Fig. 41 illustrates another typical blast heater piping hook-up frequently encountered, but with which only the return ends have auxiliary air vents. It is to be noted that while the two super-imposed heaters may drain to a trap common to both, the successive layers of heaters with reference to the air flow from the fan should each have a separate trap, since the condensation rate varies in each successive layer after its predecessor has warmed the entering air.

Unit Heater Connections

When unit heaters are used with steam heating systems the designer must always take into consideration the great condensing capacity of these devices. They must be placed high enough above the boiler water line to compensate for the pressure drop or must be used with systems having pumps or other positive return devices, and must always have pipe connections proportional to their maximum heat emission. Some typical details of unit heater connections are shown in Chapter 35.

Equalizer Connection

Low pressures may be produced in the supply piping and in the boiler of any well-built vacuum heating system by means of the vacuum of condensation. This may prevent drainage of the heating units to the pump despite the efforts of the vacuum pump.

It is desirable, therefore, to install a cross-connection with a check valve between the supply main and the vacuum return main, which will:

1. Prevent such an induced vacuum in the supply main exceeding the vacuum in the return main, by opening a check valve to equalize the pressures in the two mains.
2. Allow a higher vacuum to be carried in the return main than in the supply main by keeping the check valve closed.

This device has solved many complaints, especially where oil or gas fuels are used.

IMPORTANCE OF LAYOUT

With the increasing use of automatic temperature control, the proper layout of the steam mains to secure even distribution of the steam to all the radiators is of importance. It is not sufficient that the pipes be properly designated to carry the maximum amount of steam. Steam heating systems are operated at their maximum capacity only for a fraction of the time and they should be designed to distribute evenly at reduced capacity. Almost any piping layout will give heat in sufficient quantities to all the radiators for zero weather if the pipes are large enough, but this is only one of the requirements; the system must be capable of operating efficiently at reduced capacities. Hence the importance of careful and intelligent arrangement of the steam mains.

Chapter 10

DEVICES FOR HANDLING CONDENSATE AND AIR

Weight of Condensate; Condensation Pumps; Vacuum Heating Pumps; Traps.

THIS chapter deals with certain proprietary devices used with steam heating systems. Other equipment and accessories for steam systems, such as boilers, radiators and piping are treated elsewhere in THE GUIDE. Information concerning specific products will be found in the Catalog Data Section. The *Hydraulic Society's Standards* give descriptions of pumps for various services, standard equipment and installation data.

In the selection of devices for handling condensate it is, of course, necessary to know the weight of condensate to be handled. For systems employing the use of direct radiators, the normal rate of flow is 0.25 lb of condensate per square foot of equivalent direct *radiation* (EDR) per hour. However, an allowance must be made for the increased rate of condensation during heating-up periods.

The rate of condensation per square foot per hour for a cast-iron column type radiator for the time elapsing after the steam is turned into the radiator is given by Fig. 2, Chapter 6. The maximum rate of condensation occurs about 10 minutes after steam is turned into the cold radiator and amounts to approximately 3½ times the normal rate. At the end of about 25 minutes the radiator reaches a normal rate of condensation. The average rate of condensation during the first 20 to 25 minutes as found by integrating the area under the curve and determining the mean ordinate is 0.50 lb per square foot per hour or twice the average rate. With pressed metal or pipe coil radiators the condensation rate would be somewhat less due to the fact that the weight of metal being heated is less per square foot than with the cast-iron types.

The normal weight of condensate to be handled from indirect or central fan systems may be estimated by means of the following formula:

$$W = \frac{Q \times 60 \times T}{55.6 \times h_{fg}} \qquad (1)$$

where

W = weight of condensate, pounds per hour.
Q = volume of air, cubic feet per minute.
T = temperature rise of air, degrees Fahrenheit.
h_{fg} = latent heat of steam in the system, Btu per pound.