

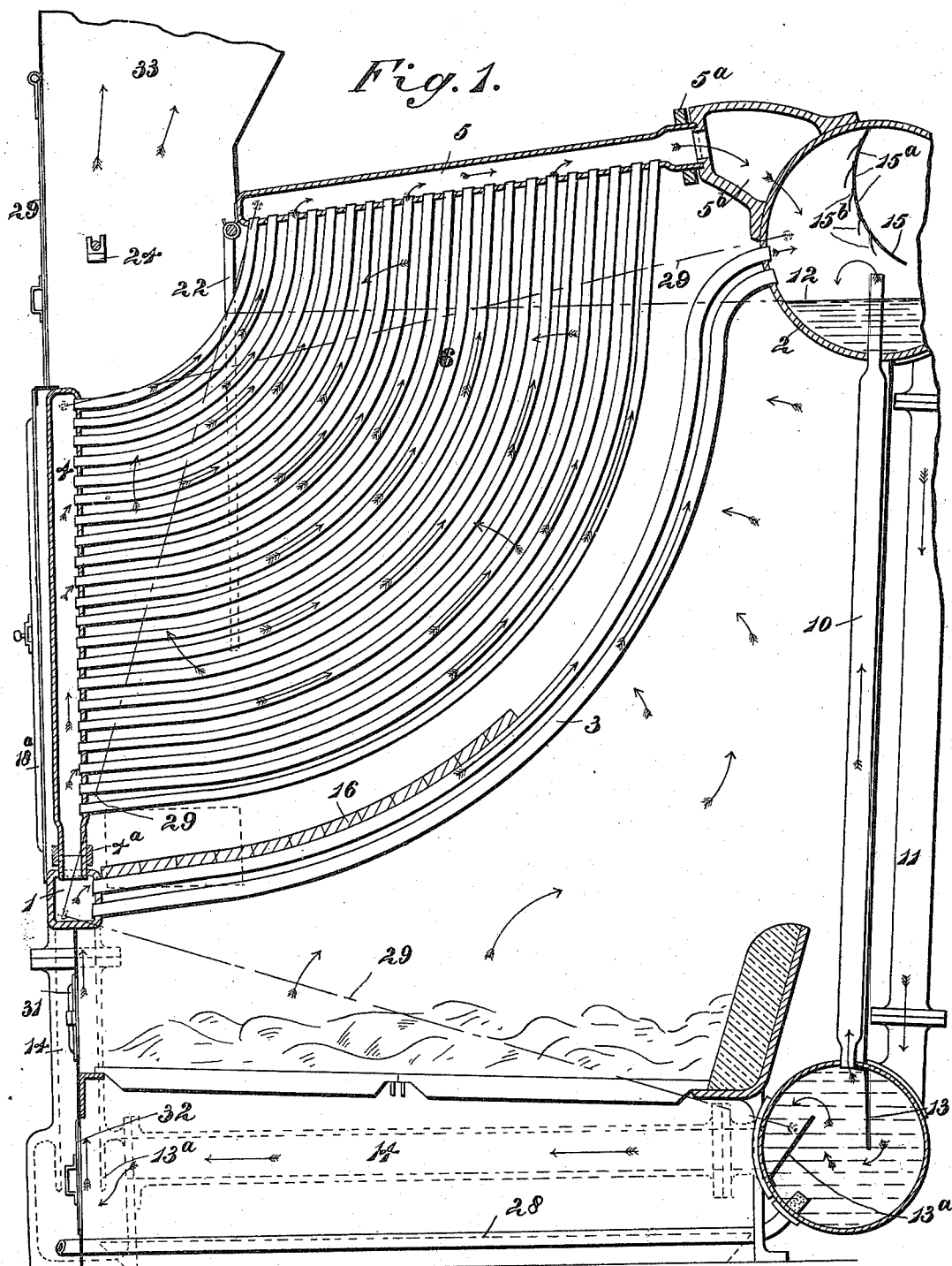
(No Model.)

6 Sheets—Sheet 1.

J. SAMPSON.
STEAM GENERATOR.

No. 579,497.

Patented Mar. 23, 1897.



Witnesses.

Geo. C. Truch

James W. Ceraux

Inventor.

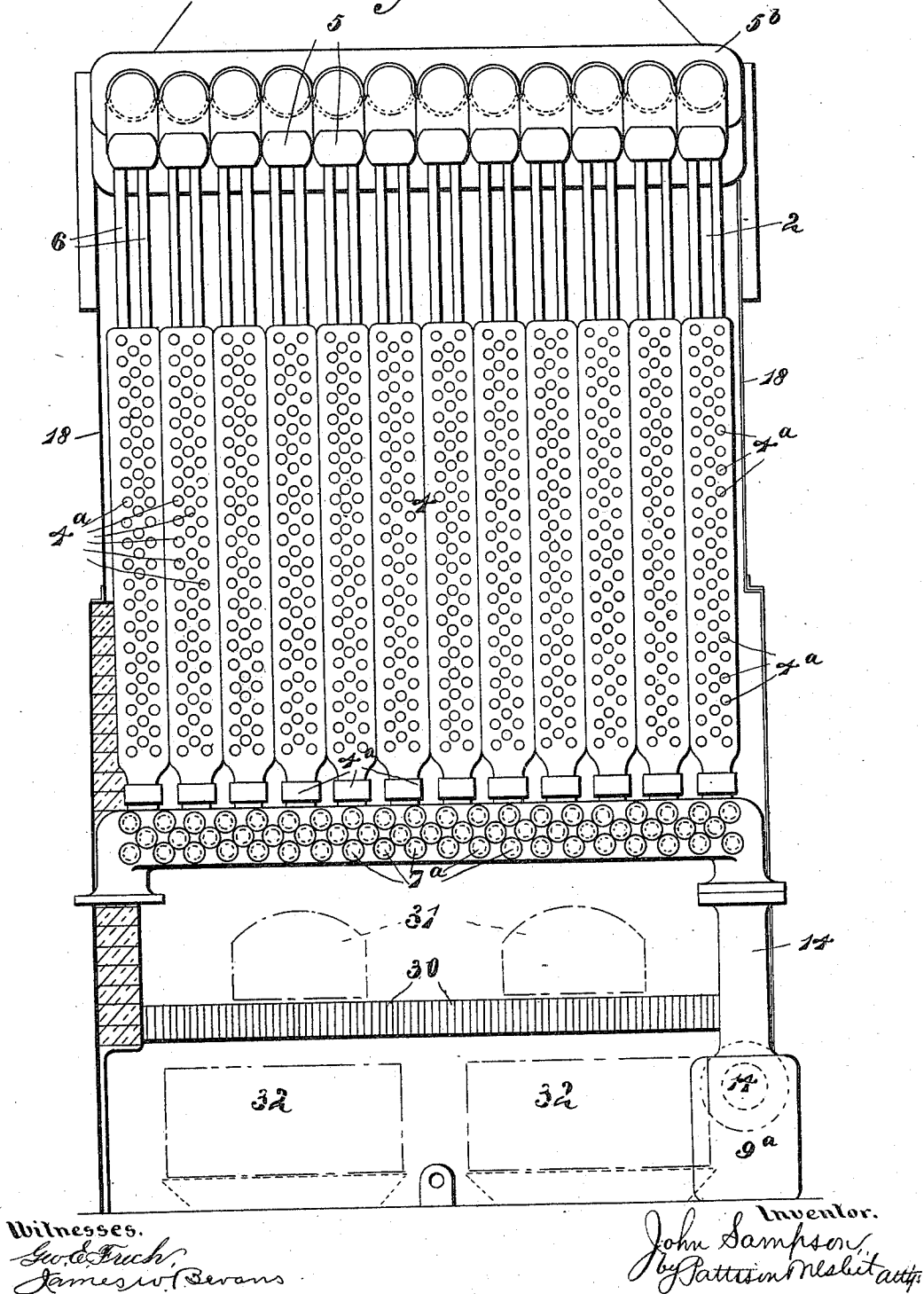
John Sampson
by *Pattison Nesbit*, atty

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Fig. 2.



(No Model.)

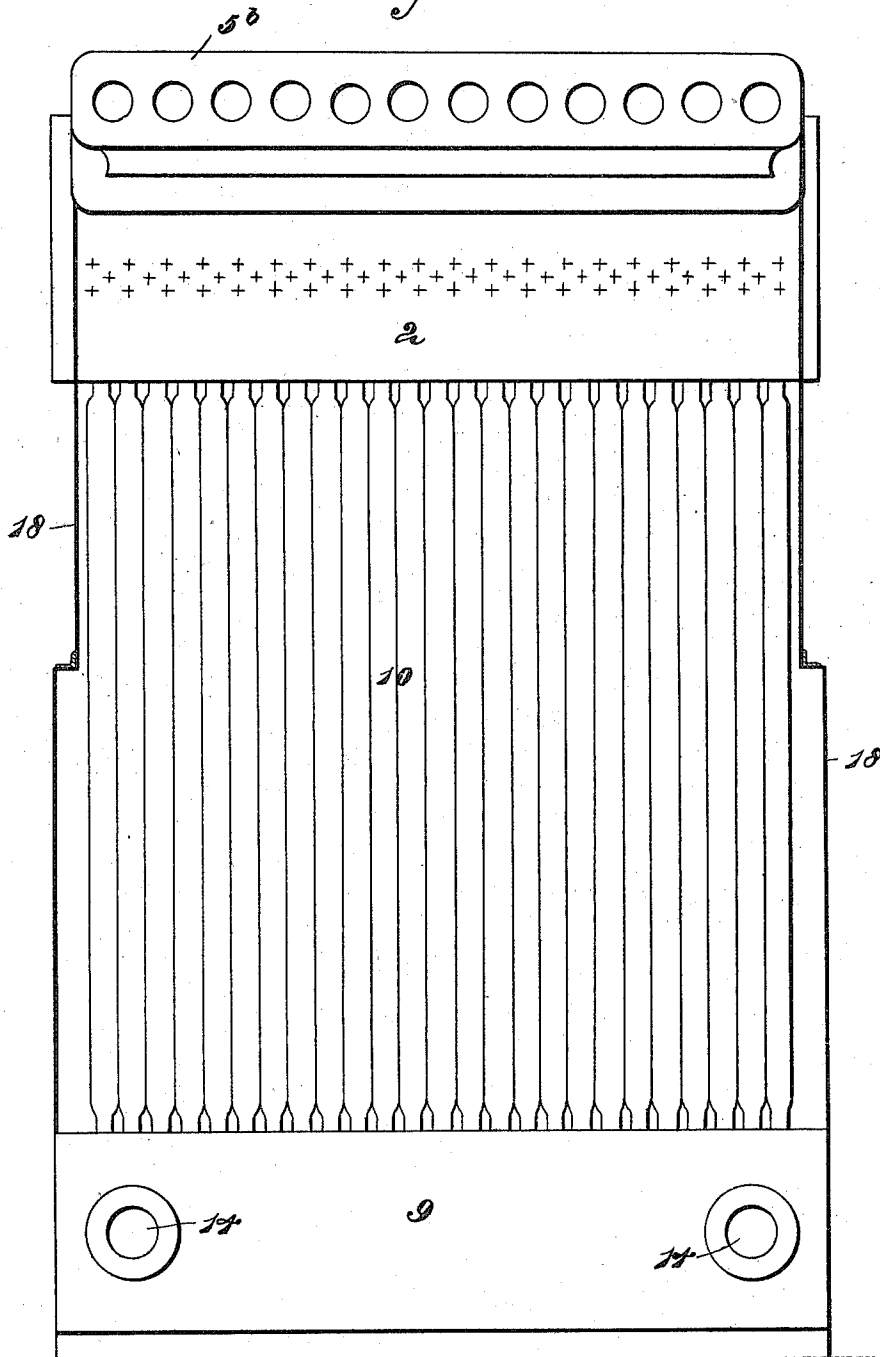
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Fig. 3.



Witnesses

Geo. C. Duck
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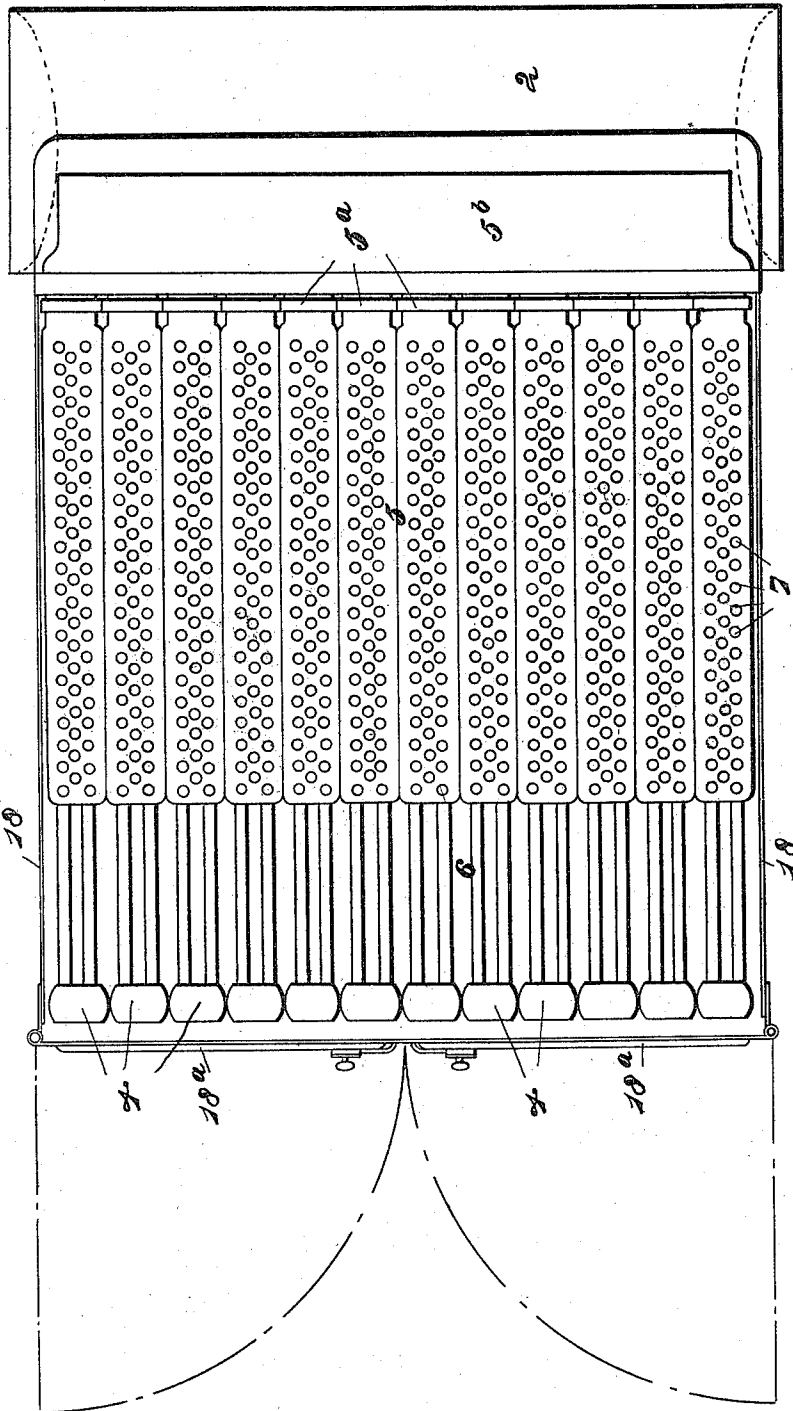
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Fig. 4.



Witnesses
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(No Model.)

6 Sheets—Sheet 5.

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Fig. 5.

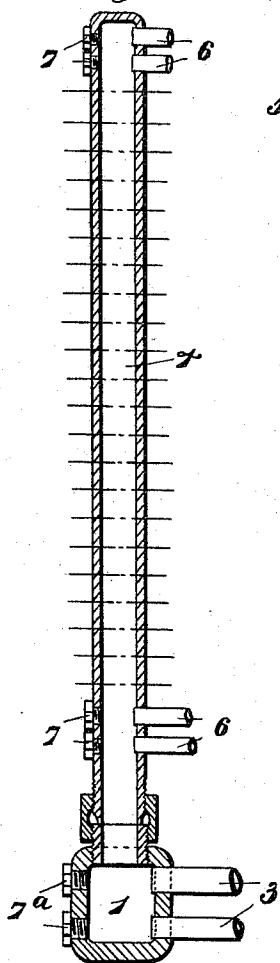


Fig. 5.^a

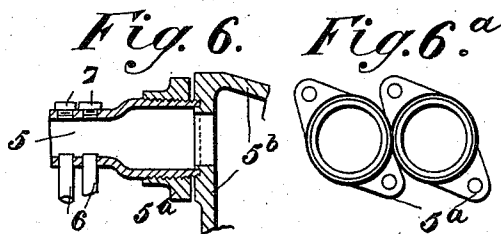
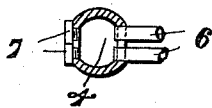
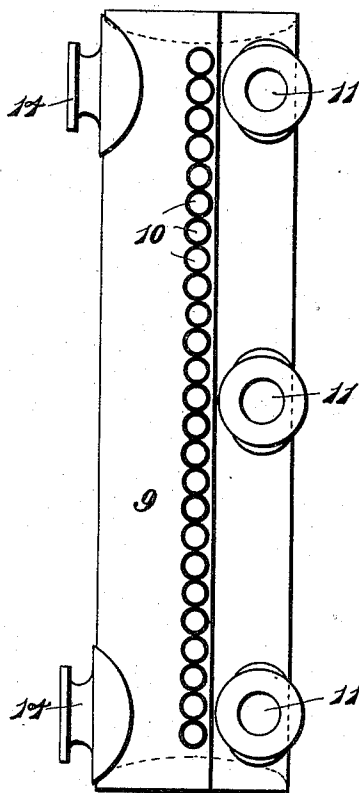


Fig. 7.



Witnesses.

Geo. E. Frick
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Fig. 8.

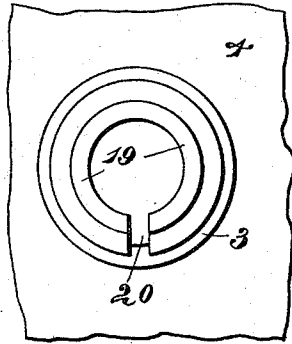


Fig. 9.

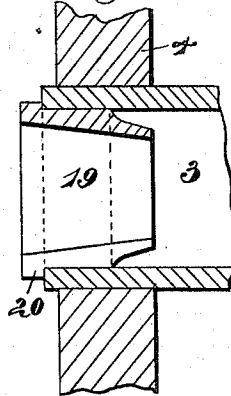


Fig. 10.

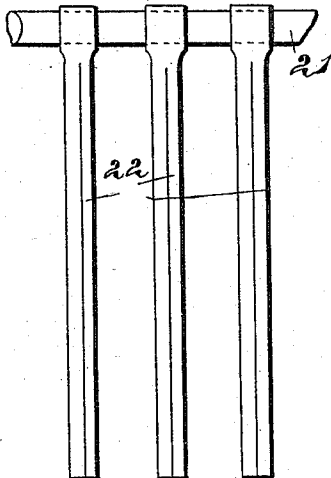


Fig. 12.

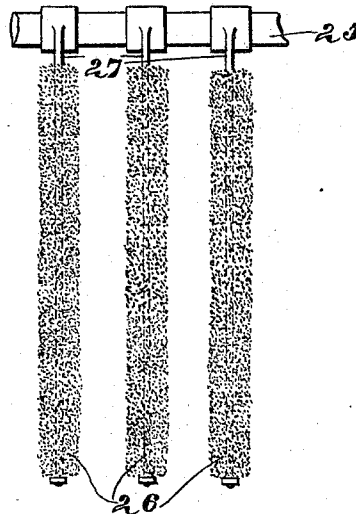
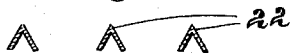


Fig. 11.



Witnesses.

Geo. C. Truch,
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UNITED STATES PATENT OFFICE.

JOHN SAMPSON, OF LONDON, ENGLAND.

STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 579,497, dated March 23, 1897.

Application filed July 1, 1896. Serial No. 597,773. (No model.)

To all whom it may concern:

Be it known that I, JOHN SAMPSON, a subject of the Queen of Great Britain and Ireland, residing at Brixton, London, in the county of London, England, have invented Improvements in Steam-Generators, of which the following is a specification.

Among the characteristics recognized as desirable in a water-tube steam-generator are
10 (a) that it should be compact, light, cheap to manufacture, easily accessible for cleaning and repairs, and should comprise separate interchangeable sections or elements adapted to be individually capable of easy removal
15 and replacement or substitution without disturbing other parts of the boiler; (b) that, regard being had to the high steam-pressures commonly adopted, the boiler should be composed as far as possible of tubes of relatively
20 small diameters, with the view of more fully insuring lightness, strength, and immunity from disastrous explosions, and that the ends of the tubes, where they are attached to other parts of the boiler, should be rolled or expanded therein, union or flange joints being
25 liable to give trouble, especially when exposed to the extreme heat of fires under forced draft; (c) that the construction should be such as to permit of any defective tube being readily removed and a new one fitted without injury to or removal of any other tube; (d)
30 that the furnace or fire-box should be such as to insure a satisfactory combustion of the fire-gases with ordinary coal and stokers; (e) that the arrangements for promoting combustion of fuel and circulation of water should be such as not only to give satisfactory results at slow speeds under natural draft, but
35 also to enable the boiler to be worked without danger under forced draft, as an express-boiler, and that in this connection the tubes exposed to the greater heat should be insured a plentiful supply of water; (f) that the construction should be such as to obviate rigidity, as also undue strains, such as are liable to arise owing to the extreme and rapid changes of temperature and pressure to which water-tube boilers are subjected; (g) that in order to obviate as far as possible the considerable
45 reduction in evaporative efficiency which is liable to occur from carbonaceous or other non-conductive deposits on the outer surfaces

of the tubes of boilers of the type referred to after they have been under steam for a relatively short period (especially when burning
55 bituminous coal) there should be provision for properly cleaning the tube-surfaces with facility and despatch while the boiler is under working pressure and the fires are burning; (h) that, with the view of keeping the
60 internal surfaces of the tubes as free as possible from deposit, means should be provided for effecting purification of the water in the boiler in an automatic and continuous manner, and (i) that the water carried over with
65 the steam from the heating-tubes should be discharged into the steam drum or header above the water-line therein.

Now my invention has reference to an improved construction of sectional water-tube
70 steam-generator designed to fulfil the requirements above indicated and which I shall now describe in detail with the aid of the accompanying drawings, wherein—

Figure 1 is a vertical longitudinal section
75 of a steam-generator constructed according to this invention. Fig. 2 is a front elevation thereof, partly in section and with the front casing removed. Fig. 3 is a front view of the steam-drum and sediment-chamber with their
80 connecting-tubes removed from the remainder of the boiler. Fig. 4 is a plan of the boiler with the uptake removed. The remaining figures are detail views drawn to larger scales, Figs. 5 and 5^a being, respectively,
85 a vertical section and a cross-section of one of the vertical headers and some of the attached parts. Figs. 6 and 6^a are respectively a longitudinal section and a front elevation showing the joint between one of the horizontal
90 headers and a junction-piece on the steam-drum, and Fig. 7 is a plan of the sediment-chamber with the vertical tubes secured thereto in section. Figs. 8 and 9 are respectively an elevation and a longitudinal section
95 illustrating a ferrule applied to a tube end. Figs. 10 and 11 are respectively a part elevation and a horizontal section of a baffling arrangement for diverting the fire-gases, and Fig. 12 is a part elevation of a brush for
100 sweeping the heating-tubes.

The steam-generator comprises a feed-collector 1 and a steam and water vessel 2, herein called the "steam-drum," which are

connected by a number of curved tubes 3, herein called "furnace-crown tubes" that are insured a plentiful supply of water, and by a number of interchangeable sections or elements, each of which comprises a vertical or inclined header 4, adapted to be secured by a cone, flange, spigot, or other suitable joint or connection to the feed-collector 1; a horizontal or inclined header 5, adapted to be connected in like manner by any suitable joint or connection to the steam-drum 2, and any convenient number of curved tubes 6, which connect the two headers, the ends of the curved tubes 6 being attached to the headers 4 and 5 in some suitable way, as, for example, by being expanded therein. The headers can be of cylindrical, oval, rectangular, or other suitable cross-section. In the example shown the headers 4 are vertical and connected to the feed-collector 1 by screwed unions 4^a, and the headers 5 are inclined and connected, by means of plates 5^a, Figs. 6 and 6^a, screwed on the tube ends and studs and nuts, to a steam and water collector 5^b, that is secured over a perforated portion of the steam-drum 2, both sets of headers being of oval form in cross-section.

In those sides of the headers opposite to the sides at which the ends of the curved tubes enter them there are provided plugs, screws, or doors. Screw-plugs 7 are shown in Fig. 5 for the purpose of affording access for examination, cleaning, or removal of tubes or for expanding tube ends. The headers 4 and 5 may be constructed of wrought or cast iron, steel, or other suitable material. They are arranged side by side in close contact, thereby forming a front and a crown to the boiler. The feed-collector 1 is also fitted with plugs, screws, or suitable doors (screw-plugs 7^a are shown) to afford access for the purposes of cleaning, examining, and expanding the lower ends of the furnace-crown tubes 3 and for the removal of these tubes, whose upper ends are expanded into the steam-drum 2 and in the example shown extend upward above the level of the water in the said drum. Below the steam-drum 2 is a vessel 9, herein called the "sediment-chamber," which is connected with the steam-drum 2 by tubes 10, which may be of any convenient number and diameter, arranged side by side with their external surfaces in mutual contact, thereby forming a wall. The steam-drum 2 is also connected with the sediment-chamber 9 in the example shown by three downcast tubes 11, placed outside the heating-space of the boiler. If desired, however, instead of this preferred arrangement the tubes 11 may be omitted, in which case the tubes 10 will be used as downcast tubes and will then terminate below instead of above the water-level 12. The sediment-chamber 9 is fitted with suitable baffles 13 13^a for the purpose of facilitating the separation of the impurities contained in the water. Pipes 14 are provided connecting the sediment-chamber with the feed-collector 1,

preferably through a second sediment-chamber 9^a with baffles 13^a, one pipe being fitted at each side of the boiler. The headers 5 may be arranged to discharge the steam and water into the steam-drum 2 either above the normal water-level of the boiler, as shown, or below. The steam-drum is fitted with a suitable baffle 15, or there may be more than one, to separate from the entering steam water carried over therewith. The baffle shown comprises a curved plate formed with perforations 15^a, over which are arranged other curved plates 15^b.

For the purpose of forming a furnace crown and diverting the passage of the fire-gases in order to insure efficient combustion fire bricks or tiles 16 are arranged over the furnace-crown tubes 3 in such a way as to be easily removable and that their number can be varied according to the rate of combustion required and the quality of coal used, a door 17 being fitted in the side of the casing 18 to enable this to be done. The front portion of the boiler-casing is in the form of hinged doors 18^a, Fig. 4, by opening which ready access can be gained to the headers 4.

For the purpose of regulating the quantity of water admitted to the furnace-crown tubes 3 and the bent tubes 6 of the sections or elements during the process of circulation in the boiler there are provided cone-ferrules 19, (see Figs. 8 and 9,) constructed of slightly larger diameter than the said tubes and sprung into place, a gap 20 being cut in the lower part of each ferrule to assist in their being sprung into place and to insure drainage of water from the tubes when the boiler is emptied. These ferrules also serve to prevent reversal of the circulating current.

For the purpose of diverting the fire-gases there is provided a baffling arrangement (see Figs. 1, 10, and 11) comprising a horizontal shaft or spindle 21, to which a number of V-shaped, Fig. 11, or otherwise conveniently-formed vertical bafflers 22 are attached, the shaft or spindle 21 being so placed in the boiler (see Fig. 1) that the bafflers 22 fit in between the heating-tubes 6 of the elements at the gaps formed between the elements and a suitable lever or levers being provided on the shaft or spindle 21, so that it can be worked from the outside and whereby the angle of the bafflers can be adjusted. When the bafflers 22 are in the vertical position shown, the boiler can be advantageously worked at comparatively slow speeds under natural draft, and upon turning them upward into a more or less horizontal position the boiler can be worked without danger under forced draft as an express-boiler.

The heating-tubes 6 of the elements can be cleaned by a steam-jet in the usual manner admitted through the smoke-box door 23, but in order that the external surfaces of the said tubes may be more thoroughly cleaned bearings 24, Fig. 1, are provided in a position eccentric to the axis of the curve of the tubes

to be cleaned. Into those bearings the spindle 25 of a compound brush, Fig. 12, somewhat resembling a comb, with bristles 26 on its teeth 27, and which can be kept in the stoke-hole, can be shipped upon opening the door 23, so that by means of a suitable lever or levers (not shown) the brush can be worked in an upward and downward direction, thereby sweeping the soot from the surfaces of the tubes.

Feed-water is injected into the steam-drum 2 and descends the downcast pipes 11 into the sediment-chamber 9, where the impurities are deposited, clean water rising over the baffles 13^a through the tubes 10 into the steam-drum 2 and through the connecting-pipes 14 into the feed-collector 1, whence a portion of it passes into the furnace-crown tubes 3 and thence into the steam-drum 2 and a portion into the vertical headers 4 and thence by the curved tubes 6 of the elements and the headers 5 into the steam-drum. The water is separated from the steam by means of the baffles 15, and again descends, together with the feed-water, through the downcast tubes 11 into the sediment-chamber 9, &c. A blow-off pipe 28 is connected to the sediment-chamber 9 for the purpose of blowing out the sediment or water from the boiler from time to time.

The headers, steam-drum, feed-collector, and sediment-chamber are or may be suitably connected together by stay-rods 29, as indicated by dotted lines in Fig. 1, to prevent undue straining of the joints between the headers 4 5 and the feed-collector 1 and steam-drum 2 by expansion of the tubes 6, connecting the headers.

The boiler is provided with a suitable grate 30, fire-doors 31, ash-pit doors 32, and uptake 33. By the construction described a large amount of tube-heating surface can be conveniently fitted into a small space.

What I claim is—

1. In a steam-generator, a feed-collector, a steam-drum, a number of interchangeable sections or elements connecting said feed-collector and steam-drum and each comprising a vertical or inclined header connected to said feed-collector, a horizontal or inclined header connected to said steam-drum and curved heating-tubes connecting said headers, and an uptake having its lower inlet end for hot gases located between the adjacent ends of the header, substantially as described.

2. In a steam-generator, a feed-collector, a steam-drum, and a number of interchangeable sections or elements and furnace-crown tubes connecting said feed-collector and steam-drum, said sections or elements each comprising two headers connected by a series of curved heating-tubes, substantially as described.

3. A steam-generator comprising a feed-collector, a steam-drum, curved tubes connecting said feed-collector and steam-drum and arranged to form the crown and one side

of the furnace, a number of interchangeable sections or elements each comprising a vertical or inclined header connected to said feed-collector, a horizontal or inclined header connected to said steam-drum and a number of curved tubes connecting the two headers, the vertical headers being arranged close together so as to form part of the front of the generator and the horizontal or inclined headers being also arranged close together so as to form the crown of the generator, and tubes located at the opposite side of said furnace and serving to connect said feed-collector and steam-drum substantially as described.

4. A steam-generator comprising a feed-collector arranged at one side of the furnace, a steam-drum and sediment-chamber arranged one above the other at the opposite side of said furnace, interchangeable sections or elements connecting said feed-collector and steam-drum and each comprising two headers connected by curved heating-tubes, and tubes connecting said feed-collector and steam-drum with said sediment-chamber, substantially as described.

5. A steam-generator comprising a feed-collector arranged at one side of the furnace, a steam-drum and sediment-chamber arranged one above the other at the opposite side of said furnace, interchangeable sections or elements connecting said feed-collector and steam-drum and each comprising two headers connected by curved heating-tubes, furnace-crown tubes arranged to connect said feed-collector with said steam-drum, a wall of tubes arranged opposite to the furnace-crown tubes and said steam-drum and sediment-chamber, and tubes connecting said feed-collector and sediment-chamber, substantially as described.

6. In a steam-generator, the combination with a lower feed-collector, an upper steam-drum, and heating-tubes connecting them, of two connected sediment-chambers provided with baffles and arranged one below said feed-collector and the other below said steam-drum, and tubes connecting said sediment-chambers with said feed-collector and steam-drum, substantially as described.

7. In a steam-generator, the combination with heating-tubes arranged in parallel vertical rows, of baffles extending down between said vertical rows of tubes and located between the furnace and uptake, and means for adjusting the position of said baffles substantially as described for the purpose specified.

8. In a steam-generator, the combination with a feed-collector, a steam-drum, and a number of interchangeable sections or elements connecting said feed-collector and steam-drum and each comprising two headers arranged at an angle to each other and connected by curved heating-tubes, arranged in parallel vertical rows, of baffles in the form of bars suspended between said rows of tubes, a shaft whereon said bars are fixed, and means

for partly rotating said shaft with baffles, substantially as described for the purpose specified.

9. In a steam-generator having headers connected by curved water-tubes arranged in parallel vertical rows, a smoke-box provided with bearings arranged eccentric to the curve of said tubes and adapted to receive a brush for cleaning the exteriors of said tubes, substantially as described.

10. In a steam-generator the combination with a feed-collector, a steam-drum, and a number of interchangeable sections or elements connecting said feed-collector and steam-drum and each comprising two headers arranged at an angle to each other and connected by curved heating-tubes, of a smoke-box provided at opposite sides with bearings arranged eccentric to the curve of said tubes, a compound brush comprising a shaft mounted in said bearings and carrying a number of bars provided with radiating wires or bristles and arranged to extend down between the rows of curved heating-tubes, and means for operating said brush, substantially as described for the purpose specified.

11. In a steam-generator having a number of rows of heating-tubes arranged at different levels and through which water flows, and a water vessel to which the lower inlet ends of said tubes are fixed, conical nozzles secured in the lower ends of some of the lower rows of tubes so as to be covered or inclosed by said water vessel and adapted to regulate the flow of water through the various tubes, substantially as described.

12. In a steam-generator having a number of rows of heating-tubes arranged at different levels and through which water flows, and a water vessel to which the lower inlet ends of said tubes are fixed, of conical nozzles secured in the lower ends of some of the lower rows of tubes so as to be covered or inclosed by said water vessel and each having a gap

in its lower part whereby water can drain from the corresponding tube into said water vessel, substantially as described for the purpose specified.

13. In a steam-generator the combination with a steam-drum having a number of water-tubes delivering into its upper part of a baffle comprising a curved perforated plate arranged opposite the inlets for jets of mixed water and steam from said tubes and extending from the top toward the bottom of said drum, and curved plates secured one above the other to said plate and overlapping the perforations therein, substantially as described and shown for the purpose specified.

14. A steam-generator comprising a feed-collector; a steam-drum, furnace-crown tubes connecting said feed-collector and steam-drum, a number of interchangeable sections or elements comprising upper and lower headers connected respectively with said feed-collector and steam-drum and curved heating-tubes connecting the headers, a sediment-chamber with baffles arranged below said steam-drum, a wall of tubes arranged at the side of the furnace opposite to the furnace-crown tubes and connecting the steam-drum with the sediment-chamber, the upper ends of these tubes extending above the water-level in said steam-drum, downcast tubes located outside the boiler-casing and connecting the lower portion of said steam-drum with the upper portion of said sediment-chamber, and pipes connecting said sediment-chamber with said feed-collector, substantially as described.

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

JOHN SAMPSON.

Witnesses:

EDMUND S. SNEWIN,
WM. O. BROWN.