central air conditioning to residences having heating systems which do not contain provision for attaching summer cooling equipment.

CENTRAL SYSTEMS—HEATING AND COOLING

A summer air conditioner can be installed beside or near an existing warm-air furnace and can be connected to the duct work if the duct system has ample capacity for the cooling operation. If it does not, additional ducts and supply outlets will be required. The conditioner is about the same size or slightly smaller than a conventional forced warm-air furnace.

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.

Cool air supplied to rooms is usually 15 to 25 deg lower than the temperature of the rooms to be cooled. The size of the ducts of year-round air conditioning systems are often larger than those of equivalent winter heating systems because large quantities of cool air at 55 F to 65 F must be circulated through them. Duct systems should be designed and installed by competent engineers in accordance with such authoritative information as the design manuals of the *Air-Conditioning and Refrigeration Institute*[3] and the *National Warm Air Heating and Air Conditioning Association*.[4]

The cooled air is admitted to the room from the ducts through supply outlets. Since this air is colder, and therefore, heavier than the air within the room, it has a natural tendency to fall toward the floor. Unless the supply outlets are properly selected, located, and adjusted, the air distribution is likely to result in (1) a low velocity of cool air falling on the occupants, or (2) a high velocity stream of cool air striking a wall or other obstruction and splashing on the occupants. Research is being conducted to determine the most advantageous type and location of supply outlets.

The most commonly used outlets are registers with either fixed or adjustable vanes, and diffusers. Registers distribute the cooled air throughout the room. They are usually located either high or low in the sidewall or in the baseboard.

The diffuser type of outlet can be used in ceiling, wall, or floor. Different designs are available for each of these locations. The floor, baseboard, and sidewall diffusers blanket the walls with a curtain of cool air (or warm air in winter); the ceiling diffuser blankets the ceiling.

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.

The cooling equipment is located in the basement or utility room near the boiler. Valves are provided so that the same piping system can be used to circulate heated water in winter and chilled water in summer. The piping must be insulated to prevent sweating when circulating cold 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, 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.

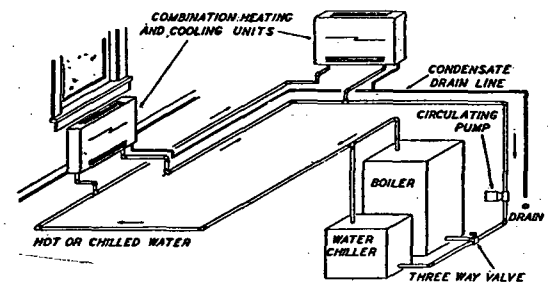


FIG. 1. COMBINATION SUMMER AIR CONDITIONING AND HOT WATER HEATING SYSTEM

NOISE

One of the prime problems of domestic air conditioning is operating noise. Due consideration must be given to location of summer air conditioning equipment, with respect to areas under bedrooms or other rooms requiring very low noise levels. Equipment is often installed without due consideration to blower and duct sizes, with a resulting increase in noise level. Consideration should be given to the use of vibration absorbers in refrigerant and water lines, to anti-vibration padding under equipment, and to flexible duct connectors to isolate operating sounds.

AIR DISTRIBUTION METHODS

Where cooling is installed with ducts and air outlets which serve the cooling function only, the practice and experience of comfort air conditioning for offices and commercial buildings apply directly to residential installation. Although cooling and heating by means of the same duct work and air outlets has been common practice in commercial and industrial applications, greater care must be taken in residential applications. It has been found that low air-flow rates are desirable for warm-air heating systems,[5] much lower than would be used for cooling systems. It is therefore recommended that in a residence located in a moderate or cold climate, provision be made for different air-flow rates for summer and winter. In warmer