

SECTION A

THE ENGINE

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GENERAL DESCRIPTION

The four-cylinder, overhead valve engine is built in unit construction with a four-speed gearbox. The four-throw crankshaft is carried in three main bearings which are white-metalled steel shells located by caps. End thrust is taken by a split thrust washer at each side of the rear main bearing. The big-end bearings are also white-metalled steel shells.

The pistons are of aluminium alloy fitted with two compression and two oil control rings. The gudgeon pin is fully floating and located by circlips.

Each camshaft runs in three bearings. The end bearings of both exhaust and inlet camshaft are flanged and bolted to the block; the centre bearing of the exhaust camshaft is a plain bronze bush; the centre inlet camshaft bearing is a split zinc-based alloy bush, the upper half of which is located by an externally accessible set screw, and dowelled to the lower half.

The valves are operated from the camshafts by hollow cylindrical tappets, short push-rods and rockers.

A thermo-siphon cooling system is assisted by a pump, thermostat and six-bladed fan.

THE LUBRICATION SYSTEM

The submerged, self-priming, gear-type oil pump is bolted to the under face of the cylinder block and driven by a skew gear on the inlet camshaft. From the pump, the oil is delivered to a full-flow oil filter and from the filter to the main and big-end bearings. Camshafts, timing chain and rocker-shafts are supplied by means of internal oilways drilled in the crankcase. The pressure relief valve is located in the oil filter body.

The oil filler is on the left-hand rocker cover, the crankcase breather on the left-hand side of the block and the dipstick on the right-hand side.

Section A.1

DRAINING THE ENGINE SUMP

The sump on new and reconditioned engines must be drained and refilled with new oil after the first 500 miles (800 km.) and then at intervals of 3,000 miles (5000 km.). The hexagon-headed drain plug is situated on the right-hand side of the sump. The oil should preferably be drained when the engine is hot, in which condition the oil flows more readily.

Allow the sump to drain for at least ten minutes before the drain plug is replaced. When the sump has been drained, approximately 13 pints (15.6 U.S. pints; 7.4 litres) of oil are required to refill it.

Section A.2

OIL PRESSURE

Under normal running conditions the oil pressure should not drop below 30 lb./sq. in. (2.11 kg./cm.²) on the gauge, whilst approximately 12 lb./sq. in. (.9 kg./cm.²) should be shown when the engine is idling.

Should there be a noticeable lack of pressure, check the following points:—

1. That there is a good supply of the correct grade of oil in the engine sump.
2. That the pump gears are in order and have the correct clearances.
3. That the gauze oil pump filter is clean and not choked with sludge.
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 automatic relief valve deals with any excessive oil pressure when the engine oil is cold.

Cold running and unnecessary use of the mixture control is often the cause of serious oil dilution by fuel, with a consequent drop in pressure.

New engines with new oil will produce considerably higher pressure readings than those given.

Particular attention is called to the recommended change of oil every 3,000 miles (5000 km.). This is a most important factor in attaining long and trouble-free service from the engine. Oil of the correct grade as specified on page P.2 must be used.

Section A.3

REMOVING THE CARBURETTERS

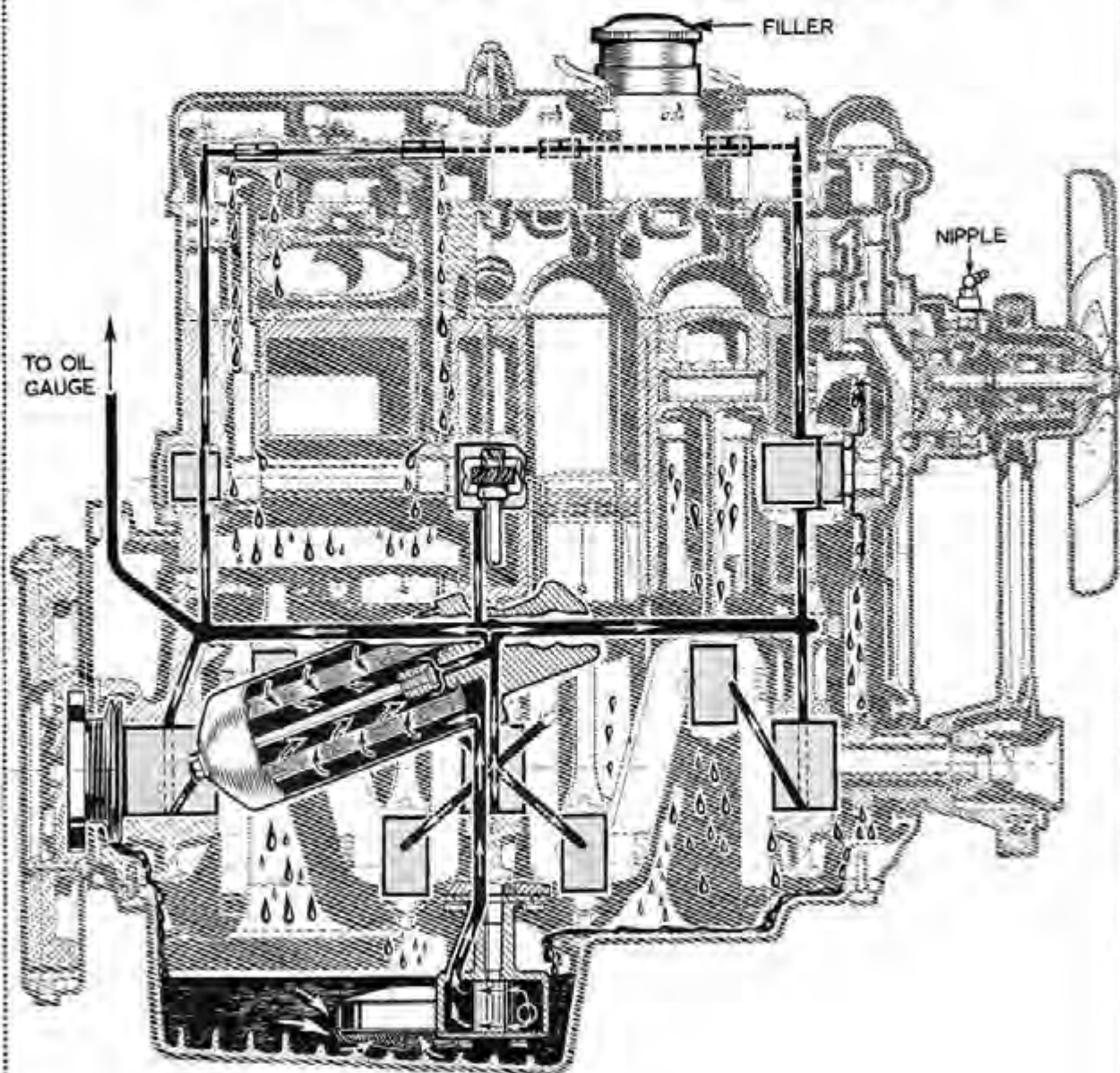
Remove the air silencer and the ignition harness. Unscrew the two set screws and nuts securing the cast aluminium intake pipe to each carburetter.

Disconnect the flexible fuel intake at the T-piece between the float-chambers, and detach the mixture control cable from both carburetter levers.

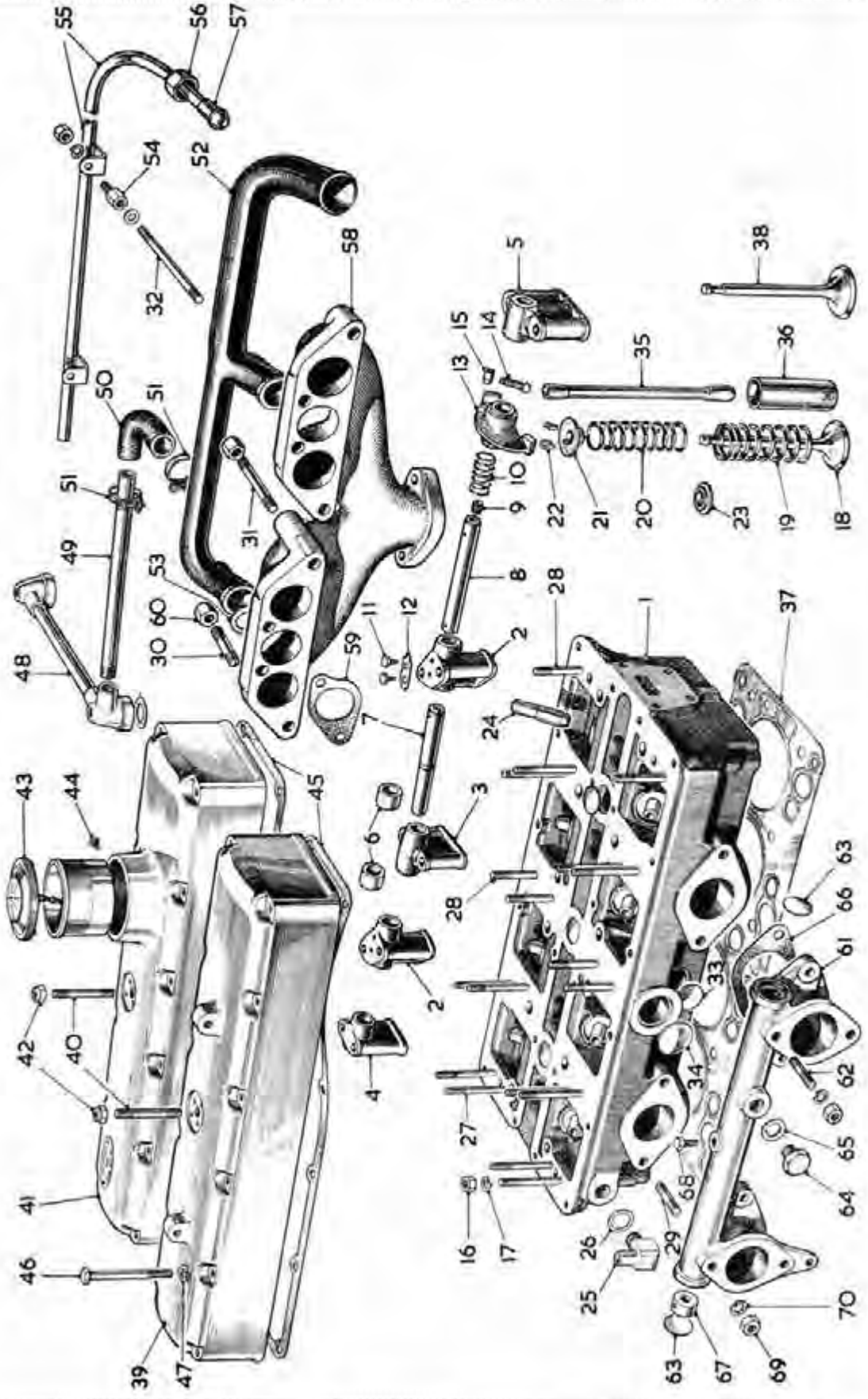
Disconnect the throttle control rod from the rear carburetter, and the hand throttle control cable.

Disconnect the suction pipe from the rear carburetter.

THE ENGINE LUBRICATION SYSTEM



THE CYLINDER HEAD AND COMPONENTS



A THE ENGINE

Unscrew the four flange nuts and remove the two carburettors, with the interconnecting throttle rod, as an assembly.

Replacement is a reversal of the above procedure. Ensure that the gaskets are in good condition.

Section A.4

REMOVING THE FAN BELT AND ADJUSTING BELT TENSION

Disconnect one of the battery leads to prevent any possibility of the engine being started.

Slacken the four dynamo securing bolts and ease the belt over one of the pulleys as the engine is turned slowly.

When the belt is replaced, the dynamo should be gently pulled outwards by hand to give the required belt tension.

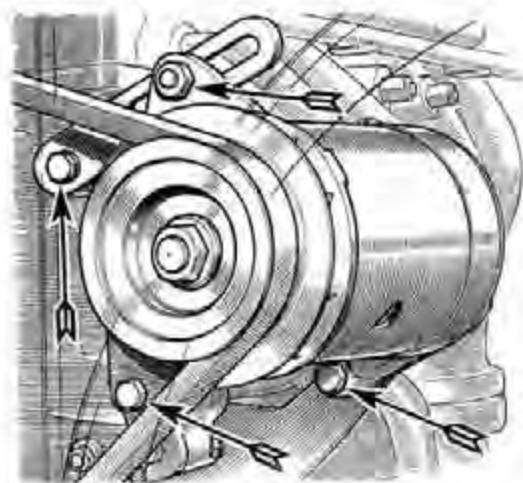


Fig. A.1.

The four dynamo securing bolts are indicated by the arrows.

Section A.5

REMOVING THE EXHAUST MANIFOLD

Drain the water from the cooling system.

Remove the windshield washer fluid container and its bracket.

Slacken the clips and disconnect the water pump outlet hose.

Disconnect the brass heater pipe union and the hose at its rear end.

Unscrew the nuts from the water manifold studs and remove the manifold and heater pipe.

Disconnect the exhaust pipe flange.

Unscrew the eight brass nuts holding the exhaust manifold and lift off the manifold.

Section A.6

REMOVING THE WATER PUMP

Drain the water from the cooling system and remove the radiator as detailed in Section D.2.

Remove the fan belt as in Section A.4.

Disconnect the two hose connections to the pump.

Unscrew the four set screws securing the pump to the timing case cover, and remove the pump impeller housing and fan assembly.

Section A.7

REMOVING THE CYLINDER HEAD

Drain the water from the cooling system.

Remove the air silencer, fume extractor pipe, distributor head and ignition harness.

Remove the carburettors as detailed in Section A.3.

Unscrew the clips and remove the top water hose.

Disconnect the heater hose from the rear right-hand side of the cylinder head.

Unscrew the four set screws securing the water outlet housing on the top of the timing case cover.

Remove the thermometer adaptor from the thermostat housing, and the housing from the cylinder head, with the water outlet housing.

Remove the rocker covers and engine steady. (See Section A.34.)

Remove the exhaust and water manifolds from the head as detailed in Section A.5.

Slightly slacken the cylinder head nuts in the order shown in Fig. A.2 and then fully unscrew and remove them. Break the joint and lift the head slightly, holding it in the lifted position by means of a strip of wood; move each valve rocker to one side and pull out the push-rods. Lift off the head.

The cylinder head is now ready for decarbonisation and valve-grinding as detailed in appropriate sections.

Replacement of the head is a reversal of the above procedure.

Tighten the cylinder head nuts in the order shown in Fig. A.2 to a torque wrench reading of 900 lb. in.

Section A.8

DECARBONISING

Remove the cylinder head as explained in Section A.7.

Take out the valves as indicated in Section A.10.

Lift off the cylinder head gasket, and plug all water holes and the tappet guides with cloth plugs.

Scrape the carbon off the piston crowns, cylinder heads and inlet and exhaust ports. Take care that the pistons are not scratched by the use of a sharp tool.

It is also advisable to polish the *combustion chambers* with emery cloth, but great care must be taken to clean away all traces of abrasive dust.

Never use emery cloth on the piston tops because small abrasive particles will undoubtedly find their way into the cylinder bores.

A ring of carbon should be left on the periphery of the piston crowns by placing a piston ring on the top, and the carbon round the top of the cylinder bores should also be retained intact.

Remove all traces of dust by means of compressed air and then clean well with paraffin (kerosene). Always use a new cylinder head gasket after decarbonising.

Section A.9

REMOVING THE ROCKER GEAR

Remove the air silencer, fume pipe and ignition harness.

Remove the rocker covers.

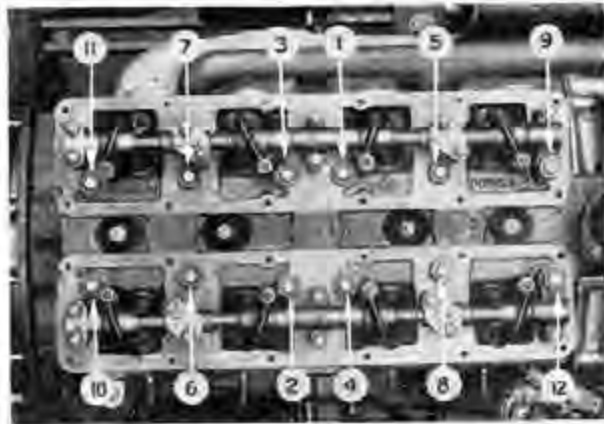


Fig. A.2

The order of tightening the cylinder head nuts.

Depress each valve in turn and remove the push-rod by pushing the rocker to one side.

Slacken the cylinder head nuts slightly in the order shown in Fig. A.2; this is necessary to prevent any possibility of distortion as two of the rocker-shaft studs also secure the head. Remove all the retaining nuts and lift off the rocker-shaft assemblies.

The rockers are bushed and of two types, left-hand and right-hand. Each rocker-shaft is in four sections carried in five pedestals, the sections being located by set screws on the second and fourth pedestals, the front and rear of which are not interchangeable with each other or side for side. They are drilled for rocker lubrication, the oil passing up a hollow stud. Note that flats are machined on the rocker-shafts. These flats must face towards the valves.

Section A.10

REMOVING THE VALVES

The valve springs are retained in position on the valves by means of a cup and split collar.

Compress the valve springs with a suitable compressor and remove the collars; withdraw the springs—inner and outer—and the locating washers.

When replacing, note that the closed coils should be placed towards the cylinder head.

Section A.11

SERVICING VALVES AND SEATINGS

Remove the valves and springs as detailed in Section A.10.

Clean each valve and examine the seat for signs of pitting. If this is apparent the valve must be refaced. The same applies to the cylinder head valve seats and in both cases only enough metal must be removed to give a suitable seat for grinding.

Each valve should be replaced in the port from which it was removed, and when grinding the faces a fine or medium grade carborundum paste should be used.

Place a light coil spring under the head of the valve and use a suction-type grinding tool to give a reciprocating motion to the valve.

An even grey matt finish is desirable and if the seating is too wide it must be reduced to approximately .080 in. (2 mm.) by means of a 45° cutter.

Make sure that no grinding paste remains anywhere on the cylinder head, valves or ports after the valves are ground in.

Section A.12

VALVE GUIDE SERVICE

The valve guides are interchangeable and quite plain without any shoulder. They may be tapped out with a drift, and when fitting a replacement guide the new one should be pressed in until the top is $\frac{1}{16}$ in. (20.64 mm.) above the seat (inlet and exhaust).

The extra length of the exhaust guides should project into the ports.

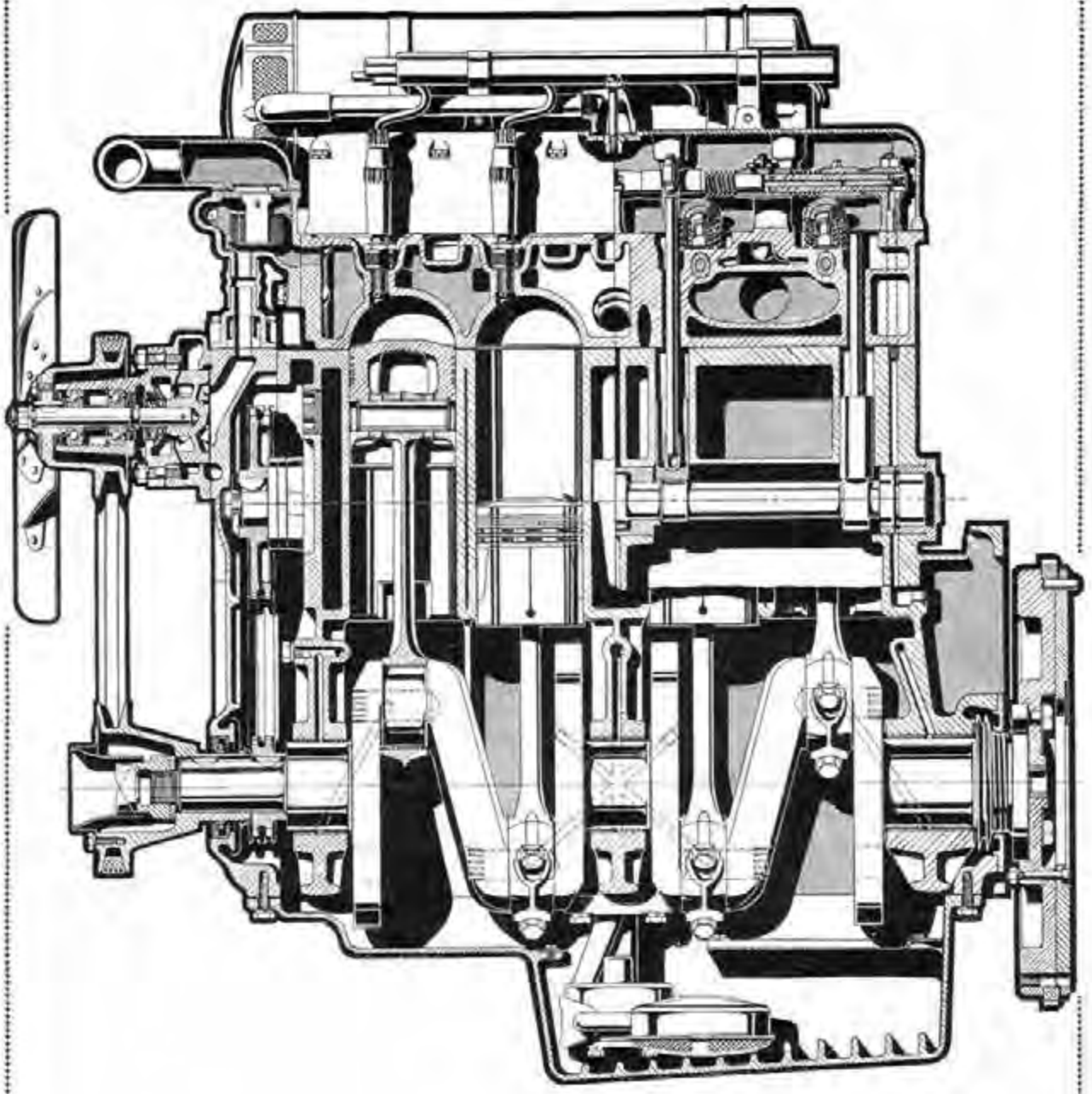
Section A.13

VALVE-ROCKER CLEARANCES

If the engine is in the car, it is first necessary to remove the air silencer, ignition harness, fume pipe, and rocker covers.

A

THE ENGINE (Longitudinal Section)



The tappets are set by screwing the ball-ended adjusting screws in or out as required to give a clearance between the valve and rocker of .011 in. (.28 mm.), for inlet and exhaust valves when the engine is hot.

Section A.14

REMOVING AND REPLACING THE POWER UNIT

Drain the cooling system ; Section D.

Drain the oil from the engine and gearbox.

Remove the bolt from the upper end of the bonnet prop, and the two bolts at each side securing the hinges to the dash ; lift off the bonnet.

Disconnect the battery connections and remove the battery.

Remove the top and bottom radiator hoses and the pipe from the bottom hose to the pump.

Remove the radiator as detailed in Section D.2.

Disconnect the thermometer adaptor from the thermostat housing.

Disconnect the horn, fog lamp and dynamo wires and pull them through the holes in the radiator cradle.

Remove the clevis pin and disconnect the bonnet lock cable at the top of the radiator cradle.

Remove the fan blades.

Unscrew and remove the 12 bolts securing the radiator cradle to the valances and front cross-member ; lift out the cradle.

Remove the starter.

Disconnect the earth strip from the bell housing.

Disconnect the exhaust pipe from the manifold at the flange ; unscrew two bell housing bolts and remove the exhaust pipe bracket.

Remove the air cleaner and disconnect :—

- (a) Hand throttle control wire.
- (b) Mixture control wire.
- (c) Windshield washer suction pipe.
- (d) Brake booster vacuum pipe union.
- (e) Auto advance suction pipe.
- (f) Fuel supply pipe at the union.
- (g) Throttle control rod.

Remove the carburetters and air intake pipe.

Remove the windshield washer fluid container.

Disconnect the oil gauge pipe union on the right-hand side of the block.

Unscrew the brass union nut and disconnect the revolution indicator drive above the oil pump on the right-hand side.

Disconnect the ignition hand control wire from the distributor.

Disconnect the heater pipe from the rear right-hand side of the cylinder head and the heater intake

hose from the copper pipe along the left-hand side of the head.

Unscrew the nuts (upper and lower) from the engine front mountings.

Unhook the clutch return spring and disconnect the adjustable operating rod.

Spring the clutch operating fork from the lever on the clutch housing and withdraw the short forked rod and spring.

Extract the clevis pins securing the gear selector and shifter rods to the bell-crank on the gearbox rear extension ; disconnect the two rods.

Unscrew the two bolts and disconnect the shifter lever at the gearbox extension end ; note the rubbers and the number of spacing washers to facilitate re-fitting.

Extract the clevis pin and disconnect the shifter rod from the gearbox lever.

Remove the engine control link, noting the number of spacing washers fitted. (See Section A.34.)

Disconnect the reverse light wires.

Unscrew the speedometer cable.

Mark the two halves of the universal joint and remove the propeller shaft.

Place a rope around the unit so that when lifted it will hang at an angle of about 15°, downwards from front to rear ; take the weight of the unit on the sling.

Remove the two bolts securing the rear engine mounting to the torsion bar bridge piece, and the single bolt passing through the mounting lug on the gearbox rear extension. (See Section A.34.)

Lift the engine until the sump clears the front cross-member ; it will be necessary to lift the rear end of the rear extension to clear the torsion bar bridge piece.

Replacement is a reversal of the above procedure.

Section A.15

REMOVING THE SUMP

Run the car over a pit or on to a hoist, or jack up the front and support it with blocks beneath the chassis side-members. Drain the engine oil from the sump.

Remove the plug from No. 1 cylinder and turn the engine until the piston is approximately half-way down the bore.

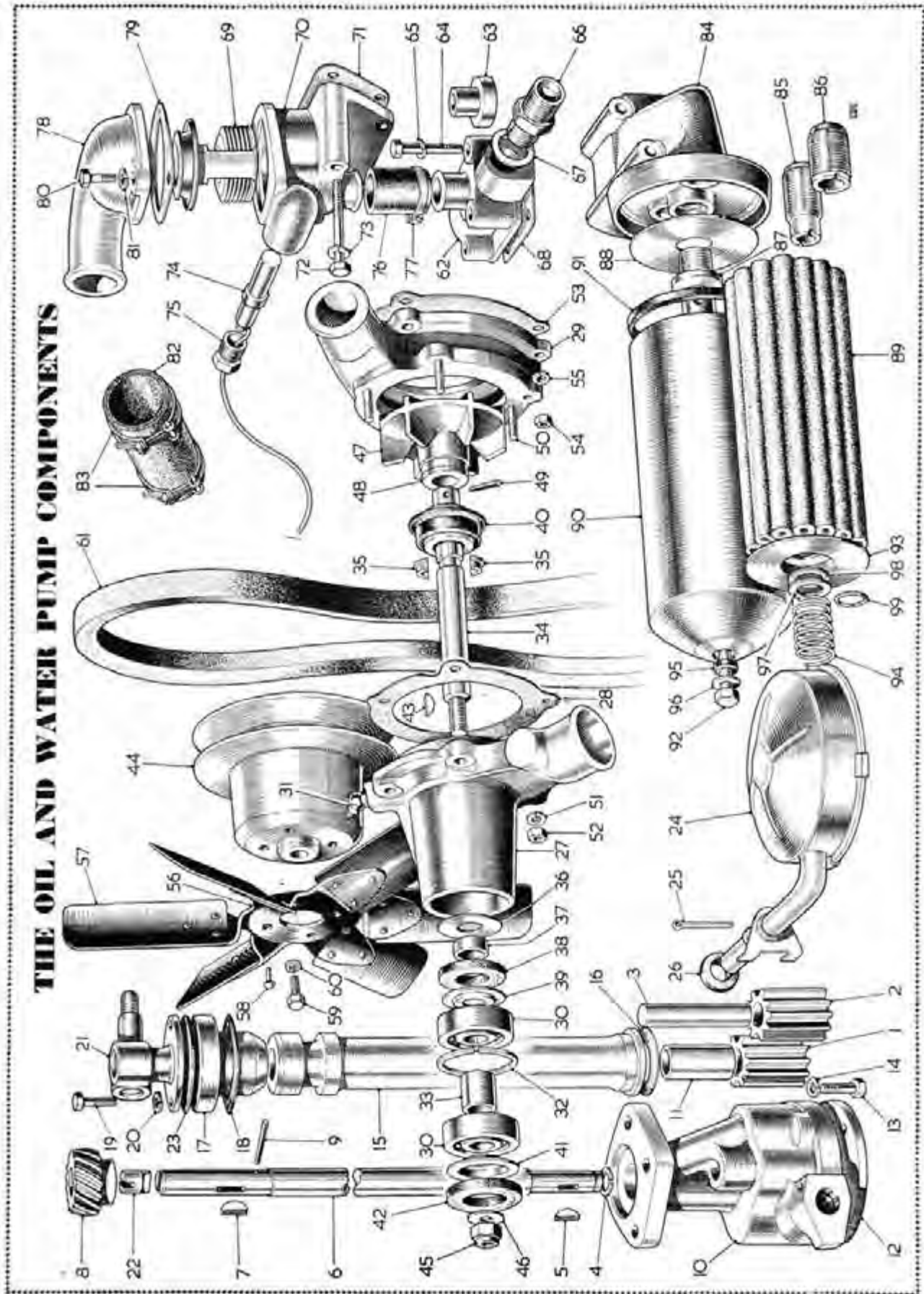
Drain the cooling system and disconnect the top and bottom radiator hoses.

Turn the fan until one of the blades is vertical ; if necessary remove the fan belt.

Disconnect the engine mounting bolts at the front.

Lift the front of the engine until the upper fan blade is just touching the inside surface of the radiator cradle.

THE OIL AND WATER PUMP COMPONENTS



KEY TO THE OIL AND WATER PUMP COMPONENTS

No.	Description	No.	Description	No.	Description
1.	Gear—driver—oil pump.	35.	Collar—split—water pump spindle.	69.	Thermostat unit.
2.	Gear—driven—oil pump.	36.	Excluder—dust (flat).	70.	Housing—thermostat.
3.	Spindle—oil pump driven gear.	37.	Collar—water pump spindle.	71.	Gasket—thermostat housing.
4.	Circlip—oil pump gear.	38.	Packing—water pump dust excluder.	72.	Set screw—long—thermostat housing to cylinder head.
5.	Key—oil pump gear.	39.	Excluder—dust (small).	73.	Washer—spring—thermostat housing set screws.
6.	Shaft—oil pump.	40.	Seal—water pump.	74.	Adaptor—thermometer.
7.	Key—oil pump gear.	41.	Cover—dust excluder (large).	75.	Nut—thermometer adaptor.
8.	Gear—oil pump.	42.	Excluder—dust (large)—fan.	76.	Hose—water pump body to thermostat housing.
9.	Pin—oil pump gear.	43.	Key—Woodruff.	77.	Clip—hose.
10.	Body—oil pump.	44.	Pulley—fan.	78.	Pipe—water outlet to radiator.
11.	Bush—oil pump body.	45.	Nut—fan pulley.	79.	Gasket—water outlet pipe.
12.	Plate—oil pump cover.	46.	Washer—fan pulley nut.	80.	Set screw—water outlet pipe to thermostat housing.
13.	Set screw—oil pump to cover-plate.	47.	Impeller—dual—water pump.	81.	Washer—spring—water outlet pipe set screw.
14.	Washer—spring—oil pump body to cover-plate.	48.	Washer—bronze—impeller.	82.	Hose—water pump to water manifold.
15.	Tube—cover—oil pump driving shaft.	49.	Pin—taper.	83.	Clip—hose.
16.	Washer—cover tube to body.	50.	Stud—impeller housing to water pump body.	84.	Head—oil filter.
17.	Flange—top—oil pump.	51.	Washer—spring.	85.	Valve—assembly—oil relief.
18.	Washer—top—oil pump top flange.	52.	Nut.	86.	Valve assembly—balance.
19.	Set screw—oil pump.	53.	Gasket—impeller housing to block.	87.	Tube—centre.
20.	Washer—oil pump set screw.	54.	Nut—impeller housing to block.	88.	Plate—oil filter clamping.
21.	Tachometer drive unit.	55.	Washer—spring—impeller housing to block.	89.	Element—oil filter.
22.	Coupling—tachometer drive.	56.	Stiffener—fan.	90.	Container assembly.
23.	Washer—tachometer drive unit.	57.	Blade—fan.	91.	Seal—container and head.
24.	Filter—floating—oil.	58.	Rives—fan blade.	92.	Bolt centre.
25.	Pin—split—floating oil filter.	59.	Set screw—fan pulley.	93.	Plate—pressure.
26.	Washer—felt—floating oil filter.	60.	Washer—spring—fan pulley.	94.	Spring—pressure plate.
27.	Body—water pump.	61.	Bolt—fan and water pump.	95.	Washer—sealing.
28.	Gasket—water pump body to impeller housing.	62.	Body—heater connection.	96.	Washer—centre bolt.
29.	Housing—water pump impeller.	63.	Insert—heater body connection.	97.	Washer—pressure plate.
30.	Bearing—fan spindle.	64.	Bolt—heater body connection.	98.	Washer—felt—pressure plate.
31.	Nipple—grease.	65.	Washer—spring—heater body connection.	99.	"C" spring.
32.	Circlip.	66.	Union—heater body connection.		
33.	Tube—distance—water pump bearing.	67.	Washer—heater body connection union.		
34.	Spindle—water pump.	68.	Gasket—heater body connection.		

A THE ENGINE

Unscrew the set screws securing the sump ; lower the back of the sump carefully to avoid damage to the gasket and remove it towards the rear.

Before replacing the sump, make sure that the engine has been set so that the pistons are approximately half-way down the bores or the crankshaft webs may prevent the refitting of the sump.

Fit a new gasket.

Section A.16

REMOVING THE OIL PUMP

Remove the sump as detailed in Section A.15.

Unscrew the two set screws securing the pump to the crankcase and withdraw the pump and floating filter assembly.

The revolution indicator is driven from the upper end of the oil pump drive shaft by a small separate dog which may fall out as the shaft is withdrawn ; it may be extracted after the revolution indicator drive housing has been removed.

Section A.17

DISMANTLING AND REASSEMBLING THE OIL PUMP

Remove the oil pump as detailed in Section A.16, withdraw the split pin, and remove the oil pump pick-up.

Next take off the bottom cover and tap the shaft downwards so that the gear is exposed. Tap the driving gear down the shaft to a collar to give access to the retaining split ring and extract the split ring holding the driving gear in position. Pull off the gear wheel and remove the Woodruff key, then pull out the shaft.

The skew gear at the top of the driving shaft is keyed and pinned in position. The bush is pinned in position.

The driven gear is bushed and runs on a spindle which is pressed into the pump body.

To check the gear clearances, the pump body, gears and shaft should be cleaned carefully and reassembled 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 gears by placing a straight-edge across the face of the pump body, and measuring the clearances with feelers. This should not be more than .003 in. (.08 mm.).

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

When refitting the cover-plate, note that the tapped holes are not symmetrically placed, and the cover-plate can therefore only be replaced one way.

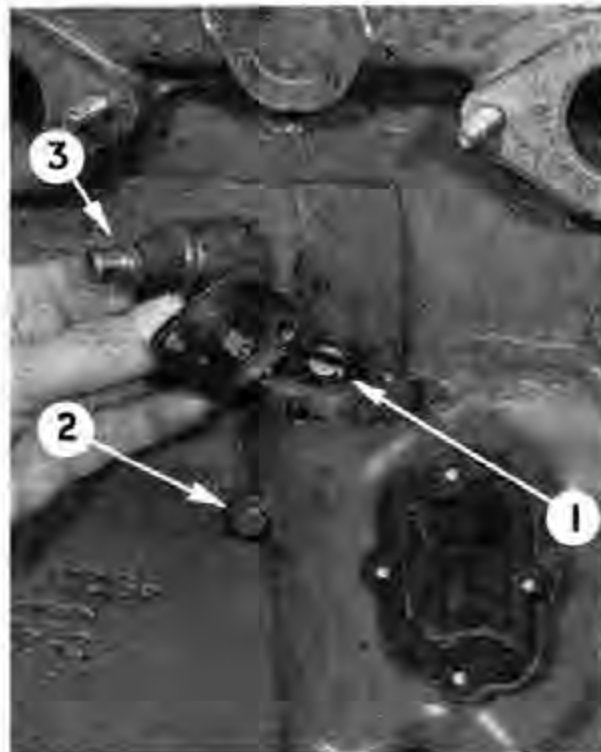


Fig. A.3.

1 and 3 are the revolution indicator drive dog and housing respectively, 2 is the camshaft bearing locating screw.

It is advisable to clean the pick-up gauze with petrol (gasoline) and a stiff brush (do not use rag), before reassembly. Allow it to dry thoroughly before replacing it.

Section A.18

REMOVING THE CRANKSHAFT PULLEY

Remove the radiator as detailed in Section D.2.

Remove the fan belt as in Section A.4.

Raise engine as in Section A.15.

Unscrew the four starting handle guide set screws and withdraw the guide.

Unscrew the starting dog with a suitable tubular spanner, and pull off the pulley.

Section A.19

REMOVING THE TIMING CASE COVER

Remove the radiator and radiator cradle as detailed in Section A.14.

Slacken the dynamo mounting bolts and remove the fan belt ; remove the dynamo.

Disconnect the hose from the water pump outlet, and the heater pipe union.



Fig. A.4.

It is necessary to remove the water pump before the timing case cover. 1 is the heater union, and 2 the water outlet housing.

Remove the thermometer adaptor from the thermostat housing ; unscrew the four water pump securing nuts and the set screws securing the thermostat housing and water outlet housing ; remove the pump, outlet and thermostat housings as an assembly.

Unscrew the front engine mounting nuts and lift the engine at the front until there is clearance for the crankshaft pulley to be withdrawn. Block up the front of the engine in this position.

Unscrew the four starting handle guide set screws from the crankshaft pulley and withdraw the guide.

Insert a tubular spanner into the pulley and unscrew the starting dog ; withdraw the pulley with a suitable puller, taking care not to damage the pulley flanges. Note the spacing washers behind the starting dog and preserve them for replacement.

Unscrew the nuts and withdraw the cover.

Section A.20

REMOVING AND REPLACING THE TIMING CHAIN

Remove the timing case cover.

Cut the locking wires and remove the two tensioner ratchets ; wedge the tensioner wheel in its extreme position with the special wedge.

Knock up the locking tabs securing the camshaft chain wheel set screws ; unscrew the set screws and withdraw one of the chain wheels. The chain may then be lifted off.

When replacing the chain, set the three chain wheels with the keys at the top. The chain is provided with three bright links to facilitate timing and these links must coincide with the letter "T" which will be found stamped on each chain wheel. With the keys at the top as above, the camshaft wheel marks will also be at the top and the mark on the crankshaft wheel at the bottom.

Section A.21

REMOVING THE CRANKSHAFT CHAIN WHEEL

With the timing chain removed as in Section A.20, the crankshaft chain wheel can be removed by the use of a suitable puller. The shaft is parallel and the wheel is held by a Woodruff key.

Section A.22

REMOVING THE CHAIN TENSIONER

Remove the timing case cover as in Section A.19.

Cut the wires and take out the screws securing the two ratchets. Remove the pawls, taking care not to lose the spring. Unscrew the two screws and remove the pawl carrier.

Slide the wheel and hub from the tensioner block ; the block is secured by two set screws, locked by tab washers.

Section A.23

REMOVING THE CAMSHAFTS

Remove the cylinder head and the timing chain as detailed in the appropriate sections.

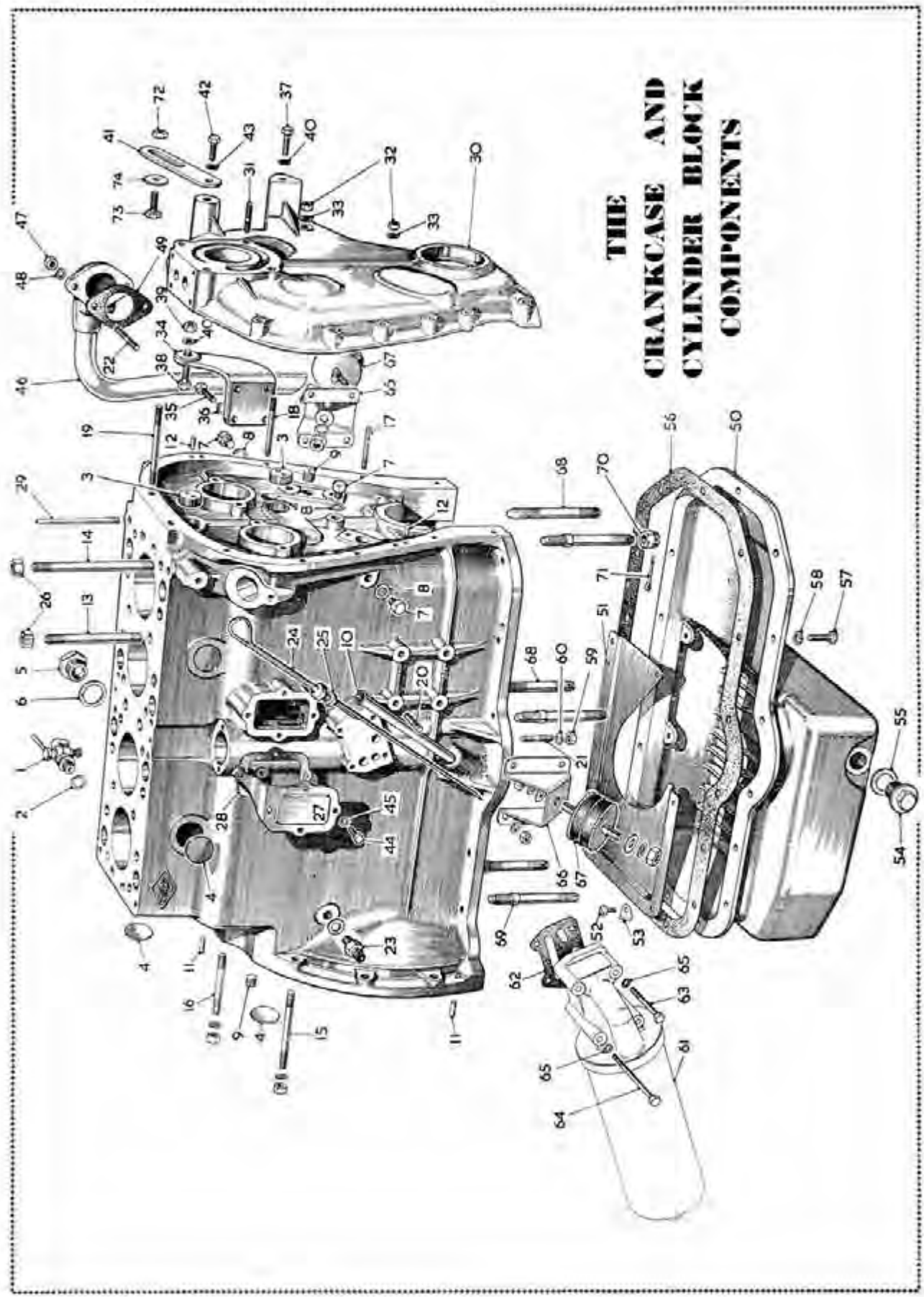
Withdraw the tappets through the top, taking care to mark them for subsequent reassembly in the same positions.

Remove the inlet camshaft centre bearing inspection cover and the bearing set screw from the right-hand side of the block.

Unscrew and remove the setscrews locating the camshaft front bearings and withdraw the camshafts and bearings. The inlet camshaft centre bearing is in two halves dowed together ; these may be collected as the shaft is removed, through the inspection cover.

The rear camshaft bearings can be withdrawn after the retaining set screws are removed.

THE CRANKCASE AND CYLINDER BLOCK COMPONENTS



KEY TO THE CRANKCASE AND CYLINDER BLOCK COMPONENTS

No.	Description	No.	Description	No.	Description
1.	Tap—cylinder block drain.	25.	Washer (felt)—oil level indicator.	49.	Gasket—crankcase breather.
2.	Washer—cylinder block drain tap.	26.	Nut—cylinder head stud.	50.	Sump assembly—crankcase oil.
3.	Plug—water jacket.	27.	Cover—camshaft inspection.	51.	Plate—sump baffle.
4.	Plug—welch.	28.	Gasket—camshaft inspection cover.	52.	Set screw—sump baffle plate.
5.	Plug—oil gallery—centre.	29.	Stud—rocker lubrication.	53.	Tab washer—sump baffle plate.
6.	Washer—oil gallery plug—centre.	30.	Cover assembly—timing.	54.	Plug—sump drain.
7.	Plug—oil gallery.	31.	Stud—timing cover to impeller housing.	55.	Washer—sump drain plug.
8.	Washer—oil gallery plug—plain.	32.	Nut—block to timing cover studs.	56.	Gasket—oil sump.
9.	Plug—oil gallery.	33.	Washer—spring.	57.	Bolt—sump to block.
10.	Guide—oil level indicator.	34.	Bracket—dynamo support—rear.	58.	Washer—spring—sump to block.
11.	Dowel—crankcase and bell housing.	35.	Screw—dynamo rear support bracket.	59.	Nut—oil pump body.
12.	Dowel—timing cover.	36.	Washer—spring—dynamo rear support bracket.	60.	Washer—spring—oil pump body.
13.	Stud—cylinder head—short.	37.	Bolt—dynamo front pivot.	61.	Filter—oil.
14.	Stud—cylinder head—long.	38.	Bolt—dynamo rear pivot.	62.	Joint—oil filter.
15.	Stud—bell housing—long.	39.	Nut—dynamo pivot bolt.	63.	Bolt—short—oil filter.
16.	Stud—bell housing—short.	40.	Washer—spring—dynamo pivot bolts.	64.	Bolt—long—oil filter.
17.	Stud—timing cover—short.	41.	Link—dynamo adjusting.	65.	Washer—spring—oil filter bolt.
18.	Stud—timing cover—long.	42.	Screw—dynamo adjusting link—to block.	66.	Bracket—engine mounting.
19.	Stud—timing cover.	43.	Washer—dynamo adjusting link.	67.	Mounting—engine—front.
20.	Stud—engine mounting.	44.	Set screw—camshaft inspection cover.	68.	Stud—crankshaft front and centre bearing cap.
21.	Stud—oil pump body.	45.	Washer—spring—camshaft inspection cover.	69.	Stud—crankshaft rear bearing cap.
22.	Stud—crankcase breather.	46.	Body and pipe—crankcase breather.	70.	Nut—crankshaft main bearing caps.
23.	Union—oil gauge.	47.	Nut—crankcase breather.	71.	Split pin—crankshaft main bearing caps.
24.	Indicator—oil level.	48.	Washer—spring—crankcase breather.		

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Section A.24

REMOVING A PISTON AND CONNECTING ROD

Remove the cylinder head and sump as detailed in Sections A.7 and A.15.

Tap up the locking tabs and remove the big-end bolts and caps. Push the assemblies up through the bores and remove from the engine.

Note that the caps and rods must be replaced in the bores from which they are removed, and that they are not marked. The pistons, however, are marked with the number of the bore and the word "Front" so that they may be refitted to the bores correctly.

Section A.25

REMOVING PISTON RINGS

If no special piston ring remover 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 ring and piston. Rotate the strip round the piston, applying slight upwards 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.

Do not remove the piston rings downwards over the skirt of the piston.

Before fitting new piston rings the grooves in the piston must be scraped clean of any carbon deposit, taking care not to remove any metal, since play between the ring and the groove reduces gas tightness 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 in order to check for correct clearance at the ends.

To do this effectively the piston should be inserted approximately 1 in. (2.5 cm.) down the cylinder and each ring then pushed down on to the top of the piston and held there in order to keep the ring square with the bore.

The end gap should be between .009 in. and .014 in. (.28 mm. and .35 mm.).

Section A.26

FITTING A GUDGEON PIN AND REPLACING A PISTON

The gudgeon pin is a push-fit in the small end bush and a light drive-fit in the piston at room temperature. Support the piston while driving in the gudgeon pin

so that it is not damaged, and fit only circlips in good condition, making sure that they are fully seated in the grooves.

Use a piston ring compressor when entering the assembly in the bore.

Section A.27

REMOVING THE CRANKSHAFT

Take out the engine unit as described in Section A.14.

Drain and remove the sump as indicated in Section A.1.

Take off the gearbox. (See Section F.1.)

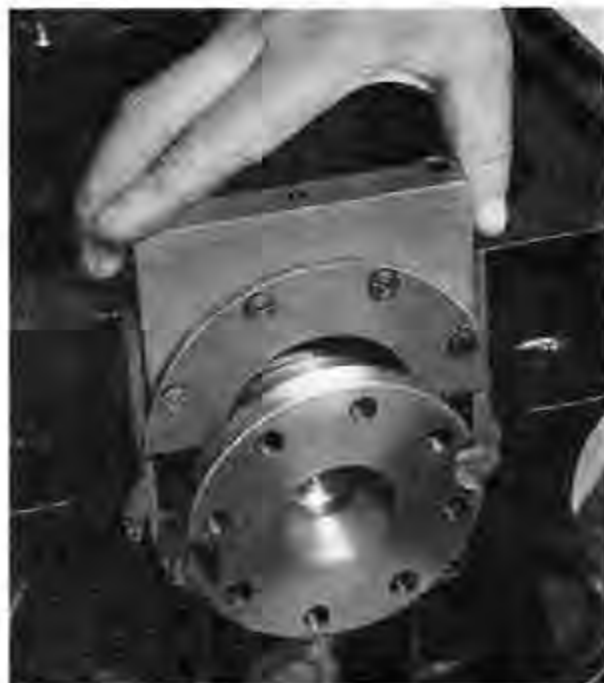


Fig. 5.
The split sealing plate.

Remove the flywheel and clutch as described in Sections A.29 and A.30.

Disconnect the connecting rods from the crankshaft. (See Section A.24.)

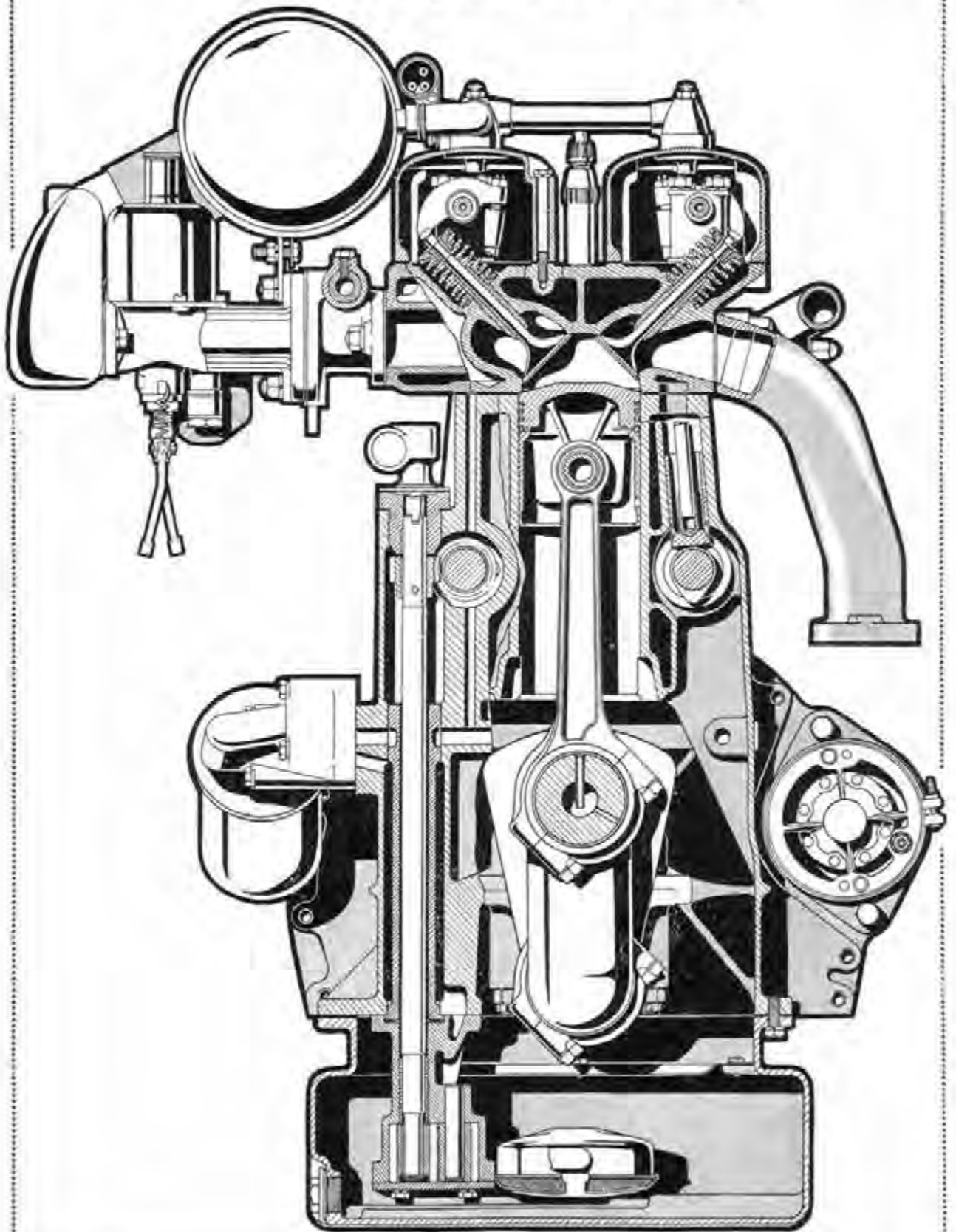
Remove the crankshaft pulley. (See Section A.18.)

Take off the timing chain cover (Section A.19) and remove the timing chain. (See Section A.20.)

Take out the split pins from the main bearing cap nuts and undo the nuts.

Lift off the bearing caps, noting that they are marked for subsequent correct assembly, and detach the split sealing plate at the rear. This is held by two long screws with tapered heads.

Lift out the crankshaft.

THE ENGINE (Transverse Section)

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Section A.28

REMOVING AND REPLACING MAIN BEARINGS

The three main bearing caps are secured with split-pinned nuts and are marked 1, 2 and 3.

To remove the bearings, take out the split pins and remove the castellated nuts. Lift off the caps and extract the crankshaft. The tabbed, white-metalled shells are then removable.

Replacement bearings do not require fitting.

Make sure the locating tabs are correctly positioned before refitting the crankshaft and bearing caps.

Section A.29

REMOVING THE CLUTCH

Remove the power unit. Section A.14.

Remove the gearbox. Section F.1.

Unscrew the set screws securing the clutch to the flywheel a little at a time until they are extracted. Lift off the clutch, having marked it for replacement in the same position.

Section A.30

REMOVING THE FLYWHEEL

Remove the clutch. Section A.29.

Bend up the locking tabs and unscrew the set bolts securing the flywheel to the crankshaft.

Withdraw the flywheel from the spigot.

When replacing the flywheel, set the crankshaft in the top dead centre position for 1 and 4 cylinders and the mark on the flywheel rim at the top.

Section A.31

REGROUNDING THE CRANKSHAFT

.020 in. and .040 in. undersize bearings are available for reground crankpins and journals.

Section A.32

LOCATING TROUBLES

Engine will not start

A. If the starter will not turn the engine, check the following:—

1. Battery discharged, and/or defective.
2. Disconnected or broken leads.

3. Faulty starter switch.
4. Faulty starter motor.
5. Starter cables shorting to earth.
6. Battery terminals badly corroded or battery leads loose.

B. If starter turns engine very slowly, check:—

1. Partly discharged battery.
2. Loose terminals or connections.
3. Dirty or corroded connections.
4. Faulty insulation on starter cables.
5. Tightness in engine.
6. Faulty starter brushes.

C. If starter turns engine smartly, but the engine will not fire, check:—

1. Plugs not sparking.
2. Spark at the coil. If the coil gives a good spark, check:—
 - (a) Gaps in plugs too wide or too close.
 - (b) Plugs oiled up.
 - (c) Plug insulators damaged, or excessively dirty.



Fig. A.6.

A general view of the crankcase, oil pump, etc.

3. If poor spark at coil, check:—
 - (a) Low-tension or high-tension leads from coil to distributor loose or corroded.
 - (b) Distributor points dirty, worn or out of adjustment.
 - (c) Carbon brush not making contact.
 - (d) Rotor cracked.
 - (e) Faulty condenser (substitute a condenser known to be in order).
 - (f) Faulty coil (substitute a coil known to be in order).

4. Check the carburetters for fuel supply. If no fuel in the float-chambers, check:—
 - (a) Functioning of the fuel pump.
 - (b) Air leak in pipe line, indicated by rapid action of the pump.
 - (c) Float-chamber needles sticking.
5. If fuel is reaching the float-chambers, check:—
 - (a) For choked jets.
 - (b) Water in the fuel.
 - (c) Dirt in the carburetters.
 - (d) Air leak in induction system.
 - (e) Check adjustment of carburetter controls.

If engine starts, but runs erratically

- A. Check the following ignition points:—
 1. Loose high-tension leads to sparking plugs.
 2. Incorrect setting of plug points.
 3. Damaged plug or moisture on plugs.
 4. Loose connection on battery or in ignition circuit.
 5. Faulty high-tension leads.
 6. Battery charge low.
 7. Battery connections faulty.
 8. Defective contact breaker.
 9. Defective distributor.
 10. Faulty condenser.
- B. Check the following carburetter points:—
 1. Water in float-chambers.
 2. Choked filters in carburetters or fuel pump, indicated by slow pumping of fuel pump.
 3. Action of fuel pump. Suspect if sluggish.
 4. Jet partially choked.
 5. Carburetter or carburetters, set too rich, indicated by sooty exhaust.
 6. Vents on fuel tank filler caps choked.
 7. Obstruction in fuel feed pipe.
 8. Air leak into induction system.
- C. Check the following mechanical points:—
 1. Sticking valves.
 2. Incorrect valve clearance.
 3. Burnt or broken valves.
 4. Incorrect valve timing.
 5. Incorrect ignition timing.
 6. Broken or weak valve spring.
 7. Valve guides worn, causing air leaks.
 8. Cylinder head gasket for leaks.
 9. Back pressure due to damaged exhaust system.

If engine starts and stops

- A. Check the following ignition points:—
 1. Loose low-tension leads.
 2. Loose distributor clamp screw.
 3. Faulty ignition switch contact.
- B. Check the following carburetter points:—
 1. Incorrect setting of carburetter controls.
 2. Blocked fuel pipe.
 3. Water in float-chambers.
 4. Sticking needle valve.
 5. Fuel pump failing to function regularly.
 6. Air leak into fuel line.
 7. Fuel level low in tank.

If engine will not idle or run slowly

- A. Check the following carburetter points:—
 1. Throttle stop screws incorrectly set.
 2. Hand throttle control requires adjustment.
 3. Throttle controls incorrectly set.
 4. Weak mixture or over-rich mixture.
 5. Faulty functioning of fuel pump.
- B. Check the following mechanical points:—
 1. Sticking valves.
 2. Incorrect valve tappet clearance.
 3. Air leak in induction system.
 4. Burnt or broken valves, indicated by loss of compression.
 5. Broken valve spring.
 6. Damaged cylinder head or gasket.
- C. Check the following ignition points:—
 1. Loose high-tension leads.
 2. Incorrect setting of plug points.
 3. Damaged plugs or moisture on plugs.
 4. Loose connections on battery or in ignition circuit.
 5. Faulty high-tension leads.
 6. Battery charge low.
 7. Battery connections faulty.
 8. Defective contact breaker, or burnt points.
 9. Defective distributor.
 10. Defective condenser.

Engine fails to give full power

- A. Check the following carburetter points:—
 1. Faulty or insufficient fuel supply.
 2. Air leaks in induction pipe or fuel pipe.
 3. Partly choked jet or jets.

ENGINE COMPONENTS (Internal)



KEY TO THE ENGINE COMPONENTS (INTERNAL)

No.	Description	No.	Description	No.	Description
1.	Bearing—front and centre (std.).	33.	Ring—scraper.	62.	Rivet—chain vibration damper pad.
2.	Cap—crankshaft front and centre bearing.	34.	Ring—gudgeon pin.	63.	Set screw—chain vibration damper bracket.
4.	Bearing—rear—complete (std.).	35.	Circlip—gudgeon pin.	65.	Shank—adjuster.
5.	Cap—crankshaft rear bearing.	36.	Bearing—front—inlet camshaft.	66.	Plate—adjuster end.
6.	Plate—crankshaft rear bearing cap.	38.	Bearing—rear—inlet camshaft.	67.	Plate—adjuster retaining.
7.	Seal—crankshaft rear main bearing.	39.	Bearing—front—exhaust camshaft.	68.	Screw—cheese-head—adjuster.
9.	Set screw—cap plate.	40.	Bearing—centre—exhaust camshaft.	69.	Peg—adjuster pawl.
10.	Screw—cap plate.	41.	Bearing—rear—exhaust camshaft.	70.	Wheel—adjuster sprocket.
11.	Retainer—oil—cap plate.	42.	Camshaft—inlet.	71.	Spring—adjuster slide block.
12.	Crankshaft (new) with main bearings.	43.	Camshaft—exhaust.	72.	Spring—adjuster pawl.
13.	Key—woodruff—crankshaft.	44.	Plate—thrust—camshaft front.	73.	Block—adjuster slide.
14.	Washer—crankshaft pulley nut.	45.	Key—camshaft.	74.	Tab washer—connecting rod bolt.
15.	Thrower—crankshaft oil.	46.	Wheel—timing—camshaft.	75.	Bearing complete—connecting rod (std.).
16.	Pulley—crankshaft.	47.	Wheel—timing—crankshaft.	76.	Set screw—chain adjuster.
18.	Plug—journal.	49.	Lock washer—front camshaft bushes.	77.	Tab washer—chain adjuster set screw.
19.	Plug—blanking.	50.	Set screw—front camshaft bushes.	78.	Bearing—centre (top half)—inlet camshaft.
20.	Plug—oil way.	51.	Set screw—rear camshaft bushes.	79.	Bearing—centre (bottom half)—inlet camshaft.
21.	Nut—crankshaft pulley.	52.	Washer—camshaft rear bushes.	80.	Dowel—inlet.
22.	Rod—connecting—assembly (std.).	54.	Washer—retaining—camshaft.	81.	Lockpin—inlet camshaft bearing.
24.	Bush—connecting rod.	55.	Set screw—camshaft.	82.	Washer—camshaft bearing lockpin.
25.	Bolt—connecting rod.	56.	Lock washer—camshaft set screw.	83.	Washer—thrust—rear bearing.
27.	Set screw—starting handle guide.	57.	Chain—timing.	84.	Seal—crankshaft oil—front.
30.	Piscon—with rings and pin.	58.	Adjuster—timing chain.	85.	Shim—crankshaft nut.
31.	Pin—gudgeon.	60.	Bracket—chain vibration damper.	86.	Guide and flange—starting handle.
32.	Ring—compression.	61.	Pad—chain vibration damper bracket.		

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- B. Check the following mechanical points:—
1. Incorrect valve tappet clearance.
 2. Burnt valve or badly seating valve.
 3. Cylinder head stud nuts not tight.
 4. Damaged cylinder head gasket.
 5. Valve timing incorrect.
 6. Broken or weak valve spring.
 7. Excessive carbon deposit.
 8. Excessively worn pistons and cylinders.
- C. Check the following ignition points:—
1. Ignition retarded too far.
 2. High-tension leads shorting, or loose.
 3. Dirty sparking plugs.
 4. Sparking plug points incorrectly set.
 5. Contact breaker points incorrectly set.
 6. Contact breaker points pitted.
 7. Faulty coil.
 8. Faulty condenser.
 9. Low-tension connection or leads faulty.
 10. Battery run down or faulty.

Engine knocks

Check the following:—

1. Ignition timing too far advanced.
2. Excessive carbon deposit.
3. Fuel unsuitable or mixture weak.
4. Loose or worn bearings or pistons.
5. Defective or unsuitable plugs.
6. Valve timing incorrect or tappet clearance incorrect.

Engine backfires

- A. Check the following ignition points:—
1. High-tension cables defective or connections loose.
 2. High-tension leads incorrectly fitted.
 3. Low-tension wiring defective or connections loose.
 4. Switch contact faulty.
 5. Distributor gap incorrect or points pitted or dirty.
 6. Contact breaker arm sticking or defective.
 7. Distributor cover cracked or loose.
 8. Distributor not correctly timed.
 9. Rotor carbon brush pick-up defective or worn.
 10. Clearance between rotor arm and distributor studs excessive.
 11. Coil defective or wet.
 12. Defective condenser.
 13. Plugs overheated, unsuitable, or points incorrectly set.

- B. Check the following carburation points:—
1. Jets choked or restricted.
 2. Jets incorrectly set, causing weak mixture.
 3. Water in fuel.
 4. Choked fuel filters.
 5. Inlet manifold joint leaking, or manifold cracked.
 6. Air cleaner passages blocked.
 7. Engine running temperature too cold.
 8. Throttle not closing completely (indicated by engine backfiring when proceeding downhill with throttle shut).
- C. Check the following mechanical points:—
1. Valve timing incorrect.
 2. Valve tappet clearance incorrectly set.
 3. Valve sticking.
 4. Valve seats pitted or faulty.
 5. Valve spring weak or broken.
 6. Valve guides excessively worn, causing air leaks.
 7. Excessive carbon deposit.

Section A.33

PISTON SIZES AND CYLINDER BORES

It is necessary to fit new pistons by selective assembly, and to facilitate this the pistons are marked on their crowns with identification figures which must correspond with those of the cylinders to which they are fitted.

The actual bore dimensions of each cylinder are stamped on the top face of the cylinder block on the front right-hand corner by the appropriate symbol:—

S.T.D., indicating that the cylinder bore is of standard diameter, i.e. possesses an actual diameter of 3.1693 in. (80.5 mm.).

+0005, indicating that the cylinder bore is oversize to the extent of +0005 in., and thus possesses an actual dimension of 3.1698 in. (80.5129 mm.).

+001, indicating that the cylinder bore is oversize to the extent of +001 in. and thus possesses an actual dimension of 3.1703 in. (80.525 mm.).

+0015, indicating that the cylinder bore is oversize to the extent of +0015 in. and thus possesses an actual dimension of 3.1708 in. (80.5383 mm.).

The pistons are marked with the actual cylinder bore size, the requisite running clearance being allowed for in the machining.

Thus those marked +001 in. should be fitted to bores marked +001 in. and so on throughout the range covered.

When the cylinder head is removed and the pistons withdrawn, the cylinder bores should be measured for wear. Indication that a rebore of the cylinders is necessary is given by general loss of performance, oiling up, and poor compression, and is confirmed by measurement of the bores.

Rebores

Four ranges of rebore sizes are provided and cylinders must only be rebored to one of these sizes to ensure the supply of the correct pistons

To provide the normal machining tolerance, oversize pistons are available which are .0005 in., .001 in. and .0015 in. (.0125 mm., .025 mm. and .0375 mm.) larger in diameter than the standard rebore sizes.

The four standard oversizes for rebores are:—
 +.010 in. (.25 mm.) [actual bore 3.1793 in. (80.75 mm.)]
 +.020 in. (.50 mm.) [actual bore 3.1893 in. (81 mm.)]
 +.030 in. (.75 mm.) [actual bore 3.1993 in. (81.25 mm.)]
 +.040 in. (1.00 mm.) [actual bore 3.2093 in. (81.5 mm.)]
 and oversize pistons are available for the above rebore sizes in the following range: +.0005 in., +.0010 in., +.0015 in.

There are thus twenty piston sizes available for replacement purposes as tabulated.

Section A.34

FITTING AN ENGINE STEADY

If judder is experienced in taking up the drive, it can be overcome by the addition of an engine steady between the rocker cover, and an improved rear engine mounting bracket.

The parts required are listed on page A.24.

Disconnect the battery, remove the blower motor and the windshield wiper motor.

Remove the four rear inner rocker cover bolts.

Offer up the bracket to the valance and position it so that the rearmost holes are 1½ in. (38.1 mm.) forward of the face of the dash, then drill through the valance in six places with a 3/8 in. drill using the bracket as a jig.

Assemble the tie-rod with rubber bushes, cup washers and nuts to the engine steady bracket. The rubber bushes must not be unduly compressed.

Remove the plug lead to number 4 cylinder and fit the bracket and tie-rod assembly to the rocker cover using new rocker cover bolts.

Clean away sound proofing material around the holes on the underside of the valance.

Thread on to the tie-rod, the locknut, plain nut, cup washer and rubber bush in that order. Insert the tie-rod through the hole in the valance bracket and

STANDARD

Piston Marking	Bore Size	Metric Equivalent
To suit standard bore ...	3.1693 in. 3.1697 in.	80.5002 mm. 80.5104 mm.
To suit +.0005 in. bore ...	3.1698 in. 3.1702 in.	80.5129 mm. 80.5231 mm.
To suit +.0010 in. bore ...	3.1703 in. 3.1707 in.	80.5256 mm. 80.5358 mm.
To suit +.0015 in. bore ...	3.1708 in. 3.1712 in.	80.5383 mm. 80.5485 mm.

1st Oversize, +.010 in. (+.254 mm.)

To suit +.010 in. bore ...	3.1793 in. 3.1797 in.	80.7542 mm. 80.7644 mm.
To suit +.020 in. bore ...	3.1798 in. 3.1802 in.	80.7669 mm. 80.7771 mm.
To suit +.030 in. bore ...	3.1803 in. 3.1807 in.	80.7796 mm. 80.7898 mm.
To suit +.040 in. bore ...	3.1808 in. 3.1812 in.	80.7923 mm. 80.8025 mm.

2nd Oversize, +.020 in. (+.5080 mm.)

To suit +.020 in. bore ...	3.1893 in. 3.1897 in.	81.0082 mm. 81.0184 mm.
To suit +.0205 in. bore ...	3.1898 in. 3.1902 in.	81.0209 mm. 81.0311 mm.
To suit +.0210 in. bore ...	3.1903 in. 3.1907 in.	81.0336 mm. 81.0438 mm.
To suit +.0215 in. bore ...	3.1908 in. 3.1912 in.	81.0463 mm. 81.0564 mm.

3rd OVERSIZE, +.030 in. (+.762 mm.)

To suit +.030 in. bore ...	3.1993 in. 3.1997 in.	81.2622 mm. 81.2724 mm.
To suit +.0305 in. bore ...	3.1998 in. 3.2002 in.	81.2749 mm. 81.2851 mm.
To suit +.0310 in. bore ...	3.2003 in. 3.2007 in.	81.2876 mm. 81.2979 mm.
To suit +.0315 in. bore ...	3.2008 in. 3.2012 in.	81.3003 mm. 81.4105 mm.

4th OVERSIZE, +.040 in. (+.1.016 mm.)

To suit +.040 in. bore ...	3.2093 in. 3.2097 in.	81.5162 mm. 81.5264 mm.
To suit +.0405 in. bore ...	3.2098 in. 3.2102 in.	81.5289 mm. 81.5391 mm.
To suit +.0410 in. bore ...	3.2103 in. 3.2107 in.	81.5416 mm. 81.5518 mm.
To suit +.0415 in. bore ...	3.2108 in. 3.2112 in.	81.5543 mm. 81.5645 mm.

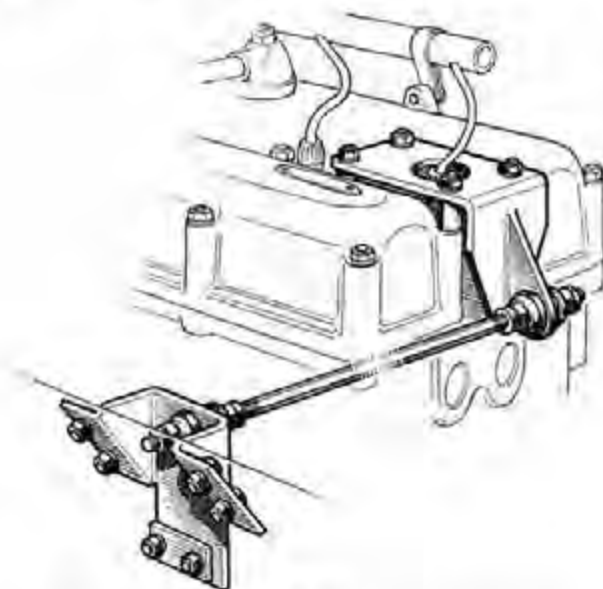


Fig. A.7.

The assembly of the engine steady tie-bar and brackets.

bolt the bracket to the valance using the bolts, washers and reinforcing piece as shown in Fig. A.7.

Fit the remaining rubbers, cup, etc., taking care that the engine is not displaced and that the tie-rod is neither in tension nor compression. Check that there is at least $\frac{1}{2}$ in. (3.18 mm.) between the end of the tie-rod and the valance, and adjust the tie-rod as necessary.

Modified rear engine mounting

Support the weight of the power unit at the rear and remove the gearbox mounting centre bolt.

Lower the tension bar anchorage and gearbox mounting bracket complete and remove the bracket.

Modify the engine mounting bracket to give the dimension $1\frac{3}{4}$ in. as shown in Fig. A.8 and reassemble the bracket to the torsion bar anchorage.

Position the spacing washers on the protruding inner sleeve of the gearbox mounting bush and reassemble the bracket and torsion bar anchorage to the car.

Finally, remove the lateral stay connecting the gearbox extension to the frame brace.

PARTS REQUIRED

Description	Part No.
Bracket, engine steady (engine)	ACB.5717
Bracket, engine steady (valance)	ACB.5723
Rocker cover studs (4)	999/2050
Rubber bush (4)	ACB5730T
Cup washer (4)	ACB5722T

Description	Part No.
Nut, $\frac{3}{8}$ " U.N.F., plain (4)	FNZ.106
Nut, $\frac{3}{8}$ " U.N.F., lock (4)	FNZ.106
Screws, $\frac{1}{4}$ " U.N.F. $\times \frac{1}{2}$ " (6)	HZS.0405
Nuts, $\frac{1}{4}$ " U.N.F., plain (6)	FNZ.104
Washers, $\frac{1}{4}$ ", spring (6)	LWZ.104
Washers, $\frac{1}{4} \times \frac{3}{4}$ " (2) (nearest dash)	PWZ.204
Reinforcing piece (1)	ACB.5723

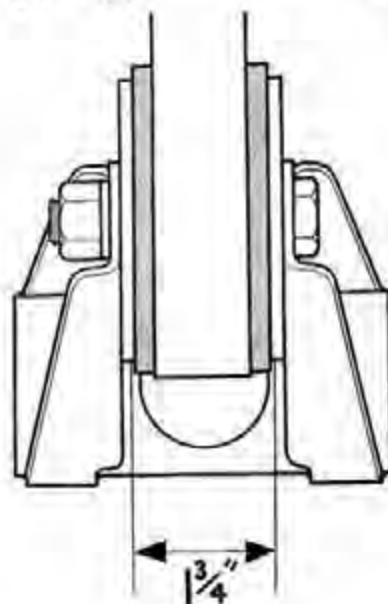


Fig. A.8.

The modified rear power-unit mounting.

Section A.35

LARGER CAPACITY OIL PUMP

To improve oil pressure, an oil pump with larger capacity gears was introduced at Engine No. 1762. The pump, as an assembly, is interchangeable with earlier models.

Section A.36

ENGINE REVOLUTION INDICATOR

From Engine No. 2920, a revolution indicator (Part No. ACB5789) to suit one-third engine speed in place of half-engine speed, is introduced.

A modified drive unit (Part No. AEB185), which is 2 to 3 ratio in place of 1 to 1 ratio, is fitted to the engine.

The new drive unit has a modified cable drive which is now similar to a speedometer cable drive, that is, it has a square hole in place of the slotted drive. This requires the fitting of a new drive cable (Part No. ACB5790 R.H.D. or ACB5791 L.H.D.).

Earlier models may be fitted with these modified parts.