Minor Mechanics

Technical Tip 1
Ignition Theory

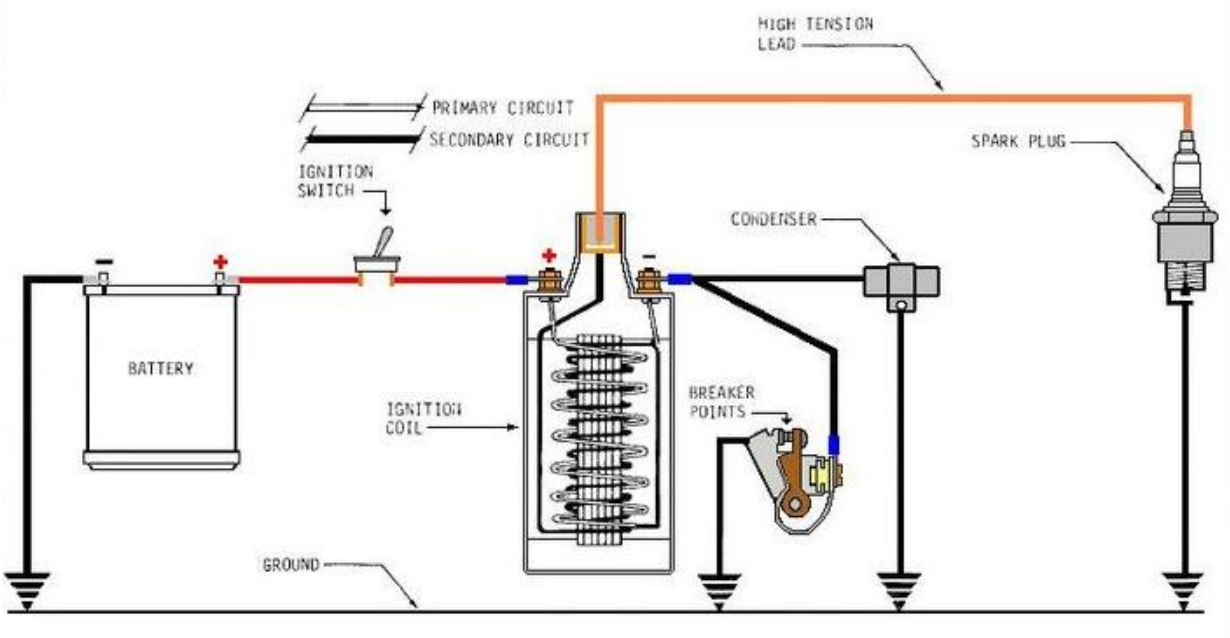
The ignition Circuit

In our opinion the important electrical circuit of a car but probably the most abused and least understood, is the ignition circuit. It's also one of the most common causes of a vehicle not starting or coming to a stop. Although a fuel problem could also be a cause, the minor fuel supply system and S.U. Carburettor tends to be quite reliable and easy to fault find.

Its function is to supply electrical sparks to each cylinder at the right time. If you imagine a Minor engine (4 cylinder four stroke engines) running at 3,000 revolutions per minute (rpm) it will require 6,000 sparks per minute to keep it running. I am sure you will agree a lot of work for points and electrical circuits.

To supply a spark to a spark plug we need to boost the typical battery 12 volts (v) to several thousands of volts (typically 20,000v (20kv) to 30,000v (30kv) to start combustion.

Basic Ignition circuit layout (single plug no distributor) (fig 1)



Typical ignition circuit components

Battery — To store electricity (typically 12 -14.7v).

Ignition switch — To control the primary circuit.

Coil — To boost the battery voltage into high voltage.

Contact points — To make and break the coil supply and to time when the spark plug fires the fuel mixture.

Condenser — To limit arcing across the points and provide a clean spark (more Information later on)

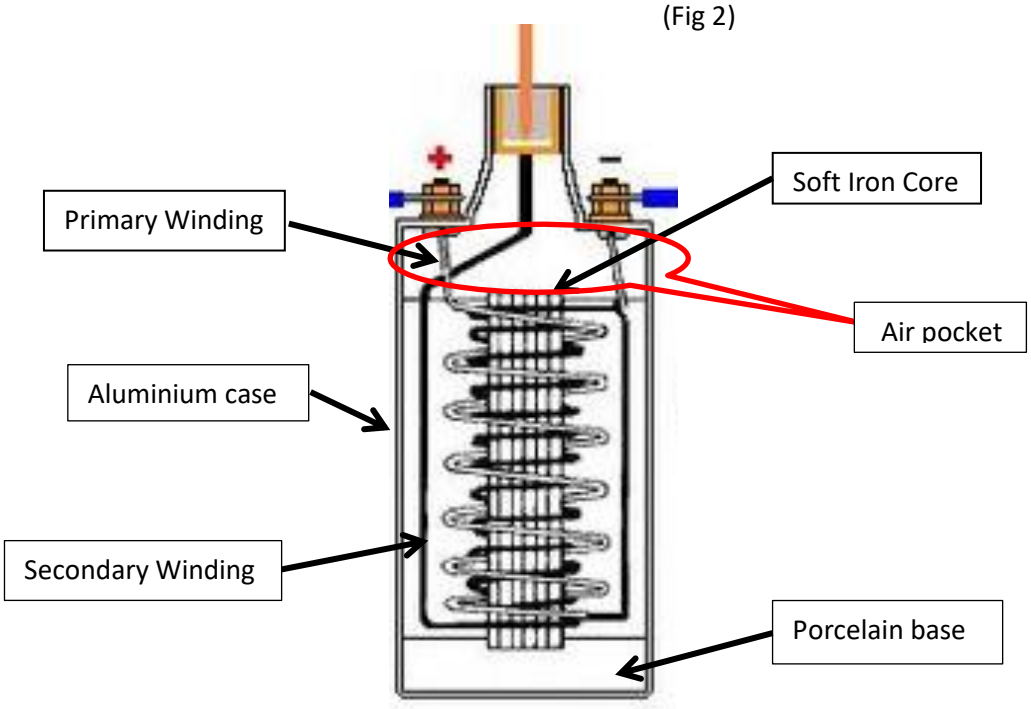
Distributor — To distribute the high voltage spark to the plugs.

Plugs — To ignite the mixture in the cylinders

The Coil

The coil as you may have worked out is a form of step up transformer. You may recall the following from you school science lessons. The primary and secondary windings are wound round a soft iron core (see fig 2)

(Fig 2)



The secondary windings of about 20,000 turns are wound on first.

The primary windings of about 300 turns are wound on second, on top of the secondary.

The reason for this order is to allow heat produced in the windings to be more easily dissipated. **Note:** If the engine is not running and you are sitting with the ignition turned on (i.e. is not turning the coil on and off) the coil could be getting over heated and this will shorten the coil life).

The complete core and windings sit on a porcelain base and is placed into an aluminium case which is then filled with oil and sealed. **Note:** the oil is to aid cooling and insulation so the coil should **not be** mounted standing up with the high voltage and low voltage terminals at the top but should be upside down (as early models) or mounted on its side (as on later models on the top of the dynamo). Failure to do this could result in arcing across the internal terminals of the coil because of the air pocket (see Fig 2).

Distributor and spark plugs

Let's consider distributing the high voltage power produced by the coil, in order to give the engine the greatest power and economy.

The purpose of the distributor is to control the on – off switch in the primary circuit (the contact breaker points) and to distribute the High Tension voltage (H.T) developed by the coil to the individual spark plugs/cylinders in the correct sequence.

The distributor is driven at half engine speed by the Cam Shaft.

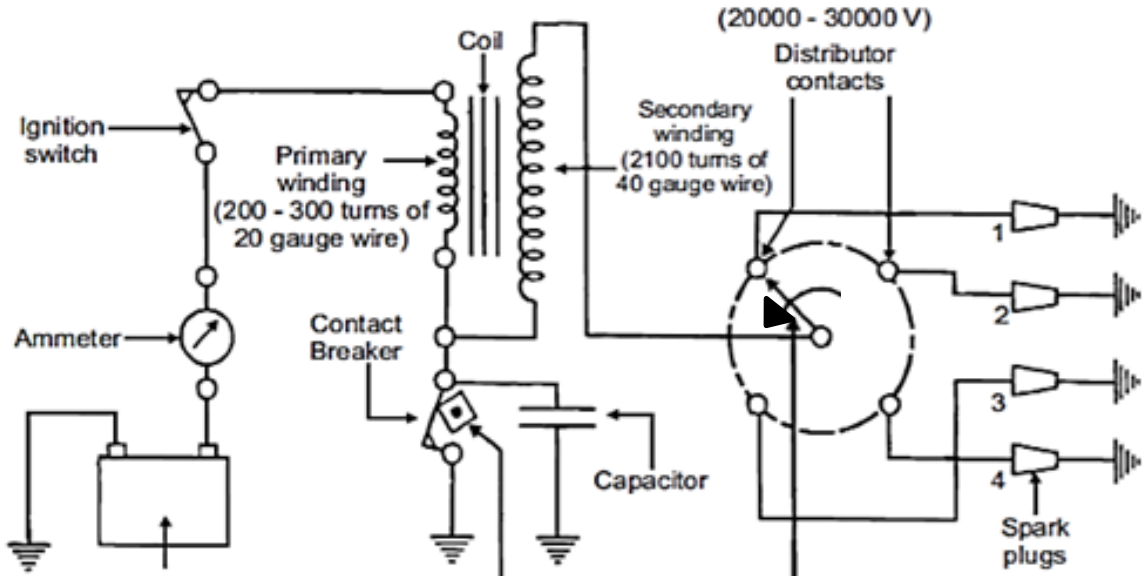


Fig 3

With the ignition on and the contact breaker points closed the Low Tension (L.T.) circuit creates a magnetic field around the primary windings. When the cam rotates further the point gap will open, switching off the circuit and induce a high voltage in the secondary circuit. **Note:** the spark at the plugs is created when the points OPEN (you will need to remember this if you ever carry out static timing).

As the points open there is a tendency for a spark to arc across the gap. To prevent this, a condenser/ capacitor is fitted across the points. If the arcing was allowed to occur (or the condenser failed and went open circuit) it would cause two problems:

1. The points would burn rapidly
2. There would not be a clean break in the circuit which is necessary to cause the sudden collapse of the magnetic field required for the coil to produce a spark at the plugs.

Note: If the condenser/capacitor failed by shorting out (going closed circuit) the engine would stop or fail to start. This is a common weakness on most modern condensers and has been for many years. The rule is buy the best condensers, replace often and carry a spare condenser and points (if a condenser goes it will burn your points so you need to replace both).

Each time the contact breaker points open the H.T. voltage from the coil is sent down the H.T. lead from the coil to the centre of the distributor cap then via a spring loaded carbon brush to a rotor arm, which sends it to one of the segments of the distributor cap and up the H.T. lead to a spark plug.

Ignition Break downs

As we discussed at the very start ignition systems can cause a number of both mechanical break downs on the road and nervous break downs in the workshop. Our aim is to try and reduce the chance of these happening and to reduce the amount of indiscriminate changing of parts also known as Diagnosis by Substitution.

The possible number of ignition faults are numerous but can be split into two main areas

1. Voltage available which is subject to gradual deterioration due to normal wear and ageing of the parts;
a. Low primary voltage (battery condition poor, dirty connections).
b. Burnt, worn, or dirty Contact breakers (C.B. points).
c. Incorrect dwell angle/point gap.
d. Faulty condenser.
e. Faulty coil.

2. Voltage required. All plugs have a certain voltage requirement to make them spark. The amount depends on a number of factors.
a. Plug electrode condition.
b. C.B. point gap.
c. Compression pressure.
d. Acceleration.
e. Coil polarity.
f. Ignition timing.
g. Speed and load.
h. Fuel air ratio.

In a good ignition system, the voltage demand of the spark plug will be above two thirds of the coil potential output leaving one third in reserve for the system to drop between servicing. Failure to service the ignition system correctly at regular intervals will ultimately result in a once healthy system misfiring, overheating, detonation, running on and a big bill that's the money kind not a big guy called Bill.

That's why you need to stick around for the next Technical Tip.

Happy servicing John and Terry