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Section 3 COIL IGNITION



JOSEPH LUCAS (SALES & SERVICE) LTD · BIRMINGHAM 18

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INTRODUCTION

It's a far cry back to the early days of coil ignition with flick contact breakers and "trembler" ignition coils. Nevertheless the principles involved have not seriously changed in any way. The high performance and absolute reliability of modern coil ignition equipment stands out as a testimony to what can be achieved by steady and persistent development.

The field of application for the modern coil ignition set now ranges from the small fractional horse power engine designed for general work right to the largest racing engines with up to 16 cylinders.

All this development has taken place at some loss to magneto Ignition, but great advances have taken place in this field and there remain extensive applications for both magnetos and flywheel ignition.

The Lucas range of ignition coils and distributors are designed to suit any type of petrol engine now in use and embody a variety of distinctive features to suit engine designers' special requirements.

The ignition coil and distributor really comprise a pair and when applied as original equipment to an engine may be accepted as the most suitable combinations for that engine, and unless subsequent change is recommended by the engine manufacturers or ourselves, there is nothing to be gained, but possibly a good deal to be lost, by haphazard exchange of ignition coils, mouldings, or other components, particularly contact breaker sets of other manufacture.

The type of ignition coil is primarily dictated by the requirements of the engine i.e. Compression Ratios, Plug Gaps, etc. To provide for the varying requirements of different engine makers, several types of ignition coils and distributors are manufactured.

Ignition coil performance will be most seriously affected by the contact breaker which operates it, particularly at the high speed end of the scale.

It is often doubtful whether the important part which the contact breaker plays in the satisfactory performance of an engine is fully realised. On a six cylinder engine running at four thousand revolutions per minute the contact breaker has to make and break at accurate pre-determined intervals, with absolute precision, some twelve thousand times per minute. At each make and break a starting current commencing at 4.0 amperes or so and falling away to about 1.5 amperes as speed increases has to pass across the points without appreciable voltage drop, if the coil is to build up a maximum spark voltage during the very brief time the contacts are closed. To achieve this a great deal of thought goes into the development of the contact breaker set.

To maintain the efficiency of the component in service only a modest amount of periodic attention is required, but this is necessary if the best results are to be consistently obtained. The racing enthusiast will give as much attention to the contact breaker as to the valves and carburation of an engine!

The original manufacturer is bound to produce a contact breaker set which will do everything that he claims for the ignition coil and distributor, and maintain this perfect condition for the longest possible time. The spurious part maker by contrast has no such responsibility, providing that his component will work reasonably well he may be satisfied.

All told the distributor comprises four distinct but complementary components each with a separate function to perform :

Firstly, the contact breaker and cam assembly which interrupts the primary winding of the ignition coil and thus produces the spark at the correct angular intervals.

Next the distributor rotor and cover which serves to distribute the spark in the correct cylinder firing order.

Thirdly, the centrifugal automatic unit which advances and retards the spark according to the requirements of varying engine speeds and fourthly a supplementary vacuum advance device. This latter being a more recent development which provides varying and additional spark advance under high speed light load conditions.

The maintenance and servicing of the whole equipment is simple and given a reasonable knowledge of the various types of units and their applications, very little specialised electrical knowledge or data is required. For this reason a study of the information contained in this book will prove most useful in the course of the day's work.

CONTENTS

PART 1.

Coil Ignition Systems — Circuit Layout, Construction and Operation of the Coil. Components of the Ignition Circuit.

The complete Ignition System.
The production of the H.T. spark.
Ignition Coils — The Primary Circuit.
The Secondary Circuit.
The function of the Condenser.
Construction of the Ignition Coil — The Windings.
Auto-Transformer action.
'Negative Spark' — The advantages gained.
'Negative Earth' Coils.
Coil Types — Factors which determine the coil make-up.

PART 2.

Distributors — Operation and Ignition Timing.

The functions of a Distributor — The Cam and Contact Breaker.
The Condenser — new metallised paper type.
Rotors — the Extended Electrode, Rotation.
Distributor Caps — Spark 'Tracking.'
Auto-Advance and Spark Timing.
Types of Centrifugal Advance Assemblies.
Engine and 'Pinking' Curves, Advance Curves.
Vacuum Advance — Its effect on Engine Performance.
Fitting Dog to Distributor.
Fitting a Distributor to an Engine — Ignition Timing and Firing Order.

PART 3.

Distributor Types, Construction and Application.

Symbols in use.
Types — DK, DKY, DKZ ; DX, DZ ; DVX, DVZ ; DU, DULF ; and the latest 'DM' range.
Design features :
Vacuum Advance Units, Bearings, Centrifugal Mechanism, The 'High Lift' Cam, Contact Sets, Distributor Caps.

PART 4.

Testing.

Test procedure for the Ignition Circuit.
All operations are detailed and in Practical Sequence.

PART 5.

Servicing.

Points in the Ignition System needing attention — Spark Plugs, H.T. Leads, Distributor Mouldings and Bearings, Rotors, Contact Breaker and Cam, Lubrication.
The Contact Gap Setting — Different Cam types.
Factors influencing cam design.

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Coil Ignition Systems

Circuit Layout, Construction and Operation of the Coil

GENERAL.

In considering the Ignition System of the modern motor vehicle we are dealing with something vital to it's running.

The many refinements introduced on individual components have not disturbed the simplicity of the ignition system as a whole; in dispensing with complications reliability has been assured.

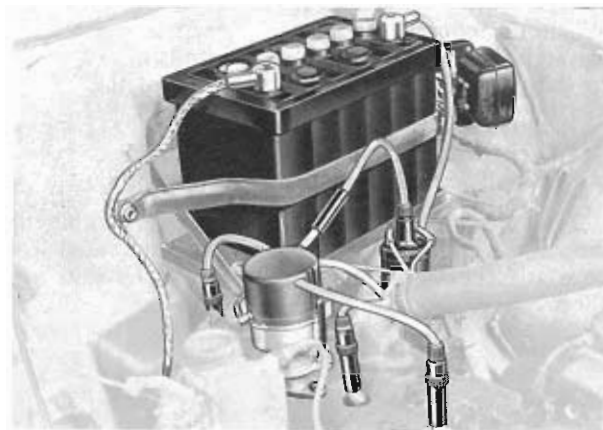
In addition, maintenance has been reduced to an absolute minimum. The average vehicle user of today is not prepared to spend a large amount of time under the bonnet, so the aim of design must be : maximum reliability with minimum maintenance.

This aim has also kept pace with the great advances which have taken place in engine design and performance, particularly as regards higher speeds, higher compression Ratios, and wide Plug Gap Settings which coupled with lean mixtures, produce greater fuel economy.

You can see then that the ignition system has a big job to do — if it doesn't do it well, even the best engine can become an 'also ran.'

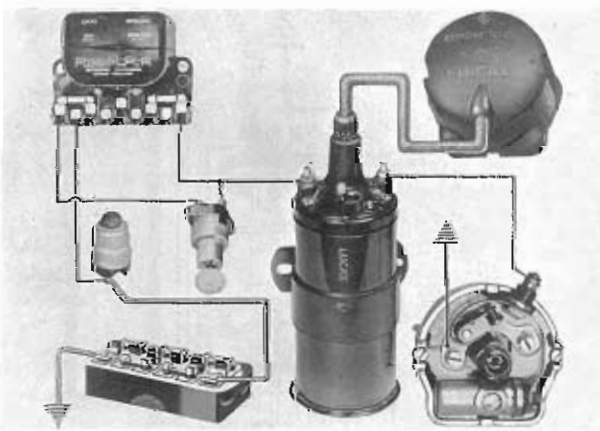
THE COIL IGNITION CIRCUIT.

Essentially, the ignition system comprises the Battery, the Coil, the Distributor, and the Spark Plugs. The Radio Suppressors shown may be optional extras.



For our purposes here, the control box on the right merely provides a convenient method of supplying the coil and distributor with current.

The general accessibility of this particular layout is most commendable, but very frequently the distributor itself is not so well placed.



PICTORIAL LAYOUT OF EQUIPMENT.

You can see from this picture how the components are connected in the circuit.

Let us start at the battery. We pass via a junction point at the starter solenoid, through terminals A and A1 of the control box to the ignition switch.

When this switch is turned to the 'ON' position, the ignition coil is fed with current which then passes through the primary winding in the coil to the C.B. terminal. This terminal is connected to the distributor. The circuit is completed via the contact breaker points in the distributor to earth.

The high tension current for the sparking plugs is taken from the chimney of the ignition coil to the distributor cap. Then the rotor arm of the distributor conveys the spark to each of the plugs in the correct firing order.

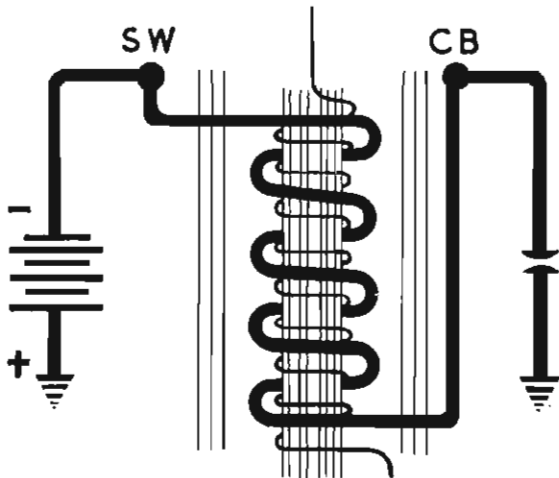
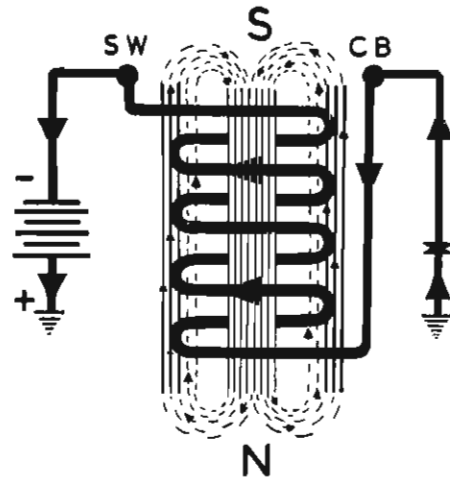
We shall now discuss the two main components of the circuit — the ignition coil and the distributor.

THE PRIMARY CIRCUIT.

This diagram shows the primary winding of the ignition coil with the battery connected to the S.W. terminal and a contact breaker to the C.B. terminal. When the contact breaker is closed, current flows through this primary winding and finds its way back to the positive, or 'earthed', terminal of the battery via the engine block and chassis.

The current flowing through the winding produces a 'magnetic field' around it, as we have illustrated.

To concentrate all the 'lines of force,' within the coil, the winding is formed round a laminated iron core and the whole assembly enclosed by thin iron sheets.



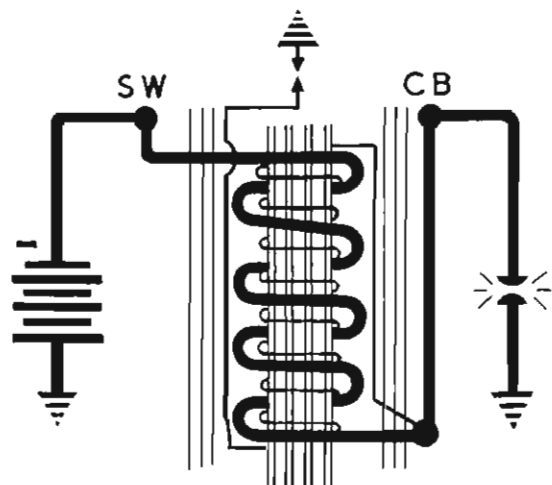
PRIMARY CIRCUIT WITH C.B. POINTS OPEN.

When the C.B. points open, the current stops flowing and the magnetic field collapses. Now if we wind a second coil of wire on to our core, about 20,000 turns of very fine wire, the collapsing magnetic field will induce a current impulse in this fine winding. This impulse can be at a pressure of 20,000 or more volts and represents the available spark plug voltage.

THE SECONDARY CIRCUIT.

One end of the fine secondary winding is connected to the primary — bottom right of the illustration — and the other end effectively to the spark plug, at the top.

The return path for this H.T. circuit is via the engine block, the chassis and the battery earth. The high voltage, therefore, causes a spark to bridge the plug gaps between the block and the insulated electrode. Additionally in this illustration, you can see that we have shown sparking across the C.B. points. And this is where a condenser comes in.

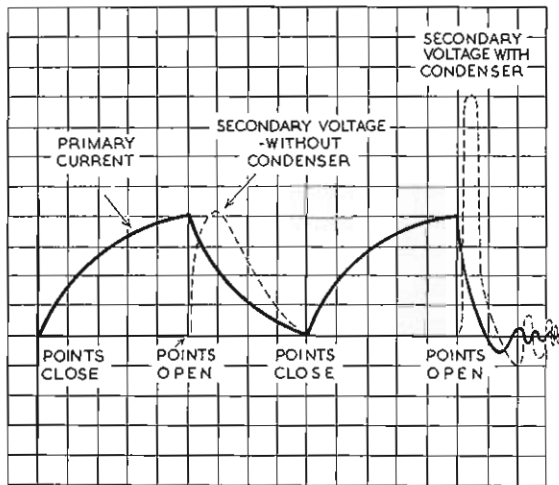
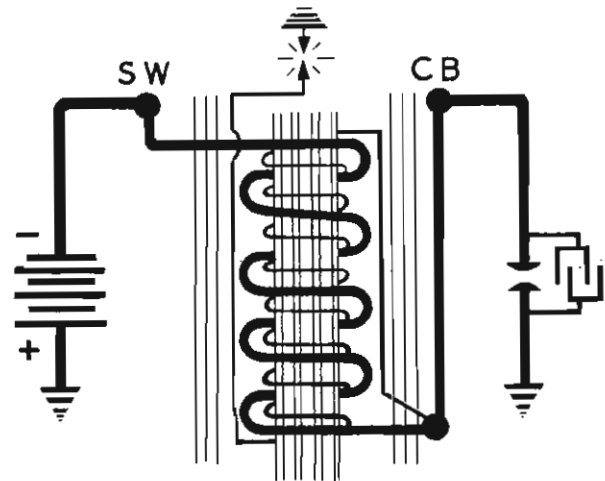


THE COIL CIRCUIT WITH CONDENSER.

We have already said that when the primary circuit is opened by the C.B. points the field collapses and a current is induced in the secondary winding.

At the same time the collapsing field also induces a new voltage in the primary which, although we are only supplying the primary winding at say 12 volts, may rise to 250 or 300 volts. This induced voltage tries to drive current round the primary circuit just as the points are opening, causing excessive arcing and sparking at great heat which would quickly destroy the C.B. points. So we place a condenser across them, the plates of which will absorb the excessive voltage and thus reduce its destructiveness.

You will see in the next illustration what effect the condenser has on the spark plug voltage.



GRAPH SHOWING EFFECT OF CONDENSER ON H.T. OUTPUT.

This graph shows how the condenser affects the H.T. output to the plug and also the arcing across the C.B. points.

Left half, without condenser. When the C.B. points close, the current builds up in the primary winding. When the points open, the current slowly collapses, arcing occurring across the C.B. points.

Only a small secondary output is obtained as shown by the dotted line.

Right half, with condenser. When the C.B. points close, the current builds up as before, but when they open, the current flow collapses almost at once, putting a very strong 'kick' into the secondary output as shown by the broken line.

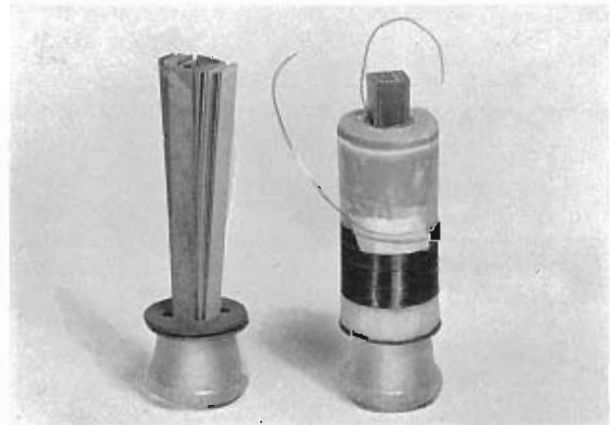
Arcing at the C.B. points is almost eliminated.

CONSTRUCTION OF THE IGNITION COIL.

Let us now see how the ignition coil is constructed.

A laminated iron core is fitted into a porcelain base-piece. The secondary or fine winding, consisting of anything from 6,000 to 20,000 turns of fine gauge enamelled wire, is then placed over the core.

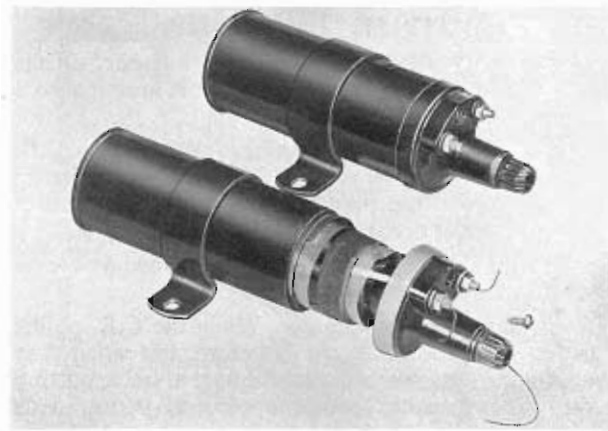
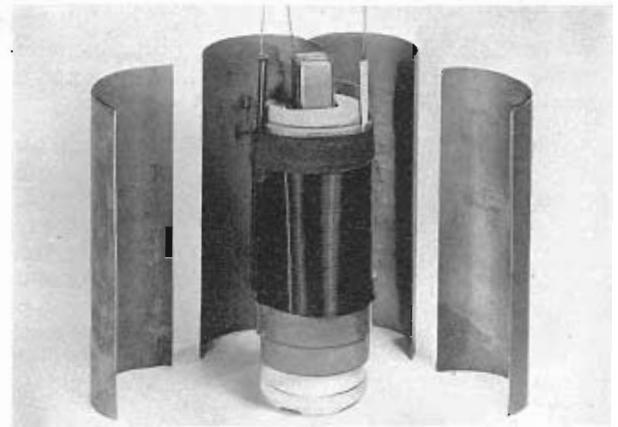
A pig-tail take-off is fastened to the end of the fine secondary wire and brought out at the top as you can see.



BUILDING THE COIL PRIMARY WINDING.

The primary winding, comprising about 300 turns of much heavier wire, is then wound on top of the secondary and brought out at the top. Winding the primary on top of the secondary helps to dissipate the heat and makes it easier to insulate the high tension winding from the case.

A magnetic shield of sheet iron is then placed round the complete winding.



ASSEMBLING THE COIL.

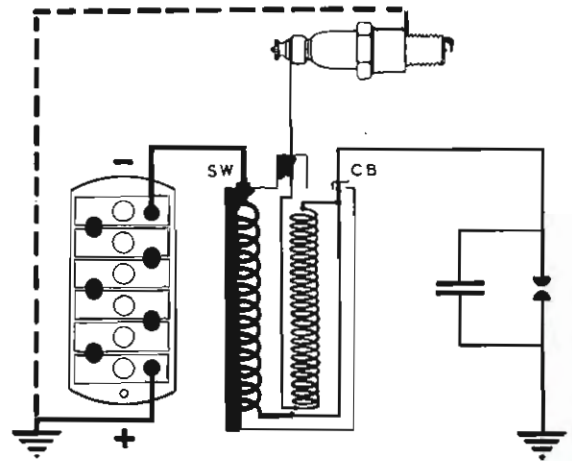
The whole assembly is then put into a steel case, the moulded top threaded over the leads, and the moulding with its metal base-ring soldered on to the case.

At this stage it is desirable to seal the whole assembly hermetically in order to prevent condensation and corrosion occurring at any subsequent stage.

For many years this very important sealing operation was done by extracting all the air and filling the case with Bitumen. More recently a fluid filling technique has become popular. Both methods are equally effective but with the fluid-filled coils a noticeable result in service is that the outer case of the fluid-filled coil is rather hot to the touch, due to the fluid filling which has a better heat conductivity than the earlier bitumen filled types. This apparent overheating should cause no concern, and is in fact an indication that the coil is working efficiently.

AUTO TRANSFORMER ACTION.

The internal circuit of the coil is of special interest. You can see that the secondary winding is in series with the primary. This improves the spark at the plug, the 300 volts induced in the primary at the contact break being added to the secondary voltage. This effect is known as auto-transformer action.

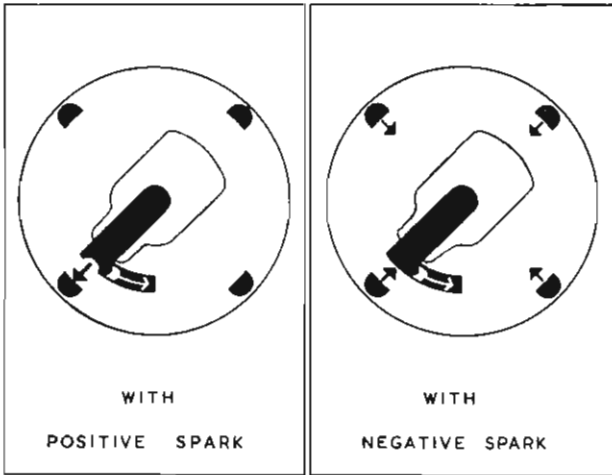
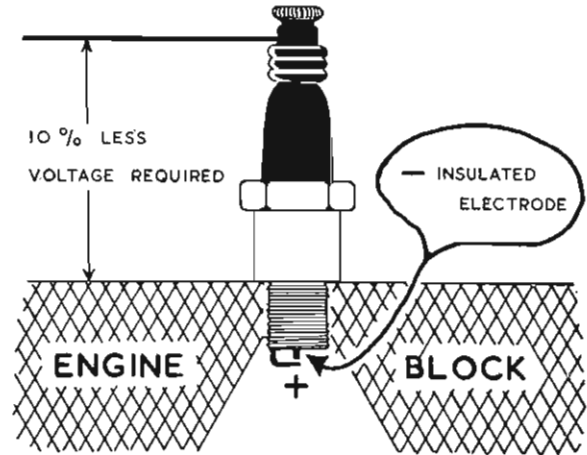


THE 'NEGATIVE SPARK.'

Coils are normally wound to give a *positive* earth spark — that is, the spark plug insulated electrode is *negative* with respect to the engine block or earth. We usually refer to this as a 'negative spark.'

Several distinct advantages are obtained. We have the same sparking efficiency at considerably lower voltages — approximately a 10% reduction in the H.T. voltage required to break down the gap. By lowering the voltage, the strain on the insulation throughout the high-tension circuit is considerably reduced — i.e. cable insulation, distributor cap and all mouldings and plugs.

We will point out that if the external connections to the SW and CB terminals of the coil are reversed, current will flow in the opposite direction through the coil, reversing the H.T. spark polarity. In addition the auto-transformer action is lost.



ROTOR WEAR.

A further advantage gained with this *negative* spark is little or no wear of the rotor arm. The picture on the left shows how metal is transferred from the rotor to the fixed electrode on each spark. With the *negative* spark on the right, the metal transference is in the opposite direction and wear is divided evenly between the four fixed electrodes.

NEGATIVE EARTH COIL.

Standard Lucas coils are all wound for use with *positive earth* battery : but special coils are available for use on negative earth systems, such coils being connected internally to give a similar spark polarity to those used with the *positive earth system*.

In emergency the negative earth coil can be used on a positive earth vehicle.



TYPES OF COILS.

We will now discuss some of the reasons why different types of coils must be produced. Factors other than the ones we have mentioned — spark polarity and supply voltage — must be taken into consideration. For instance, the work the coil has to do depends on the engine : coils for single cylinder engines need nowhere near the same spark performance as those used on 8 cylinder engines.

The 'breakdown voltage' of the plug varies with different engines, according to the plug gap, the compression ratio, heat, etc.

Another thing, the speed range of engines vary : one 6 cylinder engine may run up to 4,000 r.p.m. another, say, up to 6,000 r.p.m.

Our ignition coils, then, must cater for all these varying requirements. Each coil must be more than

sufficient to fulfil all the operating conditions of a particular engine.

Thus we must produce a wide range of coils, varying, as far as physical make-up is concerned, in the ratio of primary to secondary turns, primary current consumption and of course size. And don't forget that this primary current has a great influence on the maintenance necessary to the contact breaker points.

The fitting of oversize or special coils can only produce an advantage in performance if accompanied by carburettor and other adjustments or modifications.

We can sum up by saying that it won't do to fit any old coil as a replacement : look up the coil recommended for the particular engine.



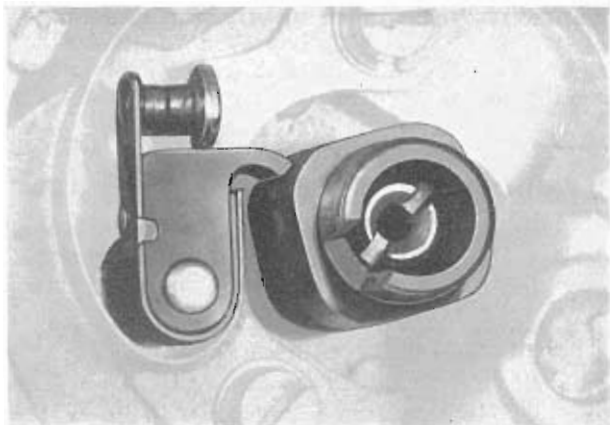
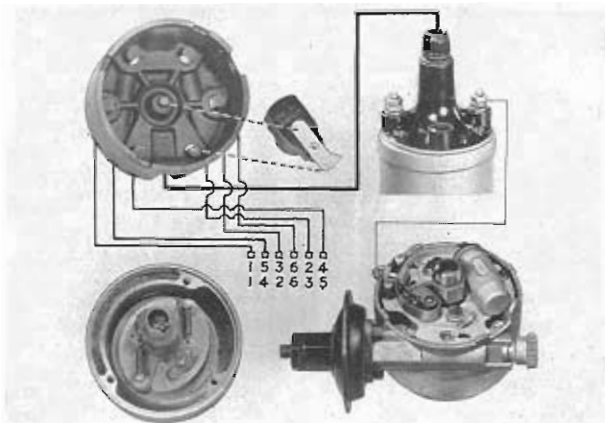
Distributors & Ignition Timing

THE FOUR FUNCTIONS OF THE DISTRIBUTOR.

The four functions of the distributor are :—

1. To interrupt the primary circuit of the ignition coil and so produce the high tension spark. The contact breaker makes this possible.
2. To distribute the high tension spark to the spark plugs, in the correct firing order. The rotor and distributor cap deal with this.
3. To provide automatic regulation of the spark timing over the whole engine speed-range — the function of the auto-advance mechanism.
4. To provide means, when required — by the addition of the vacuum advance mechanism — of varying the spark timing according to the loading of the engine.

We shall now deal in turn with each of these functions.



THE CAM AND CONTACT BREAKER.

This photograph shows you the normal form of the cam and contact breaker for a four-cylinder engine.

The heel of the moving contact rides on the cam face, causing the contacts to open on each lobe of the cam, thus breaking the primary circuit of the ignition coil.

Adjustment of the contact gap is effected by moving the fixed contact. The gap is set when the contact breaker heel is on the peak of the cam lobe.

We shall deal more fully with the gap settings for the various types of cam in a later part of this book.

THE CONDENSER.

In this illustration we show the condenser, which is placed in parallel across the C.B. points.

The early types you see here consisted of two large areas of aluminium foil in strip form, separated by waxed paper.

One strip of foil is soldered to the case of the condenser, the other to a wire which is soldered to the screw terminal.

Generally speaking, if moisture, dust and foreign matter can be completely excluded at the time of manufacture, the effective life of the condenser is practically unlimited.

On the other hand if either the fixing screw or terminal nut becomes loose in service, a lot of ignition trouble will be caused due to a weak H.T. spark and burnt C.B. points.

The ignition condenser has a capacity of .18 to .24 M.f.d. which is of considerable importance in obtaining maximum performance from the ignition coil over its full sparking range.



METALLISED-PAPER CAPACITORS.

The condensers used in the latest Lucas distributors are of further improved construction.

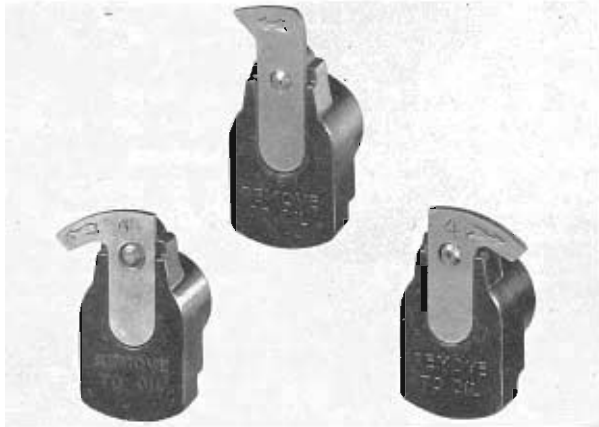
The normal foils have been replaced by an extremely thin coating of aluminium on one side of a paper tissue. A pair of these coated tissues are then wound together to form the condenser, or capacitor as we now prefer to call it.

The effect of a breakdown of the 'Dielectric' for any reason is momentarily to produce a short circuit through which passes the high discharge current from the already charged capacitor; a high temperature results in the immediate vicinity of the breakdown which vapourises and oxidises the aluminium and so the fault is cleared, the capacitor continuing to function normally.

The energy required to clear a fault is extremely low and the wax and paper are not damaged in the vicinity of the breakdown. Since the aluminium oxide is non-conducting, no appreciable decrease in insulation resistance is experienced, even after several hundreds of internal breakdowns have occurred under test conditions.

Note — the Dielectric is the separating medium — in this case, paper.

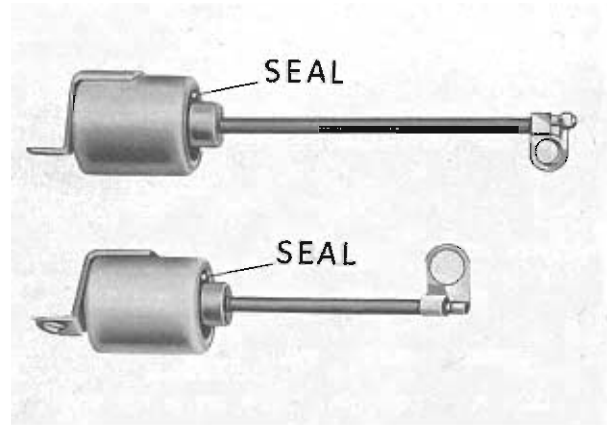
Another factor of great importance is the size of



DISTRIBUTOR CAPS.

A major consideration in the design of distributor caps is the avoidance of 'tracking' of the high tension spark under extreme conditions of humidity. At the same time, adequate ventilation must be provided to allow the corrosive nitrous-oxide produced by the sparking to escape from the cap.

The cap shown here is a good example of a design which gives the maximum space between fixed electrodes. This reduces tracking of the H.T. Spark between electrodes, or to earth, to a minimum. In addition, extremely high quality bakelite is used. Distributor caps for agricultural and marine equipment are sprayed with a special anti-tracking substance.



these new type condensers: they are approximately one third the volume of the equivalent paper-foil condensers. The capacity is the same as the early types.

The sealing of the condenser has also been improved, rubber replacing the earlier bakelite end-cap. You'll notice too that the terminal nut arrangement has been replaced by a lead. This improvement avoids the strain on the end-cap which was formerly experienced when the nut was tightened.

DISTRIBUTOR ROTORS.

The most noticeable feature of our rotors is the extended electrode. Most of you know that the reason for this is to prevent back running of the engine (not backfiring).

The important point is always to have the correct lead of rotor in the distributor.

The direction of rotation of our distributors is always given *viewed from the driving end*.

Therefore the extension of the electrode must always point in the direction of rotation.

The rotors on the left and centre will both be fitted to clock distributors; that on the right to anti-clock distributors.



AUTO ADVANCE AND SPARK TIMING.

Having shown you mainly constructional features of Lucas distributors, let us now delve a little more deeply into the technicalities of the subject.

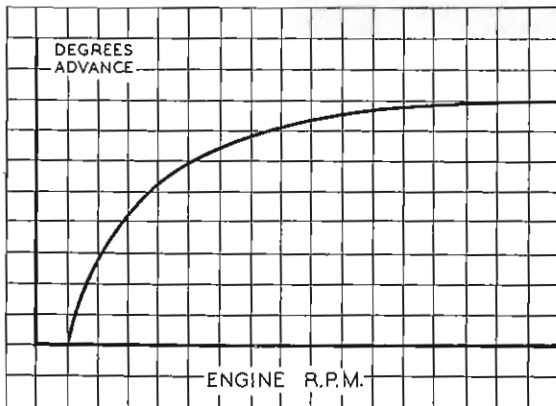
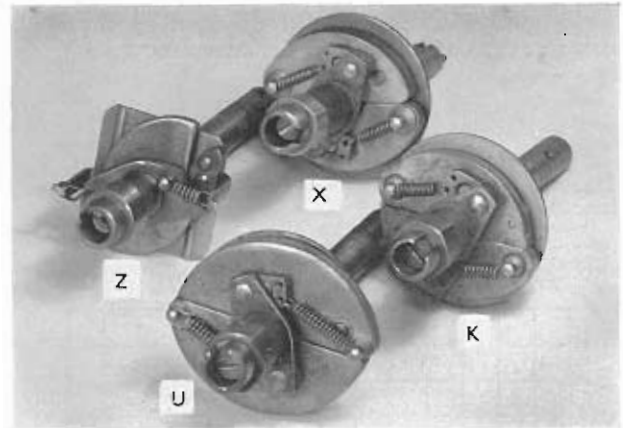
The problem of automatically varying the ignition timing to suit the running of the engine is dealt with in two ways : firstly by using centrifugal force, and secondly by using the vacuum existing in the engine inlet manifold — which of course varies with the load on the engine.

TYPES OF ADVANCE ASSEMBLIES.

Several types of centrifugal advance mechanism have been evolved during the last few years, employing different designs for the moving weights, different spring combinations and different materials. The 'X' type unit shown here has special hardened steel weights and is designed mainly for motor-cycle work. The 'Z' indicates the so-called 'rolling weight' mechanism ; the 'U' a pressed steel assembly suitable for fitting in the larger type 6 and 8 cylinder distributors. The 'K' mechanism employs die-cast auto-advance weights.

A moving weight mechanism built into the distributor and actuated by centrifugal force, in other words *governed by the speed of the engine*, is employed to give the main advance to the ignition timing.

An additional variation is provided by a vacuum advance unit tapped into the engine inlet manifold and controlled directly by the throttle position, in other words *governed by the load on the engine*.



ENGINE CURVE.

In building up the many different advance curves required by the engine manufacturers, we operate from a curve taken from the engine test which shows the degrees of advance required at different engine speeds and loads.

In general terms, an engine requires sufficient spark advance when idling to keep the plugs clean, and thereafter the advance must increase relative to speed, load, mixture, etc.

PINKING CURVE.

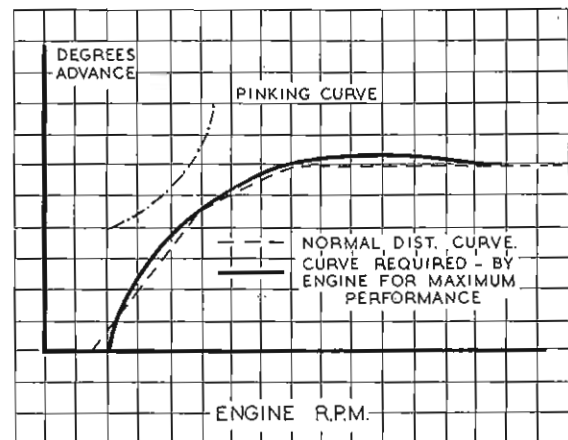
All engine tests produce a 'Pinking or Detonation Curve.'

At times, to obtain maximum power together with maximum fuel economy, the ignition advance curve will lie very close to the 'pinking' point and in many overhead valve, high compression engines, actually crosses the Pinking Curve at some point or other.

So our job is to produce an advance range in the distributor which matches the engine manufacturer's specification.

The dotted line on the diagram shows this distributor curve.

Now let's see the mechanism required to do the job.

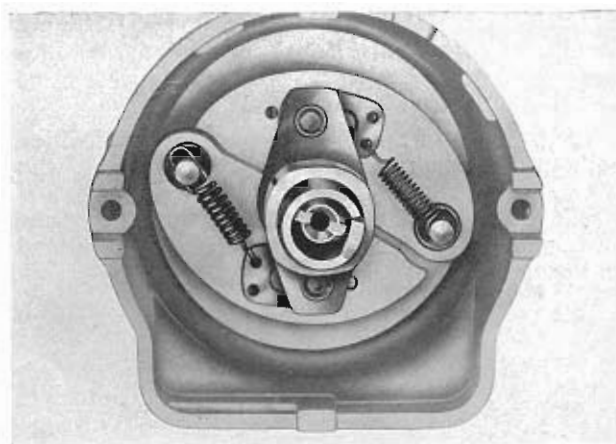


THE DIFFERENTIAL SPRING ASSEMBLY.

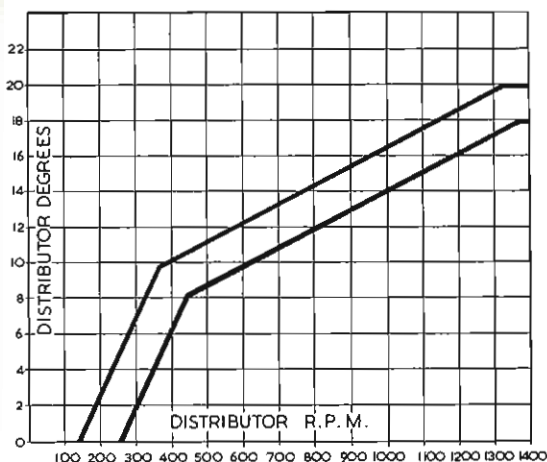
This is the most popular form of centrifugal advance. With increasing engine speed, the two weights are flung out, altering the position of the cam in relation to the contact breaker and thus advancing the ignition spark.

The rate of advance is controlled by the tension of the two springs. This type of mechanism employs one light spring to give a quick initial advance, and a second heavier spring to produce the main characteristic.

You will notice that there is a looped end on the heavy spring which allows free action by the light spring at the beginning of the advance movement.



AUTOMATIC ADVANCE CURVE



DIFFERENTIAL CURVE.

This diagram shows the typical spark timing curve produced by such a differential spring assembly.

The space between the two curves represents the tolerance allowed.

You will notice the quick initial rate of advance permitted by the light spring, in this case 8-10° at 400 r.p.m.

The advance then increases more gradually to a maximum of 20° at about 1,350 r.p.m. and there is no further increase at higher revs.

It should be realised that the total advance range varies considerably for different engines. In fact at the present time there are over 300 different advance ranges in use, built up expressly to meet the engine makers' requirements.

DISTORTED CURVES.

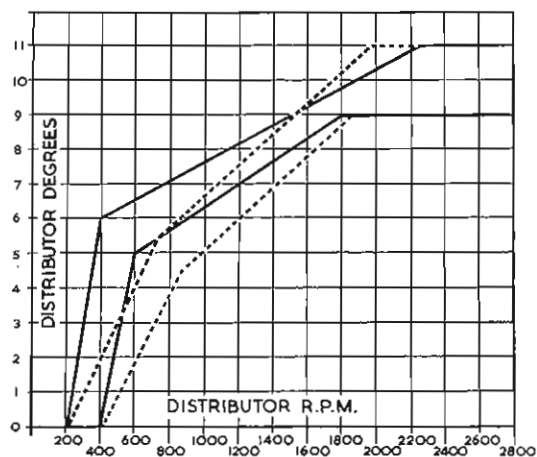
This diagram shows the result of partly closing the loop in the heavy spring.

The dotted lines represent the advance obtained when the loop is partly closed; the continuous line, the normal advance curve.

Now, although it might appear that the engine has lost its 'pink' when revved quickly under no-load conditions, it will be sluggish when accelerating under load.

From this, you will realise that the loop is there for a purpose and must not be bent, squeezed or otherwise 'adjusted.'

AUTOMATIC ADVANCE CURVE

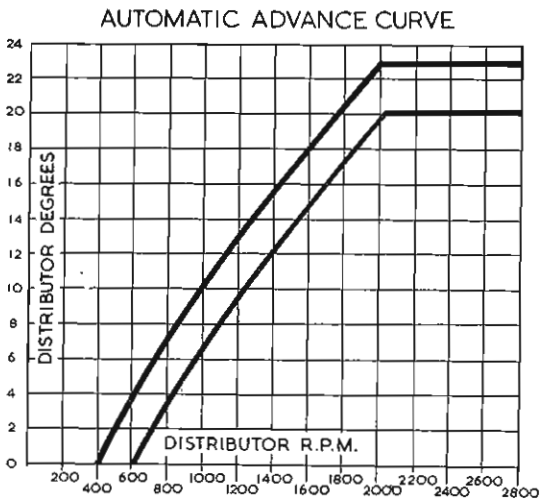
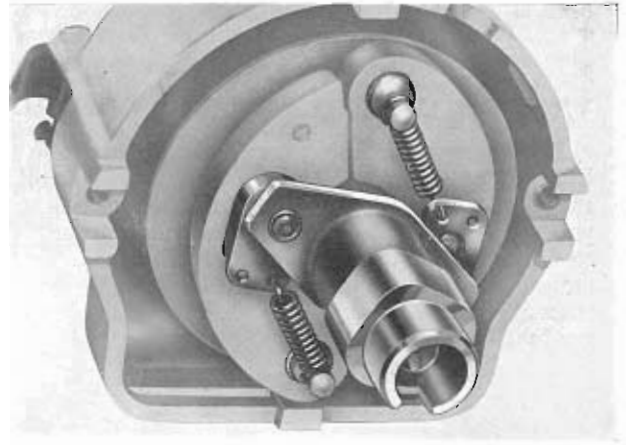


EQUAL SPRING ASSEMBLY.

The other type of auto advance in general use employs two equal springs and gives a 'straight line' advance curve.

The spring loops are always carried by the inside holes in the toggles.

These toggles have two holes for interchangeability purposes only.



STRAIGHT LINE ADVANCE CURVE.

The equal spring mechanism produces this form of advance curve.

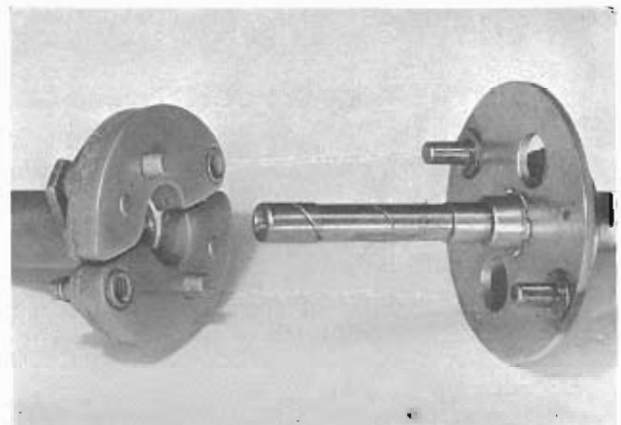
You see here that this particular advance commences at about 400 r.p.m. and progresses steadily to the maximum, which will again vary considerably with different engines.

In this case there is no quick initial advance, permitted by the weaker spring of the assembly we showed you a few pictures back.

ACTION PLATE WITH HOLES AND ADVANCE WEIGHTS WITH PINS.

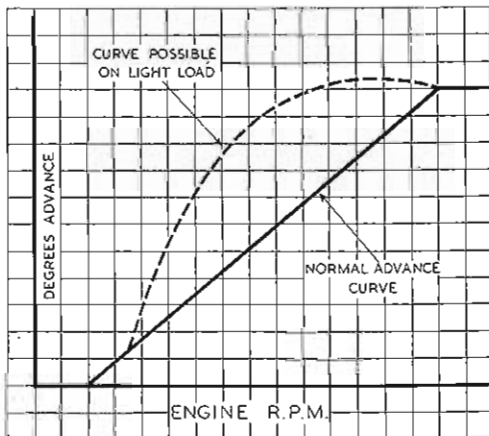
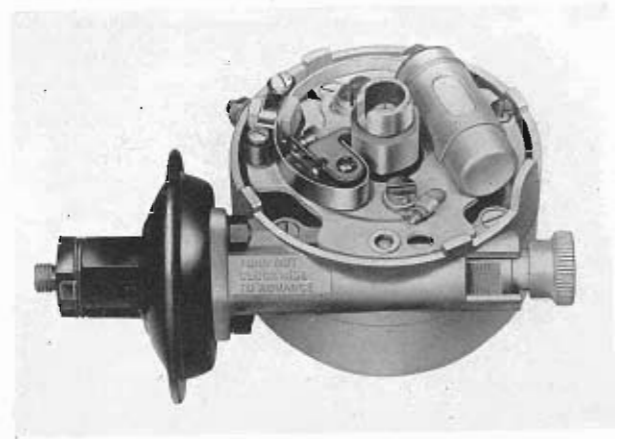
A very important point to remember with both types of advance mechanism is, that manipulation of the springs in no way affects the *total* advance given to the spark timing.

The total advance is controlled by the size of the two holes in the action plate on the right of the photograph. These limit the amount of movement of the weights.



VACUUM OPERATED TIMING CONTROL.

The advance mechanism we have discussed so far is dependent on r.p.m. alone. Additional control of the spark timing is brought about by the vacuum unit you see in this photograph. You will remember we said that, as the unit is connected to the engine inlet manifold, it's operation depends on the depression present in the manifold — that is, it's effect varies with the load on the engine.



THE SUCTION ADVANCE CURVE.

Interpreting this graph, we can say that the vacuum unit produces additional advance, as shown by the dotted line, when the engine revs are high, but the load light — that is when there is a high vacuum in the induction manifold due to the small throttle opening.

When the engine is pulling hard on full throttle, the vacuum in the manifold is low and the suction advance becomes wholly or partly inoperative. The spark timing is then solely dependent on the centrifugal advance.

The general effect of the vacuum unit is to increase the 'liveliness' of the engine and, when economy type carburetors and wide spark plug gaps are used, a noticeable improvement in petrol consumption is possible.

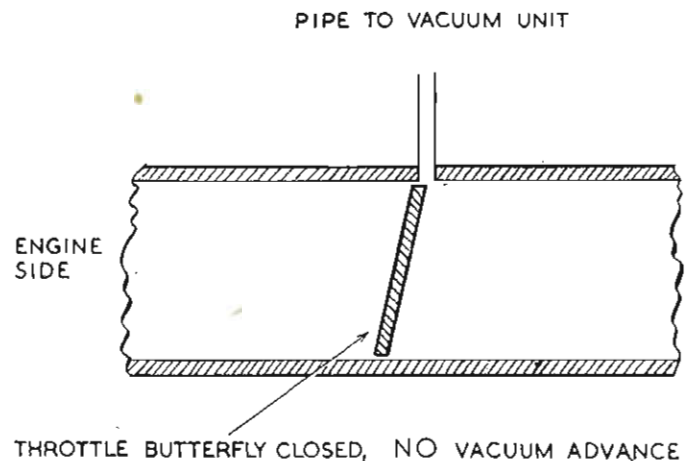
Now how and where is the pipe leading to the unit attached to the manifold ?

WHERE THE VACUUM CONTROL IS CONNECTED.

If the unit is to function correctly, the point at which it is connected to the manifold is all important.

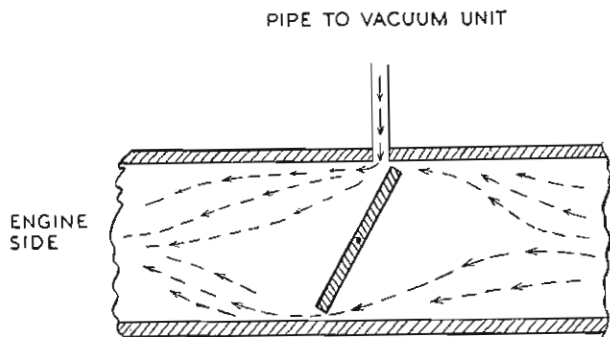
The vacuum pipe should be half sealed when the throttle butterfly is closed.

The main condition of operation is that at idling speed the vacuum unit is out of operation.



SMALL THROTTLE OPENING.

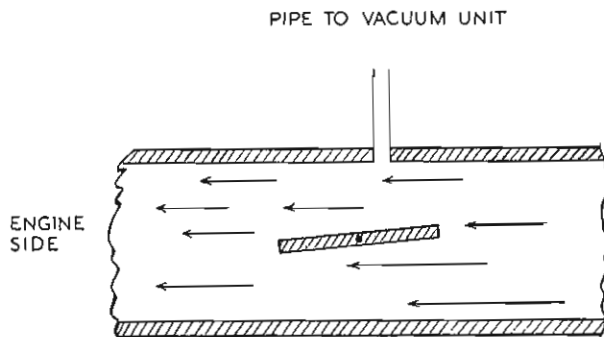
Now with small throttle opening, the vacuum at the inlet pipe is high and we have maximum permissible advance.



THROTTLE PARTLY OPEN WITH PISTON SPEED HIGH. SO MAX VACUUM ADVANCE

FULL THROTTLE OPENING.

With full throttle opening, we have a low vacuum and accordingly little or no extra advance from the suction unit.



FULL LOAD, FULL THROTTLE, LOW PISTON SPEED SO NO VACUUM ADVANCE

SECTIONED ADVANCE UNIT.

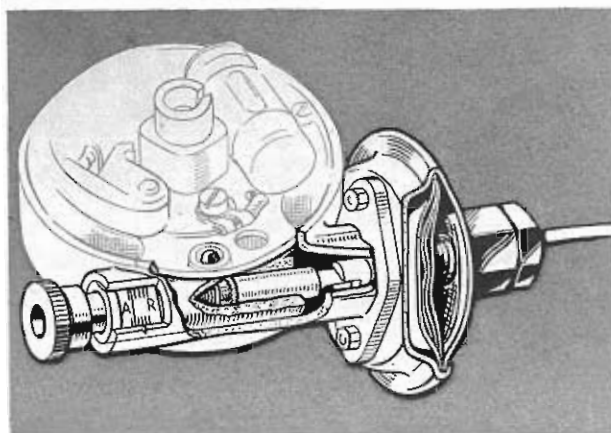
This picture shows the operation of the unit itself. You can see the plunger which moves the contact breaker plate in relation to the cam, thus altering the spark timing. A micrometer adjustment is also included.

These units are not interchangeable by the way, unless they carry the same identification number, as each unit is made up to suit a particular engine.

To check the operation of the unit in some cases, it is only necessary to run the engine at idling speed when, with changes in the throttle opening, the sliding barrel will be seen to move in and out.

A cut away distributor cap should be employed when the movement is not visible by this method.

Failure to operate is generally the result of air leaks in the pipe line, usually caused by cracked or chafed pipes or loose unions. These possibilities should be checked before suspecting a damaged diaphragm.



DISTRIBUTOR DOGS.

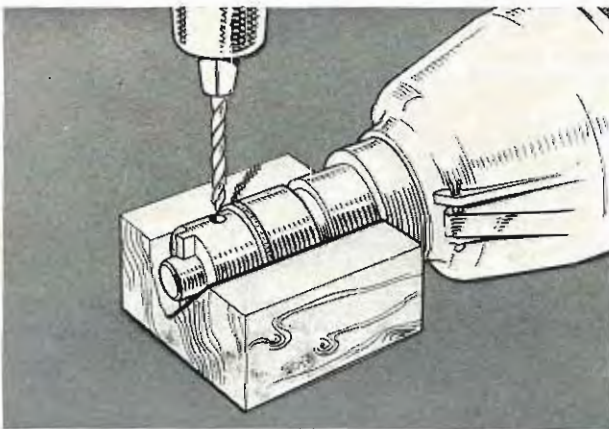
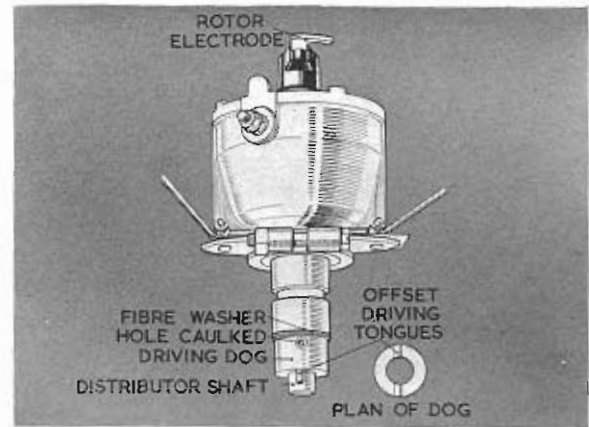
Having dealt mainly with the distributor as a separate unit and discussed the method of advancing the spark timing according to the requirements of the engine, we must now consider how a distributor should be fitted to a vehicle, from the point of view of timing, firing order and rotation.

This picture shows a correctly fitted driving dog on the distributor shaft.

There are two important points to remember.

1. The driving tongues of the dog are in line with the rotor arm.
2. The driving tongues are offset with respect to the centre line of the shaft and, when viewed from the rotor electrode side, as you are seeing it now, are to the left of this line.

This guide for fitting is applicable to both clock and anti-clock distributors.



DRILLING THE DISTRIBUTOR SHAFT.

You see here the method of drilling a new distributor shaft, using the hole in the dog as a guide. To obviate shaft 'end float,' the shaft itself must be pushed down from the rotor end, with the dog hard against the fibre washer, before commencing to drill.

After fitting the pin, caulk over the holes to secure. The dog must be a tight fit on the shaft.

Driving gears are fitted in a similar manner, but then the position of the gear in relation to the rotor is immaterial.

The diameter of the drilled hole is normally $\frac{1}{8}$ " ; but later supplies of driving dogs for fitting to D.M. Distributors are to be drilled to take a $\frac{3}{16}$ " x $\frac{7}{8}$ " Mill's grooved pin. In such cases, the diameter of the hole through the shaft must be 0.187" to 0.188".

INSTALLING AND TIMING A DISTRIBUTOR.

Firstly, it must always be remembered that distributors are directional, i.e. either CLOCK or ANTI-CLOCK. The correct direction of rotation is shown with the identification symbols on the body of the distributor and is always as viewed from the DRIVING END.

Additionally the letter A or C appears on the end of the distributor shaft to denote the rotation of the shaft and action plate assembly.

Let us take a specimen case — we have a replacement distributor to fit to an engine and we want to reset the ignition timing, as this has been accidentally disturbed. We are assuming of course that nothing is wrong with the engine valve timing.

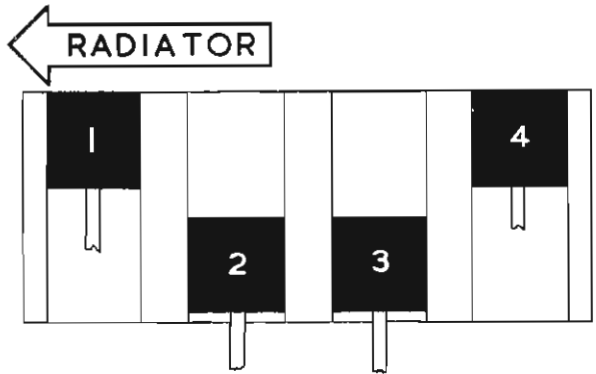


IGNITION TIMING.

The engine should normally be timed according to the engine maker's recommendations, but timing marks are not always easily accessible or clearly visible, so we shall show you here a simple method of setting the piston in relation to the ignition spark from the distributor.

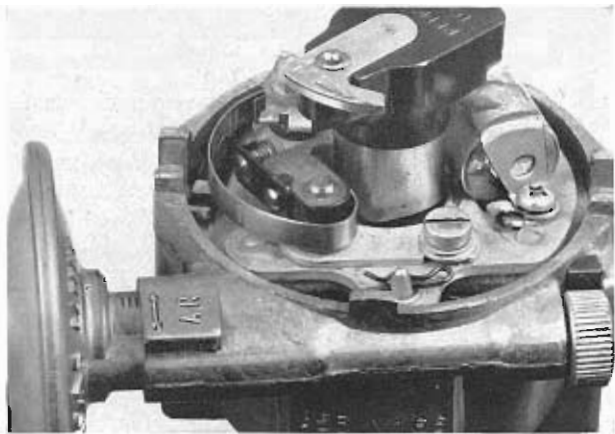
First take out the sparking plug from No. 1 cylinder — this is usually the front cylinder of the block, that is, the one nearest the radiator. Then turn the engine over slowly with the starting handle, with your thumb tight over the spark plug hole, until compression is felt.

Bring the piston slowly to the top of its stroke, using where possible a piece of wire as a final guide to the piston travel. Leave the piston set at T.D.C. on the compression stroke.



No. 1 CYLINDER

COMPRESSION STROKE T. D. C.



SETTING THE ROTOR POSITION.

Having set any micrometer advance adjuster on the distributor approximately at the half-way position, next place the distributor in position with the rotor pointing to what we can call for our purpose the No. 1 electrode in the distributor cap — that is pointing to about 7 o'clock. This is only a preliminary rough setting, being of necessity governed either by the tongues of the distributor dog-drive or by the pitch of the gears. A finer adjustment should then be made by turning the body of the distributor until the contacts are just opening, still with the rotor pointing to the No. 1 electrode. Clamp the distributor provisionally at this setting. It is not important which electrode in the cap we make No. 1. We must start from somewhere, however, and it's just a matter of convenience. What is important is that the plug lead from the cylinder we've positioned for firing, that is No. 1, is sparked from the correct electrode position in the distributor cap, that is the one in line with the rotor. For simplicity's sake, then, we'll connect No. 1 electrode in the cap to No. 1 cylinder.

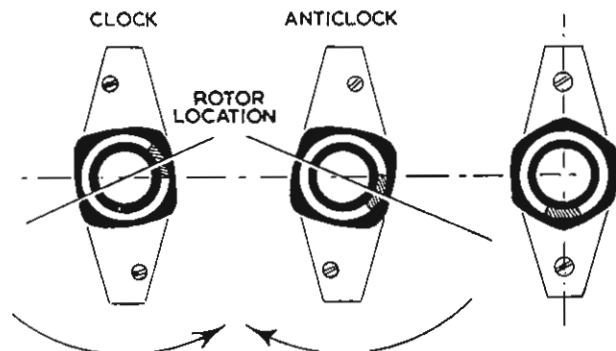
CAM AND ROTOR ASSEMBLY.

If any difficulty is experienced in obtaining this initial setting of the timing, correctly and easily, the cam should be examined.

On four cylinder distributors the cams are handed left and right, and as shown in the illustration, the most apparent difference is the position of the rotor locating slot in relation to the Cam Lobes.

Unless the rotor is correctly positioned in relation to the cam the running of the engine may be seriously affected.

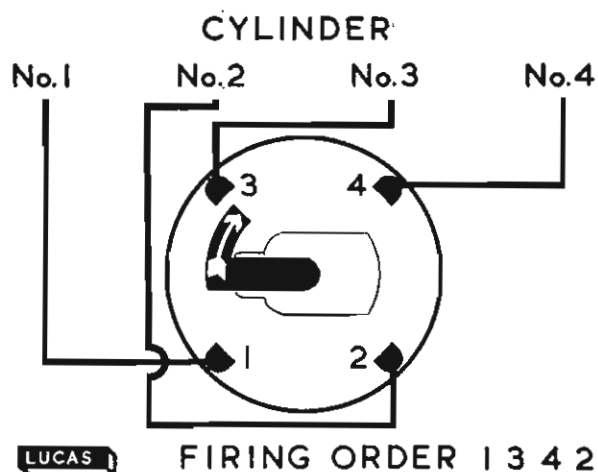
This does not apply to the 6 cylinder cam where the rotor locating slot is centrally placed in relation to the cam lobe as shown in the right-hand illustration.



ROTATION AND FIRING ORDER.

Before we can connect the remaining plug leads, we must know two things: the direction of rotation of the distributor rotor and the engine firing order. The rotation can quickly be established from the rotor itself—the extended brass electrode is usually arrowed—or the distributor body is marked. But, just to make absolutely certain, turn the starting handle just a fraction and watch the rotor. We will assume for the moment that the firing order is known, and that for the particular 4 cylinder engine it is 1, 3, 4, 2. The rotation we'll take to be as is indicated on the rotor illustrated. The plug leads can then be inserted into the distributor cap, the lead from No. 1 cylinder going to No. 1 electrode, from No. 3 cylinder to the next electrode (in the direction of rotation), No. 4 following and finally No. 2.

Connect up the vacuum advance unit if fitted and the engine should run.



TIMING : FINAL ADJUSTMENT.

The final adjustment of the timing is something which can only properly be dealt with during a practical demonstration. It can be set in the garage fairly accurately by vacuum gauge, but this method on its own is not accurate enough as a final adjustment. This final setting can best be carried out on the road. To obtain the best results it must be done scientifically. One engine manufacturer arrives at the best engine performance by timing the vehicle with a stop-watch

over a series of test runs, conditions being identical for each run—that is, the prevailing wind must be the same, the run must be made in the same direction and the vehicle accelerated to the same m.p.h. figure.

The distributor can be moved slightly if necessary by slackening the clamp and moving the distributor body, thus varying the point at which the contacts open. The micrometer adjustment will allow an extremely fine setting to be made.

FIRING ORDER.

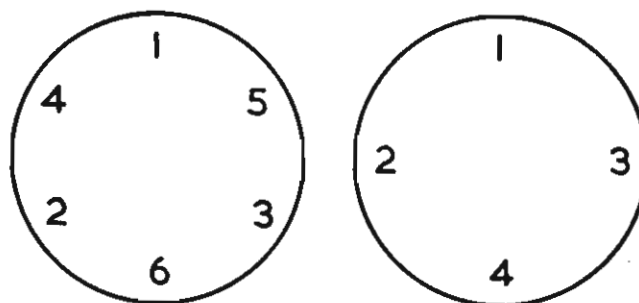
Where the firing order is not known, and cannot be found from the engine maker's instruction manual, two possible sequences exist for a four cylinder engine: 1, 3, 4, 2 or 1, 2, 4, 3.

Thus, after finding T.D.C. on the compression stroke of No. 1 cylinder, check which is the next cylinder to fire by taking out all the plugs and testing for compression on either cylinders 2 or 3. The one coming up to compression will establish which of the two possible orders it is.

The same method can be applied to a 6 cylinder engine, when once again there are only two possible firing orders, as we have indicated:—

1, 5, 3, 6, 2, 4 or 1, 4, 2, 6, 3, 5.

In every case, the method of connecting the plug leads to the distributor cap is the same: start from No. 1 cylinder to No. 1 cap electrode and continue round the cap in the cylinder firing order, NOT forgetting to follow the rotation of the distributor rotor.



SIX CYLINDER ENGINE

FOUR CYLINDER ENGINE

POSSIBLE FIRING ORDER

Distributor Types & Application

Before showing you photographs of various Lucas distributors, we must consider for a moment the symbols used for identifying the different types.

TYPE SYMBOLS.

Prefix

- B. Ball Bearing.
- D. Distributor.
- D1. 1st design.
- D2. 2nd design.
- D3. 3rd design.
- F. Flange mounting.
- H. Horizontal cable outlets.
- K. Small cast iron body, with moulded contact breaker base and die-cast auto-advance weights.
- KY. Die-cast body with pressed steel contact breaker base.
- L. Double contact breakers.
- M. Micro control.
- P. Porous Bushing.

- U. Large cast iron body with moulded contact breaker base.

Prefix

- V. Built-in vacuum control.
- X. Hardened steel auto-advance mechanism.
- Z. Rolling weight auto-advance mechanism.

Numerals

- 1. Suitable for single cylinder engines.
- 2. Suitable for twin cylinder engines.
- 4. Suitable for four cylinder engines.
- 6. Suitable for six cylinder engines.
- 8. Suitable for eight cylinder engines.

Prefix or Suffix

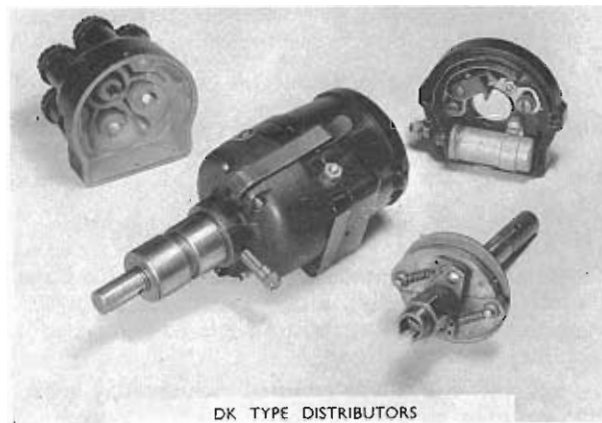
- *A. Fitted with automatic advance and retard.
- * *This symbol is omitted from latest models as they are all fitted with automatic advance mechanism.*

THE DK TYPE DISTRIBUTOR.

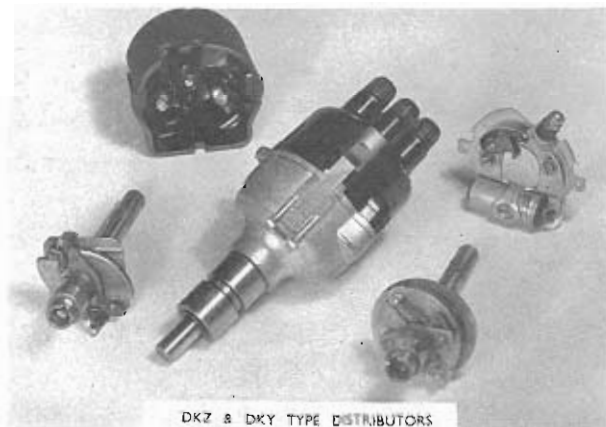
And now the units themselves. This picture shows the early standard DK distributor.

It has a cast-iron body, a bakelite contact-breaker base and the shaft turns in porous bronze bearing bushes.

Nowadays this type is used mainly for 'Insulated Return' circuits on Light Commercial Vehicles and Motor Cycles. When used for this latter purpose it becomes type 'DKX' (Hardened Steel Weights).



DK TYPE DISTRIBUTORS



DKZ & DKY TYPE DISTRIBUTORS

THE DKY AND DKZ DISTRIBUTOR.

These distributors are again standard types, but they are fitted with a die-cast body and metal contact-breaker base.

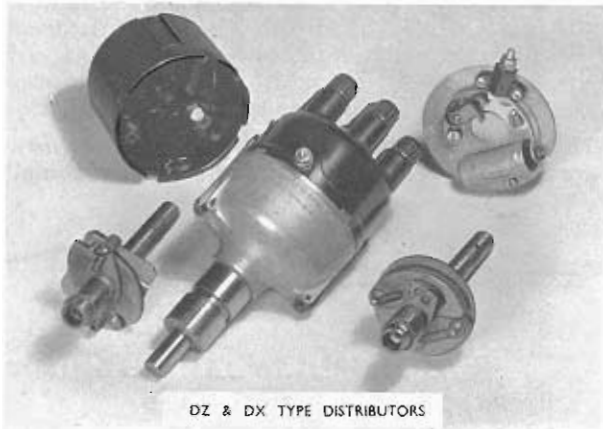
Die-cast or rolling weight auto-advance mechanism is used. The bearings for the shaft are still porous bronze bushes.

These types are usually applied to light cars and light commercial vehicles with medium-speed four cylinder engines.

THE DZ AND DX DISTRIBUTOR.

These types are made with a larger die-cast body. Pressed steel is used for the contact breaker base and either the hardened steel or* the rolling weight auto-advance mechanism is fitted. Porous bronze bearings are again employed.

These are particularly applicable to high compression four and six cylinder engines.



DZ & DX TYPE DISTRIBUTORS

THE DVZ AND DVX DISTRIBUTORS.

The main features of these distributors is the built-in vacuum advance unit. An oil well is also incorporated for lubrication.

The top bearing for the distributor shaft is a ball race, a porous bronze bush being still retained for the bottom bearing.

The DVZ and DVX distributors are applied to four and 6 cylinder engines which require vacuum advance.

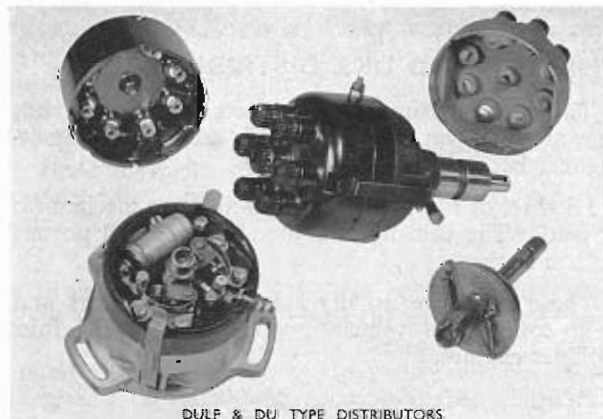


DVZ & DVX TYPE DISTRIBUTORS

THE DULF AND DU DISTRIBUTORS.

These models are standard productions with a large diameter body, usually of cast iron, except for the flange-mounted version, (bottom left in the picture) which may be die-cast.

A bakelite C.B. base is fitted, which may carry single or twin contact breakers. The twin contact breaker model is generally applied to eight cylinder engines such as the FORD V8 and the ROLLS B80. Large six cylinder engines usually take the DU or DULF with a single contact breaker.



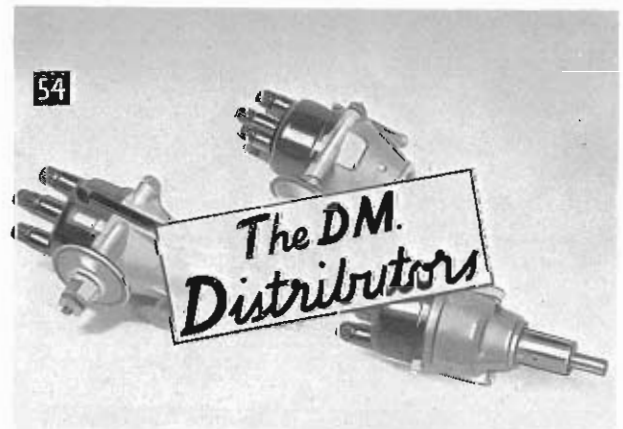
DULF & DU TYPE DISTRIBUTORS

THE DM DISTRIBUTOR.

More recently a new range of distributors has been introduced and is now widely used on most British cars.

There are two main models, the DM4 and DM6, applied to high performance four and six cylinder engines. Variations of these two models fit a ball bearing.

A smaller model DM2A4 may be used for medium compression four cylinder engines together with a similar model known as the D2A4 which does not incorporate a vacuum advance unit.



DESIGN FEATURES.

Here you see the main features of these DM distributors.

The vacuum unit is built into the distributor and incorporates a micrometer adjustment.

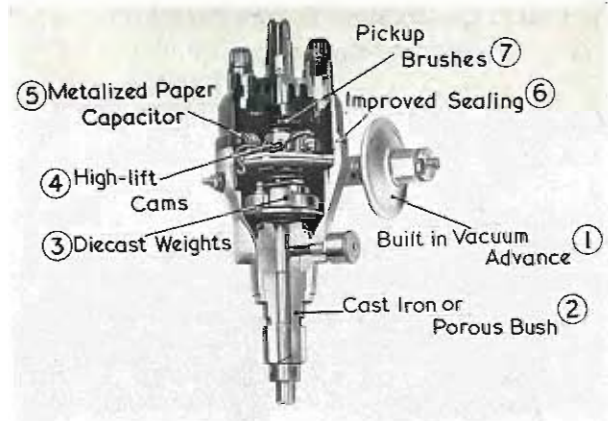
The bearings may be either cast iron or porous bronze bushes. A ball bearing is fitted, as we have mentioned, in some models.

Die-cast or rolling weight auto-advance mechanism is used.

The cam is a new design called the 'High Lift' — we shall tell you more about this in a moment.

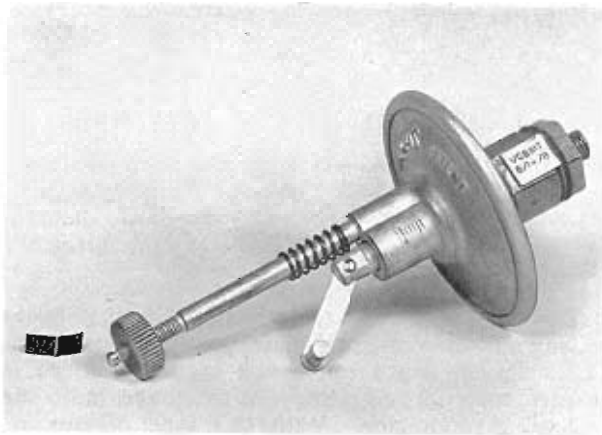
We have already discussed the new metalised paper capacitors — you will remember their 're-healing' property if a dielectric breakdown occurs, and their comparatively small size.

The sealing of the distributor cap has been improved, rendering the unit much more dustproof — the necessary ventilation is still of course provided.



And finally the H.T. pick-up brushes are designed to act as radio suppression resistors.

But now let us examine some of these features in detail.



THE VACUUM ADVANCE UNIT.

This unit, as we have said, is built into the distributor and incorporates a fine adjustment for the spark timing.

Whilst generally similar to the earlier models, each vacuum unit is made up for a particular engine and you will remember that we stressed that *units are inter-changeable only if the numbers on the locking tabs are identical.*

BEARINGS.

Three types of shaft bearings are used. The DM6 is fitted with a long cast-iron bush.

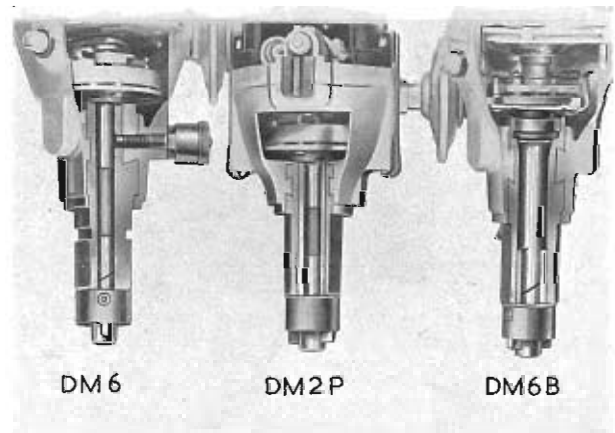
This bush is part of the shank and is not renewable. The lower part of the bearing is lubricated by oil mist from the engine and the upper part by means of a grease lubricator.

The second type of bearing consists of a single long bronze bush, shown here in the DM2P.

The bronze bushes are easily replaceable, and, as they are used in conjunction with hardened steel shafts, are expected to give extremely long service.

The lubrication is again by oil mist from the engine.

A third type of bearing consists of a porous bronze bush at the bottom with a grease packed ball bearing at the top, and no additional lubrication is required. This bearing assembly is signified by the letter 'B.'

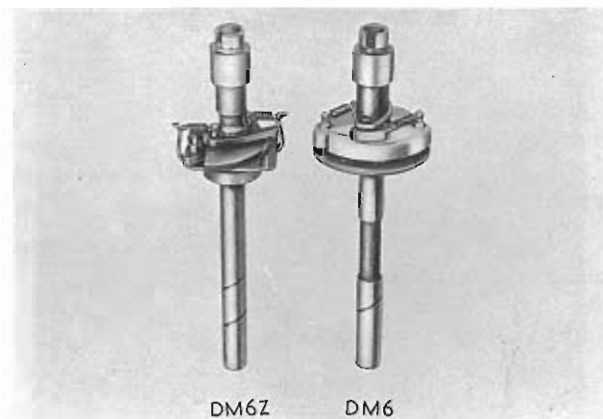


THE AUTO-ADVANCE MECHANISM.

Two types of auto-advance assembly are fitted in the D.M. distributors.

The 'rolling weight' mechanism is shown here in the left of the picture. This arrangement may employ either equal or differential springs.

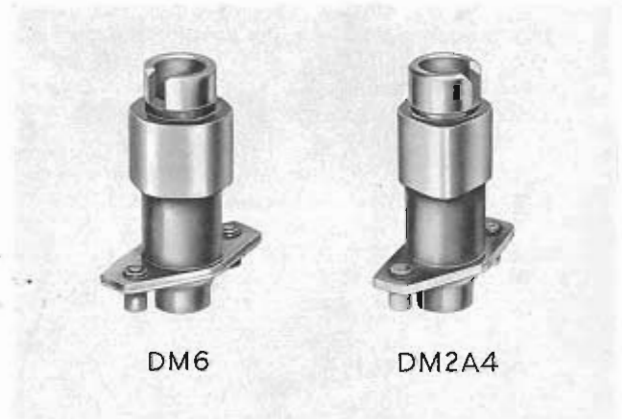
The die-cast weight assembly on the right closely follows the earlier pattern, but is much heavier in construction; also, brass toggles are used instead of steel.



THE HIGH LIFT CAM.

All D.M. distributors fit the new 'high lift' cam. This form gives a very quick break of the contacts, increased 'cam dwell'—that is a longer closed period—and generally results in increased life of the contact points.

We shall further discuss the contact setting with the 'high lift' cam in the maintenance part of this lecture, but it certainly won't hurt to say now that the contact gap should be set and maintained at .014" — .016" in service.

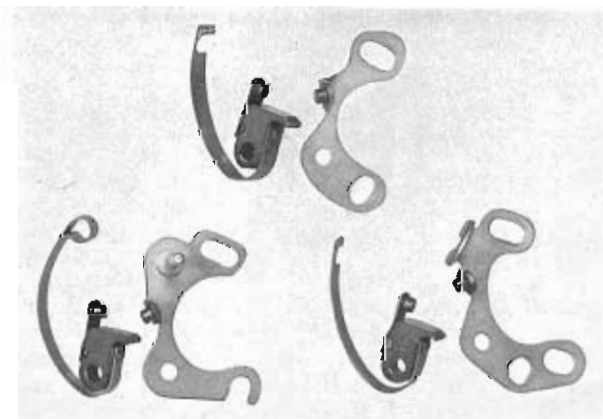


THE CONTACT SET

The contact breaker assembly used in the D.M. range of distributors has the same characteristics, a $\frac{1}{2}$ " rocker arm and long stainless steel spring, as those fitted to the earlier distributors.

The spring anchorage may be slotted in the end of the spring, or alternatively, looped as shown in the left hand picture; this being the latest design which has now been standardised for all the DM range.

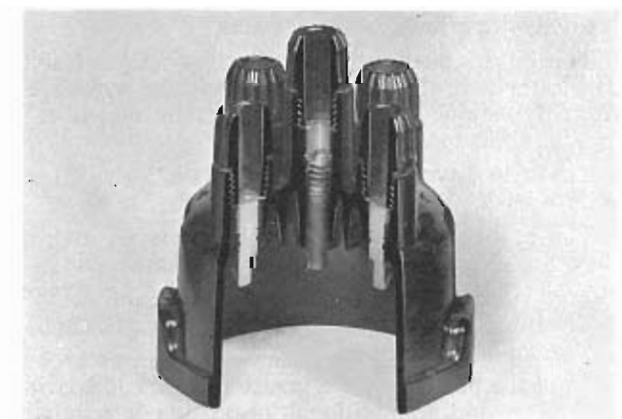
It is very simple to identify the various sets from the illustrated spares lists we supply.



THE DISTRIBUTOR CAP

This picture shows a typical cap design. Both the sealing and the ventilation have been improved. The H.T. pick-up brush contains a high percentage of resistive material and is designed to act as a radio and television suppressor. With this type of cap, no further suppressor is required in the distributor-coil H.T. cable and none should be fitted.

Caps are manufactured with both vertical and horizontal H.T. lead outlets.



Testing

The testing and servicing of coil ignition equipment can be considered from two separate standpoints.

Firstly, there is the testing and servicing of the distributor and ignition coil, this is the province of the specialist who will have a proper testing machine available together with the relevant data appertaining to the whole range of this equipment.

The more general requirement is for the Motor Engineer to be able to diagnose the cause of intermittent misfiring or complete breakdown of the ignition system in situ on the vehicle. Such preliminary diagnosis will generally precede unit testing or major overhaul. At the same time the most common faults which develop arise as the result of general neglect and can be put right at once.

These 'service' faults frequently involve the ignition circuit as a whole, that is the wiring, switches, etc.,

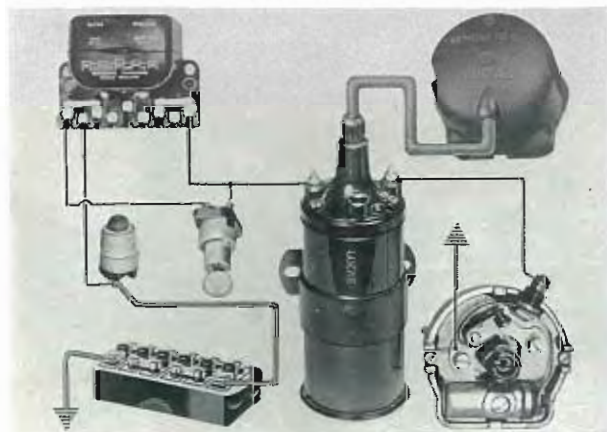
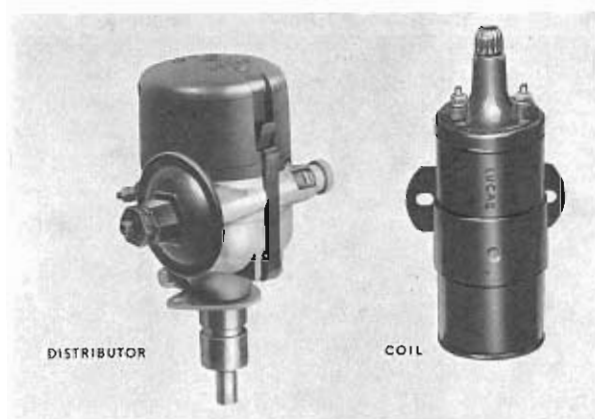
quite apart from the distributor and ignition coil units themselves. By the use of a simple routine test procedure any such faults can easily and quickly be located and corrected. If, at this stage satisfactory performance is not regained, it may become necessary to bench test the coil and distributor unit as a pair.

For our own purpose when setting out this routine, which can easily be memorised let us assume that we are faced with a complete failure of the ignition system on the vehicle.

In this circumstance we must first prove the current supply, i.e. the battery and then follow the current path to the ignition coil and distributor. For this purpose it is possible to completely check the low tension or PRIMARY circuit of the supply and the ignition units in FOUR operations, with a further THREE operations to check the high tension system and the condenser.

THE DISTRIBUTOR AND COILS.

Ignoring for the moment the battery, the two main components in the ignition system are the distributor and coil. Each takes its share of the blame for nearly all ignition faults.



PICTORIAL DIAGRAM OF IGNITION CIRCUIT.

However, let us see exactly how these units fit into the complete ignition circuit. Here we see a pictorial diagram of the system used on the post-war car.

The *primary circuit*: we must have a satisfactory current supply from the battery to the primary winding of the ignition coil. This current must be interrupted at the right moment by the contact-breaker points, in order to induce current in the secondary circuit and so produce the ignition spark.

The *secondary circuit* consists of the high-tension winding in the coil, the distributor rotor and cover, the high tension leads and spark plugs.

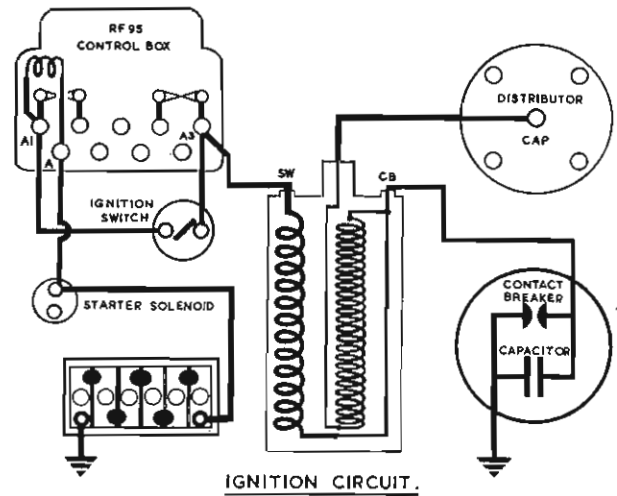
WIRING DIAGRAM OF IGNITION CIRCUIT.

A more precise idea can be obtained from this wiring diagram. Following the ignition circuit through from the battery, the feed wire is tapped off from the starter solenoid to terminal 'A' on the control box. From there it passes through the load winding of the regulator to terminal 'A1.' The circuit then continues to the ignition switch.

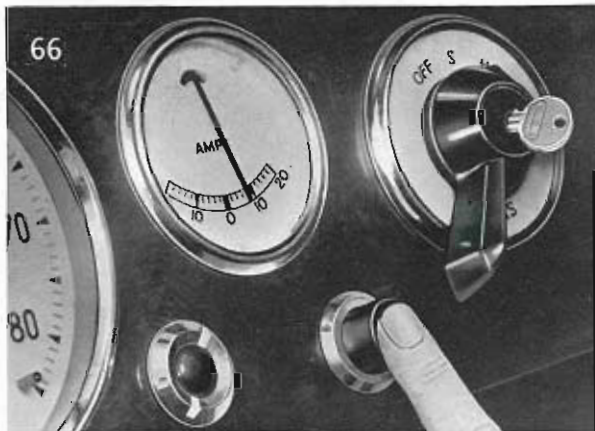
When the ignition is switched on, A3 of the control box is 'live.' You can follow the circuit from the other side of the ignition switch to the 'A3' terminal. The 'SW' terminal of the coil is then fed from this 'A3' terminal. The circuit continues through the primary winding of the coil to the 'CB' terminal, the contact breaker being connected to this terminal. The circuit is completed via the contacts to the distributor earth, and so back to the battery via the chassis.

The high tension side of the system starts from the secondary winding of the coil at the chimney, through to the rotor, and then via the distributor cap to the plugs. The circuit is again completed via the chassis, in this case the block, and so back to the battery.

In the following tests, we shall prove the circuit at



most of the points we have mentioned, i.e. the battery, A and A1 terminals, at the A3 terminal, at the coil 'SW' and 'CB' terminals, finally checking the H.T. side of the circuit from the coil chimney, through the rotor, the cap and on to the spark plugs.



LAMPS SWITCHED ON.

Having given you an overall picture of the ignition system, what should be the first step when we are confronted with a complete failure? Surely the first point is to see whether there is any current available on the system at all.

The quickest method is to switch on the head-lights and operate the starter motor.

If the starter operates satisfactorily, without dimming the lights excessively, we can safely assume that the *battery is not the cause of the breakdown.*

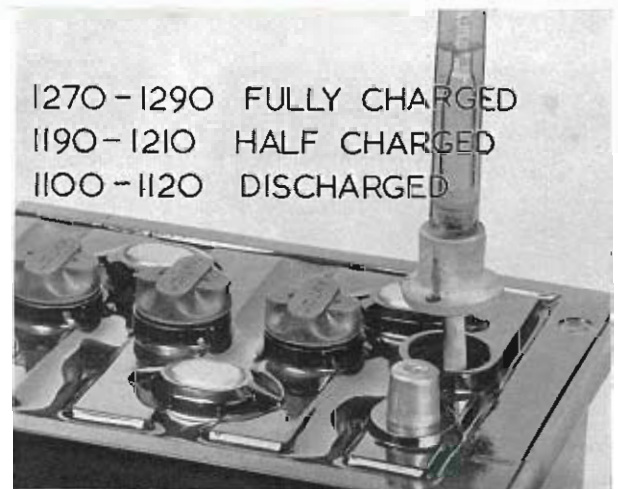
HYDROMETER TEST.

The test we have just shown you is of course a quick check for the battery.

This Hydrometer check will give a more exact idea of the state of charge of the battery.

The readings should be at least between 1.200 — 1.210, that is, about half-charged.

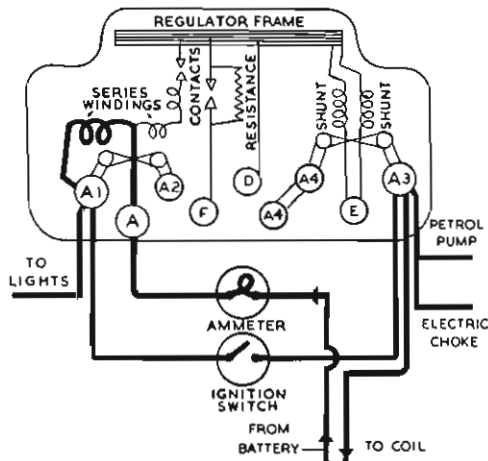
If in a very low state of charge, the voltage of the battery may be so greatly reduced when the starter is operated that the ignition coil will not spark.



HEAVY DISCHARGE TEST.

This test, which puts a heavy discharge across the battery, will complete an exact check on the condition of the cells.

The voltmeter should register approximately 1.5 volts per cell. The cell reading should remain constant throughout a 15 second application of the tester.



A1 AND A.

If we prove that the battery is serviceable and that the car lights are working satisfactorily, we have actually proved that the current supply arrives at the A1 terminal of the control box.

With the ignition 'on,' we find out next, with the voltmeter, whether the A3 terminal of the control box is 'live,' as this terminal feeds the coil and the petrol pump. In some cases this A3 terminal is located on a fuse block mounted separately from the control box.

Let us assume that there is no fault so far.

The next thing to do is to check straight through the Primary or L.T. circuit of the ignition system. From terminal A3, which we've just checked, the current should arrive at the ignition coil.

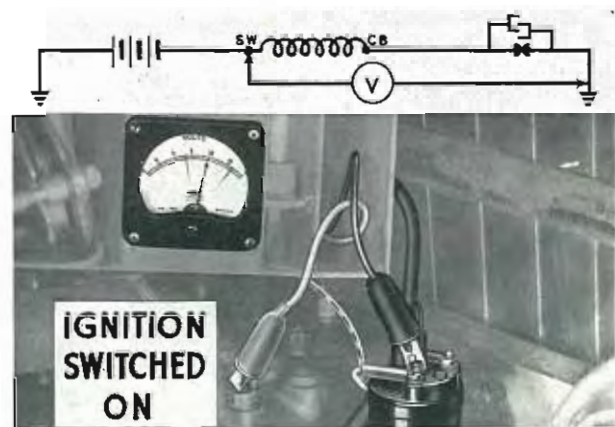
VOLTS AT 'SW' TERMINAL OF THE COIL.

Connect the voltmeter between the 'SW' terminal on the coil and an earthing point.

Full battery volts should be registered on the voltmeter, irrespective of whether the C.B. points are open or not, although it is preferable for them to be closed and the coil taking current. If no voltage is shown we have an open circuit in the cable between the control box A3 terminal and the coil 'SW' terminal. This fault can soon be remedied.

But let us assume that we do get full battery volts at the 'SW' terminal of the ignition coil. It pays to pull at the cable near the coil, thus making sure that the terminal nuts are not loose and that there is no intermittent break in the cable inside the covering.

You can see what connections we've made at the top of the picture.



VOLTS AT 'CB' TERMINAL.

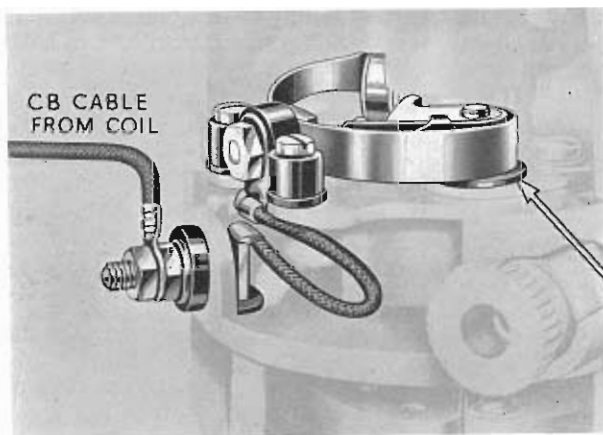
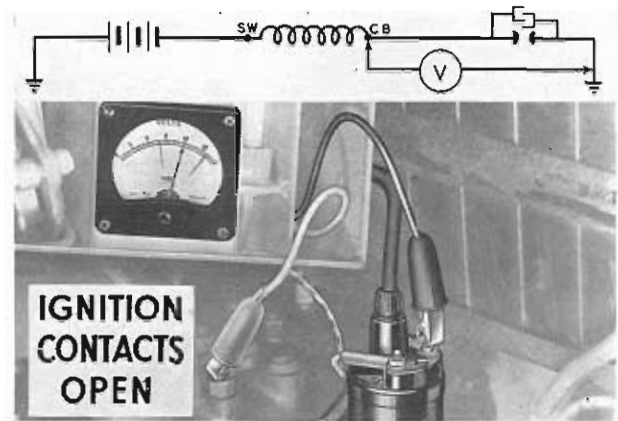
We must next see whether the circuit is intact through the coil.

Open the CB points and, with a voltmeter connected to the 'CB' terminal of the coil, we should still get full battery volts.

If no voltage is shown at this point, there are two possibilities.

The first is an open-circuited primary in the ignition coil. The second possibility is an EARTH inside the distributor. Both points can easily be checked by disconnecting the wire from the C.B. terminal and taking another voltage reading at the coil terminal itself.

A Zero reading will then indicate a break in the primary winding, a full voltage reading, a short to earth on the distributor.



POSSIBLE EARTHING POINTS.

Such an earth can be at any of the following points :—

- The C.B. cable between the ignition coil and the distributor L.T. terminal — left of the picture.
- The flexible lead between the L.T. terminal on the distributor and the moving contact.
- On the moving contact itself — the insulating washer may have been omitted for instance. This washer is arrowed in the picture.
- Or finally at the condenser — this however is unlikely.

If none of these show up, that is, if we get *Full Battery Volts*, the next step is to CLOSE the contact breaker points.

VOLTS AT THE 'CB' TERMINAL WITH CONTACTS CLOSED.

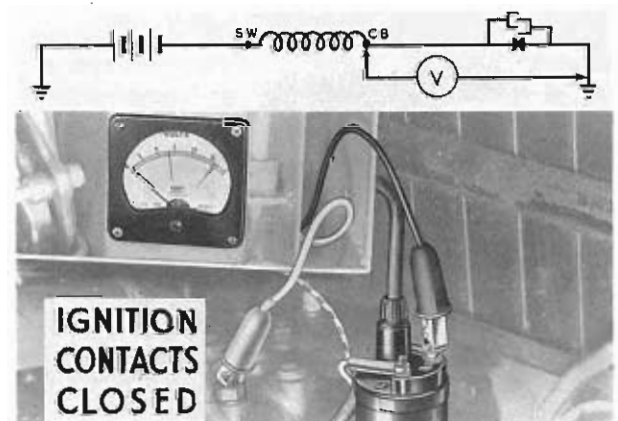
With the contact breaker points closed, we should now have a zero reading on our voltmeter.

You see, by closing the points we are shorting out the meter, providing that the distributor internal circuit is not faulty.

If any voltage reading still shows, it is probable that the points are dirty, oily or oxidised slightly, and may be cleaned up.

If heavily burned and showing grey green deposit, suspect the condenser.

Sometimes there is a bad earth between the distributor shank and the engine block and chassis. If the battery voltage does fall to zero with the contacts closed, we need only check that the cam is opening the C.B. points properly when rotating, and we have completed the check on our primary circuit.



CHECKING THE SECONDARY OR H.T. CIRCUIT.

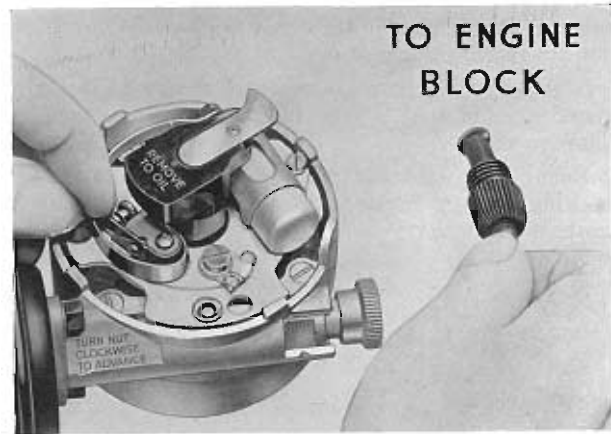
We now proceed to check the secondary or H.T. spark circuit with which we can conveniently include the condenser. The H.T. test is carried out in three operations.

The most convenient way of checking the H.T. circuit of the ignition coil is to use a short length of H.T. cable, one end of which can be pushed into the chimney of the Coil and used as a 'Jumper Lead.' The other end of the lead must be held $\frac{1}{4}$ " away from the engine block.

Our ignition switch is still 'ON' remember.

Flick the contacts from the closed position and, if the coil and condenser are good, we shall have a good spark thrown to the block at each flick of the contacts.

If NO spark is thrown, then we must have a defective H.T. winding. Remembering that we have already cleaned the points, sparking may occur even if the condenser is open circuited. The engine may run — but very roughly.



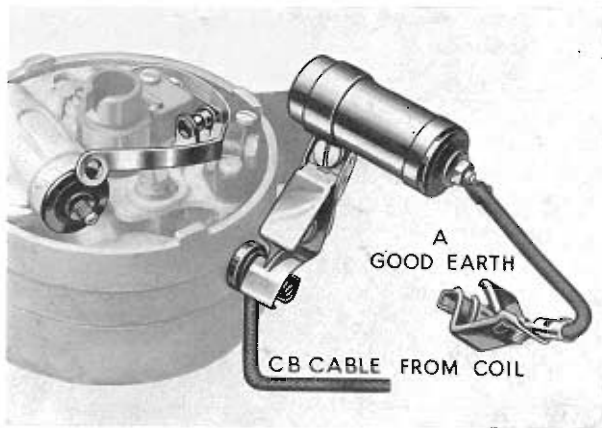
JUMPER CONDENSER.

We can easily check the position by fitting a 'jumper' or substitute condenser. After disconnecting the original condenser, the 'jumper' can be conveniently connected between the L.T. Terminal on the distributor and earth.

If we still have no spark when we flick the contacts, we know definitely that the secondary winding of the coil is faulty.

If on the other hand the spark is now improved and the engine runs much more smoothly, then the original condenser was inoperative. This might be due to the condenser screws being loose and this point should be checked first. Otherwise, the original condenser was faulty.

Assuming that this last test shows the H.T. Winding and the condenser to be in order, it remains only to test the distributor rotor and the distributor cap and H.T. cables.



CHECKING THE ROTOR.

Examine the rotor first. If this is punctured it will earth the spark on to the cam head. A tiny puncture is often invisible to the eye and we therefore test in the following manner.

Hold the piece of H.T. cable, still connected to the coil, on to the rotor electrode as shown.

If on flicking the C.B. points a spark is thrown to the rotor, then the latter is defective.

Under very damp conditions, any *faint* sparking which may be visible, will be due to static leakage and must not be confused with the true H.T. spark.



FINAL CHECK.

Our final check concerns the distributor cap and the H.T. cables.

Burnt or cracked caps can easily cause misfiring but are rarely the cause of complete breakdown.

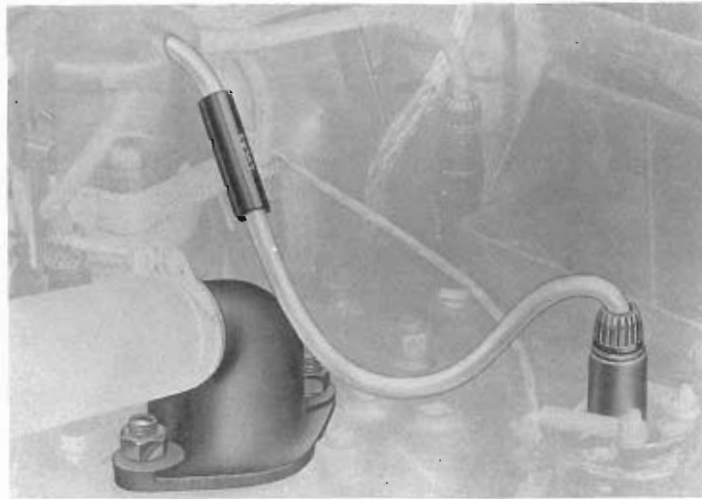
Mechanical fractures are usually easy to find by visual examination. Tracking between segments is likewise visible.

Burning around the pick-up electrodes due to a sticking pick-up brush is more elusive and may only cause misfiring.

The H.T. cables are much more likely to cause such a breakdown and all leads should be checked to see

that the insulation is in good condition. In our case, with an assumed complete failure, the lead in question would be the main H.T. cable from the coil to the distributor. Any chafing at this point would of course earth the H.T. spark completely. Pay particular attention to these H.T. leads when they pass through any sort of clips or channeling, or when a suppressor is in circuit.

With this check, the testing procedure for the whole of the ignition system has been completed. There are only seven operations in all : four for the primary circuit and three for the secondary ; and the only tools we need are a voltmeter, a test condenser and a piece of H.T. cable.



Servicing

MAINTENANCE POINTS.

The maintenance necessary to obtain consistently satisfactory performance from coil ignition equipment is very small and for standard routine servicing or 'checking-over' purposes there are NINE items which require periodic inspection. Three of these require fairly regular attention. They are: the contact breaker points and gap, the general lubrication of the bearings and auto-advance mechanism and thirdly the spark plugs.

We have listed these points in the system which require periodic attention.

1. H.T. Leads.
2. Distributor Mouldings.
3. Rotor.
4. C.B. Set.
5. Bearing Bushes.
6. Auto-advance.
7. Suction Advance.
8. Coil Connections.

THE SPARK PLUGS.

You have probably noticed that we did not list spark plugs. The importance of good, clean plugs with properly adjusted gaps cannot of course be over-estimated. Set the gaps to the manufacturer's recommended setting, making sure that they are all even.



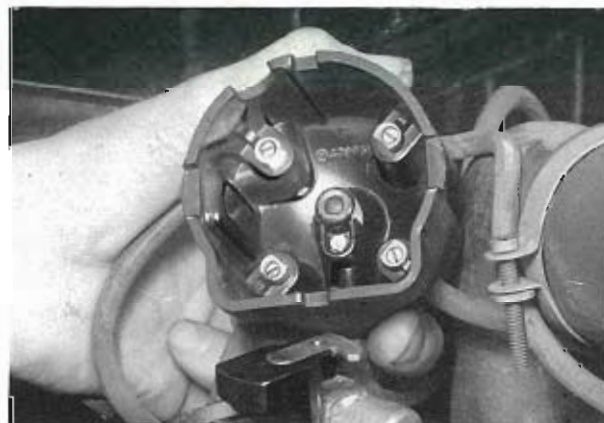
THE H.T. LEADS.

H.T. leads in a poor condition are often the cause of intermittent misfiring, even of complete breakdowns. General deterioration and cracking of the cable covering occurs with time, particularly if the leads are allowed to chafe against metal.

See that the leads are kept clean and free from oil and, as we have said, run as far as possible away from the metal parts of the engine, thus minimising wear due to vibration.

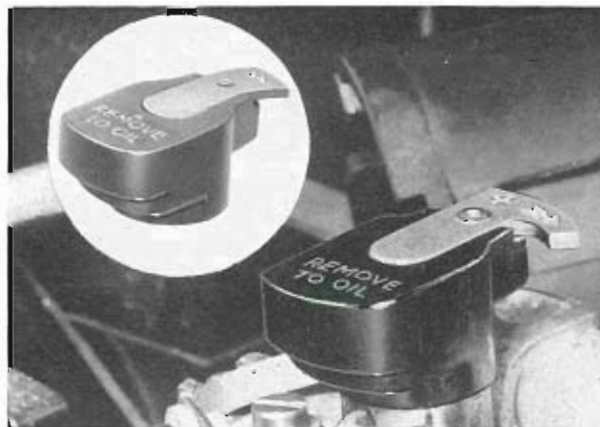
THE DISTRIBUTOR MOULDINGS.

With the increased use of high voltage ignition coils, distributor mouldings have been developed with a very open construction to prevent 'tracking.' The mouldings should be kept clean and dry inside and out, and the carbon brush checked for free movement in its holder.



THE ROTOR.

Rotors call for little or no maintenance in service. Just see that they are kept clean and dry. And remember too that rotors can't be replaced indiscriminately — make sure that the rotor is the correct one for the job, i.e. that the extended electrode points in the direction of rotation. And, by the way, there is a difference between a four and a six cylinder rotor. The design of the six cylinder rotor is visible in the inset.



THE CONTACT BREAKER.

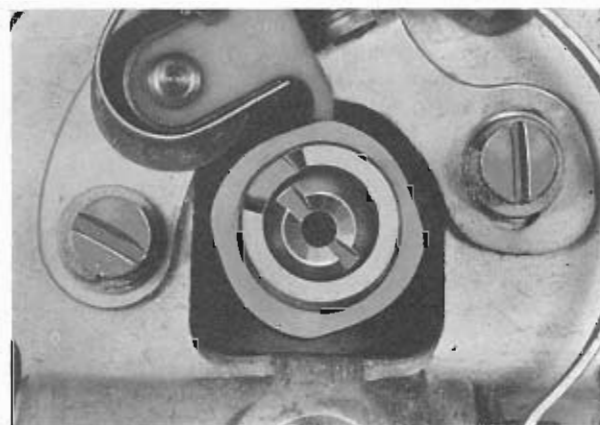
The next point for attention is the C.B. set. The C.B. points must of course be maintained in good condition, either by cleaning and facing up or by the fitting of a new set if the old points are badly burnt.

Closing-in of the C.B. points gap due to wear on the 'heel' can be practically eliminated by a little light grease applied to the cam face or the felt pad when provided.

The points setting should be maintained at a minimum of $\cdot 010''$ to $\cdot 012''$ to obtain full performance with all Lucas ignition coils irrespective of working conditions.

A gap setting of $\cdot 014''$ to $\cdot 016''$ when fitting new contacts will ensure that after the initial 'bedding-down' the final gap will not close below $\cdot 010''$.

There is an exception to these settings when a



distributor is fitted with the new 'high lift' cam. Here the contact gap should be set and maintained at $\cdot 014''$ — $\cdot 016''$.

THE THREE TYPES OF CAM.

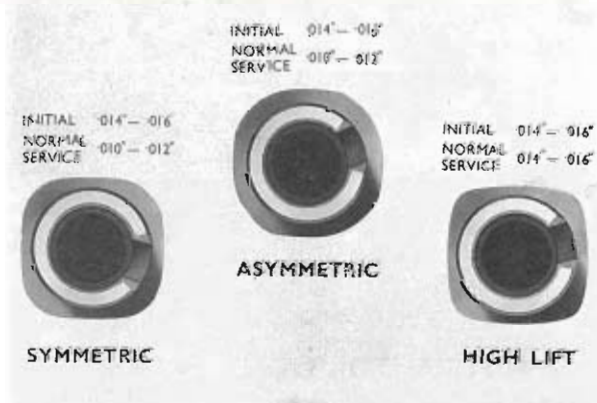
Here you can see the difference between the cam forms. The older type symmetric and asymmetric cams, as we have said, are used with a contact gap of $\cdot 010''$ — $\cdot 012''$, the 'High Lift' with the gap increased to $\cdot 014''$ — $\cdot 016''$. You can recognise the 'High Lift' cam by the much sharper form of the lobes.

You are probably wondering why there are different cam forms. Stated simply, cam development has had to keep pace with engine development. The early symmetrical cam was adequate for the ignition performance required by engines up to 1949, and gave equal open and closed periods of the contacts.

The asymmetric cam by reason of its special form helped to reduce contact breaker noise and at the same time provided a slightly increased dwell period. The contact breaker setting with this cam was somewhat critical and it was subsequently superseded by the current production 'High Lift' cam.

This cam with a sharp profile provides a very fast break, a long dwell period and is suitable for any type, high, or medium to low speed engines.

We hope that the summary will impress upon you that the contact gap must be set according to the cam form.



We'll repeat the gap settings once more :

With Symmetric and Asymmetric Cams :

New Contacts	...	...	...	$\cdot 014''$ — $\cdot 016''$
In service	...	...	...	$\cdot 010''$ — $\cdot 012''$

With High Lift Cams :

New Contacts	...	...	...	$\cdot 014''$ — $\cdot 016''$
Maintained in Service at	...	...	...	$\cdot 014''$ — $\cdot 016''$

DISTRIBUTOR BEARINGS.

Excessive side play at the cam head, generally caused by wear of the distributor bearings will cause uneven running and missing at speed.

Check for possible wear by putting side pressure on the cam and watching the movement at the C.B. points. *The variation in the gap should not exceed .004".*



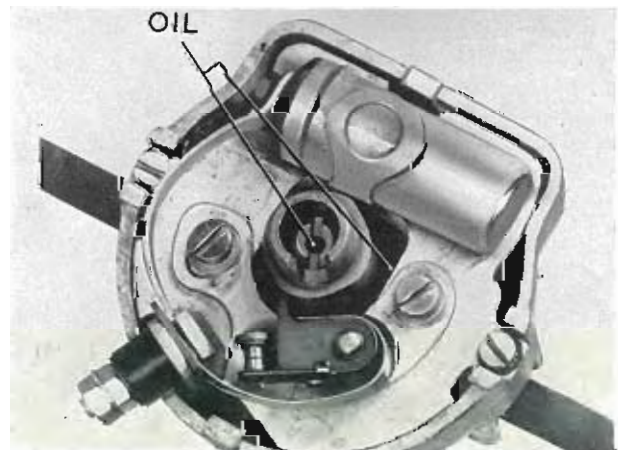
THE AUTO ADVANCE MECHANISM.

Sluggish operation or sticking of the centrifugal auto-advance mechanism will cause failure of the engine to accelerate and general erratic performance. Check the auto-advance for freedom of movement by turning the rotor heel against the spring tension.

There should be no 'back-lash' at the start and the cam and rotor should return fully to the original position when released.

THE AUTO ADVANCE — LUBRICATION.

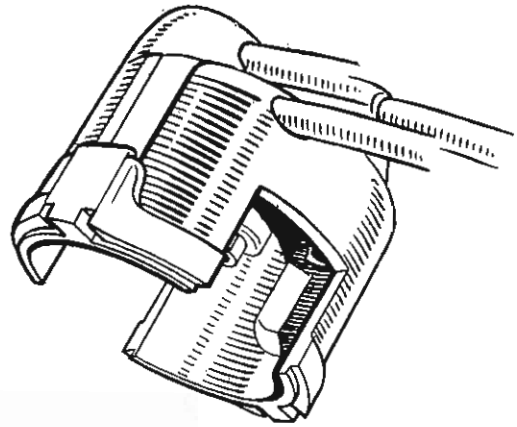
The Auto-advance should be lubricated with light machine oil at the points shown, particularly if any sticking is observed.



THE SUCTION ADVANCE.

Sticking or failure of the suction advance will cause poor engine acceleration, and sluggish running. An increase in the petrol consumption may also be noticed. The mechanism can be checked manually, and then observed with the engine running at varying speeds. If the suction diaphragm is working correctly, the plunger should move freely in its guide.

In some instances a cut-away distributor cap will have to be used for the movement to be seen. The picture shows how the cap should be cut away.



THE IGNITION COIL AND SWITCH CONNECTIONS.

Loose L.T. connections cause misfiring and even intermittent or total failure.

H.T. leakage at the coil chimney due to the accumulation of dirt and moisture on the moulding will frequently cause misfiring when accelerating under load.

A quick check of the L.T. circuit wiring, paying particular attention to connections at the switch and coil, plus an inspection of the coil chimney, will complete the maintenance of the ignition circuit.