mounted in each individual room to permit the occupant to maintain any desired temperature independent of the rest of the building.

ELECTRIC BOILERS

Steam or hot water generating boilers using electrical energy are entirely automatic, and are well adapted to intermittent operation. Small electric boilers usually have heating elements of the enclosed metal resistor type immersed in the water. Boilers of this construction may be used either with direct or alternating current since the heat is delivered to the water by contact with the hot surfaces. To lessen the likelihood of burning out of heating elements, they should be of substantial construction, with a low heat density per unit of surface area, and provision should be made for

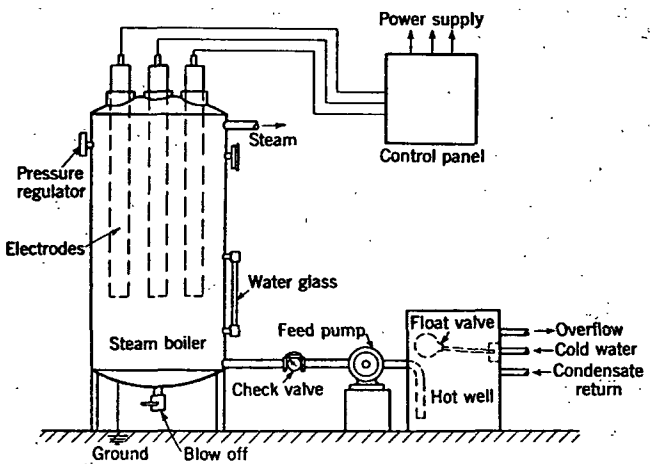


FIG. 3. DIAGRAMMATIC ARRANGEMENT OF AN ELECTRODE BOILER

cleaning off deposits of scale which restrict the heat flow. A typical resistance type of steam or hot water boiler is shown in Fig. 2.

Large electric boilers are usually of the type employing water as the resistor, using immersed electrodes. With this type only alternating current can be used, as direct current would cause electrolytic deterioration. Such a type of electrode boiler is shown in Fig. 3.

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.

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, automatic time switches, and automatic limit controls for temperature and pressure. The heating system installed in the building may be of any standard design. 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 water heating boiler is illustrated in Fig. 2.

HEATING DOMESTIC WATER BY ELECTRICITY

Electric water heaters of the automatic storage type for domestic hot water supply are simple and reliable. In many sections of the country low electric rates have been established by the electric utilities to secure this load. In many localities, electric rate schedules divide the current

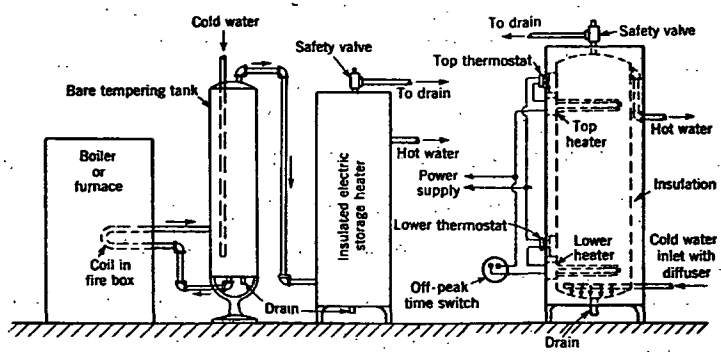


FIG. 4. PIPING ARRANGEMENT FOR CONNECTING ELECTRIC WATER HEATER TO FIRE-BOX COIL

FIG. 5. DOMESTIC HOT WATER HEATER FOR OFF-PEAK SERVICE

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 help carry over the periods when the off-peak element is timed out. Some utilities now offer a schedule which, beyond a stipulated minimum, lowers the rate for all electric service if an electric water heater is installed.

Competition with other fuels, especially gas, seems to be the major controlling factor in the use of electricity. The first cost of electric storage heaters is greater than for gas, owing to the need for larger tank storage due to off-peak service and slower recuperating capacity.

In residential work, to effect a saving in the cost of operation, it is sometimes desirable to use a furnace coil or indirect heater in connection with an electric water heater. In this case it is important to make the proper connections in order to benefit by any heat obtained from the furnace, and at the same time to prevent dangerous overheating. The proper piping connections are shown in Fig. 4, and in this case the electric heater will only furnish heat when insufficient heat is supplied from the furnace. This arrangement has a further advantage in the summertime in that the bare tank through which the cold water passes on its way to