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METHOD AND APPARATUS FOR THE PRODUCTION
OF GLASS FIBER MATS
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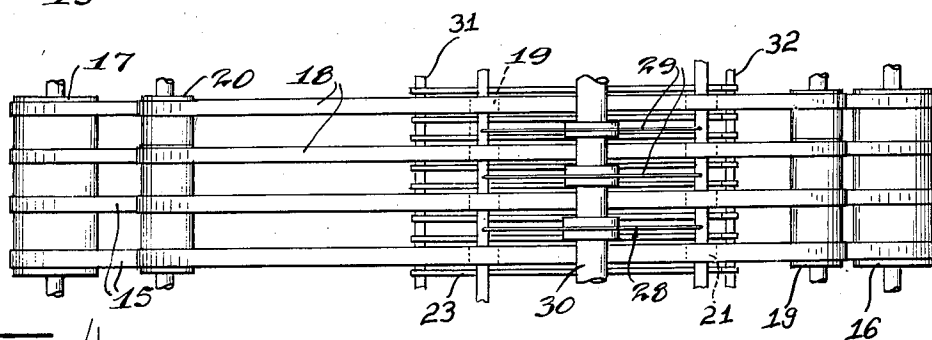
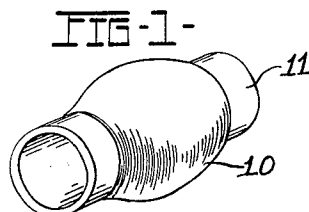
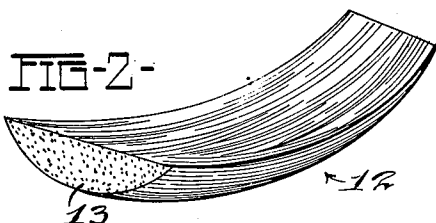


FIG-4-

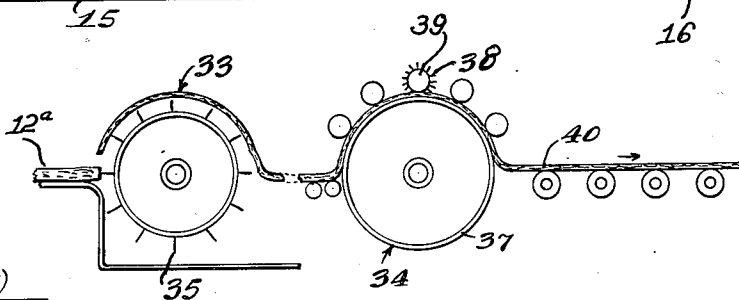
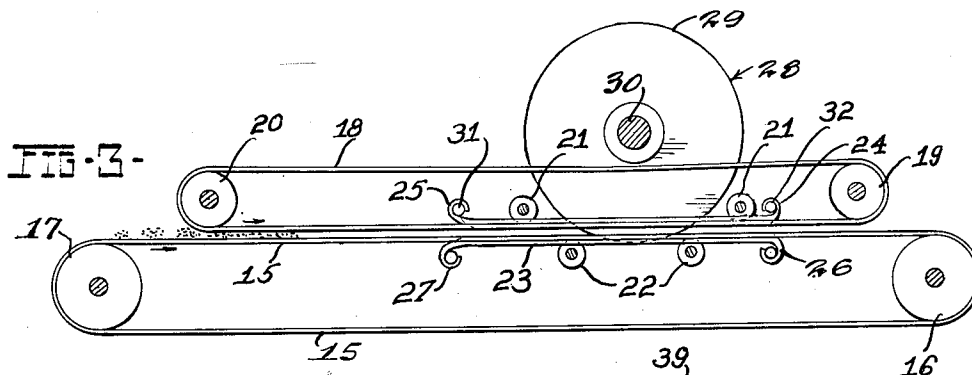
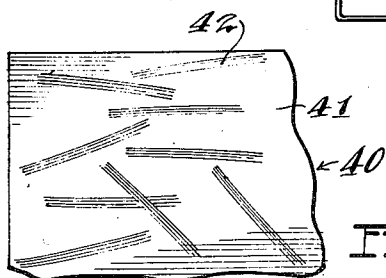


FIG-5-



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METHOD AND APPARATUS FOR THE PRODUCTION OF GLASS FIBER MATS

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7 Claims. (Cl. 19-155)

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This invention relates to fibrous mats and more particularly to the preparation of mats of glass fibers for heat and sound insulation, padding, resinous reinforcement and the like.

Fibrous mats and particularly glass fiber mats have been made by collecting a multiplicity of strands of limited length into a mat of haphazardly arranged, loosely associated strands. The term "strand" is intended to include both strands of untwisted fibers and single and piled yarns of intertwisted fibers. Some of the strands are opened or spread out into individual, haphazardly arranged fibers or smaller strands or bundles of fibers, but usually the mat is made up of a large proportion of substantially intact strands or yarns intermingled with the individual fibers. In some cases the presence of individual fibers may be almost completely eliminated, as by sizing the strands with a resin or other binding agent to prevent the separation of the strands into individual fibers during the mat making operation.

The first step in production of the mat is cutting or chopping masses of strands for dividing the strands up into shorter lengths, say average lengths of $\frac{1}{2}$ to 5 inches. The masses of short strands are then torn apart and rearranged into a web or mat of haphazardly arranged strands by passing the fibrous material through carding machines or other web making machines, for instance Garnetts.

Difficulties commonly experienced in the making of mats in this manner stem from the tendency of the strands to ball up and knot or intertangle to such an extent that the finished mat has areas where clumps of fibrous material are present so that the uniformity of the fiber distribution in the mat is impaired and the quality of the product greatly reduced.

It is the principal object of this invention to provide an improved glass fiber mat, and more particularly to provide a mat having a highly uniform distribution of fibers throughout the mat and that is substantially free of clumps and balls of intertangled or interknotted fibers and strands.

Another object is to provide an improved process for converting masses of fibers of great length into mats of haphazardly arranged fibers of substantially uniform, short lengths.

A further object is to produce a process and apparatus for preparing masses of glass fibers for subsequent processing by automatic or mechanical means to form a mat having the desired arrangement and distribution of fibers.

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Other objects and advantages of this invention will hereinafter appear, and for purposes of illustration but not of limitation, an embodiment of the invention is shown in the accompanying drawings, in which:

Figure 1 is a perspective view of a package of glass fibers as collected as strands on a winding drum;

Figure 2 is a perspective view of an opened package of glass fibers removed from the winding drum;

Figure 3 is a diagrammatic side elevational view of apparatus of the invention;

Figure 4 is a top plan view of the apparatus of Figure 3;

Figure 5 is a schematic diagram of a fabricating process for forming a mat of glass fibers; and

Figure 6 is an enlarged schematic plan view of a portion of the mat formed by the process of the invention.

Mats of the type referred to herein are commonly made from strands of glass fibers that have been wound on a drum or spool and have been cut off the spool and the annular package of strands flattened out to form a roughly rectangular body of fibrous material. The same general type of fibrous body results where yarns are cut from bobbins or the spools on which they have been wound except that in this latter case the fibers are all intertwisted into strands. The fibrous material from which the mats are produced may also contain or even be largely composed of weaving waste and spinning waste such as large masses of loosely wound or intertangled yarns or strands, or scraps of cloth.

In the present invention the strands are cut up into short lengths of from $\frac{1}{2}$ to 5 inches in such a way that substantially all of the strands in the mass are all approximately the same length.

The short lengths of strands are then distributed in suitable fashion upon a collecting surface in the form of a mat. The distribution is effected preferably in such a manner that the strands are all haphazardly arranged.

Referring now to the drawings, Figure 1 illustrates one of the packages in which a substantially continuous strand 10 of glass fibers is wound about a cylindrical drum 11 during the production of the fibers. The strand is composed of 100 to 200 fibers all arranged in parallelism and extending substantially continuously throughout the strand. When the wound glass strands 10 are cut through along a line extending generally parallel to the axis of the drum,

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the mass of glass fibers may be removed as a body from the drum. The mass may be opened up into a roughly rectangular pack 12 having a length corresponding to the circumference of the drum with the fibers 13 in the pack 12 extending lengthwise of the pack and in the same general direction in the pack. If a traverse mechanism is used in winding the strand on the drum, the fibers in the pack may extend at a slight angle relative to each other but will still extend in the same general direction, that is, lengthwise of the pack.

In accordance with this invention, the pack 12 of glass fibers may be placed on a feed table adapted to feed the pack into engagement with cutting mechanism. For this purpose, the feed table may consist of multiple parallelly arranged and laterally spaced apart endless belts 15. These belts operate about a pair of forward and rearward rollers 16 and 17 respectively, one of which is a driving roll for effecting the desired belt movement. In superposed relation are another series of endless belts 18 which operate between forward and rearward rolls 19 and 20 respectively, one of which is a driving member adapted to operate the belts in a direction so that the adjacent flights of belts 15 and 18 move together in the same direction as indicated by the arrows in Figure 3. The roller 20 is disposed forwardly of the roller 17 with the result that a portion of the belts 15 is available as a table on which the packs may be positioned before being gripped between the two sets of belts. The space between adjacent flights of the sets of belts is substantially less than the thickness of the packs so that the packs are tightly gripped between the flights. Idler rolls 21 and 22 are arranged to support the adjacent flights of the belts 15 and 18 against undue movement away from each other.

A series of elongate bars 23 are arranged in two rows in superposed relation, each row being in substantial parallelism with the respective flights of the belts 15 and 18 but with the forward and rearward end portions 24 and 25 of the upper row of bars turned upwardly into loops and portions 26 and 27 of the lower bars turned downwardly into loops, the bars of each row being located between the belts of each conveyor in the cutting zone, the belts of one conveyor being vertically aligned with the belts of the other conveyor. The bars are supported by suitable framework including supporting bars 31, 32.

Disposed intermediate the ends of the flights of the two sets of belts and with its axis of rotation above the flights is a gang saw 28. It consists of a series of cutting discs 29 arranged in spaced relation on a rotatable shaft 30 so as to project between and below the adjacent flights of the belts 15 and 18. These cutting discs may be saws with suitable cutting teeth, but preferably they are narrow blades of an abrasive material capable of effectively cutting ceramic materials, for instance, blades of Carborundum, emery, or the like, or may be diamond cutting wheels.

During the passage of the fiber pack 12 through the area between the belts 15 and 18, the cutting blades pass through the pack and subdivide the bundle into sections equivalent to the span between adjacent blades which, for the purposes described, are of a length greater than $\frac{1}{4}$ inch and preferably in the range of $\frac{1}{2}$ to 5 inches. The pack is fed with the fibers extending substantially perpendicularly of the cutting blades so that the lengths of fibers in the resulting subdivisions are of a length corresponding to the

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distance between blades. It is manifest that the distance between blades may be varied by their lateral adjustment on the shaft 30, or the packs may be fed at a predetermined angular relation with the blades so as to dispose greater lengths of fiber between cutting blades.

The subdivided groups of fibers are propelled forwardly in the grip of the belts 15 and 18 and are aided in their movement through the cutting zone by the oncoming fiber masses. The cut fibers are carried to a delivery unit. This delivery unit may be in the form of a metal chute, hopper, conveyor, or other means for holding the cut fibers or for transporting them to further processing stations.

In view of the uniformity of fiber lengths produced by this cutting process, a suitable fabricating unit may consist only of a single picker 33 and a Garnett machine 34. In a picker of the conventional "shredder" type, the pins 35 operate to break open the compact chunks 12a of strands and separate them into a flocculent body of rather high density. If it is desired to open substantially all of the fiber bundles, the fibers may be recycled a number of times with the result that a mass of lighter density is produced. But, if it is desired to produce a mat in which almost all or a large portion of the strands remain in their original form, that is, unseparated, or in incompletely separated form, one or two passages only will usually suffice.

From the picker, the fibers may be fed into the Garnett machine 34. This machine is in the form of a central drum 37 suitably clothed which draws the haphazardly arranged fibers between pins 38 on smaller rolls 39 of the Garnett. These pins move adjacent the surface of the drum in a direction opposite to the rotational movement of the drum to effect further separation and fluffing of the fibers and also comb the fibers so that they are haphazardly arranged but predominantly extend in the same general direction. The fibers prepared by the process described are substantially of uniform predetermined length. If they were otherwise, that is, of non-uniform length, such tangling would occur that additional units or machines may be necessary to separate and comb the fibers, with the result that the added combing might unnecessarily separate and align the fibers and thus detract from the desirable properties.

Thus the product from the Garnett is a web, sheet, or mat 40 composed of a mixture of fluffed or separated fibers 41 and fiber bundles 42 in haphazard arrangement, which fabric is especially suitable for padding or for reinforcing resinous material wherein increased strengths are desired in all directions.

It is to be understood that other methods of severing the packs or fiber bundles into smaller divisions may equally be used. For example, successive slices at predetermined intervals may be effected while the fiber bundles are positively moved in one direction at a predetermined rate. One such method comprises a guillotine method in which a vertically reciprocating cutting blade operates to sever portions of the fiber mass disposed thereunder. By regulation of the intervals of reciprocation, the forward movement of the fiber bundles or their angular disposition, the lengths produced can be readily determined. In this method, the fibers should extend generally in a direction perpendicular of the length of the cutting blade.

Manifestly, uniform lengths of shortened glass

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fibers are produced by this invention, and these fibers are adapted more efficiently and effectively to be used in the fabrication of a mat, sheet or preform by the mechanical and automatic means described; by the separation on a contoured foraminous member of the fibers which are entrained in a fluid medium by settling on a movable belt of the fibers from a cloud or suspension; or by other suitable means.

It is to be understood that other means of forwardly advancing the fibers may be used, and that numerous changes may be made in the details of construction and arrangement of parts without departing from the spirit of the invention, especially as specified in the following claims.

I claim:

1. Apparatus for subdividing bundles of glass fibers into uniform lengths comprising a pair of superposed conveyors each made up of a plurality of laterally spaced-apart parallel belts for engaging masses of glass fibers between adjacent flights of the conveyors and continuously advancing the fibers toward a cutting zone, means cooperating with said conveyors during the movement of the fibers through the cutting zone to hold the fibers against the cutting action including a pair of rows of bars with the rows in superposed relation and the bars of each row being located between the belts of each conveyor in the cutting zone, and severing means located between the belts of the conveyors for cutting the glass fibers during their advancing movement.

2. Apparatus for subdividing bundles of glass fibers as claimed in claim 1, in which the laterally spaced-apart belts of one conveyor are arranged vertically over the belts of the other conveyor, and the belts of the upper conveyor are of shorter length than the belts of the lower conveyor to provide an apron at the infeeding end of the conveyors upon which the bundles of fibers may be deposited.

3. Apparatus for subdividing glass fibers as claimed in claim 1, in which the severing means comprises a series of laterally spaced rotatable cutting discs having their axes of rotation generally perpendicular to the advancing movement of the fibers.

4. The process of making mats of interlaced glass fibers which comprises feeding through a cutting zone a mass of glass fibers in which the fibers are arranged in side-by-side relation in bundles with the bundles and fibers all extending in the same general direction in the mass, the direction of feed of the mass through the cutting zone being generally transverse of the length of the bundles of fibers in the mass, severing the mass in said zone into a plurality of shorter substantially uniform lengths and thereby cutting the bundles of fibers into shorter substantially uniform lengths, separating the said shorter masses into individual bundles, and arranging the separated bundles into haphazard relation in a mat.

5. The process of making mats of interlaced

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glass fibers which comprises feeding through a cutting zone a mass of glass fibers in which the fibers are arranged in side-by-side relation in bundles with the bundles and fibers all extending in the same general direction in the mass, the direction of feed of the mass through the cutting zone being generally transverse of the length of the bundles of fibers in the mass, severing the mass into a plurality of shorter substantially uniform lengths during its movement through the cutting zone, separating the said shorter masses into individual bundles, and arranging the separated bundles into haphazard relation in a mat.

6. The process of making mats of interlaced glass fibers which comprises feeding through a cutting zone a mass of glass fibers in which the fibers are arranged in side-by-side relation in bundles with the bundles and fibers all extending in the same general direction in the mass, the direction of feed of the mass through the cutting zone being generally transverse of the length of the bundles of fibers in the mass, severing the mass into a plurality of shorter substantially uniform lengths during its movement through the cutting zone, thereafter separating the said shorter masses into individual bundles and separating some of said separate bundles into individual fibers, and arranging the separated fibers and bundles into haphazard intermingled relation in a mat.

7. The process of making mats of interlaced glass fibers which comprises collecting into a compact mass strands of glass fibers in which the fibers are arranged in compact side-by-side relation in the strands providing bundles of fibers all extending in the same general direction in the mass, feeding said mass through a cutting zone with the direction of feed of the mass through the zone being generally transverse of the length of the bundles of fibers in the mass, severing the mass into a plurality of shorter substantially uniform lengths during its movement through the cutting zone, thereafter separating the said shorter masses into individual bundles, and arranging the separated bundles into haphazard relation in a mat.

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