Physics Class (11)

Galvanometer

"It is a basic electro mechanical instrument used to detect and measure small amount of currents"

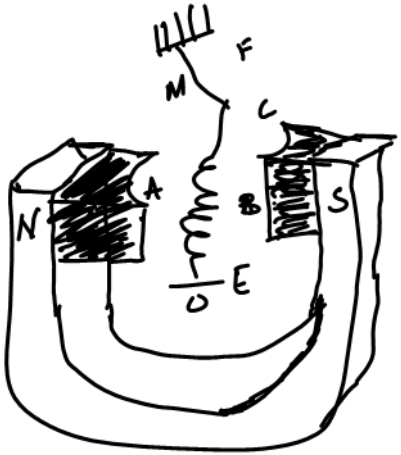
i) Moving Coil Galvanometer
ii) Moving Magnetic Galvanometer

Principle :-

It is based on the interaction between a current and magnet when a current flows in a

rectangular coil placed in a magnetic field. It experiences a magnetic torque and rotates. Thus electrical energy is converted into mechanical energy.

Construction



The moving coil galvanometer consists of a U-Shaped magnet with a coil suspended between its poles. The insulated copper wire is wound over a non-magnetic material (C) The first current lead is (AB) and second current lead is (E)

Working :-

When current (I) is passed through the coil, the coil is acted upon by deflecting couple

which tends to rotate the coil. The deflecting couple is the deflecting torque,

$$\text{Deflecting torque} = BIAN\cos\alpha$$

The coil while being will twist the suspension wire. As a result opposing torque is developed called the restoring torque, whose magnitude is equal to the twist in the suspension. (θ)

Restoring torque $\propto \theta$

Restoring torque $= C\theta$

Where C is called couple per unit twist (for suspension)

In Equilibrium Condition

Deflecting Torque = Restoring Torque

$$BI_A N \cos\alpha = C\theta$$

$$I = \frac{C\theta}{B_A N \cos\alpha}$$

$$I = \left(\frac{C}{BAN}\right)\theta$$

$$I = \text{Constant} \times \theta$$

$$\boxed{I \propto \theta}$$

Sensitivity of Galvanometer :-

Galvanometer is said to be more sensitive if it gives a large deflection with the same value of current.

$$\text{Sensitivity} = \frac{\text{Deflection}}{\text{Micro ampere current}}$$

$$\text{Sensitivity} = \frac{\theta}{I} \quad -(1)$$

$$\frac{1}{C/BAN} = \frac{\theta}{I} \quad -(2)$$

By comparing

$$\text{Sensitivity} = \frac{C}{BAN}$$

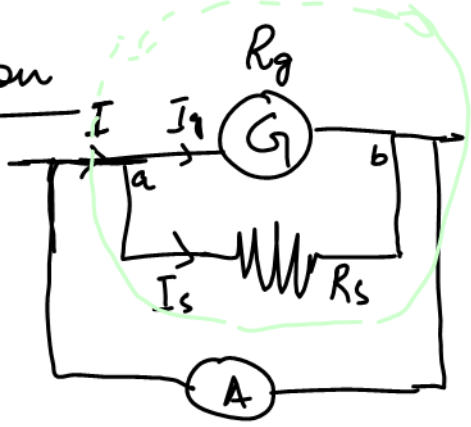
Ammeter :-

An electrical instrument which is used to measure current passing through a circuit

Principle

It works on the same principle as moving coil Galvanometer.

Construction



To convert a galvanometer into an ammeter a small resistance (R_S) is connected parallel to galvanometer. This resistance is called shunt resistance.

Calculation of (R_S):-

Let (I_g) be the current in galvanometer which gives full scale deflection, due to its resistance (R_g).

So, $V_g = I_g R_g$

But, when we connect a a shunt resistance, the current (I) is divided at the terminal a into (I_g) and (I_s)

$$I = I_g + I_s$$

$$I_s = I - I_g$$

where (I_s) is current passing through shunt. Then,

$$V_s = I_s R_s$$

Since in parallel

$$V_s = V_g$$

$$I_s R_s = I_g R_g$$

$$R_s = \frac{I_g R_g}{I_s}$$

$$\boxed{R_s = \frac{I_g R_g}{I - I_g}}$$