

No. 724,560.

PATENTED APR. 7, 1903.

F. M. FABER.
WATER TUBE BOILER.

APPLICATION FILED MAR. 3, 1902.

NO MODEL.

2 SHEETS—SHEET 1.

Fig: 1.

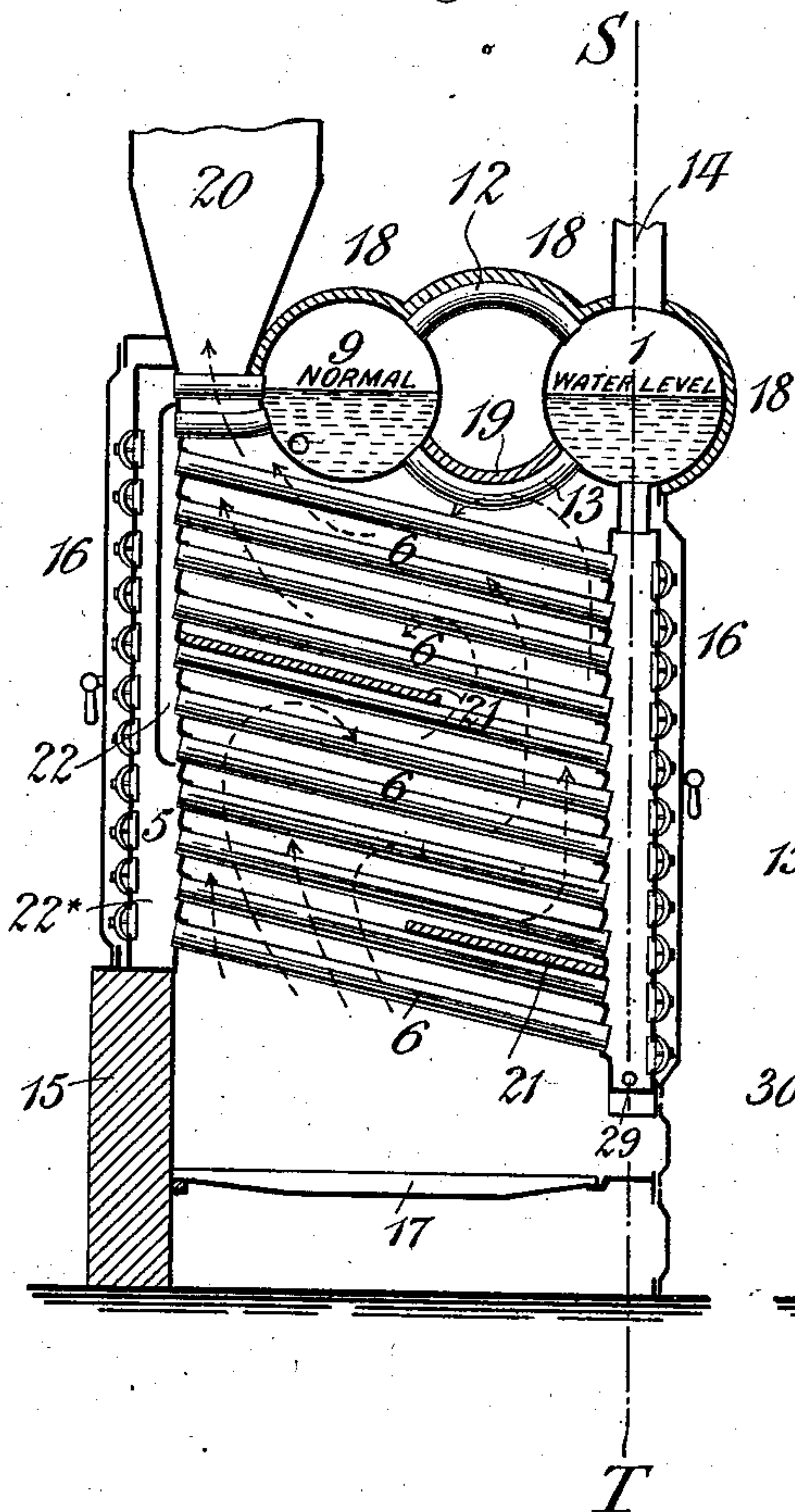
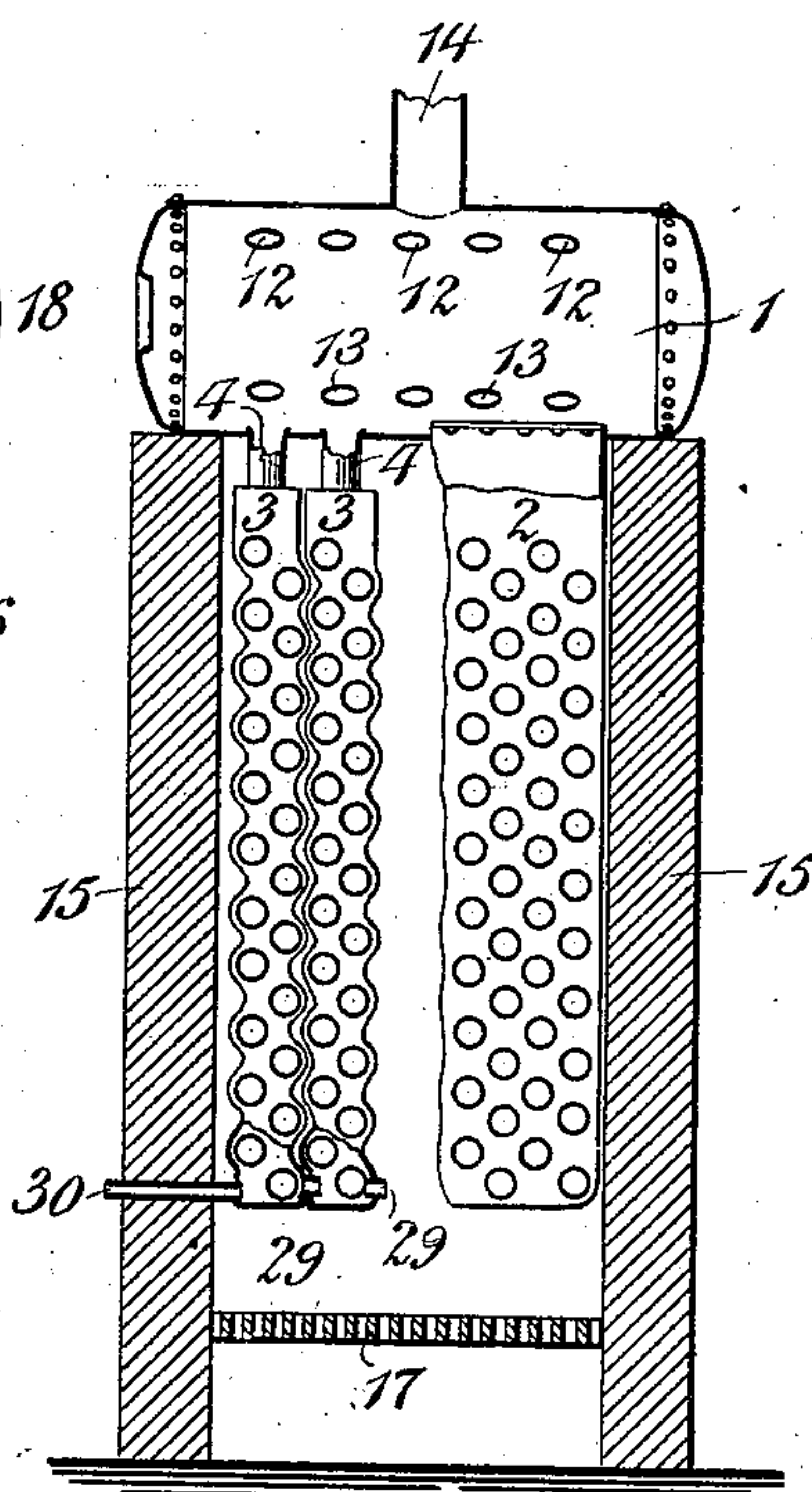


Fig: 2.



WITNESSES:

John A. Rennie
A. F. Sweeney

INVENTOR

Frank M. Faber

BY

Wm. J. Appleton
ATTORNEY

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2 SHEETS—SHEET 2.

Fig. 3.

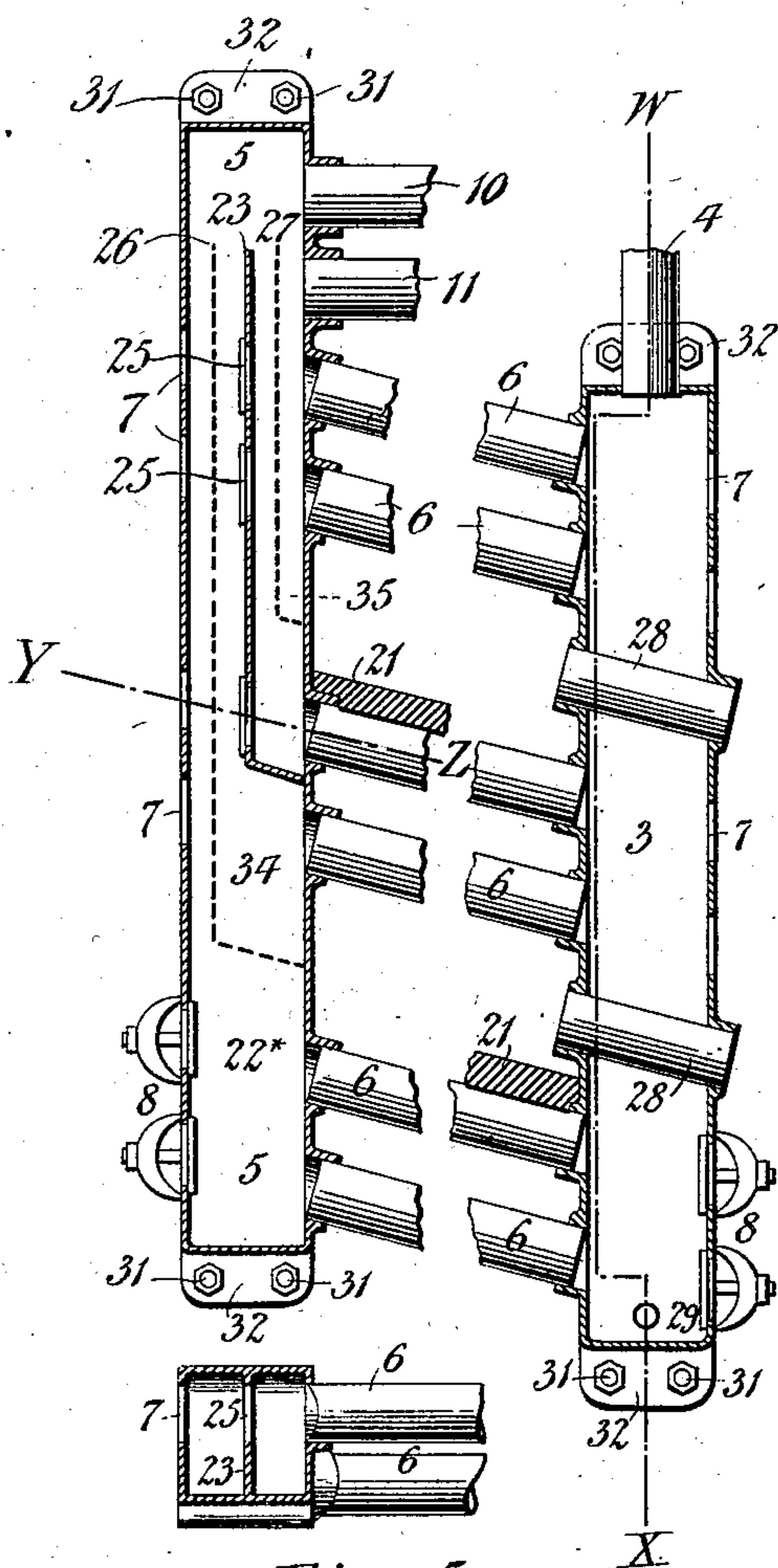
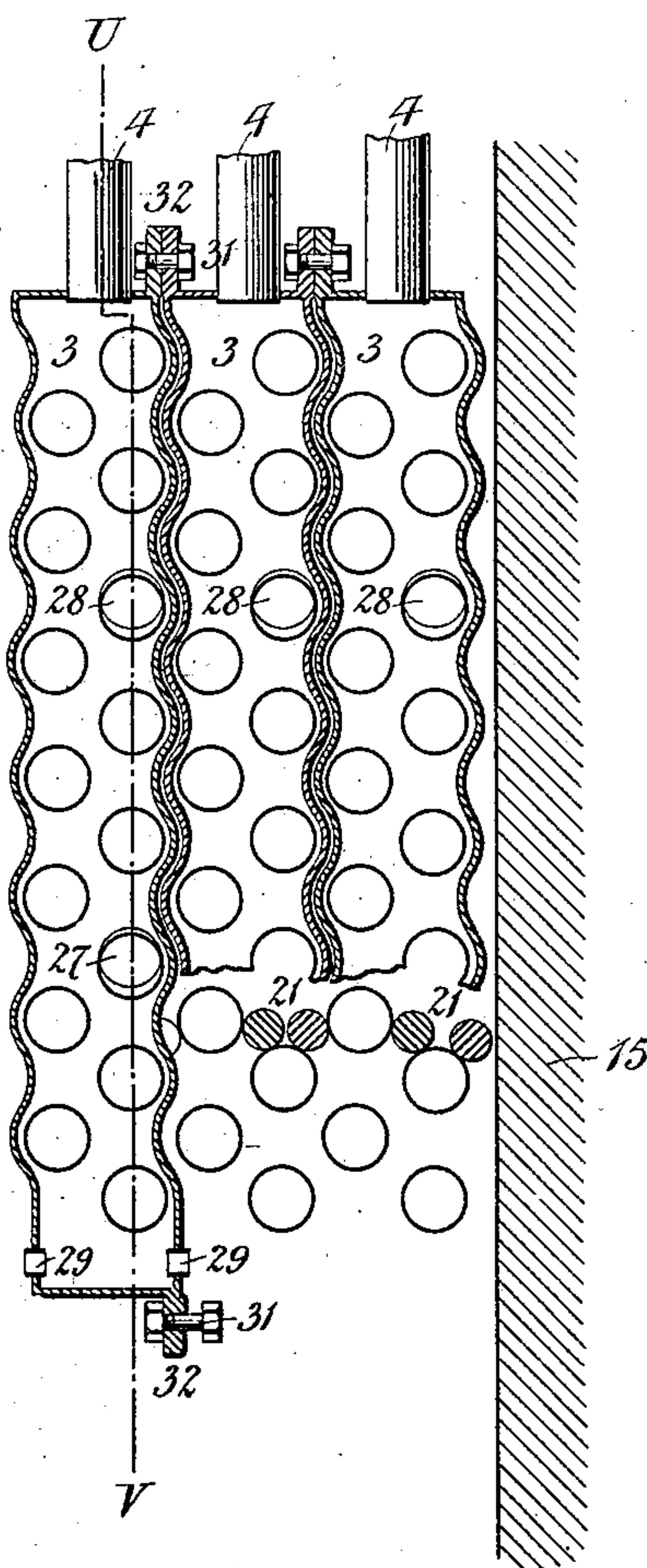


Fig. 5.

Fig. 4.



WITNESSES:

John A. Rennie
A. D. Swamy

INVENTOR

Frank M. Faber

BY
Wm. H. Apperton
ATTORNEY.

UNITED STATES PATENT OFFICE.

FRANK M. FABER, OF PITTSBURG, PENNSYLVANIA.

WATER-TUBE BOILER.

SPECIFICATION forming part of Letters Patent No. 724,560, dated April 7, 1903.

Application filed March 3, 1902. Serial No. 96,427. (No model.)

To all whom it may concern:

Be it known that I, FRANK M. FABER, a citizen of the United States, and a resident of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Water-Tube Boilers, of which the following is a specification.

My invention relates to water-tube boilers, and its distinctive features are means for accelerating the circulation in the tubes in which the greatest volume of steam is formed and for improving the quality of the steam delivered at the outlet and means for increasing the rigidity of the structure as a whole by securing the contiguous headers together, all as will hereinafter more fully appear.

Referring to the accompanying drawings, which form a part of this specification, and in the several figures of which like characters of reference are employed to designate corresponding parts, Figure I is a longitudinal sectional elevation of a boiler constructed in accordance with my invention. Fig. II is a transverse sectional elevation of the same, taken in the plane S T of Fig. I and showing the sectional type of header on the left and the continuous type on the right. Fig. III is a sectional elevation, on a larger scale, taken in the plane U V of Fig. IV. Fig. IV is a sectional elevation in the plane W X of Fig. III, partly cut away to show the baffles in position; and Fig. V is a sectional plane of a header and part of the tubes, taken in the plane Y Z of Fig. III.

1 indicates a steam and water drum, which for convenience of description I shall refer to herein as the "main" drum, and 3 indicates a header or headers which is or are connected therewith. These headers are or may be of any ordinary or preferred construction, and in some instances but a single header will be employed, in which cases it will be made of a width to extend across the entire front of the boiler, as shown at the right in Fig. II, and be secured to the under portion of the drum in line with a suitable aperture therein either by being riveted thereto or by suitable pipes or nipples 4, expanded at their opposite ends in orifices respectively formed through

the walls of the drum and through the upper end of the header to receive them. In other instances a number of these headers will be made use of, as shown at the left in Fig. II, and when this form of construction is employed the individual headers will preferably be connected with the drum through pipes or nipples 4 in the same way as is the single header of the former construction when pipes or nipples are employed in connection therewith for that purpose. As thus connected with the main drum 1 this header or these headers 3 will be connected with a similar header or with similar headers 5 by means of generator-tubes 6, which are expanded or otherwise secured at their opposite ends in suitable orifices respectively formed through the rear walls of such headers for their reception, an appropriate hand-hole 7 being formed in the front walls of these headers opposite each of the generator-tubes, through which the tubes may be emplaced, inspected, repaired, and cleaned when desired. These hand-holes when the boiler is in operation are or may be closed by any convenient means. I prefer, however, to employ caps 8 for the purpose and to secure them in place by appropriate coöperating bridges and threaded stems and nuts, as shown. With the header or headers 3 thus connected with the main drum 1 the upper end portions of the headers 5 are preferably connected with a second steam and water drum 9, which for convenience of description I shall call a "supplementary" drum herein. For effecting this connection I make use of one or more pipes or intakes 10 and 11, which, like the pipes or nipples 4, are expanded at its or their opposite ends in suitable orifices respectively formed through the walls of that drum and through the upper end portions of the header or headers for their accommodation. While the headers and their respective drums are thus connected, these drums are themselves connected by pipes 12 and 13, of which the former extends from the steam-space of one to the steam-space of the other and the latter extends from the water-space of one to the water-space of the other, with their opposite ends expanded or otherwise secured within

appropriate orifices formed through the walls of the respective drums to receive them.

The several parts being connected as above described, the boiler when in use is disposed within a suitable casing, of which the supporting and side walls 15 are preferably constructed of brick or other appropriate heat-resisting material, and the portions 16, which cover the headers, made of metal or its equivalent in the shape of doors whereby to permit of ready access to these headers when desired. As thus disposed a fire-box is provided beneath the generator-tubes 6, which is separated from the ash-pit below by a suitable grate 17 and coöperates with an appropriate chimney 20, which preferably leads from the upper portion of the casing, as shown.

With the boiler inclosed as above explained the drums 1 and 9 and their connecting-pipes 12 may be covered with an appropriate heat-conducting covering 18, whereby to prevent the loss of heat from those parts by radiation, while to prevent access of too much heat from the boiler-furnace to these pipes and the parts of the drums above the water-line I sometimes find it convenient to seal the openings between the pipes 13 with tile or other refractory material 19.

When the boiler is in operation, the heated products of combustion pass from the fuel on the grate 17 upward between and around the generator-tubes 6 to the chimney 20, and in order to insure of the immersion of the entire surface of the generator-tubes in the furnace-gases when the latter are pursuing that course I make use of the baffles 21, which are preferably disposed in alternate relationship between those pipes and extending inwardly from their opposite ends conduct these products upwardly in a sinuous course between such tubes, as indicated by the arrows in Fig. I.

The generator-tubes being preferably inclined from the horizontal, as shown, the circulation in the boiler always takes place in the same direction, which is as follows: from the main drum 1 downwardly to the header or headers 3, through the passage-way or passage-ways therein, which for convenience of description I shall call the "downtake" or "downtakes" herein, thence through the generator-tubes 6, where steam is generated, to the header 5, thence upwardly through the passage-way or passage-ways with which it or they are provided and which for convenience of description I shall call the "uptake" or "uptakes" herein, and thence into the supplementary drum 9, where the steam and water become separated. From this supplementary drum 9 the steam and water thence passes, respectively, through the pipes 12 and 13 to the main drum 1, whence it will be conducted through the outlet 14, with which this drum is provided, to the point or points where required. The employ-

ment of a supplementary drum 9 and the pipes 12 and 13 is a distinct advantage in the type of boiler herein illustrated, for moisture unavoidably entrained with the steam entering the supplementary drum 9 from the header or headers 5 settles or decants out while in the drum and as it passes through the pipe 12 to the main drum, whereby when the steam is finally discharged from the outlet 14 it is practically devoid of all entrained moisture.

In boilers of this type the circulation, as is well known, is mainly due to the difference in specific gravities or densities of the contents of the downtake and the uptake passage-ways. The former being composed of water only is heavier than the latter, which is a mixture of steam and water, and as a consequence the greater the proportion by volume of steam in this mixture the greater will be the velocity of circulation. In order, therefore, to maintain the highest possible velocity of circulation in any given generator-tube, the proportions by volume of steam and water through the uptake should be the same as that discharged by that tube. If these proportions be altered by admission to the uptake of water from a source other than the tube in question, the density of the mixture of steam and water in the uptake will be increased, and consequently the velocity of circulation will be reduced.

In boilers of this type as heretofore constructed the upper tubes, or those remote from the furnace, in which a relatively small amount of steam is generated, discharge into the same uptake or uptakes as do the lower tubes, which are nearer the furnace, and the excess of water entering the uptake or uptakes from the upper tubes greatly retards the circulation in the lower tubes, where the highest possible velocity should be maintained by increasing the density of the mixture in the uptake or uptakes. It follows, therefore, as a necessary consequence of this that the maximum velocity of circulation is attained when each individual generator-tube is independently connected with the supplementary drum 9. In practice, however, I find that this individual form of connection is unnecessary and that by dividing the pipes that lie in close relationship to the fire-box and those that are disposed at different altitudes above them into separate groups and by connecting each of these groups with the supplementary drum 9 independently of the others I accomplish all that is required for practical operation. To this end I construct the header 5 when a single header is employed or each of the headers when a number are made use of with a plurality of uptake passage-ways therein and connect one or the other of the groups of the generator-tubes with each of these passage-ways. In some instances these headers will be provided with but two of these uptakes each, as shown at 22 and 22* in Fig. I, in which case they will be separated from each other

by a diaphragm 23, and the uptake 22 will be preferably closed at its lower end 24. As thus arranged the uptake 22 will serve to connect the group of generator-tubes 6 that is disposed at the greater distance above the fire-box with the supplementary drum 9, while the uptake 22* will in like manner connect the group of generator-tubes therewith which lies below the former and in close relationship to such fire-box. In other cases the number of these uptakes may be increased in each of the headers 5—as shown, for instance, at 22*, 34, 22, and 35 in Fig. III—and when this form of the invention is adopted the several uptakes will be separated from one another by suitable diaphragms or other appropriate walls 23, 26, and 27, and with their respective lower ends preferably closed each of these uptakes will connect one or another of the differently-located groups of generator-tubes with the supplementary drum 9, as with the uptakes in the former construction.

With the headers 5 constructed and connected as last described the steam and water discharged from the group of generator-tubes nearest the fire-box will pass upwardly along the uptake 22*, at the left in Figs. I and III, unmixed with the discharge from the generator-tubes above the bottom of the uptake next on its right in those figures and be discharged into the supplementary drum 9 through the intake-pipe 10. In like manner the steam and water discharged from the group of generator-tubes next above those last mentioned will pass upwardly through the uptake 34, next on the right in Figs. I and III, unmixed with the discharge from any of the other generator-tubes and be similarly discharged into the supplementary drum through its appropriate intake-pipes, and so on throughout the series, each group of generator-tubes discharging its contents into its own cooperating uptake and the same being carried upwardly therein without intermixing with or being influenced in any way by those discharged by any of the others.

To prevent the intermixture of the contents discharged by the different groups of generator-tubes in passing upwardly through their respective uptakes, the upper ends of these uptakes may extend upwardly to a point slightly below the upper intake-pipe 10, as shown in Fig. III, or these upper ends may be closed, as illustrated in Fig. I, in which latter case a separate intake for each of the uptakes will be required, and in order to permit access to the interior of the generator-tubes for cleaning, inspection, and repairs I find it convenient to provide each of the diaphragms or the walls of the different uptakes opposite the ends of each of those tubes with a hand-hole or opening, which when the boiler is in use may be closed by a suitable cap 25 or otherwise.

While it is essential that the contents dis-

charged by any one of the groups of generator-tubes in passing upwardly within their appropriate uptake should be practically isolated from those discharged from the other group or groups and passing upwardly within their respective uptake or uptakes, it is not absolutely necessary that the joints between the diaphragms or walls of the different uptakes and the inner walls of the header be water-tight, as a certain amount of leakage between the different uptakes may occur without material detriment to the operation of the boiler.

In addition to the orifice before mentioned either the header 3 or the header 5, or both, may be provided with orifices in which are expanded or otherwise secured short pieces of pipe 28, that extend inward across the interior of the header, as shown in Fig. III, whereby to afford means through which the baffles 21 may be emplaced, inspected, and repaired when required or necessary.

To permit of the "blowing down" of the boiler when the sectional form of header is employed without a mud-drum, I connect each of these headers with its neighbor at or near its bottom by a short pipe 29 or its equivalent and secure in the header adjacent to one of the side walls of the casing near its lower end a "blow-off" pipe 30, which is or may be provided with an appropriate closing valve or cock. (Not shown.) With a view likewise to increasing the rigidity of the structure as a whole when the sectional form of header is employed and prevent independent movement from shock or vibration, as well as to relieve the joints of the various tubes and pipes in the headers and other parts of the boiler from strain, I provide each of the headers at top and bottom with a lug 32 and secure it to its neighbor by suitable bolts 31, passed through suitable orifices in such lugs and held in place, with the lugs pressed firmly together by appropriate nuts with which the bolts are provided, as shown.

While in the construction of my boiler I find it convenient in most instances to locate the main drum 1 directly over the upper end or ends of the header or headers 3, I prefer to locate the supplementary drum intermediate the headers 3 and 5 and over the generator-tubes 6, with its under surface below the upper end of the header 5 and with its axis in approximately horizontal relationship to the axis of the main drum 1, and to provide it in its lower portion, near the inner end of the intake-pipes 10 and 11, with an orifice 33 for the inflow of water when supplied to the boiler. By these means I am enabled to materially lessen the height of the boiler from what it would be if the supplementary drum was located directly over the headers 5 and to introduce the feed-water to that drum at or about at the point where the heated water of circulation enters it, thus assuring an intimate admixture of the cooler feed-water with the

hotter water of circulation before entering the tubes 13, wherein it is heated by the furnace-gases to approximately boiler temperature before entering the downtake or downtakes in the header or headers 3, and thus avoiding sudden changes of temperature in the generator-tubes and other parts exposed to very high degrees of heat.

It will thus be seen that I produce a boiler which is not only simple in construction and insures of the freest and most efficient circulation of water and steam therein, but one in which its various joints are relieved from strain and its different parts protected from accidental movement or displacement by shocks or vibrations.

While in the foregoing I have described the best means contemplated by me for carrying my invention into practice, it is obvious that modification can be made in its various parts and still be within the scope of the invention.

Having now described my invention and specified certain of the ways in which it is or may be carried into effect, I claim and desire to secure by Letters Patent of the United States—

1. A header for water-tube boilers, constructed with a plurality of passage-ways extending upwardly within the same and having their respective lower ends closed and located at different elevations therein, substantially as described.

2. The combination, with a header for a water-tube boiler constructed with a plurality of passage-ways extending upwardly within the same, a second header for cooperating therewith, and a steam and water drum, of a plurality of groups of generator-tubes located at different elevations with each group connecting one or the other of such passage-ways with the cooperating header, and means whereby the upper ends of both of the headers are connected with the steam and water drum, substantially as described.

3. The combination, with a header for a water-tube boiler, constructed with a plurality of passage-ways extending upwardly within the same, and with their lower ends closed and located at different elevations therein, a second header for cooperating with such first-mentioned header, and generator-tubes connecting each of such passage-ways with the cooperating header, of a main steam and water drum, a supplementary steam and water drum, means by which the last and first mentioned headers are respectively connected with these main and supplementary drums and by which the main and supplementary drums are themselves connected, whereby the circulation of water through the drums, the headers, and the generator-tubes may be effected, substantially as described.

4. The combination, with a header constructed with a plurality of uptake passage-ways having closed bottoms and such bottoms located at different elevations therein, a steam

and water drum with which such passage-ways are connected, a cooperating header having a downtake passage-way therein, and a second steam and water drum with which such downtake passage-way is connected, generator-tubes for connecting each of the uptake passage-ways in the first-mentioned header with the downtake passage-way in the last-mentioned header, and pipes for connecting said steam and water drum located respectively above and below the water-level therein, substantially as described.

5. The combination, with a header constructed with a plurality of uptake passage-ways extending upwardly therein and having their lower ends closed and located at different elevations, a supplementary steam and water drum with which such uptake passage-ways are connected, a second header for cooperating therewith, and provided with a downtake passage-way therein, and a main steam and water drum with which such downtake passage-way is connected, of generator-tubes for connecting each of the uptake passage-ways in the first-mentioned headers with the downtake passage-way in the last-mentioned header and inclining upwardly from the latter to the former header, and pipes for connecting the main and supplementary steam and water drums respectively above and below the water-level therein, substantially as described.

6. The combination, with a main steam and water drum, a header connected therewith, generator-tubes secured at one of their ends in such header, and a supplementary steam and water drum connected with the main steam and water drum, of means for connecting the opposite ends of the upper and under of these generator-tubes in separate series directly with such supplementary steam and water drum independently of each other, substantially as described.

7. The combination, with the sectional headers of a water-tube boiler, each of which is provided with an ear at its top and bottom ends, of bolts by means of which the adjoining sections may be secured together at their opposite ends, substantially as described.

8. The combination, with a header having a downtake passage-way therein, a header having an uptake passage-way extending upwardly within the same, generator-tubes connecting the two headers and inclining upward from the former to the latter, and a main drum, and connections between such drum and the header having the downtake passage-way, of a supplemental drum located intermediate the main drum and the header containing the uptake passage-way, with its lower surface below the upper end of this header and its axis in approximately horizontal relationship to the axis of the main drum, connections between this supplemental drum and this last-mentioned header, a pipe for connecting the steam-space of said supple-

mental drum with the steam-space of the main drum, and a second pipe for connecting the water-space of the former drum with the water-space of the latter drum, whereby the
5 height of the boiler may be reduced to the minimum and the efficient circulation of the steam and water within the boiler insured, substantially as described.

Signed at New York, in the county of New York and State of New York, this 19th day 10 of February, A. D. 1902.

FRANK M. FABER.

Witnesses:

THOS. J. MCTIGHE,
DUDLEY R. HORTON.