Water is heated by various methods using heat exchangers arranged so that the boiler heating medium gives up its heat to the water in the hot water circulating system. These heat exchangers may be classified as follows:

1. Submerged steam heating coil in storage tank.
2. Submerged water heating coil in storage tank. (Fig. 8).
3. Indirect water heater, mounted on side of boiler below water line. (Fig. 9).
4. Submerged indirect water heater, placed in boiler below water line. (Fig. 10).

The efficiency of these heaters may be estimated as nearly 100 per cent as the heat loss from surface radiation of the heater and tank shell when covered with insulating material is generally reduced to a minimum. The capacities of these heaters are usually available from manufacturers

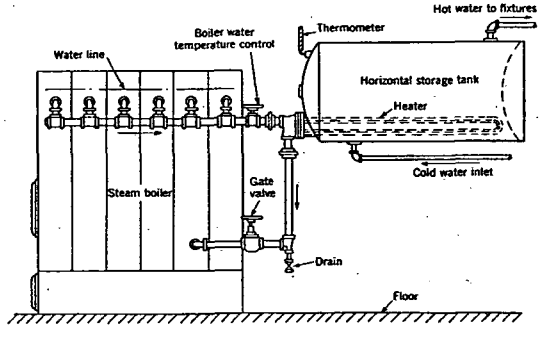

FIG. 8. HOT WATER HEATING COIL SUBMERGED IN STORAGE TANK

rating tables. The area of the inside surface of a heating coil may be determined from the following equation:

$$A = \frac{Q \times 8.33\ (t_o - t_i)}{K_o \times t_m} \qquad (1)$$

where

A = surface area of coil, square feet.
Q = quantity of water heated, gallons per hour.
t_o = hot water outlet temperature, degrees Fahrenheit.
t_i = cold water inlet temperature, degrees Fahrenheit.
K_o = coefficient of heat transmission, Btu per hour per square foot surface.
For copper or brass coils K_o = 240 (steam) and 100 (hot water).
For iron coils K_o = 160 (steam) and 67 (hot water).
t_m = logarithmic mean of the difference between the temperature of the heating medium and the average water temperature. t_m is approximately = $\left[t_s - \frac{(t_o + t_i)}{2}\right]$

Equation 1 may also be used for determining revised heating coil ratings under different temperature conditions as stated in the manufacturers ratings. When selecting a water heater, the conditions of operation should be carefully considered, as well as the location of the storage tank and the piping arrangement between the boiler, heater and tank. It is generally good practice to allow a margin of safety when

selecting an indirect heater of the proper size to provide for loss of efficiency due to the accumulation of scaling on the coils and piping. Heat exchangers classified according to (3) and (4) may be used with or without a storage tank, but when tanks are omitted, the indirect water heaters should be increased in size so as to heat the water instantaneously as it is needed.

The storage tank should be installed as high as possible. Horizontal tanks are preferable for all medium size installations and absolutely essential on larger installations. Where possible the storage tank should be installed with the bottom of the tank at or above the boiler water line. Horizontal storage tanks smaller than 18 or 20 in. diameter are not recommended because of the difficulty of preventing the hot and cold water from mixing, and especially is this an important consideration when large quantities of water are withdrawn.

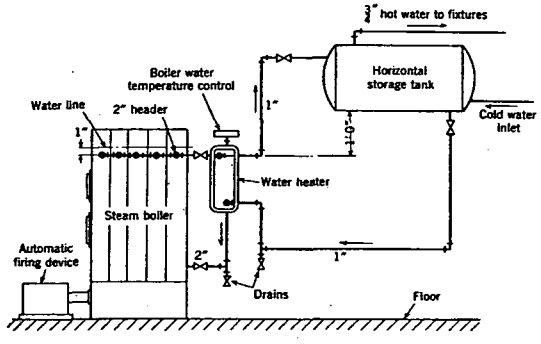

FIG. 9. INDIRECT WATER HEATER MOUNTED ON SIDE OF BOILER

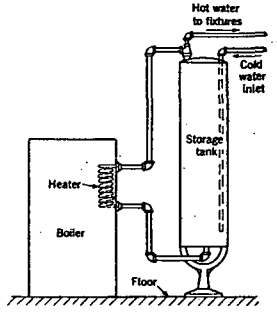

FIG. 10. INDIRECT WATER HEATER PLACED IN BOILER

Pipe sizes between the water heater and boiler should be full size of the heater tappings (Table 12). When a heater is connected to a horizontal sectional boiler, it is recommended that connections be made to all sections and joined together a few inches below the water line as shown in Fig. 8, so that steaming is prevented in those sections which are not connected to the header.

When a steam coil is used for heating the water, an automatic thermostatic valve may be installed in the steam supply to the coil. The operation of this automatic valve is controlled by a thermostat located in the storage tank which permits the proper amount of steam to enter the coil so as to maintain an even water temperature.

An indirect water heater may be used on either a steam or hot water system, and generally this type of heater is provided with a temperature control device located in the boiler water circulating connection to the water heater. The setting on this thermostatic valve may be as low as 140 F or as high as 180 F and may be readily adjusted to meet particular requirements. With this type of control it is impossible to overheat the hot water supply which is an important safety consideration in some installations. This type of system may also be conveniently used during