Laboratory type potentiometer (Crompton's type)

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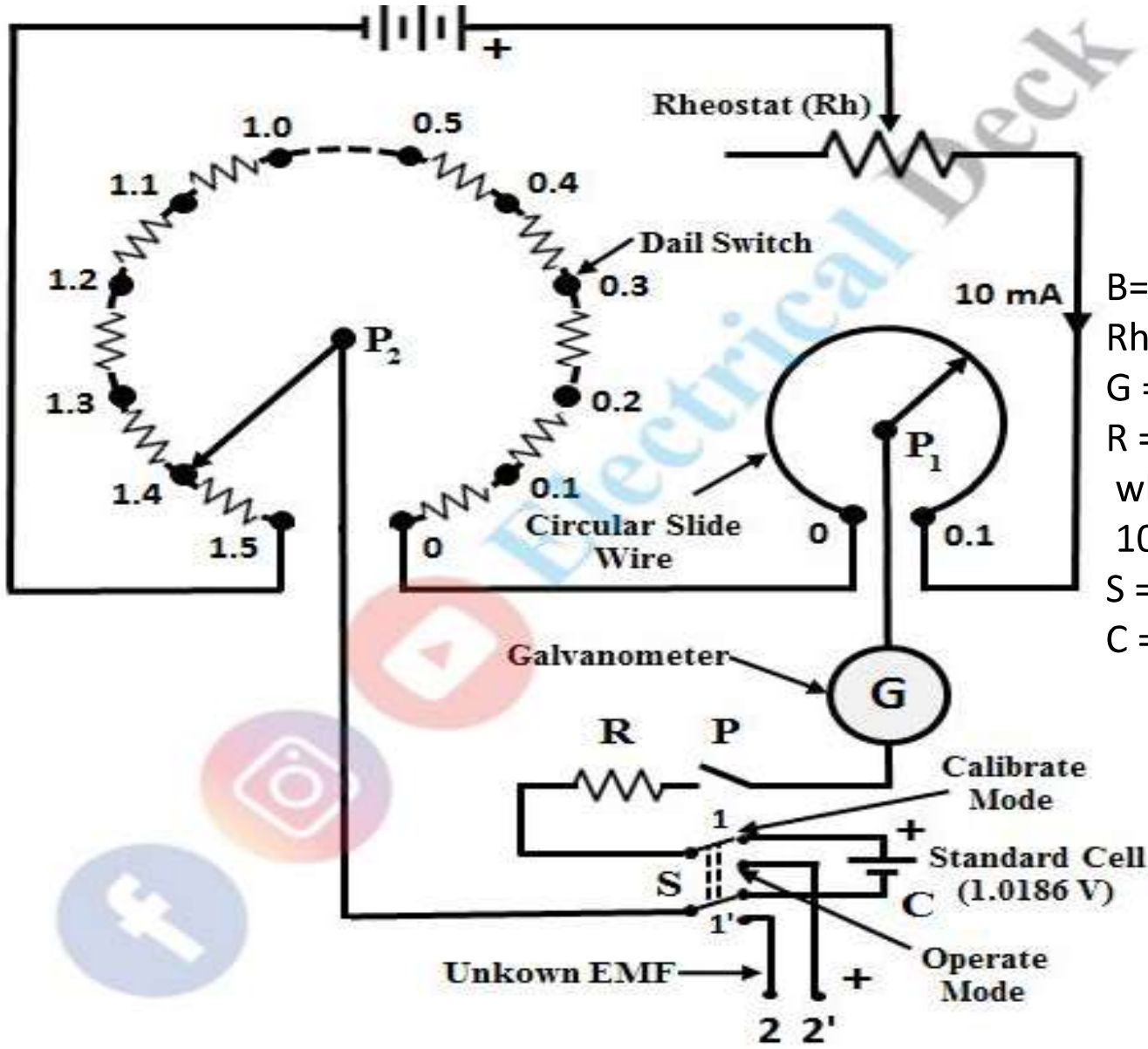
Introduction

- DC Crompton's potentiometer is the laboratory-type potentiometer that is used to measure unknown emf effectively with a great degree of precision.

Introduction

- DC Crompton's potentiometer works on the principle of a slide wire potentiometer.
- In other words, the DC Crompton potentiometer is a modified version of a slide-wire potentiometer.
- It basically consists of a small slide wire which is circular in shape and a dial switch with calibrated resistors, as shown in the figure below.

Circuit Diagram



B= Battery
Rh = Rheostat
G = Galvanometer
R = Protective resistar
which is of order of
10 KΩ
S = Double throw swi
C = Standard cell

Working

- In DC Crompton's potentiometer, the dial switch is divided into fifteen steps with each step having a resistance of 10Ω.
- Hence, the total resistance of dial switch is equal to 150Ω (15 X 10 = 150).
- The slide wire is in the form of a circular wire and has a resistance of 10Ω, with a single turn.
- A double-throw switch is provided for standardization and for measuring the unknown emf, one after the other.

Working

- A protective resistance is connected in series with the galvanometer in order to protect the galvanometer and is shorted when the galvanometer reaches the balanced condition.
- As the working current provided by the battery is 10 mA, the voltage drop across each step is 0.1 V and hence it has a total range of 1.5 V (1.5 x 10 = 15 V).

Working

- If circular slide wire has 200 divisions, then each division in slide wire has a resolution of 0.0005 V (0.1/200 = 0.0005).
- Hence, it is possible to measure the readings up to 0.0001 V with great precision and accuracy by taking readings up to 1/5th division in the scale.

Working

- First, the potentiometer is to be standardized to the standard cell voltage (1.0186 V) by keeping the dial switch at 1.0 V and slide wire at 0.0186.
- After making these adjustments, switch S is operated in calibrate mode and key k is closed and the rheostat is adjusted in such a way that, the galvanometer shows null deflection.
- With this, the potentiometer is standardized to the voltage of standard cell which is connected between the terminals 1 and 1'.

Working

- Now, the switch is thrown into the operating mode for measuring the unknown emf connected between terminals 2 and 2'.
- The value of unknown emf can be measured directly from the dial switch and circular slide wire, after balancing the galvanometer to show null deflection.
- In this way, an unknown emf can be measured with great precision using DC Crompton's potentiometer.

Working

- Once the instrument has measured the required voltage, then cross check the circuit conditions whether they are disturbed or not
- In order to check, move the switch operate to calibrate position.
- Keeping the dial switch at 1.0 V and slide wire at 0.0186 and shorting key as closed, galvanometer shows zero reading.

Working

- Suppose galvanometer not shows zero reading, the working current and circuit condition get disturbed.
- Due to some reason, it is disturbed and repeat the entire procedure in order to maintain accuracy

Standardization of DC Crompton's Potentiometer :

- DC Crompton potentiometer is a laboratory-type potentiometer, with high precision. Here, the long slide wire is replaced with extension coils having the resistance same as that of the slide wire.
- Standardization is defined as the process of adjusting the working current of the potentiometer such that the voltage drop across the section of slide wire is equal to the standard reference voltage.

Steps involved in the standardization of DC Crompton's potentiometer.

- Settings are made such that, the sum of the voltage across the dial resistors and the slide wire is equal to the standard cell voltage.
- The switch is closed to calibrate the positions and the rheostat is set for null deflection.
- The galvanometer key is tapped and the resistance is kept in the circuit to protect the galvanometer.

Steps involved in the standardization

- As soon as zero deflection is obtained, the protective resistance is replaced by a short-circuit, and then final settings are done for null deflection using a rheostat.
- Standardization has to be checked each time while measuring unknown emf.

Applications of DC Crompton's Potentiometer :

- Measurement of resistance.
- Measurement of power.
- Calibration of wattmeter.
- Calibration of voltmeter.
- Calibration of ammeter.