S. WILCOX, Jr.

STEAM GENERATOR.

No. 51,395. Patented Dec. 5, 1865.

Fig. 1.

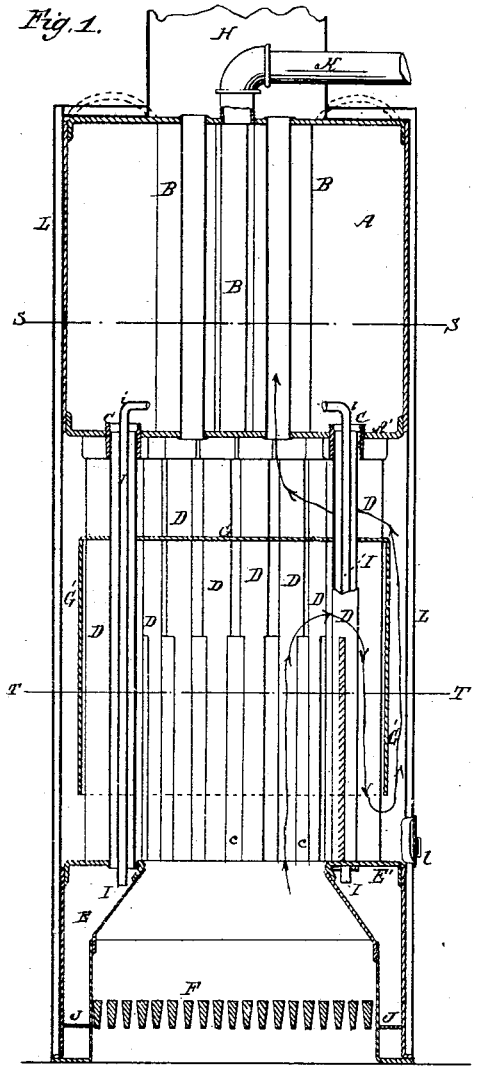


Fig. 2.

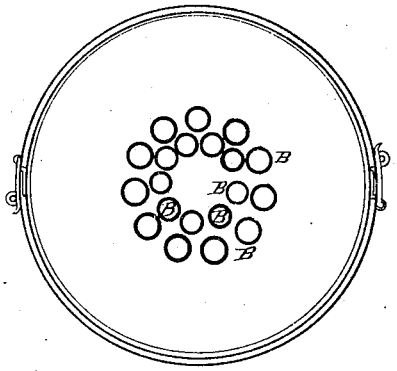
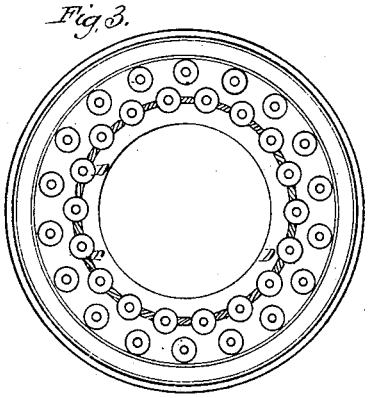


Fig. 3.



Witnesses.

Emil Tofsmack

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UNITED STATES PATENT OFFICE.

STEPHEN WILCOX, JR., OF WESTERLY, RHODE ISLAND, ASSIGNOR TO HIMSELF AND CHARLES POTTER, JR., OF SAME PLACE.

IMPROVEMENT IN STEAM-GENERATORS.

Specification forming part of Letters Patent No. **51,395**, dated December 5, 1865.

To all whom it may concern:

Be it known that I, STEPHEN WILCOX, Jr., of Westerly, in the county of Washington and State of Rhode Island, have invented certain new and useful Improvements in Steam-Boilers; and I do hereby declare that the following is a full and exact description thereof.

The accompanying drawings form a part of this specification.

Figure 1 is a vertical section. Fig. 2 is a horizontal section on the line S S in Fig. 1, and Fig. 3 is a horizontal section on the line T T in Fig. 1.

Similar letters of reference indicate like parts in all the figures.

My boiler is upright. The heating-surface is formed almost entirely of tubes; but an ample surface for the disengagement of the steam is provided at the water-level, and a proper space is also provided for the deposit of mud at the bottom. These, as also many other important ends, are fulfilled more perfectly in my boiler than in any other of analogous character known to me.

To enable others skilled in the art to make and use my invention, I will proceed to describe its construction and operation by the aid of the drawings and of the letters of reference marked thereon.

A is an upper or main chamber, of cylindrical form, and traversed near the axis by the tubes B, which serve as drying and superheating tubes. The lower plate, A′, of the chamber A is tapped to receive two circular rows of screw-thimbles, C, which thimbles are tapped on their interiors and receive the screwed ends of tubes D in the manner represented. The lower ends of the tubes D are screwed into the upper plate, E′, of an annular lower chamber, E, serving as a water and mud chamber. The fuel rests on the grate F, and gaseous products of combustion rising therefrom pass upward until they meet a horizontal plate, G, then pass outward between the inner set of tubes, D, and downward around the outer row of tubes beneath the lower edge of a hanging curtain, G′, which is connected to the periphery of the plate G. The gases then rise, having imparted a portion of their heat to form steam in the inner series of the tubes D, and again another portion of their heat to form steam in the outer series of the tubes D, and thence move inward between the plate G and the plate A′, again imparting some heat to the tubes D, ultimately rising through the drying and superheating tubes B into the chimney H.

Bent tubes I, much smaller than the tubes D, are inserted in the manner represented, one tube I being placed in each tube D in such manner that the lower end shall project downward beyond the lower end of D, and the upper end project upward beyond the upper end of the thimble C, and serve as an efficient circulating-tube to carry a constant and active current of water downward through the center of the tube D to supply the place of the water which is vaporized, as also that which is drawn upward by the ascending particles of steam. The bend *i′* at the upper end is important for insuring that the fluid received may be dense water, and not the mingled steam and water which is found immediately over each thimble C. The lower end, by projecting downward into the water-annulus, delivers its downward current in such a manner as not to interfere with the upward current ascending from E into D. I propose, in some cases, to introduce a perforated plate, as indicated by J, to allow mud to settle in the bottom of the annulus E, entirely undisturbed by any currents descending through the pipes I.

The steam generated in the pipes D, as also that formed on the interior of the annulus E and on the lower plate, A′, of the chamber A, all rises freely to the water-level, and is ultimately drawn inward between the superheating-pipes B and discharged through the steam-pipe K, which connects to the center of the chamber A.

The chamber A and the annulus E are of the same external diameter. They are incased in a non-conducting jacket, L, formed of sheet metal in two or more sections and adapted to include not only the chambers A and E, but also the entire space between them, as represented. It follows that the non-conducting jacket L forms the exterior wall or inclosure for the space traversed by the gaseous products of combustion in their upward movement along the exterior of the curtain G′, and also forms a protection to prevent radiation of heat from the exteriors of the chambers A and

E. It is important for both these uses that the jacket L be a good non-conductor. Its qualities in this respect are available in protecting A and E from cooling by radiation, and in preventing the external air of the building or vessel from becoming inconveniently heated and conveying away the useful heat which still remains in the gaseous products of combustion in the intermediate space between A and E.

I stop the spaces between the tubes D D by introducing properly-shaped castings *c*, which extend from the tube-sheet E′ upward about half-way to the tube-sheet A′. It follows that the gaseous products of combustion cannot flow directly outward from the furnace to pass under the lower edge of the sheet G′, but must first rise up nearly or quite to the plate G in order to mount over these castings *c*. In other words, the castings *c*, arranged as described relatively to the tubes D, act as a bridge, and the gases are compelled first to rise and pass over them and afterwards to sink and pass under the hanging bridge G′. This insures a thorough presentation of the gases to the tubes D.

This boiler allows a great fluctuation in the level of the water and will bear an exposure of most intense heat when such accidentally occurs.

The conducting-jacket L is in two halves, fitted to each, as indicated in Fig. 2. I maintain the parts in this position by any convenient attachments, preferring, however, one acting on the principle of the hasp and staple, as indicated. When dirt accumulates in the spaces between the tubes D it is necessary only to remove the jacket L in order to obtain the fullest access thereto. Hand-holes covered by convenient doors *l*, as indicated, allow of cleaning around the lower end of the tube without removing the jacket.

When it is necessary, for any reason, to remove a tube, D, I first remove the jacket L and then, applying a suitable wrench, turn the thimble C in such direction as to move it downward upon the tube D until it is entirely below the plate A′. I then turn the entire tube D, so as to unscrew it from the plate E′. It is then free from both plates and may be readily removed with its interior tube, I, and may be repaired or its place supplied by a new one by reverse operation. In case one of the tubes in the inner series requires removal I first remove the two tubes exterior to it in order to gain convenient access to it, and afterward replace the whole.

It will be seen that this boiler is easy to repair and that its flues cannot become choked with ashes, so as to cause more than a very brief delay in cleaning them.

Fire-brick or other enduring material may be substituted in place of iron plate G.

This boiler possesses the advantage of a very high furnace. It presents the water to the hot gases within tubes, yet without exposing the tube-plates to an insufferably high temperature. It circulates the water actively, and breaks up and distributes the hot gases effectually, so as to extract the heat well from every particle.

It will be observed, of course, that the flat upper and lower sheets of the chamber A are effectively stayed by the tubes B. In making a very large boiler I would make the top plate of A either in the form of a dome or of a swelled ring, as indicated in red lines in Fig. 1, so as the better to enable the annular surface exterior to the tubes B to resist the pressure.

It has been common to convey the water down the interior of upright tubes to supply the place of the water evaporated and that carried upward by the current of steam; but it has not before been practiced to convey the water quite through and beyond the bottom of the tube and to provide a suitable water and mud chamber, E, to perform like this.

It will be observed that the conical form of the interior of the annular chamber E provides for a much larger area of grate, and particularly for a larger furnace, than would be produced did the interior of E coincide in diameter with the clear space inclosed within the tubes D; but this form of furnace is not essential, because the boiler will perform satisfactorily with the fire-grate contracted and placed within the inner row of tubes.

One very marked advantage, due to the protrusion of the bent top *i* of each circulating-tube I above and beyond the top of the steam-generating tube D, lies in its effect when the water in the boiler becomes very low. Circulating-tubes with bent tops analogous to *i* have been used before; but in such case the generating-tubes D were extended up beyond the end of I, so that the bend *i* was in fact extended through a hole in the side of the generating-tube just above the tube-sheet. The arrangements might be identical when the water is plenty; but when the water becomes low my boiler will operate satisfactorily, while the former arrangement referred to would fail to deliver any water over the top of the prolonged generating-tube. These tubes end at or below the upper edge of the thimbles C, and the water carried up by the ascending steam spreads immediately upon the surface of the plate A′. These tubes I *i*, by reason of their peculiar construction, as described, allow of repairs being more readily effected. In order to remove the tube I *i* it is necessary simply to raise it bodily.

The tube I, bending over the upper end of the generating-tube D, is out of range of the rising current, and at the same time the bend does not interfere with its ready removal, and when the water gets very low the column has only to rise to a level with the crown-sheet.

The thimbles C may be rusted, soldered, or otherwise firmly fixed on the tubes D prior to the introduction into the boiler, and may in such case be applied and removed with the tube D by turning the entire tube and its at-

tachments around. The part C may be welded upon the tube D, if preferred; but in all such cases the tube must be inserted and removed through the top of chamber A.

Having now fully described my invention, what I claim as new, and desire to secure by Letters Patent, is as follows:

1. The combination and arrangement of the chambers A and E and the tubes D and I, substantially as and for the purpose herein set forth.

2. The removable jacket L, made in two or more thicknesses of the same or different materials, and arranged relatively to the chambers A and E, and to the series of tubes connecting them, substantially in the manner and for the purposes herein set forth.

3. The within-described construction and arrangement of the parts C G G′ or their equivalents, whereby the draft is made to pass first around the middle and lower portions of the tubes D and then around their upper portions, and finally through the tubes in the steam-chamber, as herein set forth.

4. The conical sides of the furnace F, arranged, as represented, relatively to the tubes D I, and adapted to extend the furnace outward under the tubes D, substantially as herein specified.

5. The arrangement of the arm *i*, extending laterally from the axial line of the tube I above the tube-sheet A′, and the extension of the lower end of the tube I below the tube-sheet E′, substantially as herein specified, for the purpose of receiving the water at the upper end unmixed with the steam rising from the tube D, and of delivering it at the lower end without interfering with the current rising into the tube D.

6. The within-described arrangement of the steam-pipe K, whereby it receives the steam from the interior of a series of tubes, B, and compels it to circulate more perfectly in contact with the latter before its exit from the boiler, substantially as herein specified.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

STEPHEN WILCOX, JR.

Witnesses:

EMIL VOSSNACK,

D. W. STETSON.