Resistance Thermometer:

Principle: It is based on the principle of variation of resistance of a conductor with temperature which is given by a parabolic formula as

$R_t = R_0\left(1+\alpha t+\beta t^2+......\right)\rightarrow(1)$ where α and β are constant of the material of the conductor.

$\alpha \approx 10^{-3}, \beta = 10^{-7}$

Since value of β is very small unless t is very large βt^2 is neglected compared to 1.

Hence equation(1) reduces to

$R_t = R_0\left(1+\alpha t\right)\rightarrow(2)$

Where R_0 and R_t are the resistance of the conductor at 0^0C and t^0C respectively. Since α the temperature coefficient of variation of resistance is not accurately known it is to be eliminated from equation (2).

Let R_{100} be the resistance at 100^0C, following equation (2)

$R_{100} = R_0\left(1+\alpha\times100\right)\rightarrow(3)$

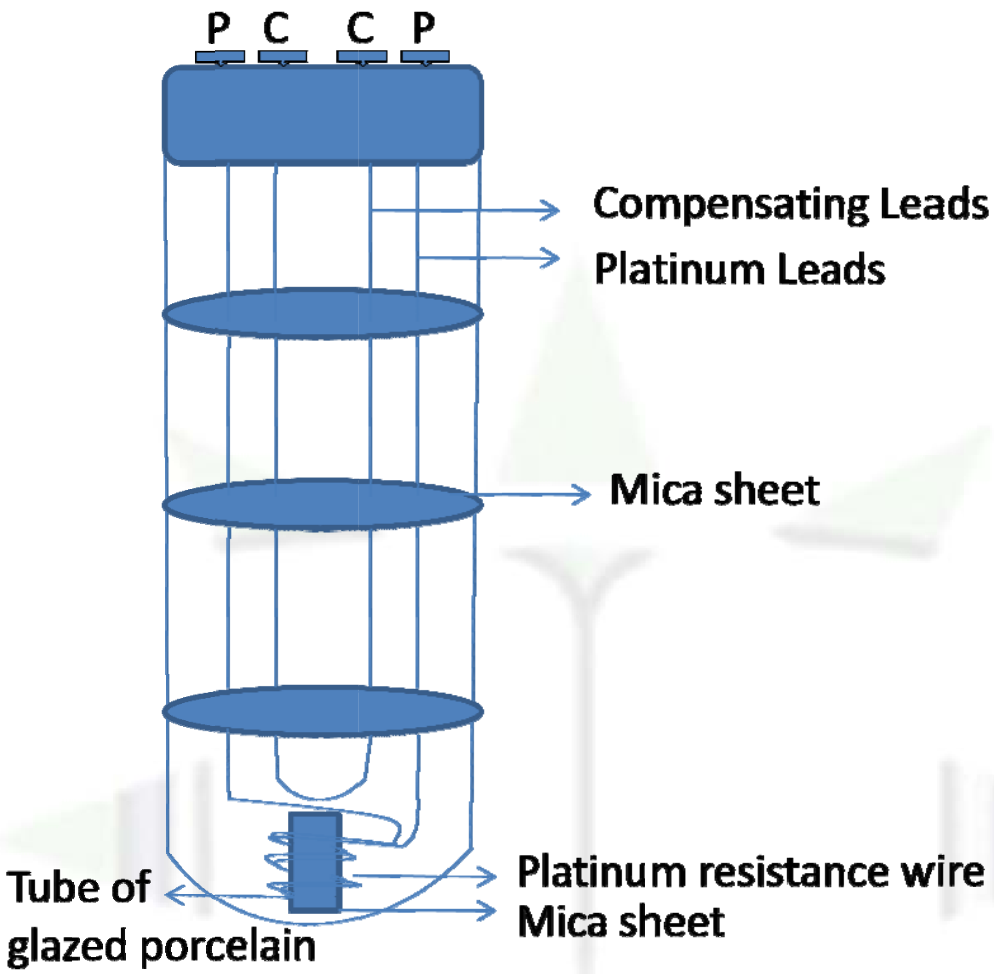
From equation(2):

$\frac{R_t}{R_0}-1=\alpha t$

$\frac{R_t-R_0}{R_0}=\alpha t\rightarrow(4)$ Similarly from equation(3): $\frac{R_{100}-R_0}{R_0}=\alpha\times100\rightarrow(5)$

Dividing (4) by (5) we get:

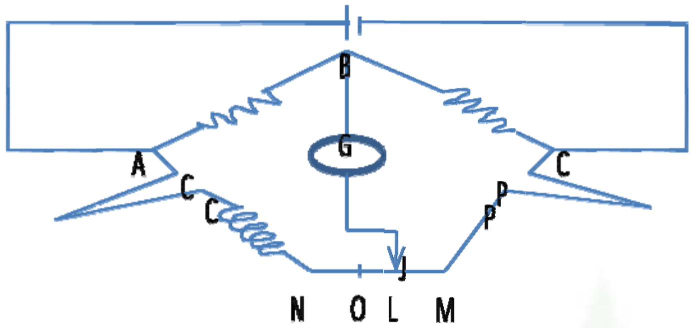
$t=\frac{R_t-R_0}{R_{100}-R_0}\times100\rightarrow(6)$



Construction: A pure wire free from carbon, silicon, tin and other impurities is selected. The wire is doubled on itself to avoid induction effect. The wire is wound on a thin sheet of mica and the two free ends of the wire are connected to the two platinum rods, which pass through the mica sheet and connected to the terminal PP at the top.

An exactly similar pair of rods are placed close to the platinum leads with their lower ends joined together and Are connected to the terminals C,C. The whole Arrangement is enclosed in a tube of glazed porcelain.

For rough work copper rods instead of platinum rods can be used and the whole thing is enclosed in a tube of hard Glass.



Measurement of Resistance by Callendar & Griffith bridge:

This is a modification of Wheatstone bridge where the ratio arms are kept equal by makers of the instrument. The third arm consists of series of resistance1, 2,4,8,16,32,64,128Ω.The terminal CC & PP are connected in the 3rd and 4th arm and connected by the wire NM of uniform crosssection having resistance of 0.005 ohm/cm. The galvanometer is connected to this wire by a jockey J,

Suitable resistance is put in the 3rd arm and jockey J is adjusted on the wire NM till we get null deflection.

Calculation:

Let R_{pp} and R_{cc} = Resistance of the rods of the platinum leads and compensating leads respectively ($R_{pp} = R_{cc}$)

R_t = Resistance of the platinum wire

R = Resistance put in the 3rd arm

ρ = Resistance per unit length of the wire MN

L= Position of the jockey at null deflection

The resistance of the 3rd arm $R_3 = R_{cc} + R + \rho\, NL$

Resistance of the 4th arm $R_4 = R_{pp} + R_t + \rho\, ML$

At null deflection : $R_3 = R_4$

$R_{cc} + R + \rho\, NL = R_{pp} + R_t + \rho\, ML$

$R_t = R + \rho(NL - ML)$

Let O be the electrical mid point

$\therefore NL = NO + OL, ML = MO - OL$

$R_t = R \pm \rho\, 2OL$

$R_t = R \pm 2\rho x \rightarrow (6)$

Using equation(6) resistance can be calculated.

Correction: It is found that the temperature measured by a platinum resistance thermometer of a bath t_{pt} is slightly different from that measured by a gas thermometer(t). The correction is given by

$$t - t_{pt} = \delta\left[\left(\frac{t}{100}\right)^2 - \frac{t}{100}\right] \rightarrow (7)$$

Where δ = constant of the element of the conductor.

Disadvantage: Since some time is required in balancing the bridge hence quickly varying temperature cannot be measured by a platinum resistance thermometer.