GENERAL DESCRIPTION

Both the ETC (vaporizing oil) and ETD (petrol) four-cylinder side-valve engines are built in unit construction, each having a single-plate dry clutch.

Each has a robust four-throw crankshaft carried in three renewable white-metal steel-backed bearings fitted without shims.

The thrust is taken by the front bearing, which is flanged for this purpose.

The connecting rod big-end bearings are also renewable white-metal-lined steel-backed bearings fitted without shims. The little-end, embracing the gudgeon pin, is split and fitted with a clamp screw and spring washer, which serve to lock it solidly to the gudgeon pin.

The light-alloy pistons are fitted with two compression rings, one oil control ring, and one scraper ring.

The camshaft is supported in three bearings in the cylinder block casting and is driven from the crankshaft by a duplex roller chain. The camshaft bearings are pressure-fed with oil from the main oil gallery.

The camshaft operates the valves through the medium of chill-cast tappets located in detachable guide blocks. Provision for adjustment of the tappets is made by the orthodox tappet-head screw and locknut.

The engine is cooled by thermo-siphon action, assisted by an impeller and fan.

To give a rapid warm up, water circulation is confined within the engine, up to a predetermined temperature, by a thermostat in the outlet pipe. The working temperature of the ETC engine is controlled in addition by manually operated shutters on the radiator.

LUBRICATION SYSTEM

The oil supply is carried in the sump below the cylinder block. An oil indicator dipstick is fitted on the right-hand side of the engine below the oil filler.

The gear-type oil pump is carried in the sump of the engine and is driven from a helical gear on the camshaft. It draws the oil from the sump through a floating oil filter and delivers it to the external filter unit.

A pressure relief valve of the non-adjustable ball type is provided to deal with cases of excessive pressure when starting from cold, surplus oil being returned to the sump. A baffle above the valve prevents excessive oil reaching Nos. 2 and 3 cylinder walls.

A by-pass valve integral with the filter unit is provided to ensure that in the event of pressure building up inside the filter, or the filter becoming blocked, oil is fed to the main oil gallery direct. The filter element should be renewed every six months or every 500 hours.

From the filter the oil enters the external main oil gallery running from front to rear of the engine on the left-hand side. The oil is fed to the camshaft bearings and crankshaft main bearings through drilled passages.

Surplus oil from the front camshaft journal passes through the hub of the camshaft chain wheel and is fed through radial holes onto the timing chain and into the governor.

Drilled passages in the crankshaft provide lubrication for the big-end bearings, the surplus oil from which splashes onto the camshaft, tappet gear, and cylinder walls.

An oil pipe connects the delivery side of the external filter unit with the oil gauge.

Crankcase ventilation is ensured by a closed breathing circuit in which the crankcase fumes are consumed through the air cleaner and air intake.

Section AAA.1

DRAINING THE ENGINE SUMP

This operation should be carried out when the engine oil is warm. Extract the hexagon-headed drain plug at the rear of the sump on the left-hand side and allow the oil to drain for several minutes.

Drain the sump entirely after the first 50 working hours and thereafter at the end of every two weeks or 100 working hours. The sump on ETD engines only requires draining every month or 200 working hours. Refill with the recommended lubricant (see page PPP.4). The capacity is 1½ gallons (6·8 litres).

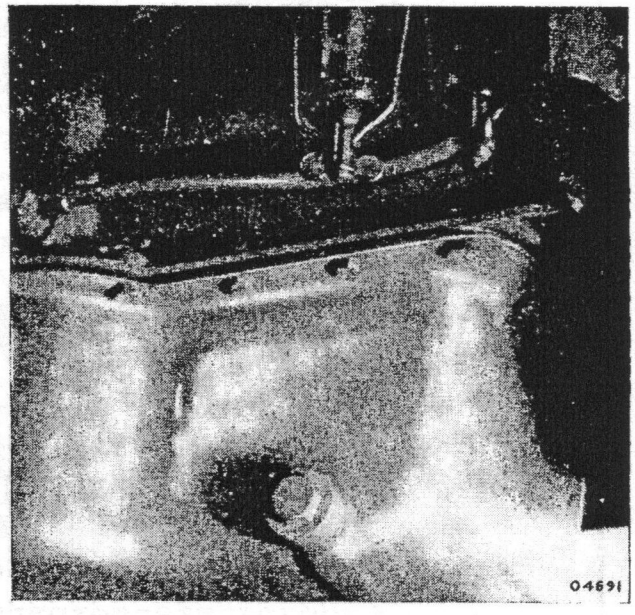


Fig. AAA.1

The engine sump drain plug is on the right-hand side of the engine below the fuel tap

An additional 2 pints (1·14 litres) of oil are required to refill the engine sump after the oil filter bowl and element have been cleaned. The oil filter element should be cleaned whenever the engine oil is changed (see Section AAA.6).

Section AAA.2

REMOVING AND REPLACING THE SUMP

Drain off the oil as in Section AAA.1.

Take out the dipstick and the screws holding the sump to the crankcase and withdraw the sump.

Clean out the sump with paraffin and inspect the joint seal. If it is damaged fit a new one. Sealing compound is not necessary when making the joint.

Refit the sump and tighten the screws evenly. Clean and replace the drain plug and dipstick before refilling the sump with 1½ gallons (6·8 litres) of the recommended oil to Ref. A (page PPP.4).

Section AAA.3

REMOVING AND REPLACING THE OIL PUMP

Drain and remove the sump as in Sections AAA.1 and AAA.2.

Undo the screw securing the pump to the crankcase and withdraw the pump complete with its drive shaft and gear.

Replacement of the oil pump is a reversal of the method given for its removal, but a point to be noted is

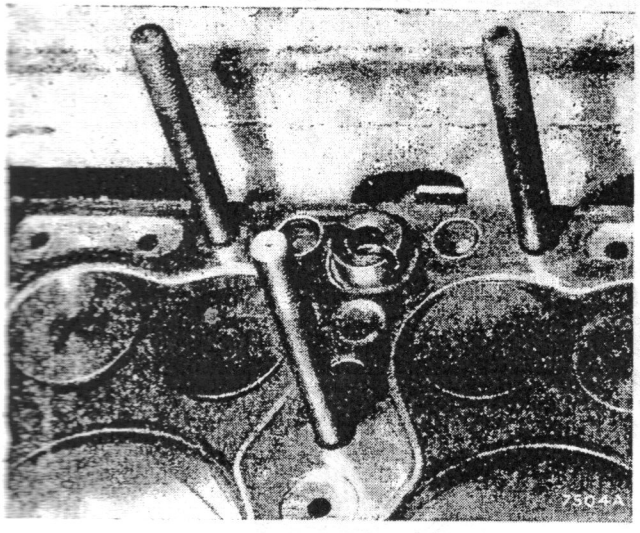


Fig. AAA.2

The offset slot in the top of the distributor driving shaft is shown in the timing position

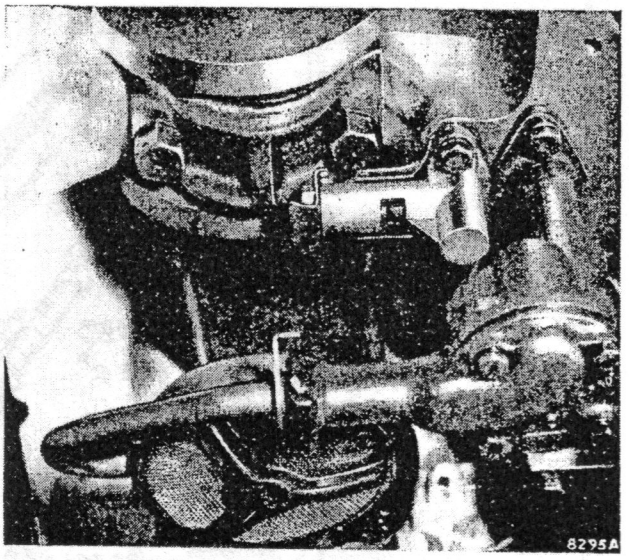


Fig. AAA.3

The floating oil strainer and the combined relief valve and sludge trap. Note the relief valve deflector plate and the method of locking the end plug

that the slotted end of the drive shaft which engages with the distributor spindle must be located correctly.

The offset slot should point approximately across No. 4 valve (or No. 2 sparking plug if the cylinder head is on) with the narrow side of the driving dog nearest to the crankshaft when No. 1 piston is at T.D.C. on its firing stroke. The distributor must be removed to ensure that this position is obtained.

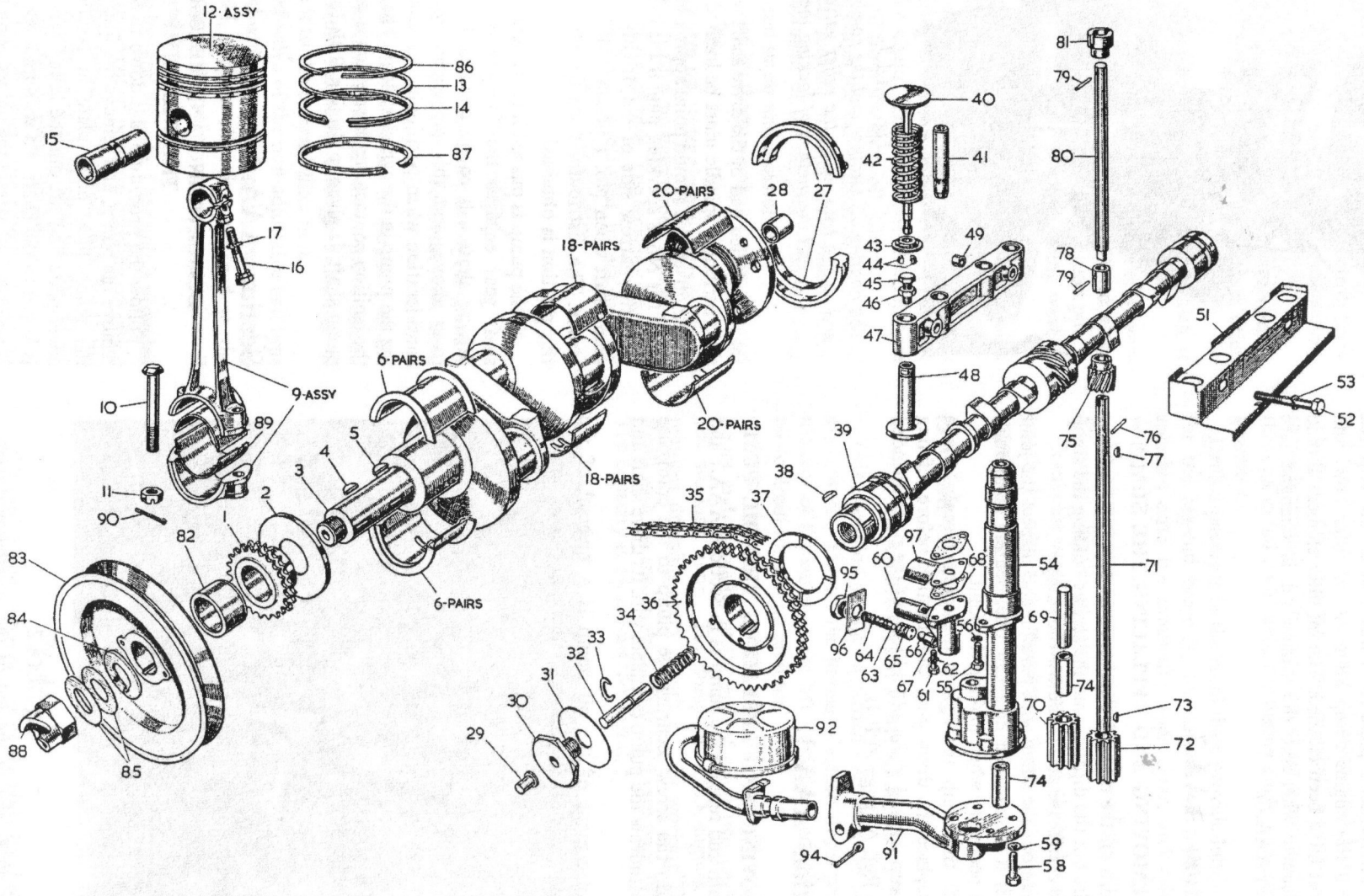
As the pump is pushed into its housing and the driving shaft gear engages that on the camshaft, the pump driving shaft will rotate counter-clockwise, when seen from above, and this movement must be taken into consideration when positioning the shaft prior to inserting the pump in the cylinder block. The method of timing the ignition contact breaker, which is driven from the oil pump shaft, is given in Section BBB.13.

Section AAA.4

DISMANTLING AND REASSEMBLING THE OIL PUMP

Follow the procedure laid down in Section AAA.2 to remove the pump, and remove the four set bolts securing the pump filter cover-plate in position. Remove the cover-plate and lift out the idling gear. The driver gear is keyed to the shaft. To withdraw the oil pump shaft it is necessary to extract the pin securing the helical driving gear to the shaft, drive the shaft through the gear, and

THE OIL PUMP, CAMSHAFT, CRANKSHAFT, AND PISTON COMPONENTS



Section AAA.6

CHANGING THE OIL FILTER

The external filter contains a by-pass relief device Extreme oil pressure inside the filter housing forces the element down against a large coil spring, thus breaking the seal and allowing the oil to pass through the filter cover direct to the main oil gallery.

To change the oil filter element unscrew the hexagon nut at the top of the filter body and withdraw the bowl complete with the element. Lift out the element and spring, wash out the bowl with petrol, and allow it to dry.

Note that the spring in Fram filters has the end plate uppermost against the rubber grommet in the location plate. The location plate is fitted with the convex side towards the element.

Replace the spring, fit the new element, and fill the bowl with engine oil. Replace the bowl, taking care to see that it beds evenly on its sealing ring, and tighten the hexagon nut.

Should it be necessary to remove the oil filter unit complete, disconnect the three oil pipe unions and remove the two set screws securing it to its mounting.

ETC engines. Clean the Fram oil filter element every two weeks or 100 hours.

ETD engines. Clean the Fram oil filter element every four weeks or 200 hours.

A new oil filter element should be fitted to both types of engine every six months or 500 hours. The part number of the Fram element is 17H541.

After cleaning or renewing the oil filter element always check the oil level in the sump after the engine has been running and top up with fresh oil as necessary.

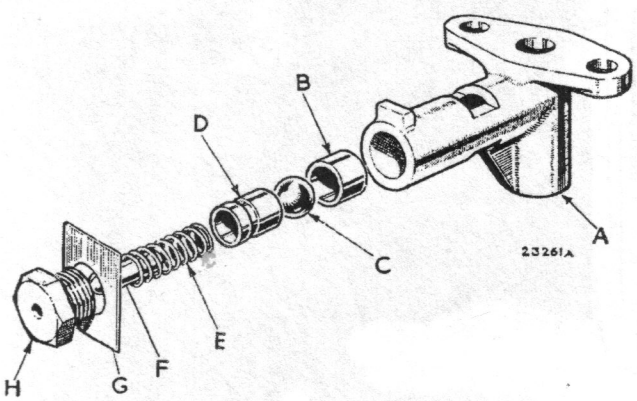


Fig. AAA.6

The component parts of the oil relief valve with sludge trap

A. Body.
B. Seating.
C. Ball.
D. Plunger.
E. Spring.
F. Steady.
G. Lock washer.
H. Plug.

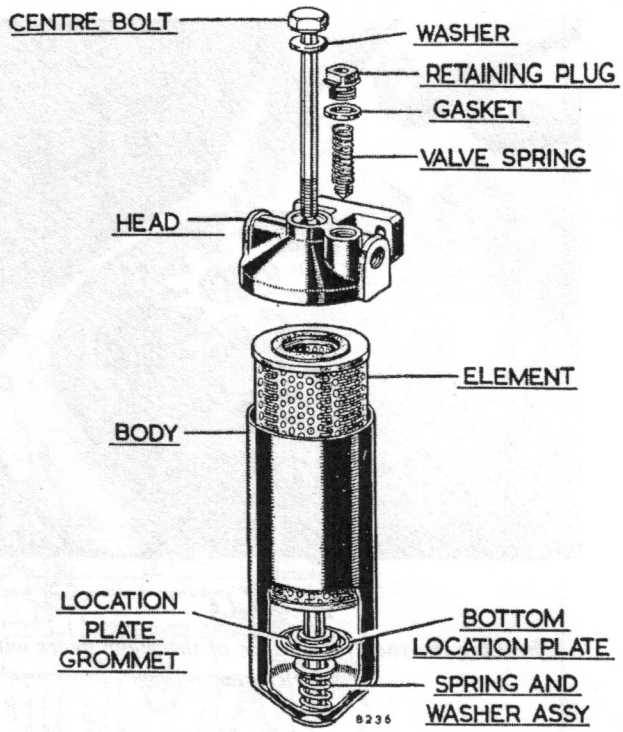


Fig. AAA.7

The component parts of the Fram filter

Section AAA.7

EXTERNAL OIL GALLERY

The external oil gallery is bolted to the left-hand side of the crankcase by two flanged unions (centre and rear end) and a banjo union (front end). The front feed pipe is attached to the oil filter outlet and the external delivery pipe from the pump is attached to the inlet side of the filter, both by banjo-type unions.

These pipes can readily be dismantled for cleaning and inspection with the engine in position. The pipes may be cleaned out by the use of an ordinary hand pump or syringe, or by compressed air if available.

When replacing see that the jointing washers are in their correct positions, but if damaged fit new ones to ensure oiltight joints. The two flanged unions on the oil gallery are provided with steel locking plates; see that these are in position and bent up to lock the set bolt heads when they are reassembled.

Section AAA.8

OIL PRESSURE

Under normal running conditions the oil pressure should not drop below 30 lb./sq. in. (2·1 kg./cm.²) on the gauge, whilst approximately 15 to 20 lb./sq. in. (1·05 to 1·4 kg./cm.²) should be shown when the engine is idling.

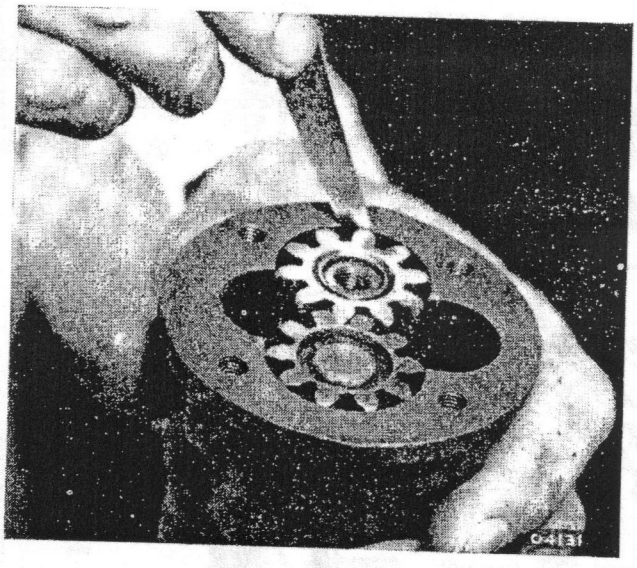


Fig. AAA.4
Checking the radial clearance of the pump gears with a feeler gauge

remove the key. The shaft can then be withdrawn from the pump body and the gear and key removed.

To check the pump gear clearances the pump body, gears, and shaft should be cleaned carefully and re-assembled before carrying out the following procedure:

(1) Measure the diametrical clearance between the teeth of the gears and the pump body. This should not be more than ·006 in. (·15 mm.).

(2) Check the end-float on the pump gears by placing a straight-edge across the face of the pump body and measuring the clearance with feelers, as shown in the illustration (Fig. AAA.5). This should not be more than ·003 in. (·08 mm.).

Ensure that the pump cover filter plate and pump body faces are perfectly clean before reassembling. They form a metal-to-metal joint and no gasket or sealing compound should be used.

The filter plate must be refitted so that the sleeve for the strainer is over the idler gear and will be towards the centre of the engine when the pump is replaced.

The floating strainer must be fitted with the gauze side downwards facing the bottom of the sump; the gauze should be cleaned thoroughly in petrol (gasoline) with a stiff brush when the sump is removed for cleaning every 12 months or 1,000 hours. Never use rag to clean it.

An exploded view of the pump is given on page AAA.6.

Section AAA.5

OIL PRESSURE RELIEF VALVE

Drain and remove the sump as in Sections AAA.1 and AAA.2.

Take out the two set bolts which hold the relief valve assembly and oil deflector adjacent to the oil pump on the under side of the crankcase.

To dismantle the relief valve assembly unscrew the hexagon-headed plug and remove the locking tab washer, spring steady, spring, valve plunger, and ball. The ball seat is a press fit in the valve body. (See Fig. AAA.6.)

Examine the relief valve plunger. If it is worn or scored it may seize in the valve body and cause high oil pressure by keeping the relief ball valve on its seat. If there is any doubt about its condition fit a new plunger. To check that the ball is seating correctly when the relief valve is assembled pour fuel into the oil inlet hole until it is filled. Allow the valve assembly to stand. If the fuel level drops the valve seat requires attention.

Make sure that all components are clean before assembling the relief valve and tap the ball onto its seat to make sure that this is true. Assemble the valve in the reverse order to the dismantling procedure.

Use new paper joint seals between the oil deflector plate and the valve body and cylinder block and ensure that the joint is oiltight.

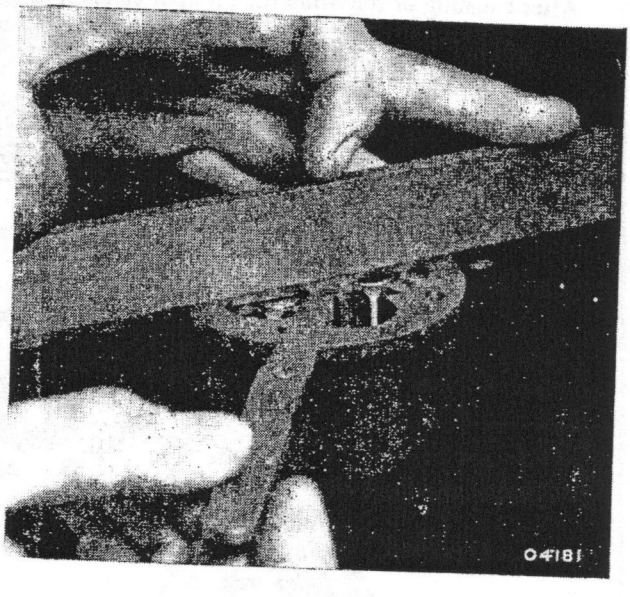
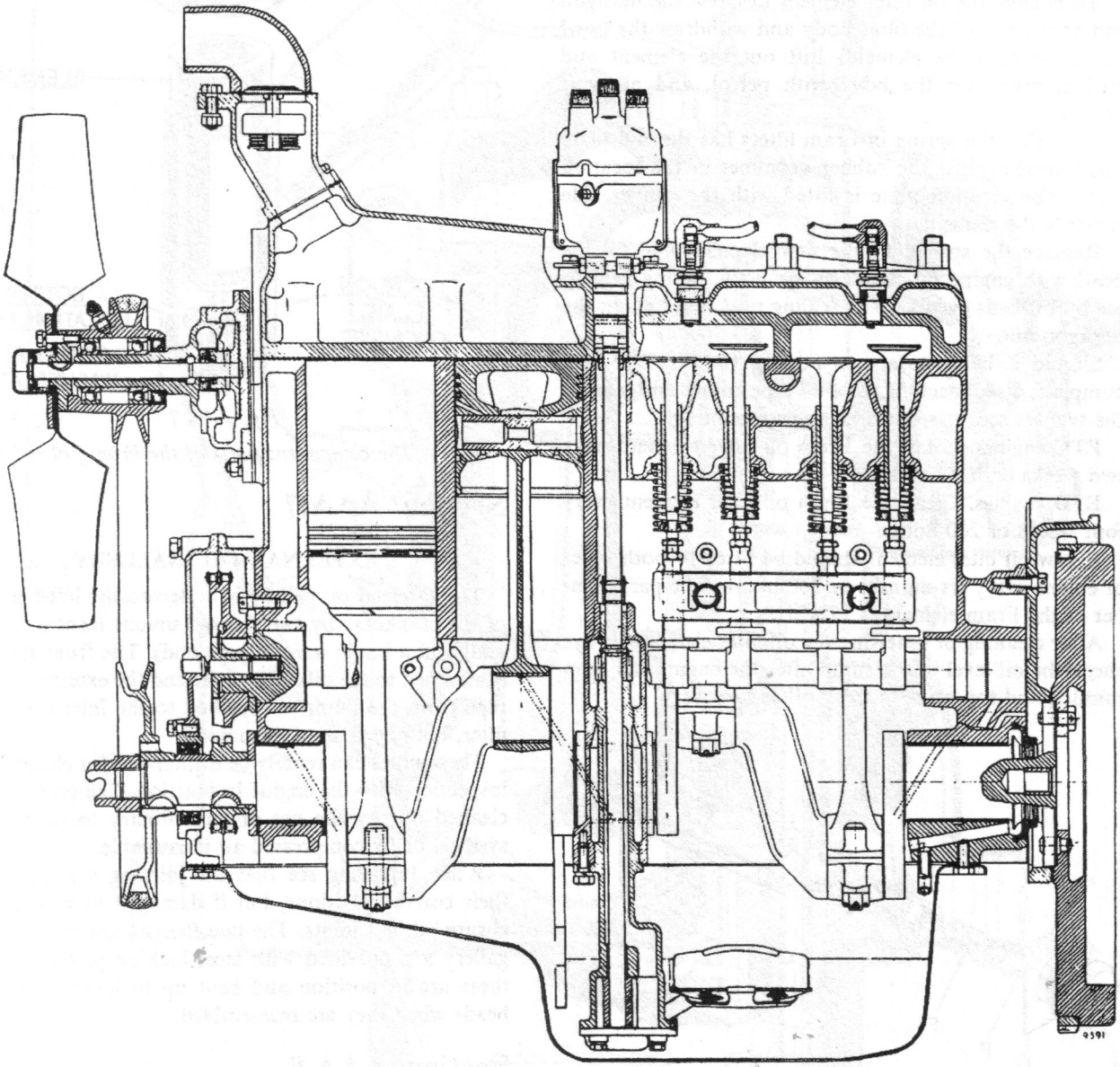


Fig. AAA.5
The end-float of the oil pump gears can be checked with a straight-edge and feelers

THE ETC (V.O.) and ETD (PETROL) ENGINE (LONGITUDINAL SECTION)



Section AAA.6

CHANGING THE OIL FILTER

The external filter contains a by-pass relief device Extreme oil pressure inside the filter housing forces the element down against a large coil spring, thus breaking the seal and allowing the oil to pass through the filter cover direct to the main oil gallery.

To change the oil filter element unscrew the hexagon nut at the top of the filter body and withdraw the bowl complete with the element. Lift out the element and spring, wash out the bowl with petrol, and allow it to dry.

Note that the spring in Fram filters has the end plate uppermost against the rubber grommet in the location plate. The location plate is fitted with the convex side towards the element.

Replace the spring, fit the new element, and fill the bowl with engine oil. Replace the bowl, taking care to see that it beds evenly on its sealing ring, and tighten the hexagon nut.

Should it be necessary to remove the oil filter unit complete, disconnect the three oil pipe unions and remove the two set screws securing it to its mounting.

ETC engines. Clean the Fram oil filter element every two weeks or 100 hours.

ETD engines. Clean the Fram oil filter element every four weeks or 200 hours.

A new oil filter element should be fitted to both types of engine every six months or 500 hours. The part number of the Fram element is 17H541.

After cleaning or renewing the oil filter element always check the oil level in the sump after the engine has been running and top up with fresh oil as necessary.

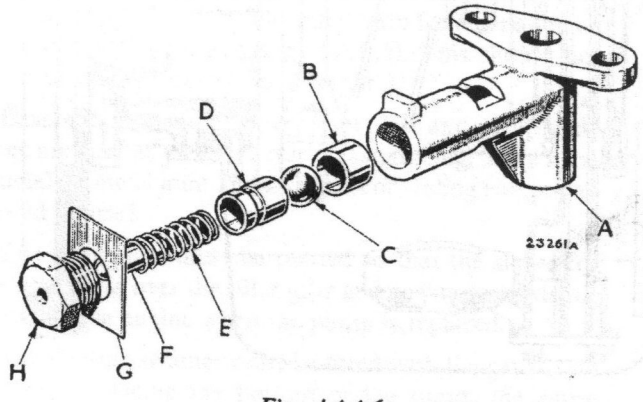


Fig. AAA.6

The component parts of the oil relief valve with sludge trap

A. Body.
B. Seating.
C. Ball.
D. Plunger.
E. Spring.
F. Steady.
G. Lock washer.
H. Plug.

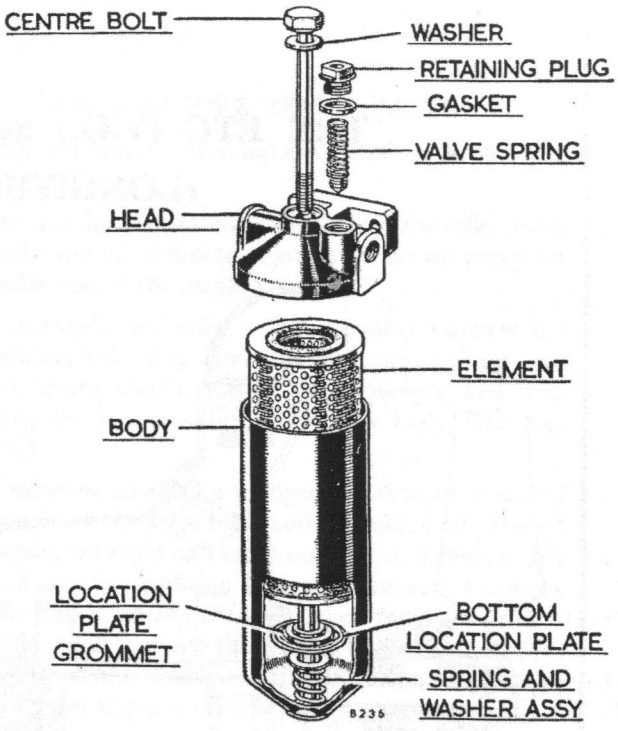


Fig. AAA.7

The component parts of the Fram filter

Section AAA.7

EXTERNAL OIL GALLERY

The external oil gallery is bolted to the left-hand side of the crankcase by two flanged unions (centre and rear end) and a banjo union (front end). The front feed pipe is attached to the oil filter outlet and the external delivery pipe from the pump is attached to the inlet side of the filter, both by banjo-type unions.

These pipes can readily be dismantled for cleaning and inspection with the engine in position. The pipes may be cleaned out by the use of an ordinary hand pump or syringe, or by compressed air if available.

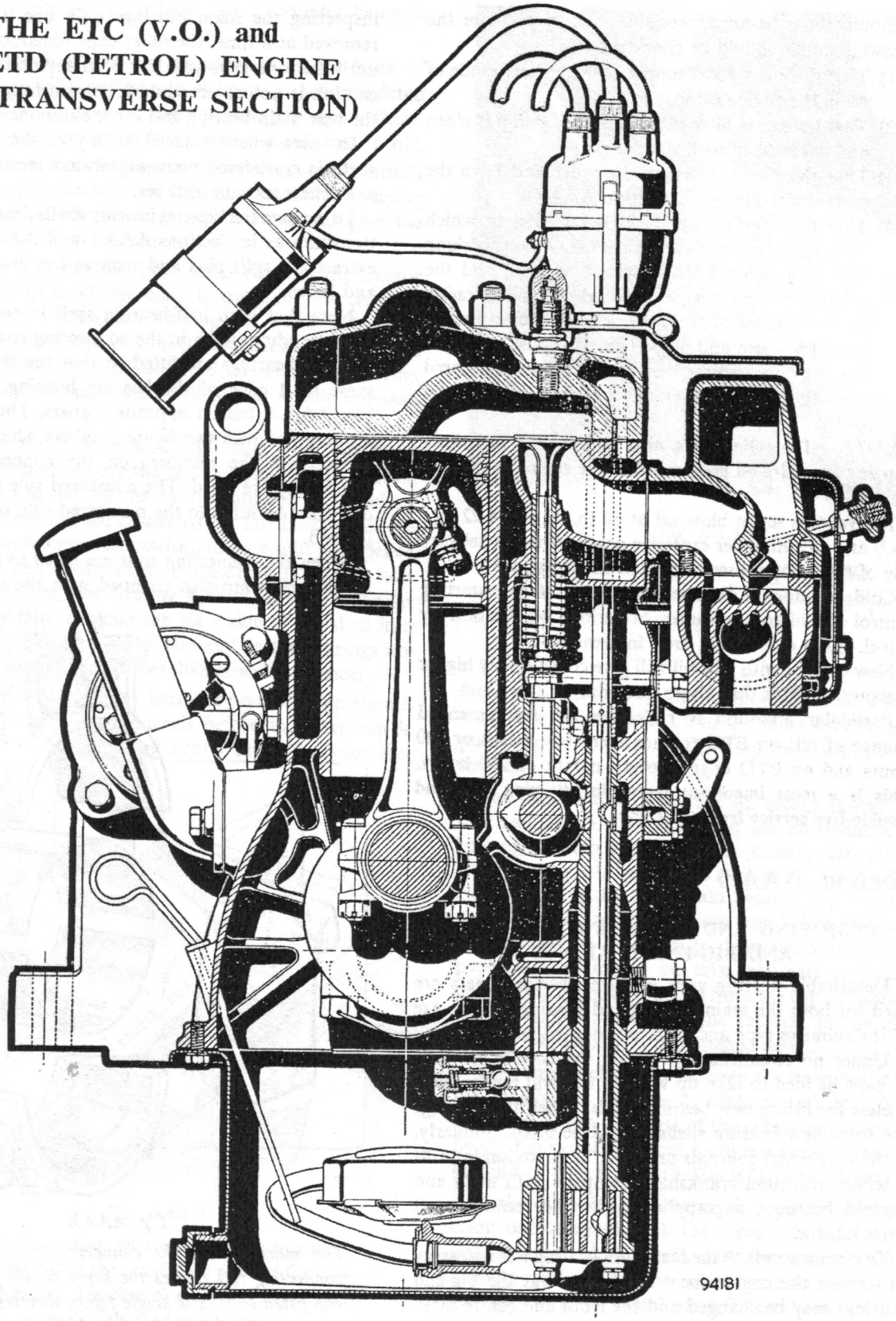
When replacing see that the jointing washers are in their correct positions, but if damaged fit new ones to ensure oiltight joints. The two flanged unions on the oil gallery are provided with steel locking plates; see that these are in position and bent up to lock the set bolt heads when they are reassembled.

Section AAA.8

OIL PRESSURE

Under normal running conditions the oil pressure should not drop below 30 lb./sq. in. (2·1 kg./cm.²) on the gauge, whilst approximately 15 to 20 lb./sq. in. (1·05 to 1·4 kg./cm.²) should be shown when the engine is idling.

THE ETC (V.O.) and ETD (PETROL) ENGINE (TRANSVERSE SECTION)



Should there be an appreciable lack of pressure the following points should be checked over:

(1) That there is a good supply of the correct grade of oil in the engine sump.
(2) That the gauze filter fitted to the oil pump is clean and not choked with sludge.
(3) That the pump gears are in order and have the correct clearances (see Section AAA.4).
(4) That the bearings on the delivery side, to which oil is fed under pressure, have the correct working clearance. Should the bearings be worn and the clearances excessive the oil will escape more readily from the sides of the bearings, particularly when the oil is warm and fluid. This will cause a drop in the pressure recorded on the gauge as compared with that shown when the bearings are in good order.

NOTE.—The relief valve next to the oil pump deals with any excessive oil pressure when the engine and the oil are cold.

The valve is set to blow off at 60 lb./sq. in. (4·22 kg./cm.^{2}) and any oil under excessive pressure on the delivery side of the pump returns direct to the sump.

Cold running and unnecessary use of the starting control are often the causes of serious oil dilution by petrol, and a consequent drop in pressure.

New engines with new oil will give considerably higher pressure readings than those quoted.

Particular attention is called to the recommended change of oil: on ETC engines every two weeks or 100 hours and on ETD engines every month or 200 hours. **This is a most important factor in attaining long and trouble-free service from the engine.**

Section AAA.9

REMOVING AND REPLACING THE MAIN AND BIG-END BEARINGS

Detachable bearing caps and steel-backed liners are used for both the main and big-end bearings, which are of the shimless type and therefore non-adjustable.

Under no circumstances should the connecting rods or caps be filed to take up wear as this will render them useless for fitting new bearing shells. When the bearings are worn new bearing shells should be fitted. Similarly, if the crankshaft journals are worn it is advisable to fit a service reground crankshaft, complete with main and big-end bearings, as supplied under the reconditioned parts scheme.

To obtain access to the rear main bearing it is necessary to remove the engine from the frame, but the big-end bearings may be changed and the front and centre main bearings examined with the engine in position. When inspecting the main bearings only one cap should be removed at a time, the other caps remaining in position until the one removed has been replaced. If this precaution is not observed undue strain may be placed on the rear main bearing and other components.

In cases where renewal of any of the main bearing shells is considered necessary always remove the engine and renew the complete set.

To remove the big-end bearing shells drain and remove the sump as in Sections AAA.1 and AAA.2, and then extract the split pins and remove the bearing cap nuts and bolts.

Note that each half-bearing shell is notched to fit a corresponding notch in the connecting rod and cap and that the bearings are fitted so that the tags are on the same joint edge of the bearing housing, as shown in Fig. AAA.8, but on opposite corners. The bearing caps are stamped with two-figure numbers which must correspond with the numbers on the connecting rods to which they are fitted. The numbered side of the bearing cap must be fitted to the numbered side of the connecting rod.

When the connecting rods are fitted to the engine the bearing caps are also stamped with the number of the

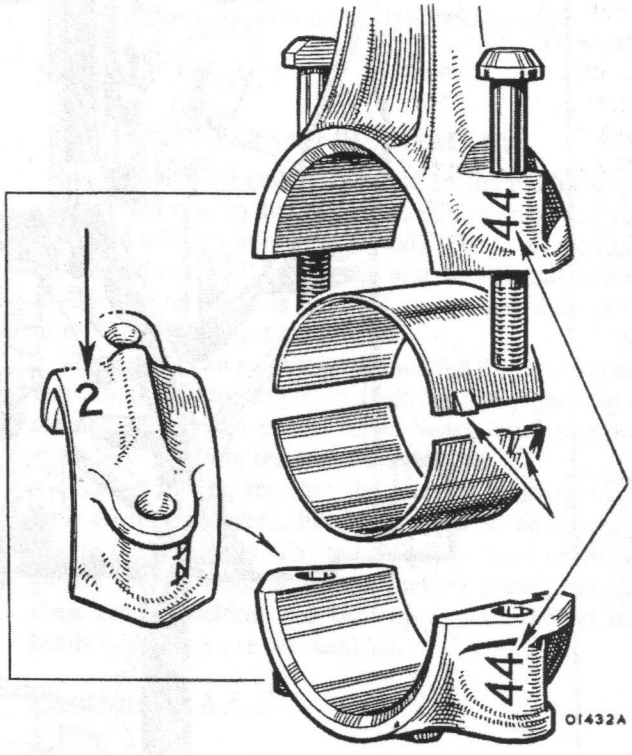


Fig. AAA.8

The markings on the connecting rod big-end. The connecting rod carries the same double figure as the cap fitted to it. The single figure denotes the cylinder to which the assembly belongs

cylinder to which they belong, No. 1 cylinder being at the front.

Corresponding numbers are stamped on the back of the bearing shells, and when new bearing shells are fitted this number should be lightly stamped upon them. Remove any consequent burrs with a dead-smooth file.

Make sure that the bearings, housings, and journals are thoroughly clean before installing them. No scraping is required, as the bearings are machined to give the correct diametrical clearance.

When the engine has been removed from the tractor and the sump is off, the main bearings may be changed one at a time without removing the crankshaft. Note that the number stamped on the crankcase face near the oil pump housing is also stamped on each main bearing cap and that the caps are fitted so that all the numbers are the same way up.

Remove the locking wire and bolts from one main bearing cap and remove the cap and bottom half-bearing shell. The top half of the bearing shell is extracted by rotating it around the crankshaft in the direction of the locating tag (counter-clockwise), using a split pin opened at the end and inserted into the crankshaft oil feed hole as a driver. The new bearing shell is fitted in a similar manner by first inserting the plain side of the shell into its housing. No scraping is required as the bearings are machined to give the correct diametrical clearance.

When one bearing has been renewed the cap should be refitted and fully tightened before the next cap is removed, but before fitting lightly smear the joint surfaces with Wel-Seal sealing compound to ensure a perfect seal. It is recommended that the main bearing bolts be pulled up to 100 lb. ft. (13·8 kg. m.), using a torque wrench.

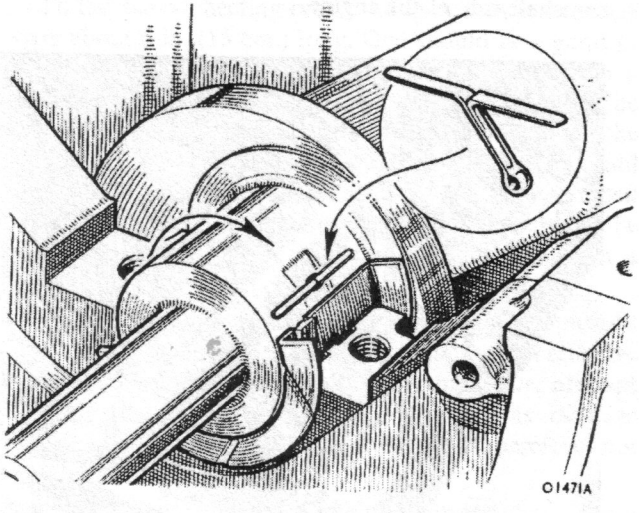


Fig. AAA.9

The method of using an open split pin to rotate the half-bearing round the crankshaft journal for removal and replacement. The direction of rotation for replacement is indicated by the arrow

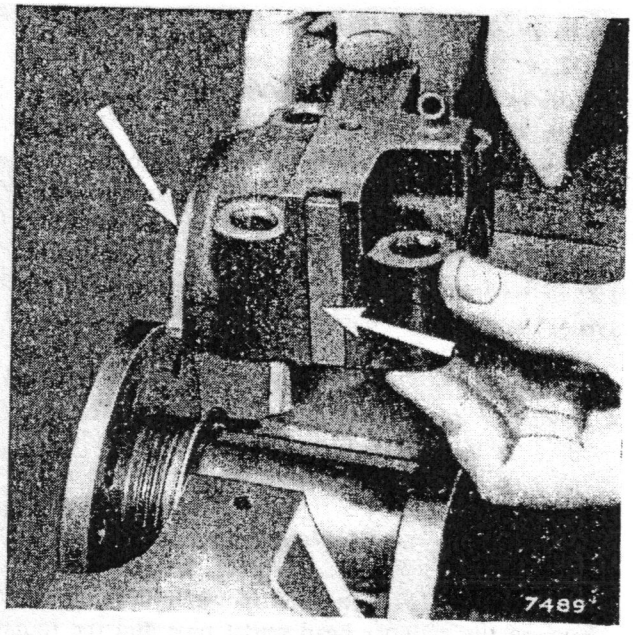


Fig. AAA.10

Replacing the rear main bearing cap. The arrows indicate the return thread oil seal cover and the rear bearing cap seal

The clearance between the oil return thread on the rear end of the crankshaft and the oil retainers in the bearing housing and rear main bearing cap should be from ·014 to ·018 in. (·35 to ·46 mm.). Ensure that the special seals in the rear main bearing cap are in good condition and form an efficient seal. When new seals are fitted it may be necessary to drive the bearing cap into position with a mallet, but take great care to see that the bearing shell is not dislodged from the cap. If the locating tags do not register with the recesses in the cap the bearing will seize as it is tightened down.

The running clearance between the main bearings and the crankshaft journals is ·002 to ·003 in. (·0508 to ·0762 mm.). The end-float of the crankshaft is controlled by the flanges of the front main bearing and the correct amount of float is ·004 to ·008 in. (·10 to ·20 mm.).

In the case of a run bearing it is always advisable to clean out thoroughly all the oilways in the crankshaft and cylinder block, wash out the engine base with paraffin, and remove the pump cover to ensure that no particles of white metal are left anywhere in the lubricating system.

Section AAA.10

REMOVING AND REPLACING THE CYLINDER HEAD

Disconnect the negative (front) lead from the battery terminal. Drain the cooling system by means of the tap at the bottom right-hand side of the radiator and the tap on the right-hand side of the cylinder block. If an anti-freeze solution is mixed with the water drain the mixture into a suitable container. Rubber tubes fitted to the taps will facilitate this operation.

Unscrew the temperature gauge thermometer fitted to some models from the water outlet pipe. Detach the exhaust silencer from the manifold.

Next remove the air intake pre-cleaner by tapping it upwards.

Remove the two bonnet hinge screws and lift off the bonnet.

Slacken the clips on the top water hose connection between the cylinder head outlet pipe and the radiator and remove the hose. Remove the bolt securing the radiator stay to the water outlet pipe.

Remove the high-tension leads from the sparking plugs and the lead from the side of the distributor.

Remove the distributor locating screws from the top of the cylinder head and withdraw the distributor and drive shaft. The clamp screw for the plate at the base of the distributor should not be slackened as this regulates the timing, and if slackened the setting will be lost.

Slacken the cylinder head holding-down nuts in the order shown in Fig. AAA.11.

Remove the heat shield. Turn the engine smartly with the starting handle while the governor control lever is against the maximum speed stop. The compression in the cylinders should be sufficient to break the cylinder head joint and allow the head to be lifted from the studs. Should this fail, insert a screwdriver between the special lugs provided on the block and cylinder head and lever the head upwards, taking care not to damage the gasket. Remove the ignition coil bracket from the studs.

The cylinder head gasket should be examined carefully and, if damaged in any way, it should be discarded and a new one fitted. No jointing compound is required with a new gasket, which should be guided over the cylinder head studs evenly with a length of tube or box spanner to avoid damage. The gasket is fitted with the flanged side uppermost.

When retightening the cylinder head stud nuts do so in the order given in Fig. AAA.11, turning each a half-turn at a time until they are all quite tight.

Reassembly of the remaining parts takes place in exactly the reverse order to the dismantling procedure.

Run the engine until it attains its normal running temperature and then tighten down the cylinder head nuts in their proper sequence to a torque tightness of 100 lb. ft. (13·8 kg. m.).

Section AAA.11

REMOVING AND REPLACING A PISTON AND CONNECTING ROD

The pistons and connecting rods can only be withdrawn from the top of the cylinder block, and it is therefore necessary to remove the cylinder head for this operation, as detailed in Section AAA.10.

Drain and remove the sump as in Sections AAA.1 and AAA.2.

If a piston is to be withdrawn from its connecting rod the crown of the piston should be scribed lightly to mark its front side and the number of the cylinder bore noted to ensure the piston being refitted in its original position.

Remove the split pins and nuts from the big-end bolts and lift off the bearing cap.

The piston and connecting rod may then be withdrawn upwards through the cylinder block.

Each connecting rod and each bearing cap is stamped with a two-figure number, and each cap must always be kept with its original connecting rod which bears a corresponding number.

When fitted on the engine the bearing caps are also stamped to indicate the cylinder to which they belong, No. 1 being at the front of the engine. Again, they should always be fitted to the same cylinder.

The gudgeon pin clamp screw must be fitted on the camshaft side of the engine.

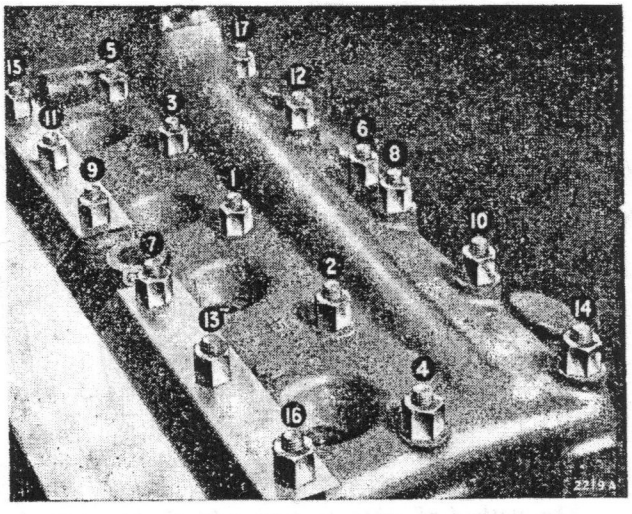


Fig. AAA.11

Always tighten or slacken the cylinder head stud nuts in the order indicated

When reassembling ensure that each piston is replaced in its own cylinder bore and the same way round as before removal.

Each connecting rod, with its own bearing cap and bearings, must be fitted to the crankshaft journal from which it was removed.

It is recommended that the big-end bearing cap nuts be tightened to 55 lb. ft. (7·6 kg. m.) torque, measured with a torque-indicating spanner.

Section AAA.12

DISMANTLING AND REASSEMBLING A PISTON AND CONNECTING ROD

The gudgeon pin is rigidly held in the split little-end of the connecting rod by a clamp bolt engaging its central groove. The bolt must be withdrawn before the piston and gudgeon pin can be dismantled from the connecting rod.

In carrying out this operation or in replacing the clamp screw when reassembling care must be exercised not to twist or strain the connecting rod or distort the piston. The best practice is not to hold the rod or piston at all, but to grip the gudgeon pin on either side of the piston by means of two plugs of a suitable size inserted in its hollow ends so that it can be rigidly secured in the jaws of a vice.

Unscrew the clamp screw, withdraw it completely, release the assembly from the vice, and push out the gudgeon pin.

To test the connecting rods for alignment use two steel bars about 6 in. (15 cm.) long. One should be a good fit in the little-end ($1\frac{1}{16}$ in. dia.) (27 mm.) and the other a good fit in the big-end (2·145 in. dia.) (54·5 mm.). The bars should be parallel, and the dimensions between the ends of the bars each side of the connecting rod should be exactly the same provided that the bars are clamped in the connecting rod at their centres. There should be no twist when the rods are set up in 'V' blocks on a surface plate.

Each gudgeon pin should be a double-thumb push-fit in its piston when cold, and a certain amount of selective assembly may be necessary to ensure this. Never attempt to ream out a piston gudgeon pin boss as oversize gudgeon pins cannot be used and are therefore not obtainable.

When reassembling ensure that the gudgeon pin clamp screw is firmly tightened (approximately 17 lb. ft. [2·3 kg. m.] with a torsion spanner) and that the spring washer retains sufficient tension to remain effective. The clamp screw should be on the camshaft side when the connecting rod is refitted to the engine.

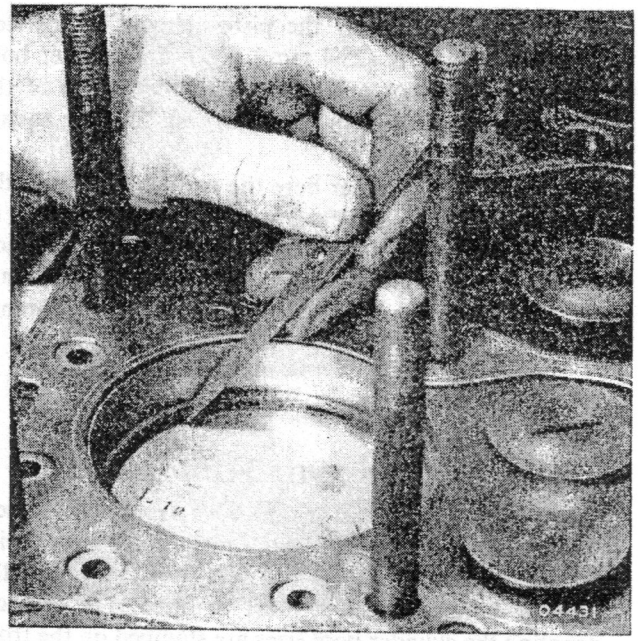


Fig. AAA.12

Checking the piston ring gap. The weight marking on the piston is also clearly shown

Section AAA.13

REMOVING AND REPLACING THE PISTON RINGS

If no special piston ring expander is available use a piece of thin steel such as a suitably ground hacksaw blade or disused ·020 in. (·50 mm.) feeler gauge.

Raise one end of the ring and insert the steel strip between the ring and the piston. Rotate the strip round the piston, applying slight upward pressure to the raised portion of the ring until it rests on the land above the ring groove. It can then be eased off the piston by the shortest route, but take care not to score the piston with the ring ends.

If the rings are in order and are to be used again they should be fitted to the same ring groove without cleaning any of the carbon deposit in the groove.

Before fitting **new** piston rings any carbon deposit must be scraped from the grooves in the piston, taking care not to remove any metal since play between the rings and the sides of the grooves reduces gastightness and produces a pumping action leading to excessive oil consumption. There must be no play between the rings and their grooves, but they must nevertheless be free to move without restriction.

IMPORTANT.—New rings should be tested in the cylinder bore to ensure that the ends do not butt together.

To do this effectively the piston should be inserted approximately 1 in. (25·4 mm.) down the cylinder bore and each ring then pushed down onto the top of the piston and held there in order to keep the ring square with the bore.

In an unworn cylinder bore the two top rings and the bottom ring should have a gap of ·011 to ·016 in. (·28 to ·41 mm.) and the ring immediately above the gudgeon pin should have a gap of ·008 to ·012 in. (·20 to ·30 mm.).

The side-clearance on the rings is ·001 in. (·025 mm.).

Section AAA.14

PISTON SIZES AND CYLINDER BORES

When fitting new pistons selective assembly is necessary, and for this purpose each piston is stamped with a distinguishing symbol which indicates the size of the cylinder bore to which it must be fitted. The symbols denoting the cylinder bore sizes are stamped on the front face of the cylinder block between the exhaust manifold and the water pump.

The pistons are marked as follows: AX (the standard size), which must be fitted to an AX cylinder bore; AZ (standard +·001 in.), which must be fitted to an AZ cylinder bore.

Oversize pistons are marked CX, CZ, EX, or EZ and must be fitted to rebored engines bearing similar bore markings.

When X pistons only are obtainable these may be fitted to X, Y, or Z cylinder bores, but a suitably graded piston is one with a clearance of ·005 in. (·127 mm.) between the thrust face of the piston skirt and the cylinder wall.

The symbols for the cylinder bores as stamped on the block are as follow:

AX, indicating a standard bore size of 100 mm. (3·937 in.).

AY, indicating standard +·0005 in. (·012 mm.).

AZ, indicating standard +·001 in. (·025 mm.).

CX, indicating an oversize bore standard +·020 in. (·508 mm.).

CZ, indicating an oversize bore standard +·021 in. (·533 m.).

EX, indicating an oversize bore standard +·040 in. (1·016 mm.).

EZ, indicating an oversize bore standard +·041 in. (1·041 mm.).

Pistons are also graded for weight and stamped either H (heavy) or L (light). The figures following the letter denote the weight in drams that the piston is heavy or light from standard, and if possible the pistons fitted to one engine should not vary in weight more than 4 drams.

The standard oversizes for rebores are +·020 in. (·508 mm.) or +·040 in. (1·016 mm.), making actual bore sizes of 3·957 in. (100·508 mm.) or 3·977 in. (101·016 mm.), and cylinders should be bored to one of these sizes only to ensure a supply of the correct pistons. Only two rebore sizes of piston are available, with additional pistons ·001 in. (·025 mm.) larger in diameter than each size to cover the normal machining tolerance.

When the cylinder bores will not clean up at the maximum oversize diameter 3·978 in. (101·041 mm.), cylinder liners may be fitted or the engine replaced by a factory-reconditioned unit. See Section AAA.32.

Section AAA.15

REMOVING AND REPLACING THE CARBURETTER

Extract the four screws securing the air intake pipe to the square carburetter flange.

Disconnect one end of the carburetter throttle control link by means of the snap clips on the ball joint.

Disconnect the starting control.

Turn off the fuel supply and disconnect the fuel pipe unions, taking care not to lose the fibre washers or damage the filter on the banjo bolt which secures the main fuel pipe to the float-chamber cover.

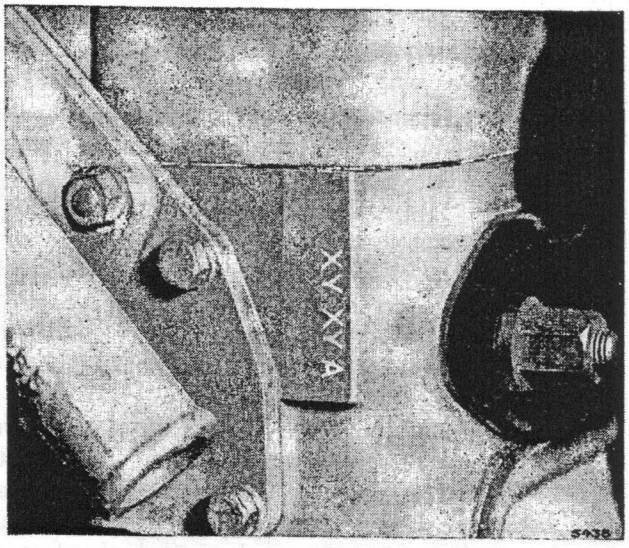


Fig. AAA.13

The location of the cylinder bore size markings on the front of the cylinder block. On the engine illustrated, reading from the bottom upwards, Nos. 1 *and* 3 *cylinders are standard* + ·0005 *in.* (·012 *mm.) and Nos.* 2 *and* 4 *cylinders are a standard bore size of* 3·937 *in.* (100 *mm.*)

Release the carburetter from the manifold studs.

Before refitting the carburetter place a straight-edge across the carburetter flange and check it for distortion. If necessary, the carburetter throttle tube must be plugged with clean cloth and the flange carefully trued with a file. A distorted flange is a source of air leakage, which may be indicated by difficult starting, poor idling, and poor performance generally.

Refit the carburetter to the manifold with a new joint if necessary.

Section AAA.16

REMOVING AND REPLACING THE MANIFOLDS

Remove the carburetter as in Section AAA.15.

Slacken the clamping bolt and lift the exhaust silencer from the manifold.

Withdraw the manifold shutter lever knob after removing the self-locking nut and spring. Extract the four heat shield bolts and remove the shield (ETC engines only).

Release the air inlet pipe from the air cleaner and release the inlet and exhaust manifolds from the cylinder block by removing the seven nuts and flat washers.

A carburetter flange adaptor on some tractors is secured to the inlet manifold by two studs with nuts and

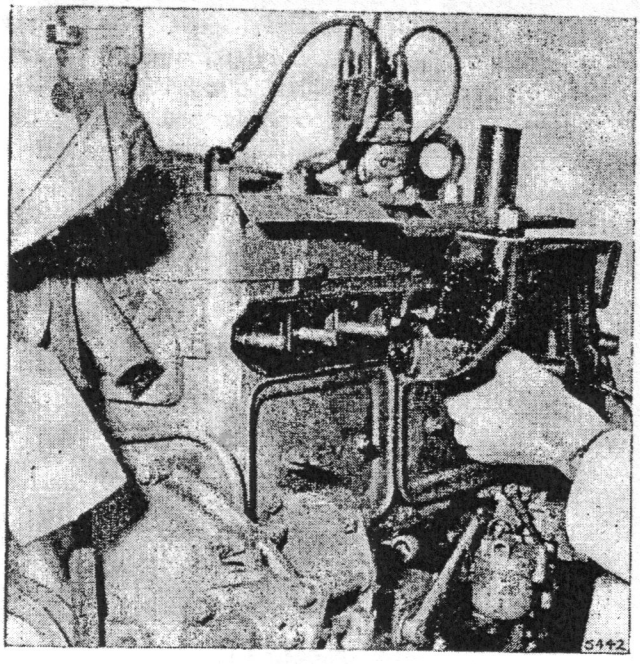


Fig. AAA.14

Removing the inlet and exhaust manifolds and the carburetter as an assembly

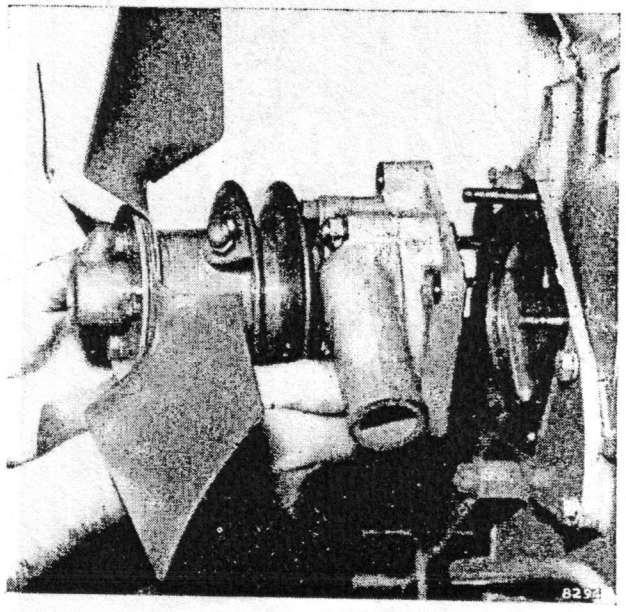


Fig. AAA.15

Removing the water pump from the adaptor plate

the inlet and exhaust manifolds are held together, with a joint seal between them, by four long bolts. Extract these bolts to gain access to the manifold shutters which are pinned to the operating spindle.

When reassembling, examine the exhaust flange gasket, the carburetter flange gasket, and the seal between the inlet and exhaust manifolds.

Clean any excessive carbon from the manifold faces and fit new gaskets if necessary, with their metal faces outwards, making contact with the faces of the manifolds.

NOTE.—If the inlet and exhaust manifolds have been separated they should be reassembled and secured to the cylinder block as detailed in Section AAA.33. Failure to observe this precaution may cause damage to the manifold flanges or permit air leaks.

Section AAA.17

REMOVING AND REPLACING THE WATER PUMP

Follow the instructions at the commencement of Section AAA.10 and drain the cooling system, remove the temperature gauge (if fitted), exhaust silencer, air intake pre-cleaner, bonnet, and radiator top hose and stay.

Remove the radiator and radiator case (Section CCC.4).

Slacken the dynamo mounting bolts and take off the fan belt.

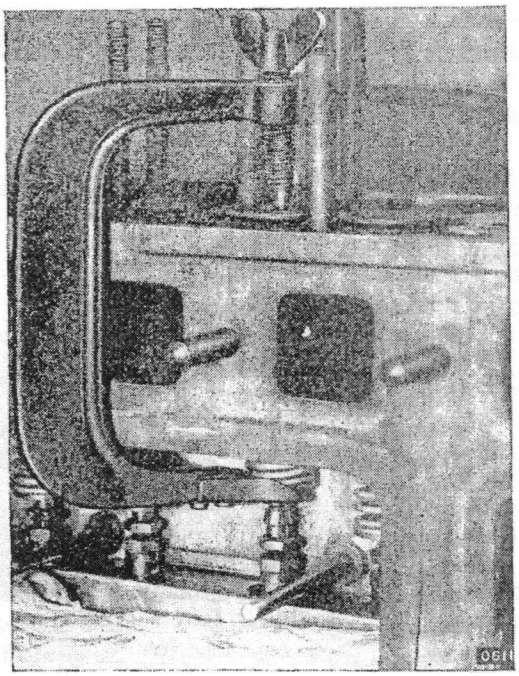


Fig. AAA.16

A valve spring compressed to show the split collars prior to removal

Remove the three nuts and two bolts holding the pump to the adaptor plate and cylinder block and detach the pump.

Replacement of the pump is a reversal of this procedure. Adjust the fan belt as detailed in Section CCC.2.

Section AAA.18

REMOVING AND REPLACING THE VALVES

Remove the carburetter and manifold as in Sections AAA.15 and AAA.16.

Remove the cylinder head as in Section AAA.10.

Unscrew the nuts with plain and fibre washers and withdraw the tappet covers. Take care not to damage the cork gaskets.

With the valve fully closed, compress the valve spring and remove the split collars.

Release the spring and remove the spring cap, spring, and valve.

The clearance between the valve stems and their guides should be from ·003 to ·005 in. (·076 to ·127 mm.). Renew valves and guides that are worn (see Section AAA.21).

When reassembling note that the valve springs are of the variable-pitch type and that they must be fitted with their close coils uppermost. Fit the spring retaining caps and drop a few spots of oil into each valve guide. Replace the valves and compress each spring until the split collars can be placed in position. Release the springs carefully. If trouble is experienced when replacing the collars they should be smeared liberally with grease and applied with the help of a screwdriver blade.

Set the tappets as instructed in Section AAA.25.

Section AAA.19

DECARBONIZING

Remove the cylinder head as detailed in Section AAA.10.

Turn the engine until two of the pistons are at the top of their stroke. Pack the other two cylinder bores and all water passages with clean cloth. With a flat scraper (not too sharp) remove the carbon deposit from the top of the pistons and cylinder block, leaving a ring approximately $\frac{1}{8}$ in. (3 mm.) wide undisturbed round the outside edge of the piston. An old piston ring placed in the top of the cylinder bore will be of assistance in protecting the carbon edges. Leave also the ring of carbon which has formed at the upper ends of the cylinder bores.

When these two pistons have been cleaned turn the engine half a revolution and repeat the operation on the two remaining pistons.

Remove the valves as detailed in Section AAA.18.

Clean the carbon from the valves, valve ports, and the faces of the cylinder head and the combustion chambers.

Grind in the valves as detailed in Section AAA.20.

Finally, with a clean rag damped with petrol or paraffin, clean all traces of foreign matter from the valves,

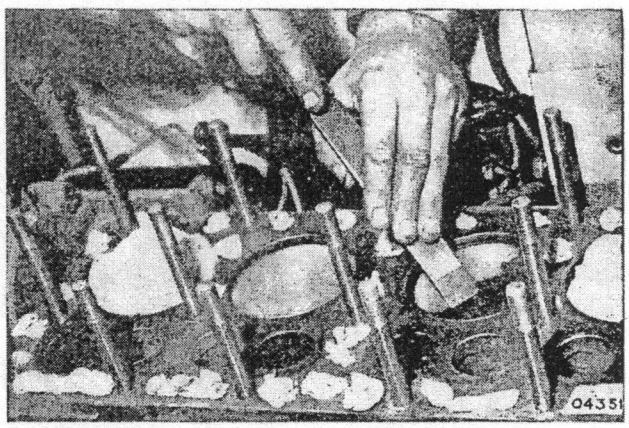


Fig. AAA.17

When removing carbon from the piston crowns place an old ring on top of the piston to conserve a small ring of carbon round the outer edge of the piston

valve guides, and cylinder block and head faces, but do not attempt to polish with emery-cloth or any other abrasive material.

Replace the valves and then adjust the tappets as detailed in Section AAA.25.

Section AAA.20

GRINDING AND TESTING VALVES AND SEATINGS

Remove the valves as detailed in Section AAA.18. Clean all carbon deposits from the valves and examine the seat face for signs of pitting. Pitted valves should be refaced, using a suitable grinder, or discarded in favour of new ones.

Examine the valve seats in the cylinder block. If they show signs of pitting they should be trued with a suitable grinder or seat cutter, taking great care to remove as little metal as possible to ensure a true face.

Before grinding in the valves protect the cylinder bores, ports, and any holes in the tappet chamber (particularly if the tappet blocks have been removed) by covering

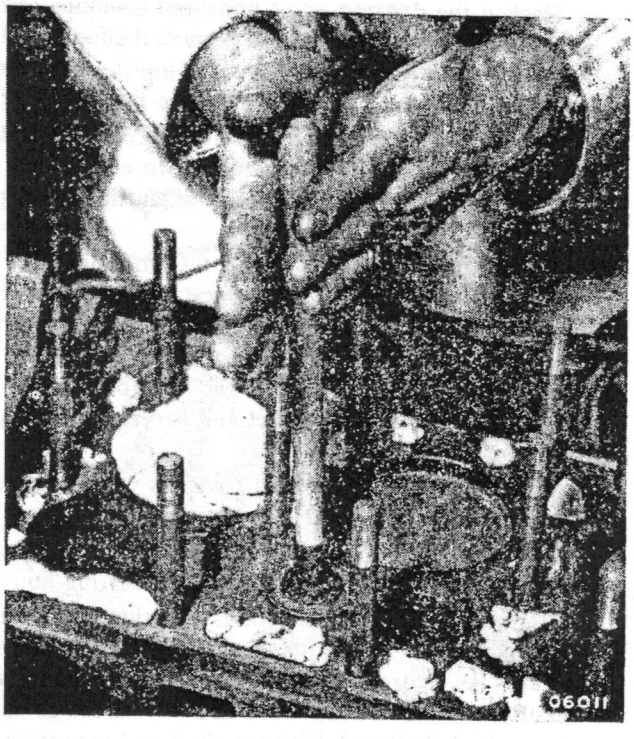


Fig. AAA.18

A suction tool is used for grinding the valve seats. A light coil spring under the head of the valve helps to carry out the process more easily

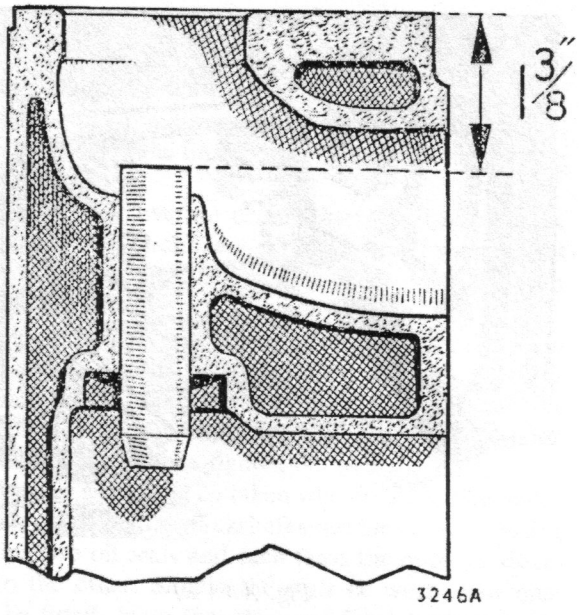


Fig. AAA.19

The correct location of the valve guides in the cylinder block

them or plugging them with clean cloth. Slacken the locknut and screw the tappet adjusting screw into the tappet three or four turns. Crank the engine until the tappet is on the back of its cam.

Smear the valve face lightly with fine- or medium-grade grinding paste and then lap the valve to its seat, using a suction grinding tool.

Avoid the use of excessive quantities of grinding paste and see that it remains on the valve seating and does not get onto the engine working faces.

A light coil spring placed under the valve head will assist considerably the process of grinding. The valve should be lapped to its seat with a semi-rotary motion and occasionally allowed to rise by the pressure of the light coil spring. This assists in spreading the paste evenly over the face and seat. Continue grinding until a dull, even, mat surface free from blemish is produced on the valve seat and face.

On completion the valve seats and ports should be cleaned thoroughly with petrol-soaked cloth, dried, and then cleaned by compressed air. Wash the valves themselves thoroughly in paraffin and make sure that all traces of grinding paste are removed.

Note that all the valves are numbered on their heads from 1 to 8 and should be ground to, and replaced in, the corresponding ports. No. 1 valve is fitted to the port at the front of the engine. When new valves are fitted they should be numbered to identify the port to which they belong. An inlet valve may be identified by the slot milled in its head. Exhaust valves have plain heads.

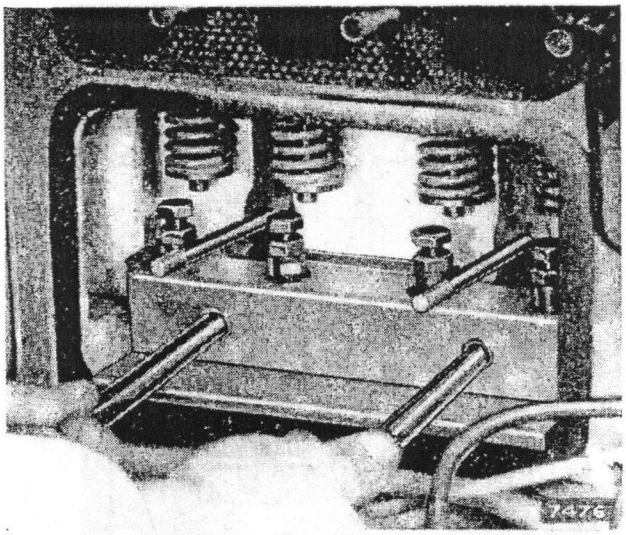


Fig. AAA.20

A tommy-bar inserted in each bolt hole will greatly assist in withdrawing a tappet guide block from its locating dowels

Section AAA.21

REMOVING AND REPLACING THE VALVE GUIDES

Remove the carburetter and manifolds as detailed in Sections AAA.15 and AAA.16.

Remove the cylinder head as in Section AAA.10.

Remove the valves as in Section AAA.18.

Remove the tappet guide blocks as in Section AAA.22.

Drive out the old valve guide carefully with a copper drift. When refitting a new guide press it in position until the distance from the top of the cylinder block to the top of the valve guide is $1\frac{3}{8}$ in. (34·9 mm.). Guides should not be knocked or driven in as they are liable to be damaged.

Section AAA.22

REMOVING AND REPLACING THE TAPPET GUIDE BLOCKS

Remove the carburetter and manifold as in Sections AAA.15 and AAA.16.

Unscrew the nuts and fibre washers and withdraw the tappet covers. Take care not to damage the cork gaskets.

To remove the front tappet guide block and tray rotate the crankshaft until Nos. 6 and 8 valves are rocking, thus leaving the other valves closed. Take out the two set bolts and washers securing the block and insert a tommy-bar in each of the holes to assist in withdrawing the block from the hollow dowels locating it. Remove the guide block complete with its tray and the tappets.

To remove the rear guide block rotate the crankshaft until Nos. 1 and 3 valves are just rocking and apply the same method.

After releasing the tappet adjustment locknuts and taking out the tappet screws the tappets are free to drop out of the guide blocks. If they are unduly slack or oval through wear they should be renewed, as should any worn tappet screws or guide blocks. The clearance between the tappet and guide block should be ·001 in. (·025 mm.), but if this has increased to over ·002 in. (·05 mm.) new parts are recommended. When refitting tappet blocks and trays see that the dowels are in position and that the dowel holes in the blocks are towards the engine. Replace the spring washers on the attachment bolts.

Section AAA.23

REMOVING AND REPLACING THE TIMING CHAIN COVER, CHAIN, AND CHAIN WHEELS

Remove the bonnet, radiator case, and radiator, as detailed at the commencement of Section AAA.24.

Slacken the dynamo pivot bolts and clamping screw; swing the dynamo inwards and remove the fan belt.

Remove the starting dog nut securing the fan driving pulley to the crankshaft and withdraw the pulley. Note the number of shims fitted beneath the dog nut and fit the same amount when reassembling to ensure that the starting dog is in the best position for starting the engine with the starting handle.

Extract the four bolts securing the front flange of the sump to the timing cover. **Support the engine beneath the front end of the sump** and remove the engine front support bracket by extracting the two bolts securing the bracket to the main frame and the nut from each of the two studs securing the bracket and cover to the cylinder block on the right-hand side.

Remove the rear half of the governor with hour-meter (if fitted) as in Section FFF.2.

Take out the two bolts and remove the cover-plate and paper washer from the governor front bearing housing.

Remove the three long bolts securing the bearing housing plate to the timing cover and move the housing towards the centre of the engine to give maximum slackness to the chain. Remove the circlip from the governor chain wheel shaft and drive the shaft and gear from the bearing in the front bearing housing.

Remove the front bearing housing and disengage the shaft and gear from the chain and withdraw from the rear.

Remove the bolts and stud nuts and withdraw the timing cover, taking care not to damage the oil seals fitted in the crankshaft aperture. Withdraw the pulley distance collar from the shaft.

Tap back the lock washer and remove the camshaft chain wheel retaining nut, plunger, and spring. Lever the wheel from the camshaft, taking care not to damage the floating thrust washer behind it. The crankshaft chain wheel may also be levered from the shaft.

When reassembling, the thrust washer behind the camshaft wheel must be fitted so that the plain side is towards the engine and the chamfered side is towards the chain wheel. The washer between the crankshaft chain wheel and the bearing journal is fitted with the chamfered side towards the journal. Both chain wheels must be fitted with their largest boss towards the engine.

To facilitate retiming the engine a tooth on the crankshaft wheel and one on the camshaft wheel are marked with a 'T', and there are two bright links on the chain located 22 pitches apart.

Position the crankshaft so that the 'T' on the chain wheel is at B.D.C. with No. 1 piston at T.D.C., and turn the camshaft until the 'T' on the camshaft wheel is approximately 40° above a horizontal line and to the left of a vertical line drawn through the centre of the wheel when seen from the front of the engine.

Examine the chain to find the two bright links and, with the smallest run of the chain between the bright links to the left of the operator, engage the bright links of the chain with the marked teeth of the chain wheels.

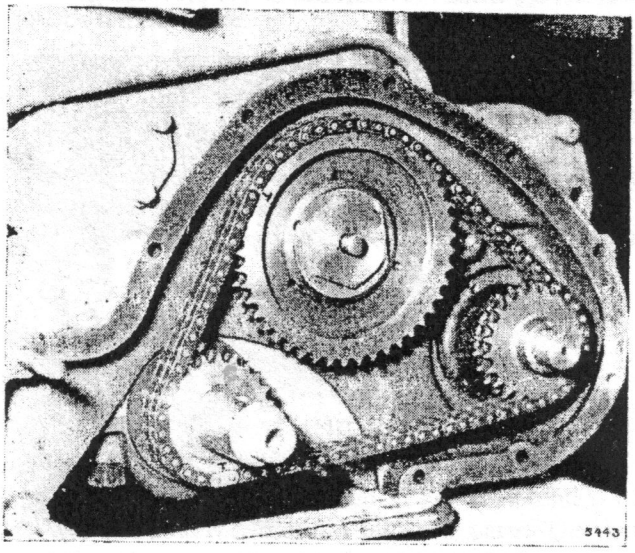


Fig. AAA.21

The camshaft and crankshaft chain wheels in the timing position with the 'T' marks engaging the bright links in the chain

With the gear wheels correctly replaced and the camshaft wheel secured by its nut, secure the timing chain in position and replace the timing cover, taking care that the bright links remain engaged with the marked teeth. The joint faces of the timing case are sealed with jointing compound only.

Assemble the governor chain wheel and key onto the shaft, replace the circlip, and press the shaft into the front bearing housing. Replace the assembly with the gear engaging the chain.

Replace the governor and hour-meter assembly, and before tightening the bolts tension the chain. Pivot the governor and front bearing housing outwards on the bottom bolt until the pawl engages the innermost position on the ratchet and then tighten the bolts.

Particular care must be taken when refitting the pulley distance collar on the crankshaft since the oil seal housing contains two oil seals and each faces the opposite direction to the other. Should the seals be worn, new ones must be fitted. Note that they are fitted back to back. The distance collar should be pushed home carefully with the greatest chamfer towards the chain wheel.

Replace the pulley and starting dog nut with shims. Ensure that the dog nut is in the best position for starting the engine with the starting handle. With No. 1 piston at T.D.C. the pin of the starting handle should engage the starting dog from 20 to 30° beyond the vertical.

Reassembly continues in the reverse order to the dismantling procedure.

Readjust the carburetter connecting link as detailed in Section CCC.

Section AAA.24

REMOVING AND REPLACING THE CAMSHAFT

Drain the cooling system by opening the tap at the bottom of the radiator and at the right-hand side of the cylinder block.

Remove the exhaust silencer and detach the air precleaner and extension pipe from the air cleaner.

Remove the temperature gauge thermometer (if fitted) by unscrewing the nut from the water outlet pipe.

Extract the two retaining screws and lift off the bonnet.

If a lighting set is fitted disconnect the headlamp cable at the dynamo bracket. Remove the radiator case.

On tractors fitted with radiator shutters take out the split pin securing the shutter control to the shutter operating lever. Slacken the clips securing the top and bottom water hoses.

Extract the bolt securing the radiator stay to the water outlet pipe and the bolts securing the radiator block to the support brackets.

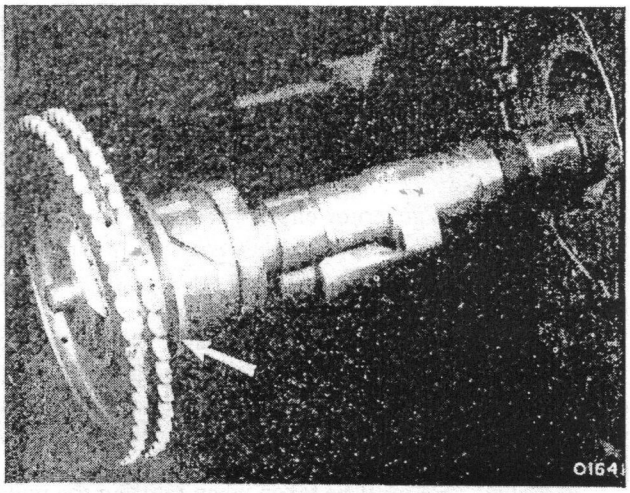


Fig. AAA.22

The camshaft partly withdrawn from its housing to show the correct position of the thrust washer behind the chain wheel

Remove the radiator and store in an upright position to prevent accumulated sediment in the bottom tank passing into the cooling tubes.

Remove the magneto or distributor and its drive shaft.

Drain and remove the engine sump.

Extract the bolt securing the oil pump to the crankcase and withdraw the pump assembly complete.

Remove the timing chain as detailed in Section AAA.23, supporting the engine across the crankcase flanges below the front main bearing so that the crankshaft is free to rotate.

Slacken the clips on the hoses and remove the air cleaner pipe. Disconnect the carburetter throttle control link at one of the ball joints. Disconnect the starting control cable and the fuel pipes at the banjo unions, taking care not to lose the fibre washers or damage the gauze filter in the main fuel connection.

Release the manifold shutter lever knob by removing the retaining nut and spring. Extract the heat shield bolts and remove the shield (ETC engine only).

Release the manifold and carburetter assembly from the cylinder block by removing the seven nuts and flat washers.

Remove the valve tappet covers and joint seals.

Remove the tappet guide blocks and trays as detailed in Section AAA.22.

Withdraw the camshaft forward from the crankcase complete with the end thrust plunger, chain wheel, and thrust washer.

The method of replacing the camshaft is exactly the reverse of that given above for the removal, but care must be taken to see that the tappet cover seals and exhaust manifold gaskets are in good condition when refitted, the manifold gaskets being fitted with the metal side towards the manifold.

Details for replacing the timing chain correctly and engaging the oil pump drive, which also drives the magneto or distributor, will be found in Sections AAA.23 and AAA.3 respectively.

Section AAA.25

TAPPET ADJUSTMENT

Remove the carburetter and manifold as in Sections AAA.15 and AAA.16.

Unscrew the nuts with plain and fibre washers and withdraw the tappet covers. Take care not to damage the cork gaskets.

Turn the engine until No. 8 valve (exhaust valve—No. 4 cylinder) is fully lifted from its seat. In this position No. 1 valve (exhaust valve—No. 1 cylinder) is fully closed. **This is most important.** Check the clearance of No. 1 valve with a ·014 in. (·356 mm.) feeler gauge. The gauge should be a sliding fit if the clearance is correct and the engine is cold.

To adjust the clearance hold the tappet by its flats with a spanner, slacken the adjusting screw locknut with another, and turn the adjusting screw until the required clearance is obtained. Hold the tappet screw and tappet in this position with two spanners in one hand and tighten the locknut with a third spanner, avoiding undue force. Re-check the clearance before proceeding.

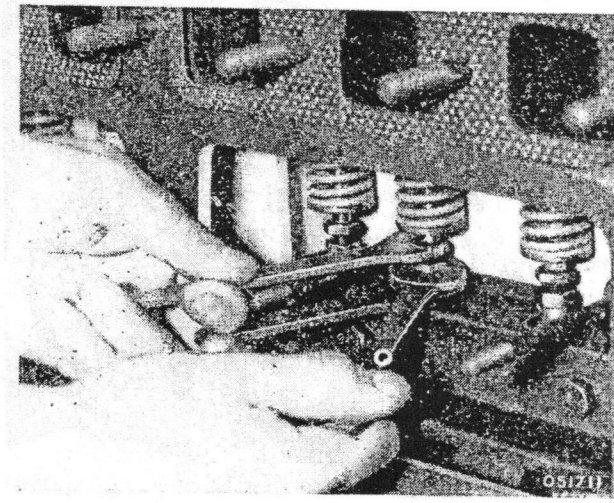


Fig. AAA.23

Adjusting the tappets. Two spanners are used to hold respectively the tappet and the adjusting screw against rotation whilst a third is used to tighten the locknut

Repeat the operation on the remaining valves in the following sequence as this will only entail two revolutions of the engine:

Set	No.	1	tappet	(ex.)	with	No.	8	valve	fully open
,,	,,	3	,,	(in.)	,,	,,	6	,,	,, ,,
,,	,,	5	,,	(ex.)	,,	,,	4	,,	,, ,,
,,	,,	2	,,	(in.)	,,	,,	7	,,	,, ,,
,,	,,	8	,,	(ex.)	,,	,,	1	,,	,, ,,
,,	,,	6	,,	(in.)	,,	,,	3	,,	,, ,,
,,	,,	4	,,	(ex.)	,,	,,	5	,,	,, ,,
,,	,,	7	,,	(in.)	,,	,,	2	,,	,, ,,

As a guide, remember that the sum of any set of numbers is nine.

When cold, exhaust tappets must be adjusted to ·018 in. (·457 mm.) clearance and inlet tappets to ·004 in. (·101 mm.) clearance.

Section AAA.26

CHECKING VALVE TIMING

Remove the battery lead to ensure that the engine is not started accidentally.

Remove the 'hot-spot' heat shield from ETC engines.

Remove the nuts securing the rear tappet cover and partly remove the cover. (This cannot be removed completely unless further stripping is undertaken.)

Remove the clutch inspection cover-plate.

Turn the engine over until No. 4 piston is at the top dead centre of its exhaust stroke.

In this position No. 4 cylinder inlet valve tappet should just be free to rotate.

If the timing pointer is only slightly out of line with the mark on the flywheel when the tappet is free to rotate this is possibly due to the tappet clearance and does not indicate that the timing is incorrect.

Should the timing prove to be incorrect, it must be reset as detailed in Section AAA.23.

NOTE.—Tappet clearances do not seriously affect the results of this check.

Section AAA.27

REMOVING AND REPLACING THE ENGINE

The instructions on the removal and replacement of the engine have been divided into two parts. The first part describes the removal and replacement of the clutch housing and steering assembly, and the second part deals with the removal and replacement of the engine unit. By following the instructions the work involved will be reduced to a minimum, and if the operations are carried out in the order in which they are given time spent in walking unnecessarily from side to side of the tractor will be saved. When this work is to be carried out by two men, after removal of the bonnet and disconnecting the battery, let one man proceed with operations numbered 5 to 12 whilst the other deals with operations 13 to 18.

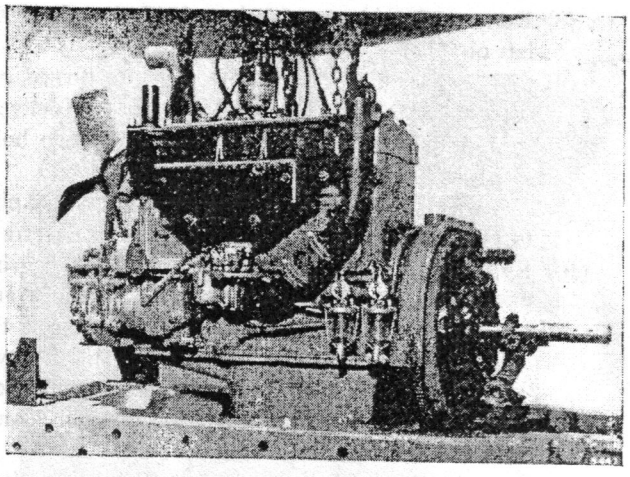


Fig. AAA.24

An ETD-type petrol engine (PM model) is here being lifted from the frame

Removal and replacement of the clutch housing and steering assembly

(1) Lift off the pre-cleaner and extension from the air cleaner.

(2) If fitted, disconnect the temperature gauge by unscrewing the brass hexagon nut securing the adaptor in the water outlet pipe.

(3) Detach the bonnet by removing the two securing screws and lift off.

(4) Remove the battery tray top cover, and disconnect and remove the battery.

(5) Slacken the clip at the top of the air cleaner pipe and free the rubber elbow. Remove the screw which fastens the air cleaner strap and lift off the air cleaner complete with rubber elbow. Keep the air cleaner in an upright position to avoid spilling the oil contained in the bowl.

(6) *ETC engine.* Disconnect the starting carburetter control at the carburetter.
ETD engine. Disconnect the choke control at the choke level and the air intake pipe.

(7) Disconnect the front end of the governor control rod. Note the position of the governor control assembly on the side panel, extract the retaining bolts, and remove the assembly, drawing out the control rod from the guide on the engine.

(8) Remove the side panel below the fuel tank on the left of the tractor.

(9) *ETC engine.* Ensure that the taps are turned off, disconnect the fuel pipes in turn on the delivery side of the filter bowls, and extract the two bolts securing each filter unit.

ETD engine. On these models there is only one pipe to be disconnected and one filter to be released.

(10) Release the petrol tank (ETC engine only) securing bolts and lift out the tank complete with pipe and filter unit. Extract the nuts and bolts securing the air cleaner bracket to the rear bracket and the two bolts securing the front bracket to the flywheel housing. Lift out the front bracket and air cleaner bracket to release the oil pipe.

(11) Remove the clutch inspection cover from the left-hand side of the clutch housing and disconnect the front end of the clutch-operating rod from the clutch withdrawal shaft. Scribe a mark on the face of the clutch pedal lever and the pedal lever shaft before removal to assist correct positioning on reassembly and to ease the re-entry of the pinch-bolt in the groove of the shaft. Taking care not to lose the 'D' washer, remove the clamping bolt from the clutch pedal lever and drive the shaft from the pedal.

(12) Remove the bolts securing the clutch housing to the main frame and transmission case on the left-hand side of the tractor, commencing with the bolt securing the pedal return spring anchorage. Allow the clutch pedal assembly to remain suspended in the clutch housing.

If a hand clutch unit is fitted this is removed by detaching the return spring and slackening the adjusting screw until the operating spring and cup can be removed. Disconnect the operating rod fork from the withdrawal shaft, remove the circlip from the right-hand side of the pedal shaft, and drive the shaft through the casing from the right.

The following operations are carried out from the right-hand side of the tractor:

(13) Disconnect the dynamo cables. Disconnect the starter cable at the starter. On tractors with a lighting set disconnect the headlamp cable at the snap connector and release the cable casing from the front dynamo clip. Disconnect the cable from the coil.

(14) Remove the two forward bolts holding the battery tray to the flywheel housing. Remove the radiator shutter control rod clip from the base of the battery tray.

(15) Disconnect the oil gauge pipe at the oil filter.

(16) Remove the side panel below the fuel tank on the right of the tractor, complete with radiator shutter control on M models.

(17) On tractors fitted with a lighting set disconnect the sidelamp cables from the lighting switch.

(18) Extract the clamping bolt and remove the steering drop-arm from the cross-shaft.

(19) Remove the bolts securing the clutch housing to the main frame and transmission casing on the right-hand side of the tractor.

(20) Lift one end of the rubber sealing strip between the flywheel housing and the clutch housing and peel the strip out.

(21) Place a rope sling beneath the fuel tank support brackets. Pack with rag to avoid abrasions and lift off the assembly. Ensure that the fuel pipe is not caught up and that the instrument panel and filter bowl is not damaged when lowered to the ground.

Replacement of the clutch housing and steering assembly is carried out in the reverse order to the removal procedure.

Removal and replacement of the engine unit

(22) Drain the cooling system from the right-hand side by opening the tap at the base of the radiator and the tap on the cylinder block. (If the engine is to be dismantled after removal drain the oil by removing the plug in the left-hand side of the engine sump.)

(23) Remove the four bolts holding the radiator case to the support brackets and lift off the radiator case.

(24) Take out the split pin securing the front end of the radiator shutter control, if fitted, and remove the

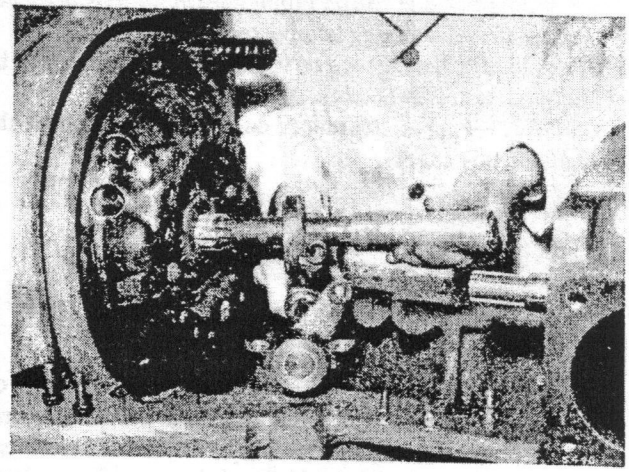


Fig. AAA.25

The engine must be lifted slightly before the transmission shaft can be completely withdrawn

control complete. Slacken the clips securing the top and bottom water hoses and free the hoses. Remove the bolt securing the stay to the outlet pipe and take out the bolts fastening the radiator block to the support brackets. Lift off the radiator block and leave it in an upright position in a safe place. (Flush out the radiator block with clean running water on removal from the tractor.)

(25) Remove the locking wire and withdraw the clevis pin from the transmission driving sleeve. Slide the sleeve forward along the shaft.

(26) Remove the four bolts securing the release bearing cross-shaft brackets and withdraw the cross-shaft assembly.

(27) Remove the four bolts securing the engine in position; arrange a suitable sling or, if available, insert eyebolts in place of Nos. 1 and 4 sparking plugs. The engine is located on the main frame by a dowel either side of the flywheel housing, and as the engine is lifted from the frame great care must be taken to ensure that it is lifted evenly, prising up the low side if lifting rings are used in the plug holes (which are off centre) to prevent tilting of the engine and damage to the flywheel housing and dowels. Take care not to allow the sump drain plug to foul the engine frame.

Replacement of the engine unit is a reversal of the removal procedure. Make sure that the sealing strip is in position beneath the flywheel housing and take care to locate the engine on the dowels in the main frame.

When an engine is to be returned to the Factory for reconditioning remove the following parts: distributor and coil, dynamo, starter motor, carburetter, fuel pipes and fuel filters, air intake pipe, sparking plugs, fan belt, fan blades, water outlet pipe, silencer assembly, heat shield (ETC engines only), and manifolds.

Section AAA.28

REMOVING AND REPLACING THE FLYWHEEL

Remove the clutch housing as detailed in Section AAA.27.

Slacken in diagonal sequence the eight clutch retaining bolts and remove the assembly from the flywheel.

Extract the locking wire and bolts securing the flywheel to the crankshaft.

Withdraw the flywheel from the locating dowels, using $\frac{3}{8}$ in. BSF bolts screwed into the two withdrawal holes provided. Take care to use bolts with the correct thread; the flywheel bolts themselves will not fit.

If the starter ring requires attention, see Section AAA.29.

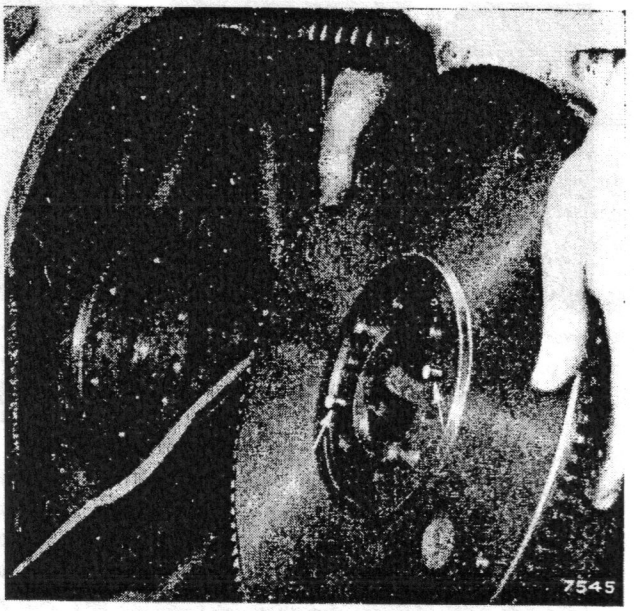


Fig. AAA.26

The arrows indicate the two bolts used to assist in the removal of the flywheel and dowels

Section AAA.29

FITTING A NEW FLYWHEEL STARTER RING

If the teeth on the flywheel starter ring have been damaged or badly worn a new flywheel complete with ring should be fitted. If, however, a new ring is to be fitted to the existing flywheel the following procedure is recommended:

Take out the three equally spaced grub screws.

Drill one $\frac{1}{4}$ in. (6·35 mm.) hole through the ring between two of the teeth and then burst open the hole with a punch to split the ring. Drive the ring from the flywheel.

Expand the new ring by heating to a temperature not exceeding 932° F. (500° C.) and then quickly place it over the flywheel spigot and hammer it into position carefully and evenly all round, using a hide-faced hammer. Ensure that the inner chamfer and the lead on the teeth faces inwards against the flywheel flange.

Finally, secure the ring with the three $\frac{5}{16}$ in. BSF grub screws. Drill and tap to take the three screws equally spaced between the original holes on a $14\frac{3}{8}$ in. (36·5 cm.) pitch circle diameter. The $\frac{17}{64}$ in. (6·75 mm.) tapping holes should be drilled $\frac{9}{16}$ in. (14 mm.) deep on the centre-line of the teeth.

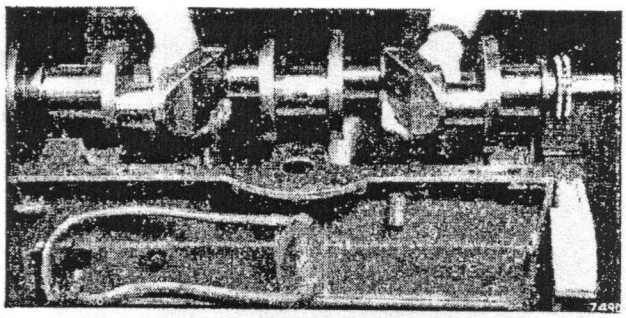


Fig. AAA.27

Lifting out the crankshaft from the main bearings and cylinder block

Section AAA.30

REMOVING AND REPLACING THE CRANKSHAFT

Drain the sump and then remove the engine as detailed in Section AAA.27.

Remove the fan belt, crankshaft pulley, starting dog oil seal housing, timing cover, and timing chain. (For details see Section AAA.23.)

Remove the clutch and the flywheel as detailed in Section AAA.28.

Extract the locking wire and bolts securing the flywheel housing to the cylinder block and tap the housing from the dowels.

Remove the sump, extract the split pins and locking wire, and remove the main and big-end bearing caps. Release the connecting rods from the crankshaft and lift the crankshaft out of the bearings.

Thoroughly clean all the oilways before replacing the crankshaft. The clearance between the oil return thread on the rear end of the crankshaft and the oil seals should be from ·014 to ·018 in. (·36 to ·46 mm.).

Section AAA.31

REGROUND CRANKSHAFTS

If, on examination, the crankshaft is found to be worn, scored, or oval it must be reground to one of the standard undersizes or exchanged for an undersize crankshaft under the special replacement scheme. The standard undersizes are —·015 in. (—·38 mm.) and —·030 in. (—·76 mm.), and undersize crankshafts are available in these sizes complete with sets of bearings machined to give the correct working clearances and fit into the bearing housings without any adjustment by scraping or fitting of the caps..

To enable these special bearings to be fitted crankshafts must be ground to one of the standard undersizes given above, and no attempt should be made to take up bearing wear by filing connecting rods or bearing caps as this will render the rods and caps useless for future bearing renewal.

Reground crankshafts are stamped with an indication of their undersize dimension on the front face of the front web, and undersize bearings are marked on their back surfaces.

Section AAA.32

FITTING CYLINDER LINERS

When a cylinder bore will not clean up at the maximum oversize diameter 3·978 in. (101·041 mm.) cylinder liner (Part No. T6680) may be fitted after machining the bore in the cylinder block to the dimensions given in Fig. AAA.28.

The liners are of the slip type and no special presses are required to insert them; if the cylinder block is

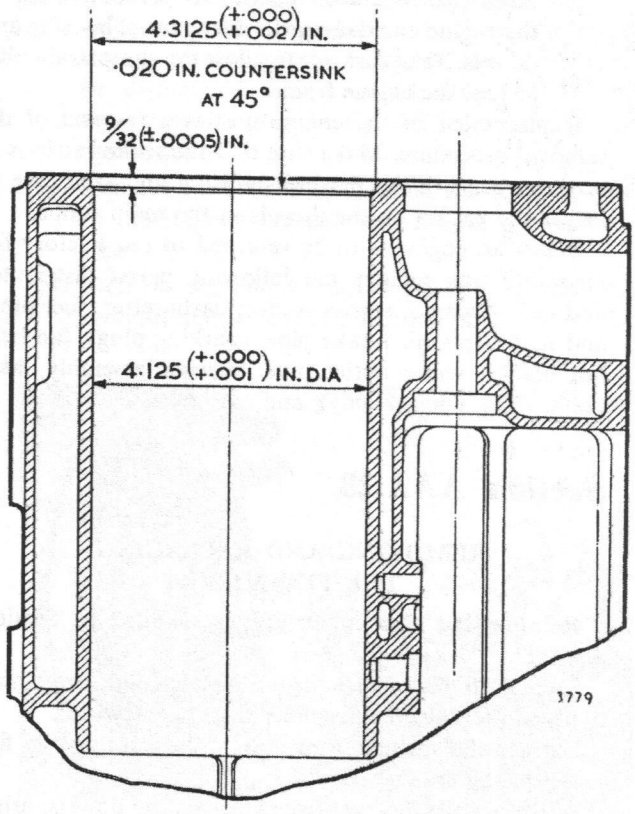


Fig. AAA.28

When cylinder liners (Part No. T6680) are to be fitted to ETC or ETD engines the cylinder bores must be machined to the dimensions given here

correctly machined it is not necessary to face off the liner level with the top of the block.

Section AAA.33

FITTING A NEW HOT-SPOT GASKET ON ETC ENGINES

Remove the manifolds as detailed in Section AAA.16.

Part the two manifolds at the hot-spot joint and remove all traces of the previous gasket. Clean the mating faces of the manifold and cylinder block.

Assemble the inlet and exhaust manifolds with the new hot-spot gasket (Part No. NT5072), tightening the securing nuts until they are finger-tight.

Place the two manifold gaskets in position on the cylinder block studs, steel surface outwards, away from the cylinder block.

Fit the exhaust and inlet manifold assembly to the cylinder block, replace the large plain washer, and tighten the securing nuts.

Slacken the four nuts which secure the inlet manifold to the cylinder block and tighten the hot-spot nuts. Retighten the inlet manifold nuts.

Reassemble the parts previously removed, with the exception of the heat shield.

Run the engine until it reaches the normal working temperature and again slacken the four brass nuts which secure the inlet manifold. Tighten the hot-spot nuts firmly and retighten all manifold nuts. Refit the heat shield.

Since a certain amount of joint shrinkage is inevitable after the tractor has been running for approximately 30 hours, again slacken the nuts securing the inlet manifold to the block, tighten the hot-spot nuts, and retighten the inlet manifold nuts.

NOTE.—While carrying out these operations it is as well to remove the carburetter from the manifold and check with a straight-edge that the top flange of the carburetter is true; any distortion at this point will cause an air leak. If necessary, carefully reface this flange with a file. The carburetter should be refitted with the correct thin joint.

SECTION AAAA

THE ENGINE
(TYPE OEE FOUR-CYLINDER DIESEL)

GENERAL DESCRIPTION

The B.M.C. 3·8-litre Type OEE compression-ignition engine is of the same construction as the 3·4-litre Type OEA engine, with the following exceptions.

The wet cylinder liners are of larger internal diameter and the pistons have hemispherical combustion cavities. The top compression ring is taper-sided and has a chromium-plated periphery while the peripheries of the second and third compression rings are tapered. The camshaft, and the Simms fuel injection pump which incorporates a mechanical governor, are driven from the crankshaft by a train of gears.

Lubrication of the gear train is effected by an oil jet screwed into the oil gallery in the front of the crankcase. From this gallery oil is also fed to the timing idler gear shaft to lubricate the idler gear bearing.

LUBRICATION

The engine lubrication system is as described on page A.4, with the exception of the following.

The timing gears are lubricated by an oil feed jet, which screws into the connecting passage from the front of the main oil gallery. From this passage oil is fed to the idler gear shaft to lubricate the idler gear bearing.

Section AAAA.1

REMOVING AND REPLACING THE TIMING GEAR CASE COVER

Remove the radiator and case (Section C.7).

Take the weight of the engine at the front, preferably with a sling. Do not jack up directly under the sump.

Release the engine front support bracket from its mountings on the frame.

Remove the dynamo and driving belt (Section N.3).

Press back the lock washer and unscrew the nut from the end of the crankshaft, using spanner 18G564.

Withdraw the crankshaft pulley, using remover 18G231 and adaptor 18G231A, and extract the pulley key from the end of the crankshaft.

Unscrew the eight bolts securing the front support bracket to the timing gear case and remove the bracket.

Remove the four set screws and withdraw the idler gear shaft outrigger bearing complete with gasket from the middle of the timing gear case cover.

Unscrew the set bolts securing the timing gear case cover to the engine and remove the engine front lifting bracket and the dynamo link support bracket. Release the four set bolts securing the front of the sump to the under side of the gearcase cover and slacken the remaining sump bolts one or two turns.

Remove the timing gear case cover complete with crankshaft oil seal and distance piece, taking care to avoid damage to the sump joint washer. The gear case cover is located at its lower end on the gear case by two dowels.

Before replacing the gear case cover examine the joint faces of both the case and cover. Clean off any particles of old joint gasket which may adhere to the cover and ensure no burrs are evident. Inspect the crankshaft oil seal for wear and renew it if the lips of the oil seal show the slightest signs of damage. Ensure that the crankshaft distance piece is free from burrs and scratches where the oil seal lips contact.

Replacement of the gear case cover is a reversal of the removal procedure. Fit a new joint gasket between the gear case and cover and do not use jointing compound.

Section AAAA.2

REMOVING AND REPLACING THE TIMING GEARS AND CASE

Remove the timing gear case cover (Section AAAA.1).

Slacken all the fuel injector securing bolts to relieve the compression when cranking the engine.

If the timing gears only are to be renewed, refit the crankshaft nut and rotate the crankshaft with spanner 18G564 until Nos. 1 and 4 pistons are at T.D.C. with No. 4 piston commencing its induction stroke. The timing marks on the crankshaft and camshaft gears (Fig. AAAA.1) are now positioned correctly for reassembly. This will enable the new gears to be fitted without the necessity of rotating the crankshaft or camshaft (see **'NOTE'** below).

Cut the locking wires and slacken the fuel injection pump, and the camshaft drive gear securing screws.

Remove the thrust washer and withdraw the idler gear from its shaft.

NOTE.—With the idler gear removed the crankshaft and the camshaft must not be rotated unless all the valve rocker adjusting screws are completely released to allow all the valves to be in the fully closed position. If this procedure is not carried out the valves may foul the pistons and cause serious damage.

Remove the set screws and washers and withdraw the gears from the camshaft and the fuel injection pump drive hubs.

Withdraw the oil pump driving gear and the crankshaft gear, using remover 18G231 and adaptor 18G231B.

If the timing gears are not to be renewed the camshaft and fuel injection pump drive gears should be withdrawn complete with drive hubs. The camshaft drive gear hub must be withdrawn before the timing case can be removed.

Press back the lock washers and unscrew the camshaft

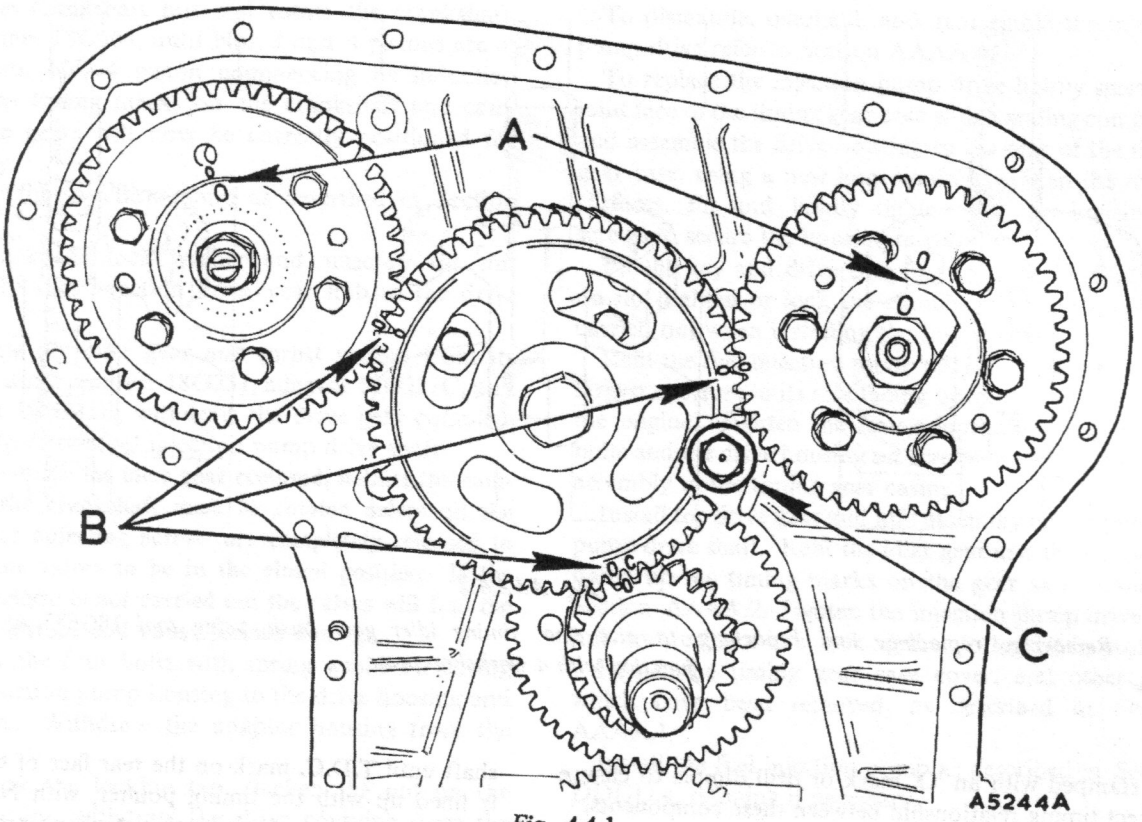


Fig. AA.1

Timing gears, showing (A) *the 'O' marks of the drive gears and hubs,* (B) *the timing marks on the idler and drive gears, and* (C) *the timing gear oil feed jet*

and the fuel injection pump drive shaft nuts. This should be carried out before the idler gear is withdrawn.

Withdraw the camshaft drive gear and hubs complete, using remover 18G231 with adaptor 18G231C and thrust pad 18G231D. The fuel injection pump drive gear and hub is withdrawn complete, in the same manner, but using thrust pad 18G231E to protect the end of the drive shaft.

Remove the fuel injection pump (see Section DDDD.4).

Remove the idler gear shaft, which has a left-hand thread, and unscrew and remove the timing gear oil feed jet and copper sealing washer.

Unscrew and remove the six set bolts securing the timing gear case and withdraw the case, located on the front of the crankcase and cylinder block by three dowels, complete with the fuel injection pump drive and adaptor housing.

Remove and dismantle the fuel injection pump drive, if necessary, as described in Sections AAAA.3 and AAAA.4.

Inspect the timing gears for broken, worn, or chipped teeth, and renew if necessary.

Clean out the oilway in the idler gear shaft and check the shaft for wear. Blow clear the timing gear oil jet with compressed air.

Check the idler gear bush and the thrust washer for wear against the dimensions given in **'GENERAL DATA'.** New bushes must be finished to size, using broaching tool 18G683 (see **'GENERAL DATA'**), after pressing them into the idler gear.

Replacement of the timing gears and case is a reversal of the removal instructions but the following points should be noted.

Fit a new gasket between the timing gear case and the cylinder block, coating the joint face of the cylinder block with sealing compound.

Do not over-tighten the idler gear shaft; sufficient to retain the shaft in position is all that is necessary.

To facilitate retiming, one tooth on each gear, with the exception of the idler gear, is marked with an 'O' or drill dimple (see Fig. AAAA.1). The corresponding teeth on the idler gear which mesh with the marked teeth on the camshaft and fuel injection pump drive gears are each identified with an 'O' mark or drill dimple, and the two corresponding teeth which mesh with the marked tooth on the crankshaft gear are marked with 'OC' or twin drill dimples. Also, the faces of the fuel injection pump and camshaft drive hubs and their respective drive gears

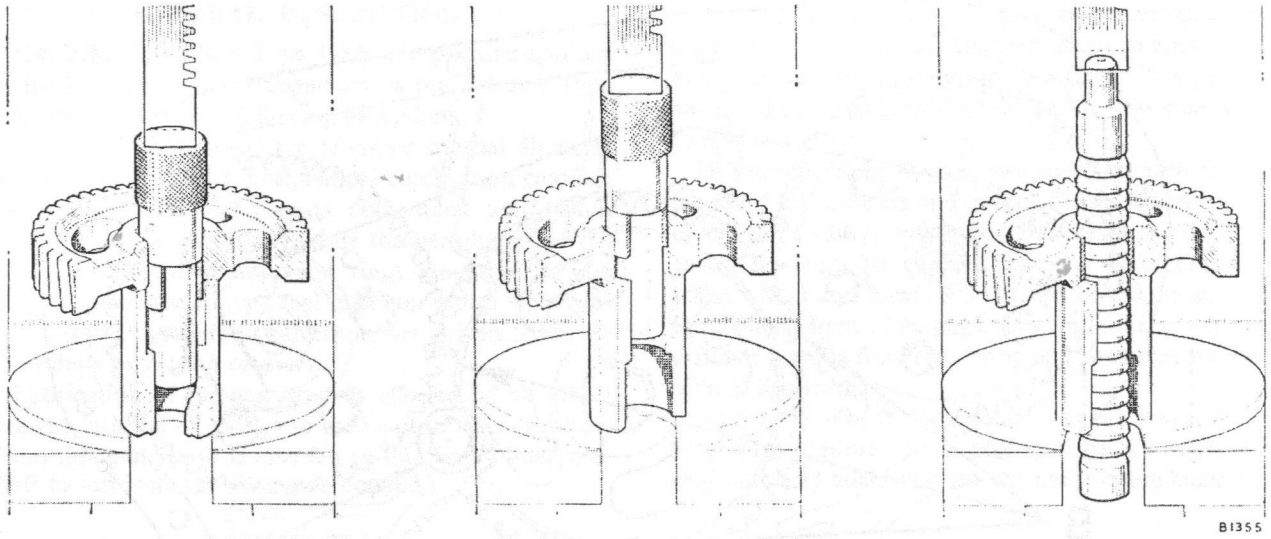


Fig. AAAA.2

Removing, replacing, and broaching to size the timing idler gear bush, using tool 18G683 in conjunction with a workshop press

are stamped with an 'O' mark or drill dimple to ensure correct timing relationship between these components.

Assemble the fuel injection pump drive gear to its hub, lining up the timing mark on the face of the gear with the timing mark on the face of the hub. Tighten and wire lock the securing bolts. In a similar manner assemble the camshaft drive gear to its hub, lining up the timing marks, but do not lock the securing bolts at this stage as final adjustment of the valve timing has still to be carried out.

If necessary, after first ensuring that the valve rocker adjusting screws are fully released, rotate the crankshaft to position No. 4 piston at T.D.C. on its induction stroke. The tooth with the timing mark on the crankshaft gear will now be between 11 and 12 o'clock (see Fig. AAAA.1).

Rotate the camshaft to position the gear tooth with the timing mark between 8 and 9 o'clock and then turn the fuel injection pump drive gear so that its tooth with the timing mark is between 3 and 4 o'clock (see Fig. AAAA.1).

Fit the idler gear to its shaft with the marked teeth on the drive gears engaging the corresponding teeth on the idler gear as shown in Fig. AAAA.1.

Fit the idler gear thrust washer with the oil groove in the washer next to the gear.

Final adjustment of the valve timing must now be carried out as follows.

Adjust the valve rocker clearances as described in Section AA.3. Obtain access to the rim of the flywheel and to the timing pointer by removing the cover on the left-hand side of the clutch housing. Rotate the crankshaft until T.D.C. mark on the rear face of the flywheel is lined up with the timing pointer, with No. 4 piston about to commence its induction stroke. Carefully rotate the crankshaft and determine the exact point at which the exhaust valve (No. 8) of No. 4 cylinder closes. A clock gauge mounted on the exhaust manifold rear studs with the foot of the gauge on the valve collar will facilitate the operation. No. 4 piston should now be at 5° A.T.D.C. indicated by the 5° A.T.D.C. mark on the flywheel aligning with the timing pointer in the clutch housing.

If the valve timing, in accordance with these instructions and valve-timing diagram (Fig. A.33), is incorrect, slacken the six set bolts securing the drive gear to the camshaft drive hub and rotate the crankshaft in the normal direction of rotation to line up the 5° A.T.D.C. mark of the flywheel with the pointer in the housing. Tighten and wire up the camshaft drive gear set bolts.

Check the fuel injection timing as described in Section DDDD.4 and bleed the fuel system as described in Section D.6 after the fuel pipe connections have been made.

Section AAAA.3

REMOVING AND REPLACING THE FUEL INJECTION PUMP DRIVE

Remove the timing gear case cover as detailed in Section AAAA.1.

Slacken all the fuel injector securing bolts to relieve the compression and ease the cranking of the engine.

Refit the crankshaft nut and rotate the crankshaft, using spanner 18G564, until Nos. 1 and 4 pistons are at T.D.C. with No. 4 piston commencing its induction stroke. The timing marks on the crankshaft and camshaft drive gears will now be correctly positioned for reassembly.

Remove the injection pump as described in Section DDDD.4.

Press back the lock washer and unscrew the nut securing the fuel injection drive gear hub to the drive shaft.

Withdraw the idler gear and thrust washer from its shaft and, using remover 18G231, adaptor 18G231C, and thrust pad 18G231E, withdraw the drive gear complete with hub from the fuel injection pump drive shaft.

NOTE.—With the idler gear removed, neither the camshaft nor the crankshaft must be rotated unless all the valve rocker adjusting screws are completely released to allow all the valves to be in the closed position. If the above procedure is not carried out the valves will foul the top of the pistons and cause serious damage.

Unscrew the four bolts with spring washers securing the fuel injection pump housing to the drive housing and timing case. Withdraw the adaptor housing from the engine.

Press back the locking tab, slacken the nut on the clamp bolt and withdraw the drive coupling from the drive shaft. Remove the coupling key.

Unscrew the two set screws securing the injection pump drive housing to the timing gear case and withdraw the drive housing rearwards from the engine. Remove the drive housing joint washer.

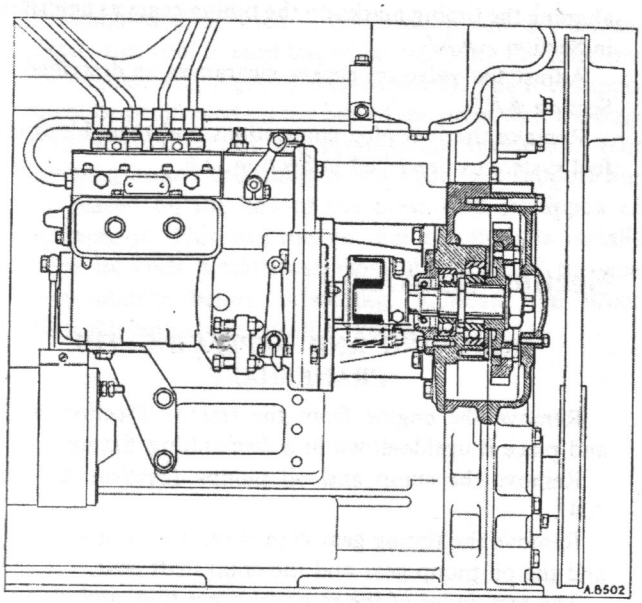


Fig. AAAA.3

A sectional view of the fuel injection pump drive

To dismantle, overhaul, and reassemble the injection pump drive refer to Section AAAA.4.

To replace the injection pump drive lightly smear the joint face of the timing gear case with a sealing compound and assemble the drive housing to the rear of the timing gear case, using a new joint washer between the mating surfaces. Fit and lightly tighten the two housing set screws to secure the housing in position.

Fit the key and drive coupling to the drive shaft, but do not tighten or lock the clamping bolt. This will be carried out when installing the fuel injection pump.

Refit the fuel injection pump adaptor housing with the largest aperture in its side facing upwards and away from the engine. Tighten the four adaptor housing securing bolts and the drive housing set screws to secure the whole assembly to the timing gear casing.

Install the drive gear and hub assembly on the injection pump drive shaft. Refit the idler gear and thrust washer, lining up the timing marks on the gear as described in Section AAAA.2. Tighten the injection pump drive gear hub nut, using a new lock washer to lock it in position.

Install the timing gear case cover, and other parts which have been removed, as described in Section AAAA.1.

Install the fuel injection pump as described in Section DDDD.4, retiming if necessary.

Section AAAA.4

DISMANTLING, OVERHAULING, AND REASSEMBLING THE FUEL INJECTION PUMP DRIVE

Remove the assembly from the engine as described in Section AAAA.3.

Remove the end cover from the drive housing complete with oil seal.

Release the four countersunk screws securing the cover-plate to the front of the drive housing.

Press the drive shaft out of the housing from the plain end; take care of the large ball bearing as it becomes disengaged from the housing.

Extract the drive gear hub key from the shaft.

Press the small ball bearing out of the rear of the housing.

Press the oil seal from the end cover.

To release the drive gear from the hub, break the locking wire and remove the six set bolts.

Clean and examine the joint faces of the drive housing and chain case cover.

Clean and inspect the oil seal for wear and damage. If the slightest damage is evident, especially on the lip, the seal must be renewed.

Inspect the drive gear for broken, worn or chipped teeth; renew if necessary.

Inspect the ball bearings for signs of pits or scores. To dislodge solid particles remaining in the bearing tap the bearings sharply on a block of wood and immerse them in paraffin (kerosene), spinning them slowly. Renew any bearings that are worn. Coat the bearings in engine oil and wrap them in a clean cloth until required for re-assembly.

Commence reassembly by pressing the large bearing into the front of the housing.

Fit the cover-plate over the front of the housing, using new countersunk-headed set screws; peen them over when fully tightened.

Fit the gear wheel hub key to the front of the drive shaft and insert the shaft into the housing with the shoulder against the ball bearing.

With the shaft held in this position, press on the rear ball bearing fully against its abutment shoulder.

Press the oil seal into the end cover, with the lip of the seal towards the open end of the cover.

Thread the oil seal and cover over the drive shaft, take particular care when engaging the lip of the seal over the shaft; it must not be damaged in any way or oil leakage will occur. Lightly smear the joint faces with a sealing compound and secure the end cover with the four set bolts.

Inject a liberal amount of engine oil into the housing for initial lubrication of the bearings until the engine oil is circulated.

Replace the injection pump drive to the engine as detailed in Section AAAA.3.

Section AAAA.5

REMOVING AND REPLACING THE CAMSHAFT AND TAPPETS

Remove the radiator and case (Section C.7).

Remove the timing gear case cover and the camshaft drive gear complete with hub as described in Section AAAA.1 and AAAA.2.

Remove the rocker gear cover, slacken the rocker arm adjusting screws fully, and withdraw the push-rods.

Remove the tappet and push-rod cover.

Remove the tappets.

Remove the fuel lift pump (Section D.4).

Remove the camshaft thrust plate.

Withdraw the camshaft in a forward direction, being careful to avoid damage to the bearing surfaces.

Remove the locating bolt and withdraw the camshaft front bearing out of the cylinder block if it is to be renewed.

Inspect the camshaft bearing journals and cams for evidence of scoring and wear. If the journals are not of the required clearances (see **'GENERAL DATA'**) the camshaft must be renewed.

The camshaft front bearing bush should be examined for scores, pits, or evidence of failure.

Examine the tappet cam contacting surfaces for wear or scores, and the spherical push-rod seats for grooves or flats. New tappets should be installed wherever evidence of unusual wear is found. Ensure the tappet oil holes are perfectly free from obstructions.

Check the camshaft end-float. If the end-float exceeds the figure given in **'GENERAL DATA'** the locating plate bronze thrust washer must be renewed.

Press the camshaft front bearing into its bore, plain edge foremost, lining up the two holes in the bush with the oil hole and locating hole in the crankcase. When in position the bearing can be lined up accurately with a soft drift engaging the aligning notch in the foremost edge of the bearing.

A new bearing must be finished-reamed in position with a line reamer to a diameter of 1·9995 to 2·001 in. (50·787 to 50·825 mm.).

Lubricate the camshaft bearing journals liberally with clean engine oil before installing the camshaft.

Install the camshaft locating plate with its bronze thrust washer next to the camshaft drive gear hub.

Assemble the drive gear complete with hub to the camshaft before reassembling the tappets and push-rods, aligning the timing marks on the timing gears as described in Section AAAA.2.

Adjust the valve to rocker clearances as described in Section AA.3.

Remake the fuel pipe connections and then bleed the fuel system as described in Section D.6.

Section AAAA.6

REMOVING AND REPLACING THE CRANKSHAFT

Remove the engine from the tractor (Section A.21, and place it upside-down in a dismantling fixture.

Remove the sump and oil pumps (Section A.1 and A.4).

Remove the timing gear case cover (Section AAAA.1) and the oil pump gear and the crankshaft gear.

The remainder of the removal procedure, and that for examination and replacement of the crankshaft, is as detailed in Section A.22.

Section AAAA.7

REMOVING AND REPLACING MAIN AND BIG-END BEARINGS

Unless the bearing journals are badly worn the big-end bearings may be renewed without removing the crankshaft. To renew the main bearings it is necessary to remove the engine (Section A.21) and withdraw the crankshaft as detailed in Section AA.6, after which the procedure detailed in Section A.5 should be followed.

Section AAAA.8

PISTONS, PISTON RINGS, AND GUDGEON PINS

The pistons are of aluminium alloy, having a hemispherical combustion cavity, employing three compression and two oil control rings. The top compression ring is taper-sided and has a chromium-plated periphery, while the peripheries of Nos. 2 and 3 compression rings are tapered. The oil control rings are of the slotted scraper type.

Follow the instructions detailed in Sections A.10 and A.11, but with the following exceptions.

Check the pistons for maximum wear, which may occur on the thrust face of the skirt, against the dimensions given in **'GENERAL DATA'.**

Check the piston ring fitted gaps and groove clearance against the dimensions given in **'GENERAL DATA'.**

Install the rings into their respective grooves in the piston in the following order.

Oil scraper rings, one in the skirt and one immediately above the gudgeon pin.

Tapered periphery compression rings in grooves Nos. 2 and 3 with the side marked with a 'T' uppermost.

Chromium-plated periphery and taper-sided compression ring in the top groove.

Section AAAA.9

MODIFIED OIL FILTER

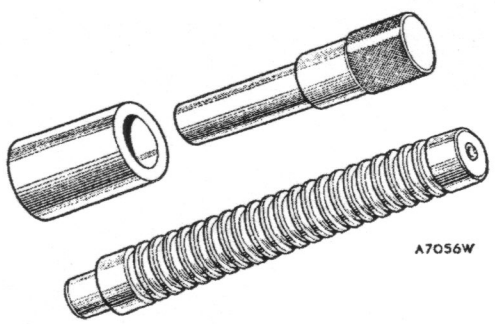
A modified Purolator oil filter is fitted from Engine No. OEE10803.

Refer to Fig. A.42 for details of the filter and to Section A.35 for removal, dismantling, and element renewal instructions.

SERVICE TOOLS

18G683. Idler Gear Bush Broaching Kit

Designed to be used in conjunction with a workshop press, this tool is essential when renewing the idler bush on engines with a gear-driven camshaft. The tool support must be positioned on the bed of the press with the larger bore uppermost for the pressing-out operation. When pressing in and broaching a new bush, the support must be placed on the bed of the press with its lipped end uppermost. This will ensure that the bush is installed with its ends equidistant from the sides of the gear. Immediately before broaching, lubricate the broach liberally with clean paraffin (kerosene).



18G683

SECTION AAAAA

THE ENGINE

(TYPE OEG THREE-CYLINDER DIESEL)

GENERAL DESCRIPTION

The B.M.C. Type OEG compression-ignition engine is a 2·8-litre three cylinder unit, similar to the gear-driven version of the 2·55-litre engine described in Section A, but with larger cylinder bores and pistons.

LUBRICATION

The lubrication system is as described in Section A, except that the oil pressure relief valve for the rockers is located on the rear rocker bracket, and the timing gears are lubricated by an oil jet screwed into the oil gallery which crosses the front of the crankcase.

Section AAAAA.1

REMOVING AND REPLACING THE ROCKER GEAR

Follow the instructions in Section A.6, noting the following points:

(1) The rocker gear oil relief valve is situated on the rear rocker bracket.

(2) Two widths of rocker spacer are fitted, one wide spacer should be in the centre of each pair of rockers, and a narrow spacer should be fitted between each rocker and bracket.

Section AAAAA.2

REMOVING AND REPLACING THE TIMING GEARS AND CASE

Follow the instructions in Section A.32, but when removing or replacing the fuel injection pump refer to Section DDDD.4. After refitting the injection pump, bleed the fuel system as described in Section DDDDD.6.

Section AAAAA.3

INJECTION PUMP DRIVE

Follow the instructions in Section A.33, but refer to Section DDDD.4 for removing and replacing the fuel injection pump, and when bleeding the fuel system refer to Section DDDDD.6.

SECTION BBB

THE IGNITION SYSTEM

GENERAL DESCRIPTION

The coil ignition equipment comprises a high-tension induction coil and combined distributor, contact breaker, and automatic timing control assembly driven at half engine speed by the camshaft.

Specially designed for use where exposure is encountered, the distributor incorporates a metal dust-excluding plate which fits round the cam spindle. A felt ring seals this plate to the cam spindle and thus ensures a moisture- and dust-proof enclosure for the contact breaker and automatic timing control.

Section BBB.1

ROUTINE MAINTENANCE

In general, maintenance consists of cleaning and lubrication and the occasional adjustment of the contact breaker.

Take great care to prevent oil or grease getting on or near the contacts.

Every two weeks or 100 hours

Lift off the rotor arm and apply to the spindle a few drops of thin machine oil to lubricate the cam bearing. It is not necessary to remove the screw in the top of the spindle as an oilway is provided.

Lift off the dust-excluding plate. Lightly smear the cam with a little clean engine oil and drop one spot of oil on the moving contact pivot. Ensure that the contact arm moves freely on its pivot.

Add a few drops of thin machine oil through the hole in the contact breaker base through which the cam passes in order to lubricate the automatic timing control. Do not allow any oil to get on or near the contacts. Replace the dust-excluding plate.

Replace the rotor arm, carefully locating the keyway and pushing right home.

Every month or 200 hours

Thoroughly clean the distributor cap inside and out with a dry cloth. Pay particular attention to the spaces between the metal electrodes and ensure that the small carbon brush moves freely in its holder.

Check that the contacts are free from grease or oil. If they are dirty or pitted they must be cleaned with fine emery-cloth or a fine carborundum stone. Cleaning the points is made easier if the moving contact is removed. The contact breaker spring is slotted to assist its removal and may be released by slackening the nuts on the low-tension terminal post. The fixed contact may be removed after extracting the two securing screws and washers and the insulating washer on the moving contact pivot post. After cleaning the contact points the gap should be set as in Section BBB.2.

Section BBB.2

SETTING THE CONTACT BREAKER GAP

The contact breaker gap should be checked every 200 hours.

To gain access to the contacts remove the rotor arm and withdraw the dust-excluding plate.

If the contacts are dirty or pitted they must be cleaned by polishing with a fine carborundum stone and afterwards wiped with a cloth moistened with petrol (gasoline) (see Section BBB.1).

Check that the moving arm moves freely on its pivot. If it is sluggish it should be removed and the pivot pin polished with a strip of fine emery-cloth. Afterwards apply a spot of clean engine oil to the top of the pivot.

Turn the engine until the contact breaker points are fully opened and check the gap with a gauge having a thickness of ·014 to ·016 in. (·36 to ·41 mm.). If the gap is correct the gauge will be a sliding fit. Do not alter the setting unless the gap varies considerably from the gauge thickness.

To adjust the setting keep the engine in the position which gives maximum opening of the contacts and then slacken the two screws securing the fixed contact plate. Adjust the position of the plate until the gap is set to the thickness of the gauge and then tighten the two locking screws.

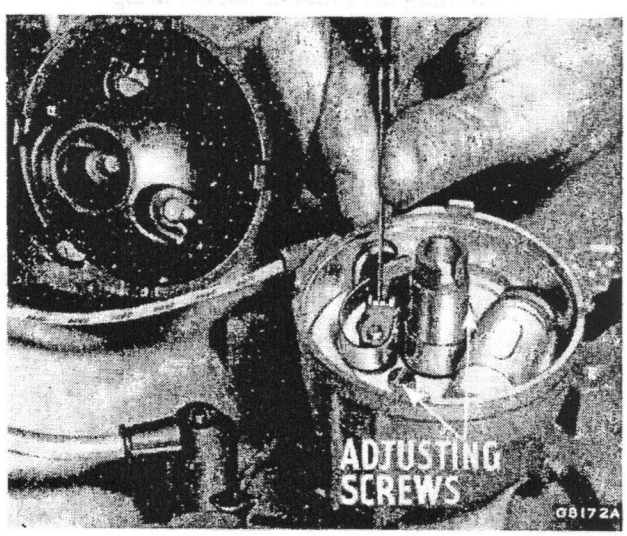


Fig. BBB.1

To adjust the cam between the distributor contacts slacken the screws indicated by the arrows

Section BBB.3

LOCATING THE CAUSE OF UNEVEN FIRING

Detach the leads from the sparking plugs and allow them to rest on the terminals.

Start the engine and set it to run at a fairly fast idling speed.

Cut out each plug in turn by lifting the lead from the plug. No difference in the engine performance will be noted when cutting out the plug in the defective cylinder. Cutting out the other plugs will make uneven running more pronounced.

Having located the cylinder which is at fault, stop the engine and remove the cover from the end of the plug lead. Restart the engine and hold the end of the cable about $\frac{3}{16}$ in. (4·8 mm.) from the cylinder head.

If the sparking is strong and regular the fault probably lies in the sparking plug. Remove the plug, clean it, and adjust the gap to the correct setting, or alternatively fit a new plug.

If there is no spark or if it is weak or irregular examine the cable from the sparking plug to the distributor. After a long period of service the rubber insulation may be cracked or perished, in which case the cable should be renewed (see Section BBB.7). Finally, examine the distributor moulded cap, wipe the inside and outside with a clean dry cloth, see that the carbon brush moves freely in its holder, and examine the moulding closely for signs of breakdown. After long service it may have become tracked—that is, a conducting path indicated by a thin, black line may have formed between two or more of the electrodes and some part of the distributor in contact with the cap. A new distributor cap must be fitted in place of one that has become tracked. If the distributor has been fitted recently it may have been timed incorrectly (see Section BBB.13).

Section BBB.4

TESTING THE LOW-TENSION CIRCUIT FOR CAUSE OF IGNITION FAILURE

Remove and examine the distributor cap. Lift off the rotor, levering it carefully if necessary, and remove the dust-excluding plate. Clean and adjust the contacts (see Section BBB.2).

Switch on the ignition and turn the engine. The ammeter reading should rise and fall with the closing and opening of the contacts if the low-tension wiring is in order.

When the reading does not fluctuate a short circuit is usually indicated, and no reading indicates a broken or loose connection in the low-tension wiring.

Another method of testing the low-tension circuit is to disconnect the cable at the contact breaker terminal of the coil and the low-tension terminal of the distributor and connect a test lamp between these terminals. If the lamp lights when the contacts close and goes out when the contacts open the low-tension circuit is in order.

If it is determined that the fault lies in the low-tension circuit switch on the ignition and turn the engine until the contact breaker points are fully opened.

Refer to the wiring diagram and check the circuit with a voltmeter (0–20 volts) between the following points and a good earth. If the circuit is in order the voltage reading should be approximately 12 volts. No reading indicates a damaged cable or loose connections or a breakdown in the section under test.

(1) **Battery to starter switch.** Connect the voltmeter between that terminal of the starter switch which is connected to the battery and earth.

(2) **Starter switch to ammeter** (brown lead). Connect the voltmeter between the ammeter terminal and earth.

(3) **Ammeter.** Connect the voltmeter between the other terminal of the ammeter and earth. No reading indicates a fault in the ammeter, which must be renewed.

(4) **Ammeter to ignition switch** (brown with white lead). Connect the voltmeter between the ignition switch terminal and earth.

(5) **Ignition switch.** Connect the voltmeter between the other terminal of the ignition switch and earth. No reading indicates a faulty switch.

(6) **Ignition switch to ignition coil** (white lead). Remove the lead from the ignition coil 'SW' terminal and connect the voltmeter between the free end of the cable and earth. If the correct reading is obtained remake the connection to the coil.

(7) **Ignition coil.** Disconnect the lead from the 'CB' terminal of the coil and connect the voltmeter between the 'CB' terminal and earth. No reading indicates a fault in the primary winding of the coil and a new coil must be fitted. If the correct reading is obtained remake the cable connection to the coil.

(8) **Ignition coil to distributor** (white with black lead). Disconnect the cable from the low-tension terminal on the distributor and connect the voltmeter to the end of the cable and earth. If the correct reading is given remake the connection to the terminal.

(9) **Contact breaker and condenser.** Connect the voltmeter across the contact points. No reading indicates a fault in the condenser.

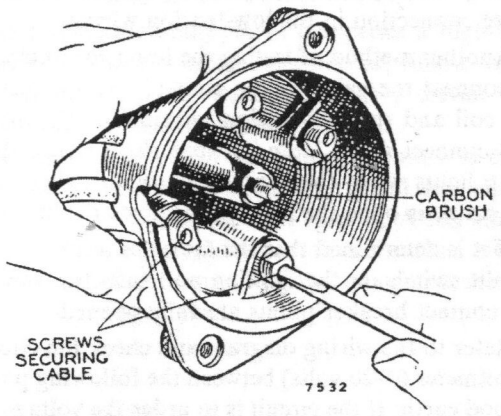


Fig. BBB.2

The high-tension cables are secured in the distributor cover segments by pointed screws

Section BBB.5

CONDENSER

The best method of testing the condenser is by substitution.

Disconnect the original condenser and connect a new one between the low-tension terminal of the distributor and earth.

The condenser is secured to the contact breaker base with a clip-retaining screw and spring washer, and the connecting strip to the low-tension terminal is slotted to enable it to be lifted off the terminal bolt when the terminal nut is slackened.

Section BBB.6

TESTING THE HIGH-TENSION CIRCUIT

Before carrying out this test ensure that the low-tension circuit is in working order (see Section BBB.4).

Remove the high-tension lead from the centre terminal of the distributor. Switch on the ignition and turn the engine until the contacts close. Flick open the contact breaker lever while the high-tension lead from the coil is held about $\frac{3}{16}$ in. (4·8 mm.) from the cylinder block.

If the ignition equipment is in good order a strong spark will occur. If there is no spark the secondary winding of the coil is faulty and a new coil must be fitted.

Section BBB.7

HIGH-TENSION CABLES

The high-tension cables must be examined carefully, and any which have the insulation cracked, perished, or damaged must be discarded and new 7-mm. rubber-covered ignition cable fitted.

The cables from the distributor to the sparking plugs must be connected up in the correct firing order, which is 1, 3, 4, 2. Remember that the direction of rotation of the rotor arm is counter-clockwise.

To fit a new cable to the ignition coil or distributor pass the cable through the knurled, moulded terminal, bare the end of the cable for about $\frac{1}{4}$ in. (6 mm.), thread the wire through the brass washer removed from the original cable, and bend back the strands. Finally, screw the nut into its terminal.

Section BBB.8

SPARKING PLUGS

It is recommended that the plugs be cleaned, set, and tested every 200 working hours. In order to maintain maximum engine performance a new set of plugs should be fitted every 500 hours.

When sparking plugs are removed from the engine their gaskets should be removed with them and replaced on the plugs, which should be placed in a suitable holder. It is advisable to identify each plug with the number of the cylinder from which it was removed so that any faults revealed on examination can be traced back to the cylinder concerned. A simple plug stand, possessing a series of numbered holes to admit the upper ends of the plugs, will be found useful.

When examining the plugs place a new plug of the same type beside the others to afford a ready comparison of the relative condition of the used plugs.

Examine for signs of oil fouling. This will be indicated by a wet, shiny black deposit on the insulator, and is due to worn cylinders and pistons, or gummed-up or broken rings. Under such conditions oil from the cylinder walls is forced up past the rings on the suction stroke of the piston and is eventually deposited on the plugs.

This trouble can be overcome only by fitting a new piston and rings, or, in extreme cases, a rebore may be necessary.

Next examine the plugs for signs of excess fuel fouling. This is indicated by a dry, fluffy black deposit which is usually caused by over-rich carburation, although ignition system defects such as a faulty condenser or a broken or worn-out cable may be additional causes. The important thing is for the carburetter setting to be correctly adjusted

and the ignition system overhauled. If the plugs appear to be suitable for further use proceed to clean and test them.

First remove the plug gaskets and examine them. A large proportion of the heat of the plug is normally dissipated to the cylinder head through the gasket between the plug and the head. Plugs not screwed down tightly can thus easily become over-heated so that they operate out of their proper heat range, thus producing pre-ignition and short plug life. On the other hand, it is unnecessary and unwise to tighten up the plugs too much. What is required is a reasonably good seal between the plug and the cylinder head and the use of a torque wrench is recommended to tighten the plugs to a figure of 30 lb. ft. (4·15 kg. m.).

If the plugs require cleaning it is preferable to make use of a proper plug cleaner of the type recommended by the plug manufacturers, and the makers' instructions for using the cleaner should be carefully followed.

Occasionally a blistered insulator or a badly burnt electrode may be noticed when examining the plugs.

If the plug is of the type normally recommended for the engine and it was correctly installed (down tightly on the gasket), this condition may have been brought about by a very lean mixture or an overheated engine. There is, however, a possibility that a plug of another type is required, but as a rule the plug recommended should be adhered to.

After cleaning carefully, examine the plugs for cracked insulators and wear of the insulator nose due to excessive previous cleaning. In such cases the plugs have passed their useful life and new plugs should be installed.

Examine the insulator for deposits underneath the side electrodes which have possibly accumulated and which act as a 'hot-spot' in service.

After cleaning the plugs in the special cleaner blow all surplus abrasive out of the body recesses, and off the plug threads, by means of an air blast. Next examine the threads for carbon. Any deposits can be removed and the threads cleaned with a wire brush. A wire buffing wheel may also be utilized, but reasonable care must be used in both methods in order not to injure the electrodes or the tip of the insulator. The thread section of the plug body is often neglected when cleaning the plugs owing to the fact that it is not generally realized that, like the gaskets, the threads are a means of heat dissipation, and that when they are coated with carbon the flow of the heat from the plug is retarded, producing overheating. This simple procedure will also ensure absence of binding on the threads on replacement and also avoid the unnecessary use of the plug spanner.

When replacing a plug always screw it down by hand as far as possible and use the torque wrench for final tightening only. Whenever possible use a socket to avoid fracture of the insulator.

Examine the electrodes for the correct gap (see **'GENERAL DATA'**). Avoid an incorrect reading in the case of badly pitted electrodes.

Remember that electrode corrosion and the development of oxides at the gap area vitally affects the sparking efficiency. The special cleaner can remove the oxides and deposits from the insulator, but the cleaner stream does not always reach this area with full effect owing to its location, and cannot necessarily deal with corrosion effectively as this sometimes requires too strong a blast for proper removal.

When plugs appear worthy of further use it is good practice to dress the gap areas with a small file before resetting them. The intense heat, pressure, explosion shock, and electrical and chemical action to which the plugs are submitted during hours of service are so intense that the molecular structure of the metal points is eventually affected. Plugs then reach a worn-out condition and resetting the points can no longer serve a good purpose. When points are burnt badly it is indicative that the plug has worn to such an extent that its further use is undesirable and wasteful.

Before fitting the plug in the engine test it for correct functioning under air pressure in a plug tester, following out the instructions issued by the makers of the plug tester. Generally speaking, a plug may be considered satisfactory for further service if it sparks continuously under a pressure of 100 lb./sq. in. (7 kg./cm.^{2}) with the gap between the points set at ·022 in. (·56 mm.). It is essential that the plug point be reset to the recommended gap before the plug is refitted to the engine (see **'GENERAL DATA'**).

While the plug is under pressure in the tester it should be inspected for leakage by applying oil round the terminal. Leakage is indicated by the production of air-bubbles, the intensity of which will serve to indicate the degree of leakage. The leakage gases have a 'blow-torch' effect which rapidly raises the temperature of the plug, raising its temperature above its designed heat range, thus producing overheating, pre-ignition, and rapid electrode destruction.

The top half of the insulator is frequently responsible for poor plug performance due to the following faults: splashes, accumulation of dirt and dust, cracked insulators (caused by a slipping spanner), overtightness of the terminals.

Examine for a cracked insulator at the shoulder and the terminal post and remove any accumulation of dirt and dust.

Section BBB.9

REMOVING AND REPLACING THE DISTRIBUTOR

The distributor can be removed and replaced without upsetting the ignition timing if the clamp bolt in the plate at the base of the distributor is not slackened.

Detach the high-tension leads from the sparking plugs and coil and the low-tension lead from the distributor terminal.

Extract the two bolts securing the clamp plate to the top of the cylinder head and withdraw the distributor and driving shaft.

Replacing

Insert the distributor into the cylinder head until the driving dog rests on the drive shaft and then rotate the rotor arm until the driving dog engages. The drive shaft slots are offset to ensure correct engagement. Adjustment to the position of the distributor or magneto body made by slackening the bolt in the clamping plate will affect the ignition timing and should only be made after road trial.

The rotor arm rotation is anti-clockwise and the firing order is 1, 3, 4, 2 (see Section BBB.13).

Section BBB.10

DISMANTLING THE DISTRIBUTOR

Before dismantling, carefully note the positions in which the various components are fitted so that they can be replaced correctly.

Spring back the securing clips and remove the moulded cap.

Lift the rotor arm off the top of the spindle. If it is a tight fit it must be levered off carefully with a screwdriver.

Note the relative positions of the offset driving dog slot on the bottom of the shaft and the rotor arm drive slot in the cam.

Remove the dust-excluding plate, together with the felt seal.

Remove the nuts, washers, and insulating grommet from the low-tension terminal.

Extract the three screws and washers at the edge of the plate and lift out the complete contact breaker assembly.

Slacken the nut remaining on the low-tension terminal and lift off the contact breaker lever, the insulating washer, and the condenser.

Extract the two screws with spring and plain washers to release the fixed contact plate.

Drive out the pin and withdraw the driving dog from the spindle.

Remove the cam, automatic timing control, and shaft assembly from the distributor. Take out the screw from inside the top of the cam spindle and lift off the cam to release the automatic timing control.

Section BBB.11

FITTING NEW BEARINGS AND BUSHES

After dismantling the distributor as detailed in Section BBB.10 the ball bearing can be withdrawn from the distributor shaft with an extractor. Refit the bearing to

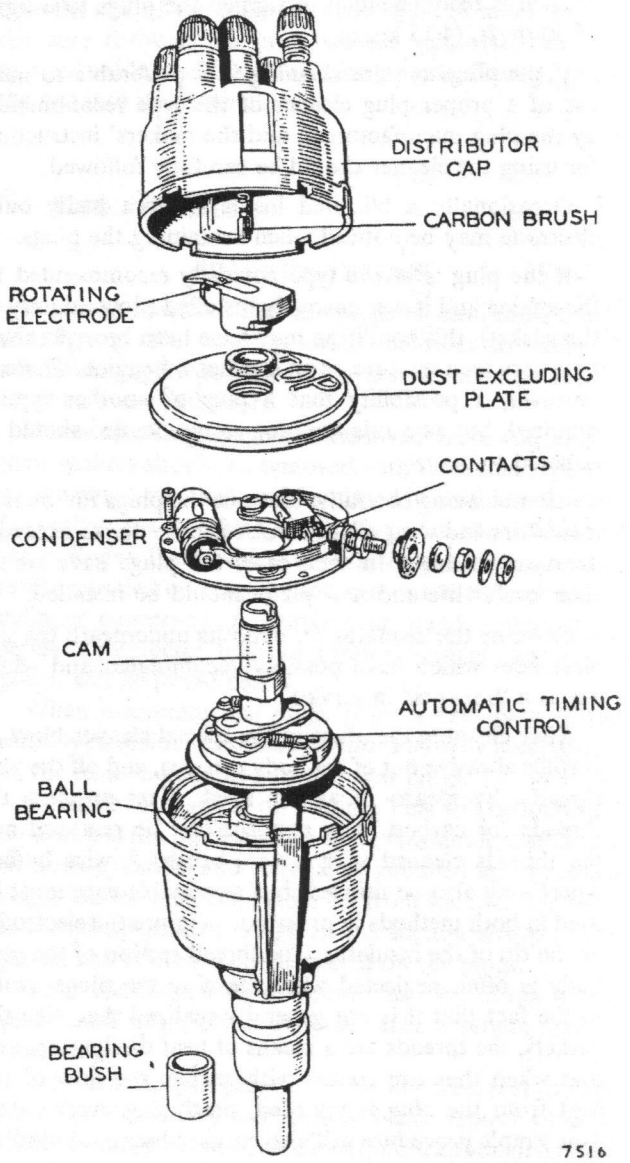


Fig. BBB.3
The distributor components

the shaft with a tube which bears on the inner journal of the bearing.

The bush in the lower end of the distributor housing can be pressed out with a suitable mandrel.

Before fitting, new bushes must be immersed in thin engine oil for 24 hours. In cases of emergency this period may be reduced to two hours by heating the oil to 100° C. (212° F.). The bushes must not be bored out by reaming or any other means as this will impair the porosity, and hence the effective lubricating quality, of the bushes.

New bushes can be fitted to the inverted distributor body with a shouldered mandrel (see Fig. BBB.4).

Section BBB.12

REASSEMBLING THE DISTRIBUTOR

Before reassembly the automatic advance mechanism, distributor shaft, and the cam spindle must be lubricated with thin engine oil. Pack the bearing on the distributor shaft with high-melting-point grease.

Assemble the automatic timing control, taking care to fit the components in their original positions. If the control springs have stretched or there is any doubt about their condition compare them with new ones, and fit a new set if necessary. Two holes are provided in each toggle and the springs must be fitted to the inner hole in each case. Place the cam on the spindle, engaging the two pegs on the cam foot with the holes in the toggle levers, and tighten the retaining screw.

Fit the shaft in its bearings and replace the driving member, remembering that the relative position of the offset of the driving dog to the rotor arm locating slot in the cam must be the same as before the distributor was dismantled if the timing is not to be disturbed. Fit the driving pin and burr over each end to retain it in position.

Reassemble and replace the contact breaker assembly and adjust the contacts to give a maximum gap of ·014 to ·016 in. (·36 to ·41 mm.).

If it is necessary to fit new contacts a set of both fixed and moving contacts must be fitted. Remember to check and reset the contact breaker gap after the first 15 hours' running to compensate for any initial wear on the fibre heel of the moving contact.

Replace the dust-excluding plate, carefully locating the felt seal. Place the rotor on the spindle and push it fully home. Fit and secure the distributor cover.

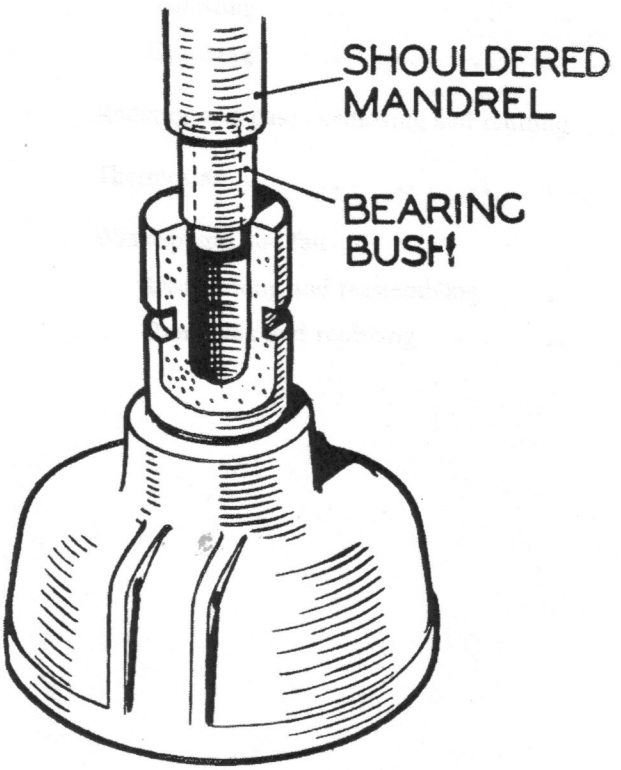


Fig. BBB.4

Pressing in a new distributor bearing bush

Section BBB.13

TIMING THE IGNITION

Check the gap between the contact points, and if necessary reset it to the correct clearance of ·014 to ·016 in. (·36 to ·41 mm.).

Remove the inspection cover from the left-hand side of the clutch housing and turn the engine with the starting handle until the arrow stamped on the flywheel is in line with the pointer when viewed through the inspection hole. The pistons of No. 1 and No. 4 cylinders are now at T.D.C.

If No. 1 cylinder is at the T.D.C. of its compression stroke, then the tip of the rotor arm will be towards the distributor cover segment for No. 1 cylinder at the front of the engine. If the rotor is towards the segment for No. 4 cylinder, then No. 4 cylinder has just completed its compression stroke and is at T.D.C.

Give the engine almost one complete turn (nearly two turns of the starting handle) and examine the contacts as the flywheel timing mark approaches the pointer on the housing. If the timing is correct the contacts will just break when the mark on the flywheel is in line with the pointer on the casing (Fig. BBB.5).

If the points do not open at the correct position reset the flywheel arrow to the timing position, in front of the pointer, and slacken the clamping bolt in the distributor base plate.

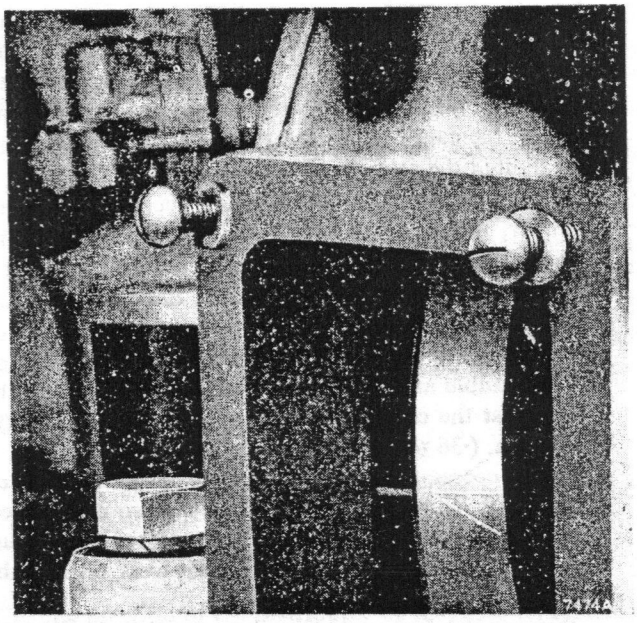


Fig. BBB.5

The mark on the flywheel is here shown in the timing position in line with the pointer in the flywheel housing

If the timing is late rotate the distributor body in a clockwise direction until the points commence to open. If the timing is early rotate the body in an anti-clockwise direction until the points are completely closed and then rotate the body in a clockwise direction until the points commence to open. Tighten the clamping bolt and re-check the timing with the electrical check as follows.

With the low-tension lead connected to the distributor terminal, connect a 12-volt lamp in parallel with the contact breaker points, one lead being connected to the distributor low-tension terminal and the other to earth. With the ignition switched on the lamp will light as soon as the points open.

SECTION C

THE COOLING SYSTEM

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GENERAL DESCRIPTION

A centrifugal impeller-type water pump is mounted on the front of the cylinder block and is driven in tandem with the fan by a 'V' belt from the crankshaft. Coolant drawn from the radiator by the pump is directed around the injector sleeves in the cylinder head via a gallery in the cylinder block and connecting passages. The cylinders are cooled by a thermo-siphon flow action through connecting holes in the top of the block and the cylinder head.

A thermostat is installed in the outlet pipe, mounted on the front of the cylinder head, to impede the circulation of the water into the radiator until it has reached a predetermined temperature in the cylinder block and so provides a more rapid warming up of the engine.

A drain tap is situated on the left-hand side of the cylinder block.

Air is drawn through the radiator by a two-bladed fan which is mounted on the pump pulley.

Section C.1

ADJUSTING THE FAN BELT

The purpose of the following adjustments is to maintain the performances of the fan, pump, and dynamo at their maximum, and consists of moving the dynamo in relation to the cylinder block to adjust the tension of the belt. Proceed as detailed below.

Referring to Fig. C.1, slacken the dynamo pivot bolts. Support the dynamo with one hand and release the dynamo set bolt and the nut and bolt securing the link to the engine.

Using a hard hand pressure, swing the dynamo away from the side of the cylinder block, thereby taking up any slackness in the belt.

The belt should be adjusted so that when the securing bolts are finally locked up the vertical run of the belt can be pressed in 1 in. (25·4 mm.) at the centre by normal thumb pressure.

NOTE.—It is important that the fan belt is always run taut, as any slackness will cause slip and rapid wear of the belt. Care should also be taken to avoid overtightening the belt, otherwise undue strain will be thrown on the dynamo bearings.

Section C.2

THERMOSTAT

To remove the thermostat first drain the cooling system as instructed in Section C.6.

Disconnect the outlet hose from the outlet pipe.

Release the two bolts and remove the outlet pipe from the thermostat housing. The thermostat may now be lifted out.

A thermostat may be tested by immersing it in water, heating the water, and checking the temperature. The thermostat valve should start to open between 170 and 176° F. (77 and 80° C.) and be fully open at 201° F. (94° C.). If the valve does not open between the given temperatures or if it sticks in the fully open position the thermostat should be renewed. No attempt should be made to repair a faulty thermostat—always fit a new one.

Clean the joint faces of the water outlet pipe and the thermostat housing before refitting the thermostat, which is carried out in the reverse order to the dismantling procedure.

Fit a new joint gasket between the thermostat housing and the outlet pipe.

Section C.3

CHANGING THE FAN BELT

Slacken the two bolts on which the dynamo pivots, release the bolt securing the dynamo to the slotted link, indicated by arrows (Fig. C.1), and move the unit towards the engine.

Withdraw the belt by pressing its outer face into the slot until the belt is clear of the fan blades and then rotate the fan (Fig. C.2).

Check the pulley grooves to ensure that they are quite clean.

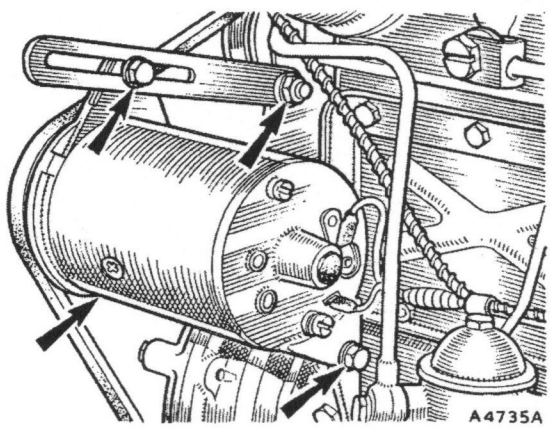

Fig. C.1
Adjusting the fan belt

Feed the new belt through the cowling and over the fan blades and pulley, (Fig. C.2).

Tension the belt as detailed in Section C.1 until there is 1 in. (25·4 mm.) of side movement in the centre of the longest run. Replace the cowl sealing plate.

Check the tension of a new belt after the first day's running.

Section C.4

REMOVING AND REPLACING THE WATER PUMP AND FAN

Drain the cooling system as described in Section C.6.

Remove the radiator case and block as described in Section C.7.

Disconnect the water inlet hose from the pump body.

Slacken the dynamo securing bolts, swing the dynamo towards the cylinder block to release the tension of the belt, and remove the belt.

Support the pump and remove the six bolts securing the impeller housing to the cylinder block. Disengage the fuel filter feed pipe clip and carefully withdraw the complete assembly. Take care of the joint gasket fitted between the pump body and the cylinder block.

Replacement of the water pump and fan is a reversal of the dismantling procedure, but be sure to fit a new one-piece gasket.

Inspect the fan belt carefully for stretching, uneven wear, or frayed fabric and renew it if it shows any of these signs.

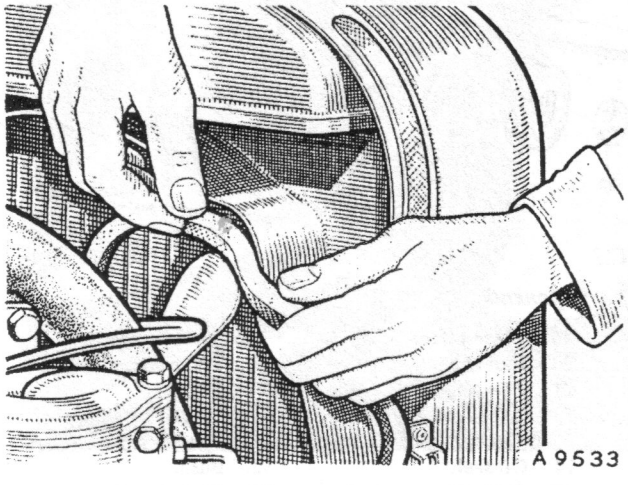

Fig. C.2
Refitting the fan belt

Adjust the fan belt as described in Section C.1.

Apply an oil gun filled with oil to Ref. D (page P.6).

Section C.5

DISMANTLING AND REASSEMBLING THE WATER PUMP

Remove the four bolts and withdraw the nave plate, cap, and fan blades.

Unscrew the four nuts securing the pump body to the impeller housing, carefully break the joint, and withdraw the pump body from the studs.

Hold the pump in a vice with soft-metal or fibre jaws, or on a suitable fixture and prevent movement of the impeller without the risk of damaging it. Extract the split pin from the spindle securing nut, unscrew the nut, and withdraw it together with the plain washer.

Press the spindle to the rear, taking care not to damage the threads, until the spindle circlip behind the end cover is hard against the bearing support and prevents further movement. Gently ease off the end cover and remove the shims.

Remove the key and circlip from the spindle, and withdraw the spindle and impeller assembly to the rear.

NOTE.—On no account should any attempt be made to separate the impeller from the shaft. Should renewal of these parts be necessary a new impeller and shaft assembly must be fitted.

Remove the three bolts securing the bearing support to the pump body and withdraw the support.

Press the water pump seal out of the pump body.

Remove the circlip from the front of the bearing support. Support the fan pulley between two blocks of wood, bearing support downwards, and, using a piece of wood slightly less in diameter than the front end of the bearing support, drive out the support.

Thread the distance collar off the bearing support.

Withdraw the oil seal and remove the circlip securing the bearings in the pulley body.

Press the bearings and distance piece out of the pulley body.

Clean all the dismantled pump parts.

Inspect the spindle and bearing support bush for wear. Ensure that the impeller is secure on the spindle.

Inspect the seals for damage and wear. It is advisable to install new seals whenever the pump has been dismantled.

Inspect the bearings for pits and scores. Renew if evidence of excessive wear is detected.

Reassembly of the fan and pump is a reversal of the dismantling procedure, but particular attention should be paid to the following points.

Replace the rear bearing distance collar with the countersunk bore towards the shoulder of the bearing support. Pack the bearings and bearing housing with grease before assembling onto the bearing support.

If a new spindle and impeller assembly has been fitted check between all the impeller blades and the pump body for a clearance of ·010 in. (·25 mm.) and add or remove end cover shims as required.

Install a new joint gasket between the pump body and the impeller housing.

Section C.6

DRAINING, SERVICING, AND FILLING THE COOLING SYSTEM

Remove the radiator filler cap.

Drain the coolant from the system, using the drain tap on the left-hand side of the radiator bottom tank and the tap on the left of the engine cylinder block at the rear.

The system cannot be drained completely from the radiator tap alone.

If an anti-freeze mixture is used it should be drained into a suitable clean container and kept for future use.

If the flow of water appears to be restricted clear the drain tap apertures with a piece of wire. After the water has ceased to flow turn the engine a few times to ensure that the water pump is drained completely.

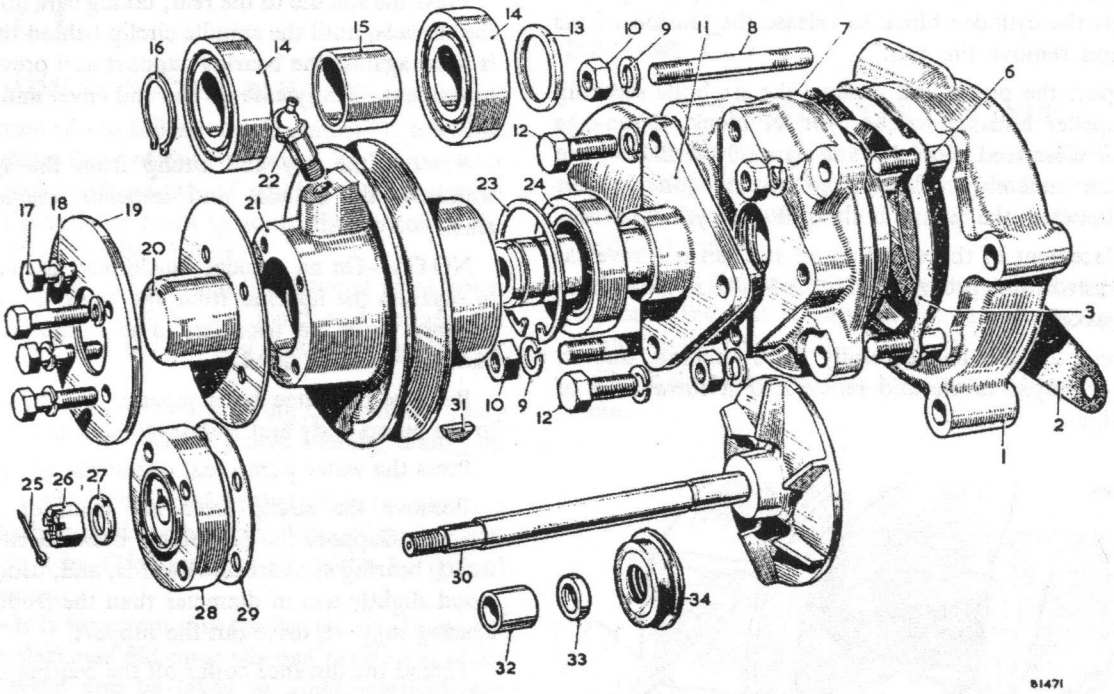

Fig. C.3

The water pump components

1. Impeller housing.
2. Gasket.
3. Gasket.
6. Stud.
7. Pump body.
8. Stud.
9. Spring washer.
10. Nuts.
11. Bearing support.
12. Set bolts.
13. Distance collar.
14. Bearings.
15. Distance piece.
16. Circlip.
17. Set bolt.
18. Spring washer.
19. Nave plate.
20. Fan cap.
21. Fan pulley.
22. Lubricating nipple.
23. Circlip.
24. Oil seal.
25. Split pin.
26. Nut.
27. Plain washer.
28. End cover.
29. Shim.
30. Spindle and impeller.
31. Spindle key.
32. Bush.
33. Sealing ring.
34. Water seal.

It is advisable to prevent the accumulation of sediment by periodically flushing out the cooling system with water fed from a hosepipe inserted into the filler neck while both drain taps are open.

When the system is completely drained and is likely to remain empty for a period turn off the drain taps and place a label on the tractor in a prominent place to indicate that the cooling system is drained. Do not replace the radiator cap until the system has been refilled.

Refill the system through the radiator filler until the coolant is approximately 2 in. (50·8 mm.) from the top of the filler neck. The capacity of the cooling system is 21 pints (12 litres). Whenever possible use clean rain-water.

Avoid overfilling when using anti-freeze to prevent unnecessary loss on expansion.

Screw the filler cap firmly into position.

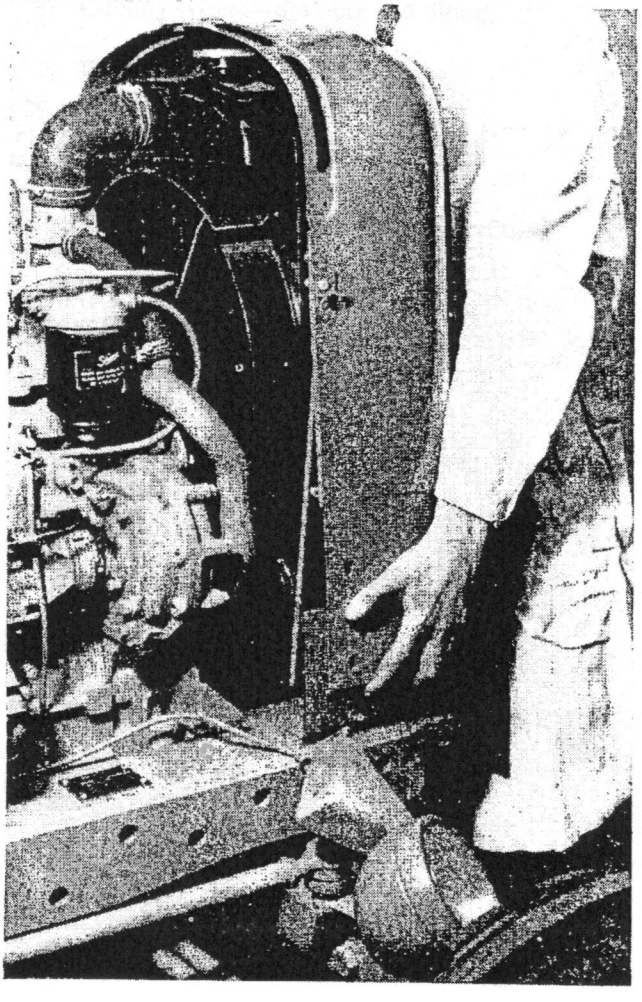

Fig. C.4
Withdrawing the radiator case

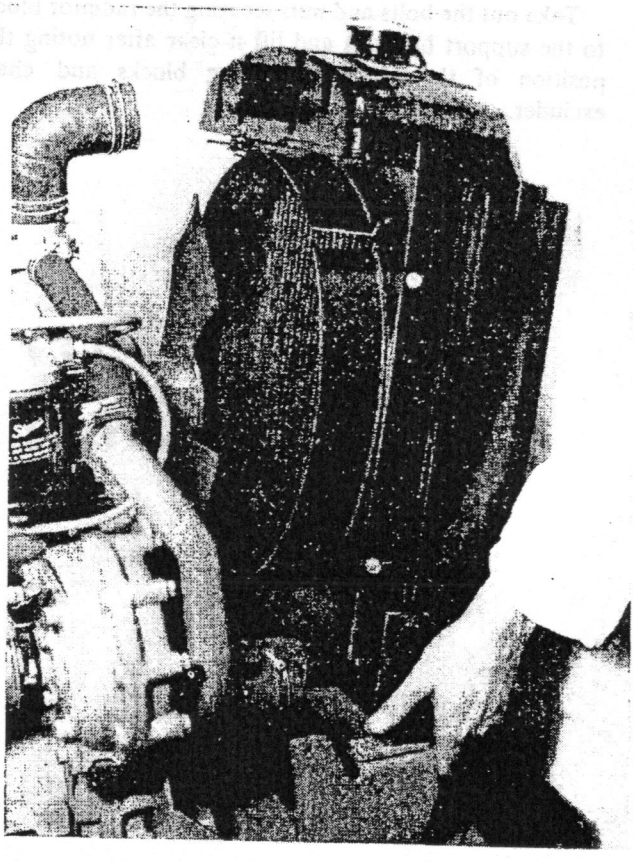

Fig. C.5
Removing the radiator and fan cowl. Note the position of the mounting blocks

Section C.7

REMOVING AND REFITTING THE RADIATOR AND CASE

Lift off the pre-cleaner and extension from the air cleaner.

Unscrew the nut and bolt from the clip securing the silencer and lift off the silencer.

Detach the bonnet by removing the front and rear securing screws.

Disconnect the shutter control rod from the radiator shutters, if fitted, and release the radiator top stay from the rocker cover.

Withdraw the two bolts from each side to release the headlamp, when fitted, and radiator case from the support brackets. Carefully lodge the headlamp and bracket on the main frame. Lift off the radiator case.

Drain the cooling system (Section C.6).

Slacken the clips securing the top and bottom water pipe hoses and free the hoses.

Take out the bolts and nuts securing the radiator block to the support brackets and lift it clear after noting the position of the rubber mounting blocks and chaff excluder.

Store the radiator block in an upright position to prevent the possibility of accumulated sediment in the bottom tank passing into the cooling ducts.

Refitting is a reversal of the dismantling procedure. See Section C.6 on refilling the system.

SECTION CCC

THE COOLING SYSTEM