G. H. BABCOCK & S. WILCOX.

WATER-COIL STEAM-GENERATOR.

No. 192,214. Patented June 19, 1877.

Fig: 1.

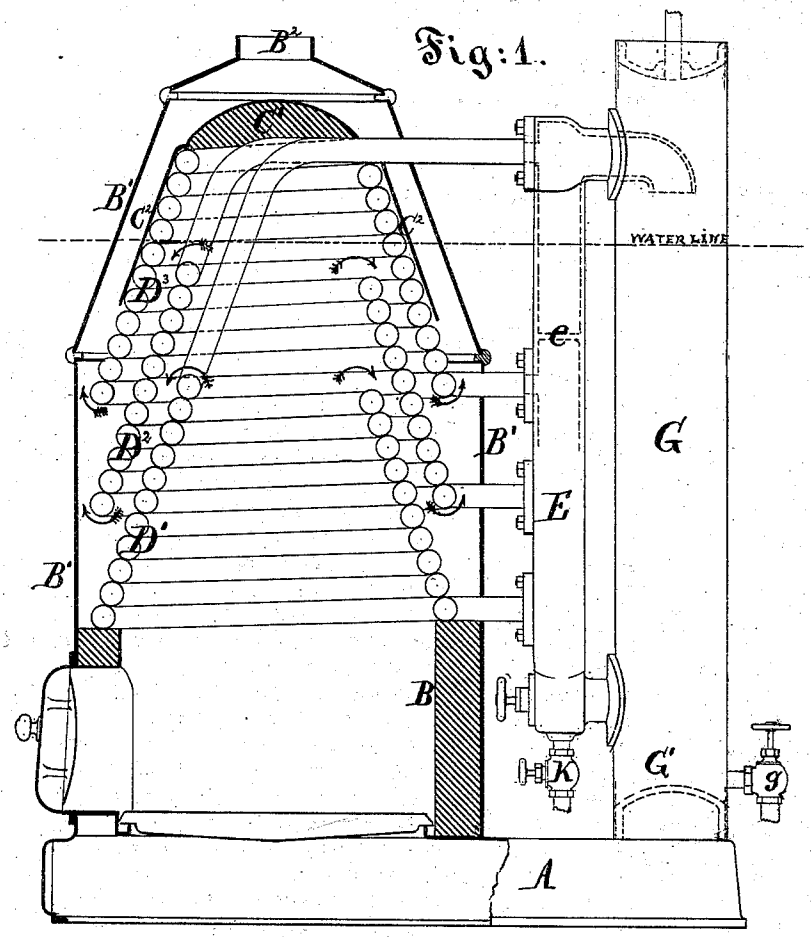



Fig: 2.

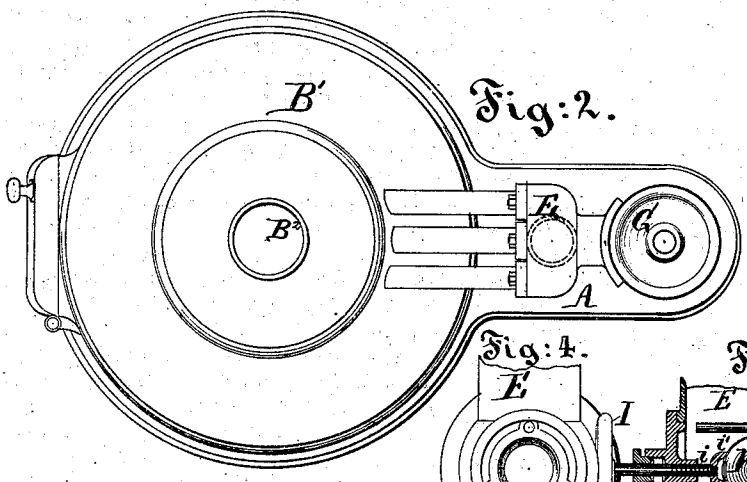



Fig: 4.

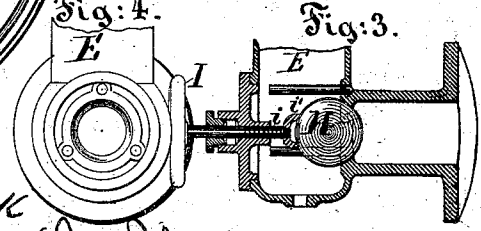



Fig: 3.




Witnesses:

A. Henry Gentner Jr.

Chas. C. Stetson.

Geo. H. Babcock

S. Wilcox

by their Attorney D. D. Stetson

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

# UNITED STATES PATENT OFFICE.

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

## IMPROVEMENT IN WATER-COIL STEAM-GENERATORS.

Specification forming part of Letters Patent No. **192,214**, dated June 19, 1877; application filed November 28, 1876.

*To all whom it may concern:*

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

We propose to employ a series of coils formed each in the shape of a frustum of a cone, arranged one above another, and partly surrounding each other. The draft is caused to pass outward between each cone and the next. There is a separate and independent circulation of the water through each. The separation of the steam from the water is effected in an upright drum, which may be of thin metal, illy adapted to allow so many separate connections. To obviate this we provide a second vessel, which may be of small section, but of nearly equal height, and which, being of thick metal, allows the connections to be easily made at the proper heights. The bottom of the main drum, extending below the lowest connection, forms a mud-collecting space. The coils are incased in thin metal, and the whole, together with a suitable fire-brick furnace, door, and ash-pit, with the necessary accessories, are rigidly connected together. To avoid the regurgitation and irregularities sometimes experienced with coil-boilers when their action is forced, we provide a valve which controls the communication between the lower part of the drum and the coils. This valve allows the water to issue from the drum into the coils, and prevents its return, however sudden or violent may be the generation of steam in the coil. We provide means for controlling the opening of this valve. This valve, having its opening properly limited, regulates the flow and keeps the circulation approximately steady and uniform. In addition to the ordinary provisions for blowing off from the mud-collector at the bottom of the main upright drum, we provide for blowing off from the bottom of the intermediate vessel, and so manipulate the valves that the current shall pass violently through the coils and tend to clean them.

The accompanying drawings form a part of this specification, and represent what we consider the best means of carrying out the invention.

Figure 1 is a vertical section through the main body, and a side elevation of the separating drum and intermediate vessel. Fig. 2 is a plan view of the whole. Fig. 3 is a section through a part on a larger scale; and Fig. 4 is an end elevation of the same.

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

A is a foundation-plate, which may be of cast iron of suitable depth to form the ash-pit. B is a furnace-wall of fire-brick. $B^1$ is a casing of sheet-iron properly connected together, and inclosing the coils with a sufficient space for the passage of the products of combustion. $B^2$ is the base of the chimney. $C^1$ $C^2$ is a casing serving as a sort of baffle-plate, the central and upper portion $C^1$ being of fire-clay, properly supported, and $C^2$ being a flaring extension downward from the periphery. $D^1$ $D^2$ $D^3$ are conical coils telescoped one over the other, as shown. E is what we designate the intermediate vessel. The top of each coil is connected to the top of this vessel. The bases of the several coils are connected to the vessel E at different levels. A partition, *e*, divides the vessel E into upper and lower parts, which are entirely disconnected. G is a tall drum of thin metal. The upper chamber of the vessel E communicates therewith near the top. The lower part of the vessel E communicates therewith near the bottom. But there is a space, G′, at the bottom of the drum G, which is below the connection to the intermediate vessel E. A valve, *g*, allows the discharge of water and mud from this space G′ when desired.

The communication between the top of the intermediate vessel E and the top of the separating-vessel G is always open. But the lower connection is controlled by an intermediate valve, H, (see Fig. 3,) which allows the water to flow from G into E, but prevents its return. A hand-wheel, I, operates a screw, *i*, which carries a suitable bearing-piece, *i′*, to act against the valve H and limit its motion.

The several convolutions of the coiled pipes $D^1$ $D^2$ $D^3$ are applied so closely together that there is but little space for the direct escape of the gaseous products of combustion from the furnace or central line of the coils to the annular space outside thereof. The gaseous products of combustion flow outward principally or entirely by moving obliquely down-

ward through the space between $D^1$ $D^2$, and also through the space between the coils $D^2$ $D^3$. Arriving at the exterior of the boiler, the gases move freely upward and are discharged through the chimney, as will be obvious.

The construction and arrangement of the several coils and their connections gives a very favorable exposure of the whole to the heat. The lowermost coil $D^1$ receives the most heat, and its circulation is the most active. A good circulation is maintained in the whole. By removing the exterior casing $B^1$, the spaces are easily cleaned. Either coil is readily accessible or exchangeable.

The heat is well absorbed from the gaseous products of combustion. The hottest gases are retained the longest.

It is an infirmity of coil-boilers, as ordinarily constructed, that the coil or coils become overheated, and deliver steam and water intermittently. Our experiments indicate that it is due to an intermittent backward flow. The steam at one moment being generated rapidly drives steam and water before it out through the proper passage above, but, being unable to relieve itself in that direction with sufficient rapidity, it acts backward and drives back the water which is being admitted through the proper passage below. This empties the coil and aggravates the evil by allowing the metal to become still more highly heated, and the action is repeated indefinitely. Our valve H prevents this regurgitation.

The hand-wheel I and its connections determine the extent of opening of the valve H. When it is desired to clean the coils, the hand-wheel I is operated to tightly close the valve H, and, the coil blow-off cock K being opened, the lower part of the vessel E and, consequently, of the connecting coils, is put in free communication with the atmosphere, while the drum G remains filled with steam and water at high temperature and pressure. The result is a violent downward or backward motion of the steam and water through the coils, thoroughly cleansing them of all that is detachable.

In the ordinary working the blowing-off cocks *g* and K are closed, and, the proper connections being opened for supplying feed-water and taking away the steam, the water flows continuously from the base of the drum G past the valve H, and upward and inward through the coils $D^1$ $D^2$ $D^3$, and through the proper connection represented from the upper end of each coil, into the top of the intermediate vessel E, and thence is discharged with a downward deflection into the separating-drum G, from the top of which the dry steam is taken to be used.

When thus working, the hand-wheel I may be turned in one direction or the other, to allow a greater or less flow of the water past the valve H, so as to maintain a steady action. When, under any extraordinary conditions, as after long stopping, with an intense fire, the boiler acts intermittently, the valve H may be held almost closed, and the water thus limited in its rate of flow into the several coils.

Many modifications may be made without entirely defeating the objects of the invention. Among others the degree of taper of the several conical coils $D^1$ $D^2$, &c., may be varied, and they may even be made strictly cylindrical, telescoped one into the other, as shown. Even so great a modification as to make the several coils of equal size, but cylindrical, and mounting them exactly in line with each other, with other means for the discharge of the gases, would still afford the advantage that the coils are short, and the steam generated in the lowermost is discharged through an independent connection to the drum G, while the next coil, $D^2$, a little higher, is supplied, not with mingled steam and water from the coil below, but with dense water coming freshly from the drum; and so for any other number of short coils mounted one higher than the other.

We claim as our invention in coil-boilers—

1. The combination of two or more distinct coils, mounted at different levels, and each connected independently with a separating-drum, as and for the purposes herein specified.

2. The series of conical coils $D^1$ $D^2$, &c., telescoped and inclosed, as and for the purposes herein specified.

3. The baffle-plate $C^1$ $C^2$, in combination with the series of conical coils, and with the inclosing case, to induce a downward draft through the conical spaces between the coils, as herein set forth.

4. The intermediate vessel E, in combination with the separating-drum G and a series of coils, $D^1$ $D^2$, &c., as and for the purposes specified.

5. The self-acting valve H, in combination with a coil-boiler, and with a separating vessel, to prevent the regurgitation of the water and steam, as herein specified.

6. The valve-controlling means I, in combination with the valve H, and with one or more heating-coils, and with the separating-drum G, as herein specified.

7. In combination with a coil-boiler having a separating-drum, G, and a valve, H, with closing means, as shown, the blow off valve K, adapted to induce a violent passage of the steam and water through the coils, as and for the purposes herein specified.

8. The mud-space G′, below the bottom connection in the drum G, in combination with the blow-off cock *g*, and with provisions for the generation of steam in one or more connected coils, as and for the purposes herein specified.

In testimony whereof we have hereunto set our hands this 20th day of November, 1876, in the presence of two subscribing witnesses.

GEO. H. BABCOCK.
STEPHEN WILCOX.

Witnesses:
L. C. WARNER,
NAT. W. PRATT.