(No Model.) 3 Sheets—Sheet 1.

L. M. G. DELAUNAY-BELLEVILLE.

WATER TUBE BOILER.

No. 506,165. Patented Oct. 3, 1893.

fig. 2.

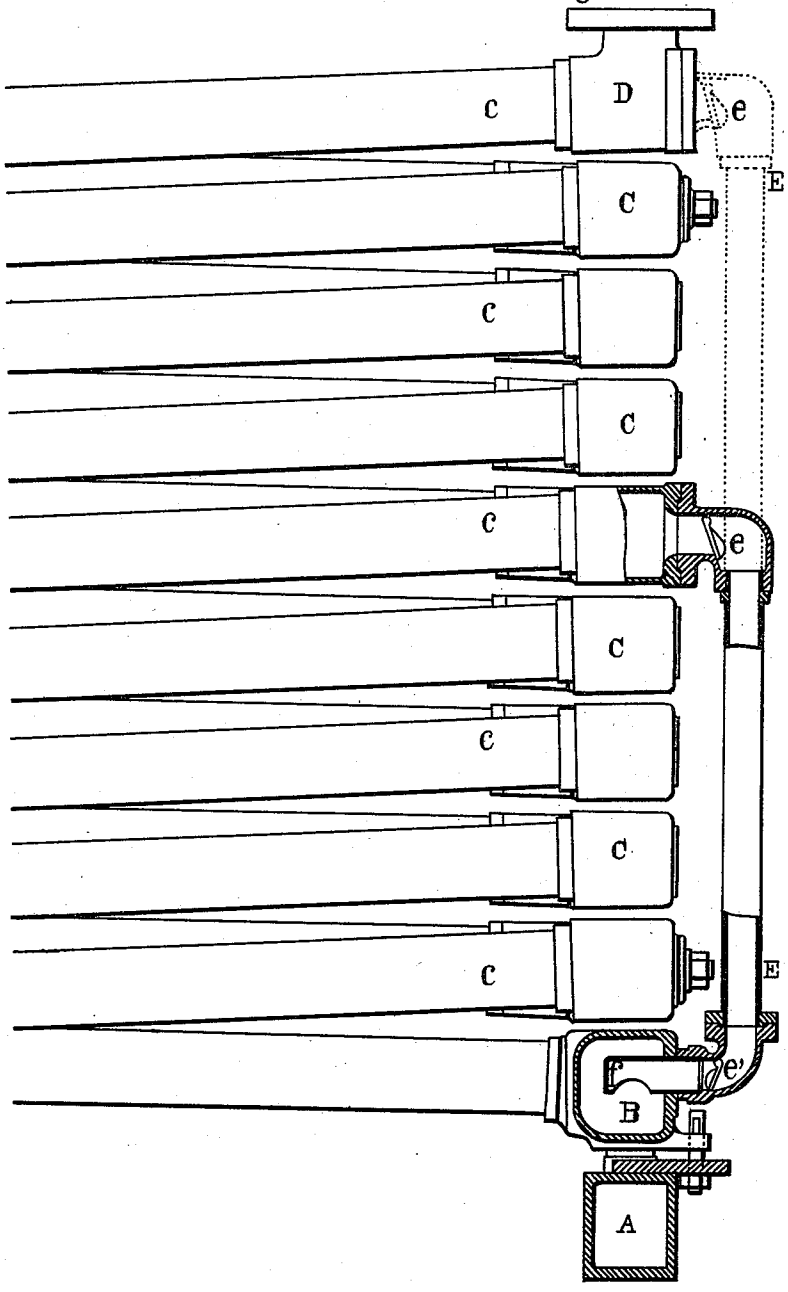
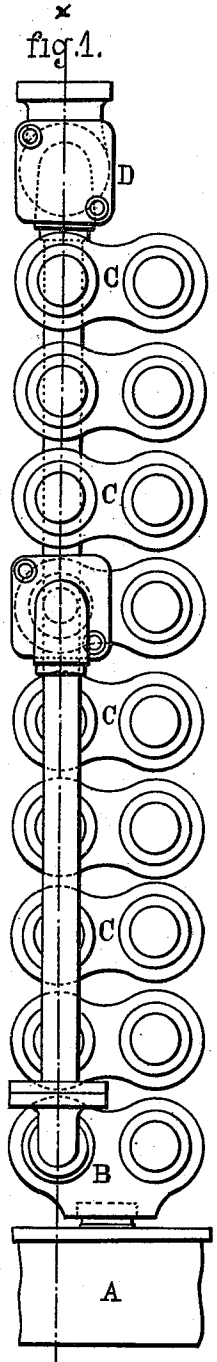


fig. 1.



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Robert Everett.

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By Francis L. Norris.
Atty

(No Model.) 3 Sheets—Sheet 2.

L. M. G. DELAUNAY-BELLEVILLE.

WATER TUBE BOILER.

No. 506,165. Patented Oct. 3, 1893.

fig. 4.

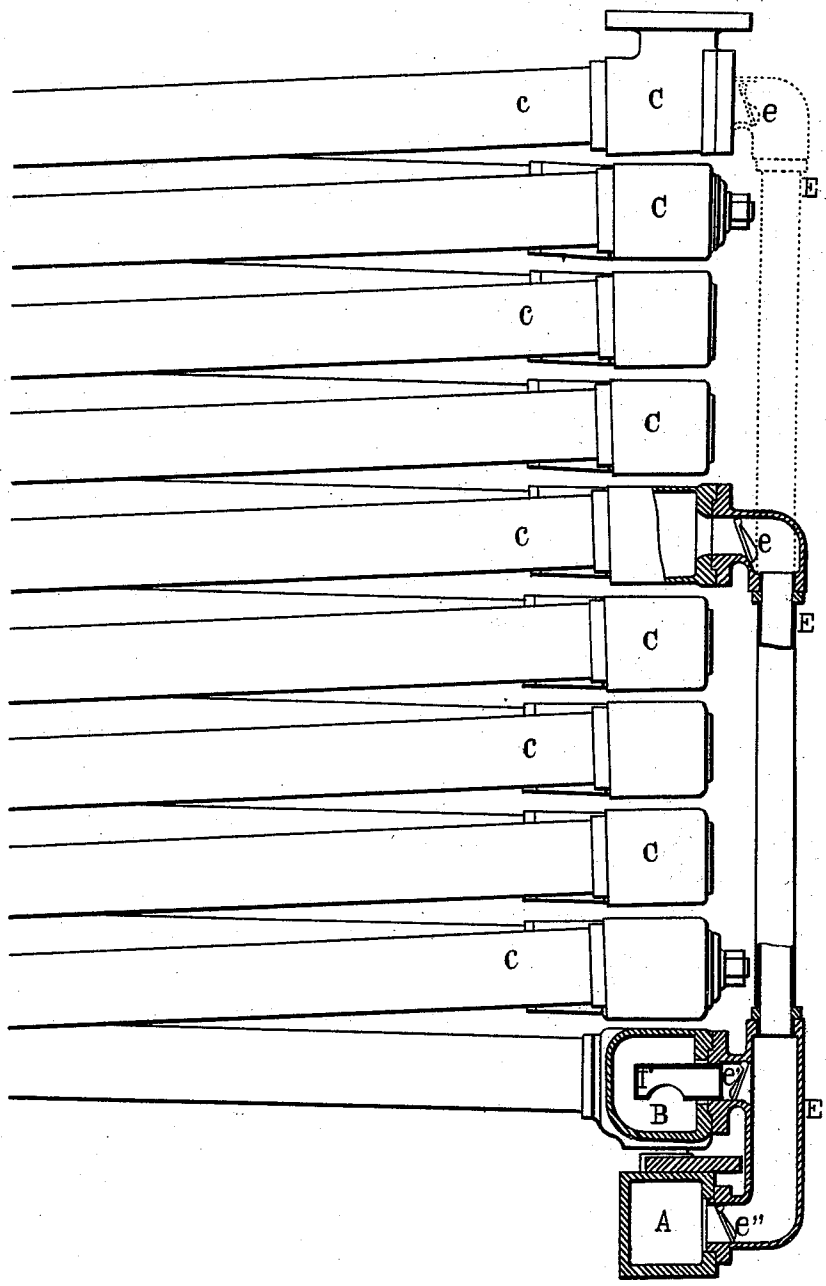
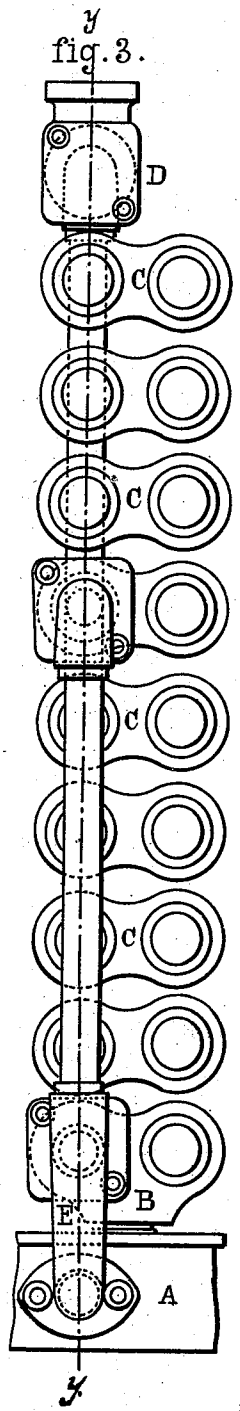


fig. 3.



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(No Model.)

3 Sheets—Sheet 3.

L. M. G. DELAUNAY-BELLEVILLE.

WATER TUBE BOILER.

No. 506,165. Patented Oct. 3, 1893.

fig. 6.

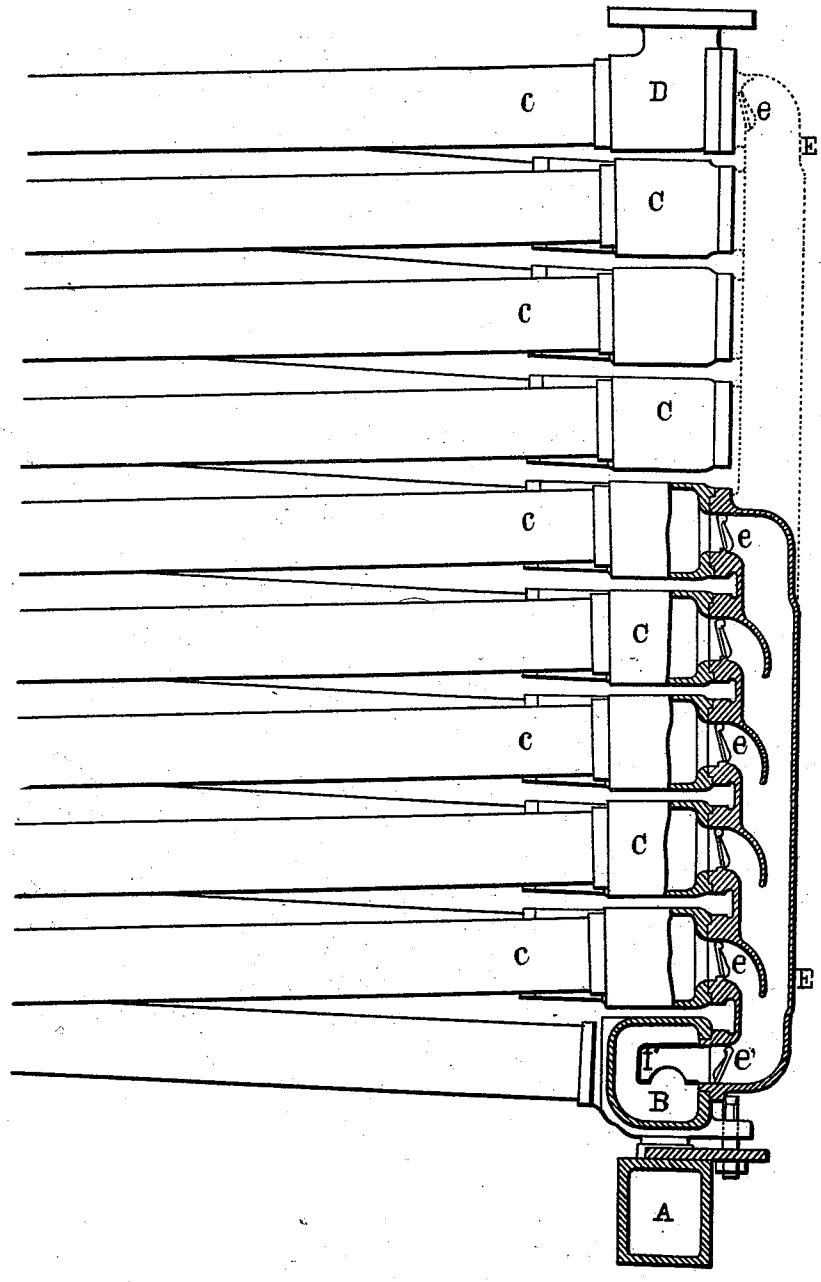
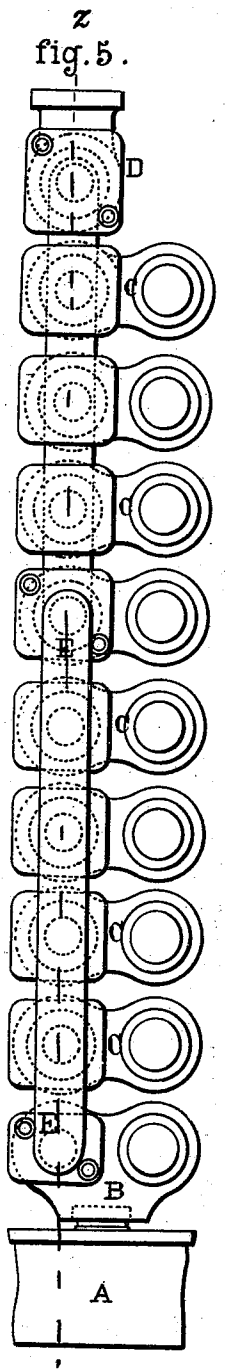


fig. 5.



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By James L. Norris.

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UNITED STATES PATENT OFFICE.

LOUIS MARIE GABRIEL DELAUNAY-BELLEVILLE, OF ST. DENIS, FRANCE.

WATER-TUBE BOILER.

SPECIFICATION forming part of Letters Patent No. 506,165, dated October 3, 1893.

Application filed December 20, 1892. Serial No. 455,784. (No model.) Patented in France October 22, 1892, No. 225,112, and in England December 5, 1892, No. 22,251.

To all whom it may concern:

Be it known that I, LOUIS MARIE GABRIEL DELAUNAY-BELLEVILLE, a citizen of France, and a resident of St. Denis, in the Department of the Seine, Republic of France, have invented a new and useful Improvement in Water-Tube Boilers, (for which I have obtained Letters Patent in France, No. 225,112, dated October 22, 1892, and in Great Britain, No. 22,251, dated December 5, 1892, and for which I filed application for Letters Patent in Germany the 7th day of December, 1892, which patent when granted will bear date December 7, 1892,) of which the following is a specification.

This invention has for its object the application, to the sections of steam generators having inclined water tubes (known as serpentine tubes), of individual return water tubes acting for each element or section, taken separately, like the general arrangement of water return, now applied to most systems of water tube boilers, acts for the entire generator. This application, to each element or section taken individually, of an arrangement which has, as yet, only been applied to the entire boiler, enables the whole, or a portion of the water of the upper and intermediate tubes to be continuously brought back into the lower tubes of each section, without the water being compelled to pass through the purifying collector and the ordinary return tube to be distributed among the various sections by means of the feed collector which connects said sections. By this new arrangement the following advantages are obtained: A continuous and almost immediate return is obtained, in the tubes most exposed to the fire, of the water which is expelled therefrom at each instant by the pressure due to the formation of steam. The abundant feeding of these tubes is therefore insured as well as the constant presence of water in contact with the walls of the tubes which are the most exposed to the fire, and all local overheating is therefore prevented. The resistance to the flow in those tubes which cause the water to return in whole or in part, is decreased, and the disengagement of steam is thus facilitated. The circulation is increased in each section by continually restoring to the lower part a portion of the water already arrived at the upper level. This purifying collector is the object of a very recent French patent, and consists of a cylindrical vessel located at the lower part of the boiler and provided with internal partitions or baffle-plates suitably disposed for precipitating the calcareous and other salts contained in the feed water by previously heating the same. The purifying-collector is relieved of the greater portion of the water that it receives from the sections; this enables the working to be more perfect, as well as the size and weight of the boiler and the general return tube, or tubes, to be reduced. A large quantity of water can be contained in the sections, as there is no fear of encumbering the purifying-collector with water, a large part of the water being returned to the lower tubes without leaving the sections. This increase of volume of water is very advantageous for forced working, and permits of a larger vaporization per hour, and per square meter of grate surface, being obtained with these generators. A better utilization of the fuel is obtained by reason of the greatest circulation of the water in the lower tubes of the sections. According to the uses to which the generators are destined, the direct return of the water from the upper to the lower tubes of the sections may be carried out in various ways. For instance the return may be effected from the upper elbow to the lower header; in this case it is sufficient to discharge from the purifier the greatest amount of water which it at present now receives. Or the return of the water may be effected from any intermediate header to a lower one. In this case the tubes situated above the header from which the return starts complete the vaporization of that portion of the water which, not having been entirely taken by the return tube, may still be mixed with the steam. Or the return of the water to the lower header may be effected from several headers situated at any height of the section, in order to progressively rid the upper tubes of their excess water and to thus obtain dry steam at the outlet of the section, while having a large quantity of water in the tubes directly exposed to the action of the fire. Lastly, the communication of each section with the feed collector may be effected by

means of the individual return tube of this section. These water return tubes may be provided with automatic retaining valves, situated either at the orifice of the lower header of the section, so as to enable the return water to enter the said header without being expelled therefrom through the same way under the action of the pressure due to the rapid vaporization in the lower tube, or at the orifice of the header, or headers, of the rows which are above the first and from which the return tube, or tubes, start, to permit the water to enter from these headers into the return tube, but not from the tube into these headers. These arrangements may be completed by a reverse arrangement located either at the front or at the back extremity of the section and permitting the direct escape of the steam produced by each row of tubes.

In order that my invention may be more readily understood I will describe the same fully with reference to the accompanying drawings in which the same letters indicate similar parts.

Figures 1 and 2 show the arrangement, on one section, of a direct return tube, the water returning to the front lower header either from the sixth header (shown in full lines) or from any other, or even from the outlet elbow of the section (shown in dotted lines). Fig. 1 is a front view and Fig. 2 is a partial section on the line *x x* of Fig. 1. Figs. 3 and 4 show the same arrangement as that shown by Figs. 1 and 2, but with the addition of the communication between the direct return tube with the feed collector, the retaining valves being so disposed that, first, the return water can enter the lower header, but cannot enter the feed collector; second, the water from the feed collector can enter the return tube, and from this tube the lower header; third, the water in the tube which is connected to the lower header cannot pass back into the return tube. The individual return tube could also be in free communication with the lower feed collector, in such a manner that, the water, so returned benefits the whole of the sections instead of benefiting each section considered individually. Fig. 3 is a front view and Fig. 4 is a partial section on the line *y y* of Fig. 3. Figs. 5 and 6 show the arrangement with direct return collector putting all or only a portion of the front headers into communication, and especially putting several upper headers into communication with the lower header. In this arrangement the lower header may be furnished with a valve allowing inlet, but not outlet, while the other headers are furnished with valves allowing outlet, but not inlet of the water. Fig. 5 is a front view, and Fig. 6 is a partial section on the line *z z*, of Fig. 5.

In the various figures, A represents the feed collector of the boiler, B the lower front header carrying only one tube. C are the intermediate front headers, the vaporizing tubes being shown at *c*. An outlet elbow D puts each of the sections into communication with a steam drum or collector forming no part of this invention. The direct return tube collector is shown at E, and the retaining valves are shown by the letters *e e' e''*.

The sections of the boilers constructed according to this invention work as follows: Referring to the arrangement more particularly shown by Figs. 1 and 2, the water carried by the steam into the tubes *c*, is forced by its speed into the elbow which puts one of the upper headers (here the sixth) into communication with the direct return tube E. It descends into the tube E and returns into the lower header B. The steam carrying with it the water not retained by the return tube, rises in the upper tubes through which it passes in becoming more or less completely vaporized to return to the purifying collector.

Experience proving that in the sections shown in the drawings herewith, the water pressure necessary to insure the flow of the water and steam from one row to the next immediately above, is less than the vertical distance between the axes of these two successive rows, the level of the water which will ensue in the return tube will generally constitute a sufficient pressure on the lower header to insure the entry of the return water into this header and to prevent any contrary action. Any possibility of this contrary action may be guarded against by the use of the retaining valve *e*, which prevents the water in the return tube coming back into the header which it left, should the level of the water rise in said return tube, especially above this header. The retaining valve *e'* can also be applied for the same purpose; it opens in a contrary direction to the movement of the valve *e*, and is so arranged as to prevent the water in the lower tube of the section being forced into the direct return tube E during the action of pressure which results from the disengagement of the steam formed in this lower tube.

The plug or short tube *f*, has for its object to protect the outlet of the return tube from the direct influence of the above mentioned action of pressure.

The fresh feed water which reaches the collector A through the purifier, the ordinary return tube, and the injector, enters the lower header through the ordinary feed cone nipple which effects a junction between the lower header and the collector A.

In the case of the arrangement corresponding to Figs. 3 and 4, the working is the same. There is, moveover, introduction of the fresh feed water from the collector A to the lower header B through the intervention of the direct return tube E, the valve *e''* preventing the water from the direct return tube returning into the feed collector in case the level in the individual return tube should be very high and considerably higher than the level in the general return tube.

If it be considered expedient according to the nature and mode of working of the sections, the valve *e''* may be dispensed with, and this will permit of the individual return water being distributed between all the sections of the same generator.

In cases where the arrangement would be applied in the manner shown in Figs. 5 and 6, the direct return would be effected by means of a collector putting several upper headers into communication with several lower ones. In this manner, each upper header frees itself of its excess water, which returns to the lower headers.

The retaining valves *e e*, &c., prevent the direct return water being introduced afresh into the upper headers, and the retaining valve *e'* prevents the water from the lower header being forced into the return collector, while permitting the return water to enter into this header.

Having described my invention, I claim—

1. In a water tube boiler, the combination with a vertical series of inclined vaporizing tubes and their headers, of a direct return pipe E connecting one of the upper headers with a lower header, the valve *e* located in an upper portion of the said return pipe and adapted to open outward from an upper header, the valve *e'* located in the lower or outlet end of said return pipe and opening inward toward the lower header, and the short tube *f* in the outlet of said return tube, substantially as described.

2. In a water tube boiler, the combination with a series of inclined vaporizing tubes and their headers, of a feed water collector a direct return tube connecting one of the upper headers with the lower header and feed water collector, and retaining valves located in said return tube to permit the passage of water from an upper header to the lower header and from the feed water collector to the lower header and which prevent direct passage of water from said tube to an upper header and from said tube to the feed water collector, substantially as described.

3. In a water tube boiler, the combination with a vertical series of inclined water tubes and their headers, of a direct return tube connecting each upper header with the lower header, a series of valves located in said return tube and opening outward from each upper header, and a valve located in the lower end of said return tube and opening toward the lower header, substantially as described.

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

LOUIS MARIE GABRIEL DELAUNAY-BELLEVILLE.

Witnesses:
W. TONY,
G. DELON.