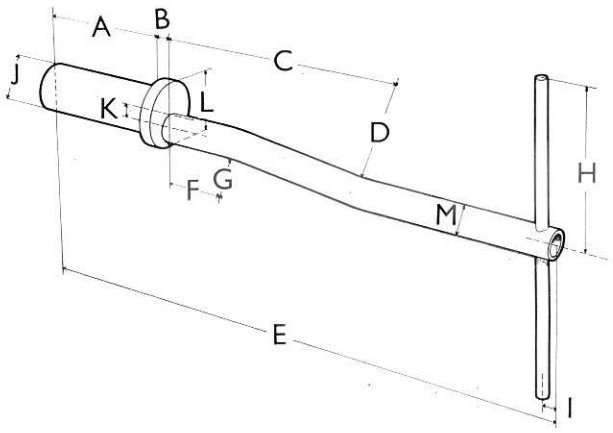


Fig. 2. DIMENSIONS OF SERVICE TOOL MISC. 1081

A.	4¼ in. (11·43 cm)	B.	½ in. (1·27 cm)
C.	6½ in. (16·51 cm)	D.	4 in. (10·16 cm)
E.	19½ in. (48·89 cm)	F.	1½ in. (3·81 cm)
G.	4 in. (10·16 cm)	H.	9 in. (22·86 cm)
I.	½ in. (1·27 cm)	J.	1½ in. (3·81 cm)
K.	½ in. (1·27 cm)	L.	2¼ in. (5·71 cm)
		M.	1 in. (2·54 cm)

If the hydraulic lift pump and support plate are in position, service tool Misc. 1081 (Fig. 2) should be used. After pushing the spring into position inside the differential, place the sleeve against the spring and insert the large end of the tool through the oil seal housing aperture and into the sleeve. Whilst holding the diff-lock control in the disengaged position, push the tool inwards to compress the spring then turn the tool to engage the sleeve groove into the fork. Depress the diff-lock pedal and lock in the engaged position before withdrawing the tool.

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If the hydraulic pump support plate and main oil pipe are not in position, an alternative method of assembling the differential lock is

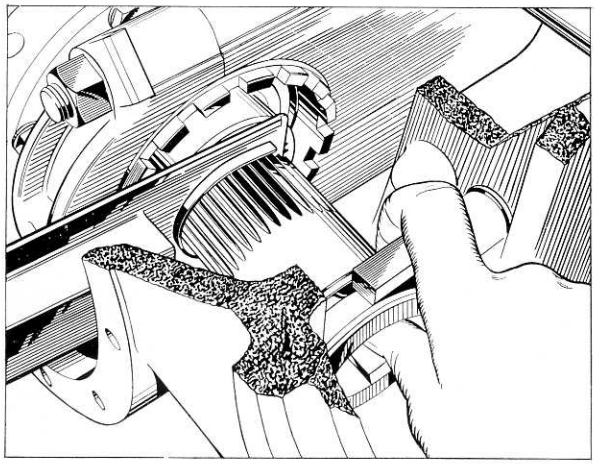


Fig. 3. INSERTING THE DIFF.-LOCK SLEEVE

to use service tool 904170. This tool is inserted between the axle case and differential and enables the spring to be compressed whilst the sleeve is fitted in position (Fig. 3).

Caution

The diff.-lock pedal must be retained in the fully engaged position until after the right-hand reduction unit is fitted, otherwise the sleeve may become displaced.

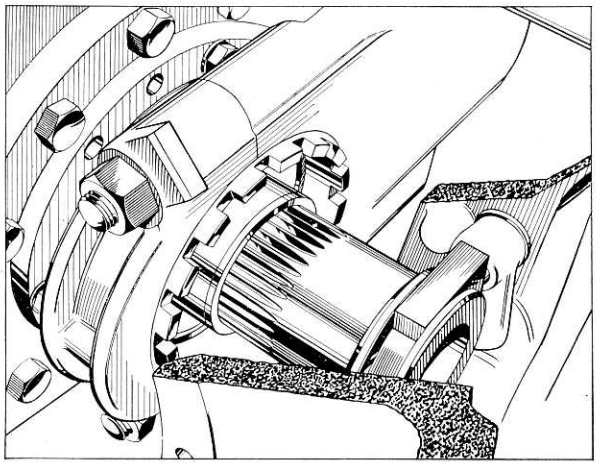


Fig. 4. DIFF.-LOCK SLEEVE IN ENGAGED POSITION

4. When refitting the power take-off unit ensure that lubrication pipe enters the hole in the PTO housing, otherwise the unit will receive no lubrication.
5. Refit the reduction units carefully to prevent damaging the oil seal in the end of the axle case.

Dismantling the Gearbox

To support the gearbox whilst carrying out dismantling or assembly a simple stand may be fabricated from scrap material as shown in Fig. 5.

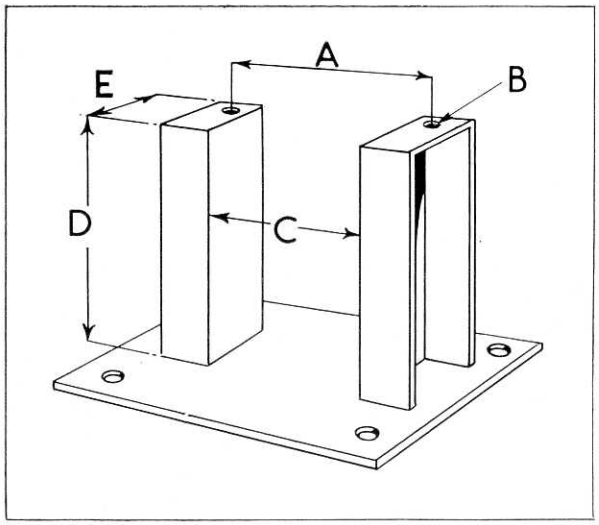


Fig. 5. GEARBOX SUPPORT STAND

A. $12\frac{5}{8}$ in. (32·07 cm) B. $\frac{3}{4}$ in. (19 mm) Dia.
C. $11\frac{1}{8}$ in. (28·26 cm) D. $9\frac{1}{2}$ in. (24·13 cm)
E. $4\frac{1}{4}$ in. (10·79 cm)

With the gearbox rear-end plate mounted on the stand, remove the Nyloc nut from the end of the pinion shaft. This nut is $1\frac{1}{4}$ in. B.S.F. and is LEFT-HAND thread. Remove the six bolts securing the thrust bearing to the backplate, then insert two extractor bolts, part number 901726, into the tapped holes in the housing flange. Tighten the extractor bolts evenly until the housing is drawn clear of the end plate, gently tapping the end of the pinion shaft whilst doing this, to prevent the shaft from being withdrawn with the housing.

After removing the housing, carefully note the number of shims fitted between the inner tracks of the thrust race, so that these may be refitted as removed.

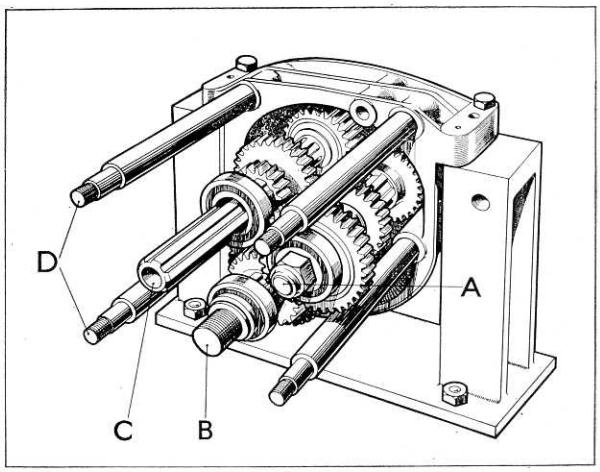


Fig. 6. GEARBOX WITH FRONT END PLATE REMOVED

A. Layshaft B. Pinion Shaft
C. Mainshaft D. Spacer Bars

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Remove the four nuts from the front end of the spacer bars and engage reverse gear, by pushing the reverse selector rod to the rear of the gearbox, then carefully tap the front end plate forward until the reverse selector is clear of the interlocking plunger and retaining ball. The front end plate may now be removed allowing the gears, shafts and selector rods to remain in position. After removing the end plate extract the selector rod interlock plunger, retaining balls and spring from their locations in the end plate.

The selectors and rods, gears and shafts may now be removed from the rear end plate and the differential assembly removed after releasing the four side bearing cap bolts. Before removing the side bearing caps, make suitable marks on the caps and end plate so that the caps may be replaced in their original positions when re-assembling.

Dismantle the differential by removing the gear pin and extracting the gears from the housing. If the differential case is of the split type, make suitable marks on the case and cover to facilitate refitting in the same relative position.

To dismantle the layshaft, support the reverse gear on the bed of a press, then press the shaft out of the gear and bearing. Remove the nut from the front end of the shaft, then press the gears, distance piece and bearing off the shaft.

To dismantle the driven shaft, remove the circlip from the front end then slide the high-low range pinion off the shaft. Press the reverse gear complete with carrier bush and bearing off the rear end of the shaft, taking care not to damage the circlip inside the recess in the gear carrier bush.

Assembling the Gearbox

Having cleaned and examined all components, assemble the layshaft in the reverse order of dismantling. Ensuring that the two distance pieces are in position and the inner tracks of the roller races are pressed on to the shaft until the gears contact the shaft shoulder. The outer tracks of the roller races should be pressed into their respective housings, noting that the shims fitted between the end plate and front bearing track are replaced as removed.

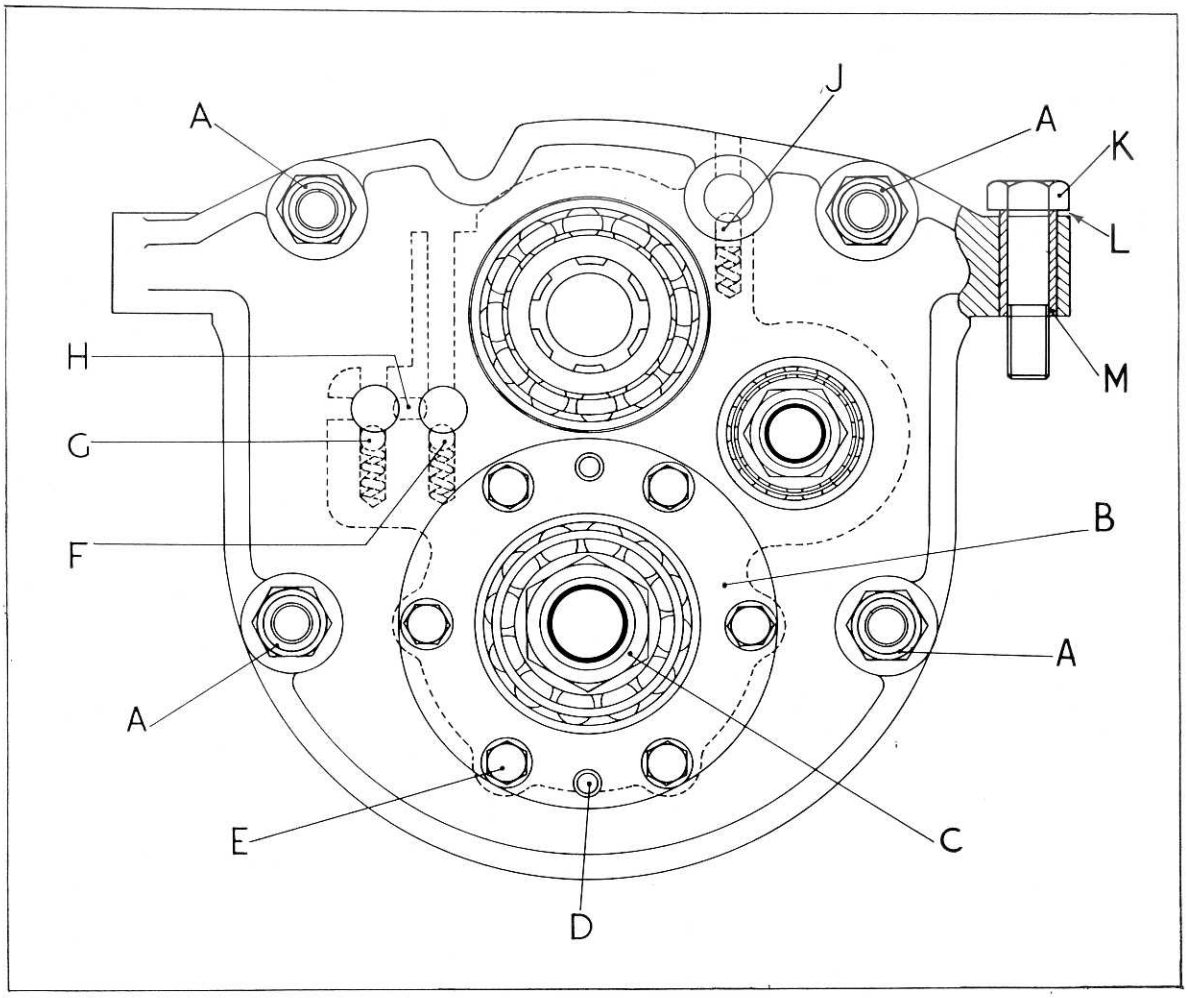


Fig. 7 GEARBOX FRONT END PLATE

A. Spacer Bar Nuts
B. Bearing Housing
C. Pinion Shaft Nut
D. Extraction Holes
E. Bearing Housing Bolt
F. 1st/Reverse Selector Ball
G. 2nd/3rd Selector Ball
H. Gear Interlock Plunger
J. High/Low Selector Plunger
K. Mounting Bolt
L. Clearance
M. Bush

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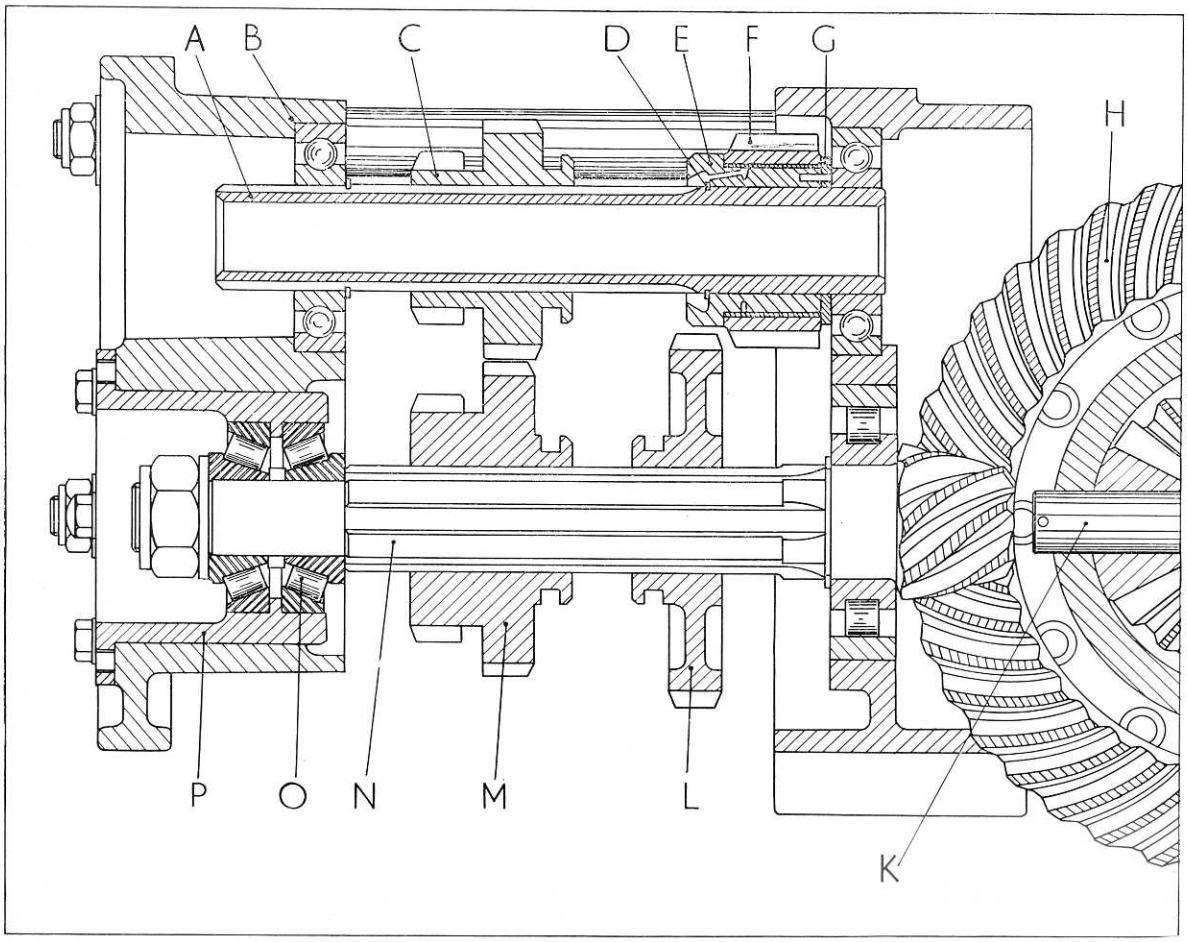


Fig. 8 SECTIONAL ARRANGEMENT OF GEARBOX

A. Primary Shaft
B. Shims
C. Range Pinion
D. Circlip
E. Carrier Bush
F. Reverse Idler
G. Thrust Washer
H. Crown Wheel
K. Pinion Pin
L. Low/Reverse Gear
M. 2nd/3rd Gear
N. Pinion Shaft
O. Thrust Bearing
P. Bearing Housing

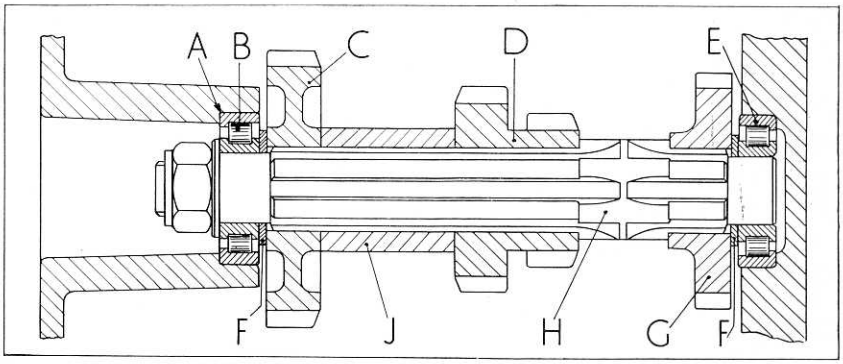


Fig. 9 SECTION THROUGH LAYSHAFT

A. Shims
B. Bearing
C. 3rd Gear
D. 1st/2nd Gear
E. Bearing
F. Distance Washer
G. Reverse Gear
H. Layshaft
J. Spacer Bush

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Fit the outer track of the mainshaft rear bearing into the rear end plate. Pressing the track flush with the housing and securing with two bolts fitted with a flat washer on each side of the track.

Press the primary shaft rear bearing into the rear end plate until the outer track contacts the shoulder in the recess.

Place the mainshaft in a vice, fitted with soft jaw grips, and temporarily assemble the double thrust bearing in its housing. Fit the bearing assembly on to the shaft, replacing the shims previously removed from between the two inner bearing tracks, and fully tighten the mainshaft nut, then check the end float of the bearing. This should be 0·001 to 0·003 in. (0·025 to 0·076 mm) and if incorrect should be adjusted by removing, or adding, shims of the required thickness between the two inner bearing tracks. When the correct bearing clearance has been obtained, remove the mainshaft nut and withdraw the bearing housing, taking care of the shims to ensure that they are replaced intact when the bearing is finally assembled.

Press the reverse idler carrier bush on to the primary shaft until it contacts the circlip, then fit the range pinion followed by the front bearing circlip. Press the front bearing on to the shaft until it contacts the circlip and fit the reverse idler and thrust washer, ensuring that the thrust washer is locked to the carrier bush by means of the small dowel.

Press the drive shaft into the rear end plate, then mount the end plate on to the support stand. Install the layshaft and mainshaft assemblies on to the rear end plate, then fit the selectors and rods.

After fitting the drive shaft front bearing shims into the recess in the front end plate, carefully fit the end plate on to the spacer bars. Guiding the front end of the selector rods into the holes in the end plate and fitting the gear interlocking plunger and retaining balls and springs before tapping the end plate fully home. **NOTE**—The selector balls should be fitted against the main selector rods and the selector plunger against the high-low range selector rod.

After tightening the spacer bar nuts, check the end float of the driveshaft and layshaft. The driveshaft should have 0·006 to 0·010 in. (0·152 - 0·254 mm) end play and the layshaft 0·010 - 0·015 in. (0·254 - 0·381 mm). Adjust if required by removing the front end plate and changing the thickness of the shims fitted between the end plate and front bearing.

When the spacer bar nuts have been finally tightened, and the end float of the shafts found correct, fit the mainshaft thrust bearing housing. Ensuring that the shims are replaced between the inner bearing tracks and between the housing flange and end plate. After firmly tightening the mainshaft nut check the end float of the shaft, if the shims have been replaced correctly the end float should be 0·001 - 0·003 in. (0·025 - 0·076 mm) as set previously.

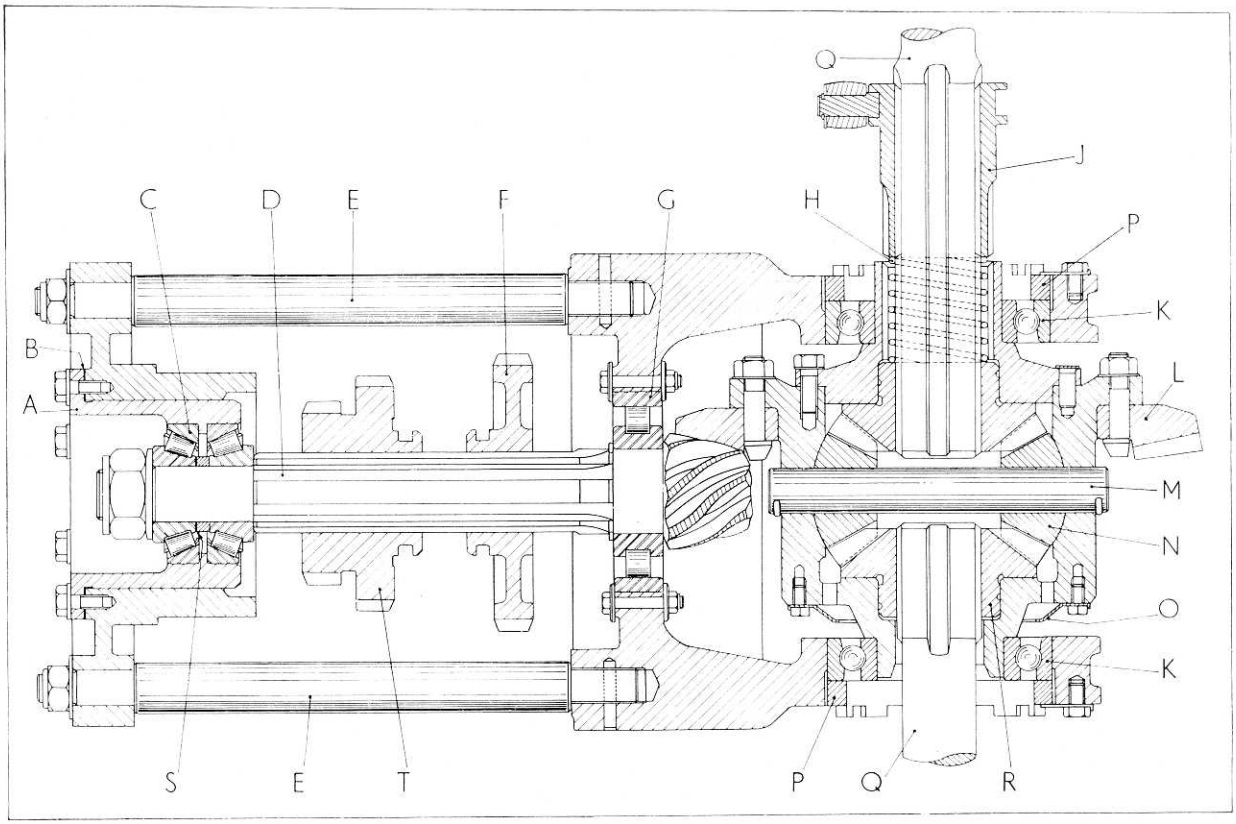


Fig. 10 SECTIONAL ARRANGEMENT OF DIFFERENTIAL

A. Bearing Housing
B. Shims
C. Thrust Bearing
D. Pinion Shaft
E. Spacer Bar
F. 1st/Reverse Gear
G. Roller Bearing
H. Diff.-Lock Spring
J. Diff.-Lock Sleeve
K. Diff. Side Bearing
L. Crown Wheel
M. Diff. Pin
N. Diff. Pinion
O. Oil Baffle
P. Adjusting Nut
Q. Spur Pinion Shaft
R. Diff. Gear
S. Bearing Shims
T. 2nd/3rd Gear

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Assemble the differential unit in the reverse order of dismantling, smearing the pinions and pin with anti-scuffing paste to provide initial lubrication. If the differential case is of the split type, ensure that the locking plates on the casing bolts also cover the locating dowels, thus preventing any possibility of the dowels becoming displaced during service. When fitting the crown wheel to the differential case tighten the bolts evenly to 45 lb. ft. (7·12 kgm) before locking with the tab washers.

When mounting the differential assembly on to the rear backplate, fit the side bearing caps, with the marks made during dismantling in alignment, and enter the adjusting nuts into their threads before tightening the bearing cap bolts.

NOTE—The differential side bearings are angular contact ball races, and must, therefore, be fitted with the word "THRUST" stamped on the outer track against the adjusting ring nut.

Crown Wheel and Pinion Adjustment

Adjustment of the crown wheel is by means of the two ring nuts on the side bearing supports, and adjustment of the pinion is by means of shims fitted between the thrust bearing housing flange and front end plate.

After mounting the differential assembly in its bearings, set the two adjuster nuts so that the differential has 0·002 to 0·004 in. (0·05 to 0·101 mm) end float in its bearings and the crown wheel has 0·007 to 0·009 in. (0·178 to 0·229 mm) backlash against the pinion teeth.

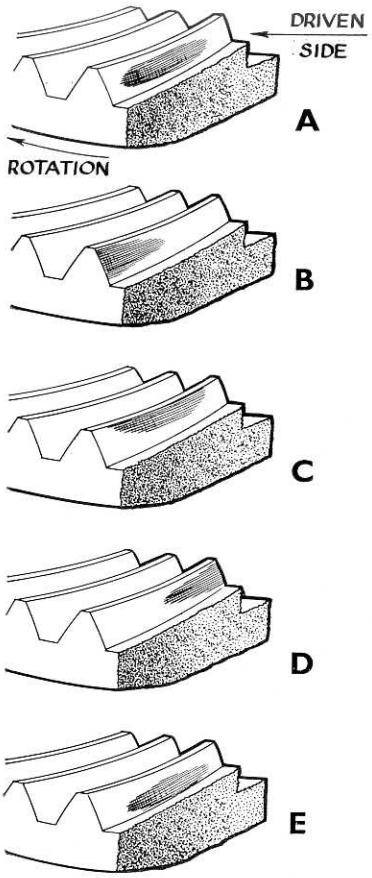
After smearing the crown wheel teeth with a suitable marking compound, apply a slight load to the mainshaft and rotate the crown wheel in alternate directions. The resulting mark on the crown wheel teeth should be slightly towards the outer edge of the teeth and extend approximately two thirds the length of the teeth (Fig. 11).

After examining the crown wheel tooth marking, correct as necessary by withdrawing the thrust bearing housing away from the end plate and adding, or removing, shims as required.

NOTE—Shims may be cut adjacent to one of the semi-circular cut-outs, to facilitate fitting without removing the bearing housing.

As any adjustment made to the position of the pinion will also affect the gear backlash, it will be necessary to re-adjust the position of the crown wheel after each pinion adjustment.

When a satisfactory tooth marking has been obtained, and the gear backlash and bearing clearance are correct, lock the bearing adjusters and firmly tighten the cap bolts. Replace the differential oil scraper, if fitted, positioning so that the scraper is just clear of the differential case.



A. CORRECT MARKING
Contact area extending approximately two thirds the length of the tooth and positioned slightly towards the outer edge.

B. HEEL CONTACT
Pinion requires moving closer to crown wheel by reducing the thickness of the bearing housing shims.

C. PEAK CONTACT
Gears too far out of mesh. If backlash is not excessive move pinion closer to crown wheel.

D. TOE CONTACT
Gears too deep in mesh. Increase thickness of bearing housing shims to move pinion away from the crown wheel.

E. ROOT CONTACT
Gears too deep in mesh. If backlash is sufficient, move pinion away from the crown wheel by increasing the thickness of the bearing housing shims.

Fig. 11. CROWN WHEEL TOOTH MARKING

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REDUCTION UNITS

The reduction units are bolted to the ends of the rear axle case and consist of a one piece casting which houses the spur reduction final drive gears. The spur pinion shafts are splined into the differential side gears at their inner ends and are supported by two angular contact ball races, in the reduction housing, at their outer ends. The rear wheel flange is integral with the final drive shaft, which is fitted with two taper roller bearings spaced one each side of the final drive gear.

Removal of the Reduction Units

Before attempting to remove a reduction unit first ensure that the tractor is standing on firm and reasonably level ground and that suitable packing material is available to support the weight of the tractor.

Raise the rear end of the tractor until the rear wheels are just clear of the ground, then place packings under the rear axle case. Remove the rear wheels and remove the bolts attaching the reduction housings to the axle case.

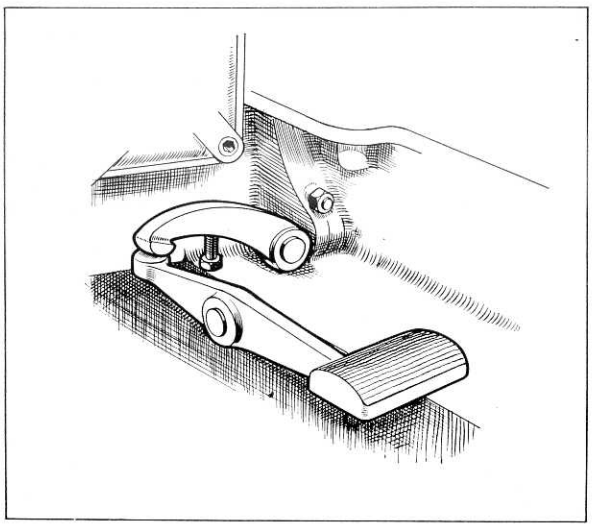


Fig. 12 DIFFERENTIAL-LOCK PEDAL LOCKED IN ENGAGED POSITION

CAUTION—If the tractor is fitted with a differential lock, this must be retained in the engaged position, by placing a suitable bolt under the rear end of the pedal lever (Fig. 12) before the right-hand reduction unit is removed. Otherwise, the diff.-lock sleeve may become displaced and prevent the reduction unit from being refitted.

After placing the handbrake in the "off" position, release the brake adjustment (see page 13), to prevent the brake drums from binding on the shoes, then withdraw the reduction units, taking care not to damage the oil seal in the end of the axle case. A large box, or packing case, placed underneath the reduction case will assist in supporting the weight of the reduction and allow the unit to be withdrawn horizontally until the spur pinion shaft is clear of the oil seal.

Replacement of the reduction units should be carried out in the reverse order of removal, paying special attention to the following points:—

1. Examine the condition of the brake linings and replace if contaminated with oil or if excessively worn.
2. Examine the axle case oil seal, renew if damaged or if any signs of oil leakage are apparent.

Replacing the Axle Case Oil Seal

The oil seal in the axle case prevents transmission oil from reaching the brake shoes. To remove the seal first draw the housing out of the axle case, using service tools 900207 and 900208. This tool consists of a bridge piece and four extractor bolts, the two $\frac{1}{4}$ in. B.S.F. bolts fit through the inner holes in the bridge piece and into the two tapped holes in the seal housing, the two $\frac{1}{2}$ in. B.S.F. bolts screw through the tapped holes in the bridge piece and against the axle case (Fig. 13). Tightening the two outer bolts will then draw the housing out of the axle case and allow the oil seal to be removed from the housing by tightening the two inner bolts.

When fitting a new seal into the housing, position the seal so that its inner lip is pointing away from the

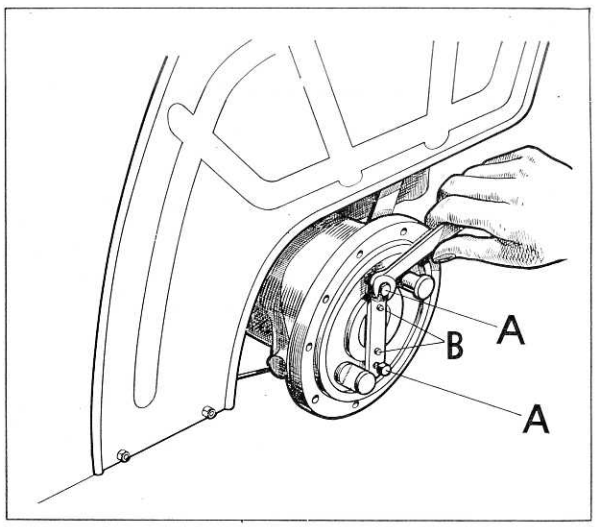


Fig. 13. REMOVING THE AXLE CASE OIL SEAL
A. Extraction Bolts B. Bolts into Seal Housing

shoulder on the housing, i.e. pointing towards the centre of the axle case when installed, then smear the outside of the housing with jointing compound before pressing into the axle case.

Dismantling the Reduction Units

The brake drums are pressed on to the spur pinion shafts and may be removed by using service tool 960618, or two suitable extractor bolts. The two extraction holes on early tractors were threaded $\frac{1}{2}$ B.S.F. but holes on later models are threaded $\frac{1}{2}$ U.N.C.

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Release the ring nut and insert two jacking screws, service tool 900207, through the tapped holes in the driveshaft flange. Do not force the extractor screws into the flange holes; clean the flange threads with a $\frac{1}{2}$ B.S.F. tap if necessary. Turn the driveshaft so that the extraction screws are between two seal housing bolts and fit a thrust pad (fig. 15) between the end of each screw and the face of the seal housing. Tighten the two screws evenly to withdraw the shaft out of the bearings, releasing the shaft ring nut at the same time.

After withdrawing the driveshaft, remove the gear and distance pieces from inside the casing, remove the seal housing and withdraw the bearing.

To remove the spur pinion shaft, remove the cover circlip and push the shaft and cover out by tapping the inner end of the shaft with a soft-faced hammer.

To remove the spur pinion shaft inner race, first remove the oil seal by passing a drift through the casing and driving the oil seal outwards then, using a soft drift, tap the bearing into the inside of the casing.

Assembling the Reduction Units

After cleaning and examining all components, fit the outer track of the spur pinion shaft inner race into the casing. Fitting the track from the inside of the case and tapping up against the circlip by means of a brass drift inserted through the opposite bearing aperture.

NOTE—The spur pinion shaft ball races are of the angle contact type and must, therefore, be fitted so that word "THRUST" stamped on the outer track is facing away from the pinion teeth, i.e. towards the circlip on the inner bearing and towards the cover on the outer bearing.

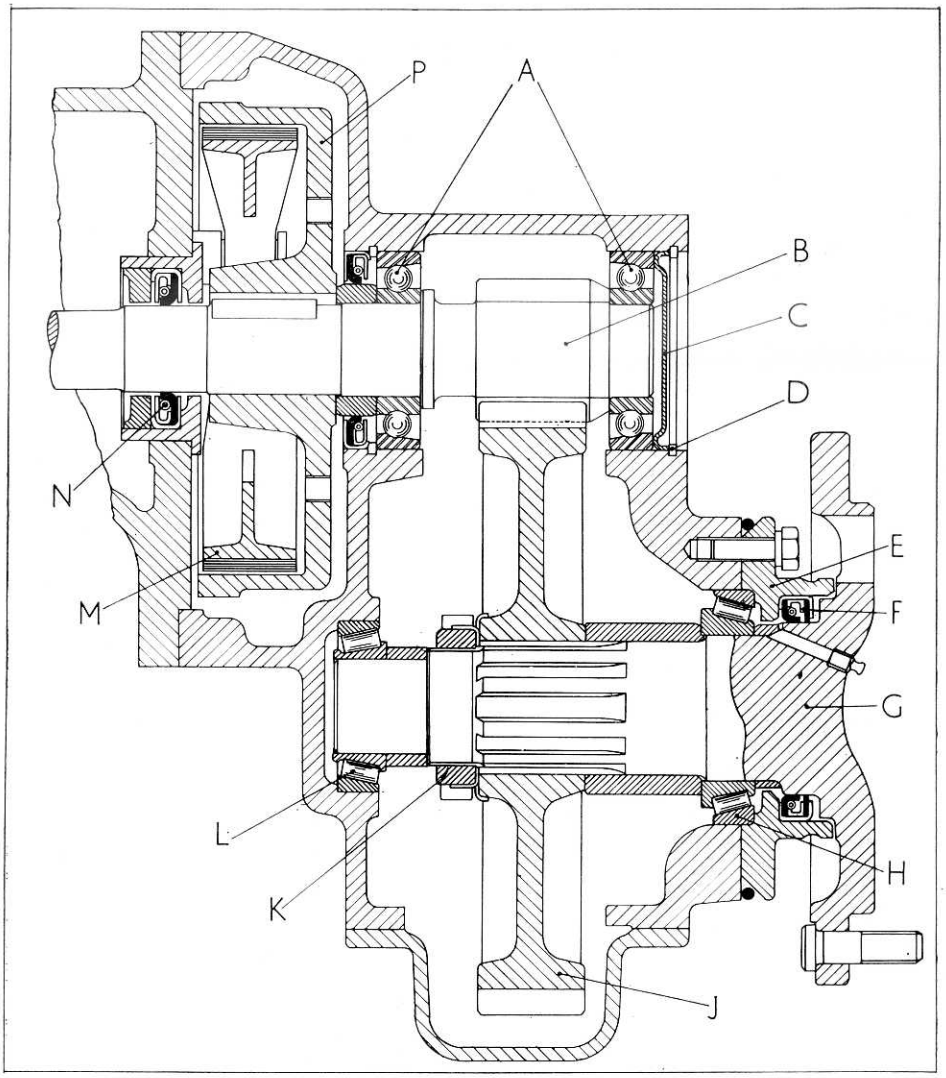


Fig. 14. SECTIONAL ARRANGEMENT OF REDUCTION UNIT

A. Pinion Shaft Bearings
B. Spur Pinion Shaft
C. Cover
D. Circlip
E. Oil Seal Housing
F. Oil Seal
G. Final Drive Shaft
H. Outer Bearing
J. Final Drive Gear
K. Retaining Nut
L. Inner Bearing
M. Brake Shoe
N. Axle Case Oil Seal
P. Brake Drum

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Remove the brake drum key and oil seal collar from the spur pinion shaft then fit the shaft, complete with both bearing inner tracks, into the reduction case. Fit outer bearing track into the case, but do not replace the cover, then replace the oil seal collar, key and brake drum. Drive the brake drum onto the pinion shaft, using a hammer and brass drift, until the drum, collar and bearings are solid against the shaft shoulder. The outer end of the pinion shaft should be supported on a suitable block whilst carrying out this operation.

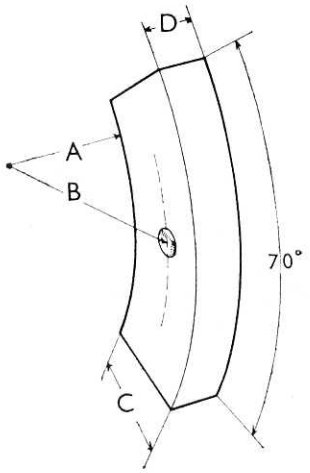


Fig. 15. DIMENSIONS OF THRUST PAD. MISC. 1233

A. $2\frac{9}{16}$ in. (6·51 cm) B. 3 in. (7·62 cm)
C. $1\frac{5}{16}$ in. (3·34 cm) D. $\frac{9}{16}$ in. (1·43 cm)
Drill $\frac{1}{4}$ in. (6·3 mm) diameter indentation
$\frac{1}{16}$ in. (1·58 mm) deep, at position shown

Fit the shims, cover and circlip into the outer bearing location then check the bearing end float. This should be 0·001 to 0·003 in. (0·025 to 0·076 mm) and if incorrect should be adjusted by adding, or removing, shims between the bearing and cover.

Fit the final drive oil seal into its housing, then pack the cavity inside the seal with high melting point grease. As the main function of the seal is to exclude dirt from the bearing, the seal should be fitted so that the spring-loaded lip is pointing towards the drive shaft flange, i.e., away from the bearing.

Place the seal housing on to the shaft followed by the bearing and distance piece. Ensure that the inner bearing is in position inside the casing then fit the drive shaft into the casing, placing the drive gear, tabwasher, ring nut and distance piece in position on the shaft at the same time. After firmly tightening the ring nut lock with the tabwasher.

Replace the shims between the seal housing and case, placing the splits in the shims horizontal, then replace and tighten the housing bolts. Check the pre-load of the final drive shaft bearings, this should be 0·002 to 0·005 in. (0·050 to 0·127 mm) and may be adjusted by removing, or adding, shims as required. When the pre-load is correct, fit the "O" ring into the recess between the seal housing and case.

Refit the casing cover plate, noting that the special breather bolt should be fitted in the uppermost hole.

BRAKE MECHANISM

Operation of the Brakes

The brake shoes are mounted on the ends of the rear axle case and operate inside the brake drums attached to the spur pinion shafts. Each brake is operated by its own pedal, permitting the brake to be applied on one side only to assist turning in the field. For normal operation, when both brakes are required to operate simultaneously, the two pedals are locked together by means of the connecting plate fitted to the left-hand pedal.

The hand lever mounted on the right-hand side of the rear axle case applies both brakes and the spring-loaded pawl retains the lever in the "on" position for parking.

Brake Adjustment

Normal adjustment for lining wear should be made by reducing the lengths of the two rods connecting the camshaft levers to the pedal cross shaft. As the brakes are not compensated the adjustments will have to be balanced so that when the brakes are applied with the pedal locked together, both brakes are applied evenly.

To adjust the brakes, raise the rear wheels clear of the ground and lock the two pedals together with the interlocking lever.

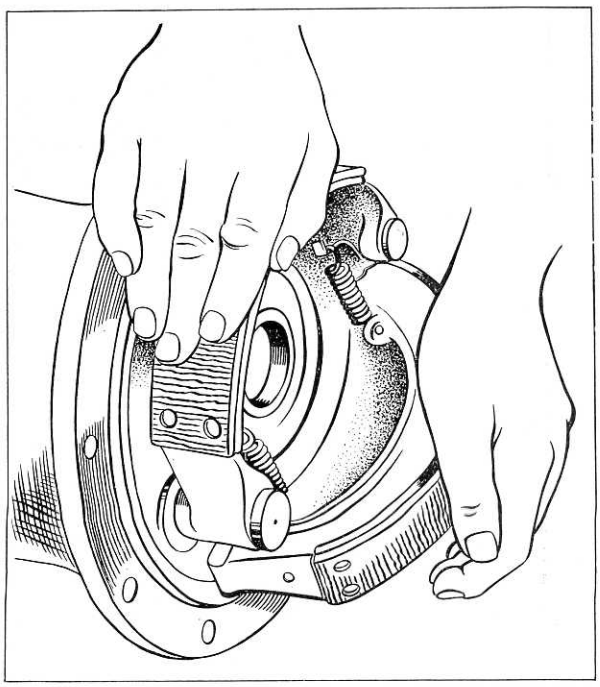


Fig. 16. REMOVING THE BRAKE SHOES

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Release the locknut and tighten the adjusting nut until the brake starts binding, then release, until the brake is quite free. Repeat the adjustment on the opposite side brake then lightly apply the handbrake. If the resistance to turning is not equal on both wheels, unscrew the adjusting nut on the most active brake, then tighten both locknuts to lock the adjustments.

The footbrake adjustment also adjusts the handbrake and unless the handbrake linkage has been disturbed no further adjustment is required.

Brake Linkage

The brake linkage is shown in Fig. 17. The two foot pedals are mounted on a cross shaft which is attached to the underside of the main frame by two brackets incorporating self-aligning bushes. The left-hand (inner) pedal is secured to the shaft by means of a Mills' pin, but the right-hand (outer) pedal is loose on the shaft and retained in position by means of a collar pinned on the end of the shaft.

For independent operation of the two brakes, it is essential that the right-hand pedal is free to pivot on the cross shaft, the pedal boss should, therefore, be lubricated regularly through the nipple provided.

The hand brake lever is connected to the foot pedals by means of two push rods C. These should be adjusted so that when the brake pedals and hand brake lever, are in the "off" position, both nuts are just contacting their respective collars. Push rods are not fitted to later models as the hand brake is connected directly to the cross shaft.

Relining the Brake Shoes

After removing the reduction units to expose the brake mechanism, remove the brake shoes, taking care not to overstretch the springs (Fig. 16).

Remove the rivets from the brake shoes by drilling out the open portion of the shank then punching out. Clean the shoes then fit the new linings ensuring that these fit close to the shoes and are not contaminated with oil or grease.

The shoe operating camshafts are supported in two self-lubricating bushes in the axle case. These may be removed if required by withdrawing the camshaft then punching out with a suitable drift.

If the shoe fulcrum pin is removed from the axle case, the threads should be coated with jointing compound when the pin is replaced, to prevent transmission oil leaking along the threads and on to the brakes.

When relining the brake shoes, examine the brake drums. If these are excessively scored they should be replaced, or reground, otherwise excessive lining wear may take place.

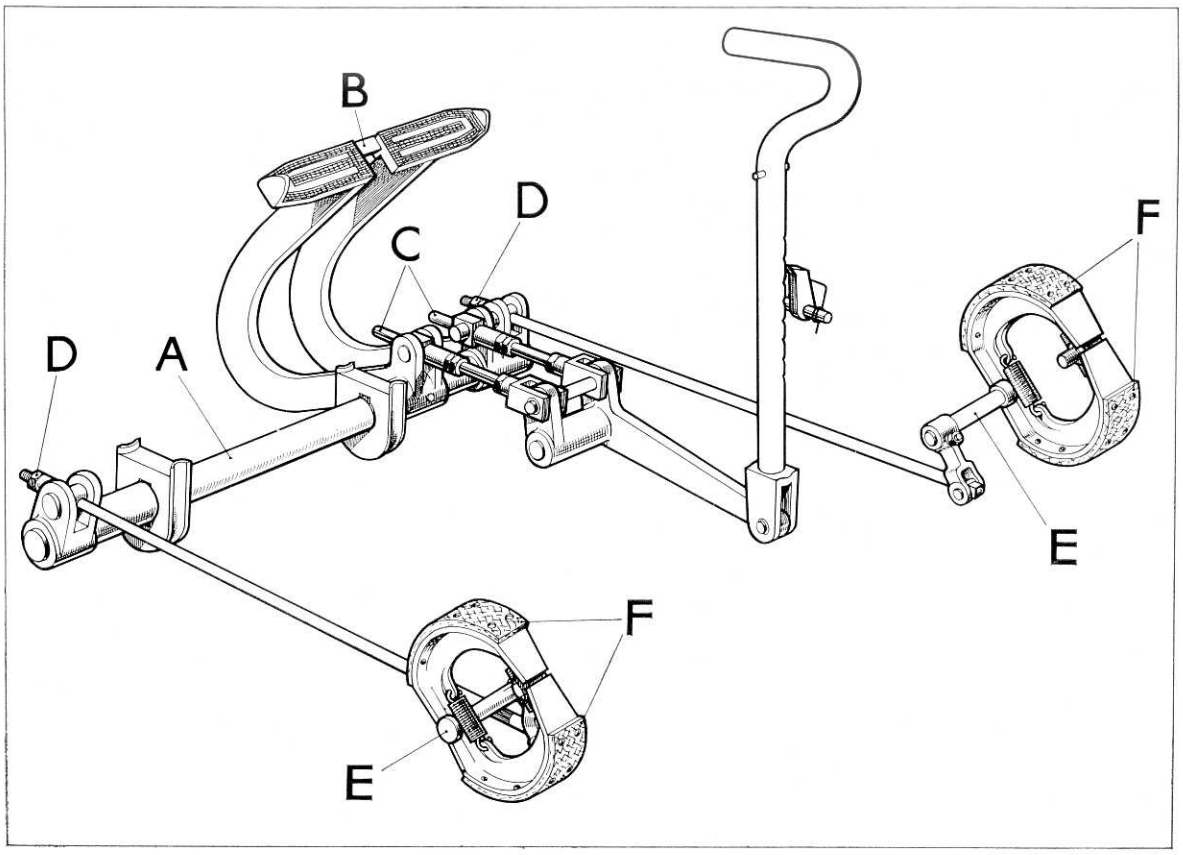


Fig. 17. BRAKE MECHANISM

A. Cross Shaft
B. Pedal Interlocking Lever
C. Push Rods
D. Adjusting Nuts
E. Camshafts
F. Brake Shoes

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DIMENSIONAL DATA

Driveshaft end float	0·006 - 0·010 in.	(0·152 - 0·254 mm)
Layshaft end float	0·010 - 0·015 in.	(0·254 - 0·381 mm)
Pinion thrust bearing clearance	0·001 - 0·003 in.	(0·025 - 0·076 mm)
Differential side bearing clearance	0·002 - 0·004 in.	(0·05 - 0·101 mm)
Spur pinion bearing clearance	0·001 - 0·003 in.	(0·025 - 0·076 mm)
Final drive bearing pre-load	0·002 - 0·005 in.	(0·050 - 0·127 mm)
Crown wheel backlash	0·007 - 0·009 in.	(0·178 - 0·229 mm)
Gearbox mounting clearance	0·012 - 0·016 in.	(0·3 - 0·4 mm)

Tightening Torques

Gearbox mounting bolts	100 lb ft.	(13·83 kgm)
Spacer bar nuts	70 lb ft.	(9·68 kgm)
Thrust bearing housing bolts	30 lb ft.	(4·149 kgm)
Ground wheel nuts	110 lb ft.	(15·21 kgm)
Crown wheel attachment bolts	45 lb ft.	(7·12 kgm)

Brake drum diameter (New)	8·50 - 8·51 in.	(21·59 - 21·615 cm)
Brake drum diameter (Max. regrind)	8·685 in.	(22·06 cm)
Final drive seal land diameter	3·252 - 3·248 in.	(82·600 - 82·499 mm)