This invention relates to fiber preparation and more particularly to the decortication of the stalks of certain bast fiber yielding plants, whereby this fiber is liberated therefrom, and to the degumming and other subsequent treatment of the fiber preparatory to use in textile or paper manufactures or similar arts.

The general object of the invention is the provision of a novel process of preparing fiber of this character and also to provide a novel and greatly improved apparatus for economically carrying the process into effect.

Among the more specific objects of my invention is the provision of means for liberating the fiber more rapidly and effectively and for eliminating more completely the shive or woody material and the gums and waxes of which the straw is composed. Although applicable to the treatment of a wide variety of fiber yielding plants, the invention is particularly adapted for the preparation of flax fiber for the manufacture of either textiles or paper.

It is well known in the art that the stalks or straw of the flax and similar plants are composed essentially of a central portion or core of woody material and an outer layer of longitudinally extending fibers united by certain gums and pectic matters. The traditional method of liberating the fibers from the woody core and from the adherent gums, and indeed the one most widely employed today in supplying fiber for the textile and linen paper industry, comprises retting or steeping the stalks or straw by submergence in water, then scutching the subsequently dried stalks by means of hand slitts or mechanically rotated beater blades, and then hacking or combing the fiber.

The disadvantages of these ancient processes are very apparent. Among the more obvious of them may be cited the extremely long time consumed—especially in the retting process—which in some countries is allowed to proceed for several months—the danger of rotting, and weakening the fiber by unduly prolonging the retting, the general uncleanness of the process, and the breaking of the fibers by the rather violent scutching and hacking operations. Several proposals have been made having as their object the improvement of the scutching step and also the elimination of the retting phase, but none of these attempts to properly prepare the fiber by mechanically dry decorticating and degumming processes has proved practical and economical.

These prior endeavors have failed to completely remove the shive and, due to the comparatively harsh mechanical treatments, employing combs, scrapers, or the like, the long fibers have been broken and weakened and thus rendered unfit for textile use. In such devices, also, the fiber tends to wind up on the various rotating members and clog the machine. In many cases the use of strong chemicals, mainly of an alkaline nature, has been resorted to in order to further decorticate and degum the material and this expedient has resulted in seriously impairing the strength of the fibers.

It is therefore another object of the present invention to provide an apparatus of simple construction and mode of operation, whereby the straw comprising the bast fibers of the kind described may be subjected to a series of successive comparatively gentle operation which will effectively liberate the fiber, completely eliminate the shive and get rid of such portion of the gummy matter which may be necessary for the particular purpose for which the fiber is to be used.

The successful development of my invention has opened up a very wide field for supplying an exceedingly strong and clean (shive-free) flax fiber for textile use at a great saving in cost over the prevalent hand scutching and hacking methods, and also makes possible the use as raw material of the coarser-fibered straw obtained from flax which is grown for seed, this material being as completely decorticated and degummed in my apparatus as the finer fiber-flax straw.

Another new field of usefulness of the invention is found in the preparation of practically 100% shive-free fiber for use in the manufacture of fine linen paper where exception of strength and quality are needed, as in the case of the preparation of condenser dielectric paper or carbon paper, or where great purity and peculiar properties are required as in the manufacture of cigarette paper. The present supply for these uses is the relatively expensive linen rag stock.

In its preferred embodiment, the invention contemplates the provision of a success of superposed alternating pairs of horizontal fluted breaker rolls and squared beater rolls, all of relatively small diameter and so operated that the path of movement of the material between the rolls is in an upward direction. Devices are also provided in the apparatus for performing certain preliminary operations on the straw such as deseeding and topping, feeding, straightening, crushing, pressing, etc. as well as a drier for eliminating moisture from the fiber and embrittling the gummy material therein, and also certain folding and delivery mechanisms for operating upon the lap of cleaned fiber as it passes from the machine. Novel driving mechanism is also provided whereby power is applied from a suitable source for rotating the numerous rolls and driving the conveyors and other elements at relatively high speeds controlled in accordance with their proper individual functions, their sequence of operation throughout the machine, and their relation to each other.

There are also provided suitable conveying or
material handling devices for transferring the straw and fiber from one operating portion to the other, and other mechanism and attachments which cooperate to render the installation a unitary instrumentality for continuously and successively operating upon the material at relatively great speeds to accomplish the described functions.

Other objects of the invention include the provision of novel methods and apparatus wherein the operations set forth may be performed on either long or short straw, without loss of fiber and without producing tow or nolls. Means are also provided for preventing the separated fibers from being carried away with the web or lap of fiber, and the apparatus is also adapted to gradually draw out or attenuate the lap as it passes from one operative element to another of the machine, this effect being capable of regulation in accordance with the requirements of the material being treated.

Other objects and features of novelty will be apparent from the following specification when read in connection with the accompanying drawings in which certain embodiments of my invention are illustrated by way of example.

In the drawings:

Figure 1 is a somewhat diagrammatic view in side elevation of an installation embodying the principles of my invention; part of the device being broken away in order to disclose certain interior mechanisms and others being shown in dotted lines;

Figure 2 is a plan view of the same installation;

Figure 3 is a view in side elevation of one of the decorticating units of the apparatus, part of the device being illustrated in vertical cross section;

Figure 4 is a plan view of the device illustrated in Figure 3;

Figure 5 is a fragmentary detail view in front elevation of a portion of the device illustrated in Figures 3 and 4, the view being taken substantially on line 5—5 of Figure 3;

Figure 6 is an enlarged view of part of the rotary operating members of the device, illustrated partly in vertical longitudinal cross section and partly in perspective;

Figure 7 is a fragmentary detail view in vertical cross section of the decorticating unit illustrating an alternative form of delivery mechanism applicable to certain of the operating units;

Figure 8 is a view in horizontal cross section of a portable fiber liberating apparatus designed to be drawn across a field and to collect the straw from windrows left by a thresher or the like; and

Figure 9 is a vertical cross sectional view of the apparatus illustrated in Figure 8.

The exemplary installation illustrated in Figures 1 and 2 of the drawings, is adapted for use in a mill or other permanent structure and comprises essentially the following units which are arranged to operate upon the straw and fiber lap in the named order: the feeding conveyor A; the deheader and topper B; the orienting conveyor C for changing the position of the straws from transverse to longitudinal; the decorticating unit D; the drier E, which may be eliminated in mild or moderate climates; the further decorticating and degumming units F and G; and the longitudinal and transverse folding and packing units H and I.

The flax straw or other fibrous stalks is placed upon the feeder A which may be a belt conveyor of conventional type, so that the stalks are advanced toward the deheading and topping or deheading unit B transversely of their length. The deheading unit B and the aligning or orienting conveyor C may conveniently be mounted upon a bench or support. The conveyor unit B is adapted to cooperate with the upper chain 12 which is also carried by the sprockets 13 to seize the mid-portions of the advancing straws and to transport them past the pair of rotary members 18 which are adapted to operate upon the head ends of the stalks. The members 18 may be of any suitable type as, for example, slatted drums which are driven obliquely to the direction of passage of the straw so as to receive the headed ends of the stalks between them and scrape and pull the seeds, seed balls, and branches from the main useful fiber bearing portions of the stalks.

The stalks as they pass from the deheading drums 19 are moved into the orienting conveyor C by means of the chains 13 and 14; the projecting frayed and deheaded ends of the stalks coming in contact with the rapidly movin conveyor belt 20 disposed edgewise to the stationary table 11 and guided around the vertically disposed pulley or roller 21. This belt 20 is also guided by means of the pulleys 22 and 23 and is adapted to cooperate with the mating belt 24 which is also guided by means of the pulleys 25, 26 and 27, any or all of which may be driven by any suitable means. The belts 20 and 24 move in the directions indicated by the arrows in Figure 2 of the drawings. The ends of the stalks are contacted by the belt 24 as it passes around the pulley 21 and are successively "brushed" into the space between the belts 20 and 24 and into contact with the transversely moving portion of the belt 24 indicated at 28. Thus the straws or stalks are successively seized between the two belts, pass between the parallel runs thereof and are delivered at any desired rate of speed upon the conveyor belt 22 which feeds the first unit D of the decorticating and degumming apparatus.

The conveyor 22 is preferably provided with side walls 23 forming a trough through which the straw is passed longitudinally. In order to compact the mass of straw being fed into the decorticating machine and to make sure that it is properly fed to the initial crushing or flattening rollers, there is provided a pressing roll 25 of relatively large diameter which is furnished with trunnions 26 guided in the slots 27 formed in the frame 28 of the machine. This pressing roll 25 bears, by its own weight upon the conveyor belt 22 preferably at the point where it is tangent to its pulley 26 and may have its surface roughened to better lay any upwardly projecting ends of the oncoming stalks.

Suitably jointed in the frame 28 are the successive pairs of crusher or flattening rolls 30. Two cooperating pairs are shown in the illustrated installation, but it is obvious that more may be employed if found desirable. These rolls may be plain surfaced, but are preferably provided with shallow flutes or are roughened to some degree so as to ensure that the oncoming ends of the straws are properly seized and fed between the rolls. These rolls perform the function of flattening the otherwise substantially cylindrical stalks, whereby during subsequent breading operations the outermost fibers on the opposite sides of the stalks will not snap or break. These crusher rolls are adapted to be 25
driven by suitable mechanisms which will presently be described.

From the crusher rolls 40 the web of flattened stalks is carried by means of the conveyer belt 42 to the decorticating mechanism of the first unit D. This conveyer belt 42 passes around the rollers 44 and 45. In this installation the roller 44 is preferably a driven roller and the rollers 43 and 45 are idlers. The conveyer belt 42 is arranged in an angular formation with an upwardly inclined delivery section, and the roller 44 is preferably a driven roller and the rollers 43 and 45 are idlers. The conveyer belt 42 is running on the conveyer rolls 48 and 49. This conveyer section 47 together with the upwardly inclined end of the conveyer 42 cooperates to feed the web of straw between them to the first pair of breaker rolls 56 of the unit D.

The decorticating unit D comprises a vertical series of alternating pairs of breaker rolls 80 and squared beater members 52 which are journalled in the bearing plates 53 and the fastening elements 60 and 61 of the inner faces of the two side members 54 and 57 of the main supporting frame 58. The shafts of the driven breaker rolls are provided with pulleys which are adapted by means of belts or chains to a suitable source of power and the arrangement is such that successive rollers are driven at somewhat higher speeds than the preceding ones. The driving connections for these rolls will be described hereinafter.

Each of the breaker rolls 80 is fluted as clearly indicated in Figure 6 of the drawings and the flutes of the rolls of each pair are in mesh so that when the web 100 of straw or fiber passes therethrough the shive or woody core is broken into fine pieces by the alternate bending of the flattened stalks. Any non-fibrous woods or other extraneous matter are also broken up and eliminated from the web of fiber in this way. The meshing of the rolls is not close enough to break the fiber and the rearwardly disposed rolls 90 are provided with the corresponding driven roll as by means of the adjustable bearings shown very clearly in Figures 3 and 7 of the drawings. These trunnions 80 on opposite ends of the rolls 80 are carried in slidably bearing blocks 81 which are guided by means of the flanges 82 and 83 of the side frame members 56 and 57. The plate or flange 84 is secured to each of the side members 56 and 57 and is provided with openings adapted to receive the bolts 85 which are threaded as at 86 into the ends of the movable dog blocks. Between the plates 54 and 57 at the ends of the block 81 there are disposed the springs 88 which are adapted to press the blocks 81 forwardly and thus urged the plates 54 and 57 of the pairs of breaker rolls 80 into contact with the web 100 as it passes between the flutes of the two rolls. The clearance between the flutes of the cooperating rolls 80 may be adjusted by rotation of the bolts 85 as by means of a suitable tool applied to the webs 87.

The breaker members 52 are arranged in pairs and the pair is disposed immediately after the preceding pairs of breaker rolls 80. These rotatory beater members are preferably square in cross section and serve to apply a mild beating and shaking action to the web of the particles of shive broken and loosened by the breaker rolls 56. The rotary beater members 52 are provided with trunnions or axle shafts 70 which are journalled in the plates 53, the two trunnions 55 of the side frame members 56 and 57. The forward members 52 of each pair are provided with sprockets or pulleys 72 from which they may be driven by suitable mechanism which will be later described. The trunnions 70 are at the opposite ends of these members 52 and are provided with intermeshing pinions 73 and 75 whereby the rear member may be driven by the roller 74 of the forward member of each pair. The beater rolls 52 or rotatory elements 52 should be rotated at a much more rapid rate than the breaker rolls 50. In practice it has been demonstrated that these rolls may be run from six to ten times as fast as the average speed of the breaker rolls of each unit.

Both the breaker rolls and the beaters are of relatively small diameter, say from ¾ to 2¾ inches, very superior results having been obtained with rolls 1¾ inches in diameter.

At this point it may be well to explain and emphasize the beneficial effects of the cooperation of these two types of rolls upon the web of straw and fiber. Fluted or grooved rolls are the most efficient devices for bending the straw and breaking the shive in a continuous manner. There is no lost motion as would be the case in the use of reciprocating mechanisms and consequently the apparatus can be run at very high speeds. For most effective operation the flutes or grooves in the successive rolls must vary in size and depth, becoming finer as the lap of fiber increases. The fiber tends to cling or adhere to the rollers and be wound about them during operation, just as in the case of slatted beating and upon drums which have been tried in some devices. Some means must be provided to "doff" the fiber and prevent it being wound about the roll. Also, if the breaker rolls are of a large diameter, the gap between the beater and one pair of these rolls and that of the succeeding pair is too great and the fiber gap will not jump the gap, and some form of guiding and doffing means must be employed. For this reason, the rolls are made relatively small in diameter in the present invention, and the gaps between the en-gaging or cooperating flutes of adjacent pairs of rolls are smaller and, furthermore, the rotatory beaters of the type employed herein serve to carry the fiber across the gap and at the same time perform several other important operations upon the lap of fiber. These beaters which are preferably of the square type indicated, not only act as doffers, but by their gentle beating or acting as vibrators and shakers to further eliminate the particles of shive and gum from the rapidly moving lap of fiber, they also act as opening and softening devices to loosen and separate the web and maintain it in a somewhat fluffy condition. The form of these beat-
ers is of the utmost importance. The square cross section is preferred and the comparatively blunt corners or edges of these members must be perfectly smooth. Any paddle type of beating especially those with serrations or toothed edges will catch the ends of the fiber and wind them up as they pass and break the individual fibers. The beating or scutching action must be very gentle and preferably repeated many times. For example, there have been employed in a practical machine as many as twenty to twenty-four sets of beating and beating rolls.

Another important feature of the present arrangement is the vertically upward travel of the lap of straw and fiber through these decortication and degumming units. Obviously, the rotation of the operating rolls must be such that the lap is fed upwardly through the machine and that all of the shive particles are thrown outwardly from the beater rolls and away from the traveling web or web of fiber. The particles of shive and gum are collected by suitable devices which may include the traveling conveyor, and, if desired, some form of pneumatic collecting system. The collected shive may be utilized in numerous ways. Among the uses of this by-product may be mentioned the employment of this material as a base for cattle feed and as a filler in molded plastics. In any device in which the web of shive moves downwardly or even in a horizontal direction, the effect of gravity would be to cause the shive particles to fall directly into the teeth of the rolls and be pressed into the lap of fiber.

Just beyond the last set of beater rolls 80 in the decorticating unit D there may be disposed a pair of drawing rolls 85 one of which is spring-pressed toward the other by the same type of device employed in connection with the breaker rolls 50 including the elements 61 to 69. These rolls are rotated at a somewhat greater rate of speed than the preceding operating rolls and serve to draw out or attenuate the lap of fiber. It will be noted from subsequent descriptions that there are provided throughout the present apparatus several devices for effecting this attenuation of the lap at various points during the operation of the machine. By this means the lap of fiber moves at a considerably faster rate at the delivery end of the machine than at the beginning. For example, in one practical embodiment of the device the mass of straw is fed into the first unit D of the decorticating apparatus at a little less than 100 feet per minute and is delivered from the final unit at about 300 feet per minute.

From the unit D the web of partly cleaned fiber is delivered by suitable conveying means as, for example, the belt conveyor 80. In Figure 7 of the drawings there is shown a guiding shield 82 that is an integral part of devices of which is disposed closely adjacent one of the drawing rolls 85 and the upper end curved to guide the lap of fiber 100 onto the conveyor 80. In some cases, however, the web 100 is moving too rapidly to be effectively conducted to the belt conveyor 80 by means of this guiding device and in such cases a cooperating belt conveyor element 84 is provided as indicated in Figures 1 and 2 of the drawings, the lap of fiber 100 being guided into the space between the receiving ends of the two conveyor belts 84 and 80 and pressed between these belts as it is carried forward by the unit D. The use of a double belt conveyor of this type permits a desirable drawing or attenuating action on the lap 75 of fiber at this point by running the conveyor at a speed greater than that of the preceding operating members.

In places of arid climate, or in fact in localities where a moderate humidity prevails, the lap of fiber may be carried directly from the decorticating unit D to the subsequent decorticating and degumming units F and G without any intermediate treatment. However, in extremely humid districts it is preferred to interpose suitable drying means such as indicated at E immediately beyond the first decorticating unit D. Such a drier serves to embitter the gummy and waxy material remaining in the fiber following the first treatment and greatly facilitate its removal in the units F and G. The drier E is in the form of an oven or other enclosure 86 which may be heated by steam, electricity or by other suitable means. The lap of fiber 100 is fed from the delivery end of the conveyor belt 97 onto the first conveyor 57 of a series of conveyors disposed in somewhat zig-zag relation in the drier casing 95. From the first conveyor 57 the lap is delivered upon the projecting end of the second conveyor 65 and is carried in the opposite direction until it is again delivered upon a succeeding conveyor 25 running in the same direction as the first conveyor 57. Any suitable number of these alternately oppositely moving conveyors may be employed, the last conveyor delivering the lap to the belt conveyor 102 with which the auxiliary belt 104 cooperates to feed the lap of fiber into the unit F. The unit F is in most respects exactly like the decorticating unit D, with the exception that the breaker rolls 90 are provided with somewhat finer flutes and all of the rotating elements are operated at a greater speed than in the preceding unit. Also, the unit F need not be provided with delivering drawing rolls such as shown at 85 in the unit D, but the lap 100 may be seized immediately after it has passed the last beaters 105 by the forward ends of the cooperating belt conveyors 104 and 105 as they pass around the rollers or pulleys 106.

In transferring the lap of fiber 100 from the unit F to the unit G the conveyors 101 and 105 are arranged in a somewhat Z-shaped configuration and cooperate throughout substantially their entire length to control the passage of the web of fiber between the units. The delivery ends of the conveyors 104, 105 are immediately beneath the first breaker rolls 58 of the unit G and at a point there the fiber passes through the successive breakers and beaters 58 and 57 of the unit G. From this unit the lap is carried by the forward end 109 of the rather complex belt conveyor 110. Cooperating with this forward portion 109 of the auxiliary belt 111. Adjacent the intermediate portion of the conveyor 110 there are provided curved laterally disposed blades 112 and a forming member 113 comprising the folding device H 60 by which the side edges of the lap are turned over upon the intermediate portion and thus reduce the total width thereof.

The final folding and packing mechanism K comprises essentially the swinging pendulum-like frame 114 which is suitably pivoted as at 115 and which is provided with suitable rollers or rolls about which is driven a portion of the belt conveyor 115. The swinging member 114 also carries an auxiliary belt 117 which cooperates with the belt portion 118 of the conveyor 110 to carry the web of fiber down over the receptacle or chute 120. The mouth 121 of the receptacle or chute 120 is curved arcuately and is adapted to be contacted by the series of rollers 75.
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122 carried by the arcuate lower frame portion 123 of the swinging member 114. The operation of this folding and packing device will be readily apparent. The longitudinally divided web or lap 100 is carried forwardly between the conveyor portion 106 and 111 and due to the swinging of the frame 114 the web is delivered into the chute 120 in a laterally folded condition, each successive fold 125 being pressed into the chute by the action of the rollers 122 as they oscillate across the mouth of the chute. In starting the lap of fiber into the chute it is necessary to employ a plug 126 which may comprise a compressible cushion which is inserted in the mouth of the chute to receive the folded layers of fiber upon it. By means of this folding and packing device a very great pressure may be applied to the fiber and it may be compressed in the chute or other receptacle as effectively as in a conventional type of baling press. The folded and compressed web of clean fiber may be delivered through the chute 120 to any desired destination.

A driving system for the machine which has been described is illustrated in Figures 1 and 4 of the drawings. The prime mover may be the motor indicated at 108 and is adapted to drive the belt 110 provided with a countershaft 154 and the unit 155 has a corresponding shaft 156, a chain 158 connects the pulleys carried by the shafts 154 and 156, and a chain 159 extends from suitable pulleys on the shafts 155 and 156 whereby the driving force is transmitted successively from one unit to the others. The diameters of the pulleys are suitably chosen so as to drive the shafts 155 and 156 successively faster than the preceding shafts.

Another chain 160 operatively connects a sprocket 161 carried by the countershaft 154 with a pulley or sprocket 162 carried by the shaft 156 which provides an axle for one of the initial crusher rolls 121, the drive being transmitted to the other crusher rolls through pinions 165 and 166 between which an idler gear 167 operates.

Carried by the countershaft 154 upon opposite sides of the unit D are the two sprockets 170 and 171 from which the chains 172 and 173 are respectively driven. Upon the truncated ends of the alternate driven breaker rolls 30 and upon one end of the drawing rolls 35 there are provided sprockets 176, 177, 178 and 179 as clearly shown in Figures 1 and 3 of the drawings. The sprocket chain 173 is passed around an idler 180, then around the two sprockets 176 and 177, then around another idler 181 and finally around the two sprockets 177 and 178 from whence the chain returns to the driving sprocket 111. The sprockets 176, 177, 178 and 179 are of successively diminishing diameters so that each succeeding roll driven thereby is rotated at a slightly faster speed than those preceding it. Upon the remote side of the unit D as viewed in Figure 3 the intervening breaker rolls 30 are provided with similar sprockets 183, 184 and 185 about which the driving chain 172 is trained. An idler 186 is inserted in order to ensure the constant meshing of the chain with the driving sprockets. The sprockets 183, 184 and 185 are also of diminishing diameters as in the case of the ones previously described.

The transmission for driving the beater rolls 52 will now be described. A sprocket 190 carried by the countershaft 154 drives a chain 191 which is passed around the sprocket 192 carried by the short shaft 193 which is carried by the bracket 194 secured to the frame 38. A bevel gear 196 secured to the shaft 193 meshes with a corresponding bevel gear 197 carried by the vertically disposed shaft 198 which is provided with suitable bearings supported, for example, by means of the bracket 199. At suitably spaced intervals along the shaft 199 corresponding to the spacing of the beater rolls 52 are secured the pulleys 200 about which are trained the endless belts 201 which are also passed around the pulleys 72 carried by the forwardly disposed beater rolls 52 of each pair. These forward rolls driven by the means just described also serve to drive the rearwardly disposed beaters through the gearing 73, 74, to which reference has already been made.

As mentioned heretofore, the beater rolls are preferably driven from about six to ten times faster than the average speed of the breaker rolls in the unit D. All of the beater rolls may be driven at the same speed, or by suitably graduating the pulleys 200 they may be driven at different speeds.

As a means for driving the conveyor belts 32 and 42 the following mechanism may be employed. A pulley 263 is mounted upon the end of the countershaft 154 and a belt 264 operatively connects the pulley 263 with a pulley 265 so as to drive it in the opposite direction. The pulley 265 is mounted upon a shaft 266 which serves as an axe for the driven roller 44 which about the conveyor 42 is passed. Another sprocket 268 is carried by the shaft 266 and serves to drive a chain 269 which is passed around a sprocket 270 carried by the shaft 271 which forms the axe of the roller 39 carrying the belt conveyor 32.

From the countershaft 155 of the unit F a sprocket chain 260 serves to drive the beater rolls of this unit through mechanism exactly similar to that described in connection with the unit D. Similarly the two chains 272 and 273 drive the alternate breaker rolls of this unit and corresponding driving chains are employed to actuate the belt conveyors. In the same way the chains 365, 372 and 373 serve to drive the corresponding devices associated with the final unit G.

In Figures 8 and 9 of the drawings there is disclosed a vehicle upon which is mounted an installation corresponding to the operating units D, E and F of the permanent installation and designated by the reference characters D', E' and F' in these illustrations. The vehicle designated by the reference character 215 is preferably enclosed and provided with pneumatic ground wheels 216 carrying balloon tires of considerable diameter to prevent breakage of the straw lying upon the field which the machine is adapted to traverse, and also to prevent jolting or vibration of the apparatus due to the uneven surface of the ground.

Ordinarily, in the use of this portable unit, the device will have been preceded by a thrasher or combine which has mowed and threshed the flax and deposited the straw in windrows along the ground. The vehicle 215 which may be provided with any suitable tractor hitch whereby it may be propelled across the field is designed to collect the straw and feed it through the decorticiating and degumming apparatus. For this purpose a conveyer 220 projects from the forward end of the unit and is adapted to collect the straw by means of the short prongs or tines 221 provided on each of the slats 222 which are carried by the belts 220 passed around the rollers or pulleys 224 and 225, the latter being driven by means of a sprocket 226 associated with the subsequent drive conveyor means.
Since most of the mechanism in the portable unit is the exact counterpart of corresponding devices in the stationary installation, they will not be described in detail but will be designated in some cases by the same numerals employed in the previous instances with the addition of a prime. However, certain slight differences in this construction will be explained. The conveyor belts serving to carry the lap of fiber from the unit D to the unit E are arranged as already shown in Figure 3 of the drawings and described in connection with the conveyors 190 and 180 between the units F and G in Figure 1. These conveyors are exactly the same as the conveyors 190 and 180 and will be given the designations 69' and 68' although they differ slightly from the conveyors having the corresponding designations in the devices first described. The shive particles eliminated in the first unit D may be collected in the trough 69' and delivered through the side of the vehicle into bags or other receptacles either carried by the vehicle 218 or by an attendant walking alongside thereof. The lap is adapted to be delivered by any suitable type of conveyor 110' into a receptacle 123' and removed at suitable intervals from the vehicle. For the purpose of driving the devices carried by the vehicle 218 an internal combustion engine may be employed as suggested at 120'.

The lap of fiber which is passed through the chute 120 or collected in the receptacle 123' is practically free of shive and sufficiently free of gummy matter for many purposes including that of paper manufacture. Also in the case of the preparation of the fiber for this purpose the stalks need not be perfectly aligned as they are passed through the machine but may be operated upon as a more or less tangled or matted web of straw. However, for textile purposes the stalks should be introduced into the devices in an approximately longitudinally aligned position. Also, for textile purposes the cleaned fiber web obtained from the machine forming the subject of the present invention may be put through certain subsequent processes including a wet extraction phase for eliminating more of the gums from which these by-products may be recovered for certain industrial uses. The fiber may also be drawn, fluffed or carded, or otherwise treated depending upon the specific purpose for which it is to be used.

As employed herein, the term "threshing" may include any preliminary treatment of the plant whereby the seeds, seed bolls, top branches, etc. are removed and the straw or stalks thus prepared for decortication. It will be understood that various changes and modifications may be made in the devices illustrated and described herein without departing from the scope of the invention as defined by the following claims.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. A decorticating device for the liberation of fiber from bast fiber yielding straw comprising a series of alternate pairs of fluted breaker rolls and square breaker rolls, between the members of each pair of which a slot of straw is made to pass, said breaker rolls having plane surfaces, and the beater rolls of each pair being spaced apart sufficiently to prevent pinching of the straw during its passage therethrough.

2. In a fiber liberating device of the class described, in combination, a pair of intermeshed fluted rolls disposed with sufficient clearance to permit the passage of a lap of fiber yielding straw between them, a pair of rotary members disposed closely adjacent said fluted rolls and adapted to receive between them the lap of straw passing from said fluted rolls, said rotary members being square in cross section and of small diameter, and means for rotating said fluted rolls in opposite directions compatible with the passage of the lap of straw therebetween and means for rotating said rotary members in corresponding directions at a speed greater than that of said rolls.

3. In a fiber liberating device of the class described, in combination, a plurality of superposed pairs of intermeshed fluted rolls, each pair disposed in a horizontal plane with sufficient clearance between the members thereof to permit the passage of an upwardly moving lap of fiber yielding straw, a plurality of pairs of rotary beater members alternating with said fluted rolls and adapted to receive between the members of each pair the lap of straw, said rotary beater rolls being square in cross section and adapted to operate upon the lap to apply a gentle beating and shaking action thereto in order to eliminate the shive therefrom.

4. The device as set forth in claim 3 in which means are provided for rotating said fluted rolls progressively faster throughout the device, successive rolls being provided with progressively finer flutes, whereby the lap of fiber is drawn out or attenuated and effectively decorticated and degummed.

5. A unitary device for continuously liberating fiber from fiber yielding plants passed therethrough comprising, in combination, a supporting floor, a supporting beam, a support frame, a pair of intermeshed crushing rolls, and means for transferring the web or lap of crushed stalks from said rolls to said floor in order to effect the decortication and degumming of the fiber.

6. In a fiber liberating apparatus of the class described, in combination, conveying mechanisms for moving fiber yielding plant stalks continuously in the same general direction throughout the apparatus, a device for continuously treating said stalks while they are disposed transversely to their direction of movement, a device for subsequently treating said stalks while disposed longitudinally in the same general direction of movement, and a reorienting conveyor between said devices for turning said stalks without affecting their general advance in said direction through said apparatus, said conveyor comprising a pair of cooperating travelling belts disposed at planes transversely to the plane of movement of the oncoming stalks, the greater portion of said conveyor being disposed in the direction of continuous forward movement of the stalks, the cooperating belts at the receiving end of the conveyor being passed around pulleys and the opening between said belts adjacent to and facing the ends of the oncoming stalks so as to 70 guide them, immediately turn them in a longitudinal direction, and forward them thus aligned to the second named device.

ROBERT B. COCHRANE.