W. J. McKNIGHT.

BOILER FEED WATER HEATER AND PURIFIER.

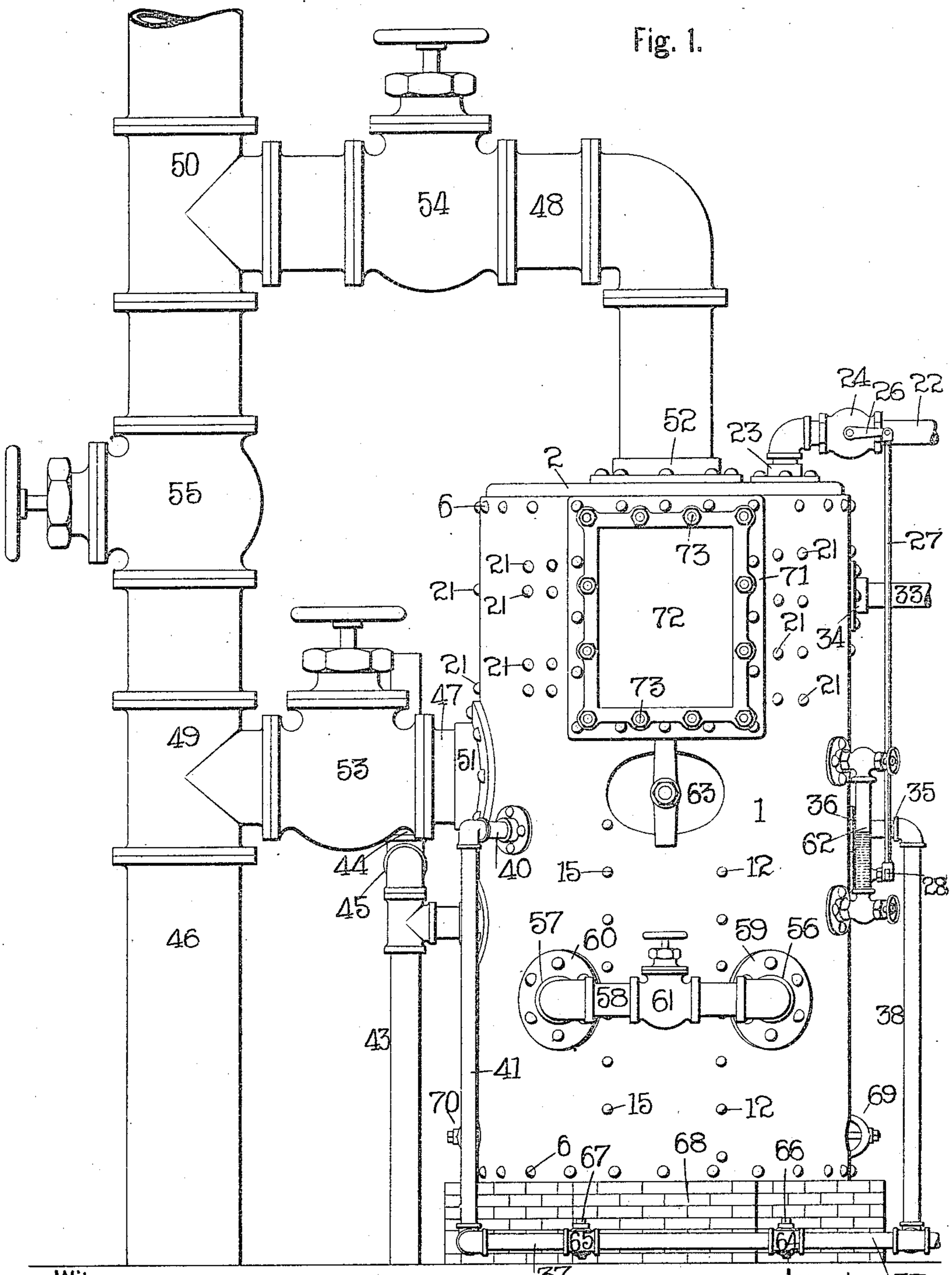
APPLICATION FILED JUNE 19, 1908.

952,930.

Patented Mar. 22, 1910.

3 SHEETS—SHEET 1.

Fig. 1.



Witnesses.

L. M. Langster.

George A. Neubauer.

Inventor.

Walter J. McKnight.

By C. J. Langster Attorney.

W. J. McKNIGHT.

BOILER FEED WATER HEATER AND PURIFIER.

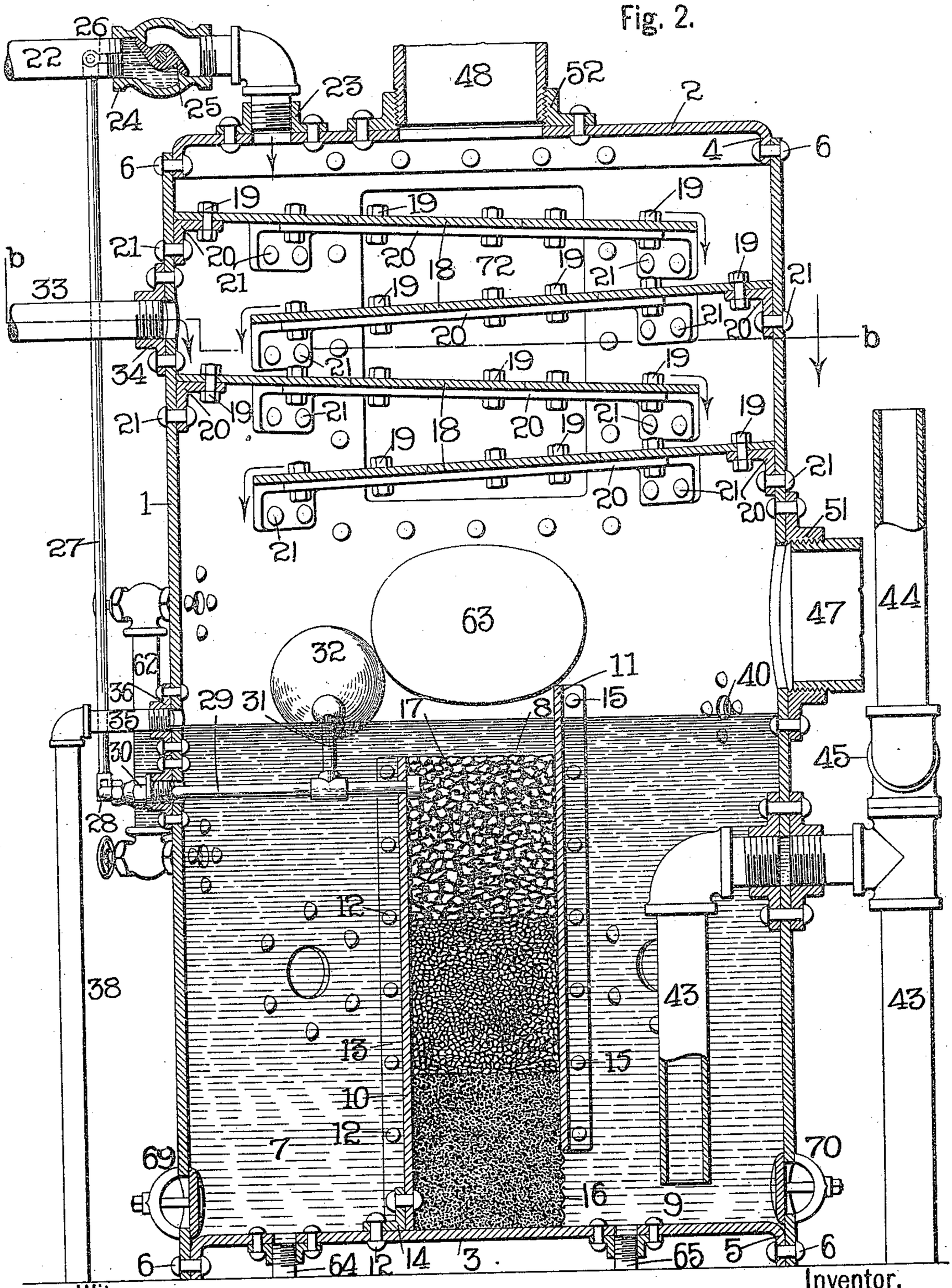
APPLICATION FILED JUNE 19, 1908.

952,930.

Patented Mar. 22, 1910.

3 SHEETS—SHEET 2.

Fig. 2.



Witnesses.

L. M. Sangster.

George A. Neubauer.

Inventor.

Walter J. McKnight.

By A. J. Sangster Attorney.

W. J. McKNIGHT.

BOILER FEED WATER HEATER AND PURIFIER.

APPLICATION FILED JUNE 19, 1908.

952,930.

Patented Mar. 22, 1910.

3 SHEETS—SHEET 3.

Fig. 3.

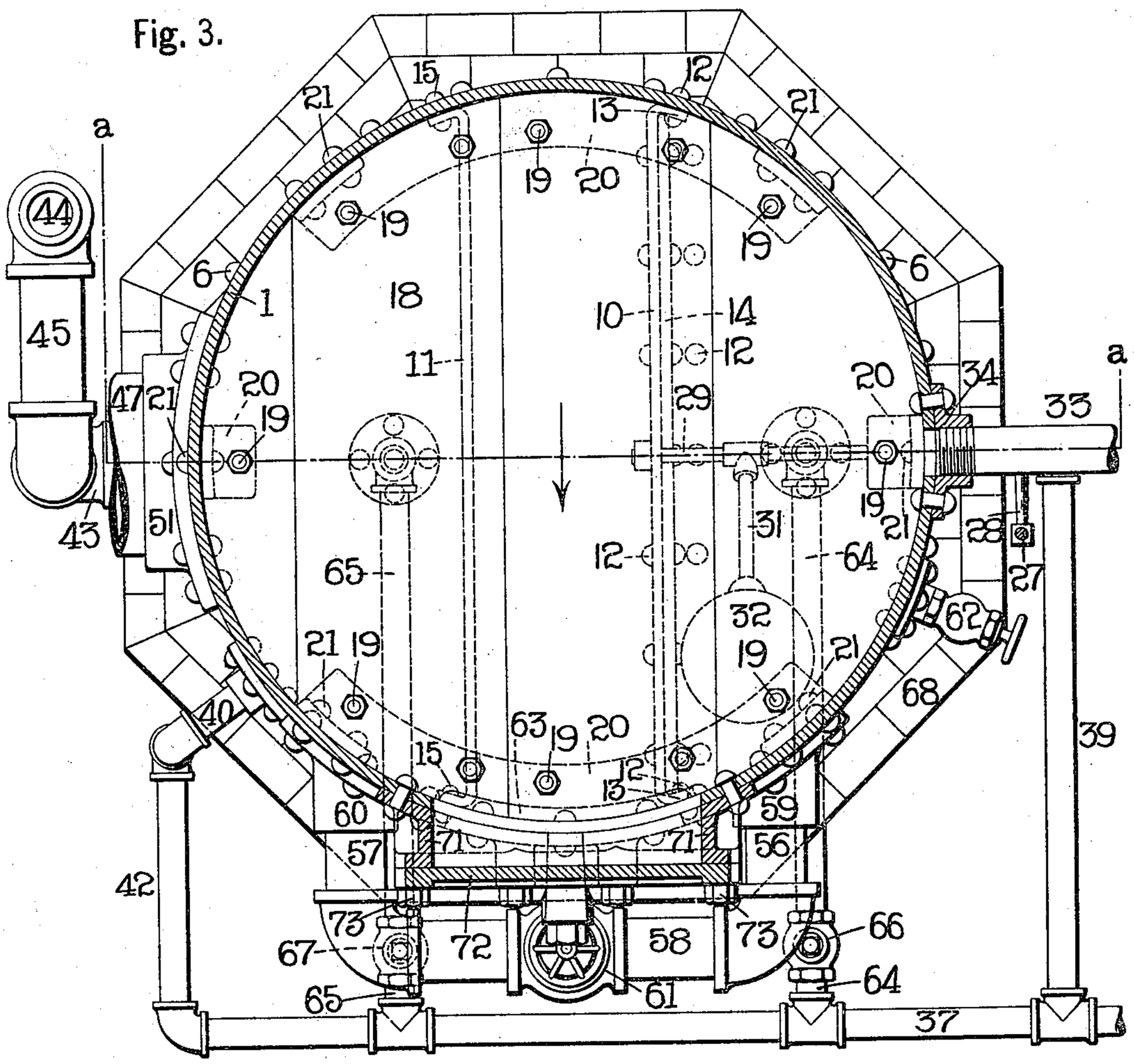
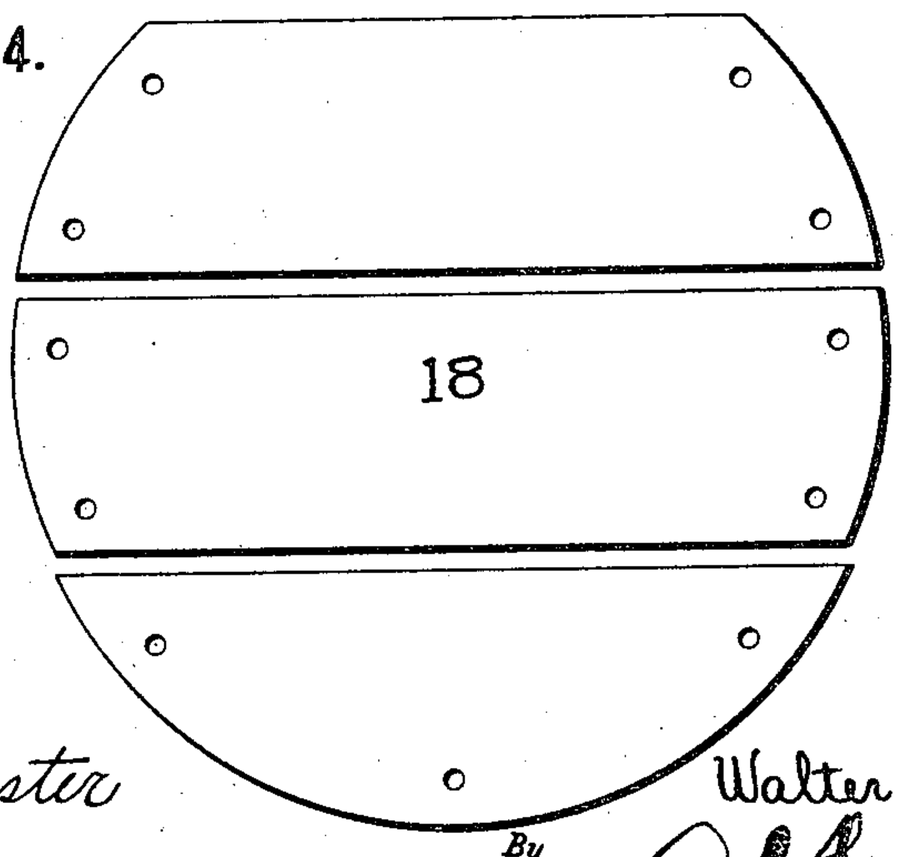


Fig. 4.



Witnesses.

L. M. Langster

George A. Neubauer.

Inventor.

Walter J. McKnight.

By Langster Attorney.

ANDREW B. GRAHAM CO., PHOTO-LITHOGRAPHERS, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

WALTER J. McKNIGHT, OF BUFFALO, NEW YORK.

BOILER-FEED-WATER HEATER AND PURIFIER.

952,930. Specification of Letters Patent. Patented Mar. 22, 1910.

Application filed June 19, 1908. Serial No. 439,317.

To all whom it may concern:

Be it known that I, WALTER J. McKNIGHT, a citizen of the United States, residing at Buffalo, in the county of Erie and State of New York, have invented a certain new and useful Improvement in Boiler-Feed-Water Heaters and Purifiers, of which the following is a specification.

This invention relates to an improved tank for heating and purifying boiler feed water, and the object of the invention is to construct a simple, strong, and exceedingly efficient apparatus for this purpose.

The invention also relates to certain details of construction, which will be hereinafter described and claimed, reference being had to the accompanying drawings in which one adaptation of the invention is illustrated.

Figure 1 is a side elevation of the improved tank, showing the various pipes and connections. Fig. 2 is a central vertical section through the improved tank on line *a a*, Fig. 3 with certain pipes and other necessary devices in elevation or partially in section and partially in elevation. Fig. 3 is a horizontal section through the tank on line *b b*, Fig. 2. Fig. 4 is a detached plan view of one of the inclined shelves showing the sectional character thereof.

In referring to the drawings in detail, like numerals designate like parts.

In the adaptation of the invention shown in the accompanying drawings, the tank consists of a cylindrical member 1, constituting the sides of the tank, and top and bottom end members 2 and 3, which are flanged as shown at 4 and 5 and fitted within the respective ends of the cylindrical member, and rigidly fastened in place by rivets 6.

The tank is of a vertical or upright form and the lower portion of its interior is divided into a series of vertical compartments 7, 8 and 9, by vertical partitions 10 and 11. The partition 10 extends upward from the bottom 3 of the tank and terminates a short distance below the water line. It is fastened in place by rivets 12 which pass through its flanged vertical side margins 13 and the cylindrical member 1 of the tank, and through an angle iron 14 and the bottom member 3 of the tank. The partition 11 begins a short distance above the bottom 3 of the tank, extends parallel to the partition 10 and terminates above the water line. It is fastened to the cylindrical member 1 of the tank by rivets 15 in the same manner as the partition 10. The space between the lower edge of the partition 11 and the bottom of the tank is closed by a screen 16 of wire cloth or other suitable material of pervious character so as to separate the compartments 8 and 9, but still permit the passage of water from one to the other, see Fig. 2.

The three compartments 7, 8 and 9 constitute respectively, an inlet chamber, a filtering chamber, and an outlet chamber. The middle compartment or filtering chamber 8 is filled up to a level with the top edge of the partition 10, with a filtering compound 17 which is preferably arranged in layers or strata of different grades of material. In the drawings, three such layers or strata are shown, a lower layer of very fine material, an intermediate layer of medium grade and a top layer of comparatively coarse material. The purpose in thus arranging the filtering compound in layers of different grades is to facilitate the operation of filtering the water and to enable the compound to be used longer without cleaning. The upper layer will remove the coarse impurities first as the water passes through, the intermediate layer will gather the impurities which the upper layer failed to remove, and the lower layer will retain the very minutest impurities so that when the water passes beneath the partition 11 into the compartment 9 it will be, to all practical purposes, chemically pure. The filtering compound 17 is prevented from being washed into the outlet chamber 9 by the screen 16, see Fig. 2 which is fine enough to prevent the filtering compound from passing through, but offers no obstacle to the passage of the filtered water.

The upper portion of the interior of the tank is divided into a plurality of approximately horizontal compartments by a series of inclined shelves 18 which are arranged in opposed relation to each other, incline alternately in opposite directions and are fastened alternately to opposite sides of the tank. It will be noticed that the shelves are all inclined to about the same degree and that those extending from the same side of the tank are substantially parallel with each other. The shelves 18 are each composed of a plurality of sections which are secured by bolts 19 to brackets 20 fastened to the interior of the cylindrical member 1, of the tank by rivets 21, see Fig. 2.

A pipe 22 which is connected to a suitable source of water supply, such as, for instance, a service pipe, leads into the interior of the tank through the top 2 thereof being secured thereto by a flanged coupling 23 riveted in place. The pipe 22 is provided with an automatic valve which is operated by means of a float within the tank so that the inflow of water is regulated by the water level inside the tank. This automatic valve is illustrated in Fig. 2 and consists of a body 24, in which is located a leaf 25, supported on a stem and adapted to coöperate with shoulders inside the valve body to obstruct the passage of water. A crank 26 is fastened to the outer end of the valve stem, and is connected by means of a depending connecting rod 27, to a crank 28, on the outer end of a horizontal shaft 29, which is located within the lower portion of the tank and is journaled in a stuffing box bearing 30 in the side of the tank and in a bearing in the vertical partition 10, see Fig. 2. A crank arm 31 is fastened to the shaft 29 within the tank and carries at its outer extremity a float 32 of suitable design. It will readily be seen by reference to Fig. 2, that when water is drawn from the tank and the float descends, the automatic valve is opened and admits water into the tank from the supply pipe 22. As soon as the inflow of water exceeds the outflow, the float rises and closes the automatic valve, thereby shutting off the supply of water.

The water is used over and over again, the returns from the building heating system entering the tank through a pipe 33. This pipe is connected to the upper portion of the tank so that the return enters one of the horizontal compartments as shown in Fig. 2. It is fastened to the cylindrical tank member 1 by a flanged coupling 34. This return maintains the water level within the tank at approximately a uniform height, so that only sufficient water is admitted through the service pipe 22, to replace the loss due to waste or leakage in the building heating system.

Provision is made for removing oil and other floating impurities from the water before it passes through the filtering compound so as to lessen the work of the compound and thus prolong its life. It consists of a horizontal pipe 35 which enters the compartment 7 through the side 1 of the tank at about a level with the normal level of the water therein. The pipe is fastened to the tank by means of a flanged coupling 36, and is connected to a general waste pipe 37 by vertical and horizontal pipes 38 and 39. An additional overflow pipe 40 is provided which enters the compartment 9 through the side 1 of the tank at about the same level as the pipe 35, and is connected to the waste pipe 37 by vertical and horizontal pipes 41 and 42. This pipe serves as a safety or supplementary overflow to remove any oil which may splash over the partition 11 into the compartment 9.

The heated and purified water is withdrawn from the compartment 9 by a pipe 43 which is connected to a suction pump in the usual manner. This pipe enters the compartment 9 through the side 1 of the tank below the water line and extends downward with its open end near the bottom of the compartment. A vertical pipe 44 is connected to the suction pipe 43 outside the tank by a short horizontal pipe 45, and extends upward above the water level in the tank with its upper end open to the air. In case the water level in the tank should for any reason fall below the upper end of the pipe 43, the pump would draw air through the pipe 44 and by its action notify the operator of the fact that the water in the tank is low.

The feed water is heated by the use of exhaust steam which is conveyed through the tank in such a manner that the inflowing water, either from the service pipe 22 or the return pipe 33, is well heated before it enters the compartment 7.

The exhaust steam pipe 46 is connected to the side 1 of the tank by a branch pipe 47, which leads into the tank at a point above the water line and below the lower inclined shelf 18, see Fig. 2. Another branch pipe 48 leads from the exhaust pipe 46 above the pipe 47 into the tank through the top 2 thereof. The branch pipes 47 and 48 are connected respectively to the exhaust pipe 46 by two couplings 49 and 50 and to the tank by flanged couplings 51 and 52 and are provided with valves 53 and 54 by means of which communication with the tank may be cut off. A valve 55 is located in the exhaust pipe 46 between the connections of the branch pipes, by means of which the direct passage of the exhaust steam through the pipe can be cut off and the steam directed into the tank.

The tank is provided with a by-pass by means of which direct communication is afforded between the inlet and outlet compartments 7 and 9 so that in cases of emergency the feed water can flow directly from one to the other without first passing through the filtering chamber 8. This by-pass consists of two short horizontal pipes 56 and 57 which communicate with the compartments 7 and 9 respectively through the side 1 of the tank below the water line and which are connected at their outer ends by a transverse horizontal pipe 58. The pipes 56 and 57 are connected to the tank by flanged couplings 59 and 60 riveted in place, and to the pipe 58 by elbow couplings in the usual manner. The pipe 58 is provided

with a valve 61 whereby communication between the compartments 7 and 9 is normally closed.

A water gage 62 of the well known type is provided and a manhole 63 is located in the side of the tank above the water line to afford convenient access for introducing and removing the filtering material and cleaning the interior of the tank.

Washout pipes 64 and 65 which enter the compartments 7 and 9 through the bottom 3 of the tank connect to the general waste pipe 37 and are provided with stop cocks 66 and 67. By means of these pipes any sediment which may be deposited in the bottom of the tank can be easily washed out.

The tank is preferably raised above the floor level by supporting it upon a brick or concrete foundation 68 through which the pipes 64 and 65 pass as shown in Fig. 1.

Hand holes 69 and 70 are located in the side of the tank near the bottom of the compartments 7 and 9 to afford convenient access for cleaning.

The upper portion of the tank is provided with a removable door or cover so that access can be had to the interior of the tank for the introduction and removal of the inclined shelves. A rectangular opening of sufficient size is cut into the side 1 of the tank near the top thereof and is surrounded by a rectangular flanged casing 71 which is riveted to the tank. A cover or plate 72 is securely fastened to the casing 71 by stud bolts 73 the joint being made steam tight in any of the usual well known ways.

In the preferred construction of the inclined shelves as shown in Figs. 2, 3 and 4 of the accompanying drawings, each one consists of three sections which are fastened to the brackets 20 as heretofore described. By constructing the shelves in this manner, they may easily be removed and replaced in case of corrosion or breakage.

The operation of the improved boiler feed water heater and purifier is as follows,—The filtering compartment 8 is filled with layers or strata of filtering material of any of the well known compounds used for this purpose. The valve 55 in the exhaust pipe 46 is closed, and the valves 53 and 54 in the branch pipes 47 and 48, opened so as to direct the exhaust steam into the tank. After the steam enters the tank it pursues a sinuous or serpentine course through the compartments formed by the inclined shelves 18 and in so doing thoroughly heats the plates comprising the shelves, and then passes out through the pipe 48 back into the exhaust pipe 46. As the feed water enters the tank either through the service pipe 22 or the return 33 it strikes the hot plates of the shelves 18 and is thoroughly heated. It will be noticed by reference to Fig. 2 that the feed water pursues the same course as the steam in passing through the compartments formed by the inclined shelves, only in an opposite direction. From the inclined shelves, the water falls into the compartments 7, filters through the filtering compound 17 in the compartment 8 and flows thence through the screen 16 into the outlet compartment 9 from whence it is withdrawn through the pipe 43.

I claim—

1. A combined feed water heater and purifier comprising a tank, a vertical partition extending from the bottom of the tank and terminating below the normal water line, another vertical partition extending from a point sufficiently above the bottom of the tank to leave a passage for water between the lower end of the partition and the bottom of the tank and terminating above the normal water line, said partitions dividing the lower portions of the tank into three connecting compartments arranged side by side and forming inlet, filtering and outlet chambers, overflow pipes leading from the inlet and outlet chambers for removing oil and other floating impurities, a series of upper approximately horizontal heating compartments in the upper portion of the tank above the lower compartments, said upper compartments being formed by inclined shelves extending alternately from opposite sides of the tank, an inlet pipe connected to a water supply and a return pipe both leading into the heating compartments, an automatic valve in the inlet pipe, a pipe leading into the tank above the normal water line and providing an inlet for the heating agent, a pipe leading from the tank above the inclined shelves and providing an exit for the heating agent, and an outlet pipe leading from the lower outlet chamber.

2. In a combined feed water heater and purifier, a tank having vertical partitions located in the lower portion thereof and dividing said lower tank portion into inlet, filtering and outlet chambers, a series of inclined shelves located in the upper portion of the tank above the vertical partitions, and extending from opposite sides of the tank and forming a series of approximately horizontal heating compartments; said shelves being formed in separable sections for convenient removal, an inlet pipe and a return pipe both leading to the heating compartments, means for heating the inclined shelves and thus heating the inflowing water as it comes into contact with said shelves, an outlet pipe leading from the outlet chamber and said tank having an opening closed by a cover through which the inclined shelves may be removed.

3. A combined feed water heater and purifier comprising a tank having vertical inlet, filtering and outlet chambers arranged side by side in the lower portion of the tank,

a series of inclined shelves in the upper portion of the tank and extending alternately from opposite sides of the tank and inclining alternately in opposite directions thereby forming a series of approximately horizontal compartments through which the water flows in a sinuous course and from the lower one of which it drops into the vertical inlet chamber in the lower portion of the tank, a pipe connected to a water supply and a return pipe; both of said pipes leading to the horizontal compartments, means for heating the water as it passes through the horizontal compartments, and an outlet pipe leading from the outlet chamber.

4. A combined feed water heater and purifier comprising a tank having inlet, filtering and outlet chambers located side by side in the lower portion of the tank and being connected with each other, a series of sectional inclined shelves located in the upper portion of the tank and arranged to form a series of approximately horizontal compartments through which the water flows in a sinuous course, means for heating the inclined shelves, a pipe connected to a water supply and a return pipe leading into the tank, an automatic valve in the first mentioned water supply pipe for automatically regulating the admission of water into the tank and an outlet chamber.

5. In a combined feed water heater and purifier, a tank having its lower portion divided by vertical partitions into inlet, filtering and outlet chambers, and the filtering chamber being located between the inlet and outlet chambers and being in communication at its top with one of the remaining chambers and at its bottom with the other remaining chamber, a series of horizontal heating compartments arranged in a vertical row in the upper portion of the tank above the lower chambers and having the lowest compartment arranged to direct the flow of liquid into the inlet chamber, an inlet pipe leading to the heating compartments and an outlet pipe leading from the outlet chamber.

6. In a combined feed water heater and purifier, a tank having its lower portion divided by vertical partitions into inlet, filtering and outlet chambers, and the filtering chamber being located between the inlet and outlet chambers and being in communication at its top with the inlet chamber and at its bottom with the outlet chamber, a series of horizontal heating compartments arranged in a vertical row in the upper portion of the tank above the lower chambers and having the lowest compartment arranged to direct the flow of liquid into the inlet chamber, an inlet pipe leading to the heating compartments and an outlet pipe leading from the outlet chamber.

7. In a combined feed water heater and purifier, a vertical tank having vertical partitions in its lower portion dividing said portion into inlet, filtering and outlet chambers which are arranged side by side, the inlet chamber being arranged to communicate with the top of the filtering chamber, and the outlet chamber being arranged to connect with the bottom of the filter chamber, a series of horizontal compartments formed by shelves in the upper portion of the tank, a service pipe connected to a water supply, and a return pipe both leading to the horizontal upper compartments, means for heating the water as it passes through said horizontal upper compartments, and an outlet pipe leading from the tank and communicating with the outlet chamber thereof, substantially as set forth.

8. A combined feed water heater and purifier comprising a tank, inlet, filtering and outlet chambers located in the lower portion of the tank, a series of sectional inclined shelves located in the upper portion of the tank and arranged to form a series of connected compartments through which the water flows in a sinuous course, a pipe located adjacent to the tank for conducting exhaust steam to the open air, branch pipes connecting the exhaust pipe to the tank, valves in the exhaust pipe and the branch pipes for directing the exhaust steam into the tank, the branch pipes being located in such a manner that the exhaust steam passes through the series of connected compartments in a sinuous course and in a direction opposite to that of the inflowing water, whereby the inclined shelves are thoroughly heated, a pipe connected to a water supply and a return pipe both leading into the connected compartments and arranged to discharge upon the heated inclined shelves whereby the water is thoroughly heated before it reaches the inlet chamber, an automatic valve in the supply pipe for regulating the admission of water to the tank and an outlet pipe leading from the outlet chamber.

9. A combined feed water heater and purifier comprising a tank, a vertical partition extending from the bottom of the tank and terminating below the normal water line, another vertical partition extending from a point sufficiently above the bottom of the tank to leave a passage for water between the lower end of the partition and the bottom of the tank and terminating above the normal water line, said partitions dividing the lower portions of the tank into three connecting compartments arranged side by side and forming inlet and outlet chambers and an intermediate connecting chamber, overflow pipes leading from the inlet and outlet chambers for removing oil and other floating impurities, a series of upper approximately horizontal heating compart-

ments in the upper portion of the tank above the lower compartments, said upper compartments being formed by inclined shelves extending alternately from opposite sides of the tank, an inlet pipe connected to a water supply and a return pipe both leading into the heating compartments, an automatic valve in the inlet pipe, a pipe leading into the tank above the normal water line and providing an inlet for the heating agent, a pipe leading from the tank above the inclined shelves and providing an exit for the heating agent, and an outlet pipe leading from the lower outlet chamber.

10. In a combined feed water heater and purifier, a tank having its lower portion divided by vertical partitions into three chambers arranged side by side, two of said chambers constituting inlet and outlet chambers and the other chamber an intermediate connecting chamber and being located between the inlet and outlet chambers and being in communication at its top with the inlet chamber and at its bottom with the outlet chamber, a series of horizontal heating compartments arranged in a vertical row in the upper portion of the tank above the lower chambers and having the lowest compartment arranged to direct the flow of liquid into the inlet chamber, an inlet pipe leading to the heating compartments and an outlet pipe leading from the outlet chamber.

WALTER J. McKNIGHT.

Witnesses:

L. M. SANGSTER,

FREDERICK P. DUCHSCHERER.