an adequate source of cold well water is available, this may be used as a direct spray and run to waste.

Other methods of dehumidification accomplished by direct contact with the transfer medium are by means of the so-called *adsorption* and *absorption* systems. (See Chapter 23). It must be recognized that these methods of dehumidification do not in themselves provide cooling. The substance removes the water vapor from the air thereby heating it. This highly dehumidified air may then be cooled either by partial rehumidification or by direct contact with a cooling medium of cold water or direct expansion refrigerant. There are now on the market solid adsorbents such as silica gel and activated alumina. Water solutions of the chloride of various inorganic elements such as calcium and lithium chloride are the absorbents most frequently used.

Finally a common direct means of cooling and dehumidification is through the use of ice. In such units the ice is brought into as intimate contact as possible with the air handled. Provision is made for the removal of the moisture as rapidly as it is formed from the melting of the ice. Ice is also used to cool water which is circulated through the sprays.

In conditioning units, the use of surface cooling is probably more common than direct spray or other direct transfer means. The type of surface employed may, of course, be cast or fabricated from tubes. In present day practice finned tubes or plate fins through which tubes are passed form the most generally used cooling surface. The detailed fabrication of this surface and the arrangement of the tubes will depend largely upon the type of refrigerant for which it is intended.

The simplest construction is where chilled water or brine is used as the refrigerating medium. With direct expansion refrigerant it is usually necessary to provide a special arrangement of headers so that proper distribution of refrigerant through all the surface is obtained. In some cases, ordinary brine coils can be used when operated as a flooded refrigerant system. In some units a combination of a direct spray and a refrigerant surface is used, the spray being directed against the surface. Such systems claim the advantage of air washing together with the maintenance of a clean and effective cooling coil.

It should be noted that when surface coolers are used, adequate protection in the form of filters or at least lint screens are necessary to prevent fouling of the surface from the air borne dirt. Surface not so protected frequently becomes completely matted with lint, grease, and similar dirt.

The sources of refrigeration used with these surface type conditioning units are discussed in Chapter 23. However, they may be divided into the following groups:

1. Direct expansion refrigerant in which the liquid refrigerant is evaporated within the coils of the unit. The vapor from these coils may be recompressed in centrifugal, rotary, or reciprocating type compressors, and the refrigerant again returned to the evaporator coil.

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.

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 26.

Ventilation

Inasmuch as air purity is one of the factors that constitute 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 outdoor 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 outdoor air.

Location of Air Conditioning Units

The characteristics of the conditioned space, the building construction, the type of system employed, the duct connection, the accessibility of the unit for servicing, as well as the source of power, piping and refrigeration influence directly the location of air conditioning units.

Fundamentally, there are two types of unit air conditioners. The first type is entirely the self-contained. These units are usually finished in decorative cabinets designed to harmonize with the interior finish of residences, stores, and small commercial establishments. They are, however, sometimes located outside the conditioned space with small lengths of ducts transmitting the conditioned air to the space where it is required. The primary problem in locating units within the conditioned space is to insure proper air distribution. If ventilation air is required, or if the condenser is of the air cooled type, the proximity to a source of fresh air should be considered when locating the units. Units with water cooled condensers should be placed close to the water supply and drain, and care must be exercised that the ambient temperature is never below 32 F, to prevent freezing the water in the condenser.

Proper care should be observed to locate the unit so that all parts are easily accessible in case of trouble.

The second type of unit is the air conditioner which is designed for connection to some remote source of refrigeration. In the smaller sizes these units are sometimes placed within the conditioned space. The