EXPERIMENT NO :

AIM:-

To Study Different Types of Ignition System

Requirements of Ignition System

The important requirements of the spark ignition systems are listed below:

1. The voltage across the spark plug electrodes should be sufficiently large to produce an arc required to initiate the combustion. The voltage necessary to overcome the resistance of the spark gap and to release enough energy to initiate the self-propagating flame front in the combustible mixture is about 10,000 to 20,000 volts.

2. The intensity of spark should lie in a specified limit because too high intensity may

burn the electrodes and too low intensity may not ignite the mixture properly.

3. The volume of the mixture (clearance volume) at the end of compression should not be too large; otherwise the spark produced may not be sufficient to ignite the whole charge. There is definite relation between the size of the spark and clearance volume.

4. There should be no missing cycle due to failure of spark.

5. In a multi-cylinder engine, there must be arrangement (distributor) to carry this voltage to the right cylinder at the right time.

BATTERY IGNITION SYSTEM :

The function of battery ignition system is to product high voltage spark and to deliver it to the spark plugs at regular intervals and at the correct time with respect to the crank position. The

Required components of the system are listed below:

1. A battery of 6 to 12 volts.

2. Induction coil.

3. Contact breaker.

4. Condenser.

5. Distributor.

6. Spark-Plugs.

The arrangement of all the components of battery ignition system for 4-cylinder engine is shown in Fig. .

The source of current is the storage battery and it is connected to the primary of the induction coil through starting switch as shown in the figure. The other end of the primary coil is connected to the breaker and through it to the ground, when the. breaker contact points are closed. (In the figure, the breaker contact points are shown in open position). As one terminal of the battery is grounded, the circuit is closed by passing the current from the battery through the starting switch, primary coil, contact breaker, ground and back to the battery when contact points are closed.

The induction coil consists of primary winding usually 100 to 200 turns and a secondary winding usually 10,000 turns. Both windings are mounted on soft iron core.

The contact breaker consists of contact points, camshaft on which a cam is mounted which is used to break and make the contacts between the contact points.

The distributor consists of distributor arm, as shown in figure. The arm is mounted on a cam-shaft and is rotated at half the speed of crankshaft. The function of the arm is to make the contact with each spark plug as shown in figure.

The distributor unit generally includes the contact breaker also to make the unit more compact, as both are driven by the same cam-shaft.

A condenser is included in the circuit as shown in the figure.

WORKING OF BATTERY IGNITION SYSTEM :

When the primary circuit is closed by the contact breakers (shown m open position m Fig.) a current begins to flow through the primary coil and magnetise core of the coil. The E.M.F. is induced in the secondary as the current in the primary increases. The E.MF. Induced m the secondary coil is proportional to the rate at which the magnetic flux increases The EMF. Produced m the secondary due to the growth of current in the primary is not sufficient to produce a spark at the spark plug because the primary circuit has to establish the magnetic flux

When the primary circuit is opened by the contact breaker, the magnetic field collapses. Electromotive force is induced in the secondary which is directly proportional to the rate at which the magnetic field of the core collapses which in turn depends on the rate of decrease of the primary current. A condenser is connected across the contact breaker in the primary circuit as shown in Fig. This helps to collapse the field very rapidly by absorbing part of the energy of the magnetic which is thrown back into the primary winding and produces a very high voltage in the secondary. This E.M.F. in the secondary is sufficient to ignite the charge by producing the spark.

One end of the secondary coil is connected to the ground and other end is connected to the central terminal of the distributor. The distributor connects the secondary coil in turn to the different spark plugs of the engine in their firing order. The spark plug of a .particular cylinder is ed in circuit of the secondary coil with the help of the distributor when the time comes for the charge in that cylinder to be ignited and at the same time the primary circuit is opened by contact ,breaker. A spark is produced between the points of the spark plug.

The distributor and contact breaker are generally mounted on the same cam-shaft which rotates at half speed of the crankshaft. The function of the distributor is to connect the secondary to each cylinder of a multi-cylinder engine at the time of ignition. The contact breaker also works simultaneously with distributor and its function is to disconnect the primary circuit exactly at the same time when the spark in the particular cylinder is required. The distributor are connects 4-spark plugs in one rotation of the cam shaft and therefore four contact points are required in 4-cylinder engines. The contact breaker has to break the contacts 4-times in four cylinder engines so it required 4 cams as shown in Fig. If there are n cylinders, then the contact points and cams required are also n in number.

In a single cylinder engine, the distributor is not required as in scooter engine, and single cam is sufficient for giving the spark. A ignition system used in single cylinder petrol engine is shown in Fig In stead of battery, magneto is used in this system.

Cam is mounted on the crankshaft only as breaking of circuit during each rotation is required in to stroke engine and there is no necessity of cam-shaft.

ADVANTAGES AND DISADVANTAGES OF BATTERY IGNITION SYSTEM :

Advantages

1. Its initial cost is low compared with magneto. This is the main reason for the adoption of coil ignition on cars and commercial vehicles.
2. It provides better sparks at low speeds of the engine during starting and idling. This is because the maximum current is available throughout the engine speed range Including starting.
3. The maintenance cost is negligible except for the battery.
4. The spark efficiency (intensity) remains unaffected by advance and retard positions of The timing control mechanism.
5. The simplicity of the distributor drive is another factor in favour of coil ignition.

Disadvantages

1. The engine cannot be started if the battery runs down.
2. The weight of the battery ignition system is greater magneto which is major Consideration in adopting the system in aero-engines.
3. The wiring in the coil ignition is more completed than that used in magneto ignition and therefore there is more likelihood of defect occurring in the system.

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Spark Plug

The function of the spark plug is to generate the spark in the combustion using a high voltage communicated by the secondary. The spark plug provides two electrodes with a proper gap across which, high potential is discharged and spark is generated.

A sectional view of a conventional spark plug is shown in Fig. It consists of a steel shell, an insulator, and two electrodes. The high voltage supply from secondary is given to the central electrode which is insulated with porcelain. The other electrode is welded to the steel shell of the plug and thereby automatically grounded when the plug is fitted in the cylinder head of the engine. The electrodes are made of high nickel alloy to withstand severe corrosion and erosion to which they are subjected.

The tips of central electrode and insulation are exposed to the burned gases. This results high thermal stresses and the insulator may crack. As the tips are subjected to high temperature (2000-2500°C), the heat must flow from the insulator and tip to the surrounding shell in order to cool the electrodes and prevent preignition.

The spark plugs are classified as hot plug and cold plug. Depending upon the temperature at the tip of the electrodes, the operating temperature of the tip depends upon the amount of heat transferred and it depends upon the path followed by the heat to flow. A cold plug has a short heat flow path where as hot plug follows a long flow path for the heat to flow as shown in Fig.

The hot plug is used to avoid cold fouling where combustion chamber temperatures are relatively low as during low power operation and continuous idling.

A spark plug which runs satisfactory, the temperature at cruising speed may run cool at idling speed and tips will be fouled by unburned carbon deposits or excess lubricating oil. The carbon deposits burns at 350°C where as lubricating deposits burn at 550°C. If the spark plug runs hot at idling speed to prevent carbon deposits, it may run too hot at high speed. This may cause undesirable preignition. If the plug runs above 800°C, then preignition generally occurs.

Insulator tip length is the most important parameter which controls the operating temperature. Therefore, the tip temperature is generally controlled by varying insulator tip position and electrode material.

It is necessary in practice to compromise in order to obtain a proper spark plug which would operate satisfactorily throughout the engine operating range. An improper spark plug has remained a major source of engine trouble as misfiring and preignition.

MAGNETO IGNITION SYSTEM WORKING :

The arrangement of the Magneto-Ignition system is shown in Fig. 11.25. The only difference between battery and Magneto system is that the battery is replaced by the rotating magnet. As the magneto rotates, the voltage and current is generated in the primary and circuit is completed passing the current through the contact breaking point and through the ground. As the current passes through the primary coil through the contact breaker, the circuit is completed through ground. As the camshaft rotates, the cam 1 opens the contact breaker and interrupts the flow of current in the primary. This causes the decay in the magnetic field lines and cuts the lines of magnetic field in the secondary, and a high voltage is generated in the secondary. The process of j generating the high voltage in the secondary is known as induction phenomenon. The voltage generated in the secondary depends upon the ratio of number of turns in the secondary and primary.

The purpose of the condenser is to suck the current from the primary when the primary circuit is broken which helps to decay the magnetic field rapidly and enhance the process of increasing the voltage in the secondary. The high voltage generated in the secondary is carried through the distributor through point 1 to spark plug **1,** the spark is generated due to high voltage across the spark plug gap.

In the mean time, cam-1, goes out of action and contact points touch each other and completes the primary circuit. Again the cam-2 breaks the contact points and the process described above is repeated and the spark is carried to the distributor and then to the next spark plug.

In this way during one rotation of the camshaft, each spark plug in each cylinder ignites the mixture and power is generated.

In a 4-stroke engine, after every two rotations, power is developed, therefore only once the spark must occur therefore the camshaft rotates at half rpm of the crankshaft. The camshaft is rotated by transmitting the power from the crankshaft through bevel gear as shown in Fig.

ADVANTAGES AND DISADVANTAGES OF MAGNETO SYSTEM OVER BATTERY IGNITION SYSTEM :

Advantages

1. It is more reliable as compared to coil ignition system, because there is no maintenance problem in magneto ignition system.
2. As the speed increases, the voltage in the primary winding also increases rapidly and Intensity of spark is also higher and provides better combustion, as compared to battery ignition system. Therefore magneto ignition is very popularly used in racing cars.
3. It is used for medium to high speeds.
4. Space required is less as compared to coil ignition system.
5. By providing suitable shunts *on* magneto, the danger *of* burning *of* spark plug is minimized.
6. Very light in weight and compact in size.
7. Automatic time adjusting *of* ignition can be affected.

Disadvantages

1. Initial cost is very high as compared to coil ignition system.
2. To start with, 75 RPM is necessary.
3. For high power engines, some other devices are necessary to start an ignition.

ELECTRONIC IGNITION SYSTEMS :

Primary Circuit

There is a difference between the contact breaker point ignition system and the electronic ignition system in the primary circuit.

In the contact breaker point ignition system, the contact breaker points open and close the primary circuit Fig. In the electronic system, the electronic control unit (ECU) opens and closes the primary circuit Fig.

Secondary Circuit

Both the electronic ignition system and the contact breaker point ignition system have nearly the same arrangements for the secondary circuits, but with a small difference.

The voltage developed in the secondary circuit of the electronic ignition system is very high some times reaching 47000 V. This high voltage should be handled in the secondary circuit. Therefore the ignition coil, the distributor and wiring are altered in the secondary circuit in order to handle the higher voltage.

Spark Plugs

In the electronic ignition system, a very high voltage is produced. Therefore spark plugs with increased gaps can be used in these systems. The spark produced is longer and readily ignites the air--

fuel mixture even when it is leaner. The use of leaner air-fuel mixtures leads to better fuel economy and also lowers emissions.

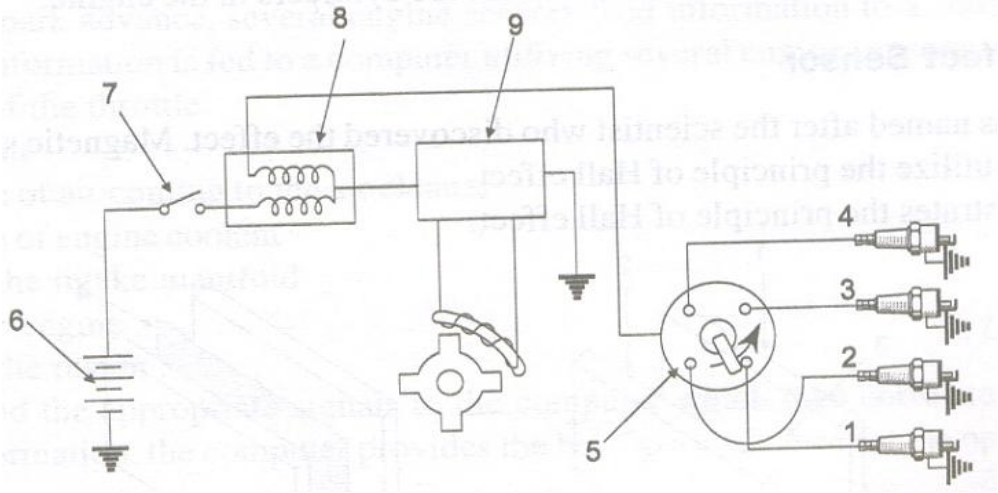
Advance Mechanisms

In some electronic ignition systems, there are no mechanical advance devices, either centrifugal or vacuum. Instead of the advance devices, ignition timing may be adjusted electronically.

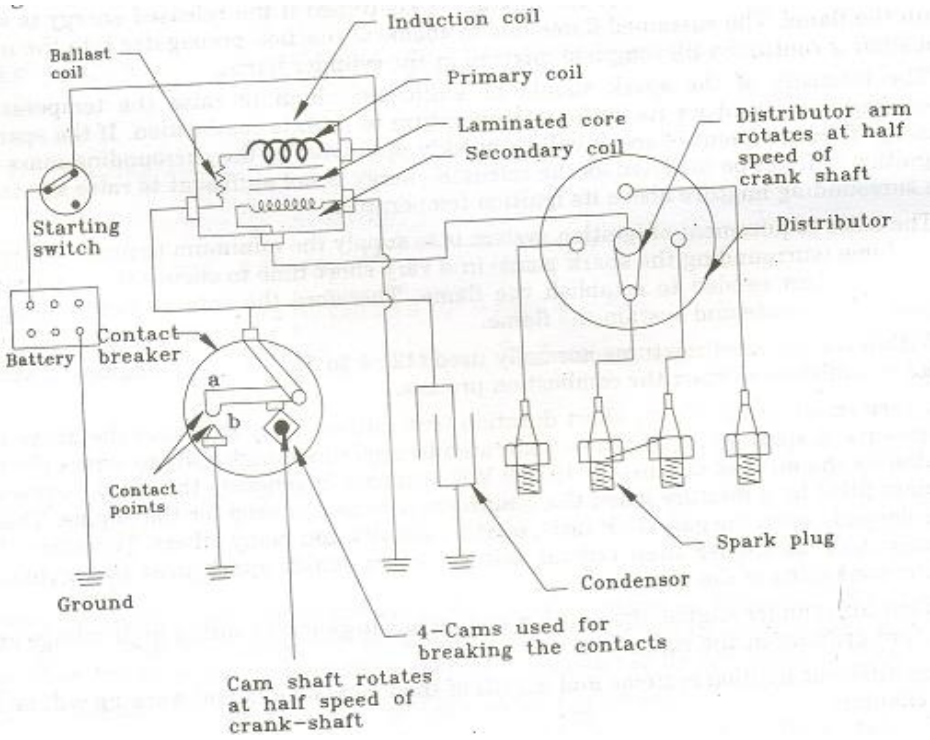
PRINCIPLE OF ELECTRONIC IGNITION SYSTEM :

A timer is used in the distributor of the electronic ignition system (Fig. 9.38). It sends electrical pulses to an electronic control unit (ECU) which switches off the flow of current to the primary winding. As a result, a high voltage is induced in the secondary winding which is then distributed to the spark plugs as in the case of the breaker point ignition system. the Electronic Control unit later switches on the flow of current to the primary circuit so that the next cycle. The timer may be a pulse generator or Hall Effect sensor.

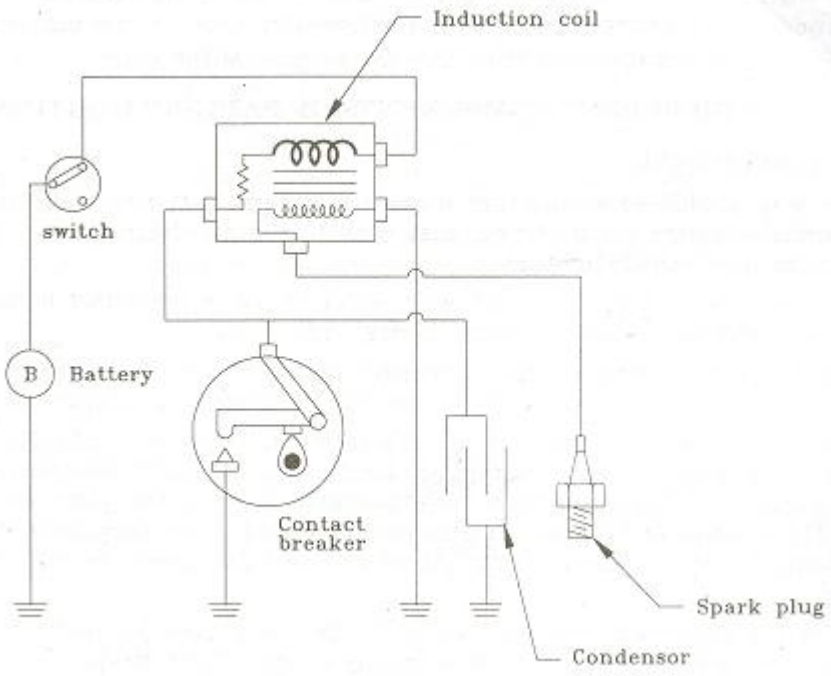
PRINCIPLE OF ELECTRONIC IGNITION SYSTEM



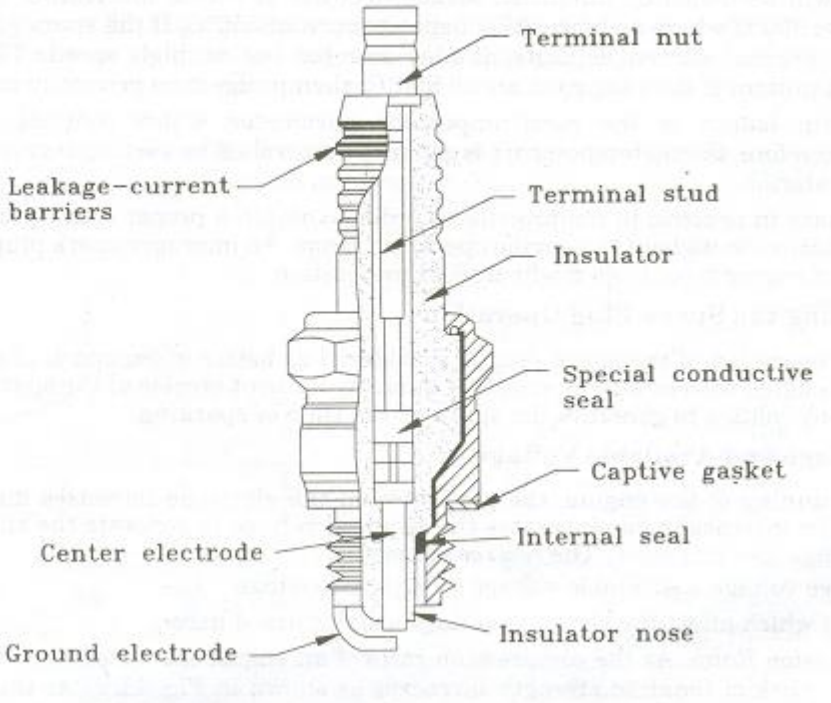
BATTERY IGNITION SYSTEM



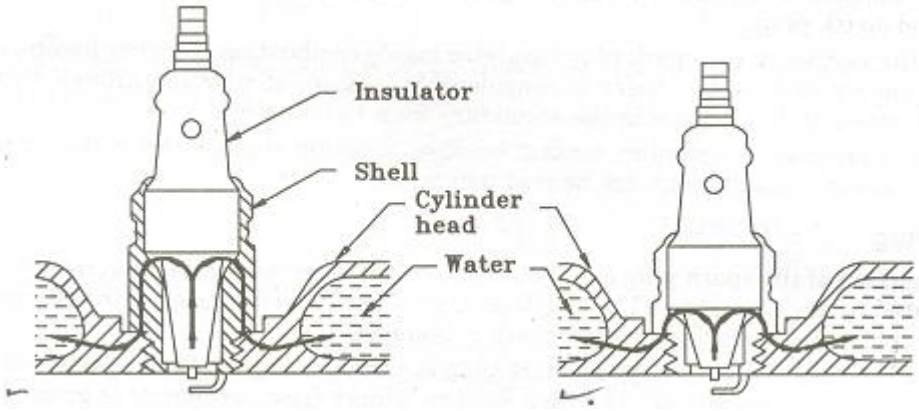
BATTERY IGNITION SYSTEM FOR SINGAL CYLINDER ENGINE



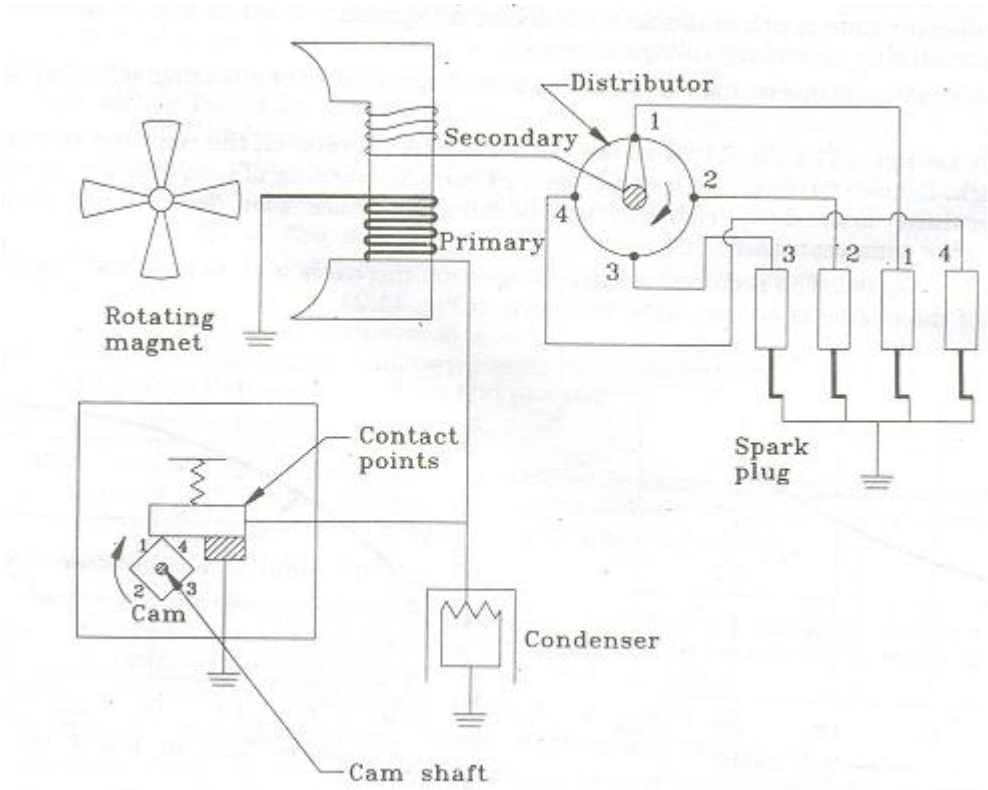
SCHEMATIC OF TYPICAL SPARK PLUG



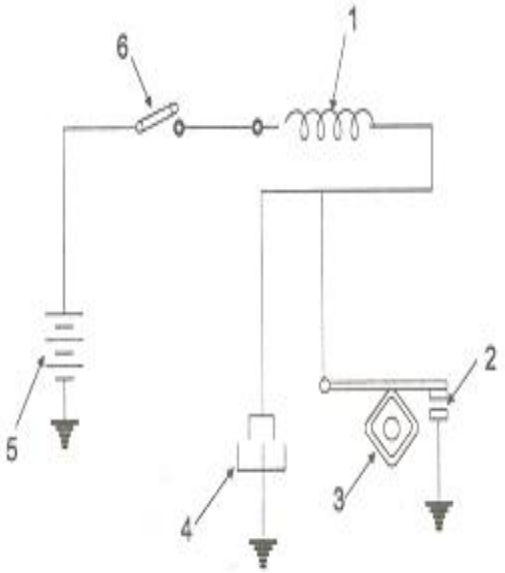
HOT AND COLD SPARK PLUG



MAGNETO IGNITION SYSTEM-WORKING



ELECTRONIC IGNITION SYSTEMS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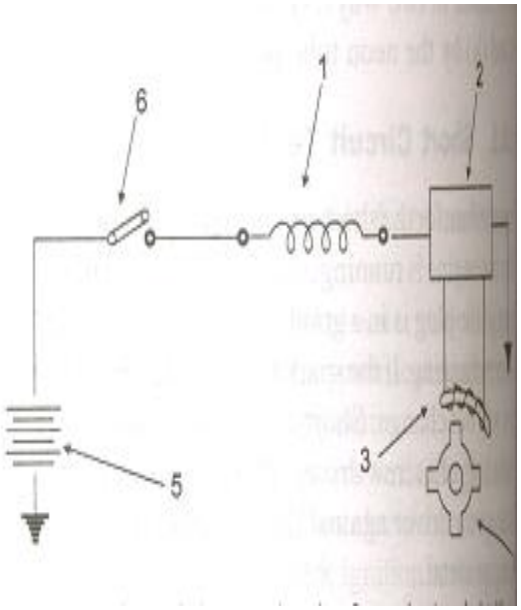
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