will support the return condensation. Dry returns may also be those returns which have protective devices for preventing water from backing up in them if excessive boiler pressure is generated.

Wet returns shall be defined as those returns which are below the level of the water line in the boiler or below an elevation at which the boiler will support the return condensation.

Down-feed or *overhead systems* shall be defined as those in which the supply mains are above the level of the heat-emitting units which they serve.

Up-feed systems shall be defined as those in which the supply mains are below the level of the heat-emitting units which they serve.

One-pipe systems shall be defined as those in which there is but one connection to each radiator which must answer for both supply and return.

Two-pipe systems shall be defined as those in which one pipe is used for the supply of steam to the radiator and another for the return of condensation.

One-pipe supply risers are those which carry steam upward to the radiator and which also carry the condensation from the radiator flowing in a direction opposite to the steam flow.

Down-feed one-pipe risers are those which carry steam and the condensation from the radiator, in the same direction.

Two-pipe supply risers are those which carry steam to the radiator but which do not carry the condensation from the radiator, the condensation returning through a separate return pipe or riser.

STEAM DISTRIBUTION

The piping for steam distribution will be divided into two classes: (1) transmission mains; (2) service piping.

Transmission mains are defined as those that convey steam for a considerable distance either through or between buildings such as in district heating plants. In this type the steam is usually generated and transmitted to the building under high pressure. The velocities of flow used in the transmission mains are limited by the available or allowable drop in pressure.

Service piping is defined as that which conveys the steam and condensate in the building, starting either at the boiler or other source of supply and comprising the mains, branches, risers, run outs and return piping. This part of the system usually is low pressure and the pipe sizes are larger than for the distributing piping, as the velocity of the steam is lower and the available or allowable drop in pressure is small. See Tables 9 to 16 for the service pipe sizes for various systems.

The principal factors upon which the determination of pipe sizes for steam heating depends, are:

1. The equivalent length of the run from the boiler, or source of steam supply, to the farthest heating unit.

2. The total pressure drop, which may be allowed, between the source of supply and the end of the return system.

3. The maximum velocity of steam allowable for quiet and dependable operation of the system.

4. Unusual conditions in the building to be heated.

Length of Run

The length of run must not only include the actual linear feet of straight pipe, but also the proper allowance for fittings, valves and other items which cause drop in pressure.

Pressure Drop

Theoretically there are several factors to be considered such as initial pressure and the pressure required at the end of the line, but it is most important that (1) the total pressure drop does not exceed the initial pressure of the system; (2) that the pressure drop is not so great as to cause high velocities and in the case of counter-flowing condensate to cause water hammer; (3) that there is a constant initial pressure; (4) that there is sufficient difference in level between the water line of the boiler and the lowest point of the steam main, dry return and heating units.

It is recommended that all systems be designed for low initial pressure and a reasonably small pressure drop. Such systems will operate under higher pressures without difficulty. When a system is designed for high pressure with a relatively large pressure drop and then operated at a low pressure, it is apt to be noisy and to have poor circulation.

It is recommended that the total pressure drop never exceed one-half of the initial pressure. This applies to cases where the condensate is flowing in the same direction as the steam, but in the case of counter-flowing condensate the capacities should not exceed those shown in Tables 5 and 6.

Maximum Velocity

The capacity of pipe of a given size in any part of a steam or vapor heating system depends upon the quantity of condensation present, as well as upon the available pressure drop in the pipe. Where no water is present or where a limited quantity flows by gravity in the same direction as the steam the available pressure drop only need be considered.

Where water and steam flow counter to each other the velocity of the steam must not exceed certain values above which disturbance between the counter-flowing steam and water may produce objectionable sounds, water hammer, or may retain water in some parts of the system until pressure goes off. The velocity at which such disturbance takes place depends upon the size of the pipe, its position (whether vertical or horizontal), its pitch and the quantity of water flowing counter to the steam.

Unusual Conditions

Under this heading are the character and class of the building, the periodicity of use, the temperature required and the time in which it is to be attained at the beginning of each period.

In public buildings, schools, offices, stores and such buildings (where the occupants are normally at rest), the building should be heated to or near its required temperature at all times. In places of assemblage such