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FELTING APPARATUS AND METHOD

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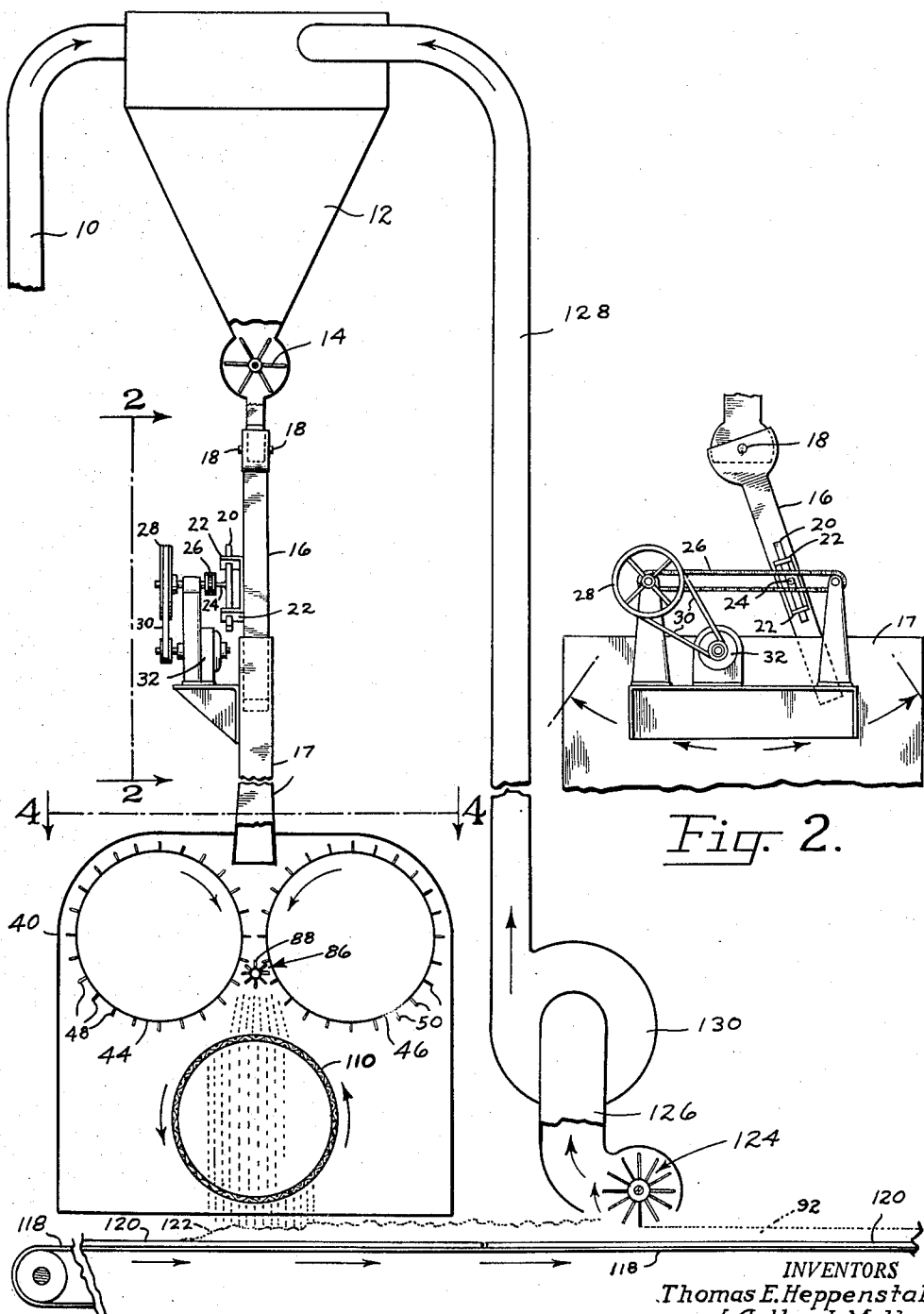


Fig. 2.

Fig. 1.

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FELTING APPARATUS AND METHOD

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This invention relates to felting apparatus for forming moist or dry fibrous material into a felt or mat preliminary to pressing the mat into fiberboard. The apparatus is applicable to the felting of a variety of fibrous materials, but is particularly applicable to the felting of particles of lignocellulose such as wood fibers, flakes, shavings, chips, or sawdust and is described herein with particular reference to that application although no limitation is thereby intended.

In making hardboard and other consolidated fibrous products it is common practice to reduce wood to the form of small particles, to mix the particles with a resinous binder and a size, and then to form them into a felt or mat. The latter then is consolidated to the desired density by the application of heat and pressure.

In the foregoing sequence of operation, the properties of the felt are of critical significance in determining the properties of the final consolidated product. If the felt is non-uniform in composition, thickness or density, this non-uniformity is reflected in the finished product which therefore is of an inferior grade.

It is particularly difficult to control the uniformity of a mat felted by the dry or moist processes from fibrous elements of irregular size, such as wood flakes, shavings or chips because of the difficulty involved in delivering them from the felting apparatus in the uniform, continuous flow which is necessary for building up a uniform, continuous felt. In spite of this, however, it is desirable to use such materials as raw materials for hardboard manufacture because of their low cost, abundance, and, in some cases, because of desirable properties which they impart to the finished board.

It therefore is an important object of the present invention to provide felting apparatus capable of forming dry or moist wood flakes, chips, and shavings and similar fibrous materials into a uniform felt.

It is another important object of this invention to provide felting apparatus which will dry felt wood flakes, chips, shavings and like material continuously and at a high rate.

Another object of this invention is the provision of felting apparatus which will dry felt fibrous materials uniformly even though the materials are supplied to the apparatus at a non-uniform rate.

Still another object of the present invention is the provision of apparatus which will dry felt fibrous materials rapidly and uniformly without plugging of the apparatus by the fibrous materials.

It is another object of the present invention to provide apparatus for dry felting fibrous materials which though of high capacity, is simple in construction and readily adaptable to plant operation.

The manner in which the foregoing and other objects of this invention are accomplished will be apparent from the accompanying specification and claims, wherein:

Figure 1 is a schematic view in side elevation, partly in section, illustrating the presently described felting apparatus;

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Figure 2 is a detail view in side elevation as viewed from the direction indicated by the arrows 2—2 of Figure 1;

Figure 3 is a detail sectional view in side elevation illustrating the felting head of the presently described apparatus; and

Figure 4 is a detail sectional view taken along the line 4—4 of Figure 1.

Generally stated, the felting apparatus of this invention comprises a hopper for receiving and transmitting a quantity of fibrous material. Feeding means communicates with the hopper for supplying the material to it at a rate which is not necessarily uniform. Stationed side by side adjacent the outfeed end of the hopper are a pair of parallel, rotatably mounted, spaced apart, feed rolls for receiving between them material discharged by the hopper.

The opposed peripheral surfaces of the feed rolls are separated by a distance which is less than the thickness of the hopper. The feed rolls therefore engage the material leaving the hopper and compress it while advancing it toward the discharge side.

A comb roll is rotatably mounted between the feed rolls on the discharge side in the region of compression of the fibrous material. It rotates relatively rapidly and combs out substantially individual fibrous elements from the compressed mass. These elements pass next to distributing means which distributes them upon receiving means, such as an endless belt where they are built up into a substantially uniform felt. The thickness of the felt is controlled still further, however, by means of a levelling device which scalps or levels it to the desired thickness. The fibrous material thus removed from the felt then may be recycled to the hopper, if desired.

Considering the foregoing in greater detail and with particular reference to the drawings:

Dry or moist fibrous material, such as wood, chips, shavings, or fibers coming, for example, from a debarker, a chipper or other suitable wood reducing apparatus is fed through a conduit 10 into a separator 12. Thence it passes through a rotary sealing valve 14 into a spout 16.

Spout 16 has for its function the delivery of the fibrous material to the hopper 17 of the felting apparatus in such a manner as to build up an accumulation of the material within the hopper to a uniform height across its width. This facilitates uniform delivery of the material from the hopper.

To this end the upper end of spout 16 is pivotally attached to separator 12 below the rotary valve by means of pins 18. Its lower end extends within the upper end of the hopper so that it may oscillate therein, delivering fibrous material across the entire width of the hopper.

Accordingly spout 16 is connected to drive means which in the illustrated form comprises a slide 20 attached longitudinally to the spout through guide members 22. A pin 24 extends outwardly from the slide. It is attached to a link of the endless drive chain 26, mounted on suitably positioned sprockets and driven through a pulley wheel 28 interconnected by belt 30 to a motor 32. Thus as is indicated particularly in Figure 2, spout 16 may be swung from side to side across the width of the hopper.

Hopper 17 may be of any desired configuration, but preferably is downwardly and outwardly flared and of substantial height to provide ample storage space. This is because in normal plant operation it is difficult to provide a uniform flow of fiber. The hopper thus affords a reservoir for storage of a substantial quantity of fibrous material which then may be fed out of the hopper at a uniform rate. The discharge end of the

hopper has a thickness a (Figure 3), the significance of which is discussed below.

Hopper 17 extends within housing 40 of the felting head of the apparatus to such an extent that its discharge end is immediately adjacent a pair of feed rolls 44, 46. These are stationed side by side immediately below the hopper for receiving the material discharged thereby in the area between the rolls.

The rolls are provided with spikes 48, 50 for engaging the fibrous material and for carrying it into the area between the rolls. The spacing of the spikes is such as to engage the fibrous material without becoming clogged thereby, and also such as to provide a clearance distance between the spikes as the rolls rotate.

Feed roll 44 is rotatably mounted on a shaft 52 journaled in bearings 54, 56. Feed roll 46 is rotatably mounted on a shaft 58 journaled in bearings 60, 62. Bearings 54, 56 are mounted on a frame member provided with slots, and bearings 60, 62 are similarly mounted so that the position of the two feed rolls relative to each other may be varied as desired.

It is to be noted that in order to have a uniform feed of fibrous material, such as wood fibers, between the feed rolls 44 and 46, one or more of several critical factors must be observed. In the first place, the diameter b , of the rolls should be substantial as compared with the thickness a of the hopper. Thus, diameter b should be at least equal to, preferably from two to eight times thickness a . In the second place, the sidewalls of hopper 17 should extend as closely as possible to the surfaces of rolls 44, 46. Thus the opposed surfaces of the two rolls become restricted continuations of the side walls of the hopper.

Also, and of particular importance, the distance c separating the opposed peripheral surfaces of the two feed rolls should be substantially less than the thickness a of the hopper. Thus c should be between one-fourth and three-fourths, preferably about one-half a . This insures that the loose, fluffy mass of fibers present in the hopper will be compacted to a coherent mat which can be passed at a uniform rate between the rolls. Under these conditions it will be apparent that the column of fiber within hopper 17 will move in the direction of the feed rolls uniformly at substantially the same rate as the compressed column moves between the rolls.

Drive means are provided for driving feed rolls 44, 46 in the feed direction synchronously with each other at the desired rate. In the illustrated form the drive comprises a worm gear 64 keyed to shaft 52 and a worm gear 66 keyed to shaft 58. These two gears are driven respectively by worms 68, 70 splined to a common shaft 72. This shaft carries on one of its ends the pulley 78 connected through belt 80 to pulley 82 on the variable speed motor 84. In this manner roll 44 may be driven clockwise and roll 46 counterclockwise, as viewed in Figure 3, synchronously, but very slowly, for example, at a speed of but 1 or 2 revolutions per minute.

Fibers transmitted between rolls 44, 46 are in a coherent, compressed condition as has been indicated above. Accordingly in this condition they are amenable to combing for dislodging individual fibers which may then be dispersed and collected for subsequent processing. In the illustrated form, the combing means employed comprises a combing roll 86 provided with a plurality of teeth 88 which are dimensioned and spaced to clear teeth 48, 50 on the feed rolls. The axis of the combing roll is located well within the fiber compression area so that the teeth of the roll act upon the compressed fibers, disentangling them and combing out individual fibers, thereby avoiding the dropping away of fibrous clumps from the apparatus.

The combing roll assembly includes a shaft 90 which is journaled in bearings 92, 94. It is driven, by pulley

96 interconnected through belt 98 to pulley 100 on motor 102, at a relatively high rate, for example, about 400 revolutions per minute, as compared with the slow rate of revolution of the feed rolls. The fibers combed out of the compressed mass by comb roll 86 then pass to distributing means having for its function distribution of the fibers on a receiving means such as a continuous belt upon which they are built in a uniform mat. The distributing means also serves the function of correcting for minor fluctuations in feed.

Although the distributing means may assume diverse forms such as a reciprocating screen or a rapidly rotating spiked roll, in the illustrated form it comprises a foraminous cylinder, preferably a screen cylinder 110 having openings of a size sufficient to pass and distribute the fibrous elements. When felting wood flakes, for example the screen openings may be about 2 inches on a side.

The screen cylinder is driven at a suitable rate, for example, at from 50 to 150 r.p.m., by a drive which in the illustrated embodiment comprises a pulley 112 fastened to the cylinder, and driven through belt 114 by gear motor 116.

The fibrous elements in substantially individual form thus are rained down on the receiving means which preferably comprises an endless conveyor 118. If desired, caul plates 120 may first be placed on the surface of the belt. As a result, felt 122 will build up directly on the caul plates which furnish convenient support means for transferring it in sections to a suitable press, wherein the caul plates also serve their usual function.

Although the felt, as formed, is of reasonably uniform thickness, it may be desirable to include in the apparatus suitable levelling means for levelling or scalping it to the precise thickness desired. Such a levelling means may comprise the spiked levelling roll 124, rotatably mounted across the felt and positioned relative thereto in such a manner that its teeth extend into the felt an appreciable distance.

Roll 124 is driven by motor means at an appropriate rate. It is partially enclosed by and communicates with a vacuum conduit including the sections 126, 128 and fan 130. This conveys away the fibrous material removed by the levelling roll and preferably transports it to the separator 12 for recycling to the felting head.

Operation

The operation of the presently described felting apparatus is as follows:

Fibrous material such as wood flakes, chips, shavings, fiber or sawdust is introduced through conduit 10 into separator 12. Thence it passes into oscillating spout 16 which distributes it across the width of hopper 17. The latter stores the material and delivers it between a pair of spiked feed rolls 44 and 46.

The feed rolls compress the material and pass it downwardly against a comb roll 86 rotatably mounted in the region of fiber compression. The comb rolls comb out from the compressed mass substantially individual fibrous elements and passes them downwardly upon distributing means such as the rotatably mounted screen cylinder 110.

The latter cylinder has for its function the distribution of the fibrous elements into a uniform flow and also of correcting for minor fluctuations in the flow of material delivered from the feed rolls. It passes the fibrous elements in a uniform rain down upon conveying means such as the endless belt 118 carrying caul plates 120. The mat or belt 122 built up upon the caul plates then is levelled by means of the leveling roll 124, the material removed by the roll being conveyed away via vacuum conduits 126, 128 and recycled into separator 12.

Thus it will be apparent that by the present invention we have provided felting apparatus characterized by several significant advantages. It makes a uniform dry or moist felt of fibrous materials. The felt is uniform in density, thickness and composition, even though such ir-

regular and difficultly handleable materials as wood chips, shavings and flakes are the subject matter of the felting operation. The apparatus is easy to control and operate and does not plug despite the tendency of fibrous materials to cause this difficulty. The apparatus, furthermore, is simple in construction and design and well suited for continuous production of dry or moist felts in large scale plant operations.

It is to be understood that the form of our invention, herewith shown and described, is to be taken as a preferred example of the same, and that various changes in the shape, size and arrangement of parts may be resorted to, without departing from the spirit of our invention, or the scope of the subjoined claims.

Having thus described our invention, we claim:

1. Felting apparatus for felting fibrous materials comprising a hopper for receiving and transmitting a quantity of fibrous material, a spout the outfeed end of which feeds into the hopper, means for mounting the spout for oscillation with respect to the hopper, slide means stationed on the spout longitudinally thereof, a pin extending outwardly from the slide means, an endless chain adjacent the pin, means for connecting the pin to the chain, motor means connected to the chain for driving the same at a rate calculated to oscillate the spout at a predetermined velocity, a pair of parallel, rotatably mounted feed rolls stationed side by side adjacent the outfeed end of the hopper for receiving between them material discharged thereby, the feed rolls having their opposed peripheral surfaces separated by a distance substantially less than the thickness of the hopper, motor means connected to the feed rolls for driving them in the feed direction, thereby engaging the material discharged by the hopper and compressing it while advancing it toward the discharge side of the feed rolls, a comb roll having an operating diameter not substantially exceeding the space between the feed rolls and rotatably mounted between the feed rolls at the discharge side thereof in the region of substantially maximum compression of the fibrous material, motor means for driving the comb roll at a rate sufficient to comb out substantially individual fibrous elements from the compressed mass, distributing means stationed below the comb roll for uniformly distributing the individual fibers over an area therebelow, and felt forming means stationed below the distributing means for receiving the uniformly distributed fibers and forming a felt therefrom.

2. Felting apparatus for felting fibrous materials and comprising a hopper for receiving and transmitting a quantity of fibrous material, a spout the outfeed end of which feeds into the hopper, means for mounting the spout for oscillation with respect to the hopper, slide means stationed on the spout longitudinally thereof, a pin extending outwardly from the slide means, an endless chain adjacent the pin, means for connecting the pin to the chain, motor means connected to the chain for driving the same at a rate calculated to oscillate the spout at a predetermined velocity, a pair of parallel, rotatably mounted feed rolls stationed side by side adjacent the outfeed end of the hopper for receiving between them material discharged thereby, the feed rolls having their opposed peripheral surfaces separated by a distance substantially less than the thickness of the hopper, motor means connected to the feed rolls for driving them in the feed direction, thereby engaging the material discharged by the hopper and compressing it while advancing it toward the discharge side of the feed rolls, a comb

roll having an operating diameter not substantially exceeding the space between the feed rolls and rotatably mounted between the feed rolls at the discharge side thereof in the region of substantially maximum compression of the fibrous material, motor means for driving the comb roll at a rate sufficient to comb out substantially individual fibrous elements from the compressed mass, a rotary screen having openings of a size sufficient to pass therethrough all of the fibrous elements from the fiber combing means, means for mounting the rotary screen below the fiber combing means for rotation to uniformly distribute all of the fibrous elements from the fiber combing means, and felt forming means below the rotary screen for receiving the uniformly distributed fibrous elements and forming a felt therefrom.

3. Felting apparatus for felting fibrous materials, comprising a hopper for receiving fibrous material and having a horizontally elongated outfeed end, a pair of spaced power driven feed rolls mounted below and adjacent the outfeed end of the hopper for rotation on horizontal axes extending substantially parallel to the elongated outfeed end of the hopper, the spacing between the adjacent surfaces of the feed rolls being substantially less than the horizontal width of the outfeed end of the hopper, whereby to compress the fibrous material received therebetween from the hopper, a comb roll having an operating diameter not substantially exceeding the said spacing between the feed rolls and rotatably mounted between the feed rolls at the discharge side thereof in the region of substantially maximum compression of the fibrous material, power drive means connected to the comb roll for rotating the latter at a speed substantially greater than that of the feed rolls to comb out substantially individual fibrous elements from the compressed material, and means positioned below the feed rolls and comb roll for receiving the combed fibrous elements and forming a felt therefrom.

4. A method of producing substantially individual fibrous elements from fibrous lignocellulose material, comprising supplying bulk fibrous lignocellulose material, subjecting the bulk fibrous lignocellulose material to a compressive force, and subjecting the compressed mass of fibrous lignocellulose material to a combing action while in the area of substantially maximum compression whereby to comb out substantially individual fibrous elements from the compressed mass.

5. A method of felting fibrous lignocellulose material, comprising supplying a continuous feed of bulk fibrous lignocellulose material, subjecting the bulk fibrous lignocellulose material to a compressive force, subjecting the compressed mass of fibrous lignocellulose material to a combing action while in the area of substantially maximum compression whereby to comb out substantially individual fibrous elements from the compressed mass, and distributing the fibrous elements uniformly over an area to form a uniform felt.

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