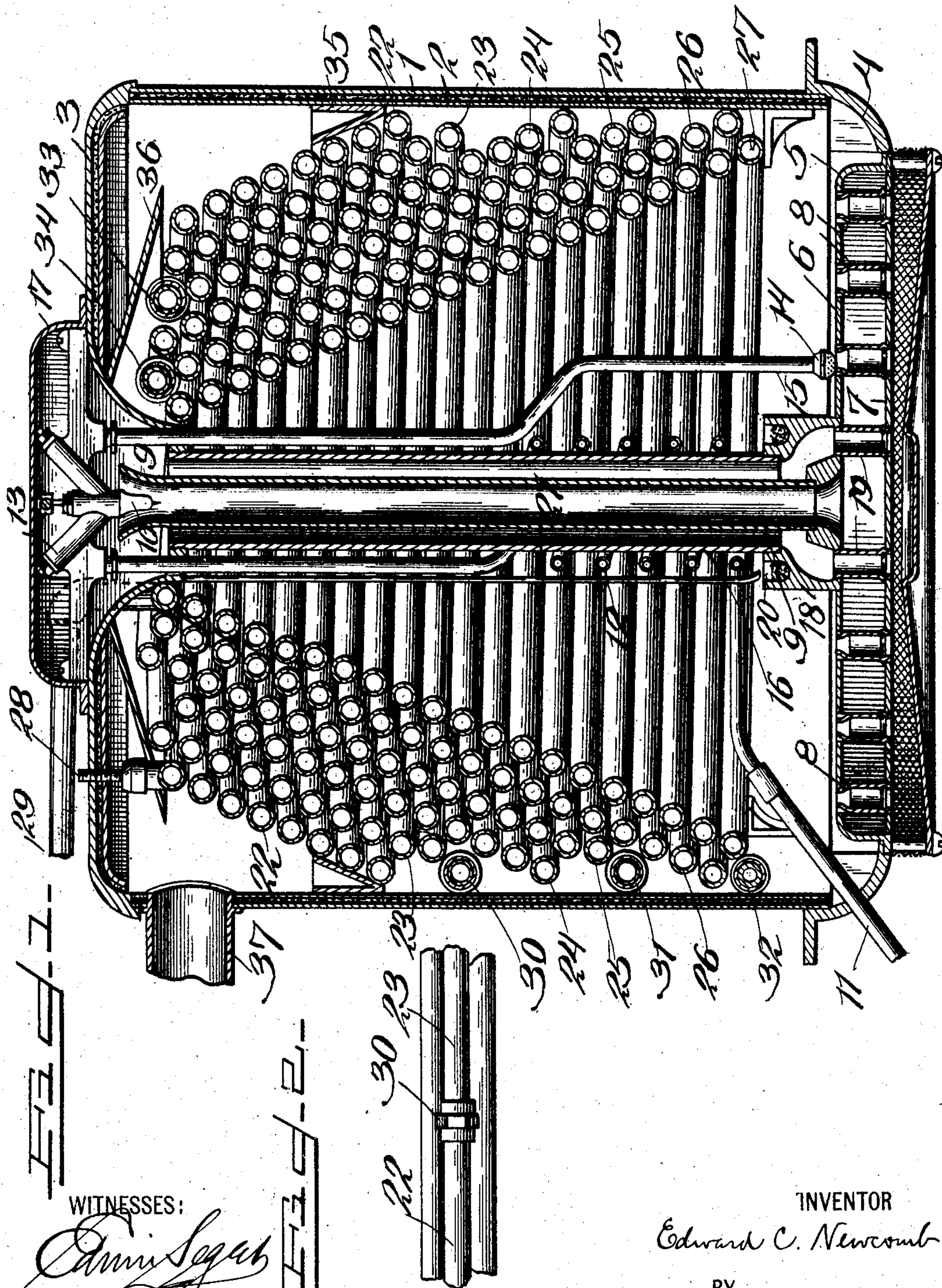


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E. C. NEWCOMB.
STEAM GENERATOR.

APPLICATION FILED JULY 14, 1902. RENEWED JUNE 14, 1904.



WITNESSES:

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STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 780,955, dated January 24, 1905.

Original application filed June 7, 1901, Serial No. 63,555. Divided and this application filed July 14, 1902. Renewed June 14, 1904.
Serial No. 212,507.

To all whom it may concern:

Be it known that I, EDWARD C. NEWCOMB, a citizen of the United States, and a resident of Jamaica Plain, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Steam-Generators, of which the following is a specification.

My invention relates to steam-generators, and while it is more particularly addressed to the provision of a generator especially adapted to form part of an apparatus for generating superheated steam or other vapor, such as that forming the subject-matter of my prior application, Serial No. 63,555, filed June 7, 1901, of which application this is a division, it may be advantageously employed in other relations and for other purposes than for generating superheated steam, as for heating water and other fluids for domestic and other purposes.

An object of my invention is to provide a steam-generator which is highly efficient and in which the efficiency does not change greatly with variations of the demand for the steam generated thereby.

Other objects of my invention are to provide a generator which is simple and cheap in construction and easily assembled and taken apart for cleaning or repair; also, one which is durable and not apt to rupture or to get out of order; also, one in which a high pressure may be safely maintained; also, one in which provision is made for a large combustion-chamber and a large burner area; also, one in which the combustion-chamber is completely inclosed and in which the outer surfaces are relatively cool, thereby securing great efficiency and avoiding the necessity of heavy jacketing. These and other objects of the invention will more fully appear from the following description.

My invention consists in the novel parts, improvements, and combinations herein shown and described.

The accompanying drawings, which are referred to herein and form a part hereof, illustrate one embodiment of my invention and

serve, in connection with the description herein, to explain the principles thereof.

Of the drawings, Figure 1 is a central vertical section of a generator constructed in accordance with my invention. Fig. 2 is a side elevation illustrating a detail.

In accordance with my invention the generator consists of a single continuous passage which is so arranged with relation to a combustion-chamber that a liquid introduced into one end of the passage will be gradually and progressively heated and gradually vaporized and superheated, the general direction of the flow of the fluid being opposite to that of the products of the combustion maintained in the combustion-chamber.

In carrying the invention into effect three or more pipe-coils are used, each having open convolutions, said coils being so arranged one within another around a combustion-chamber that substantially all of the products of combustion have to pass between the convolutions of the coils successively in a direction opposite to that in which the fluid flows. Preferably the coils are so formed and arranged that the total area of the passages between the convolutions of the successive coils decreases from the inner coil toward the outer coil in such manner that as the volume of the products of combustion decreases as a result of the absorption of the heat thereof the passages therefor are correspondingly decreased, thereby maintaining the speed of the products of combustion at its maximum throughout the generator. Preferably, also, the coils are so formed and arranged as to inclose a combustion-chamber having ample dimensions to permit of the use of a large burner area and to permit complete combustion of the fuel before the same comes in contact with any of the heat-absorbing surfaces and also to provide the greatest mass of the heat-absorbing surfaces in the direct path of the greatest volume of the products of combustion. These objects are well combined in the embodiment of the invention herein shown.

Referring now to the drawings in detail, 1 is a suitable jacket or casing, the same being

preferably cylindrical in form and constructed of two sheet-metal cylinders, inclosing between them a packing of suitable heat-insulating material, as asbestos. The upper end of the casing is closed by a similarly constructed and insulated head 3, and the lower end of the casing is closed by a suitable casting 4, in a central opening of which is secured a burner 5. Any suitable form of burner may be used, that shown consisting of a pair of separated plates 6 and 7, which are provided with a multiplicity of tubes 8, adapted to admit air from below the burner to the combustion-chamber. A suitable mixture of air is admitted to the chamber formed between the plates 6 and 7 by a central vertically-arranged mixing-tube 9, into the upper end of which the fuel is injected through a suitable nozzle 10. In accordance with the construction shown the liquid fuel is supplied from any suitable source through the inlet-pipe 11, which after being coiled around the mixing-tube 9 to form a suitable vaporizer for the fuel is connected to the nozzle 10 through a suitable casting 13.

14 is a pilot-burner which is placed in constant communication with the fuel-supply by means of the tube 15. For the purpose of shielding the tube 9 from the direct heat of the combustion-chamber a tube 16, having a diameter somewhat larger than that of tube 9, is concentrically arranged with the latter tube so as to provide an air-chamber between the two tubes. With the object in view of heating the air which is supplied to the mixing-tube a casing 17 is provided to form a closed chamber for the upper ends of the tubes 9 and 16 and the lower end of the air-chamber formed between said tubes is placed in communication through suitable openings in a casting 18 with a central series of air-tubes 19, as shown. Suitable openings are provided around the upper ends of each of the air-tubes 8 to permit the escape of the fuel mixture from the burner to the combustion-chamber. As shown, these openings are provided by suitably corrugating the upper ends of the air-tubes. For the purpose of heating the vaporizer 12, as required in starting the burner, an annular trough 20 is provided in the upper surface of the casting 18, said trough being adapted to receive a small quantity of inflammable fluid the burning of which will heat the vaporizer 12. To facilitate the introduction of the inflammable fluid into the trough 20, a suitable filling-tube 21 is provided. While this form of burner is preferred on account of the even distribution of the flame secured thereby, any other suitable form of burner may be used.

In accordance with the construction shown the generator consists of a plurality of pipe-coils 22, 23, 24, 25, 26, and 27. Each of the coils consists of a number of convolutions, which are so wound as to form between them

narrow openings for the passage of the products of combustion. Each of the coils also is preferably frusto-conical in form, all of the coils being of substantially the same diameter at their larger ends and successively shorter, so that when they are arranged one within the other, the longest coil on the inside and the shortest coil on the outside, they substantially conform to the shape of the cylindrical casing. With the coils thus associated and arranged vertically, with the larger end of the inner coil adjacent to and substantially concentric with the burner, a combustion-chamber of ample dimensions is provided, and the greatest mass of the heat-absorbing surfaces is located directly in the natural path of the greatest volume of the products of combustion. The water-inlet pipe 28, in accordance with the construction shown, is connected to the upper end of the outer coil, and the steam-outlet pipe is connected to the upper end of the innermost coil. Each of the coils preferably is separately formed and removably connected to the adjacent coil by a suitable coupling, that shown consisting of an ordinary union. As shown, the unions 30, 31, and 32, connecting the coils 22 and 23, 24 and 25, and 26 and 27, respectively, are arranged at the outer side of the generator, and the unions 33 and 34, connecting the coils 23 and 24 and 25 and 26, are arranged at the upper end of the generator. With this arrangement each of the unions, with the exception of the one numbered 32, is protected from the hottest products of combustion by two or more rows of the heat-absorbing surfaces, so that they cannot become so highly heated as to destroy them or as to destroy the packing used therein. The union 32 is located to one side of the burner in such a position that it is not subjected to the hot products of combustion, the flame formed at the edge of the burner having a natural tendency to pass toward the center of the combustion-chamber and away from the lower coils of the generator.

To compel substantially all of the products of combustion to flow successively between the convolutions of each of the coils, a shield or deflector 35 is arranged at the base of the outer coil 22, and a deflector 36 is arranged at the top of the coils, as shown. An escape-pipe 37 for the products of combustion is provided near the top of the casing.

While six coils are shown, it is obvious that a greater or less number may be used, if desired. There should be a sufficient number of coils, however, to form a sufficient mass of the heat-absorbing surfaces and to insure a suitable temperature-gradient between the successive coils. It may be observed generally, moreover, that the coils should be so connected that the water cannot flow directly from a colder portion to a much hotter portion of the heating-surfaces. They should also be so connected that the water is brought

to the boiling-point at some part of the generator where it will not flow by gravity into a hotter part of the generator. While these conditions can possibly be realized by the use of not more than three coils, it is preferable to use more than three coils, as the greater the number of coils used the greater will be the heat-absorbing efficiency of the generator and the less will the efficiency vary with variations in the demand for steam generated by the apparatus.

By reason of the constructions shown and described the liquid supplied to the generator is caused to flow gradually and uniformly from the outer coil toward the inner coil in a direction opposite to that of the flow of the products of combustion, and the liquid is gradually and uniformly heated and is prevented from flowing by gravity to the inner coil or coils, as it would if the coils were arranged one above another and directly connected. With this construction also the products of combustion are uniformly subjected to the action of the successively-cooler heat-absorbing surfaces, the available heat thereof being thus nearly all absorbed. By reason of the conical construction of the coils, moreover, they can all be formed on the same tool or mandrel, and when in position they can slip with relation to each other as required to compensate for unequal expansion and this without being distorted. The generator can be readily taken apart for cleaning or to replace an imperfect section. There are few connections and all of them are readily accessible.

My invention in its broader aspects is not limited to the particular construction shown nor to the particular constructions by which it may be carried into effect, as many changes may be made in the construction without departing from the main principles of the invention and without sacrificing its chief advantages.

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

1. A steam-generator, the heating-surface of which consists of three or more pipe-coils, connected in series, each having open convolutions throughout substantially its entire length, said coils being so arranged one within another around a combustion-chamber that substantially all the products of combustion have to pass between the convolutions of the coils successively in a direction opposite to that in which the fluid flows from coil to coil.

2. A steam-generator, the heating-surface of which consists of three or more pipe-coils, connected in series, each having open convolutions, said coils being so arranged one within another around a combustion-chamber that substantially all the products of combustion have to pass between the convolutions of the coils successively in a direction opposite to that in which the fluid flows from coil to coil,

said coils being so formed and arranged that the total area of the passages between the convolutions of the successive coils decreases from the inner coil toward the outer coil.

3. A steam-generator, the heating-surface of which consists of three or more pipe-coils each having open convolutions throughout substantially its entire length, said coils being connected together in series and arranged one within another around a combustion-chamber, the liquid-inlet being connected to the outer coil and the steam-outlet being connected to the inner coil whereby the products of combustion are caused to flow radially outward between the convolutions of the successive coils in a direction opposite to the flow of the fluid through the generator.

4. A steam-generator, the heating-surface of which consists of three or more pipe-coils connected together in series and arranged one within another around a combustion-chamber, the liquid-inlet being connected to the outer coil and the steam-outlet being connected to the inner coil whereby the products of combustion are caused to flow radially outward between the convolutions of the successive coils in a direction opposite to the flow of the fluid through the generator, said coils being so formed and arranged that the total area of the passages between the convolutions of the successive coils decreases from the inner coil toward the outer coil.

5. A steam-generator, the heating-surface of which consists of three or more pipe-coils connected together in series and arranged one within another around a combustion-chamber, the liquid-inlet being connected to the outer coil and the steam-outlet being connected to the inner coil whereby the products of combustion are caused to flow radially outward between the convolutions of the successive coils in a direction opposite to the flow of the fluid through the generator, the connections between the successive coils being located at the exterior of the generator so as not to be subjected to the action of the hottest products of combustion.

6. A steam-generator, the heating-surface of which consists of three or more frusto-conical pipe-coils connected together in series and arranged one within another around a combustion-chamber, said coils being of substantially the same diameter at their larger ends and successively shorter from the inner coil toward the outer one.

7. The combination with a steam-generator, the heating-surface of which consists of three or more frusto-conical pipe-coils connected together in series and arranged one within another around a combustion-chamber, of a burner arranged at the larger end of the inner coil, said coils being of substantially the same diameter at their larger ends and successively shorter from the inner coil toward the outer one whereby the greatest mass of

the heat-absorbing surfaces is located directly in the path of the flow of the greatest volume of the products of combustion.

8. The combination with a steam-generator, the heating-surface of which consists of three or more frusto-conical pipe-coils connected together in series and arranged one within another around a combustion-chamber, of a burner arranged at the larger end of the inner coil and a cylindrical casing inclosing the top and sides of said coils, said casing having at or near the top an outlet for the waste gases and said coils being of substantially the same diameter at their lower ends and successively shorter from the inner coil toward the outer one whereby the mass of heat-absorbing surfaces is made to conform to the shape of the casing.

9. The combination with a steam-generator, the heating-surface of which consists of three or more frusto-conical pipe-coils removably connected together in series and arranged one within another around a combustion-chamber, of a burner arranged at the larger end of the inner coil and a cylindrical casing inclosing the top and sides of said coils, said casing having at or near the top an outlet for the waste gases and said coils being of substantially the same diameter at their larger ends and successively shorter from the inner coil toward the outer one whereby the greatest mass of the heat-absorbing surfaces is located directly in the path of flow of the largest volume of the products of combustion.

10. In a steam-generating apparatus, the combination with a combustion-chamber of three or more pipe-coils, each having open convolutions, said coils being connected in series and so arranged with relation to each other and to the combustion-chamber that substantially all of the products of combustion

must pass between the convolutions of successive coils in a direction opposite to that in which the fluid flows from coil to coil.

11. In a steam-generating apparatus, the combination with a combustion-chamber of a plurality of pipe-coils, each having open convolutions, said coils being connected in series and so arranged with relation to each other and to the combustion-chamber that substantially all of the products of combustion must pass between the convolutions of successive coils in a direction opposite to that in which the fluid flows from coil to coil, and said coils being so formed that the total area of the passages between the convolutions of the coil or coils farthest from the combustion-chamber is less than that of the coil or coils nearest the combustion-chamber.

12. In a steam-generating apparatus, the combination with a combustion-chamber of a plurality of pipe-coils, each having open convolutions, said coils being connected in series and so arranged with relation to each other and to the combustion-chamber that the fluid flows from the coils farthest from the combustion-chamber to the coils nearest to the combustion-chamber and said coils being so formed that the total area of the passages between the convolutions of the coil or coils farthest from the combustion-chamber is less than that of the coil or coils nearest the combustion-chamber, and means causing substantially all of the products of combustion to pass between the convolutions of the coils.

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

EDWARD C. NEWCOMB.

Witnesses:

CHAS. HALL ADAMS,
FRANCIS W. MCGURTY.