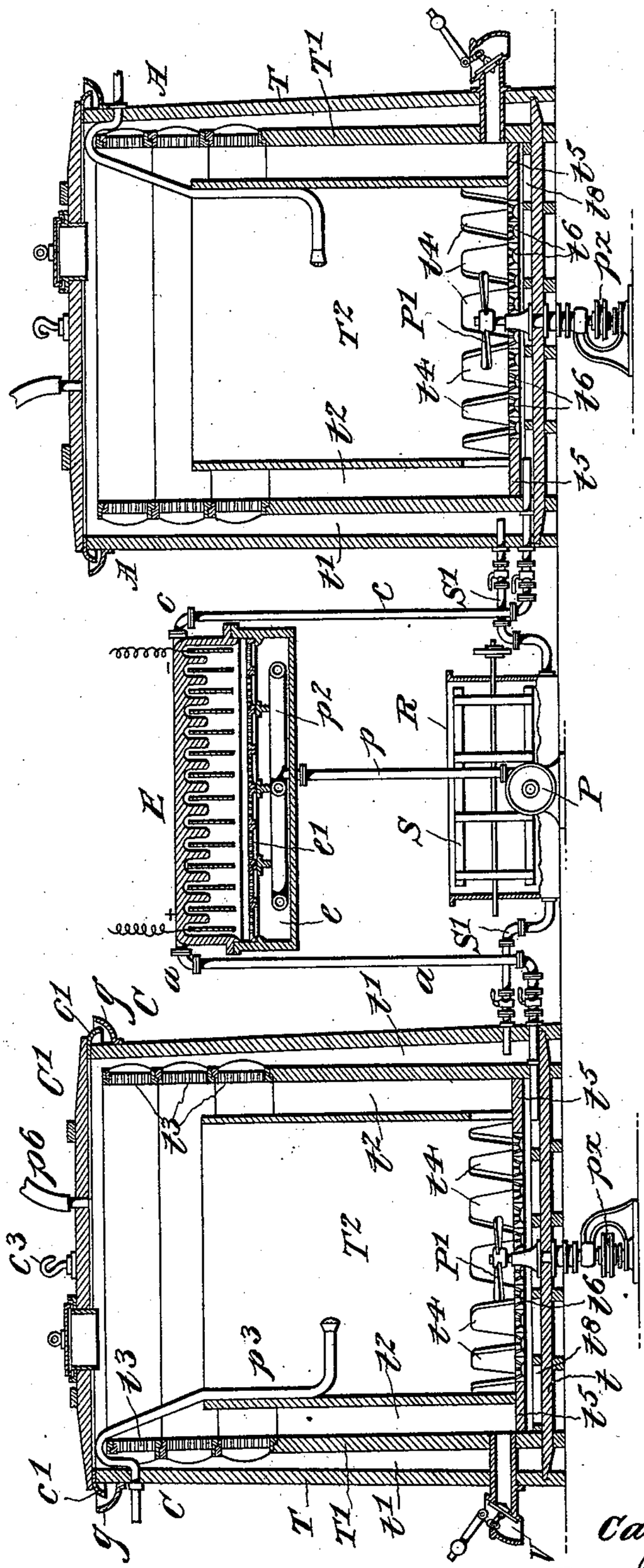
(No Model.) 2 Sheets—Sheet 1.

C. KELLNER.

PROCESS OF AND APPARATUS FOR BLEACHING VEGETABLE FIBERS.

No. 560,411. Patented May 19, 1896.

Fig. 1.



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(No Model.) 2 Sheets—Sheet 2.

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Fig. 2.

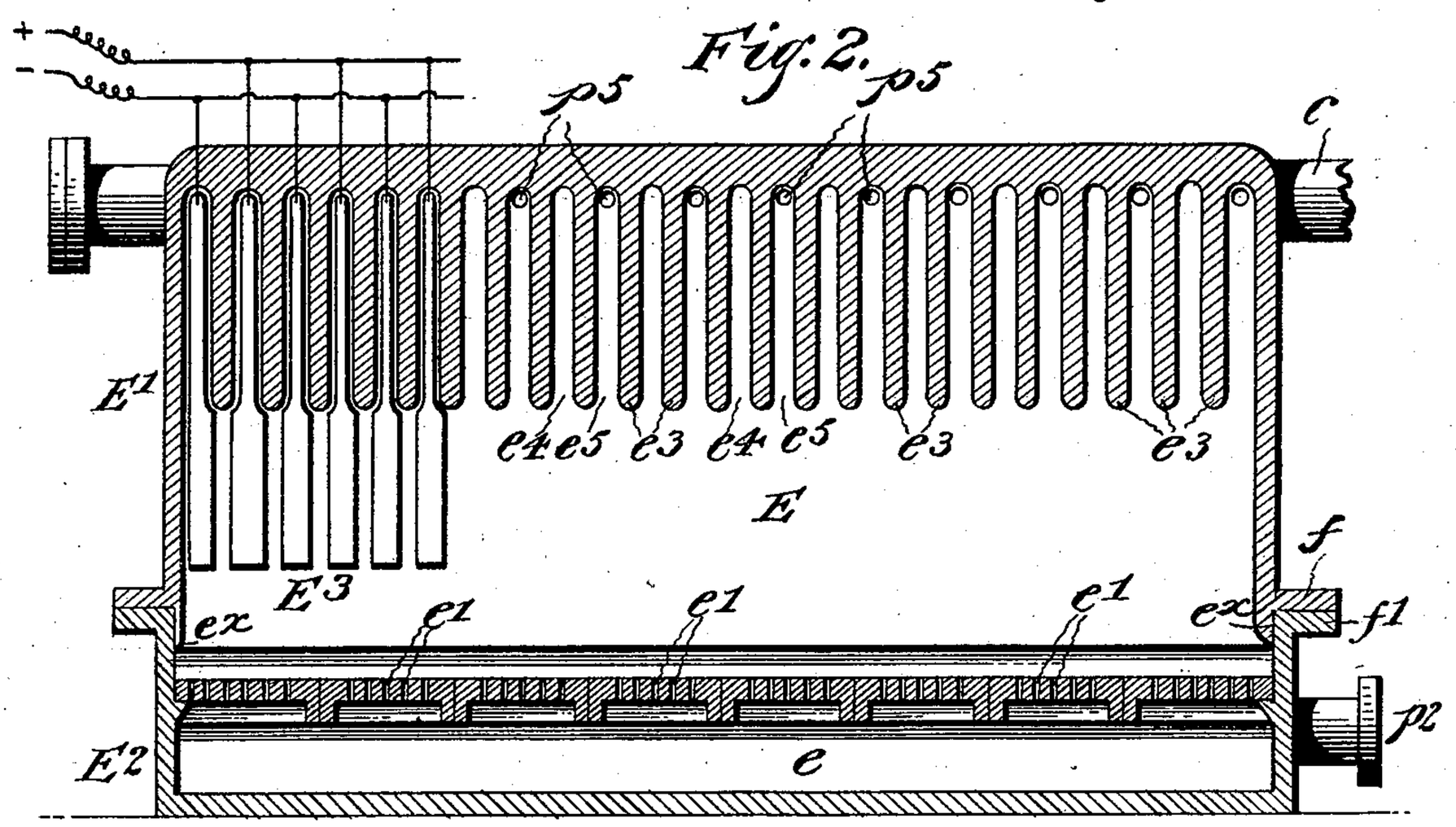


Fig. 3.

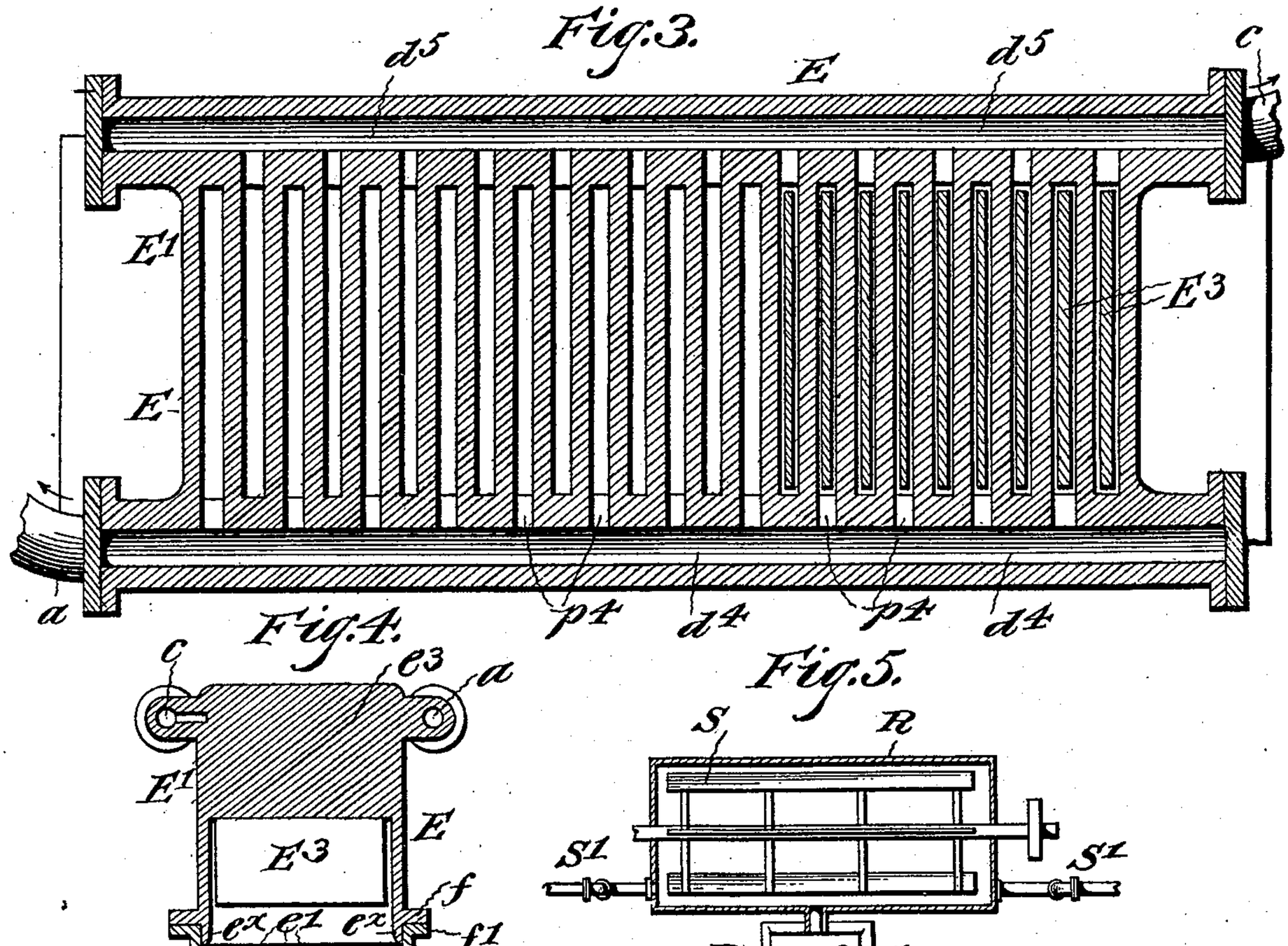


Fig. 4.

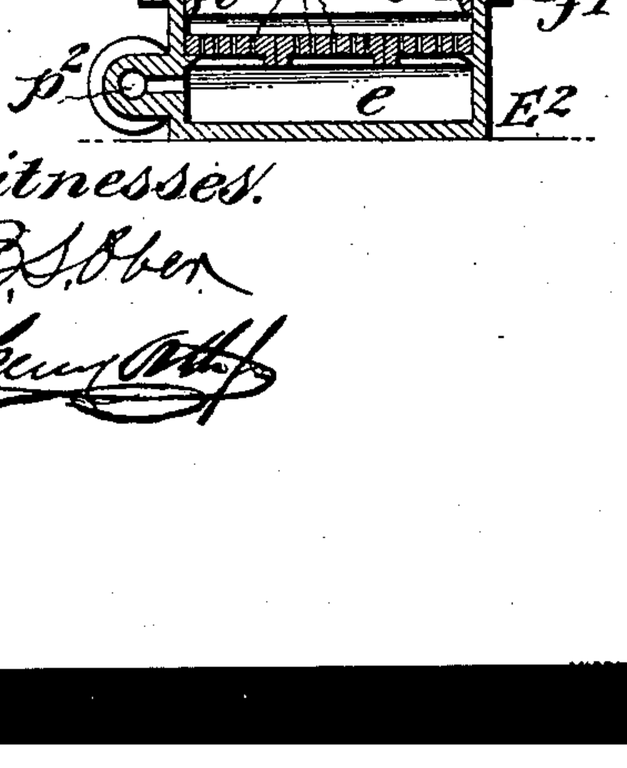
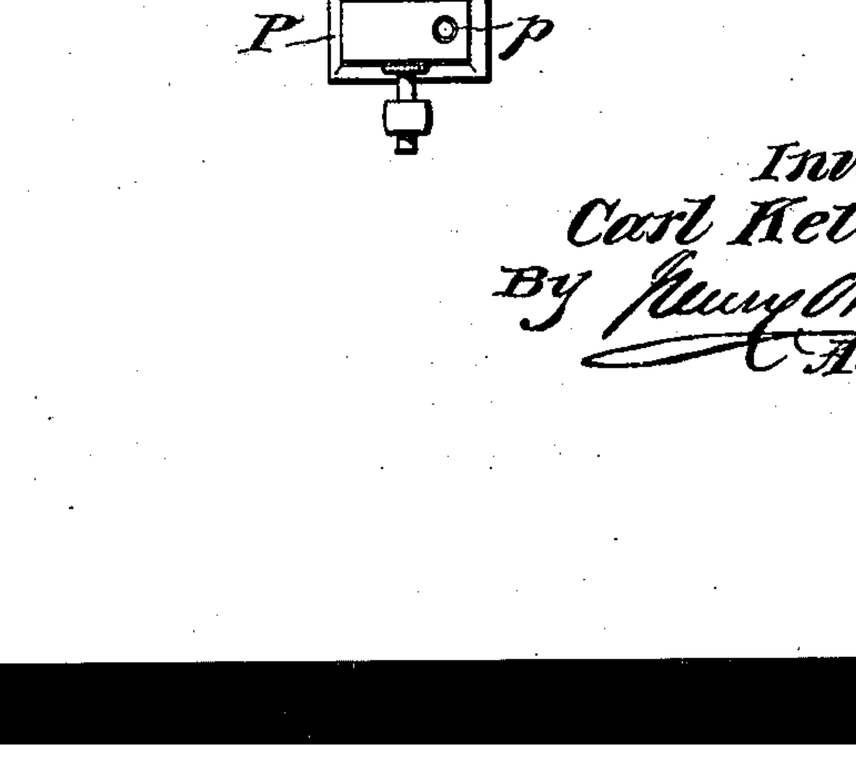


Fig. 5.



Witnesses.
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Henry Orth

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UNITED STATES PATENT OFFICE.

CARL KELLNER, OF VIENNA, AUSTRIA-HUNGARY.

PROCESS OF AND APPARATUS FOR BLEACHING VEGETABLE FIBERS.

SPECIFICATION forming part of Letters Patent No. 560,411, dated May 19, 1896.

Application filed December 5, 1891. Serial No. 414,204. (No model.) Patented in England April 5, 1890, No. 5,285; in France April 5, 1890, No. 204,827; in Germany April 6, 1890, No. 59,218; in Sweden June 18, 1890, No. 3,339; in Norway June 26, 1890, No. 1,896, and in Austria-Hungary December 3, 1890, No. 29,548 and No. 51,561.

To all whom it may concern:

Be it known that I, CARL KELLNER, a subject of the Emperor of Austria-Hungary, residing at Vienna, in the Province of Lower Austria, in the Empire of Austria-Hungary, have invented certain new and useful Improvements in the Processes of and Apparatus for Bleaching Vegetable Fibers, (for which I have obtained Letters Patent in Austria-Hungary, No. 29,548 and No. 51,561, dated December 3, 1890; in Germany, No. 59,218, dated April 6, 1890; in France, No. 204,827, dated April 5, 1890; in England, No. 5,285, dated April 5, 1890; in Norway, No. 1,896, dated June 26, 1890, and in Sweden, No. 3,339, dated June 18, 1890;) and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters of reference marked thereon, which form a part of this specification.

The invention relates to the art of bleaching fibrous materials, and has for its object the provision of means whereby the operation of bleaching may be more effectually and more economically and rapidly carried out than has been the case prior to my invention; and to these ends my said invention consists in a novel method of bleaching fibrous materials and in apparatus therefor, as will now be fully described, reference being had to the accompanying drawings, in which—

Figure 1 is a vertical sectional elevation of an apparatus constructed according to my invention. Fig. 2 is a longitudinal vertical sectional view, Fig. 3 a like horizontal view, and Fig. 4 a transverse section, of the electrolytic apparatus or electrolyzer; and Fig. 5 is a detail view.

In the process of bleaching fibrous materials with chlorin as heretofore carried out hydrochloric acid is formed, the material being subjected to the action of chlorin for a sufficient length of time to convert the coloring elements into bodies that are soluble in hydrochloric acid.

I have discovered that the coloring-matter of fibrous materials can be converted into bodies soluble in water, and that the conversion—*i. e.*, operation of bleaching—can be carried out more thoroughly and more effectually. I have also discovered that under the action of chlorin intermediate products of the coloring-matter are formed that are not soluble in water, but readily soluble in alkalies, and consequently that these products can be readily removed by a solution of an alkali.

My improved process consists, therefore, in alternately subjecting the fibrous material to the action of chlorin and to that of an alkali, whereby both the products or compounds soluble in water and in an alkali may be readily removed and the operation of bleaching effected in a thorough and rapid manner. I have also found that a comparatively great saving in chlorin can be effected and the solution of an alkali obtained by resorting to electrolysis. Thus, for instance, by electrolytically decomposing a suitable chlorid of a metal—as, for instance, sodium or potassium chlorid or any other chlorin compound—chlorin and an alkali solution are obtained, so that the anion and cation become directly available for my improved process by subjecting the fibrous material alternately to the action of the anion and cation solutions.

In the accompanying drawings I have illustrated a convenient apparatus composed of two tanks, within which the material is subjected to the alternate action of the anion or chlorin solution and the cation or alkali solution, or one of said tanks may be used as a chlorinater and the other as an alkalizer, if so desired, and for the purposes of description I will hereinafter denominate one of these as the "chlorinater" and the other as the "alkalizer." With these I combine an electrolytical apparatus which I will hereinafter call the "electrolyzer," a reservoir common to both chlorinater and alkalizer, and a pump for drawing the liquid from said reservoir and forcing it into the electrolyzer. Notwithstanding that the apparatus shown is simple in construction and very efficient in operation I do not desire to limit myself to its specific

construction, which, although preferred, may be variously modified, as will be apparent from the description thereof.

Referring now more particularly to Fig. 1, inasmuch as both the chlorinater C and alkalizer A are alike in construction, it will suffice to describe one of them in order that the construction of the other may be fully understood. The chlorinater C is composed of three concentrically-arranged tanks or vats T T' T² of such relative diameter as to leave a space between each two of the tanks, as indicated at t' t^2. The intermediate tank T' has its bottom t^5 arranged some distance from its lower edge, so as to form with the bottom t of the outer tank a chamber t^8 between them. A portion of the bottom of tank T' is imperforate, and a central portion thereof is provided with perforations or composed of a foraminous or porous material—as, for instance, porous earthenware or so-called "filter-stones"—as shown at t^6, and said foraminous or porous portion of the bottom t^5 of tank T' constitutes the bottom of the inner tank T², which is simply an open-ended cylinder. As shown, the tank T² has openings t^4 formed around its lower edge and is of considerably less height than the intermediate tank T', which is nearly of the same height as the inclosing tank T, and has its upper portion to a point some distance below the upper edge of the inner tank T² provided with perforations or constructed of a foraminous or filtering material, preferably finely-perforated earthenware sections, as shown at t^3. The object of providing tank T² with a filter-bottom is to prevent any solid particles coming from the anion cells of the electrolyzer passing to the material, while the upper filtering-section t^3 of the intermediate tank T' serves to prevent fibrous material from passing to the electrolyzer. A steam-pipe p^3, extending into the tank T² and terminating in a rose-head, is connected with a suitable steam-generator, so that steam may be admitted to said tank for the purpose of heating the chlorin solution. The outer tank T is closed by a cover C', which during the operation of bleaching is luted to the tank, a gutter g being arranged around the upper edge of said tank, while the cover C' is provided with an overhanging flange c', that projects into said gutter.

In bleaching fibrous materials it is preferred to keep the same in motion, so as to expose the fibers more thoroughly to the bleaching agent, and to this end I provide a propeller P' in tank T², driven from any suitable motor, said propeller operating to propel the contents in tank T² upwardly, so that it will overflow into the space t^2 between said tank and tank T' and be drawn back again to tank T² through the openings t^4. It will be understood that the propeller may be caused to act in a downward direction, forcing the contents of tank T² through openings t^4, thence up the space t^2 over the upper edges of said tank, or in a reverse direction to that described, without departing from the spirit of my invention. The cover C' has an aperture a', closed by a suitable cover, for the purpose of inspecting the progress of the operation of bleaching by the taking of samples. It is also provided with a pipe p^6 for taking off the gases evolved during said operation and with a hook c^3, whereby the cover may be lifted off and on again after charging, the discharge of the material taking place through a pipe connected with space t^2 and having therein a weighted sluice-valve V.

A reservoir R (also shown in Fig. 5) is arranged between the chlorinater and alkalizer and contains a stirrer S (shown in dotted lines in Fig. 1) of a well-known construction—namely, of stirrer-blades parallel with and secured to a horizontal shaft by means of radial arms, said shaft extending outside the reservoir R and carrying a belt-pulley that may be driven from any suitable motor. This stirrer is used for intimately mixing the anion and cation solutions flowing or drawn from the space t' between the outer and intermediate tanks T and T' of said apparatus through valved connections S', and P is a pump connected with a chamber e, formed by a foraminous or perforated false bottom e' of the electrolyzer E through the vertical pipe p and a pipe or duct p^2, having ports opening into said chamber, (see also Fig. 4,) whereby the electrolyte can be returned to the electrolyzer. The anion and cation cells of the electrolyzer are connected with the chamber t^8 below the bottom of the intermediate tank T' of the chlorinater C and alkalizer A, respectively, by means of a valved pipe a and c.

Any suitable electrolyzer may be employed provided with means for separating the anion from the cation solution and with means for conducting them separately to the chlorinater and alkalizer, respectively. I prefer, however, the construction of electrolyzer shown in Figs. 2, 3, and 4 as being specially designed for the purpose. It is composed of a tank in which a chamber e is formed by a false bottom e', constructed of a foraminous or filtering material and having a lateral duct p^2, provided with ports opening into said chamber, these parts constituting the lower portion E² of the electrolyzer, which is constructed in two sections, as shown, secured together fluid-tight in any desired or preferred manner—as, for instance, by providing both sections with bolt-flanges f f', respectively, and by providing the upper section E' with an extension $e^{\times}$ below the bolt-flange f, projecting into the lower section E², as shown in Fig. 2. The upper section E' has depending ribs e^3, forming alternating plus and minus cells e^4 and e^5, the former being connected by ports p^4 with a duct d^4, connected with valved pipe a and the chlorinater, while the alternate minus cells e^5 communicate through ports p^5 with a duct d^5, that is connected through pipe c with the alkalizer, as above stated.

The electrodes E^3 are made of any suitable material—as carbon, zinc, or platinum—and have that portion below the cells in which they are suspended of increased thickness for the purpose of reducing the resistance as much as possible. Of course all the positive electrodes are connected in series and all the negative electrodes are connected in series.

The foraminous or filter bottoms of the chlorinater and alkalizer and the electrolyzer not only serve the purpose of holding back any foreign substances that may be carried along with the electrolytes, but also serve to more uniformly distribute the supply of liquid to these apparatuses.

From the above description the operation of the apparatus will be readily understood, and in order that the material to be bleached may be alternately subjected to the action of chlorin and to the action of an alkali the current in the electrolyzer is reversed from time to time, the chlorinater becoming the alkalizer and the latter the chlorinater. Thus, in starting, the tank T^2 of the chlorinater is first supplied with a charge of fibrous material, the anion flowing to said chlorinater C and the cation to the empty alkalizer A. After the material in the chlorinater C has been subjected to the action of the anion for the required time it is removed to the alkalizer and a fresh charge of material is introduced into the chlorinater, the fibrous material being subjected to the alternate action of the anion and cation until it is bleached. If desired, the same results may be obtained by reversing the current in the electrolyzer, thereby reversing the polarity of the electrodes, the anion flowing to the alkalizer and the cation to the chlorinater, as will be readily understood. On the other hand, a number of chlorinaters and alkalizers may be arranged in battery, as in the well-known diffusion processes, with the usual provision for cutting out any one of the apparatuses, whereby the operation of bleaching may be made continuous.

Of course the various parts of the apparatuses liable to come in contact with chlorin will be constructed of a material capable of resisting the action of chlorin and alkalies.

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

1. In a process for bleaching fibrous materials, decomposing a solution of an alkali metal chlorid electrolytically to produce chlorin or a compound thereof and a caustic alkali, subjecting the material first to the chlorin solution, whereby the coloring-matter in such material, is converted into combinations that are soluble in water and into combinations that are insoluble in water, withdrawing the material from the action of the chlorin solution and removing the coloring-matter insoluble in water by subjecting the said material to the action of the alkali solution, substantially as set forth.

2. In a process for bleaching fibrous materials, decomposing a solution of an alkali metal chlorid electrolytically to produce chlorin or a compound thereof and a caustic alkali, subjecting the material to be bleached first to the chlorin solution whereby the coloring-matter in said material is converted into combinations that are soluble in water and into combinations that are insoluble in water, removing the material from the chlorin solution, and removing the insoluble coloring-matter by subjecting said material to the action of the alkali solution and keeping said material in suspension or motion while being acted upon by the aforesaid solutions, for the purpose set forth.

3. In a process for bleaching fibrous materials, decomposing a solution of an alkali metal chlorid electrolytically to produce chlorin or a compound thereof and a caustic alkali, subjecting the material to be bleached first to the chlorin solution whereby the coloring-matter in said material is converted into combinations that are soluble in water and into combinations that are insoluble in water, removing the material from the chlorin solution, and removing the insoluble coloring-matter by subjecting said material to the action of the alkali solution, keeping said material in suspension or motion while being acted upon by the aforesaid solutions, then mixing said solutions and returning the same into the field of electric action, substantially as and for the purpose set forth.

4. The herein-described bleaching apparatus comprising a pair of bleaching tanks or vats, an electrolyzer having its cells of like name connected in series and connecting-pipes connecting the terminal positive cell of the series with one of said tanks and the like negative cell with the other, a reservoir common to both bleaching-tanks, a pump and suitable connections connecting the said reservoir with the bleaching-tanks and pump respectively and said pump with the electrolyzer, for the purpose set forth.

5. The herein-described bleaching apparatus comprising a pair of bleaching tanks or vats, an electrolyzer having its positive cells connected with one of said tanks and its negative cells with the other, a reservoir common to both tanks, a revoluble stirrer contained in the reservoir, and a pump for pumping the liquid flowing into the reservoir from said tanks back to the electrolyzer, for the purpose set forth.

6. A bleaching apparatus comprising three concentrically-arranged tanks or vats of decreasing diameter to form a passage between each two of the tanks and so arranged that the contents of the inner tank can overflow into the intermediate tank, and the contents of the latter into the outer tank, said inner tank being provided with a porous or foraminous bottom and with passages formed in its walls along said bottom, a chamber below said bottom, a heating appliance contained in

the inner tank, and means for supplying the bleaching agent to the chamber below the bottom of the inner tank, for the purpose set forth.

7. A bleaching apparatus comprising three concentric tanks of decreasing diameter, the inner tank being of less height than the outer and intermediate tanks, the upper portions of the walls of the latter being porous or foraminous, and the inner tank having a like bottom and ports or passages in its vertical walls along said bottom, a chamber below the latter, a propeller revolving axially within the inner tank, a heating appliance therein, a cover for the outer tank, a valved discharge-pipe connected with the space between the inner and intermediate tanks, and means for supplying the bleaching agent to the chamber below the bottom of the inner tank, for the purpose set forth.

8. The combination with the chlorinater and alkalizer, C, and A, each having a chamber, t^8, below the bottom of the central tank, T^2, of a reservoir connected with the space, t', between the outer and intermediate tanks of said apparatus, an electrolyzer having its positive cells connected with the chamber, t^8, of the chlorinater, and its negative cells with the like chamber of the alkalizer, and a pump connected with the reservoir and electrolyzer, for the purpose set forth.

9. The combination with the chlorinater and alkalizer, C, and A, each having a chamber, t^8, below the bottom of the central tank, T^2, the steam-pipe, p^3, extending into said central tank, the propeller, P', revoluble within said tank, of a reservoir connected with the space, t', between the outer and intermediate tanks, a revoluble mixer in said reservoir, an electrolyzer provided with a chamber, e, formed by a porous or foraminous partition below the cells, separate valved ducts connecting the positive cells with the chamber, t^8, of the chlorinater and the negative cells with the like chamber of the alkalizer, and a pump connected with the chamber, e, of the electrolyzer and with the reservoir, for the purpose set forth.

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

CARL KELLNER.

Witnesses:

JULIUS GOLDSCHMIDT,

A. SCHLENING.