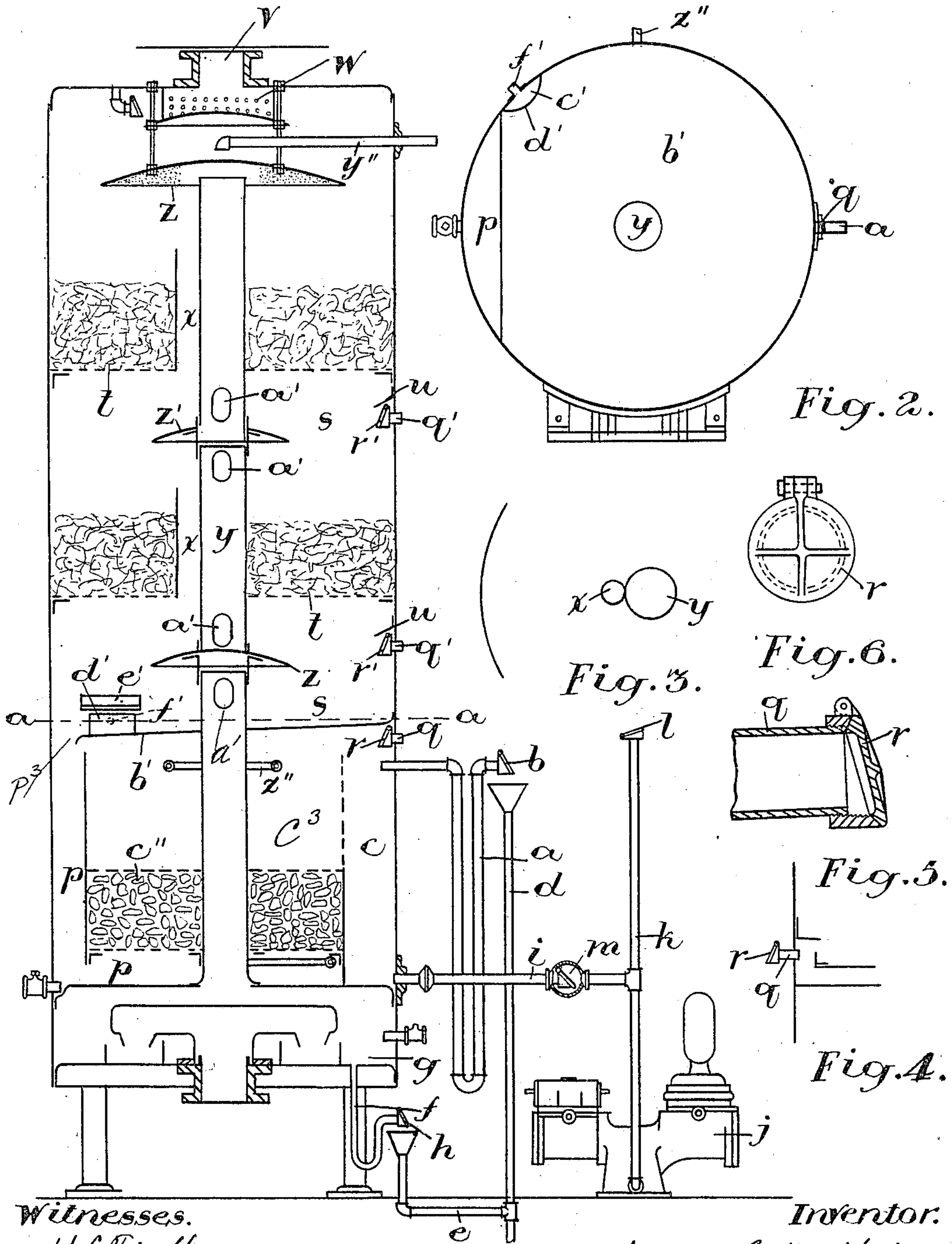


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H. E. MOFFAT.
FEED WATER HEATER AND PURIFIER.
APPLICATION FILED OCT. 30, 1905.



Witnesses.
H. L. Trimble.
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Fig. 1.

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UNITED STATES PATENT OFFICE.

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FEED-WATER HEATER AND PURIFIER.

No. 831,886.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, HENRY ESSON MOFFAT, of Woodstock, in the county of Oxford and Province of Ontario, Canada, have invented certain new and useful Improvements in Feed-Water Heaters and Purifiers; and I hereby declare that the following is a full, clear, and exact description of the same.

All open types of feed-water heaters and purifiers—that is, those classes of feed-water heaters and purifiers in which the feed-water and steam mingle as they pass to their respective outlet-ports—are subject to internal variations of pressure and at intervals and under certain physical conditions complete or practically complete vacuums are created within them. The atmosphere which is always in touch with the overflow, vent, vapor, and oil-drip pipes can then rush into the feed-water heaters and purifiers and disturb the internal condition and arrangement of the parts and not only prevent them properly performing their functions, but in some cases cause the feed-water to pass directly into the engines or the other apparatuses connected therewith, the presence of which therein is destructive to property and dangerous to the safety of the operators. These vacuums when created are not confined to the feed-water heaters and purifiers, but extend to the apparatuses connected therewith and cause the same trouble therein.

One of the objects of the present invention is to prevent the occurrence of these accidents by the application of check or other quick-acting valves placed at the danger-points to automatically operate as a result of the unnatural actions occurring within the feed-water heaters and purifiers or their attachments. While any style of valves may be used, it is preferable to employ those of simple construction, such as gravity check-valves, and attach them to the overflow, vent, and oil-drip pipes to open outward and prevent the atmospheric pressure disturbing the contents of the pure-water and settling chambers, suction-pipes, and oil-extractors, respectively, without retarding the free outflow of the contents thereof and to provide the feed-water heaters and purifiers with relief-pipes to establish a communication between the atmosphere and those parts of the feed-water heaters and purifiers where vacuums are liable to occur and to attach to these pipes inwardly-opening check-valves to automatically admit atmospheric pressure to the interior of

the feed-water heaters and purifiers during the formation of the vacuums therein or when the pressure therein is falling below atmospheric pressure to maintain a constant pressure within the feed-water heaters and purifiers equal to atmospheric pressure, and thus prevent the displacement or disorganization of the filters or the equivalent purifying means, which would result from the formation of vacuums.

A further feature of the invention is to protect the exhaust-outlets with perforated guards or shields having openings of sufficient area to permit the uncondensed steam to freely pass therethrough, but not of sufficient dimensions to permit the contents of the filters, displaced by natural or unnatural causes, passing into the apparatuses connected with the exhaust-outlets of the feed-water heaters and purifiers.

As the filters of the feed-water heaters and purifiers become choked with impurities the feed-water gradually rises above them until it attains the level of the steam-outlet ports through which the steam circulates from the exhaust-steam pipes. The water then passes into the exhaust-steam pipes and descends below the choked filter or filters, depositing during its passage mineral and metallic impurities in the bores of the exhaust-steam pipes, which in the course of time become choked thereby. When the bores of the exhaust-steam pipes become choked, the circulation of the steam is retarded, and back pressure is put upon the engines and direct pressure upon the bottoms of the filters, which disorganizes the internal arrangement of the feed-water heaters and purifiers and the action of the engines. To prevent these possibilities, each filter is provided with an independent internal by-pass extending through its filter mass from a point above the same, but below the adjacent steam-outlet port of the exhaust-steam pipe, so that when the feed-water above the filter rises to the level of the top of the by-pass it will descend through it instead of through the exhaust-steam pipe. By the use of these by-passes it is possible for the feed-water heaters and purifiers to run much longer without the necessity of cleaning the filters than without them, and it is also possible to run the apparatus in an emergency for weeks after the filters have become a solid mass without danger of the feed-water passing into the exhaust-steam pipes.

Large pieces of precipitated matter from

various causes become loosened from the deflecting-plates and slide into and fill the passages leading into the primary settling-chambers and retard the progress of the water to the suction-pipes, causing it or a portion of it to back up and pass into the exhaust-steam pipes through the steam-outlet ports thereof and create internal disturbances detrimental to the operation of the feed-water heaters and purifiers and to the apparatuses connected therewith. To prevent the occurrence of such disturbances, auxiliary inlets are formed through the deflecting-plates into the final-settling chambers at the farthest points from the suction-pipes to give the precipitates in the feed-water an opportunity to deposit or settle before reaching the suction-pipes, and these auxiliary inlets are protected by vertical partitions extending above the deflecting-plates, but below the steam-outlet ports of the exhaust-steam pipes. While the usual channels for the flow of the feed-water from the deflecting-plates to the pure-water chambers are unobstructed, the auxiliary inlets perform no functions, but should these channels become obstructed the feed-water will rise to the tops of and flow over the partitions and through the inlet-ports into the final-settling and pure-water chambers. To prevent the feed-water passing directly through the auxiliary inlets as it descends toward the deflecting-plates the auxiliary inlets are covered by hoods located above the tops of the partitions and at a sufficient height therefrom to leave unobstructed passages for the feed-water to pass through the inlet-ports.

For a full understanding of the invention reference is to be had to the following description and to the accompanying drawings, in which—

Figure 1 is a vertical section of a feed-water heater and purifier. Fig. 2 is a transverse section on the lines *a a*, Fig. 1, showing the position of the auxiliary inlet for the pure-water chamber. Fig. 3 is a similar view to Fig. 2, showing one of the internal by-passes for the filters. Fig. 4 is a vertical section of a portion of the apparatus, taken at right angles to Fig. 1 to show the auxiliary overflow. Fig. 5 is an enlarged section of a check-valve and a portion of one of the relief-pipes. Fig. 6 is an end elevation of the check-valve shown in Fig. 5.

Like characters of reference refer to like parts throughout the specification and drawings.

The outer end of the overflow-pipe *a* is fitted with an outwardly-opening check-valve *b* to permit of the free discharge of water from the pure-water chamber *c* when the water therein has risen to the level of the overflow-pipe and to prevent the inlet through the overflow-pipe of atmospheric pressure to the pure-water chambers. The outlet of the overflow-pipe may be arranged to discharge

into a drain-pipe *d*, which has a branch *e*, leading to the drip-pipe *f* of the oil-extractor *g*. The outer end of the drip-pipe *f* is fitted with an outwardly-opening check-valve *h*, similar to the check-valve *b*, to allow of the discharge of the drainage through the drip-pipe *f* into the branch *e* of the drain-pipe *d* and to prevent the atmospheric pressure entering the oil-extractor therethrough. Leading from the lower end of the pure-water chamber *c* is a suction-pipe *i*, connected with the pump *j*, and fitted to the suction-pipe *i* is a vapor-pipe *k*, having an outwardly-opening check-valve *l* to relieve the pressure within the vapor and suction pipes during the operation of the suction-pump. To prevent the water returning into the pure-water chamber, the suction-pipe is fitted with a check-valve *m* between the pure-water chamber and the pump, and this valve is so arranged as to allow the water to flow from the pure-water chamber to the pump and prevent it flowing from the pump to the pure-water chamber. The purpose of this arrangement of pipes and check-valves is to prevent the possibility of an excessive atmospheric or back pressure disturbing the water within the pure-water chamber.

To maintain a constant pressure within the pure-water chamber and the intervals between the filters above it equal to atmospheric pressure, the pure-water chamber is provided with a relief-pipe *q*, located above the line of the overflow, and this relief-pipe is fitted with an inwardly-opening check-valve *r*, and each interval *s* between the filters *t* above the pure-water chamber is provided with similar pipes *q'*, fitted with inwardly-opening check-valves *r'*. The check-valves *r'* are protected by water-sheds *u*, which direct the feed-water away from the check-valves as it descends through the apparatus to prevent the metallic and mineral precipitates contained therein depositing or settling upon the check-valves and interfering with the proper and instantaneous performance of their functions. Protecting the inner end of the exhaust-outlet *v* is a perforated shield or grating *w*, the perforations of which are of sufficient area to provide for the free circulation of the uncondensed steam passing from the apparatus and of sufficient fineness to prevent the filter mass or any portion of it displaced by disturbances within the feed-water heater and purifier passing through the exhaust-outlet to the heating or other devices connected therewith.

Extending through the filters *t* are internal by-passes *x*, preferably located adjacent to the exhaust-steam pipe *y*, so that their upper ends will be protected by the disks *z* and *z'*, which deflect the circulation of the steam as it passes from the steam-exhaust pipe *y* into and through the feed-water heater and purifier. The internal by-passes *x* project above

the filters t preferably to a point slightly below the steam-outlet ports a' , so that in the event of the filter mass of any of the filters t becoming choked with impurities the water will find a channel from above the choked filter to the filter below it without having to pass through the exhaust-steam pipe y . The internal by-passes x are preferably removable, so that they can be removed, cleaned, and replaced without requiring the displacement of any of the internal parts of the apparatus other than themselves. By this means the liability of the exhaust-steam pipe y becoming choked by metallic and mineral precipitates depositing within its bore and the danger to the apparatus and surroundings arising therefrom is entirely obviated, and the upper grating formerly employed to retain the filter mass in place can be conveniently dispensed with.

Formed through the deflecting-plate b' into the final settling-chamber c^3 is an auxiliary inlet c' , protected by a guard d' , which prevents the water under normal conditions passing through the auxiliary inlet c' into the pure-water chamber, and covering the top of the guard d' is a hood e' , so arranged as to leave an opening of sufficient area to allow the feed-water to flow freely through the port c' into the final settling-chamber c^3 under the conditions hereinafter described.

It has been stated in the outline of the present invention that the scale and precipitated matter become loosened on the deflecting-plate b' by contraction, expansion, and other causes, and when loosened their tendency is to slide into the passage p^3 and primary settling-chamber p and obstruct the free circulation of the water through the final filter c'' to the final settling-chamber c^3 and pure-water chamber c . To supply the pure-water chamber under these conditions with feed-water, the auxiliary inlet c' is formed in the deflecting-plate b' , and to prevent the water under normal conditions entering the pure-water chamber through said inlet c' the latter is fitted with the guard d' , which extends to a level slightly below the first steam-outlet port a' above the deflecting-plate, so that when the passage of the feed-water from the settling-chamber to the pure-water chamber is choked the feed-water will rise to the top of the guard d' and flow through the inlet c' to the final settling-chamber c^3 and pure-water chamber and from there through the suction-pipe to the pump or through the overflow-pipe to the drain, as the case may be. By forming the inlet c' through the deflecting-plate the feed-water is prevented from rising to the level of the steam-outlet port a' and passing into the first section of the exhaust-steam pipe y , which is connected through the oil-extractor with the steam-exhaust of the engine. The inlet-port c' , in addition to providing for the circulation of the

water to the pure-water chamber, also forms a means for equalizing and relieving the atmospheric and steam pressure within the pure-water chamber, so that the pressure therein may be the same as that in the other parts of the apparatus, which is substantially normal atmospheric pressure. This construction effectively prevents accidents and disturbances arising within the apparatus as a result of unequal pressure upon the parts. Extending from within the guard d' is an emergency overflow-pipe f' , leading to the main overflow-pipe a , drain-pipe, or other drain-outlet to carry off the water from the pure-water chamber when it rises above the level of the deflecting-plate.

Should the auxiliary inlet and the usual water channels through the final settling-chamber to the pure-water chamber become obstructed, water may be delivered into the pure-water chamber from a supplemental inlet-pipe z'' , connected with the usual sand-pipe leading to the main inlet-pipe y'' . When the auxiliary inlet and the usual channels from the settling-chamber to the pure-water chamber are unobstructed, the usual course for the feed-water is from the main inlet y'' through the filters t to the deflecting-plate b' and through the primary settling-chamber p and final filter c'' to the final settling-chamber c^3 and pure-water chamber c . When the water-channels from the deflecting-plate through the primary settling-chamber p and final filter c'' to the final settling-chamber c^3 and pure-water chamber c are obstructed, the water rises above the deflecting-plate until it attains the level of the top of the partition d' , over which it flows through the inlet-port c' , and then through or across the final settling-chamber c^3 into the pure-water chamber c . Should the inlet-port c' , in addition to the settling-chamber p , become obstructed, the feed-water can be admitted through the supplemental inlet-pipe z'' to enable the apparatus to continue the function of supplying water to the pump until it is convenient to remove the cause of the trouble.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. A feed-water heater and purifier, comprising a pure-water chamber, an outlet-pipe and an automatically-operating check-valve to allow of the egress of the contents of the pure-water chamber and prevent the ingress of atmospheric air thereto.

2. A feed-water heater and purifier comprising a pure-water chamber, a suction-pipe, a vent-pipe for the suction-pipe and an automatically-operating check-valve to allow of the egress of the contents of the vent-pipe and prevent the ingress of atmospheric air thereto.

3. A feed-water heater and purifier comprising a pure-water chamber, a suction-

pipe, a vent-pipe for the suction-pipe, an automatically-operating check-valve to allow of the egress of the contents of the vent-pipe and prevent the ingress of atmospheric air thereto, a pump connected with the suction-pipe and an automatically-operating check-valve interposed in the suction-pipe between the pump and pure-water chamber.

4. A feed-water heater and purifier comprising a pure-water chamber, an overflow-pipe having its inner end above the high-water level, and an automatically-operating check-valve fitted to the outer end of the overflow-pipe opening outward to permit of the egress of the contents of the overflow-pipe and prevent the ingress of the atmospheric air.

5. A feed-water heater and purifier comprising a pure-water chamber, suction and overflow pipes therefor, an oil-extractor, an oil drip-pipe for the oil-extractor and automatically-operating check-valves opening outward to permit of the egress of the contents of the suction, overflow and oil drip pipes and to prevent the ingress therethrough of atmospheric air to the pure-water chamber.

6. A feed-water heater and purifier comprising a deflecting-plate, a pure-water chamber below the deflecting-plate, a final settling-chamber at the side of the pure-water chamber, and an auxiliary inlet through the deflecting plate into the final settling-chamber.

7. A feed-water heater and purifier comprising a deflecting-plate, a pure-water chamber below the deflecting-plate, a settling-chamber, an auxiliary inlet through the deflecting-plate to the settling-chamber, a vertical partition for the auxiliary inlet extending above the deflecting-plate, and an exhaust-steam pipe having a steam-outlet port above the top of the partition.

8. A feed-water heater and purifier comprising a deflecting-plate, a pure-water chamber below the deflecting-plate, a settling-chamber, an auxiliary inlet through the deflecting-plate to the settling-chamber, a vertical partition for the auxiliary inlet extending above the deflecting-plate, an exhaust-steam pipe having a steam-outlet port above the top of the partition and a hood covering the top of the partition and separated therefrom to provide an opening for the unobstructed flow of the feed-water over the top of the partition into the auxiliary inlet.

9. A feed-water heater and purifier comprising a pure-water chamber, a relief-pipe therefor communicating with the atmosphere and an automatically-operating check-valve to prevent the egress of the contents of the pure-water chamber through the relief-pipe and to allow of the ingress of atmospheric air thereto when the pressure in the

pure-water chamber has fallen below atmospheric pressure.

10. A feed-water heater and purifier comprising a pure-water chamber, purifying means above the pure-water chamber, relief-pipes above the pure-water chamber and automatically-operating check-valves for the relief-pipes to prevent the egress of the contents of the apparatus and permit of the ingress of atmospheric air thereto when the pressure therein has fallen below atmospheric pressure.

11. A feed-water heater and purifier comprising a pure-water chamber, purifying means above the pure-water-chamber relief-pipes above the pure-water chamber, automatically-operating check-valves for the relief-pipes to prevent the egress of the contents of the apparatus and permit of the ingress of atmospheric air thereto when the pressure therein has fallen below atmospheric pressure, and water-sheds protecting the check-valves to prevent the precipitates from the feed-water depositing thereon.

12. A feed-water heater and purifier comprising a steam-exhaust outlet, a relief-pipe adjacent thereto, an automatically-operating check-valve therefor to prevent the egress of the contents of the feed-water heater and purifier to permit of the ingress of atmospheric air thereto when the pressure therein has fallen below atmospheric pressure.

13. A feed-water heater and purifier comprising a water-chamber, a steam-inlet port at one end, and a steam-outlet port at the other end, thereof, a suspended filter interposed between the steam inlet and outlet ports, and a perforated shield covering the steam-outlet port to permit of the free circulation of the steam therethrough, and arrest the passage of the disturbed parts of the filter through the steam-outlet port.

14. A feed-water heater and purifier comprising a steam-exhaust pipe, having steam-outlet ports, purifying means located below the steam-outlet ports, and internal by-passes extending through and above the purifying means but below the steam-outlet ports.

15. A feed-water heater and purifier comprising a pure-water chamber, a main feed-water inlet-pipe, water-channels to supply the pure-water chamber from the main feed-water inlet-pipe and a supplemental feed-water inlet-pipe to supply the pure-water chamber in the event of the water-channels becoming obstructed.

Woodstock, October 21, 1905.

HENRY ESSON MOFFAT.

In presence of—

ALBERTA M. YOUNG,
J. G. WALLACE.