

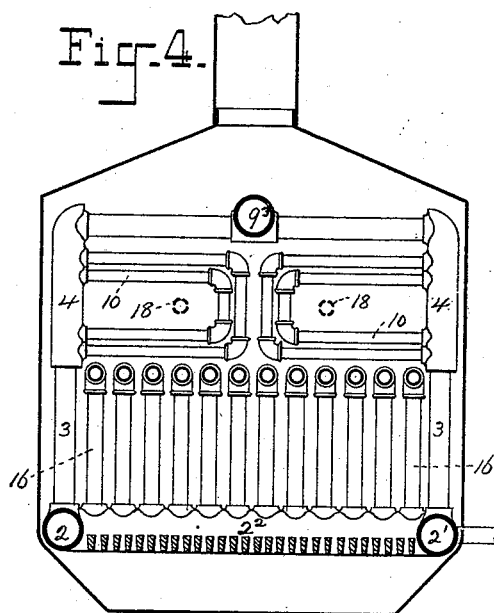
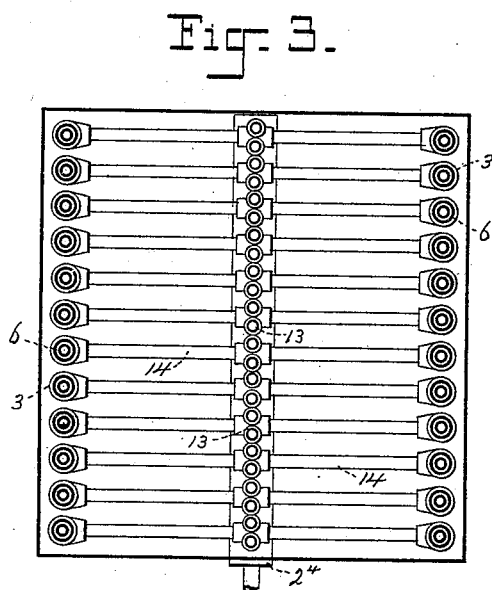
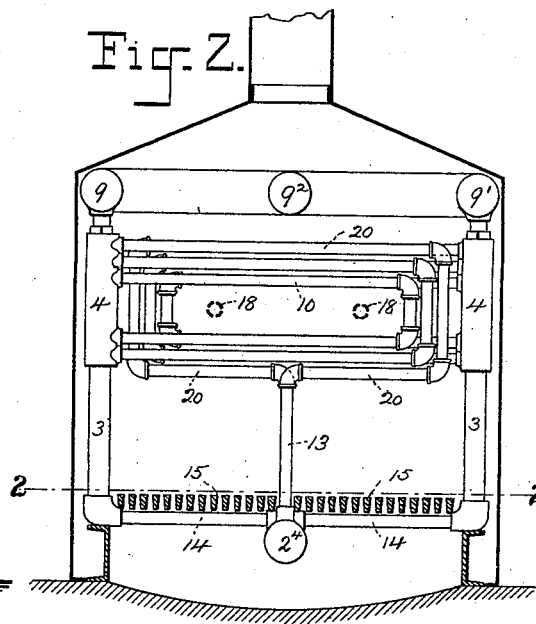
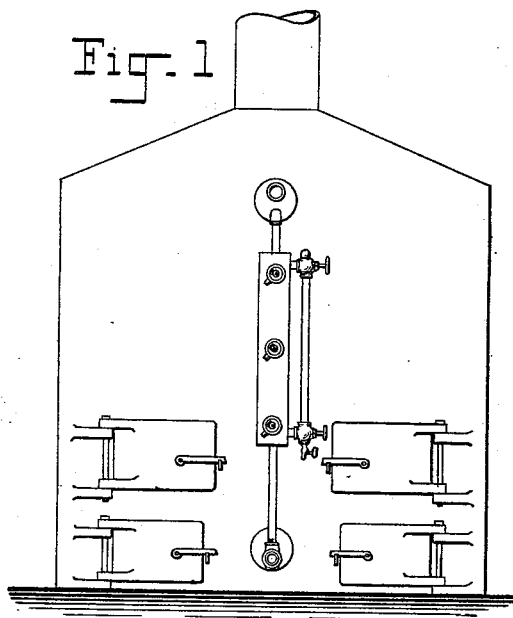
(No Model.)

2 Sheets—Sheet 1.

T. L. & T. J. STURTEVANT.  
STEAM GENERATOR.

No. 523,448.

Patented July 24, 1894.



Witnesses.

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*by H. C. Lodge Atty.*

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Fig. 5.

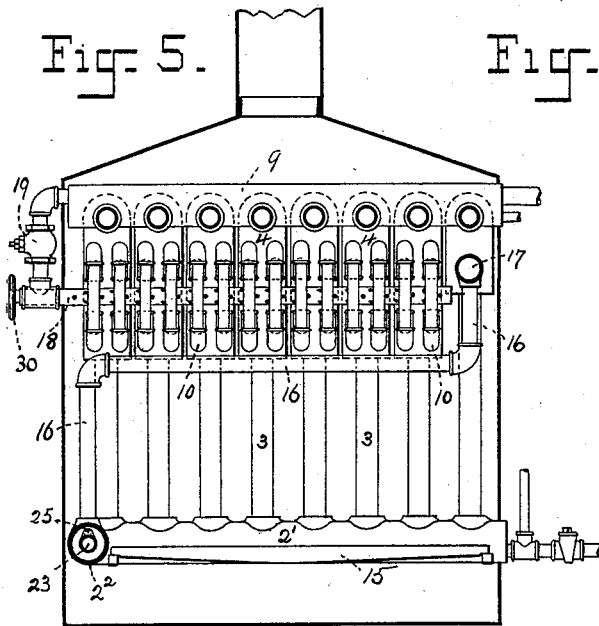


Fig. 6.

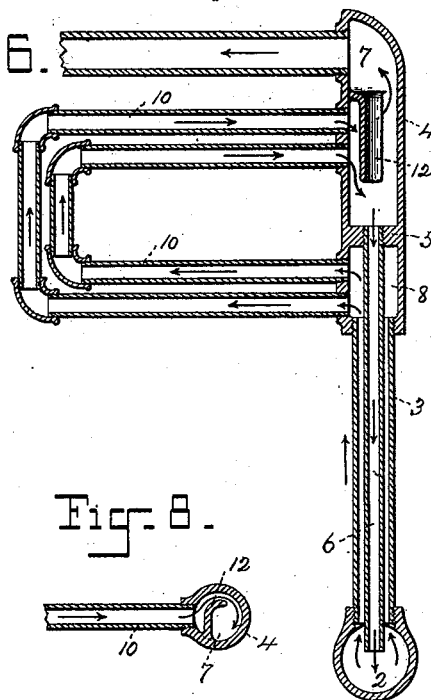


Fig. 8.

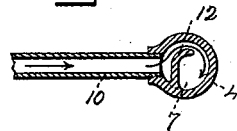


Fig. 7.

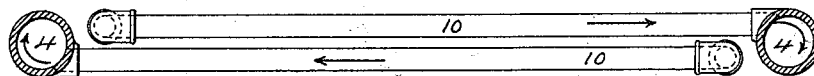


Fig. 9.

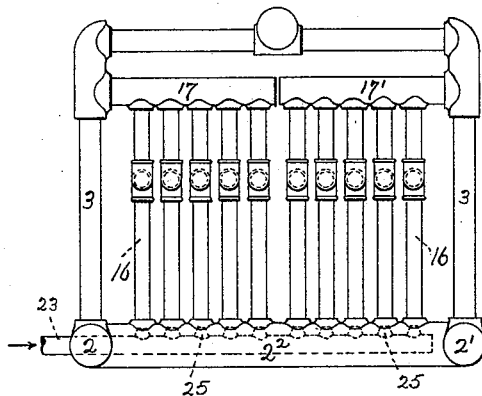
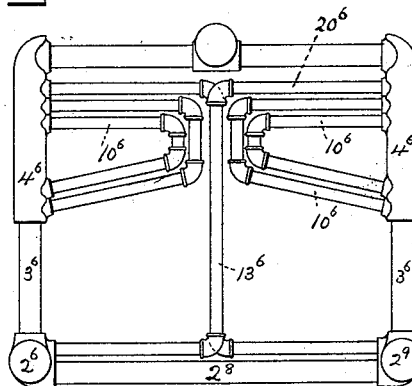


Fig. 10.



Witnesses.

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# UNITED STATES PATENT OFFICE.

THOMAS L. STURTEVANT AND THOMAS J. STURTEVANT, OF QUINCY,  
MASSACHUSETTS.

## STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 523,448, dated July 24, 1894.

Application filed February 20, 1894. Serial No. 500,913. (No model.)

*To all whom it may concern:*

Be it known that we, THOMAS L. STURTEVANT and THOMAS J. STURTEVANT, citizens of the United States, residing at Quincy, in the county of Norfolk and State of Massachusetts, have invented certain new and useful Improvements in Steam-Generators; and we 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 figures of reference marked thereon, which form a part of this specification.

This invention relates to steam generators particularly that class composed of sections adapted for multiplication. Our invention further relates to and may be considered as an improvement upon that class of generator described under Serial No. 488,241, filed October 11, 1893, in our names.

This present form of generator embodies several advantages of construction, among them being that all the sections are easily formed and are easily removable, while ample opportunity is afforded for expansion and contraction under working conditions. The steam drum or drums are so placed that all the water carried in is immediately drained out, and in this respect is a characteristic and important feature.

A further feature is embraced in a series of water pipes supporting the grate bars which in this way may be made lighter. In connection with the steam generating tubes one or more perforated pipes are employed which are adapted to receive steam and by its escape to free the exterior of the tubes from soot. This is a most important feature.

In the endeavor to create steam rapidly and at the same time to deliver it in a dry condition, the steam generating tubes are so united with the separators that steam and water which enter the latter are given a rotary or circular motion in order to separate the water from the steam thereby allowing the water to pass downwardly while the steam escapes in a dry condition to the drums adapted to receive it.

Figure 1 is a front elevation of the exterior

of a steam generator embodying our invention. Fig. 2 is a transverse vertical sectional elevation. Fig. 3 is a sectional plan on line 22. Fig. 4 is a vertical cross section showing the end tubes and a modified arrangement of the U tubes. Fig. 5 is a longitudinal section of the generator. Fig. 6 is a sectional view enlarged of one of the steam generating sections as in Fig. 4. Fig. 7 is a plan showing the arrangement of the U pipes in the vertical side pipes as in Fig. 2. Fig. 8 is a section of casting to illustrate one form of centrifugal partition. Fig. 9 is an end elevation of the generator showing the pipes at one end of fire box. Fig. 10 shows a modified form of generator section.

In the above drawings the generator is adapted for a double furnace and is generally provided with a water base composed primarily of cylinders or water legs 2, 2', 2<sup>2</sup>; while sometimes only a single central cylinder 2<sup>4</sup> is employed to act as mud drum. The circulation through the various parts is such the water entering the top portion of said drum or drums and again withdrawn from said top portion, that the dirt or sediment is allowed to fall to the bottom of said drum or drums and settles in this the least disturbed portion of the generator. The general circulation is as indicated by the arrows.

Each steam generating section is composed of a vertical side pipe 3, so called, since when grouped they form the sides of the fire chamber and are surmounted by a separator 4, subdivided by a partition 5, while an interior circulating tube 6 connects the upper chamber portion 7 with the water legs or drum. Moreover the lower chamber 8 into which the side pipe delivers hot water and steam is interconnected by U tubes 10 which terminate in the upper chamber. Hence the circulation is as indicated the hottest water with mingled steam rises up through the side pipes 3, courses through the U tubes and enters the chamber 7 where the steam and water are separated. The latter returns to the water leg by way of the circulating tube 6 which is cooler than the outside tube while the steam rises and escapes into the drum or drums 9, 9', 9<sup>2</sup>.

In order to more completely separate the water and steam and thus produce the latter in a dry condition we have so arranged the parts that the steam and water when they enter the chamber of the separator shall be given a rotary motion. In some instances as shown in Figs. 2 and 7 the steam generating tubes 10 enter the separator tangentially hence as the liquid strikes the curved walls of the separators a centrifugal effect is produced and the water thus quickly separates and gravitates while the steam escapes upwardly. As shown in Figs. 6 and 8 when said pipes enter radially some mechanical device in the shape of a curved shield or deflector 12 is fitted within the separator and opposite the delivery ends of the generating tubes.

The fire box surface is by far the most efficient steam making surface, therefore we have arranged to make this surface as large as possible and in every part to provide for a short and rapid circulation of the water.

Our improvements are particularly applicable to double furnaces in which event a central row of upright tubes 13 are provided. These are united with L pipes 20, which are alternately connected with opposite separators as shown in Fig. 2. In other words the first L pipe 20 terminates in the separator on the left, the next L pipe in the separator on the right. In Figs. 2 and 7 the U pipes are adapted to extend clear across the fire box, while in Figs. 4, 6, 9 and 10 only to the center. But this is a mere matter of preference and does not alter the function nor depart from the spirit of our invention.

To further increase the pipe surface of the fire box, the water legs or drums 2, 2', are sometimes omitted as in Figs. 2 and 3, while a series of pipes 14 is arranged transversely beneath the grate bars 15. Since the latter are supported thereby the weight of said bars may be materially lessened.

By the construction above premised, the fire box is now provided with steam generating and water circulating pipes upon the top, bottom and both sides. To still further increase the capacity and efficiency of said generator and to obtain all the heat possible from escaping gases and other products of combustion, a group of pipes 16 are located at the rear end or back of the generator. These rise from the water leg 2<sup>2</sup> until just before they reach the under surface of the U tubes said pipes 16 are bent and then extend longitudinally above the fire box and just beneath the U tubes. When they reach the front of the generator they rise take a second upward turn and terminate in a lateral arm or arms 17 17' from the side sections at this point. From their general direction and shape we term them intermediary or Z pipes, since they intervene between the grate surface and the general under surface created by the U pipes taken collectively. In a pipe steam generator much of its efficiency depends upon having the exterior surface of the pipes free from soot.

This is not an easy result to obtain, although most important. It frequently happens that soot or unconsumed carbon collects upon the exterior surface of these various pipes which compose a generator. To remove this substance which acts to materially diminish the effects of the fire we propose to introduce a perforated pipe or pipes 18 which extend within the generator and are preferably in the present instance located in the central space formed by the U tubes as shown. These pipes are joined to the steam space of the generator and are controlled by a valve 19, see Fig. 5. Hence whenever it may be necessary steam is allowed to enter said pipes and issues in the form of jets which sweep the exterior of the various groups of pipes, clean and keep them in the best condition to receive the influence of heat units. These pipes may be rotated as shown in Fig. 5 by aid of a hand wheel 30, so as to more thoroughly sweep the surfaces. In these several drawings there are a few variations in the structural arrangement, but merely introduced to show their application for large or small steam generators. Thus Figs. 4, 9 and 10 are suitable for a small class of boiler and have the water base in the form of the cylinders 2, 2', 2<sup>2</sup>, while a single steam drum 9<sup>2</sup> is supplied, the separators being joined thereto by cross pipes. On the other hand Fig. 2 is intended for a larger capacity and the said water legs are omitted while three steam drums more or less are supplied and a single central water leg or mud drum 2<sup>4</sup> is substituted.

In Fig. 10 the vertical pipes 13<sup>6</sup> in lieu of rising from a common base pipe and being joined with the L pipes as shown in Fig. 2 are connected directly at the bottom to the water legs and at the top are united by lateral pipes 20<sup>6</sup> to the opposite but corresponding vertical side pipes.

In providing a water supply and at the same time to increase the circulation we propose to extend the feed pipe 23 within the water leg from which rise the series of vertical pipes 16. That portion of the feed pipe within the water leg is perforated, the said holes being arranged to correspond with the position of said end pipes. In lieu of the holes short pipes 25 may be inserted in the feed pipe and such may extend just into the lower ends of said vertical pipes. This arrangement is adapted because of the length of the said pipes 16 which are most exposed to heat. Hence when water is admitted under pressure it enters the group of pipes and by injector action the rapidity of the circulation in this special group of pipes is increased, the fluid supply passing directly into them.

What we claim is—

1. A steam generator containing one or more base water legs or mud drums, a central group of steam making pipes rising therefrom, and bottom cross tubes or grate-supporting pipes, combined with vertical steam-making side pipes, separators which surmount said side

pipes, together with means for connecting the central vertical pipes with said separators, substantially as shown.

2. In a steam generator, the combination, with a mud drum, of two parallel groups of vertical side pipes, a series of centrally disposed vertical pipes and a series of horizontal L-tubes which connect said central pipes alternately with opposite side pipes, substantially as described.

3. A steam generator having in combination one or more mud drums or water legs, two series of opposite steam making side pipes, separators which surmount each pipe, a system of U. steam-making tubes, connected at one end with the side pipes at the opposite end with the separator, and a series of steam-making central pipes connected with said mud drum and terminating in the side separators, and means for discharging the steam from said side separators into a steam-collecting reservoir, substantially as set forth.

4. A steam generator having in combination a series of upright steam-making side pipes, a water base common to the series, separators adapted to surmount each upright pipe, a series of U. shaped steam-making tubes leading from said upright pipes and terminating in a separator, and means by which centrifugal motion is imparted to the water entering the separators, substantially as specified.

5. The combination in a steam generator section comprising an upright steam and water pipe, and a separator thereupon, of a curved plate within the separator, a series of U pipes leading from said separator, and a return pipe adapted to conduct the water in the separator to the base of the steam and water pipe, substantially as stated.

6. In a steam generator provided with a water base, a series of side pipes vertical therefrom, a group of U tubes transversely from each of said side pipes, a series of end pipes rising from said water base and arranged to extend longitudinally of the generator beneath the U tubes, said longitudinal pipes terminating in an arm or projection from a vertical side pipe, substantially as shown.

7. In steam-generating sections an upright vertical steam and water pipe, a separator thereupon, and a series of U tubes adapted to enter the separator tangentially in order to produce a centrifugal motion to liquid as it enters, substantially as explained.

8. A steam generating section comprising

an upright vertical steam and water pipe, a separator which surmounts said pipe, a curved partition in said separator, and a series of U pipes adapted to discharge behind the partition, substantially as described.

9. In a steam generator, the combination with a series of vertical steam generating pipes, of separators mounted thereon, U-shaped pipes carried thereby, and revoluble, perforated steam pipes positioned in the bend of said U-shaped pipes, for the purposes and substantially as described.

10. A steam generator having a series of vertical steam-making side pipes, separators which surmount said pipes, and tubes to connect said side pipes with the separator and adapted to create centrifugal currents, combined with return pipes interiorly of said side pipes and adapted to convey water carried over by the steam to the base of the generator, substantially as specified.

11. A steam generator having a series of vertical side pipes, a water drum to which said pipes are connected, separators to surmount each side pipe, U shaped pipes communicating with said separators, a lateral arm upon two side pipes, combined with a group of pipes which lead from said water drum lengthwise of the fire-box beneath the U-pipes and terminate in the said lateral arms, all substantially as explained.

12. In a steam generator, the combination with a water drum, of a series of intermediary or Z-pipes carried thereby and connecting said drum with a lateral arm at the other end of the combustion chamber, and a feed pipe located centrally of said water drum and having injector pipes which enter the lower members of said Z-pipes, substantially as described.

13. A steam generator having in combination a series of upright steam-making side pipes, a water base common to the series, a separator adapted to surmount each side pipe in the series, a group of U. shaped steam-making tubes leading from said upright pipes and terminating in a separator, and one or more perforated soot-removing-pipes, all operating as explained.

Intestimony whereof we affix our signatures in presence of two witnesses.

THOS. L. STURTEVANT.

THOMAS J. STURTEVANT.

Witnesses:

W. H. ELLIS,

H. E. LODGE.