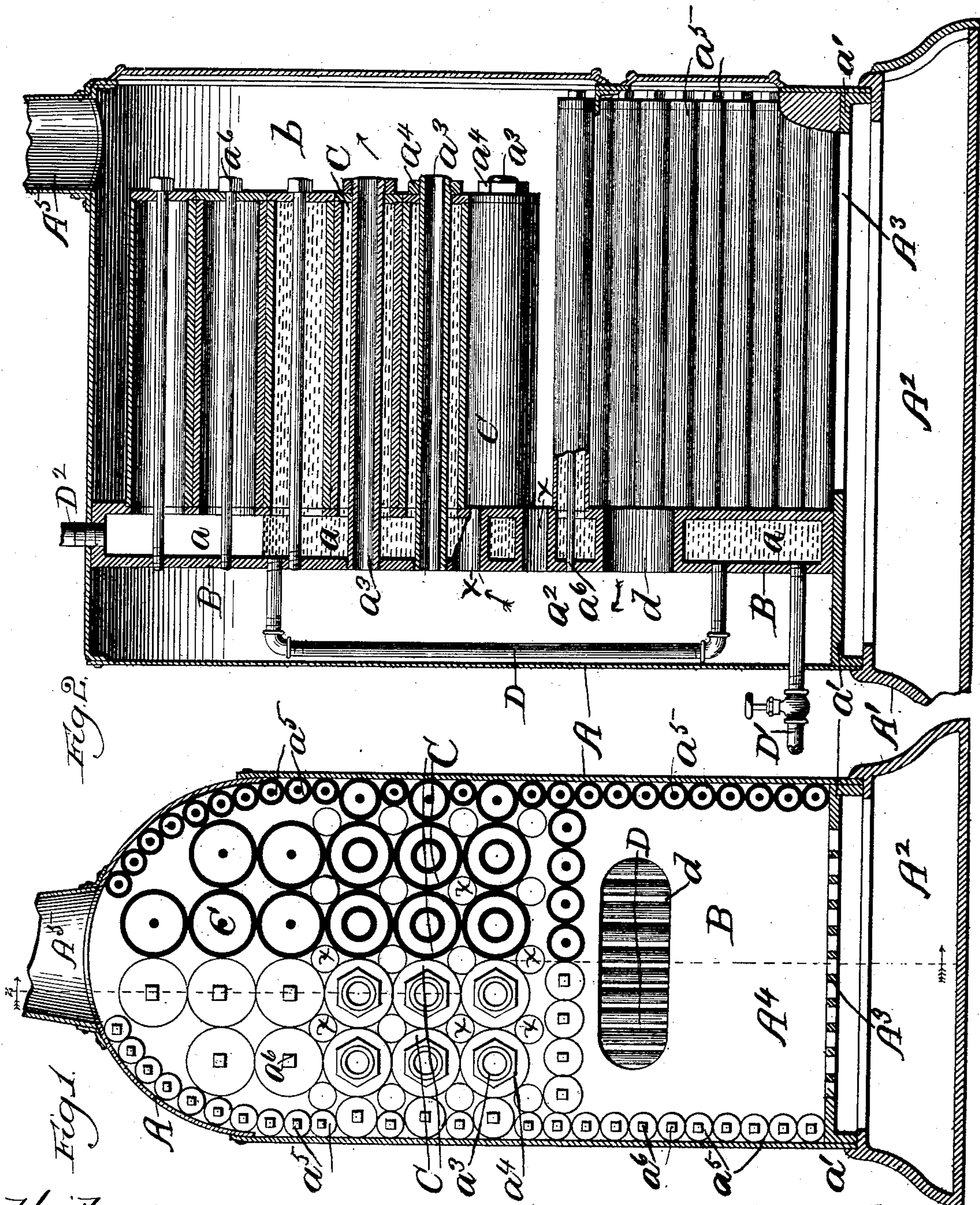


(No Model.)

H. H. WARD.  
STEAM GENERATOR.

No. 359,193.

Patented Mar. 8, 1887.



Witnesses:  
Chas. E. Gaylord.  
L. M. Freeman.

Inventor:  
Henry H. Ward  
By L. B. Coupland & Co.  
Attys.



# UNITED STATES PATENT OFFICE.

HENRY H. WARD, OF BATAVIA, ILLINOIS.

## STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 359,193, dated March 8, 1887.

Application filed June 8, 1886. Serial No. 204,447. (No model.)

*To all whom it may concern:*

Be it known that I, HENRY H. WARD, of Batavia, county of Kane, and State of Illinois, have invented certain new and useful Improvements in Steam-Generators, of which the following is a full, clear, and exact description, that will enable others to make and use the same, reference being to the accompanying drawings, forming a part of this specification.

The object of this invention is to provide a steam-generating apparatus having largely-increased heating-surfaces in order to utilize all or nearly all of the products of combustion.

The nature of the invention consists in constructing a generator of tubes or pipes so arranged as to present a large heating-surface to the action of the flames, and combining therewith the qualities and advantages of a quick steam-raising apparatus, all as will be herein-after set forth, and pointed out in the claims.

Figure 1 is a front elevation and partial section of a steam-generating apparatus embodying my improved features; and Fig. 2, a vertical longitudinal section in the angular plane 2 2, Fig. 1, looking in the direction indicated by the arrows.

In the drawings, A represents a metallic jacket inclosing the apparatus; A', a hollow supporting-base containing the ash-pit A<sup>2</sup>; A<sup>3</sup>, the line of the grate-bars; A<sup>4</sup>, the combustion-chamber, and A<sup>5</sup> the smoke-escape pipe.

The double or hollow back tube-plate B is provided with the water and steam spaces  $a$ , (see Fig. 2,) which communicate with each other. This tube and flue-plate is supported on the horizontal angle-plate  $a'$ , which in turn rests upon the base A'. The plate  $a'$  also provides an inclosing-bottom for the compartment  $a^2$ , formed by leaving the space (shown in Fig. 2) between the rear side of the back-plate B and the walls of the inclosing-jacket. The back ends of the larger water-tubes, C, abut against the front side of the tube-plate B. Some of the tubes C are supported in position and clamped endwise by means of the flues  $a^3$  and the clamping-nuts  $a^4$ , while the rest of the large tubes and the small tubes  $a^5$  are secured in place by means of the clamping-rods  $a^6$ . The flues  $a^3$  are arranged on the inside of the water-tubes, and are of a less diameter, so as to provide the annular water-space between

the tubes and flues, as shown in Fig. 2. The back ends of the flues pass through to and are screwed into the back part of the plate B, while the front projecting ends are provided with the screw-threaded clamping-nuts  $a^4$ , by which means these parts are drawn close together to form tight joints. The tubes and flues are secured at the back ends only, the front ends being left free.

The series of tubes C are arranged to have contact with and rest against each other their entire length, so as to form flue-passages for the heat coming through the openings  $x$  in the double flue-plate B, as shown in Fig. 1. By nesting the tubes C together in this manner every four tubes form an additional flue-passage, thus greatly increasing the heating-surface.

The two sides of the fire-box are lined with the series of horizontal tubes  $a^5$ , which rest upon each other and extend clear to the top of the generator, as shown in Fig. 1. These series of tubes lining the two sides are of a greater length than the tubes C, (see Fig. 2,) and extend from the back plate, B, clear to the front. A space or compartment,  $b$ , is provided at the front of the apparatus which communicates with the smoke-pipe. By this arrangement the heating-surface and generating capacity of the apparatus are greatly increased.

A number of water-circulating pipes, D, are arranged vertically in the compartment  $a^2$  back of the tube-plate B. The lower ends of these pipes communicate with the water-space of the tube-plate B at a point back of the fire-box, the upper ends being inserted just below the water-line, as shown in Fig. 2. This arrangement of water-circulating pipes also greatly increases the heating-surface and utilizes heat that would be otherwise lost.

The portion of the tube-plate forming the back part of the fire-box is provided with the elongated opening  $d$ , (see Fig. 1,) through which the products of combustion escape, the heat striking the pipes D and then passing through the flues  $a^3$  and the passages  $x$  to the front on the way to the smoke-pipe.

D' is the feed-water pipe, and D<sup>2</sup> the safety-valve connection.

This form of construction and arrangement provides a very compact apparatus, and pre-



sents so great an amount of heating-surface as to utilize all or nearly all of the heat from the fuel expended.

The structure shown forms a portable apparatus; but a stationary generator may be provided by substituting brick walls for the inclosing-jacket shown.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a steam-generating apparatus, the combination, with a back or tube plate, B, having a water-compartment and provided with the openings *x*, of a series of tubes, a number of flues arranged on the inside of said tubes, and the means for securing said parts in proper relation to each other, substantially as described.

2. In a steam-generating apparatus, the series of tubes C, which have contact with and rest against each other to form additional flue-passages, in combination with the flue-plate B, provided with the openings *x*, which open into the passages formed by the nesting of said tubes, substantially as set forth.

3. In a steam-generating apparatus, the combination, with the double back-plate having a water-compartment, of a series of horizontal water-tubes resting one upon the other and inclosing two sides of the fire-box, the back ends of said tubes having a circulating-connection with the front side of said back-plate, while the front ends are free, substantially as described.

4. In a tubular steam-generating apparatus, the combination, with a double back-plate supporting the tubular structure and provided with the elongated opening *d*, of the series of vertical water-pipes D, having both ends inserted in the rear side of said back-plate and communicating with the water-compartment therein, substantially as and for the purpose set forth.

HENRY H. WARD.

Witnesses:

L. M. FREEMAN,  
L. B. COUPLAND.