N. A. T. JONES.

Feed Water-Heater and Purifier.

No. 196,808. **Patented Nov. 6, 1877.**

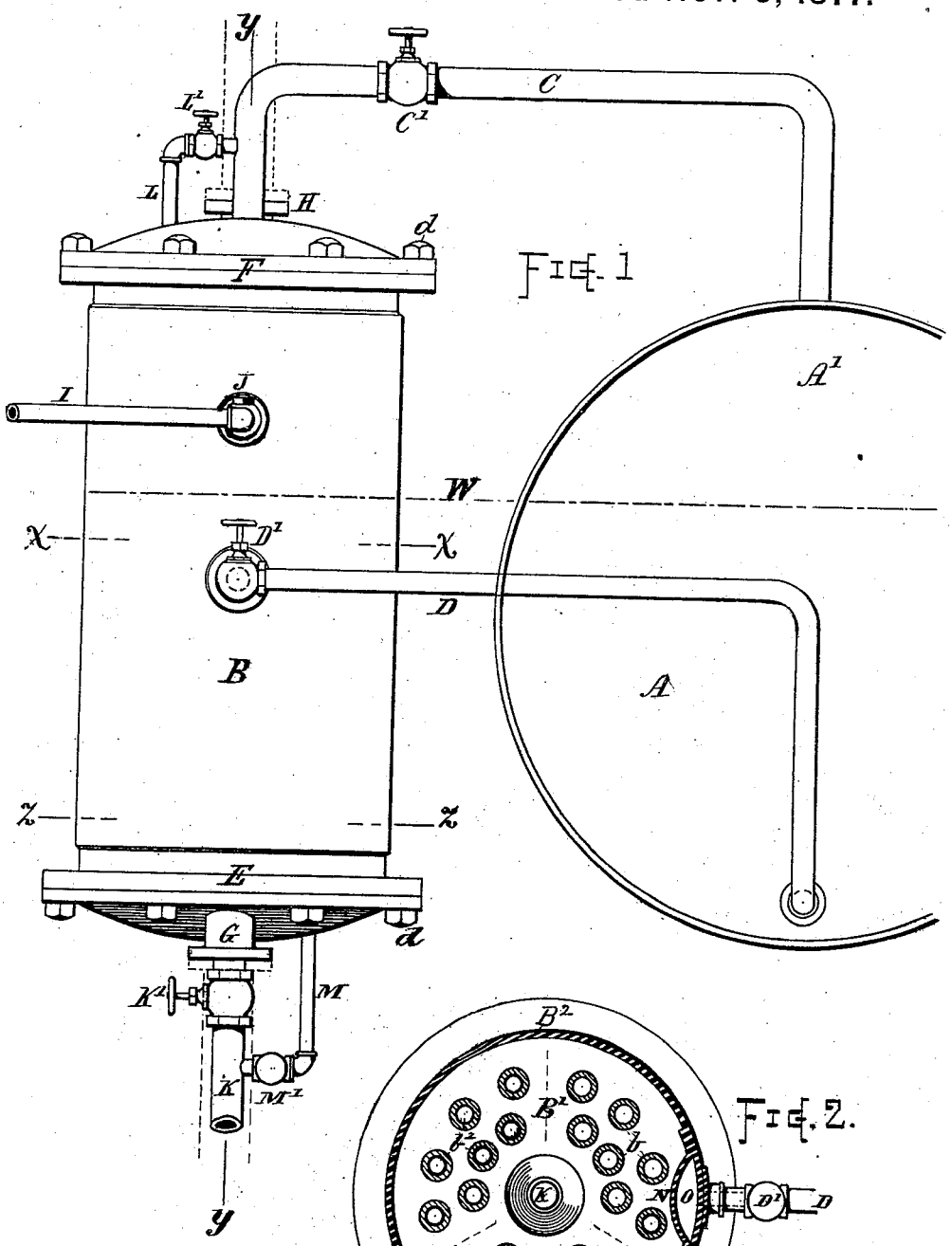

Fig. 1

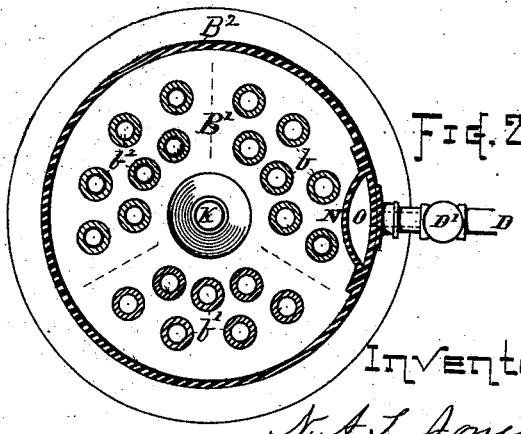

Fig. 2.

Witnesses.

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2 Sheets—Sheet 2.

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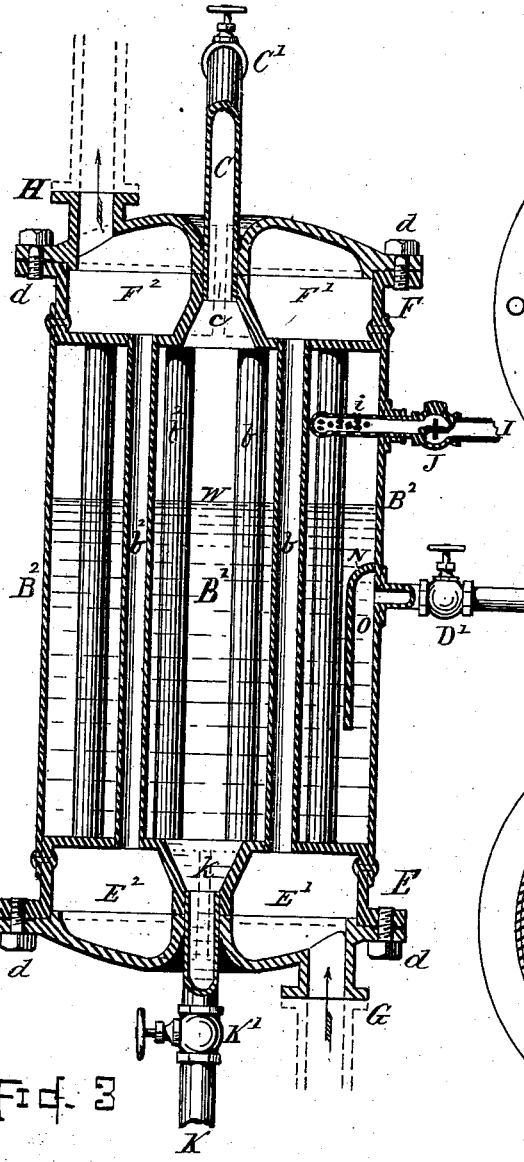

Fig. 3

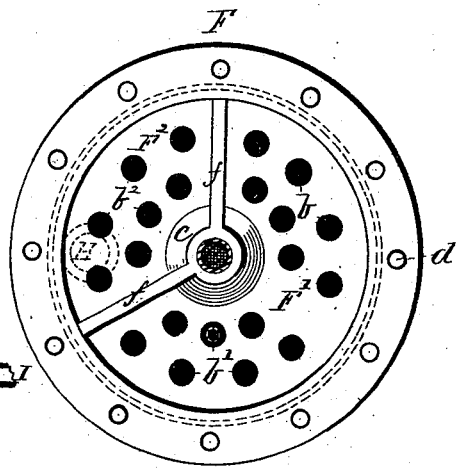

Fig. 4

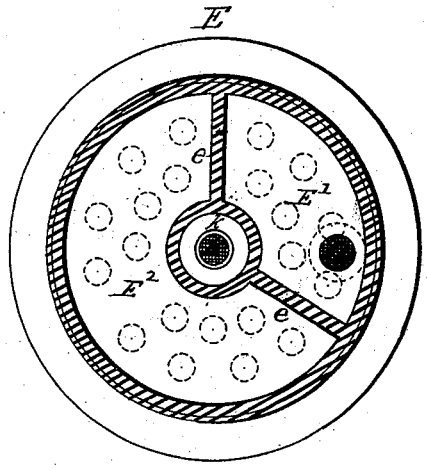

Fig. 5

Witnesses.

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UNITED STATES PATENT OFFICE.

N. A. T. JONES, OF PLYMOUTH, ASSIGNOR OF THREE-FOURTHS OF HIS RIGHT TO WILLIAM ALLEN, WILLIAM P. ALLEN, AND GEORGE L. ALLEN, OF WORCESTER, MASSACHUSETTS.

IMPROVEMENT IN FEED-WATER HEATERS AND PURIFIERS.

Specification forming part of Letters Patent No. **196,808**, dated November 6, 1877; application filed August 3, 1877.

To all whom it may concern:

Be it known that I, N. A. T. JONES, of Plymouth, in the county of Plymouth and State of Massachusetts, have invented certain new and useful Improvements in Feed-Water Heaters and Purifiers for Steam-Generators; and I hereby declare that the following is a description of my said invention sufficiently full, clear, and exact to enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, which form a part of this specification, and in which—

Figure 1 represents a front view of my improved heater and such portions of a boiler as are necessary to illustrate the nature of my invention. Fig. 2 is a horizontal section at line *x x*, Fig. 1. Fig. 3 is a vertical section at line *y y*, Fig. 1. Fig. 4 is a plan view with top plate removed; and Fig. 5 is a horizontal section at line *z z*, Fig. 1.

The nature of my invention consists in a feed-water heating and purifying apparatus so constructed and combined with the generator or boiler as to be capable of operation either by the use of exhaust steam, direct steam, or both exhaust and direct steam together, as hereinafter described.

Another feature of my invention consists in the construction and arrangement of the feed-water heating and purifying apparatus, and the combination thereof with the boiler or generator in such manner that the interior of the heating and purifying reservoir can be "blown off dry," or by direct live steam, without blowing off the water in the boiler, thus permitting the thorough and complete removal of mud, scum, or deposited matter from said reservoir at any time without interfering with the working of the generator.

Other features of my invention, consisting in the peculiar construction and combination of the various parts of the apparatus, are fully explained in the following description, the subject-matter claimed being hereinafter definitely specified.

In the drawing, A denotes the boiler or steam-generator, which may be of any ordinary form; and B indicates the feed-water heater and purifier, which I connect directly with the boiler or generator A by the connecting passages or pipes C and D, one of which, C, communicates with the steam-chamber A^1 of the generator, and with the upper interior of the water-space B^1, or heater-reservoir, serving to admit live steam direct from the boiler to the interior of said reservoir B^1, while the other pipe, D, extends from the central portion of the heater-reservoir B^1 to the lower part of the generator A, and serves to pass the heated and purified water from the heater-reservoir to the steam-generating boiler. The steam, freely entering through pipe C, equalizes the pressure in the boiler and heater, thus causing the water to flow quietly to the boiler without the aid of a pump or other forcing device, while the water-level W within the heater and boiler is maintained uniform, and the action of the steam on the surface of the water tends to hasten the throwing down or precipitation of the impurities or refuse matter held in suspension by the water.

The heater B is made with two chambered heads, E F, formed in the present instance of cast metal, and of similar shape, which heads are connected with each other by an outer shell, B^2, of sheet metal, and by upright straight tubes b b^1 b^2 extending from one head, E, to the other, F. The tubes are arranged in three groups, b, b^1, and b^2, and the heads E F are each made with partitions *e e f f*, dividing their space into separate chambers E^1 E^2 and F^1 F^2, respectively.

The chambers and tubes form passages for exhaust steam, which is passed through the heater without coming in contact with the feed-water, said exhaust steam being entered through the butt or nozzle G in the cap-plate of the lower head E, and discharged through the butt H in the cap-plate of the upper head F, suitable pipes being connected to the butts G and H for the conveyance of the exhaust steam to and from the heater. The chambers E^2 and F^1 are made about twice the size of the chambers E^1 and F^2, and the groups of tubes are so arranged that the steam passing from the entrance G to the exit H traverses three times through the reservoir B^1, where the wa-

ter is in contact with the external surface of the tubes. The tubes are straight, and have their ends firmly riveted in openings formed through the disks of the cast heads E and F, while the shell B^2 is secured around the peripheries of the heads by rivets or otherwise, the water-reservoir B^1 comprising the space between the tubes and shell. The cap-plates of the heads are secured by bolts *d d* through their rims, as illustrated, the joints at the rims and along the partitions *e f* being made steam-tight by packing or other suitable means.

The direct-steam pipe C extends through the center of the cap-plate and into the central hollow hub or boss *c* of the head F, the parts being fitted together and held by screw-threads, thus forming very firm steam-tight joints.

A blow-off or waste pipe, K, is connected in similar manner to hollow hub *k* of the lower head E, through which pipe the water or refuse can be discharged from the reservoir B^1.

Stop-cocks or valves C^1, D^1, and K^1 are arranged in the respective pipes C, D, and K for opening or closing their passages, as desired. A small passage or pipe, L, having a stop or valve, L^1, is combined with the pipe C and head F, whereby live steam can at pleasure be let into the chamber F^1 and tubes *b* b^1 for increasing the heat, or for any other purpose.

A pipe, M, having valve M^1, is combined with chamber E^2 and pipe K, as shown, by means of which the water condensed from the exhaust steam can be drawn from the chambers and tubes.

Fresh water is supplied to the reservoir B^1 through the pipe I, entering near the upper heads, preferably through a spray-nozzle, *i*. The water may be forced in by a pump, injector, or any suitable means. A check-valve, J, is provided to prevent backward flow through pipe I. A partition, N, is arranged within the reservoir B^1, in front of the opening into pipe D, as indicated in Figs. 2 and 3. Said partition is joined to the shell B^2 at its sides and top, so as to form a chamber, O, to which the water passes from below, and at some distance up from the bottom of the reservoir, so that only clear water will be delivered to the pipe D.

The operation of my improved heater and purifier is as follows: The exhaust steam first enters the chamber E^1 from the pipe G; then passes upward through the group of tubes *b* to the chamber F^1; thence downward through the group of tubes b^1 to the chamber E^2; and then upward through the group of tubes b^2 to the chambers F^2, from which such portion as has not become condensed can escape through the pipe H.

It will thus be seen that the exhaust steam has passed three times through the reservoir-length, and has been brought in contact with a large area of heating-surface in the tubes and chambers, thereby transferring the greater portion of its heat to the water contained in the reservoir B^1. In ordinary action the valves C^1 D^1 are open, and valves K^1, L^1, and M^1 closed.

The water enters through the spray-nozzle *i* from the pipe I, becomes heated and purified by contact with the tubes *b* b^1 b^2, and by the settling of the mineral and earthy matter and rising of the scum to the surface, so that it flows clear and pure from the chamber O through the pipe D to the boiler A, the flow being self-regulating, owing to the steam-pressure on its surface. No pump or other forcing device being necessary for the heated water, there is no cause for agitation within the reservoir, so that the impurities quickly deposit and remain settled until blown off through the pipe K.

The mud and scum can be cleared from the reservoir by blowing off dry or by live steam direct from the boiler. For this purpose the valve D^1 is closed and the valve K^1 is opened. The steam through the pipe C forces out the entire contents of the reservoir through the pipe K. The heater may also, if desired, be blown off wet, or with the boiler by closing the valve C^1 and opening valves D^1 and K^1; or, again, the heater can be washed out cold by closing the valves C^1 D^1, and letting the water run in by way of pipe I and out at pipe K.

The operation of blowing off dry or by the action of live steam can be performed at any time when desired with the generator or boiler in operation, and without interfering with continuous generation of steam.

To draw off the condensation water from the chambers and tubes it is simply necessary to open the valve M^1, which permits such water to run into the waste-pipe K.

If it is desired to operate the heater by exhaust steam only, the valve C^1 is closed. The heater may be operated by live steam only by closing the exhaust-passages G H, (valves not herein shown,) and permitting the steam to enter the chambers and tubes by way of the pipe or passage L. This latter feature is of considerable importance when using the heater with low-pressure engines, or with steam-generators for heating buildings and similar purposes.

A greater or less number of tubes may be used in the several groups, according to the size of heater to be made, it being desirable to have as many as convenient. The heads being reversible and the tubes straight, the heaters can be manufactured with facility, while all parts are readily accessible in case of needing repairs.

Having described my improvements in feed-water heaters and purifiers, what I claim therein as new and of my invention, and desire to secure by Letters Patent, is—

1. The combination, in a feed-water heating and purifying apparatus, of a water space or reservoir having direct communication with the steam-chamber of the generator, an exhaust-steam space or series of passages separated from the water-space, and a connecting passage and valve, whereby communication

can be opened or closed between the steam-supply of the water-reservoir and the exhaust-steam space, substantially as and for the purpose hereinbefore set forth.

2. A feed-water heater and purifier having a water space or reservoir separate from the exhaust-steam passages, and provided with a live-steam inlet and a blow-off pipe, whereby the contents of said reservoir can be discharged or blown off dry by the action of live steam direct from the boiler, and without interfering with the continuous generation of steam, substantially as hereinbefore set forth.

3. In combination, substantially as set forth, the boiler A, heating and purifying tank B, live-steam connection-pipe C, feed-water connection-pipe D, valves C^1 D^1, and exhaust-steam connections G H, for the purposes described.

4. In a feed-water heating apparatus, in combination substantially as hereinbefore set forth, the exhaust-steam spaces E^1 E^2 F^1 F^2 and passages b b^1 b^2, the water-heating space or reservoir B^1 surrounding said passages, the direct steam-supply pipe C, the blow-off pipe K, the water-pipes I D, and the valves C^1 D^1 K^1, for the purposes described.

5. The peculiar-constructed duplicate heads E F, having central-chambered screw-threaded hubs or bosses c k, radial partitions e f, and pipe butts G H, in combination with the sheet-metal shell B^2, connecting-tubes b b^1 b^2 in triangular uniform groups, and pipes C K screwed into the caps and bosses c k, substantially as herein shown and described.

6. In combination with the head F and steam-pipe C, the pipe L and valve L^1, as and for the purpose set forth.

Worcester, Massachusetts, July 31, 1877.

N. A. T. JONES.

Witnesses:
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A. E. STRICKLER.