

No. 714,084.

Patented Nov. 18, 1902.

W. A. WOODSON.

STEAM BOILER.

(Application filed Apr. 5, 1902.)

(No Model.)

3 Sheets—Sheet 1.

Fig. 1.
A

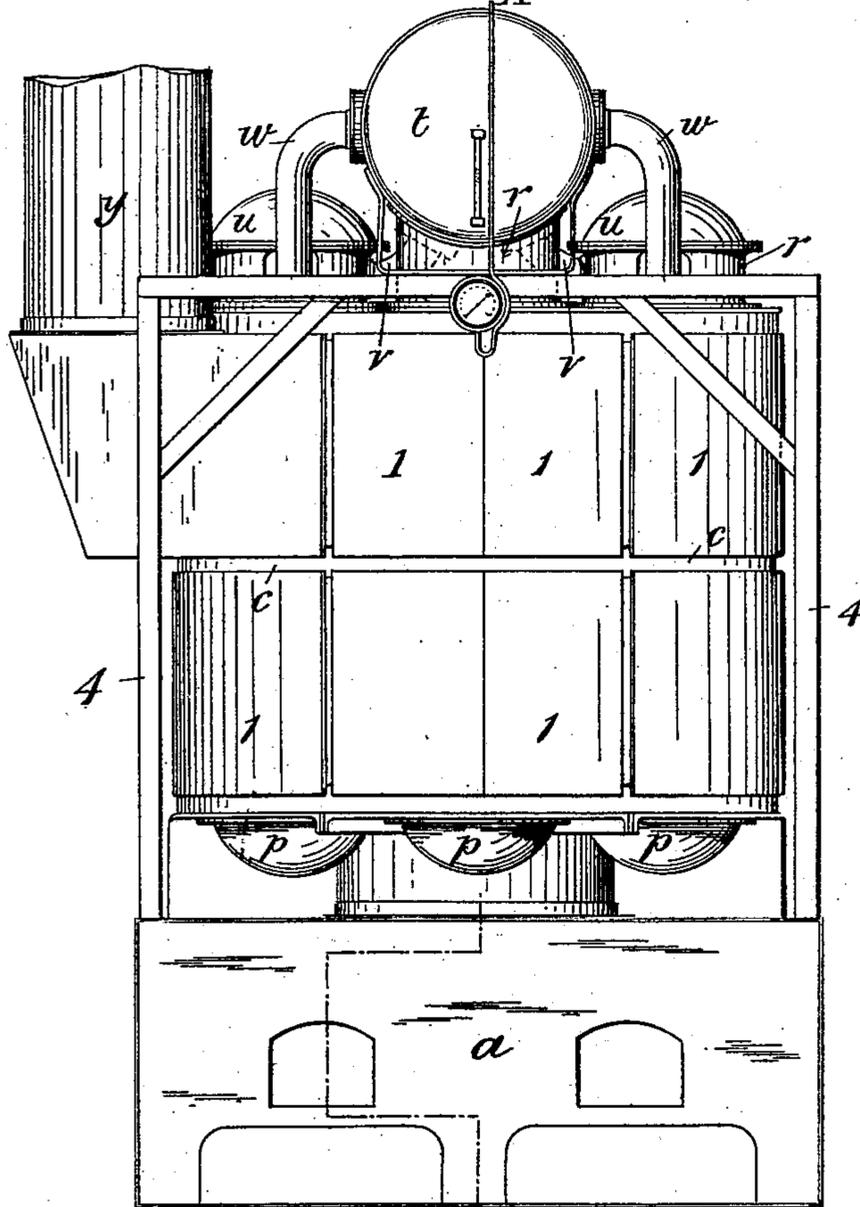
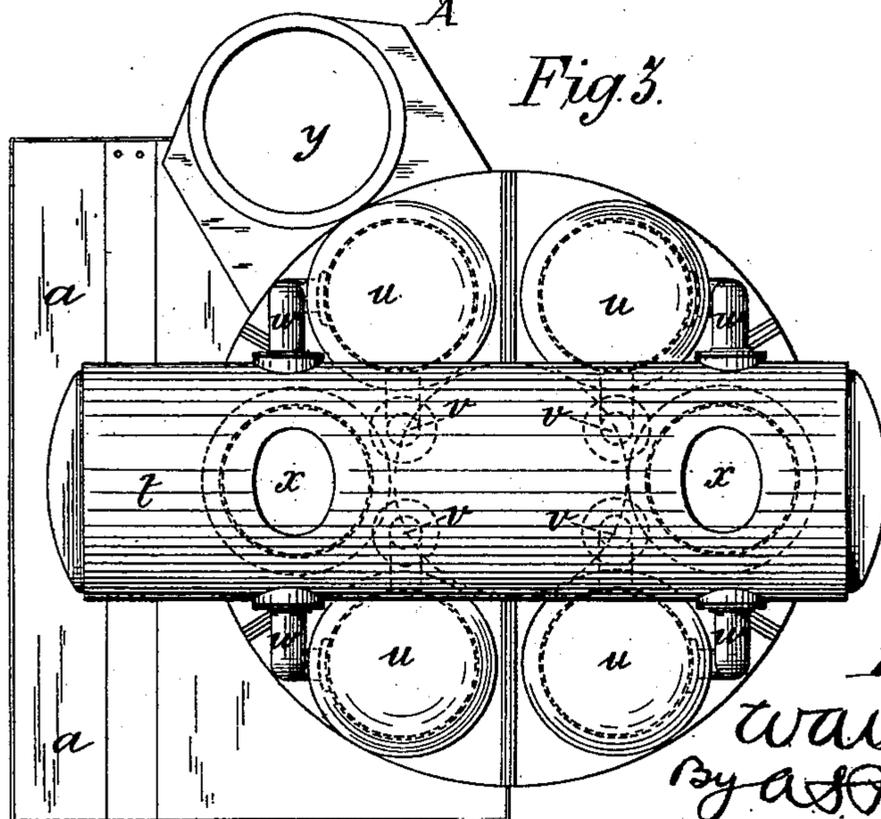


Fig. 3.



Witnesses

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Fig. 2.

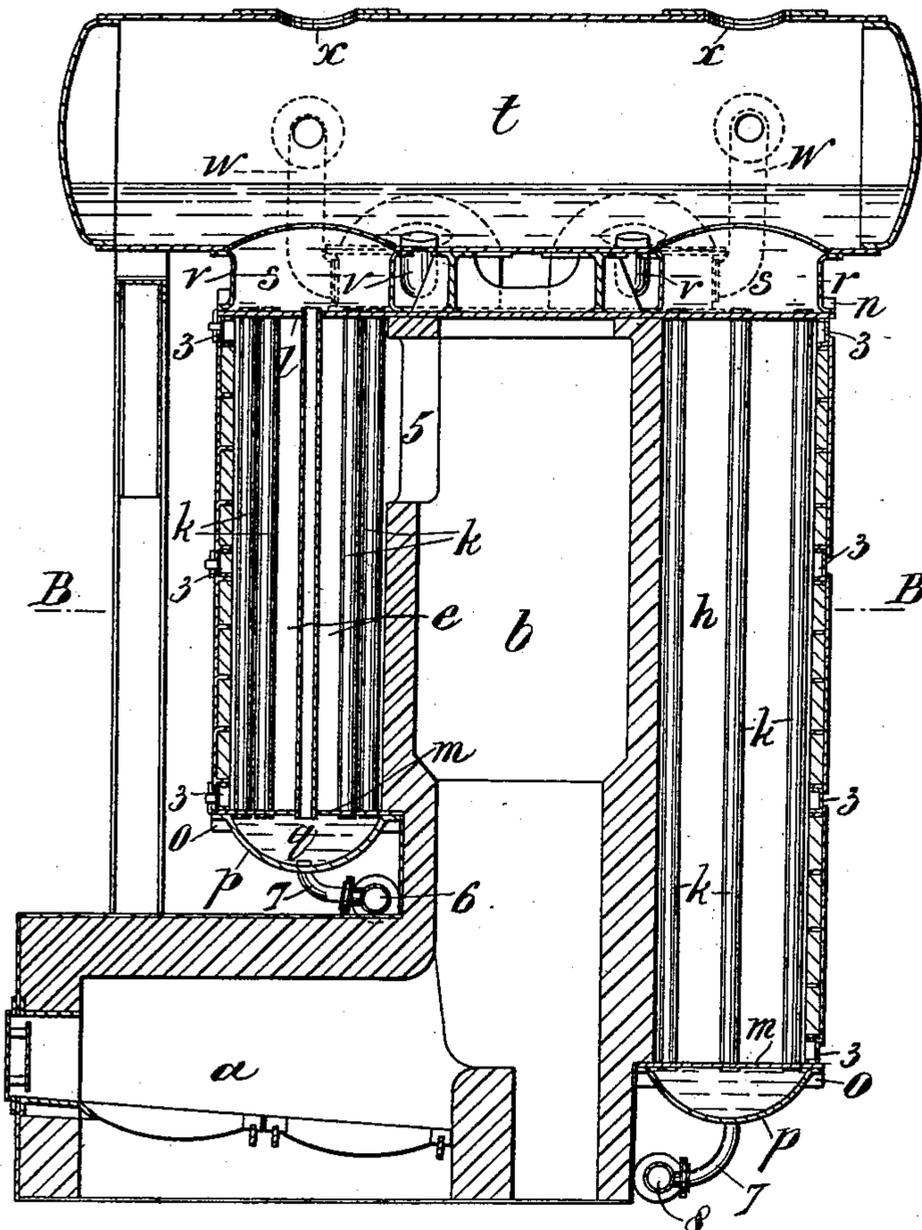
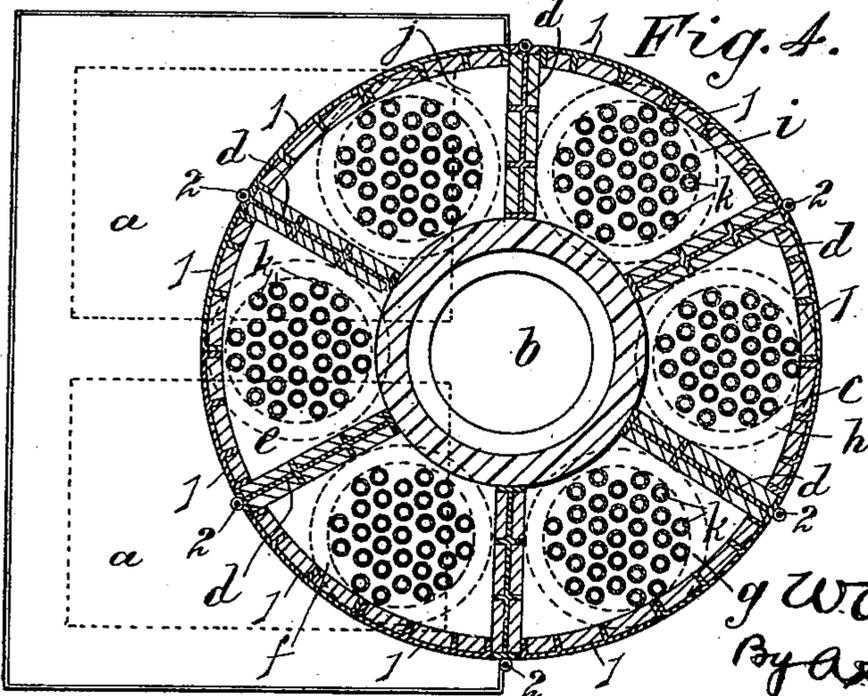


Fig. 4.



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3 Sheets—Sheet 3.

Fig. 5.

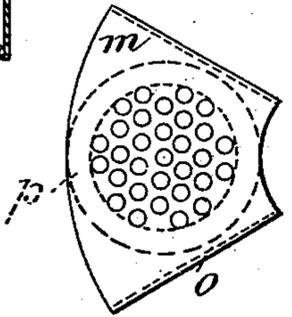
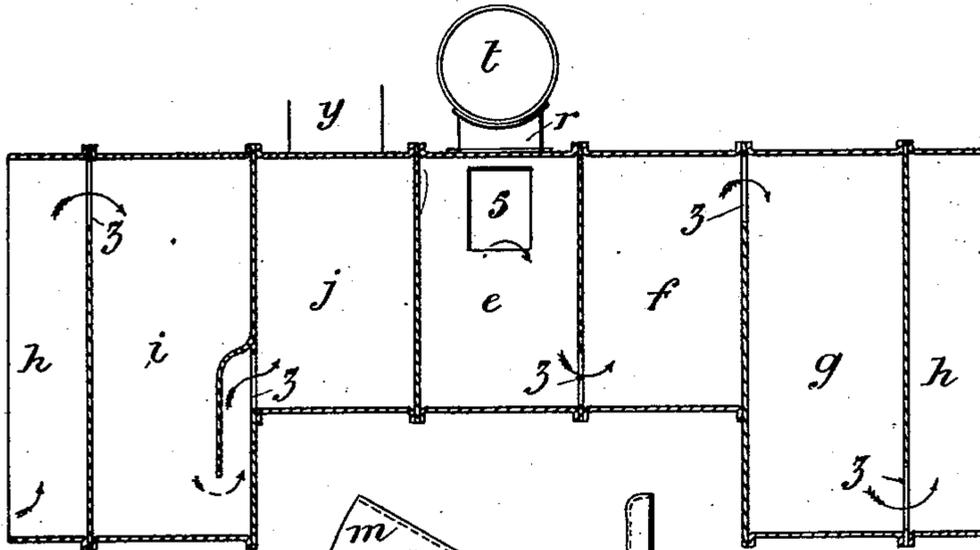


Fig. 6.



Fig. 7.

Witnesses

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UNITED STATES PATENT OFFICE.

WILLIAM ARMSTRONG WOODSON, OF GATESHEAD, ENGLAND, ASSIGNOR TO HIMSELF AND CLARKE, CHAPMAN AND COMPANY, LIMITED, OF GATESHEAD, DURHAM COUNTY, ENGLAND.

STEAM-BOILER.

SPECIFICATION forming part of Letters Patent No. 714,084, dated November 18, 1902.

Application filed April 5, 1902. Serial No. 101,485. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM ARMSTRONG WOODSON, a subject of the King of Great Britain and Ireland, residing at Gateshead-on-Tyne, in the county of Durham, England, have invented Improvements in Steam-Boilers, of which the following is a specification.

This invention has reference to water-tube steam-boilers, and according thereto the furnace is provided with an upwardly-extending combustion-chamber surrounded by an outer casing, the space between being divided by partitions into a number of compartments in each of which is a steam-generating element comprising water-tubes whose ends are fixed in tube-plates, a water-chamber below the lower tube-plate and a water-space above the upper tube-plate, the arrangement being such that the products of combustion are compelled to take a long course before leaving the heating-surface of the boiler, so that a large proportion of their heat will be transmitted to the water before they finally pass into the uptake or chimney.

Referring to the accompanying drawings, Figure 1 is a front elevation of one arrangement of boiler according to this invention. Fig. 2 is a vertical section on the line A A, Fig. 1. Fig. 3 is a plan, and Fig. 4 a horizontal section, on the line B B. Fig. 5 is a diagram illustrating a development of these series of element-containing compartments, and Figs. 6 and 7 are detail views at right angles to each other of one of the tube-plates of an element.

a is the furnace, which may be double or arranged in two separate parts and built of brickwork cased in iron, as shown, and *b* is a large cylindrical combustion-chamber, which communicates with the rear end of each part of the furnace *a* and may be built of or lined with refractory material.

c is the outer casing, which in this example concentrically surrounds the combustion-chamber, and *d* designates radial partitions, which divide the annular space between into a series of compartments *e, f, g, h, i,* and *j*.

k k are the water-tubes, those of each element being fixed at the ends in an upper tube-plate *l* and a lower tube-plate *m*.

The tube-plate *l* is formed with upwardly-extending flanges *n* and the tube-plate *m* with downwardly-extending flanges *o*, and to these flanges *n* and *o* are bolted the partitions *d*, which extend the whole height of the water-tubes, so as to form a separate compartment for each element. The partitions are covered with refractory material. The tops and bottoms of the compartments are formed by the respective tube-plates *l* and *m*, which are suitably shaped for the purpose.

To each tube-plate *m* an inverted-dome-shaped cover *p* is bolted, so as to form a lower water-space *q*, and on each tube-plate *l* is riveted or bolted a flanged annular wall *r*, which forms an upper water-space *s*. The water-spaces *s* of the elements that are contained in the compartment *e* and *h* are riveted to a horizontal steam or steam-and-water drum *t*, while the water-space *s* of each of the elements in the remaining four compartments is closed in by dome-shaped covers *u*, bolted to the annular wall *r*, and pipes *v* and *w* connect said spaces to the under side of the drum *t* to about the level of the center line thereof, the said pipes *v* and *w* forming, respectively, down-comers and up-comers. These pipes *v* and *w* may either be bolted or riveted to the walls *r* of the water-spaces, or the up-comers may be led from their water-spaces into or near the bottom of the steam-and-water drum and be fitted with vertical pipes to discharge the contents above water-line.

The compartments *e, f,* and *j*, which are at the front of the boiler, are shorter than the remaining compartments, so as to enable the furnace to be arranged as far as may be underneath the boiler.

In the top of the drum *t* and immediately above the water-tubes *k* in the elements whose water-spaces *s* directly communicate therewith manholes *x* are provided for enabling the water-tubes of these elements to be cleaned or removed and replaced. The tubes in the other elements are cleaned on the insides or removed and replaced after removing the bolted covers *p* and *u*.

Each partition *d*, with the exception of that between the compartments *e* and *j*, which

communicate, respectively, with the top of the combustion-chamber and the bottom of the uptake or chimney *y*, is formed with an opening *z*, the said openings being disposed alternately at top and bottom, so as to cause the gases after leaving the combustion-chamber to take a "zigzag" course up and down through the several compartments, around and through the water-tubes of the elements, escaping from the last compartment *j* to the uptake or chimney *y*. With such a construction of boiler it will be seen that the gases have an opportunity of being more completely consumed than is usual, and the products of combustion travel in contact with such a length of heating-surface that a large proportion of their heat is transmitted to the water.

The outer wall of each of the compartments *e f g h i j* may be in the form of or provided with doors 1 1, which may be of wrought or cast iron and are hinged to flanges 2 on the partitions *d*, as shown in Fig. 4, and secured at top and bottom to channel-bars 3, extending around the row of compartments. The doors 1 1 are covered on the inside with refractory material.

By means of the manholes *x*, covers *p* and *u*, and doors 1 1 the various parts of the boiler are rendered accessible for cleaning, repairing, &c.

A baffle or damper (not shown) may be arranged to control the orifice 5 in the wall of the combustion-chamber and leading into the first compartment *e*, so as to regulate the flow and supply of gases from the furnaces to the compartments, this baffle or damper being actuated from the outside.

The short front elements in the compartments *e, f, and j* are "sludged" at one operation through a common sludge-pipe 6, to which branches 7 connect the bottoms of the covers *u*, and the longer elements in the rear compartments *g, h, and i* through a pipe 8, that is common to them.

The baffles or partitions *d* (shown in the drawings) are castings lined with refractory material and bolted at top and bottom to the flanges of the tube-plates; but they may consist of walls built up of ordinary fire-bricks or quarles and resting on the bottom tube-plates. Where orifices are required at top, the necessary space is left, and where orifices are required at the bottom arches are built to form these orifices and the wall continued up to the top tube-plate. In such cases the tube-plates can be bolted direct to each other or distance-pieces can be fitted between the tube-plate flanges before they are bolted together.

Means are in some cases provided for admitting hot air to the compartments either at the top or the bottom, or both, so as to insure proper combustion.

The feed-water may be admitted to the steam-and-water drum or into the bottom water-space of one of the elements, as may be desired.

As will be understood, the arrangement may be modified to suit particular requirements, and in some cases special external down-comer pipes may be provided, the several elements then being connected to the steam-and-water drum or vessel only above its lowest part; also, in some cases the gases on leaving the last compartment can be led into a brick or other flue contained within and running lengthwise of the upwardly-extending combustion-chamber and thence to a main flue underground.

What I claim is—

1. In a water-tube steam-boiler, the combination of a furnace, a combustion-chamber communicating therewith, a series of upright compartments surrounding said combustion-chamber and connected alternately top and bottom, a communication between one of said compartments and the combustion-chamber, another of said compartments having a smoke-outlet, a bundle of water-tubes within each of said compartments, water-chambers communicating through said tubes, upper and lower tube-plates respectively forming the tops and bottoms of the said compartments and the bottoms and tops of said water-chambers, as set forth.

2. In a water-tube steam-boiler, the combination of a furnace, an upwardly-extending combustion-chamber communicating therewith, a series of upright compartments surrounding said combustion-chamber and connected alternately top and bottom, a communication between one of said compartments and the combustion-chamber, another of said compartments having a smoke-outlet, a bundle of water-tubes within each of said compartments, water-chambers communicating through said tubes, upper and lower tube-plates respectively forming the tops and bottoms of the said compartments and the bottoms and tops of said water-chambers, as set forth.

3. In a water-tube steam-boiler, the combination of a furnace, an upwardly-extending combustion-chamber communicating therewith, a casing surrounding said combustion-chamber, partitions extending across the space between said combustion-chamber and casing and dividing said space into a series of upright compartments connected alternately top and bottom, a communication between one of said compartments and the combustion-chamber, another of said compartments having a smoke-outlet, a bundle of water-tubes within each of said compartments, water-chambers communicating through said tubes, upper and lower tube-plates respectively forming the tops and bottoms of the said compartments and the bottoms and tops of said water-chambers, as set forth.

4. In a water-tube steam-boiler, the combination of a furnace, a combustion-chamber communicating therewith, a series of upright compartments surrounding said combustion-chamber and connected alternately top and

bottom, a communication between one of said compartments and the combustion-chamber, another of said compartments having a smoke-outlet, a bundle of water-tubes within each of said compartments, water-chambers communicating through said tubes, upper and lower tube-plates respectively forming the tops and bottoms of the said compartments and the bottoms and tops of said water-chambers, and a steam-and-water drum communicating with the upper water-chambers, as set forth.

5. In a water-tube steam-boiler, the combination of a furnace, an upwardly-extending combustion-chamber communicating therewith, a casing surrounding said combustion-chamber, partitions extending across the space between said combustion-chamber and casing and dividing said space into a series of upright compartments connected alternately top and bottom, a communication between one of said compartments and the combustion-chamber, another of said compartments having a smoke-outlet, a bundle of water-tubes within each of said compartments, water-chambers communicating through said tubes, upper and lower tube-plates respectively forming the tops and bottoms of the said compartments and the bottoms and tops of said water-chambers, and formed with flanges adapted to have the edges of the partitions bolted between them, as set forth.

6. In a water-tube steam-boiler, the combination of a furnace and a combustion-chamber of refractory material, a communication between them, steam-generating elements and compartments within which said elements are located surrounding said combustion-chamber, as set forth.

7. In a water-tube steam-boiler, the combination of a furnace, an upwardly-extending cylindrical combustion-chamber communicating therewith, an outer casing concentrically surrounding same, radial partitions extending across the annular space between said combustion-chamber and casing and dividing said space into a series of upright compartments, connected alternately top and bottom, a communication between one of said compartments and the combustion-chamber, another of said compartments having a smoke-outlet, a bundle of water-tubes within each of said compartments, water-chambers communicating through said tubes, upper and lower tube-plates respectively forming the tops and bottoms of the said compartments and the bottoms and tops of said water-chambers, as set forth.

8. In a water-tube steam-boiler, the combination of a furnace, an upwardly-extending cylindrical combustion-chamber communicating therewith, an outer casing concentrically surrounding same, radial partitions extending across the annular space between said combustion-chamber and casing and dividing said space into a series of upright compartments, connected alternately top and bot-

tom, a communication between one of said compartments and the combustion-chamber, another of said compartments having a smoke-outlet, a bundle of water-tubes within each of said compartments, water-chambers communicating through said tubes, upper and lower tube-plates respectively forming the tops and bottoms of the said compartments and the bottoms and tops of said water-chambers, and a steam-and-water drum communicating with the upper water-chambers as set forth.

9. In a water-tube steam-boiler, the combination of a furnace, an upwardly-extending cylindrical combustion-chamber communicating therewith, an outer casing concentrically surrounding same, radial partitions extending across the annular space between said combustion-chamber and casing and dividing said space into a series of upright compartments, connected alternately top and bottom, a communication between one of said compartments and the combustion-chamber, another of said compartments having a smoke-outlet, a bundle of water-tubes within each of said compartments, water-chambers communicating through said tubes, upper and lower tube-plates respectively forming the tops and bottoms of the said compartments and the bottoms and tops of said water-chambers, and a steam-and-water drum communicating with some of the water-chambers direct and with others through pipes, as set forth.

10. In a water-tube steam-boiler, the combination of a furnace, an upwardly-extending cylindrical combustion-chamber communicating therewith, an outer casing concentrically surrounding same, radial partitions extending across the annular space between said combustion-chamber and casing and dividing said space into a series of upright compartments, connected alternately top and bottom, a communication between one of said compartments and the combustion-chamber, another of said compartments having a smoke-outlet, a bundle of water-tubes within each of said compartments, water-chambers communicating through said tubes, upper and lower tube-plates respectively forming the tops and bottoms of the said compartments and the bottoms and tops of said water-chambers, and a steam-and-water drum communicating with some of the water-chambers direct and with others through pipes, arranged to communicate with the drum at different levels, as set forth.

11. In a water-tube steam-boiler, the combination of a furnace, an upwardly-extending cylindrical combustion-chamber communicating therewith, an outer casing concentrically surrounding same, radial partitions extending across the annular space between said combustion-chamber and casing and dividing said space into a series of upright compartments connected alternately top and bottom, a communication between one of

said compartments and the combustion-chamber, another of said compartments having a smoke-outlet, a bundle of water-tubes within each of said compartments, water-chambers communicating through said tubes, upper and lower tube-plates respectively forming the tops and bottoms of the said compartments and the bottoms and tops of said water-chambers, and a steam-and-water drum communicating with some of the water-chambers direct and with others through pipes, arranged to communicate with the drum at different levels, those water-chambers which are connected to the drums by pipes being provided with removable dome-shaped covers and manholes with covers being formed in the drum opposite directly-connected chambers, as set forth.

12. In a water-tube steam-boiler, the combination of a furnace, an upwardly-extending cylindrical combustion-chamber communicating therewith, an outer casing concentrically surrounding same, radial partitions extending across the annular space between said combustion-chamber and casing and dividing said space into a series of upright compartments, connected alternately top and bottom, a communication between one of said compartments and the combustion-chamber, another of said compartments having a smoke-outlet, a bundle of water-tubes within each of said compartments, water-chambers communicating through said tubes, upper and lower tube-plates respectively forming the tops and bottoms of the said compartments and the bottoms and tops of said water-chambers, and a steam-and-water drum communicating with the upper water-chambers, the whole of the gases passing through all the compartments in succession, substantially as described.

13. In a water-tube steam-boiler, the combination of a furnace, an upwardly-extending combustion-chamber communicating therewith, a casing surrounding said combustion-chamber, partitions extending across the space between said combustion-chamber and casing and dividing said space into a series

of upright compartments connected alternately top and bottom, a communication between one of said compartments and the combustion-chamber, another of said compartments having a smoke-outlet, a bundle of water-tubes within each of said compartments, water-chambers communicating through said tubes, upper and lower tube-plates respectively forming the tops and bottoms of the said compartments and the bottoms and tops of said water-chambers, the upper tube-plates having upwardly-extending flanges and the lower tube-plates having downwardly-extending flanges adapted to have the edges of the partitions bolted between them, as set forth.

14. In a water-tube steam-boiler, the combination of a furnace, a combustion-chamber communicating therewith, a series of upright compartments surrounding said combustion-chamber and connected alternately top and bottom, a communication between one of said compartments and the combustion-chamber, another of said compartments having a smoke-outlet, and a steam-generating element in each of said compartments, as set forth.

15. In a water-tube steam-boiler, the combination of a double furnace, a combustion-chamber communicating therewith, a series of upright compartments surrounding said combustion-chamber and connected alternately top and bottom, a communication between one of said compartments and the combustion-chamber, another of said compartments having a smoke-outlet, and a steam-generating element in each of said compartments, as set forth.

16. In a water-tube steam-boiler, the combination of a furnace and a combustion-chamber, a communication between them, steam-generating elements, and compartments within which said elements are located surrounding said combustion-chamber, as set forth.

Signed at Gateshead, in the county of Durham, England, this 19th day of March, 1902.

WILLIAM ARMSTRONG WOODSON.

Witnesses:

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THOS. HENDERSON.