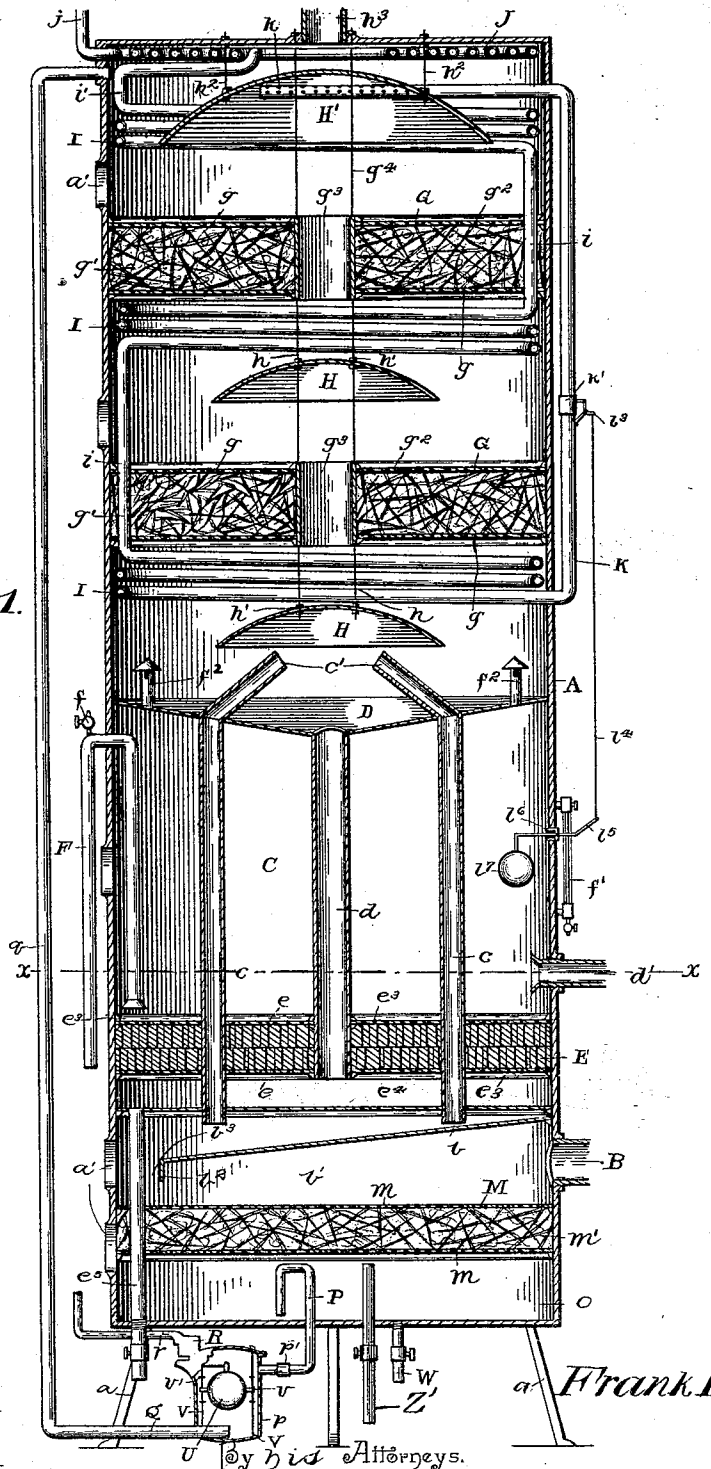
(No Model.) 2 Sheets—Sheet 1.

F. DIEHL.

FEED WATER HEATER AND PURIFIER.

No. 521,337. Patented June 12, 1894.

Fig. 1.



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(No Model.) 2 Sheets—Sheet 2

F. DIEHL.

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Fig. 2.

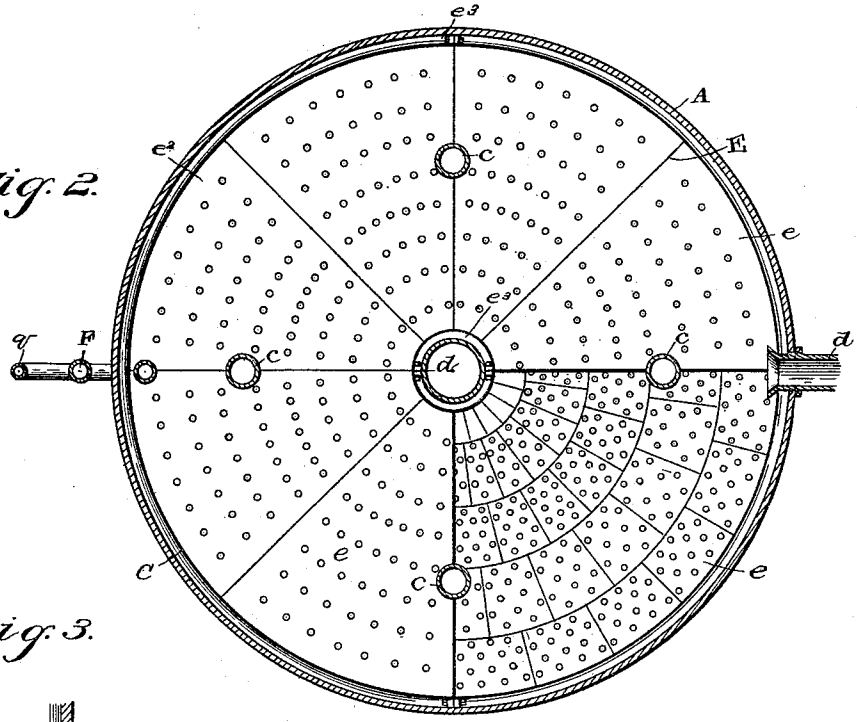


Fig. 3.

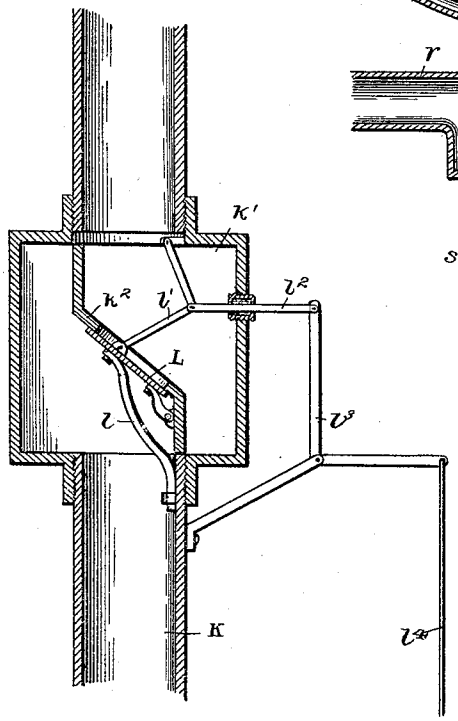
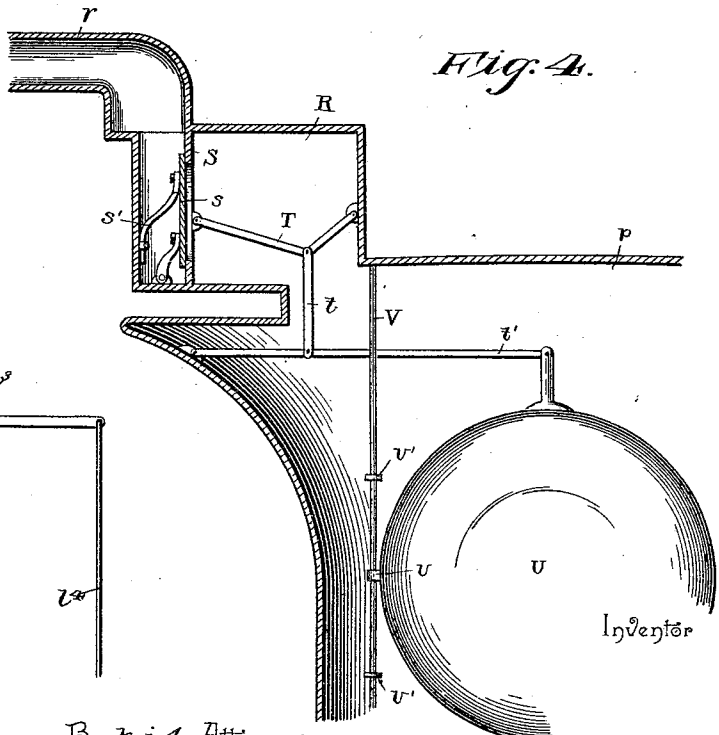


Fig. 4.



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FRANK DIEHL, OF SHEBOYGAN, WISCONSIN.

FEED-WATER HEATER AND PURIFIER.

SPECIFICATION forming part of Letters Patent No. 521,337, dated June 12, 1894.

Application filed September 4, 1893. Serial No. 484,764. (No model.)

To all whom it may concern:

Be it known that I, FRANK DIEHL, a citizen of the United States, residing at Sheboygan, in the county of Sheboygan and State of Wisconsin, have invented a new and useful Feed-Water Heater and Purifier, of which the following is a specification.

This invention relates to feed water heaters and purifiers; and it has for its object to provide certain improvements in devices of this character whereby the feed water to be pumped into a boiler will not only be thoroughly heated up to a considerable degree, but will at the same time be freed from all impurities therein.

To this end the main and primary object of the present invention is to effect certain improvements in feed water heaters and purifiers so as to insure an automatic operation thereof, while at the same time attaining with great efficiency the purposes for which devices of this character are used.

With these and other objects in view, which will readily appear as the nature of the invention is better understood, the same consists in the novel construction, combination, and arrangement of parts hereinafter more fully described, illustrated, and claimed.

Referring to the accompanying drawings:—Figure 1 is a central vertical sectional view of a combined feed water heater and purifier constructed in accordance with this invention. Fig. 2 is a horizontal sectional view on the line x—x of Fig. 1. Fig. 3 is an enlarged detail sectional view of the automatic feed valve located in the spray pipe. Fig. 4 is a similar view of the automatic trap valve.

Referring to the accompanying drawings, A represents a cylindrical shell or casing inclosed at the top and bottom and supported in a convenient location by suitable supporting legs a, and said cylindrical shell or casing is provided at suitable points in its sides with the manholes a', which provide convenient means for gaining ready access to the interior of the shell or casing for the purpose of repairing or removing any part of the apparatus. The cylindrical shell or casing of the apparatus is provided at one side and near the lower end thereof with the steam inlet B, to which is connected a suitable pipe for leading the exhaust steam from the engine, whereby such exhaust steam may be utilized for heating up the feed water, which is circulated throughout the interior of the apparatus. The heating steam entering through the steam inlet B, first comes in contact with the inclined deflecting plate or disk b, which is arranged in the lower steam box b', located at the bottom of the shell or casing. The said deflecting plate or disk b, is arranged at an inclination or an angle within the lower portion of the shell or casing, and extends from a point at one side of the shell or casing directly over the steam inlet to a point near the opposite side, and terminates near such opposite side in a depending lip b^2, which forms between the same and the side of the shell or casing a steam passage b^3. The steam striking the plate or disk b, is necessarily eliminated of oil and other impurities carried thereby and which drop into the bottom of the shell or casing as will be hereinafter described, while the separated steam passes through the passage b^3, and entering the space above the deflecting plate or disk b, comes in heating contact with the bottom of the inclosed water chamber or tank C, and ascends through a series of vertical steam pipes c. The vertical steam pipes c, extend entirely through the inclosed water chamber or tank C, from the bottom to the top thereof and are provided at their upper extremities above the said water chamber or tank with the convergent discharge ends c', which jet the steam escaping therefrom toward a common point as will be presently referred to.

The steam passing through the pipes c, necessarily heats up the water contained in the water chamber or tank after it has worked its way into such chamber or tank, and the latter is closed in at the top by the declining top or drip apron D, which inclines downwardly from the inner sides of the shell or casing to the central water pipe d. The central water pipe d, has its upper end joined with the depressed center of the top drip apron D, and extends therefrom to a point in close proximity to the bottom of the water chamber C, thereby providing means for conducting the feed water, which runs off of the apron D, into said water chamber, from which it is drawn off through the water outlet d', to the ordinary pump employed for pumping the feed water into the boiler. Arranged transversely

within the lower portion of the water chamber C, is the filter diaphragm E, comprising the upper and lower parallel strainer plates *e*, and two or more courses of perforated filter brick *e'*, clamped between said strainer plates. The strainer plates *e*, are preferably composed of a number of segmental sections e^2, surrounding the vertical water pipe *d*, and the vertical steam pipes *c*, while at the same time being capable of easy removal and replacement. The outer and inner edges of the parallel strainer plates *e*, are engaged by the clamp lugs e^3, attached to the inner side of the shell or casing, and also the vertical water pipe *d*, and the upper one of said clamp lugs, or more properly rings, is removably clamped onto the vertical water pipe *d*, so as to provide for conveniently removing or repairing the filter diaphragm.

The disposition of the filter diaphragm E, near to the closed bottom of the water chamber C, provides a bottom water space e^4, below such diaphragm and into which the feed water runs from the lower end of the vertical water pipe *d*, and such water, rising through the said filter diaphragm passes into the main portion of the water chamber or tank in a well filtered condition and properly purified, so as to be ready for introduction into the boiler, and this water space e^4, as well as the entire water chamber may be properly drained through the valved blow-off pipe e^5, connected at its upper end to the bottom of the water chamber and passing out through the bottom of the shell or casing A. An overflowing of the water chamber C, is prevented by means of an overflow siphon F, having its short leg arranged inside of the water chamber and depending to a point in very close proximity to the top of the filter diaphragm E, while the long leg thereof is arranged outside of the shell or casing to discharge or carry off an overflow, and said siphon is provided with an air or priming cock *f*, located outside of the shell or casing, and though this siphon is useful for the purpose noted, still the height of the water in the water chamber or tank C, is always indicated by the water gage *f'*, connected to one side of the shell or casing and communicating with the interior of the water chamber or tank. The said water chamber or tank is also provided with the capped vent pipes f^2, connected to and arising from the declining top apron thereof, and opening into the water chamber in order to provide for the admission of steam into the top portion of the water chamber above the water therein, whereby the water may be held steady, which would be otherwise if these vent pipes were not employed, because there is always more or less steam pressure existing in the vertical water pipes *d*.

In the space between the top apron of the water chamber and the top of the shell or casing, the heating exhaust steam and the feed water are brought into contact with each other so that certain portions of the exhaust steam will be condensed and utilized as feed water, while the water introduced into the apparatus will be heated up by the steam to some degree before it finds its way into the water chamber or tank C. This space accommodates therein the parallel filter baskets G. The parallel filter baskets G, are regularly spaced apart from each other and are arranged in any suitable number between the top of the water chamber or tank, and the top of the inclosing shell or casing, according to the size of the apparatus, and each of said filter baskets comprises perforated sectional strainer plates *g*, arranged parallel with each other and of a similar construction to the strainer plates *e*, previously referred to. Between the parallel strainer plates *g*, of each of the filter baskets G, is placed a suitable filtering medium *g'*, composed of sea grass or any other substance available for this use, and the outer and inner edges of the said sectional strainer plates *g*, of the filter baskets are engaged by the clamp lugs g^2, attached to the inner side of the shell or casing and also to the short central steam pipes g^3, arranged in a line one above the other and supported centrally in position within the shell or casing by suitable hanging wires g^4, connected to their upper and lower edges and to the top of the shell or casing. The upper one of the clamp lugs or rings removably clamped onto the short pipes g^3, can be easily adjusted so as to provide for conveniently removing or repairing the filter baskets.

Arranged a suitable distance below the lower ends of the short central steam pipes g^3, of each filter basket, are the curved or concaved baffle plates H, which serve to throw the steam and dripping water out toward the side of the shell or casing, and such baffle plates are suitably supported in position on the supporting wires *h*, suitably suspended from their upper ends and having lower threaded ends passing through openings in said plates and engaged on both sides of said plates by the clamp nuts *h'*, whereby the baffle plates may be properly supported and adjusted. It is to be observed that the lower one of the concaved baffle plates H, is disposed directly over the upper convergent ends *c'*, of the vertical steam pipes *c*, and serves to direct the steam issuing from such pipes out toward the inner sides of the shell or casing, while at the top of the shell or casing is located a larger concaved baffle plate H', which is adjustably supported by the hanging rods h^2, directly over the upper one of the filter baskets and directly under the top steam escape opening h^3, out of which the completely utilized exhaust steam finds escape.

The upper larger baffle plate H', serves to throw the steam which passes through the upper one of the central steam pipes d^3, out toward the inner sides of the shell or casing in close contact with the upper one of the

circular water coils I. The upper one of the circular water coils I is located in the space between the top one of the filter baskets and the top of the shell or casing, and similar coils are arranged directly below each filter basket between the same and the baffle plates H, and the several water coils forming the water supply for the apparatus are connected together by the coil connecting pipes *i*. The convolutions of the several circular water coils I, are disposed in close proximity to the sides of the shell or casing, and the upper one of said circular water coils I, is connected by a coil connecting pipe *i'*, with the top horizontal water coil J. The top horizontal water coil J, has the convolutions thereof disposed close to the top of the shell or casing and is supplied with water through the top water supply pipe *j*, leading from a suitable source of water supply.

The water which passes through the top horizontal water coil and the several circular water coils, is necessarily subjected to the heating action of the exhaust steam thrown against the coils by the baffle plates, while at the same time the cold coils condense some of the steam, which in its condensed condition works through the filter baskets and into the water chamber or tank C, in the manner already described. The circulating water passes out from the lower one of the circular water coils I, through the vertical spray pipe K, having at its upper end a perforated nozzle portion *k*, which leads into the top portion of the shell or casing and sprays the feed water throughout the entire top portion of said shell or casing, so that it will be heated by the exhaust steam and will also work its way through the filter baskets and the filter diaphragm E, into the water chamber or tank from which it is ultimately drawn out and forced into the boiler.

At a point intermediate of its ends the vertical spray pipe K, is provided with a valve casing *k'*, inside of which is arranged an inclined valve seat k^2. A pivoted valve L, works at one side of said valve seat, and is held normally closed onto the same by the spring *l*, loosely connected thereto and to one side of the pipe. The normally closed valve L, has connected with one side thereof the jointed toggle arms *l'*, to the joint of which is pivoted the inner end of the sliding rod l^2, working through one side of the valve casing and pivoted at its outer end to a suitably supported bell crank lever l^3. One end of the bell crank lever l^3, has pivoted to the free arm thereof the upper end of the operating wire or rod l^4, the lower end of which is connected to the float lever l^5, working through a suitably arranged stuffing box l^6, in one side of the shell or casing A, and connected at its inner end to a float l^7, which floats on top of the water in the water chamber or tank C. Now it will be apparent that as the water lowers in the water chamber or tank C, the float therein will also lower and communicate motion to the several valve connections just described, so that the operating wire or rod l^4, will be shoved up, and through the bell crank l^3, spread apart the arms *l'*, thereby throwing the valve L, off of its seat, and permitting a free flow of water from the water coils into the spray devices of the apparatus. As the water in the water chamber resumes its proper level the float l^7, rises, and the valve L, is thrown back against its seat, again turning off the supply of water.

Returning to the steam entering the shell or casing at the inlet B, it will be remembered that the deflecting plate *b*, serves to eliminate the oil and other greasy matter therefrom, and this oil drips from the deflecting plate *b*, onto the oil filter basket M. The oil filter basket M, is arranged transversely in the lower steam box *b'*, and comprises the parallel strainer plates *m*, suitably supported in position in the lower part of the shell or casing and holding in the space therebetween a filtering medium *m'*, of sea grass or other suitable material, so that the oil and condensed steam may be readily freed from impurities in passing therethrough and into the bottom oil chamber O. The oil, being the lighter of the two substances, of course floats on top of the condensed steam or the water which lies directly at the bottom of the shell or casing, and this condensed steam or water is automatically drawn out of the oil chamber O, through the trap siphon P, the short leg of which is disposed in very close proximity to the bottom of the inclosing shell or casing.

The long leg of the trap siphon P, is connected to the upper end of a water trap tank *p*, and is provided at a point near to such tank with a check valve *p'*, which prevents the steam employed to operate the trap from blowing back into the oil chamber. The said water trap is provided with a valved bottom discharge pipe Q, connected to a conducting pipe *q*, which leads up to the top of the shell or casing, and projects into the same so as to discharge the water from the water trap directly back into the apparatus, so that it may work its way into the water chamber or tank C, as already described. The said water trap tank *p*, is provided at the top and near one side thereof with an off-standing valve casing R, to which is connected the live steam pipe *r*, and which is provided inside thereof with a valve seat S. A pivoted valve *s*, is arranged to work at one side of said valve seat, and has loosely connected thereto at one side a spring *s'* which serves to normally hold the valve closed against the seat, and to the opposite side of said valve is connected one end of one of the jointed toggle arms T. To the joint of said toggle arms T, is connected the upper end of the connecting arm *t*, pivoted at its lower end to an intermediate point of the float arm *t'*. The float arm *t'*, is pivoted at one end to one side of the trap tank *p*, and at its other end to a float U, floating inside of said tank. The said float U, is provided at

opposite sides thereof with the perforated guide lugs *u*, which have a limited vertical play between the stops *u'*, on the vertical guide or slide rods V, arranged in opposite sides of the trap. When the water is low in the water trap, the float is in such a position that the automatic valve is closed against its seat to prevent the inflow of live steam, and at this time water runs freely from the oil chamber of the apparatus through the trap siphon P, and into the trap tank. When a sufficient quantity of water has accumulated in the trap, the float rises and opens the valve *s*, thereby allowing the live steam to enter the top of the trap. This closes the valve *p'*, and shuts off the trap siphon, while at the same time forcing the accumulated water out through the pipes Q and *q*, and up into the top of the shell or casing A. This automatic trap device is an important auxiliary to the feed water heater herein described and provides for a thorough utilization of the condensed water.

At any time the oil chamber O, may be drained through the valve drain pipe W, connected to the bottom of the shell or casing A, and the overflow escape of the oil from the chamber O, is provided for by the oil-overflow pipe Z' which projects through the bottom of the shell or casing and up into the same to a point directly under the filter basket M, so that such pipe will carry off the oil or grease which floats on the water after the water has risen sufficiently high.

From the foregoing it is thought that the construction, operation and the many advantages of the herein described feed water heater and purifier will be readily understood by those skilled in the art without further description, and I will have it understood that changes in the form, proportion and the minor details of construction may be resorted to without departing from the principle or sacrificing any of the advantages of this invention.

Having thus described the invention, what is claimed, and desired to be secured by Letters Patent, is—

1. In a feed water heater, the casing having an upper water inlet and a bottom steam inlet, an inclosed water holding chamber or tank located between said inlets and having a central inlet pipe opening into the space above the chamber, and a series of steam pipes passing vertically through said water chamber or tank concentric with the central inlet pipe and having upper projected discharge ends, substantially as set forth.

2. In a feed water heater, the shell or casing having a lower steam inlet, an inclosed water chamber or tank arranged inside of said shell or casing above the steam inlet, a series of spaced horizontal circular water coils arranged inside of the shell or casing above said water chamber, and a spray pipe connected in the circuit of said water coils and discharging into the top of the shell or casing above the uppermost of said circular coils, substantially as set forth.

3. In a feed water heater and purifier, the casing having a bottom steam inlet and an inclosed water chamber directly above the inlet, a series of separated and connected water coils arranged above the water chamber, a spray pipe connected in the circuit of said water coils, and filter baskets alternating with said water coils, substantially as set forth.

4. In a feed water heater and purifier, the casing, the inclosed water chamber open at its top a series of steam heating pipes passing upwardly through the water chamber and projecting there-above, an alternate series of circular water coils and immediately adjacent filter baskets located above said water chamber, and a spray pipe leading from the lower one of said water coils, substantially as set forth.

5. In a combined feed water heater and purifier, the casing having a bottom steam inlet, a water chamber arranged above the steam inlet and open at its top, water supply and filtering devices located above the water chamber, an oil chamber located at the bottom of the casing, and an automatically operating water trap feeding automatically from the bottom portion of said oil chamber and a conducting pipe leading from the discharge of said trap into the top of said casing, substantially as set forth.

6. In a feed water heater and purifier, the casing having a bottom steam inlet, an inclosed water chamber arranged above the said inlet and open at its top, a series of steam pipes passing vertically through the water chamber and having upper discharge ends projecting thereabove, an alternate series of water coils and immediately adjacent filter baskets located above the water chamber, a spray pipe connected with the lower one of said water coils and provided with an automatic float actuated feed valve, an oil chamber arranged below the steam inlet, and an automatic water trap feeding automatically from the bottom of the oil chamber and a conducting pipe connected with said water trap and discharging into the top of the casing, substantially as set forth.

7. In a feed water heater and purifier, the casing having a bottom steam inlet, an inclosed water chamber arranged above the steam inlet and provided with a declining top apron and a vertical water pipe leading from the center of said apron to a point near the bottom of the chamber, vertical steam pipes passing entirely through the water chamber and discharging above the same, a filter diaphragm arranged transversely within the water chamber near its bottom, an alternate series of water coils and filter baskets located above said water chamber, said filter baskets having short central steam pipes, and a feed spray pipe connected with one of said water coils and discharging into the top of said casing, substantially as set forth.

8. In a feed water heater and purifier, the casing having a bottom steam inlet, a closed water chamber arranged above the steam inlet and provided with a declining top apron, a vertical water pipe leading from the center of said apron to a point near the bottom of the chamber and a side outlet pipe, vertical steam pipes passing through the water chamber, an overflow siphon having its short leg depending inside of said water chamber, a transverse filter diaphragm surrounding the lower end of the vertical water pipe inside of the water chamber, and water supply and filter devices located above said water chamber, substantially as set forth.

9. In a feed water heater and purifier, the combination with the water supply and filtering devices, and the water collecting chamber having a vertical water supply tube or pipe; of a filter diaphragm surrounding the lower ends of said vertical water pipe within the water chamber and comprising suitably supported parallel sectional perforated strainer plates, and separate courses of perforated filter brick arranged between said strainer plates, substantially as set forth.

10. In a feed water heater and purifier, the casing having a bottom steam inlet, the inclosed water chamber located above said steam inlet and having top vent pipes and a vertical water supply pipe leading there-into, separate spaced filter baskets suitably supported within the casing above the water chamber and having short central steam pipes, said filter baskets comprising parallel strainer plates and filtering material there-between, the casing outlet at the top, suitably supported concaved baffle plates, arranged below said top outlet and below the central steam pipes of said filter baskets, a series of circular connected water coils alternating with said filter baskets, a horizontal top water coil connected with the water supply in the upper one of said circular coils, and the spray pipe connected to the lower one of said circular coils and discharging into the top of the casing over the upper filter basket, substantially as set forth.

11. In a feed water heater, the casing, the inclosed water chamber open at its top, an alternate series of water coils and filter baskets located above said water chamber, a spray pipe connected with one of said water coils and provided with a perforated nozzle portion leading into the top of the casing and an intermediate valve casing provided with an inclined seat, a normally spring-closed valve arranged at one side of said seat, suitably arranged lever devices for opening said valve, a float working inside of said water chamber, and suitable connections between said float and said lever devices, substantially as set forth.

12. In a feed water heater and purifier, the inclosed water chamber having a side outlet and a vertical water pipe, an inclined deflecting plate arranged within the casing below the water chamber and having a depending lip at one end, said plate being arranged above the steam inlet of the casing, vertical water pipes extending through the water chamber and having upper convergent ends, spray and filter devices located above and discharging into the water chamber, and suitably arranged baffle plates, the lower one of which is disposed directly above the upper convergent ends of said vertical steam pipes, substantially as set forth.

13. In a combined feed water heater and purifier, the casing having a bottom steam inlet, the water heating, filtering and collecting devices arranged above said inlet, a transverse filter located below the steam inlet and forming there-below an oil chamber, a suitably arranged water tank having an upper siphon inlet pipe having the short leg thereof disposed near to the bottom of the oil chamber, and a bottom discharge pipe leading up into the top of said casing, said water tank being further provided with an off-standing valve casing connected with a live steam supply pipe and having an interior valve seat, a normally spring closed valve working at one side of said valve seat, a float guided for vertical movement inside of said water tank, and suitable lever connections between said float and said valve substantially as set forth.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

FRANK DIEHL.

Witnesses:
W. D. VAN ALLEN,
A. J. MALLMANN.