(No Model.) 4 Sheets—Sheet 1.

T. DEEGAN.

WATER TUBE STEAM BOILER.

No. 567,456. Patented Sept. 8, 1896.

Fig. 1.

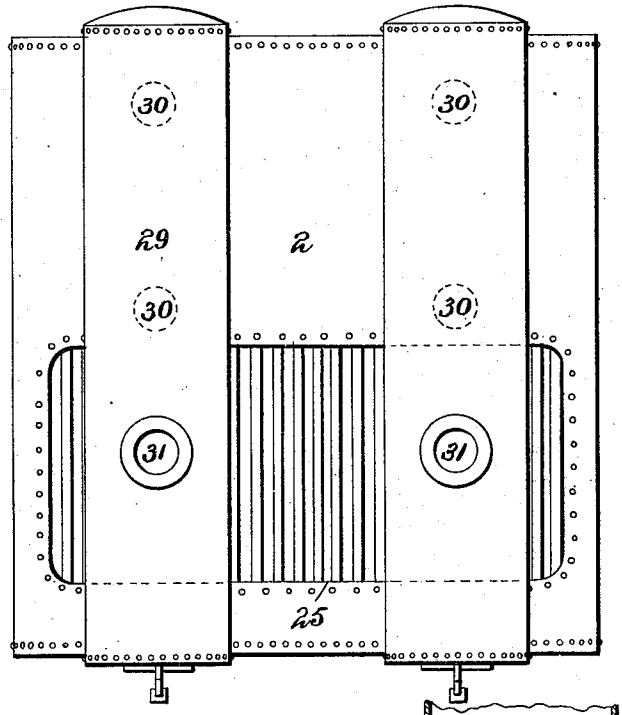
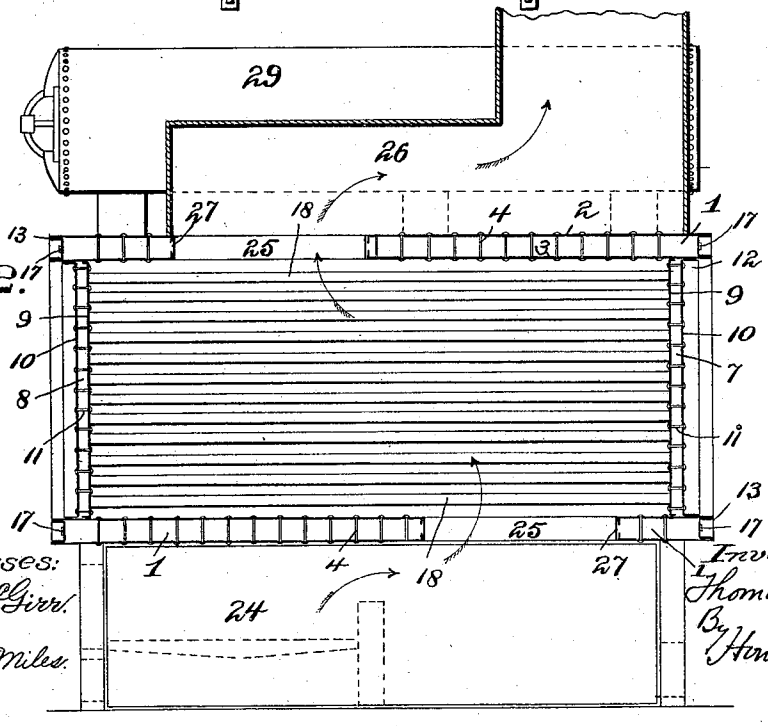


Fig. 2.



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(No Model.) 4 Sheets—Sheet 2

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Fig. 4.

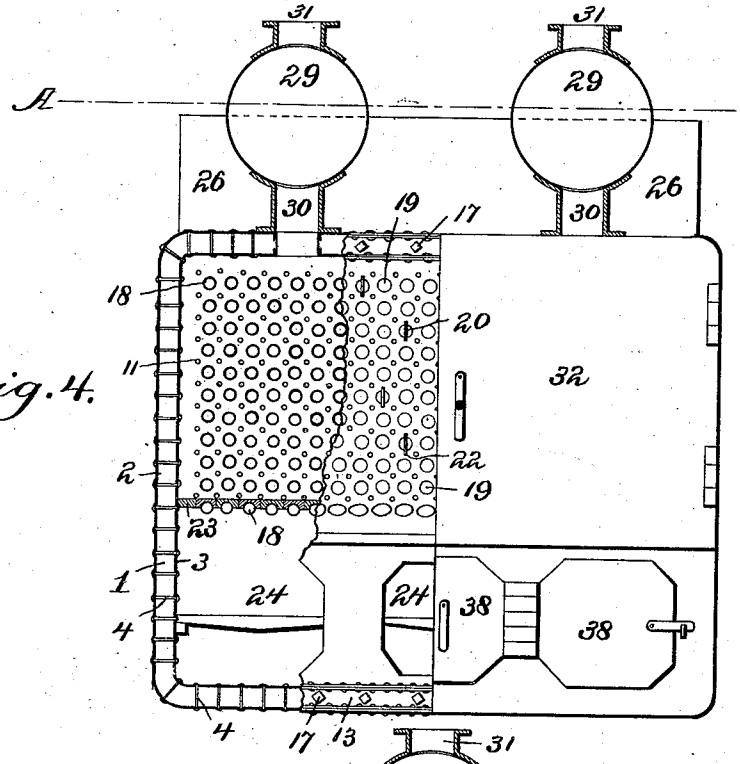
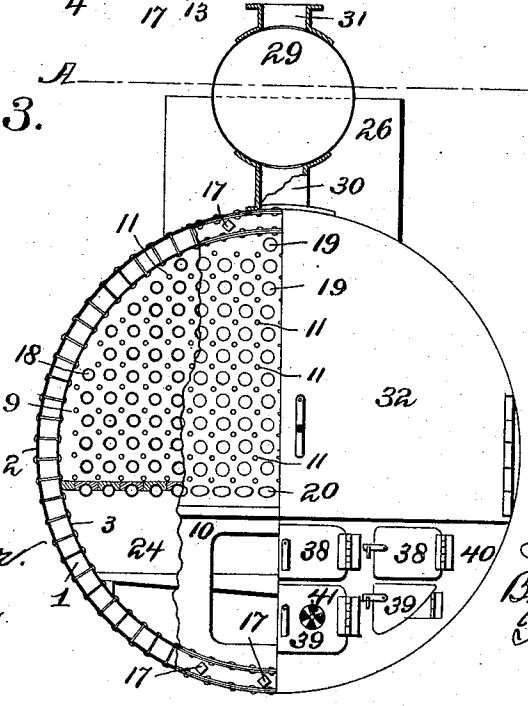


Fig. 3.



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WATER TUBE STEAM BOILER.

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Fig. 5.

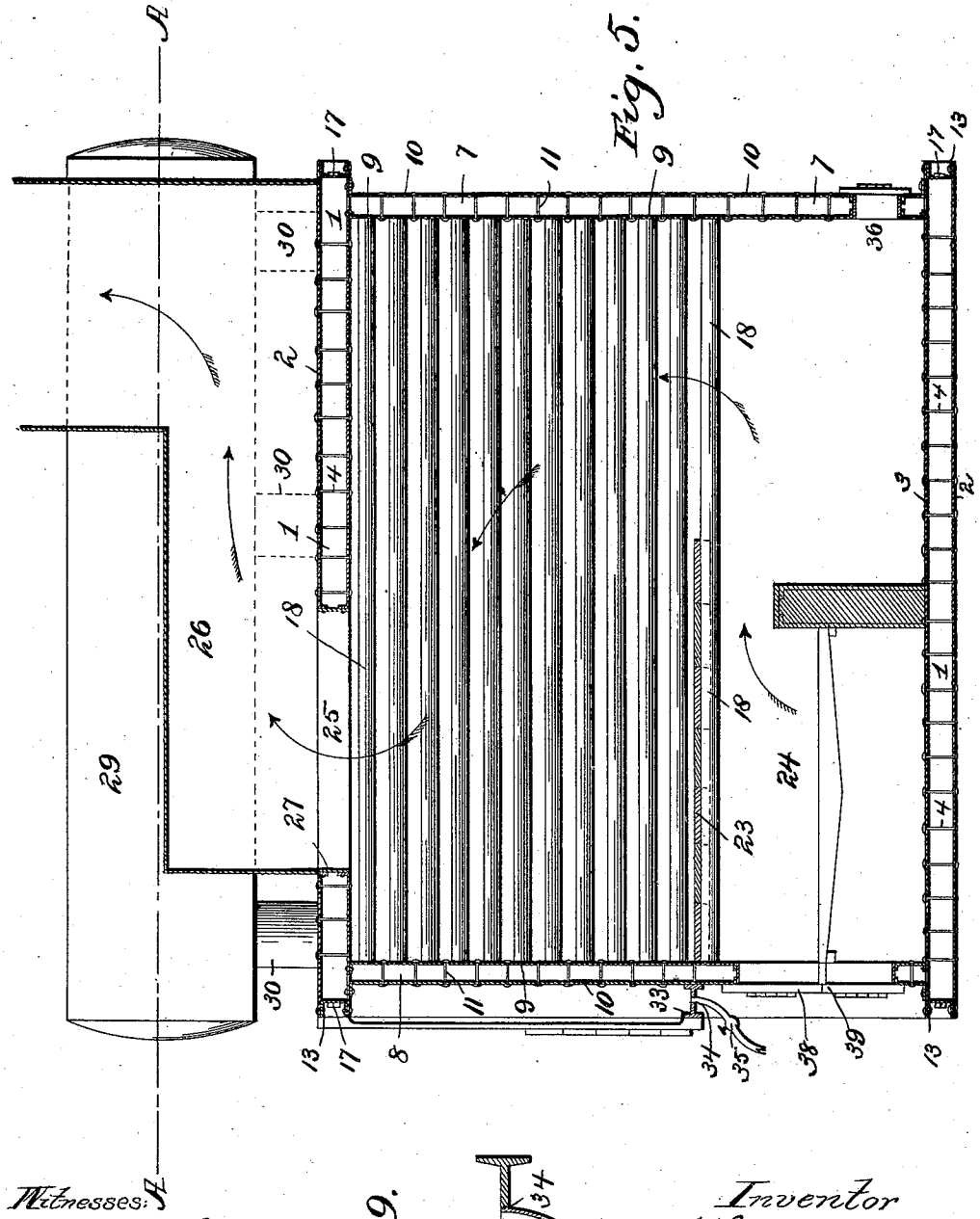

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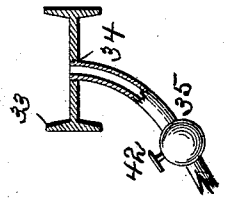
Fig. 9.



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WATER TUBE STEAM BOILER.

No. 567,456. Patented Sept. 8, 1896.

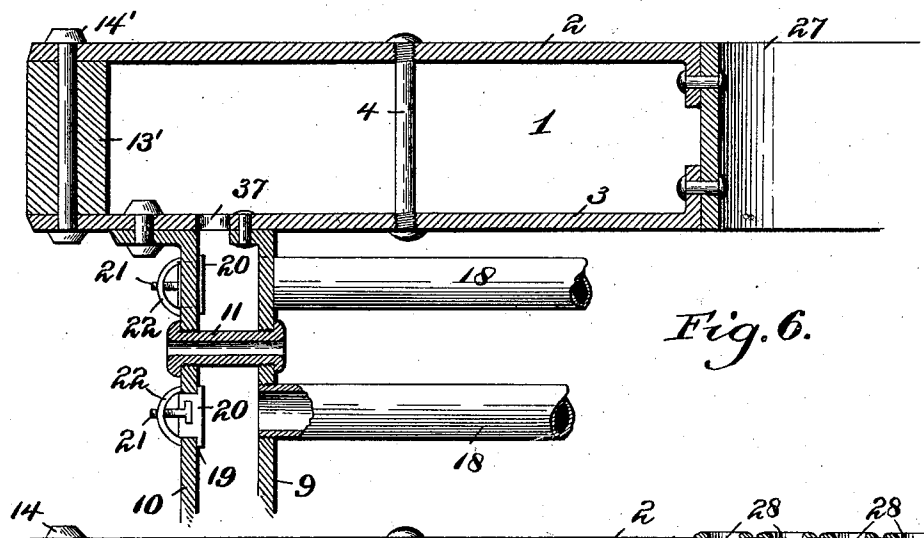


Fig. 6.

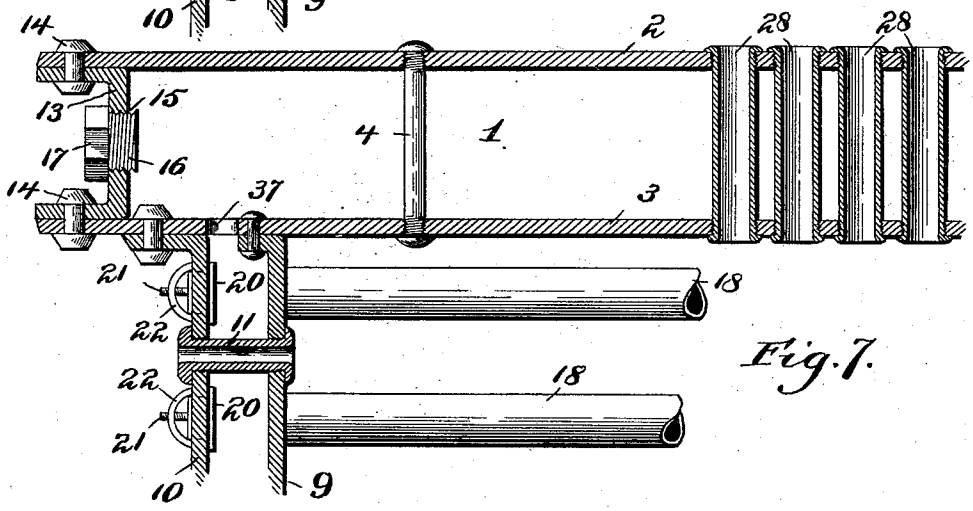
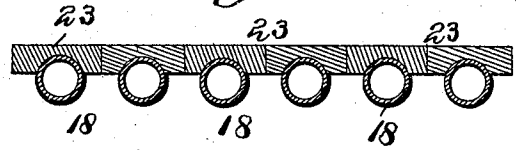


Fig. 7.

Fig. 8.



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UNITED STATES PATENT OFFICE.

THOMAS DEEGAN, OF CHICAGO, ILLINOIS.

WATER-TUBE STEAM-BOILER.

SPECIFICATION forming part of Letters Patent No. 567,456, dated September 8, 1896.

Application filed June 25, 1895. Renewed February 14, 1896. Serial No. 579,324. (No model.)

To all whom it may concern:

Be it known that I, THOMAS DEEGAN, 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 Steam-Boilers, of which the following is a specification.

My invention relates to steam-boilers, and more particularly to marine steam-boilers; and its principal object is to provide a water-tube marine steam-boiler which shall embody the necessary attributes of a steam-boiler for marine purposes.

Heretofore many attempts have been made to construct a water-tube marine boiler, but for various reasons, while highly desirable, no construction has yet been devised possessing the essential characteristics necessary to insure the adoption of water-tube boilers for marine purposes. It may be generally stated that in all prior constructions, of which I am aware the general objections have been due to the complicated features of construction, to incomplete circulation, and to the great weight of the structure growing out of the manner in which the tubes and connections and headers have been made. A further very serious disadvantage existing in many of these prior constructions arises from the fact that the tube-sheets, shell, and other parts of the boiler have been designed in such a way that the riveting cannot all be done by the most improved automatic riveting-machines, and consequently some of the rivets must necessarily be driven by hand. This of course materially increases the cost of construction, and to this defect is added the further objection of the increased weight of these boilers over the ordinary fire-tube boiler now in general use. This weight is also materially increased in such constructions by the necessary increase in thickness of the boiler-shell in order to withstand the greater and higher pressure sought to be maintained in the employment of water-tube boilers.

It is obvious that the essential requirements of a good marine boiler are chiefly simplicity of construction, minimum weight of the structure consistent with the maximum power to be developed, complete and perfect accessibility for repairs and cleaning, thorough and complete circulation of the water in the boiler, large water-heating surfaces, and a good draft, all of which requirements must be fulfilled in order to secure a marine boiler capable of generating steam of sufficient quantity, quality, and pressure to meet the demands of the modern high-speed engines now in use upon sea-going vessels.

By my invention I am enabled to secure a boiler of such construction as will answer all these requirements, since a boiler constructed in accordance with the said invention occupies minimum space, at the same time producing maximum power and has the least weight for a given power, the thickness of the shell being materially decreased within the bounds of absolute safety against disastrous explosion. Furthermore, a steam-generator embodying the features of my invention is conducive to the greatest economy of fuel, while its extreme simplicity of construction renders not only the original cost, but the cost of maintenance, materially less than any of the constructions heretofore made.

With this general statement my invention consists in the novel construction of water-tube steam-boilers hereinafter described and claimed, with reference to the accompanying drawings, in which—

Figure 1 is a top plan view of a cylindrical marine water-tube boiler constructed in accordance with my invention. Fig. 2 is a vertical longitudinal section of a stationary boiler with my invention applied thereto. Fig. 3 is a front elevation, partly sectional, of the construction shown in Fig. 1. Fig. 4 is a front elevation of a rectangular water-tube boiler, partly sectional, with my invention applied thereto. Fig. 5 is a vertical longitudinal section of the construction shown in Fig. 3, drum in elevation. Fig. 6 is a sectional detail of the water-heads and annular water-shell. Fig. 7 is a similar view of a preferred construction thereof. Fig. 8 is a sectional detail of part of the lower tubes, showing the tiling or fire-brick covering the same. Fig. 9 is a detail of the lower frame of the upper doors.

Referring particularly to the drawings, in which the same characters represent corresponding parts throughout the same, the numeral 1 indicates an annular water jacket or space formed by outer and inner shells about five inches apart in the clear, preferably of

wrought-steel, the said shells being stay-bolted together by the stay-bolts 4 and with the double water-heads 7 and 8 form the boiler-casing. These double water-heads 7 and 8 comprise the inner tube-sheets 9 and the outer heads 10, which are about three inches apart in the clear and are stayed by the hollow stay-bolts 11 and connected to the inner shell 3 by suitable flanges 12, riveted to said shell. The annular water space or jacket 1 is connected at the front and rear ends of the boiler with the double water-heads 7 and 8 by a series of water openings or passages 37, thus affording a direct communication between the water-heads and the annular water-jacket and, through the water-heads, with the water-tubes 18. The boiler is thus completely surrounded by a water-jacket formed of a double shell, which jacket, in operation, is always filled with water, so that the thickness of the shells and heads may be reduced materially in constructing the boiler, a thickness of one-half inch being ample for the highest pressures maintained, without exceeding the limits of perfect safety. This jacket, it will be observed, entirely surrounds or envelops the water heads and tubes. By the use of the term "annular water-jacket" I intend to include not only the preferable shape of jacket, circular in cross-section, but other shapes as well, such as rectangular, oval, elliptical, &c., it being essential merely that the said jacket shall be made of double shells and the space between said shells being filled entirely with water.

The ends of the annular jacket 1 are closed, preferably, by an annular channel-plate 13, Fig. 7, whose flanges are riveted by suitable rivets 14 to the outer and inner shells 2 and 3, the said channel-plates being provided with screw-threaded openings 15, closed by screw-plugs 16, having polygonal heads 17. These holes 15 are distributed at suitable intervals around the boiler, as shown, so as to provide a sufficient and ready means of cleaning the annular shell when desired. In Fig. 6 I have shown another way of closing the ends of the annular shell, which consists of a solid rim of metal 13', secured by bolts 14', passing through the said rim and the two shells, but I prefer the construction shown in Fig. 7, since it is lighter and is better adapted for providing a ready means of cleaning the annular water-space.

Referring now more particularly to the preferable construction shown in Figs. 3 and 5, it will be seen that the water-heads are connected by a series of three-and-a-half-inch water-tubes 18, the horizontal rows being about six inches from center to center, while the vertical rows are about three-and-a-half inches from center to center. The outer heads 10 of the the boiler, front and rear, are provided with a series of hand-holes 19, one opposite each tube, closed by suitable flanged plugs 20, having outwardly-extending screw-threaded bolts 21, passing through the spanning-yokes 22. The lower row of tubes is preferably covered with baffle fire-brick or tiles 23, which divert the draft from the furnace 24 backward, so that the products of combustion will pass upward and around the greatest extent of the superficial area of water-heating surface formed by the tubes, boiler-shell, and heads, the said products of combustion passing through the lower smoke-discharge opening 25 into the boiler around the tubes, through the upper smoke-discharge opening or passage 25, into smoke connection 26, thence into the smoke-stack. The smoke-discharge openings 25, as shown in Figs. 5 and 6, are formed of a rectangular frame of wrought-steel 27 or other suitable metal, riveted to flanges on the outer and inner shells 2 and 3. Instead, however, of forming this smoke-passage in this manner, I may pass through the two shells, at the proper points, a sufficient number of wrought-metal nipples 28, Fig. 7, preferably about four inches in diameter and spaced about five inches from center to center, these nipples being expanded into the two plates and beaded over at each end, as shown. The dimensions of these nipples may of course be varied as desired, and as illustrated they are considerably reduced in size with respect to the other parts of the boiler for better illustration in connection therewith.

Mounted upon the boiler are one or more steam and water drums 29, connected with the annular water-space of the boiler by water legs 30, in which drums the water is carried about at or slightly above the horizontal diameter thereof, and from the top of which drums extend suitable steam connections 31. The line A A indicates about the normal water-level carried in the boiler. The upper part of the front end of the boiler is closed by suitable doors 32, hinged at the side and provided with suitable retaining lugs and catches, said doors extending from the top to a point at or slightly below the lower row of tubes. The lower edge of the door, when closed, rests preferably against a frame formed of an I-beam 33, extending transversely of the boiler and bolted or riveted to the outer head. This beam is provided with a suitable number of perforations 34, into which are tapped the ends of one or more valved pipes 35, which form the discharge or delivery of a blowing apparatus or an air-fan located in a suitable position near the boiler. Where the forced draft is applied, this connection may, of course, be made with the draft-supplying apparatus. By this construction it will be seen that the space between the tubes can be readily and effectively cleaned of deposits of soot, ashes, &c., in the most effective manner by simply turning the air-valves 42 in the pipes 35, thus slightly increasing the air-pressure in the space between the closed doors 32 and the interior of the boiler, said doors being practically air-tight. The hollow stay-bolts 11 afford a clear passage-way for the air

from the pipes 35, to be forced into the interior of the structure and blow the soot and ashes to the rear where such sediment falls down into the ash-pit, the damper in the smoke connection being closed, if desired, to prevent the said soot and ashes from being blown out through the smoke-stack upon the deck of the vessel; and the door 36 in the rear water-head permits the ashes to be cleaned out of the ash-pit in rear of the bridge-wall. By using air-blast for cleaning the exterior water-heating surfaces of soot and ashes in the manner described I avoid the injurious action of steam, usually employed for this purpose, which contains a large percentage of moisture, that causes the soot, &c., to be incrusted to a greater or less degree upon the tubes, and thus lessens the heating effect while injuring the tubes themselves. When the pipes 35 are connected with the ordinary blowing apparatus of the vessel, to effect the thorough cleaning of the tubes and interior of the boiler it is only necessary to close the upper door and then open the valves 42 in the blowing-pipes, closing, in the meantime, the damper in the smoke connection, whereupon the operation is effected quickly and effectively, in a simple manner.

The lower part of the boiler, inclosing the furnace and ash-pit, is closed by the usual fire-doors 38 and ash-pit doors 39, the latter of which are provided with valved air-holes 41, all of said doors being mounted upon the frame 40, secured to the lower part of the boiler-head.

In order to readily fit the hand-hole plates or covers in position, I preferably make the middle and lower rows of hand-holes of oval form, as shown, so that the round covers may be passed through the same.

The construction shown in Fig. 2 is particularly adapted for stationary use, while that shown in the other figures of the drawings is especially adapted for marine use, though it is to be understood that either may be used interchangeably with such slight variations as would be suggested to any one skilled in the art to adapt it to the particular use intended. With this construction of boiler shown and described the water is fed into the rear end of the upper steam and water drum and descends naturally into the rear heads, which are connected by the series of water-openings 37 with the annular shell and by the water-tubes 18 with each other. Passing through the rear head the water circulates through the tubes into the front water-head, thence through the water connections into the steam and water drum above, the unevaporated water passing to the rear of the said steam and water drum or drums, from which the circulation continues as before, the steam generated being released at the water-level into the upper part of the drum or drums 29. In this way it will be seen the circulation is free and direct through the heads into the outer casing and through tubes connecting the said water-heads and annular casing and from thence into the steam and water drums.

A steam-boiler made in accordance with my invention answers all the requirements of a good marine boiler for the reasons already given, and when set for use it resembles the well-known Scotch marine boiler now so generally used, while the improvements embodying the essential features of my invention preserve all the known advantages of this type of boiler and add thereto the advantages of a water-tube over a fire-tube boiler, and these improvements make my invention capable of extended application upon seagoing vessels, particularly upon the modern war vessels, where boilers of great capacity for generating and maintaining steam under high pressures, combining the greatest strength, safety, and durability with the least weight and bulk, are required to meet the demands of the high speeds to be developed by the modern multiple-expansion engines universally adopted.

Without limiting myself to the specific details shown and described, I claim as my invention—

1. A water-tube steam-boiler comprising double water-heads, a series of water-tubes connecting the said heads, and an annular water-jacket in communication with said tubes and heads and entirely surrounding the same, substantially as described.

2. A water-tube steam-boiler comprising water-heads at the front and rear of the structure, a series of water-tubes connecting said heads, an annular water-jacket enveloping and communicating directly with the said heads, and one or more water and steam drums mounted upon the structure connected by water-legs with the annular water-jacket, substantially as described.

3. A water-tube steam-boiler comprising water-heads at each end of the boiler, a series of water-tubes connecting said heads, an annular water-jacket surrounding and enveloping the water heads and tubes, the internal shell of said water-jacket being provided with water-passages connecting the heads with the said water-jacket, and a smoke-passage in said jacket near the one end of the same through which the products of combustion are diverted after passing around the tubes, substantially as described.

4. In a water-tube steam-boiler, the combination with the water-heads at each end thereof, of the water-tubes connecting said heads, around which the products of combustion pass, the water-jacket surrounding the heads and tubes, consisting of an inner and outer shell, and channel-plates riveted to said shells and closing the ends of the jacket, the inner shell of said jacket being provided with water-passages communicating with the heads, substantially as described.

5. In a water-tube boiler, the combination of double shell forming an enveloping water-jacket, channel-plates riveted to shell at each

end for closing the ends of said water-jacket, and provided with a series of cleaning-openings, water-heads at each end of the boiler riveted to and in communication with the jacket, a series of water-tubes connecting said heads, the said water-heads being provided with hand-holes opposite each water-tube, substantially as described.

6. In a water-tube boiler, the combination with the water-jacket, formed of an inner and outer shell, of the steam and water drum or drums mounted upon the outer shell and connected to the jacket by water-legs, the water-heads at each end of the boiler formed of inner and outer plates, and communicating with the jacket through openings in the inner shell of the latter, the water-level being maintained at or near the diametrical line of the drum, and a series of nipples expanded into openings in the shells of the water-jacket forming passages for the products of combustion through the boiler into the smoke connection, substantially as described.

7. In a water-tube boiler, the combination with the furnace, of the water-heads and the tubes connecting the same, the water-jacket formed of the inner and outer shells surrounding said tubes, and provided with smoke-passages formed of a series of nipples expanded into holes in the shells of said jacket, substantially as described.

8. In a water-tube boiler, the combination with the furnace, of the water heads and tubes connecting the same, the baffle brick or tiling upon the lower row of tubes over the furnace, for diverting the products of combustion to the rear of the structure, the water-jacket enveloping the tubes, formed of inner and outer shells, the inner shell of which is provided with water-openings directly communicating with the water-heads, steam and water drum or drums mounted upon the outer shell of said jacket and communicating therewith by water-legs, in which drum the normal water-level is maintained, and smoke-passages in the jacket for diverting the products of combustion into the smoke connection, substantially as described.

9. In a water-tube boiler, the combination with the casing of the boiler, of the water-heads composed of inner and outer plates connected by hollow stay-bolts, the water-tubes expanded into the inner plates and connecting said heads, the front doors hinged to the casing, the lower door-frame extending transversely of the boiler at or below the lower row of water-tubes, the said frame being provided with one or more perforations, and a valved air pipe or pipes connected with said perforations, whereby the tube-surfaces may be cleaned by air forced through the pipes into the space between the front doors and the water-head and through the hollow stay-bolts into and around the tubes, substantially as described.

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

THOMAS DEEGAN.

Witnesses:
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EUGENE LEWIS.