Distributor

A distributor is a device in the ignition system of an internal combustion engine that routes high voltage from the ignition coil to the spark plugs in the correct firing order. The first reliable battery operated ignition was developed by Dayton Engineering Laboratories Co. (Delco) and introduced in the 1910 Cadillac. This ignition was developed by Charles Kettering and was considered a wonder in its day.

Description

It consists of a rotating arm or rotor inside the distributor cap, on top of the distributor shaft, but insulated from it and the body of the vehicle (ground). The distributor shaft is driven by a gear on the camshaft. (Usually the distributor shaft extends to also drive the oil pump.) The metal part of the rotor contacts the central high voltage cable from the coil via a spring loaded carbon brush. The metal part of the rotor arm passes close to (but does not touch) the output contacts which connect via high tension leads to the spark plug of each cylinder. As the rotor spins within the distributor, electrical current is able to jump the small gaps created between the rotor arm and the contacts due to the high voltage created by the ignition coil.

The distributor shaft has a cam that operates the contact breaker. Opening the points causes a high induction voltage in the system's ignition coil.

The distributor also houses the centrifugal advance unit: a set of hinged weights attached to the distributor shaft, that cause the breaker points mounting plate to slightly rotate and advance the spark timing with higher engine rpm. In addition, the distributor has a vacuum advance unit that advances the timing even further as a function of the vacuum in the inlet manifold. Usually there is also a capacitor attached to the distributor. The capacitor is connected parallel to the breaker points, to suppress sparking and prevent wear of the points.
Around the 1970s the primary breaker points were largely replaced with Hall effect sensors. As this is a non-contacting device and the primary circuit is controlled by solid state electronics, a great amount of maintenance in point adjustment and replacement was eliminated. This also eliminates any problem with breaker follower or cam wear, and by eliminating a side load extends distributor shaft bearing life. The remaining secondary (high voltage) circuit was as described above, using a single coil and a rotary distributor.

**Distributor cap**

A distributor cap is used in an automobile's engine to cover the distributor and its internal rotor.

The distributor cap has one post for each cylinder, and in points ignition systems there is a central post for the current from the ignition coil coming into the distributor. In high energy ignition (HEI) systems there is no central post and the ignition coil sits on top of the distributor. On the inside of the cap there is a terminal that corresponds to each post, and the plug terminals are arranged around the circumference of the cap according to the firing order in order to send the secondary voltage to the proper spark plug at the right time.

The rotor is attached to the top of the distributor shaft which is driven by a gear on the engine's camshaft and thus synchronized to it. Synchronization to the camshaft is required as the rotor must turn at exactly half the speed of the main crankshaft in the 4-stroke cycle. Often, the rotor and distributor are attached directly to the end of the one of (or the only) camshaft, at the opposite end to the timing drive belt. This rotor is pressed against a carbon brush on the center terminal of the distributor cap which connects to the ignition coil either through the top and wired directly to the coil in HEI systems, or via the center terminal in points ignition systems and remotely connected to the coil.

The rotor is constructed such that the center tab is electrically connected to its outer edge so the current coming in to the center post travels through the carbon point to the outer edge of the rotor. As the camshaft rotates, the rotor spins and its outer edge passes each of the internal plug terminals to fire each spark plug in sequence.

Car engines that use a mechanical distributor may fail if they run into deep puddles because any water that leaks into the distributor can short out the electric current that should go through the spark plug, rerouting it directly to the body of the vehicle. This in turn causes the engine to stop as the fuel is not ignited in the cylinders. This problem can be fixed by removing the distributor's cap and drying the cap, cam, rotor and the contacts by: wiping with tissue paper or a clean rag, by blowing hot air on them, or using a moisture displacement spray ie. WD 40 or similar. Oil, dirt or other contaminants can cause similar problems, so the distributor should be kept clean inside and outside to ensure reliable operation.
The distributor cap is a prime example of a component that eventually succumbs to heat and vibration. It is a relatively easy and inexpensive part to replace if its bakelite housing does not break or crack first. Carbon deposit accumulation or erosion of its metal terminals may also cause distributor-cap failure.

**Direct & Distributorless ignition**

Modern engine designs have abandoned the distributor and coil, instead performing the distribution function in the primary circuit electronically and applying the primary (low-voltage) pulse to individual coils for each spark plug, or one coil for each pair of companion cylinders in an engine (two coils for a four-cylinder, three coils for a six-cylinder, four coils for an eight-cylinder, and so on). In traditional remote distributorless systems, the coils are mounted together in a transformer oil filled ‘coil pack’, or separate coils for each cylinder, which are secured in a specified place in the engine compartment with wires to the spark plugs, similar to a distributor setup. Coil packs by Delco for use with General Motors engines allow removal of the individual coils in case one should fail, but in most other remote distributorless setups, if a coil were to fail, replacement of the whole pack would be required to fix the problem. More recent layouts utilize a coil located very near to or directly on top of each spark plug (Direct Ignition, 'DI' or coil-on-plug). This setup avoids the need to switch very high voltages, which is very often a source of trouble, especially in damp conditions. Both direct and remote distributorless systems also allow finer levels of ignition control by the engine computer, which assists in increasing power output, decreasing fuel consumption and emissions, and implementing features such as Active Fuel Management. Spark plug wires, which need routine replacement due to wear, are also eliminated when the individual coils are set directly on top of each plug, with the spark being transported a short distance from the coil through a rubber boot to the plug.

2-cylinder engines can be built without a distributor, as in the Citroen 2CV of 1948 and BMW boxer twin motorcycles. Both spark plugs of the boxer twin are fired simultaneously, resulting in a wasted spark on the cylinder currently on its exhaust stroke.

**See also**

- Engine Control Unit (ECU)
- Ignition system
- Saab Direct Ignition
- Timing mark