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PROCESS AND DEVICE FOR THE MANUFACTURE OF FLEECES OF MINERAL FIBERS

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It is an object of the present invention to provide a process and device for manufacturing fleeces of mineral fibers, in particular of glass fibers, which have a high tenacity per unit weight, as well as fleeces obtained by said process and device.

The term "fleeces" is used herein to designate continuous webs having layers of filaments arranged partly longitudinally and partly non-longitudinally with respect to the axis of the web, wherein the filaments may be continuous or discontinuous, and are fixed with respect to one another by means of suitable adhesive.

Such webs, which are known in the art as fleeces (German "Vlies"), differ from common felts obtained from short fibers arranged at random.

There are several known processes and devices for obtaining fleeces of fibers, wherein the direction of the fibers is more or less at random and the fibers are generally discontinuous, and are of greater or smaller length. So, for instance, it is possible to extrude glass filaments from convenient spinnerets, to break off these filaments by means of a stream of hot gas, and to deposit upon a net or gauze or other device the short fibers so obtained. Or it is possible to produce glass filaments by spinning from a rod, namely by melting a certain number of glass rods at their ends, advancing these filaments on a drum or similar device, and then detaching them from the drum surface and depositing them on a tape, whereby said filaments become broken and lie on the tape at random.

There is no way in practice of controlling the orientation of the glass fibers, nor of arranging them in any determined desired way.

The present invention provides a process and device for manufacturing fleeces, to obtain different orientation of the filaments while controlling said orientations. It permits moreover obtaining a fleece comprising continuous filaments or discontinuous filaments but of considerable length. In any case, the strength of the fleece obtained is far higher than that of any fleeces known heretofore. As for the invention, it is of no consequence how the filaments are produced or formed, but commonly they are produced or formed just by spinning from rods. However the mention of a spinning method should not be construed as a limitation of the scope of the patent by any means.

The process according to the invention comprises advancing parallel glass filaments, howsoever produced, over a portion of a cylindrical surface, then disengaging them from that surface, and advancing them while causing them to converge, and then projecting them by effect of a stream of air in periodically variable directions upon a support where they become arranged in mutually crossing directions and mutually intermesh to constitute the fleece, and whence they are finally removed continuously in the shape of a fleece. Preferably the filaments are subdivided into two groups, one of which is arranged in a substantially longitudinal direction with respect to the axis of the fleece to be obtained, while the other one is placed in zigzag fashion with respect to said axis. In that way, the first group of filaments imparts considerable strength to the fleece in the longitudinal direction,

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while the filaments arranged in zigzag or transverse fashion, impart considerable transverse strength thereto.

The device according to the invention comprises a rotary drum or analogous element which receives and advances glass fibers generated by any convenient means, a shell enveloping a portion of said drum and defining therewith a narrow space through which said filaments travel, the rotation of the drum in juxtaposition to said shell generating a stream of air, an element that separates the filaments from said drum, a fixed conduit having a tapering cross-section to receive the filaments separated from the drum and adapted to cause the filaments to converge as they advance in this conduit, a pivotal conduit having a pendular movement and an open outlet, to direct the filaments in different directions, a tubular element arranged transversely and interposed in the path of the filaments issuing from the pivotal conduit to engage part of the filaments, a netlike stationary support to engage and retain the remaining filaments, and finally means to grip and draw the fleece formed by the intermeshing of the filaments engaged by said tubular element and said net-like support.

The invention will be more fully understood from the preferred embodiment to be now described, with reference to the accompanying drawings wherein:

FIG. 1 is a diagrammatic end view of this embodiment; and

FIG. 2 is a diagrammatic plan view thereof.

With reference to the drawing, numeral 10 indicates the filaments, shown in dotted lines. The filaments are engaged and advanced by a drum 11, which rotates in a semi-cylindrical shell 12 and mounted on a base 13. After having described an angle of about 180° around said cylinder, the filaments are separated therefrom by a stationary wedge or knife 14 at the outlet portion 27 of the shell 12 which directs them into a fixed conduit 15.

The fixed conduit 15 is tapered as can be seen in FIG. 2, so that the filaments advancing therein under the action of the stream of air produced by the drum 11 in its rotation converge toward one another. At the outlet end of the fixed conduit 15 there is mounted a short pivotal conduit 16 in the shape of a parallelepiped sleeve oscillatable around a pin 17 in an inclined plane (see FIG. 2), in such a way as to describe the same angle to the right and to the left of the axis 18 of the fleece 19. The means for producing the oscillation of the sleeve 16 is not illustrated but may be any conventional well-known means in the art.

The filaments 10 that pass from the conduit 15 to the sleeve 16 are thus projected from the latter by the stream of air generated by the drum 11 in varying directions depending on the instantaneous angular position of the sleeve 16. In the path of the filaments issuing from sleeve 16 there is interposed a tubular rod 20 normal to the axis 18. Beneath rod 20 there are arranged two nets or screens 21 placed close to each other in such a way as to leave a slit 22 therebetween.

Part of the filaments thus projected from sleeve 16 by the stream of air generated by the drum 11 are deposited directly on the nets or screens 21; and, since the sleeve is oscillating transversely with respect to the average direction of travel of the filaments, this causes the filaments to assume on the nets or screens a substantially transverse configuration. Some of the filaments impinge rod 20 and they ride thereon. The air leaving the sleeve 16 meshes the filaments deposited on the nets or screens and those filaments which straddle the rod 20, the latter nevertheless being long enough so that they have at least a part thereof meshing with the filaments deposited on the nets or screens 21; and other parts thereof projecting through the slit or gap 22. All those filaments which

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straddle the bar 20 or are deposited on the screens 21 have a comparatively great length, for instance 50 to 100 cm. average, and constitute a fleece 19, which, once introduced into the slit 22, is gripped by a take-up device which may conveniently comprise an endless conveyor belt 23 and a feed roller 24, pressed against the drive roller 25 supporting the belt 23 at one end thereof.

In operation, the drum 11 is rotated by conventional means, such as a motor and transmission (not shown) in the direction indicated by the arrow in FIG. 1 and at very high speed so that its peripheral speed will be in the order of 4000 meters per minute. Since its cylindrical surface rotates in close proximity to the semi-cylindrical shell 12, the skin or surface friction effect will generate a substantial stream of air to flow in the interspace between the periphery of the drum 11 and the shell 12. This stream is deviated by the stationary wedge 14 and flows into the tapered conduit, whence, due to the convergence of the side walls of this conduit, it is emitted at high speed through the pivoted conduit 16 to impinge onto the bar 20 and the upper and lower screens 21.

The filamentary material 10, which enters the interspace between the drum 11 and the inlet portion 26 of the shell 12 will be carried along with said stream; and the individual filaments, which, as above stated, are pretty long (such as from 50 to 100 centimeters), will be parallelized by the action of the drum, and will be projected from the pivoting conduit 16 onto the rod 20 and the screens 21. Such filaments are essentially oriented in the direction of the stream, and will impinge on said screens more or less perpendicular thereto.

It is evident that such light weight and pliable filaments will tend to lie on any surface on which they have impinged, and that they will be oriented randomly on the rod 20 and the screens 21, being pressed thereon by the stream of air. Such randomly arranged filaments will include a number of filaments which are nearly parallel to the rod 20, a number of which are nearly perpendicular thereto, which will be deposited astraddle the member 20, while the remaining filaments will form different angles with said member 20, and some of these latter filaments will lie diagonally astraddle thereof.

After a short time of operation, there will be formed on the rod 20 and screens 21 a soft layer or felt of randomly oriented filaments, in which the filaments superimpose and intercross with one another in mutually entangled relationship. This soft layer will extend both above and below the rod 20, and its lower end will span the slit 22. The width of this layer, which is a function of the angle of swing of the conduit 16 about its pivot 17, will determine the width of the fleece which is to be produced.

After a sufficient thickness of layer has been laid down, the operator manually feeds the lower end of the layer of filaments through the slit 22 and into the bite between the roll 24 and the conveyor 23 at the roll 25. The conveyor 23 thereupon will start drawing the layer through the slit 22. The drawing of the thus formed web is performed at a relatively low linear speed, such as 0.2 to 1.5 meters per minute; and the rate at which the filamentary material is fed in the apparatus and projected by the air stream onto the rod and the screens is so adjusted that a substantial amount of the filaments will be present at any given time on the rod 20 and screens 21 so that the layer of intercrossing and entangled filaments will be continuously formed, and will be coherent enough to be pulled through the slit 22 by the conveyor 23 in the bite between the roll 24 and the conveyor. Thus, the fleece is continuously formed, the filaments, which are oriented longitudinally in the direction 18 of movement of the conveyor being caught and drawn by their leading end portions onto the conveyor, while the transversely oriented filaments are carried on with these longitudinally oriented filaments, since they are entangled therewith and located between a number of overlying and underlying

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longitudinal filaments. Of course, proper operation of the apparatus requires that the feeding of the filaments onto the rod 20 and screens 21 be adjusted so that a substantial layer of randomly oriented filaments will always lie and be formed on the screens to insure drawing of the web of filaments through the slit 22.

It has been found that the presence of the rod 20 causes those filaments, which are not deposited directly on the nets or screens 21 but settle on the rod instead, to remain for a certain length of time on the rod and to be subjected to the action of the stream of air issuing from sleeve 16. The stream of air tends to comb these filaments and cause them to assume a direction substantially parallel to the average direction of travel of the filaments, that is, longitudinal with respect to the direction of axis 18. Instead the filaments that deposit on nets or screens 21 have pre- vailingly transverse direction owing to the pivotal movement of the sleeve 16, and come to bind in sideways the filaments placed longitudinally. As a consequence, the filaments are partly arranged in transverse direction and partly longitudinally, and transversely extending filaments mesh with one another, and a certain number of longitudinal filaments protrude through the slit or gap 22 to a point where they become engaged between the belt 23 and the roller 24 of the take-up device. These filaments are drawn by the traveling belt through the gap 22 and are advanced in the direction of the travel of belt 23, and the longitudinal filaments carry with them the transversely arranged filaments meshing with them to form a continuous mat or web 19 which is drawn through slit 22 and carried forward by belt 23. The fleece transported in the said manner by the roller 24 and belt 23, is then conveniently glued, and dried, to bond the various filaments, in the usual manner which need not be described herein.

The amplitude of the angle described by the sleeve 16 is related to the width of the fleece to be obtained, and is so calculated. It is evident, in particular from consideration of FIG. 2, that the filaments will be spread on the screens 21 over a width which is proportional to the amplitude of swing of the sleeve or conduit 16 about its pivot 17, and to the distance between said pivot and the surfaces on which the filaments are caused to impinge. As shown in FIG. 2, the width of the produced fleece 19 corresponds to the width of the part of the screens 21 on which the filaments have been spread by the swinging conduit 16. The frequency of the pendular movement of said sleeve is preferably of from 40 to 150 oscillations (complete oscillations) per minute; it determines the distribution of the filaments over the area described by the movement of the sleeve 16. The peripheral speed of the rollers 24, 25 determines (at equal peripheral speed of the cylinder 11) the weight of the fleece per surface unit (unit area). So if the cylinder 11 has a peripheral speed of the order of magnitude of 4000 meters per minute, the rollers 24, 25 may have a speed of 0.2 to 1.5 meters per minute. In any case the latter is always comparatively low. The position of the tubular rod 20 may vary. It may be in contact with the nets or screens 21, or have therefrom an even considerable distance for instance up to 400 mm. Also, it may be located as indicated in FIG. 1, on the extension of the middle plane of sleeve 16 or it may be above or below said plane, for instance, by up to a distance of 200 mm. above or below. These displacements of position of the rod 20 determine the ratio between the number of filaments which become arranged along the axis of the fleece, and the number of the filaments which become arranged transversely, whereby they determine the ratio between the longitudinal strength and the transverse strength of said fleece, under otherwise equal conditions.

An embodiment of the invention has been described but not by way of limitation; however it is apparent that the invention can be embodied in many adaptations and modifications by those skilled in the art.

We claim:

1. A process for manufacturing a fleece from glass or like mineral fibers comprising,
 - (a) advancing a plurality of filaments along a portion of a cylindrical surface by the action of a stream of air,
 - (b) separating said filaments from said surface after a predetermined advance therealong,
 - (c) continuing to advance said filaments after the separation thereof from said surface, while simultaneously drawing them closer to one another,
 - (d) then projecting the filaments in a periodically variable direction onto a support so that the filaments become arranged in mutually crossing directions and mutually intermesh, and
 - (e) continuously withdrawing the filaments as a fleece from said support.
2. A process as defined in claim 1 wherein in projecting the filaments, they are subdivided into two groups, the filaments of one group being projected onto said support in a direction longitudinal of the axis of the fleece to be obtained, and the filaments of the other group being projected onto said support in zigzag fashion with respect to said axis.
3. Apparatus for manufacturing fleece from mineral fibers of glass or the like comprising,
 - (a) means for producing a plurality of parallel glass filaments,
 - (b) a rotating drum for engaging and guiding said filaments along its peripheral surface as it rotates,
 - (c) a shell radially spaced from and enveloping a portion of said drum, to define therewith a narrow space through which the filaments travel,
 - (d) said drum being operative upon rotation thereof to generate a stream of air,
 - (e) a fixed guide member for separating said filaments from said drum after passage of said filaments through said space,
 - (f) a fixed conduit communicating at one end with said space adjacent said guide to receive said stream of air and the filaments separated from said drum,

- and having a tapering cross section thereby to draw said filaments closer to one another as they advance toward the opposite end of said conduit,
- (g) a movable conduit communicating at one end with said opposite end of said fixed conduit and having an outlet opening at its other end, said movable conduit being oscillatable to discharge said filaments in variable directions,
- (h) a net-like stationary support positioned in front of said movable conduit to receive some of the filaments discharged from said movable conduit,
- (i) an element positioned between said movable conduit and said support to engage others of said filaments, and
- (j) take-up means adjacent said support operative for gripping and drawing off from said element and from said support said filaments in intermeshed relation whereby the form the fleece.
4. Apparatus as defined in claim 3 wherein said stationary support comprises two screens positioned side by side but separated by a slit through which said fleece is adapted to be drawn by said take-up means.
5. Apparatus as defined in claim 3 wherein said take-up means comprises at least one rotatable take-up feed roller and having a peripheral speed corresponding to the weight per unit area desired in the fleece.
6. Apparatus as claimed in claim 3 wherein said movable conduit is operative to cause a corresponding increase or decrease in the width of the fleece produced on said support upon an increase or decrease, respectively, in the total pivotal displacement in operation of said movable conduit.

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