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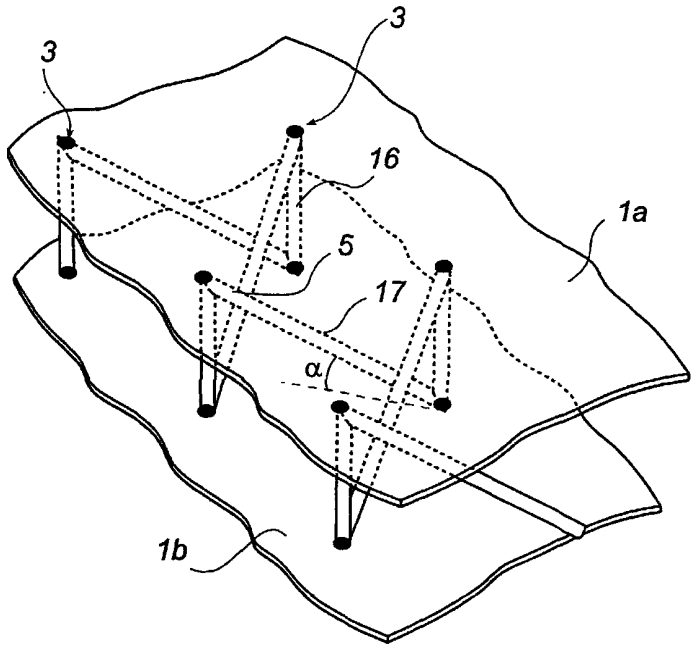
(54) Title: SANDWICH CONSTRUCTION AND METHOD FOR ITS MANUFACTURE



(57) Abstract: This invention refers to a sandwich construction that includes at least a first (1a) and a second (1b) plate and an intermediate distance layer. The distance layer includes at least a wire formed, moment of force distance element (2), which is adapted in points of attachment (3) which are located to stagger with the first (1a) respectively the second (1b) plates toward each others faced surfaces. The distance element stretches accordingly forward and back between the plates in various angles. A sandwich construction of this kind can be fashioned in different modes without it fracturing up or being deformed.

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SANDWICH CONSTRUCTION AND METHOD FOR ITS MANUFACTURE

Technical field

The invention in question refers to a sandwich construction, which at least consist of a first and a second plate and an intermediate distance layer in between. The invention in addition refers to a process for production of such a sandwich construction.

Technical setting

A great number of different types of sandwich constructions are known since before. They mainly consist of two plates or sheets between which a material of softer or of the same kind has been applied. The sheets or plates can be of the same material or of different kinds, and the material between them can be homogenous or composed of different materials.

The sandwich constructions are often stiff and consequently strong in proportion to their weight and therefore used in light constructions like boats, building materials, aeroplanes, rail bound vehicles and similar.

Known sandwich constructions have the limitation of consisting of organic material, and also of being glued together which means that they are not suitable for higher temperature for a long period of time. Materials that are glued together with organic material can at heat or cold stratify due to exhaustion in the fixing adhesive or in the material. Known intermediate layers today can not fully take up draught, pressure, vibrations and heat as desired. They are furthermore difficult to repair, enlarge or change. Since the intermediate layers in known sandwich constructions allow for vibration, sandwich constructions with metallic outer layers will in addition become acoustic conductive, something that is normally not desirable.

It is also desirable to have vacuum or insulating protective gas as an intermediate layer in order to create a sandwich element with the similar insulating properties as a vacuum flask of steel has. This can not be achieved in large plane or bent sandwich elements according to known technology.

Finally it would be desirable to use so-called foamglass as filling material in a sandwich construction, but this is not possible because of insufficient stability in known constructions. The foamglass will crack and it will be damaged by the small displacements that are allowed for in known constructions.

The objects of the invention

It is therefore an object with the invention in question to achieve a sandwich construction that is suitable for construction material in boats, aeroplanes, vehicles like trucks, buses, cars and trains, machine constructions, buildings etc., which is easy formable and has satisfactory mechanical properties in form of stiffness, high elasticity and high resistance of temperature.

Summary of the invention

This object is according to the invention achieved by a sandwich construction of stated kind by way of introduction, at which the distance layer includes at least a threadlike, moment of force distance element, which is applied in points of attachment that are situated alternating by the first and the second plate respectively towards each others faced surfaces, at which every distance element (2) has the shape of a spiral (4) with its longitudinal axis principally parallel with the plates (1a, 1b).

The distance element consequently forms several parts of segment, all of which each reaches between both the plates´ against each other faced surfaces. Depending on which angle the various segments form against the plates, every segments´ moment of force ability varies.

That the points of attachment are alternating situated by the plates does not exclude that two successive points of attachment are situated on the same plate. The essentials are that the distance element alternating reaches there and back between the plates in different angles.

A sandwich construction of this kind can be shaped in different ways without it cracking up or getting deformed. The material is very light in relation to its thickness and furthermore it has a great mechanical strength because of its construction with an intermediate threadlike distance element.

The distance element can be made of high-tensile steel or light metals like stainless, titanium, silumin, spring steel or some other suitable material or alloy.

The plates in the sandwich construction can consist of the same material as the distance element or of some other, preferably metallic material. With the term "plates" also panel, sheets or the like is referred to. Thanks to the stability of the sandwich construction the space between the plates can be filled with so-called foamglass, without risking that the filling will be damaged. The space can furthermore be set under vacuum without losing its form, which can be utilised in heat insulating applications. An alternative to vacuum is to fill the space with insulating protective gas, possibly with a lower pressure than in the surroundings.

If the sandwich construction according to the invention in question is used for a roof on a house or for a wall it is possible to use a profiled or patterned plate that imitates the desired look. It is possible to use all sorts of profiles or patterns in combination with the construction of the invention. Thanks to its construction, preferably of steel, the sandwich construction according to the invention is easy to repair and to change.

Every spiral can be stiff or elastic across its longitudinal direction. An elastic distance element is preferably made of some kind of prefabricated spiral model of threadlike or bandlike material before it is applied between the plates.

The distance element can furthermore be arranged between the plates without thermally connecting the plates, at which an isolating function is achieved. This is especially immediate when the plates and the distance element are made of metal, since the thermal conduction through the sandwich construction in this case may be substantial.

Since the sandwich construction is so stable it will not bulge if it is exposed to heat, for instance in a fire. The sandwich construction is thus suitable as material in, for instance, a fire door. The fire doors of today, which normally consist of double plates of steel without intermediate distance element, risk to bulge, and therefore a larger gap is left around the door to prevent that the door get stuck in case of fire.

According to one form of execution of the invention the plates are sealed longitudinal its edges, so that a closed space is formed between the plates. This form of execution is especially suitable when a sandwich construction under vacuum is desired.

Short description of drawings

The present invention will in the following be explained in detail with reference to the attached drawings, which have the exemplifying purpose to show reported forms of executions of the invention.

Fig 1 shows a cross-section of a sandwich construction according to the invention.

Fig 2 shows from above in section the sandwich construction in fig 1.

Fig 3a-e shows in cross-section varying forms of execution of the distance element according to the invention.

Fig 4 shows in cross-section further one form of execution of a sandwich construction according to the invention.

Fig 5 shows in cross- section further one form of execution of a sandwich construction according to the invention.

Fig. 6a-b presents in perspective a reported form of execution of the distance element according to the invention.

Fig. 7 presents a method of manufacturing a sandwich construction according to one form of execution of the invention.

The description of reported forms of execution

Fig. 1 shows a cross section of a springy sandwich construction according to the invention with two plates, which in this example consist of plates 1a, 1b of metal and one distance element 2, here in the form of helical spring steel 5. The distance element 2 is adapted with its longitudinal axis parallel with the planes of the plates, and attached to the points of attachment 3, which are alternating located by the first plate and by the second plate. Welding (pressure- or fuse welding), soldering, sizing or some similar technique attaches the distance element. It is especially reported to attach the distance elements with newly developed pressure/stud welding. Pressure welding means that a pointed part of lace is attached to one plate and reduces the risk of hot cracking between wire and plate.

Each spiral 4 has upset contact surfaces 3 against the plate for better fit against the plate 1a and thereby better buoyant of forces in this sandwich construction. To still improve the contact surface 3 against the plate 1 the materials in spiral 4 can be flattened, which is especially important when soldering or sizing the spiral to the plates. With this design of the distance element 2 the sandwich construction becomes springy cross the longitudinal direction of spiral 4 and in that way this can take up impacts and vibrations.

The wire diameter d1of the spring steel 5 can be from example 0,5 mm and up, depending on how much and with what one shall load the element, and the circle diameter d2 of spiral 4 can be from example 4 mm and up, depending on the thickness one want to have on the sandwich construction.

In some cases it is suitable with a sandwich construction that consist of one sheet of steel and an aluminium plate, which are connected by distance elements of varying designs.

The distance element can then be weld-fixed, for example by molten metal pressure welding, at the aluminium plate. The distance element is aluminium zinc-lined in order to stop galvanic transitions between the aluminium plate and the distance element. Thereby the adhesion increases in force and thereby the actual life of the sandwich construction. Against the steel the distance element is panel resistance pressure- or fuse welded.

The space between the plates can also in combination with the distance element 2, be filled with an adequate material, for example foamed materials 10. The foamed material 10 can be insulating or sound absorptive. The space can even be filled with foamed concrete or foamglass.

In fig 2 is a top plan view of how helices 4 are organised in the sandwich construction. The steel spiral 4 is organised thin or thick depending on expected vibrations, expected pressure etc. One big advantage with such distance elements, consisting of parallel introductory spirals, is that the production can be more efficient. In fig 7 is presented sketchy how a sandwich element according to the invention, in this case with continuous spirals as distance elements, is manufactured. The plate 21 is going on from two reels 22 into a parallel path 23 and between the plates to advance wire 24 in helical. The point welding is carried out with a welding robot 25, which relatively easy can reach the wire spiral 24 in the mouth 26 between the plates 21. In fig 7 is a welding electrode 27 placed on a movable robot arm 28, and additional electrodes 29 are fixed on two cylinders 30 that are forced to get in contact with the passing plates. At the same time cylinders 30 govern the thickness of the sandwich construction. Several parallel wire spirals 24 can as well be fixed at the same time.

Fig 3a-e show alternative designs of the spiral 4. The spiral form of execution according to fig 3a shows a stiffer design of the round spiral in fig 1, which takes up more trust load. The design according to fig 3b and 3c is a so-called rectangular or square spiral and is designed so it can admit shearing and pressure or draught in all planes. This spiral is therefore rigid. In fig 3b the

spirals´ 4 contact pieces against the plates are flattened, in order to facilitate attachment, for example with sizing. In fig 3c the contact surfaces are instead pointed, and thereby specially designed for projection welding.

In fig 3d and 3e every spiral is constituted of more parts, which each is composed of two parts 4a, 4b, which are placed with each plate. The parts are on several places 7 twisted in each other, and these places 7 can be protected by a non-conductor material, so that parts 4a, 4b, won't come in direct contact with each other. This is desirable if the construction is not supposed to carry off heat or current. One way to realise the spiral form of execution according to fig 3d-e would be to arrange several " barbed-wire barbs " between the plates. Barbed-wire barbs consist of two parts that have been twisted into each other and of which the ends stick out from the twist. These ends would accordingly be attached in the two plates, either by way of gluing or the like, as shows in fig 3d, or else with pressure welding, as shown in fig 3e. The intermediate material 10 is in fig 3e suitably some kind of non-conducting composition or vacuum to further prevent conductivity of heat and chill.

The spiral forms of execution in fig 3a-e are only examples, and the design is in reality limited only by the necessary machine- working.

Fig 4 shows a cross section of a sandwich element that is loaded with vibration- or sound absorptive material on the inside of the sandwich element. The absorptive material 14 can be of different kinds, for example rubber-asphalt built-up materials, and can be combined with the foam material 10. Of course the material 14 can equal readily be placed on the outside of the construction.

The section in fig 4 also shows how the edges of the plates 1 on one of the sides show a down bending 11 on one of the plates. This down bending 11 results in that one sandwich element fits into the corresponding other side of the next element when the elements are joined. With this type of conclusion one can

attach the sandwich elements with each other by soldering or some form of welding process and in connection with this the joint zone between the sandwich elements can be filled with vacuum or foam material. This gives a rigid and insulated section assembly.

Fig 5 shows a cross section of a closed sandwich element, according to one further form of execution of the invention. The plates are here longitudinal with its edges 15 associated with each other, so that a closed space 8 is formed between the plates. When pressing the sandwich element the space 8 between the plates can be filled with liquid and then be closed. In this way the form strength is increased at the pressing occasion. After the pressing the sandwich element is tapped off on liquid and filled up with foam material 10 or similar, or is put under vacuum, to be closed afterwards. The box terminals 15 of the sandwich element are adapted in order to be assembled with other sandwich elements, so that profile 13 suits in profile 12. With these profiles one can at the assembly choose what type of joining system one needs, such as welding in some form or solder or glue and so on.

Fig 6a-b shows a form of execution of a sandwich construction according to the invention, with a prefabricated distance element in the form of a wire 5 that forms a " rectangular " spiral.
In each bending the wire is designed to be attached in one of the plates. The fact that the wire proves sections in numerous varying directions means that the distance element can resist shearing strain and pressure in all directions. In the showed example exists partly sections 16, where the wire is parallel with the plates normal N, partly sections 17, where the wire forms an angle a (alpha) with the plates normal N. The angle alpha can as evidenced by the figure be different for different sections 17, so that the complete effect will be that the wire can take up forces 18, 19 in all directions. In fig 6a the wire presents a squashed flat part in every point of attachment 3, while it in fig 6b instead is pointed in every point of attachment 3, in order to be better adapted for pressure welding.

In all types of sandwich constructions according to the invention one can apply sound or vibration retarding material on the in- or outside of a sandwich construction, as well as some form of insulating material or stiffening material between the different plates. The plates can be two or more depending on what one wants to achieve.

According to a variant of the invention the sandwich construction consists of three plates, which gives a more turn rigid construction. The two intervening spaces can in this case be filled with various filling materials, which increase the prospecting still more.

PATENT ACCORDING.

1. Sandwich construction consisting of at least a first (1) and a second plate and an intermediate distance layer, **characterised** by that the distance layer consists of at least one wire formed, moment of force distance element (2), which is adapted in points of attachment (3) which are located to stagger with the first (1a) respectively the second (1b) plates towards each others faced surfaces, at which each distance element (2) has the form of a spiral (4) with its longitudinal axis essentially parallel with the plates (1a, 1b).

2. Sandwich construction according to claim 1, at which the spiral (4) is rectangular.

3. Sandwich construction according to claim 1, at which the spiral (2) is springy cross its longitudinal axis.

4. Sandwich construction according to any of the previous claims, at which the plates (1a, 1b) and the distance element (2) are made of a metal.

5. Sandwich construction according to claim 4, at which the distance element (2) is arranged at the plates (1a, 1b) with such method that no electrical or thermally leading connection is being produced between the plates, at which the thermal conductivity of the sandwich construction is limited.

6. Sandwich construction according to any of the previous claims, at which the space between the plates is filled with for instance an insulating material (10).

7. Sandwich construction according to any of the previous claims, consisting of at least three plates with intermediate distance element.

8. Sandwich construction according to any of the previous claims, where the plates are closed along their edges (15), so that a closed space (8) is formed between the plates (2).

9. Sandwich construction according to claim 8, at which the mentioned closed space (8) is produced under vacuum.

10. Method of approach for manufacturing of sandwich constructions consisting of at least two plates (1a, 1b) and one intermediate distance element (2), **characterised** by the steps

to prefabricate a thread formed distance element in form of a spiral (4),

to adapt the spiral between the plates (1a, 1b), with the spirals (4) longitudinal axis parallel with the plates, by attaching the mentioned spiral (4) in points of attachment (3), which are located to stagger with the first and the second plates toward each others faced sides, by one of the methods welding, soldering and sizing.

11. The method according to claim 10, further includes the step to seal the edges of the plates with each other, so that a closed space (8) is formed between the plates.

12. The method according to claim 11, further include the steps to pour the sandwich construction with liquid, to press the element into desired form, and after that to drain the liquid.

13. The method according to claim 11 or 12, further includes the step to vacuum pump suction the space (8).

14. The method according to claim 11 or 12, further includes the step to fill up the space (8) with insulating protective gas.

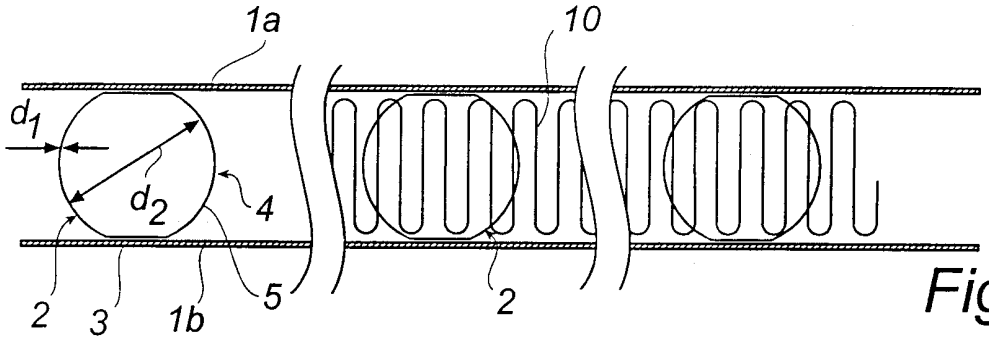

Fig. 1

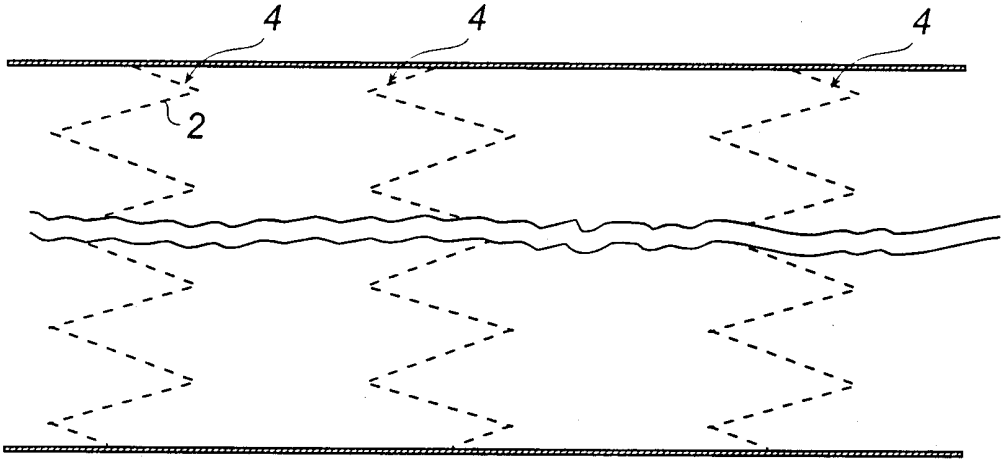

Fig. 2

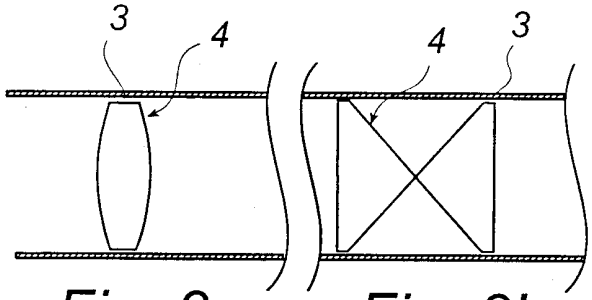

Fig. 3a

Fig. 3b

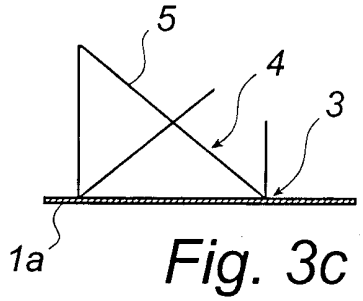

Fig. 3c

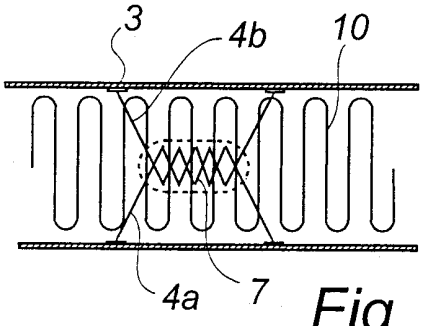

Fig. 3d

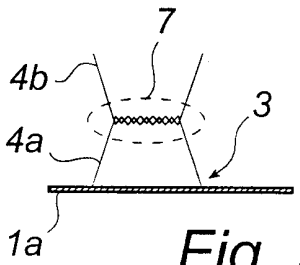

Fig. 3e

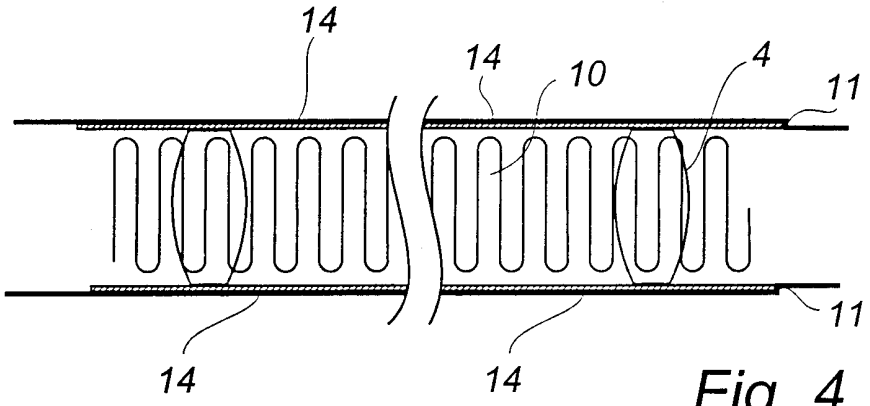

Fig. 4

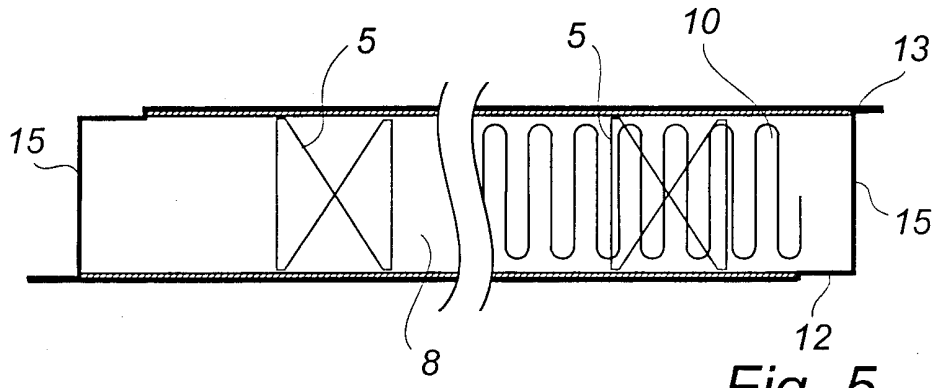

Fig. 5

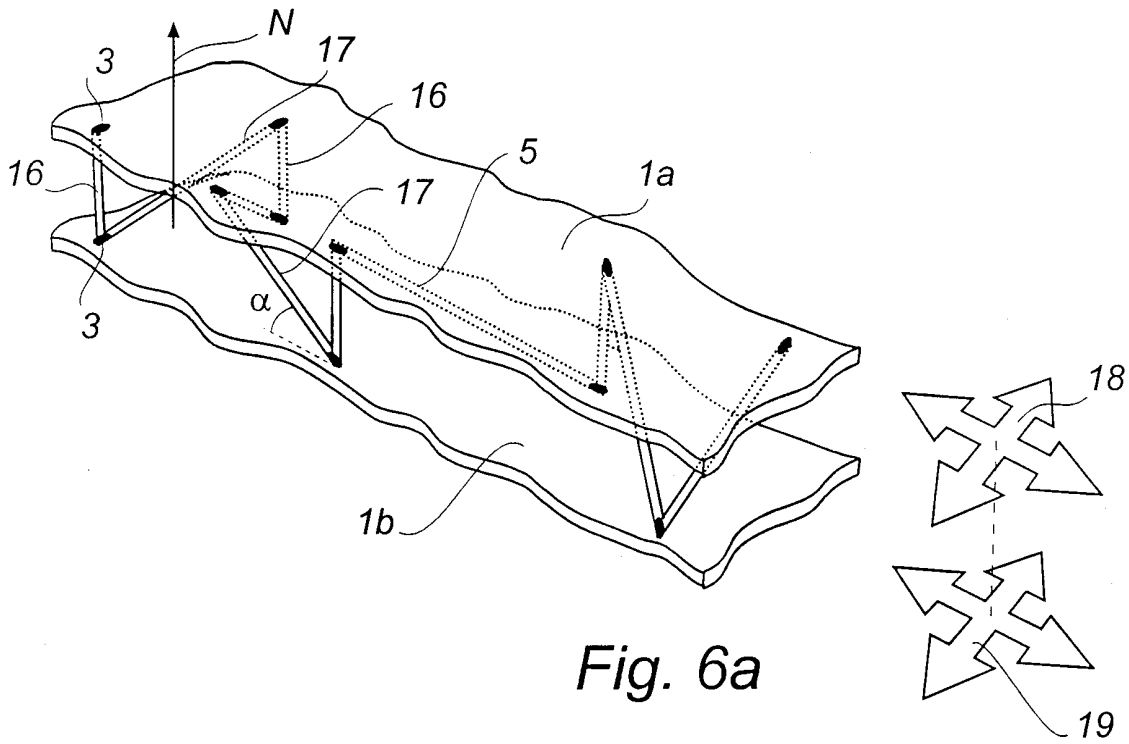

Fig. 6a

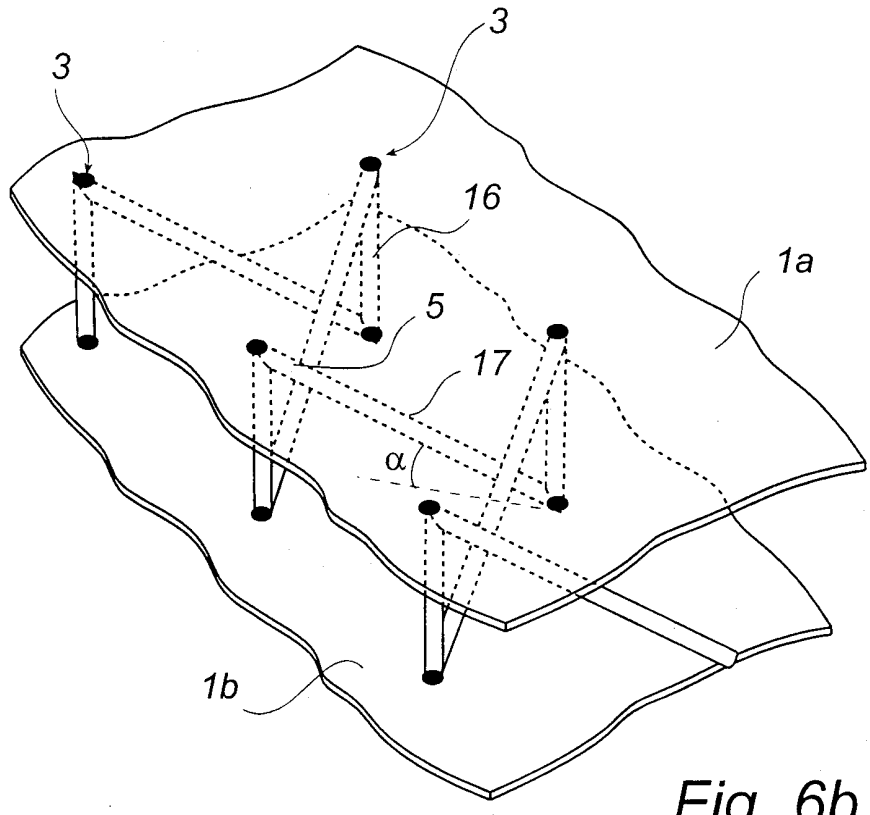

Fig. 6b

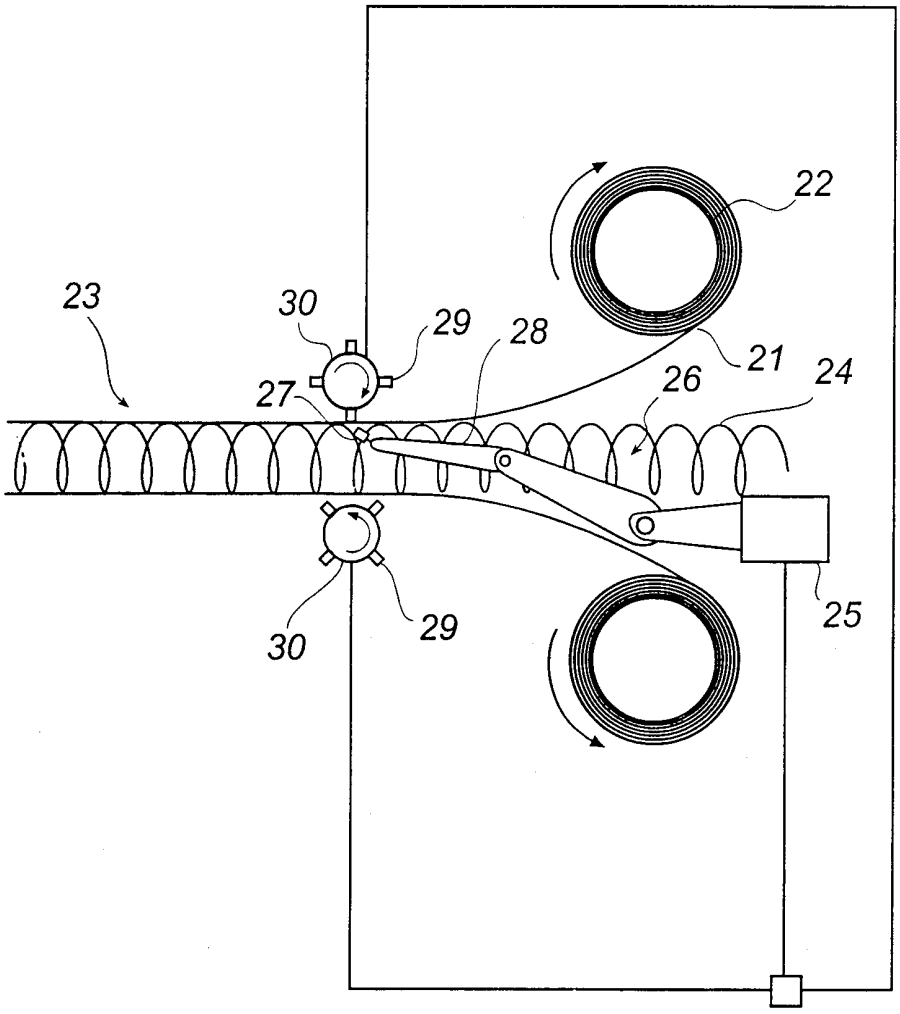

Fig. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 00/02272

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B32B 3/22, B32B 5/02, B32B 15/02, E04C 2/36
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)

IPC7: B32B, E04B, E04C

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

SE,DK,FI,NO classes as above

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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A	EP 0895852 A1 (USINOR), 10 February 1999 (10.02.99), column 1, line 7 - line 14; column 2, line 6 - line 41, figure 1, abstract --	1,4,10
A	US 3869778 A (RAYMOND W. YANCEY), 11 March 1975 (11.03.75), column 2, line 1 - line 37; column 6, line 52 - line 68, figures 1-7,23,47-49,57,59, 78-79 --	1-2,4,10

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
22 February 2001	05 -03- 2001
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Monika Bohlin/ELY Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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Information on patent family members

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