THE LUCAS 25D DISTRIBUTOR

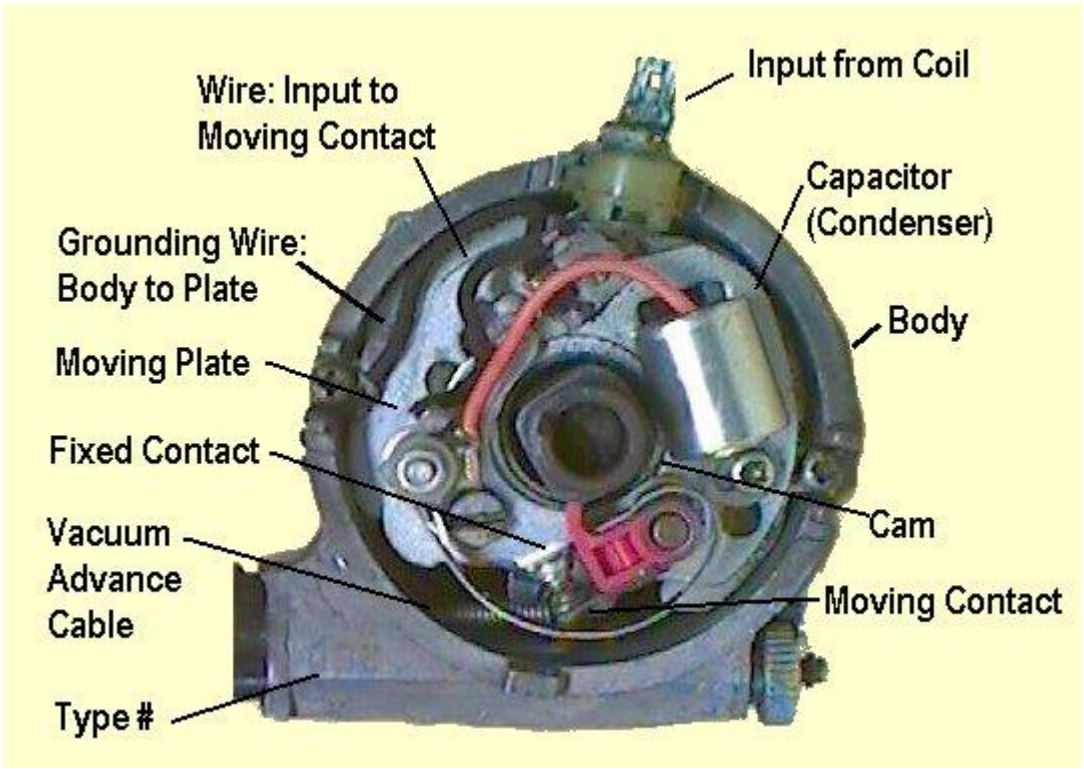
Courtesy of the MG Cars Enthusiast's Club - www.mgcars.org.uk

General Description

The distributor is the jack of all trades of the ignition system. At one and the same time it is mechanically rotates a cam that operates an electrical switch (the contact breaker) that feeds a low tension circuit to the external coil. The coil then feeds back the transformed voltage as a very high voltage which the mechanical rotor arm then distributors to each spark plug.

While doing all this, the cam can move relative to its driving shaft by centrifugal force and the plate that retains the contact breaker can be moved by vacuum or more accurately: differential pressure, both mechanisms advancing and retarding the timing of the opening of the contacts according to engine conditions.

What's Inside



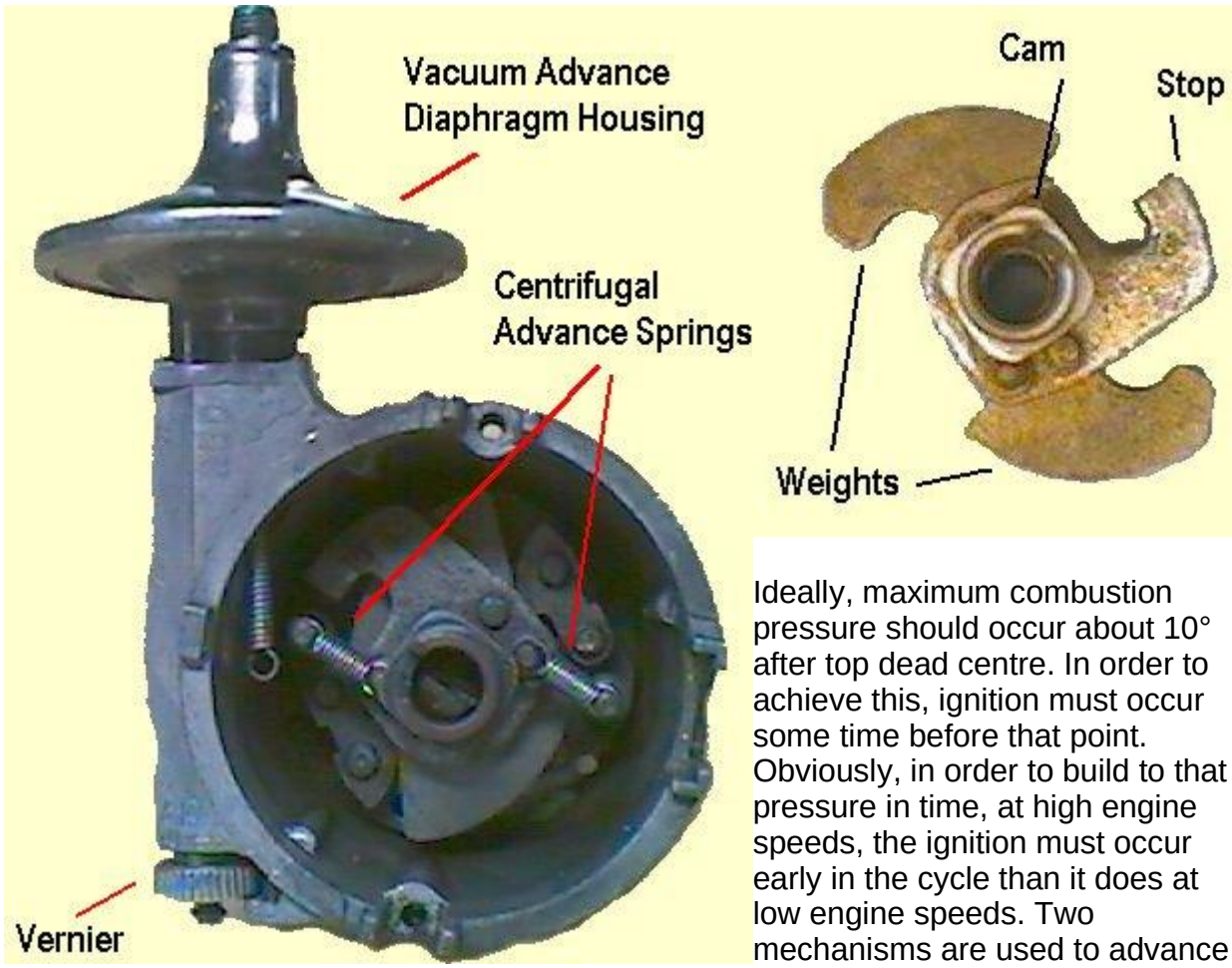
The photo at left shows the Lucas 25D distributor that was fitted to MGA's and MGB's until 1974 and which is typical of many of its era. With the ignition ON, voltage is applied to the top of the + contact of the coil (- contact on positive ground cars). No current can flow until the circuit is complete. The low side of the coil finds its ground, and thus completes the circuit, by the action of the distributor to which it is connected at the contact marked "Input from Coil". Inside the distributor, the Input is then connected by means of the "Wire: Input to Moving Contact" to a bow spring which can conduct current to the Moving Contact via a rivet that passes through an insulator. The bow spring tends to want to push the Moving Contact toward the centre of the distributor and thus also toward the Fixed Contact, which is electrically connected to ground via the metal Moving Plate and the Grounding Wire. However, the insulator section of the moving contact has a cam follower that the bow spring forces to follow the a 4 lobed Cam profile. When the cam follower is on a flat section of the Cam, the contacts are closed and current can flow to ground from the coil. As the engine rotates, so the Cam rotates at half engine speed.

When the Cam rotates to a point where a peak opens the contacts, current ceases to flow, the magnetic field in the coil collapses and a high voltage is generated as described in Basics. As the contacts open, a spark is generated between them. The effect of the spark is to cause (i) metallic exchange between the contacts so that one gets prematurely pitted while the other grows (a phenomenon called piling), resulting in poor contact performance, (ii) theft of the energy that would otherwise be dissipated at the spark plug. The Capacitor (formerly called a Condenser) is a kind of electrical spring. It quenches the spark rather in the way that an air spring does to stop water hammer in plumbing.

A notch in the Cam serves as a key into which to lock the rotor arm (not shown). As each of the 4 lobes of the Cam causes the contacts to open and a spark to be produced, the rotor arm points towards a different contact in the the distributor cap, each of which is attached via the ignition cables to the spark plugs. Note that the rotor arm does nor touch the high tension contacts in the cap, it passes so close, however, that the spark can jump the gap.

Because the distributor Cam rotates at half engine speed, it provides a spark to each spark plug only every other engine revolution, as per the principle of the 4 cycle (or stroke) engine.

The Advance Mechanisms



Ideally, maximum combustion pressure should occur about 10° after top dead centre. In order to achieve this, ignition must occur some time before that point. Obviously, in order to build to that pressure in time, at high engine speeds, the ignition must occur early in the cycle than it does at low engine speeds. Two mechanisms are used to advance the spark, one is related directly to engine speed — the high the speed the greater the spark advance, the other is dependant on depression in the carburettor — the more the throttle butterfly is open and the greater the engine speed, the greater the spark advance.

Centrifugal Advance
This mechanism makes the spark occur earlier in the cycle as engine speed increases. Whereas, the "static" timing of the high compression engine engine may be 10° of rotation, it will have advanced by up to a further 6° at idling speed. It does this by mean of two weights that are thrown outward against the force of springs which are trying to pull them back. The cam that operates the contact breaker has no hard connection between itself and its driving shaft, rather it is connected to the shaft by the pivot points of the weights. As the weights move in out out, the cam rotates back or forward relative to the driving shaft. The photo above left shows the partially hidden weights pulled in by the springs. In the right-hand photo, the camshaft has been removed from the driving shaft and the weights moved outward to make them more visible. It should be possible to turn the cam anti clockwise, against the force of the springs until the Stop touches the spring retaining post. If the springs and lubrication are good, the cam should spring back clockwise when released. The Stop will have a number stamped on it, and that number will be different depending on the exact model of distributor. Some will be stamped 10° some 13° and others different numbers. This Stop limits the centrifugal advance to the number of degrees indicated.

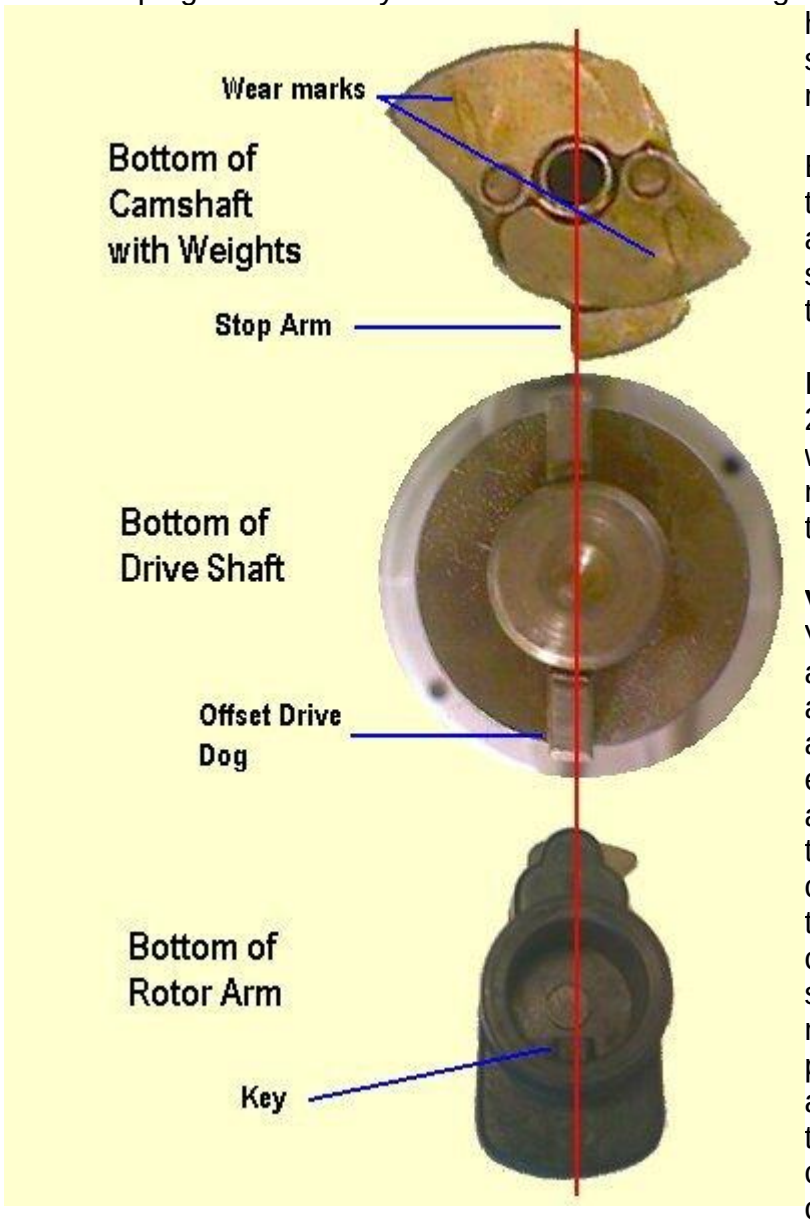
The springs are not identical. One spring has a fairly light force and is always under tension. The other is stronger and is initially lose on its pins and so not under tension. The static timing (usually 10° for high compression engines or 8° for low compression) is really there to aid starting. As soon as the engine rotates at any speed above cranking, the centrifugal force overcomes the light spring and advances the ignition about 3° - 6°. At that point the slack in the stronger spring is taken up and limits the advance such that thereafter it more gradually increases with speed up to the maximum defined by the Stop,

The springs do a lot of work under high vibration and temperature conditions and are frequently found to be in poor shape. Unfortunately, replacements are hard to get and stock springs just don't exist that fully mimic the originals in terms of length, hook design and tension.

Assembly.
If you remove the camshaft and weights from the sleeve ***it is very important*** to reassemble them correctly. Be aware that it is possible to assemble the cam 180° out of rotation, such that the spark plug fires on the exhaust, rather than the compression stroke, in which case the car will not start but may backfire (possibly damaging the exhaust).

The distributor is best assembled upside down. That way, the weights on the camshaft can be positioned as shown in the top image at left (note the wear marks are on the *bottom* of the weights) without moving outward or falling off their pins. Point the Stop arm toward you and the notch in the cam that retains the rotor arm should then also be toward you.

Next invert the distributor body, *ensuring that the offset drive dog is to the left*, as shown in the photo centre left. Slide the camshaft sleeve over the drive shaft, all the while keeping the assembly vertical so as not to dislodge the weights. When fully home, the camshaft should seat in the body with the minimum of wiggling.



Before securing the springs, temporarily refit the rotor arm and check it is pointing as shown at left bottom relative to the drive dog.

It is not important which of the 2 different springs goes in which position, but be careful not to over-stretch them or their hooks.

Vacuum Advance

Vacuum advance is more anticipatory than centrifugal advance. Whereas centrifugal advance works on the current engine speed, vacuum advance occurs when the throttle is opened ready for the car to accelerate and retards the engine when the throttle is closed, before the engine speed has reduced The manifold depression is proportional to engine loading and so a pipe taken from close to the butterfly in the carburettor to the distributor, can expose the distributor to that depression, or vacuum, to alter the distributor advance.

One form of the 25D distributor is shown above with the Vacuum Diaphragm clearly shown. The exact shape may be different on other 25D's. The principle is the same, however. A tube from the rear carburettor, is routed around the back of the engine to the vacuum diaphragm. Suction, vacuum or depression, as it is variously known, will cause a diaphragm to move and with it a cable or rod that is attached to its centre. The cable or rod in turn connectors to the Plate onto which the contact breaker is mounted. The Plate tends to move clockwise, toward the oncoming anticlockwise direction of the cam, and thus the points open earlier than they would otherwise, and so the spark is advanced.

It is easy to check that the vacuum advance works. With the distributor cap removed, pull the vacuum tube from the carburettor and suck hard on it, watching the Plate. Verify that the plate moves clockwise and that you can hold the vacuum, and the Plate in the advance position by holding your tongue against the end of the tube. If you

cannot hold the partial vacuum with your tongue, then the tube, its connection or the diaphragm may be leaky. If the tube and diaphragm don't seem leaky, (and you have good lungs) but you cannot pull sufficient vacuum to move the Plate, check that the cable or rod is properly attached to the Plate. If it is, remove the cable or rod from the pin where it attaches on the Plate and check that the Plate can move freely: it may need lubricating where it slides on the second plate below it.

Distributor Variations

The illustrations above show the 25D distributor. While it remained basically the same there were some variations, particularly in the design of the vacuum advance assembly. Some had screw-on metal tube fittings, some push-on rubber attachments.

The photo at left shows a 25D but note how different the vacuum diaphragm housing looks, with its offset tube attachment point, compared to that shown above .

Other variations included different Stop lengths that allowed different degrees of centrifugal advance.

Note the model number label with date code.
