W. V. WENTWORTH & A. B. LARCHAR.

PROCESS OF HANDLING THE ELECTROLYTIC PRODUCTS OF BRINE IN THE TREATMENT OF FIBER.

APPLICATION FILED JAN. 29, 1907.

912,340.

Patented Feb. 16, 1909.

3 SHEETS—SHEET 1.

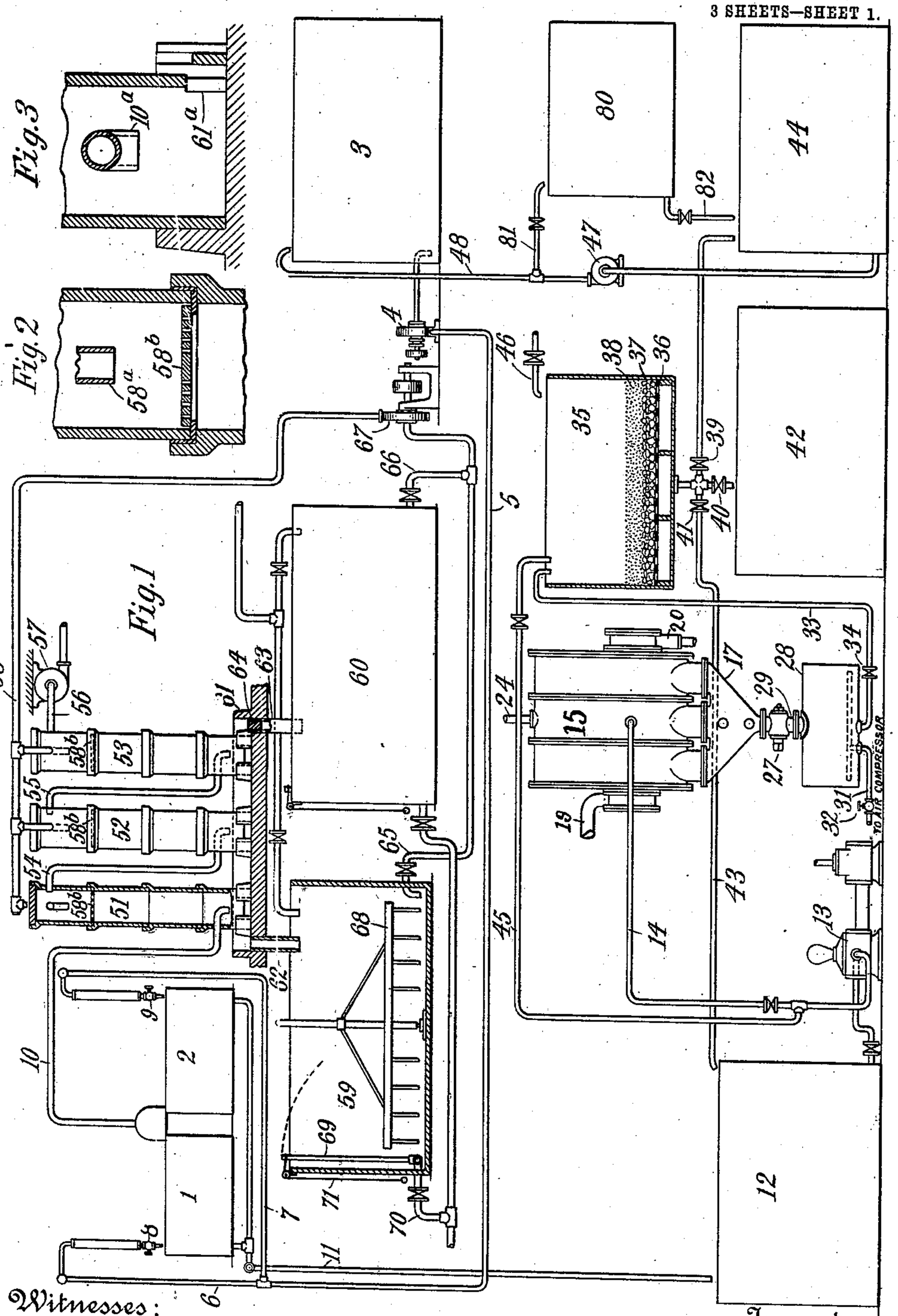

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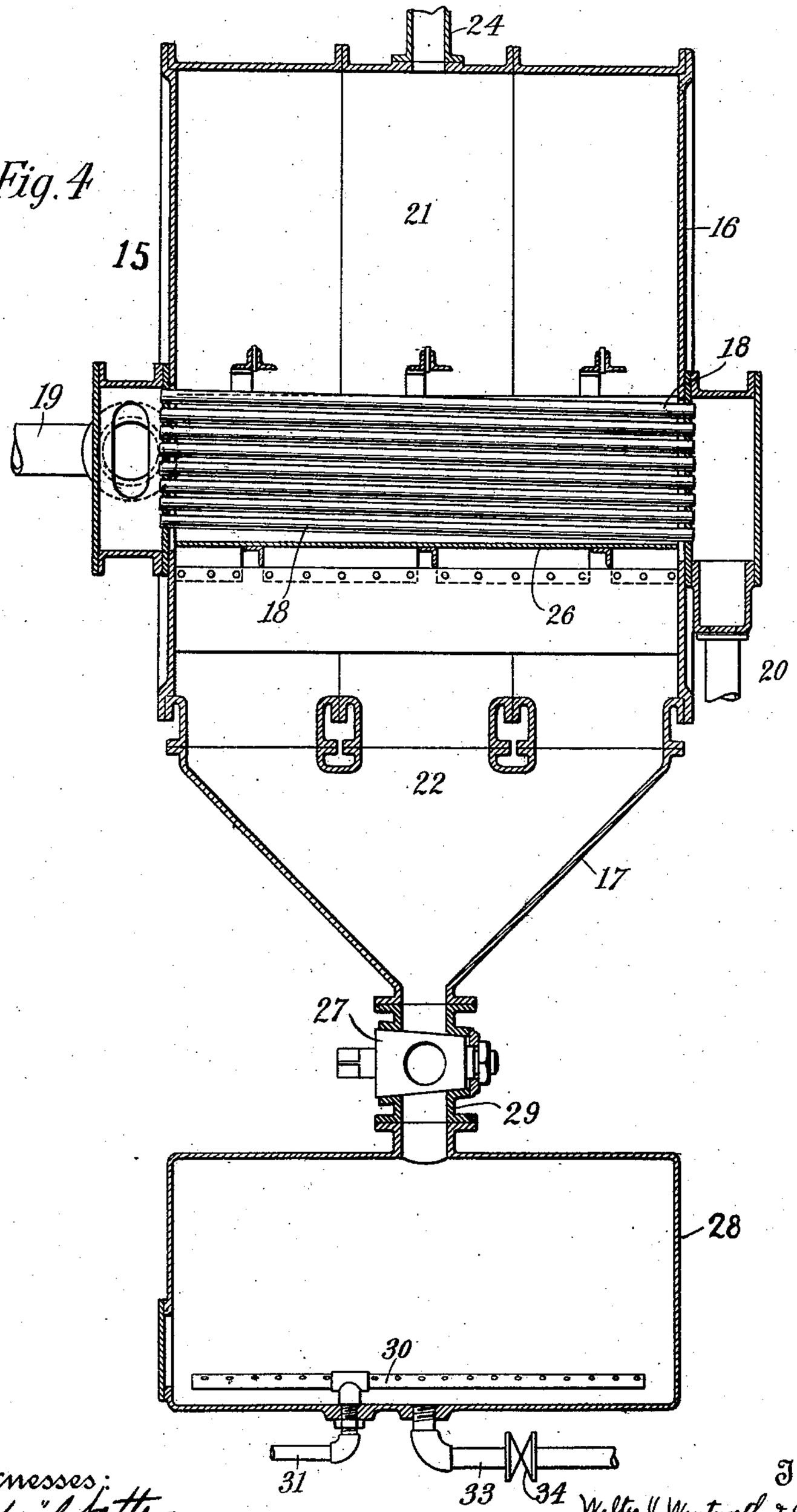
Fig. 4



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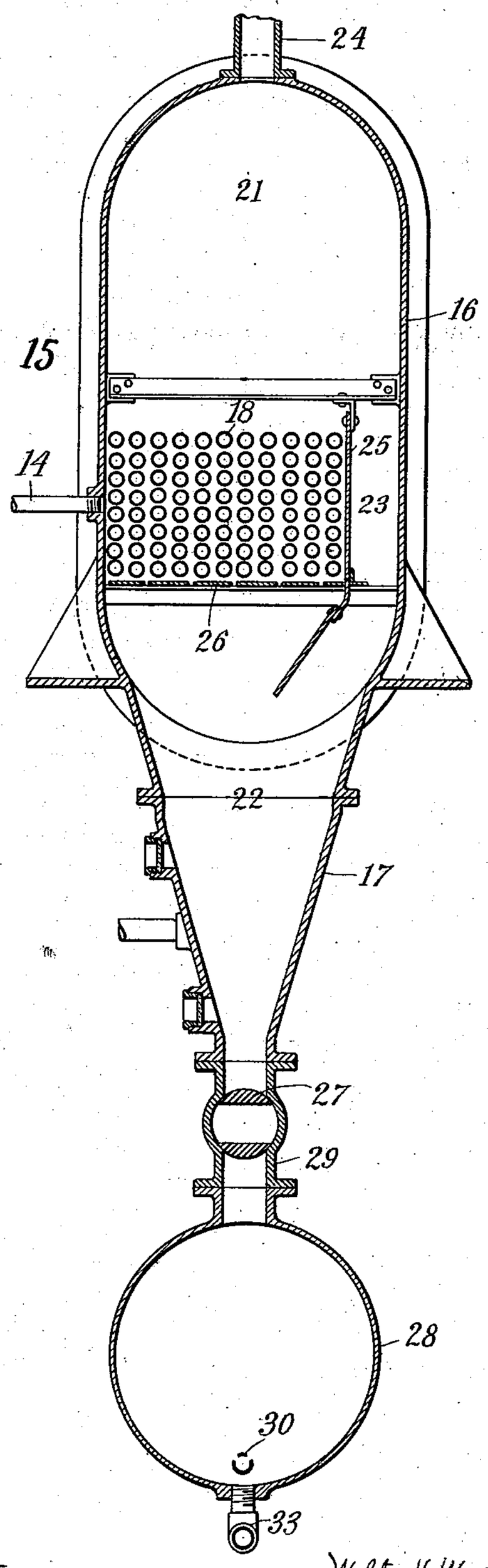
3 SHEETS—SHEET 3.

Fig. 5



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UNITED STATES PATENT OFFICE.

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PROCESS OF HANDLING THE ELECTROLYTIC PRODUCTS OF BRINE IN THE TREATMENT OF FIBER.

No. 912,340. Specification of Letters Patent. Patented Feb. 16, 1909.

Application filed January 29, 1907. Serial No. 354,609.

To all whom it may concern:

Be it known that we, WALTER V. WENTWORTH and ARTHUR B. LARCHAR, citizens of the United States, and residents of Oldtown, county of Penobscot, State of Maine, have invented a new and useful Improvement in the Processes of Handling the Electrolytic Products of Brine in the Treatment of Fiber, of which the following is a specification.

Heretofore, caustic soda and chlorin produced by electrolysis of brine (for example, in the cell shown in U. S. patents, to Arthur B. Larchar, patentee, 736,892 dated August 25, 1903, and 793,138 dated June 27, 1905) have been applied, respectively, to the separation of cellulose fiber from wood and to the bleaching thereof.

Our present invention constitutes an improved process of handling said electrolytic products between the cell and their points of application to the fiber.

In the accompanying drawings is shown one form of apparatus which may be used to carry into execution the process which is comprised in our invention.

Figure 1 is a diagrammatic elevation of the apparatus comprised in our system. Figs. 2, 3, 4 and 5 are details of the same.

1 and 2 are two electrolytic cells which are preferably of the construction shown in said Patents 793,138 and 736,982. They are supplied with salt brine from the tank 3, whence it is forced by the pump 4 through the pipe 5 and the branch pipes 6 and 7 and valved nozzles 8 and 9 to the cells, respectively. The chlorin gas product of the electrolysis leaves the cells through the glazed tile pipe 10 and must be combined with lime to form "bleach" before it is applied to the fiber. The caustic soda effluent leaves the cells by the pipe 11, which discharges into the storage tank 12. This caustic soda effluent generally consists of about equal parts of caustic soda and unchanged salt in solution, which salt must be separated from the caustic soda before the latter is applied to the fiber.

We will describe separately the systems for handling the caustic soda and the chlorin, respectively, on their way to the fiber.

Handling the caustic soda.—The combined caustic soda and brine are forced by the pump 13 through the pipe 14 into a concentrator 15, which is shown in detail in Figs. 4 and 5. This consists of a shell 16 having a funnel-shaped or hopper-shaped bottom 17. The bank of steam tubes 18, slightly inclined from the horizontal, extends across from side to side of the shell 16, through which tubes steam is circulated between the steam pipes 19 and 20. These steam tubes are so located as to divide the concentrator chamber into the upper vapor space 21 and the settling space 22 connected at one side of the bank of tubes by the vertical passage 23.

The liquid pumped from the tank 12 fills the body of the concentrator 15 to nearly the top of the bank of tubes 18 and is maintained continuously at about that level. Under the heat of the tubes, it boils up through the bank of tubes; part of the water forming vapor in the chamber 21, whence it escapes through any suitable opening as 24. The portion that is not vaporized flows down through the passage 23 which is separated from the bank of tubes by the partition 25. It deposits a portion of its salt crystals in the hopper 17 and thence circulates up again through the openings in the horizontal partition 26 among the tubes 18. This circulation continues until the desired concentration is reached and the strength of the circulation combined with the continuous removal of the salt crystals as fast as formed prevent the scaling of the steam tubes. The valve 27 being open, the concentrated liquor settles into the receiving tank 28 (which is, during this operation, maintained under a vacuum through connection as desired with any suitable means of exhaust, such exhaust not being shown) through the passage 29 at the bottom of the hopper. The receiving tank 28 consists preferably of a drum provided near its bottom with a perforated horizontal pipe 30 connected by the pipe 31 with a source of compressed air normally shut off by the valve 32 (Fig. 1).

33 is the outlet pipe from the receiver 28, and 34 the valve therein. This outlet pipe leads to the filter tank 35. When the liquor in the receiving tank 28 has reached the desired concentration, the valve 27 is temporarily closed, the valves 32 and 34 are opened and the compressed air blows the contents of the tank through the pipe 33 into the filter tank 35. If compressed air is not available, a pump may be used for forcing the liquor from the tank 28 to the filter tank 35. In the meantime, additional liquor has been

pumped into the concentrator 15 from the tank 12 and concentrated, the salt crystals partly filling the hopper so that as soon as the valve 27 is again opened, the crystals will wash down into the tank 28, whereupon the valve 27 is again closed and the receiver 28 emptied as before. In this way, in normal operation, the process becomes substantially continuous since by opening the valve 27 at frequent intervals, the salt crystals accumulated in the hopper are intermittently withdrawn without stopping the evaporation which is proceeding above. In other words, the salt crystals accumulate in the downwardly extending hopper-shaped bottom below the zone of evaporation and can be permitted to discharge periodically without interfering with the evaporating process going on in the zone of evaporation.

The salt crystals with entrained caustic soda descending into the vacuum receiver 28, as above described, are in a viscous condition and the air by which they are blown from the vacuum receiver to the filter tank prevents the consolidation of the viscous mass in the receiver 28 because it keeps the mass in a state of agitation as it passes in separate jets from the perforated pipe 30 to the position above the mass which it must occupy for forcing the mass into the bottom outlet 33. The filter tank 35 contains above its bottom a perforated filter support 36 upon which is supported a layer 37, 38 preferably of sand.

If the attempt be made to filter the viscous mass of salt crystals and entrained caustic soda while still retaining the heat of the separator or evaporator 15, an excessive amount of salt is dissolved; while if the partially drained mass of crystals is allowed to cool and is washed at a temperature low enough to obviate this difficulty, it is liable to partially congeal so as to prevent the completion of the operation, and if pressure be applied to force it through the filter, such pressure will tend to force the finer salt crystals through with the caustic soda and possibly, also, particles of the filtering material itself. We have made the important discovery, among others, that these difficulties may be avoided by permitting the mass to cool as a preliminary to filtration. Putting this discovery into use and omitting the pressure, but depending upon gravity for the filtration, we have found the operation to be entirely successful; the mass of salt crystals remaining comparatively loose and uncongealed upon the top of the filter. Two advantages are thus attained: (1) The cooling causes the separation of a larger percentage of salt crystals; and (2) when the salt crystals cool in the caustic solution, they form a loose mass and are much more easily washed. When, therefore, the filter tank 35 is being filled from the receiving chamber 28, the outlet valves 39, 40 and 41 are closed and remain so until the mass has had as much time as practicable to cool, when the valve 40 is opened and the concentrated caustic soda allowed to filter through and drain into the concentrated caustic soda storage tank 42, the contents of which are in condition to be applied to the fiber. When the strong concentrated caustic soda ceases to run through the filter, a small quantity of unevaporated caustic brine is pumped through the pipe 45 onto the crystals which washes most of the nearly pure caustic soda before it. This is followed, after closing the valve 40 and opening valve 41, by repeated additions of small quantities of cold water from the pipe 46 until the effluent shows the desired freedom from caustic. All of this dilute caustic soda is discharged through the pipe 43 into the tank 12, whence it again passes through the separator 15. The valve 41 is now closed and the valve 39 opened and the pure salt crystals remaining on the filter are dissolved by additions of hot water and run into the brine storage tank 44 from which it is raised by the pump 47 through the pipe 48, into the brine tank 3, whence it is returned with additional brine, to the cells 1, 2 and the operation repeated. It will thus be seen that all the salt that escaped decomposition at the outset will be returned after being separated from its entrained caustic soda to the cells until it is completely decomposed, while the separated caustic soda accumulated in the tank 42 will be in a condition of purity enabling it to be applied to the fiber through the proper channels.

80 is a tank in which fresh salt crystals are dissolved to make brine and which is connected, respectively, with the pipe 48 and tank 44 by the valved pipes 81 and 82.

Handling the chlorin.—The chlorin gas leaving the cells through the pipe 10 proceeds through the series of absorption towers 51, 52 and 53, each of which is composed of glazed tile. These towers are arranged in series; the chlorin gas being discharged into the first one at the bottom from the pipe 10, passing thence upward through the tower and through the pipe 54 down to the bottom of the next tower, thence up through that tower and through the pipe 55 down to the bottom of the third tower, thence up through that tower to the outlet 56, which is under the slight exhaust of a fan 57. Milk of lime is conveyed into the top of each tower from the pipe 58 and in descending through each tower it meets the ascending current of chlorin and unites with it forming "bleach" or chlorid of lime. Each tower is provided with a perforated slate dash-plate 58^b arranged below the lime inlet and chlorin outlet so as to afford intimacy of contact between the lime and the chlorin. When the lime is fresh, most of the chlorin is absorbed in the first tower but as the proportion of

"bleach" increases and that of free lime decreases, more chlorin passes onto the second tower and toward the end of the operation some chlorin reaches the third tower, but only a trace ever passes through this third tower to the outlet 56, if the apparatus is in proper working order.

59 and 60 are two milk of lime tanks below the towers.

61 is a concrete trough into which all of the towers discharge their liquid chlorid of lime at the bottom and from which trough such liquid may be discharged either into the tank 59 through the pipe 62, or into the tank 60 through the pipe 63; the pipe not in use being closed by a suitable plug 64. Valved outlet pipes 65 and 66 lead from the bottom of each milk of lime tank to the pump 67 by which the milk of lime from the tank in use is pumped through the pipe 58 to the tops of the towers. An agitator 68 in each milk of lime tank keeps the lime in suspension while it is in operation. Each milk of lime tank is provided with a pivoted stand-pipe 69 connected with a valved outlet pipe 70 and controlled by a cord 71 so that the "bleach" or finished chlorid of lime can be drawn off from the tank to any depth desired. This "bleach" is in proper condition to be applied through suitable channels to the bleaching of the wood fiber.

In Fig. 2 is shown a detail of the dash-plate 58^b and the lime-inlet-pipe 58^a in one of the towers. In Fig. 3, is shown a detail of the bottom of one of the towers and the chlorin-inlet-pipe 10^a and of the liquid-outlet pipe 61^a into the concrete trough 61.

In operation, one of the milk of lime tanks will be filled with milk of lime which will be circulated by the pump 67, over and over, through the absorption towers 51, 52, 53, until it is all converted substantially into "bleach". In the meantime, the other tank 60 will be filled with milk of lime so that as soon as the conversion in the tank 59 is complete, it can be cut off from the towers and connection made with the tank 60. In this way, the absorption towers will be in substantially continuous operation; the two tanks 59 and 60 being alternately employed.

From the foregoing description, it will be seen that the whole system, inclusive of that portion for handling the caustic soda, as well as that portion for handling the chlorin is substantially continuous, enabling the cells, the absorption towers and the concentrator 15 to be in substantially continuous operation and yielding a substantially continuous supply of both "bleach" and caustic soda to the fiber treating operations of a paper pulp mill.

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

The process of treating brine which consists in electrolyzing the same, then concentrating the caustic soda effluent of the electrolysis, then cooling the concentrate and separating the same into its caustic soda and salt constituents.

In testimony whereof, we have hereunto signed our names in the presence of two subscribing witnesses.

WALTER V. WENTWORTH.
ARTHUR B. LARCHAR.

Witnesses;
JOS. F. GOULD,
CLARA H. GOULD.