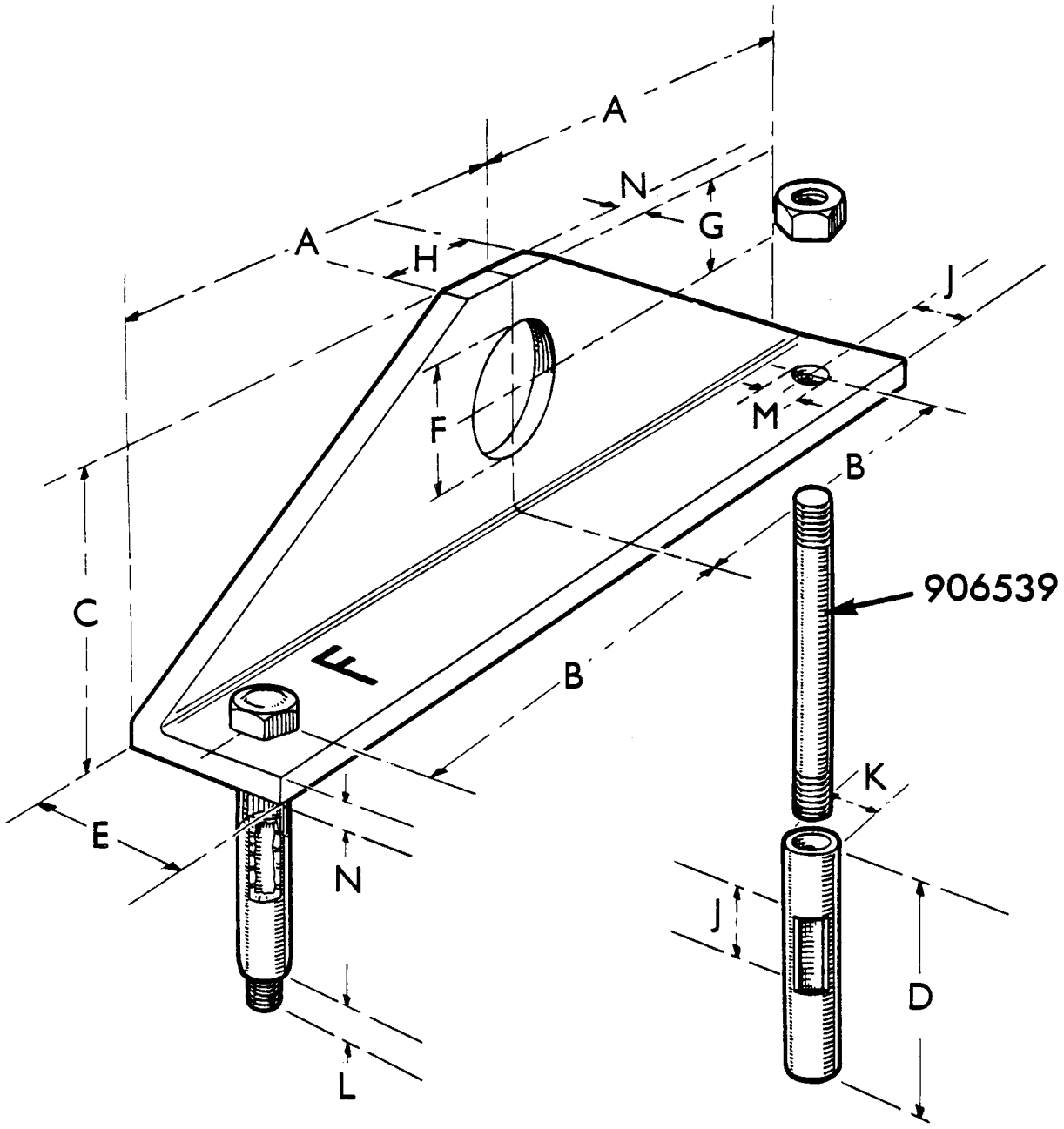

Figure 45. ENGINE LIFTING BRACKET

Nut and distance piece to be welded to stud allowing $\frac{1}{16}$ in. (0·158 cm) clearance between nut and angle bracket

A. 6 in. (15·24 cm)
B. $5\frac{1}{16}$ in. (12·86 cm)
C. 4 in. (10·16 cm)
D. $3\frac{11}{16}$ in. (9·366 cm)
E. $2\frac{1}{2}$ in. (6·350 cm)
F. 2 in. (5·080 cm)
G. $1\frac{3}{4}$ in. (4·445 cm)
H. $1\frac{1}{2}$ in. (3·810 cm)
J. 1 in. (2·54 cm)
K. $\frac{7}{8}$ in. (2·222 cm)
L. $\frac{5}{8}$ in. (1·587 cm)
M. $\frac{9}{16}$ in. (1·428 cm)
N. $\frac{3}{8}$ in. (0·952 cm)

Engine removal procedures may be summarised as follows:

Non-Livedrive Models
All numbers — Lift engine (Method 'A').

Livedrive Models — Six-Speed
Nos. 440001 to 479538 — Lift engine (Method 'A').

Nos. 479539 to 487806 — "Split" tractor (Method 'B').

Nos. 487807 onward — Lift engine (Method 'A').

Livedrive Models — Twelve-Speed
All numbers — "Split" tractor (Method 'B').

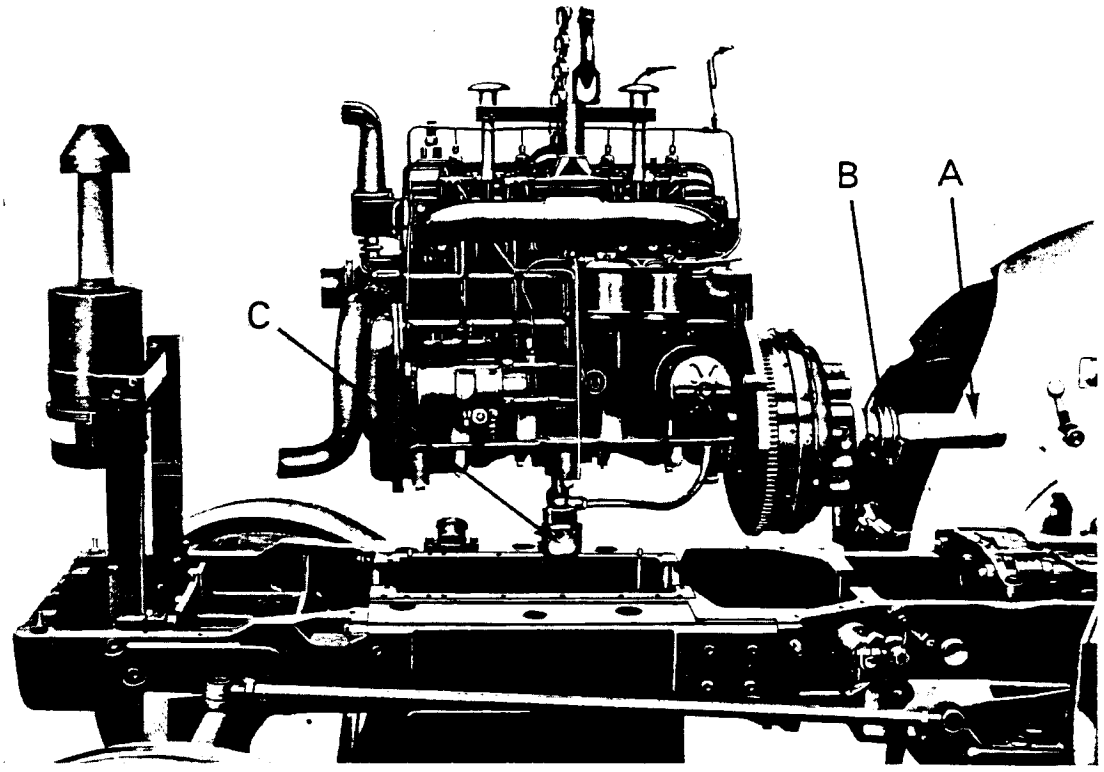

Figure 46. TRACTOR WITH ENGINE REMOVED

A. Muff coupling B. Support snout C. Engine oil pump

Engine Removal — Method 'A'

Remove pre-cleaner, silencer and bonnet. Disconnect battery terminals and main lead to starter. Drain radiator and cylinder block, disconnect hoses and remove radiator. Disconnect throttle and stop-control linkage from injection pump. Remove the fuel pipe from tank to fuel feed pump and remove the short pipe connecting the leak-off to tank.

Disconnect the wiring and tractormeter cable. Remove fuel-tank mounting nuts and remove tank complete with instrument panel.

Remove steering drop-arm from its shaft and remove the steering-box, complete with column and wheel. This will expose the clutch-housing bolts inside the steering-box and enable gearbox cover and clutch housing to be removed.

On Livedrive tractors it is necessary to drain the transmission oil and remove the power take-off unit so that the cardan shaft can be withdrawn clear of clutch driveshaft.

If the tractor is fitted with a band-type clutch-stop remove the pins from each end of the band so that the band can be removed. Release the circlips on clutch driveshaft so that the drum and muff coupling can be slid far enough forward on the shaft to clear the gearbox.

If the tractor is not fitted with a band-type clutch-stop, release the circlip at the front of the muff coupling and slide the coupling fully forwards.

Remove the three bolts attaching the support snout to the axle case and remove the clutch-stop bracket, if fitted. Remove the two figure-of-eight spring clips from clutch fork so that the release bearing can be lifted clear of the fork.

Remove the cylinder-block-to-main-frame bolts (four of these are long bolts fitted from the underside of the main frame) and remove valve rocker cover. Fit a lifting bar (Fig. 45) on to the two cylinder-head lifting nuts, or place suitable slings round the engine, and lift the engine complete with clutch and clutch driveshaft vertically out of the frame. Ensure that the support snout is lifted clear of frame and lift the engine carefully until oil pump is clear of frame.

Replace engine in the reverse order to removal, using new gaskets and seals. Clean main frame and cylinder block faces, ensuring that all traces of the old gasket are removed. Smear main frame face with jointing compound, also both sides of the gaskets before placing them in position. A rubberised jointing compound such as Hylomar (962184) should be used. Fit new bearing-cap seals, pushing ends of seals into holes in block so that seals fit closely in bearing cap grooves.

Two $\frac{3}{8}$ UNC studs temporarily screwed into main frame at opposite points will assist in locating the engine and allow it to be lowered into position without disturbing the gaskets. Note that the clutch shaft is inserted in the clutch, and the support snout and muff coupling are in position on the shaft, before lowering the engine into position.

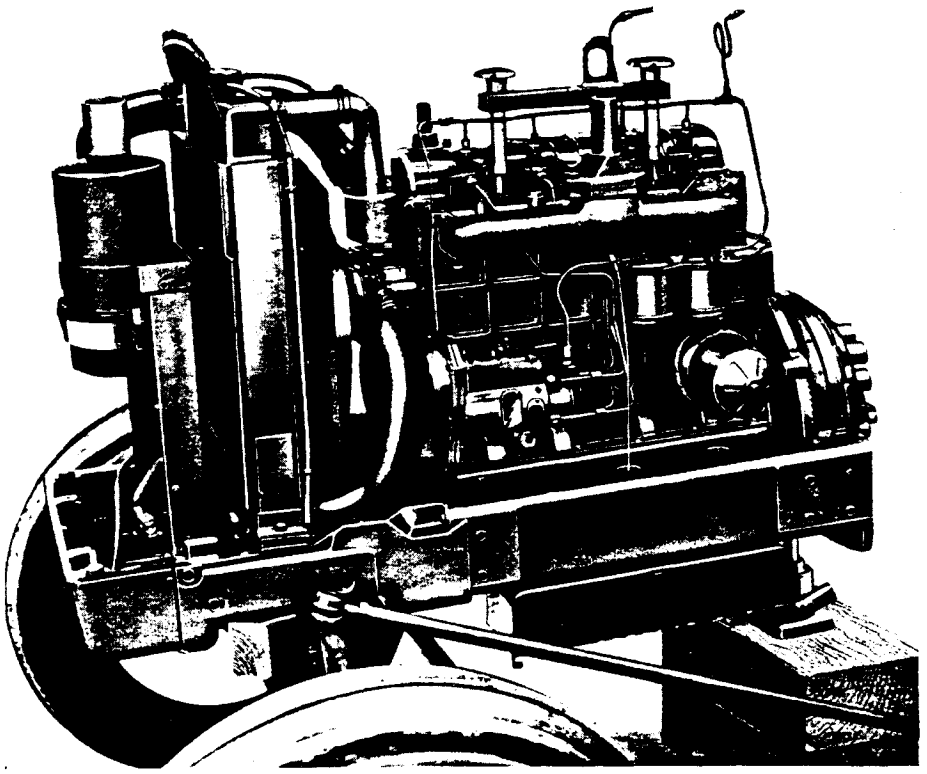

Figure 47. TRACTOR SPLIT FOR ENGINE REMOVAL

When refitting the steering drop-arm on to its shaft ensure that it is fitted on its correct spline, otherwise the steering lock will be restricted on one side. Shafts and arms are marked during assembly and should be refitted so that the centre-punch mark on the arm is opposite the mark on the end of the shaft.

Engine Removal — Method 'B'

As the two halves of the tractor are heavy and require to be maintained in alignment during assembly, this operation should be carried out with the tractor standing on firm and reasonably level ground.

Place a trolley-jack under rear of tractor so that it can support the rear half of tractor when the main frame is "split". Place the jack-pad immediately behind the clutch-pit cover and raise the jack so that it takes weight but does not lift the frame. Drive wooden wedges between each side of the front extension and axle beam so that the engine unit will remain upright when it is not attached to the rear half of tractor. The wedges should be of hard wood and approximately 5 in. (12 cm) long so that they can be driven firmly into position without any possibility of becoming dislodged. Chock the front wheels so that they cannot move either way and place a jack under the front main frame positioned just in front of the rear flange. Extend the jack so that it takes weight but does not lift the frame.

Remove the bonnet and drain radiator and cylinder block. Disconnect throttle and stop-control linkage. Disconnect instrument panel and wiring and tractor-meter cable.

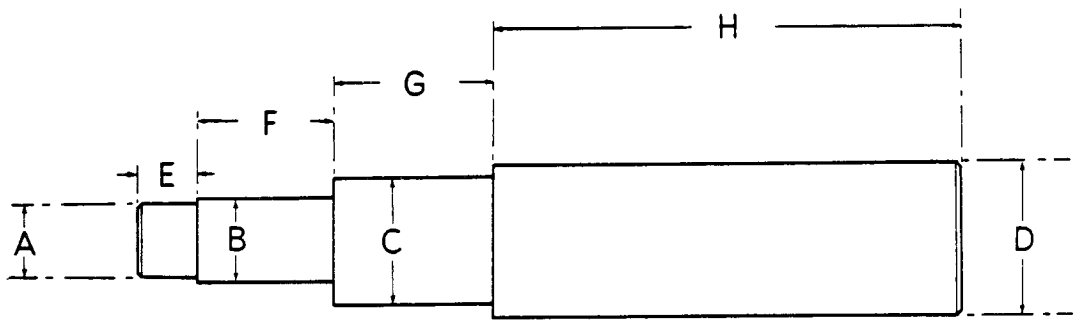

Figure 48. CLUTCH PLATE PILOT

A. 0·874 in. (22·20 mm) B. 0·915 in. (23·24 mm) C. 1·420 in. (36·07 mm) D. 1·771 in. (44·98 mm)
E. $\frac{5}{8}$ in. (15·88 mm) F. $1\frac{1}{2}$ in. (38·10 mm) G. $1\frac{3}{4}$ in. (44·45 mm) H. 5 in. (127 mm)

Remove fuel pipe from tank to feed pump and remove the pipe connecting the leak-off to tank.

Remove steering drop-arm from its shaft. Remove starter and remove bolts attaching the main frame and clutch housing to front half of tractor. Using the two jacks to support the two halves of frame in alignment, draw the rear half away until PTO cardan shaft is clear of the clutch.

Having separated the two halves of tractor, remove the radiator and the cylinder-block-to-main-frame bolts — four of which are on the underside of the main frame. Attach a lifting bar (Fig. 45) to the two cylinder head lifting nuts, or place suitable slings round the engine, and lift the engine vertically until the oil pump is clear of the frame.

Replace engine in reverse order of removal, using new gaskets and seals. Clean main frame and cylinder block faces, ensuring that all traces of the old gasket are removed. Smear main frame face and both sides of the gaskets with jointing compound before placing the gaskets in position. A rubberised jointing compound such as Hylomar (962184) may be used. Fit new bearing-cap seals, pushing ends of seals into holes in cylinder block so that seals fit closely in bearing-cap grooves.

Two $\frac{3}{8}$ UNC studs temporarily screwed into main frame at opposite points will assist in locating the engine and allow it to be lowered into position without disturbing the gaskets.

If the clutch assembly has been removed from flywheel it will be necessary for the clutch plates to be centralised so that the clutch shafts can be entered. When fitting clutch assembly on to flywheel a pilot shaft (Fig. 48) should be used to hold the plates central until the cover bolts are fully tightened.

When refitting the steering drop-arm on to its shaft ensure that this is on the correct spline, otherwise the steering lock will be restricted on one side. Shafts and arms are marked during assembly and should be refitted so that the centre-punch mark on the arm is opposite the mark on end of the shaft.

DIMENSIONAL DATA

Torque Figures

Big-end bearing nuts	50 lb ft	6·92 kg metres
Breather filter cover nut	10 lb ft	1·38 kg metres
Camshaft gear bolt	40 lb ft	5·53 kg metres
Cylinder head nuts and bolts	90 lb ft	12·4 kg metres
Cylinder head studs into block	35 lb ft	4·84 kg metres
Flywheel housing to engine bolts	30 lb ft	4·14 kg metres
Flywheel nuts	50 lb ft	6·92 kg metres
Front extension to main frame bolts	50 lb ft	6·92 kg metres
Fuel Injection Pump:		
Automatic retard fixing bolt	120 lb in	1·38 kg metres
Governor housing nuts (Permanite gasket)	40 lb in	0·46 kg metres
Governor housing nuts (cork gasket)	30 lb in	0·35 kg metres
Head-side fixing bolts	170 lb in	1·96 kg metres
Inspection cover nuts	30 lb in	0·35 kg metres
Inspection pipe banjo bolts	270 lb in	3·11 kg metres
Manual lock fixing bolt	350 lb in	4·02 kg metres
Throttle and stop lever nuts	30 lb in	0·35 kg metres
Main bearing cap bolts	140 lb ft	19·3 kg metres
Main frame to engine bolts	30 lb ft	4·14 kg metres
Main frame to flywheel housing bolts	50 lb ft	6·92 kg metres
Oil filter bowl bolt	10 lb ft	1·38 kg metres
Sump to main frame bolts	20 lb ft	2·76 kg metres
Valve rocker adjusting nuts	14 lb ft	1·94 kg metres

The following 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

Capacities

Cooling system	3 gal	12·6 litres
Engine lubricating oil	13 pints	7·4 litres
Steering-box oil	2 pints	1·1 litres
Air-cleaner oil bath	$1\frac{1}{4}$ pints	0·7 litres
Fuel tank	$13\frac{1}{2}$ gal	61·4 litres

Wear Limits

The following figures are only intended to serve as a guide to determine when a component should be renewed:

Crankshaft big-end journals should be reground if ovality exceeds 0·005 in. (0·127 mm).

Crankshaft main-bearing journals should be reground if wear exceeds 0·005 in. (0·127 mm).

Piston rings should be replaced if the ring gap exceeds 0·060 in. (1·524 mm) when checked in the unworn part of the cylinder.

When there is evidence of ring and slight bore wear causing oil consumption, fit oil control rings. These should control oil consumption if the bore wear is not greater than 0·010 in. (0·25 mm) and are available to suit either standard or oversize bores. If oil consumption exists and oil control rings have already been fitted it will be necessary to renew the cylinder liners and pistons.

Piston groove clearance should not exceed 0·010 in. (0·25 mm) when checked with a new ring.

Oversize valves should be fitted if the bore in the cylinder head is worn in excess of 0·006 in. (0·15 mm). For details of oversize reamers and seat cutter pilots see Service Tool Leaflet A28.

Piston Dimensions (new)

Nominal diameter	3⅝ in	92·075 mm
Piston skirt diameter (at right-angles to gudgeon pin bore)	3·619 — 3·618 in	91·93 — 91·91 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	3·6255 — 3·6250 in	92·088 — 92·076 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

Valve Clearance (set cold)

Inlet	to AD4/47A 60389	0·015 in	0·35 mm
Exhaust	and AD4/47B 40724	0·012 in	0·30 mm
Inlet	from AD4/47A 60390	0·010 in	0·25 mm
Exhaust	and AD4/47B 40725	0·007 in	0·18 mm

Valve Springs (inlet and exhaust)

Free length	1·970 in	5·0 cm
Length at 40 lb load	1·530 in	
Length at 80 lb load	1·102 in	
Length at 15 kg load		4·08 cm
Length at 30 kg load		3·15 cm

Valve Stem Diameters (inlet and exhaust)

Standard	0·3732 — 0·3722 in	9·479 — 9·454 mm
Oversize 0·010 in. (0·007 mm)	0·3832 — 0·3822 in	9·733 — 9·708 mm
Oversize 0·020 in. (0·014 mm)	0·3932 — 0·3922 in	9·987 — 9·962 mm
Valve seat angle	45°	45°
Valve guide bore	0·375 — 0·374 in	9·525 — 9·499 mm
Valve tappet diameter	0·624 — 0·623 in	15·850 — 15·824 mm

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

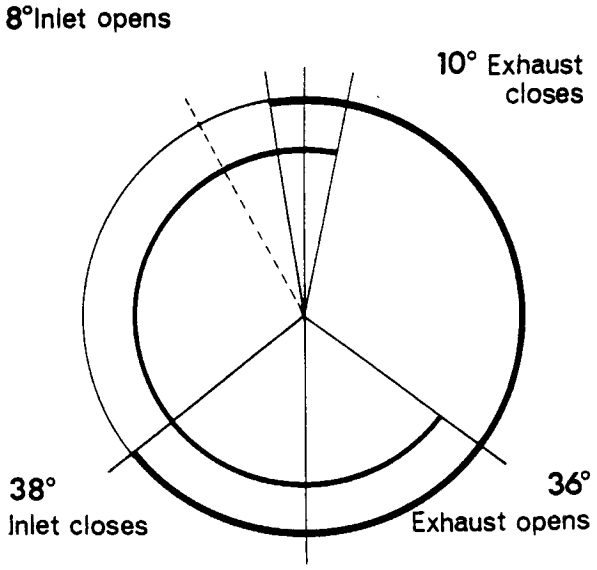

Figure 49. VALVE TIMING DIAGRAM

Fuel System

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

Spill timing mark: Pump flange and engine mounting flange are marked, and correct pump timing is obtained when these marks are in alignment.

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 Flange Mounting

AD4/47 .. .. 69½° from blank spline when at point of injection

Injection Pump Fuel Setting

AD4/47 .. .. 10·4 — 10·6 cc per 200 shots at 850 rev/min

Injector Nozzle Hole Diameter

AD4/47 .. .. 0·28 — 0·30 mm

Injection Pump and Injectors

Pumps		Injectors		
DB No.	CAV No.	DB No.	Holder	Nozzle
906899 909458	3243090 3243860	904442	BKBL 97S5152	BDLL 140S6276
910521 910521 918912	3243960 3248260 3248680	910530	BKBL 97S5152	BDLL 140S6417

Oil Pump

Spindle diameter	0·4895 — 0·490 in	12·43 — 12·45 mm
Spindle bush bore	0·4905 — 0·4925 in	12·458 — 12·509 mm
Rotor width	1·1865 — 1·1855 in	30·137 — 30·112 mm
Housing depth	1·1890 — 1·1875 in	30·191 — 30·162 mm
End float	0·001 — 0·0035 in	0·025 — 0·088 mm
Pump rotor backlash	0·020 — 0·026 in	0·511 — 0·66 mm

Crankshaft

Main journal diameter

Standard size	2·4995 — 2·4990 in	63·487 — 63·474 mm
Undersize 0·010 in. (0·254 mm)	2·4895 — 2·4890 in	63·233 — 63·220 mm
Undersize 0·020 in. (0·508 mm)	2·4795 — 2·4790 in	62·979 — 62·966 mm
Undersize 0·030 in. (0·762 mm)	2·4695 — 2·4690 in	62·725 — 62·712 mm

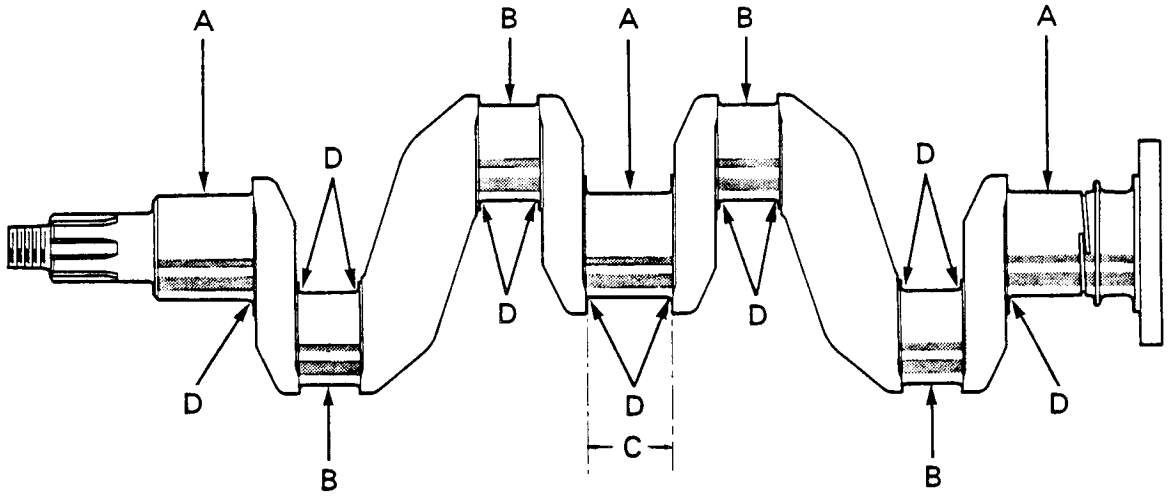

Figure 50. CRANKSHAFT DIMENSIONS

A. Main journal diameters
B. Big end journal diameter
C. Centre journal width
D. Fillet radius

When regrinding crankshaft 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.

Big-end journal diameter

Standard size	2·2485 — 2·2480 in	57·111 — 57·099 mm
Undersize 0·010 in.	2·2385 — 2·2380 in	56·848 — 56·845 mm
Undersize 0·020 in.	2·2285 — 2·2280 in	56·604 — 56·591 mm
Undersize 0·030 in.	2·2185 — 2·2180 in	56·350 — 56·337 mm

Centre journal width

Standard size	2·126 — 2·124 in	54·00 — 53·95 mm
Oversize 0·010 in.	2·136 — 2·134 in	54·254 — 54·204 mm
Oversize 0·040 in.	2·176 — 2·174 in	55·270 — 55·220 mm

Bearing fillet radius	0·16 — 0·15 in	4·06 — 3·81 mm
Big-end bearing clearance	0·0015 — 0·0025 in	0·038 — 0·063 mm
Main bearing clearance	0·002 — 0·004 in	0·051 — 0·102 mm
End-float of crankshaft	0·002 — 0·010 in	0·051 — 0·258 mm

Thrust Washer thickness

Standard	0·091 — 0·093 in	2·3114 — 2·3622 mm
Oversize 0·005 in. (0·127 mm)	0·096 — 0·098 in	2·4384 — 2·4892 mm
Oversize 0·020 in. (0·508 mm)	0·111 — 0·113 in	2·8194 — 2·8702 mm

Connecting Rod Alignment

Maximum out of parallel	0·001 in/in	0·01 mm/cm
Maximum twist	0·001 in/in	0·01 mm/cm
Maximum weight variation in set of three rods ..	0·25 oz	7·1 gm

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

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

Camshaft Journal Diameters

Front	1·872 — 1·870	in	47·55	— 47·50	mm
No. 2	1·827 — 1·825	in	46·41	— 46·35	mm
Nos. 3 and 4	1·811 — 1·810	in	46·00	— 45·97	mm
No. 5	1·765 — 1·763	in	44·83	— 44·78	mm
No. 6	1·749 — 1·747	in	44·42	— 44·37	mm
Camshaft thrust washer thickness	0·245 — 0·240	in	6·223	— 6·096	mm
Camshaft end-float	0·010 — 0·020	in	0·254	— 0·508	mm

SUMMARY OF DESIGN CHANGES

Details of change	When introduced
Across-flats dimension of crankshaft nut reduced from 1·670–1·658 in. (42·42–42·11 mm) to 1·500–1·488 in. (38·10–37·80 mm). Part No. 623300 unchanged.	AD4/47A/32776 AD4/47B/31181 (July 1962)
Exhaust valve spring (907895) also fitted on inlet valve. The previous inlet-valve spring (905215), which is marked with red paint, is weaker than the 907895 spring and should not be used for replacements.	AD4/47A/31773 AD4/47B/32002 (July 1962)
Length of thread on injection-pump coupling bolts reduced to $\frac{1}{2}$ in. (12·5 mm). Part No. of bolts, 600353, unchanged.	AD4/47A/34476 AD4/47B/31901 (July 1962)
Changes to reduce amount of oil leakage down valve guides. Rocker shaft oil-holes reduced. Part No. of shaft changed from 904192 to 909622, and 30° chamfer machined at top of exhaust valve stem bore.	AD4/47A/34932 AD4/47B/32082 (August 1962)
Position of injection cut-off lever turned through 180° and control rod changed so that operation of engine control stop is reversed, i.e., the engine being stopped when the control is in the forward position. Part No. of pump unchanged but Part No. of stop control rod changed from 908221 to 908524.	AD4/47A/34065 AD4/47B/31734 (September 1962)
Injection pump changed from 906899 (CAV 3243090) to 909458 (CAV 3243860). As the new pump has a slightly different internal timing the pump drive gear marking has been retarded one tooth. Part No. of gear changed from 902006 to 909457. Pumps and gears are interchangeable if the gears are meshed one tooth advanced, or retarded, in order to obtain the correct timing.	AD4/47A/35277 AD4/47B/32248 (September 1962)
Drain-hole drilled in water pump body (902029) to prevent any water which leaks past the gland seal from damaging the bearing and provide a visible indication that the seal is leaking.	AD4/47A/32074 AD4/47B/30917 (January 1963)
Dynamo 35521 (Lucas C39-2) replaced by dynamo 908882 (Lucas C40A). The new dynamo, which is fitted with Lucar connectors, is interchangeable with the previous dynamo if suitable connectors are used.	AD4/47A/36228 AD4/47B/32834 (January 1963)
Fitting of injection pump 909458 (CAV 3243860) discontinued and 906899 (CAV 3243090) re-introduced. Pump drive gear 909457 also changed back to previous gear 902006.	AD4/47A/36230 AD4/47B/32832 (January 1963)
Crankshaft breather changed so that overtightening the nut does not compress the breather element and cause pressure build-up in the crankcase. Parts not interchangeable unless fitted complete.	AD4/47A/37593 AD4/47B/33527 (February 1963)
Injection pump 906899 (CAV 3243090) changed to 910521 (CAV 3243960) and injectors changed from 904442 to 910530.	AD4/47A/43672 AD4/47B/36677 (January 1964)
Timing gear cover changed from cast iron to pressed steel. Part No. of cover changed from 904056 to 910057. Covers interchangeable if the appropriate bolts are used.	AD4/47A/44311 AD4/47B/37572 (July 1964)
Distance piece, Part No. 912812, fitted between water-pump pulley (900476) and fan in order to comply with U.K. safety requirements.	AD4/47A/46417 AD4/47B/37384 (July 1964)

Details of change	When introduced
Oil flinger, Part No. 913369, fitted between the crankshaft gear and pulley.	AD4/47A/46481 AD4/47B/37378 (July 1964)
Gasket, Part No. 914404, fitted between crankshaft oil retainer and cylinder block.	AD4/47A/49989 AD4/47B/37876 (September 1964)
Two $\frac{5}{16}$ in. (7·8 mm) diameter holes drilled through rear main-bearing cap to assist oil drainage into sump when operating on severe gradients.	AD4/47A/51137 AD4/47B/38316 (October 1964)
Length of water-pump pulley-hub increased to make the fitting of distance piece (912812) unnecessary. Part No. of pulley changed from 900476 to 914335.	AD4/47A/57582 AD4/47B/40057 (October 1964)
Injection pump changed from CAV 3243960 to CAV 3248260. Part No. of pump, 910521, unchanged.	(November 1964)
Water pump pulley, Part No. 914335, changed back to 900476. Distance piece 912812 re-introduced on U.K. tractors only.	AD4/47A/60986 AD4/47B/40825 (November 1965)
Camshaft, Part No. 902050, replaced by camshaft 914673, which has higher lift inlet cams. To accommodate the increased valve opening the valve recess in the pistons has been made deeper, the valve heads slightly thinner, and stronger valve springs fitted. With the exception of the camshaft, which must not be fitted unless the other parts are also fitted, the new parts may be used as replacements for earlier engines. The introduction of this change has required a reduction in valve clearances to inlet — 0·010 in. (0·25 mm) — and exhaust — 0·007 in. (0·18 mm).	AD4/47A/60390 AD4/47B/40725 (November 1965)
Retaining plate, Part No. 919660, fitted on fan bolts and bolt-holes in fan blade repositioned, to prevent any possibility of blade fracture.	AD4/47A/68495 AD4/47B/41696 (October 1966)
Face width of crankshaft gear (901989) and intermediate gear (904074) increased to 1 in. (25·4 mm). Part No. of gears changed to 917898 and 917904 respectively. Fitting of a crankshaft oil flinger discontinued.	AD4/47A/69515 AD4/47B/41792 (September 1966)
Injection pump 918912 (CAV 3248680), with direct mounted gear used as an alternative pump to quill-shaft driven pump 910521 (CAV 3248260) on a number of tractors not fitted with power-assisted steering.	AD4/47A/69515 and AD4/47B/41792 to AD4/47A/71241 and AD4/47B/42115 (November 1966)
Tappet cover studs (608206) changed to bolts (600408) and material of tappet cover gaskets (10030) changed from cork/aluminium to cork only.	AD4/47A/71160 AD4/47B/42116 (December 1966)
Material of cylinder head gasket (902040) changed from copper and asbestos sandwich to graphite-surfaced asbestos. Part No. of gasket unchanged. Wellseal should not be used when fitting gaskets of the later material.	AD4/47A/74181 AD4/47B/42612 (January 1967)
Cap nut, Part No. 607516, fitted on the oil pump locating screw (900748) in place of the locknut (607053) fitted previously.	AD4/47A/76496 AD4/47B/42941 (April 1967)

Under this service classification, the factors of operating conditions, fuel character, especially sulphur content, and design features combine in various ways to make the service and hence the lubrication requirements less severe than for Service DS. Some designs are critical with respect to lubricating oil residues; for these designs some oils suitable for Service DS are not satisfactory.

Footnote: The characteristics of oil in this rating are similar to Supplement 1 oils I.C.E.I. (Internal Combustion Engine Institute) rating.

(c). Service DS — Extreme Conditions — Diesel

Service typical of Diesel Engines operating under very severe conditions, or having design characteristics, or using fuel tending to produce excessive wear or deposits.

The service requirements in this classification are the most severe encountered in the operation of diesel engines. High-load operation at high temperatures, design factors, especially supercharging or engine installation details causing unusually high temperatures within the engine, constitute severe service, as does intermittent operation at low temperatures, since both promote wear and deposit formation. Cooling system and crankcase ventilating system design, also exhaust line arrangement, can aggravate or minimise the severity in either case. The use of high-sulphur content fuels increases service severity with respect to wear and deposits, depending upon design, maintenance and operating conditions. Hence, frequently their use is considered to constitute severe service, especially in low temperature operation.

Note: The characteristics of oil in this rating are similar to Supplement 3 I.C.E.I. rating or Series 3 "Caterpillar rating" oil.

(d). Service ML — Least Severe Conditions — Petrol

Service typical of Gasoline and other Spark Ignition Engines used under light and favourable operating conditions, the engines having no special lubrication requirements and having no design characteristic sensitive to deposit formation.

This is the least severe condition. It includes moderate speed driving or moderate load operation most of the time, with no severe low or high engine temperature operation. It also includes operation of engines insensitive to sludge, deposit formation, bearing corrosion, wear or fuel characteristics.

(e). Service MM — Moderate Conditions — Petrol

Service typical of Gasoline and other Spark Ignition Engines used under moderate to severe operating conditions, but presenting problems of deposit or bearing corrosion control when crankcase oil temperatures are high.

This is a more moderate service requirement than Service MS. Vehicles powered by engines which are relatively insensitive to deposit formation or wear when operated at high speeds or under heavy loads are included in this service, particularly when using fuels of suitable characteristics. It does not include extensive operation under the severe type of low engine temperature service such as start-and-stop driving or prolonged idling described under Service MS.

(f). Service MS — Severe Conditions — Petrol

Service typical of Gasoline and other Spark Ignition Engines used under unfavourable or severe types of operating conditions, and where there are special lubrication requirements for deposit, wear or bearing corrosion control, due to operating conditions or to engine design or fuel characteristics.

This class of oil also covers operation in extremes of temperature, stop/start or prolonged idling conditions and the resulting crankcase condensation and dilution which causes the formation of sludge, being taken into consideration.

APPROVED LUBRICANTS

OVERSEAS

Lubricants

Application	A.P.I. Classn.	Air Temp.	GRADE Recomm.	GRADE Alternative	AMOCO	B.P.	CASTROL	ESSO	MOBIL	SHELL
Engine and Air Cleaner	DG, MS, DM	Below —7°C (20°F)	Multi-purpose 10W/30	10W Diesel (SAE 10W)	AMERICAN HD – M Motor Oil 10W – 30	Tractor Oil Universal	Agricastrol Multi-use 10W/30	Esso Tractorlube Universal 10W/30	Mobiland Universal 10W/30	Rotella Multigrade 10W/30
	DG, MS, DM	—7°C to 32°C (20°F to 90°F)	Multi-purpose 20W/30 or 20W/40	20/20W Diesel (SAE 20W)	AMERICAN HD – M Motor Oil 20W – 30 or 20W – 40	Tractor Oil Universal	Agricastrol Multi-use 20W/30 or 20W/40	Esso Tractorlube Universal 20W/30	Mobiland Universal 20W/30 or 20W/40	Rotella Multigrade 20W/40
	DG, MS, DM	Above 32°C (90°F)	Multi-purpose 20W/30 or 20W/40	30 Diesel (SAE 30)						
Details of Alternative Grade Oils			10W Diesel (SAE 10W)		AMERICAN HD – M Motor Oil SAE 10W	Energol Diesel D SAE 10W	Castrol CR10 or Agricastrol HD10	Essolube HD 10W	Mobiloil 10W or Delvac Oil 1110	Rotella 10W
			20/20W Diesel (SAE 20W)		AMERICAN HD – M Motor Oil SAE 20-20W	Energol Diesel D SAE 20W	Castrol CR20 or Agricastrol HD20	Essolube HD20	Mobiloil Arctic or Delvac Oil 1120	Rotella 20/20W
			30 Diesel (SAE 30)		AMERICAN HD – M Motor Oil SAE 30	Energol Diesel D SAE 30	Castrol CR30 or Agricastrol HD30	Essolube HD30	Mobiloil A or Delvac Oil 1130	Rotella 30

Engine oil: Under normal operating conditions the engine oils should be marked with viscosity grade and API classification as shown in the above table. Oils marked with service classification DM are recommended when one or more of the following conditions is present:—abnormally high operating temperatures, intermittent operation at low temperatures or fuel contains more than 1% sulphur. Service DS (Series 3) oil is not listed as it has super-detergent qualities which are not considered essential for D.B. tractor engines operating in normal field conditions.

Air cleaner: All M and D classifications with the exception of DS are recommended for use in oil-washed air cleaners fitted to D.B. tractors. DS is not recommended due to its frothing characteristics. Where possible a straight mineral oil should be used as an alternative to engine oil to avoid frothing.

Fuel, Grease and Anti-freeze

Diesel fuel: For temperature above 0°C (32°F) use No. 2D fuel (ASTMD 975) with a minimum cetane rating of 45.

For temperature below 0°C (32°F) use No. 1D fuel (ASTMD 975) with a minimum cetane rating of 50.

Note: For low temperature operation a fuel with a pour point 6°C (10°F) below lowest starting temperature should be specified. Fuels with not more than 0·5% by weight sulphur should be used when available. A high sulphur content fuel requires an engine lubricating oil with high detergent characteristics to prevent carbon build up in the nozzles and combustion chambers and to neutralise the acid created by sulphur.

Greasing points: A good quality multi-purpose grease should be applied to all grease fittings (except water pump which requires a high-melting-point grease applied sparingly every 500 hours). High-melting-point grease may be used for all fittings except those which require oil.

Anti-freeze solutions for engine coolant: Use only a brand formulated for use in diesel engines to British Standard 3151 (1959) type B (or equivalent) which specifies a corrosion inhibited ethanediol anti-freeze. (Sodium benzoate and sodium nitrite inhibited.)

BRITISH ISLES

Lubricants

APPLICATION	GRADE Recommended	Alternative	AMOCO	B.P.	CASTROL	ESSO	MOBIL	SHELL
Engine & Air Cleaner	Multi-purpose Oil	20/20W	Vitamatic Tractor Oil	Tractor Oil Universal	Agricastrol Multi-use	Esso Tractorlube (Universal)	Mobiland Universal	Tractor Oil Universal
Alternative Grade Oils	20/20W		New Ace 20/20W	Energol DD 20W	Castrol CR20 or Agricastrol HD20	Essolube HD20	Mobiloil Arctic or Delvac Oil 1120	Rotella 20/20W

Fuel, Grease and Anti-freeze

Diesel fuel: Farm diesel fuel of high quality is recommended for use in David Brown engines. Fuels with not more than 0·5% by weight sulphur should be used when available. A high sulphur content fuel requires an engine lubricating oil with high detergent characteristics, to prevent carbon build up in the nozzles and combustion chambers, and to neutralise the acid created by sulphur.

Greasing points: A good quality multi-purpose grease should be applied to all grease fittings (except water pump which requires a high-melting-point grease applied very sparingly every 500 hours). A high-melting-point grease may be used for all fittings except those which require oil.

Anti-freeze solution for engine coolant: Use only a brand formulated for use in diesel engines to British Standard 3151 (1959) type B (or equivalent) which specifies a corrosion inhibited ethanediol anti-freeze. (Sodium benzoate and sodium nitrite inhibited.)

Fuel Injection Equipment Test Oils

New oils made from a refined mineral oil with the addition of oxidation and corrosion inhibitors have recently been introduced for use when testing fuel injection equipment.

The oils previously approved have therefore been superseded by the new oils as follows:

Previously Approved	New Recommendation
Shell — Fusus 'A' Oil	Shell Calibration Fluid 'C' (obtainable in the U.K.) Shell Calibration Fluid 'B' (obtainable overseas)
Esso — TSD Oil 815	Esso — Calibration Fluid IL/1838
Wakefield — Calibration Oil 8327	Castrol — Calibration Oil 'C'

Note: As Shell Fusus 'A' Oil does not now include a viscosity control but will still be available for other industries, e.g., for use as a burning or drying oil, **it is important that Fusus 'A' Oil is not now used as a test oil.**
The two Shell grades 'B' and 'C' are interchangeable.

Printed in England by The Cloister Press Ltd., Heaton Mersey, Stockport