general, the temperature differences per foot of elevation, when using unit heaters are less than corresponding variations when using direct radiation[4]. High velocity units will maintain slightly lower temperature differences than low discharge velocity units. Correspondingly, units with lower discharge air temperature will maintain lower temperature differences than units with higher discharge temperatures. Directional control of the discharged air from a unit heater can be an important factor, added to qualities of reasonably good outlet velocity and outlet temperature, in effecting satisfactory distribution of heat and restraining floor-to-ceiling temperature difference.

When some *outside air* is introduced, the temperature of the mixture of outside and recirculating air must be calculated and used as the entering air temperature at the heater. Unit heaters connected in this manner perform the function of unit ventilators. For a discussion of this function see the section of this chapter entitled *Unit Ventilators*.

For recirculating heaters located *at the floor* or with *intakes at the floor*, the temperature of air entering the heater should be assumed to be the same as that to be maintained in the room itself.

### Automatic Control of Unit Heaters

Thermostatic control of unit heaters may be accomplished by starting and stopping the fan or by controlling the flow of heat to the heating element. If the fan is controlled, it is advisable to provide a thermostat on the return from the heater so as to prevent the fan from starting until the heating element is heated throughout.

Unit heaters may be used in the summer time as a means of circulating the air to give some measure of comfort due to air motion. In such cases the heating element should be shut off from the source of heat by closing the steam valve to the heating element, and also the return line thermostat should be provided with a by-pass switch, which upon being closed will permit the fan to be operated independently of the heating element.

### Location of Unit Heaters

Unit heaters should not be located in a corner or placed close to a wall, since the full effect of the unit will not be available under such conditions if the circulation of air is impeded. The best arrangement is to locate units so that they discharge air nearly parallel to exterior walls, and in a direction which will produce a rotational circulation around the room. This is preferable to directing the discharge against the outside walls.

Various types and makes of unit heaters are illustrated in the *Catalog Data Section* of this edition. As hot blasts of air in working zones are usually objectionable, heaters mounted on the floor should have their discharge outlets above the head line and suspended heaters should be placed in such manner and turned in such direction that the heated air stream will not be objectionable in the working zone. In the interest of economy, however, the elevation of the heater outlet and the direction of discharge should be so arranged that the heated air shall be brought as close above the head line as possible, yet not into the working zone.

In connection with the use of vertical type unit heaters, care must be exercised in the selection of the heater. It has been found that the higher the unit is placed above the floor, the lower must be the outlet temperature of the air leaving the heater in order that the heated air may be forced into the occupied zone.



### Determining Unit Heater Requirements

The formulas given in the section on Unit Ventilators may be used to determine unit heater capacity requirements.

## PIPING CONNECTIONS FOR STEAM UNIT HEATERS

Piping connections for steam unit heaters are similar to those for other types of fan blast heaters. The piping of unit heaters must conform strictly to the system requirements while at the same time permitting the heaters themselves to function as intended. The basic piping principles for steam systems are discussed in Chapter 23.

Rapid condensation of steam, especially during heating-up periods, is

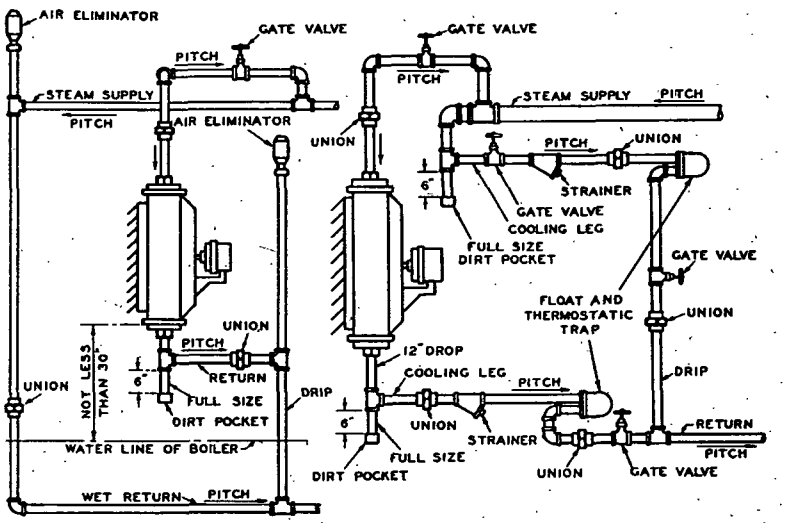


FIG. 5. UNIT HEATER CONNECTION TO ONE-PIPE GRAVITY STEAM SYSTEM




FIG. 6. UNIT HEATER CONNECTION FOR VACUUM OR VAPOR SYSTEM DISCHARGING CONDENSATION INTO DRY RETURN

characteristic of this type of equipment. The return piping must be planned to keep the heating coil free of rapid condensation, while the steam piping must be ample to carry a full supply of steam to the unit to take the place of that condensed. Adequate sizes of piping are especially essential where a unit heater fan is operated under start-and-stop control and where all or part of the air is taken from the outside. In such installations the condensation rate may vary rapidly and the necessity for ample pipe capacity is particularly important.

A method of connecting a unit heater to a one-pipe gravity system is illustrated in Fig. 5. In cases where the return main is located above the boiler water line, an artificial water line must be created by providing an equalizing loop to prevent steam passing into the return and thus into other units.

A piping arrangement where both the air and condensate pass through a common return to a boiler, with vent trap or condensate pump and