Positive Acting: A thermostat, humidistat or relay which maintains its valve or damper either wide open or fully closed, that is, when there is always full force or none in its branch line.

Intermediate Acting: A thermostat, humidistat or relay which holds its valve or damper in any position, that is, when its branch line may have full main force, or any part of it.

Two-Point Thermostat: A thermostat having two branch lines, each of which is independent of the other, thus being equivalent to two separate instruments.

Direct-Acting Thermostat: A thermostat that increases power in its branch line on rising temperature. A *direct-acting valve* is one that is normally open.

Reverse-Acting Thermostat: A thermostat that increases the power in its branch line on falling temperature. A *reverse-acting valve* is one that is normally closed.

Threeway Valve: A valve having three pipe connections and used to regulate the flow of a fluid through either one of two circuits; it may be operated either positively or intermediately.

THERMOSTATS

Automatic control of temperature requires the use of an instrument known as a *thermostat* which responds to a change in temperature. Although there are many types of thermostats, the basic principles of operation of practically all types are included in the following classifications:

1. The *diaphragm* type (Fig. 1) which, by means of an expanding liquid or gas within a diaphragm or bellows, furnishes motion; which motion may be mechanically transmitted in proportion to the rise and fall of temperatures surrounding the diaphragm.

2. The *direct-expansion* type (Fig. 2) which operates by direct expansion and contraction of a substance which has a high coefficient of expansion such as hard rubber. The slight movement of the thermostatic element usually must be multiplied through a system of levers.

3. The *bi-metallic* type (Fig. 3 a, b, and c) which is actuated by means of two intimately attached metals having dissimilar coefficients of expansion. This type is inherently more sensitive to temperature changes than the diaphragm or direct expansion types, but lacks the necessary force to cause motion of the controlled equipment and must be used with compressed air, electric current or other source of power. The sensitive element may take any one of a number of forms, the most common being the straight strip, the circular strip, the spiral and the helix. Fig. 3-a shows the straight strip used in a compressed air thermostat, Fig. 3-b shows the spiral used in a mercury tube type of thermostat, and Fig. 3-c shows the curved strip used in an open contact thermostat.

Direct- and Indirect-Acting Thermostats

Thermostats may control directly, or indirectly, the equipment which regulates the supply of heat and are frequently classified on this basis as follows:

Direct-Acting or Self-Contained Thermostats. These instruments have sufficient power in themselves to actuate the controlling devices. They may be subdivided further into two groups: (1) those in which the sensitive element and the controlling device are in one body, the power from the thermostat being transmitted by a system of levers; and (2) those in which the sensitive element and the controlling device are separated, the power from the thermostat being transmitted through a capillary tube.

The expansion or volatilization of a fluid actuates a diaphragm which transmits its motion to a valve or damper. The small movement of the diaphragm may, if necessary, be multiplied and transmitted by mechanical means, such as a system of levers, or by liquid pressure in order to produce sufficient movement of the damper or valve. This thermostat is inherently intermediate acting since the expansion or volatilization of the fluid and the movement of the diaphragm are proportional to the change in temperature.

There are many types of thermostatic radiator valves which come in the first group.

In general they maintain some temperature at their location which bears a relation to the room temperature. Since these control devices are inherently intermediate acting, they should not be used on one-pipe systems because a partially closed valve will not allow the condensation to leave the radiator.

Fig. 4 shows the operation of a self-contained thermostat in connection with a hot water storage tank whereby the supply of steam to the tank is controlled directly by the temperature of the water in the tank. Fig. 5 shows the use of a self-contained thermostat on a hot water tank with vacuum return.

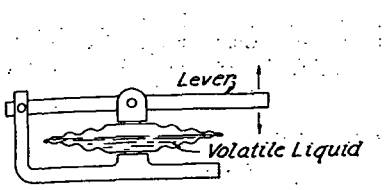


FIG. 1. DIAPHRAGM TYPE THERMOSTAT

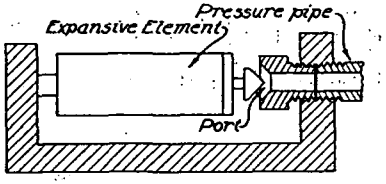
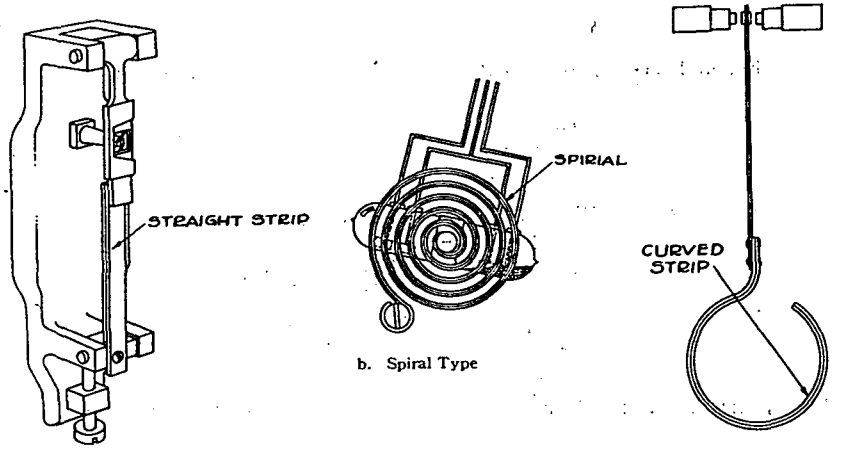


FIG. 2. DIRECT EXPANSION TYPE THERMOSTAT



a. Straight Strip Type

b. Spiral Type

c. Curved Strip Type

FIG. 3. THREE TYPES OF BI-METALLIC THERMOSTAT

Indirect-Acting Thermostats. These instruments do not have sufficient power to operate the controlling devices, but function to control the external source of power which in turn operates the valves and dampers. There are two distinct groups of these instruments, the *compressed air* and the *electric*.

Essentially the compressed air thermostat consists of a hole or leak port which is opened or closed by means of the thermostatic element. This port communicates with a diaphragm which in turn controls the supply of compressed air reaching the valve or damper operator. The instrument regulates the flow of the compressed air to and from the controlled devices. There are two classes of these instruments, one of which allows the air pressure to build up or be released instantly and is called the positive or snap-acting type; and the other which allows the compressed air to be maintained at any intermediate pressure, called the intermediate or gradual-acting type.