No. 637,617. Patented Nov. 21, 1899.

P. J. KEENE.

WATER TUBE BOILER.

(Application filed Mar. 6, 1899.)

(No Model.) 5 Sheets—Sheet 1.

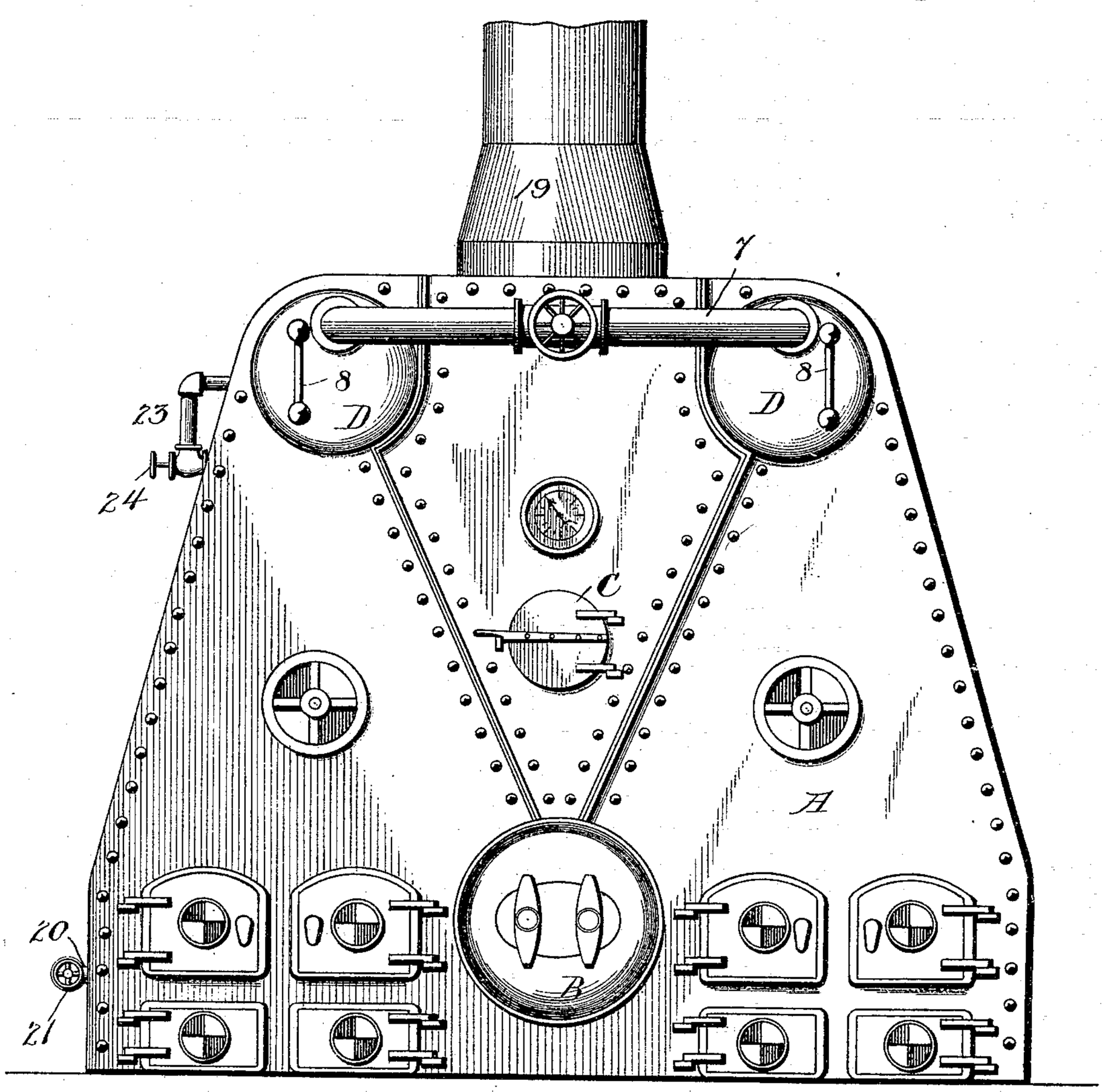

Fig. 1.

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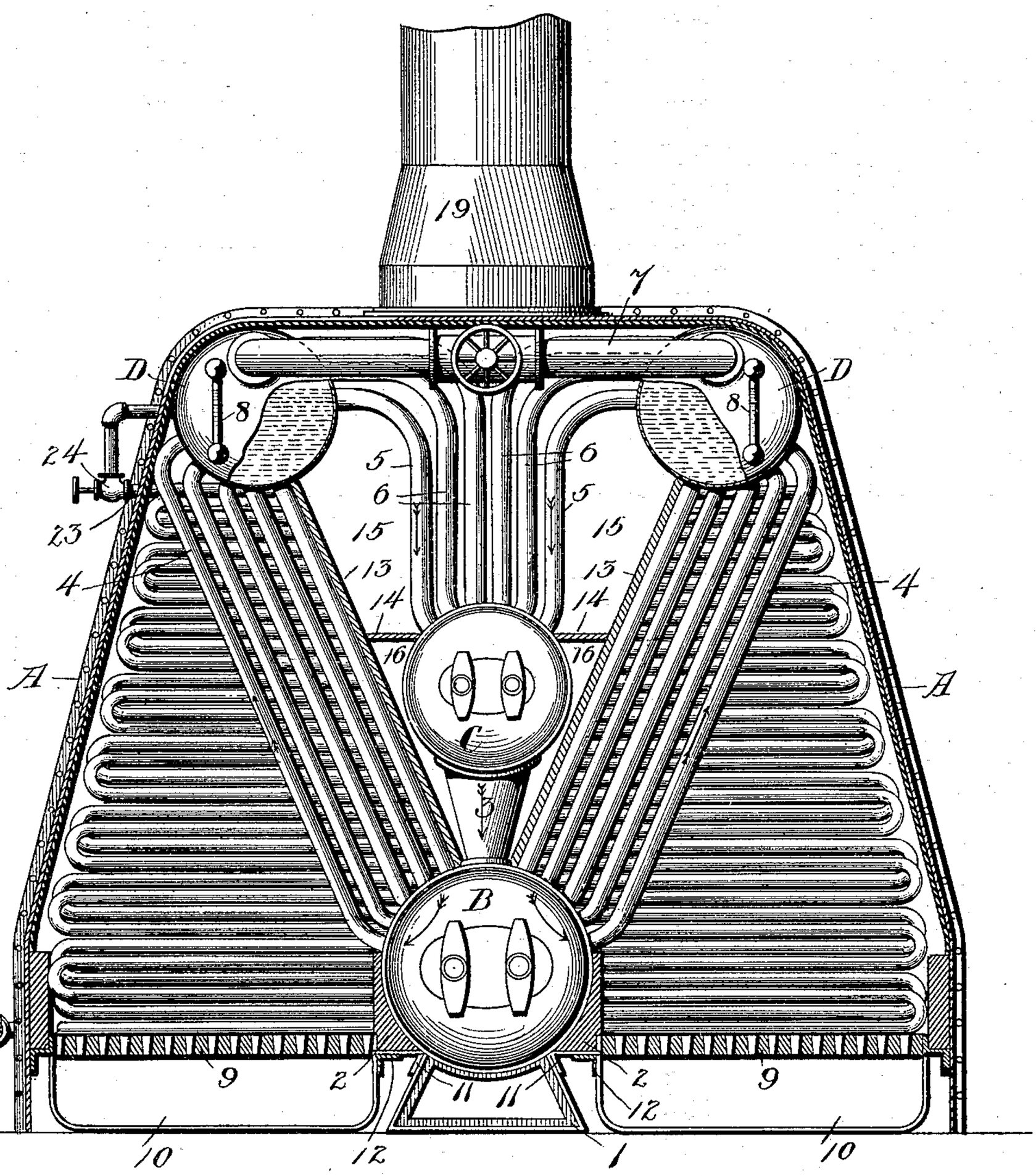

Fig. 1.

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(No Model.) 5 Sheets—Sheet 3.

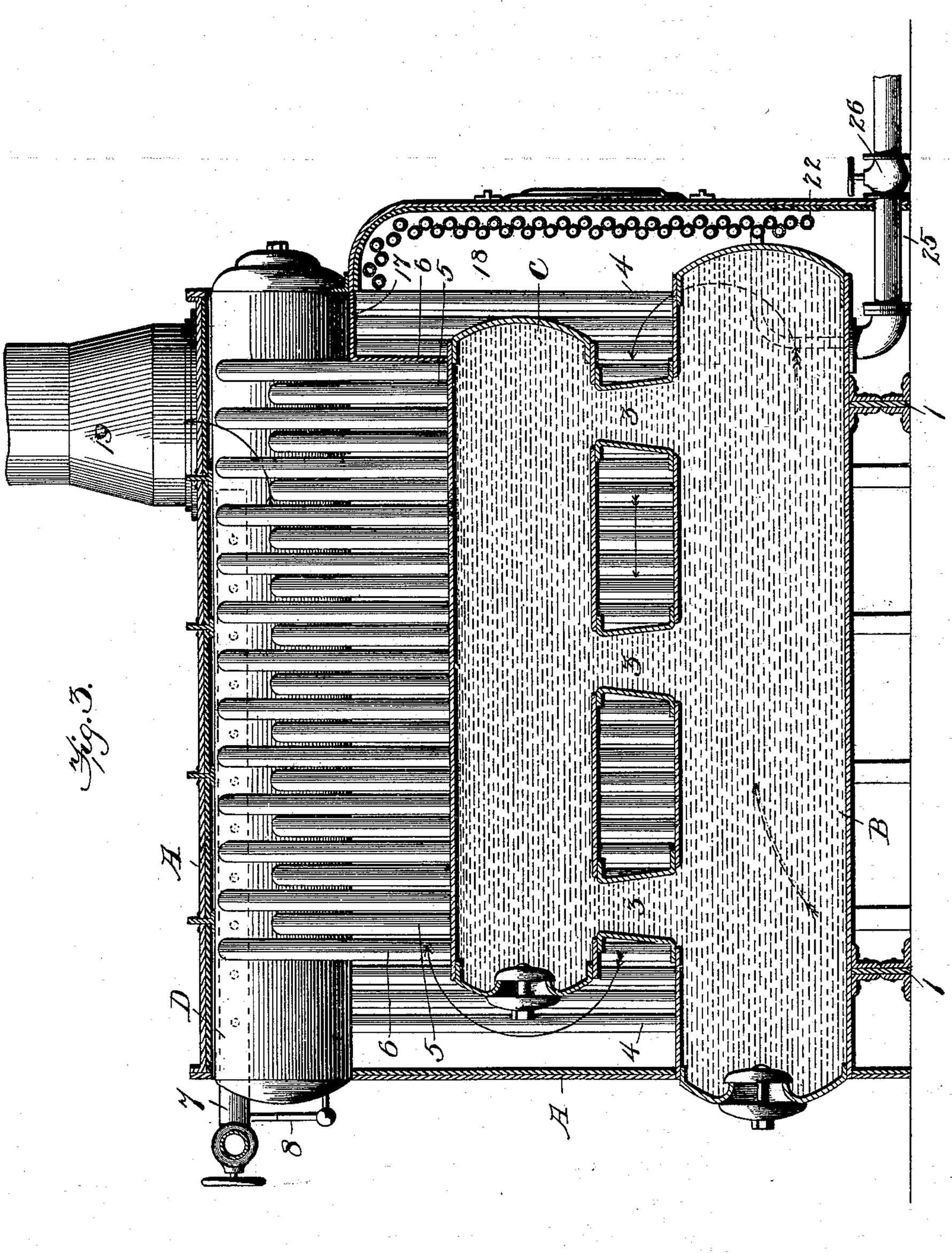

Fig. 3.

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(No Model.) 5 Sheets—Sheet 4.

Fig. 4.

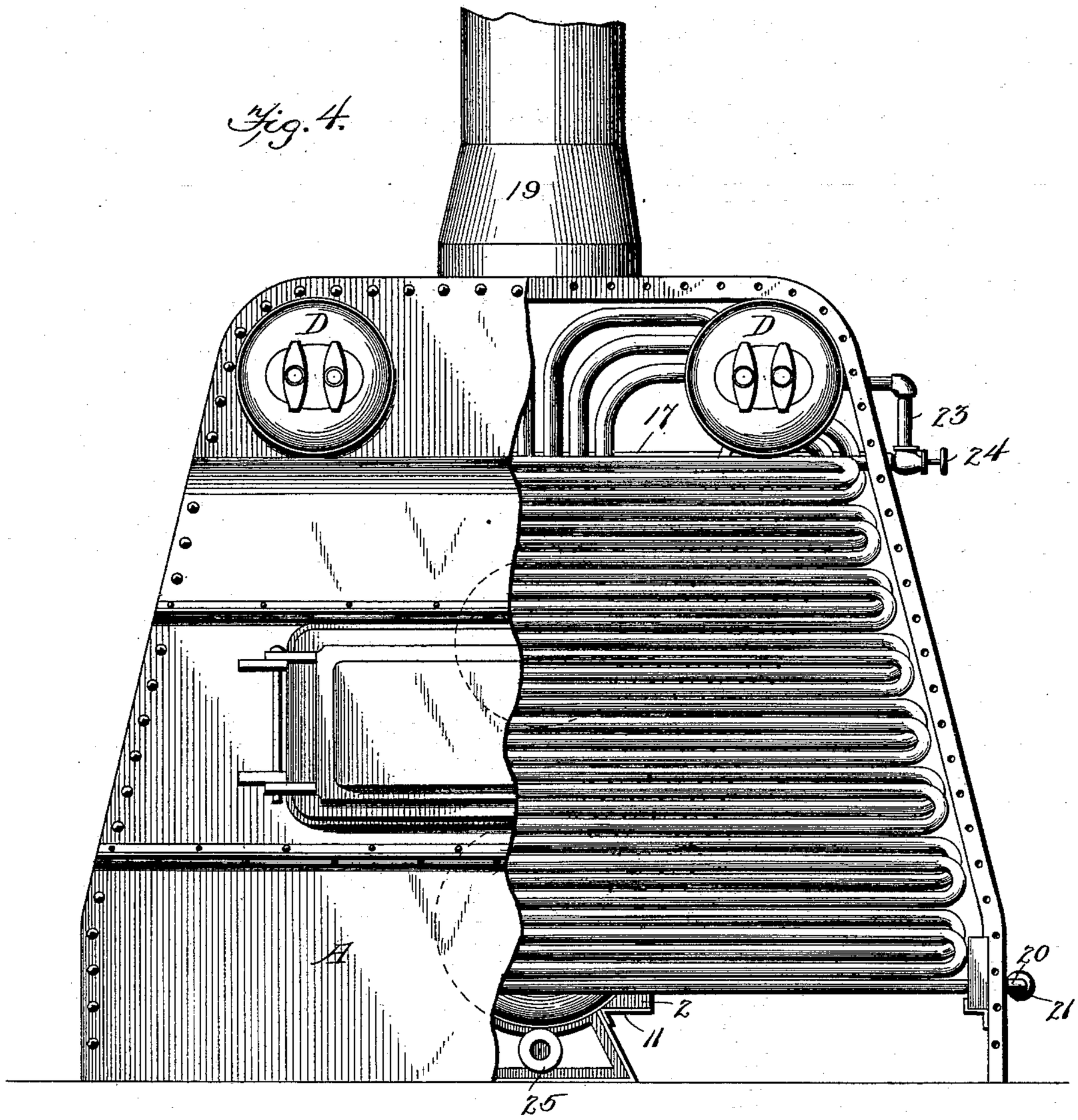
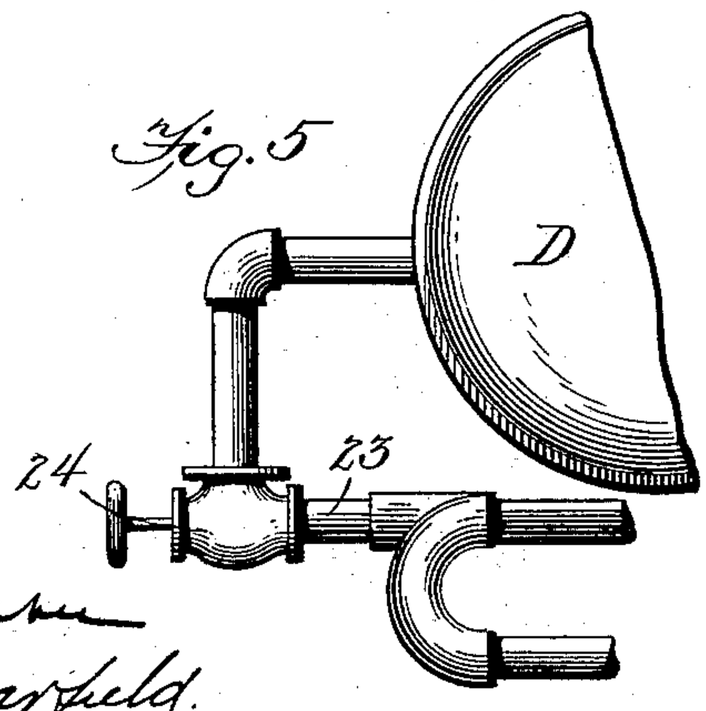


Fig. 5



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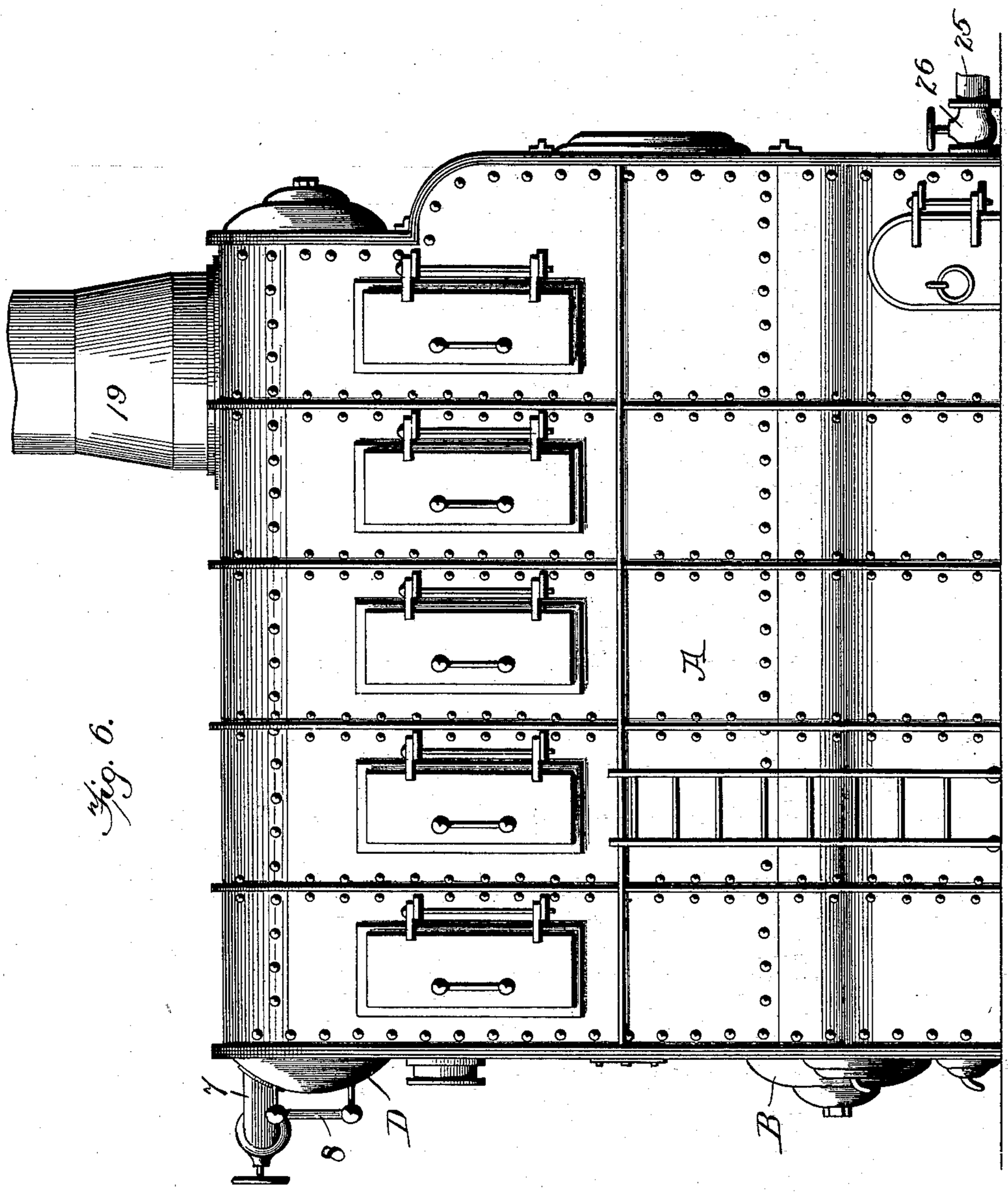

Fig. 6.

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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. 637,617, dated November 21, 1899.

Application filed March 6, 1899. Serial No. 707,991. (No model.)

To all whom it may concern:

Be it known that I, PHILIP J. KEENE, a citizen of the United States of America, 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.

The object is to provide a boiler of the character named having a large grate area and a large heating-surface.

Another object is to provide a compact water-tube boiler especially applicable to efficient service as a marine boiler, as well as for other purposes.

Another object is to provide a boiler of such construction that its various parts are readily accessible both in the construction and repair of the boiler. In other words, it is my purpose to construct the drums of this boiler of such size as not to be detrimental to high pressure and yet of a size to allow easy access for all necessary purposes, thus overcoming an objection to many other boilers in which the parts are of such size as to render them inaccessible.

A still further object is to provide a boiler in which the lower drum is of a large size to permit the deposit of sediment without its capacity being materially lessened, as would be the case by the circulation through a small drum. Again, by providing a large drum a free and easy flow of the sediment results along the bottom of the drum toward the blow-off pipe at the back.

With the foregoing objects in view my invention consists, in the main, of a central drum around which are grouped several other drums in triangular relation to one another, said drums being properly connected together by water-tubes in connection with a fire-box on either side of one drum, whereby the heat therefrom is applied directly to all the drums in the triangle and the tubes extending from the lower drum.

The invention also consists of two upper drums, one central drum, and one lower drum, all connected by tubes, the said drums being surrounded by a steel or other metal casing lined with a non-combustible material.

It still further consists of a centrally-arranged lower drum, two upper drums, the three being in triangular relation to one another, and a central drum, in combination with tubes connecting these drums. Fire-boxes are placed on each side of the lower drum, whereby the heat therefrom radiates in and around the entire tube and drum construction.

The invention also consists in two upper, one lower, and one central drum connected together by suitable tubes, certain of the tubes extending from the upper drums to the central drum not being submerged, so that they are utilized as superheating steam-surfaces.

Finally, the invention consists in certain other novel features of construction and combinations of parts, which will be 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 similar view with the front removed, showing the interior construction. Fig. 3 is a longitudinal sectional view. Fig. 4 is a rear elevation with part of casing removed, showing heater-coils. Fig. 5 is a detail of the circulating arrangement of the heater-coils. While Fig. 4 shows this arrangement on one side only, it will be understood that it can be applied to one or both sides, as desired. Fig. 6 shows an exterior side elevation.

A represents the outer casing or housing, which is preferably composed of a steel front, rear, and side plates, the said plates being securely bolted or riveted, as shown. These several parts of the casing or housing are lined with non-combustible material—such as asbestos, for example, or the like. Doors and manholes are provided in the usual manner for affording access to the interior.

Referring to the interior construction, B represents a lower water-drum which extends from the front nearly to the rear of the casing or housing. For convenience in construction this drum rests upon wrought-iron supports or steel stands 1 1. On each side of this lower drum tiling 2 2 is provided, as shown in Fig. 2 of the drawings. Above and parallel with this lower drum B is the central drum C. This central drum C is usually shorter than

the lower drum, as indicated in Fig. 3. The two communicate with each other through the water-legs 3 3.

D D indicate the two upper drums, their relation to the lower drum being triangular, as indicated in Figs. 1 and 2. Water-tubes 4 4 connect these upper drums to the lower drum, they being diagonally disposed, as indicated, and as would naturally be the condition in consequence of the triangular disposition of the three outer drums. Tubes 5 and 6 extend from the two upper drums inwardly and downwardly to the central drum. Tubes 5 are wholly submerged, whereas the tubes 6 are not submerged at their upper ends, they leading from the upper water-drums above the water-line. These latter tubes 6 6 are utilized as superheating steam-surfaces, besides delivering any upward currents through these tubes above the water-level. A main steam-pipe 7 connects the two upper drums, this pipe extending through the heads of these drums inwardly and horizontally for some distance and the upper surfaces of that portion of the pipes inside of the drums being perforated to serve as dry pipes or steam-separators, their location being of course in the steam-space above the water-level, thus taking the place of steam domes or drums of ordinary boilers. The numerals 8 8 indicate water-glasses, one being provided for each of these upper drums D D, as shown in Figs. 1, 2, and 3.

There are two grates 9 9, one on each side of the lower drum B, and beneath them are the ash pans or pits 10 10. As a convenient means for supporting the tiling 2 2 the Z-bars 11 11 are employed, they being attached to the sides of the wrought-iron supports or steel stands 1 1 for holding or supporting the tiling. Angle-bars 12 12 form stiffening-rings on the ash pans or pits. There is also tiling at the outer sides of fire-boxes, between the grates and casing, supported by Z-bars attached to sides of casing, as shown in Fig. 2.

Extending upward from the lower drum to the upper drums just inside of the tubes which connect said drums is the tiling 13 13, and extending horizontally from the central drum C to the tiling 13 13 is the tiling 14. By means of these tilings spaces 15 and 16 are formed above and below the tiling 14, respectively, and the spaces 15 are practically sealed in the rear by tiling in order to prevent the gases finding an easy escape to the chimney without passing over and around the tubes 5 and 6, and it will be observed that the tubes 5 5 form a wall over the spaces 15 15. In the rear not only are the spaces 15 15 closed, but also there is tiling under the upper drums D D from drum to drum, as at 17, to prevent the gases from having a direct passage from the grates up the stack without returning to the front through the passages or spaces 16 16. Thus it will be observed that the tiling seals the back chamber 18 completely at the top, compelling the gases to go through the passages or spaces 16 16 toward the front, as just explained, and to return through the spaces 15 to the stack 19.

Circulation.—The products of combustion from the two grates pass upward and toward the rear of the boiler beneath the tiling 13 13, thence returning to the front through the spaces 16 16 under the tiling 14 14 until they reach the front of the furnace, when they return from that point over the tiling 14 14, passing around and between the upper banks of tubes 5 and 6 to the back of the boiler and finally passing out through the stack. The circulation of the water through the drums and tubes is indicated by the arrows. The water ascends from the lower drum B through the tubes 4 4 to the upper drums D D, then returning downward to the central or intermediate drum, and from there through the legs to the lower drum, and so on continuously, steam being accumulated in the upper portion of the drums D D. The steam generated in the lower drum, central or intermediate drum, and water-legs connecting these drums will find a proper and easy escape through the upper tubes 6, which, it will be remembered, are unsubmerged, they opening directly into the steam-spaces of the two upper drums.

Feed-water heater.—The pipe 20 for supplying feed-water (shown at the left in Fig. 1) preferably extends from front to rear of the boiler and outside of the boiler-casing, it having a valve 21 at the forward end within easy reach. This pipe enters the casing at point 22, as shown in Fig. 3, at the back of the boiler. It then passes upward in a zigzag or circuitous route, forming the outer row of coils or those lying next to the casing all the way up from this point to the top of the boiler, at which point the pipe crosses over and comes downward, forming an inner row, the several rows interlocking each other and making a practically solid water-back. The object of these coils is not only to heat the feed-water, but also to protect the back of the casing or housing from intense heat. At the extreme upper end of this feed-water coil a pipe 23 extends from the coil outside of the casing and discharges into one or both of the upper drums D, and this pipe or pipes 23 are provided with a valve or valves 24. When not feeding water into the boiler, the valve or valves 24 are to be kept open, so that there shall be a circulation between the upper and lower drums through the coils of the feed-water heater. When water is being fed into the boiler through the heater-coils, these valves are to be closed. It will be readily understood that without the addition of the pipes 23 and valves 24 at the extreme upper end of the heater-coils connecting the latter to the upper drum or drums there would be practically no circulation through the heater-coils when water was not being fed into the boiler, in which case the small quantity of water contained in the coils might possibly

become exhausted or forced downwardly through the coils into the lower drum, thereby exposing the heater-coils to intense heat, with the liability of their burning out. A blow-off pipe 25 leads out of the lower drum and is provided with a valve 26, and the feed-water pipe preferably terminates downwardly just above this blow-off pipe.

It may be said in conclusion that the construction and disposition of the parts of the boiler are such that a maximum of heating-surface is exposed, and at the same time the products of combustion are to a large extent concentrated and brought directly into contact with this maximum area of surface. In like manner it is obvious that the various parts are compactly assembled, so that the boiler is of comparatively small size in comparison with its extensive area of heating-surface and grate-surface. Mention has already been made of the facility with which access may be gained to the interior, the large grate area, and numerous other features of superiority, and hence further allusion to them need not be made.

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

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

1. In a water-tube boiler, the combination with a central or intermediate drum, of a series of drums in triangular relation with one another around this intermediate drum water-tubes connecting the drums, a portion of said tubes being submerged and a portion above the water-level.

2. In a water-tube boiler, the combination with a central or intermediate drum and outside drums in triangular relation with respect to one another, of tubes connecting said drums and a pair of grates on either side of the median line of the furnace, whereby all of the drums in triangular relation are exposed to the products of combustion.

3. In a water-tube boiler, the combination with a central or intermediate drum and outside drums in triangular relation with respect to one another, of tubes connecting said drums and a pair of grates on either side of the median line of the furnace, whereby all of the drums in triangular relation and the tubes connecting the outer drums directly together are exposed to the products of combustion.

4. In a water-tube boiler, the combination with a central or intermediate drum and three outer drums and water-tubes connecting all four drums, of combustion-chambers placed on each side of one of the drums.

5. In a water-tube boiler, the combination with a central or intermediate drum and three outer drums, and water-tubes connecting all four drums, of combustion-chambers placed on each side of one of the drums and an outer casing lined with non-combustible material.

6. In a water-tube boiler, the combination with a central or intermediate drum and three outer drums in triangular relation with respect to one another, of tubes connecting the drums together certain of said tubes being above the water-level, of a main steam-pipe extending into the steam-space of the two upper drums, a portion of said steam-pipe inside of the drums being perforated on their upper surface, whereby to act as dry pipes or steam-separators.

7. In a water-tube boiler, the combination with a central or intermediate drum, a lower drum beneath the latter and two upper drums arranged above and at either side of the central or intermediate drum, the three outer drums in triangular relation one with another, of water-tubes extending from the two upper drums to the lower drum and from the two upper drums to the central or intermediate drum.

8. In a water-tube boiler, the combination with a central or intermediate drum, a lower drum beneath the latter and two upper drums arranged above and at either side of the central or intermediate drum, the three outer drums in triangular relation one with another, of water-tubes extending from the two upper drums to the lower drum and from the two upper drums to the central or intermediate drum, a portion of these latter tubes being submerged and the remaining portion above the water-level.

9. In a water-tube boiler, the combination with a central or intermediate drum, a lower drum and two upper drums, said outer drums in triangular relation with one another, of tiling extending diagonally from the lower drum to the two upper drums, tubes connecting said drums and located below said tiling, and horizontal tiling extending from the diagonal tiling to the central or intermediate drum.

10. In a water-tube boiler, the combination with a central or intermediate drum, a lower drum and two upper drums, said outer drums in triangular relation with one another, of tiling extending diagonally from the lower drum to the two upper drums, tubes connecting said drums and located below said tiling, horizontal tiling extending from the diagonal tiling to the central or intermediate drum and tubes leading from the upper drums to the central or intermediate drum, said tubes constituting a wall above the space between them and the tiling.

11. In a water-tube boiler, the combination with a central or intermediate drum, a lower drum and two upper drums, said outer drums in triangular relation with one another, of tiling extending diagonally from the lower drum to the two upper drums, tubes connecting said drums and located below the tiling, horizontal tiling extending from the diagonal tiling to the central or intermediate drum,

tubes leading from the upper drums to the central or intermediate drum, said tubes constituting a wall above the space between them and the tiling, and tiling extending across vertically at the rear of the furnace and closing the space above the horizontal tiling and between it and the upper drums.

12. In a water-tube boiler, the combination with a casing, of a feed-pipe bent back and forth in parallel arrangement across from opposite points within the casing to form one row and then in similar arrangement opposite the spaces between the folds of the tubes in another row so that the tubes of the two rows interlock to form a practically solid water-back for the protection of the casing from intense heat.

13. In a water-tube boiler, the combination with a casing, of a feed-water pipe coiled in interlocking rows close to a wall of the casing and tiling for deflecting the heat in the direction toward said feed-water or heater coils.

14. In a water-tube boiler, the combination with an outer casing, of sheet metal lined with non-combustible material, of drums, combustion-chambers and heater-coils arranged in interlocking rows and located close to the rear end of the casing and tiling which deflects the products of combustion in a direction toward said coils.

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In presence of—
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