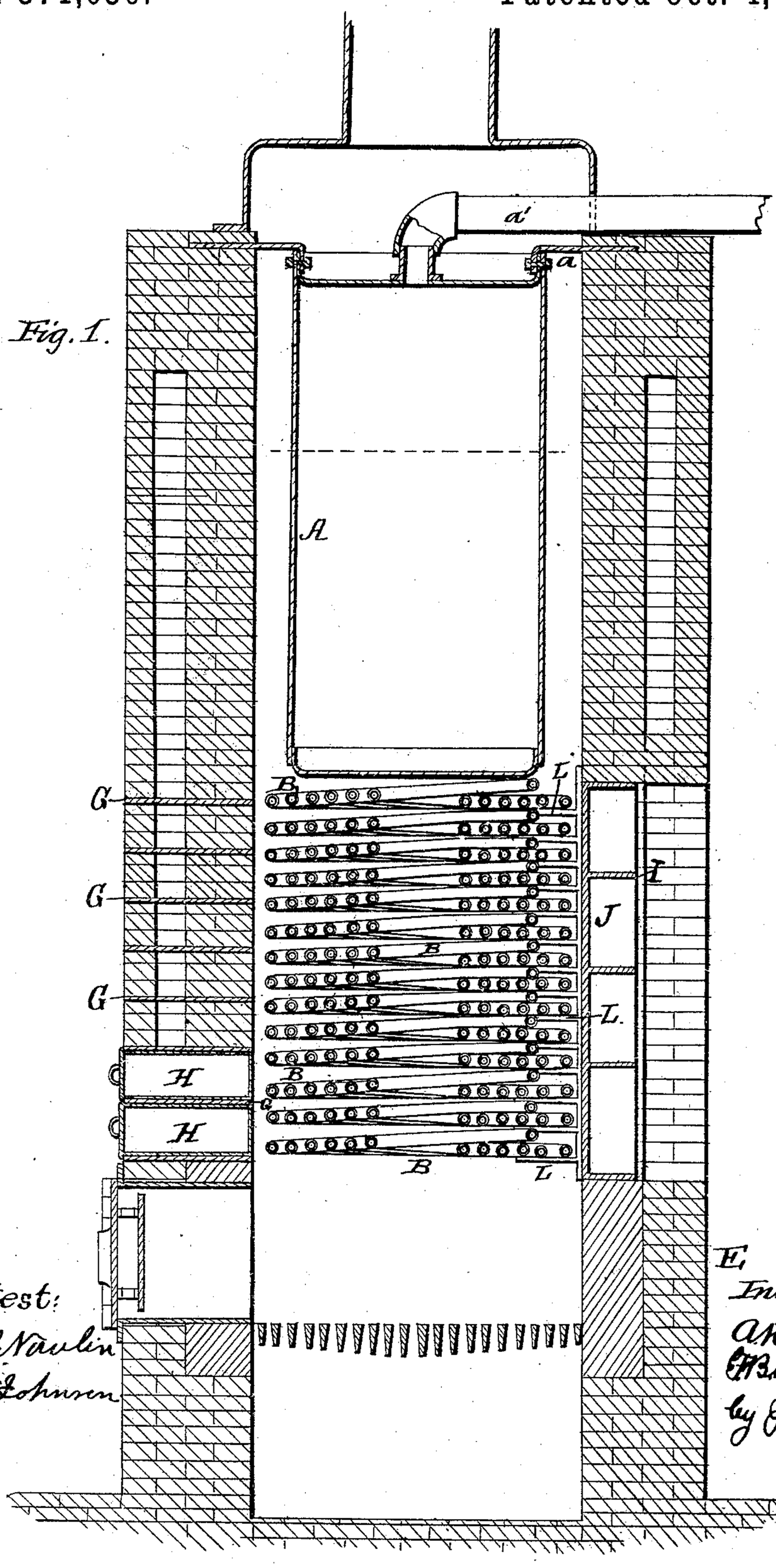
(No Model.) 3 Sheets—Sheet 1.

A. D. & F. B. BROCK.

STEAM BOILER.

No. 371,030. Patented Oct. 4, 1887.

Fig. 1.



Attest:
A. W. Le Saulin
W. J. Johnson

Inventors:
A. D. Brock
F. B. Brock
by F. B. Brock,
Atty

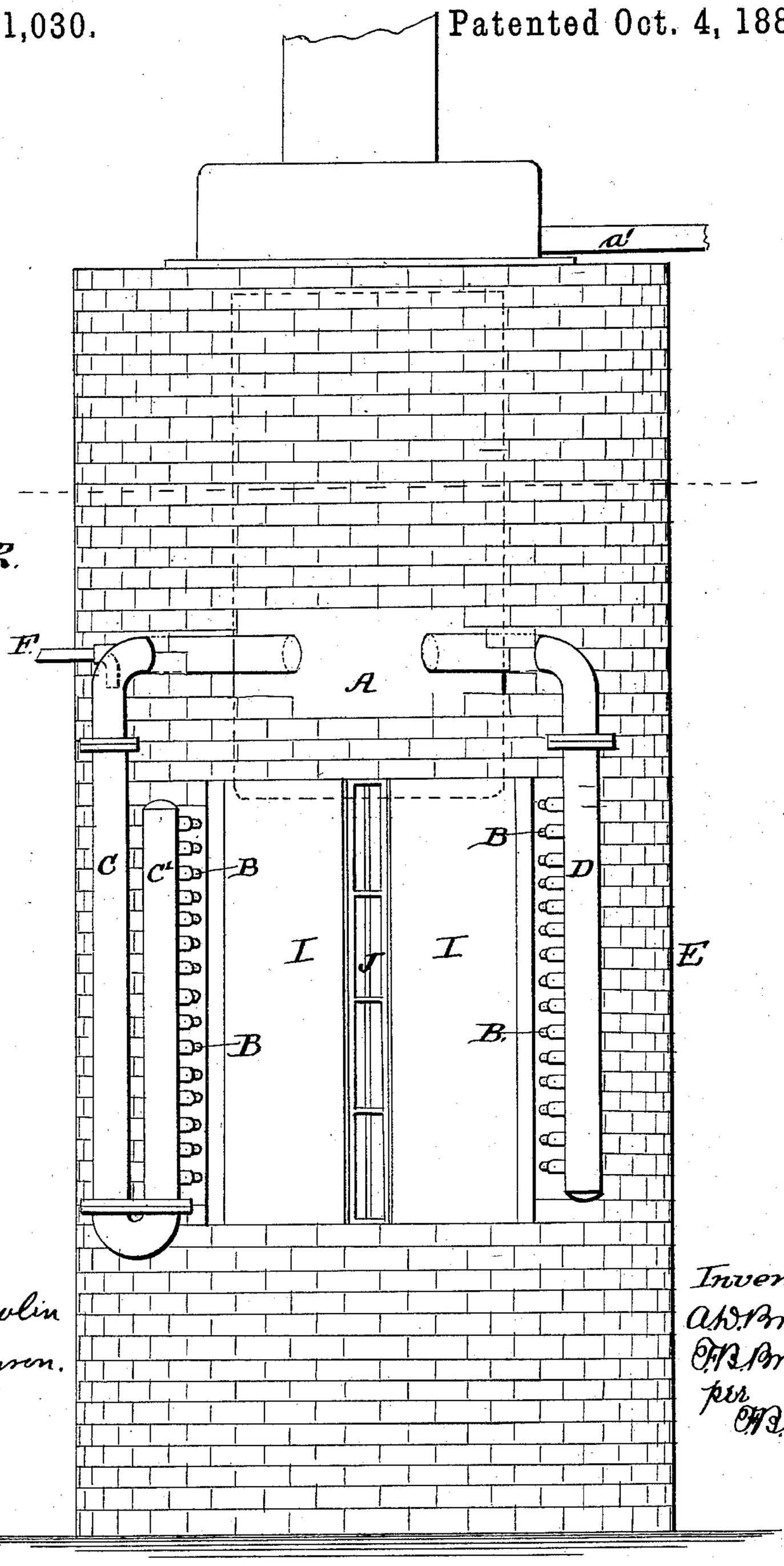
(No Model.) 3 Sheets—Sheet 2.

A. D. & F. B. BROCK.

STEAM BOILER.

No. 371,030. Patented Oct. 4, 1887.

Fig. 2.



Attest:
N. W. LeNowlin
W. F. Johnson.

Inventors:
A. D. Brock
F. B. Brock
per
F. B. Brock
atty.

(No Model.) 3 Sheets—Sheet 3.

A. D. & F. B. BROCK.

STEAM BOILER.

No. 371,030. Patented Oct. 4, 1887.

Fig. 4¹

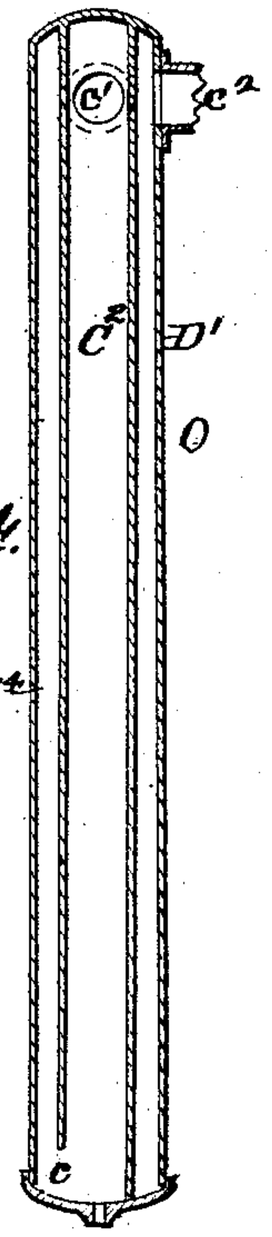


Fig. 4.

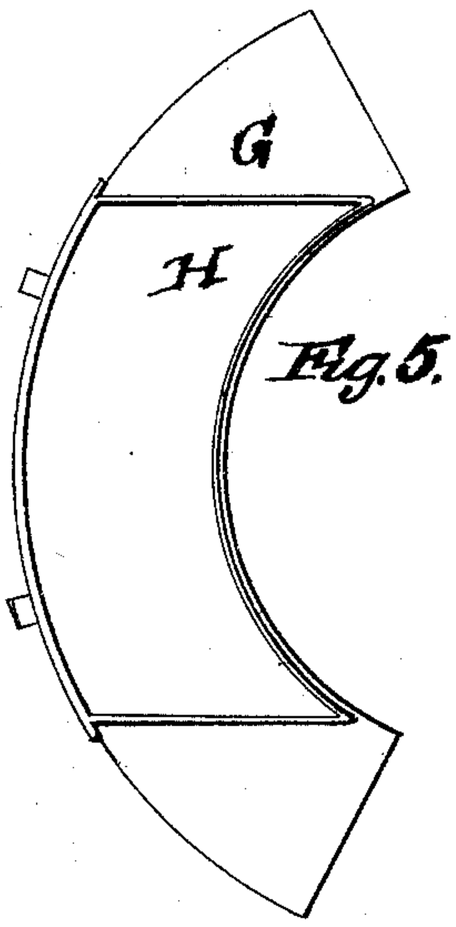
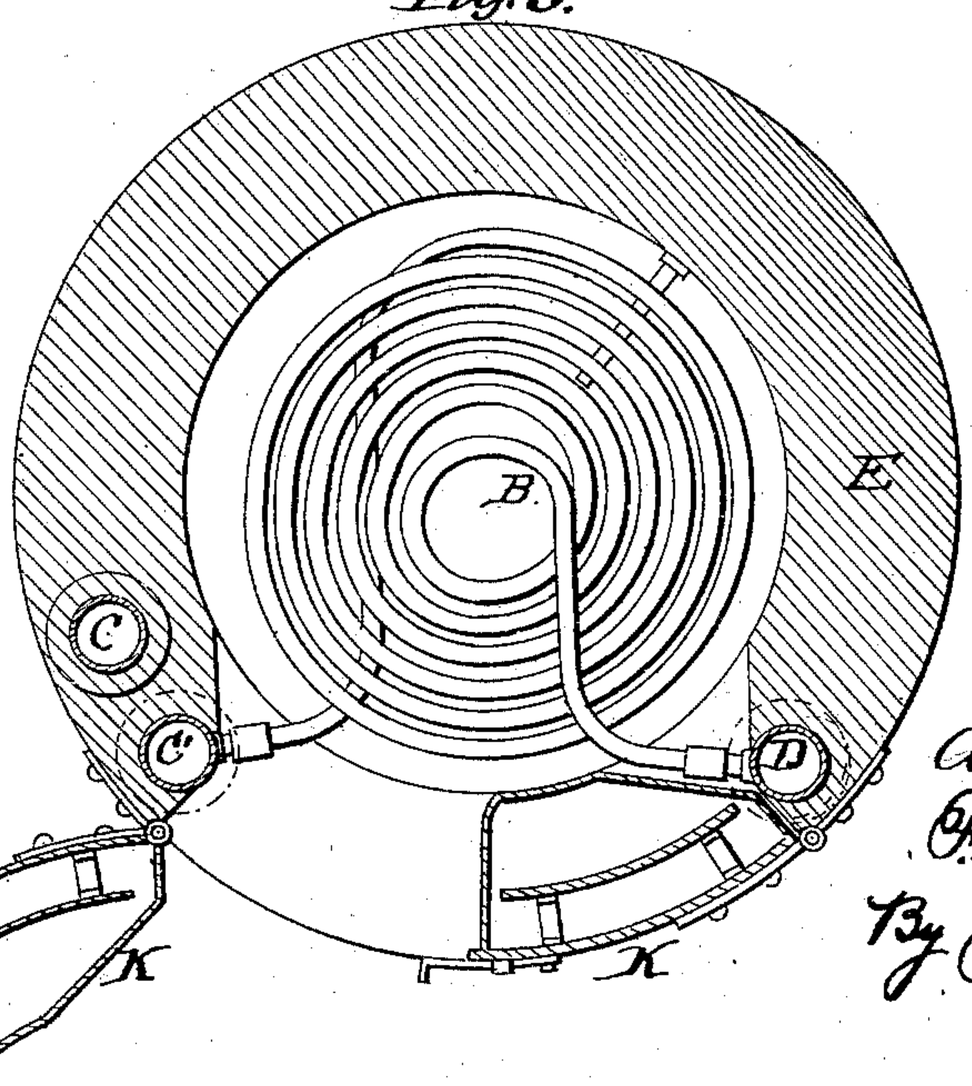


Fig. 5.

Fig. 3.



Attest:
A. W. Le Naulin
W. F. Johnson.

Inventors:
A. D. Brock and
F. B. Brock
By F. B. Brock Atty

UNITED STATES PATENT OFFICE.

ALVAN D. BROCK AND FENELON B. BROCK, OF WASHINGTON, DISTRICT OF COLUMBIA.

STEAM-BOILER.

SPECIFICATION forming part of Letters Patent No. 371,030, dated October 4, 1887.

Application filed October 19, 1882. Serial No. 74,650. (No model.)

To all whom it may concern:

Be it known that we, ALVAN D. BROCK and FENELON B. BROCK, citizens of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Steam-Boilers; and we do 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 the letters and figures of reference marked thereon, which form a part of this specification.

Figure 1 represents a central vertical section of a boiler to which our improvements have been applied. Fig. 2 represents a rear elevation of the same. Fig. 3 is a transverse section of a boiler showing a modification of our improvements. Fig. 4 is a vertical section of the modified circulation-tube, taken through the line *x x* of Fig. 4¹, and Fig. 4¹ is a cross-section of said tube; Fig. 5, a detail view, hereinafter referred to.

The invention relates to steam-boilers of the water-tube type.

The object of the present improvement may be generally expressed as, first, to give free accessibility for the easy removal of any one or more of the water-tubes through the side of the casing; second, to remove all joints from the action of the fire by making such joints outside the casing, or in such position that they can be coupled or uncoupled from the outside; third, to arrange the circulation-tubes and the water-tubes so that the junction of the two is made from the outside of the boiler; fourth, to secure comparatively unlimited freedom for the expansion of the water-tubes and connections, and therefore safety from rupture and explosions because of unequal expansion; fifth, to provide against the destruction of life and property by explosions by so distributing the water exposed to the action of the heat into small masses in water-tubes of small diameter that the tubes, if ruptured, could do no material injury; sixth, to cause rapid and effective circulation of the water; seventh, to gain ease of transportation and largely-increased heating-surface with proportional increase of effectiveness. We attain these objects by means of the mechanism illustrated in the accompanying drawings.

The boiler consists, essentially, of a reservoir, A, water-tubes B, and circulation tubes or chambers C D.

The reservoir A we prefer to make superimposed or directly above the level of the water-tubes in most cases; but in some instances we may arrange it at one side, or in any position where it will work with good results. It may, moreover, be of any desired shape or construction suitable for the purpose. It has been built with longitudinally-arranged fire-tubes, so that all the draft was through such tubes. In the drawings it is shown constructed of boiler-iron, without fire-tubes, and supported by ears *a*, bolted thereto and resting in the brick-work, the products of combustion passing up exteriorly of the reservoir. The steam-pipe *a'* leads from the top thereof, and connection is had with the circulation-tubes C D below the water-line, as seen in Fig. 2.

The water-tubes B, as shown in the drawings, are single flat helical coils. They may, however, be double helical coils, or of cylindrical or other practical shape. We also contemplate the use of straight tubes in different combinations, as such may be used in our invention with satisfactory results.

Whatever the kind or configuration of the pipe we may employ may be, we connect one end with the circulation-pipe C and the other end with the circulation-pipe D, thereby placing each and every one of the series of water-tubes B in communication with the reservoir A.

The mechanical construction and arrangement of the circulation-tubes C D are different, and they serve as a means and communication for a very rapid and efficient circulation of water between each tube B and the reservoir. The tubes or chambers C D are either arranged outside the casing or brick-work E, so that the junction or coupling of the water-tubes B may be effected with the tubes or chambers C D from the outside, or the chambers are so arranged within the brick-work that access may be had from the outside for the same purpose.

The circulation-tube C has a return-bend, C', with which the water-tubes B communicate directly. From the point of junction with

the reservoir to the bottom of the bend in this siphon-shaped or return-bend chamber C it is preferably without or free from taps, save where provision is made for the entrance of the feed-water pipe F. The bend C′ of the siphon-shaped tube is tapped for the reception of one end of each of the water-tubes B, and the circulation-tube D is tapped in like manner for the reception of the other end of each of the water-tubes, the connections being preferably made by right-and-left couplings. The tube D is simply a pendent tube from the reservoir A, closed at its lower end. The tube C has the upper end of its branch C′ closed. The return-bend of tube C and the bottom of tube D may have blow-off cocks, if desired. It is essential that the siphon-shaped circulation-tube have its return-bend at least as low as the level of the lowest water-tube B; or it may have its return-bend extend to or below the fire-box, or indefinitely in that direction.

We make provision for the ready removal of any one or more of the water-tubes B, should it become impaired or ruptured, or for any other cause. When using flat helical coils, as shown in the drawings, we place a series of metallic plates, G, of the form shown in Figs. 1 and 5, between every three or four courses of brick-work. When it is desired to remove any one of the coils of water-tubes B, the brick-work E is torn away between two of the adjacent plates sufficiently to allow the horizontal withdrawal of the coil, the disconnection with the circulation-tubes being previously made from the outside, as set forth.

In lieu of the brick-work between the plates, we may provide for the removal of the water-tubes by leaving a space large enough for the withdrawal of the tubes B between the series of plates G, which would ordinarily be closed by a closed removable sheet-iron chamber, H, the interior of which serves as a non-conducting air-space. This modification, as also that first described, is shown by Figs. 1 and 5.

The openings hereinbefore described are shown made in front of the boiler-casing and opposite the circulation-tubes C D. However, if desired, the water-tubes B may be withdrawn through the back of the boiler, and between the tubes C D. Figs. 1 and 2 illustrate this joint. An opening is shown therein large enough for the removal of all the tubes B. It has a central skeleton casting, J, between which and the sides of the opening is a filling of removable fire-clay, I I.

Fig. 3 illustrates the arrangement of the circulation-chambers C D within the casing, and so that connection may be had therewith, whereby the water-tubes B may be disconnected from the outside of the casing without requiring its removal. The space between the circulation-tubes also admits of the water-tubes being removed at pleasure. It is closed by double swinging doors K K, having non-conducting air-spaces formed therein.

O, Figs. 4 and 4^1, represents a modification of the circulation tubes or chambers C D. The lower figure is a longitudinal vertical section through the line $x\ x$ of the upper figure. This construction combines the siphon-shaped tube C and tube D, as shown in Fig. 2, into one column having three longitudinal passages, C^2, C^4, and D′, corresponding to those of the hereinbefore-described chambers. Passage C^2 communicates with the reservoir through opening c', and passages C^2 C^4 communicate at c. The upper end of passage C^4 is closed. It is tapped for the reception of water-tubes B in the same manner as branch C′ in Fig. 2. Passage D′ is similarly tapped, as in Fig. 2, and has no connection with the other passages. It communicates with the reservoir through opening c^2.

L L represent a series of projections arranged for the support of the coils B. They may be of any desired construction, and are attached to the brick-work, or to a vertical bar or pipe connected therewith. They may be placed at one or more points for the support of the coils.

The reservoir A may be composed of a nest of water-tubes, if desired, having free communication.

The operation is as follows: When the boiler is fired, the water in the water-tubes B becomes heated, its specific gravity is lessened, and it rises, flowing out of the tubes. The circulation-tube D gives the water free access to reservoir A in this upward tendency—that is, the pipe or chamber D presents a route of less resistance than that presented by circulation-tube C. The water in attempting to flow upward through tube C would have to flow downwardly through the branch C′ of tube C before it could rise to the reservoir. When under the continued action of the products of combustion steam is generated and the water in the boiler raised to a very high temperature, the circulation of the water is still maintained. This is mainly due to the comparative difference in the temperature between the water in the water-tubes in more immediate contact with the products of combustion and that in the circulation-tube C flowing from the reservoir. Moreover, the return-bend in circulation-tube C, being below the level of the water-tubes B, presents a column of water through which the steam and water in the water-tubes B (in direct contact with the fire, and consequently of lighter specific gravity than the water in the return-bend) would have to force itself—a condition of things contrary to known laws. Thus a rapid, constant, and effective circulation is maintained downwardly through circulation-tube C, into and through the water-tubes B, and outwardly and upwardly through circulation-tube D, back to the reservoir A. The circulation of the water is kept up perfectly, no matter how much the fire may be forced, and we believe that by this plan three square feet of heating-surface may be made under intense heat to equal ten square feet under the ordinary firing temperature.

Reference is made to the divisional applications of A. D. Brock, filed September 12, 1883,

and the scope of the present application is made to conform therewith.

What we claim is—

1. The combination, with the reservoir of a water-tube steam-boiler and a casing having an opening for the removal of the combustion-tubes, of a series of combustion-chamber tubes or coils, a return-bend circulation-tube, and a straight circulation-tube, having connections with the whole series of combustion-chamber tubes, and arranged within the brick-work or casing of the boiler in such manner that the said connections may be coupled or uncoupled from the outside of the boiler-casing.

2. A three-way circulation-tube provided with longitudinal divisions common to two or more of the ways, a connection at the bottom between two of the ways, and an independent connection of two of the ways at the top with a reservoir, all in combination, as set forth.

3. A two or three way circulation-tube provided with longitudinal divisions common to two or more of the ways and having a connection at the bottom between two of the ways, in combination with a reservoir and a series of combustion-chamber tubes, both communicating with said circulation-tube, substantially as set forth.

In testimony whereof we affix our signatures in presence of two witnesses.

A. D. BROCK.
FENELON B. BROCK.

Witnesses:
W. T. JOHNSON,
A. W. C. NOWLIN.