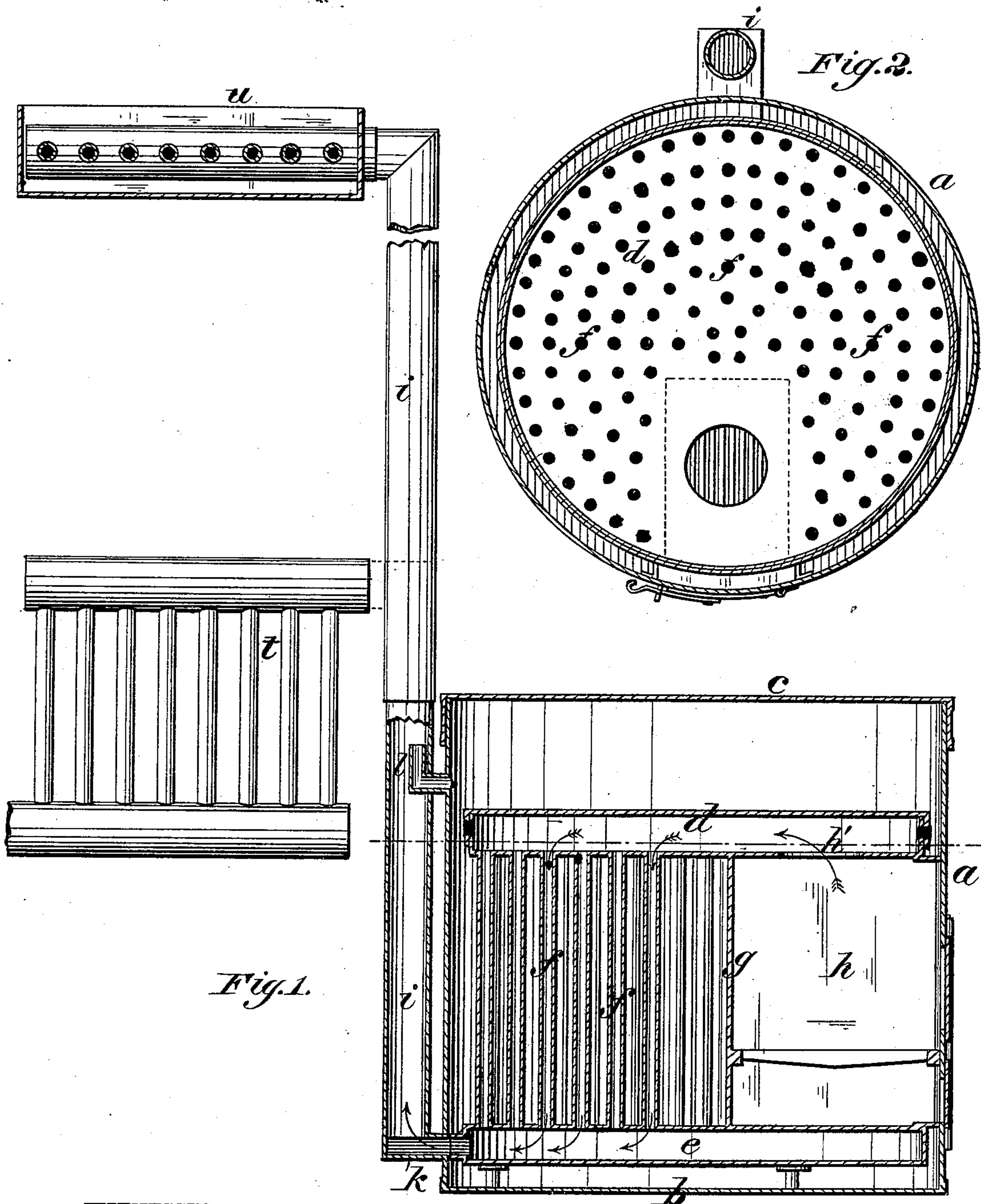


(Model.)

J. E. CULVER.
Steam Generator.

No. 236,558.

Patented Jan. 11, 1881.



WITNESSES:

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JOSEPH E. CULVER, OF JERSEY CITY, NEW JERSEY.

STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 236,558, dated January 11, 1881.

Application filed August 7, 1880. (Model.)

To all whom it may concern:

Be it known that I, JOSEPH EDWIN CULVER, M. D., of Jersey City, in the county of Hudson and State of New Jersey, have invented
5 a new and useful Improvement in Steam-Generators and Furnaces, of which the following is a specification.

Hitherto in steam-generators the gaseous products of combustion escaping to the smoke-stack have had a much higher temperature
10 than the steam in the boiler, thus involving a vast and unnecessary waste of heat-force.

In my improved generator the boiler may be constructed of sheet metal or boiler-iron, the
15 strength of which must be adapted to withstand the strain to which it is to be subjected. The flues may be constructed of sheet-metal boiler-tubes or cast-iron, or of any suitable material. The furnace may be of ordinary
20 construction.

When my improved generator is to be used solely for heating purposes, or when the tension of the steam in the boiler is to be carried only a few degrees above atmospheric pressure, the fire-box may advantageously be constructed within the water-space of the boiler,
25 and connected with an upper flue-chamber, from which flue-tubes pass to a smoke-chamber in the lower part of the water-space; but when it is intended to furnish motive power, and the steam-pressure within the boiler is to be raised to two or more atmospheres, then I prefer to have the fire-box constructed outside the boiler-shell and to be connected with
30 a system of intercommunicating flue-tubes, arranged within the water-space of the boiler so that the smoke shall traverse them from above downward. If the flues intercommunicate freely within the water-space at the bottom of the boiler only, the desired result can be but imperfectly obtained; but if, besides these junctions beneath, free intercommunication exists among all the uppermost flues also, a perfect working will be assured; nevertheless I prefer that the intercommunication shall
45 be yet more numerous, and be distributed throughout the entire system of flues from top to bottom. I have estimated, from some experiments, that the total capacity of the submerged flues in my generator should equal
50 about one-third of the water-space, in order that the smoke and steam may emerge from

the boiler at a common temperature when the grate-surface is about one-third the customary proportions.

When a considerable depth of the water-space is called for, an upright cylindrical boiler is the best; but the shape of the boiler may be determined by other requirements. However, the longer and more numerous the flue-tubes, and the greater the total capacity of the flues relatively to that of the water-space, the more effectually will the water be heated and the smoke cooled, the consumption of fuel remaining the same.

Accordingly as may be preferred for especial purposes, or whensoever it is sought merely to illustrate in practice the novel principle made use of in the construction of my improved generator, the flues may consist of tubes alone, or of chambers alone, or of any suitable combination of chambers and tubes, provided, always, that they be arranged within the water-space of the boiler below the water-level; provided, also, that they do freely intercommunicate one with another at the bottom within the water-space; provided, furthermore, that they do so connect with the furnace and smoke-stack that the smoke shall traverse them from above downward; and provided, moreover, that the descending smoke in every flue and in every part or section thereof is left free to descend according as it is cooled, or to maintain a higher level according as it retains its heat and rarefaction. Thus the continual cooling of the smoke in the flues and its increasing gravity serve to accelerate its descent, while throughout the breadth and depth of the water-space the smoke in all the flues maintains at the same level a uniform temperature—an equilibrium not liable to be disturbed by variable drafts—the water boils at the surface, and steam does not bubble up from the lower part of the boiler. The temperature of the water decreases from above downward; but it is uniform throughout any given horizontal plane. At all times the hottest stratum of water is opposed to the hottest flues, and the coolest stratum to the coolest flues. The cooled smoke in the lowermost flues is carried off by one large flue, or more, continued through the boiler-shell for this purpose. Into this discharge-flue, just outside the boiler, a two-way cock or valve, of ample

size, is inserted, through which the discharge-flue connects, at option, with a chimney, to carry away the unused smoke, or with a smoke-pipe, known as a "mixing-pipe," that is also connected with the steam-space by a pipe furnished with a cut-off, so that the gaseous products of combustion and the steam can be carried off together or separately for use. This mixture may be used to drive a suitable motor for heating purposes, for evaporating liquids, for extinguishing fires, and for other uses.

In the accompanying drawings, forming part of this specification, Figure 1 is a central vertical section of the generator and furnace. Fig. 2 is a horizontal section of the same on line *x x* of Fig. 1.

Similar letters of reference indicate corresponding parts.

a is the side of the boiler-shell, *b* the bottom, and *c* the top, which are formed of boiler-iron. Within the boiler are the upper and lower smoke-chambers, *d e*. These are made in the form of hollow circular disks, of a diameter somewhat less than the boiler, and are connected by vertical flue-tubes *f*, which are placed closely together, sufficient space being left between them for circulation of water. At the front part of the boiler the chambers *d e* are connected by partitions *g*, that form the fire-box *h*, which is provided with a grate. There are openings in the side *a* of the boiler to the fire-box *h*, above and below the grate, provided with doors. The lower smoke-chamber, *e*, is supported on short legs, so that the water has free access beneath it. The fire-box *h* and chamber *d* are connected by an opening, *h'*.

i is the pipe for carrying off the steam and products of combustion. This connects, by a pipe, *k*, with the smoke-chamber *e*, and, by a pipe, *l*, with the steam-space of the boiler. A suitable valve will be provided in pipe *l* for regulating the flow of steam to pipe *i*. The steam entering pipe *i* becomes mixed with the heated gases, and at the same time the steam-jet tends to increase the upward draft.

In operation, the products of combustion pass from the fire-box to the chamber *d*, and from thence, as they cool, they descend, by flues *f*, to chamber *e*. The flues and chambers are thus heated, and, by their large extent of heating-surface, rapidly and uniformly heat the water, the temperature decreasing from above downward. The products of combustion pass from chamber *e* to pipe *i*, and are conveyed away for use alone or mixed with more or less steam, as desired. The heated mixture may be conveyed to the cylinders of an engine, which may be worked as a high-pressure engine or may be provided with a suitable condenser. The mixture, at 212° to 215° Fahrenheit, may

be used simply for purposes of heating and ventilation, or in connection with evaporating-pans, and, conveyed by a suitable pipe, it may be employed to extinguish fires or to disinfect sick-rooms, hospitals, and ships, or as an antiseptic. A little sulphur thrown upon the fire in the furnace will add to the efficiency of the mixture as a disinfectant.

At *t*, I have shown a radiator consisting of horizontal and vertical tubes, which will be connected to pipe *i*, and with a chimney, for the final escape of the gases, thus utilizing the mixture of the heated gases and steam.

At *u* is an evaporating-pan containing tubes that connect with pipe *i*, so that the heat shall be equally distributed throughout the liquid in the pan.

The generator and furnace may also be used for other purposes than those named, and in all cases will give good results, compared with the amount of fuel consumed. The steam may be used under pressure, or at atmospheric pressure only. If it be desirable to use steam under extraordinary pressure, it can be safely accomplished by nesting-boilers built on this plan one within another, whereby, for example, if the outer boiler can safely sustain a pressure of ten atmospheres, the inner boiler can, without being subjected to greater strain than the former, sustain a pressure of twenty atmospheres.

If it be desired to use the residual gases of combustion under pressures above that of the atmosphere, the furnace-doors must be closed tightly with strong fastenings, and the air-supply to the fire kept up by a pressure-blower adapted to the purpose. A safety-valve will then be necessary in smoke-pipe *i*, as well as one for the boiler. When steam only is used, and combustion proceeds at atmospheric pressure, the latter valve will be kept open to convey away the unused smoke.

Having thus fully described my invention, I claim as new and desire to secure by Letters Patent—

1. The combination, in a boiler, of the shell *a* and fire-box *h*, with an upper and lower smoke-chamber, *d e*, connected by flues *f* and partition *g*, and arranged within the water-space, so as to be surrounded on all sides by water, substantially as shown, and for the purposes specified.

2. In combination with a boiler constructed substantially as described, the mixing-pipe *i*, provided with smoke-pipe *k* and steam-jet *l*, arranged substantially as and for the purposes described.

J. E. CULVER, M. D.

Witnesses:

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GEO. D. WALKER.