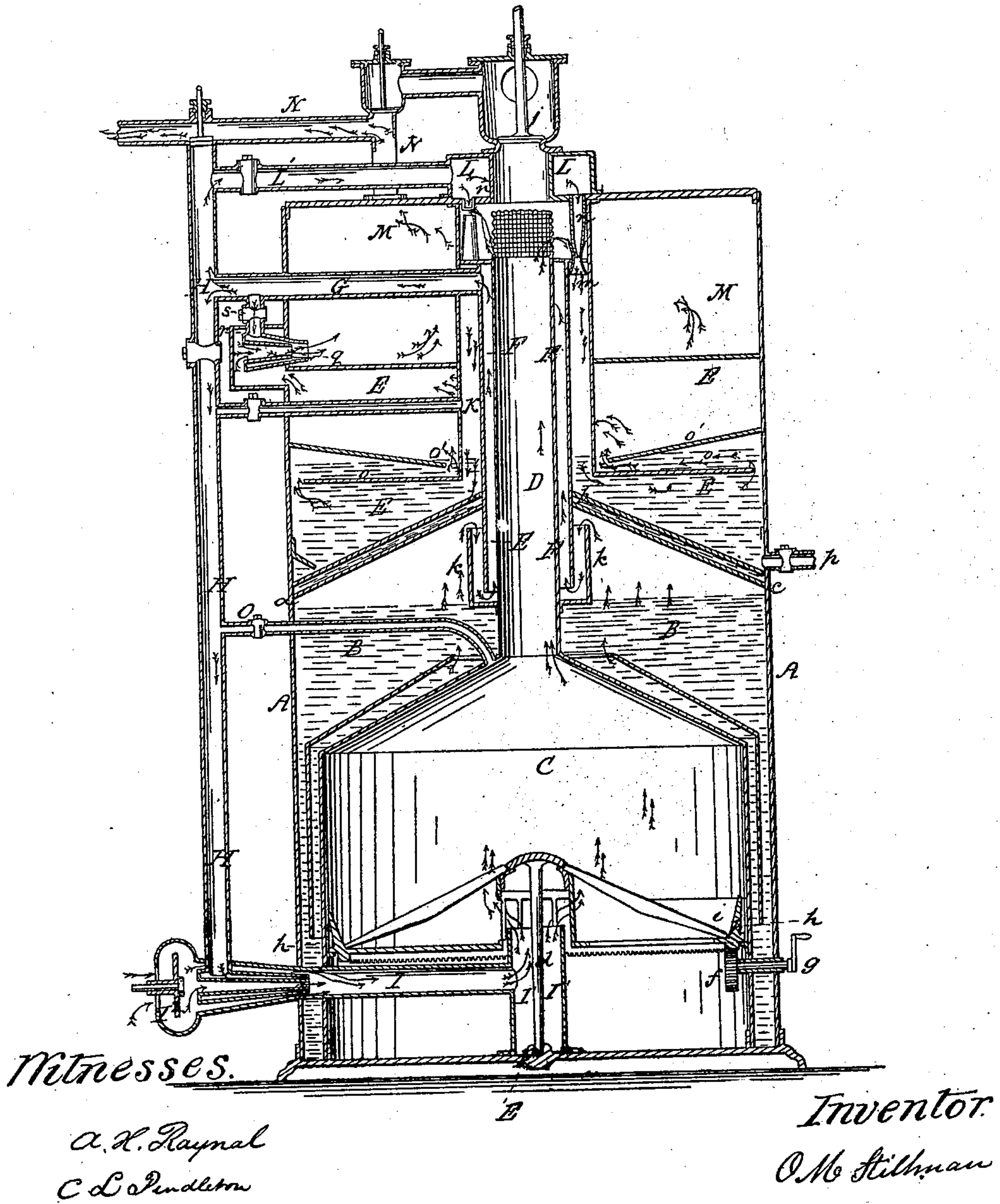


No. 76,845.

PATENTED APR. 14, 1868.

O. M. STILLMAN.
COMBINED STEAM GENERATOR AND AIR HEATER.



United States Patent Office.

O. M. STILLMAN, OF WESTERLY, RHODE ISLAND.

Letters Patent No. 76,845, dated April 14, 1868.

IMPROVEMENT IN COMBINED STEAM-GENERATOR AND AIR-HEATER.

The Schedule referred to in these Letters Patent and making part of the same.

TO ALL WHOM IT MAY CONCERN:

Be it known that I, O. M. STILLMAN, of Westerly, in the county of Washington, and State of Rhode Island, have invented certain new and useful Improvements in Combined Steam and Air-Engines; and I do hereby declare that the following specification, taken in connection with the drawing making a part of the same, is a full, clear, and exact description thereof.

The drawing represents the apparatus as cut by a plane through the central vertical axis.

The invention relates to that class of apparatus for developing motive-power in which both the force of steam and that of the gases evolved during the process of generating it are combined.

In the drawing, A represents the outer shell of a boiler, which should be of sufficient strength and of proper material to sustain the pressure which, under working conditions, as hereinafter explained, it will be called upon to bear.

My improvement involves the use of more than one water-compartment or boiler, and, in the present instance, two are shown. The first, or, as I may term it, the primary steam-generator, B, is cylindrical in form, and extends in height to the conical crown-sheet *abbc*, which surmounts it. Within this primary generator, and having its shell concentric with the shell of the generator, is the furnace C, the material and construction of which should be adequate to sustain the pressure to which it is exposed. The space between the upright walls of the furnace and the shell of the boiler is occupied with water, the height of which body of water above the dome of the furnace is maintained at the proper level, by means of a forcing-pump, in the usual way.

I prefer to make use of a single feeding-aperture, for the introduction of fuel to the furnace, which is not shown in the drawing, but it may be located at any convenient point, and should be furnished with a steam-tight door, and a partition of boiler-plate should surround it, as in the case of similar apertures through the water-leg of a locomotive-boiler.

Wherever I employ a single feeding-aperture, I construct the grate so that it, with its body of coals, can be revolved, whereby any portion of the grate-surface can be brought within the reach of the fireman.

As seen in the drawing, the grate is made up of bars radiating from a common centre, and surrounded, at the outer ends, by a circular high rim or fender, *r*. The bars are arranged so as to form a conical figure, the apex of which is supported by a central spindle, *d*, whose foot is stepped in a bearing, E. A toothed wheel, *f*, worked by a crank, *g*, from the outside, engages with the teeth of a rack, surrounding the under surface of the rim of the grate, and a flanch, *h*, projecting from the fender, overlaps a lip riveted to the shell of the fire-box, which lip may be furnished with friction-rollers.

It is quite evident that the coals will be kept upon the grate-bars by the circular fender *i*, and that the whole fire-pan so formed can be revolved at will.

The advantage which results from the conical arrangement of the grate-bars is, that as the atmospheric air and steam to support combustion are, as will hereafter be seen, admitted through a close pipe, the axis of which is coincident with the axis of the cone formed by the grate-bars, the air and steam so admitted will naturally be deflected by the central plate, forming the apex of the cone, and be distributed equally to all parts of the fire.

From the apex of the crown-sheet of the furnace rises a flue-pipe, D. Its upper end is furnished with a wire-gauze spark-arrester, and above its outlet is a valve, *j*, which, when opened, upon starting the fire, allows free passage for all smoke and products of combustion to escape from the furnace.

Before describing the secondary generator, E, whose location is directly over the primary one, B, and explaining the office which it performs, I will trace the direction which the steam from the primary generator takes, after it has been formed, up to the point when it enters the furnace to combine with the gases evolved by combustion, and from thence trace the course of such combined steam and gases to the point of their admission to the secondary generator.

To assist the explanation, I have designated steam by arrows in blue, and gases by arrows in red, and when both agents are combined, I have placed arrows of both colors in near proximity to each other.

Starting, now, with the supposition that the apparatus is under proper working conditions, the valve *j* being closed so as to secure the utilization of the gases, as hereinafter to be explained, steam, as it is formed in the primary generator, will rise, as shown by the single arrow in blue, and, passing over the circulating-plate *k*—intended, in part, for the protection of the flue-pipe *D* against overheating, in case the water falls below the proper line—enter the passage *F*, which is concentric with the flue-pipe, and from thence pass on through the pipe *G* to the point of distribution.

As the volume of steam enters from the pipe *G* into the upright side-pipe *H*, it is free to divide. The portion which we will now trace descends the side-pipe, and, entering the horizontal pipe *I*, underneath the furnace, gains admission, through the upright induction-pipe *I'*, to the space within the furnace.

Accompanying the introduction of such volume of steam into the fire-chamber, there is a volume of atmospheric air mixed with it, (indicated by dotted light red arrows,) which the force of the steam, in entering the pipe *I*, through a contracted enclosed passage, as shown, acting in combination with a self-operating valve, *I'*, is taken in, in the way explained in the Letters Patent granted to me, August 9, 1864.

The steam, thus admitted to the furnace, becomes at once decomposed, and its elements, combining with the gases evolved by combustion, constitute an agent of force which, upon the drawing, is indicated by double arrows—one in blue, and the other in red. Following the course of this agent or combination of gaseous forces, it will be seen that it passes up the flue-pipe *D*, and, discharging through the gauze bonnet *J*, pours itself through the contracted enclosed passages *m* into the space *K*, arranged concentrically with the space *F*, and, passing through such space, finds admission into the secondary generator *E*. Contemporaneously with its entrance into the space *K*, a volume of simple steam, (single blue arrow,) from the primary generator, combines with it, and gives it impulse, such steam being admitted through the nozzles *n n*, opening from the annular chamber *L*, which is connected, by the horizontal pipe *L'*, with the side-pipe *H*, which side-pipe is, as heretofore explained, in direct communication with the primary generator.

The number of nozzles, *n*, for discharging jets of steam into the passage *K*, and the number of contracted orifices, *m*, into which the nozzles, respectively, enter, should be as great as the space at hand will afford. In addition to the office which these jets of steam perform, in dragging the gaseous products of the furnace into the passage *K*, they also incidentally cause a vacuum to be formed in the flue-pipe *D*, so that, whenever it is desired to charge the furnace with coal—by first closing the stop-cocks, which allow steam or mixed steam and gases to enter below the fire-pan—the full volume of the steam from the primary generator will be discharged through its nozzles, *n*, and thereby the pressure on the furnace will be immediately relieved, so that the furnace-door can be opened with safety and convenience.

The secondary generator, *E*, is located directly above the primary one, *B*. Its bottom is separated from the crown-sheet of the generator *B* by a space, which is filled with plaster of Paris or other suitable non-conductor. It should be supplied with water, which occupies one-third or more of its interior capacity, as indicated in the drawing. The office of this secondary generator is to furnish a receptacle for all the hot gases from the furnace after they have been combined with gases of decomposed steam, as hitherto shown, and afford opportunity and means for such gases to pass through a body of water, whereby they impart their heat to such water and convert it into steam. At the same time, a volume of direct steam from the primary generator is admitted, for the double purpose of forcing in the gaseous products, and of adding its quantum of heat to the temperature of the water.

The products of combustion mixed with steam, as indicated by the red and blue arrows, enter the water in the secondary generator, as shown in the drawing, and, by their high temperature, develop a portion of such water in the secondary generator into steam. They are compelled to pass through the body of the water in the generator by means of the deflector-plates *o* and *o'*, as indicated.

In future, the course of the steam and gaseous products will be represented by three arrows colored red, blue, and black, respectively.

The effect of the water in the secondary generator is to wash the heavier impurities from the gases of combustion, which impurities naturally settle upon the conical surface of the bottom of the generator, suitable provision being made for their removal by blow-off cocks *p*.

The combination of steam and gaseous forces rising from the surface of the water in the secondary generator proceeds to find an outlet through the contracted nozzle *q*, within the enclosed chamber *r*, and which, like the outlets before described, may be arranged so that steam from the primary generator may be admitted through the pipe *s*, branching from the pipe *G*, to effect the same office, as before described. The accumulated motive-agents, which the apparatus above described develops, are now collected within the annular chamber *M*, whose location, as shown, is directly above the secondary generator, and from thence they can be conducted through a proper delivery-pipe, *N*, to be employed in driving an engine, or for heating, or other purposes.

It will be observed that a means is provided, through the pipe *O*, of introducing steam from the primary generator over the fire, and thus supply oxygen thereto when desirable; and also, by means of the pipe *P*, combined steam and gaseous products of the same quality as those entering the secondary generator may be discharged into the side-pipe *H*, and by it be distributed again through the different channels which lead from it.

Having thus described the apparatus shown in the drawings, it will be seen that its leading characteristic consists, first, in introducing into engines of this class a secondary generator, into the water in which the gases of the furnace are forced by the superior pressure of steam in the primary generator, and are made to act upon it to generate more steam, while, in turn, these gases are purified by the action of the water; and second, in relieving the furnace from pressure, whenever desired, by the agency of the steam developed by the primary generator.

I wish it to be understood that I do not confine myself to the form of the apparatus or of its several parts, as shown, nor to the particular described arrangement of the furnace with the generators; neither do I limit

myself to a single secondary generator, as it is evident that, without change of principle, more than one such secondary generator can be employed, and the product of each be transferred, by a repetition of the means shown, to the next in succession.

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

1. An apparatus for generating steam, and mixing and superheating air and steam, consisting of a furnace, C, a primary generator, B, connected with such furnace by suitable injection-pipes H, and discharge-nozzles *n n*, and one or more secondary generators, E, arranged and operating together substantially as set forth.

2. I also claim connecting the furnace C with the passages, K, leading to the secondary generator E, by means of the blast-nozzle *n*, discharging steam from the primary generator, for the purpose of exhausting the contents of the flue D, for the passage of gases, and thereby relieving the furnace from pressure, as set forth.

3. I also claim combining the conducting-passage or passages, K, leading to the secondary generator, with the furnace C, by means of suitable connecting-pipes, whereby the products of combustion, in the state in which the same are in the passage K, can be readmitted to the fire-chamber, substantially as described.

O. M. STILLMAN.

Witnesses:

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C. L. PENDLETON.