

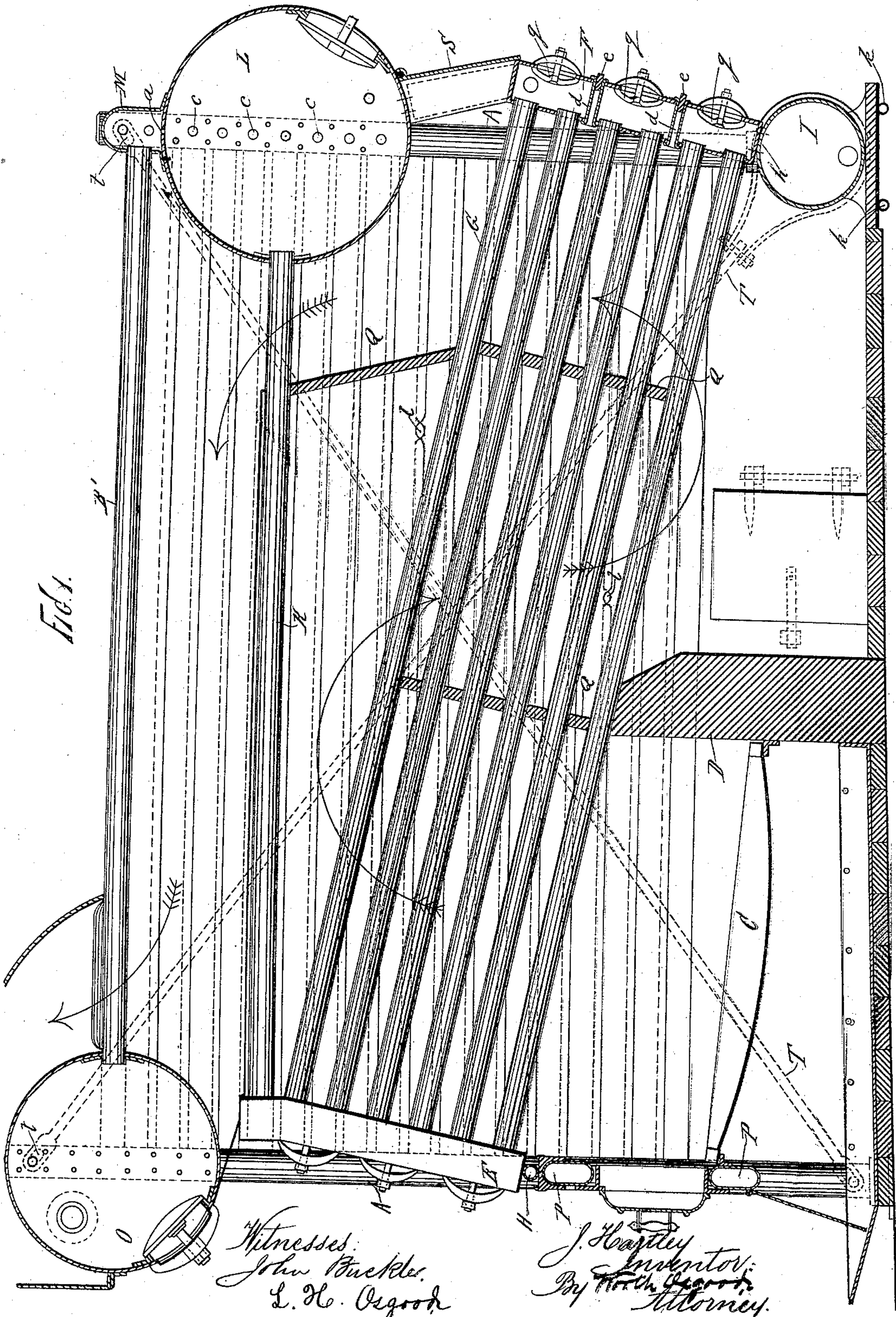
(No Model.)

4 Sheets—Sheet 1.

J. HARTLEY.  
STEAM BOILER.

No. 335,696.

Patented Feb. 9, 1886.



Witnesses:  
John Buckler.  
L. H. Osgood.

J. Hartley  
Inventor.  
By H. C. Osgood,  
Attorney.



(No Model.)

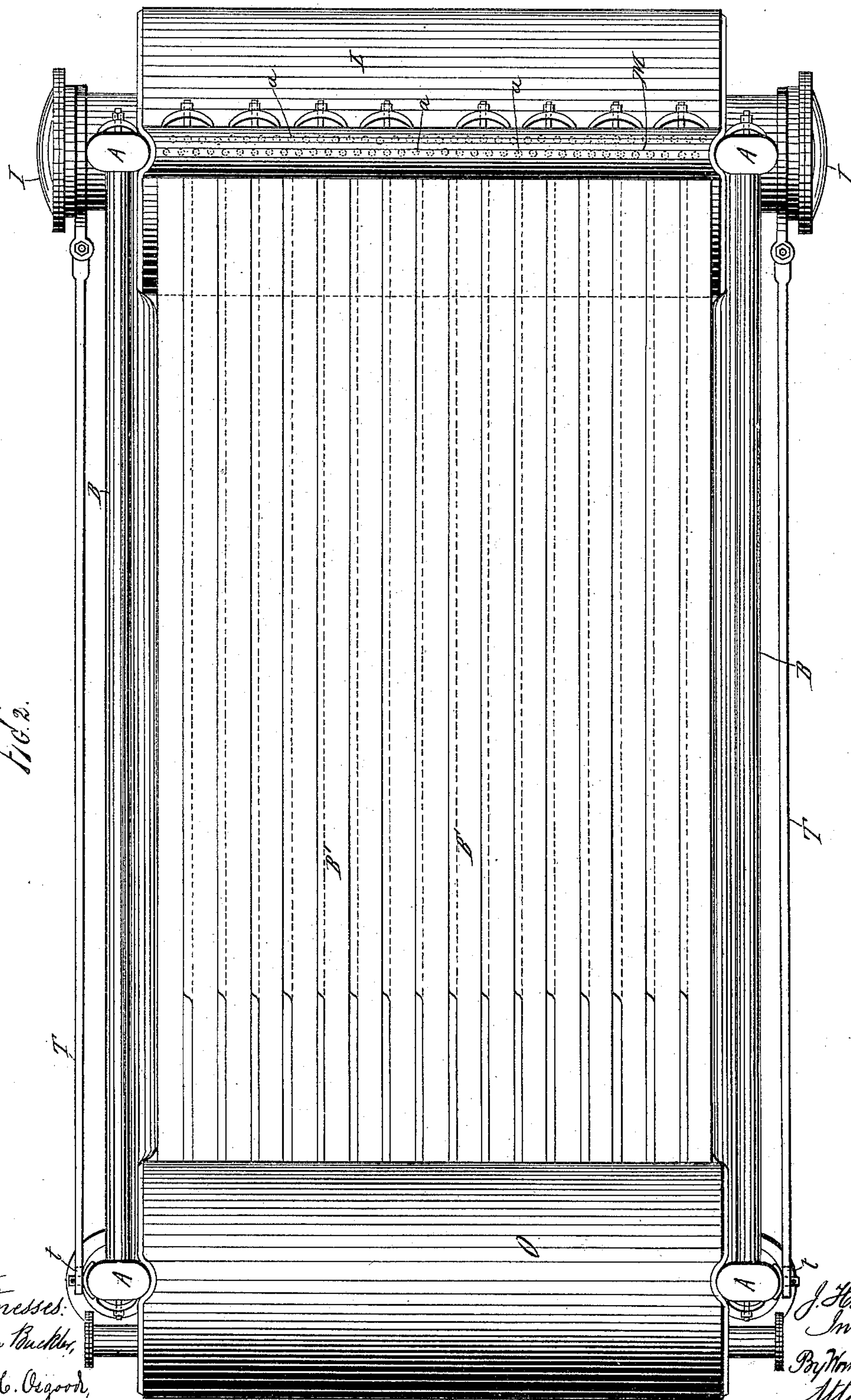
4 Sheets—Sheet 2.

J. HARTLEY.

STEAM BOILER.

No. 335,696.

Patented Feb. 9, 1886.



Witnesses:  
John Buckler,  
L. H. Osgood,

J. Hartley,  
Inventor.  
By Wm. Osgood,  
Attorney.



(No Model.)

4 Sheets—Sheet 3.

J. HARTLEY.

STEAM BOILER.

No. 335,696.

Patented Feb. 9, 1886.

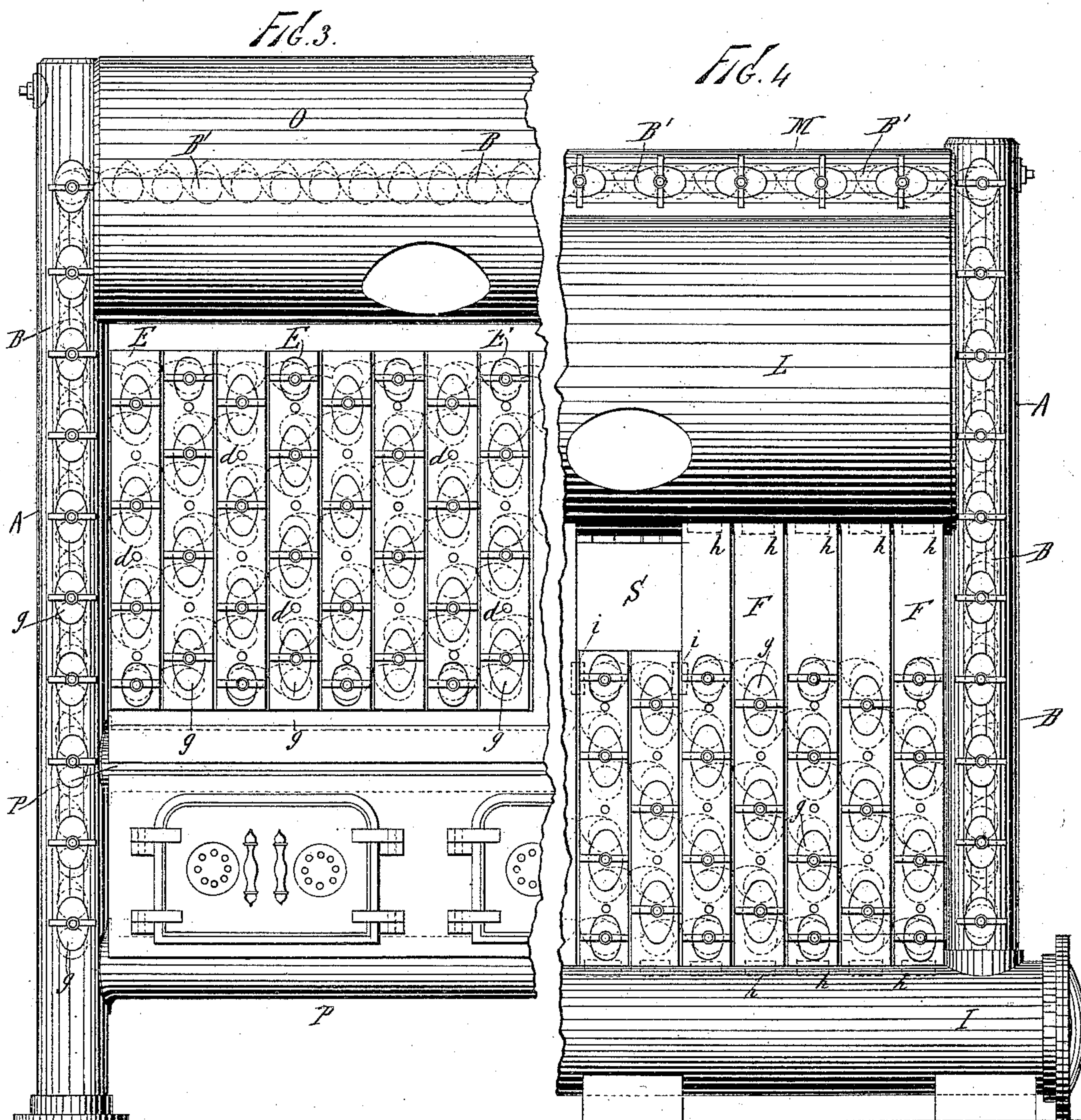


Fig. 5.

Witnesses:  
John Buckler,  
L. H. Osgood

J. Hartley,  
Inventor.  
By North Osgood  
Attorney.

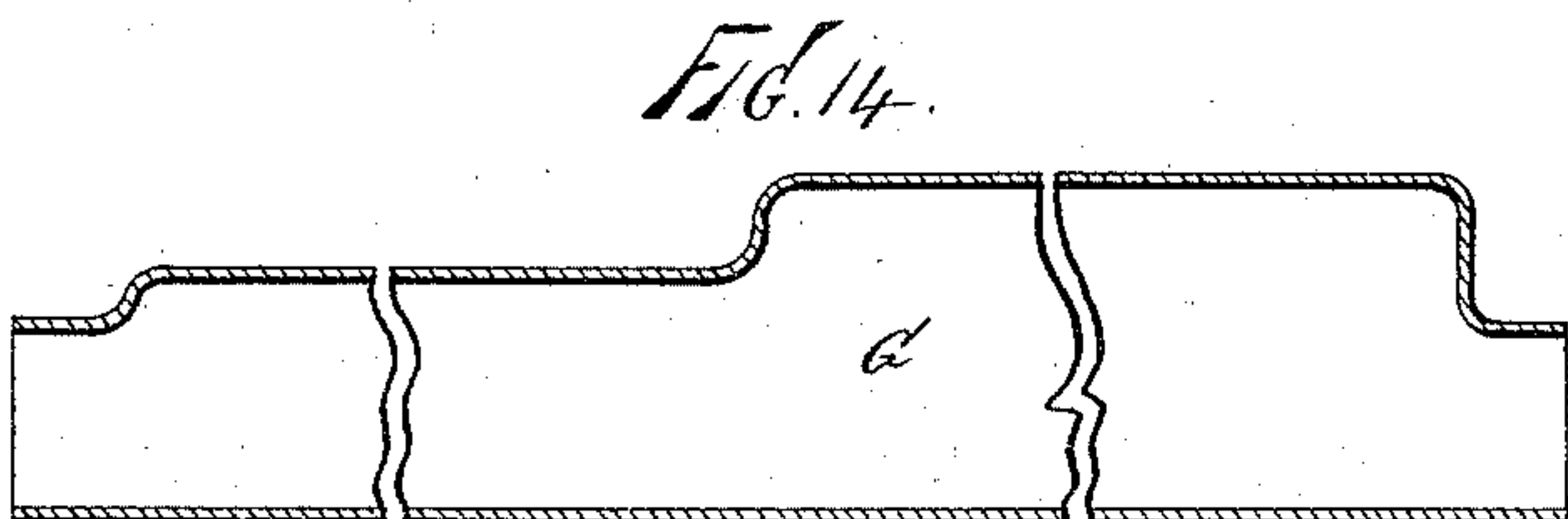
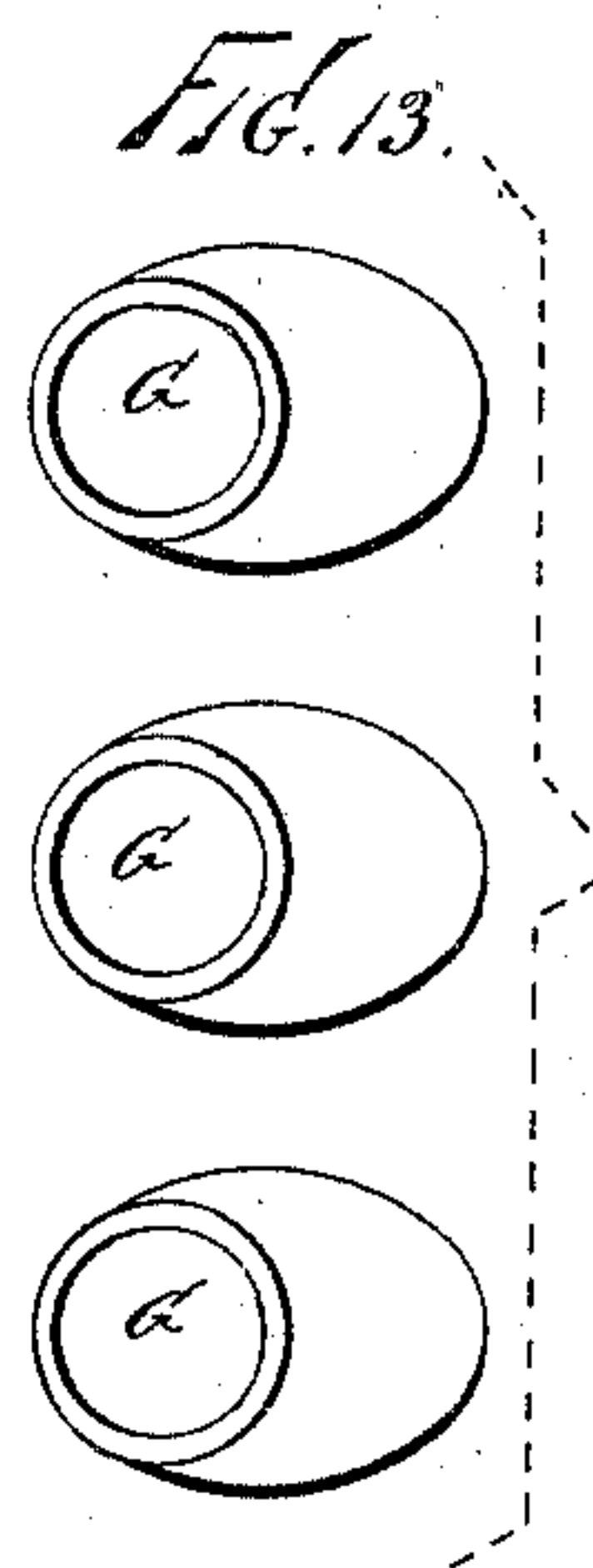
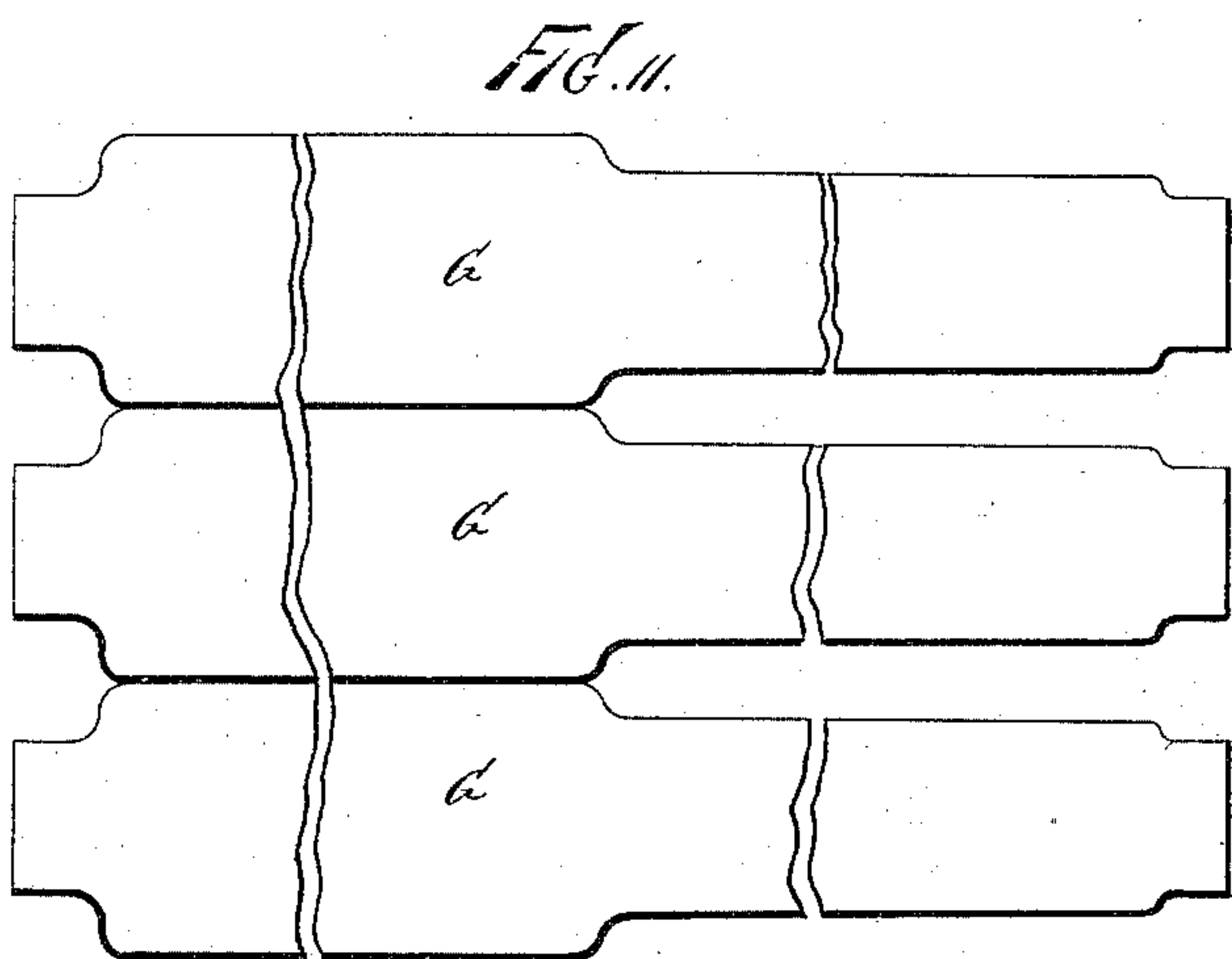
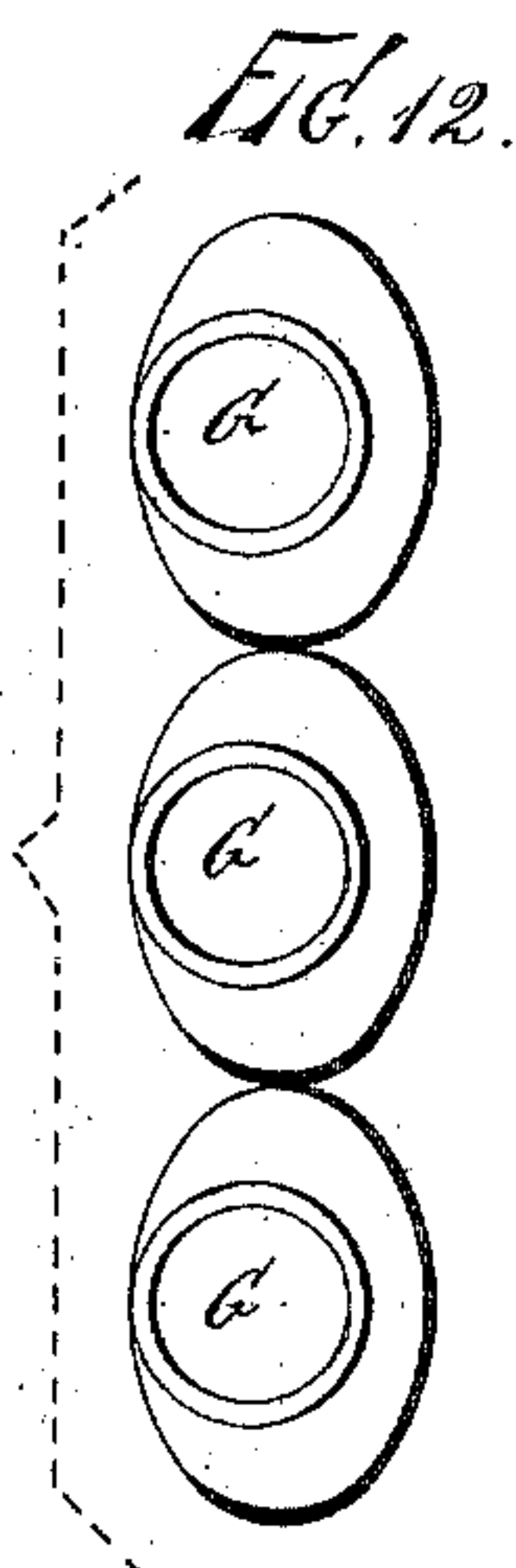
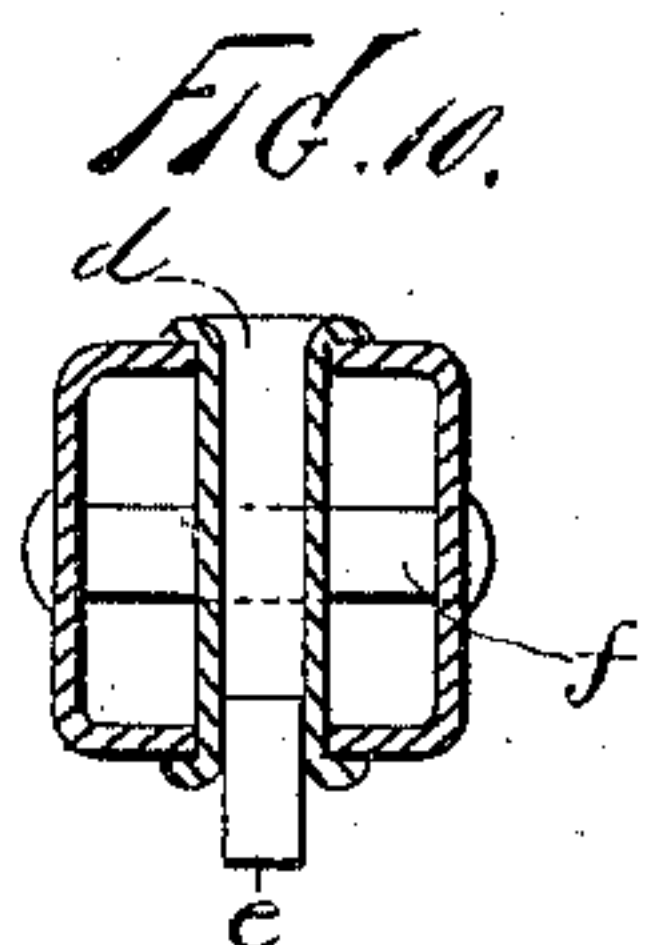
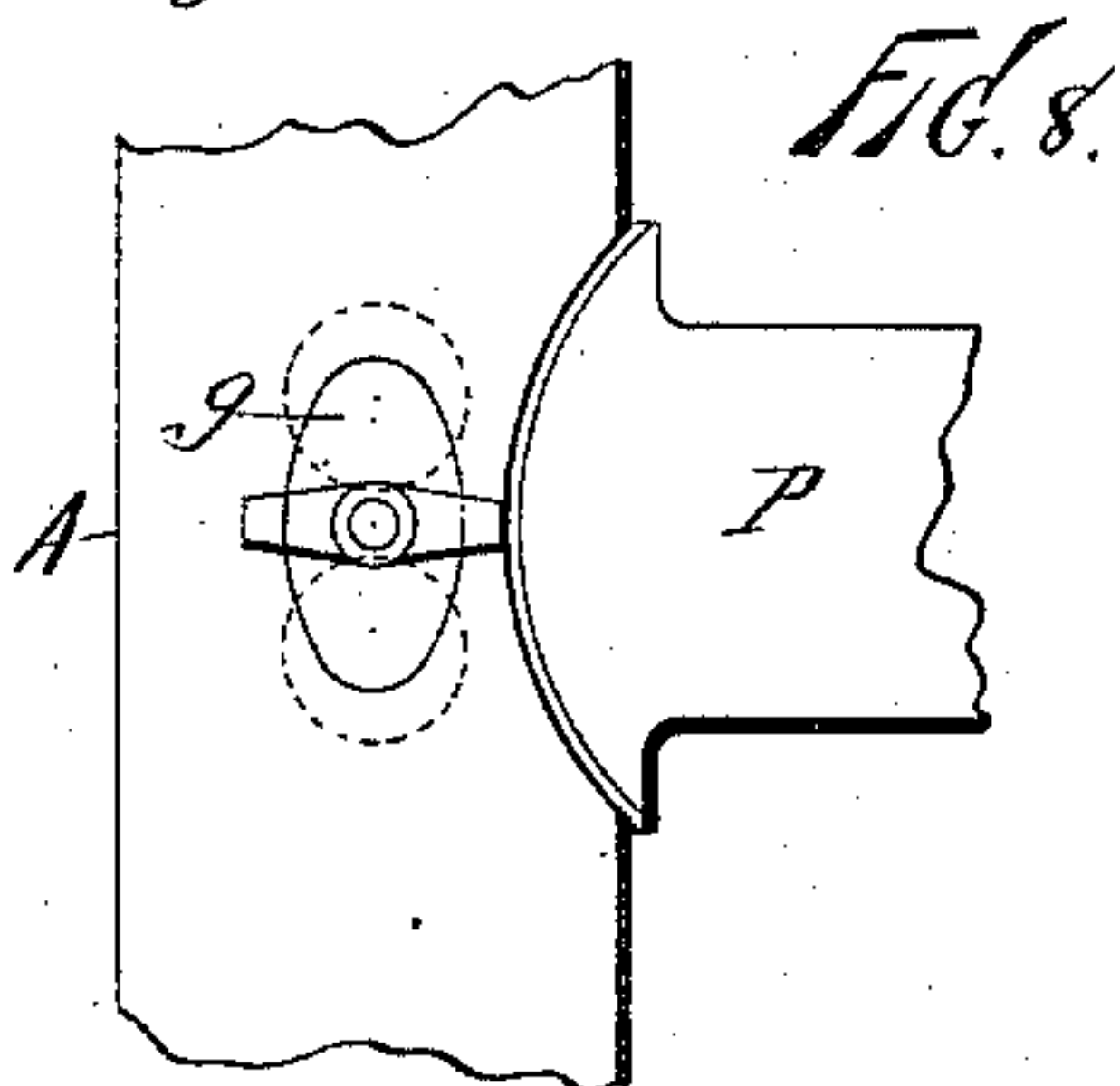
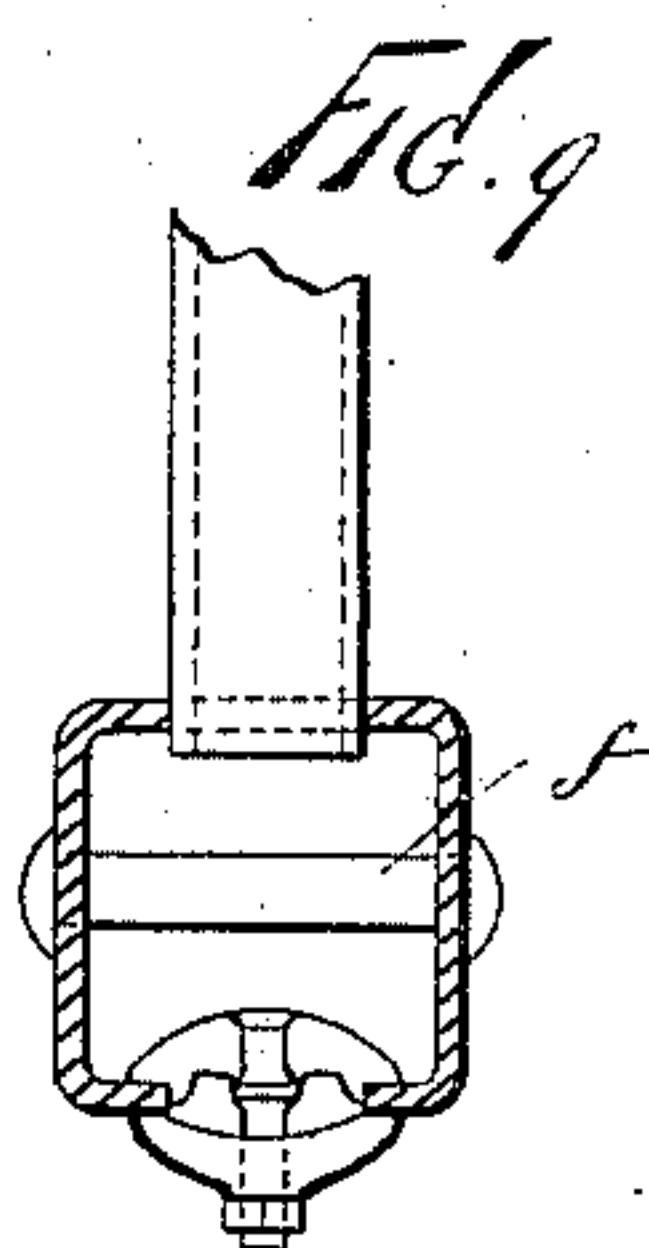
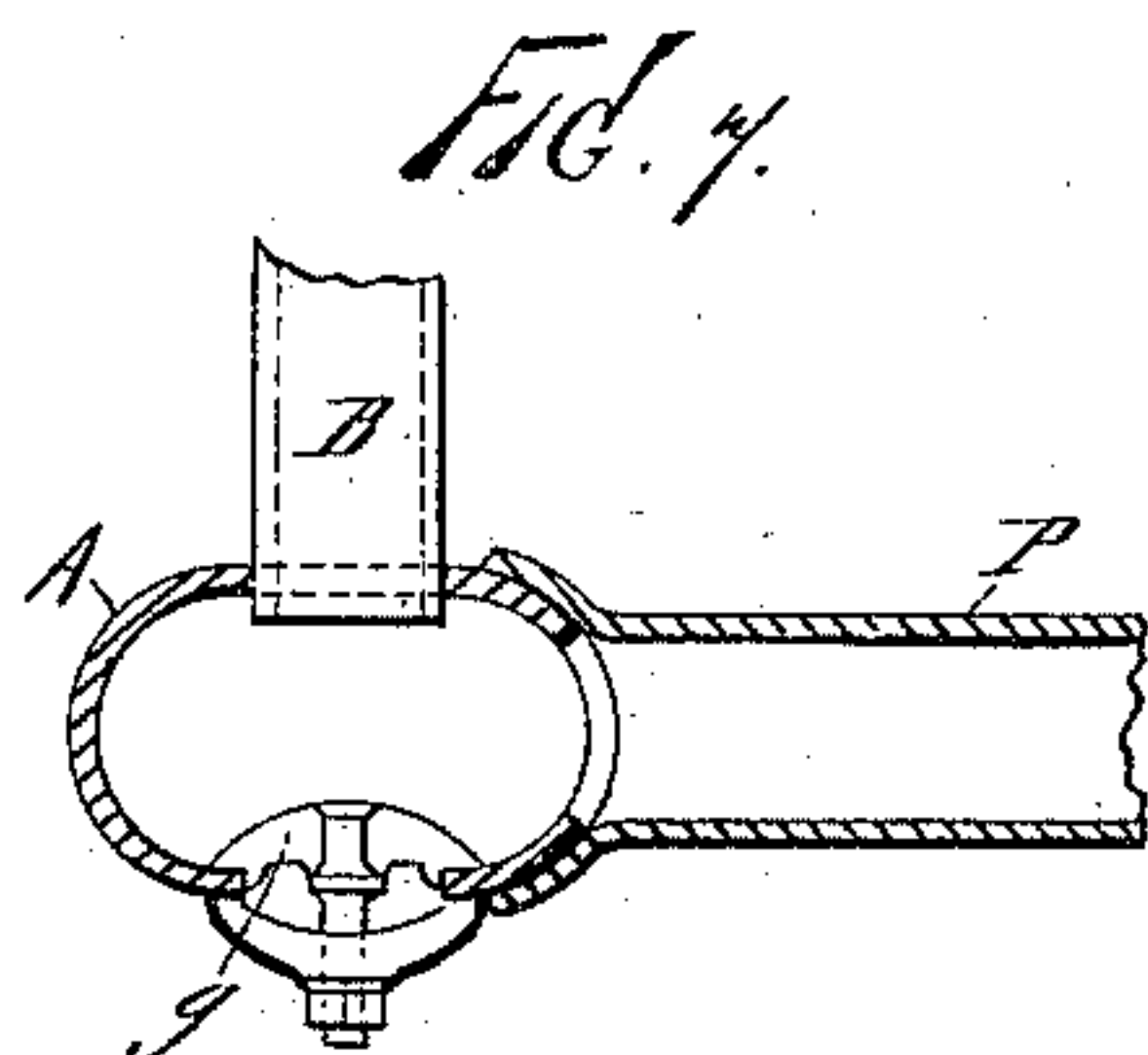
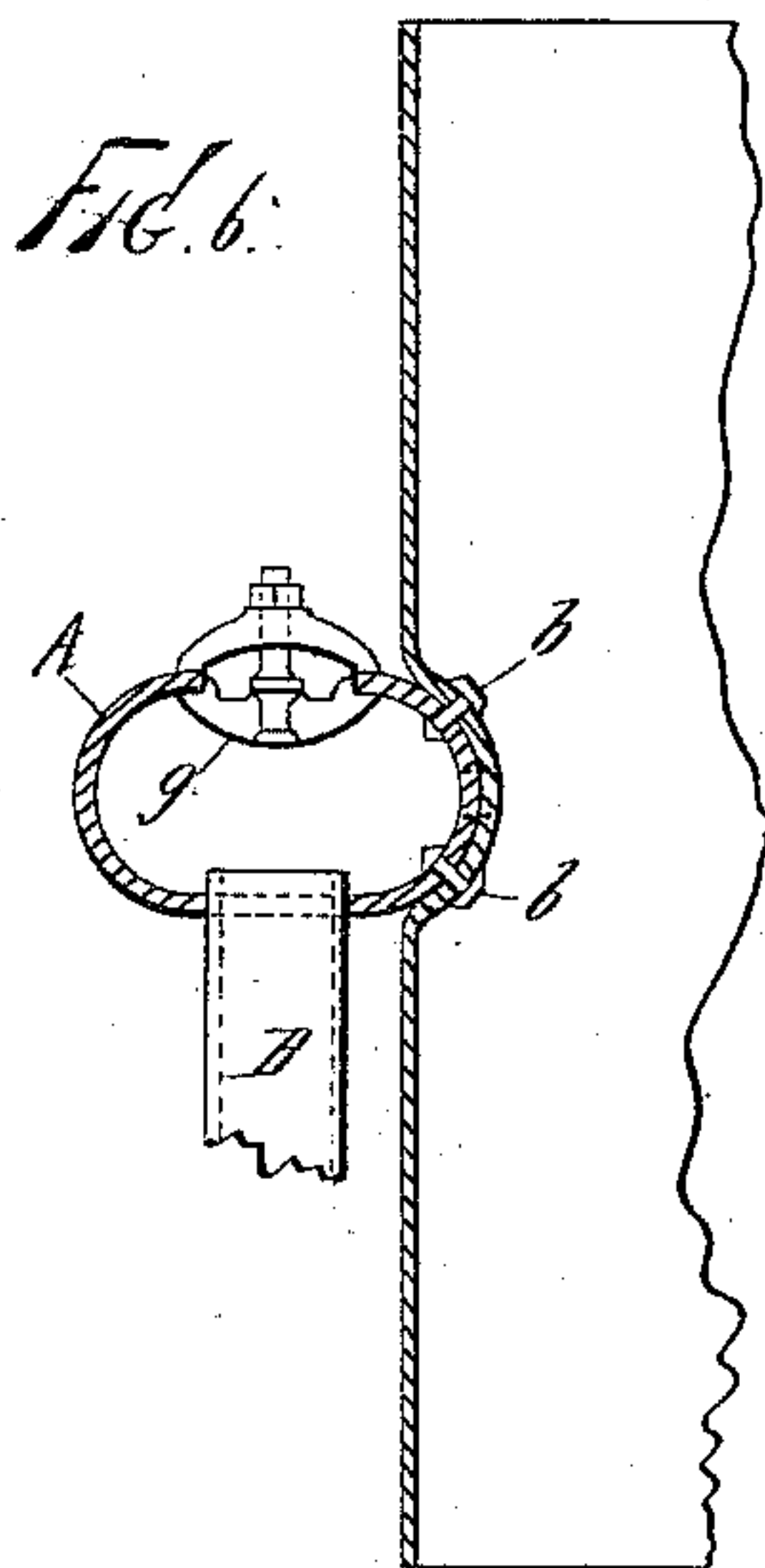
(No Model.)

4 Sheets—Sheet 4.

J. HARTLEY.  
STEAM BOILER.

No. 335,696.

Patented Feb. 9, 1886.



Witnesses:  
John Backler,  
L. H. Osgood

J. Hartley,  
Inventor:  
By North Osgood,  
Attorney.



# UNITED STATES PATENT OFFICE.

JAMES HARTLEY, OF BROOKLYN, NEW YORK.

## STEAM-BOILER.

SPECIFICATION forming part of Letters Patent No. 335,696, dated February 9, 1886.

Application filed May 18, 1885. Serial No. 165,860. (No model.)

*To all whom it may concern:*

Be it known that I, JAMES HARTLEY, of Brooklyn, county of Kings, and State of New York, have invented certain new and useful  
5 Improvements in Steam-Boilers, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

10 My invention has relation to steam and analogous boilers, and among the objects of my invention are the production of a simple, cheap, and effective boiler of the class named,  
15 wherein the several parts are easy to unite and easy to detach and replace or to repair without disturbing other parts; to produce a boiler of the variety known as "sectional" boilers with all the steaming capacity of the  
20 ordinary forms of such boilers, while dispensing with the cast-metal end boxes usually employed, and employing wrought metal instead; to make the sectional boiler in easily-detachable vertical sections or portions which may be removed without disturbing other parts,  
25 and to so construct and arrange the tubes as to insure a proper and efficient direction and confinement of the heat within the boiler and upon and around the tubes; to provide for ample circulation within the boiler; to make  
30 the boiler of light weight, capable of withstanding high pressures with safety, and economical in the consumption of fuel.

To accomplish all of this, and to secure other advantages in the matter of arrangement,  
35 construction, and operation, as will hereafter appear, my improvements involve certain novel and useful arrangements or combinations of parts, peculiarities of construction, and principles of operation, all of which will  
40 be herein first fully described, and then pointed out in the claims.

In the accompanying drawings, forming part of this specification, Figure 1 is a view partly in section and partly in elevation of a  
45 boiler constructed and arranged for operation in accordance with my invention. Fig. 2 is a top or plan view of the same. Fig. 3 is an elevation of a portion of the front end, and Fig. 4 an elevation of a portion of the rear  
50 end, of the boiler. Fig. 5 shows in end eleva-

tion several tubes arranged in pairs in accordance with my invention. Fig. 6 is a horizontal section and partial plan view showing the manner of mounting the steam-drum (and water-drum) upon the corner columns. Fig. 55 7 is a similar view; and Fig. 8 an elevation, showing one manner of connecting the front corner columns with pipes. Fig. 9 is a cross-section and partial plan view showing one of the the end boxes of the sectional part of the 60 boiler with stay-bolt; and Fig. 10 is a cross-section of one of the said end boxes, showing the port or passage therethrough and a stay-bolt. Fig. 11 is a plan view representing several tubes assembled to form a crown at 65 one part, leaving open spaces between the tubes at the other part, in accordance with my invention. Fig. 12 is an end elevation looking toward the right of Fig. 11; Fig. 13, a similar view looking toward the left of Fig. 11, and 70 Fig. 14 a vertical axial section of one of the tubes shown in Fig. 11.

In all these figures like letters of reference wherever they occur indicate corresponding parts. 75

In the construction of this boiler I employ tubes with an offset, involving some of the general principles and advantages of tubes described and claimed in my previous application for patent filed April 27, 1885, Serial 80 No. 163,548, and I desire it understood that I make no broad claim herein to tubes having such offsets.

A A A A are the four corner columns, made of suitable size, shape, and strength, and of 85 wrought metal. Into these are expanded the tubes B B, which make up the sides of the boiler, said tubes being provided each with an offset or enlarged part, so that one tube can abut against the one adjacent to it and close 90 the joint between them against the passage of flame, &c., the cylindrical ends of the tubes which enter the boxes leaving ample extent of metal in the boxes, so as not to weaken them, as more fully explained in the above-named 95 previous application for patent.

C is a fire-grate, and D an ordinary bridge-wall. The top of the boiler is also made up of tubes B', having offsets, and made close, where required, by abutting one tube against 100



the other. Any light covering may be employed at the sides and top, if desired, to prevent too great radiation of heat or possible emission of flame; but it is no essential part of the boiler. The interior sectional portion is composed of similar tubes, G, with offsets entering wrought-metal boxes E and F at each end. These boxes are made with flattened sides, so as to abut against each other and form a close front and end wall, and they extend from top to bottom of the sectional part, except a few at the rear made shorter than the others, as will hereinafter appear.

In ordinary constructions of sectional boilers the tubes are "staggered,"—that is, arranged so that those in one horizontal row shall occupy positions over the spaces between the tubes in the row below and under the spaces in the row above—and this necessitates the employment of peculiarly-formed boxes, which can only be made of cast metal, and of which it is impossible to remove those between the exteriors without disturbing the others.

To accomplish the same result in the matter of heating the tubes as is accomplished by the staggering arrangement, I arrange the tubes G G so that they shall abut, as indicated by dotted lines in Figs. 3 and 4, and as more plainly shown in Fig. 5—that is, so that two adjacent tubes shall abut against each other, forming one pair, and the pairs thus formed so arranged that one pair will lie above the space between two pairs in the row below and below the space between two pairs in the row above. This arrangement confines and directs the heat upon the various tubes in a manner equally as efficient as the before-mentioned method of staggering single tubes, and with the advantage of exposing a greater surface to be heated, as will be readily understood.

It should be observed that the end boxes (with the exception of a few at the rear) extend from top to bottom of the sectional part, and between one front and its corresponding rear end box the tubes G extend in such manner that these boxes and their connecting-tubes can be separated from the others and drawn out of the structure without disturbing the others. It should also be observed that the end boxes are of ample interior capacity, so as to provide for the free circulation of water from all the tubes in one vertical line, whereas, when the small cast-metal boxes are employed the opening in the upper box is no larger than in the lower one, and the circulation is impeded more and more as the number of tubes is increased, for a greater volume of water is required to pass through the contracted opening.

H is the roller upon which the sectional part may move as it varies in length under the influence of the heat.

I is the mud-drum, at the rear and across the lower end of the boiler. The boiler is

preferably assembled so that the side tubes, B, will have an inclination toward this drum.

K is one of the water-circulating tubes leading from the front of the sectional part, communicating with the front end boxes thereof and with the water-drum L at the rear. The water-circulation is in the direction up through the tubes G, through the front end boxes, back through K, through drum L, through the rear end boxes, and again up through G. Inasmuch as ample areas are provided for unimpeded circulation in the direction indicated, the circulation will be sufficient under all circumstances.

Upon the water-drum L is the steam-canal M, mounted and secured in place as plainly shown, and receiving steam from said drum through a row of small perforations, *a*, in the top of said drum. These perforations (shown dotted in Fig. 2) are always open to the free passage of steam, but impede the flow of water when the boiler is moved, as in the case of marine boilers on board ship. From M steam is conveyed through the superheating-tubes B' to the steam-drum O in front, and, passing through these tubes, forming the top of the boiler, it is further heated or superheated and enters drum O in the best condition for use. The heat escapes between the front ends of tubes B', which are suitably twisted to leave the required openings, and strikes directly upon the steam-drum before leaving the structure. The front corner columns are connected by two pipes, P P, located one above and the other below the location of the fire-doors. These pipes are flanged upon the corner columns, and secured as best indicated in Figs. 7 and 8. They brace the lower extremities of the front corner columns and hold them securely. The front and rear corner columns are connected by the side tubes, B B, which are expanded in place. The drums L and O must be properly sustained in position, and serve also to brace the corner columns upon which they are mounted. The manner of uniting them with the corner columns is most plainly indicated in Fig. 6. The head of the drum is indented so as to accommodate a considerable portion of the corner column, and the two are riveted together, as by rivets shown at *b*. Communication between the rear corner columns and the water-drum L is afforded by perforations *c*, which are indicated in Fig. 1; but the front corner columns do not communicate directly with the steam-drum O, so that in that portion of the structure the perforations *c* do not appear, Fig. 5 being intended to represent either drum O or drum L in position. By indenting the heads of these drums as indicated, and sinking the corner columns into the indentations, I am enabled to firmly secure the parts together and to bring the whole structure into compact form, so that the upper one of the side tubes B, shall be located as near as possible to the adjacent tube of the series of top tubes. Both these tubes are twisted so that



they touch the top tubes lying next adjacent. The rear corner columns are flanged upon the mud-drum, as plainly indicated. The water maintains the same level in the sides and ends as in the sectional part and communicating water-drum, and steam arising within the sides and ends passes back to the water-drum through the upper side tubes, and thence through the steam-canal and the superheating top tubes to the steam-drum. The fire or heat may be directed by fire-walls of clay, &c., as represented at Q Q Q, and a crown or cover, as R, may be employed above the tubes, if desired.

Another manner of controlling the direction of the heat is by constructing the crowns as indicated in Figs. 11, 12, and 13—that is, by twisting the tubes having the offsets so that when united any portion of the series will present a barrier to the passage of flame, while the remaining portion will have open spaces between the tubes, through which the flames may pass. One crown so made may be located at the front, the next at the rear, and so on, any number of barriers being thus provided, and, as will be readily seen, the barrier might be located midway of the ends, and thus any desired arrangement effected.

It should be observed that the bottom portion of the tubes should be plain, as indicated in the sectional view Fig. 14, to prevent lodgment of sediment in the tubes, to facilitate circulation, and to render “blowing off” effectual to clean the tubes.

The end boxes of the sectional part are provided at suitable intervals with through-and-through pipes or tubes, as *d*, expanded in place, so as to stiffen the boxes, and having suitable plugs, *e*, which are removable. The purpose of the tubes *d* is to afford means of cleaning these crowns from the exterior. A pipe can be inserted and a jet of steam directed upon the crowns to clear them off. The end boxes may also have stay-bolts, as indicated at *f*, Figs. 9 and 10. Hand-hole plates *g g* are provided wherever necessary, to acquire access to the interior of the tubes or boxes. A number of the rear end boxes (two in the drawings) are not extended to the top of the sectional part, having room above them to permit free access to the interior of the boiler. The space above these short-boxes is closed by any suitable door, as at *S*. The rear end boxes are secured upon the mud-drum, and communicate therewith through the medium of nipples *h h*. The short end boxes communicate with those next adjacent through similar nipples, *i i*. To remove any one of these boxes, the nipples connected therewith have to be cut, as also the tube connecting with the water-drum, when it and the tubes and front box can be withdrawn. The hand-holes provided afford facility for reaching the interior of the boxes, and through these the nipples can be easily replaced when desired to replace the parts removed. The boiler has of course to be supplied with the

usual adjuncts, not necessary to be shown in detail.

The improved boiler is best adapted for marine purposes, but of course may be used for other purposes. The parts being all of wrought metal, it is lighter and possesses better steaming qualities with greater safety under high pressures than the usual style of marine boilers, and the parts being arranged as indicated the entire structure is firmly secured and supported upon the corner columns, and may be easily and quickly assembled and repaired in sections without disturbing other parts not required to be repaired. These peculiarities render it specially well adapted for use upon shipboard and in other situations where economy of room is necessary.

When used on board ship, the diagonal braces or tie-rods T T are employed. These are shown in dotted lines, Fig. 1, and are suitably connected with portions of the boiler and arranged with suitable slip-joints, as at *t t*, so as to admit of all necessary expansion under heat and contraction under cooling, being tight and firm when the boiler is fully expanded, and serving to add to the security of the structure under various strains and shocks. The boiler is generally secured in front, the rollers *k k* serving to permit it to move as it is expanded toward the rear, the sectional part, which expands more than the remainder, being allowed to move toward the front upon the roller H.

The side tubes are indented, as at *l l*, Fig. 1, in any number of places and at convenient points. These indentations form small openings, through which a steam-jet may be introduced to clean the crowns, same as through the tubes or hollow stay-bolts *d*, and the openings so formed may be closed by any suitable form of plug easy to be removed when desired, same as plug *e*.

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

1. In a boiler of the character herein set forth, the four corner columns supporting the steam and water drums and the side and top tubes, substantially as and for the purposes set forth.

2. In a boiler of the character herein set forth, the combination, with the corner columns, of a drum supported thereon and secured thereto, said drum having its heads indented, thereby affording recesses to receive the said columns, substantially in the manner and for the purposes set forth.

3. In a boiler of the character herein set forth, the sectional part having the upright wrought-metal end boxes extending from top to bottom of the sectional part, arranged side by side and made removable, as explained, said boxes being connected by tubes arranged one above the other, and the front end boxes communicating by suitable tubes with the water-drum, located at the rear of the boiler,



the parts being made detachable, substantially in the manner and for the purposes set forth.

4. In a boiler of the character herein set forth, the front and end upright wrought-metal boxes sustaining the tubes of the sectional part, said tubes having offsets and being turned or arranged, as explained, so that one pair of tubes shall lie above the open space between two pairs in the row below, substantially as shown, and for the purposes set forth.

5. In combination with the front corner columns sustaining one end of the side tubes and the drum, the connecting and bracing pipes above and below the location of the fire-door, substantially as and for the purposes set forth.

6. In a boiler of the character herein set forth, the series of rear end boxes abutting against each other and forming the rear wall of the sectional part, the shorter boxes being connected with the adjacent longer boxes by nipples, substantially as and for the purposes set forth.

7. In a boiler of the character herein set forth, the four wrought-metal corner columns, the side tubes having offsets, as explained, said tubes being connected with the corner columns and arranged to form the close side walls, and the top tubes similarly provided with offsets and forming the closed top of the boiler,

all combined substantially as shown and described.

8. In a boiler of the character herein set forth, the top tubes having offsets and arranged to form the close top of the boiler, said tubes being combined with the steam-canal and the steam-drum, substantially as shown and described.

9. In combination with the boiler, the diagonal braces or tie-rods, provided with slip-joints and arranged to secure the structure and permit contraction of the parts thereof, substantially as and for the purposes set forth.

10. The herein-described boiler, composed of the wrought-metal corner columns, side tubes, sectional part having wrought-metal end boxes, drums, and top tubes, all combined and arranged substantially as shown and described.

11. In a boiler of the character herein set forth, the side tubes having the indentations therein, substantially as shown, and for the purposes set forth.

In testimony that I claim the foregoing I have hereunto set my hand in the presence of two witnesses.

JAMES HARTLEY.

Witnesses:

HENRY FRANKE,  
WILLIAM H. SHAW.