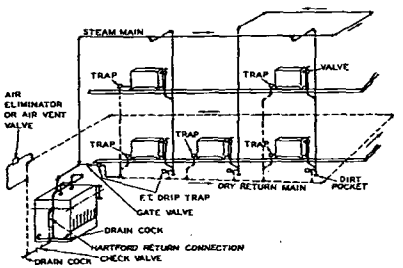


Note: When an air eliminator or vent valve is used on a vapor system, the boiler pressure must not exceed the static head necessary for the return by gravity of the condensate.

Fig. 12 .... Typical Down-Feed Two-Pipe System

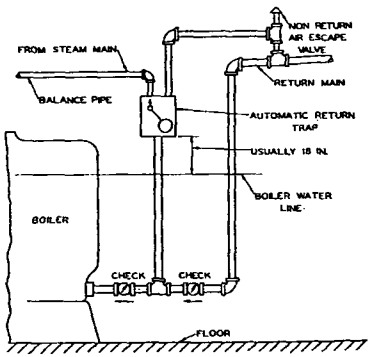


Fig. 14 .... Typical Connections for Automatic Return Trap

with unit heaters or large built-up fan units, or in which high-pressure steam is required for process work.

Fig. 9 illustrates a typical high-pressure system. Because of the high pressures and the great differential between steam and return mains, it is possible to locate returns above the heating units and lift the condensate to these returns.

The condensate can be flashed into steam in low-pressure mains if any are available, or passed through an economizer heater before being discharged to a vented receiver. It is, of course, necessary to provide for the elimination of air from high-pressure systems, just as in low-pressure systems.

Return traps used on high-pressure systems are usually of the bucket, inverted-bucket, float, or impulse type. They are described in a later section Steam Traps.

Two-Pipe Low-Pressure Systems

Low-pressure systems operate at pressures of 0 to 15 psig. The piping arrangement of both up-feed and down-feed low-pressure systems is identical with those of two-pipe vapor systems described in the following section. The only difference between the two systems is in the type of air valve used. The air valves used in low-pressure systems usually do not contain the check discs and hence, the system cannot operate under a vacuum. The low-pressure systems are not as popular as the vapor systems, because they have the disadvantage of not holding heat when the rate of steam generation is diminishing. They also have the disadvantage of corroding to a greater extent than vapor systems, due to the continued presence of new air in the system.

Low-pressure systems have the advantage, however, of returning condensate to the boiler readily and not retaining it in the piping, as may be possible in vapor systems when the system pressure exceeds the static head provided for the gravity return at the boiler. Fig. 10 illustrates the conversion of a conventional gravity return system to a typical low-pressure system with a condensation pump. A check valve and a gate valve must always be installed between the pump discharge and the boiler. A check valve on the receiver vent will prevent the backflow of air when the system is cooling down.

Two-Pipe Vapor Systems

Two-pipe vapor systems operate at pressures varying from 20-in. vacuum or more (depending upon the tightness with which the system is assembled) to 15 psig without the use of a vacuum pump. A typical two-pipe up-feed vapor system is shown in Fig. 11, and a typical two-pipe down-feed system is illustrated in Fig. 12. The method of dripping drop

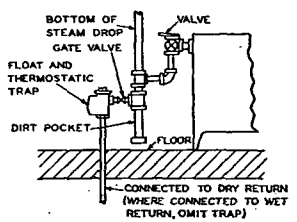


Fig. 13 .... Detail of Drip Connections at Bottom of Down-Feed Steam Drop

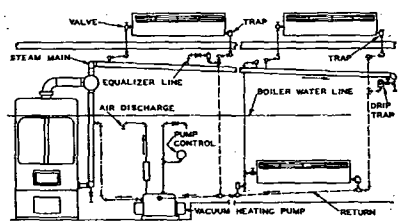


Fig. 15 .... Typical Two-Pipe Vacuum Pump System

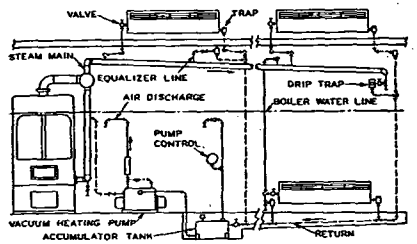


Fig. 16 .... Accumulator Tank Installation in Typical Two-Pipe Vacuum Pump System

risers in a down-feed system is illustrated in Fig. 13. Radiators discharge their condensate and air through thermostatic traps to the dry-return main. Air is eliminated, when the system is under pressure, at the ends of the supply and return mains just before they drop to the wet return. The vent valves are of the float rather than float and thermostatic type since there should be no steam in the return main as long as the thermostatic traps on the radiators or convectors are operating properly. The float element of the valve closes the valve when, due to pressure differences, water rises to the point of overflow in the main. The vent valves are also provided with a small check disc which closes to prevent the inflow of air to the system when the pressure drops below atmospheric pressure. This enables the system to operate under vacuum conditions at lower steam temperatures for a period of four to eight hours, depending on the tightness of the system.

Vapor systems may also be provided with an automatic return trap or alternating receiver which automatically returns condensate to the boiler when the boiler is steaming under pressure conditions which would prevent the return of condensate by gravity. The typical connections for an automatic return trap are illustrated in Fig. 14. The two check valves are necessary for its successful operation.

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.

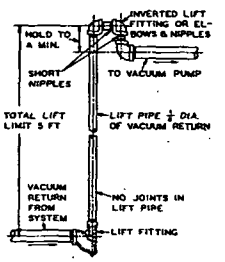
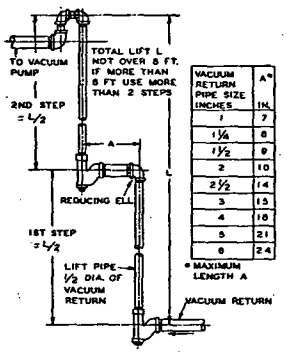


Fig. 17 .... Method of Constructing a Lift in a Return Line

Two-Pipe Vacuum Systems

Vacuum systems operate under conditions of both low pressure and vacuum, but employ the vacuum pump to insure maintenance of subatmospheric pressures in the return piping for all operating conditions. The pump thus assists the supply steam in overcoming the resistance of the system piping and insures rapid circulation and even heating. The system may operate transiently with subatmospheric 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 vacuum system is illustrated in Fig. 15.



VACUUM RETURN PIPE SIZE INCHES	A* IN.
1	7
1¼	8
1½	9
2	10
2½	14
3	15
4	18
5	21
6	24

Fig. 18 .... Construction of a Step Lift

The return risers are connected in the basement into a common return main which slopes downward toward the vacuum pump. The vacuum 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 return system should provide unrestricted gravity flow of the condensate and air to the pump receiver so that the vacuum differential may be more uniformly applied throughout the return system. In some instances, load conditions make it necessary to drop the return below the level of the vacuum pump inlet before this pump can be reached. This can be taken care of when using a vacuum pump by installing a float controlled auxiliary accumulator tank, pitted if necessary, just ahead of the vacuum pump inlet as shown by Fig. 16. The auxiliary tank as shown still permits an uninterrupted gravity flow from all return lines, but it does reduce the vacuum on the returns by 1-in. Hg for every foot of lift. The lift should be limited to 5 ft.

Lifts should be avoided, but on individual mains near the end of the system a lift fitting may be employed. Fig. 17 shows a single-step lift, which may be used up to 5 ft of lift. When the lift is greater but does not exceed 8 ft, it should be divided into two lifts shown in Fig. 18. It is preferable