STEAM & HOT WATER BOILERS 1840-1930

Hot Water Boilers

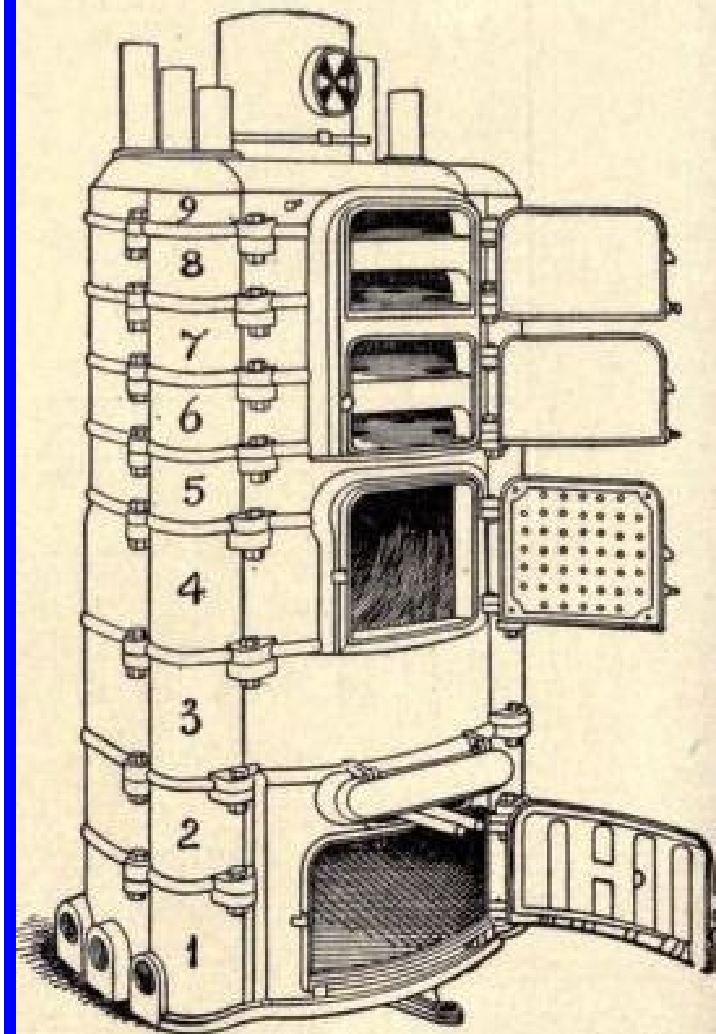

FIG. 95.

FROM AMERICAN TEXTBOOK BY WILLIAM J BALDWIN 1908

HOT WATER HEATING AND FITTING

Modern Hot Water Apparatus, the Methods of Their Construction and the Principles Involved

BY

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lower one, so that the water is compelled to pass from the bottom to the upper chamber in the continuous tubes, local or return circulation going on only within the drop tubes, making, it is claimed, a positive circulator.

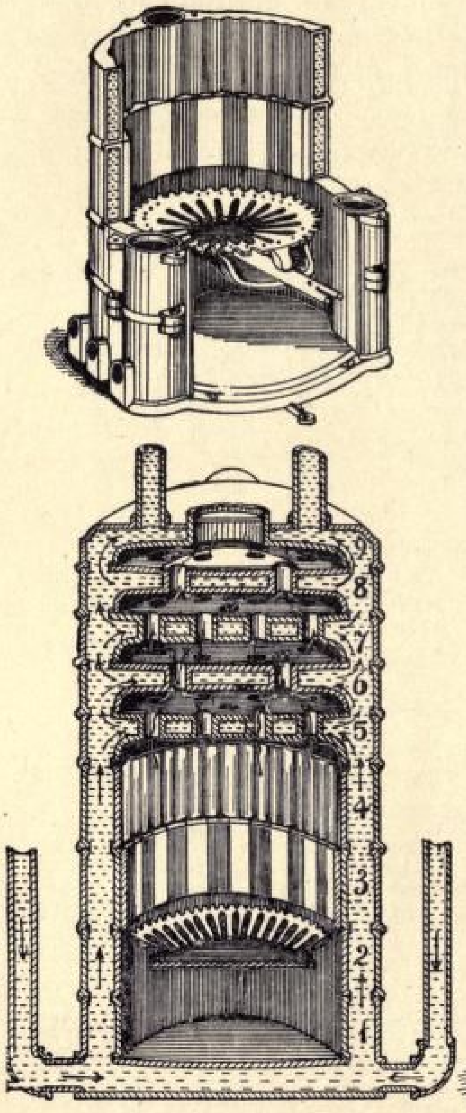


FIG. 94.

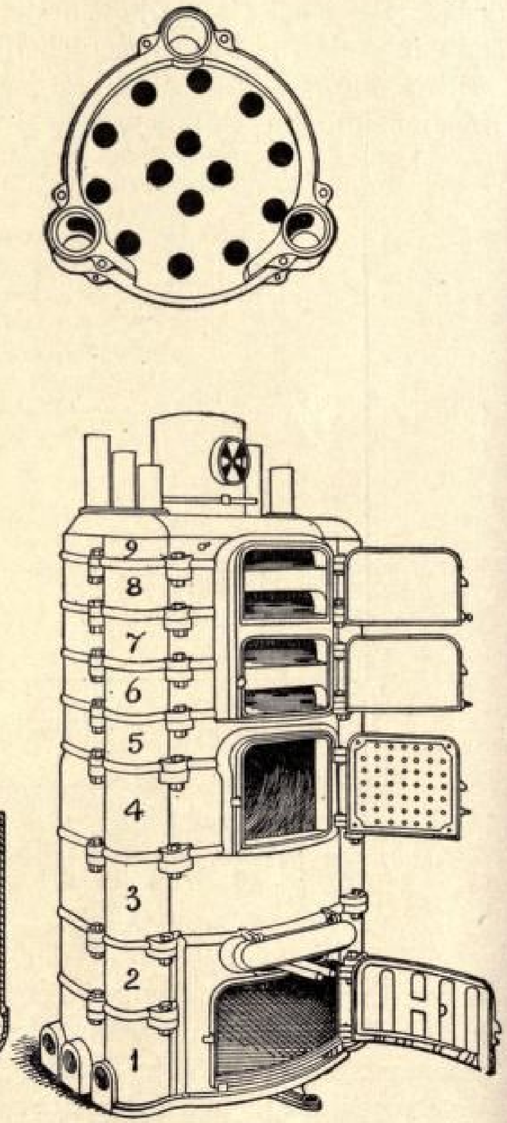


FIG. 95.

The " Gurney " hot-water boiler, shown in Fig. 95, was the first prominent cast-iron boiler of its type put in the market. It was invented by Mr. Edward Gurney, of Toronto, and was first used in Canada.

The illustrations, Figs. 94 and 95, show the boiler in its early form. The lower section (No. 1) forms a " water-bottom " beneath the fire. The second section (2) is technically a " water-leg." Section (3) forms the fire-pot, and is arranged on the fire side so that a little more than half the inside surface is covered with fire-brick. Between the fire-brick panels the iron of the fire-pot projects to the fire, so as to make alternately a fire-brick and an iron panel. The advantage claimed for this is that the fire-brick, when so arranged, is practically indestructible. The explanation given is that when a fire-pot is

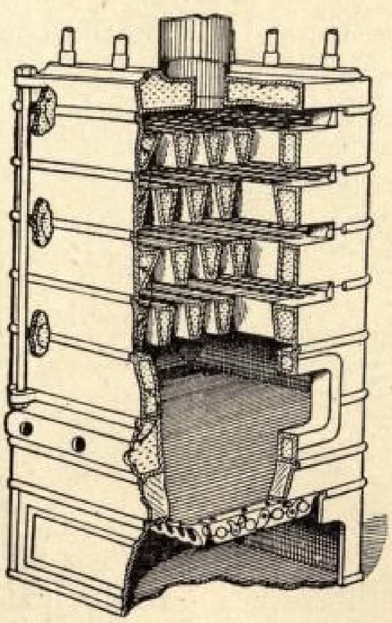


FIG. 96.

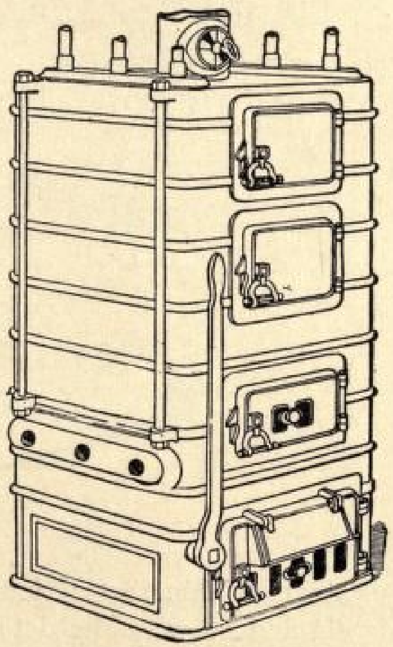


FIG. 97.

all fire-brick the slag of the fire clinkers on it and ruins the brick. On the other hand, when a fire-pot is all iron the heat of the fire is taken away so rapidly that combustion is interfered with and slow fires are more likely to go out, but that with this arrangement enough of the heat of a strong fire is taken away through the iron panel to prevent the adhesion of the slag to the brick, and that with slow fires the brick forms refractory surface enough to prevent the fires from becoming black at the sides. As to the correctness of the theory I do not presume to give an opinion. I do know, however, that the brick lasts much longer arranged this way than when in a continuous ring around the fire, and that they do not clinker.

The fourth section of the boiler is corrugated inside and out to increase the surface. The fifth section forms the crown sheet and above it the tube and flue surface.

A noticeable feature is the system of bolting the sections together. Formerly long bolts ran from top to bottom, but in the improved form short bolts are used, as shown in Fig. 95. Several advantages are claimed for the short bolts, an important one of which is the ability to break any single joint without disturbing the others. In the flue sections all the angles are replaced by curved corners, and the top and bottom surfaces of each section are concaved on the fire side, while the water side is convex, leaving no chance for lodgment of

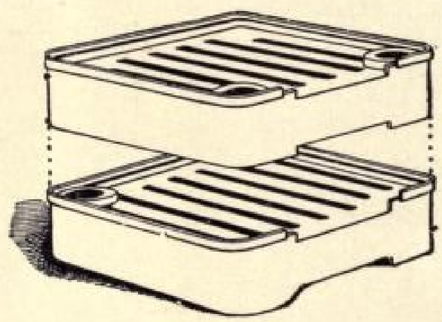


Fig. 98.

air or steam within the sections. Reference to the illustrations (Figs. 94 and 95 with the details above them) show the other peculiarities of the boiler and its general arrangement.

Another of this class of boilers is shown in Figs. 96 and 97. It was called the "Perfect."

It is square and a section lined with fire-brick forms the fire-box. The next two are water sections and form the furnace. The remaining sections form the crown and flue surfaces. This boiler may be said to be a cast-iron box coil, as it fully contains that principle in the arrangement of its water-ways. The water enters the lower hollow section, passes upwards at the front corner into the second section; thence backwards and upwards again to the third section; thence front again, and so on, giving a positive circulation of the water in its passage from the inlet to the outlet. The internal resistance of this boiler compared to a wrought-iron, box-coil boiler is very small.

The Fig. 98 shows two sections of the heating surface above the fire, and the method of joining them at the opposite corners is clearly made apparent. The broken sections, Fig. 96, show

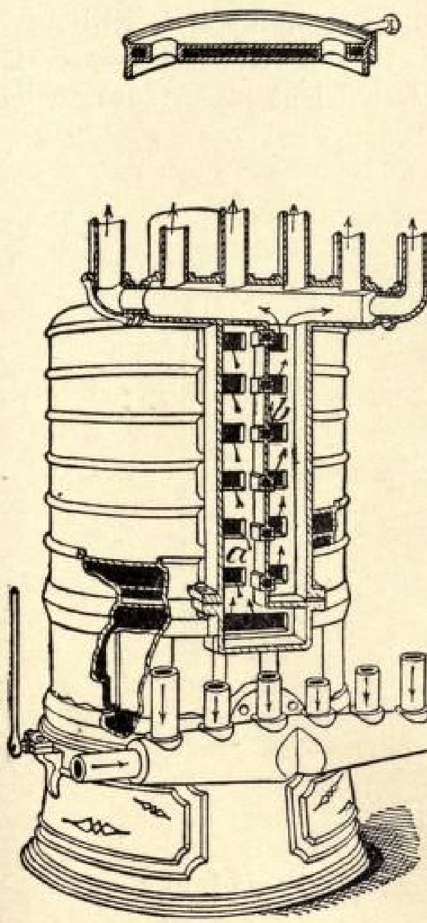


FIG. 99.

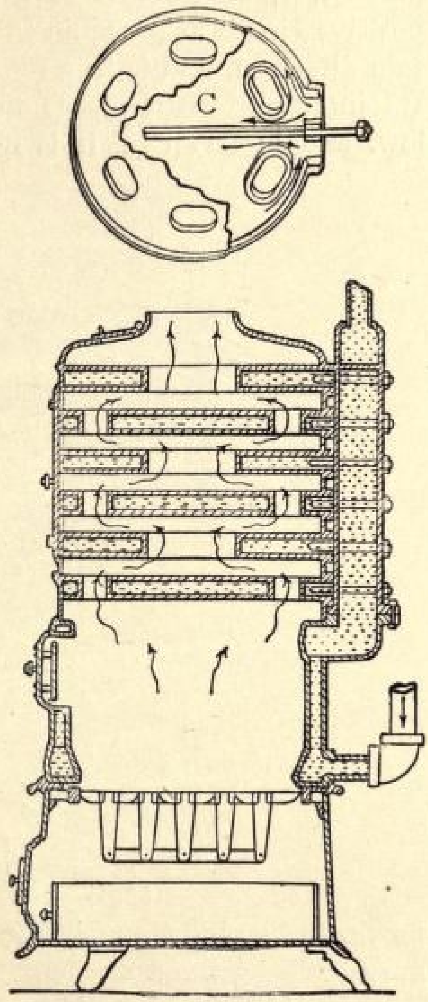


FIG. 100.

the general arrangement and cross section through the V-shaped water tubes.

An early boiler of this class to appear was the "Spence," a Canadian boiler, shown in Figs. 99 and 100.

In general appearance and in some points of detail it resembles the boiler, Figs. 94 and 95, as may be readily seen.

A feature of it is the arrangement of its internal circulation. The water that enters the fire-pot section passes to the second section at the back and enters the upright water passage, *a*, where it is made to flow around the septum, *c*, in each remaining section before it can get into the second upright water passage, *b*, on its way to the flow-pipes at the top. It is a positive circulator, meaning that the water must flow in a certain direction, and is in a measure a cast-iron spiral-coil boiler. Its internal resistance, compared to coil-boilers, however, is low, and in any case it is not of sufficient importance to be

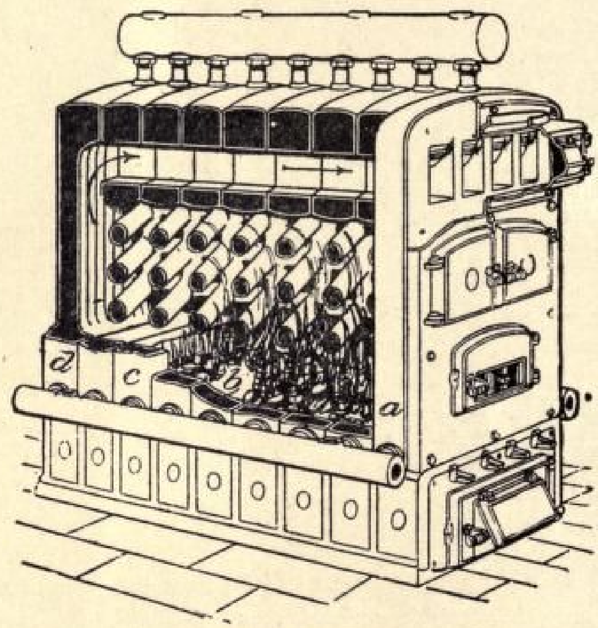


FIG. 101.

particularly objectionable, or to materially add to the resistance of the general circuit.

Figs. 101, 102, 103, 104, and 105 show the Richmond sectional steam and hot water heater. The claims made for this heater are not for any new creation of external form, but for the special construction, arrangement and quality of the fire and flue services, and the system of water-ways, embodying the principle of vertical circulation.

Fig. 101 shows a view of the heater in its ordinary form, but broken, showing the arrangement of the water-ways, fire surface, combustion chamber and flues, and the course of the products of combustion to point of exit.

Fig. 102 shows the front section, which is also a water section, in front of which is placed a shield or front connection, as shown in Fig. 101, and on which the doors are hung. When

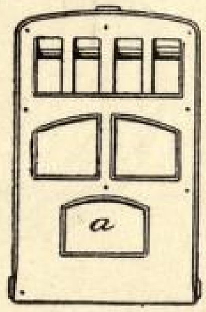


FIG. 102.

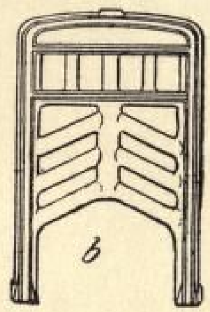


FIG. 103

the heater is to be brick-set a shield or front is furnished, recessed with a flange extending beyond the sides of the heater.

Fig. 103 is a view of leg section, showing the form and arrangement of the surface, placed directly above the fire. This cut also serves to illustrate the system of water-ways and the course of circulation.

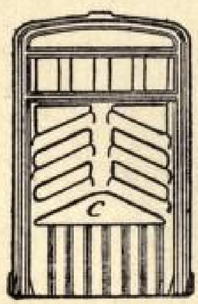


FIG. 104.

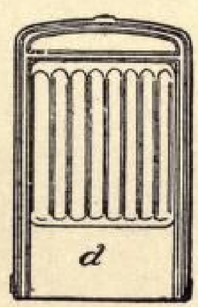
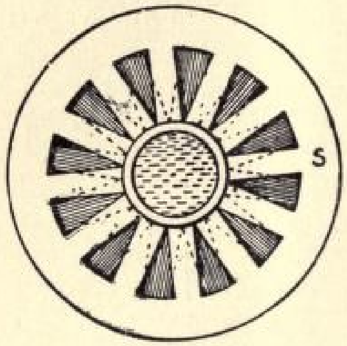
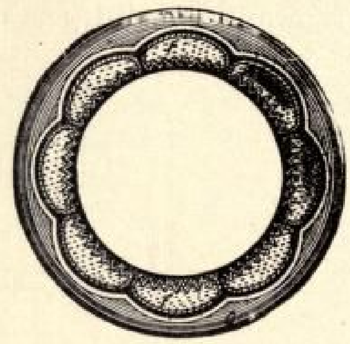


FIG. 105.

Fig. 104 is a view of an intermediate section, which is the first section, placed at the back end of the fire-box, the lower end having a corrugated surface exposed to the direct action of the fire and forming a bridge wall over which the products of combustion pass.

Fig. 105 illustrates a back section, forming the back wall of the heater, and presenting a corrugated fire-surface to the products of combustion in their passage to the flues.





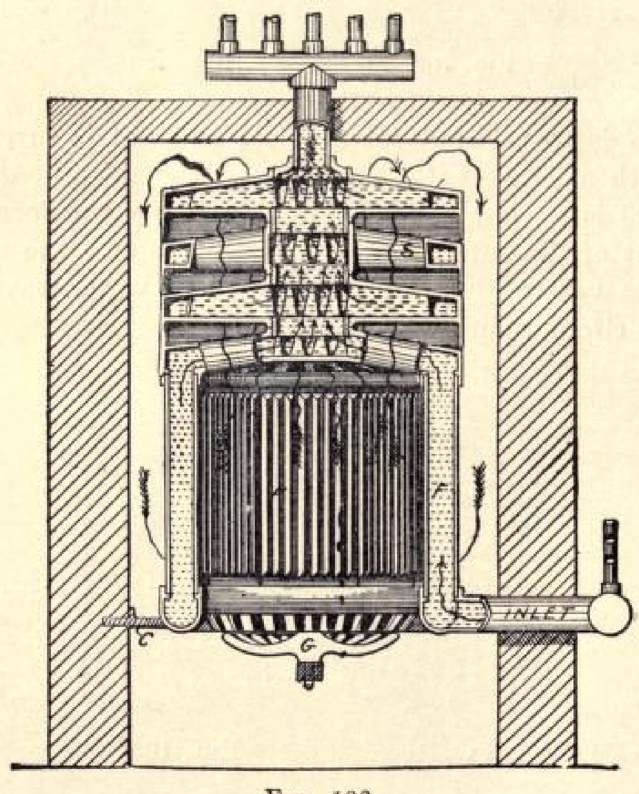


Fig. 106.

The Richmond sectional heater is equally adapted for steam or hot water heating, the steam trimmings being dispensed with, and the necessary provision made for flows and returns when used for hot water.

Fig. 106 shows the Mowry hot-water boiler. It is made up of cast-iron sections with screwed joints, and contains features that may be traced in the boilers shown in Figs. 94 to 99, with many that are particularly its own.

For instance, the fire-box is made up of a number of upright section or "staves," shown in cross section at the upper right hand corner at *F*, which are made into a shoe at the bottom. The upper ends of these staves or fire-pot sections are made into a crown section, which in plan is somewhat like the figure

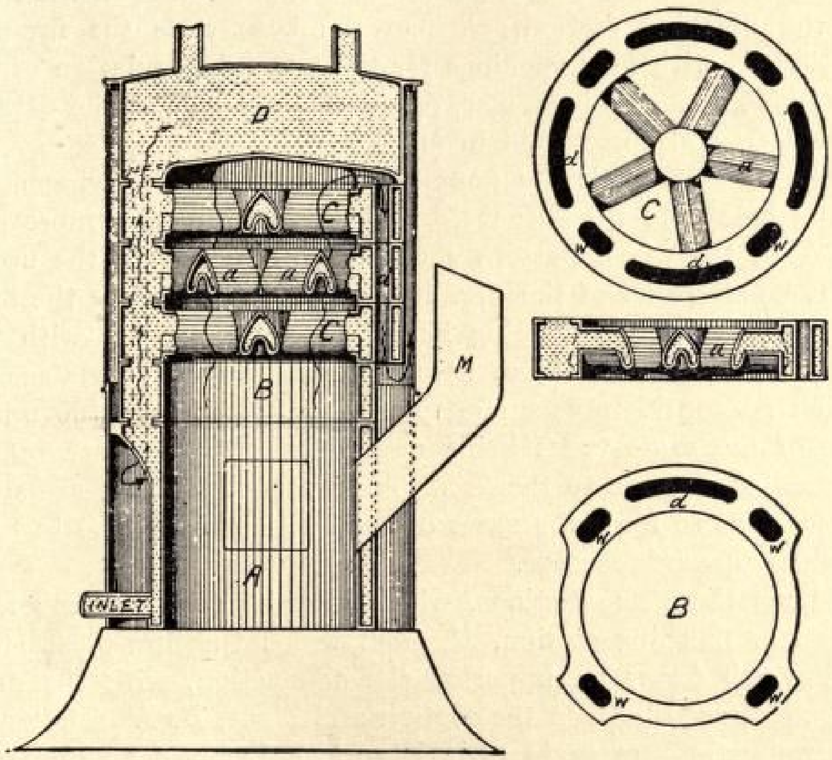


FIG. 107.

in the upper left-hand corner (Fig. 106) and which is composed of V-shaped radial arms. The remaining sections (*s*) are very similar to the crown section, with radial V-shaped arms, arranged one above the other in such a manner that the gases of combustion are deflected from one to the other, so they do not find a straight passage between the arms of the wheel. It is in the V shape of the heating surface of the wheel sections and in the "staggered" arrangement of the flues the similarity to the boilers before mentioned can be seen.

The sections are joined together with 8-inch screwed nipples at the centre as shown, and a manifold header is arranged top and bottom for the flow and return pipes.

Fig. 107 shows the "Auburn" hot-water boiler. It is made entirely of cast iron and consists of a base, in which hangs the grate, the base also forming the ash-pit.

These boilers are jacketed with cast-iron cases up to the centre of the second section, *B*. Above this point a sheet-iron case is used, the lower edge of which rests in the cast-iron case at the bottom, and reaches to the projecting flange at the head of the finishing section, *D*. On the base rests the fire-pot, section *A*, with four openings for the upward circulation of the water. These openings, *w w*, can be plainly seen in the details, *B* and *C*, and correspond in all the sections.

The section, *B*, is the next above the fire-pot: giving additional height to the furnace. Then follows *three* or more sections, of the wheel pattern shown in plan at *C*, in the upper right hand corner of the Fig. 107, these sections form the flue-surface; the arms, *a*, being heart-shaped in section, with the point upwards, the object being to form an upper surface on which no considerable quantity of ashes can lodge, the under side of the same tubes being coved so as to offer as great a surface as possible to the fire. The water-tubes, *a a*, are staggered so as to force the gases of combustion from tube to tube in their upward passage.

Above these flue-sections, which may be of any number, is a cap or finishing section, *D*, from which the flow-pipes start and which forms an upper smoke connection, with the drop flues, *d d*, seen both in the section and plans, *B*, *C*. The gases of combustion are again turned upwards between an iron case and the outside of the boiler, as shown by the arrows in the sectional illustration.

Side magazines are used on these boilers as shown at *M*, and the cleaning-door extends the full height of the flue sections, admitting the introduction of a flue brush at any state of the fire through openings or slots between the sections. The internal resistance of this boiler is very small.

Figs. 108 and 109 show the "Mahoney" boiler. It is simple and efficient, and is made of cast iron in but two pieces, the outer shell, *a*, and the inner casting, *b*, Fig. 109. The internal casting contains the entire fire surface forming no less than the fire-box and the flue surface above it. It is practically an upright-tubular boiler of cast iron, the water being in the leaves, *c*, and the triangular spaces, *d*, between them forming the upright tubes. Fig. 109 is a cross-section through the magazine and flues above the fire-box.

Fig. 110 shows the "Plaxton" hot-water boiler.

It is made in vertical sections, and has the coil principle involved in it. The principle is so apparent with regard to the

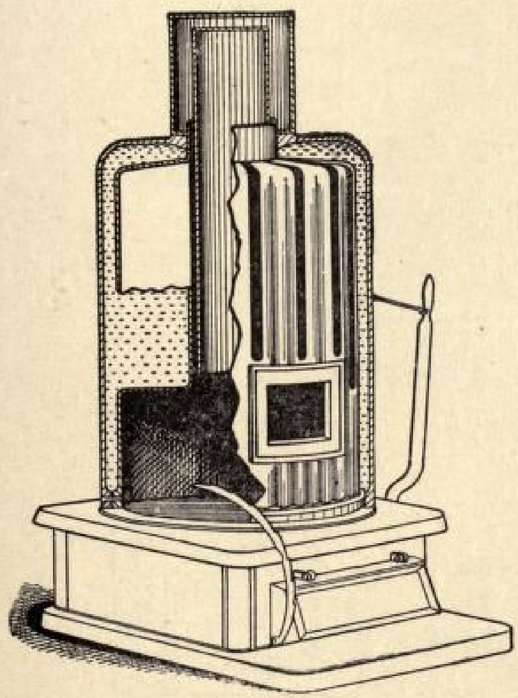


Fig. 108.

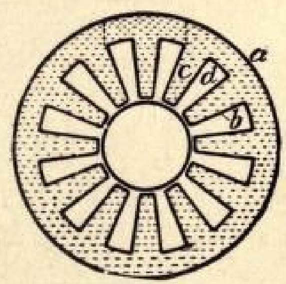


Fig. 109.

direction and movement of the gases of combustion, as well as of the water, that no comment is necessary.

A class of boilers entirely different from anything so far shown is the wrought-iron welded-boiler. They were first made in England, where they are used to a considerable extent.

Figs. 111 and 112 show one of the ordinary forms of this class of boilers. Fig. 111 is the boiler in perspective without setting. Fig. 112 shows it in section with brick setting.

There are many modifications of this boiler made by Hartley

& Sugden, Halifax, Eng. They developed from the simple saddle boiler, *a*, Fig. 113, into boilers like *b*, *c*, *d*, *e*, *f*, and many other forms that it is not necessary to show here.

The form of saddle boiler shown in Fig. 114 has been made in this country for greenhouse heating for many years, by Messrs. Hitchings & Co., of New York. Boilers of this class are set in connection with an ordinary horizontal flue extending through the greenhouse as shown, and the hot-water pipes are

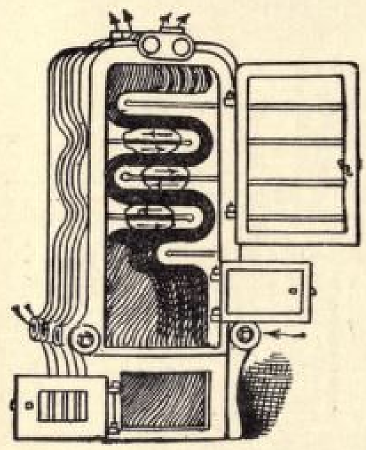


FIG. 110.

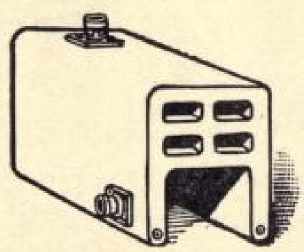


FIG. 111.

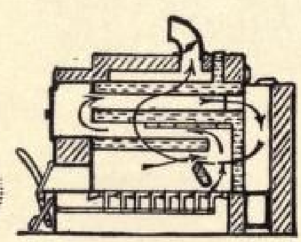


FIG. 112.

carried from the boiler to the side of the house opposite that occupied by the flue, or placed where the heat is most desired, so as to equalize the heat of the house.

The " Champion " boiler, made in Canada, is a type not readily classified. It is shown in Figs. 115, 116, and 117. It has the advantage of presenting a large surface in a small space, however, and may, no doubt, present ideas not suggested by any of the former types. A point about it, which is not purely its own, but which is not apparent in any of the others, is the double grate, where ashes and cinders can be separated and the latter thrown back on the fire, the former being removed at the lower door. There is another and probably greater advantage,

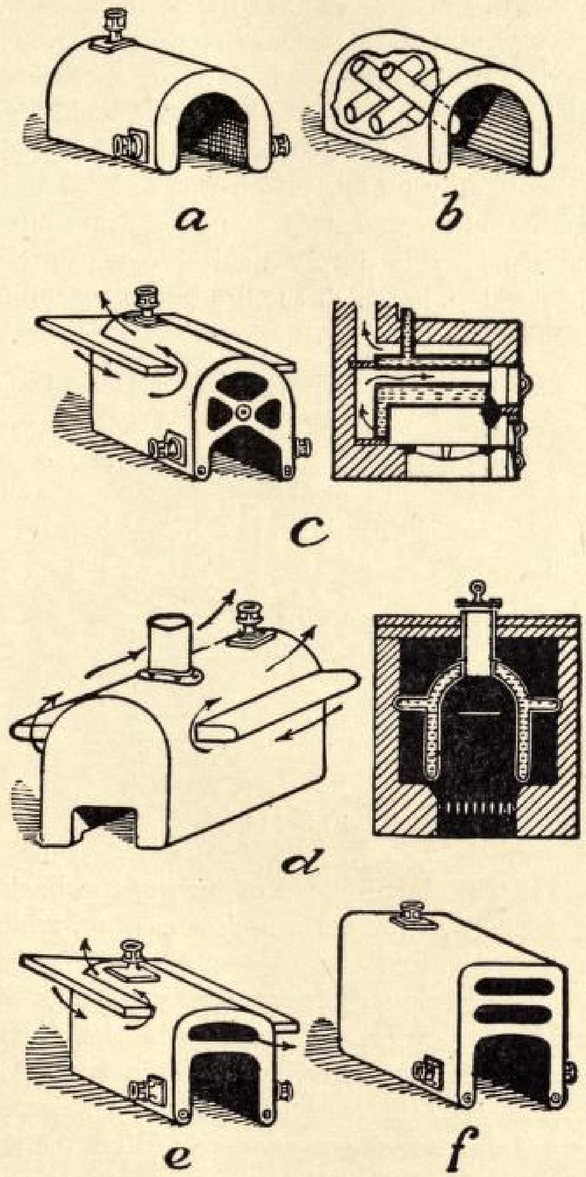


FIG. 113.

however, in the second grate of having the air pass through it and the ashes, etc., it contains on the way to the fire. It results in warming the air on its way to the fire and cooling the ashes and cinders, thereby prolonging the life of the upper or fire grate.

Fig. 115 shows the general appearance of the boiler with the cleaning door, etc., open. Fig. 116 is a back view, and Fig. 117 is a view showing the details of construction.

Before leaving the subject of boilers, or "heaters," as they are often called, I want to refer to a type of small heaters sometimes met with. They are properly water-backs, from which one or two rooms may be fairly well warmed. The one shown, Fig. 118, is a novel arrangement of parlor grate and hot-water heating apparatus, and is simply a suitable open fire-place grate of appropriate design, in which the fire burns, warming the room

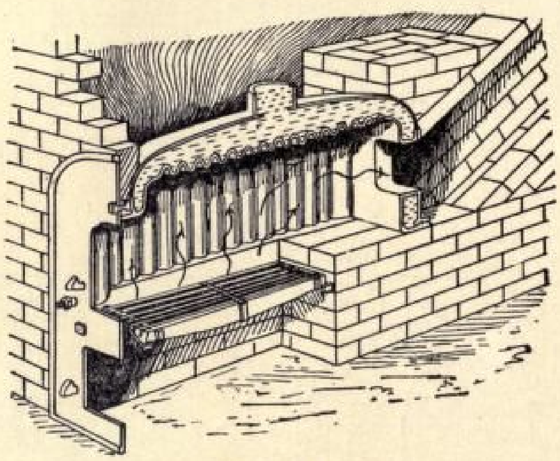


FIG. 114.

in which it is placed, but instead of having the back, sides and top of fire-brick tiles, they are a hollow casting, which properly forms a hot-water boiler.

From this boiler is an ordinary flow pipe of a water-circulating apparatus, as shown at the top in the illustration. A similar return pipe enters the back at the bottom, and from these pipes a system of three or four coils or hot-water radiators can be warmed in a manner exactly similar to that from a regular heating boiler. Usually a room on the second floor of the house can be warmed by the hot water, and when it is necessary to warm a room on the same floor, large diameter pipes and a coil may be used.

To one acquainted with hot-water apparatus, it is enough

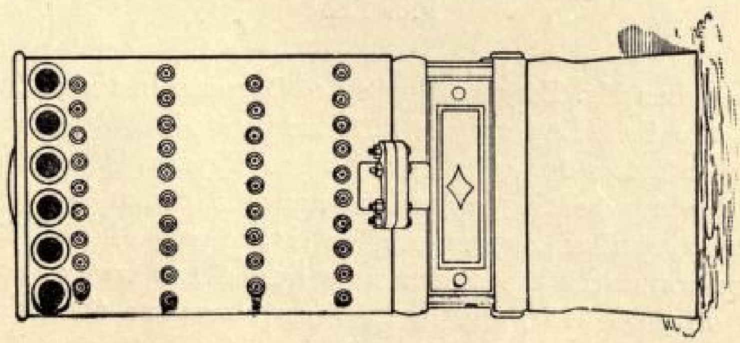


FIG. 116.

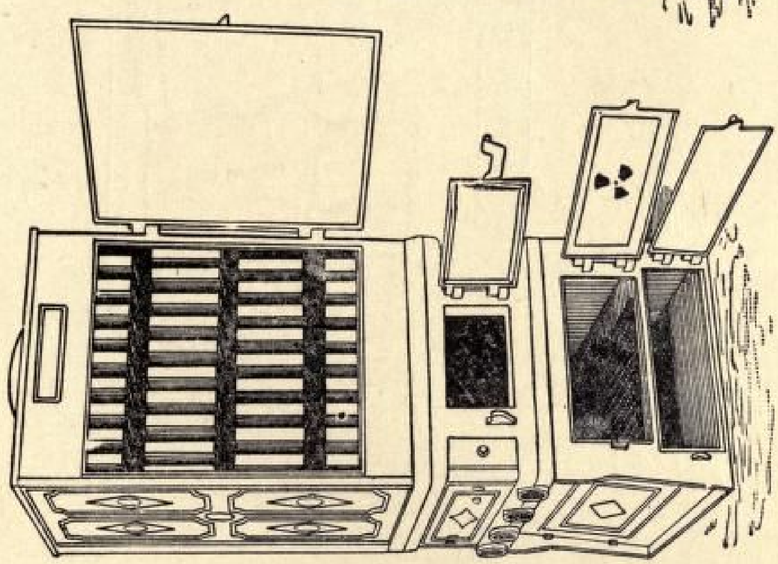


FIG. 115.

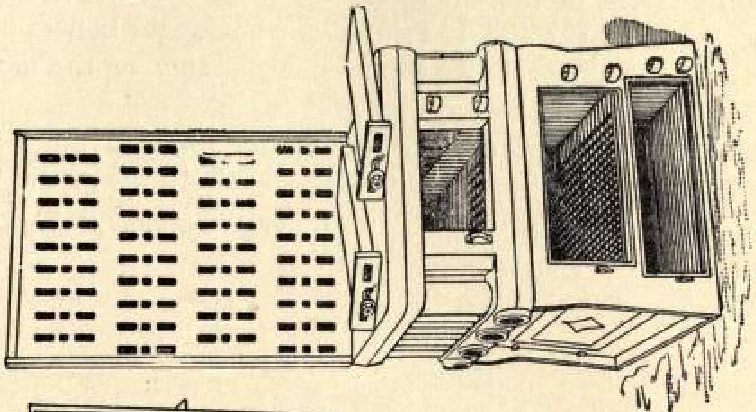


FIG. 117.

to say that an open-tank system may be maintained with it in any usual manner, but it should never be used with a closed tank, on account of the flat sides.

Figs. 119, 120, 121 and 122 show four hot water boilers of the latest types. They occupy a prominent place among the modern hot water boilers of the day.

The use of hot water for warming buildings in the United States is a revival. Steam had almost entirely taken the place of the early methods of hot water heating—except in green-

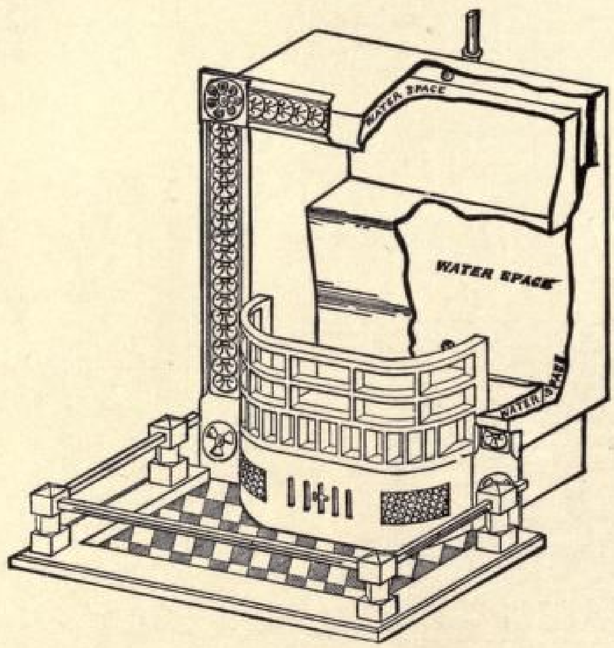


FIG. 118.

houses—when Mr. Edward Gurney of Toronto in the early 80's carried the Canadian system into the United States and substituted radiators for coils in hot water apparatus. This gave the hot water heating apparatus and the steam heating apparatus a similar appearance. The makers of the Bundy radiator converted the steam type into a hot water type (as shown on page 213), and in this way overcame the principal objection offered by American householders. Boston became the headquarters for the hot water boiler trade, until after four or five years the system spread over the country with many

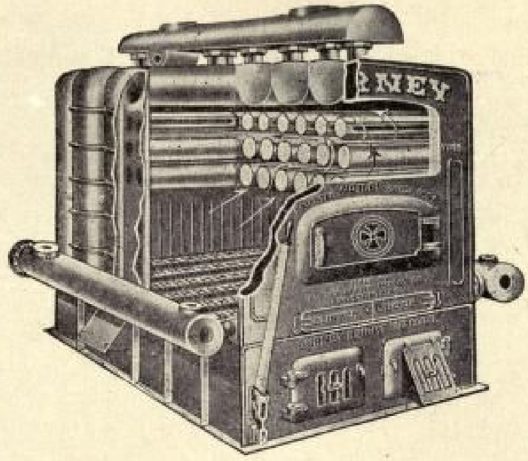


FIG. 119.

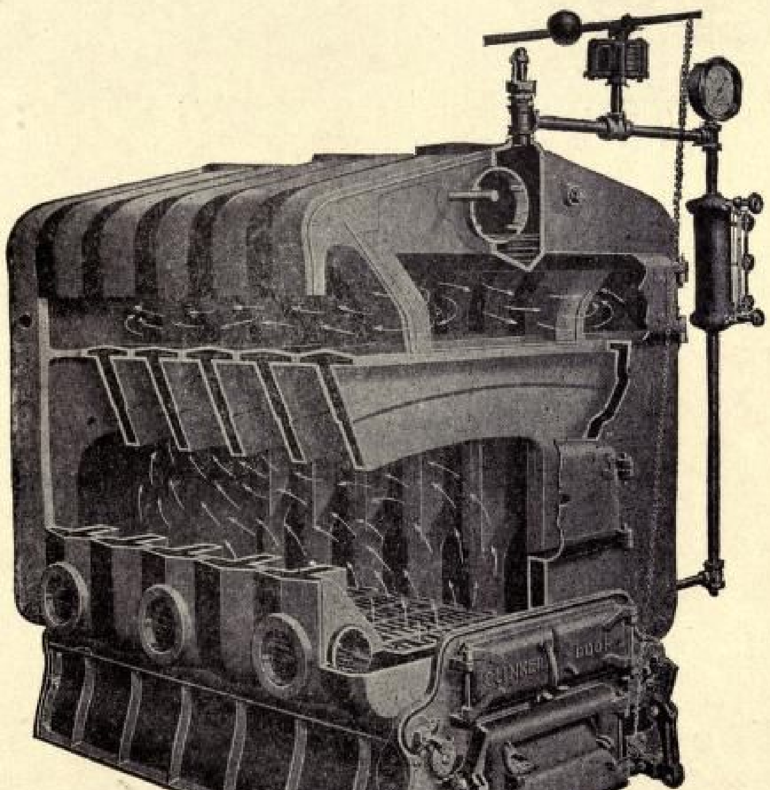


FIG. 120,

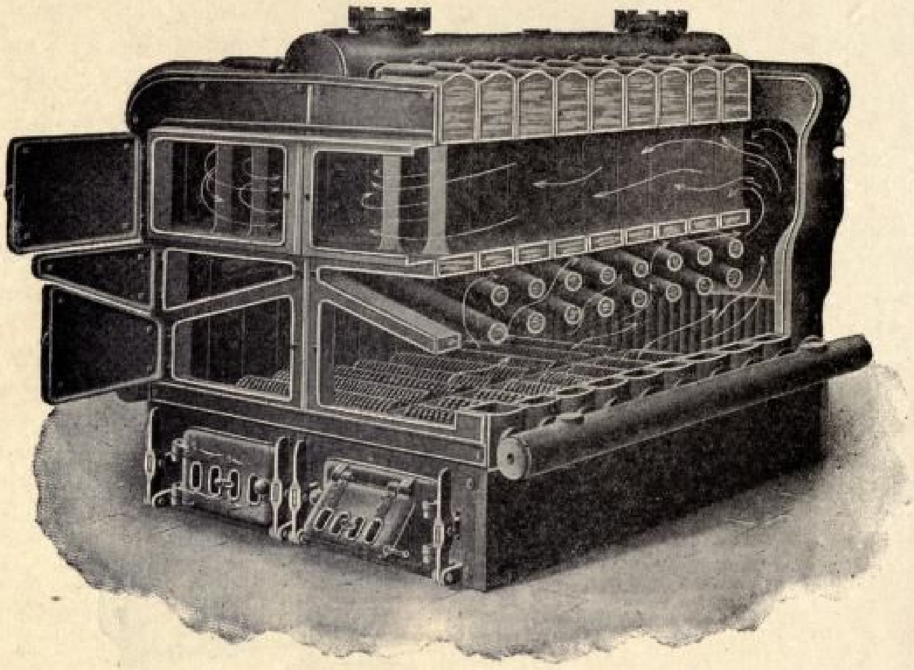


FIG. 121.

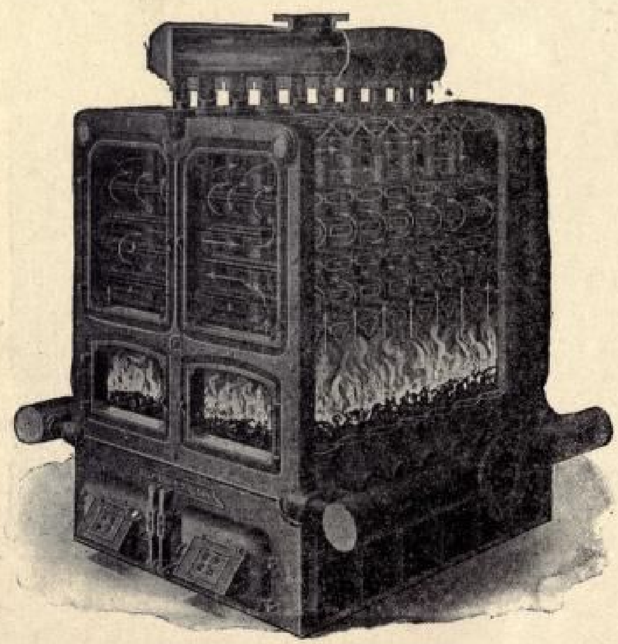


FIG. 122.

improvements in boilers and radiators. This has culminated in the enormous trade, in practical boilers and beautiful radiators which we see to-day, and the great industries which produce them. Fig. 119 shows the Gurney boiler of the present day. It is representative of the drum and header type and its design is such that it is capable of being increased in size and magnitude almost without limit. It is a circulating water tube boiler, the tubes being similar to the Bundy tube. This gives a positive and quick local circulation and a value in heating surface efficiency equal to power boilers. A notable feature of the arrangement of this boiler is that the engineer has power to increase or decrease the grate area. He may, in other words, proportion it as he pleases to the total heating surface of the boiler. This is done by the moving of the bridge wall section.

The writer made the early trial tests of the Gurney Bright Idea boiler and he found the evaporation efficiency very high.

Fig. 120 shows the Ideal boiler. It is made by the American Radiator Company and is probably the finest example of a cast iron sectional boiler without headers or drums. It is a push nipple boiler with extremely effective heating surfaces. It can be rapidly and cheaply put together and the quality of the castings fittings and doors shows an excellence of foundry work and fitting that is extraordinary.

Fig. 121 is a low drum type of the cast iron boiler. It is made by the McCrum-Howell Co. and is a good example of the cast iron sectional boiler, many modifications of which are now on the market. It is known as the Richmond.

The name Boynton has been identified with the cast iron boiler trade for from 15 to 20 years. Fig. 122 shows their latest development of a heating boiler. Their first hot water boiler was without headers and the sections were joined at their corners by asbestos gaskets and long bolts running through the water space. They early abandoned this method of joining the sections and now use the header method exclusively. The writer used one of their "soft-joint" boilers in his own house and despite its defects obtained about 14 years of economical service, before he had to renew it, although it was one of their experimental boilers. In the same house he has the first Detroit hot water radiators and although the upper joints are made on india rubber gaskets, none of their joints have leaked.