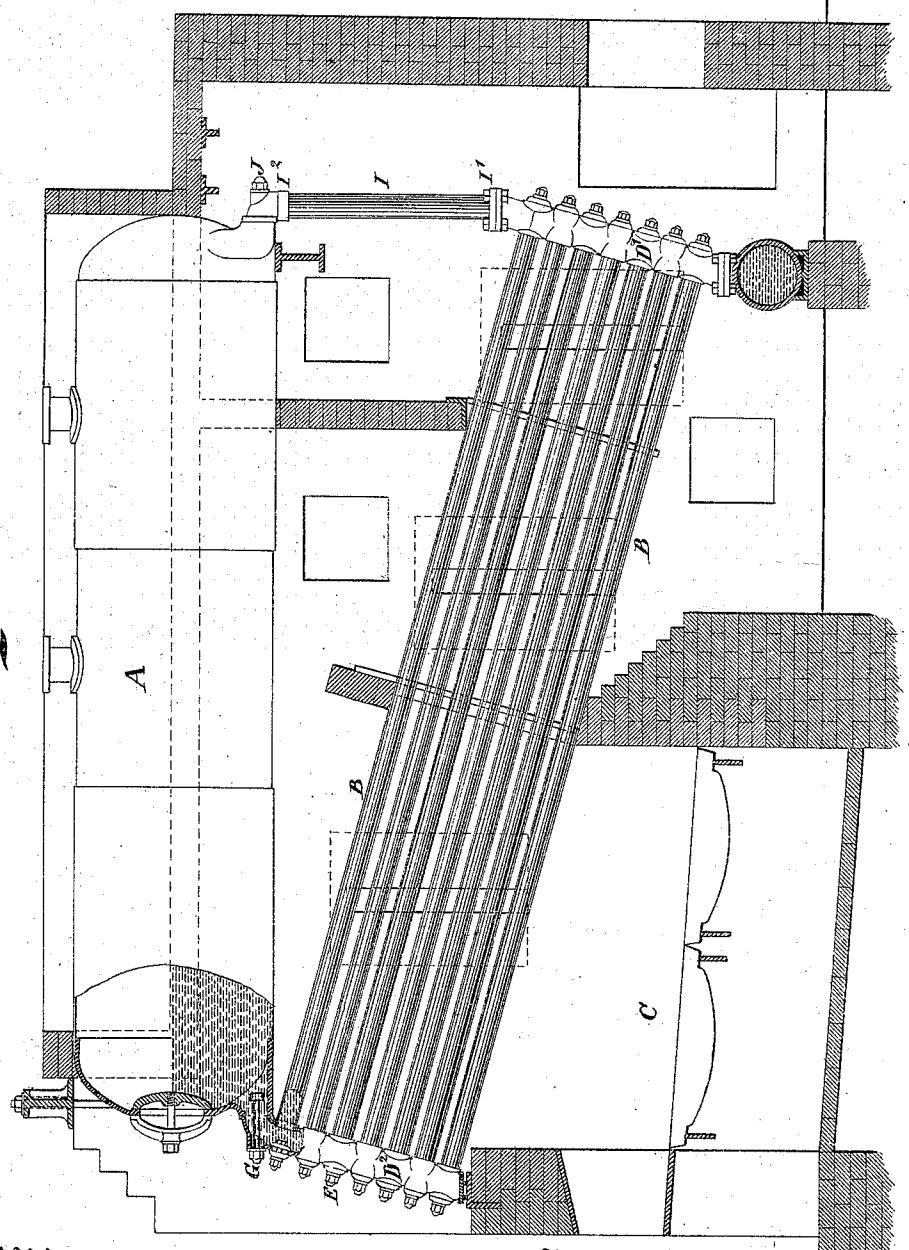
2 Sheets--Sheet 1.

G. H. BABCOCK & S. WILCOX.

Sectional Steam-Boilers.

No. 135,877. Patented Feb. 18, 1873.

Fig. 1.



Witnesses:

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A. G. Westbrook

Inventors:

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S. Wilcox

by their attorney T. D. Stetson

2 Sheets--Sheet 2.

G. H. BABCOCK & S. WILCOX.

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Fig. 4.

Fig. 3.

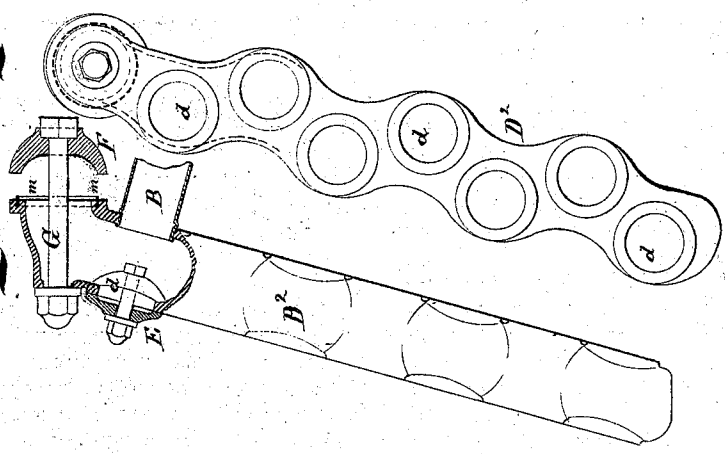
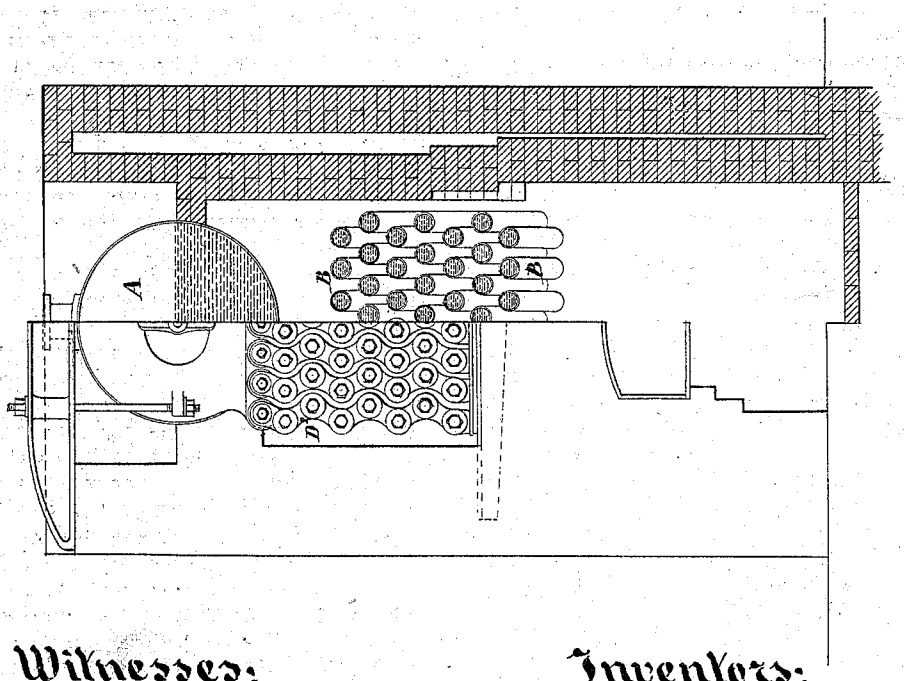


Fig. 2.



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Inventors:

Geo. H. Babcock and
Stephen Wilcox
by their attorney T. D. Stetson

UNITED STATES PATENT OFFICE.

GEORGE H. BABCOCK, OF PLAINFIELD, NEW JERSEY, AND STEPHEN WILCOX, OF BROOKLYN, NEW YORK.

IMPROVEMENT IN SECTIONAL STEAM-BOILERS.

Specification forming part of Letters Patent No. **135,877**, dated February 18, 1873.

To all whom it may concern:

Be it known that we, GEORGE H. BABCOCK, of Plainfield, Union county, New Jersey, and STEPHEN WILCOX, of Brooklyn, Kings county, New York, have invented certain Improvements relating to Steam-Boilers, of which the following is a specification:

The invention applies to that class of boilers for which we received Letters Patent of the United States, dated May 28, 1867, numbered 65,042, which Letters Patent were reissued August 15, 1871, and numbered 4,512. We have devised an improved mode of construction of the same, and of the means of connecting the tubes to each other, and to the larger vessel or separating chamber above.

The following is a description of what we consider the best means of carrying out the invention:

The accompanying drawing forms a part of this specification.

Figure 1 is a side elevation, partly in section. Fig. 2 is an end elevation, partly in section. Figs. 3 and 4 represent certain portions on a larger scale.

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

A is a vessel, of boiler-iron or other suitable material, containing a body of water, and in which a sufficient surface is allowed for the separation of the steam therefrom. B B are inclined tubes, which form the main heating-surface of the boiler. C is the furnace or fire-place. The hot products of combustion arising therefrom are caused to cross the series of tubes, circulating actively through the space between them several times.

We have successfully constructed great numbers of this class of boilers. The present invention is the result of long-continued endeavors to secure their perfection. Instead of threading the ends of the tubes B and screwing each into a separate small cast-iron chamber, and then bolting the several chambers together by a bolt extending through the series, we adopt a plan which, while it also allows the boiler to be made in sections, overcomes many of the difficulties heretofore encountered. The whole number of tubes in our present boiler is divided, as in our previous boilers, into sections, each section including a series of tubes arranged vertically or nearly vertically over each other, and capable of being applied and removed in a mass, so that we can form these tubes into sections in the shop and aggregate together a greater or less number of sections, as may be required, to constitute any given boiler. We make a single connection or pipe of peculiar form, extending up and down at each end of each section. In order to give sufficient strength and most convenient form to these connections, we make them of cast-steel, preferably of what is known as McHaffie metal, using in their manufacture all the care and skill necessary for the production of sound and perfect castings. A hollow boss or nozzle is formed both front and rear, where a tube connects, and the holes for the tubes are cored a little less than the proper size, and then bored properly to receive the tubes. We make these connections or end pipes in a sinuous form, and insert a tube at each bend, so that when two or more sections are placed contiguous they produce what is known as "staggering" of the tubes. D^1 D^2 represent these peculiarly crooked or sinuous pipe-connections, adapted to receive the staggered tubes and to match together in series, as shown. D^1 is the casting at the rear and lower end, and D^2 the casting at the forward and upper end.

We provide hand-holes *d* with tight-fitting covers E, arranging a hand-hole opposite the end of each tube. We employ tubes with soft-iron ends, without threading, and set them in place in the end pipes D^1 D^2 by treating them by an expanding tool in the well-known manner. Our small castings, being of steel of proper thickness, are able to endure the strain due to this mode of fastening. This construction avoids the necessity for making the great number of tight-fitting joints heretofore necessary between separate castings, one of which was joined to the end of each tube separately. It avoids also the necessity for the connecting-bolt which previously extended up and down through the series or sections at each end. It diminishes the weight of the structure, and increases the water and steam capacity with a given volume of boiler. It increases the freedom of the circulation of the water and the steam; and especially it allows tubes to

be removed and replaced without disturbing the neighboring tubes or sections.

In our former arrangement, when a tube from any cause became defective, it was necessary to remove with the tube the T-heads at each end, thus separating or treating all the joints in the series, and sometimes to also separate the several sections, and these joints are difficult to remake without taking out the whole section. Our improved construction greatly reduces the labor of such an exchange. When a tube is found leaky or becomes burned, blistered, or otherwise defective, the hand-holes *d* adjacent to the ends thereof are opened by simply removing the two covers E E, one at each end of that tube, and, a proper tool being introduced, the tube is cut out and a new one is inserted and made tight by an expanding-tool, as at first. The other tubes in the section and the other sections need not be disturbed.

The front pipes or castings D^2 are united to the main vessel A by horizontal bolts G, as shown. To connect the back castings D^1 to the main vessel A, we provide connections peculiarly adapted to allow for the slight imperfections and inequalities liable to occur in such work. The main lengths of these several connections are wrought-iron tightly set in castings at each end. The employment of wrought-iron for the main body of these connections allows a high degree of elasticity. The castings at the lower ends serve simply as flanges to bolt to the casting D^1 below. Each casting at the upper end presents a face, the plane of which is parallel to the axes of the wrought-iron connections, and at right angles to the faces of the flanges at their ends. It matches on a corresponding face formed on the main vessel A, and they form tight connections whether they match together at exactly the proper level, or a little above or below, or, in other words, whether the lengths of the vessel A and the tubes B exactly correspond or not. In Fig. 1 these connections are represented by $I\,I^1\,I^2$. The main wrought-iron portion is marked I, the lower flange I^1, and the upper casting I^2. J is a horizontal bolt adapted to hold the casting I^2 tightly against the adjacent face of the main vessel A.

The inner end of the bolt should take hold of a vertical cross-bar adapted to allow it to stand at slightly different levels. This mode of construction allows the joint to be fitted tightly and perfectly, whether the work is matched together so that all the several castings I^2 shall come at exactly the same level, or so that they vary appreciably. It is represented in the figure as a little below the best position. It may go still lower or it may come higher without involving any difficulty.

To produce a tight joint without much labor, we sink a dovetailed groove in one of the abutting surfaces, and turn off a short length of copper tube of corresponding diameter and thickness, and set it therein so that it projects a little. Copper will endure the heat and strain, and yet will yield sufficiently to adapt itself to inequalities. When the parts are bolted together, even if left quite rough, the joint is tight. The copper, in being compressed, adapts itself to the inequalities.

In Fig. 3, *m* represents the copper ring thus projecting from the face of the front casting D^2, ready to be compressed upon the adjacent face of the vessel A by the force of the holding-bolt G acting on the cross-piece F.

We claim as our invention—

1. A sectional boiler having inclined tubes in sections joined to a separating vessel, A, presenting a large surface for the separating of the steam from the water, and having the ends of the sections formed each of a single casting or connecting-piece with a hand-hole opposite to each tube, which will allow the insertion of a new tube when required, the tubes being connected and arranged substantially as herein set forth.

2. The sinuous pipes $D^1\,D^2$, in combination with a series of tubes, B B, fixed therein, and with hand-holes *d* to allow of access to the interior of the tubes, and of the removal and insertion of the same, and adapted, when placed side by side, to produce a staggered position of the tubes B, all substantially as and for the purpose herein set forth.

In testimony whereof we have hereunto set our hands this 7th day of January, 1873, in the presence of two subscribing witnesses.

GEO. H. BABCOCK.
STEPHEN WILCOX.

Witnesses:
WM. C. DEY,
ARNOLD HÖRMANN.