system of control is most economical in gas consumption, but if air leaks into the steam distribution system during the periods that the gas is turned off and then vents out slowly when the thermostat calls for heat, the result will be a further cooling of the premises between the time that the thermostat calls for heat and the time that steam reaches the radiators. The combination of "all on or all off" control with a freely venting steam or vapor system gives maximum gas economy and minimum temperature variation.

Although a gas appliance will operate with a very slight draft, it is none the less necessary that it be connected to an adequate chimney. A chimney so situated that it is subject to momentary down drafts presents no difficulties, but a gas appliance should not be expected to operate against a continuous down draft any more than a coal appliance is expected to. Lack of chimney draft results in stagnation of the gases in the chimney with consequent condensation of the water vapor that is always present in the products of the combustion of gas. Table 1 gives the minimum cross section areas of chimneys (in square inches) for various amounts of heat supplied to the appliance and for various chimney heights.

TABLE 1. CHIMNEY SIZES FOR GAS APPLIANCES

Height of Chimney Feet	Gas Consumption in Thousands of B.t.u. per Hour								
	75	125	175	300	500	750	1000	1500	2000
10	24.0	35.7	46.6	71.6	107.5	148.5	187.0	259.0	327.0
25	14.8	21.9	28.7	43.8	66.0	91.2	114.6	159.0	200.0
50	13.6	20.2	26.5	40.5	60.9	84.1	105.5	146.1	183.9
70	13.3	19.8	25.8	39.5	59.6	82.2	103.4	143.1	180.5
100	12.9	19.4	25.3	38.8	58.4	80.8	101.4	140.6	176.7

Gas appliances, because of their small heat storage and quick response, are particularly adaptable to thermostatic control and should always be so installed. Any standard thermostatic control system is generally applicable. In addition to provision for operation under thermostatic control, practically all gas boiler manufacturers provide their product with gas pressure regulators, steam pressure regulators, low-water gas cut-off devices on steam boilers, and water temperature controls on water boilers. Thermostatic pilot controls, that shut off the main gas supply in the event of the pilot becoming extinguished, are also quite generally standard equipment.

Gas burning boilers for hot water heating systems present no particular problems in their installation. Like steam boilers they should always be under thermostatic control with a water temperature control to serve as a limiting device.

WARM AIR FURNACES

Gas burning warm air furnaces are obtainable in sizes from those sufficient to heat the largest residence, down to sizes applicable to a single room. The practice of installing a number of separate furnaces to handle individual rooms is peculiar to mild climates, such as Southern

California. Small furnaces, frequently controlled by electrical valves actuated by push-buttons in the room above, are often installed to heat bedrooms and other rooms where heat may be desired for an hour or so each day.

Manufacturers offer gas furnaces made wholly of cast iron or of a combination of cast iron and sheet metal, usually lead coated to resist corrosion. High efficiencies are obtainable with either type. The remarks in a previous paragraph, relative to the great desirability of using an appliance designed for gas when gas is to be the fuel, perhaps apply even more strongly to furnaces than they do to boilers.

Codes for the proportioning of warm air heating plants, such as that formulated by the *National Warm Air Heating and Ventilating Association* (See Chapter X), are equally applicable to gas furnaces and coal furnaces; with the exception of some furnaces which are designed to give a rather low air temperature. In that case the warm air pipes should be liberal in size. Recirculation should always be practiced with gas fired warm air furnaces. It not only aids in heating but is essential to economy.

SPACE HEATERS

In residence heating work, the space heater is most commonly used in the form of a *radiant heater*. Radiant heaters make admirable auxiliary heating appliances to be used during the occasional cool days at the beginning and end of the heating season; when heat is wanted in some particular room for an hour or two. The radiant heater gives off its heat in the form of radiant energy emitted by an incandescent refractory that is heated by a Bunsen flame.

Radiant heaters are frequently installed in places where venting to outdoors is either very poor or totally non-existent. This is a potential source of danger to the occupants of the space heated unless precautions are taken to insure safe operation. The gas should not be turned any higher than is necessary to make the radiants glow two-thirds of the way to the top. Radiants glowing clear to the top indicate the possibility of incomplete combustion. Burners should be kept clean and broken radiants should be promptly replaced.

Radiant heaters, and all other types of space heaters as well, should be flue connected if it is at all possible, and should never be operated in unvented rooms, particularly bedrooms.

Luminous flame reflector heaters diffuse a large part of their heat by virtue of the radiating power of the bright yellow flame. They are usually backed by a polished copper sheet which reflects radiant heat into the room. The flame must never be so long that it strikes any part of the heater.

Convection type heaters are typified by the *gas-fired steam radiator*, the *gas-fired tubular heater* (built in radiator form) and the *floor furnace*. The radiator types of gas-fired heaters provide an economical form of heating apparatus for intermittently heated spaces, such as stores, small churches, and some types of offices and apartments. Since they give off the greater portion of their heat by convection they do not produce a "hot spot" within the room and are therefor capable of being operated under thermostatic control.