No. 676,665. Patented June 18, 1901.

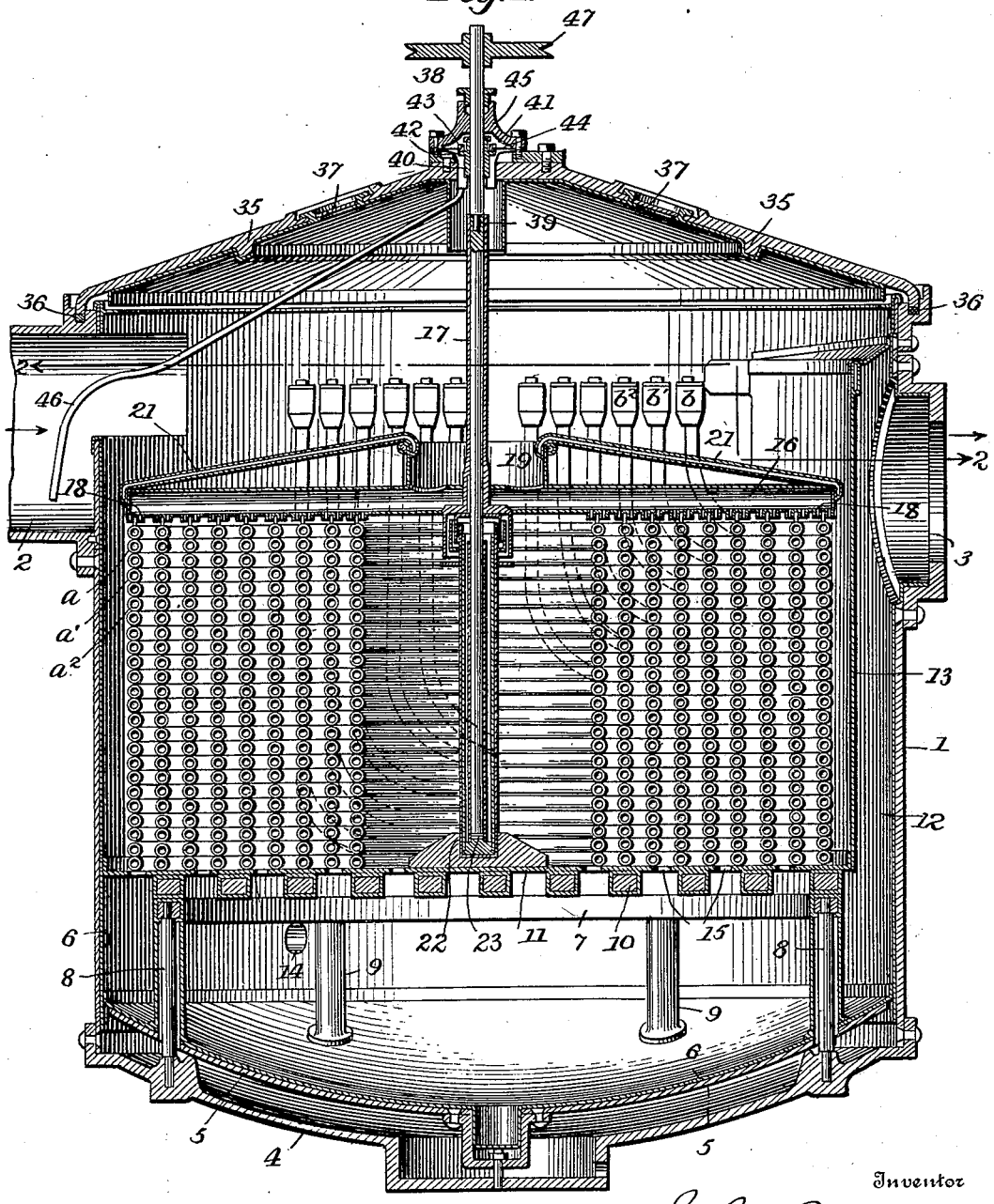
J. PATTEN.

VAPOR ABSORBER.

(Application filed Sept. 17, 1900.)

(No Model.) 4 Sheets—Sheet 1.

Fig. 1.



Witnesses

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Fig. 2.

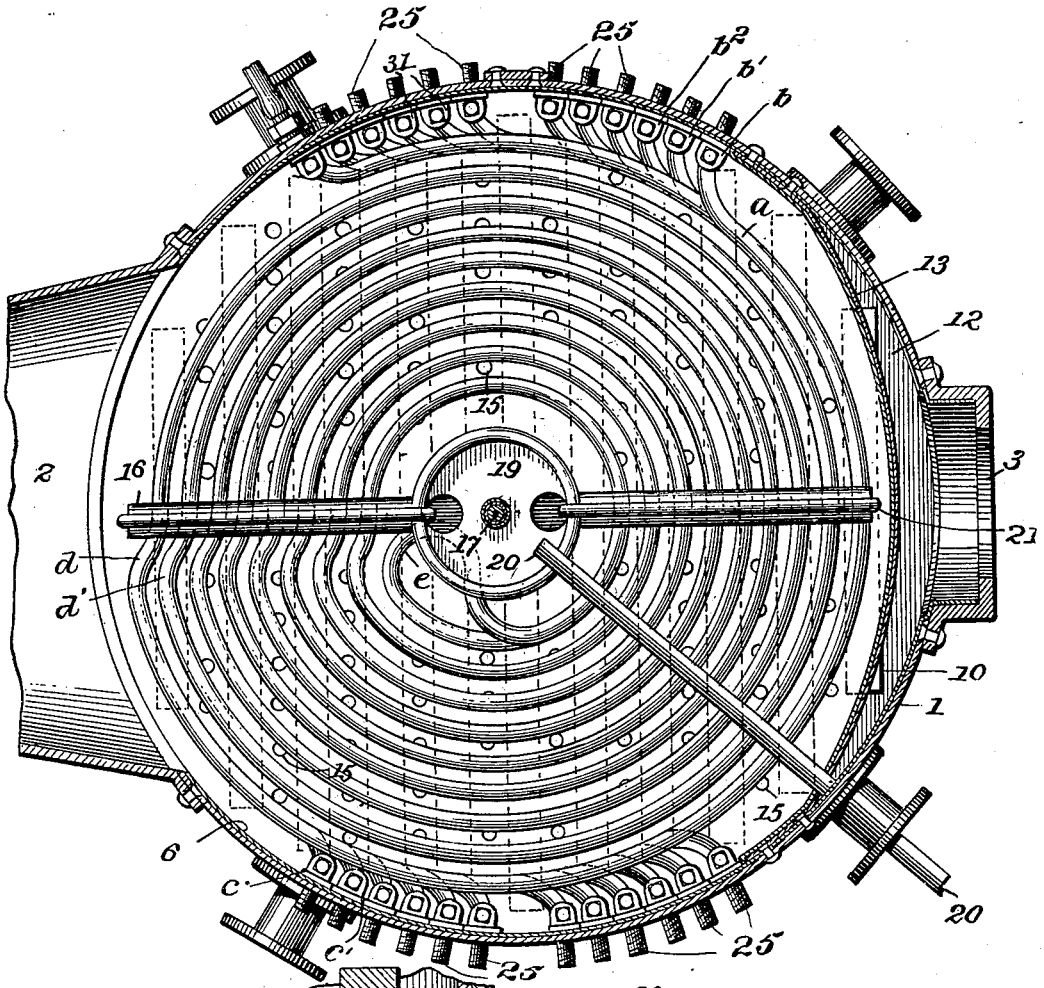
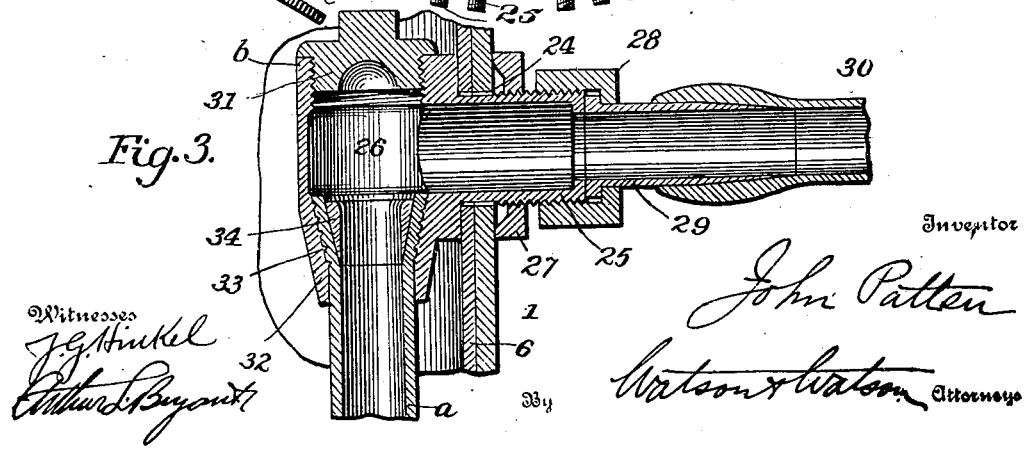


Fig. 3.



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No. 676,665. Patented June 18, 1901.

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(Application filed Sept. 17, 1900.)

(No Model.) 4 Sheets—Sheet 3.

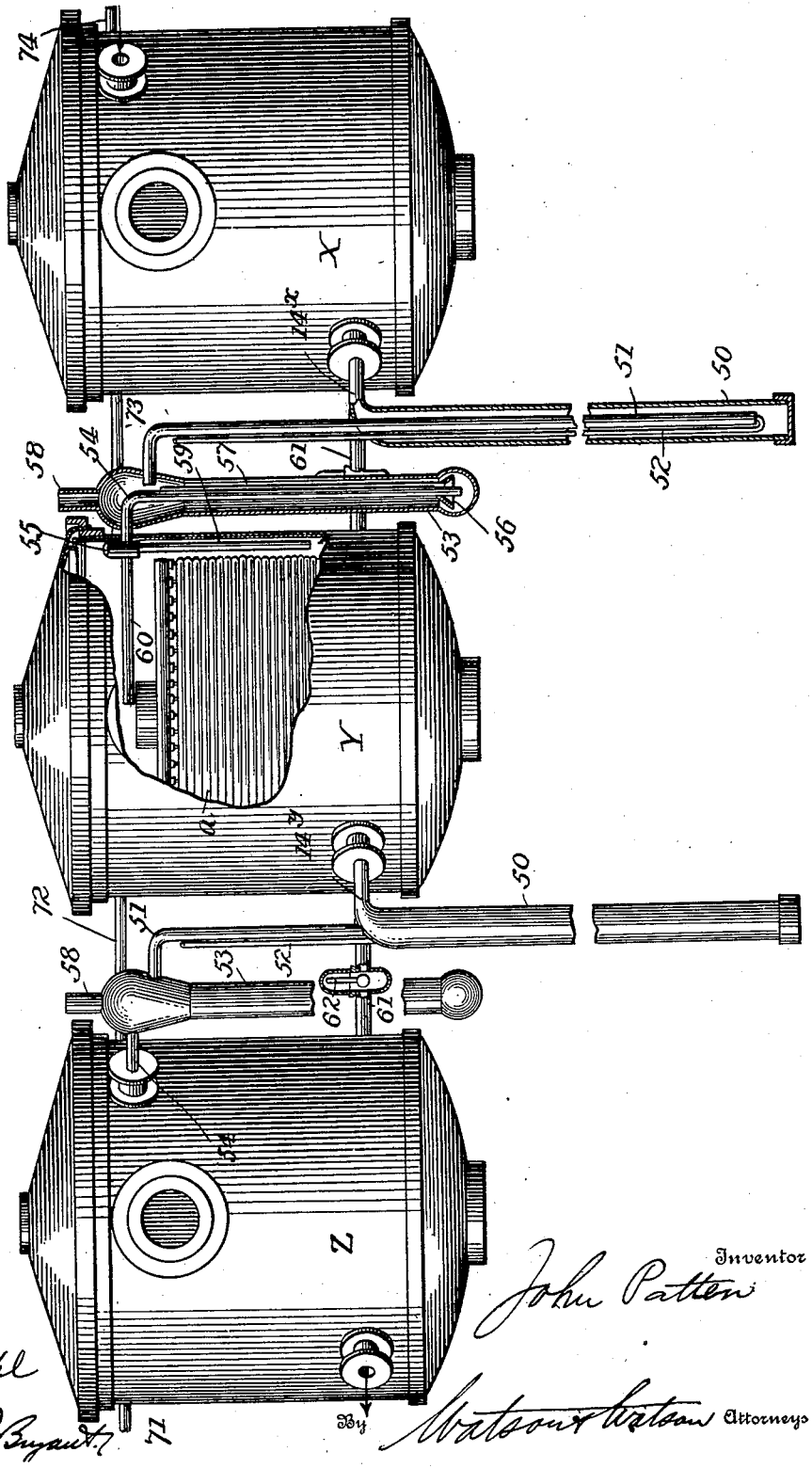

Fig. 4

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Fig. 5.

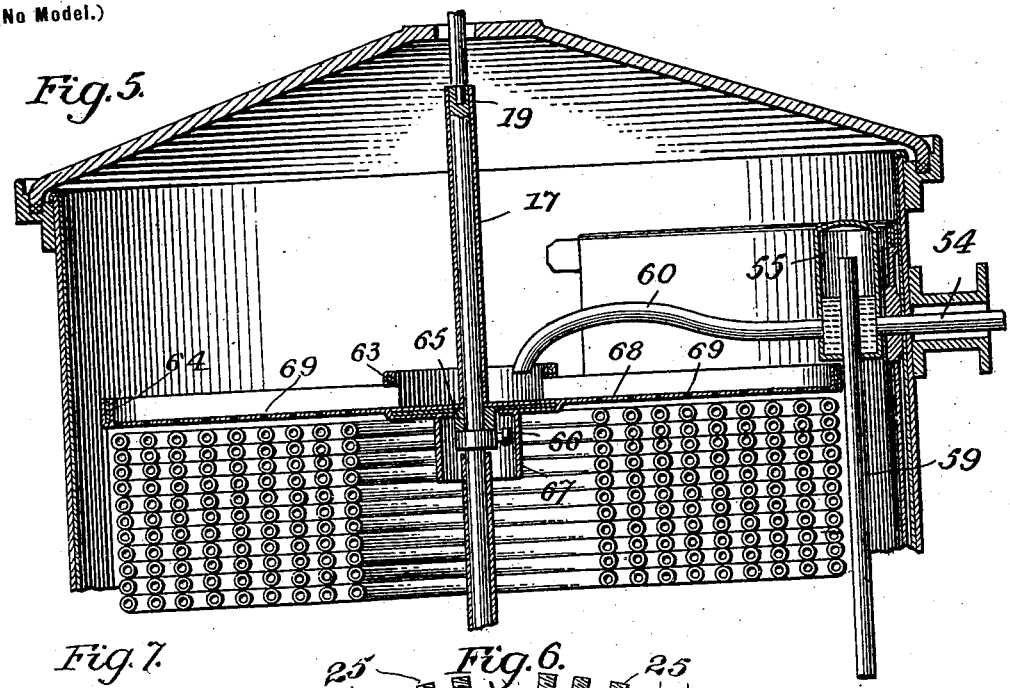

Fig. 7.

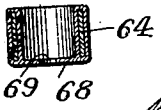

Fig. 6.

Witnesses

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

VAPOR-ABSORBER.

SPECIFICATION forming part of Letters Patent No. 676,665, dated June 18, 1901.

Application filed September 17, 1900. Serial No. 30,348. (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 Vapor-Absorbers, of which the following is a specification.

The present invention consists in apparatus for absorbing aqueous vapor; and it is designed for use in connection with ice-making and refrigerating apparatus in which the water is frozen or cold produced by rapid evaporation. The air, gases, and aqueous vapor from the freezing-chamber are drawn off by means of a suitable exhaust-pump, and the absorber is placed between the freezing-chamber and the pump for the purpose of absorbing the larger part of the aqueous vapor.

The object of the present invention is to produce an absorber of compact and simple construction and in which the sulfuric acid or other absorbing material will be utilized to its full capacity.

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

Figure 1 is a vertical central section through the apparatus. Fig. 2 is a sectional view on the line 2 2 of Fig. 1. Fig. 3 is a detail. Fig. 4 is an elevation of a connected series of absorbers. Fig. 5 is a partial vertical section, and Fig. 6 a horizontal section showing another form of acid-distributer.

Referring to the drawings, 1 indicates a tank, which, as shown, is cylindrical in form. 2 indicates the vapor-inlet pipe, and 3 the connection to the exhaust-pump. The tank is provided with a suitable bottom 4, within which is a false bottom 5. A lead lining 6 covers the inside of the cylindrical wall and the false bottom. Some distance above the bottom is a heavy lead-covered ring 7, supported by posts 8, which rest upon the lower bottom 4, said posts being surrounded and protected by lead tubes 9. Resting upon the ring 7 are a series of lead-covered bars 10, arranged similar to grate-bars, and upon these bars rests a perforated plate 11. The compartment below the lead plate 11 communicates with the outlet-opening 3 by a passage 12, which is formed between the cylindrical wall of the tank and a vertical diaphragm or partition 13. The bottom 11 is joined to the partition 13 and the tank-wall, and communication is therefore cut off between the inlet and outlet pipes excepting through the perforations in said bottom plate. Below the bottom 11 is an acid-outlet 14.

Resting upon the bottom 11 and the bars 10 is a series of cooling-coils a a', &c., preferably constructed and arranged as follows: The coils are all alike, and a description of the upper coil, for instance, will be sufficient to illustrate their arrangement. The upper coil a has its inlet at c and its outlet at b on the opposite side of the tank. The pipe in coil a is circular from the outlet b to a point d, where it is offset inward slightly more than the diameter of the pipe and then continued to form a complete circle, at the end of which, d', it is again offset inward. In this manner a series of complete circles are formed until the pipe or coil reaches a point near the center of the tank. At this point e it is doubled upon itself and follows the previously-described circular coils outward to the outlet b. As shown, each of the coils consists of two layers of pipe, each layer consisting of a series of eight circles. The coils a' a^2, &c., are constructed in exactly the same manner, and the several coils are superposed upon one another. The entire mass of coils rests upon the bottom 11, which bottom has a series of perforations 15 to permit the acid which trickles over the coils to pass through to the outlet-pipe and to allow the unabsorbed air, gases, and vapor to pass on to the pump. The object of constructing and arranging the coils as above described is to continuously cool the acid as it trickles from the upper to the lower coils. The vapor passes down between the coils, and the acid as it passes over the first coil absorbs considerable vapor and would become too hot to work efficiently if it were not in contact with the surfaces of the pipe-coils, which are kept cool by circulating water through them. The acid runs or trickles over the surfaces of the cooling-pipes from one coil to the other in a continuous flow and is kept cool by being constantly in contact with the cooling-coils. This

is a very important feature in my invention and enables the acid to perform its function with a much greater efficiency than is possible with any previously-constructed vapor-absorbers. As shown in Figs. 1 and 2, the acid is sprayed on the coils by means of a rotating transverse spray-pipe 16, which is carried by a central vertical shaft 17, said spray-pipe having each of its branches provided with four small nozzles or outlets 18 for each circle of coils, two of said openings being in each branch of the pipe, the openings being arranged to spray the acid on opposite sides of the coils. The acid is supplied to a central pan 19, having openings communicating with the spray-pipe 16, and the pan is kept constantly supplied by means of an inlet-pipe 20. The spray-pipes are suitably sustained by braces 21, connected with the upper edge of the pan 19. The shaft 17 is arranged within a lead-covered tube 22, which is filled with oil to prevent acid from attacking the shaft. At the bottom of the tube 22 is a step 23, having upon it several washers, upon which the shaft rests.

The construction of the connections at the inlets and outlets *c b* is shown in Fig. 3. Referring to this figure, 24 indicates an opening in the wall of cylinder 1, through which passes a hollow shank 25 of a casting having a vertical chamber 26 therein. This casting is connected rigidly to the tank by means of a nut 27. A coupling 28 connects a piece of brass tube 29 to the shank 25. To the tubing 29 is connected a lead water-supply pipe 30. The upper end of the chamber 26 is closed by a screw-cap 31. The lower part 32 of the chamber is tapered and provided with internal ribs or projections 33. The end of tube *a* extends into the chamber and is expanded within the tapered portion by a tapering expanding-ring 34, which can be driven down from the top when the cap 31 is removed.

It will be seen that the coupling above described renders it very easy to connect and disconnect the coils on the inside of the tank. One of the coils can be disconnected in a moment by removing the caps 31 and the rings 34, after which the ends of the coil can be pulled out of the couplings. This is important, as it saves much time in getting the coils out for repairs.

The apparatus is provided with a strong cover 35, which has a flange resting on suitable packing in a groove 36. The cover is preferably provided with glass-covered openings or windows 37. In line with the shaft 17 and passing through a stuffing-box in the cover is a short shaft 38, which, as shown, is removably coupled to the shaft 17 by means of a square projection and socket 39. The shaft 38 can be lifted off of the shaft 39 when the lid is removed. The shaft 38 passes through an air-tight stuffing-box in the cover, which is constructed as follows: Upon the shaft is a tight collar 40, which runs within a chamber 41, surrounding the shaft. Upon the collar 40 is a flange 42, upon which rests a ring 43, carried by a diaphragm 44, the margin of said diaphragm being clamped between the cover and a central cap 45. The chamber 41 above the diaphragm is filled with oil, and the atmosphere presses the diaphragm down, making close contact between the ring 43 and the flange 42. The oil will leak through just fast enough to lubricate the bearing of ring 43, and no air can leak in until the oil is exhausted. Any oil which passes through under the ring 43 will be conveyed away by a waste-pipe 46 into any suitable receptacle. It is shown as discharging into the vapor-inlet pipe. The shafts 38 and 17 are driven by a pulley 47.

The operation of the apparatus will be understood from the foregoing description, and it need only be briefly recapitulated. The several coils *a a'* are kept cool by a continuous circulation of cold water. A vacuum is created in the apparatus by the pump connected with the outlet 3, and air and vapor from the freezing-chamber enter through the inlet-pipe 2. The acid is continuously sprayed on the coils by the rotating spray-pipe, and the vapor passes down between the coils, coming into intimate contact with the acid. The acid, laden with absorbed vapors, runs through the openings 15 in the bottom 11 and accumulates in the bottom of the tank, eventually running out of the outlet-pipe 14. From the outlet-pipe 14 it is taken to a concentrator, (not shown,) where the water is driven off. The strong acid is again returned to the absorber through the pipe 20. The unabsorbed air and gases, carrying with them a large amount of vapor, also pass through the openings 15, then through the passage 12, and up and out through the pipe 3 to the pump or vapor-exhauster.

I believe myself to be the first to provide an absorber in which the acid or other absorbing material is passed in a thin film over a continuously-cooled surface, or, to speak more exactly, over a series of independently-cooled surfaces in close contact, whereby the acid is continuously being cooled while it is subject to contact with the vapor.

In apparatus heretofore constructed for absorbing vapor the acid would become heated while being exposed to the absorption of the vapors, and after it became too hot to become efficient it would be brought in contact with the cooling-surfaces and used again, thereby necessitating a large number of operations. I find that when the acid is exposed to the vapors being absorbed it gets too hot to be efficient before it has absorbed but a very small percentage of the amount of vapor it is capable of absorbing at the temperature at which it is supposed to work. Consequently when it is periodically exposed first to the vapors being absorbed and then to the cooling-surfaces it requires a very large

number of operations and much more space to accomplish what is obtained by a single continuous operation in my apparatus.

In apparatus of limited capacity a single absorbing-chamber, such as that heretofore described, may be used. In more extensive apparatus I prefer to use a connected series of absorbing-chambers, such as that shown in Fig. 4. Referring to said figure, X, Y, and Z indicate three absorbing vessels, each similar in interior construction and arrangement to that shown in Figs. 1 and 2. The acid circulates successively through the vessels X, Y, and Z, being pumped or lifted from the bottom of one vessel to the top of the next, preferably by an "air-lift," which I construct as follows: The acid leaving the vessel X by the outlet-pipe $14^{\times}$ falls into a well 50. A pipe 51 extends from near the bottom of said well to the level of the upper part of the next vessel, Y. An air-tube 52 extends from a point above and outside of the well to and into the lower end of the pipe 51 within the well. It being remembered that the entire apparatus is subject to the action of an air and gas pump, it will be evident that air will be drawn in through the pipe 52 and delivered into the lower end of pipe 51. The air rising in pipe 51 causes the acid in said pipe to rise to an elevation from which it can flow by gravity into the distributer of the tank Y. From the pipe 51 the acid is discharged into a vessel 53, which is of considerable depth. The function of the vessel 53 is to separate air and gas which may be present from the acid before discharging the latter into the absorber Y. A pipe 54 leads from near the bottom of the vessel 53 into a second air-separating vessel 55 within the chamber Y. Near the lower end of pipe 54 is an inverted funnel 56, under the edge of which the acid must pass to reach the inlet of pipe 54. From the upper end of the funnel a small air-pipe 57 carries off any air or gas which may be entrapped in the funnel. The upper end of the vessel 53 is connected with the exhausting apparatus by means of a vent-pipe 58. The air which passes in through the pipe 52, and also any air or gas contained in the acid which comes from the absorber X, will be discharged into the vessel 53. The larger part of such air and gas will pass directly into the exhaust-pipe 58. Another smaller portion will be entrapped by the funnel 56 and carried up to the exhaust 58. Any remaining air or gas will be discharged by the pipe 54 into the vessel 55 within the absorber Y. This vessel is subject to the high vacuum of the absorber Y, which will cause any air or gas remaining in the acid to rise in vessel 55 and pass down to the lower part of the absorber through the pipe 59. By the apparatus described the air and gas will be completely separated from the acid, and the latter will flow in a solid stream through the pipe 60 to the acid-distributer. If the air and gas were not completely separated from the acid, the latter would foam and splash upon being discharged into the absorber Y, which would render it difficult or impossible to sprinkle it evenly upon the cooling-pipes. The foaming and splashing of the acid would also throw more or less of it upon the cover and upper parts of the absorber, which would injure them unless protected by a costly lining of lead.

In Fig. 4 are shown pipes 61, connecting the tanks near their lower ends. These pipes are for the purpose of conveying from the vessel X to the vessel Y and from Y to Z any surplus acid in case the air-lifts are not of sufficient capacity to transmit all of the acid supplied by the distributer in vessel X. In the pipe 61 I sometimes place a thermometer 62 for the purpose of ascertaining the strength of the acid. The strength can be deduced from the degree of vacuum and the temperature in a well-known manner.

When using a connected series of absorber-tanks, I prefer to circulate the same water through all of the tanks in the reverse direction to that in which the acid is circulated. Thus in Fig. 4 the water enters tank Z through the pipe 71, passes from Z to Y through pipe 72, and from Y to X through pipe 73, finally passing out of X at 74. The weakest acid is by this arrangement caused to flow over the coolest coils, and thereby it is used for absorbing purposes to the largest extent possible. The water may be caused to flow through the several tanks by gravity, a pump, or any suitable means.

The acid-distributer illustrated in Figs. 5 and 6 comprises a rigid metal pan 63 and rigid U-shaped metal arms 64, connected thereto. The pan 63 is provided with a hub 65, through which the shaft 17 passes, said hub being connected to said shaft by means of a set-screw 66 or other suitable device. The pan is covered with lead, and upon its under side is a cylindrical skirt 67, of lead, which surrounds and protects the hub 65. The U-shaped arms 64 are also covered with lead, and a web 68 connects their lower edges, forming, with the sides, troughs which convey the acid from the central pan out over the cooling-coils *a a'*, &c. The bottom 68 has perforations 69 directly over the several coils. There are, as shown, four of the distributing-arms. The acid is supplied continuously to the pan of the distributer by means of the pipe 60.

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

1. In an absorber, a plurality of cooling-coils superposed in a vertical series, the successive coils being in contact and being independently supplied with cooling liquid, whereby a continuously-cooled surface is provided, in combination with means to spray absorbing fluid upon the uppermost coil of the series, for the purpose set forth.

2. In an absorber, a plurality of cooling-coils superposed in a vertical series, the successive coils being in contact and each comprising a plurality of circular sections, and being independently supplied with cooling liquid, in combination with a rotating spray-pipe arranged to spray absorbing fluid upon the uppermost coil of said series.

3. In an absorber, a series of cooling-coils arranged one upon another in close contact, each coil comprising two series of circular sections, one arranged above the other with a central return-bend, in combination with a rotating spray-pipe having perforations for spraying the absorbing fluid on the uppermost coil of said series, for the purpose set forth.

4. In an absorber, the combination of the tank, a vertically-arranged series of cooling-coils within the tank, a diaphragm or bottom supporting said coils and provided with openings, a vapor-inlet communicating with the tank above the coils, and an exhaust-outlet communicating with the space below said bottom.

5. In an absorber, the combination with the cooling-coils, of the perforated bottom on which said coils rest, lead-covered bars supporting said bottom, means for supporting said bars, the rotating distributer for spraying absorbing fluid upon the coils, and means for circulating vapor between said coils.

6. In an absorber, a vertical series of independent coils arranged in close contact, said coils having independent inlet and outlet openings, in combination with a rotating distributer arranged immediately above the uppermost coil and having perforations arranged to direct the absorbing fluid onto said coil.

7. In an absorber, the combination with the coils having circular sections, and the rotating distributer arranged to direct the absorbing fluid upon the sections of the uppermost coil, of a perforated plate upon which said coils rest, a compartment below said plate, a vapor-inlet above said plate, an exhaust-outlet communicating with the compartment below said plate, a pipe for supplying acid to the distributer above the coils, and an outlet for the acid from the chamber beneath the coils.

8. In an absorber, the combination with a tank, of a series of cooling-coils arranged within and removable connections to the ends of said coils each comprising a part having a branch 25 extending through the tank-casing, a vertical chamber within the casing having a tapering lower end into which the end of the coil fits, a tapering plug to lock the coil in the lower end of said chamber, a removable cap at the upper end of said chamber, and means for locking said part to the casing.

9. In an absorbing apparatus, an acid-distributer comprising a central pan and U-shaped arms connected thereto, said arms and pan being constructed of rigid metal, a lead covering on the pan, lead coverings on said arms, and perforated webs of lead connecting the lead covering on said arms and forming troughs from which the acid is sprinkled on the cooling-coils.

10. In an absorbing apparatus, the combination with the tank and cooling-coils therein, of a vertically-rotating shaft, an iron pan surrounding and supported on said shaft, U-shaped iron arms extending from said pan radially, a lead covering for said pan and said arms, and perforated lead bottoms to said arms whereby acid delivered to the pan is sprinkled from the rotating arms.

11. In an absorbing apparatus, the combination of a series of tanks, cooling-coils in each tank, an acid-distributer in each tank, means for circulating the acid through the tanks of the series successively in one order, and means for forcing water through the coils of the several tanks successively in the reverse order, said coils being connected in series.

12. In a refrigerating apparatus, means for circulating acid through one or more partially-exhausted chambers, said means comprising a well into which the acid is supplied, a vertically-arranged discharge-pipe leading from the lower part of the well, and an air-duct having one end in communication with the atmosphere and its other end arranged to discharge air into said acid-discharge pipe, the air being forced through said duct by atmospheric pressure.

13. In a refrigerating apparatus, the combination with one or more partially-exhausted chambers through which the acid is circulated, of means for circulating acid comprising a well into which the acid is supplied, a vertically-arranged discharge-pipe leading from the well, an air-duct arranged to conduct air under atmospheric pressure into the lower end of said discharge-pipe, and means for separating said air from the acid after it has operated to lift the same.

14. In a refrigerating apparatus, the combination with two tanks through which acid is circulated, of a well into which the acid is supplied from one of said tanks, a vertically-arranged discharge-pipe in said well and extending upward from near the bottom thereof, means for admitting air into the lower end of said discharge-pipe whereby the acid is propelled upward therein, an elongated vertically-arranged vessel into which said air and acid is discharged, an exhaust-pipe through which the air and gases are exhausted from the upper part of said vessel, a second discharge-pipe leading from the lower part of said vessel into the second tank, and a second air and gas separating device within said second tank.

15. In a refrigerating apparatus, the combination of a plurality of tanks, means for circulating acid through all of said tanks, said means comprising vertically-arranged

discharge-pipes and devices for supplying air to the lower ends thereof and separating said air from the acid after its discharge from the upper ends thereof, and direct connecting-pipes 61 between the lower parts of said tanks arranged to carry any surplus acid through the series of tanks.

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

JOHN PATTEN.

Witnesses:
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FELIX R. SULLIVAN.