

## CH # 17 MAGNETISMS AND ELECTROMAGNETISMS

### MAGNETIC:

*"it is a natural occurring substance which attract the things made up of cobolt, iron and nickel and when it is suspended freely it always point towards geographical north and south."*

### MAGNETIC FIELD:

*"The space around a magnet in which its magnetic effect is felt is called magnetic field."*

### MAGNETIC FIELD OF THE EARTH:

*"The earth behaves as a large bar magnet along the north south direction with the north pole towards the south geographic pole. Earth's magnetic field is similar is to that of an imaginary bar magnet situated at its centre. "*

### MAGNETIC POLE:

*"Magnet has maximum power of attraction or repulsion on its opposite ends called pole."*

### MAGNETIC FORCE:

*"Force experienced by a magnetic substance in a field of magnet is called magnetic force."*

### MAGNETIC SUBSTANCE:

*"Substance which can be converted into magnet is called magnetic substance. E.g. iron, steel, nickel."*

### NON MAGNETIC SUBSTANCE /NON-MAGNETS:

*"Substance which are neither attract nor repelled by a magnet are called non-magnet. E.g. Wood, Glass, Paper."*

### FERROMAGNETIC SUBSTANCE:

*"A substance, which behaves like a magnet in the presence of strong magnetic field, is called ferromagnetic E.g. Iron, Nickel."*

### SOFT MAGNETIC SUBSTANCE:

*"Ferro magnetic substances, which lose their magnetism when remove from magnetic field are called soft-ferromagnetic substances. E.g. Soft iron."*

### HARD MAGNETIC SUBSTANCE:

*"Ferro magnetic substances which retain their magnetism when removed from the magnetic field are called hard Ferro magnetic substances. E.g. Steel."*

### MAGNETIC FIELD OF EARTH:

- The earth behaves as a large bar magnet along the north south direction with north pole towards the south geographical pole.
- Earth's magnetic field is similar to that of an imaginary bar magnet situated at its centre.
- It has two poles like an ordinary bar magnet.

### MAGNETIC LINES OF FORCE:

**Definition:**

*“In magnetic field the effect of magnet is caused by special lines of force which are named as magnetic lines of force”*

**Properties of magnetic lines of force:**

- The magnetic lines of force start from North Pole and ends at its south pole.
- Inside the magnet these lines continue from South Pole to the north.
- They pass through iron more easily as compare to air.
- They do not intersect each other.
- They can contract longitudinally.
- The magnetic lines tend to repel each other horizontally.
- The lines of magnetic forces are crowded at the pole of the magnet.

**METHODS OF MAKING MAGNET****1. SINGLE TOUCH METHOD:**

In this method a hard steel bar is rubbed with one end of an inclined magnet in direction from south to north. On reaching the end 'N', the magnet is lifted and the same end is brought back to the end 'S' of the bar.

**2. ELECTRICAL METHOD:**

If we take a U-shaped steel bar and wound its arm by insulated copper wire in opposite direction and passing current through the wire by connecting it with a battery for few minutes then the bar will become a magnet. A bar of steel can also be magnetized by this method.

**METHODS OF DEMAGNETIZATION:****1. BY HAMMERING:**

Magnet can be partially demagnetized by hammering them when they are point in east-west direction.

**2. BY HEATING:**

Magnets lose their magnetism when they are strongly heated.

**3. BY ELECTRICITY:**

A magnet can be demagnetized by placing it in a solenoid, which is carrying an alternating current.

**SIMILARITIES BETWEEN STATIC ELECTRICITY AND MAGNETISM:**

- There are two types of charges, positive and negative. There are two types of magnetic poles, north and south.
- Like charges and like poles repel each other, opposite charges and opposite poles attract each other.
- Charged object setup electric fields of force, the magnetic object setup magnetic field of force.
- Certain substance may be electrically charged by rubbing together, certain magnetic substance may be magnetized by rubbing with another magnet.

## MAXWELL'S RIGHT HAND RULE:

### Introduction:

James Clark Maxwell gave a rule relating the direction of magnetic lines of forces round a wire to the direction of the current flowing through it. This is known as right hand rule."

### Rule:

*"Hold a wire in right hand with the thumb point along the wire in the direction of current then the direction of curling fingers will be the direction of magnetic lines of force."*

## FLEMING'S LEFT HAND RULE:

*"Place the fore-finger, second finger, of the left hand mutually at right angles. Then, if the fore-finger points in the direction of the field and the second finger in the direction of the current, the thumbs will point in the direction of the motion wire."*

## SOLENOID:

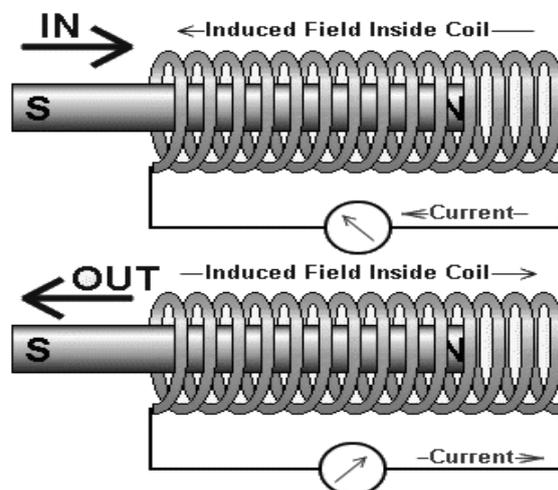
*"Solenoid is a coil of insulated copper wires in the form of along cylinder."*

### Polarity of solenoid:

The end of the solenoid at which the current appears to flow in anti-clock direction is north pole and if it is flowing in the clockwise direction then the end is south pole.

### Use of solenoid:

A current carrying solenoid can be used as bar magnet and also used for preparing electromagnets.



## ELECTROMAGNETS:

*"When an iron bar is placed inside a solenoid and current is passed for a short time, it is found after testing that the iron bar is magnetized. Such magnets are called electromagnets."*

### Factors affecting the strength of electromagnet:

It depends on the following factors:

- Length of the conductor.
- Amount of current passing through the conductor.

### USE OF ELECTROMAGNETS:

Electromagnets are use in:

- Electric bell, telephone, telegraphs.
- Galvanometer, Ammeter, Voltmeter.

## ELECTRIC BELL:

### Construction:

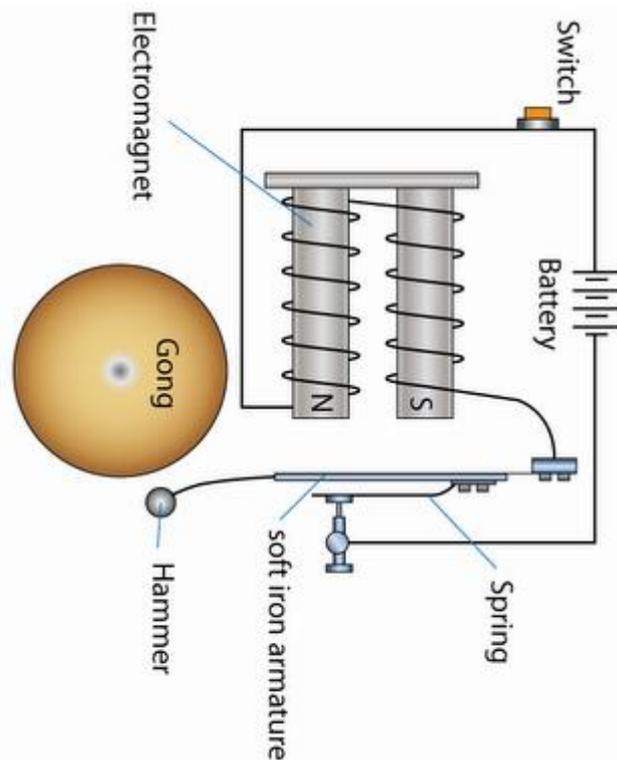
An electric bell consists of the following parts.

- Electromagnet.
- Armature.
- Rod with hammer.
- Metallic Sphere.

One end of the winding is connected to a terminal  $T_1$  and the other to the spring, which is mounted armature.

A rod is attached to the armature, the free end of the rod carries a small hammer which can strike against a bell. A very light spring is attached to a contact adjusting screw which is joined to second terminal  $T_2$  by a wire. The electric circuit is

complete through a battery and push switched button connected to the terminals  $T_1$  and  $T_2$ .



### WORKING:

When the pushed button is pressed the electric circuit is completed and the armature is attracted towards the electromagnet as a result, the small spring gets detached from the screw due to which the electric circuit is broken and electromagnet is demagnetized. Due to this, armature is brought back by the spring to its original position. Contact of the spring with screw is now remade which completes the circuit. This action is repeated over and over again. Consequently, the armature vibrates and hammer attached to it strikes the gong and bell rings and sound is produced.

## ELECTRIC MOTOR:

*"It is a device, which converts electrical energy into mechanical energy."*

### Construction:

It consists of a suspended rectangular coil between the poles of a permanent magnet. The ends of the coil are attached to a split copper ring, which rotates along the coil. This split ring made to have a continuous contact with the two stationary pieces of carbon called brushes, which are connected to a battery. The currents enter through one brush and leave through the other.

### WORKING:

When electric current passes through the coil a mechanical force acts on the coil and electrical energy is converted into mechanical energy.

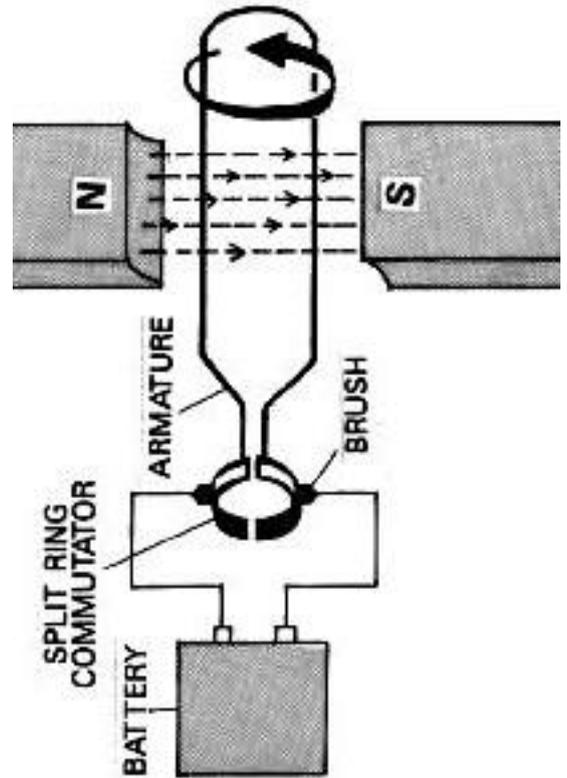
### FACTORS ON WHICH SPEED OR ROTATION OF MAGNET DEPENDS:

1. Magnitude of current through the rotor.
2. Strength of magnetic field of the permanent magnet.

3. Number of turns in the coil of rotor.
4. Permeability of its armature.

**FORCE ON CURRENT CARRYING CONDUCTOR IN A UNIFORM MAGNETIC FIELD:**

1. The current carrying conductor situated in a magnetic field experiences a force whenever it is placed at an angle to the direction of field.
2. The force is always directed perpendicular to the direction of the current and to the magnetic field.
3. The magnitude of the force produced is proportional to the current and the field strength.
4. The direction of the force exerted on the current carrying wire in magnetic field can be determined by using the right hand rule.



**GALVANOMETER:**

*"It is a device, used for measure and detection of an electric current."*

**TYPES F GALVANOMETER**

- Moving coil galvanometer.
- Moving magnetic galvanometer.

**MOVING COIL GALVANOMETER:**

*"Galvanometer in which coil of the wire is freely rotate because of couple is called moving coil galvanometer."*

**AMMETER:**

*"It is a modified form of galvanometer used to measure large amount of current."*

**Connection in circuit of ammeter:**

An ammeter is always place in series with other circuit components through which the current is to measure.

**VOLTMETER:**

*"It is a modified form of galvanometer used to measure potential difference between the two points of a circuit."*

**Connection in circuit of voltmeter:**

Voltmeter is always place in parallel with other circuit components through which the voltage is to measure.

**CONVERSION OF GALVANOMETER INTO AMMETER:**

To convert a galvanometer into ammeter, a low resistance wire called "Shunt" is connected parallel to galvanometer coil.

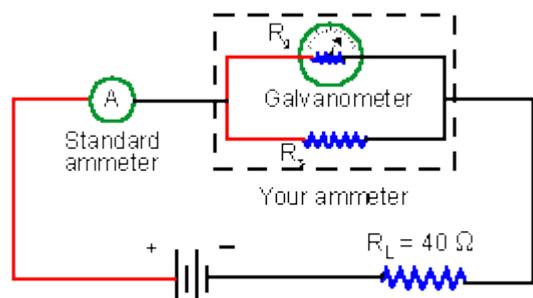


Figure 4.2 - Conversion of a galvanometer to an ammeter.

An ammeter is always placed in series with other circuit components through which the current is to be measured.

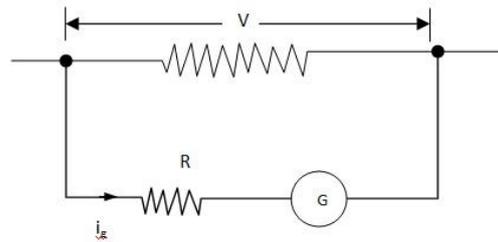
**SHUNT:**

*"It is a low value resistance connected in parallel with the coil of galvanometer."*

**CONVERSION OF GALVANOMETER INTO VOLTMETER:**

To convert galvanometer into voltmeter, a wire of high resistance is connected in series to the coil of the galvanometer.

In order to measure the potential difference of a resistor a voltmeter is always connected parallel to the source.



**USE OF ELECTROMAGNET IN INDUSTRY:**

- They are using the separating the mixture containing magnetic and non-magnetic substances.
- They are used to produce strong magnetic fields for power motors and generators.
- They are also use in research laboratory.

**FAHAD AKHTER**