

surfaces. The simplest method is to have the fire on one side of a metal barrier and water on the other. In such a method if the water surfaces of heat transfer are small, and if the water carries a heavy proportion of precipitable salts, the water passages may soon clog and then burn out. A familiar example of such trouble is the water back of the firebox in the kitchen stove or the pipe coil inserted into the firebox of a warm air furnace or small boiler. The critical water temperature at which the lime, magnesia, etc. collect on hot surfaces, varies with the character and proportions of the solids, but generally such deposits are not a serious trouble with water temperatures lower than 140 F.

Coal burning direct-fired water heaters are either of cored-out cast-iron, with water entirely surrounding the combustion chamber, or of steel with water tubes which in some cases form racks to suspend garbage above the fire. These heaters are generally so small that low temperature com-

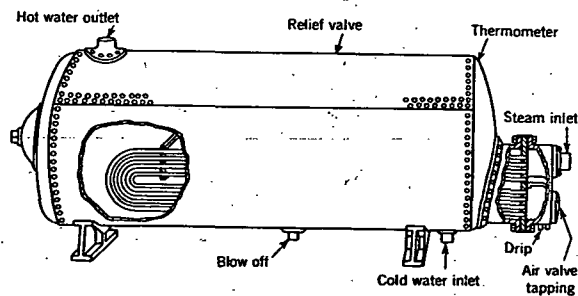


FIG. 7. INDIRECT WATER HEATER

bustion at poor efficiency ensues. Mud and scale may eventually close the water ways.

Oil burning direct-fired water heaters usually are of steel and operate with higher flame temperature and better efficiency than commensurate sized coal burning heaters. They have the same tendency as coal boilers to *lime up*, and the water passages should be large in cross-section and accessible for periodic cleaning.

Gas burning water heaters may be of the water-tube type having spiral copper tubes or of the instantaneous type used without a storage tank.

In the indirect method either steam or hot water is used for heating the water. With steam the water to be heated is preferably circulated around the outside of the steam tubes which are submerged within a tank. A typical indirect heater using steam is shown in Fig. 7. The coils usually are of copper and are U shaped to permit expansion and contraction. The shell may be of steel, copper or with a special inside protective lining. Where straight heating tubes are used, one end of the tube is usually expanded into a *floating head* to take care of expansion. The coils should be capable of easy withdrawal for inspection and for removal of scale. Instead of steam the heating medium may also be hot water inside the tubes.

Another method of transferring heat from a heating boiler to the

domestic water is illustrated in Fig. 8. The water heater is generally a cast-iron shell within which there is located a spiral copper coil. Hot water from the boiler circulates inside the shell and around the coil and returns to the boiler, while domestic water from the storage tank circulates inside the coil. The storage tank should be installed with the bottom of the tank as far above the boiler as possible. 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. In Fig. 9 the heat transfer surface is placed inside the boiler instead of in a separate vessel, but otherwise the operation is similar to that of Fig. 8. This arrangement with vertical tank is commonly used for small domestic installations.

Sometimes the heating element is located inside of the larger type fire tube boilers. In this case the heat transfer surface is in the form of a

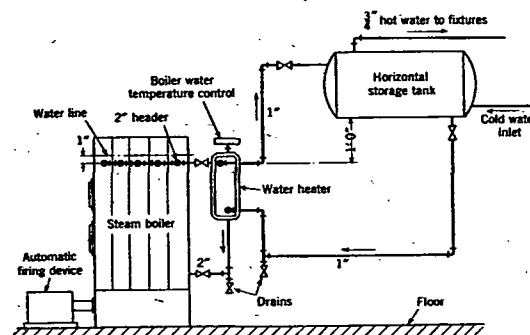


FIG. 8. INDIRECT WATER HEATER MOUNTED ON SIDE OF BOILER

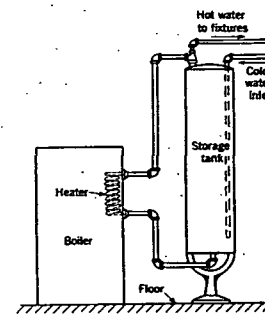


FIG. 9. INDIRECT WATER HEATER PLACED IN BOILER

number of straight copper tubes with rear U bends or a floating head, inserted through the front head of the boiler. While the coil may be located in the steam space above the water line of a steam boiler, it operates more satisfactorily when below the water line since clogging of the water tubes may thereby be delayed. This method is widely used without storage tanks since the intimate contact and efficient circulation of the water in this arrangement permits the utilization of the heat stored in the water of the boiler. A thermostatic three-way mixing valve is used to maintain a uniform temperature of the hot water going to the plumbing fixtures.

In order to reduce clogging by precipitated solids, water heating plants sometimes develop steam in a closed circuit, transferring the heat through a tubular heater to the domestic water. The water in the primary heater, exposed to the high temperature of the fire is repeatedly used and hence has no appreciable tendency to deposit scale, while the domestic water, heated by steam at a much lower temperature than that of the fire, also exhibits a much reduced tendency to separate its dissolved salts.