speed of the fans, so that no specific percentage reduction can be assigned for all heaters at a given added resistance. The heat output to be expected under other than free delivery conditions should be secured from the manufacturer.

Location of Unit Heaters

Care should be taken in the location of unit heaters to insure free air circulation to the intake and proper heat distribution over the working level. Manufacturers' catalogs usually give suggestions for best arrangements of the various heaters. Types and makes of available heaters are shown in the Catalog Data Section of this volume.

Hot blasts in working zones should have their discharge outlets above the head line, and suspended heaters should be so adjusted that the heated air stream will not be objectionable.

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.

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

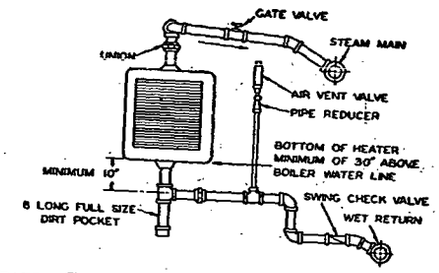


FIG. 5. UNIT HEATER CONNECTION TO LOW PRESSURE STEAM GRAVITY SYSTEM

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 21.

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 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

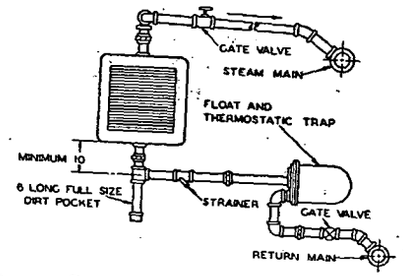


FIG. 6. UNIT HEATER CONNECTION FOR VACUUM OR VAPOR STEAM SYSTEM