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(54) **Co-extruded pallet block**

(57) A pallet block (50) includes an extruded inner core (52) and an outer shell (54) co-extruded with the inner core. The outer shell (54) surrounds the inner core (52) with respect to an extrusion axis (56) defined by the inner core (52). The compositions of the inner core and

outer shell differ by one or both of mass density and formula. For example, the outer shell may have a higher mass density than the inner core and may protect the inner core from impact and moisture ingress. Each of the inner core and outer shell may include product-packaging waste.

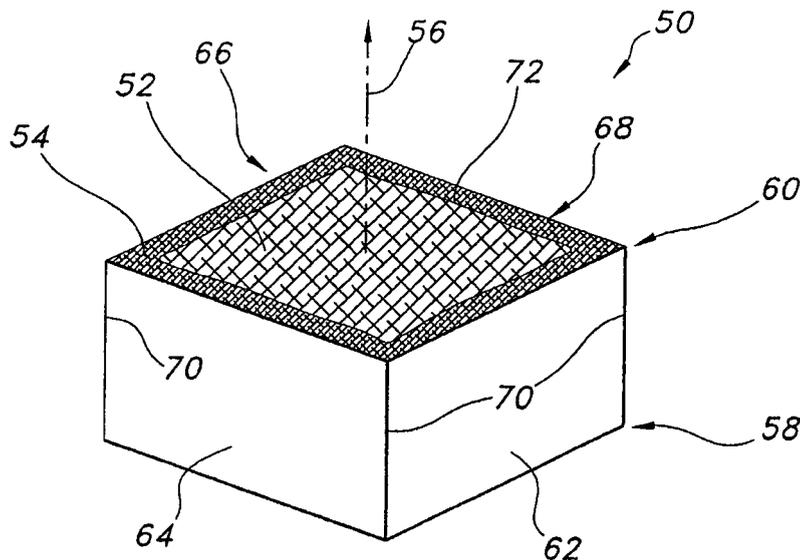


FIG. 2

Description

FIELD OF THE INVENTION

5 **[0001]** Embodiments of the present invention relate generally to co-extruded members. More particularly, embodiments of the invention relate to co-extruded pallet blocks and pallets constructed therewith.

BACKGROUND OF THE INVENTION

10 **[0002]** Though pallets have been in use in product transportation for decades, many improvements in their designs and materials have been adopted and continue to appear. Typical early pallets, consisting of deckboards and stringers, were approachable by a forklift from one of two directions defined by the stringers. These are now accordingly called two-way pallets. In many transportation and storage applications, however, pallets approachable from any of four directions are preferred. Thus, pallets having pallet blocks are popular as the spaces defined between the blocks typically permit approaches from any side of such a pallet.

15 **[0003]** Traditional pallet blocks were made of solid wood. Solid wood, however, has nail retrieval and impact resistance properties that typically vary from piece to piece and that vary with the orientation of the grain. Nail retrieval relates generally to the forces required to remove a nail from a host material. High nail retrieval properties in a pallet block assures the rigidity and integrity of a pallet as it is lifted about and as it undergoes the vibrations of long-distance travel. Impact resistance relates to the resistance of a pallet block against penetration by the tip of a forklift blade or other lifting member. A pallet constructed with solid wood pallet blocks typically has nails driven into the blocks either through or along the grain pattern. The nails are typically vertically disposed and the orientation of the pallet block defines the relationship of the grain pattern to the nails. A solid wood pallet block having nails driven through the grain pattern typically exhibits high nail retrieval but poor impact resistance. A pallet so constructed is therefore rigid and durable when heavy payloads are carefully lifted and transported but is unduly susceptible to damages, such as the splitting of a pallet block, when a forklift blade inadvertently strikes the pallet block. Conversely, a solid wood pallet block having nails driven along the grain pattern typically exhibits good impact resistance properties but poor nail retrieval. A pallet so constructed may therefore fall apart from use as nails slip from the pallet blocks without impacts ever occurring. A good pallet block would preferably have both high nail retrieval and high impact resistance.

20 **[0004]** Pallet blocks made of compressed wood shavings are free from overall grain patterns and offer some relief to the dilemma of choosing either high nail retrieval or high impact resistance. However, such pallet blocks tend to readily absorb water and expand. A pallet constructed with compressed wood pallet blocks can therefore cause payload tipping when exposed to water. Unfortunately, it is not always feasible to maintain shipping pallets in climate-controlled environments. A good pallet block would preferably be relatively stable in various humidity and weather conditions.

25 **[0005]** Therefore a need exists for improvements in pallet blocks and the associated pallets. Improvements are needed toward pallet blocks having high nail retrieval, high impact resistance, and some degree of resistance to moisture.

BRIEF SUMMARY OF THE INVENTION

30 **[0006]** Embodiments of the invention may address at least some of the above needs and achieve other advantages. For example, a first aspect of the invention relates to a pallet block that includes an extruded inner core and an outer shell co-extruded with the inner core. The outer shell surrounds the inner core with respect to an extrusion axis defined by the inner core. The inner shell includes a foamed composition comprising a mixture of plastic and at least one of paper, wood, and metal. The outer shell includes plastic and at least one of paper, wood, and metal. The mass density of the outer shell is greater than the mass density of the inner core. Like the inner core, the outer shell may include a foamed composition. For example, the inner core may be more foamed than the outer shell. Either or both of the inner core and outer shell may include product-packaging waste as a component of the compositions from which they are formed.

35 **[0007]** A second aspect of the invention relates to a pallet that includes at least one pallet member and a pallet block attached to the pallet member. For example, the pallet member may be a deckboard, a stringer, or a pallet deck. The pallet block includes an extruded inner core and an outer shell co-extruded with the inner core. The outer shell surrounds the inner core with respect to an extrusion axis defined by the inner core. The inner shell includes a foamed composition of plastic and at least one of paper, wood, and metal. The outer shell includes plastic and at least one of paper, wood, and metal. The mass density of the outer shell is greater than the mass density of the inner core. The pallet block may be attached to the pallet member by way of an elongate connector, such as a nail, disposed essentially parallel to the extrusion axis such that the connector is retained by the inner core without the connector contacting the outer shell.

40 **[0008]** A third aspect of the invention relates to a cargo item. In this aspect, a pallet member is horizontally disposed beneath, and at least partially supports, a payload. A pallet block is disposed beneath, and at least partially supports,

the pallet member and the payload. The pallet block includes an extruded inner core and an outer shell co-extruded with the inner core. The outer shell surrounds the inner core about a vertical axis. The outer shell may differ from the inner core in at least one of formula and mass density. The outer shell may be connected together by a vertically disposed nail or screw that is retained by the inner core and that does not penetrate the outer shell.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0009] 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 pallet, according to at least one embodiment of the present invention, shown in an inverted disposition;

FIG. 2 is a perspective view of a pallet block according to at least one embodiment of the invention; and

FIG. 3 is a partial cross-sectional view of the pallet of **FIG. 1**.

DETAILED DESCRIPTION OF THE INVENTION

[0010] The present invention 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, the invention 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.

[0011] With reference to **FIG. 1**, a pallet **10** in accordance with one embodiment of the invention is illustrated. The pallet **10** includes a number of pallet members and inventive pallet blocks **50**. These descriptions relate to many pallet architectures. In the illustrated embodiment, the pallet **10** includes two types of pallet members. Pallet members of the first type, which are typically called stringers **12**, are attached directly to the pallet blocks. Each particular stringer **12** is attached to and maintains the relative dispositions of a particular row of pallet blocks. Pallet members of the second type, which are typically called deckboards **14**, abut the stringers **12** and are attached to the pallet blocks by way of the stringers. The stringers **12** perform as rails to which many deckboards **14** can be attached. The various pallet members are connected to the pallet blocks **50** by elongate connectors **20** such as nails or screws.

[0012] In the pallet **10** of **FIG. 1**, openings **22** defined between the stringers, deckboards, and pallet blocks receive the lift members of forklifts, pallet trucks, pallet jacks, and other lifting apparatuses when the pallet is to be lifted and moved about. The illustrated pallet **10** is typically called a four-way pallet because a forklift or the like can approach and lift the pallet from any of four directions due to the presence of openings **22** along four sides of the pallet.

[0013] For the purpose of illustrating the architecture thereof, the pallet **10** is shown in **FIG. 1** in an inverted disposition relative to its typical orientation when used in transporting cargo. That is, a first face **18** defined by the many upper deckboards **14** typically faces upward and receives a payload disposed above the pallet. The lower deckboards **16** typically define a base upon which the pallet rests. The illustrated pallet **10** is typically called a single-faced pallet as the first face **18** is typically preferred for receiving a payload. It should be understood that these descriptions relate as well to a double-faced pallet that would be produced by supplementing the pallet **10** with additional lower deckboards **16** to define a second face for receiving a payload such that little or no distinction would remain for determining whether the pallet is inverted. It should be understood that these descriptions relate both to single-faced and double-faced pallets. Indeed, it should be understood that these descriptions relate to pallet architectures other than that shown in **FIG. 1**. For example, in at least one embodiment of the invention, nine inventive pallet blocks are attached in a spaced grid pattern to the lower surface of a wide-area pallet member. In that embodiment, the pallet blocks and the wide-area pallet member, which in this context can be called a pallet deck, define a four-way single-faced pallet having an architecture similar to that illustrated in Figure 1 of the U.S. Patent Application No. 10/167,567 of Benner. The published version of the Benner application, namely Patent Application Publication No. US2002/0189507A1, published on December 19, 2002, is hereby incorporated herein by this reference.

[0014] Inventive aspects of the illustrated pallet **10** generally relate to the inventive pallet block **50** in accordance with at least one embodiment of the invention. As shown in **FIG. 2**, the pallet block **50** includes an extruded inner core **52** and an outer shell **54** co-extruded with the inner core. The inner core and outer shell define an extrusion axis **56** as the movement axis along which is material advanced as the pallet block is extruded during its manufacture. The pallet block is severed at opposing first and second ends **58** and **60** from a longer extruded member extending along the extrusion axis **56**. The outer shell surrounds the inner core with respect to the extrusion axis. The opposing first and second ends **58** and **60** are each generally planar and each is disposed essentially perpendicular to the extrusion axis.

[0015] The outer shell is illustrated to include four generally planar sides **62**, **64**, **66**, and **68** that are essentially parallel to the extrusion axis. The sides **62**, **64**, **66**, and **68** together define the outer shell as a continuous wall that surrounds

and protects the inner core. Edges **70** defined at the junctions of adjacent sides may be chamfered for guiding lifting members of forklifts and other lifting apparatuses into the openings **22** of the pallet. The opposing first and second ends **58** and **60** of the pallet block **50** are illustrated as rectangular though these descriptions relate to other shapes. Indeed, any number of planar sides can be selected to define polygonal opposing ends of the pallet block. For example, in another embodiment of the invention, a pallet block has eight generally planar sides and opposing octagonal ends. In yet another example, a pallet block according to yet another embodiment of the invention has a cylindrical outer shell and circular opposing ends.

[0016] Regarding materials by which the pallet block **50** is constructed, the inner core **52** comprises a foamed composition of plastic and at least one of paper, wood, and metal. For example, the inner core may consist of foamed and extruded product-packaging waste such as food-packaging waste. Particular examples of product-packaging waste include laminated paperboard packaging waste materials such as tetrapack materials. Regarding food-packaging waste, the inner core may include the materials of which tubular containers for packaging potato chips are constructed. Such tubular containers, referred to herein as composite containers, are constructed as cardboard tubes with inner liners made of plastic film and aluminum foil. In other examples, the inner core may include ground wood, film or plastic bags, and paper.

[0017] The inner core **52** comprises a foamed composition in that one or more foaming agents are introduced into the material of the inner core as the core is manufactured by extrusion. A foamed composition may contain the introduced foaming agents, may contain some residual amount or by-product of the agents, or may remain foamed as a result of the activities of foaming agents without regard to whether any foaming agents remain in the final product. For example, an amount of hollow glass microspheres may be used as a foaming agent and, if so used, will typically remain in the final product. As another example, a gas such as carbon-dioxide may be blown into an extrusion stream to produce a foamed composition though the gas may ultimately migrate from the final product or be replaced by ambient air. Furthermore, chemical foaming agents may act to support or promote chemical reactions such as material decompositions that produce gases and thereby cause foaming. In any event, the inner core **52** comprises a foamed composition having a mass density that may be selectively controlled by choice of the materials and foaming agents and their relative proportions, and the extrusion process used in manufacturing the composition.

[0018] The outer shell **54** comprises a composition of plastic and at least one of paper, wood, and metal. For example, the outer core may consist of foamed and extruded product-packaging waste such as food-packaging waste. For further example, the outer shell may include ground and extruded cable shavings, plastic film or bags, wood, and paper. The outer shell is co-extruded with the inner core and surrounds the inner core with respect to the extrusion axis **56**. The outer shell **54** may be a composition foamed by the introduction of a foaming agent into the material of the outer core as the outer core is co-extruded with the inner shell.

[0019] In some embodiments of the invention, the outer shell and inner core differ in at least one of formula and mass density. The formula of a composition relates to the materials and chemicals of which the composition consists. For example, a first foamed composition containing plastic, paper, and a foaming agent differs in formula from a second foamed composition containing plastic, paper, metal, and a foaming agent. The mass density of a composition represents a measure of the mass of a composition divided by its volume, and may be expressed in arbitrary or standard units such as grams per cubic-centimeter. For example, two compositions differ in mass density if equal volumes of the two differ in mass. That the outer shell and inner core differ in at least one of, and possibly both of, formula and mass density characterizes the shell and core as different compositions. Nonetheless, due to the nature of co-extruded products, some partial blending of their compositions may occur along the outer perimeter **72** of the inner core where the inner core **52** contacts the outer shell **54** (**FIG. 2**).

[0020] In the embodiment illustrated in **FIGS. 1-2**, the outer shell **54** of the pallet block **50** differs from the inner core **52** at least in mass density. More specifically, the outer shell **54** exhibits a higher mass density than the inner core **52** and protects the inner core from damage when the pallet block is struck, for example, by the lifting member of a forklift of other lifting apparatus. The difference in the mass densities of the outer shell and inner core may be affected in a number of ways according to various embodiments of the invention. For example, in one embodiment of the invention, the inner core and outer shell differ in formula merely with regard to the inner core being more foamed, and less dense, than the outer shell. In another example, according to another embodiment of the invention, the outer shell contains relatively more plastic in its formula and may therefore protect the inner shell from moisture ingress.

[0021] In **FIG. 3**, a cargo item according to at least one embodiment of the invention is illustrated in a partial cross-sectional view. A payload **80** is shown representing products and materials transported upon, stored upon, or otherwise supported by, the pallet **10**. At least one pallet member is disposed beneath and at least partially supports the payload. For example, deckboards **14** and stringers **12** are disposed beneath and at least partially support the payload. The pallet block **50** is disposed beneath and at least partially supports one or more pallet members and the payload. As described previously, the pallet block **50** includes an extruded inner core **52** and an outer shell **54** co-extruded with the inner core. In **FIG. 3**, the pallet block **50** is oriented such that the outer shell surrounds the inner core with respect to a vertical axis **82**. The pallet members **14** and **12** are connected to the pallet block by a vertically disposed connector **20**, such as a

nail or screw. That is, in this example, the extrusion axis **56 (FIG. 2)** of the pallet block **50** is vertically disposed, essentially parallel to the vertical axis **82**, such that the opposing first and second ends **58** and **60** of the pallet block are horizontally disposed to bear the forces imparted by the weight of the payload **80**.

[0022] Advantageously, the elongate connectors **22** are disposed essentially parallel to extrusion axis defined by the inner core. Thus, the connector is retained by the inner core **52** without the connector contacting or penetrating the outer shell **54**. In this configuration, nail retrieval, which relates generally to the forces required to remove a nail from a host material, depends particularly on the composition of the inner core. Furthermore, impact resistance, which relates to the resistance of a pallet block against penetration by the tip of a forklift blade or other lifting member, depends upon the composition and thickness of the outer shell. Moreover, with the pallet members **12** abutting the opposing ends **58** and **60** of the pallet block, the inner core is surrounded by the outer shell and pallet members and is at least somewhat protected from environmental factors such as moisture.

[0023] As a typical pallet may have as many as nine pallet blocks, dense pallet blocks represent a weight disadvantage which is suffered each time a pallet is lifted and moved whether by laboring persons or by motorized means. It has been found that a co-extruded pallet block according to the invention can be manufactured to have an overall mass density that is lower than a satisfactorily strong pallet block manufactured as a singly extruded member. A singly extruded pallet block, which does not separately define an inner core and outer shell, may exhibit an overall mass density as high as 1.4 grams per cubic-centimeter. However, a co-extruded pallet block according to at least one embodiment of the invention can meet load-bearing expectations in pallet transportation industries and yet exhibit an overall mass density of 1.13 grams per cubic-centimeter. In this example, the co-extruded pallet block has an outer shell exhibiting a mass density of approximately 1.3 to 1.4 grams per cubic-centimeter and an inner core exhibiting a mass density of approximately 0.9 grams per cubic centimeter.

[0024] Further beneficial advantages provided by the inventive pallet block 50 include that the overall weight and strength of the pallet block can be varied by selection of the formulas and mass densities of the inner core and outer shell. For example, the density of the inner core may be minimized so that a lightweight pallet block that benefits from a protective outer shell can be manufactured. Furthermore, the nail retrieval and impact resistance properties of the pallet block can be separately varied to obtain an optimal performance. Optimal performance of the pallet block may not entail the highest achievable nail retrieval in all situations. For example, in a situation where expensive hardwood pallet members are used, moderate nail retrieval properties may be preferred in order to preserve the condition of the pallet members in circumstances where a pallet is damaged. In such a situation, it may be economically advantageous to select a pallet block that is more fragile than the pallet members. Thus, the overall enterprise of manufacturing, using, and repairing pallets benefits from the inventive pallet block 50, which can be manufactured to meet any of a variety of specifications.

[0025] The data provided in Table 1 demonstrates that a pallet block according to the invention can be manufactured according to a variety of specifications toward overall mass, nail retention, and impact resistance. The table provides measured values for total mass, nail retention (NR), and impact resistance (IR) for each of five pallet blocks. The formula for the outer shell of each pallet block is expressed in the table in terms of the contributions of particular materials to the mass of the outer shell. The formula for the inner core of each pallet block is similarly expressed. For example, regarding the second pallet block, the outer shell is seventy percent wood shavings and thirty percent polyethylene film by mass, and the inner core is fifty percent aluminum foil and fifty percent polyethylene film by mass. Nail retrieval forces were measured according to the D1761-06 ASTM standard test, which entails measuring the force required to remove a connector from a host material. For some of the five pallet blocks listed below, nail retrieval was measured several times and a range is provided in the table. For example, several nail retrieval measurements for each of blocks 2, 3, and 5, provided results between a minimum of three hundred and forty two pounds and a maximum of four hundred and forty pounds. Impact resistance was measured according to a proprietary method that entails measuring the force required for a metal probe to penetrate a pallet block. Though such a proprietary method may not represent a standard industry test, the table below does provide evidence that the impact resistance properties of a pallet block vary with and can be selected by the construction of the pallet block with regard to total mass and the compositions of the outer shell and inner core. In the table below: "comp. cont." refers to composite containers; "cable shavings" refers to plastic outer insulator material from electrical wires; "wood" refers to wood shavings; "PE film" refers to polyethylene film; "candy wrapper" refers to plastic candy-packaging film; and, "Alum. foil" refers to aluminum foil.

TABLE 1

No.	MASS (grams)	OUTER SHELL	INNER CORE	NR (pounds)	IR (pounds)
1	522	33% comp. cont. 33% cable shavings	60% comp. cont. 20% PE film	100	2100

(continued)

No.	MASS (grams)	OUTER SHELL	INNER CORE	NR (pounds)	IR (pounds)
		33% wood	20% wood		
2	549	70 % wood 30% PE film	50% Alum. foil 50% PE film	342/440	2912
3	570	65% candy wrapper 35% PE film	50% Alum. foil 50% PE film	342/440	4397
4	652	65% Alum. foil 35% PE film	60% candy wrapper 40% PE film	350/430	4492
5	572	65% comp. cont. 35% PE film	50% Alum. foil 50% PE film	342/440	4805

[0026] Many modifications and other embodiments of the invention set forth herein will come to mind to one skilled in the art to which the invention pertains having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. Therefore, it is to be understood that the invention is 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 block comprising:

an extruded inner core defining an extrusion axis, the inner core comprising a foamed composition of plastic and at least one of paper, wood, and metal;
 an outer shell co-extruded with the inner core, the outer shell surrounding the inner core with respect to the extrusion axis, the outer shell comprising plastic and at least one of paper, wood, and metal;
 wherein the mass density of the outer shell is greater than the mass density of the inner core.

2. The pallet block of Claim 1, wherein the outer shell contains more plastic per gram than the inner core contains plastic per gram.

3. The pallet block of Claim 1, wherein the outer shell comprises a foamed composition of plastic, and at least one of paper, wood, and metal.

4. The pallet block of Claim 3, wherein the inner core is more foamed than the outer shell.

5. The pallet block of Claim 1, wherein the inner core comprises product-packaging waste.

6. A pallet comprising:

at least one pallet member;
 a pallet block attached to the pallet member, the pallet block comprising:

an extruded inner core defining an extrusion axis, the inner core comprising a foamed composition of at least one of plastic, paper, wood, and metal;
 an outer shell co-extruded with the inner core, the outer shell surrounding the inner core with respect to the extrusion axis, the outer shell comprising plastic;
 wherein the mass density of the outer shell is greater than the mass density of the inner core.

7. The pallet of claim 6, wherein the pallet member comprises a deckboard, a stringer, or a pallet deck.

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8. The pallet of Claim 6, wherein the pallet member has a generally planar surface to which the pallet block is attached, and wherein the extrusion axis defined by the inner core is disposed essentially perpendicular to the generally planar surface of the pallet member.
- 5 9. The pallet of Claim 6, wherein the pallet block is attached to the pallet member by way of an elongate connector disposed essentially parallel to the extrusion axis defined by the inner core.
- 10 10. The pallet of Claim 9, wherein the elongate connector is retained by the inner core without the elongate connector contacting the outer shell.
- 10 11. The pallet block of Claim 6, wherein the outer shell contains more plastic per gram than the inner core contains plastic per gram.
- 15 12. The pallet block of Claim 6, wherein the outer shell comprises plastic and at least one of plastic, paper, wood, and metal.
13. A cargo item comprising:
- 20 a payload;
a pallet member disposed beneath and at least partially supporting the payload; and
a pallet block disposed beneath and at least partially supporting the pallet member and payload, the pallet block comprising an extruded inner core and an outer shell co-extruded with the inner core, the outer shell surrounding the inner core with respect to a vertical axis.
- 25 14. The cargo item of Claim 13, wherein the outer shell differs from the inner core in at least one of formula and mass density.
15. The cargo item of Claim 13, wherein the pallet member and pallet block are connected together by a vertically disposed nail or screw.
- 30 16. The cargo item of Claim 15, wherein said nail or screw is retained by the inner core, and wherein said nail or screw does not penetrate the outer shell.
- 35 17. The cargo item of Claim 13, wherein the inner core comprises a foamed composition of plastic and at least one of paper, wood, and metal.
18. The cargo item of Claim 17, wherein the mass density of the outer shell is greater than the mass density of the inner core.
- 40 19. The cargo item of Claim 17, wherein the outer shell comprises plastic and at least one of plastic, paper, wood, and metal.
20. The cargo item of Claim 13, wherein the inner core comprises product-packaging waste.
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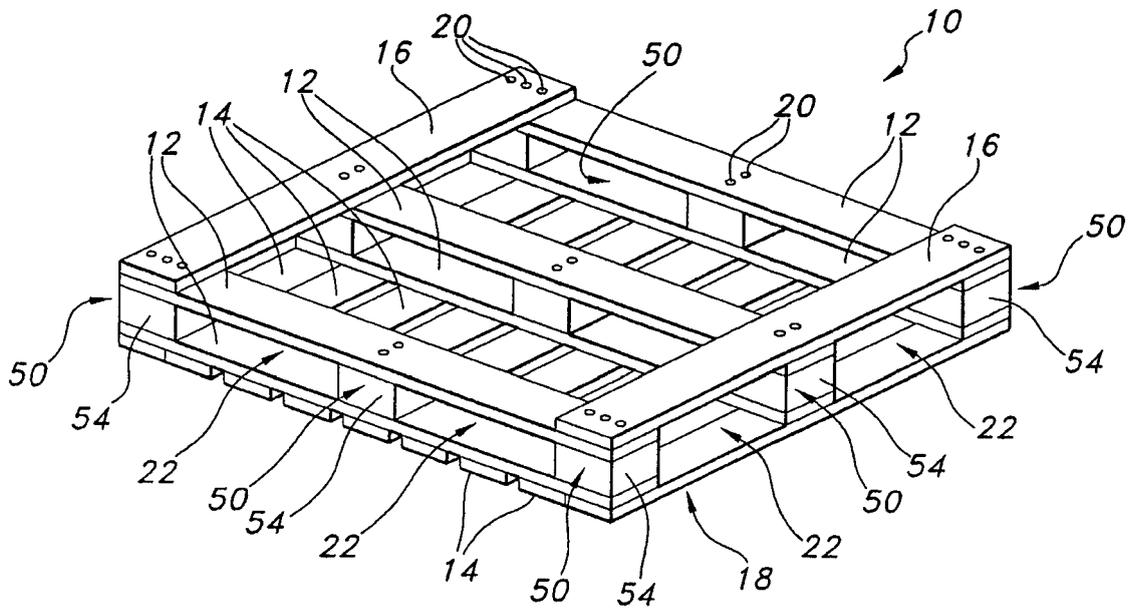


FIG. 1

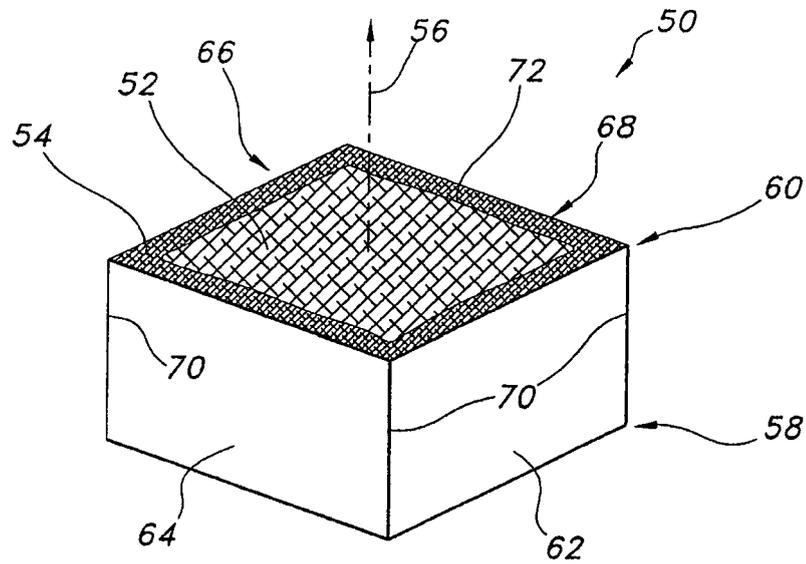


FIG. 2

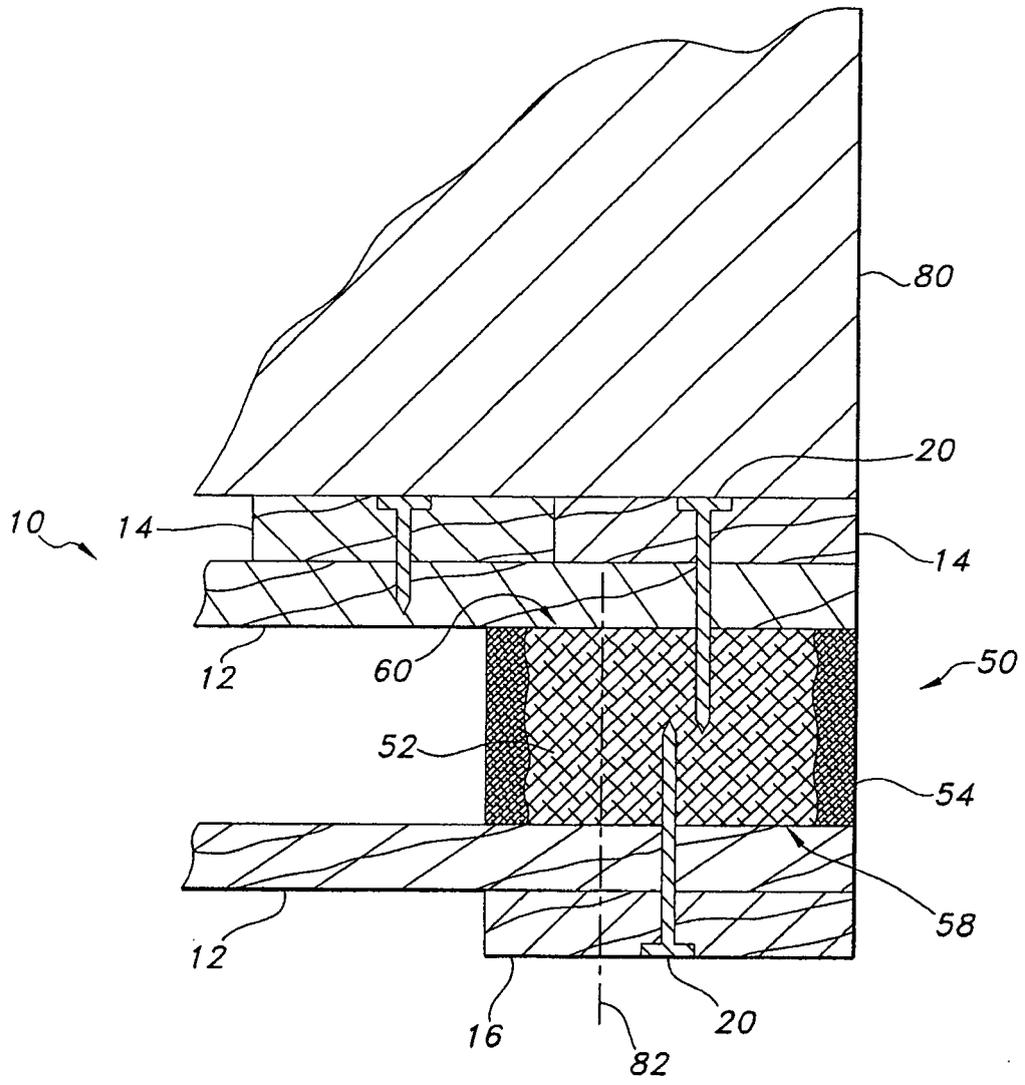


FIG. 3



DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A	* page 3, line 7 - line 30; claims; figures *		B65D
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The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		21 April 2008	Jagusiak, Antony
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ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

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