

No. 776,732.

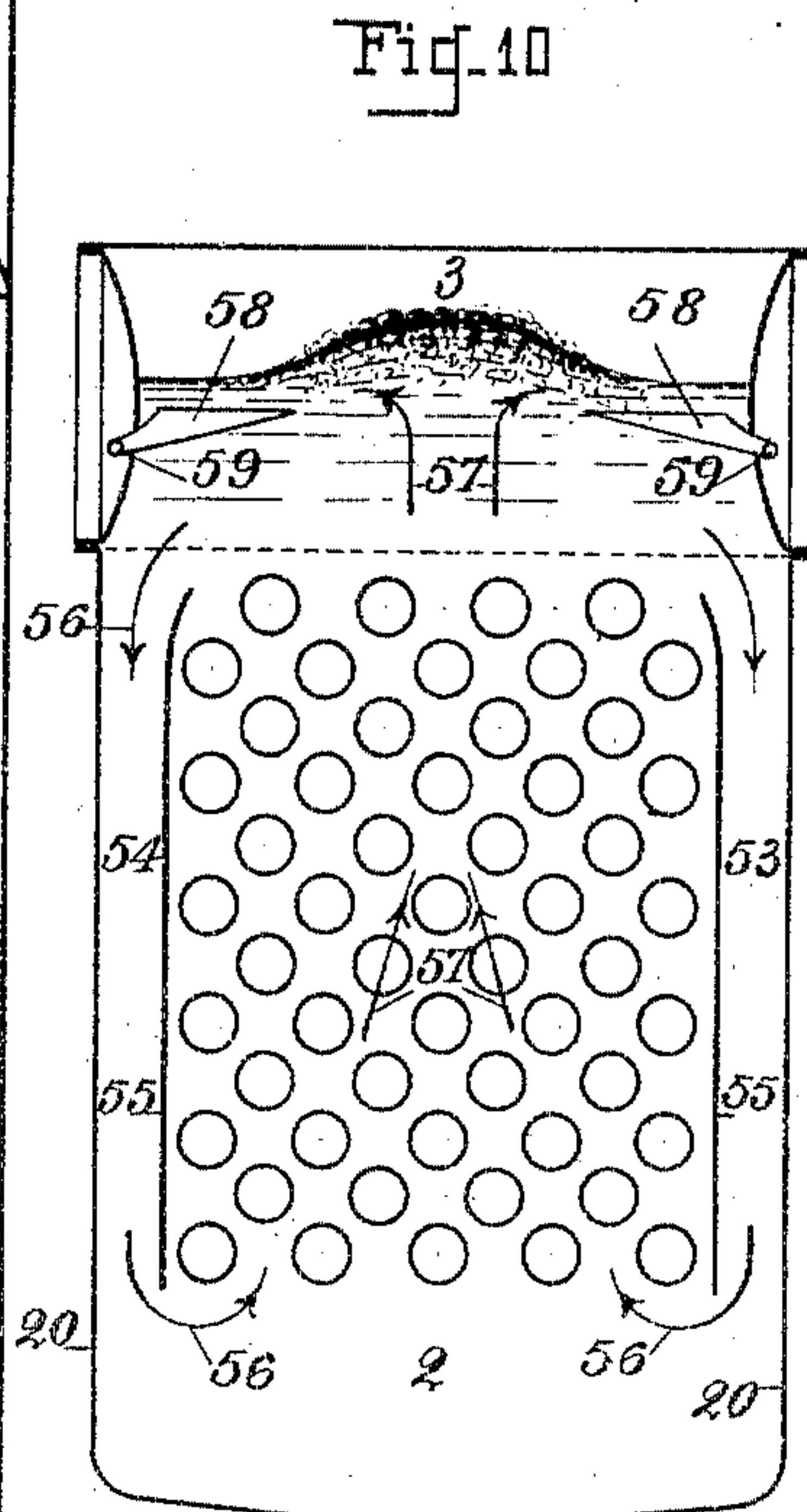
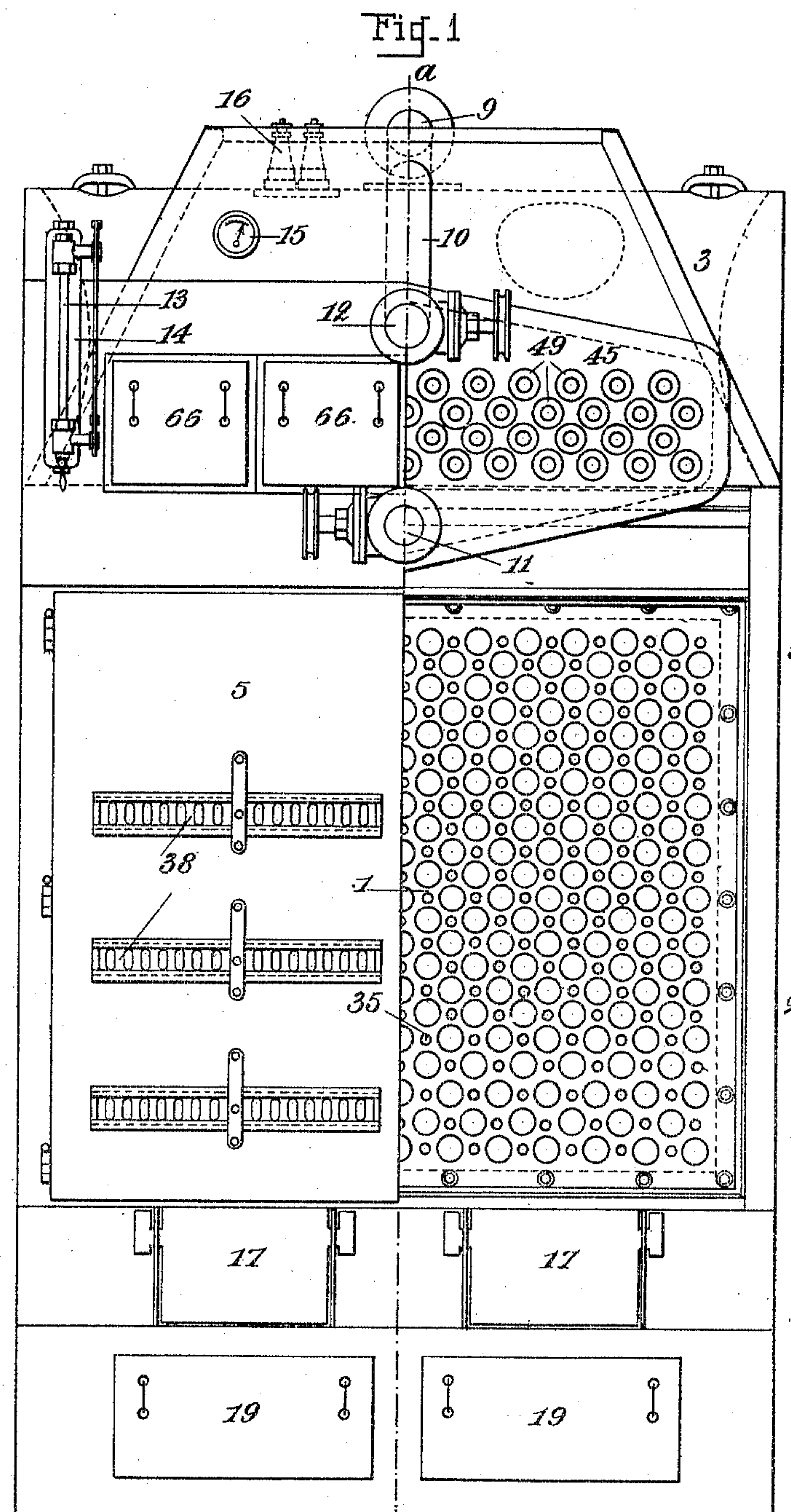
PATENTED DEC. 6, 1904.

E. DUCHESNE.  
MULTITUBULAR STEAM GENERATOR.

APPLICATION FILED FEB. 8, 1904.

NO MODEL.

4 SHEETS—SHEET 1.



Witnesses:  
*J. P. Menard*  
*J. P. Menard*

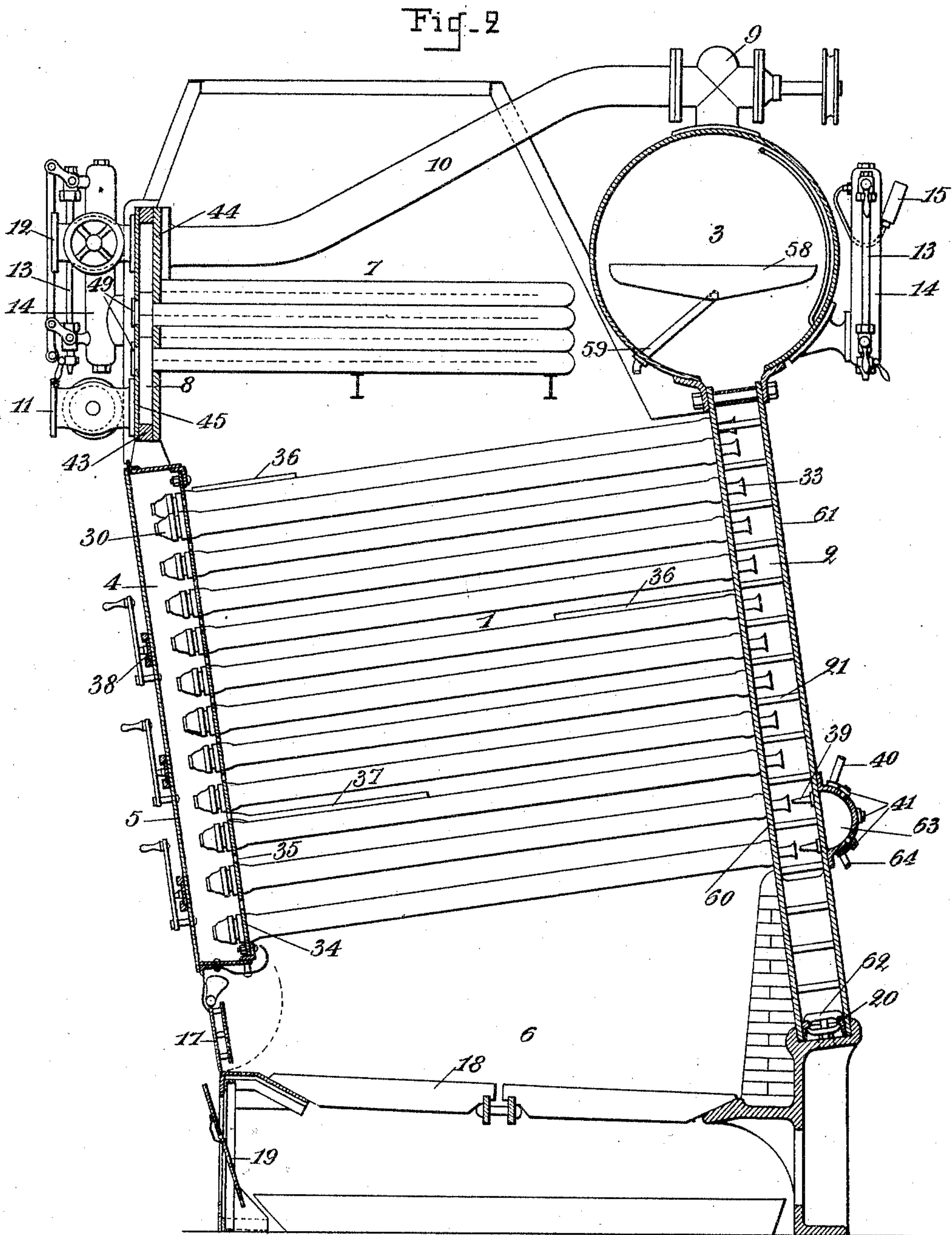
*Ernest Duchesne, Inventor,*  
By *Marion Marion*  
*Attorneys*

E. DUCHESNE.  
MULTITUBULAR STEAM GENERATOR.

APPLICATION FILED FEB. 8, 1904.

NO MODEL.

4 SHEETS—SHEET 2.



Witnesses:

J. D. Menard  
J. D. Menard

Ernest Duchesne, Inventor,

By Marion Marion

Attorneys.

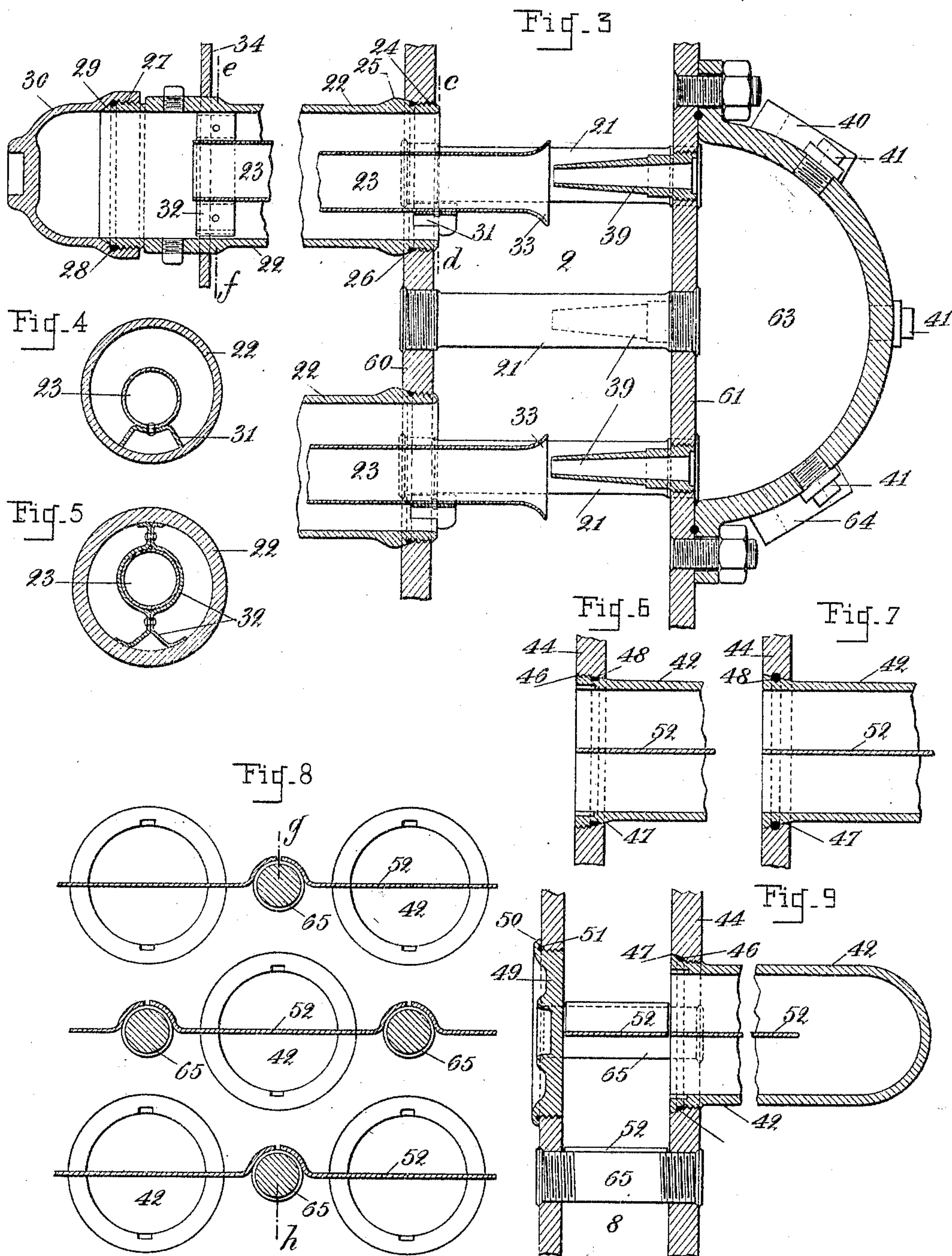


E. DUCHESNE.  
MULTITUBULAR STEAM GENERATOR.

APPLICATION FILED FEB. 8, 1904.

NO MODEL.

4 SHEETS—SHEET 3.



Witnesses:

*J. A. Leonard*  
*J. Mynard*

Ernest Duchesne Inventor,

By *Marion & Marion*

Attorneys.

No. 776,732.

PATENTED DEC. 6, 1904.

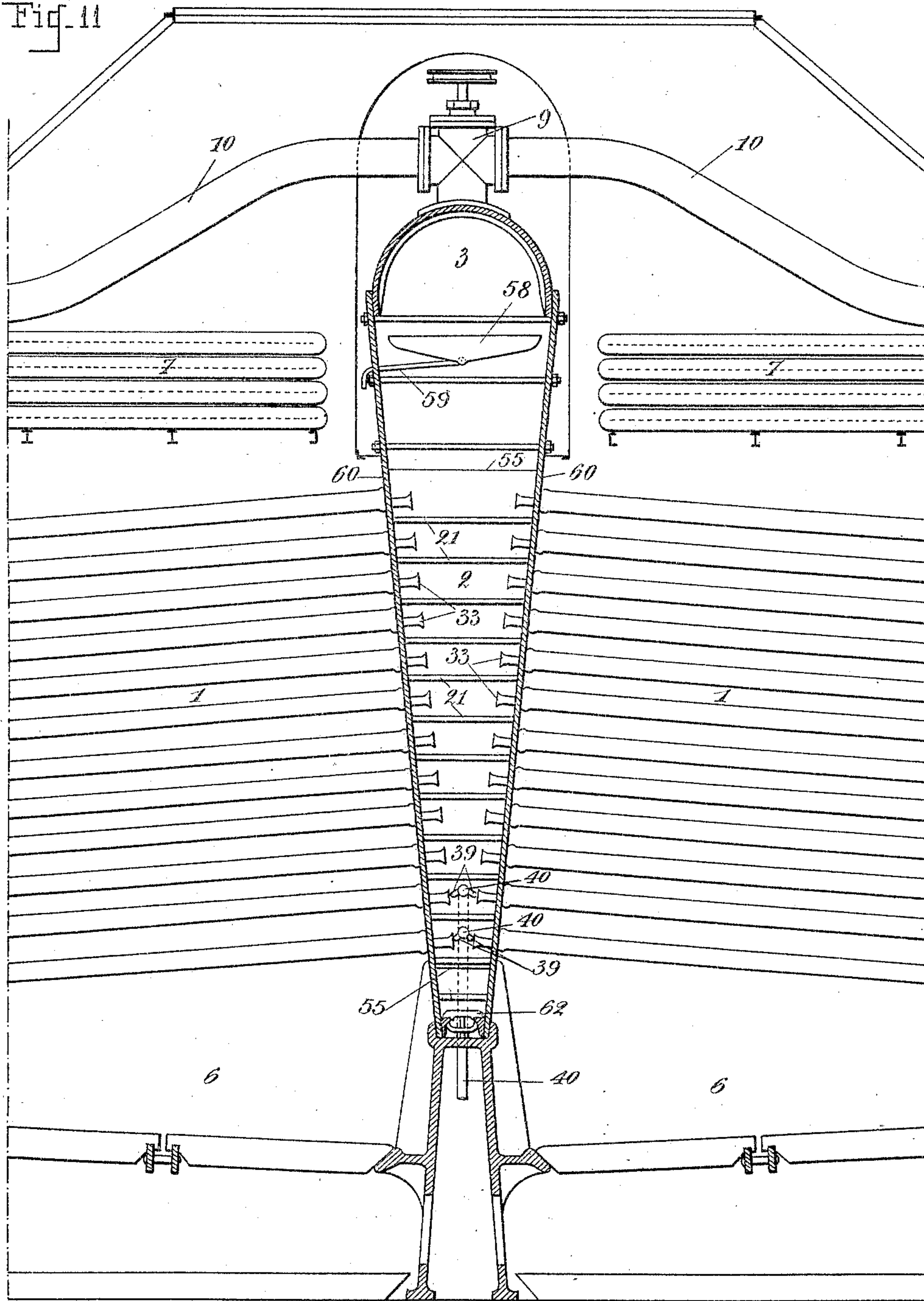
E. DUCHESNE.  
MULTITUBULAR STEAM GENERATOR.

APPLICATION FILED FEB. 8, 1904.

NO MODEL.

4 SHEETS—SHEET 4.

Fig. 11



Witnesses:

*A. J. Senger*  
*C. J. Cousins*

*Ernest Duchesne, Inventor*

By *Marion Marion*,  
*Attorneys*



## UNITED STATES PATENT OFFICE.

ERNEST DUCHESNE, OF PARIS, FRANCE.

## MULTITUBULAR STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 776,732, dated December 6, 1904.

Application filed February 8, 1904. Serial No. 192,607. (No model.)

*To all whom it may concern:*

Be it known that I, ERNEST DUCHESNE, a citizen of the French Republic, residing in Paris, France, have invented certain new and useful Improvements in Multitubular Steam-Generators, (for which I have obtained a patent in France, No. 329,941, bearing date February 11, 1903,) of which the following is a specification.

My invention has for its object certain improvements in steam-generators in which the hot gases from a furnace first pass through a group of tubes in which the water is converted into steam and then through a second group of tubes in which the steam produced in the first group is superheated before passing to the apparatus where it is utilized, the said improvements enabling me to form an improved water and steam tube generator which I call the "Pluto" generator.

The said invention relates more particularly to the arrangement of the group of inner and outer tubes which communicate with a compartment, so-called "water-header," and to their mounting as a whole in the apparatus, as well as the arrangement and mounting of the tubes of the superheating group.

The said invention further relates to the peculiar arrangement of the water-header and of the feed-reservoir in order to insure for the water which feeds these tubes and the steam which results therefrom a practical and well-defined general circulation.

In order to more completely describe my invention, I will now refer to the accompanying drawings, in which, as an example—

Figure 1 is a front elevation of an improved generator arranged conformably with my invention, the right-hand part of this figure assuming the doors giving admission to the generating and superheating groups of tubes to be removed; Fig. 2, an elevation and partial section of the same apparatus, the section being made on the line *a b* of Fig. 1; Fig. 3, a detail view, on an enlarged scale, with part removed, of a portion of the group of generating-tubes; Figs. 4 and 5, views in section, respectively, on the lines *c d* and *e f* of Fig. 3; Figs. 6, 7, and 8, detail views indicating the mounting and arrangement of the tubes

of the superheater group; Fig. 9, a view in partial section, with portions removed, on the line *g h* of Fig. 8 of a portion of the superheater group of tubes; Fig. 10, a diagrammatic view indicating the circulation of the water and the steam in the rear chamber of the generating group. Fig. 11 is an elevation and partial section of a boiler constituted by the combination of two generators each substantially of the character of the boiler shown in Fig. 2 and having a common water-header presenting a V-shaped section.

The like reference characters indicate the like parts in the various figures.

As a whole my apparatus comprises a group 1 of generating-tubes, the parts of which connect at their rear end with a rear header 2, surmounted by a drum 3 for water and steam. On the other hand, the front and closed ends of these elements penetrate into a front or header 4, closed on the front of the apparatus by a door 5.

The gases from a furnace 6 pass through the generating group 1 and then through a superheating group 7, the tubes of which connect with a steam-header 8, and through which tubes 7 the steam produced in the group 1 may circulate. This steam is drawn from the top of the drum 3 by means of a suitable valve 9 and reaches the header 8 by a pipe 10 in order to pass through the tubes of the group 7 and from thence to go to the apparatus, where it is to be used through a steam-valve 11. An auxiliary steam-valve is also arranged at 12 in case it is desired to utilize the steam without directly superheating it. The water-level in the drum 3 is indicated by gage-glasses 13, the chambers 14 of which are suitably connected in any ordinary manner with the said reservoir.

15 represents manometers, indicating the pressure of steam in the drum 3, which pressure is evidently the same as that in the chambers 14 of the gage-glasses, while 16 represents safety-valves of any suitable type.

17 is the door of the furnace, the grate 18 of which is slightly inclined toward the rear, and 19 is the door of the ash-pit, the opening of this door enabling the air admitted under the grate to be regulated.



I will now more particularly describe the parts of the apparatus to which the improvements forming the object of my invention relate. The said improvements first relate to  
 5 the arrangement of the tubes of the generating group 1 and to their mounting as a whole in the apparatus, as I shall now hereinafter more particularly describe.

The rear header 2, with which the rear ends  
 10 of the tubes of group 1 connect, is formed of a frame or socket 20, supporting two plates 60 and 61, firmly connected by stays 21, Figs. 2 and 3. At the lower part of the water-space 2 a sludge-plug 62 is also arranged, enabling  
 15 any solid deposits which may arise from the feed-water to be eliminated. Each of the elements of the tubular group 1, Fig. 3, comprises an external vaporizing-tube 22 and an internal feed-tube 23. The external tube 22  
 20 is firmly screwed at its rear end into the tube-plate 60 and fits therein still more tightly owing to the conical shoulder 25, Fig. 3, separated from the threaded part 24 by a groove 26, which receives a lubricant very largely formed  
 25 of graphite. This arrangement has for its object to insure tightness, to preserve the surfaces in contact against oxidation, and to facilitate the removal of the vaporizing-tubes. The front end of the external tube 22 in the  
 30 interior of the front header 4 is also terminated by a threaded part 27, having a groove 28 for graphite and terminated by tapering part 29. This end receives a movable breech-piece 30, and the whole of these breech-pieces  
 35 of the elements being on one face thus allows of the tubes being cleaned with the greatest facility.

The external or feed tube 23 has a diameter about one-half less than that of the vaporizing-tube 22, in which it is fixed by two  
 40 small metal holders or trestles. One of these holders, 31, is arranged at the rear in order to prevent the tube 23 from descending toward the front. The second of these trestles, 32, is  
 45 arranged at the front and slightly jammed into the vaporizing-tube 22 in order to maintain the feed-tube 23 in its normal position. Figs. 4 and 5 represent these trestles or holders in section on the lines *c d* and *e f* of Fig. 3.  
 50 This feed-tube 23 has narrow slots on its upper generating-line, enabling bubbles which may be formed therein to be discharged into the vaporizing-tube 22, and it may be constituted by a tube or a simple piece of sheet  
 55 metal bent around without being soldered or riveted. The extremity of the tube 23 which connects with the water-space has the form of a funnel 33, so as to facilitate the entrance of the liquid, and in this region it almost touches  
 60 the upper generatrix of the vaporizing-tube 22 in order to allow of the easy admission of the water. In the rear, on the contrary, it almost touches the lower generatrix of the tube 22 in order to leave as much room as possible  
 65 for the steam to escape or be released.

The front part of the tubes 22 is held up by a plate 34, perforated with holes slightly larger than the external diameter of said tubes. Between these holes the plate 34 has  
 other smaller ones, 35, Figs. 1 and 2, which  
 70 have for their object to allow air to penetrate into the group 1 in order to complete the combustion and usefully burn the smoke. The holes 35 also allow of the introduction of  
 a stem-jet for cleaning purposes and the plac-  
 75 ing of zigzags or baffle-plates in places where it is thought desirable to place them. These zigzags or baffle-plates 36 are formed of solid or hollow fire-clay or metal cylinders. The  
 zigzags or baffle-plates 37, placed on the face,  
 80 are hollow, and they project at the front by apertures 35, so that air passes through them in order to be heated before mixing with the gases of combustion, combustion of which  
 thus becomes complete. The holes 35 not  
 85 utilized by the baffle-plates are closed by means of special stoppers. On the front door 5 of the chamber 4 slide-regulators 38—so-called “combustion-regulators”—serve for  
 regulating the quantity of air admitted.  
 90

The feed is effected simultaneously in all the tubes of the lower rows (three in the case of Fig. 3) by nozzles 39, Fig. 3, placed in front of each of them at the level of the feed-tubes and fitted into the external plate 61 of  
 95 the header 2. On this plate a half-cylinder 63 is bolted or riveted, which serves as feed-reservoir for all the nozzles and receives a pipe 40, bringing water from the feed-pump. It has an easily-removable screw-stopper 41  
 100 opposite each nozzle to allow of cleaning. The feed of the nozzles also takes place by means of individual external tubes, so as to be able to verify at a touch the good working  
 of each of them. Finally, the feed-reservoir  
 105 63 has also at its lower part a sludge-cock 64, usually closed, but enabling possible deposits to be removed from the reservoir 63.

The improvements forming the object of my invention also relate to the arrangement  
 110 and mounting of the tubes of the superheating group 7, as I shall now more particularly hereinafter describe.

The vaporizing group 1 is surmounted by a group of superheating-tubes 7, Figs. 1 and 2,  
 115 composed of several tiers of tubes 42, Figs. 6 to 9, closed at the rear and projecting in front into the steam-header 8, formed of a frame 43, and two plates 44 45 well tied by  
 stays 65. One of these plates—the plate 44—  
 120 is tubular and receives the front end of the tubes 42, which fit therein by means of a threaded part 46 and a tapering shoulder 47, Figs. 7 and 9, or merely a tapering shoulder,  
 Fig. 8, having a groove 48 filled with graphite  
 125 lubricant. The front plate 45 of this wall is provided with holes situated opposite the tubes 42 and serving for their insertion and cleaning. These holes are threaded and receive a  
 threaded plug 49, having an external flange  
 130



50, provided with a groove 51, filled with graphite lubricant, and access may be obtained to these plugs by opening the doors 66. Each of these tubes 42 is divided into two tiers by  
 5 a horizontal partition 52 of thin plate, and a similar partition exists also in the steam-space 8. The object of this arrangement is to force the steam to pass twice through the length of the tubes, flowing from the less heated parts  
 10 to the more heated parts, and it is only after having passed through the lower tier that it passes into the steam-pipe leading to the engines.

Finally, I will now describe the means which  
 15 I employ for obtaining a regular and well-defined circulation of the water and steam in movement in the header 2.

In order to assist the circulation of the water in the header 2, I first incline this chamber  
 20 somewhat considerably toward the front of the apparatus—that is to say, toward the group of generating-tubes—and I further arrange there two pipes 53 54, Fig. 10, one to the right and the other to the left, formed of two  
 25 plates 55, placed at a short distance from the frame 20, and thus dividing the header into three vertical compartments, the middle one serving solely for the ascension of hot water and steam in the direction indicated by the  
 30 arrows 56, and the side compartments serving for the descent in the direction indicated by the arrows 57 of the water which has not been vaporized. The upper part of these lateral pas-  
 35 sages projects a little above the upper tier of the tubes, and the lower part projects a little below the lowest row of these same tubes. This arrangement avoids any conflict between the ascending and descending currents. I also arrange in the drum 3 and a little above the  
 40 lowest level of the water contained therein two ladles or scoops 58, Figs. 2 and 10, the bottom of which ends at a pipe 59, communicating with the exterior by a pipe fitted with a tap. (Not shown in the accompanying draw-  
 45 ings.) These scoops collect foreign bodies of slight density contained in the water, and such bodies are thrown into the said scoops by the action of the agitation produced by the ascension of the steam rising in the direction indi-  
 50 cated by the arrows 57, Fig. 10. It then suffices to open from time to time the sludge-taps corresponding to the scoops 58 in order to eliminate the substances in question.

It is needless to explain here the general  
 55 working of this improved generator forming my invention as a whole, such general working presenting, as compared with the working of the tubular generators at present known, no differences other than those which have  
 60 been clearly brought out in the foregoing specification. I will simply remark in terminating that my improved generator is particularly suitable for forming a double generator having two fronts, which result is obtained  
 65 by arranging a water-header the section of

which is V-shaped and to the two branches of which the elements of the two generating groups are respectively screwed. Fig. 11 represents a generator thus established.

I declare that what I claim is—

70 1. A multitubular boiler having a group of inner and outer tubes, whose axes are inclined relative to one another; a compartment so-called "water-header," for the circulation of water and steam, the said water-header being  
 75 inclined toward the tubular group, which opens into it; two lateral partitions separating the said group from the side walls of the water-header, so as to form two lateral passages al-  
 80 lowing the non-vaporized water to easily descend, and providing a large central passage for the ascension of the steam; a steam and water drum surmounting said water-header and containing extraction-scoops for collect-  
 85 ing and expelling the light residuals drawn up by the ascending steam; a feed-reservoir at the lower part of the water-header, comprising nozzles for individually feeding the inner tubes of the lower rows of the tubular  
 90 groups; a front plate supporting the front end of all the outer tubes of said group; and a tubular group for superheating the steam produced by the generator proper, substantially as described.

95 2. In a multitubular boiler having a group of inner and outer tubes communicating with a water-header; trestles maintaining the axes of the inner tubes inclined to the axes of the outer tubes and preventing each inner tube  
 100 from advancing into the outer tube, while maintaining constant the relative inclination of the axes of the two tubes; funnels projecting the inner tubes into the water-header, and nozzles respectively connecting each funnel  
 105 of the lower tubes of the generating group with the feed-pump; longitudinal slots on the upper generatrix of the inner tubes, and movable sockets accessible from the outside for closing the outer tubes at their front end;  
 110 substantially as described.

115 3. In a multitubular boiler having a water-header, a steam and water drum surmounting said water-header and a tubular group for superheating the steam produced by the generator proper; a connection on top of the  
 120 steam and water drum and one end of a steam-header in which open the tubes of the superheater, the said tubes being closed at one of their ends, and having a horizontal diaphragm arranged in a plane diametral with said tubes  
 125 and stopping a little in front of their closed ends; horizontal diaphragms arranged in the steam-header at the same level as the diaphragms of the said tubes; screw-plugs arranged in the steam-header and correspond-  
 130 ing to the orifices of the tubes of the group; a pipe for taking the steam for utilization, situated at the end of the steam-header opposite at which the steam to be superheated enters; and an auxiliary pipe for taking the



steam, situated in the steam-header at this latter end; substantially as described.

4. A multitubular boiler having two groups of tubes symmetrically inclined relative to the vertical median plane of the boiler, each group of tubes including inner and outer tubes whose axes are inclined relative to one another; a compartment so-called "water-header" for the circulation of water and steam, the said water-header having two front walls respectively inclined toward each tubular group which open into it; two lateral partitions separating the said groups from the side walls of the water-header, so as to form two lateral passages allowing the non-vaporized water to easily descend, and providing a large central passage for the ascension of the steam; a steam and water drum surmounting said water-header and containing extraction-scoops for collecting and expelling the light residuals drawn

up by the ascending steam; a feed-reservoir at the lower part of the water-header, comprising nozzles for individually feeding the inner tubes of the lower rows of the tubular groups; two front plates supporting respectively the front end of all the outer tubes of each of said groups; two tubular groups for superheating the steam produced by the generator proper, and two connections between the top of the steam and water drum and one end of each steam-header in which open the tubes of the superheaters, substantially as described.

In witness whereof I have hereunto set my hand in the presence of two witnesses.

ERNEST DUCHESNE.

Witnesses:

HANSON C. COXE,  
JULES FAYOLLET.