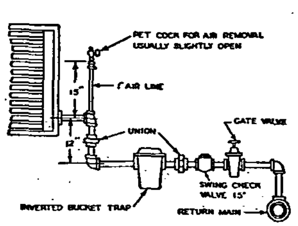

Fig. 61 .... Typical Return Connections to Finned-Tube Blast Heaters with High-Pressure Steam

shown in Fig. 53. Where the vertical distance is limited and the runouts must run above the floor, the radiator may be set on pedestals or raised by means of high legs. A method of connecting a unit heater to a one-pipe steam heating system is illustrated in Fig. 2.

Typical two-pipe radiator connections are shown in Figs. 54 and 55. While these show top inlet supply connections which are preferred, it is also possible to connect the supply to the bottom of the radiator. Short radiators may be connected with top supply and bottom return on the same end.

A typical method of connecting convectors is shown in Fig. 56. Sometimes the supply valve is omitted on convector connections, and a damper is supplied in the outlet grille for heat control.

A typical connection for finned pipe convectors is shown in Fig. 57.

Typical connections to blast heaters are shown in Figs. 58, 59 and 60. Some precautions which should be noted with regard to connections for blast heaters are:

1. Steam mains should not be dripped into heater sections.
2. If it is necessary to keep the heater in service at all times, a bypass with globe or plug-type valve should be installed around the automatic regulating valve.
3. A strainer should be provided on the steam supply side of a regulating valve.
4. The sizing of regulating valves should be based on the steam load and not on the heater supply connection.
5. Each heater or bank of heaters installed in series should have a separate trap.
6. Return piping from heater to trap should be of the same size as the heater outlet connection.
7. Return piping should not be run to an overhead main which is above the heater return connection, or into mains under pressure which contain modulating or on-off steam control valves. A pump and receiver, or boiler return trap, should be installed between the heater condensate trap and the overhead main or return main under pressure.
8. Steam piping and heater sections should be supported independently.

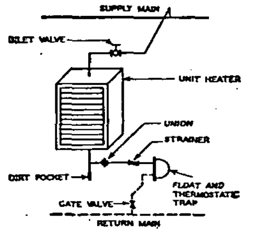

Fig. 62 .... Typical Unit Heater Connections for Two-Pipe System

Fig. 61 shows a typical return end connection for blast heaters connected to high-pressure systems.

A typical two-pipe connection to a unit heater is indicated in Fig. 62.

MANUAL VALVES

Gate valves are recommended in all cases where service demands that the valve be either entirely open or entirely closed, but they should never be used for throttling. Angle globe valves and straight globe valves should be used for throttling in such cases as bypasses around pressure-reducing valves or on bypasses around traps.

For information on automatic controls see Chapter 13 of the 1961 Guide And Data Book.

REFERENCES

[1] F. C. Houghten and J. L. Blackshaw: ASHVE Research Report No. 954—Condensate and air return in steam heating systems (ASHVE Transactions, Vol. 39, 1933, p. 199).

[2] Reducing and relief valves on consumers' premises (*American Standard Code for Pressure Piping*, ASA B31.1-1955, p. 66).

[3] *American Standard Code for Pressure Piping* (ASA B31.1-1955, p. 66).

[4] N. H. Davidson: Economies effected by combination pressure and temperature control valve (*National District Heating Association Proceedings*, 1956).

[5] *ASHVE Standard Code for Testing and Rating Return Line Low Vacuum Heating Pumps* (ASHVE Transactions, Vol. 40, 1934, p. 33).

CHAPTER 7

DISTRICT HEATING

Steam Requirements, Boiler Plants, Steam Distribution, Design Considerations, Distribution Pressures, Pipe Sizes, Conduits for Piping, Manholes and Tunnels, Accessory Equipment, Insulation, Return of Condensate, Building Piping and Equipment, Metering, Hot Water Distribution

THE term *district heating* refers to the supplying of heat from a central plant to a group of buildings in a city, institution, housing development, or industrial or commercial area. The heat may be used for any applicable purpose such as space heating, air conditioning, or processing. It is usually preferable that groups of commercial, industrial, or institutional buildings be supplied with heat from a central plant rather than from individual plants in order to permit design for better combustion efficiency with less expensive fuel, and reduction of labor per unit of output. The central plant justifies use of more competent personnel, and often decreases the investment required.

Those phases of district heating which frequently fall within the province of the heating engineer are treated here, and information is given for solving incidental problems. Some data are included with reference to special requirements for steam piping in buildings served with district steam. The data are confined principally to the use of steam as the heating medium, but the use of hot water has gained some recognition in recent years.[1]

In the design of a district heating system to provide public utility service in a city, it is advantageous to make a thorough study of the entire problem with competent men having experience in design and operation of such systems.

STEAM REQUIREMENTS

The first step in the design of a district heating system is to determine the maximum hourly and the annual steam requirements of each of the buildings to be supplied. Methods of determining the maximum *hourly* requirements will be found for space heating in Chapter 25 of the 1961 Guide And Data Book, for building service-water heating in Chapter 76, and for various process applications in Table 1.[2] Measured demands of several types of buildings are given in Table 9, Chapter 12.

Methods of estimating *annual* steam requirements for heating various types of buildings are also given in Chapter 12. Table 7 in Chapter 12 lists the average annual steam consumption per degree-day for buildings located in all sections of the United States. Annual steam requirements for building service-water heating are given in Table 2 of this chapter. Additional data on annual steam requirements, including those for process uses and air conditioning, of various types of buildings in a number of cities may be found in the *District Heating Handbook*, Third Edition.[2]

BOILER PLANTS

In the design of a plant for district heating, consideration should be given to the following factors:

1. *Annual load factor.* This factor is the ratio of the average hourly plant send-out (defined as rate of flow to the distribution system) to the maximum hourly send-out, which is a direct measure of the extent to which investment in facilities is used. It is often employed to determine savings by equipment offering higher efficiency. The load factor for space heating is usually between 15 and 30 percent. For space heating plus additional steam requirements such as water heating, cooking, or laundry, it is between 15 and 40 percent. Where process requirements predominate, as in factories, load factors are sometimes 50 percent or more. Load factors for various types of buildings are given in Table 9, Chapter 12.

2. *Duration of plant output.* The cumulative number of hours for the various plant send-outs and the predicted peak boiler demand on the coldest day are used in conjunction to determine the number and sizes of boilers, in order to effect most efficient loading of individual units and the plant as a whole. The cumulative number of hours a typical district heating plant will send out steam at various plant outputs, with outputs expressed in percentage of maximum hourly rate, is given in Table 3. *It will be noted that the duration of plant output for the higher send-outs is very low.*

3. *Feed-water treatment.* Good feed-water treatment is an absolute necessity in a plant in order to be able to operate the boilers at maximum outputs. Dirty tubes will limit boiler capacity. Proper feed-water treatment will prevent corrosion and scale formation and keep boiler outage to a minimum.

4. *Smoke abatement.* This is a modern requirement. The installation of suitable fuel-burning and dust-collecting equipment to limit the emission of smoke and fly ash is usually necessary.

5. *Plant location.* A boiler plant location is determined by an economic study of fuel handling, water supply, system piping, land costs, and other associated factors. Such a study usually reveals that the economical location of the plant will be near the distribution center, in order to simplify and shorten the distribution piping. Plant location and the local air pollution ordinances will have a direct bearing on the type of firing equipment selected and the dust collection apparatus required.

STEAM DISTRIBUTION

Distribution piping in district heating systems must be designed in accordance with the same basic principles applying to any other steam piping. The piping may be run through buildings, through the air on poles or other structures, or underground in conduits or tunnels. Local conditions and investment will be governing factors in establishing the route of the pipes.

Design Considerations

Important points in laying out distribution piping are:

1. Piping within buildings or basements is normally least expensive to install and to maintain.
2. Underground installations involve excavation which represents a substantial portion of the total cost. The depth of such excavations should be kept to a minimum after due consideration has been given to the possible damaging effect of the operating-line heat on lawns and shrubbery and the possible damage to the underground structure due to heavy traffic, etc.
3. Walking tunnels usually are not provided for steam mains in the district heating industry because of their relatively high first cost as compared with smaller conduits unless they are required to accommodate miscellaneous other services or to provide underground passage between buildings.
4. Overhead piping on poles or structures is generally less expensive than underground lines, especially in some institutional and industrial areas and may be a means of eliminating buried conduit in areas where underground installations would