United States Patent [19]

Schuller et al.

[11] **3,766,003**

[45] **Oct. 16, 1973**

[54] **PROCESS FOR MANUFACTURING ENDLESS FIBER WEBS FROM INORGANIC FIBER SUSPENSIONS**

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[73] Assignees: **Werner Hugo; Wilhelm Schuller,** Munich-Grunwald, Germany

[22] Filed: **Mar. 2, 1972**

[21] Appl. No.: **231,341**

[30] **Foreign Application Priority Data**

Mar. 5, 1971 Germany ..... P 21 10 599.7

[52] **U.S. Cl.** ..... **162/156,** 65/2, 65/11 W

[51] **Int. Cl.** **C03b 37/02,** D21h 5/18

[58] **Field of Search** ..... 65/1, 2, 3, 11 W; 162/156

[56] **References Cited**

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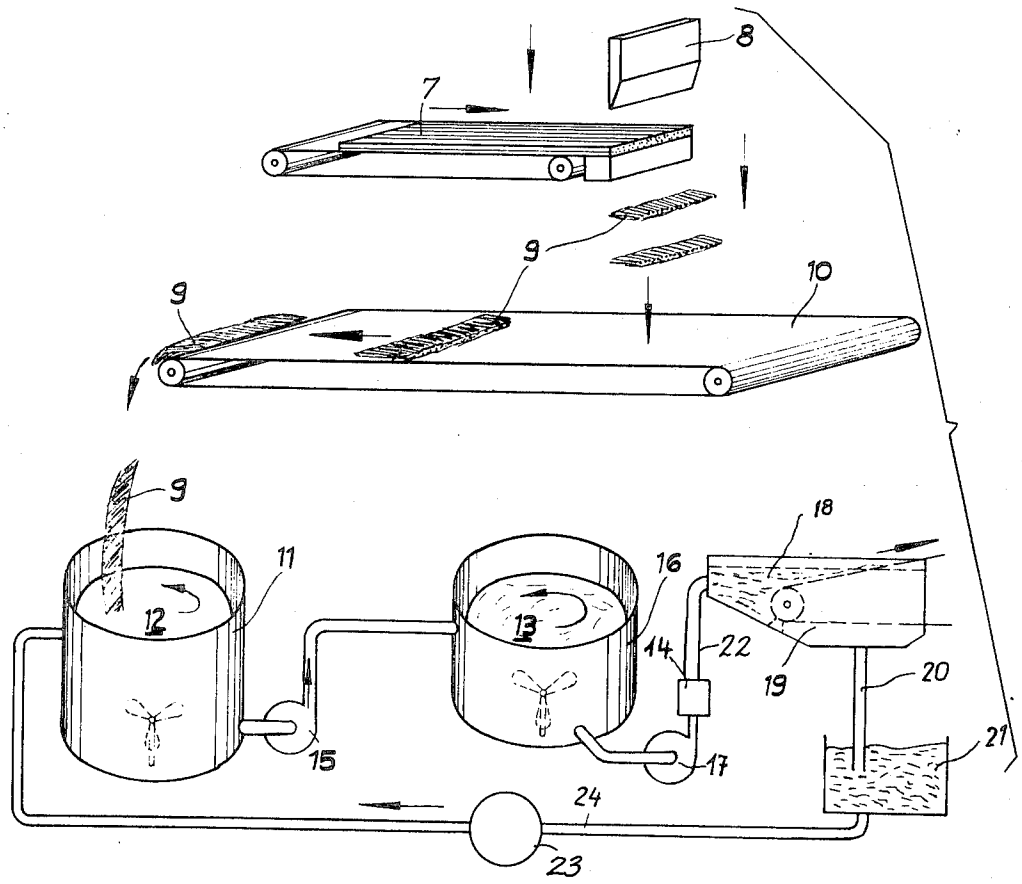
Primary Examiner—Robert L. Lindsay, Jr.
Attorney—Michael S. Striker

[57] **ABSTRACT**

In the process of manufacturing flat fibrous structures from suspensions of fibers by depositing a suspension of such fibers onto a moving permeable surface such as an endless sieve or belt wherein the fibrous suspension has been prepared from fibrous structures formed of a plurality of fibers which have been obtained by drawing a flowing glass melt, followed by chopping of the drawn fibers to form the fiber structures of predetermined length, the improvement in accordance with the invention of preparing the fiber suspension from fiber structures obtained by directing jets of liquid onto the glass fibers drawn from the glass melt and which are being wound onto the periphery of a rotating drum in a parallel arrangement and which after a certain layer thickness thereof has been obtained are cut to a predetermined length with the fibers still being in the moistened state.

6 Claims, 4 Drawing Figures



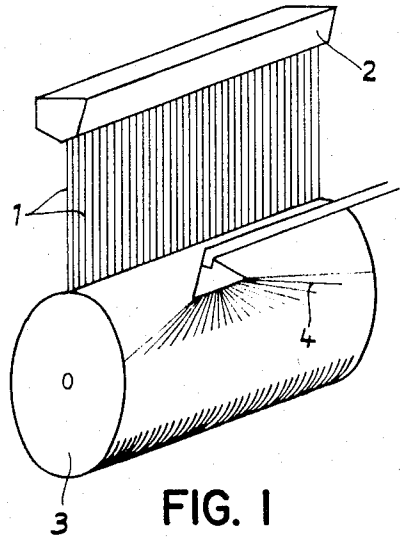


FIG. 1

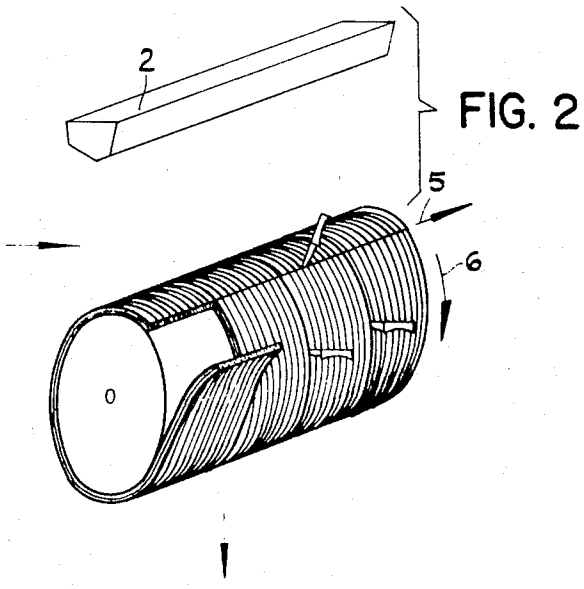


FIG. 2

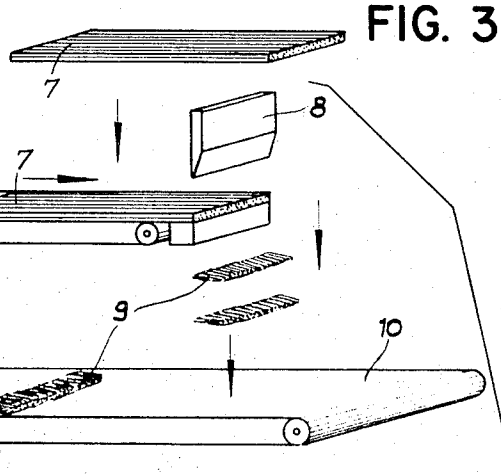


FIG. 3

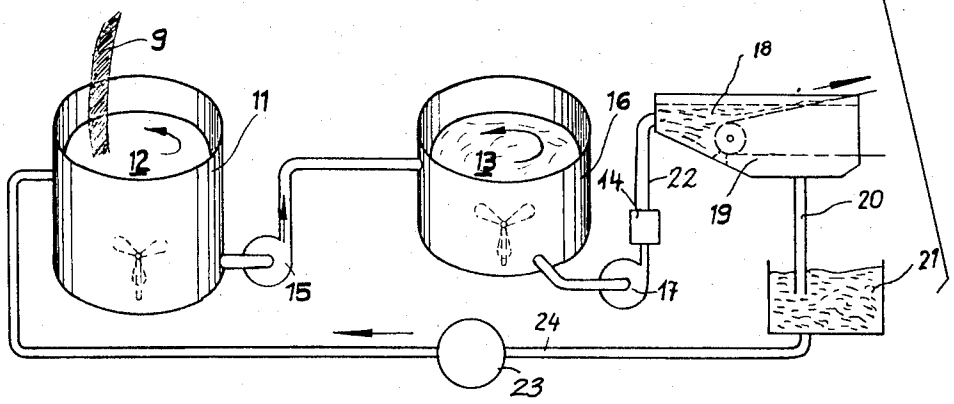


FIG. 4

PROCESS FOR MANUFACTURING ENDLESS FIBER WEBS FROM INORGANIC FIBER SUSPENSIONS

This invention relates to a process for preparing endless fibrous webs from suspensions of inorganic fibers and more particularly relates to an improved process of preparing fibrous suspensions for use in the making of endless fibrous webs.

It is known that flat fibrous structures can be manufactured by the procedures utilized in the manufacture of paper and in particular by the so called wet process. The fibers are for this purpose possibly in admixture with a binding agent, suspended in water to form the fiber suspension. The fiber suspension is required to be entirely uniform in nature as the quality of the resultant fibrous structure or web is directly determined by the degree of uniformity, i.e., homogeneity of the suspension. It is accordingly necessary that the starting fiber material be dispersed in the water so that there is obtained a suspension of the individual single fibers. The resultant fiber suspension is then delivered onto a moving perforated belt on which it is deposited out in a uniform form. The thusly obtained layer of fibers is then withdrawn while still moist and further worked up to form a coherent felted fiber web.

Recently it has been observed that this technique which has been associated with cellulosic and other natural fiber materials can be satisfactorily adapted for use with glass fibers. As is known, as raw fiber starting material, there are used bundles of fibres chopped up to form staple. The requirement that the bundles of fibers thereafter be decomposed into the individual fibers has posed great difficulties in connection with the use of inorganic materials such as glass fibers.

In the manufacture of glass cords or ropes there is in the known manner provided a plurality of individual fibers of endless length but without any rotation or twist having been imparted thereto so as to provide a substantially parallel arrangement of closely associated fibers joined so as to form the unitary cord or rope. In order to ensure that the single untwisted fibers are sufficiently adhered one to the other as to impart to the resultant cord or rope a resistance to abrasion as required by the later working, the fibers in the process of their manufacture have been adhered one to the other by means of a binding agent. The fibers are thusly combined one with the other to form the unified structure and this structure is thereafter chopped up to form staple consisting of the same units each of substantially equal length. However, these units are thereafter only with considerable difficulty separated into the single or individual fibers as is required in connection with the production of the satisfactory webs.

In order to avoid the above difficulties, it has been proposed that the binding agent be reduced in amount to a minimum, i.e., that in order to improve the decomposition of the bundle of fibers forming the staple into the single and individual fibers in the suspension medium, such as water, the binding agent has been considerably reduced in amount. The result has been that in the chopping process considerable and unsatisfactory dust is evolved and more important a preliminary splitting up of the bundle into the individual fibers takes place which in no way enhances the distribution of the fibres in the suspending medium but which rather only results in that the fibers before their introduction into the suspending medium becomes entangled and are

thereafter disentangled only with great difficulty, if at all.

The poor decomposition of the fiber bundles into the single fibers has the disadvantageous effect that it results in the formation of specks or spots. This speck formation and spotting not only gives rise to a non-uniform fiber suspension but also produces an impaired final product. In order to avoid the speck formation or for extensively reducing the same, a number of precautionary measures have been proposed. Such measures include regulating the length of the staple so as to be as low as possible, for example, a maximum length of 6 mm has been proposed and in addition to employ in the fiber suspension an additional agent serving to segregate the speck or spot forming material. Still further, it has been proposed that to obtain a better and more uniform distribution of the individual fibers in the suspension agent, there be employed certain additives, such as for example, wetting agents. The disadvantage of such additives includes not only the increased costs for the additives but for the increased working time and equipment required in order to achieve the same operating capacity as when no additives are present. Still further, the use of additives such as the wetting agent has the disadvantage that the same brings about a formation of foam which result in the production of finished webs chracterized as defective by virtue of included flaws and by a cloudy or hazy appearance. The quality of the finished web is particularly so adversely affected, when the webs are very thin in nature, i.e., have a surface weight of about 45–55 g/m².

Further the webs prepared on the basis of short length staples, i.e., about 6 mm are characterized as noted above by their lack of uniformity, impaired strength resistance and also by optically negative effects. When glass fiber webs having a non-uniform fiber distribution are used, for example, as surfacing felts in the synthetics industry, for example as insulating and decorating plates or as so-called painting felts, there results that in the non-uniform areas of the web there is an uneven porosity resulting in an unequal uptake of the dye, paint or other coating material applied thereon, so that the final finished product presents an uneven appearance characterized by so-called disturbing spots.

In addition to the use of glass fiber bundles or bundles of glass fiber rovings, it has been proposed to use so-called fiber ribbons or tapes. The ribbons or tapes are prior to suspension in the suspension medium cut up to staple length and in this form introduced into the suspension medium. It was believed by the art that the staple segments formed from the glass fiber ribbon or tape and which contain no binding agent would be decomposed and distributed in the water or like suspension medium in the form of the desired single fibers more readily than were the bundles of glass fibers as previously described.

This has however not been the case. All of the deficiencies and defects associated with the use of bundles of fibers containing the decreased amount of binder are encountered when using the fiber ribbon or tape staple. The disadvantages are already evident in the chopping process in that different lengths of fiber have been used in the production of the ribbon or tape, the chopping forther contributing to the unevenness in resultant fiber length. Further the fibers in the ribbon are not parallelly arranged with respect to each other and are fur-

ther entangled in the chopping or cutting process. The entanglement is so marked that the necessary separation into the individual fibers in the suspension medium is no longer possible. As a result, a strong flock formation takes place which is manifested in the finished product as an optically disturbing flaw or defect and in untenable variations in the surface weight, strength, porosity, etc. of the finished web.

It is an object of the invention to provide a method for economically and simply producing fibrous webs characterized by their uniformity in surface weight, strength and porosity throughout.

It is another object of the invention to provide a process for producing uniform fiber suspension for use in the preparation of such endless webs.

Still another object of the invention is to provide a process for producing uniform and homogeneous suspensions of glass fibers making possible endless fibrous webs and felts characterized by the uniformity of the fiber distribution therein.

These and other objects and advantages of the invention will be apparent from the following description including the drawing forming a part thereof and which diagrammatically illustrates the process of the invention.

In accordance with the invention it has now been found that substantially uniform and homogeneous suspensions of glass fibers in a suspension medium intended for use in the production of endless fiber webs can be obtained if the individual units each composed of a plurality of glass fibers of uniform length are introduced into the suspension medium in a moistened state, wherein the moistness has been imparted to the fiber units in the process of their manufacture and namely between the drawing of the glass melt into endless fibers and the chopping thereof into staple.

The choice of the agent serving for moistening the drawn glass fibers is from amoung the materials known to the art in connection with the manufacture of fiber cords and ropes and includes those liquids used for instance as finishes or lubricants. The particular material selected depends on the choice of the material employed as suspension medium. If the latter is water, then for the moistening, water or a liquid soluble in water can be used.

In accordance with the invention there is now provided a process for manufacturing flat fiber structures from fiber suspensions by deposition of such suspensions on a moving permeable surface for instance an endless sieve or belt, wherein the fiber suspension is obtained by introducing unitary fiber structures each composed of a plurality of parallelly arranged fine glass fibers prepared by drawing a glass melt and while winding such fibers in a parallel arrangement onto the periphery of a known type of rotating drum, spraying the same with jets of a liquid material, the winding being continued util a certain layer thickness has been reached. Thereafter the movement of the drum is interrupted and the layers are cut through while still in the moistened state to form the units composed of the adhering parallelly arranged fibers all having substantially the same predetermined length.

These units composed of the moistened fibers are then introduced into the suspension medium with the result that the units of the adhering fibers undergo rapid and complete decomposition and are substantially completely uniformly distributed as individual fibers in the suspension liquid. The parallel arrangement of the fibers, absence of any binder and the assistance of the moistening agent all contribute to the rapid decomposition of the structure of the fiber units or bundles.

The distribution of the fibers in the suspension medium can be even further improved upon if there is added to the fiber suspension any of the known wetting agents. In accordance with a particularly preferred embodiment of the invention the wetting agent can be incorporated into the liquid, for instance water used for spraying the fibers as they are being wound onto the drum. This has the advantage that the wetting agent is incorporated directly as a part of process of producing the fibers. Under the conditions of the just-mentioned embodiment, the decomposition of the fiber bundles into their component single fibers is considerably enhanced, this being the case even where the fibers have undergone a considerable drying out of the moisture on the surfaces thereof.

The process of the invention will be further illustrated by reference to the accompanying drawing which is a flow sheet representing the sequence of operations that are required to produce the continuous webs of glass strands that are referred to herein.

In FIG. 1 the molten glass is drawn in the form of strands onto a rotating drum while a stream of liquid is applied to the drum.

In FIG. 2 the plurality of successive drawn and spooled layers of parallel glass strands are cut into units and peeled from the rotating drum.

In FIG. 3 the peeled unit is flattened.

In FIG. 4 the flattened unit is chopped into smaller units composed of strands of shorter lengths, which are then placed into a liquid where the unit is broken up into individual short strands and are then passed along in the form of a suspension in a liquid through various conduits and vessels to a webforming machine.

As can be seen from the drawing, the process is carried out by forming in the conventional manner a plurality of single fibers by extrusion of a flowing glass melt using therefor a plate provided with a plurality of nozzles. The glass is delivered from a tank or source 2 containing the molten glass and the fibers thus formed applied onto a rapidly rotating drum 3 so that they are wound in a parallel arrangement onto the periphery of the drum. An intensive and thorough moistening of all of the individual fibers is carried out in accordance with the invention by spraying over the entire drum surface a liquid stream, for example water, using therefor a fan-shaped spray device 4. There is thusly simultaneously obtained a good adhesion of the first fiber layer on the drum surface and moistening of all of the applied fibers.

The intense moistening of the individual fibers acts also to further ensure the cohesion of the fibers to each other under maintenance of the parallel arrangement. After a certain layer thickness has been reached, the movement of the drum is halted and the layers of fiber cut through along the longitudinal direction 5 of the drum. The cut layers of fibers are then separated off from the drum surface. Advantageously the layers can also be cut in the direction 6 of the drum circumference. This latter cutting serves to form smaller packets or bundles 7 of the moist fibers.

It has been established by testing that the average moisture content of the fiber material present on the

drum surface amounts to about 17 percent which in the time elapsed from their manufacture to the chopping is reduced to about 12–15 percent.

A too marked decrease in the moisture content can be avoided by taking appropriate measures self evident to the artisan.

It has been found to be particularly advantageous if the moist fiber packets are delivered immediately following their formation into a chopping apparatus 8 wherein the same are chopped up into fiber structures 9 preferably having a length of between 10 and 30 mm. Another advantage of the process of the invention and in particular stemming from the use of the moistened glass fibers results therefrom that the brittleness of the fiber which is manifested in their dry state and which for instance in the conveying of the fibers leads to breakage and entanglements is considerably lessened in accordance with the invention as is the disadvantage of dust evolvement.

The still moist parallel fiber structures 9 are then continuously conveyed for instance by means of a conveying belt 10 the movement of which is preferably controlled by an intermediately arranged apportioning apparatus provided for feeding the fiber structures at regularly spaced distances, into a mixing tank 11 and therein admixed with the suspension medium which preferably is water.

The condition of the fibers in the packet, that is, the existing cohesion of the fibers in the structure by virtue of the moistening agent particularly in the case where the same agent also serves as the suspension medium and also where the moistening agent is soluble in such suspension medium results in that there is quickly and completely brought about a destruction of the cohesive bonds between the fibers and the same are separated one from the other.

The separation is a very extensive one resulting in a uniform distribution of fibers in the suspension medium. The mixture of fibers and suspension medium is then fed from the mixing tank 11 by means of a pump 15 into the working tank 16 and from there by means of a pump 17, possibly via an intermediately installed beater 14 of the known construction, discharged into the conduit 22 of the circulating suspension medium and while still in this highly dilute form introduced into the material take-off tank 18. Following separation of the liquid suspension medium from the fibers in chamber 19, the suspension medium is delivered over a conduit 20 after passing through a conventional filter apparatus into a storage container 21. By means of pump 23 the circulating suspension medium is thereafter recycled via conduit 24 into the mixing tank 11 where it is reused for suspending additional fibrous material. The suspension of fibers still present in the take-off tank 18 is then applied onto the moving perforated belt for forming the web.

It is also possible in accordance with the invention in the case of particularly difficulty suspendable glass fibers to continuously circulate the suspension agent 12 from the mixing tank 11 through the working tank 16 and the material take off 18 back into the mixing tank 11 whereby if necessary there can be installed further mixing and working tanks. In this way, instead of directly delivering the material to the storage or take off tank, a further working tank and mixing tank are installed prior to the take-off tank and adequate and uniform distribution of the fibers in the suspension medium thereby assured. It is to be understood that there can be used in the working tank the conventional stirring apparatus for ensuring the best possible decomposition of the fiber packets and distribution of the individual fibers.

We claim:

1. A process of producing a continuous web of individual short glass strands which comprises drawing onto the outer surface of a rotating drum a single layer consisting of a plurality of parallel strands of molten glass from a feeder provided with a plurality of orifices, spooling the said drawn glass strands in successive layers upon the said rotating drum while continuously applying a liquid to the said outer surface of the said drum and to the layers of parallel glass strands as they are being spooled upon the said rotating drum and, after a preselected number of layers of parallel wet glass strands have been spooled upon the said rotating drum, cutting through the said plurality of layers along a line transverse to the parallel strands and peeling the said plurality of layers as a unit of cohering wet glass strands from the said rotating drum, subsequently chopping the said unit of wet coherent parallel glass strands into units of shorter strands having a preselected length along lines transverse to the parallel strands, distributing the thus-chopped units of wet cohering parallel glass strands into a liquid to form a flowable suspension of individual short glass strands in the liquid, and depositing the said flowable suspension of individual glass strands upon a moving continuous screen that is permeable to the liquid on which the short glass strands are retained as a continuous web.

2. A process as defined in claim 1 in which the liquid that is continuously applied to the outer surface of the rotating drum is water.

3. A process as defined in claim 2 in which the liquid into which the cut glass strands are distributed to form a flowable suspension is water.

4. A process as defined in claim 1 in which the liquid that is continuously applied to the outer surface of the rotating drum contains a wetting agent.

5. A process as defined in claim 1 in which the liquid that is continuously applied to the outer surface of the rotating drum is the same as that into which the cut glass strands are subsequently distributed to form the flowable suspension.

6. A process as defined in claim 1 in which the unit consisting of successive layers of parallel glass strands that was peeled from the rotating drum is chopped at such intervals as to produce a unit consisting of successive layers of shorter strands having a length between 10 and 30 millimeters.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,766,003 Dated October 16, 1973

Inventor(s) Wolfgang Schuller et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

The correct name of the assignee should read -- Werner Hugo Wilhelm Schuller --.

Signed and sealed this 3rd day of December 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
U.S. GOVERNMENT PRINTING OFFICE : 869-930