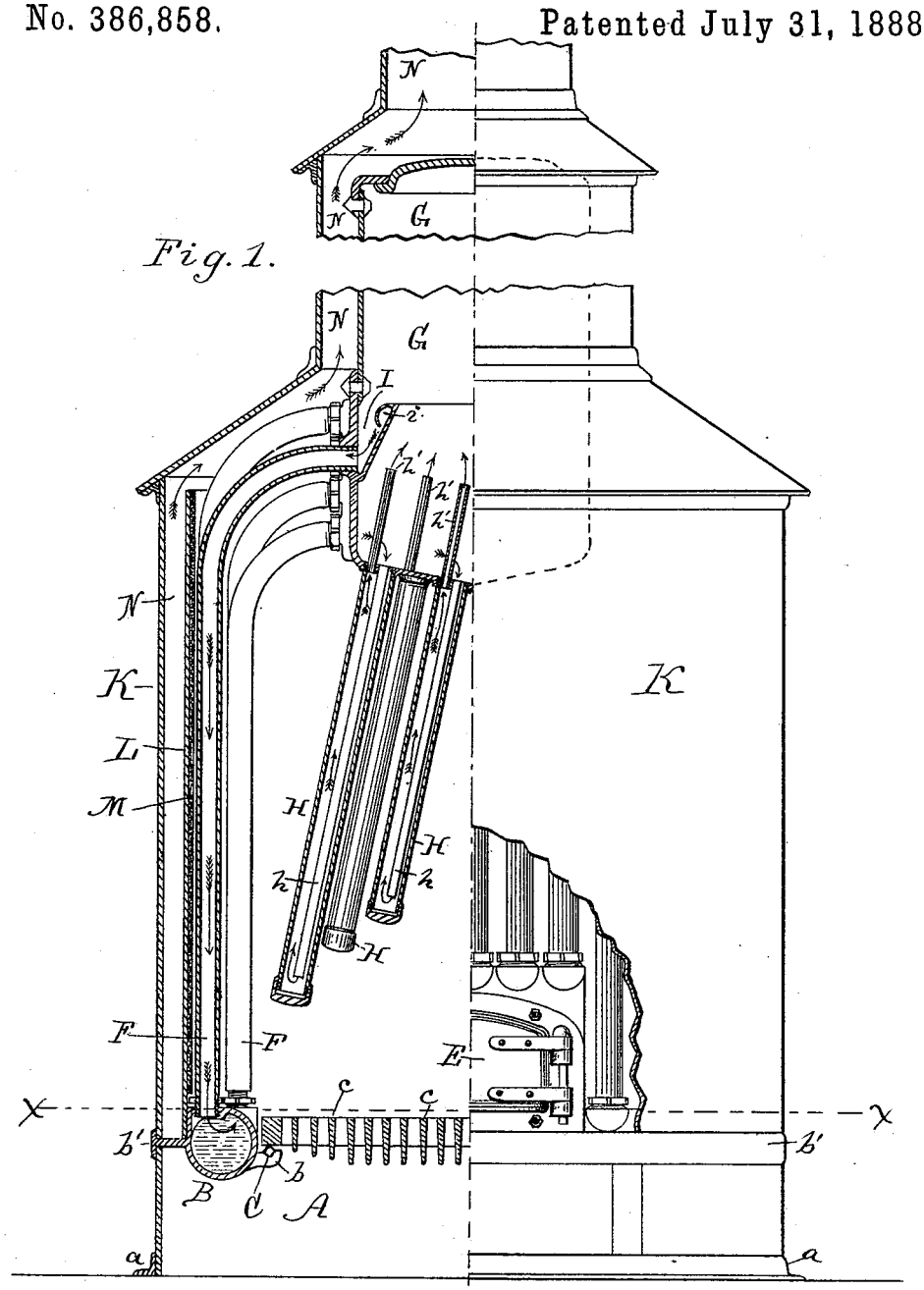
(No Model.) 2 Sheets—Sheet 1.

C. WARD.

WATER TUBE STEAM BOILER.

No. 386,858. Patented July 31, 1888.

Fig. 1.



Witnesses:
Thos. Houghton.
E. Guthrie.

Inventor:
Charles Ward,
By his Attorney Chas. F. Benjamin.

(No Model.) 2 Sheets—Sheet 2.

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Fig. 2.

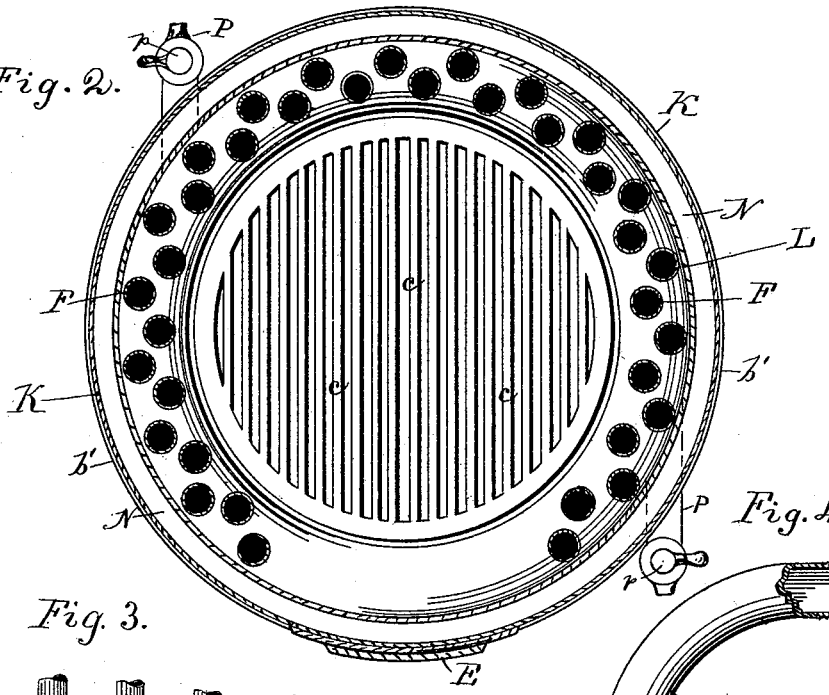


Fig. 3.

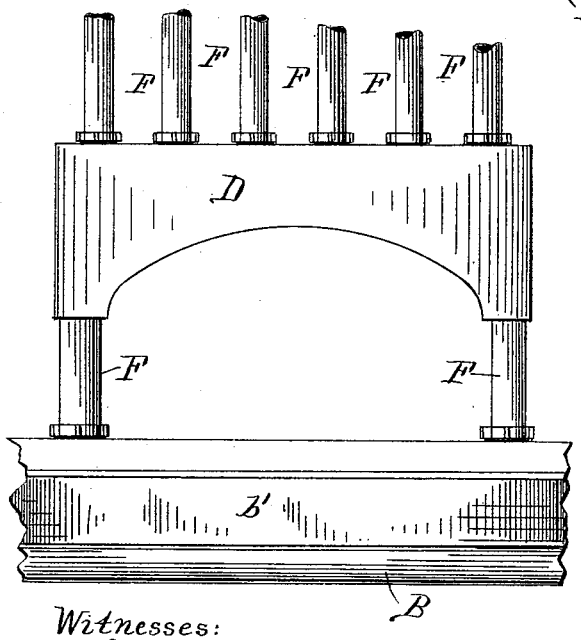
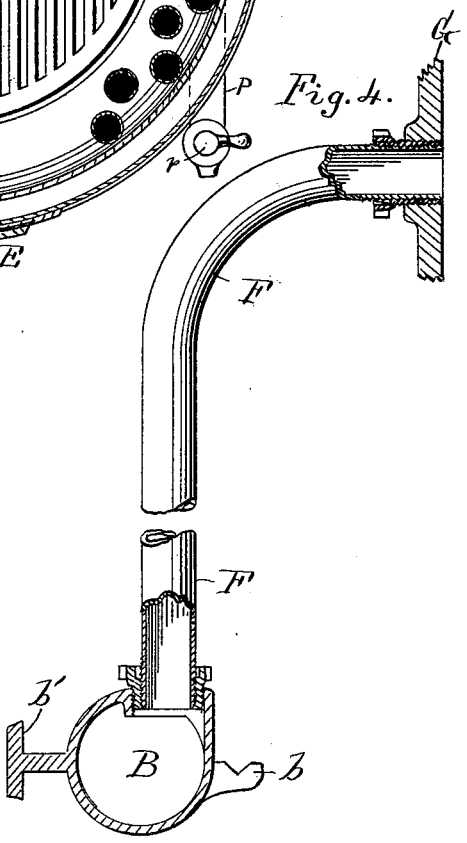


Fig. 4.



Witnesses:
Thos. Houghton,
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Inventor:
Charles Ward,
By his Attorney Chas. F. Benjamin.

UNITED STATES PATENT OFFICE.

CHARLES WARD, OF CHARLESTON, WEST VIRGINIA.

WATER-TUBE STEAM-BOILER.

SPECIFICATION forming part of Letters Patent No. 386,858, dated July 31, 1888.

Application filed December 17, 1887. Serial No. 258,186. (No model.)

To all whom it may concern:

Be it known that I, CHARLES WARD, a citizen of Great Britain, residing at Charleston, in the county of Kanawha and State of West Virginia, have invented certain new and useful Improvements in Water-Tube Steam-Boilers; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

This invention relates to steam-boilers of a vertical and cylindrical form, in which tubes of small diameter are used to contain the water and generate the steam; and its objects are to obtain a rapid and perfect circulation of the water and economical results in proportion to the fuel, space, and weight.

In the accompanying drawings, wherein like letters represent like parts, Figure 1 is an elevation, partly in section, of the boiler; Fig. 2, a plan on the line *x x* of Fig. 1; and Figs. 3 and 4, enlarged views of some of the details of the boiler.

A is a cylindrical ash-pit, stiffened at the base by an angle-iron, *a*.

B is a hollow ring having lugs or brackets *b b*, upon which rests a circular bar, C, intended to support the grate-bars *c c*. A T-shaped flange, *b'*, projects from the ring B and supports the latter upon the rim of the ash-pit. Above the grate-door opening a hollow arch, D, is formed, supported upon and connected with the hollow ring B, and brought above into communication with certain of the tubes by which the water-circulation is effected. To allow for expansion due to the radiant heat from the fuel on the grate-bars, it has been found advisable to form this arch D in sections.

The furnace is closed by an ordinary door, E.

Tubes F F connect at one end with the hollow ring B and at the other with a drum, G. The circumference of the drum being smaller than that of the base-ring, it is necessary to connect the tubes with the drum at two or more horizontal planes, and the tubes are bent upon any convenient systematic plan to enable this to be done. To economize space and material, the tubes connect with the hollow base-ring B in two or more rows in the manner shown, wherein the arrangement is for two rows only. A pocket, I, runs around the interior of the drum G, joining the vertical wall thereof just below the entrance of the outside row of the tubes F F. A conduit, *i*, delivers the feed water into this pocket by means of a slot formed in the bottom of the conduit. From the pocket the water-current descends the outer row of tubes F into the base-ring B, wherein it leaves its sediment, and thence ascends the inner row of tubes F into the lower space of the drum. The angular bottom of the drum connects with the hanging tubes H H, and the purified-water current descends the sub-tubes *h h*, which are open at both ends, and, being now highly vaporized, ascends the uptake of the tubes H H, and is carried above the water-level and discharged into the drum by the prolonged tubes *h' h'*.

The boiler has an outer casing, K, and an inner casing, L, the latter provided with an asbestus or other equivalent lining, M. The two casings are separated, so as to form a non-circulating air-space, which constitutes part of an uptake, N, for the escape of the gases of combustion; but one of the casings may be omitted at pleasure.

Blow-off tubes P P, with suitable valves, *p p*, connect with the base-ring B for the discharge of the sediment by the action of the superheated water in said ring.

The circulation of the water in this boiler is perfectly accomplished; no counter-currents can be produced in it; the masses of water flow unimpeded along the heating-surface, water and steam in the same direction; the lowest heating temperature is applied to the lowest water temperature; the comparatively small quantity of water in the tubes causes the circulation to be extremely rapid, and the construction and arrangement of the several parts are calculated to produce a maximum of water-heating surface.

Having thus sufficiently described the construction and operation of my boiler, what I claim, and desire to secure by Letters Patent, is the following:

1. In vertical tubular steam-boilers, the combination of a horizontal base tube or chamber, as B, with vertical tubes, as F, a steam drum or chest, as G, and hanging tubes, as H, said

hanging tubes having sub-tubes *h* and prolonged tubes *h'*, all substantially in the manner described, and for the purpose of facilitating the circulation of the water and the collection of steam.

2. In vertical tubular steam-boilers, a drum or chest, as G, when provided with a pocket, as I, in combination with a conduit, as *i*, substantially in the manner described, for the purpose of separating the purified and impure water in said drum or chest.

3. A vertical tubular concentric steam-boiler, consisting in the combination of an ash-pit, A, a base-tube or hollow ring, B, having blow-offs P, lugs *b b*, and a T-flange, *b'*, a seat-bar, C, having grate-bars *c c*, a hollow furnace arch or frame, D, a suitable furnace-door, E, tubes F, a drum, G, having a pocket, I, and conduit *i*, hanging tubes H, having sub-tubes *h* and prolonged tubes *h'*, a casing, K, and an escape-flue, N, in the manner and for the purposes described.

4. A vertical tubular concentric steam-boiler, consisting in the combination of an ash-pit, A, a base-tube or hollow ring, B, having blow-offs P, lugs *b b*, and a T-flange, *b'*, a seat-bar, C, having grate-bars *c c*, a hollow furnace arch or frame, D, a suitable furnace-door, E, tubes F, a drum, G, having a pocket, I, and conduit *i*, hanging tubes H, having sub-tubes *h* and prolonged tubes *h'*, an outer casing, K, an inner casing, L, and an escape-flue, N, in the manner and for the purposes described.

5. A vertical tubular concentric steam-boiler, consisting in the combination of an ash-pit, A, a base tube or hollow ring, B, having blow-offs P, lugs *b b*, and a T-flange, *b'*, a seat-bar, C, having grate-bars *c c*, a hollow furnace arch or frame, D, a suitable furnace-door, E, tubes F, a drum, G, having a pocket, I, and conduit *i*, hanging tubes H, having sub-tubes *h* and prolonged tubes *h'*, an outer casing, K, an inner casing, L, having a non-heat-conducting lining, M, and an escape flue, N, in the manner and for the purposes described.

In testimony whereof I affix my signature in presence of two witnesses.

CHARLES WARD.

Witnesses:
FRANK B. MARLOW,
E. GUTHRIE.