MOVING COIL GALVANOMETER

PRINCIPLE

When a current carrying coil is suspended in a uniform magnetic field it is acted upon by a torque. Under the action of this torque, the coil rotates and the deflection in the coil in a moving coil galvanometer is directly proportional to the current flowing through the coil.

CONSTRUCTION

+ COIL

The suspended type consists of a rectangular coil of thin, insulated copper wires having a large number of turns.

+ ~~HORSE SHOE~~ SUSPENSION FIBRE AND SPRING

The coil is suspended between the poles of a powerful horse shoe magnet by a suspension fibre. A spring is attached to the other end of the coil. The current enters the coil through the fibre and leaves the coil through the spring.

ROTATING SCREW HEAD

The upper end of the suspension fibre is connected to a rotating screw head so that the plane of the coil can be adjusted in any desired position.

HORSESHOE MAGNET

The horseshoe magnet has cylindrically concave pole-pieces. Due to this shape, the magnet produces radial magnetic field so that when coil rotates in any position its plane is always parallel to the direction of magnetic field. When current flows through the coil it gets deflected.

IRON CYLINDER

A ~~small~~ soft iron cylinder is fixed inside the coil such that the coil can rotate freely between the poles and around the cylinder. Due to the high permeability, the soft iron core increases the strength of the radial magnetic field.

MIRROR

A small plane mirror is fixed to the suspension fibre. This along with lamp and scale arrangement is used to measure the deflection of the coil.

THEORY

Consider a rectangular coil ABCD of single turn having length 'l' and width 'w' suspended in a uniform magnetic field of induction B such that the plane of the coil is parallel to the magnetic field. Let 'I' be the current through the coil.

The sides AD and BC being parallel to the magnetic field donot experience any force, but the sides AB and CD being perpendicular to the magnetic field experience force. The force experienced by each side is given by

$$F = BIl$$

By Fleming's Left Hand Rule these forces are opposite in direction. As these two forces are equal and opposite they form what is called as couple and due to which a torque acts on the coil which tries to deflect the coil. The deflection torque is given by

τ = Force x Perpendicular distance b.w the forces

$$\tau = F \times w$$

$$\tau = BIl \times w$$
$$= ~~B(Iwl)~~ \; BI(wl)$$
$$= BIA$$

If the coil has 'n' turns then the deflecting torque is given by

$$\tau = nBIA$$

Under the action of this torque, the plane of the coil rotates through an angle θ before coming to rest. Due to the radial magnetic field, the plane of the coil is always parallel to the direction of magnetic field. Thus at any positio the deflecting torque has constant magnitude. The rotation of the coil produces a twist in the fibre which produces a restoring torque which is directly proportional to the angle of deflection θ

$$\tau \propto \theta$$
$$\tau = C\theta$$

wher C is torque per unit twist (or torsional constant) of the suspension fibre.

When the coil comes to rest i-e when it attains equilibrium, the restoring torque will balance the deflecting torque. So in equilibrium position of the coil

Deflecting Torque = Restoring Torque

$$NBIA = C\theta$$

$$I = \frac{C\theta}{NAB}$$

As C, N, A, B are constant

$\therefore I \propto \theta$

Thus in a moving coil galvanometer current in the coil is directly proportional to the angle of deflection of the coil.