

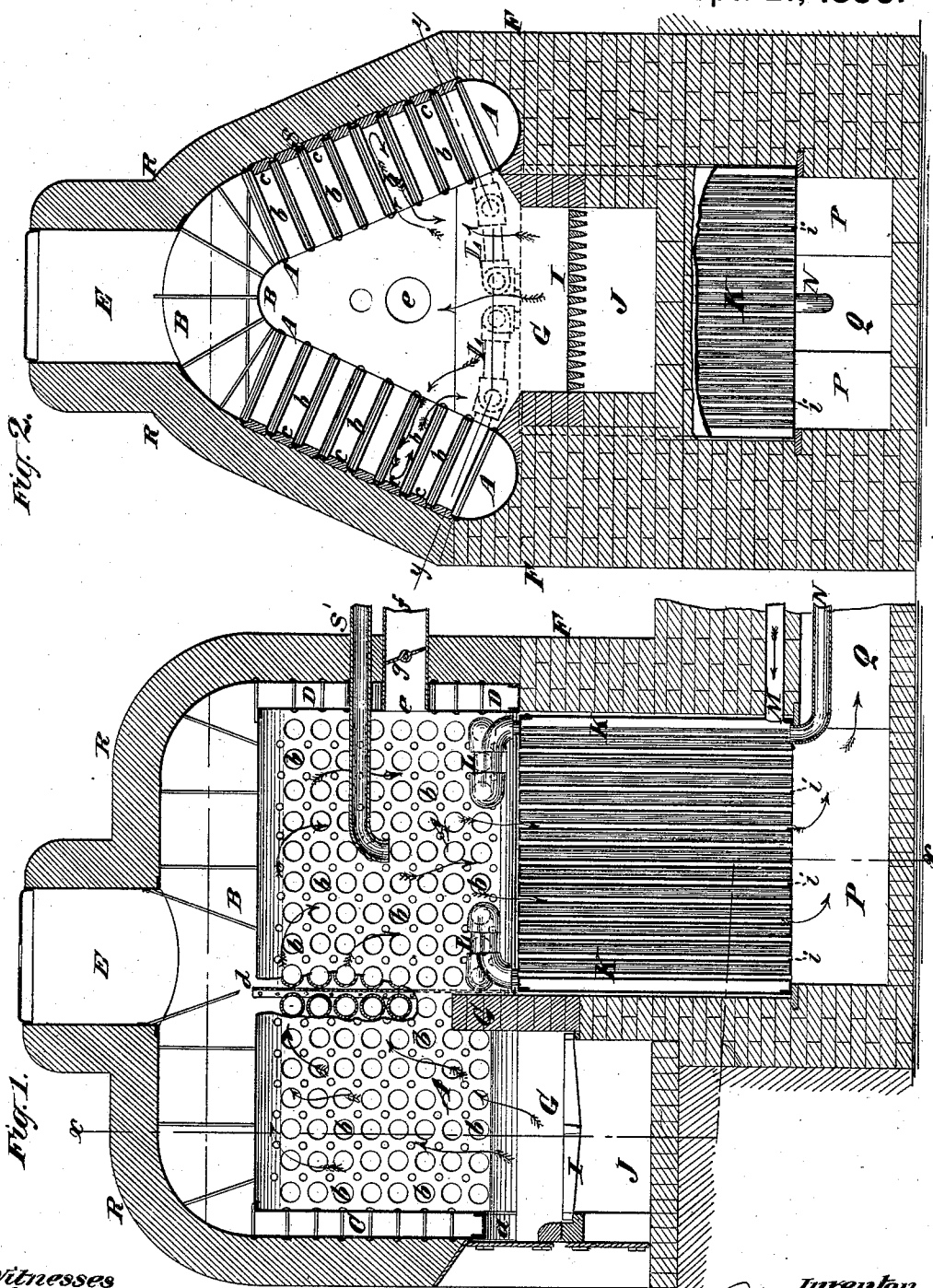
(No Model.)

2 Sheets--Sheet 1.

D. DAVISON.
Steam Generator.

No. 232,465.

Patented Sept. 21, 1880.



Witnesses
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Fred Haynes

Inventor
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by his Attorneys
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(No Model.)

2 Sheets—Sheet 2.

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Fig. 3.

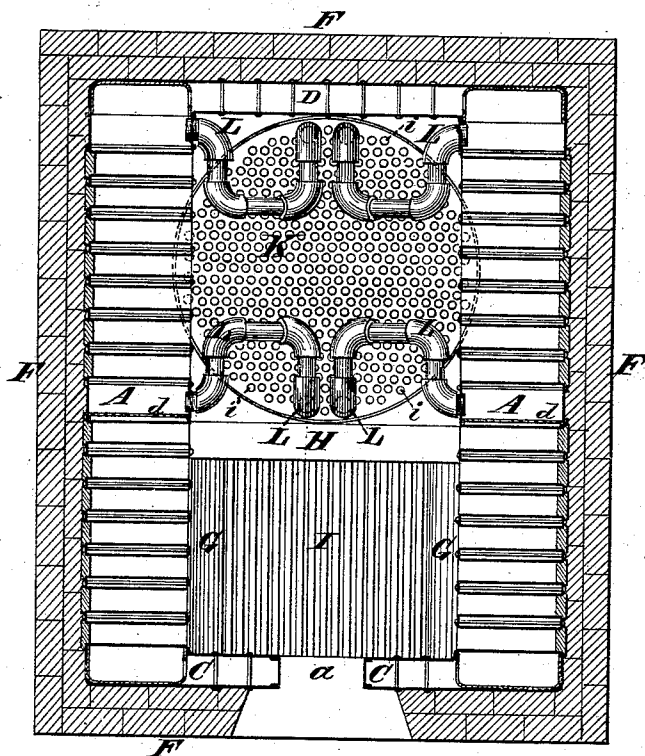
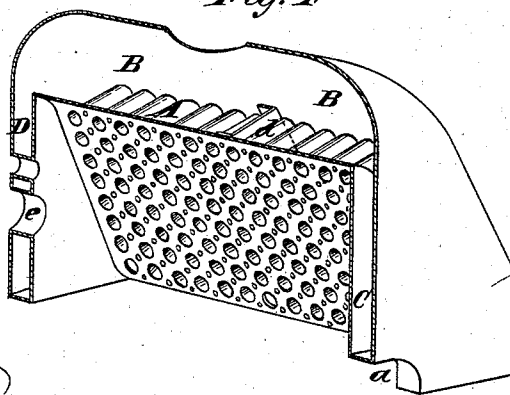


Fig. 4.



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UNITED STATES PATENT OFFICE.

DARIUS DAVISON, OF NEW YORK, N. Y.

STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 232,465, dated September 21, 1880.

Application filed May 6, 1880. (No model.)

To all whom it may concern:

Be it known that I, DARIUS DAVISON, of the city, county, and State of New York, have invented certain new and useful Improvements in Steam-Generators, of which the following is a specification, reference being had to the accompanying drawings.

The principal objects of this invention are as follows: first, to effect as nearly as possible a perfect combustion of the fuel used and the gases eliminated therefrom; second, to provide a very large area of heating-surfaces and such an arrangement of them as to obtain the greatest benefit from the radiant heat of the fire, and to retain the heated gaseous products of combustion in contact with them long enough to insure the transmission into the water and steam in the generator of all or nearly all of the heat evolved by combustion; third, to obtain such a gradual movement of the water in the generator in an opposite direction to the movement of the gaseous products of combustion that the water and steam are constantly passing from the cooler to the hotter parts of the generator, and especially in accomplishing this object to take advantage of the natural tendency to descend of the gradually-cooling gases and the natural tendency to ascend of the water and steam as they become gradually more and more heated; fourth, to effect the retransmission into the water in the generator of the heat remaining in the exhaust-steam from a steam-engine.

The invention consists in a novel combination of what I call "primary" and "secondary" generators, and novel arrangement of their connections for the circulation of the water and steam within them and of the gaseous products of combustion in contact with their heating-surfaces, and in a novel construction of what I call the "primary generator," whereby the above-mentioned objects are attained.

Figure 1 in the drawings is a central vertical section of a combination of primary and secondary generators illustrating my invention. Fig. 2 is a transverse vertical section taken in the indirect line *x x*, shown in Fig. 1. Fig. 3 is a horizontal section taken in the line *y y* of Fig. 2. Fig. 4 is a perspective longitudinal central sectional view of the primary generator.

A A B C D indicate the principal parts of a primary generator of the form which I propose generally to employ. Its transverse sectional form is substantially that of a saddle, it being composed of two horizontal water-legs, A A, set wide apart at the bottom and inclining upwardly and inwardly toward each other and forming the principal water-spaces, a hollow arch, B, uniting said legs at the top throughout their whole horizontal length and forming in part water-space and in part steam-space, and two hollow ends, C D, which extend all across the hollow arch and across the space between the two water-legs and form communications between the water-spaces within the legs, from top to bottom thereof, and between the said spaces and the space within the hollow arch B, the said water-legs, hollow arch, and hollow connecting ends constituting one entire body which is double in all its parts—that is to say, has double sides, a double top or crown, and double ends.

On the top of the arch I make a steam-dome, E. The bottoms of the legs are preferably rounded, as shown in Figs. 2 and 4. The legs and other parts are suitably braced internally. An opening, *a*, is provided in the front C for the fire-door.

In the legs A A are a number of tubes, *b b*, secured in the inner and outer walls thereof and inclining upward and outward, the inner ends of the said tubes being open and the outer ones being closed either by stoppers *c c*, of fire-clay, or in any other suitable manner. Across the interior of the legs A A, more or less near to the middle of its length, are upright water-tight partition-plates *d d*, which reach entirely across the said legs from the bottom thereof upward to or near the height of the lower plates of the hollow arch B, to prevent any horizontal circulation of the water in the legs and keep the water in the back part thereof entirely separate from that in the front part thereof. These plates, however, not extending above the lower plates of the hollow arch B B, do not prevent the flow of water through the said arch. The primary generator thus constructed is supported at the bottom of its legs and ends upon a setting, F F, of masonry or other material, within which and under the front part of the generator is pro-

vided a fire-place, G, with grate I and ash-pit J, at the rear of which is the bridge-wall H, which may extend some distance upward between the water-legs A A. The sides, top, and ends of this generator are covered externally with plaster-of-paris or other non-conducting material, as shown at R R.

K is the secondary generator, of upright tubular construction, consisting of an upright water-cylinder, arranged in rear of the bridge-wall H, immediately below the open space between the water-legs A A of the primary generator, and having in it a series of upright tubes, *i i*, for the direct downward circulation through it of the gaseous products of combustion escaping from the primary generator. This secondary generator is connected at its upper part by pipes L L with the lower parts of the water-legs A A, and it has connected with its lower part the feed-pipe M, which supplies it and, through it and the pipes L L, the primary generator with water. It has a blow-off pipe, N, at the bottom.

Below the secondary generator K is a pit, P, which forms the communication from both generators with the main flue Q, leading to the smoke-stack or chimney. An opening at *e* through the back D of the primary generator forms a communication with a flue, *f*, which leads directly from the primary generator to the smoke-stack or chimney, to be used for starting the fire under the primary generator. This flue *f* is furnished with a damper, *g*, to be closed after the fire has been started. Into the rear part of the open space between the legs A A and under the hollow arch B of the primary generator is introduced a pipe, S, with a downward outlet, for the introduction therein of exhaust-steam from a steam-engine.

The operation of these generators is as follows: Both generators having been supplied with water to the requisite level—that is to say, the secondary generator being full and the primary one being filled to above the level of the lower plates of the hollow arch B—the damper *g* in the draft-pipe *f* is opened and a fire is made in the furnace. When the fire has been well started the damper *g* is closed and the draft then passes down through the tubes *i i* of the secondary generator to the lower flue-connection, P, and thence by the flue Q to the chimney.

Cold or hot air may be introduced into the fire-place above the grate or at any suitable point or points within the space formed between the legs A A, under the arch B, to supply the requisite oxygen to effect the perfect combustion of the gases eliminated from the fuel on the grate.

The inner walls of the legs A A and the arch B form a large reverberatory combustion-chamber of the whole length of the primary generator, and the circulation of the highly-heated gaseous products of combustion through the chamber is very slow, first upward, then

over the bridge-wall, and thence downward in the rear portion of the chamber and on directly downward through the tubes of the secondary generator, while the circulation of the water is all directly upward through the secondary generator, and through the portion of the primary generator in rear of the partition-plates *d*, and thence over the said plates into the hotter portion of the said generator in front of said plates, the cooler water in the rear part of the legs of said generator being separated from the hotter water in the front part thereof by the partition-plates.

It will be observed that the gaseous products of combustion, after passing the bridge-wall G, and as they gradually part with their heat, have a gradual downward circulation, while the water has, in the corresponding parts of the generators, a gradual upward movement, and hence the water and the steam generated from it are constantly passing from the cooler to the hotter parts of the generators, the circulation of the gaseous products and the movement of the water and steam being according to the well-known natural laws under which liquid and gases in any confined space have a tendency to assume a relative altitude corresponding to their relative temperatures, their hottest particles ascending to or remaining at the upper part of such space, and their coolest particles descending to or remaining at the lower part of such space.

By this construction, arrangement, and combination of the generators a very perfect combustion of the fuel and its gaseous products is obtained, and not only is the radiant heat from the incandescent fuel most advantageously applied, but the heat evolved from its gaseous products is as nearly as practicable all abstracted and utilized to the very highest degree for the generation of steam.

The heating-surface of the primary generator is very largely augmented by the tubes *b b*, within which there is a constant slow circulation of the gaseous products of the fuel and heated air, such circulation being upward against the inclined surfaces of the upper half of each of said tubes and downward against the inclined surfaces of the lower half thereof, as indicated by arrows in two of the said tubes in Fig. 3.

It may be here stated that the generator herein described as the primary generator may be used without any secondary generator by making in its rear part, or in the place occupied by the secondary generator, a more or less direct connection with the chimney.

The secondary vertical tubular generator can be so proportioned and adapted to its use as to absorb all the heat from the draft-air and heat from the exhaust-steam from the cylinder in which it has been used when such steam is exhausted into the rear part of the primary generator in a downward direction through the pipe arranged for that purpose in connection with the exhaust-ports from the cylinder,

thence to descend, mingled with the draft-air in the primary generator, down through the tubes in the secondary generator to the flue at the bottom thereof, the heat in the draft-air and steam being thus all, or nearly all, transmitted into the steam and water spaces surrounding the tubes in the secondary generator, if it is of sufficient diameter and length or height to have the requisite tube-surface in proportion to the heat produced in the primary generator before the final passage of the hot air and exhaust-steam out of the bottom ends of the tubes in such generator, and thus produce a substantial equilibrium of temperature between the feed-water at the bottom thereof and the air and steam passing therefrom at that point, thus fully utilizing all the heat for the production and reproduction of steam.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. A steam-generator composed of two water-legs inclining upward toward each other, a double or hollow arch uniting the said legs at the top throughout their whole horizontal length, and two hollow upright ends which extend all across the hollow arch and across the space between the two hollow water-legs and form communication between the water-spaces in the legs from top to bottom thereof and between the said spaces and the space within the hollow arch, substantially as herein described.

2. The combination, with a steam-generator composed of water-legs and a double or hollow arch uniting said water-legs at the top, of transverse partition-plates in the said legs reaching all across the same from the bottom thereof to, or nearly to, the level of the bottom of said hollow arch, preventing the horizontal circulation of the water in said legs without interfering with its flow through the hollow arch, substantially as herein described.

3. The combination, in a steam-generator, of hollow water-legs inclining upwardly toward each other and forming the sides of a fire-chamber, and tubes inserted into said water-legs and inclining upwardly and outwardly, open at their inner ends and closed at their outer ends, substantially as herein described.

4. The combination of a primary generator, a furnace for heating the same, a secondary generator composed of an upright water-cylinder arranged below the primary generator, and containing vertical tubes for the direct downward circulation of the gaseous products of combustion escaping from the primary generator, with steam and water connections between the upper part of said secondary generator and the lower part of said primary generator, and a feed-pipe connected with the

lower part of the secondary generator, substantially as herein described.

5. The combination, with a primary generator having within it a transverse partition-plate and heated by a furnace under or within one end, of a secondary upright tubular generator arranged below said primary generator and connected at its upper part with the lower part of the said primary generator on one side only of its upright partition-plate, substantially as herein described.

6. The combination of a primary generator, an upright tubular generator arranged below one part of the said primary generator, and consisting of an upright water-cylinder with tubes for the downward circulation of the gaseous products of combustion from the primary generator, a fire-grate arranged under another part of said primary generator, and a bridge-wall between said fire-grate and said secondary generator, substantially as herein described.

7. The combination of a primary steam-generator having within it a transverse partition-plate, a fire-place arranged under one part of the said primary generator, an upright tubular secondary generator arranged under another part of the said primary generator and connected at its own upper part with the lower part of said primary generator, a bridge-wall between said fire-place and secondary generator, a flue-connection below the said secondary generator, and a feed-pipe near the bottom of said secondary generator, substantially as described, whereby a circulation of water upward through said secondary generator and the part of the primary generator on one side of its transverse partition, and thence over the said partition, is obtained, while the circulation of the gaseous products of combustion is first upward in or under one part of the primary generator and downward through the other part thereof, and thence downward through the said secondary generator, substantially as herein described.

8. The combination, with the primary generator A A B C D, constructed as described, and the fire-place G, bridge-wall H, and secondary generator K, arranged as described in relation thereto, of the exhaust-steam pipe S, introduced between the said primary and secondary generators in rear of the bridge-wall, substantially as and for the purpose herein specified.

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Witnesses:

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