G. H. BABCOCK & S. WILCOX, Jr.

STEAM GENERATOR.

No. 65,042. Patented May 28, 1867.

Fig. 2.

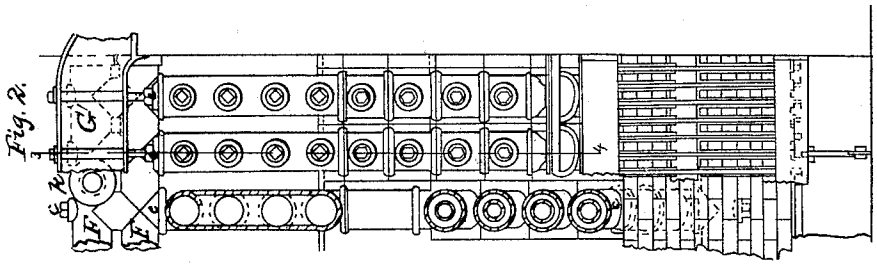
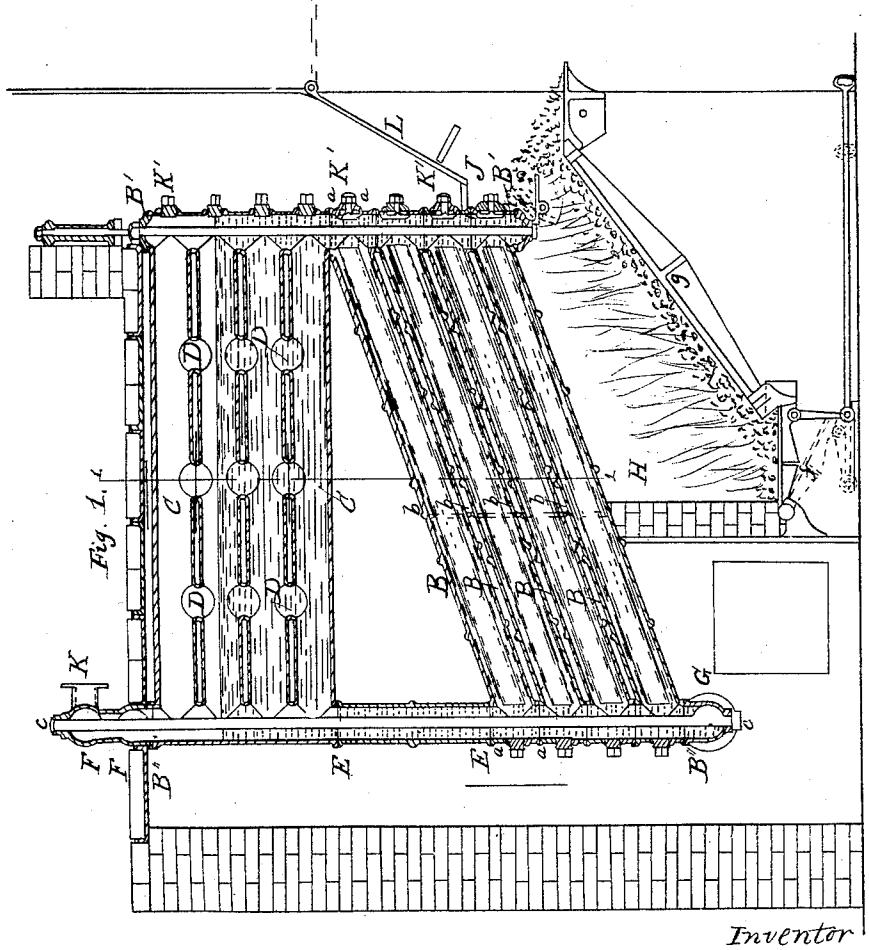


Fig. 1.



Witnesses

H. B. Vincent

Inventor

Geo. H. Babcock

Stephen Wilcox Jr

THE WIRRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

United States Patent Office.

GEORGE H. BABCOCK AND STEPHEN WILCOX, JR., OF PROVIDENCE, RHODE ISLAND.

Letters Patent No. 65,042, *dated May* 28, 1867.

IMPROVEMENT IN STEAM GENERATORS.

The Schedule referred to in these Letters Patent and making part of the same.

TO ALL WHOM IT MAY CONCERN:

Be it known that we, GEORGE H. BABCOCK and STEPHEN WILCOX, Jr., both of the city and county of Providence, in the State of Rhode Island, have invented certain new and useful Improvements in Steam Generators; and we do hereby declare that the following specification, taken in connection with the drawings making a part of the same, is a full, clear, and exact description thereof.

Figure 1 is a longitudinal and vertical section of the apparatus in a plane through the line 3–4 of fig. 2.

Figure 2 is partly a front elevation and partly a transverse section in a plane through the line 1–2 of fig. 1.

The apparatus herein described belongs to that class of steam boilers whose peculiarity is that in them water, during its conversion into steam, instead of being confined in one mass as in the common steam boilers, is contained in a number of vessels of small capacity independent of each other in this, that each vessel is distinct in itself, but connected together by means of pipes for the purpose of aggregating the power of the steam which is developed in each. The great capacity of steam generators of this class to resist the explosive forces liable to be developed in any one of the several vessels, the certainty that no wide spread destruction can ensue in case rupture in any one vessel occurs, and the economy of their construction, from the fact that cast iron can be safely employed to compose the generating compartments, give to them manifest advantage in these particulars over the various kinds of single-shell wrought-iron boilers in common use. On the other hand the deficient circulating capacity of this class of generators, the difficulty of removing incrustations from the interior of the generating vessels, which deposits are increased by a sluggish circulation of the water and a want of economy in the application of the heat of the furnace to the fire-surface to be acted upon, are disadvantages which go far to counterbalance the good capacities mentioned. Our invention seeks to remedy these defects and to combine in one apparatus, for producing steam, the advantages and conveniences which belong to generators of both the above-named classes.

In the accompanying drawings there is exhibited in fig. 1 one section of the generator, and in fig. 2 there are seen several of such sections united. Each section is composed of two sets of pipes, say of about five inches diameter, one of which sets is in a horizontal position, and the other is inclined at an angle therewith. The space A so formed between the two sets of pipes constitutes a chamber for the combustion of the gases of the fuel used in the furnace. The drawing exhibits these pipes in sets of four, which number may be increased or diminished to suit the judgment of the constructor. Each of the pipes B, composing the series, which is inclined, is cast separately, and made with a T-head, *a a*, fig. 1, cast with the pipes, so that when the several pipes of the series are placed one above the other, as shown at fig. 1, such heads will constitute integral prts of continuous side pipes B′ B′ and B″ B″. In this way a joint at the junction with the side pipe is not only avoided altogether, but a manifest advantage is obtained in the facility with which the several pipes can, as will presently be seen, be clamped together to form a united structure. These T-heads, which may be flanched or not, should be milled or brought to a true face upon their edges, so as to allow of being tightly packed at the joint. Each one of the pipes of this series is also made with a square flanch, *b b*, of such size that when the several pipes of each section and the several sections of pipes are arranged in order, such flanches will constitute a continuous transverse partition and a portion of the back wall of the fire-chamber. The series of horizontal pipes C composing each section is made in one casting, and is connected together by the perpendicular short pipes D, as shown. Each section of pipes to compose the generator being fitted as exhibited in fig. 1, and an intermediate piece of pipe, E E, prepared so as to complete the connection at the rear end between the set of inclined and the set of horizontal pipes, the generator is ready to be put together. The several sections are now to be built up, as shown in fig. 1, and the sections arranged side by side until the desired capacity is obtained. The sections are connected together at the top by the double transverse pipes F F, fig. 2, and at the bottom by the single transverse pipe G, fig. 1, provided with nozzles *e e e*, fig. 2, corresponding in size and distance from each other with the ends of the rear side pipes B′ B′. These transverse connecting pipes are secured to the several sections by rods *c c*, which pass through them and the axes of the side pipes, and are provided with nuts at their ends for clamping the structure together. Similar clamp-rods are also employed to

tie together the several pipes of each section at their front ends, which rods, at their upper ends, pass through and are sustained by an overhanging yoke, G′, fig. 2. H is the furnace, having a hinged ash-grate, *f*, and a stationary inclined grate, *g*, the coals being fed through the opening I. As the spaces between the sections of pipes constitute the flues, it will be seen that the flames and combustible gases pass, as indicated by the arrows, first into the combustion-chamber A, thence downward between the pipes of the inclined series on the back side of the partition wall formed by the flanches *b* already described, (this being the only outlet from the combustion-chamber,) for the reason that each of the sets of side pipes B B and B′ B′ from their bottoms to the point of junction with the series of horizontal pipes, as well, also, as the lowest pipe of the several sections of the horizontal series, is cast with longitudinal fins or flanches along its sides, so that when the several sections are arranged side by side there will be formed a wall whenever the edges of such fins abut. The smoke and products of combustion having passed downward through the flues as indicated, enter this space between the generator and the brick walls of the chamber in which the same are set, and passing upward along the back side of the side pipes B″ B″ continue through the longitudinal flues between the series of horizontal pipes to the front of the generator, whence they escape by suitable flues into the chimney. It will be readily understood that aside from the incidental formation of a combustion-chamber, A, the arrangement of the two series of inclined and horizontal pipes accomplishes the following important effects upon maintaining in one direction throughout the generator a constant circulation of the water: The temperature of the water in that portion of the series of inclined pipes which projects beyond the line of the rear wall of the fire-chamber is necessarily lower than the temperature of the water in that portion of the pipes directly over the furnace. Also this difference in temperature is increased from the circumstance that the feed-water is admitted through the nozzle G, and passes directly from the side pipes B′ B′ into the series of inclined pipes, and thence into the series of horizontal pipes, and never in the reverse direction. As the steam disengages itself from the water it will pass upward through the short connecting pipe D of the horizontal series, and seeking the highest point enter the transverse pipe F and be delivered at the nozzle K. And thus a constant and complete circulation of water throughout the generator in one direction will be always maintained, while the steam will be freed therefrom so soon as formed and pass off through the series of upright connecting pipes D, which should be sufficiently numerous to meet the requirements of the case.

In order that this principle may be carried out to the best advantage, and to prevent the possibility of the water foaming in the side pipes B′, which, as already stated, are the conveyers of the water contained in the whole series of inclined pipes, and possess relatively to the aggregate of them a reduced capacity in proportion to their respective numbers, we have introduced into each of the inclined pipes small circulating pipes, shown in section in fig. 2, which are simply plain cylindrical pipes extending through the axes of the main pipes from front to rear, and which have the effect here, as in other instances when they are applied, to allow the colder particles of water in the main pipes to separate from the warmer particles and be returned through such pipes to the lower end of the main pipes. For convenience in removing any incrustation upon the inside of the pipes of both series, we have provided hand-holes K′ at each end of the same, covered by suitable plates, which, when removed, will afford every facility for scraping out the inside of the pipes; and to enable the flues of the horizontal series, as well as these hand-holes, to be conveniently reached, we construct the front of the furnace with a hinged man-hole door, L.

What we claim as our invention, and desire to secure by Letters Patent, is—

1. A steam generator made up of sections of pipes, each of the several sections being composed of a series of inclined pipes, B, and a series of horizontal pipes, C, united at the ends by distinct side pipes appropriate to each section; the several sections, when arranged side by side and connected, forming an intermediate combustion-chamber, A, and operating to cause a constant circulation of the water through the pipes in one direction, substantially as described.

2. In combination with the series of horizontal pipes C, the series of upright connecting pipes D for the purpose of allowing the steam, as formed, to separate from the water and rise to the discharge aperture, arranged substantially as described.

G. H. BABCOCK,
STEPHEN WILCOX, JR.

Witnesses:
W. B. VINGENT,
W. W. RICKARD.