

1.2 DOUBLE METAL EXPANSION

Double metal expansion is the differential expansion of 2 different metals, not laminated together. Metal thermal expansion produces huge force, enough for example to bend railway rails when expansion gaps are not correctly designed.

1.2.1 CARTRIDGES

The cartridge consists of an outer expandable tube, usually stainless steel, and two non-expandable internal blades, usually Invar.

The elongation of the envelope is a function of temperature. For a length of about 100 mm, this expansion is 0.0020mm per ° C.

1.2.2 PARALLEL BLADES

Their principle is similar to cartridges, they are made of one expandable copper alloy blade to which is welded at each of its ends a bow shaped invar blade. Expansion of the copper alloy blade will tend to reduce the distance between the two blades

1.2.3 RODS

The rods are formed of an outer expandable tube in stainless steel, copper or brass, and an inner invar rod. Expansions value are similar as the cartridges. This principle is the basis of most current water heater thermostats. This is a very simple, very reliable, the reaction time is very fast, as it is the outer tube itself that measures the temperature.

Through the use of expandable metal instead of Invar, it is possible to obtain devices with anticipative control action, which is very close to proportional action of electronic controllers.

Using the same metal for the outer tube and the inner rod provides controls that are only responsive to fast changes in temperature and are used in fire detectors.

In very high temperatures, invar rod can be replaced by quartz or alumina.



1.3 LIQUID EXPANSION

Liquids are incompressible and expand as solids. The expansion forces are very important and will develop considerable power to the mechanisms.

The expansion of liquid are used in closed subassemblies named « diastats », they consist of a bulb, a capillary, a bellows or diaphragm.

The expansion of the liquid in the bulb is transmitted through the capillary to the diaphragm which inflates and produces movement. Diaphragms expansion ranges are between 0.4 and 0.8mm for the entire measuring range. Bulbs volumes are calculated to provide a specific displacement for a given range. Freezing temperature of the liquid gives the lower limit of use, the upper limit is the boiling temperature. Raising these limits generally cause the destruction of the diastat.

The good thermal conductivity of liquids used provides short response time.

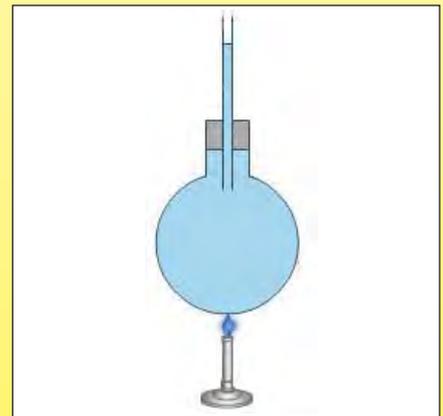
1.3.1 LIQUID METALS

Mercury was the first liquid used in thermostats.

Its first use was the traditional mercury thermometer.

Its expansion is almost linear from ambient to 500 ° C.

This is an excellent conductor of heat. So it was ideal for liquid thermostats. However its toxicity has done it to virtually disappear during last decade



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