

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11)

EP 1 293 616 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
01.12.2004 Bulletin 2004/49

(51) Int Cl.7: **E04B 1/74**, D04H 1/70

(21) Application number: **01122132.2**

(22) Date of filing: **14.09.2001**

(54) **Method for the manufacturing of a mineral wool product and mineral wool product**

Verfahren zur Herstellung eines Mineralwolleproduktes und Mineralwolleprodukt

Procédé de fabrication de produits en laine minérale et produit en laine minérale

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE TR**

(43) Date of publication of application:
19.03.2003 Bulletin 2003/12

(73) Proprietor: **SAINT-GOBAIN ISOVER
92400 Courbevoie (FR)**

(72) Inventor: **Hojholt, Susanne
7000 Fredericia (DK)**

(74) Representative:
**GROSSE BOCKHORN SCHUMACHER
Patent- und Rechtsanwälte
Forstenrieder Allee 59
81476 München (DE)**

(56) References cited:
**WO-A-97/36034 US-A- 4 632 685
US-A- 5 671 518**

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

EP 1 293 616 B1

Description

[0001] The present invention concerns a method for the manufacture of a mineral wool product, especially a mineral wool board in accordance with the description of Claim 1, and also concerns a mineral wool product, especially a mineral wool board, in accordance with the description of Claim 6 hereinbelow. The invention relates in particular to glass wool products and their manufacture.

[0002] Mineral wool products, especially when made of glass wool or rock wool, are mainly used for heat insulation purposes and, more particularly, the heat insulation of buildings in the area of roofs, walls and ceilings. To this end the mineral wool sheeting strips or mineral wool boards are laid between rafters or beams and, whenever necessary, attached to the rafters or beams by appropriately tacking the projecting edges of aluminium linings; alternately, they may be inserted between the rafters and beams by means of a pressure fit, in which case there is no need to fix them mechanically.

[0003] However, the heat insulation of roofs and the like gives rise to problems by virtue of the fact that very often the distance between the rafters or beams is not the same, but rather tends to differ even in one and the same building, so that it becomes necessary for the heat insulation board or strip that is to be inserted between the rafters or beams to be specially designed or prepared for these different distances between the beams or rafters.

[0004] In this connection it is known that heat insulation sheeting, which is usually supplied in the form of rolls, can be produced and kept in stock in finely graduated nominal widths, so that an appropriate nominal width of sheeting can always be selected in accordance with the particular distance between the rafters. But this leads to corresponding cutting wastes. Furthermore, the need for making the sheeting available in such graduated nominal widths requires large quantities of the individual products to be kept in stock, and this in itself represents a considerable disadvantage.

[0005] An ingenious solution envisages the use of so-called crimped felts, i.e. mineral wool sheeting of higher flexural rigidity, rolled up under pressure at the production works to save space and provided on at least one of the large surfaces with transverse markings in band form or the like, which can be used as guides for cutting the sheeting. Appropriate lengths of the mineral wool sheeting can then be cut either along or parallel to these transverse markings, the lengths of the sections being always made equal to the clear distance between the rafters plus a small excess. The sections are thus individually adapted to the rafters. Given the higher flexural rigidity, moreover, once the sheeting has been unrolled, the cut sections are always available in board form, as it were, and this led to the coinage of the slogan "a board from a roll"; furthermore, the fact that the oversized mineral wool sections are pressure-fitted into the space be-

tween the rafters makes sure that the heat insulation will be devoid of gaps even at the points where the sheeting bears against the rafters or beams.

[0006] US 5,671,518 discloses a method for processing mineral wool mats, comprising the steps of producing fibres, providing a binder, depositing that fibres in the form of a laminar mat on a production line and crimping that laminar mat by introducing forces parallel to a surface of the laminar mat and in a direction of movement of the laminar mat before the binder hardens.

[0007] Document WO 97/36034 discloses a mineral wool product comprising layers of different densities bonded to each other.

[0008] There is also a need for alternative mineral wool products that can be used for heat insulation between rafters or beams. The invention therefore sets out to create a mineral wool product that will not give rise to cutting wastes and be characterized by a carefully balanced relationship between flexibility and flexural rigidity, the aim being, in particular, to create a method that will make it possible to set this relationship between the flexibility and the flexural rigidity in an appropriate and simple manner. The mineral wool board created in this manner should be simple to handle, assure a wide range of possible uses due to the possibility of a quasi-inherent tolerance compensation and should also be particularly suitable for being fixed in the space between rafters or beams when buildings have to be insulated. In particular, the invention should assure a firm seating of the mineral wool board and close contact with the adjacent rafters or beams; perfect heat insulation also requires the seating to be free of heat bridges.

[0009] In accordance with the invention, this task is solved by the features set out in Claim 1 as far as the method is concerned, while in the case of the mineral wool product it is solved by the features set out in Claim 6.

[0010] Advantageous further developments of both the method and the mineral wool product are set out in the respective dependent claims.

[0011] In accordance with the invention a method for the manufacture of the mineral wool product as per the invention is characterized by the fact that, prior to being hardened, at least one section that delimits one of the two principal faces of the board or sheeting strip is subjected to a so-called crimping process, a kind of crushing respectively upsetting, in the longitudinal direction. Owing to this process the fibres in this section tend to fold and assume an up and down pattern, whereas the fibres in the adjacent section lying above it substantially retain their original orientation, i.e. the fibre orientation in this section remains essentially parallel to the two principal faces. The crimping process produces a higher density in the section that has been crimped and this section will also be characterized by greater compressibility (a kind of crinkled zone), whereas the properties of the adjacent layer or section, which has not been crimped, will not have been modified and therefore remain substantially

as before. This produces the desired balanced relationship between flexibility and flexural rigidity, a feature that is further facilitated by the enhanced density produced by the crimping process.

[0012] For the purposes of the invention it will be advantageous to subject only a single section to the crimping process, in particular, one of the sections that delimit one of the principal faces and extend over the entire length of the board or sheeting.

[0013] The crimping process can be advantageously performed by means of conveyers arranged in sequence and operated at different speeds and, more precisely, at gradually diminishing speeds. A kind of rippling or goffering effect will thus be obtained at the interface between adjacent conveyers operated at different speeds, because the upstream conveyer will supply more mineral wool than is taken away by its downstream counterpart. In this connection it will be advantageous if the conveyers are arranged below the mineral wool sheeting, because in that case the self-weight of the lower section of the mineral wool sheeting will subject it to the desired crimping process in a very controlled manner. In general principle two conveyers operated at different speeds would be sufficient for the desired crimping process to be rendered possible, but it will be more appropriate to provide four such conveyers and, whenever necessary, more than four may also be provided. Particularly advantageous is the use of endless conveyor belts. If necessary, above the conveyor unit made up of the conveyers with gradually diminishing speeds there may be arranged a conveyor or several conveyers to act almost as a holder-up or counter-pad, in which case the crimping process may be carried out by the conveyers in contact with the upper face of the mineral wool sheeting.

[0014] A uniform rippling effect will be obtained when the conveyor speeds also diminish in a uniform manner. The greater the speed difference between successive conveyers, the more intense will be the crimping process.

[0015] It will be appropriate for the speed of the fastest conveyor of the conveyor sequence to be about 20% greater than the speed of the hardening kiln, while the speed differences between successive conveyers should be of the order of 4%. The length of the carrying run of the diminishing-speed conveyor sequence can also be used as a control parameter for the crimping process. The shorter the carrying run of these conveyers, the more intensive will be the crimping process and the resulting crimping structure. The thickness of the section with the crushed fibres can likewise be determined by means of an appropriate choice of the length of the conveyor belts, but also the distance between the conveyers.

[0016] The mineral wool product in accordance with the invention, especially the mineral wool board, is characterized by the fact that it contains at least two sections with different fibre orientations, and it will be advanta-

geous if one of these sections delimits one of the principal faces of the board and if the said section has a fibre structure that has been produced by means of a crimping process. It will also be advantageous for the mineral wool product to be made up of only two sections with different fibre orientations. In that case the section that has been structured by means of the crimping process can account for up to 90% of the total product thickness, but in general its thickness will not exceed one third of this total thickness. In this way the product can be given the desired finely balanced relationship between the flexibility and the desired flexural rigidity.

[0017] A preferred implementation example will now be described with the help of two figures, of which

Figure 1 shows the mineral wool board in accordance with the invention in its built-in position between two beams of a ceiling, and

Figure 2 shows a side view of a conveyor system to explain the manufacturing method in accordance with the invention.

Both figures are purely schematic and not to scale.

[0018] As is the normal practice in mineral wool production, the mineral wool board 1 shown in Figure 1 is formed by cutting a certain length of mineral wool sheeting that was produced by collecting mineral wool fibres on a conveyor belt, adding a binding agent and then passing the whole through a kiln (furnace) for hardening. When mineral sheeting is produced in this manner, the greater part of the fibres are oriented parallel to the conveyor belt surface on which they are collected and therefore parallel to the two principal faces of the sheeting. In Figure 1 the two principal faces of the mineral wool board have been assigned the numbers 2 and 3.

[0019] As schematically shown in Figure 1, the mineral wool board 1 of the illustrated implementation example consists of two sections with different fibre alignments or orientations, namely a section 4 that delimits or constitutes the upper principal face 2 of the board 1 and a lower section 5 that delimits or constitutes the opposite principal face 3 of the board 1. Due to the described method of producing the sheeting, the fibres in the upper section 4 are substantially parallel to the two principal face 2 and 3. The fibres in the lower section 5, on the other hand, are rippled and/or folded in the manner of a meandering river, a state of affairs that is obtained by means of the crimping process to be described with the help of Figure 2. It can be seen that the fibres in the lower section 5 are no longer predominantly parallel to the principal faces of the board, the fibres being rather characterized by an up and down pattern and a limited parallel alignment, so that the structure in a certain sense can be broadly described also as a wave-like structure. Owing to this fibre pattern, the flexibility of board 1 is rather greater than that of a board in which all the fibres are substantially parallel to the principal faces. Owing to the partial crimping process, moreover,

section 5 will have a greater density and this, in its turn, constitutes an advantage inasmuch as it enhances the rigidity, a desired feature that facilitates handling when the mineral wool board has to be inserted or pressed into the space between rafters or beams and also has favourable effects on the contact between the board and the rafters or beams. The board is therefore particularly suitable whenever the board does not have to be self-supporting in retaining its positions between the rafters or beams, but the rafters or beams have some kind of closure on their underside, wooden boarding for example, in which case the mineral wool board 1 can be inserted from above.

[0020] In the implementation example illustrated in Figure 1 the upper section 5, which has undergone the additional crimping treatment, and the lower section 4, which has not undergone this treatment, are of roughly the same thickness, so that the thickness of the upper section 4 and the thickness of the lower section 5 account for roughly 50% of the total board thickness each. It should however be noted that the transition between the treated section 5 and the untreated section 4, where the fibres have remained substantially parallel to the principal faces of the board, is gradual, i.e. the passage from the rippled fibres of the treated section 5 to the parallel alignment of the fibres of the untreated section 4 is not sudden, but the rippled and more or less wavelike or up and down pattern of the fibres tends to flatten in the direction of the parallel alignment and to constitute a transition section, as has been roughly indicated in Figure 1. The intensity of the crimping process can be regulated by appropriate setting of the operating parameters and the rippling of the fibres can therefore be made either more or less pronounced.

[0021] By way of example, the mineral wool board 1 shown in Figure 1, which may in particular be made of glass wool, has a length L (prior to being built in) of 980 mm and a width of 600 mm. The thickness of the illustrated implementation example amounts to 150 mm. These values may however be freely chosen according to the particular application and are not to be understood as limitative in any way. In actual fact the dimensions of the board or the sheeting can be chosen to match the proposed application. As brought out by a comparison between the board as such (upper part of the figure) and the board in its built-in position (lower part of the figure), the board 1 is made available in such a way that its length L, here 980 mm, is slightly greater than the clear distance between the rafters. When the board 1 has to be built in, it is first compressed in the longitudinal direction and then pressed between the beams 6 of a ceiling 7, the clear distance between the beams amounting to 960 mm. This means that the board is kept in position between the beams 6 by means of the pressure fit caused by the elastic restoring force built up during the insertion operation. The excess length $\ddot{U}$ is indicated in Figure 1 and in this particular case amounts to about 2% of the length L of the board 1. When boards have to

be inserted between rafters or beams, it will generally be appropriate to work with excess lengths $\ddot{U}$ in the range between 1.5 and 5%.

[0022] Figure 2 shows the customary conveyor belt 8 transporting a strip or blanket 10 of mineral wool sheeting on its carrying run 9; the said mineral wool strip comes from the mineral wool production plant and the adjustable calibration roll 10' is used to bring it to the required thickness. As a general rule, the sheeting will then pass over the two conveyers 11 and 12 of a hardening kiln, where the binding agent is hardened to form the finished mineral wool sheeting strip.

[0023] With a view to forming the mineral wool board or sheeting in accordance with the present invention, however, at least two and preferably four additional conveyers 14-17 (as shown in the figure) have to be provided before the hardening kiln 13, the said conveyers being here shown as endless belt conveyers. These conveyor belts are here arranged below the mineral wool strip or blanket 18 that is being taken to the hardening kiln 13, so that the mineral wool strip 17 is being carried on these conveyers 14-17 until just before it enters the hardening kiln 13. These conveyers are arranged in immediate sequence and each downstream conveyor, say the conveyor 14, is operated at a smaller speed than the immediately following upstream conveyor, here the conveyor 15. This means that the speed of the conveyers 17-14 gradually diminishes from conveyor 17 to conveyor 14 and in the implementation example here illustrated the reduction from conveyor 17 to conveyor 14 is effected in three identical steps. But such a uniform speed reduction from one conveyor to the next is not by any means obligatory. Rather, the successive speed reductions may differ, always provided that the consequent differences in the crimping structure are desired. In the implementation example here shown, if we take the transporting speed of the conveyers to be 100%, it will be appropriate for the conveyor 17 to be operated at a speed of 116% and the three subsequent conveyers at speeds of, respectively, 112%, 108% and 104%. In this case the conveyor 8 will be operated at 120%, so that advantageously there will be five transitions between conveyers operated at different speeds. This will produce the staged rippling structure with the up and down pattern of the fibres shown and described in Figure 1.

[0024] If necessary and as shown in Figure 2, use may also be made of a conveyor 19 arranged above the mineral wool sheeting strip and the conveyers 14-17 or also several such conveyers arranged in sequence, though all these conveyers will have to be operated at the same speed if interference with the essentially parallel alignment of the fibres in the upper section of the mineral wool strip is to be avoided. Nevertheless, such upper conveyers can also be used to crimp the mineral wool strip and thus to modify its fibre structure. But even when such upper conveyers are installed, the crimping process can also be carried out without them, for all that

has to be done is to set them at a certain distance from the upper face of the mineral wool strip carried on the conveyers 14-17 .

[0025] As can be seen, the method in accordance with Figure 2 can be used to produce an endless mineral wool strip with a desired crimping structure in the lower section, though it is equally possible to produce strips or boards of limited length. It will however be advantageous to produce an endless strip, in which case the required mineral wool boards can be obtained by appropriately sectioning the strip as it leaves the hardening kiln.

[0026] Overall, the mineral wool product in accordance with the invention makes it possible to provide heat insulation between rafters and beams without wasting material, since this product, given the partial crimping process to which it has been subjected, possesses an appropriate crinkling zone and can therefore compensate 1.5 - 5% of the clear distance between the rafters or beams without any problems. Lastly, the slight loss suffered by the so-called λ -value as a result of the fibre realignment caused by the crimping process is compensated by the fact that the initial gross density - which may lie in the range between 8 and 30 kg/m³, and particularly between 15 and 20 kg/m³ - is stepped up by about 0.5 kg/m³ as a result of the crimping process.

Claims

1. A method for the manufacture of a mineral wool product, especially a mineral wool board, in which the mineral wool fibres are collected on a conveyor, receiving the addition of a binding agent, to form a board or a sheeting strip, the alignment of the said fibres being substantially parallel to the two principal faces of the board or strip or the collection surface of the conveyor, and in which the board or strip is subsequently hardened, **characterized in that** only one of the two sections (4, 5) delimiting the principal faces (2, 3) of the board or strip is subjected to a crimping process before being hardened.
2. A method in accordance with claim 1, **characterized in that** with a view to triggering the crimping process the board or strip is passed over at least two conveyers (14-17), preferably belt conveyers, that are operated at different speeds, each downstream conveyor (14) being operated at a smaller speed than the conveyor (15) situated immediately upstream of it.
3. A method in accordance with any one of claims 1 or 2, **characterized in that** four or five conveyers (14-17) are arranged in sequence and operated at different speeds.
4. A method in accordance with any one of the preceding claims, **characterized in that** the operating speeds of successive conveyers are uniformly reduced.
5. A method in accordance with any one of the preceding claims, **characterized in that** the operating speed of the fastest conveyor is about 20% greater than the speed of the conveyor belts (11, 12) of the hardening kiln (13).
6. A mineral wool product, especially a mineral wool board for the heat insulation of roofs, walls and ceilings, wherein the board (1) consists of at least two sections (4, 5) with different fibre orientations, that the sections (4, 5) with different fibre orientation extend parallel to the two opposite principal faces (2, 3) of the product or the board, and that one of the sections (5) delimits one of the principal faces (3) and the fibres in this section (5) are rippled and/or curled and/or form meanders in the longitudinal direction, **characterized in that** the transition from one (5) of the at least two sections (4, 5) with different fibre orientations, which is crimped, to the other (4), non-crimpled section of the sections with different fibre orientations is not jump-like and takes place gradually.
7. A mineral wool product in accordance with claim 6, **characterized in that** the fibres in the section (4) delimiting the other principal face (2) are substantially aligned parallel to the plane of the principal face (2, 3).
8. A mineral wool product in accordance with any one of claims 6 or 7, **characterized in that** the product consists of only two sections with different fibre orientation.
9. A mineral wool product in accordance with any one of claims 6 to 8, **characterized in that** the gross density amounts to 8-30 kg/m³, especially 15-20 kg/m³.
10. A mineral wool product in accordance any one of claims 6 to 9, **characterized in that** the section (5) has a thickness of up to 90% of the total product thickness, especially up to one third of the said product thickness.
11. A mineral wool product in accordance any one of claims 6 to 10, **characterized in that** the gross density of the crimped section (5) is about 6-8% greater than the gross density of the non-crimpled section (4).
12. A mineral wool product in accordance any one of claims 6 to 11, **characterized in that** the fibre orientation in the crimped section (5) is formed by a

predominantly meander- or wavelike structure (fibres up and down with respect to the plane parallel to the two principal faces).

13. A mineral wool product in accordance any one of claims 6 to 12, **characterized in that** when the mineral wool board (1) is to be built in between rafters or beams, it is made available with a length that exceeds the clear distance between the rafters or beams by between 1.5 and 5.0 %, preferably 2 %

Patentansprüche

1. Verfahren zur Herstellung eines Mineralwolleproduktes, insbesondere einer Mineralwolleplatte, bei dem die Mineralwollefasern unter Bindemittelzugabe auf einem Förderer zur Bildung einer Platte oder Bahn gesammelt werden, wobei die Fasern im wesentlichen parallel zu den beiden großen Hauptflächen bzw. zur Sammelfläche des Förderers gerichtet sind, und bei dem die Platte oder Bahn danach ausgehärtet wird, **dadurch gekennzeichnet, dass** nur einer der beiden die großen Hauptflächen (2, 3) begrenzenden Abschnitte (4, 5) der Platte oder Bahn einem Crimping-Prozess unterzogen wird.
2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** die Platte oder Bahn zum Einleiten des Crimping-Prozesses über mindestens zwei hintereinander angeordnete Förderer (14-17), vorzugsweise Förderbänder geführt wird, deren Fördergeschwindigkeit divergiert, wobei jeweils der stromabwärtige Förderer (14) mit geringerer Fördergeschwindigkeit umläuft als der hierzu stromaufwärtig angeordnete Förderer (15).
3. Verfahren nach einem der Ansprüche 1 oder 2, **dadurch gekennzeichnet, dass** vier oder fünf hintereinander geschaltete Förderer (14-17) mit divergierender Fördergeschwindigkeit vorgesehen sind.
4. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die divergierenden Fördergeschwindigkeiten gleichmäßig abgestuft sind.
5. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Fördergeschwindigkeit des schnellsten Förderers etwa 20 % größer als die der Förderbänder (11, 12) des Aushärtetofens (13).
6. Mineralwolleprodukt, insbesondere Mineralwolleplatte für die Wärmedämmung von Dächern, Wänden und Decken, wobei die Platte (1) mindestens zwei Abschnitte (4, 5) mit unterschiedlicher Faserorientierung aufweist, sich die Abschnitte (4, 5) mit

unterschiedlicher Faserorientierung parallel zu den beiden großen gegenüberliegenden Hauptflächen (2, 3) des Produkts bzw. der Platte erstrecken, und dass einer der Abschnitte (5) eine der Hauptflächen (3) begrenzt und die Fasern in diesem Abschnitt (5) längsgestaucht und/oder gekräuselt und/oder mäanderartig sind, **dadurch gekennzeichnet, dass** der Übergang von einer (5) der wenigsten zwei Abschnitte (4, 5) mit unterschiedlicher Faserorientierung, welche gecrimpt ist, gegenüber dem anderen (4), nicht gecrimpten Abschnitt der Abschnitte mit unterschiedlicher Faserorientierung, fließend, d. h. allmählich ist.

7. Mineralwolleprodukt nach Anspruch 6, **dadurch gekennzeichnet, dass** die Fasern in dem die andere Hauptfläche (2) begrenzenden Abschnitt (4) im wesentlichen parallel zur Ebene der Hauptflächen (2, 3) gerichtet sind.
8. Mineralwolleprodukt nach einem der Ansprüche 6 oder 7, **dadurch gekennzeichnet, dass** das Produkt nur zwei Abschnitte (4, 5) mit unterschiedlicher Faserorientierung aufweist.
9. Mineralwolleprodukt nach einem der Ansprüche 6 bis 8, **dadurch gekennzeichnet, dass** die Rohdichte 8-30 kg/m³, insbesondere 15-20 kg/m³ beträgt.
10. Mineralwolleprodukt nach einem der Ansprüche 6 bis 9, **dadurch gekennzeichnet, dass** der Abschnitt (5) eine Dicke bis zu 90 % der Produktdicke aufweist, insbesondere bis zu 1/3 der Produktdicke ausmacht.
11. Mineralwolleprodukt nach einem der Ansprüche 6 bis 10, **dadurch gekennzeichnet, dass** die Rohdichte des gestauchten Abschnitts (5) etwa 6-8 % größer als die Rohdichte des ungestauchten Abschnitts (4) ist.
12. Mineralwolleprodukt nach einem der Ansprüche 6 bis 11, **dadurch gekennzeichnet, dass** die Faserorientierung im gestauchten Abschnitt (5) durch eine überwiegend mäanderartige oder wellenartige Struktur (Auf und Ab der Fasern aus der Ebene parallel zu den beiden Hauptflächen) gebildet ist.
13. Mineralwolleprodukt nach einem der Ansprüche 6 bis 12, **dadurch gekennzeichnet, dass** die Mineralwolleplatte (1) für den Einbau zwischen Sparren oder Balken mit einem Übermaß von 1,5-5, vorzugsweise 2 % gegenüber dem lichten Maß zwischen den Sparren und Balken bereitgestellt ist.

Revendications

1. Procédé de fabrication d'un produit de laine de roche, spécialement d'une plaque de laine de roche, dans lequel les fibres de laine de roche sont collectées sur un convoyeur, recevant l'adjonction d'un agent liant pour former une plaque ou une bande de revêtement, l'alignement desdites fibres étant essentiellement parallèle aux deux faces principales de la plaque ou de la bande ou à la surface de collecte du convoyeur, et dans lequel la plaque ou la bande est ultérieurement durcie, **caractérisé en ce que** seule l'une des sections (4,5) délimitant les faces principales (2, 3) de la plaque ou de la bande est soumise à un processus d'ondulation avant d'être durcie. 5
2. Procédé selon la revendication 1, **caractérisé en ce qu'en** vue de déclencher le processus d'ondulation, la plaque ou la bande passe sur au moins deux convoyeurs (14, 17), de préférence des convoyeurs à bande, qui sont actionnés à des vitesses différentes, chaque convoyeur aval (14) étant actionné à une vitesse plus petite que le convoyeur (15) situé immédiatement en amont. 10 20
3. Procédé selon l'une quelconque des revendications 1 ou 2, **caractérisé en ce que** quatre ou cinq convoyeurs (14 - 17) sont disposés successivement et actionnés à des vitesses différentes. 25 30
4. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce que** les vitesses de fonctionnement des convoyeurs successifs sont réduites de façon uniforme. 35
5. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce que** la vitesse de fonctionnement du convoyeur le plus rapide est d'environ 20% supérieure à la vitesse des convoyeurs à bande (11, 12) du four de durcissement (13). 40 45
6. Produit en laine de roche, spécialement plaque de laine de roche destinée à l'isolation thermique de toits, de parois et de plafonds, dans lequel la plaque (1) est constituée d'au moins deux sections (4, 5) présentant des orientations de fibres différentes, en ce que les sections (4, 5) ayant une orientation de fibres différente s'étendent parallèlement aux deux faces principales opposées (2, 3) du produit ou de la plaque, et en ce que l'une des sections (5) délimite l'une des faces principales (3) et en ce que les fibres de cette section (5) sont ondulées et/ou bouclées et/ou forment des méandres dans la direction longitudinale, **caractérisé en ce que** la transition de l'une (5) des au moins deux sections (4, 5) présentant des orientations de fibres différentes, laquelle est ondulée, à l'autre (4) section sans ondulation des sections présentant des orientations de fibres différentes, n'est pas brutale et se produit progressivement. 50 55
7. Produit en laine de roche selon la revendication 6 **caractérisé en ce que** les fibres de la section (4) délimitant l'autre face principale (2) sont essentiellement alignées parallèlement au plan de la face principale (2, 3).
8. Produit en laine de roche selon l'une quelconque des revendications 6 ou 7, **caractérisé en ce que** le produit est constitué de seulement deux sections présentant une orientation de fibres différente.
9. Produit en laine de roche selon l'une quelconque des revendications 6 à 8, **caractérisé en ce que** la densité globale s'élève de 8 à 30 kg/m³, spécialement de 15 à 20 kg/m³.
10. Produit en laine de roche selon l'une quelconque des revendications 6 à 9, **caractérisé en ce que** la section (5) présente une épaisseur allant jusqu'à 90% de l'épaisseur totale du produit, de façon spécifique atteignant jusqu'au tiers de ladite épaisseur du produit.
11. Produit en laine de roche selon l'une quelconque des revendications 6 à 10, **caractérisé en ce que** la densité globale de la section ondulée (5) est environ de 6 à 8% plus grande que la densité globale de la section sans ondulation (4).
12. Produit en laine de roche selon l'une quelconque des revendications 6 à 11, **caractérisé en ce que** l'orientation des fibres dans la section ondulée (5) est formée, de façon prédominante, par une structure en forme de vague ou de méandres (les fibres s'élevant et descendant par rapport au plan parallèle aux deux faces principales).
13. Produit en laine de roche selon l'une quelconque des revendications 6 à 12, **caractérisé en ce que**, lorsque la plaque de laine de roche (1) doit être encastree entre des chevrons ou des poutres, elle est fabriquée de façon disponible avec une longueur qui dépasse la distance nette entre les chevrons ou les poutres de 1,5 à 5,0%, de préférence, de 2%.

FIG.1

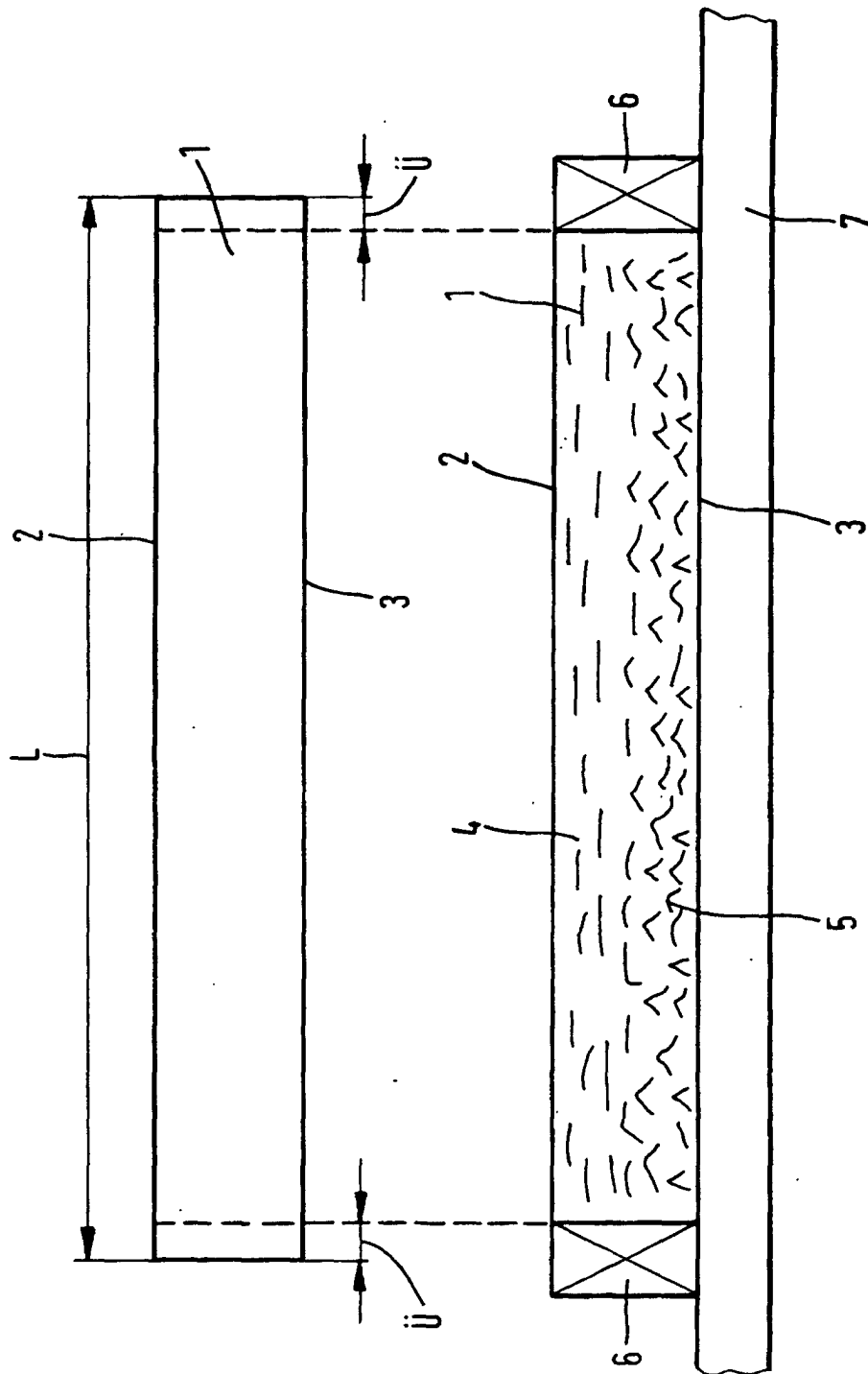


FIG. 2

