



Minor Mechanics

## Technical Tip 3

### Ignition timing

Following on from distributor servicing the next logical job is ignition timing. We strongly recommend that you use this section in conjunction with the Distributor Technical Tip 1, if only to ensure you have the correct points gap first. (Adjusting the points gap will alter the ignition timing.)

### Why it's important for your engine to have the correct ignition timing?

The aim is to ignite the air/fuel mix at exactly the correct time so that the expanding gases can do the maximum amount of work.

If your engines ignition timing is not correct you can experience the following problems:

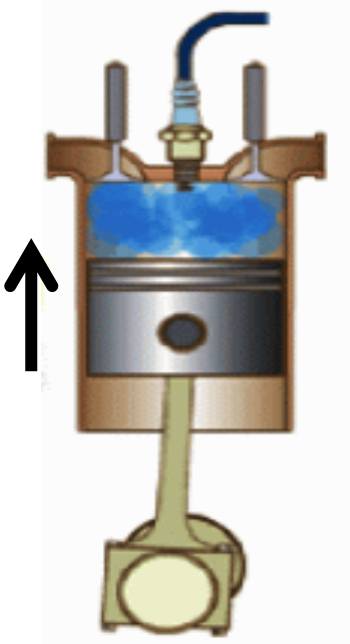
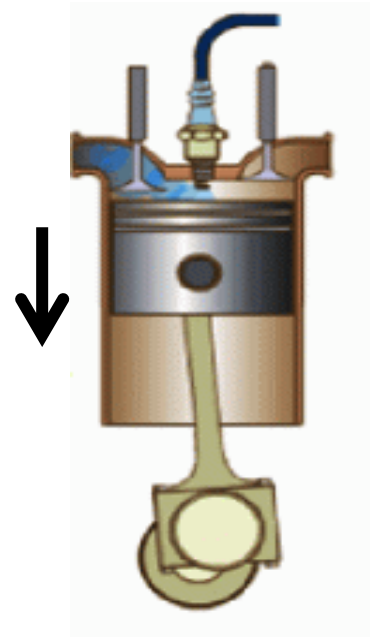
1. Poor engine performance. (Loss of power, poor acceleration, starting problems, backfiring, pinking or knocking see terms page 11)
2. Poor engine economy.
3. Overheating of engine and the exhaust system.
4. Noises from the engine.
5. Damage to spark plugs
6. Expensive engine damage
  - a. Burnt valves.
  - b. Damaged pistons and bores.
  - c. Excessive wear to crankshaft and bearings.
  - d. Excess loading of the engine parts.

### The theory

A standard Morris minor has a 4 cylinder 4 stroke normally aspirated engine. This means the engine has 4 cylinders (bores) each requires 4 strokes for a complete cycle (induction, compression, power and exhaust strokes). Normally aspirated means the atmospheric pressure pushes the air/fuel mix into the cylinders.

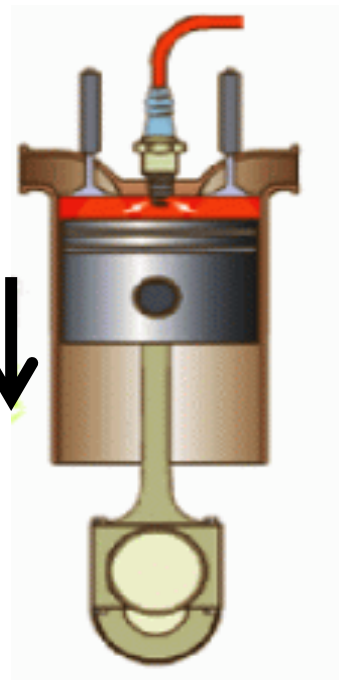
### 1. Induction stroke (Suck)

The first downward stroke allows the air/fuel mix to enter the cylinder through the open inlet valve, at the bottom of the downward stroke the inlet valve shuts.



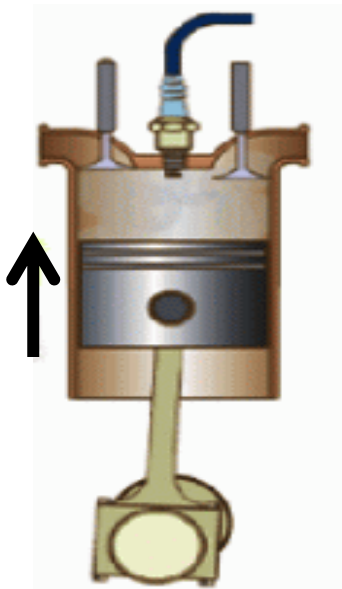
### 2. Compression stroke (Squeeze)

The piston rises to compress the air/fuel mix and just before the piston reaches Top Dead Centre (TDC) the spark plug fires the air/fuel mix. Note: The spark at the plug occurs typically 5° before TDC because there is a small delay before the maximum pressure is achieved in the cylinder.



### 3. Power stroke (Bang)

The rapidly burning and expanding compressed air/fuel mix forces the piston down.



### 4. Exhaust stroke (Blow)

The exhaust valve opens and the upward stroke pushes the exhaust gases out.

# Ways to check and adjust ignition timing

There are two ways of checking/adjusting ignition timing.

## 1. Static timing (Note: you cannot carry out static timing on distributors with electronic ignition)

This is carried out with the engine stationary (hence the title Static Timing). Static timing was once the only way to perform ignition timing (before they developed stroboscopic timing lights).

The benefits of Static timing are:

1. You only need basic equipment
2. You are not running the engine so the engine could be cold to work on.
3. You don't have moving parts to worry about or high tension (HT) voltages to avoid from the high tension circuits.
4. If you have lost the original basic setting for the distributor/timing it allows you to get an initial starting point so you can start the car for stroboscopic timing.

The cons

1. It doesn't allow fully for wear and tear in the distributor drive chain.
2. It takes time and practice to get it perfect.
3. If you have electronic ignition you need to ensure you have marked the distributor position before you remove it.

## 2. Stroboscopic (Dynamic) timing

This is carried out with the engine running and is the preferred most accurate method.

When the strobe light flashes you are able to see the notch in the rotating pulley in relation to the timing marks. This is the point when the spark plug fires.

The benefits of stroboscopic timing are:

1. It allows you to time the engine under its normal running conditions which takes into account the wear and tear in the distributor drive chain.
2. It's a quick and easy way to carry out ignition timing if you follow the simple instructions.

The cons

1. You cannot carry out stroboscopic timing until you have the engine running.
2. You are running the engine so the engine could be very hot, you have to take care around the moving parts and HT circuits (HT leads, coil and distributor cap).
3. The cost of the strobe light £17 to £50+.

## Before we start

Changing the point gap will alter the ignition timing so you need to check that the point gap is correct before timing the ignition (ideally with a new set of points).

It's good practice to carry out the following:

1. Clean/Change and gap the spark plugs.
2. Check and adjust the tappets.
3. Check/replace air filter.
4. Check/clean/replace engine breathers.
5. After doing all these and checking/adjusting the ignition timing warm the engine to normal temperature then check and adjust the carburettor.

## To Check and adjust the ignition timing you will need:

1. Pair of gloves to help keep your hands clean and offer some protection to your skin.



They could be disposable gloves or more robust multi use mechanics gloves

2. To adjust the distributor timing you will need a spanner to loosen the clamp.



3. Inspection torch or inspection lamp



4. White paint and a small brush e.g. car touch up paint, Tipp-Ex etc.



5. For static timing a 12volt (v) test lamp. Mechanics normally made a test light from a bulb with wires soldered to it (Fig 1) (An old brake light bulb with one element blown is ideal for this but any 12v bulb would do). The bulb and soldered connections are then insulated (Fig 2)



Fig 1



Fig 2

The modern equivalent is possibly a Light Emitting Diode (LED) in place of a bulb. Note: A bulb test light will work connected either way round but a LED must be connected red to positive black to negative to work. Again you can get the parts and make one or buy one from John and Terry Service Tools Ltd for £2.00 (Fig 3).



Fig 3

6. For stroboscopic/dynamic timing you will need a strobe light. There are a number to choose from. From a basic one with just the timing light (Fig 4) starting at around £16 and increasing in price depending on what options you want. You can have a timing light with a dial or digital system to adjust the degrees Before TDC (BTDC) so that you only have to align the pulley timing mark with the TDC pointer (covered later). It's also possible to have a display for engine Revolutions Per Minute (rpm), dwell angle and options for 2 or 4 stroke engines.





Fig 4

Inline timing light (fits between No1 plug and No1 lead.



Induction timing light clips onto No1 lead



## Data

Distributor direction of rotation      Anti-clockwise (viewed from above).

Firing order    1 3 4 2

11 clicks of the knurled vacuum unit Vernier nut represent 1° of timing movement.

Static timing 1098cc engine (always check details for your engine) but typically 3° Before Top Dead Centre (BTDC).

Stroboscopic timing 1098cc engine (always check details for your engine) but typically 6° BTDC at 600rpm with the vacuum unit pipe disconnected.

## Carrying out static timing

There are two methods of carrying out static timing but we are covering the most common/least intrusive method.

1. If you have just fitted the distributor and have reference marks on the distributor and its bracket, line them up. (Well done. It's a real benefit if you have them). If you don't have reference you need to orientate the distributor into a rough position by rotating it so the vacuum unit is to the rear and is vertical with the vacuum hose connection at the top (Fig 5).
2. You need No1 cylinder to be on the compression stroke, to check this you will need to remove No1 spark plug (you may want to remove all of the spark plugs to allow the engine turn easily). Fit the starting handle and cover No1 spark plug hole with a finger or thumb and slowly turn the engine with the starting handle until you can feel the pressure starting to increase and then stop turning.
3. Locate the crankshaft pulley at the front of the engine, (the starting handle locates into the bolt in the centre of the pulley) look between the radiator and the engine.
4. Using the torch or inspection light look for timing marks usually in the form of 3 peaks and on a morris minor it may well be visible from under the front of the car. (Fig 6) See the Workshop manual for you engine.)

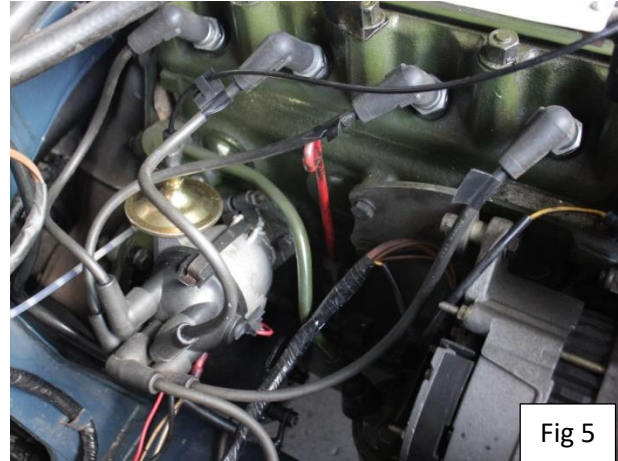


Fig 5

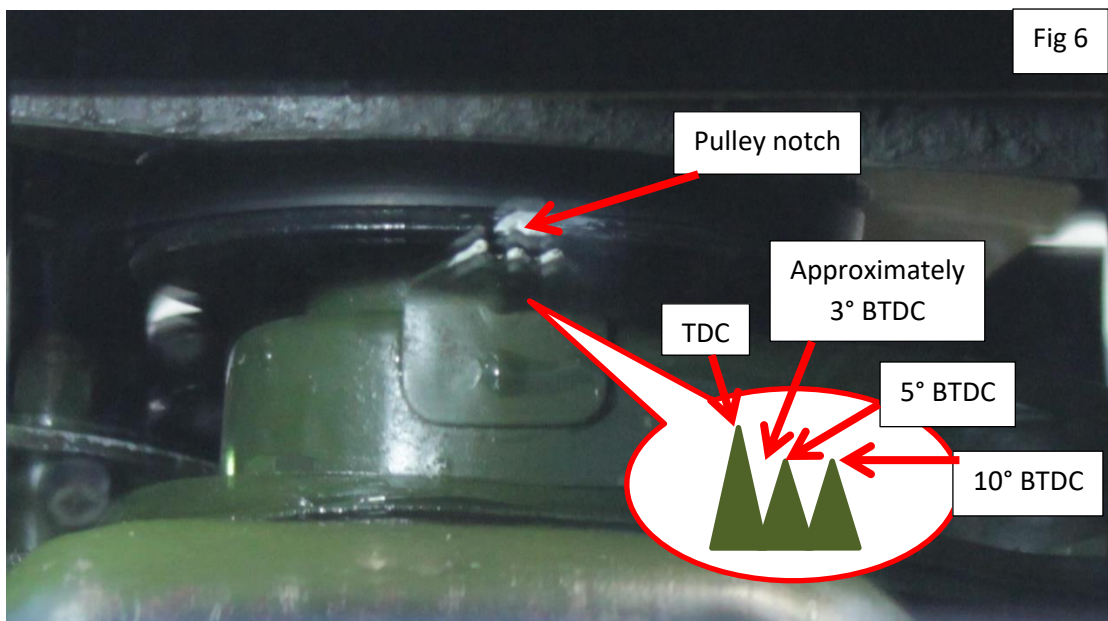
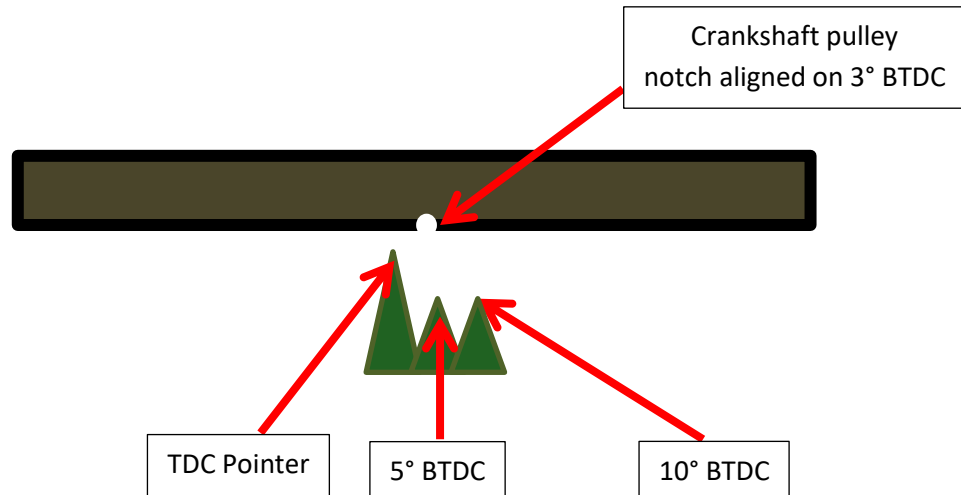


Fig 6

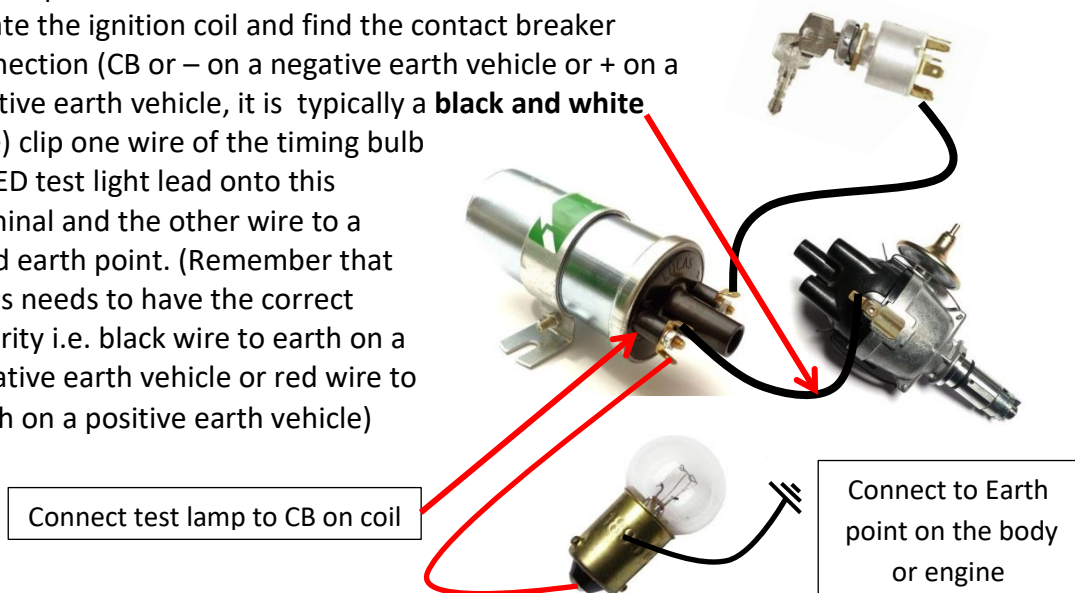
5. Look around the pulley edge nearest to the timing marks for a notch cut into it. You may well have to turn the engine slowly to see the notch and turn it into a position

where you can clean it and the timing marks with a cloth and put a spot of white paint on the tips of the peaks and the notch to make them more visible.

6. Look at the timing marks, turn the starting handle clockwise until the notch on the pulley lines up between the centre peak and the large peak (Approximately 3° BTDC for a 1098cc engine (Fig 5) Note : if the pulley goes past this position you will have to start again at the beginning of page 11 paragraph 2 until it comes around again. This is because you need to take up any slack in the distributor drive system.



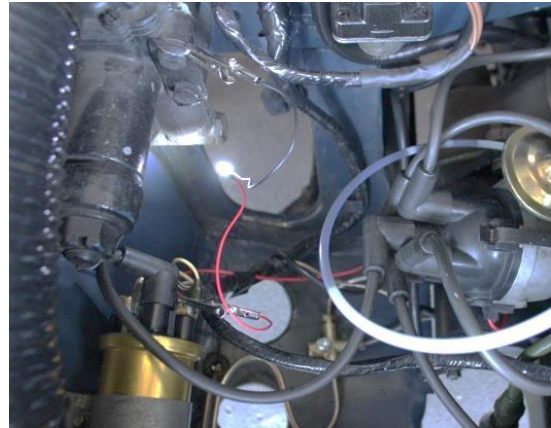
7. Remove the distributor cap and check that the rotor points to approximately the No1 lead segment inside the distributor cap.
8. You may need to turn the distributor to get it into the correct position
9. Locate the ignition coil and find the contact breaker connection (CB or – on a negative earth vehicle or + on a positive earth vehicle, it is typically a **black and white** wire) clip one wire of the timing bulb or LED test light lead onto this terminal and the other wire to a good earth point. (Remember that LED's needs to have the correct polarity i.e. black wire to earth on a negative earth vehicle or red wire to earth on a positive earth vehicle)







Static timing light with bulb connected



Static timing light with LED connected

10. Note: the spark plug fires when the contact points open. Turn on the ignition if the timing light is lit up, the points are already open and you need to turn the distributor slowly anti-clockwise until the light goes off. With the light off, turn the distributor slowly clockwise until the light just comes on. This indicates that the points have just opened. Check that the rotor still points at the No1 segment of the distributor cap.
11. Turn off the ignition Note: It's not good practice to leave the ignition on any longer than you need without the engine running as it can overheat the coil and associated wiring.
12. Hold the distributor to stop it moving when you tighten the distributor clamp (as described in the Distributor Service edition).
13. To get a more accurate adjustment you can turn the vernier nut on the distributor vacuum unit (Fig 11) in the 'A' direction until the timing light goes out and then in the opposite direction (in the 'R' direction) until the timing lamp comes on.
14. The timing is now set.
15. Remove the timing light.
16. Fit the distributor cap.
17. Start the engine.

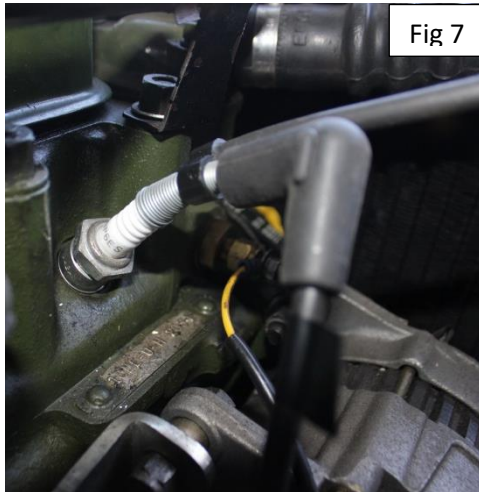
## Stroboscopic/dynamic timing

As we discussed earlier this is the best way of timing an engine.

1. To perform stroboscopic timing you must have an engine that will start and run at idling speed.
2. With the ignition turned off connect your strobe light:
  - a. If you have an induction clamp on your light leads, clip it onto No 1 plug lead



- If you have an inline connector for the plug leads on your light, remove No 1 spark plug lead from No1 spark plug and insert the light lead between the No1 lead and No1 plug. (Fig 7)

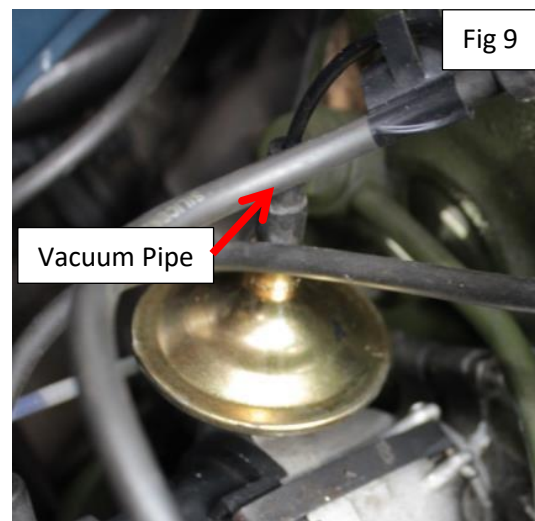


Inline connector fitted



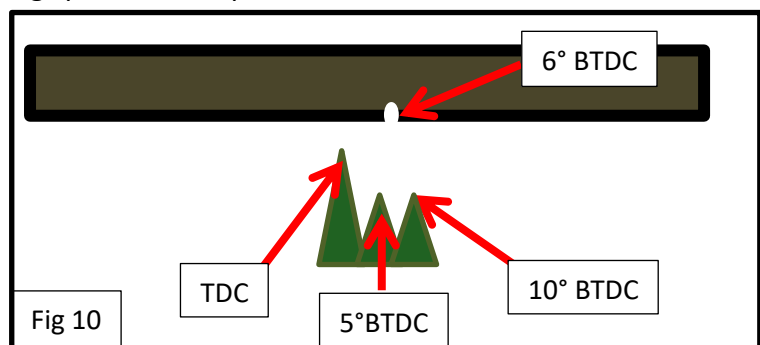
Power supply leads connected to battery

- Connect the power leads of the light to the battery terminals (observe the correct polarity red wire to positive terminal black wire to negative terminal). (Fig 8)
- Remove the vacuum pipe from the vacuum unit of the distributor. (Fig 9)
- WARNING:** Ensure wires and strobe light are clear of the moving parts of the engine. The distributor and all the High Tension (HT) wires will give you an electric shock (If they are clean, dry and in good condition the risk is less).

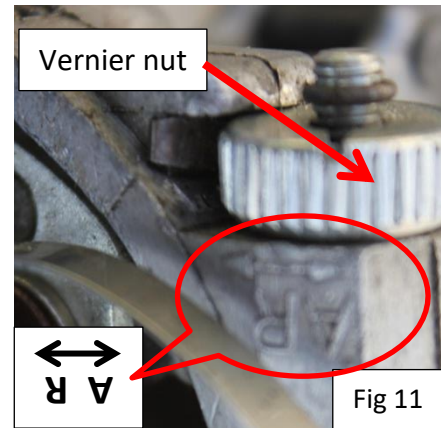


- Start the engine and set the idling speed at 600rpm.

- Point the timing light at the timing marks, the pulley notch should be on just before the middle timing pointer (Fig 10)  
Note: If your timing light has the option to set the number of degree BTDC, set it to 6° in this case then your pulley notch should line up with the large pointer (TDC).



9. If the marks do not align you can adjust the timing by turning the Vernier nut on the distributor vacuum unit (Fig 11). If you turn it in the 'A' direction (the pulley notch will move away from largest pointer (TDC)) the spark will fire earlier. Turning the 'R' direction (the pulley notch will move closer to the largest pointer (TDC)) the spark will fire later.



10. If the Vernier does not have enough adjustment to correct the timing turn the engine off.

11. Turn the Vernier nut to approximately the mid position.

12. Loosen the distributor clamp bolt one full turn and the clamp nut until the distributor can be rotated.

13. Restart the engine and adjust the timing by rotating the distributor body to the correct timing position.

14. Stop the engine and tighten the distributor clamp.

15. Restart the engine; recheck the timing, adjusting if required with the Vernier nut.

16. Check/adjust the carburettor.

17. Stop the engine and remove the timing light and refit the No1 lead to the No1 spark plug and the vacuum hose to the vacuum unit.

18. Now would be a good time to mark the reference marks on the distributor and its bracket.

19. Clear away all tools, remove timing light and check that everything is in place and you haven't disturbed something while working on the engine and it's safe to drive the car.

20. Close the bonnet. Job Done

## Terminology

**Pinking/ Knocking:** The spark plug is supposed to ignite the air/fuel mix at a precise point in the piston stroke to produce an even controlled burn. If this doesn't occur because one or more air/fuel pockets burn uncontrollably and independently from the normal burn, the pressure wave can move up to 12 times faster than normal resulting in pinking (pinking is not an explosion but is very fast combustion causing a tinkling/rattling sound within the engine). Knocking is a more metallic, hollow, hammering or rattling sound. You may experience pinking/knocking when accelerating hard under load i.e. uphill. By taking your foot off the throttle the sound should stop. This can be a sign of the ignition timing having a touch too much advance.

This job is a bit involved but with practice it becomes easier and is a very good skill to have.

It should certainly help make your car run at its best.