No. 775,829. PATENTED NOV. 22, 1904.

I. KITSEE.

PRODUCTION OF PAPER PULP.

APPLICATION FILED MAY 1, 1903.

NO MODEL.

Fig. 1.

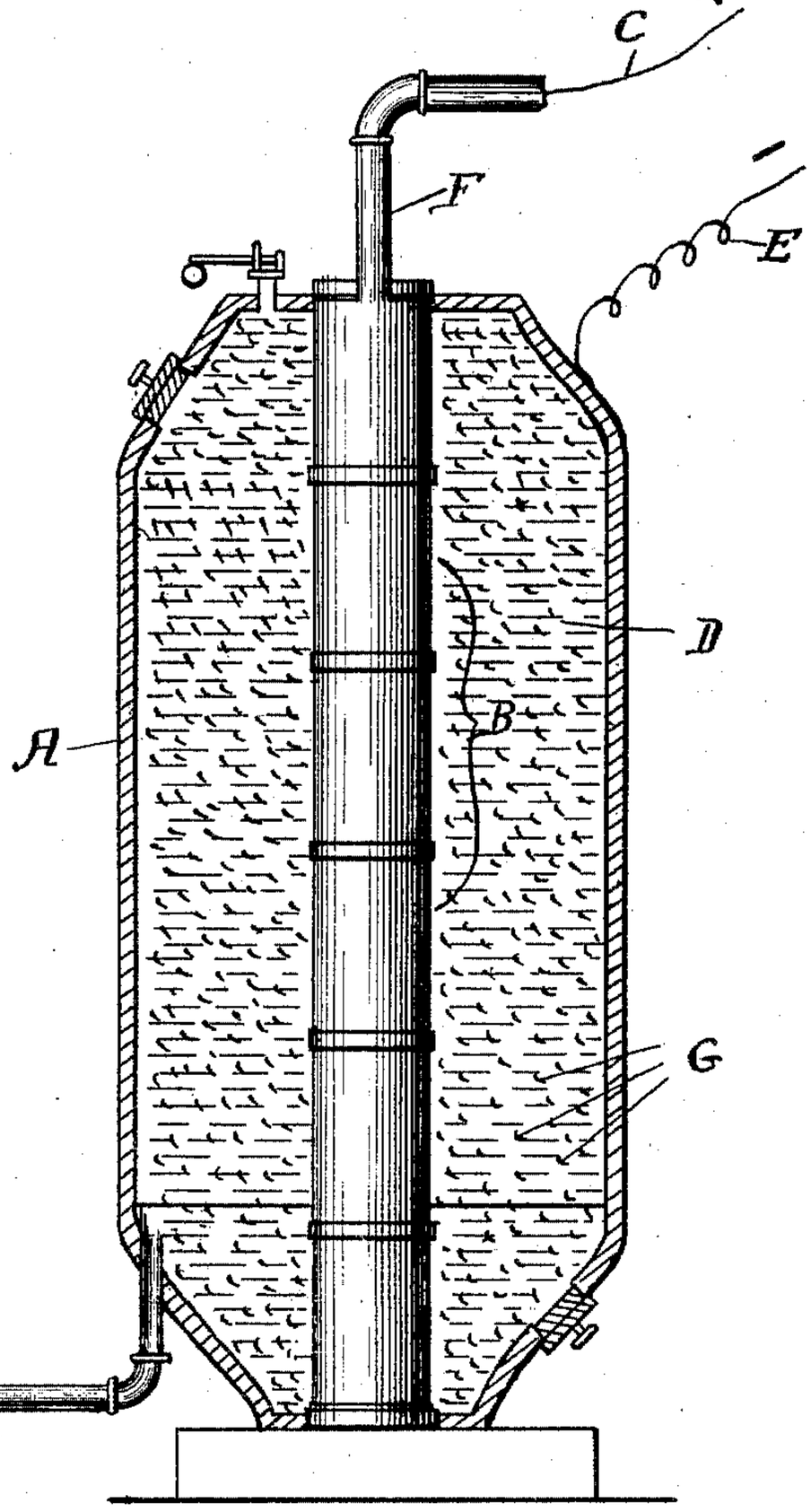
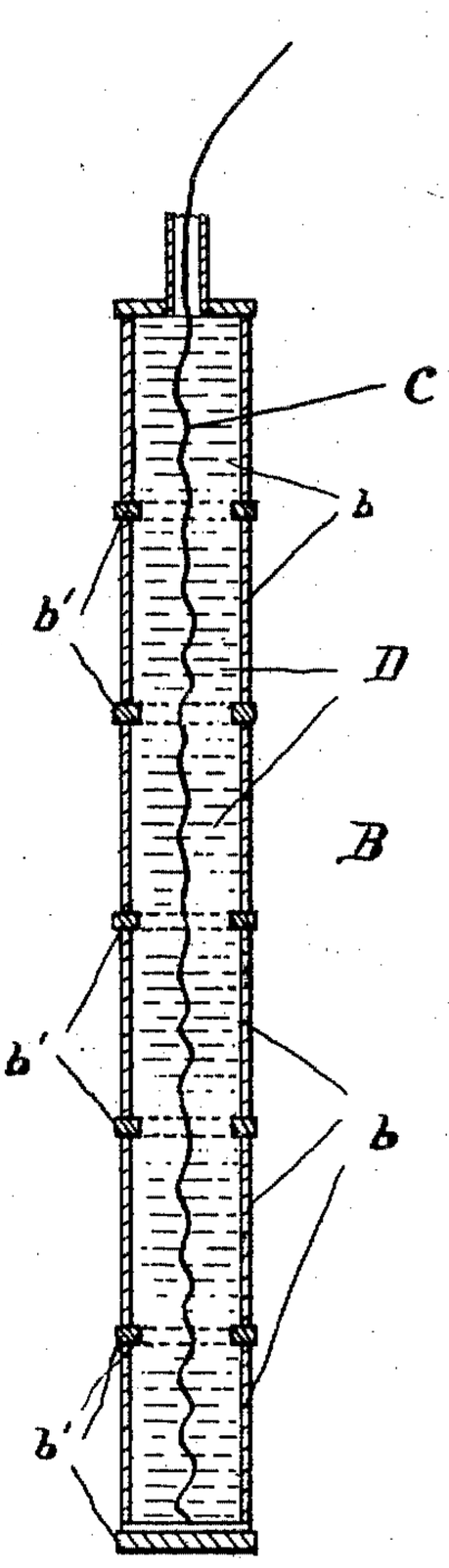


Fig. 2.



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No. 775,829. Patented November 22, 1904.

UNITED STATES PATENT OFFICE.

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PRODUCTION OF PAPER-PULP.

SPECIFICATION forming part of Letters Patent No. 775,829, dated November 22, 1904.

Application filed May 1, 1903. Serial No. 155,177. (No model.)

To all whom it may concern:

Be it known that I, ISIDOR KITSEE, of the city and county of Philadelphia, State of Pennsylvania, have invented certain new and useful Improvements in the Production of Pulp Useful for Paper, of which the following is a specification.

My invention relates to an improvement in the production of pulp useful for paper and like purposes.

To-day most of the paper-pulp is produced from wood fiber, and this fiber has to undergo first the process of boiling or cooking, whereby the resinous and allied substances and the intercellulose matter consisting of inorganic substances are extracted.

The process of extracting as practiced today is as follows: The finely-divided chips or ground wood fibers are placed in a boiler, commonly called "digester," with the addition of a liquid containing a causticity of about 10° Baumé. About one gallon of the liquid is used to every five pounds of the fibers, and for economy's sake the causticity is produced only partially by pure hydrated sodium and partially by an addition of caustic lime and carbonate of soda. This item (the item of extracting the resinous and other matters from the fiber with the aid of a caustic alkali) is one of the greatest expenses in the production of paper out of wood fiber, and it is the aim of my invention to reduce such expense to a minimum and yet make the process as efficient, if not more so, as the process as now practiced.

Formerly most of the caustic alkali (hydrated sodium) used in the above-described process was produced by chemical action; but in later days the process of producing this caustic with the aid of the current was substituted. This process consists therein that a chlorid of sodium is electrolyzed in an electrolytic apparatus with the aid of the electric current, producing a caustic and liberating the chlorin.

Different methods are used to produce the best results, for it is well known to persons versed in the art that if the proper precautions are not taken so-called "hypo compounds" are formed in the negative compartment, destroying the usefulness of the product. For this reason and for other reasons not necessary to enumerate here the production of the hydrated compound is a complicated process, and the employment of the moving mercury cathode, whereby the generated sodium is made to produce an amalgam with said mercury, is now universally practiced. With this arrangement the amalgam, consisting of the metallic sodium and mercury, is subjected to a water-bath, whereby the sodium is, as a hydrated compound, liberated and dissolved in the water and is then again produced as a solid compound by the evaporation of the water, and in such solid state the hydrated sodium is made an article of commerce to be used in the process of producing pulp out of fibers.

The aim of my invention is to obviate all these intermediate steps, to obviate the necessity of producing an amalgam, of dissolving out the sodium in the form of a hydrated compound, of evaporating the water, and thereby regaining the compound as a solid and, in fact, to obviate all those intermediate steps whereby at one place this product has to be produced in its solid state and pass through a number of hands till finally it reaches the paper manufacturer; and it is the object of this invention to enable the manufacturer of pulp useful for paper to produce the necessary causticity in conjunction with the cooking or boiling of the fiber.

To enable persons versed in the art to use this my invention, I have illustrated in the drawings the simplest form in which the same may be practiced.

In the drawings, Figure 1 illustrates in a partial section and partial side elevation one form of a digester or boiler embodying my invention, and Fig. 2 is a sectional view of one of the compartments of said digester.

A is the boiler or digester, preferably in the shape and of a construction as used to-day, but with such alterations as are necessary for the adaptation of the boiler to the process as will later on be described. B is a compartment contained in said boiler. This compartment is here shown in tubular form. In reality this compartment represents a large por-

ous cup made of clay or earthenware in a manner well known to persons versed in the art; but as it is impracticable to make a porous tubular compartment out of one solid piece of the required dimensions I have illustrated the preferred form, which consists of a series of porous sections *b*, each about one foot long, these sections formed into one mechanical unit, with the interposition of the non-porous rings *b'*, formed in a manner so that the ends of the sections may be cemented into the cavities with which these rings are provided; but as it is only my purpose to present a practical device it is obvious that the shape and, in fact, the whole ensemble of this compartment may be varied to suit requirements, the only necessary consideration being that said compartment should be porous enough so as to allow the "ions" liberated through the action of the electric current to travel from and into said compartments. The inner space of this compartment is provided with the conductor C. This compartment, as well as the digester proper, contains the liquid D and the digester proper also contains the chips or others fibers G. In fact, the digester is made an electrolytic apparatus, the conducting-shell of said digester forming the cathode of said apparatus and is therefore provided with the conducting-wire E, adapted to be connected to the negative pole of the charging-circuit. The porous compartment is nothing more or less than the porous septum generally used in such electrolytic apparatus wherein the radicals contained in the compound to be electrolyzed should be separated from each other, and this compartment is used as the compartment in which the anode C is contained. This anode is therefore provided with means to connect the same to the positive pole of the charging-circuit.

The liquid to be used in this apparatus is preferably a strong brine—such, for instance, as common sea-water or plain water in which common table-salt (chlorid of sodium) is dissolved.

The *modus operandi* of my invention is as follows: The inner or positive compartment of the digester is then provided with the salt solution, and the outer or negative compartment is provided with the fibers to be treated and in addition thereto with salt solution sufficient to cover the fibers with said liquid. The digester is then hermetically sealed up. The steam or other source of heat is applied, and after a short time the conductor C is connected with the positive pole of the source of electricity, and the conductor E is connected with the negative pole of said source. A current of electricity will then travel through the conductor C, liquid contained in the compartment B, liquid contained in the digester proper, and will return to the point of starting. The action of the electric current on the briny liquid is such that the chlorid of sodium contained therein is electrolyzed, liberating the chlorin in the porous compartment and liberating the sodium, which is instantly reacted upon by the water, producing a hydrated alkali, therefore a caustic, in the outer compartment. This caustic, with the aid of heat and pressure produced by the steam or other source of heat, will extract the resinous and intercellulose matter from the fiber in the same manner as this matter is extracted to-day if the solution is made caustic by dissolving the solid alkali compound in common water.

Formerly the digester used to be revolved or the contents of same otherwise agitated; but in later days the digester remains stationary and the agitation is produced through the introduction of steam, and it is obvious that with this my invention either one or the other of these methods may be practiced.

It is unnecessary for me to state here the exact pressure or the exact degree of temperature necessary for the proper treatment, because this pressure and temperature do not need to differ from the pressure and temperature now employed, and as the same have to vary now in accordance with the quality of the fiber treated such will also be the case if this my invention is substituted.

It is only necessary for me to state that a density of about one hundred amperes for a digester of, say, eight feet in diameter by six feet in depth, is sufficient for all practical purposes; but where a stronger causticity in a shorter time is required then the density should be raised accordingly as required.

The chlorin accumulated in the inner space of the compartment B may be carried off with the aid of the pipe F to any desired point, and it is contemplated that this chlorin may be carried to large vats containing water and there be used as an agent for bleaching the pulp coming from the digester after passing through the usual process of washing.

From this description the simplicity and cheapness of the process as compared with the processes of today will be readily apparent; but besides this economy this process has various other advantages, of which I enumerate the following:

First. The treatment of the raw fiber with the saline solution, *per se*, under heat and pressure is of great advantage, and for this reason I prefer that the electric current should be applied to the digester after the fiber has been cooked in the briny solution for a certain time—say about one-half hour; but, obviously, this time may be shortened or lengthened, according to requirements.

Second. Whereas in the process as employed to-day only one predetermined degree of causticity can be used at the beginning and every time interval from the beginning to the end the usefulness of the liquid is decreased, with my process the initial causticity may be always maintained, because the flow of the

current of electricity can be regulated so as to electrolyze a given amount of salt in any period. It will also be noted that in the process as practiced to-day there must be at the beginning of operations sufficient causticity in the liquor to extract all the resinous and intercellulose matter from the whole mass of fiber, and such initial strength of the liquor is detrimental to the finer or weaker fibers which are always with the coarser or stronger fibers. This mixture of fibers is mostly due to the fact that the fibers in the heart of the tree are more tender than the ones remote therefrom, and these tender fibers not being able to resist the initial degree of causticity are destroyed and rendered useless as far as pulping for paper is concerned. With the present process, however, only sufficient causticity is produced initially for successfully acting upon the fine fibers, and by gradually increasing the electric current the causticity is increased in order to attack and convert the coarse fibers. Thus the weak fibers hitherto lost or destroyed may be successfully acted upon by the present process and saved.

Third. In the usual process the whole of the resinous and allied substances are dissolved in the liquor, remaining there during the whole process, thereby contaminating the liquor and decreasing the usefulness of same, whereas in my process part of the resinous matter is carried in its dissolved state into the porous compartment wherein it is precipitated in its solid state by means of the acid radical.

To persons versed in the art it is well known that in the electrolytic process of chlorid of sodium the liquid must be frequently changed, for the reason that chemical combinations are formed which are detrimental in the production of a plain hydrate of soda or a plain chlorin; but such formation is here prevented, for the reason that the causticity is as soon as generated taken up by the process of digesting the resinous and allied substances.

I have above mentioned sea-water or a solution of common salt as the preferred bath for the raw fiber on account of the cheapness and ease with which the same may be procured; but it is obvious that other compounds may be substituted therefor, the only condition to be fulfilled being that such compound should contain an alkali adapted to form in the presence of water a caustic if released from its other radical by the electrolytic action of the electric current.

As in such factories as paper-mills the production has to go on uninterrupted for a great length of time, the selection of the positive conductor or anode has to be such that the usual corroding influence of the current or chlorid should not affect the same, and therefore where the high price of platinum is not prohibitive the conductor should consist of this metal. Otherwise a high class of carbon may be employed; but in this case the compartment B should be provided with means to enable the person in charge to inspect its contents from time to time without necessitating the stopping of the process.

With this process the causticity of the liquid in which the raw fiber is immersed for the purpose of producing out of same a pulp can be, as was hereinbefore mentioned, always maintained at the same degree, for the reason that just as much causticity as was neutralized or taken up through the dissolving of the resins and other substances can be produced from the briny or other solution with the aid of the electric current as soon as this degree of causticity is reduced beyond the normal. In other words, this process enables the person in charge to raise or lower the degree of causticity and at any time during the period that the fiber is subjected to the action of the liquor for the purpose of producting therefrom pulp—a feature impossible to attain with any other process and yet of great importance.

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

1. In the art of producing paper-pulp, the step which consists in bringing in contact the raw fibrous material with the electrolyte in an electrolytic apparatus during the time that a current of electricity is passing through said apparatus, said electrolyte containing an alkali and an acid radical in combination, the fibrous material being in contact with or in juxtaposition to the negative pole of the charging-circuit.

2. The process of extracting resinous and intercellulose matter from woody and similar fiber, which consists in causing, during the time that said woody or similar fiber is immersed in a solution containing an alkaline salt, said solution to be electrolyzed, thereby producing from said solution a caustic adapted to dissolve out said resinous and other intercellulose matter from said fiber, said fiber being contained within the negative compartment of an electrolytic apparatus.

3. The process of extracting resinous and allied substances from raw fiber, which consists in subjecting the raw fiber in a liquid containing a chlorid of soda in solution to the action of heat and pressure, and sending at one and the same time a current of electricity through said solution, the raw fiber being contained within the negative compartment of an electrolytic apparatus.

4. The process of extracting resinous and intercellulose matter from raw fiber, which consists in simultaneously subjecting the raw fiber to the action of heat and pressure in a bath containing a salt of the alkali group, and sending a current of electricity through said bath, thereby producing a causticity adapted to dissolve said resinous and intercellulose matter, the raw fiber being contained

within the negative compartment of an electrolytic apparatus.

5. The process of converting woody or similar fiber into pulp, which consists in immersing said fiber in a liquid containing a chlorid of sodium in solution, and sending a current of electricity through said liquid during the time that said fiber is immersed in the same, said fiber being contained within the negative compartment of an electrolytic apparatus.

6. The method of producing pulp from raw fiber, which consists in causing an electrolytic current to electrolyze a saline solution into which said fiber is immersed, thereby causing said solution to assume a causticity necessary for the production of said pulp, the fiber being contained in the negative compartment of an electrolytic apparatus.

7. The process herein described consisting therein that divided raw wood is subjected to the action of a saline bath in the negative compartment of an electrolytic apparatus during the time that said saline bath is converted into a caustic bath through the action of the electric current.

8. The method of producing out of a raw fiber a pulp useful for paper which consists in subjecting said raw fiber while in the negative compartment of an electrolytic apparatus to heat and pressure in a liquid containing a compound adapted to produce a caustic through the electrolytic action of the electric current and sending such electric current through said liquid.

9. The process of producing pulp useful for paper out of raw fiber while the latter is in the negative compartment of an electrolytic apparatus which consists in subjecting the raw fiber to heat and pressure in a bath containing a chlorid of sodium and then electrolyzing said bath without removing said fiber from same.

10. In the process of producing pulp from raw fiber the following steps: first, treating the fiber to a bath having in solution a compound containing an alkali metal, and second, electrolyzing said compound without removing said fiber from said solution, the fiber being contained within the negative compartment of an electrolytic apparatus.

11. The process of extracting the resinous and allied substances from raw fiber, which consists in subjecting the fiber to a bath having in solution a compound containing an alkali metal, and then subjecting said alkali compound to the action of an electric current without removing the fiber therefrom, the fiber being contained within the negative compartment of an electrolytic apparatus.

12. The improved process of extracting resinous and allied substances from raw fibers, which consists in producing by the action of an electric current the required causticity of the bath into which the fibers are immersed during the time that said fibers are immersed in said bath, the fibers being contained within the negative compartment of an electrolytic apparatus.

13. The improved process of producing paper-pulp, which consists in subjecting the raw fiber to a saline bath, and, after a predetermined period, subjecting the raw fiber while in the saline bath to the cathode action of an electric current, whereby the saline bath is converted into a caustic bath.

14. The improved process of producing paper-pulp which consists in subjecting the raw fiber to the action of heat and pressure in a saline bath for a predetermined period of time, and then changing said saline bath into a bath containing the necessary causticity without removing the fiber therefrom.

In testimony whereof I hereby sign my name, in the presence of two subscribing witnesses, this 23d day of April, A. D. 1903.

ISIDOR KITSEE.

Witnesses:
EDITH P. STILLEY,
CHAS. KRESSENBUCH.