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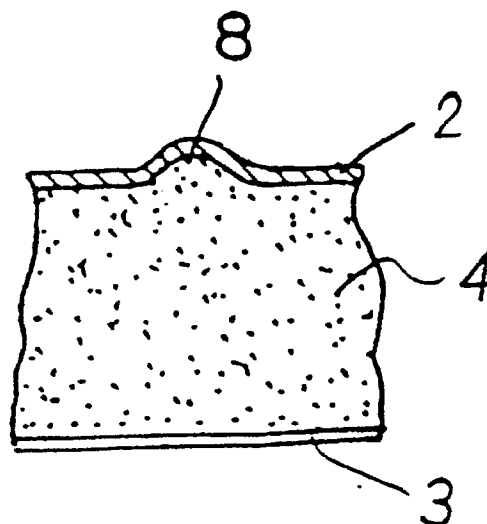
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(54) **Marine container roof structure with heat insulation.**

(57) A heat-insulated marine container has an elongate hexahedral shape and includes a roof, a floor confronting the roof, and corner members positioned at four corners of each of the roof and the floor. The marine container has a roof structure which comprises a roof (2) and an inner lining (3) panel which are bonded to the opposite surfaces of a heat insulation (4) sandwiched therebetween. At least one of the roof and the inner lining panel has a plurality of stress-absorbing corrugations (8). The corrugations extend longitudinally or transversely of the marine container, and may have various cross-sectional shapes.

Fig. 2



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MARINE CONTAINER ROOF STRUCTURE WITH HEAT INSULATION

The present invention relates to a marine container roof structure with a heat insulation, and more particularly to a marine container roof structure with a heat insulation, which structure is protected from damage during usage.

2. Description of the Prior Art:

Containers are in the form of simple transportation boxes whose outside surfaces are covered with metal panels, and widely used in many transport applications such as ship, railroad, and automobile transport systems.

Among various containers are large-size marine containers used mainly for sea transport. One known marine container disclosed in U.S. Patent No. 3,206,902 comprises a floor, a roof, and side walls each comprising a heat-insulated structural body which is composed of a heat insulation sandwiched between two metal panels. The roof structure of a marine container with a heat insulation will be described below with reference to the accompanying drawings.

Fig. 14 of the accompanying drawings shows in fragmentary cross section a roof of a marine container which is in the form of a long rectangular parallelepiped (see Fig. 13) or a hexahedral shape, the view being taken along a longitudinal plane extending from the roof to the confronting floor of the container. As shown in Fig. 14, the roof of the marine container has a flat roof panel 2 and a flat inner lining panel 3 which are disposed upwardly and downwardly of transverse beams 1 spaced at intervals in the longitudinal direction of the container. The space between the roof panel 2 and the inner lining panel 3 is filled with a heat insulation 4. The container also includes side panels 11 extending downwardly from the side edges of the roof.

The marine container, with cargo stored therein, is loaded from ground onto a ship or unloaded from a ship onto ground, by a container crane.

As shown in Figs. 13 and 14, the marine container has corner members 5 on its corners which will be hooked for loading and unloading. More specifically, as shown in Fig. 13, fastening hooks 7 of a spreader 6 of a container crane are held in engagement with the respective corner members 5, and the marine container is lifted or lowered by the container crane through the spreader 6. When the marine container is suspended by the container crane, the container is largely flexed by a vertical interval at its center due to the weight of the cargo stored in the container as illustrated in Fig. 15. Therefore, the roof panel 2 of the marine container

is subjected to a compressive load while the container is being suspended. Since the marine container is repeatedly used over a long period of time, the roof panel 2 undergoes repeated compressive loads when the container is loaded and unloaded, and hence will have localized metal fatigue regions or localized deformed regions. The localized metal fatigue regions produce cracks in the roof panel 2, or the localized deformed regions force the roof panel 2 to be peeled off the heat insulation 4 or rupture the heat insulation 4. The cracks in the roof panel 2 allow rainwater to enter into the container roof, and the peeling or rupture of the heat insulation 4 reduces the heat insulation capability thereof.

In view of the aforesaid problems of the conventional heat-insulated marine container roof structure, it is an object of the present invention to provide a marine container roof structure with a heat insulation, which structure is capable of absorbing localized load irregularities or deviations which are caused in the roof when the container is loaded or unloaded.

Another object of the present invention is to provide a marine roof structure with a heat insulation, which structure being capable of more fully absorbing localized load irregularities or deviations which are caused in the roof when the container is loaded or unloaded.

According to the present invention, there is provided a roof structure for a heat-insulated marine container having an elongate hexahedral shape and including a roof, a floor confronting the roof, and corner members positioned at four corners of each of the roof and the floor, the roof structure comprising a heat insulation, a roof panel attached to a face of the heat insulation, an inner lining panel attached to a back of the heat insulation, and a plurality of stress-absorbing corrugations disposed on at least the roof panel. The stress-absorbing corrugations may be disposed on both the roof panel and the inner lining panel. The corrugations comprise ridges projecting outwardly from the roof, or grooves concaved inwardly into the roof. The corrugations may have a triangular cross section, a semicircular cross section, or a trapezoidal cross section.

The corrugations may extend longitudinally of the marine container, or transversely of the marine container. The corrugations are spaced at pitches which are smaller in a region of the roof where produced stresses are larger.

The above and other objects, features and advantages of the present invention will become more apparent from the following description when taken

in conjunction with the accompanying drawings in, which;

Fig. 1 is a plan view of a marine container roof structure according to a first embodiment of the present invention;

Fig. 2 is an enlarged cross-sectional view taken alone line II - II of Fig. 1;

Fig. 3 is an enlarged cross-sectional view taken along line III - III of Fig. 1;

Figs. 4(a) and 4(b) are plan views of a marine container roof structure according to a second embodiment of the present invention;

Fig. 5 is an enlarged cross-sectional view taken along line V - V of Fig. 4(a)

Fig. 6 is a plan view of a marine container roof structure according to a third embodiment of the present invention;

Fig. 7 is an enlarged cross-sectional view taken along line VII - VII of Fig. 6;

Figs. 8(a), 8(b), and 8(c) are cross-sectional views showing modified longitudinal ridges;

Fig. 9 is a fragmentary perspective view of a modification of the marine container roof structure according to the third embodiment;

Fig. 10 is a perspective view of a marine container with a roof structure according to a fourth embodiment of the present invention;

Fig. 11 is an enlarged cross-sectional view taken along line XI - XI of Fig. 10;

Fig. 12 is an enlarged cross-sectional view taken along line XII - XII of Fig. 10;

Fig. 13 is a perspective view of a marine container and spreader for suspending the marine container;

Fig. 14 is a fragmentary vertical cross-sectional view of a conventional marine container; and

Fig. 15 is a side elevational view showing the manner in which a roof panel of a marine container is flexed when the container is suspended.

Figs. 1 through 3 show a marine container roof structure according to a first embodiment of the present invention. As shown in Fig. 2, the roof of a marine container is of a laminated construction comprising a roof panel 2, an inner lining panel 3, and a heat insulation 4 sandwiched between the roof panel 2 and the inner lining panel 3. The roof panel 2 is bonded to the upper surface of the heat insulation 4 and the inner lining panel 3 is bonded to the lower surface of the heat insulation 4. The roof panel 2 has transverse corrugations or ridges 8 projecting outwardly from the roof and spaced at constant intervals in the longitudinal direction of the roof, as shown in greater detail in Fig. 2. As shown in Fig. 1, each of the transverse ridges 8 terminates short of the lateral edges of the roof panel 2, leaving an attachment margin to which an upper side frame 9 (Fig. 3) of the marine container is

fastened.

According to a second embodiment of the present invention, each ridge 8 extends the fully transverse width of the marine container as shown in Fig. 4(a), or each ridge 8 is interrupted in the transverse direction of the marine container as shown in Fig. 4(b).

In the first embodiment shown in Fig. 1, since the transverse ridges 8 do not extend fully to the lateral edges of the roof panel 2, each lateral edge of the roof panel 2 can easily be fastened to the upper edge of the upper side frame 9 by rivets 10 as shown in Fig. 3. In the second embodiment shown in Figs. 4(a) and 4(b), however, each transverse ridge 8 extends fully to the lateral edges of the roof panel 2. Therefore, as shown in Fig. 5, the roof panel 2 is fastened to the upper edge of the upper side frame 9 by rivets 10 fixed to those portions of the lateral edges of the roof panel 2 which are free of the transverse ridges 8. In Fig. 5, each lateral edge 2' of the roof panel 2 is bent downwardly around and over the side edge of the upper side frame 9, thereby preventing rainwater and seawater from entering the marine container from between the roof panel 2 and the upper side frame 9.

While the roof panel 2 has transverse corrugations or ridges 8 in the above arrangement, the inner lining panel 3 may also have similar ridges which appear as grooves when viewed from within the container.

The interval (Fig. 15) by which the marine container is flexed when it is suspended is maximum at the center of the marine container. Therefore, the transverse ridges 8 may be positioned at spaced intervals or pitches that are progressively greater in longitudinal directions from the center of the container toward the front and rear ends thereof.

Since the transverse ridges 8 are provided on at least the roof panel 2 at longitudinally spaced intervals, irregular compressive loads applied to the roof which are produced when the marine container is suspended can be absorbed by the transverse ridges 8. The transverse ridges 8 are also effective to absorb thermal strains in the roof. Therefore, any damage to the roof of the marine container due to compressive load irregularities and thermal strains can be reduced, and the service life of the marine container is extended.

A marine container roof structure according to a third embodiment will be described below with reference to Figs. 6 through 8(a) - 8(c).

As shown in Fig. 6, the marine container roof structure includes a roof panel 2 bonded to the upper surface of a heat insulation. The roof panel 2 has two pairs of longitudinal ridges 80 respectively at lateral sides thereof and a single longitudinal

ridge 80 at the center. As shown in Fig. 7, the two pairs of longitudinal ridges 80 at the lateral sides are located inwardly of the lateral edges of the roof panel 2, leaving attachment margins along which the lateral edges of the roof panel 2 are fastened to upper side frames 9 by rivets 10.

The longitudinal ridges 80 may be of a triangular cross section as shown in Fig. 8(a), or a trapezoidal cross section as shown in Fig. 8(b), or a semicircular cross section as shown in Fig. 8(c).

As shown in Fig. 7, an inner lining panel 3 bonded to the lower surface of the heat insulation also has similar longitudinal ridges 80. Therefore, the upper and lower surfaces of the roof of the marine container are stiffened by the ridges 80, so that the marine container has an increased service life.

As with the previous embodiments, inasmuch as the longitudinal ridges 80 are provided at the lateral sides and center of at least the roof panel 2, irregular compressive loads applied to the roof which are produced when the marine container is suspended can be absorbed by the transverse ridges 8, and hence the roof panel 2 is prevented from being locally buckled. The longitudinal ridges 80 are also effective to absorb thermal strains in the roof. Therefore, any damage to the roof of the marine container due to compressive load irregularities and thermal strains is minimized, and the service life of the marine container is extended.

Fig. 9 shows a modification of the marine container roof structure according to the third embodiment. As shown in Fig. 9, a roof panel 2 has two pairs of longitudinal grooves 80' respectively at lateral sides thereof and a single longitudinal groove 80' at the center. An inner lining panel 3 also has similar longitudinal grooves 80'. These longitudinal grooves 80' in the roof panel 2 and the inner lining panel 3 are also effective in stiffening the upper and lower surfaces of the roof and hence increasing the service life of the marine container.

A marine container roof structure according to a fourth embodiment of the present invention will be described below with reference to Figs. 10 through 12.

As shown in Fig. 10, a roof panel 2 bonded to the upper surface of a heat insulation 4 has a plurality of transverse grooves 12 concaved inwardly into the roof and spaced at intervals in the longitudinal direction of the roof panel 2. The transverse grooves 12 extend the full transverse width of the roof panel 2. Alternatively, the transverse grooves 12 may terminate short of lateral edges of the roof panel 2, leaving attachment margins which are fastened to upper side frames 9. Each of the transverse grooves 12 is shown being continuous, but may be interrupted in the transverse direction of the roof panel 2.

As described above, the transverse grooves 12 extend fully to the lateral edges of the roof panel 12, as shown in Fig. 10. To attach the roof panel 12 to the upper side frames 9, the lateral sides of the roof panel 12 are first pressed to flat shape, and then the flat lateral sides are fastened to the upper side frames 9. As shown in Fig. 11, each of the lateral edges of the roof panel 2 is bent downwardly over and around a flange 9a of the upper side frame 9, thereby preventing rainwater and seawater from entering the marine container from between the roof panel 2 and the upper side frame 9.

While the roof panel 2 has transverse grooves 12 in the above arrangement, an inner lining panel 3 bonded to the lower surface of the heat insulation 4 may also have similar transverse grooves 12, as shown in Fig. 12, which appear as grooves that are upwardly concave when viewed from within the container.

The roof structure with the transverse grooves 12 will be described below in greater detail. The transverse grooves 12 are pressed into triangular cross section at predetermined intervals or pitches as shown in Fig. 12. To attach the roof panel 2 to the upper side frames 9, the lateral sides of the roof panel 2 are pressed into flat attachment margins, which are then bent over and fastened to the flanges 9a of the upper side frames 9. As shown in Fig. 12, the heat-insulated roof structure also includes a plurality of transverse beams 1 positioned between the roof panel 2 and the inner lining panel 3 and spaced at intervals (e.g., about 600 mm) in the longitudinal direction of the marine container. The transverse grooves 12 in the roof panel 2 and the inner lining panel 3 are positioned off the beams 1.

Compressive loads which are produced in the roof when the marine container is suspended are absorbed by the transverse grooves 12, so that the roof panel 2 or the inner lining panel 3 is prevented from being buckled.

The interval δ (Fig. 15) by which the marine container is flexed when it is suspended is maximum at the center of the marine container. Therefore, the transverse grooves 12 may be positioned at spaced intervals or pitches that are progressively greater in longitudinal directions from the center of the container toward the front and rear ends thereof.

Because the transverse grooves 12 are provided on at least the roof panel 2 at longitudinally spaced intervals, irregular compressive loads applied to the roof which are produced when the marine container is suspended can be absorbed by the transverse grooves 12. Consequently, the roof panel 2 or the inner lining panel 3 is prevented from being locally buckled.

The grooves 12 in the roof panel 2 increase the

surface area with which the roof panel 2 is bonded to the heat insulation 4. Therefore, the roof panel 2 and the heat insulation 4 are strongly bonded to each other and prevented from being peeled off each other.

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Claims

1. A roof structure for a heat-insulated marine container having an elongate hexahedral shape and including a roof, a floor confronting the roof, and corner members positioned at four corners of each of the roof and the floor, said roof structure comprising:
 - a heat insulation;
 - a roof panel attached to a face of said heat insulation;
 - an inner lining panel attached to a back of said heat insulation; and
 - a plurality of stress-absorbing corrugations disposed on at least said roof panel.
2. A roof structure according to claim 1, wherein said stress-absorbing corrugations are disposed on both said roof panel and said inner lining panel.
3. A roof structure according to claim 1 or 2, wherein said corrugations comprise ridges projecting outwardly from the roof.
4. A roof structure according to claim 1 or 2, wherein said corrugations comprise grooves concaved inwardly into the roof.
5. A roof structure according to claim 1 or 2, wherein said corrugations extend longitudinally of the marine container.
6. A roof structure according to claim 1 or 2, wherein said corrugations extend transversely of the marine container.
7. A roof structure according to claim 1 or 2, wherein said corrugations have a triangular cross section.
8. A roof structure according to claim 1 or 2, wherein said corrugations have a semicircular cross section.
9. A roof structure according to claim 1 or 2, wherein said corrugations have a trapezoidal cross section.
10. A roof structure according to claim 1 or 2, wherein said corrugations are spaced at pitches which are smaller in a region of the roof where produced stresses are larger.

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Fig. 1

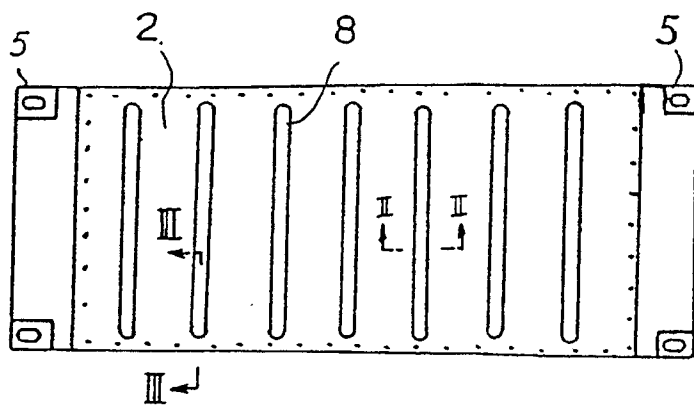


Fig. 2

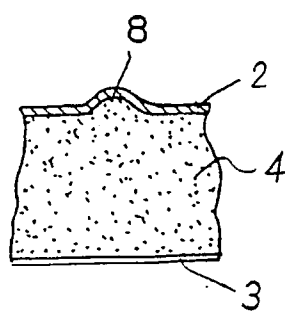


Fig. 3

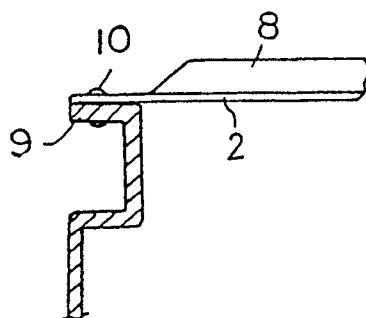


Fig. 4 (a)

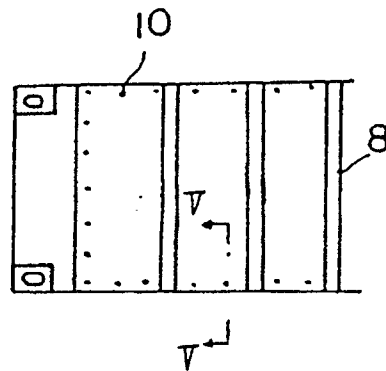


Fig. 4 (b)

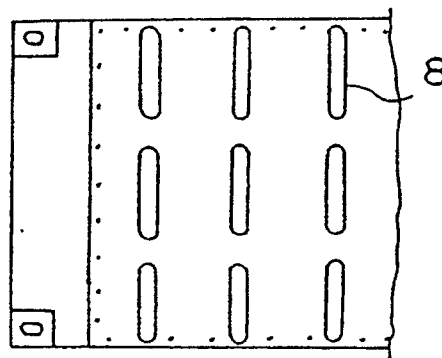


Fig. 5

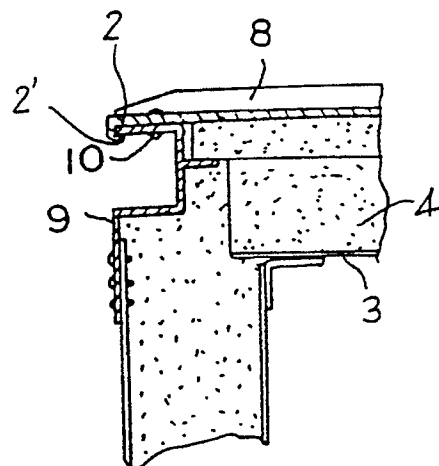


Fig. 6

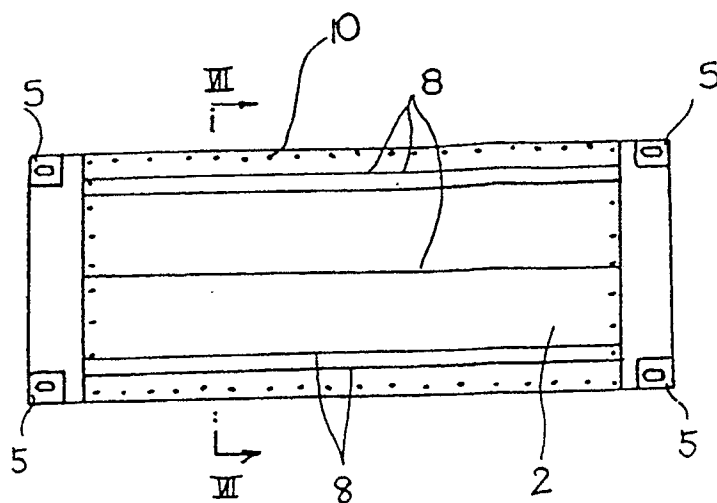


Fig. 7

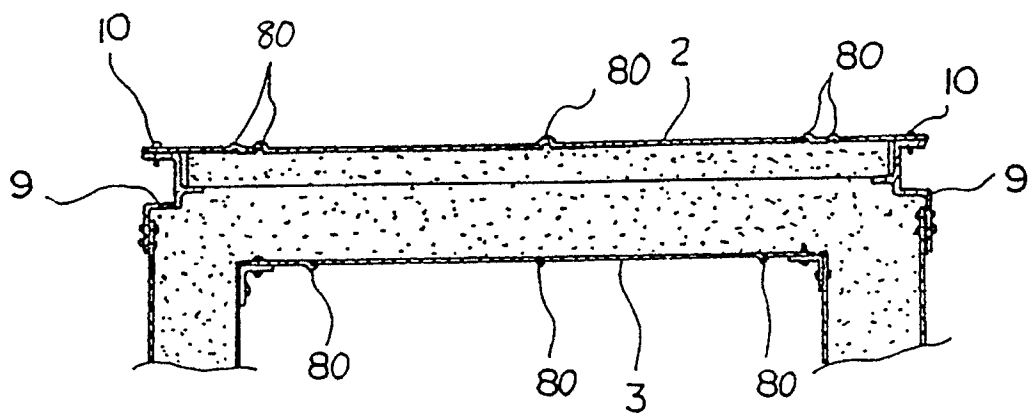


Fig. 8

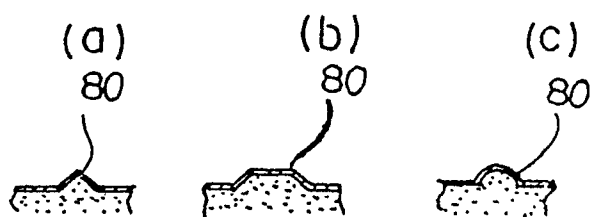


Fig. 9

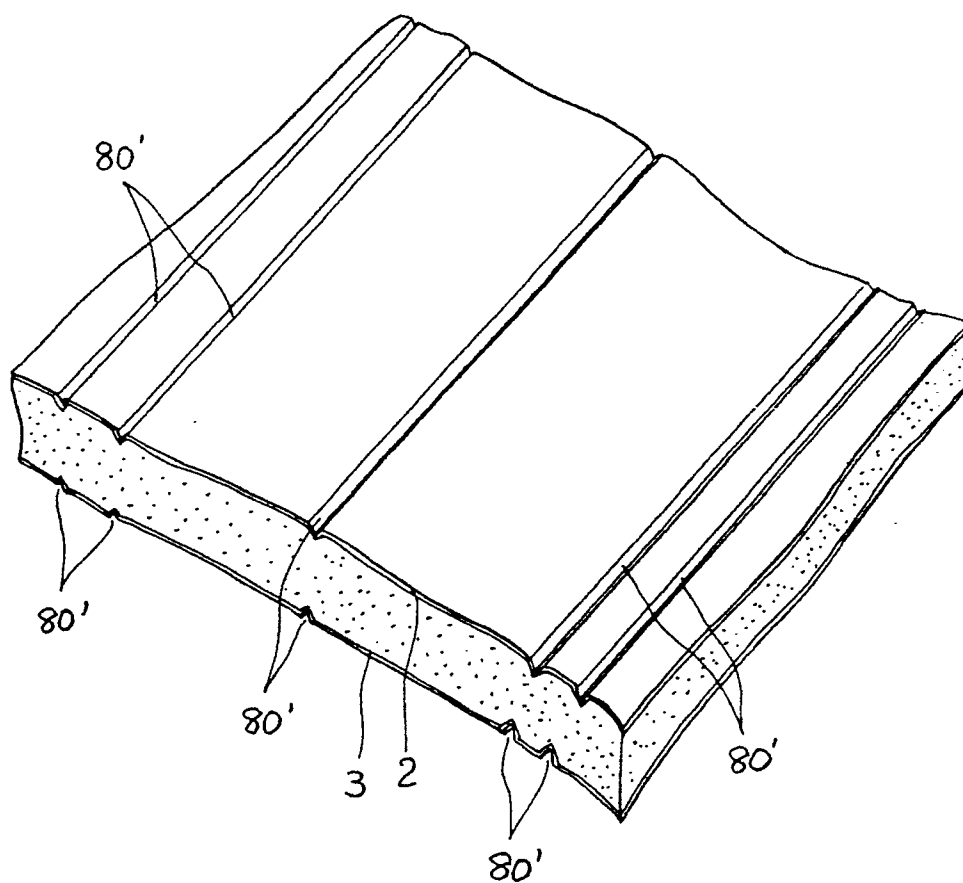


Fig. 10

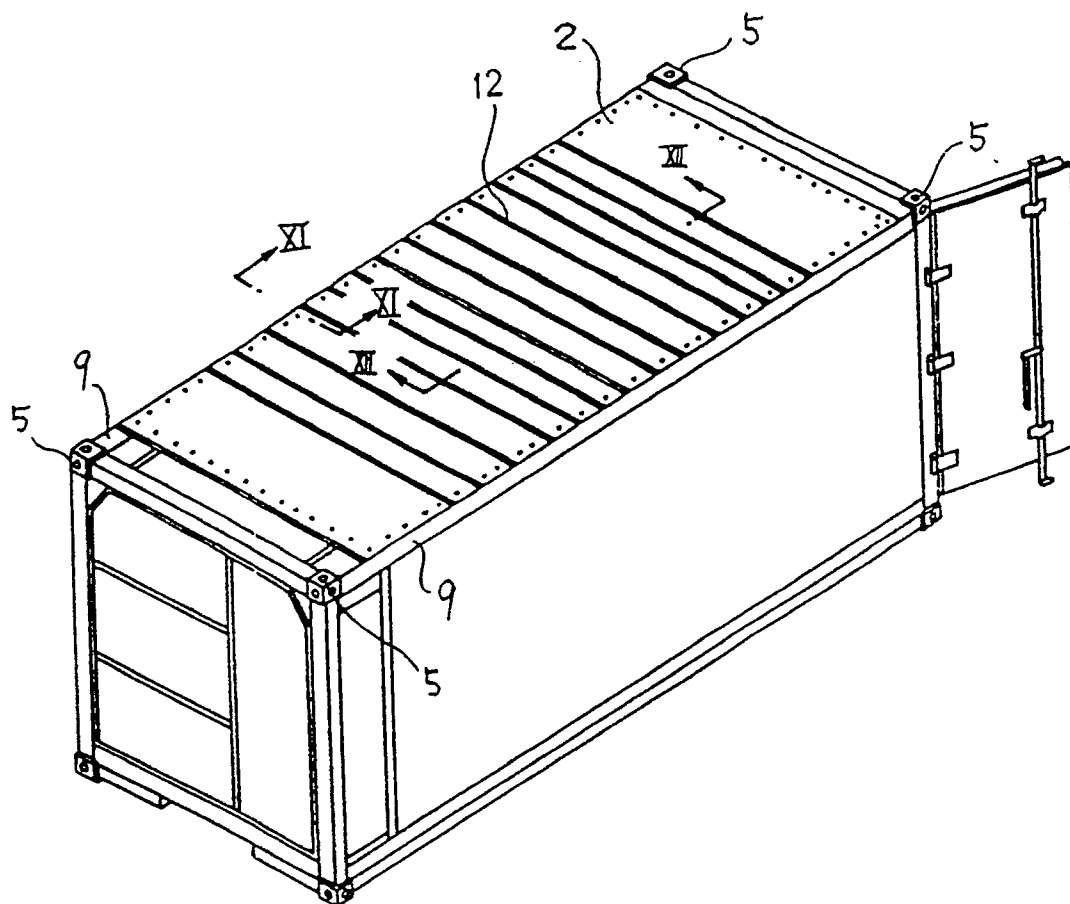


Fig. 11

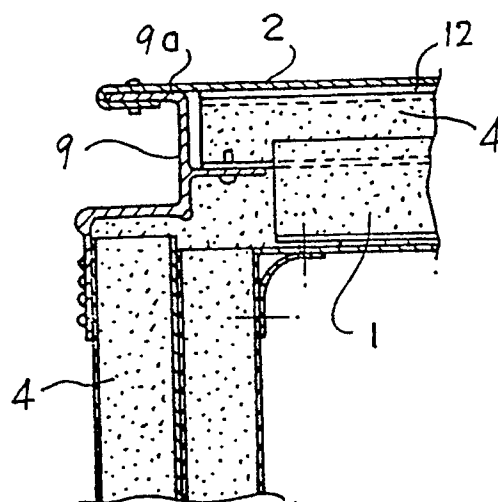


Fig. 12

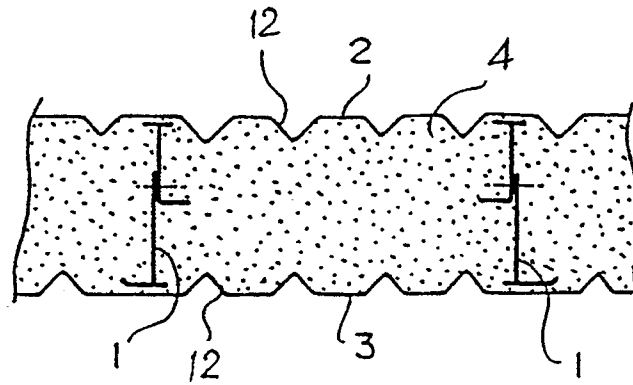


Fig. 13

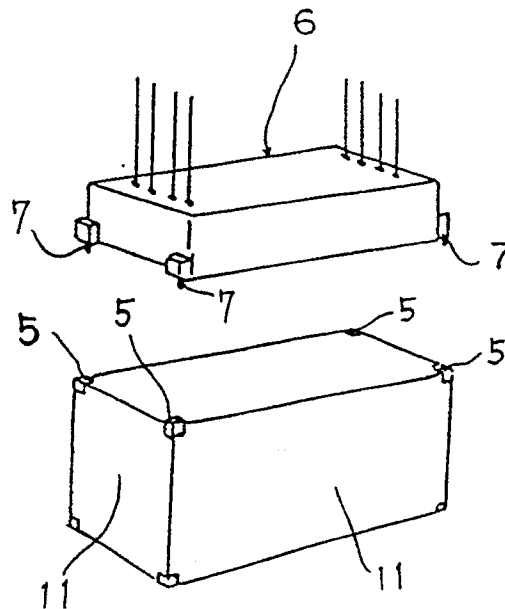


Fig. 14

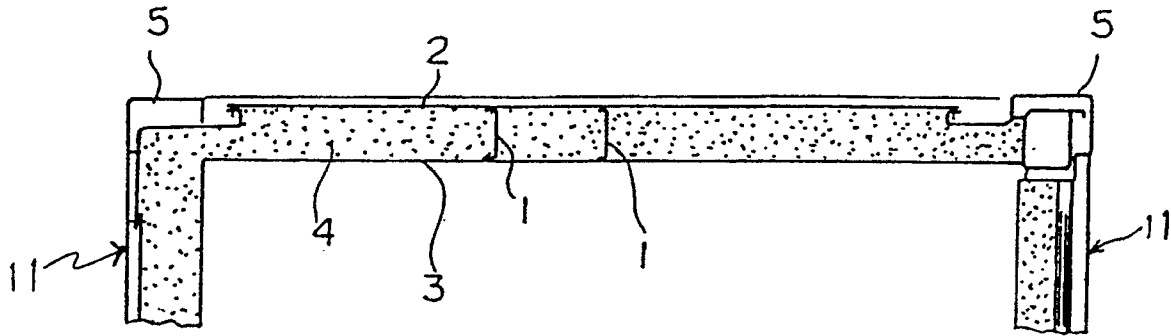
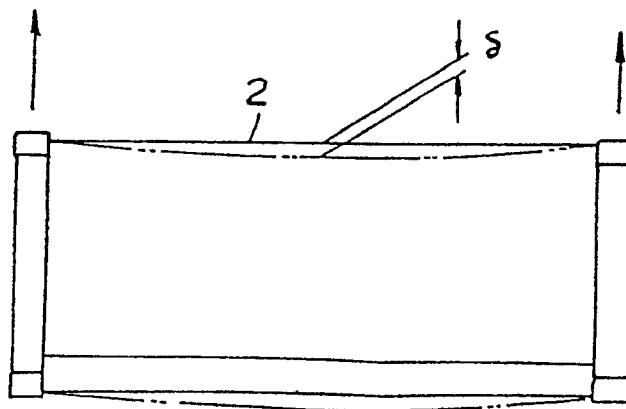


Fig. 15





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EUROPEAN SEARCH REPORT

Application Number

EP 90 31 0053

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	DE-U-8 800 536 (CASSENS) * Page 9, lines 11-20; figures * - - -	1-5	B 65 D 90/06 B 65 D 88/12
X	FR-A-2 363 050 (BOCK) * The whole document * - - -	1,3,6,9	
X	FR-A-2 364 828 (DIESEL EXCHANGE SERVICES) * Page 8, lines 1-7; figures * - - -	1,3,7,8	
A	NL-A-6 916 329 (KOELTECHNISCH BEDRIJF WAL-RAVEN) * The whole document * - - -	1,2	
A	FR-A-2 083 539 (WAGGONFABRIK TALBOT) * The whole document * - - - - -	1	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			B 65 D B 60 P
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of search 06 December 90	Examiner OSTYN T.J.M.
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