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12/500,197 9 July 2009 (09.07.2009) US(71) Applicant (for all designated States except US): **SONOCO DEVELOPMENT, INC.** [US/US]; 1 North Second Street, Hartsville, SC 29550 (US).

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(54) Title: WOOD PALLET WITH MULTI-PLY LAMINATED LEAD BOARDS

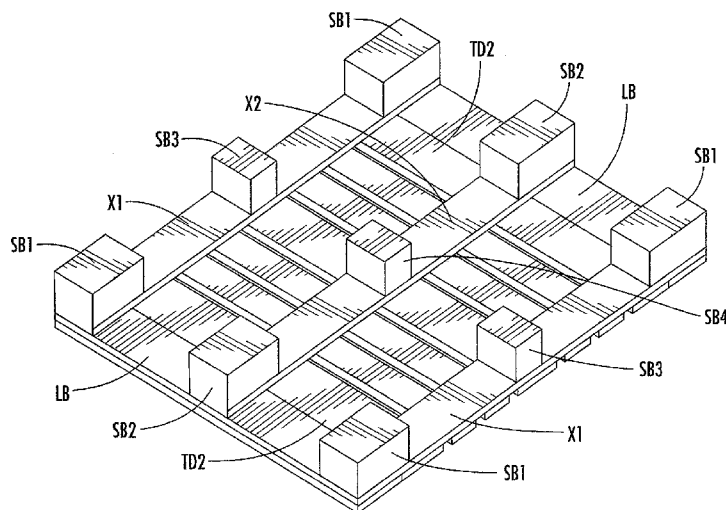


FIG. 2

(57) Abstract: A wood pallet includes a top deck affixed atop a plurality of spaced-apart wood spacer members such that openings for receiving tines of a forklift are defined between the spacer members. The top deck is formed by a plurality of elongate wood boards arranged parallel and side-by-side one another, the boards including two lead boards respectively located at two opposite edges of the top deck, and a plurality of intermediate boards disposed between the two lead boards. The intermediate boards are solid virgin wood boards. Each of the lead boards is a multi-ply laminated wood board made up of a plurality of wood material sheets adhesively laminated one atop another. The laminated wood boards have a capacity to withstand a greater number of edgewise forklift impacts of a given magnitude without failing, in comparison with the solid virgin wood boards.

WOOD PALLET WITH MULTI-PLY LAMINATED LEAD BOARDS

BACKGROUND OF THE INVENTION

The present disclosure relates to pallets. The disclosure relates more particularly to pallets formed entirely or substantially entirely of wood.

Wood pallets are in widespread use for shipping products between manufacturers,
5 distributors, and retailers. It is estimated that at present there are over one billion pallets in circulation worldwide. The vast majority of pallets in circulation are constructed with a top deck formed of solid wood boards (typically softwood such as southern yellow pine) nailed to a plurality of wood spacer members such as stringers or wood blocks. Two-way entry pallets typically employ long stringers as the spacer members, while four-way entry
10 pallets (which are becoming more popular because of the greater ease of use that four-way entry allows) typically employ wood blocks. Of the pallets used in North America, by far the most commonly used is the Grocery Manufacturers' Association (GMA) pallet, which accounts for about 30% of all new wood pallets produced in the United States. The GMA pallet has dimensions of 48 inches by 40 inches. The solid wood deck boards are
15 generally 3.5 inches or 5.5 inches wide by 40 inches long by about 11/16-inch thick.

The two deck boards located at the opposite edges of the pallet (which are referred to herein as the "lead board") are often impacted by the forklift or pallet jack as it moves forward to insert the tines in the spaces defined by the stringers or blocks. Such impacts can quickly damage the lead boards, rendering the pallet unusable until it is
20 repaired by replacing the lead boards. In many cases, pallets with damaged lead boards are simply discarded rather than repaired. Whether the pallets are discarded or repaired, significant costs are incurred because of the damage.

BRIEF SUMMARY OF THE DISCLOSURE

Accordingly, it would be desirable to provide a pallet whose design tends to
25 reduce the extent or likelihood of lead board damage from impacts, so that the lead boards can withstand a greater number of impacts of a given magnitude, compared to

conventional solid wood deck boards. In accordance with one aspect of the present disclosure, a wood pallet is described, comprising a top deck affixed atop a plurality of spaced-apart wood spacer members such that openings for receiving tines of a forklift are defined between the spacer members. The top deck comprises a plurality of elongate
5 wood boards arranged parallel and side-by-side one another, the boards including two lead boards respectively located at two opposite edges of the top deck, and a plurality of intermediate boards disposed between the two lead boards. The intermediate boards comprise solid virgin wood boards. Each of the lead boards comprises a multi-ply laminated wood board made up of a plurality of wood material sheets adhesively
10 laminated one atop another. The laminated wood lead boards have a capacity to withstand a greater number of edgewise forklift impacts of a given magnitude without failing, in comparison with the solid virgin wood boards, when tested according to the dynamic "Incline-Impact Resistance of Leading Edge Deckboard of Pallet" in test standard ASTM D 1185 or its equivalent.

15 In particular, the laminated wood lead boards advantageously can withstand at least three times as many impacts as the solid virgin wood boards, more preferably at least four times as many impacts, and still more preferably at least five times as many impacts.

In one embodiment, each of the wood material sheets making up the lead boards
20 has a predominant grain direction, and each lead board has at least one of the wood material sheets oriented with the predominant grain direction parallel to a first direction and at least one of the wood material sheets oriented with the predominant grain direction parallel to a second direction different from the first direction. For example, the first and second directions can be perpendicular to each other. In a particular embodiment, each
25 lead board is made up of 7 to 15 wood material sheets arranged with the predominant grain directions alternately parallel to the first direction and parallel to the second direction.

In accordance with one embodiment, the lead boards are Russian birch plywood each made up of 11 to 15 plies of birch. A suitable lead board can be, for example, a 13-
30 ply Russian birch plywood having a thickness of 18 mm.

In an alternative embodiment, each lead board can comprise a plurality of bamboo wood material sheets adhesively laminated together. For example, the lead boards can be bamboo plywood wherein each layer is formed by a plurality of parallel strips of

bamboo arranged side-by-side. The face sheets can be formed from very thin strips of bamboo running at 0° and 90° angles and interwoven together.

In other embodiments, each lead board can have at least one relatively soft wood material sheet and at least one relatively hard wood or non-wood material sheet. For example, in some embodiments each lead board has a core of relatively soft wood and at least one relatively hard wood or non-wood material sheet disposed on one or both sides of the core. The core can be, for instance, pine, birch, or the like; the outer hard material sheets can be a hard wood such as bamboo, or hardboard, or a hard non-wood material such as a polymer-based material. It is also possible for each lead board to have hard and soft sheets disposed in an alternating hard/soft fashion (e.g., hard/soft/hard/soft/hard, or hard/soft/soft/soft/hard, or the like).

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

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

FIG. 1 is a schematic top view of a pallet in accordance with one embodiment of the invention;

FIG. 2 is a perspective view of the pallet of FIG. 1, with the pallet inverted to show its underside, and with the bottom boards removed to show the spacer blocks;

FIG. 3 is a bottom plan view of the pallet.

DETAILED DESCRIPTION OF THE DRAWINGS

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

A pallet **20** in accordance with one embodiment of the invention is depicted in FIGS. 1 and 2. The pallet has a top deck formed by a plurality of elongate top deck boards arranged parallel and side-by-side one another, the boards being designated **LB**, **TD2**, **TD3**, and **TD4**. The top deck boards are arranged in order, from one side to an

opposite side of the pallet, as **LB-TD2-TD3-TD3-TD4-TD3-TD3-TD2-LB**. The top deck boards **LB** are designated herein as “lead boards” because they are at the opposite edges of the pallet and thus are the boards that tend to be impacted by a forklift or pallet jack during the process of picking up and moving the pallet and its load. The other top deck boards **TD2-TD4** are called “intermediate boards” because they are disposed between the two lead boards **LB**. The deck boards are nailed or otherwise affixed to a plurality of spaced cross boards **X1, X2** oriented with their lengths perpendicular to the lengths of the deck boards, and to a plurality of spacer blocks **SB1, SB2, SB3, SB4** that space the top deck off the ground. As shown in FIG. 3, typically there are a plurality of elongate bottom deck boards **BD1, BD2, BD3** affixed to the bottom ends of the spacer blocks **SB1-4** to form the bottommost surface of the pallet that rests on the ground.

In accordance with the present invention, the intermediate deck boards **TD2-TD4** are solid virgin wood boards (i.e., single-thickness, non-laminated wood boards), such as southern pine boards or hardwood boards of any of various species, while each of the lead boards **LB** is a multi-ply laminated wood board made up of a plurality of wood material sheets adhesively laminated one atop another. The lead boards **LB** can have any of various constructions. In one embodiment, each lead board is a Russian birch plywood board having from 11 to 15 plies of birch adhesively laminated together to form a board having a thickness of about 15 to 21 mm. In one embodiment, the board has 13 plies and has a thickness of about 17 to 18 mm. Each birch ply has a predominant grain direction, and the plies of the board are arranged such that the predominant grain directions are not all parallel. Advantageously, adjacent plies have their grain directions oriented 90° relative to each other. This “cross-laminated” construction can impart to the lamination substantially the same degree of impact resistance in the two different grain directions, which enables greater flexibility in manufacturing, since it is not as critical how the lead board’s length direction is oriented with respect to the sheet from which the lead board is cut. Additionally, the cross-laminated construction can reduce or eliminate crack initiation at nail holes.

In another embodiment, each lead board is a bamboo plywood board. For example, the bamboo plywood board can have from 7 to 11 plies and a thickness of about 15 to 21 mm. In a particular embodiment, the bamboo plywood has 9 plies and a thickness of about 18 mm.

Other constructions are possible for the lead boards. For example, each lead board can have a core that is relatively soft (e.g., a solid softwood board) and one or more outer wood material layers disposed on one or both sides of the core. The outer

wood material layer(s) can comprise, for example, a bamboo sheet, or a hardboard sheet. Hardboard, also called high-density fiberboard, is an engineered wood product similar to particleboard and medium-density fiberboard, but denser and much stronger and harder because it is made out of exploded wood fibers that have been highly compressed. It
5 generally has a density of 31 lbs. or more per cubic foot, and usually about 50-65 lbs. per cubic foot. It differs from particle board in that the bonding of the wood fibers requires no additional materials, although resin is often added.

While all-wood lead board structures are generally preferred for reasons of cost, renewability, and recyclability, it is also possible for the lead boards to have outer layer(s)
10 of non-wood material, such as polymer-based material, combined with one or more wood material layers.

The hard/soft construction of the lead boards is susceptible of many variations. For example, the lead boards can have any of the following structures, which are given merely by way of example and are not limiting in any way:

- 15
- hard/soft
 - hard/soft/hard
 - hard/soft/soft/hard
 - hard/hard/soft/hard/hard
 - hard/soft/hard/soft/hard

20 The various hard and soft layers can have various thicknesses. As one example, the soft layer(s) can have a collective thickness that is greater than a collective thickness of the hard layer(s). It is thought that by combining hard outer layers with one or more soft core or inner layers, the hard outer layers can help reduce crushing of the board, while the soft layer(s) can absorb and dissipate the impact energy.

25 Testing was performed using a forklift impact simulator to compare the impact resistance of pallets having laminated lead boards with the impact resistance of pallets having solid virgin wood lead boards. The testing was performed in accordance with the dynamic "Incline-Impact Resistance of Leading Edge Deckboard of Pallet" in test standard ASTM D 1185. A 750-pound weight was supported atop the pallet, which was
30 placed on a freely rolling carriage. The carriage was started from a dead stop on a 10°

inclined ramp and was then released and allowed to roll down the ramp, with the lead board of the pallet having its length extending perpendicular to the rolling direction. Forklift forks were fixedly mounted on an essentially immovable mass at the bottom end of the ramp, and were positioned such that the heels of the forks were impacted by the leading edge of the lead board of the pallet. The forks had a tine of 36 inches in length (from the tine tip to the heel of the fork). Both 0° and 4° heel impact tests were conducted (the indicated angle being the angle between the plane of the tine and the plane in which the lead board traveled down the inclined ramp). Additionally, direct tine tip impact tests were conducted in which the lead board impacted the tips of the tines. For the 0° heel impact tests, the leading edge of the lead board was spaced 36 inches from the fork heel when the carriage was released. For the 4° heel impact test, the leading edge of the lead board was spaced 36 inches from the tine tip when the carriage was released. While ASTM D 1185 does not include a tine tip impact test protocol, the tine tip impact testing was performed using the same general test setup as described above. The spacing for the tine tip impact tests was 6 inches from the leading edge of the lead board to the tine tip.

Several pallet lead board configurations were tested. In each pallet configuration, the lead board (**LB** in FIG. 1) was butted against the adjacent board (**TD2** in FIG. 1). Four different specimens of each configuration were tested. Table I below shows the test results:

Table I

		5.5"SYP+5.5"SYP	5.5"RB+3.5"SYP	4.75"RB+3.5"SYP
	% of unit wood area	100%	82%	75%
Tine Heel Impact test	Specimen 1	15	75	75
	Specimen 2	12	75	75
	Specimen 3	8	75	75
	Specimen 4	21	75	75
	Average	14	75	75
4-Degree Heel Impact Test	Specimen 1		75	75
	Specimen 2		75	75
	Specimen 3		75	75
	Specimen 4		75	75
	Average		75	75

SYP = southern yellow pine board of about 0.7 inch (about 17.5 mm) thickness

RB = Russian birch plywood of about 0.7 inch (about 18 mm) thickness, made up of 13 plies of birch

The SYP lead boards failed in the 0° heel impact test after an average of only 14 impacts. The 4° heel impact test was not performed on the SYP lead boards, because since the SYP lead boards failed the 0° heel impact test after relatively few impacts, the SYP lead boards were deemed to be unacceptable such that further testing would have
5 been pointless.

In contrast, the RB lead boards were able to survive 75 impacts in each test without failure. Testing was halted after 75 impacts, rather than continuing on until failure, because 75 impacts was deemed to be an acceptable impact resistance. Furthermore, some RB lead boards were tested sequentially in both the 0° and 4° heel
10 impact tests, and survived a total of 150 impacts (75 in the 0° test and 75 in the 4° test).

In these tests, it was observed that the SYP lead boards tended to fail because of cracking that initiated around the nail holes. The small cracks at the nail holes progressively grew with further impacts until failure occurred. The RB lead boards appeared to have much greater resistance to crack initiation and growth.

The tine tip impact tests indicated that the SYP lead boards tended to splinter at their leading edges. In the case of the RB lead boards, however, the tine tip tended to penetrate into the board by partially separating adjacent plies of the board, but this did not result in the plies breaking. The tine could then be withdrawn from between the plies, and although the board had evident distortion (waviness) of the plies, it remained intact, with
15 no splinters.
20

To compare the Russian birch lead board impact resistance with that of conventional plywood, pallets with 5-ply pine plywood lead boards (3/4-inch thickness, 5.5 inch width) butted against a 5.5 inch wide SYP solid wood board were tested according the 0° heel impact test procedure described above. The 5-ply plywood lead boards failed
25 after only seven (7) impacts.

The 0° heel impact test was also performed on 7-ply bamboo plywood lead boards (18 mm thickness, 5.5 inch width) butted against a 3.5 inch wide SYP solid wood board. The bamboo plywood lead boards survived 75 impacts without failure.

The test results indicate that lead boards of hardwood plywood such as Russian
30 birch and bamboo plywood had a dramatically better resistance to forklift impacts than either solid wood lead boards or conventional plywood lead boards (and that was true even though the Russian birch plywood lead boards in some tests were narrower than the solid wood and conventional plywood lead boards).

The types of board constructions described above for the top deck lead boards can also be applied to the bottom deck boards **BD1**, **BD2** of the pallet (FIG. 3), if desired or needed in a particular application.

As used herein, the term “multi-ply laminated wood board” (or, alternatively, “plywood”) includes conventionally produced plywood wherein logs are debarked and sawn into approximately 8-foot lengths known as “peeler blocks”, the peeler blocks are soaked in hot water for a period of time, and the soaked peeler blocks are then processed on a peeler lathe to cut a continuous thin sheet in a generally spiral fashion from the peeler block until the diameter of the block is reduced to a core of about 3 to 4 inches in diameter. The core is discarded and the continuous sheet is converted into rectangular sheets that are subsequently laminated together to form the plywood or laminated wood structure.

Additionally, however, the term “multi-ply laminated wood board” or “plywood” also includes similar structures produced in other ways. For example, an alternative to conventionally produced plywood is known as “oriented strand board”, which is made by shredding the entire log into strands, rather than peeling a veneer from the log and discarding the core. The strands are mixed with an adhesive and compressed into layers with the grain running in one direction. These compressed layers are then oriented at right angles to each other and are bonded together.

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

WHAT IS CLAIMED IS:

1. A wood pallet, comprising:

a top deck affixed atop a plurality of spaced-apart wood spacer members such that openings for receiving tines of a forklift are defined between the spacer members, wherein the top deck comprises a plurality of elongate wood boards arranged parallel and side-by-side one another, the boards including two lead boards respectively located at two opposite edges of the top deck, and a plurality of intermediate boards disposed between the two lead boards, wherein the intermediate boards comprise solid virgin wood boards, and each of the lead boards comprises a multi-ply laminated wood board made up of a plurality of wood material sheets adhesively laminated one atop another, the laminated wood boards having a capacity to withstand a greater number of edgewise forklift impacts of a given magnitude without failing, in comparison with the solid virgin wood boards.

2. The wood pallet of claim 1, wherein each of the wood material sheets making up the lead boards has a predominant grain direction, and each lead board has at least one of the wood material sheets oriented with the predominant grain direction parallel to a first direction and at least one of the wood material sheets oriented with the predominant grain direction parallel to a second direction different from the first direction.

3. The wood pallet of claim 2, wherein the first and second directions are perpendicular to each other.

4. The wood pallet of claim 3, wherein each lead board is made up of 7 to 15 wood material sheets arranged with the predominant grain directions alternately parallel to the first direction and parallel to the second direction.

5. The wood pallet of claim 1, wherein the wood material sheets are from hardwood species of wood.

6. The wood pallet of claim 5, wherein the lead boards comprise Russian birch plywood made up of plies of birch.

7. The wood pallet of claim 6, wherein each lead board is made up of 11 to 15 plies of birch.

8. The wood pallet of claim 5, wherein each lead board comprises a plurality of bamboo wood material sheets adhesively laminated together.

9. The wood pallet of claim 8, wherein each lead board is made up of 7 to 11 plies of bamboo wood material sheets.

10. The wood pallet of claim 1, wherein each lead board has at least one relatively soft wood material sheet and at least one relatively hard wood material sheet.

5 11. The wood pallet of claim 1, wherein each lead board has a core of relatively soft wood and at least one relatively hard wood material sheet disposed on at least one side of the core.

12. The wood pallet of claim 11, wherein each lead board has at least one relatively hard wood material sheet disposed on each side of the core.

10 13. The wood pallet of claim 1, wherein each lead board has hard and soft wood material sheets disposed in an alternating hard/soft fashion.

14. The wood pallet of claim 1, wherein the laminated wood boards have a capacity to withstand at least three times as many edgewise forklift impacts of a given magnitude without failing, in comparison with the solid virgin wood boards, when tested by an incline
15 impact test according to ASTM D 1185 or equivalent.

15. The wood pallet of claim 1, wherein the laminated wood boards have a capacity to withstand at least four times as many edgewise forklift impacts of a given magnitude without failing, in comparison with the solid virgin wood boards, when tested by an incline impact test according to ASTM D 1185 or equivalent.

20 16. The wood pallet of claim 1, wherein the laminated wood boards have a capacity to withstand at least five times as many edgewise forklift impacts of a given magnitude without failing, in comparison with the solid virgin wood boards, when tested by an incline impact test according to ASTM D 1185 or equivalent.

17. A pallet comprising:

25 a top deck affixed atop a plurality of spaced-apart wood spacer members such that openings for receiving tines of a forklift are defined between the spacer members, wherein the top deck comprises a plurality of elongate boards arranged parallel and side-by-side one another, the boards including two lead boards respectively located at two opposite edges of the top deck, and a plurality of intermediate boards disposed between
30 the two lead boards, wherein the intermediate boards comprise solid virgin wood boards, and each of the lead boards comprises a multi-ply laminated board made up of a core of

solid virgin wood and at least one face sheet disposed on at least one side of the core, wherein the core is relatively soft compared to the at least one face sheet.

18. The pallet of claim 17, wherein the at least one face sheet is a polymer-based material.

5 19. The pallet of claim 17, wherein the at least one face sheet comprises a hardboard sheet.

20. The pallet of claim 17, wherein the at least one face sheet comprises bamboo.

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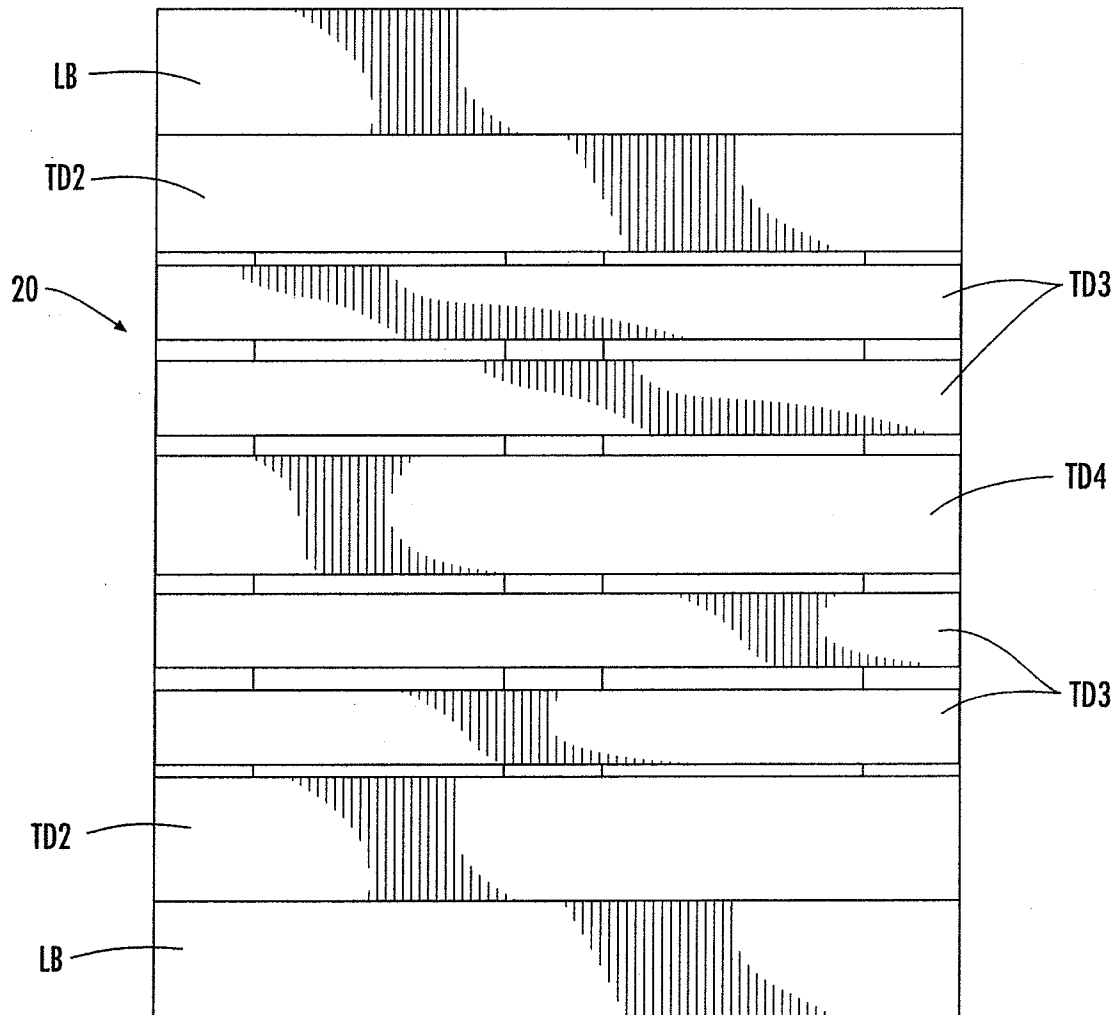


FIG. 1

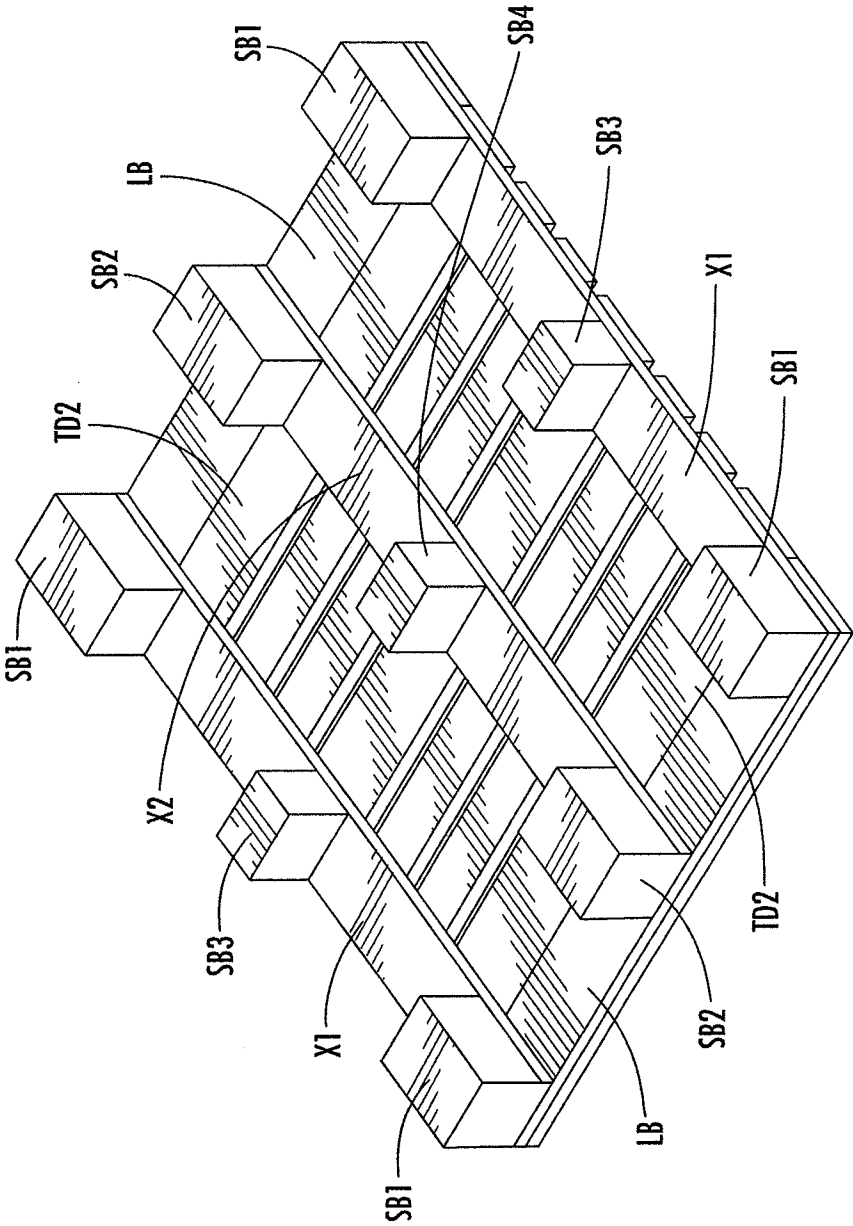


FIG. 2

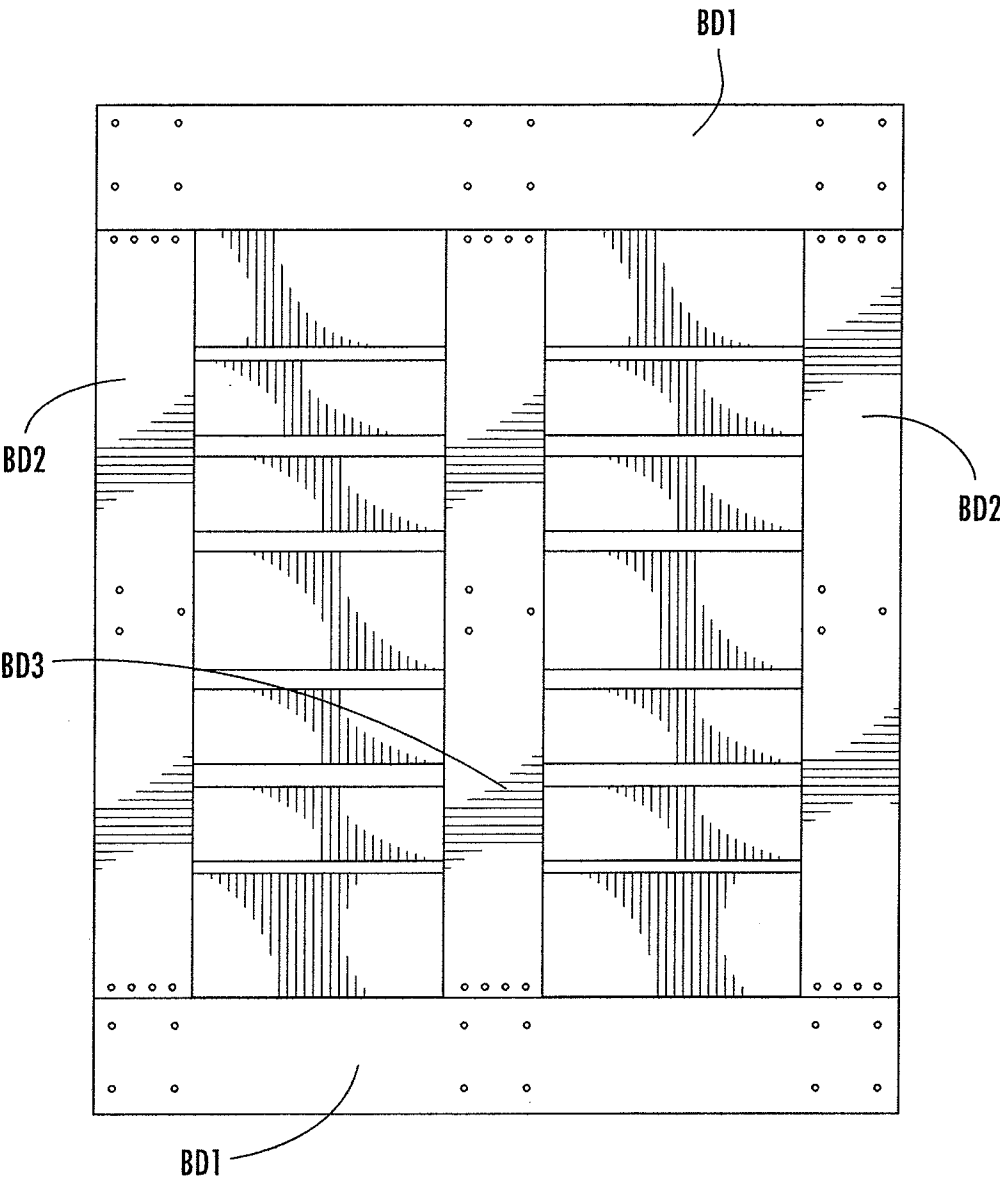


FIG. 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2010/040709

A. CLASSIFICATION OF SUBJECT MATTER
INV. B65D19/00
ADD.

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)
B65D

Documentation 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 practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	page 2, line 19 - page 3, line 19; figures 1-2	1-16
Y	----- WO 90/03922 A1 (CHINCHILLA GONZALEZ VICTOR M [SE]) 19 April 1990 (1990-04-19) page 3; figure 1	1-16
A	----- US 6 003 448 A (SKUSE THOMAS P [US]) 21 December 1999 (1999-12-21) column 2, line 57 - column 3, line 65; figures 1-4	1,2,4
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☒ Further documents are listed in the continuation of Box C.

☒ 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

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"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.

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Date of the actual completion of the international search

31 August 2010

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09/09/2010

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2010/040709

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2010/040709

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