MAGNETIC EFFECT OF ELECTRIC CURRENT
Electric Motor

ELECTRIC MOTOR:

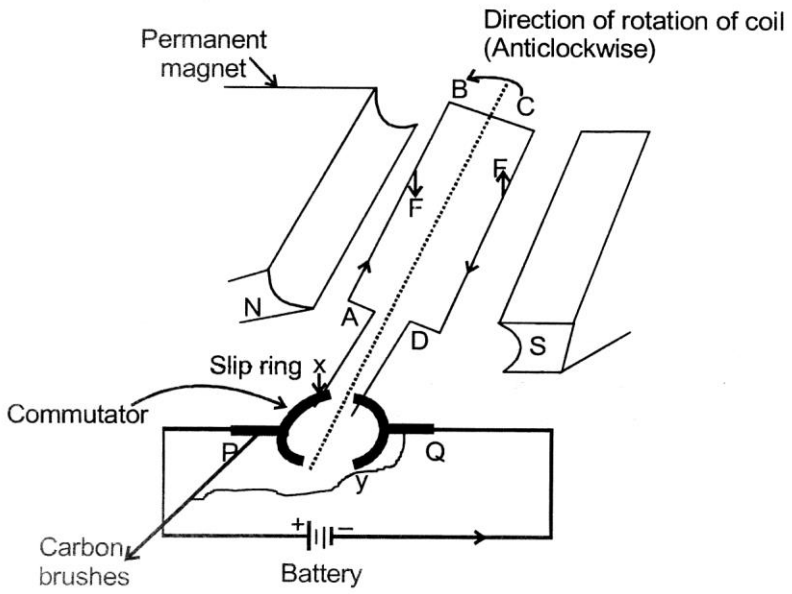
A motor is a device which converts electrical energy into mechanical energy. Every motor has a shaft or spindle which rotates continuously when current in passed into it. The rotation of its shafts is used to drive the various types of machines in homes and industry. Electric motor is used in electric fans, washing machines, refrigerators, mixer and grinder and many other appliances. A common electric motor works on direct current. So, it is also called DC motor, which means a "Direct Current motor"/ The electric motor which we are going to discuss now is actually a DC motor.

(a) Principle of a Motor:

An electric motor utilizes the magnetic effect of current. A motor works on the principle that when a rectangular coil is placed in a magnetic field and current is passed through it, a torque acts on the coil which rotates is continuously. When the coil rotates, the shaft attached to it also rotates. In this way the electrical energy supplied to the motor is converted into the mechanical energy of rotation.

(b) Construction of a Motor:

An electric motor consists of a rectangular coil ABCD of insulated copper wire, wound on a soft iron core called armature. The soft iron core has not been shown in figure to make things simple. The coil is mounted between the curved poles of a U-shaped permanent magnet is such a way that it can rotate between the poles N and S. The two ends of the coil are soldered (or welded) permanently to the two half rings X and Y of a commutator.



An electric motor

A commutator is a copper ring split into two parts X and Y, these two parts are insulated from one another and mounted on the shaft of the motor.
End A of the coil is welded to part X of the commutator and end D of the coil is welded to part Y of the commutator. The commutator rings are mounted on the shaft of the coil and they also rotate when the coil rotates.

The function of commutator rings is to reverse the direction of current following through the coil every time the coil just passes the vertical position during a revolution.
We cannot join the battery wire directly to the two commutator's half rings to pass current into the coil because if we do so, then the connecting wires will get twisted when the coil rotates. So, to pass the electric current to the coil, we use two carbon strips P and Q known as brushes. The carbon brushes P and Q are fixed to the base of the motor and they press lightly against the two half rings of the commutator. The function of carbon brushes is to make contact with the rotating rings of the commutator and through them to supply current to the coil. It should be noted that any one brush touches only one ring at a time, so that when the coil rotates, the two brushes will touch both the rings one by one.

(c) Working of a Motor :

Suppose that initially the coil ABCD is in the horizontal position as shown in figure. On pressing the switch, the current enters the coil through carbon brush P and commutator half ring X. The current flows in the direction ABCD and leaves via ring Y and brush Q.

(i) In side AB of the coil, the direction of current is from A to B and the direction of magnetic field is from N to S pole. So, by applying Fleming's left hand rule to the side AB of the coil we find that it will experience a force in the upward direction.

(ii) In side DC of the coil, the direction of current is from C to D towards but the direction of magnetic field remains the same from N to S pole as shown in figure. So, by applying Fleming's lef hand rule to the side DC of the coil, we find that. It will experience a force in the downward direction.

(iii) We find that the force acting on the side AB of the coil is in the upward direction whereas the force acting on the side DC of the coil is in the downward direction. These two equal, opposite and parallel forces acting on the two sided to the coil form a couple (torque) and rotate the coil in the anticlockwise direction.

(iv) While rotating, when the coil reaches the vertical position, then the brushes P and Q will touch the gap between the two commutator rings and current to the coil is cut off. Though the current to the coil is cut off when it is in the exact vertical position, the coil doesn't stop rotating because it has already gained momentum due to which it goes beyond the vertical position.

(v) When the coil goes beyond the vertical position, the two commutator's half rings automatically change contact from one brush to the other. This reverses the direction of current through the coil which, in turn, reverses the direction of forces acting on the two sides of the coil. The side AB of the coil now be one the left-hand side with a downward force on it, whereas side DC of the coil will come on the right-hand side with an upward force on it. In this position also a couple acts on the coil which rotates it in the same direction (anticlockwise direction). This process is repeated again and again and the coil continues to rotate as long as the current is passing. This is how an electric motor works.