

of the air entering the unit with a stipulated refrigerant temperature within the coil. When chilled water or brine is used, the rate of circulation of the cooling media as well as its entering temperature must be given.

AIR CONDITIONING UNITS

Air conditioning with unit equipment has gained in popularity during the last few years and this type of apparatus now represents the bulk of the production of the industry. It is to be noted that some equipment does not fulfill all of the basic requirements of a true air conditioning unit. True air conditioning equipment involves not only the ability to alter temperature and humidity conditions within the conditioned space, but it must also be able to *control* these conditions.

The means for accomplishing these functions are outlined herewith:

Heating

The normal air conditioning unit derives its heating function from a heating coil, usually of the non-ferrous finned tube type supplied with either steam or hot water. Steam may be supplied directly from a self-contained and built-in oil or gas fired unit, from a separate domestic steam boiler, or even from an outside source of a central heating plant. Hot water is supplied either from a separate hot water boiler or in rare instances from a domestic water heater.

In domestic or household conditioning units, adapted from a warm-air heater to which humidification is added, or possibly all-year-round conditioning, a direct-fired air interchanger is frequently used. The source of heat in this case may be from the combustion of coal, oil, or gas. A wide variety of designs and structures are used. In such direct-fired systems, the bulk and volume of the heat transfer surface is necessarily large in proportion to the rest of the equipment.

Where electric power is low in cost, electric heat has been furnished for air conditioning units either in the form of encased heaters, or open wire heaters. (See Chapter 39.) Radiant electric heaters are seldom used except as their radiant heat is absorbed by some receiving wall and there transmitted to the air in the form of convected heat.

Another method of applying electric heat is by means of the reversed refrigeration cycle, whereby electric energy is used to compress a refrigerant and to deliver the heat of compression, withdrawn from a lower temperature source, to the conditioned space by locating the condensing coils in the air circulation circuit of the air conditioning unit. While this method of heating has gained wide interest, it is practical only in a limited number of applications. Its economic practicability depends largely upon the availability of a source of heat during the winter season at as high a temperature as is possible. Thus, while it is frequently applicable in mild climates, it is not of great value in the northern climates where sub-freezing temperatures are common. It has the other unfortunate property that when the outdoor temperature is the lowest and the heat requirement the greatest, the heating capacity of the system is a minimum. This means that in many installations, an auxiliary and separate source of heat must be supplied to carry through these peak winter conditions. Such

factors as these have limited a more general application of this principle. (See Chapter 2 on Refrigeration.)

Humidifying

A variety of methods have been used to furnish humidification in winter to air conditioning units. The oldest and best known is by means of a direct spray which is used in many different ways. The simplest system is where the spray water is furnished from a constant water source, such as city water, and is permitted to run to waste. Under such conditions, the spray may be either of the direct atomizing type where, by means of the nozzles, the water is broken into fine particles, or of the so-called target spray type, where a fine stream of water under pressure is caused to impinge upon a flat surface or target. Such methods are normally rather inefficient in the use of water.

Any spray system where water is run to waste must of necessity atomize as completely as possible to provide for evaporation of the maximum amount of water. This normally calls for moderately high pressures and for very fine orifices or passages in order to produce fine atomization. This in turn involves the danger of occasional clogging of the nozzles with resulting service problems. Self cleaning spray nozzles developed during the past two or three years materially reduce this hazard. Such methods even at best are wasteful of water inasmuch as only a comparatively small proportion of the water used is actually evaporated, the remainder running to waste. In spite of the water wastage this method is normally more economical in the case of small conditioning units than the installation of a pump to recirculate and reuse the waste water.

In the larger conditioning units where much larger quantities of water are used and the amount of water wastage becomes an appreciable item, it frequently is profitable to install a recirculating pump. It is important to note that when spray water is recirculated in such equipment in industrial areas and in large cities, it becomes necessary that water treatment be supplied, in order to reduce the corrosive action resulting from the absorption of acids and impurities from the air.

In some units, in order to increase the humidifying capacity and to utilize a greater portion of the spray water, the atomized spray is permitted to impinge against a heated surface thereby forcing its evaporation. While this is practical in some instances, there is danger of scale formation where hard water is employed. It should be pointed out that in any atomizing system if extremely hard water is used, the air will carry with it a content of infinitely fine solids which should be removed by a filter before discharging into the conditioned space. If it is not so removed, this may result in the formation of an apparent *dust* upon furniture and exposed surfaces.

One of the simplest methods of humidification in winter is by means of a direct steam spray. This is seldom used in air conditioning units for comfort applications due to the resulting odors. In industrial applications, however, it finds frequent use. The steam is usually introduced to the air through a perforated tube or through some type of porous material.

If a small atomizing spray is not used in comfort conditioning units, the