Abstract: A pallet has an upper deck and a lower deck. The upper deck and the lower deck are connected by a plurality of spaced apart columns. Fork insertion apertures are formed by the upper deck, the columns and the lower deck to all four sides of the pallet. The pallet includes at least one upper deck member and a lower deck member, at least the upper deck member includes a low density core and a surrounding shell of reinforced plastic. The pallet may be made using reaction injection moulding, with said plastic being predominantly polyurethane.
**Pallet having a low density core upper deck.**

**FIELD OF THE INVENTION**

The present invention relates to pallets used for transporting and storing goods.

**SUMMARY OF THE PRIOR ART**

It has become commonplace to use a pallet when moving or storing small goods. In general a pallet consists of a rectangular platform that supports goods above a support surface such as a floor, or in a rack. The pallet includes openings on at least one side for receiving forks of a material handling vehicle such as a forklift or crane attachment. For improved working flexibility modern pallets are designed to have fork access from all four vertical sides.

Typically pallets have been constructed from wooden materials. For example a simple pallet construction that is commonly used includes three spaced apart stringers with a set of cross planks forming an upper deck and a reduced number of cross planks forming a lower deck. The upper and lower cross planks are fastened to the stringers. The fork openings are provided by the space between the stringers. Alternative wooden constructions include a plywood upper deck and a plywood lower deck, with the decks separated by a set of nine blocks. Four of the blocks are located at the corners of the pallet, four of the blocks are located at the centre of each side of the pallet, and one block is located in the centre. This provides a wooden pallet construction allowing access from four sides.

Wooden pallets have been known to be a potential fire hazard, are subject to regular damage during normal handling and use large quantities of timber which is an increasingly scarce resource. Alternative pallets have been proposed formed from plastic materials.

For example US Patent 6,006,677 proposes a four-way plastic pallet in which the upper deck and lower deck are moulded separately from high density polyethylene or polypropylene. The lower deck includes integral posts at the corners, at the centre of each side and at the centre of the rectangle. The top end of each of the posts are welded to the under surface of the upper deck to form a complete pallet.

US 6,138,582 describes a similar pallet construction, except that a main portion of each column is formed with the upper deck and a further portion of each post is formed with the lower deck.

In each case the pallet structure includes a downwardly open cellular arrangement of walls or ribs on both the upper and lower deck and within the posts. This is provided for strength and stiffness without the weight of solid plastic to the same thickness. This
arrangement provides a multitude of pockets or cavities on the pallet surface which may provide a repository for dirt or insects and be difficult to adequately clean. This presents a potential bio-security hazard.

US Patent 5,687,652 describes a monolithic pallet formed from self-skinning plastic foam injected into a mould cavity. Due to the limitations of this process the pallet does not include a complete lower deck, having cross members spanning in only one direction. Furthermore the process results in sharp edges and bluff faces at each fork entry port which increase the risk of damage to the pallet during normal handling.

It is an object of the present invention to provide a pallet which goes some way towards overcoming the above disadvantages or which will at least provide the industry with a useful choice.

SUMMARY OF THE INVENTION

In a first aspect the present invention may consists in a pallet having an upper deck and a lower deck, the upper deck and the lower deck being connected by a plurality of spaced apart columns, with fork insertion apertures formed by the upper deck, the columns and the lower deck to all four sides of the pallet,

wherein said pallet includes at least an upper deck member and a lower deck member each including a low density core and a surrounding shell of reinforced plastic, with the exterior faces of at least said upper deck, being substantially free of deep cavities.

According to a further aspect said lower deck and said columns are also substantially free of deep cavities.

According to a further aspect said lower deck also comprises a low density core and a surrounding shell of reinforced plastic.

According to a further aspect said plastic is a polyurethane.

According to a further aspect upper deck low density core is a single contiguous core.

According to a further aspect said lower deck low density core is a single contiguous core.

Alternatively said lower deck low density core is formed in several nested pieces within the lower deck part. The low density core may extend into said columns of said pallet.

According to a further aspect each said column of said pallet includes a column portion integrally formed with either said upper deck or said lower deck.

According to a further aspect each said column is formed as part of the lower deck part.
According to a further aspect the upper end of each column is fitted to registration points in the upper deck. According to a further aspect said resin is predominantly polyurethane.

According to a further aspect said urethane is reinforced with fibres.

According to a further aspect said fibre reinforcement is glass fibre. Alternatively, different requirements of design could call for aramid, Kevlar or other fibre reinforcements.

According to a further aspect said quantity of fibre reinforcement is at least 40% by weight of the plastic shell.

According to a further aspect said low density core comprises a foam core preform insert.

According to a further aspect said foam core insert is a polyurethane foam.

In a further aspect the invention consists in a pallet having an upper deck and a lower deck, the upper deck and the lower deck being connected by a plurality of spaced apart columns, with fork insertion apertures formed by the upper deck, the columns and the lower deck to all four sides of the pallet,

wherein the upper surface of said upper deck includes a plurality of raised cleats.

According to a further aspect said upper deck includes a plurality of apertures therethrough, associated with said cleats.

According to a further aspect said cleats each include an annular raised ridge surrounding a said aperture, and one or more channels or valleys through said ridge.

According to a further aspect said lower deck includes at least one substantial opening, and According to a further aspect four substantial openings, and said cleats are arranged only above said lower deck opening or openings.

According to a further aspect at least a portion of said cleats placed directly above said openings are placed substantially adjacent the vertical projection of the perimeter of the said openings.

According to a further aspect said upper deck includes on its upper surface additional texture or relief in the portions thereof that are not above said lower deck openings.

In a further aspect the invention consists in a pallet having an upper deck and a lower deck, the upper deck and the lower deck being connected by a plurality of spaced apart columns, with fork insertion apertures formed by the upper deck, the columns and the lower deck to all four sides of the pallet,

wherein the upper surface of said top deck includes an inlay panel, said inlay panel including printed indicia.
According to a further aspect said lower deck comprises a perimeter of four side beams meeting at corners of said lower deck and at least one crossbeam extending between opposed perimeter columns and under said central column.

According to a further aspect said side beams and said crossbeam have an upwardly facing chamfer along each edge.

According to a further aspect all lower columns are permanently bonded to the top deck part.

According to a further aspect all lower columns have a mutual socket engagement with their corresponding top deck positions.

According to a further aspect said pallet is rectangular, approximately 1m x 1.2m in plan. Alternatively said pallet may be square.

According to a further aspect said pallet is between 140mm and 200mm in height.

According to a further aspect the top surface of said upper deck includes texture or relief.

According to a further aspect said texture or relief includes a plurality of tapered channels radiating from the centre of the pallet.

According to a further aspect the composition of said urethane resin shell includes at least one flame retardant.

According to a further aspect the composition of said urethane resin shell includes at least one UV stabiliser.

According to a further aspect said top deck member is formed by Reaction Injection Moulding polyurethane resin to surround a fibre and nested foam prepositioned preform in a closed mould.

Alternatively said top deck member is formed by moulding sheets of reinforcement loaded plastic around a preformed foam core.

According to a further aspect said lower deck member is formed by Reaction Injection Moulding polyurethane resin to surround a fibre and nested foam prepositioned preform in a closed mould.

Alternatively said lower deck member is formed by moulding sheets of reinforcement loaded plastic around a preformed foam core.

In a further aspect the invention consists in a pallet having an upper deck and a lower deck, the upper deck and the lower deck being connected by a plurality of spaced apart columns, with fork insertion apertures formed by the upper deck, the columns and the lower
deck to all four sides of the pallet, the parts of said pallet being formed by reaction injection moulding using a polyurethane resin into a closed mould.

According to a further aspect said parts include an upper part including a top deck, and at least said top deck includes a low density core.

According to a further aspect said polyurethane resin is injected to infiltrate a fibre reinforcement perform in said closed mould.

In a further aspect the invention consists in a pallet having an upper deck and a lower deck, the upper deck and the lower deck being connected by a plurality of spaced apart columns, with fork insertion apertures formed by the upper deck, the columns and the lower deck to all four sides of the pallet, the parts of said pallet being formed from fibre reinforced plastic, wherein said fibre reinforcement has sufficient energy absorbancy to act as a projectile shield against bullets and/or shrapnel.

This invention may also be said broadly to consist in the parts, elements and features referred to or indicated in the specification of the application, individually or collectively, and any or all combinations of any two or more of said parts, elements or features, and where specific integers are mentioned herein which have known equivalents in the art to which this invention relates, such known equivalents are deemed to be incorporated herein as if individually set forth.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view of a pallet according to a first embodiment of the present invention.

Figure 2 is a perspective view from below of the pallet of Figure 1.

Figure 3 is a top view of the pallet of Figure 1.

Figure 4 is a perspective view sectioned along line AA in Figure 3.

Figure 5 is a perspective view sectioned along line BB in Figure 3.

Figure 6 is a perspective view sectioned as in Figure 5 of a pallet according to a variation including advertising inlay.

Figure 7 is a perspective view of a pallet according to a second embodiment of the present invention.

Figure 8 is a perspective view from below of the pallet of Figure 7.

Figure 9 is a top view of the pallet of Figure 7.

Figure 10 is a view of the underside of the upper deck part of the pallet of Figure 7.

Figure 11 is a perspective view sectioned along line CC in Figure 9.
Figure 12 is a perspective view sectioned along line DD in Figure 9.

DETAILED DESCRIPTION

Referring to Figures 1 to 3 and to Figures 7 to 9, the pallet according to the present invention includes an upper deck 10 and a lower deck 12. The upper deck 10 and the lower deck 12 are connected by a number of spaced apart columns 14. The columns 14 preferably include a column at each corner of the pallet, a column at the centre of each side of the pallet, and at least one column at the centre of the pallet.

The upper deck 10, the lower deck 12 and the columns 14 form fork insertion channels that extend through the pallet from each side of the pallet to the opposite side of the pallet. Each fork insertion channel is framed by a combination of the upper deck, lower deck and columns at three spaced locations. For example as shown in figure 2 fork insertion aperture 16 is framed by the upper deck 10, near side centre column 18, lower deck 12 and near side corner column 20 at one location, by the upper deck 10, central column 22, lower deck 12 and left side centre column 24 at a middle position and by upper deck 10, far side centre column 26, lower deck 12 and far side corner column 28 at its far end. A pair of such fork insertion channels extend through the pallet from each side. The channels of each side intersect with the perpendicular extending channels from each adjacent side. This provides a true four-way pallet which may be addressed by a fork lifting apparatus from any of the four sides.

The pallet is constructed from an upper deck portion and a lower deck portion. Each of the spaced apart columns preferably comprises column portions formed integrally with the upper deck portion, the upper deck portion or both.

In the embodiment shown in Figure 4 the upper deck portion is shown as member 41, and the lower deck portion as member 42. Referring to Figure 4, each column of this embodiment includes an upper portion 43 integral with the upper deck member 41 and a lower portion 44 integral with the lower deck member 42. The upper deck member 41 and the lower deck member 42 are joined by connection of the respective column portions. Preferably the respective column portions are bonded together. The connection may include a mechanical interengagement, such as a socket joint including engaged male and female parts, which are preferably bonded in the engaged relationship.

In the embodiment of Figures 7 to 9 the upper deck portion is shown as member 71, and the lower deck portion as member 72. Referring to Figure 11, each column 73 of this embodiment is integral with the lower deck member 72. The upper deck member 71 and the
lower deck member 72 are joined by connection of the top of each column 73 to the lower face of the upper deck. Preferably the under face of the upper deck member 71 includes locating depressions 76. Preferably the respective column ends 74 are bonded into the locating depressions 76. The connection may include a mechanical interengagement, such as a socket joint including engaged male and female parts, which are preferably bonded in the engaged relationship.

In the preferred embodiment the pallet is formed from a urethane resin. Preferably the predominant urethane in the construction is a two part polyurethane. The urethane may include additives to achieve desirable properties, such as a flame retardant, a colouriser, or other fillers or property enhancing adducts.

Examples of a preferred plastic resin include: Bayer Baydur SRIM polyurethane resins, or B.A.S.F. SRIM Polyurethane Resins. An example of a preferred flame retardant additive includes Alumina Trihydrate. These materials can allow the pallet to be recycled at the end of its lifespan.

A UV stabiliser additive may be included in the material if required.

A typical overall material composition for the pallet (by weight) would be:

<table>
<thead>
<tr>
<th>Material</th>
<th>% by weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urethane Resin</td>
<td>35</td>
</tr>
<tr>
<td>Surfactants</td>
<td>0.3</td>
</tr>
<tr>
<td>Pigment</td>
<td>1.3</td>
</tr>
<tr>
<td>Filler</td>
<td></td>
</tr>
<tr>
<td>Release agent</td>
<td>1.5</td>
</tr>
<tr>
<td>Glass</td>
<td>40</td>
</tr>
<tr>
<td>Urethane core</td>
<td>20</td>
</tr>
<tr>
<td>Foaming agent</td>
<td>1.0</td>
</tr>
<tr>
<td>Other additives</td>
<td>0.9</td>
</tr>
</tbody>
</table>

The pallet embodiment of Figures 7 to 9 is particularly suited to this SRIM construction.
Alternatively the pallet may be formed from other plastics, for a thermoset plastic such as polyester. The plastic may include additives to achieve desirable properties, such as a flame retardant, a catalyst, and a colouriser.

Examples of a possible plastic resin include: NCS989 Isophthalic polyester resin. An example of a preferred flame retardant additive includes SB-432 Alumina Trihydrate. An example of a preferred catalyst additive includes BPIC 75 Trignox 149. An example of a preferred colouriser additive includes Polychrome Pigment Pastes.

These materials also allow the pallet to be recycled at the end of its lifespan.

Thermoset plastics such as polyester contain a naturally occurring UV stabiliser. Typically no further UV stabiliser additives are necessary. Alternatively a UV stabiliser additive may be included in the material if required.

A typical resin composition may comprise the following ratio of materials for Dough Moulding Compounding (DMC) and Sheet Moulding Compounding (SMC):

<table>
<thead>
<tr>
<th></th>
<th>DMC</th>
<th>SMC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyester Resin</td>
<td>18</td>
<td>17</td>
</tr>
<tr>
<td>Low shrink Additives</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td>Surfactants</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Catalyst</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td>Pigment</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>Filler</td>
<td>57.5</td>
<td>43.4</td>
</tr>
<tr>
<td>Release agent</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Glass</td>
<td>15</td>
<td>25</td>
</tr>
<tr>
<td>Thickening agent</td>
<td>-</td>
<td>0.5</td>
</tr>
</tbody>
</table>

The polyester thermoset process is considered less preferable than the SRIM polyurethane process due to longer cycle times required in manufacturing each pallet.

The plastic is reinforced with a suitable fibre to improve tensile strength, and ultimately to improve the strength and stiffness of each component of the pallet. The reinforcement is preferably a substantial proportion by weight of fibrestrands, such as glass fibre, aramid fibre or other reinforcing fibre. Alternatively, but less preferably, the reinforcement may consist of a framework of steel rods inserted in the upper deck, lower deck or both.
Each of the major components, the upper deck member 41 (or 71) and the lower deck member 42 (or 72), includes a low density core 51 (81) as shown in Figure 5 (or Figure 8 respectively). Preferably the low density core is a single preformed foam insert. Alternatively the low density core may comprise a plurality of rigid foam inserts either contacting or non-contacting within the resin matrix.

In the SRIM manufacturing process the foam inserts are held in a closed injection mould, surrounded by a fibre preform. The polyurethane resin is injected into the residual mould cavity to surround the inserts and fully penetrate the fibre perform. The preferred perform would have 50% of the fibre running longitudinally and 40% of the fibre running diagonally in the lengthwise directions of the beam and about 10% transversely to the beam length. These are considered ideal numbers, in practice the fibre arrangements are not accurately achievable to such tolerances.

Preferably the foam insert occupies a substantial proportion of the volume of each of the members 41(51), 42(52), and conforms to the general shape of each member. Preferably the low density core is entirely surrounded by a thickness of reinforced plastic. Preferably the thickness of the plastic does not vary substantially over each component. For example the material thickness may be between 1.5 mm and 5 mm across the full area of each component and vary as is required for the manufacture.

Each foam core insert may be formed by any suitable process. For example a suitable material such as polyurethane may be injected into a closed mould in combination with a suitable foaming agent.

To provide additional tensile strength to the pallet, steel rods may be inserted into the resin matrix alongside the foam inserts. Alternatively the steel rods may be used instead of the foam inserts. The steel rods preferably extend substantially along the length of each side and cross beam. Alternatively the steel rods form a frame and the urethane material is formed around the outside of the frame.

The addition of steel inserts is determined by the particular strength and cost requirements of each pallet. For example, a pallet required to be low cost and require a low load rating may not require any reinforcing. Long-fibre injection moulding (LFI) and other lower strength manufacturing alternatives can be used in lower cost or less strength applications.

A pallet required to bear heavy loads may require the addition of steel rods for extra tensile strength, or other high strength reinforcing rods.

The upper deck member 71 or lower deck member 72 may be manufactured by, for example, reaction forming a fibre surrounded core material preformed and placed in a two-
piece mould. Alternatively each member may be formed by inserting the foam core into a two-piece mould to provide a residual cavity around the two-piece core, with suitable support for the foam or steel core within the mould, and injecting a fibre loaded resin into the residual cavity provided the mechanical properties of the resin meet the performance requirements of the design. Alternatively the upper deck member 41 or lower deck member 42 may be manufactured by, for example, pressure forming a sheet of fibre reinforced plastic material over the outside of the preformed core in a two-piece mould.

The nature and quantity of fibre reinforcement for each of the upper deck and lower deck may be selected according to the load requirement and manufacturing cost. Some manufacturing processes, such as LFI and SRIM covering over the foam or steel core, may allow for variation of the fibre density and composition throughout the area of the product and through the thickness of the resin layers.

Typical fibre loading will be in excess of 40% of the urethane layer by weight. Design simulations and test data have shown that a ratio in this range of fibre loading can provide a pallet capable of withstanding a two-tonne load.

In accordance with generally followed standards for material handling pallets the preferred overall form of the pallet is a square or rectangle. For example the pallet may be a 1165 x 1165 square. Alternatively the pallet may be a rectangle approximately 1200mm x 1000mm in plan.

Preferably the pallet is 150mm deep to meet standards set by Australian pallet protocols. Alternatively the pallet is between 140mm and 200mm deep. The imperial standard prevailing in the USA varies slightly from the metric standard prevailing in Europe and a pallet may be made that is a compromise between the dimensions provided in each standard that may meet the requirements of both standards.

In the preferred forms of the invention, the lower deck 12 includes a number of substantial openings in the regions that do not form part of the frames defining the fork insertion channels. In practice this allows for four large square or rectangular openings 29 in the base of the pallet.

To reduce the potential for any stress raising features in the construction the corners of the openings are preferably formed with a substantial radius.

The large openings in the lower deck of the pallet allow for drainage and airflow, and reduce the weight of a part of the product that does not contribute as much to the strength and utility of the pallet as the upper deck.
The square or rectangular openings 29 are also designed to accommodate a hand pallet trolley jack. The rear wheels on the hand pallet trolley jack locate above the openings in the lower deck. The rear wheels on the pallet jack extend through the openings in the lower deck to hoist the pallet for transportation.

The upper surface 61 and lower surface 62 of the lower deck 12 are substantially smooth, although the lower surface 62 of the lower deck may have shallow ridges formed on it for stability.

In the embodiment of Figures 7 to 9 the upper surface 63 and lower surface 64 of the upper deck 10 are also substantially smooth and do not have any significant cavities. The upper surface of the deck is textured to provide grip on the upper deck for product stacked on the pallet. In one preferred form there are six tapering indentations 90 on the upper surface of the upper deck radiating out from the centre of the top surface 92. These tapered indentations allow moisture and air flow to take place above the pallet surface.

In the embodiment of Figures 1 to 5, the upper surface 63 and lower surface 64 of the upper deck 10 are also substantially smooth and do not have any significant cavities. The surface of the upper deck preferably includes a plurality of cleat formations 45. The cleat formations are distributed over the surface of the upper deck to provide grip on the upper deck for product stacked on the pallet.

The cleats 45 preferably comprise a local pattern of ridges protruding from the surface. The cleats may, for example, rise to a height of 3-8mm from the general surface of the deck.

In the preferred form the upper deck includes a corresponding plurality of apertures 55 passing through the deck, with a cleat associated with each aperture. In the preferred form, each cleat comprises an annular ridge 56 rising from the plane of the upper deck 10, surrounding an aperture. For each cleat a series of valleys or channels run across the cleat to the aperture so that liquids spilled on the top surface of the upper deck may reach the apertures.

Preferably the cleats are aligned with the large openings 29 in the lower deck to provide a stable nesting arrangement between adjacent pallets in a stack.

The cleats are present only on portions of the top surface of the upper deck that are directly above the large openings 29. For example as shown in Figure 4, two groups of cleats are shown. One group of cleats is provided above each large opening in the lower deck. In each group, peripheral cleats in the group are arranged closely adjacent the vertical projection of the perimeter of the large opening of the lower deck 12. When multiple similar pallets are stacked, the upwardly protruding cleats of one pallet protrude into the large openings in the lower deck.
of the immediately adjacent pallet. With the cleats positioned to be closely adjacent the perimeter of the large openings the adjacent pallets are held against relative lateral movement.

In either embodiment, the upper deck 10 may have an additional relief pattern, perhaps including branding or advertising, on its upper surface 63 in the region that is not directly above the large openings of the lower deck 2. This relief pattern may provide useful grip in those regions. The relief pattern preferably extends no more than 2mm, and preferably no more than 0.35mm, from the general plane of said upper surface 63.

Preferably the lower deck comprises a perimeter square or rectangle of four side beams, together with one or more crossbeams passing through the centre of the pallet. Preferably a pair of crossbeams 71 pass through the centre 70 of the pallet meeting and crossing at the centre. Most preferably the crossbeams 71 are positioned and aligned to create (together with the columns 14 and upper deck 10) the aforementioned frames defining the fork receiving channels, and extend from the centre column location of one side to the centre column location of the opposite side. Each side beam and each crossbeam has an upwardly facing chamfer 72 along each edge in the region of the fork receiving channels. These chamfers serve to guide the tips of inserted forks through the channel and reduce the incidence of fork tips butting against, and damaging, bluff surfaces of the pallet.

A hand pallet trolley jack has insufficient ground clearance to avoid butting against the side of each side and crossbeam. The upwardly facing chamfers 72 also act as a ramp to such pallet jacks. When the hand pallet trolley jack engages the pallet it is guided over each side beam and crossbeam by the chamfers.

Similarly, downwardly facing chamfers 73 are preferably provided on the outer edges of the upper and lower deck in the region of the fork receiving apertures, and all comers and edges of the columns in the region of said fork receiving apertures have a substantial radius.

To protect the upper deck from the forks, a shallow rim may be providing around the perimeter of the underside of the upper deck. For example the upper deck of the embodiment of Figures 7 to 12 includes a shallow perimeter rim 102.

As described earlier, the upper deck member 41 and lower deck member 42 are joined by mechanical engagement, or bonding, or both. In the preferred embodiment, to promote a secure engagement between the upper deck member and the lower deck member, the engagement is preferably a combination of a socket connection and bonding. In the embodiment of Figures 1 to 5 one of the column portions includes a socket form and the other of the column portions includes a plug form complementary to the socket form. In the
embodiment of Figures 7 to 12 the end of each column includes a plug form and the underside of the upper deck includes a set of shallow sockets (depressions 16 in Figure 10).

A suitable plug form may comprise, for example, a cylindrical extension from the upper or lower column portion for insertion into a cylindrical cavity in the other column portion. Preferably all contacting surfaces are bonded using a suitable adhesive for bonding the two components. For example for the preferred urethane outer materials a suitable syntactic adhesive may be a methacrylate or epoxy based adhesive. For the alternative polyester materials a suitable adhesive may be Plexus MA300.

The columns may include an enclosed low density core, for example as in the embodiment of Figures 1 to 5. Alternatively the columns may be substantially hollow. For example the columns may open to below the pallet as in the embodiment of Figures 7 to 12, or may be open at the upper end and be closed by the upper deck part.

Accordingly to a further aspect in the invention, and referring to Figure 6 an advertising inlay 80 may be provided in the upper surface of the upper deck. The advertising inlay may for example comprise a preprinted sheet material. The sheet material may be any suitable sheet material that will bond acceptably with the base urethane material of the pallet. In a pallet having cleats or apertures, such as the pallet of Figures 1 to 5, the advertising inlay 80 may be provided in those regions having the cleats 45 and apertures 55 and may include suitable openings 81 in alignment with the cleats and apertures. The inlay may be included as a layer in a sheet forming process or as an insert in an injection moulding process.

The pallet according to the present invention has a form and construction that has the potential to achieve the required performance standards for rigidity, strength and durability while at the same time having full utility from all four directions and presenting smooth surfaces without any significant small cavities.

Pallet identification tags may be integrated into the pallet structure. The identification tags allow the pallet load to be easily and quickly identified. The identification tags may be active or passive Radio-Frequency (RF) identification tags. Alternatively the identification tags may be barcodes. Each identification tag is unique to each individual pallet. The identification tag is read remotely by a barcode scanning device or RFID reading device or similar. The identification tag allows the contents of the pallet to be electronically associated with the barcode or RFID signature. A database is stored on a computer or similar storage device. The database associates the individual pallet identification tag with a list of the items loaded upon the pallet.
Specialty constructions utilising materials, particularly fibre reinforcement material, with enough energy absorption characteristics to provide ballistic protection can also be incorporated into the pallet design to allow the pallet to be used as a shield or barrier to shrapnel and bullets.
Claims:

1. A pallet having an upper deck and a lower deck, the upper deck and the lower deck being connected by a plurality of spaced apart columns, with fork insertion apertures formed by the upper deck, the columns and the lower deck to all four sides of the pallet, wherein said pallet includes at least an upper deck member and a lower deck member, at least the upper deck member including a low density core and a surrounding shell of reinforced plastic, with the exterior faces of said upper deck being substantially free of deep cavities.

2. A pallet as claimed in claim 1 wherein said lower deck also comprises a low density core and a surrounding shell of reinforced plastic.

3. A pallet as claimed in either claim 1 or claim 2 wherein the external surfaces of said lower deck member and columns are substantially free of deep cavities.

4. A pallet as claimed in any one of claims 1 to 3 wherein said upper deck low density core is a single contiguous core.

5. A pallet as claimed in any one of claims 1 to 4 wherein said lower deck low density core is a single contiguous core.

6. A pallet as claimed in any one of claims 1 to 4 said lower deck low density core is formed in several nested pieces within the lower deck part.

7. A pallet as claimed in claim 5 or claim 6 wherein said low density core extends into columns extending from said lower deck part.

8. A pallet as claimed in any one of claims 1 to 7 wherein each said column of said pallet includes a column portion integrally formed with either said upper deck or said lower deck.

9. A pallet as claimed in claim 7 wherein the whole of each said column is formed as part of the lower deck part.
10. A pallet as claimed in claim 9 wherein the upper end of each column is fitted to registration points in the upper deck.

11. A pallet as claimed in any one of claims 1 to 10 wherein said resin is predominantly polyurethane.

12. A pallet as claimed in claim 11 wherein said polyurethane is reinforced with fibres.

13. A pallet as claimed in claim 12 wherein said fibre reinforcement is glass fibre.

14. A pallet as claimed in any one of claims 1 to 13 wherein said fibre reinforcement is selected from the group of aramid, Kevlar or other fibre reinforcements.

15. A pallet as claimed in any one of claims 12 to 14 wherein said quantity of fibre reinforcement is at least 40% by weight of the plastic shell.

16. A pallet as claimed in any one of claims 1 to 15 wherein said low density core comprises a foam core preform insert.

17. A pallet as claimed in claim 16 wherein said foam core insert is a polyurethane foam.

18. A pallet as claimed in any one of claims 1 to 17 wherein said lower deck comprises a perimeter of four side beams meeting at corners of said lower deck and at least one crossbeam extending between opposed perimeter columns and under said central column.

19. A pallet as claimed in claim 18 wherein said side beams and said crossbeam have an upwardly facing chamfer along each edge.

20. A pallet as claimed in any one of claims 1 to 19 wherein the upper end of each said column is permanently bonded to the top deck part.

21. A pallet as claimed in any one of claims 1 to 20 wherein the upper end of each said column has a mutual socket engagement with their corresponding top deck positions.
22. A pallet as claimed in any one of claims 1 to 21 wherein said pallet is rectangular, approximately 1m x 1.2m in plan, or square.

23. A pallet as claimed in any one of claims 1 to 22 wherein said pallet is between 140mm and 200mm in height.

24. A pallet as claimed in any one of claims 1 to 23 wherein the top surface of said upper deck includes texture or relief.

25. A pallet as claimed in claim 24 wherein said texture or relief includes a plurality of tapered channels radiating from the centre of the pallet.

26. A pallet as claimed in any one of claims 1 to 25 wherein the composition of said plastic shell includes at least one flame retardant.

27. A pallet as claimed in any one of claims 1 to 26 wherein the composition of said plastic shell includes at least one UV stabiliser.

28. A pallet as claimed in any one of claims 1 to 27 wherein said top deck member is formed by Reaction Injection Moulding polyurethane resin to surround a fibre and nested foam prepositioned preform in a closed mould.

29. A pallet as claimed in any one of claims 1 to 28 wherein said lower deck member is formed by Reaction Injection Moulding polyurethane resin to surround a fibre and nested foam prepositioned preform in a closed mould.

30. A pallet as claimed in any one of claims 1 to 27 wherein said top deck member is formed by moulding sheets of reinforcement loaded plastic around a preformed foam core.

31. A pallet as claimed in any one of claims 1 to 27 and 30 wherein said lower deck member is formed by moulding sheets of reinforcement loaded plastic around a preformed foam core.
32. A pallet having an upper deck and a lower deck, the upper deck and the lower deck being connected by a plurality of spaced apart columns, with fork insertion apertures formed by the upper deck, the columns and the lower deck to all four sides of the pallet, wherein the upper surface of said upper deck includes a plurality of raised cleats.

33. A pallet as claimed in claim 32 wherein said upper deck includes a plurality of apertures therethrough, associated with said cleats.

34. A pallet as claimed in claim 33 wherein said cleats each include an annular raised ridge surrounding a said aperture, and one or more channels or valleys through said ridge.

35. A pallet as claimed in any one of claims 32 to 34 wherein said lower deck includes at least one substantial opening, and preferably four substantial openings, and said cleats are arranged only above said lower deck opening or openings.

36. A pallet as claimed in claim 35 wherein at least a portion of said cleats placed directly above said openings are placed substantially adjacent the vertical projection of the perimeter of the said openings.

37. A pallet as claimed in any one of claims 32 to 36 wherein said upper deck includes on its upper surface additional texture or relief in the portions thereof that are not above said lower deck openings.

38. A pallet having an upper deck and a lower deck, the upper deck and the lower deck being connected by a plurality of spaced apart columns, with fork insertion apertures formed by the upper deck, the columns and the lower deck to all four sides of the pallet, wherein the upper surface of said top deck includes an inlay panel, said inlay panel including printed indicia.

39. A pallet having an upper deck and a lower deck, the upper deck and the lower deck being connected by a plurality of spaced apart columns, with fork insertion apertures formed by the upper deck, the columns and the lower deck to all four sides of the pallet, the parts of said pallet being formed by reaction injection moulding using a polyurethane resin into a closed mould.
40. A pallet as claimed in claim 39 wherein said parts include an upper part including a top deck, and at least said top deck includes a low density core.

41. A pallet as claimed in either claim 39 or claim 40 wherein said polyurethane resin is injected to infiltrate a fibre reinforcement perform in said closed mould.

42. A pallet having an upper deck and a lower deck, the upper deck and the lower deck being connected by a plurality of spaced apart columns, with fork insertion apertures formed by the upper deck, the columns and the lower deck to all four sides of the pallet, the parts of said pallet being formed from fibre reinforced plastic, wherein said fibre reinforcement has sufficient energy absorbancy to act as a projectile shield against bullets and/or shrapnel.

43. A pallet substantially as herein described with reference to and as illustrated by any one of more figures of the accompanying drawings.
INTERNATIONAL SEARCH REPORT  

International application No

PCT/NZ2007/000086

A.  CLASSIFICATION OF SUBJECT MATTER

Int.  CL

B6SD 19/32 (2006.01)  B29C 70/08 (2006.01)  B6SD 19/38 (2006.01)
B29C 45/00 (2006.01)  B29C 70/70 (2006.01)
B29C 70/00 (2006.01)  B6SD 19/22 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B.  FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database consulted during the international search (name of database and, where practicable, search terms used)

DWPI JPC: B29C/-, B29D/-, B32B/-, B6SD 19/- with keywords: pallet, surface, inlay, plastic, strong, mould, polyurethane and similar terms.

C.  DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
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<td>US 5343814 A (PIGOTT ET AL) 6 September 1994 Abstract; figure 1</td>
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<td>US 6006677 A (APPIS ET AL) 28 December 1999 Abstract; figure 1</td>
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[X]  Further documents are listed in the continuation of Box C  
[X]  See patent family annex

* Special categories of cited documents

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"X" document member of the same patent family

Date of the actual completion of the international search 02 August 2007

Date of mailing of the international search report 9 - AUG 2007

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Form PCT/ISA/210 (second sheet) (April 2007)
This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. [ ] Claims Nos.:
   because they relate to subject matter not required to be searched by this Authority, namely:

2. [ ] Claims Nos.:
   because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. [ ] Claims Nos.:
   because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box No. III  Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
See supplemental sheet.

1. [x] As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. [ ] As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. [x] As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.: 1-31, 38-41, 43.

4. [ ] No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

[ ] The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
[ ] The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
[ ] No protest accompanied the payment of additional search fees.
**INTERNATIONAL SEARCH REPORT**

**International application No.**

PCT/NZ2007/000086

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Note: for Y indications, first four documents can be combined: amongst themselves for claims 1-10, 15, 16, 18-25, 30, 31, 39-41 and 43 as well with common general knowledge; with the fifth document for claims 11-14, 17, 28, 29; with the sixth document for claim 26; with the seventh document for claim 27 and with the last three documents for claim 38.

Form PCT/ISA/210 (continuation of second sheet) (April 2007)
Supplemental Box
(To be used when the space in any of Boxes I to VIII is not sufficient)

Continuation of Box No: III

In assessing whether there is more than one invention claimed, I have given consideration to those features which can be considered to potentially distinguish the claimed combination of features from the prior art. Where different claims have different distinguishing features they define different inventions.

This International Searching Authority has found that there are different inventions as follows:

- Claims 1-31, 43 are directed to a pallet having an upper and a lower deck. It is considered that the upper deck being made of a low density core and a surrounding shell of reinforced plastic, the exterior surfaces of the upper deck being free of deep cavities comprises a first distinguishing feature.

- Claims 32-37 are directed to a pallet having upper and lower decks. It is considered that a plurality of raised cleats on the upper surface of the upper deck comprises a second distinguishing feature.

- Claim 38 is directed to a pallet having upper and lower decks. It is considered that the inlay panel on the upper surface of the upper deck including printed indicia comprises a third distinguishing feature.

- Claims 39-41 are directed to a pallet having upper and lower decks. It is considered that the parts of the pallet being formed by reaction injection moulding using a polyurethane resin into a closed mould comprises a fourth distinguishing feature.

- Claim 42 is directed to a pallet having upper and lower decks. It is considered that the parts of the pallet being formed from fibre reinforced plastic, wherein the fibre reinforcement has sufficient energy absorbancy to act as a projectile shield against bullets and/or shrapnel comprises a fifth distinguishing feature.

PCT Rule 13.2, first sentence, states that unity of invention is only fulfilled when there is a technical relationship among the claimed inventions involving one or more of the same or corresponding special technical features. PCT Rule 13.2, second sentence, defines a special technical feature as a feature which makes a contribution over the prior art.

The only feature common to all of the claims is a pallet having an upper deck and a lower deck with fork insertion apertures formed to all four sides of the pallet. However this concept is not novel in the light of:

US 6138582 and US 6006677

This means that the common feature can not constitute a special technical feature within the meaning of PCT Rule 13.2, second sentence, since it makes no contribution over the prior art.

Because the common feature does not satisfy the requirement for being a special technical feature it follows that it cannot provide the necessary technical relationship between the identified inventions. Therefore the claims do not satisfy the requirement of unity of invention *aposteriori.*
This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX