

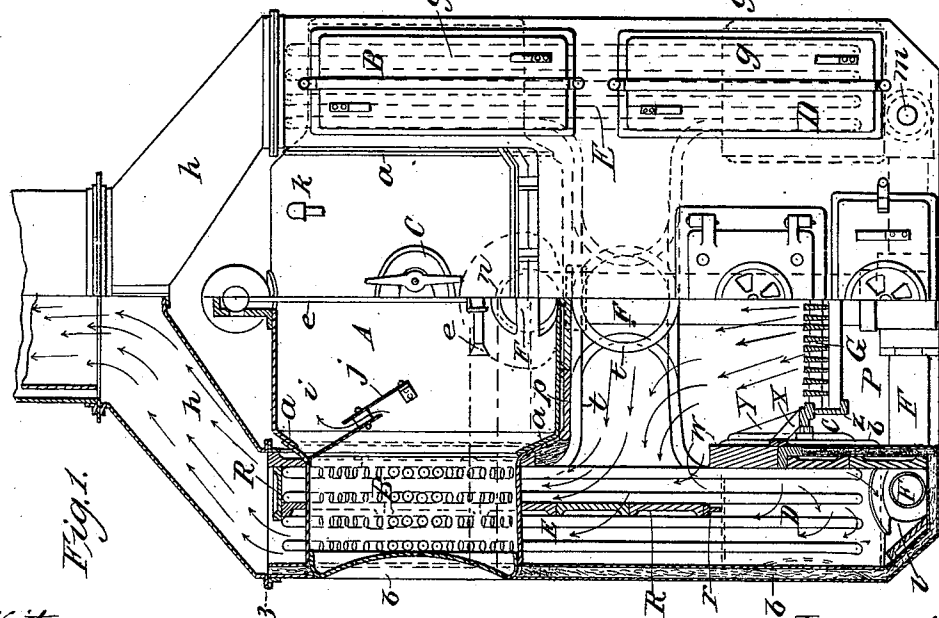
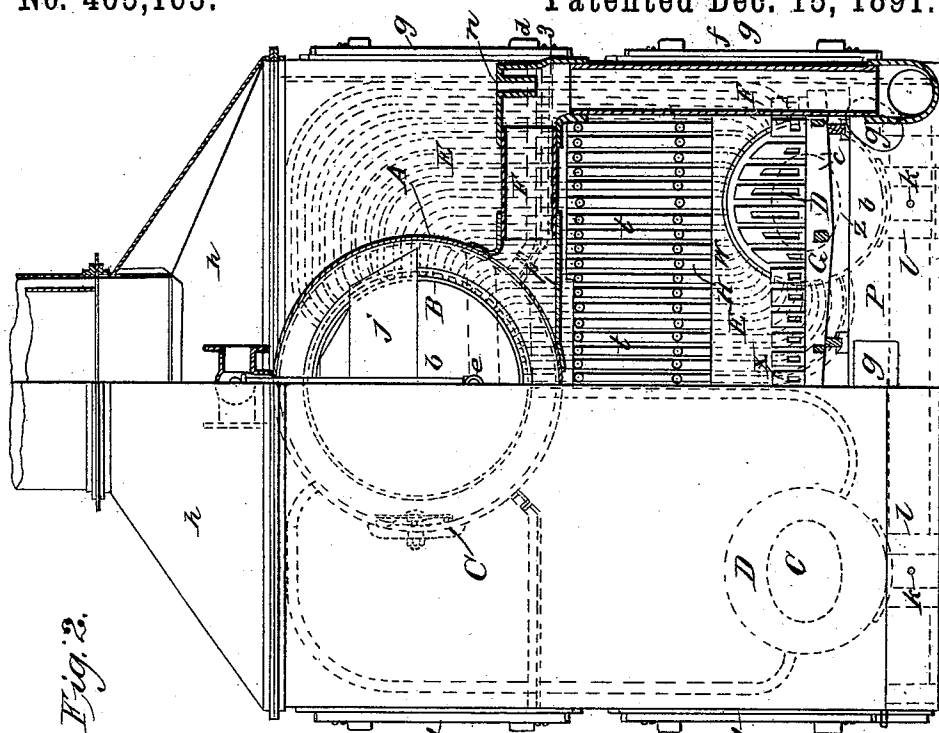
(No Model.)

4 Sheets—Sheet 1.

W. COWLES.
WATER TUBE BOILER.

No. 465,163.

Patented Dec. 15, 1891.



Witnesses:

E. M. B. B. B.
J. Kennedy

Inventor.

William Cowles

By *Philip Phelps & Co.*
attys

(No Model.)

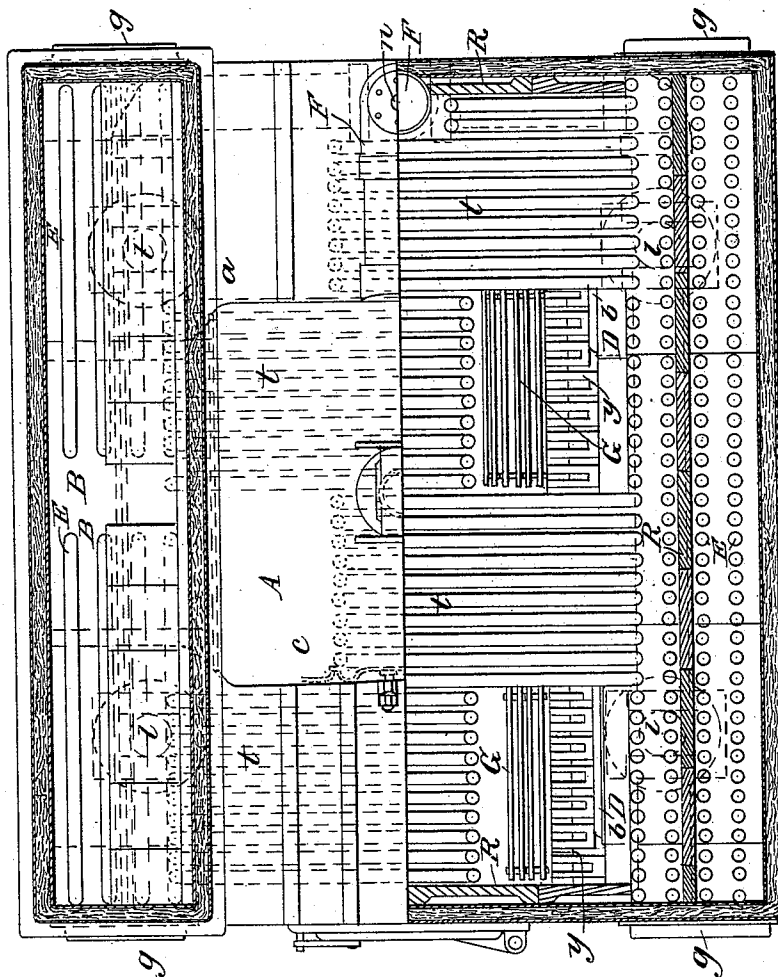
4 Sheets—Sheet 2.

W. COWLES.
WATER TUBE BOILER.

No. 465,163.

Patented Dec. 15, 1891.

Fig. 3.



Witnesses:

J. M. Brown
J. Kennedy

Inventor:

William Cowles
By *Philip Phelps & Co.*
attys

4 Sheets—Sheet 3.

No. 465,163.

Patented Dec. 15, 1891.

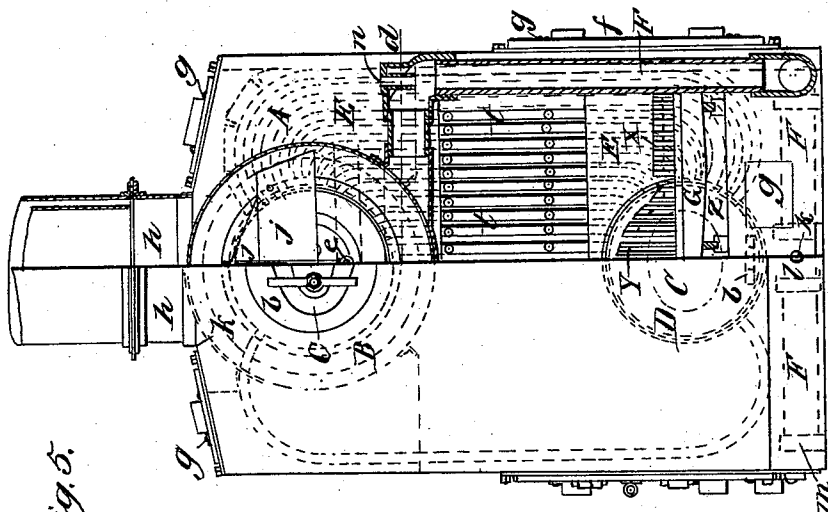


Fig. 5.

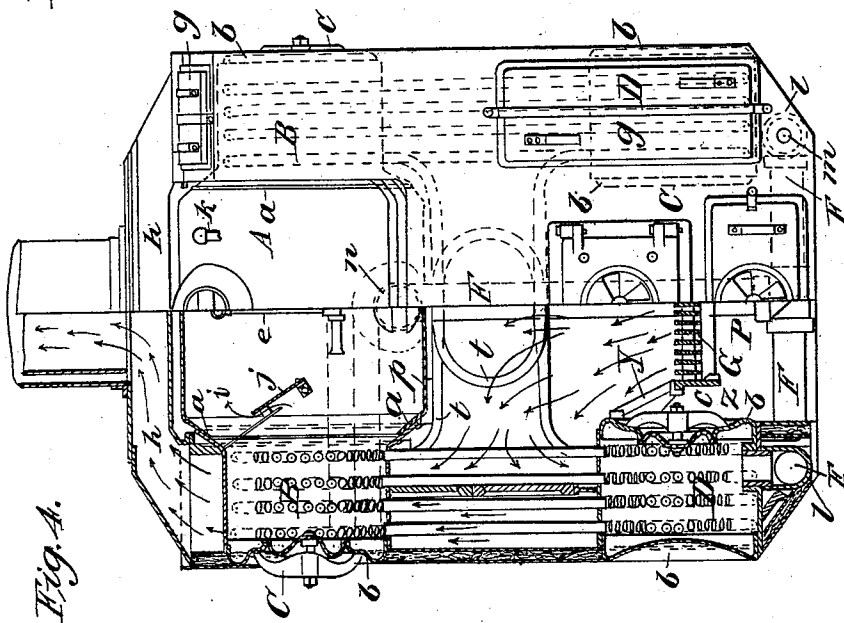


Fig. 4.

G. M. Boring
J. F. Kennedy

Inventor:
William Cowles
By Philip Phelps & Henry
Atty

(No Model.)

4 Sheets—Sheet 4.

W. COWLES.
WATER TUBE BOILER.

No. 465,163.

Patented Dec. 15, 1891.

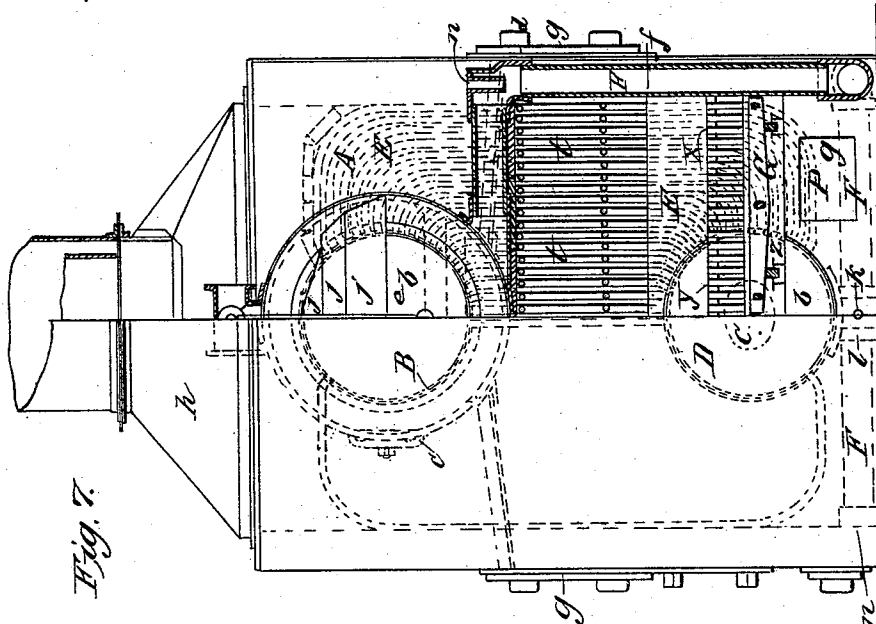


Fig. 7.

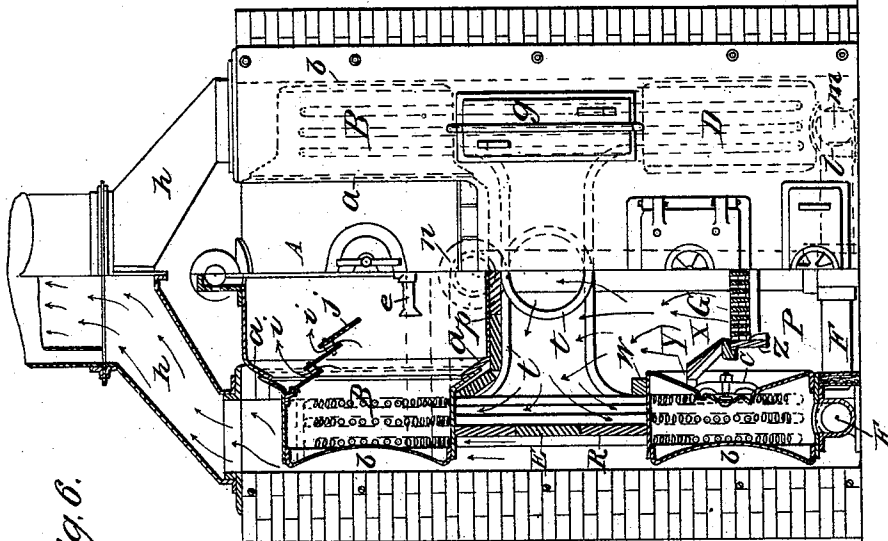


Fig. 6.

Witnesses:

G. W. Borer
J. Kennedy

Inventor:

William Cowles

By *Philip Phelps* Attorney
atty

UNITED STATES PATENT OFFICE.

WILLIAM COWLES, OF BROOKLYN, NEW YORK; ASSIGNOR TO THE COWLES
ENGINEERING COMPANY, OF JERSEY CITY, NEW JERSEY.

WATER-TUBE BOILER.

SPECIFICATION forming part of Letters Patent No. 465,163, dated December 15, 1891.

Application filed June 13, 1890. Renewed May 22, 1891. Serial No. 393,709. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM COWLES, a citizen of the United States, residing at Brooklyn, county of Kings, and State of New York, have invented certain new and useful Improvements in Water-Tube Boilers, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

This invention relates to steam-boilers, and especially to that general class of steam-boilers in which the water is caused to circulate through circulating-tubes between one or more water-drums or manifolds located at or near the bottom of the boiler and one or more steam-drums or manifolds located at or near the top of the boiler.

It is the object of the present invention to improve the general construction of boilers of this class and to provide a boiler which shall be light, compact, and of simple construction; in which all the parts shall be easily accessible and so constructed and arranged that the cleaning and repair of any part shall be possible without removing or disturbing other permanent parts of the boiler; in which the heating-surface shall be such as to secure the greatest economy of operation and to avoid danger from overheating or sudden and unequal heating and cooling; and in which the space for steam and water is enlarged as greatly as possible and a rapid circulation of all the water secured.

With these ends in view my invention consists in various constructions and combinations of parts, all of which will be more particularly described in the specification, and pointed out in the claims.

While the improvements constituting the present invention are of general application in this class of boilers and such as to constitute a new boiler, the boiler has been designed especially as an improvement in the type of boiler covered by United States Letters Patent No. 396,545, granted to me January 22, 1889.

A single-ended boiler is shown in the Letters Patent above referred to; and one of the general objects of the present invention being to construct a double-ended boiler of this type the improvements constituting my in-

vention will be described and illustrated as embodied in a double-ended boiler; but it will be understood that certain improvements included in the invention are applicable to boilers either of the single-ended or double-ended style.

In order to aid in a more ready understanding of the detailed description of the construction and organization which will be hereinafter given, a brief general description of the organization of a double-ended boiler embodying the present invention will first be given.

The double-ended boiler proper consists of a horizontal cylindrical shell extending transversely to the boiler and opening at each end into a steam-drum, the steam-drums and shell having preferably a common axis and being located at or near the top of the boiler. At or near the bottom of the boiler on each side one or more water-drums are located, with preferably a common axis or axes parallel with the axis of the steam-drums and shell. Extending vertically or in a substantially vertical direction between the steam and water drums on each side are nests of bent or curved circulating-tubes located in duplicate parallel rows, the rows being in vertical planes and the space between adjacent rows or each alternate space being sufficient to admit of the passing of any tube in or out. These tubes are preferably expanded into suitably-drilled holes in the drums and furnish communication between the same. From the bottom of the shell one and in large boilers two downcast pipes or water-legs extend out horizontally and then down to the bottom of the boiler, where they branch into two pipes, which connect—one on each side—with the bottoms of water-drums. In the space directly underneath the shell and between the water-drums and tube nests is located the furnace, fitted with a suitable grate and with bridge-walls on each side, the ash-pit being underneath. In the row of circulating-tubes next to the furnace on each side some or all of the tubes have a loop projecting out over the grate and underneath the shell, thus protecting the latter and the horizontal sections of downcast pipes from the direct heat of the fire and increasing the heating-surface where

the heat is most effective. The drums, tube-nests, furnace, and ash-pan are suitably inclosed within masonry walls or within a sheet-metal casing bolted together in removable sections and lined with non-conducting material, and at each side over the tube nests and steam-drums this casing or masonry opens into suitable uptakes for the waste gases, which uptakes join and connect with the stack or flue. Suitable deflecting-walls and covers of thin fire-tile are properly located on each side in and on the tube nests to guide the flame and hot gases over the entire heating-surface in the most effective manner. The circulating-tubes are so arranged in rows that any one or more of them can be taken out without disturbing any of the others or any permanent part of the boiler. Suitable doors are arranged in convenient positions in the uptakes and in the casing or masonry to give access to the tube nests and to the soot-pits below these nests and under the water-drums. On each side, where the steam-drums open into the shell, suitable baffle-plates are arranged to deflect spray and water downward to the bottom of the shell and the downcast pipes and allow the steam to escape to the top of the shell and the steam-pipe. The downcast pipes are so arranged that in certain sections at the bottom of the boiler below the water-drums the circulating currents of water meet in a "dead-middle" and stop or run into a "dead-end" and stop. At these points all sediment collects and is removed by the bottom blow-off valves located at these points. A suitable surface blow-valve is provided with an internal pipe-opening near the water-line in the shell. The feed-water enters at the top elbows of the downcast pipes and is projected directly down the vertical parts of these pipes to the water-drums, thus preventing any cold feed-water from entering the shell or circulating-tubes directly.

In operation the boiler is first filled with water to the proper height in the shell, which height is shown by the ordinary glass gage and try-cocks suitably connected. Fire is then started in the furnace, and as soon as the heat strikes the circulating-tubes steam commences to form in small globules and rises up through the tubes to the surface of the water. As the heat increases this process becomes more rapid and the rise of the steam globules in the circulating-tubes very quickly becomes so great as to carry the water with them mechanically, thus starting the circulation. The circulation thus commenced must necessarily continue as long as heat remains in the furnace, for as soon as the water is projected up through the tubes into the steam-drums it pours out into the shell, falls immediately through the downcast tubes to the water-drums, and is directly returned to the circulating-tubes to repeat the circuit. This process does not depend at all upon the flow of feed into the boiler or of steam out of it, as it will go on precisely the same whether

the feed and steam valves be shut or open. This process keeps the circulating-tubes scoured clean and practically full of water throughout their entire length without regard to the height of water-level in shell, as shown by the water-gage.

The construction and organization thus briefly outlined will now be described in detail, reference being had to the accompanying drawings, forming a part of this specification, in which—

Figure 1 is a front view, half in elevation and half in section, of a "double-ended" boiler constructed and organized according to the present invention with two water-drums on each side and inclosed in a sheet-metal casing, the section being taken upon the axes of the steam-drums and shell. Figure 2 is a similar side view of the same, the section being taken across the middle of the shell and furnace. Figure 3 is a similar top view, the section being taken on the line 3 3 of Figs. 1 and 2. Figs. 4 and 5 are views similar to Figs. 1 and 2 of a boiler having one water-drum on each side and inclosed in a sheet-metal casing. Figs. 6 and 7 are similar views of a boiler of the same construction inclosed in masonry.

Referring now particularly to Figs. 1 to 3, it is to be understood that the shell A and steam-drums B at the top of the boiler are welded or riveted up, flanged conically or spherically at the ends *a*, as shown, and riveted or welded together, forming a single steam and water chamber with flanged plate-heads *b* in the outboard ends of the steam-drums. Man or hand holes and plates *c* are placed in the shell or in the ends of the steam-drums, as desired, giving perfect access to all parts of this chamber. At the bottom the four water-drums D are similarly welded or riveted up and supplied with flanged plate-heads *b* at both ends, the heads being fitted with man or hand holes and plates *c*, preferably at the inner end, as shown.

The circulating-tubes E are bent on templets or formers to substantially the shape shown in Fig. 2 and are made in duplicate rows or sets, so that a tube of a certain shape (designated by a number or letter) will go in its proper position in any row or set. The number of tubes in a set or the number of rows or sets may be varied, and the vertical distance between the centers of steam and water drums may also be varied without changing the bends or templets which are used to curve the tubes, these bends being all above the line *d* or below the line *f*, Fig. 2. In this way the design for a boiler using the same diameter of circulating-tubes, shell, and drums may be made broader or narrower, higher or lower, longer or shorter, to suit varying conditions without altering the standard templets by which the boilers are built, the straight length between the lines *d* and *f*, the lengths of shell and drums, and the number of rows of tubes being the only variables.

For the purpose of protecting the shell and downcast pipes and increasing the heating-surface a shield *p*, formed, preferably, of a layer of fire-brick tile, is used, and some of the circulating-tubes *f* are provided with furnace-loops *t*, upon which this shield is supported. These furnace-loops may be provided in alternate tubes of the inner rows on opposite sides of the boiler, or arranged together in diagonally-opposite parts of the boiler, as shown in Fig. 3. The circulating-tubes being placed in vertical and straight rows running transversely to the axis of the drums and shell and the rows being also spaced far enough apart to allow ample clearance for passing a tube in between any two of the rows, or at least in each alternate space, it follows that perfect access can be had for inspection and for cleaning the outside of all tubes through the casing-doors *g* and the removable uptakes *h*, an ordinary or flat tube-brush on the end of a rod being used for this purpose.

In view of the location and arrangement of the man or hand holes *c* and the fact that all the tube ends are expanded from the inside into drilled holes in the drums, also that the furnace-loops *t* are on alternate tubes only or arranged together in diagonally-opposite parts of the boiler, it also follows that the ends of any tube may be freed from the drums by simply cutting off or loosening up the projecting lips inside and driving the tube ends out of the drums, the clearance between tubes in each row being sufficient to allow this, and that the tube being thus cleared from the drums can, by a suitable small bar and pair of tongs, be pushed sidewise into the space between the rows and pulled out bodily through the uptake or one of the casing-doors *g*. In the sole case of a tube having a furnace-loop it is necessary to remove parts of the furnace casing or grate, which is bolted and removable for this purpose. It also follows that this process can be reversed and a new tube put in to replace the one taken out, this latter operation being further facilitated by passing a wire rope through the tube and the tube-holes in the drums in order to haul the tube into place. The spring of the tube, owing to the bends, also facilitates both the taking out and putting in.

It further follows from the above-described arrangement that any tube or tube-hole may be plugged by simply reaching the arm or a pair of tongs inside of the drum or shell, entering the tapered plugs in the proper holes, and then giving them a slight tap with a hammer, the steam-pressure acting afterward to keep the plugs in place. It still further follows from what has been said that a wire rope can be pushed through any tube from one drum to another, (the curves all being large enough to allow this,) and that to this rope can be attached an ordinary flexible tube brush or scraper, which can be drawn back and forth through the tube, thus thoroughly cleaning the inside.

The downcast pipes and fittings *F* connect the bottom of the shell with the bottom of the water-drums. In these downcast pipes the bottom blow-off valves are connected in the extremity of the dead end at *m* on each side. When the downcast pipes are in duplicate, one set at the front and one set at the back, as in large boilers, there are no dead-ends; but on each side in this case there is a dead - middle part, where the bottom blow-off valves are connected. On the top elbows in these downcast pipes the feed-valves are located at *n* with internal pipes pointing downward. The downcast - pipe fittings *l*, which connect with the water - drums, form legs or chairs for supporting the boiler, and the lower end of the water-gage pipe connects on one of these fittings at *k*, where the current changes direction, but where no sediment collects. The upper end of said pipe connects on the top of the shell at *k*.

Baffle-plates *j* are placed in the shell on each side over the mouths of the steam-drums, and consist of two or more sheet-metal plates secured in an inclined position and overlapping one another, as shown, so as to deflect the water downward and allow the steam to escape upward between the plates, as indicated by the arrows *i*. The surface blow-pipe *e* is so arranged as to skim off the surface of water in the shell when in operation.

The furnace *H* and the ash-pan *P* extend between the water-drums *D* and bridge-walls *w* and from the front to the back of the casing or masonry. When a sheet-metal casing is used, the non-conducting lining of the same is protected throughout the furnace by suitable fire - brick tile, and, as previously described, the furnace - loops *t* in the circulating-tubes support a layer or shield *p* of fire-brick tile for the same purpose, and, in addition, to protect the shell from the direct action of the fire. The grate *G* may be of any desired style in the central part, where it is flat and rectangular; but at the sides it is formed by inclined grate-bars *x y*, which extend from the side bar *z* to the bridge-wall *w* and the inside water-drum heads *b*. The inclined grate-bar *y* forms a curved shield or guard over the drum-head *b* and hand-hole and plate *c* to protect the latter from the fire. The bars *x* and *y* rest loosely upon the side bar *z*, and can be easily removed for access to the hand-hole from above as well as underneath the grate. The fire-tile deflecting-walls *R* on each side in and over the tube nests are supported by the cast-iron bar *r* and cause the fire and hot gases to circulate between the tubes, as indicated by the arrows on the drawings.

The organization shown in Figs. 4 and 5 has but one water-drum on each side. In all other essential features the description already given applies to this construction also.

The organization shown in Figs. 6 and 7 also has a single water-drum on each side, but differs from the boiler of Figs. 4 and 5, in

that an inclosure of masonry and cast-iron plates is substituted for the sheet-metal casing.

It will be seen from the above description that by my construction I provide a boiler of the general class described which is light, compact, and simple in its construction; in which all the parts are easily accessible for cleaning, inspection, and repair; in which the circulating-tubes can be separately removed and replaced without disturbing other tubes or permanent parts of the boiler; in which any circulating tube can be re-expanded or plugged at both ends without entering the boiler, except with the arms; in which every circulating-tube and all other parts of the heating-surface in the boiler can be thoroughly cleaned with a brush or scraper both inside and outside; in which every rivet and the full length of every seam in the boiler can be recalked without disturbing any permanent part of the boiler; in which every part of the boiler (except the interior of the tubes) can be examined with the eye, and in which every part of the boiler (except certain parts of the tubes) can be touched with the hand; in which the heating-surface is so arranged as to cause a positively constant, reliable, steady, and rapid circulation of all the water over it, and in which this circulation is automatic—that is, not dependent upon the action of a pump or upon the drawing off of steam from the boiler—but caused directly and solely by the action of the fire, thereby permitting salt-water to be used and allowing the boiler to be forced hard without danger; in which every circulating-tube and all parts of the heating-surface of the boiler are allowed to expand and contract independently, thus avoiding danger from sudden or unequal heating and cooling; in which the use of bracing or stays of any kind is entirely avoided; in which there is a comparatively large space included for steam and water, thus allowing effective separation of the steam from the water within the boiler proper and avoiding sudden fluctuations of water-level or steam-pressure, and, finally, a boiler in which there are no butt-welds, screwed joints, bolted joints, glands, steel or iron castings, dead-end tubes, straight tubes, or tube ends in the fire-surface or heating-surface.

It will be understood that the construction shown and described is but one of the forms in which the improvements constituting my invention may be embodied, and that my invention is not to be limited to this specific construction, which may be varied widely while retaining the essential features of the invention. It is evident, also, that many of the special features claimed are applicable in other classes of boilers.

What I claim is—

1. In a steam-boiler, the combination, with horizontal steam and water drums and vertical or substantially vertical circulating-tubes connecting said drums, of a shell A, extend-

ing transversely to the boiler and communicating with the steam and water drums to form a chamber for steam and water, substantially as described.

2. In a steam-boiler, the combination, with one or more horizontal water-drums and a plurality of horizontal steam-drums, of vertical or substantially vertical circulating-tubes connecting said drums, and a shell located between said steam-drums and communicating with the steam and water drums to form a central chamber for steam and water, substantially as described.

3. In a steam-boiler, the combination, with one or more horizontal water-drums, of a horizontal steam-drum extending transversely to the boiler, vertical or substantially vertical circulating-tubes connecting said drums, and a shell A, communicating with said steam and water drums to form a chamber for steam and water, substantially as described.

4. In a steam-boiler, the combination, with one or more horizontal water-drums, of a plurality of horizontal steam-drums extending transversely to the boiler, vertical or substantially vertical circulating-tubes connecting said drums, and a shell A, located between said steam-drums and communicating with the steam and water drums to form a chamber for steam and water, substantially as described.

5. In a steam-boiler, the combination, with one or more horizontal water drums, of a plurality of steam-drums extending transversely to the boiler, vertical or substantially vertical circulating-tubes connecting said drums, and a shell A, extending transversely to the boiler between said steam-drums and opening at each end into one of said drums to form with the drums a steam-chamber, substantially as described.

6. In a steam-boiler, the combination, with one or more horizontal water-drums on each side and extending transversely to the boiler, of horizontal steam-drums extending transversely to the boiler, vertical or substantially vertical circulating-tubes connecting said drums, and a horizontal shell A, extending transversely to the boiler between the said steam-drums and communicating with said steam and water drums to form a chamber for steam and water, substantially as described.

7. The combination, with horizontal steam and water drums on each side of the boiler and the shell A, extending transversely to the boiler and communicating with said steam and water drums, of vertical or substantially vertical circulating-tubes located in nests on each side of the boiler and connecting said drums, substantially as described.

8. The combination, with horizontal steam and water drums on each side of the boiler, and the shell A, extending transversely to the boiler and communicating with said steam and water drums, of vertical or substantially vertical circulating-tubes connecting said drums, said tubes being located in nests on

each side of the boiler and bent to allow of expansion and contraction and sprung into place in said drums, substantially as described.

9. The combination, with horizontal steam and water drums on each side of the boiler, and the shell A, extending transversely to the boiler and communicating with said steam and water drums, of vertical or substantially vertical circulating-tubes connecting said drums, said tubes being located in nests on each side and arranged with space between rows for the removal and insertion of any tube without disturbing any of the others, substantially as described.

10. The combination, with horizontal steam and water drums on each side of the boiler, and the shell A, extending transversely to the boiler and communicating with said steam and water drums, of vertical or substantially vertical circulating-tubes connecting said drums, said tubes being bent to allow of expansion and contraction and sprung into place and expanded in said drums and arranged in rows, with space between rows for the removal and insertion of any tube without disturbing any of the others, substantially as described.

11. In a steam-boiler, the combination, with horizontal steam and water drums on each side of the boiler and vertical or substantially vertical circulating-tubes connecting said drums, of the shell A, extending transversely to the boiler and connecting with the steam-drums to form a steam-chamber, and the downcast pipe or pipes F, connecting said shell and water-drums, substantially as described.

12. The combination, with horizontal steam and water drums on each side of the boiler and vertical or substantially vertical circulating-tubes connecting said drums and arranged in nests on each side, of the shell A, extending transversely to the boiler and communicating with the steam-drums to form a steam-chamber, and the downcast pipe or pipes F, connecting said shell and water-drums, substantially as described.

13. The combination, with horizontal steam and water drums on each side of the boiler and vertical or substantially vertical circulating-tubes connecting said drums, said tubes being located in nests on each side and arranged in rows with space between rows for the removal and insertion of any tube without disturbing any of the others, of the shell A, extending transversely to the boiler and communicating with the steam-drums to form a steam-chamber, and the downcast pipe or pipes F, connecting said shell and water-drums, substantially as described.

14. In a steam-boiler, the combination, with horizontal steam and water drums and a shell A, communicating with said steam and water drums, of vertical or substantially vertical circulating-tubes having the loops *t* extending

over the furnace and beneath the shell, substantially as described.

15. In a steam-boiler, the combination, with horizontal steam and water drums on each side of the boiler, and the shell A, extending transversely to the boiler and communicating with said steam and water drums, of vertical or substantially vertical circulating-tubes located in nests on each side, connecting said drums and having the loops *t* extending over the furnace and beneath the shell, substantially as described.

16. The combination, with horizontal steam and water drums on each side of the boiler, and the shell A, extending transversely to the boiler, of the downcast pipe or pipes F, connecting the shell with the water-drums, and vertical or substantially vertical circulating-tubes located in nests on each side and connecting said drums, said tubes having the loops *t* extending over the furnace and beneath the shell and downcast tubes, substantially as described.

17. In a steam-boiler, the combination, with horizontal steam and water drums and vertical or substantially vertical circulating-tubes connecting said drums, of the downcast pipe or pipes F, having extensions or dead-ends *m* for collecting sediment, substantially as described.

18. In a steam-boiler, the combination, with horizontal steam and water drums and vertical or substantially vertical circulating-tubes connecting said drums, of the downcast pipe F, extending horizontally and downward, and the feed-pipe *n*, entering said downcast pipe at the downward bend to deliver the feed-water directly down the pipe, substantially as described.

19. The combination, with the steam-drum B and shell A, of the baffle-plate consisting of a series of inclined parallel plates *j*, with space between them for the passage of the steam upward, substantially as described.

20. The combination, with the steam-drums B, of the shell A, extending between and communicating directly with said drums, and inclined baffle-plates *j* inside the shell for directing the water downward from the mouths of the steam-drums, substantially as described.

21. The combination, with horizontal steam and water drums and the shell A, of circulating-tubes E, having the loops *t* extending over the furnace and beneath the shell, and the shield *p*, supported by said loops, substantially as described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

WILLIAM COWLES.

Witnesses:

C. J. SAWYER,

J. J. KENNEDY.