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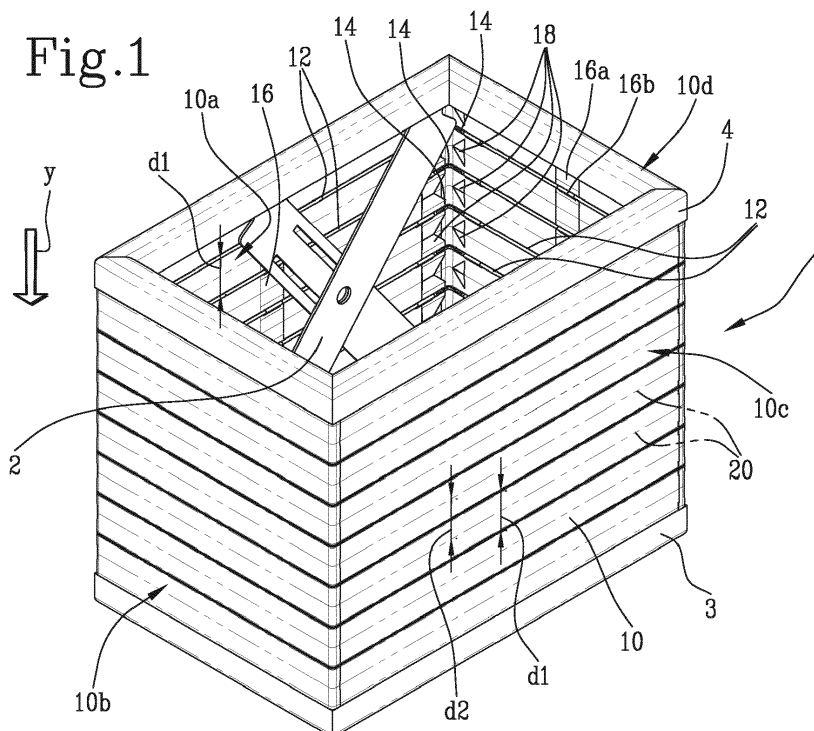
(54) **BELLOWS FOR LIFTING DEVICE, LIFTING DEVICE, TRANSPORT KIT AND CORRESPONDING METHOD**

(57) Described is a bellows (1) for a vertical lifting device, the bellows (1) comprising:

- a sheet (10) divided into a plurality of sections (10a, 10b, 10c, 10d) having respective widths,
- a plurality of reinforcement bars (12), the tubular reinforcement bars (12) being mounted on each of the above-mentioned sections (10a, 10b, 10c, 10d) of the

sheet (10) and configured for reinforcing the section of the sheet (10) on which they are mounted, and

- a plurality of connecting joints (14), each flexible joint (14) configured for connecting together a pair of the reinforcement bars (12) belonging to adjacent sections of said sheet (10).



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Description

[0001] This invention relates to bellows for lifting devices, for example lifting platforms.

[0002] The use of bellows is known to cover the lifting mechanics of lifting platforms, in order to prevent shearing of the pantograph and/or to protect the lifting mechanism from dust, dirt or foreign objects as well as to protect operator's limbs from possible injuries due to contact with moving parts of the mechanism.

[0003] Prior art bellows have one or more drawbacks, such as, for example, a high transport cost since the overall size of the bellows is large (approximately equal to the overall dimensions of the lifting device) since the bellows must be transported already mounted on rigid supports. Moreover, the prior art bellows are relatively fragile and it is not therefore desirable to position objects stacked on them during transport.

[0004] Moreover, the prior art bellows have a high production cost which may be in the order of magnitude greater than the cost of the lifting device they are coupled to.

[0005] An aim of this invention is therefore to provide a bellows for lifting devices which facilitates the resolution of one or more drawbacks of the prior art.

[0006] In particular, an aim of the invention is to provide a bellows which has reduced transport dimensions and which is particularly easy and resistant to transport.

[0007] A further aim of the invention is to provide an inexpensive bellows which is particularly easy to produce, transport and install on a lifting device.

[0008] The technical characteristics of the invention, with reference to the above aims, are clearly described in the claims below and its advantages are apparent from the detailed description which follows, with reference to the accompanying drawings which illustrate a preferred embodiment of the invention provided merely by way of example without restricting the scope of the inventive concept, and in which:

- Figure 1 shows a bellows mounted on a lifting device according to one or more embodiments,
- Figure 2 shows a top view of a lifting device according to one or more embodiments,
- Figures 3 and 4 show side views, respectively, from the inside and from the outside of parts of a bellows according to one or more embodiments,
- Figures 5 and 6 show details of a bellows according to one or more embodiments,
- Figure 7 shows a bellows mounted on a lifting device according to one or more embodiments,
- Figures 8 and 9 show details of a bellows according to one or more embodiments,
- Figures 10 and 11 show a flexible joint of a bellows 1 according to one or more embodiments,
- Figure 12 shows a bellows folded according to one or more embodiments,
- Figure 13 shows a top view of the bellows of Figure

12,

- Figure 14 shows an example of a kit for transporting a bellows according to one or more embodiments,
- Figure 15 shows a schematic side view of a folded and rolled bellows according to one or more embodiments,
- Figure 16 shows a perspective view of a bellows according to one or more embodiments, and
- Figures 17 to 19 show details of a bellows according to one or more embodiments.

[0009] Figure 1 illustrates an example of a bellows 1 for vertical lifting devices according to the invention, comprising:

- a sheet 10 divided into a plurality of sections 10a, 10b, 10c, 10d having respective widths, illustrated open in the example of Figure 1,
- a plurality of reinforcement bars 12, the reinforcement bars 12 being mounted on each of the above-mentioned sections 10a, 10b, 10c, 10d of the sheet 10 and being configured for reinforcing the cross-section of the sheet 10 on which they are mounted, and
- a plurality of connecting joints 14, for example flexible, each joint 14 being configured for connecting together, for example directly, a pair of the reinforcement bars 12 belonging to adjacent sections of said sheet 10.

[0010] As illustrated in Figure 1, the lifting device may comprise lifting means 2, for example lifting arms, and a first and a second rigid frame 3, 4 coupled to the lifting means 2. The first lower rigid frame 3 may face towards the ground. As illustrated in the top view of Figure 2, the second upper rigid frame 4 can be coupled, by supporting elements 6, to a supporting plate 5 on which an object or a person can be positioned to be raised.

[0011] A first end and a second end of the bellows 1 can be coupled, respectively, to the first rigid frame 3 and to the second rigid frame 4 of the lifting device. For example, the sheet 10 may comprise a lower end and an upper end which can be coupled, respectively, to the first lower rigid frame 3 and to the second rigid upper frame 4 of the lifting device.

[0012] The supporting plate 5 may be positioned above the remaining components of the lifting device, that is to say, the supporting plate 5 may be rested on the second rigid upper frame 4 which is positioned on top of the bellows 1 which, in turn, is positioned above the first rigid lower frame 3.

[0013] According to an aspect of the invention, the sheet 10 may consist of a single piece or a plurality of portions of sheet which are connected to each other, for example in a reversible manner. The sheet 10 may comprise closing means at lateral ends, for example closed with Velcro. In the example wherein the sheet 10 is made as one piece, the lateral ends of the sheet 10 can close

together and the sheet 10 can thereby define a closed space.

[0014] Advantageously, the sheet 10 may be made of any deformable material, for example a plastic material. On the contrary, the prior art bellows are limited to being made of thermoplastic materials.

[0015] Advantageously, the sheet 10 may be open during the installation on, the inspection of and/or the removal from, a lifting device. Moreover, the sheet 10 which can be opened can more easily adapt to existing lifting devices which use prior art bellows.

[0016] Advantageously, the sheet 10 may be a single sheet with a single joint at the point at which it closes on itself. On the other hand, the prior art bellows have a plurality of joints. This can more easily result in damage to the body of the bellow and dust and dirt can also be inserted more easily through the joints.

[0017] The plurality of sections 10a, 10b, 10c, 10d of the sheet 10 may be equal in number and width to the number and width of sides of the lifting device. For example, the sections 10a, 10b, 10c, 10d may all have the same size, if the bellows 1 can be coupled to a lifting device having a square supporting plate 5, or they may be in equal pairs, if the bellows 1 can be coupled to a lifting device having a rectangular supporting plate 5.

[0018] According to one or more embodiments, the reinforcement bars 12 may also be configured to prevent movements of the sheet 10 in directions different from a vertical direction Y (that is, the direction of movement of the lifting device). In this way, the sheet 10 may only open or close vertically (like the lifting device) and may remain rigid with respect to movements in different directions from the vertical direction. According to one aspect of this invention, the reinforcement bars 12 may be tubular. The reinforcement bars 12 can be positioned along the sheet 10 at different heights, spaced from each other by a predetermined distance d1 along the vertical direction Y. The reinforcement bars 12 can be mounted on the sheet 10 only on a first side of the sheet 10, with the second side of the sheet 10, opposite the first side, which remains without reinforcement bars 12. The first side, when the sheet 10 is coupled to the first and to the second rigid frame 3, 4 of the lifting device, may be the side facing towards the lifting means 2, that is, towards the inside of the device, whilst the second side may be that facing towards the surrounding environment, that is, towards the outside of the device.

[0019] Figures 3 and 4 show non-limiting examples of sections of sheet 10 respectively of a long side and a short side of the device, if the sheet 10 is divided into sections of different width. Figure 3 shows a view from the inside of the lifting device towards the outside, that is to say, the first side of a section 10a of the sheet 10 is visible. Figure 4 is a view from the outside of the lifting device towards the inside, that is to say, the second side of a section 10b of the sheet 10, adjacent to the section 10a shown in Figure 3, is visible.

[0020] As illustrated, each section of the sheet 10 may

comprise reinforcement bars 12 mounted on it. The reinforcement bars 12 can extend substantially for the entire width of the section, that is to say, the reinforcement bars 12 may have a width substantially equal to the width of the section on which they are mounted. The reinforcement bars 12 of a certain section 10a are at a same height with respect to the reinforcement bars 12 of the adjacent sections of sheet 10, for example 10a and 10d, so as to have a continuity of reinforcement bars 12 between one section of sheet 10 and the next. The joints 14 (described in more detail with reference to Figures 10 and 11) may therefore be configured for connecting, for example directly, pairs of reinforcement bars 12 belonging to adjacent sections, for example 10a, 10b, which are at the same height. For example, the joints 14 may be made of polyurethane.

[0021] When the bellows 1 is mounted on the lifting device, the joints 14 may be at corners of the lifting device, that is to say, at meeting points between adjacent sides of the device. The joints 14 can be configured for reinforcing and preventing movements of the sheet 10 at the corners.

[0022] According to one or more embodiments, the sheet 10 may comprise a plurality of fixing elements 16, as shown by way of example in the enlargement of Figure 5, configured to hold in position the plurality of reinforcement bars 12 on the sheet 10. The fixing elements 16 may comprise cavities designed to receive inside respective reinforcement bars 12. The fixing elements 16 can be located at the centre and/or at the sides in the sections of the sheet 10. The fixing elements 16 may be made of a plastic material, for example PVC (polyvinylchloride) and/or of the same material as the sheet 10.

[0023] According to one or more embodiments, each fixing element 16 may comprise at least a first portion 16a connected to the sheet 10, for example at an upper end and a lower end, and at least a free second portion 16b which defines the cavity, that is, a space between the fixing element and the sheet 10.

[0024] For example, the fixing elements 16 may comprise a plurality of pieces of flexible material, for example the same material as the sheet 10, where each piece may comprise first portions connected to the sheet 10 at an upper end and a lower end and a second free portion which defines the cavity, that is to say, a space between the piece and the sheet 10. The cavities thus defined may be at the same height relative to the corresponding reinforcement bars 12.

[0025] Alternatively, as illustrated in the non-limiting example of Figure 5, the fixing elements 16 may comprise strips of flexible material, for example the same material as the sheet 10, connected to the sheet 10. Each fixing element 16 may be divided into first portions 16a connected to the sheet 10, for example fixed in a non-reversible manner, and second free portions 16b which define the cavity, that is, a space between the fixing element 16 and the sheet 10. The body of the reinforcement bars 12 may be inserted in the cavity at the second portions 16b

and kept in position. The cavities thus defined may be at the same height relative to the corresponding reinforcement bars 12.

[0026] According to one or more embodiments, the sheet 10 may comprise a plurality of stiffening elements 18 coupled to the sheet 10, as shown by way of example in the enlargement of Figure 6, and configured to impart a predetermined shape to the sheet 10 during the closing movement (that is, retraction) and opening movement (that is, extension) of the sheet 10 due to movements of the lifting device. In other words, the stiffening elements 18 can be configured to accompany the sheet 10 whilst it closes or opens, so that the sheet 10 closes following a predetermined shape, as described in more detail below. The stiffening elements 18 may be fixed to the sheet 10, for example in a non-reversible manner. The stiffening elements 18 may be made of a plastic material, for example PVC (polyvinylchloride) and/or of the same material as the sheet 10. The stiffening elements 18 may be located at the sides in the sections of the sheet 10.

[0027] According to one or more embodiments, the stiffening elements 18 may comprise pointed and/or tapered portions configured to facilitate the closing of the sheet 10. As illustrated in the non-limiting example of Figure 6, the stiffening elements 18 may comprise a plurality of triangular elements 18a and/or rectangular elements with recesses, for example triangular, 18b.

[0028] According to one or more embodiments, the stiffening elements 18 can define, in the sheet 10, a plurality of closing lines 20 at different heights of the sheet 10 relative to heights of the plurality of reinforcement bars 12. The closing lines 20 may be positioned along the sheet 10 spaced from each other by a predetermined second distance d_2 , which may or may not correspond to the first predetermined distance d_1 .

[0029] According to an aspect of the invention, one or more or all of the fixing elements 16 may comprise stiffening elements 18. For example, at least the first portions 16a of the fixing elements 16 may be partly rigid to impart a predetermined shape to the sheet 10 when it closes or opens.

[0030] In Figures 1 to 6, the bellows 1 is in a first open configuration, that is to say, the lifting device is in the raised position, the lifting means 2 are extended and the sheet 1 is open, that is, taut and free of folds. Figure 7 shows the bellows 1 when it is in a second closed configuration, Figures 8 and 9 show enlargements of a portion respectively central and lateral of one side of the lifting device when the bellows 1 is in the second closed configuration.

[0031] As illustrated in Figures 7 to 9 the lifting device is in the lowered position, the lifting means 2 are closed and the sheet 10 is closed, that is to say, it has the shape of an accordion. The sheet 10 forms a bellows together with the closing lines 20 and the reinforcement bars 12, which perform the function of rigid frames of the bellows. In other words, the closing lines 20 and the reinforcement bars 12 define crests and troughs of the bellows 1 (or

vice versa).

[0032] In effect, as illustrated in Figure 7, when the sheet 10 lowering is closed, the plurality of stiffening elements 18 push the material of the sheet 10 towards the inside or towards the outside of the lifting device, at the closing lines 20.

[0033] When the bellows 1 is closed, the reinforcement bars 12 may be one above the another and in the same way the closing lines 20 may be located on each other.

[0034] According to one or more embodiments, when the bellows 1 closes the stiffening elements 18 may be configured for superposing. Advantageously, this facilitates closing of the sheet 10 following a predetermined shape.

[0035] Figures 10 and 11 show a non-limiting example of a flexible joint 14, in a closed configuration (that is, the joint 14 is folded back on itself) and in an open configuration (that is, the joint 14 is straight). The flexible joint 14 comprises a central portion 14a configured for folding and extending and lateral portions 14b, configured for coupling, for example directly, to the reinforcement bars 12. In this way, during the installation and subsequent use of the bellows 1, the central portion 14a of the flexible joints 14 can be folded at a right angle and the reinforcement bars 12 connected to the lateral portions 14b can extend in a mutually perpendicular direction. The flexible joints 14 can therefore stiffen and protect the corners of the sheet 10.

[0036] For example, during transportation of the bellows 1, the central portion 14a of the flexible joints 14 may be folded on itself, as illustrated in Figure 10 or it may be straight, as illustrated in Figure 11. In this way, the reinforcement bars 12 connected to the side portions 14b can extend in a parallel direction.

[0037] According to one or more embodiments, the reinforcement bars 12 may be hollow at lateral ends and the lateral portions 14b of the flexible joints 14 may be configured to be inserted (in a reversible or irreversible manner) inside the lateral ends of the reinforcement bars 12.

[0038] Figure 12 shows a non-limiting example of the bellows 1 when it is partly folded for transport. Figure 13 shows a top view of the bellows 1 of Figure 12.

[0039] The bellows 1 can be folded on itself and the sheet 10 can be flattened: in this way, the reinforcement bars 12 are parallel to each other and the flexible connecting joints 14 are either straight (as shown in the central portion of the folded bellows 1) or folded onto themselves (as can be seen at the ends of the folded bellows 1).

[0040] The dashed lines show the lateral ends of the sections 10a, 10b, 10c, 10d of the sheet 10 and, as illustrated in Figures 12 and 13, two adjacent sections, for example 10a, 10d, may be positioned in contact with the remaining two sections, for example 10b, 10c.

[0041] In particular, in Figure 12, the dashed line superposed on the drawing shows the end between the section 10b and 10c, whilst the one partially visible shows the end between the section 10a and 10d.

[0042] In the case illustrated, where the sections 10a, 10b, 10c, 10d comprise a first and a second width, that is to say, if the lifting device has a rectangular supporting plate 5, an overall transport size of the bellows 1 may be equal to the sum of the first width and the second width. If the sections 10a, 10b, 10c, 10d have an equal size, that is to say, if the lifting device has a square supporting plate 5, the sheet 10 may be further folded on itself and the transport dimensions of the bellows 1 may have a length equal to the width of the single section.

[0043] Once the sheet 10 is flattened as illustrated in Figure 12, the sheet 10 may be rolled on itself in a direction (for example, the vertical direction Y) perpendicular to a direction of extension of the reinforcement bars 12. Figure 14 shows a non-limiting example wherein the bellows 1 is folded and rolled up and Figure 15 shows a side view of the bellows 1 illustrated in Figure 14.

[0044] As may be observed in the drawings, the folded and rolled bellows 1 may comprise, shown outwards, the second side without reinforcement bars 12. All the remaining components of the bellows 1 apart from the second side of the sheet 10 may be inside the rolled sheet 10.

[0045] The bellows 1 thus folded and rolled can be inserted inside a tubular element 7, configured to receive and protect the bellows 1 during transport.

[0046] The tubular element 7 may comprise a covering of flexible material, for example cellophane, wound around the folded and rolled sheet 10.

[0047] In addition or alternatively, the tubular element 7 may comprise a rigid cylinder with an opening 7a through which the bellows 1 can be inserted in the tubular element 7. Once the bellows 1 has been inserted, the opening 7a may be closed.

[0048] If the sections of the sheet 10 have a first and a second different width (that is, if the supporting plate 5 of the lifting device is rectangular), a length of the tubular element 7 corresponds to a sum between the first width and the second width. If, on the other hand, the sections of the sheet 10 have equal width (that is, if the supporting plate 5 of the lifting device is square), a length of the tubular element 7 corresponds to this width.

[0049] One or more embodiments may therefore refer to a kit for transporting a bellows 1 for lifting devices, which may comprise:

- a bellows 1 of the type describe above, wherein the bellows 1 is folded in such a way that the sheet 10 is flattened and rolled on itself in a direction perpendicular to the direction in which the reinforcement bars 12 extend (for example le vertical direction Y), and
- a tubular element 7, configured to receive the folded and rolled bellows 1, for example wrapping them.

[0050] One or more embodiments may refer to a method for folding a bellows 1 for lifting devices. The method may comprise:

- flattening the sheet 10, so that the reinforcement bars 12 of the plurality of reinforcement bars 12 are parallel, and
- rolling the sheet 10 on itself in a direction perpendicular to the direction (for example the vertical direction Y) in which the reinforcement bars 12 extend.

[0051] The method may further comprise a step of inserting the folded and rolled bellows 1 inside a tubular element 7, for example by winding a covering of flexible material around the sheet 10 or inserting the sheet 10 inside a rigid cylinder at an end of the rigid cylinder which comprises an opening 7a. Advantageously, under equal conditions of dimensions of the bellows once mounted on the lifting device, the transport kit of the bellows occupies less space than a transporting package of a prior art bellows.

[0052] Advantageously, the bellows according to the invention is modular, and the various components may be replaced without having to change the entire bellows, in the case of damage. Prior art bellows are monolithic and must be replaced completely even if only part of them is damaged.

[0053] One or more embodiments relates to a bellows 1 for vertical lifting devices described with reference to Figures 16 to 19. The bellows 1 comprises:

- a sheet 10 divided into a plurality of sections 10a, 10b, 10c, 10d having respective widths, illustrated open in the example of Figure 16,
- a plurality of reinforcement bars 12, the reinforcement bars 12 being mounted on each of the above-mentioned sections 10a, 10b, 10c, 10d of the sheet 10 and being configured for reinforcing the cross-section of the sheet 10 on which they are mounted, and
- a plurality of connecting joints 14, illustrated in detail for example in Figures 17 and 19, for example flexible, each joint 14 being configured for connecting together, for example directly, a pair of the reinforcement bars 12 belonging to adjacent sections of said sheet 10.

[0054] The bellows 1 described with reference to Figures 16 to 19, if not specified otherwise, have the same characteristics as the bellows 1 described with reference to Figures 1 to 15. For example, it may be connected to the lifting means and may comprise a sheet 10 similar to that described with reference to Figures 1 to 15. The bellows 1 may have a plurality of sides, for example four, equal in number to the sections 10a-10d of the sheet 10. According to one or more embodiments, the reinforcement bars 12 may comprise substantially rectangular segments which comprise, at opposite lateral ends, connecting elements 120 for coupling with the joint 14. The coupling elements 120 may comprise portions projecting from the reinforcement bars 12. For example, when adjacent sides 10a, 10b, 10c, 10d of the sheet are connect-

ed together, connecting elements 120 of a reinforcement bar 12 are configured to be at least partly superposed with elements 120 for coupling the reinforcement bars 12 adjacent to it, belonging to sides of the bellows 1 adjacent to the side on which the reinforcement bar 12 is mounted. In other words, for a pair of sides of the bellows 1 adjacent and connected to each other, the coupling elements 120, located at the ends of the sides in contact with each other, are at least partly superposed.

[0055] According to an aspect, the coupling elements 120 may have a shape tapered away from the reinforcement bars 12 and towards a central portion of the reinforcement bars 12. In this way, when the bellows 1 is installed as illustrated for example in Figure 16, the corners of the bellows 1 are more protected.

[0056] According to an aspect, the coupling elements 120 comprise through holes 122 and wherein the connecting joint 14 comprises a pin, the pin being configured for inserting inside the through holes 122 of coupling elements 120 of adjacent reinforcement bars 12. The pin may comprise a pull-off rivet or it may comprise a button which fixes together two adjacent reinforcement bars 12. For example, to facilitate insertion of the connecting joint 14 inside the through holes, the through holes may be aligned when the coupling elements 120 of adjacent reinforcement bars 12 are partly superposed.

[0057] According to an aspect, for each pair of adjacent sides of the bellows 1 connected to each other, as illustrated in Figure 18, the joint 14 introduced in the through holes 122 allows a relative rotation of the reinforcement bars 12 about an axis of rotation X. The axis of rotation X may be identified as a direction of extension of the connecting joint 14. The rotation of the reinforcement bars 12 is advantageous for transporting the bellows 1, since adjacent sides connected to each other may be carried substantially parallel, that is, during transport, adjacent connected sides may be in contact substantially along their entire length.

[0058] The joints 14 can be configured to be inserted (in a reversible or irreversible manner) inside the through holes 122 of the coupling elements 120 of the reinforcement bars 12.

[0059] According to an aspect, the reinforcement bars 12 may be configured to prevent movements of the sheet 10 in different directions from a vertical direction Y (that is, the direction of movement of the lifting device). In this way, the sheet 10 may only open or close vertically (like the lifting device) and may remain rigid with respect to movements in different directions from the vertical direction.

[0060] The reinforcement bars 12 can be positioned along the sheet 10 at different heights, spaced from each other by a predetermined distance d1 along the vertical direction Y. The reinforcement bars 12 can be mounted on the sheet 10 only on a first side of the sheet 10, with the second side of the sheet 10, opposite the first side, which remains without reinforcement bars 12. The first side, when the sheet 10 is coupled to the first and to the

second rigid frame 3, 4 of the lifting device, may be the side facing towards the inside of the device, whilst the second side may be the side facing towards the surrounding environment, that is, towards the outside of the device.

[0061] As illustrated, each section of the sheet 10 may comprise reinforcement bars 12 mounted on it. The reinforcement bars 12 can extend substantially for the entire width of the section, that is to say, the reinforcement bars 12 may have a width substantially equal to the width of the section on which they are mounted. The reinforcement bars 12 of a certain section 10a are at a same height with respect to the reinforcement bars 12 of the adjacent sections of sheet 10, for example 10a and 10d, so as to have a continuity of reinforcement bars 12 between one section of sheet 10 and the next. The joints 14 may therefore be configured for connecting, for example directly, pairs of reinforcement bars 12 belonging to adjacent sections, for example 10c, 10d, which are at the same height.

[0062] When the bellows 1 is mounted on the lifting device, the joints 14 and the coupling elements 120 to which the joints 14 are coupled may be at corners of the lifting device, that is, at meeting points between adjacent sides of the device.

[0063] According to one or more embodiments, the reinforcement bars 12 may be mounted on the sheet 10 for example through a plurality of fixing elements 16 configured to hold in position the plurality of reinforcement bars 12 on the sheet 10. The fixing elements 16 may comprise mechanical coupling elements or a glue. In addition or alternatively, the reinforcement bars 12 may be heat-sealed on the sheet 10.

[0064] According to an aspect, the points of contact between the reinforcement bars 12 and the sheet 10 can define elements 18 for stiffening the sheet 10, such that the sheet 10 has a predetermined shape during the closing (that is, retraction) and opening (that is, extension) movements of the sheet 10 due to vertical movements of the lifting device. According to this embodiment, the opening and closing movements are similar to those described with reference to Figures 1 to 15.

[0065] Figure 18 shows the bellows 1 when it is in the closed position and partly mounted, suitable for transport. During transport, the sides of the bellows 1 can be transported in pairs and can be folded in such a way that the reinforcement bars 12 of the two sides 10c, 10d of the bellows 1 extend in a parallel direction.

[0066] For example, the transport of the bellows 1 may occur with the bellows 1 being divided into two portions each consisting of a pair of sides of the bellows 1 joined to each other by joints 14. In particular, the pairs of sides may be positioned during transport with the reinforcement bars 12 parallel. One or more embodiments may refer to a method for transporting a bellows 1 for lifting devices according to one or more embodiments. The method may comprise:

- providing a first pair of sections, for example 10a and

10d of the sheet 10 and a plurality of reinforcement bars 12 mounted on the first pair of sections 10a-10d of the sheet 10, the reinforcement bars 12 mounted on a section being coupled to the reinforcement bars 12 of the other section by means of a plurality of joints 14,

- providing a second pair of sections 10c and 10d of the sheet 10 and a plurality of reinforcement bars 12 mounted on the second pair of sections 10b-10c of the sheet 10, the reinforcement bars 12 mounted on a section being coupled to the reinforcement bars 12 of the other section by means of a plurality of joints 14,
- rotating the reinforcement bars 12 about an axis of rotation X defined by the joints 14 carrying all the reinforcement bars 12 of the first and the second pair of sections 10a-10d, 10b-10c substantially parallel to each other, and
- optionally, linking together the sides of the first pair and the sides of the second pair and/or linking together the first pair and the second pair.

[0067] During installation, the method may comprise:

- disconnecting the first pair of sides and the second pair of sides,
- rotating the reinforcement bars and bringing the reinforcement bars 12 belonging to the first and the second pair of sections 10a-10d, 10b-10c at right angles to each other,
- positioning the first pair of sections at the second pair of sections, with elements 120 for coupling the reinforcement bars 12 of the first pair of sections, free from connections with joints 14, positioned at least partly superposed on coupling elements 120 of the reinforcement bars 12 of the second pair of sections, free from connections with joints 14, and
- coupling the free reinforcement bars 12 at least partly superposed of the first and the second pair 10a-10d and 10b-10c using a plurality of joints 14.

[0068] Advantageously, under equal conditions of dimensions of the bellows once mounted on the lifting device, the transporting of the folded bellows occupies less space than a transporting package of a prior art bellows. Advantageously, the bellows according to the invention is modular, and the various components may be replaced without having to change the entire bellows, in the case of damage. Prior art bellows are monolithic and must be replaced completely even if only part of them is damaged.

Claims

1. A bellows (1) for a vertical lifting device, the bellows (1) comprising:
 - a sheet (10) divided into a plurality of sections

(10a, 10b, 10c, 10d) having respective widths,
 - a plurality of reinforcement bars (12), the reinforcement bars (12) being mounted on each of the above-mentioned sections (10a, 10b, 10c, 10d) of the sheet (10) and configured for reinforcing the cross-section of the sheet (10) on which they are mounted, and
 - a plurality of connecting joints (14), each joint (14) being configured for connecting together a pair of the reinforcement bars (12) belonging to adjacent sections of said sheet (10).

2. The bellows (1) according to claim 1, wherein each joint (14) is flexible and/or comprises a central portion (14a), configured for folding and extending, and lateral portions (14b), configured for coupling to the reinforcement bars (12), such that for each flexible joint (14), when the bellows (1) is coupled to the lifting device, the central portion (14a) is folded at right angles and the reinforcement bars (12) connected to the lateral portions (14b) extend in a mutually perpendicular direction.
3. The bellows (1) according to claim 2, wherein the reinforcement bars (12) are hollow at the lateral ends and the lateral portions (14b) of the flexible joints (14) are configured to be inserted inside said lateral ends.
4. The bellows (1) according to claim 1, wherein the reinforcement bars (12) comprise segments having, at opposite lateral ends, coupling elements (120) for coupling with the connecting joint (14).
5. The bellows (1) according to claim 4, wherein the coupling elements (120) have a shape tapered away from the reinforcement bars (12) and towards a central portion of the reinforcement bars (12).
6. The bellows according to claim 4 or 5, wherein the coupling elements (120) comprise portions projecting from the reinforcement bars (12) configured for superposing at least partly with coupling elements (120) of adjacent reinforcement bars (12).
7. The bellows (1) according to any one of claims 4 to 6, wherein the coupling elements (120) comprise through holes (122) and wherein the connecting joint (14) comprises a pin, the pin being configured for inserting inside the through holes (122) of coupling elements (120) of adjacent reinforcement bars (12).
8. The bellows (1) according to any one of the preceding claims, wherein:
 - the reinforcement bars (12) are mounted along the sheet (10) at different heights, spaced from each other by a predetermined distance (d1)

- along the vertical direction (Y), and/or
- the reinforcement bars (12) are mounted on a first side of the sheet (10), with a second side of the sheet (10), opposite the first side, without reinforcement bars (12), and/or
 - the reinforcement bars (12) mounted on a first section of sheet (10) are at the same height as reinforcement bars (12) mounted on sections of sheet (10) adjacent to the first section and the joints (14) are configured for connecting pairs of reinforcement bars (12) belonging to adjacent sections of said sheet (10) which are at the same height.
9. The bellows (1) according to any one of the preceding claims, comprising a plurality of fixing elements (16) configured to hold in position the plurality of reinforcement bars (12) on the sheet (10), each fixing element (16) preferably comprising a glue or mechanical coupling elements.
10. The bellows (1) according to any one of claims 4 to 9, wherein said reinforcement bars (12) are heat-sealed to the respective section (10a, 10b, 10c, 10d) of sheet (10).
11. The bellows (1) according to any one of claims 4 to 10, wherein points of contact between the reinforcement bars (12) and the sheet (10) define elements (18) for stiffening the sheet (10), such that the sheet (10) has a predetermined shape during the movements of the bellows (1).
12. A lifting device, comprising:
- lifting means (2),
 - a first rigid frame (3) and a second rigid frame (4), coupled to the lifting means (2), with the first rigid frame facing towards the ground,
 - a supporting plate (5) coupled to the second rigid frame (4), and
 - a bellows (1) according to any one of the preceding claims, wherein said bellows comprises a first end and a second end coupled, respectively, to the first rigid frame (3) and to the second rigid frame (4).
13. A method for transporting a bellows (1) for connecting devices according to any one of the preceding claims, the method comprising the steps of:
- providing a first pair of sections (10a-10d) of the sheet (10) and a plurality of reinforcement bars (12) mounted on the first pair of sections (10b-10c), the reinforcement bars (12) mounted on a section being coupled to the reinforcement bars (12) of the other section by means of a plurality of joints (14),
 - providing a second pair of sections (10b-10c) of the sheet (10) and a plurality of reinforcement bars (12) mounted on the second pair of sections (10b-10c), the reinforcement bars (12) mounted on a section being coupled to the reinforcement bars (12) of the other section by means of a plurality of joints (14),
 - rotating the reinforcement bars (12) of the first (10a-10d) and of the second (10b-10c) pair of sections about an axis of rotation (X) defined by the joints (14), carrying all the reinforcement bars (12) of the first (10a-10d) and of the second (10b-10c) pair of sections substantially parallel to each other.
14. The method according to claim 13, comprising the step of linking together the sides of the first pair (10a-10d) and the sides of the second pair (10b-10c) and/or linking together the first pair (10a-10d) and the second pair. (10b-10c).
15. The method according to claim 13 or 14, comprising the steps of:
- disconnecting the first pair of sides (10a-10d) and the second pair of sides (10b-10c),
 - rotating the reinforcement bars (12) about the axis of rotation (X) and bringing the reinforcement bars (12) of the first (10a-10d) and second (10b-10c) pair at right angles to each other,
 - positioning the first pair of sections (10a-10d) at the second pair of sections (10b-10c), with elements (120) for coupling the reinforcement bars (12) of the first pair of sections (10a-10d), free from connections with joints (14), being positioned at least partly superposed on coupling elements (120) of the reinforcement bars (12) of the second pair of sections (10b-10c), free from connections with joints (14), and
 - coupling the at least partly superposed reinforcement bars (12) of the first pair (10a-10d) and second pair (10b-10c) using a plurality of joints (14).

Fig.1

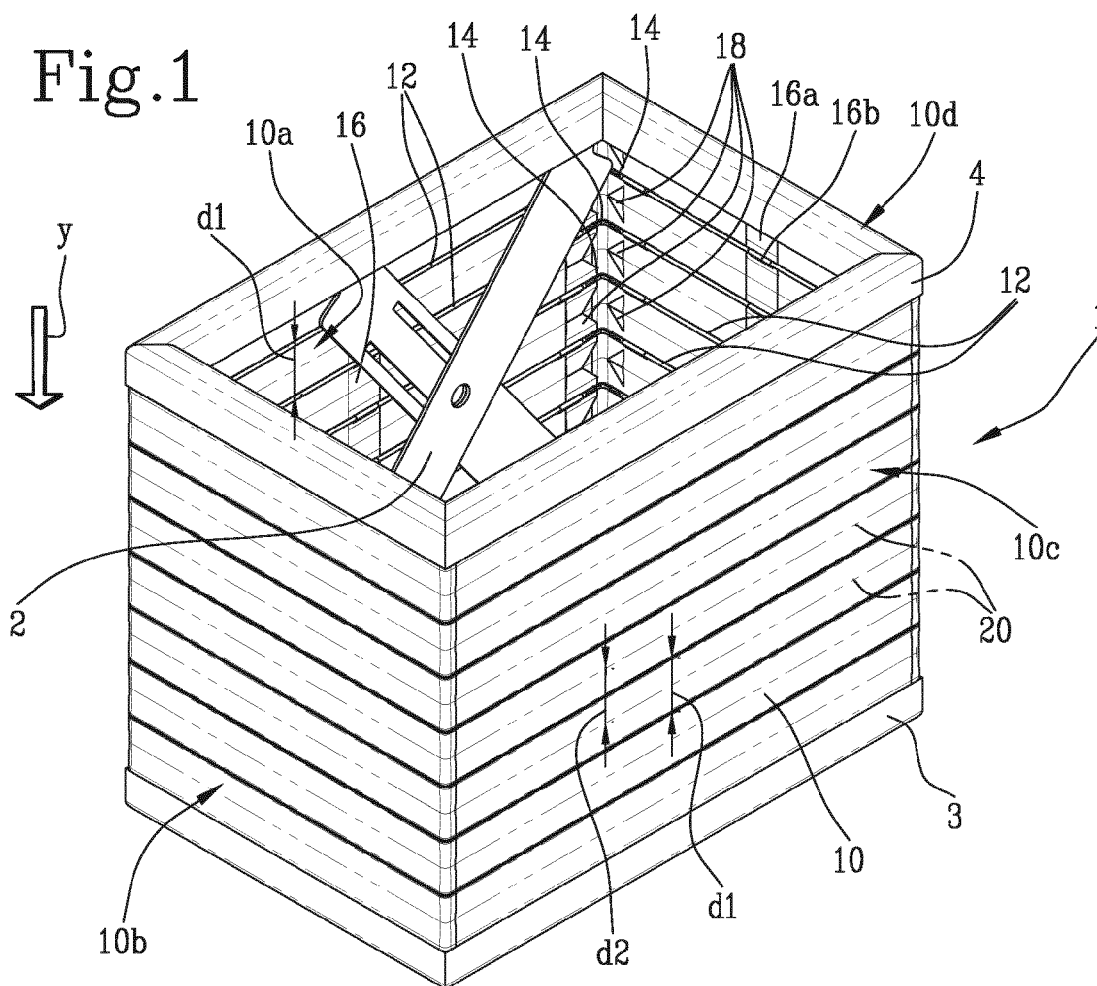


Fig.2

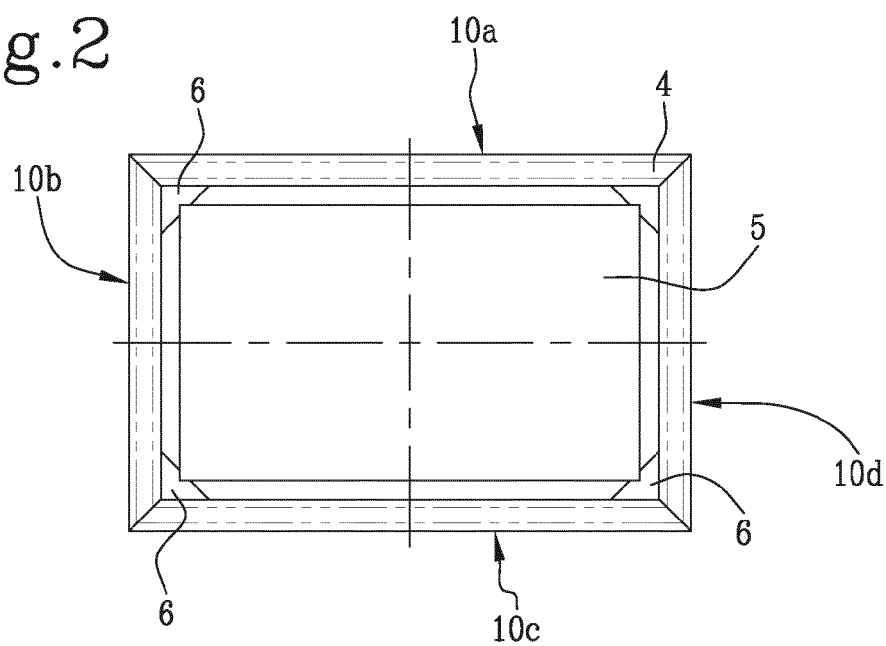


Fig.3

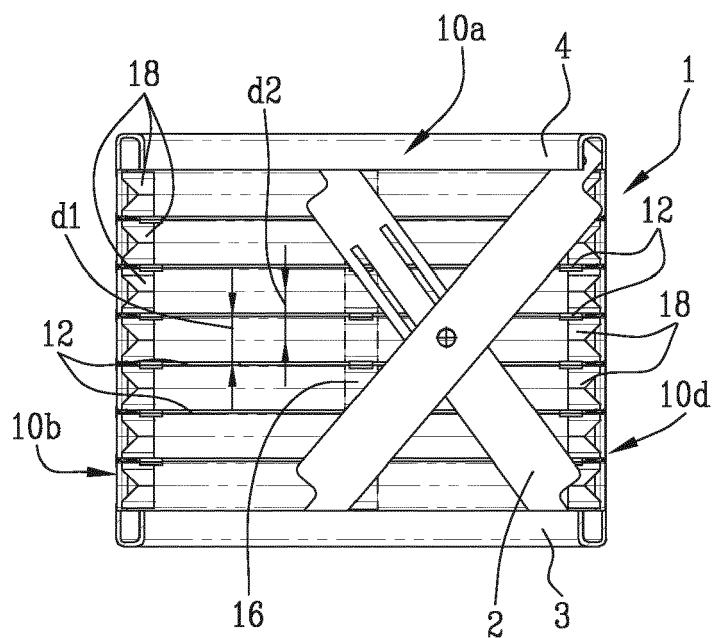


Fig.4

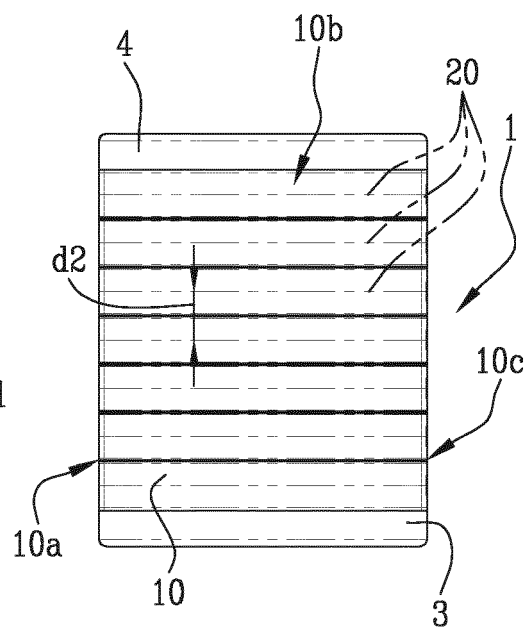


Fig.5

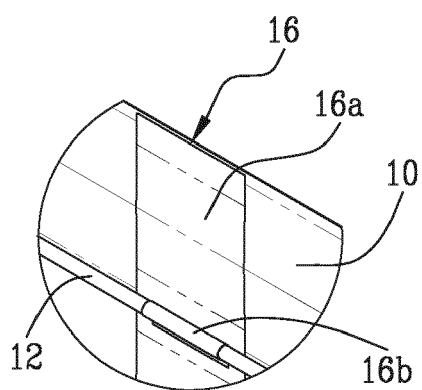


Fig.6

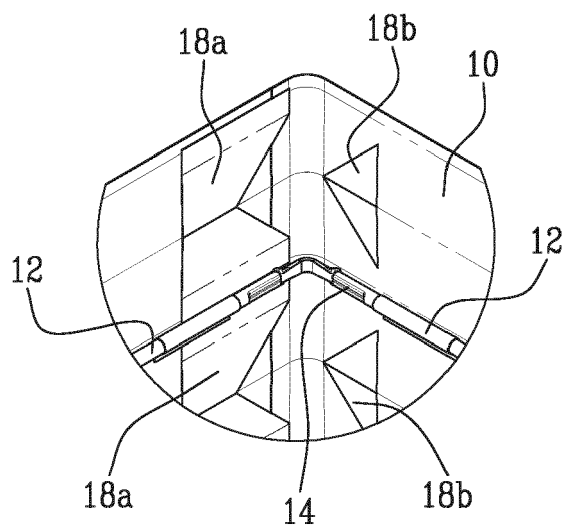


Fig.7

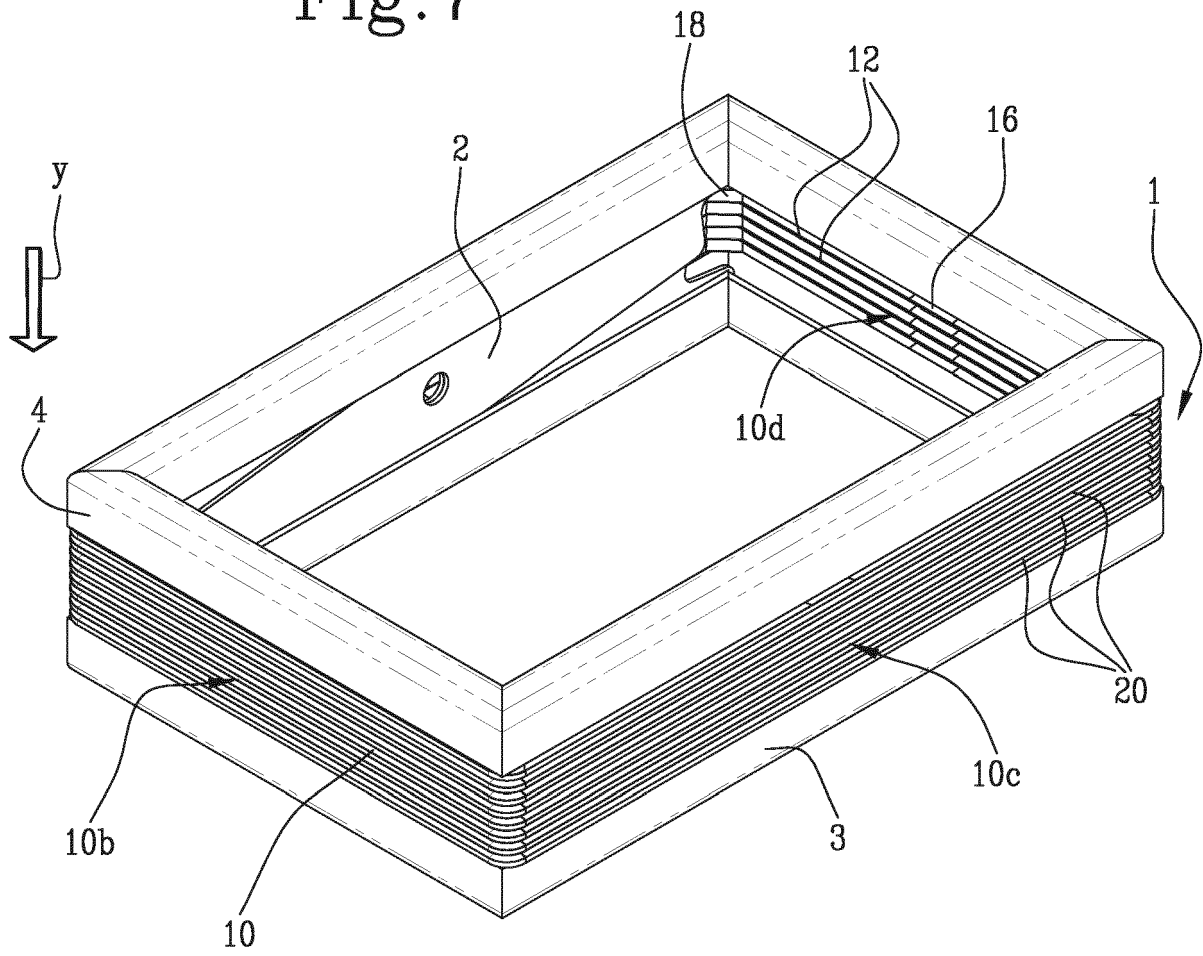


Fig.8

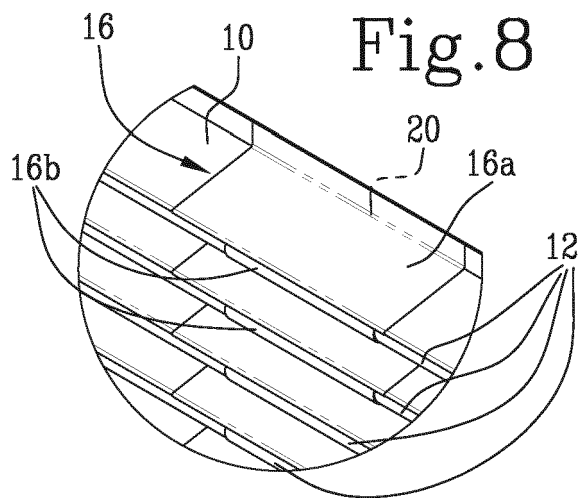


Fig.9

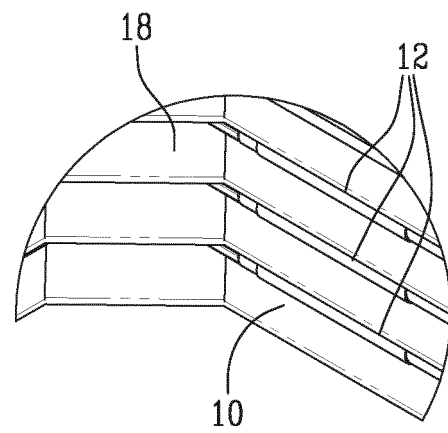


Fig.10

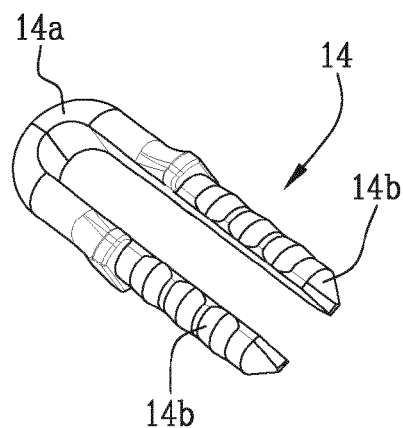


Fig.11

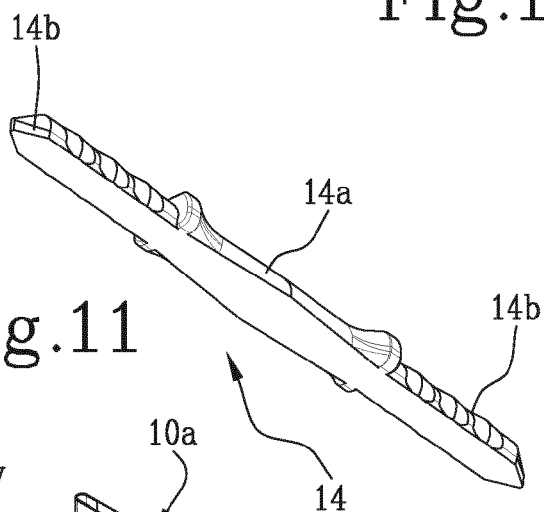


Fig.12

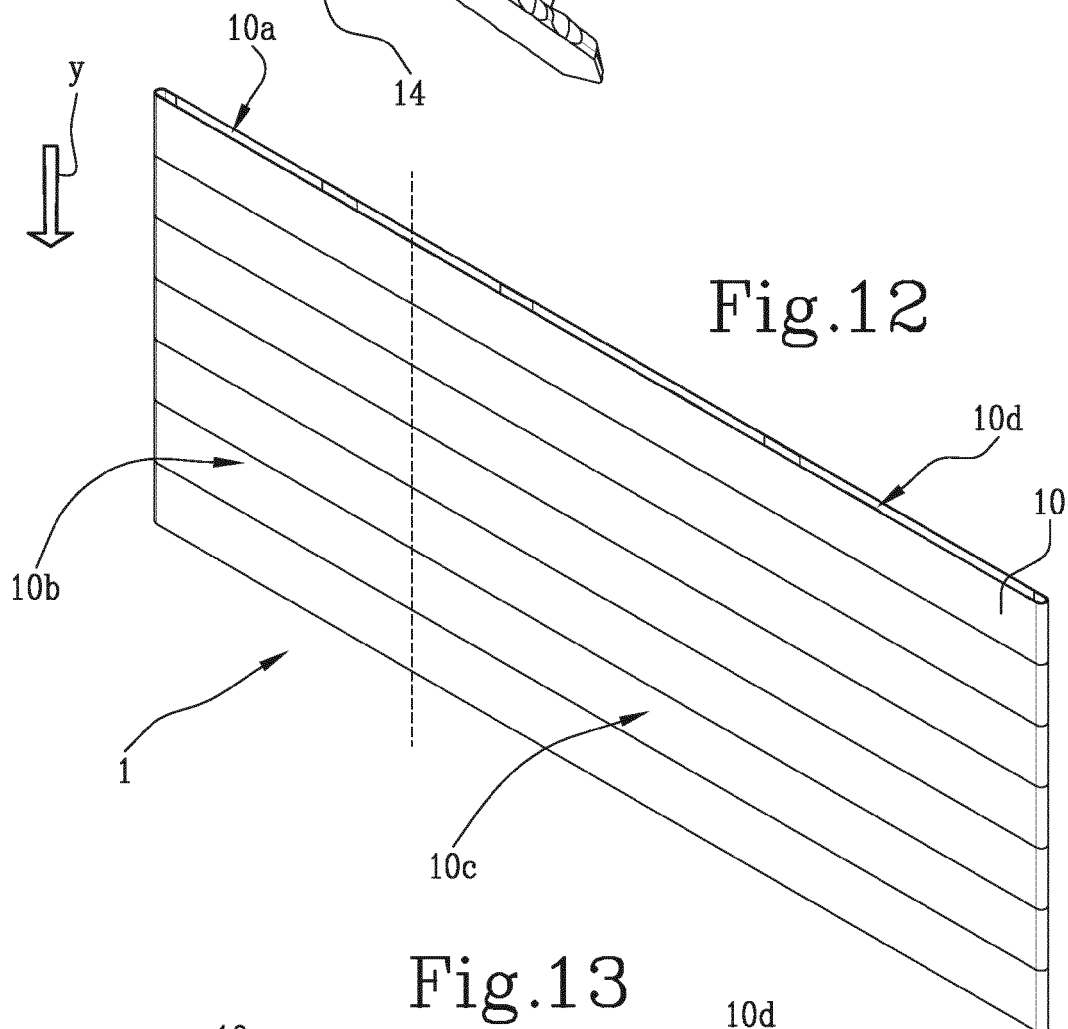
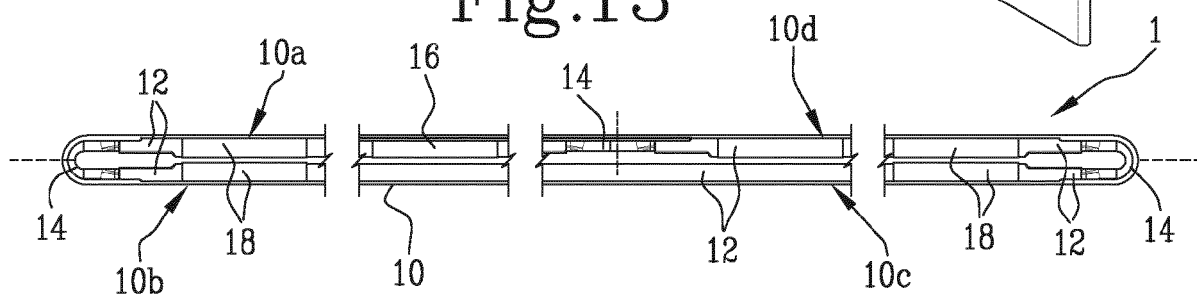
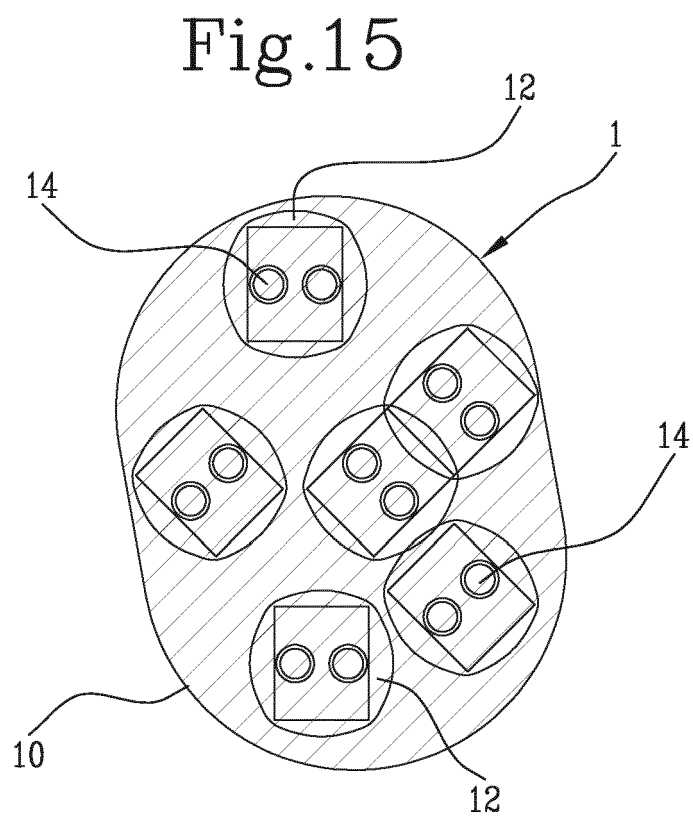
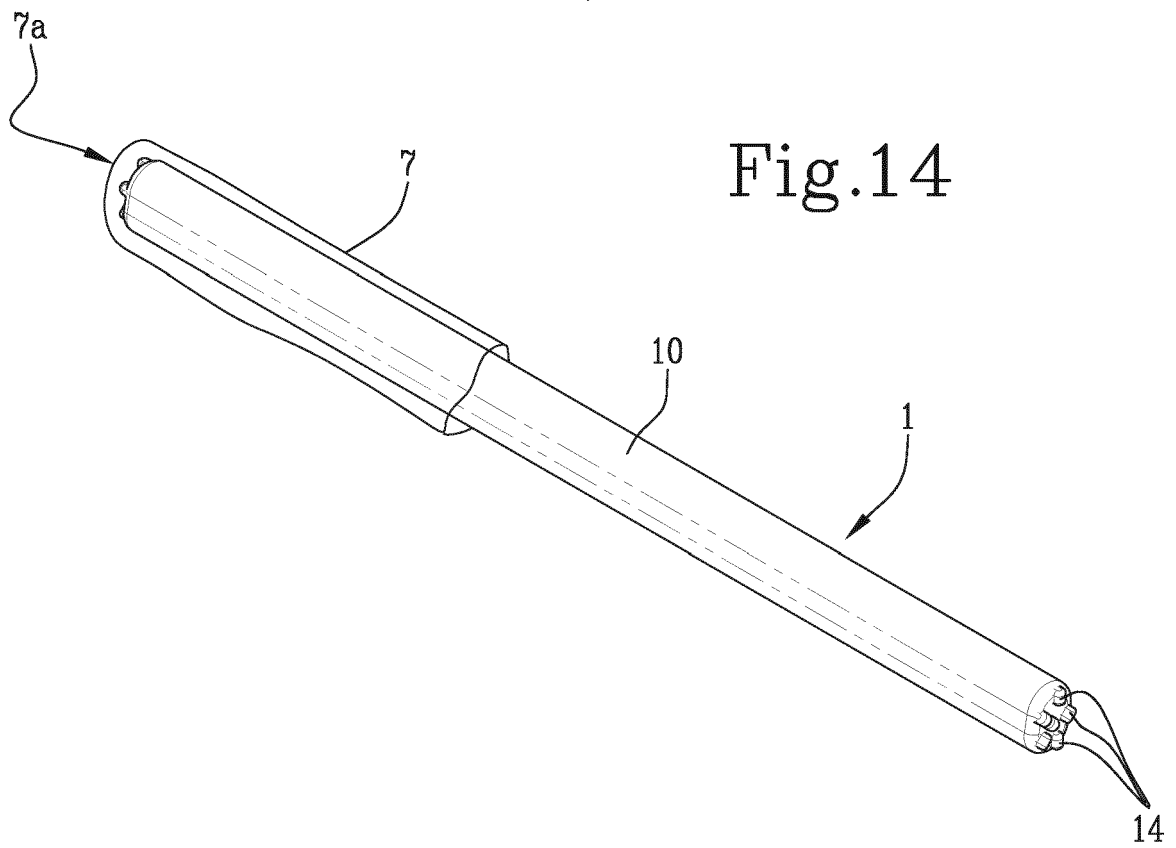


Fig.13





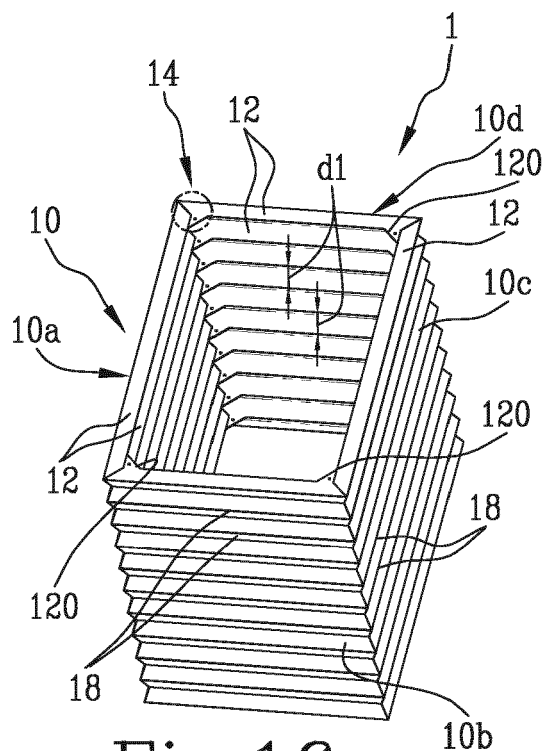


Fig.16

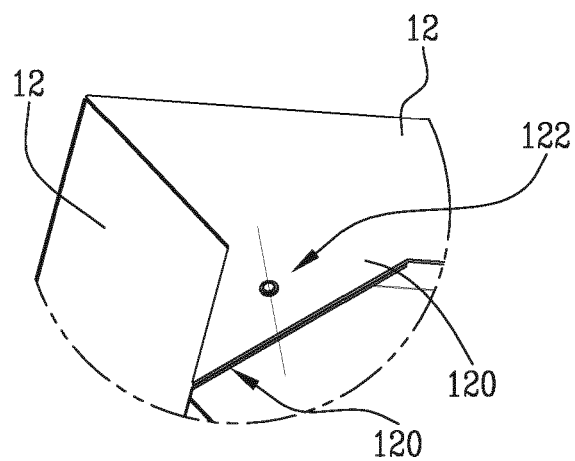


Fig.17

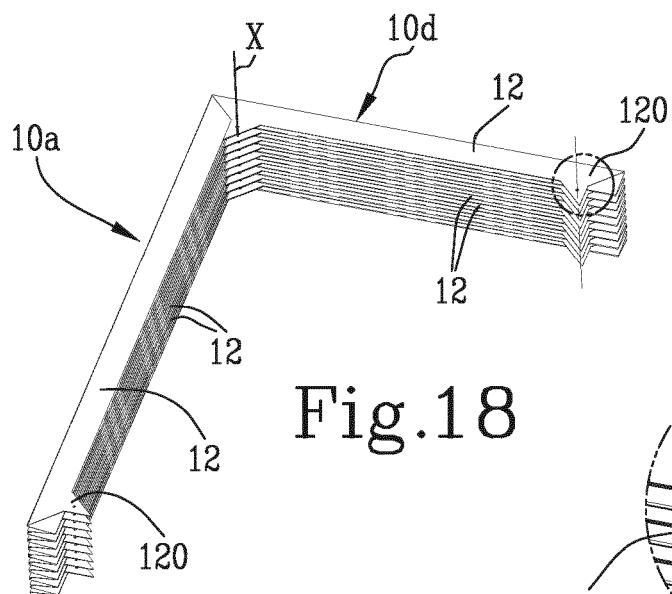


Fig.18

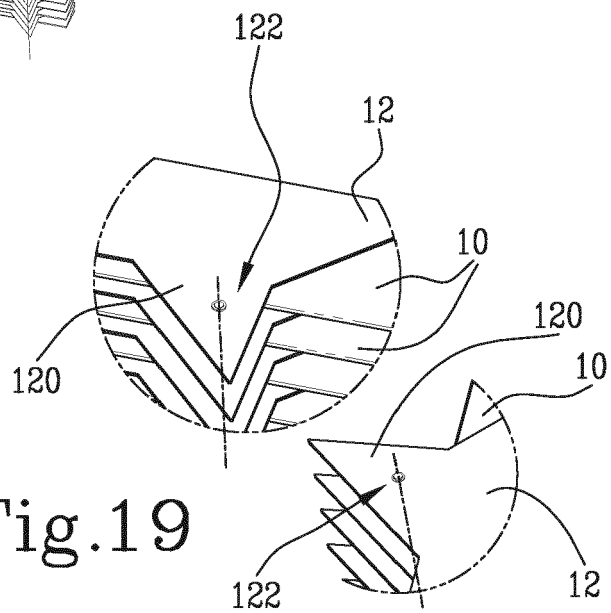


Fig.19



EUROPEAN SEARCH REPORT

Application Number
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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2003/064193 A1 (DAY STEVEN D [US] ET AL) 3 April 2003 (2003-04-03)	1,8,9,12	INV.
A	* paragraph [0029] - paragraph [0032]; figures 1,11-14 *	2-7,10,11,13-15	B66F7/06 B23Q11/08
A	CH 698 089 B1 (GILGEN LOGISTICS AG [CH]) 15 May 2009 (2009-05-15) * abstract; figures 1-5 *	1-15	
A	US 6 119 815 A (ZIEGLER KIMBERLY [US]) 19 September 2000 (2000-09-19) * abstract; figures 1-7 *	1-15	
			TECHNICAL FIELDS SEARCHED (IPC)
			B66F F16J B23Q
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 11 February 2021	Examiner Rupcic, Zoran
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 20 20 1929

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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11-02-2021

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2003064193 A1	03-04-2003	AT 404321 T	15-08-2008
		CA 2461727 A1	10-04-2003
		EP 1432550 A1	30-06-2004
		ES 2311629 T3	16-02-2009
		JP 2005504643 A	17-02-2005
		US 2003064193 A1	03-04-2003
		US 2005037173 A1	17-02-2005
		WO 03028948 A1	10-04-2003
CH 698089 B1	15-05-2009	NONE	
US 6119815 A	19-09-2000	NONE	