temperatures exist. Sometimes an entire building is on one general control, which results in overheating some sections when sufficient heat is supplied to accommodate the coldest portion.

By separating a building into *zones*, each with its own piping system, each *zone* may be controlled separately. Systems are zoned to care for exposure, hours of occupancy, stack effect and the requirements of occupancy activity.

In large buildings it is important to consider zoning for exposure because of the varying effects of the wind and sun. With the prevailing winter winds from the northwest, for example, a simple zoning would place the north and west sides of the building on one zone and the south and east sides on another. If the size of the building justifies the expenditure, a better arrangement would be to place all north walls on one zone, all west walls on a second, all east walls on a third, and all south walls on a fourth. Certain interior areas, such as basements, light well walls and other locations where sun and wind do not affect the conditions, should be placed in still another zone if the most economical operation is to be secured.

In high buildings it is often important to consider zoning for stack or *chimney* effect, caused by the difference in density between the warm air on the inside of a building and the colder air on the outside. Where the lowest eight or ten stories are protected from winds by surrounding buildings, it may accentuate the need for zoning to correct for the *chimney effect*. On still days the heat demands vertically will vary little, but on windy days there will be a marked difference in the heat requirements for the different horizontal sections at different elevations. An arrangement to provide for difference in heat requirement for exposure and *chimney effect* would give 12 zones; namely, north, east, south, and west lower zones; similar middle zones; and similar top zones. Every type of steam heating system may be zoned. The extent to which any system may be zoned is governed by the limitations of the given installation and the particular type of system. Zone control is used principally with sub-atmospheric, orifice and vacuum heating systems.

Each zone should constitute an individual and separate system with its own control valve (controlled by thermostats in its respective zone), steam supply and return piping and preferably its own return pump or vacuum pump. It is possible for a single vacuum pump to serve several zones with a controller for each section connected in parallel so that the zone in which the lowest differential or vacuum is produced may start the pump.

Zoning has advantages even where individual thermostatic radiator control is installed, whether this be of pneumatic, electric, or the self-contained radiator valve type. The control secured by zoning in supplying heat in parallel with its outside temperature and wind fluctuations removes a large part of the load from such individual thermostatic controls; they operate less frequently and the radiators follow a more even temperature.

CONDENSATION RETURN PUMPS

Condensation return pumps are used for gravity systems when the local conditions do not permit the condensation to return to the boiler

under the existing static head. The return of the condensate permits the water to repeatedly go through the cycle of vaporization, with subsequent condensation and return to the boiler. During such repeated cycles any incrustants or other substances in solution are precipitated and the water de-activated to a considerable extent so that corrosion of a serious nature is seldom ever encountered where the condensate is repeatedly used. Serious corrosion is more frequently found in systems where the condensation is not repeatedly used but is wasted and fresh make-up water is continually being introduced.

The most generally accepted condensation pump unit for low pressure heating systems consists of a motor-driven centrifugal pump with receiver and automatic float control. Other types in use include rotary, screw and reciprocating pumps with steam turbine or motor drive, and direct-acting steam reciprocating pumps.

The receiver capacities of these automatic units should be sized so as not to cause too great a fluctuation of the boiler water line if fed directly to the boiler and at the same time not so small as to cause too frequent operation of the unit. The usual unit provides storage capacity between stops in the receiver of approximately 1.5 times the amount of condensate returned per minute and the pump generally has a delivery rate of 3 to 4 times the normal flow. This relation of receiver and pump size to heating system condensing capacity takes account of the peak condensation rate.

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. They are furnished complete with receiver, 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,