Moving Coil Instruments

There are two types of moving coil instruments namely, ***permanent magnet moving coil*** type which can only be used for ***direct*** current, voltage measurements and the ***dynamometer*** type which can be used on either ***direct or alternating*** current, voltage measurements.

1. *Permanent Magnet Moving Coil Mechanism (PMMC)*

In PMMC meter or (D'Arsonval) meter or galvanometer all are the same instrument, a coil of fine wire is suspended in a magnetic field produced by permanent magnet. According to the fundamental law of electromagnetic force, the coil will rotate in the magnetic field when it carries an electric current by electromagnetic (EM) torque effect. A pointer which attached the movable coil will deflect according to the amount of current to be measured which applied to the coil. The (EM) torque is counterbalance by the mechanical torque of control springs attached to the movable coil also. When the torques are balanced the moving coil will stopped and its angular deflection represent the amount of electrical current to be measured against a fixed reference, called a scale. If the permanent magnet field is uniform and the spring linear, then the pointer deflection is also linear.

2. *Mathematical Representation of PMMC Mechanism*

Assume there are (N) turns of wire and the coil is (L) in long by (W) in wide. The force (F) acting perpendicular to both the direction of the current flow and the direction of magnetic field is given by:

$F = N \cdot B \cdot I \cdot L$ where N: turns of wire on the coil I: current in the movable coil
B: flux density in the air gap L: vertical length of the coil

Electromagnetic torque is equal to the multiplication of force with distance to the point of suspension

$T_{I1} = NBIL\frac{W}{2}$ in one side of cylinder $T_{I2} = NBIL\frac{W}{2}$ in the other side of cylinder

The total torque for the two cylinder sides

$T_I = 2\left(NBIL\frac{W}{2}\right) = NBILW = NBIA$ where A: effective coil area

This torque will cause the coil to rotate until an equilibrium position is reached at an angle θ with its original orientation. At this position

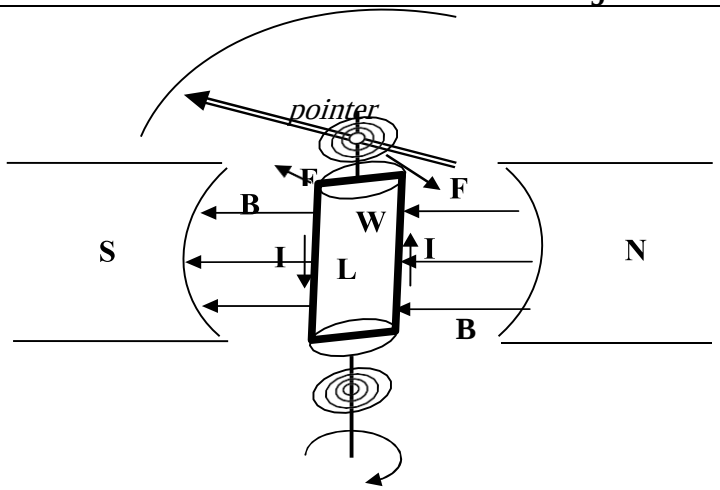
Electromagnetic torque = control spring torque

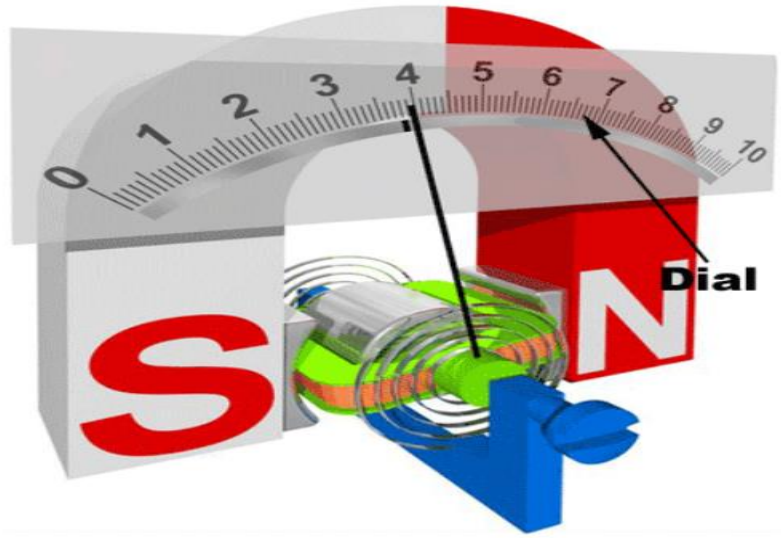
$T_I = Ts$

Since $Ts = K\theta$

So $\theta = \frac{NBA}{K}I$ where $C = \frac{NBA}{K}$ Thus $\theta = CI$

The angular deflection proportional linearly with applied current





PMMC Meter

3. PMMC Construction

A PMMC meter (or D'Arsonval meters) is constructed of 5 main components:

- Stationary Part or Magnet System
- Moving Coil
- Control System
- Damping System
- Meter.