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 therefore capable of being operated under thermostatic control. The floor furnace is a convection type heater that is hung underneath the floor. It is generally installed with a duplex register having a warm-air outlet and a cold-air return, so that complete recirculation is secured.

SELECTION OF GAS BOILERS

While gas-burning equipment can be and usually is so installed as to be completely automatic, maintaining the temperature of rooms at a predetermined and set figure, there are in use installations which are manually controlled. Under such control the temperature variations are considerable because the human body does not react as readily to temperature changes as does a thermostat, and a greater boiler output is required quickly to regain comfortable temperatures. Experience has shown that in order to effectively overcome the starting load and losses in piping, a manually-controlled gas boiler should have an output as much as 100 per cent greater than the equivalent standard cast-iron column radiation which it is expected to serve.

Boilers under thermostatic control, however, are not subject to such severe pick-up or starting loads. Consequently, it is possible to use much lower selection or safety factors. A gas-fired boiler under thermostatic control is so sensitive to variations in room temperatures, pressure of steam, or temperature of water, that in most cases a factor of 25 per cent is eminently sufficient for pick-up load.

The factor to be allowed for loss of heat from piping, however, must vary somewhat, the proportionate amount of piping installed being considerably greater for small installations than for large ones. Consequently, a selection factor for thermostatically controlled boilers must be variable. Table 5 gives selection factors to be added to the installed steam radiation under thermostatic control. They have been established by experience and are recommended by the *American Gas Association*.

Appliances used for heating with gas should bear the Approval Seal of the *American Gas Association* Testing Laboratory. Installations should be made in accordance with the recommendations shown in the publications of that Association.

RATINGS FOR GAS HEATING APPLIANCES

Since a gas appliance has a heat-generating capacity that can be predicted accurately to within 1 or 2 per cent, and since this capacity is not affected by such things as condition of fuel bed and soot accumulation, makers of these appliances have an opportunity to rate their product in exact terms. Consequently all makers give their product an hourly B.t.u. rating. This is the amount of heat that is available at the outlet of a

boiler in the form of steam or hot water, or at the bonnet of the furnace in the form of warm air. The output rating is in turn based upon the B.t.u. input rating which has been approved by the *American Gas Association* Testing Laboratory and upon an arbitrary efficiency which has been assigned by that Association.

In the case of boilers, the rating can be put in terms of square feet of equivalent direct radiation by dividing it by 240 for steam, and 150[1] for water. This gives what is called the *American Gas Association* rating, and is the manner in which all appliances approved by the *American Gas Association* Laboratory are rated. To use these ratings it is only necessary to increase the calculated heat loss or the equivalent direct radiation load by an appropriate amount for starting and piping, and to select the boiler or furnace with the proper rating.

It might be stated at this point that the rating given by the *American Gas Association* Laboratory is not only a safe rating when considered from the standpoint of capacity, but is also a safe rating when considered from the standpoint of physical safety to the owner or caretaker. The

TABLE 5. SELECTION FACTORS FOR GAS BOILERS

EQUIVALENT CAST IRON STEAM RADIATION (SQUARE FEET OF 240 B.T.U. EACH)	SELECTION FACTOR (PER CENT)
500	56.0
800	54.0
1,200	51.0
1,600	48.0
2,000	45.0
3,000	42.5
4,000 and over	40.0

rating that is placed upon an appliance is limited by the amount of gas that can be burned without the production of an amount of carbon monoxide that would be dangerous to human life. This same limitation applies to all classes of gas-consuming heating appliances that are tested and approved by the Laboratory. Gas boilers are available with ratings up to 14,000 sq. ft. of steam, while furnaces with ratings up to about 500,000 B.t.u. per hour are available.

CONTROL FEATURES

One feature of the piping installation that adds to the satisfactory service rendered by gas boilers is provision for adequate and rapid venting of the air from steam heating systems. If air leaks into the steam distribution system during the period 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. A freely venting steam or vapor system gives maximum economy and minimum temperature variation. When gas boilers are attached to existing heating

[1] A value of 160 for the heat-emission of hot-water radiators is used by many engineers.