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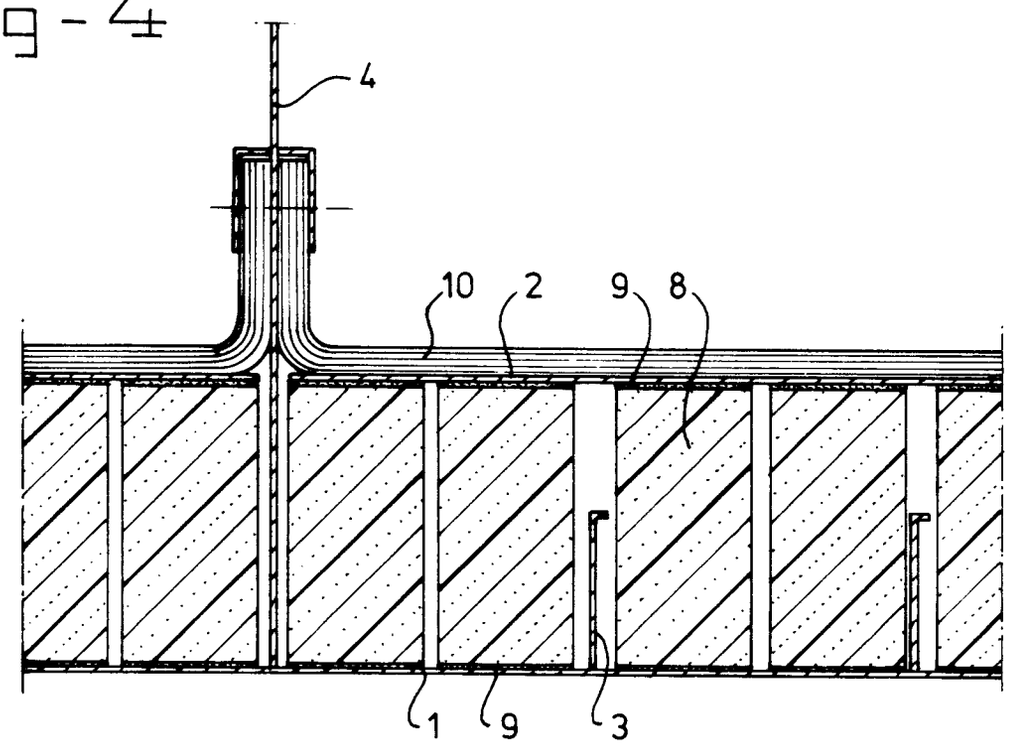
(54) Vessel, in particular intended for transporting fluids

(57) A vessel, in particular intended for transporting fluids, such as chemicals, has a skin which at least partially is of double-walled construction with a steel outer wall (1) and an inner wall (2) which is fixed to parts such as transverse stiffeners or partitions (4) which are joined to the outer wall. The fixing of the inner wall is of limited strength such that said fixing can be broken in the event of the vessel being involved in a crash or collision, it being impossible, or barely possible, for membrane stresses to build up in the ship's skin.

Fig-4



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Description

The invention relates to a vessel, in particular intended for transporting fluids, at least one part of the skin of which vessel is of double-walled construction with a steel outer wall and an inner wall which is fixed to parts, such as transverse stiffeners or partitions, which are joined to the outer wall.

Vessels normally have a ship's skin consisting of a single steel wall, which can split and be punctured relatively easily in the event of a crash or collision. This risk is reduced by making the ship's skin double-walled, but because the inner and outer walls are rigid and robustly joined to one another the risk of puncturing and splitting in the event of calamities is nevertheless still fairly high.

The aim of the invention is further to limit said risk in such a way that the inner wall elements are able to shift and deform in their plane in the event of crashes or collisions.

According to the invention the vessel is, to this end, characterised in that the fixing of the inner wall is of limited strength such that said fixing can be broken in the event of the vessel being involved in a crash or collision, it being impossible or barely possible for membrane stresses to build up in the ship's skin.

The inner wall is fixed by means of an elastic adhesive, by means of a mechanical joint or by means of a welded joint.

As a result of application of the invention, in the event of crashes and collisions the inner skin will indeed deform but will also come away from the transverse stiffeners and partitions. Membrane stresses occur to a much lesser extent, so that the resistance to puncturing of the ship's skin is appreciably increased and the sensitivity to splitting of the ship's skin is appreciably reduced. The buoyancy can be essentially retained, despite the deformation of the inner wall and possible local leaks.

Preferably, high-resistance foam in which the gas bubbles are fully enclosed is fitted between the inner and the outer wall and the inner wall is fixed to the foam. The high-resistance foam provides residual buoyancy in the event of a leak. It supports the inner wall. Moreover, it fills the space so that little or no water is able to penetrate. Incidentally, fitting foam to the inside of a ship's skin is known per se from European Patent Application 0 445 893, but said application relates to a fluid-tight container made of flexible material, such as polyethene, inside the ship's hold.

In the event of a collision, the inner wall is pushed inwards by the foam. Foam injection to completely fill the space between the outer and the inner wall is not precluded, but it is preferable to use blocks or slabs and optionally to fill the open spaces between the blocks or slabs with injected foam.

Instead of high-resistance foam, it is possible to make use of honeycomb between the inner and the outer wall, in which case the inner wall is fixed to the honeycomb.

In order to increase the tensile strength of the construction material of a double-walled ship's skin, the inner wall can consist of a steel plate or aluminium plate on which fibre-reinforced plastic sheets are fixed, which plastic sheets are also joined to transverse partitions via a bend.

A very suitable material is PE-Dyneema, which is a laminate of alternating plastic sheeting and fabric layers. For the purpose of the invention, the fixing to the steel inner wall can easily be produced using adhesive sheeting.

It is also possible to manufacture the inner wall itself from fibre-reinforced plastic sheets, which are joined to transverse partitions via a bend.

An inner wall of this type consisting of fibre-reinforced plastic can also be fixed to the partitions via L-shaped fixing elements made of fibre-reinforced plastic.

The invention will now be explained in more detail with reference to the figures.

Figure 1a shows a cross-section of a part of a double-walled ship's skin according to a first embodiment of the invention.

Figure 1b shows a section along the line Ib-Ib in Figure 1a

Figure 2a shows a cross-section of a second embodiment.

Figure 2b shows a section along the line IIb-IIb.

Figure 3 shows a longitudinal section according to a third embodiment.

Figure 4 shows a longitudinal section according to a fourth embodiment.

Figure 5 shows a longitudinal section according to a fifth embodiment, and

Figure 6 shows a longitudinal section according to a sixth embodiment.

The ship's skin section shown in Figures Ia and 1b comprises an outer wall 1, an inner wall 2, consisting of elements, and transverse stiffening strips 3, whilst transverse partitions 4 can also be seen.

The characteristic feature is that the inner wall 2 consists of elements which are fixed to the stiffening strips 3, to the transverse partitions 4 or, optionally, to other elements, by means which have limited strength such that in the event of a collision or crash the inner wall elements are able to come away from their fixing and shifting is able to take place, essentially in one plane. With this arrangement, no or hardly any membrane stresses arise in the construction material, with the result that the resistance to puncturing is appreciably increased and the sensitivity to splitting is reduced.

In Figure 1, the inner wall elements are, for this purpose, fixed via an elastic adhesive 5. It can be seen in the figure how the inner wall element, which is bent up at one end, is fixed by adhesive to a partition 4 and the other end of the inner wall element, which is not bent up, is fixed by adhesive to an L-shaped connecting element 6, which, in turn, is fixed to a transverse partition

4. The adhesive fixing of an inner wall element of the bottom of the ship's skin to an inner wall element of the side wall of the ship's skin can also be seen.

The result of the relatively weak fixing of the inner wall elements is that in the event of collisions and crashes the inner wall of the bottom and side walls is able to deform as a sort of crumple zone without being punctured and without splitting.

Figure 1 also shows long, narrow stiffening strips 7 which are mounted on the outer wall and the inner wall of the ship's bottom.

Instead of a joint consisting of elastic adhesive, it is also possible to use a relatively weak mechanical joint or a relatively weak welded joint.

The invention according to Figures 2a and 2b differs from that according to Figures 1a and 1b in that blocks or slabs 8 of high-resistance foam (for example PVC or polystyrene) are placed between the inner and the outer wall. The blocks or slabs 8 can also consist of honeycomb material. The space between the foam blocks or slabs can be filled by injecting foam.

Advantages of the slabs or blocks are that the inner wall is supported, that the force of any collision is distributed over a large surface area and that sharp parts are held apart. In the case of closed cellular foam containing gas bubbles which are not in communication with one another, little or no water is able to penetrate into the space between the inner and the outer wall. In the embodiment according to Figure 2, the strips 7 on the inner wall elements have been omitted.

The embodiment according to Figure 3 differs from those according to Figures 1 and 2 in that the elements of the inner wall 2 are fixed with adhesive to slabs or blocks 8 at 9 and are joined to one another by an adhesive joint or a mechanical joint.

Figure 4 shows an embodiment in which the elements of the inner wall 2 have been reinforced by a sheet 10 attached thereto by adhesive. Said sheet 10 consists of a fibre-reinforced plastic, for example a laminate containing alternating layers of sheeting and fabric, in particular material which is available commercially under the name PE-Dyneema.

The adhesive joint between wall 2 and sheet 10 can consist, for example, of adhesive sheeting. The join between the inner wall elements and the transverse partitions has been produced by end sections of the sheet 10 being bent upwards and fixed to partition 4 by means of a bolted joint.

Despite its low weight, the sheet 10 results in the tensile strength of the construction material being increased several-fold, whilst, moreover, there is little increase in the stretch and the resistance to bending.

In particular, the embodiment according to Figure 4, with high-resistance foam slabs 8 in the space between the inner wall and outer wall and with an elastic adhesive layer 2 between the foam slabs and the inner wall elements and with a fibre-reinforced plastic sheet 10 fixed by adhesive (for example by double-sided adhesive tape) to the inner wall elements, which plastic sheet 10 is also used to produce the join to the partitions 4, appears to be an exceptionally advantageous embodiment for increasing the resistance to puncturing and splitting and for maintaining buoyancy and stability in the event of leakage.

Figure 5 shows a variant of Figure 4, in which the steel inner wall elements 2 have been completely replaced by inner wall elements made of fibre-reinforced plastic. In other words, the steel inner wall sections have been omitted.

Finally, an embodiment which has an inner wall element in the form of flat fibre-reinforced sheets 2 without bent-up ends can be seen in Figure 6. The join to the partitions 4 is effected by means of L-shaped fixing elements 10 made of fibre-reinforced plastic or steel.

A common feature of all embodiments is that the inner wall 2 is fixed by relatively weak means, such as elastic adhesive, which is able to break in the event of a crash or collision, enabling the inner wall elements to shift and deform. A sort of crumple zone is produced. The inner wall elements peel away from the partitions to which they have been fixed. The strength of the ship's skin and the retention of the buoyancy can be improved by fitting the fibre-reinforced layers and the foam or honeycomb blocks or slabs.

Supplementary features and modifications are, of course, possible within the scope of the invention.

Claims

1. Vessel, in particular intended for transporting fluids, at least one part of the skin of which vessel is of double-walled construction with a steel outer wall and an inner wall which is fixed to parts, such as transverse stiffeners or partitions, which are joined to the outer wall, characterised in that the fixing of the inner wall is of limited strength such that said fixing can be broken in the event of the vessel being involved in a crash or collision, it being impossible or barely possible for membrane stresses to build up in the ship's skin.

2. Vessel according to Claim 1, characterised in that the inner wall is fixed by means of an elastic adhesive.

3. Vessel according to Claim 1, characterised in that the inner wall is fixed by means of a mechanical joint.

4. Vessel according to Claim 1, characterised in that the inner wall is fixed by means of welding.

5. Vessel according to one of the preceding claims, characterised in that high-resistance foam in which the gas bubbles are fully enclosed is fitted between

the inner and the outer wall and the inner wall is fixed to the foam.

6. Vessel according to Claim 5, characterised in that the high-resistance foam consists of blocks or slabs.

7. Vessel according to Claims 1 to 4, characterised in that honeycomb is arranged between the inner and the outer wall and the inner wall is fixed to the honeycomb.

8. Vessel according to one of the preceding claims, characterised in that the inner wall consists of a steel plate or aluminium plate on which fibre-reinforced plastic sheets are fixed, which plastic sheets are also joined to transverse partitions via a bend.

9. Vessel according to one of Claims 1 to 7, characterised in that the inner wall consists of fibre-reinforced plastic sheets which are joined to transverse partitions via a bend.

10. Vessel according to one of Claims 1 to 7, characterised in that the inner wall consists of fibre-reinforced plastic sheets which are fixed to transverse partitions via L-shaped fixing elements made of fibre-reinforced plastic.

Fig-1a

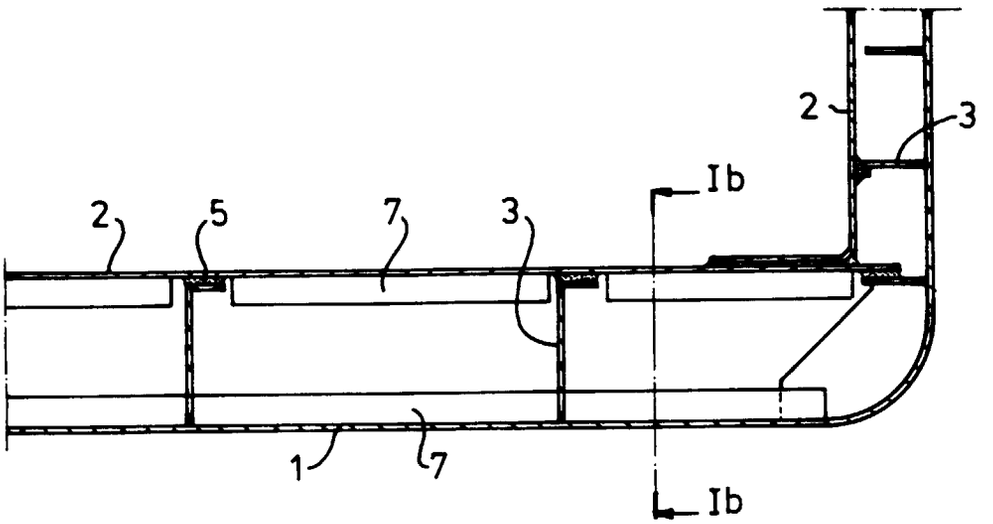


Fig-1b

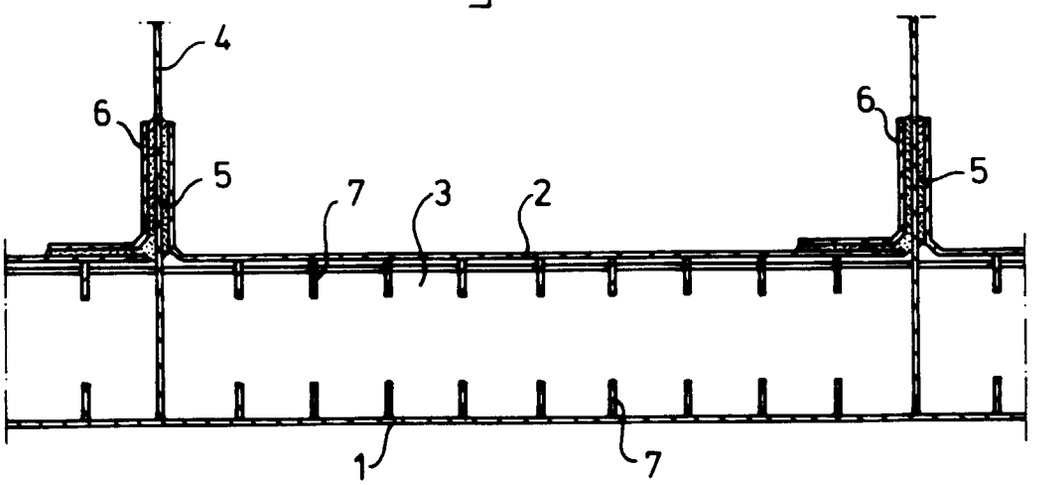


Fig-2a

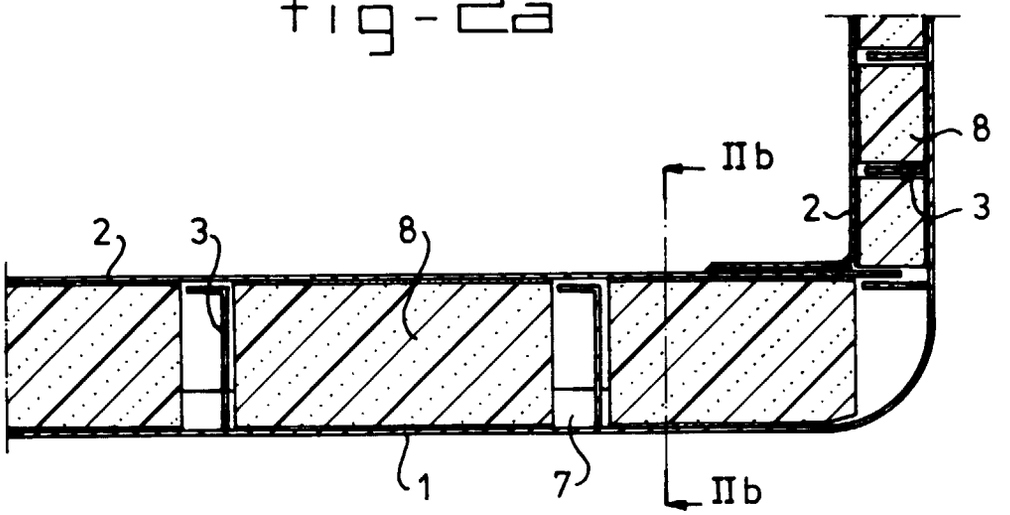


Fig-2b

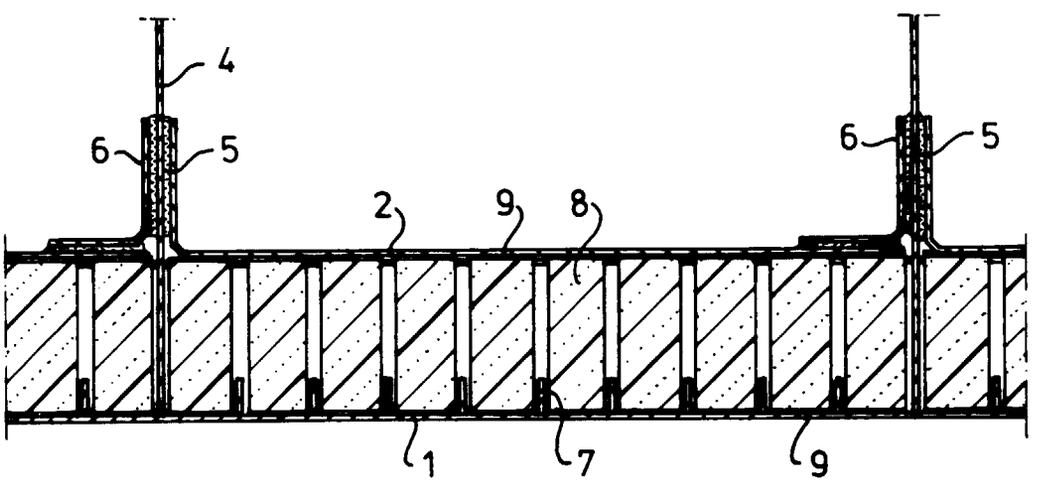


Fig-3

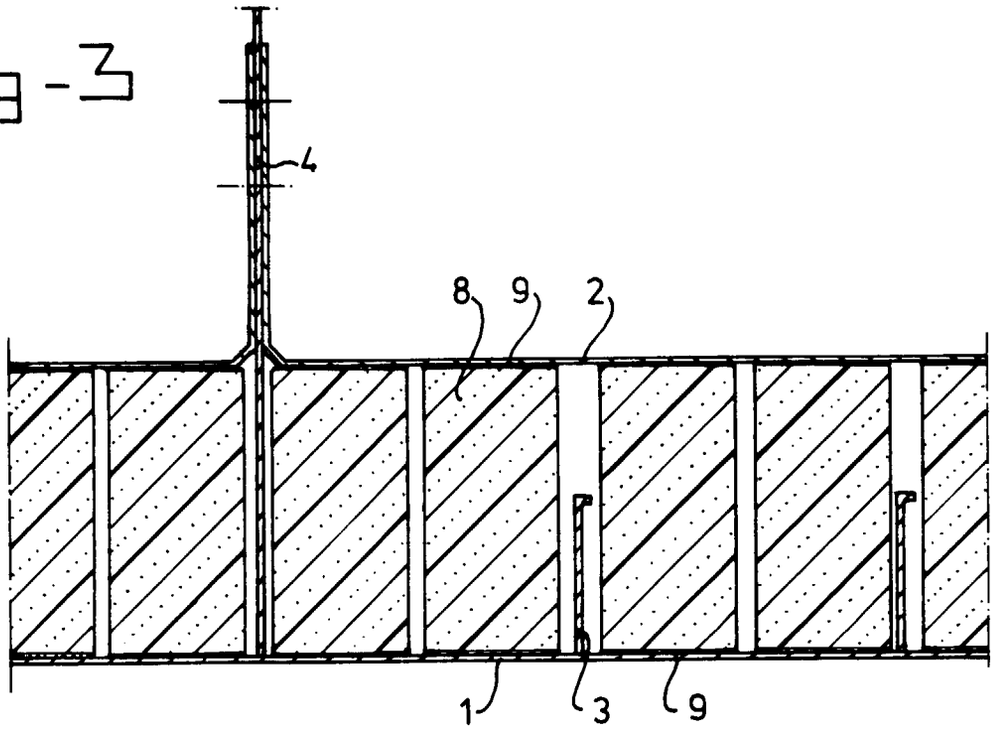


Fig-4

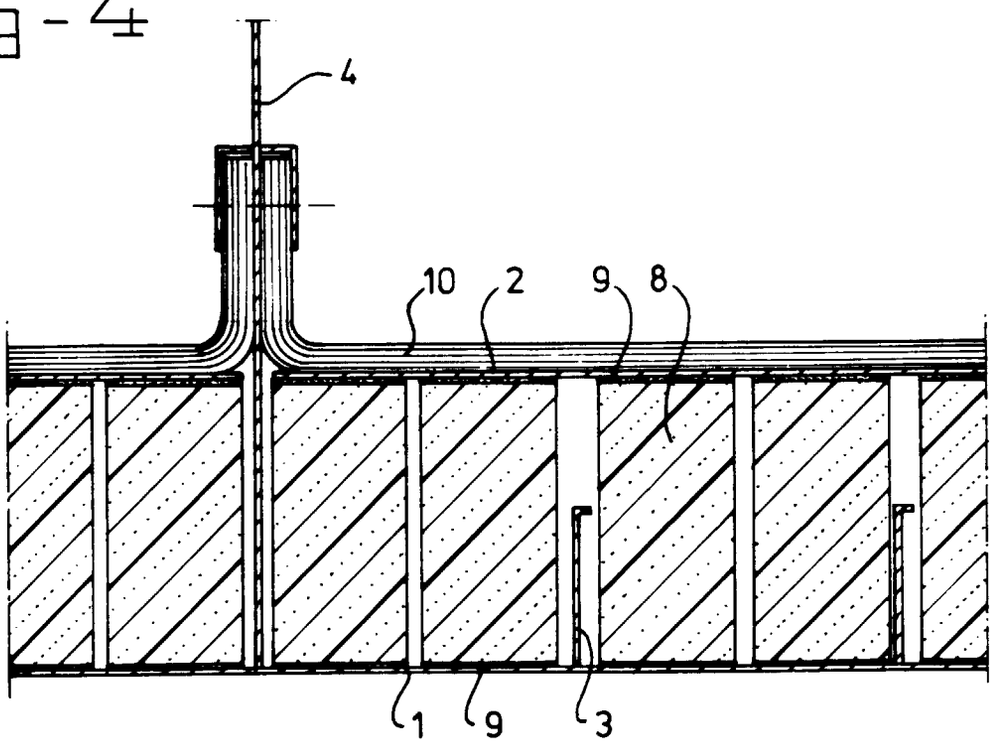


Fig-5

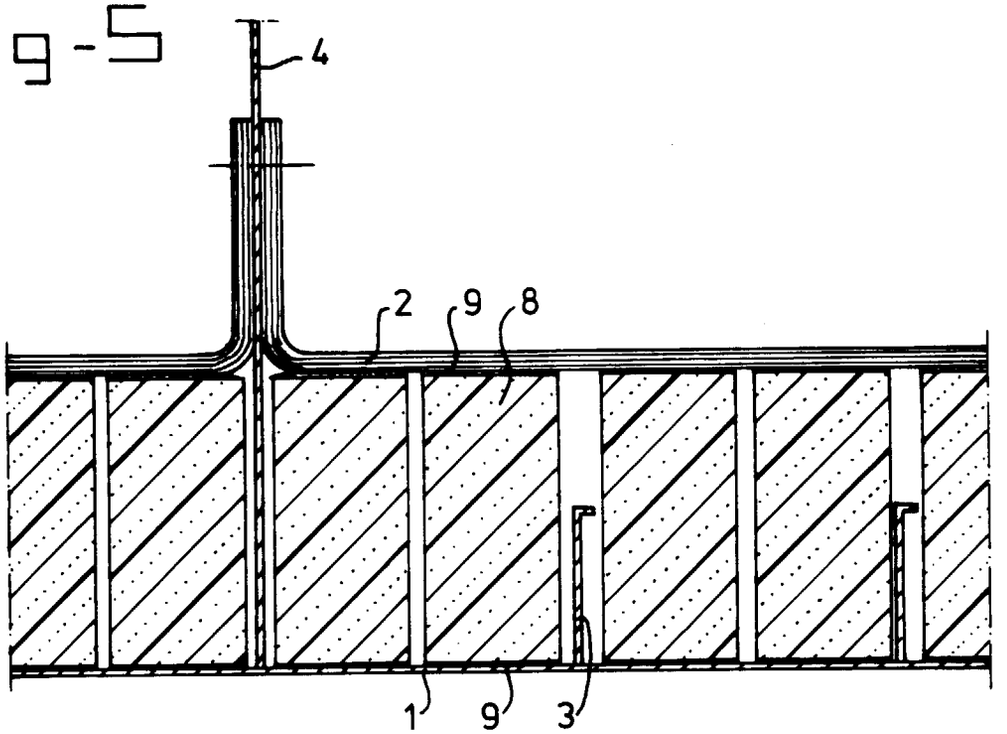
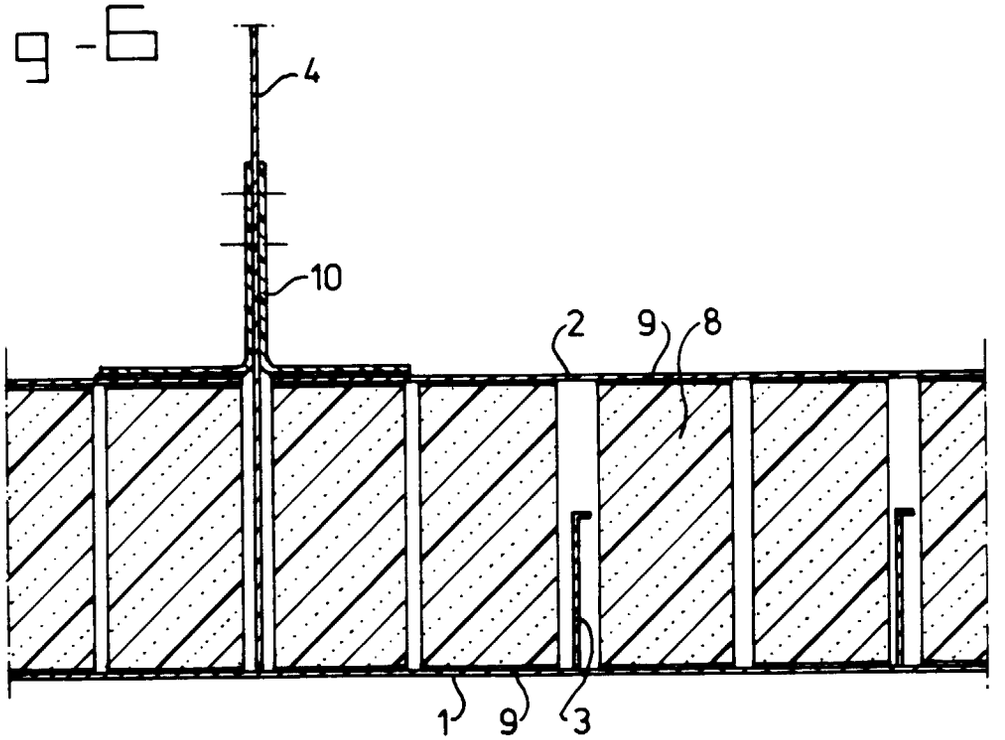


Fig-6



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EUROPEAN SEARCH REPORT

Application Number
EP 96 20 0168

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.6)
X	US-A-3 844 239 (L.MCLAUGHLIN) 29 October 1974 * column 6, line 41 - line 49; figures 8-13 *	1,3	B63B3/20 B63B25/08 B63B43/18 B63B43/10
X	EP-A-0 035 786 (P.STRAIN) 16 September 1981 * page 8, line 9 - page 9, line 13; figures *	1,3	
A	US-A-5 379 711 (E.FISCHER) 10 January 1995 * abstract; figures *	1,5,6	
A	DE-C-43 21 105 (G.KOLLMANN) 3 November 1994 * abstract; figures *	1,5,6	
A	PATENT ABSTRACTS OF JAPAN vol. 2, no. 50 (M-15), 10 April 1978 & JP-A-53 011486 (ISHIKAWAJIMA HARIMA HEAVY INDUSTRIES), 1 February 1978, * abstract *	7	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6) B63B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	25 April 1996	Stierman, E

CATEGORY OF CITED DOCUMENTS

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