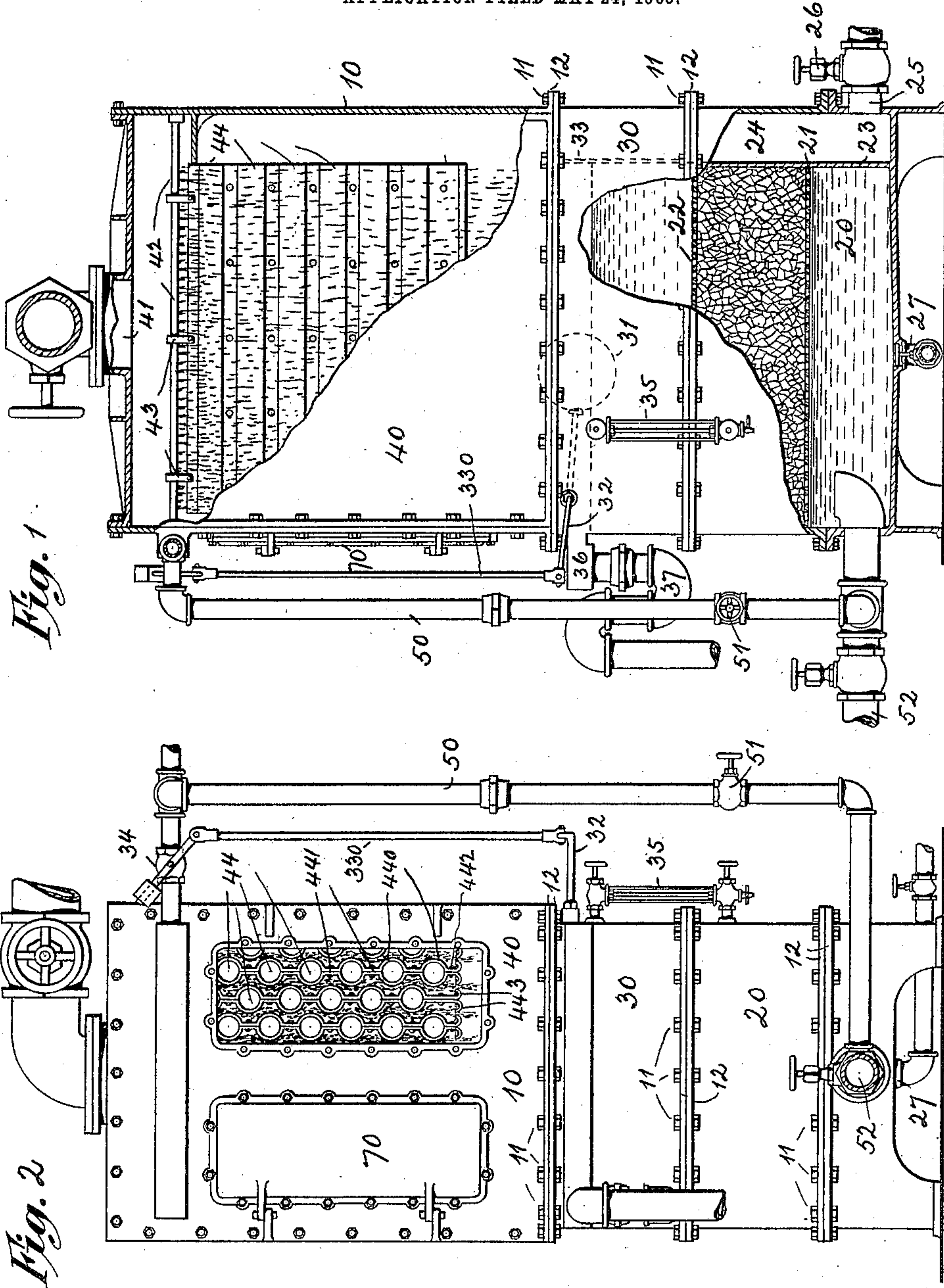


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H. G. MILLER.
FEED WATER HEATER.
APPLICATION FILED MAY 24, 1905.



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UNITED STATES PATENT OFFICE.

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FEED-WATER HEATER.

No. 812,944.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, HENRY G. MILLER, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Feed-Water Heaters, of which the following is a specification.

My invention relates to feed-water heaters, and its novelty resides in the construction and adaptation of the parts, as will be more fully hereinafter pointed out. I am well aware that numerous inventions have been made in this class of appliances and that some are more efficient than others. The one which embodies my invention and which is herein described seems to me to have obvious points of superiority in that its heating capacity is great, it permits of a relatively rapid passage of the water, it heats much water in a small time, and it does not exhaust the heat from the steam so completely as many forms of similar apparatus, because of the speed of its action.

In the drawings, Figure 1 is a side elevation of a form of apparatus embodying my invention, parts being broken away to show concealed parts; and Fig. 2 is an end elevation of the same structure, showing one of the doors adapted to close the heating-tubes removed.

In the drawings, 10 is a large box or chamber the walls of which are made of any suitable material, as steel or iron. It is preferably made in three horizontal sections 20, 30, and 40, adapted to be superimposed one above the other in proper relations and secured together by means of bolts 11 11, passing through external flanges 12 12 or in any other suitable manner. The lowermost section 20 is divided horizontally by means of a perforated partition 21, and a similar perforated partition 22 forms its upper wall or ceiling. It is also divided vertically by means of a non-porous or unperforated partition 23, which leaves a conduit or passageway 24 between it and the outer wall of the apparatus. At the bottom of this conduit is the steam-inlet aperture 25, the same being controlled by a suitable valve 26. At the bottom of this section is also an outlet-pipe 27 for emptying the apparatus. Between the partitions 21 and 22 is placed a layer of suitable filtering material, as coke, wood-

pulp, asbestos, or the like. The section 30 comprises a water-collecting chamber. It is divided vertically by a partition 33, which forms, in effect, with the wall of the apparatus a continuation of the steam-inlet way 24. It is also provided with a float 31, to which is secured a lever 32, which serves in turn to operate the rod 330 of a valve 34, which controls the cold-water-inlet valve. A water-gage glass 35 is placed outside of this section to afford an indication of the height of the water within.

40 is the water-heating section or chamber. This is a long chamber with an aperture 41 in its ceiling or uppermost wall to provide an outlet for the steam. Arranged horizontally in the upper part of the chamber are water-inlet pipes 42 42, each suitably perforated to admit of the discharge of the water in a spray or rain. Beneath the water-supply pipes are suspended on suitable brackets or from the supply-pipes themselves by means of hangers 43 43 the water-heating tubes 44.

The water-heating tubes are made of thin metal, preferably copper, and are made in the form of several parallel series of horizontal cylinders each 440, connected to its neighbor above and below by a vertical member 441, each series terminating at the bottom in a vertical member 442, having two upturned flanges 443 443, the purpose of which will presently appear. The series are arranged side by side, and the tubes of one series are staggered with those adjacent series on each side and are preferably so arranged that a vertical plane equidistant from the centers of any two series would intersect the surfaces of all the tubes of each series. While I have described the tubes as cylindrical, it will be understood that any form of tube having essentially the same functions is included within the principle of the invention. A pipe 50 depends from the cold-water inlet to the bottom of the apparatus outside of the same and is provided with a valve 51 near the bottom. At its bottom it enters a main pipe 52, leading from the lowermost part of the section 20 to the feed-pump. (Not shown.) The cold-water pipe, it will be understood, receives its water from a suitable source of supply, as a city main. The section 30 is provided with an overflow-pipe 36, leading to a trap 37, which in turn may lead

to a sewer or any other suitable place of discharge.

The mode of using the apparatus is as follows: The steam is allowed to enter from the exhaust of the engine or from any other suitable source of supply through the valve 25. It passes up through the passage-way 24 until it reaches the chamber 40, which it at once completely fills. Of course it also fills the empty spaces in the chambers 20 and 30. If the parts of the apparatus are cold, the steam will condense at first, and the water thus formed will trickle down to the bottom of the apparatus. The supply of steam being continued, however, the parts become rapidly heated, and particularly the series of water-heating tubes. These being made of thin copper rapidly absorb the heat, and the temperature is maintained because of the thorough contact with the steam both within and without such tubes. After the parts are thoroughly heated the cold water is turned on. It falls in a shower from the supply-pipes 42 42 onto the water-heating tubes 440. It rapidly takes up their heat, which is constantly renewed from the steam inside of these pipes. As the water falls it must pass from the surface of one tube to the one next below it in the adjacent series, because the tubes are so arranged that it cannot fall clear of them to the bottom. Finally, the water reaches the bottom of the chamber 40 thoroughly heated, thence it passes to the chamber 30, and finally to the chamber 20. When it reaches the latter, it goes through the filter-bed and leaves beneath the filter freed of all of the suspended impurities. The trough-shaped flanges 443 443 at the bottom of each series of vertical tubes are intended to catch and retain the solid impurities deposited out from the water, and this they do very efficiently. As the water accumulates it finally reaches a level sufficiently high to raise the float. This causes the excess to pass into the overflow-pipe and causes the valve operated by the float to close to shut off the source of cold-water supply. Doors 70 70 give access to the apparatus.

What I claim as new is—

1. An apparatus of the kind described, comprising a chamber, tubes arranged in said chamber and open to permit of the free passage of steam therethrough, a sprinkling-pipe for supplying with water the space in said chamber containing said tubes, and means for the inlet of steam into said space and also into the interiors of said tubes.

2. In an apparatus of the kind described, comprising a chamber having a steam-space therein: tubes each arranged in said steam-space and open at each end to permit the free passage of steam therethrough, whereby said tubes are heated by steam within and around the same, diaphragms arranged in said space and connecting the tubes with

each other, and a water-sprinkling pipe arranged above the uppermost tube.

3. In an apparatus of the kind described, comprising a chamber adapted to receive steam, tubes, each arranged in substantially horizontal position and open at each end to permit the free passage of the steam, such tubes being arranged in vertical series, each tube connected to its neighbor above and below by a diaphragm in combination with a water-sprinkling pipe arranged above the uppermost tube and a shallow sediment-receptacle beneath the lowermost tube.

4. In an apparatus of the kind described, a steam and water chamber, tubes, each made of heat-conducting material and arranged in a substantially horizontal position and open at each end to permit of the free passage of steam therethrough, said tubes being arranged in vertical series, diaphragms exposed to the steam and water in said chamber and connecting each tube with its neighbors above and below, means through which water is supplied to the space in said chamber around said tubes and a steam-inlet means having communication with said space and also with the interiors of said tubes.

5. In an apparatus of the kind described, comprising a chamber adapted to receive steam, tubes, each made of heat-conducting material and arranged in a substantially horizontal position and open at each end to permit of the free passage of the steam, such tubes being arranged in vertical series, each tube connected to its neighbor above and below by a conducting-diaphragm in combination with a water-sprinkling pipe arranged above the uppermost tube, and a shallow sediment-receptacle beneath the lowermost tube.

6. In an apparatus of the kind described, comprising a chamber having a steam and water space therein, a plurality of tubes arranged in vertical series in said space, each tube being substantially horizontal in position and open at each end to permit of the free passage of steam through it, and each connected to its neighbor above and below by a diaphragm, the tubes in adjacent series being staggered.

7. In an apparatus of the kind described, comprising a chamber having a steam-space therein, a plurality of tubes arranged in vertical series in said space, each tube being substantially horizontal in position and open at each end to permit of the free passage of steam through it, and each connected to its neighbor above and below by a diaphragm, the tubes in adjacent series being staggered, in combination with a water-sprinkling mechanism arranged above the tubes and supplying said space with water.

8. In an apparatus of the kind described, comprising a chamber having a steam and water space therein, a plurality of tubes ar-

ranged in vertical series in said space, each tube being substantially horizontal in position and open at each end to permit of the free passage of steam through it, and each
 5 connected to its neighbor above and below by a diaphragm, the tubes in adjacent series being staggered, and so arranged that each tube has a portion of its surface vertically beneath the surface of its nearest neighbor above
 10 it in each adjacent series.

9. In an apparatus of the kind described, comprising a chamber having a steam-space therein, a plurality of tubes arranged in vertical series in said space, each tube being substantially horizontal in position and open at
 15 each end to permit of the free passage of steam through it, and each connected to its neighbor above and below by a diaphragm, the tubes in adjacent series being staggered, and so arranged that each tube has a portion
 20 of its surface vertically beneath the surface of its nearest neighbor above it in each adjacent series, in combination with a water-sprinkling mechanism arranged above the tubes.

10. In an apparatus of the kind described, comprising a chamber adapted to receive steam, a plurality of tubes arranged in vertical series, each tube being substantially
 25 horizontal in position and open at each end to permit of the free passage of steam, and each connected to its neighbor above and below by a diaphragm, the tubes in adjacent series being staggered, and a shallow sediment-receptacle beneath the lowermost tube in each
 30 series.

11. In an apparatus of the kind described, comprising a chamber adapted to receive steam, a plurality of tubes arranged in vertical series, each tube being substantially horizontal
 40 in position and open at each end to permit of the free passage of steam, and each connected to its neighbor above and below by a diaphragm, the tubes in adjacent series being staggered, and a shallow sediment-receptacle beneath the lowermost tube in each
 45 series, in combination with a water-sprinkling mechanism arranged above the tubes.

12. In an apparatus of the kind described, comprising a chamber adapted to receive steam, a plurality of tubes arranged in vertical series, each tube being substantially horizontal
 50 in position and open at each end to permit of the free passage of steam and each connected to its neighbor above and below by a diaphragm, the tubes in adjacent series being staggered, and so arranged that each tube has a portion of its surface vertically beneath the surface of its nearest neighbor above
 55 it in each adjacent series, and a shallow sediment-receptacle beneath the lowermost tube in each series.

13. In an apparatus of the kind described, comprising a chamber: a plurality of series of heat-radiating tubes arranged in said
 65 chamber, said tubes being open to permit the

free passage of steam through the same and having external diaphragms which connect with each other the tubes of each series, said tubes and diaphragms being arranged to provide a steam and water passage-way between
 70 the two series, means through which said passage-way is supplied with water and means through which said passage-way and the interiors of said tube are supplied with steam.

14. In an apparatus of the class described, comprising a chamber: a plurality of heat-radiating tubes arranged in a vertical series in said chamber, said tubes being open to permit the free passage of the steam through the
 75 same, a diaphragm connecting each of said tubes with its neighbors above and below it, a second vertical series of heat-radiating tubes, arranged to alternate with the tubes of the first series, a diaphragm connecting
 80 each tube of said second series with its neighbors above and below, and means for supplying the interiors of said tubes and the passage-ways between the two series of tubes and diaphragms with steam and water respectively.

15. In an apparatus of the kind described, comprising a chamber: a plurality of series of tubes arranged in said chamber, said tubes being open to permit the free passage of
 90 steam through the same and having external diaphragms which connect with each other the tubes of each series, and said plurality of series of tubes and diaphragms being so related that the intermediate tubes of each will confront the diaphragms and be between the
 95 contiguous tubes of its companion series, whereby there is formed a circuitous passage-way between the two series, means through which said passage-way is supplied with water and means through which said passage-way and the interiors of said tubes are supplied
 100 with steam.

16. An apparatus of the kind described, comprising a chamber having a steam-conduit at one side and having its interior in communication with said conduit, a series of
 110 open tubes arranged in said chamber and having communication with said conduit, whereby the steam enters the interior of the chamber and also flows through said tubes, diaphragms connecting said tubes in series,
 115 and a sprinkling-pipe for supplying said chamber with water which commingles with the steam in the chamber and is further heated by the radiant heat of the tubes and diaphragms.

17. In an apparatus of the kind described, comprising a chamber adapted to receive steam, a plurality of tubes arranged in vertical series, each tube being substantially horizontal
 120 in position and open at each end to permit of the free passage of steam, and each connected to its neighbor above and below by a diaphragm, the tubes in adjacent series being staggered, and so arranged that each tube has a portion of its surface vertically
 125

beneath the surface of its nearest neighbor above it in each adjacent series, in combination with a water-sprinkling mechanism arranged above the tubes, and a water-receiving chamber comprising a filter arranged below the series of tubes.

18. In an apparatus of the kind described, comprising a steam-chamber provided with inlet and outlet steam-conduits, a plurality of tubes arranged in vertical series, each tube being substantially horizontal in position and open at each end to permit of the free passage of steam through the same, and each connected to its neighbor by a diaphragm, the tubes in adjacent series being staggered and so arranged that each tube has a portion of its surface vertically beneath the surface of its nearest neighbor above it in each adjacent series, in combination with a water-sprinkling mechanism arranged above the tubes, a water-receiving chamber comprising a filter arranged below the tubes and doors in the wall of the steam-chamber giving access to the tubes.

19. An apparatus of the kind described, comprising a steam-chamber provided with a conduit through which the same is supplied with steam and having a water-receiving chamber at one end portion, tubes arranged in series in the steam-space of said chamber and in advance of said water-receiving cham-

ber, said tubes being open for the passage of steam through the same and having communication with said conduit, diaphragms connecting with each other the tubes of each series, and a water-supplying means arranged in advance of said series of tubes, for supplying with water the steam-containing passage-way between the series of tubes.

20. An apparatus of the kind described, comprising a chamber provided with a conduit through which the same is supplied with steam and having a water-receiving portion at one end; tubes arranged in series in the steam-space of said chamber and in advance of said water-receiving chamber, said tubes being open for the passage of steam through the same and having communication with said conduit, and the tubes of one series alternating in position with those of the next series, diaphragms connecting with each other the tubes of each series, and a water-supplying means arranged in advance of said series of tubes for supplying with water the steam-containing circuitous passage-way between the series of tubes.

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

HENRY G. MILLER.

Witnesses:

ALAN C. McDONNELL,
MAY HUGHES.