stat so as to turn heat on or off, when the desired temperature of 80 F, or any other predetermined surface temperature of the cylinder, decreases or increases as a result of changes in the Operative Temperature.

For testing work, the *globe thermometer* is a useful instrument. It consists of an ordinary mercury thermometer, with its bulb placed in the center of a sphere from 6 to 9 in. in diameter, usually made of thin copper, and painted black, and sometimes covered with cloth. The temperature recorded by a thermometer with its bulb in the center of the sphere is termed the *radiation-convection temperature*. See Chapter 49.

CONTROL OF PANEL AND RADIANT HEATING

The effectiveness of any type of control will depend largely on the time lag of the system. With warm air passing through floor ducts, the time lag

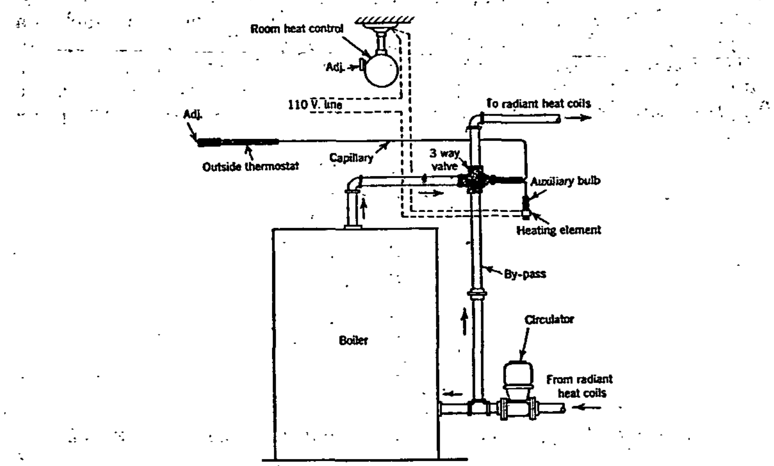

FIG. 11. TYPICAL PANEL AND RADIANT HEAT CONTROL SYSTEM

is usually too long for any kind of room thermostat; in fact a thermostat will not prove suitable with any system if the building is constructed with massive brickwork and masonry, unless it operates in conjunction with a time control responsive to changes in outside conditions.

The heat emitted by hot water pipes imbedded in the plaster of the ceiling and walls or in the concrete base of a floor, can be effectively controlled by an instrument designed to modulate the temperature of the water circulating in the system according to the outside conditions. Metal panels which can be installed in the ceiling or side walls, may be either controlled by an instrument responsive to outside weather conditions, or by a specially designed instrument responsive to both air temperature and radiation. Any purely *on or off* control system is not recommended for panel heating.

A typical control system operated from an outside thermostat and supplemented with a room heat control instrument, is illustrated in Fig. 11. The outside thermostat modulates the temperature of the circulating water in the coils by mixing some of the hot water leaving the boiler with a proportionate amount of return water which is diverted to the three-way valve.

One type of room instrument consists of a blackened copper sphere of 6

or 8 in. in diameter, in which a cylindrical sump contains a volatile liquid. A small electric heating coil creates in the sphere a vapor pressure which remains constant as long as the total heat loss from the sphere is at the desired rate. If the Operative Temperature becomes too high for comfort, a greater vapor pressure results from the smaller heat loss from the sphere. This acts on a diaphragm and reduces the supply of heat to the room. With too low an Operative Temperature, the reverse action occurs. A similar instrument, which has an electric heating element for warming the air inside the sphere and the thermostat-operated switch, is also used for controlling room conditions.

In addition to a thermostatically controlled device for modulating the temperature of the circulating water, it is advantageous to insert in each coil a locked flow control or adjustable resistance to give uniform conditions throughout all rooms. Owing to unforeseen difficulties with varying frictional losses in pipes, emission factor, and exposures, it is an advantage to be able to regulate permanently the flow through each circuit by means of a key operated valve as indicated in Fig. 4.

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