Each heating unit in a vapor system, as in all two-pipe systems, is provided with a graduated or modulating valve which permits the control of heat in the radiator by varying the opening of the valve.

Two-Pipe Vacuum Systems

Vacuum systems operate under conditions of both low pressure and vacuum, but employ the use of a vacuum pump to insure maintenance of sub-atmospheric pressures in the return piping for all operating conditions. The system may operate transiently with sub-atmospheric pressure in the supply piping during the time the rate of steam generation is equivalent to or less than the total connected load.

A typical two-pipe up-feed vacuum system is illustrated in Fig. 14, and a down-feed arrangement in Fig. 15.

The return risers are connected in the basement into a common return main which slopes downward toward the vacuum pump. The vacuum

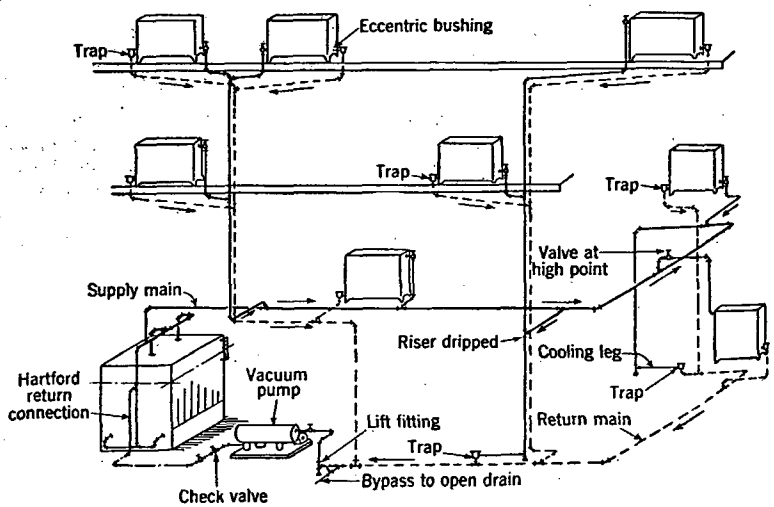

FIG. 14. TYPICAL UP-FEED VACUUM PUMP SYSTEM

pump withdraws the air and water from the system, separates the air from the water and expels it to atmosphere, and pumps the water back to the boiler or other receiver, which may be a feed-water heater or hot well. It is essential that no connection be made from the supply side to the return side at any point except through a trap. The desirable practice demands a return flowing to the vacuum pump by an uninterrupted downward slope. In some instances local conditions make it necessary to drop the return below the level of the vacuum pump inlet before the pump can be reached. In such an event one of the advantages of the vacuum system is the ability to raise the condensate to a considerable height, by the suction of the vacuum pump, by means of a lift connection or fitting inserted in the return. The height the condensate can be raised depends on the amount of vacuum maintained. It is preferable to limit lift connections to a single lift at the vacuum pump. A still more preferable arrangement is the use of an accumulator tank, or receiver tank, with a

float control for the pump at the low point of the return main, located adjacent to the vacuum pump.

When the vertical lift is considerable, several lift fittings should be used in steps as shown in Fig. 16. This permits a given lift to be secured with a somewhat lower vacuum than where the vertical distance is served by a single lift. Where several lifts are present in a given system at different locations, the lifting cannot occur until the entire system is filled with steam. A lift connection for location close to the pump, where the size may be above the commercial stock sizes, is shown in Fig. 17. It is desirable that means be provided for manually draining the low point of the lift fittings to eliminate danger of freezing.

TWO-PIPE SUB-ATMOSPHERIC SYSTEMS

Sub-atmospheric systems are similar to vacuum systems but, in contrast, provide control of building temperature by variation of the heat

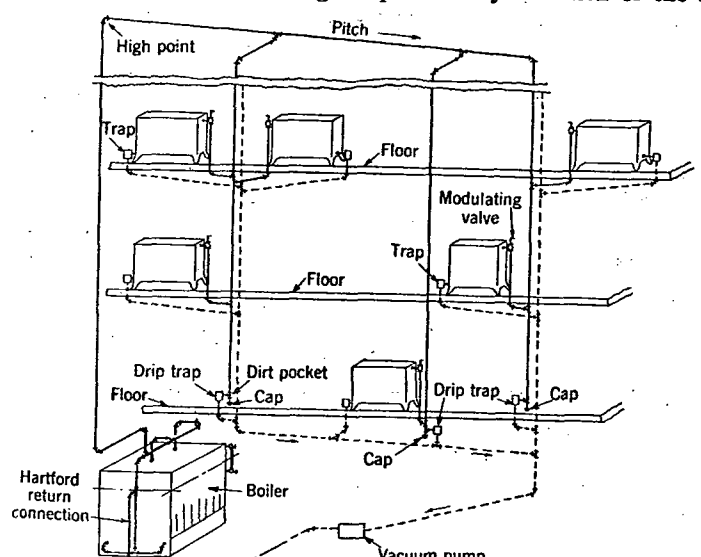

FIG. 15. TYPICAL DOWN-FEED VACUUM SYSTEM

output from the radiators. The radiator heat emission is controlled by varying the pressure, temperature and specific volume of steam in circulation. These systems differ from the ordinary vacuum system in that they maintain a controllable partial vacuum on both the supply and return sides of the system, instead of only on the return side. In the vacuum system, steam pressure above that of the atmosphere exists in the supply mains and radiators practically at all times. In the sub-atmospheric system, atmospheric pressure or higher exists in the steam supply piping and radiators only during severe weather. Under average winter temperature the steam is under partial vacuum which in mild weather may reach as high as 25 in. Hg, after which further reduction in heat output is obtained by restricting the quantity of steam.

The rate of steam supply is controlled by a valve in the steam main or by thermostatically controlling the rate of steam production in the boiler.