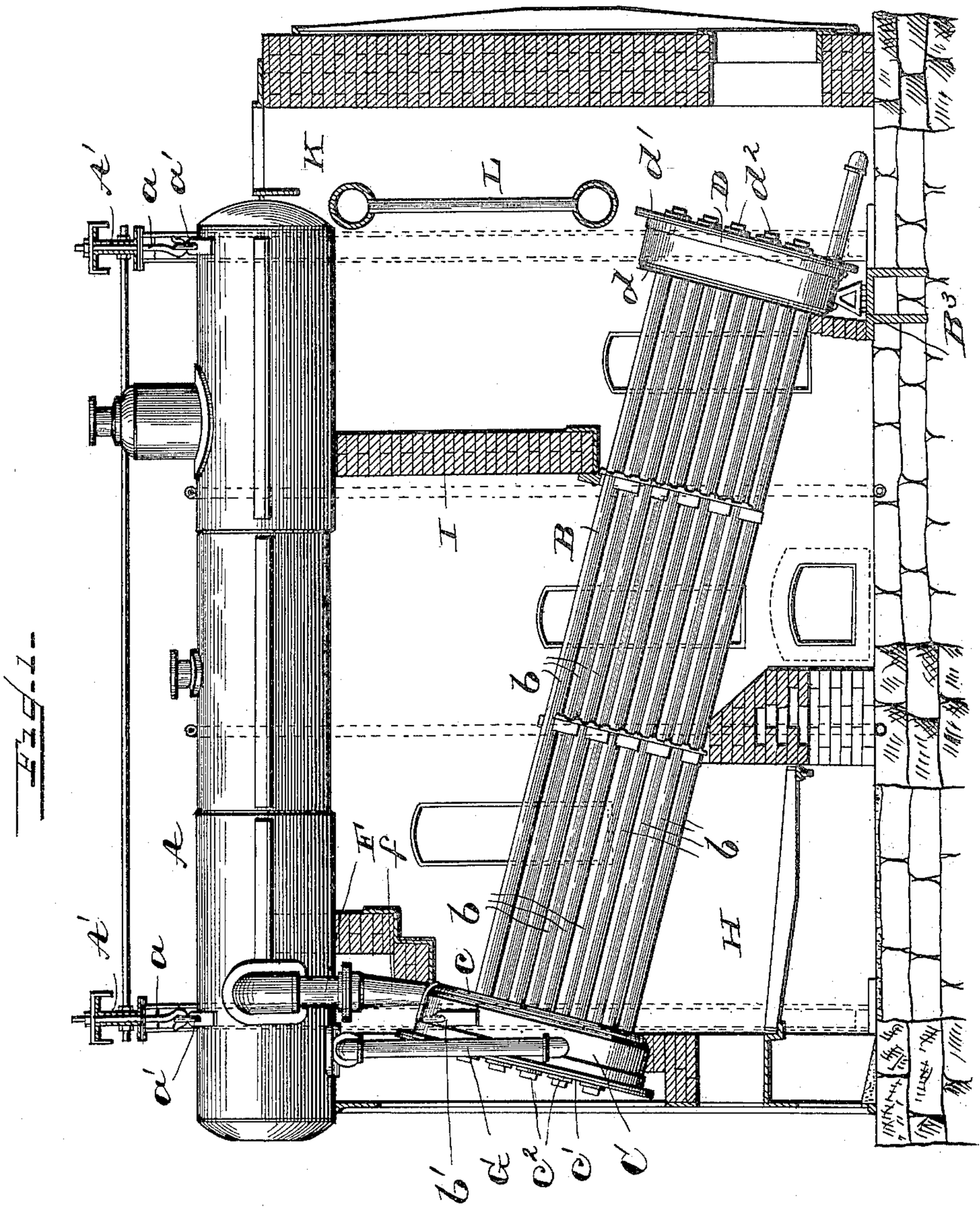
(No Model.)

4 Sheets—Sheet 1.

W. HAMMOND.

WATER TUBE BOILER.

No. 599,234. Patented Feb. 15, 1898.



Witnesses.
G. A. Rauberschmidt.
J. D. Kingsbury

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(No Model.)

4 Sheets—Sheet 2.

W. HAMMOND.

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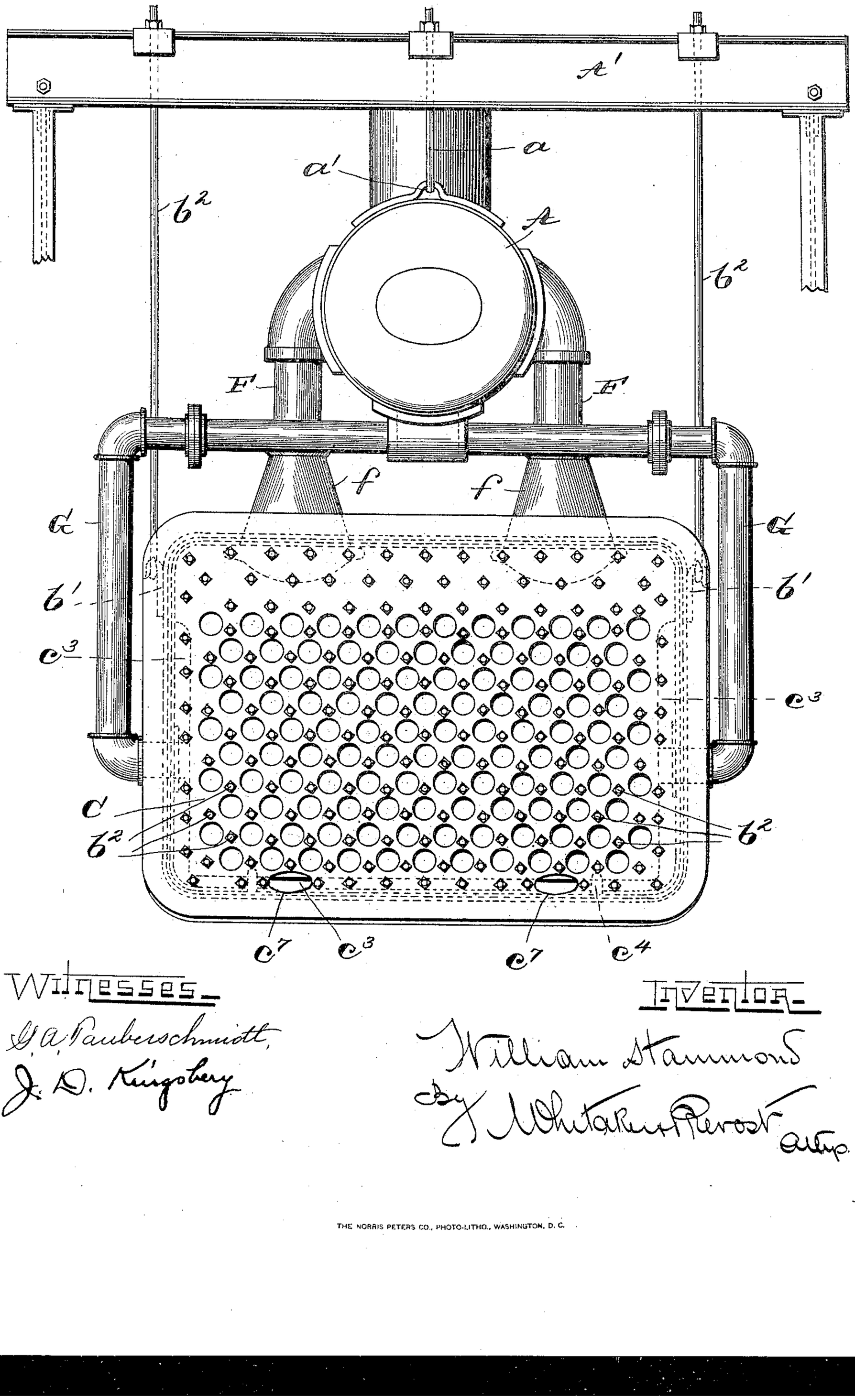
Fig. 2.



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(No Model.)

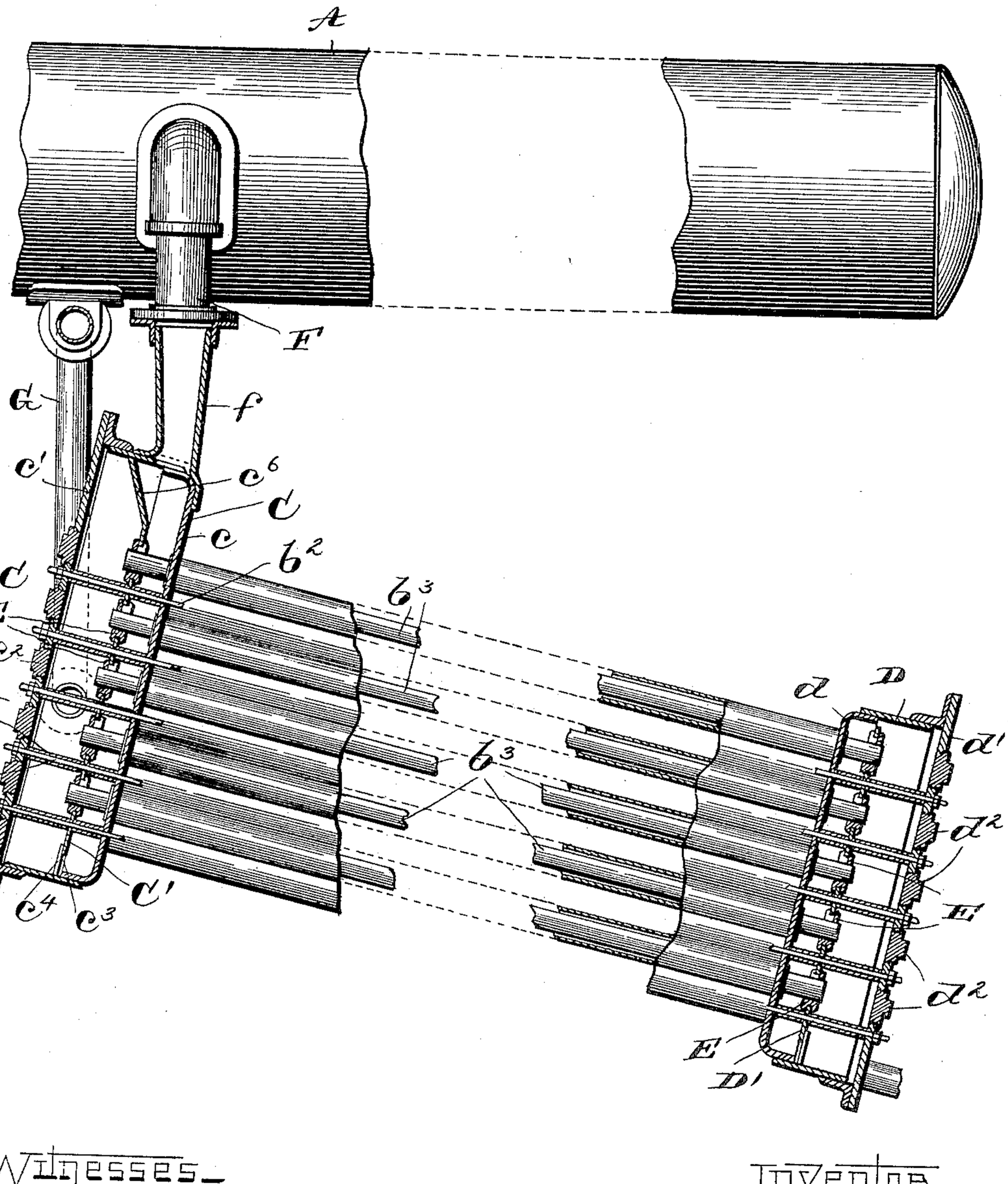
4 Sheets—Sheet 3.

W. HAMMOND.

WATER TUBE BOILER.

No. 599,234. Patented Feb. 15, 1898.

Fig. 3.



Witnesses—

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(No Model.) 4 Sheets—Sheet 4.

W. HAMMOND.

WATER TUBE BOILER.

No. 599,234. Patented Feb. 15, 1898.

Fig. 4.

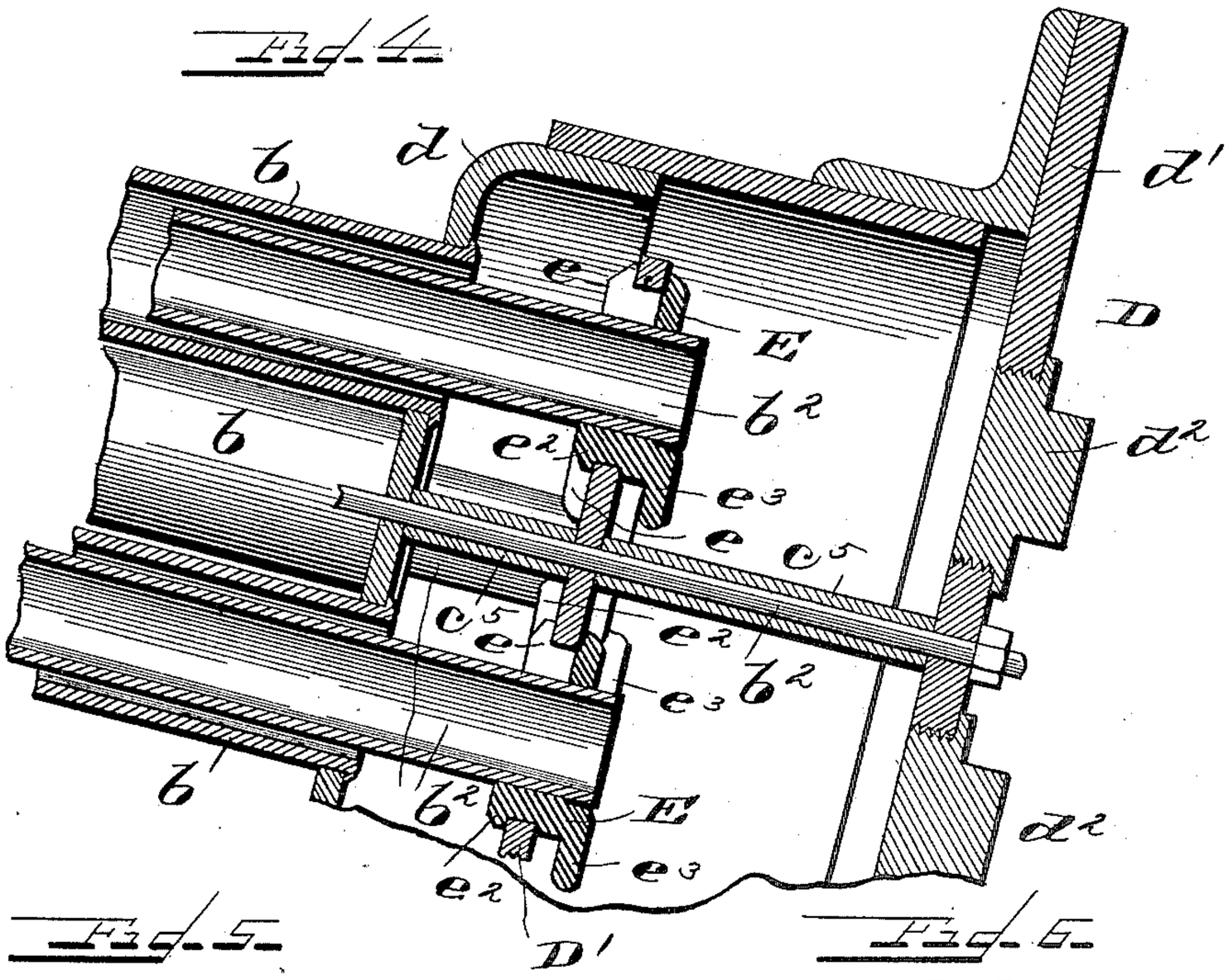

Fig. 5. Fig. 6.

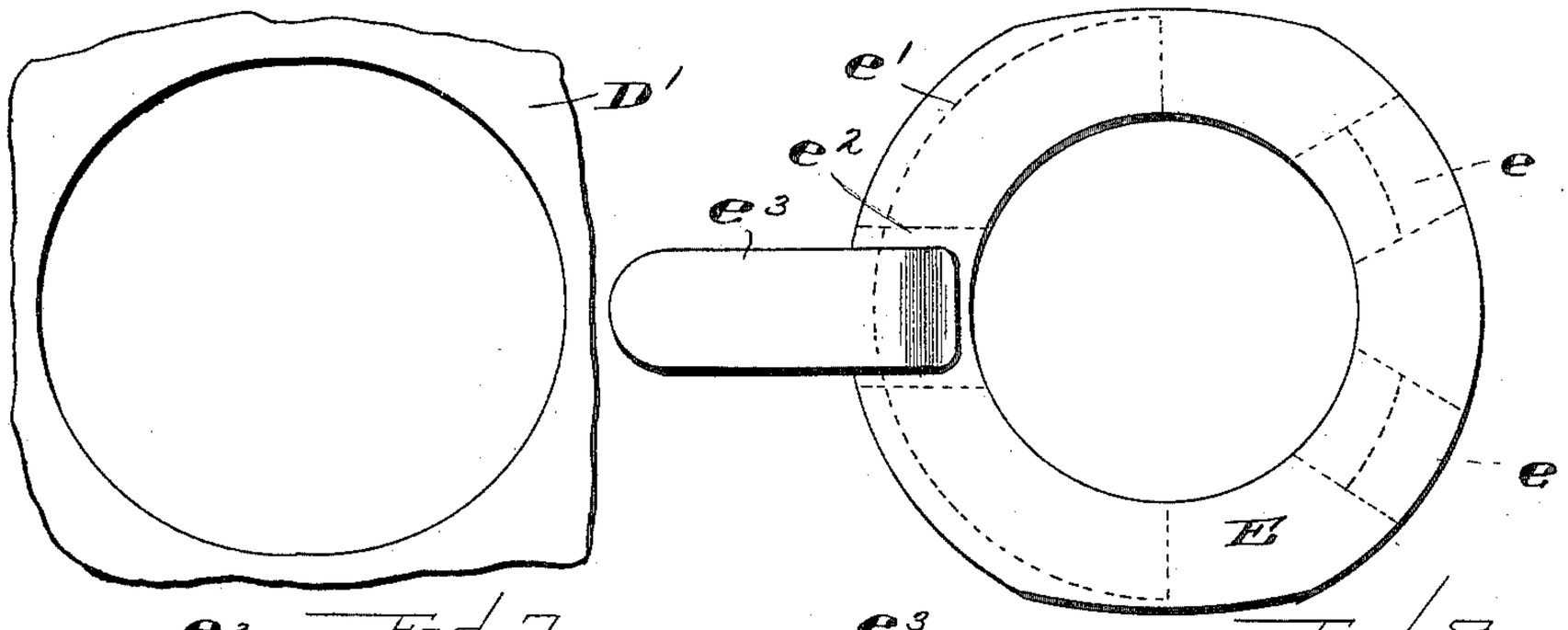

Fig. 7. Fig. 8.

Witnesses.

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UNITED STATES PATENT OFFICE.

WILLIAM HAMMOND, OF WARREN, PENNSYLVANIA, ASSIGNOR OF ONE-HALF TO WILLIAM MUIR, OF SAME PLACE.

WATER-TUBE BOILER.

SPECIFICATION forming part of Letters Patent No. 599,234, dated February 15, 1898.

Application filed September 22, 1897. Serial No. 652,590. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM HAMMOND, a citizen of the United States, residing at Warren, in the county of Warren and State of Pennsylvania, have invented certain new and useful Improvements in Water-Tube Boilers; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention is an improvement in water-tube boilers; and it consists in the novel features of construction and combination of parts hereinafter described, reference being had to the accompanying drawings, which illustrate one form in which I have contemplated embodying my invention, and said invention is fully disclosed in the following description and claims.

Referring to the drawings, Figure 1 represents a side view of the boiler, the arch and supports being shown in section. Fig. 2 is a front view of the boiler, showing also the method of supporting it at the front. Fig. 3 is an enlarged view of the boiler, parts being broken away and the water-tube section being shown partly in section. Fig. 4 is an enlarged sectional view of a part of one of the ends of the water-tube section, showing the construction of the parts. Fig. 5 is a view of a portion of one of the diaphragms, showing the shape of the aperture for the reception of the circulating-tube. Figs. 6, 7, and 8 are detail views of the spacing-collar, which is placed in the apertures of the diaphragms to receive and hold the circulating-tubes.

In the drawings, A represents the upper horizontal section of the boiler, consisting of a cylindrical shell closed at each end and provided, if desired, with a steam-dome. In order to support this shell, I prefer to provide two or more transverse I-beams A′ A′, for supporting the shell A, which rest upon the masonry of the arch and are provided with vertically-adjustable hangers *a*, which engage straps, eyes, or loops *a′* on the shell A, as shown in the drawings.

The lower inclined water-tube section B comprises two heads or boxes C and D, which are connected by water-tubes *b b b*, said section being inclined to the shell A from the front downwardly. The front head or box C is provided with eyes or straps *b′*, which are engaged by hangers b^2, suspended adjustably from the front I-beam A′, and the rear shell or box D is provided, preferably, with a supporting truck or carriage B^3, having wheels or rollers resting upon a suitable horizontal abutment. This construction allows the water-tube section to expand and contract independently of the shell A, without straining or weakening the construction or any of the connections, as will hereinafter more fully appear.

The head or box C consists of a casing having a rear plate *c* and a removable front plate *c′*, secured to flanges on the casing by means of suitable bolts. The rear plate *c* is provided with apertures to receive the ends of the water-tubes *b*, which are secured therein by being expanded or turned over the edges of the apertures. The front plate *c′* is provided with a series of apertures which register with those in the rear plate and are of the same or greater size and are closed by means of screw-plugs c^2.

Within the box C is a diaphragm C′, which at its upper end fits the interior of said box, but which is reduced along its lateral and bottom edges, as indicated in dotted lines at c^3 c^3 c^3, Fig. 2, so as to leave a space between its edges and the walls of the casing. At the bottom of the box lugs c^4 c^4 are provided, (see Figs. 2 and 3,) which engage the edge of the diaphragm, and the diaphragm is held in place rigidly by means of spacing sleeves or collars c^5 c^5, which are placed on the stay-bolts b^2, which connect the two heads or boxes of the water-tube sections. The diaphragm C′ is also provided with a series of apertures, which register with and are preferably of the same size as the apertures in the front and rear plates, or they may be slightly larger. The upper end of the diaphragm is also inclined forwardly, as shown at c^6, to give a greater space in rear of that portion of the diaphragm for the steam to pass out. The front plate *c′* is also provided with two or more hand-holes c^7 c^7 (see Fig. 2) to enable the box to be cleaned out when necessary.

The rear box or head D is formed, like the

box C, of a casing provided with a rear plate *d*, in which the ends of the water-tubes *b* are secured, and a front plate *d'*, having registering apertures closed by screw-plugs d^2. It is also provided with a diaphragm D', having registering apertures and held in place by collars d^3 d^3 on the stay-bolts b^2, the diaphragm D' being of less size than the interior of the casing, leaving a space entirely surrounding the diaphragm, forming a communication between the two parts of the box or head. At its lower end the box D is provided with a blow-off pipe of considerable size, which is led off to a convenient point for discharging the sediment collecting in said box and is provided with the usual valve. (Not shown.)

Within each of the water-tubes *b* is a circulating-tube b^3 of less diameter than the interior of the water-tube, said circulating-tubes being sufficiently longer than the water-tubes to engage the apertures in the diaphragms C' and D'. In order to hold said tubes in said diaphragms, I provide each of the apertures therein with a removable collar E, adapted to fit the apertures in the diaphragm and provided each with a central opening to receive one of the circulating-tubes. The construction of these collars E is shown best in Figs. 4 to 8, inclusive. The holes in the diaphragms are made slightly elliptical instead of circular, as shown in Fig. 5, and the collar E is so made that it can be readily inserted in the aperture; but if turned a quarter of a revolution it will be held firmly in position. The collar is provided on its rear face at its upper side with a pair of hook-lugs *e e* and on its lower side with a curved or segmental flange *e'*, provided centrally with a shallow hook-lug e^2. The collar is also provided with a projection e^3 on its front side, which serves the double purpose of a handle and a weight for preventing the accidental displacement of the collar. By placing the handle e^3 in a horizontal position the collar can be placed in one of the diaphragm-apertures, and by turning the collar until the handle e^3 is at the lower side it will be locked in the aperture, and the weight of the handle prevents the collar from being accidentally turned.

The water-tube section is connected with the upper section A at the front end only and in the following manner: A pair of conducting-pipes F F are connected to the shell A at the water-line, extend downwardly, and have flaring portions *f*, which are connected to the top of the box or head C in rear of the diaphragm C'. At the bottom of the shell A, just forward of pipes F F, is an aperture from which two pipes G G lead to opposite points on the side of the head C at or below the center of the same.

In Fig. 1 I have shown the boiler set up in a suitable arch, provided with a fire-box H, fire-wall I, and outlet K to the stack, and the water-tubes are shown provided with the usual partitions for giving the products of combustion a tortuous course and compelling them to pass around the tubes several times before ascending the stack. I also prefer to place a feed-water heater L below the outlet K, as shown, to further utilize the heat from the products of combustion.

When the boiler is in use, it will be filled with water to about the center of the shell A, leaving the upper half of shell A and the steam-dome to hold the steam. When the heat is applied to the tubes B, it will be readily seen that the water between the circulating-tubes and the water-tubes will be subjected to the greatest heat and will be converted into steam very rapidly, the steam passing upwardly into the head C in rear of the diaphragm C', and thence through the pipes F F to the shell A, where it enters the steam-space. The steam being generated so rapidly produces a strong current and forces a rapid and vigorous circulation of the water. The water which is converted into steam is replaced by water from the shell A, which passes through the pipes G G to the head C forward of the diaphragm, thence through the circulating-tubes to the head D in rear of the diaphragm, thence around the edges of the diaphragm to the front of the same, and into the spaces between the circulating-tubes and the water-tubes.

It will be noted that all sediment in the tubes will tend to collect at the bottom of the box or head D in line with the blow-off, so that it can be quickly cleaned out, and the tubes are not liable to become clogged. In case any sediment is collected in head C it will be removed by means of the hand-holes. When it becomes necessary to clean out the circulating-tubes, or any of them, the water will be drawn off, the plugs in the front plates *c'* and *d'* opposite the ends of the tube to be cleaned will be removed, and the tube can then be cleaned by any desired form of tube-cleaner. Furthermore, the operator can look through the tube from one end to the other and can thus readily ascertain when it is cleaned. If it is desired to clean one of the water-tubes, the circulating-tube within it will be drawn out and the collars E E removed, so as to give access to the tube, which can be cleaned in the same way. If it becomes necessary to remove one of the water-tubes which is to be replaced, the plugs opposite each end will be removed, the collars E E will be taken out of the openings in the diaphragms in line therewith, and the circulating-tube within it will be drawn out. The operator will then insert a tool through the holes in the front plate and diaphragm of each box and bend in the outwardly-rolled edge of the tube, after which the tube can be drawn out through the diaphragm and front plate and a new tube can be inserted and secured in place without disturbing any other part of the boiler.

It will also be noted that the two sections of

the boiler, as before stated, are independently supported and are connected only at the front end. Hence each is at liberty to expand or contract independently without affecting the other and without straining the pipes connecting the two parts of the boiler.

It will also be seen that the rear box establishes a universal connection between the water-tubes and the circulating-tubes, so that even if one or more of either series of tubes should become entirely clogged with scale or otherwise (which, however, is not likely to happen) the operation of the water-tube section would go on without interruption through the remaining tubes.

What I claim, and desire to secure by Letters Patent, is—

1. In a water-tube boiler, a water-tube section comprising among its members, two boxes each provided with a vertically-disposed diaphragm, a series of water-tubes connecting said boxes, and a series of circulating-tubes each extending through one of the water-tubes and having its ends extending through said diaphragms, whereby the sediment will be collected at the bottom of said boxes, and the tubes will remain free, substantially as described.

2. In a water-tube boiler, the combination with the upper or steam section, of a water-tube section comprising among its members a vertically-disposed box, a series of water-tubes connected at one end to the upper section adjacent to the water-line, and at the other end to said box, a series of circulating-tubes, connected at one end with the upper section below the water-line, each circulating-tube extending through one of the water-tubes and extending into said box beyond the ends of said water-tubes, whereby a universal communication is provided between said circulating-tubes and water-tubes through said box and whereby sediment will be deposited at the bottom of said box, substantially as described.

3. In a water-tube boiler, the combination with the upper or steam section, of a water-tube section comprising among its members a vertically-disposed box provided with a diaphragm, dividing the box into two compartments, and having a communication between said compartments, of a series of water-tubes communicating at one end with the upper section adjacent to the water-line, and at the other end communicating with said box, a series of circulating-tubes, having a communication at one end with the upper section below the water-line, each circulating-tube extending through one of the water-tubes and through said diaphragm, whereby a universal communication is established between said water-tubes and circulating-tubes through said box and whereby sediment will be collected at the bottom of said box, substantially as described.

4. In a water-tube boiler, a water-tube section comprising among its members, a front box and rear box supported one on a higher level than the other, each provided with a vertically-disposed diaphragm, a series of inclined water-tubes connecting said boxes, a series of circulating-tubes each extending through one of said water-tubes and having its ends extending through said diaphragms, and a cleaning-out device located adjacent to the lower end of the lower box, whereby a universal communication is established between the circulating-tubes and the water-tubes through said lower box and whereby sediment will be collected in said lower box, and discharged therefrom, and the tubes will remain free, substantially as described.

5. In a water-tube boiler, a water-tube section comprising among its members, two boxes, one located on a higher level than the other, inclined water-tubes connecting said boxes, and circulating-tubes of greater length than the water-tubes each extending through one of the water-tubes and having its ends extending into said boxes beyond the ends of the water-tubes, whereby a universal communication is established between said water-tubes and circulating-tubes through said lower box, and whereby the sediment will be collected at the bottom of said boxes and the tubes will remain free, substantially as described.

6. In a water-tube boiler, a water-tube section comprising among its members, a front box and a rear box each box being provided with a vertically-disposed diaphragm, dividing it into two compartments, a series of water-tubes connecting said boxes, a series of circulating-tubes each extending through one of said water-tubes and having its ends extending through the said diaphragms, said rear box being provided with a communication between its two compartments whereby a universal communication will be established between said water-tubes and circulating-tubes through said rear box and whereby the sediment will be collected in said boxes, leaving the tubes free, and cleaning-out devices adjacent to the lower end of each of said boxes for removing the sediment therefrom, substantially as described.

7. In a water-tube boiler, a water-tube section comprising among its members, two boxes each provided with registering apertures in its front and rear plates, a diaphragm in each of said boxes, disposed substantially parallel to said plates and having apertures therein, registering with the apertures in said plates, water-tubes connecting said boxes and having their ends secured in the apertures of their rear plates, circulating-tubes each extending through one of the water-tubes, said circulating-tubes having their ends removably secured in the apertures in said diaphragms and removable plugs closing the apertures in the front plates of said boxes, whereby by removing said plugs access may be had to both boxes to clean the circulating-tubes throughout their length, to remove and replace the circulating-tubes, and to clean or

remove and replace the water-tubes, substantially as described.

8. In a water-tube boiler, the water-tube section comprising among its members, two boxes each having its front and rear plates provided with registering apertures, a diaphragm in each box provided with apertures registering with those of the front and rear plates, water-tubes having their ends engaging the apertures in the rear plates of both boxes, circulating-tubes each extending through one of the water-tubes and having its ends extending through the apertures in the said diaphragms, removable collars in the openings in said diaphragms for supporting said circulating-tubes and removable plugs closing the apertures in the front plates of said boxes, substantially as described.

9. In a water-tube boiler, the combination with the horizontal steam-containing section, of the inclined water-tube section, communicating therewith at one end only, supports for the horizontal section, a stationary support for the water-tube section adjacent to its connections with the horizontal section and an independent support for the opposite end of said water-tube section whereby the two parts of the boiler may expand and contract independently without affecting their connections, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

WILLIAM HAMMOND.

Witnesses:
S. G. ALLEN,
O. C. ALLEN.