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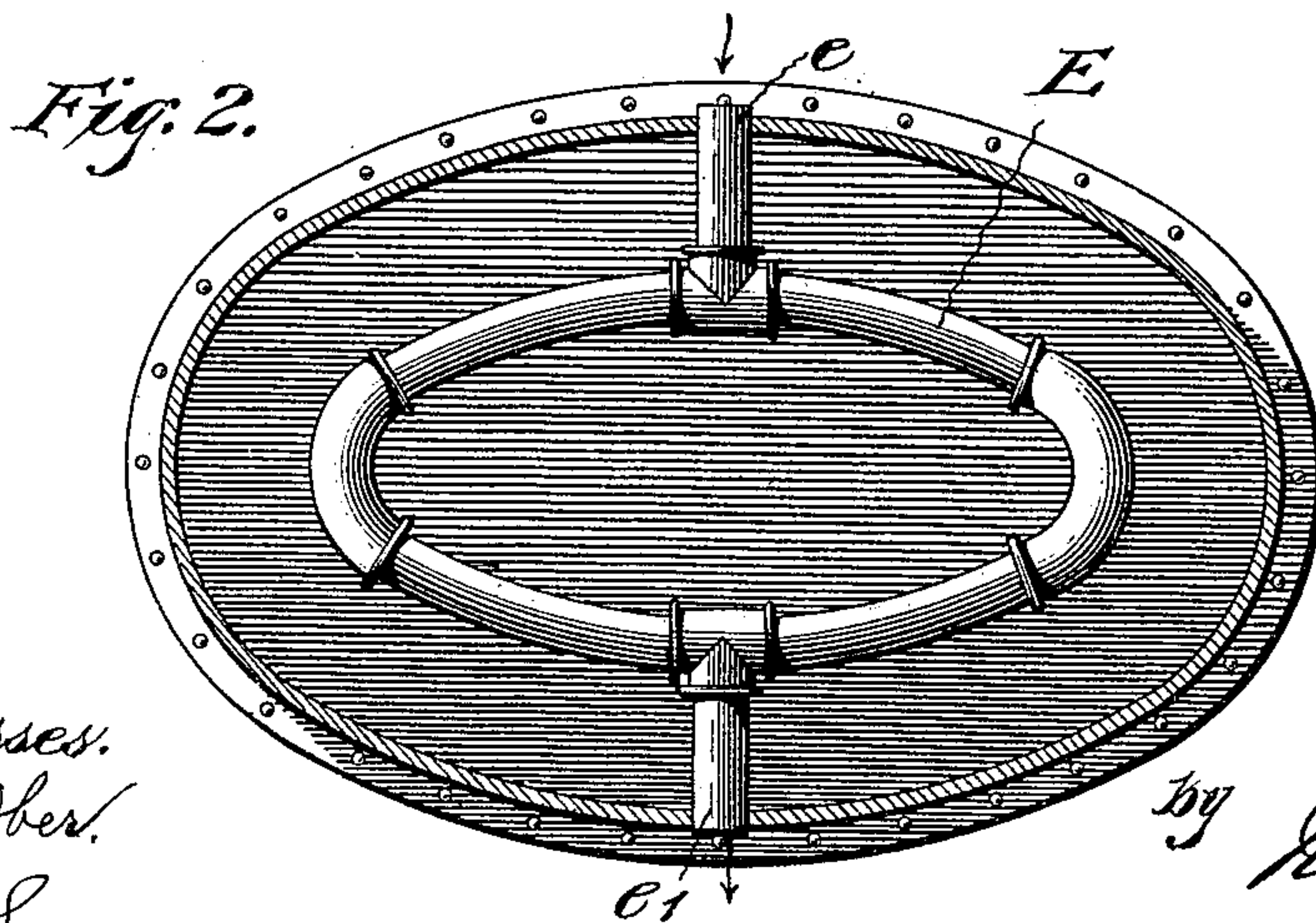
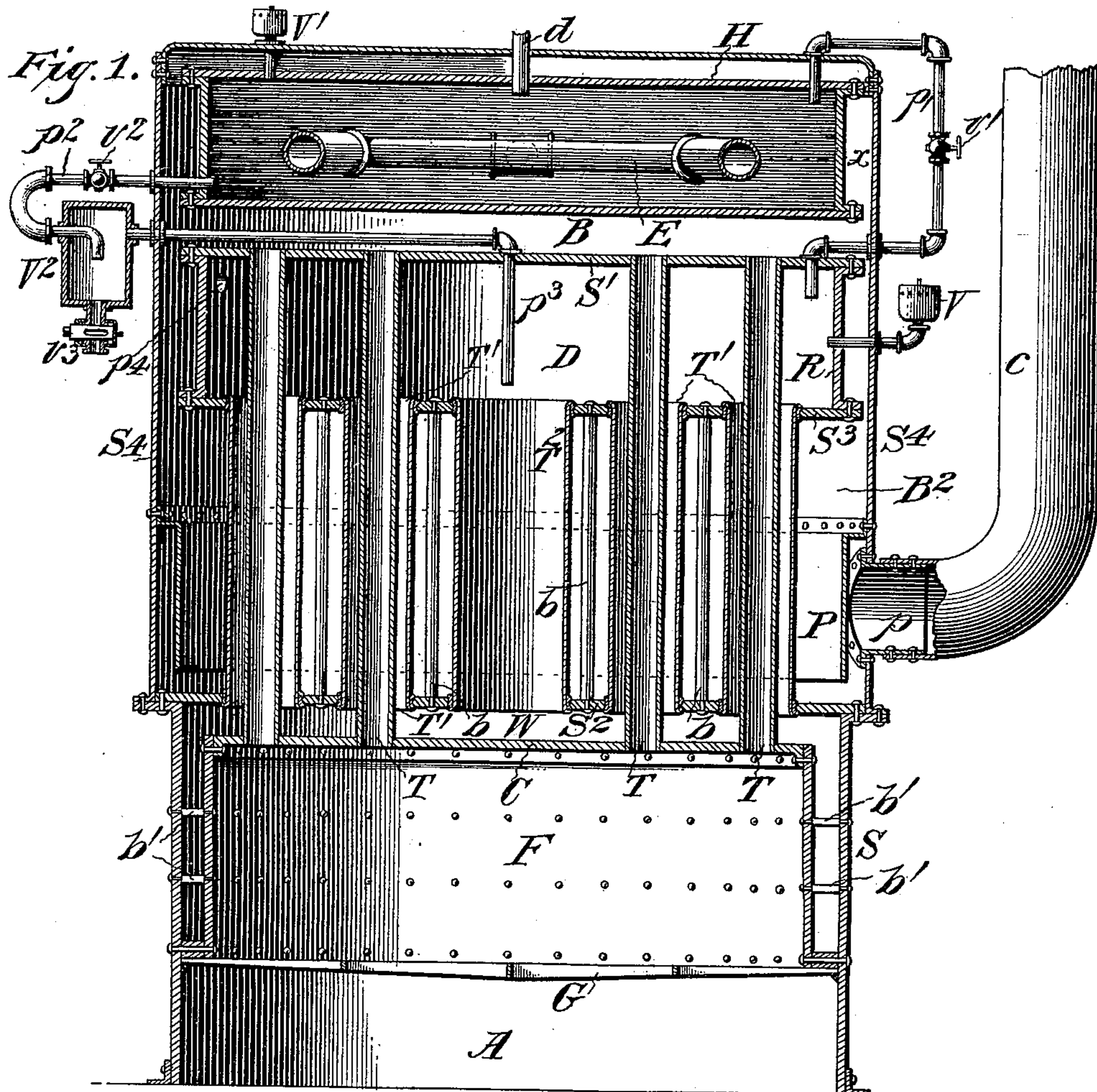
Patented Apr. 4, 1899.

V. HANSON.
STEAM BOILER.

(Application filed May 28, 1898.)

(No Model.)

3 Sheets—Sheet 1.



Witnesses.
B. S. Ober.
B. W. Sommers

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by *Henry G. H.*
Atty.

No. 622,352.

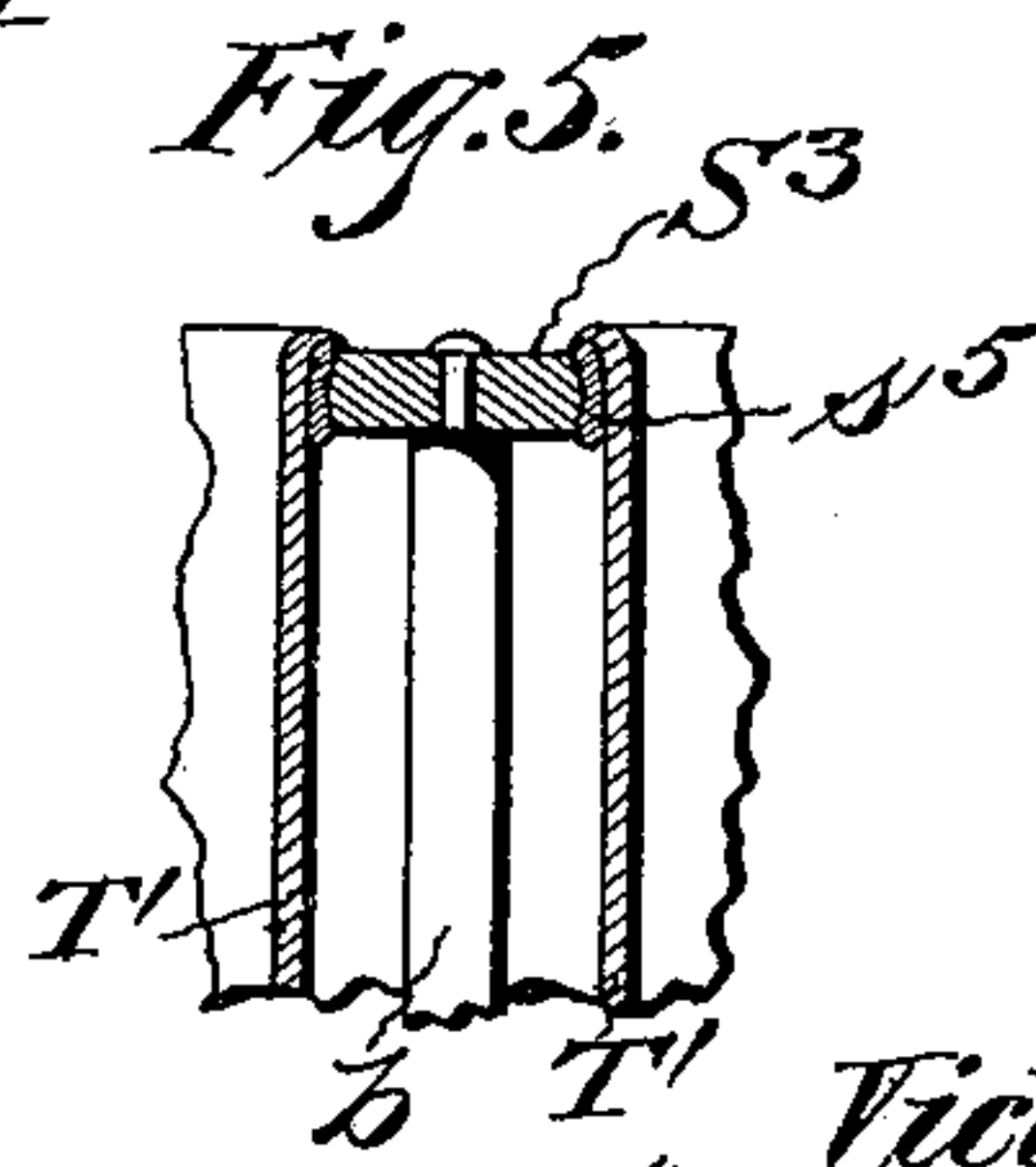
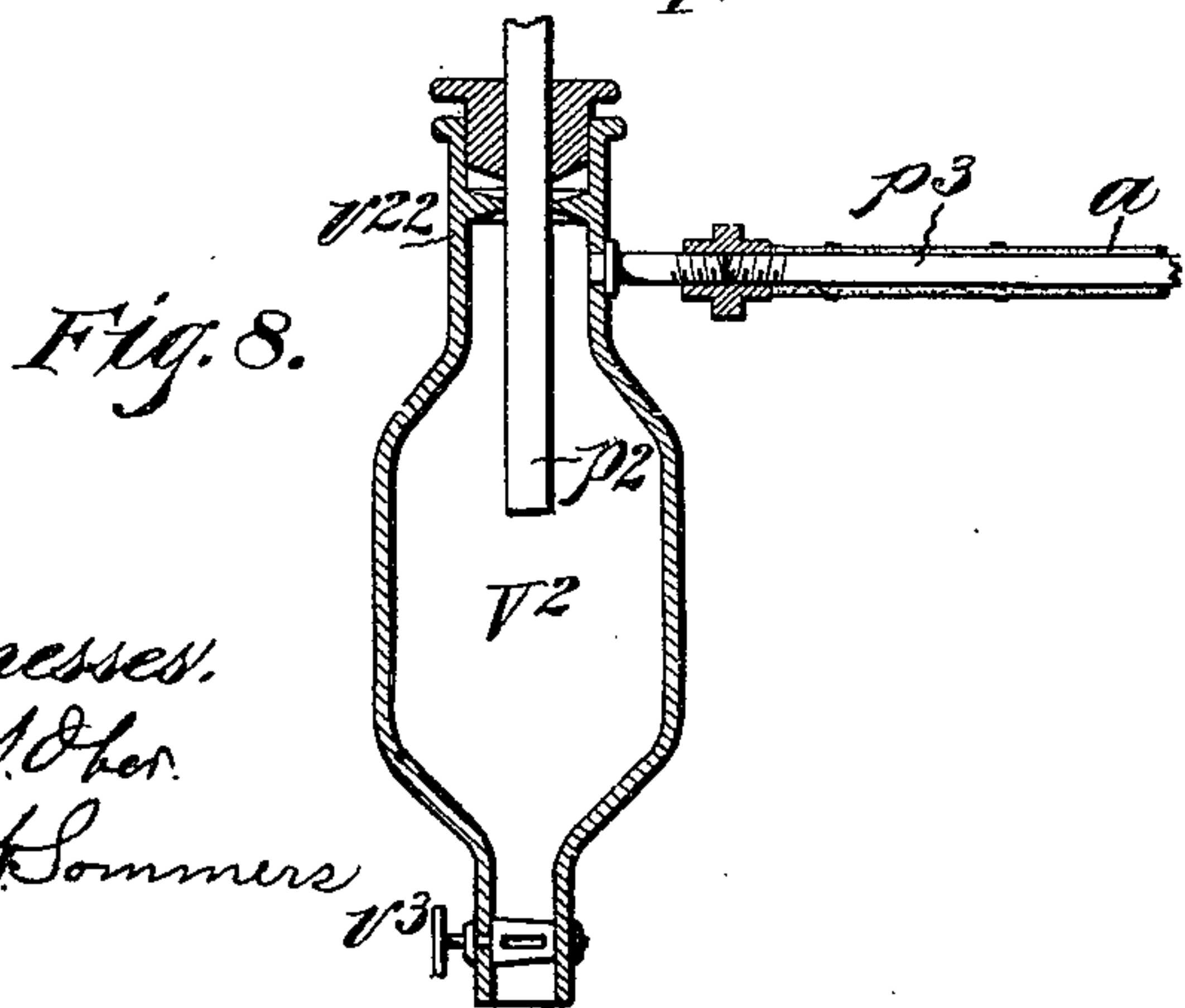
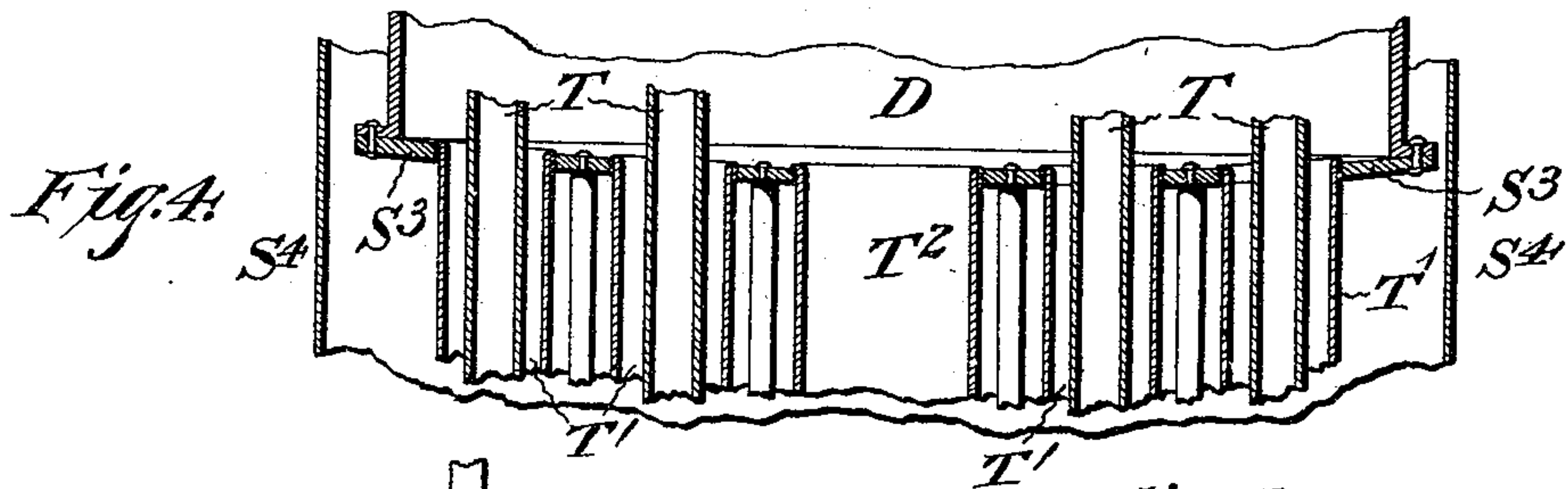
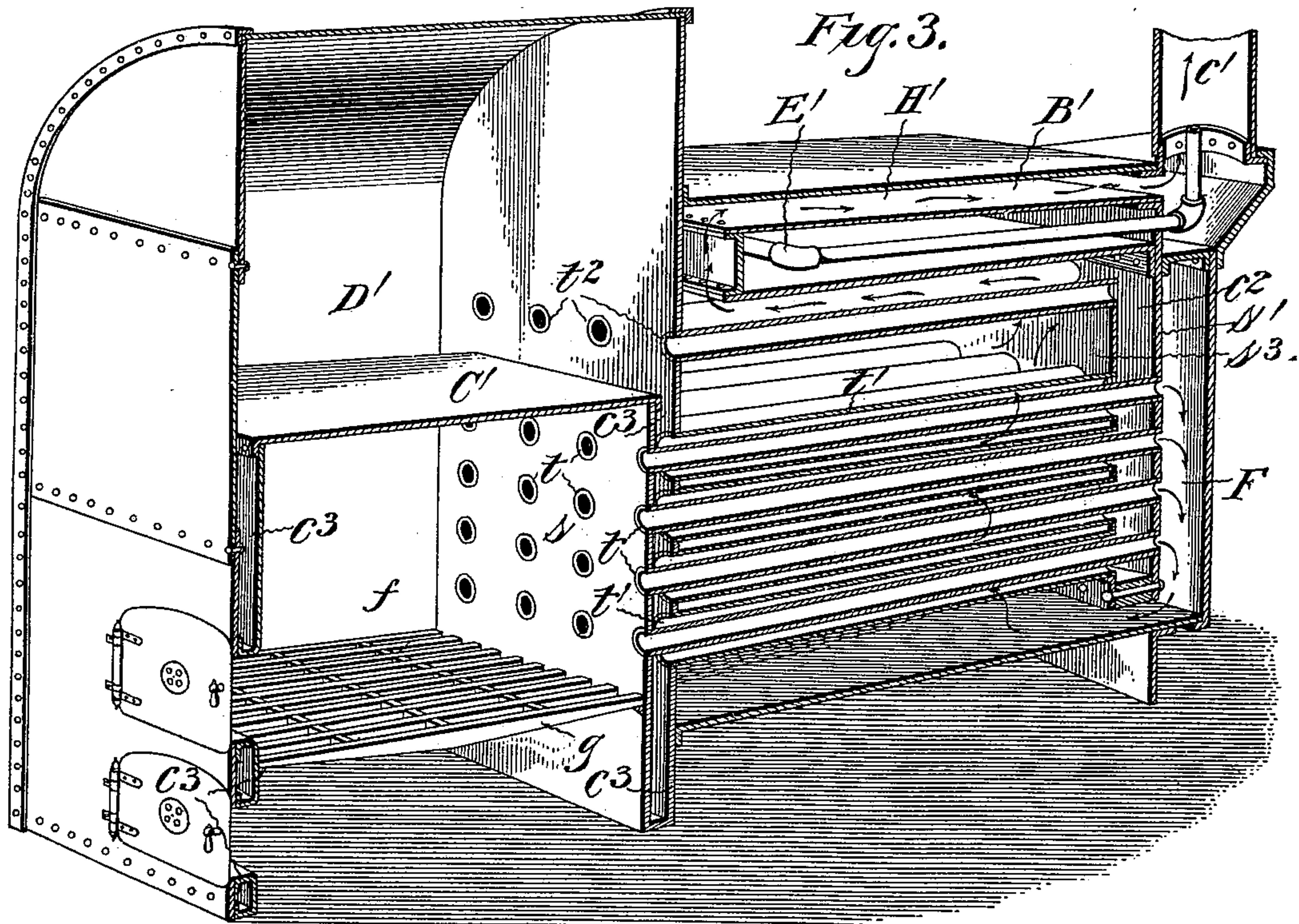
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3 Sheets—Sheet 2.



Witnesses.
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3 Sheets—Sheet 3.

Fig. 6.

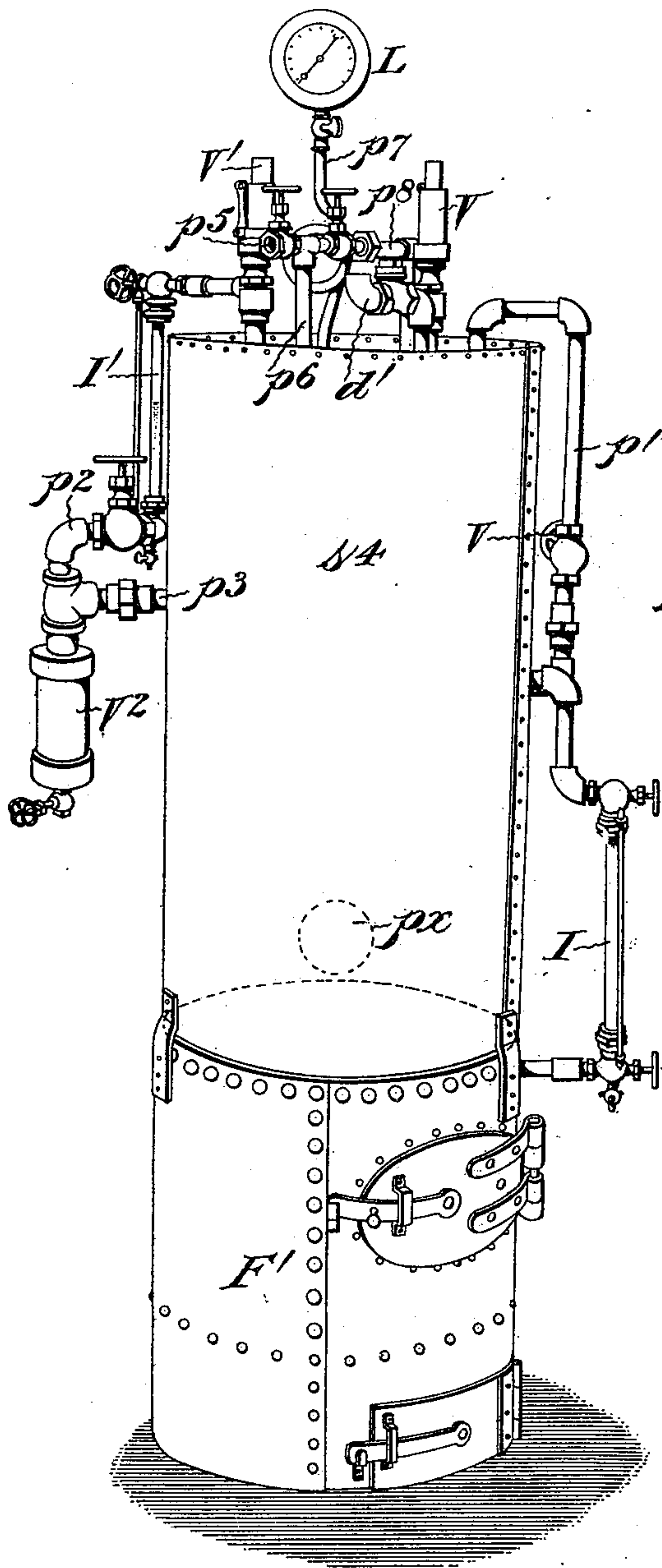
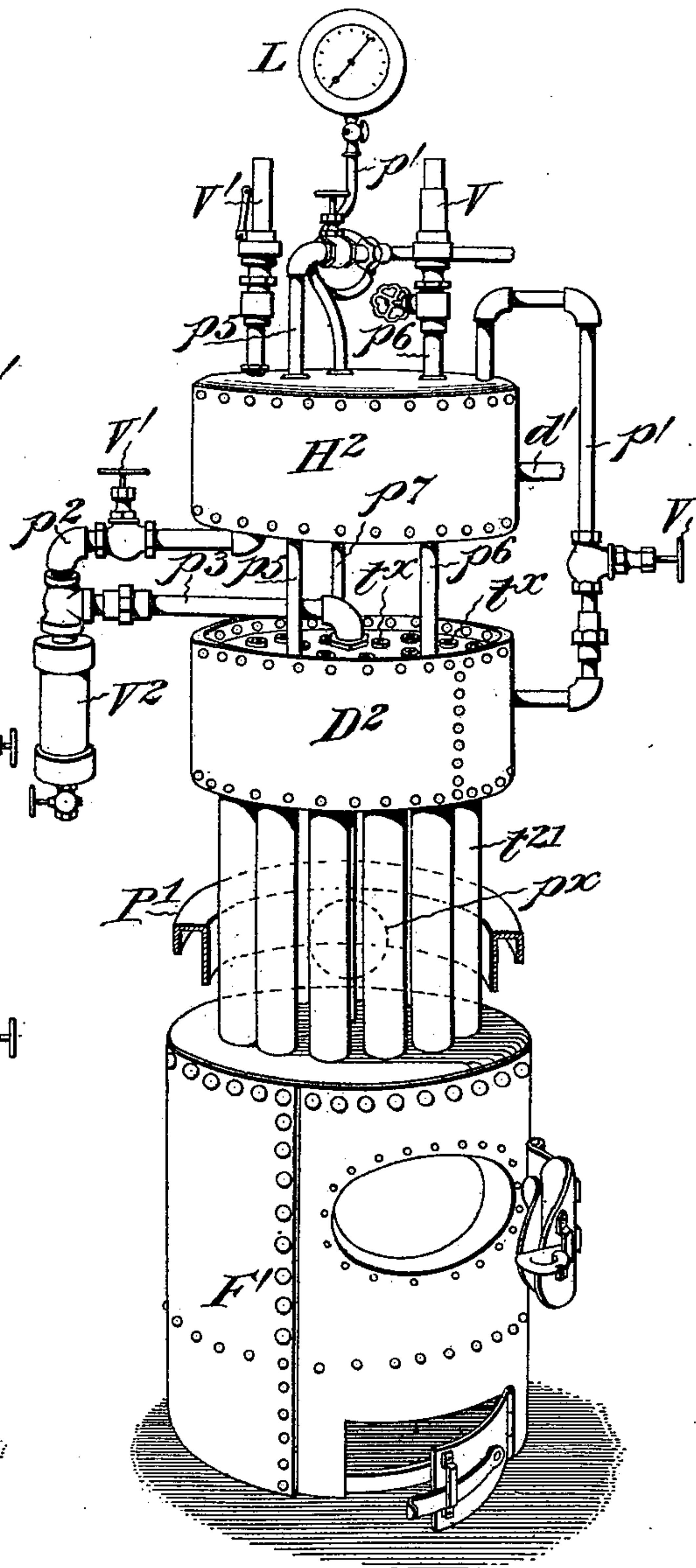


Fig. 7.



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UNITED STATES PATENT OFFICE.

VICTOR HANSON, OF RICHMOND, VIRGINIA, ASSIGNOR OF ONE-HALF TO
JAMES G. WHITLOCK, OF HANOVER COUNTY, VIRGINIA.

STEAM-BOILER.

SPECIFICATION forming part of Letters Patent No. 622,352, dated April 4, 1899.

Application filed May 28, 1898. Serial No. 682,007. (No model.)

To all whom it may concern:

Be it known that I, VICTOR HANSON, a citizen of the United States of America, residing at the city of Richmond, county of Henrico, State of Virginia, have invented certain new and useful Improvements in Steam-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, reference being had to the accompanying drawings, and to letters of reference marked thereon, which form a part of this specification.

This invention has relation to steam boilers or generators, and more particularly to that class of boilers known as "multitubular circulating-boilers."

The invention has for its object a construction of boiler wherein the heating-surfaces relatively to the maximum quantity of water are materially increased and whereby a more efficient circulation of the water and utilization of the heat units are obtained than has been possible heretofore.

The invention has for its further object the provision of means whereby the feed-water is heated by the waste products of combustion and by the exhaust-steam from the engine and such feed controlled by the pressure of the boiler-steam.

The invention has for its further object a simple means for securing the fire-tubes fluid-tight into the flue sheets or plates and whereby in case of leakage said tubes can be made tight in a simple and expeditious manner.

In the accompanying drawings, Figure 1 is a vertical cross-section of a steam-boiler constructed in accordance with my invention. Fig. 2 is a horizontal section of the heating-chamber above the steam-dome of the boiler through the feed-water heater. Fig. 3 is a perspective longitudinal sectional view of a horizontal steam-boiler embodying my improvements. Figs. 4, 5, and 8 are sectional detail views, and Figs. 6 and 7 are perspective views, of a vertical cylindrical boiler the shell of which is removed in Fig. 7.

Referring to Fig. 1, F indicates the furnace or fire-box; G, the grate; C, the crown-sheet; S, the water-jacket surrounding the fire-box, and A the ash-pit. In the crown-sheet C and the upper flue-sheet S' are secured the fire-

tubes T, and in the intermediate flue-sheet S³ and the lower flue-sheet S², that separates the smoke-chamber B² from the water-space, are secured what I term "primary" circulator-tubes T', of considerably greater diameter than the fire-tubes T, which latter pass centrally through said circulator-tubes. The intermediate flue-sheet S³ and the upper flue-sheet S' are secured to a ring R and constitute the steam chamber or dome D of the boiler, said steam-dome D being of less cross-sectional area than the boiler-shell S⁴. Above the steam-dome D is arranged the feed-water heater H, also shown in Fig. 2 and likewise of less cross-sectional area than said boiler-shell S⁴, to which is secured, at a point proximate to the outlet-port *p* for the products of combustion connected with the stack or chimney *c*, a deflecting-plate P, that projects from said shell toward the circulator-tubes T and thence downward to a point below the aforesaid outlet-port *p*. By this arrangement the products of combustion flowing through the fire-flues T pass into the heating-chamber or smoke-box B, around all sides of the feed-water heater H, and thence downward around the steam-dome and circulator-tubes T to the deflecting-plate, which deflects them toward and around said circulating-tubes nearly to the lower flue-sheet S², whence they pass upward into the space between the boiler-shell and deflecting-plate P and out at port *p* to chimney *c*. The deflecting-plate P performs here an important function in that it prevents the products of combustion from flowing directly across the shell to the outlet-port *p* from points below the steam-dome D, and it will readily be seen that by the described arrangement the heat of the products of combustion is almost wholly utilized before said products reach the chimney in that the water circulating through the tubes T' is heated both from within and without, the circulating-tubes T' constituting a series of independent water-spaces forming part of the main water-space W, that surrounds the furnace or fire-box on four sides.

In practice and to obtain the best results the area of the passage between the lower edge of the deflecting-plate P and the lower flue-sheet S² should be about equal to the cross-sectional area of the outlet-port *p*.

In the feed-water heater H is arranged a

coil of pipe E, whose inlet e is or may be connected with the exhaust-port of the engine and its outlet e' with the chimney c in any usual manner.

5 To facilitate the circulation of the boiler-water and to provide means for carrying the feed-water gradually to the more intensely heated portions of the boiler, I preferably provide an auxiliary circulator-tube T^2 of at
10 least twice the cross-sectional area of the primary circulator-tubes T' , arranged centrally of the group of such, and to insure a more rapid circulation may also use a dished intermediate flue-sheet or steam-dome bottom S^3 ,
15 Fig. 4, having its greatest depression about said auxiliary circulator-tube T^2 .

The feed-water heater has a puppet or other safety or blow-off valve V' , a like valve V being provided for the steam-dome D , and d is
20 the supply-pipe for the said feed-water heater. The feed-water heater H is connected with the steam-dome of the boiler by a pipe p' , provided with a suitable stop cock or valve v' , so as to admit steam from the dome
25 D to the upper part of the heater H , which latter is also connected near its bottom with the boiler by a feed-pipe p^2 , provided with a suitable stop cock or valve v^2 . As shown in
30 Figs. 1 and 8, the feed-pipe p^2 does not lead directly to the boiler, but into a sediment vessel or chamber V^2 , said pipe having its outlet below the outlet of the vessel, to which
35 latter outlet is connected a pipe p^3 , that extends into the smoke-box below the feed-water heater H to the center of the boiler, where it dips into the steam-dome nearly to the upper end of the enlarged central circulator-tube T^2 , the normal water-level being on a
40 line somewhat below the bottom of the steam-dome D .

The vessel V^2 has an outlet from its bottom provided with a purge cock or valve v^3 . Inasmuch as the chamber V^2 is normally full of water the feed-water coming from the
45 heater H enters into a quiescent body of water, allowing solid impurities to settle, and as the separation of the solids from the liquids is facilitated by heat the water reaches the boiler almost free of such solids.

50 Practical experience has shown that the portion of the feed-pipe p^3 within the smoke-box B becomes so intensely heated as to result in back pressure, which interferes with the proper feeding, to avoid which I sheath said
55 pipe in an incombustible non-conductor of heat, as a sheathing of asbestos a , as shown in Fig. 8, which also shows a slight modification in the construction of the sediment vessel or chamber V^2 , wherein the feed-pipe p^2
60 extends through a tubular extension v^{22} into vessel V^2 .

Steam may be taken from the steam-dome D at any suitable point, as through the port p^4 , or the service-pipe may be carried from the
65 steam-dome through the feed-water heater, as will hereinafter appear.

The difficulties met with in boilers to keep

the flues water-tight in the flue-sheets are well known. To facilitate this work, I make the surface of the openings slightly convex
70 and place around each tube, particularly the circulating-tubes T' in the boiler under consideration, a sleeve s^5 , of ductile metal, preferably copper, said sleeve being gradually
75 reduced in thickness from its ends to its longitudinal center or to the point in contact with the greatest convexity of the inner face of the tube-sheet opening, as shown in Fig. 5, so that should the tube T' become leaky it
80 can be tightened by means of a calking-tool or the like, there being sufficient metal in the sleeve at its opposite ends to admit of this.

b b are braces or stays that brace the flue-sheets S^2 and S^3 together, and b' b' are the braces or stays for the furnace or fire-box
85 jacket.

Referring now to Fig. 3, f is the furnace; g , the grate; C' , the crown-sheet; s and s' , the fire-tube flue-sheets; t , the fire-tubes; t' , the
90 primary circulator-tubes through which said fire-tubes pass, and t^2 the auxiliary circulator-tubes emptying onto the crown-sheet C' . D' is the steam-dome, and c^3 are the water-spaces that surround the fire-box f . In rear of the
95 fire-tube sheet s' is a flue F , that leads to the bottom of the boiler-shell back of the fire-box, so that the products of combustion are compelled to flow down and under the tube-sheet s' , thence up and around the circulating-tubes t' and t^2 to the smoke-box B' , in
100 which is arranged the feed-water heater H' , in such a manner that the said products of combustion flow forwardly along the under side thereof, thence over its top to the chimney c' , and E' is the exhaust-steam pipe with-
105 in the feed-water heater, one of the terminals of which leads into the chimney, as shown. The water here circulates through the water-tubes t' to the space or chamber c^2 at the rear end of said tubes through the auxiliary water-
110 tubes t^2 , and over the crown-sheet C' to the water-spaces c^3 , the boiler involving the same principles of construction as that shown in Fig. 1—that is to say, an enormous heating or
115 evaporating surface relatively to the water capacity of the boiler and a more thorough utilization of the heat than is possible in boilers of known construction.

I have shown in Fig. 1 a boiler of general elliptical form in cross-section simply to show
120 that such a form may be employed and which I believe could not be economically done in boilers of known construction. In Figs. 6 and 7 I have, however, shown the invention in its application to a cylindrical boiler. F'
125 indicates the fire-box, and t^{21} the primary circulator-tubes opening into the water-space above the crown-sheet of said fire-box and into the steam-dome. Through these primary circulator-tubes and the steam-dome D^2
130 pass the fire-tubes t^x , which are in communication with the fire-box and the boiler-shell s^4 at its upper end, which constitutes the smoke-box and surrounds the feed-water

heater H^2 , and P' is the deflecting-plate, the outlet for the products of combustion being shown in dotted lines at p^x . The service-pipe p^5 is carried through the feed-water heater H^2 , and so is the pipe p^6 , that carries the puppet or blow-off valve V for the steam-dome, as is also the pipe p^7 , that carries the pressure-gage L , and d' is the water-supply pipe for the feed-water heater. The feed-water heater H^2 is connected through valved pipe p^2 , sediment-chamber V^2 , and pipe p^3 to the boiler, said pipe p^3 having its outlet near the upper end of the central enlarged auxiliary circulator-tube, (not shown, but hereinbefore referred to and shown in Fig. 1,) and p' is the valved pipe that connects the steam-dome D^2 with the feed-water heater H^2 , which is likewise provided with a puppet or safety valve V' and with a level-indicator I' , the boiler being also provided with a level-indicator I .

Steam-boilers of the construction shown in Figs. 6 and 7 can be made sufficiently small to be carried by two men of ordinary strength and yet have a capacity of carrying from eighty to one hundred pounds of steam, which can be obtained from a few gallons of water in a very short time. Such a boiler can be used for many purposes other than supplying motive power—as, for instance, for cleansing drain and other pipes of obstructions or sedimentary matter, for cleansing beer-pipes in dispensing apparatus, and the like—to which end the service-pipe p^5 is connected by a valved branch pipe p^8 with the feed-water heater, so that water from the latter and steam from the boiler can be forced through the service-pipe and the pipe to be cleansed.

Practice has shown that beer-pipes, for instance, can be thoroughly cleansed of the slime and other sedimentary matter in a few seconds, which is not possible by the means usually resorted to—as, for instance, by the use of hot alkali lyes—and this latter means of cleansing has the further disadvantage in that after such cleansing the pipes have to be freed from all trace of the alkali lye to prevent injury to the pipes and to the liquid flowing therethrough.

I have shown means for feeding the boiler by gravity from the feed-water heater in a well-known manner; but I do not desire to limit myself to this arrangement, which, although of great convenience in a steam-generator such as last hereinabove referred to, need not necessarily be used in a stationary vertical or horizontal or in a locomotive boiler, yet in the arrangement of feed-water heater within the direct path of the fire gases or products of combustion, as shown and described, the feed-water heater becomes an auxiliary generator, as has been shown by practice, so that I can obtain in the feed-water heater a pressure higher than that in the boiler, for which reason a safety-valve is provided. I am thus enabled to feed the water to the boiler under the pressure of the steam in the feed-water heater instead of under the

boiler-pressure, as has been the custom before my invention, thereby avoiding all loss of boiler-steam by condensation, and not only that, but I can utilize the overpressure in the feed-water heater as motive power by simply establishing the communication between the said heater and the steam-dome of the boiler through the pipe p' . These advantages have before my invention never been realized in steam boilers or generators.

Having thus described my invention, what I claim as new therein, and desire to secure by Letters Patent, is—

1. In a multitubular steam-boiler, the combination with the boiler-shell having steam and water spaces, the fire-box, and fire-tubes connecting said box with the atmosphere through said shell; of primary circulator-tubes inclosing said fire-tubes and connecting the steam and water spaces, and an auxiliary circulator tube or tubes also connecting the steam and water spaces and arranged relatively to the primary tubes to receive and discharge the water flowing from the latter tubes into the aforesaid water-space, for the purpose set forth.

2. In a multitubular steam-boiler, the combination with the boiler-shell having steam and water spaces, the fire-box, and fire-tubes connecting said box with the atmosphere through said shell; of primary circulator-tubes inclosing said fire-tubes and connecting the steam and water spaces, and an auxiliary circulator-tube of greater cross-sectional area than said primary tubes, also connecting the water and steam spaces, said auxiliary circulator-tube connected with said steam-space at a lower level than the primary tubes, for the purposes set forth.

3. In a multitubular steam-boiler, the combination with the boiler-shell having steam and water spaces, the fire-box, and fire-tubes connecting the same with the atmosphere through said shell; of primary circulator-tubes inclosing the fire-tubes and connecting the steam and water spaces, and an auxiliary circulator-tube of greater cross-sectional area also connecting said steam and water spaces and arranged centrally of the group of primary circulator-tubes and connected with the steam-space at a lower level than the surrounding primary circulator-tubes, for the purpose set forth.

4. In a multitubular steam-boiler, the combination with the primary circulator-tubes and fire-tubes extending axially therethrough, of an auxiliary circulator-tube of greater diameter than said primary circulator-tubes, arranged centrally of the group of such, and the tube-sheets for said circulator-tubes, the upper one of which is dished and has its greatest depression about said auxiliary circulator-tube, for the purpose set forth.

5. In a multitubular steam-boiler, the combination with the boiler-shell having steam-space in its upper part, a fire-box in its lower part, and a water-space encompassing the

same; of fire-tubes connecting said fire-box with the shell, and extending through the water-space above the crown-sheet of the box, circulator-tubes inclosing said fire-tube and
5 connecting the aforesaid water and steam spaces, and means whereby the products of combustion discharged into the shell are caused to circulate about the circulator-tubes before they escape to the atmosphere, for the
10 purpose set forth.

6. In a multitubular steam-boiler, the combination with the boiler-shell having a steam-space in its upper part, a fire-box in its lower part, and a water-space encompassing the
15 same; of fire-tubes connecting said fire-box with the shell and extending through the water-space above the crown-sheet of the box, circulator-tubes inclosing the fire-tubes and connecting the water and steam spaces, and
20 means whereby the products of combustion are caused to circulate about the steam-space and circulator-tubes before they escape to the atmosphere, for the purpose set forth.

7. In a multitubular steam-boiler, the combination with the boiler-shell having a steam-space in its upper part, a fire-box in its lower part and a water-space encompassing the
25 same; of fire-tubes connecting the fire-box with the upper end of the shell and extending through the water-space above the crown-sheet of said box and through the steam-space, circulator-tubes inclosing said fire-tubes and connecting the aforesaid water and
30 steam spaces, and means whereby the products of combustion discharged into the upper end of the shell are caused to circulate about the steam-space and circulator-tubes before they escape to the atmosphere, for the purpose set forth.

8. The combination with the boiler-shell having a steam-space in its upper part, a fire-box in its lower part, and a water-space encompassing the same; of fire-tubes connecting the fire-box with said shell and extending
40 through the water-space above the crown-sheet of said box, primary circulator-tubes inclosing the fire-tubes and connecting the aforesaid water and steam spaces, an auxiliary circulator-tube of greater cross-sectional
45 area than and located centrally of the group of primary circulator-tubes and connecting said water and steam spaces, and means whereby the products of combustion are caused to circulate about the aforesaid circulator-tubes,
50 for the purpose set forth.

9. In a multitubular steam-boiler, the combination with the boiler-shell having a steam-space in its upper part, a fire-box in its lower part, and a water-space encompassing the
60 same; of fire-tubes connecting the fire-box with said shell and extending through the water-space above the crown-sheet of said box, primary circulator-tubes inclosing the fire-tubes and connecting the aforesaid water
65 and steam spaces, an auxiliary circulator-tube of greater cross-sectional area than and located centrally of the group of primary cir-

culator-tubes and connecting said water and steam spaces, said auxiliary circulator-tube connected with said steam-space at a lower
70 level than the surrounding primary circulator-tubes, and means whereby the products of combustion are caused to circulate about the aforesaid circulator-tubes, for the purpose set forth.

10. In a steam-boiler, the combination with the boiler-shell, means for generating steam contained therein, and a feed-water heater located within the shell above the generating
80 devices; of means whereby the products of combustion are caused to circulate about the feed-water heater before said products escape to the atmosphere, for the purpose set forth.

11. In a steam-boiler, the combination with the boiler-shell, means for generating steam
85 contained therein, and a feed-water heater located within the shell above the generating devices; of means whereby the products of combustion are caused to circulate about the feed-water heater and generating appliances
90 before said products escape to the atmosphere, for the purpose set forth.

12. In a multitubular steam-boiler, the combination with the boiler-shell having in its upper part a steam-space, in its lower part a
95 water-space, a fire-box, fire-tubes connecting the fire-box with the upper part of the shell and extending through said steam-space, and circulator-tubes connecting the said spaces; of a feed-water heater located in the shell
100 above the steam-space and outlet of the fire-tubes, and means for feeding the water from the heater to said water-space, for the purpose set forth.

13. In a multitubular steam-boiler, the combination with the boiler-shell having in its
105 upper part a steam-space and in its lower part a water-space, a fire-box, fire-tubes connecting said box with the upper part of the shell, and extending through said steam-space, and
110 circulator-tubes connecting the water and steam spaces; of a feed-water heater contained in the shell above the steam-space proximate to the outlet of the fire-tubes means for feeding the water from the heater to the aforesaid
115 water-space, and means for causing the products of combustion to circulate about the heater, steam-space and circulator-tubes before said products escape to the atmosphere, for the purpose set forth.

14. In a multitubular steam-boiler, the combination with the boiler-shell having a steam-space in its upper end, a fire-box in its lower end, a water-space encompassing said box, fire-tubes connecting the fire-box with the
125 upper part of the shell and extending through the aforesaid water and steam spaces, circulator-tubes inclosing the fire-tubes and connecting the water and steam spaces, a feed-water heater within the shell above the out-
130 let of the fire-tubes, a valved pipe connection connecting said steam-space with the upper part of the feed-water heater, a similar connection connecting said steam-space with the

lower part of said heater, and suitable safety-valves for said steam-space and feed-water heater, for the purpose set forth.

15. In a multitubular steam-boiler, the combination with the boiler-shell having a steam-space in its upper part, a water-space in its lower part, the fire-box, fire-tubes connecting the same with the shell, primary circulator-tubes and an auxiliary circulator-tube connecting said water and steam spaces, said auxiliary tube arranged relatively to the primary tubes to receive the water flowing therefrom; of a feed-water heater within the shell above the steam-space therein, and a feed-pipe connected with the lower part of the feed-water heater, said pipe extending into the steam-space and discharging into the auxiliary circulator-tube, for the purpose set forth.

16. In a multitubular steam-boiler, the combination with the boiler-shell having a steam-space in its upper part, a water-space in its lower part, the fire-box, fire-tubes connecting the same with the shell, primary circulator-tubes and an auxiliary circulator-tube connecting the steam and water spaces, said auxiliary tube arranged relatively to the primary tubes to receive the water flowing therefrom; of a feed-water heater within the shell above the steam-space, a feed-pipe connected with the lower part of the heater, said pipe extending into the steam-space and discharging into the circulator-tube, and means whereby the products of combustion are caused to circulate about the feed-water heater, steam-space and circulator-tubes before they escape to the atmosphere, for the purpose set forth.

17. In a multitubular steam-boiler, the combination with the boiler-shell having a steam-space in its upper part, a water-space in its lower part, the fire-box, fire-tubes connecting the same with the shell, primary circulator-tubes and an auxiliary circulator-tube connecting said water and steam spaces, said auxiliary tube arranged relatively to the primary tubes to receive the water flowing therefrom; of a feed-water heater within the shell above the steam-space therein, a feed-pipe connected with the lower part of the feed-water heater, said pipes extending into the steam-space and discharging into the auxiliary circulator-tube, and a sediment-collector interposed in the feed-pipe outside of the boiler-shell, for the purpose set forth.

18. In a multitubular steam-boiler, the combination with the boiler-shell having a steam-space in its upper part, a fire-box in its lower part and a water-space encompassing the same, fire-tubes connecting the fire-box with the upper part of the shell and extending through the steam-space, primary circulator-tubes inclosing the fire-tubes, and an auxiliary circulator-tube of greater cross-sectional area than the primary tubes, said circulator-tubes connecting the steam and water spaces and said auxiliary tube connected with said steam-space at a lower level than the primary

tubes; of a feed-water heater in the shell proximate to the outlet of the fire-tubes, a valved pipe connection between the steam-space and the upper part of said heater, a valved feed-pipe connected with the lower part thereof, and extending into the steam-space of the boiler and discharging into the auxiliary circulator-tube, and means whereby the products of combustion are caused to circulate about the feed-water heater, steam-space and circulator-tubes before they escape to the atmosphere, substantially as and for the purpose set forth.

19. In a steam-boiler, the combination with the furnace or fire-box, the boiler-shell, a steam-generator and feed-water heater contained in said shell, and means for heating the water in the generator and feed-water heater both from within and from without, for the purpose set forth.

20. In a multitubular steam-boiler, the combination with the fire-box or furnace, the water-space, a steam-collector, a feed-water heater, and the boiler-shell containing said parts one above another, of a service-pipe, a steam-escape pipe provided with a safety-valve, and a pressure-gage and supply-pipe, all of which pipes are carried from the steam-dome through the feed-water heater and thence through the boiler-shell, for the purpose set forth.

21. In a steam-boiler, the combination with the boiler-shell, the fire-box, and the generating appliances; of a feed-water heater located within the shell above said generating appliances, a coil of pipes within the heater adapted to be connected with the exhaust of a steam-engine and with a smoke-stack, and means for causing the products of combustion to circulate about the heater before they escape to the atmosphere, for the purpose set forth.

22. In a boiler such as described, the combination with the shell having a steam-space in its upper part, a fire-box in its lower part, a water-space encompassing said fire-box, the fire-tubes connecting the same with the upper part of the shell and extending through the steam-space, the circulator-tubes connecting the steam and water spaces; of an outlet for the products of combustion in the boiler-shell in a plane proximate to the lower end of the circulator-tubes, and a deflecting-plate secured to the boiler-shell and arranged to form a flue between the two, said plate extending downwardly over the aforesaid outlet nearly to the lower tube-sheet, substantially as and for the purpose set forth.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

VICTOR HANSON.

Witnesses:

C. R. LUKHARD,
J. G. WHITLOCK.