

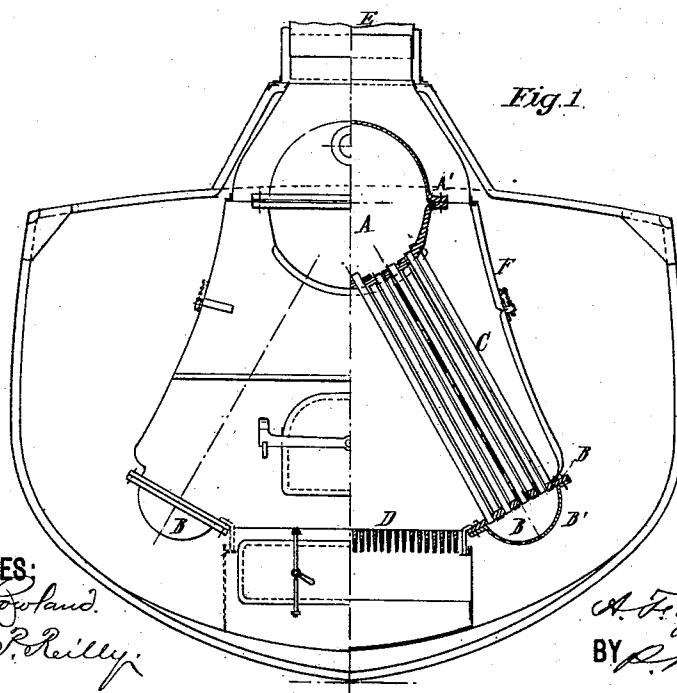
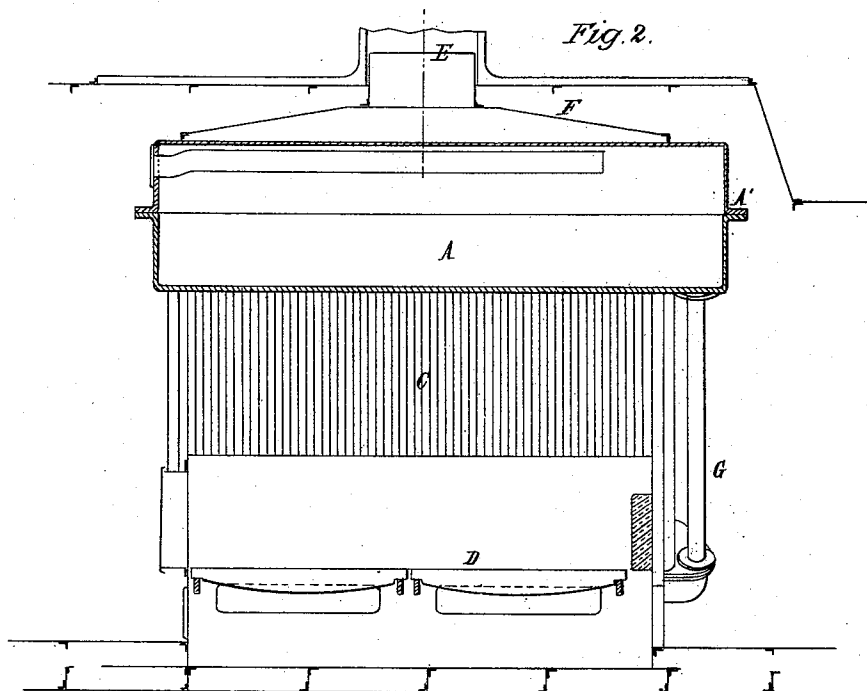
(No Model.)

3 Sheets—Sheet 1.

A. F. YARROW.
WATER TUBE BOILER.

No. 472,777.

Patented Apr. 12, 1892.



WITNESSES:
Edward C. Roland.
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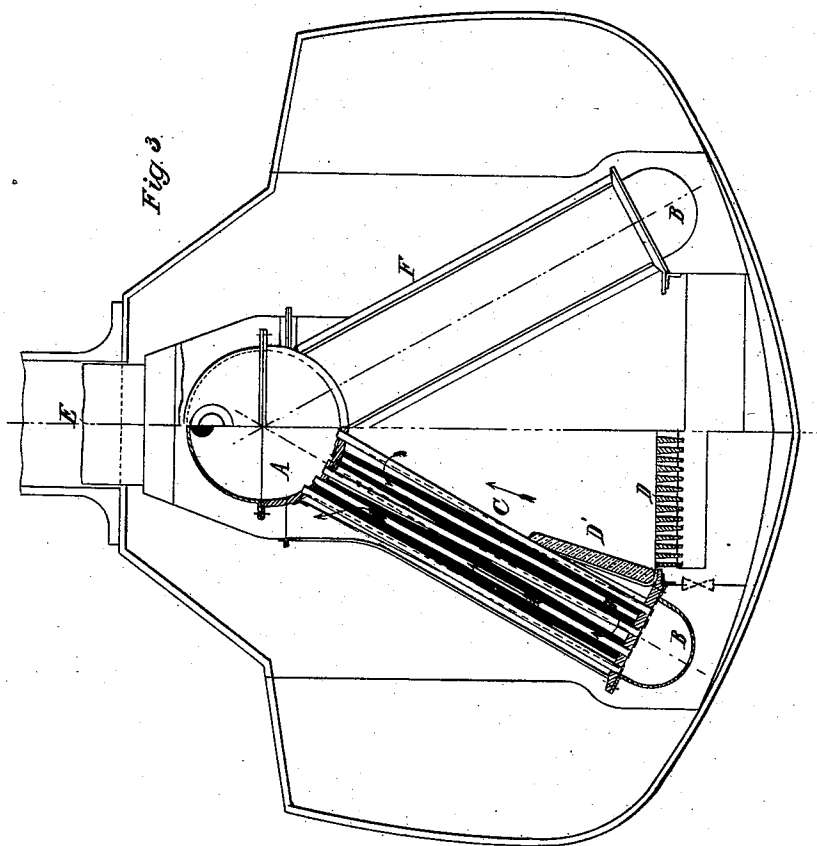
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3 Sheets—Sheet 2.

A. F. YARROW.
WATER TUBE BOILER.

No. 472,777.

Patented Apr. 12, 1892.



WITNESSES:

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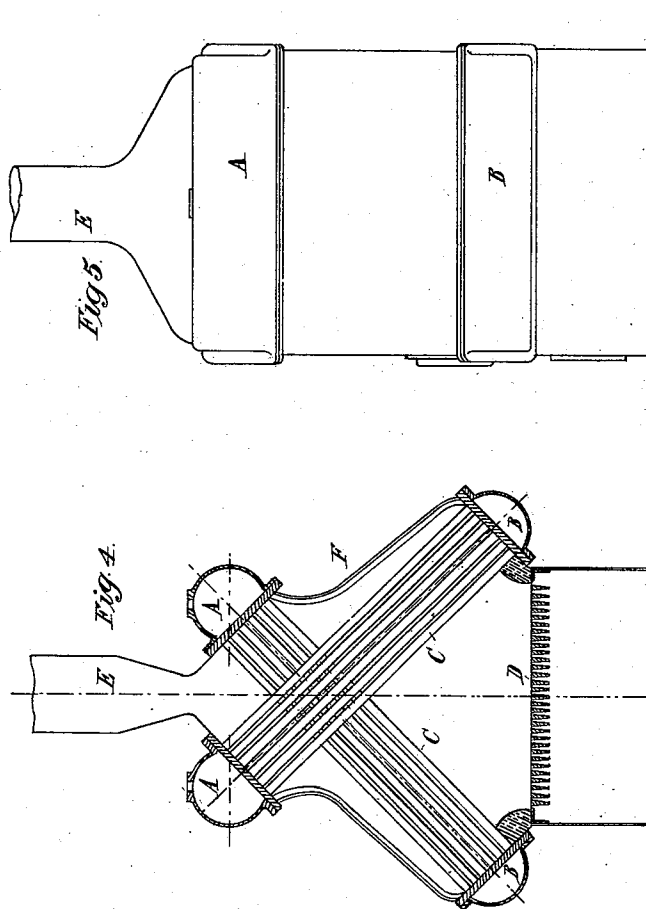
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3 Sheets—Sheet 3.

A. F. YARROW.
WATER TUBE BOILER.

No. 472,777.

Patented Apr. 12, 1892.



WITNESSES:
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UNITED STATES PATENT OFFICE.

ALFRED F. YARROW, OF LONDON, ENGLAND, ASSIGNOR TO HORACE SEE,
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WATER-TUBE BOILER.

SPECIFICATION forming part of Letters Patent No. 472,777, dated April 12, 1892.

Application filed August 8, 1891. Serial No. 402,073. (No model.) Patented in England November 11, 1889, No. 17,958.

To all whom it may concern:

Be it known that I, ALFRED FERNANDEZ YARROW, of Isle of Dogs Poplar, London, in the county of Middlesex, in the Kingdom of Great Britain, have invented a new and useful Improvement in Water-Tube Boilers, (for which Letters Patent of Great Britain, No. 17,958, were issued to me, dated November 11, 1889,) which invention or improvement is fully set forth and illustrated in the following specification and accompanying drawings.

The object of this invention is to provide a simple and strong boiler of comparatively light construction, the ends of whose tubes shall be easily accessible for the cleaning, repair, or renewal of the tubes.

The invention will first be described in detail and then particularly set forth in the claims.

In the accompanying drawings, Figure 1 shows a part end elevation and part cross-section of a boiler embodying my invention, set within the transverse contour or outlines of a boat or vessel. Fig. 2 illustrates in longitudinal section the parts shown in Fig. 1. Fig. 3 is a view similar to that shown in Fig. 1, but having the tubes differently set in the tube-sheets. Fig. 4 shows in cross-section a modified form of construction in which there are two upper steam and water chambers connected by crossed tubes to two similar lower steam and water chambers. Fig. 5 illustrates in end elevation the modification shown in Fig. 4.

In said figures the several parts are indicated by reference-letters, like letters indicating like parts.

Referring to Figs. 1, 2, and 3, the letter A indicates an upper cylindrical water and steam chamber formed in halves secured together by flanges A'. Two bottom water-chambers B B are connected to the chamber A by the water-tubes C. The chambers B are constructed each of a semi-cylindrical part B', closed by a flat cover B², bolted to flanges on the part B' and having holes into which are screwed or otherwise fixed the lower ends of the tubes C, the upper ends of which are screwed or otherwise fixed in holes formed in the chamber A. The furnace D is situated

between the bottom chambers B, the flames or gases of combustion being caused to pass transversely between the tubes C on their way to the uptake E.

F indicates the casing of the boiler.

Longitudinal or transverse baffle-plates may be provided between the tubes C, so as to cause the flames and gases of combustion to take a circuitous course on their way to the uptake and chimney, or in lieu thereof the modified arrangement shown in Fig. 3 may be adopted, in which the tubes of the middle and outer rows cross each other at the middle, so as to obstruct the passage of the flames and gases at that part, and thus cause them to take the circuitous course indicated by the arrows, fire-brick cheeks D' being provided at the sides of the furnace to obstruct the direct passage of the flames between the lower ends of the inner rows of tubes. The tubes G, of larger diameter than the tubes C, connect the chambers A and B B at the ends of said chambers outside the casing F for effecting the downward circulation of the water.

In Fig. 4 two upper steam and water chambers A A are shown, constructed similar in form to the lower ones B B, to which said chambers A A are connected by the tubes C C in such manner that the two sets of tubes cross each other over the furnace, as shown, so that as the part where the tubes cross acts as a baffle the flames and hot gases are made to effectually penetrate first between the lower ends of the tubes and then between the upper ends of the same on their way to the uptake E. The two sets of tubes C C may, however, connect the upper chambers A and lower chambers B without crossing.

From the description above given it will be perceived that I provide two bottom water-chambers at some distance apart with the furnace and flame-space between them, and above these I provide an upper chamber for water and steam, situated at the apex of a triangle having the two lower chambers at the extremities of its base. Each of the lower chambers is a semi-cylinder having a flat cover flange-jointed to it, this cover having holes through it, so as to constitute a tube-plate, and lying at an angle. I make the upper chamber

a cylinder in two parts flange-jointed together, and I bore in its lower side two sets of holes for tubes corresponding with those of the tube-plates below. Between the upper chamber
 5 and each of the lower chambers I fix a number of straight or approximately straight tubes, which lie at an angle. I secure the tubes in the usual way either by screwing or by expanding their ends in the holes in the tube-
 10 sheets. By unbolting the flanges and removing the bottom parts of the lower chambers I get access to the lower ends of the tubes, and by removing the upper part of the upper chamber I get access to the upper ends of the tubes.
 15 It will also be perceived that instead of a single upper chamber receiving both sets of tubes I provide for two upper chambers flange-jointed; the one chamber receiving one set of tubes and the other receiving the other set of
 20 tubes, as already hereinbefore described. By making the chamber A a true cylinder, yet at the same time longitudinally and diametrically divided, so that the two semi-cylinder halves may be separably united by bolts, and
 25 combining this chamber with the semi-cylinders at the sides of the grate-bars, said semi-cylinders being also separably bolted to flat tube-sheets, there is secured not only the vital characteristic of strength to all parts, but the
 30 equally vital feature, in particular for this class of boilers, mostly of limited size, of accessibility to the tubes for cleaning, repair, or replacement.

I am aware that many years ago it was proposed to connect in some indeterminate way
 35 within a furnace steam and water chambers discharging at one open end into an interior "water-space" between water-walls of a "shell-boiler" or partial shell-boiler, and such
 40 a construction I do not claim. Such construction is a practically permanent connection and not a separable connection of any of its parts. Moreover, in so great a mass of water as must be contained in said water-space exposed to the full heat of the furnace the tendency of the circulation of the water to therein ascend and thus defeat the course of circulation desired is so great that special mechanical means were proposed to produce a
 45 descending current in the water-space. Great weight of water and of metal, greater complexity and cost, and less durability are also involved in the use of said water-space-shell construction. In my invention the separable
 55 character of each entire generator-chamber into two parts or sections is one of its essential elements. Both parts in all the generator-chambers are not only secured together by steam-tight joints at both sides, but in both heads also by bolts through said joints. Not
 60 only do no ends of any of my generator-chambers connect with or discharge between shell water-walls in the furnace, but both ends of each generator are closed by heads outside of the furnace-walls and no shell constructions
 65 are anywhere employed.

Having thus fully described my said invention, I claim—

1. In a water-tube boiler for the generation of high steam, the combination of the following-named elements: generator-chambers,
 70 each chamber composed of two sections separably secured together longitudinally on both sides and both heads by bolts passing through steam-tight joints in said sides and heads, water-tubes for ascending circulation within a
 75 furnace and connecting one section of each of said chambers to a section of another chamber, and downcast pipes outside of the furnace-walls, connecting said generator-chambers, substantially as and for the purposes set forth.

2. In a water-tube boiler, the combination of a single upper generator cylinder or drum composed of two semi-cylinders separably
 85 bolted together longitudinally through steam-tight joints in both sides and heads and lower water-chambers composed each of two sections, the one a flat tube-sheet and the other a semi-cylinder, separably bolted together longitudinally through steam-tight joints in both
 90 sides and both ends, said upper cylinder and lower chambers being connected by circulating-tubes within the furnace, whereby access is obtained to both ends of said tubes by the
 95 removal of the bolts in said joints, substantially as set forth.

A. F. YARROW.

Witnesses:

ANN UNDERWOOD,
 EMILY J. PEASCOD.