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.

Inlet, Outlet and Space Temperatures with Unit Heaters

In the selection of unit heaters for any particular design, consideration should be given to the temperature of air entering the heaters, as well as the temperature to be maintained in the working zone of the space. In 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 reducing floor-to-ceiling temperature difference.

Since the outlet temperature of air from a unit heater increases with the temperature of the heating medium, such as high pressure steam, heaters can be obtained with heating elements having less than the regular amount of heating surface in order to obtain, with the high temperature heating medium, approximately the same leaving air temperature as would be obtained from a lower temperature heating medium.

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 either by starting and stopping the fan, or by controlling the flow of the heating medium to the heating element. Unit heaters may be used in summer as a means of circulating 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. The thermostat should be provided with a by-pass switch which will permit the fan to be operated independently of the room temperature.

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 to function as intended. The basic piping principles for steam systems are discussed in Chapter 20.

Rapid condensation of steam, especially during heating-up periods, is characteristic of this type of equipment. The return piping must be planned to keep the heating coil free of rapid condensation, while the steam

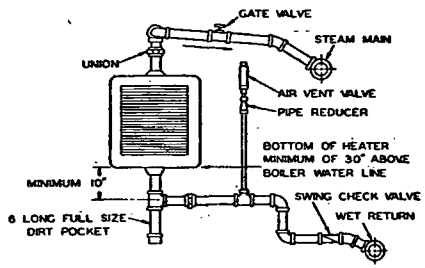

FIG. 5. UNIT HEATER CONNECTION TO LOW PRESSURE STEAM GRAVITY SYSTEM

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 important 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.

Piping connections for unit heaters as recommended by the *Industrial Unit Heater Association* are shown in Figs. 5 to 9.

In steam systems the branch from the supply main to the heater should pitch toward the main, and be connected to its top to prevent condensation in the main from draining through the heater where it might reduce capacity and cause noise.

The return piping from steam heaters should provide a minimum drop of 10 in. below the heater so that the head of water required to overcome resistances of check valves, traps, and strainers will not cause condensation to remain in the heater.

Dirt pockets shown in Figs. 5 to 7 are essential, and strainers are recommended as an additional means of retaining dirt and scale which might affect operation of check valves and traps. Return piping between the heater and strainer should be of the same size as the heater outlet. Strainers should always be installed in the steam supply line if the heater is equipped with the steam distributing type of coils.

An adequate air vent is required for closed low pressure gravity systems. The vertical pipe connection to the air vent should be at least $\frac{3}{4}$ in. I.P.S. to permit separation of the water from the air passing to the vent.

In vacuum systems, if thermostatic instead of float and thermostatic traps are used, a cooling leg must be provided ahead of the trap.

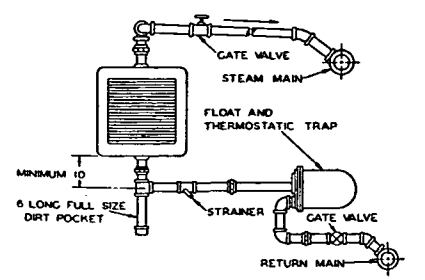

FIG. 6. UNIT HEATER CONNECTION FOR VACUUM OR VAPOR STEAM SYSTEM