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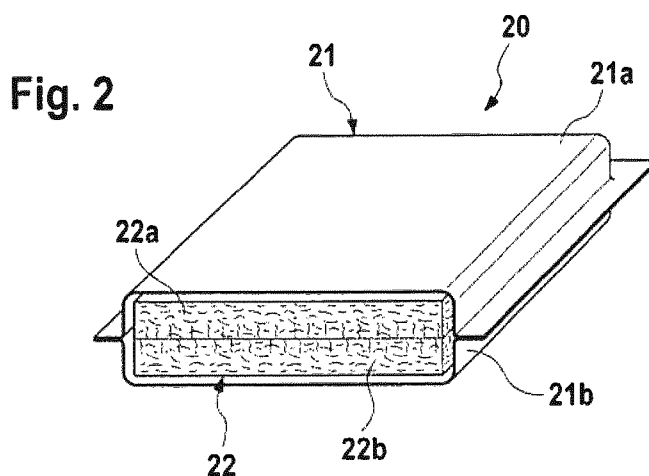
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(54) Title: VACUUM INSULATION PANEL WITH NEEDLE FELT CORE



(57) **Abstract:** The invention relates to a vacuum insulation panel (20) with a core (22) of fibers and a sleeve (21) in which the core (22) is available in the evacuated condition, wherein the core (22) comprises at least one needle felt with a plurality of fibers arranged predominantly in parallel to the large areas of the needle felt, and individual fibers at needling points which are arranged predominantly transversely to the large areas by a needling process and by which the fibers of the needle felt are fiber-mingled such that the needle felt is adapted to be handled as one element. The vacuum insulation panel (20) is characterized in that a near-surface region at at least one large area of the core (22) is substantially free from fibers arranged transversely to the large areas. Thus, a vacuum insulation panel (20) is obtained which maintains its insulating effect for a longer time than in the state of the art.



WO 2015/185643 A1

Description**Vacuum Insulation Panel with Needle Felt Core**

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The invention relates to a vacuum insulation panel with a core of fibers and a sleeve in which the core is available in the evacuated condition, wherein the core comprises at least one needle felt with a plurality of fibers arranged predominantly in parallel to the large areas of the needle felt, and individual fibers at needling points which are arranged
10 predominantly transversely to the large areas by a needling process and by which the fibers of the needle felt are fiber-mingled such that the needle felt is adapted to be handled as one element.

Such vacuum insulation panels are characterized by good heat insulation properties
15 with comparatively small insulation thickness. Therefore, they are used primarily in areas in which the space available is restricted. As examples, refrigerators, freezers or the like have to be mentioned. In addition, such vacuum insulation panels are, however, also used for the insulation of buildings.

20 The known vacuum insulation panels have in common that they comprise a core of an open porous body which is adapted to be evacuated. This core is accommodated in a foil sleeve and is available under vacuum there. Thus, the gas heat conduction as well as the convection is largely prevented inside such a vacuum insulation panel, so that heat losses occur predominantly by solid body conduction and heat radiation.

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As core materials, different open porous materials are used, such as for example foamed polyurethane or polystyrene, precipitated silica, pyrogenic silica, or the like. Due to the very low solid body heat conduction, fibers are also usual as a core material.

30 With the foil sleeves used, different modes of design are also common. Thus, composite plastic foils, e.g. in the form of a two-layer foil with a layer of HDPE of 150-200 μm and an aluminum layer of 6 to 20 μm are frequently used. Furthermore, multi-layer foils on a plastics basis are also known in which, for instance, several plastic foils

of 20 to 50 μm each are connected with one another by aluminizing, the layer thickness of which is typically less than 3 to 5 μm each. In the following, the multi-layer foils on a plastics basis will also be referred to as composite plastic foils. Such composite plastic foils have the advantage of being to provide at low cost and to process with little effort.

5 In particular the gas-tight sealing of the foil sleeve can, as a rule, be performed without problems with plastic materials since appropriate welding seams and/or sealing seams can be produced without problems. Moreover, such composite plastic foils define relatively insignificant thermal bridges in the edge-side connection area. Due to the insufficient diffusion resistance, pure plastic foils play a role with niche applications only.

10 They are basically unsuited for applications in which a useful life of the vacuum insulation panels of years or even decades is required, such as in the building sector.

A disadvantage of such composite plastic foil sleeves is, however, that they are not completely gas-tight. The gas molecules penetrating in the course of time will lead to a

15 rise of the inside pressure. Moisture that is also penetrating will lead to heat conduction in the interior of such vacuum insulation panels. Thus, the insulating effect may be reduced substantially in the long term. Another disadvantage of such plastic foil sleeves consists in the fact that they are relatively sensitive to mechanical damage. If such a mechanical damage occurs already during transportation and in the course of processing,

20 the vacuum is directly lost and the insulating effect is largely abolished.

An alternative are foil sleeves on the basis of metal foils such as, for instance, stainless steel foils. Such metal foils are largely gas-tight, so that an almost unlimited lifetime can be achieved. Moreover, they offer high resistance to mechanical damage.

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A disadvantage of such metal foil sleeves is, however, that quite substantial thermal bridges occur in the edge region due to the high thermal conductivity of the metal. They cause a distinct reduction of the insulating effect. Moreover, such metal foils are expensive to provide and complex to process. In particular, the welding of such metal foil

30 sleeves is associated with much more effort than is the case with plastic foils.

In the overall design of such vacuum insulation panels, the core serves as a support body, so that it is conventionally provided as a relatively dimensionally stable molded body. If a fiber material is used for the core, a fiber material is usually employed which does not contain any binder. Experience in practice has shown that negative effects are associated with the use of binders. If organic binders are used, they may disintegrate in the vacuum, so that the insulating effect then decreases due to increasing gas heat conduction. Although inorganic binders do not have this effect, they are difficult to handle and expensive.

For this reason, one has proceeded to use binder-free mineral wool. It is known to compress it under thermal effect to form the core. This processing, however, is energy-intensive. An alternative are needled fiber elements in the form of so-called needle felts. They are as a rule of binder-free design and are subjected to a mechanical needling process for producing sufficient inherent stability to be handled as one element. The fibers thus mingle with one another within the needle felt.

The fibers for such a needle felt are produced in a per se conventional manner by a defibration process of a mineral melting and are subsequently deposited on a collecting member. In doing so, a primary fleece is formed in which the individual fibers are arranged predominantly in parallel to the large areas of the fleece. No binder is added to the fibers, but needling aids, in particular so-called finishes, may be added. Due to the lacking binder, the structural coherence in this primary fleece is restricted. In a subsequent needling process, a plurality of needles is then introduced into the primary fleece through the large areas at predetermined needling points. These needles comprise barbed hooks by which individual fibers are seized and taken along. The fibers pulled more deeply into the needle felt in this manner produce a fiber mingling of the fleece and arrange themselves predominantly transversely to the large areas. Such a needling process is, as a rule, performed as a double needling at both large areas so as to ensure the structural integrity of the needle felt produced in this manner.

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An example of a vacuum insulation panel with a needle felt as a core has become known from CN 101 666 416 A. The needle felt comprises in the core an additional

lamination on at least one large area, wherein this lamination is glued with organic glue and is additionally fastened by a needling step. Such a multi-layer core, however, has the disadvantage that an organic binder is available in the vacuum insulation panel. This organic binder disintegrates over time, so that degassing takes place and the insulation effect deteriorates distinctly after a relatively short time already.

Another example of such a vacuum insulation panel has become known from EP 0 128 235 A1. The needle felt used here does not comprise any binder and is also fiber-mingled by a needling process. In practice it has turned out, however, that the insulating effect decreases over time with such a vacuum insulation panel, too, although no binder exists. The lifetime of such a vacuum insulation panel is thus surprisingly restricted.

In this respect it is also relevant that exactly core materials on the basis of fibers have very high demands on a permanent impermeability of the sleeve since such vacuum insulation panels suffer substantial loss of insulating effect with a relative low rise of the inside pressure already.

It is therefore an object of the invention to improve a vacuum insulation panel so that it maintains its insulating effect for a longer time than in the state of the art.

This object is solved by a vacuum insulation panel with the features of claim 1. It is characterized in particular by the fact that a near-surface region at at least one large area of the core is substantially free from fibers arranged transversely to the large areas.

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The present invention is therefore based on the approach that, despite their fineness and their relatively small quantity, the ends of the fibers in the core which are arranged transversely to the large areas due to the needling process are also responsible for an aggravation of the insulating effect of a vacuum insulation panel.

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Without being bound to a theory, the inventors assume that these fiber ends form quasi load peaks at the position of the sleeve which is in close contact therewith due to

the vacuum, and damage same in a subtle manner. This is particularly the case if, for instance, dynamic strains appear. These may i.a. occur by a vibration of the object in which the vacuum insulation panel is incorporated, for instance, in a refrigerator or the like. Then, the fiber ends will gradually bore themselves into the sleeves and reduce its
5 gas tightness. By the subtle loss of vacuum and/or the increase of inside pressure within the vacuum insulation panel related therewith, it will then lose its insulating effect quite considerably.

The present invention now suggests on the basis of these assumptions a new
10 configuration of the needle felt serving as a core such that substantially no fibers arranged transversely to the large areas are available at at least one large area. Thus, the risk of a subtle damage to the sleeve by such fibers does no longer exist at any rate at this large area. Consequently, the thermal insulation will be maintained in a reliable manner also in the long run. Hence, the lifetime of the vacuum insulation panel according to the invention
15 increases substantially as compared to the state of the art.

Another advantage of the needle felt designed in accordance with the invention consists in that the thermal bridges formed by the fibers relocated in the heat flow direction during the needling process will also be reduced. Thus, already after its
20 manufacturing the vacuum insulation panel according to the invention has a better heat insulation property than conventional vacuum insulation panels with continuously needed needle felts.

At the same time, the needle felt serving as a core further comprises the fibers
25 arranged transversely to the large areas in other regions and thus enables fiber mingling in the needle felt, so that it is adapted to be handled as one piece.

Such a needle felt may readily be produced with per se conventional methods and devices by being needled on one side only and not throughout the thickness of the needle
30 felt. Thus, a near-surface region at the large area opposite to the needling device will remain substantially free from relocated fibers and accordingly comprises predominantly

only the fibers oriented in parallel to the large area which enfold a particularly good insulating effect.

Alternatively, such a needle felt may be obtained in that it is needled on one side
5 across the entire thickness. In this case, too, a gradient is produced due to a decreasing
entrainment of fibers by the needles as the needles penetrate more deeply into the web to
be needled. Thus, the desired fiber orientation may also be implemented.

Advantageous further developments of the vacuum insulation panel according to
10 the invention are the subject matter of the dependent claims 2 to 8.

Thus, the near-surface region may also be substantially free from fibers arranged
transversely to the large areas at both large areas of the core. Damage to the sleeve due to
fibers oriented in this manner can then be avoided reliably on both large areas of the core.
15 This further increases the lifetime of the vacuum insulation panel. Above all, it is possible
to maintain the insulating effect for a very long time on a high level. Moreover, the
insulating effect is particularly advantageous with such a further developed vacuum
insulation panel since substantially no fibers in heat flow direction will then be available
in both near-surface regions at the large areas of the core.

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In this respect it is possible that the core is of two-layer design, wherein each layer
consists of a needle felt in which a near-surface region at a large area is substantially free
from fibers arranged transversely to the large areas, and wherein the two layers of needle
felt are arranged relative to each other such that their large areas comprising in the near-
25 surface region fibers arranged transversely to the large areas are facing each other. In this
way, the vacuum insulation panel according to the invention is particularly simple to
manufacture. For this purpose, for instance, two needle felts needled on one side down to
a predetermined needling depth, but not fully, may be used and may be arranged on top
of each other such that the cross-sectional areas substantially free from fibers arranged
30 transversely to the large areas are eventually available outside on the core thus formed
and are hence facing a sleeve. This can be done with little effort with respect to
manufacturing technology.

It is of further advantage to use a sleeve of a composite plastic foil or the like. Since in the vacuum insulation panel according to the invention the core comprises at least one large area substantially no fibers available transversely to the large area and hence to the sleeve, less robust sleeves that are more susceptible to mechanical strain than metal foils may readily also be used. This improves efficiency during the manufacturing of the vacuum insulation panels according to the invention and reduces in particular the manufacturing costs. At the same time, when using composite plastic foils, additional thermal bridges by the welded side edges of the sleeve, as they exist with metal foils, are also avoided. The insulating properties of the vacuum insulation panel according to the invention are thus further improved.

If the fibers are inorganic fibers, an insulating material that is well approved in practice is resorted to. Such inorganic fibers are characterized by a particularly long lifetime and duration with respect to the insulating effect. Moreover, they are not inflammable. Preferably, mineral wool, in particular glass wool or rock wool, is used, or textile glass fibers are used.

It is of further advantage if the core is of binder-free design. Then, the manufacturing thereof is facilitated distinctly, in particular as compared to the use of inorganic binders such as, for instance, soluble glass, which is also an absolutely feasible possibility for vacuum insulation panels. The binder-free design of the core makes an otherwise required complex handling of such binders obsolete, and the material costs are also reduced.

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Moreover, it is also possible that the core does not comprise a lamination and yet provides a near-surface region at at least one large area of the core which is substantially free from fibers arranged transversely to the large areas, for instance, by using a needle felt needled on one side. This would theoretically also be possible by a lamination, wherein the problem of fixing of this lamination to the needle felt would then exist. This is, on the one hand, possible by the use of binders, wherein organic binders have to be avoided for vacuum insulation panels due to the problem of disintegration of the organic

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material. Inorganic binders for fixing the lamination on the needle felt are, however, a problem with respect to process technology, so that it is of advantage to refrain from such binders and hence from a lamination in general.

5 It would, on the other hand, absolutely be possible to needle a lamination with the needle felt, but this would lead to a departure from the basic idea of the invention since fibers arranged transversely to the large areas which adhere directly to the foil would inevitably result.

10 In accordance with a further aspect of the present invention the use of a needle felt as a core for a vacuum insulation panel according to the invention is proposed in accordance with claim 9, wherein the needle felt comprises a plurality of fibers arranged predominantly in parallel to the large areas of the needle felt, and individual fibers at
15 needling points which are arranged predominantly transversely to the large areas by a needling process and by which the fibers of the needle felt are fiber-mingled such that the needle felt is adapted to be handled as one element, and wherein a near-surface region at a large area is substantially free from fibers arranged transversely to the large areas.

 Thus, a needle felt needled only on one side down to a particular penetration depth
20 can be used advantageously for forming the vacuum insulation panel according to the invention. This makes it possible to achieve the above-explained advantages.

 In accordance with claim 10, a use of two needle felts as a core for a vacuum insulation panel according to the invention is proposed, wherein the needle felts are each
25 formed with a plurality of fibers arranged predominantly in parallel to the large areas of the needle felt, and individual fibers at needling points which are arranged predominantly transversely to the large areas by a needling process and by which the fibers of the needle felt are fiber-mingled such that the needle felt is adapted to be handled as one element, and wherein a respective near-surface region at one large area is substantially free from
30 fibers arranged transversely to the large areas. The two needle felts are arranged relative to each other such that their large areas comprising in their near-surface region fibers arranged transversely to the large areas are facing each other.

It is thus possible with low effort with respect to manufacturing technology to provide, by a simple, but purposeful combination of two needle felts needled on one side, a core for a vacuum insulation panel which indeed comprises in its interior fibers arranged transversely to the large areas, but is free therefrom in the near-surface regions adjacent to a sleeve. Thus, a core quasi with three layers results, wherein a central layer comprises fibers arranged predominantly in parallel to the large areas of the needle felt and additionally fibers arranged transversely to the large areas, and wherein the two outer layers in the near-surface region at a respective large area of the core are free from fibers arranged transversely to the large areas and predominantly only comprise fibers arranged in parallel to the large areas of the needle felt. Thus, a subtle damage to the sleeve can be reduced in a particularly good manner. Moreover, an improved insulating effect is achieved, which may also be maintained for a particularly long time due to the above-explained effects.

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If a larger product thickness is required, further insulation layers may be applied between the two needle felts needled on one side, which may in turn not affect the vacuum, for instance, by degassing, binder disintegration, entry of moisture, or the like. Needle felts needled on one side or on both sides are particularly preferred.

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The invention will be explained in detail in the following in embodiments by means of a drawing with three Figures. There show:

Fig. 1 a schematic illustration of a vacuum insulation panel in accordance with a first embodiment in section;

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Fig. 2 a schematic illustration of a vacuum insulation panel in accordance with a second embodiment in section; and

Fig. 3 a table relating to a comparative test of the heat conductivity of vacuum insulation panels in accordance with the invention as compared to a conventional vacuum insulation panel.

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Fig. 1 schematically illustrates a vacuum insulation panel 10 in accordance with a first embodiment in section. It comprises a sleeve 11 entirely enclosing a core 12.

5 The sleeve 11 comprises two foil sections 11a and 11b which are welded to each other in lateral edge regions of the core 12 at projecting lateral edge portions. In the instant embodiment, the sleeve 11 is designed as a composite plastic foil, here in the form of a two-layer foil of a HDPE with a thickness of 150 μm and an aluminum layer of 6 μm . Furthermore, a vacuum is available inside the sleeve 11 in which the inside pressure is
10 set to approx. 0.01 mbar. Contrary to the schematic illustration in Fig. 1, the sleeve 11 is therefore in close contact with the core 12 in practice.

 In the instant embodiment, the core 12 consists of a binder-free mineral wool, here glass wool. It is available as a needle felt which is needled on one side. It is of single-
15 piece and ashlar-shaped design with two large areas parallel to each other and two lateral edge faces.

 The fibers inside the core 12 extend predominantly in parallel to the large areas of the needle felt and/or the core 12. The core 12 comprises individual fibers 12 arranged
20 predominantly transversely to the large areas of the core 12 by means of a needling process. These fibers oriented transversely to the large areas are, however, viewed across the thickness of the core 12, distributed therein such that a near-surface region at a large area of the core 12 is substantially free from fibers arranged transversely to the large areas. In the illustration shown in Fig. 1, the near-surface region without the fibers arranged
25 transversely to the large areas is facing the foil section 11a.

 The needle felt used as a core 12 is manufactured in that a binder-free primary fleece of mineral wool is needled on one side down to a predetermined needling depth, wherein this needling depth is smaller than the thickness of the primary fleece. From this primary
30 fleece the individual needle felt elements can then be cut in length and in breadth.

In the vacuum insulation panel illustrated in Fig. 1, significantly reduced strain of the foil section 11a by fibers arranged transversely to the large areas in the core 12 and/or their fiber ends in both near-surface regions does thus exist. The sleeve 11 is therefore less susceptible to damage in this place and can enfold its sealing effect for a longer
5 duration.

Fig. 2 illustrates a second embodiment of the invention. A vacuum insulation panel 20 illustrated here comprises a sleeve 21 entirely enclosing a core 22. Like in the first embodiment, the sleeve 21 is formed of two foil sections 21a and 21b which are welded
10 to each other at their lateral edges. This embodiment relates to the composite plastic foil of embodiment 1. Inside the sleeve 21 a vacuum is again available in which the inside pressure is set to approx. 0.01 mbar. Contrary to the schematic illustration in Fig. 2 the sleeve 21 is therefore in close contact with the core 22 in practice.

15 The core 22 of the vacuum insulation panel 20, however, is of two-layer design and consists of two needle felts 22a and 22b in the second embodiment.

The needle felts 22a and 22b have the same basic construction and are again fiber-mingled on one side only down to a particular penetration depth of the needles. Thus,
20 both needle felts 22a and 22b each have a near-surface region at a large area which is substantially free from fibers arranged transversely to the large areas. Here, like in the other regions across the thickness of the needle felts 22a and 22b, fibers that are arranged predominantly in parallel to the large areas are available. The needle felts 22a and 22b resemble in the basic structure substantially to the respective individual needle felt
25 serving as a core in the embodiment pursuant to Figure 1.

As may be taken clearly from Fig. 2, the two needle felts 22a and 22b are arranged relative to each other such that those large areas are facing each other and are in contact with one another which comprise in their near-surface region the fibers arranged
30 transversely to the large areas.

Thus, a quasi three-layer core 22 is provided which comprises a central layer with fibers arranged predominantly in parallel to the large areas of the core 22, and individual fibers transversely thereto, and two outside layers which are free from the fibers arranged transversely to the large areas and thus comprise quasi exclusively the fibers arranged in parallel to the large areas.

In the vacuum insulation panel 20 illustrated in Fig. 2, the foil sections 21a and 21b in the region of the large areas of the core 22 are thus substantially not subjected to any strain by fibers arranged transversely to the large areas of the core 22. Thus, it is possible for the sleeve 21 to enfold its protective effect permanently and to maintain in particular the vacuum inside the vacuum insulation panel 20 over a longer period.

Fig. 3 illustrates the results of a comparative test for determining the heat conductivity λ pursuant to EN 12667 (single plate device). Three vacuum insulation panels each having two layers of a needle felt core and manufactured and evacuated in the same manner were tested.

The element 1 consisted of two layers of a conventional standard needle felt with a weight per unit area of 1600 g/m^2 with a product thickness of 20 mm. The reference sample having the design according to the invention, element 2, consisted of two layers of a needle felt with a weight per unit area of 2000 g/m^2 with a product thickness of 25 mm, while the other element 3 having the design according to the invention was formed of two layers of a needle felt with a weight per unit area of 2400 g/m^2 with a product thickness of 30 mm. All elements had a bulk density of 80 kg/m^3 .

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The element 1 was a standard needle felt with a full needling on both sides, as it has been used conventionally. The elements 2 and 3 consisted in analogy to the second embodiment of the invention pursuant to Fig. 2 of two needle felts arranged inside the sleeve such that the near-surface regions at the large areas of the core were substantially free from fibers arranged transversely to the large areas. All elements were enclosed with a composite plastic foil in the form of a two-layer foil of a HDPE with a thickness of $150 \text{ }\mu\text{m}$ and an aluminum layer of $6 \text{ }\mu\text{m}$.

30

Three days after the manufacturing of the three test elements a first measurement of the heat conductivity (measurement 1) was performed in which a slightly better heat conductivity, which lies in the scope of measurement accuracy, though, was determined
5 for the elements 2 and 3 in accordance with the invention as compared to element 1 in accordance with the state of the art. The second measurement was performed after about two months of storage at environmental conditions (measurement 2). No change in heat conductivity λ was exhibited here.

10 Then, the samples were subject to a first artificial aging, 21 days at 80°C in the climate cabinet, corresponding roughly to a period of three years. Here, a distinctly larger increase in heat conductivity of the standard product according to element 1 was exhibited in the test as compared to the elements 2 and 3 designed in accordance with the invention (measurement 3).

15

This result was then confirmed after a second artificial aging, 39 days at 80°C in the climate cabinet, corresponding roughly to another six years, thus altogether about 9 years for the first and second agings in total. The heat conductivity had again increased distinctly in the standard product according to element 1, with the distance to the elements
20 2 and 3 designed in accordance with the invention having increased even further (measurement 4).

The two devices 2 and 3 in accordance with the invention thus exhibited in the test a more permanent heat insulating effect for the long term than a vacuum insulation panel
25 with a conventional needle felt.

In addition to the embodiments explained, the invention allows for further design approaches.

30 Thus, the core of the vacuum insulation panel may also be constructed of more than two layers or three layers. Layers being free from fibers arranged transversely to the large areas may alternate with other, needled layers. In the scope of the invention it is above all

essential that a near-surface region at at least one large area of the core is substantially free from fibers arranged transversely to the large areas.

Furthermore, it is, for instance, also possible to form the core with two layers such
5 that a first layer consists of a needle felt needled on one side and only partially, so that a near-surface region is given there which is substantially free from fibers arranged transversely to the large areas, and that a second layer of a fiber layer with fibers which are predominantly of laminar orientation and which are not bound is arranged at the large area of the first layer without a binder, said second layer comprising fibers in the near-
10 surface region which are arranged transversely to the large areas. As a result of this, sections which are free from fibers arranged transversely to the large areas can thus in the end also be formed at the near-surface regions of both large areas of the core.

Moreover, it is also possible to form the sleeve of a stainless steel foil. Another kind
15 of metal foil may also be used.

The fibers arranged in the core may, alternatively or in supplement, also comprise organic fibers. In particular, fibers of a thermoplastic material are preferred, such as, for instance, of polyethylene, polyamide, or polypropylene.

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In the embodiments pursuant to Figs. 1 and 2 the core 12 and/or 22 is of binder-free design. If it is desired, for instance, for purposes of process technology, a binder that is not disintegrating in vacuum may, however, also be used. For this purpose, in particular inorganic binders such as, for instance, soluble glass are suited.

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Moreover, it is also possible that the core has a lamination, wherein a binder not disintegrating in vacuum is then preferably used for fixing the lamination.

Additionally, it is also possible that the core comprises a getter material by which
30 the lifetime of the vacuum insulation panel can be further increased.

Claims

1. A vacuum insulation panel (10; 20) with a core (12; 22) of fibers and a sleeve (11; 21) in which the core (12; 22) is available in the evacuated condition, wherein the core (12; 22) comprises at least one needle felt with a plurality of fibers arranged predominantly in parallel to the large areas of the needle felt, and individual fibers at needling points which are arranged predominantly transversely to the large areas by a needling process and by which the fibers of the needle felt are fiber-mingled such that the needle felt is adapted to be handled as one element, characterized in that a near-surface region at at least one large area of the core (12; 22) is substantially free from fibers arranged transversely to the large areas.
2. The vacuum insulation panel according to claim 1, characterized in that the near-surface region at both large areas of the core (12; 22) is substantially free from fibers arranged transversely to the large areas.
3. The vacuum insulation panel according to claims 1 or 2, characterized in that the core (22) is of two-layer design, wherein each layer consists of a needle felt (22a, 22b) in which a near-surface region at a large area is substantially free from fibers arranged transversely to the large areas, and wherein the two layers of needle felt are arranged relative to each other such that their large areas comprising in their near-surface region fibers arranged transversely to the large areas are facing each other.
4. The vacuum insulation panel according to claim 3, characterized in that at least one further layer which does not affect the vacuum, in particular needle felts needled on one or on both sides, is arranged between the two layers of needle felt.

5. The vacuum insulation panel according to any of claims 1 to 4, characterized in that the sleeve is formed of a composite plastic foil.
6. The vacuum insulation panel according to any of claims 1 to 5, characterized in that the fibers are inorganic fibers, preferably mineral wool, particularly glass wool or rock wool, or textile glass fibers.
7. The vacuum insulation panel according to any of claims 1 to 6, characterized in that the core (12; 22) is designed to be binder-free.
8. The vacuum insulation panel according to any of claims 1 to 7, characterized in that the core (12; 22) does not comprise a lamination.
9. A use of a needle felt with a plurality of fibers arranged predominantly in parallel to the large areas of the needle felt, and individual fibers at needling points which are arranged predominantly transversely to the large areas by a needling process and by which the fibers of the needle felt are fiber-mingled such that the needle felt is adapted to be handled as one element, and wherein a near-surface region at one large area is substantially free from fibers arranged transversely to the large areas, as a core (12) for a vacuum insulation panel (10) according to any of claims 1 to 8.
10. A use of two needle felts (22a, 22b) each formed with a plurality of fibers arranged predominantly in parallel to the large areas of the needle felt, and individual fibers at needling points which are arranged predominantly transversely to the large areas by a needling process and by which the fibers of the needle felt are fiber-mingled such that the needle felt is adapted to be handled as one element, and wherein a respective near-surface region at one large area is substantially free from fibers arranged transversely to the large areas, as a core (22) for a vacuum insulation panel (20) according to any of claims 1 to 8, wherein the two needle felts (22a, 22b) are arranged relative to each other such that their large areas comprising in their near-surface region fibers arranged transversely to the large areas are facing each other.

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Fig. 1

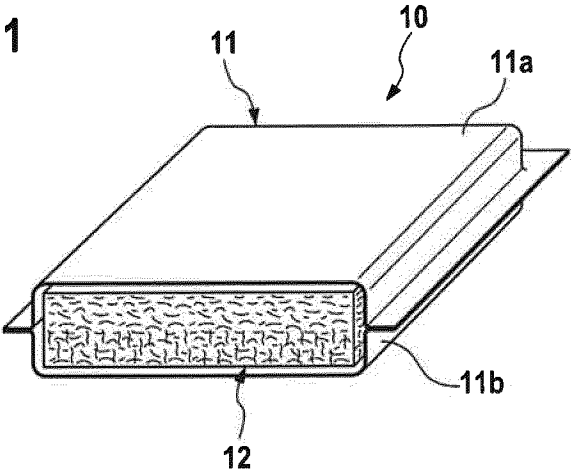
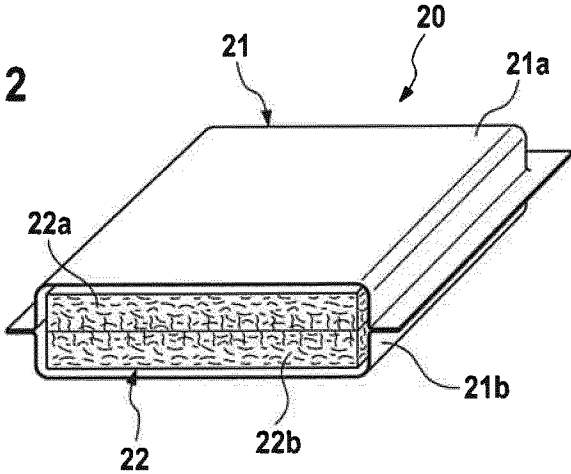


Fig. 2



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Measurement	Element 1 (conventional) Heat conductivity λ [mW/(m·K)]	Element 2 (invention) Heat conductivity λ [mW/(m·K)]	Element 3 (invention) Heat conductivity λ [mW/(m·K)]
1	3,6	3,4	3,5
2	3,6	3,4	3,5
3	4,5	4,0	4,0
4	5,6	4,7	4,8

Fig. 3

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2015/062408

A. CLASSIFICATION OF SUBJECT MATTER

INV. E04B1/80

ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

E04B F16L F25D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP H07 96563 A (SANYO ELECTRIC CO) 11 April 1995 (1995-04-11) abstract paragraph [0015] - paragraph [0018]; figures 2,3	1,2,5-9
A	----- WO 2007/061196 A2 (LG ELECTRONICS INC [KR]; KIM KYUNG-DO [KR]; JUNG DONG-JU [KR]; KIM YOU) 31 May 2007 (2007-05-31) paragraph [0005] page 26; figure 4	1-10
A	----- EP 1 669 485 A2 (PARAMOUNT GLASS MFG CO LTD [JP]) 14 June 2006 (2006-06-14) paragraph [0004] paragraph [0017] -----	1-10



Further documents are listed in the continuation of Box C.



See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search

29 July 2015

Date of mailing of the international search report

05/08/2015

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2015/062408

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
JP H0796563	A	11-04-1995	NONE	

WO 2007061196	A2	31-05-2007	AU 2006317921 A1	31-05-2007
			DE 112006003120 T5	02-10-2008
			US 2008280090 A1	13-11-2008
			WO 2007061196 A2	31-05-2007

EP 1669485	A2	14-06-2006	EP 1669485 A2	14-06-2006
			KR 20060115719 A	09-11-2006
			US 2007017625 A1	25-01-2007
			US 2009004450 A1	01-01-2009
			WO 2005024107 A2	17-03-2005
