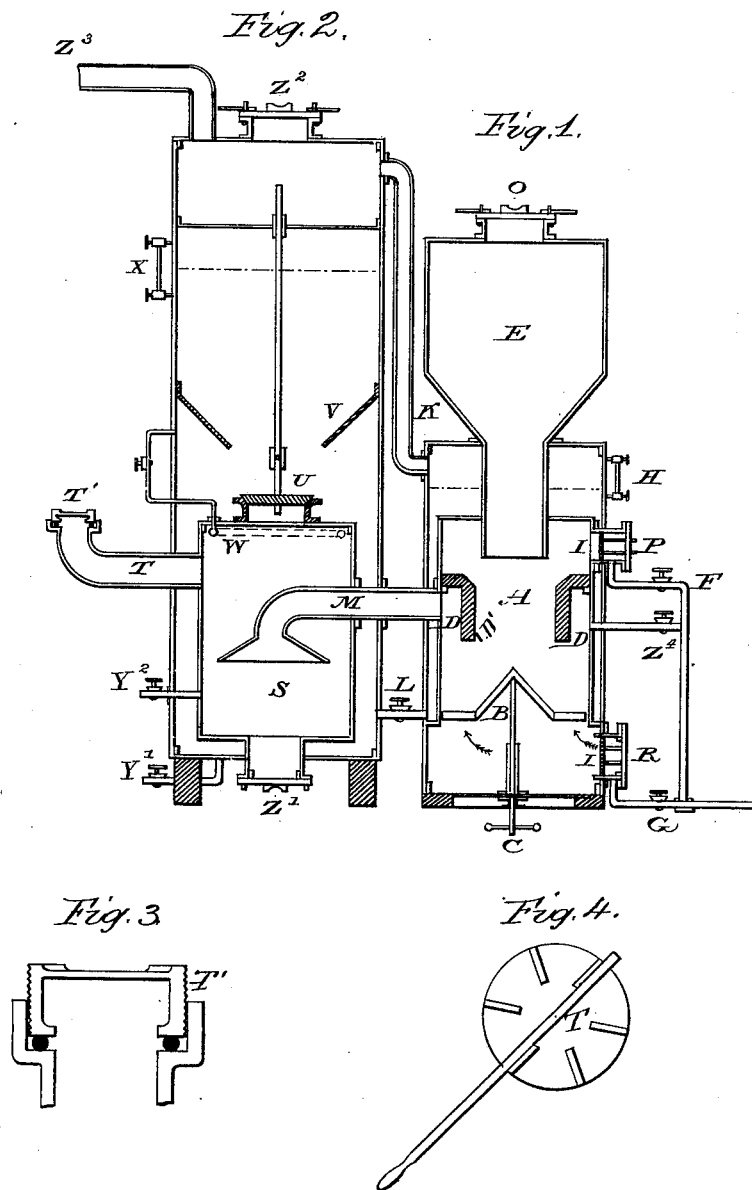


T. M. FELL.  
Steam Generator.

No. 220,017.

Patented Sept. 30, 1879.



Witnesses:

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# UNITED STATES PATENT OFFICE.

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## IMPROVEMENT IN STEAM-GENERATORS.

Specification forming part of Letters Patent No. **220,017**, dated September 30, 1879; application filed October 24, 1878.

*To all whom it may concern:*

Be it known that I, THOMAS MARA FELL, of the city of Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Steam-Generators; and I do hereby declare that the following is a full, clear, and exact description of the invention, which 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 the letters of reference marked thereon, which form a part of this specification.

My invention relates to steam and vapor generators, in which the gaseous vapors and products of combustion are introduced or forced into the steam and water space of the boiler.

In my invention I employ the products of combustion, air, and steam combined in the direct production of motive power by using one of the agents as an auxiliary to the others, in order to produce and utilize the heat developed by the furnace under its best condition.

The advantage of this arrangement is manifest. The same quantity of fuel with the combustion under pressure can be consumed on a much smaller area of furnace-bars, or, inversely, the quantity of heat transmitted will be greater for the same heating-surface, while the air introduced under pressure will, by virtue of the mechanical equivalent for heat, become expanded into a superior force. A great saving is therefore made in the reduction of weight of machinery. Further, there is produced an active combustion at an elevated temperature in the interior of the furnace, an increased density of the circulating gas, the production of a forced circulation of the gases, and an easy abstraction of the heat by the forced circulation of the water in the boiler.

Thus it will be seen that I construct a generator cheap in first cost, easy of repair, facility for transportation, readiness of adaptability, and in which simplicity and economy are combined; and to this end my invention consists, first, in an apparatus for generating and using steam, gases, and air, of a close fire-place for containing the fuel under pressure, and is formed, by preference, of a cylindrical

shape. It rests upon an iron base, and is surrounded by a head or dome, (but may be made horizontal or any other shape best calculated to subserve the ends in view,) in combination with a peculiarly-constructed inner base and grate, by which the fuel is more evenly distributed and subjected to the air-blast; second, in the means employed for supplying air to the furnace by sealed doors provided with cold air and injection pipes, said doors being also provided with inner perforated plates by which the air is delivered in jets instead of in volumes, one of said doors being above the fuel in the fire-box and one below, so that the whole body of fuel is equally incandescent, passing off in flame to the adjoining combustion-chamber; third, in the arrangement and combination of the connections of the separate vessels, by which a uniform heat and pressure is maintained in both; fourth, in the peculiar construction and arrangements of the valves, fastenings, diaphragms, fuel-hopper, &c., all of which will hereinafter more fully appear, reference being had to the accompanying drawings by the letters of reference.

Figure 1 represents a vertical sectional elevation of my preparatory generator, A being the furnace; B, conical-shaking and ash-discharging grate; C, handle, provided with shaking spindle; D, combustion-chamber and annular outlet for the flame and gases, and D' an inner base, made of any refractory or other suitable material, provided with a projecting lip, which forms a concentric disk dividing the upper portion of the fire-box from the lower portion, except through the center, which is filled with coal, the space between this base D' and the sides of the inner shell of the boiler forming the annular chamber D, through which passes the products of combustion, and thence through a pipe, M, into a secondary combustion-chamber, S. The flue M is provided on the end within chamber S with an elbow and a funnel-shaped or flaring mouth, the object being to deflect the hot gases against the entire bottom of said chamber for the purpose of forcing them in contact with any water that might escape from the valve U, which, by co-operating, is again passed into the upper chamber with said hot gases.

E is the coal-hopper, the lower end of which

extends down through the steam-space and into the fire-box. This projecting end is purposely made smaller, so that only a small quantity of coal or fuel is retained therein, as the coal or fuel being cold, a large body thereof would tend to lessen the temperature in the steam-space of the boiler. The upper end of the reservoir enlarges off to such extent as to be capable of holding nearly or quite a sufficient quantity for a day's run, thus avoiding the necessity of frequently opening the door through which cold air would enter and cause a loss of heat and damage, by contraction to the metal of the boilers.

H is a water-gage, and F an air-pipe, for the supply of air to the doors, and thence to the fire-box. G is a horizontal air-pipe entering the lower sides of the doors R. A similar pipe also enters the chamber D. I I are perforated diaphragms, through which the air passes in jets into the fire-box and ash-pit. These diaphragms may be made of iron or fire-clay, or any suitable refractory material. In front of these diaphragms, and on the outside door or plate, I insert a piece of glass or mica to be used as a spy-hole, so that the condition of the fire may be observed. The immediate neighborhood of the perforated diaphragms and doors is kept comparatively cool by the air-blast passing through them, which not only preserves them from burning out, but, by non-expansion by heat, are easily opened. The air-supply by the pipe and cock (shown at Z<sup>4</sup>) enters the combustion-chamber D at the point where the gases are about to leave, and thus ignite any that would otherwise go off uncombusted. All these entrances for air are provided with stop-cocks, so that the supply may be admitted or regulated where it is most needed. O is the seal to the hopper.

I will now pass to Fig. 2, which represents a sectional elevation, showing my mixing and second generating chamber. S is the auxiliary combustion gas and flame receptacle, through which the air, gases, and heat pass to the valve U, which said valve is guided on its seat by the central guides and rod. Z<sup>1</sup> and Z<sup>2</sup> are sealed man-holes, the lower one for the purpose of discharging ashes, cinders, &c., that may pass over with the flame, and Z<sup>2</sup> for access to the interior of the vessel for cleaning or adjustment of its parts. K is the steam-passage between the two vessels, by which an equal temperature and pressure are maintained in both; and L the connecting water-feed pipe. Y<sup>1</sup> is a pipe used for blowing out the sediment from the vessel when required, and Y<sup>2</sup> a testing-pipe for the presence of water in the chamber S; W, a perforated pipe provided with a cock for washing out the chamber S through the man-hole Z<sup>1</sup>. T is a flue for the passage of smoke when the fire is first started, and T' a stop or a cover inserted when the fire-chambers are used under pressure. X is a water-gage, and Z<sup>3</sup> a pipe for leading the resulting gases and steam to the engine. V is an inverted frustum of a

cone. This cone is perforated and acts as a separator, the purpose being to compel the gaseous products of combustion and hot air to mix with the water, so as to extract the heat. It is also a strainer to arrest any foreign matter, which is forced to the bottom of the vessel, where it can be blown off by the pipe and tap Y<sup>1</sup>.

Fig. 3 is an enlarged view of the cap T', showing a packing and the readiness by which it may be removed and replaced; and Fig 4, a top view of the same.

Having now fully described my invention, its construction, and operation, I desire to say that many modifications may be made of this apparatus in general detail, without departing from the spirit of this invention, and also all these details modified may be used in one boiler, and that the vessel may be horizontal, of the ordinary type, or of the locomotive style. The usual safety-valves, whistles, and other appliances not shown may be used and attached.

I claim and desire to secure by Letters Patent—

1. In an apparatus for the production of motive power from steam, air, and gases of combustion, the combination of the base D', made of any suitable material, with the fire-box A and the feed-reservoir E, with the grate B, for the purposes set forth.

2. The fire-box A, with its base D', with the chamber D, reservoir E, and grate-bars B, with the flue M and air-pipes G and F, substantially in the manner and for the purposes set forth.

3. The combination of the fire-box, adapted to work under pressure of the doors R and P, provided with air-chambers and perforated disks I I, with the supply-pipes entering same, and pipes Z<sup>4</sup>, all arranged substantially as and for the purpose set forth.

4. The combination of the fire-box A with its base D', annular chamber D, feed-reservoir E, and air-supply doors R and P, with the pipe M leading into a second chamber, S, substantially as set forth.

5. The combination of two boilers connected together by the flue M, delivering heated gases in a downward direction, steam-connecting pipe K, for maintaining an equal pressure in the two vessels, and the pipe L, provided with a cock for equalizing the supply of water, for the purposes as set forth.

6. The combination, in a motive-power generator, of the internal chamber, S, with the valve U and conical perforated diaphragm V, all operating substantially and for the purposes set forth.

7. The combination, in a motive-power steam-generator adapted to burn fuel under pressure, of the fire-box A, internal chamber, S, connected by flue M, and exit-flue T, the chamber S being provided with waste-pipe Y<sup>2</sup>, by which water in said chamber is prevented from rising so as to stop the mouth of the flue

M while combustion is going on under natural draft, all constructed and arranged as shown and described.

8. The combination, in a motive-power generator, of the fire-box A, with its base D', air-pipes G and F, feeder E, chamber S, perforated pipe W, for washing out said chamber

S, man-holes Z<sup>1</sup> and Z<sup>2</sup>, the flue M, with the exit-flue T and its stopper T', substantially for the purposes set forth and described.

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