(No Model.) 2 Sheets—Sheet 1.

H. WOODS.

WATER PURIFIER.

No. 525,302. Patented Aug. 28, 1894.

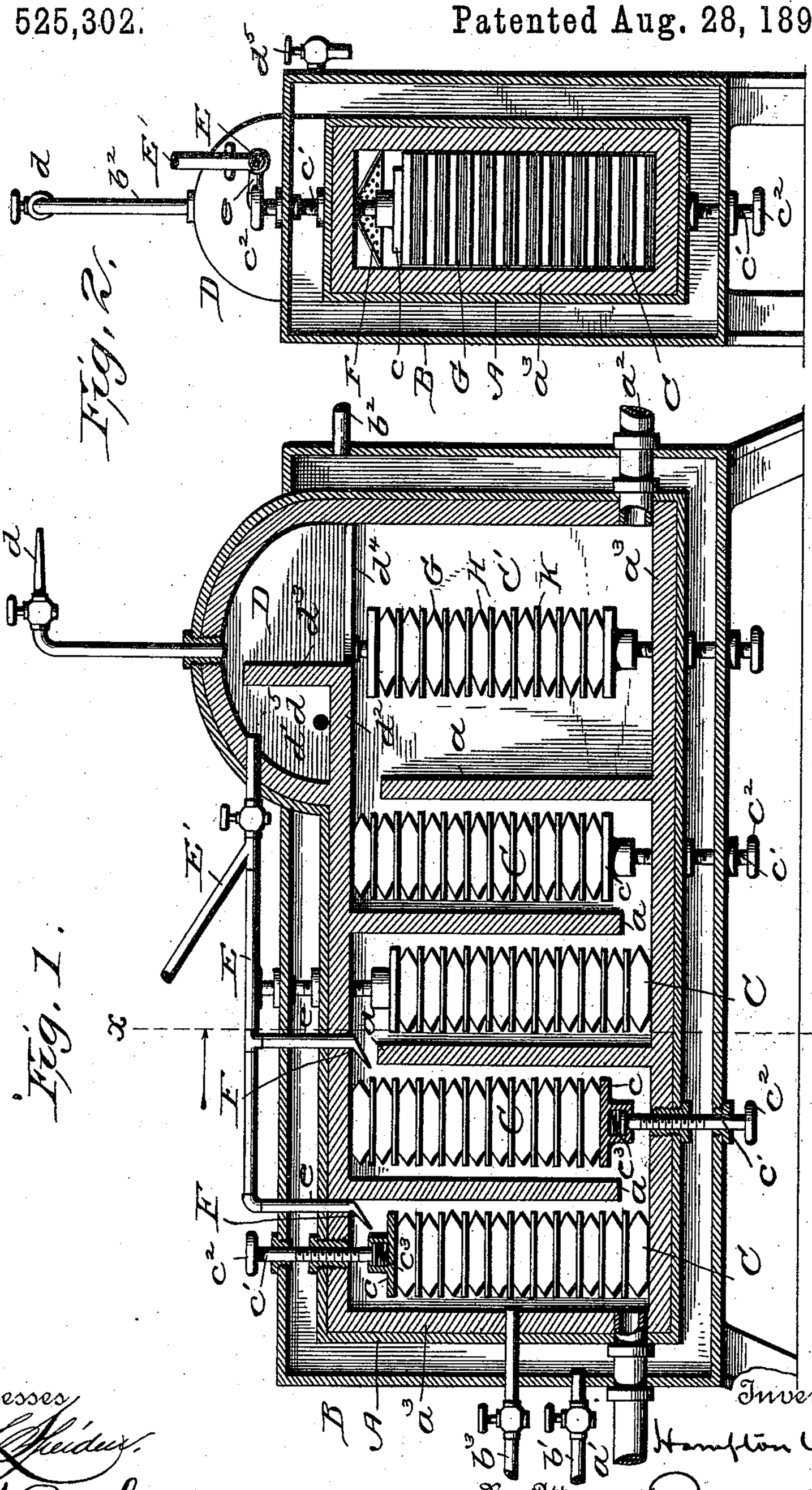

Fig. 2.

Fig. 1.

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(No Model.) 2 Sheets—Sheet 2.

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Fig. 5.

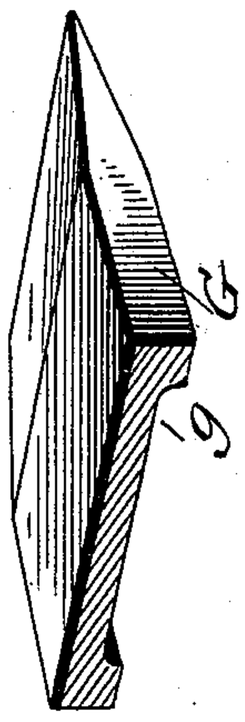


Fig. 4.

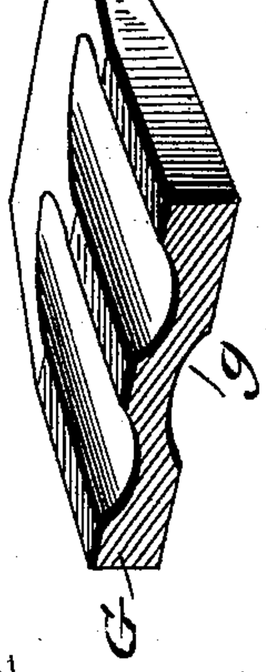


Fig. 3.

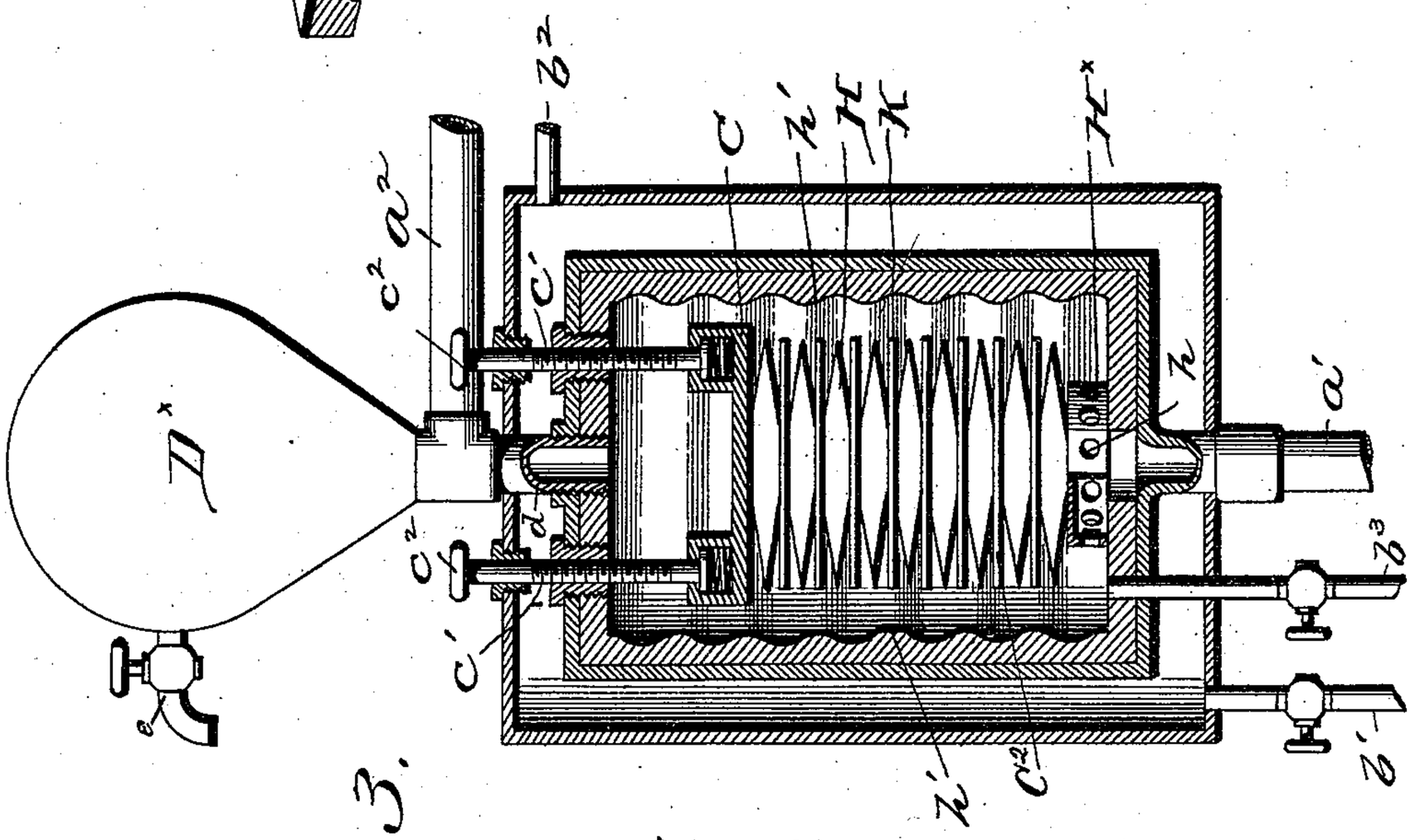
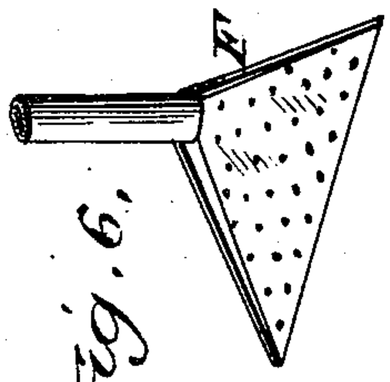


Fig. 6.



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UNITED STATES PATENT OFFICE.

HAMPTON WOODS, OF CHICAGO, ILLINOIS, ASSIGNOR OF ONE-HALF TO HERBERT CASSARD, OF BALTIMORE, MARYLAND.

WATER-PURIFIER.

SPECIFICATION forming part of Letters Patent No. 525,302, dated August 28, 1894.

Application filed September 15, 1893. Serial No. 485,592. (No model.)

To all whom it may concern:

Be it known that I, HAMPTON WOODS, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Water-Purifiers; and I do hereby 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 letters of reference marked thereon, which form a part of this specification.

The present invention relates to the purification of water for steam boilers by electric or electrolytic action, for the purpose of preventing the formation of scale in the boiler, and the object of the invention is to produce an improved purifier for feed-water for steam boilers which shall be self contained, positive and uniform in its action and not liable to be injured in the hands of inexperienced boiler attendants. I have never seen correctly stated the action of an electrical or galvanic feed-water purifier, and a brief explanation thereof, according to my theory, may not be out of place.

While the general principle or action of chemical compounds or purgers injected with feed-water into the boiler has been known, there has been a mystery surrounding the performance of the same duty, *i. e.*, the non-scaling of the boiler, by electrolytic action.

The most common impurities of water are sediment, organic matter, SiO_2, Fe_2O_3, CaO, MgO, CO_2, SO_3, Cl, NH_3, (the latter four free and in combination;) KO, NaO, NO_2 and NO_3, as well as other elements of more or less importance. These on their evolution and deposition, from the boiler of the water and its evaporation, form sediments and scales of varying composition, which adhere tenaciously to the sheets of boilers, not only impairing the same, but causing much loss in efficiency. It is my present intention to show that the electrolytic action of such devices as mine accomplishes results of very much the same character, and introduces similar elements to those of well known purgers, most of which are caustics and alkalies. The electrolysis of NaCl in solution (and as such it is found in most waters) gives us factors Na and Cl. The Na decomposes the water, sets free H; and NaOH (caustic soda) remains in solution. Thus it is seen that I have manufactured, by this process a well known chemical purger. The liberated Cl acts variously upon the water, inasmuch as some of it may remain free, or combine with the hydrogen and form HCl, or with the impurities to form chloride compounds. In the same manner we may study the reactions of the others, for instance $CaCO_3$. $CaCO_3+(2HCl+Aq)=(Cacl_2+H_2O+Aq)+CO_2$; $CaCl_2$ + electrolysis = $Ca+Cl_2$. $Ca+2H_2O=Ca(OH)2+H_2$, which is soluble in water. With small quantities of H_2O it forms milk of lime, and with less water it forms a plastic paste. Calcic hydrate has many of the properties of caustic alkalies. The reactions of Mg are as a rule closely allied to those of Ca, and while the hydrate is but slightly soluble in H_2O it is yet sufficiently so to give a distinct alkaline reaction. $CaSO_4$ and $MgSO_4$ are readily disassociated, and in the presence of zinc tend to form sulphate of the latter. The strength of the electrolytic action generated is of course dependent upon the existing electrolyte, and while under favorable circumstances the above reactions occur, it can not be sweepingly asserted that the combinations are as complete as those indicated, as such changes would require the impurities to be not only of certain combinations, but in exact proportions. The main point to be clearly prominent is the increased solvent power of the water by the manufacture of alkalies and caustics, as the water and its impurities are subjected to electrolytic action; thus producing chemical combinations with the result aimed at by such of the best purgers as has been scientifically adapted, after an analysis of each individual water. The solubility of the impurities is increased; but even when the quantity of lime, for instance, becomes so great as to be no longer soluble, it is deposited as a gelatinous or flaky substance, never adhering to the surface of iron plates.

A considerable percentage of the electrical energy in purifiers of this character has heretofore been lost through incomplete insulation, and in some cases insulation has been practically ignored. In such cases the actual work done by the purifier is but a small part

of what it is capable of doing and the prime object in view in the present case is to secure as complete insulation as possible of the voltaic pile of a water purifier, and thereby secure the full electrical work of the apparatus in the line of purification. To this end the voltaic pile is centrally placed within the chamber of the purifier so that the flow of water therethrough is around the pile, between it and the walls of the containing cylinder or apartment. The pile is supported on an insulating base and cut off from contact with the walls of the apartment. The cylinder or chamber containing the pile is also provided with a lining of terra-cotta, or any suitable insulating material, so as to prevent the waste of the electric or galvanic energy.

The invention in its preferred form is so constructed as to contain a series of apartments, each containing a voltaic pile, with means for catching the free sediment in the several apartments as the water flows therethrough and conducting it to a receptacle from which it can be readily removed; the course of the feed water in traveling through the several apartments being circuitous, so as to secure an effective contact with the successive piles. I am aware that it has been often proposed to use voltaic piles within the steam boiler itself under such conditions that the water surrounds the pile; but generation of electrolytic action in the boiler itself is not to be commended, for the reason that the boiler is injured by the galvanic action and may be eaten through, hence the purification should be effected, and all the free sediment removed, before the water enters the boiler.

The invention further consists of numerous details of construction and arrangement all of which will be fully described and then pointed out in the claims.

In the accompanying drawings: Figure 1 is a longitudinal sectional view of a feed-water purifier constructed according to my invention, the same having a series of voltaic piles. Fig. 2 is a vertical transverse section of the same taken on the line x—x. Fig. 3 is a vertical sectional view of a feed-water purifier containing a single pile. Fig. 4 is a detail view of one of the zinc plates of a voltaic pile, and Fig. 5 is a modification of the invention, described hereinafter, and Fig. 6 is an enlarged detached view of one of the screens F.

Referring to Figs. 1 and 2, A is a metal casing or receiver, preferably of a rectangular form and provided with partitions a dividing it into a series of compartments, a passage being left through the said partitions successively at the bottom and top so that the water must travel in a circuitous course as it flows through the several compartments of the purifier.

a' is the inlet pipe for the water and a^2 the outlet. The whole casing is provided with an insulating lining, a^3, of earthen ware, or other suitable non-conducting material, and the partitions a may be of the same material. Incasing the aforesaid casing there is a steam jacket, B, within which exhaust steam is admitted, b', b^2, being respectively the inlet and outlet pipes therefor; also for the purpose of injecting steam into the purifier itself, there is a steam pipe b^3.

C, C, are the voltaic piles in the several compartments. The said piles extend laterally from wall to wall but have open space for the flow of the water around their front and rear faces. Each pile is seated against one end of its compartment, preferably the end where the passage is left for the flow of the water from that compartment into the next of the series, and the opposite end of each pile is provided with a cap plate, c, and a screw c', which latter passes through the top, or bottom, of the outer shell as the case may be, and has on its outer end a hand wheel c^2. The screw-rod, c', is seated on a spring c^3 on the top of the cap plate c, so that any small shrinkage of the pile is taken up by the spring, while by means of the screw the pile is kept tight and compact as it is from time to time disintegrated. It will be understood that the special construction of the spring-pressed screw follower is not essential. The compartment for the last of the voltaic pile of the series is preferably made much larger than the others, and is capped with a dome, D, which latter has a blow off cock d. Within said dome there is a receptacle, d', for free sediment, the said receptacle being formed by partitions d^2, d^3, across the dome; and a cross bar d^4 serves to support the end plate of the voltaic pile, C', of this section. Above the purifier there is a pipe, E, with branches, e, connected with the top of all or part of the compartments of the purifier. This pipe E leads into the aforesaid sediment receptacle d'. The several connecting pipes, open into the several voltaic cell apartments at a point where the water in flowing makes a bend in its course, and at this point there is provided a screen apron, F, which extends across the water channel from side to side of the purifier, and is set at an angle of about forty-five degrees. These screen aprons preferably do not extend down far enough to dam the entire water course, but an open channel is left below them for the passage of a part of the water; the aprons catching the floating sediment.

E' is a steam injector opening into the sediment pipe E and when steam is injected into the pipe E the suction produced draws the free sediment that is caught on the screen F up through the feeders e, and discharges it into the catch basin d'. A drawing off cock d^5 is provided for emptying this catch basin. Referring now to the structural features of the pile, the preferred form to be given to the zinc plates thereof, or equivalent members, will be understood from Fig. 4. The zinc plate G is made with the channel g in its side face, or it is corrugated or grooved or channeled on both its faces so that the pile when built up will contain numerous shallow

passages through it between its members, wherein the water necessarily has a reduced flow and is subject to an increased amount of galvanic action. The zinc plates, or the equivalent members of the pile, are also formed with wedge ends so that the exposed sides of the pile when built up will present a serrated face and thus secure a large area of active surface.

In the embodiment of the invention illustrated in Fig. 3, wherein a single voltaic pile C^2 is used, the latter may take a circular form. In this case the inlet pipe is located at the bottom of the gland and the water discharges through a pipe *d* in the top connecting with a dome $D^\times$ having a stop cock E.

$H^\times$ is a perforated ring of lead, or any suitable material, which forms the base plate for supporting the pile, the water entering within the ring and then flowing outward through the openings, *h*, therein and up around the pile. The sides of the casing, or the lining thereof, is made with corrugations or inwardly projecting ridges, *h'*, opposed to the serrated face of the pile, for the purpose of imparting to the water flowing through the gland successive inward directions, and thus cause it to strike the exposed face of the pile.

Further the specific details of construction and arrangement herein shown can be changed to suit special requirements.

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

1. In a water-purifier, a voltaic pile having an adjustable end-plate with automatic means for taking up slight shrinkage of the pile, substantially as set forth.

2. In a water-purifier, a voltaic pile having an adjustable end-plate with a spring for compressing and taking up slight shrinkage of the pile, substantially as set forth.

3. The combination with a multiple compartment water purifier having a voltaic pile in each compartment, of a sediment discharge pipe having branch connections with each compartment and an ejector, substantially as and for the purpose set forth.

4. In a water purifier the combination of one or more screens arranged in the path of the water to catch the floating matter, with pipes leading therefrom and connected to a receptacle for the impurities within the chamber of the purifier substantially as and for the purpose set forth.

5. The combination with a chamber of a water-purifier of a series of voltaic pile plates extending across the chamber, said plates having channels or grooves in their contiguous faces, substantially as and for the purpose set forth.

6. The combination in a water purifier of a centrally located voltaic pile, with a chamber wall having corrugations or ridges adapted to direct the flow of water therebetween against the pile in successive impulses, substantially as and for the purpose set forth.

7. The combination in a water purifier of a water chamber having a corrugated or ridged lining, with a voltaic pile placed within the chamber, substantially as and for the purpose set forth.

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

HAMPTON WOODS.

Witnesses:

STORY B. LADD,

L. C. STRIDER.