2. Indirect refrigeration by means of:
   a. Cold well water.
   b. Cold city water.
   c. Artificial refrigerated water provided by direct expansion of refrigerant in a water cooler, direct steam jet refrigeration, or by the melting of ice.

It should be recognized that direct expansion of refrigerant within the coils of a unit conditioner, represents a certain hazard unless the refrigerant is of the non-irritating, non-inflammable type. Therefore, in many cities rather stringent codes have been set up limiting the use of such direct expansion unit conditioners. In the case of hospitals, or places where a large number of people are present, direct expansion is prohibited and the so-called *indirect* systems are required. In these systems the refrigerant is used to cool a brine which is then circulated through the cooling coil.

Filtering—Air Cleaning

A variety of methods are employed as a means of controlling air purity. In unit systems where filtering alone is considered satisfactory, the degree of filtering varies widely and in proportion to the actual needs. If the air is chiefly recirculated with but little outside air used for ventilation, filtering requirements are largely limited to keeping the coils in a clean and operable condition. Thus such units are frequently furnished with simple lint screens of low resistance and formed of moderately close meshed wire. Where outside air is used for ventilation, more complete filtering of dust particles is necessary and for this purpose, there are a large number of filters available on the market. Some of these filters are of the so-called *throw-away* type, constructed of inexpensive material so that when they become dirty or clogged they may be thrown away and replaced with new ones. All of these filtering methods are described in detail in Chapter 16.

A number of air conditioning units are being offered for the relief of hay fever sufferers and render relief in this disease both by maintaining proper air conditions and by removing most of the air borne pollens from the ventilated air. Such filters, however, must be designed for this purpose and must have an exceptionally high efficiency.

The degree of filtration and its efficiency depends entirely upon the design of the unit or the unitary system. For high efficiency of air cleaning, large and expensive filtering area is required. Small filters mean either low efficiency of cleaning or else high resistance with increased fan power or decreased air capacity.

Ventilation

Inasmuch as air purity is one of the factors that constitutes true air conditioning, ventilation or the introduction of outside air is an essential part of any air conditioning unit or system. While a unit that recirculates all its air capacity is still considered an air conditioning unit, the better type system provides for the introduction of a certain proportion of out-door air. In some instances one of several units may operate entirely on outside air, while in other cases only a portion of the air handled by the unit is drawn from out of doors. In such cases a damper is provided either

in the unit or in the duct connections for controlling the proportion of out-door air.

Location of Unit Conditioners

The characteristics of the conditioned space, the building construction, the type of system employed, and the source of duct connections, power, piping, and refrigeration influence directly the location of the unit conditioners. Primarily a unit conditioner is either of the portable or fixed type. The portable unit is usually a simple summer conditioner either with or without ventilation, but includes the refrigerating compressor. If this compressor is of the air-cooled type, the unit must be located adjacent to a window or other source of outside air. On the other hand, if it is of the water cooled type, its location should be made convenient to sources of water and drainage. Thus portable units are almost invariably located within the conditioned space.

Non-portable units, or units of fixed location may or may not be located within the occupied space. Naturally units that are located in such spaces must be built with decorative cases in order to harmonize with the surroundings. Such units are normally of comparatively small capacity varying from a fraction of a ton up to as much as five or six tons. Many conditioning units and particularly those of the larger sizes are located externally to the occupied and conditioned space and are connected thereto by means of delivery and return ducts. Such an arrangement permits the location of the conditioning unit convenient to either the sources of refrigeration or outside air. It frequently permits the use of the basement or of space less valuable than that on the level or floor of the occupied zone. Oftentimes the same type of unit may find application in an exposed position for one job and in a concealed location for another. Thus it can be seen that it is not possible to define a unit merely on the basis of its location. Frequently conditioning units are built into the structure or into the architectural design of a room so that they are entirely concealed except for the discharge and return grilles or openings which are designed so as to correspond to the decorative scheme of the room.

Air Distribution

With portable units or units exposed within the conditioned space, the distribution is usually through grilles or louvres built entirely into the equipment. The discharge of the air from this unit, in general, should be upward immediately at the conditioner, with sufficient horizontal component to carry it to the most remote point in the room. Such a distribution permits the cool air to drop slowly over the entire zone and return to the inlet of the unit below the breathing line and along the floor. The location of doorways, air vents, and heat exposed walls should be carefully observed, as they have a marked effect on the direction of the air flow and on its uniformity of temperature. Velocities below the breathing line should be kept low, normally not over 40 to 70 fpm. Such velocities are usually best checked by a Kata thermometer rather than by means of an anemometer.

With the suspended type of unit conditioners located within the conditioned space, sufficient outlet air velocity should be provided to give