Title: CARGO PALLET HAVING TWO DECKS JOINED BY PROJECTIONS ON THE SURFACES

Abstract: A cargo pallet comprising a planar top deck and a planar bottom deck, each with an upper surface and an opposing lower surface. The top deck and bottom deck have a plurality of hollow projections integrally formed therewith and extending therefrom. For the top deck, each of said hollow projections has its one end opening to the upper surface and its other end as a closed mating surface and for the bottom deck, each of said hollow projections having its one end opening to the lower surface and its other end as a closed mating surface. The top deck and bottom deck are arranged with the upper surface of the bottom deck being parallel to and facing the lower surface of the top deck such that the positioning of each of the hollow projections of the bottom deck correspond to those of the top deck; and the mating surfaces of the hollow projections of the top deck mate with, and are securable to, the mating surfaces of the hollow projections of the bottom deck.
Cargo pallet having two decks joined by projections on the surfaces.

DESCRIPTION

[0001] The present invention relates to the field of cargo pallets and in particular, to a cargo pallet that is portable and lightweight for the transportation of goods in various carrier vehicles.

[0002] Cargo pallets have been used for transporting goods for over a century. The early pallets were made of wood. One embodiment of the early pallet included a first set of between three to five wooden planks arranged in parallel to each other and being nailed to a second set of between three to five parallel wooden planks. The first set of wooden planks was known as a deck, with the second set of wooden planks being located beneath the first set and orientated transversely (at a right angle) to said first wooden set of planks. The second set of wooden planks provided support to the first set of wooden planks and aided in the even distribution of the load imposed thereon.

[0003] Over time, the cargo pallet evolved and today, a standard pallet, according to the International Standards Organization (ISO), measures 100 by 120 by 12 cm (slightly less than 40 inches by 48 inches by 5 inches). It weighs between about 15 to about 21 kilograms (kg) when unladen. Most pallets can easily carry a load of 1,000 kg (about 2,000 lb.). The gradual advent of containers for the transport of nearly all goods has spurred the use of pallets because the containers always offer the clean and level surfaces needed to make pallet movement economical. The ISO standard pallets also fit neatly into ISO containers, which in turn fit neatly on container ships, trains and trucks. The size of the cargo pallet is also standardized to fit any mobile forklift or other jacking device.

[0004] Today, over half a billion pallets are manufactured each year and about two billion pallets are in use across the United States alone. Over 90% of all pallets are made of wood, consuming close to 12% of all the lumber produced in the United States. Present day pallets essentially retain the shape and form of the early pallets in that it they too have a deck, and beneath the deck, supports are
present. Some pallets may even include a second deck below the supports. Most present day cargo pallets are still made of wood though in some cases, of plastic, metal and even paper.

5 [0005] As mentioned, although cargo pallets have been in use for over a century, only recently, has the environmental impact of pallets been a cause of concern. In particular as a result of the continued use of wooden pallets, two major environmental concerns have been raised. The first environmental concern stems from the fact that wooden pallets are prone to having parasitic infestations. When infested pallets are shipped to foreign countries, these parasites constitute in introduction of a non-indigenous species to the local ecological system (ecosystem), which creates a threatening ecological imbalance therein. A further drawback is that the parasites may have an adverse effect on the cargo being transported by the pallet as such.

15 [0006] In order to prevent the introduction of such parasites to the local ecosystem, global protocols, such as the International Plant Protection Convention (IPPC), have been introduced. The IPPC is a multilateral treaty to harmonize regulations governing those imports that could impact the physical condition of forests and crops. Under the IPPC, the ISPM 15 describes phytosanitary (plant protection) measures to reduce the risk of introducing and/or spreading pests associated with wood packaging material made of coniferous and non-coniferous raw wood, in the course of international trade. Pests of particular concern are the pinewood nematode [found in the United States, Canada, Mexico and Japan (where it is not a threat due to the existence of natural predators)] and the Asian Long-Horned Beetle (which is found in China and several other locations and is a threat to forests of the United States), for example.

[0007] Several countries have begun implementing measures to comply with the IPPC for wood packaging materials and have established two options. The first option requires methyl bromide (MB) fumigation. In this option, the wood packaging material is fumigated with methyl bromide to eliminate any pest infestation that may be present in the raw wooden pallets. The second option
requires the heat treatment (HT) of the wooden pallet. In this second option, the
wood packaging material is heated to a minimum core temperature of 56°C for a
minimum of 30 minutes. ISPM 15 requirements apply to all species of coniferous
(softwood) and non-coniferous (hardwood) packaging materials.

[0008] Unfortunately, while the above-mentioned measures have been adopted to
protect the environment, the implementation of either of the options to ensure
ISPM 15 compliance has led to a reduction in business efficacy. In this regard,
additional costs have to be incurred by businesses to ensure that the pallets that
transport their goods comply with the provisions of the IPPC. In addition, at any
point of inspection, should a pallet bearing goods be found to be ISPM 15 non-
compliant, it will be destroyed and the goods thereon have to be re-palletized on
approved pallets (ISPM 15 compliant pallets) at cost to the shipper.

[0009] Apart from the above-mentioned environmental impact from using wooden
pallets, the second environmental concern is the amount of wood, which is derived
from forests, required to sustain the production of such pallets. According to the
Rainforest Action Network, an environmental group, nearly one million acres of
forest are chopped down annually to manufacture wooden pallets.

[0010] In order to overcome the difficulties in conforming to the ISMP 15
standards and in response to the environmental impact of raw wooden pallets, as
mentioned earlier, plastic pallets have been introduced. Examples of plastic pallets
are disclosed in Japanese patent application JP 2005-320057, Australian patent
a pallet made entirely of plastic. The pallet comprises a flat rectangular deck. In
each corner of the flat rectangular deck, a through-hole is formed. Each through-
hole has a corresponding leg that extends into the through-hole and is attached
directly therein (i.e. directly to the pallet at the circumference of the through-hole).
The height of the leg is the minimum required to lift the flat plate of the ground
sufficiently so that a forklift may be utilized to transport the pallet.
[0011] AU 730573 describes a plastic pallet having a planar platform (deck) supported by a plurality of legs. The platform is formed from a plurality of plastic sheets while the each of the plurality of legs is formed from the combination of two halves. The legs are first assembled and then, later affixed to the planar platform in a circumferentially spaced relation around the periphery of the platform. The plastic pallet may further include a second platform acting as a base for the pallet.

[0012] PCT application WO 2006/032816 A1 discloses a pallet made of plastic material. The pallet includes a substantially rectangular tray (deck), which is supported by legs. The legs extend along and beyond the length of tray and are reinforced.

[0013] Although the pallets described in the aforesaid patent and patent applications overcome the difficulties in ensuring ISPM 15 compliance, other problems such as manufacturing costs and portability are associated with plastic pallets in addition to the problem of the plastic pallets being non-biodegradable. Incidentally, the weight of a pallet has always been a problem even with the existing wooden pallets. The average air freight cost for a pallet is about USD$20 per kilogram (DHL standard air freight rates). Accordingly, the cost of transporting a standard pallet (which as mentioned earlier weighs between about 15 – 21 kg) alone is approximately between USD$320 – $420. Hence, the costs of shipping the standard pallet on its own can have an impact on the total transportation costs.

[0014] In order to overcome the difficulties associated with plastic pallets, U.S. patent application US 2005/0229819 A1 discloses a hybrid pallet having a deck which is supported by a plurality of support structures. Each deck support structure has a plurality of prongs protruding therefrom to penetrate and engage the underside of the deck, thereby causing the support structures to be attached to the deck. The deck is fabricated from waterproofed linerboard facings while the support structures are formed from plastic materials via extrusion processes.

[0015] However, there still exists a need for a cargo pallet that is environmentally friendly, ISPM 15 compliant, of low weight and is yet economical to manufacture.
In addition, there is also a need for such a pallet to be portable. In this regard, a cargo pallet according to the present invention, as defined in the appended claims and as described below, overcomes the aforesaid difficulties.

5 [0016] In a first aspect of the cargo pallet according to the present invention, said cargo pallet includes a planar top deck with an upper surface and an opposing lower surface. The planar top deck has a plurality of hollow projections integrally formed therewith and extending therefrom. Each of said hollow projections has its one end opening to the upper surface and its other end as a closed mating surface. The cargo pallet also includes a planar bottom deck with an upper surface and an opposing lower surface. The upper surface of the bottom deck has a plurality of hollow projections integrally formed therewith and extending therefrom. Each of said hollow projections has its one end opening to the lower surface and its other end as a closed mating surface.

10 [0017] The top deck and bottom deck are arranged with respect to each other such that the upper surface of the bottom deck is parallel to and faces the lower surface of the top deck. In addition, the positioning of each of the hollow projections of the bottom deck corresponds to those of the top deck; and the mating surfaces of the hollow projections of the top deck mate with, and are securable to, the mating surfaces of the hollow projections of the bottom deck.

[0018] The hollow projections extending from the top and bottom decks respectively are cup-like and may be of any suitable shape. Examples of suitable shapes that the hollow projections may adopt include, but are not limited to, cone-shaped, triangular, rectangular or cylindrical shapes.

[0019] In one embodiment of this first aspect of the present invention, at least one mating surface of a hollow projection of the top deck includes a protruding portion that is adapted to fit into a corresponding recess on a corresponding mating surface of a hollow projection of the bottom deck. Alternatively, at least one mating surface of a hollow projection of the bottom deck may include a protruding portion adapted to fit into a corresponding recess on a mating surface of a hollow
projection of the top deck. The protruding portion and its corresponding recess may be of any suitable shape. Examples of such suitable shapes include, but are not limited to, annular, triangular, elliptical or rectangular shapes.

5 [0020] In another embodiment, at least one mating surface or a selection of mating surfaces of hollow projections of the top deck may include a protruding portion adapted to be received into a corresponding recess of at least one or a selection of mating surfaces of hollow projections of the bottom deck. The remaining mating surfaces of hollow projections of the top deck may include a recess adapted to receive a protruding portion of at least one or the remaining mating surfaces of hollow projections of the bottom deck. Accordingly, the mating surfaces of the top deck may have a mix of protruding portions and recesses that correspond to respective recesses and protruding portions on the mating surfaces of the bottom deck.

10 [0021] In all the embodiments described herein, the mating surfaces of the top deck and/or the bottom deck may be planar or of non-planar complementary shape. In one embodiment, the mating surfaces of both the top and bottom decks contact their respective corresponding mating surfaces completely and in entirety when assembled. In another embodiment, the mating surface may contact its corresponding mating surface only partially. For example, in such an embodiment, the protruding portions (which are integrally formed) may have the shape and form as the legs used in Australian Patent AU 730573.

20 [0022] Each of the hollow projections opening to the upper or lower surface of the top and bottom decks respectively is adapted to accommodate therein at least a portion of another hollow projection when the decks are stacked. Accordingly this allows for the stacking of top decks, bottom decks and a mix of top decks on bottom decks as well since the hollow projections of the bottom decks may accommodate the hollow projections of the top deck.

25 [0023] This mode of stacking the decks in a securable way (via said accommodation of hollow projections) is actually known in the pallet industry as
nesting. Having nestable components of a pallet means that, from a logistics point of view, the storage and transportation of the nested components is easier as compared to non-nestable pallet components. These nestable components are typically transported to where they are needed and then assembled for use.

[0024] The positioning of the hollow projections of the bottom and top decks of the present invention may follow that of a circumferentially spaced apart relationship around the periphery of the respective decks where at least one further hollow projection may be centrally located on the respective decks. This distribution is typical of known cargo pallets where the supports are positioned such that they are able to best transfer the load borne by the pallet to the ground. In an exemplary embodiment, the top deck and bottom deck may be substantially rectangular. In this exemplary embodiment, the hollow projections may be distributed such that each corner of the rectangular decks has a hollow projection and each midpoint between the corner hollow projections also has a hollow projection. In addition, a further hollow projection may be centrally located.

[0025] In another embodiment of the first aspect of the invention, the bottom deck of the cargo pallet includes a plurality of cut-ins along at least two of its peripheral edges. These cut-ins are to allow for the adaptation of said pallet for storage and transport in cargo and/or commercial aircraft, for example. In an exemplary embodiment, the bottom deck may include two cut-ins along each of its peripheral edges or along at least two peripheral edges, such that each of the two cut-ins is located on either side of the midpoint of the peripheral edge.

[0026] Generally speaking, the feature of having cut-ins is applicable to any cargo pallet having a top deck with an upper surface and an opposing lower surface, and a bottom deck with an upper surface and an opposing lower surface. In known cargo pallets having a top and bottom deck, the top deck and bottom deck may be co-joined by a plurality of legs therebetween, where said legs may be arranged in a symmetrically spaced relationship with respect to each other. In such cargo pallets cut-ins may be incorporated such that the periphery of the bottom deck has
at least one cut-in resulting in either its longitudinal or lateral dimension being reduced at said cut-in.

[0027] In an exemplary embodiment, a cargo pallet may have a bottom deck that includes at least one pair of cut-ins, wherein each cut-in of the pair is symmetrically arranged on opposite sides to each other and along the periphery of the bottom deck. The resulting effect of having a pair of cut-ins arranged on opposing sides thereof is that overall width or length of the bottom deck (or lower deck) is reduced at the point of the cut-ins. This feature is applicable to all cargo pallets of the present invention, and to pallets found in the prior art, and is further described below and with reference to Figures 6A – 6D.

[0028] In the first aspect of the cargo pallet, the decks and hollow projections are fabricated from any suitable class of material. Suitable classes of materials include, but are not limited to, plastics, metals, wood derivatives or any combination thereof. Examples of suitable plastics include, but are not limited to, polycarbonate, acrylic and polyethylene terephthalate (PET). Examples of suitable metals include, but are not limited to, steel, titanium, aluminum or alloys thereof. Examples of wood derivatives include, but are not limited to, compressed wood chips or paper-based materials.

[0029] In all the embodiments of the invention according to the first aspect, the mating surfaces of the hollow projections may be further securable to each other by thermal bonding, fasteners, adhesives, snap-fit mechanisms or press-fit mechanisms.

[0030] In a specific exemplary embodiment of the cargo pallet according to the first aspect of the invention, the cargo pallet includes a planar top deck and a planar bottom deck, each with an upper surface and an opposing lower surface. The top deck has nine hollow projections integrally formed therewith and extending therefrom. Each of said hollow projections has its one end opening to the upper surface and its other end as a closed mating surface. The bottom deck has nine hollow projections integrally formed therewith and extending therefrom.
Each of said hollow projections having its one end opening to the lower surface and its other end as a closed mating surface. The top deck and bottom deck are arranged with the upper surface of the bottom deck being parallel to and facing the lower surface of the top deck such that the positioning of each of the hollow projections of the bottom deck correspond to those of the top deck; and the mating surfaces of the hollow projections of the top deck mate with, and are securable to, the mating surfaces of the hollow projections of the bottom deck. The securing of the mating surfaces of the hollow projections of the top deck and bottom deck may be further reinforced by any of the means described above.

[0031] The distribution of the nine hollow projections of either the top deck or bottom deck is such that eight of the nine are in a circumferential relationship around the periphery of the decks. In the case where said decks are rectangular in shape, each corner has a hollow projection while the midpoints of each side of the rectangle include four hollow projections making a total of eight. The ninth hollow projection, in this embodiment, is located at the centre of the rectangular deck.

[0032] In all embodiments of the cargo pallet according to the first aspect of the invention, each of the mating surfaces of each of the hollow projections include a drainage hole offset from the centre of said mating surface. Accordingly, when said top deck and bottom deck are arranged with the upper surface of the bottom deck being parallel to and facing the lower surface of the top deck, and when the mating surfaces of the hollow projections of the top deck and bottom deck mate and are secured, the drainage holes of the hollow projections of the top deck align with the drainage holes of the hollow projections of the bottom deck to form what may be considered to be a through-hole extending from the top deck to the bottom deck.

[0033] The drainage hole allows any water that may accumulate as a result of adverse weather to be drained from the pallet. This significantly reduces the possibility of the accumulation of stagnant water, which may lead to the breeding of parasites such as mosquitoes, for example.
[0034] In all the preceding embodiments and those that follow, in order to comply with ISO standards, and to allow for the pallet in question to be handled by forklifts globally, the top deck and bottom deck are separated by a vertical distance of at least about 10.0cm. This distance is judged to be when said top deck and bottom deck are arranged with the upper surface of the bottom deck being parallel to and facing the lower surface of the top deck, and when the mating surfaces of the hollow projections of the top deck and bottom deck mate and are secured. Accordingly, in this first aspect of the invention, it follows that the combined height of the hollow projections of the top deck and bottom deck are about 10.0cm altogether.

[0035] In one embodiment of the first aspect of the cargo pallet, a mating surface of a hollow projection has an inner surface that includes a recess adapted to accommodate a screw. This is particularly suitable when the mechanism for connecting the top deck and bottom deck is by fasteners such as screws, for example. In this embodiment, the recess found on the internal surface of the mating surface of the hollow projection (which may belong to either the top and/or bottom deck), allows the screw to not only be screwed through this mating surface but also through the corresponding mating surface of the other deck. In addition, the recess may be chamfered to accommodate the screw head as well. By having the recess accommodate the screw head, the internal surface of the mating surface is level even after the top deck is secured to the bottom deck via said screw fasteners.

[0036] Alternatively, a mating surface of a hollow projection of one deck (such as the top deck, for example) may simply have a recess in connection to a through-hole. The recess, may be chamfered such that when a screw is inserted into said recess the threaded portion of the screw passes through the through-hole and the screw head is accommodated in the chamfered recess. In this embodiment, a corresponding mating surface of the other deck (such as the bottom deck, for example) does not have a matching through-hole. Accordingly, when the screw in the through-hole is screwed the threaded portion of the screw penetrates the
mating surface without a through-hole. As such, the top deck is secured to the bottom deck via the screw head and threaded portion of the screw.

[0037] In the fabrication of the cargo pallet according to the first aspect of the invention, separate molds are used to form the top and bottom decks individually prior to said decks being assembled together to form the cargo pallet as described above. Such a mold for fabricating a top deck of a cargo pallet typically includes a die having a cavity. The cavity is complementary in shape to a top deck of a pallet having an upper surface and an opposing lower surface having a plurality of hollow projections integrally formed therewith and extending therefrom. The mold cavity is also shaped such that it forms each of said hollow projections to have its one end opening to the upper surface of the top deck and its other end as a closed mating surface, wherein said mating surface has an extruded annular portion adapted to be received by a corresponding annular recess.

[0038] Correspondingly, the mold for fabricating the bottom deck also includes a die having a cavity. However in this case, the cavity is complementary in shape to a bottom deck of a pallet having an upper surface and an opposing lower surface, said upper surface having a plurality of hollow projections integrally formed therewith and extending therefrom. The mold cavity is also shaped such that it forms each of said hollow projections to have its one end opening to the lower surface of the bottom deck and its other end as a closed mating surface, wherein said mating surface has a recess adapted to receive a corresponding protruding portion.

[0039] In the case of the mold for fabricating the bottom deck, in another embodiment thereof, the cavity of the mold is complementarily shaped so as to form the aforesaid cut-ins in the bottom deck. Typically, the cut-ins are symmetrically formed around the periphery of the bottom deck. In the embodiment where the bottom deck is rectangular, the cut-ins may be formed on one, two, three or four peripheral edges of the deck. In addition, each peripheral edge may also have more than one cut-in. As such, in all embodiments having the feature of a cut-in, the longitudinal or latitudinal dimension of the deck is reduced.
In a second aspect of the cargo pallet according to the present invention, the top deck and bottom deck, as described earlier, are arranged with the upper surface of the bottom deck being parallel to and facing the lower surface of the top deck such that the mating surfaces of the hollow projections of the bottom deck mate with, and are securable to, the lower surface of the top deck. Correspondingly, the mating surfaces of the hollow projections of the top deck mate with, and are securable to, the upper surface of the bottom deck. As such, in this embodiment, there is no alignment or contact between the mating portions of the hollow projections of the top and bottom decks. Rather, the mating surfaces contact either the upper surface of the bottom deck or the lower surface of the upper deck.

A third aspect of the cargo pallet according to the present invention includes a deck with an upper surface and an opposing lower surface, having a plurality of through-holes extending from the upper surface to the lower surface of the deck. The cargo pallet also includes a plurality of support structures, each of which is attached to the deck, via a corresponding through-hole. Each support structure includes a leg having a through-hole and a leg fastener. The leg is arranged with its first end in abutment with the lower surface of the deck and in alignment thereto, such that the central longitudinal axes of rotation of the through-holes of the leg and the deck are collinear. The leg fastener has a head which has a larger diameter than the through-hole of the deck and engages the upper surface and secures the leg to the deck when threaded through the respective aligned through-hole of the deck and its corresponding leg.

Typically, as in the first and second aspects, the deck is, but is not limited to being, rectangular and may be substantially rectangular in shape, especially in an embodiment where the corners are rounded. The dimensions of the deck are in accordance with the ISO and are 100 cm (width) by 120 cm (length). The thickness of the deck may vary according to the load it is subjected to. A thicker deck may have the advantage of being less susceptible to bending moments and
therefore, is also less likely to crack under loading but may cause the pallet, as a whole, to weigh more.

[0043] As mentioned, the deck has a plurality of through-holes extending from the upper surface to the lower surface. In exemplary embodiments of this third aspect, the deck may have anywhere between four to nine through-holes. The through-holes may be distributed along the periphery of the deck and in some embodiments of the third aspect, the through-holes may be located in the centre of the entire deck as well.

[0044] One exemplary embodiment of the third aspect is one where the deck is rectangular and has four through-holes, each through-hole is located at a respective corner of the rectangular deck in a symmetrical manner. In another exemplary embodiment where the rectangular deck has five through-holes, the first four through-holes are located at the corners as in the previous exemplary embodiment while the fifth through-hole is located in the centre of the entire deck.

[0045] A further illustrative embodiment of the third aspect is one where the deck has nine through-holes. Again, five of the nine through-holes are located at the corners and in the centre of the rectangular deck, as in the previous embodiment. The remaining four through-holes are each located, along the peripheral edge, but equidistant from any two corner through-holes. In other words, the remaining four through-holes are located at the respective mid-points between the four through-holes located at the corners of the rectangular deck. Generally, although the distribution of through-holes over the deck may vary, it is typically done evenly (or symmetrically) over the deck in order to allow for an even distribution of the laden weight when in use.

[0046] As mentioned, the pallet also includes a plurality of support structures, each of which is attached to the lower surface of the deck via a corresponding through-hole. Each support structure includes a leg of a given height and a leg fastener. Typically, the height of the leg should be sufficient to raise the deck above ground-level such that a standard forklift is capable of carrying out forklift
operations on the pallet concerned. In an exemplary embodiment, a typical height of the support may be about 12 cm, in accordance with ISO standards.

[0047] In one exemplary embodiment of the third aspect, the leg may simply be a hollow tube with an inner diameter that corresponds to that of the respective through-holes of the deck. In this embodiment, the leg may be considered to be a bush (mechanical).

[0048] In another exemplary embodiment, the leg may include an outer hollow tube; and an inner hollow tube that is concentric to the outer hollow tube. In this embodiment, the inner hollow tube substantially defines the latitudinal cross-sectional area of the through-hole of the leg. The inner hollow tube is held or supported in its concentric position by at least one supporting rib. The at least one supporting rib extends radially from the outer surface of the inner hollow tube to the inner surface of the outer hollow tube.

[0049] In one embodiment of the third aspect, the at least one supporting rib may extend perpendicularly between the inner and outer hollow tubes. In this embodiment, two (180 degrees apart), three (120 degrees apart), four (90 degrees apart), six (60 degrees apart) and eight (45 degrees apart) supporting ribs may be utilized, but is not limited thereto. Alternatively, the at least one supporting rib may extend tangentially from the inner hollow tube to the outer hollow tube.

[0050] Alternatively, each supporting rib may be a simple bar that joins the inner hollow tube to the outer hollow tube. Alternatively, the supporting rib may be an entire planar fin that extends not only between the inner hollow tube and the outer hollow tube but also along the height of the entire leg (outer hollow tube).

[0051] As mentioned earlier, each of the plurality of legs is associated with a corresponding through-hole of the deck. Each leg is arranged with respect its corresponding through-hole such that a first end of the leg abuts the lower surface of the deck leaving the second end of the leg free. The alignment and orientation of the leg with respect to the deck is such that the central longitudinal axes of
rotation (which are taken to pass through the origin of the cross-section of the respective through-holes) of the through-holes of the leg, and that of the corresponding through-hole of the deck, are collinear. In other words, each through-hole of the deck and the through-hole of the leg associated therewith is vertically oriented and aligned such that by virtue of the abutment of the leg to the lower surface of the deck, an at least substantially continuous through-hole is formed by both the through-hole of the deck and that of the leg.

[0052] As also mentioned earlier, each support structure also includes a leg fastener. The leg fastener has a head which is of a larger diameter than the through-hole of the deck. Extending from the head is a elongated tube-like body. When the leg fastener is threaded (with its elongated tube-like body first) through a through-hole of the deck and subsequently through a through-hole of a corresponding leg, the head of the leg fastener, engages the upper surface of the deck and prevents any further movement of the leg fastener into the leg, when the leg fastener is fully inserted. Accordingly, the leg fastener, having its head in connection with the upper surface of the deck and its elongated tube-like body in connection with the leg, secures said leg to the lower surface of the deck.

[0053] The securing of the leg to the deck by the leg fastener, as described above, may be achieved by serrations, snap-fit mechanisms or press-fit mechanisms on the elongated body of the leg fastener. In one exemplary embodiment where the elongated body of the leg fastener has serrations, the serrations may be miniature teeth like structures, or threads similar to those on screws, designed to cut into the boundary of the through-hole of the leg, thereby engaging the leg and securing it against the lower surface of the deck.

[0054] In another exemplary embodiment of the third aspect of the invention where the leg fastener secures the leg to the deck via snap-fit means, the elongate tube-like body of the leg fastener, and the respective through holes of the leg and/or deck, may include complementary undercuts and ribbed features that are adapted to receive and lock the leg fastener to the leg.
[0055] In yet another exemplary embodiment of the third aspect where the leg fastener secures the leg to the deck via press-fit means, the elongate tube-like body of the leg fastener may be of a slightly larger diameter than that of the through hole of the leg. As such, when the leg fastener is pressed (or inserted) into the through-hole of the leg, via the through-hole of the deck, a tight fit is formed between the elongated tube-like body of the leg fastener and the through-hole of the leg, thereby securing the leg to the lower surface of the deck.

[0056] In another embodiment, the cargo pallet according to the third aspect of the present invention further includes a second deck. The second deck is similar to the first deck in that it too has an upper surface and an opposing lower surface as well as a plurality of through-holes extending from the upper surface to the lower surface. In addition, the positioning and arrangement of through-holes of the second deck correspond to those of the first deck. This embodiment also includes a plurality of second leg fasteners as well.

[0057] As described above in the earlier embodiments of the third aspect having only one deck, the second deck is also arranged to abut the leg, except that it abuts the second end of the leg. Again, the orientation of the second deck is similar to that of the first deck (i.e. parallel). Furthermore, the arrangement of the second deck is such that the central longitudinal axes of rotation of the through-hole of the leg and the through-hole of the second deck are collinear thereby forming a substantially continuous through-hole through the leg and second deck.

[0058] In this embodiment having a second deck, each of the second leg fasteners engage the lower surface of the second deck and secure the leg to the upper surface of the second deck when threaded through (or inserted) the aligned through-holes of the of the second deck and the leg, respectively. As such, when the elongated tube-like body of all the leg fasteners is of equal length, then the first leg fastener may simply contact (without being fixed) the second leg fastener at the midpoint of the height of the leg.
[0059] Alternatively, the first and second leg fasteners may not contact each other if the sum of the lengths of their elongated tube-like bodies is less than the height of the leg. In this embodiment, a gap is present between the first and second leg fasteners within the inner hollow tube.

[0060] In yet another alternative embodiment the elongated tube-like body of all the leg fasteners may not be of equal length, i.e. the length of the elongated tube-like body of the first leg fastener is less (or more) than that of the second leg fastener. When the length of the elongated tube-like body of the first leg fastener is less (or more) than that of the second leg fastener, the leg fasteners, when inserted, may have an overlapping relationship, or, as mentioned above, be contacting each other or not contacting each other thereby leaving a gap in between.

[0061] In the embodiment resulting in an overlapping relationship, a press-fit may result between the two leg fasteners thereby also securing the leg and decks therebetween together. In this embodiment, as a result of the overlap, one leg fastener may be adapted to accommodate the overlapping section of the other leg fastener in a snap-fit manner or tight-fit manner with the aid of suitable serrations and/or threading mechanisms.

[0062] As such, in any of the embodiments of the third aspect of the invention where the leg fasteners are of equal or differing lengths, the securing means between the second leg fastener and its corresponding leg may be achieved by adhesive means, serrations, snap-fit mechanisms or press-fit mechanisms on the elongated body of the leg fastener.

[0063] As in the embodiment of the first aspect, a cargo pallet having two decks may also be adapted to be suitable for storage and transport in cargo and/or commercial aircraft, for example. This is achieved by the second deck having a plurality (two or more) of cut-ins along each or at least two of its peripheral edges.
[0064] In a further exemplary embodiment, the bottom (or lower) deck may include at least two pairs of cut-ins with each pair located on opposing peripheral edges of the bottom deck. In this embodiment, each cut-in of the respective pairs is located at either side of the midpoint of the peripheral edge such that either the longitudinal or lateral dimension of the bottom deck is reduced at the cut in. A more detailed description of this particular embodiment is provided in the description of Figures 6A – 6D which follows later.

[0065] The cargo pallet of all the aspects of the present invention may also further include a Radio Frequency Identification (RFID) tag located within the support structure, embedded in the top deck or bottom deck, or within the hollow projections.

[0066] The various components of the cargo pallet, such as the deck (inclusive of the hollow projections as in the first aspect of the present invention) and support structures may be fabricated from any suitable material, for example, a material such as plastic, metal, a wood or plant derivative or any combination thereof. Examples of suitable plastics include, but are not limited to, polycarbonate, acrylic and polyethylene terephthalate (PET). Examples of suitable metals include, but are not limited to, steel, titanium, aluminum and alloys thereof. Examples of suitable wood or plant derivatives include, but are not limited to compressed wood chips, paper-based materials, bamboo plants, maize plants and palm trees.

[0067] In one specific exemplary embodiment of the third aspect, the deck (top and bottom) is molded from compressed wood chips and each of the plurality of support structures is made from plastic, such as any one of the above-mentioned plastics, for example. In this specific embodiment the wood chips are first dried and then placed in a compression mold along with a suitable binder material. This is followed by the application of heat and pressure.

[0068] A typical range of the temperature within the compression mold is between about 150°C to about 250°C, for example. A more specific temperature range that may be used is between about 180°C to about 200°C, for example. A suitable
pressure range that may be applied during compression molding varies between about 6 MPa to about 21 MPa, for example. As for the first and second aspects according to the present invention, the top and bottom decks having the hollow projections may also be formed via compressed wood chips and in a similar manner as described herein.

[0069] The wood chips may be obtained from wood waste such as sander dust, sawdust, chips and logs, for example. The wood chips used may be about 3cm – about 15cm in length, and may have a thickness of between about 0.01cm – about 0.18cm, and a width of about 7cm or less. An example of a suitable binder material may be, but is not limited to, a formaldehyde based material or polyethylene. The binder protects the wood chips that form the deck from breaking and absorbing moisture. As such, the moisture content of decks manufactured from wood chips via compression molding is typically about ten percent or less.

[0070] A more detailed method of preparation of wood chips for compression molding is described, for example, in U.S. patent 4,408,544 and is hereby incorporated by reference with regard to describing a method of compression molding a deck of a pallet. However, the mold used in connection with the method as described in this U.S. patent pertains to the fabrication of an entire pallet via compression molding. As such, a suitable mold to form the requisite cavities, indentations and surfaces of just a deck, when used in conjunction with the method of preparation of wood chips for compression molding as disclosed in the aforesaid U.S. patent is capable of fabricating a deck of the cargo pallet according to the present invention. Another exemplary method of manufacturing a deck from wood chips via compression molding is also disclosed in U.S. patent 4,385,564 and is also hereby incorporated by reference.

[0071] As for the various components of the support structure according to the third aspect of the invention, they may be fabricated by injection molding, for example. In a further embodiment, should more strength be required for the various components of the cargo pallet, a metal skeletal structure for the
components may be fabricated followed by insert molding to provide a coating of a suitable polymer, for example.

[0072] Another means of strengthening the top (upper) and bottom (lower) decks is to include at least one v-shaped notch that runs, in either a continuous or discontinuous manner, across the upper surface or lower surface of the respective decks. In the case of the top deck, it may include at least one v-shaped notch that runs, in either a continuous or discontinuous manner, across the upper surface or lower surface of said top deck in a typically symmetrical pattern. As for the bottom deck, the same applies in that it too includes at least one v-shaped notch that runs, in either a continuous or discontinuous manner, across the upper surface or lower surface in a typically symmetrical manner. It should also be noted that the v-shaped notches may run laterally or transverse or a combination thereof across the top and bottom decks. In further exemplary embodiments, the notches may be u-shaped, rectangular in shape or a combination of any of the above-mentioned shapes of notches.

[0073] It is to be noted that all description pertaining to the first aspect of the invention is interchangeably applicable to the second and third aspects of the invention as well and vice versa. In this regard, the description to the top (upper) or bottom (lower) decks of the first aspect of the cargo pallet may also apply to the top and bottom decks of the second and third aspects of the cargo pallet where possible.

[0074] In order to aid in the further understanding of the present invention, various exemplary embodiments of the cargo pallet are described below with reference to the attached drawings in which:

[0075] Figures 1A – 1D show a top deck of an exemplary embodiment of the first aspect of the invention;

[0076] Figures 2A – 2D show a bottom deck of an exemplary embodiment of the first aspect of the invention;
[0077] Figures 3A – 3D show the assembly of the top deck of Figure 1 and the bottom deck of Figure 2 to form said exemplary embodiment of a first aspect of the invention; Figures 3E and 3F show another embodiment of the top and bottom deck according to the present invention;

[0078] Figures 4A – 4B show the assembly of an exemplary embodiment of a third aspect of a cargo pallet according to the present invention;

[0079] Figures 5A – 5D show the first exemplary embodiment of Figures 4A – 4B of the cargo pallet in an assembled form;

[0080] Figures 6A – 6D show an exemplary second embodiment of a third aspect of the cargo pallet in an assembled form;

[0081] Figures 7A – 7D show an exemplary third embodiment of a third aspect of the cargo pallet in an assembled form;

[0082] Figures 8A – 8D show an exemplary fourth embodiment of a third aspect of the cargo pallet in an assembled form;

[0083] Figures 9A – 9C show an embodiment of a second aspect of the present invention; and

[0084] Figures 10A – 10C show three embodiments of internal surfaces of mating surfaces of a top deck and bottom deck.

[0085] Figures 1A – 1D show various views of a top deck 100 of an exemplary embodiment of the first aspect according to the invention. In Figure 1A, the top deck 100 has an upper surface and an opposing lower surface and includes a plurality of hollow projections 102. Each hollow projection 102 extends from the lower surface and has one end opening to the upper surface of the top deck while its other end is closed to form a closed mating surface. As shown, the top deck in
this illustrative example is rectangular in shape and has eight hollow projections 102 distributed evenly around its periphery and one hollow projection 103 in the centre of said rectangular top deck.

5 [0086] Figure 1B shows a side view of the top deck 100 of the pallet. From this view the hollow projections 102 are shown. Each hollow projection 102 includes an annular projection 104 that extends from the closed mating surface of the hollow projections 102.

10 [0087] Figures 1C and 1D show the bottom view (lower surface) and top view (upper surface) of the top deck 100 respectively. In Figure 1C, the hollow projections 102 are shown to include an opening 106 that is offset from the centre of the hollow projection 102, as shown. The opening 106 permits drainage of any fluid that may accumulate in the hollow projections 102 due to weather variations. The annular projections 104 are also shown. In addition, the top deck also includes 'v-shaped' notches 109 that are continuous and run near the periphery of the top deck. These 'v-shaped' notches serve to reduce bending along the top surface and bottom surfaces of the deck thereby strengthening said deck in load bearing operations. As mentioned earlier, the notches may also be u-shaped or rectangular in shape, for example.

[0088] Figures 2A – 2D show various views of a bottom deck 200 of an exemplary embodiment of the first aspect according to the invention. Figure 2A shows the bottom deck 200 having an upper surface and a lower surface. The bottom deck 200 includes a plurality of hollow projections 202 extending from the upper surface of the bottom deck 200. Each hollow projection 202 of the bottom deck 200 includes an annular recess 204 that is adapted to accommodate therein either in a fixed or removable manner, the annular projection 104 as described above. Figure 2B shows a side view of the bottom deck 200 having hollow projections 202.

[0089] Figure 2C and 2D show the bottom (lower surface) and top (upper surface) views of the bottom deck 200 respectively. As in the top deck 100, the
hollow projections 202 of the bottom deck 200 also include openings 206 for the same purposes as those labeled 106. In the Figure 2D, the annular recesses 204 and the opening 206 is clearly illustrated. Figures 2C and 2D also show that the bottom deck 200 includes cut-ins 208. Cut-ins 208 are useful for adapting the cargo pallet for storage and transportation in commercial aircraft, for example. In Figure 2C, the bottom deck also includes 'v-shaped' notches 209 similar to those described earlier and indicated with the reference sign 109.

[0090] Figures 3A – 3D show the assembly of the top deck 100 of Figure 1 and the bottom deck 200 of Figure 2 to form an exemplary embodiment of the cargo pallet 300 according to a first aspect of the invention. Figure 3B shows how the top deck 100 and the bottom deck 200 are aligned with respect to each other such that the upper surface of the bottom deck 200 is parallel to and faces the lower surface of the top deck 100. In addition, the positioning of each of the hollow projections 202 of the bottom deck 200 corresponds to the hollow projections 102 of the top deck 100; and the mating surfaces of the hollow projections 102 of the top deck mate with, and are securable to, the mating surfaces of the hollow projections 202 of the bottom deck. Figures 3C and 3D show the bottom and top view of the embodiment of Figure 3A.

[0091] Figure 3E is essentially an embodiment of Figure 1C with the exception that the 'v-shaped' notches 109 of Figure 1C is no longer continuous but is discontinuous and distributed across the top deck shown in Figure 3E. The discontinuous 'v-shaped' notches 309 are symmetrically distributed and serve to reduce bending along the top surface and bottom surfaces of the top deck. Figure 3F shows a bottom deck having discontinuous 'v-shaped' notches 309 distributed along the length and width of the bottom deck. The function of the 'v-shaped' notches 309 is similar to those indicated with the reference sign 109.

[0092] Figures 4A – 4B show the assembly of the cargo pallet according to the present invention. In this embodiment, the cargo pallet includes a first deck 10 and a second deck 16, each having an upper surface and a lower surface. The first deck 10 includes a plurality of through-holes 15 that extend from its upper surface
to the lower surface. The second deck 16 also includes a plurality of through-holes 13, which correspond to those of the first deck. As shown in Figure 4A, the four corners of the decks 10 and 16 each have a through-hole. In addition, there are four through-holes 15 and 13 at the midpoints along the peripheral lengths of the respective decks 10 and 16. A final through-hole 15 and 13 is formed at the centre of the entire top and bottom deck decks 10 and 16 bringing the total number of through-holes on each of the decks 10 and 16 to nine.

[0093] Figure 4A also shows a plurality of support structures. Each support structure includes a leg 14, a top deck fastener 12 and a bottom deck fastener 11. When the support structure is assembled together, it joins the first deck 10 to the second deck 16 via the leg 14. A more detailed drawing of the support structure is shown in Figure 4B and is correspondingly described below.

[0094] As mentioned, Figure 4B is an enlargement of the support structure in Figure 4A, and shows a partial sectional view of the leg 14. The leg 14 includes an outer hollow tube 2 having an inner circumferential surface area. Within the outer hollow tube 2, in a concentric arrangement, is an inner hollow tube 4. The inner hollow tube 4 has an external circumferential surface from which eight ribs 6 extends radially outwards to the inner surface of the hollow tube 2. The ribs 6 also extend over the entire height of the leg 14. The inner hollow tube 2 may also be supported by at least just one rib, if necessary.

[0095] In Figure 4B, the hollow tube 2 is circular; however, both the outer hollow tube 2 and the inner hollow tube 4 may be of any other shape. For example, when seen from its diametric cross sectional view, the leg 2 may be rectangular, triangular, pentagonal, hexagonal or any other polygonal shape. The height of the legs is also adapted to provide sufficient distance between the first deck and the second deck such that a typical forklift may insert its lifting mechanism therebetween to transport the pallet.

[0096] Figure 4B also shows the first and second leg fasteners 12 and 11, which each have a head end 1 and an elongate tube-like body 3 extending therefrom.
The leg fasteners 12 and 11 are adapted to be accommodated by the inner hollow tube 4. The head end 1 of each of the leg fasteners 12 and 11 is typically larger in diameter than the diameter of the through-holes 15 and 13. Said head end 1 is adapted to allow for only the elongate tube-like body 3 to enter and to be threaded (or inserted) into the inner hollow tube 4 and through-holes 15 and 13. The head end 1 may be adapted to fit into an indentation or recess (not shown) that may be formed around the through-holes 15 and 13, thereby resulting in a flat surface on the top and bottom decks 10 and 16.

During assembly, the leg abuts the lower surface of the first deck and the upper surface of the second deck. The inner hollow tube 4 of each of the legs 14 is aligned with the through-holes of the first and second decks 10 and 16 such that a substantially continuous through-hole is formed from the first deck 10 through to the second deck 16, with the inner hollow tube 4 of the leg 14 forming the intermediate portion of that continuous through-hole. Following the alignment, the leg fasteners 12 and 11, are threaded through the through-holes 15 and 13, respectively in order to secure the decks 10 and 16 together. In this regard, depending upon the length of the elongate tube-like body 3 of the respective leg fasteners 11 and 12, the leg fasteners may either attach themselves to the inner hollow tube 4, i.e. each leg fastener occupying half of the height of the inner hollow tube. Alternatively, if the elongate tube-like body of the second fastener is sufficiently long enough, the first leg fastener 12 may attach and secure itself to the second leg fastener 11.

The attachment means for the leg fasteners 12 and 11 may be snap-fit means, press-fit means, friction welding or any commonly known adhesion bonding means. With regard to snap-fit or press-fit means, the elongate tube-like body 3 may be adapted accordingly to include the necessary mechanism such as undercuts, grooves, recesses and/or serrations that are designed to cut into the inner circumferential surface area of the inner hollow tube 4.

Figures 5A – 5D show a first exemplary embodiment of the cargo pallet. The Figures 5A – 5D illustrate the isometric, side, top and bottom views of the
pallet respectively. **Figure 5C**, which shows the first deck having nine first deck leg fasteners 12. The top deck 10 shown has essentially five main horizontal sections 20 and three main vertical sections 30, all of which are integrally formed as a single part. In contrast, the second deck 16 of **Figure 5D** includes just three horizontal 40 and vertical 30 sections each, all of which are also formed as a single integral part.

[00100] It should be noted that there is no upper limit on the number of horizontal and vertical sections that the decks 10 and 16 may include, and is subject to practicality given that the decks 10 and 16 are load bearing members. However, a lower limit on the number of sections exists in that each deck 10 and 16 may be formed as a single section, i.e. a solid planar part with no gaps.

[00101] **Figures 6A – 6D** show a second exemplary embodiment of the cargo pallet. The only difference between the embodiment of **Figure 5** and this present embodiment is that the second deck 16 includes a plurality (two or more) of cut-ins 18 along its peripheral edges. The cut-ins may be about 5.0 cm – about 8.0 cm inwards along the plane of the deck 16 and towards the centre thereof. The cut-ins 18 serve to reduce the length and breadth of selected portions of the deck 16 in order to allow for this embodiment of the pallet to be accommodated in transport vehicles such as commercial or cargo aircraft, for example.

[00102] **Figure 6D** shows that bottom view of the deck 16. Each cut-in 18 has a corresponding cut-in 18 diametrically opposite to it. Accordingly, the plurality of cut-ins 18 is symmetrical about the central axes (vertical or horizontal), as seen from this view. Basically, each peripheral edge of the deck 16 has at least two cut-ins 18. In the case of there being just two cut-ins 18, each one is located on either side of the midpoint of the edge of the deck 16. The corners of the cut-ins 18 in the present embodiment are shown to be tapered inwards but they may also be straight, concave or convex in shape.

[00103] **Figures 7A – 7D** show a third exemplary embodiment of the cargo pallet and is essentially the same in all aspects to the embodiment of **Figure 2**, except
that the first deck 10 is patterned differently. Figure 7C shows that the deck 10 has a plurality of circular and major segment features cut out from what would otherwise be a solid deck.

5 Figures 8A – 8D show a fourth exemplary embodiment of the cargo pallet. Essentially, this embodiment is similar to that of Figure 6 except that it now incorporates the first deck as shown in Figure 7.

[00105] Figures 9A – 9C show a side view of a second aspect of the invention. Figure 9A illustrates a top deck 98 having an upper surface and an opposing lower surface. The top deck 98 has integrally formed therewith a plurality (two or more) of hollow projections 92. Each hollow projection 92 extends from the lower surface of the top deck 98 and has one end 95 opening to the upper surface of the top deck 98 while its other end 97 is closed to form a closed mating surface. In this embodiment, the closed mating surface has a protrusion 94 extending therefrom. In the centre of the top deck 98, a recess 96 is formed and is capable of accommodating therein a corresponding protrusion 94.

[00106] Figure 9B illustrates a bottom deck 99 having an upper surface and an opposing lower surface. The bottom deck 99 has integrally formed therewith a plurality (two or more) of hollow projections 92 although only one is shown in the present side view. Each hollow projection 92 extends from the upper surface of the bottom deck 99 and has one end 95 opening to the lower surface of the bottom deck 98 while its other end 97 is closed to form a closed mating surface. In this embodiment, the closed mating surface has a protrusion 94 extending therefrom. At either end of the bottom deck 99, a recess 96 is formed and is capable of accommodating therein a corresponding protrusion 94.

[00107] Figure 9C shows a side view of the top deck 98 assembled with the bottom deck 99 to form a cargo pallet according to an aspect of the present invention. From this view the hollow projections 92 are shown. Each hollow projection 92 has its respective protrusion 94 that extends from the closed mating surface of the hollow projections 92 and engages the corresponding recess 96.
Accordingly, the closed mating surfaces of the hollow projections 92 of the top and bottom decks, in effect, mate with the upper surface of the bottom deck and the lower surface of the top deck respectively.

5 [00108] It is to be noted that the above mentioned features of the first aspect of the invention such as the shape and form of the hollow projections, cut-ins, RFID tags, fabrication materials, securing mechanisms and manufacturing processes are also applicable to the second aspect of the invention.

10 [00109] Figures 10A – 10C show three embodiments of mating surfaces 97 of a top deck 98 and bottom deck 99. The top decks 98 and the bottom decks 99 of each of the respective figures include a hollow projection. The hollow projection of the top deck 98 (and similarly for the bottom deck) has one end 95 that opens to an upper surface (lower surface) of the top deck 98 (bottom deck 99) and its other end that forms a closed mating surface 97.

[00110] In Figure 10A the closed mating surface 97 of the hollow projections of the top and bottom decks have an internal surface that includes a recess 801. The recess 801 is chamfered such that it is able to accommodate the head of a screw. As both the hollow projections of the top and bottom deck have said recess 801, during assembly, the screw may be screwed into either the top deck 98 or the bottom deck.

[00111] In Figure 10B, unlike Figure 10A, the internal surface of the closed mating surface 97 of the hollow projection of the bottom deck 99 does not have a recess 801. As such, in this embodiment, the screw may only be inserted from the top deck 98 during the assembly process.

[00112] In Figure 10C the internal surface of the closed mating surface 97 of the hollow projection of the bottom deck 99 is identical to that in Figure 10B. In this embodiment, the internal surface of the closed mating surface 97 of the hollow projection of the top deck 98 includes a recess 801. The recess 801 has its one
end chamfered while its other end opens to a through-hole 802 that extends right through the closed mating surface 97.

[00113] During assembly, the through-hole 802 permits a screw to be inserted therein with the screw head being accommodated by the chamfered recess. The fastening of the top deck 98 to the bottom deck 99 takes place when the screw is screwed in and penetrates the closed mating surface 97 of the hollow projection of the bottom deck 99 thereby forming the cargo pallet. It is to be noted that although the fastening mechanisms and features are illustrated (in Figures 10A – 10C) and described in relation to the first aspect of the invention, said description is also applicable to the second aspect of the present invention as well.

[00114] The above description of the various exemplary embodiments of the cargo pallet according to the present invention is merely illustrative. As such, the present invention should not be construed as being limited only to those embodiments described herein but rather, as defined by the claims appended hereto.
CLAIMS

What is claimed is:

1. A cargo pallet comprising:
   a planar top deck with an upper surface and an opposing lower surface having a plurality of hollow projections integrally formed therewith and extending therefrom such that each of said hollow projections has its one end opening to the upper surface and its other end as a closed mating surface; and
   a planar bottom deck with an upper surface and an opposing lower surface, said upper surface having a plurality of hollow projections integrally formed therewith and extending therefrom, each of said hollow projections having its one end opening to the lower surface and its other end as a closed mating surface;
   wherein said top deck and bottom deck are arranged with the upper surface of the bottom deck being parallel to and facing the lower surface of the top deck such that the positioning of each of the hollow projections of the bottom deck correspond to those of the top deck; and the mating surfaces of the hollow projections of the top deck mate with, and are securable to, the mating surfaces of the hollow projections of the bottom deck.

2. The cargo pallet according to claim 1, wherein at least one mating surface of a hollow projection of the top deck comprises a protruding portion adapted to fit into a corresponding recess of a mating surface of a hollow projection of the bottom deck.

3. The cargo pallet according to claim 1, wherein at least one mating surface of a hollow projection of the bottom deck comprises a protruding portion adapted to fit into a corresponding recess of a mating surface of a hollow projection of the top deck.

4. The cargo pallet according to claim 1, wherein at least one mating surface of a hollow projection of the top deck comprises a protruding portion adapted
to fit into a corresponding recess of a mating surface of a hollow projection of the bottom deck; and at least one mating surface of a hollow projection of the bottom deck comprises a protruding portion adapted to fit into a corresponding recess of a mating surface of a hollow projection of the top deck.

5. The cargo pallet according to any of the preceding claims, wherein each of the plurality of hollow projections opening to the upper or lower surface of the top and bottom decks respectively is adapted to accommodate therein at least a portion of another hollow projection when the decks are stacked.

6. The cargo pallet according to any of the preceding claims, wherein the positioning of the hollow projections of the bottom and top decks follows that of a circumferentially spaced apart relationship around the periphery of their respective decks with at least one hollow projection centrally located on the respective decks.

7. The cargo pallet according to any of the preceding claims, wherein the top deck and bottom deck are substantially rectangular.

8. The cargo pallet according to claim 7, wherein the bottom deck comprises at least one cut-in along at least two of its peripheral edges.

9. The cargo pallet according to any of claims 7 or 8, wherein the bottom deck comprises two pairs of cut-ins with each pair located on opposing peripheral edges of the bottom deck and with each cut-in of the respective pairs being located at either side of the midpoint of the peripheral edge such that either the longitudinal or lateral dimension of the bottom deck is reduced at the cut in.

10. The cargo pallet according to any of the preceding claims, further comprising a Radio Frequency Identification (RFID) tag located within the hollow projection, top deck or bottom deck.
11. The cargo pallet according to any of the preceding claims wherein the decks and hollow projections are fabricated from a material selected from the group consisting of plastic, metal, wood derivatives or any combination thereof.

12. The cargo pallet according to claim 11, wherein the plastic includes polycarbonate, acrylic and polyethylene terephthalate (PET).

13. The cargo pallet according to claim 11, wherein the metal includes steel, titanium, aluminum or alloys thereof.

14. The cargo pallet according to claim 11, wherein wood derivatives include compressed wood chips or paper-based materials.

15. The cargo pallet according to any of the claims 2 – 14, wherein the mating surfaces of the hollow projections are further securable to each other by thermal bonding, fasteners, adhesives, snap-fit mechanisms or press-fit mechanisms.

16. A cargo pallet comprising:
   a planar top deck with an upper surface and an opposing lower surface having nine hollow projections integrally formed therewith and extending therefrom, such that each of said hollow projections has its one end opening to the upper surface and its other end as a closed mating surface; and
   a planar bottom deck with an upper surface and an opposing lower surface, said upper surface having nine hollow projections integrally formed therewith and extending therefrom, each of said hollow projections having its one end opening to the lower surface and its other end as a closed mating surface;
   wherein said top deck and bottom deck are arranged with the upper surface of the bottom deck being parallel to and facing the lower surface of the top deck such that the positioning of each of the hollow projections of the
bottom deck correspond to those of the top deck; and the mating surfaces of
the hollow projections of the top deck mate with, and are securable to, the
mating surfaces of the hollow projections of the bottom deck.

17. The cargo pallet according to any of the preceding claims, wherein each of
the mating surfaces of each of the hollow projections comprises a drainage
hole offset from the centre of said mating surface and positioned such that
the drainage holes of the hollow projections of the top deck align with the
drainage holes of the hollow projections of the bottom deck when said top
deck and bottom deck are arranged with the upper surface of the bottom
deck being parallel to and facing the lower surface of the top deck, and
when the mating surfaces of the hollow projections of the top deck and
bottom deck mate and are secured.

18. The cargo pallet according to any of the preceding claims, wherein the top
deck and bottom deck are separated by a distance of at least about 10cm
when said top deck and bottom deck are arranged with the upper surface of
the bottom deck being parallel to and facing the lower surface of the top
deck, and when the mating surfaces of the hollow projections of the top
deck and bottom deck mate and are secured.

19. The cargo pallet according to any of the preceding claims, wherein the
mating surfaces of the hollow projections have an inner surface that
includes a recess adapted to accommodate a screw therein.

20. A planar top deck of a cargo pallet comprising:

an upper surface and an opposing lower surface having a plurality
of hollow projections integrally formed therewith and extending therefrom
such that each of said hollow projections has its one end opening to the
upper surface and its other end as a closed mating surface,

wherein at least one mating surface has a protruding portion
adapted to be received by a corresponding recess.
21. A planar bottom deck of a cargo pallet comprising:

an upper surface and an opposing lower surface, said upper
surface having a plurality of hollow projections integrally formed therewith
and extending therefrom, each of said hollow projections having its one end
opening to the lower surface and its other end as a closed mating surface,
wherein at least one mating surface has a recess adapted to
receive a corresponding protruding portion.

22. A planar bottom deck according to claim 21, further comprising at least one
cut-in along its periphery such that either its longitudinal or lateral dimension
is reduced at the cut-in.

23. A mold for fabricating a top deck of a cargo pallet comprising:

a die having a cavity;

wherein said cavity is complementary in shape to a top deck of a
pallet having an upper surface and an opposing lower surface having a
plurality of hollow projections integrally formed therewith and extending
therefrom such that each of said hollow projections has its one end opening
to the upper surface and its other end as a closed mating surface, and
wherein at least one mating surface has a protruding portion
adapted to be received by a corresponding recess.

24. A mold for fabricating a bottom deck of a cargo pallet comprising:

a die having a cavity;

wherein said cavity is complementary in shape to a bottom deck of
a pallet having an upper surface and an opposing lower surface, said upper
surface having a plurality of hollow projections integrally formed therewith
and extending therefrom, each of said hollow projections having its one end
opening to the lower surface and its other end as a closed mating surface,
wherein at least one mating surface has a recess adapted to
receive a corresponding protruding portion.
25. The mold of claim 24, wherein the cavity is complementary in shape to also provide at least one cut-in along the periphery of the bottom deck such that either the longitudinal or lateral dimension of said bottom deck is reduced at the cut-in.

26. A cargo pallet comprising:
   a top deck with an upper surface and an opposing lower surface, and
   a bottom deck with an upper surface and an opposing lower surface,
   wherein said top deck and bottom deck are co-joined by a plurality of legs therebetween, said legs being arranged in a symmetrically spaced relationship with respect to each other, and
   wherein the periphery of the bottom deck comprises at least one cut-in such that either the longitudinal or lateral dimension of the bottom deck is reduced at the cut-in.

27. A cargo pallet according to claim 26, wherein the bottom deck comprises at least one pair of cut-ins, wherein each cut-in is symmetrically arranged on opposing sides of the periphery of the bottom deck.

28. A cargo pallet comprising:
   a deck with an upper surface and an opposing lower surface, having a plurality of through-holes extending from the upper surface to the lower surface of the deck; and
   a plurality of support structures, each of which is attached to the deck, via a corresponding through-hole, each support structure comprising:
   a leg having a through-hole with its first end arranged in abutment with the lower surface of the deck and in alignment thereto, such that the central longitudinal axes of rotation of the through-holes of the leg and the deck are collinear; and
   a leg fastener;
   wherein a head of the leg fastener has a larger diameter than the through-hole of the deck and engages the upper surface and secures
the leg to the deck when threaded through the respective aligned through-hole of the deck and its corresponding leg.

29. The cargo pallet according to claim 28, further comprising:
   a second deck with an upper surface and an opposing lower surface, having a plurality of through-holes extending from the upper surface to the lower surface of the deck wherein said through-holes correspond to those of the first deck; and
   a plurality of second leg fasteners;
   wherein the upper surface of the second deck is arranged in abutment with a second end of each leg such that the central longitudinal axes of rotation of the through-hole of each leg, and the corresponding through-holes of the second deck are collinear; and each of the second leg fasteners engages the lower surface of the second deck and secures the leg to the second deck when threaded through the respective aligned through-holes of the second deck and its corresponding leg.

30. The cargo pallet according to claims 28 or 29, wherein each of the first leg fasteners contacts and secures itself to each of its corresponding second leg fasteners, thereby also securing the leg therebetween to the lower surface of the first deck and upper surface of the second deck, respectively.

31. The cargo pallet according to claim 30, wherein the first and second leg fasteners and/or through-hole of each leg comprise serrations, snap-fit mechanisms or press-fit mechanisms.

32. The cargo pallet according to any of claims 29 – 31, wherein the second deck comprises a plurality of cut-ins along at least two of its peripheral edges.

33. The cargo pallet according to any of claims 29 – 32, wherein the second deck comprises at least two pairs of cut-ins with each pair located on opposing peripheral edges of the bottom deck and with each cut-in of the
respective pairs being located at either side of the midpoint of the peripheral edge such that either the longitudinal or lateral dimension of the bottom deck is reduced at the cut in.

34. The cargo pallet according to any of the claims 28 – 33, wherein the leg comprises a hollow tube having an inner diameter that substantially corresponds to the diameter of the through-holes of the deck.

35. The cargo pallet according to any of claims 28 – 33, wherein the leg comprises:
   an outer hollow tube; and
   an inner hollow tube concentric to the outer hollow tube, such that the inner hollow tube substantially defines the latitudinal cross-sectional area of the through-hole of the leg;
   wherein the inner hollow tube is supported with respect the outer hollow tube by a plurality of supporting ribs arranged therebetween.

36. The cargo pallet according to any of the claims 28 – 35, further comprising a Radio Frequency Identification (RFID) tag located within a support structure.

37. The cargo pallet according to any of the claims 28 – 36, wherein the deck and support structures are fabricated from a material selected from the group consisting of plastics, metals, wood derivatives or any combination thereof.

38. The cargo pallet according to claim 37, wherein plastics include polycarbonate, acrylic and polyethylene terephthalate (PET).

39. The cargo pallet according to claim 37, wherein metals include steel, titanium, aluminum and alloys thereof.

40. The cargo pallet according to claim 37, wherein wood derivatives include compressed wood chips or paper-based materials.
41. The cargo pallet according to any of the claims 28 – 36, wherein the deck is made of compressed wood chips and each of the plurality of support structures is made of plastic.

42. The cargo pallet according to any of the claims 28 – 41, wherein the deck is rectangular.

43. The cargo pallet according to any of the claims 28 – 42, wherein the deck comprises at least four through-holes symmetrically distributed from each other.

44. The cargo pallet according to claim 43, wherein the respective decks further comprise an additional through-hole located at the centre of said decks.

45. The cargo pallet according to any of claims 28 – 44, wherein the deck is rectangular and comprises nine through-holes, wherein one through-hole is located at the centre of the deck, four through-holes are located at each of the corners of the deck and the remaining four through-holes are located at the four mid-points between the four through-holes located at each of the corners of the deck.

46. The cargo pallet according to any of the preceding claims, wherein each of the respective decks further comprise at least one notch that runs, in a continuous manner, across the upper surface or lower surface of the respective decks.

47. The cargo pallet according to any of the preceding claims, wherein each of the respective decks further comprise at least one notch that runs, in a discontinuous manner, across the upper surface or lower surface of the respective decks.
48. The cargo pallet according to claim 46 or 47, wherein the at least one notch is v-shaped, u-shaped or substantially rectangular in shape.

49. The top deck according to any of claims 1 – 20, 23 or any of claims 26 – 48, further comprising at least one notch that runs, in either a continuous or discontinuous manner, across the upper surface or lower surface.

50. The bottom deck according to any of claims 1 – 19, 21 – 22, 24 – 27 or any of claims 29 – 48, further comprising at least one notch that runs, in either a continuous or discontinuous manner, across the upper surface or lower surface.

51. The top or bottom decks according to claim 48 or 49, wherein the at least one notch is v-shaped, u-shaped or substantially rectangular in shape.

52. A cargo pallet comprising:

   a planar top deck with an upper surface and an opposing lower surface having a plurality of hollow projections integrally formed therewith and extending therefrom such that each of said hollow projections has its one end opening to the upper surface and its other end as a closed mating surface; and

   a planar bottom deck with an upper surface and an opposing lower surface, said upper surface having a plurality of hollow projections integrally formed therewith and extending therefrom, each of said hollow projections having its one end opening to the lower surface and its other end as a closed mating surface;

   wherein said top deck and bottom deck are arranged with the upper surface of the bottom deck being parallel to and facing the lower surface of the top deck such that the mating surfaces of the hollow projections of the bottom deck mate with, and are securable to, the lower surface of the top deck; and the mating surfaces of the hollow projections of the top deck mate with, and are securable to, the upper surface of the bottom deck.
**INTERNATIONAL SEARCH REPORT**

### A. CLASSIFICATION OF SUBJECT MATTER

**Int. Cl.**

*B65D 19/32 (2006.01)  B65D 19/31 (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)

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

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

DWPI IPC: B65D 19/- with keywords: pallet, deck, above, project, recess, mate and similar terms.

USPTO & ESPACE: B65D 19/- & keywords: projections, RFID, drain, cut?in.

### C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
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<td>GB 2412108 A (PVAXX RESEARCH &amp; DEVELOPMENT LTD) 21 September 2005</td>
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<td>X</td>
<td>Page 47, lines 18-27; page 53, lines 31, 32; figures 52-55</td>
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<td>2-4, 6, 8-10, 16, 17</td>
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<td>GB 1382737 A (HAIFMER) 5 February 1975</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
  
  "g" document member of the same patent family

Date of the actual completion of the international search: 09 October 2006

Date of mailing of the international search report: 13 OCT 2006

Name and mailing address of the ISA/AU

AUSTRALIAN PATENT OFFICE

PO BOX 200, WODEN ACT 2606, AUSTRALIA

E-mail address: pat@ipaustralia.gov.au

Facsimile No. (02) 6283 3929

Authorized officer

JAGDISH WABLE

Telephone No: (02) 6283 2638

Form PCT/ISA/210 (second sheet) (April 2005)
**INTERNATIONAL SEARCH REPORT**

**Box No. II  Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)**

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<td>1.</td>
<td></td>
<td>because they relate to subject matter not required to be searched by this Authority, namely:</td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td>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:</td>
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<tr>
<td>3.</td>
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<td>because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)</td>
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**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

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<td>As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.</td>
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<td>As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.</td>
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<td>3.</td>
<td>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.:</td>
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<tr>
<td>4.</td>
<td>X 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.: 1-19</td>
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**Remark on Protest**

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Form PCT/ISA/2/10 (continuation of first sheet (2)) (April 2005)
# INTERNATIONAL SEARCH REPORT

## DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>US 3835792 A (WHARTON) 17 September 1974</td>
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<td>JP 9267842 A (MINAMI KK) 14 October 1997</td>
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<td>US 2699912 A (CUSHMAN) 18 January 1955</td>
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<td>US 3404642 A (S. L. BELCHER ET AL.) 27 July 1967</td>
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<td>DE 4114372 A1 (THYSSEN POLYMER GMBH ET AL) 5 November 1992</td>
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**NOTE:**
For Y indications, any one of US 3404642 or EP 680691 can be combined with first 7 documents for claims 8 and 9. DE 4114372 can be combined with first 7 documents for claim 17. Also first seven documents can be combined amongst themselves to disclose the missing features. For example, JP 9267842 discloses a feature of an offset drainage hole that is not disclosed by the remaining six documents.
This International Searching Authority has found that there are different inventions as follows:

1. Claims 1-19 are directed to a cargo pallet. It is considered that the combination of two decks with a plurality of hollow projections integrally formed therewith comprises a first distinguishing feature.

2. Claims 20 and 23 are directed respectively to a planar top deck and mould for fabricating the same. It is considered that the combination of a plurality of hollow projections with at least one mating surface of the projection having a protruding portion comprises a second distinguishing feature.

3. Claims 21, 22 and 24, 25 are directed to a planar bottom deck and mould for fabricating the same. It is considered that the combination of a plurality of projections with at least one mating surface having a recess comprises a third distinguishing feature.

4. Claims 26 and 27 are directed to a cargo pallet. It is considered that the combination of top and bottom decks, a plurality of legs between the top and bottom decks and at least one cut-in on the bottom deck comprises a fourth distinguishing feature.

5. Claims 28-51 are directed to a cargo pallet. It is considered that the combination of a deck with through holes, legs passing through the holes, fasteners for fastening legs to the deck comprises a fifth distinguishing feature.

6. Claim 52 is directed to a cargo pallet. It is considered that combination of bottom and top decks having a plurality of hollow projections that mate with the corresponding bottom and top surfaces of the decks comprises a sixth 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 deck. However this common feature is generic in the art. 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 a posteriori.
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