F. F. STRONG.

APPARATUS FOR DISSECTING PULPY AND FIBROUS PLANTS.

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1,013,235.

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Fig. 1.

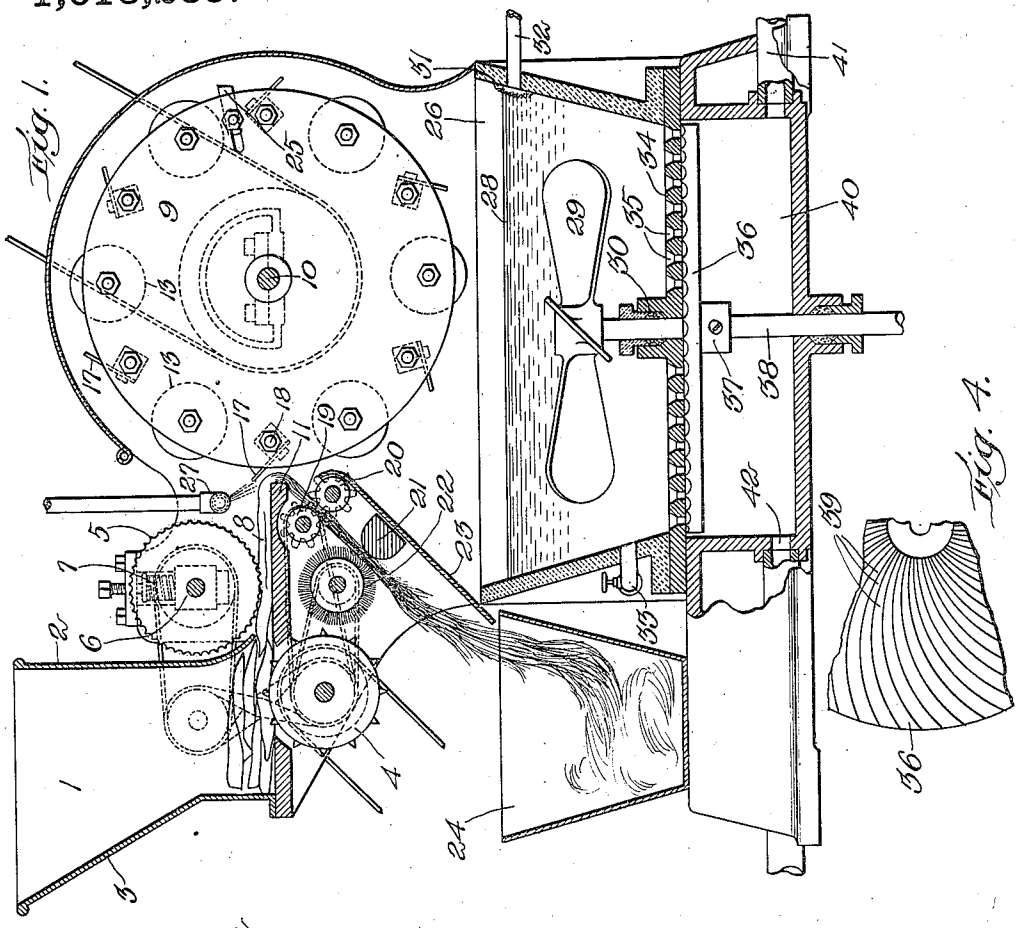


Fig. 4.

Fig. 2.

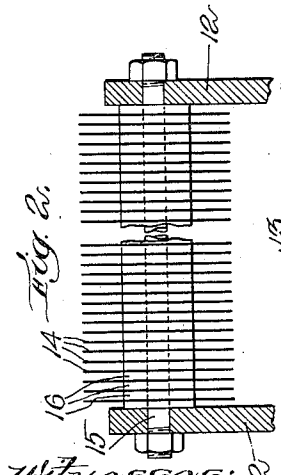
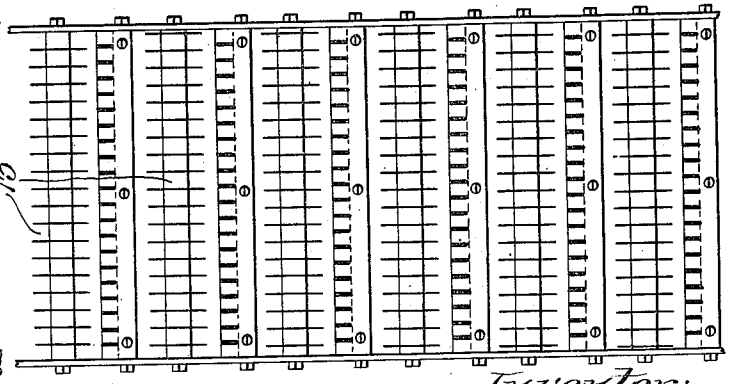


Fig. 3.



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UNITED STATES PATENT OFFICE.

FREDERICK F. STRONG, OF ST. PETERSBURG, FLORIDA.

APPARATUS FOR DISSECTING PULPY AND FIBROUS PLANTS.

1,013,235. Specification of Letters Patent. Patented Jan. 2, 1912.

Application filed June 10, 1910. Serial No. 566,221.

To all whom it may concern:

Be it known that I, FREDERICK F. STRONG, a citizen of the United States, and resident of St. Petersburg, in the county of Hillsboro and State of Florida, have invented an Improvement in Apparatus for Dissecting Pulpy and Fibrous Plants, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

My invention aims to handle stalky plants so as to separate the pulp and fibers from each other without requiring previous treatment of the stalks.

My invention is particularly intended for handling such plants as are common in the southern part of the United States, whereby the rapid and economical production of commercial commodities, such as crude paper pulp, raw textile and cordage fiber, raw material for the manufacture of artificial hard rubber or ivory and vulcanized fiber, is rendered practicable from the leaves, leaf stalks, stem, sheaths, trunk wood, and roots of a large variety of these tropical and sub-tropical plants and trees. Some of these plants have been heretofore utilized in connection with various preliminary treatments whereby the fibers and pulpy substance have been softened and disintegrated chemically previous to the separating process; and this feature of my invention is distinguished therefrom by providing means for mechanically accomplishing the separation without substantial injury to the fibers. In this respect it is of particular value in handling those plants which contain long parallel fibers, or bundles of fibers, running continuously from the root through the trunk, leaf-stalk, and leaf.

In carrying out my invention, I provide means to feed the fibrous material end-on while the end is being subjected simultaneously to a rapid whipping and sub-dividing operation. The mechanism is such that the pulpy matter is separated mechanically from the fibers without injury to the latter. The sub-dividing mechanism operates practically on each fiber to push therefrom the pulp but not to injure the fiber, simply leaving the uninjured fiber stripped clean of its pulp and juices or parenchyma. The pulp is pushed from between contiguous fibers and is beaten or whipped and combed away by a continuous succession of exceedingly rapid and yet delicate blows; and I regard my invention as broadly new in providing means for accomplishing this action on the endwise-fed material. Having separated the fibrous material from its pulpy container, it is squeezed and brushed so as still further to clean and straighten it, while all the tissue substance and juices removed therefrom are passed to a further separator which separates and sub-divides the latter.

In the drawings, in which I have shown a preferred embodiment of my invention, Figure 1 is a vertical longitudinal sectional view of one form of the machine, parts being broken away for clearness of illustration; Fig. 2 shows in enlarged front elevation one of the mechanical dissector rolls; Fig. 3 is a view partly diagrammatic showing a projection of the drum with its successive portions laid out in a plane so as to exhibit their mutual relation; and Fig. 4 is a fragmentary plan view of the grinding scraper or pulp reducer.

In handling the plants, the raw material (leaves and stalks) is delivered into a hopper 1, which preferably has a vertical front wall 2 and a sloping rear wall 3 so that the stalks, etc., are caused to aline themselves endwise against the front wall in horizontal layers ready for the feeding operation, being fed forward by a toothed or spiked roller 4 to a finer feed roll 5, whose journals 6 are spring-held at 7 so as to prevent injurious pressure to the fibrous stratum 8 which is being fed forward endwise to the dissector apparatus, herein shown as a reel-like member 9 mounted on a shaft 10. The bottom of the hopper projects forward in the form of a delivery bed plate 11, over the edge of which the material being treated is bent, as clearly shown in Fig. 1, by the rapid whipping and sub-dividing action of the dissector mechanism, the front edge of said bed plate being parallel to and nearly in contact with the peripheral portion of the rotating reel 9. The purpose of the latter is to effect the separation and isolation of the structural and skeletal elements by the progressive multiple splitting of the plant along the lines of least resistance, combined with a brushing or rubbing away of the loosened tissues and juices, leaving the raw textile or cordage fibers separated one from the other and practically free from previously adherent cells and coloring matter.

Between the heads or ends 12 of the rotary

member 9, I mount a series of dissector rolls 13, herein shown as six in number, each being herein shown as consisting of a series of metal disks 14 mounted on a shaft 15 and separated by spacing washers 16. These thin sheet metal disks or plates constitute fingers for sub-dividing the stalks, etc. which are fed endwise thereto, the finger-like members or disks 14 of the successive rolls being staggered with relation to each other, as clearly shown in Fig. 3, where it will be seen that the corresponding knife-like fingers of the successive rolls are not in the same plane but are staggered from each other just sufficiently so that each occupies a vertical plane by itself and therefore engages the fibrous material at a separate point, which fact, taken with the rapid movement of the dissector device, secures the required results. For instance, if the thin metal disks are set one-tenth of an inch apart, it follows that, in view of the fact that the disks of the six rolls 13 are staggered as shown in Fig. 3, the fiber will receive sixty cuts to the inch. In other words, the individual disks of a row are set sufficiently far apart so as not to break or tear away the fiber but merely to cut through the stalk, and the successive rows of disks are set so as to engage at successive points of the stalk laterally of the preceding cuts, with the result that the stalk is cut with a degree of fineness which separates all the individual fibers from each other. This degree of fineness could not be attained by setting all the disks in one row, because, if so set, the cutters would have such a small space between them as to allow no place for the passage of the fibers, and hence the fibers would be torn off instead of remaining in a fringe as at present. As each dissector roll 13 passes through the material being cut, each of its disks or knives loosens and pushes forward some of the pulp tissue, and this proceeds continuously and progressively until practically all the tissue or pulpy matter has been removed, leaving nothing but a fringe of fibers. Between the successive cutter members 13, I provide combs 17 held in angular adjustment on transverse rods 18, these combs having relatively wide teeth and narrow slots so as to permit the passage therethrough of more or less of the fibrous portion of the plant while at the same time accomplishing a rapid whipping. These combs are made of thin ribbon steel which yields sufficiently to provide a light combing blow, and coöperate with the dissector rolls to whip out the subdivided material into a fringe of fibers which, being freed from the soft tissue and debris, are bent downwardly under the edge of the plate or table 11, where they are pulled forward by two small rolls 19, 20, which squeeze them together more or less as the fibers are fed over a supporting block 21 in position to be thoroughly brushed and fully cleaned by a brush roll 22. An apron 23 guides the cleaned and straightened fibers into a receptacle 24 (which may be of any suitable size, shape and construction). The rolls 19, 20 aid in freeing the fibers of any remaining juices and pulp, and the brush 22 and block 21 further clean and dry the freed fibers from all remaining debris. The brush rotates faster than the movement of the fiber so as to give a slight brushing action, its bristles being preferably made of fine metal wires. In working cabbage-palm leaves, saw palmetto, saw grass, or other material which is to be converted entirely into paper pulp, I provide a steel bar or knife 25 adjustably supported radially in the dissector reel 9, being adjusted so as to coöperate with the front edge of the bed plate to form therewith a cutting shear to cut the plan fiber into short portions. Each time the knife meets the bed plate, it cuts off the fiber fringe which has been fed out and split or subdivided by the dissecting apparatus. By varying the peripheral speed of the feed roll in relation to the rate of rotation of the dissector apparatus, the length of the fringe of fibers cut at each revolution of the knife is adjusted according to the requirements of the given product to be made. As the portions of the fringe are cut, they are whipped between the rolls 19, 20 and thence carried into the receptacle 24 the same as before, where they are washed in salt water and prepared for the next stage of their treatment. The pulp cells and debris which are separated from the isolated fibers or fringe, are pushed and whipped off into a tank 26, being aided in their movement by jets of salt water driven from a transverse pipe 27 under pressure against the fiber at the point of dissecting. The particular construction of this tank and the subjacent and coöperating mechanism are not herein claimed, being covered in a divisional application. The tissue, etc., collected in the tank 26 is agitated in the salt water 28 therein by a suitable stirrer 29, herein shown as journaled at 30 vertically in the bottom of the receptacle. This mechanical stirring removes much of the microscopic chlorophyl granules, soluble pigments, and finely divided debris, which, being light, rise and pass through the meshes of a fine wire screen 31 and out through an outlet 32 in the side of the tub or receptacle 26, whence it passes to evaporating and settling tanks for further refining in the production of minor by-products. The material left in the tub consists of bits of torn fibers, together with the pulp or parenchyma cells more or less broken and mechanically freed from their green juice and chlorophyl, also bits of leaf cuticle and thin laminæ formed of skin cells free of chlorophyl and consisting of nearly

pure tough cellulose, admirably adapted for the production of paper pulp. Being already in a more or less finely divided condition, they are easily reached and acted upon by any chemical agents used for refining or bleaching. When treated mechanically as thus far described, this pulp-like material is more or less bound together by its inherent resinous constituents, which it is one object of my invention to leave in the mass whereby the pulp is to a considerable extent self-sizing.

In another concurrent application, I have described and claimed the process herein partially shown, and hence I will not enter more at length into a description thereof at this place.

The pulp-like portion in the solution 28 gradually settles to the bottom as it is washed and separated by the stirrer 29, the proper depth of solution being provided by any suitable means, as through a pipe 33 in addition to the washing solution at 27. The bottom 34 of the tank 26 is provided with a series of holes 35 for the passage of the pulp, which are preferably substantially closed at their lower end by a circular sub-bottom or scraper 36 secured at 37 to the shaft 38 which operates the stirrer. The upper surface of this scraper 36 is provided with a series of radial and preferably curved grooves of flutings 39, see Figs. 1 and 4, which operate to pull the pulp gently downward and outward as it settles in the holes 35 of the foraminous bottom of the tank. It is thus further macerated and refined and finally dropped into a collecting basin 40, whence it passes through a pipe 41 for its further treatment, an inlet pipe 42 being preferably provided for introducing further salt solution and facilitating the more rapid delivery of the pulp through the pipe 41.

The operation of my mechanism has already been sufficiently described, and it will be sufficient to point out that although macerating and decorticating fibrous material (previously rotted or chemically treated) has been heretofore accomplished, my invention is entirely different therefrom and is not to be confused therewith. One of its chief characteristics is that it feeds the non-rotted and integral original growth endwise into position where it is longitudinally dissected automatically in a manner approximating the careful hand dissection in the botanist's laboratory. It is simultaneously whipped, bent and mechanically freed of its juices, pulp, and cellular tissue. This takes place continuously and rapidly and yet delicately, so that the plant is literally dissected into its primal elements, roughly speaking. The fibers are separated, limbered, washed, squeezed, brushed, and dried. The pulpy container is mechanically pushed, brushed, washed, and stripped from the separated fibers. It is then collected in a tank in proper solution, where it is further washed and separated mechanically and the lighter coloring matter and other light parts drained off from the pulpy parts. The latter are then gently and yet rapidly squeezed, pulled, mashed, and ground into such a sub-divided state that, when diluted or permitted to mix freely with the liquid in the collecting tank, they readily pass forward in a practically self-propelling stream.

From the above, it will be evident that my invention in its broader aspects is capable of a wide variety of mechanical embodiments without departing from the spirit and scope of the invention as defined in the appended claims.

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

1. An apparatus of the kind described, comprising means to feed the plant-material endwise to a dissecting mechanism, combined with said dissecting mechanism, including means to cut the plant-material at its end lengthwise of the fibers with a series of cuts close to each other, said cutting means being arranged to separate the individual fibers from each other and pass between said fibers with a pushing action against the intervening pulp tissue, said cutting means comprising a plurality of successive series of cutting blades, each occupying a vertical cutting plane by itself.

2. An apparatus of the kind described, comprising means to feed the plant-material endwise to a dissecting mechanism, combined with said dissecting mechanism, including a plurality of sets of knives, the knives of each set being parallel to each other and arranged to cut the end of the plant-material lengthwise of its fibers, and the knives of each succeeding set being out of alinement with the knives of all the preceding sets.

3. An apparatus of the kind described, comprising means to feed the plant-material endwise to a dissecting mechanism, combined with said dissecting mechanism, including a plurality of sets of knives, the knives of each set being parallel to each other and arranged to cut the end of the plant-material lengthwise of its fibers and the knives of each succeeding set being out of alinement with the knives of all the preceding sets, and combing mechanism operating on the cut ends during the cutting action to comb the parenchyma from the fibers.

4. An apparatus of the kind described, comprising means to hold the plant material endwise to be operated upon, a rotary reel-like member having a series of dissector rolls mounted adjacent the periphery thereof, each roll having a series of metal disks

separated by thin spacing washers, the disks of the successive rolls being mounted to travel in vertical planes out of alinement with all the disks of all the other rolls, and a plurality of whipping means mounted at intervals on said reel-like member between said rolls in position to whip the ends of the plant material with a rapid series of whipping movements interspersed with the cutting movements of the rolls.

5. An apparatus of the kind described, comprising feeding means to feed the plant material into position to be operated upon, and a reel-like member provided with a plurality of series of cutting knives arranged parallel to each other and each knife standing in a different vertical plane from all the other knives throughout the plurality of series of knives, and intervening combs mounted for angular adjustment between certain of said series of knives.

6. An apparatus of the kind described, comprising feeding means to feed the plant material into position to be operated upon, and a reel-like member provided with a plurality of series of cutting knives arranged parallel to each other and each knife standing in a different vertical plane from all the other knives throughout the plurality of series of knives, and intervening combs mounted for angular adjustment between certain of said series of knives, said combs consisting of thin springing material provided with wide teeth and narrow slots to permit the passage therethrough of more or less of the fibrous portion of the plant while rapidly whipping the plant material in general.

7. An apparatus of the kind described, comprising feeding mechanism to feed the plant-material endwise, dissecting mechanism to dissect the fibers of the endwise fed material from the tissue parts thereof, and a separator arranged to receive the latter separate from the strong fibers and separate the lighter portions of the matter received from the heavier portions.

8. An apparatus of the kind described, comprising feeding mechanism to feed the plant-material endwise, dissecting mechanism to dissect the fiber of the endwise fed material from the tissue parts thereof, and a separator arranged to receive by gravity the latter and separate the lighter portions from the heavier portions.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

FREDERICK F. STRONG.

Witnesses:

GEO. H. MAXWELL,

M. J. SPALDING.