

J. N. LEACH.
 STEAM GENERATOR.
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917,621.

Patented Apr. 6, 1909.
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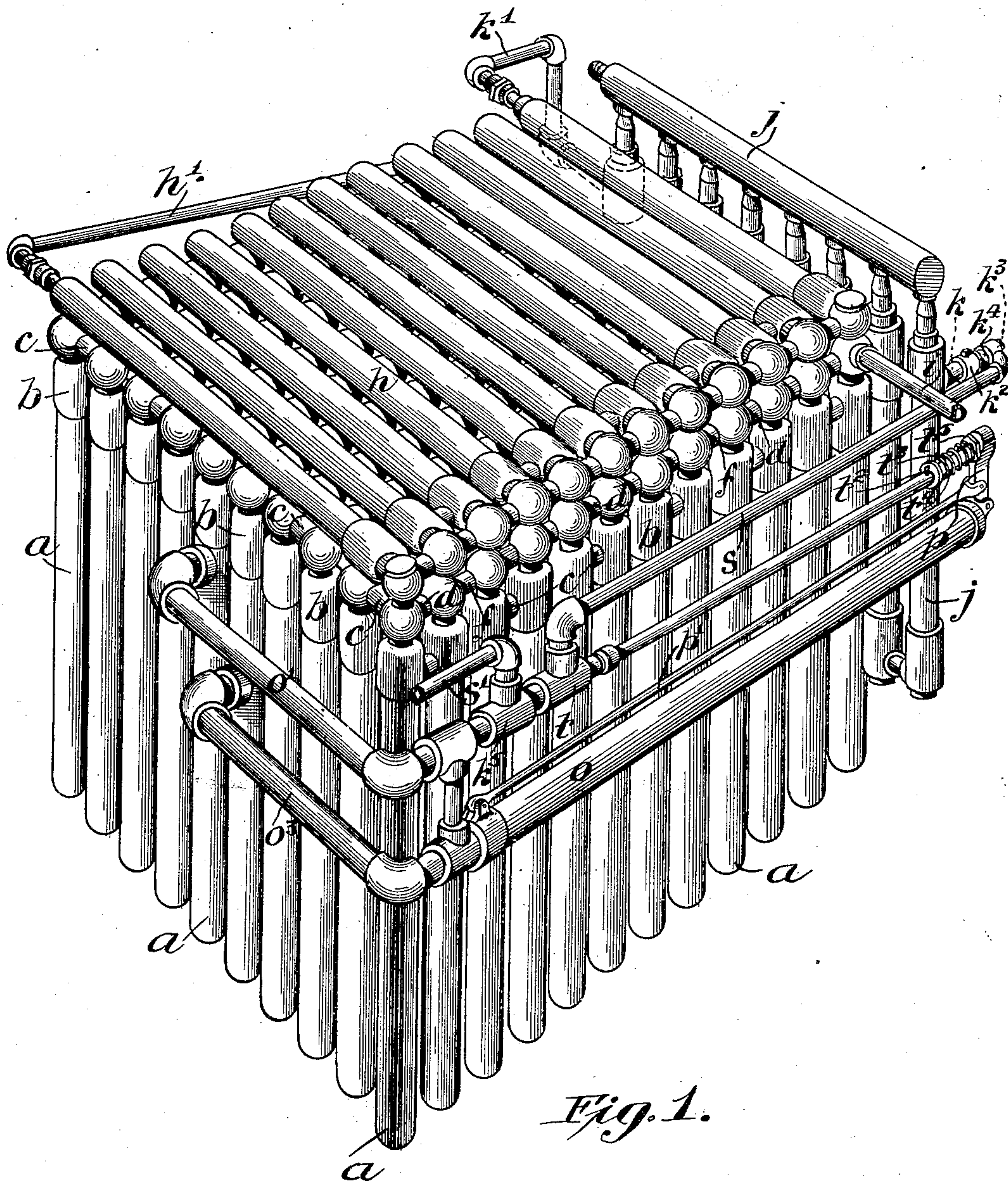


Fig. 1.

Attest:
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 his Atty

UNITED STATES PATENT OFFICE.

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STEAM-GENERATOR.

No. 917,621.

Specification of Letters Patent.

Patented April 6, 1909.

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Serial No. 352,412.

To all whom it may concern:

Be it known that I, JOHN N. LEACH, a citizen of the United States, residing at Melrose, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Steam-Generators, of which the following is a specification, reference being had therein to the accompanying drawings, which form a part thereof.

My invention relates to steam generators, and more particularly to that class thereof commonly known as water tube boilers wherein there is a substantially continuous circulation of water and steam within a tube or series of tubes subjected externally to heat.

The main object of my invention is to provide a generator of this type which will afford a great heating surface and be so constructed and arranged as to provide for a circulation of water and steam therethrough in a manner to insure high efficiency and economy in the generation of steam therein.

A further object is to provide a compact generator especially adapted for small steam plants as in steam propelled vehicles and boats, so constructed as to cause the feed water and steam to pass through the maximum of heated tubing within the minimum of boiler space, thus combining with great steaming capacity, lightness and compactness of structure.

A still further object is to provide means utilizing the thermo units not expended in generating steam, in heating the feed water prior to its entering the generator proper.

A still further object is to provide a steam generator capable of producing superheated steam under high pressure, directly within the generator proper. And a still further object is to provide a steam generator which will be simple in construction and inexpensive to manufacture; which will consist of a plurality of units or sections so assembled as to permit the removal of a burned out or injured unit or section, and the substitution of a new one therefor without material labor or expense, and which will withstand the great heat to which boilers of this type are subjected.

The invention consists in the novel features of construction and combination of parts hereinafter set forth and described and

more particularly pointed out in the claims hereto appended.

Referring to the drawings: Figure 1 is a perspective view of a steam generator embodying my invention; Fig. 2 is a sectional elevation of the generator proper, the feed water regulator and its appurtenances being shown in elevation and partly broken away to disclose the arrangement of the thermostat; and the feed water heater section and the condenser, being shown in elevation, and Fig. 3 is a plan view of the generator.

Like letters refer to like parts throughout the several views.

In connection with a generator of this type, it is necessary to provide a source of water supply and means drawing water therefrom and forcing it into the generator, ordinarily a feed water pump, which being merely appurtenant to this generator and well known in the art, are not shown in the accompanying drawings. It is also necessary to provide an inclosing casing for the generator, acting as a flue to the fire under said generator, which casing as well as the burner or other means heating the generator, are likewise omitted from the drawings as tending to obscure the invention, and as being well known in the art and not requiring illustration.

In the embodiment of my invention shown in the drawings, I employ a plurality of sections or units arranged substantially parallel to each other, and successively coupled together to form a continuous channel through which the water and steam circulates, by means of nipples at the opposite ends of each section or unit. Each such section or unit is substantially like every other section or unit, and to avoid needless repetition, a description of but one of such will be entered into.

To insure as great a heating surface as possible, I construct each section or unit of a plurality of tubes *a* closed at the bottom, preferably by being welded together as shown. These tubes are preferably substantially parallel to each other and are so arranged as to project the closed ends thereof into the fire, thus avoiding the presence of fittings at the points subjected to the highest temperatures, and causing the flames to impinge upon all parts of the outside of each

said tube, and subjecting all parts thereof equally to the heat. The tubes *a* are fitted to and suspended from a header *b* which is hollow, and provides means whereby said tubes are in communication with each other, to present a continuous channel for the circulation of water and steam through all the tubes in each section, the adjoining headers being connected by a nipple, as *c*, to place the tubes in adjoining sections in similar communication with each other to circulate the water and steam throughout the entire generator.

To increase the circulation within a limited boiler space, I divide each header *b* transversely by a plurality of partitions *d* forming two distinct chambers *b'* *b''* to each tube *a* the lower chamber *b''* of which is in direct communication with each tube *a* and the upper *b'* of which is in communication therewith through an inner tube *e* of small diameter nested within each such tube *a* and extending to a point adjacent to the closed bottom thereof. While the tubes *a* and *e* are in communication with the aforesaid chambers, care should be taken that they do not project thereinto to an extent to choke the circulation of water therethrough.

The alternate upper chambers *b'* are in communication with each other through ports in the webs *f* connecting the upper parts of said header, and the alternate lower chambers *b''* are similarly placed in communication with each other through ports in the webs *g*.

Each inner tube *e* is either screwed into the partition *d* or driven thereinto so as to form a direct and a return duct through the tube *a* and to force the water and steam to circulate through all the tubes *a* and *e*, and all chambers in the header *b* in passing through the entire generator proper, insuring a material increase in the circulation and presenting a thin film of water to the heated outer tube. This insures rapid heating of the water in the tubes *a* and incidentally the maintenance of the high temperature of the water or steam passing thereto or therefrom through the inner tubes *e*.

The header *b* is preferably cast in a single piece and of malleable iron, and cored to form the chambers therein, and the various ports heretofore referred to; and the tubes *a* and *e* are fitted thereto by means of screw threads or by a driving fit.

Arranged across the top of the generator proper is a feed water heating section *h* constructed in all respects like one of the sections or units of the generator proper, the water passing therethrough being fed to the upper chamber *b'* at one end of the channel formed by the several sections or units constituting the generator proper, through the pipe *h'*.

A steam pipe *i* to the engine, is in connection with the other end of the said channel.

Water is preferably fed to the said heating section *h* from a condenser *j* thus utilizing the heat of the exhaust to impart some heat to the feed water while so condensing said exhaust as to avoid a visible exhaust. Suitable pipe connections *k* *k'* are provided at the opposite ends of said condenser, whereby feed water is fed thereto from the feed water pump or injector (not shown); and discharged therefrom into the feed water heating section above referred to.

Arranged in the pipe *k* is a check valve *k''* beyond which is a three way fitting *k'''*, the leads of which respectively are in communication with said check valve through the pipe *k''''*, with a feed water pump or injector (not shown) and with a by-pass system actuated by a thermostat.

The automatic thermostatic control consists of an outer tubular casing *o* preferably of copper or of some metal which readily contracts and expands with a variation in its temperature. This is in communication through the piping *o'* with one of the sections or units of the generator, and through an inner tube or pipe *o''* and piping *o'''* with the next succeeding section or unit, the sole connection between said sections or units being through the thermostat, the connection *c* not being employed between the headers of these sections or units. With one arm thereof pivoted to one end of the casing *o*, is a rocking lever *p* which is mounted on a distance rod *p'*, the other end of which rod is supported in a position fixed relative to said casing. It will be seen that the lever *p*, with the expansion and contraction of the casing *o*, is rocked upon its bearing on said rod *p'*. Adjacent to the said thermostat is a by-pass system comprising a pipe composed of two sections *s* *s'* leading respectively from the fitting *k'''* and to the water tank. Arranged in this pipe is a valve *t*, the stem *t'* of which is passed through a slightly elongated opening in the long arm of the lever *p*. Secured to said stem is a collar *t''* between which and a washer *t'''* is located a spring *t''''*, the function of which is to act as a cushion in starting said valve stem, and to compensate for any movement of the casing *o* in excess of that required to close the valve. This stem is made adjustable with relation to the lever *p* by means of its screw threaded end, and a nut *t''''''* bearing upon said lever arm, said nut being set by means of an ordinary jam nut.

The operation of the generator is substantially as follows: Water as fed to the generator proper enters the upper chamber *b'* of the header *b* at one end of the entire series of sections or units; passes through the inner tube *e* to the bottom of the outer tube *a* at one end of said section or unit; up said tube *a* about the tube *e* to the lower chamber *b''*; through the port *g* therein to the adjoining chamber *b''*; down the outer tube *a* in communication

with said last mentioned chamber b^2 to the bottom thereof; up the inner tube e nested in said last mentioned tube a , to the upper chamber b' immediately above said last mentioned tube a ; through the port in the web f to the adjoining chamber b' , and through all successive tubes a and e of the same section or unit in like manner. This manner of circulating the water causes the water to be repeatedly passed downwardly into those portions of the tube suspended directly in the flame, thus tending to rapidly heat the water in the tubes a and through said water, that passing through the tubes e , thus substantially increasing the length of tubing through which the water must circulate without correspondingly increasing the boiler space. The tubes being suspended as shown, results in the subjection of the water and steam to the greatest heat at intervals aggregating the greater part of the time during which the same is in the generator, thus not only insuring rapid steam generation, but the production of a highly superheated steam. This arrangement of tubes also insures the flame and heat passing about and impinging upon the entire periphery of each said tube a , thus utilizing a large percentage of the heat units from the burner or fire in the generation of steam. The circulation of water through the generator being direct and returning through the several tubes, there is no tendency for the boiler pressure to distort such tubes. As the water and steam reach the last tube of each section or unit, they pass through the nipple c to the next section or unit and circulate to and through the successive sections or units in the manner heretofore described. The circulation of water is maintained by a feed water pump or injector, being passed through the condenser j and the feed water heating section h before being discharged into the generator proper through the pipe h' .

As heretofore stated the feed water heating section h is constructed the same as one of the sections or units of the generator proper, so that the water circulates there-through in the direct and return channel formed in each tube thereof. Its arrangement above the generator proper is solely with the view of so obstructing the vents between said headers b as to utilize the waste heat or a portion thereof, to raise the temperature of the feed water prior to its discharge into the said generator. The water as it enters the generator will be fairly well heated, therefore, and will be rapidly converted into steam therein. It is passed through the outer tube of the thermostatic feed water control, to the inner tube, in a manner to cause the expansion of said outer tube, so as to control the feed of water to the generator in the manner peculiar to the form of thermostatic feed water control described.

A detailed description of this mode of opera-

tion is not essential, as the construction and arrangement of generator may be used with or without this or any other form of feed water controlling device as may be desired.

It is found that under ordinary conditions, a highly superheated steam is generated in a generator of the type heretofore described, and that there is ordinarily maintained a sufficient head of steam to insure a reserve sufficient to meet all the demands of a small generator; and that while the pressure is ordinarily between 400 and 500 pounds, the individual tubes a and e possess more than sufficient inherent strength to withstand the high pressures.

In case any of the tubes a should blow out or burn out the nipple c affords a convenient means for removing the section or unit containing the damaged tube, and replacing it by a new section.

The construction, employing straight tubes nested together as described, is an inexpensive structure, and permits the use of material of substantially uniform strength throughout and capable of withstanding the many severe tests placed upon it in use.

It is not my intention to claim the feed water control mechanism in this application, such being immaterial to the boiler construction and being claimed in my application for Letters Patent, Serial No. 272,957, filed in the United States Patent Office, on the 7th day of August, 1905. It is also not my intention to limit the invention to the precise details of construction herein shown and described, inasmuch as while in a small steam plant it is desirable to provide many adjuncts for utilizing the heat units of the burner or fire to the best advantage, still it is apparent that such details may be varied and said adjuncts dispensed with, without departing from the spirit and scope of the invention.

Having described the invention, what I claim as new and desire to have protected by Letters Patent is:

1. In a steam generator, the combination of a plurality of separable sections or units each comprising a plurality of pendent tubes closed at the bottom, means in each of said tubes whereby a direct and a return channel is formed therein, means whereby said return channels are placed in direct communication with said direct channels in succeeding adjoining tubes, and means whereby the opposite ends of each section or unit are placed in communication with succeeding and preceding adjoining sections or units, respectively, all of said parts being so constructed and arranged as to form therein a single continuous channel extending through each and all of said tubes.

2. In a steam generator, the combination of a plurality of sections or units each comprising a plurality of pendent outer tubes closed at the bottom, an inner tube in each of

said outer tubes in communication therewith, each section comprising also a header having therein a plurality of chambers each in communication with an inner and an outer tube, the alternate chambers in communication with the inner tubes being respectively in connection with the succeeding similar chambers, said headers being connected at opposite ends, respectively, thereof with succeeding and preceding adjoining headers, all of said parts being so constructed and arranged as to form therein a single continuous channel extending through each and all of said tubes.

3. In a steam generator, the combination of a plurality of sections or units each comprising a plurality of adjoining outer tubes closed at the bottom, an inner tube in each of said outer tubes in communication therewith, each section comprising also a header having therein a plurality of upper chambers, and a plurality of lower chambers, each upper chamber and each lower chamber, respectively, being in communication with an inner tube and an outer tube, the alternate lower chambers and the alternate upper chambers being in communication with the succeeding similar chambers, said header being connected at opposite ends, respectively, thereof with succeeding and preceding adjoining headers, all of said parts being so constructed and arranged as to form therein a single continuous channel extending through each and all of said tubes.

4. In a steam generator, the combination of a plurality of sections or units each comprising a plurality of pendent tubes closed at the bottom, means in each said tube whereby a direct and a return channel is formed therein, means whereby the said return channels are placed in direct communication with said direct channels in succeeding adjoining tubes, means whereby the opposite ends of each section or unit are placed in communication with succeeding and with preceding adjoining sections or

units respectively, said channel through said sections having a steam outlet and a feed water inlet, a feed water heating section disposed above said sections or tubes, and means respectively establishing communication between said feed water heating section and said first mentioned section, and between said feed water heating section and a source of feed water supply.

5. In a steam generator, the combination of a plurality of sections or units each comprising a plurality of pendent tubes closed at the bottom, means in each tube whereby a direct and a return channel is formed therein, means whereby the said return channels are placed in direct communication with said direct channels in succeeding adjoining tubes, means whereby the opposite ends of each section or unit are placed in communication with succeeding and with preceding adjoining sections or units respectively, said channel through said sections having a steam outlet and a feed water inlet, a feed water heating section comprising a plurality of tubes horizontally disposed, an inner tube in each of said tubes in communication therewith a header comprising a plurality of outer chambers and a plurality of inner chambers, each outer chamber being in communication with said first mentioned tube, and each inner chamber being in communication with each inner tube, the alternate inner chambers and the alternate outer chambers being in communication with succeeding similar chambers, and means establishing communication between one end of the channel so formed and one of the sections or units, and between the other end thereof and a source of feed water supply.

In witness whereof, I have hereunto affixed my signature this 11th day of January, 1907, in the presence of two witnesses.

JOHN N. LEACH.

Witnesses:

N. L. FROTHINGHAM,
A. A. ASHMAN.