No. 676,664. Patented June 18, 1901.

J. PATTEN.

CONCENTRATOR FOR ACIDS.

(Application filed Aug. 9, 1900.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1.

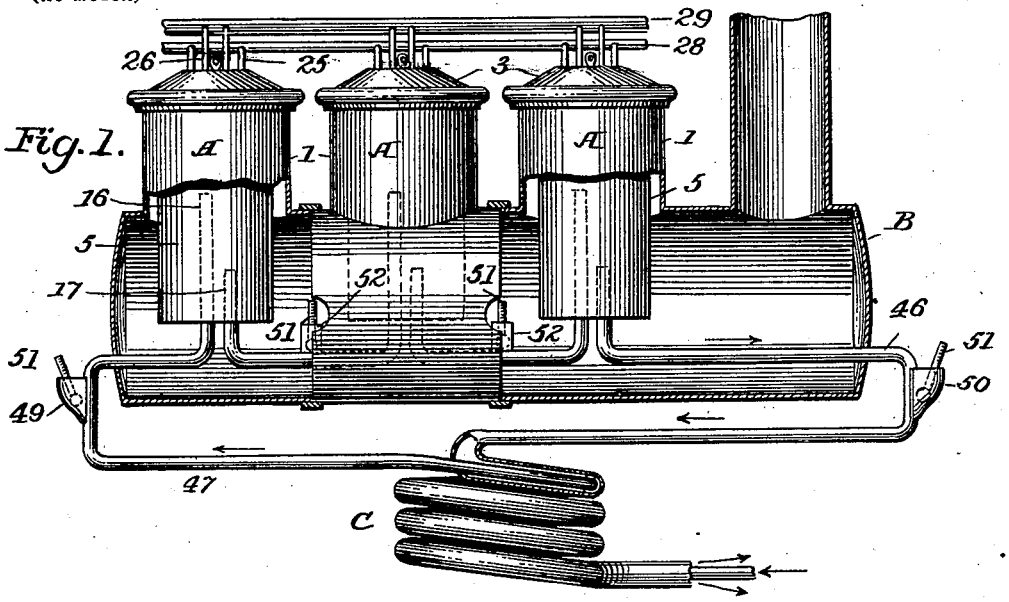
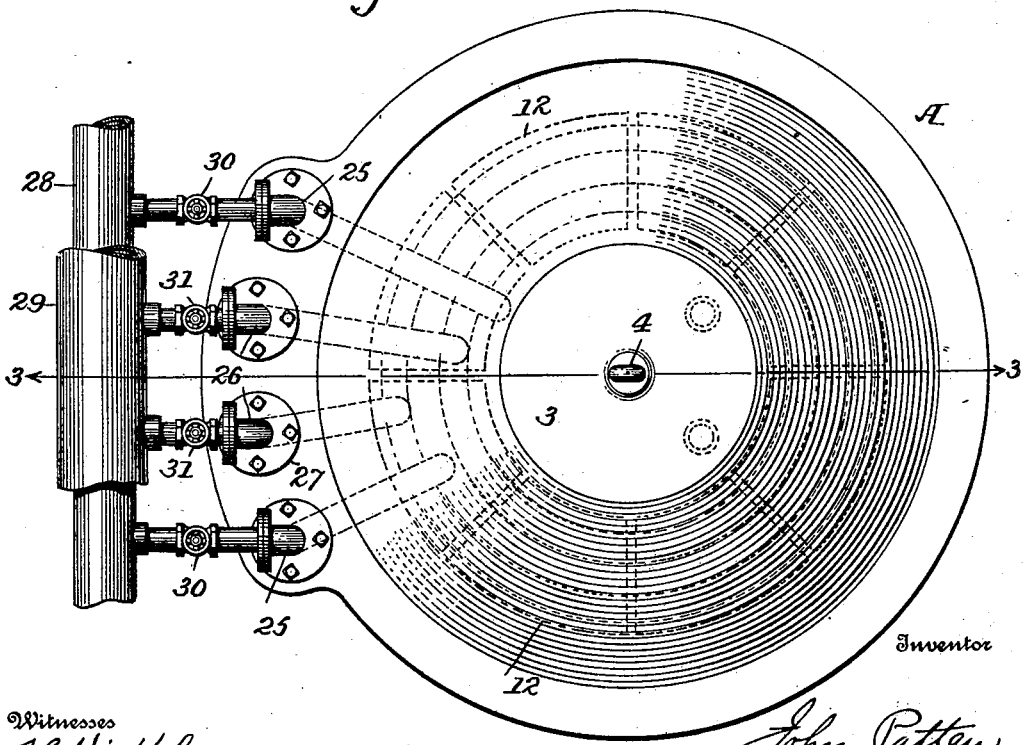


Fig. 2.



Witnesses

J. G. Hinkel

Arthur L. Bryant

Inventor

John Patten

By Watson & Watson Attorneys

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 676,664. Patented June 18, 1901.

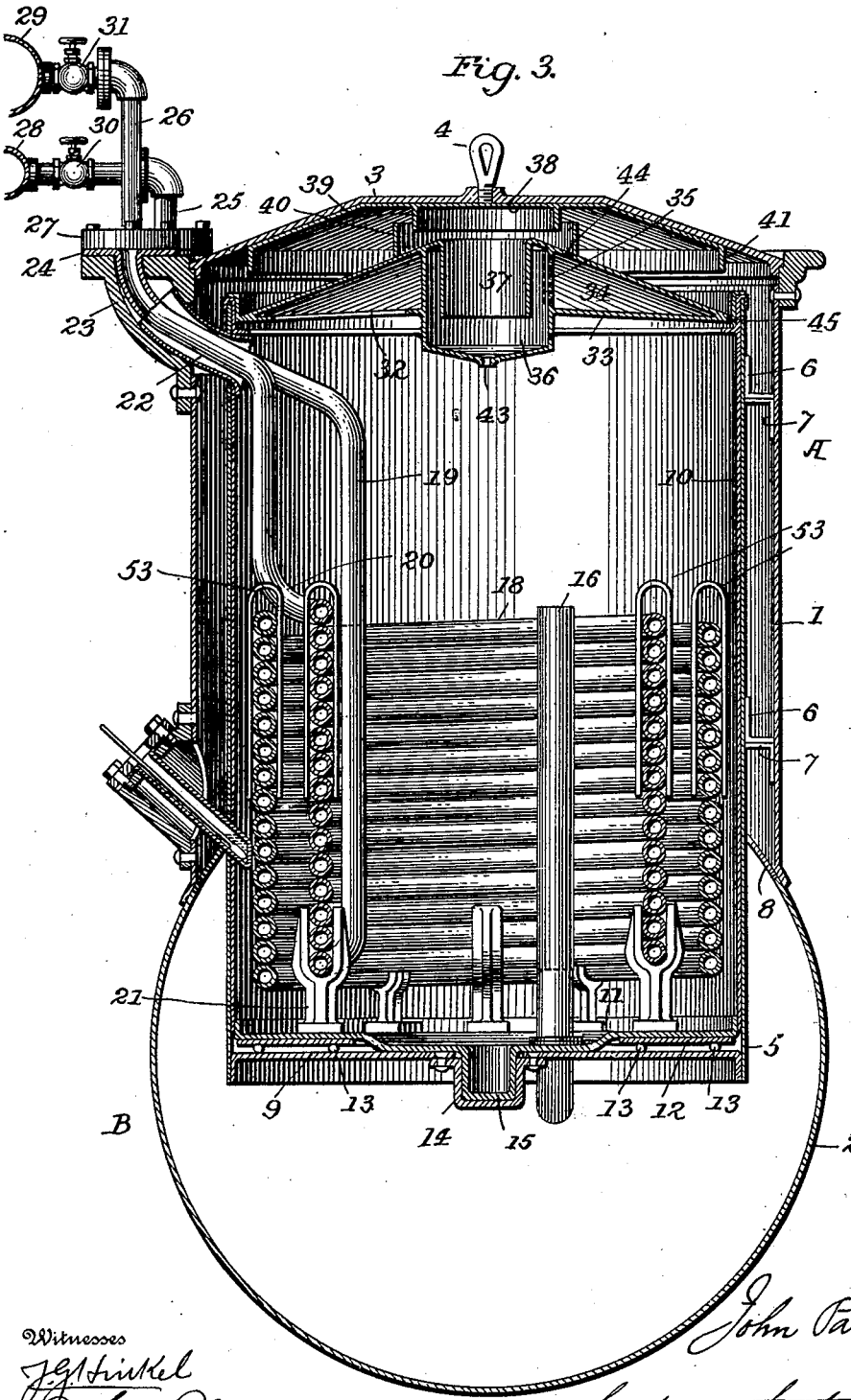
J. PATTEN.

CONCENTRATOR FOR ACIDS.

(Application filed Aug. 9, 1900.)

(No Model.) 3 Sheets—Sheet 2.

Fig. 3.



Witnesses

J. J. Finkel

Arthur L. Bryant.

Inventor

John Patten

By Watson & Watson, Attorneys.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 676,664. Patented June 18, 1901.

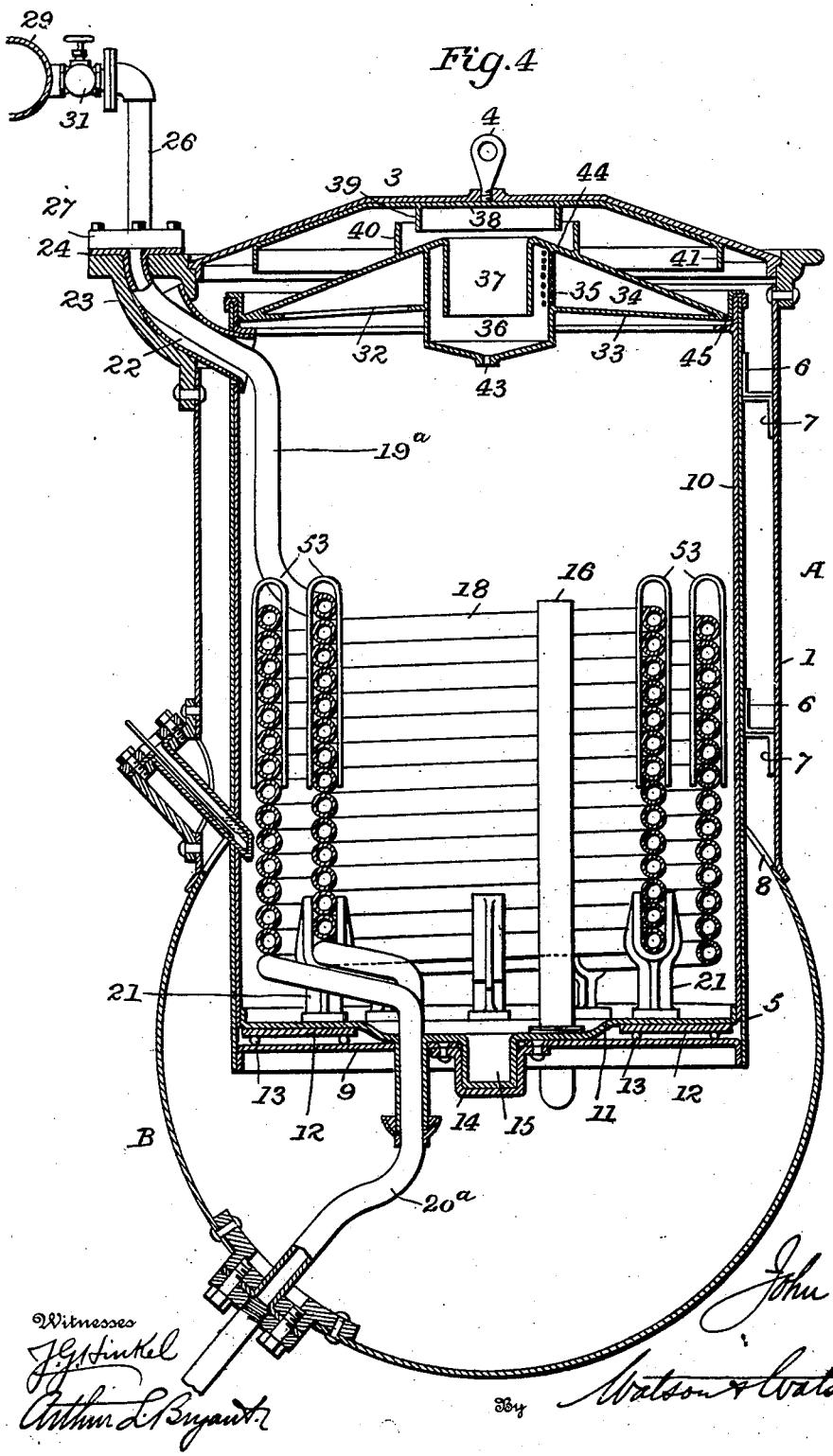
J. PATTEN.

CONCENTRATOR FOR ACIDS.

(Application filed Aug. 9, 1900.)

(No Model.) 3 Sheets—Sheet 3.

Fig. 4



Witnesses
J. G. Hinkel
Arthur L. Bryant

Inventor
John Patten

By Watson & Watson Attorneys

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

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

CONCENTRATOR FOR ACIDS.

SPECIFICATION forming part of Letters Patent No. 676,664, dated June 18, 1901.

Application filed August 9, 1900. Serial No. 26,408. (No model.)

To all whom it may concern:

Be it known that I, JOHN PATTEN, a citizen of the United States, residing at the city of Baltimore, in the State of Maryland, have invented certain new and useful Improvements in Concentrators for Acids, of which the following is a specification.

My present invention relates to apparatus for concentrating sulfuric acid and like materials. It is particularly designed for concentrating the weak acid which has been used to absorb vapor in vacuum ice-making apparatus and which has thereby become diluted and unfit for further service until reconcentrated.

In apparatus of the class mentioned a lead lining arranged within and supported by an iron casing has been generally used, and a great deal of difficulty has been caused by the acid foaming, boiling, or splashing over the vessel and getting between the lining and the casing, where it attacks the metal, forming sulfate of iron, to the injury of both the iron casing and the lead lining. In apparatus of this class also the lead lining rapidly deteriorates on account of the difference in the coefficients of expansion of lead and iron, which causes strains and eventually rupture in the lead. The present invention is designed to remedy these defects and also to provide concentrating apparatus all parts of which are easily accessible for inspection and repairs.

The invention will be more fully described in connection with the accompanying drawings, in which—

Figure 1 is a side view of a series or battery of concentrators constructed according to my invention. Fig. 2 is a plan view of one of the concentrators. Fig. 3 is a vertical section on the line 3 3 of Fig. 2; and Fig. 4 is a view similar to Fig. 3, showing a modification.

Referring to the drawings, A indicates the individual concentrators, each of which rests upon a section of a common trunk or tube B, through which the vapor is exhausted. The concentrating-chamber A comprises an outer casing 1, which is securely attached to a section 2 of the trunk B. The outer casing 1 supports a cover 3, the joint between the cover and casing being substantially air-tight. The cover may be raised by an eye 4, centrally connected to it, to expose the interior of the casing.

Within the casing 1 is a cylindrical iron vessel 5. Upon this vessel are brackets 6, which rest upon brackets 7, attached to the casing. The vessel 5 extends downward through a large opening 8 in the trunk-section 2 into the interior thereof, and it is provided with a suitable closed bottom 9.

The vessel 5 has a lead lining 10 of sufficient stiffness to stand by itself without attachment to the vertical wall of the vessel and of sufficient strength to resist the pressure of the contained acid, so that while it is hot it may be in contact with the iron casing; but when it is cooled in contracting its strength is such that it will pull the lead away from the iron, so that any strain produced by the pressure of the acid is taken by the lead lining. In other lead-lined vessels of similar construction the practice has been to depend upon the iron casing for strength, and when the lead lining cooled the pressure of the contained liquid kept the lining in contact with the iron casing, thereby stretching the lead, which eventually finds a weak place and cracks the lining, making a rupture, which allows the acid to come in contact with the iron.

I have found that when I make my linings to a certain extent independent of the casing and of sufficient strength they will last for an indefinite length of time without deteriorating, while linings without this provision will sometimes give way in a few months when they are frequently heated and cooled. The outer portion of the bottom 11 of the lining rests upon iron plates 12, which in turn rest upon rollers 13, free to move radially upon the bottom 9 of the vessel 5. These rollers permit the lead bottom to expand and contract radially. In the center of the bottom 9 is a well 14, and a corresponding well 15 is formed in the lead lining. When the tank is being drained of acid, the last portion runs into the well and may be easily removed.

In each concentrating vessel there are an inlet-pipe 16 and an outlet 17, both of which pass through the bottom of the vessel at points near the center, where the expansion and contraction are so slight that they may be disregarded.

Heat is supplied to the acid in the vessels

by means of steam-coils 18. As shown, two concentric coils are used, each having an independent supply-pipe 19 and an independent exhaust-pipe 20. The convolutions of the coils rest upon one another, and the lowest convolution rests in yokes 21, which yokes in turn rest upon the lead bottom above the plates 12. The expansion of the coils is thus taken care of by the antifriction-rollers 13, as well as the expansion of the lead bottom. The terminals 19 20 of the coils pass out through a lead tube 22 in the side of the concentrating vessel and into a hollow bracket 23, connected to the outer side of the casing 1 near its top. The terminal pipes have flanges 24, which rest on the top of the bracket 23, and the steam-pipes 25 26 have flanges 27, which are bolted to the bracket, thus clamping the lead flanges between them and making steam-tight joints between the steam-pipes 25 26 and the terminals of the lead pipes 19 20. A single steam-supply pipe 28 supplies the entire battery of concentrators, and a single exhaust-pipe 29 receives the waste steam. Suitable valves 30 and 31 are provided for cutting off the steam from any concentrator. In Fig. 4 I have shown the steam-supply pipes 19^a leading into the top of the coils and the exhaust-pipes 20^a leading downward from the bottoms of the coils. This arrangement permits the water of condensation to run by gravity from the coils to a common pipe (not shown) beneath the coils.

The vapor of water arising from the hot acid in the concentrator carries with it a certain amount of acid, which it is desirable to entrap and return to the vessel. To accomplish this, I provide the inner vessel with a lead cover of the form shown in Fig. 3. The vapor first passes through an opening 32 in the lower diaphragm 33 of the cover into a chamber 34 between the lower and upper diaphragms. It then passes through openings 35 in the side of a cylindrical chamber 36 and strikes against a downwardly-projecting flange 37. The vapor is then directed against the bottom of the chamber 36 and then upward within the cylindrical wall 37 against the lead lining 38 of the outer cover 3. The vapor finally passes between baffle-plates 39 40 on the outer and inner covers, respectively, which causes it to again strike against the outer lead lining 38. This lining has a peripheral flange 41 over the outer margin of the inner cover. The vapor after passing the flange 41 passes down through the space between the outer casing 1 and the inner vessel 5 into the common trunk B and finally out through a stack or pipe 42, Fig. 1, which may, if desired, be in communication with an exhaust-pump. It will be seen that the vapor strikes first against the conical upper plate of the inner cover, then takes a semicircular course, through which means the centrifugal force separates the unvaporized acid from the vapor, then against the cylindrical wall 37, then against the bottom of the chamber 36, then against the lining 38, and finally against the baffle-plates 39 and 40. All entrained acid is thus separated and permitted to run back into the concentrator through suitable openings 43, 44, and 45 and the opening 32. A suitable opening is provided in the trunk B to permit a repair-man to enter. In practice there will always be in the trunk B, which is horizontal, a few inches of water, in which is dissolved a certain amount for alkali, preferably common sal-soda. This solution of soda or alkaline-carbonate has no injurious effect upon the iron, and, in fact, prevents it from rusting. Then if any acid should by any means pass out of the lead-lined concentrators into the large pipe or trunk it is immediately neutralized by the alkali, so that it will do no harm to the metal.

It will be evident from an inspection of the drawings that the apparatus described can be very readily separated, so that any part can be repaired. Thus the outer cover can be lifted off and the inner cover also removed without difficulty, as they simply rest upon their respective vessels. By disconnecting the flanges 27 from the bracket 23 the lead-pipe terminals may be drawn in through said bracket and the coils lifted out of the inner vessel 5. All parts of the lead lining are thus exposed and rendered accessible.

The acid leaving the concentrators through the pipe 46 is made to give up its heat to the weaker acid entering by the pipe 47 by means of a heater-exchanger C. As shown, this consists of a coil of large pipe through which the hot acid passes and an inclosed coil of pipe through which the weak acid runs in the opposite direction. On the inlet and outlet pipes are metal cups 49 and 50, containing thermometers 51, which are immersed in some non-evaporating fluid. Similar cups 52 and 55 are arranged on the pipes connecting the several concentrating vessels and in the sides of the concentrating vessels, respectively. The degree of vacuum in the concentrators being known, the temperature of the acid in the several pipes will indicate its strength. These thermometers are used to enable the operator to properly regulate the heat applied to each concentrating vessel by means of the steam-valves 30 and 31.

The several turns of the lead coils 18 are welded together, and straps 53 are securely connected to them. By means of the straps 53 the coils may be lifted out of the tanks.

It will be seen that I concentrate the acid by steps or degrees. It increases in strength from the initial tank until it reaches the final tank, and said final tank is therefore the only one likely to be injured by reason of the acid becoming accidentally concentrated to too high a degree.

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

1. In an acid-concentrating apparatus, the

combination with a horizontal vapor-tube, of a series of acid-concentrating vessels supported upon and above said tube and arranged to discharge vapor downward into the same, means for circulating acid through said vessels, and means for heating the acid in said vessels, said tube being adapted to hold a layer of fluid material to protect its bottom against acid which may be carried over from the concentrating vessels.

2. In an acid-concentrating apparatus, the combination with a common vapor-tube, of a series of casings supported on said tube, acid-concentrating vessels removably supported within said casings and arranged to discharge vapor into said tube, means for circulating acid through said vessels successively, and means for heating the acid in said vessels.

3. In an acid-concentrating apparatus, the combination with a relatively large vapor-tube, of a series of casings supported on said tube and communicating therewith, acid-concentrating vessels removably supported within the casings, heating-coils within said vessels, and acid-circulating pipes extending between the vessels and arranged within the vapor-tube.

4. In an acid-concentrating apparatus, the combination with a common trunk or vapor-tube, of the casings supported on said tube and provided with removable covers, the acid-concentrating vessels removably supported in said casings, acid-circulating pipes communicating with said vessels, heating devices in said vessels, and means for independently controlling the heat supplied to each of said vessels.

5. In an acid-concentrating apparatus, the combination of the vapor-exhaust tube, the outer casing supported on and in communication with said tube, a cover for said casing, the acid vessel removably supported within the casing, the heating-coils within said vessel, and the acid supply and discharge pipes entering through the bottom of the acid vessel, the portions of said pipes outside of the acid vessel being within the exhaust-tube.

6. In an acid-concentrating apparatus, the combination of a vapor-exhaust tube, a vertical casing supported on said tube and having its interior in communication with the interior of the tube, an acid vessel removably supported within the casing and having its lower end extending into the tube, a closed cover for said casing, a cover for the acid vessel having a circuitous passage therethrough, and suitable devices for heating the acid within the vessel.

7. In an acid-concentrating apparatus, the combination of a common trunk or tube, a series of openings in the upper side of said tube, casings upon the tube in communication with said openings, acid vessels removably supported within the casings, a closed cover for each casing, a cover having passages therein for each acid vessel, and acid-transmitting pipes connecting the acid vessels within the tube, said exhaust-tube being in communication with the interior of each casing.

8. An acid-concentrating apparatus comprising an outer casing having a suitable cover, an inner acid-containing vessel, coils within said vessel, a passage extending transversely through the side walls of the casing and acid vessel, and steam-coils within the acid vessel having their terminals extending through said passage whereby the covers may be removed without disturbing the steam connections.

9. In acid-concentrating apparatus, the combination of the outer casing, the inner acid-containing vessel, the hollow bracket upon the outer casing near the upper end thereof, the tube connecting said bracket with the acid vessel, and the heating-coils within the acid vessel, said coils having terminals extending through said tube and bracket and detachably connected to the latter, for the purpose set forth.

10. In an acid-concentrating apparatus, the combination of the acid vessel, the lead lining therein, the supporting-plates for the bottom of said lining, and the antifriction-bearings for said plates.

11. In an acid-concentrating apparatus, the combination of the acid vessel, the lead lining therein, the supporting-plates for the bottom of said lining, the antifriction-bearings for said plates, the coil within the concentrator, and the supports for said coil resting upon said plates and bearings.

12. In acid-concentrating apparatus, the combination of the cylindrical acid vessel, the lead lining therein, the radially-movable plates supporting the outer portion of the bottom of said lining, and the antifriction-bearings for said plates.

13. In acid-concentrating apparatus, the combination of the concentrating vessel, the lead lining therein, the movable plates supporting the outer portion of the bottom of said lining, and the acid inlet and discharge pipes extending through the middle portion of the bottom of said lining, for the purpose set forth.

14. In acid-concentrating apparatus, the combination of the vertically-arranged cylindrical concentrating vessel having a central wall in the bottom thereof, the lead lining fitting said vessel and having a corresponding wall, the acid inlet and discharge pipes extending through the bottom of the vessel adjacent to the wall, and the movable supports for the outer portion of the bottom of the lead lining.

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

JOHN PATTEN.

Witnesses:
WM. G. HOOFNAGLE,
JOHN W. HEWES.