

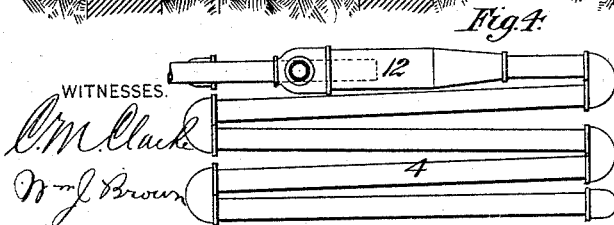
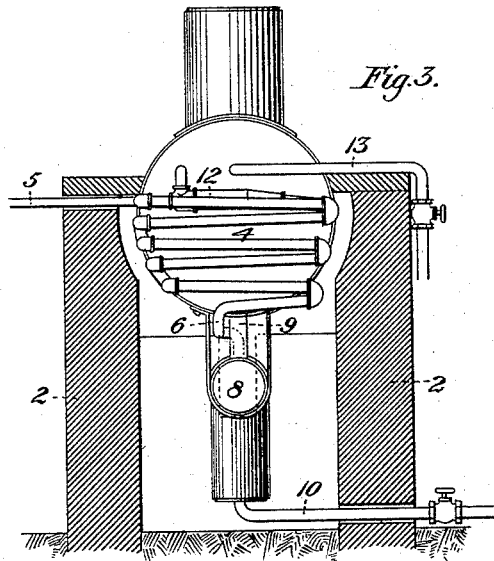
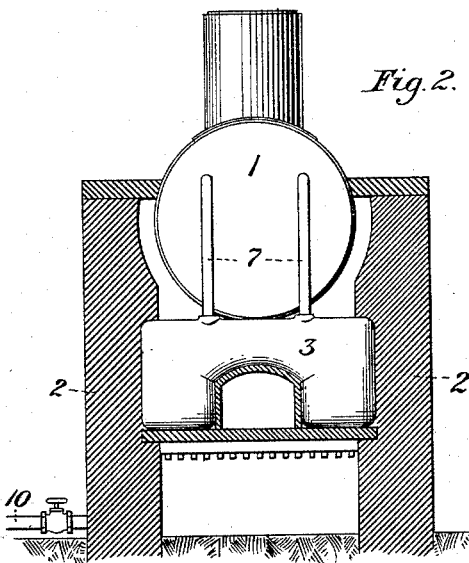
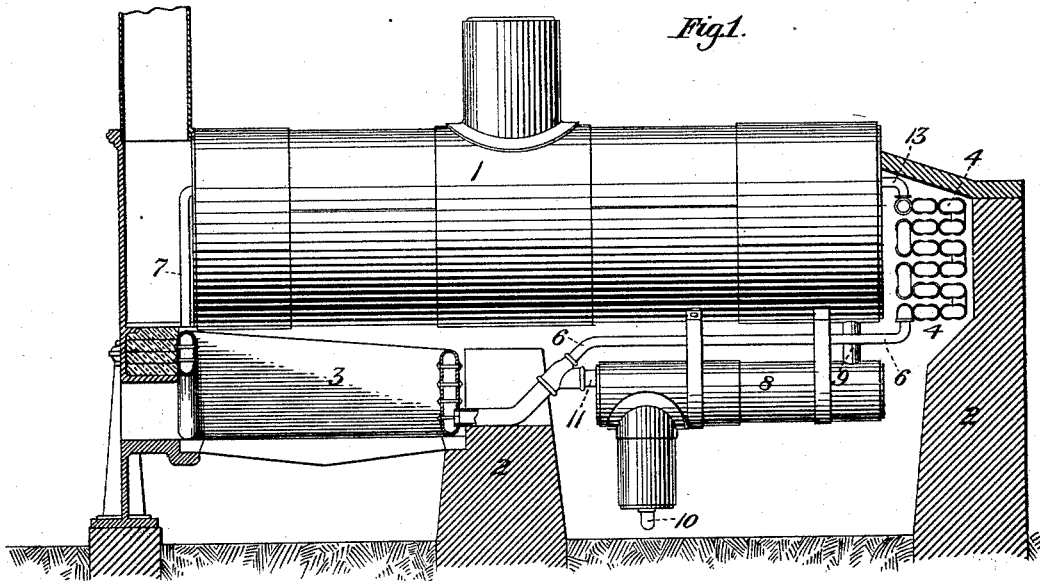
(No Model.)

3 Sheets—Sheet I.

A. J. DAVIS.  
STEAM GENERATOR.

No. 456,648.

Patented July 28, 1891.



WITNESSES.

*C. M. Clark*  
*W. J. Brown*

INVENTOR.

*Andrew J. Davis,*  
*by George H. Christy*  
*att*

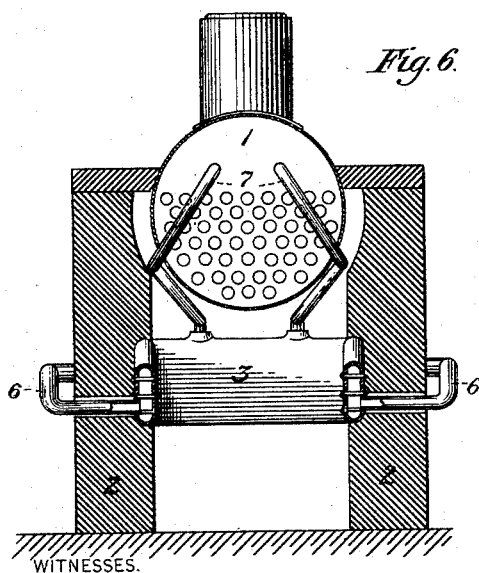
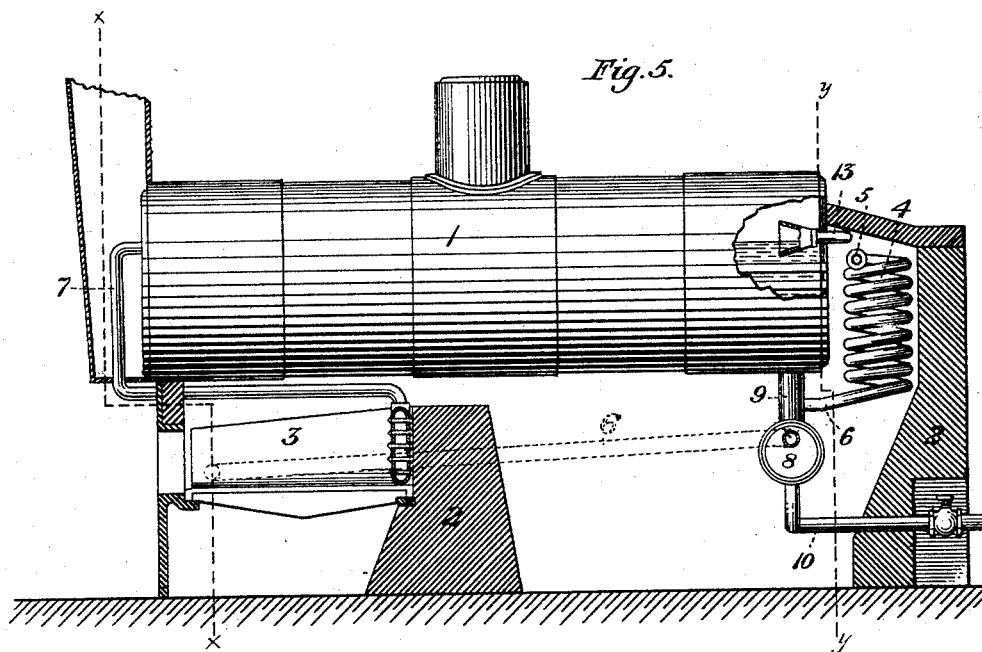
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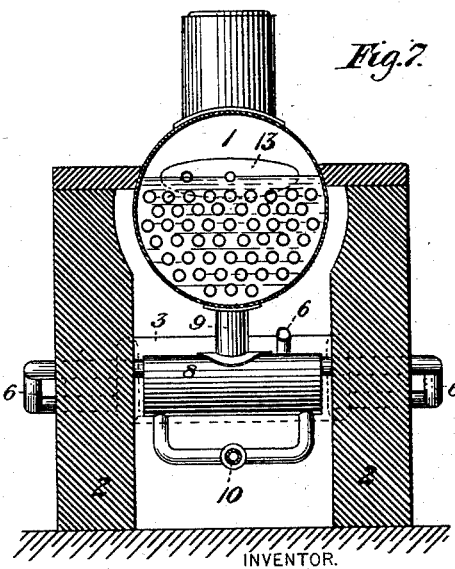
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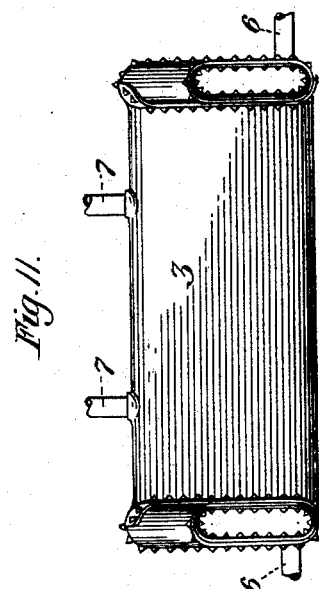
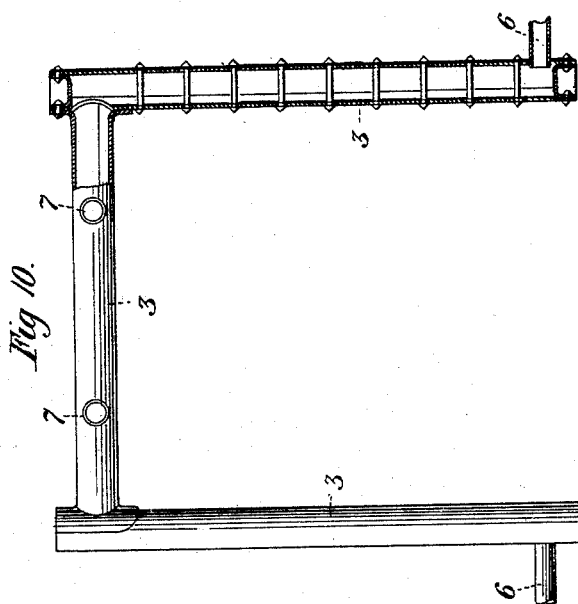
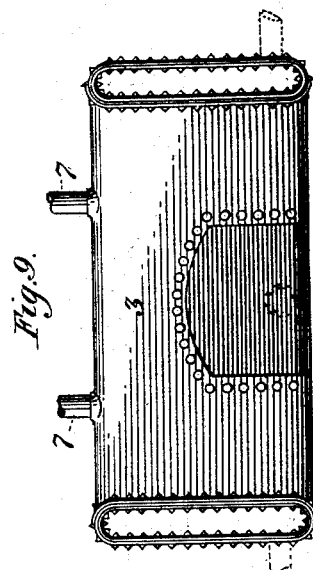
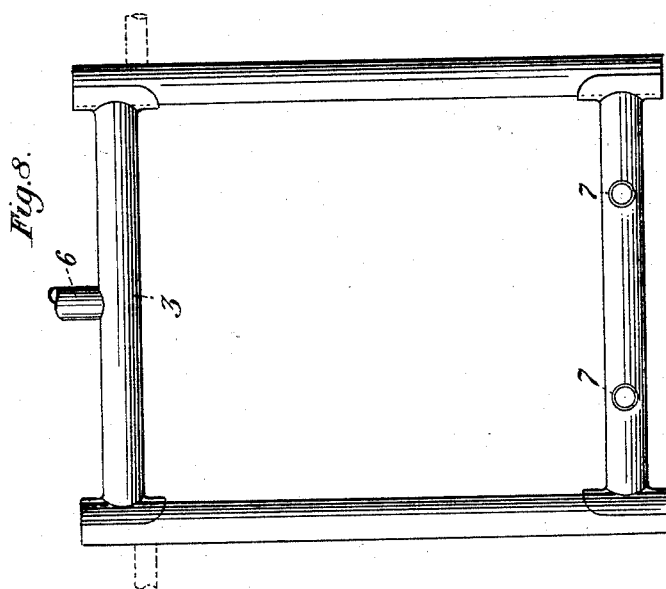
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3 Sheets—Sheet 3.

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WITNESSES.

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# UNITED STATES PATENT OFFICE.

ANDREW J. DAVIS, OF ALLEGHENY, PENNSYLVANIA.

## STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 456,648, dated July 28, 1891.

Application filed September 1, 1890. Serial No. 363,595. (No model.)

*To all whom it may concern:*

Be it known that I, ANDREW J. DAVIS, a citizen of the United States, residing at Allegheny, in the county of Allegheny and State of Pennsylvania, have invented or discovered certain new and useful Improvements in Steam-Generators, of which improvements the following is a specification.

The invention described herein relates to certain improvements in steam-generators, and has for its object a construction whereby a more complete utilization of the heat of the combustion of the fuel is effected, a more efficient circulation of the water is produced, and provision is made for the detention and deposit of foreign matter outside of the generator, thereby preventing the formation of scale or other injurious deposit on the plates, tubes, or flues of the boiler.

In general terms the invention consists in the construction and combination of the several parts or elements, all as more fully hereinafter described and claimed.

In the accompanying drawings, forming a part of this specification, Figure 1 is a view in side elevation of a steam-generator embodying my invention. Figs. 2 and 3 are respectively front and rear elevations of the same. Fig. 4 is a detail view of the heater. Fig. 5 is a view in side elevation of a steam-generator wherein the water-box surrounds the fire-chamber on three sides only. Figs. 6 and 7 are sectional elevations on the lines  $x$  and  $y$ , respectively, of Fig. 5. Fig. 8 is a plan, and Fig. 9 an end elevation, of the water-box entirely surrounding the fire-chamber. Fig. 10 is a view partly in section and partly in plan, and Fig. 11 is an elevation, of the form of water-box shown in Fig. 5.

The boiler 1 is of the usual or any suitable construction, and is supported in the customary manner upon brick foundations 2.

In lieu of forming the fire-chamber of brick, as is customary, I provide a double-walled shell 3, which, for convenience, I term the "water-box." This shell or water-box is formed with four sides, as shown in Figs. 1, 2, 8, and 9, or with three, as shown in Figs. 5, 6, 10, and 11, and is made of a height to extend from the grate-bars up to top of the bridge-wall, which is formed, in part, by the rear wall of the water-box, as shown in Figs.

1 and 5. While it is preferred to form this water-box of metal plates properly stayed by transverse bolts or rivets in the manner well known in the art, it may be formed of cast steel or iron in such manner as to withstand the pressure to which it may be subjected.

In the smoke-box at the rear end of the boiler I arrange a coil of pipe 4, which is connected at one end to the feed-water-supply pipe 5 and at its opposite end by a pipe 6 to the water-box 3 at a suitable point near its lower edge, as shown in Fig. 1. The water-box is connected to the front end of the boiler by one or more pipes 7, extending from one or more points near the upper edge of the water-box and entering the boiler at or near its normal water-level, as shown in Figs. 1, 2, 5, and 6.

As is customary, a mud-drum 8 is arranged under the boiler and is connected thereto by a pipe 9, entering the boiler near its rear end. This mud-drum is provided with a blow-off pipe 10, and is connected by a branch pipe 11 with the pipe 6, connecting the feed-water heater 4 and the water-box, as shown in Fig. 1. If desired, the heater 4 may be connected to the mud-drum and the latter connected to the water-box by the pipe 11, as shown in Figs. 5 and 7. The supply-pipe 5 is connected by a siphon 12 to the heating-coil 4, and the receiving end of the siphon is connected to the boiler at or near its normal water-level, thereby providing for an upward flow or circulation of the water through the coil when the feed-water is cut off. A surface blow-off 13, having a flaring mouth, is arranged at the rear end of the boiler for the removal of oil and scum therefrom. At the same time it is carried to the rear end of the boiler by the constant travel of the water in that direction, produced by the peculiar arrangement of the connection between the boiler and the water-box. The water-box being subjected to the greatest heat and containing a comparatively small volume of water, the latter will be rapidly heated and will by reason of its reduced specific gravity rise up through the pipes 7, and the colder water at the rear end of the boiler will pass down into the mud-drum, and thence by the pipes 11 and 6 in the arrangement shown in Figs. 1, 2, and 3, or by the pipes 11 in the construction shown in Figs. 5, 6, and 7, thus pro-

5 producing a rapid circulation of the water through  
 said water-box and boiler. When the feed  
 is shut off, circulation will also be established  
 through the pipe 6, up through the heater  
 10 4, into the rear end of the boiler, the heat  
 applied during the flow through the heater  
 accelerating circulation in this direction.  
 When the water is being fed, it will be heated  
 to a considerable degree by the heater before  
 15 entering the water-box, where it will be heated  
 to the point of ebullition. The water and  
 saturated steam flow thence by pipes 7 into  
 the boiler, where, being further heated, the  
 steam separates from the water the impuri-  
 20 ties remaining in the latter, which pass there-  
 with to the rear end of the boiler and thence  
 into the mud-drum, where the ebullition, if  
 there be any, is at a minimum, thus afford-  
 ing opportunity for the impurities to settle  
 therein.

When water containing a considerable  
 amount of impurities is used, it is preferred  
 to connect the heater to the mud-drum, as  
 shown in Figs. 5 and 7, so as to afford oppor-  
 25 tunity for at least a partial separation of  
 such impurities before the water enters the  
 water-box.

While it is not new to employ a water-box  
 furnace in connection with a steam-boiler,  
 30 yet by reason of my new arrangement of con-  
 nections between the water-box and boiler I  
 attain new and useful results—as, for example,  
 by connecting the upper portion of the water-  
 box to the front end of the boiler at or near  
 35 the normal water-level and the lower portion  
 of the water-box to the under side of the  
 boiler at or near its rear end. Provision is  
 made for a circulation of the water through  
 the fire-box and through the entire length of  
 40 the boiler, thereby rendering the boiler more  
 efficient as a steam-generator, such construc-  
 tion producing such a circulation as will ef-  
 fect a movement of the oil and scum to the  
 rear end of the boiler, where it can be re-  
 45 moved by means of the surface blow-off pro-  
 vided for that surface. It will also be ob-  
 served that the water from the feed device  
 passes through the mud-drum, as does also  
 the water in its circulation from the rear end  
 50 of the boiler to the water-box, thus providing  
 a receptacle wherein matter held in suspen-  
 sion in the water may be deposited. It will  
 be readily understood that in such a con-  
 struction all scale-producing elements, which  
 55 have heretofore been a source of great annoy-  
 ance and expense to steam uses, can be en-  
 tirely or to a very large extent removed. By  
 the construction and arrangement of the feed-  
 water heater at the rear end of the boiler and  
 60 its connection thereto by means of a siphon  
 the waste heat can be utilized, and that ir-  
 respective of whether feed-water is passing into  
 the boiler or not. By admitting the feed-wa-  
 ter partially heated into the circulating water  
 65 from the boiler, which is at a high tempera-  
 ture, the liability to corrosion and the crack-  
 ing of the plates by expansion and contrac-

tion is avoided, and, further, by producing a  
 circulation of the water from the front to the  
 rear end of the boiler all liability of a deposit  
 70 of scale or sediment over the fire is avoided.

It will be observed that in the construction  
 heretofore described the heating-surface of  
 the generator is largely increased and that  
 the additional heating-surfaces are so ar-  
 75 ranged as to utilize heat heretofore wasted;  
 and, further, it is a characteristic of this im-  
 provement that the additional heating-sur-  
 faces are so arranged relatively to each other  
 and to the boiler proper as to effect a circula-  
 80 tion of the water from the front to the rear  
 end, and that independent of the feed-wa-  
 ter—i. e., whether water is being supplied or  
 not—thereby preventing to a greater extent  
 any deposit within the boiler proper; and, 85  
 further, by highly heating the water prior to  
 its entrance into the boiler the latter is re-  
 lieved of strains incident to alternate cooling  
 and heating.

I claim herein as my invention— 90

1. A steam-generator having in combina-  
 tion a boiler and a water-box forming the fur-  
 nace of said boiler, the water-box being con-  
 nected to the extreme front and rear ends of  
 the boiler, the rear connection being located at  
 95 the lower side of the boiler, whereby the wa-  
 ter is caused to traverse the entire length of  
 the boiler, substantially as set forth.

2. A steam-generator having in combina-  
 tion a boiler and a water-box forming the fur-  
 100 nace of said boiler, either wholly or in part,  
 the upper portion of the water-box being con-  
 nected to the front end of the boiler at or  
 near the normal water-line and the lower por-  
 tion to the rear end of the boiler at or near  
 105 the bottom thereof, substantially as set forth.

3. A steam-generator having in combina-  
 tion a boiler, a water-box forming the furnace  
 of said boiler and connected to the front end  
 thereof by external connections, and a feed-  
 110 water heater connected to the water-box and  
 to the rear end of the boiler, substantially as  
 set forth.

4. A steam-generator having in combina-  
 tion a boiler, a water-box forming the furnace  
 115 of said boiler and connected to the front end  
 thereof at or near the normal water-level, and  
 a mud-drum connected to the rear end of the  
 boiler at or near its under side and to the  
 water-box, whereby the water is caused to  
 120 circulate from the front to the rear end of the  
 boiler and thence through the mud-drum to  
 the water-box, substantially as set forth.

5. A steam-generator having in combina-  
 tion a boiler, a water-box forming the furnace  
 125 of said boiler, either wholly or in part, and con-  
 nected to the front end thereof, a mud-drum  
 connected to the water-box and to the rear end  
 of the boiler, and a feed-water heater con-  
 nected to the water-box, substantially as set  
 130 forth.

6. A steam-generator having in combina-  
 tion a boiler, a water-box forming the furnace  
 of said boiler, either wholly or in part, and

connected to the front end thereof, a mud-drum connected to the water-box and to the rear end of the boiler, and a feed-water heater also connected to the water-box and the rear  
5 end of the boiler at or near the normal water-level, substantially as set forth.

7. A steam-generator having in combination a boiler, a water-box forming the furnace for said boiler, the water-box being connected  
10 to the front and rear ends of the boiler by

external connections, and a surface blow-off arranged in the rear end of the boiler at or near the normal water-level, substantially as set forth.

In testimony whereof I have hereunto set  
15 my hand.

ANDREW J. DAVIS.

Witnesses:

DARWIN S. WOLCOTT,  
W. B. CORWIN.