PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 : D04H 1/70 — A1

(11) International Publication Number: WO 91/14816

(43) International Publication Date: 3 October 1991 (03.10.91)

(21) International Application Number: PCT/FI91/00078

(22) International Filing Date: 22 March 1991 (22.03.91)

(30) Priority data:
901486 26 March 1990 (26.03.90) FI

(71) Applicant *(for all designated States except US):* PAROC OY AB [FI/FI]; SF-21600 Pargas (FI).

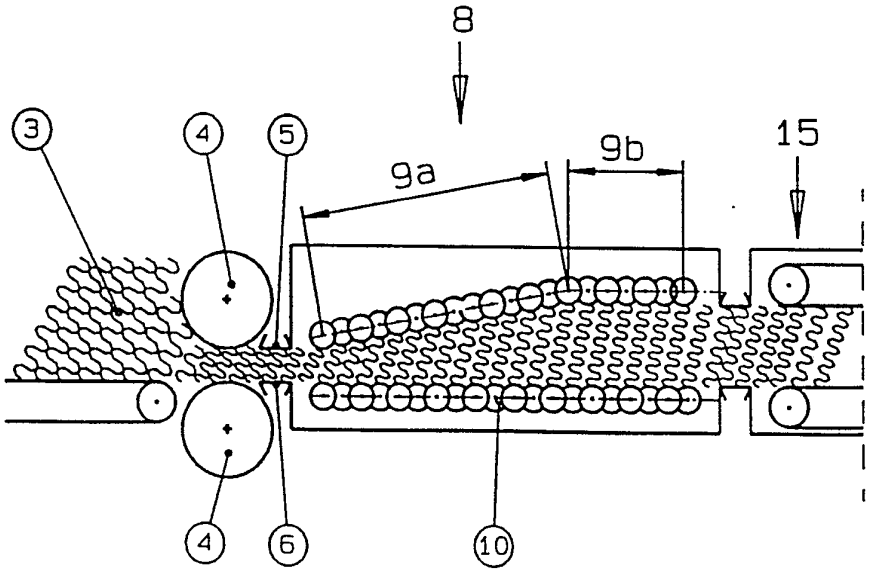
(72) Inventors; and
(75) Inventors/Applicants *(for US only) :* LAURÉN, Henning [FI/FI]; Regnbågen 6, SF-21600 Pargas (FI). UNKURI, Matti [FI/FI]; Malmnäsvägen 11 B, SF-21600 Pargas (FI).

(74) Agent: OY JALO ANT-WUORINEN AB; Skepparebrinken 2 A, SF-00120 Helsingfors (FI).

(81) Designated States: AT (European patent), BE (European patent), CA, CH (European patent), DE (European patent), DK (European patent), ES (European patent), FI, FR (European patent), GB (European patent), GR (European patent), IT (European patent), JP, LU (European patent), NL (European patent), NO, PL, SE (European patent), SU, US.

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: METHOD AND APPARATUS FOR THE TREATMENT OF A MINERAL FIBRE FELT



(57) Abstract

The invention relates to a method and a device for the treatment of a mineral fibre felt whereby the felt is transported through a transport apparatus while changing the speed thereof. The change of speed is brought about by bringing the felt into contact with at least two elements arranged successively in the transport direction of the felt, the areas of influence of which overlap each other. The apparatus comprises two conveyors (9, 10) arranged opposite each other, between which the felt (3) is transported. Each conveyor comprises at least two shafts (11, 12, and 11′, 12′, respectively), which are provided with a number of means (16) to be brought into contact with the upper and the lower surface, respectively, of the felt.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	**ES**	Spain	**MG**	Madagascar
AU	Australia	**FI**	Finland	**ML**	Mali
BB	Barbados	**FR**	France	**MN**	Mongolia
BE	Belgium	**GA**	Gabon	**MR**	Mauritania
BF	Burkina Faso	**GB**	United Kingdom	**MW**	Malawi
BG	Bulgaria	**GN**	Guinea	**NL**	Netherlands
BJ	Benin	**GR**	Greece	**NO**	Norway
BR	Brazil	**HU**	Hungary	**PL**	Poland
CA	Canada	**IT**	Italy	**RO**	Romania
CF	Central African Republic	**JP**	Japan	**SD**	Sudan
CG	Congo	**KP**	Democratic People's Republic of Korea	**SE**	Sweden
CH	Switzerland			**SN**	Senegal
CI	Côte d'Ivoire	**KR**	Republic of Korea	**SU**	Soviet Union
CM	Cameroon	**LI**	Liechtenstein	**TD**	Chad
CS	Czechoslovakia	**LK**	Sri Lanka	**TG**	Togo
DE	Germany	**LU**	Luxembourg	**US**	United States of America
DK	Denmark	**MC**	Monaco		

Method and apparatus for the treatment of a mineral fibre felt

The present invention relates to a method and an apparatus for the treatment of a mineral fibre felt for the purpose of re-orienting the fibres in the felt, by successively changing the speed of the felt during its transport through a transport apparatus.

Mineral wool products of glass wool, rock wool and slag wool type, are the most well known and used products for both heat insulation and acoustical insulation.

These products are commonly made by melting the raw material, forming fibres from the mineral melt e.g. by feeding it to a spinning unit, which can consist of a number of rotating wheels, carrying the fibres formed with an air current from the spinning unit and collecting them onto a conveyor in the form a fibre felt. The collecting can take place either so that the fibres are collected onto the conveyor to form a felt of the desired end thickness, or by forming a so-called primary web by collecting a thin layer of fibres, which thereafter, e.g. by means of a pendulum conveyor, is folded to form a secondary felt of the desired thickness.

At some point of manufacture, the felt is impregnated with a suitable binder, e.g. a resin, which at a final stage of the treatment of the felt is cured by heat treatment, e.g. in an curing oven, whereby the fibres are fixed to each other and form a dimensionally stable continuous felt of desired density and thickness. Thereafter the felt is cut to the desired shape, either in the form of sheet type products or roll products, which are then packed or processed further.

When the fibres are collected from the spinning unit, either in the form of a primary web, or in its final

thickness, the fibres are received on the conveyor substantially in a plane parallel to the conveyor, i.e. only a small amount of the fibres will be oriented in a direction which is more or less perpendicular to the plane of the conveyor. This phenomenom is of advantage in some fields of application, as such products exhibit good elastic properties, but are of a great disadvantage in other. This structure of the felt results in particular in poor strength characteristics in a direction perpendicular to the felt plane, wherefore such products cannot be used in constructions which are subject to great mechanical loads, e.g. in floors, or in ceilings under load.

One way of achieving sufficient mechanical strength in a direction against the felt plane is to increase the volume weight, i.e. the density of the felt,which can be done by increasing the fibre amount, or in some cases, the amount of binder. The manufacturing costs are, however, directly proportional to the fibre weight, wherefore increasing the strength by increasing the amount of fibre can be economically unacceptable in some cases.

Increasing the strength in a direction perpendicular to the felt plane can also be achieved by changing the direction of the fibres in the felt so that a greater fraction of these are arranged in a direction which deviates from the felt plane. This can be accomplished in many ways.

It is, e.g., possible to cut the felt into strips having a width corresponding to the desired thickness of the mat. The strips are turned 90° and are glued together to form a so-called lamellar mat, the fibre direction of which is predominantly perpendicular to the main surfaces of the mat. An example of such a method is disclosed in the EP A 0 000 378. However, these lamellar products have to be manufactured in a special post-treatment or processing line with associated additional costs.

It is also possible to manufacture a mat which has substantially the same properties as a lamellar mat without cutting and gluing, by corrugating the fibre felt in a suitable manner, compressing the corrugated mat to the desired density and curing the same. Such a procedure is described in the US-patent specification US A 1,656,828 (Fig. 6). Also in this product the fibre direction is predominantly perpendicular to the plane of the felt.The formation of creases on the felt surfaces is, however, associated with disadvantages. In addition to reducing the bending strength in the longitudinal direction of the felt, creases are disturbing if the sheet as such is to be used as an acoustical sheet. The heat insulating properties of the lamellar products as well as of the corrugated products are up to 10% poorer compared to conventional sheet type products.

A third way of changing the major fibre direction in the felt has been described in DE A 16 35 620. According to this method, the rate of progress of the felt is decelerated between two successive conveyors by running the back conveyor, as viewed in the direction of movement, at a lower speed than the preceeding one. This braking effect results in a longitudinal compression with a re-orientation of the fibres within the felt, without the formation of creases on the surface. According to the method, good results are achieved as regards both the mechanical and insulating properties of the final product, provided the degree of compression, i.e. the speed reduction of the felt during the treatment, is kept below about 30 %. If the degree of compression is higher, creases begin to appear on the surfaces of the felt. This disadvantage can, however, easily be avoided if the procedure is repeated, i.e. a number of successive compression stages are performed, which procedure has also been suggested in the FI-patent application 84 2734.

According to the above described method, compression takes place in a zone of the felt which is situated in front of the later, slower conveyor, and which extends linearly over the width of the felt. Within this zone, a re-orientation of the fibres takes place in a rather uncontrolled manner and is controlled solely by the inlet to the later conveyor, which forms a braking plane for the felt,and by possible guiding plates arranged above and beneath the felt,which plates prevent the felt from swelling more than is desired. These plates do not participate in the re-orientation itself of the fibres. Nor does any appreciable compression take place within the conveyor itself, which functions rather as a stabilizing zone following the applied shock-like compression. In case a higher degree of compression is desired, it is necessary to use an apparatus which requires a large space, which in any case does not allow a more accurate control over the course of treatment.

The present invention aims at overcoming the disadvantages associated with the known apparatuses, especially the uncontrolled treatment of the felt at a few forceful separate locations acting over the width of the felt. Namely, in accordance with the method and the apparatus according to the invention, a controlled and fine-structured re-orientation of the fibres takes place in the felt as a result of a substantially continually controlled change of speed of the felt, without formation of creases and in a single treatment stage, which easily can be incorporated into existing manufacturing lines.

This is achieved by the method according to the invention which is characterized in that the change of speed of the felt is effected by bringing the felt into contact with at least two elements arranged successively in the transport direction of the felt, the areas of influence of the elements overlapping each other.

The change of speed of the felt over all the elements is preferably negative, i.e. the exit speed of the felt from the last element is lower than its speed before the first element.

According to another preferred embodiment, the elements are of such a shape and mutual arrangement that the border or border zone where the influence of one element on the felt is greater than that of the adjacent element, is a substantially waveshaped line, extending over the width of the felt.

The said element is preferably comprised of a pair of shafts extending across the felt, one shaft on either side of the felt rotating in a direction towards each other. The shafts are provided with means which come into contact with the felt and which affect the advancing speed of the felt, that is, depending on the rotational speed of the shafts in relation to the advancing speed of the web, they can exert a braking or an accelerating effect on the felt, leading to a re-orientation of the fibres. The shafts are arranged in such a manner that when the felt is transported through a number of consecutive elements, the areas of influence on the felt of two consecutive elements overlap or mesh. It is assumed that it is this overlapping of the areas of influence of the elements, i.e. the continuous effect of the elements on the felt, which leads to the advantageous end result, in contrast to the shocking impact-like treatment according to the known technique.

In order to understand the invention better one can imagine that the part of the felt which is under treatment is divided into a number of treatment or re-orientation zones which extend over the width of the felt. A treatment zone can be defined as an area where one element has a greater influence on the felt than the adjacent element(s). The

rate of progress of the felt just in front of an element is completely governed by the said element, but the effect on the advancing speed is thereafter gradually shifted to the next element. At some point between these elements the speed is governed more by one element than the other. These more or less theoretical points define a line, which is not necessarily straight, and which extends across the felt. This line in turn defines the border between two treatment zones.

As, according to the treatment of the invention, the area of influence of each element overlaps or meshes with the area of influence of an adjacent element, every cross-section of the felt is always within a treatment zone, where it is subject to and affected by at least one element. In this manner the above mentioned fine-structured and "gentle" re-orientation of fibres in the felt is obtained.

By shaping the elements so that they form discrete contact areas with the felt in a direction across the felt, their influence on the felt is directed not only in the transport direction of the felt,but also in a direction more or less perpendicular to the transport direction of the felt, i.e. in a direction over the width of the felt. When these contact areas are arranged in a laterally staggered manner with respect to each other in the transport direction of the felt, the border between the areas of influence between two elements will form a substantially wave shaped line, whereby additional advantages are obtained. If the speed of the felt at two consecutive contact areas is different, shearing forces will develop in the felt which are directed both forward and backward, but also sideways, in a direction towards the edges of the felt. This results in a more even treatment of the fibre felt in all its dimensions and thus gives a better bending strength to the product than has been possible with the prior known solutions. By

varying the size of the contact areas, their mutual position, the compressing force of the elements on the felt and the degree of change of speed of the felt, the treatment can be precisely controlled in accordance with the desired result.

The felt is preferably subjected to a treatment over a number of, e.g. 4 to 12 elements. According to one embodiment of the invention, the felt is subjected to a decrease in speed over the whole length of the transport apparatus which decrease preferably is continuous and uniform, i.e. there is an equal decrease in speed from element to element, which preferably is about 10 to 20%. The change in speed does not, however, need to be uniform, but it can be advantageously of different magnitude at different stages of the treatment. The decrease in speed from element to element can thus be smaller in the beginning and bigger towards the end of the treatment, or the difference in speed between two consecutive zones can be substantially bigger than between the other zones. In this case such a more forceful treatment takes advantageously place in the later part of the apparatus. It is, however, also possible to increase the speed of the felt in one or some of the treatment zones, provided that the treatment leads to an end product with re-oriented fibres.

An acceptable product, without crease formation, is obtained according to the invention if the felt is subjected to a treatment which results in varying degrees of compression, but preferably a degree of compression is used which is about 2:1 to 10:1, especially 3:1 to 6:1, which corresponds to a speed reduction of about 50 to 90%, especially about 70 to 80%.

According to a preferred embodiment, prior to the treatment, the felt is precompressed in a direction perpendicular to the main plane of the felt to a thickness less

than that of the felt after the treatment. Precompression of the felt,for example to about 70% of the final thickness, and expansion thereof during the treatment, allows for a greater degree of compression without giving rise to non-uniformities in the surface layer and inner layer, respectively, of the felt, i.e. without the formation of a so-called arrow-shaped fibre structure in a cross-section of the product. This has been an additional problem associated with a high degree of compression according to the prior known methods.

The invention relates also to an apparatus for carrying out the method. The apparatus comprises in its simplest form a transport apparatus with two conveyors facing each other and between which the fibre felt is transported, whereby each conveyor comprises at least two shafts which can be driven with different rotational speed, the shafts carrying means to be brought into contact with that surface of the felt facing the respective conveyor, the areas of influence of the shafts on the felt overlapping each other.

The shafts in a conveyor can be driven at different rotational speeds, whereas a pair of shafts which is formed by mutually facing shafts in separate conveyors, is always driven at the same speed, but in opposite direction.

Preferably the shaft carries a number of means arranged in a mutually spaced relationship on the shaft, which means on one shaft are directed towards and extend into the spaces between the means on an adjacent shaft. According to one embodiment the means on one shaft in one conveyor form a nip for the felt with the corresponding means on a shaft in the other conveyor, but they can also be directed towards the spaces between the means in the last mentioned conveyor.

The transport apparatus contains preferably 4 to 12 shafts

in each roller conveyor thus forming the same number of shaft pairs. The means which come into contact with the felt can be of any suitable design, they can e.g. have the shape of paddles, needles, plates, flanges or the like, or they can be shaped as short endless conveyor belts arranged in a mutually spaced relationship across the width of the felt and extending in the transport or longitudinal direction of the felt, and they may carry formations for increasing the friction, such as spikes or the like.

In order to make it possible to convert the apparatus for the manufacture of products of different type, it is advantageous to provide the shafts with means for independent variation of the rotational speed of the shafts. The design of the driving means is known technique for a person skilled in the art.

In addition, the conveyors can be provided with per se known means for adjusting the distance between and/or the mutual inclination of the conveyors. As the treatment in such cases can be made with simultaneous thickness compression or expansion of the felt, the re-orientation conditions of the fibres can be further modified and thus the treatment adjusted for highly varying product types. The distance and/or the degree of inclination may also be varied along the length of the transport apparatus.

In order to further illustrate the invention, in the following reference is made to the attached drawing, wherein

Figure 1 illustrates schematically an apparatus for making a fibre felt which includes an apparatus for the treatment of the felt according to the invention,

Figure 2 illustrates schematically two co-operating roller conveyors forming the apparatus for treatment of the felt,

viewed from the side,

Figure 3 illustrates schematically the principle for an embodiment of co-operating shafts in a roller conveyor, in a plan view,

Figure 4 shows an element formed by a pair of shafts viewed in the direction of progress of the felt,

Figure 5 shows an embodiment of the means intended to come into contact with the felt,

Figure 6 illustrates schematically the apparatus with variable distance and inclination between the conveyors, and

Figures 7a to 7d show different speed profiles of the felt during its transport through the transport apparatus.

Figure 1 illustrates schematically the treatment of a fibre felt which in the form of a primary felt 1 is transported from a spinning unit, not shown, and folded to form a secondary felt 3 of desired thickness. This secondary felt 3 is thereafter fed in between two rolls 4, 4', which cause the felt 3 to be precompressed in a direction perpendicular to the plane of the felt. In the nip 4, 4' the felt is compressed to a thickness which is less than the thickness of the felt after the treatment, and suitably to about 70% of the final thickness of the felt. Thereafter the felt is fed, suitably over guiding means into a transport apparatus for the treatment according to the invention, which apparatus as a whole is designated with the reference numeral 8. After the treatment the felt is transported through a curing oven which in the drawing has been designated with the reference numeral 15. In the curing oven the end product is cured and fixed.

The transport apparatus 8, as best seen in Figure 2, comprises an upper and a lower conveyor 9 and 10, respectively, which both in the embodiment shown have a number of rolls in the form of cam shafts, whereby two mutually opposite cam shafts 11 and 11', 12 and 12', etc. form a cam shaft pair, which together define nips 11a, 12a etc. for the felt. According to a preferred embodiment the speed of the conveyors decreases in the direction of progress of the felt due to the fact that the cam shaft pairs rotate with gradually decreasing rotational speed. A suitable speed reduction between two successive shafts is 10 to 20%. In the instant case, e.g. the first two pairs of shafts can have the same rotational speed as the speed of the conveyor preceeding the transport apparatus, whereas the speed thereafter is gradually reduced as has been mentioned, at successive shafts and the last few shafts in the apparatus can have the same speed as the conveyor in the curing oven.

Figure 3 shows schematically how the cam shafts can be designed and co-operate in one conveyor, illustrated in a plan view. The direction of progress of the felt between the shafts is illustrated with an arrow. Thus, in the embodiment shown each cam disk 16 on a cam shaft extends into the space between two cam disks 16" in the adjacent cam shaft. In the embodiment shown, the cam shafts have a center distance (a) which is about 70% of the disk diameter of the cam shaft disks, the width (b) of the disks being about 30% of the center distance, and the interspace (c) about 40 to 50% of the center distance. In the figure also the nip 17 for a few adjacent cam disks have been indicated. Thus the nips between the cam shafts result in this embodiment in substantially linear contact areas with a restricted dimension primarily in the transverse direction of the felt, two subsequent cam shaft nips forming contact areas of a zig-zag design across the width of the web.

The Figure 4 shows a treating element comprising a pair of

shafts with the same rotational speeds rotating in opposite directions and viewed in the direction of progress of the felt. In the Figure the solid lines refer to the embodiment according to the invention where the cam disks 16 in each conveyor are directed towards each other forming a nip 17. In the same Figure also an alternative embodiment is shown with dotted lines where the cam disks in each conveyor are not directed towards each other, but the cam disk in one conveyor is facing the interspace between the cam disks in the other conveyor.

An embodiment for the means intended for contact with the felt is illustrated in the Figure 5, which shows a plate 16 mounted on a shaft which plate on its outer periphery is provided with a number of flanges 18 distributed evenly around the circumference.

Figure 6 shows schematically an embodiment where the upper conveyor is divided into two parts 9a, 9b. The first part 9a is arranged in an inclined manner with respect to the lower conveyor 10.

In the Figures 7a to 7d alternative embodiments for the speed profile of the felt during the treatment according to the invention are shown. Figure 7a shows the case where the felt is subjected to a uniform speed reduction over all the elements in the apparatus. Figure 7b, on the other hand, shows the case where the speed reduction is less at the beginning part of the treatment, and bigger towards the end, whereas the Figure 7c shows the case where the biggest speed reduction takes place in the middle of the treatment. Finally, the Figur 7d shows the case where the speed of the felt is also allowed to increase at one or several elements.

Claims

1. Method of treating a mineral fibre felt for the purpose of re-orienting the fibres in the felt, by successively changing the speed of the felt, **characterized** in that the change of speed of the felt is effected by bringing the felt into contact with at least two elements (11, 11', and 12, 12', respectively) arranged successively in the transport direction of the felt, the areas of influence of the elements overlapping each other.

2. Method according to the Claim 1, **characterized** in that the speed of the felt is reduced in such a way that the ratio between the speed at the beginning of the treatment to that at the end is about 2:1 to about 10:1, preferably about 3:1 to about 6:1.

3. Method according to the Claim 1 or 2, **characterized** in that the border where the influence of one element overrides that of the adjacent element, is comprised of a substantially wave shaped line extending over the width of the web.

4. Method according to the Claim 3, **characterized** in that the contact between the felt and one of the said elements is restricted to a number of mutually separate contact areas arranged across the felt, whereby the contact areas of the felt with consecutive elements are mutually displaced sideways.

5. Method according to any one of the preceeding Claims, **characterized** in that the thickness of the felt successively changes during the treatment.

6. Method according to any one of the preceeding Claims, **characterized** in that the speed of the felt is successive-

ly reduced during the treatment, the speed reduction between two successive elements being 10 to 20%.

7. Apparatus for the treatment of a mineral fibre felt for the purpose of re-orienting the fibres in the felt, by changing the speed of the felt during its progress through a transport apparatus, **characterized** in that the transport apparatus (8) comprises two conveyors (9,10) arranged opposite each other, between which conveyors the fibre felt (3) is transported, whereby each conveyor comprises at least two shafts (11, 12 and 11', 12' respectively), which can be driven at different rotationel speeds and which comprise means (16) to be brought into contact with the surface of the felt facing the conveyor in question, the areas of influence of the shafts on the felt overlapping each other.

8. Apparatus according to the Claim 7, **characterized** in that the shafts carry a number of mutually spaced means whereby the means (16) on one shaft are directed against and extend into the interspaces between the means (16', 16") on an adjacent shaft in the same conveyor.

9. Apparatus according to the Claim 8, **characterized** in that the means (16) on one shaft (11) in the conveyor are directed towards the corresponding means on the corresponding shaft (11') in the other conveyor forming a nip for the felt.

10. Apparatus according to the Claim 8, **characterized** in that the means (16) on one shaft (11) in one conveyor are directed towards the interspaces between the corresponding means on the corresponding shaft (11') in the other conveyor.

11. Apparatus according to any one of the Claims 7 to 10, **characterized** in that the means for contact with the felt

comprise pins, paddles, cam disks, endless belt conveyors or the like, which may be provided with friction increasing formations.

12. Apparatus according to any one of the Claims 7 to 11, **characterized** in that the shafts in each conveyor are provided with means for varying the rotational speeds of the shafts independently of each other.

13. Apparatus according to any one of the Claims 7 to 12, **characterized** in that the conveyors are provided with means for adjusting the mutual distance and/or the mutual inclination between the conveyors, which means allow a change in the distance and/or the mutual inclination along the length of the transport apparatus.

14. Apparatus according to any one of the Claims 7 to 13, **characterized** in that it comprises, in front of the transport apparatus (8), a device (4, 4') for compressing the felt to a thickness which is less than the thickness of the felt after the treatment.

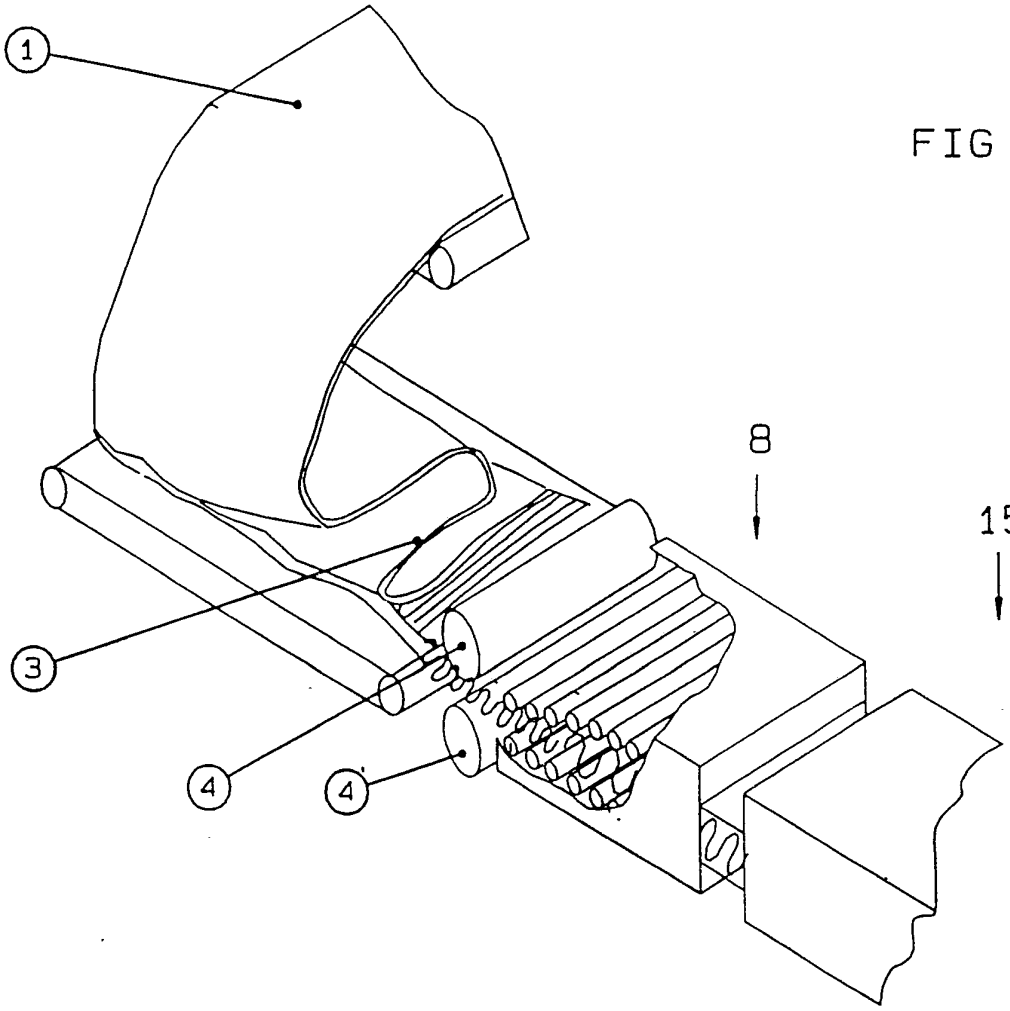


FIG . 1

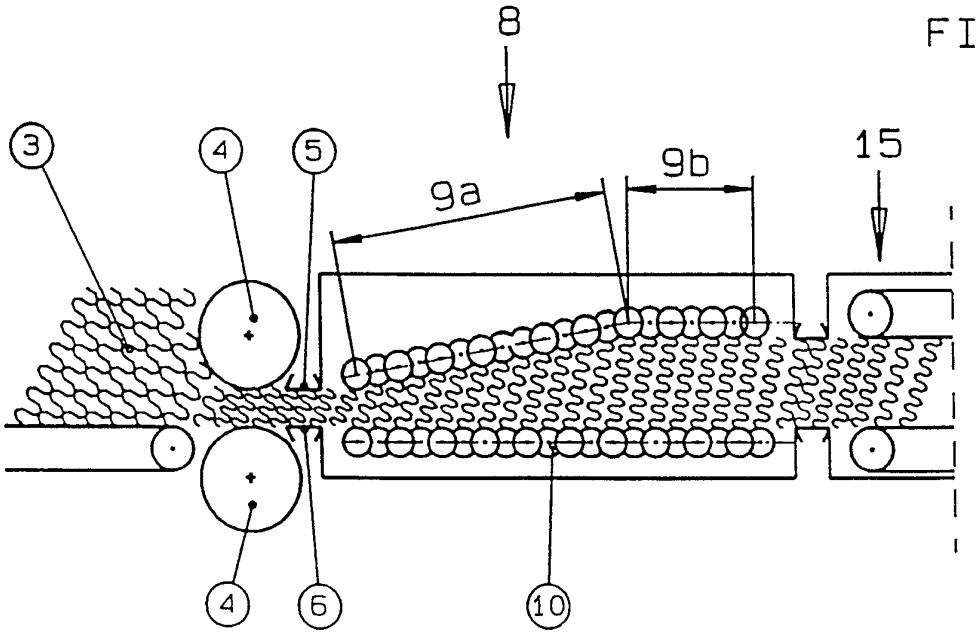


FIG . 6

FIG . 2

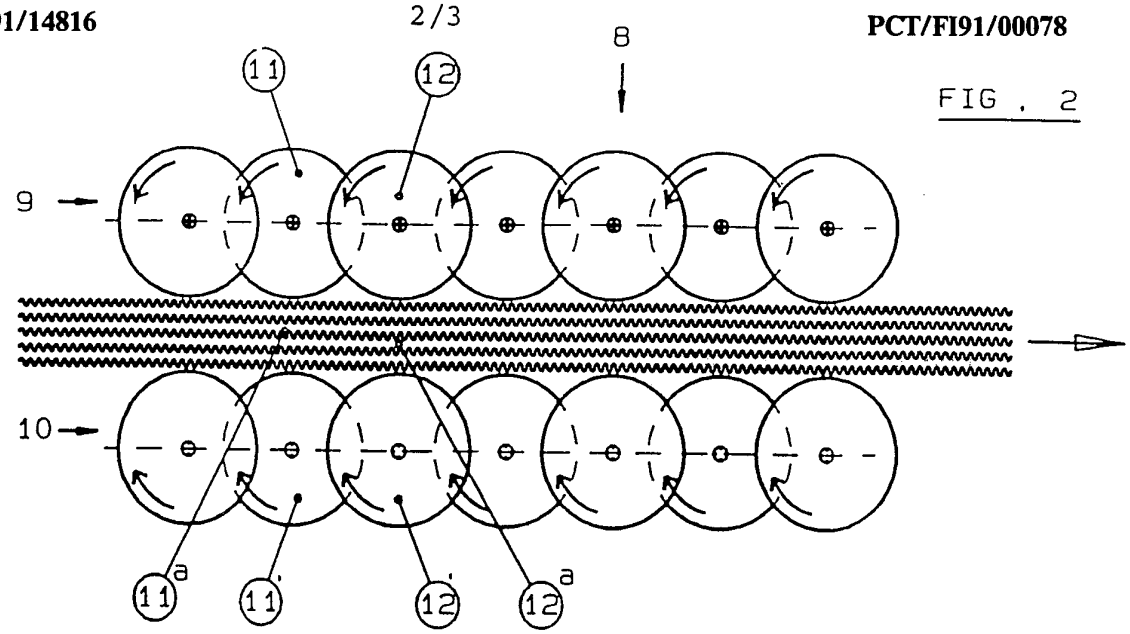


FIG . 3

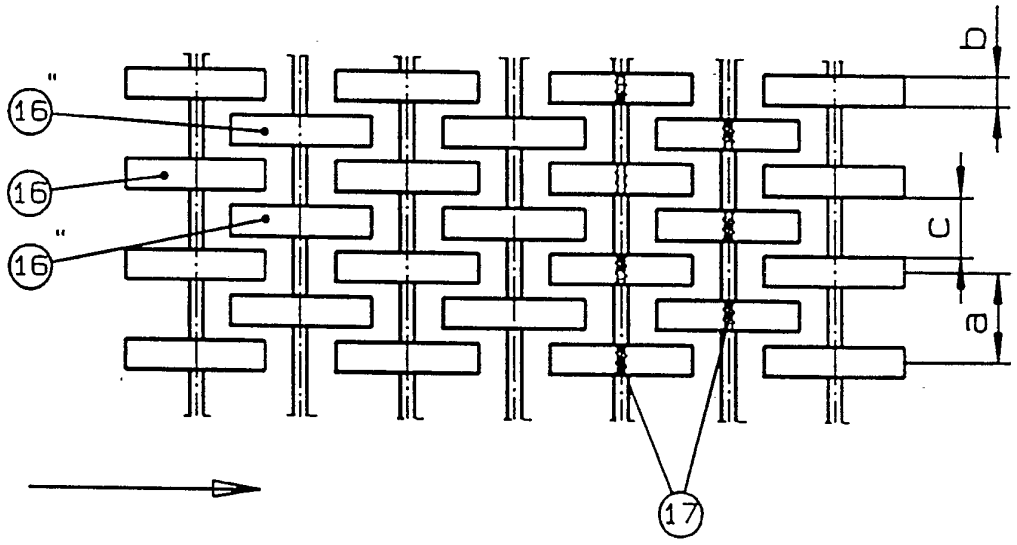


FIG . 4

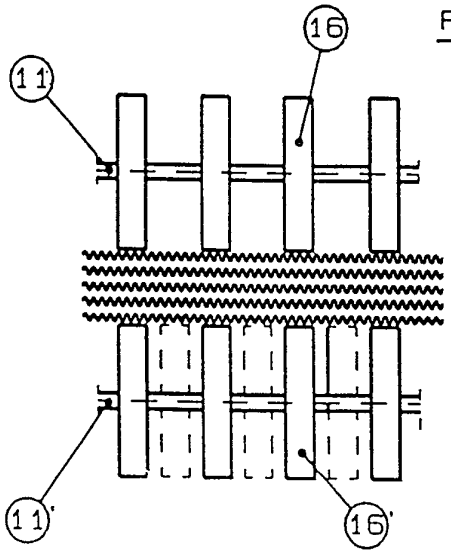
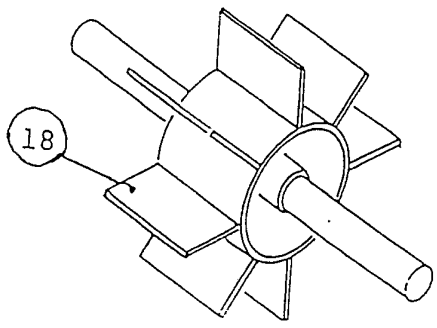


FIG . 5



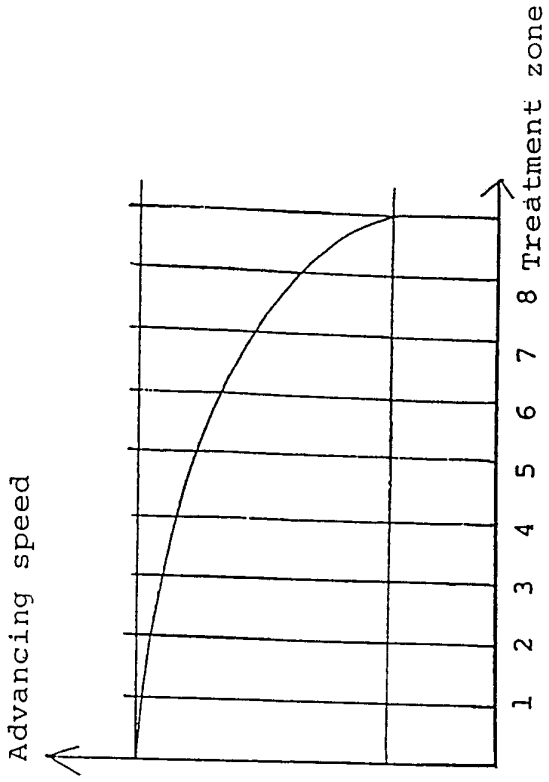


Fig. 7b

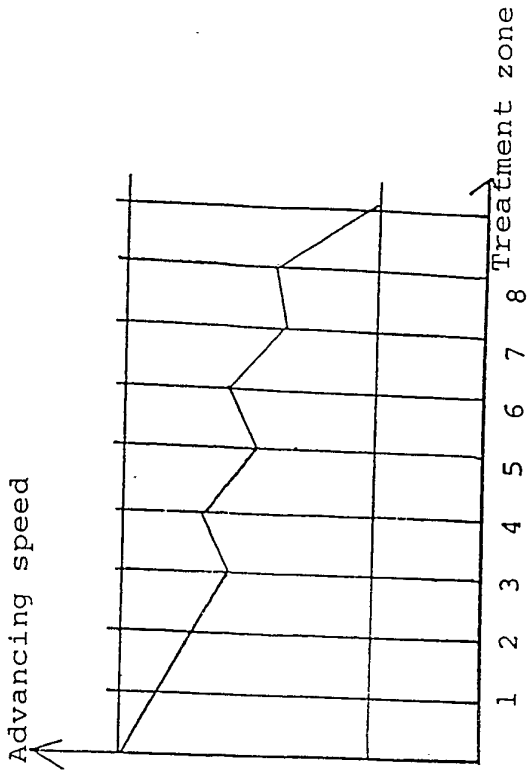


Fig. 7d

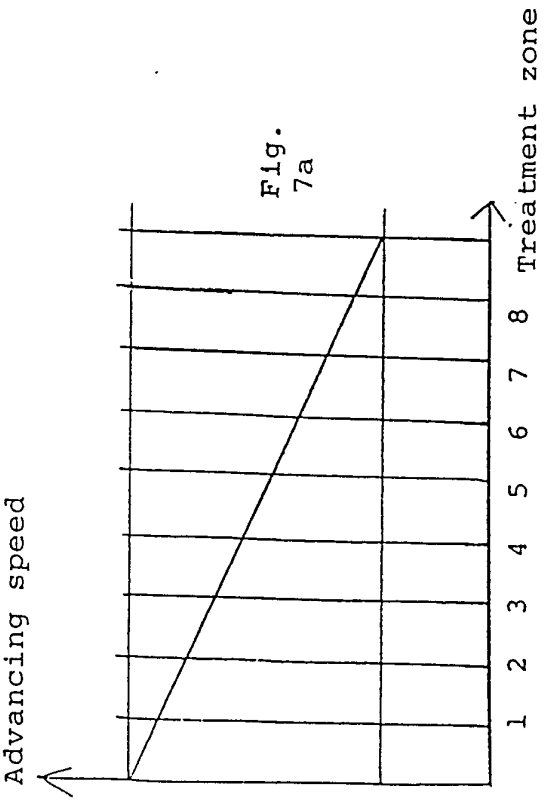


Fig. 7a

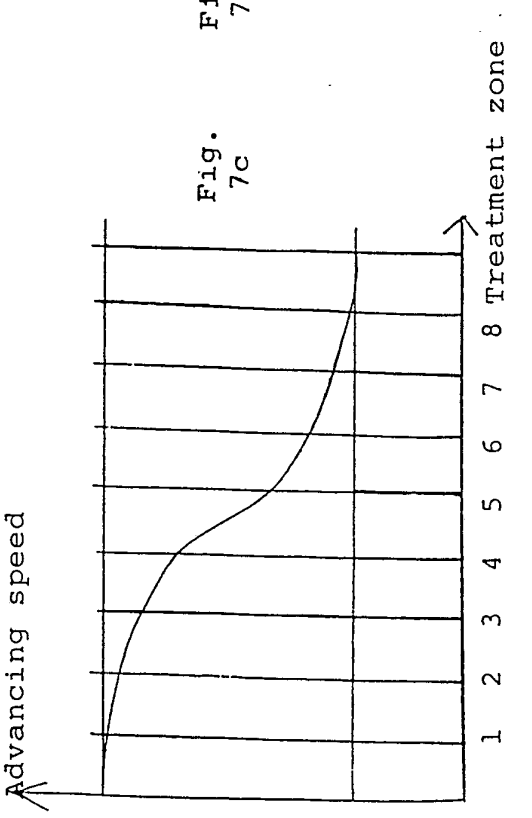


Fig. 7c

INTERNATIONAL SEARCH REPORT

International Application No PCT/FI 91/00078

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC5: D 04 H 1/70

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
IPC5	D 04 H

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in Fields Searched[8]

SE DK,FI,NO classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category *	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
A	DE, A, 1635620 (REICHHOLD-ALBERT-CHEMIE AG) 25 March 1971, see the whole document --	
A	EP, A1, 0133083 (ISOVER SAINT-GOBAIN) 13 February 1985, see the whole document --	

---

* Special categories of cited documents:[10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
17th July 1991	1991 -07- 19
International Searching Authority	**Signature of Authorized Officer**
SWEDISH PATENT OFFICE	Axel Lindhult

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO.PCT/FI 91/00078

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the Swedish Patent Office EDP file on 91-06-27
The Swedish Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
DE-A- 1635620	71-03-25	NONE		
EP-A1- 0133083	85-02-13	AU-B-	570250	88-03-10
		AU-D-	2940084	85-01-10
		DE-A-	3469573	88-04-07
		FR-A-B-	2548695	85-01-11
		JP-A-	60052662	85-03-25
		US-A-	4632685	86-12-30
		US-A-	4826722	89-05-02
		US-A-	4964978	90-10-23