

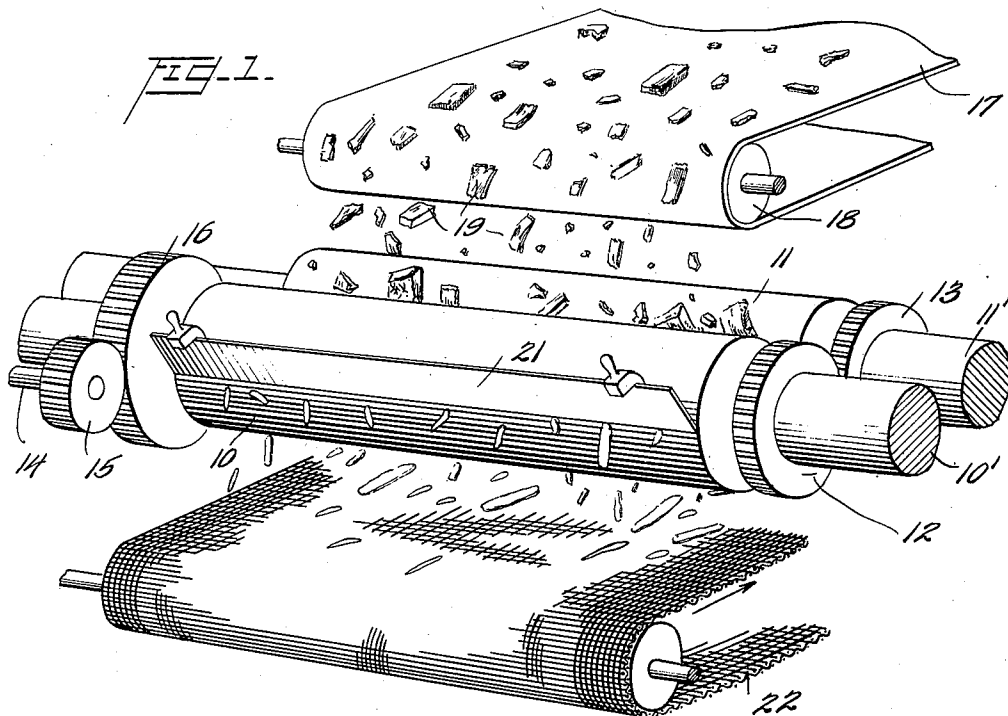
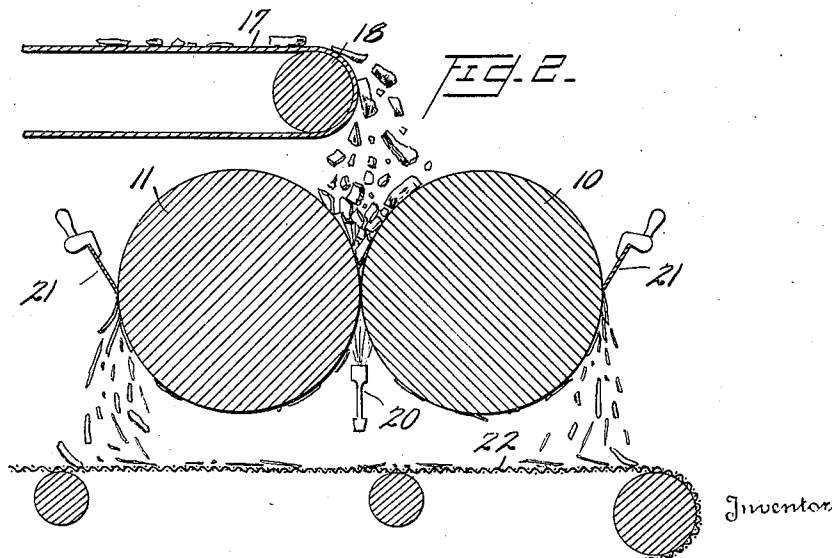
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METHOD OF LIBERATING PAPER FIBERS

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METHOD OF LIBERATING PAPER FIBERS

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The present invention relates to methods of producing fibers from vegetable material for subsequent use in the manufacture of paper and paper board.

Heretofore numerous methods or processes have been suggested whereby fibrous material of vegetable origin may be so treated that component fibers thereof may be liberated, or separated from one another so that, when such fibers are suspended in a suitable carrier liquid and passed into a paper or paper board making machine, the fibers are caused to mat or interlock in a layer of the desired thickness. It is the object of all processes of this character to effect the complete separation of the individual fibers of the raw material undergoing treatment as rapidly as possible, with the least expense, and with the least injury to the fibers. The vegetable material now most commonly subjected to processing for the purpose of producing fibers for use in the manufacture of paper or paper board is wood, wood of various kinds being available in large quantities and being readily transportable to plants provided for its reduction to fibrous form.

The general purpose of the present invention is to provide an improved method for the treatment of various kinds of fibrous material in the production of fibers suitable for paper stock, not limited with respect to the type of raw material used, but particularly useful in the liberation of wood fibers. Practically all methods which have heretofore been employed in the production of paper stock fiber from wood have involved, generally speaking, three main operations or processing steps. The wood, which is originally in the form of logs, is first subjected to the action of a mechanical chipping mechanism by means of which each log is reduced to chips. The chips may vary widely in size, some being two inches square and a half inch thick and even larger, but most being substantially smaller. The chips are then subjected to the action of various chemical solutions for various periods of time and under various degrees of heat and pressure, the object being to soften each chip so that the individual fibers thereof may be parted from each other without injury in a subsequent operation. In some processes the chips are cooked in digesters until completely reduced to very soft pulp while in other processes they are prepared chemically only to such extent that they become slightly softened, although softened throughout. Finally, regardless of the character or duration of the cooking process, the chips are refined or given

such subsequent mechanical treatment as may be necessary to effect fiber separation.

In the practice of each of the refining processes heretofore used commercially it has been found necessary to expend a very substantial amount of power to effect complete separation of the fibers. This is so even when the chips come from the second step of the process, i. e., the cooking step, in a very soft and pulp-like condition, perhaps completely disintegrated. When the chips are so treated in the digesters that they are discharged therefrom in only slightly softened condition and practically the same in appearance as when they are introduced in the digesters, the final or refining step must obviously be drastic in order that the fibers may be completely liberated, one from the other, or even imperfectly liberated.

It has been suggested that chips which have only been subjected to a mild chemical digestion, and which therefore issue from the digesters intact and only slightly softened, might be reduced to fiber by being mechanically beaten, pounded, rubbed or tumbled in a rod mill. In other forms of refining apparatus, softened chips or, in the usual case, a pulpy mass from the digester, is caused to flow, together with a large excess of water, into a drum, or through a plurality of drums in series, in which drum, or in each drum of the series, are located a plurality of rollers which are caused to roll around the interior of the drum in contact with its cylindrical surface, thus mashing the chips or pulpy bodies between the rollers and the drum surface. This action is continued until the desired fiber separation has been effected. In the last mentioned type of machine the large excess of water which is used to cause the pulp to flow into, through and out of each of the refiners must necessarily be acted upon and will frictionally retard the rotation of the rollers and the mechanism for propelling the same, and hence a large amount of power is expended in the refining process.

Still further types of refining apparatus are employed for the purpose of separating chips or pulpy bodies into fibrous form after digestion. All forms of such apparatus heretofore made use of have, however, proven to be costly to install and maintain in efficient working condition, requiring excessive amounts of water and power in operation, and have been found to be only fairly successful in the liberation of fibers.

While, as previously pointed out, the present invention provides an improved method of processing fibrous material which is applicable to fibrous vegetable materials of many kinds, it is

particularly suitable for use in processes for the liberation of wood fibers. While also, in a broad sense, the invention is quite independent of any specific process for the digestion of the vegetable material prior to refining, it is especially well adapted for use in the process in which the material undergoing treatment is subjected to what may be designated a mild chemical digestion, issuing from the digesters in solid rather than pulpy condition, although softened throughout, or substantially throughout.

I have discovered that the liberation of fiber from vegetable material, after such material has been digested, can be materially facilitated by subjecting the chips to great pressure by mechanical means, by "great" pressure being meant a pressure sufficient in magnitude to reduce the thickness of a chip or pulpy body drastically, the chip being reduced to flake-like condition when so acted upon. It will of course be understood that the pressure is applied transversely of the fibers and not in the direction of the lengths thereof. While various mechanical means may be chosen for flattening chips or pulpy bodies by heavy pressure, the most satisfactory mechanism which may be employed in a continuous process is one comprising heavy metallic rollers normally forced into contact by forces of such magnitude that no chip, however resistant to compression, can fail to be reduced to the desired thickness. Thus chips, regardless of their original thicknesses prior to passage between the rollers, are reduced to flaky or film-like bodies by the rolling operation, preferably having the approximately thickness of the thinnest tissue paper. These flake-like bodies are then collected and, when introduced into a water or carrier liquid, and slightly agitated, readily separate into individual fibers, quite suitable for use in the manufacture of paper, paper board or like products.

The action of the pressure rollers is not a pounding or beating action. On the other hand it may be designated a process involving the gradual application of rapidly increasing but nevertheless purely compressive forces of great magnitude, quite sufficient to reduce all chips, regardless of size, to the approximate flake-like form previously mentioned. This great reduction in thickness of the chips or pulp-like bodies is effected without damage to the individual fibers, which retain their original lengths and, in some cases, may be slightly flattened, or have their ends split or frazzled. When this occurs the fibers are in best condition for subsequent use in the manufacture of paper or paper board. Naturally there is developed, in the flattening of a chip to flake-like form, a quantity of heat, due to its frictional resistance to deformation. The heat thus developed is not injurious to the product, in fact is of assistance in softening the chip.

The refining operation just described even effects a certain degree of hydration of the individual fibers and, by passing the flake-like bodies resulting from a first compression, after the addition of a small quantity of water in the event that the flakes are in dry condition, through one or more similar compressions, various degrees of hydration, or differences in fiber characteristics, can be obtained at slight expense so that the product can be controlled in character for the purpose of providing fiber for the manufacture of various types of paper or fiber board. The refining operation is likewise characterized by the absence of any appreciable amount of

water. The chips or pulp-like bodies as they come from the digester may be transported by a mechanical means such as a belt conveyor which permits the treatment liquids to drain off, so that the pulp, when it arrives at the refining apparatus, hereinafter designated a mill, is dry except for water contained within the individual chips or clinging to the surface thereof. No power is expended therefore in the propulsion of large bodies of water and substantial savings effected are for this reason realized. Naturally, in view of the radical change in the refining operation, modifications in the previous treatment or cooking of the chips may advantageously be made, the chips being subjected to a cooking operation of minimum duration so that they are only softened sufficiently to permit the drastic refining step to be carried out without injury to the fibers. It is only essential, for the successful practice of my improved refining process that the chips or raw material be given a preliminary treatment by some process to the extent that the material which bonds the fibers thereof together be softened to the extent that separation of the fibers, without injury thereto, may occur when the chips are flattened.

In the accompanying drawing one form of apparatus by means of which the process may be carried out is illustrated by way of example. It will be appreciated, however, that numerous alternative mechanisms may be employed for subjecting the chips to the great mechanical pressures necessary and that the apparatus illustrated is only one of a number which might be successfully utilized.

In the drawing:

Figure 1 is a perspective view of the essential elements of the apparatus; and

Figure 2 is a transverse section through the rolls and associated mechanism.

The essential elements of the mechanism comprise the rollers 10 and 11, the axes of which are disposed in parallelism and the cylindrical surfaces of which are in contact. The surfaces of these rollers are preferably trued by grinding and the rollers are of such size as to substantially resist all tendency to deformation due to the passage therebetween of the chips to be compressed. Spur gears 12 and 13 are rigid with the rollers 10 and 11 respectively, the teeth of these gears intermeshing so that the rollers must necessarily rotate in opposite directions but at the same peripheral speed. Roller 10 is driven from a power shaft 14 through pinion 15 and large gear 16 rigid with the roller 10, the rotatory motion of roller 10 being communicated to roller 11 through the aforementioned gears 12 and 13. It will be understood that the rollers and gearing described is mounted upon a suitable frame or housing and that the other parts hereinafter to be described are likewise suitably supported. Positioned above the rollers is a means for conveying chips, this means being preferably in the form of an endless belt conveyor, having a belt member indicated at 17, which belt passes over a plurality of supporting rollers, one of which is indicated at 18.

By means of this conveyor chips or pulpy bodies, indicated at 19, are transferred from the vicinity of the digesters to a point approximately over the line of contact of the rollers 10 and 11, where they are discharged downwardly so as to fall into the elongated trough defined by the adjacent upper surfaces of these rollers. The process is preferably continuous, the rollers

and feed conveyor maintaining a constant supply of chips to be compressed by the mill. The rollers 10 and 11, which are rotated in the directions of the arrows shown in Figure 2, are held in desired relationship by suitable means, such as heavy weights or levers, stiff springs, or fluid actuated pistons, if a constant pressure is desired, or by screws or wedges if constant flake thickness is sought, such pressure elements being oppositely directed against the roller trunnions, two of which are indicated at 10' and 11' respectively. The chips are drawn downwardly into the bite or pass of the mill by the roller surfaces, are flattened completely to flake-like bodies and substantially all water contained therein expelled, the flake-like bodies formed by the action of the rollers being quite dry. These flake-like bodies, which have undergone such enormous pressure, tend to stick tightly to the roll surfaces and in order to effect their removal they are first given a preliminary spraying by a suitable water jet apparatus indicated at 20, which directs a water spray upwardly against the roll surfaces, and are subsequently removed from the roll surfaces by means of scrapers, indicated at 21, 21. The flakes thus removed from the roll surfaces fall downwardly onto a second belt conveyor, comprising a belt member 22 mounted upon suitable rollers, two of which are indicated at 23, and are by such conveyor transported to any suitable point where they are collected.

While it is convenient to feed the chips vertically downward to a mill the rollers of which are horizontally disposed, the invention is no wise limited in this respect. By providing chip feeding devices of various kinds mills having rollers the axes of which are inclined to the horizontal, or even vertically disposed, may be used if desired.

Likewise, while in the apparatus disclosed by way of example the rolls are geared together so as to rotate at the same peripheral speeds, the invention is in no wise limited to such identical peripheral speeds, one roll being revolved at a speed greater than the other whenever it is determined that any certain material may be more satisfactorily processed by so doing. The great compressive forces applied to the material undergoing treatment result in the development of various forces within such material tending to produce relative movements of the individual fibers, but it is not essential to define such forces inasmuch as they are only the resultants of the application of the compressive forces to the materials passing through the apparatus.

Having thus described the invention, what is

claimed as new and desired to be secured by Letters Patent is:

1. The method of producing fibers for use in paper making, from fibrous material, comprising cutting or chipping said material into small sized, irregular shaped pieces, subjecting said pieces to a digestive process to soften the material which binds the fibers together, passing said pieces only once at random into the nip of closely contacting, substantially smooth rollers rotating toward each other to thereby substantially dry each piece and reduce it to a flake of approximately one fiber thickness.

2. The method of producing fibers for use in paper making, from fibrous material, comprising cutting or chipping said material into small sized, irregular shaped pieces, subjecting said pieces to a digestive process only sufficient to soften the material which binds the fibers together, passing said pieces at random into the nip of closely contacting, substantially smooth rollers rotating toward each other to thereby substantially dry each piece and reduce it to a flake of approximately one fiber thickness which adheres to one of the rollers, and scraping said flakes from the rollers.

3. The method of producing fibers for use in paper making, from fibrous material, comprising cutting or chipping said material into small sized, irregular shaped pieces, subjecting said pieces to a digestive process to soften the material which binds the fibers together, passing said pieces only once at random into the nip of closely contacting, substantially smooth rollers rotating toward each other to thereby substantially dry each piece and reduce it to a flake of approximately one fiber thickness which adheres to one of the rollers, wetting the flakes and scraping them from the rollers.

4. The method of producing fibers for use in paper making, from fibrous material, comprising cutting or chipping said material into small sized, irregular shaped pieces, subjecting said pieces to a digestive process to soften the material which binds the fibers together, passing said pieces only once at random into the nip of closely contacting, substantially smooth rollers rotating toward each other to thereby substantially dry each piece and reduce it to a flake of approximately one fiber thickness which adheres to one of the rollers, wetting the flakes, scraping them from the rollers, transporting the flakes from the rollers in a continuous, loose mass and permitting the flakes to drain during the transportation.

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