

VACUUM HEATING PUMPS

On vacuum systems, where the returns are under a vacuum, and sub-atmospheric systems, where the supply piping, radiation and the returns are under a vacuum, it is necessary to use a vacuum pump to discharge the air and non-condensable gases to atmosphere and to dispose of the condensation. Direct-acting steam driven reciprocating vacuum pumps are sometimes used where high pressure steam is available or where the exhaust steam from the pump can be utilized. In general, however, these have been replaced by the automatic motor-driven return line heating pump especially developed for this service. Steam turbine drive is also frequently used where steam at suitable pressures is available, the steam being used afterward for building heating. The usual vacuum pump unit consists of a compact assembly of exhausting unit for withdrawing the air-vapor mixture and discharging the air to atmosphere and a water removal unit which discharges the condensate to the boiler furnished complete with receiver and separating tank and automatic controls mounted as an integrated unit on one base. There are also special steam turbine driven units which are operated by passing the steam to be used in heating the building through the turbine with only a 2 to 3 lb drop across the turbine required for its operation. Under special conditions such as installations where it is necessary to return the condensate to a high pressure boiler, auxiliary water pumps may be supplied. In some instances separate air and water pumps may be used.

Practically all automatic motor-driven return line vacuum heating pumps make use of a portion of the condensate to operate either as a liquid piston pump or as a kinetic exhauster (which operate on a modified ejector principle) to withdraw the air and condensate from the system, discharge the air to atmosphere and return the condensate to the boiler. Some type of hydraulic action is utilized to produce the suction. Such hydraulic evacuating devices may be classified as:

- a. Water ring centrifugal displacement pumps.
- b. Water piston pumps.
- c. Stationary kinetic exhauster pumps.
- d. Rotary kinetic ejector pumps.

The evacuating element is generally combined with a centrifugal water impeller for the delivery of the condensate to the boiler or feed-water heater.

The assembled units may be further grouped under two general classifications:

- a. Those which perform the function of air separation under atmospheric pressure.
- b. Those which perform the function of air separation under a partial vacuum.

Pumps coming under the first classification remove both the air and condensate from the returns by means of the hydraulic evacuator and deliver both to a separating tank under atmospheric pressure. From this tank the air and non-condensable vapors are vented to atmosphere while the condensate is removed and delivered to the boiler by means of the built-in boiler feed pump impeller.

In the second classification, the air and condensate are first separated under vacuum by means of the receiver which is directly connected to the returns. The hydraulic evacuator withdraws only the air and non-condensable vapors from the top of the receiver and delivers them to atmosphere. The built-in condensate pump impeller removes the condensate from the bottom of the receiver and delivers it direct to the boiler or feedwater heater.

Under special conditions such as returning the condensate to a high pressure boiler or the furnishing of large air removal units for high vacuum systems, it is customary to supply separate motor-driven air and water pumps.

For rating purposes¹ vacuum pumps are classified as *low vacuum* and *high vacuum*. Low vacuum pumps are those rated for maintaining $5\frac{1}{2}$ in.

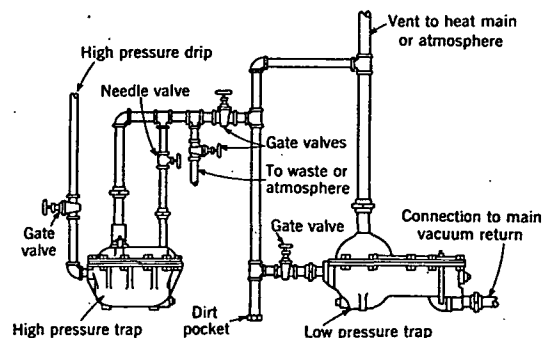


FIG. 20. METHOD OF DISCHARGING HIGH-PRESSURE APPARATUS INTO LOW-PRESSURE HEATING MAINS AND VACUUM RETURN MAINS THROUGH A LOW-PRESSURE TRAP

Hg. vacuum on the system, and high vacuum pumps are those rated to maintain vacuums above $5\frac{1}{2}$ in.

The vacuum maintained in the returns of a system is affected by the steam pressure being carried on the system. Thus when pressures in the upper ranges used in low pressure steam heating are carried, the temperature at which the condensate enters the return piping increases. A portion of the condensate in flowing through the traps, upon entering the lower pressure region of the returns re-evaporates because it is at a temperature higher than the saturation temperature for the pressure existing in the return piping. This vaporization tends to increase the pressure existing in the return piping (reduce the vacuum). The amount vaporizing is proportional to the difference between the heat content of the condensate at the temperature it leaves the radiator and that corresponding to the vacuum in the return piping. This action also frequently results in the inability to produce as high vacuums in systems having covered return piping as would otherwise be the case even though the same steam pressure is carried on the radiation. It is obvious that conditions may be

¹A.S.H.V.E. Standard Code for Testing and Rating Return Line Low Vacuum Heating Pumps. (A.S. H.V.E. TRANSACTIONS, Vol. 40, 1934, p. 33).