No. 756,745. PATENTED APR. 5, 1904.

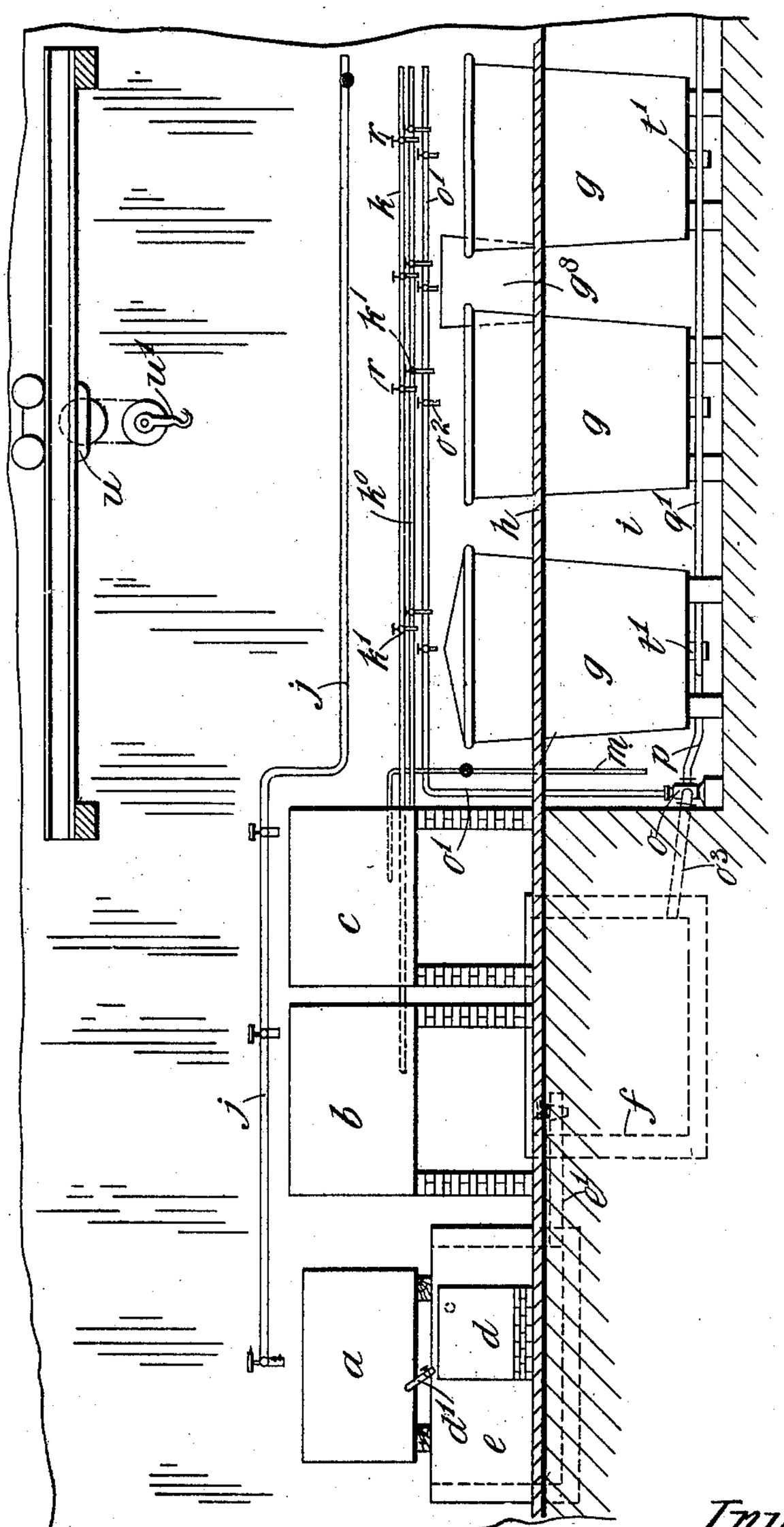
A. A. VOGELSANG.

APPARATUS FOR ELECTRICALLY BLEACHING MATERIALS.

APPLICATION FILED SEPT. 21, 1901.

NO MODEL. 6 SHEETS—SHEET 1.

Fig. 1.



Witnesses.
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By James L. Norris.
Att'y.

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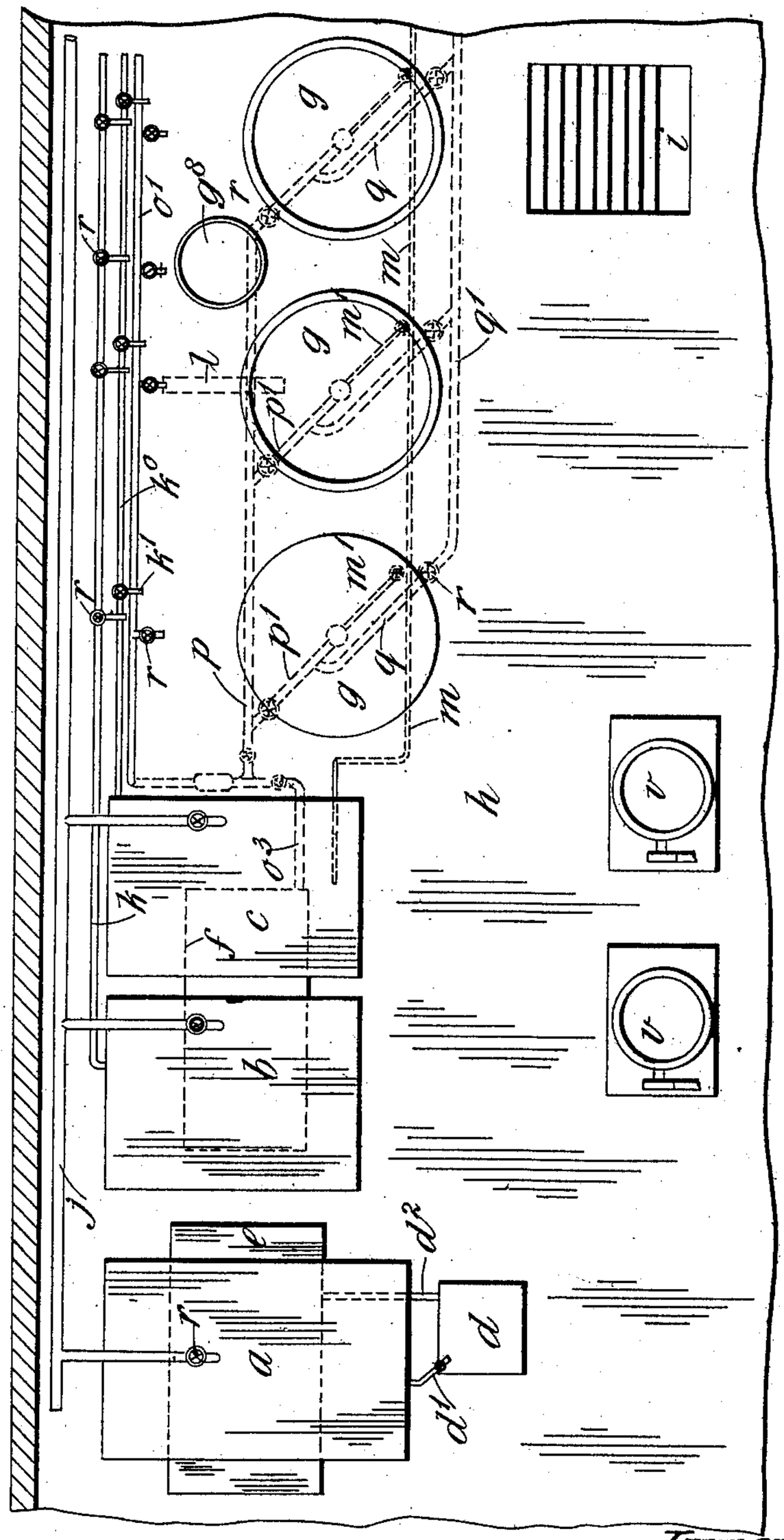
NO MODEL. 6 SHEETS—SHEET 2.

Fig. 2.



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NO MODEL. 6 SHEETS—SHEET 3.

Fig. 3.

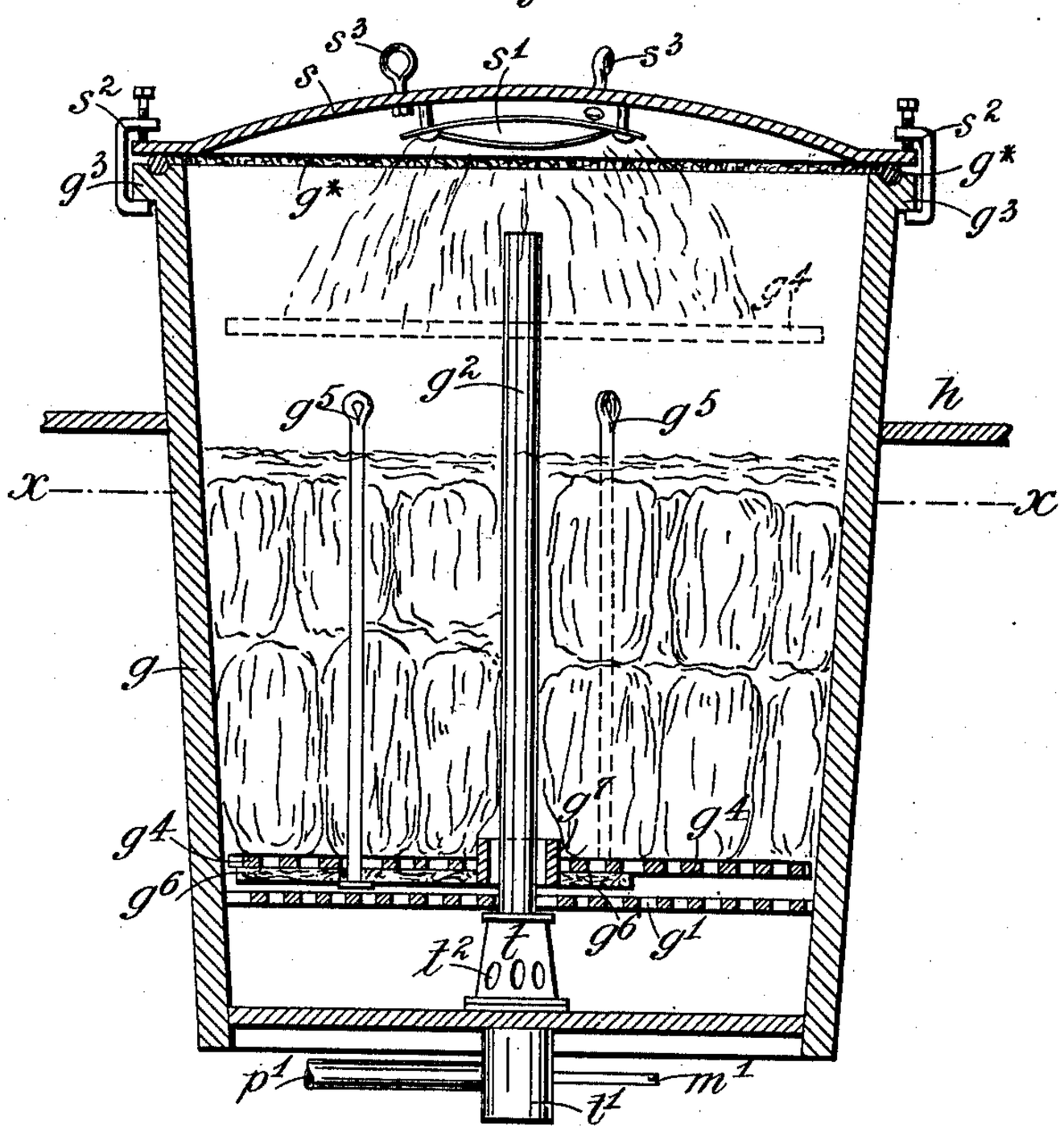
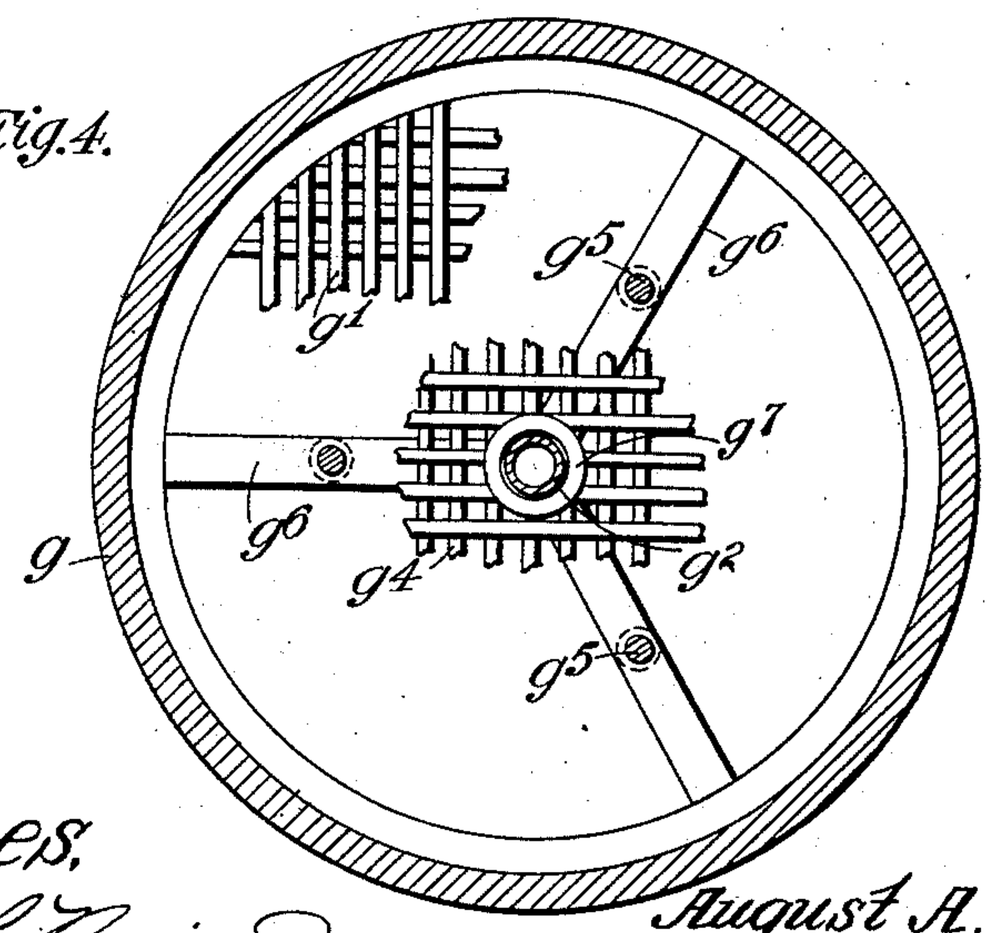


Fig. 4.



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NO MODEL. 6 SHEETS—SHEET 4.

Fig. 5.

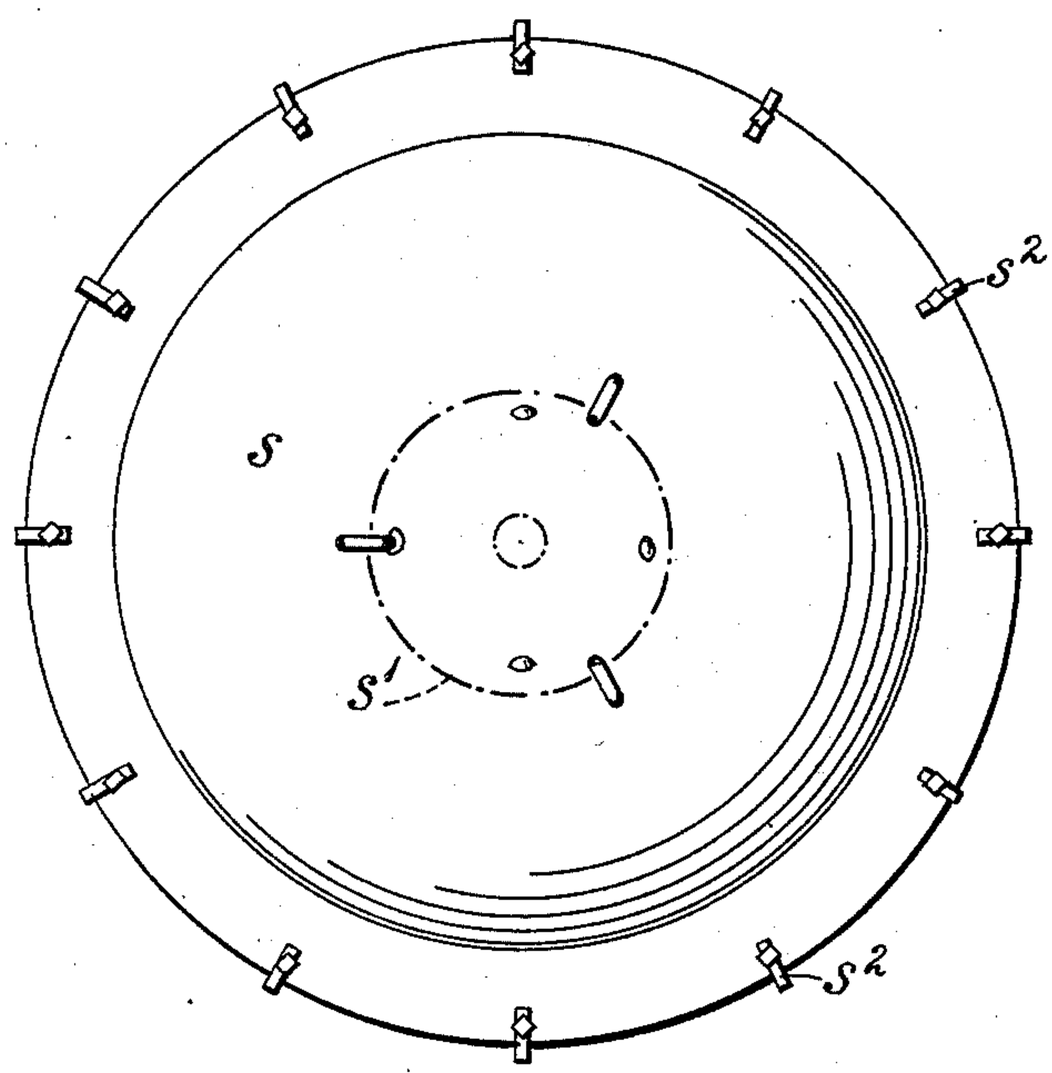
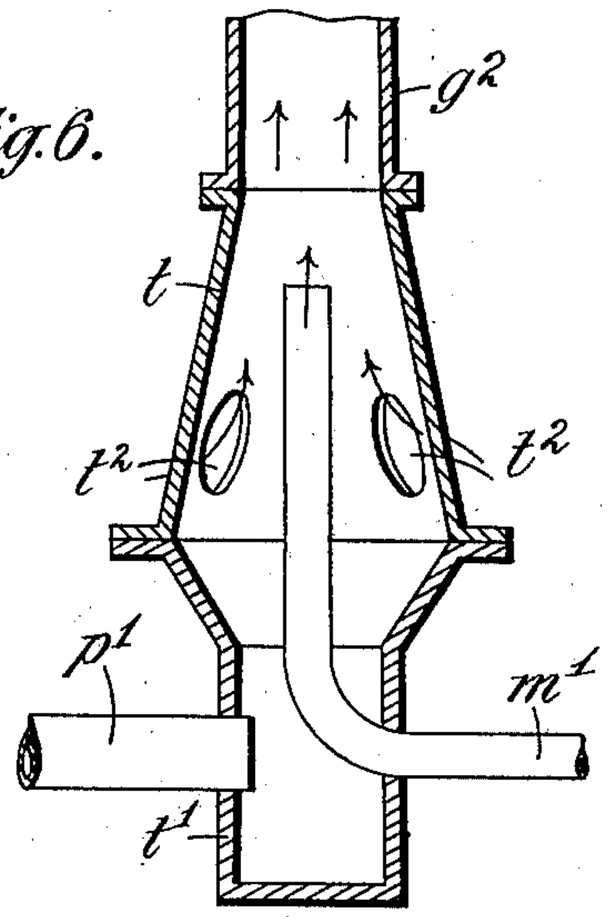


Fig. 6.



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NO MODEL. 6 SHEETS—SHEET 5.

Fig. 7.

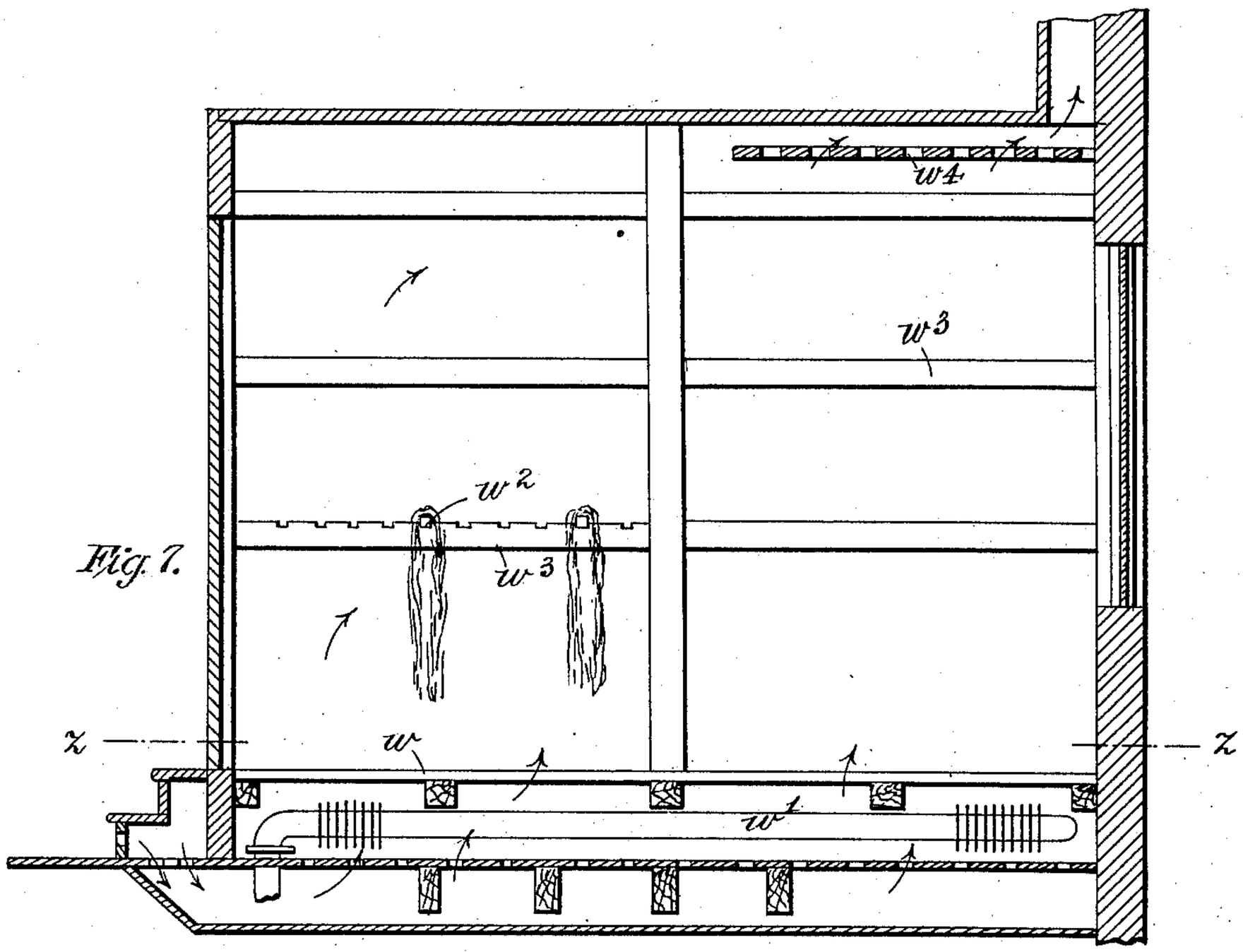
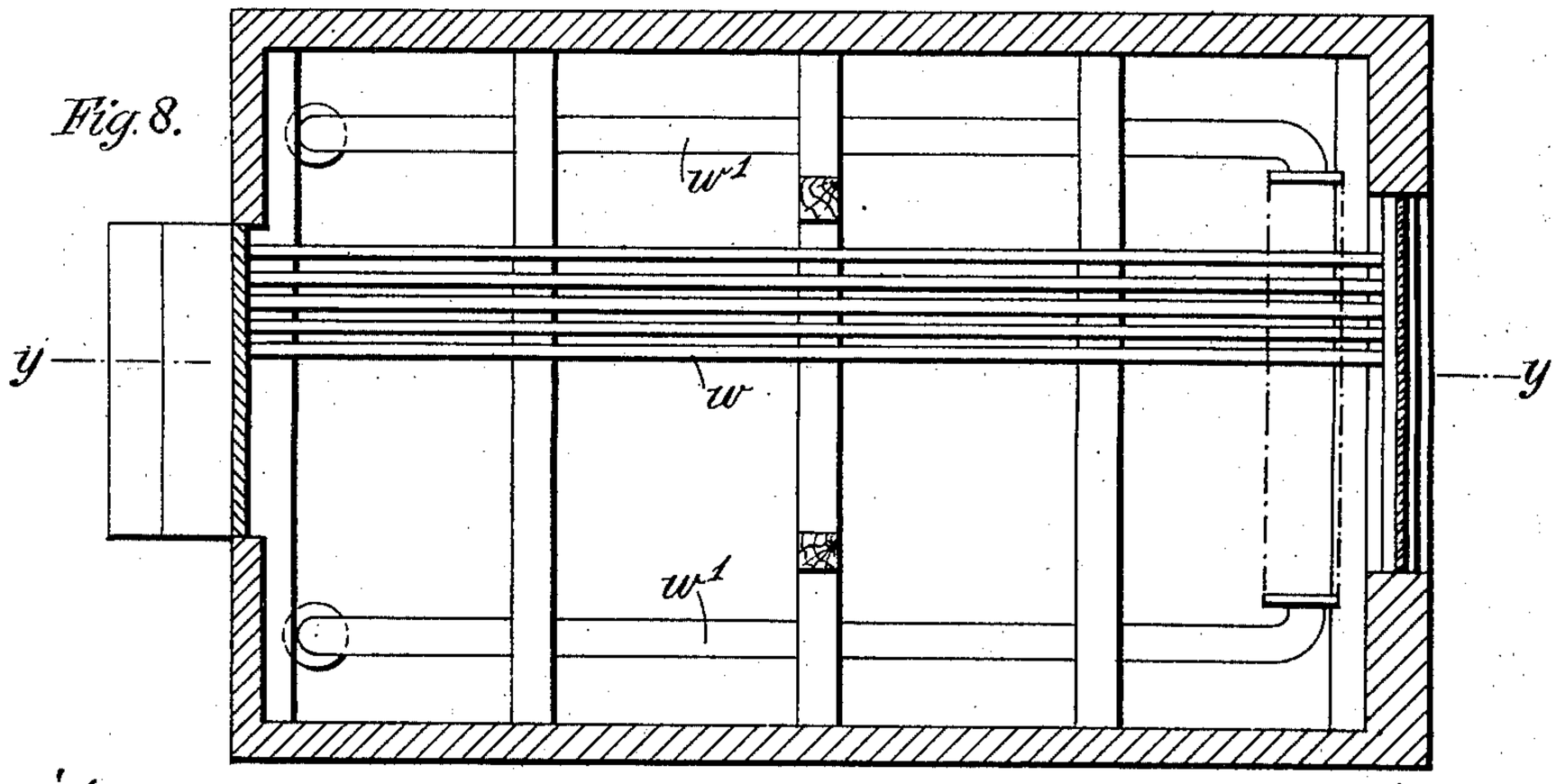


Fig. 8.



Witnesses,
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NO MODEL. 6 SHEETS—SHEET 6.

Fig. 9.

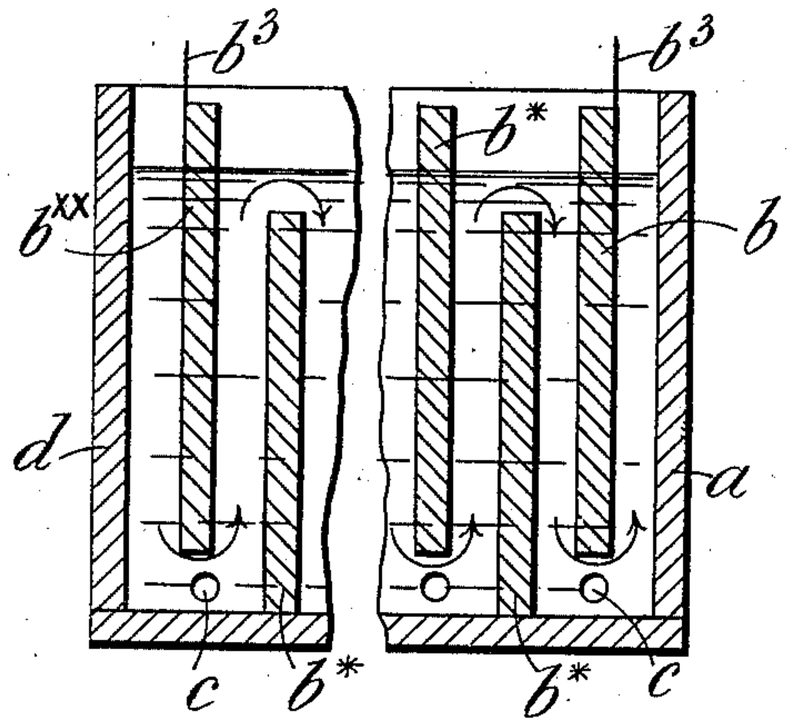


Fig. 10.

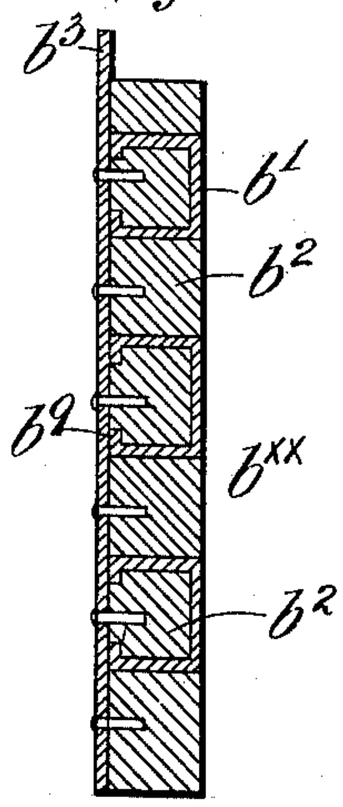


Fig. 11.

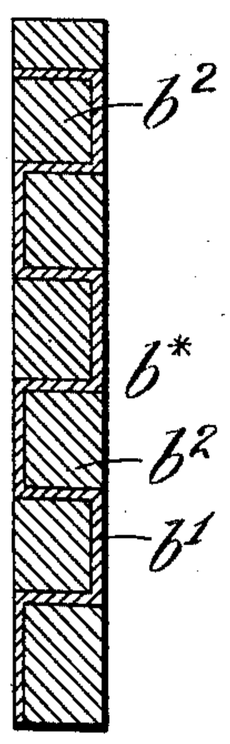


Fig. 12.

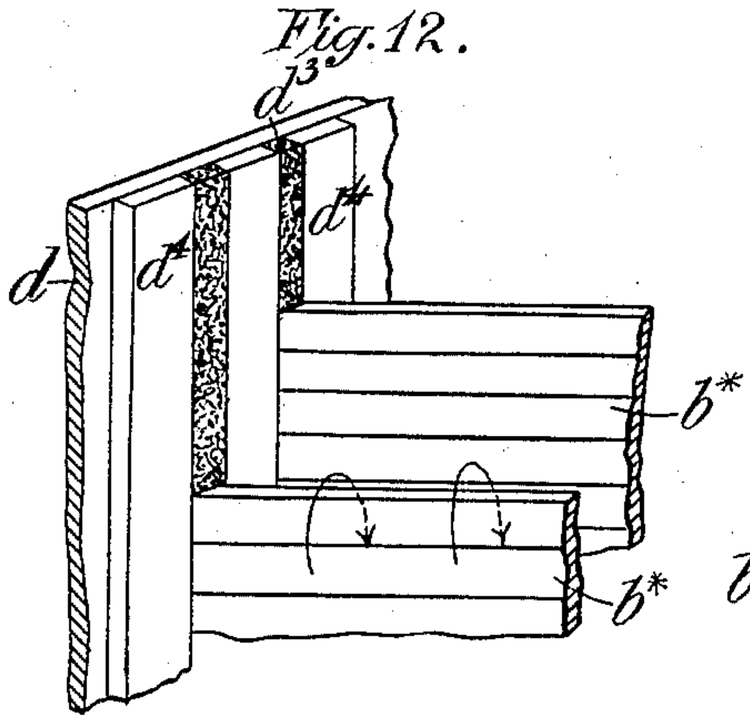


Fig. 13.

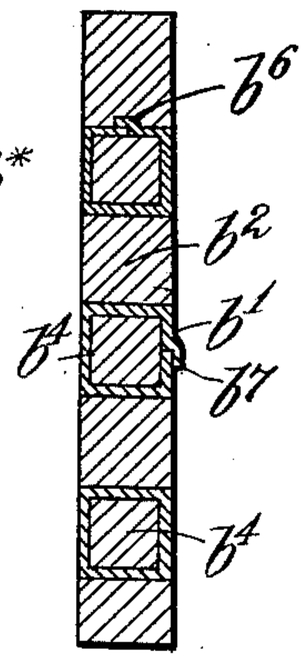


Fig. 14.

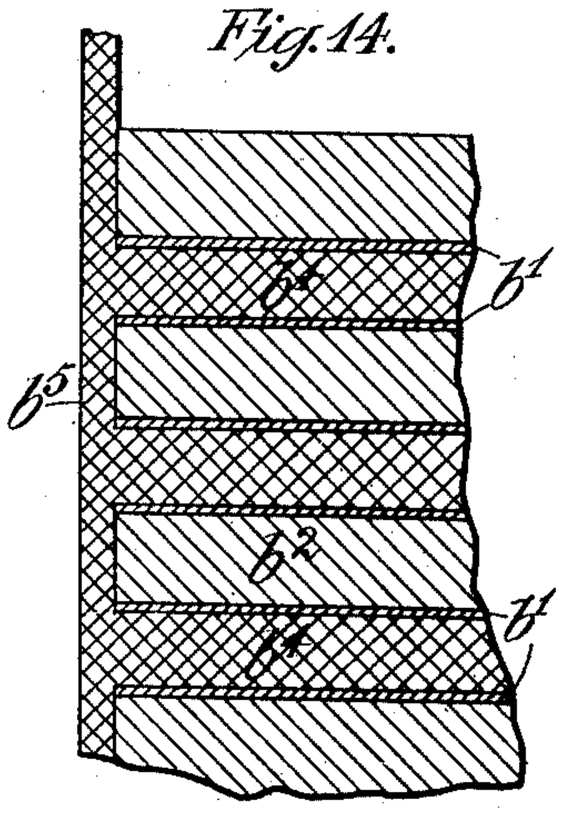


Fig. 15.

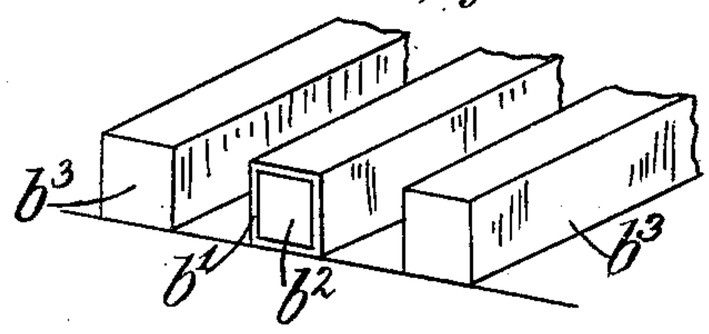


Fig. 16.

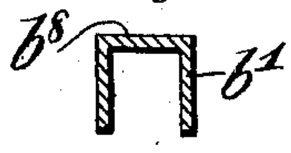
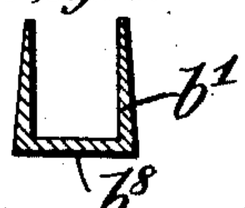


Fig. 17.

Fig. 18.



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James L. Norris, Jr.
Robt Sorrett.

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By James L. Norris.
Atty.

No. 756,745. Patented April 5, 1904.

UNITED STATES PATENT OFFICE.

AUGUST ALFRED VOGELSANG, OF DRESDEN, GERMANY, ASSIGNOR TO CHARLES MARTIN, OF NOTTINGHAM, ENGLAND.

APPARATUS FOR ELECTRICALLY BLEACHING MATERIALS.

SPECIFICATION forming part of Letters Patent No. 756,745, dated April 5, 1904.

Application filed September 21, 1901. Serial No. 76,103. (No model.)

To all whom it may concern:

Be it known that I, AUGUST ALFRED VOGELSANG, chemical engineer, a subject of the Emperor of Germany, residing at 541 Rosenstrasse, Dresden, in the Empire of Germany, have invented certain new and useful Apparatus for Electrically Bleaching Cotton and other Textile Materials, of which the following is a specification.

This invention relates to certain new and useful improvements in apparatus for electrically bleaching cotton and other textile materials, and aims particularly to provide an apparatus which is adapted for the bleaching of cotton yarn and other textile materials in large quantities—weighing, say, from a ton upward—in such a manner that the material to be treated is never touched or moved from the time it is placed into the bleaching-vat until the bleaching of the material is completed, or, in other words, the invention aims to provide an apparatus for the electrical bleaching of a large bulk of material *in situ*.

According to the invention the material is first treated with a solution of caustic soda, then with one of bleaching liquor, and, finally, with a weak solution of sulfuric acid, the composition of these solutions and their mode of application being hereinafter described. The apparatus comprises tanks for the preparation and reception of these solutions, an electrolyzer, vats for the bleaching operation, and other parts hereinafter mentioned. A special feature is the construction and arrangement of the bleaching-vat and its associated parts. The general construction of the apparatus is such as to enable the solutions to be employed in the easiest and most economical manner, with very little labor, and to permit the material to be completely bleached in bulk.

The invention also has reference to an improved electrolyzer for use in combination with the other parts of the apparatus.

The invention will be readily understood by aid of the accompanying drawings, in which—

Figure 1 is an elevation of a complete bleaching plant. Fig. 2 is a plan thereof. Fig. 3 is a vertical central section of a bleaching-vat. Fig. 4 is a transverse section thereof on the line *x x*, Fig. 3. Fig. 5 is a plan of said vat. Fig. 6 is a detail sectional view of a part of said vat. Fig. 7 is a longitudinal section on the line *y y*, Fig. 8, showing a convenient construction of drying-room; and Fig. 8 is a horizontal section thereof on the line *z z*, Fig. 7. Fig. 9 is a section of the electrolyzer, showing the relative arrangement of the plates or electrodes. Figs. 10 and 11 show sections of different forms of electrodes hereinafter referred to. Fig. 12 is a perspective view showing a detail of construction. Figs. 13 and 14 are respectively a transverse and a longitudinal section of one of the main or terminal electrodes. Fig. 15 shows in perspective how the electrodes are built up. Figs. 16, 17, and 18 show different sections for the platinum-foil coverings used in making the electrodes.

a, *b*, and *c* are respectively the tanks for the solutions of salt, sulfuric acid, and caustic soda.

d is an electrolyzer (preferably such as that hereinafter described) situated so that the salt solution can flow into it by gravity.

e is a receiving-tank into which the bleach liquor flows as produced.

f is a measuring-tank into which specific quantities of liquor can be allowed to flow as required for use, and, lastly, *g* represents bleaching-vats to hold the material under treatment, the number varying according to the size of the plant.

The tank *f* is termed a "measuring-tank," because its capacity being known and equal to that of one of the vats it enables enough liquor to be collected in one body to fill said vats.

The tanks *a*, *b*, and *c* are conveniently arranged above the level of the floor *h*, the receiving and measuring tanks being situated beneath them, as shown, while the vats are arranged in a chamber *i* below the floor and project, say, two or three feet above the latter, so that the workmen can have easy access to them.

The tank *a* for the salt is a wooden one, as is also the acid-tank *b*, while the caustic-tank *c* is formed of sheet-iron. These tanks are of the same capacity or of not less capacity than that of one of the vats. The purpose of this

is to insure that each vat shall be filled at one single operation and that the liquor with which it is so filled shall be of uniform strength throughout, a result which cannot be easily attained if the liquor be mixed in small quantities which are added separately. A pipe *j*, connected with a cold-water supply, is arranged for filling the said tanks. The acid and caustic tanks are connected, respectively, with a leaden pipe *k* and with an iron pipe k^0, provided with nozzles *k'* opposite each vat to enable either the acid or the caustic to be run into the vats, as required. The pipe and nozzles are some little distance behind the vats to allow room for the workmen to pass around the latter, and when the liquors are to be run into either of the vats an extension-piece *l* (shown dotted in Fig. 2) is attached to the corresponding nozzle. A steam-pipe *m* serves to conduct steam from a boiler into the caustic-tank to heat the solution therein, and a hot-water pipe *n* serves to allow hot water to be run into the same when desired.

The electrolyzer *d* is situated as shown, so that the salt solution from the tank *a* can be allowed to run slowly into it through a pipe *d'* and after being electrolyzed can overflow freely through a rubber pipe d^2 into the receiver-tank *e*, which may be of brickwork lined with cement.

A leaden pipe *e'* enables the desired quantities of bleaching solution to be run into the measuring-tank *f* ready for use. The capacity of this tank is such that it will hold enough liquor to charge one of the vats at a single operation. This is an important point, since it insures that the bleach liquor is perfectly uniform in its character, and there is thus no danger of the goods being injured or the bleaching impaired by variations in the strength of the liquor, such as would occur if the whole of the liquor were not previously collected in a separate tank, such as *f*.

Situated in the chamber *i* is a centrifugal pump *o*, which enables the bleach liquor to be pumped up from the measuring-tank through a leaden pipe *o'* (having nozzles o^2 like the pipe *k*) into any of the vats, the pump being connected with the measuring-tank by a pipe o^3. Another pipe *p*, connected with the pump, has branches *p'* leading to each vat, and these branches again are connected with other branch pipes *q*, leading to a common waste-pipe *q'*. In this way when the plant is at work the liquor can be pumped up from the bottom of the vats through the pipe *p* and be discharged into them again through the pipe *o'*, thus keeping up a constant circulation, while either tank can be emptied at will through its waste-pipe *q*. A series of branch pipes *m'*, leading from the steam-pipe *m*, permit of steam being discharged into the vats, as hereinafter described.

The various pipes and nozzles above referred to are provided with shut-off cocks *r*—say in the positions shown—for enabling the flow through them to be properly controlled. The cocks for the acid *d* and bleach liquors are preferably of earthenware. Those for the caustic are of iron.

The bleaching-vats *g* (see Figs. 3 to 6) are formed of wood and are provided with a removable cover *s*. Each of them has a perforated false bottom or grating *g'* and a central upright pipe g^2, as shown. This pipe at its lower end communicates with a hollow cone *t*, connected with a cylinder or well *t'*, having a funnel-shaped mouth where it meets the cone. Passing into the cylinder or well *t'* are the two pipes *p'* and *m'*, the former, as will be readily understood, serving for the outflow of the liquor, whereas the latter being the steam-pipe is extended upward into the cone, so that the steam from it will set up an injector action. The effect of this is that the cone *t* acts as an injector to draw the liquor from below the grating *g'* through openings t^2 and force it up the central pipe g^2 against a baffle-plate *s'* on the cover of the vat. Thus the liquor (in this case the caustic solution) is thrown into violent circulation and is heated to boiling-point by the steam.

The cover *s* for the vats is of iron and when in use is rendered steam-tight by the following arrangement: The upper edge of each vat has an outward flange g^3, with a fillet of hemp or other suitable packing $g^\times$ let into it and projecting above it. The rim of the cover *s* is caused to rest on this packing and is then forced down tightly onto the same by a series of screw-clamps s^2, engaging the flange g^3. As the cover is of considerable weight, an overhead traveler *u*, Fig. 1, is arranged above the vats, and the cover has eyes s^3 for the attachment of chains from the pulley-hook *u'* of said traveler. In this way the manipulation of the cover is rendered easy.

To enable the material after treatment to be easily removed from the vats, which might in some cases be a matter of difficulty on account of its weight while in the wet state, (weighing, say, from one and one-half to two tons,) a rising and falling platform or grid g^4 may in some cases be fitted in the vat above the false bottom, as shown, by way of example, in Figs. 3 and 4. This platform is provided with means whereby it can be attached to the pulley of the traveler, a convenient arrangement being by means of three upright rods g^5, of copper, terminating in suitable eyes for the attachment of the pulley-chains. The platform is supported on radial arms g^6 and has a center piece or boss g^7 surrounding the pipe g^2. It can be raised by the pulley, say, into the dotted position, and after a layer of material has been piled on it it may be lowered a little to receive the next layer, and so on until the whole charge is packed, when it can be let down to the bottom of the vat and the pulley-chains attached. After the treat-

ment is over the chains have simply to be again attached to the rods g^5, when the whole charge can be hoisted up, so as to be easily reached by the workmen on the floor h. On removal from the vat the material is first thoroughly washed, say, in an ordinary hand washing-machine, and is then ready to be dried. This is effected first by means of centrifugal driers v and then in a drying-room.

An experimental vat g^8 is arranged, say, in the position shown to enable small quantities of material to be treated as a test before dealing with large quantities. This vat resembles, on a smaller scale, the large vats.

A convenient construction of drying-room is shown in Figs. 7 and 8. It enables the air to act very readily on the material, and so thoroughly removes or deadens any residual bleaching matters which might possibly be left in the yarn. This drying-room has a raised floor or grating w, beneath which steam-pipes w', having gills, are arranged, only the two outer ones being shown. Air is admitted around these pipes and flows upward into the chamber, in which are the hanks of yarn hung on cross-bars w^2, supported by bearers w^3, notched, if desired. The air leaves the chamber through openings w^4 and passes to a flue or out into the atmosphere.

Referring now to the electrolyzer shown in Figs. 9 to 18, this forms the subject of my prior United States patent, No. 703,861, dated on or about July 1, 1902, and belongs to the class in which secondary electrodes are employed—that is to say, to electrolyzers or cells in which only the end electrodes are connected to the source of current and the intervening or intermediate electrodes act in series without any connection with an external circuit. The improvements therein relate principally to the construction of the electrodes, which are built up partly of bars of insulating material sheathed in or faced with platinum foil and partly of plain insulating-bars, the whole being cemented or clamped together. The main object is to enable the platinum foil to be more economically employed than has heretofore been possible and to provide a cell which shall act very efficiently in the electrolysis of alkaline chlorid solutions for the production of bleach liquors. $b^\times$ represents the secondary or intermediate electrodes, and $b^{\times\times}$ represents the end or terminal electrodes. These are arranged in a suitable outer cell d and serve to divide it into separate compartments, each of which acts as a separate cell in series with the rest. Thus the cell as a whole can be fed directly with a current of relatively high potential, the terminal electrode b being, for instance, connected to an incandescent-lighting circuit, of, say, one hundred volts. The solution is admitted at one end of the cell and flows out at the other end after passing up and down between the electrodes, as indicated by the arrows, the said electrodes being arranged alternately at different levels, as shown. The secondary electrodes $b^\times$ are built up of square rods or bars b^2—say, for instance, of slate covered with a sheath b' of platinum or platinum-iridium foil—and of plain rods b^3. These rods are cemented together by Portland or other suitable cement. Fig. 15 shows in perspective two of the plain rods b^3 with an intervening sheathed rod b^2, these being laid side by side ready to be cemented together. The electrodes are fitted into grooves or channels d^3, formed between distance-strips d^4, cemented to the side walls of the cell, the upper and lower parts of the grooves d^3 being filled with Portland cement, as shown, thus preserving a uniform smooth surface on the side walls of the cell. In the case of the end electrodes, which serve as the main anode and cathode, the arrangement is modified, as shown in Fig. 14, the sheath b' being fitted to rods b^4, of lead or other conducting material, which extend laterally from an upright lead strip b^5, serving to form the electrical connection with the external circuit. The sides of each sheath b' form electrolyzing strips or surfaces, while the top and bottom parts embedded in the electrode simply act as conductors or connectors in parallel between the electrolyzing-surfaces. Furthermore, one side of each sheath acts as a cathode in one compartment, while the other side acts as an anode in the next compartment. By arranging the foil as a rectangular sheath the flow of the current divides equally through the top and bottom parts thereof, and thus a current can safely be employed which might cause too high a density and lead to overheating if the conduction were confined to a single thickness of foil. The sheaths are entirely separated from each other, and hence the electrode has on each side a series of electrolyzing-strips alternating with intervening insulating-surfaces. To avoid overheating of the electrode, a convenient current density is two amperes per square millimeter of cross-section and fifty amperes per square decimeter of electrolyzing strip or surface. Within these limits solutions of common salt (NaCl) can be safely electrolyzed without any undue rise of temperature occurring such as would lead to the formation of chlorates instead of hypochlorites. The edges of the platinum sheaths may be joined by a lap-seam either centrally along the top, as at b^6, Fig. 13, or along the side, as at b^7. The advantage in the former case is that the joint is embedded in the insulating material, and is thus protected from the electrolyte; but as the current must pass through it it is necessary to solder the seam or otherwise insure its electrical efficiency, whereas a joint in the position shown at b^7 is at a point which is electrically neutral and its electrical efficiency is not so essential. It should be understood that the thickness of the platinum foil is greatly exaggerated in the

drawings, this being done for the sake of clearness. In actual practice foil as thin as .03 millimeter may be employed.

Figs. 16, 17, and 18 show sections for the platinum foil which give results approximately to those of the rectangular sheaths, but in which the platinum forms a facing instead of a complete sheath. In these cases the horizontal or "conducting" portion b^8 of the section is embedded in the electrode between the square rods and the vertical or flange-like portions form the electrolyzing strips or surfaces. The horizontal portions are preferably made thicker in these cases, since the current density through them is obviously doubled relatively to that in either of the horizontal parts of the sheath. In Fig. 18, moreover, the electrolyzing-strips are tapered off toward their free edges, thus economizing platinum, while preserving a uniform current density throughout their section.

In some cases the end electrodes may be formed, like the intermediate ones, entirely of insulating-rods, and the current may be led to the platinum foils by a lead backing b^9, extending down one side of the electrode and riveted to the insulating-rods—as indicated, for instance, in Fig. 10—or the platinum strip may be wound between the rods in zigzag fashion, as in Fig. 11.

Returning now to the general portion of the apparatus, the solutions employed in the tanks *a*, *b*, and *c* may be as follows: For treating, say, a thousand pounds of cotton yarn the salt solution may be formed by dissolving four hundred kilograms of salt in ten cubic meters of water; the sulfuric-acid solution, by adding twenty pounds of commercial acid (at 66° Baumé) to six hundred liters, or, say, two-thirds centimeter of water, while the caustic-soda solution consists of twenty to thirty pounds of NaHO dissolved in about 2.5 cubic meters of water, and it is heated to about 50° by the steam from the pipe *m* before it is used. Obviously these proportions may be varied somewhat, according to the material being treated and according to the results obtained in the experimental vat. It is desirable also that the material should not be subjected to the action of the liquors longer than may be necessary, especially when dealing with loose fluffy yarn.

The mode of proceeding when carrying out the bleaching is as follows: The solution of salt is allowed to flow through the electrolyzer, whereby on well-known principles it becomes charged with bleaching agents and forms the bleaching liquor. A convenient mode of estimating the proper working of the electrolyzer is by the difference in temperature of the inflowing and outflowing solutions, a rise of 12° to 18° centigrade being an indication that the proper strength is being attained. The bleach liquor is then allowed to flow into the receiving-tank *e*, whence it is drawn into the measuring-tank *f*, ready for use. The material to be treated is meanwhile packed in a quantity of from one to two tons or more into the vat in which it is to be bleached, the bundles in the case of yarn being placed on end, so that the solutions will flow up or down through them more easily. The caustic solution is then run into the tank and circulated first by the injector action up the pipe g^2 and then by the pump *o* in the manner described. The caustic removes any greasy and other matters that might interfere with the action of the bleach solution. While the caustic is acting, the vat is kept tightly covered, and after the liquor has been raised nearly to the boiling-point by the injector the cover is removed and the external circulation by the pump from the bottom of the vat back into the top of the same is started. After a suitable time the caustic is run off and clean water is admitted, so as to rinse the material. When the caustic residues are thoroughly removed, the bleach liquor is pumped in from the measuring-tank and is allowed to act for a suitable time, being circulated by the pump. It is then run off through the pipes *q q'* and the material is again rinsed. The solution of sulfuric acid is next admitted and serves to scour the material, after which the latter is finally rinsed and is removed from the vat. It is then ready to be treated in the rinsing-machine and then dried, first by the driers *v* and then in the drying-room.

The invention is applicable to the bleaching of curtains and piece goods, as well as to various other goods. In dealing with such goods as curtains a convenient way is to provide a system of rollers so arranged that the articles can be wound backward and forward and be caused at the same time to pass through the vats in order to be acted on by the various solutions. It is to be particularly noticed, however, that in dealing with yarn the same is not handled in any way during treatment, but is simply packed in the vats in bulk in the bundles in which it comes from the mills, and the whole mass is left absolutely *in situ* during the bleaching operation until it is ready to be removed from the vats to be dried. This is a great practical advantage of the system.

What I claim, and desire to secure by Letters Patent of the United States, is—

1. In an apparatus for electrically bleaching cotton and other textile materials in large quantities, the combination of a vat or vats for containing the material in bulk, an electrolyzer, a tank for supplying said electrolyzer with brine solution, a measuring-tank for enabling the required quantities of bleach liquor to be drawn off, tanks and pipes for supplying said vat or vats successively with caustic solution, bleaching liquor, and scouring solu-

tion, and an injector for circulating said liquors from the bottom of the vats directly into the top thereof, substantially as described.

2. In an apparatus for electrically bleaching cotton and other textile materials in large quantities the combination of a vat to hold the materials to be bleached in quantities of say a ton or upward, an electrolyzer for the production of bleaching liquor, a tank for the collection of such bleaching liquor and for insuring its strength being uniform throughout, a tank for holding caustic solution, a tank for holding acid solution, and means for transferring the contents of said three tanks separately to the vat to allow them to act on the materials resting all the while *in situ* therein, substantially as described.

3. In an apparatus for electrically bleaching cotton and other textile materials in large quantities, a bleaching-vat adapted to receive a large quantity of the material, means for supplying to said bleaching-vat cleansing and bleaching solutions causing thereby the complete bleaching of the large quantity of material without its removal from the said vat, a steam-injector inside said vat for circulating the solution, and a removable cover for closing the vat during such circulation.

4. In an apparatus for electrically bleaching cotton and other textile materials in bulk, the combination of a vat or vats for containing the material in bulk, an electrolyzer for producing the bleach liquor, and tanks for supplying caustic and scouring solutions to the vat or vats and salt solution to the electrolyzer, a movable false bottom on which said materials rest, and means for raising and lowering said false bottom with the material in bulk thereon, substantially as described.

5. In an apparatus for electrically bleaching cotton and other textile materials in bulk, the combination of a vat or vats for containing the material in bulk, an electrolyzer for producing the bleach liquor, and tanks for supplying caustic and scouring solutions to the vat or vats and salt solution to the electrolyzer, a measuring-tank for enabling the whole of the required quantity of liquor to be supplied to the vat at one operation, a movable false bottom on which the materials under treatment rest, and means for raising and lowering said false bottom with the material in bulk thereon, substantially as described.

6. In an apparatus for electrically bleaching cotton and other textile materials in large quantities the combination of a bleaching-vat adapted to receive a quantity of material weighing say from one to two tons, an electrolyzer, a measuring-tank to receive the liquor from the electrolyzer, and means for transferring said liquor from the measuring-tank to the vat causing thereby the complete bleaching of the whole of said material *in situ* without handling or removing from the vat.

7. In an apparatus for electrically bleaching cotton and other textile materials in large quantities the combination of a brine-tank, a storage-tank at a lower level, an electrolyzer at an intermediate level, a bleaching-vat, means for permitting the brine liquor to flow by gravity first into the electrolyzer and then into the tank, and means for transferring the liquor from the latter into the vat, causing thereby the complete bleaching of the whole of said material *in situ* without handling or removing from the vat.

8. In an apparatus for electrically bleaching cotton and other textile materials in large quantities the combination of a vat, an electrolyzer, a measuring-tank for receiving the liquors from the electrolyzer, means for supplying the vat with liquors, and means for circulating said liquors from the bottom to the top inside said vat, causing thereby the complete bleaching of the whole of said material *in situ* without handling or removing from the vat.

9. In an apparatus for electrically bleaching cotton and other textile materials in large quantities, the combination of a bleaching-vat, tanks of approximately the same capacity as said vat for holding the supplies of caustic and acid liquor, a brine-tank also of approximately the same capacity, all of said tanks being at a higher level than said vat, a measuring-tank at a lower level, an electrolyzer receiving liquor from the brine-tank and delivering it to the measuring-tank, and means for transferring the liquor from the latter tank to the vat, causing thereby the complete bleaching of the whole of said material *in situ* without handling or removing from the vat.

10. In an apparatus for electrically bleaching cotton and other textile materials in large quantities, a receptacle for a large quantity of the material, an electrolyzer, a tank for collecting the liquor from said electrolyzer before its admission to the said receptacle, and means for supplying to said vat successively, caustic liquor, electrolyzed liquor and a scouring solution, causing thereby the complete bleaching of the material without the handling or removal thereof from the bleaching-vat.

11. In an apparatus for electrically bleaching cotton and other textile materials in large quantities, a bleaching-receptacle adapted to receive a large quantity of the material, an electrolyzer, a measuring-tank for collecting the electrolyzed bleach liquor in the required quantity at a uniform strength, and means for transferring such liquor to the bleaching-receptacle thereby causing the complete bleaching of the material without the handling or removal thereof from the bleaching-vat.

In testimony whereof I have hereunto set my hand, in presence of two subscribing witnesses, this 16th day of August, 1901.

AUGUST ALFRED VOGELSANG.

Witnesses:
WM. H. SACON,
S. E. GREENDALE.