have an element in the pilot flame which will automatically close the gas valve on pilot failure.

Oil-Fired. The oil-fired unit heater is usually equipped with a centrifugal fan, and can be obtained in sizes ranging from 125,000 to 1,650,000 Btu per hr output capacity in standard units. It is furnished in either the floor-mounted or in smaller sizes in the suspended type.

Stoker-Fired. The stoker-fired type of unit heater can be obtained in ranges of from 300,000 to 6,000,000 (or more) Btu per hr output capacity. Ratings are based upon delivered output at heater outlet.

Effect of Resistance Upon Capacity

Unit heaters are customarily rated as free delivery type units. If outside air intakes, air filters, or ducts on the discharge side are used with the unit, a reduction in air and heating capacity will result because of this added resistance. The percentage of this reduction in capacity will depend upon the characteristics of the heater, and on the type, design and speed of the fans, so that no specific percentage reduction can be assigned for all heaters at a given added resistance. In general, however, propeller fan type units will experience a larger reduction in capacity than housed centrifugal fan units for a given added resistance, and a given heater will have a larger reduction in capacity as the fan speed is lowered. The heat output to be expected under other than free delivery conditions should be secured from the manufacturer.

Determining Unit Heater Requirements

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

Location of Unit Heaters

Care should be taken in the location of unit heaters to insure free air circulation to the intake. 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 is 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.

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

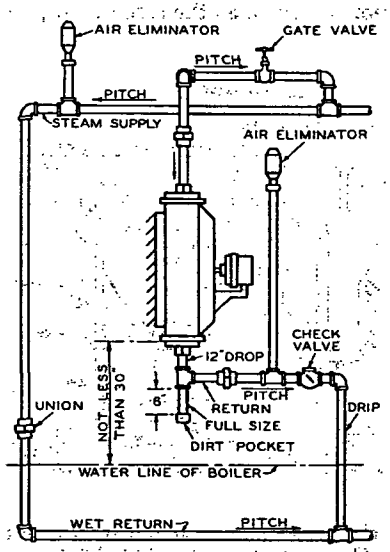

FIG. 5. UNIT HEATER CONNECTION TO ONE-PIPE GRAVITY STEAM SYSTEM

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. If the fan is controlled, it is advisable to