

vacuum system is illustrated. The supply main slopes down in the direction of flow; the runouts pitch down toward the riser if the riser is dripped (Fig. 3) or up toward the riser if the riser is not dripped (Fig. 2); both conditions are indicated in Fig. 14. The matter of dripping the risers depends largely on the height of the riser and the judgment of the designer. Ordinarily risers less than three stories high are not dripped and those more than four stories high are dripped, but there is no set rule for this. When risers are dripped the runouts from the steam main may be taken from the bottom if desired and each runout then serves as a drip for the main.

The risers are carried up to the highest radiator connection and are connected to the radiator through runouts sloping back toward the riser. The radiators usually have graduated valves on the supply end, although this is not absolutely necessary. Angle-globe valves and gate valves may be used where graduated manual control is not desirable. The return valves must be of the thermostatic type which will pass air and water but which will close against the passage of steam.

The return risers are connected in the basement into a common return line, which slopes downward toward the vacuum pump. The vacuum pump discharges the air from the system and pumps the water back to the boiler, or other receiver, which may be a feed-water tank or a hot well. It is essential on these systems that no connection from the supply side to the return side be made at any point except through a trap.

While the best practice demands a return flowing to the vacuum pump in an uninterrupted downward slope, in some cases limitations make it necessary to drop the return below the level of the vacuum pump inlet before the pump can be reached. In such event one of the advantages of the vacuum system is that the return can be raised by the suction of the vacuum pump to a considerable height, depending on the amount of vacuum maintained, by means of a lift fitting inserted in the return. Best practice dictates that the lift should be limited to a single lift connection at the entrance to the vacuum pump and that lifts scattered throughout the system be avoided. When the lift is considerable, several lift fittings are used in steps (Fig. 15), more successful operation being obtained by this method than when the lift is made in one step. If the lift occurs close to the vacuum pump, a special arrangement is used as shown in Fig. 16. It is desirable that means be provided for draining manually the low points of the lift fittings to eliminate from the return piping all water in danger of freezing in case the system is shut down for a considerable length of time.

Down-Feed Vacuum System

The piping arrangement for the down-feed vacuum system is similar on the supply side to the down-feed vapor system in that it has similar runouts, radiator valves, drips on the bottom of the steam drops, and enlargement of the drops for the lower radiator connections. The return side of the system is exactly the same as the up-feed system except that the steam riser drips at the bottom are connected into the return line through thermostatic traps. It is preferable to take the runouts for the risers from the bottom or at a 45-deg angle down from the steam main (Fig. 6) so that they may serve as steam main drips. When this is done

it is practical to run the steam main level if a runout is located at every change in pipe size, or if eccentric fittings are used (Fig. 17). A slight pitch in the steam main, however, should be used when possible. An overhead vacuum down-feed system is shown diagrammatically in Fig. 18.

SUB-ATMOSPHERIC SYSTEMS

Sub-atmospheric systems are similar to vacuum systems, but in contrast provide temperature control by variation of the heat output from the radiators both by varying the pressure at which steam is circulated in the radiation and the amount of steam. The steam supply is continuous

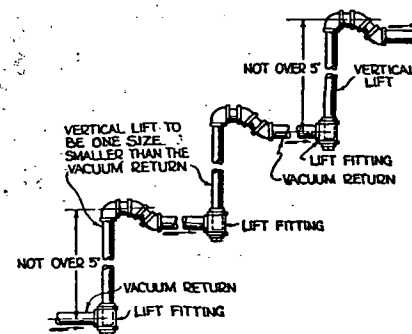


FIG. 15. METHOD OF MAKING LIFTS ON VACUUM SYSTEMS WHEN DISTANCE IS OVER 5 FT

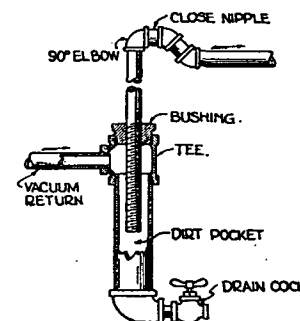


FIG. 16. DETAIL OF MAIN RETURN LIFT AT VACUUM PUMP



FIG. 17. METHOD OF CHANGING SIZE OF STEAM MAIN WHEN RUNOUTS ARE TAKEN FROM TOP

at varying rates. A vacuum pump capable of operating at high partial vacua is preferable since the higher the vacuum the greater is the accuracy in the distribution of steam through the system, particularly in mild weather. A pump capable of producing up to 25 in. of vacuum on the system is used in such cases. A controller is placed on the pump so that the vacuum or absolute pressure carried in the returns can be maintained at a certain amount below that existing in the line to insure circulation.

The traps are designed to operate in high vacuum. It is apparent that this system differs from the ordinary vacuum system by having a vacuum on both sides of the system, instead of only on the return side, in order to secure control of the heat emission from the radiators and thus to control the temperature in the building. These systems permit the heat output from the steam mains and risers to be diminished as the weather becomes milder, thus giving control to this portion of a heating system. The system can be operated in the same manner as the ordinary vacuum system when desired.