STEAM & HOT WATER BOILERS 1840-1930

PRACTICAL

STEAM AND HOT WATER HEATING

AND VENTILATION

A MODERN PRACTICAL WORK ON STEAM AND HOT WATER HEATING AND VENTILATION, WITH DESCRIPTIONS AND DATA OF ALL MATERIALS AND APPLIANCES USED IN THE CONSTRUCTION OF SUCH APPARATUS; RULES, TABLES, ETC.

BY

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CONTAINING OVER THREE HUNDRED SPECIALLY MADE ILLUSTRATIONS SHOWING IN DETAIL ALL OF THE VARIOUS HEATING SYSTEMS, WITH PIPE, RADIATOR AND BOILER CONNECTIONS

NEW YORK

THE NORMAN W. HENLEY PUBLISHING COMPANY

132 NASSAU STREET

1908

EXTRACT FROM ALFRED G KING TEXTBOK OF 1908

CHAPTER III

Evolution of Artificial Heating Apparatus

The arrangement of some form or method of securing warmth within our homes or buildings is a matter to which our attention has grown in keeping with our advancement as a nation.

History relates that among the ancient Romans it was customary for the poorer class to build fires upon a stone or brick floor located at one side or end of a room, the smoke and soot passing out of the room through holes in the roof. The wealthier class used braziers in their living rooms, in which was burned carefully dried wood.

The heating apparatus of our forefathers was the open fireplace, and it is related of the old New England type of fireplace that it was six or eight feet in length and so deep that the children had blocks on which they sat far within, where they could see the stars up the chimney. Large logs of wood were used for fuel. Later, after coal could be purchased, the fireplace was built very much smaller.

In either case a very large proportion of the heat thus obtained escaped up the chimney, probably from seventy-five to ninety per cent being lost in this manner.

As the country grew in population, cities and towns sprang up and fuel became scarcer. Larger buildings were erected and the number of rooms increased until, as a matter of economy, it became necessary to provide some other form of heating apparatus.

To this end the old Franklin stove was designed, followed by later styles more improved, all in order to provide better combustion and save the lost heat.

Again was "necessity the mother of invention," as, to save labor of carrying fuel and ashes for many fires, the idea of centralizing the heating apparatus and of warming several rooms from one fire, led to the adoption of the inclosed stove. Tin or

sheet-iron pipes were used to convey the heated air to each separate room and from this arrangement developed the modern furnace.

Experiments were next conducted with heated water and steam as means of conveying heat from a central point to various parts of a building, a form of heating which has been carried to such a state of perfection as to warrant the use of either system under almost any known condition, and the establishing of foundries and shops for the manufacture of heating apparatus. The development has been such that at the present time there are many millions of dollars invested in the business of manufacturing and installing apparatus for heating by steam and hot water.

The relative efficiency of the several methods of heating may be given as follows:

1. Open Fireplaces.
2. Stoves.
3. Hot-Air Furnaces.
4. Steam.
5. Hot Water.

In classifying them in this order, we consider not only efficiency, but healthfulness, durability, and cost of maintenance, i. e., cost for fuel.

Were healthfulness alone considered, we should prefer the open fireplace to either stoves or furnaces. The waste of fuel in fireplaces and stoves, largely also in hot-air furnaces, is too well known to need many comments.

Fireplaces radiate the heat from one side of the room only, and stoves warm but in spots.

Furnaces fail to produce the right results when placed in buildings not well protected from the wind; and there is no uniformity in temperature where any one of the three above-mentioned systems are used.

Furnaces as ordinarily installed are not much more satisfactory than stoves, and nine tenths of them are too small. They are used in preference to a steam or hot-water apparatus because of the apparent saving in cost. We say *apparent* saving in cost, as after all things are weighed, *there is no saving* in using a furnace in preference to steam or hot water, and it is well that the steam fitter or heating contractor has this fact clearly in mind. There-

fore, we shall discuss this feature of furnace heating very freely and shall consider the matter, endeavoring to show a comparison between the furnace and steam or hot-water heat.

First: As to cost and average life of the apparatus.

Second: As to comfort and healthfulness.

Average Life and Cost

Where a furnace too small is installed, it is necessary, in extreme cold weather, to raise the heating surfaces to an exceedingly high temperature, often a red heat, in order to secure comfort. As a result, the expansion and contraction loosens the joints of the furnace and allows the sulphurous and carbonic-oxide gases and other poisonous products of combustion to escape through the hot-air pipes into the rooms above. This is true of both wrought-iron and cast-iron furnaces.

Again, heating the furnace to this extremely high temperature shortens the life of the apparatus, with the result that ten per cent of the first cost is needed for repairs during the first five years, while, as a rule, the next five years find the furnace entirely worn out.

A steam-heating apparatus has an average life of probably twenty-five years, the first ten years of this period without any repairs except of a trivial nature, such as the repacking of valves, etc.

A hot-water-heating apparatus will last an even greater length of time, without the expense of repairs, the system being practically indestructible. Thus it will be readily seen that while the cost of a furnace, as usually installed, is but one half that of a steam-heating apparatus, or probably two fifths that of a hot-water-heating apparatus, it is, as an investment, not counting healthfulness or the excess amount of fuel consumed, by far the more costly of the three systems.

In pondering the question of cost, we have not taken into consideration the long list of fires and damaged buildings resulting from the "defective flue," nor the damage to house furnishings, due to dust and dirt from the furnace. The housewife, more than anyone else, knows of the constant dusting and cleaning and the frequency with which it is necessary to renew carpets and draperies.

Healthfulness of Furnace Heating *vs.* Steam or Hot Water

We have mentioned some of the disadvantages of heating with a furnace. Let us now consider the healthfulness of the various systems, the quality of the heat produced and its effect on the human system.

A furnace must of necessity have an air supply. The source of this air supply is often very bad. Perhaps the air is admitted to the furnace direct from the basement or cellar in which it is located. This air may be contaminated with the odors from decaying vegetable matter, or gases from a sewer. The air is admitted to the furnace at its base, or from underneath the base, and when a fresh air supply is taken from outside the building, it is frequently conveyed to the furnace through an underground duct which is not air tight, with the result that it gathers impurities from the earth. The duct may run across the basement floor and if not air tight, will, owing to the draught produced by the furnace, suck in the impure air from the basement through the numerous cracks or crevices. With an impure air supply, it is impossible to serve the occupants of the building with pure air. Again, the air is devitalized by passing over metal, heated often to 1,200 or 1,500 degrees Fahr., which robs it of all its health-giving properties.

The advocate of the furnace will endeavor to tell of the pure air which is constantly admitted to the building, and its advantages—an exploded theory, as every heating and ventilating engineer knows.

What then with devitalized air, often charged with dust or poisoned by gases, can we say in favor of the healthfulness of heating with a hot-air furnace? Nothing, except possibly the apparent saving in first cost and the freedom of the house owner from participating in the "semiannual stovepipe performance," viz.—that of taking down or putting up a miscellaneous assortment of stovepipe loaded with soot, as would be the case where stoves were used.

Heating by either steam or hot water has none of the disadvantages mentioned and for this reason, since the large reduction in cost during the last decade, have in their several forms and

variations, been generally adopted as the best methods of heating known.

There are many buildings more or less protected from the variable winds of winter, where a furnace *properly installed* will heat *all parts* of the building to a uniformly comfortable temperature. We emphasize " properly installed " and " all parts " for the reason that the average furnace has neither of these conditions to recommend it. As a rule, the contractor setting the furnace places it near to the center of the basement in order to shorten the hot-air supply pipes and thereby simplify or cheapen the work. It is impossible to force the heated air to the side of the building against which the wind is blowing, and for this reason the furnace should be set near to the side which most frequently receives the action of the wind. We think it safe to say that a furnace installed in this manner and built heavy enough to last a considerable term of years, with the tin work of first quality, will cost one third more than the average furnace job as regularly installed, or to within a very small amount of the price of a low-pressure steam-heating apparatus.

The Heart of the System

In a steam or hot-water heating apparatus, the boiler or heater is the real heart of the system and largely upon the character of the boiler or heater installed, depends the success of the apparatus as a whole.

It has become customary to refer to the heart of a steam-heating apparatus as a " boiler," and to the heart of a hot-water-heating apparatus as a " heater," probably from the fact that in a steam-heating apparatus it is necessary to boil the water to make steam, while in a hot-water-heating apparatus it is necessary only to heat or expand the water in the heater to produce a circulation in the system.

Early Types of Boilers

There seems to be no question but that the original type of boiler used for steam heating was the horizontal tubular, or the upright tubular wrought-iron boiler, or the same character of a boiler as was used for power, and very much the same in outward appearance as those in use to-day.

Fig. 1 shows a standard make of tubular boiler, with full-arch front and manner of bricking.

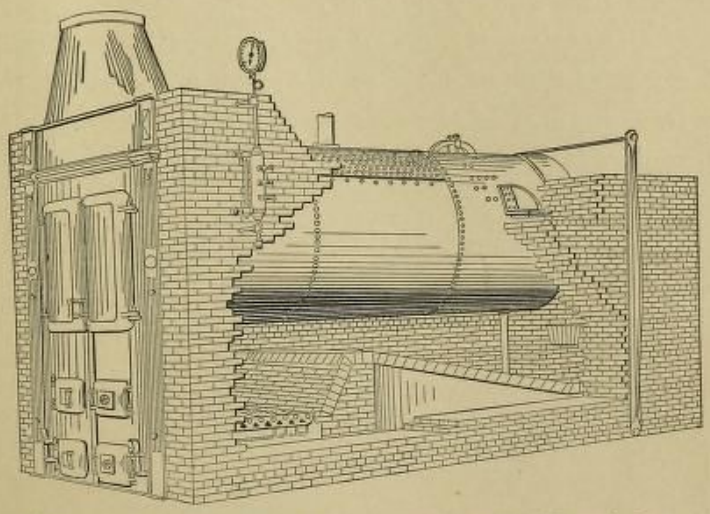

FIG. 1.—Standard type of tubular boiler with full-arch front.

Fig. 2 shows the same character of a boiler, with half-arch front and manner of bricking.

Under "Boiler Setting" will be found explanations and di-

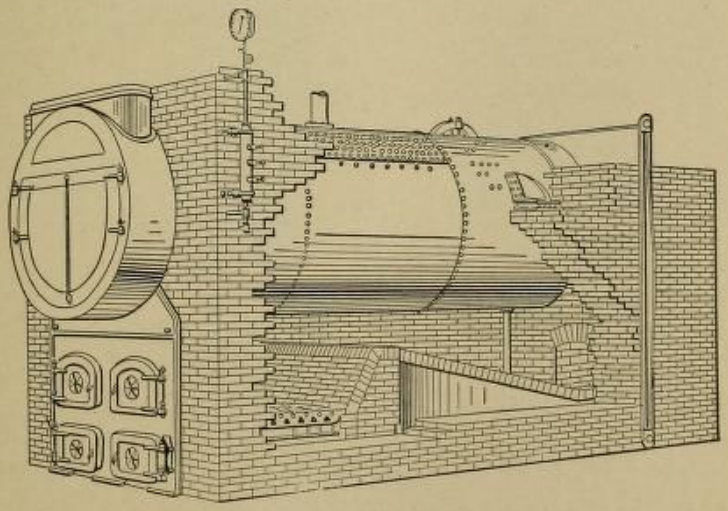

FIG. 2.—Standard type of tubular boiler with half-arch front.

rections for setting each of the above, with sketches showing ground plan, longitudinal section and cross section of brickwork, etc.

The original type of upright tubular was mounted on a brick

and iron base, forming the ash pit and supporting the grate. Fig. 3 shows this boiler as it is now commonly used, with a cast-iron portable base and without brickwork.

One of the earliest types of wrought-iron boilers used exclusively for heating purposes was designed and patented by Mr. William B. Dunning, of Geneva, N. Y., and is yet manufactured as the Dunning Boiler in an improved form by the New York Central Iron Works Company.

Fig. 4 shows the shell of this boiler; Fig. 5, the boiler as it appears when bricked.

Another early type and somewhat similar character of a boiler

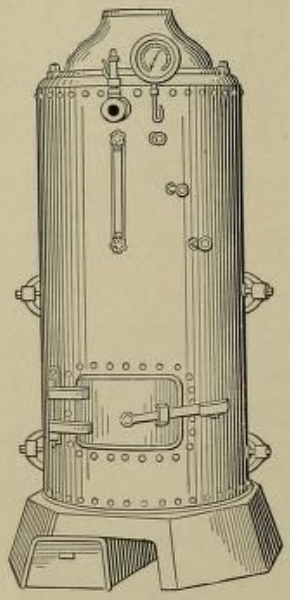

FIG. 3.—Common type of upright tubular boiler.

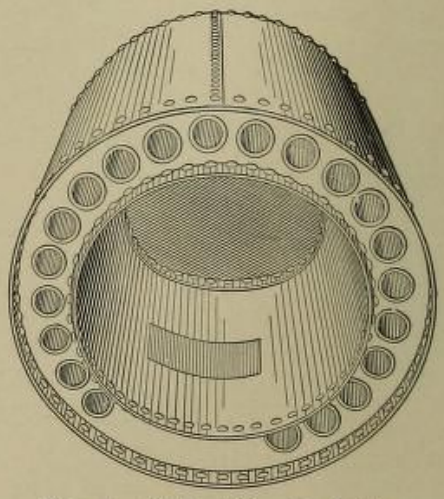

FIG. 4.—Shell of Dunning boiler.

is shown by Fig. 6. This is known as the " Haxtun " boiler, manufactured by the Kewanee Boiler Company, Kewanee, Ill.

Many other boilers of similar construction were built and sold, following the introduction of those illustrated, some of them having a local sale only, being used in the immediate vicinity where they were manufactured.

It is probable that the H. B. Smith Company, of Westfield, Mass., were the pioneers in the manufacture of the cast-iron boiler for steam heating, as the Gold Boiler (see Fig. 7), manufactured

by this concern, was undoubtedly the first of the cast-iron steam boilers, and as such should receive more than a passing mention.

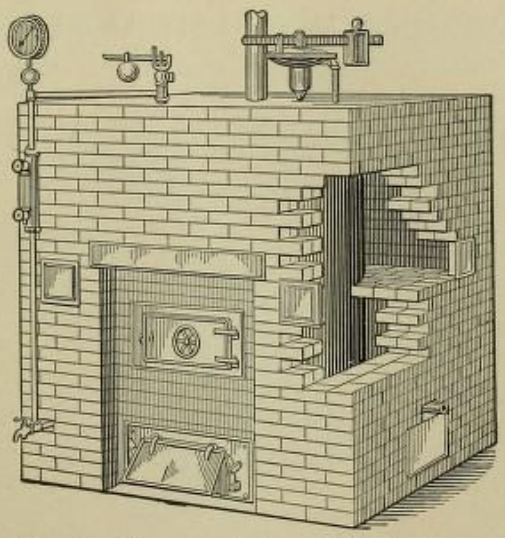

FIG. 5.—Dunning boiler set in brickwork.

Reference to the illustration (Fig. 8) will show the Mills Boiler and the manner in which this boiler is constructed. The

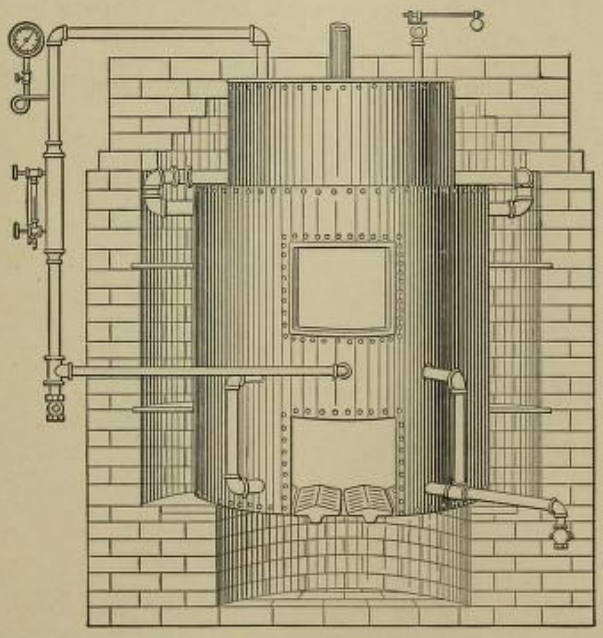

FIG. 6.—The Haxtun boiler.

sections are cast in halves, and on the square or rectangular base supporting the grate, these half sections are erected in pairs. The

upper parts of the half sections are joined to a central dome or header, lock-nut nipples being used for this purpose. The upper part of each half section, as well as the header suspended between these half sections, form a steam chamber from which the supply

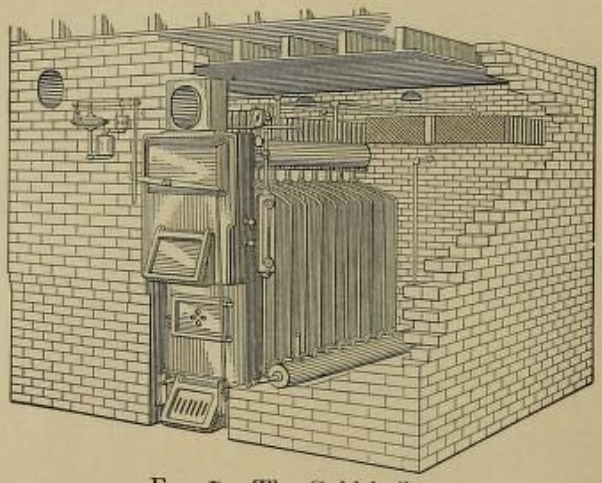

FIG. 7.—The Gold boiler.

pipes are taken. In depth these sections are about six inches, and they may be arranged to form a boiler of practically any size desired.

Along either side of the boiler is a cast-iron header into which

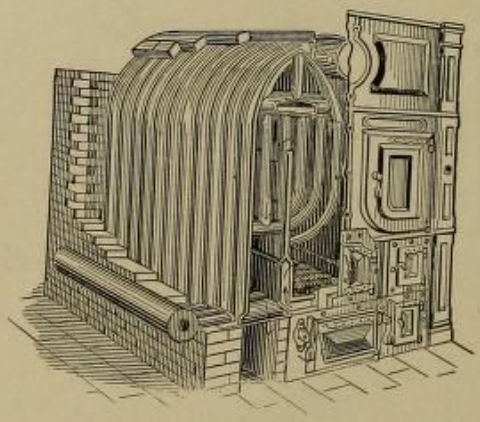

FIG. 8.—The Mills boiler.

the various return pipes are connected, the water being admitted to the boiler through nipples connecting each individual half section with the return header. This connection is made in the same manner as the connections to the steam header with lock-nut

nipples. Each half section, therefore, is a unit or boiler by itself, contributing its quota of steam to the steam chamber above.

This proved to be a very strong type of boiler, able to withstand

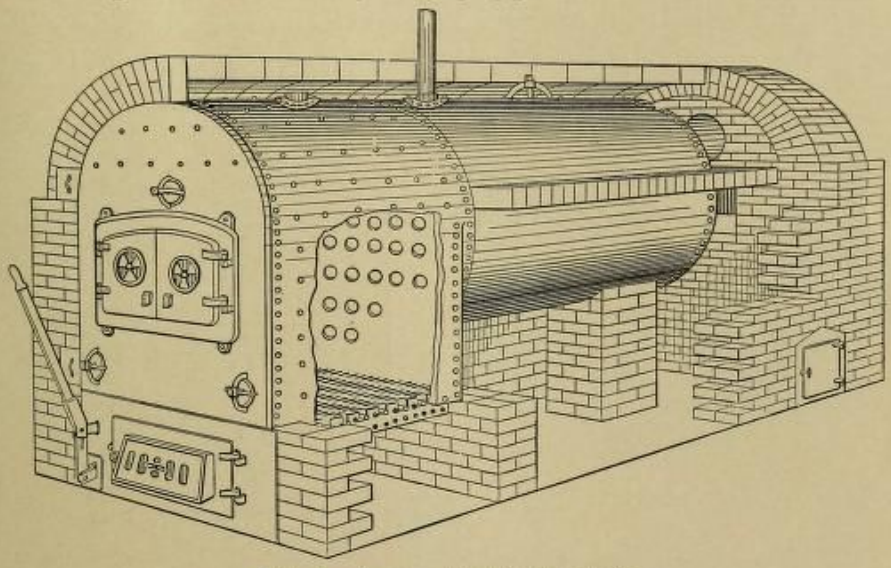

FIG. 9.—Locomotive fire-box boiler.

a considerable pressure and being also a quick and powerful steamer.

It is worthy of note that some of the more modern boilers are

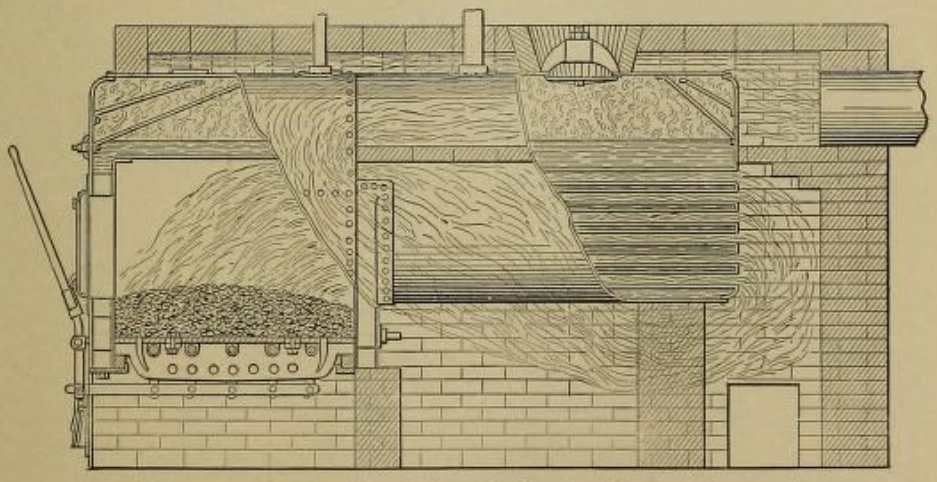

FIG. 10.—Locomotive fire-box boiler showing smoke travel.

built along the lines of the Mills Boiler, without the brick setting. We refer to the "divided-section" or "half-section" idea of boiler construction which we illustrate elsewhere.

Aside from those already mentioned, the most common type of wrought-iron boiler now used for heating is the locomotive fire-box boiler, as illustrated by Fig. 9 and Fig. 10. Fig. 9 shows a view of the boiler as it appears in the bricking, and Fig. 10 shows the smoke travel. In some localities these boilers are used largely

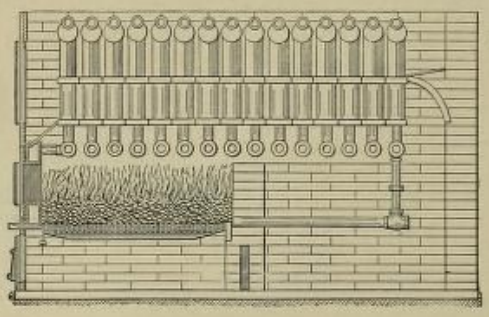

Fig. 11.—Page safety sectional boiler.

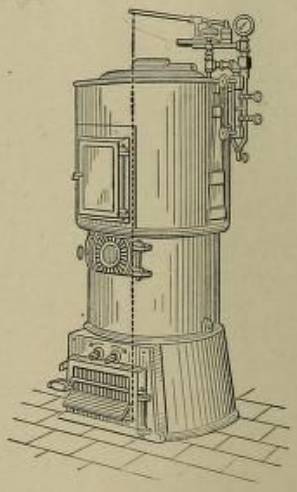

Fig. 13.—Original type of Volunteer boiler.

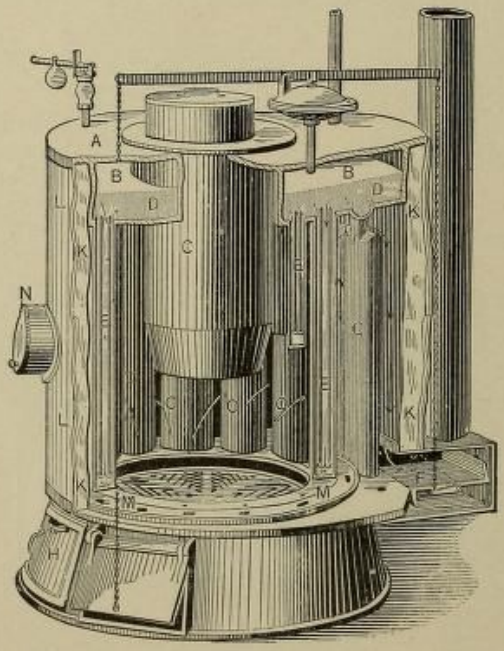

Fig. 12.—Original type of Furman boiler.

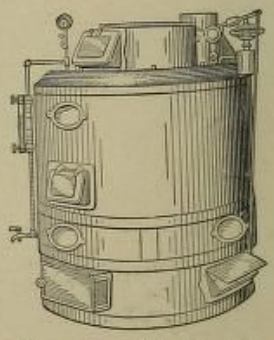

Fig. 14.—The Florida boiler.

in apartment houses and business blocks, and while there is considerable argument as to their longevity and economical qualities, it is an established fact that they are comparatively quick steamers and do the work required of them.

Still another of the early types of sectional brick-set boilers is

shown by Fig. 11. It is the Page Safety Sectional Boiler and it also is capable of withstanding a heavy pressure for a cast-iron heater. A few of the earlier designs of heating boilers had maga-

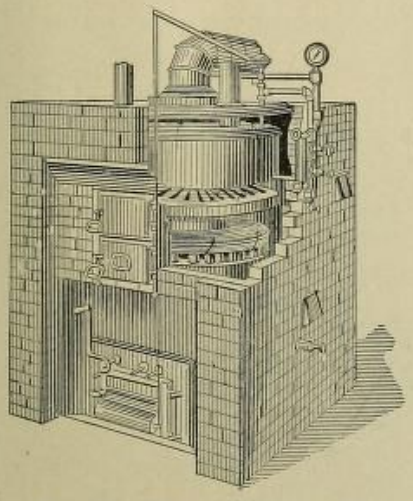

FIG. 15.—The All Right boiler.

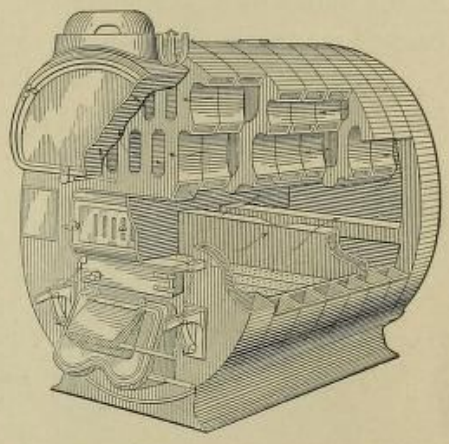

FIG. 16.—The Bundy cast-iron tubular boiler.

zine feeds similar to that of a parlor stove, although at the present time the number of boilers sold so equipped is very small.

The Furman Boiler, Fig. 12, the Volunteer Boiler, Fig. 13, the

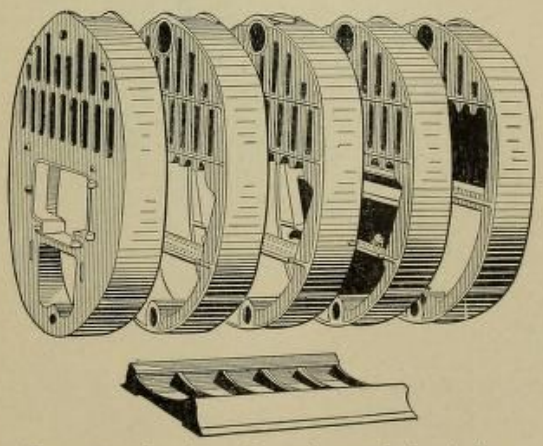

FIG. 17.—Sections of cast-iron tubular boiler.

Florida Boiler, Fig. 14, the All Right, Fig. 15, comprise some of the earlier round and sectional boilers.

Many of the early models of round boilers were cased with a jacket of black or galvanized iron, frequently lined with asbestos.

The latest method of boiler construction, however, dispenses with the brick setting and the sheet-iron casing, the sectional, as well as the round boilers, being portable, and, when covered, are coated to the depth of 1″, or more, with a plastic cement made of a mixture of magnesia and asbestos.

A departure from the regular style of cast-iron sectional boiler is shown by Figs. 16 and 17. It is the Bundy Tubular Boiler

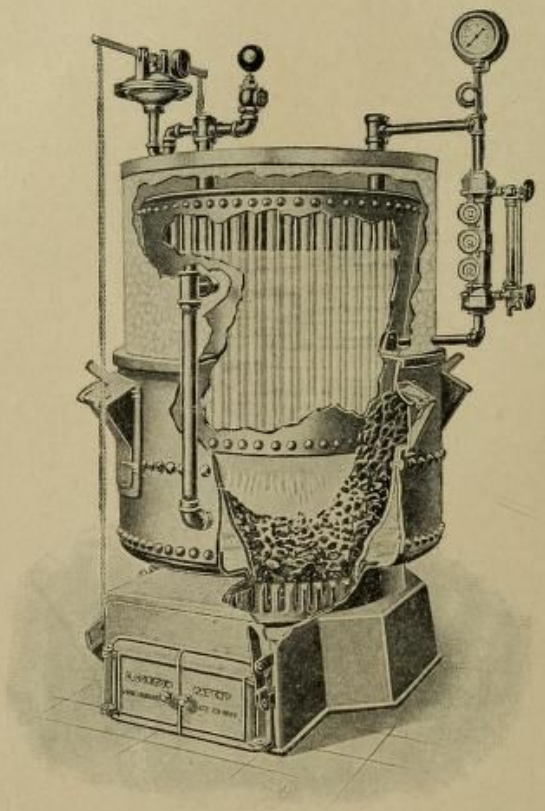

Fig. 18.—The Gorton boiler.

and is on the order of the Scotch Marine type of construction. The Gorton Side-feed Boiler, as shown by Fig. 18, is a peculiar type of wrought-iron boiler construction.

So rapid has been the advancement in methods of boiler construction during the past ten to twenty years that a large number of styles have been and are now being manufactured, approximating probably over one hundred varieties.

Among the round boilers may be found, in addition to those

already mentioned, the Doric, Richardson, Boynton, Cambridge, Ideal, Richmond, Orbis, Winchester, Capitol Mascot, Arco and Radiant.

In the list of manufactured sectional boilers we find the Mercer, Richmond, American, Ideal, Thermo, Carton, Sunray, Sunshine,

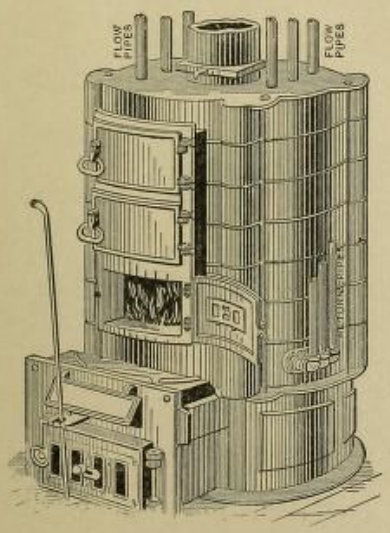

FIG. 19.—Early type of Gurney hot-water heater.

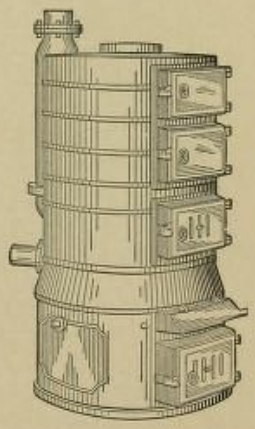

FIG. 20.—The Spence hot-water heater.

Boynton, Cornell, Monarch, Furman, Capitol, Gem, Model, Thatcher, Richardson, Royal and many others which lack of space prevents our mentioning.

Hot-Water Heaters

What has been said regarding the multiplicity of steam boilers is equally applicable to hot-water heaters.

One of the pioneer heaters was the Gurney, shown by Fig. 19. In the Spence Heater, Fig. 20, we have another early design of a hot-water heater. Each of these heaters was originally made in Canada, as was also the Champion, a heater of square construction manufactured at Montreal by Rogers & King.

The Spence Heater in Canada was known by the name "Daisy," and it was after being brought to this country that it was called the "Spence." This heater in this country was originally manufactured by The National Hot Water Heater Co.,

of Boston, Mass., long since out of business, and is now one of the productions of the Pierce, Butler & Pierce Mfg. Co., Syracuse, N. Y.

The firm of E. & C. Gurney Co., of Toronto, Canada, were the

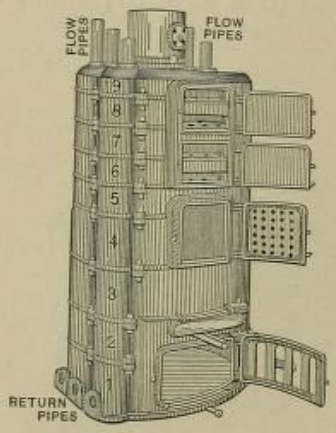

FIG. 21.—Improved Gurney heater.

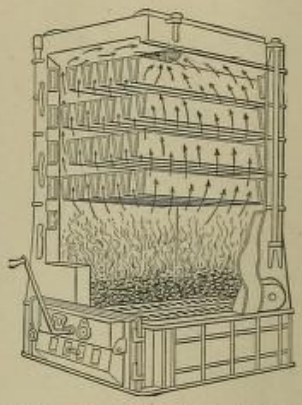

FIG. 22.—The Perfect hot-water heater.

original builders of the Gurney, which, when brought to this country in the year 1884, was manufactured under the same firm name, but now known as the Gurney Heater Mfg. Co. This boiler was

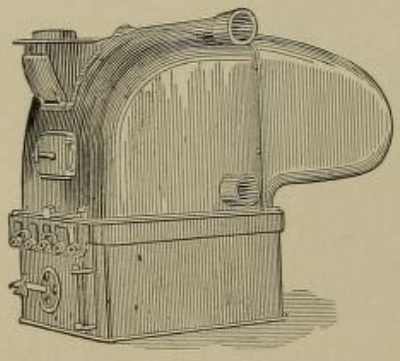

FIG. 23.—The Hitchings hot-water heater.

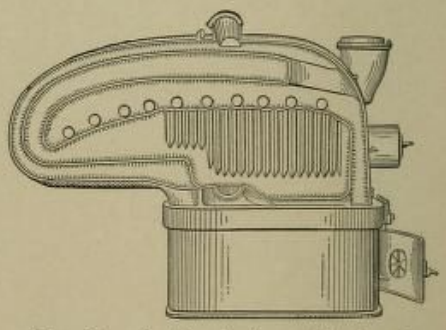

FIG. 24.—Sectional view of hot-water heater.

further improved as shown by Fig. 21, and later, still other improvements were made in its construction.

The Perfect Heater, Fig. 22, was another of the old-time heaters which helped to contribute to the success of hot-water heating in this country.

We have still another type in the Hitchings Boiler, Fig. 23 and Fig. 24. This was an old-time cast-iron heater of peculiar construction, originally intended for the heating of hothouses, and known as a Corrugated Fire-Box Boiler. It was first made about the year 1867. The concern who manufactured it was established in 1844, and their first production was a conical-shaped affair.

Fig. 25 shows the Carton, one of a number of later styles of sectional hot-water heaters.

The advancement in the manufacture of hot-water heaters has kept pace with the improvements in the steam boiler, and many

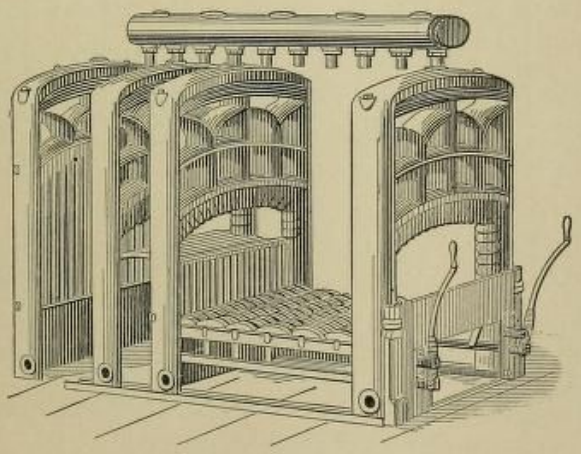

Fig. 25.—The Carton hot-water heater.

manufacturers make both steam and hot-water heaters under the same name and with the same general form of construction.

We have spoken of the half-section or divided-section type of boiler construction, as shown by the original Mills Boiler. This has, in a very great measure, come to be a favorite method of building sectional boilers. The Capitol, The Monarch Sunshine, and the Henderson Thermo are boilers of this type. Fig. 26 shows a line drawing of the Thermo, illustrating the style of sections and the manner of nippling them together.

Naturally it would seem that with such a large number of makes and types of boilers, the steam fitter or heating contractor would get confused in the selection of a suitable boiler or heater, but such should not be the case. Each individual fitter may have

his own ideas of what constitutes a good boiler or heater, and select his favorite type of boiler construction. Again, his customer may have previously decided upon the make of heater he

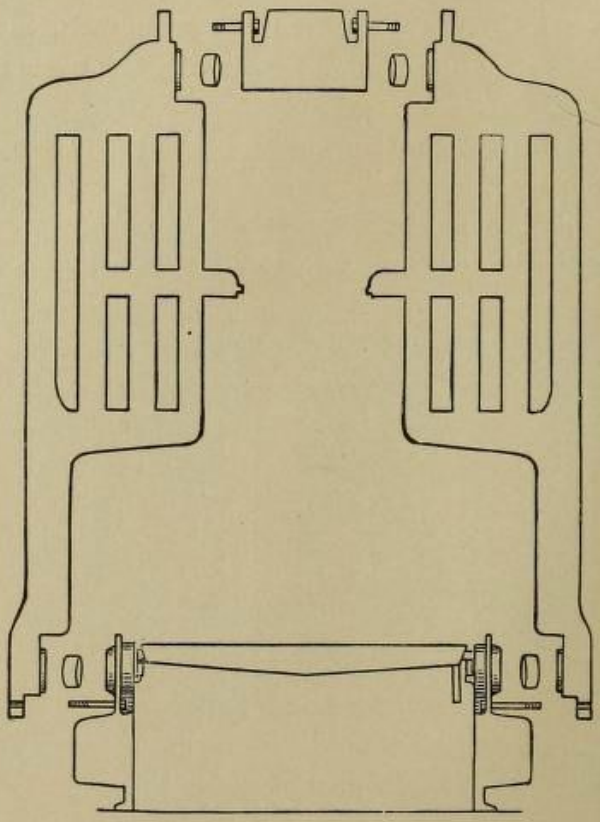

FIG. 26.—Line cut of the Thermo hot-water heater.

wishes installed,—a fact which the fitter cannot afford to overlook, as it is much easier to sell a prospective customer what he wants than what he does not desire, or thinks that he does not.