

cost of the equipment installed, and (2) it results in less desirable humidity conditions within the residence because of the increased size.

TYPES OF EQUIPMENT

Low Side

Three types of low side equipment (the equipment that actually removes the heat from the conditioned space) have been developed for residential work as follows: (1) refrigerated coils, (2) chilled-water coils, and (3) water-cooled coils.

The first and most commonly used method of absorbing heat from the conditioned air is to use direct evaporation of the refrigerant in a coil with the air to be conditioned passing over the outside of the coil surface. The heat is passed directly from the air into the refrigerant for removal. This requires the use of an air distribution system and, although generally most economical in new construction, may present costly problems in modernization work where ductwork is not installed.

In a chilled-water system, water is circulated through a closed circuit containing two coils. In one coil the water removes heat and moisture from the air in the conditioned space. In the other coil (water chiller) the heat is removed from the water by mechanical refrigeration. This type of system is called a duplex system in that the heat is picked up by chilled water and later removed from the water by means of a refrigeration system.

The water-cooled coil using water directly from city mains or wells is the simplest type of installation but, because of limitations imposed by the capacity, cost, or temperature of the available water supply, its use is not generally practicable. Cold water is circulated directly through the coil while air from the conditioned space is passed over the coil to remove heat and moisture. After the water has passed through the coil, it is wasted. To operate satisfactorily, an installation of this type requires water of sufficiently low temperature to chill the air enough to remove the desired amounts of heat and moisture. Where a large supply of cool water is obtainable, the water-cooled coil will operate with satisfactory results. As a general rule a water-cooled coil should not be used unless there is a supply of 52 F or colder water at the peak of the cooling season and in sufficient quantities to take care of the cooling load with a temperature rise of no more than 10 deg. Where water is not obtainable in sufficient quantities or at the required temperatures, it is necessary to chill the water to the desired temperature by using mechanical refrigeration.

High Side

The high side of a conditioning system, the section of equipment that removes the heat from the refrigerant and reclaims the refrigerant for further use in the system may be either the air or water-cooled type. The air-cooled high side is so constructed that the heat is removed from the compressed or hot refrigerant by passing it into a cooling coil over which outside air (air taken from outside the conditioned area and returned to outside of the conditioned area) is circulated.

The major advantage of air-cooled equipment is that no water is required to accomplish the removal of heat from the refrigerant and only an electrical supply is needed. The disadvantage is that operating pressures are higher because of the inability to cool the refrigerant as much by air as by

water. This results in an increase in electrical input to the compressor motor.

Water-cooled equipment can be of two types. In one type the water drawn from a well or from city mains is passed through the condenser of the high side and is allowed to flow to a drain, swimming pool, a wetted roof, or to other means of disposal. Where the water supply is sufficient and at low cost, this type of water-cooled unit is the better type installation because of lower equipment cost, lower operating costs and quieter operation. In a second type, if water is in short supply or is expensive, about 95 percent of the cooling water can be reclaimed by evaporating sufficient water to rid the remaining water of the heat picked up in the condensing unit. This can be done by the use of an evaporative condenser or a cooling tower described in Chapters 38 and 40.

TYPES OF SYSTEMS

The present generally accepted method of cooling residences is to employ a central system. The main components of the central plant for year-round air-conditioning systems may be obtained in factory-made assemblies providing matched components for both winter and summer conditioning functions or they may be obtained in one or more separate parts and combined on the job into an integrated system. Summer conditioning equipment may be obtained separately and added to existing heating systems or may be installed independently of any heating system. Cooling coils may be used in conjunction with warm-air furnaces and duct systems, or chillers may be combined with boilers to provide hot and cold water for circulation to room units as required. Refer to other Chapters 15, 16, 19, 42, and 43 for information on specific system components.

Self-contained room coolers, which are discussed in Chapter 16, are used for room or spot cooling and are not generally used to cool an entire residence. Their application and use is not to be considered further, but it may be noted that when only a portion of a residence is cooled the load calculation methods currently used in the industry for central residential systems are not applicable. Refer to Chapter 13 when calculating the load for such applications.

In some areas there is little or no need for heating but there is a distinct need for summer cooling. Both air- and water-cooled package cooling units are available for such installations, ranging in size from one ton to at least 15 tons capacity. To install these units it is only necessary to make plumbing and electrical connections and add the duct work required to convey air to and from the conditioned space. These units can also be used to provide central air conditioning for residences

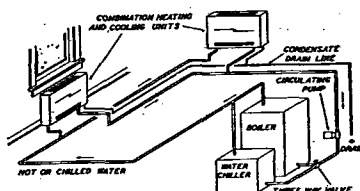


Fig. 1 . . . Combination Summer Air-Conditioning and Hot Water Heating System

Residential Summer Air Conditioning

having heating systems which do not contain provision for attaching summer cooling equipment.

Year-round air conditioners require less space than a separate heating plant plus a separate summer conditioner. Usually the heating and cooling portions of a year-round air conditioner operate independently of each other. The air circulated by the fan passes through the cooling or heating portion of the equipment, only one of which is in operation at any one time.

Air conditioning can be installed in homes having a hot-water heating system by use of either of the following:

1. Room units resembling convectors and containing both heating and cooling coils. These units are used in place of the conventional radiator or convector. They can be installed in all rooms of the house to provide complete summer cooling, or they can be used in only one or two rooms. This arrangement is shown in Fig. 1.

2. A split system. The cooling coil is located in a duct through which air from the rooms is circulated, cooled, and returned to the rooms. Another coil in the same duct can be used for winter heating, or conventional radiators, convectors, or panels can be used to bring heat to the rooms.

When the cooling equipment to be used in houses equipped with forced-circulation hot water heating is of the type which produces chilled water, it may be located in the basement or utility room near the boiler. In most of such systems it is then possible, with the addition of suitable valves, to use the same piping system for circulation of heated water in winter and chilled water in summer. The piping must be insulated to prevent sweating when circulating chilled water.

GAS YEAR-ROUND AIR CONDITIONERS

Gas-fired year-around air conditioners, based on the absorption cycle are available in sizes suitable for residential use and small commercial applications.

The conditioners are built in 3½ ton and 5 ton sizes with heating capacities appropriate for various climates. The 3½ ton and one model of the 5 ton units have heating inputs of 120,000 Btuh. This makes them suitable for homes having design heat losses up to 76,800 Btuh. The other 5 ton model has an input of 180,000 Btuh making it suitable for homes having design heat losses up to 115,200 Btuh.

General Description

The principal components of the gas-fired year-around air conditioner are an absorption unit, a gas burner, a centrifugal fan for air circulation, a filter section, and controls. The gas flame supplies the heat to actuate the absorption unit which provides heating in winter and cooling in summer.

The entire unit operates under a vacuum at all times. The absolute pressure within the generator and condenser on cooling cycle is of the order of 2 to 2½ in. Hg (50 to 60 mm) absolute pressure. The pressure within the cooling coil and absorber is between 0.25 to 0.3 in. Hg (6 to 9 mm) pressure. On the heating cycle, since the same coil is used for both heating and cooling, the absolute pressure is on the order of 14 in. Hg (350 mm) or about ½ atmosphere.

Heating Cycle

The gas flame, when applied to the generator of the absorption unit in winter, boils the solution. The water vapor which is thus produced goes directly (bypasses the condenser) to the single coil over which air is passed by the

blower. The heat is taken from the water vapor, and the water is returned to the generator by gravity to be used again.

Cooling Cycle

The gas flame, when applied to the generator of the absorption unit, boils the solution. The water vapor which is thus produced goes to the condenser where this vapor is condensed. It then flows into the single coil (which is the evaporator on the cooling cycle). The air being cooled and dehumidified is blown over this coil. The water vapor (through the process of absorption) is returned to the liquid state and flows by gravity to the generator to be used again. The refrigeration unit is factory-sealed and contains a solution of lithium bromide and water which acts as the absorbent, water vapor being the refrigerant. Circulation of these fluids in the system is accomplished by differences in temperature and height of liquid columns, without moving parts.

Control System

Manual switches permit the owner to select heating or cooling, constant or automatic fan operation, and turn the system on or off. For protection of the unit a generator limit switch and a cooling circuit preventive control switch are provided. The former protects the generator from excessive input and is preset to operate at safe temperature levels both on the heating and cooling cycles. The preventive control switch keeps the unit from serving as a heating plant if the condensing water were cut off. Another protective device used in the year-round gas air conditioner is the low temperature control which prevents the unit from freezing as a result of improper equipment operation.

A fan delay control delays fan operation until the heating coil has reached 140 F so as to prevent cold air circulation when heat is desired.

LOCATION OF COOLING EQUIPMENT

The preferred location for summer cooling equipment will depend upon the type. In a combination self-contained unit, the location will depend upon accessibility to the duct system, the fuel supply, the chimney, and the electrical supply. Too often, a heating or cooling unit is located by giving consideration to installation only, without considering the usability of the basement. This may result in breaking up the basement area to such an extent that it becomes practically useless for other purposes. In a remote type combination unit, consideration must be given to the location of the condensing unit, whether it is located in the basement area or whether the unit is located in a remote area such as the garage breezeway. Preferences of the family and their habits of living must be given consideration so as to keep all space as useful as possible and still locate the equipment in such a place that it can do its intended job and be accessible.

NOISE

One of the prime problems with residential air-conditioning installations is the operating noise level. Almost any degree of quietness in an installation can be had for a price. However, the numerical standards for describing sound levels have little meaning for the average person. It is difficult to ascertain from the prospective user in advance of installation just what sound levels will be acceptable and to describe what sound levels will result from any particular arrangement.

Motors and motor drives, compressor, blower, pumps if