(No Model.)

H. A. ANDERSON & C. C. McCLAUGHRY.

FEED WATER HEATER AND PURIFIER.

No. 453,072. Patented May 26, 1891.

Fig. 2.

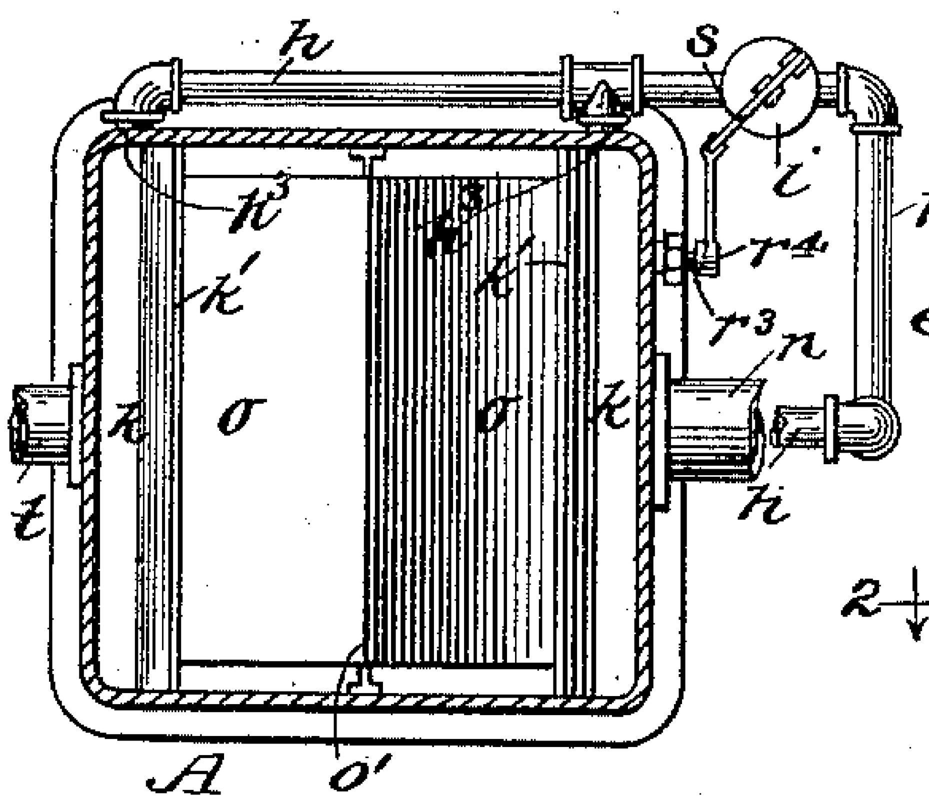
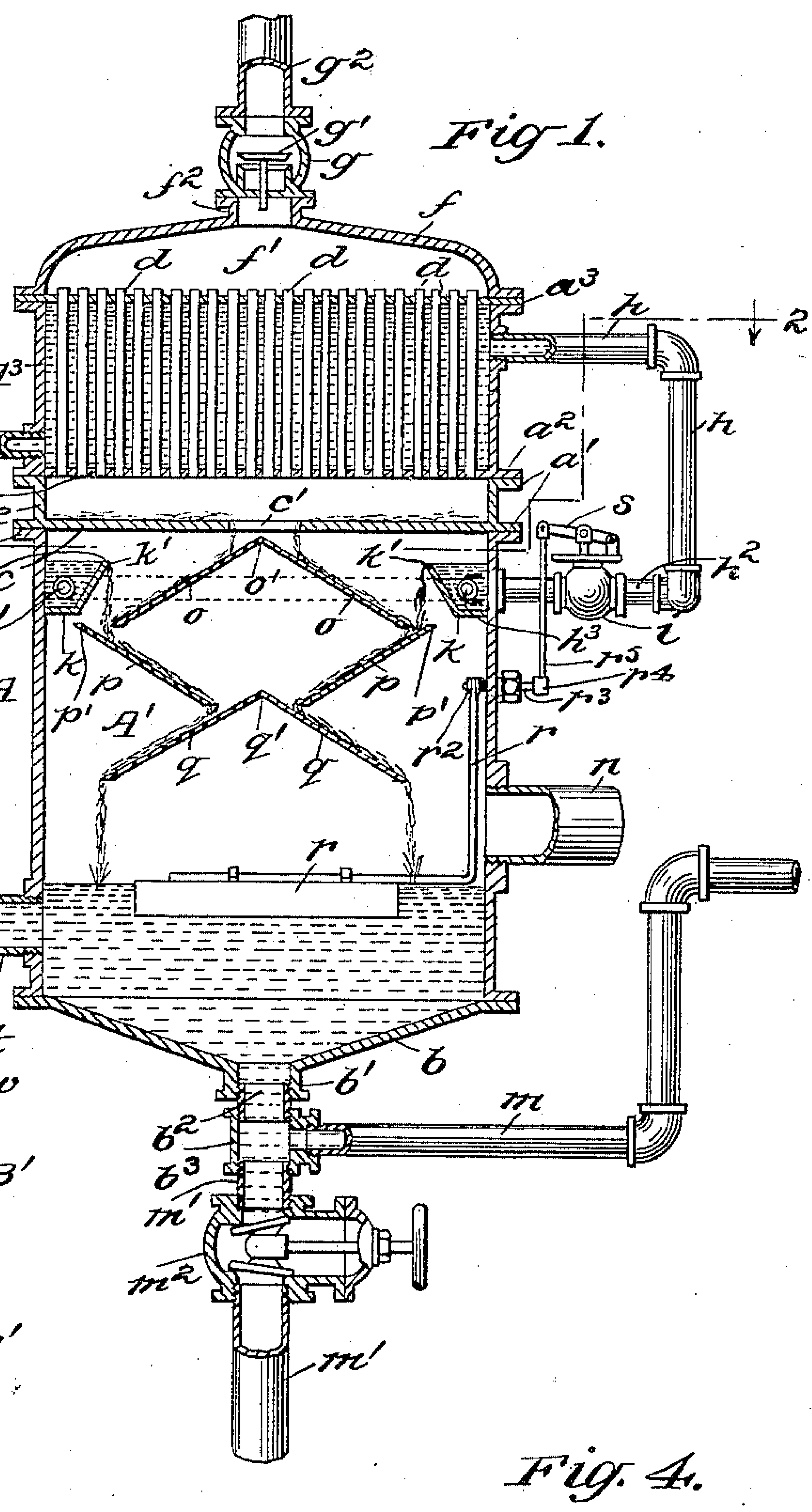


Fig. 1.



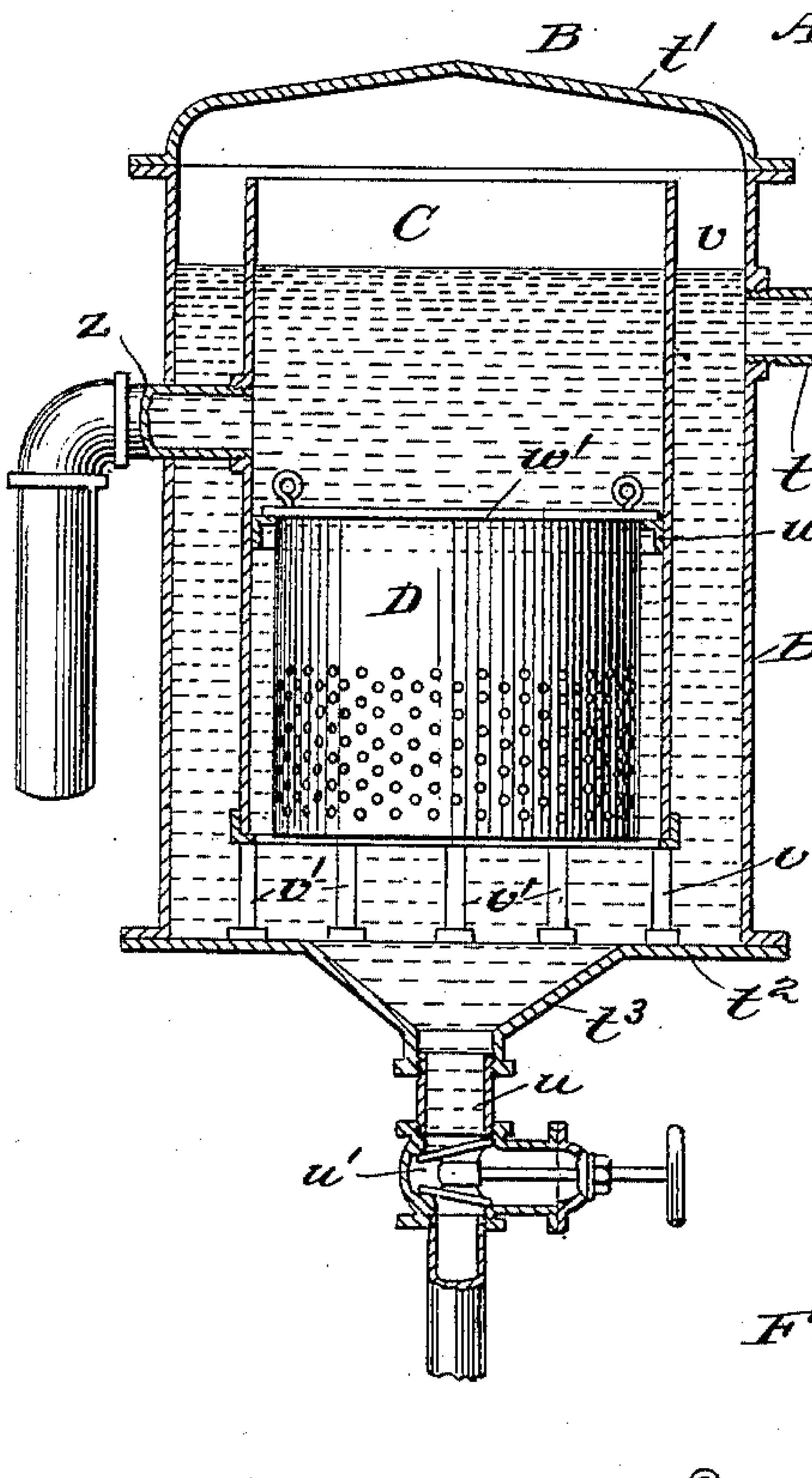


Fig. 4.

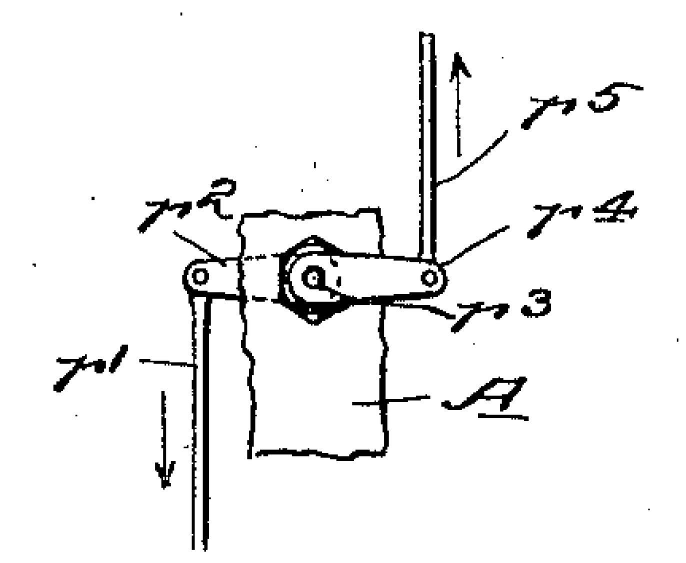
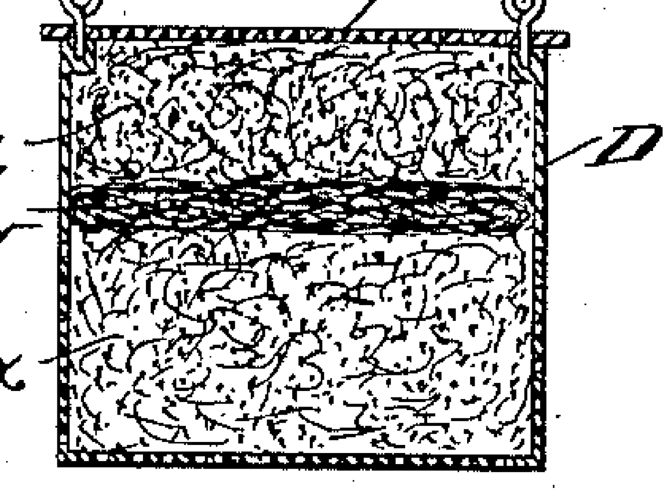


Fig. 3.



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HAMILTON A. ANDERSON AND CHARLES C. McCLAUGHRY, OF JOLIET, ILLINOIS.

FEED-WATER HEATER AND PURIFIER.

SPECIFICATION forming part of Letters Patent No. 453,072, dated May 26, 1891.

Application filed August 30, 1890. Serial No. 363,497. (No model.)

To all whom it may concern:

Be it known that we, HAMILTON A. ANDERSON and CHARLES C. McCLAUGHRY, of Joliet, in the county of Will and State of Illinois, have invented a new and useful Feed-Water Heater and Purifier, of which the following is a full, clear, and exact description.

Our invention relates to improvements in a device for the heating and purification of water used for feeding steam-generators and other purposes, and has for its objects to produce a water-heater which will embody means to heat cold water and to a large degree remove therefrom calcareous impurities or earthy matter held in suspension, and further to provide means for the prevention of incrustation within the water heater and purifier and the discharge of eliminated impurities.

To these ends our invention consists in the construction and combination of parts, as is hereinafter described, and pointed out in the claims.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar letters of reference indicate corresponding parts in all the figures.

Figure 1 is a sectional side elevation of the apparatus. Fig. 2 is a plan view in section of the device taken on the broken line 2 2 in Fig. 1. Fig. 3 is a vertical section of a filtering device which forms a portion of the purifier, and Fig. 4 is a detached view of one of the details which more fully illustrates its construction.

The water heating and filtering apparatus is contained in two main compartments A and B, which are suitably connected and operate conjointly, the water-heating chamber being furnished with internal parts that from their peculiar construction and arrangement are adapted to separate calcareous and earthy matter from the water passed through the heater and precipitate it, provision being also made for the removal of said precipitates at any time while the device is in operation, as will appear from the specific description which will now be given.

The water-heating mechanism is contained, principally, in a casing A, which is preferably made in the form of rectangular shell, other shapes being admissible, and may be made of cast or sheet metal, as convenience of manufacture dictates.

To facilitate the construction of the casing A, that constitutes an envelope for the devices which heat and partly purify the feed-water and permit the insertion of said parts in their places, the casing A is transversely divided into three unequal compartments or chambers, which are erected as one vertical apparatus or heater. The separated sections of the casing or shell A are joined by radial flanges, as at a a' a^2, which latter are bolted or otherwise connected together. The lower portion of the heating-chamber A′, which is the lower compartment of the three, is closed by a dished bottom plate b, which is secured to the flanged edge of the casing and has a depending short branch pipe b' centrally formed on it for the attachment of other parts. The portion A^2 of the heater apparatus is seated on the upper end of the chamber A′, and is thereto secured. It has a flat bottom wall or diaphragm c, which is transversely slotted or apertured centrally, as at c', and above this compartment the upper chamber A^3 is located, which chamber is designed to serve as a receiver for cold water that is to be purified, and also as a tubular condenser, which is part of the purifying apparatus. The chamber A^3 is of proper height for its indicated use, and, to render it available as a condenser of steam, is provided with a series of tubes d, which are secured by any approved means within the perforated top and bottom plates a^3 of the condenser-chamber. The tubes d are evenly spaced apart throughout the area of the plates or end walls a^3, and are vertically located therein.

The supply of cold water from the condenser A^3 may be taken from any source which will afford a sufficient quantity under pressure from a pump or by the force of gravity, and is introduced through the supply-pipe e, (shown broken,) that may be extended from the water-source and made to intersect the condenser A^3 near the bottom wall a^3 of the same.

A dome-shaped cover f is placed upon the chamber A^3 and secured to it by bolts, (not shown,) which engage the flanged edge of the cover and chamber named. The form of the cover f produces a shallow chamber f' between it and the top plate a^3, so that vapor from the series of flues d may circulate in this chamber. At a central point an outlet branch f^2 is formed on the dome-cover f, and on this short pipe f^2 is secured the valve-chamber g, which contains a valve g', that is of a proper weight to serve as a partial check for steam which passes up through the tubes d. Any excess of steam-pressure that will lift the valve g' finds a vent through the relief-pipe g^2, which is seated upon the valve-chamber g.

The shallow compartment A^2 is designated a "drip-chamber," from the fact that it receives water of condensation from the vapor-chamber f' and tubes d, and below the drip-chamber the larger water-heating chamber A' is located, upon which the other chambers are supported, as before stated.

The condenser-chamber A^3 is tapped on its side near the upper end wall a^3 for the introduction of the end portion of the upper leg h' of the water-feeding pipe h, that is properly bent to form two horizontal legs h' h^2, the lower leg h^2 extending across the heating-chamber and penetrating the side wall of said chamber A' at two points, as branch outlets h^3, shown plainly in Fig. 2. There is a globe-valve i introduced into the lower leg h^2 of the feed-pipe h, which is designed to control the passage of water from the condenser-chamber A^3 to the heating-chamber A'. This is preferably effected by automatically-operating mechanism, which will be further mentioned.

At a suitable point below the diaphragm-wall c of the chamber A^2 two opposite troughs k are secured to the side walls of the casing in the same horizontal plane, which troughs have their inner sides inclined toward each other. The feed-water pipe h is properly extended so as to supply water in equal volume to each of the troughs. The outlets h' of the pipe, being located near the bottoms of the troughs k, are submerged when the troughs are filled with water.

A depending short pipe b^2 is secured in the branch or outlet b' of the chamber bottom b, and to this pipe or nipple a T-fitting b^3 is attached, having an overflow-pipe m screwed into its lateral outlet, which pipe is bent upwardly and then outwardly so that its discharging end will be sufficiently elevated to allow a proper depth of water to remain in the lower part of the heating-chamber A'. Below the aforesaid overflow-pipe m a depending blow-off pipe m' is secured in the T b^3, having a valve m^2 in it, which will seal the blow-off pipe when the device is in service.

In the side wall of the chamber A' a pipe n is introduced and secured, (shown broken,) which may be extended to any source of steam-supply. Preferably the escape-pipe for exhaust-steam from a steam-engine is thus connected to the casing A for the introduction of steam which has done duty in the engine, thus affording economy in the matter of feed-water heating.

Below the aperture c' two thin plates o are extended across the heating-chamber A' and may be joined to two opposite sides for support. Said plates o are oppositely inclined and have their top edges in contact, or a single plate may be bent to form an angle, the vertex o' of which lies directly beneath the aperture c' in such a relative position that water of condensation flowing from the opposite edges of the aperture will fall upon and flow down the diagonally-located deflector-plates o and escape at their lower edges. Near the lower edges of the deflector-plates o two similar plates p are attached by their ends to the same side walls of the chamber A', which plates p are inclined inwardly and downwardly, a proper space intervening between their lower edges which are parallel to the upper edges p', these latter extending such a distance upwardly and outwardly as will permit any overflow of water from the troughs k to fall upon the upper surfaces of the plates p and flow down in a thin sheet. The water from the plates o, also impinging upon the plates p, will mingle with water from the troughs.

Below the converging plates p two plates q are located. These are inclined from their junctional point q' outwardly and downwardly, preferably forming an equal angle of divergence with that of the plates o, the position of the lower divergent plates q being such with regard to the lower edges of the plates p that water flowing from said edges will fall on the top surfaces of the plates q, and after traversing the same drip into the lower portion of the heating-chamber A'. All of the plates o, p, and q are preferably made of sheet brass or copper.

In the operation of the water-heating device herein described, it is desirable that the flow of water through the pipe h and valve i be automatically controlled to prevent an excess of water entering the chamber A'. To this end a hollow sheet metal or wooden float r is placed in the heating-chamber A' and rests on water which accumulates therein. From the float r an arm r' is upwardly extended and is loosely connected to a horizontal rock-arm r^2, that is attached to the inner end of a rock-shaft r^3, a similar rock-arm r^4 being affixed to the outer end of the rock-shaft lying in the same plane, but oppositely projected from the shaft r^3, which latter is supported to rock in a steam-tight box-bearing formed in the side wall of the chamber A'.

Upon the side of the casing A at a proper point, which should be nearer the bottom b than is the steam-pipe n, an outlet-branch pipe t is inserted, which is of sufficient caliber to serve as a water-conduit between the water-heating device and the filtering attachment B.

The shell B' of the filter B is made either square or cylindrical in cross-section, and is represented in the latter form, its capacity being proportional to that of the water-heating apparatus to which it is connected.

The branch pipe t is secured to the side of the shell B′ near the upper edge, upon which is seated an arched bonnet t', the lower end of the shell being closed by a base-plate t^2, which has a conical depression t^3 on it centrally located. To an axial aperture in the depression t^3 a discharge-pipe u is secured, having a valve u' introduced in it which when closed will seal the pipe, the bonnet t' and base-plate t^2 being removably affixed by any proper means.

Within the shell B′ a concentric cylindrical water-receiver C is placed, which is of such a reduced diameter as will afford an annular water-passage v between the wall of the receiver and the inner surface of the shell B′.

Upon the horizontal portion of the base-plate t^2 a circular row of short columns v' are erected for the support of the receiver C, which is seated upon them. The height of the receiver C is about equal to that of the shell B′, and said receiver is open at the top and bottom, a suitable air-space being provided for the receiver and annular water-way around it by the arched form of the bonnet t'.

Within the receiver C a filtering-chamber D is suspended upon the annular bracket-flange w, whereon the lid w' of said chamber rests, the cylindrical wall to which the lid is fastened hanging pendent and concentric with the wall of the receiver C. As will be seen in Figs. 1 and 3, the filtering device consists of alternate layers of shavings, straw, or coke x and fibrous material y, so disposed as to form a porous mass, which will permit the water to freely permeate its mass, while all sediment or impurities held in suspension will by the mechanical action of the layers of filling be retained. There are series of spaced perforations produced in the bottom and side walls of the filter D, whereby the introduction of water from below the filter and partly up its side wall into its interior is permitted, the top or removable lid w' being also foraminated for the discharge of water that is introduced at and near the bottom of the filtering-chamber. There is an outlet-branch z secured to the side of the receiver-chamber C, which penetrates water-tight through the shell B′, and is from thence extended to any desired point of discharge, which may be a feed-tank for a boiler or other reservoir for purified water, the branch z having a location over an aperture in the side wall of the receiver C above the filtering-chamber D.

In operation, cold water in an unpurified condition is introduced into the condenser A^3 and surrounds the tubes d, filling the condenser and the feed-pipe h and the drip-troughs k, also flowing over the inner edges k' of said troughs and thence onto the plates p. Steam of high pressure or, preferably, exhaust-steam is introduced to the heating-chamber A′ through the pipe n, and fills said chamber. The contact of the steam with the diverging plates q, converging plates p, and deflector-plates o heats said plates speedily, and by its intimate contact with the thin sheets of water transversing said plates quickly raises the temperature thereof and absorbs sufficient water to become supersaturated therewith. The steam then passes up through the aperture c', spreads out in the drip-chamber A^2, and thence upwardly through the condenser-tubes d. The extensive area of cold surface afforded by the tubes d condenses the water-laden steam and precipitates it in streams from the tubes to the drip-chamber A^2 and thence through the aperture c' onto the deflector-plates o, which are covered by the condensed water, and convey it in thin sheets to the upper portions of the converging plates p, from which the water falls onto the diverging plates q, and thence into the lower portion of the chamber A′. As the heat to which the plates o, p, and q are exposed is not sufficient to cause their incrustation, the calcareous matter and earthy impurities which are liberated from the hot water, by expansion of its volume and separation of its molecules, is deposited in grains or scales upon the plates named and from them washed by the flow of water into the lower part of the chamber A′. The separated impurities just mentioned, which may consist of lime, magnesia, silica, earthy compounds, and metallic ores in a comminuted condition will, by their specific gravity, be caused to collect in a mushy mass at the bottom of the chamber A′, from which said precipitates may be removed by a flushing action that will result if the valve m^2 is opened. If the blow-off valve m^2 is opened, the downward current of water will create a corresponding movement in the overflow-pipe m and remove any flocculent or muddy deposits from said pipe m, which latter serves to carry off any excess of water that enters the chamber A′ from above, and thus prevents the water from backing up into the steam-pipe n. The comparatively pure water which rises in the chamber A′, above the precipitates mentioned, is transferred as it accumulates to the annular water-space v and thence through the bottom and lower portion of the filter D into the upper part of the receiver C, the purified and thoroughly-filtered water passing out through the branch pipe z and pipe connected to the same, flowing by gravity to any desired point of discharge. Any sedimentary deposit in the bottom portion of the shell B′ will be removed if the valve u' is opened, and it is evident that the downward passage of water that lies above the filter D will wash considerable quantities of deposited matter from the filling of the filter, if a rapid current is created by the opening of this valve.

From the foregoing it will be evident that the apparatus herein described will afford means to remove calcareous, silicious, and mineral impurities held in suspension in water that is passed through the apparatus and also heat said water to near the boiling-point.

Having thus described our invention, we claim as new and desire to secure by Letters Patent—

1. The combination, with a vertical heating-chamber having a lateral steam-pipe attached to it, a condensing-chamber above, and a water-supply pipe for the condenser, of a device which will convey water from the condenser in graduated quantity to the water-heating chamber, and series of oppositely-inclined plates arranged in series vertically on which the inducted water may flow and be heated by enveloping steam, substantially as set forth.

2. The combination, with a water-heating chamber, a water-feed pipe above which is adapted to introduce water into the heating-chamber, and troughs that receive the inducted water and allow it to drip over their edges, of two inclined deflector-plates, two converging plates below, and two diverging plates below the converging plates, substantially as set forth.

3. The combination, with a heating-chamber, two troughs oppositely located in the heating-chamber having inwardly-inclined walls over which water may drip, and a water-feed pipe which connects the drip-troughs to a source of water-supply above, of two converging plates below the drip-troughs, two diverging plates below the converging plates, and a steam-supply for the heating-chamber, substantially as set forth.

4. The combination, with a water-heating chamber, a drip-chamber above the heating-chamber having an apertured diaphragm-wall adjacent to the heating-chamber, a condensing-chamber above the drip-chamber, and a water-supply pipe, of a water-feed pipe that is provided with an automatically-adjustable valve, two water-dripping troughs oppositely located in the heating-chamber, two deflector-plates, two converging plates, two diverging plates below the converging plates, and a steam-supply for the heating-chamber, substantially as set forth.

5. The combination, with a water-heating chamber having a steam-supply pipe on one side, two opposite water-dripping troughs above the steam-supply, two converging plates that receive water from the troughs, two diverging plates below, and an overflow-pipe, of a drip-chamber having a bottom diaphragm-plate which is centrally apertured, two deflector-plates located above the converging plates and adapted to receive water from the drip-chamber and deposit it in thin sheets on the converging plates, a tubular condenser above the drip-chamber having a water-supply pipe to introduce water therein, and a water-feeding pipe that transfers water from the condenser to the troughs in the heating-chamber, substantially as set forth.

6. The combination, with a heating-chamber having a blow-off pipe and valve at its base, an overflow-pipe on its side, and a steam-supply pipe above the overflow-pipe, of a series of plates within the heating-chamber which are downwardly inclined and adapted to convey water from above and expose it to enveloping steam, a water-feeding device which is actuated by a float in the heating-chamber, troughs that receive water from the water-feeding device and distribute it on the inclined plates, a drip-chamber above the heating-chamber, a tubular condenser above the drip-chamber, and a water-supply pipe for the condenser, substantially as set forth.

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