

Packaging of equipment

FIELD OF THE INVENTION

- 5 The invention relates to a packaging structure, a packaging system and a corresponding method to apply such a packaging structure for shock-absorbing packaging of equipment.

BACKGROUND OF THE INVENTION

- A large variety of equipment is shipped over long distances. Fragile goods or sensitive
10 equipments have to be secured against mechanical impacts acting on the equipment during shipment. Therefore the equipment is commonly enclosed with packaging material to absorb an eventual mechanical impact, e.g. with different kinds of foam arranged between container wall and goods. To be able to wrap equipment of different sizes, currently more than 20 different types of shock-absorbing packaging materials are used.
- 15 The large number of different packaging material types increases the logistic costs of shipping companies. Furthermore foam can easily being damaged and subsequently the reliability to absorb shocks might vanished. Additionally this packaging material is commonly a one-way-material. Foam and carton parts eventually glued together prevent recycling of the packaging material. Currently, there is strong demand to save resources
20 and subsequently to provide packaging material usable frequently and enabling recycling.

SUMMARY OF THE INVENTION

- It is an object of the invention to provide a packaging structure for shock-absorbing packaging of equipment, which is usable multiple times and enables recycling and
25 reduction of costs for logistics. It is a further object to provide a method to apply this packaging structure for packaging of the equipment.

- This object is solved by a packaging structure for shock-absorbing packaging of equipment comprising at least a first cell and a second cell, which is gastight separated
30 from the first cell, the cells are inflated with a gas, preferably air, each cell comprising multiple connected tubular cavities arranged essentially parallel to each other in a comb-shaped structure, where the comb-shaped structures of the at least first and second cells are interlocked and each tubular cavity of the first cell is mechanically joined to the neighbored tubular cavity of the second cell establishing a first mat of mechanically joined
35 tubular cavities to enwrap the equipment to be transported

The shape of the packaging structure do not has to be adapted to a certain shape and/or size of the equipment to be transported. The packaging structure can be used for any shape or size of the equipment strongly reducing the manufacturing costs for such packaging material since there is no demand to provide several different types of
5 packaging material. The use of one type of packaging structures for all kinds of equipment strongly reduces the packaging logistic effort since the shipping centers have to have only one type of packaging structures on stock. Situations, where equipment cannot be shipped, because the required packaging material is not present, can be fully avoided. The manufacturing of this packaging structure will be more efficient, because the
10 manufacturing machines for this packaging structure can be standardized and there will be only one type of machines being required resulting in lower manufacturing costs for this packaging structures.

The mat of mechanically joined tubular cavities provides an air balloon structure to
15 prevent the equipment from mechanical impacts during transportation suitable to wrap heavy and large equipment. The at least two separated cells provide a shock-absorbing structure even if one of the cells is damages and/or comprises a leakage, where the inflated gas leaves the cell leading to a deflation of the particular cell. The redundancy of the shock-absorbing structure is further improved by increasing the number of gastight
20 separated cells. In case of three cells, two cells might be damaged without losing the shock-absorbing character of the packaging structure. Packaging structures with four or more separated cells provide packaging structures with an exceeding reliability to protect the wrapped equipment. The gas pressure inside the inflated cells is at least 1 atm, preferably, the pressure is above the pressure of the environment to provide a reliable
25 shock-absorbing character of the packaging structure. More preferably, the gas pressure inside the cells is 2 atm. A standard pressure of 1 atm corresponds to 1,01325 bar. The applied gas to inflate the cells may be any suitable gas, e.g. air, nitrogen etc. Air will be applicable without any effort and is therefore the cheapest applicable gas. However, noninflammable gases such as nitrogen as gases for inflating the cells might be
30 advantageous in case of transporting equipment requiring additional security effort.

In an embodiment each of the cells has at least one closable valve suitable to inflate gas into the cell. This allows to adjust the pressure inside the cells to the demanded pressure value to provide an optimized shock-absorbing property adjusted to the size, weight and
35 shape of the equipment to be transported. In a preferred embodiment the valve is also

suitable to remove gas from the cell enabling multiple inflation and removable of gas. After use (de-loaded equipment) the packaging structure can be reduced in size by removing the gas from the cells. The packaging structure can be folded into a small package and returned to an equipment distribution center to be used to enwrap the next equipment to be shipped. Multiple use of the packaging structure up to 100 times is possible. Suitable valves are for example check valves as used in bicycle tires, preferably a double check valve for easy removal of gas out of the cells of the packaging structure. These valves are suitable for gas pressures up to 6 bar. Alternative so-called Schläverand valves suitable for gas pressure up to 15 bar may also be used. The cells of the packaging structure may be inflated manually with a hand pump or automatically on an inflating station adjusting the gas pressure to a certain desired pressure value. People skilled in the art may choose other suitable valves within the scope of this invention

In an embodiment the cells of the packaging structure are made of a resin material. Resin material can be easily recycled by returning the resin to its raw material state. This recycle process of returning old packaging structures to raw material and manufacturing new packaging structures out of this raw material can be applied up to 40 times, which strongly reduces material waste disposal. The environmental relevant total CO₂ emission for these packaging structures in its entire life cycle is significantly reduced to 3% of the CO₂ emission of corresponding conventional packaging materials (such as foams). This value is based on CO₂ release for manufacturing of the packaging material and its waste disposal. Multiple use and recyclability strongly reduces the environmental relevant total CO₂ emission of the packaging material.

In a preferred embodiment the resin material comprises polyamide, polyethylene and reinforced nylon being resistant against stretching of the material. The number of damages (leakages of one of the cells) of the packaging structure of this material is strongly reduced leading to a strongly increased reliability of this packaging structures compared to conventional packaging structures. With this material even large equipment such as servers of weights of 1 metric ton can be wrapped and shipped in a shock-absorbing packaging. This packaging structure is able to provide a shock-absorbing packaging of equipment of weights up to 5 metric tons. The claimed resin material is even applicable under unstable pressure conditions as present during air transports (in planes), where the environmental pressure may decrease below 1 bar, e.g. down to 0,79 bar.

In another embodiment the packaging structure further comprises at least a second mat of tubular cavities mechanically connected to the first mat, preferably along a connection line, in order to increase the number of gastight separated cells connected to each other to enwrap the equipment to be transported. The setup of the second mat is preferably
5 identical to the first mat, where the second mat comprises a third and a fourth cell, which is gastight separated from the third cell, the cells are inflated with a gas, preferably air, each cell comprising multiple connected tubular cavities arranged essentially parallel to each other in a comb-shaped structure, where the comb-shaped structures of the third and fourth cells are interlocked and each tubular cavity of the third cell is mechanically
10 joined to the neighbored tubular cavity of the fourth cell establishing a second mat of mechanically joined tubular cavities. The mechanical connection is established between the second cell and the third cell at the side of the cells being essentially vertical to the long side of the tubular cavities. The mechanical connection is preferably established via a connection line arranged between the second and third cell, which could be rigid or
15 flexible. The first and second mat may be arranged in one plane or on top of each other or with the flexible mechanical connection along the connection line between first and second mat enabling to arrange the first and second mat in one plane to increase the area of the packaging structure or to arranged both mats on top of each other in order to enhance the shock-absorbing properties of the packaging structure.

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In another embodiment the packaging structure comprises at least one first connection means and at least one second connection means suitable to provide a connection to the second and first connection means of another packaging structure along a first direction in order to provide a tight fit of the packaging structure on the equipment. Two packaging
25 structures can easily be connected to each other to enwrap both sides of an equipment to be shipped, either front side and back side and/or left side and right side of the equipment. The directions back/front and left/right shall be understood in the sense of an upright standing equipment, e.g. a computer server. The first and second connection means may be any suitable means to connect two packaging structures together, e.g. clips, clamps,
30 fasteners or belts and the corresponding counterparts to apply this means such as holes, slits, recesses etc. People skilled in the art may consider other first and second connection means within the scope of this invention. In a preferred embodiment the first connection means and/or the second connection means comprise at least one elastic part. The elastic part allows to apply a certain force to the packaging structures resulting
35 in a tight fit of the packaging structure around the wrapped equipment. Elastic parts may

be any suitable part to apply such a force to the packaging structures, e.g. elastic belts or springs. People skilled in the art may consider other elastic parts within the scope of this invention.

- 5 In another embodiment the packaging structure comprises at least one first attaching means and at least one second attaching means suitable to provide a connection to the second and first attaching means of another packaging structure along a second direction perpendicular to the first direction to increase the area of the joined packaging structures to the size of a larger equipment to be enwrapped. The possibility to attach additional
- 10 packaging structures to a packaging structure enables the adjustment (increase) of the area of the packaging structure to the size of the equipment to be wrapped with the packaging structures, which might vary strongly for different kinds of equipment. The first and second attaching means may be any suitable means to attach the packaging structure to each other. For example suitable first and second attaching means are hook-
- 15 and-loop-fasteners, zipper, slide fastener, hooks clips, clamps, belts or springs and the corresponding counterparts to apply this means such as holes, slits, recesses etc. People skilled in the art may consider other first and second attaching means within the scope of this invention
- 20 The invention further relates to a packaging system comprising at least two packaging structures according to the present invention each comprising first connection means and second connection means to be connected together to form an outer cover for shock-absorbing packaging of equipment to be transported. The packaging system may enwrap both side of an equipment to be shipped, either front side and back side and/or left side
- 25 and right side of the equipment.

The invention further relates to a method for shock-absorbing packaging of equipment with packaging structures according to the present invention comprising the steps of

- inflating the cells via the valve with gas, preferably air,
- 30 - closing the valve after cells are inflated,
- wrapping the packaging structures around the equipment.

The cells can be inflated to a gas pressure adapted to the packaging purpose, e.g. a higher gas pressure for heavier equipment or more shock sensitive equipment. The valve enables the removal of gas out of the cells for sending back the non-wrapped packaging

35 structures. The packaging structure with empty cells occupies is much smaller volume

compared to a packaging structure with inflated cells. Therefore, a larger number of packaging structures with reduced volume can be transported with a certain transport vehicle reducing the transport costs per packaging structure.

- 5 In an advantageous embodiment of the method the step of wrapping comprises the step of connecting the packaging structures together via at least one first connection means of the packaging structure and at least one second connection means of the other packaging structure along a first direction in order to provide a tight fit of the packaging structure on the equipment. In a preferred embodiment the method further comprises the step of
- 10 connecting the packaging structures together via at least one first attaching means of the packaging structure and at least one second attaching means of the other packaging structure along a second direction perpendicular to the first direction to adjust the area of the joined packaging structures to the size of a larger equipment to be enwrapped.

15 BRIEF DESCRIPTION OF THE DRAWINGS

These and other aspects of the invention will be apparent from and elucidated with reference to the embodiments described hereinafter.

20 In the drawings:

- Fig.1: an embodiment of the packaging structure according to the present invention comprising a first mat in a top view.
- Fig.2: another embodiment of the packaging structure according to the present invention comprising a first and a second mat in a top view.
- 25 Fig.3: two packaging structures according to the present invention attached to each other in a top view.
- Fig.4: an embodiment of the packaging system according to the present invention wrapped around an equipment to be shipped.
- Fig.5: another embodiment of the packaging system according to the present invention wrapped around a large equipment to be shipped.
- 30 Fig.6: another embodiment of the packaging system according to the present invention wrapped around an equipment with large circumference to be shipped.

DETAILED DESCRIPTION OF EMBODIMENTS

- 35 Fig.1 shows an embodiment of the packaging structure 1 according to the present

invention. The first cell 21 (grey area) comprises tubular cavities 210 essentially parallel to each other forming a comb-shaped structure. The second cell 22 (white area) has the same arrangement of tubular cavities 220. The comb-shaped structures of first and second cells 21, 22 are interlocked to establish a first mat 11, which will be wrapped
5 around an equipment in order to provide a shock-absorbing packaging for this equipment. In order to improve the stiffness of the mat 11, first and second cells 21, 22, in particular the tubular cavities 210, 220, are mechanically joined. The tubular shape of the cavities 210, 220 shown in fig.1 is only one example. The shape of the cells may vary for other embodiments as long as the comb-shaped structure is maintained. The dimensions of
10 cells and tubular cavities is only one specific example. People skilled in the art may chose different dimensions of cells and tubular cavities within the scope of this invention. The cells 21, 22 are filled with gas, e.g. air or nitrogen, via the valves 3, which enables to inflate the cells 21, 22 as well as to remove the gas out of the cells 21, 22. The position of the valves is only one example and may vary for other embodiments. The deflated
15 packaging structure 1 (removed gas) with empty cells can be shipped with a much smaller transport volume, which lowers the costs for transport of the packaging structure back to the distribution center in order to be wrapped around the next equipment to be shipped (multiple use). The packaging structure can be wrapped around the equipment to be shipped in different ways within the scope of this invention. The packaging structure may
20 be attached to the equipment by adhesives or may be fixed to the equipment by rope or tapes. A preferred embodiment is shown in fig.1, where the packaging structure 1 comprises first connection means 41 and second connection means 42 in order to be connected either together wrapping a small equipment or may be connected to the corresponding second and first connection means 42, 41 of another packaging structure 1
25 in order to enwrap a larger equipment. In this embodiment, first and second connection means 41, 42 are arranged approximately in the middle of the height of the packaging structure 1, where the first connection means is a stripe and the corresponding counterpart is a knob as the second connection means 42, where the stripe is fixed to. The height of the packaging structure 1 is the extension in direction of the tubular cavities
30 210 and 220 (direction 5 of fig. 3). Number, type and position of the connection means 41, 42 may vary for other embodiments. People skilled in the art may choose other required positions and numbers of connection means 41, 42 means within the scope of this invention.

35 Fig.2 shows another embodiment of the packaging structure 1, where the packaging

structure further comprises a third cell 23 with tubular cavities 230 and a fourth cell 24 with tubular cavities 240 forming a second mat 12 of tubular cavities attached to the first mat 11. The principal structure is the same as shown in fig.1, but the number of separate cells is doubled in order to improve the reliability against damages of one cell. If one cell has a leakage, there are three remaining cells to provide sufficient shock-absorbance to secure the wrapped equipment. First and second mats 11, 12 are mechanically connected along the connection line 13 arranged between the sides of second and third cell 22, 23 facing together. The connection line 13 is arranged at the side of the cells 22, 23 being essentially vertical to the long side of the tubular cavities 220, 230. The connection line 13 might be made of the same material as the cells 21, 22, 23, 24 of the packaging structure 1. Alternatively, the connection line 13 can be made of any other material suitable to permanently connect both mats 11, 12, preferably a flexible material. People skilled in the art are able to chose a suitable mechanical connection of both mats 11, 12. Alternatively, the mats 11, 12 may be also glued together.

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Fig.3 shows another embodiment of a packaging structure 1. Here two packaging structures 1 are connected together in a reversible manner in contrast to fig.2. The packaging structures shown in fig.3 each comprise two first attaching means 51 at the lower side of the packaging structure and two second attaching means 52 at the upper side of the packaging structure to connect separate packaging structures 1 to the present attaching means 51, 52. To establish a connection between the packaging structures the first connection means 51 of a first packaging structure 1 is connected to the second attaching means 52 of a second packaging structure 1 (or vice versa) along the direction perpendicular to the direction 4, which is the direction to connect the connection means in order to wrap the packaging structures around the equipment. In this embodiment the first and second attaching means 51, 52 are hook-and-loop-fasteners. However, number and the type of the attaching means may vary for other embodiments. People skilled in the art may choose other positions and numbers of the attaching means within the scope of this invention.

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Fig.4 shows a packaging system 10 comprising two packaging structures 1 connected to each other by suitable connection means 41, 42, where the first connection means 41 of the first packaging structure (right side) is connected to the second connection means 42 of the second packaging structure (left side) in order to enwrap the equipment 6. The same connection between the first and second packaging structures 1 is present on the

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backside of the equipment 6 (not shown here). In order to establish a tight fit of the packaging system to the equipment 6, the first and/or second connection means 41, 42 may comprise at least one elastic part, e.g. springs to apply a certain force to the packaging structures 1.

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Fig.5 shows another enwrapped equipment 6 with larger height than the equipment enwrapped in fig. 4, now enwrapped with four packaging structures (as shown in fig. 3 in details) with first and second attaching means 51, 52. The four packaging structures are attached to each other in direction 5 (see fig.3) with the attaching means 51, 52 and are connected to each other in direction 4 (see fig.1) perpendicular to direction 5 in order to provide a shock-absorbing packaging of the equipment 6. For heavy equipment up to 5 metric tons, the packaging structure can be applied using a resin material of polyamide, polyethylene and reinforced nylon for the materials of the cells of the packaging structures.

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Fig.6 shows another enwrapped equipment 6 with a larger circumference than the equipment enwrapped in fig. 4, now applying four packaging structures (as shown in fig.3 in details). The four packaging structures are connected to each other in direction 4 (see fig.1) in order to provide a shock-absorbing packaging of the equipment 6. Here, the attaching means 51, 52 are not required. For the same purpose, packaging structures without attaching means can be applied also.

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For all embodiments shown in fig.1 – 6, the gas pressure inside the cells may be adjusted to the demands for the specific equipment to be shipped. Valves such as check valves, double check valves or so-called Sclaverand valves are suitable for gas pressure inside the cells of 6 bar or more.

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While the invention has been illustrated and described in details in the drawings and foregoing description, such illustration and description are to be considered illustrative or exemplary and not restrictive; the invention is not limited to the disclosed embodiments.

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Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims. In the claims, the word “comprising” does not exclude other elements or steps, and the indefinite article “a” or “an” does not exclude a

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plurality. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage. Any reference sign in the claims should not be construed as limiting the scope.

LIST OF REFERENCE SIGNS

	1	packaging structure
	10	packaging system
5	11	first mat
	12	second mat
	13	connection line
	21	first cell
	22	second cell
10	23	third cell
	24	fourth cell
	210	tubular cavity of first cell
	220	tubular cavity of second cell
	230	tubular cavity of third cell
15	240	tubular cavity of fourth cell
	3	valve
	4	first direction
	41	first connection means
	42	second connection means
20	5	second direction
	51	first attaching means
	52	second attaching means
	6	equipment to be wrapped

CLAIMS

1. A packaging structure (1) for shock-absorbing packaging of equipment (6) comprising at least a first cell (21) and a second cell (22), which is gastight
5 separated from the first cell (21), the cells (21, 22) are inflated with a gas, preferably air, each cell (21, 22) comprising multiple connected tubular cavities (210, 220) arranged essentially parallel to each other in a comb-shaped structure, where the comb-shaped structures of the at least first and second cells (21, 22) are interlocked and each tubular cavity (210) of the first cell (21) is mechanically
10 joined to the neighbored tubular cavity (220) of the second cell (22) establishing a first mat (11) of mechanically joined tubular cavities (210, 220) to enwrap the equipment (6) to be transported.
2. The packaging structure (1) as claimed in claim 1, characterized in that
15 each of the cells (21, 22) has at least one closable valve (3) suitable to inflate gas into the cell.
3. The packaging structure (1) as claimed in claim 2, characterized in that
20 the valve (3) is also suitable to remove gas from the cell (21, 22) enabling multiple inflation and removable of gas.
4. The packaging structure (1) as claimed in any of the preceding claims, characterized in that the cells (21, 22) are made of a resin material.
- 25 5. The packaging structure (1) as claimed in claim 4, characterized in that the resin material comprises polyamide, polyethylene and reinforced nylon.
6. The packaging structure (1) as claimed in any of the preceding claims,
30 characterized in that the packaging structure (1) further comprises at least a second mat (12) of tubular cavities (230, 240) mechanically connected to the first mat (11), preferably along a connection line (13), in order to increase the number of gastight separated cells (21, 22, 23, 24) connected to each other to enwrap the equipment (6) to be transported.

7. The packaging structure (1) as claimed in any of the preceding claims, further comprising at least one first connection means (41) and at least one second connection means (42) suitable to provide a connection to the second and first connection means (42, 41) of another packaging structure (1) along a first direction (4) in order to provide a tight fit of the packaging structure (1) on the equipment (6).
8. The packaging structure (1) as claimed in claim 6, characterized in that the first connection means (41) and/or the second connection means (42) comprise at least one elastic part.
9. The packaging structure (1) as claimed in claim 7 or 8, characterized in that the packaging structure (1) comprises at least one first attaching means (51) and at least one second attaching means (52) suitable to provide a connection to the second and first attaching means (52, 51) of another packaging structure (1) along a second direction (5) perpendicular to the first direction (4) to increase the area of the joined packaging structures (1) to the size of a larger equipment (6) to be enwrapped.
10. A packaging system (10) comprising at least two packaging structures (1) according to claim 1 each comprising first connection means (41) and second connection means (42) to be connected together to form an outer cover for shock-absorbing packaging of equipment (6) to be transported.
11. A method for shock-absorbing packaging of equipment (6) with packaging structures (1) according to claim 1 comprising the steps of
- inflating the cells (21, 22, 23, 24) via the valve (3) with gas, preferably air,
 - closing the valve (3) after the cells (21, 22, 23, 24) are inflated,
 - wrapping the packaging structures (1) around the equipment (6).
12. The method as claimed in claim 11, characterized in that the step of wrapping comprises the step of
- connecting the packaging structures (1) together via at least one first connection means (41) of the packaging structure (1) and at least one second connection means (42) of the other packaging structure (1) along a

first direction (4) in order to provide a tight fit of the packaging structure (1) on the equipment (6).

13. The method as claimed in claim 12, further comprising the step of

- 5 - connecting the packaging structures (1) together via at least one first
attaching means (51) of the packaging structure (1) and at least one
second attaching means (52) of the other packaging structure (2) along a
second direction (5) perpendicular to the first direction (4) to adjust the area
of the joined packaging structures (1) to the size of a larger equipment (6)
10 to be enwrapped.