(No Model.)

J. A. SOUTHMAYD.

DISINTEGRATION OF VEGETABLE TISSUES.

No. 304,674. Patented Sept. 2, 1884.

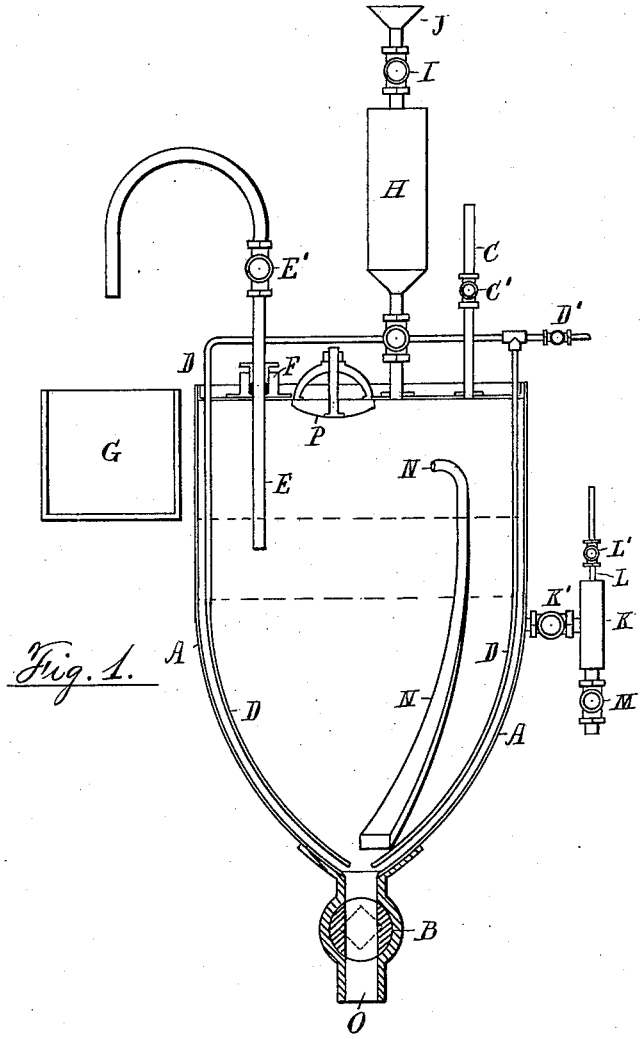

Fig. 1.

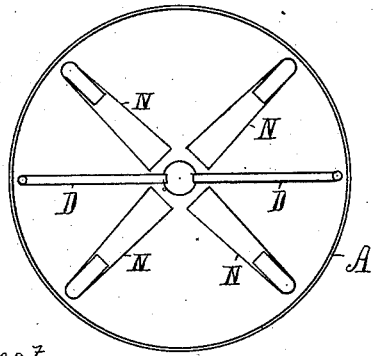

Fig. 2.

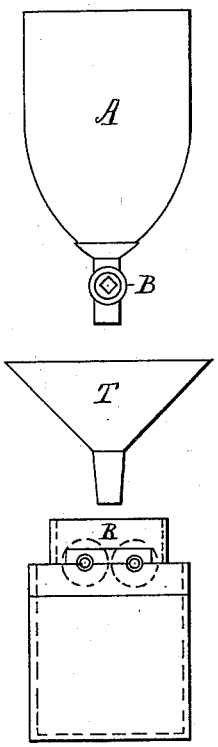

Fig. 3.

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UNITED STATES PATENT OFFICE.

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DISINTEGRATION OF VEGETABLE TISSUES.

SPECIFICATION forming part of Letters Patent No. 304,674, dated September 2, 1884.

Application filed December 11, 1883. (No model.)

To all whom it may concern:

Be it known that I, JOHN A. SOUTHMAYD, a citizen of the United States, residing at Elizabeth, Union county, New Jersey, have invented certain new and useful Improvements in Disintegration of Vegetable Tissues, fully described and represented in the following specification, and the accompanying drawings, forming a part of the same.

This invention consists in an improved process for reducing vegetable tissues to fine fibers for the production of paper-pulp, and also in a special apparatus for practicing the same. The chemical processes heretofore used have generally caused the destruction of a considerable portion of the tissues during the reduction of the harder parts of the fiber; and my invention is primarily intended to obviate this loss or destruction of material by arresting the chemical action when the disintegration is but partly effected, and completing the disintegration by a violent expulsion of the tissues and their contained fluids from the boiling-vessel.

I am aware that it is not new to perform different parts of the process which I claim in a series of operations requiring much more time and apparatus than I employ, and I therefore disclaim the elements of my invention, except in the combination I have devised, by which I am enabled to reduce the raw material, in a single vessel and in a single continuous operation, to the condition of pulp ready in all respects for use in making paper, when bleached in any suitable manner.

My improved process consists, first, in removing a part of the resinous gums or other adhesive matter from the tissues by boiling under pressure in alkaline solutions; second, in softening the remainder of such adhesive matter to facilitate mechanical disintegration; and, third, in removing the solution from the tissues and completing the disintegration of that part of the tissue which is still bound together by softened gum by a violent expulsion of the tissues and their contained fluids from the boiling-vessel.

The apparatus consists in a closed boiler of peculiar construction, adapted to prepare the tissues, as described, and to discharge them, when desired, in a species of explosion adapted to complete the process of disintegration. Such an apparatus requires very few adjuncts; but in order to effect the desired disintegration or discharge in the most convenient manner, I have shown in the drawings a boiler provided with the following attachments: first, a special means for circulating steam through its contents; second, with special means for testing the condition of the contents while boiling; third, with special means for introducing the chemical agents; fourth, with special means for removing the spent liquor; and, fifth, with means for discharging the contents violently. These special means are all fully described hereinafter, so as to be readily understood, both as to their functions and the constructive features claimed.

The purpose of my invention is to lessen the time required in reducing vegetable tissues to paper-pulp, to diminish the amount of alkali required, and to greatly increase the proportion of fiber obtained from a given amount of the crude vegetable matter.

In the method ordinarily practiced for reducing wood chips, grasses, hemp, and other hard tissues to pulp, the crude material is placed in a closed boiler with a solution of soda or potash and subjected to steam vapor and pressure for many hours—often twenty—until the hardest parts of the material are disintegrated.

It is obvious that the material used will consist of tissues having great difference of character, caused by variations in its age, hardness, and place of growth, and that such harder parts as are found in the outer skin in rattan and the chips cut from aged or heart wood will require much longer treatment to disintegrate their fibers than the softer part—as the middle of the rattans, the softer grasses, and the wood and twigs of young trees. In such a process, by which the harder parts are disintegrated by boiling, it is obvious that the softer parts of the tissue must be held in contact with steam and powerful alkalies during a much longer time than is necessary to entirely remove the gums which unite the fibers of such soft parts together. Such softer fibers are therefore corroded and destroyed by the continued action of the alkali, and the latter is wasted in performing a merely destructive work upon the fibers just freed from the tissue;

and in fact it is found that the exposure of the softer parts of the tissue to the disintegrating agents actually destroys so large a part of it that in a charge of five tons of crude material only about one and one-half ton of fiber are actually obtained, the remainder being consumed by undue contact with the caustic agent after the gum in the tissue has been removed from such part and the softer fibers thoroughly disintegrated.

My invention obviates any injury to the fibers by treating the charge only to such a point that the gum or elements which bind the fibers together in the tissue shall be actually removed from about one-third of the material, leaving the gum in the other two-thirds of the materials thoroughly softened, so that the fiber can be readily torn asunder by suitable mechanical treatment. As the gum hardens very rapidly when the charge is withdrawn from the boiler and permitted to cool, it is preferable that such treatment should be performed upon the tissue while hot, and I therefore, in practice, utilize the effects of a violent discharge from the boiler while the material is hot and saturated with the boiling liquids. Such expulsion of the material and the concussion produced not only separates all the fibers which are held together by the softened gum or other binding agent, but it ruptures the fibers themselves in such a manner that the whole charge is substantially reduced to pulp.

To effect the boiling in the manner just described, and to test the extent to which the charge is disintegrated, that the process may not result in the destruction of the softer tissue, is the object of the apparatus shown in the accompanying drawings, in which Figure 1 is a vertical section of the boiler provided with my improvements, and Fig. 2 is a plan of the same in section on line *x x* in Fig. 1. Fig. 3 is a side elevation of boiler, hopper, and rolls for completing the disintegration.

A is the shell of the boiler, formed of curved tapering shape at the bottom, to discharge the mass with facility through the cock B, which is represented in the drawings as open, and with an aperture of the same size as the discharging-pipe, to cause no obstruction to the discharge.

P is a man-hole for admission to the boiler.

C is a vent-pipe, with cock C′.

D D are steam-pipes inserted near the top of the boiler, and carried downward to a point near the discharge-outlet O, the cock D′ serving to regulate the admission of steam.

E is a pipe inserted in the boiler to remove the fluid from above the charge, the same being shown fitted through a stuffing-box, F, in the top of the boiler, and provided with a cock, E′. The outer end of the pipe is shown curved downward over a tank, G.

H is a charging-vessel connected with the boiler by the cock H′, and provided at the top with a cock, I, and funnel J.

K is a test-chamber connected with the boiler by supply-cock K′, and provided with an air-pipe, L, and cock L′.

M is a tap for drawing the contents from the test-chamber to discover their nature.

N is a circulating-pipe secured inside the boiler, with its lower end close to the bottom thereof, and the upper end extended above the level of the charge, and preferably curved over so as to throw its contents into the surface of the charge. In the plan at Fig. 3 the pipes D D are shown at opposite sides, and four pipes, N, are arranged around the circumference of the boiler, the lower parts of these pipes being preferably made much larger than the top, and tapered upward, as shown in Fig. 1.

My method of operation with a boiler of this construction is as follows: A charge of the tissue is inserted in the boiler with the proper proportion of caustic liquor, and the outlets all being closed, steam is introduced through the pipes D, and the contents of the boiler kept at the pressure of seventy-five to one hundred and fifty pounds, with a corresponding temperature, for three or four hours. The steam being introduced at the bottom of the boiler tends to raise the mass inside the same and thoroughly agitate the whole charge. The weight of the charge, however, obstructs the rising steam, which therefore chooses the channels provided in the pipes N, carrying the water or alkaline fluid and disintegrated matter to the upper part of the boiler, where it is discharged and mingled over and over with the gaseous and other contents at that point. The action of the liqnor is therefore very effectual and thorough upon the contained mass, and the softer parts of the tissue are speedily disintegrated by the removal therefrom of the gum or other binding-matter. After a suitable lapse of time a portion of the contents is tested by drawing it off into the test-chamber K, the cock M being closed and the cock L being open, if necessary, to facilitate the entrance of the pulpy matter when the cock K′ is open. The chamber being filled, the cock K′ is closed, that at M, and at L also, if necessary, being then opened and the material drawn out to be tested, the cock at L affording an inlet for air to facilitate the passage of the pulpy mass. Tests are made from time to time, until it is found that a suitable proportion—say thirty to fifty per cent.—of the fiber has been disintegrated, and the gum in the remainder of the tissue sufficiently softened to permit of ready disintegration by mechanical means when in a heated state. I find in practice that this condition can be reached in about one-fourth of the time required to disintegrate the hardest tissues, with a corresponding saving in the steam and alkali consumed. For bleaching or otherwise treating the softened tissues, the boiling is then stopped by closing the cock D′, and the charge allowed to settle for fifteen to thirty minutes, or un-

til the supernatant liquor can be drawn off, by the pipe E′, which, without the use of any pump, can be accomplished by utilizing the pressure in the upper part of the boiler by opening the cock E, the adjustment of the pipe E through the stuffing-box affording the means of pushing it downward into the boiler to any level that may be assumed by the surface of the fibrous matter, the liquor being discharged in the tank G or other suitable receptacle, and the process being arrested when the liquor cannot be drawn off any longer. When the charge is to be finally disintegrated by expulsion from the boiler, the liquor need not be thus drawn off as its presence helps to keep the fiber suspended in a very desirable manner.

In lieu of the explosion or violent discharge described above, the softened tissue may be passed through rollers while in a hot condition, as shown in Fig. 2, where A is the boiler, B the outlet-cock, and R a pair of rollers adjusted to separate the fibers by pressure, without crushing them so as to shorten the fiber. A hopper, T, is shown, to receive the tissues from the boiler. In the use of such a means for disintegrating the softened tissues, the pressure may be discharged from the boiler by opening the vent-cock C′, and the charge allowed to pass from the boiler slowly, and in a heated condition, to the rolls. It may also be thrown into a covered tank, where it can be kept hot, and fed to the rolls as required. The provision of the circulating-pipe N affords the means of agitating the mass in the boiler, and of diffusing the gases that may rise to the upper part throughout the whole charge; and it is therefore possible to use my construction effectively in the application of light bleaching agents, like chlorine, for bleaching the tissues after disintegration, as claimed by me in a patent application filed herewith.

It is obvious that any gas that may be generated during such a bleaching operation would accumulate in the upper part of a closed receiver, and fail to operate upon the greater part of its contents, unless absorbed by the contained fluids. The construction I employ secures such absorption in a very thorough manner, as the wet steam and fluid elevated from the bottom of the boiler by the pipes N is ejected into the gas lying at the top of the boiler, and carries the same by percolation to the bottom in a continuous current.

The grinding or rolling of the softened tissue while in a heated state is necessarily a slow operation, while the expulsion of the charge in a violent manner effects the desired object in a few moments, and secures the most perfect result. To effect such discharge most powerfully is the object of the sloping form of the boiler toward the outlet-opening O, as well as the adjustment of the steam-pipes D D with their nozzles close to such outlet, as the contents thus flow toward the open outlet with the least obstruction, and are driven violently outward by throwing steam from the nozzles D D, as well as by the expansion of the steam in the boiler itself. The nozzles being directed toward the outlet O, the steam not only drives the charge outward, but mingles with it most intimately, so that the tendency of the tissue is to an immediate and rapid expansion as soon as it has passed out of the boiler into space, thus effectually loosening the separate fibers and tearing them from one another, the effect being greatly augmented by the penetration of the steam to the innermost parts of the tissue while boiling under pressure. The reservoir H is used for introducing a fresh charge of alkali or other agents into the boiler while under pressure, as claimed by me in another application filed herewith, the charge being poured in through the funnel J when the upper cock is open and the lower one shut. The charge can then be passed into the boiler by closing the upper cock, I, and opening the lower one, H′, when the pressure in the reservoir becomes equal to that in the boiler, and the fluid flows down without having impaired the pressure and heat in the charge. When introduced into the top of the boiler, such liquids are rapidly mingled with the mass by the action of the circulating-pipes K, as before described. The liquor drawn off at the close of the boiling may be strengthened by adding more alkali, and used for treating a subsequent charge, and the resinous matter in it may also be extracted and saved.

Having thus set forth the nature and object of my invention, it will be seen that it consists partly in a process for saving the softer part of the tissues from destruction by prolonged boiling, and I have therefore claimed the same independently of the other and later steps which may be added to such process.

I do not claim herein anything claimed in my application No. 114,181, filed at the same time herewith, as I have made three applications simultaneously for the express purpose of securing separate claims upon different parts of the same general invention.

As I have stated above, many elements of my process have been practiced before in apparatus different from mine and not capable of effecting the same results. I do not, therefore, claim the separate steps of my process except as combined in a continuous operation to effect the reduction of vegetable tissue, in the manner herein described.

Heretofore the management of many disintegrating processes has been governed by empirical rules derived from repeated experiments and involving great waste of time and material, whenever a new class of material required reduction, while by my method of operation the material in the boiler is placed under inspection at suitable intervals, so that the chemical action may be arrested at any moment and the softer parts of the tissue be preserved from destruction. I am thus en-

abled to operate upon some new kind of fiber as successfully and economically at the first attempt as if I had frequently disintegrated the same. To secure such results, the samples drawn from the test-chamber K should be examined by the fingers, by a magnifier, by diffusion in water, and by the application of any solvents adapted to test the nature or condition of the binding-matter in the tissue. As the result sought is the complete disintegration of about one-third of the tissue and the thorough softening of the remainder, such tests can afford a perfectly decisive indication of these facts, and the treatment can be controlled with as perfect intelligence as if the mass were in an open kettle. To secure the most exact results several test-chambers may be attached to different parts of the boiler. My invention, therefore, differs from others chiefly in the thorough and exact preparation of the tissues for mechanical disintegration before discharging the mass from the boiling-vessel.

Having thus distinguished my invention from others, I claim certain parts thereof herein, as follows:

1. The process for disintegrating vegetable tissue which consists in boiling the same with alkali until from thirty to fifty per cent. of the fibers is disintegrated by the removal of the gum or binding agent, the contents of the boiler being tested from time to time in the manner described, and the boiling arrested when the given proportion of the tissue is disintegrated and the gum in the remainder is softened in the desired manner.

2. The process of disintegrating vegetable tissue which consists in boiling the same with alkali until from thirty to fifty per cent. of the fibers is disintegrated by the removal of the gum or binding agent, the contents of the boiler being tested from time to time in the manner described, and the boiling arrested when the given proportion of the tissue is disintegrated and the gum in the remainder is softened in the desired manner, and then completing the disintegration by discharging the tissue from the boiling-vessel under an active steam-pressure.

3. The combination, with the boiler A, constructed with outlet-cock B, sides tapered toward the outlet, and steam-pipes D D, arranged and operated as described, of the feeding-reservoir H, constructed with cocks I and H′, and connected with the top of the boiler A, substantially as and for the purpose set forth.

4. The disintegrating-boiler provided with an outlet-cock for discharging the contents in a rapid manner, as set forth, the boiler being tapered internally toward the outlet, and provided with steam-inlet pipes D D and regulating-cock D′, the whole arranged and operated substantially as herein set forth.

5. The disintegrating-boiler constructed with outlet-cock B, the boiler being tapered toward the outlet, as described, and provided with steam-inlet pipes D D, extended downward near the outlet, the circulating-pipes N, arranged as described, the blow-off cock C′, and the fluid-outlet pipe E, provided with cock E′, and arranged to draw off the supernatant liquor, all substantially as shown and described.

6. The combination, with the boiler A, tapered toward its discharge-outlet, as described, of the outlet-cock B, steam-pipes D D, arranged and operated as described, a pipe for drawing off the supernatant liquor, as set forth, and the feeding-reservoir H, provided with cocks at the top and bottom, and connected with the boiler, as described, the whole being operated substantially as and for the purpose set forth.

7. The combination, with the boiler A, constructed and operated as set forth, of the chamber K, connected therewith by a cock, K′, and provided with means, as cocks L and M, for removing the contents therefrom to test the same, substantially as shown and described.

8. The combination, with a closed boiler for disintegrating vegetable tissues, of the stuffing-box F and sliding pipe E, arranged and operated substantially as described, and for the purpose set forth.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

JOHN A. SOUTHMAYD.

Witnesses:

C. C. HERRICK,

THOS. S. CRANE.