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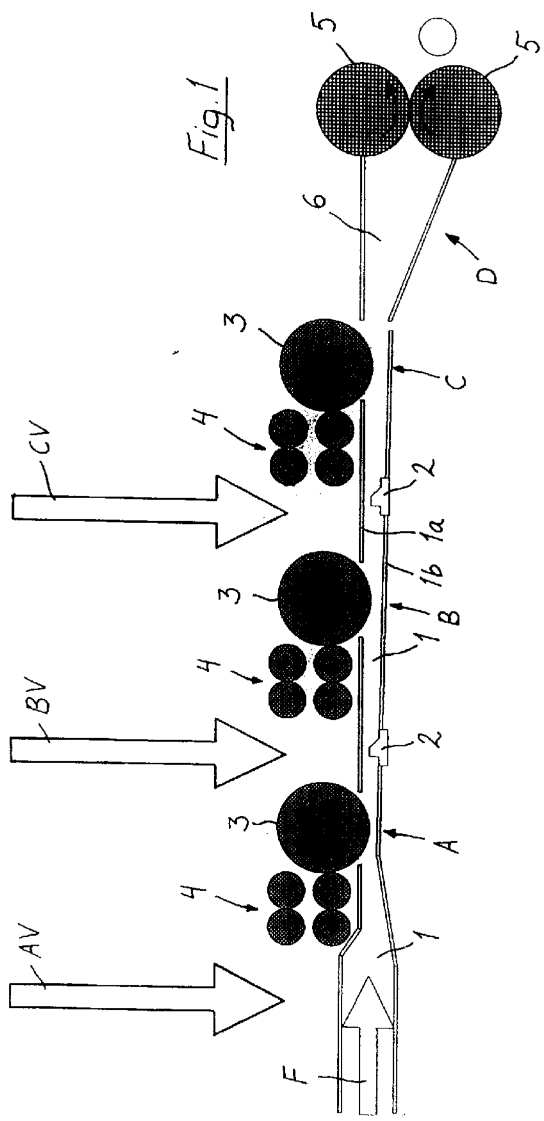
(54) **Method and apparatus for formation of a mat containing different fibre types.**

(57) In a method for formation of a mat containing different fibre types, a mixture of different fibre types is deposited by an air flow to form a mat. Fibres are fed at two or more successive feeding points (A, B) to the same air flow (F). Turbulence is generated in the air flow for mixing the fibres together uniformly, and the air flow (F) is conveyed to a mat formation point (D).



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The invention relates to the method presented in the ingress of the appended claim 1 for formation of a mat containing different fibre types, as well as to the apparatus presented in the ingress of the appended claim 5 for formation of a mat containing different fibre types.

In the manufacture of mats from staple fibres, it is often necessary to form a mat from a fibre mixture containing two or more fibre types in order to provide the mat e.g. with optimal physical properties. In this case, different fibre types denote either fibres of the same material with various lengths or sizes, or fibres of different materials, for example mineral fibres, glass fibres and synthetic fibres, which can be of some polymer, such as polyethylene, polypropylene or polyester.

A mat of this kind is usually formed in such a way that the staple fibre bales used as raw material are broken down and the fibres are "opened" in a special opening unit to make them as well separated as possible and to prevent the formation of fibre bundles. The fibres are generally mixed to each other during an opening process of this kind. A method is also used in which the fibres are mixed to each other before the opening or in a carding process after the opening. All these methods have the disadvantage that the fibres are not mixed evenly to each other and the finished mat product is not homogeneous. At the process stages before formation of the fibres by means of an air flow onto a suitable support to form a mat, the fibres tend to remain in bundles or form bundles with fibres that are of a type most similar to them. Also the density values of the fibres have influence on their settling at the stage of formation of the mat. This is particularly problematic in the case of stiff fibres, such as mineral and glass fibres.

It is an aim of the invention to present a method for overcoming the difficulties mentioned above and for mixing two or more fibre types for manufacturing of a homogeneous mat product. To attain this aim, the method according to the invention is primarily characterized by the disclosure in the characterizing part of the appended claim 1. By supplying the different types of fibre one after the other in the same air flow having a sufficient turbulence, it is possible to mix the fibres well to each other and no mixing is needed at a preliminary stage.

In addition, some advantageous embodiments of the method according to the invention are presented in the appended dependent claims 2 to 4.

It is an aim of the invention also to present an apparatus using the method mentioned above. This apparatus is characterized in the disclosure in the characterizing part of the appended claim 5. The apparatus comprises an air duct which has two or more fibre feeding openings disposed one after another in the direction of air flow and is equiped with means for generating a sufficient turbulence.

Some advantageous embodiments of the apparatus are also presented in the appended dependent claims 6 to 10.

In the following, the invention is described in more detail by reference to the appended drawing, in which

Fig. 1 shows a side view of the apparatus according to the invention, and

Fig. 2 shows two successive fibre feeding points of the apparatus in a larger scale.

Fig. 1 shows an apparatus for formation of a mat from staple fibres. The said apparatus can be used for formation of non-woven mats from staple fibres with various weights per square meter. The raw material used consists of staple fibres, which term in this case denotes fibres which are sufficiently short to be carried by an air flow.

The apparatus comprises a long air duct 1 with a closed cross-section, into which an air flow F is led from its one end. At the opposite end, the air duct opens into a mat formation point D, which will be described in more detail hereinafter. In the longitudinal direction of the air duct, there are three separate fibre feeding points in succession, i.e. the feeding points A, B and C.

The feeding of the fibres is performed by feeding through each feeding point a fibre type of its own to the air flow F. After this, a sufficient turbulence is generated in the air flow, effecting the mixing of the fibres fed at the next feeding point after the feeding point to the fibres conveyed by the air flow and fed at the previous feeding point. Although three feeding points are shown in the appended drawing, there can be also more than three or only two feeding points, according to the number of fibre types to be mixed.

At two successive feeding points in a long air duct, the fibre-mixing turbulence can be generated by means placed after the first feeding point and sufficiently close to the second feeding point, by shaping the second feeding point suitably, or by special means placed after the second feeding point.

In the example shown in Fig. 1, a suitable volume of mineral fibres may be fed to the feeding point A, a suitable volume of glass fibres to the next feeding point B, and a suitable volume of synthetic fibres to the next feeding point C. The input volumes are shown in the figure schematically by the arrows AV, BV, and CV. These input volumes can be used to regulate the percentage of different fibre types in the finished product, and the total input volume can be used to regulate the weight per square meter of the finished product.

The fibres are fed advantageously in a succession consisting of feeding the stiffer fibres to the air flow F before the more flexible fibres. For example in the case shown in Fig. 1, the mineral and glass fibres, which are stiffer, are fed to the air duct before the synthetic fibres, which are flexible and more easily entangled together. There is thus no bundling of synthetic fibres, but each synthetic fibre is surrounded by previously fed mineral and/or glass fibres, whereby a homogeneous air/fibre mixture is obtained. In addition, the stiffer mineral and glass fibres are easily opened in the air duct by strong turbulence, thus contributing to the homogeneity of the final product.

At the distal end of the air duct 1, there is the mat formation point or zone D. The mat formation point is equipped with a diffuser 6 with an expanding cross-section, as seen in the direction of the flow, the air duct 1 ending at the narrower proximal end of said diffuser. The speed of the well-mixed fibres coming from the air duct is slowed down at this point or area D, and the fibres are allowed to be deposited at the distal end of the diffuser 6 on a support, through which the air flow is conducted. At the distal end of the diffuser 6 shown in Fig. 1, are located two opposite cylinders with air-permeable surfaces, i.e. air screens 5, on the surfaces of which the fibres are deposited. As the cylindical screens rotate in opposite directions, the finished mat exits from therebetween and is transferred for further processing. The air screens can, naturally, be replaced by other formation means, such as by an air-permeable conveyor belt.

The term point or zone of mat formation is used here to denote all members, which receive fibres conveyed by an air flow and form a mat on a support. This mat is not necessarily the final product but it can also be an intermediate product to enter further processing; for example, it can be disintegrated again by means of an air flow and re-deposited to form a mat, e.g. by a method presented in Finnish Patent Application No. 880755 by the same applicant.

A sufficient turbulence for mixing the fibres in the air duct 1 is generated by means 2 throttling the cross-sectional area of the air duct, situated in the apparatus shown in Fig. 1 at each section between two successive feeding points, i.e. the first one between the feeding points A and B and the second one between the feeding points B and C. It should further be noted that turbulence is generated also before the first feeding point A by a reduction in the cross-sectional area of the air duct which is larger in the beginning, or at the feeding point itself, as will be described hereinafter.

Fig. 2 shows two successive feeding points A and B and the throttling means 2 therebetween in a larger scale. At the fibre feeding point, there is a roll 3 provided for rotation and equipped with spikes or Similar projections 3a, the circumferential surface of the roll being connected to the inner part of the duct 1 through an opening in the upper wall 1a of the duct, so that a part of the circumferential surface of the roll 3 penetrates at one point into the duct 1. The direction of rotation of the circumferential surface at the point of the opening is equal to the direction of the air flow F. The fibres are thus fed by the spikes of the roll 3 into the opening, at which point they are carried away by the air flowing in the duct. Also at this point, it is possible to generate turbulence in the air flow F due to the fact that the roll 3 extending at the point of the opening to the inner part of the duct reduces the cross-sectional area of the duct. A slight turbulence is thus generated at the last feeding point C right before the diffuser 6. This turbulence is fully sufficient for the flexible fibres to be fed at this point, and there is no reason to use any means generating turbulence after this point.

Fig. 1 shows also the feeding roll arrangement 4 next to the roll 3, with opposite rolls feeding the fibres towards the surface of the roll 3 at a point which in the direction of rotation of the roll is located before the point connected to the duct 1. In other words, the feeding roll arrangement 4 is disposed upstream of, and adjacent to said roll 3.

Fig. 2 shows also the structure of the throttling means. The throttling means are situated in the lower wall 1b of the air duct 1, and they comprise a projection extending to the centre of the duct. The face of the projection facing the air flow is at a sufficiently steep angle to the air flow for generating the desired turbulence. The throttling means 2 are arranged to be movable in a direction transverse to the longitudinal direction of the duct for changing the cross-sectional area of the duct and, consequently, for changing the turbulence. Furthermore, the face of the throttling means facing the air flow induces a pressure impact on the stiff fibres, thus opening the fibres better.

Particularly after the two successive points A, B at which stiff fibres (such as mineral and glass fibres) are fed, it is advantageous to use this kind of a separate throttling means securing a sufficient turbulence for mixing together the stiff fibres fed at these feeding points.

The air duct can be formed to a duct with a closed cross section and a width corresponding to the width of the mat to be manufactured. The upper wall 1a of the air duct is in this case equipped with openings for the rolls 3 at the feeding points, and the opposite lower wall 1b is equipped with points for the throttling means 2 extending over the width of the duct.

The air flow F can be generated by known methods, and its speed can be e.g. 30 to 100 m/s at the point of the rolls 3, but always greater than the surface speed of the roll. The speed of rotation of the rolls can be such that the surface speed exceeds 30 m/s.

Claims

1. Method for formation of a mat containing different fibre types, in which method a mixture containing different fibre types is deposited by means of an air flow to form a mat, characterized in that fibres are fed at two or more successive feeding points (A, B) into the same air flow (F), turbulence is generated in the air flow for mixing the fibres together uniformly, and the air flow (F) is conveyed to the mat formation point (D).

2. Method according to claim 1, characterized in that for generating turbulence, the fibre containing air flow (F) is throttled after each one of at least the first two successive feeding points (A, B).

3. Method according to claim 1 or 2, characterized in that the stiffer fibres are fed before the more flexible fibres into the air flow (F).

4. Method according to one of the claims 1 to 3, characterized in that the fibres are fed into the air flow (F) by a roll (3) comprising spikes or similar projections (3a).

5. Apparatus for forming a mat containing different fibre types, which apparatus comprises an air duct (1) and means connected thereto for depositing the mixture, which exits the duct and contains different fibre types, to form a mat, characterized in that two or more fibre feeding points (A, B) open into the same air duct (1) one after the other in the direction of air flow, and that the duct (1) comprises means (2, 3) for generating a turbulence required for mixing the fibres uniformly.

6. Apparatus according to claim 5, characterized in that means (2, 3) for generating a turbulence are means throttling the air flow in the duct (1) and situated after at least one fibre feeding point (A, B).

7. Apparatus according to claim 6, characterized in that the means (2, 3) throttling the air flow in the duct are situated after each one of at least the first two successive feeding points (A, B) and constitute means that are separate from the fibre feeding point.

8. Apparatus according to claim 7, characterized in that the throttling means (2) are arranged to be movable in a direction transverse to the longitudinal direction of the duct for changing the cross-sectional area of the duct for adjusting the turbulence.

9. Apparatus according to one of the claims 5 to 8 above, characterized in that a roll (3) provided for rotation is disposed at the fibre feeding point (A), said roll comprising spikes (3a) or similar projections, a part of the circumferential surface of the roll penetrating at one point into the duct (1).

10. Apparatus according to claim 9, characterized in that a feeding roll arrangement (4) for feeding fibres to the roll (3) penetrating into duct (1), is disposed upstream of and adjacent to said roll (3).

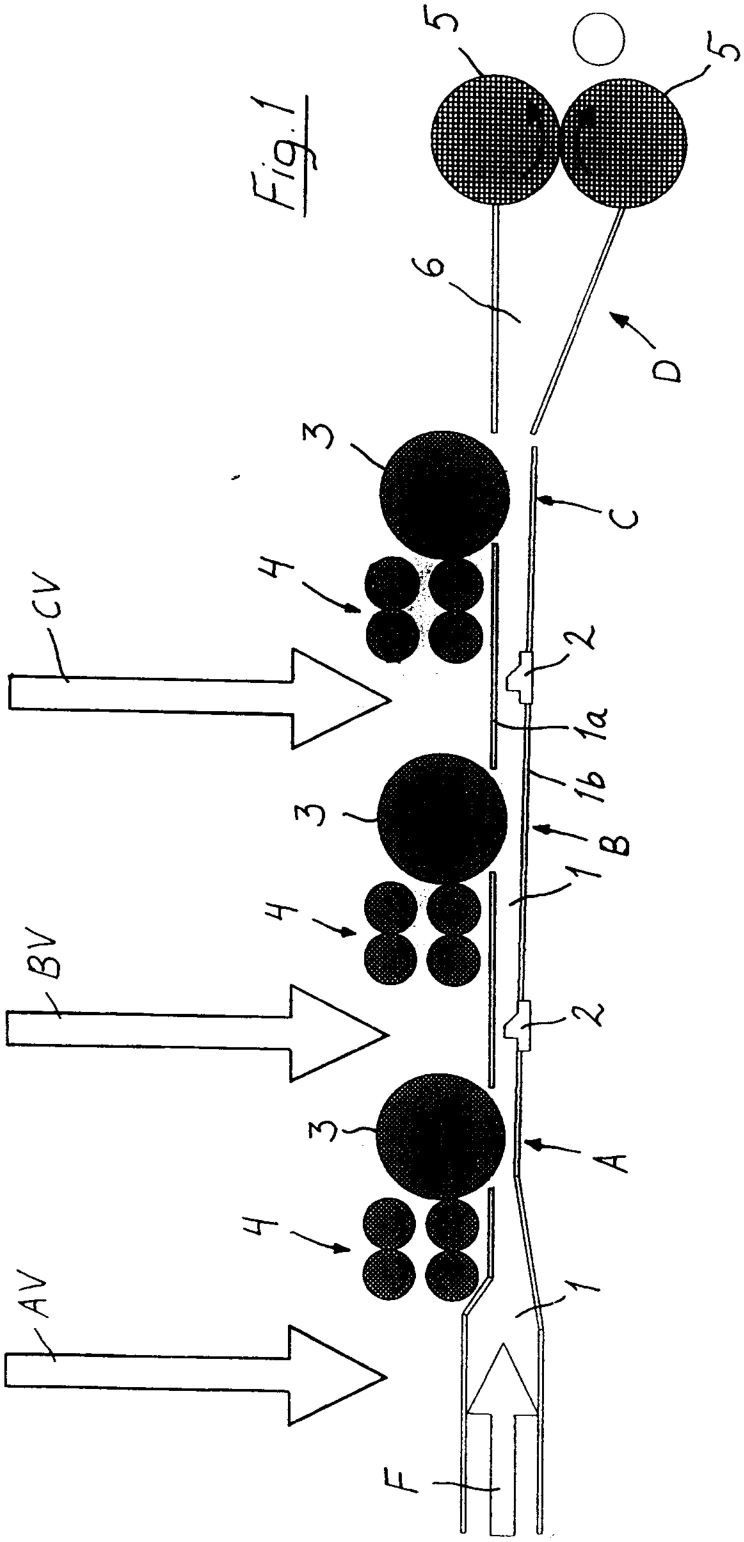

Fig.1

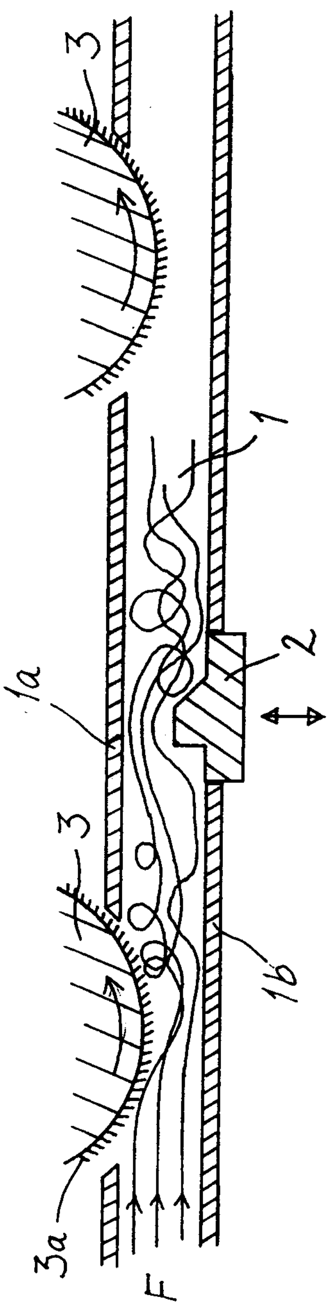

Fig.2

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EUROPEAN SEARCH REPORT

Application Number

EP 93400584.4

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	SE-B- 461 339 (ISOVER SAINT-GOBAIN *Figure 4* ---	1-10	E04B 1/80 // E04C 2/16 B28B 1/52
A	DE-C- 723 320 (SOCIETA ANONIMA STABILIMENTI DI DALMINE ET AL) *Figure 1* ---	1-10	
A	DE-A1-1 960 396 (OWENS-CORNING FIBERGLAS CORP.) *Figure 1* ---	1-10	
A	US-A- 3 758 375 (H. KEIB ET AL) *Figure 2* --- -------	1-10	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			B28B B28C E04B E04C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
STOCKHOLM	12-05-1993	JUVONEN V.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
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