

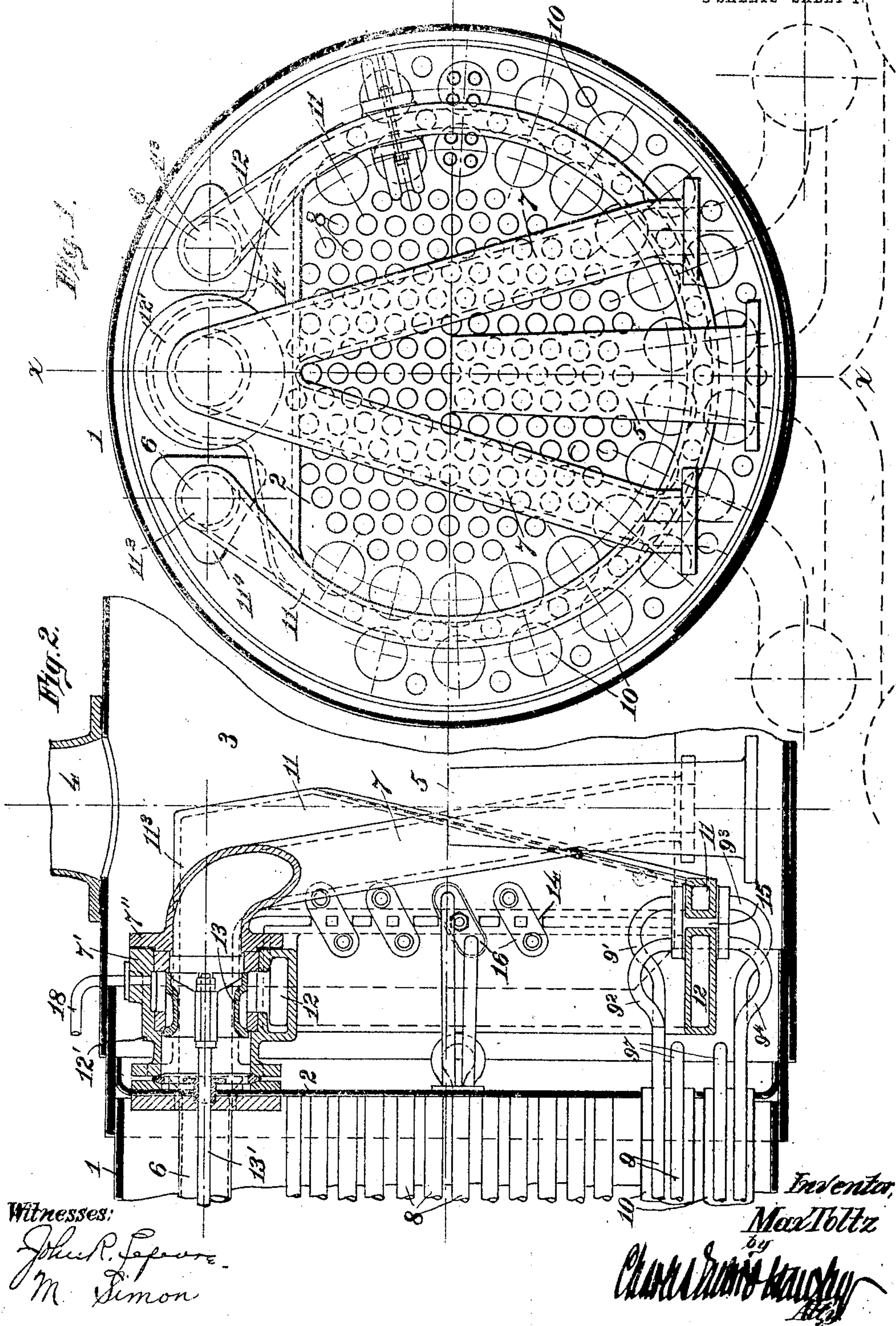
No. 869,600.

PATENTED OCT. 29, 1907.

M. TOLTZ.
SUPERHEATER.

APPLICATION FILED JAN. 25, 1907.

2 SHEETS—SHEET 1.



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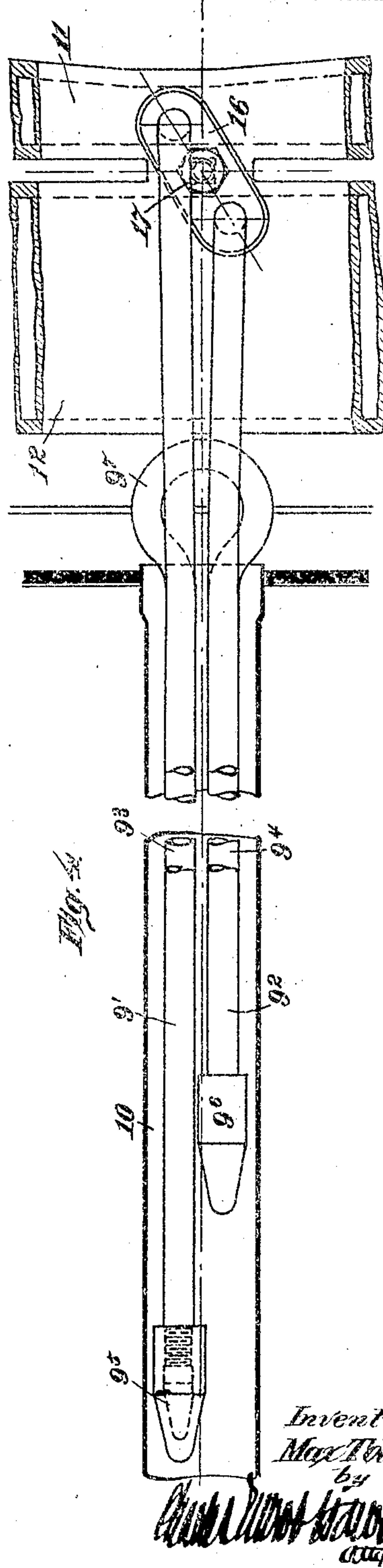
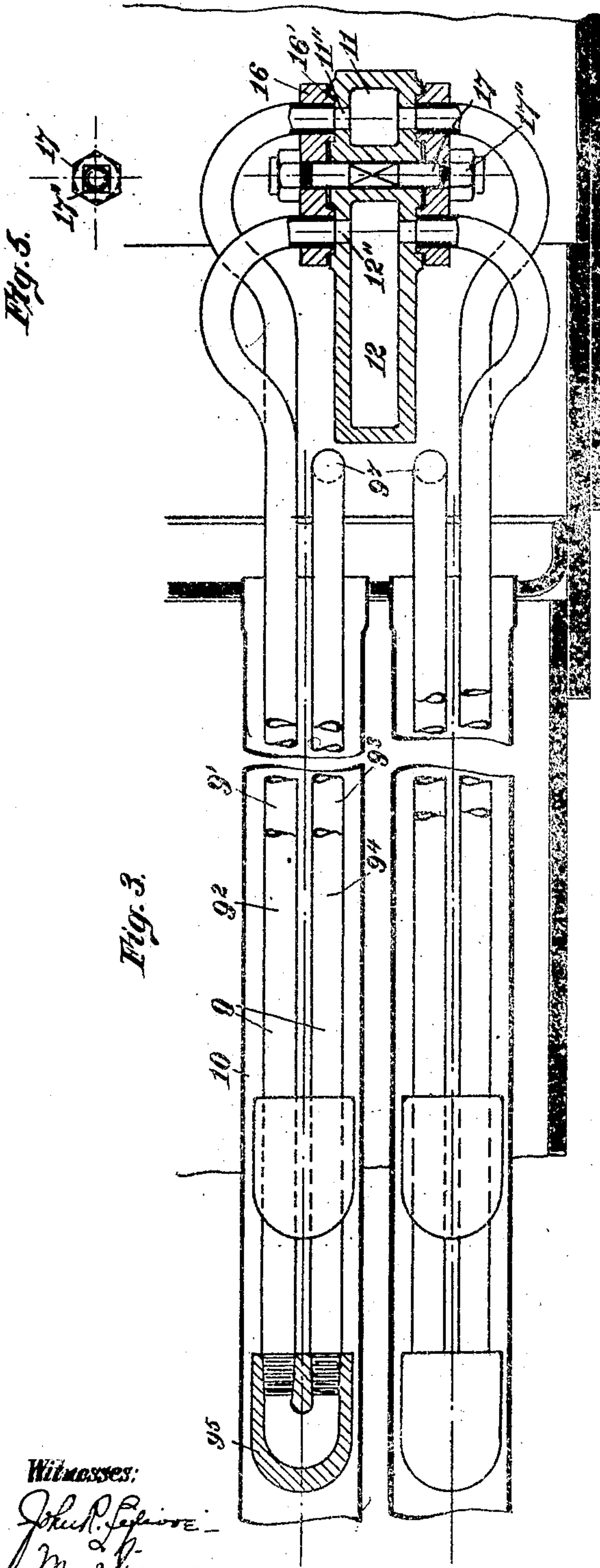
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2 SHEETS—SHEET 2.



UNITED STATES PATENT OFFICE.

MAX TOLTZ, OF ST. PAUL, MINNESOTA, ASSIGNOR OF ONE-FOURTH TO CHARLES GILBERT HAWLEY, OF CHICAGO, ILLINOIS.

SUPERHEATER.

No. 869,600.

Specification of Letters Patent.

Patented Oct. 29, 1907.

Application filed January 26, 1907. Serial No. 354,154.

To all whom it may concern:

Be it known that I, MAX TOLTZ, a citizen of the United States, and a resident of St. Paul, county of Ramsey, and State of Minnesota, have invented a certain
5 new, useful, and Improved Steam-Superheater, of which the following is a full, clear, and exact description, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to improvements in steam
10 superheaters of the kind which are used upon, or in connection with locomotive boilers, and has particular reference to improvements in superheaters of the class wherein the superheating elements, or pipes, are situated within the flues of the boiler, and connected with
15 headers which are located in the front end, or smoke-box, of the boiler. The saturate steam header of such a superheater is connected with the dry-pipe of the boiler, and the superheated steam header is connected with the steam-chests of the locomotive engines. The
20 steam flowing through the boiler enters the saturate steam header and passes thence through the large number of small superheating pipes or elements which are exposed to the heat within the boiler flues. Therein the steam is raised to a high temperature by reason of
25 the minute subdivision of the body of steam in the numerous pipes, coupled with the intense heat to which said pipes are exposed. The superheated steam is discharged into, or collected within the superheated steam header, from whence it is supplied to the engines.
30 Obviously, the capacity and efficiency of a superheater is principally dependent upon the number of the superheating pipes or loops employed, and to accommodate these loops it is necessary to relatively enlarge many of the fire flues of the boiler. Convenience has seemed
35 to dictate the location of the large flues in the central portion of the boiler, and because of the number of superheater pipes, or loops, required, the practice has been to devote the greater part of the central portion of the boiler to the superheating of steam. The enlargement of the flues reduces the effective heating surface of the boiler, and for this reason, and because the central flues of the boiler are the most efficient in the evaporation of water, many motive power experts have
40 objected to, and opposed the use of superheaters, on the ground that the same detract from the efficiency of the locomotive boiler, already known to be lacking in size in comparison with stationary boilers of equal rated horse powers.

With the foregoing in view, a primary object of my
50 invention is to provide a locomotive steam superheater, which shall be so constructed that it may be

applied to a boiler, without reducing the number, or increasing the size of the fire flues in the central portion of the boiler.

More specifically stated, the object of the invention 55 is to provide a superheater comprising headers and a plurality of superheating pipes, or loops, which latter shall occupy enlarged flues arranged in the outer, lower portions of the boiler, leaving the central flues undisturbed and unobstructed. 60

The superheaters which are now in common use in this and other countries, generally speaking, are of two classes. In the first class the steam headers are arranged in the upper part of the smoke-box and the superheating loops, or elements, occupy enlarged flues 65 in the central portion of the boiler, and are bent upwardly and joined to the headers. In the second class, the headers are of an entirely different form, being of greater number, and being arranged in a plane, or planes, parallel with the front flue sheet of the boiler, 70 and substantially covering the same, the superheating pipes extending from the different portions of the headers directly back into the fire flues. Superheaters of both types are objectionable on the grounds above stated, and are further objected to on the ground that 75 the superheating pipes, or elements, are difficult to remove in case they become leaky, and that the entire body of flues in the central portion of the boiler, are made practically inaccessible, so that it is difficult to inspect either the flues or the parts of the superheater, 80 or clean the same, unless the superheater is first removed.

Another object of my invention is to provide a steam superheater for locomotive boilers, which shall be of such construction as to leave practically all of the flues 85 open and easily accessible from the smoke-box of the boiler. Further, to provide a superheater, every part of which may be closely inspected upon opening the front end, or smoke-box. And a further object of my invention is to provide a steam superheater from which 90 any superheating pipe or element may be removed without disturbing the others, and further, to provide a superheater, wherein the superheating pipes or elements shall be of uniform dimensions throughout, and hence interchangeable. 95

Still further objects of my invention will appear hereinafter.

My invention consists generally in a steam superheater for locomotive boilers, comprising the constructions, members, and combinations of parts all as here- 100 inafter described, and particularly pointed out in the claims.

The invention will be more readily understood by reference to the accompanying drawings, forming a part of this specification, in which,

Figure 1, is a front end elevation of a boiler equipped with a superheater, embodying my invention. Fig. 2, is a vertical section on the line X, X, of Fig. 1. Fig. 3, is an enlarged sectional detail of the lower part of the superheater and boiler, corresponding to the lower part of Fig. 2, on an enlarged scale. Fig. 4, is a plan view of the parts shown in Fig. 3. Fig. 5, is a detail end view of one of the bolts belonging to the superheater.

As shown in the drawings, instead of locating my superheater in or at the middle of the boiler flue sheet I employ circular or annular headers; leaving the greater number of the flues of the boiler undisturbed, and employing only the outer flues to contain the superheating pipes, loops, or elements. This is a chief characteristic of my invention. The invention is further characterized by the employment of two circular rows of enlarged fire tubes, and the arrangement of the annular or ring like headers between said circular rows; the superheating elements or loops being connected to both the inner and outer sides or faces of said headers.

In the drawings, 1, represents the shell of the boiler;—2, the front flue sheet of the boiler;—3, the smoke-box, or front end;—4, the smoke stack;—5, the exhaust nozzle;—6, the dry pipes;—and 7, 7, the steam chest connections. Most of the flues, 8, of the boiler, are of the usual diameter, but the outer rows of flues, 10, those nearest the cylindrical shell of the boiler, are much enlarged, as required to contain the superheating pipes, or loops, 9. I arrange the large flues, 10, 10, in two circular rows, one within the other. These flues do not form complete circles, as they all must be beneath the water level of the boiler; nevertheless, for convenience, I shall refer to the rows of flues, 10, as circular, or substantially circular, rows.

I preferably employ superheating elements, 9, which are double return loops, each thereof as shown in Figs. 3 & 4, comprising lengths, 9^1 , and 9^2 , having bent forward ends, to join the headers together with intermediate lengths, 9^3 , and 9^4 . The ends of the lengths, 9^1 , and 9^3 , are joined in the elbow casting, or return bend, 9^5 , and the ends of the lengths, 9^4 , and 9^2 , are similarly joined by a U connection, or bend, 9^6 . The forward ends of the lengths, 9^3 , and 9^4 , are joined by a short integral bend, 9^7 . By reason of this construction, the steam which enters the superheating pipe or element through the end of the length, 9^1 , is compelled to travel back and forth within the fire flue, twice, before escaping at the end of the length, 9^2 . Obviously, the steam will take on a high temperature while flowing through the many loops, which provide a passage therefor between the boiler dry pipe and the engine steam chests. The ends, 9^1 , and 9^2 , of the superheating loops are connected, respectively, to the saturate steam header, 11, and to the superheated steam header, 12. These headers are of novel form, being substantially circular, or annular, and located close to the walls of the smoke-box. Referring to Fig. 1, it will be noted that the headers are arranged one before the other, and occupy the space between the rows of large fire tubes, 10, in the flue sheet; that is, the headers are of less di-

ameter than the outer row of flues, 10, and of greater diameter than the inner row thereof.

The positions of the loops, 9, within the flues, 10, are well shown in the drawings, from which it will be seen that substantially the whole of each flue, 10, is left open *i. e.*, is not covered by the headers; hence, said flues may be readily reached for the purpose of inspection, or for cleaning the same and the superheating pipes. Furthermore, the ends of the superheating pipes are readily accessible and in open view upon opposite sides of the headers. (See Figs. 1, 2, & 3).

The superheated steam header, 12, is of substantially the same cross section throughout, being a thin rectangular bent tube, or passage. It is not exactly circular, but is flattened at the top, and is there formed into a throttle-valve casing, $12'$. This portion of the header 12, is suitably connected to the flue sheet of the boiler, and contains the throttle-valve, 13, the rod, $13'$, wherein, works through a stuffing box in the flue sheet plate. The forward end of the valve casing is provided with a flange, $7'$, to which the flange $7''$, of the divided steam pipe, or Y, is attached. It will be obvious that the header 12, may be made in several parts, provided the same are tightly bolted together, but I prefer that the header and valve casing shall be integral. The saturate steam header is arranged in front of, and in line with the superheated steam header. If desired, it may be joined thereto by integral connecting webs, 14, but in all cases a considerable crack, or opening, 15, is left between the two headers. This opening and the adjacent edges or ends of the headers 12, and 11, are in planes which are perpendicular to the axis of the boiler, to the end that the superheating elements may be of uniform length, and connected to the headers by devices of the same form and dimensions throughout. These connectors comprise short cross bars, 16, having seats, $16'$, in the headers, 11, and 12; (see Figs. 3 and 4). The ends, 9^1 and 9^2 of the superheating pipes, are secured in the ends of the bar, 16, and register with holes $11''$ and $12''$ in the sides or faces of the headers. As the most convenient means for securing the bar, 16, and as a means of securing the same in pairs, I employ bolts 17, which pass through the webs 14. The middle portion of each bolt is squared, to prevent its turning in the hole, and the ends of the bolts are provided with cap nuts, $17''$, to be screwed solidly against the bars 16, to clamp the same on opposite sides of the headers. The cap nuts of any particular bolt being removed, said bolt may be slipped out, and thereafter the elements or pipes connected to the bars 16, 16, may be readily drawn forward out of the boiler flues. If it is necessary to remove a superheating element, when another is not at hand to replace it, a blind, or solid bar, 16, is substituted for the one removed, the same closing the holes in the headers, so that the superheater may continue in use. The forward edge or end of the saturate steam header, 11, is irregular. The superheated steam header serves as a receiver, whereas the saturate steam header is in contradistinction, a steam distributor, and to insure the delivery of the same quantity of steam to each of the superheating elements I reduce the cross-section of the saturate steam header, in proportion to the distance between the point of steam admission to each

element, and the saturate steam inlet. Thus the sides of the header, 11, are tapered and join in a relatively small section at the bottom. The upper ends of the header, 11, are provided with rearwardly extending elbow portions, 11³, which extend back over the header, 12, and terminate in flanges, 11⁴, which latter join the ends of the two part, or divided dry pipe, 6.

18, represents a bleeder pipe which leads from the valve casing, 12', i. e., from the superheated steam header, providing a conduit, through which a small quantity of superheating steam is discharged at all times, to maintain a minimum flow of steam in the superheater at times when the normal flow is interrupted by the closing of the throttle valve, 13.

The operation of my superheater is as follows: the steam which enters the upper end or ends of the saturate steam header, 11, flows thence to the receiving ends or connections, 9' of the numerous superheating pipes or elements, 9. Passing through said elements, the steam having been superheated is discharged into the receiving or superheated steam header 12, whence it flows to the throttle valve casing, 12'. From thence, if the throttle valve 13 is open, the superheated steam passes through the pipes, or the Y, 7, to the steam chests of the locomotive engines. (See dotted lines, Fig. 1.) If the throttle valve is closed, at least a small quantity of steam will continuously pass through the superheating elements, by reason of the connection of the open bleeder pipe, 18, to the superheated steam header. It will now be seen that the several objects and advantages herein-before set forth are attained in the superheater herein disclosed. As this superheater is capable of modification by one skilled in the art, and may be so modified without departing from the spirit of the invention, I do not confine my invention to the specific structure herein shown and described.

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

1. A locomotive boiler containing a substantially circular row of enlarged fire flues, in combination with a superheater comprising substantially circular saturate and superheated steam headers, and a plurality of superheating elements arranged in said fire flues and connected with said headers, substantially as described.

2. A locomotive boiler containing two substantially circular rows of enlarged fire flues, in combination with steam superheater elements occupying said flues, and saturate and superheated steam headers arranged between said rows and connected to said elements, substantially as described.

3. A locomotive boiler containing a substantially circular row of enlarged fire flues, in combination with superheater elements arranged in said flues, a superheated steam header adjacent to said flues, in shape conforming to the row thereof, a like saturate steam header, and means connecting said elements to said headers, substantially as described.

4. A locomotive boiler containing a dry pipe and having a substantially circular row of enlarged fire flues, in combination with superheater elements occupying said flues, and substantially circular saturate and superheated steam headers connected to said elements, said saturate steam header being connected to said dry-pipe, substantially as described.

5. A locomotive boiler containing a centrally located group of small flues and a substantially circular row of enlarged flues surrounding said group of smaller flues, in combination with superheater elements occupying said en-

larged flues, and substantially circular superheated and saturate steam headers whereto said elements are connected, substantially as described.

6. A locomotive boiler containing a substantially circular row of enlarged fire flues and provided with a dry-pipe, in combination with a substantially circular saturate steam header connected to said dry pipe, a substantially circular superheated steam header, a throttle valve provided in the latter, steam feed pipes connected thereto, and a plurality of superheater elements occupying said enlarged flues and having their ends connected to respective headers, substantially as described.

7. A locomotive boiler containing two substantially circular rows of enlarged fire flues, in combination with saturate and superheated steam headers, and superheater elements occupying said flues and having their ends connected to respective headers, said headers being arranged one in advance of the other and between the rows of flues and elements, substantially as described.

8. A locomotive boiler containing two circular rows of fire flues, in combination with superheater elements or loops occupying said flues, saturate and superheated steam headers arranged one in line with and directly in front of the other between said rows of flues and the elements therein and connected to said elements, substantially as described.

9. A locomotive boiler containing two rows of enlarged fire flues, in combination with saturate and superheated steam headers arranged one in front of the other in line with, and directly between said rows of flues, and a plurality of superheater elements occupying said flues and having their ends joined to the inner and outer sides, or faces, of said headers, substantially as described.

10. A locomotive boiler containing two rows of enlarged fire flues, in combination with saturate and superheated steam headers arranged one in front of the other between said rows of flues, superheater elements arranged in said flues and having their ends joined to respective headers, and a single securing bolt for each pair of said elements, substantially as described.

11. A locomotive boiler containing two substantially circular rows of enlarged fire flues arranged about the central group of small flues, in combination with substantially circular saturate and superheated steam headers arranged between said rows of enlarged flues, and superheater elements occupying said enlarged flues and having bent ends connected to respective sides of said headers, substantially as described.

12. A locomotive boiler containing two substantially circular rows of enlarged fire flues, in combination with a substantially circular superheated steam header arranged between said rows of flues adjacent to the flue sheet of the boiler, a like saturate steam header having its sides tapered, and superheater elements arranged in said flues and connected with said headers, substantially as described.

13. A locomotive boiler containing two substantially circular rows of enlarged flues, in combination with a superheated steam header of substantially uniform cross section, said header being arranged between and conforming to said rows of flues, a like saturate steam header of varying cross section, and superheater elements arranged in said flues and connected to said headers, substantially as described.

14. A locomotive boiler containing two substantially circular rows of enlarged flues, in combination with a plurality of double return superheater elements arranged in said flues and having curved ends, and substantially circular saturate and superheated steam headers, whereto the ends of said elements are connected, substantially as described.

15. A locomotive boiler containing two substantially circular rows of enlarged fire flues, in combination with superheater elements occupying said flues, a substantially circular superheated steam header adjacent to the flue sheet of the boiler in front of and between said rows of flues, a valve casing provided in the upper part of said header, a throttle valve therein, a substantially circular saturate steam header, and means connecting ends of said elements to said headers, substantially as described.

16. A locomotive boiler containing a substantially circu-

lar row of enlarged fire flues, in combination with substantially circular saturate and superheated steam headers, a throttle valve arranged at the outlet of said superheated steam header, a bleeder pipe leading from the latter, and
5 superheater elements or loops arranged in said flues and connected to said headers, substantially as described.

10 17. A locomotive boiler, containing two rows of enlarged fire flues, in combination with saturate and superheated steam headers arranged parallel with the flue sheet, relatively between said rows of flues and one directly in front of the other, the superheater elements or tubes arranged in said flues, connections whereby the ends of the elements in

the different rows are joined to opposite sides of said headers, the elements in the different rows, being paired and a single securing bolt for the connections of each such pair of elements, said bolts having nuts on both ends and being held against rotation, substantially as described. 15

In testimony whereof, I have hereunto set my hand, this 17th day of January, 1907, in the presence of two subscribing witnesses.

MAX TOLTZ.

Witnesses:

M. SIMON,

A. W. NELSON.