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(11) **EP 1 588 951 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
26.10.2005 Bulletin 2005/43

(51) Int Cl.7: **B65D 19/00**

(21) Application number: **05250867.8**

(22) Date of filing: **15.02.2005**

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IS IT LI LT LU MC NL PL PT RO SE SI SK TR**
Designated Extension States:
AL BA HR LV MK YU

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(30) Priority: **03.03.2004 US 792629**

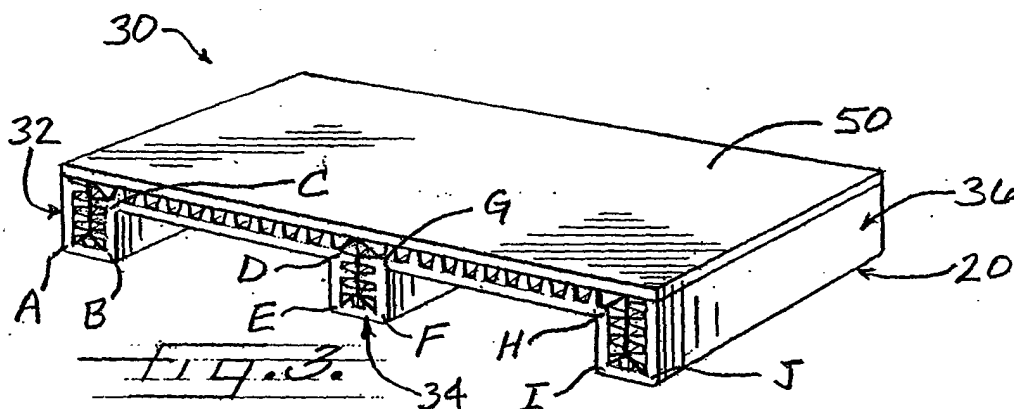
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(54) **Pallet formed from molded fibrous panel material**

(57) A pallet (30) is constructed of a molded fibrous panel material (20) comprising a sheet portion (22) defining opposite planar surfaces (24 and 26), and a grid of intersecting ribs (28) projecting from one of the planar surfaces (24) of the sheet portion (22), the sheet portion (22) and ribs (28) being integrally molded from fibrous material. The pallet (30) comprises a horizontal portion (50) of the molded fibrous panel material (20) forming an upper support surface of the pallet, and at least two

spaced runners (32,34,36) joined to the horizontal portion for engaging the ground to space the horizontal portion above the ground. Each runner (32,34,36) comprises at least two vertical portions of the molded fibrous panel material arranged in parallel relation and bonded to one another. In one embodiment, a single panel member (20) is folded along a series of parallel fold lines extending across a width of the member, so as to form the runners and the horizontal portion from the single member.



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Description

FIELD OF THE INVENTION

[0001] The invention relates to pallets for supporting items during shipment and storage. In particular, the invention relates to a pallet formed predominately from fibrous material.

BACKGROUND OF THE INVENTION

[0002] Pallets traditionally have been manufactured of wood. The drawbacks associated with wooden pallets are well known, as noted for example in U.S. Patent No. 5,184,558, incorporated herein by reference. Briefly, such drawbacks include heaviness, which makes the pallets cumbersome to handle and costly to ship, relatively great expense because of the costliness of wood, and difficulty and expense of disposing of the pallets when their useful life has been expended.

[0003] Because of such problems, various types of non-wooden pallets have been proposed. Some of these pallets are based on corrugated paperboard materials; others are based on honeycomb sandwich types of sheet materials. Still others are one-piece structures molded from fibrous material.

[0004] Pallets based on corrugated paperboard materials suffer from relatively poor rigidity because corrugated paperboard material by its nature is weak in bending parallel to the running direction of the flutes. Attempts have been made to improve rigidity in all directions by forming laminations of multiple layers of corrugated paperboard with the flutes in successive layers being oriented orthogonally. There is thus a need for a substantial number of separate pieces of corrugated sheet material, each die cut to appropriate size and shape, the pieces then being glued together. Thus, production and assembly of a pallet from such materials is relatively complex and expensive.

[0005] Pallets formed from honeycomb sandwich materials likewise tend to consist of a substantial number of separate pieces, and hence are relatively complex and expensive to produce and assemble. Additionally, the bond between the honeycomb cells and the face sheets represents a weak link in honeycomb sandwich structures; if this bond should break, the structure loses a great deal of its bending stiffness. In honeycomb sandwich panels based on paper, furthermore, exposure of the panels to water or other liquids can substantially weaken the panels.

[0006] With regard to one-piece molded fibrous pallets, a significant drawback is the need for a differently configured mold for each different pallet size or configuration to be produced.

SUMMARY OF THE INVENTION

[0007] The invention addresses the above needs and

achieves other advantages, by providing a pallet formed of molded fibrous panel material of a special type having substantial strength and relatively light weight. The pallet can be constructed from a small number of separate pieces of the panel material, or even from a single piece of the panel material.

[0008] More particularly, in accordance with the invention, a pallet is constructed of a molded fibrous panel material comprising a sheet portion defining opposite planar surfaces, and a grid of intersecting ribs projecting from one of the planar surfaces of the sheet portion, the sheet portion and ribs being integrally molded in one piece from fibrous material. The fibrous material can be, for example, recycled paper fibers. If water-resistance is required, the molded fibrous panel material can be impregnated with a suitable resin. The panel has substantial rigidity and integrity by virtue of its one-piece construction and the grid of intersecting ribs.

[0009] A pallet in accordance with the invention comprises a horizontal portion of the molded fibrous panel material forming an upper support surface of the pallet, and at least two spaced runners joined to and extending downward from the horizontal portion for engaging the ground to space the horizontal portion above the ground. Each runner comprises at least two vertical portions of the molded fibrous panel material arranged in parallel relation and bonded to one another.

[0010] In one embodiment, a single panel member is folded along a series of parallel fold lines extending across a width of the member, so as to form the runners and the horizontal portion from the single member. Because of the substantial rigidity of the panel, the grooves are formed in the panel to create the fold lines. The grooves represent regions in which fibrous material that would otherwise be there is missing or removed. The grooves preferably are generally V-shaped with a 90-degree included angle between opposite side walls of the grooves so that the panel can be folded 90 degrees about the fold line. The grooves either can be molded into the panel when it is molded, or alternatively can be formed by mechanically removing material (e.g., by routing) from the panel after it is formed.

[0011] In another embodiment, a top panel is affixed atop the horizontal portion of the pallet, such as by gluing. The top panel gives added strength to the pallet and also presents a smooth top surface. The top panel in one embodiment comprises a laminated multi-layer sheet, for example formed from paperboard sheets. Alternatively, the top panel can be another piece of the molded fibrous panel material, with the ribs facing downward toward the horizontal portion of the pallet. The ribs of the top panel can be bonded to the ribs of the horizontal portion, optionally with an intervening piece of sheet material (e.g., paperboard or the like) disposed therebetween.

[0012] The molded fibrous panel material forming the horizontal and vertical portions of the pallet can comprise a single layer of the molded fibrous panel material,

such that one side of the panel is planar and the other side has exposed ribs. Alternatively, the panel material can comprise a double layer wherein the two layers are joined rib-to-rib, for added rigidity.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S)

[0013] Having thus described the invention in general terms, reference will now be made to the accompanying drawings, which are not necessarily drawn to scale, and wherein:

FIG. 1 is a perspective view of a piece of molded fibrous panel material used for constructing pallets in accordance with the invention;

FIG. 2 is a cross-sectional view taken along line 2-2 in FIG. 1;

FIG. 3 is a pallet in accordance with a first embodiment of the invention;

FIG. 4A shows a portion of a molded fibrous panel, illustrating a series of parallel fold lines defined as V-shaped grooves in the panel;

FIG. 4B shows the panel after being folded 90 degrees along one of the fold lines;

FIG. 5 shows a portion of the panel of FIG. 3, depicting a runner in greater detail;

FIG. 6 illustrates an alternative embodiment of the invention;

FIG. 7 shows another embodiment of the invention;

FIG. 8 depicts a further embodiment of the invention;

FIG. 9 shows a still further embodiment of the invention; and

FIG. 10 shows yet another embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0014] The present inventions now will be described more fully hereinafter with reference to the accompanying drawings, in which some, but not all embodiments of the invention are shown. Indeed, these inventions may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will satisfy applicable legal requirements. Like numbers refer to like elements throughout.

[0015] FIGS. 1 and 2 show a molded fibrous panel **20** that is used for constructing pallets in accordance with the invention. The panel **20** can be formed by a process generally similar to that disclosed in U.S. Patent No. 4,702,870 to Setterholm et al., incorporated herein by reference, or by a process such as described in co-pending U.S. Patent Application Serial No. 10/729,686, filed on December 5, 2003, entitled "Apparatus and Process for Forming Three-Dimensional Fibrous Panels" incorporated herein by reference. The process produces a three-dimensional panel that has a sheet portion **22** defining opposite planar surfaces **24** and **26**, and a grid of intersecting ribs **28** projecting from one surface **24** of the sheet portion. To make the panel, an aqueous fiber stock is deposited into a mold comprising a porous support plate or screen on which are affixed a plurality of resilient elastomeric mold pieces or projections of truncated conical or pyramidal shape. The mold pieces are spaced apart on the porous support plate so that intersecting channels are defined between the mold pieces. The aqueous stock fills the mold to a depth greater than the height of the mold pieces, so the stock covers the upper surfaces of the mold pieces. A flat mold plate is urged against the stock and presses the stock down into the mold; the stock is dewatered through openings in the porous support plate. The pressure dewateres and densifies the panel, and the wet panel is then dried fully to complete the process.

[0016] The panel **20** advantageously can have a thickness ranging from about ¼-inch to about ¾-inch or more. The panel can be formed from recycled paper fibers. The panel can be impregnated with a resin to render it water-resistant, if desired. An advantage of the panel over the prior art is its relatively large strength-to-weight ratio, which makes possible the construction of pallets of relatively light weight but substantial strength.

[0017] FIG. 3 depicts a pallet **30** in accordance with a first embodiment of the invention. The pallet **30** is constructed from a single molded fibrous panel **20** and a top panel **50**. The molded fibrous panel **20** is rectangular in shape. The panel **20** is folded along a series of parallel fold lines to form three runners **32**, **34**, **36** spaced apart and parallel to one another, as further described below. The top panel **50** is then bonded to the folded panel **20** by gluing or the like.

[0018] The formation of the runner **32** is depicted in FIGS. 4A, 4B, and 5; the other runners are formed in a similar fashion. The panel **20** is provided with a series of spaced, parallel fold lines **A**, **B**, **C**, **D**, **E**, **F**, **G**, **H**, **I**, **J** (FIG. 3); the fold lines **A**, **B**, and **C** are used for forming the first runner **32**. The fold line **A** is spaced from one edge of the panel **20** by a distance corresponding to a desired vertical extent of the runner **32**; panel section **20a** is defined between the panel edge and the fold line **A**. The fold line **B** is spaced from the fold line **A** by a minimum distance roughly equal to 1.5 to 2 times the thickness of the panel; panel section **20b** is defined between fold lines **A** and **B**. The fold line **C** is spaced from

the fold line **B** by a distance approximately equal to the vertical height of the runner minus the thickness of the panel **20**; panel section **20c** is defined between the fold lines **B** and **C**, and a panel section **20d** is connected to the panel section **20c** at the fold line **C**.

[0019] Because the panel **20** has substantial bending stiffness as a result of the ribs **28**, it is not possible to fold the panel without substantial breakage of fibers and buckling of the panel along the fold, and accordingly it is necessary to provide a groove or channel along each of the desired lines about which the panel is to be folded, as shown in FIG. 4A. In the region of each groove, the ribs are substantially removed or interrupted so that the remaining material, at least at the bottom of the groove, consists substantially entirely of the sheet portion **22** of the panel. A preferred configuration of the grooves is depicted in FIG. 4A. Each groove preferably is V-shaped; the opposite side walls of the groove preferably define an angle of substantially 90 degrees therebetween. Accordingly, when the panel is folded 90 degrees about the fold line, the opposite side walls of the groove come into substantially abutting relation and can be glued together to secure the panel in the folded position.

[0020] The V-shaped grooves can be formed in various ways. In one embodiment, the grooves are formed during the molding process, by suitably configuring the mold. Alternatively, the panel can be molded without grooves, and then the panel can be routed, machined, or otherwise mechanically operated upon to remove material to form the grooves.

[0021] To form the runner **32**, the panel sections **20a** and **20b** are folded as a unit 90 degrees clockwise about the fold line **B** as shown in FIG. 4B, then the panel section **20a** is folded relative to panel section **20b** 90 degrees clockwise about the fold line **A**. At this point, the panel sections **20a** and **20c** are parallel to each other and are rib-to-rib. These panel sections are glued together to form the runner **32**. The runner is then folded 90 degrees counterclockwise about the fold line **C**, with the resulting structure being shown in FIG. 5. Panel section **20d** forms a horizontal portion of the pallet on which a load will be supported. The other runners **34** and **36** and further horizontal portions are similarly formed by folding the panel about the respective fold lines **D-J**. Finally, the top panel **50** is attached atop the panel **20** by gluing or the like to complete the pallet construction. Although a particular order of folding the panel **20** about the fold lines has been described, it will be recognized that the order may be different while arriving at the same end result.

[0022] FIG. 6 illustrates a portion of a pallet **30'** in accordance with a second embodiment of the invention. This pallet is essentially the same as the pallet **30** described above, except that the panel **20** is reinforced in the region of the fold lines **A** and **B** by a reinforcing web **52**. The reinforcing web **52** is employed to prevent or minimize fiber breakage in the region of the fold lines that may otherwise result upon folding of the panel. The

reinforcing web may be an adhesive tape such as a pressure-sensitive adhesive tape comprising a substrate of paper or cloth having a layer of pressure-sensitive adhesive thereon. The reinforcing web preferably is affixed to the panel prior to folding.

[0023] A third embodiment of the invention is depicted in FIG. 7. The pallet **130** shown in FIG. 7 is generally similar to the pallet **30** previously described, except as noted herein. The pallet **130** has a panel **20** folded along fold lines **A, B, C**, etc., so as to form runners **32**, etc., as previously described, and a top panel **50** affixed atop the panel **20**. However, in the present embodiment, the runners are reinforced with additional stiffening members. Thus, the runner **32** is shown having a stiffening member **60** disposed between the panel portion **20a** and the panel portion **20c** that make up the runner. The stiffening member is bonded to the panel portions **20a** and **20c** with adhesive or the like. To provide the necessary space between the panel portions to accommodate the thickness of the stiffening member **60**, the fold lines **A** and **B** are spaced slightly farther apart than in the previously described pallet **30**, so that when the panel portions **20a** and **20c** are parallel to each other there is a space between them substantially equal to the thickness of the stiffening member **60**. The stiffening member **60** can comprise various materials, including but not limited to metal, wood, hard plastic, hard rubber, fiber-reinforced plastic, multi-layer paperboard laminations, and the like.

[0024] FIG. 8 shows a fourth embodiment of the invention. The pallet **230** of FIG. 8 is generally similar to the pallet **30** described above, except that the top panel **250** comprises a fibrous molded panel of the type shown in FIG. 1. Thus, the top panel **250** has a sheet portion **252** and ribs **258** projecting therefrom. The top panel **250** is bonded to the panel **20** that forms the runners of the pallet. Preferably, the panel **20** has its ribs **28** projecting upwardly and the top panel **250** has its ribs **258** projecting downwardly, and the two panels are bonded rib-to-rib. Optionally, there can be an intervening sheet **260** of paper or other material disposed between and bonded to the two panels.

[0025] A fifth embodiment of the invention is illustrated in FIG. 9. The pallet **330** of FIG. 9 is constructed in a fashion similar to that used for constructing the pallet **30**, except that the starting panel **320** used for forming the runners is a double-layer panel having two panels of the type illustrated in FIG. 1, bonded rib-to-rib (with or without an intervening sheet therebetween). Thus, both opposite surfaces of the panel **320** are smooth and planar. The panel is provided with grooves along the desired fold lines by routing or the like, as previously described, and is folded to form the runners **332**, etc., and the horizontal portions **320d**, etc. However, in the pallet **330**, since the horizontal portions of the panel **320** already comprise a double-layer of panel material, there is no need for an additional top panel. Thus, the entire pallet is formed from one double-layer panel. As with the

embodiment of FIG. 7, the runners can be further strengthened, if desired, by stiffening members.

[0026] Finally, a sixth embodiment of the invention is shown in FIG. 10. The pallet **430** of FIG. 10 is formed differently from the previously described pallets, with respect to the formation of the runners. In this embodiment, each runner, such as the runner **432** shown in the drawing, is formed by bonding together two or more separate and discrete pieces of panel material, and is then bonded to a top panel of the pallet. Thus, as shown, the runner **432** comprises two double-layer pieces of panel material **440** and **442** bonded together. The piece **440** comprises two panels **440a** and **440b** bonded together rib-to-rib (with or without an intervening sheet therebetween); likewise, the piece **442** comprises two panels **442a** and **442b** bonded together rib-to-rib (with or without an intervening sheet therebetween). The pallet **430** includes a top panel **450** comprising a double-layer piece of panel material having two panels bonded together rib-to-rib (with or without an intervening sheet therebetween). Alternatively, the top panel could be a single layer of the panel material, or could be another type of construction such as a multi-layer paperboard lamination. The runners could be formed of fewer than four layers of the panel material; for example, the runners could comprise two layers of the panel material. The runners could include stiffening members as previously described.

[0027] Many modifications and other embodiments of the inventions set forth herein will come to mind to one skilled in the art to which these inventions pertain having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. Therefore, it is to be understood that the inventions are not to be limited to the specific embodiments disclosed and that modifications and other embodiments are intended to be included within the scope of the appended claims. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.

Claims

1. A pallet formed predominately of molded fibrous material, comprising:

a molded fibrous panel material comprising a sheet portion defining opposite planar surfaces, and a grid of intersecting ribs projecting from one of the planar surfaces of the sheet portion, the sheet portion and ribs being integrally molded in one piece from fibrous material;
a horizontal portion of said molded fibrous panel material forming an upper support surface of the pallet;
the pallet further comprising at least two spaced runners joined to and extending downward

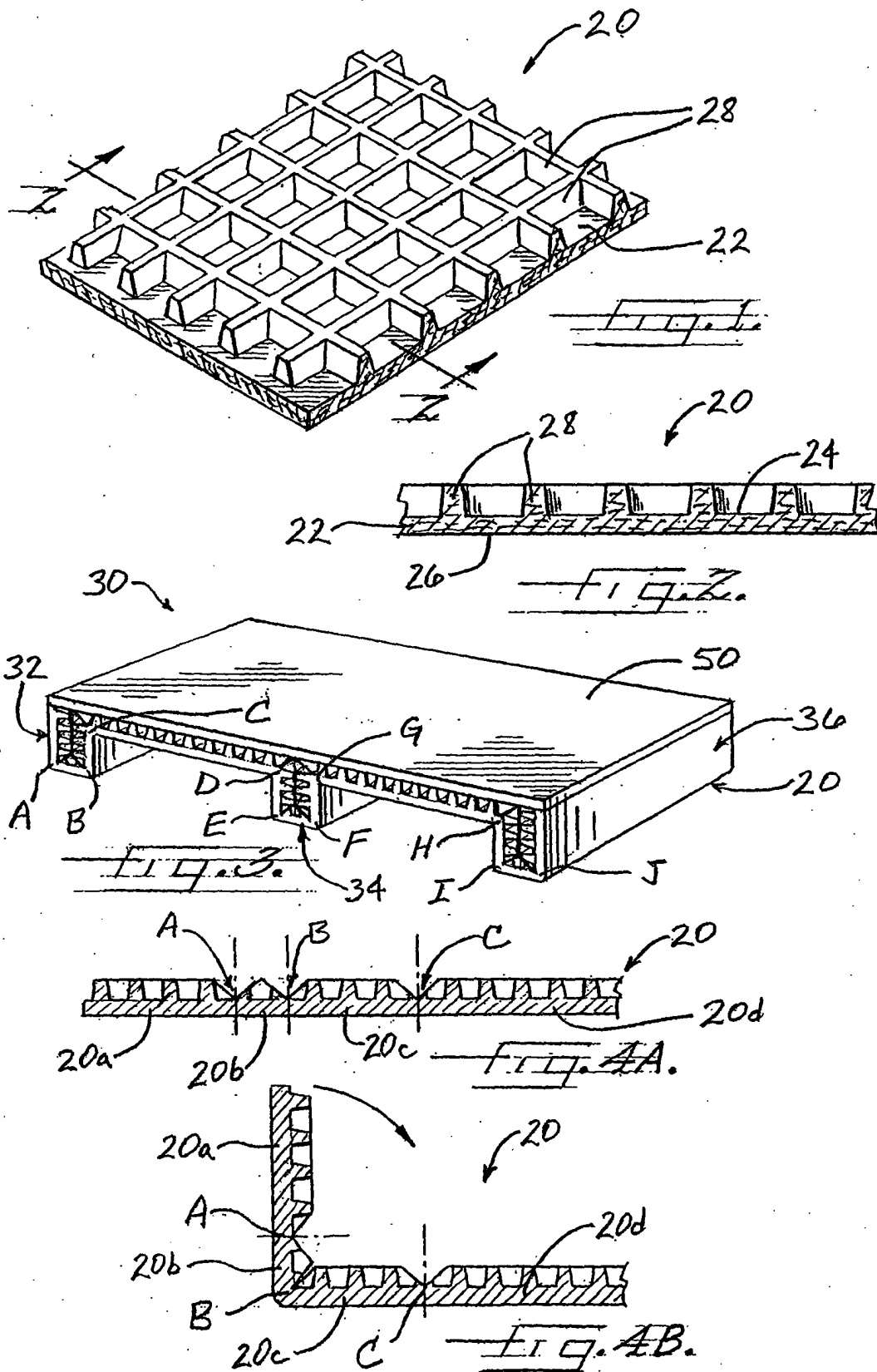
from the horizontal portion for engaging the ground to space the horizontal portion above the ground, each runner comprising at least two vertical portions of the molded fibrous panel material arranged in parallel relation and bonded to one another.

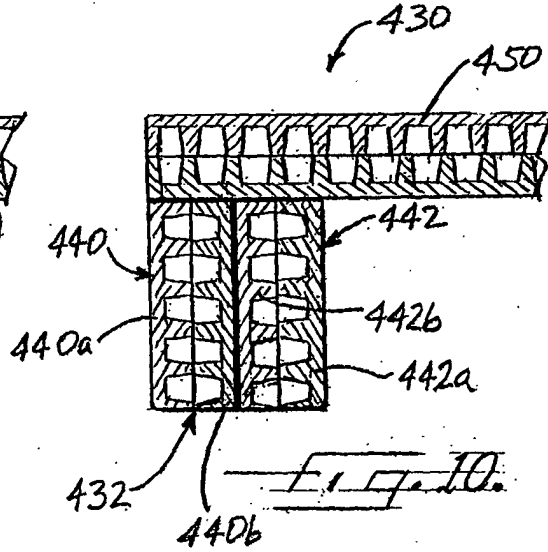
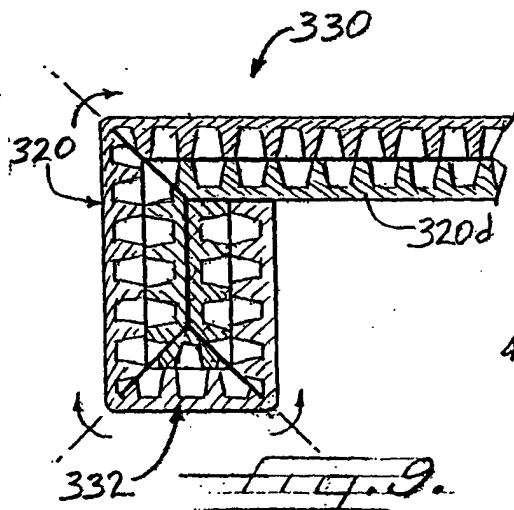
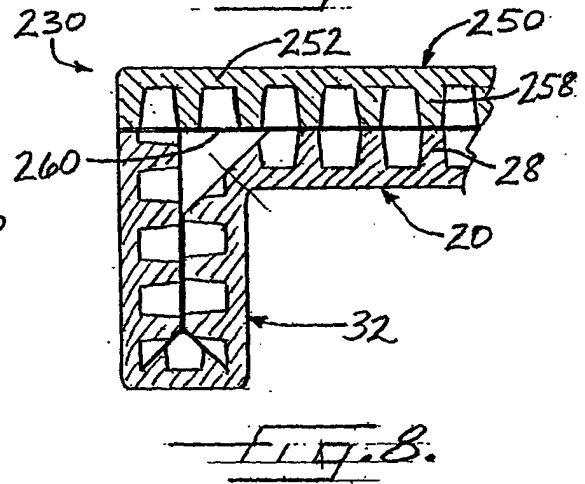
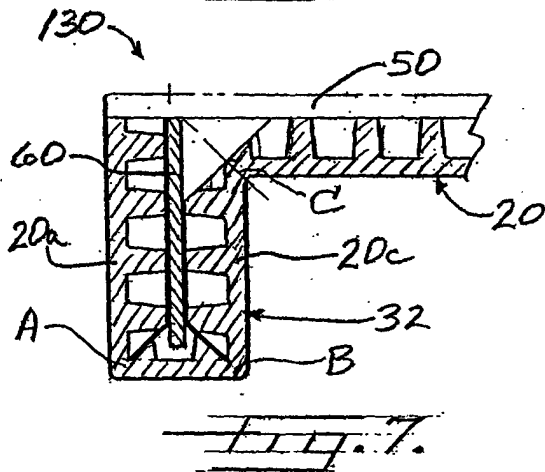
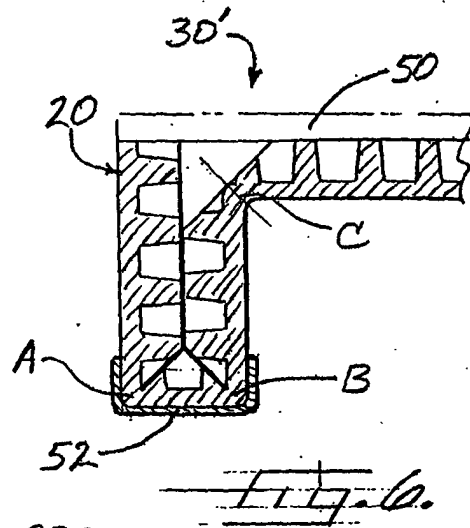
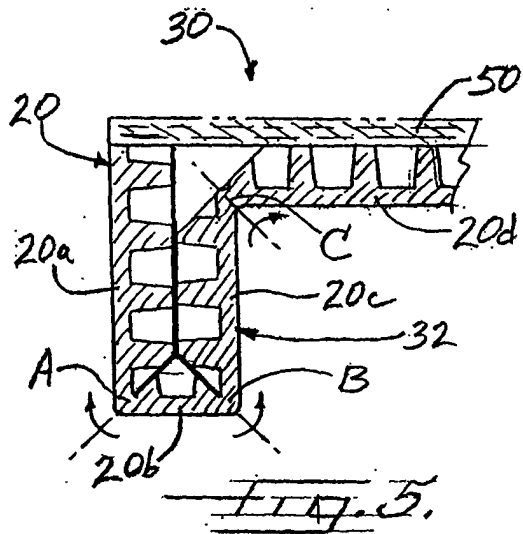
2. The pallet of claim 1, wherein each runner includes a separate stiffening member disposed between and bonded to two of the vertical portions.
3. The pallet of claim 1, wherein the horizontal portion and the vertical portions are all integrally and serially joined together along a series of spaced parallel fold lines in the molded fibrous panel material.
4. The pallet of claim 3, wherein each fold line comprises a groove in the molded fibrous panel material.
5. The pallet of claim 4, wherein the grooves are molded into the molded fibrous panel material.
6. The pallet of claim 4, wherein the grooves are formed by mechanically removing fibrous material from the molded fibrous panel material.
7. The pallet of claim 4, wherein at least some of the grooves are generally V-shaped with an included angle of about 90 degrees between opposite side walls of the groove.
8. The pallet of claim 1, further comprising a top panel affixed atop the horizontal portion.
9. The pallet of claim 8, wherein the top panel comprises a multi-ply laminated material.
10. The pallet of claim 9, wherein the laminated material comprises paperboard.
11. The pallet of claim 8, wherein the top panel comprises another piece of the molded fibrous panel material.
12. The pallet of claim 11, wherein the ribs of the top panel face downward and the ribs of the horizontal portion face upward to oppose the ribs of the top panel.
13. The pallet of claim 12, wherein the ribs of the top panel are bonded directly to the ribs of the horizontal portion.
14. The pallet of claim 12, wherein the ribs of the top panel are joined to the ribs of the horizontal portion via an intervening piece of sheet material disposed therebetween, said sheet material being bonded to

the ribs of the top panel and horizontal portion.

15. The pallet of claim 3, wherein the molded fibrous panel material forming the horizontal and vertical portions comprises a single layer of the molded fibrous panel material. 5
16. The pallet of claim 3, molded fibrous panel material forming the horizontal and vertical portions comprises two layers of the molded fibrous panel material joined rib-to-rib. 10
17. The pallet of claim 3, further comprising a reinforcing web bonded to one side of the molded fibrous panel material along at least one of the fold lines. 15
18. The pallet of claim 17, wherein the reinforcing web comprises a pressure-sensitive adhesive tape.
19. The pallet of claim 3, wherein the molded fibrous panel material has, in order, from one end to an opposite end of the molded fibrous panel material: 20
 - first, second, and third fold lines for forming a first runner; 25
 - fourth, fifth, sixth, and seventh fold lines for forming a second runner; and
 - eighth, ninth, and tenth fold lines for forming a third runner. 30
20. The pallet of claim 1, wherein the molded fibrous panel material is formed from recycled paper fibers.
21. The pallet of claim 20, wherein the molded fibrous panel material is impregnated with a resin for rendering the molded fibrous panel material substantially water-resistant. 35
22. The pallet of claim 1, wherein each runner comprises a first pair of layers of the molded fibrous panel material joined rib-to-rib. 40
23. The pallet of claim 22, wherein each runner comprises a second pair of layers of the molded fibrous panel material joined rib-to-rib and joined to the first pair such that the runner comprises four layers. 45
24. The pallet of claim 22, wherein the horizontal portion comprises a separate piece of the molded fibrous panel material joined to the runners. 50

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EUROPEAN SEARCH REPORT

Application Number
EP 05 25 0867

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	US 4 759 295 A (NILSEN ET AL) 26 July 1988 (1988-07-26) * column 3, line 41 - column 4, line 45; figures 1-8 *	1	B65D19/00
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 12 July 2005	Examiner Grondin, D
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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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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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