SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

COIMBATORE-35

Accredited by NBA-AICTE and Accredited by NAAC – UGC with A+ Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE NAME: 19EET205/ MEASUREMENTS AND INSTRUMENTATION

II YEAR / IV SEMESTER

Unit 1 –**MEASUREMENT OF VOLTAGE AND CURRENT**

Topic 10: PERMANENT MAGNET MOVING COIL INSTRUMENTS

Course outcome

Compare AC and DC meters along with its internal construction

Continued…

- **Types of instruments used for Voltmeter and Ammeters:**

➢ The practically used ammeters and voltmeters can be of the following two types:

1. Permanent ,magnet moving coil (PMMC) type
2. Moving iron (MI) type
3. Hot wire type
4. Induction type

Moving Coil Instruments

- Moving coil instruments (ammeter and voltmeter) are of two types:

1. Permanent magnet moving coil type (PMMC) used only for D.C.
2. Dynamometer type can be used for AC as well DC.

Continued…

1. **PMMC Instruments:**

- They are also known as d'Arsonval instruments.
- These instruments works on the electromagnetic effect of current.
- A permanent magnet used to produce magnetic flux and coil that carries the current to be measures moves in this field.

Continued…

- **Working principle:**

➢ When a current carrying conductor is placed in a magnetic field, it experiences a force. It is given by expression,

$$F = BIL$$

Where F = Force in Newton,

B = Flux density is tesla,

I = Current is ampere,

L = Length of conductor in meter.

➢ The current I which is to be measured is passed through the moving coil and experiences a force which is directly proportional to this current.

➢ Due to this force the coil moves and the pointer attached to it will also move.

➢ The angle through which the pointer moves is proportional to current I.

Continued…

- **Construction of PMMC instrument:**

- A coil of thin wire is mounted on an aluminum frame (spindle) positioned between the poles of a U shaped permanent magnet which is made up of magnetic alloys like alnico.
- The coil is pivoted on the jewelled bearing and thus the coil is free to rotate. The current is fed to the coil through spiral springs which are two in numbers.
- The coil which carries a current, which is to be measured, moves in a strong magnetic field produced by a permanent magnet and a pointer is attached to the spindle which shows the measured value.

Continued…

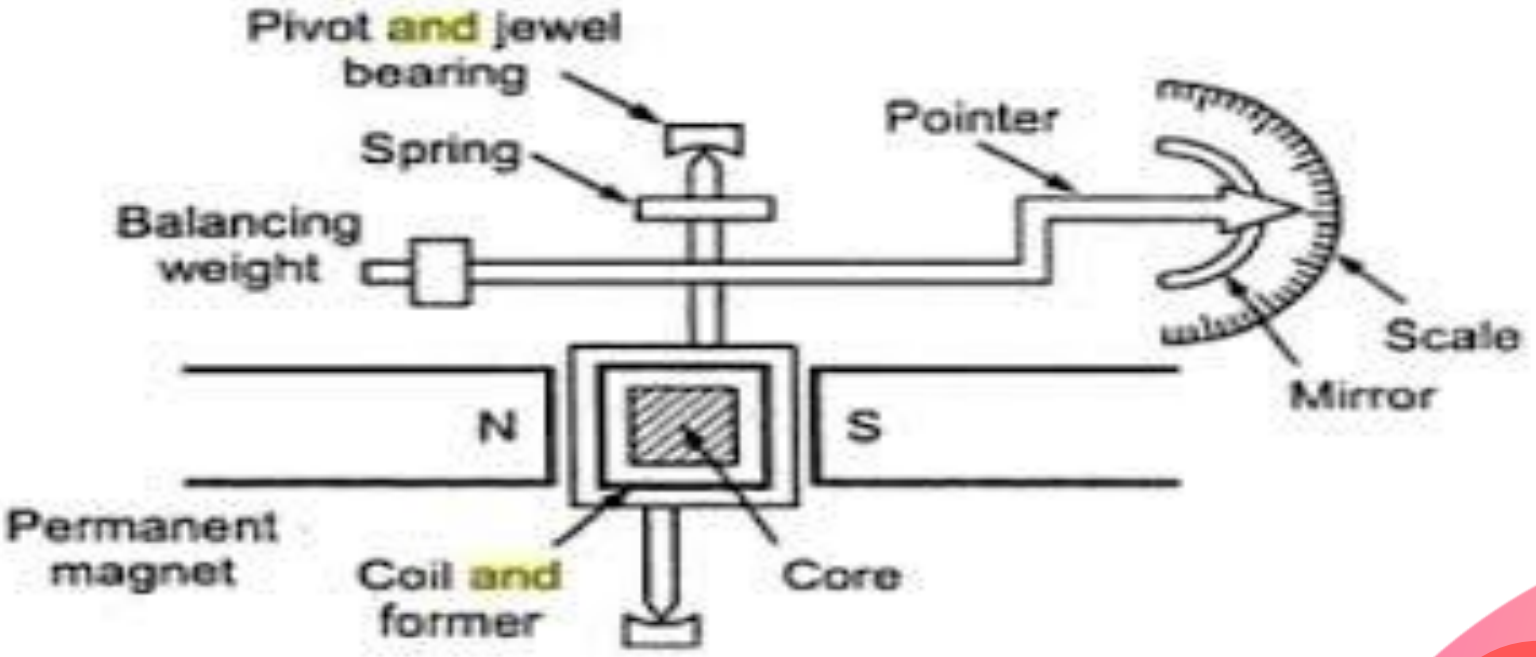

Fig.(1): construction of PMMC instrument

Continued…

- **Deflecting Torque:**

➢ It can be proved that the expression for the deflecting torque is given by,

$$T_d = G \times I$$

where G = constant

I = Current through the moving coil

- **Controlling Torque:**

➢ The controlling torque is given by,

$$T_c = C.\ \theta$$

where C = Control spring constant in N-m/rad

θ = Deflection of coil from zero position

Continued…

- For steady state, the controlling torque is equal to the deflection torque

$$\therefore T_c = T_d$$

$$\text{i.e. } C\theta = GI$$

$$\therefore \theta \propto I$$

- Thus deflection of the pointer is proportional to current passed through the coil.

Continued…

- **Advantages of PMMC Instruments:**

1. The PMMC consumes less power and has great accuracy.
2. It has uniformly divided scale and can cover arc of 270 degree.
3. The PMMC has a high torque to weight ratio.
4. It can be modified as ammeter or voltmeter with suitable resistance.
5. It has efficient damping characteristics and is not affected by stray magnetic field.
6. It produces no losses due to hysteresis.

Continued…

- **Disadvantages of PMMC Instruments:**

1. The moving coil instrument can only be used on D.C supply as the reversal of current produces reversal of torque on the coil.
2. It’s very delicate and sometimes uses ac circuit with a rectifier.
3. It’s costly as compared to moving coil iron instruments.
4. It may show error due to loss of magnetism of permanent magnet.

Continued…

- **Connection of PMMC instruments as Ammeter or Voltmeter:**

1. **Ammeter**:

- When the instrument is used as an ammeter, an external low resistance called shunt is connected in parallel with the movement so that net resistance of the instrument is very low and the instrument can be connected in series with any equipment whose current is to be measured.
- Due to low resistance, voltage drop across instrument is negligible.

Continued…

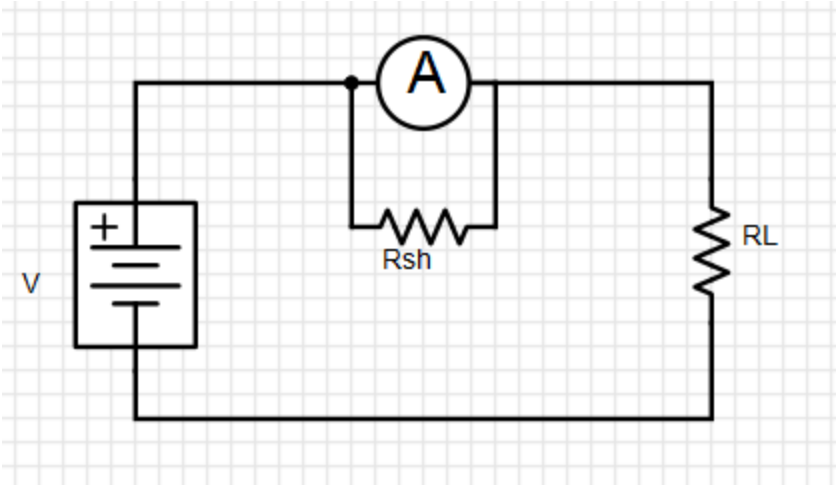

Fig.(2a): Connection as an ammeter

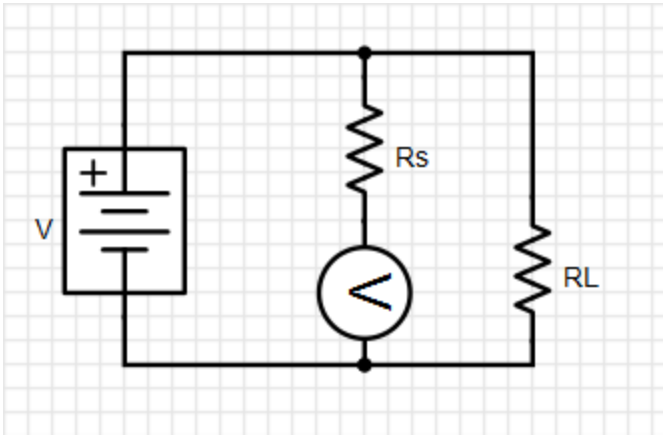

Fig.(2b): connection as a voltmeter

Continued…

2. Voltmeter:

- When the instrument is used as a voltmeter, an external resistance is connected in series with the movement and this series combination is connected across supply terminals or load terminals or in general cross any two terminals where terminal voltage is to be measured.
- Due to high series resistance, current flowing through the instrument is negligible.