

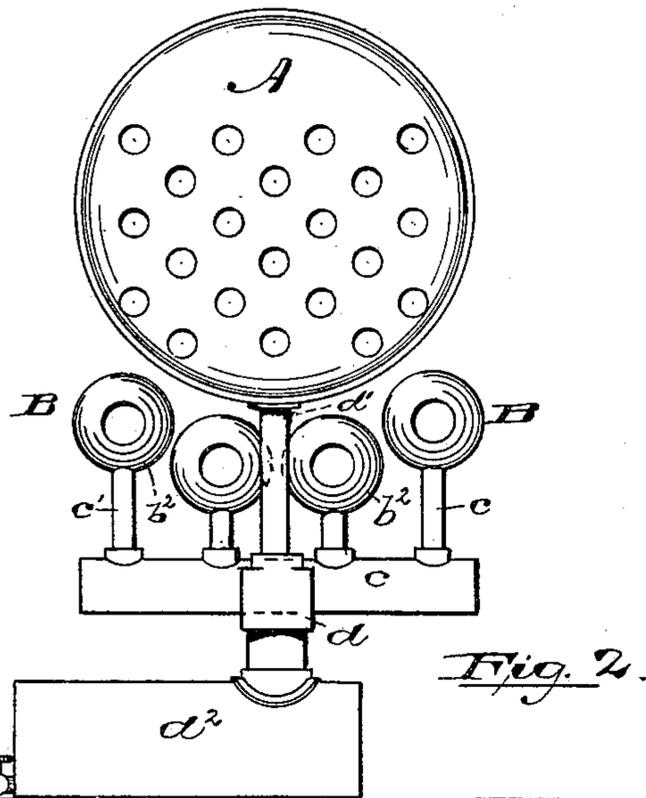
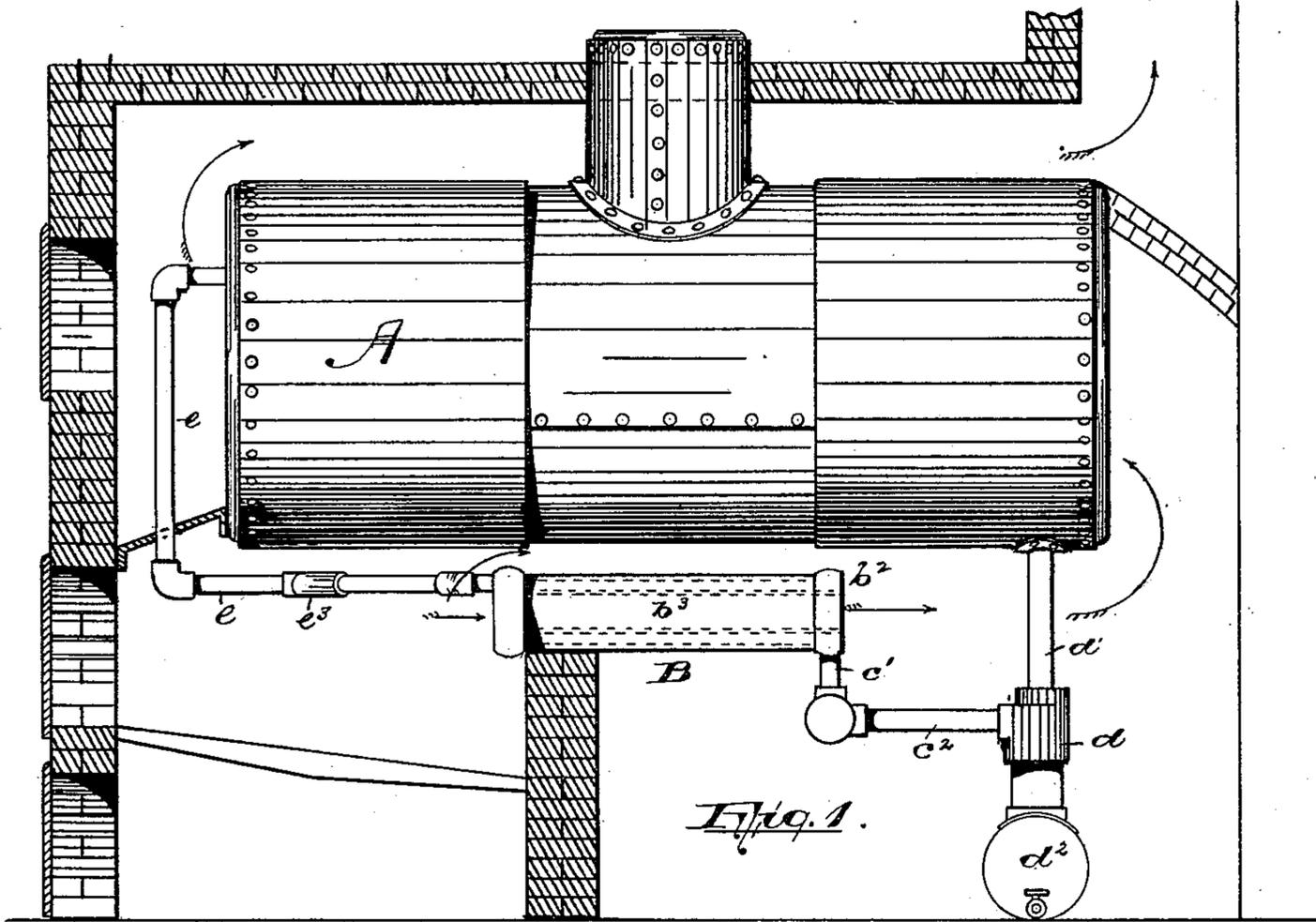
(No Model.)

2 Sheets—Sheet 1.

J. A. ENO.  
STEAM GENERATOR.

No. 344,522.

Patented June 29, 1886.



WITNESSES:

*Frank P. Campbell*  
*Oscar A. Michels*

INVENTORS:

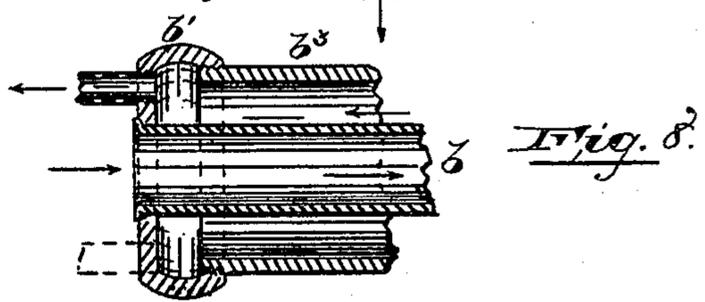
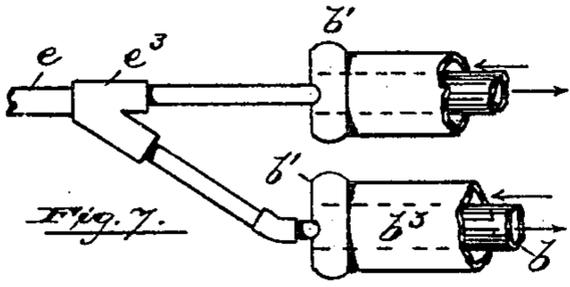
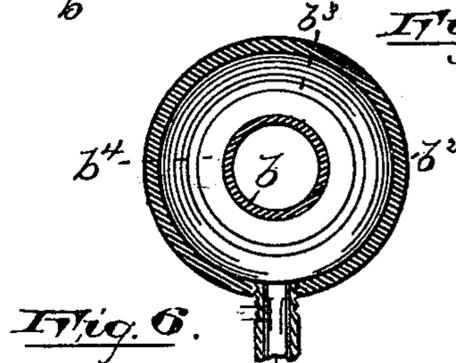
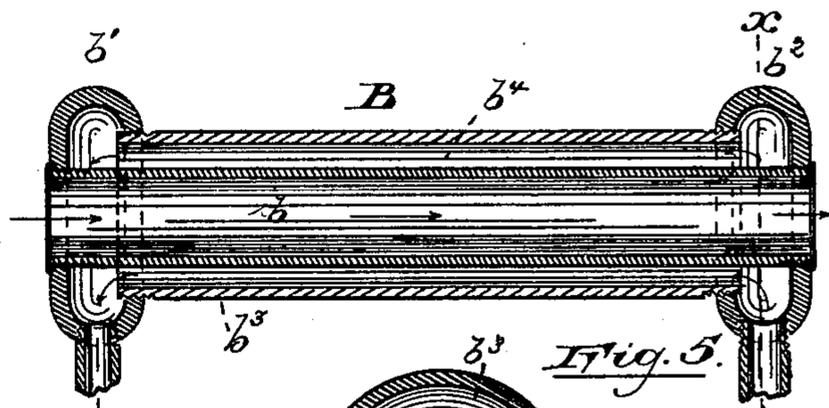
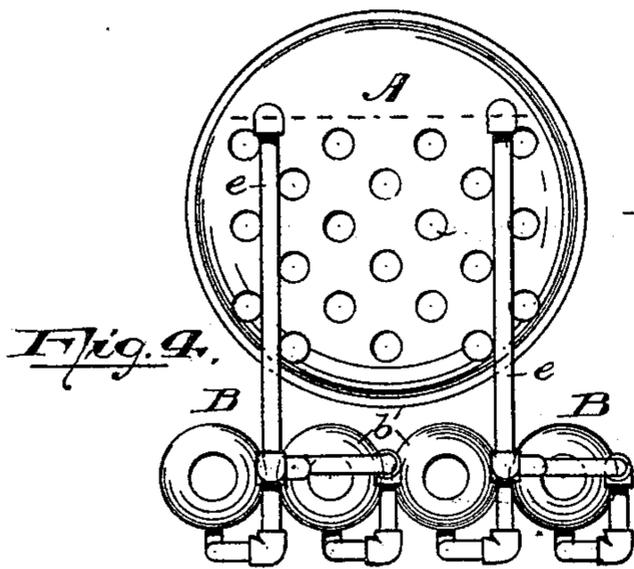
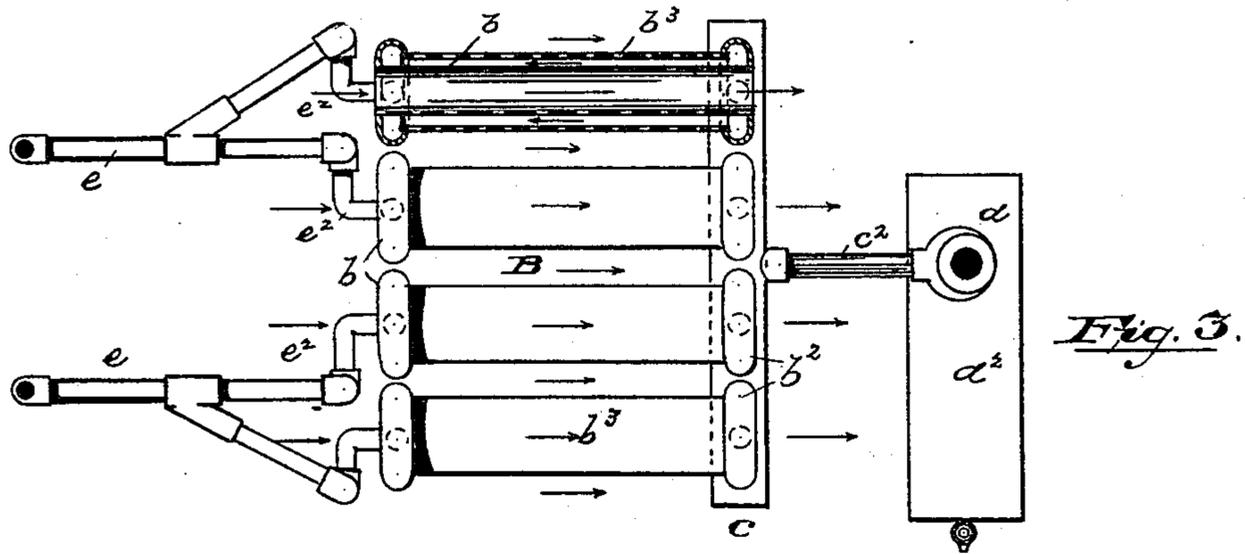
*Joseph A. Eno,*

BY *Drew & Co.*, ATTYS.

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INVENTOR:

*Frank F. Campbell,*  
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*Joseph A. Eno,*

BY *Drake & Co.,* ATTYS

# UNITED STATES PATENT OFFICE.

JOSEPH A. ENO, OF NEWARK, NEW JERSEY.

## STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 344,522, dated June 29, 1886.

Application filed February 12, 1886. Serial No. 191,715. (No model.)

*To all whom it may concern:*

Be it known that I, JOSEPH A. ENO, a citizen of the United States, residing at Newark, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Steam-Generators; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters of reference marked thereon, which form a part of this specification.

The object of this invention is to secure a more complete and effective circulation of the water in steam-boilers or steam-generating apparatus, to remove the sedimentary deposits from said boilers, and thereby increase their durability and the efficiency of the heat, and also to provide a steam-generator which can be readily attached and easily adjusted to a boiler, and so arranged therewith as to utilize to the fullest extent the heat applied thereto without impeding or interfering with the direct action of said heat or the crown-sheets, or the sheets immediately over the fire of said boiler.

The invention consists of a series or group of generator-flues provided with double walls, between and through which the water passes, the water-space in said flues being connected with a boiler or water-tank by suitable pipes, and preferably arranged centrally under said boiler over the bridge-wall, substantially as hereinafter set forth, and finally embodied in the claims.

In the accompanying drawings, in which similar letters of reference are employed to designate like parts in each of the views, Figure 1, Sheet 1, is a side elevation of a boiler to which my improved generator is attached, illustrating one arrangement and construction of the same. Fig. 2 is an elevation of the rear of said boiler and generator. Fig. 3, Sheet 2, is a plan of the generator, illustrating one method of grouping a series of four of said generator-flues, one of said flues being therein shown in section. Fig. 4 is an elevation of the front of the boiler and the generator, the flues being arranged in the same plane. Fig. 5 is a longitudinal section of one of the gener-

ator-flues shown in Fig. 3. Fig. 6 is a section of one of the chambered heads of said flues, taken through line  $x$  on Fig. 5. Fig. 7 is a plan of two of the generator-flues illustrated in Fig. 1; and Fig. 8 is a longitudinal section of one end of said flues, illustrating the pipe-connection and form of the chambered head.

In said drawings, A represents a boiler or water-tank with which the improved generator may be used, said generator being adapted to be applied to any boiler to cause the circulation of the water therein, the removal of the sediment therefrom, and to increase the quantity and improve the quality of the steam produced.

The generator consists of one or more flues, B, and the several parts connected therewith. The said generator-flues may be used singly, or in groups of as many as may be desired, and are preferably placed under the center of the boiler, between the ends thereof, with their forward ends resting on the bridge-wall, as illustrated in Fig. 1, the flames and heated gases from the fire passing over, around, and through said flues, as indicated by the arrows in Figs. 1 and 3.

The generator-flues may be constructed and the pipe-connections made as illustrated in Fig. 5, or they may be formed and the connections made as indicated in Figs. 1, 7, and 8, to neither of which methods of construction the invention is intended to be limited. The said flues consist of an inner tube,  $b$ , of any shape in cross-section, extending the full length of the flue-chambered heads  $b'$   $b''$  on the ends of the tube  $b$ , and an outer tube,  $b^3$ , surrounding the tube  $b$ , and screwed into the inner walls of the heads, leaving a water-space,  $b^4$ , between the said outer and inner tubes, which extends to and communicates with the chambers in the heads  $b'$   $b''$ , as indicated in Figs. 3, 5, and 8.

Beneath the rear ends of the generator-flues is a cylinder or T-branch,  $c$ , communicating with the head  $b''$  by pipes  $c'$ , the said cylinder being connected by a pipe,  $c^2$ , with a sediment-pipe,  $d$ , which is in turn connected with the bottom of the boiler by a pipe,  $d'$ . The sediment-pipe leads downward to a drum or sediment-receptacle,  $d^2$ , which is of sufficient capacity to hold the deleterious precipitates fall-

ing thereinto from the water as it flows from the boiler through the pipe  $d'$  over the mouth of the sediment-pipe. The generator-flues are connected at their front ends with the front of the boiler by pipes  $e^2$ , which preferably turn outwardly away from the central line of the boiler, as indicated in Fig. 3, thereby avoiding all obstruction to the direct action of the fire on said boiler. Any desired number of said generator-flues may be grouped together and connected to one or more of the pipes  $e$ . The said connections are preferably made by means of Y-branches  $e^3$ , which permit the several currents of water from different generator-flues to unite and form one current without impeding each other. The pipes  $e$  preferably pass through the fire-chamber near its sides or edges, and convey the said currents of water, together with the steam, from the generator-flues into the front of the boiler, preferably at about the water-line, as indicated in Fig. 4. The pipes  $e^2$  may communicate with the interior of the heads  $b'$  at any point directly at the bottom, as shown in Fig. 5, at the top, as indicated in Fig. 8, or at both top and bottom, as in Fig. 8, the dotted lines indicating the point of connection of the second pipe in said figure.

One advantage resulting from entering the head  $b'$  at the bottom, either as shown in Fig. 5 or as indicated by the dotted lines on Fig. 8, is, that there is thereby no opportunity afforded for the deposition of the impurities contained in the water, the only place at which said deposition can take place being the sediment-pipe  $d$ , which conveys the impurities into the sediment-drum.

By this construction and arrangement of a generator it will be apparent that the heat and flames from the fire have free and unimpeded access to the whole of the bottom of the boiler. The generator-flues, by commencing only at the bridge-wall and extending rearward therefrom, present no obstacle to the action of the fire on the boiler in front of said bridge-wall, while affording to the flames and heated gases in their passage beyond said bridge-wall practically the same access to the bottom of said boiler as would exist if no generator were employed. It will thus be seen that by this arrangement of the generator the boiler itself is enabled to form as much steam as before the generator was employed, while the whole of that produced by said generator is so much additional steam, which is thereby superadded to that produced by the boiler. The pipes  $d'$   $e^2$  are each preferably of about equal diameter, while the sediment-pipe  $d$  is preferably made very much larger in diameter, so as to reduce the motion of the water therein, and thereby permit the impurities to gravitate into the sediment-drum.

The arrangement of the generator-flues may conform to the curve of the boiler, as shown in Fig. 2; or they may be placed in one plane, as in Fig. 4, or in any other position desired.

When the generator is in operation, the water passes out of the rear of the boiler through the pipe  $d'$  into the generator, and from said generator into the front of said boiler through the pipe  $e$ , maintaining thereby a continuous current and constant circulation of the water through the whole length of the boiler and generator, separating and removing the sediment from said water, preventing the formation of scale within the boiler, and thereby adding to its efficiency and durability, and at the same time largely increasing the supply of steam and the economy of fuel used in its production.

It will be readily understood that the said generator flues and pipes may be constructed in a variety of ways and forms other than those herein described. I therefore do not wish to be understood as limiting myself in any manner to the special forms of construction and arrangement herein set forth.

Having described my invention, what I claim is—

1. In a steam-generator, the combination, with a boiler, of two or more generator-flues constructed substantially as described, and a cylinder or branch adapted to receive the water from the boiler and distribute it to each of said flues, substantially as set forth.

2. In a steam-generator, the combination, with a boiler, of two or more generator-flues constructed substantially as described, a cylinder or branch adapted to receive the water from the boiler and distribute it to each of said flues, and a supply-pipe adapted to take the water from said boiler and convey it to said cylinder or branch, substantially as set forth.

3. In a steam-generator, the combination, with a boiler, of a generator-flue constructed substantially as described and arranged approximately horizontally, and a discharge-pipe adapted to convey the water and steam from said flue into the forward part of the boiler, substantially as set forth.

4. In a steam-generator, the combination, with a boiler, of two or more generator-flues constructed substantially as described and arranged approximately horizontally, a supply-pipe adapted to take water from the boiler and convey it to said flue, and one or more discharge-pipes adapted to convey the water and steam from said flues into the forward part of the boiler, substantially as set forth.

5. In a steam-generator, the combination, with a boiler, of two or more generator-flues constructed substantially as described, a cylinder or branch adapted to receive water from the boiler and distribute it to said flues, a supply-pipe arranged to take water from said boiler and convey it to said cylinder or branch, and one or more discharge-pipes adapted to convey the water and steam from said flues into said boiler, substantially as set forth.

6. In a steam-generator, an assemblage of two or more generator-flues, constructed sub-

stantially as described, and united to one or more discharge-pipes by one or more Y-branches, substantially as and for the purposes set forth.

5 7. In a steam-generator, the combination, with a boiler, of two or more generator-flues, constructed substantially as described, a cylinder or branch adapted to receive water from said boiler and distribute it to said flues, and  
10 one or more discharge-pipes connected with said flues by Y-branches, substantially as and for the purposes set forth.

8. In a steam-generator, the combination, with a boiler, of one or more generator-flues,  
15 constructed substantially as described, and a sediment drum or receptacle arranged to separate and remove the sedimentary matters from said water, said drum or receptacle being placed entirely below the point of ingress of  
20 the water which supplies said generator-flues, substantially as and for the purposes set forth.

9. In a steam-generator, the combination, with a boiler, of one or more generator-flues, constructed substantially as described, a sedi-  
25 ment drum or receptacle, a sediment-pipe

adapted to convey water and sediment to said drum, and a pipe adapted to convey the water from said sediment-pipe toward said flues, said sediment-pipe being of larger internal diameter than the other said pipe, substantially as  
30 and for the purposes set forth.

10. In a steam-generator, the combination, with a boiler, of one or more generator-flues, constructed substantially as described, a supply-pipe arranged to take water from said  
35 boiler and convey it to said flues, a discharge-pipe adapted to convey the water and steam from said flues to said boiler, and a sediment drum or receptacle arranged to separate and remove the sedimentary matter from said wa-  
40 ter, substantially as and for the purpose set forth.

In testimony that I claim the foregoing I have hereunto set my hand this 11th day of  
45 February, 1886.

JOSEPH A. ENO.

Witnesses:

FREDK. F. CAMPBELL,  
CHARLES H. PELL.