Should the steam pressure be dropped to ¼-lb gage, the pressure on each side of the orifice would be balanced and no steam flow would take place. From this it will be seen that if an orifice of a given diameter will fill a given radiator with steam when there is a given pressure on the main, it is simply a question of dropping this main pressure provided the supply pipe pressures be controlled sufficiently closely, so as to fill any desired portion of the radiator down to the point where the main pressure equals the back pressure in the radiator, at which time no steam will be supplied at all. If orifices throughout a system are designed on a similar basis, all radiators will heat proportionately to the steam pressure within the limits for which the orifices are designed.

Some systems use orifices not only in radiator inlets but also at different points on the main, thus balancing the system to a greater extent. For example, the system may be designed for a particularly long run involving an initial pressure of 3-lb gage on the main and 2 lb at the end of the main, but each branch from the main may have an orifice for reducing the pressure at it to 2-lb gage. This is particularly useful for branches near the boiler where the drop in the main has not yet been produced.

Orifice systems using a vacuum pump operate successfully with the ordinary low vacuum type of pump producing 8 to 10 in. of vacuum. They are controlled by various means to regulate the steam pressure. One method is by a thermostat located on the roof to govern the steam pressure by a combination of outside and inside temperatures; another, useful on systems without traps and vacuum pumps, controls the steam pressure manually from temperature indication stations in the building, or automatically by a thermostatically-controlled pressure reduction valve or draft regulator on the boiler; with oil or gas firing, the on-and-off control or a boiler pressure control may be used.

ZONE CONTROL

Certain portions of a building may require more heat at times than others but if the whole building is on one general control, such as would occur with a single piping system with an on-and-off control or with the sub-atmospheric or the orifice systems, it would be necessary to supply sufficient heat to accommodate the coldest portion of the building even though some sections would be overheated. By separation of a building into zones each with its own piping system, each zone of the building may be controlled separately.

The sides of the building with different exposures should be considered first, because of the varying effects of the wind and sun. With the prevailing winter winds from the northwest, a simple zoning would place the north and west sides of the building on one system and the south and east sides on another. If the building is large enough to justify 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.

In case of high buildings, the lowest 8 or 10 stories may be well protected from wind by surrounding buildings, the next 10 stories may have moderate exposure, and above this there may be an unobstructed exposure to gales. 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. In addition, the *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 will give an air movement which will require zoning to correct. Where such conditions are encountered, the building should be divided horizontally as well as vertically. An arrangement of this character would give 12 zones: namely, north, east, south, and west lower zones; similar middle zones; and similar top zones. Each zone should constitute an individual and separate system of piping with its own supply steam valve (controlled by thermostats in its respective zone) and with its own return or vacuum pump, if one is used. Certain interior areas, such as basements, light well walls and other

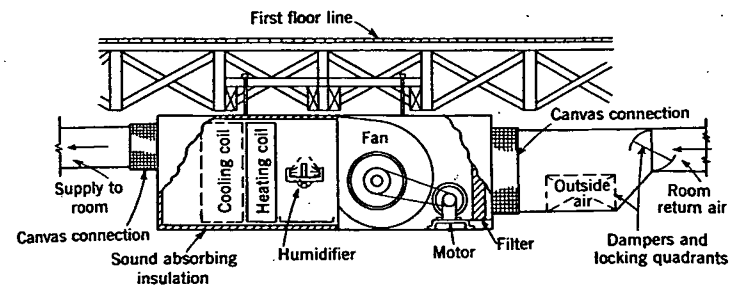

Fig. 19. Residential Conditioning Unit

locations where sun and wind do not affect the conditions, should be placed in still another zone if the most economical results are to be secured.

Zoning has advantages even where individual thermostatic radiator control is installed whether this be of pneumatic, electric, or the self-contained radiator valve type. By operating each zone to supply heat in parallel with its outside temperature and wind fluctuations, a large part of the load is taken off the thermostatic controls; they operate less frequently and the radiators follow a more even temperature instead of fluctuating from extreme hot to extreme cold.

Sub-atmospheric, orifice, and zone control systems, generally are proprietary.

AUXILIARY CONDITIONING UNIT

In connection with a residential steam or hot water system using radiator or convector heating a unit as shown in Fig. 19, is available to supplement the old or new system. The unit is arranged in a sheet metal enclosure with a filter, circulating fan, means for adding moisture to the air, heating or tempering coil and generally provisions are made for the addition of a cooling coil in case summer air circulation is desired. The unit is frequently located on the ceiling of the basement and is connected with one or more supply in return air ducts in the various rooms. In some cases, provisions are made for the introduction of a portion of the