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Magnet and Electromagnetism

DEFINITION:

A substance having ability to attract magnetic materials is called magnet. The properties related to magnet are called magnetism.

MAGNET POLES:

Whenever a magnet is suspended freely, it comes to rest with one end facing north and the other end facing south. The end facing north is called North Pole (N) of the magnet and the end facing south is called South Pole (S) of the magnet. It is found that South Pole of one magnet attracts the north pole of other magnet and the north and south pole of one magnet repel the north and south pole of another magnet respectively. Thus it can be said that "like pole repel each other and unlike pole attracts each other."

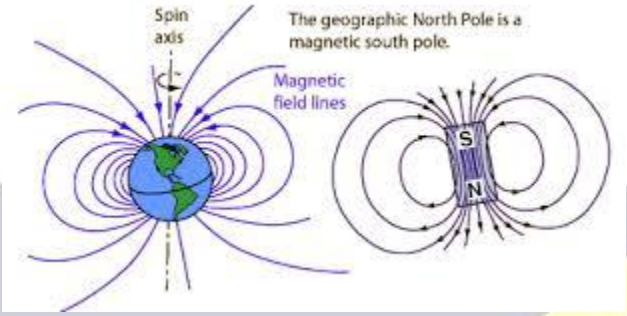
MAGNET FORCE:

If the pole of two magnets is brought closer to each other, than a force is found to be present between them. The force is repulsive if the poles are like and attractive if the poles are unlike. This force is called magnetic force. It is also found that, "the force decreases square times with the increase of the distance between the poles and it increases with the increase of the strength of the poles."

MAGNETIC FIELD:

The region around the magnet in which it attracts any magnetic material is called magnetic field. Or

The region in which magnet can exert its magnetic force is called magnetic field.



MAGNETIC FIELD OF EARTH:

A freely suspended magnet points north and south because it is under the influence of earth's magnetic field. The earth behaves like a bar magnet having its north pole towards geographical south and the South Pole towards geographical north.

MAGNETS AND MAGNETIC MATERIALS:

MAGNET:

A substance having ability to attract magnetic substances is called magnet.

MAGNETIC SUBSTANCES:

The substances which are attracted by magnets are called magnetic substances.

For example:

Iron, Cobalt, nickel etc.

NON-MAGNETIC SUBSTANCES:

The substances which neither attracted nor repelled by a magnet are called non-magnetic substances.

For example: Wood, glass, paper etc.

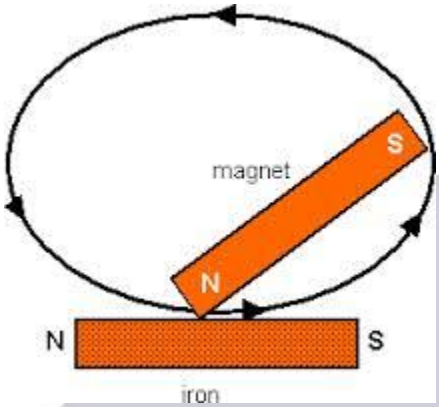
FERROMAGNETIC SUBSTANCES:

A substance which behaves like a magnet in the presence of strong magnetic field is called ferromagnetic substances.

For example: Soft iron.

METHODS OF MAKING MAGNET:

Following are the two main method of making magnet.



1. SINGLE TOUCH METHOD:

Consider a steel rod placed on a horizontal table as shown in figure. The steel rod is rubbed by the north pole of the bar magnet which is in the inclined position. Each time when the bar magnet reaches from N to S; it is lifted and again to brought to N. This process is repeated till the steel bar is turned into magnet.

2. ELECTRICAL METHOD:

A U shaped steel bar is wound with an insulated copper wire. The two arms are wound in the opposite direction if the current is now passed through the wire for few second. The steel bar becomes a permanent magnet. In the similar way an iron or steel bar can be magnetized by the placing inside the current carrying solenoid.

DEMAGNETIZATION:

Definition:

The process which removes the magnetic properties from the magnet is called demagnetization.

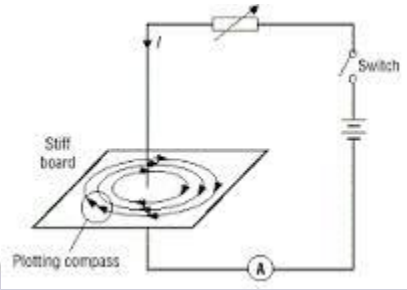
Following are the methods used for demagnetization.

i. By hammering the magnet when they are pointing in east west direction.

ii. By heating the magnet strongly.

iii. By passing alternating source through the magnet when it is placed inside east west direction.

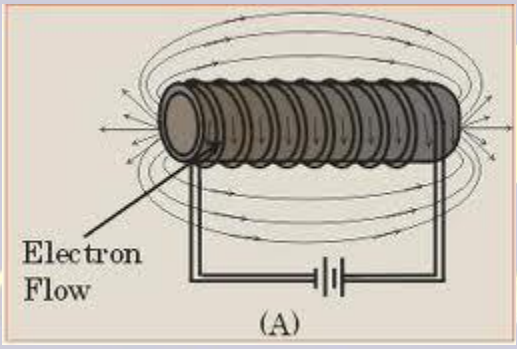
MAGNETIC EFFECT OF CURRENT:



When current passes through any conductor it becomes magnet and a magnetic field develops around it. The strength of magnetic field is directly proportional to the amount of current flowing through the galvanometer and inversely proportional to the distance around it.

The direction of magnetic field can be determined by using write hand rule which is given as; "If the direction of thumb of right hand indicates the direction of the flow of current, then the core of the fingers gives the direction of the magnetic field." When two current carrying conductors are placed parallel to each other and if the direction of flow of current in both wire is same then both repel each other and if the directions are opposite them both attracts each other.

MAGNETIC FIELD DUE TO SOLENDIOD:



Definition:

A long coil of insulated copper wire in the form of cylinder is called solenoid. If the current is passed through solenoid, a very strong magnetic field is produced inside it. The magnetic field outside the solenoid is very weak.

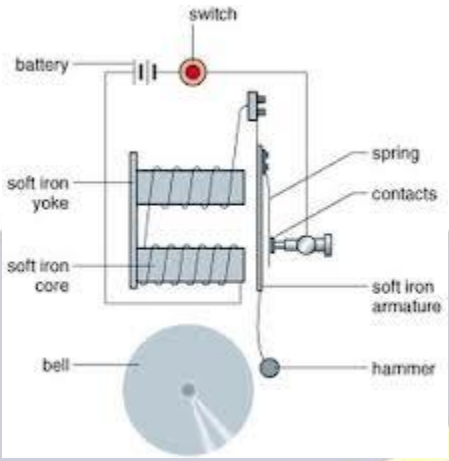
ELECTROMAGNETISM AND THEIR APPLICATIONS:

Definition:

When current pass through any conductor it becomes magnet or a magnetic field develops around it this process is called electromagnetism. Electromagnets are used in electric bells, telephones receiver, loud speaker, electric fans, etc.

ELECTRIC BELL:

Definition:



It is an electromagnetic instrument used to produce sound.

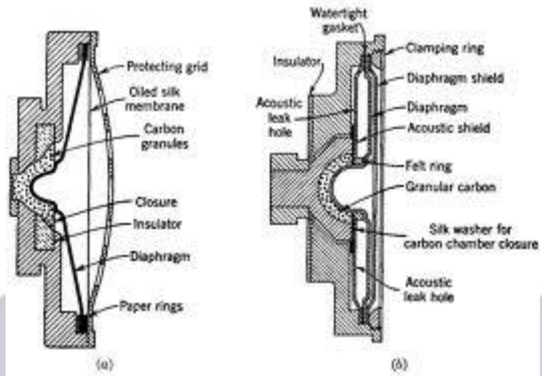
Construction:

It is an electromagnetic of electric bell is shown in the figure. One end of the coil of the coil of Electromagnet is connected to the terminal T_1 of the bell and the other end to a screw which is mounted on an iron strip called armature. A rod carrying a hammer at its end is attached to the armature. A very light spring is attached to the contact adjusting screw. The contact adjusting screw is connected to terminal T_2 of the bell. A battery and push button are connected to the terminals T_1 and T_2 of the bell.

Working:

When the push button is pressed, the circuit is completed and current flows through the coils of electromagnet. The electromagnet is magnetized and attracts the armature. Due to which the hammer strikes the bell when the electromagnet attracts the armature, the armature looses contacts with the screw and current stop flowing due to which the electromagnet gets demagnetized. The spring brings back the armature in contact with the screw and the current is again completed. The whole process is repeated again and again so long as the push button in pressed position and the bell continuously rings.

TELEPHONE RECEIVER:



The telephone receiver consists of a permanent magnet which is in contact with two soft non cores having coil wound on them in the opposite sense. The two soft iron cores from an electromagnet. A diaphragm made of magnet alloy is fixed in front of the electromagnet. The message coming from transmitting end has variation in current caused by the variation in sound spoken there. This current when passes through the coil of the electromagnet the electromagnet is magnetized and the pulling force acts on the diaphragm. Due to variation in current magnetic strength and the magnetic force diaphragm vibrates and give rise to sound.

ELEVATED TRAIN:

The rolls of elevated train are made of electromagnets in series on the ground. These are other electromagnets attached to the lower side of the train. Due to the strong repulsive force between these magnets elevated trains moves.

FORCE ON A CURRENT CARRYING CONDUCTOR IN A MAGNETIC FIELD:

When a current carrying conductor is placed inside the magnetic field. Magnetic field exerts magnetic force on it. The force acting on the conductor was studied by Faraday. It is found that:

i. The current carrying conductor experiences force when it is placed at certain angle with the magnetic field.

ii. The force acts perpendicular to the direction of current and the magnetic field.

iii. The magnitude of force is proportional to the current and the magnetic field strength.

iv. The direction of force is found by a rule, called right hand rule which is given as: ‘The thumb is place in the direction of conventional of magnetic field. The direction in which the palm would push gives the direction of force.

GALVANOMETER:

Definition:

An instrument which is used for detection and measurement of small amount of current is called galvanometer.

TYPES:

There are two types of galvanometer.

i. Moving coil galvanometer.

ii. Moving magnet galvanometer.

MOVING COIL GALVANOMETER:

A galvanometer in which coil rotates while magnet remains at fixed at its position is called Moving coil galvanometer.

MOVING MAGNET GALVANOMETER:

A galvanometer in which magnet rotates while coil remains fixed at its position is called moving magnet galvanometer.

MOVING COIL GALVANOMETER:

Definition:

An instrument in which coil rotates while magnet remains fixed and used for the detection of current called moving coil galvanometer.

CONSTRUCTION:

It consists of following part.

PERMANENT MAGNET:

A permanent horse shoes magnet with curve poles is used.

ARMATURE:

A rectangular coil is would on a light frame with a pointer at the top of the coil is pivoted between the poles of a horseshoe magnet.

HAIR SPRINGS:

At the both ends of the coil hair springs are attached which not only act to provide the path for the current to pass through the coil and also responsible to bring the coil back to its position when the current is switched off.

WORKING:

When current passes through the coil, the two sides of the coil which are parallel to the magnetic field no force but the two sides which are perpendicular to the magnetic experience equal force in the opposite direction. Due to this force the coil rotates and pointer at the top of the coil moves over a scale. The force acting on the coil depends upon.

i. The strength of current.

ii. The strength of magnetic field.

iii. The number of turns in the coil.

The movement of the coil gives the amount of work.

AMMETER:

Definition:

An instrument which is used to measure large amount of current is called ammeter.

CONVERSION OF GALVANOMETER TO AMMETER:

A galvanometer can be converted into ammeter just by connecting a low resistance in parallel combination with the galvanometer the low resistance connected in parallel is called shunt resistance.

VOLTMETER:

Definition:

An instrument which is used to measure potential difference is called voltmeter.

CONVERSION OF GALVANOMETER TO VOLTMETER:

A galvanometer can be converted into voltmeter just by connecting a high resistance in series combination with the galvanometer.

SIMPLE ELECTRIC MOTOR:

Definition:

An electrical device is used to converts electrical energy to mechanical energy is called simple electric motor.

It is based on the principle of electromotor.

The speed of rotation of motor depends upon.

i. The magnitude of current through coil.

ii. The strength of magnetic field.

iii. The number of turns in the coil.

ELECTRIC MOTOR:

Definition:

A device which converts electrical energy into mechanical energy is called electric motor.

PRINCIPLE:

It is based on the principle of electromagnetism and force exerted by the magnetic field on a current carrying coil when it is placed, inside the magnetic field.

CONSTRUCTION:

A coil ABCD is placed between the poles of a magnet. The ends of the coil are connected to a ring split into two halves. Each end is connected to each half of the ring. The ring split into two halves is called commutator. Two carbon rods, called brushed remain in touch with commutator segments.

WORKING:

First consider the coil is in the horizontal position. When the coil is connected to a battery, current flows, through it. According to right hand rule, a force acts on the side BC upward and an equal force acts on the side AD downward. Due to these forces the coil rotates anti-clock wise. To keep the rotation in one direction, the direction of the current should change its

direction after every half rotation. This is achieved by the action of commutator. Brushes remain connected the negative and positive commutator. The speed of the rotation of motor depends upon.

(i) The magnitude of current through the coil.

(ii) The strength of Magnetic field.

(iii) The number of turns in the coil.