(No Model.)

2 Sheets—Sheet 1.

S. G. CABELL.

GALVANIC FEED WATER PURIFIER.

No. 552,414. Patented Dec. 31, 1895.

Fig. 1.

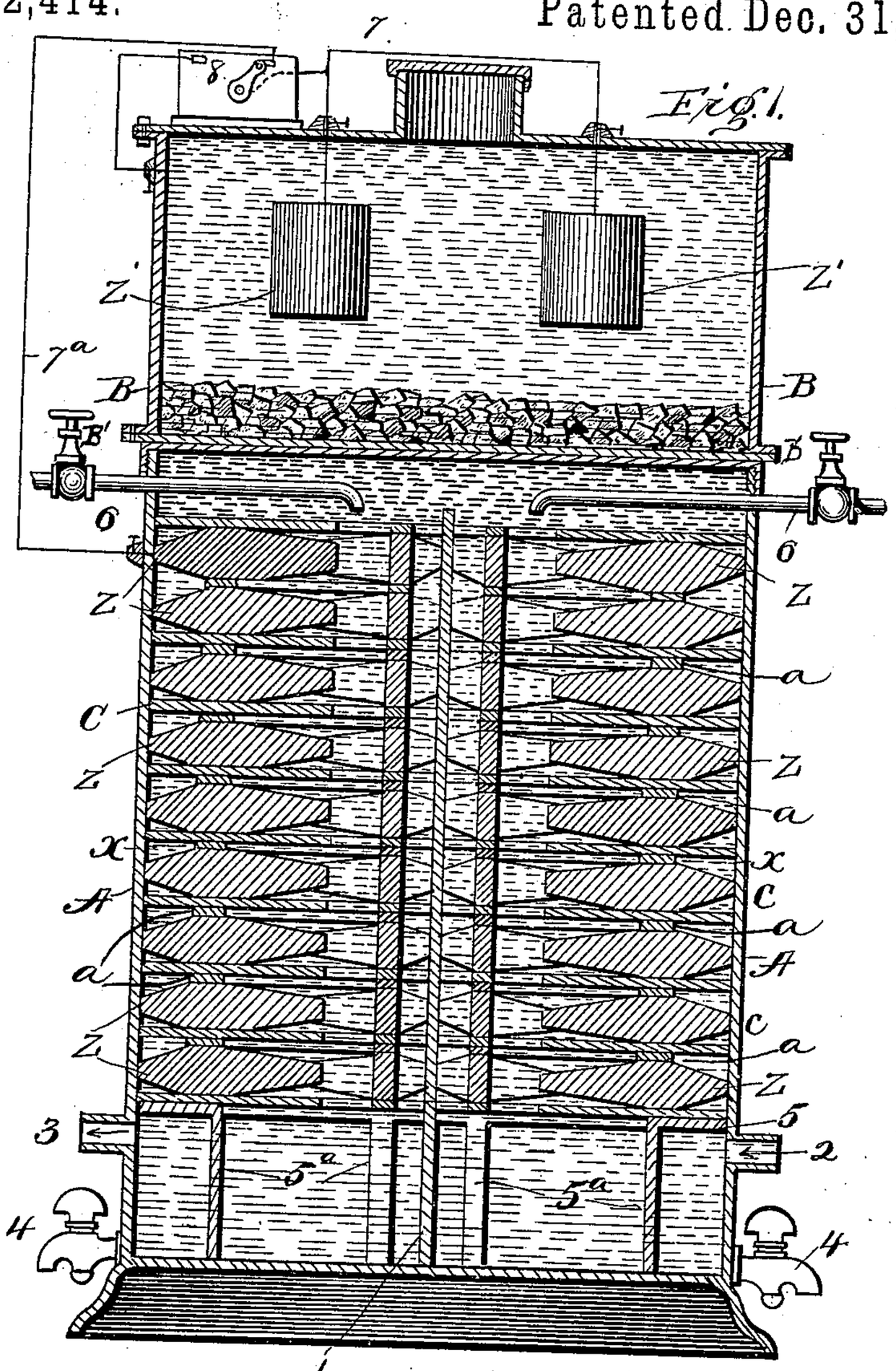
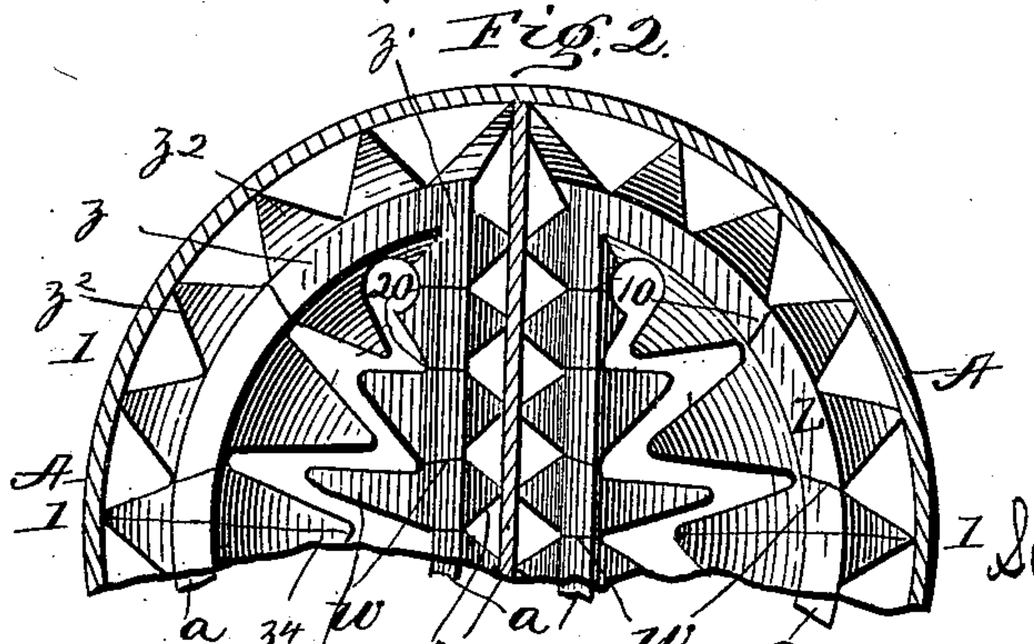


Fig. 2.



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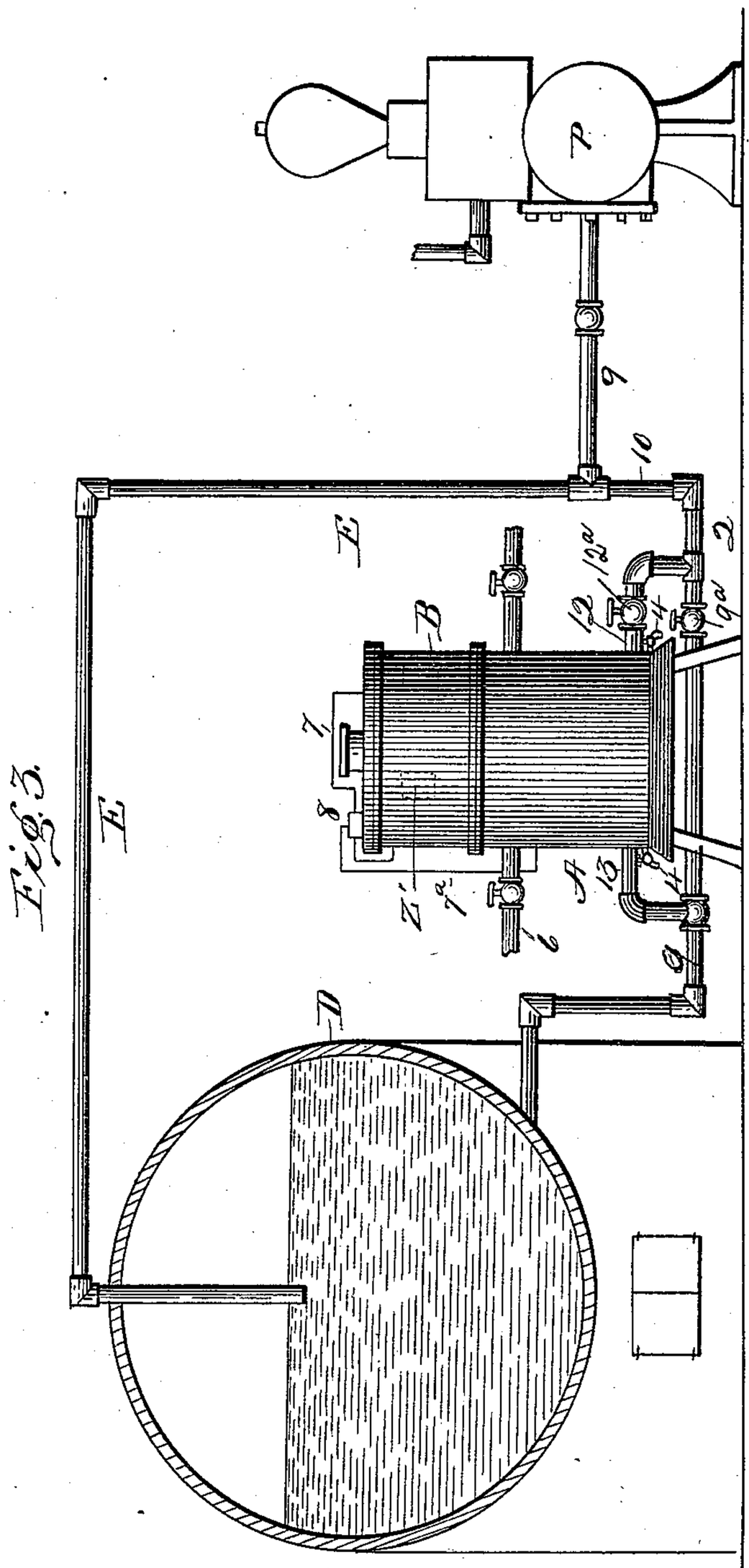

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UNITED STATES PATENT OFFICE.

SAMUEL G. CABELL, OF WASHINGTON, DISTRICT OF COLUMBIA.

GALVANIC FEED-WATER PURIFIER.

SPECIFICATION forming part of Letters Patent No. 552,414, dated December 31, 1895.

Application filed October 16, 1895. Serial No. 565,859. (No model.)

To all whom it may concern:

Be it known that I, SAMUEL G. CABELL, a citizen of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Galvanic Feed-Water Purifiers; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

My invention relates to improvements in feed-water purifiers of that class wherein the water in its passage to a boiler is subjected to galvanic or electrical influences.

One object of the invention is to increase the energy of purifiers without increasing the size of the same.

Another object of the invention is to so connect the purifier with the pump and boiler that the water may be caused to flow directly from the pump to the boiler without passing through the purifier whenever desired.

To these ends the invention consists in certain peculiarities in the construction, arrangement and combination of the several parts, substantially as hereinafter described, and particularly pointed out in the subjoined claims.

In the accompanying drawings, Figure 1 is a central vertical section on line *l l* of Fig. 2 through a purifying gland or vessel, showing the arrangement of instrumentalities to make a purifier according to my invention. Fig. 2 is a section on the line *x x* of Fig. 1. Fig. 3 is a view showing the connection between the purifier and the boiler in connection with which it is used, the boiler being shown in cross-section and the purifier and connecting-pipes in elevation.

A designates a gland or vessel, preferably cast of suitable metal. This vessel may be made entirely of copper, or it may be made of other and cheaper metals; but I prefer to so construct it that it will form one of the battery elements. It is preferably divided into two substantially equal compartments by a vertical partition or diaphragm 1 extending from the bottom nearly to the top of the water-gland A. This partition, like the body or shell, is preferably made of copper, but may be made of other metal or metals without departing from the spirit of the invention.

2 and 3 are inlet and outlet ports, respectively, some distance above the bottom and preferably in the same, or substantially the same, horizontal plane, and 4 4 are petcocks at or near the bottom for drawing or blowing off from time to time sedimentary deposits and impurities precipitated or thrown down.

5 is a flat ring or annulus fitting closely within the vessel or gland A and supported above the inlet and outlet ports 2 3 by legs 5^a resting on the bottom. This ring or annulus forms a support for a galvanic pile, leaving thus in the bottom of the gland below the galvanic pile an open space or chamber for the collection of impurities.

Z and C represent respectively the positive and negative elements of a galvanic pile arranged within the shell A and sustained above the bottom by the ring or annulus 5, as and for the purpose already explained. These elements are made substantially in the form shown in Fig. 2 of the drawings, with toothed or serrated edges, which contact with the shell A and partition 1 and with fingers or projections, preferably rounded at their ends to prevent rapid shortening by decomposition of the metal, as would be the case if the ends were pointed.

Preferably the elements Z each consists of a flat plate of proper shape, having openings within its body and in its edge, arranged to form the strips *z* and *z'* constituting what I term the "sides" of the element, fingers z^4 and z^5 extending inward toward each other from the respective sides *z* and *z'* and each entering but not closing the space between the sides of the adjacent pairs of fingers extending from the other side of the element, fingers z^2 extending outward from the outer edge of side *z*, and fingers z^3 extending outward from the outer edge of side *z'*. All of said fingers are preferably beveled on their upper and under surfaces. When these elements are arranged within a gland having the transverse partition 1, the fingers z^2 will project toward the wall of the gland and the fingers z^3 will extend toward the diaphragm.

Each of the copper elements C preferably

consists of flat plate, made semicircular when the gland is cylindrical, engaging the strips z and z' of the respective zinc elements, and formed with fingers corresponding with those of the latter, or with suitable openings so as to not prevent the flow of water through the spaces between said fingers. It will be seen that such construction of battery elements provides a great number of separated vertical water-passages arranged adjacent to the inner wall of the gland and on opposite sides of the diaphragm 1 and contiguous thereto, and also a number of vertical water-passages between fingers z^4 and z^5, and that, furthermore, the beveling of the fingers forms a number of laterally-extending water-passages contiguous to the fingers, whereby the latter will be entirely immersed in the water. Thus a very powerful battery is formed, possessing maximum efficiency in eliminating scale-producing impurities from the water flowing through the battery elements and around the fingers thereof in its passage from the inlet-port to the outlet-port of the gland or casing. For convenience in handling the galvanic pile and removing it from the vessel or gland for cleaning purposes, or for renewal, I bind or tie the elements together by means of copper wire w.

a is a separating-ring of asbestos or other like porous material to divide the zinc and copper elements into pairs. Leading into the top of the vessel above the galvanic pile are shown steam-pipes 6 6 extending from a source of steam-supply and arranged so that when the gland is cut off from the boiler and feed-pump it may be blown out through the cocks 4 4, which are to be opened for that purpose.

9 designates the main supply-pipe, extending from the pump to the boiler and connected at one place within inlet 2 by pipe 12 and at another place with outlet 3 by pipe 13. This pipe 9 is provided with a valve 9^a, and pipe 12 is provided with a valve 12^a. When it is desired to cause the water to flow directly from the pump to the boiler, cock 9^a is opened and cock 12^a closed, and when it is desired to cause the water to flow through the battery from the pump to the boiler the former cock is closed and the latter opened. This facility for quickly cutting the battery out of the water-circuit is an advantage of some importance, especially when the battery is as powerful as the present one.

By dividing the gland into two compartments by the partition 1, and making the galvanic elements in the form and arranging them in the matter shown, I obtain for a gland of given dimensions a capacity nearly double that of other devices known to me.

In operation the water from the feed-pump enters through port 2, passing thence upward through and among the fingers of the galvanic elements on that side of the partition 1, over the top of the partition and down through and among the fingers of the galvanic elements on the opposite side and out and toward the boiler through outlet-port 3. During the passage of the water through the gland the impurities are subjected to galvanic action and are thereby precipitated and thrown down into the collecting-chamber at the bottom, from which they are drawn or blown off, from time to time, through the cocks 4 4, as above explained.

In order to enlarge that part of my invention above described, I combine with it a galvanic-battery cell B to increase the energy of the galvanic pile. The cell B is, by preference, made of suitable size and shape to be mounted upon and form an upward continuation of the water-gland A, and is separated from the latter by a horizontal partition B', preferably of non-conductive material. It may be made wholly of copper or of other suitable material.

Within the cell B, I suspend one or more elements, such as zinc Z', by means of an insulated wire 7 which is connected with a positive element of the pile in gland A by a wire 7^a, whereby the energy of the pile is augmented by that of the battery-cell. A cut-off or switch 8 may be arranged in the circuit between the battery-cell B and the pile in gland A, whereby the cell and pile may be connected or disconnected at pleasure, as circumstances may require.

It is well known that a great portion of the insoluble impurities contained in the water may be precipitated by heating the water to or above the boiling point, and therefore, with the view of increasing the efficiency of my purifier, I propose to employ this method of purification in connection with the galvanic operation above described, and for this purpose I employ the connections illustrated in Fig. 3, in which A designates the water-gland, B the superposed battery-cell, 2 the inlet and 3 the outlet ports through which water passes into and out of the gland, as above explained.

P designates the force-pump which is located in connection between the gland A and feed-water heater, (not shown,) as usual; D, the steam-boiler, in connection with which the purifier is used, and E a pipe connecting the boiler with the inlet at a point in the latter between the gland A and the pump P.

The pipe E enters the boiler at the top and projects down within the same to a point somewhat below the water-level, as seen in Fig. 3. In practical operation, feed-water is usually supplied to the boiler at a temperature of from 170° to 180° Fahrenheit, while the temperature of the water in the boiler ranges from 250° to 375°, or even higher, according to the pressure employed, and, therefore, by drawing from the boiler a sufficient volume of water at the higher temperature and passing it into the purifier with the feed-water supplied by the feed-pump the temperature in the purifier may be raised to or above the boiling-point and so maintained while the

water in the boiler is kept up and the circulation of hot water through the pipe E is continued.

It is well known that by reason of the expansion of water by heat the water in a steam-boiler is always hotter at the surface than at the bottom, and it is equally well known that if the two ends of the return-pipe be connected with a boiler at different levels a constant circulation will be maintained, the water carrying the higher degree of heat flowing out through the upper connection and returning, after giving up or being deprived of a portion of its heat, through the lower connection. Thus it will be understood that hot water drawn from the boiler will readily circulate through the pipe E, gland A, and inlet 2, returning to the boiler at the lower level.

In starting the apparatus, the circulation through the pipe E will be readily started by the steam-pressure within the boiler, assisted by the siphonic action induced by the pump P.

In order to prevent backflow toward the pump, a check-valve *p* may be located in connection between said pipe and pump. It will thus be understood that the gland A acts also as a mud-trap to catch and hold the mud or other solid matters carried in suspension, that its sufficiency in this respect is increased by maintaining the water during its passage therethrough at a temperature at or above the boiling-point; also that this operation of trapping mud and other insoluble matters in no wise interferes with its operation as a galvanic separator or purifier, the two functions or operations being independent of, but supplemental to each other.

Having thus described my invention, what I claim is—

1. In a feed water purifier, the combination of a gland having a separate chamber for impurities, a galvanic pile within the gland, a supplementary battery electrically connected with the pile, means for forcing water through the gland to the boiler, and a return connection for conveying hot water from the boiler to the gland.

2. In a feed water purifier, the combination of the shell or gland divided into two compartments by a vertical partition, said compartments communicating at the top, a feed pump communicating with one of said compartments near the bottom to deliver therein, a connection leading from near the bottom of the other compartment to the boiler to be supplied, a galvanic pile in each of said compartments, and collecting chamber below said galvanic pile.

3. In a galvanic or electrical feed water purifier, a gland or vessel embracing the combination of a shell or vessel having a transverse diaphragm extending from the bottom to near the top thereof, and galvanic elements within the vessel, substantially as described.

4. In a galvanic or electrical feed water purifier, a gland or vessel embracing the combination of a shell or vessel having a transverse diaphragm extending from the bottom to near the top thereof, and galvanic elements within the vessel, having fingers projecting toward said diaphragm and the wall of the cylinder, respectively, substantially as described.

5. As an improved article of manufacture, a galvanic battery element, consisting of a plate, having within its body a series of openings forming a series of fingers projecting inward toward each other from opposite sides of the plate, each of said fingers extending into but not closing the space between a pair extending from the other side of the plate, the outer edge also of the plate being formed with openings, to provide a series of outwardly extending fingers, as described.

6. In a galvanic or electrical feed water purifier, the combination with the galvanic vessel having inlet and outlet ports at its opposite sides near its bottom, the diaphragm therein, dividing the vessel into two compartments communicating at the top, and the voltaic pile in each of said compartments, substantially as described.

7. In a galvanic or electrical feed water purifier, the combination with the galvanic vessel having inlet and outlet ports at its opposite sides near its bottom, the diaphragm therein, dividing the vessel into two compartments communicating at the top, and the voltaic pile in each of said compartments, said voltaic pile embodying elements each of which is formed with fingers extending from its outer edge toward the diaphragm and wall of the vessel respectively, and with other fingers extending toward each other from the inner edges of its sides.

8. In a galvanic or electrical feed water purifier, the combination with the vessel having inlet and outlet ports, of the electro-positive plates having outwardly projecting fingers and also formed with fingers arranged within their respective bodies, and the electro-negative plates having openings coinciding with those between the fingers in the positive plates, said positive and negative plates alternating substantially as described.

9. In a galvanic or electrical feed water purifier, the combination with the vessel, having inlet and outlet ports at its opposite sides near its bottom, a transverse diaphragm, arranged between said ports and dividing the vessel into two chambers, and a voltaic pile in each chamber, each of said piles embodying electro-positive plates formed with fingers projecting to the diaphragm and wall of the vessel respectively, from the outer edges of its sides and with other fingers projecting inward toward each other from the inner edges of opposite sides of the plate and into the space between an adjacent pair of fingers, and electro-negative plates, alternating with said positive plates and formed with openings.

10. The combination with the gland and its

contained galvanic pile, said gland having inlet and outlet ports, of the force pump, the boiler, the main pipe extending from the force pump to the boiler, a valved branch pipe connecting the inlet port of the gland with said main pipe, a branch pipe connecting the outlet port of the gland with said main pipe, and a valve, arranged in said main pipe, between said branch pipes and a return connection for conveying hot water from the boiler to the battery.

In testimony whereof I affix my signature in presence of two witnesses.

SAMUEL G. CABELL.

Witnesses:
JOHN H. O'DONNELL,
FLORA B. CABELL.