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(54) **BONDED FIBRE PRODUCTS**

FASERVLIESTOFF

PRODUITS FIBREUX LIAISONNES

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US-A- 3 740 282 US-A- 5 906 669**

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Description

[0001] This invention relates to bonded man-made vitreous fibre (MMVF) batts which may be of relatively low density (such as 5 to 50kg/m³) and in particular to elongated pieces cut from such batts and supplied to the user as a compressed packaged roll.

[0002] One conventional way of producing such batts involves fiberising mineral melt on a centrifugal spinning apparatus and thereby forming a cloud of fibres entrained in air, including curable binder in the cloud, carrying the cloud forwards from the spinner in a stream of air, collecting the cloud of fibres as a primary web on a substantially continuous moving collector, transporting the web to a cross-lapping position, cross-lapping a plurality of layers of the web while substantially continuously conveying the resultant continuous batt from the cross-lapping position, curing the binder by passing the batt through a curing oven and cutting the continuous batt into elongated pieces before, during or after curing, and compressing and packaging the elongated pieces of batt as rolls.

[0003] The continuous batt can be considered as having upper and lower faces which extend in the X and Y axes or directions with the X direction being the width of the batt as it is collected and the Y direction being the length of the continuous batt as it is collected and carried away from the cross lapping position.

[0004] The quality of the final product tends to deteriorate as the primary web increases in thickness, and so there is an incentive for the primary web to have reduced thickness. However reducing the thickness of the primary web results in reduced productivity (tons per hour) unless either the web is made wider than usual or the web is made to travel faster than usual. The normal maximum width of the primary web is 2 metres, although widths of webs (made by other methods) of up to 2.5 metres are mentioned in DE 3501897 A and up to 4 metres in WO 99/51535 A. Increasing the speed of travel of the web has the disadvantage of increasing the frequency of reciprocation of the cross lapping apparatus, and this causes engineering problems. It would be desirable to achieve increased productivity whilst minimising or avoiding these problems and whilst maintaining quality.

[0005] Although the continuous bonded batt may be used in various forms, most continuous batt is converted into elongated pieces of batt usually having a length greater than the width.

[0006] The normal width of the continuous batt in the X direction is up to 2 metres (although a width of up to 2.5 metres is described in DE 3501897 for batts made by different fiberising techniques) with the result that the maximum length of pieces cut from the batt is normally 2 metres if the pieces are cut transversely, along the X direction. The cut pieces usually have a shorter dimension in the Y direction and so have a width below 2 metres. Because the maximum length in the X direction is, in normal practice, 2 metres, this curtails the type of prod-

ucts which can be made by cutting in this direction. In particular, transverse cutting along the X direction cannot provide elongated pieces having a length above 2 metres.

[0007] However it is often desired to provide elongated pieces of batt which have a length greater than 2 metres, and to supply them in the form of packaged compressed rolls. It is then necessary to cut them from the batt so that the length direction of the ultimate pieces extends in the Y direction of the continuous batt, ie. the direction of travel of the continuous batt as it is being collected from the cross lapper. These cut batts have a shorter dimension in the X direction. Unfortunately pieces cut in this manner have a lower tensile strength in the Y direction than pieces whose major length extends in the X direction.

[0008] It would be desirable to produce long pieces which are cut from continuous batt and which have increased tensile strength in their length direction.

[0009] Space is often a restricting factor in the design of production lines for the production of mineral fibres, because of the need to provide, in sequence, the furnace, the spinner or spinners, the collector, the cross lapper, the batt conveyor a curing oven, and cutting arrangements for cutting the batt into pieces, before, during or after curing. The curing oven in particular has a considerable length. If productivity is increased by increasing the speed of travel of the continuous batt then the length of the oven has to be increased even further and this places a severe restriction in the ability to increase the productivity of existing plants or to install new plants having high levels of productivity. It would be desirable to avoid the use of curing ovens which have to be so long.

[0010] The present invention simultaneously solves all these problems.

[0011] According to the invention we provide an elongated, bonded man-made vitreous fibre (MMVF) batt which has a length direction X and a width direction Y and which has upper and lower faces which extend in the X and Y direction and wherein the batt is formed of a compressed and cured intermeshed stack of layers each of which is formed of air laid MMVF primary web which includes a bonding agent and wherein, each layer is substantially parallel to the faces when viewed in cross section along the X direction, the layers are regularly displaced relative to each other in zig-zag fashion in the Y direction, and each layer is inclined to the faces when viewed in cross section along the Y direction, characterised in that the layers between the faces extend as continuous layers throughout the X direction, the length in the X direction is at least 3 metres and is greater than the width in the Y direction and the batt is in the form of a compressed and packaged roll whose axis extends in the Y direction.

[0012] Preferably the length of the batt in the X direction is at least 4 metres, for instance as much as 6 or even 8 metres.

[0013] The length in the X direction is usually at least

two times longer than the width in the Y direction.

[0014] The products of the invention are made by fiberising mineral melt on a centrifugal fiberising apparatus and thereby forming a cloud of fibres entrained in air, including curable binder in the cloud, carrying the cloud forwards from the spinner in a stream of air, collecting the cloud of fibres as a web on a substantially continuously moving collector, transporting the web to a cross lapping position, cross lapping a plurality of layers of the web while substantially continuously conveying the resultant continuous batt away from the cross lapping position along the Y direction of the batt, curing the binder by passing the batt through a curing oven, and cutting the continuous batt along the X direction (transverse to the Y direction of the continuous batt) into pieces before, during or after curing, and packaging each piece as a compressed roll, and in this process the cross lapped continuous batt and each of the pieces has a length in the X direction of, and the width of the curing oven is, at least 3 metres and the width of each of the pieces in the Y direction is less than the length in the X direction.

[0015] Thus, in the invention, the cross lapping is conducted to produce a continuous batt which is wider (in the X direction) than usual, and in particular is at least 3 metres wide and often 4 metres up to 6 metres or even 8 metres wide, and this very wide batt is then cut transversely.

[0016] As a result of the increased width of the continuous batt, the frequency of reciprocation of the cross lapper is reduced (at constant web speed), or the frequency does not have to be increased despite increased web speed. This therefore reduces the engineering problems associated with increasing the web speed of the primary web. Thus it is possible to increase productivity (tons per hour) or increase quality by reducing web thickness (or both) without having to increase the frequency of cross-lapper reciprocation.

[0017] As a result of the continuous batt being wider than conventional, the length of the curing oven can be reduced. Thus increased production can be achieved by a fast primary web speed and a wide batt, without the need to increase the length of the curing oven unacceptably. Instead, the curing oven merely needs to be made wider, and in many plants this is a significantly preferred option compared to increasing the length of the oven.

[0018] In the invention, the batt is cut transversely to provide elongated pieces having a dimension in the X direction of at least 3 metres and generally at least 4 metres and with a lesser dimension in the Y direction, for instance up to 1 metre or 2 metres.

[0019] The product of the invention is a compressed and packaged roll which, when unwound, has better tensile strength in the length direction than conventional roll products having a length of at least 3 or 4 metres, since

these conventional products have their major length extending in the Y direction. In the invention, the axis of the roll extends along the Y axis, ie. transverse to the length direction of the initial batt.

[0020] The elongated pieces are rolled into compressed and packaged rolls in conventional manner. For instance each piece may be rolled tight with plastic film trapped between the layers of the roll, at least towards the end of the piece, and then sealed to itself after rolling, thereby trapping the roll in an envelope of plastic film. Other conventional methods of packaging the roll in its compressed state can be used.

[0021] The amount of compression of the roll is generally such that the thickness and volume of the roll is 10 to 50% of the norm volume of the batt. The extent of compression is typically from about 50% to about 90% based on the volume of the batt.

[0022] When the packaging is removed, the roll unwinds and expands back towards its original thickness. After the unwound batt has had an opportunity to equilibrate to a final thickness, and therefore a final density, the thickness is generally at least 50mm and usually at least 80 to 100mm. It is frequently up to 180 or 220mm and can be up to 250mm. The thickness of the batt before being compressed and rolled is likewise usually within the range 50mm to 250mm. Usually the thickness before rolling and compression is 5 to 20%, often around 10%, more than the desired thickness after unrolling and equilibration.

[0023] In this specification, thickness is determined by laying the product on a hard flat surface, laying a 200mm x 200mm pressure plate on the surface so as to apply a pressure of 50Pa and measuring the separation between the supporting surface and the plate. The measured thickness is the average of values taken at a number of points. The number of points is 5 when the roll is 2 metres long, 7 when 3 metres long and 9 when 4 metres long, with the points being distributed uniformly over the width of the roll but excluding the outer 150mm of the width.

[0024] The products of the invention usually have a nominal density of 5 to 50kg/m³, and generally at least 15 or 20kg/m³ up to 40 or 45kg/m³. Preferably the product after unrolling and equilibrating has a density in these ranges. The density is derived by calculation from the thickness, measured as above, and measurements of the surface area of the unrolled material and its mass.

[0025] Conventional compressed, low density. MMVF rolls of provide a tensile strength of 3 to 4kN/m² in the length direction (along the Y axis) (indexed to 30kg/m³ density and ignition loss 1.4%) but in the invention typical values for slabs can be from 6 to 8 kN/m² in the length direction because the length direction is along the X direction during initial manufacture of the batt which is cut to provide the elongated pieces.

[0026] It is preferred that the primary web is as described in our application GB 0019999.2 filed 14 August 2000 and in our PCT application WO 01/23312 A filed even date herewith, wherein the primary web also has a

width of, generally, at least 3 metres and preferably 4 to 8 metres.

[0027] Although the invention can be applied to mineral fibres made by any centrifugal technique, the fibres are preferably made using one more centrifugal cascade spinners each comprising a first rotor and one or more subsequent rotors which rotate about the substantially horizontal axis and thereby form the cloud of fibres entrained in air.

[0028] Suitable apparatus and techniques for forming the fibres are described in, for instance, WO 92/06047 A, WO 92/12939 A, WO 92/12.940 A, -WO 96/38391 A and WO 99/51535 A.

[0029] The invention is illustrated in the accompanying drawings in which

Figure 1 is a diagrammatic illustration of an apparatus and process for forming the batt.

Figure 2 is a perspective view of the batt during manufacture and

Figure 3 is an end view of a roll according to the invention.

[0030] Referring to Figure 1, three cascade spinners 1, 2 and 3 each having four rotors are located in an end wall of a spinning chamber shown diagrammatically as 6, and discussed in more detail below. Melt is poured on to the top rotor in each spinner and is thereby fiberised in conventional manner into fibres which are carried forwards by primary air which is blasted forward as wall jets over the individual rotors and secondary air which is induced into the chamber around the spinners. Suction is applied through a continuously moving collector 5, whereby the fibres are deposited as a web 7 which is carried to a cross lapper 8 by which the web is cross lapped on to a conveyor 9, thereby forming a batt 10 which is continuously conveyed away from the cross lapping position.

[0031] The conveyer 9 and the batt has a dimension X of at least 3 metres, usually 4 to 8 metres.

[0032] The details of the air supplies and the construction of the chamber may be as described in more detail in WO 96/36391 A.

[0033] The batt 10 is passed through rollers or the like to compress it and cause intermeshing of the individual layers in the batt and is then passed through a curing oven to cure binder which is sprayed into the cloud of fibres from the cascade spinners 1, 2 and 3.

[0034] The collector 5 and the web 7 can be, for instance, 2 metres wide but are preferably 3 or 4 metres wide, up to 7 or 8 metres wide. The angle of the collector 5, to the horizontal can be about 30°, as shown in the drawings, but is preferably 45 to 90°, often around 50 to 80°. The collecting chamber is substantially closed as described in WO 96/38391 A. The collector can be a cylindrical drum mounted with its axis transverse to the direction of travel of the web. Instead of travelling away from the spinners, the collector can travel towards the

spinners for instance as described in WO 01/23314 A.

[0035] Figure 2 shows the construction of the batt in more detail. The batt has upper and lower faces 30 and 31. It has an end edge 32 formed by cutting the batt transversely and thus exposing the cross section along the X direction. It has side edges 33 and 34 formed in Figure 3 by the edges of the cross lapping. When the batt is cut along the Y direction the cut side edges will show the same inclined arrangement of layers as is apparent in the edges of the batt formed by cross lapping. The end edges 32 extend in the X direction and the side edges 33 and 34 extend in the Y direction.

[0036] The web 7 is cross lapped in the X direction as the conveyor 9 travels under the conveying position. As a result it can be seen that the end edges 35 in the cut end edge 32 are substantially parallel to the faces 30 and 31 whilst the uncut edges 36 of the layers extend between the side edges 33 and 34 at substantially regularly spaced apart positions, in a zig zag pattern.

[0037] Figure 3 is an end view of a roll and shows the edge 32 of the rolled and compressed batt held compressed in the roll by plastic wrapping 37 which is interleaved in the roll and secured on itself at position 37, so as to hold the roll in its compressed rolled configuration.

[0038] Although it is not shown in Figure 1, the conveyor 9 carries the batt through a curing oven which can be a conventional construction except that it has to be at least as wide as X. The conveyor also carries the batt through conventional cutting systems and rolling systems so as to cut the continuous batt into elongated strips which may have a length of X (more than 3 metres) and a width which is usually less than this.

Claims

1. An elongated, bonded, man-made vitreous fibre batt which has a length direction X and a width direction Y and has upper and lower faces (30,31) which extend in the X and Y directions and wherein the batt is formed of a compressed and cured intermeshed stack of layers (7) each of which is formed of air laid man-made vitreous fibre primary web (7) which includes a bonding agent and wherein each layer (7) is substantially parallel to the faces when viewed in cross section along the X direction, the layers (7) are regularly displaced relative to each other in the Y direction, each layer (7) is inclined to the faces when viewed in cross section along the Y direction, characterised that the layers (7) between the faces (30,31) extend as continuous layers throughout the X direction, the length in the direction X is at least 3 metres and is greater than the width in the direction Y, and the batt is in the form of a compressed and packaged roll whose axis extends in the Y direction.

2. A batt according to claim 1 in which the X direction has a length of 4 to 8 metres.
3. A batt according claim 1 in which each layer in the batt has a weight of below 550 g/m², preferably 100 to 400 g/m².
4. A batt according to any preceding claim and which has, after unrolling and equilibration, a thickness of 50 to 250mm (preferably 80 to 180mm) and a density of 5 to 50 kg/m³ (preferably 15 to 40 kg/m³).
5. A batt according to any preceding claim in which the length in the direction X is at least twice the width in the direction Y.
6. A process for making a batt according to any preceding claim comprising
 fiberising mineral melt on a centrifugal fiberising apparatus and thereby forming a cloud of fibres entrained in air,
 including curable binder in the cloud,
 carrying the cloud forwards from the spinner in a stream of air,
 collecting the cloud of fibres as a primary web on a substantially continuously moving collector,
 transporting the web to a cross lapping position,
 cross lapping a plurality of layers of the web while substantially continuously conveying the resultant continuous batt away from the cross lapping position along the Y direction of the batt,
 curing the binder by passing the batt through a curing oven and
 cutting the continuous batt along the X direction (transverse to the Y direction of the continuous batt) into pieces before, during or after curing, and packaging each piece as a compressed roll,
characterised in that the continuous batt and each of the pieces has a length in the X direction of, and the width of the curing oven is, at least 3 metres, preferably 4 to 8 metres, and the width of each piece in the Y direction is less than the length in the X direction.
7. A process according to claim 6 in which the primary web has a width of at least 3 metres, preferably 4 to 8 metres.
8. A process according to any preceding claim in which the centrifugal fiberising apparatus comprises one or more centrifugal cascade spinners each comprising a first rotor and one or more subsequent rotors each mounted for rotation about a substantially horizontal axis.

Patentansprüche

1. Längliches gebundenes Vlies aus künstlichen glasartigen Fasern, das eine Längsrichtung X und eine Breitenrichtung Y aufweist und eine obere und untere Außenseite (30, 31) hat, die sich in X- und Y-Richtung erstrecken, und bei dem das Vlies aus einem komprimierten und gehärteten ineinandergreifenden Stapel von Schichten (7) gebildet ist, die jeweils aus einer im Luftstrom gelegten primären Bahn (7) aus künstlichen glasartigen Fasern gebildet sind und die ein Bindemittel enthalten, und wobei jede Schicht (7) bei Betrachtung im Querschnitt entlang der X-Richtung im wesentlichen parallel zu den Außenseiten ist, die Schichten (7) relativ zueinander in Y-Richtung regelmäßig versetzt sind, jede Schicht (7) bei Betrachtung im Querschnitt entlang der Y-Richtung schräg zu den Außenseiten steht,
dadurch gekennzeichnet, dass die Schichten (7) sich zwischen den Außenseiten (30, 31) als kontinuierliche Schichten in der ganzen X-Richtung erstrecken,
 die Länge in der Richtung X mindestens 3 Meter beträgt und größer ist als die Breite in der Richtung Y, und das Vlies in Form einer komprimierten und gepackten Rolle vorliegt, deren Achse sich in Y-Richtung erstreckt.
2. Vlies nach Anspruch 1, bei dem die X-Richtung eine Länge von 4 bis 8 Meter aufweist.
3. Vlies nach Anspruch 1, bei dem jede Schicht in dem Vlies ein Gewicht von unter 550 g/m², bevorzugt 100 bis 400 g/m², aufweist.
4. Vlies nach irgendeinem vorhergehenden Anspruch, das nach Aufrollen und Gleichgewichtsausbildung eine Dicke von 50 bis 250 mm (bevorzugt 80 bis 180 mm) und eine Dichte von 5 bis 50 kg/m³ (bevorzugt 15 bis 40 kg/m³) aufweist.
5. Vlies nach irgendeinem vorhergehenden Anspruch, bei dem die Länge in der Richtung X mindestens das doppelte der Breite in der Richtung Y beträgt.
6. Verfahren zur Herstellung eines Vlieses nach irgendeinem vorhergehenden Anspruch, umfassend Zerfasern einer mineralischen Schmelze auf einer Schleuderzerfaserungsvorrichtung und **dadurch** Bilden einer Wolke aus von Luft mitgeführten Fasern,
 Zugeben von härtbarem Bindemittel in die Wolke,
 Befördern der Wolke von der Schleudervorrichtung vorwärts in einem Luftstrom,
 Sammeln der Wolke aus Fasern als primäre Bahn auf einer sich im wesentlich kontinuierlich bewegen-

den Sammelvorrichtung,
Transportieren der Bahn zu einer Stelle des kreuz-
weise Aufeinanderlegens,
kreuzweises Aufeinanderlegen einer Mehrzahl von
Schichten der Bahn, während das sich ergebende
Endlosvlies im wesentlichen kontinuierlich weg von
der Stelle des kreuzweise Aufeinanderlegens ent-
lang der Y-Richtung des Vlieses befördert wird,
Härten des Bindemittels durch Hindurchleiten des
Vlieses durch einen Härtungssofen und
Schneiden des Endlosvlieses entlang der X-Rich-
tung (quer zur Y-Richtung des Endlosvlieses) in
Stücke vor, während oder nach dem Härten und
Packen jedes Stücks als komprimierte Rolle,
dadurch gekennzeichnet, dass das Endlosvlies
und jedes der Stücke eine Länge in der X-Richtung
von mindestens 3 Meter, bevorzugt 4 bis 8 Meter,
aufweisen und die Breite des Härtungssofens minde-
stens 3 Meter, bevorzugt 4 bis 8 Meter, ist und die
Breite von jedem Stück in Y-Richtung kleiner als die
Länge in der X-Richtung ist.

7. Verfahren nach Anspruch 6, in welchem die primäre
Bahn eine Breite von mindestens 3 Meter, bevorzugt
4 bis 8 Meter, aufweist.
8. Verfahren nach irgendeinem vorhergehenden An-
spruch, in welchem die Schleuderzerfaserungsvor-
richtung eine oder mehrere Zentrifugal-Kaskaden-
schleudervorrichtungen umfasst, die jeweils einen
ersten Rotor und einen oder mehrere folgende Ro-
toren umfassen, die jeweils zur Rotation um eine im
wesentlichen horizontale Achse montiert sind.

Revendications

1. Nappage de fibres vitreuses allongées et liaison-
nées, faites par l'homme, qui a une direction dans
le sens de la longueur X et une direction dans le sens
de la largeur Y et qui a des faces supérieure et infé-
rieure (30, 31) qui s'étendent dans les directions X
et Y, et dans lequel le nappage est constitué d'un
empilement de couches (7) compressées, séchées
et enchevêtrées qui sont formées chacune d'un voile
principal (7) de fibres vitreuses air laid faites par
l'homme, qui comprend un agent liant et dans
lequel :

chaque couche (7) est sensiblement parallèle
aux faces quand on la regarde en coupe dans
le sens de la direction X ;
les couches (7) sont uniformément décalées les
unes par rapport aux autres dans la direction Y ;
chaque couche (7) est inclinée vers les faces
quand on la regarde en coupe dans le sens de
la direction Y,
caractérisé en ce que les couches (7) entre

les faces (30, 31) s'étendent sous la forme de
couches continues dans la direction X ;
la longueur dans la direction X est d'au moins 3
mètres et elle est supérieure à la largeur dans
la direction Y ;
et le nappage se présente sous la forme d'un
rouleau compressé et conditionné dont l'axe
s'étend dans la direction Y.

2. Nappage selon la revendication 1, dans lequel la di-
rection X a une longueur de 4 à 8 mètres.
3. Nappage selon revendication 1, dans lequel chaque
couche du nappage a un poids de moins de 550
g/m², de préférence de 100 à 400 g/m².
4. Nappage selon l'une quelconque des revendications
précédentes et qui a, après déroulage et équilibra-
tion, une épaisseur de 50 à 250 mm (de préférence
de 80 à 180 mm) et une densité de 5 à 50 kg/m² (de
préférence de 15 à 40 kg/m²).
5. Nappage selon l'une quelconque des revendications
précédentes, dans lequel la longueur dans la direc-
tion X est au moins le double de la largeur dans la
direction Y.
6. Procédé de fabrication d'un nappage selon l'une
quelconque des revendications précédentes, com-
prenant les étapes consistant à :

décomposer en fibres un minéral fondu sur un
appareil de décomposition en fibres centrifuge
et former ainsi un nuage de fibres entraînées
dans l'air ;
incorporer un agent liant polymérisable dans le
nuage ;
déplacer le nuage vers l'avant à partir du filateur
dans un flux d'air ;
collecter le nuage de fibres en tant qu'un voile
principal sur un collecteur de déplaçant sensi-
blement en continu ;
transporter le voile vers une position de recou-
vrement en croix ;
recouvrir de façon croisée une pluralité de cou-
ches du voile tout en déplaçant de manière sen-
siblement en continu le nappage continu ainsi
obtenu à l'écart de la position de recouvrement
en croix dans le sens de la direction Y du
nappage ;
faire sécher l'agent liant en faisant passer le
nappage dans un four de séchage ; et
découper le nappage continu dans le sens de
la direction X (la direction transversale par rap-
port à la direction Y du nappage continu) en piè-
ces, avant, pendant ou après le séchage ; et
conditionner chaque pièce sous la forme d'un
rouleau compressé,

caractérisé en ce que le nappage continu et chacune des pièces ont une longueur dans la direction X de, et que la largeur du four de séchage est au moins de 3 mètres, de préférence de 4 à 8 mètres, et que la largeur de chaque pièce dans la direction Y est inférieure à la longueur dans la direction X. 5

7. Procédé selon la revendication 6, dans lequel le voile principal a une largeur d'au moins 3 mètres, de préférence de 4 à 8 mètres. 10

8. Procédé selon l'une quelconque des revendications précédentes, dans lequel l'appareil de décomposition en fibres centrifuge comprend un ou plusieurs filateurs centrifuges agencés en cascade, qui comprennent chacun un premier rotor et un ou plusieurs rotors successifs qui sont montés chacun pour une rotation autour d'un axe sensiblement horizontal. 15

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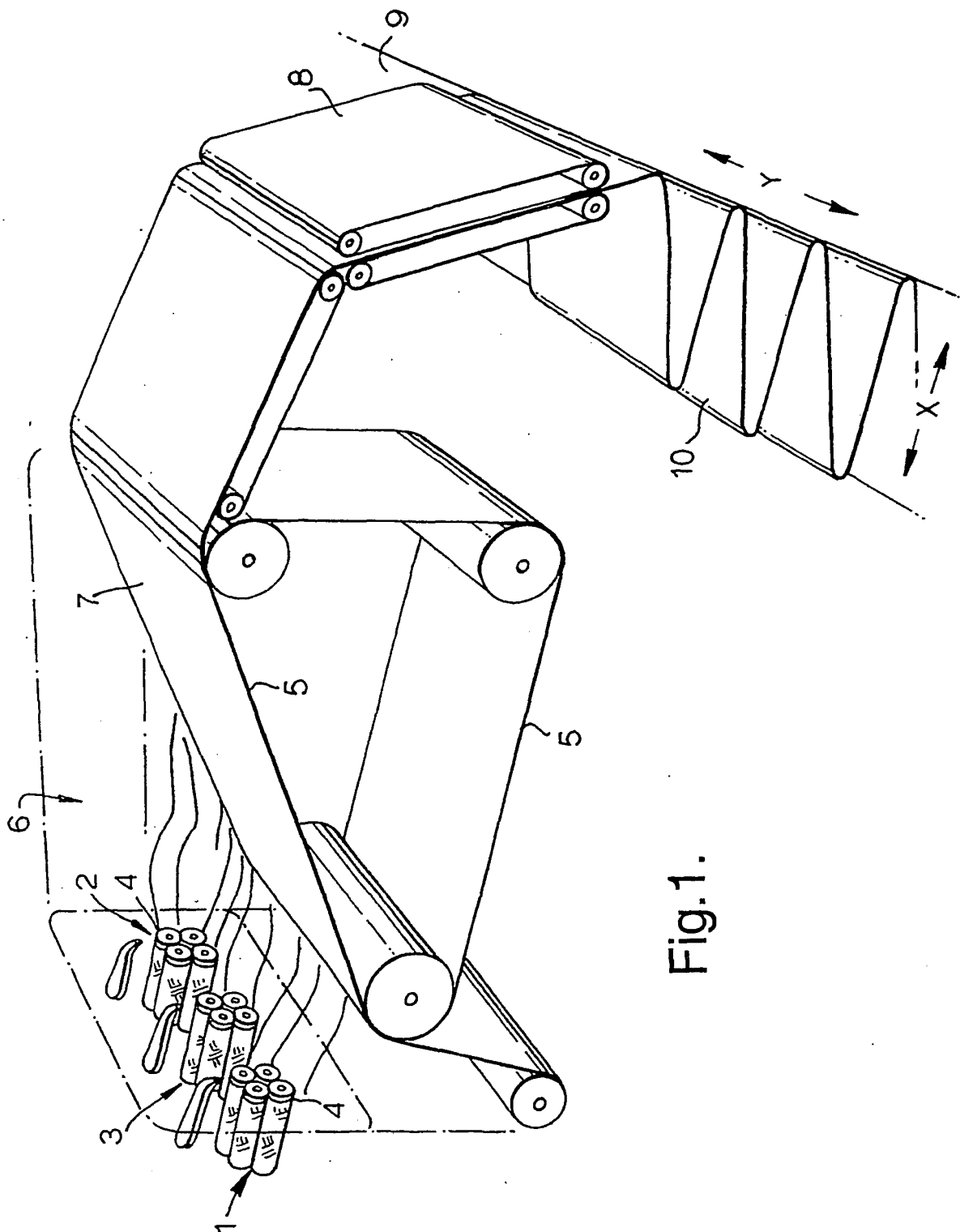


Fig.1.

Fig.2.

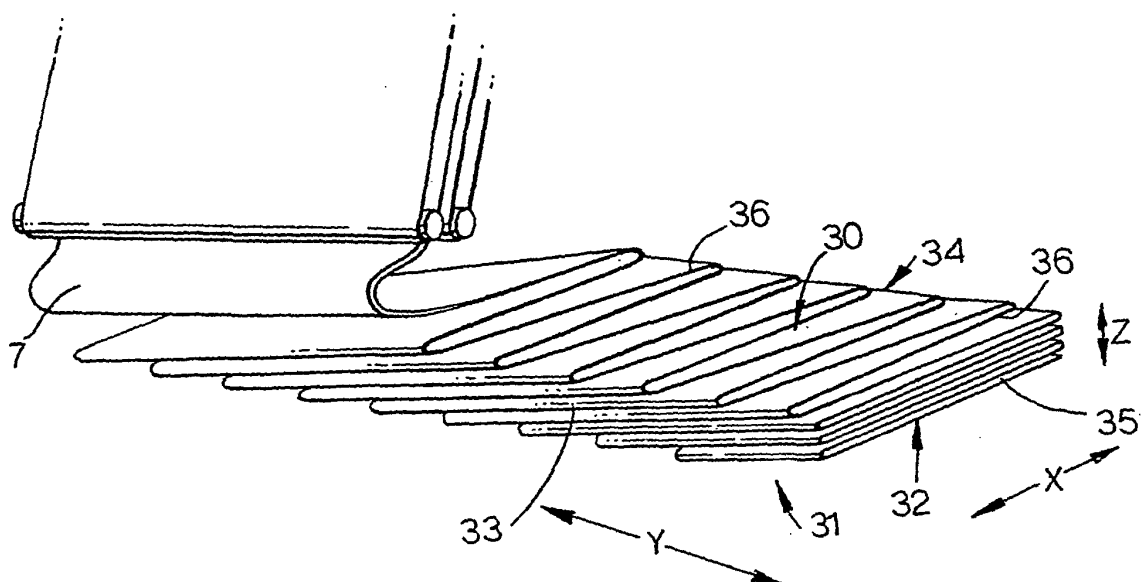


Fig.3.

