UNIT 3 TYPES OF THERMOMETERS

3.2.2 Platinum Resistance Thermometers

As the name of the thermometer suggests, it is a thermometer that depends on the resistance of a wire whose values change with temperature.

Callendar found out that the resistance of pure metals increases as the temperature increases. He showed that the resistance of pure platinum varies with the gas thermometer temperature t according to the equation.

$$R_t = R_0 (1 + At + Bt^2) \quad \ldots\ldots\ldots\ldots\ldots (3.4)$$

Where, R_t and R_0 are the resistances at t^oC and 0^oC respectively. A and B are some constants for a given specimen. On the platinum resistance scale of temperature, equal changes in resistance denote equal changes in temperature.

Fig. 3.3 Platinum Resistance

Fig. 3.3 shows a typical platinum resistance which is used in connection with the Wheatstone (Meter) Bridge devised by Callendar and Griffiths (Fig. 3.4). The bridge is used to obtain a balance point which enables the experiment to determine the various values of R_t , R_{100} and R_0

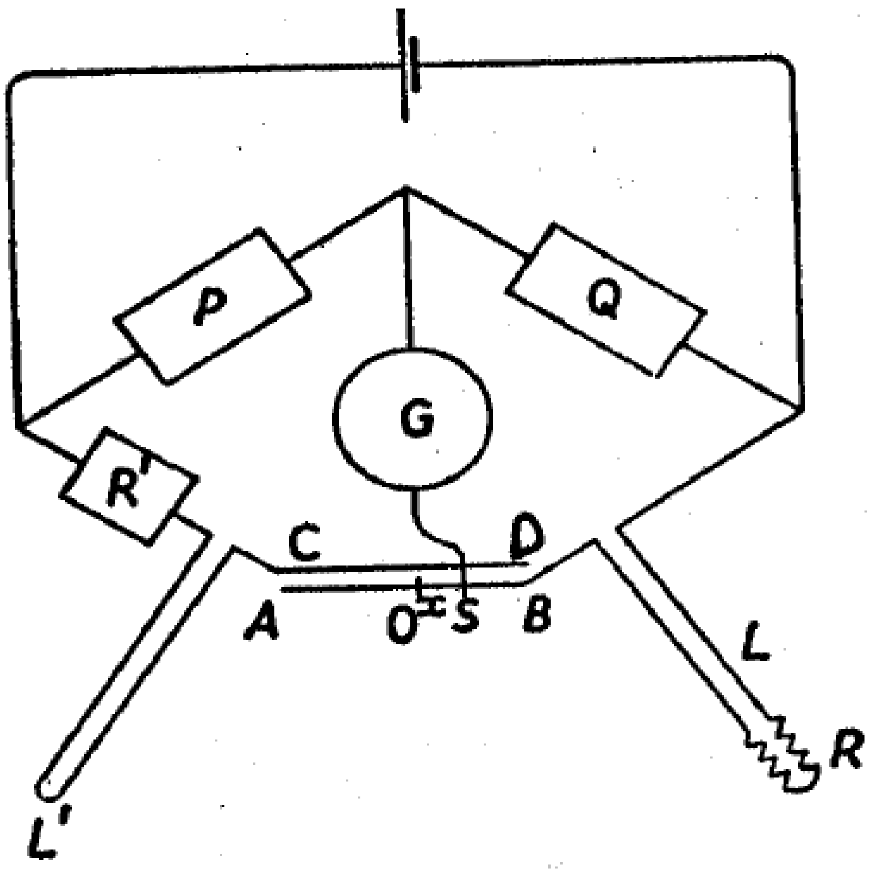

Fig. 3.4 Callendar and Griffiths Wheatstone Bridge

Let R0 and R100 be the resistances of ice and steam respectively and R_t the resistance of the platinum at t_p oC.

$$T_P = \frac{R_t - R_o}{R_{100} - R_0} X100°C \qquad \text{..........................(3.5)}$$

The platinum resistance thermometer has a wide range noted for its extreme accuracy over the length of this range. However, its chief disadvantage is the long time needed for it to assume the temperature of its surroundings and the time required for making an observation so tat it

cannot follow rapidly changing temperatures. This is where the thermoelectric thermometer is a good substitute.

3.2.3 Thermo-Electric Thermometers

The thermo-electric thermometer is otherwise called *thermo-couple.*

This type of thermometer is constructed by using the Seebeck effect. First, we will discuss about the Seebeck effect.

Seebeck effect simply states that if two dissimilar metals, such as copper and iron are joined to make a complete circuit, then on heating one end of the junctions, a current flows round the circuit.

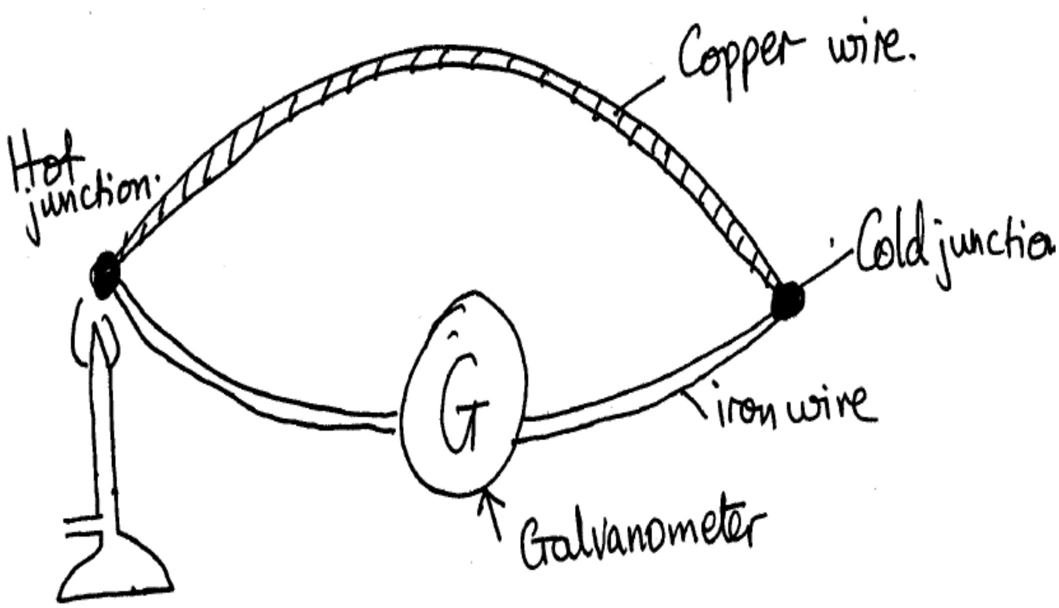

Fig. 3.5: Thermo-Electric Couple

The presence of the galvanometer is to detect and measure the magnitude of the current that flows in the circuit.

This type of arrangement is called a thermo-couple.

The emf established round the circuits depends

1- **on the nature of the metals used to form the couple**
2- **and also on the temperature t difference between the hot and cold junctions.**

The cold junction is usually maintained at ice point. It has been shown experimentally that when the other junction is at some temperature t, the thermo- electric emf set up depends on the temperature accordingly as

$$E = A + Bt + Ct^2 \quad \cdots\cdots\cdots\cdots.\cdots.. \quad (3.6)$$

Where A, B and C are constants depending on the metals used. The graph between emf versus t is shown in fig. 3.6.

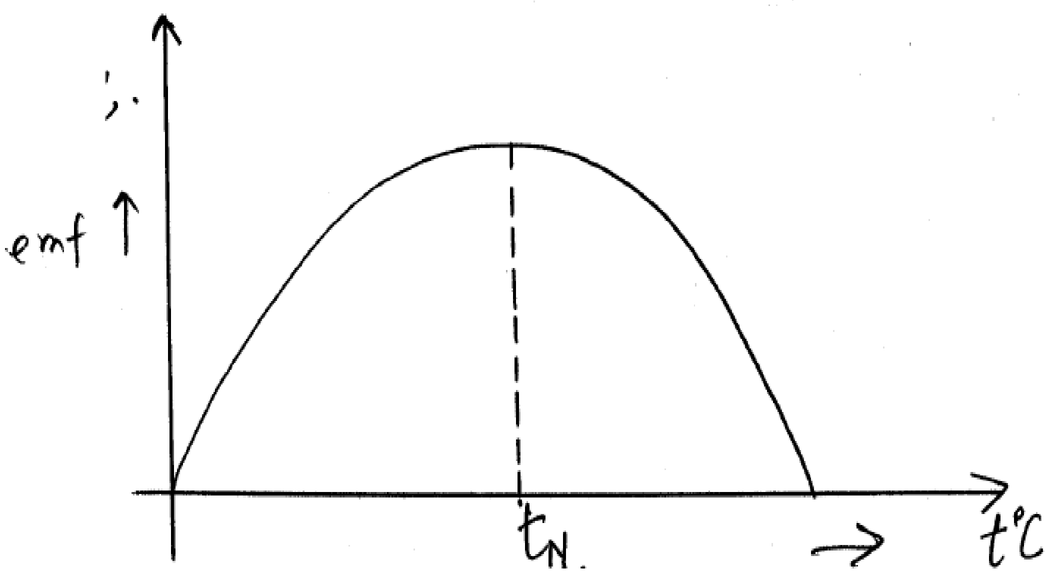

Fig. 3.6: emf against t

The temperature where the emf is maximum for the two metals is called the neutral temperature tN.

It is however more convenient to observe the thermo- electric behavior of the two metals graphically by plotting their thermo-electric power (P) against temperature.

Thermo-electric power is the change in the thermo-electric emf per degree Celsius in temperature between the hot and cold junctions.

From the Eq. (3.6) if t is measure from the ice point, then A is equal to zero. Then,

$\therefore E = Bt + Ct^2$ ································. (3.7)

The graph of E versus t is either fig. 3.7 (i) or fig. 3.7 (ii) as shown below.

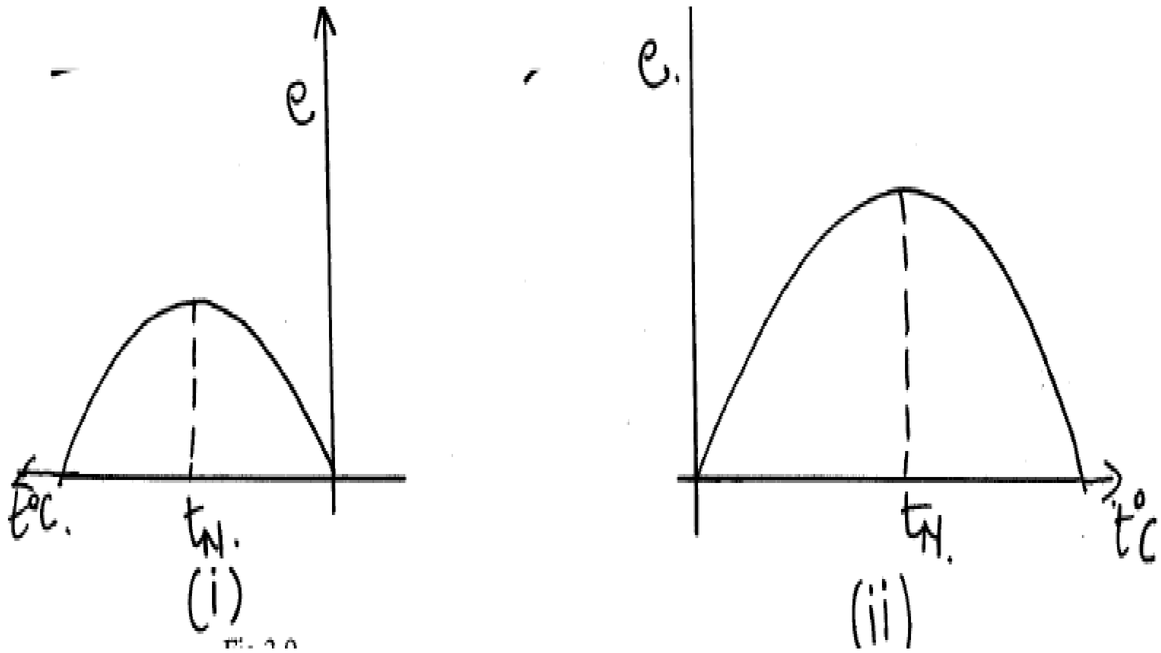

Fig. 3.7