IGNITION TIMING ON DISTRIBUTOR CARS

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READ THIS IN CONJUNCTION WITH CAR ELECTRICS AND FAULT FINDING SIMPLIFIED DOC.

SAFETY

When working on the ignition system always take care not to cause any electrical shorts especially on unfused ignition circuits.
Take extreme care when working on a running engine and checking with a stroboscope
Keep hands, clothing, strobe leads etc clear of any moving parts
Always work in a well ventilated space

WHY IS THERE A STATIC ADVANCE TIMING AND A DYNAMIC ADVANCE TIMING

To understand why, we need to check there is a correct static timing advance and a maximum dynamic advance, a fundamental understanding of the 4 stroke cycle is required. I call it **SUCK/SQUEEZE/BANG/BLOW**

SUCK – The correct air/fuel mixture is drawn into the engine through the open inlet valve by the vacuum created by the downward motion of the piston
SQUEEZE – Both valves are closed and as the piston moves upwards towards the cylinder head cavity it compresses the fuel air mixture (on a standard Low compression engine the ratio is around 8:1).
BANG – before it quite reaches **TOP DEAD CENTRE (TDC)** on the compression stroke the mixture is ignited by the spark plug. This forces the piston down (power stroke)
BLOW – as the piston moves down and back up towards TDC on the exhaust stroke, the exhaust valve is open and the exhaust gases are expelled into the exhaust manifold

A key point here is that when the spark plug fires, it takes a finite time for the fuel/air mixture to burn and develop a flame front which rapidly expands the gas and provides the compressive motive power for the engine.
In an ideal engine the pressure caused by combustion reaches its maximum just after the piston has passed TDC to ensure all the power is used to the maximum to force the piston down the cylinder before the exhaust valve starts to open.
If there was no way of altering the timing set at static, then under different engine speeds as engine revs increase, the piston would be further down the cylinder when maximum compression force is reached and therefore would be less effective.
Also the exhaust valve would be opening (typically 55 deg. After TDC) and a lot of the compressive power would be lost.

IGNITION ADVANCE/RETARD

Advance – this is how much (usually measured in crankshaft pulley degrees) the points open before compression TDC. Most crankshaft pulleys rotate clockwise, therefore an advanced timing will occur at an anticlockwise position before TDC mark on the crankshaft pulley.
Retard – for ignition to be retarded it moves closer to TDC mark i.e. clockwise

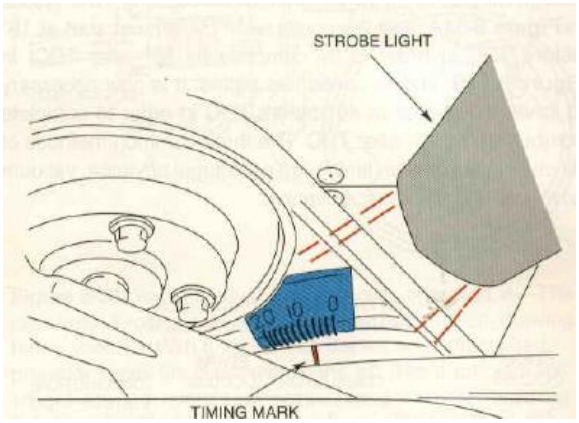
STATIC TIMING

Static timing is usually set to provide the right amount of ignition advance to get the engine starting every time whether hot or cold.
A starter usually cranks the engine over around 70 rpm, therefore static advance will be fairly small (usually around 8 to 12 degrees on a “normal” engine).

Usually static advance will be enough to start the engine and enable it to tick over fairly smoothly (if tick over is below 1000 rpm) without any kind of additional advance kicking in.

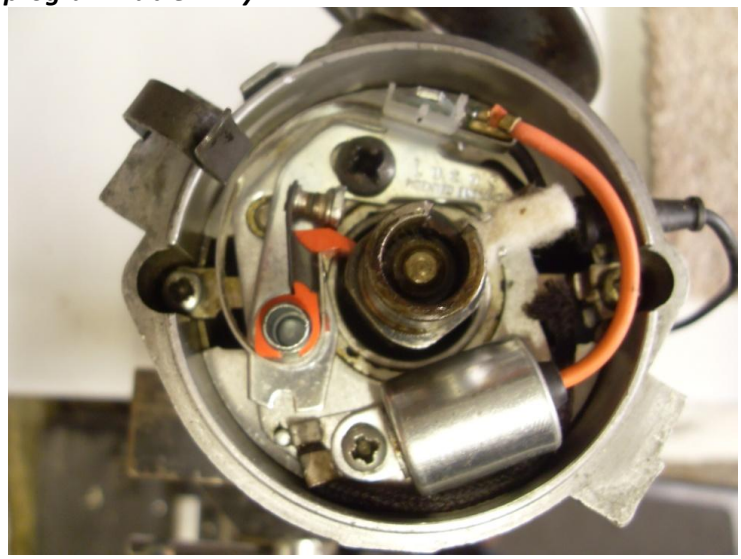
TIMING MARKS

To enable the timing to be accurately set there is usually a mark provided by the manufacturer on the crankshaft pulley which denotes TDC on the compression stroke.
If you're not sure if it's the compression stroke take the spark plug out of the cylinder which is used to time the engine (usually Number 1 cylinder) and stick your thumb over the spark plug hole. Slowly crank the engine over by hand and when you feel pressure building up against your thumb then it's on the compression stroke and not the exhaust stroke.
There will also be a gauge showing typically 5°, 10°, 15° although this varies from engine to engine.



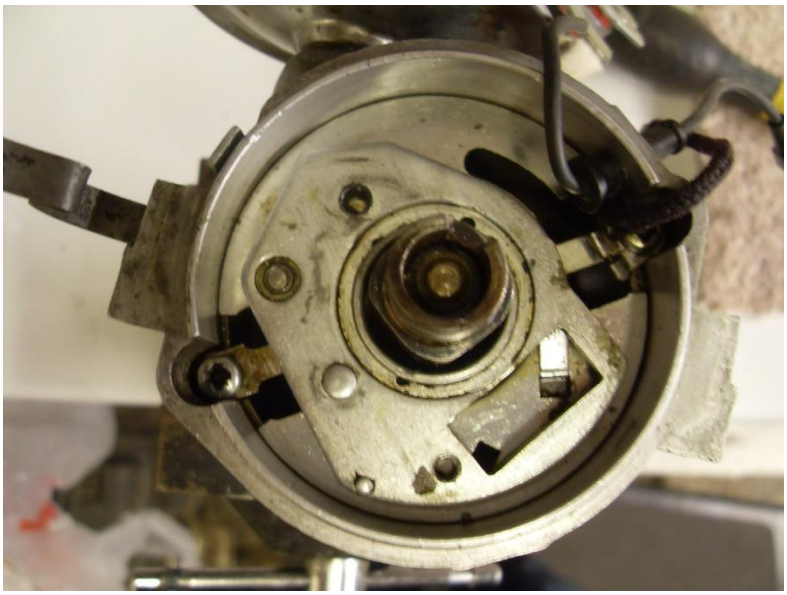
MECHANICAL ADVANCE

As we can see, static advance is fine for starting/idle but once the revs rise, the spark needs to happen earlier (advanced) to enable the flame front to spread to give maximum compressive oomph!.
Also this advance needs to be gradual and controlled in line with the increase in engine revs.
This is achieved in the standard Dizzy by incorporating mechanical advance using weights and control springs.
See pic below of a Lucas 25D as fitted to my MGB before being replaced by a 123 Electronic programmable Dizzy



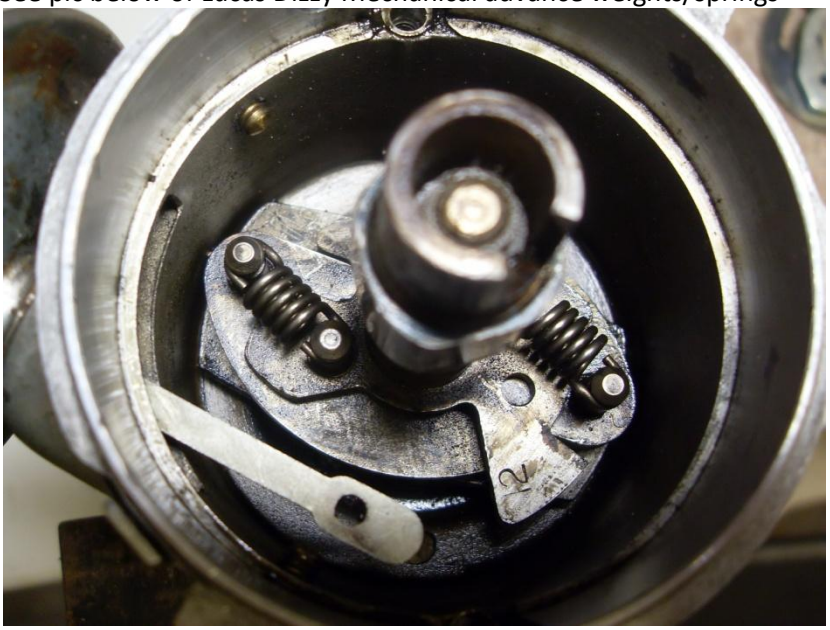
The points are fixed to a base plate and some small adjustment is possible via the black pozi screw to enable the correct gap to be set.

This base plate is fixed to the body of the dizzy via the lugs on the left and right of the dizzy.
Advance is achieved by allowing the cam lobe to move relative to the contact points
How it does this is fairly simple by the cam lobe being mounted on a plate which is controlled by the advance weights.
See pic below of Contact Breaker base plate with Contacts/condenser removed for clarity



Below the contact breaker base plate is the actual Advance/Retard mechanism.

This consists of a plate which is fixed to the dizzy rotor spindle.
The plate has two fixed posts to terminate one end of the Mechanical Advance springs and also acts as a pivot point for one end of the advance weights.
The other end of the advance weight (s) has a post and this has the other end of the spring attached.
See pic below of Lucas Dizzy Mechanical advance weights/springs



As the dizzy spins and the weights fly out due to centrifugal force they move the cam lobe in the opposite direction to the dizzy rotation which has the effect of advancing the timing.

On the advance plate there is a number stamped – 12. This refers in degrees to the **MAXIMUM ADVANCE OF THE DISTRIBUTOR**. However the **CRANKSHAFT ADVANCE IS TWICE THE DIZZY ADVANCE !**
Therefore in the above dizzy, the maximum amount of mechanical advance achievable by the distributor is 24 degrees.
Also this is in addition to the initial static advance.
If the static advance is set to 10° then the maximum Total advance is 34°.

You can also see an arm projecting into the dizzy with a hole in it. This is where the Vacuum Advance (if fitted) connects to the advance/retard mechanism.
The above describes the Lucas Dizzy Advance. Others, like the Marelli may use a system where the CB plate is moved relative to the lobe but the effect is still the same.

ADVANCE SPRINGS

The rate of advance is controlled by the two small springs. These provide an Advance Curve in line with the required performance of the engine. They allow the Advance weights to move progressively outwards as engine revs increase.
Quite often these springs are of different length and gauges to give a strong and weak spring.
The weak spring determines when the advance kicks in after idle. The weaker the spring the earlier (and quicker) the advance.
Both springs should have some tension in them when at rest otherwise if advance kicks in too soon, idle becomes erratic and lumpy.
If the springs are too strong then the engine does not get enough advance at max revs and performance and economy could suffer.

If there is too much advance (usually caused by excessive static timing or a worn dizzy) then because the gases are expanding as the piston moves towards the cylinder head, the expanding gases are rapidly compressed into a tiny space and this has an explosive effect on the internals sending a shock wave through the engine. This is typically called knocking or pinking and can be remedied by retarding the ignition a couple of degrees at a time until it stops pinking.

TESTING ADVANCE

Check Spark Plug Gap, CB gap, Tappets, Carb settings.
Mark TDC on the crankcase pulley and the Timing Marks at 10° and at maximum advance (typically 32°) with Tippex or white paint.
Set the static timing as per the handbook - typically 10° before TDC.
Connect a strobe to No 1 cylinder.
KEEP ALL HANDS, CLOTHING, LEADS CLEAR OF ANY MOVING PARTS !
Start the engine and let it settle down to a steady idle. Check the timing mark is still 10°.
Now slowly advance engine revs – the timing mark should move off static and slowly and steadily move towards the Max Advance Mark so that at approx 3000 rpm you have max advance.
If the timing moves rapidly off static towards Max or does not reach near Max advance then the mechanism/springs need checking.