(No Model.)

N. EATON.

STEAM GENERATOR.

No. 350,483. Patented Oct. 12, 1886.

Fig. 1

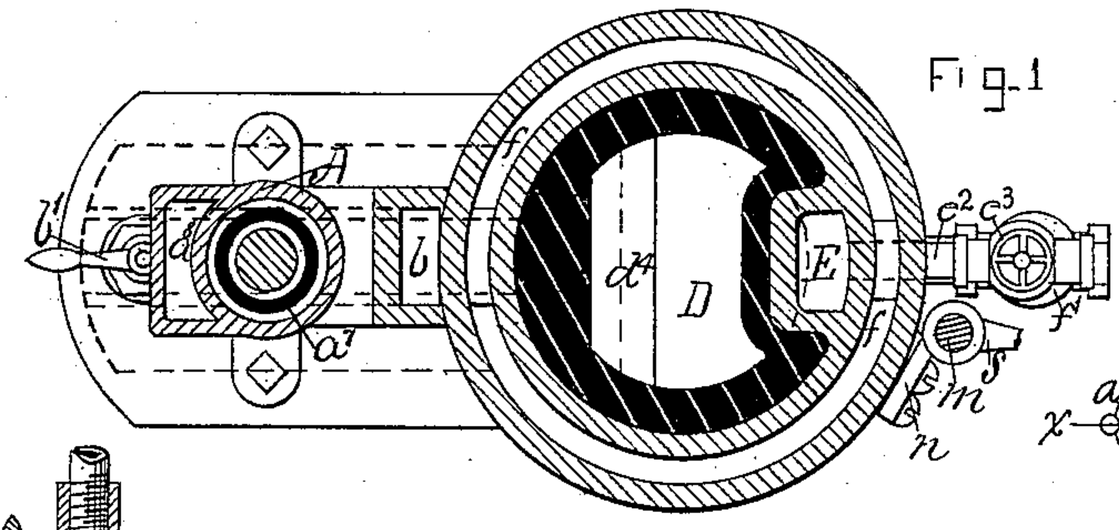

Fig. 3

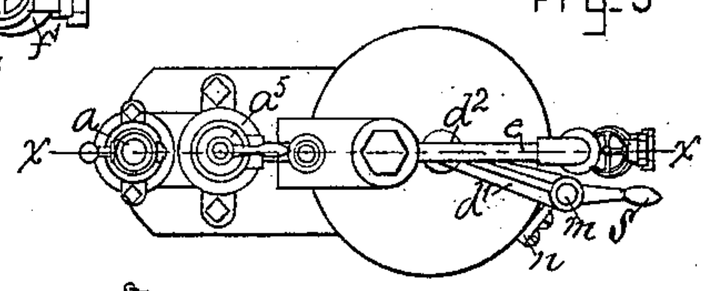

Fig. 2

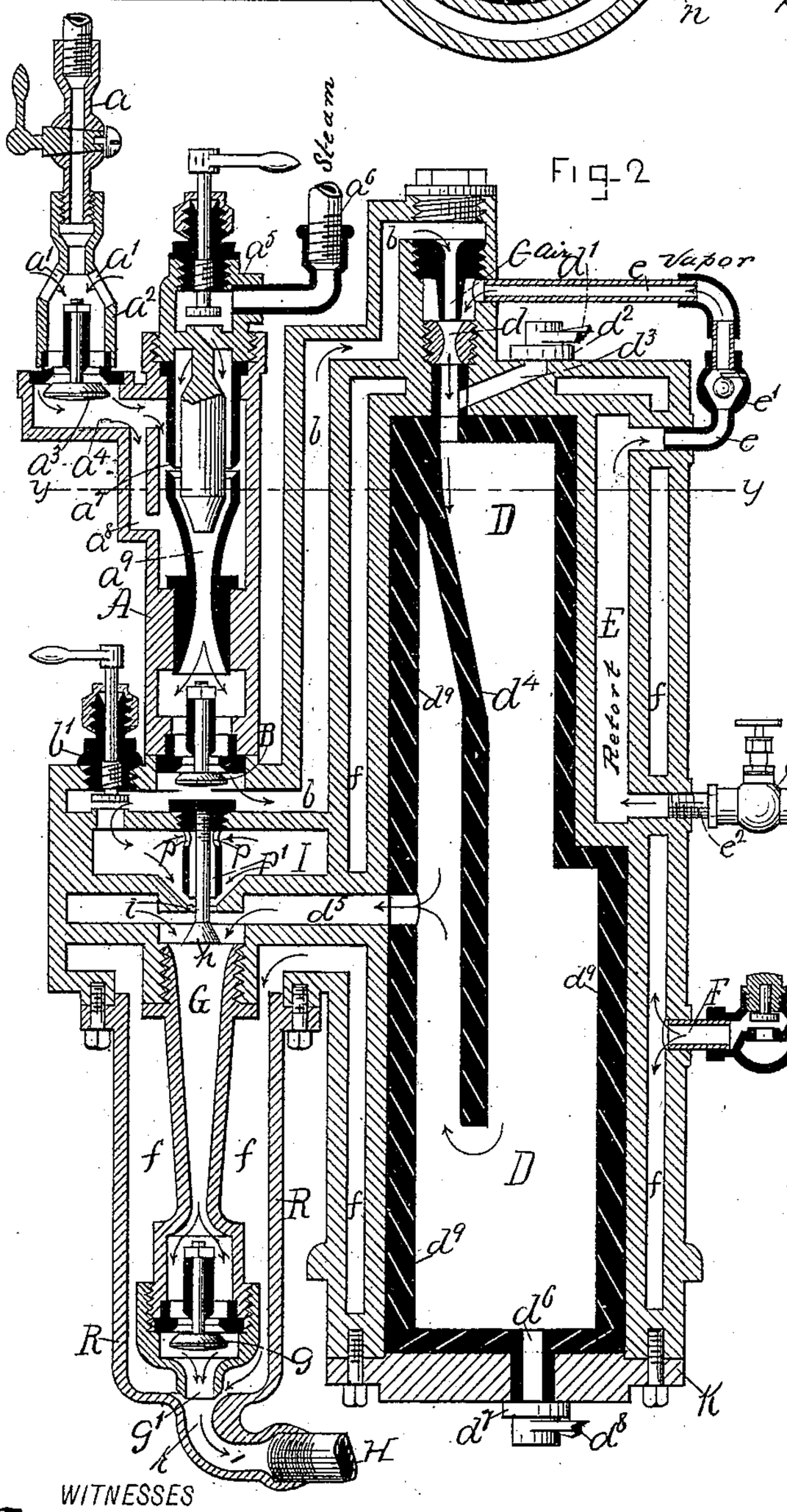

Fig. 4

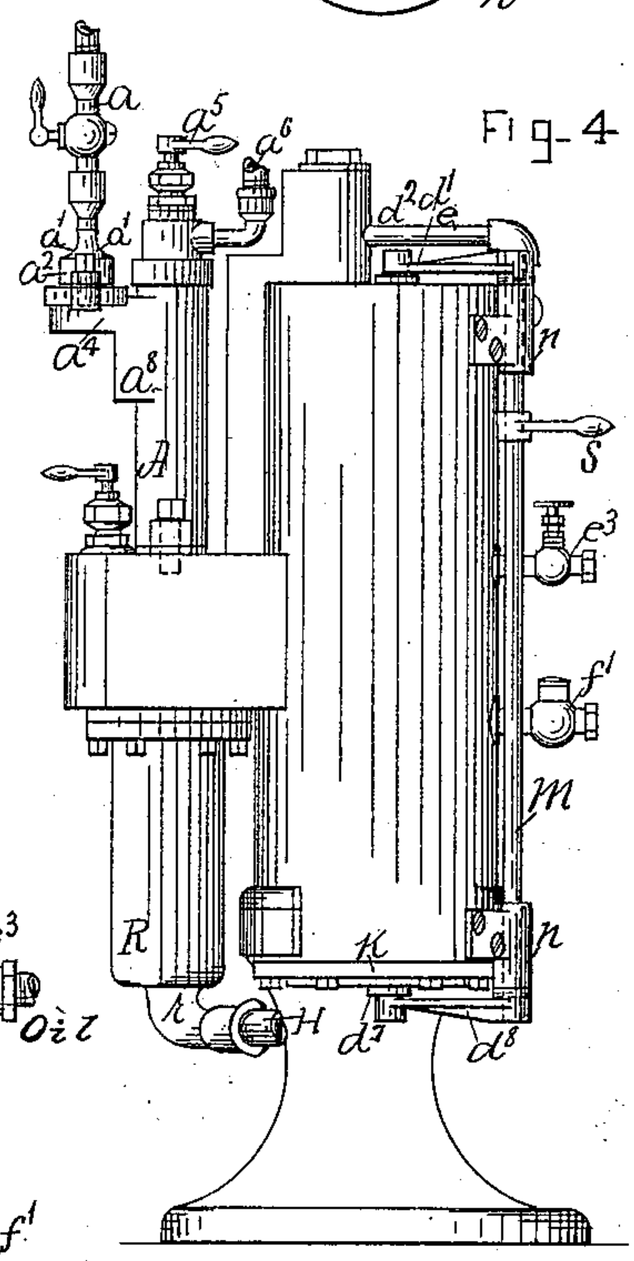

Fig. 5

WITNESSES

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NORMAN EATON, OF WOBURN, MASSACHUSETTS.

STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 350,483, dated October 12, 1886.

Application filed June 28, 1886. Serial No. 206,526. (No model.)

To all whom it may concern:

Be it known that I, NORMAN EATON, a citizen of the United States, residing at Woburn, in the county of Middlesex and State of Massachusetts, have invented a new and useful Steam-Generator, of which the following is a specification.

My invention relates to steam-generators. Its nature is to confine a combustion so that, aided by the cooling influence of water, the portion of heat used in expanding the burning gases may be utilized in storing them under a pressure greater than that of the air supplied to support the combustion, together with steam generated by the portion of heat not thus employed. Its features are, first, a furnace in which the combustion takes place, arranged with valves that compel the burning gases to expel themselves through a throat or outlet into a receptacle, they being cooled and contracted as they leave the furnace; second, a device for injecting air and water to actuate the generator; third, a lining to the furnace, of carbon or some other refractory material providing a living source of heat; fourth, vents and vent-valves for the furnace; fifth, a retort within the furnace-space to vaporize a liquid fuel before it enters the furnace; sixth, a water-jacket around the furnace and its outlet, which communicates with a passage through which the products of the furnace are expelled.

In the drawings, Figure 1 represents a cross-section through *y y* of Fig. 2. The latter figure is a vertical section, through *x x* of Fig. 3; Fig. 3, a plan. Fig. 4 is an elevation in the same direction as Fig. 2, and Fig. 5 is a section through one of the vent-valves of the furnace, representing it on a larger scale than the other figures. Figs. 3 and 4 are on a smaller scale. Fig. 4 represents the generator mounted on a stand or foot-piece. (Only shown in this figure.) In Fig. 2 I have indicated the directions of the currents by arrows, the generator being in full operation; also, I have represented the sections of some of the smaller parts in solid black to show them clearly.

The same letters refer to the same parts in all the views.

The generator is intended to be used in conjunction with a reservoir in which the generated steam and gases are stored. This reservoir may be a common steam-boiler. I have not shown it in the drawings, but will hereinafter point out how they are connected.

The invention may be adapted to either a liquid fuel or gas. In this instance a liquid fuel is used, and as it is desirable that it be in its most favorable condition to ignite before it enters the furnace, I first introduce it through a pipe, e^2, into a small retort, E, which being located within the furnace D, the liquid becomes a gas or is vaporized when the furnace-temperature is high. It then passes through the pipe *e*, ball check-valve *e'*, and through the inlet *d* into the furnace along with a jet of air from nozzle C. The lining d^9 to the furnace (represented by the heavy section-lines) has a partition, d^4, on the slanting part of which the combustible charge strikes as it enters the furnace, instantly ignites, and the gases of the combustion pass nearly to the bottom, turn, and make their exit through the passage d^5, which leads to an outlet or throat, G, screwed into this passage. I prefer to make this throat similar to the combining-cone of the injector, converging from the furnace. The main casting, which contains the furnace, also has an air and water passage, *b*, a retort, E, a small chamber, I, and a water jacket, *f*, cast in it. This jacket continues through the space inclosed between the throat G and a case, R, which is bolted to the main casting and concentric with the throat G, so that there is an annular opening between a nozzle, *g'*, screwed to the end of throat G and the outlet *r* of case R. This nozzle holds in place a check-valve, *g*, which prevents the gases from returning to the furnace. A reservoir partly filled with water is placed on a higher level than the generator, and is connected below its water-level with the water-jacket *f* by a pipe, F, having a check-valve, *f'*, so that water from the reservoir circulates around the furnace and throat G, and is drawn into the outlet *r* of case R by the gases of the furnace as they discharge through nozzle *g'*, and is carried back to the reservoir through a pipe, H, which is screwed into the outlet *r*, and connected with the upper part of the reservoir. The hot gases from the furnace as they pass through this throat G generate some steam from the water circulating around it, and are cooled and contracted. The amount of steam thus generated and the

contraction of the gases depend on the length of the throat when incased in water-jacket *f*.

I have provided other means for reducing the temperature of these gases and generating steam, consisting of an opening or inlet, *i*, in the passage d^5, and communicating with the chamber I, into which both air and water are forced. A nozzle, *p'*, is screwed down through this chamber, and is concentric with this inlet *i*, and a core, *h*, with a cone-shaped end, is screwed into this nozzle, so that the air, which enters the latter through its holes *p p*, dashes the water against this core *h* as it runs out of the inlet *i*, and distributes it among the hot gases from the furnace as they pass into the outlet G.

The device for supplying air and water to actuate the generator consists of the case A, bolted to the main casting and holding check-valve B in place. Within this case is a throat, a^9, concentric with an annular nozzle, a^7, the latter being held in place by a valve, a^5. Branching from this case is an air and water passage, a^4, having a check-valve, a^3, held in place by a small chamber or connecting piece, a^2, which is bolted to the case, and which has air-holes *a' a'* in it, and in its upper end a water-cock, *a*, is screwed.

In Fig. 2 the furnace is represented with a vent, d^3, in its upper end, having a vent-valve, d^2. The lower end of the furnace is closed by a head, K, in which there is another vent, d^6, with a vent-valve, d^7. These vent-valves are held in the ends of arms *d'* and d^8, which are represented in this figure as broken off. In Fig. 4 these arms are shown secured to an upright shaft, M, which is turned in boxes *n n* (screwed to the main casting) by handle S. Thus the valves are swung around to cover the vents or uncover them. In Fig. 5 a spring is shown to hold the valve to its seat, which also serves as a safety-valve for the furnace.

To start the operation of the generator, steam must be taken from some prime source. If a common steam-boiler is used for a reservoir, steam is first made in this and led to the generator by the pipe a^6, which is screwed into valve a^5. The vents of the furnace are opened, valve *b'* and water-cock *a* are closed, and the steam let on through valve a^5, and passing through the nozzle a^7, throat a^9, and passage *b* discharges through nozzle C into the furnace. The liquid fuel is forced into the retort E by opening valve e^3, and after filling the former passes through pipe *e* and the ball check-valve *e'* and into the furnace with the jet of air from the nozzle C. The blast is lighted through vent d^3, now open, and passing through the furnace escapes through the vent d^6, also now open. The valve *b'* being closed, the only exit for the steam is through this nozzle C, whose area is not sufficient to deliver it as fast as received when valve a^5 is fully open, so there is a back-pressure in the space between the latter and the nozzle C, so that the check-valve a^3, through which air and water afterward pass, closes, the air to support the combustion at this stage of the operation being drawn through the vent d^3. The operation continues thus until the carbon lining d^9 is hot enough to insure a combustion under pressure. By this time the liquid fuel will be vaporized or changed to a gas. Valve *b'* and water-cock *a* are now opened. By opening the former the back-pressure is relieved and free air and water are drawn into the throat a^9 by the jet of steam from nozzle a^7. The water settles in the pocket a^8 of the case, and is drawn in evenly around the annular opening between this throat and nozzle a^7 by the jet of steam from the latter. This water serves two purposes—it condenses this steam, thereby adding to its efficiency in driving the air and water through the throat a^9, past check-valve B, into passage *b*, and also in cooling the hot gases of the furnace, by which it is converted into steam. From this passage *b* the air not discharged through nozzle C to support the combustion, rushes past valve *b'* into chamber I with the water, and blows the latter in a spray into the passage d^5, as before described. The check-valve *g* being closed by the pressure of the boiler, this air, loaded with water, enters the furnace, and striking the hot partition d^4 the water is converted into steam and rushes through the vent d^6 with the products of the combustion. The vents are now closed, and the carbon lining and partition being raised to a high temperature, serve as a reservoir, wherein a great quantity of heat is stored, whereby the steam and air loaded with water now confined in the furnace are raised to a high tension, and, recoiling, close the check-valve B and the ball check-valve *e'* in the fuel-pipe *e*, and force open the check-valve *g* in the throat G, through which they rush, carrying with them the water accummulated in this throat and in the chamber I, which is converted into steam, the gases collapsing.

The volume of steam thus generated, added to the reduced volume of gas, is less than the volume of the same gas under the same pressure before it meets the water in passing from the furnace. Thus an impact is given by the gases rushing from the furnace, and also by the generated steam, both of which, acting through throat G, force themselves into the boiler. The operation once started, the flow continues and the pressure in the furnace falls until the check-valve B again opens and the furnace is again filled with the hot gases under pressure, that are cooled and contracted as they rush into the throat G by the water from the inlet *i*. Steam and gas should be generated fast enough to maintain a continuous flow through the throat G into the boiler, this depending on the capacity of the device for supplying air and water. After the products of the furnace leave the throat G and pass through check-valve *g* and nozzle *g'*, they mix with the water of jacket *f*, and are conducted to the boiler, as before described. This water evens the temperature of the gases, and after the operation is continued long enough to circulate all the water of the reservoir

through the jacket it serves as a reserve force in the reservoir, the same as the water in a common steam-boiler. After the vents are first closed they are kept so until it is desired to stop the operation of the generator, when steam is shut off and these vents are opened. The carbon lining to the furnace will keep hot for some time, so that the operation may be started again by closing the vents and letting on steam. The generator may be actuated by compressed air from an air-compressor, in which case a connection is made with the compressor by a pipe which would be bolted to the main casting in place of case A; but the advantage of the device just described for supplying air and water is obvious. There are no forces wasted, as all the energy exerted in compressing and forcing the air and water into the generator is finally carried to the reservoir. Hereinafter this device will be called "injector A."

I do not claim a steam-generator in which a combustion is maintained under pressure and in which water is forced into direct contact with the burning gases.

I claim—

1. In a steam-generator in which a combustion takes place under pressure, a furnace wherein the combustion is confined, an inlet through which water is forced into direct contact with the products of the said combustion as they leave the furnace, and a throat, G, combined with valves that guard the inlet and the outlet of the said furnace, whereby its gaseous products are compelled to eject themselves through the said throat and are prevented from returning thereto, substantially as described.

2. In a steam-generator in which a combustion takes place under pressure, the furnace D, throat G, water-inlet *i*, and valves that compel the gases of the said furnace to eject themselves through the said throat and prevent them from returning thereto, combined with the injector A, consisting of the following elements: case A, throat a^9, steam-nozzle a^7, and check-valve a^3, substantially as described.

3. The furnace D, provided with a lining of refractory material, combined with throat G, water-inlet *i*, and valves that compel the gases of the said furnace to eject themselves through the said throat and prevent them from returning thereto, substantially as described.

4. The furnace D, provided with vents d^3 d^6, and vent-valves d^2 d^1, combined with throat G, water-inlet *i*, and valves that compel the gases of the said furnace to eject themselves through the said throat and prevent them from returning thereto, substantially as described.

5. The furnace D, combined with the retort E, throat G, water-inlet *i*, and valves that compel the gases of the said furnace to eject themselves through the said throat and prevent them from returning thereto, substantially as described.

6. The furnace D, throat G, valves that compel the gases of the said furnace to eject themselves through the said throat and prevent them from returning thereto, combined with the water-jacket *f*, substantially as described.

NORMAN EATON.

Witnesses:
L. W. HOWES,
WM. H. CHAMBERLIN.