usually have heating elements of the enclosed metal resistor type immersed in the water. Boilers of this construction may be used on either direct or alternating current since the heat is delivered to the water by contact with the hot surfaces. To lessen the likelihood that the heating elements will burn out, they should be of substantial construction, with a low heat density per unit of surface area. Provision should be made for cleaning off deposits of scale which restrict the heat flow. A typical

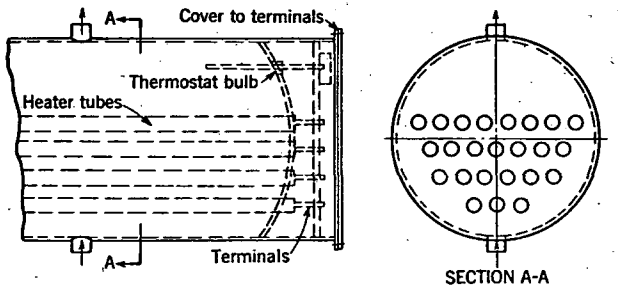

FIG. 8. RESISTANCE TYPE BOILER FOR STEAM OR HOT WATER

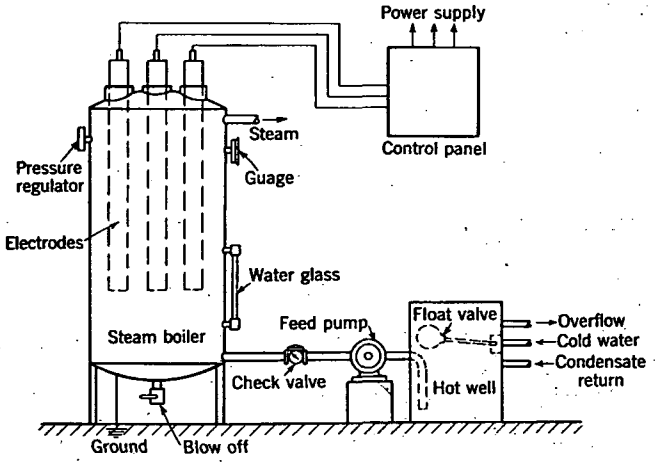

FIG. 9. DIAGRAMMATIC ARRANGEMENT OF AN ELECTRODE BOILER

resistance type of hot water or steam boiler is shown in Fig. 8. Large electric boilers are usually of the type employing water as the resistor. Only alternating current can be used, as direct current would cause electrolytic deterioration. Large boilers of this kind have electrodes immersed in the water where heat is generated directly. Electric steam boilers are useful in industrial plants which require limited amounts of steam for local processes, and for sterilizers, jacketed vessels and pressing machines which need a ready supply of steam. It sometimes is economical

to shut down the main plant fuel burning boilers when the heating season ends, and to supply steam for summer needs with small electric steam boilers located close to the operation. In general, electric steam heating is confined to auxiliary or other limited applications. If the heating system is designed to use electricity exclusively, steam generating or distributing equipment is superfluous. A diagrammatic arrangement of an electrode boiler is shown in Fig. 9.

ELECTRIC HOT WATER HEATING

Electric water heating, using an electric boiler in place of a fuel burning boiler, like electric steam heating, is generally confined to auxiliary or other limited applications. The use of insulated water storage tanks in which to store heat generated by electricity during off-peak hours at extremely low rates, is a development which has some special applications.

In this system of heating, the primary storage tank is simply a large, well-insulated, pressure type steel tank, equipped with electric heating elements connected to line with automatic time switches, which also have automatic limit controls for temperature and pressure. The heating system installed in the building may be of any standard individual radiator or fan-served indirect type or with provisions for the heating and humidification phases of an air conditioning system. A system of this kind requires very careful design to avoid excessive overall radiation losses during periods of low heat demand. It is also important to provide for sudden changes in heat demand. A typical hot water heating boiler is illustrated in Fig. 8.

HEATING DOMESTIC WATER SUPPLY [1]

Electric water heaters of the automatic storage type for domestic hot water supply are simple and reliable, and in many sections of the country low electric rates have been established by the electric utilities to secure this load. In some districts, rate schedules divide the current used for water heating into two classifications, regular and off-peak. A time switch automatically limits use of the off-peak heating element to the hours of off-peak load, while the regular heating element is a stand-by at all times. Storage of this two-element type of water heater is larger than average to carry over the periods when the off-peak element is timed out, without too frequent demands on the regular heating element which takes the higher domestic lighting service rate. Some utilities now offer a schedule which, beyond a stipulated minimum, lowers the rate for all service if an electric water heater is installed.

A comprehensive survey covering United States and Canada shows a rapidly growing use of electric water heaters, although the per cent of saturation, based on the total number of domestic power customers, is still low. Public acceptance is effected by the cost of other competitive fuels, by the electric power rate, and by the temperature of the cold water supply.

[1] Test Results of Electric Water Heaters, by C. G. Hillier (A.S.H.V.E. JOURNAL SECTION, *Heating, Piping and Air Conditioning*, November, 1936, p. 632).
Fourth Annual Survey, by B. J. Martin (*Electric Light and Power*, March, 1937).