

No. 637,616.

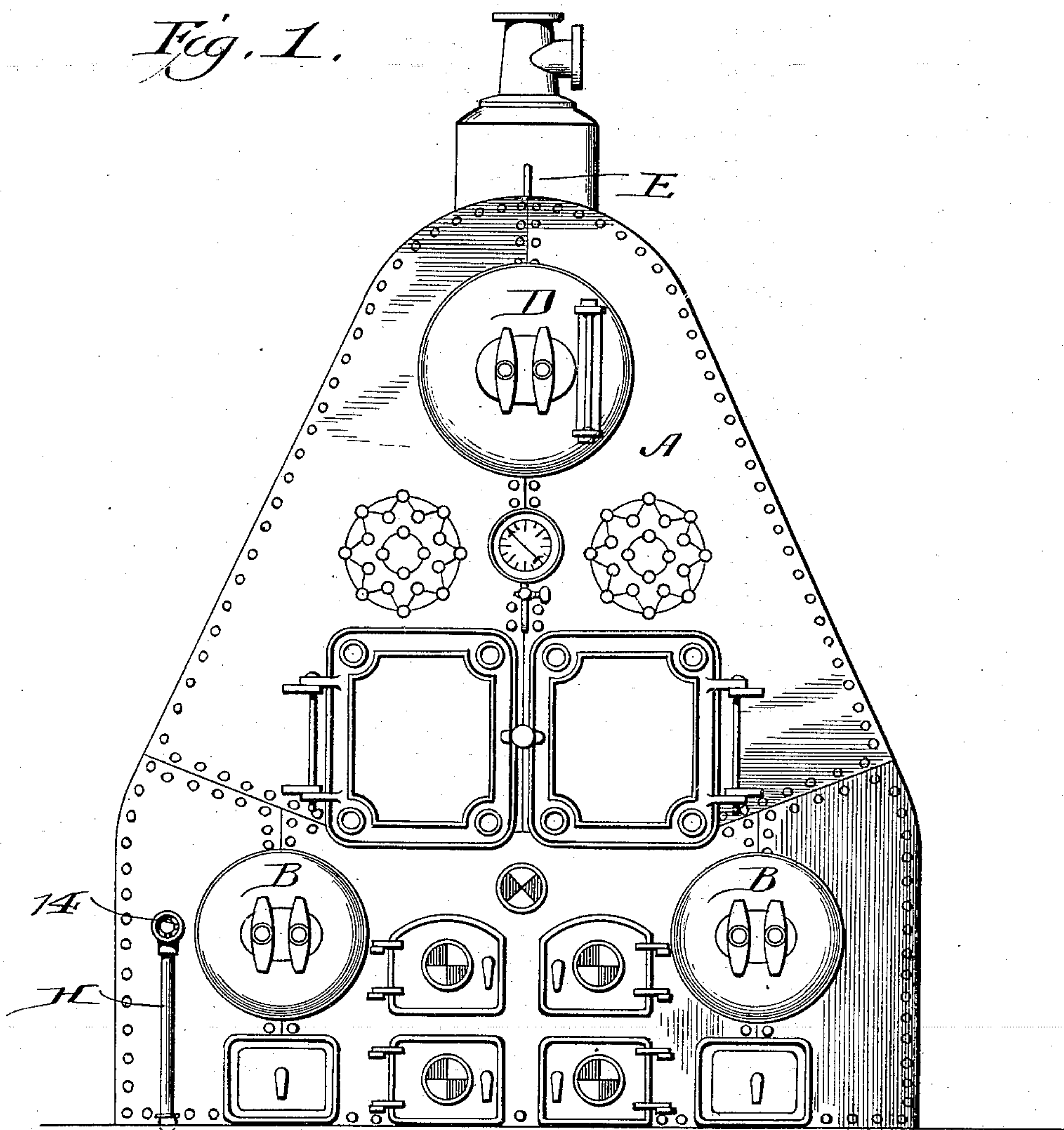
Patented Nov. 21, 1899.

P. J. KEENE.  
WATER TUBE BOILER.

(Application filed Nov. 26, 1898.)

(No Model.)

5 Sheets—Sheet 1.



Witnesses

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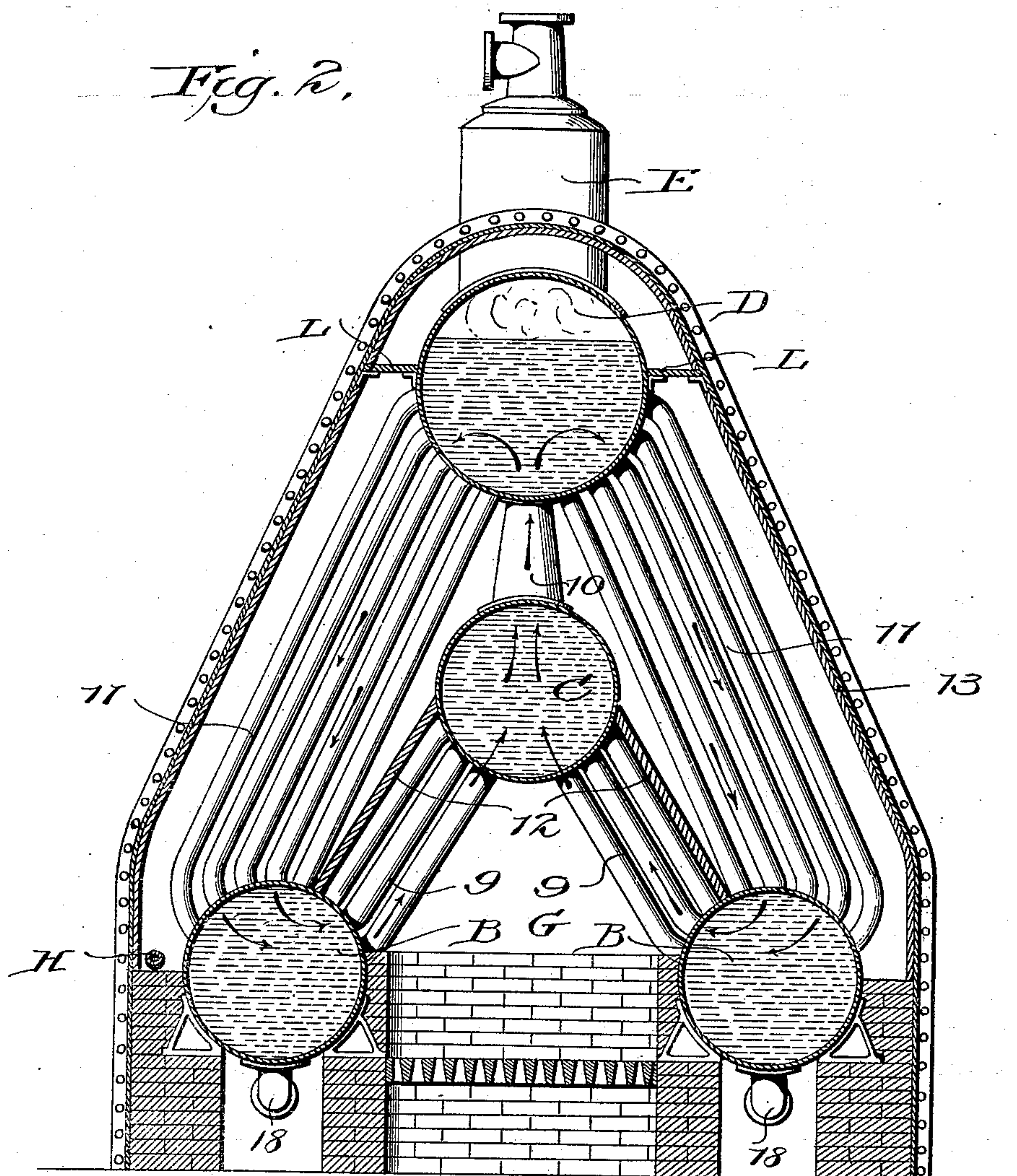
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**5 Sheets—Sheet 2.**



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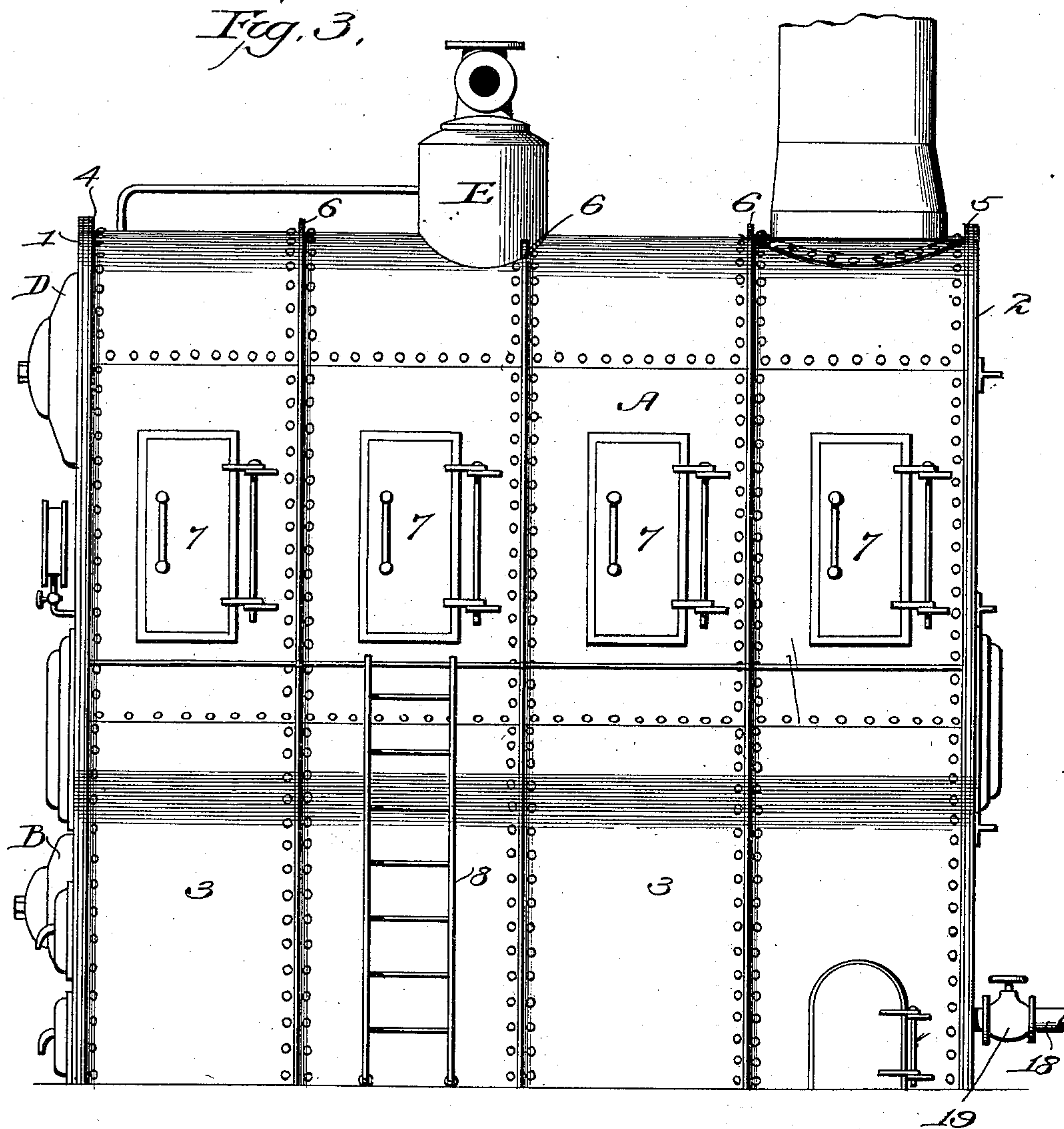
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5 Sheets—Sheet 3.



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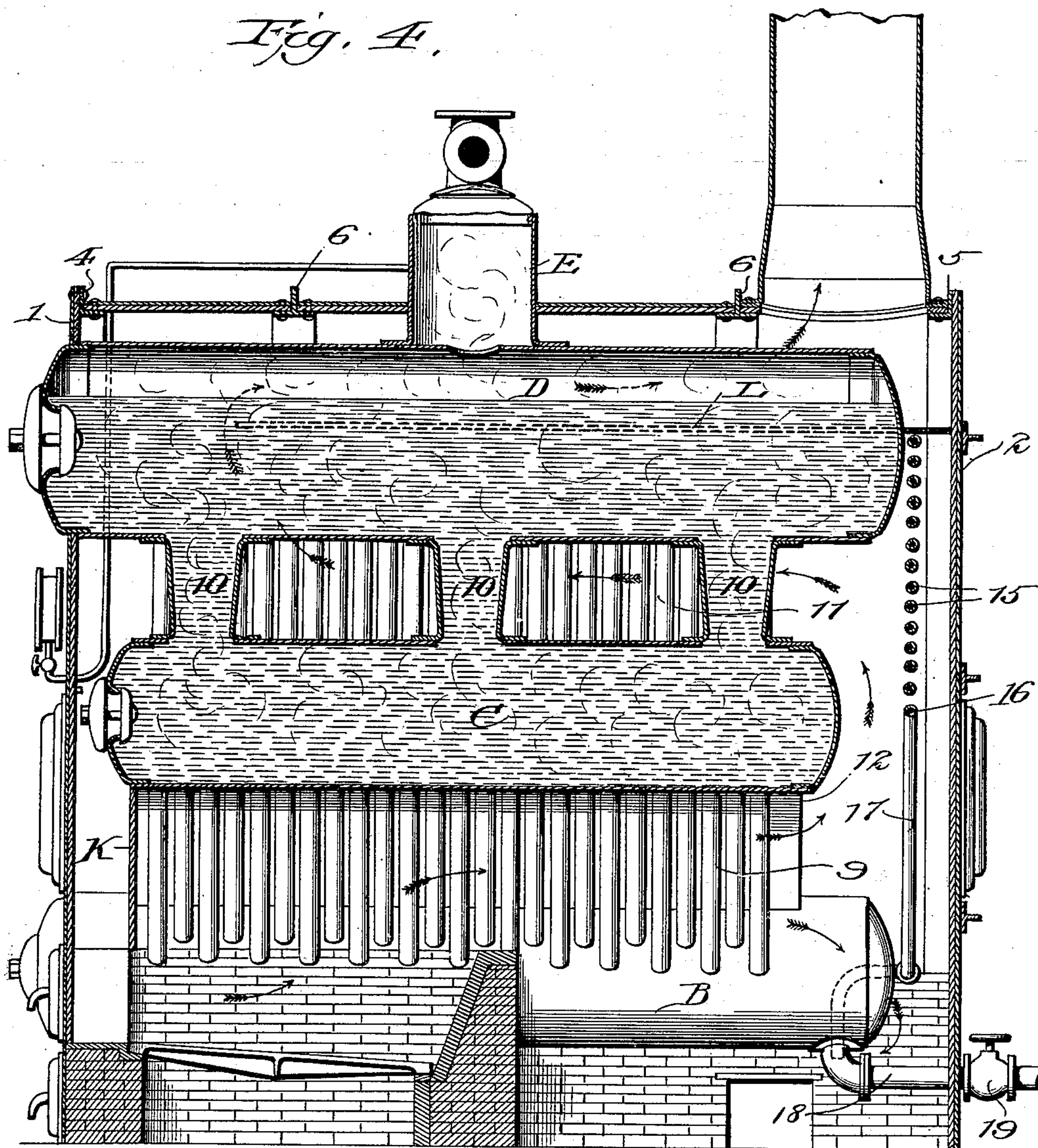
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*Fig. 4.*



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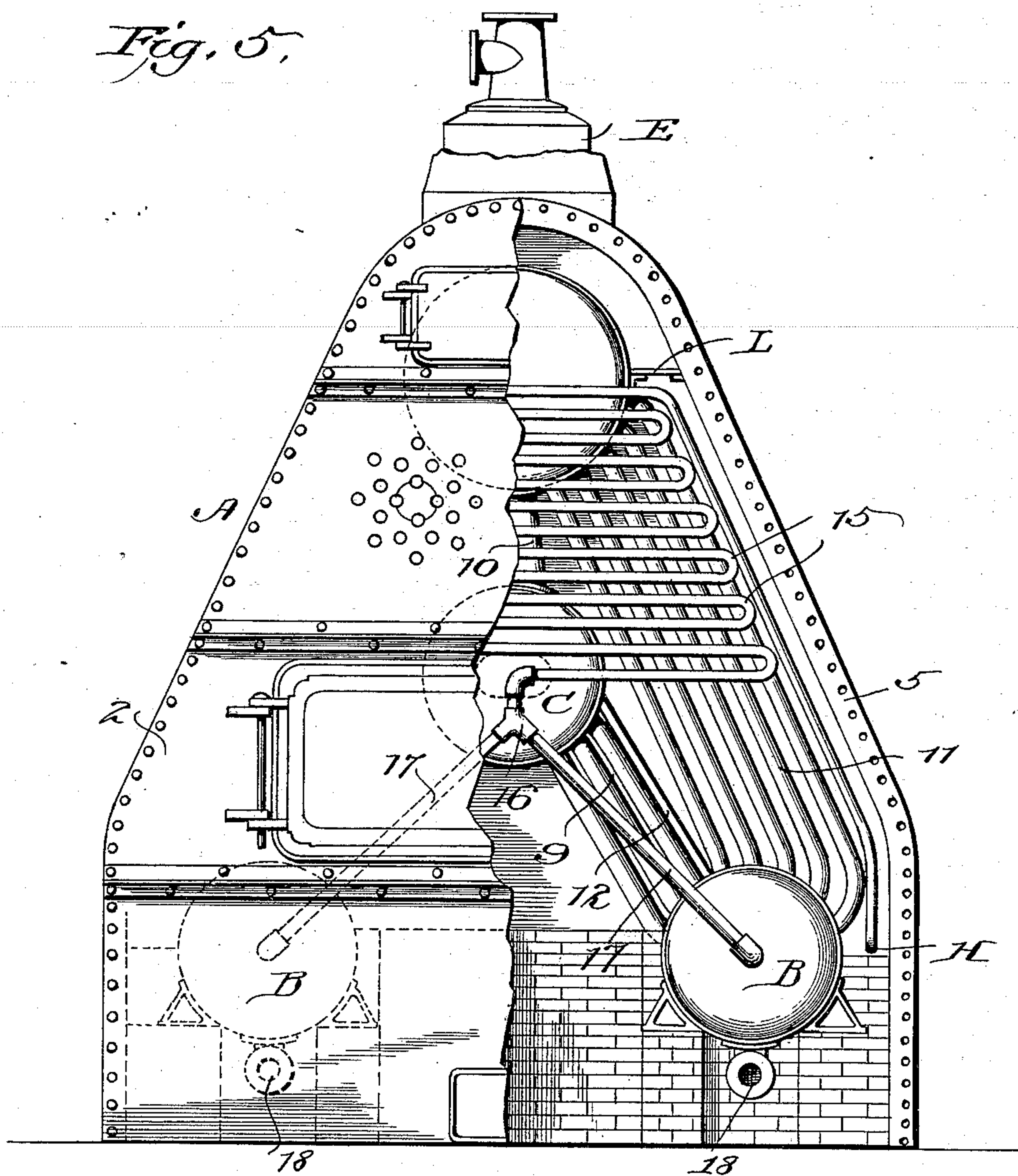
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5 Sheets—Sheet 5.



Witnesses

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# UNITED STATES PATENT OFFICE.

PHILIP J. KEENE, OF CHICAGO, ILLINOIS, ASSIGNOR OF ONE-HALF TO  
GEORGE J. ROCKWELL, OF SAME PLACE.

## WATER-TUBE BOILER.

SPECIFICATION forming part of Letters Patent No. 637,616, dated November 21, 1899.

Application filed November 26, 1898. Serial No. 697,516. (No model.)

*To all whom it may concern:*

Be it known that I, PHILIP J. KEENE, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Water-Tube Boilers, of which the following is a specification.

My invention relates to an improvement in water-tube boilers, a primary object being to construct a boiler entirely of steel without the use of cast-iron, thereby materially lightening it and also rendering it less liable to breakage and at the same time dispensing with the cumbrous brick-setting and masonry.

A further object is to provide a boiler of minimum size and weight which will present a maximum area of heating surface, thus affording a compact boiler which may be utilized where the space which it is to occupy is restricted.

A still further object is to provide a boiler which will admit of high pressure without impairing its perfect efficiency, also to afford a construction requiring no braces or accessories to add to its weight or detract from its appearance.

A still further object is to provide a water-tube boiler of such construction that the more heated gases will be accumulated and concentrated at the upper part of the casing, where they may be utilized for superheating the steam which is formed in that portion of the boiler and in the lower part of the steam-dome.

With these several objects in view my invention consists in a water-tube boiler the outer casing or housing of which is composed of sheet-iron sections and the boiler proper of sheet-steel.

It also consists in a series of drums arranged in different horizontal planes, in combination with banks of tubes communicating with these drums, whereby to afford a circulation of water in a compact area and at the same time disposed in such a manner as to utilize the heat with the greatest economy in the production of steam.

It further consists in a pair of lower drums, a central drum, and an upper drum, in com-

bination with two inner, two outer, and one central bank of circulating-tubes and a steam-dome connected with the upper drum.

It further consists in certain novel features of construction and combinations of parts more fully described hereinafter, and particularly pointed out in the claims.

In the accompanying drawings, Figure 1 is a view in front elevation. Fig. 2 is a vertical sectional view. Fig. 3 is a view of the side outside. Fig. 4 is a vertical longitudinal section; and Fig. 5 is a rear elevation, a portion of the rear part being removed to show the interior arrangement.

A represents the outer casing or housing, which is preferably composed of steel front and rear plates 1 and 2, respectively, and several sheet-iron side plates 3 3, which latter are securely bolted, as shown, to the front and rear angle-irons 4 and 5 and the interposed T-irons 6 6, the object of this construction being that any one of these plates could be readily removed should occasion demand its renewal or an enlarged opening to the interior construction. The front and rear as well as the side plates are lined with tiling, asbestos, or any non-heat-conducting material, the edges of this lining being bolted to the casing. On both sides of the boiler are placed doors 7 7 for easy access to the interior construction. A steel ladder 8, conveniently mounted to travel the length of the boiler, may be provided on each side of the boiler to afford easy access to these doors. Other doors for draft purposes, for supplying fuel or removal of soot, and the cleaning of the water-drums may be provided wherever they are required, and it is unnecessary at this point to describe in further detail any of these features except to say that in every instance I prefer that these doors should be made of pressed steel rather than cast-iron, for the reason heretofore mentioned.

Referring now to the interior construction, B B represent a pair of lower water-drums which extend from the front to or nearly to the rear of the casing or housing and are located on each side of the combustion-chamber on suitable piers constructed for the pur-



pose. Centrally above these water-drums B B is a center drum C, and vertically above drum C is the upper steam-drum D, and leading out of the latter and partly within the casing or housing is the usual steam-dome E. These four drums are made to communicate by means of three banks of tubes—namely, the lower ones 9, which extend from the lower drums in an inwardly-inclined direction through the combustion-chamber G to the center drum C, the central water tubes or legs 10, which connect the central drum with the upper or steam drum D, and the outer banks of tubes 11, which extend from the upper or steam drum D downward to the lower drums B B. The lower banks of tubes 9 are covered by tiling, asbestos, or any non-heat-conducting material 12, which extends from the lower drums, respectively, to the central drum, and a lining 13 of similar material covers front, back, sides, and top of boiler-casing. There is also specially-arranged tiling or asbestos K, in triangular shape, in front of the lower banks of tubes, which is removable for the purpose of access.

H indicates a feed-water pipe which draws its supply from any suitable source and preferably enters one end of the boiler, where it is controlled by a valve 14 and extends through to the opposite or rear end of the boiler, from which point it preferably rises to the upper region of the casing or housing and returns in a circuitous system of coils, as shown at 15, and finally divides at the point 16, with the two branches 17 17 entering into the rear ends of the lower drums, the coils constituting a heater for the feed-water proper before its entrance into the lower drums. These pipes 17 17 enter the rear ends of the lower drums a short distance and then turn downward and empty into the larger mud-pipes 18 at the bottom, depositing the sediment there, these pipes 18 being furnished with valves 19 for the removal of the accumulated mud from time to time.

The construction of this boiler is readily understood from the description and the drawings. The positively perfect circulation is clearly indicated by the arrows in Fig. 2.

*Circulation.*—The feed-water becomes heated during its circuitous passage through the coils 15, which are disposed in a vertical bank, thus reaching the point at the top where the greatest heat is concentrated. Upon entering the lower drums this heated feed-water is still further heated, the more-heated water ascending through the lower tubes 9 into the central drum C, which drum is located immediately over the fire, and by virtue of the location of the tubes 9 receives the greatest heat from the combustion-chamber. From C the water ascends through the tubes or legs 10 into the upper steam-drum D, this being located at the constricted upper end of the boiler. The steam ascending to

its top and into the lower end of the steam-dome becomes superheated by the accumulated heat at the top. From this upper drum D the water descends through the tubes 11 to the lower drums, and in this manner the circulation proceeds and repeats itself in continuous circuit. The heat from the grate circulates around the inner bank of tubes 9 to the extreme back of the furnace, passing upward and over the tiling 12, Fig. 4. There is tiling L L, Figs. 2, 4, and 5, between the upper drum and outside casing below the water-line for the purpose of deflecting the heat, causing it to travel horizontally over the entire outer and central tube-surface and lower and central drum C under portion of upper drum D. Hence over upper portion of upper drum D and lower portion of steam-dome E, thereby superheating the steam.

It will be seen from the tapering shape of the boiler and the general construction and arrangement that all the parts are compact and that the heat is distributed and utilized with the greatest possible economy, also that the entire boiler may be light and attractive in appearance and well adapted not only for any purpose to which such a boiler may be put, but more especially for marine purposes.

It is evident that slight changes might be made in the form and arrangement of the several parts without departing from the spirit and scope of my invention, and hence I do not wish to limit myself to the exact construction herein set forth; but,

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

1. A water-tube boiler consisting of four drums, one of which is arranged at a point between the other three, tubes connecting the central drum with each of the other three drums, and tubes connecting two of the outer drums with a third outer drum.

2. A water-tube boiler consisting of two lower drums, an upper drum, a central drum approximately midway between the other drums and tubes extending from the upper drum to the two lower drums, from the lower drums to the central drum and from the central drum to the upper drum whereby a complete circulation of water is economically effected in the generation of steam and partitions between said direct and return tubes.

3. A water-tube boiler consisting of two lower drums, an upper drum, tubes for the circulation of water back and forth through the drums, partitions between the direct and return tubes and a steam dome or drum surmounting the upper water-drum.

4. A water-tube boiler consisting of four drums, three of which have a triangular arrangement with respect to one another and the fourth located approximately at the central point, tubes extending from drum to drum whereby to create a circulation of water, par-



titions extending from two of the drums to the central drum and between certain of the tubes and a steam dome or drum surmounting the upper water-drum.

5 5. A water-tube boiler consisting of two lower, one upper and one central water-drum, partitions extending from the two lower drums to the central drum and water-tubes extending from the upper to the two lower drums on the outer side of the partitions, from the lower drums to the central drum on the inner side of the partitions and tubes extending from the central drum to the upper drum.

15 6. A water-tube boiler consisting of two lower, one upper and one central water-drum, partitions extending from the two lower drums to the central drum, and water-tubes extending from the upper to the two lower drums on the outside of the partitions, from the lower drums to the central drum on the inner side of the partitions, tubes extending from the central drum to the upper drum, and a steam dome or drum surmounting the upper water-drum.

25 7. In a water-tube boiler, the combination with three drums arranged triangularly, a fourth drum approximately centered between the other three, and circulating-tubes connecting two of the outer drums with the third outer drum, of tubes connecting two of the outer drums with the central or centered drum, and partitions between the sets of tubes which connect two outer drums with the central drum and the tubes which connect the three outer drums.

35 8. In a water-tube boiler, the combination with three drums arranged triangularly, a fourth drum approximately centered between the other three, and circulating-tubes connecting two of the outer drums with the third outer drum, of tubes connecting two of the outer drums with the central or centered drum, partitions between the sets of tubes which connect two outer drums with the central drum, and the tubes which connect the three outer drums, an outer casing or housing inclosing the drums and tubes, said casing or housing having a lining of indestructible material.

50 9. In a water-tube boiler, the combination with two lower drums, an upper drum, a central drum and partitions extending from the two lower drums to the central drum, of a set of water-tubes extending from the two lower drums to the upper drum and another set from the lower drums to the central drum, said sets of tubes located on opposite sides of the partitions.

60 10. In a water-tube boiler, the combination with two lower drums, an upper drum, a central drum, partitions and water-tubes extending from drum to drum on opposite sides of the partitions whereby a complete circulation of water is effected, of an outer casing or housing inclosing the drums and tubes, said

casing or housing lined with asbestos or other comparatively indestructible material, and a steam dome or drum surmounting the upper water-drum and extending outside of the casing or housing. 70

11. In a water-tube boiler, the combination with an outer casing or housing, of two lower drums, a central drum and an upper drum, of water tubes or pipes connecting the several drums and non-heat-conducting material extending from the lower drums to the central drum between certain of the pipes or tubes and dividing them into lower and upper banks. 75 80

12. In a water-tube boiler, the combination with an outer casing or housing, of two lower drums, a central drum, and an upper drum, of water tubes or pipes connecting the several drums, and non-heat-conducting material extending from the lower drums to the central drum between certain of the pipes or tubes, dividing them into lower and upper banks, and a horizontal diaphragm for controlling the direction of the hot-air passage. 85 90

13. In a water-tube boiler, the combination with an outer casing or housing, and water-drums therein, of a feed-water pipe having a circuitous passage inside of the casing at one end and emptying into mud-pipes leading from the drums. 95

14. In a water-tube boiler, the combination with an outer casing or housing, of two lower drums, a central drum, an upper drum, circulating-tubes connecting these several drums, partitions extending from the lower drums to the central drum and dividing the circulating-tubes into two banks, said partitions extending nearly to the rear wall of the casing, and an upper diaphragm extending across from wall to wall of the casing or housing from the rear end forward nearly to the front whereby the products of combustion pass upwardly and rearwardly among the inner bank of tubes, thence upwardly and forwardly into the larger space outside of the partitions among the outer banks of tubes and finally around the forward edge of the diaphragm and thence rearwardly over the latter and out of the casing. 100 105 110 115

15. In a water-tube boiler, the combination with an outer casing or housing, of two lower drums, a central drum, an upper drum, circulating-tubes connecting these several drums, partitions extending from the lower drums to the central drum and dividing the circulating-tubes into two banks, said partitions extending nearly to the rear wall of the casing, and an upper diaphragm extending across from wall to wall of the casing or housing from the rear end forward nearly to the front, whereby the products of combustion pass upwardly and rearwardly among the inner bank of tubes, thence upwardly and forwardly into the larger space outside of the partitions among the outer bank of tubes and finally around the forward edge of the 120 125 130



diaphragm and thence rearwardly and over  
the latter and out of the casing, and a feed-  
water pipe which draws its supply from a  
suitable source and extends into the rear end  
5 of the casing, thence upwardly to a point at  
or near the top of the casing, then returning  
in a circuitous system of coils and finally

dividing and entering the two lower water-  
drums.

PHILIP J. KEENE.

In presence of—  
LOCKE PERFITT,  
B. C. SAMMON.