(No Model.) 3 Sheets—Sheet 1.

# J. BAIRD.

## FEED WATER HEATER.

No. 456,713. Patented July 28, 1891.

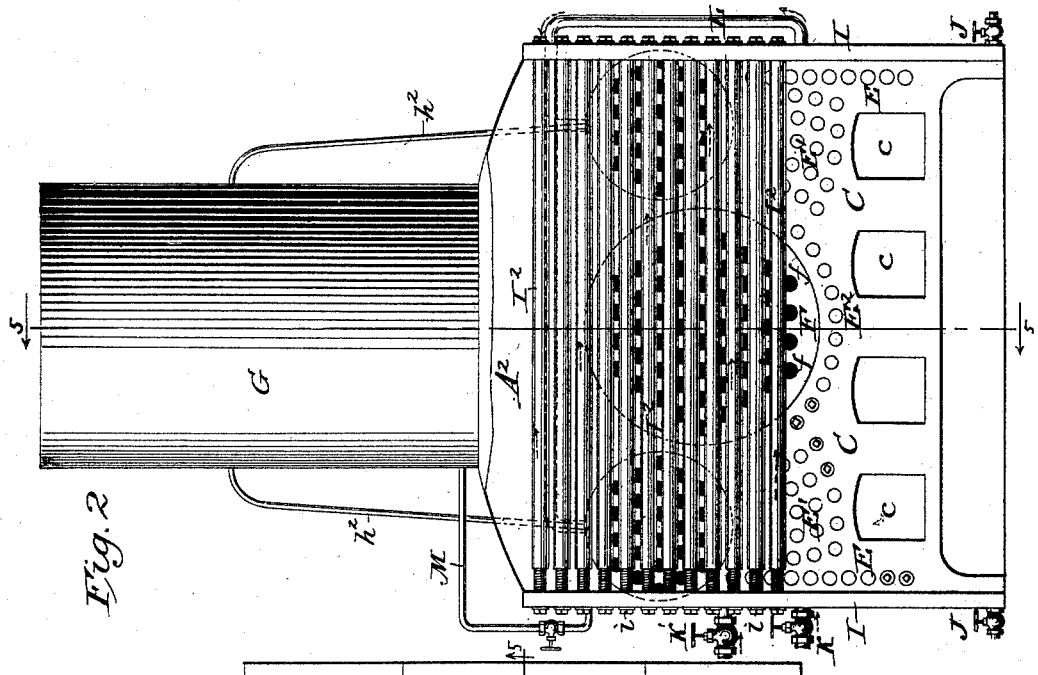

Fig. 2.

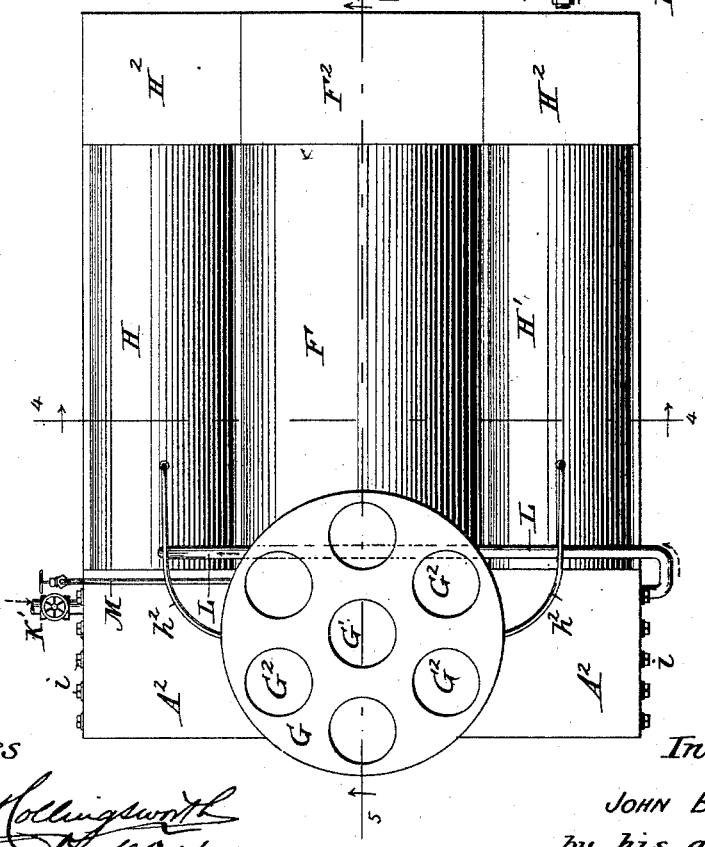

Fig. 1.

Witnesses

Sidney R. Hollingsworth

B. Washington Miller

Inventor

John Baird

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(No Model.) 3 Sheets—Sheet 2.

# J. BAIRD.

## FEED WATER HEATER.

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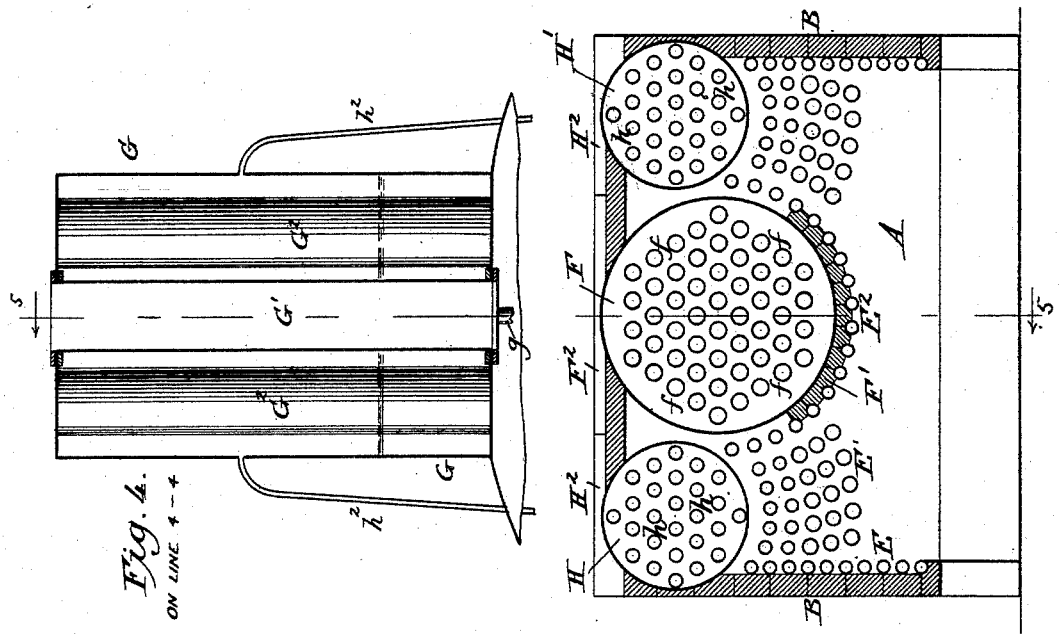


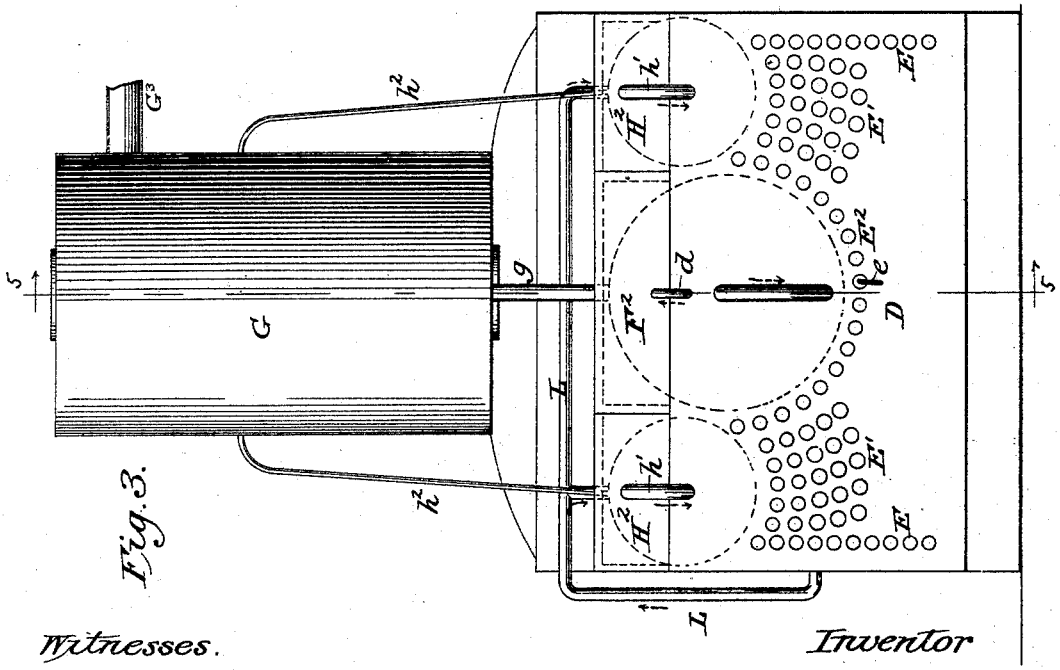


Witnesses.

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(No Model.) 3 Sheets—Sheet 3.

# J. BAIRD.

## FEED WATER HEATER.

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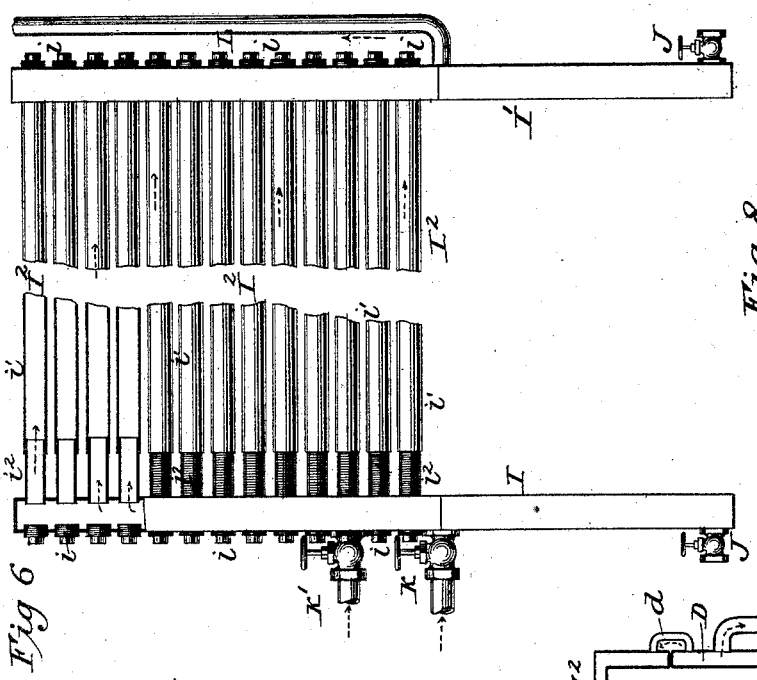

Fig 6

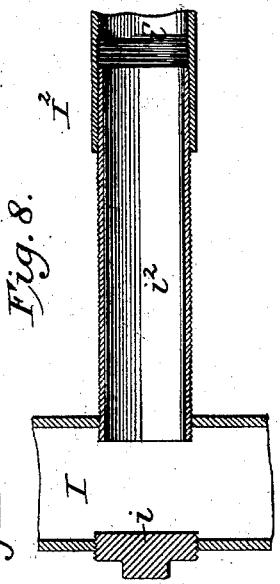

Fig. 8.



Fig. 7.

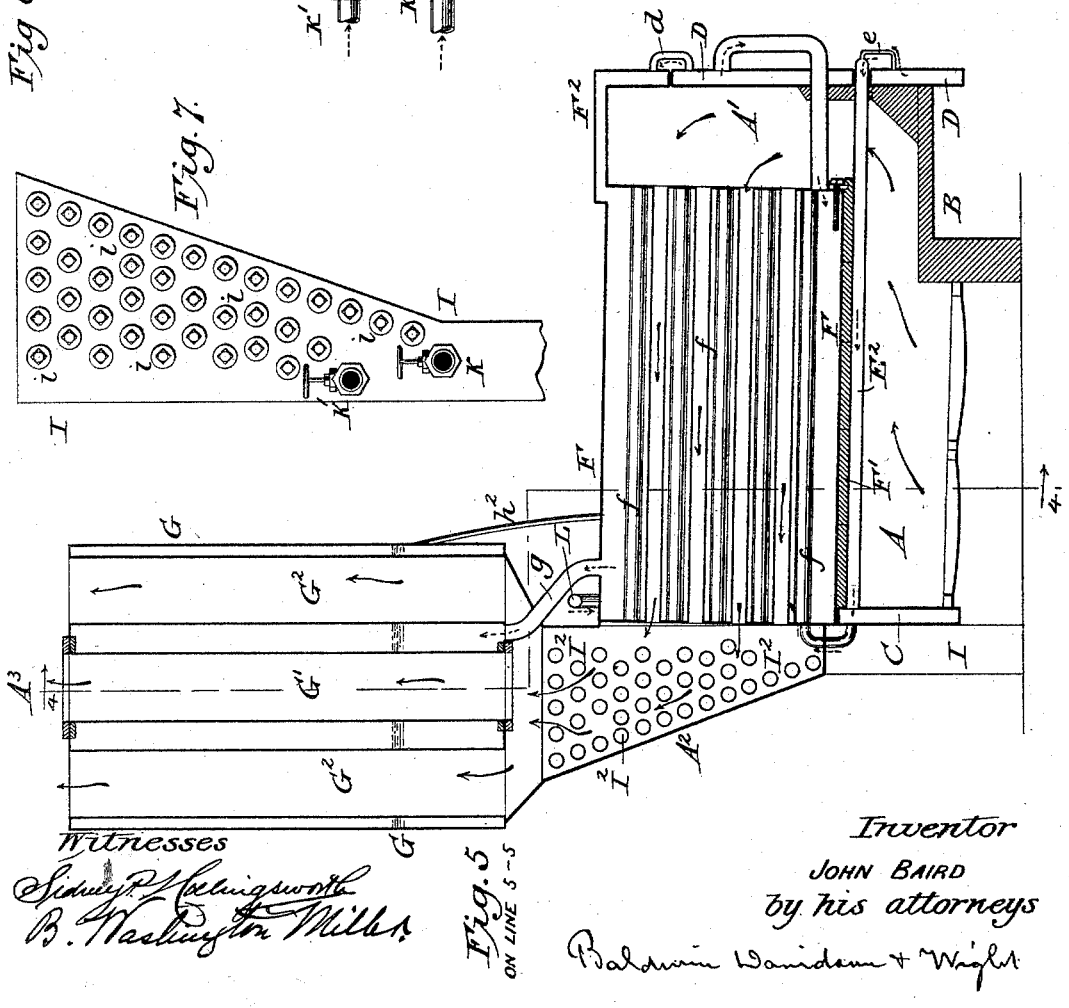

Fig. 5 ON LINE 5-5

Witnesses

Sidney P. Collingsworth

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# UNITED STATES PATENT OFFICE.

JOHN BAIRD, OF NEW YORK, N. Y.

## FEED-WATER HEATER.

SPECIFICATION forming part of Letters Patent No. 456,713, dated July 28, 1891.

Application filed March 25, 1891. Serial No. 386,335. (No model.)

*To all whom it may concern:*

Be it known that I, JOHN BAIRD, mechanical engineer, a citizen of the United States, residing at No. 324 Lexington avenue, in the city, county, and State of New York, have invented certain new and useful Improvements in Feed-Water Heaters for Steam-Boilers, of which the following is a specification.

My invention more especially relates to marine and stationary steam-boilers having both vertical and horizontal or slightly-inclined tubes.

Its objects are to secure a compact and efficient boiler of high steam-generating capacity adapted for highly heating the feed-water and for thoroughly drying and superheating the steam, which ends I attain by certain novel organizations of instrumentalities hereinafter specified.

The accompanying drawings represent so much of my improved steam-boiler as is necessary to illustrate the subject-matter herein claimed.

Figure 1 is a plan; Fig. 2, a front elevation with the outer casing removed; Fig. 3, a rear elevation; Fig. 4, a vertical transverse section on the line 4 4; Fig. 5, a vertical central longitudinal section on the line 5 5; and Figs. 6, 7, and 8, details of the feed-water-heating apparatus.

I term the fire-door end the "front" and the opposite the "rear" end. Short unfeathered darts indicate the direction of view of the sections, solid feathered arrows show the course of the hot gases, and dotted ones the water-circulation. Unless otherwise indicated, the parts are of usual construction.

Many details of construction herein shown are exemplified in United States Letters Patent granted to me as No. 411,882, October 1, 1889, and No. 437,745, of October 7, 1890.

The products of combustion pass from a fire-box A around and through the various water and fire tubes by way of the back connection A′, front hood or uptake $A^2$, and smoke-stack $A^3$.

B represents the inclosing brick-work; C, the front head; *c*, fire-doors therein; D, the back head. E E′ $E^2$ respectively represent three series of water-tubes, arranged alongside the side walls of the furnace, under and alongside the central shell, and in the space between it and the side walls. They are respectively connected with the front head and pass, water-tight, through sleeves in the back head, being supplied with water therefrom by pipes *e*. A central or lower shell F, resting on the front head, extends backward over the fire-box to the front end of the back connection, which lies between the shell and back head. The bottom of this shell is covered by fire-brick F′, interposed between the shell and its surrounding water-tubes E′. The shell is filled with fire-tubes *f* and is provided with a hood $F^2$, extending over the back connection, resting upon the back head, and connected therewith by a water-pipe *d*. Side shells H H′, of smaller size than the central one, are shown as arranged parallel with, on opposite sides thereof, and with their tops about the same level and resting upon and connected with the back and front heads in a similar manner to that above described, their back hoods $H^2$ being connected with the back head by pipes *h*′. They are likewise filled with fire-tubes *h*.

An upright shell G, arranged in the smoke-stack, is provided with large flues G′ $G^2$, the central one G′ of which is made removable in well-known ways, the openings thus left serving the purposes of a man-hole. These flues, it will be observed, are so large as to constitute the chimney of the boiler. The water-space of this vertical shell is connected with the lower shell by tubes *g*, while its steam-space is connected with the top of the side shells by pipes $h^2$, which permit the steam to pass from the small shells to the vertical shell without interfering with the water-circulation. The normal water-line of the boiler preferably stands at about one-fourth of the height of this vertical shell, the lower part of which thus forms a water-space, while the upper part constitutes a steam-space for drying and heating the steam, which ultimately passes off through a steam-pipe $G^3$.

Most sea-going steamers nowadays are provided with apparatus for evaporating sea-water, so as to keep the boilers supplied with fresh water; but the use of salt-water at times becomes obligatory. The deleterious effects of such water on boilers are well known. It is likewise well known that salt-water heated to about its boiling-point will

deposit its calcareous or saline constituents and become sufficiently pure for steam-generating purposes. With this end in view I have adopted the following organization: Vertical water boxes or legs I I′ are arranged on each side of the boiler front, preferably extending from the floor above the top of the horizontal shells and close to the bottom of the vertical shell. These boxes are connected by water-tubes $I^2$, arranged horizontally in the front hood opposite and above the fire-tubes of the lower shells in such manner that the hot gases escaping therefrom may circulate freely around the tubes on the way to the flues of the vertical shell. These tubes, moreover, are so disposed in horizontal rows that the spaces between them coincide with the longitudinal axes of the flues, so as to facilitate the cleaning of the latter in well-known ways. Screw-plugs *i* fit openings in the outer shell of the water-boxes in the longitudinal axes of the water-tubes, so as to facilitate their insertion, removal, or cleansing. Where the boilers are arranged in batteries, or from any other cause there is not sufficient room to remove the water-tubes endwise through the sides of the boxes, I construct these tubes in two sections $i'$ $i^2$, of different diameters, provide their contiguous ends with corresponding male and female screws, and screw them together. The tubes are also made to screw into the inner walls of the water-boxes, the short section being adapted to be screwed far enough therein to permit of the insertion of the longer section, the two then being screwed together. (See Fig. 8.) The water-boxes are provided with blow-off valves J near their bottom. Separate inlet-valves K K′ are preferably provided for fresh and salt water, so that either or both may be supplied at pleasure. The feed-water is shown as entering the left-hand box I, whence it flows through the tubes $i^2$ to the opposite box I′, being highly heated in its passage, and consequently depositing its calcareous, saline, or other sediment either in the pipes or boxes. The water then rises through the inlet-pipe L, which extends horizontally across the tops of the horizontal shells into the side shells. The dead-water space in the bottom of the water-boxes below the tubes facilitates the deposit of sediment. The feed-water entering the upper front portion of the side shells, as above mentioned, flows backward through their hoods and connecting-pipes *h′* to the back head, and thence through the pipes *e f* to the tubes E E′ $E^2$ and the front head C and the lower part of the shell F, and through the pipes *g* to the vertical shell G, thus securing an excellent circulation. A steam-pipe M, provided with a suitable stop-valve, connects the steam-space of the vertical shell with one of the water-legs, by which means steam may be blown into this shell to further heat the feed-water and increase its circulation instead of being wasted in the air.

I claim as of my own invention—

1. The combination, substantially as hereinbefore set forth, of a fire-box, a horizontal boiler-shell, its fire-tubes, the back connection, a front hood, a smoke-stack, a vertical boiler-shell therein, its vertical flues constituting the uptake or smoke-stack, and water-circulating pipes connecting the horizontal and vertical shells.

2. The combination, substantially as hereinbefore set forth, of a fire-box, parallel horizontal shells thereover, their fire-tubes, their back connection, their front hood, a vertical boiler-shell, flues therein constituting the uptake or smoke-stack, and steam and water pipes connecting all the shells.

3. The combination, substantially as hereinbefore set forth, of a vertical boiler-shell and a series of vertical flues therein constituting an uptake, one of said flues being detachably connected with the shell, so that when removed the opening left thereby may serve as a man-hole.

4. A feed-water-heating apparatus consisting, substantially as hereinbefore set forth, of vertical boxes or water-legs, horizontal water-tubes connecting them above the lower portion of the water-legs, an inlet-pipe connected with one of the legs, an outlet-pipe connected with the other leg below the horizontal tubes, and blow-off valves near the bottom of each leg.

5. The combination, substantially as hereinbefore set forth, of a fire-box, a boiler-shell thereover, its fire-tubes, a back connection, a front connection, feed-water boxes extending on each side from the bottom of the fire-box to a point above the top of the boiler, and water-pipes connecting them and extending across the front connection or hood in front of the fire-tubes.

6. The combination, substantially as hereinbefore set forth, of a horizontal boiler-shell, its fire-tubes, a vertical boiler-shell arranged thereover, its flues constituting an uptake or chimney, a front hood connecting the fire-tubes and flues, and feed-water heater-pipes interposed between the two boilers.

7. The combination, substantially as hereinbefore set forth, of parallel horizontal boiler-shells, their fire-tubes, a fire-box, a back connection, a front hood, a vertical boiler-shell over this hood, flues therein constituting an uptake or smoke-stack, and feed-water heater-tubes interposed between the horizontal and vertical shells.

8. The combination, substantially as hereinbefore set forth, of parallel horizontal boiler-shells, their fire-tubes, their back connection, a front hood, a vertical boiler-shell thereover, flues therein constituting an uptake, vertical side boxes or water-legs on each side of the front hood, and their connecting feed-water heater-pipes extending across the front hood.

9. The combination, substantially as hereinbefore set forth, of a horizontal boiler-shell, its fire-tubes, a front connection, a vertical

boiler-shell thereover, pipes connecting the boiler-shells, a feed-water heater interposed between the vertical and horizontal shells, and a pipe connecting the steam-space of the vertical shell with the feed-water heater to blow the waste-steam therethrough.

10. The combination, substantially as hereinbefore set forth, of a central horizontal boiler-shell, parallel shells on each side thereof, a fire-box common to all the shells, their fire-tubes, their back connection, their front hood, a vertical boiler-shell thereover, its flues constituting the uptake, the vertical water-boxes constituting the sides of the uptake, the feed-water heater-tubes connecting these boxes, and the water-circulating pipes connecting the feed-water heater and boiler-shells.

11. The combination, substantially as hereinbefore set forth, of the vertical feed-water boxes, the pipes of different diameters connecting them, and the couplings between the sections and between them and the water-boxes.

12. The combination, substantially as hereinbefore set forth, of the double-walled water-box, with a water-tube screwed into its inner wall, a larger tube screwed thereon at one end, and a screw-plug in the outer wall of the outer box in line with the tube-sections to permit of their removal, replacement, or cleansing.

In testimony whereof I have hereunto subscribed my name.

JOHN BAIRD.

Witnesses:
A. J. BAIRD,
ADDISON W. BAIRD.