

Chapter 4 Ignition system

For modifications, and information applicable to later models, see Supplement at end of manual

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Specifications

| | | |
|--|--|--------|
| Type | Battery, coil, mechanical breaker distributor | |
| Firing order | 1 – 3 – 4 – 2 (No 1 at timing chain end of engine) | |
| Distributor | Marelli S156DXY or Ducellier 52 52 59A | |
| Make | Clockwise | |
| Rotor rotational direction | 0.40 ± 0.03 mm (0.016 ± 0.001 in) | |
| Contact breaker gap | 58 to 64 % | |
| Dwell angle | | |
| Ignition timing | 5° BTDC | |
| Static or with vacuum advance hose disconnected and engine idling at specified speed | | |
| Ignition advance | 12° ± 2° | |
| Vacuum | 33° ± 2° @ 4360 crankshaft rev/min | |
| Centrifugal – maximum | | |
| Spark plugs | Champion RN9YCC or RN9YC | |
| Type | | |
| Electrode gap: | | |
| RN9YCC plugs | 0.8 mm (0.032 in) | |
| RN9YC pugs | 0.6 mm (0.024 in) | |
| Spark plug (HT) leads | Champion CLS 5 (boxed set) | |
| Type | | |
| Ignition coil | | |
| Types | | |
| Marelli | BE 200 B | |
| Bosch | K 12 V | |
| Pol-Mot | BE 200 B | |
| O.E.M. | G 52 S | |
| Condenser capacity | 0.225 to 0.275 mF | |
| Torque wrench setting | | |
| Spark plugs | Nm | lbf ft |
| | 32 | 24 |

1 General description

For the engine to run correctly it is necessary for an electrical spark to ignite the fuel/air mixture in the combustion chamber at exactly the right moment in relation to engine speed and load. The ignition system is based on feeding low tension current to the coil where it is converted to high tension current. This high voltage is powerful enough to jump the spark plug gap in the cylinders under

high pressures, providing that the system is in good condition and that all adjustments are correct.

The ignition system is divided into two circuits, the low tension circuit and the high tension circuit.

The low tension (sometimes known as the primary) circuit consists of the battery; lead to the control box; lead to the ignition switch; lead from the ignition switch to the low tension or primary coil windings, to the contact breaker points and condenser in the distributor.

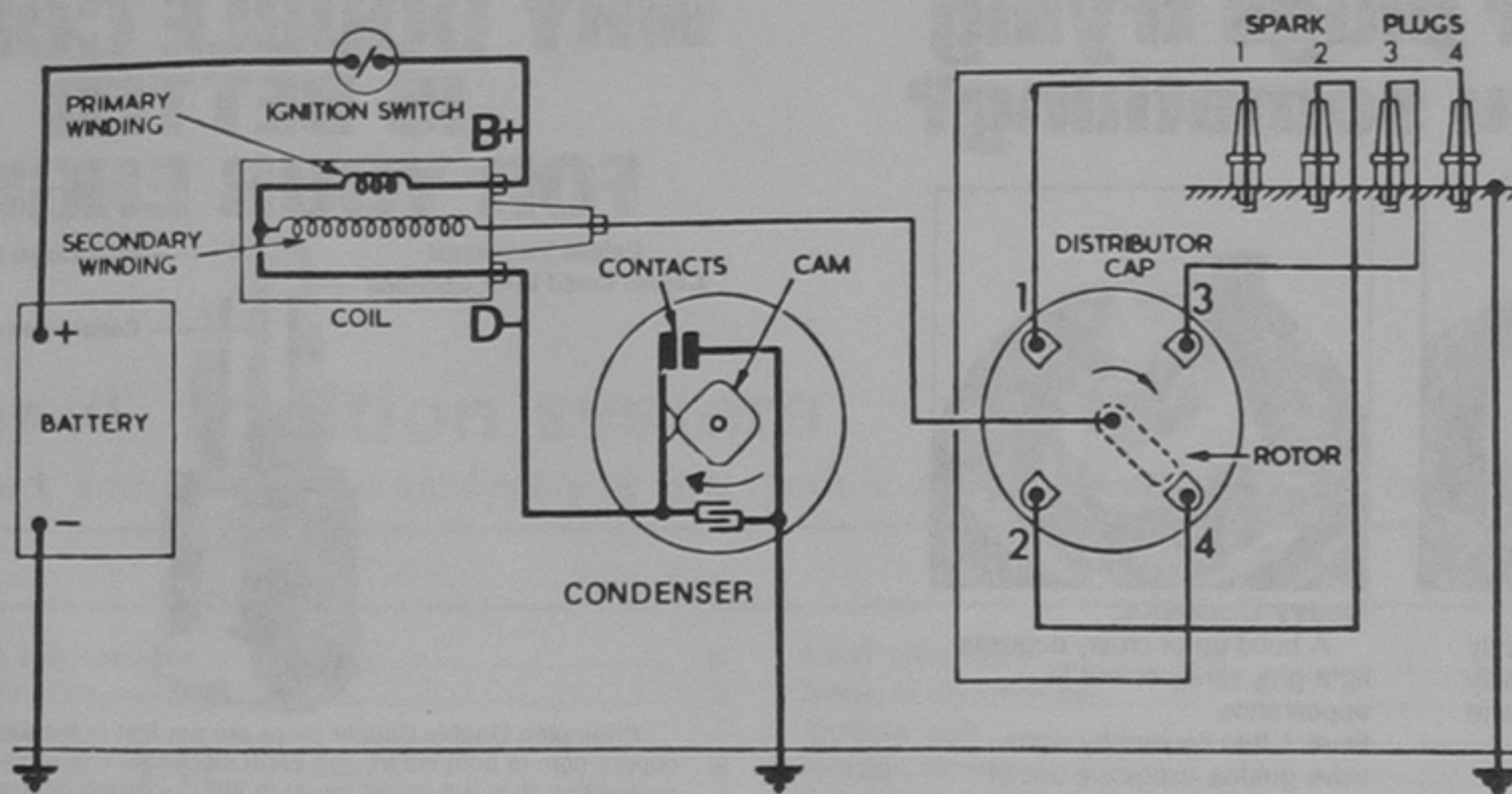


Fig. 4.1 Schematic diagram of ignition system (Sec 1)

The high tension circuit consists of the high tension or secondary coil windings, the heavy ignition lead from the centre of the coil to the centre of the distributor cap, the rotor arm, and the spark plug leads and spark plugs.

The system functions in the following manner. High tension voltage is generated in the coil by the interruption of the low tension circuit. The interruption is effected by the opening of the contact breaker points in this low tension circuit. High tension voltage is fed from the centre of the coil, via the carbon brush in the centre of the distributor cap, to the rotor arm of the distributor.

The rotor arm revolves at half engine speed inside the distributor cap, and each time it comes in line with one of the four metal segments in the cap, which are connected to the spark plug leads, the opening of the contact breaker points causes the high tension voltage to build up, jump the gap from the rotor arm to the appropriate metal segment, and so via the spark plug lead to the spark plug, where it finally jumps the spark plug gap before going to earth.

The ignition is advanced and retarded automatically, to ensure the spark occurs at just the right instant for the particular load at the prevailing engine speed.

The ignition advance is controlled mechanically and by vacuum. The mechanical governor mechanism consists of two weights, which move out from the distributor shaft as the engine speed rises, owing to centrifugal force. As they move outwards they rotate the cam relative to the distributor shaft, and so advance the spark. The weights are held in position by two springs and it is the tension of the springs which is largely responsible for correct spark advancement.

Vacuum control is by means of a diaphragm unit and hose to the carburettor venturi.

2 Contact breaker – points servicing

- 1 At the intervals specified in Routine Maintenance, check the condition of the contact breaker points.
- 2 Unclip and take off the distributor cap and place it to one side.
- 3 Remove the rotor, this may be of push-on type or held by two screws according to make of distributor.
- 4 With the thumb nail, prise back the movable contact arm and examine the faces of the points. If they are burnt, pitted or eroded, they must be removed and renewed. If they are in good condition then just clean them by drawing a fuel-moistened cloth between them.

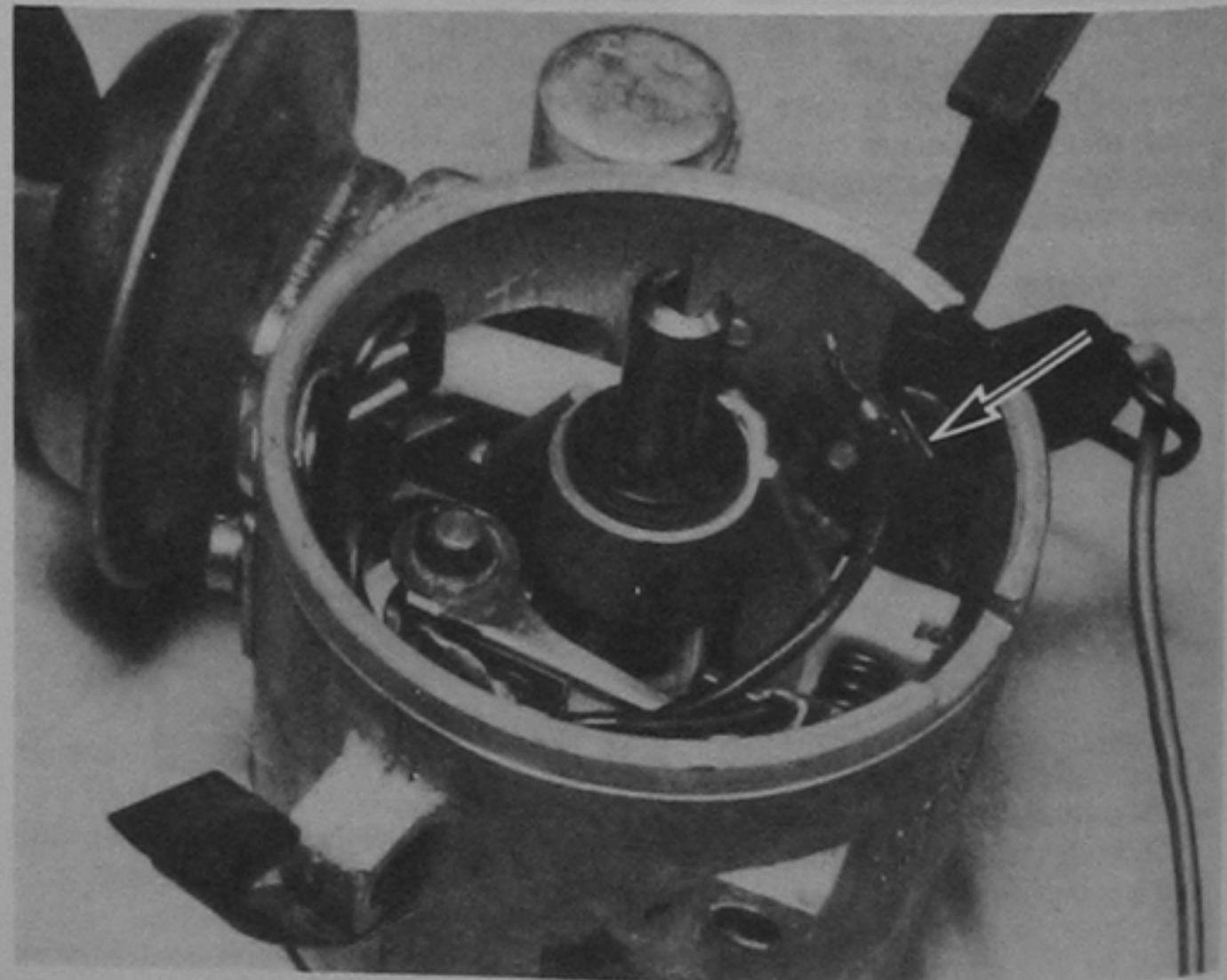
Ducellier

- 5 To remove the points, first unscrew the terminal screw and remove it together with the washer under its head. Remove the low tension cable from the terminal, together with the condenser cable.

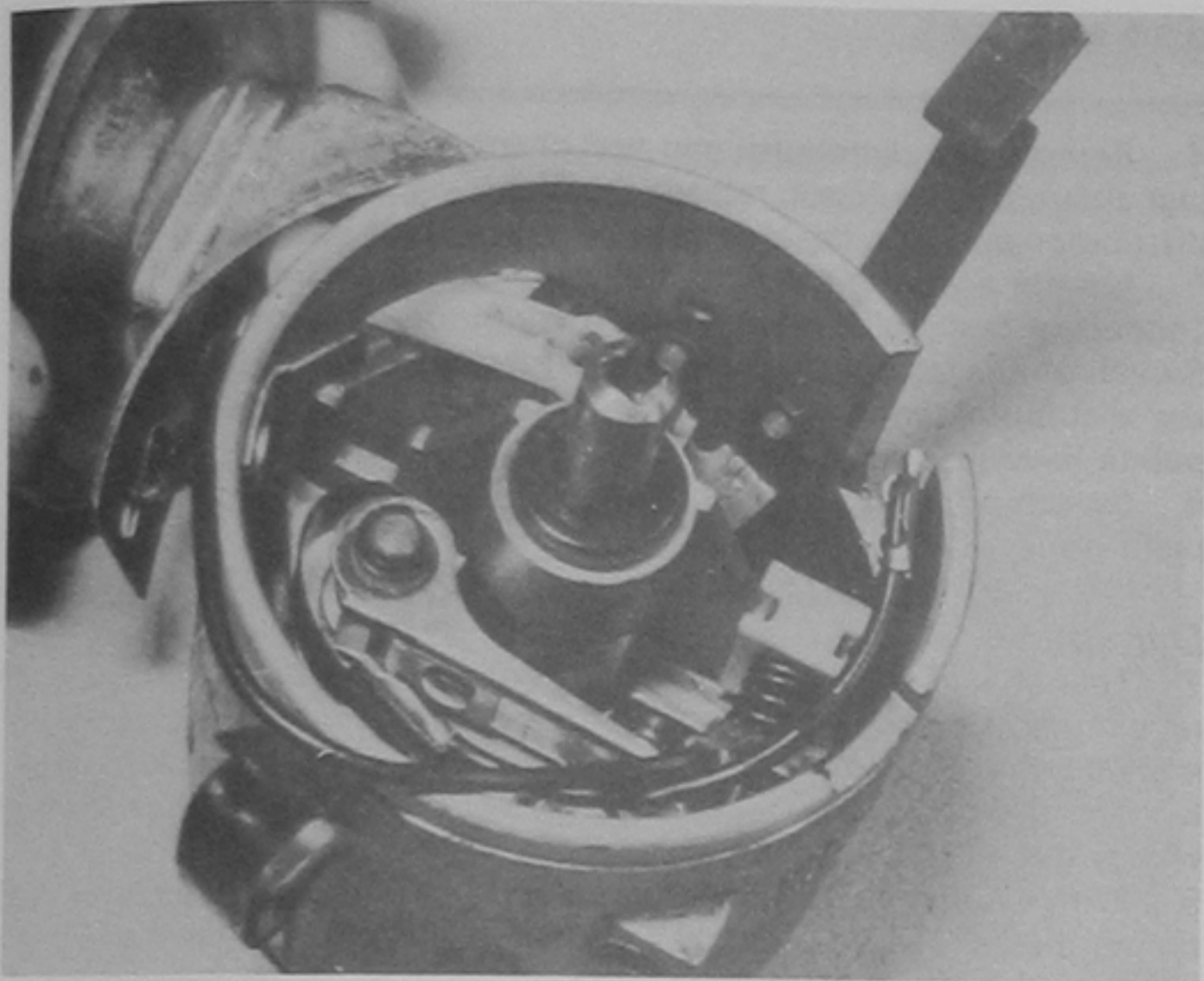
- 6 Unscrew and remove the contact breaker locking screw.
- 7 Lift away the contact breaker points.

Marelli

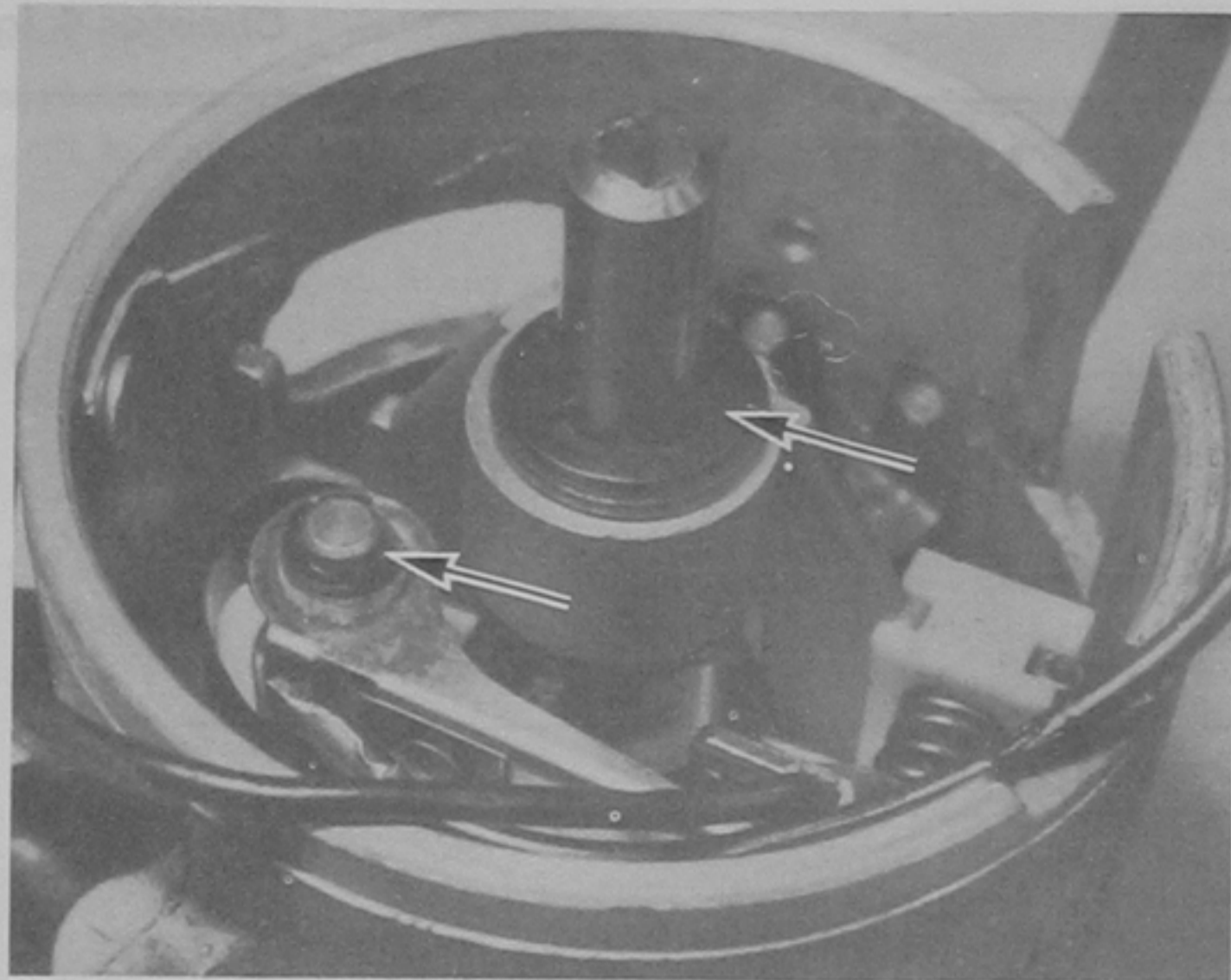
- 8 Remove the distributor cap, rotor and spark shield.
- 9 Disconnect the LT lead from the spade terminal inside the body (photo).
- 10 Extract the two screws and remove the vacuum unit by unhooking the connecting link (photo).
- 11 Extract the E-clip from the top of the distributor shaft, remove the shims (photos).
- 12 Remove the complete top bearing and contact points assembly to the bench.
- 13 Extract the circlip from the movable arm pivot post. Prise the arm upwards (photos).
- 14 Extract the circlip from the fixed arm post on the underside of the baseplate.
- 15 Unscrew the fixed arm Allen type adjuster screw and lift off the fixed arm (photo).
- 16 It is not recommended that the faces of the points are dressed smooth on an oil stone or abrasive paper as it is impossible to maintain the correct face contour. Obtain new points, clean their faces with methylated spirit, apply a drop of oil to the pivot and fit them.



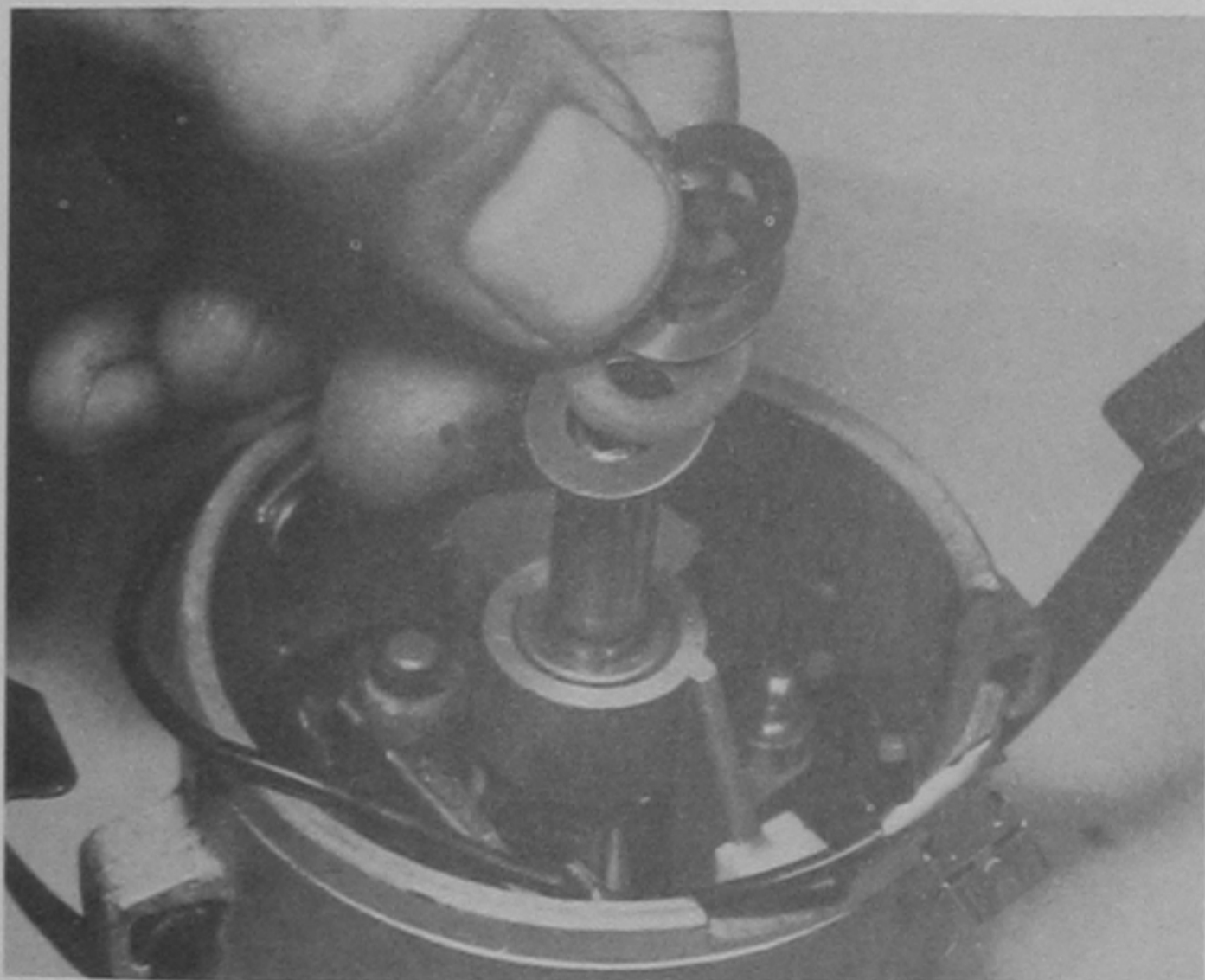
2.9 LT lead and terminal



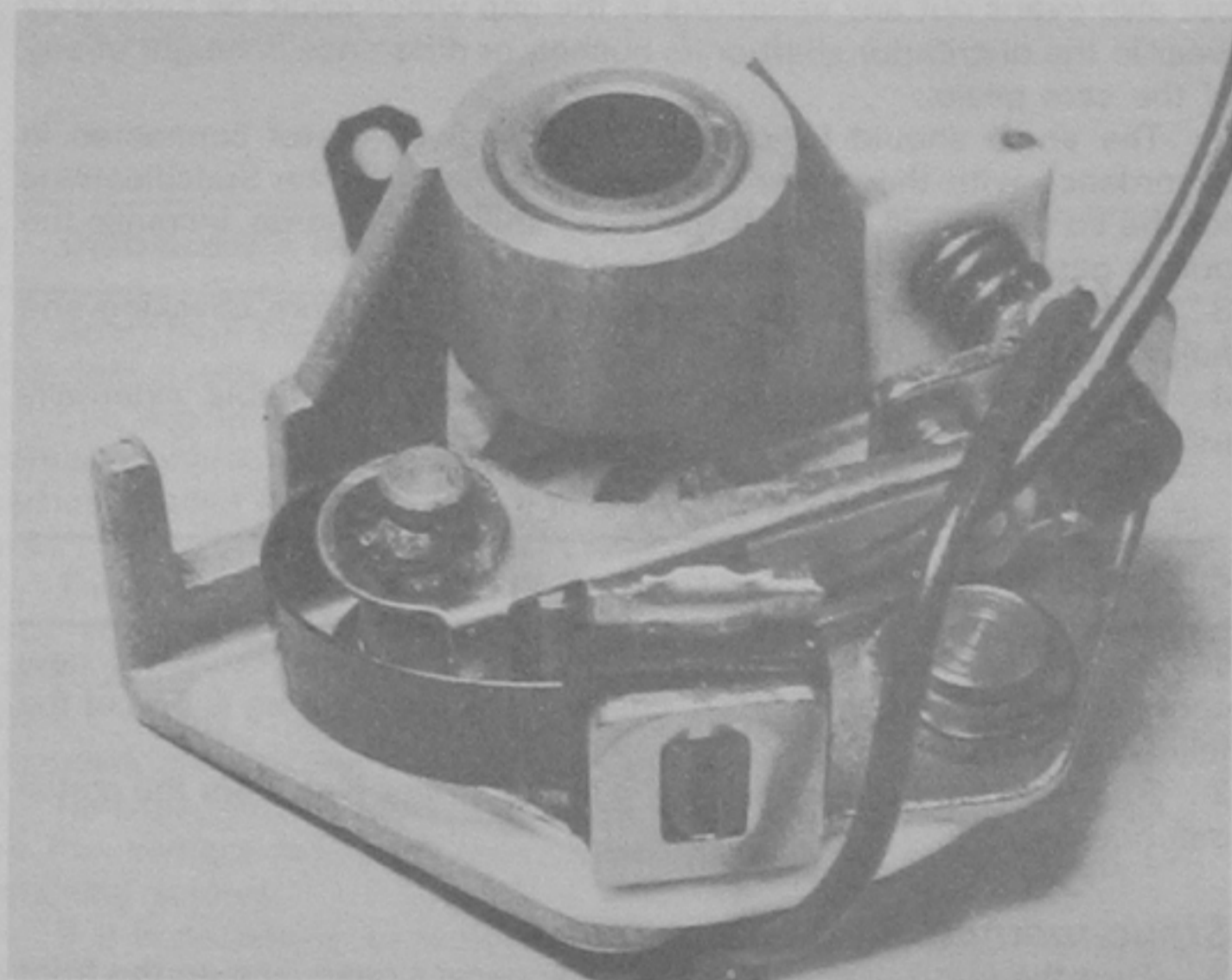
2.10 Removing distributor vacuum unit



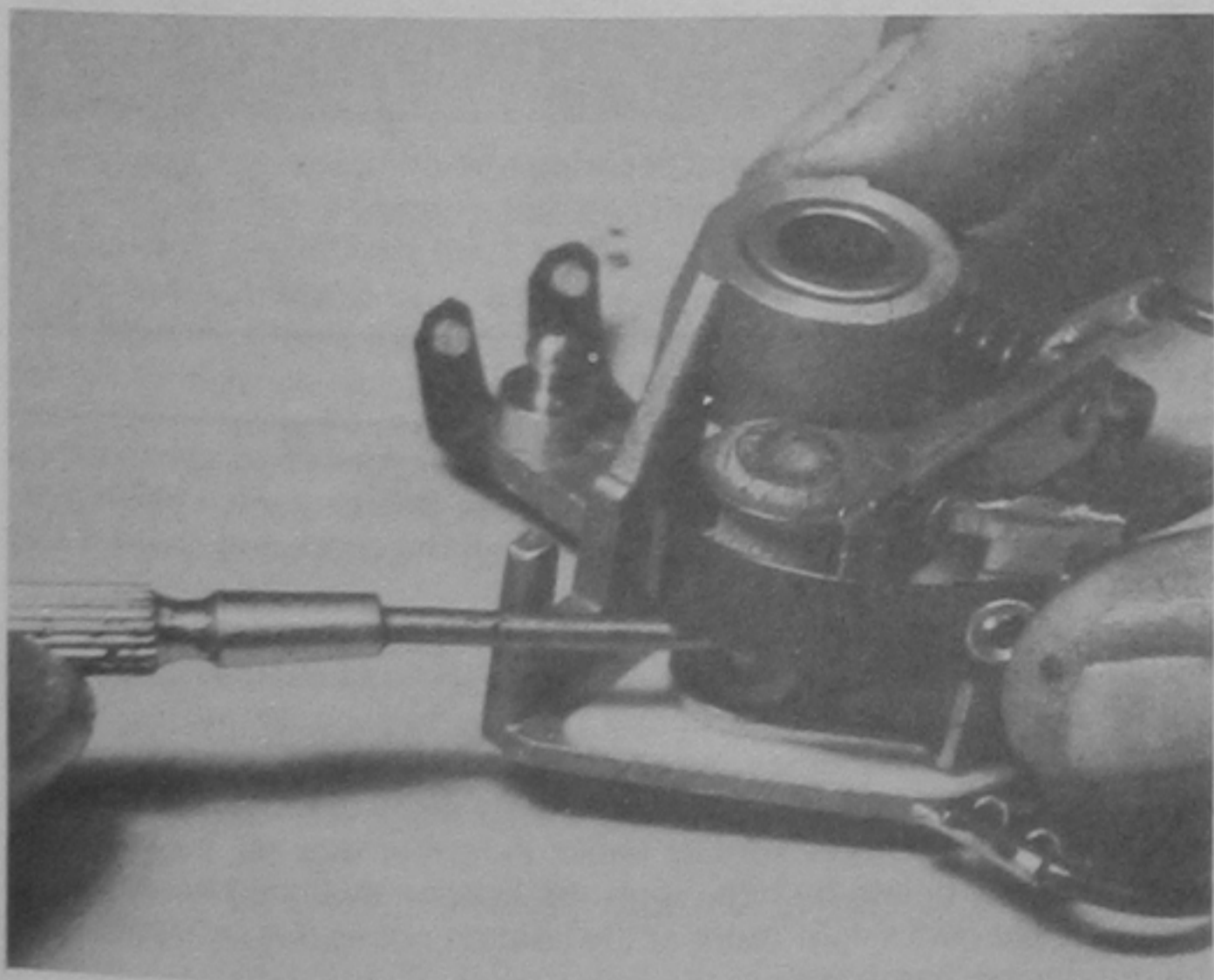
2.11A Distributor shaft and contact arm pivot circlips



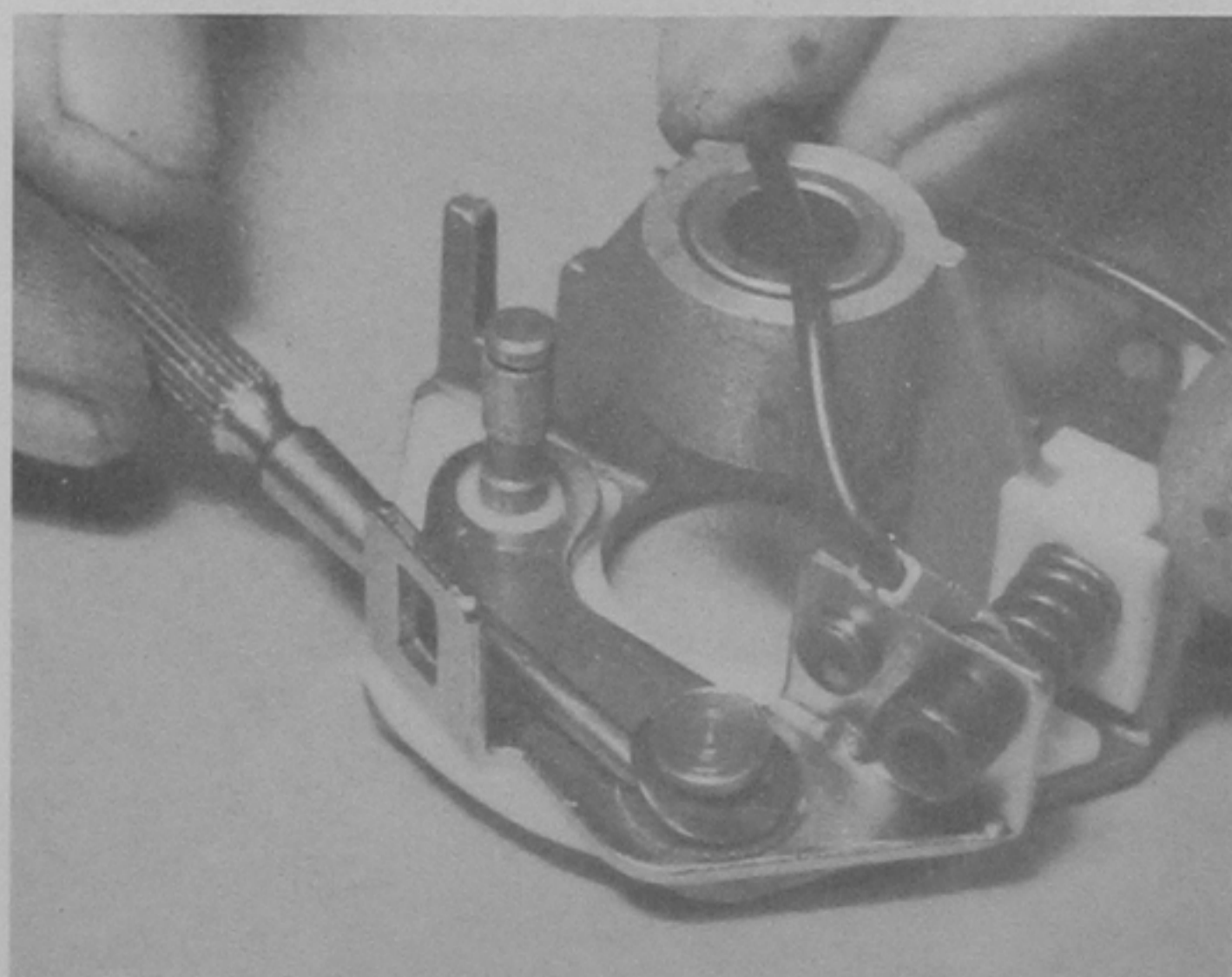
2.11B Removing distributor shaft shims



2.13A Distributor top bearing assembly



2.13B Removing moveable contact arm



2.15 Fixed contact arm

- 17 Turn the crankshaft pulley nut until the rubbing block of the movable contact arm is on one of the high points of the distributor shaft cam.
- 18 Move the fixed arm until the points gap is as specified using a feeler blade. Tighten the arm fixing screw without altering the gap.
- 19 Check the contact end of the rotor arm. If this is eroded, renew it.
- 20 Check the distributor cap for cracks, or erosion of the interior contacts.
- 21 The carbon brush in the centre of the cap should be free to slide and not be too worn, otherwise renew the cap.
- 22 Fit the rotor and cap.
- 23 Check the dwell angle as described in the following Section.

3 Dwell angle – checking

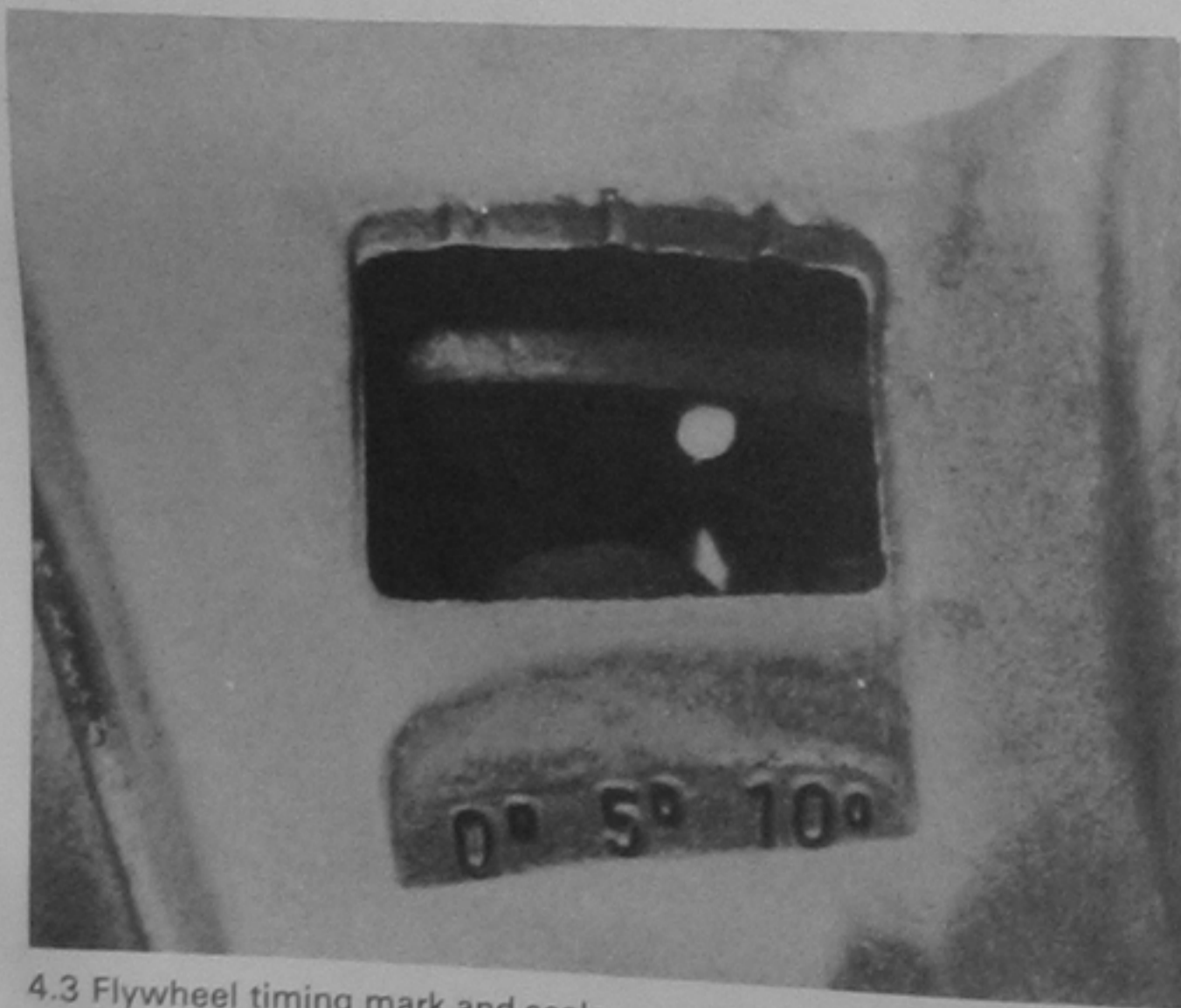
- 1 On modern engines, setting the contact breaker gap in the distributor using feeler gauges must be regarded as a basic adjustment only. For optimum engine performance, the dwell angle must be checked. The dwell angle is the number of degrees through which the distributor cam turns during the period between the instance of closure and opening of the contact breaker points. Checking the dwell angle not only gives a more accurate setting of the contact breaker gap but also evens out any variations in the gap which could be caused by wear in the distributor shaft or its bushes, or difference in height of any of the cam peaks.
- 2 The angle should be checked with a dwell meter connected in accordance with the maker's instructions. Refer to the Specifications for the correct dwell angle. If the dwell angle is too large, increase the points gap, if too small, reduce the points gap.
- 3 The dwell angle should always be adjusted before checking and adjusting the ignition timing.
- 4 On Marelli distributors, the points gap is adjustable externally using an Allen key.

4 Ignition timing

- 1 At the intervals specified in Routine Maintenance, or if new contact points have been fitted, check the ignition timing in one of the following ways.
- 2 Remove the spare wheel and pull the rubber plug from the clutch bell housing.

Static method

- 3 Turn the crankshaft pulley nut or engage a gear, jack up the front of the car and turn a front roadwheel until the timing mark on the flywheel is aligned with the 5° BTDC mark on the edge of the bell housing aperture (photo).

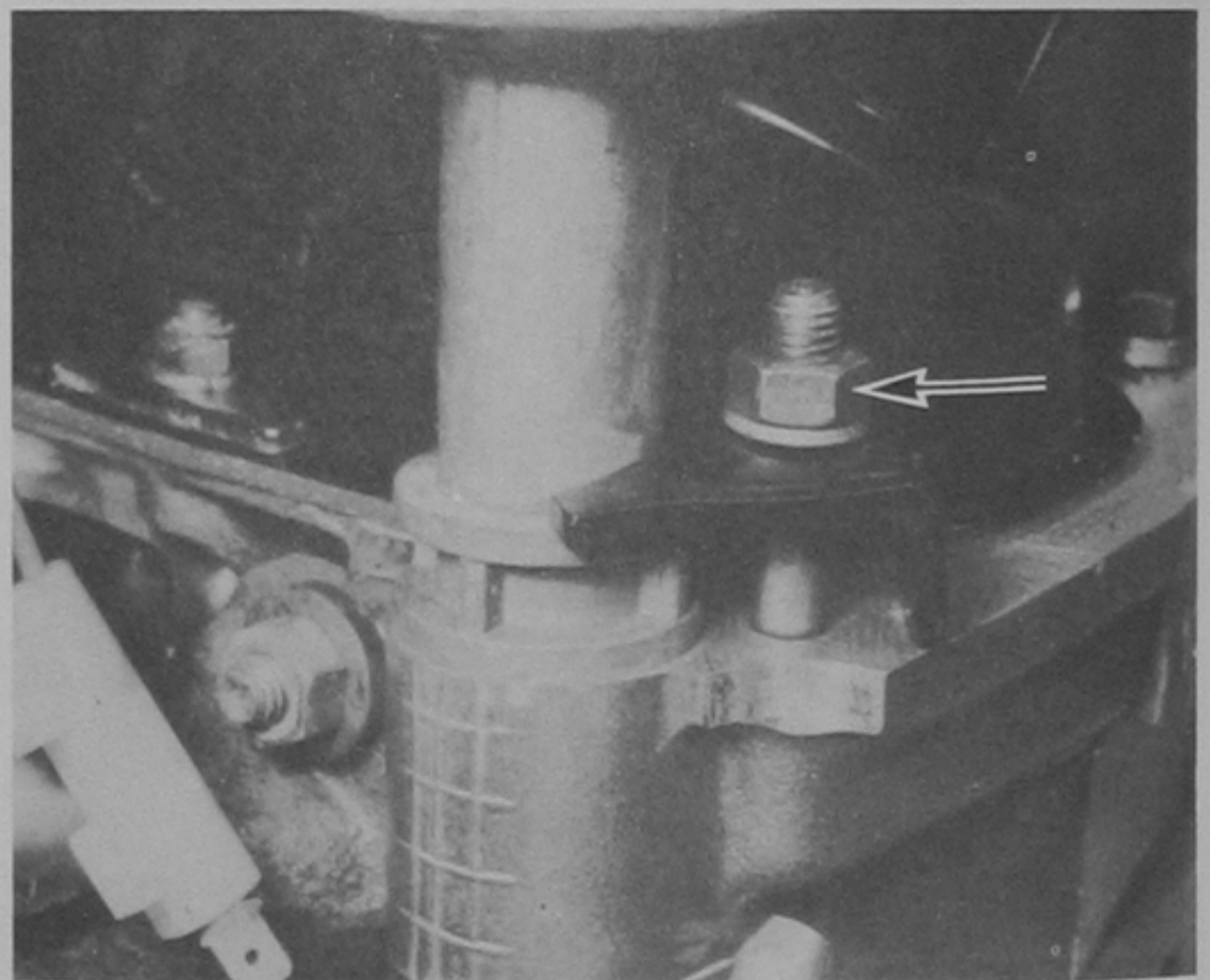


4.3 Flywheel timing mark and scale

- 4 Remove the distributor cap and check that the contact points are just about to open. If not, release the distributor clamp nut and turn the distributor until the desired position is obtained (photo).
- 5 A more accurate method of determining the point of opening is to connect a test bulb between the distributor LT terminal and earth. Switch on the ignition, release the distributor clamp plate nut and turn the distributor until the test bulb just goes out indicating that the points have just separated.
- 6 Switch off the ignition, fit the distributor cap and tighten the clamp plate nut.

Dynamic method

- 7 This should be regarded as the more accurate method, but will require the use of a stroboscope connected in accordance with the manufacturer's instructions. Disconnect the distributor vacuum hose.
- 8 The flywheel and bell housing timing marks may be highlighted with a dab of quick-drying white paint.
- 9 With the engine running at idle speed, point the stroboscope at the timing marks. They should appear stationary with the flywheel mark opposite the specified housing mark.
- 10 If the marks are not in alignment, release the distributor clamp plate nut and rotate the distributor until they align.
- 11 Tighten the clamp plate nut.
- 12 The correct functioning of the centrifugal advance mechanism may be checked if the engine speed is increased. Then the timing marks should move away from each other.
- 13 Having completed the adjustment of the ignition timing, replace the distributor vacuum hose and check the security of all ignition leads.

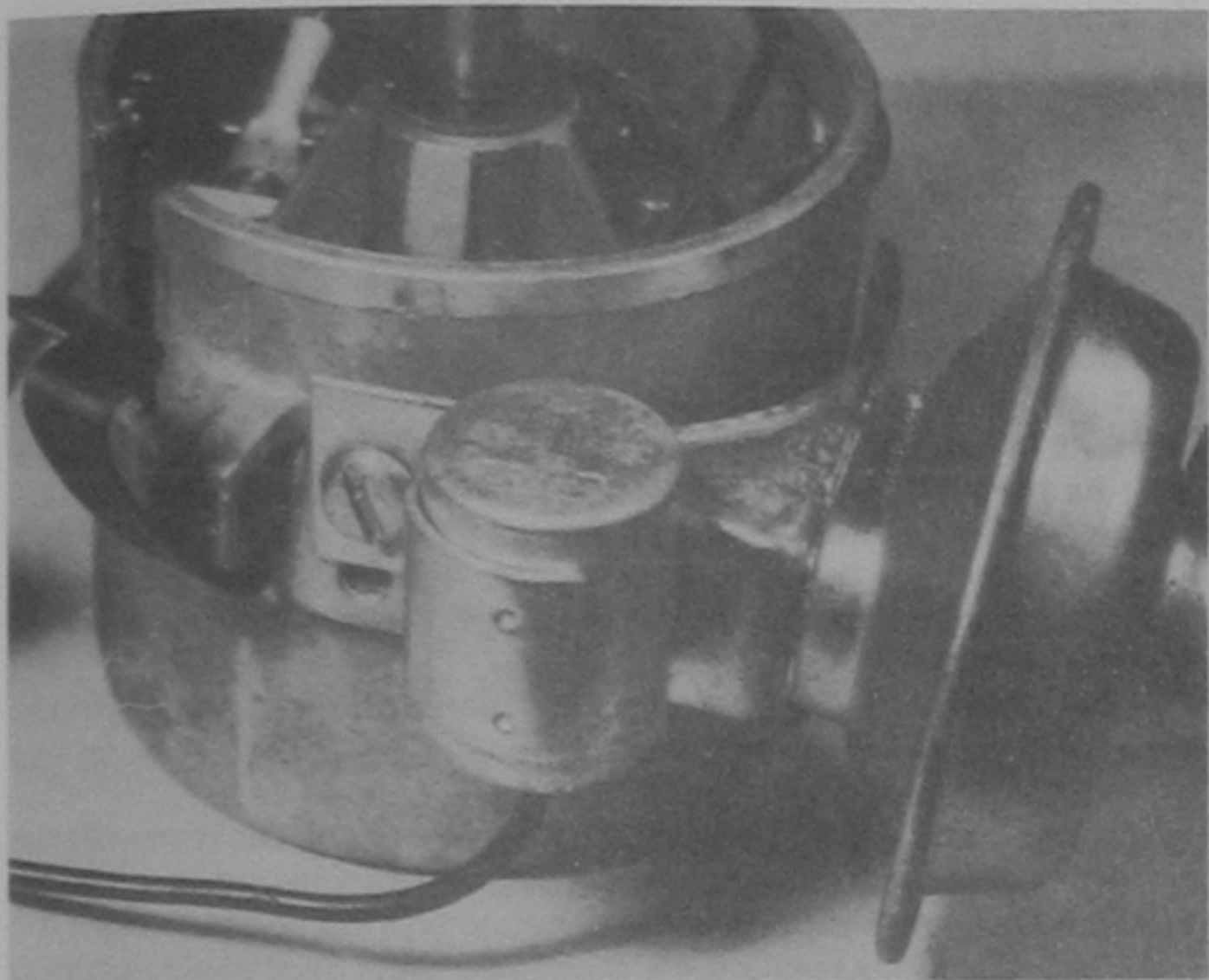


4.4 Distributor clamp plate and securing nut

5 Condenser – testing and renewal

- 1 The purpose of the condenser (sometimes known as capacitor) is to ensure that when the contact breaker points open there is no sparking across them which would weaken the spark and cause rapid deterioration of the points.
- 2 The condenser is fitted in parallel with the contact breaker points. If it develops a short circuit, it will cause ignition failure as the points will be prevented from interrupting the low tension circuit.
- 3 If the engine becomes very difficult to start or begins to misfire whilst running and the breaker points show signs of excessive burning, then suspect the condenser has failed. A further test can be made by separating the points by hand with the ignition switched on. If this is accompanied by a bright spark at the contact points it is indicative that the condenser has failed.
- 4 Without special test equipment the only sure way to diagnose condenser trouble is to replace a suspected unit with a new one and note if there is any improvement.

- 5 To remove the condenser from the distributor, release the screw which secures it to the distributor body (Marelli) or baseplate (Ducellier). Release the condenser lead from the LT terminal (photo).
- 6 When fitting the condenser it is vital to ensure that the fixing screw is secure and the condenser tightly held. The lead must be secure on the terminal with no chance of short circuiting.



5.5 Condenser

6 Distributor – removal and refitting

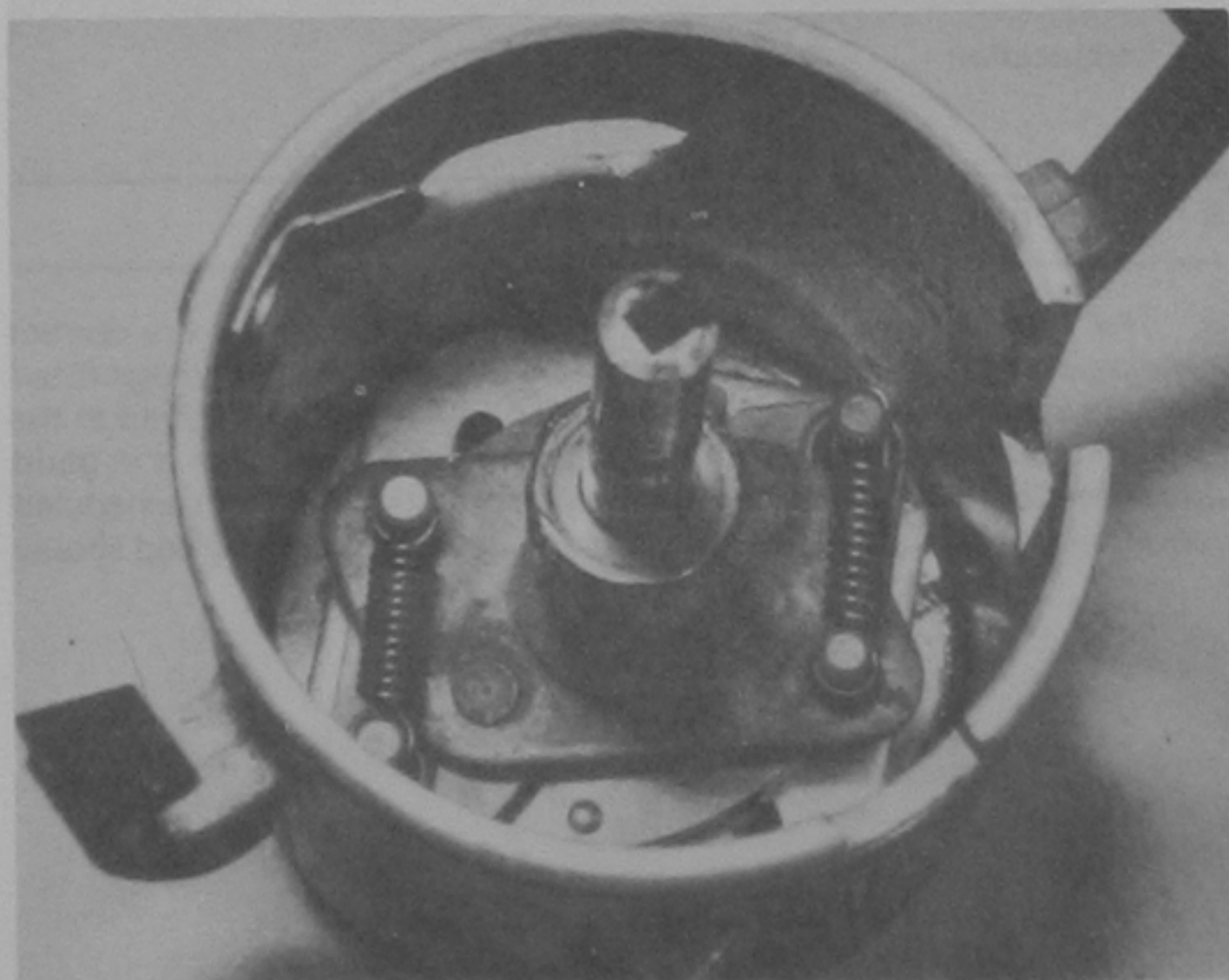
- 1 The distributor driveshaft is driven from the upper end of the oil pump driveshaft which is geared to the camshaft.
- 2 Turn the crankshaft (by means of the pulley nut or by engaging a gear, raising a front roadwheel and turning the wheel) until number one piston is at TDC on the compression stroke. This can be established by removing No 1 spark plug and placing the finger over the hole and feeling the compression being generated. This can also be determined by aligning the timing marks and removing the distributor cap and checking that the rotor contact end is pointing at number one spark plug contact in the distributor cap. If it is pointing at number four, turn the crankshaft one revolution.
- 3 Mark the alignment of the contact end of the rotor with the distributor body and the setting of the distributor pedestal in relation to the cylinder head.
- 4 Unscrew the clamp plate nut.
- 5 Disconnect the distributor cap and lay it to one side complete with the HT leads. Disconnect the LT lead.
- 6 Pull the distributor up and out of the cylinder head.
- 7 If the oil pump driveshaft is displaced, simply push it back into position. It has no set position. The oil pump driveshaft can be removed if necessary by pushing a tapered piece of soft wood into the hole in the gear and pulling the shaft out.
- 8 Before the distributor can be refitted, No. 1 piston must be set to TDC on the compression stroke as described in the first part of paragraph 2.
- 9 Hold the distributor over its mounting hole with the pedestal mark aligned with the one on the cylinder head, and the contact end of the rotor aligned with the one made on the distributor body rim.
- 10 Push the distributor into position. The rotor may need a very slight turn to engage the shaft splines as the distributor is pushed downwards (photo).
- 11 Align the distributor mounting pedestal to cylinder head marks and fit the clamp plate nut.
- 12 Reconnect the LT lead and fit the distributor cap and clip it with the retaining springs.
- 13 Start the engine and check the ignition timing as described in Section 4.



6.10 Fitting distributor

7 Distributor – overhaul

- 1 Apart from the contact points the other parts of a distributor which deteriorate with age and use, are the cap and the rotor.
- 2 The cap must have no flaws or cracks and the four HT terminal contacts should not be severely corroded. The centre spring-loaded carbon contact is replaceable. If in any doubt about the cap buy a new one.
- 3 The rotor deteriorates minimally but with age the metal conductor may corrode. It should not be cracked or chipped and the metal conductor must not be loose. If in doubt renew it. Always fit a new rotor if fitting a new cap. Assuming the cover and rotor have been removed, proceed with dismantling as follows:
- 4 Release the low tension and condenser cables from the terminal on the contact set, then remove the contact set by releasing the retaining screws.
- 5 If it is necessary to remove the centre shaft from the distributor body, use a small parallel pin punch to drive out the pin securing the collar to the bottom of the centre shaft. Recover the washer from under the collar and slide out the centre shaft.
- 6 Check the contact breaker points as described in Section 2.
- 7 Examine the balance weights and pivot pins for wear (photo). Also examine the shaft and bushes.

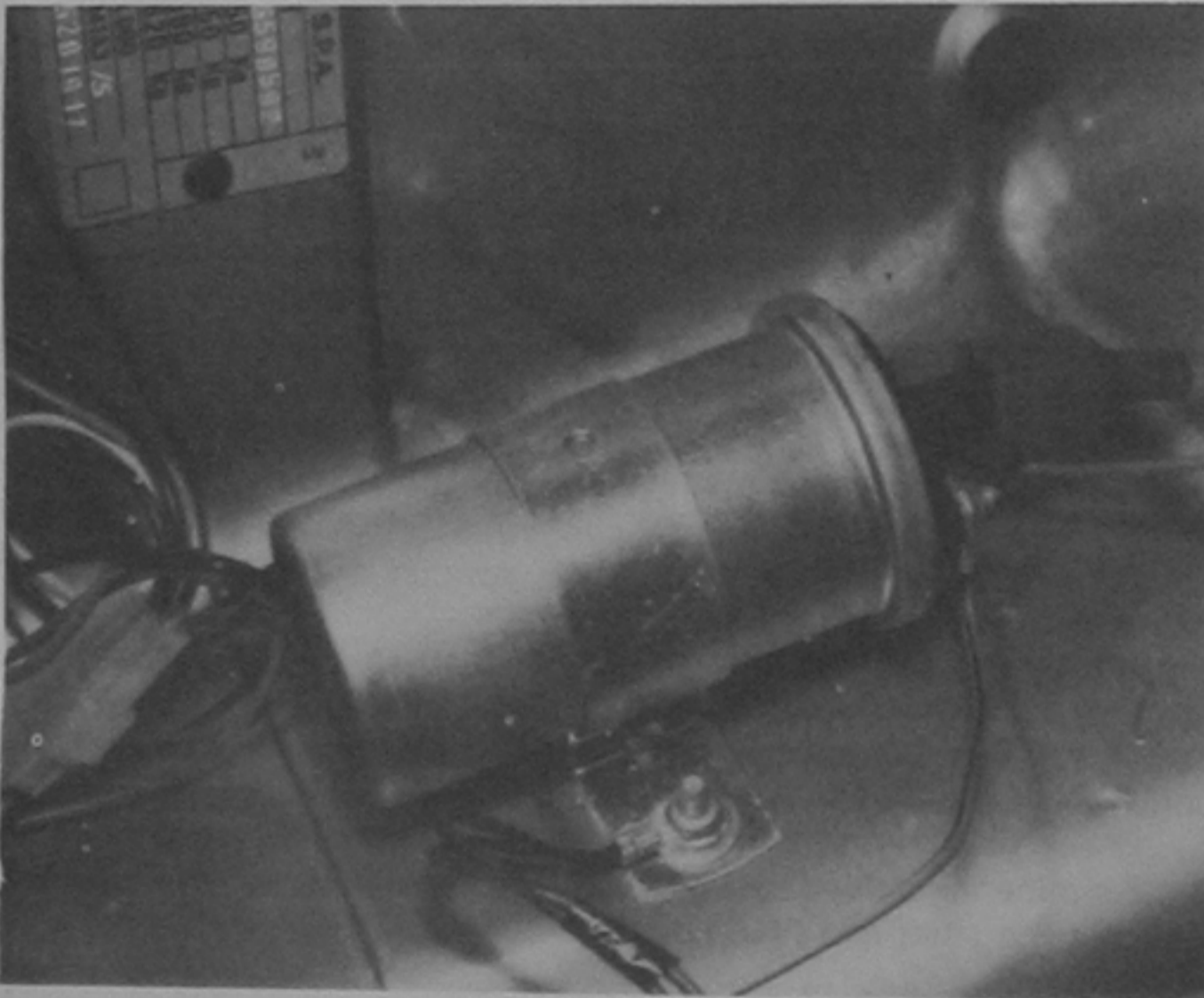


7.7 Distributor counterweights and springs

- 8 If these components are worn, it will normally be more economical to renew the complete distributor.
- 9 Reassembly is a straightforward reversal of the dismantling process, but there are several points which should be noted.
- 10 Lubricate the balance weights and other parts of the mechanical advance mechanism, and the distributor centre shaft, with engine oil during assembly. Do not oil excessively but ensure these parts are adequately lubricated.
- 11 Check the action of the weights in the fully advanced and fully retarded positions and ensure they are not binding.
- 12 Finally, set the contact breaker gap to the correct clearance (refer to Section 2).

8 Ignition coil

- 1 Coils normally last the life of the car. The most usual reason for a coil to fail is after being left with the ignition switched on but the engine not running. There is then constant current flowing, instead of the intermittent flow when the contact breaker is opening. The coil then overheats, and the insulation is damaged (photo).
- 2 The contact breaker points should preferably not be flicked without a lead from the coil centre to some earth, otherwise the opening of the points will give a HT spark which, finding no proper circuit, could break down the insulation in the coil. When connecting a timing light for setting the ignition, do so in accordance with the manufacturer's instructions.
- 3 Unless an ohmmeter is available, testing the coil should be left to your dealer or auto electrician, or by substitution of a new coil.



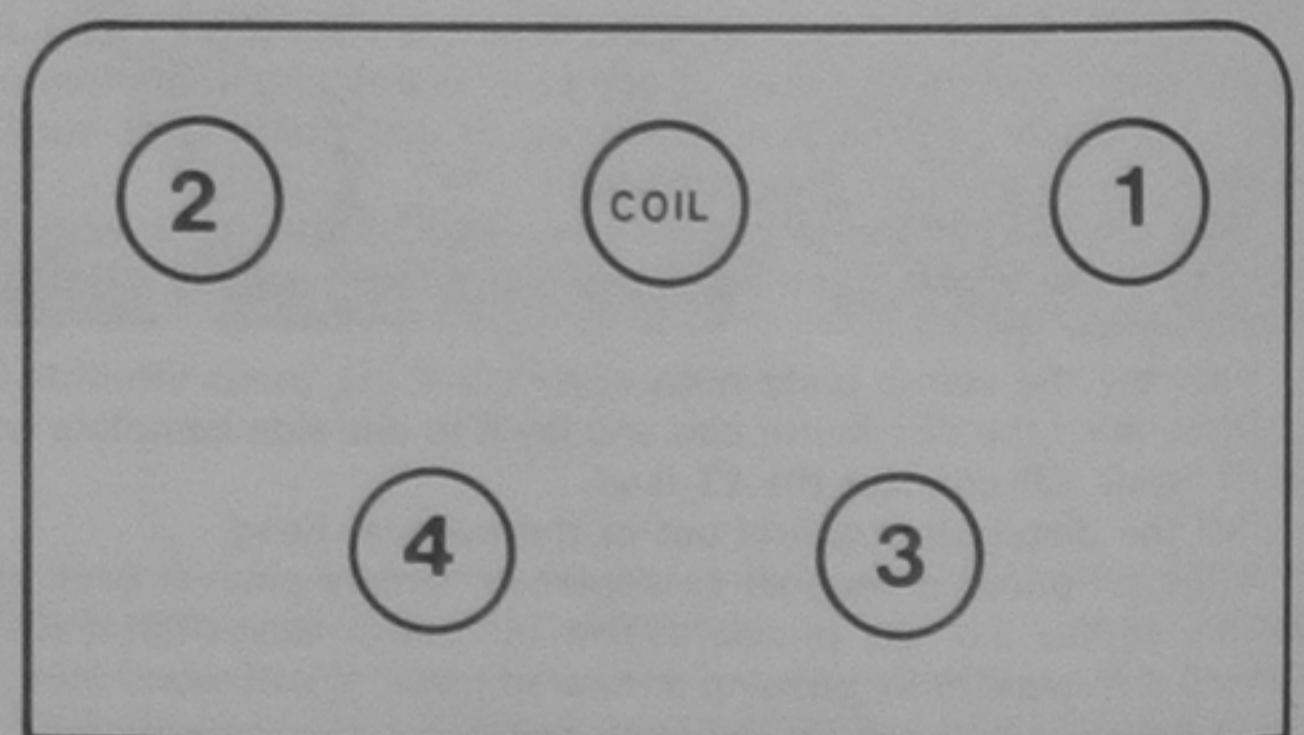
8.1 Coil location

9 Spark plugs and high tension leads

- 1 The correct functioning of the spark plugs is vital for the correct running and efficiency of the engine. It is essential that the plugs fitted are appropriate for the engine, and the suitable type is specified at the beginning of this chapter. If this type is used and the engine is in good condition, the spark plugs should not need attention between scheduled replacement intervals. Spark plug cleaning is rarely necessary and should

not be attempted unless specialised equipment is available as damage can easily be caused to the firing ends.

- 2 To remove the plugs, open the bonnet and pull the HT leads from them. Grip the rubber end fitting, not the lead, otherwise the connection to the cable end fitting may fracture.
- 3 Brush out any accumulated dirt or grit from the spark plug recesses in the cylinder head otherwise it may drop into the combustion chamber when the plug is removed.
- 4 Unscrew the spark plugs with a deep socket or box spanner. Do not allow the tool to tilt otherwise the ceramic insulator may be cracked or broken.
- 5 Examination of the spark plugs will give a good indication of the condition of the engine.
- 6 If the insulator nose of the spark plug is clean and white with no deposits, this is indicative of a weak mixture, or too hot a plug (a hot plug transfers heat away from the electrode slowly, a cold plug transfers heat away quickly).
- 7 If the tip and insulator nose are covered with hard black looking deposits, then this is indicative that the mixture is too rich. Should the plug be black and oily, then it is likely that the engine is fairly worn, as well as the mixture being too rich.
- 8 If the insulator nose is covered with light tan to greyish brown deposits, then the mixture is correct and it is likely that the engine is in good condition.
- 9 The spark plug gap is of considerable importance as, if it is too large or too small, the size of the spark and its efficiency will be seriously impaired.
- 10 For the best results, the spark plug gap should be set in accordance with the Specifications at the beginning of this Chapter.
- 11 To measure the gap, use a feeler gauge and then open or close the gap as necessary by bending the outer electrode. Special plug gapping and electrode bending tools are available for the purpose. *Never* bend the centre electrode or the ceramic insulator will crack.
- 12 To fit the plugs, screw in each one by hand. This will ensure that there is no chance of cross-threading.
- 13 Tighten the plugs to the specified torque. If a torque wrench is not available, just lightly tighten each plug. It is better to under-tighten rather than strip the threads from the light alloy cylinder head.
- 14 When reconnecting the spark plug leads make sure that they are refitted in their correct order 1 - 3 - 4 - 2 (No. 1 being at the timing chain end).
- 15 The spark plug leads require no routine attention other than being kept clean by wiping them regularly.
- 16 In order to minimise corrosion, in the distributor cap lead sockets, smear the HT cable end fittings with a light coating of petroleum jelly.



H.15772

Fig. 4.2 Distributor cap lead connections viewed from oil filler cap (Sec 9)

10 Fault diagnosis – ignition system

General

1 If the engine fails to start and the car was running normally when it was last used, first check that there is fuel in the fuel tank. If the engine turns over normally on the starter motor and the battery is evidently well charged first check the HT (high tension) circuit.

2 A common reason for bad starting is wet or damp spark plug leads and distributor cap. A moisture dispersant such as Holts Wet Start, can be very effective. To prevent the problem recurring, Holts Damp Start may be used to provide a sealing coat, so excluding any further moisture from the ignition system. In extreme difficulty, Holts Cold Start will help to start a car when only a very poor spark occurs.

3 If the engine still fails to start, disconnect an HT lead from any spark plug and, using a nail inserted into the end fitting, hold the lead

approximately 5.0 mm (0.2 in) away from the cylinder head with well-insulated pliers. While an assistant spins the engine on the starter motor, check that a regular blue spark occurs. If so the spark plugs are probably the cause of the engine not starting and they should therefore be cleaned and regapped.

4 If no spark occurs, disconnect the main feed HT lead from the distributor cap and check for a spark as in paragraph 3. If sparks now occur, check the distributor cap, rotor arm, and HT leads, as described in Section 4, and renew them as necessary.

5 Check the security of the wiring to the ignition coil, distributor and ignition module.

6 If the engine still fails to start, the following step-by-step procedure may be used to check the complete ignition system.

Symptom**Reason(s)**

Engine fails to start

Loose battery connections
Discharged battery
Oil on contact points
Disconnected ignition leads
Faulty condenser

Engine starts and runs but misfires

Faulty spark plug
Cracked distributor cap
Cracked rotor arm
Worn advance mechanism
Incorrect spark plug gap
Incorrect contact points gap
Faulty condenser
Faulty coil
Incorrect timing
Poor engine/transmission earth connections

Engine overheats, lacks power

Seized distributor weights
Incorrect ignition timing