March 20, 1956 H. J. SELLING ET AL 2,738,552

DEVICE FOR DECORTICATING BAST FIBER MATERIAL

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Fig. 1.

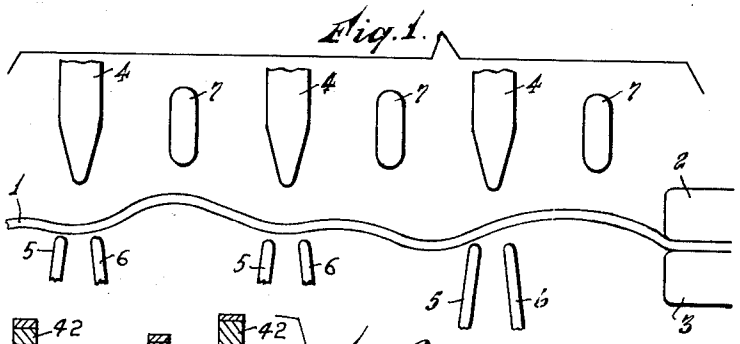

Fig. 2.

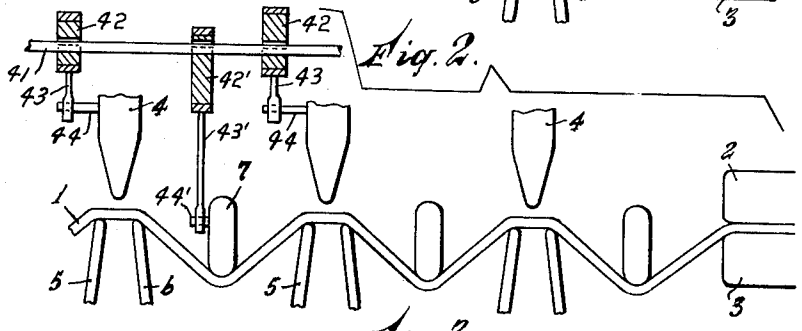

Fig. 3.

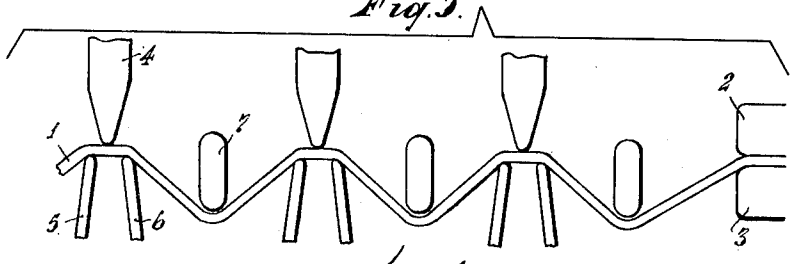

Fig. 4.

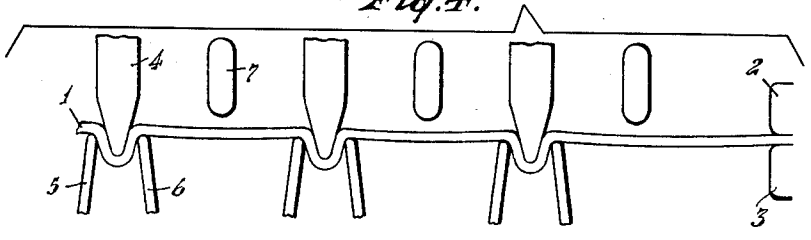

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Fig. 5.

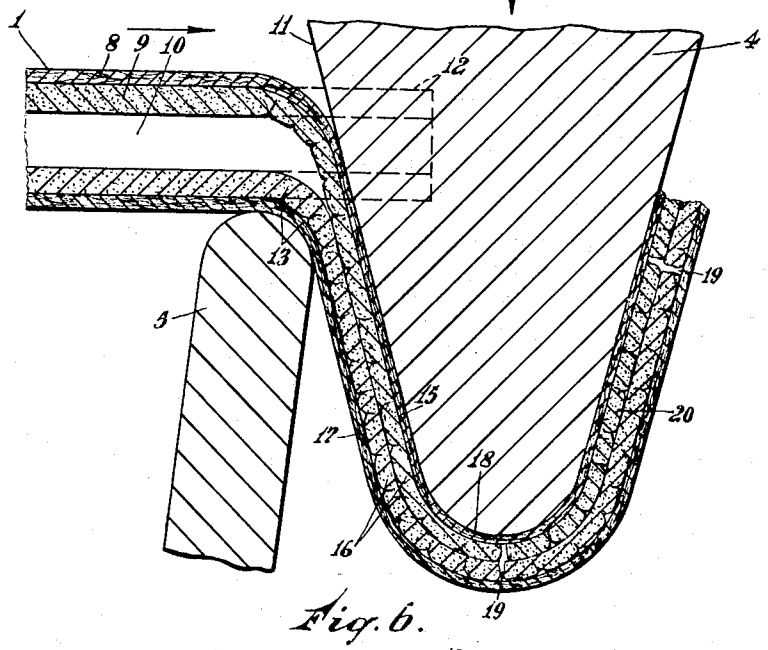

Fig. 6.

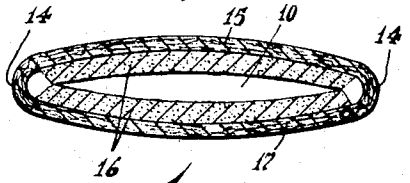

Fig. 7.

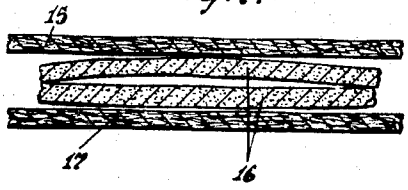

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Fig. 8.

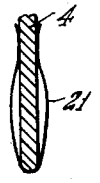


Fig. 10.

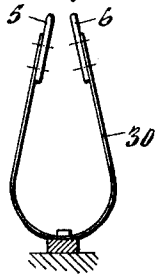


Fig. 11.

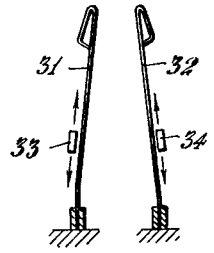


Fig. 9.

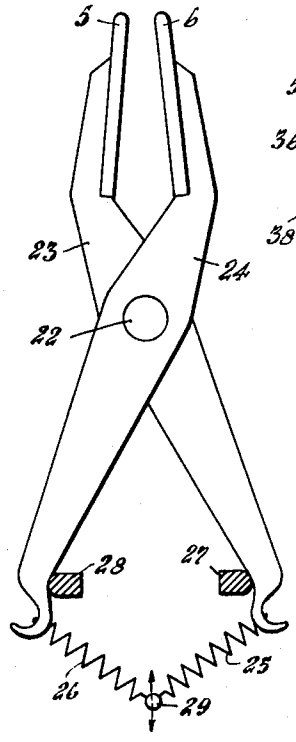


Fig. 12.

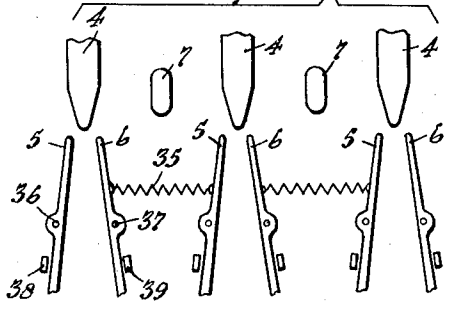
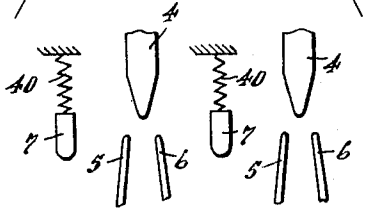


Fig. 13.



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United States Patent Office

2,738,552

Patented Mar. 20, 1956

2,738,552

DEVICE FOR DECORTICATING BAST FIBER MATERIAL

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Application July 1, 1950, Serial No. 171,674

Claims priority, application Netherlands July 27, 1949

2 Claims. (Cl. 19—23)

The invention relates to an apparatus for decorticating bast fibre material, such as flax, especially flax in an unretted condition, so-called green flax.

The method followed up till now which, however, cannot be applied to green flax, consists chiefly in a breaking process, followed by scutching. A few devices, working with combs and slats have been proposed, some of which are destined for the working of green flax but all of them have the disadvantage, that much fibre material is lost, whilst the loosening of the ligneous particles is far from complete.

It has appeared from the inventor's researches that when decorticating long fibre flax varieties as well as short oil flax varieties and other bast fibre plants, a considerably better separation with much less and even hardly any loss of useful fibre material may be achieved if the stalks are subjected to a bending process proceeding in longitudinal direction, followed by a bending in an opposite direction, the stalks being supported at the place of the bending during the first bending operation. Thereby, penetration of the bast layer by the ligneous core and damage to the bundles of fibres in the bast layer are prevented. The operation is carried out in such manner that excessive tensile stress in the fibres is avoided.

The object of the invention is to provide an apparatus to carry out this process. In the apparatus according to the invention the cohesion between the ligneous core, made brittle by preliminary drying, and the bast layer, due to a layer of cambium cells, is destroyed and the core fractured into short particles. The process is carried out in such a way that the fibres are not broken into shorter lengths and that the shorter fibres, which are, for instance, present in oil flax, are not removed. During the first bending the stalks are supported in such a manner that the woody core which cannot follow the bending of the bast fibre layer on account of its greater rigidity, is forced to buckle and to remain within the fibre sheath. The core is now bent so that the outside is under tensile strength whilst in the parts lying more inwards compressive stresses occur. By buckling is here understood the butting action in the parts of the core under strain of pressure, the tensile stress causing hardly a fracture or no fracture at all. In this way the cohesion between the bast layer and the ligneous core is lost for the greater part, some cohesion, however, may remain in the buckled core whilst the rigidity of the core has disappeared at the same time. In the consecutive bending in an opposite direction the cohesion within the core is locally destroyed, so that the core particles obtained in this way come to lie loosely within the bast strands, which, in the mean-time, have formed in the bast layer. The broken and loosened ligneous particles can thereupon be removed in any suitable way without any damage to the fibres.

The object of this invention is to provide an apparatus to carry out the treatment described above. Another object of the invention is to provide an apparatus to decorticate bast fibre material in such a way that no undue tensile stresses occur in the fibres, preventing thereby

breakage of fibres and allowing an accordingly high output of high-grade fibres. The material to be treated must obviously be brought to a suitable degree of humidity, e. g. by drying followed, if necessary, by conditioning.

The apparatus according to the invention comprises operating units, each consisting of a beating knife and one or more stripping knives, said beating knives and said stripping knife or knives having rounded working edges and being located on both sides of the plane in which the fibre material has been spread and being able to carry out, with respect to each other, such a periodical, relative movement, substantially perpendicularly to said plane, that they overlap each other during the working stroke, one or more knives being provided with members enabling the knife flanks to deflect sideways, substantially perpendicularly to the direction of the stroke.

According to the invention these members may be springs, but it is also possible to make the stripping knives and/or the beating knives partly or entirely resilient so as to permit deflection of the lateral faces thereof.

In order to control the tensile stresses occurring in the fibres during the treatment it is furthermore possible to render the resilience of the said resilient members adjustable.

At the same time the invention comprises means to make each working unit treat, in case of two or more working units being simultaneously used, a length of stem per stroke which is only determined by the beating depth. These means may consist in accumulating knives, driven with the same frequency as the beating knives but advancing on the latter and lying on either side of the working units, the arrangement and movement of said knives being such that they draw between the working units a certain length of stalk, whilst furthermore the possibility exists to apply resilient members to drive the accumulating knives.

The principle of the method according to the invention will be nearer elucidated with reference to the drawings in which, moreover, some embodiments of parts, essential to the execution of the method are shown diagrammatically as well as a decorticating machine, provided with a device according to the invention.

Figs. 1–4 show the units diagrammatically in various working positions in a cross-section perpendicular to the plane in which the stalks are spread.

Figs. 5, 6 and 7 show in an enlarged cross-section diagrammatically the principle of the method.

Fig. 8 shows a cross-section of a beating knife provided with resilient flanks.

Fig. 9 shows a possible construction of a couple of stripping knives with springs.

Fig. 10 shows another execution of a couple of stripping knives, mounted on one plate spring.

Fig. 11 shows a couple of stripping knives consisting of separate plate springs.

Fig. 12 shows a cross-section of some work units, in which the stripping knives of two different operating units are connected in couples with the same springs.

Fig. 13 shows a cross-section of two operating units with resiliently mounted accumulating knives.

In Figs. 1–4 the reference numeral 1 represents one of the stalks to be treated which is moved in a suitable but not in any particular way in a direction substantially perpendicular to the plane of the drawing. In the embodiment shown, the movement of the stalks is caused by a couple of endless conveyor belts 2 and 3, between which the stalks 1 are clamped during the transport through the operating units. A beating knife 4 forms with a pair of stripping knives 5 and 6 an operating or working unit. On either side of the working units the gathering knives 7 are arranged. An upward and downward movement is in a suitable way communicated to

the beating knives 4 as well as to the accumulating knives 7, whilst the stripping knives 5 and 6 may move away in a direction substantially perpendicular to the flanks of the beating knives.

The drive arrangement includes a drive shaft 41, driven by any means, not shown in the drawing, which extends in longitudinal direction over the plurality of beating and gathering knives provided in the device. A plurality of eccentrics 42, one for each of the beating knives, are keyed to the shaft and respectively connected to each of the beating knives by connecting rods 43 and pins 44. Similar eccentrics 42' keyed to the shaft 41 are provided for each of the gathering knives which are connected to each of the gathering knives by connecting rods 43' and pins 44'. Only two eccentrics 42 and only one of the eccentrics 42' are shown in the drawings, but it is understood that each of the beating knives and each of the gathering knives is provided with an eccentric and the necessary connecting members. The eccentrics 42 and 42' are respectively keyed to the shaft 41 as clearly indicated in the drawing in such a way that the beating knives and the gathering knives will reciprocate, respectively, in opposite direction upon rotation of the shaft 41. The eccentricity of the eccentrics 42 and 42' may be the same or different, depending on the stroke respectively desired for the beating or gathering knives.

Fig. 1 shows the moment that the still untreated stalk has just reached the working units. Beating knives 4 and accumulating knives 7 are situated above the plane in which the stalks are spread and stalk 1 is therefore lying free and is supported by stripping knives 5, 6.

Fig. 2 shows a consecutive position of treatment. Accumulating knives 7, which just as the beating knives 4 execute a forced movement, are here in a lower position and have drawn a certain length of the stalk between the working units.

Fig. 3 shows the moment at which the beating knives 4 in their downward movement just touch the stalk 1 to be treated. At this moment the direction in which the accumulating knives 7 are moving is already reversed and therefore they are no longer in their lowest position.

When the treatment proceeds, Fig. 4, the beating knives are moving still further downwards, whereas the accumulating knives 7 go upwards. At the downward movement of the beating knives 4 the stalk is clamped between the flanks of the beating knife 4 and the stripping knives 5, 6 which now move sideways, and the length of stalk previously drawn between the working units by the accumulating knives 7, is drawn between the stripping knives 5, 6 without subjecting the stalk to tension. The stripping knives 5, 6 move sideways, exerting a certain pressure on the stalks in a direction perpendicular to the flanks of the beating knives.

After the beating knives have reached their lowest position, their direction of movement in reversed and they arrive again in the position of Fig. 1, upon which the cycle of treatments repeats itself.

The working units are arranged with respect to the conveying device in such a way that the whole length of the stalk is successively subjected to the said treatment.

It is possible to aid the transport of the stalks by having the knives execute a movement having a component in the direction in which the stalks are moving.

Fig. 5 shows the principle of the method. In this figure a stalk is shown during the treatment by beating and stripping knives. The stalk 1 is composed of the bast layer 8 in which the fibre bundles are lying and of the ligneous tube 9. In the core of this ligneous tube is the pith cavity 10'.

The stalk is supported by stripping knife 5 and, at the downward movement of the beating knife 4, is moving in the direction of the beating knife. The woody core 9, which has a much greater rigidity than the bast layer 8, would keep moving in its longitudinal direction as indicated in broken lines at 12 but for the presence of the flank of the beating knife 11 and would, but for this knife, break through the bast layer, thus damaging the fibres.

The lateral face of the knife 11, however, forces the stem to bend together with the woody core 9, which is buckled in the process. The bending of the stem around the stripping knife 5 and the resilient lateral pressure exerted by said knife and the beating knife 11 thereupon cause the stems to flatten and the woody core to split lengthwise.

In Fig. 6 a cross-section of a stem is shown in the process of flattening, and in Fig. 7 this cross-section is shown after the stem has been pinched between the knives 5 and 11. The stem is entirely flattened and the bast layer 8 is separated lengthwise in the parts 15 and 17 while core 16 is flattened and broken. The buckling of the woody core 9 causes fractures as indicated by the numerals 13 in Fig. 5. This destroys the rigidity of the core, but does not separate it into short particles. At the consecutive bending in the opposite direction the cohesion is broken locally at 19 at the circumference 18 of the beating knife 4. The ligneous particles 20 produced in this way are now lying completely loose and may be removed in a suitable manner without fear for damage.

Fig. 8 shows an embodiment of a resilient beating knife. The beating knife is provided with a plate spring 21 connected thereto. When using such knives the stripping knives may be rigid since the spring 21 provides resilient knife flanks which are capable of yielding in a direction substantially perpendicular to the direction of the beating movement of the knives.

The stripping knives 5 and 6 shown in Fig. 9 are connected to levers 23 and 24, rotatable around an axis 22 at the ends of which levers draw springs 25 and 26 engage. Stops 27 and 28 limit the stroke of the levers in one direction, so that between the knives 5 and 6 there is always sufficient room to enable the beating knife to enter. Of course it is possible to control the force with which the knives 5 and 6 press against the stem, e. g. by rendering the end 29 of the springs 25 and 26 adjustable in and up- and downward direction.

Fig. 10 shows the arrangement of a couple of stripping knives 5 and 6, rigidly fixed to a U-shaped leaf spring 30. The channel formed by the spring 30, is substantially closed, and may be advantageously connected to an exhauster for the removal of the ligneous particles or chaffs which, are separated from the stalks and fall into said channel.

Fig. 11 shows another embodiment of the stripping knives.

The stripping knives consist here of two separate and fixedly arranged plate springs 31 and 32 of a suitable shape. By rendering stops 33 and 34 adjustable in an up- and downward direction the possibility to control the force of compression on the stalk is created.

Fig. 12 shows an embodiment in which the stripping knives of two adjoining working units are driven in twos by the compression springs 35. The stripping knives are mounted to oscillate about axes 36 and 37, whilst stops 39 and 38 limit the stroke.

Fig. 13 shows a modified arrangement of the accumulating knives. Instead of being driven by a suitable mechanism to carry out a reciprocating movement, these knives 7 are now mounted on suitable compression springs 40, the upper ends whereof are secured to non-moving suitable supports, which e. g. may be a part of the apparatus-frame. The length of the stroke and the resilience of the springs 40 are chosen in such a way, that the lower ends of the accumulating knives 7 are situated, as shown in Fig. 13, below the tops of the stripping knives 5 and 6, drawing thereby a certain length of the material to be treated between the work units. When the beating knives 4 penetrate in their downward movement between the stripping knives 5 and 6, the material treated will be drawn between said knives 5 and 6, the accumulating knives will be pushed in upward direction by the tension in the stalks

of the material, situated between the work units, and the springs 40 will be compressed. The elasticity of these springs is such, that this upward movement of the accumulating knives can be carried out without undesired stresses occurring in the material treated. Another possibility is to connect the upper ends of the springs 40 not to a non-moving part of the apparatus, as shown in the drawing, but to a part, carrying out a reciprocating movement perpendicularly to the plane, wherein the material to be treated is spread out.

It may be of advantage to have only one or more than two stripping knives cooperate with one beating knife. In the first case the beating knives are working at one side only; in the second case the stripping knives are subdivided in their longitudinal direction, thus restricting the possibility that some stalks are too much and others are not subjected to the compressive forces of the stripping knives.

It is evident that where in this description the word "movements" is used, such as those of the beating knives and the stripping knives, always "relative movements" are meant and that e. g. the same effect may be achieved with non-moving stripping knives and moving beating knives as with non-moving beating knives and moving stripping knives.

In the latter case, the springs carrying at one end the gathering knives will have to be secured at their other ends either to stationary supports, which may, for instance, be a part of the apparatus frame, or of the stripping knives.

What we claim is:

1. In an apparatus for decorticating bast fiber material, an operating unit comprising in combination, at least one elongated flat beater element having a rounded working edge; at least one elongated flat stripping element having a rounded working edge extending substantially parallel to said working edge of said beater element, one of said elements being reciprocably movable relative to the other element in a plane parallel to the plane in which said other element is located from a spaced position to an overlapping position in which opposite lateral faces of said elements partly overlap so that the working edge of each of said elements is located oppositely a lateral face of the other of said elements; a resilient convex plate associated with one of said elements and extending over the lateral face of the same facing the working edge of the other of said elements and adapted to engage said other element during reciprocating movement of one of said elements so as to cause resilient engagement between said convex plate and the working edge of said other element in said overlapping position thereof; and drive means reciprocating at least one of said elements whereby a bast fiber material arranged between said working edges is decorticated.

2. In an apparatus for decorticating bast fiber material, in combination, at least two operating units, each comprising at least one elongated flat beater element having a rounded working edge, at least one elongated flat stripping element having a rounded working edge extending substantially parallel to said working edge of said beater element, one of said elements being reciprocably movable relative to the other element in a plane parallel to the plane in which said other element is located from a spaced position to an overlapping position in which opposite lateral faces of said element partly overlap, resilient means associated with at least one of said elements and adapted to cause resilient engagement of said elements in said overlapping position thereof; a flat elongated reciprocable gathering member located intermediate said two operating units and adapted to engage while moving in one direction fiber material extending between said two working units and to gather a predetermined length of fiber material between said operating units when said elements of the same are in spaced position, and adapted to release said fiber material when said elements are in said overlapping position; and drive means for reciprocating at least one of said elements in each of said operating units, and for reciprocating said gathering member at the same frequency and in opposite direction to the reciprocating movement of said one of said elements of each of said operating units.

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