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(54) METHOD FOR MANUFACTURING A MATTRESS

PRODUKTIONSVERFAHREN EINER MATRATZE

PROCÉDÉ DE FABRICATION D'UN MATELAS

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Description

[0001] The invention concerns a method for manufacturing a mattress component, in particular a layer of a mattress or an inlay for a layer of a mattress, to achieve a user-selected predefined firmness with low deviation and a method for manufacturing a mattress having a predefined firmness with at least one layer to achieve a user-selected predefined firmness with low deviation. The invention further concerns a mattress.

[0002] Mattresses and mattress components, like a mattress layer or an inlay for a mattress layer, that are made out of foam are well-known. The mattresses or mattress components are cut off a large block of foam with dimensions much bigger than the mattress or mattress component to be produced. Typical dimensions of such blocks of foam may be slightly larger than 2 by 2 meters wherein the height of the blocks of foam varies. The height depends on the foam type, for instance. Particularly, the cross section of a block of foam has an area of 2.30 by 2.30 meters. During the foaming process of the blocks of foam, the process conditions, like the temperature or ratio of chemical used, usually vary so that the manufactured blocks of foam also have varying properties.

[0003] WO 2014/0237728 A1 discloses a method for manufacturing a mattress with different comfort zones. Two blocks of foam with different hardnesses are created and cut into two halves with a continuous cut that runs along a predetermined wavy shape. The upper half of the hard foam block and the lower half of the soft foam block are glued together to form a mattress with different comfort zones. Likewise, the lower half of the hard foam block and the upper half of the soft foam block are glued together. It is mentioned that different hardnesses of mattresses exist and the corresponding ISO standard for measuring the hardness of a mattress is cited.

[0004] WO 2017/134492 A1 shows a mattress with a foam shell and resiliently compressible block elements having a predetermined compressibility. The block elements have different compressibilities and thus hardnesses.

[0005] WO 2016/110772 A1 discloses a mattress having multiple layers that can be changed by the user according to his or her wishes and needs to achieve a certain firmness.

[0006] Especially the hardness of the foam varies between blocks of foam that have the same nominal hardness. Further, the hardness varies even within the same block of foam. The deviations of the hardness may be as big as 15% above or below the nominal hardness of the block of foam. However, the deviation can be even smaller or larger. Thus, the actual material properties of the block of foam may differ drastically from the desired material properties.

[0007] The firmness of the mattress or mattress component usually vary largely at different levels of compression, inter alia due to the varying material properties of

the raw material of the mattress or mattress component, making a user-selected predefined firmness hard to achieve in a reliable and repeatable manner with known techniques.

[0008] Thus, it is a problem in the mass production of mattresses and mattress components to achieve the same firmness with small deviations occurring in each mattress or mattress component that is produced.

[0009] It is therefore the object of the invention to provide a method for manufacturing a mattress component and/or a mattress that yield mattresses and mattress components with the desired user-selected predefined firmness with high accuracy and a low deviation, especially between same components produced at different times.

[0010] For this purpose a method according to claim 1 is provided.

[0011] The term "basic geometry" refers to the geometry of the mattress or mattress component as designed under the assumption that the block of foam has actually the nominal material properties, especially the nominal hardness. The "adapted geometry" is a geometry of the mattress component or mattress that has been adapted in dependence of the determined material properties of the at least one region of the block of foam. Accordingly, the geometry may also be called design parameter as it is adapted.

[0012] In this disclosure, the word "firmness" is used as a general term for the comfort properties and the force-displacement behavior of a mattress, a mattress component, a layer and/or an inlay. The firmness may be influenced by the density, the stiffness and/or the hardness of the foam of the mattress, mattress component, layer or inlay.

[0013] The invention is based on the idea that the deviations in hardness or stress strain behavior of the block of foam may be compensated by adapting the basic geometry of the mattress component as the geometry also influences the firmness of the mattress component. This way, it is possible to eliminate the deviation of the material properties of the block of foam, and high quality mattress components can be produced with precisely the firmness that is selected and desired by the user. Further, there is no deviation any more in the firmness of mattress components across different batches produced at different times of the mattress component increasing the overall quality of mass produced mattresses.

[0014] The term "low deviation" is used with respect to the firmness of different mattresses or mattress components of the same type and batch as well as for mattresses or mattress components of the same type across various batches. Thus, mattresses with a high quality and a low deviation in firmness across different mattresses of the same type can be reliably and repeatedly achieved.

[0015] The method can also be seen as a method for high quality mass production of mattresses.

[0016] The connecting may be done by gluing or other known processes.

[0017] Taking into account the material properties of both of the blocks of foam when adapting the basic geometries allows to eliminate deviations in material properties of the blocks of foam throughout the mattress. This way, a mattress with multiple layers may be manufactured having a firmness that precisely matches the firmness selected by the user, for example the designer of the mattress.

[0018] The identifiers are used in order to facilitate the manufacturing process further and to avoid deviations in the firmness due to an accidental mix-up of the manufactured mattress components.

[0019] The identifiers may be unique and the assignment may be done logically or physically. Further, the linking may also be done logically, e.g. by a cross-reference in the database to another identifier, or physically, e.g. by using same colored markers or codes being at least partly the same.

[0020] Of course, an identifier may also be applied to the section of the block of foam, the group of points and/or the corresponding CNC-file of one of the mattress components, and the identifiers may also be linked to the identifiers of other mattress components.

[0021] Further, it is possible that the mattress and/or the layer may have multiple zones with different firmnesses.

[0022] Preferably, the geometry of the mattress component comprises a cut-out, a groove, a height and/or a contour of the cross-section of the mattress component. Using such complex geometry, a plurality of design parameters are present for precisely and flexibly adapting the geometry to achieve the desired firmness.

[0023] The term "cut-outs" is to be understood as cavities that lie within a layer, i.e. that do not open to the top or bottom surface of the layer. Preferably, the dimensions and design of cut-outs and grooves may be adapted. The height of a layer may remain the same as in the basic geometry to achieve a predefined height of the total mattress. Alternatively, the height of the layer may be adapted as long as a predefined height of the total mattress is maintained.

[0024] For example, a CNC-machine is used to cut the block of foam. The control instructions for the CNC-machine, also called CNC-file, are created in step c) for controlling the CNC-machine during the cutting process in order to precisely create the mattress component according to the adapted geometry in an automated manner.

[0025] In a variation, the basic geometry is adapted using also information about at least one other mattress components of the mattress. The information may include material properties of the block of foam used to manufacture the other mattress component. This way, the firmness of mattress components or complete mattresses comprising different mattress components made out of the same or different foams can be achieved with high precision.

[0026] Preferably, the basic geometry is adapted, in particular in an automated manner, using an algorithm

and/or a look-up table relating the determined material properties or deviated material properties of the block of foam with adapted geometries and/or deviations from the basic geometry to be applied. Therefore, a fast and reliable way for determining the adapted geometries based on the measured material properties is provided. The look-up table and/or the algorithm may also take material properties of the block of foam for other mattress components of the mattress into account. Thus, the look-up table may be a table with thousands or tens of thousands entries.

[0027] In an embodiment of the invention, the actual material properties are determined by performing measurements on the block of foam and/or on at least one sample of the block of foam providing a high precision input to adapt the basic geometry.

[0028] For example, the material properties are measured for multiple points distributed over the entire block of foam in order to obtain precise information about the changes of the material properties throughout the block of foam.

[0029] It is also possible to determine the actual material properties by estimating the deviation based on the process parameters, like temperature, that occurred during foaming of the block of foam in question.

[0030] At least one measurement may be taken in each part of the block of foam that will correspond to a different zone in the manufactured mattress in order to reliably achieve the desired firmness in the different zones.

[0031] In a variation, the material properties at points in the block of foam that have not been measured are estimated based on the material properties at the points that have been measured in order to provide an efficient but reliable method for obtaining information about the actual material properties.

[0032] In another embodiment of the invention, multiple mattress components are cut off the block of foam, wherein for each of the mattress components

a) a section of the block of foam, in particular a group of points of the block of foam is determined that will form the mattress component after the cutting step,

b) the basic geometry of the mattress component is adapted in dependence of the material properties of the determined section of the block of foam, in particular the material properties at the group of points, and

c) cutting of the block of foam is controlled in a way that the determined section is detached from the block of foam and that the corresponding mattress component with the adapted geometry is obtained.

[0033] This way, it is ensured that each of the mattress components cut off the single block of foam has the same firmness even though their actual geometries after cutting may differ from one another. It is most likely that each

mattress component will have a different geometry.

[0034] In order to retrieve a specific one of the mattress components again, an identifier is assigned to each one of the mattress components. The identifiers may be unique. The assignment can be done logically, e.g. in a data base, or physically, for example by attaching a marker, RFID-chip or the like to the mattress component. It is also possible to print or spray an identification number or code on the mattress component.

[0035] It is also possible that the identifier may be assigned to the corresponding section or group of points of the specific mattress component and/or to the CNC-file for the specific mattress component as well.

[0036] Preferably the first mattress component is a first layer, and the second mattress component is a second layer or an inlay for the first layer.

[0037] Of course, an identifier may also be applied to the section of the block of foam, the group of points and/or the corresponding CNC-file of one of the mattress components, and the identifiers may also be linked to the identifiers of other mattress components.

[0038] In another embodiment of the invention, the mattress has at least one additional mattress component being manufactured using the inventive method, wherein the basic geometry of at least the first mattress component, the second mattress component and the at least one additional mattress component to be cut is adapted in dependence of at least the determined material properties of the respective blocks of foam in order to achieve the predetermined firmness of the mattress. The additional mattress component may be cut off the first block of foam, the second block of foam or an additional block of foam. This way, mattresses with a plurality of different mattress components with precisely the user-selected predefined firmness may be manufactured.

[0039] Of course, the additional mattress component may have an identifier as explained above that may also be linked to the first, the second and/or any other additional mattress component.

[0040] The invention further provides a mattress manufactured using the method according to the invention. The mattress may have three or more mattress components, especially two or more layers.

[0041] Further features and advantages of the invention will be apparent from the following description of the embodiments and the attached drawings to which reference is made. In the drawings:

- Figure 1 shows a mattress according to the invention in an exploded side view,
- Figure 2 shows an enlarged view of a section of the mattress according to Figure 1,
- Figure 3 shows a block of foam for manufacturing the mattress according to Figure 1,
- Figure 4 shows a side view of the block of foam of

Figure 4,

- Figures 5a) to c) show different geometries of the mattress components,
- Figure 6 shows one of the mattress components of the mattress according to Figure 1 in a side view,
- Figure 7 shows a side view of the mattress according to Figure 1, and
- Figure 8 shows a diagram of the methods according to the invention.

[0042] Figure 1 shows a mattress 10 having five different mattress components 12.

[0043] The mattress components 12 are a top layer 14, a bottom layer 16, a first layer 18, a second layer 20 and an inlay 22.

[0044] At least the first layer 18 and the second layer 20 are made out of foam.

[0045] The mattress components 12 are stacked upon each other in a vertical direction V of the mattress 10.

[0046] Further, the mattress 10 has a longitudinal direction L and a transverse direction T, wherein a person would lie on the mattress in the longitudinal direction L.

[0047] The mattress 10 comprises several zones z_1 , z_2 , z_3 in the longitudinal direction L as indicated by the vertical dashed lines in Figure 1, wherein each of the zones z_1 , z_2 , z_3 has a different firmness. In the shown embodiment, the mattress 10 has five zones, namely a head zone z_1 , a shoulder zone z_2 , a middle zone z_3 as well as the first two ones z_1 , z_2 on the other side of the middle zone z_3 for symmetry purposes.

[0048] The firmnesses have been predefined during the design of the mattress 10 and are thus user-selected.

[0049] The top layer 14 is the uppermost layer in the vertical direction V and the bottom layer 16 is the lowermost layer in the vertical direction V.

[0050] The first layer 18 and the second layer 20 are arranged in between the top layer 14 and the bottom layer 16, the first layer 18 being on top of the second layer 20.

[0051] Further, the first layer 18 comprises a recess 24 in which the inlay 22 is received. The recess 24 has the same shape as the inlay 22.

[0052] Figure 2 shows an enlarged view of a section of the first layer 18 and the inlay 22.

[0053] The first layer 18 has a specific height h and naturally a contour.

[0054] Further, the first layer 18 is provided with several grooves 26 extending on either the top or bottom surface of the first layer 18 in the transverse direction T.

[0055] The first layer 18 further comprises cut-outs 28 being channels within the first layer 18, i.e. channels having a fully closed contour in a cross-section. The cut-outs 28 are not shown in Figure 1 for the sake of clarity.

[0056] It can be seen in Figure 2 that each one of the

cut-outs 28 shown has a different shape and a different diameter d_1, d_2, d_3, d_4 . The difference in shape and diameter arises from the adaption process during the manufacturing of the mattress components 12 as will be explained below.

[0057] The grooves 26, the cut-outs 28, the height h and the contour define the geometry of the first layer 18, being an adapted geometry in the case of Figure 2.

[0058] Likewise, the inlay 22 has a geometry, e.g. a height h_i and a contour.

[0059] The manufacturing process for the specific mattress 10 will now be explained. The mattress 10 will be manufactured along with many other mattresses in a mass manufacturing process. A diagram of the manufacturing process is shown in Figure 8 schematically.

[0060] For manufacturing the mattress 10, the mattress components 12 have to be manufactured first. The first mattress component 12 and the second mattress component 12 that will be adapted in the exemplary method are the first layer 18 and the second layer 20, respectively.

[0061] In order to avoid repetitions, the method for manufacturing a mattress component 12 is explained by way of the example of the first layer 18 only.

[0062] The manufacturing process may be controlled by a control unit (not shown). The control unit may control the various machines used for the different process steps and may issue instructions to workers.

[0063] In a first step S1 a first block of foam 30 is provided, as seen in Figure 3.

[0064] The first block of foam 30 is much larger than the first layer 18 but it is made out of the same foam as the first layer 18.

[0065] The first layer 18 will cut off the first block of foam 30 as explained below. Because of the difference in dimensions between the first block of foam 30 and the first layer 18, multiple first layers 18 for different mattresses 10 are cut off a single first block of foam 30.

[0066] During the forming process to produce the first block of foam 30, irregularities, like a change in temperature or an inhomogeneity in chemicals, may occur so that the material properties of the first block of foam 30 are not homogeneous throughout the entire block of foam 30. Likewise, the material properties like density, stress properties and/or strain properties vary in the vertical, longitudinal and/or transverse direction.

[0067] Thus, even though the first block of foam 30 has nominal material properties, i.e. intended or desired material properties, the actual properties of the block of foam may deviate from this nominal value.

[0068] For example, the stress-strain properties may vary by $\pm 15\%$ from the nominal value.

[0069] In the next step S2 (Fig. 8), measurements are taken to determine the actual material properties of the first block of foam 30.

[0070] The actual material properties of the first block of foam 30 are determined by taking various measurements at multiple measurement points 32 distributed over

the entire block of foam, especially over the surface of first the block of foam 30.

[0071] Additionally or as an alternative, the measurements can be taken of samples 34 of the block of foam 30 that are obtained as clippings during the manufacture of the first block of foam 30 when the first block of foam 30 is cut into the desired dimensions.

[0072] As the next step S3, the material properties at the points of the first block of foam that are not measurement points 32 are estimated, for example by extrapolating the material properties at the measurement points 32. Mostly, these points are located inside the block of foam 30.

[0073] Thus, information about the material properties at every point of the first block of foam 30 is obtained that can be used during the further manufacturing process.

[0074] The information is preferably collected and stored in the control unit or accessible for the control unit.

[0075] In the next step S4, the first block of foam 30 is divided into different sections that will become the first layers 18 for different mattresses 10. This process is depicted in Figure 4, whereas the different first layers 18 are separated by dotted lines.

[0076] The first block of foam 30 of the shown example will be cut into ten different first layers 18. Thus, ten different sections 36 are defined in the block of foam 30.

[0077] A plurality of points corresponding to measurement points 32 may lie within each section 36 that can be seen as a group of points corresponding to one of the first layers 18.

[0078] As illustrated by the vertical dashed lines, each of the sections 36 has five different parts that will form the five zones of the mattress 10 provided by three different zones z_1, z_2, z_3 of the mattress 10 with regard to the firmness as already mentioned above.

[0079] During the measurement step, at least one measurement point 32 is taken for the V direction in order to identify different firmnesses of the several sections 36, in particular the ones stacked in vertical direction (V direction). Optionally, at least one measurement point 32 is taken for the L direction of each section 36.

[0080] After having defined the specific sections 36, each of the sections 36 may be assigned a unique identifier. The identifier may be an entry in a data base of the control unit.

[0081] Alternatively or in addition, the identifier may be a physical identifier 38. For example, each of the sections 36 may be marked with a print of a unique code, or a marker, like an RFID-chip or the like.

[0082] In this example, the first layer 18 in question shall be cut off the middle section 36 on the left hand side.

[0083] Thus, for the mattress 10 of this example, the actual material properties of the foam that will form the first mattress component 12, i.e. the first layer 18, are known precisely.

[0084] Likewise, the material properties of the foam that will form the second mattress component 12, i.e. the second layer 20, will be determined.

[0085] For the second layer 20 of the mattress 10, a second block of foam is provided. The second block of foam may be of a different foam or of the same foam as the first block of foam 30.

[0086] The material properties of the second block of foam are determined in the same manner as the material properties of the first block of foam 30 in steps labeled S1', S2', S3' and S4' in the diagram of Figure 8.

[0087] Further, a section of the second block of foam that will become the second layer 20 of the mattress 10 of this example is specified.

[0088] In the case that the other mattress components 12 of the mattress 10 are also made out of foam, the same steps might be performed for the inlay 22, the top layer 14 and/or the bottom layer 16. However, it is also possible, that the inlay 22 or the other components are not made out of foam.

[0089] In the next step S5, the section 36 of the first block of foam 30 for the first layer 18 of the mattress 10 and the section of the second block of foam for the second layer 20 of the mattress 10 are linked or assigned to one another.

[0090] In other words, before cutting the actual layers 18, 20 from the respective blocks of foam, it is decided for each section 36 of the first block of foam 30 which section of the second block of foam will be used to form a mattress 10. Thus, each section 36 of the first block of foam 30 is assigned another section of the second block of foam.

[0091] Further, an inlay 22, a top layer 14 and a bottom layer 16 may also be assigned to the sections forming the first layer 18 and the second layer 20 before the first layer 18 and the second layer 20 are actually cut.

[0092] This assignment may be done by linking the identifiers 38 of the section 36 of the first block of foam 30 and the identifier 38 of the section of the second block of foam and/or the other component 12.

[0093] This can be done by linking or cross referencing the identifiers in the data base of the control unit.

[0094] The linking may also be done physically by assigning the same or partly the same codes or markers to the sections designated for the same mattress.

[0095] In the next step S6, the actual or adapted geometries of the first layer 16 and the second layer 20 are determined.

[0096] The first layer 18 and the second layer 20 both have a basic geometry that has been created during the design process of the mattress 10. The basic geometries have been chosen based on the assumption that the first block of foam 30 and the second block of foam have precisely known and homogeneously distributed material properties. Therefore, the basic geometries correspond to an ideal design of the first layer 18 and the second layer 20.

[0097] As an example, the basic design of the first layer 18 is shown in Figure 5a. In this basic geometry, each of the cut-outs 28 has the same shape and the same diameter d_b .

[0098] This basic geometry is adapted to become the actual or adapted geometry of the first layer 18 and the second layer 20. The actual or adapted geometry of the first layer 18 is shown in Figure 5b which corresponds to Figure 2.

[0099] As can easily be seen, the shapes and diameters d_1 to d_4 of the cut-outs 28 are changed. The amount of change of the shapes and diameters of the cut-outs 28 is determined taking the measured actual material properties of the first block of foam 30 and also the second block of foam into account.

[0100] More specifically, the material properties of the section 36 that will become the first layer 18 of the first block of foam 30 and the material properties of the second block of foam that will become the second layer 20 are taken into account.

[0101] In a simplified example depicted in Figure 5b, if the density of the first block of foam 30, in particular for a certain section 36, is higher than the nominal density, then the cut-outs 28 have to be enlarged to compensate for the harder and therefore stiffer foam, in particular the foam of the certain section 36. This is exemplarily shown for the cut-outs 28 on the left side in Figure 5b.

[0102] On the other hand, if the axial density of the first block of foam 30, in particular of a certain section 36, is smaller than the nominal value, then the cut-outs 28 have to be decreased in size to compensate for the softer foam, in particular the foam of the certain section 36. This is exemplarily shown for the cut-outs 28 on the right side in Figure 5b.

[0103] Moreover, the material properties may be taken into account across the L direction in order to compensate deviations within a certain section 36.

[0104] This way, an adapted geometry for the first layer 18 is obtained.

[0105] Of course, the firmness of the mattress 10 depends on both the first layer 18 and the second layer 20 as well as on the other components. Thus, the adapted geometries of the first layer 18 and the second layer 20 (and possibly of the other layers) are adapted taking the other components into account in order to achieve the predetermined firmness of the entire mattress 10 as precisely as possible.

[0106] This adaption process is preferably done by the control unit in an automated manner using an algorithm and/or a look-up table relating the determined material properties of the first block of foam 30 and the second block of foam with adapted geometries for the first layer 18 and the second layer 20 or with deviations from the basic geometries of the first layer 18 and the second layer 20 that have to be applied.

[0107] The control unit may create a CNC-file containing the adapted geometry of the first layer 18 and another CNC-file containing the adapted geometry of the second layer.

[0108] The CNC-files may also have the identifier of their corresponding layer 18, 20.

[0109] In the next step S7, the first layer 18 is cut off the first block of foam 30 to obtain the first layer 18 with the adapted geometry. Figure 6 shows the first layer 18 that has been cut off the first block of foam 30.

[0110] Likewise, the second layer 20 with the adapted geometry is cut off the second block of foam.

[0111] For example, the CNC-files are supplied to the CNC-machines, like a CNC milling cutter that cut off the first layer 18 or second layer 20 of the respective block of foam. The CNC-machines may be controlled by the control unit.

[0112] In the next step S8, the actual mattress 10 is created.

[0113] To do so, the first layer 18 and the second layer 20 as well as the inlay 22, the bottom layer 16 and the top layer 14 with linked identifiers 38 are connected to each other in the correct order to form the mattress 10 as shown in Figure 7. For example, the components may be glued to one another.

[0114] Because of the adapted geometries of the first and second layer 18, 20 the mattress 10 has a firmness actually corresponding to the firmness predefined by the user during the design process of the mattress 10.

[0115] Due to the individual adaption of each layer, it is assured that the mattresses 10 have a firmness being but as close as possible to the user defined firmness.

[0116] Further, the use of identifiers 38 and/or the control unit make this manufacturing method suitable for mass production.

[0117] In short, the control unit may receive the measurement values of the measurements taken on the first block of foam 30, the second block of foam and any other block of foam. The control unit then divides each of the blocks of foams 30 into sections 36 and applies an identifier to each of the sections.

[0118] Then, the control unit virtually creates a mattress by choosing one section of each of the block of foams to form a single mattress and adapts the geometries of the first layer 18 and the second layer 20 designated for the same mattress 10 according to the actual material properties of the respective blocks of foam.

[0119] The control unit may then create a CNC-file or control a CNC-machine directly in order to cut the blocks of foam 30 according to the adapted geometries of the layers 18, 20. The control unit may then output, which of the manufactured layers 18, 20 have to be combined into a single mattress.

[0120] Alternatively, the control unit may control a machine for combining the different layers 18, 20 accordingly.

[0121] Figure 5c shows another embodiment of the method in which also the geometry of the inlay 22 is adapted during the adaption step.

[0122] In particular, the height and contour, more precisely the angles of the sidewalls, are adapted in order to achieve the desired firmness.

[0123] Obviously, also the recess 24 of the first layer

18 has been adapted to the adapted geometry of the inlay 22.

[0124] Other than that, the first layer 18 shown in Figure 5c corresponds to the first layer shown in Figure 5b.

[0125] Alternatively, it is possible that each of the layers 18, 20 is manufactured independently of the other components of the mattress. In this case, the geometry of each layer 18, 20 is adapted to achieve the same predefined firmness.

[0126] Then, any first layer 18 may be used with any second layer 20 to form a mattress 10 with the predefined firmness. Identifiers and complex logistics are not necessary in this case.

[0127] It is of course possible that the mattress 10 has additional mattress components, like a third layer, more inlays, etc.

Claims

1. Method for manufacturing a mattress (10) having a predefined firmness with at least one layer (14, 16, 18, 20) to achieve a user-selected predefined firmness with low deviation, wherein the mattress (10) has at least a first mattress component (12) and a second mattress component (12), wherein the method comprises the following steps:

- a) providing at least a first block of foam (30) and a second block of foam,
- b) determining the actual material properties of at least one region of the at least first block of foam (30) and the second block of foam, in particular density, stress properties and/or strain properties,
- c) determining at least the sections (36) and/or points of the first block of foam (30) and of the second block of foam that will form the first mattress component (12) and the second mattress component (12), respectively, of the same mattress (10),
- d) adapting a basic geometry of at least the first mattress component (12) and the second mattress component (12) to be cut off at least the first block of foam (30) and the second block of foam, respectively, in dependence of at least the determined material properties of the corresponding section (36) and/or points of the first block of foam (30) and the determined material properties of the corresponding section and/or points of the second block of foam in order to achieve the user-selected predetermined firmness of the mattress (10),
- e) cutting at least the first mattress component (12) off the first block of foam (30) and the second mattress component (12) off the second block of foam according to the respective adapted geometry to obtain the respective mattress

component (12), and
f) connecting at least the first mattress component (12) and the second mattress component (12) to form the mattress (10),

characterized in that an identifier is assigned to at least each of the first mattress component (12) and the second mattress component (12), wherein the identifiers of the first mattress component (12) and the second mattress component (12) that are intended for the same mattress (10) are linked with one another, and wherein the mattress (10) is formed using at least the first mattress component (12) and the second mattress component (12) having linked identifiers.

2. Method according to claim 1, **characterized in that** the geometry of the mattress component (12) comprises a cut-out (28), a groove (26), a height (h , h_i) and/or a contour of the cross-section of the mattress component (12).
3. Method according to claim 1 or 2, **characterized in that** a CNC-machine is used to cut the block of foam (30).
4. Method according to any one of the preceding claims, **characterized in that** the basic geometry is adapted using also information about at least one other mattress component (12) of the mattress (10).
5. Method according to any one of the preceding claims, **characterized in that** the basic geometry is adapted, in particular in an automated manner, using an algorithm and/or a look-up table relating the determined material properties or deviated material properties of the block of foam (30) with adapted geometries and/or deviations from the basic geometry to be applied.
6. Method according to any one of the preceding claims, **characterized in that** the actual material properties are determined by performing measurements on the block of foam (30) and/or on at least one sample (34) of the block of foam (30).
7. Method according to any one of the preceding claims, **characterized in that** the material properties are measured for multiple points distributed over the entire block of foam (30).
8. Method according to any one of the preceding claims, **characterized in that** material properties at points in the block of foam (30) that have not been measured are estimated based on the material properties at the points that have been measured.
9. Method according to any one of the preceding

claims, **characterized in that** multiple mattress components (12) are cut off the block of foam (30), wherein for each of the mattress components (12)

- a) a section (36) of the block of foam (30), in particular a group of points of the block of foam (30) is determined that will form the mattress component (12) after the cutting step,
- b) the basic geometry of the mattress component (12) is adapted in dependence of the material properties of the determined section (36) of the block of foam (30), in particular the material properties at the group of points, and
- c) cutting of the block of foam (30) is controlled in a way that the determined section (36) is detached from the block of foam (30) and that the corresponding mattress component (12) with the adapted geometry is obtained.

10. Method according to claim 9, **characterized in that** the identifier is assigned to each one of the mattress components (12).
11. Method according to any one of the preceding claims, **characterized in that** the first mattress component (12) is a first layer (18), and that the second mattress component (12) is a second layer (20) or an inlay (22) for the first layer (18).
12. Method according to any one of the preceding claims, **characterized in that** the mattress (10) has at least one additional mattress component (12), wherein the basic geometry of at least the first mattress component (12), the second mattress component (12) and the at least one additional mattress component (12) to be cut is adapted in dependence of at least the determined material properties of the respective blocks of foam (30) in order to achieve the predetermined firmness of the mattress (10).
13. Mattress manufactured using a method according to any one of the preceding claims.

Patentansprüche

1. Verfahren zur Herstellung einer Matratze (10) mit vorgegebener Festigkeit mit mindestens einer Lage (14, 16, 18, 20), sodass eine von dem Nutzer gewählte, vorgegebene Festigkeit mit geringer Abweichung erhalten wird, wobei die Matratze (10) mindestens eine erste Matratzenkomponente (12) und eine zweite Matratzenkomponente (12) umfasst, wobei das Verfahren folgende Schritte umfasst:
 - a) Bereitstellen mindestens eines ersten Schaumstoffblocks (30) und eines zweiten Schaumstoffblocks,

- b) Ermitteln der tatsächlichen Materialeigenschaften mindestens eines Bereichs des mindestens ersten Schaumstoffblocks (30) und zweiten Schaumstoffblocks, insbesondere Dichte, Spannungseigenschaften und/oder Dehnungseigenschaften,
- c) Ermitteln zumindest der Abschnitte (36) und/oder Stellen des ersten Schaumstoffblocks (30) und des zweiten Schaumstoffblocks, die die erste Matratzenkomponente (12) bzw. die zweite Matratzenkomponente (12) ein- und derselben Matratze (10) bilden,
- d) Anpassen einer Grundgeometrie zumindest der ersten Matratzenkomponente (12) und der zweiten Matratzenkomponente (12), die zumindest aus dem ersten Schaumstoffblock (30) bzw. dem zweiten Schaumstoffblock zu schneiden sind, in Abhängigkeit zumindest von den ermittelten Materialeigenschaften des entsprechenden Abschnitts (36) und/oder der entsprechenden Stellen des ersten Schaumstoffblocks (30) und der ermittelten Materialeigenschaften des entsprechenden Abschnitts und/oder der entsprechenden Stellen des zweiten Schaumstoffblocks, um die von dem Benutzer gewählte, vorbestimmte Festigkeit der Matratze (10) zu erhalten,
- e) Ausschneiden zumindest der ersten Matratzenkomponente (12) aus dem ersten Schaumstoffblock (30) und der zweiten Matratzenkomponente (12) aus dem zweiten Schaumstoffblock entsprechend der jeweiligen angepassten Geometrie, um die jeweilige Matratzenkomponente (12) zu erhalten, und
- f) Verbinden zumindest der ersten Matratzenkomponente (12) und der zweiten Matratzenkomponente (12) zur Bildung der Matratze (10),
- dadurch gekennzeichnet, dass** zumindest der ersten Matratzenkomponente (12) und der zweiten Matratzenkomponente (12) jeweils eine Kennung zugewiesen wird, wobei die Kennungen der ersten Matratzenkomponente (12) und der zweiten Matratzenkomponente (12), die für ein- und dieselbe Matratze (10) vorgesehen sind, verknüpft werden, und wobei die Matratze (10) unter Verwendung zumindest der ersten Matratzenkomponente (12) und der zweiten Matratzenkomponente (12) mit verknüpften Kennungen gebildet wird.
2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** die Geometrie der Matratzenkomponente (12) eine Aussparung (28), eine Nut (26), eine Höhe (h , h_i) und/oder eine Kontur des Querschnitts der Matratzenkomponente (12) umfasst.
3. Verfahren nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** eine CNC-Maschine zum
- Schneiden des Schaumstoffblocks (30) verwendet wird.
4. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Grundgeometrie auch unter Verwendung von Informationen über mindestens eine weitere Matratzenkomponente (12) der Matratze (10) angepasst wird.
5. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Grundgeometrie insbesondere automatisiert unter Verwendung eines Algorithmus und/oder einer Verweistabelle angepasst wird, der bzw. die die ermittelten Materialeigenschaften oder die abweichenden Materialeigenschaften des Schaumstoffblocks (30) mit angepassten Geometrien und/oder Abweichungen von der anzuwendenden Grundgeometrie in Verbindung bringt.
6. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die tatsächlichen Materialeigenschaften durch die Durchführung von Messungen am Schaumstoffblock (30) und/oder an mindestens einer Probe (34) des Schaumstoffblocks (30) ermittelt werden.
7. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Materialeigenschaften für zahlreiche Stellen, die am gesamten Schaumstoffblock (30) verteilt sind, gemessen werden.
8. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Materialeigenschaften an Stellen im Schaumstoffblock (30), die nicht gemessen wurden, auf der Grundlage der Materialeigenschaften an den Stellen, die gemessen wurden, geschätzt werden.
9. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** mehrere Matratzenkomponenten (12) aus dem Schaumstoffblock (30) herausgeschnitten werden, wobei für jede Matratzenkomponente (12)
- a) ein Abschnitt (36) des Schaumstoffblocks (30), insbesondere eine Gruppe von Stellen des Schaumstoffblocks (30) ermittelt wird, der bzw. die nach dem Schneidschritt die Matratzenkomponente (12) bildet,
- b) die Grundgeometrie der Matratzenkomponente (12) in Abhängigkeit von den Materialeigenschaften des ermittelten Abschnitts (36) des Schaumstoffblocks (30), insbesondere von den Materialeigenschaften an der Gruppe von Stellen angepasst wird,
- c) das Schneiden des Schaumstoffblocks (30)

derart gesteuert wird, dass der ermittelte Abschnitt (36) von dem Schaumstoffblock (30) gelöst und die entsprechende Matratzenkomponente (12) mit der angepassten Geometrie erhalten wird.

10. Verfahren nach Anspruch 9, **dadurch gekennzeichnet, dass** die Kennung jeder der Matratzenkomponenten (12) zugewiesen wird.

11. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die erste Matratzenkomponente (12) eine erste Lage (18) ist und die zweite Matratzenkomponente (12) eine zweite Lage (20) oder eine Einlage (22) für die erste Lage (18) ist.

12. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Matratze (10) mindestens eine zusätzliche Matratzenkomponente (12) aufweist, wobei die Grundgeometrie zumindest der ersten Matratzenkomponente (12), der zweiten Matratzenkomponente (12) und der mindestens einen zusätzlichen Matratzenkomponente (12), die zu schneiden sind, in Abhängigkeit zumindest von den ermittelten Materialeigenschaften der jeweiligen Schaumstoffblöcke (30) angepasst wird, um die vorbestimmte Festigkeit der Matratze (10) zu erhalten.

13. Matratze, die durch Anwendung eines Verfahrens nach einem der vorhergehenden Ansprüche hergestellt ist.

Revendications

1. Procédé de fabrication d'un matelas (10) à fermeté prédéfinie présentant au moins une couche (14, 16, 18, 20) pour obtenir une fermeté prédéfinie choisie par l'utilisateur avec une faible déviation, le matelas (10) présentant au moins un premier composant de matelas (12) et un deuxième composant de matelas (12), le procédé comprenant les étapes suivantes :

- a) fournir au moins un premier bloc de mousse (30) et un deuxième bloc de mousse,
- b) déterminer les propriétés de matériaux réels d'au moins une zone dudit au moins premier bloc de mousse (30) et du deuxième bloc de mousse, en particulier la densité, les propriétés de contrainte et/ou les propriétés d'allongement,
- c) déterminer au moins les tronçons (36) et/ou les emplacements du premier bloc de mousse (30) et du deuxième bloc de mousse qui vont former le premier composant de matelas (12) et le deuxième composant de matelas (12), respectivement, du même matelas (10),

d) adapter une géométrie de base au moins du premier composant de matelas (12) et du deuxième composant de matelas (12) à découper au moins du premier bloc de mousse (30) et du deuxième bloc de mousse, respectivement, en fonction au moins des propriétés de matériaux déterminées du tronçon correspondant (36) et/ou des emplacements correspondants du premier bloc de mousse (30) et des propriétés de matériaux prédéterminées du tronçon correspondant et/ou des emplacements correspondants du deuxième bloc de mousse pour obtenir la fermeté prédéterminée du matelas (10) choisie par l'utilisateur,

e) découper au moins le premier composant de matelas (12) du premier bloc de mousse (30) et le deuxième composant de matelas (12) du deuxième bloc de mousse selon la géométrie adaptée respective pour obtenir le composant de matelas (12) respectif, et

f) relier au moins le premier composant de matelas (12) et le deuxième composant de matelas (12) pour former le matelas (10),

caractérisé en ce qu'une identification est attribuée au moins à chacun du premier composant de matelas (12) et du deuxième composant de matelas (12), les identifications du premier composant de matelas (12) et du deuxième composant de matelas (12) prévues pour le même matelas (10) étant associées les unes aux autres, et le matelas (10) étant formé en utilisant au moins le premier composant de matelas (12) et le deuxième composant de matelas (12) présentant des identifications associées.

2. Procédé selon la revendication 1, **caractérisé en ce que** la géométrie du composant de matelas (12) comprend une découpe (28), une rainure (26), une hauteur (h , h_i) et/ou un contour de la section transversale du composant de matelas (12).

3. Procédé selon la revendication 1 ou 2, **caractérisé en ce qu'**une machine-outil à commande numérique est utilisée pour couper le bloc de mousse (30).

4. Procédé selon l'une des revendications précédentes, **caractérisé en ce que** la géométrie de base est adaptée en utilisant également des informations sur au moins un autre composant de matelas (12) du matelas (10).

5. Procédé selon l'une des revendications précédentes, **caractérisé en ce que** la géométrie de base est adaptée, en particulier de manière automatisée, en utilisant un algorithme et/ou une table de correspondance mettant en relation les propriétés de matériaux déterminées ou les propriétés de matériaux déviées du bloc de mousse (30) avec des géométries

adaptées et/ou des déviations de la géométrie de base à appliquer.

6. Procédé selon l'une des revendications précédentes, **caractérisé en ce que** les propriétés de matériaux réelles sont déterminées en réalisant des mesures sur le bloc de mousse (30) et/ou sur au moins un échantillon (34) du bloc de mousse (30). 5
7. Procédé selon l'une des revendications précédentes, **caractérisé en ce que** les propriétés de matériaux sont mesurées pour une pluralité d'emplacements répartis sur l'ensemble du bloc de mousse (30). 10
8. Procédé selon l'une des revendications précédentes, **caractérisé en ce que** les propriétés de matériaux à des emplacements dans le bloc de mousse (30) qui n'ont pas été mesurés sont estimées sur la base des propriétés de matériaux aux emplacements qui ont été mesurés. 15 20
9. Procédé selon l'une des revendications précédentes, **caractérisé en ce que** plusieurs composants de matelas (12) sont découpés du bloc de mousse (30), dans lequel, pour chacun des composants de matelas (12), 25
 - a) un tronçon (36) du bloc de mousse (30), en particulier un groupe d'emplacements du bloc de mousse (30) est déterminé, lequel va former le composant de matelas (12) après l'étape de découpage, 30
 - b) la géométrie de base du composant de matelas (12) est adaptée en fonction des propriétés de matériaux du tronçon (36) déterminé du bloc de mousse (30), en particulier des propriétés de matériaux au niveau du groupe d'emplacements, et 35
 - c) le découpage du bloc de mousse (30) est commandé de telle sorte que le tronçon (36) déterminé est détaché du bloc de mousse (30) et que le composant de matelas (12) correspondant avec la géométrie adaptée est obtenu. 40 45
10. Procédé selon la revendication 9, **caractérisé en ce que** l'identification est attribuée à chacun des composants de matelas (12).
11. Procédé selon l'une des revendications précédentes, **caractérisé en ce que** le premier composant de matelas (12) est une première couche (18) et **en ce que** le deuxième composant de matelas (12) est une deuxième couche (20) ou une pièce d'insertion (22) pour la première couche (18). 50 55
12. Procédé selon l'une des revendications précédentes, **caractérisé en ce que** le matelas (10) présente

au moins un composant de matelas supplémentaire (12), la géométrie de base au moins du premier composant de matelas (12), du deuxième composant de matelas (12) et dudit au moins un composant de matelas (12) supplémentaire à découper étant adaptée en fonction au moins des propriétés de matériaux déterminées des blocs de mousse (30) respectifs pour obtenir la fermeté prédéterminée du matelas (10).

13. Matelas fabriqué en utilisant un procédé selon l'une des revendications précédentes.

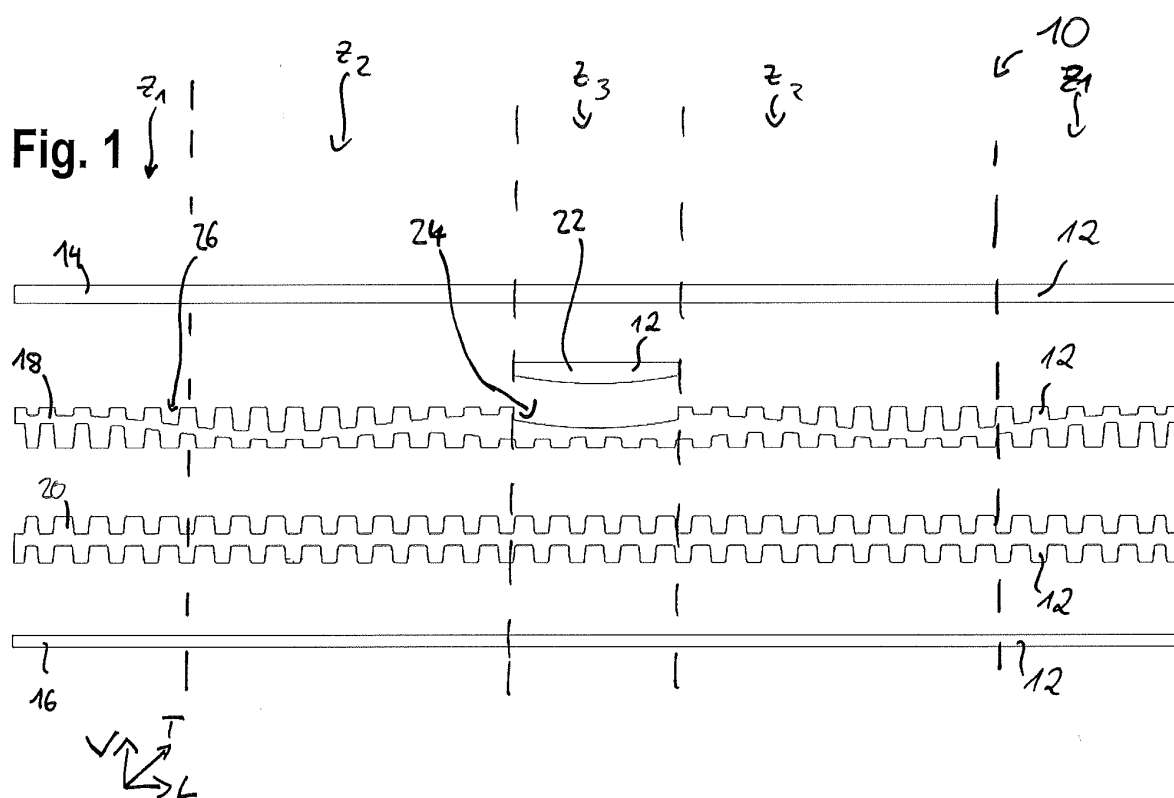


Fig. 2

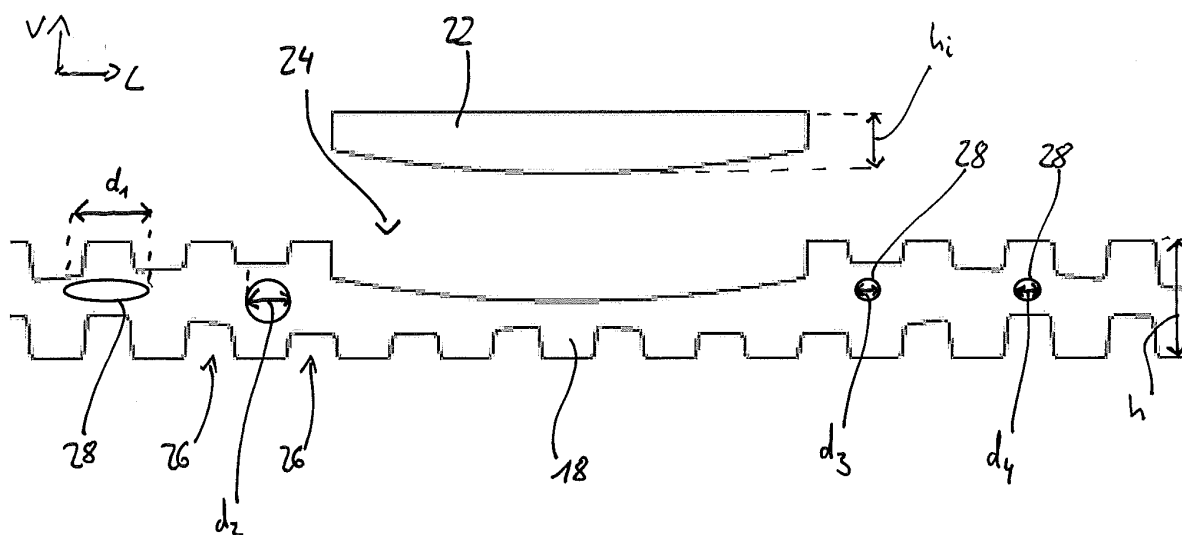


Fig. 3

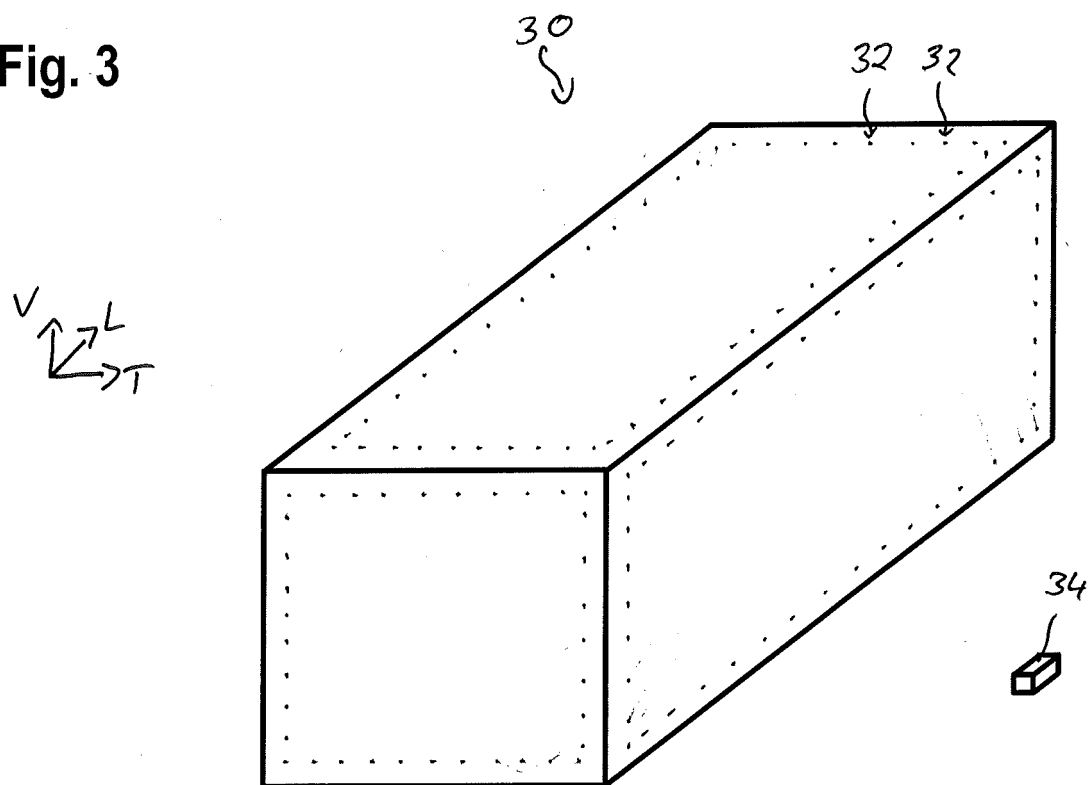


Fig. 4

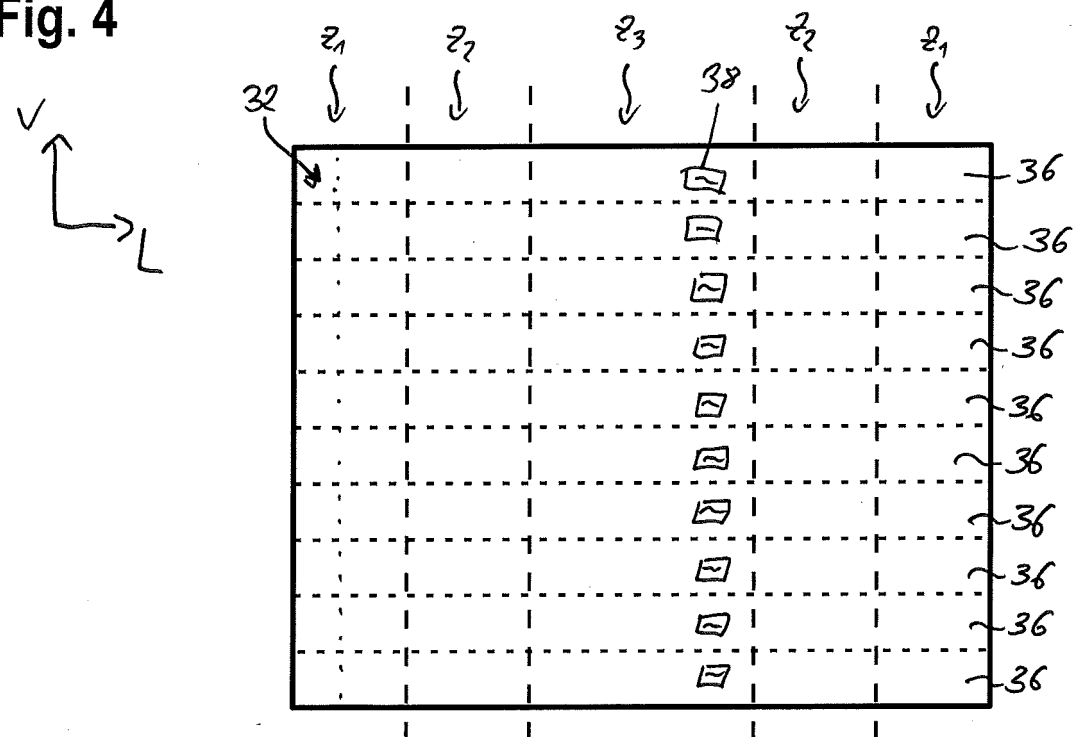


Fig. 5a)

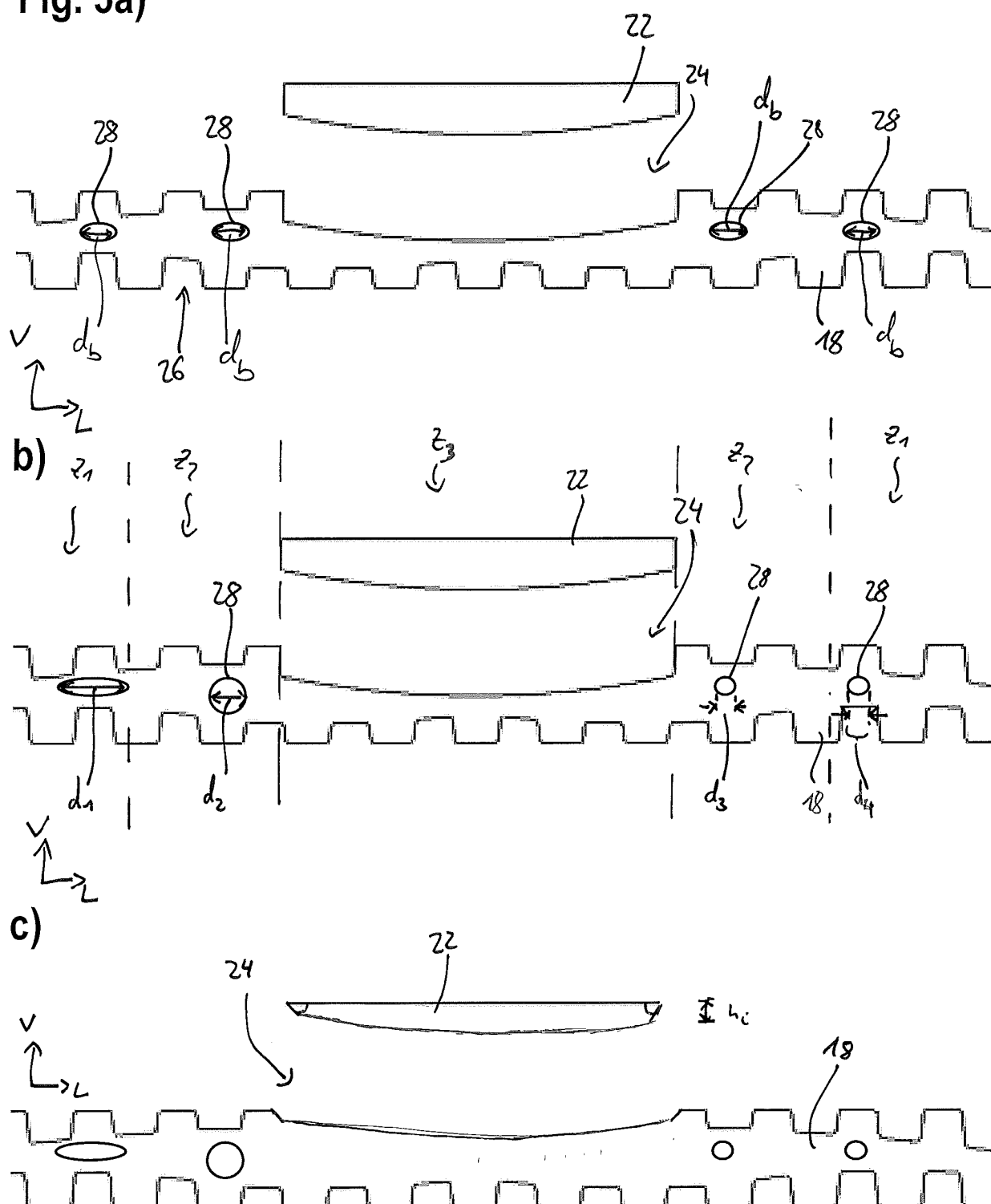


Fig. 6



Fig. 7

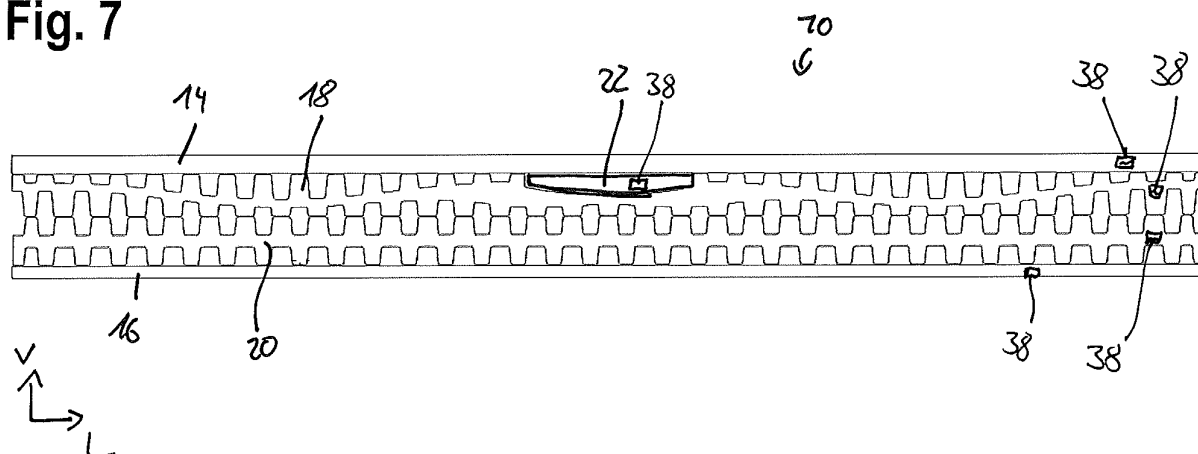
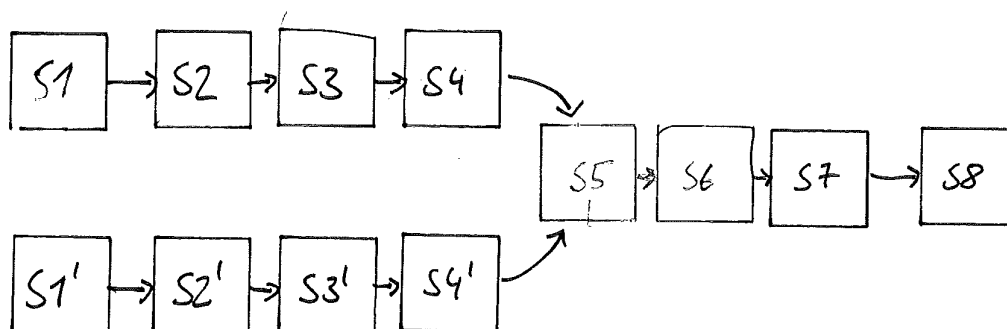


Fig. 8



REFERENCES CITED IN THE DESCRIPTION

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