cent 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. These units are described in Chapters 34 and 36.

TYPES OF APPLICATION

The generally accepted methods of cooling residences now employ central systems. 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 20, 24, 25, 37, and 38 for information on specific system components.

Self-contained room coolers, which are discussed in Chapter 25, 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 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 either by use of:

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. The coil can be used for winter heating, or conventional radiators, convectors, or panels can be used to bring the 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 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.

LOCATION OF COOLING EQUIPMENT

The location of the summer cooling equipment will depend upon the type of unit. In a combination self-contained type 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 practially 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.

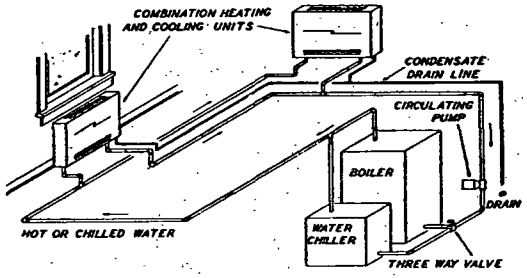

FIG. 1. COMBINATION SUMMER AIR CONDITIONING AND HOT WATER HEATING SYSTEM

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 to him what sound levels will result from any particular arrangement.

Motors and motor drives, compressor, blower, pumps if any, and flowing air and liquids are potential sources of noise and vibration. The first, and frequently the least expensive and most effective measure in noise reduction, is to put distance between the noise and the listener. Installations of cooling equipment in basements, crawl spaces, utility rooms or attached garages are preferable to those in alcoves or closets adjacent to bedrooms and living rooms. Mounting of units on concrete floors is preferred. Further steps which may be taken to achieve an acceptable low noise level are as follows:

1. Minimize the production of noise and vibration. Use only true, concentric pulleys with smooth belts at the proper tension and use properly balanced blower wheels and other rotating parts, operated at the minimum practical speed. Provide an adequate duct system which promotes smooth air flow at reasonable velocity and is sufficiently rigid in construction so that it does not vibrate unduly.