(No Model.)

4 Sheets—Sheet 1.

E. J. MOORE.

STEAM BOILER.

No. 486,731. Patented Nov. 22, 1892.

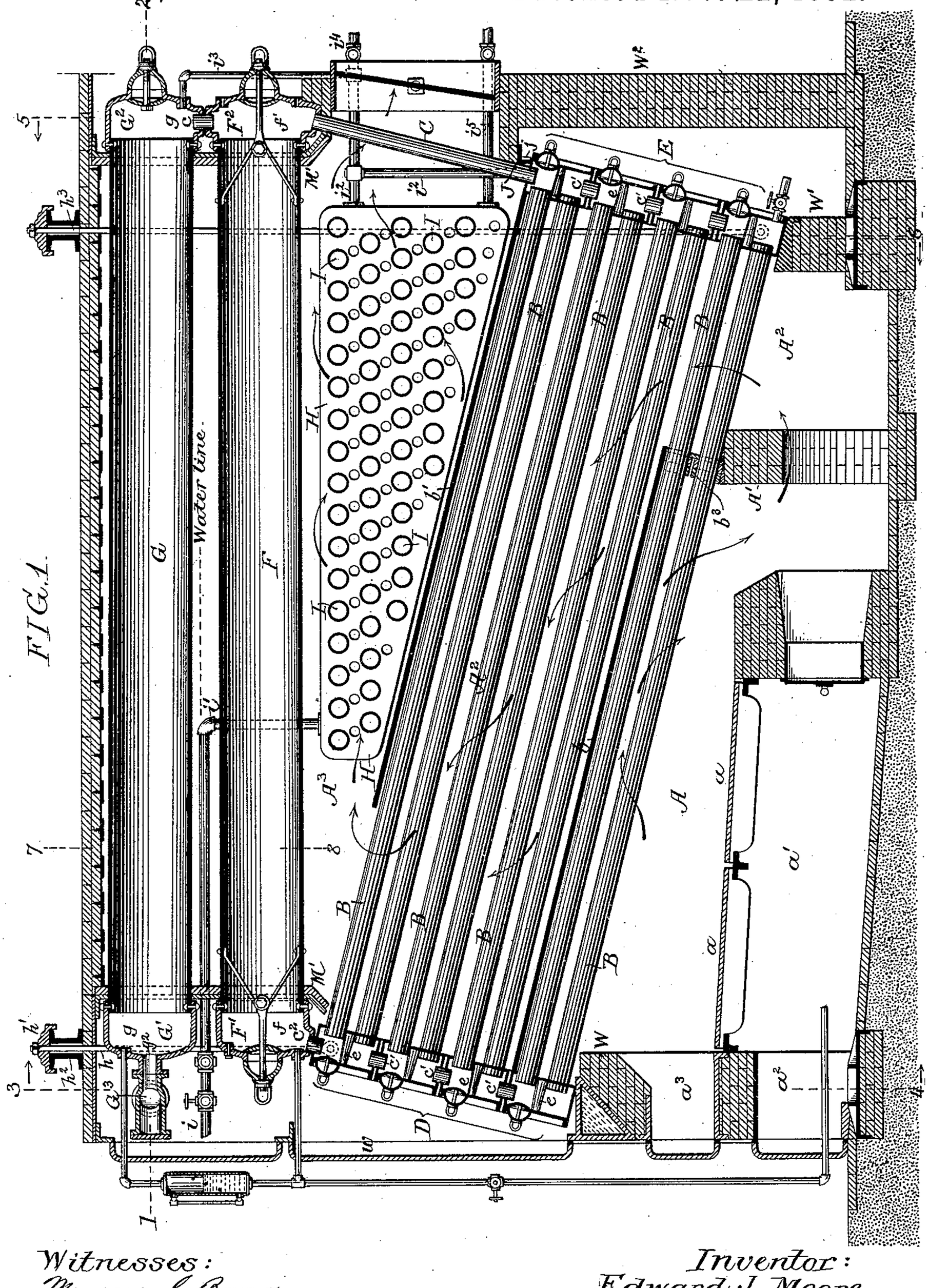

FIG. 1.

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Fred D. Goodwin

Inventor:
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by his Attorneys
Howson & Howson

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(No Model.) 4 Sheets—Sheet 2.

E. J. MOORE.

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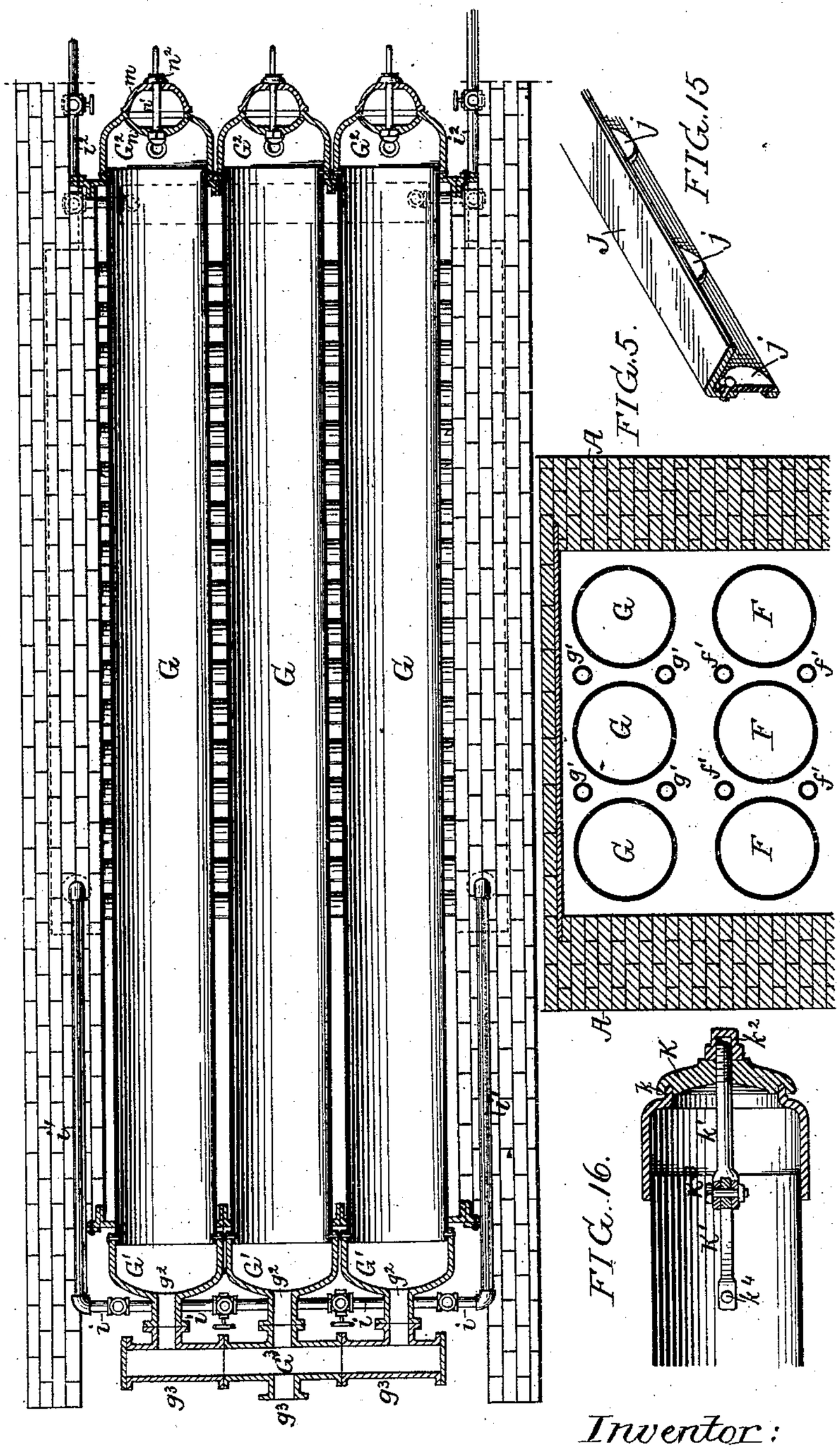

FIG. 2.

FIG. 15.

FIG. 5.

FIG. 16.

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(No Model.) 4 Sheets—Sheet 3.

E. J. MOORE.

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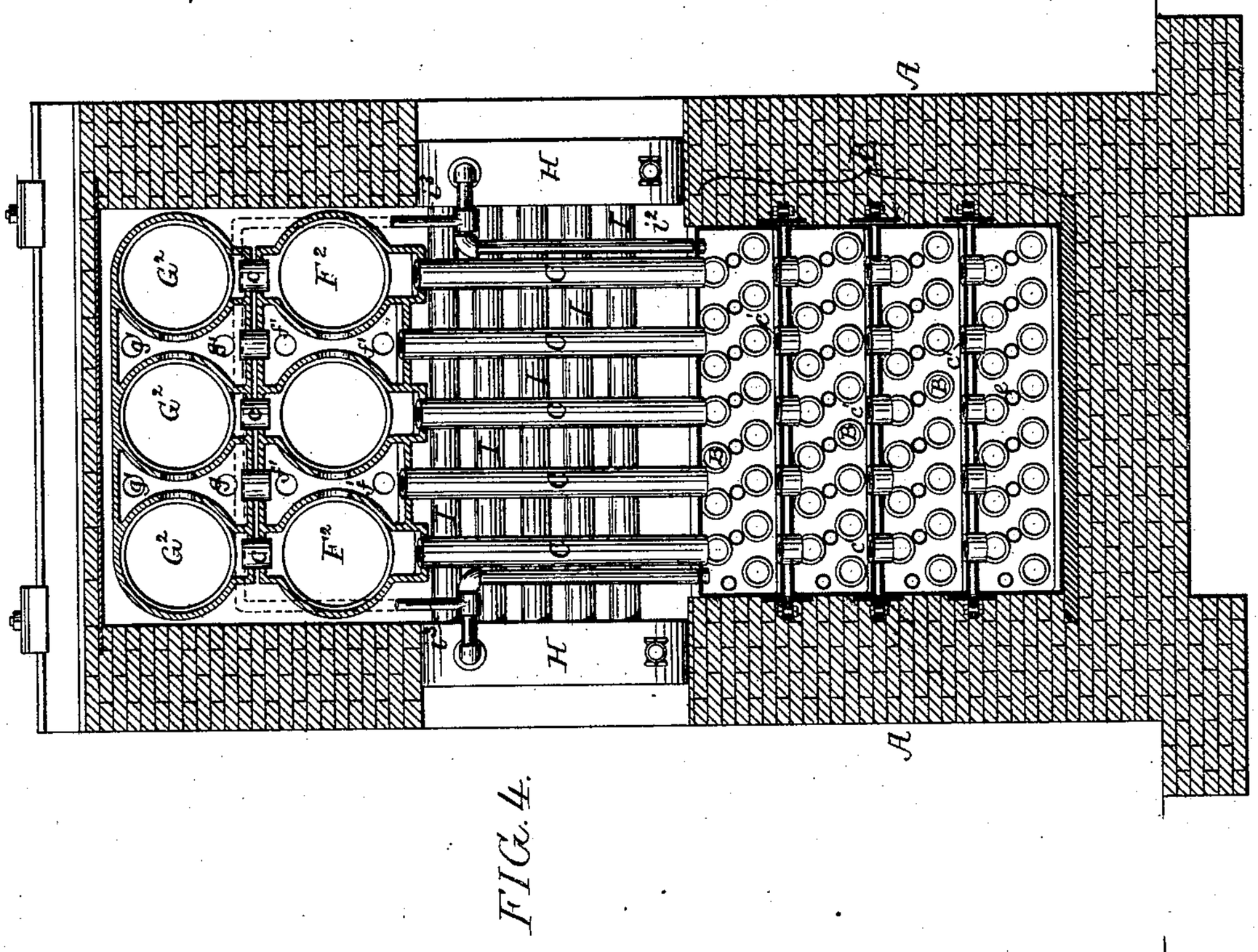

FIG. 4.

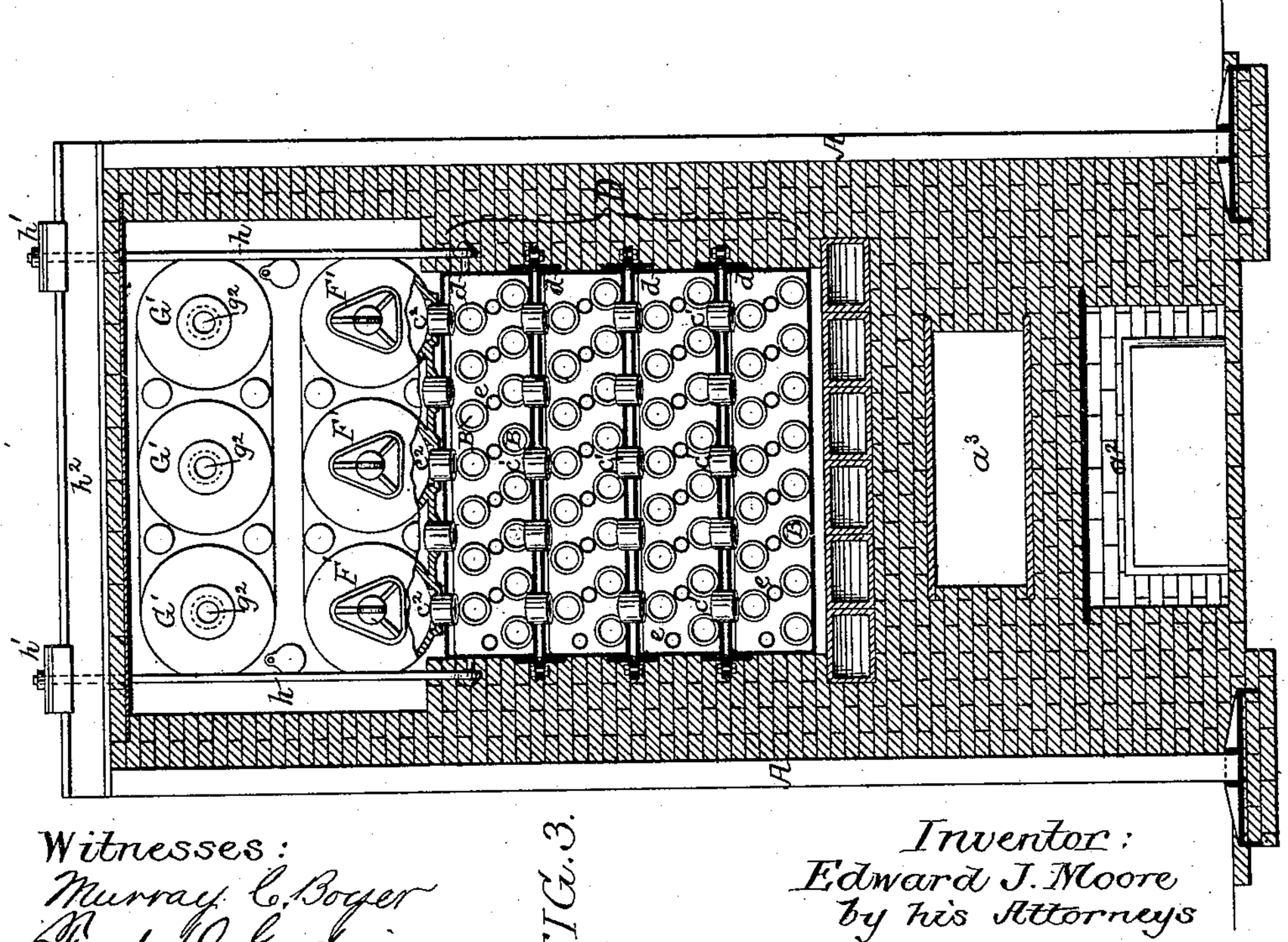

FIG. 3.

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(No Model.) 4 Sheets—Sheet 4.

E. J. MOORE.

STEAM BOILER.

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FIG. 9.

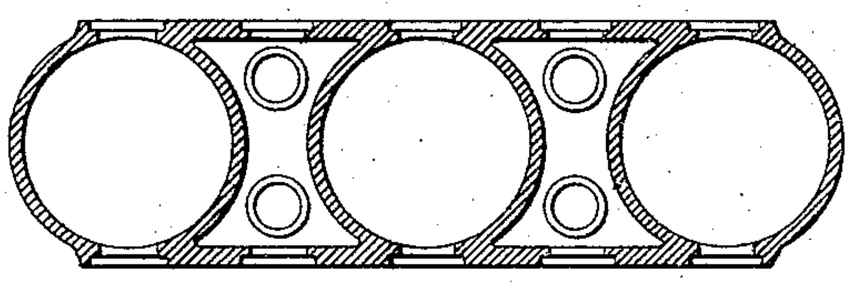


FIG. 10.

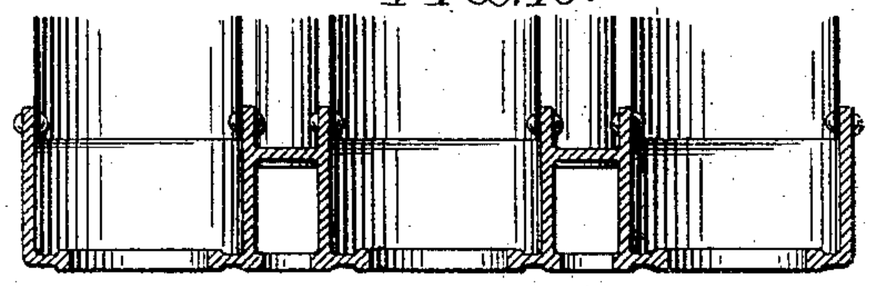


FIG. 8.

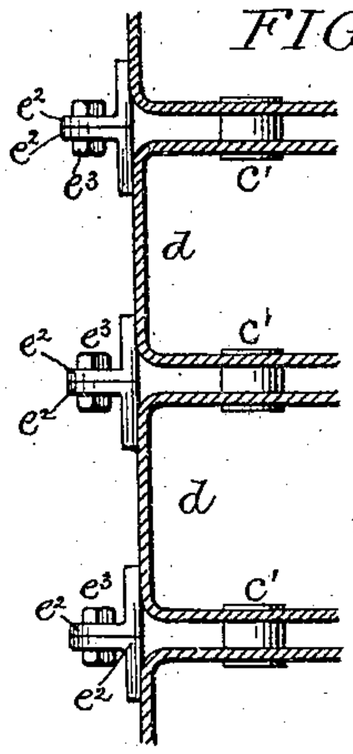


FIG. 7.

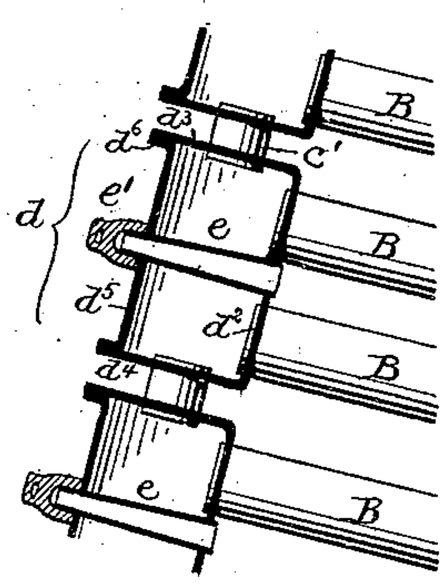


FIG. 6.

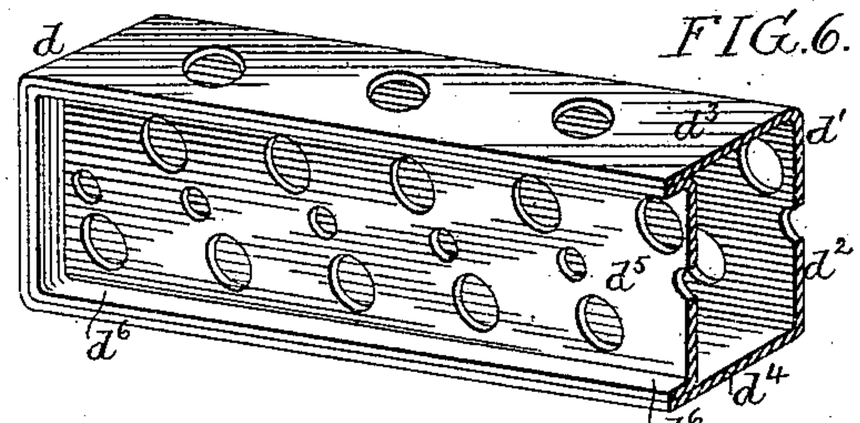


FIG. 14.

FIG. 13.

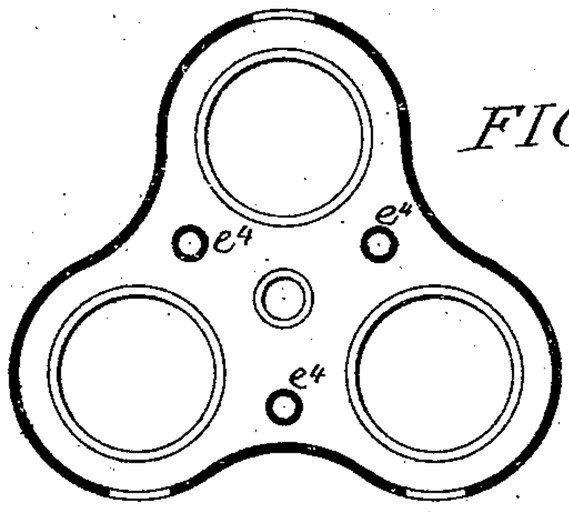


FIG. 11.

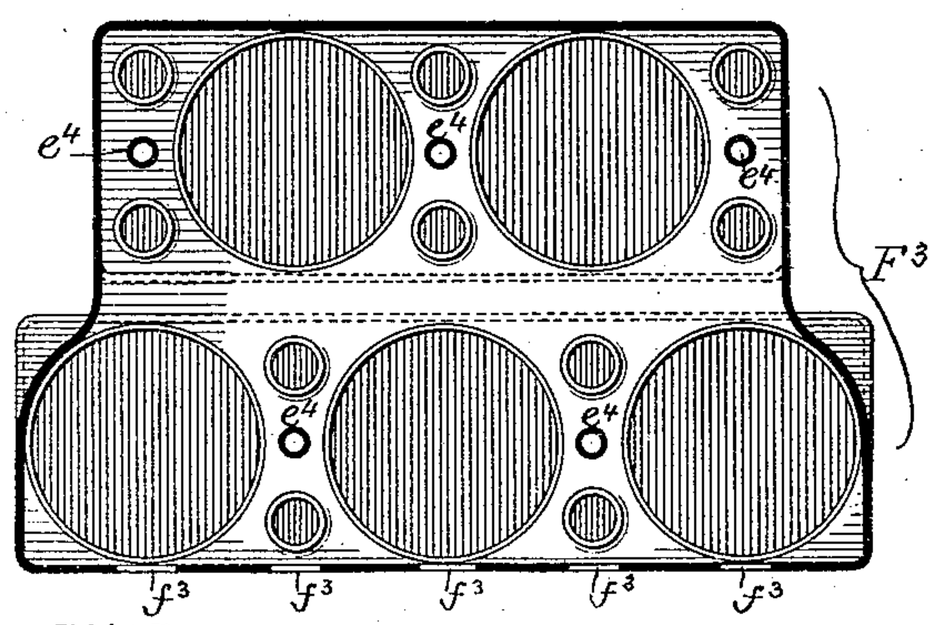
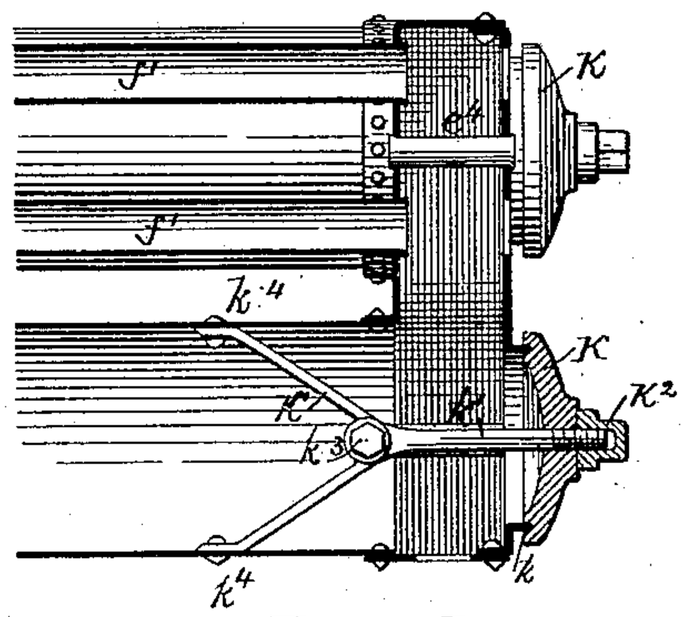


FIG. 12.



Witnesses:
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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

EDWARD J. MOORE, OF PHILADELPHIA, PENNSYLVANIA.

STEAM-BOILER.

SPECIFICATION forming part of Letters Patent No. 486,731, dated November 22, 1892.

Application filed September 26, 1891. Serial No. 406,909. (No model.)

To all whom it may concern

Be it known that I, EDWARD J. MOORE, a citizen of the United States, and a resident of Philadelphia, Pennsylvania, have invented certain Improvements in Steam-Boilers, of which the following is a specification.

The object of my invention is to so improve the construction of a sectional steam-boiler as to provide for even expansion and contraction and to increase the heating-surface of the boiler and at the same time to so construct the boiler that it will occupy a comparatively small space and to make it of material that will be proof against corroding and pitting and at the same time will be light and strong. These objects I attain in the following manner, reference being had to the accompanying drawings, in which—

Figure 1 is a longitudinal sectional view of my improved boiler. Fig. 2 is a sectional plan view on the line 1 2, Fig. 1. Fig. 3 is a transverse section on the line 3 4, Fig. 1. Fig. 4 is a transverse section on the line 5 6, Fig. 1. Fig. 5 is a transverse section on the line 7 8, Fig. 1. Fig. 6 is a sectional perspective view of one of the headers. Fig. 7 is a sectional view of a portion of the front header. Fig. 8 is a sectional view showing the clamps for securing the headers together. Figs. 9 and 10 are sectional views illustrating the modification of the manifold shown in Fig. 4. Figs. 11, 12, 13, and 14 are also sectional views showing modifications of the manifold, and Figs. 15 and 16 are views illustrating details of my improved boiler.

Referring in the first instance to Fig. 1, A is the combustion-chamber of the boiler. a are the grate-bars; a', the ash-pit; a^2, the ash-pit opening, and a^3 the stoke-hole.

A′ is an arch situated back of the bridge-wall, and under this arch pass the products of combustion. In fact, the combustion-chamber proper is divided into three parts A A^2 A^3 by inclined plates b b'. The inclined plate b extends from the front header to the arch A′ and the plate b' extends from the upper portion of the rear header to a point past the middle of the boiler, separating the second combustion-chamber A^2 from the third combustion-chamber A^3, the products of combustion passing from the chamber A, under the arch A′, through the combustion-chamber A^2, formed by the two plates b b', around the plates b', and through the combustion-chamber A^3 to the chimney, as clearly shown by the arrows in Fig. 1.

B are inclined water-tubes connected at their forward ends to the header D, their rear ends being connected to the rear header E. The inclination of these tubes may vary, according to the construction of the boiler. I will describe the details of the header hereinafter. The front header D rests upon the front wall W of the furnace, and the rear header rests upon the foundation W′. Both headers, however, so rest upon their foundations that they can move to allow for the expansion and contraction of the several parts. At the front of the furnace is a doorway w, provided with a suitable door. This doorway is opposite the front header D, and on opening the door access may be had to the front header. I provide a similar doorway in the rear wall W^2, so that access may be had to the rear header.

F are a series of horizontal water-drums connected at the front end with the front manifold-head F′ and at the rear end with the rear manifold-head F^2. In the present instance, there are three water-drums F situated side by side, and each drum is connected to a section of each manifold-head, and between each section is a circulating-section f, Fig. 4, and connected to the circulating-sections f of the front and rear manifold-heads are circulating water-tubes f'. (Shown clearly in Fig. 5.) I have shown the drum and circulating tube-sections of the head cast in a single piece and the several sections communicate with each other through the circulating-passages f^2.

G are a series of steam-drums situated above the water-drums F. These steam-drums are connected at the front end to a steam-manifold head G′ and at the opposite end to a manifold-head G^2. (Shown clearly in Fig. 4.) Steam-tubes g', situated between the steam-drums, are connected to the front and rear heads and communicate with the spaces g, Fig. 4. The drums and tubes are slightly inclined from the front to the rear, and the rear head G^2 is connected to the rear head F^2 by a

series of nipples *c*, the front steam and water heads being independent of each other. If any water of condensation accumulates in the steam drum or tube, it will pass to the rear and flow through the nipples to the water-drum rear head. I prefer that the water-line of the boiler be between the two drums F and G, so that while the drums F are at all times comparatively full of water the drums G are free from water and are purely steam-drums.

The heads or manifolds of the steam-drums and water-drums have deep flanges, as will be readily noticed in Fig. 1, and each flange is so shaped where the drum is joined to a second drum or to a header that all that is required to make a coupling is an ordinary nipple—as, for instance, the forward head F′ has an enlargement on the under side, the base of this enlargement being on a line parallel with the upper surface of the header B, consequently, when the header is brought in line with this enlargement an ordinary nipple c^2 is sufficient to secure the two together. The same is the case where the rear manifold or head F^2 is connected to the rear header E by the tube C. This is one of the important features of my invention, as a plain tube can be used and the head expanded or shaped, whether made of wrought metal or whether cast, and it matters not as far as this invention is concerned, whether it is simply a head for a single drum or a manifold for a number of drums and tubes.

I will now describe the construction of the headers D and E, referring to Figs. 6 and 7. The body *d′* of the section D of the front header D is struck up, as shown in said figures, forming the rear plates *d′* d^2 and top and bottom plates d^3 and d^4 and side plates. I then strike up a front plate d^5 with flanges d^6, and place it in position, as shown in Fig. 6, with the flange on the outside, and preferably weld the flange to the top, bottom, and end plates of the section *d′*; but in some instances I may secure the two parts together by rivets or bolts. Thus I make a header which can be built up from the outside, the seams being all exposed, so that they can be readily calked when necessary. Holes are punched or cut in the plate either before or after the header is made up, these holes being for the reception of the circulating-tubes and the nipples. The front plate has a series of large holes corresponding with the tube-holes in the back plate, and are used as hand-holes, so that access can be had to the several tubes and to the nipples. In order to strengthen each header-section I couple the front and rear plates together by tubular stays *e*, which are tapered, as shown in Fig. 7, from the back plate d^2 to the front plate d^5. I cover these tubes with caps *e′*, which are supported by the portion of the tube that extends beyond the front plate. These caps are provided with suitable handles, so that they can be readily removed when necessary. The tubes are used not only as stays, but as cleaning-openings, so that a cleaning-tool can be inserted to clean the exterior surface of the several circulating-tubes. Each header-section *d* has brackets e^2 at each end, and when the sections are mounted, as shown in Figs. 3 and 4, they are not only coupled together by the nipples *c′*, but are also coupled together by bolts e^3, which pass through the flanges of each bracket, as clearly shown in Fig. 8. It will also be noticed in referring to the drawings that the sections are not close together, but are so arranged that a clear space is left between each section. This allows for the ready insertion of cleaning-tools to clean the several circulating-tubes and the deflecting-plates. The upper section of the front header D is connected to the front water-manifold F′ by a series of nipples c^2, Figs. 1 and 3, and the upper section of the rear header E is connected to the rear water-manifold F^2 by a series of tubes C, Figs. 1 and 4. Some of the tubes and nipples connect with the drum-compartments, while others connect with the circulating-tube compartments. Thus the water circulates through the tubes B, the header D, up through the drum F, down to the header D, to the tubes B again. The steam passes through the rear manifold F^2 up through nipples *c* to the steam-manifold G^2 into the drums and steam-tubes G and *g′*. The front steam-manifold G′ has openings g^2, which communicate with the steam-manifold pipe G^3. This pipe in the present instance is made up of three sections g^3, coupled together in any suitable manner. It will be noticed on referring to Fig. 1 that the flanges of the manifold are on the outside of the drum and not on the inside, as usual, so that water will not become entrapped in the drum, as is usual in this class of boilers.

In order to take the strain off the nipples securing the headers to the drums, I suspend the front header by rods *h*, hung from caps *h′* on cross-bars h^2, and I suspend the rear header by rods h^3, hung from the cross-bars similar to the cross-bar for the front-header support. While the front header is connected to its supporting-rods at the top, by preference, the supporting-rods for the rear header are connected to the bottom of said header. Thus if at any time the foundations on which the headers rest settle the rods would support the headers.

Heretofore in the construction of boilers of the class shown and described the space available between the inclined tubes and the drums was not utilized. I, however, utilize this triangle of space, which I term the "third combustion-chamber," by filling said space with a series of transverse tubes I, which are mounted in suitable side headers H, situated, in the present instance, in the walls of the furnace, as shown in Fig. 4. I preferably expand the tubes I in the walls of the header in the same manner as the longitudinal tubes are expanded in their headers, and I also

brace the headers by stays, which may be either tubular and of the same construction, as shown in Fig. 7, or may be solid.

It will be seen by referring to Fig. 1 that the products of combustion as they pass through the third combustion-chamber will thoroughly heat the water in the transverse tubes, and as I pass the water into these tubes first before it enters the circulating-tubes this portion of the boiler acts, in fact, as a feed-water heater. The feed-water enters through the pipe *i*, which has two branches *i'*, which communicate with both the side headers H H at the small end. The side headers are connected by tubes i^2 to the upper section of the rear header E. The steam-drum G is connected by tubes i^3 to the pipe i^2, so that the water of condensation, which accumulates in said drum and which would not be carried off through the drum F, would pass down the tube i^3. Thus, as above shown, the water enters the side headers H and is heated in said side headers and in their connecting cross-tubes H and passes to the rear header, mingling with the water that is in circulation, passing through the inclined tubes to the front header and to the drum. Thus the water when it reaches the inclined tubes is heated, so that steam is more readily formed than in the boilers of the ordinary construction, and a complete circulation of the water is obtained. The deflecting-plate *b*, dividing the combustion-chamber into the sections A A^2, is mounted so that its upper surface is on a line with the opening between the two sections of the front header D, as shown in Fig. 1. The soot and dirt can be readily scraped from this deflecting-plate by simply passing a scraper through the front header at the point mentioned, the soot falling to the bottom of the furnace. It will be noticed that the deflecting-plate *b* in the present instance is above two rows of tubes and is supported by a structure b^3, mounted on the arch A', and this structure has a series of holes through which the tubes pass. Thus by this construction I heat the two lower sets of tubes in the combustion-chamber A and the balance of the tubes in the combustion-chamber A^2, as the upper deflecting-plate *b'* is by preference situated above the upper row of tubes. While I preferably close the space between the upper portion of the rear header E and the wall, I prefer to close it with a plate J. (Clearly shown in Fig. 15.) This plate I make of angle-iron and perforate it at intervals, so as to form openings for the insertion of cleaning-bars for removing the dirt and soot from the upper deflecting-plate *b'*. I provide these openings with suitable covers *j*, so that the openings can be closed at all times except during the cleaning operation. I preferably pivot the covers at a point above the openings, so that they will be automatically closed as soon as the cleaning-tool is removed. The pipes i^2 have extensions i^4, provided with suitable valves, so that water in the side headers on a level with the extension-pipes can be drawn off to remove scum, &c., and I also provide valved pipes i^5, communicating with the side headers at the bottom, so that the mud can be removed from the bottom of said headers.

The caps for the drum-heads are of the construction shown clearly in Figs. 1, 12, and 16. On each head I form a flange *k*, the edges of the flange being chamfered, as shown, to form a sharp edge. The cap K has an annular groove of the shape corresponding to the chamfer which is ground onto the edge of the flange, thus forming a ground joint. The cap has a central opening, through which passes the bolt *k'*, which is screw-threaded at the end and to which is applied a box-nut k^2. The face of this nut and the face of the cap K are ground, forming a tight joint. The bolt is secured to a V-shaped brace K' by a pin k^3, this brace being secured to the drum at k^4 by rivets or other suitable fastenings. The flanges may be either formed in the casting of a header, as shown in Fig. 1, when the header is made of cast metal, or may be pressed out from the metal, as shown in Fig. 12, when the header is made of wrought metal.

In order to expose the water and steam drum headers, so that they can be inspected or repaired at any time, I form partitions M', one directly back of the front manifolds and the other forward of the back manifold, as clearly shown in Fig. 1. These partitions I preferably make of metal plates having suitble openings for the passage of the drum and tubes, and I face these plates on the combustion-chamber side with fire-brick or other suitable material to withstand the heat. Thus the both headers are cut off from the direct action of the products of combustion, but are within the walls of the furnace. Suitable doors are provided at the front and rear of the furnace, so that on opening the doors the headers can be examined without interfering with the action of the boiler.

In Fig. 4 I have shown the manifold heads G^2 and F^2 of the steam and water drum made of cast metal, each manifold being cast in a single piece and having partitions dividing the manifold into sections. The several sections of the water-manifolds are united by passages f^2 and the sections of the steam-manifolds are united by passages g^2. The rear water-manifold header F^2 is secured to the rear header E by tubes C and to the steam-manifold by nipples *c*. The front manifolds shown in Fig. 3 are of the same construction, with the exception that the two manifolds are not connected.

In Figs. 9 and 10 I have shown a modification of the cast manifold, in which the tube and drum sections are independent of each other. In this case the steam-pipe G^3 would have to communicate not only with the drum-sections, but also with the tube-sections of the front steam manifold.

In Figs. 11 and 12 I have shown still an-

other modification, in which the rear manifolds F^2 and G^2 are combined, forming a single structure F^3, made of sheet metal, suitably struck up, as shown in said figures, and provided with openings f^3, into which are secured the tubes C. The manifold is preferably braced at intervals by the tubular braces e^4, as shown by dotted lines. The front headers, while being made of wrought metal, suitably stuck up, are independent of each other, as clearly shown by dotted lines in Fig. 11.

In Fig. 13 I have shown a triangular manifold-head receiving three drums. Two are water-drums and the third a steam-drum. This head can be made either of wrought or cast metal. I have shown in Fig. 13 the head made of wrought metal suitably stayed by stay-tubes e^4. This construction of manifold-head may be used singly, as shown in Fig. 13, being suitably mounted in the boiler, or may form one of a series of heads, as shown in Fig. 14, which are united to a common steam-drum M. This steam-drum has a series of capped openings n, by which access can be readily had to the nipples which secure the several headers to the drum. The upper row of drums may be used as steam-drums, or another set may be added, in which case one will be a steam set and the other a water set.

As shown in Fig. 4, as well as in Fig. 1, the boiler has one set of water-drums and one set of steam-drums, the drums being three abreast; but it will be understood that in larger boilers an increased number of drums may be necessary, and there may be two rows of water-drums and two rows of steam-drums, or in smaller boilers there need be only one or two water or steam drums, the number of drums depending altogether upon the capacity of the boiler.

In high-pressure steam-boilers an important point to guard against is corrosion, commonly called "pitting," and to avoid this, which is one of the most prevalent causes of steam-boiler explosions, I make the metallic parts as much as possible of aluminium alloy, as I find that this not only prevents pitting, but is considerably lighter and stronger than the metals commonly used. I not only make the plates, headers, and tubes of aluminium, but I also make the bolts, nuts, and other small parts of the same material where practicable.

In the above description it has been necessary to clearly describe the parts and to allude to matter which is claimed in an application for Letters Patent filed by me of even date herewith, Serial No. 406,910. Therefore I do not claim in this application this matter; but

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

1. The combination of the front and rear headers, inclined connecting-tubes, drum connected to said headers with side headers, and transverse tubes situated between the inclined tubes and drum, substantially as described.

2. The combination of the front and rear headers, inclined connecting-tubes, drum connected to said headers with side headers, transverse tubes situated between the inclined tubes and drum, said side headers being connected to the water-inlet pipe, and the rear header, substantially as described.

3. The combination, in a steam-boiler, of the drum, the front and rear headers made up of sections nippled together and attached to said drum, tubes connecting said headers, the front headers being secured together independent of the nipples, with front suspension-rods attached to the front header, and the reciprocated rods attached to the lower portion of the rear headers, whereby the weight of the headers is sustained by the rods and not by the nipples, substantially as described.

4. The combination, in a steam boiler, of the sectional headers, nipples forming communications between the sections, with a clamp-plate on each section, and securing devices for said plates, whereby the sections are held together independently of the nipples, substantially as set forth.

5. The combination, of the front and rear plates of a header with a tapered stay-tube having its end projecting beyond the line of the front plate, with a cap for said stay-tube, substantially as described.

6. The combination, in a steam-boiler, of the furnace, the grate-bars on or about on the line of the bridge-wall, inclined tubes, front and rear headers, an arch back of the bridge-wall, and a deflecting-plate extending from the arch forward to the front header, so that the products of combustion will be deflected through the archway to the second combustion-chamber, substantially as described.

7. The combination, in a steam-boiler, of the inclined circulating-tubes, the front and rear headers, the water-drum and the steam-drum, the deflecting-plates b b', separating the combustion-chamber into three parts, with transverse tubes situated between the upper deflecting-plate b' and the water-drum, substantially as described.

8. The combination, in a boiler of the type substantially as described, of the side headers, transverse tubes connecting the side headers, water-inlet pipes entering said headers, with a pipe i^2, communicating with the main tubes of the boiler, and an extension of said pipe, whereby scum at the water-line can be removed, and a pipe i^5, through which mud from the bottom of the side header can be removed, substantially as described.

9. The combination of the inclined tubes, front and rear headers, deflecting-plates, the upper deflecting-plates being on a line with the top of the rear header, a filling-plate between the top of the rear header and the wall of the furnace, cleaning-openings in said plate through which a cleaning-tool can be inserted to clean the upper deflecting-plate, with covers for said opening, substantially as described.

10. The combination, in a steam-boiler, of

the inclined circulating-tubes, the front and rear headers, the water-drum connected to the front and rear headers, and the steam-drum mounted above the water-drum and connected with one end only thereof, with a pipe i^3, near the passages of the two drums, a pipe i^2, communicating with said pipe i^3, through which water of condensation may be carried away from the steam-drum, substantially as described.

11. The combination, in a boiler, of the inclined water-tubes, front and rear headers therefor, and front and rear manifolds communicating with the said headers, water-drums, and circulating-tubes extending from the front manifold to the rear manifold, substantially as described.

12. The combination, in a steam-boiler, of the inclined water-tubes, front and rear headers therefor, a series of water-drums, front and rear manifolds therefor, nipples forming communications between the front water-manifold and the front header, tubes forming communications between the rear water-manifolds and the rear header, a series of steam-drums above the water-drums, front and rear manifolds therefor, and nipples forming communications between the rear steam-manifold and the water-manifold, the forward steam-manifold being connected to the steam-supply pipe, substantially as described.

13. The combination of the inclined tubes, front and rear headers, water-manifolds, drums and tubes connecting the front and rear water-manifolds, steam-drum and tubes above the water drum and tubes, and front and rear steam-manifolds with which the drums and tubes communicate, the rear steam-manifold and water-manifold being connected together, substantially as described.

14. The combination, in a steam-boiler, of the head or manifold, a flange thereon, the edge of said flange being chamfered, and a cap adapted to said flange and having an annular groove ground to the flange, so as to form a steam-tight joint, with a bolt for securing the cap to the header, substantially as described.

15. The combination of a drum, its head, an opening opposite the drum, a flange on said head projecting outward and having its edge chamfered, a cap having an annular groove corresponding with the chamfer on the flange to form a steam-tight joint, and a bolt passing through said cap and provided with a nut, with a V-shaped brace secured to the drum and connected to the bolt, substantially as described.

16. The combination of the flanged header, a cap adapted to said flange, forming a steam-tight joint, a bolt passing through said cap, a box-nut adapted to said bolt, said nut having its face ground and adapted to a ground seat on the cap, a V-shaped brace attached to the sides of the drum, and a pin securing the brace to the bolt, substantially as described.

17. The combination, in a steam-boiler, of the drum, the struck-up sheet-metal head having a deep flange which incases the drum, said flange being expanded at the point where it is coupled to another head or header, said expanded portion being wholly within the flange and having an opening for the reception of the coupling-nipple, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

EDWARD J. MOORE.

Witnesses:

HENRY HOWSON,

EUGENE ELTERICH.