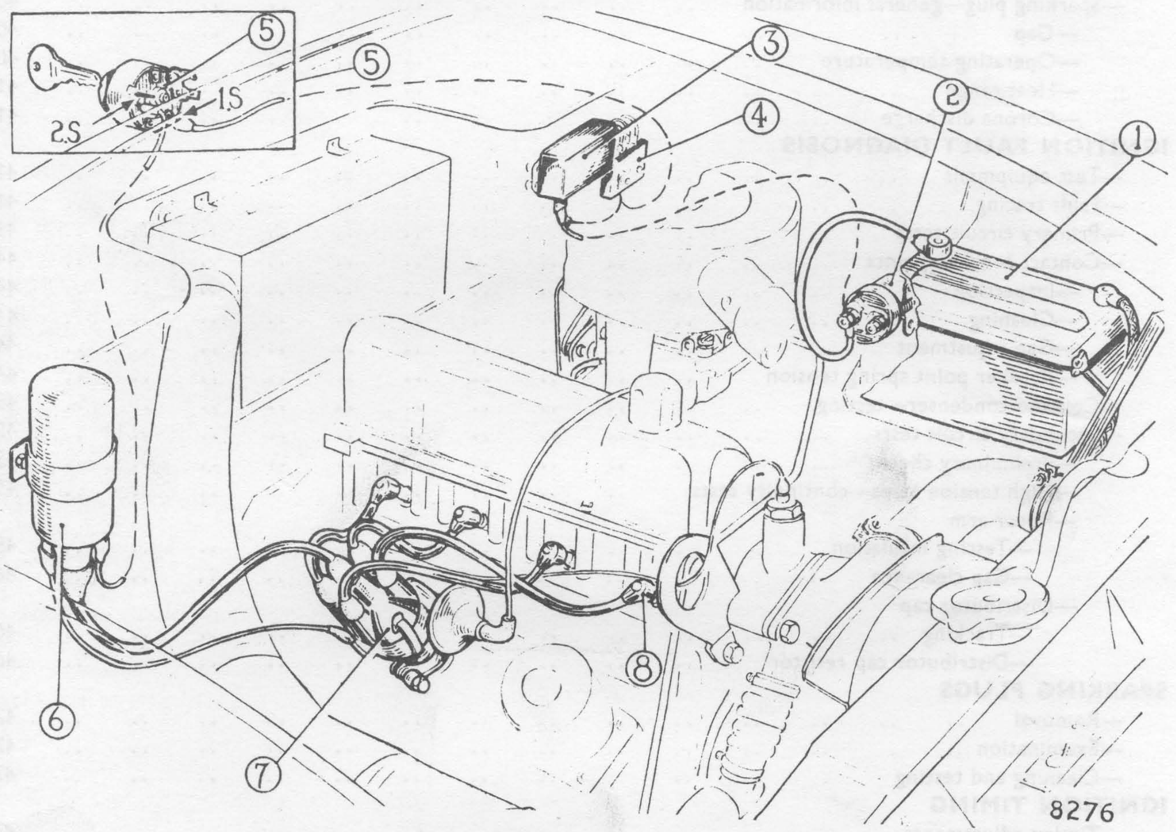
IGNITION SYSTEM

IGNITION SYSTEM



1. BATTERY
2. STARTER SOLENOID
3. CONTROL UNIT
4. FUSE UNIT
5. IGNITION SWITCH
6. IGNITION COIL
7. DISTRIBUTOR
8. SPARKING PLUGS

- - - - - - PRIMARY CIRCUIT TO COIL *(without ballast resistance)* 1S *and* 2S — IGNITION SWITCH TERMINALS

Fig. 32. *Typical ignition system*

DESCRIPTION

The ignition system contains two electrical circuits. These are the low voltage or low tension primary circuit and the high voltage or high tension secondary circuit.

These circuits connect the following list of components shown in Figs. 32 and 34.

Primary circuit (low voltage)

1. Battery to,
2. Ignition switch to,
3. Ballast resistance (if used) to,
4. Primary winding of ignition coil to,
5. Contact breaker points and condenser inside distributor to,
6. Earth return to battery.

Secondary circuit (high voltage)

1. Secondary windings of ignition coil by HT lead to,
2. Distributor cap via carbon brush to,
3. Distributor rotor via air gap to,
4. Leads from distributor cap to,
5. Sparking plugs to,
6. Earth return to battery and thence to ignition switch, primary winding to coil secondary winding.

OPERATION

When the ignition is switched on, current from the battery flows through the ignition switch to the coil primary terminal, to which the wire from the switch is connected, through the coil primary winding, and then from the other coil primary terminal to the LT terminal on the distributor and through the contact breaker points WHEN CLOSED, to earth.

Each time the contact breaker points open the current flow to the coil primary winding is interrupted. This induces a very high voltage in the coil secondary winding which is fed through the distributor rotor and spark plug leads, in the correct firing sequence, to the sparking plugs.

More particulars of the ignition system components are given in the following paragraphs.

DETAILS AND USEFUL INFORMATION

Contact breaker—Operation, four cylinder engines

A four lobed cam, running at half engine speed, opens the contact breaker points after allowing them to remain closed for intervals of 60° cam rotation. During this period, known as the DWELL ANGLE, current passes through the ignition coil primary windings to create the magnetic field required to induce the very high voltage, in the secondary winding, when the contact breaker points open.

On four cylinder engines, covered by this section, ignition occurs at 180° intervals of crankshaft rotation. This becomes 90° intervals of distributor rotation because the distributor runs at half engine speed.
The small angular tolerance allowed on the ignition phasing intervals and dwell angle intervals are given in the Data Section under ignition.

Ignition coil — Operation

The ignition coil acts as a transformer, to increase the battery voltage, to an amount that can jump the distributor rotor and sparking plug gaps, under compression.

The ignition coil has a low voltage (low tension) primary winding, a high voltage (high tension) secondary winding, and a laminated soft iron core that provides a magnetic field whenever battery current flows through the primary winding. This occurs during the "Dwell angle" period while the contact breaker points are closed, when the ignition is switched on. Directly the contact breaker points open battery current flow is interrupted and the primary windings immediately cease to magnetize the laminated iron core. The rapid collapse of the magnetic field induces a very high voltage in the secondary winding that can amount to 20,000 volts (20 KV) on open circuit when a plug lead is disconnected from its particular sparking plug.

With clean, correctly set sparking plugs and a normal rotor gap about 12,000 volts (12 KV) is needed to jump the combined plug and rotor gap, when the engine is running and the plugs firing under compression.

Ignition coil — primary connections

Most coils have their primary terminals marked CB (contact breaker) and SW (switch wire), and provided the coil is the one specified for the vehicle the terminals are connected according to their markings; that is, the lead from the ignition switch to SW and the lead to the distributor to CB.

If a coil, with CB and SW terminal marking, specified for positive earth, has to be used on a negative earth wiring system, the primary connections have to be reversed; that is the switch wire will be connected to the CB terminal and the distributor LT lead to the SW terminal. Some coils have terminals marked + and —. These are used with both positive and negative earth return systems. The terminals are connected to suit the particular earth polarity with which the coil is used. With positive earth the + terminal is connected to the distributor LT terminal. With negative earth + is lead from the ignition switch.

Condenser

The condenser is changed by the current surge in the primary circuit, and the current induced in the primary winding, by the collapse of the coil magnetic field, when the contact breaker points open. This action prevents excessive arcing at the contact breaker points. Peak voltage reached in the condenser can amount to 300-400 volts.

Immediately after the coil HT discharge has been made the condenser discharges through the primary winding in the OPPOSITE direction to the primary current flow. This assists in the rapid demagnetising of the laminated iron core and ensures that the coil gives its maximum output from its secondary winding.

An additional condenser (capacitor) must never be connected to the distributor LT terminal. If this is done excessive pitting and burning of the contact breaker points will occur.

Ballast resistance unit

This unit is fitted to cars exported to territories where extremely cold starting conditions occur. It is used with a 7 volt coil and under all running conditions, other than starting, reduces the battery voltage to 7 volts. While the starter motor is operating, and the battery voltage reduced to approximately 9 volts due to the heavy current discharge through the starter, a pair of contacts inside the starter solenoid shorts out the ballast resistance. This allows a 9 volt feed to the 7 volt coil which causes the coil to give a very high output needed for starting under adverse conditions while the starter is operating. Directly the engine starts and the solenoid switch is opened, the ballast resistance comes back into the primary circuit and the voltage fed to the coil is reduced to 7 volts.

Ignition timing requirements

The correct timing of the spark, occurring at the sparking plug gap(s), as the high voltage from the coil secondary discharges when the contact breaker points open, depend upon the following:

Static ignition timing

This is the number of CRANKSHAFT DEGREES at which contact breaker points open before the top dead centre (BTDC) position, when the engine is rotated by hand, or by the starter. The methods of setting the ignition timing are given under CHECKING THE IGNITION TIMING.

Centrifugal advance

This is given by a weight and spring mechanism, situated below the contact breaker, that increases the ignition advance, as needed, with increase of engine speed.

The mechanism is connected to the distributor cam spindle. As engine speed increases the two weights move outwards, by the action of centrifugal force, and advance the cam spindle. When the engine speed is reduced the centrifugal force decreases and the weight control springs return the weights and retard the cam spindle.

Vacuum advance

A unit, containing a vacuum operated diaphragm, is situated on the upper front end of the distributor. It increases the ignition advance under small throttle opening conditions. This is necessary to enable the weaker part throttle mixture to be properly ignited under the lower compressions pressures caused by the partly opened throttle.

The diaphragm is linked to the contact breaker mounting plate which it advances when the vacuum is high enough to overcome the diaphragm return spring.

The diaphragm unit is connected by a small bore pipe to a drilling in the carburettor body immediately above the throttle edge in the idle position, so that THE VACUUM ADVANCE CANNOT OCCUR WHEN THE ENGINE IS IDLING.

Sparking Plugs — General Information
Gap

The sparking plug gaps, when correctly set, ensure good ignition under all conditions of engine operation. If the gaps are set, or become too wide, misfiring can occur and cold starting may become difficult. Plug gaps set too close can cause rough idling and misfiring.

Operating temperature

Sparking plugs that run too cold will become fouled with combustion deposits under town driving conditions, and plugs that run too hot will fail under hard motorway driving. These failures can also be caused by engine faults producing conditions that the plugs cannot withstand.

Sparking plug temperature is controlled by the construction of the plug insulator, particularly inside the plug body. The insulator of a correct plug, operating under conditions for which the plug was chosen, will allow sufficient heat flow to give the plug a normal life, and also retain enough heat to keep the plug insulator clean inside the plug body. This ensures that the sparking plugs will operate correctly for their recommended servicing period.

Heat range

Sparking plug manufacturers grade their plugs into "cold" and "hot" or "hard" and "soft" ranges. From these a suitable plug is chosen as specified in the Data Section under Ignition.

Corona discharge

This discharge can only be seen in darkness and must not be mistaken for HT discharge shorting across the sparking plug insulator. When occurring, it is seen as a faint blue light in the plug insulator above the plug metal body, and is caused by the HT field in the plug insulator.

Corona discharge can repel dust particles from the plug insulator so that a clean band is seen around the insulator above the plug body. It is a mistake to think that this is an evidence of gas leakage past the insulator IF the clean band on the insulator is caused by this discharge.

IGNITION FAULT DIAGNOSIS

Ignition system troubles are caused by a failure in the primary and/or secondary circuit, faulty operation of the sparking plugs or incorrect ignition timing.

Excessive resistance, anywhere in the low volatge circuit will lessen the output of the coil secondary winding causing poor performance and difficult starting.

Possible faults in the ignition system, and the effect that they have on engine performance are shown on the adjoining page.

Ignition timing, centrifugal, and vacuum advance checking are explained under IGNITION TIMING.

Test equipment

While it is possible to adjust and service the ignition system with hand tools, and the substitution of new parts for suspected parts, quicker and more reliable results are obtained when instruments are used.

The minimum equipment needed for thorough checking of the ignition system is:

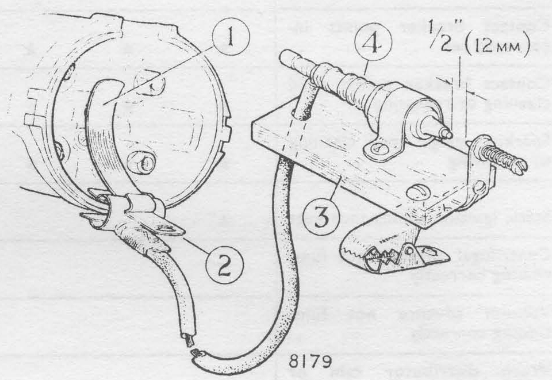
Voltmeter — with reading range of 0 - 2 and 0 - 20 volts.

Tachometer — for checking engine speed.

Stroboscopic timing light — for checking ignition timing, centrifugal, and vacuum advance.

Small vacuum gauge — for checking vacuum advance vacuum.

Adjustable spark gap — this is more convenient to use than holding an HT lead close to earth when checking the HT spark intensity. It can be made in Dealers' Workshops. See Fig. 33.



1. STEEL CONTACT STRIP
2. PAPER CLIP
3. HARDWOOD BASE
4. SPARKING PLUG—WITH THREADED END CUT AWAY

Fig. 33. *Adjustable spark gap*

The ideal equipment is an oscilloscope and other test instruments built into a complete portable unit like the "Motoscope" made by Crypton Equipment Ltd., Bridgwater, England. All makers of this class of equipment provide very comprehensive instructional and operating manuals explaining its advantages and use. Such equipment is particularly useful for tracing HT faults, testing the coil and condenser, and checking the distributor in position on the engine. It also provides the quickest and best means for checking the ignition system after overhaul, or pre-delivery checking of new or serviced vehicles.

Fault diagnosis and tracing

A breakdown or excessive voltage drop in the primary circuit can be caused by:

1. Burnt or incorrectly adjusted contact breaker points.
2. Faulty wiring, loose or dirty connections.
3. Faulty ignition switch.
4. A defective ignition coil.

A breakdown or loss of electrical energy in the secondary circuit can be caused by:

1. Fouled, worn, or improperly adjusted spark plugs.
2. A defective condenser.

IGNITION FAULTS

CAUSES	EFFECTS								
IGNITION FAULTS	Cranks but will not run	Starts but will not keep running	Misfires	Idling rough	Acceleration poor	Power and top speed down	Excessive fuel consumption	Pinking	Overheats
Discharged or defective battery	★		★						
Contact breaker points incorrectly set	★	★	★	★	★	★	★		★
Contact breaker points need cleaning or renewing	★	★	★	★	★	★	★	★	★
Sparking plugs need cleaning or renewing	★	★	★	★	★	★	★	★	★
Static ignition timing incorrect	★			★	★	★	★	★	★
Centrifugal advance not functioning correctly				★	★	★	★	★	★
Vacuum advance not functioning correctly							★	★	
Worn distributor cam or spindle bush				★	★	★	★	★	
Coil or condenser defective ..	★	★	★	★	★	★	★		★
Open circuit in ballast resistance (if fitted)		★							
HT leak on coil, distributor rotor or distributor cap ..	★	★	★						
HT lead(s) — open circuit ..	★								
HT leads incorrectly connected	★	★	★						
LT circuit—open circuit, faulty ignition switch, or high resistance or loose connections ..	★	★	★	★	★	★	★		★

★ = POSSIBLE EFFECT(S)

3. Defective high tension leads.
4. High tension leakage across the coil, distributor cap or rotor.
5. A defective coil.

The following method can be used to find in which circuit(s) the fault(s) occur.

1. Remove the distributor cap from the distributor.
2. Hold the bared end of a short length of HT wire onto the centre carbon brush that contacts the distributor rotor. A short rubber sleeve on the distributor end of the HT lead will help to keep the lead in position against the carbon brush. Hold the other end of this HT lead about $\frac{3}{16}$ in. from the cylinder head, or connect to a spark gap earthed on the engine cylinder head. See Fig. 33.
3. With the ignition switched on, rotate the engine with the starter motor and watch for a spark from the HT lead to the cylinder head, or across the spark gap.

If there is no spark, or a weak or short spark, the trouble is in one or more of the following: the Contact breaker points, condenser, HT lead from the coil to the distributor cap, the wiring in the primary circuit, or a defective coil. If the spark is satisfactory the trouble lies in the secondary circuit from the distributor to the sparking plugs not forgetting that it may be damp or tracking INSIDE the distributor cap.

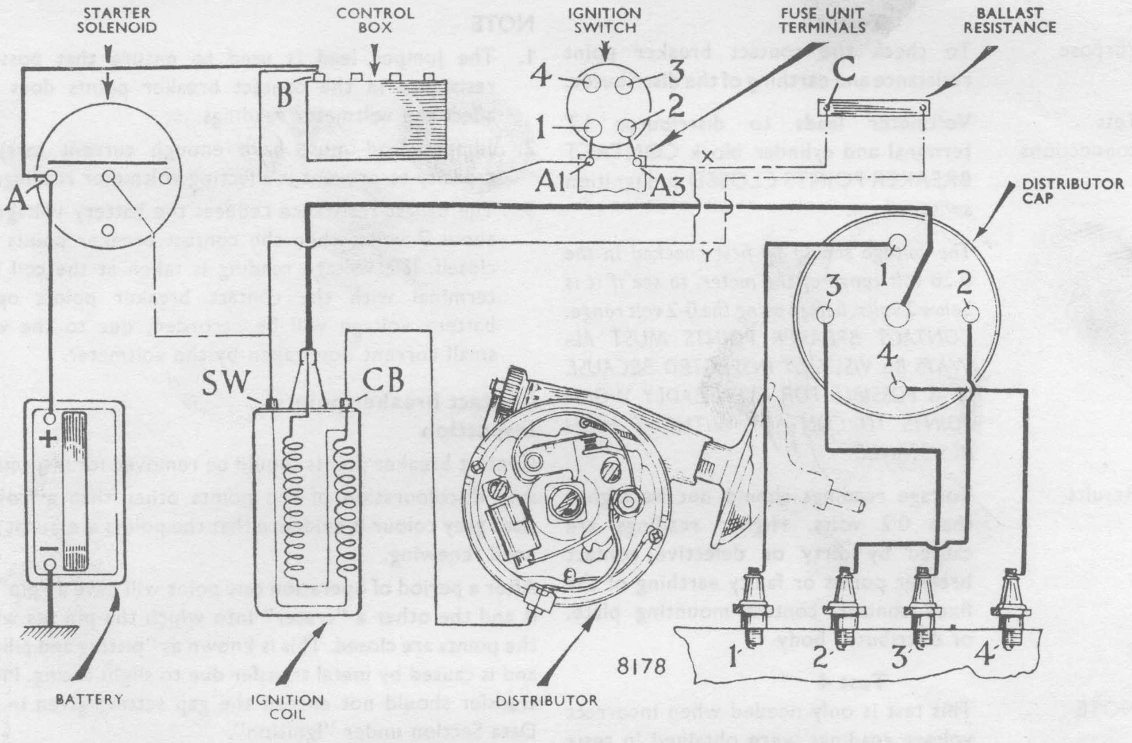


Fig. 34. *Ignition system showing voltmeter connection points for testing primary circuit*

Primary circuit tests — See Fig. 34

A complete check of the primary circuit can be made with a voltmeter having a range of 0-2 and 0-20 volts.

These tests find any excessive voltage drop in the primary circuit that will reduce the ignition coil HT output and cause difficult starting or poor performance.

Test 1

Purpose	To check voltage at the coil switch wire terminal when the ignition is switched on and the contact breaker points are closed.
Test connections	Voltmeter leads to coil SW terminal to which the switch wire is attached, and to earth, and a jumper lead connecting the distributor LT lead terminal to earth.
Results	Without a ballast resistance — 11·7 volts. With a ballast resistance — 7 volts. Lower readings are caused by defective battery, loose or high resistance connections, defective wiring, or faulty ballast resistance (if fitted).

Test 2

Purpose	To check voltage at coil under starting conditions.
Test connections	As for Test 1. The jumper lead is used to ensure that possible resistance in the contact breaker points or faulty earthing of the fixed contact point does not affect the voltage reading, and prevents the engine from starting.
Correct result	When the starter is turning the engine with the ignition switched on, the voltmeter reading should not be less than 9 volts. A lower reading indicates either a weak battery, defective cables or connections, or a faulty starter motor taking excessive current causing an abnormal volt drop.

Test 3

Purpose	To check the contact breaker point resistance and earthing of the distributor.
Test connections	Voltmeter leads to distributor LT terminal and cylinder block CONTACT BREAKER POINTS CLOSED and ignition switched on. *The voltage should be first checked in the 0-20 volt range of the meter, to see if it is below 2 volts, before using the 0-2 volt range. CONTACT BREAKER POINTS MUST ALWAYS BE VISUALLY INSPECTED BECAUSE IT IS POSSIBLE FOR EVEN BADLY WORN POINTS TO CONTACT WITHOUT HIGH RESISTANCE.*
Results	Voltage readings should not be higher than 0·2 volts. Higher readings are caused by dirty or defective contact breaker points or faulty earthing of the fixed contact, contact mounting plate, or distributor body.

Test 4

NOTE	This test is only needed when incorrect voltage readings were obtained in tests 1, 2 and 3.
Purpose	To locate any volt drop in primary circuit found in tests 1, 2 and 3.
Test connections	The voltmeter is connected to the engine cylinder block and to the ignition system terminals in the alphabetical order shown in Fig. 34. At the same time terminals should be checked for tightness because correct voltmeter readings are not an indication that terminals are tight.

Voltmeter connections	Correct voltage
Battery + and —	Not less than 12·4 volts.
Live terminal A on starter solenoid and cylinder block.	12·2 volts with ignition ON and jumper lead earthing distributor LT terminal.
Terminal B or A1 on regulator and cylinder block.	12 volts with ignition switched ON and jumper lead from distributor LT terminal to earth.
Terminal C. on ballast resistance (if fitted) and cylinder block.	11·7 volts with ignition switched ON and jumper lead from distributor LT terminal to earth.
Terminal SW on coil and cylinder block.	6·7 volts if ballast resistance is fitted. 11·7 volts without ballast resistance — with ignition switched ON and jumper lead from distributor LT terminal to earth.
C B terminal on coil and cylinder block.	0·2 volts maximum with ignition switched ON AND CONTACT BREAKER POINTS CLOSED and JUMPER LEAD REMOVED.

NOTE

1. The jumper lead is used to ensure that possible resistance in the contact breaker points does not affect the voltmeter readings.
2. Jumper lead must have enough current carrying capacity to prevent it affecting voltmeter readings.
3. The ballast resistance reduces the battery voltage to about 7 volts when the contact breaker points are closed. If a voltage reading is taken at the coil SW terminal with the contact breaker points open, battery voltage will be recorded, due to the very small current flow taken by the voltmeter.

Contact breaker points

Inspection

Contact breaker points should be removed for inspection. Any discolouration of the points other than a frosted slate grey colour is evidence that the points are burnt and need renewing.

After a period of operation one point will have a "pip" on it and the other a "crater" into which the pip fits when the points are closed. This is known as "pitting and piling" and is caused by metal transfer due to slight arcing. Metal transfer should not exceed the gap setting given in the Data Section under "Ignition".

Excessive pitting or burning is caused by:

1. Incorrect point alignment or insufficient contact area.
2. Voltage regulator setting too high.
3. Radio condenser fitted between coil CB terminal and distributor.
4. Condenser of incorrect capacity, probably due to fitting a spurious or non standard replacement.

Cleaning

Contact points can be cleaned with a fine oil stone. The "pip" should be stoned off but no attempt should be made to remove the "crater". After cleaning the contacts must meet over a large area. This is important. If the points contact over a very small area overheating, burning and arcing will occur.

Gap adjustment

The distributor breaker points must always be cleaned before adjusting the gap with a feeler gauge. If this is not done, the "pip" on one of the points will rest on top of the feeler blade and a wide setting will be obtained. The contact breaker point gap setting is given in the Data Section under "Ignition".

Breaker point spring tension

After refitting the breaker points and adjusting their gap the moveable point spring tension should be checked as shown in Fig. 35.

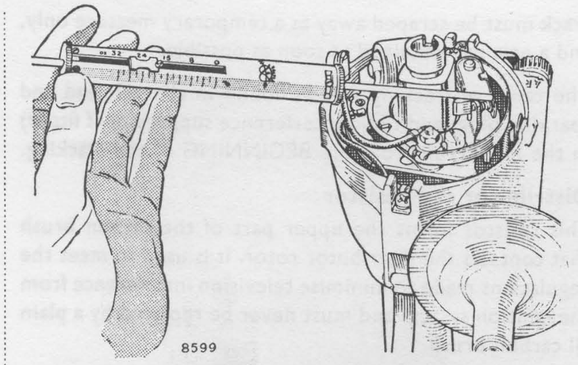


Fig. 35. *Checking contact breaker spring tension*

Because reliable spring balance readings cannot be obtained by visually observing when the contact breaker points open, a small 12 v. bulb should be used to indicate point opening. This bulb should be connected between the distributor LT lead and distributor terminal. In this position it will light when the contact breaker points are closed when the ignition is switched on. The spring balance reading should be taken immediately the bulb goes out.

If necessary, the moveable point spring can be set, at the left-hand end of the broken lines shown in Fig. 36, to obtain the correct spring tension.

Excessive spring force will cause rapid contact heel wear and consequent closing of the point gap. Too little spring force will allow the points to bounce and cause misfiring at high engine speed.

The moveable contact spring tension is given in the Data Section under "Ignition".

A suitable push type spring balance can be obtained from Geo. Salter & Co. Ltd., West Bromwich, England, under part number M.52324.

Coil and condenser — testing

Suitable test equipment is needed for testing the coil and condenser. If this is not available these items can only be checked by substituting new ones.

Should the HT spark appear to be weak or thin after the ignition circuits have been proved satisfactory, a new condenser should be fitted. If this makes no improvement a new coil should be tried. The condenser is the more likely to fail.

Secondary circuit — examination and tests

Preliminary checks

1. Inspect all HT leads for looseness or corrosion at terminal ends, breaks, and cracked insulation. Replace all defective leads.
2. Clean the inside and outside of the distributor cap and inspect for cracks, excessively erroded contacts inside the cap, and for signs of "tracking" between the contacts or from the centre carbon brush area.
3. Inspect the rotor for cracks and excessive burning on the end of the brass arm. Replace the rotor arm if it appears defective.

High tension leads — continuity tests

All types of high tension leads should be checked for continuity with a 12 volt supply. This detects any breaks however small. The use of HT current to check these leads is not a satisfactory method of testing because the HT current can jump any minor break and the lead will appear to have continuity. The break then burns wider and causes misfiring.

The high resistance type of HT lead, fitted to prevent radio and television interference, should be tested for continuity by putting the lead in series with a voltmeter—having a range of 0—20 volts and internal resistance of not less than 2000 ohms—and a 12 volt supply. The readings obtained with a good lead depend upon the lead internal resistance and the internal resistance of the voltmeter, and only prove that continuity exists.

Voltmeters having a high internal resistance give a high reading but cheap voltmeters with low internal resistance give too low a reading to be of use for this test.

Voltmeters fitted to Crypton or Suntester diagnosis equipment are suitable for making this test.

Rotor arm — testing insulation

The rotor can be checked for insulation in the following manner.

1. Remove distributor cap and attach a test length of HT cable, having a suitable rubber sleeve at one end, to the carbon brush holder inside the distributor cap. Electrical contact must be made to the carbon brush.
2. Turn the engine so that the contact breaker points are closed. Switch on the ignition and while opening the contact breaker points with a pencil hold the free end of the HT lead $\frac{3}{16}$ in. from the engine cylinder

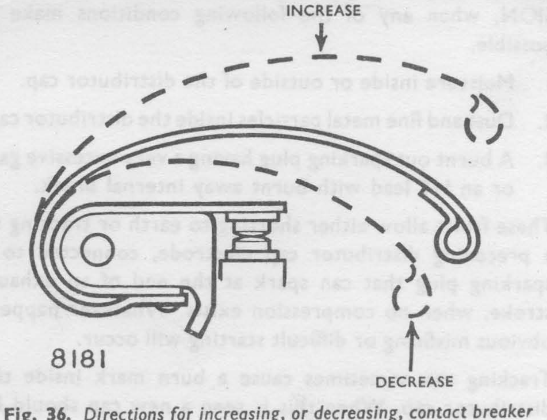


Fig. 36. *Directions for increasing, or decreasing, contact breaker spring tension*

block. A spark should occur each time the points are opened. THIS IS DONE TO PROVE THAT HT CURRENT IS AVAILABLE FOR THE ACTUAL TEST.

3. With the rotor in position on the distributor, hold the free end of the test HT lead about $\frac{1}{16}$ in. from the end of the rotor metal arm. Open the contact breaker points. NO HT SPARK SHOULD BE SEEN. If any spark is seen it is an indication that there is a leak path for HT current through the insulation of the rotor arm.

Rotor arm gap

Up to 3 KV (3000 volts) is needed to jump the ·020 ins. (·50 mm) gap between the rotor end and the HT pick up electrodes moulded into the distributor cap. This gap increases due to the erosion caused by the passage of the HT current and when it becomes excessive can cause intermittent misfiring at high engine speeds under wide throttle opening.

Badly eroded distributor caps or rotors should always be replaced.

When checking the ignition system with equipment that incorporates an osciloscope, the coil KV output to jump the rotor gap and sparking plugs, under compression, is seen as vertical "traces" representing about 12 KV. If a plug lead is removed and earthed the "trace" for this cylinder will be reduced to about a quarter of the previous height, because the HT current has only the rotor gap to jump. This trace height should be about 3 KV. A higher trace shows that there is excessive high resistance caused by a wide rotor gap or a break in the HT lead from the coil or to the plug from which the lead was disconnected.

Distributor cap — tracking and shorting

The HT current, feed to the distributor rotor, will always take an easier path to earth, than across the rotor gap and sparking plug gap UNDER CYLINDER COMPRESSION, when any of the following conditions make it possible.

1. Moisture inside or outside of the distributor cap.
2. Dust and fine metal particles inside the distributor cap.
3. A burnt out sparking plug having a very excessive gap, or an HT lead with burnt away internal break.

These faults allow either shorting to earth or tracking to a preceding distributor cap electrode, connected to a sparking plug that can spark at the end of an exhaust stroke, when no compression exists. Whatever happens obvious misfiring or difficult starting will occur.

Tracking can sometimes cause a burn mark inside the distributor cap. When this is seen a new cap should be fitted. If a new cap is not immediately available the burnt track must be scraped away as a temporary measure only, and a new cap obtained as soon as possible.

The cause of tracking will be found in the HT lead and sparking plug (and radio interference suppressor if fitted) in the HT circuit from the BEGINNING of the tracking.

Distributor cap resistor

This resistor forms the upper part of the carbon brush that contacts the distributor rotor. It is used to meet the regulations made to minimise television interference from the ignition system and must never be replaced by a plain all carbon brush.

SPARKING PLUGS

The correct type of sparking plug to use is given in the Data Section under "Ignition".

Sparking plugs should be removed, examined, cleaned and adjusted at the recommended intervals.

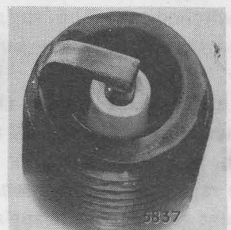


Fig. 37

Fig. 38

Fig. 39

Fig. 40

Fig. 41

Removal

Before removal the area around each plug should be cleared with a dry brush or compressed air to ensure that nothing can enter the cylinders, as the plugs are removed.

Examination—See Figs. 37—41

NORMAL CONDITION — Look for powdery deposits ranging from brown to greyish tan. Electrodes may be slightly worn. These are signs of sparking plugs used under normal conditions of mixed period of high speed and low speed driving. Cleaning and regapping of the sparking plugs is all that is required (see Fig. 37). White to yellowish powdery deposits usually indicate long periods of constant speed service. These deposits have no effect on performance if the sparking plugs are cleaned thoroughly, and the gaps reset at the recommended intervals. More frequent cleaning may be needed if the car is only used for short runs.

WORN CONDITION—This is illustrated in Fig. 38. Any spark plugs found in this condition should be replaced by the correct type given in the Data Section under "Ignition". A complete set should be fitted.

OIL FOULING — Is usually identified by wet sludge deposits traceable to excessive oil entering the combustion chamber through worn rings and pistons, excessive clearances between intake valve guides and stems or worn bearings, etc. (See Fig. 39). Hotter (softer) sparking plugs may alleviate oil fouling temporarily, but in severe cases engine overhaul is called for.

The excessive use of upper cylinder lubricant can also cause fouling.

PETROL FOULING — Is usually identified by dry black fluffy deposits which result from incomplete combustion (see Fig. 40). Too rich an air-fuel mixture or incorrect use of the choke can cause incomplete burning. In addition defective contact breaker points or H.T. cables can reduce voltage supplied to the sparking plug and cause misfiring. If fouling is evident in only a few cylinders, sticking valves may be the cause. Excessive idling, slow speeds or stop-and-go driving can also keep plug temperatures so low that normal combustion deposits are not burned off.

BURNED OR OVERHEATED — Burning or overheating of the sparking plugs are usually identified by a white, burnt or blistered insulator nose and badly eroded electrodes (see Fig. 41). Inefficient engine cooling and incorrect ignition timing can cause general overheating. If only a few sparking plugs are overheated, the cause may be uneven distribution of the coolant. Severe service, such as sustained high speed and heavy loads, can also produce abnormally high temperatures in the combustion chamber, which necessitates use of colder harder running sparking plugs.

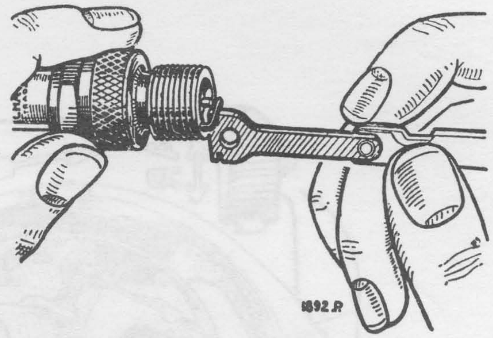


Fig. 42. *Adjusting sparking plug gap*

Cleaning, testing and adjustment

Plugs should be cleaned in a dry abrasive cleaning machine and then tested under pressure.

Excessive cleaning time must be avoided because the abrasive cleaning action can erode the electrode insulator. Before testing, the sparking surfaces of the electrodes should be lightly filed to remove all traces of burning and to restore flat parallel sparking surfaces. The gaps should then be set to the recommended dimension given in the Data Section under "Ignition".

The gap setting of sparking plugs is very important and adjustment is made by bending the earth electrode with a combined gauge and setting tool, as shown in Fig. 42.

After cleaning, the plug threads should be wire brushed to remove any accumulation of carbon or abrasive material.

A small quantity of graphite grease should be put on each sparking plug thread before the plugs are replaced.

IGNITION TIMING

Engines are very sensitive to ignition timing. Incorrect timing causes rough or harsh running, bad idling, excessive fuel consumption and poor performance.

The ignition timing summary, given on page 53, shows the interelation of ignition timing with the automatic centrifugal and vacuum advance action, and some of the effects that these can give.

Timing adjustments

Two means of adjusting the ignition timing are provided. They are:—

1. A clamp screw mounted horizontally. This is the coarse adjustment and when it is slackened the body of the distributor can be rotated in its mounting plate.
2. The vernier control. This provides an easy means of making small adjustments to the ignition timing to

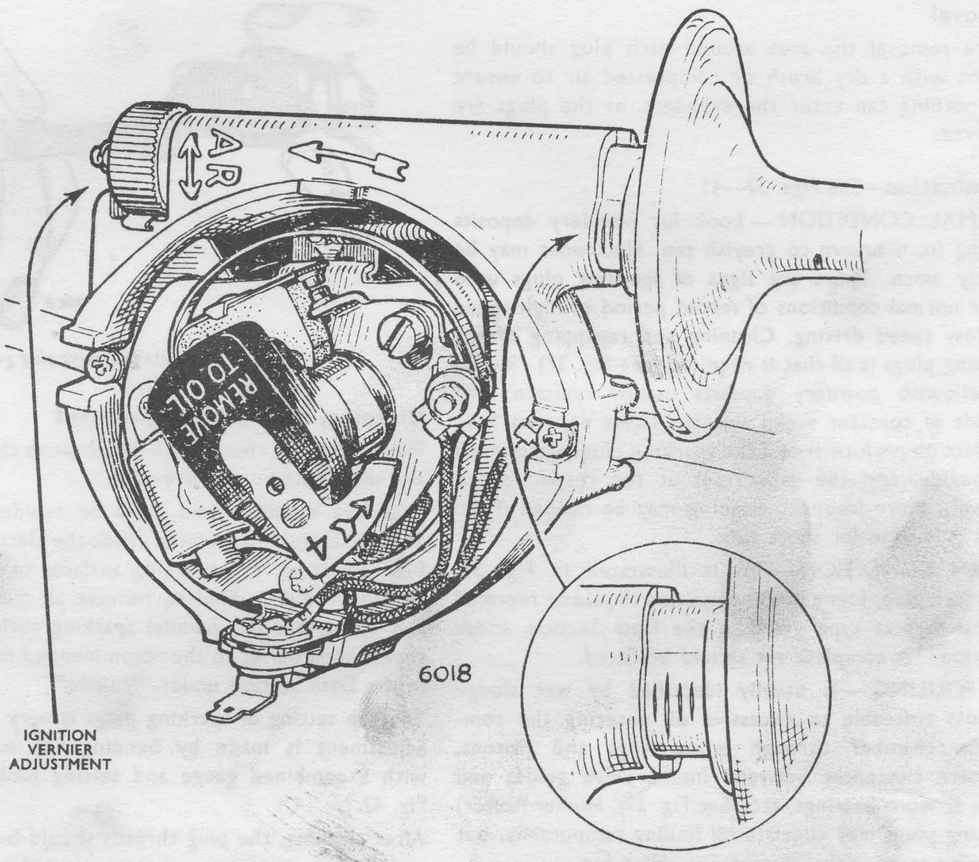


Fig. 43. *Distributor vernier control and vernier markings*

give the best performance from a particular fuel or to eliminate "pinking" when excessive carbon deposits have formed in the engine.

One turn of the vernier knurled adjustment is equivalent to three degrees of crankshaft rotation and one vernier adjustment spacing to four degrees of crankshaft rotation.

The knurled adjustment should be rotated clockwise to retard and anti-clockwise to advance as shown by the letters "R" (retard) and "A" (advance) cast on the distributor body close to the knurled adjustment.

Contact breaker gap — effect on ignition timing

Before checking the ignition timing it is most important to see that the contact breaker point gap is correctly set. If the ignition timing is adjusted while the contact breaker points are incorrectly set, the timing will alter when the points are correctly adjusted.

The contact breaker gap clearance is given in the Data Section under "Ignition System".

As the contact breaker point gap decreases through gradual wear of the moving point heel, the ignition timing becomes retarded. ·004 in. (·10 mm.) reduction of contact point gap retards the ignition by approximately 2° of crankshaft movement. This is equal to half a division on the vernier control, which is enough to reduce engine performance noticeably.

Timing marks—on crankshaft pulleys

See Figs. 44 and 45

Timing marks, spaced at six 5° intervals, are provided on the crankshaft pulleys. On engines with cast iron cylinder heads these take the form of seven or thirteen small vee notches on the rear face of the pulley. On engines with aluminium cylinder heads these spacings are given by seven or thirteen grooves cut across the face of the crankshaft damper periphery.

When the engine is rotated in its running direction TDC (top dead centre) is obtained on numbers 1 and 4 cylinders when the LAST of the vee notches, or cross lines, comes

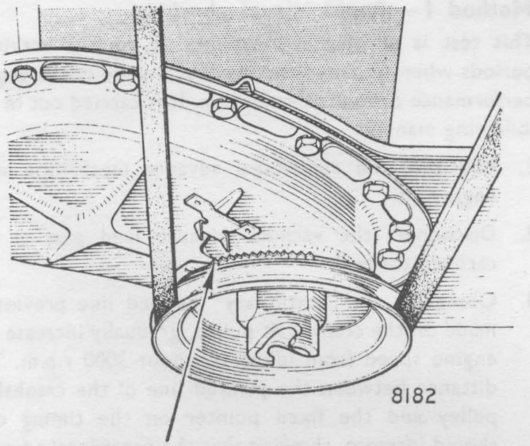


Fig. 44
Timing marks showing 10° BTDC position—engines with cast iron cylinder heads

opposite to the pointer on the timing case.

These timing marks are used to position, or measure the number of crankshaft degrees BTDC (before top dead centre).

Checking ignition timing — static method

Rotate the engine in its running direction until it reaches the required number of degrees BTDC for the ignition timing.

The number of degrees required is given in the Data Section under "Ignition System".

If 8° before TDC is needed this will be 1½ of the timing marks before TDC.

Set the vernier control to the midway position (2 divisions showing on scale). See Fig. 43 top illustration.

Remove the distributor cap and connect a 12 v. bulb between the L.T. terminal of the distributor and a good earth. With the battery connected and the ignition switched on, this bulb will light when the contact breaker points open.

Slacken the distributor clamp screw and rotate the body of the distributor anti-clockwise enough to close the contact breaker points.

Switch on ignition and applying light finger pressure to the rotor in a clockwise direction, return the distributor body clockwise until the bulb just lights.

Tighten the distributor clamp screws. Do not over-tighten because this distorts the clamp.

Check the setting by turning the crankshaft one revolution clockwise until the bulb again lights, observing the relative positions of the fixed timing pointer and pointer or mark on the crankshaft pulley.

The correct mark or pointer on the crankshaft pulley must be opposite the fixed pointer on the timing case.

Switch off the ignition, remove test light, refit distributor cap, and vacuum advance pipe, if removed.

Checking ignition timing — with stroboscopic timing light

A stroboscopic timing light allows the ignition timing to be checked while the engine is running.

When correctly connected, this type of timing light gives a high intensity flash each time No. 1 cylinder fires, and when this light is directed onto the crankshaft pulley, the pulley appears to be "stationary" whilst the engine running. It is therefore possible to "see" what the ignition timing is while the engine is running, and, if necessary, to adjust the ignition timing without stopping the engine.

When using a stroboscopic timing light the ignition timing must be checked at a speed well below that at which the centrifugal advance begins to operate, or at a known speed at which a known centrifugal advance occurs. Tests MUST NOT be made at high idling speeds.

If the engine idling speed can be adjusted to 500 r.p.m. (for this test) the distributor centrifugal advance will not have begun to operate, and the correct ignition timing mark, on the crankshaft pulley, should appear opposite to the fixed pointer on the timing case, when seen in the projected light of the stroboscopic timing light.

When the engine idling speed has to be set at some speed above 500 r.p.m. such as 850 r.p.m., the distributor centrifugal advance may have begun to operate. In such cases the ignition timing will have to be checked after the engine speed has been set to 1000 r.p.m. using a

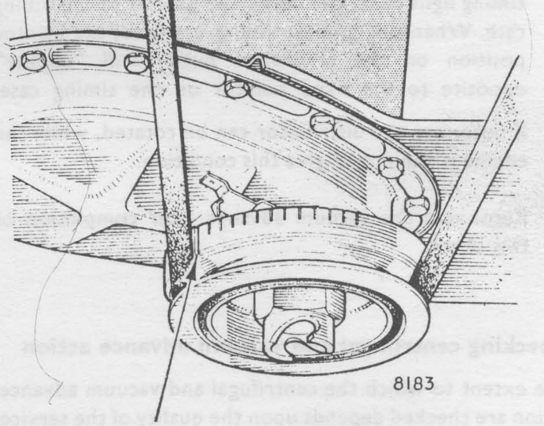


Fig. 45
Timing marks showing 8° BTDC position—engines with aluminium cylinder heads

reliable tachometer to check the engine speed. The ignition timing then becomes static advance plus the centrifugal advance in crankshaft degrees for 1000 r.p.m. crankshaft speed. This is easily arrived at by reference to "Ignition System" in the Data Section.

Example

Static advance angle	7°-9° BTDC (Crankshaft degrees)
Centrifugal advance	At a crankshaft speed of 1000 r.p.m. is 4°.
Therefore advance for engine speed of 1000 r.p.m. is	8°BTDC + 4°BTDC = 12°BTDC or $2\frac{1}{2}$ timing marks BTDC on the crankshaft pulley.

To check the ignition timing by this method:

1. Disconnect the vacuum advance pipe, from the carburettor end, to ensure that the vacuum advance unit does not begin to operate.
2. Clean the fixed pointer on the timing case and the crankshaft pulley markings. Using quick drying white paint, paint the fixed pointer point, and the correct degree position on the crankshaft pulley.
   For engines that can idle at 500 r.p.m. this is the static ignition angle.
   For engines with high idling speed this is the static ignition advance angle plus the centrifugal advance in crankshaft degrees for 1000 r.p.m. crankshaft speed.
3. With the engine running at one or the other of the previously given speeds, project the stroboscopic timing light beam onto the fixed pointer of the timing case. When the ignition timing is correct the painted position on the crankshaft pulley will "appear" opposite to the fixed pointer on the timing case.
   If necessary the distributor can be rotated, while the engine is running to give this condition.
4. Reconnect the vacuum advance after completion of this check.

Checking centrifugal and vacuum advance action

The extent to which the centrifugal and vacuum advance action are checked depends upon the quality of the service required and the symptoms requiring diagnosis.

The methods used are:

Method 1 — Rapid Visual checking

This test is all that is necessary at routine servicing periods when no complaint has been made of the engine performance or fuel consumption. It is carried out in the following manner.

1. Lubricate the centrifugal advance mechanism with engine oil.
2. Disconnect the vacuum advance feed pipe at the carburettor end.
3. Observing the "stationary" painted line previously made on the crankshaft pulley, gradually increase the engine speed from idling to about 3000 r.p.m. The distance between the painted line of the crankshaft pulley and the fixed pointer on the timing case should increase, showing that the centrifugal advance mechanism is operating. Jerky movement of the timing line while increasing or decreasing engine speed indicates sticky action of the centrifugal advance mechanism.
4. Adjust, or hold, the engine speed to about 1500 r.p.m. and still watching the line on the crankshaft pulley with the stroboscopic timing light, connect and disconnect the vacuum advance pipe rubber sleeve connection to the carburettor. This should cause the vacuum advance to come in and out of operation which will be shown by "movement" of line on the crankshaft pulley. Blockage of the vacuum pipe, vacuum take off hole in the carburettor, jamming of the contact breaker point mounting plate, leaking diaphragm, or diaphragm unit, will prevent correct vacuum advance action.

Method 2 — Measuring advance angle at, or up to 3500 r.p.m.

This method is used when investigating complaints of poor performance, rough running, "pinking", and excessive fuel consumption. While this does not give a complete test of the distributor over its entire operating speed range; because the engine should not be run above 3500 r.p.m. unloaded, the results obtained are satisfactory for almost all purposes. Tests made by this method cover ignition conditions during acceleration and economy driving conditions up to approximately 60 m.p.h. (96 k.p.h.).

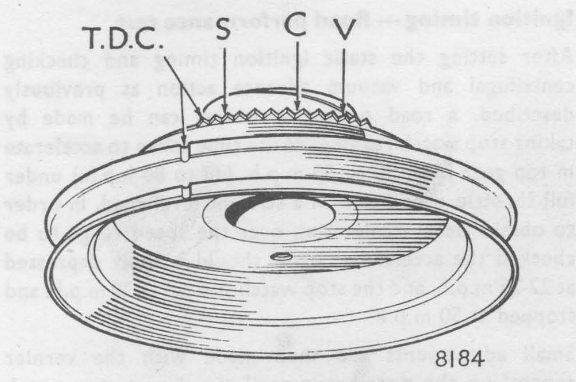
The minimum equipment need to carry out this test using the following procedure is,

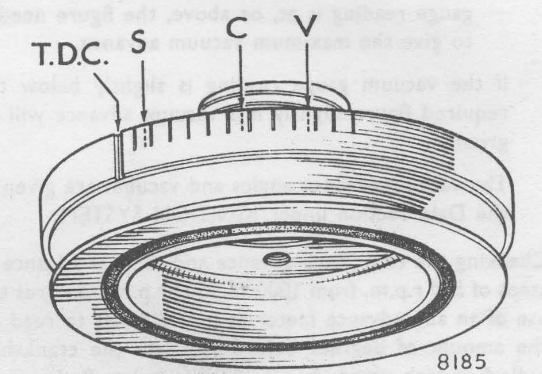
A stroboscopic timing light.

A vacuum gauge.

A reliable tachometer.

1. Disconnect the vacuum advance pipe connection at the carburettor end.





IMPORTANT—*The above only illustrate the text and must not be copied*

TDC = TOP DEAD CENTRE
S = STATIC IGNITION SETTING
C = CENTRIFUGAL ADVANCE
V = VACUUM ADVANCE

Fig. 46. *Crankshaft pulleys marked up for checking centrifugal and vacuum advance*

2. Check, and if necessary adjust the static ignition timing, using a stroboscopic timing light as described on page 50.

3. Refer to the Data Section under "Ignition System" and obtain the centrifugal advance angle for an engine crankshaft speed of 3500 r.p.m. Add this figure and the static ignition figure together and paint this position on the crankshaft pulley.

Example	Crankshaft degrees
Static ignition advance angle 7°-9° BTDC	8° BTDC
Crankshaft centrifugal advance at 3500 r.p.m. is 25°	25° BTDC
	33° BTDC

33° BTDC is $6\frac{1}{2}$ crankshaft pulley markings.

4. From this position, mark off a further number of degrees corresponding to the maximum amount of crankshaft vacuum advance. If there are not enough 5° spaced timing marks for this to be done, dividers can be set to this angle using the existing timing marks, and then using the dividers to mark off the vacuum advance angle from the centrifugal advance position.

Example — If the distributor maximum vacuum advance angle is $7\frac{1}{2}$° the crankshaft angle is twice this amount, 15°, and the dividers would be set to a distance of three 5° spacing marks.

The crankshaft pulley is now marked as shown in Fig. 46. It is an advantage to mark the position 'V' with yellow paint.

5. Connect a tachometer to the engine and a vacuum gauge between the distributor vacuum feed pipe and distributor vacuum advance unit connection.

6. Run the engine at 3500 r.p.m. and observe the crankshaft pulley in the light given by the stroboscopic timing light.

(a) With the vacuum advance pipe disconnected the centrifugal advance angle marking, shown as 'C' in Fig. 46 should appear opposite to the fixed pointer on the timing case.

(b) With the vacuum advance pipe connected the vacuum advance angle marking, shown as 'V' in Fig. 46, should appear opposite to the fixed pointer on the timing case PROVIDED THAT the vacuum gauge reading is at, or above, the figure needed to give the maximum vacuum advance.

If the vacuum gauge reading is slightly below the required figure slightly less vacuum advance will be given.

The vacuum advance angles and vacuum are given in the Data Section under IGNITION SYSTEM.

Checking the centrifugal advance and vacuum advance in steps of 500 r.p.m. from 1000 to 3500 r.p.m. requires the use of an autoadvance meter as it is difficult to read off the amount of degrees before TDC on the crankshaft pulley, at each speed. As a test it is used to find a cause for "pinking" or poor performance that still occurs after adjusting the ignition timing correctly.

Incorrect results

If any of the results appear to be incorrect the possible causes are:

1. Observation errors.
2. Instrument errors.
3. Crankshaft pulley incorrectly marked.
4. Static ignition timing not correctly set with the stroboscopic timing light.
5. Centrifugal advance mechanism sticking due to lack of lubrication.
6. Vacuum advance mechanism sticking.
7. Vacuum advance vacuum insufficient due to blockage or leaks in feed line from the carburettor, or blockage of the drilling in the carburettor body.
8. Leaking diaphragm in the vacuum advance unit.
9. Incorrect distributor fitted.
10. Wrong data used.

Method 3 — Removing distributor and testing on a synchroscope

This method is recommended when above the average standards of servicing are needed, as for instance when preparing for competition events. It enables the distributor to be tested up to its highest operating speeds corresponding to the maximum road speed.

As this test cannot show faults caused by an irregular drive to the distributor, a check should be made with the distributor in position on the engine to ensure that the firing angles are not increased by the distributor drive. This can only be done with test equipment incorporating an oscilloscope.

Ignition timing — Road performance test

After setting the static ignition timing and checking centrifugal and vacuum advance action as previously described, a road performance test can be made by taking stop watch readings of the time taken to accelerate in top gear from 30 to 50 m.p.h. (48 to 80 k.p.h.) under full throttle conditions on a straight level road. In order to obtain clean acceleration over the speed range to be checked the accelerator pedal should be fully depressed at 22-25 m.p.h. and the stop watch started at 30 m.p.h. and stopped at 50 m.p.h.

Small adjustments are then made with the vernier control on the distributor until the lowest stop watch reading is obtained. Several test runs have to be made ON THE SAME ROAD in the same direction.

The accelerator should not be fully depressed at 30 m.p.h. as this can produce inaccurate results due to possible temporary richness caused by the fuel injected by the accelerator pump or other enrichment device. This test requires considerable skill and should only be undertaken by those who have the necessary road testing experience. GREAT CARE IS NEEDED TO PREVENT OVER ADVANCING THE IGNITION TIMING.

It is emphasized that the distributor centrifugal and vacuum advance mechanism, must be working correctly and if these are in any way suspect, after checking the distributor in position, the distributor should be removed and checked on a reliable test rig or distributor analyser. The use of a Crypton test equipment is recommended. Distributor centrifugal and vacuum advance figures are given in the Data Section under "Ignition".

Weather conditions

Atmospheric temperature, pressure (barometer reading) and humidity (dampness) all affect engine performance and must be taken into account. For example, if the ignition setting was made — by the road performance method — when the barometer was very low and the air very damp, the setting made might prove to be too advanced under the operating conditions shown by a high barometer reading and warm dry air.

Fuel

Whenever possible, the ignition timing, if finalised by the road performance method, should be set to the fuel used by the owner provided it has a suitable octane rating.

Instances are met where owners have bought or use fuels of too low an octane rating. This is shown by audible pinking with the ignition correctly adjusted by the static method. If the fuel is suspected the car should be tested with a suitable fuel in a test tank connected to the fuel pump inlet connection.

IGNITION TIMING SUMMARY

Static Ignition Timing	Centrifugal Advance Action	Vacuum Advance Action	Result
Correct	Correct	Correct	Whole ignition range operating correctly giving maximum power, acceleration and low fuel consumption with smooth running.
Too advanced	†	†	†Also becomes incorrect and causes rough running sometimes "pinking" and inferior performance.
Too retarded	*	*	*Also incorrect. Causes overheating, bad performance and high fuel consumption.
Correct	Sticking or inoperative mechanism	Correct	Causes poor performance and sometimes "pinking" or back-firing.
Correct	Correct	Sticking or not operating	Can lower fuel consumption up to 4 m.p.g. under light throttle driving conditions. The effect on performance is hardly noticeable. It does not affect accelaration

Testing for air leakage in vacuum advance system

This can be done as follows.

1. Disconnect the vacuum advance vacuum pipe at the carburettor end, and using suitable rubber tubing connect a Tee piece between the end of the vacuum pipe and the carburettor connection.
2. Connect a vacuum gauge to the remaining outlet from the Tee piece.
3. Start the engine and increase its speed until the vacuum gauge reads 15 to 20 ins. of vacuum.
4. Compress the rubber tube between the Tee piece and carburettor. Then stop the engine. If the diaphragm, diaphragm unit, feed pipe, and feed pipe connection are free from air leaks the vacuum gauge reading will remain stationary until pressure on the rubber pipe is released.

DISTRIBUTOR

Identification

Distributors are normally identified by their Lucas Dispatch Number which will be found stamped on the distributor body just below the vernier control.

The dispatch number of the correct distributors for the various engines are given in the Data Section under "Ignition System".

If necessary the amount of centrifugal and vacuum advance can be found from numbers stamped on these mechanisms as explained in the following paragraphs. These will be found useful when a distributor performance does not match to the specification for its dispatch number.

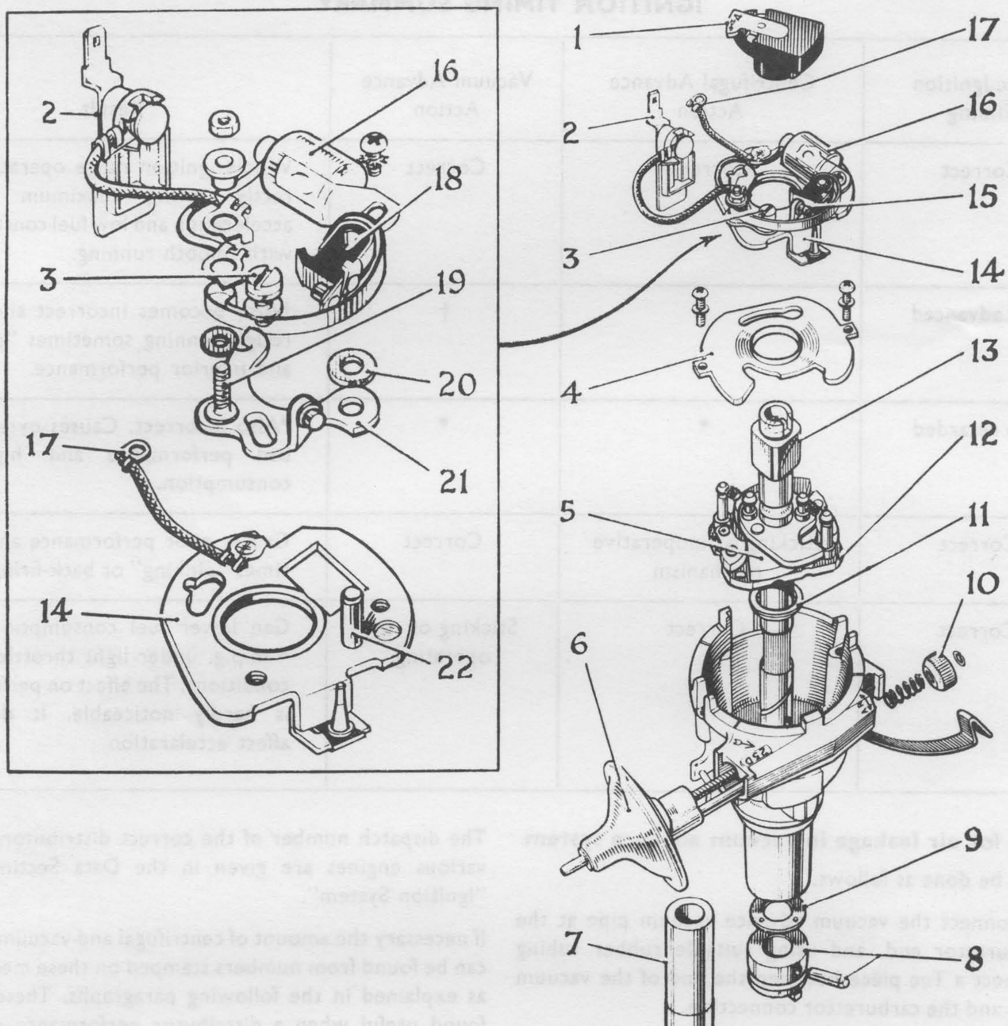
Amount of centrifugal advance

On DM2 type distributors the amount of centrifugal advance in distributor degrees, is stamped on the circular plate on which the centrifugal advance weights are mounted. To see this number it is necessary to remove the contact breaker mounting plate and the advance weights.

On 25D type distributors this number is stamped on the curved arm extension of the cam spindle and can be seen after removing the contact breaker mounting plate.

Amount of vacuum advance

Vacuum advance units are stamped externally. The following is given as an example.



1. ROTOR ARM
2. L.T. TERMINAL
3. FIXED CONTACT PLATE SECURING SCREW
4. CONTACT BREAKER BASE PLATE
5. CENTRIFUGAL ADVANCE CONTROL WEIGHTS
6. VACUUM ADVANCE CONTROL UNIT
7. BEARING BUSH
8. DOG AND PIN
9. THRUST WASHER
10. VERNIER ADJUSTMENT NUT
11. DISTANCE COLLAR
12. ACTION PLATE
13. CAM
14. CONTACT BREAKER MOVING PLATE
15. CONTACTS
16. CONDENSER
17. C.B. EARTH CONNECTOR
18. CONTACT BREAKER LEVER
19. TERMINAL PILLAR
20. FIBRE WASHER
21. FIXED CONTACT PLATE
22. CONTACT BREAKER PIVOT POST

Fig. 47. *Exploded view of Lucas 25D type distributor*

Example

Marking 5 — 11 — 7.

5 = Vacuum in inches of mercury at which vacuum advance commences.

11 = Vacuum in inches of mercury at which maximum vacuum advance is reached.

7 = Maximum amount of VACUUM ADVANCE in DISTRIBUTOR DEGREES reached after 11 ins. of vacuum is applied to the diaphragm unit.

Overhaul

Dismantling—See Fig. 47

When dismantling, carefully note the positions in which the various components are fitted, in order to ensure their correct replacement on reassembly. The tongue of the driving dog is offset: note the relation between it and the rotor electrode and maintain this relation when reassembling the distributor.

The amount of dismantling necessary will obviously depend on the repair required.

Spring back the securing clips and remove the moulded cover. Lift the rotor arm off the spindle. Disconnect the vacuum unit link to the contact breaker moving plate and remove the two screws at the edge of the contact breaker baseplate. Disconnect the L.T. cable. The contact breaker assembly, complete with external terminal, can now be lifted off. Remove the circlip on the end of the micrometer timing screw, and turn the micrometer nut until the screw and the vacuum unit assembly are freed. Take care not to lose the ratchet and coil type spring located under the micrometer nut. The shaft assembly, complete with centrifugal timing control and cam foot can now be removed from the distributor body after removing the dog securing pin.

Contact breaker

To dismantle the assembly further, remove the nut, insulating piece and connections from the pillar on which the contact breaker spring is anchored. Lift off the contact breaker lever and the insulating washers beneath it. Remove the screw securing the fixed contact plate, together with the spring and plain steel washers, and take off the plate. Withdraw the single screw securing the capacitor. Dismantle the contact breaker base assembly by turning the base plate clockwise and pulling to release it from the contact breaker moving plate.

Shaft and Action Plate

When dismantling the centrifugal timing control mechanism it is important that it is carried out in the order described otherwise damage to the springs may result. Carefully lift off the springs, withdraw the screw inside the cam and take off the cam and cam foot. The weights can now be lifted off. Note that a distance collar is fitted on the shaft beneath the action plate.

Bearing replacement

The bearing bush is of sintered copper-iron and is stepped, having the larger diameter extending $\frac{3}{4}$ in. (19 mm.) in length from the bottom of the bush. Prepare the new bush for fitting by allowing it to stand completely immersed in clean medium viscosity (SAE 30-40) engine oil for at least 24 hours. In cases of extreme urgency, this period of soaking may be lessened by heating the oil to 100°C for 2 hours, then allowing the oil to cool before removing the bush. The following procedure must be closely followed when fitting a replacement bearing bush:

(1) Using a shouldered mandrel of appropriate diameter press out the worn bush from the body end.

(2) Insert the replacement bush from the drive end, with the smaller bush diameter as the leading part. The bush will be a push fit until the larger diameter comes into contact with the shank. With the mandrel in position, the bush is then to be pushed fully in with steady pressure, using a press, vice, or similar method. When in place, the bush must be a tight fit, flush with the shank at the drive end with a slight protrusion at the top end.

(3) Drill the shaft drain hole, carefully removing any fragments of metal.

(4) Insert the shaft and action plate assembly, with clean engine oil applied to the shaft. Make sure that there is no fraze around the hole in the shaft through which the driving dog securing pin is inserted. If the shaft is tight in the bearing when fitted, tap lightly at the drive end and withdraw the shaft. Again insert the shaft, and repeat the operation as long as any tightness exists. It is important that the shaft is free to rotate without binding.

(5) Run the shaft and body in a test rig or lathe for about 15 minutes, re-lubricate the shaft with clean engine oil and reassemble the distributor.

Under no circumstances is the bush to be over-bored by reaming or any other means, since this will impair the porosity and thereby the effective lubricating quality of the bush.

Reassembly—See Fig. 47.

The following instructions assume that complete dismantling has been undertaken.

(1) Place the distance collar over the shaft, smear the shaft with clean engine oil, and fit it into its bearing.

(2) Refit the vacuum unit onto its housing and refit the spring, milled adjusting nut and securing circlip.

(3) Reassemble the centrifugal timing control weights, cam and cam foot to the shaft. Fit the cam securing screw, then engage the springs with the cam foot pillars.
(Ensure that the springs are not stretched or damaged.)

(4) Before reassembling the contact breaker base assembly, lightly smear the base plate with clean engine oil or light grease. Fit the contact breaker moving plate to the contact breaker base plate and secure using a reversal of the dismantling procedure. Refit the contact breaker base into the distributor body. Engage the link from the vacuum unit. Insert the two base plate securing screws, one of which also secures one end of the contact breaker earthing cable.

(5) Refit the capacitor. Place the fixed contact plate in position and secure lightly with the securing screw. One plain and one spring washer must be fitted under the securing screw.

(6) Place the insulating washers, etc., on the contact breaker pivot post end on the pillar on which the end of the contact breaker spring locates. Refit the contact breaker lever and spring.

(7) Slide the terminal block into its slot.

(8) Thread the low tension connector and capacitor eyelets on to the insulating piece, and place these on the pillar which secures the end of the contact breaker spring. Refit the washer and securing nut.

(9) Set the contact gap to ·015 in. (·38 mm.) and tighten the fixed contact plate securing screw.

(10) Refit the rotor arm, locating the moulded projection in the rotor arm with the keyway in the shaft, and pushing fully home. Refit the moulded cover.

Replacement contacts

If the contacts are so badly worn that replacement is necessary, they must be renewed as a pair and not individually. New contacts are covered with a protective coating which must be removed before they are fitted. The contact gap must be set to ·015 in. (·38 mm.). After the first 500 miles running with new contacts fitted, they should be cleaned if necessary and the gap reset to ·015 in. (·38 mm.). This procedure allows for the initial "bedding-in" of the heel.

To remove and refit

Remove high tension leads from plug terminals, noting their positions. Disconnect high tension lead at coil. Disconnect low tension lead at distributor body. Disconnect vacuum pipe. Remove the setbolt securing the distributor clamping plate to the distributor housing and withdraw distributor and housing together.

Refitting is a reversal of the above.

Check ignition timing.

To fit replacement distributor

Before fitting a replacement distributor, turn the engine so that the timing mark on the crankshaft pulley comes opposite to the pointer on the timing case when the distributor driving slots in oil pump gear are in the position illustrated in Fig. 14, Section B.

Install replacement distributor.

The distributor rotor is now adjacent to No. 1 H.T. connection in the distributor cap. No. 1 H.T. lead should be fitted to this connection and No. 1 cylinder spark plug and the other H.T. leads to give the correct firing order of 1, 3, 4, 2. The distributor rotor rotates in an anti-clockwise direction as seen when the distributor cap is removed.

Set the ignition timing by one of the methods previously described.