

(No Model.)

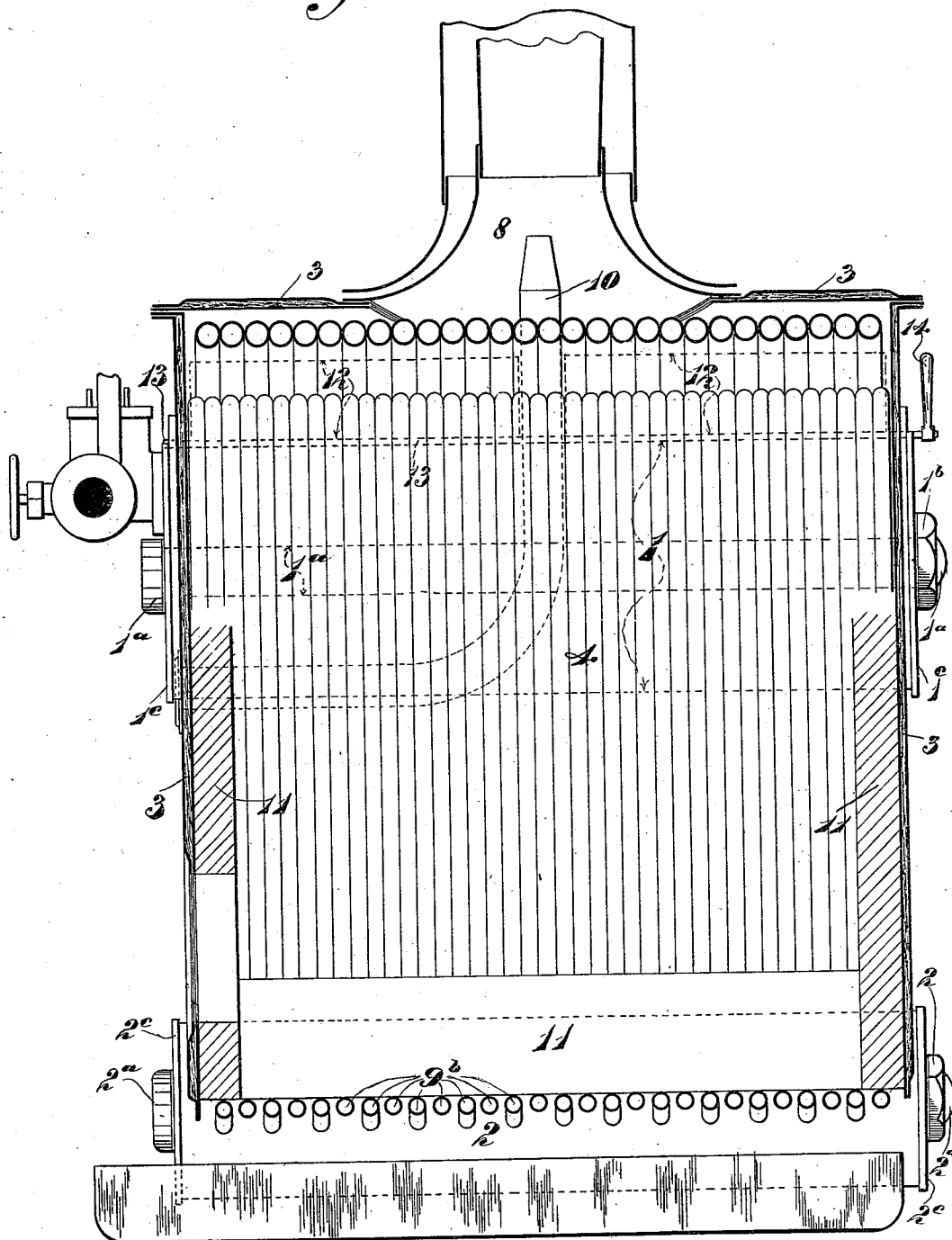
2 Sheets—Sheet 1.

J. I. THORNYCROFT.
WATER TUBE BOILER.

No. 555,543.

Patented Mar. 3, 1896.

Fig. 1.



Witnesses.
Lucy E. Matthews
Edmund S. Newell

Inventor
John Isaac Thornycroft

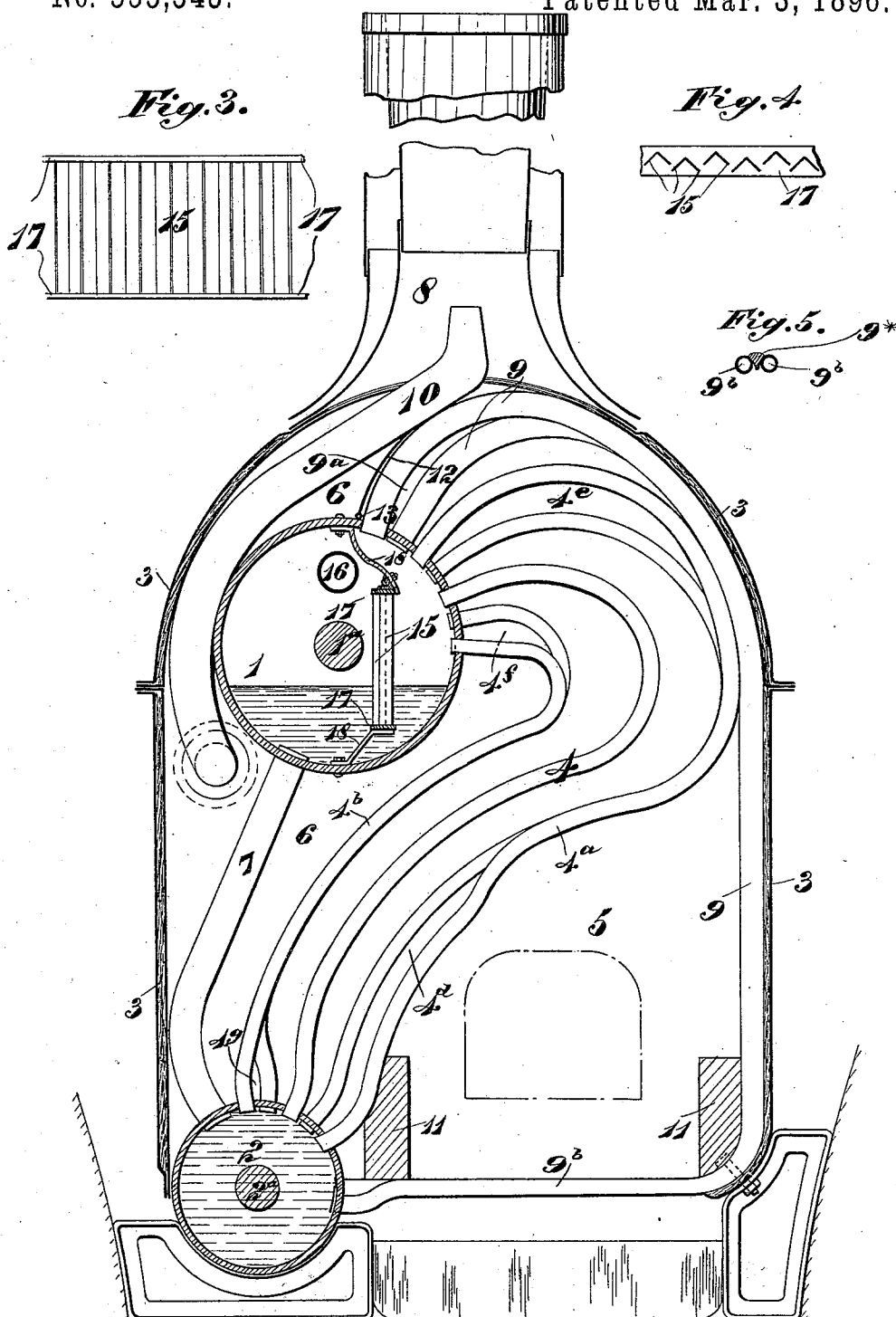
(No Model.)

2 Sheets—Sheet 2.

J. I. THORNYCROFT.
WATER TUBE BOILER.

No. 555,543.

Patented Mar. 3, 1896.



Witnesses.
Perog Emassch,
Samuel S. Shewin

Fig. 2.

Inventor:
John Isaac Thornycroft

UNITED STATES PATENT OFFICE.

JOHN ISAAC THORNYCROFT, OF LONDON, ENGLAND.

WATER-TUBE BOILER.

SPECIFICATION forming part of Letters Patent No. 555,543, dated March 3, 1896.

Application filed December 13, 1894. Serial No. 531,669. (No model.) Patented in England October 4, 1894, No. 18,838; in France December 22, 1894, No. 243,872; in Italy December 31, 1894, No. 231; in Switzerland January 3, 1895, No. 9,751; in Belgium July 16, 1895, No. 116,563; in Austria October 22, 1895, No. 3,973, and in Denmark December 2, 1895, No. 310.

To all whom it may concern:

Be it known that I, JOHN ISAAC THORNYCROFT, a subject of the Queen of Great Britain and Ireland, residing at Chiswick, London, in the county of Middlesex, England, have invented Improvements in Water-Tube Boilers, (for which Letters Patent have been granted as follows: in Great Britain, dated October 4, 1894, No. 18,838; in France, dated December 22, 1894, No. 243,872; in Austria, dated October 22, 1895, No. 3,973; in Italy, dated December 31, 1894, No. 231; in Denmark, dated December 2, 1895, No. 310; in Switzerland, dated January 3, 1895, No. 9,751, and in Belgium, dated July 16, 1895, No. 116,563.) of which the following is a specification.

This invention has reference to an improved construction and arrangement of water-tube boiler, specially designed for use in navigable vessels of small size, such as launches and pinnaces, as I will now proceed to explain by the aid of the accompanying illustrative drawings, in which—

Figure 1 is a longitudinal vertical section, and Fig. 2 a cross-section, showing my improved boiler. Figs. 3 and 4 are, respectively, a side elevation and horizontal section showing an improved construction of baffle for use in such boiler. Fig. 5 is a sectional detail view.

A steam-boiler according to this invention comprises an upper longitudinal combined steam collector and separator 1 (hereinafter called a "steam-drum") and a lower longitudinal water-vessel 2, these being arranged one above the other at one side of and within a casing 3 so as to extend from front to back of the boiler. They are connected by a main longitudinal group of bent tubes 4 that serve to divide the interior of the casing, practically in a diagonal manner, into two longitudinal chambers 5 and 6, the lower of which—viz., 5—serves as a fire-box, and in the upper of which—viz., 6—the steam-drum 1 is located. The downtake-tube 7 or tubes connecting the bottom of the steam-drum with the water-vessel is or are or may be also arranged within the said upper chamber, 6, as in the example shown, though it or they may,

if desired, be external to the boiler-casing 3. When arranged in the said upper chamber, as shown, several of such tubes may be used. The tubes 4 composing the main longitudinal group of tubes form one side and the roof of the fire-box 5, and are so bent and disposed in a manner now well understood in connection with water-tube boilers of the Thornycroft type, and as shown in the drawings, that some of them form two close walls 4^a 4^b of a flue 4^c, within which the remaining tubes are arranged, this flue communicating at its lower part with the fire-box through openings 4^d between the lower ends of the tubes forming the inner wall 4^a of such box, and at its upper end, through similar openings 4^e 4^f between the upper ends of the tubes, forming the walls 4^a 4^b, with the uptake 8, either directly through the portion of the upper chamber, 6, that is above the steam-drum 1 by passing through the openings 4^e, or indirectly through the portion of the said chamber 6 that is below the said drum by passing through the opening 4^f, or through both of these portions of the said chamber by passing through both sets of openings 4^e and 4^f simultaneously.

The openings 4^e formed by the bending of the lower ends of the tubes constituting the wall 4^b are closed by refractory material, such as fire-clay, to prevent escape of flame and hot gases at these points. The other side of the fire-box 5 is formed by bent tubes 9, arranged close together and in a row along their vertical portions and connected at their upper and lower ends with the steam-drum 1 and water-vessel 2, respectively, their upper ends being so bent and disposed, as shown, as to extend over the upper ends of the bent tubes 4, and so as to leave openings 9^a between them through which the hot gases and products of combustion, after passing through the opening 4^e between the upper ends of the tubes 4 forming the wall 4^a, can pass direct to the uptake 8.

The upper ends of the tubes 4 and 9 are shown connected to the upper side of the steam-drum, as I consider this the most advantageous arrangement, but I do not limit myself to such an arrangement, as they may be connected to any other desired part of the

steam-drum, in which case the position of the said drum can also be changed if desired. The tubes 9 may, at their lower ends, be advantageously bent inward, as shown, toward the water-vessel 2 to which they are connected, so as to form hollow grate-bars 9^b, through which water will circulate when the boiler is in action, the portions of the said tubes forming the said grate-bars being made of smaller diameter than the remaining portions in order to form air-passages between them, as shown in Fig. 1. This construction of one side of a fire-box and fire-grate by a row of tubes may advantageously be used in constructions of water-tube boilers other than that hereinbefore described. To obviate damage of the hollow grate-bars by direct contact with the fuel and by the tools used to clean the fire, the said hollow grate-bars may be partially protected by removable bars 9* of approximately T shape in cross-section and having preferably a convex upper surface, as shown in Fig. 5, these bars being arranged at intervals so as not to materially interfere with the furnace-draft.

10 is a blast-pipe extending through the upper chamber 6 and terminating at the base of the uptake 8.

11 is refractory material, such as fire-clay, arranged at the sides and ends of the fire-grate to protect the adjacent portions of the tubes 4 and 9 and end walls of the casing 3 from direct contact with the fuel on the grate.

To control the direction of the escaping hot gases and products of combustion, a flap or damper suitably slotted to clear the blast-pipe 10, or two separate flaps or dampers 12 arranged a short distance apart for a like purpose and carried by a spindle 13, may be arranged above the upper ends of the bent tubes 4 and 9, as shown, so that when turned into the dotted position shown in Fig. 2 by an external handle 14 it or they will permit the hot gases and products of combustion to pass directly to the uptake through the openings 4^e and 9^a, and when turned into the position shown in full lines in the same figure will cause the said hot gases and products of combustion to pass through the openings 4^f to the lower side of the steam-drum 1 and thence to the uptake 8.

To simplify and cheapen the construction of the steam-drum and water-vessel, and to permit of access being readily gained to their interiors, the end covers of each of them are or may be secured in place by one or more bolts passing lengthwise completely through the steam-drum or water-vessel, as the case may be, and the end covers, and provided on its or their outer ends with holding-up nuts, as shown in Figs. 1 and 2, where 1^a is a central bolt with nut 1^b for holding the covers 1^e of the steam-drum 1 in place against the end of the drum, and 2^a is a similar bolt with nuts 2^b for holding the covers 2^e of the water-vessel 2 in place against the ends of the said

vessel, the heads of the bolts and the nuts bearing against the outsides of the said covers.

To separate the steam from the water projected into the steam-drum 1 from the upper ends of the bent tubes 4 and 9, a baffle or baffles is or are provided. A convenient construction of baffle for this purpose, according to this invention, is shown in Figs. 3 and 4, and consists of a number of bars or strips 15 arranged parallel with each other and at a distance apart in two or more rows, the bars or strips in one row being opposite the spaces between the bars or strips in the adjacent row, the arrangement being such that when jets of mixed water and steam are projected upon the baffle the water will be arrested and the steam allowed to pass between the bars or strips to the main steam-pipe 16. The bars are connected together at their ends by suitable carriers or supports 17, and are preferably grooved in the direction of their length, so as to be of angular, semicircular or equivalent form in cross-section. In the example shown they are of angular form and are supported within the steam-drum between the upper ends of the tubes and the steam-pipe 16 by plates 18 18^a, the upper of which may also serve as a baffle for the jets of mixed steam and water issuing from the upper ends of the tubes 9 and of some of the tubes 4.

What I claim is—

1. A water-tube boiler comprising a water-vessel arranged along one side of the fire-grate from front to back of the boiler, a steam-drum arranged parallel with and above said water-vessel, a casing containing the same, a longitudinal main group of tubes connecting said water-vessel and steam-drum and arranged in a practically diagonal manner from one side of the boiler to the other so as to divide the casing into two longitudinal chambers the lower of which serves as the fire-box of the boiler, and a longitudinal row of tubes connecting the water-vessel and steam-drum and arranged to extend from front to back of the boiler and to form the opposite side of the fire-box, substantially as described.

2. A water-tube boiler comprising a casing with uptake, a steam-drum and a water-vessel arranged one above the other at one side of and within said casing, a longitudinal group of bent tubes connecting said steam-drum and water-vessel and arranged to divide the interior of the casing practically in a diagonal manner, into two longitudinal chambers, the lower of which serves as a fire-box and in the upper of which said steam-drum is located, and a blast-pipe passing through the casing and through the upper chamber close to the casing and the steam-drum into the uptake-pipe, substantially as described.

3. A water-tube boiler comprising an upper steam-drum, a lower water-vessel, a longitudinal main group of bent tubes connect-

ing the upper side of said steam-drum with said water-vessel, arranged to form one side and the roof of a fire-box, and some of which are arranged to form close sides of a flue in
 5 which the remaining tubes are arranged, said flue being in communication with the fire-box and with the uptake of the boiler, a close wall of tubes connecting said steam-drum and water-vessel and arranged to form the other side
 10 of said fire-box, and a casing with uptake inclosing the said steam-drum, water-vessel and tubes, substantially as herein described.

4. In a water-tube boiler, the combination with an upper steam-drum and a lower water-
 15 vessel, of a longitudinal row of bent tubes connected to said steam-drum and water-vessel, said tubes being arranged close together along their upwardly-extending portions so as to form a close tubular wall at one side of
 20 the fire-box and having their lower portions bent horizontally or approximately so and made of smaller cross-section than the upper portions so as to form hollow grate-bars with air-spaces between, substantially as herein
 25 described.

5. The combination with the steam-drum of a water-tube boiler, tubes arranged to direct streams of water and steam into the upper part thereof, and a steam-outlet pipe leading
 30 into the steam-drum, of a baffle arranged within said steam-drum between the upper ends of said tubes and said steam-outlet pipe and comprising a number of connected bars or strips grooved in the direction of their
 35 length and arranged so as to alternate with each other, substantially as herein described for the purpose specified.

6. A water-tube boiler comprising a casing 3, a steam-drum 1, a water-vessel 2, a longitudinal group of tubes that extends from front
 40 to back of said boiler, connects said water-vessel with the upper side of said steam-drum, is arranged to divide the interior of said casing into upper and lower longitudinal chambers, and forms one side and the roof of the
 45 lower of said chambers which serves as a fire-box, downtake-tubes 7 arranged in the upper chamber between the vertical side of said casing and said longitudinal group of tubes, and a longitudinal close row of tubes that also
 50 connects the water-vessel with the upper side of said drum and constitutes the other side of said fire-box, substantially as described.

7. A water-tube boiler comprising a casing 3, steam-drum 1, water-vessel 2, inner and
 55 outer groups of bent tubes 4 and 9 respectively connecting said water-vessel with the upper side of said steam-drum and forming the sides and roof of a fire-box, and one or more downtake-tubes 7 arranged in the space
 60 between said casing and the inner group of tubes 4 some of said tubes 4 being arranged to form a flue with lower and upper openings 4^d and 4^e, and said tubes 9 being arranged to extend over the tubes 4 and bent to form open-
 65 ings 9^a and a damper arranged to control said openings 9^a, substantially as described.

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

JOHN ISAAC THORNYCROFT.

Witnesses:

PERCY E. MATTOCKS,
 EDMUND S. SNEWIN.