Pumps of this type operate only at quite low pressure. The backing pressure usually required is 10^{-1} to 10^{-2} Torr. The ultimate vacuum attainable depend upon the vapour pressure of the pump liquid at the temperature of the condensing surfaces. However, by providing a cold trap between the vapour pressure of the pump liquid may be achieved.

3. <u>Pirani Gauge</u> :- In its simplest form, the Pirani Gauge is made up of a glass or metal tube enclosing a wire stretched along the tube's axis. This wire is heated by sending current through it. This heat energy is lost primarily by three distinct process :-

(i) a part of it is spent in heating the enclosed gas molecule

(ii) a part of it is lost in rotation &

(iii) there are also losses due to conduction through the wire leads.

At low pressures the energy balance may be expressed as :-

$$I^2R(1+\alpha\Delta T) = cP_x\Delta T + \sigma(T^4 - T_a^4) + b\Delta T \quad -①$$

where ΔT is the difference in the filament temperature (T) and the ambient temperature (T_a), P_x is the pressure within the enclosure c, σ and b are proportionality constant, I is the current through the filament. R is resistance of filament at room temperature and α is the temperature coefficient of the resistance for the filament material.

The first term on the R.H.S of eqn(1) gives the heat transferred by the gas surrounding the filament to the enclosure, the second term is the power dissipated by the filament by radiation and the third term is the energy loss due to conduction through the wire leads. The unknown pressure (P_x) is obtained from (1) as :-

$$P_x = \frac{I^2 R(1+\alpha \Delta T) - h\Delta T - \sigma(T^4 - T_a^4)}{C\Delta T} \quad \text{--- (2)}$$

A change in the pressure is inferred either from change in the filament current with T and Ta held constant or from the changes in the filament temperature with the filament current held constant. The working of a Pirani Gauge is demonstrated in figure 1.

Most commercial gauge heads are made of a steel tube or a glass enclosure and are provided with a tungsten filament. Nickel has also been widely used. Some commercial gauges use a semiconductor called thermistor which has a high temperature coefficient of resistivity. The measuring circuit is a simple wheat-stone bridge network. The network is formed by the four resistance R_x, R_1, R_2 & R_3. R_x is made up of material having by the four resistance coefficient of the resistance so that a small changes in R_x where R_1 is fabricated from the material having a low voltage of α. R_2 and R_3 are made up of materials having low α- value & have the same value of resistance. These resistors are made of manganin are constantan wires.

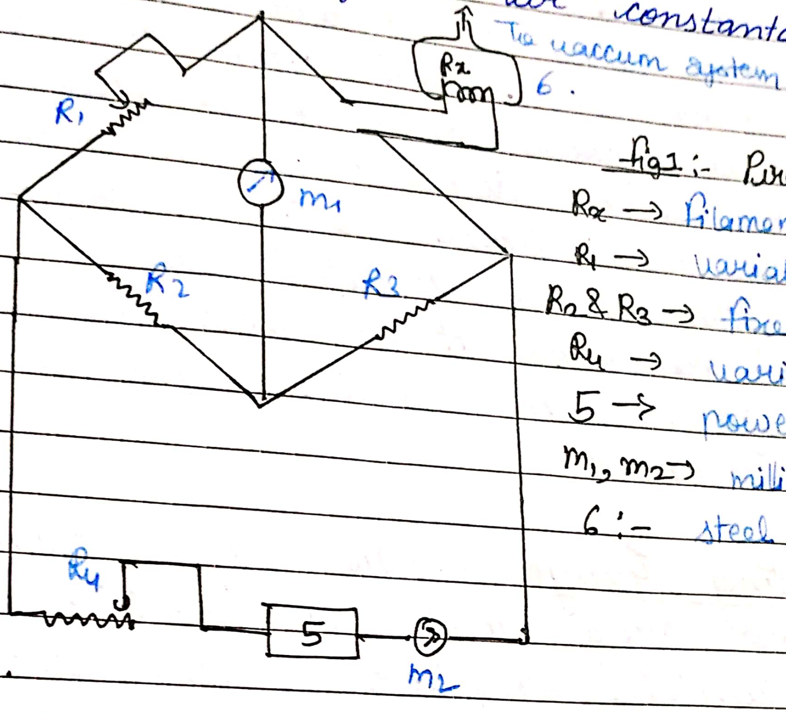

fig1 :- Pirani Gauge.

R_x → filament resistance
R_1 → variable resistor
R_2 & R_3 → fixed resistor
R_4 → variable resistor
5 → power supply
m_1, m_2 → milliammeters
6 :- steel or glass housing

→ Pressure is measured by keeping the filament R_x at constant temperature. As the unknown pressure changes, the amount of heat withdrawn from the filament changes and so does its temperature. Now the filament current is readjusted till the filament temperature is brought back to its original value of nulling the out of balance current is measured with an ammeter (m_1). The filament current once calibrated (m_2), gives the measured values of pressure. Many commercial gauge omit m_2 to monitor constant bridge current and prefer using electrical circuitry to provide a constant current sources.

This is the indirect pressure gauge and hence necessitates calibrating the ammeter reading with respect to a direct pressure gauge. The pressures covered by these gauges are in the range 1 - 10^{4} torr. Gives the calibrated pressure versus microammeter reading for various vapour and gases. Certain contaminants such as oil vapour from pumps may crack and leave various deposits on the filament and tube walls. To eliminate these deposites It is necessary to clean the gauge tube usually with chemicals & then dry It.

4. Penning Gauge :- The basic geometry of the Penning gauge with a tabular anode has been widely applied to the design of UHV pressure measurements The manner in which the gauge operates can be seen from fig 1. -

1. The anode A is b/w the two cathodes (C) and a magnetic field is produced by a horseshoe magnet. The magnetic field is perpendicular to the planes of the cathodes and the anode. It might appear at first glance that the electrical & magnetic field in a penning gauge are parallel and not crossed.

However the potential on the axis of an operating penning discharge is depressed to near cathode potential by the electronic space charge.

3. fig 1 -atio volt b/w lea bu fo