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(54) **HEAT EXCHANGER HAVING IMPROVED STRENGTH**

WÄRMETAUSCHER MIT VERBESSERTER FESTIGKEIT

ÉCHANGEUR DE CHALEUR À RÉSISTANCE AMÉLIORÉE

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to a plate heat exchanger comprising a number of heat exchanger plates, stacked in a stack and being provided with a pressed pattern of ridges and grooves, said pattern of neighboring plates cooperating to form interplate flow channels for media to exchange heat, according to claim 1.

PRIOR ART

[0002] Plate heat exchangers generally comprise a number of heat exchanger plates provided with a pressed pattern of ridges and grooves. When the plates are stacked onto one another, the ridges and grooves of neighboring plates cooperate to form interplate flow channels between neighboring plates. The heat exchanger plates are generally provided between a first cover plate and a second cover plate, which form a casing for the heat exchanger.

[0003] In prior art plate heat exchangers, the casing provided by the first cover plate and the second cover plate protects the plate heat exchanger from external forces, such as torsion or pressure; as well as internal forces, such as forces resulting from a pressure in the liquids to exchange heat, flowing through the flow channels. However, in order to increase the design pressure, the first cover plate and the second cover plate must be quite thick, which is disadvantageous due to high weight, high material consumption and the risk of "thermal fatigue" due to differences in thermal expansion during temperature changes.

[0004] WO2013/159232 discloses a plate heat exchanger wherein the heat exchanger pack is fastened to a fastening plate, which allows the heat exchanger to be fastened to e.g. an engine block.

[0005] In some heat exchangers, the first and second cover plates are provided with a pressed pattern identical to the pressed pattern of the heat exchanger plates, however made from a thicker sheet metal. By this, it is possible to maintain as many heat exchange flow channels as possible, while increasing the strength of the heat exchanger. However, in order to attain a strong heat exchanger, it is often necessary to significantly increase the sheet metal thickness of the first and second cover plates.

[0006] EP 2 138 793 discloses a plate heat exchanger having a thicker second cover plate, between which and a neighbouring heat exchanger plate is formed a flow channel. The second cover plate is fastened to a fastening plate allowing the heat exchanger to be mounted to e.g. an engine block.

[0007] CA 2 465 441 A1 discloses a plate heat exchanger according to the preamble of claim 1.

[0008] It should be noted that the above prior art heat

exchangers suffer from all of the disadvantages disclosed above.

SUMMARY OF THE INVENTION

[0009] The object of the present invention is to provide a light weight, yet strong, plate heat exchanger. This object is achieved by the combination of features set forth in appended claim 1, preferred embodiments being defined in the dependent claims.

[0010] In one aspect there is provided a heat exchanger comprising a number of heat exchanger plates made from sheet metal, stacked in a stack and being provided with a pressed pattern of ridges and grooves, said pattern of neighboring plates cooperating to form interplate flow channels for media to exchange heat. At least two of the three outer heat exchanger plates of each end of the stack are made from a thicker sheet metal than the other heat exchanger plates and the outermost heat exchanger plate is manufactured from the thicker sheet metal.

[0011] In one embodiment, at least four of the outer plates in the stack are made from a thicker sheet metal than the other heat exchanger plates. This is advantageous, since the at least four outer plates, provides a strong, yet lightweight framework in form of a sandwich structure.

[0012] In one embodiment, the plate heat exchanger has three outer plates in each end of the stack, wherein the middle plate of the three outer plates is made from a sheet metal having the same thickness as the other heat exchanger plates and the two outer plates are made from a thicker sheet metal than the other heat exchanger plates.

[0013] This is advantageous, because it provides an increased strength of the plate heat exchanger.

[0014] In one embodiment, at least six of the outer plates in the stack are made from a thicker sheet metal than the other heat exchanger plates. This is advantageous, because it provides a further increased strength of the plate heat exchanger.

[0015] In another embodiment, the plate heat exchanger further comprises a first and/or second cover plate. This is advantageous, because it provides a further increased strength of the plate heat exchanger.

[0016] In still another embodiment, the plate heat exchanger of any of the preceding claims, wherein the heat exchanger plates and the outer heat exchanger plates are brazed. This is advantageous, because it provides a further increased strength of the plate heat exchanger.

[0017] The thickness of the heat exchanger plates may range from 0.6-0.8 mm.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] In the following, the invention will be described with reference to the appended drawings, wherein:

Fig. 1 is a top view of a heat exchanger; two

section cuts A-A and B-B indicate sections taken through the heat exchanger; and
Figs 2 and 3 are schematic section views taken along the section cuts A-A and B-B of Fig. 1, respectively.

DESCRIPTION OF EMBODIMENTS

[0019] With reference to Fig. 1, a heat exchanger 100 according to one embodiment of the present invention is shown. The heat exchanger 100 comprises a first cover plate 110, a second cover plate 120 and heat exchanger plates 130, 130', 130" 130''' placed therebetween (see figs. 2 and 3). The heat exchanger 100 is also provided with four port openings 140a, 140b, 150a, 150b in a way well known to a person skilled in the art. Arrows A-A and B-B indicate positions of sections through the heat exchanger 100.

[0020] In Fig. 2, which is a section cut along the line A-A in Fig. 1, eight heat exchanger plates 130 and two sets of three outer heat exchanger plates 130', 130", 130''' are shown. It is also clearly seen how the port holes 140a, 150a extend through some of the heat exchanger plates 130 and some of the outer heat exchanger plates 130', 130", 130''', in a way obvious to a person skilled in the art. Around the heat exchanger plates 130, facing the first cover plate 110 and the second cover plate 120, respectively, the outer heat exchanger plates 130', 130", 130''' are located.

[0021] At least four of the outer heat exchanger plates 130', 130", 130''', such as at least six heat exchanger plates 130', 130", 130''', are thicker than the other heat exchanger plates 130, such as 30 % to 60 % thicker, or preferably 40 % to 50 % thicker. This is advantageous, since the outer heat exchanger plates 130', 130", 130''' then stabilize the heat exchanger plates 130 and strengthen the heat exchanger 100. The thickness of the first cover plate 110 and the second cover plate 120 may thus be reduced, such as by 50 %, without adversely affecting the strength of the heat exchanger, which saves weight and material.

[0022] The strengthening effect of the outer heat exchanger plates 130', 130", 130''' is increased by interaction between the pressed pattern of ridges and grooves, provided on each plate. These ridges and grooves interact to form a strengthening framework in form of a sandwich structure when the plates are joined.

[0023] The heat exchanger plates 130 and the outer heat exchanger plates 130', 130", 130''' may be brazed together. Brazing of heat exchanger plates is a method well known to a person skilled in the art, and is hence not described in more detail.

[0024] When the plates are brazed together, the strengthening effect is particularly prominent.

[0025] In one embodiment (not shown), the first cover plate 110 and the second cover plate 120 may be omitted completely without adversely affecting the strength of the heat exchanger, due to the strengthening effect of the outer heat exchanger plates 130', 130", 130'''. This is

advantageous, because it saves weight and material; as could be understood, there will be no heat exchange channel between the first and second cover plates and the outer heat exchanger plates 130', 130" and 130'''. Moreover, tests have shown that a thick outer plate (in this case first and second cover plates) arranged outside the heat exchanger plate pack for strengthening the heat exchanger may lead to "thermal fatigue" - if the temperature of the media to exchange heat changes rapidly, there is a risk that the temperature expansion of the thick plate does not correspond to the thermal expansion of the heat exchanger plates to which it is connected, hence stressing the connection between the thick plate and the heat exchanger plate to which it is connected.

[0026] In another embodiment (not shown), either the first cover plate 110 or the second cover plate 120 may be omitted completely without adversely affecting the strength of the heat exchanger, due to the strengthening effect of the outer heat exchanger plates 130', 130", 130'''.

[0027] It should be noted that the number of heat exchanger plates 130 positioned between the outer heat exchanger plates 130', 130", 130''' may vary, as will be appreciated by a person skilled in the art. Typically, the number of plates 130 is between one and ten, such as eight, although this number may vary within wide ranges.

[0028] A typical use of a heat exchanger according to the present invention may be in a heat pump for domestic heating. Such a heat pump generally extracts low temperature heat from a low temperature source, often a brine (e.g. a mixture of water and alcohol), which is under a relatively low pressure and a refrigerant (generally under a high pressure), by exchanging heat between the brine and a refrigerant, whereupon the heat absorbed by the refrigerant is transformed into high temperature heat by a general cooling cycle. Typical temperatures in the heat exchanger for exchanging heat between the brine and the refrigerant may be 0°C to 10°C for the brine and -5°C to -20°C for the refrigerant.

[0029] In an embodiment (not shown) the plate heat exchanger 100 comprises three outer plates 130', 130", 130''' in each end of the stack, and the middle plate 130" of the three outer plates 130', 130", 130''' made from a sheet metal with the same thickness as the other heat exchanger plates 130 and the other two outer plates 130', 130" are made from a thicker sheet metal than the other heat exchanger plates 130. This is advantageous, because this may further save weight and material.

Claims

1. A plate heat exchanger (100) comprising a number of heat exchanger plates (130, 130', 130", 130''') made from sheet metal, stacked in a stack and being provided with a pressed pattern of ridges and grooves, said pattern of neighboring plates cooperating to form interplate flow channels for media to

exchange heat, **characterized in that** at least two of the three outer heat exchanger plates (130', 130", 130''') of each end of the stack are made from a thicker sheet metal than the other heat exchanger plates (130), wherein the outermost heat exchanger plate (130') is manufactured from said thicker sheet metal.

2. The plate heat exchanger (100) of claim 1, wherein there are three outer plates (130', 130", 130''') in each end of the stack, and wherein the middle plate (130'') of the three outer plates (130', 130", 130''') is made from a sheet metal with the same thickness as the heat exchanger plates (130) in the middle of the stack and the other two outer plates (130', 130'') are made from a thicker sheet metal than the other heat exchanger plates (130, 130'').
3. The plate heat exchanger (100) of claim 1, wherein at least six of the outer heat exchanger plates (130', 130", 130''') in the stack are made from a thicker sheet metal than the other heat exchanger plates (130).
4. The plate heat exchanger (100) of any of the preceding claims, further comprising a first cover plate (110) and/or a second cover plate (120).
5. The plate heat exchanger (100) of any of the preceding claims, wherein the outer heat exchanger plates (130', 130", 130''') are 30 % to 60 % thicker than the other heat exchanger plates (130).
6. The plate heat exchanger (100) of any of the preceding claims, wherein the outer heat exchanger plates (130', 130", 130''') are 40 % to 50 % thicker than the heat exchanger plates (130).
7. The plate heat exchanger (100) of any of the preceding claims, wherein the outer heat exchanger plates (130', 130", 130''') and the other heat exchanger plates (130) are brazed to one another in order to form the heat exchanger.
8. The heat exchanger (100) according to any of the preceding claims, wherein the plate thickness of the other heat exchanger plates is 0.6 to 1.0 mm.

Patentansprüche

1. Plattenwärmetauscher (100), umfassend eine Anzahl von Wärmetauscherplatten (130, 130', 130'', 130'''), die aus Blech hergestellt sind, in einem Stapel gestapelt sind und mit Pressmustern aus Graten und Nuten versehen sind, wobei das Muster von benachbarten Platten zum Ausbilden von Stromkanälen zwischen Platten für Medien zum Austauschen von Wärme zusammenwirkt, **dadurch gekenn-**

zeichnet, dass zumindest zwei der drei äußeren Wärmetauscherplatten (130', 130'', 130''') von jedem Ende des Stapels aus einem stärkeren Blech als die anderen Wärmetauscherplatten (130) hergestellt sind, wobei die äußerste Wärmetauscherplatte (130') aus dem stärkeren Blech gefertigt ist.

2. Plattenwärmetauscher (100) nach Anspruch 1, wobei drei äußere Wärmetauscherplatten (130', 130'', 130''') in jedem Ende des Stapels vorliegen, und wobei die mittlere Platte (130'') der drei äußeren Platten (130', 130'', 130''') aus einem Blech mit derselben Stärke wie die Wärmetauscherplatten (130) in der Mitte des Stapels hergestellt ist und die anderen zwei äußeren Platten (130', 130'') aus einem stärkeren Blech als die anderen Wärmetauscherplatten (130, 130'') hergestellt sind.
3. Plattenwärmetauscher (100) nach Anspruch 1, wobei zumindest sechs der äußeren Wärmetauscherplatten (130', 130'', 130''') im Stapel aus einem stärkeren Blech als die anderen Wärmetauscherplatten (130) hergestellt sind.
4. Plattenwärmetauscher (100) nach einem der vorhergehenden Ansprüche, ferner umfassend eine erste Deckplatte (110) und/oder eine zweite Deckplatte (120).
5. Plattenwärmetauscher (100) nach einem der vorhergehenden Ansprüche, wobei die äußeren Wärmetauscherplatten (130', 130'', 130''') 30% bis 60% stärker als die anderen Wärmetauscherplatten (130) sind.
6. Plattenwärmetauscher (100) nach einem der vorhergehenden Ansprüche, wobei die äußeren Wärmetauscherplatten (130', 130'', 130''') 40% bis 50% stärker als die Wärmetauscherplatten (130) sind.
7. Plattenwärmetauscher (100) nach einem der vorhergehenden Ansprüche, wobei die äußeren Wärmetauscherplatten (130', 130'', 130''') und die anderen Wärmetauscherplatten (130) durch Hartlötten aneinander befestigt sind, um den Wärmetauscher auszubilden.
8. Plattenwärmetauscher (100) nach einem der vorhergehenden Ansprüche, wobei die Plattenstärke der anderen Wärmetauscherplatten 0,6 bis 1,0 mm beträgt.

Revendications

1. Echangeur de chaleur à plaques (100) comprenant un certain nombre de plaques d'échangeur de chaleur (130, 130', 130'', 130''') réalisées à partir d'un

- métal en feuille, empilées dans une pile et étant prévues avec un motif imprimé de crêtes et de rainures, ledit motif des plaques voisines coopérant afin de former des canaux d'écoulement entre les plaques pour un milieu d'échange de chaleur, **caractérisé en ce qu'**au moins deux des trois plaques d'échangeur de chaleur externes (130', 130'', 130''') de chaque extrémité de la pile sont réalisées à partir d'un métal en feuille plus épais que les autres plaques d'échangeur de chaleur (130), dans lequel la plaque d'échangeur de chaleur située le plus à l'extérieur (130') est fabriquée à partir dudit métal en feuille plus épais. 5 10
2. Echangeur de chaleur à plaques (100) selon la revendication 1, dans lequel il y a trois plaques externes (130', 130'', 130''') dans chaque extrémité de la pile, et dans lequel la plaque centrale (130'') des trois plaques externes (130', 130'', 130''') est réalisée à partir d'un métal en feuille avec la même épaisseur que les plaques d'échangeur de chaleur (130) au centre de la pile et les deux autres plaques externes (130', 130'') sont réalisées à partir d'un métal en feuille plus épais que les autres plaques d'échangeur de chaleur (130, 130''). 15 20 25
3. Echangeur de chaleur à plaques (100) selon la revendication 1, dans lequel au moins six des plaques d'échangeur de chaleur externes (130', 130'', 130''') dans la pile sont réalisées à partir d'un métal en feuille plus épais que les autres plaques d'échangeur de chaleur (130). 30
4. Echangeur de chaleur à plaques (100) selon l'une quelconque des revendications précédentes, comprenant en outre une première plaque de couvercle (110) et/ou une seconde plaque de couvercle (120). 35
5. Echangeur de chaleur à plaques (100) selon l'une quelconque des revendications précédentes, dans lequel les plaques d'échangeur de chaleur externes (130', 130'', 130''') sont de 30 % à 60 % plus épaisses que les autres plaques d'échangeur de chaleur (130). 40 45
6. Echangeur de chaleur à plaques (100) selon l'une quelconque des revendications précédentes, dans lequel les plaques d'échangeur de chaleur externes (130', 130'', 130''') sont de 40 % à 50 % plus épaisses que les plaques d'échangeur de chaleur (130). 50
7. Echangeur de chaleur à plaques (100) selon l'une quelconque des revendications précédentes, dans lequel les plaques d'échangeur de chaleur externes (130', 130'', 130''') et les autres plaques d'échangeur de chaleur (130) sont brasées les unes par rapport aux autres afin de former l'échangeur de chaleur. 55
8. Echangeur de chaleur à plaques (100) selon l'une quelconque des revendications précédentes, dans lequel l'épaisseur de plaque des autres plaques d'échangeur de chaleur est de 0,6 à 1,0 mm.

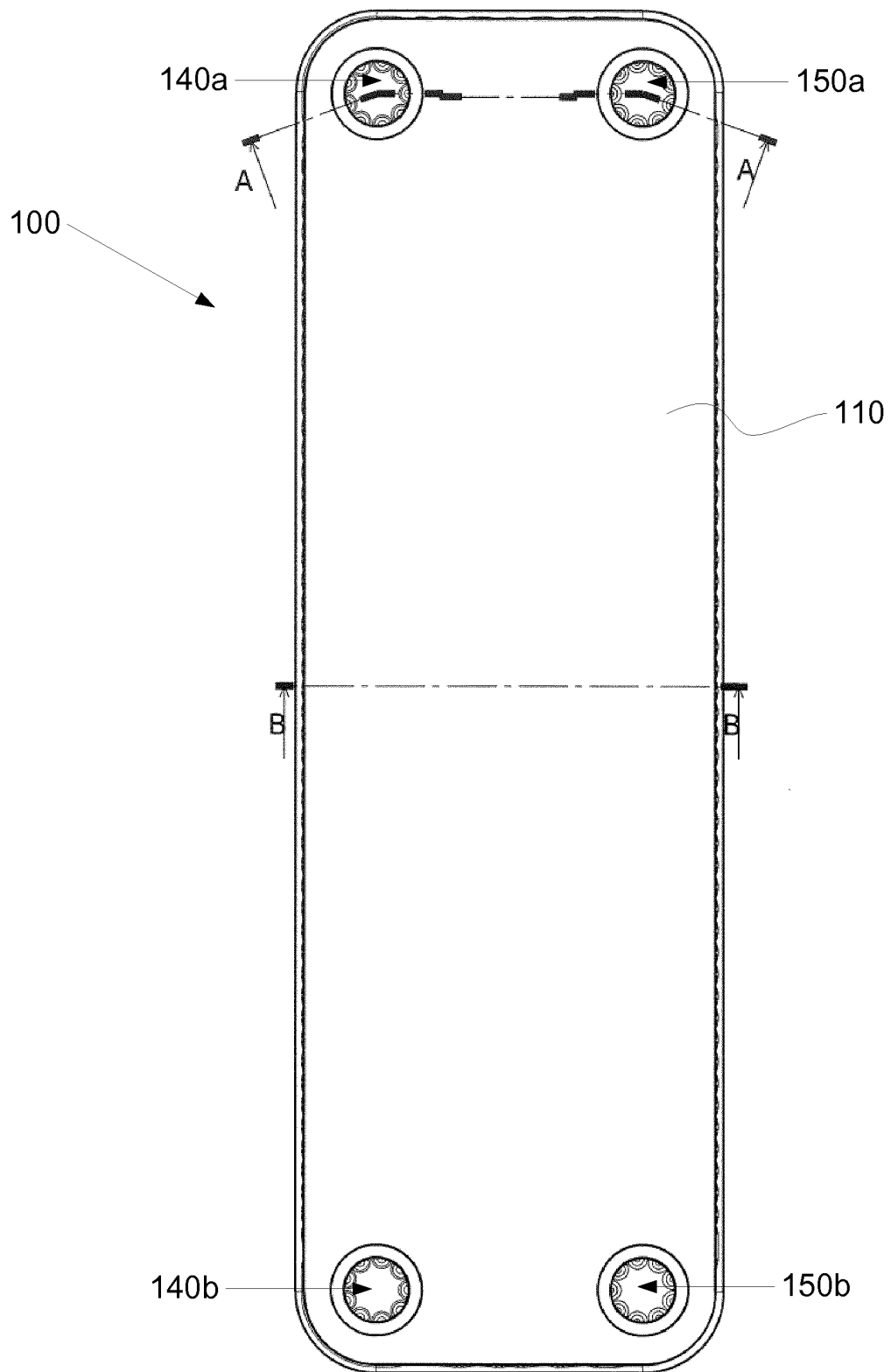


Fig. 1

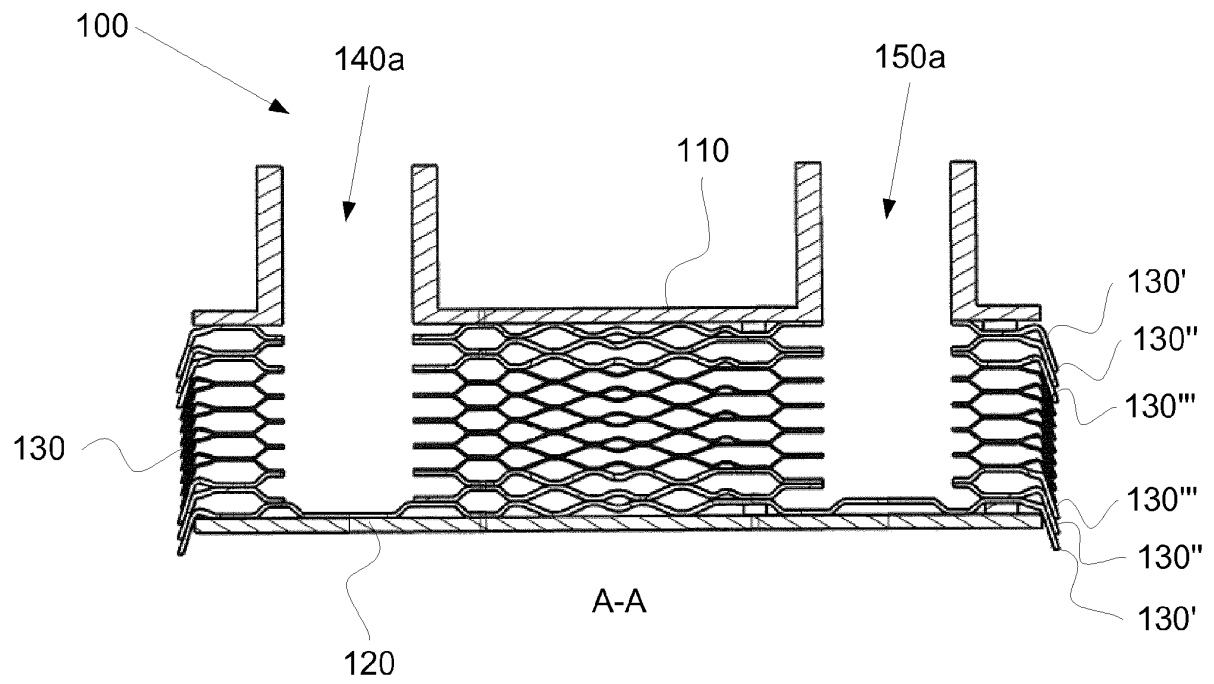


Fig. 2

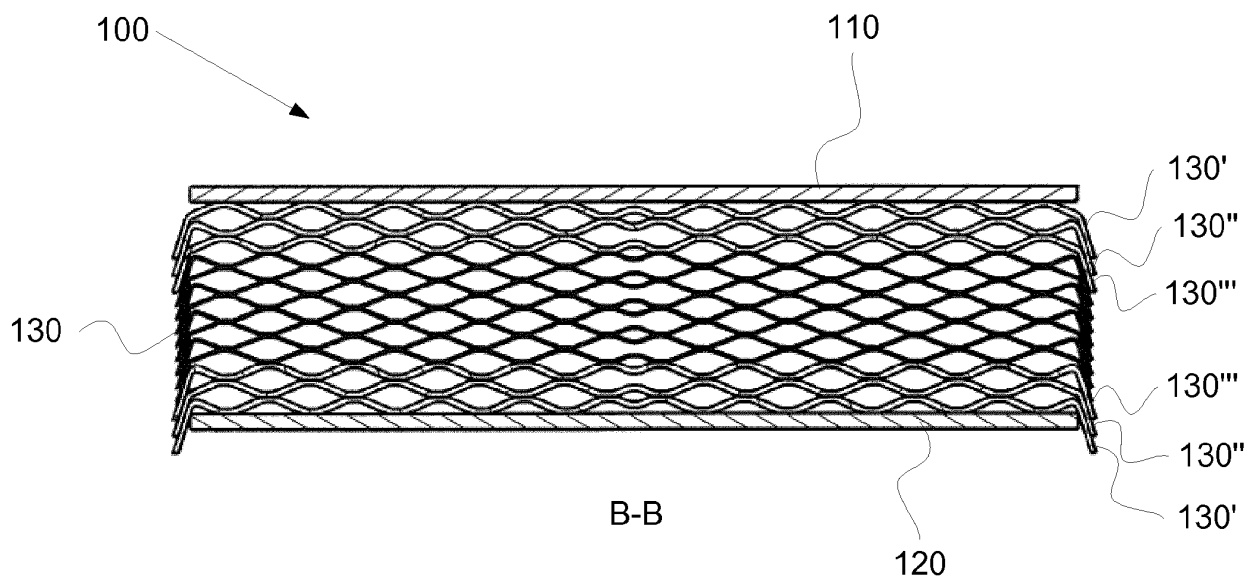


Fig. 3

REFERENCES CITED IN THE DESCRIPTION

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