

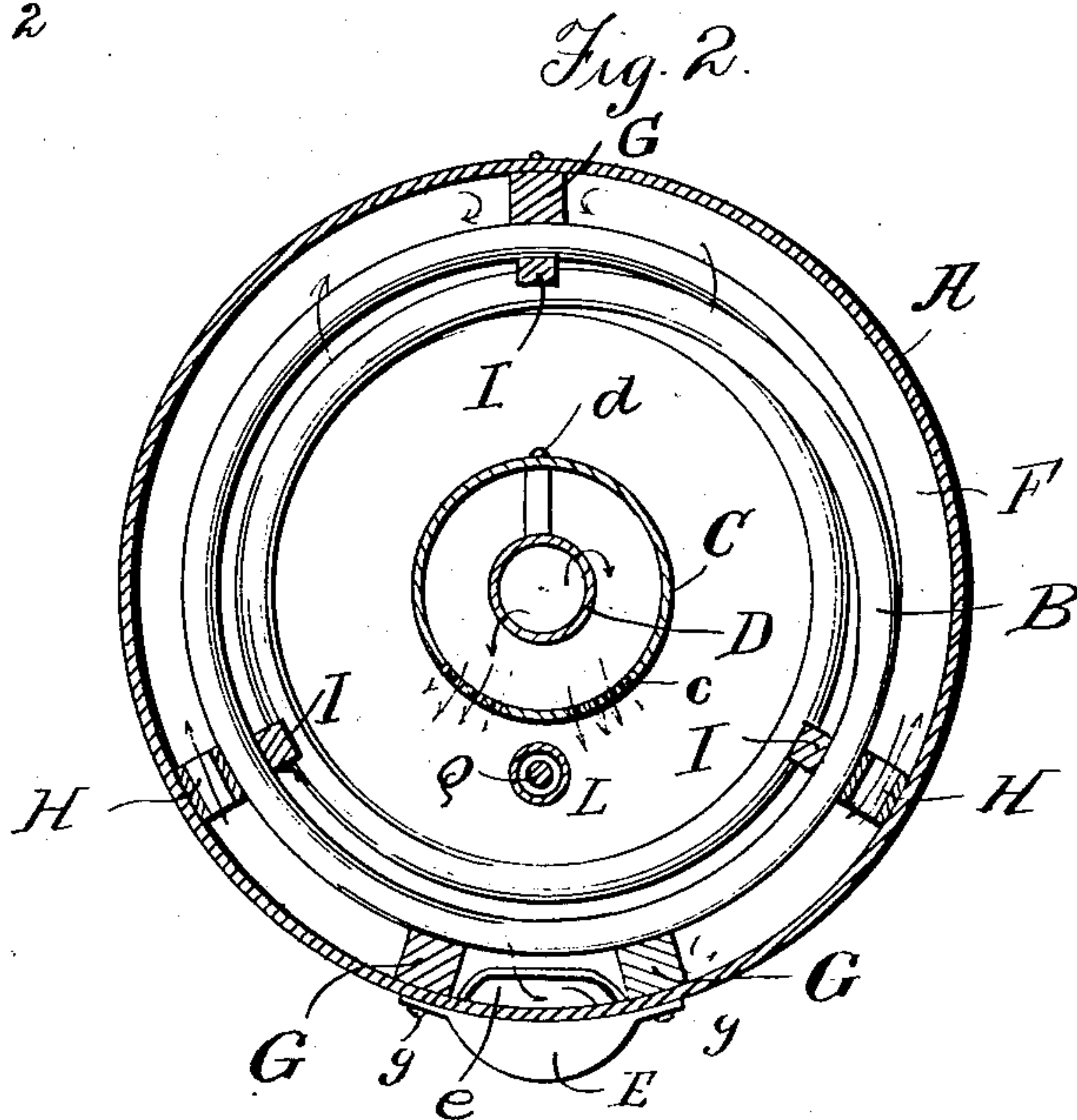
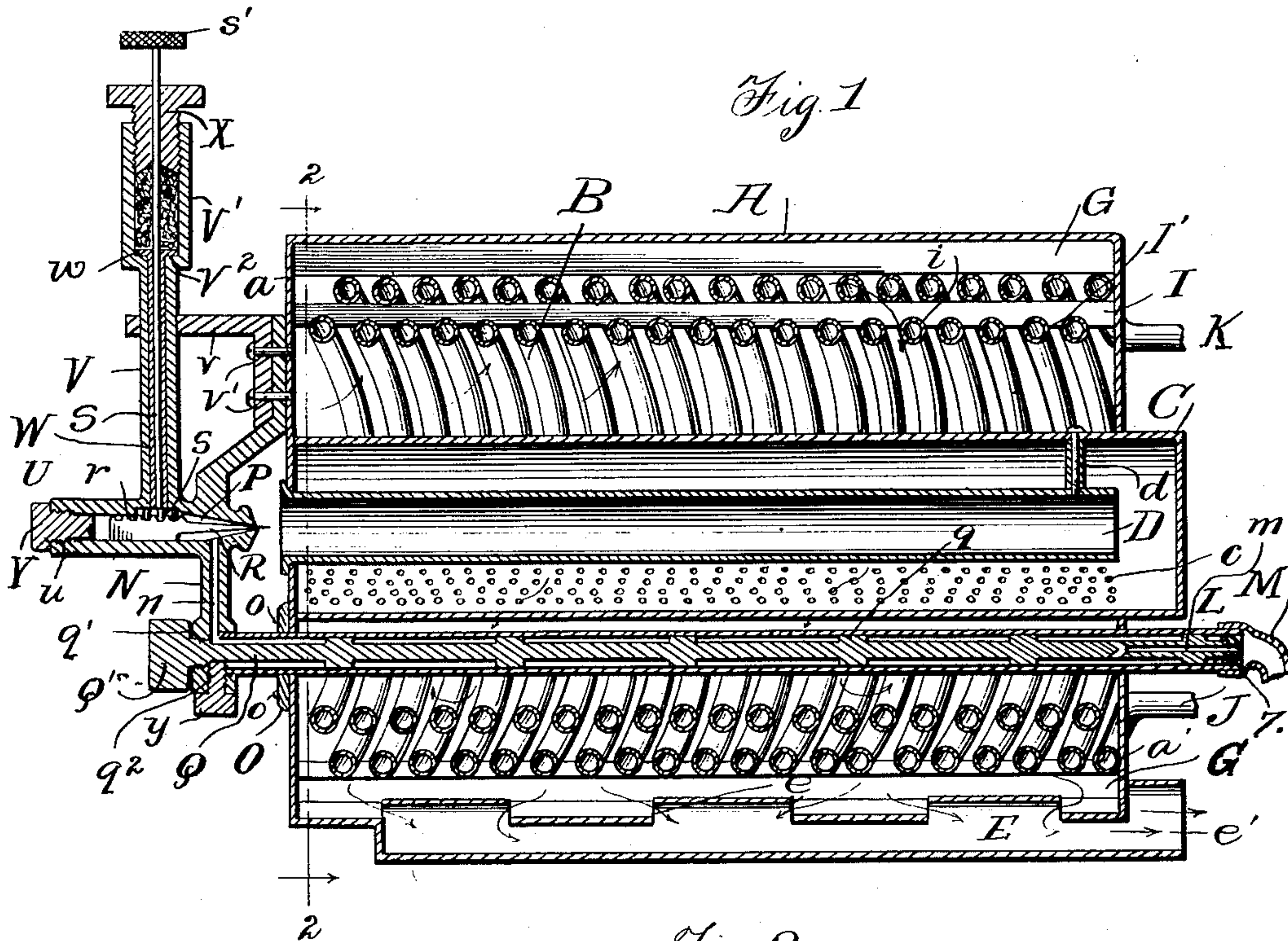
No. 848,564.

PATENTED MAR. 26, 1907.

W. MITCHELL.
STEAM GENERATOR.

APPLICATION FILED JAN. 25, 1905. RENEWED AUG. 28, 1906.

2 SHEETS—SHEET 1.



Witnesses
F. G. Campbell
James C. Babcock

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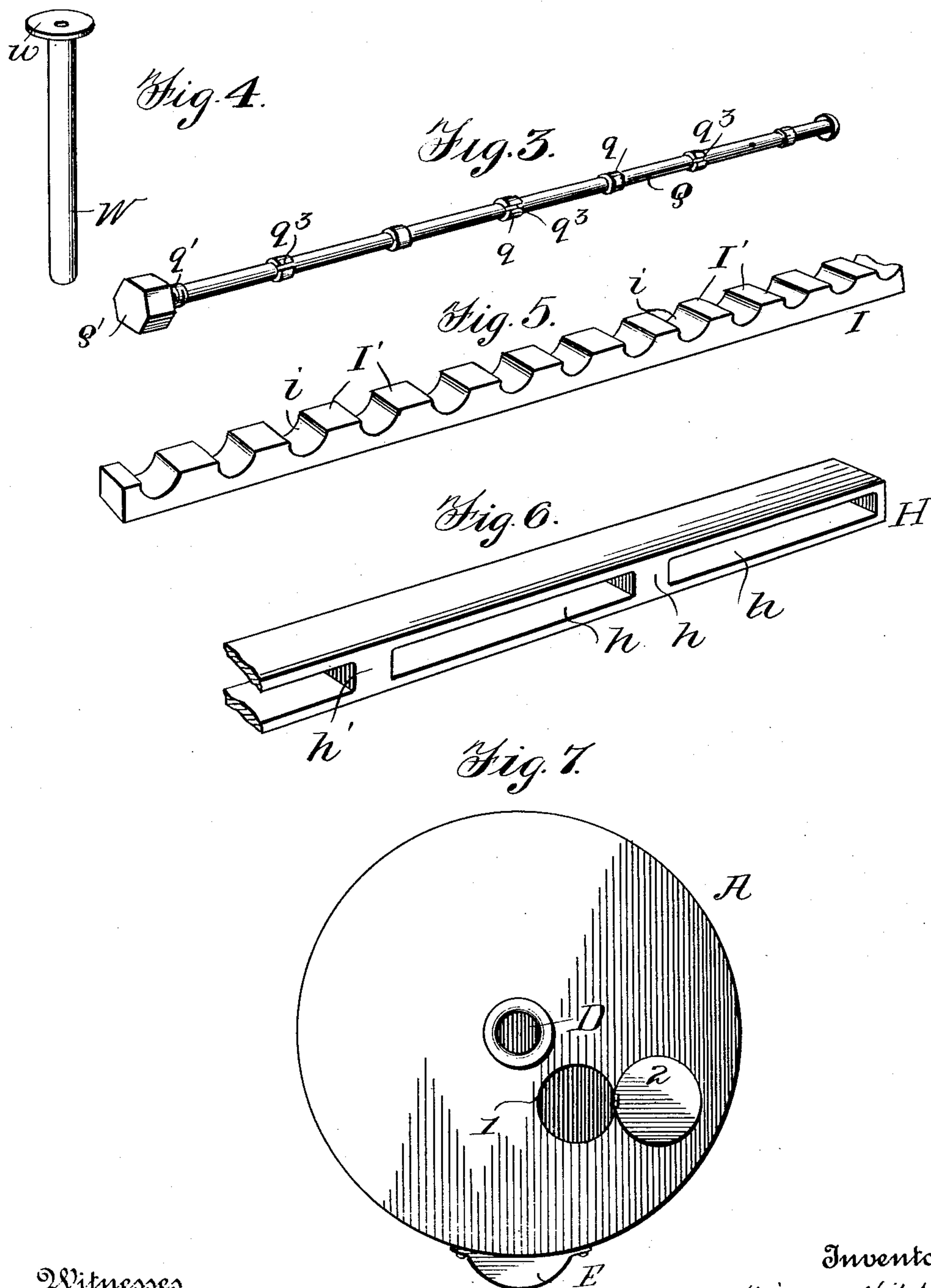
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UNITED STATES PATENT OFFICE.

WILLIS MITCHELL, OF MALDEN, MASSACHUSETTS.

STEAM-GENERATOR.

No. 848,564.

Specification of Letters Patent.

Patented March 26, 1907.

Application filed January 28, 1905. Renewed August 28, 1906. Serial No. 332,389.

To all whom it may concern:

Be it known that I, WILLIS MITCHELL, a citizen of the United States, residing at Malden, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Steam-Generators; and I 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.

The chief object of this invention is to generate the greatest practicable quantity of steam from a given amount of liquid fuel by insuring the perfect combustion of the latter and the application of the calorific gas or vapor to the water-tube in the most advantageous manner, incidentally dispensing with a chimney-flue, since the products of combustion are nearly all consumed, and the draft may escape into an apartment without being offensive. These generators embodying my invention are equally available for supplying engines or steam-heating systems or any other machine or apparatus where steam is required.

To the above ends my invention consists in the construction and combination of parts hereinafter more particularly set forth and claimed.

In the accompanying drawings, Figure 1 represents a central vertical longitudinal section through a steam-generator embodying my invention. Fig. 2 represents, looking to the right, a vertical cross-section of the same, taken just beyond the water-pipe helices on the line 2 2 of Fig. 1. Fig. 3 represents a detail view of the collared rod or solid cylinder which forms part of the gas-generator. Fig. 4 represents a detail view of a sleeve for holding the valve-operating pinion in place. Fig. 5 represents a detail view of one of the grooved tube-supports. Fig. 6 represents a detail view of one of the hollow tube-supports, partly broken away to show the interior passages. Fig. 7 represents a bottom view of the generator-casing with the door of the opening for ignition turned aside.

A designates the generator-casing, preferably cylindrical, or approximately so, in form; B, the inclosed water-tube coiled into concentric helices of any convenient number, only two, however, being shown; C, a burner fastened to the interior of the front wall *a* of the said casing and extending through the rear wall *a'* thereof, being closed at both ends

and arranged concentrically, as a hollow core, within the said water-tube helices, and D, a mixing-chamber of elongated cylindrical form, arranged concentrically within the said burner, open at both ends and supported at its forward end by said front wall *a*, through which it barely extends, the rear end of the said mixing-chamber being suspended by means of a screw *d* from the upper part of the wall of said burner or supported by any equivalent means and in any equivalent manner. That end of the said casing which is nearest the jet-hole hereinafter mentioned is herein referred to as the "front" or "forward" end, the other being called the "rear" end. The same distinction holds with regard to the generator and burner.

The burner C aforesaid is provided with many small discharge-apertures *c* in longitudinal series, as long as the helices, all said apertures being preferably below the central horizontal plane of the burner and divided into two portions on each side of its vertical central longitudinal plane in order that the jets of burning gas may be directed obliquely downward to right and left upon the lower parts of the helices. The only outlet from said casing is through a longitudinal trough or tube E on the bottom thereof and communicating therewith by slots *e*, the rear end *e'* of said tube being open. The divergence of the discharge of the heater prevents it from impinging on said outlet-tube or interfering with the flow through the said openings. There being no flue at the top of the generator, the heat from such discharges ascends partly through the coils, but more especially through the space F between the outer helix and the casing, and becomes concentrated by the connection of currents in the upper part of the said space, where it will be applied to the upper parts of the helices about as intensely as it has been applied to the parts below. This equalization of action is important, and some kind of storage space at the top of the casing is nearly indispensable to it. The cylindrical space or accumulator is the most available form, as it facilitates access of the ascending heated currents to the lateral parts of the outer helix and also provides for accumulation and concentration of heat in contact therewith. Three kinds of supports are used for the said helices—solid bars G, arranged at top and bottom between the outer helix and the casing; hollow bars H, arranged similarly at intermediate points for

the passage of gas, and grooved bars I, interposed at regular intervals between each two proximate helices. Each of these bars or supports of whatever kind extends longitudinally from end to end of the casing A, being attached to and supported by the end walls thereof. Collectively they hold the helices rigidly in place, maintaining absolutely unchanged the space F and the intervals between them. In addition, the supports I hold the individual coils of each helix at equal distances apart, the said coils being set into the grooves *i* of said supports and between their alternate projections I'. The hollow bars H extend from end to end of the casing A. Each of them is provided with transverse passages *h* through it for the upward passage of the heated products of combustion in order that these may not be impeded uselessly in reaching the top of the steam-generator. A partition *h'* separates these passages and preserves the strength of the section. The solid bars G are preferably three in number, two of them being at the bottom and receiving screws *g*, which fasten the trough or tube E to the casing A.

The extension of the burner C beyond the rear wall of the casing A provides a space in which the gas or vapor and air already mingled in the mixing-chamber D may more perfectly commingle before turning back to the discharge-apertures *c*. The said mixing-chamber ends approximately opposite the rear end of the series of said apertures. Water-inlet tube J and steam-outlet tube K enter through the rear wall of the casing A and are in continuation of the coiled water-pipe B.

The inflammable gas or vapor used in this steam-generator is produced in a vapor-generator L, extending longitudinally through casing A, parallel to burner C and between it and the inner helix of water-tube B. Generator L is supplied at its protruding rear end with volatile hydrocarbon through an oil-tube M and at its forward end, also protruding, is supported by a bent bracket N, also by a collar O, surrounding said generator and attached by screws *o* to the front wall *a* of said casing. The said bracket has a bore *n*, communicating at one end with the interior of generator L and at the other with a jet-hole P, arranged opposite the central line of mixing-chamber D, but at an interval sufficient to allow the free inflow of air with said gas to said chamber.

The generator L consists of a long cylindrical casing or tube and a removable rod Q of similar length, provided at intervals with collars or annular shoulders *q*, which fit the inside of said casing. Each collar is provided with a longitudinal groove or channel *q'*, connecting the space before it to the space behind it, these grooves or channels being arranged alternately on opposite sides of the generator. The spaces between the

said collars constitute gas-retorts, and such construction and arrangement of the said grooves compels the currents of hydrocarbon to eddy about in said retorts, the fuel being self-retarded and retained, so as to insure perfect gasifying. At each retort from rear to front it is more intensely heated, the proximity of the burner insuring no lack of additional heat-supply at any point and the continuous effect being cumulative. At last it issues as a fixed gas and is delivered in this state to the jet-hole. The collared rod Q has at its rear end a sharp-edged disk Z, which serves both to close the generator-tube and for cleaning the interior thereof while the said rod is withdrawn. This latter feature is very important, for my steam-generator is adapted to use kerosene as well as gasoline, and heavier oils like the former produce a quantity of soot and other residuum, which would soon clog the passages *q'* and stop the generation of steam unless some remedy were provided. An inlet-bore *m*, through the middle of cleaning-disk Z and the proximate part of rod Q, admits the fluid fuel from inlet-pipe M to the first retort next to the said disk.

At its outer end rod Q is provided with an operating-knob Q', also with screw-threads *q'*, engaging like threads in screw-tapped bracket N, through which it extends, being locked there normally by a small locking-screw *y*, that works against the threads *q'* through one side of said opening. The said rod is, however, easily freed by unscrewing first the said locking-screw and then itself and may then be withdrawn by a slight pull, thereby cleaning the interior of the generator tube or shell, as stated. With equal facility it is returned to place and locked there by reversing the above procedure, and the gas-generator is then complete again.

The jet-hole P is governed by a needle-valve R, having on its stem a toothed rack *r*, which engages and is operated by a pinion *s*, carried by a rotary adjusting-rod S, having a knob or head *s'*. By means of said adjusting rod, pinion, and rack the said valve is readily advanced or withdrawn more or less, as desired. The said valve-stem and adjusting-rod move in and are supported by tubular guide-arms or castings U and V at right angles to each other and preferably integral with the bracket N aforesaid. A supplemental bracket or angle-iron *v* supports the middle part of arm or casting V. Both it and the first-mentioned bracket N are fastened to the front wall *a* of casing A by screws *v'*. A sleeve W surrounds rod S within the tubular arm V, its lower end being in contact with pinion *s* and its outer end being provided with a disk-form head *w* within an enlargement V' of the said arm, this head bearing against shoulder V² thereof. The interior of said enlargement constitutes a

packing-chamber, normally supplied with any suitable readily-compressible substance, as shown, and closed at the outer end by a screw-threaded gland or screw-plug X, which is turned into integral screw-threads of the wall of said chamber, compressing said material on the rod S and against the head W. The sleeve W is thereby held against the pinion s, keeping it in engagement with the rack R by a sufficient pressure. Of course the said gland or screw-plug is centrally bored to receive the rod S. The outer end of the other tubular arm U is also internally screw-threaded at u and closed by a screw-plug Y, engaging therewith.

The front end of casing A is provided with an opening 1, through which a lighted match may be inserted to ignite the gas or vapor within. A pivoted disk-form cover 2 is provided for this opening.

For operating this generator I connect the water-inlet tube to a tank and the outlet-tube to the engine or heating apparatus, as in my Patent No. 675,862. I then force water into the tank, compressing the air therein till there is sufficient air-pressure to feed the water through the helices to the point where steam is needed. The gas having been previously ignited, the water in said helices and the outlet-pipe continuous therewith is converted into steam, the engine begins to work, a pump on said engine pumps water into the tank, maintaining water-supply and air-pressure. At a certain point of the latter a valve in a branch pipe opens, diverting the water to a supply-reservoir, as in said patent, the pressure and feeding being automatically kept up thereafter, as described therein.

In the accompanying drawings I have shown but two helices; but of course the number may be increased at will. A generator having one hundred and sixty-four feet length of water-tube in two helices, wound, respectively, on a seven-inch and an eight and one-fourth inch mandrel and having a half-inch wide accumulating-space F surrounding the outer helix within a casing A twenty-six inches long will supply five-horse power. Three helices (two hundred and sixty-two feet) similarly arranged will supply a ten-horse power, four coils (three hundred and seventy-four feet) fifteen-horse power, five coils (four hundred and ninety-four feet) twenty-horse power. The tube is steel drawn, one-half inch diameter outside, five-sixths inch inside; but of course I do not limit myself to the said material or dimensions, which are merely stated for a fuller exposition of the matter.

The gas from the jet-hole enters the open outer end of the mixing-chamber, bearing with it the intervening and surrounding air and becoming intimately mingled therewith in said chamber and at the space beyond the outer end thereof. It then flows back out-

side of said mixing-chamber through the burner and jets out obliquely through the holes c, ignited against the lower parts of each helix, flowing around and enveloping in flame each coil or winding of each helix and filling all the intervals between the coils and between the helices, as well as the surrounding accumulator-space F, where, and especially in the upper part thereof, the heat is so concentrated as to nearly equal the first direct action of the blaze, the gaseous fuel being almost entirely consumed. If the pressure of the heat and expansion becomes excessive, the openings at the bottom afford an outlet, which may be made to communicate with the oil tank or reservoir for maintaining automatic feeding of the fuel; but ordinarily the outflow will be slight and may be disregarded.

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

1. In a steam-generator, the combination of a water-tube coiled in concentric helices with a laterally-perforated burner extending longitudinally as a core within the same and discharging ignited gas or vapor against the coils thereof and means for maintaining intervals between the helices for the purpose set forth.

2. In a steam-generator, the combination of a water-tube coiled into concentric approximately horizontal helices with a burner surrounded thereby extending longitudinally as a core therein, provided with a series of perforations in its under side and discharging ignited gas or vapor against the lower parts of the coils and means for maintaining intervals between the said helices and between the coils of each helix substantially as set forth.

3. In a steam-generator, the combination of a water-tube coiled into concentric approximately horizontal helices with a burner surrounded thereby and discharging ignited gas or vapor against the lower part of the same in oblique diverging jets on each side of the vertical longitudinal central plane of the said burner substantially as set forth.

4. In a steam-generator, the combination of a water-tube coiled into concentric approximately horizontal helices with a burner surrounded thereby and discharging ignited gas or vapor against the lower part of the said helices in series of oblique diverging jets on each side of the vertical longitudinal central plane of the said burner and heat-outlets arranged along the central line of the bottom of the generator between the series of jets for the purpose set forth.

5. In a steam-generator, the combination of a water-tube coiled into concentric approximately horizontal helices with a burner surrounded thereby and discharging ignited gas or vapor against the lower part of the

said helices and an inclosing casing arranged to leave a space between it and the outer helix, as an accumulator of concentrated heat for the purpose set forth.

5 6. In a steam-generator, the combination of a water-tube coiled into concentric approximately horizontal helices with a burner surrounded thereby and discharging ignited gas or vapor against the lower part of the
10 said helices, an inclosing casing arranged to leave a space between it and the outer helix as an accumulator of concentrated heat, said casing being provided with outlets at the bottom only for the purpose set forth.

15 7. In a steam-generator, the combination of a water-tube coiled into concentric approximately horizontal helices with a burner surrounded thereby and discharging ignited gas or vapor against the lower part of the
20 said helices, an inclosing casing arranged to leave a space between it and the outer helix as an accumulator of concentrated heat and devices interposed between the said casing and the outer helix to maintain the said space
25 unchanged and hold the said helices in position substantially as set forth.

8. In a steam-generator, the combination of a water-tube coiled into concentric approximately horizontal helices with a burner
30 surrounded by the same and discharging gas or vapor in two series of diverging jets against the lower part of said helices on each side of the vertical plane of the axis of said burner, an inclosing casing arranged to leave
35 a heat-accumulator space between it and the outer helix and an outlet trough or pipe arranged longitudinally under said casing between the two series of such jets, the said pipe being connected to the interior of said
40 casing by a series of openings substantially as set forth.

9. In a steam-generator, the combination of a water-tube coiled into approximately horizontal concentric helices with a burner
45 surrounded by the same and discharging ignited gas or vapor in two series of diverging jets against the lower part of said helices on each side of the vertical plane of the axis of said burner an inclosing casing arranged to
50 leave a heat-accumulator space between it and the outer helix and an outlet trough or pipe communicating with the interior of said casing and arranged longitudinally under the said casing between the two series of diverg-
55 ing jets and supports for said helices arranged between the outer helix and the said casing and serving to keep the intervening heat-accumulator space unchanged, two of the said supports being arranged above the said
60 pipe or trough, which is fastened to these

supports and suspended therefrom substantially as set forth.

10. In an approximately horizontal steam-generator, the combination of a helical water-tube with a burner surrounded thereby and
65 discharging ignited gas or vapor against the lower part of the same, an outer casing closed at the top but having outlet below, and longitudinal helix-supports provided with transverse upward passages for heat and heated
70 matter substantially as set forth.

11. In an approximately horizontal steam-generator, the combination of a helical water-tube with a burner surrounded thereby and
75 discharging ignited gas or vapor against the lower part of the same, an outer casing closed at the top but having outlet below and longitudinal helix-supports provided with transverse upward passages and interposed between the casing and helix to maintain with-
80 out change a heat-accumulator space between them substantially as set forth.

12. In a steam-generator, the combination of a water-tube wound into approximately horizontal concentric helices, a burner sur-
85 rounded thereby and discharging ignited gas or vapor against the lower part of the same throughout the length of the same, longitudinal supports which separate the helices from each other and which are provided with
90 grooves or projecting parts which separate the coils of each helix from each other, an outer casing and additional longitudinal helix-supports, some of which are provided with upward and downward passages, and
95 some of which also serve to maintain an accumulator-space between the outer helix and the said casing substantially as set forth.

13. In a steam-generator, the combination of a water-tube wound in concentric approxi-
100 mately horizontal helices with a burner surrounded thereby and provided with a series of holes for discharging ignited gas and vapor against the lower part of said helices throughout their length, an exterior casing
105 arranged to leave an accumulator-space within it around the said helices and having outlet below but not above and means for maintaining intervals between the helices and between the coils of each helix, as well as main-
110 taining the said accumulator-space for the purposes set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

WILLIS MITCHELL.

Witnesses:

MARGARET A. DANIHER,
CHARLES D. WOODBERRY.