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(54) **Stackable lightweight pallet**

(57) A pallet system for storage and transportation of goods, comprising a load bearing support structure, wherein the support structure has an upper side for supporting a load and an underside, a number of elongated support members, the elongated support members being open on the upper side of the support structure, and tapering downwards, where by the elongated support members are at least partly nestable in a subjacent pallet.

Furthermore, the load bearing support structure is formed from a starting material containing at least one plastic-based component and at least one fiber-based component, as a single piece of material of essentially uniform thickness. In some embodiments, the pallet system further comprises a top plate adapted to be fitted within a peripheral rim of the support structure.

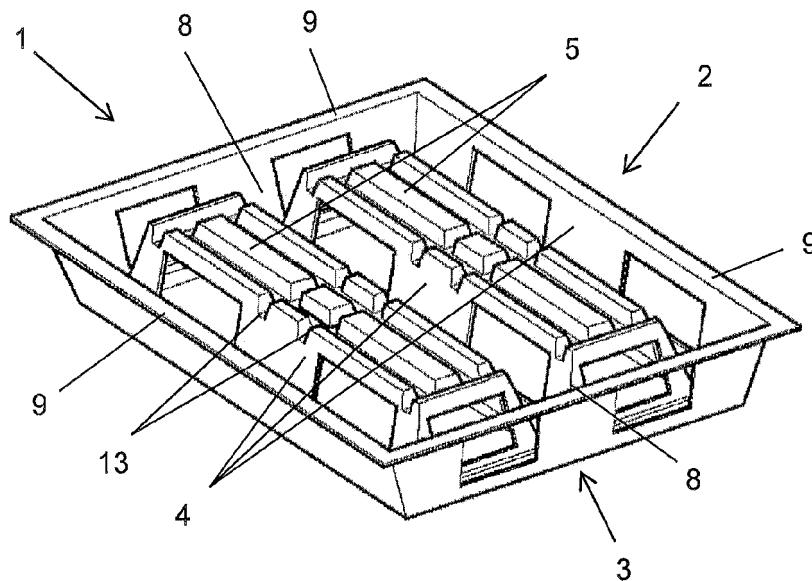


Fig.2

**Description****Field of the invention**

[0001] The present invention relates to a pallet system and in particular a pallet system including a support structure according to the preamble of the independent claim.

**Background of the invention**

[0002] Various types of pallets are commonly known in the art, and many different designs and materials have been described. Traditional pallets are commonly made of wood, and are therefore sturdy and capable of bearing high loads. However, they are also very heavy in themselves, and require a large volume of cargo space when e.g. transporting them without any cargo or goods loaded on the pallets.

[0003] To solve these disadvantages, many solutions have been presented. For instance, using plastic material brings down the pallet weight substantially, and also allows shapes that are stackable partly within each other. One such example is shown in the international patent application WO 2010/057586, where a plastic pallet is described having a corrugated rib structure strengthened by crosswise partition walls. However, in order to obtain good load bearing characteristics, it is necessary to use a relatively complicated geometry, which is hard to keep clean, as there are many nooks and crannies in the pallet where dirt and contaminations can get caught. This pallet is therefore not optimally suitable for transport of goods where sanitary conditions are high, such as food or medical supplies.

[0004] US patent 3,702,100 describes a lightweight, nestable, reusable molded plastic pallet, with a generally corrugated structure, which can be made from thermoplastic structural foam. This pallet also has a complicated geometry.

[0005] US patent 7,819,068 describes a plastic pallet with nestable feet. The feet of the pallet are reinforced with ribs. Furthermore, the pallet deck is reinforced on the underside with a complex pattern of ribs protruding downwardly. The nestable feet allow improved stacking compared to traditional transport pallets. This pallet can be manufactured by injection molding.

[0006] European patent application EP 2 067 708 describes a plastic pallet with a substantially planar and smooth upper side, and hollow elongate feet which are nestable in each other.

[0007] International patent application WO 2011/073496 describes a pallet and a method for manufacture of a pallet, wherein the pallet is formed from a starting material containing at least plastic-based components by a manufacturing method based on heat and pressure. The starting material can include plant fibers.

[0008] The inventor has identified a need for a pallet which combines the advantages of a lightweight pallet, high load bearing strength, reusability and high stacka-

bility.

[0009] Therefore, an object of the invention is to provide a lightweight reusable pallet, capable of high load bearing strength and high stackability.

**Summary of the invention**

[0010] The above-mentioned object is achieved by the present invention according to the independent claim.

[0011] The present invention describes a pallet system for storage and transportation of goods, comprising a load bearing support structure, wherein the support structure has an upper side for supporting a load and an underside, a number of elongated support members, the elongated support members being open on the upper side of the support structure, and tapering downwards, whereby the elongated support members are at least partly nestable in a subjacent pallet. Furthermore, the load bearing support structure is formed from a starting material containing at least one plastic-based component and at least one fiber-based component, as a single piece of material of essentially uniform thickness.

[0012] In some embodiments, the pallet system further comprises a top plate adapted to be fitted within a peripheral rim of the support structure.

[0013] A pallet system according to the present invention provides a lightweight pallet with high load bearing strength. Furthermore, due to the shape of the support structure and optional top plate, the components of the pallet system are highly stackable, both individually and in combination. This allows for less use of space when transporting the pallet system.

[0014] Preferred embodiments are set forth in the dependent claims.

**Short description of the appended drawings****[0015]**

Figure 1 shows a perspective view of one embodiment of the present invention.

Figure 2 shows a perspective view of another embodiment of the present invention.

Figure 3 shows a side view of the embodiment of Figure 2.

Figure 4 shows another side view of the embodiment of Figure 2.

Figure 5 shows a cross-sectional view of the invention across the line A-A of Figure 3.

Figure 6 shows an enlargement of the cross-sectional view of the invention across the line A-A of Figure 3.

Figure 7 shows a bottom perspective view of an embodiment of the present invention.

Figure 8 shows a cross-sectional view of another embodiment of the invention.

Figure 9 shows an example of the stacking of some embodiments the present invention.

Figure 10 shows a top perspective view of yet another embodiment of the present invention.

Figure 11 shows a bottom perspective view of an embodiment of the present invention.

Figure 12 show a top view of some embodiments of the invention.

Figure 13 show a bottom view of yet another embodiment of the invention.

#### **Detailed description of preferred embodiments of the invention**

**[0016]** The pallet system according to the present invention is optimized for a standard size European pallet, the Euro-pallet, but can easily be applied to various other international standards. The Euro-pallet uses 1200 mm x 800 mm floor space and can bear loads of up to 2500 kg. The Euro-pallet in itself weighs approximately 22-25 kg, more if it has absorbed moisture.

**[0017]** The inventive pallet system also complies with international requirements for pallets shipped across national borders, which must be made of materials that are incapable of being a carrier of invasive species of insects and plant diseases. A traditional wooden pallet does not meet these standards, and must be treated with either heat or fumigation before use.

**[0018]** In one embodiment, as illustrated in Figure 1, the pallet system according to the present invention comprises a load bearing support structure 1 which has an upper side 2 for supporting a load and an underside 3. It further comprises a number of elongated support members 4, adapted to support the support structure 1 against an underlying surface, e.g. a floor. The support members 4 are open on the upper side 2 of the support structure 1, and taper downwards, whereby the support members are at least partly nestable in a subjacent support structure 1 when stacked. The support structure 1 is manufactured as a single unit, by e.g. injection molding or vacuum molding (thermoforming). The material of the support structure 1 is preferably of an essentially uniform thickness throughout the structure, e.g. in a monocoque construction, which results in a reduced total weight compared to prior art pallets.

**[0019]** In another embodiment, illustrated in Figure 2, the top and bottom surfaces can have a generally corrugated structure, as will be discussed below. Except for this difference, this embodiment is essentially identical to the embodiment of Figure 1, in that it comprises a number of elongated support members 4, which are open on the upper side of the support structure 1, and taper downwards, whereby the support members are at least partly nestable in a subjacent support structure 1 when stacked. In addition, the material of the support structure 1 is preferably of an essentially uniform thickness throughout the structure. The number of elongated support members 4 is here shown as three, but can also be other numbers, such as two or four.

**[0020]** In further embodiments, the load bearing sup-

port structure 1 can comprise a flat top surface and a corrugated bottom surface, or a corrugated top surface and a flat bottom surface.

**[0021]** In one embodiment, illustrated in Figures 3-6, the load bearing support structure 1 has an overall height H, preferably within the range of 100 mm - 300 mm, more preferably 140 mm - 180 mm. The most preferred height H is approximately 160 mm. From the lengthwise side, shown in Figure 3, two through openings 20 are provided to allow entry of the forks of e.g. a fork-lift or pallet jack. These openings 20 are adapted to the chosen height H of the support structure 1, such that the openings are approximately 50-60% of the overall height H. Thereby, provided that the size is proportionate to the chosen overall dimensions of the support structure 1, the openings 20 are preferably 100 mm - 300 mm wide and 70 mm - 160 mm high, most preferably 250 mm wide and 90 mm high, as long as suitable lifting forks can be inserted. Furthermore, it is preferred that the bottom edges of the openings are a maximum of 20 mm from the bottom edge of the support structure 1, which allows use of a wide range of lifting devices, including hand-held lifting jacks. Similarly, on the short side of the support structure 1, illustrated in Figure 4, analogous openings 20 are provided, with similar sizes and placement as on the lengthwise side, although here the openings 20 are most preferably 150 mm high and 90 mm wide. The presence of openings on both the lengthwise side and the short side allow lifting from all four sides.

**[0022]** In Figure 5, a cut-through across line A-A' in Figure 3 is shown, describing one embodiment of the invention. An enlargement of a cut-through view is shown in Figure 6. In these views it can clearly be seen that the support structure 1 is formed in a single piece of material, of essentially uniform thickness, preferably 2-12 mm thick. The term "thickness" is herein meant to be the cross-sectional thickness of the material. Three elongated support members 4 have a generally tapered shape, and are open at the upper side of the support structure 1. The angle (a) of the taper can be 25 - 40 degrees, preferably 30 - 34 degrees, most preferably 32 degrees. Between the elongated support members 4 there is provided upper supporting surfaces 5. In some embodiments, as shown in Figure 5 and 6, as well as Figure 2, the upper supporting surfaces 5 have a generally corrugated structure, with 1-4 lengthwise running channels 6. These upper channels 6 can be 15 - 40 mm deep, preferably 25 - 25, most preferably 30 mm. However, in other embodiments, this surface 5 can be flat, as illustrated in Figure 1. In most embodiments, all the upper supporting surfaces 5 of an individual support structure 1 are adapted to the same level height of the support structure 1. The support members 4 can also be provided with a lengthwise running channel 7 at the bottom surface. These lower channels 7 can be 15 - 40 mm deep, preferably 25 - 25, most preferably 30 mm.

**[0023]** The thickness of the material in any cross-section of the load bearing support structure can vary be-

tween a first  $T_1$  and second  $T_2$  thickness value. As mentioned above, the thickness values can be between 2-12 mm. Preferably, the first thickness value  $T_1$  is 2-4 mm and the second thickness value  $T_2$  is 3-12 mm. In some embodiments, the first  $T_1$  and second  $T_2$  thickness values are essentially the same, such as 3 mm, 4 mm, or 5 mm.

**[0024]** In other embodiments, the second  $T_2$  thickness value is no more than twice the first  $T_1$  thickness value. For example,  $T_1$  is 3 mm and  $T_2$  is 5 mm.

**[0025]** In some embodiments, all surfaces essentially parallel with the upper side of the support structure 1 are provided with the second thickness  $T_2$  value, while all remaining parts are provided with the first  $T_1$  thickness value. In a preferred embodiment, the material thickness of all surfaces essentially parallel with the upper side of the support structure 1 is 4-8 mm, preferably 5 mm, while the remaining parts are 2-4 mm, preferably 3 mm thick.

**[0026]** Across the short side of the inventive support structure 1 (see Figure 1-2) elongated support members 8 with the same cross-sectional dimensions as the lengthwise support members 4 are provided. As can be seen in e.g. Figures 1 and 2, these short-side elongated support members 8 are integrated with the outer lengthwise support members 4, such that a continuous trough around the sides of the support structure 1 is provided, on the upper side of the load bearing support structure 1, and continuous supporting members 4,8 on the underside (as can be seen in e.g. Figure 11 and 13). The continuous supporting members 4, 8 provide a high load bearing support area against the underlying surface.

**[0027]** As illustrated in Figure 5, a horizontal rim 9 is provided around the outer periphery of the upper side of the support structure 1. This rim 9 is also shown in Figure 1 and 2. The rim 9 is preferably 10 - 40 mm wide, more preferably 20-30 mm. This rim provides a supporting frame for goods or another support structure 1 being stacked on top. The rim 9 can be provided with a vertical edge 10, thereby securing goods, other support structures or other pallets from sliding off the inventive pallet. At the vertical edge 10 the thickness of the material can be between 2 mm - 20 mm, more preferably 5-10 mm. A slightly thicker material at the edge of the supporting structure is advantageous in that it presents a less sharp outer edge, such that maneuvering of people, machinery and other pallets around the inventive pallet system is facilitated.

**[0028]** In another embodiment, the support structure 1 comprises reinforcement structures 15 just above the side openings 14, in order to further improve the buckling resistance of the pallet system when being lifted by e.g. a fork lift. This is illustrated in Figure 7.

**[0029]** In a further embodiment the pallet system of the present invention comprises a top plate 11, as seen in Figure 8, in a cut through view, and in Figure 10, in perspective view. A top view of the top plate 11 is shown in Figure 12. This top plate is adapted to be fitted within the vertical edge 10 of the peripheral rim 9 of the support structure 1. In some embodiments, the top plate is pro-

vided with contact fittings, such as elongated depressions 12 (see Figure 10 and 12) adapted to fit within complementary grooves 13 (see Figure 2). The contact fittings can also be of other types known in the art, such as snaps, hooks or other fasteners to secure the top plate to the support structure.

**[0030]** The thickness of the top plate 11 can be between 1 mm and 10 mm, preferably 1-4 mm.

**[0031]** In yet other embodiments, a pallet system comprising a support structure and a top plate can be varied to fit the user's needs. Examples include adapting the top plate to comprise specific molded shapes on the top side, in order to fit specific goods to the pallet system. These molded shapes can be adapted to e.g. a specific product shape, such that the product to be shipped or stored is optimally supported. Another example of adapting the top plate is to add on specific fasteners adapted to specific types of goods, such as snaps, hooks, straps or other fasteners.

**[0032]** The load bearing support structure and optional top plate of the inventive pallet system is made using a method based on heat and pressure, preferably injection molding or vacuum forming.

**[0033]** The load bearing support structure and optional top plate of the inventive pallet system is preferably made from a starting material containing at least one plastic-based component and at least one fiber-based component. Such a material is described in W02011/073496. The plastic-based component is preferably a plastic suitable for injection molding or vacuum forming, such as a thermoplastic. Examples of plastics that can be used in the invention are various polymer matrix materials, such as polyolefins, for example polypropylene (PP); polyesters, for example polyethylene terephthalate (PET) or polybutylene terephthalate (PBT); polyethers, for example polyetheretherketone (PEEK); or other polymers such as polyethylene (PE), polyamide (PA), polyvinyl chloride (PVC) and acrylonitrile butadiene styrene (ABS) or co-polymers of the same or blends comprising two or more of the same. Furthermore, the plastic component can be a combination of two or more of the plastics above or other plastics as known in the art. In one embodiment, the plastic material is recycled plastic. The fiber-based component can be cellulose fibers, wood fibers, plant fibers, glass fibers, carbon fibers, aramid fibers, polymer fibers, PET fibers, metal fibers, viscose fibers, or other natural fibers, such as hemp, flax, sisal or jute, or a combination thereof or other fibers as known in the art. A preferred starting material is polypropylene and cellulose fibers. One example of such material is UPM ForMi, supplied by UPM in Helsinki, Finland. UPM ForMi is produced from renewable raw materials, is recyclable and generates renewable energy in the production process.

**[0034]** The starting material can have a fiber content of 10 - 90 weight %, preferably 40 - 80 weight %. In one preferred embodiment, the starting material is polypropylene with 50 weight % cellulose fiber. In another preferred embodiment, the starting material is polypropylene

with 60 weight % cellulose fiber. Preferably, the fiber content is as high as possible, as the fiber component is the main contributor to the strength of the finished product, while the plastic mainly holds the material together. Also, the fiber content needs to be adapted to the chosen manufacturing method.

**[0035]** The combination of the inventive design and using a plastic material reinforced with fibers, such as cellulose fibers, results in a pallet system which meets the standard of bearing 2500 kg of static weight, while in itself being very light-weight. Using the specific shape shown in Figures 3-6 yields a load bearing support structure weighing approximately 5-6 kg and a top plate weighing approximately 2 - 3,5 kg. The support structure 1 can bear forces up to 25000 N, e.g. a load of 1000 kg subjected to 2,5 G. With the added top plate 11, the pallet system can bear up to 40000 N. Compared to traditional oil-based plastics, this material has superior strength and stiffness. The inventive pallet system therefore has the advantage of being able to combine the features of being light-weight, strong and using an environmentally friendly and recyclable material.

**[0036]** The pallet system is highly stackable, as is illustrated in Figure 8, and can thereby be transported without goods in a highly compact space. As the individual pallets support structures 1 are formed in a monocoque structure, with each underside adapted to fit snugly against the upper side of another. In Figure 8, ten support structures 1 and ten top plates 11 are stacked. The total height  $H_s$  of such a stack is approximately 370 mm. The added height of each added support structure 1 or top plate 11 in a stack can be as low as 10-15 mm. As another example, using the present invention, either 147 support structures 1 or 86 each of support structures 1 and top plates 11 could fit in a standard size transport trailer where the available height is approximately 2200 mm. This compares to approximately 16 traditional wood pallets within the same space.

**[0037]** The material used gives the pallet system a surface with low friction, which is useful both when moving pallets along a floor, and when unstacking the stacked pallets.

**[0038]** The pallet system as described herein can be used in all common transportation and storage needs. The present invention is especially useful in situations where light weight and small storage size are highly advantageous, such as air freight. Furthermore, the pallet system of the present invention is especially suitable for goods where sanitary requirements are high, such as transportation and storage of food or medical supplies.

**[0039]** As described above, the outer dimensions of the pallet system described herein are adapted to a standard Euro-pallet, i.e. 1200 mm x 800 mm. However, the pallet system can be adapted to other sizes, such as double, half or quarter size Euro-pallets, e.g. 1200 mm x 1600 mm, 600 mm x 800 mm, 600 mm x 400 mm etc.

**[0040]** The pallet system of the present invention can also be supplied with further adapted storage and trans-

portation parts, such as fitted box systems. Such box systems can be adapted for stackability of several units on top of each other. In addition, specific molded shapes of the rim 9 or upper supporting surfaces 5 of the support structure 1 and/or the top plate 11 can be used to fit specific goods to be transported or stored on the inventive pallet system.

**[0041]** The present invention is not limited to the above-described preferred embodiments. Various alternatives, modifications and equivalents may be used. Therefore, the above embodiments should not be taken as limiting the scope of the invention, which is defined by the appending claims.

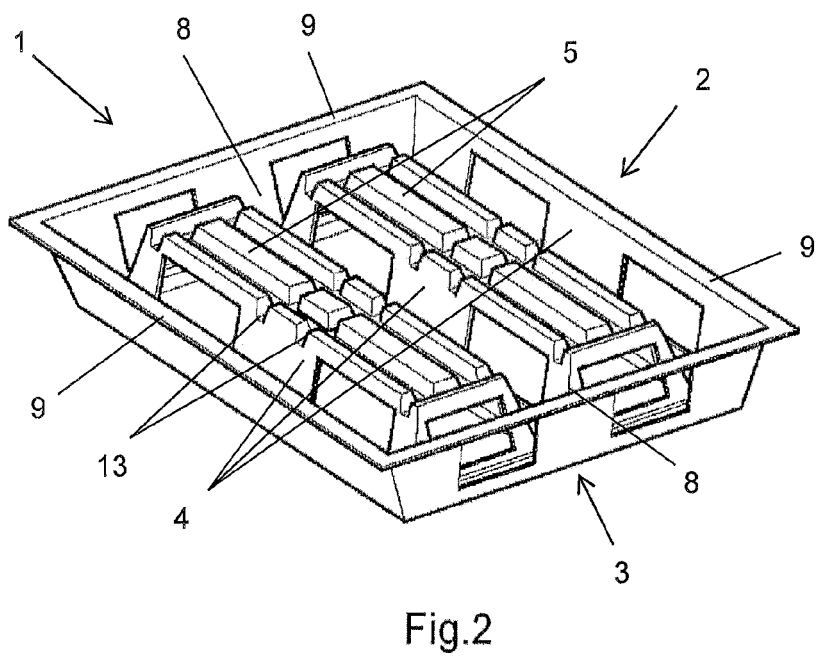
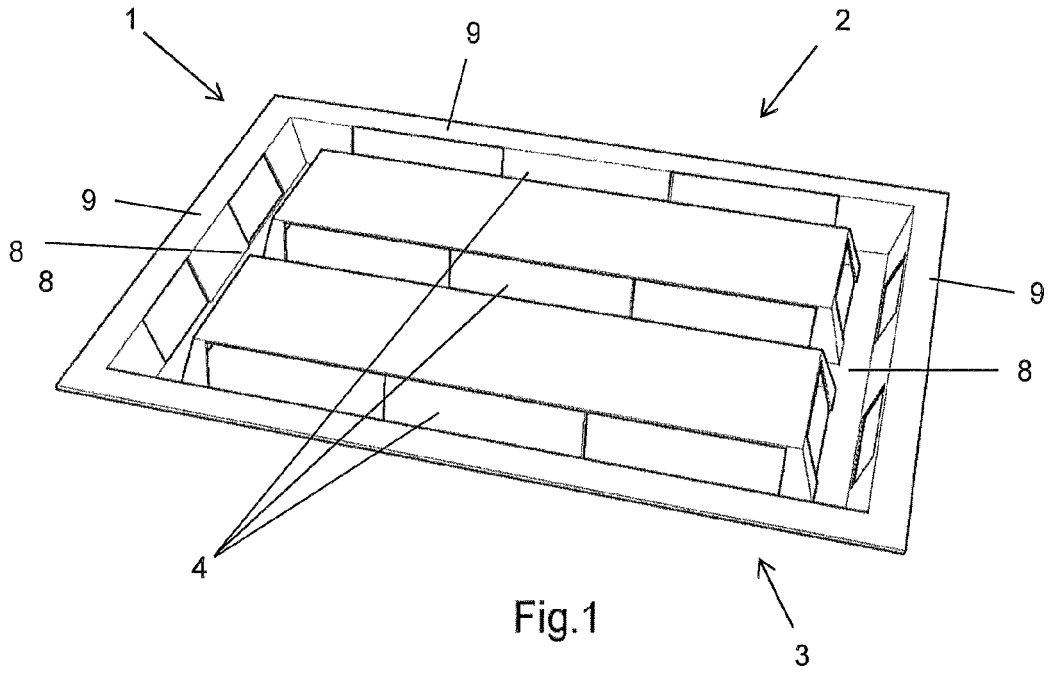
## Claims

1. A pallet system for storage and transportation of goods, comprising a load bearing support structure (1), the support structure having an upper side (2) for supporting a load and an underside (3); a number of elongated support members (4), the elongated support members being open on the upper side of the support structure, and tapering downwards, whereby the elongated support members are at least partly nestable in a subjacent pallet; a number of upper supporting surfaces (5) between the elongated support members (4), **characterized in that** the load bearing support structure (1) is formed from a starting material containing at least one plastic-based component and at least one fiber-based component, and that the load bearing support structure (1) is formed as a single piece of material of essentially uniform thickness.
2. Pallet system according to claim 1, wherein the material thickness is between 2 and 12 mm, and the material thickness varies between a first ( $T_1$ ) and second ( $T_2$ ) thickness.
3. Pallet system according to claim 2, wherein the first and second thickness values are essentially the same.
4. Pallet system according to claim 2, wherein the second thickness value is no more than twice the first thickness value.
5. Pallet system according to claim 2, wherein all surfaces essentially parallel with the upper side of the pallet are provided with the second thickness ( $T_2$ ) value, while all remaining parts are provided with the first ( $T_1$ ) thickness value.
6. Pallet system according to claim 2 or 5, wherein the first thickness value is preferably 2-4 mm and the second thickness value is preferably 3-12 mm.

7. Pallet system according to any previous claim, wherein the pallet is made by a manufacturing method based on heat and pressure, such as injection molding or vacuum molding. 5
8. Pallet system according to any previous claim, wherein the elongated support members (4) comprise a corrugated structure (7) at the bottom of each support member (4) running essentially along the entire length of each elongated support member (4). 10
9. Pallet system according to any previous claim, wherein the upper supporting surface (5) of the support structure further comprises a corrugated structure (6) running essentially along the entire length of the pallet. 15
10. Pallet system according to any of claim 1 - 8, wherein each of the upper supporting surfaces (5) of the support structure (1) is essentially flat. 20
11. Pallet system according to any previous claim, wherein further elongated support members (8) are provided perpendicular to the lengthwise support members (4), and wherein the further elongated support members (8) and the lengthwise support members (4) are integrated into a common structure. 25
12. Pallet system according to any previous claim, wherein the supporting structure (1) is provided with a rim (9) around the outer periphery of the supporting structure (1). 30
13. Pallet system according to any previous claim, wherein the pallet system further comprises a top plate (11) adapted to fit on top of the support structure (1). 35
14. Pallet system according to any previous claim, wherein the starting material comprises polypropylene and cellulose fibers. 40
15. Pallet system according to any previous claim, wherein the fiber content of the starting material is 10 - 90 weight percent. 45

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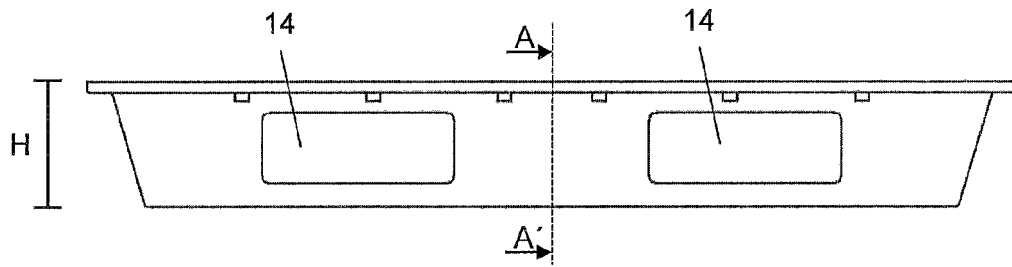


Fig.3

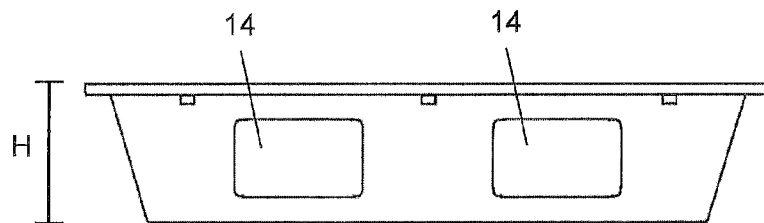


Fig.4



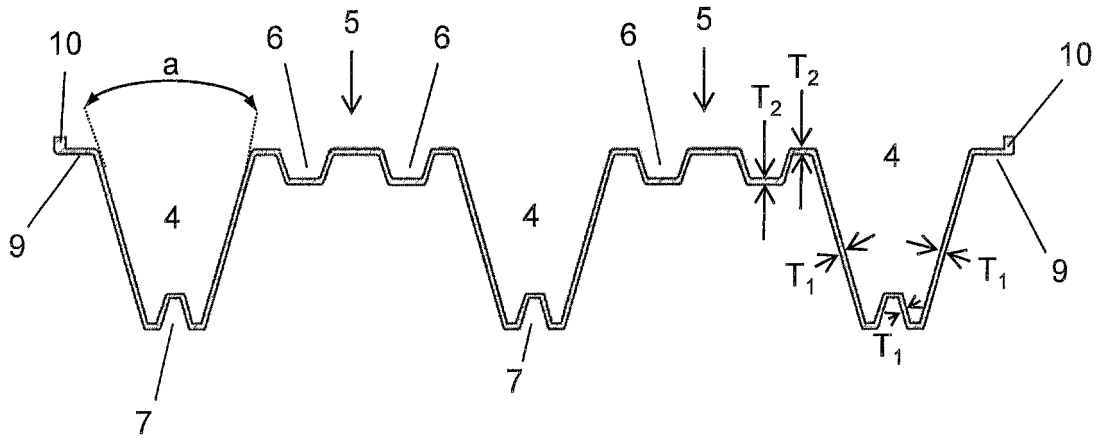


Fig.5

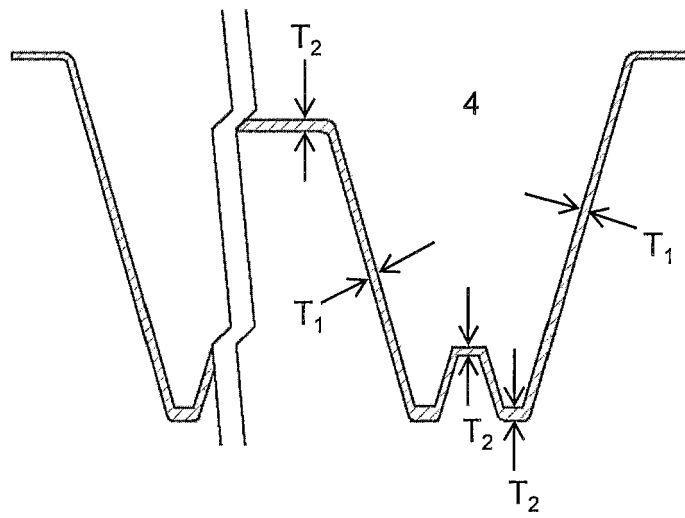


Fig.6

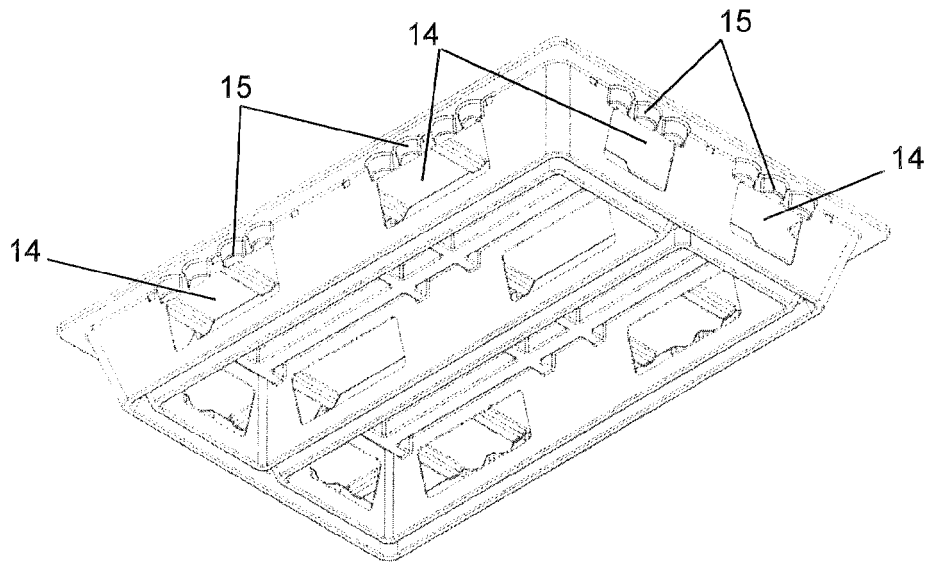


Fig. 7

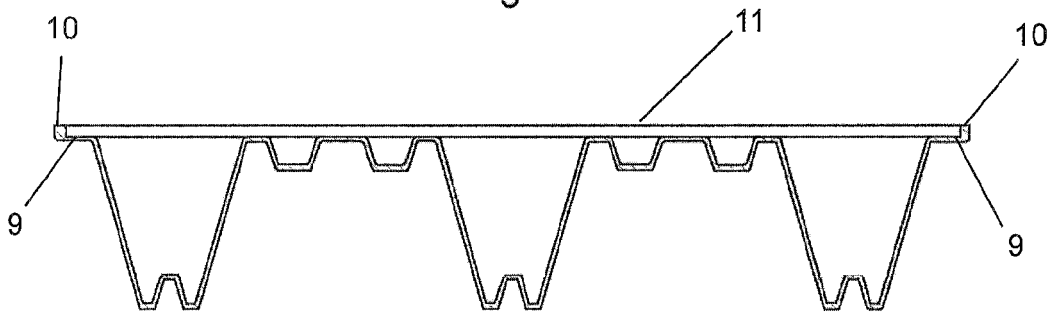


Fig. 8

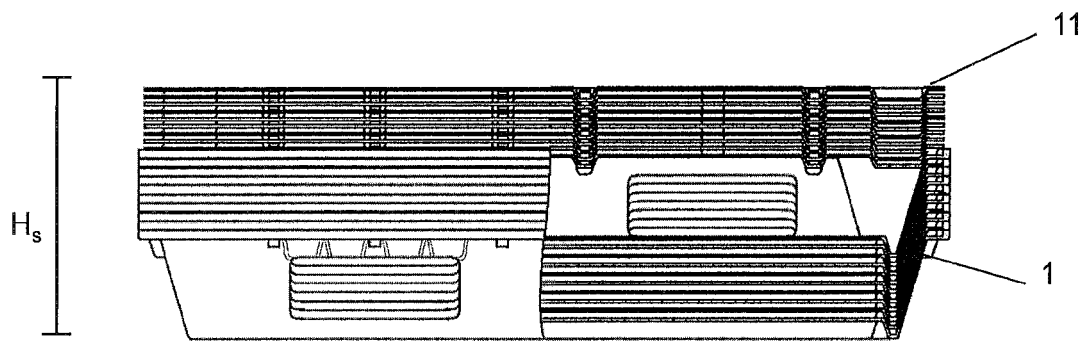


Fig. 9

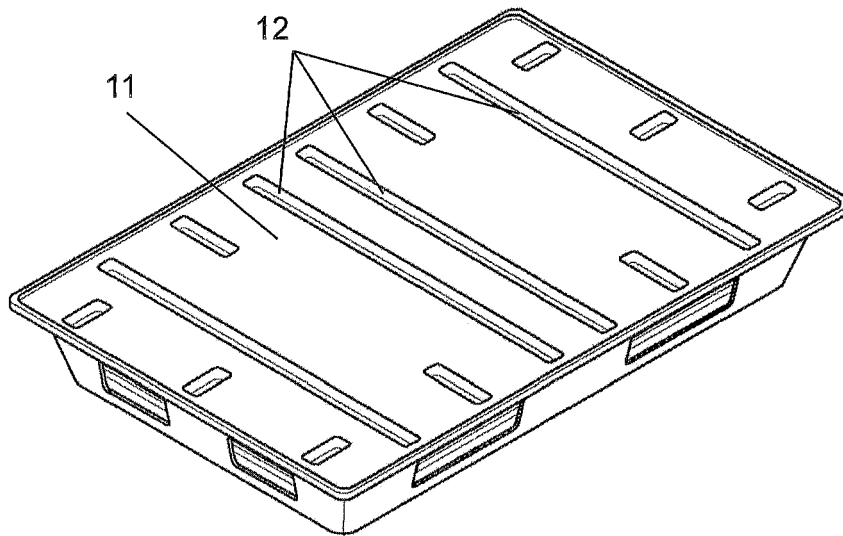


Fig. 10

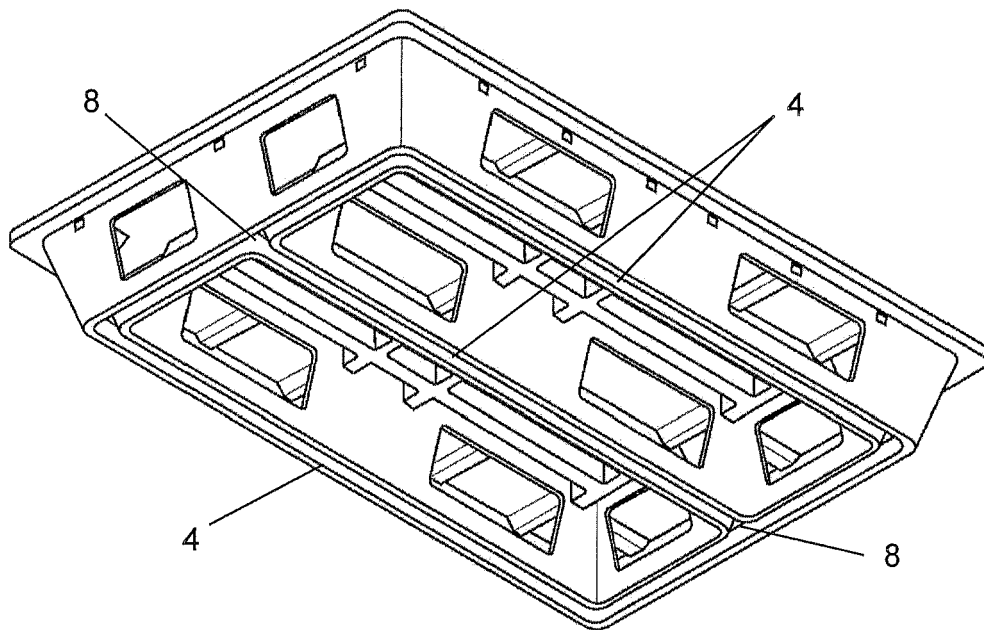


Fig. 11

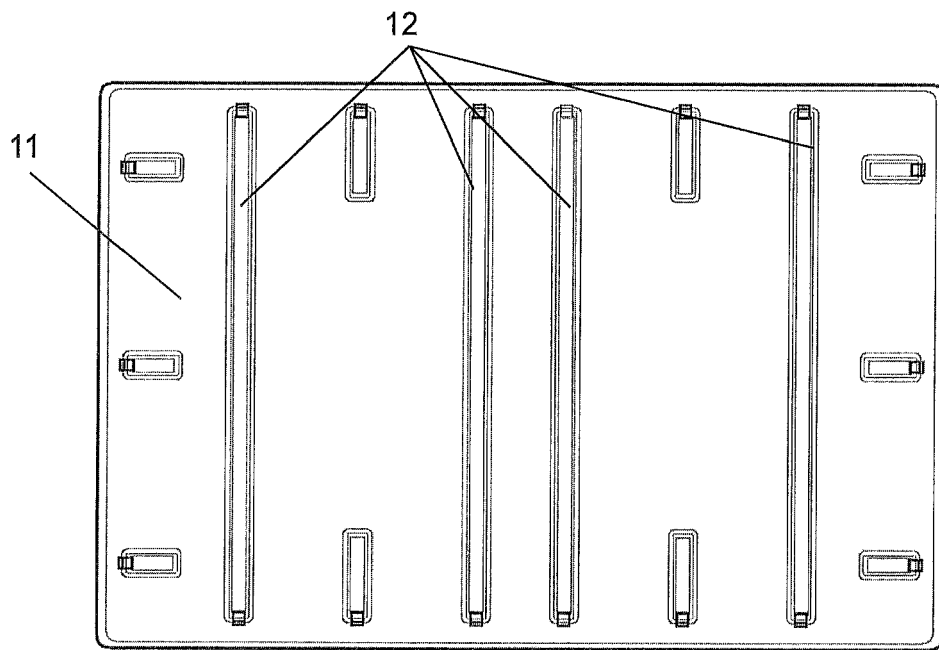


Fig. 12

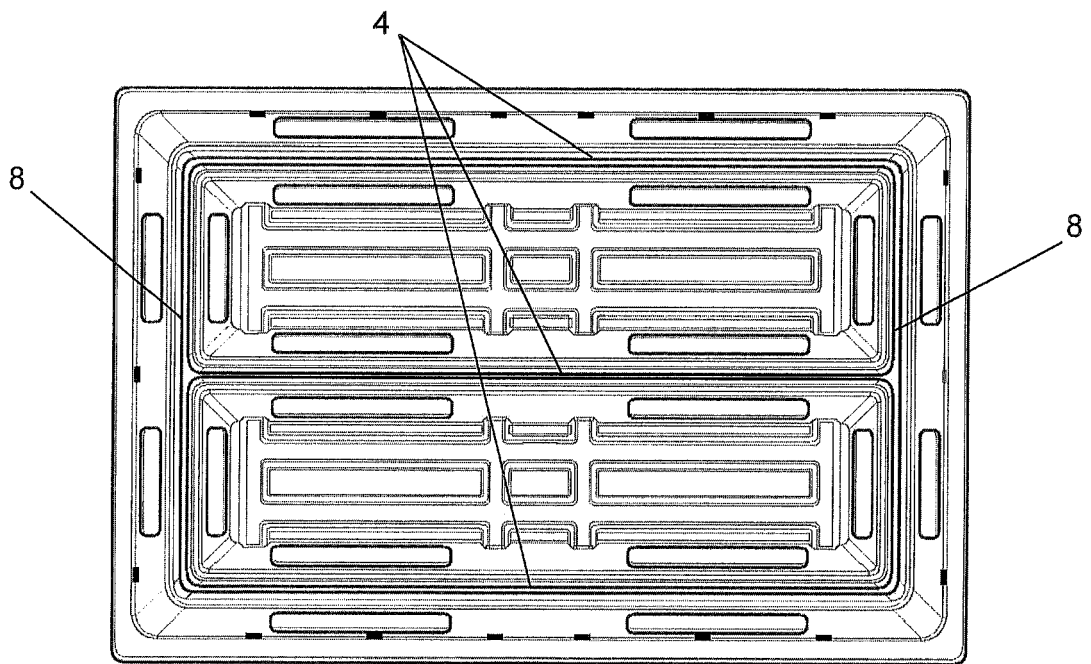


Fig. 13



EUROPEAN SEARCH REPORT

Application Number  
EP 12 19 0078

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	DE 15 31 944 A1 (KIMBERLY CLARK CO) 29 January 1970 (1970-01-29) * page 4, line 5 - line 12; figures 1-7 * -----	1-15	INV. B65D19/32 B65D19/44
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A	DE 32 17 573 A1 (WERZ FURNIER SPERRHOLZ [DE]) 17 November 1983 (1983-11-17) * page 6; figures 1-4 * -----	5	
			TECHNICAL FIELDS SEARCHED (IPC)
			B65D
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 26 February 2013	Examiner Derrien, Yannick
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EP 12 19 0078

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

**REFERENCES CITED IN THE DESCRIPTION**

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