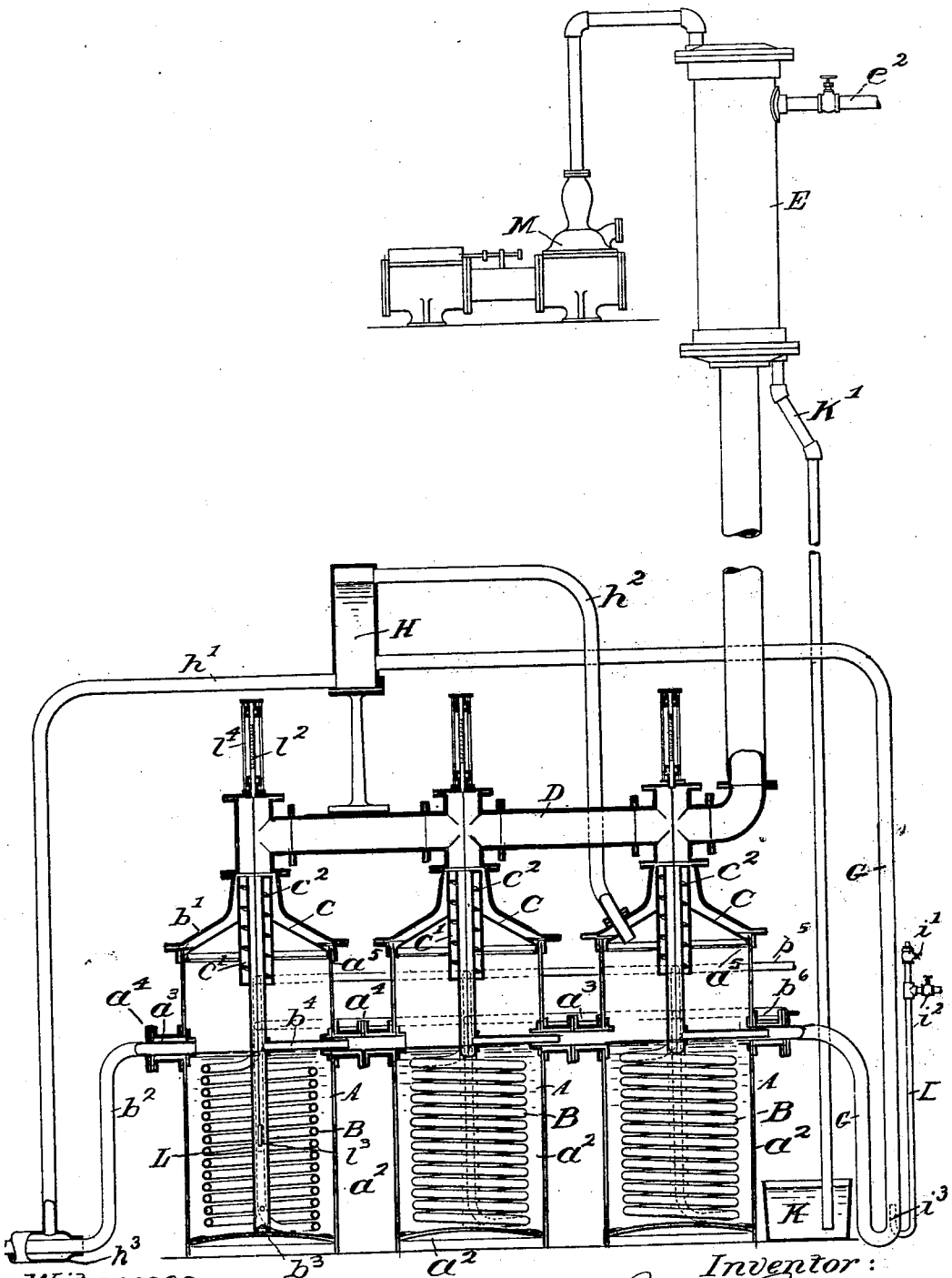
No. 676,663. Patented June 18, 1901.

J. PATTEN.

APPARATUS FOR CONCENTRATING ACIDS.

(Application filed Aug. 29, 1896. Renewed May 29, 1900.)

(No Model.)



# UNITED STATES PATENT OFFICE.

JOHN PATTEN, OF BALTIMORE, MARYLAND, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE PATTEN VACUUM ICE MACHINE COMPANY, OF SAME PLACE.

## APPARATUS FOR CONCENTRATING ACIDS.

SPECIFICATION forming part of Letters Patent No. 676,663, dated June 18, 1901.

Application filed August 29, 1896. Renewed May 29, 1900. Serial No. 18,460. (No model.)

*To all whom it may concern:*

Be it known that I, JOHN PATTEN, of the city of Baltimore, in the State of Maryland, have invented a new and useful Improvement in Concentrators for Acids, of which the following is a full description.

The object of the device is to concentrate acids in a vacuum, whereby the concentration may take place at a low temperature and within a minimum of space occupied by the device.

The accompanying drawing illustrates the invention and shows an upright side view of the apparatus with the tanks in section to exhibit the interior parts.

As shown in the drawing, the device is represented by three tanks A A A, which are constructed of suitable material, usually of iron, and are lined with lead to prevent contact of the acid with the iron. As the expansion and contraction of the lead is greater than that of the iron, it is desirable that the lining be made free to expand and contract independent of the casing and be so formed that its expansion and contraction will not break the lining and admit the acid through the break to contact with the iron.

$a^2$ represents the lead lining within the casing A, of which the sides and bottom are formed as nearly as practicable in one piece, and is provided with short inlet and outlet tubes $a^3$, which project through the longer tube-openings into the outer casing. The outer ends of these tubes are flanged over at $a^4$ and serve to form the joint with the flanged iron pipe connected therewith at the inlet and outlet. It would thus be a lead tank within an iron tank and connected therewith only at the points of ingress and egress of the acid. This lining projects up to a point near the flanges of the outer casing, and there the lead lining is provided with a flange $a^5$, which furnishes a seat for the lead hood C, which is seated upon the flange $a^5$. To this hood is connected the pipe C′, which projects above and below the apex of the hood and is furnished inside with the splash-flange or spiral $c^2$. The hood and the tube together effectually seal the device at the top and prevent the splashing of the acid from passing above and corroding the iron of the tanks or pipes, while the spiral $c^2$ imparts a winding movement to the ascending vapors and acts as a separator, whereby any particles of acid passing up with the vapor are separated and drop back. The tanks are then capped with iron hoods $b'$, which are properly flanged to make connection with the pipe D, leading to the condenser.

Within the tanks and below the acid inlets and outlets are placed the coils B. These coils are supplied with steam or other heating agent from a source not shown in the drawings through the pipe $b^5$, and passing through the coils it is discharged through the pipe $b^6$. A stand-pipe L passes down through the tube C′ and through the center of the lead lining. Its upper end opens into the pipe D, and its lower end is provided with the opening $b^3$. Projecting from the side of this pipe is another lead pipe $b^4$, which enters into the lead lining-tube $a^3$ at the outlet. The weak or dilute acid enters through the pipe $b^2$, falls into the tank surrounding the heated tube and entering the opening $b^3$ at the bottom of the stand-pipe L ascends in the pipe, finding its level just above the top of the coil, and thence passes from the tube L through the pipe $b^4$ into the next adjoining tank and on to the next, leaving a space above its level in each of the tanks closed at the top by the hoods C and C′. Thus it will be seen that the acid flowing into the tanks goes to the bottom and is drawn out from the bottom and discharged, so that when the new supply enters each tank it finds its way out only from the bottom of each tank. From the last tank it is discharged into the pipe G. This pipe extends downwardly and then curves upwardly at the bottom, and at the curve is inserted the end of pipe I, as shown at $i^3$. Into this pipe there is injected a jet of steam or air for which provision is made by means of the cocks $i'$ $i^2$, one of which is open to the air, and the other may be connected to a source of steam-supply. Either the steam or the air admitted into the bottom of the pipe G expands and mixing with the acid lightens the ascending column and forces it up into the reservoir H. This reservoir acts also as a separator, and as the acid enters and fills the same and the air and vapors accumulate at the top, and sometimes small portions

of the acid also, which pass into the pipe $h^2$ and are conducted thereby through the hood and into one of the concentrator-tanks, the acid passes out of the reservoir H in concentrated form through the pipe $h'$. This pipe $h'$ conducts the acid into a larger tube $h^3$, which surrounds the pipe $b^2$ and leads off to a receptacle for the hot concentrated acid, and as the cooler dilute acid is passing through the pipe $b^2$ it is warmed by the hot acid in $h^3$, which in turn is cooled by contact with the pipe $b^2$. The pipe D leads into the condenser E, into which cold water is admitted by means of the pipe $e^2$.

M is a pump of ordinary construction, by means of which a vacuum is formed and maintained in the condenser, the pipe D, and in the open spaces in the tanks above the coils, and the escaping vapors pass up to the condenser, where they are condensed and discharged through the pipe K', whose lower end is submerged in the tank K. It will be seen that by this construction a Torricellian vacuum is formed. The condenser is elevated something more than thirty-three feet above the outlet of the discharge-pipe K'. Now when a vacuum is formed in this condenser and the end of the discharge-pipe is submerged the water rises in this pipe as high as the vacuum in the condenser will sustain it, and as the continuous discharge from the condenser adds to the volume of water in the discharge-pipe the surplus runs off into the tank K, leaving the volume in the pipe at a constant normal height. Thus the water in the discharge-pipe is a sealing device, preventing the entrance of air into the condenser to destroy the vacuum, at the same time allowing a free discharge of the water of condensation and also the cooling-water entering the condenser.

A pipe L, passing down centrally through the pipe C and open at the bottom, enables me to provide the apparatus with a hydrometer, by means of which the density of the acid can be ascertained. This hydrometer is shown at $l^4$. It is provided with the spiral spring $l^2$, from which a plain platinum wire depends, with a small weight $l^3$ at the bottom. As the acid becomes more dense during the process of concentration this hydrometer registers and indicates the stage of concentration to which the acid has been brought.

What I claim, and desire to secure by Letters Patent, is—

1. In a concentrating apparatus, a tank provided with a coil and means for heating the same, in combination with a pipe for delivering dilute acid into the tank upon and about the heated coil, means for draining off the acid from the tank, a reservoir located above the apparatus, means for forcing the acid to the reservoir, and means for maintaining a vacuum in the tank above the surface of the acid.

2. The combination of a tank having inlet and discharge pipes through which acid is circulated, means for maintaining said tank and pipes at less than atmospheric pressure, and means for circulating the acid comprising an upwardly-extending portion of one of said pipes provided at its lower end with an inlet for atmospheric air.

3. The combination of a tank having inlet and discharge pipes through which acid is circulated, means for maintaining said tank and pipes at less than atmospheric pressure, and means for circulating the acid comprising an upwardly-extending portion of one of said pipes provided at its lower end with an inlet for atmospheric air, and means for regulating the amount of air admitted.

4. The combination of a tank having inlet and discharge pipes through which acid is circulated, means for maintaining said tank and pipes at less than atmospheric pressure, and means for circulating the acid comprising an upwardly-extending portion of one of said pipes provided at its lower end with an inlet for atmospheric air, an air-supply pipe extending upwardly from said inlet, and a valve for controlling the flow of air through said pipe.

5. The combination of a tank having inlet and discharge pipes through which acid is circulated, means for maintaining said tank and pipes at less than atmospheric pressure, and means for circulating the acid comprising a portion of the discharge-pipe which extends downwardly and then curves upwardly, and a vertically-arranged air-pipe having one end open to the atmosphere and its other end communicating with the lower part of the upwardly-extending discharge-pipe.

6. In a concentrating apparatus, a tank provided with a coil and means for heating the same, in combination with a pipe for delivering dilute acid into the tank upon and about the heated coil, means for drawing the acid from the tank, a reservoir H located upon a level above the tank, devices for forcing the acid to the reservoir, means for separating the air from the acid in the reservoir, devices for returning the separated air to the tank from the reservoir, and means for maintaining a vacuum in the tank above the surface of the acid.

7. In a concentrating apparatus, a tank provided with a coil and means for heating the same, a pipe for delivering dilute acid into the tank, upon and about the coil, in combination with devices for drawing off the acid from the tank, a reservoir for receiving the acid located above the tank, a discharge-pipe for delivering the acid drawn off into the reservoir, and means for injecting air into the discharge-pipe to thereby lighten the column of acid and force it into the reservoir.

8. In a concentrating apparatus a series of tanks, each provided with a heating-coil, means for supplying a heating agent thereto, in combination with an inlet and outlet pipe

in each of the tanks, whereby the acid is delivered over the coils in each of the tanks successively, a discharge-pipe as G located at the end of the series, means for elevating the acid in said discharge-pipe to a reservoir, a condenser and means for forming and maintaining a vacuum in the tanks through the condenser.

9. In a concentrating apparatus a tank provided with a heating-coil, means for supplying a heating agent to the coil, and means for discharging the heating agent from the coil, in combination with inlet and outlet pipes for delivering the dilute acid into the tank upon and about the coil, a hood surmounting the tank having its top inner wall elevated sufficiently to leave an open space between it and the outlet-pipe for the acid, a condenser and connections leading therefrom to the top of the hood, and means for forming a vacuum in the tank through the condenser.

10. In a concentrating device, a tank having an outlet and an inlet opening, in combination with a non-corrosive lining having its sides and bottom formed in a practically single piece and provided with means for fastening and securing the same to the tank only at the openings, and a hood surmounting the tank having its top inner wall elevated sufficiently to leave an open space between it and the outlet-pipe for the acid.

11. In a concentrating apparatus, a tank surmounted by a dome and provided with an interior lead lining also surmounted by a dome, a condenser and connections between it and the top of the dome, in combination with a tube $c'$ passing through both domes and leading to the connections with the condenser and provided interiorly with a spiral dash-plate $c^2$, substantially as described.

Signed at Baltimore, in the State of Maryland, this 20th day of July, A. D. 1896.

JOHN PATTEN.

Witnesses:

FELIX R. SULLIVAN,

G. DAVIS NEAVITT.