Solution. If the total *fh* is to be about 15 ft, the unit *fh* must be about 150 milinches per foot. With this preliminary estimate, pipe sizes may be selected from Fig. 3 and recorded with corresponding calculations as shown in Table 7 for Circuit 8, from which it appears that the *fh* of this circuit is 188,570 milinches, or 15.7 ft.

In order that each of the eight air conditioning units may receive an equal supply of water, the *fh* of each of the remaining circuits must also be 15.7 ft. Since all pipe sizes have been selected as shown in Example 6, any adjustments that may be necessary must be made in the connections from the main through the air conditioning unit and back to the main. For Circuit 8 the friction head through the air conditioning unit was assumed to be 20,000 milinches. For Circuit 4, for example, a tabular calculation like

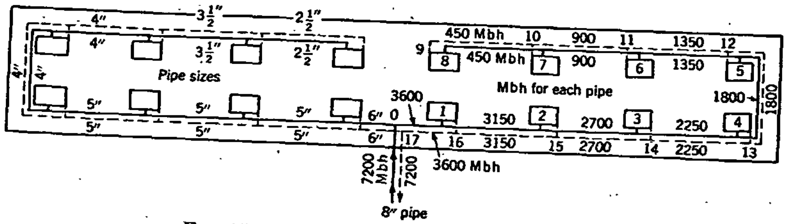

FIG. 15. TWO-PIPE DIRECT RETURN SYSTEM

that for Circuit 8 shows that the *fh* for Section 4-12 must be 19,700 milinches in order that the total *fh* may be 15.7.

This is practically equal to the 20,000 *fh* assumed for Circuit 8 and this shows how simple it is to secure well-balanced circuits in a reversed return system.

Example 8. The direct return, forced circulation system shown in Fig. 15 is similar to Fig. 14, except that the water passing through Unit 1 returns directly to the boiler and the total length of this circuit is about 130 ft, whereas, the total length of Circuit 8 is about 1990 ft, or about 15 times as long.

Solution. The design must begin with Circuit 8. The calculations for this circuit if tabulated as shown for Circuit 8 of Fig. 14 will show that the total *fh* is 318,200 milinches, or 26.5 ft, as compared with 15.7 ft for the reversed return system.

In order that each of the eight units will receive its correct share of the water, the *fh* of each of the other seven circuits must also be 26.5 ft. For Circuit 1, for example, the total *fh* for Section 0-1 and 16-17 is 15,600 milinches; hence, the *fh* in Section 1-16 (through the air conditioning unit) must be 302,600 milinches, or 25.15 ft to prevent Unit 1 having an advantage over Unit 8.

Comparing the reversed return system of Fig. 14 with the direct return system of Fig. 15, it appears that the head against which the pump must deliver the 720 gpm is 15.7 ft as compared with 26.5 ft for the direct return and that the installation of the reversed return would require 130 ft of 8 in. pipe not necessary for the direct return system. The *fh* in the lines joining the pump to the pipe system shown in Figs. 14 and 15 is not included in this calculation.

CHAPTER 17

Pipe, Fittings, Welding

Pipe Material, Types of Pipe Used, Dimensions of Pipe Commercially Available, Expansion and Flexibility of Pipe, Pipe Threads and Hangers, Types of Fittings, Welding as Applied to Erection of Piping, Valves, Corrosion of Piping

IMPORTANT considerations in the selection and installation of pipe and fittings for heating, ventilating, and air conditioning work are dealt with in this chapter.

PIPE MATERIALS

Use of corrosion-resistant materials for pipe, including special alloy steels and irons, wrought-iron, copper and brass, has increased considerably during the past few years. The recent development of copper, brass, and bronze fittings which can be assembled by soldering or sweating permits the use of thin-wall pipe and thereby has reduced the initial cost of such installation. The following brief discussion indicates the variety of pipe materials and the types of pipe available.

Wrought-Steel Pipe. Because of its low price, the great bulk of wrought pipe used for heating and ventilating work at the present time is of wrought steel. The material used for steel pipe is a mild steel made by the acid-bessemer, the open-hearth, or the electric-furnace process. Ordinary wrought-steel pipe is made either by shaping sheets of metal into cylindrical form and welding the edges together, or by forming or drawing from a solid billet. The former is known as *welded pipe*, the latter as *seamless pipe.*

Many types of welded pipe are available, although the smaller sizes most frequently used in heating and ventilating work are made by the lap-weld, resistance-weld, or butt-weld process. While the lap-weld and resistance-weld processes produce a better weld than the butt type, lap-weld and resistance-weld pipe are seldom manufactured in nominal pipe sizes less than 2 in. Seamless pipe can be obtained in the small sizes at a somewhat higher cost.

Seamless steel pipe is frequently used for high pressure work or where pipe is desired for close coiling, cold bending, or other forming operation. Its advantages are its somewhat greater strength which permits use of a