



Advance or Retard the spark?

Go forward or go back? That is an interesting question and when investigated it turns out that it isn't at all what you thought it might be. Nic Houslip prepares his RV8 and V8 Roadster for use in sprints and hillclimbs explains what's involved.

Those of us old enough will remember that cars often had a manual advance and retard lever or control, often on the steering column, in the place now occupied by the airbag on modern cars. Starting of these old cars was by cranking the engine by hand and the lever was put to the retarded spark position to prevent the engine "kicking back" as you turned the crank handle. What occurred when it did if the spark was too early was that the spark occurred before the engine reached Top Dead Centre [TDC] and this pushed the piston back down the bore with some force and the crank handle would move violently back against the hand. This is one of the reasons why you should always crank with the thumb on the same side as the fingers. Retarding the spark ensured that if, and this wasn't always a given, the engine fired it, would occur after TDC and the piston was then pushed down the bore in the correct direction, usually with the result that the engine started and continued to run.

With the engine running it was prudent not to keep the lever in the retarded position as the engine was not only poorly performing but would also overheat very quickly, moving the lever to give a little advance would give more power. From this it will be obvious that some form of automatic control would be a good idea and the centrifugal advance mechanism, A.K.A. Bob Weights in the distributor came into our lives. As the engine speed increases the centrifugal force on the weights causes them to move outwards and via a system of levers and restraining springs, move the contact breaker cam in the direction of rotation of the distributor spindle making the spark occur a little earlier; leading to smoother running and better fuel economy. The condition of the bob weights, any slack in the pivots that retain them and the springs are critical to the smooth running of the engine. The spring rates are selected for the application, i.e. that particular engine and do age with time, heat and stress.

If you have driven an old car with manual advance and retard you will find that the engine can stand a little more advance when running lightly, as it would be on a level road, but as the road begins to slope upwards and the load increases the amount of advance needs to be reduced to, and especially as the engine speed starts to fall

and the onset of the dreaded "pinkling" occurs. Pinking, or pre-ignition, is not dissimilar to what happens when trying to start the engine with too much advance. The spark is occurring before TDC, but because the engine is heavily loaded, the mixture ignites and develops pressure, but the piston hasn't quite reached TDC and the resultant explosion of the mixture cannot push the piston down the wrong way. This is dangerous as it subjects the piston, connecting rod and bearings to shock loads they were not designed for and also creates very high temperatures in the combustion chamber that can, and often does, burn a hole through the piston crown.

What is needed is a way of changing the advance in unison with the centrifugal method that is load sensitive. Fortunately, there is **a very good indicator of load in an engine, manifold pressure or lack of it**, dependent on engine speed and throttle position. If you imagine the throttle is almost closed, as in cruising on a level road, then the suction of the intake strokes mean that the manifold pressure is very much lower than atmospheric pressure and the diaphragm in the advance and retard device responds to this by moving the plate that the contact breaker points are fixed to in the opposite direction to the distributor spindle, thus advancing the spark. If the throttle is

now opened, for example as the car begins to climb a hill, the manifold pressure rises towards atmospheric pressure and the diaphragm then moves the contact breaker plate in the same direction as the distributor spindle, thus reducing the amount of advance.

But let's think about why the engine needs the spark to advance as it speeds up. Is there is some mysterious process in the combustion chamber that requires this? Indeed, the correct amount of advance for any engine is usually determined empirically, that is by observation on a road test or better on a dynamometer, to determine which setting of the distributor, bob weight sizes, spring force and how much or little the diaphragm moves the contact breaker plate is correct. But don't worry, this is all taken care of during the development of the engine and as long as each engine of that design comes off the production line exactly the same, the makers can fit the distributor with all the variables already built in.

But why does it need to advance? If you think about the piston rising up on the compression stroke at a low speed, let's say 500 RPM, a fairly typical idle speed, you can see that the piston will take a certain amount of time to move from when the spark occurs to the point where the flame propagation throughout the compressed mixture has completed and the gas pressure is exerted on the piston. Now imagine that the engine is running at 5000 RPM, or 10 times as fast. Then we can see that the piston will have moved from the spark position much further and the piston will be on its downward stroke before the flame propagation has completed. It turns out that the rate of flame propagation doesn't change much with engine speed; meaning that much of the explosive force is wasted as the piston is moving down as the gas pressure is rising. Advancing the spark's position ensures that the mixture begins to burn much earlier so by the time the flame propagation is complete the piston will be in the optimum position as the gas pressure rises to take advantage of it.

Checking the timing is best accomplished with a stroboscopic timing light. The timing of a distributor with a contact breaker can be set statically (engine off) by adjusting the distributor housing until the points just open. It is not possible to set or measure the timing dynamically (engine running) without the use of a strobe light. This handy device uses a flash tube rather like that in a camera flash that is triggered by the spark via an inductive pickup around the lead to the plug usually on number one

cylinder. Aiming the strobe light at the fan belt pulley on the end of the crankshaft it should illuminate the timing mark. As the engine speed is increased you can see the mark move forward or backward around the pulley. Increasing the speed slowly you will see the mark advance as the bob weights do their work, and as the throttle is released the advance will increase as the vacuum in the manifold pulls the diaphragm in, but as engine speed falls the advance will back off.

Wandering advance, where the mark doesn't stay in the same place, is usually caused by wear in the distributor spindle, and with contact breaker distributors the dwell time (the amount of time the coil has to charge between sparks) may be affected thereby causing poor running.

On all Rover V8s the instructions for fitting the distributor are VERY precise and must be followed to the letter to ensure that correct timing occurs. It requires that you follow a correct procedure - if you do not you risk poor performance and ultimately damage to the engine. **If you need to rotate the distributor body or reassign the leads, there is something wrong!**

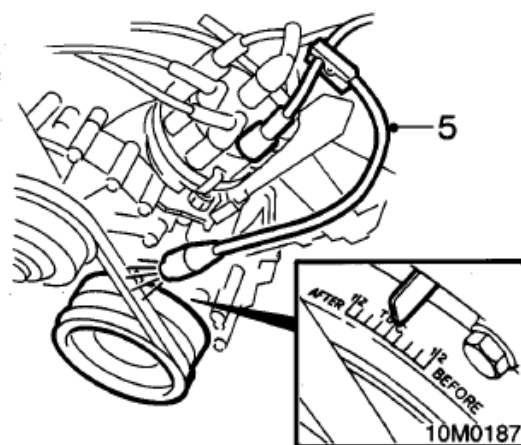
A last point is to check the condition of the ignition leads, their correct positioning and the use of the correct plastic clips and brackets to hold the leads apart from each other and prevent contact with metal parts. Old leads deteriorate and are often a source of hard to trace misfires, the insulation has to withstand in excess of 35,000 Volts and the spark will take the path of least resistance. If there is a pin hole or a worn lead the spark will leak away to earth and the plug may not fire.

Alongside is the **Ignition Timing maintenance routine** from the RV8 Repair Manual AKM7153ENG

IGNITION TIMING

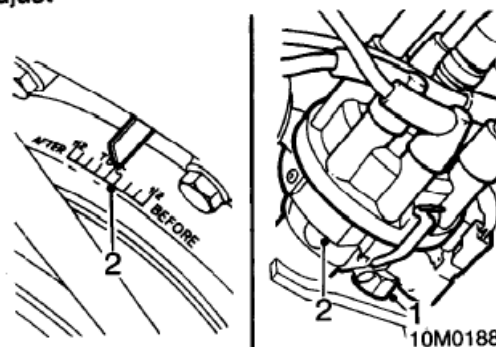
Check and Adjust

1. Connect stroboscopic light and tachometer, ensuring that stroboscopic lead is connected to No. 1 plug h.t. lead.
2. Clean timing marks on crankshaft pulley. Marks each side of TDC are $\pm 3^\circ$ tolerance.
3. Start and run engine until normal temperature is achieved; cooling fan starts to operate.
4. Disconnect vacuum pipe from distributor.



5. Check timing using stroboscopic light:
At 800 rev/min max. with vacuum disconnected = $5^\circ \pm 1^\circ$ B.T.D.C.

Adjust



1. Slacken distributor clamp nut.
2. Carefully rotate distributor body to achieve correct timing. Rotate clockwise to advance or anti-clockwise to retard.
3. Tighten distributor clamp nut to correct torque and recheck timing.
4. Connect vacuum pipe.
5. Switch off engine, disconnect tachometer and stroboscopic light.