

systems, the static pressure must also exceed the operating pressure of the boiler. The pressure drop caused by condensing rate of the radiation is especially important during those portions of the operating periods where changing pressure conditions prevail, as for example, when the system is being initially filled with steam. In systems where the condensate is wasted to the sewer no water line difference is required as is the case with closed systems. However, the waste of condensate may introduce conditions which warrant the use of an appropriate mechanical system. Whenever the conditions of a heating system are such that the returns from the radiation cannot gravitate to the boiler they must be returned by some mechanical means.

In *mechanical systems* the condensate flows to a receiver by gravity and is then forced into the boiler against its pressure. In all instances the

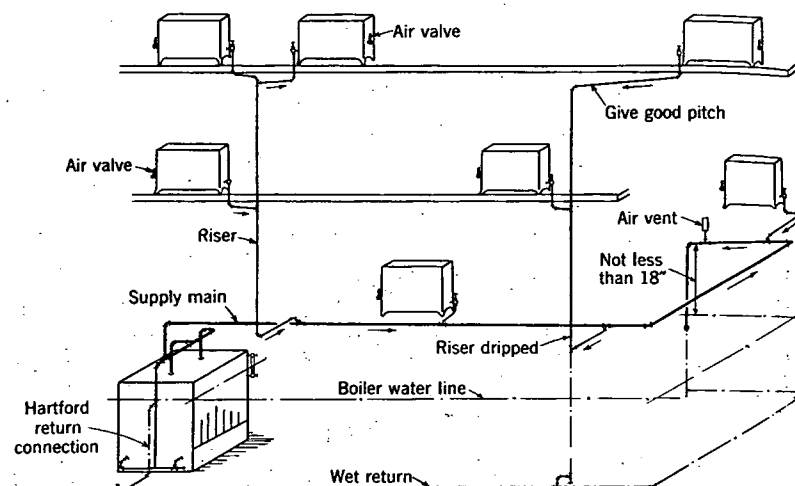


FIG. 1. TYPICAL UP-FEED GRAVITY ONE-PIPE AIR-VENT SYSTEM

preferable practice is to provide for gravity flow even where a vacuum pump is used. The lowest parts of the supply side of the system must be kept sufficiently above the water line of the receiver to insure adequate drainage of water from the system, and as long as this condition is obtained, the relative elevation of the boiler water line is unimportant.

There are three general types of mechanical return devices in common use, namely, (1) the mechanical return trap, (2) the condensation return pump, and (3) the vacuum return line pump.

GRAVITY ONE-PIPE AIR-VENT SYSTEM

This system is the most common of all methods of steam heating, especially for small size installations, due largely to its low cost and simplicity. With larger sized systems the cost of one-pipe systems may

be greater than what are regarded as more expensive systems because of the increased cost of labor and materials for the relatively larger pipe sizes required. As seen by Fig. 1, the steam piping rises to a point as high as possible, at the boiler, and pitches downward from this location until the far end of the main is reached. At the low points and the far ends, drips are taken off and sealed below the water line before being connected to other drips and brought back to the boiler through a wet return. The radiators are supplied with steam by risers branched off the main or mains, the steam passing up the riser and the condensation flowing down it. In the riser, steam and condensation flow in opposite directions, but after the condensation enters the steam main it flows in the same direction as the steam and is removed from the main through the drip. Short mains are sometimes arranged for the condensate to flow in a direction opposite the steam by sizing them so the critical velocity is not exceeded. In buildings of several stories it is customary to drip the heel of each riser to avoid counter-flow of the steam and condensate in the riser spring piece so as to improve steam circulation, but in buildings of one or two stories

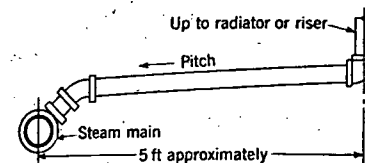


FIG. 2. TYPICAL STEAM RUNOUT WHERE RISERS ARE NOT DRIPPED

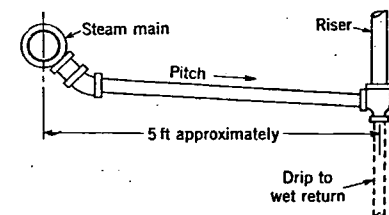


FIG. 3. TYPICAL STEAM RUNOUT WHERE RISERS ARE DRIPPED

the condensate is carried back into the steam main instead of being emptied into the wet return through a riser drip. Both types of risers are shown in Fig. 1.

Horizontal branches to radiators and risers should be pitched not less than $\frac{1}{2}$ in. per foot downward toward the riser or vertical pipe. Horizontal branches from steam mains should be graded at least this amount toward the main, except where the heel of the riser is dripped. Where the heel of the riser is dripped the direction of pitch should be toward the riser drip. (Figs. 2 and 3). Drips carried above the boiler water line or overhead should grade toward the boiler. They must be water sealed before being connected to another dry drip. Wet drips should preferably pitch toward the boiler so they may be completely drained if the building is to be left unoccupied in freezing weather. Wet returns or drips need not be pitched toward the boiler to maintain steam circulation and may be pitched in the opposite direction. In any case provision for drainage is important.

As the one-pipe system is relatively sluggish because of the slowness with which air is released from the system, provision should be made to promote it by providing air vents at the ends and at intermediate points where the steam main is brought to a higher elevation. Venting at drip point of mains is especially important. It is desirable to install the air-vent valves about a foot ahead of the drips, as indicated in Fig. 1, to