

No. 670,975

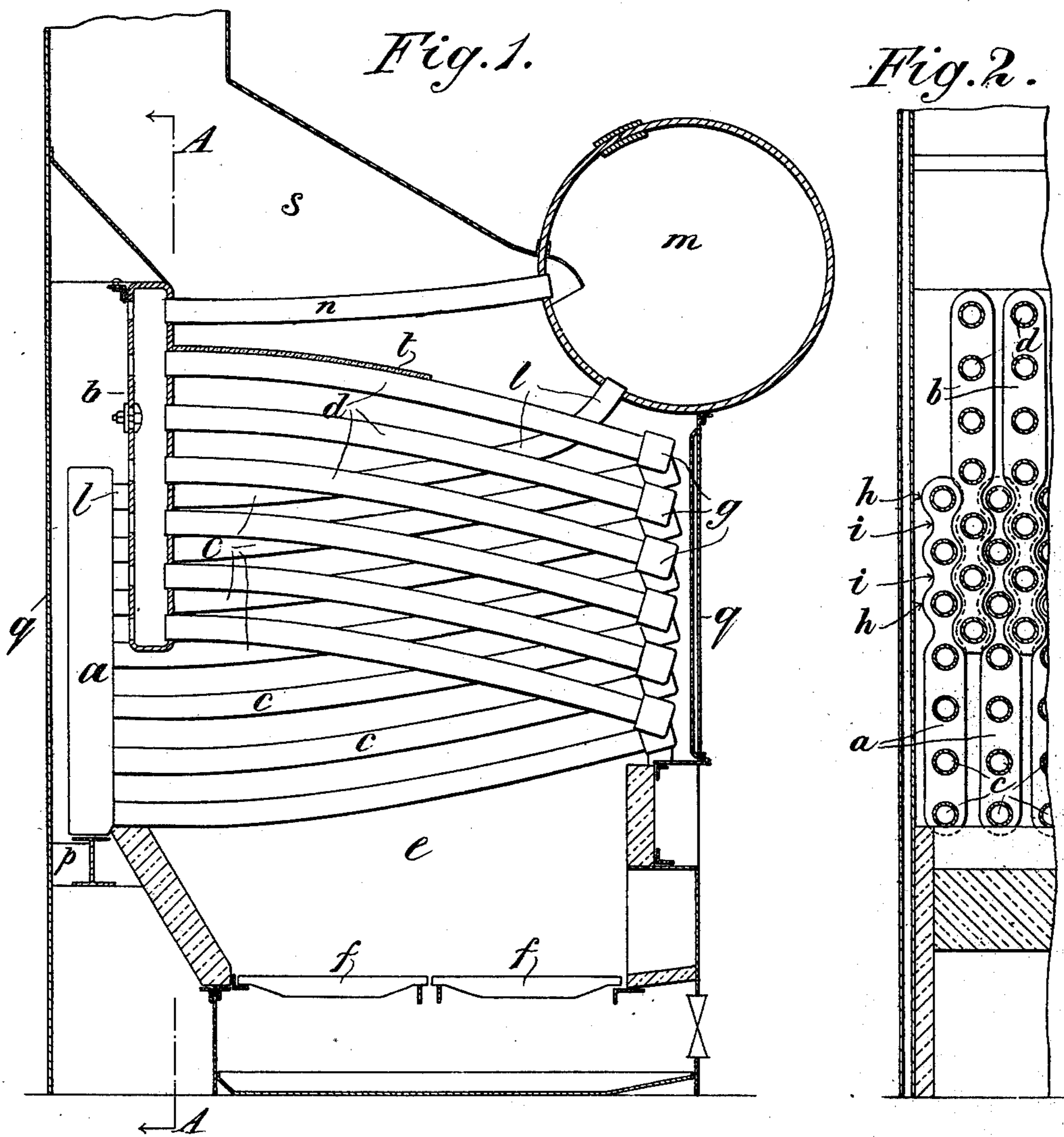
Patented Apr. 2, 1901.

J. E. THORNYCROFT.
WATER TUBE BOILER.

(Application filed May 23, 1900.)

(No Model.)

2 Sheets—Sheet 1.



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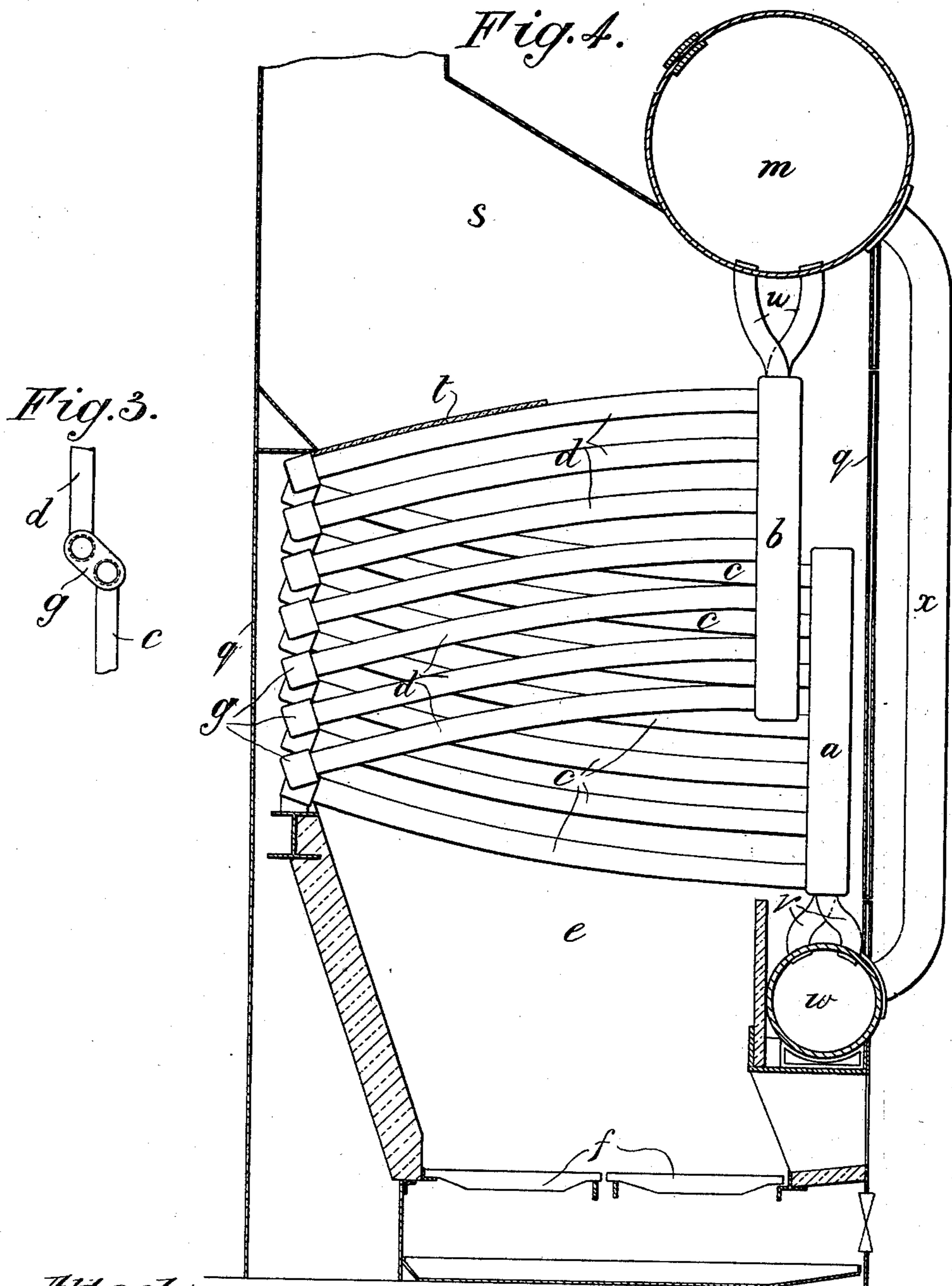
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UNITED STATES PATENT OFFICE.

JOHN EDWARD THORNYCROFT, OF CHISWICK, ENGLAND.

WATER-TUBE BOILER.

SPECIFICATION forming part of Letters Patent No. 670,975, dated April 2, 1901.

Application filed May 23, 1900. Serial No. 17,639. (No model.)

To all whom it may concern:

Be it known that I, JOHN EDWARD THORNYCROFT, a subject of the Queen of Great Britain and Ireland, residing at Chiswick, in the county of Middlesex, England, have invented Improvements in Water-Tube Boilers, of which the following is a specification.

In water-tube steam-boilers of the kind in which an upper steam and water vessel is connected to a series of tubular steam-generating elements each of which comprises two upwardly-extending tubular headers connected together by a number of pairs of inclined water-tubes that extend from front to back of the boiler over the fire-box and have their diverging ends connected to the pair of headers at different levels and their converging ends connected together by junction-boxes, so that water can flow simultaneously through all the pairs of tubes belonging to each header, it has heretofore been usual to place the headers side by side at the front or back of the boiler. With this construction and arrangement of the headers the water-tubes, which are arranged so as to be in parallel vertical rows or planes, cannot, on account of the thickness of the walls of the headers, be placed close together, with the result that between the vertical rows of water-tubes there are left comparatively wide vertical spaces through which hot gases can freely pass from the furnace to the chimney without being brought into intimate and effective contact with the water-tubes.

Now this invention has for its object to obviate this disadvantage by so constructing and arranging the headers and junction-boxes that the inclined water-tubes in the adjacent vertical rows of tubes can be arranged near together, as seen in plan, and so that the tubes composing the connected pairs of tubes of each steam-generating element can cross those of the next adjacent element or elements, so that practically no vertical spaces will be left between the vertical rows of water-tubes, and the hot gases will have to take a zigzag course between the said tubes while passing to the chimney, and thereby be brought into intimate and effective contact with the water-tubes, and thus be efficiently utilized.

For this purpose the invention consists in arranging the set of headers connected to the lower ends of the pairs of water-tubes in a different vertical plane to that in which the set of headers connected to the upper ends of the pairs of water-tubes are arranged and in making the opposite sides of the parts of the headers that overlap or extend past each other vertically in the two sets of corrugated or wavy shape and so arranging them that the convex portions of the headers in one set are opposite the concave portions of the headers in the other set, so that the water-tubes fixed to one set of headers can extend along the concave side portions of the other set of headers, and thus be brought so close to the tubes fixed in the latter headers that, as seen in plan, the adjacent tubes appear to nearly touch each other. To enable this arrangement of the water-tubes to be attained, the junction-box connecting the converging ends of each pair of such tubes is inclined to the two vertical planes containing the axes of such tubes.

The invention further consists in certain novel combinations and arrangements of parts, which will be hereinafter described, and fully pointed out in the claims.

In the accompanying drawings, which form a part of this specification, Figure 1 is a cross-section, and Fig. 2 a part-longitudinal section on the line A A of Fig. 1, showing one construction of water-tube boiler of the kind referred to embodying the present invention. Fig. 3 is a front view of one of the junction-boxes and the pair of water-tubes connected thereto. Fig. 4 is a similar view to Fig. 1, showing a modified arrangement.

In the construction shown in Figs. 1 to 3, inclusive, the two sets of headers *a* and *b*, to which the diverging ends of the pairs of water-tubes *c* and *d* are connected, are arranged at the back of the combustion-chamber *e*, above the fire-grate *f*, so that the pairs of water-tubes extend toward the front of the boiler. The water-tubes *c* and *d* are preferably curved in the direction of their length, as shown. The rear headers *a* are connected to the lower ends of the water-tubes *c* and the front headers *b* to the upper ends of the water-tubes *d*, the junction-boxes *g*, connecting

the converging ends of the pairs of tubes, being at the front of the boiler. The opposite sides of the upper portions of the headers *a* and those of the lower portions of the headers *b*, where they overlap or extend past one another, as shown in Fig. 2, are formed with the alternately-arranged convex and concave portions *h* and *i*, respectively, the convex portions *h* of each header *a* being arranged opposite the concave portions *i* of the headers *b*. By this arrangement the water-tubes *c*, connected to the upper portion of the headers *a*, can extend through or between the concave portions *i* of the headers *b*, with the result that the vertical rows of water-tubes *c* and *d* can be brought close together, as shown in Fig. 2, for the purpose hereinbefore mentioned. Fig. 3 represents one of the junction-boxes *g* and the pair of water-tubes *c* and *d* connected thereto and shows how the junction-box is inclined to allow of the adjacent rows of tubes being arranged near together.

In the example shown in Figs. 1 and 2, each of the headers *a* and *b* is closed at the bottom, the upper portions of the rear or outer headers *a* being connected by one or more rows of water-tubes *l*, (one row only is shown,) that extend across the upper part of the combustion-chamber *e* to the lower side of a transverse cylindrical steam-drum *m*, arranged at the front of the boiler and above the junction-boxes *g*, the said tubes *l* serving as downtake-tubes to conduct water from the steam-drum to the headers *a*. The upper ends of the front or inner headers *b* are also connected by steam-tubes *n* to the lower portion of the steam-drum *m*, at one side thereof, so as to conduct steam from the headers *b* and discharge it, mixed with more or less water, into the steam-drum at or near or above the water-level therein.

The headers *a* are carried by a suitable support *p* and the headers *b* by a suitable support *r*. The steam-generating elements are inclosed in a casing *q*, which, as usual, may be provided with doors at front and back for gaining access to the tubes.

s is the chimney or uptake above the water and connecting tubes *c d l n*, and *t* is a baffle above the highest row of tubes *d* to assist the distribution of hot gases among the water-tubes.

In the modified arrangement shown in Fig. 4 the two sets of headers *a* and *b*, constructed and relatively disposed as above described, are arranged at the front of the boiler below the steam-drum *m*, which is suitably connected, as by pipes *u*, to the upper ends of the headers *b*, the lower ends of the headers *a* being connected, as by other tubes *v*, to a lower water vessel *w*, that is common to them, and is connected to the lower part of the steam-drum *m* by one or more external downtake pipes *x*.

In each case the headers *a* and *b* and junction-

boxes *g* are, as usual, formed with inspection-holes, normally closed by stoppers.

What I claim is—

1. In a steam-boiler, the combination with an upper steam and water vessel, of a steam-generating element comprising two adjacent headers arranged one in front of the other and connected to said vessel, and a plurality of pairs of inclined water-tubes, the two tubes of each pair being connected together at one end and at their other ends to said headers.

2. In a steam-boiler, the combination of an upper steam and water vessel, upper and lower headers connected to said vessel and arranged near together in two parallel rows located one in front of the other, and a plurality of pairs of water-tubes, the two tubes of each pair being connected together at one end and having their other ends connected at different levels to separate upper and lower headers, substantially as described.

3. In a steam-boiler, the combination of an upper steam and water vessel, a number of pairs of upper and lower headers connected to said vessel and arranged in two sets placed one in front of the other, inclined water-tubes connected at one end to said headers and arranged in close vertical rows, and junction-boxes each uniting the adjacent ends of a pair of tubes connected to different headers.

4. In a steam-boiler, the combination of an upper steam and water vessel, a number of pairs of upper and lower headers connected to said vessel and arranged in two sets placed one in front of the other, the opposite sides of those portions of the headers that overlap or extend past each other vertically being formed with alternately-arranged ridges and recesses, and pairs of water-tubes connected at one end to separate headers, some of said water-tubes connected to one header extending through or along recesses in one side of the other header of the pair, substantially as described for the purpose specified.

5. In a steam-boiler, the combination of an upper steam and water vessel, a number of pairs of upper and lower headers connected to said vessel and arranged in two sets placed one in front of the other, pairs of inclined water-tubes the two tubes of each pair being arranged in parallel vertical planes and connected at one end to separate headers, some of the tubes in each alternate vertical row extending through recesses in the side of the header to which the tubes in the next adjacent vertical row of tubes are connected, and inclined junction-boxes joining the other ends of the pairs of water-tubes, substantially as described for the purpose specified.

6. In a steam-boiler, the combination of a number of pairs of upper and lower headers, the upper headers being arranged in a different plane to the lower headers, a plurality of pairs of oppositely-inclined water-tubes, the diverging ends of each pair being connected at different levels to one of said pairs of head-

ers, junction-boxes each connecting the converging ends of a pair of said tubes, and an upper steam and water vessel having its lower portion connected to the several headers, substantially as described.

7. In a steam-boiler, the combination of pairs of upper and lower headers arranged in different vertical planes, pairs of oppositely-inclined water-tubes connected at one end to and extending at different levels from the several pairs of said upper and lower headers, junction-boxes connected to the other ends of said pairs of tubes, and an upper steam and water vessel connected to said headers and located above said junction-boxes, substantially as described.

8. In a steam-boiler, the combination of a number of pairs of upper and lower headers arranged in two separate rows at one end of the boiler, the opposite sides of the lower portions of the upper headers and the opposite sides of the upper portions of the lower headers being corrugated, a plurality of pairs of oppositely-inclined water-tubes extending from front to back of the boiler and having their diverging ends connected at different levels to a pair of said upper and lower headers, junction-boxes connecting together the converging ends of said pairs of tubes, the two tubes of each pair of tubes having their axes in parallel vertical planes and arranged to cross and be in close proximity to the tubes of laterally-adjacent pairs of tubes and some of the tubes connected to the lower headers extending through the recesses in the sides of the upper headers, and an upper steam and water vessel connected to the several headers, substantially as described.

9. In a steam-boiler, the combination of a number of pairs of upper and lower headers closed at the bottom and arranged in two rows one in front of the other at the back of the boiler, the opposite sides of the lower portions of the upper headers and of the upper portions of the lower headers being corrugated, a plurality of pairs of oppositely-inclined water-tubes extending from back to

front of the boiler and having their diverging ends connected at different levels to separate pairs of said upper and lower headers and their converging ends connected together by junction-boxes, some of the tubes connected to the lower headers extending forward through the recesses in the sides of the upper header, and an upper steam and water vessel located at the front of the boiler and connected to the upper ends of the several headers, substantially as described.

10. A steam-boiler comprising a furnace-chamber, a number of pairs of upper and lower headers closed at the bottom and arranged in two rows at the rear of the boiler, the opposite sides of the lower portions of the upper headers and the opposite sides of the upper portions of the lower headers being corrugated and so arranged that the convex and concave side portions of the rear lower headers are opposite the concave and convex side portions respectively of the front upper headers, a plurality of pairs of oppositely-inclined water-tubes connected at their diverging ends to the front sides of separate pairs of headers and extending over the furnace-chamber toward the front of the boiler, some of the tubes connected to the lower headers extending forward through the recesses in the sides of the upper headers, inclined junction-boxes connecting the converging forward ends of the said pairs of tubes, an upper steam and water drum located at the front end of the boiler, tubes connecting the lower part of said vessel to the upper ends of said headers and located above said water-tubes, a casing inclosing said fire-box, headers, water-tubes and junction-boxes, and an uptake located above said water and connecting tubes, substantially as described.

Signed at 77 Cornhill, in the city of London, England, this 7th day of May, 1900.

JOHN EDWARD THORNYCROFT.

Witnesses:

EDMUND S. SNEWIN,
WM. O. BROWN.