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(54) **Improvements in or relating to fall arrest systems**

(57) A fall arrest assembly (11) for use, for example, with a vehicle (15) having a platform or a floor (12) elevated from the ground such as to present a fall hazard, comprising a number of impact absorbing units (19) which can be set out in an array. Each unit (19) comprises a casing (37) of flexible laminar material having a loose filling of particulate material. Restraining means (25) hold

the array of units together with at least one face of each unit (19) lying substantially in a common plane so as to define a generally level surface to receive a falling person. The fall arrest assembly (11) includes means (42, 44, 46, 48) for locating the impact absorbing units in close proximity to an edge of the platform (12) of the vehicle to minimise the gap between the array of impact absorbing units and the platform or vehicle.

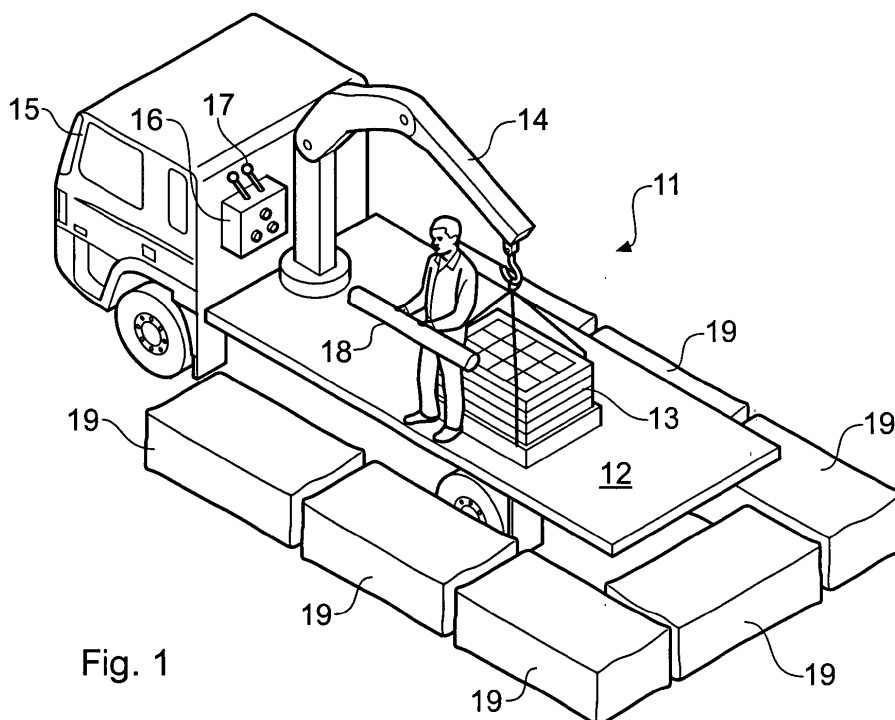


Fig. 1

## Description

**[0001]** The present invention relates generally to fall arrest systems, and in particular to an improved fall arrest system suitable for specific application in circumstances where there is a risk of a person falling from a relatively low height which is, nevertheless, sufficiently great to present a risk of injury.

**[0002]** Such situations include the bed or body of a vehicle, such as a self-unloading lorry, a platform erected or existing for performances to be visible from an arena or region other than an auditorium (although it may also be used in an auditorium) or a platform used for other purposes such as loading or unloading of goods.

**[0003]** In recent years a number of accidents have occurred when workers have been engaged in tasks on such locations. The platform or bed of a flat-bed self-unloading lorry is a particularly dangerous environment since it is elevated from the ground by four or five feet (in some cases more) (1.3 - 1.8 metres) and the terrain on which such a vehicle may be located for unloading purposes may be very irregular, containing hard protruberances and discontinuities such as rocks, bricks and other building materials scattered about, gullies or channels formed at a building site, or other similar irregularities. Frequently, a worker is required to undertake tasks whilst standing on the flat-bed of a self-unloading lorry, to engage the elements of the load (for example bricks on pallets) onto the self-unloading crane and/or to steady the load as the crane lifts and transfers the load from the flat-bed to the ground. If, in undertaking these tasks, the worker's attention is focused on the load rather than on the precise boundaries of the flat-bed of the vehicle, it can happen that he may lose his footing and fall from the edge of the bed or platform onto the ground below. Although this fall may be less than two metres, and therefore not covered by the regulations imposed by the health and safety executive, which relate to falls from greater than two metres, the consequences of such a fall may nevertheless be serious, involving strained or sprained joints, broken limbs, concussion or the like, even if they are not immediately life-threatening. The consequences of a broken limb for a manual worker include an inability to perform his or her normal functions for an extended period of time whilst the limb heals and regains its original strength, a potential loss of income and considerable inconvenience.

**[0004]** With the increased awareness of risks in industrial and commercial environments it is becoming increasingly unacceptable for workers to be allowed to function in circumstances where there are inadequate or no provisions for safely mitigating such risks, and the present invention is directed at providing a solution to the problem of preventing, or at least reducing, the consequences of accidents resulting from a fall, especially from a relatively low height.

**[0005]** According to one aspect of the present invention, there is provided a fall arrest assembly for use with

a platform or a vehicle having a platform or a floor elevated from the ground such as to present a fall hazard, said fall arrest assembly comprising a plurality of impact absorbing units in an array, each such unit comprising a casing of flexible laminar material having a loose filling of particulate material, and restraining means for holding the said array of units together with at least one face of each unit lying substantially in a common plane whereby overall to define a general surface to receive a falling person, the said fall arrest assembly including means for locating the array of impact absorbing units in close proximity to an edge of the platform or vehicle whereby to minimise the interspace between the array of impact absorbing units and the platform or vehicle.

**[0006]** The array of impact absorbing units may, in fact, be no more than a single row of such units, with the surface area of the exposed faces together extending over a sufficient region to provide a safe reception area for receiving a falling person. An array comprising several rows of impact absorbing units or even several layers of such units is envisaged within the scope of the invention.

**[0007]** Whatever the form of the array, the said restraining means may comprise a belt or band passing around the said array and acting to retain the impact absorbing units. If the array comprises more than one layer several belts or bands may be used. The impact absorbing units may be elongate, and may be cylindrical or prismatic, such as parallelepiped, and may be oriented with their longer dimension or axis upright or horizontal. In the former case the retaining belt or band may pass around a meridian plane to retain the upright units standing in the said two dimensional array. In the alternative, involving a plurality of impact absorbing units effectively lying on their sides, the retaining belt or band may lie in an azimuthal plane of the array.

**[0008]** Alternatively, the said restraining means may comprise an outer envelope within which at least one layer of the said impact absorbing units may be enclosed.

**[0009]** Rather than an enclosing envelope, of course, the array may be provided with a cover layer positionable over the said array of units to define the said common plane. It is expected that such a cover layer may not be able to provide a sufficient restraining effect to maintain the elements of the array in position on its own, and may need to be supplemental by other restraining means, such as a circumscribing belt or band or by providing all the impact absorbing units with individual interconnection means such as buckles or clasps.

**[0010]** The example, referred to above, of parallelepiped impact absorbing units is a particular example of the general form which may be considered prismatic (the cross section of the prism being triangular, square, rectangular or even involving a greater number of sides) and the array of units may be formed by orienting the units themselves on end with their axes upright.

**[0011]** The loose filling of particulate material may comprise beads, beans or grains of a crushable material such as expanded polystyrene or other plastics material

having similar physical and mechanical properties.

**[0012]** The casings of the impact absorbing units may be fabricated from a plurality of panels joined along their peripheries. The shape of the panels will depend on the form of the casing. A cylindrical casing, for example, may be made from a tubular panel with flat circular end panels, or may be made by stitching a flat rectangular panel into a tube and then attaching end panels which may be circular or elliptical. A prismatic unit may likewise be made from a rectangular panel stitched along two opposite edges to form a tube and then secured to end panels of polygonal form, namely triangular, square, rectangular etc.

**[0013]** Alternatively, a prismatic casing may be fabricated from an assembly of flat panels all joined at their peripheries, and the method of joining may be stitching, adhesive or other technique dependent on the precise nature of the material.

**[0014]** However it is formed, the junction at the peripheries of the panels is conveniently (but not necessarily) effected in such a way that the junction itself serves to encourage the casing to tend to retain a predetermined shape. For example, over-lock stitching forms a relatively stiff bead-like rib along the joined edges, effectively forming a frame-like structure.

**[0015]** The means for locating the array of impact absorbing units in close proximity to an edge of an elevated platform, or the like, may be provided by a bracing member, such as a strap or the like.

**[0016]** For example, the strap, or the like, may be positioned diagonally across one end of the assembly to secure the assembly to the elevated platform or the like. The strap may be adjustable in length to facilitate fastening to the platform, for example.

**[0017]** The bracing member may therefore provide additional stability to the safety system by preventing undesirable movement of the assembly during the fall of a worker thereon. The system may further comprise a bracing member guide. The guide may aid in the positioning of the bracing member, especially when the bracing member is positioned diagonally across an end of the assembly for example, and may also inhibit disengagement and displacement of the bracing member.

**[0018]** The present invention also comprehends a method of arresting the fall of a person from a platform or a vehicle, comprising the steps of:

- providing a plurality of impact absorbing units each comprising a flexible casing with a loose filling of particulate material;
- assembling the said plurality of impact absorbing units into an array comprising at least one row of such impact absorbing unit;
- applying restraining means to the array to hold each member of the array in position with respect to the other members, and
- locating the said array in close proximity to the edge of the said platform or vehicle.

**[0019]** The method of the invention may further comprise the step of overlaying the said array of impact absorbing units with a cover of flexible laminar material and securing the said cover in position on the said array.

**[0020]** Likewise, the method may further include the step of enclosing the said array of impact absorbing units in an envelope which acts also as the said restraining means.

**[0021]** The present invention also comprehends a safety system for a vehicle having a bed or platform elevated from the ground, comprising a two-dimensional array of individual fall arrest units, each comprising a casing containing a loose filling of particulate material, the fall arrest units being enclosed within an outer envelope which retains the units in the array in position and defines a continuous surface for receiving a falling person.

**[0022]** In all aspects of the invention the said particulate material may comprise crushable elements such as beads, beans, grains, granules or the like.

**[0023]** The safety system of the invention may further include means for engaging the outer envelope, or more generally the restraining means, to the vehicle to resist displacement of the system during unloading of the vehicle.

**[0024]** As a further refinement, there may be provided an intermediate layer between the said impact absorbing units and the outer envelope, and the said intermediate layer may be made of netting or other mesh-like material. Indeed, the outer envelope or (if provided) the cover layer, may be made of netting or mesh-like material.

**[0025]** In a further aspect of the invention a fall arrest system comprises means defining a receiving surface on which to receive a falling person, and a plurality of underlying impact absorbing units in an array each providing support for a defined portion of the receiving surface whereby to maintain it in position ready to receive a falling person.

**[0026]** In this aspect the said means defining a receiving surface may comprise a single sheet of flexible laminar material or part of an envelope enclosing the said impact absorbing units.

**[0027]** Various embodiments of the present invention will now be more particularly described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a schematic perspective view of a self unloading lorry provided with a fall arrest system in accordance with the principles of the present invention;

Figure 2 is a cut away perspective view of one embodiment of the fall arrest system of the invention; Figure 3 is a perspective view of an alternative embodiment of the fall arrest system of the invention; and

Figure 4 is a schematic perspective view of a further, and currently preferred, embodiment of the invention.

Figure 5 is a schematic perspective view of a self-unloading lorry provided with an alternative embodiment of the fall arrest system of the present invention.

**[0028]** Referring first to the drawings, a self-unloading lorry generally indicated 11 has a flat bed 12 for receiving the load, exemplified by a palette of building bricks 13. For unloading such palettes a crane 14 is provided near the cab 15 of the lorry 11, having a control valve system 16 operated by a set of levers 17 adjacent the rear of the cab 15. In use of such a vehicle, the driver, or another worker schematically indicated 18, has to climb onto the flat bed 12 to operate the levers 17 in order to engage the load 13 with the crane 14 and elevate this from the platform 12 and swing it out beyond the confines of the vehicle to enable it to be lowered onto the ground. As discussed briefly above, if, during tins operation, the operator 18 should lose his footing the consequences of a fall from the platform, which may be a distance of four or five feet (1.2 - 1.8 metres), whilst not being likely to be fatal, may nevertheless cause unacceptable injuries such as bruising, concussion strained or sprained joints or broken limbs.

**[0029]** In accordance with the principles of the present invention, this risk is mitigated by providing, around the perimeter of the flat bed 12, a plurality of fall arrest assemblies generally indicated 19 spaced along the sides of the flat bed 12 and at the rear end of the vehicle 11. These fall arrest assemblies 19 are slightly wider than they are high and of such a length that, for example, two, three or four units will be sufficient to extend along the entire length of the flat bed of a vehicle (depending on the length of the vehicle). In the embodiment shown the fall arrest assemblies 19 are 1.8 metres wide, 1.2 metres high and 2.4 metres long. Three or four units along the length of the vehicle and one unit across its tail is therefore sufficient to provide a catchment area around the entire periphery of the bed of the vehicle. One row of units is wide enough to provide an area sufficient to break the fall of a worker should he lose his footing and fall from the edge of the vehicle.

**[0030]** The internal structure of exemplary fall arrest assemblies forming embodiments of the invention is illustrated in Figures 2, 3 and 4. In Figure 2 the fall arrest assembly 19 is illustrated as being composed of a plurality of generally cylindrical impact absorbing units 20 each comprising a tubular flexible fabric casing with circular end panels 21 secured by stitching at their peripheries, generally indicated 22. A filler opening (not shown) may be provided for filling and/or emptying of the contents of the casing 20, and such contents are typically polystyrene granules or beads, although irregular chippings of expanded polystyrene may also be used. The impact absorbing units 20 are secured together by clips or buckles 23 at their ends, and at least one intermediate point by buckles 24 secured to belts or straps 25 extending between adjacent units 20. Over the entire array of units 20

extends a flexible envelope 26 having an upper catchment or receiving surface or layer 27, sides 28 and a bottom (not illustrated). Releasable fastening means such as Velcro (RTM), tie holes for a drawstring or a sliding clasp fastener may be provided to facilitate forming an opening in the envelope 26 to introduce and/or remove impact absorbing units 20.

**[0031]** In Figure 3 the alternative embodiment of the fall arrest assembly 19 comprises a plurality of prismatic impact absorbing units 29 in the form of cylindrical 'canister' shaped casings having a cylindrical side wall 30 and circular ends 31. Again, the side wall 30 is either a cylindrical tubular woven fabric or a flat element stitched along two opposite sides to form a tube. Although illustrated as circular ends 31 these may be of polygonal shape such as triangular, square, rectangular etc.

**[0032]** The prismatic impact absorbing units 29 are held in an array standing on end by a restraining belt or strap 32 passing around a meridian of the array. In this embodiment the array comprises two rows of four units 29, and in the embodiment of Figure 2 the units have a loose fill of crushable beads or beans such as expanded polystyrene or other plastics material. The loose fill may, alternatively, comprise gas-filled pockets of plastics or other impermeable material and the flexible casings comprising the walls 30 and 31 may be impermeable rather than permeable to allow a partial inflation of the casing to reinforce the impact absorbing effect of the loose fill.

**[0033]** Since the fall hazard which the fall arrest units 19 are intended to provide protection from involves only a fall from relatively low height it is not essential to ensure that the receiving surface is absolutely continuous. For this reason the open array illustrated in Figure 3 does not have an envelope or overlying cover and although the individual impact absorbing units 29 are shown as circular, and therefore a small gap, for example the gap illustrated as 33 in Figure 3, may be present, the risk of a limb of a falling person entering this gap is small, and even if it did the forces involved are unlikely to result in strain or injury. In addition to the belt or band 32 the individual units 29 may be held together by straps or buckles schematically illustrated 34 at their upper ends and possibly also at their lower ends if this is considered appropriate, although the meridian band 32 may be expected to be sufficient to retain the units 29 together in the array.

**[0034]** Turning now to Figure 4, the presently preferred embodiment comprises a two dimensional array of twelve prismatic impact absorbing units 35 each of parallelepiped prismatic form oriented with its longer side 36 upright and its end faces 37 horizontal. Each unit 35 comprises six rectangular side panels 38 of flexible fabric material secured together and two square end panels 37 secured to the side panels 38 by stitching along their peripheries with over-lock stitching to provide a secure enclosed casing. Within the casing 35 is a loose fill of particulate material which, as in the other embodiments, may be expanded polystyrene beans, grains, beads or irregularly

shaped chips or other specially shaped pieces such as S-shape or W-shape which provide a degree of interlock with one another. A filling opening, not shown, may also be provided to facilitate emptying and refilling of the casing.

**[0035]** The fall arrest assembly 19 illustrated in Figure 4 comprises three rows of four impact absorbing units 35 held together within an external envelope 39 which itself comprises a parallelepiped fabrication of flat flexible panels stitched at their peripheries to form an enclosure within which the individual impact absorbing units 35 are contained. The dimensions of the envelope 39 are such that the impact absorbing units 35 are held tightly within it and the end faces 37 each provide support for a defined area of the upper face 40 of the envelope which is, itself, held in shape by the array of twelve impact absorbing units 35 closely stacked together within it.

**[0036]** The dimensions of the impact absorbing units 35 are 1.2m high with the end faces 37 being 0.6m along each side.

**[0037]** As discussed above in relation to Figure 1, the fall arrest assemblies 19 can be positioned around the perimeter of a vehicle to provide a safe protective area around the vehicle to prevent injury in the event of a fall.

**[0038]** Referring now to Figure 5, there is illustrated a perspective view similar to that shown in Figure 1. A fall arrest assembly 19 is shown positioned on the ground adjacent to a lorry 11, having a flat bed 12. A load 13 rests upon and is supported by the flat bed 12.

**[0039]** In this embodiment, the fall arrest assembly 19 comprises a bracing member, here represented by a strap 42, and a bracing member guide 50. The strap 42 is positioned diagonally across the end panel of the outer envelope 39 of said assembly 19, and extends to an aperture 48 found in the adjacent side of the flat bed 12. In this way, the strap 42 is attached to the flat bed 12 by threading the strap 12 through the aperture 42 and tying thereto. The strap 42 is adjustable in length by means of a buckle 44, the excess strap 46 hanging loosely from the buckle 44.

**[0040]** The bracing member guide 50 is located in a corner, closest to the flat bed 12, of the panel across which the strap 42 is positioned. The bracing member guide 50 is represented by a strap substantially shorter in length than the strap 42. The strap 42 is attached to the bottom of the outer envelope 39 and extends diagonally across the end panel of the outer envelope 39, transversely beneath the bracing member guide 50, towards the aperture 48 in the flat bed 12.

**[0041]** The location of the assembly 19 is therefore substantially retained, with respect to the flat bed 12, in the event of a worker falling on the upper surface 40 of the assembly 19. This is by virtue of the additional support and securement provided by the bracing member 42.

## Claims

1. A fall arrest assembly (19) for use with a platform (12) or a vehicle (11) having a platform or a floor elevated from the ground such as to present a fall hazard, said fall arrest assembly comprising a plurality of impact absorbing units (20) in an array, each such unit comprising a casing of flexible laminar material having a loose filling of particulate material, and restraining means (23,25) for holding the said array of units together with at least one face of each unit lying substantially in a common plane whereby overall to define a general surface (27) to receive a falling person, the said fall arrest assembly including means for locating the array of impact absorbing units in close proximity to an edge of the platform (12) or vehicle (11) whereby to minimise the interspace between the array of impact absorbing units and the platform or vehicle.
2. A fall arrest assembly as claimed in Claim 1. in which the said restraining means comprises a belt or band (32) passing around the said array and acting to retain the said impact absorbing units in a single layer.
3. A fall arrest assembly as claimed in Claim 1 or Claim 2, further including a cover layer positionable over the said array of units to define the said common plane.
4. A fall arrest assembly as claimed in Claim 1, in which the said restraining means comprises an outer envelope (26) within which at least one layer of the said impact absorbing units is enclosed.
5. A fall arrest assembly as claimed in any preceding Claim, in which the said impact absorbing units (29) are generally prismatic in shape and are oriented in the array with their axes upright.
6. A fall arrest assembly as claimed in any of Claims 1 to 4, in which the said impact absorbing units are generally cylindrical in shape and are oriented in the array with their axes upright.
7. A fall arrest assembly as claimed in any preceding Claim, in which the said loose filling of particulate material comprises polystyrene beads or granules.
8. A fall arrest assembly as claimed in any preceding Claim, in which the said casings of the impact absorbing units (20) are fabricated from a plurality of panels (21) joined along their peripheries (22).
9. A fall arrest assembly as claimed in Claim 8, in which the said panels are joined by stitching.
10. A fall arrest assembly as claimed in Claim 8 or Claim

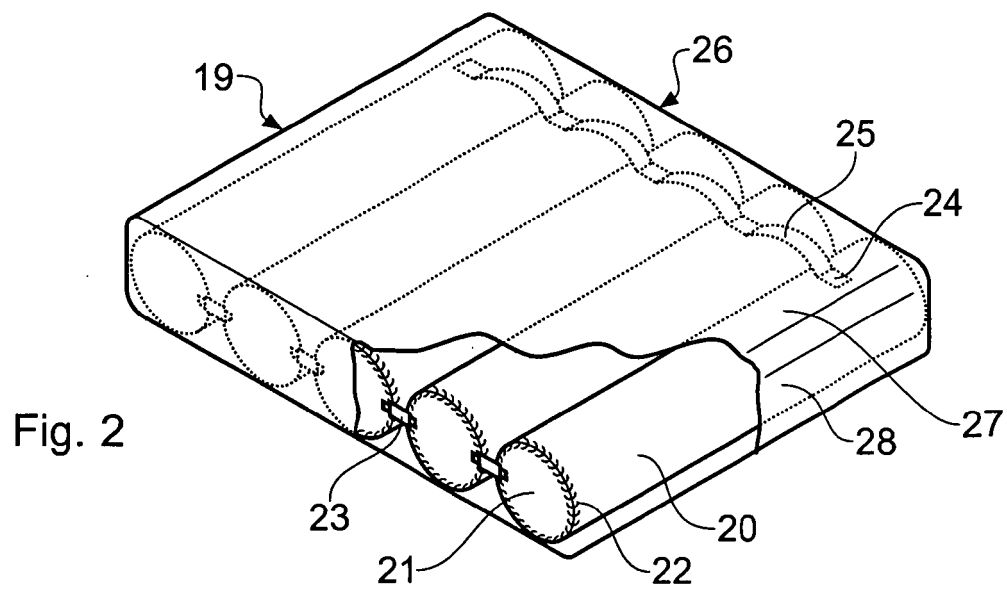
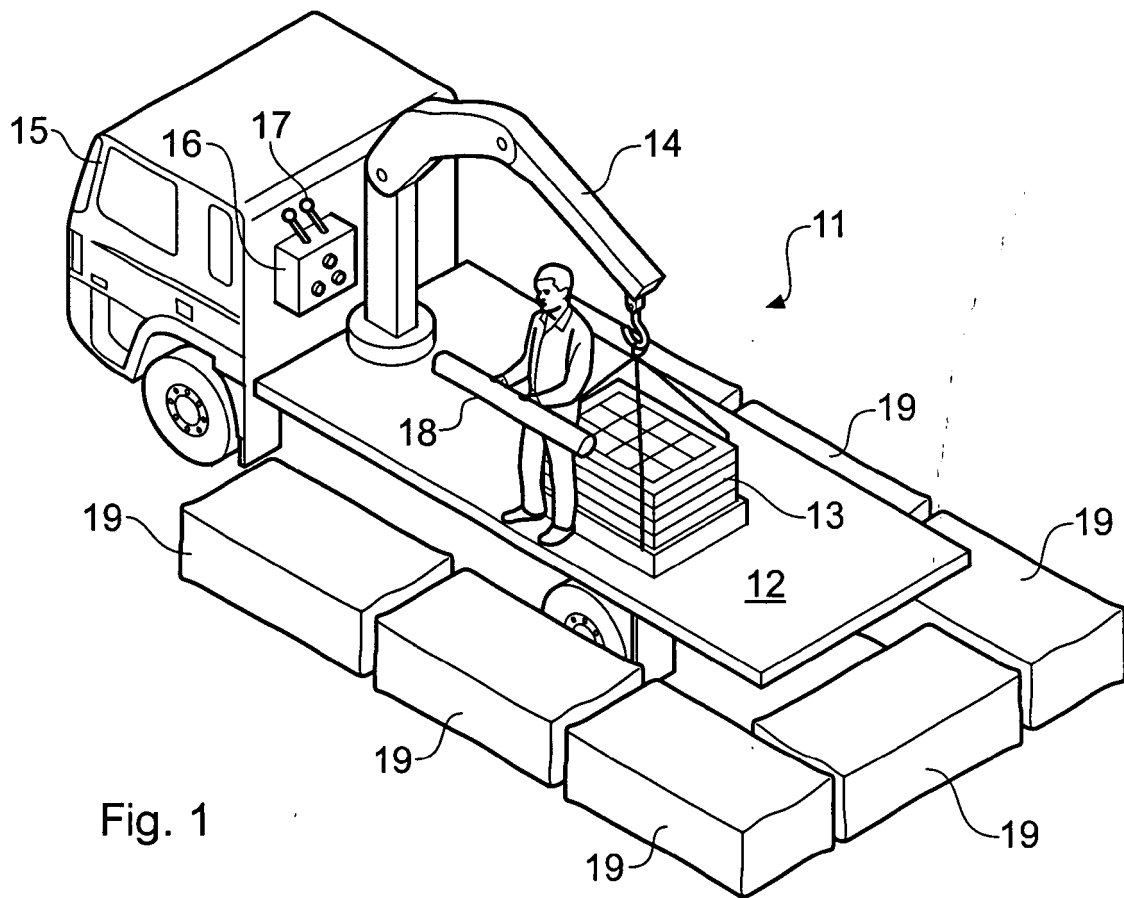
9, in which the joining of the peripheries (22) of the panels (21) is effected in such a way that the junction serves to encourage the casing to tend to retain a predetermined shape.

11. A fall arrest assembly as claimed in Claim 10, in which the joining of the said peripheries (22) is effected by overlock stitching to form a reinforced bead along the edge between two adjacent panels of a casing.
12. A fall arrest assembly as claimed in any of Claims 4 to 11, in which there is further provided an intermediate layer between the said impact absorbing units (20) and the outer envelope (26).
13. A fall arrest assembly as claimed in Claim 12, in which the said intermediate layer is made of netting or other mesh-like material.
14. A fall arrest assembly as claimed in any of Claims 4 to 13, in which the outer envelope (26) is made of netting or mesh-like material.
15. A fall arrest assembly as claimed in any preceding Claim, wherein the locating means are provided by a bracing member (42),
16. A fall arrest assembly as claimed in Claim 15, wherein the bracing member (42) comprises a strap or the like.
17. A fall arrest assembly as claimed in Claim 16, wherein the strap or the like is positioned diagonally across the end of said assembly.
18. A fall arrest assembly as claimed in any of Claims 15 to 17, further comprising a bracing member guide (50).
19. A method of arresting the fall of a person from a platform (12) or a vehicle (11) having a platform or a floor elevated from the ground such as to present a fall hazard, comprising the steps of:
  - providing a plurality of impact absorbing units (20) each comprising a flexible casing with a loose filling of particulate material;
  - assembling the said plurality of impact absorbing units (20) into an array comprising at least one row of such impact absorbing units;
  - applying restraining means (23,25) to the array to hold the members of the array in position with respect to the other members, and
  - locating the said array in close proximity to the edge of the said platform (12) or vehicle (11).

20. A method as claimed in Claim 19, further comprising

the step of overlying the said array of impact absorbing units (20) with a cover of flexible laminar material and securing the said cover in position on the said array.

21. A method as claimed in Claim 19, further including the step of enclosing the said array of impact absorbing units (20) in an envelope (26) which acts also as the said restraining means.
22. A safety system for a vehicle (11) having a bed or platform (12) elevated from the ground, comprising at least one two dimensional array of individual fall arrest units (20), each comprising a casing containing a loose filling of particulate material, the fall arrest units being enclosed within an outer envelope (26) which retains the units in the array in position and defines a continuous surface (27) for receiving a falling person.
23. A safety system as claimed in Claim 22, in which the particulate material comprises crushable beads.
24. A safety system as claimed in Claim 22 or Claim 23 further including means for engaging the outer envelope (26) to the vehicle (11) to resist displacement of the system during unloading of the vehicle.
25. A fall arrest system for a vehicle (11) having a bed or platform (12) elevated from the ground, comprising means defining a receiving surface (27) on which to receive a falling person, and a plurality of underlying impact absorbing units (20) in an array each providing support for a defined portion of the said receiving surface whereby to maintain it in position ready to receive a falling person.
26. A fall arrest system as claimed in Claim 25, in which the said means defining a receiving surface comprises a simple sheet of flexible laminar material.
27. A fall arrest system as claimed in Claim 26, in which the means defining a receiving surface comprises an envelope (26) enclosing the said impact absorbing units (20).



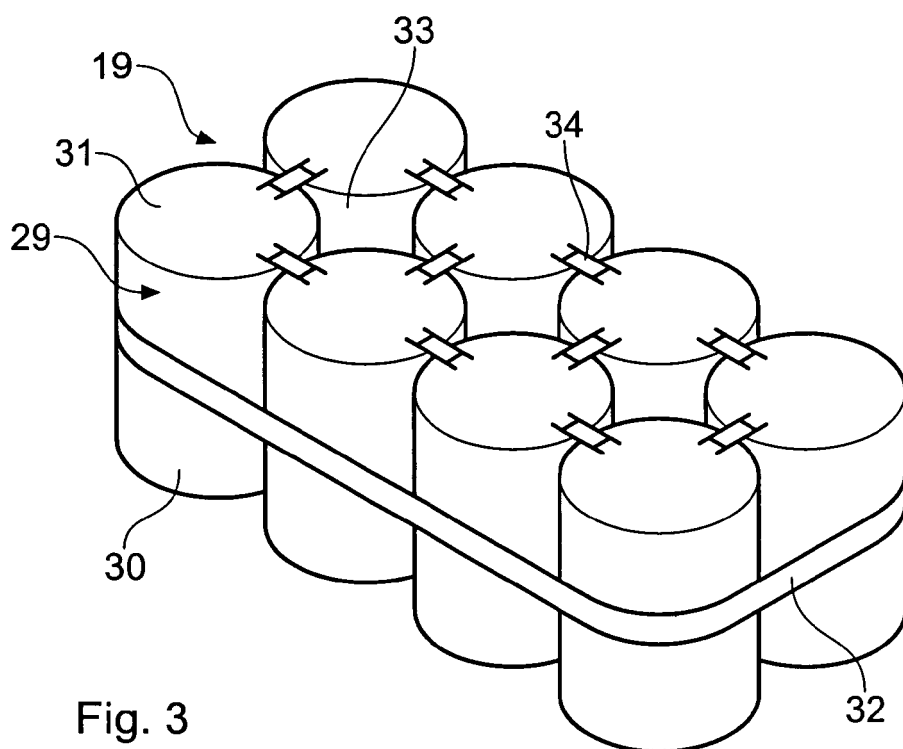


Fig. 3

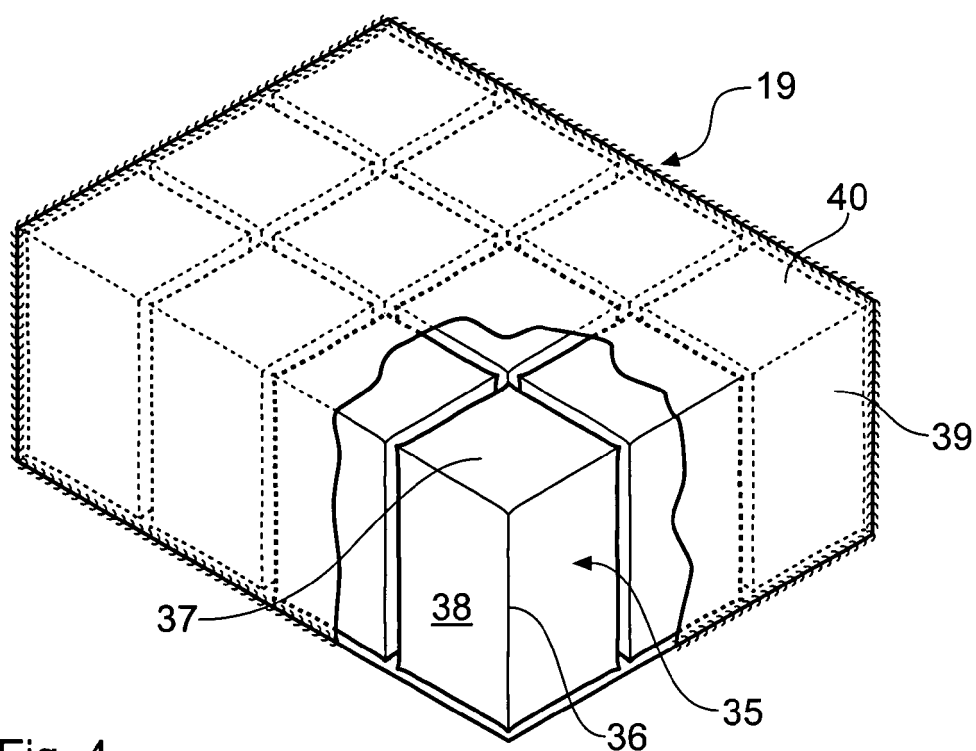


Fig. 4



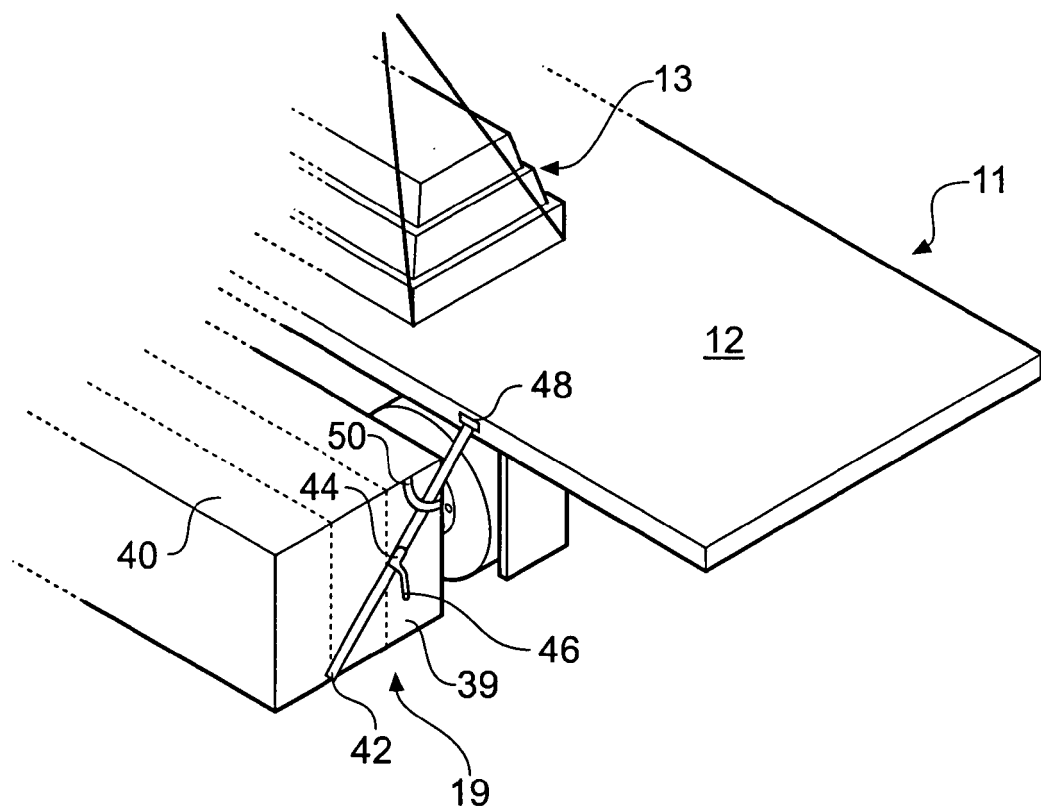


Fig. 5



European Patent  
Office

# EUROPEAN SEARCH REPORT

Application Number  
EP 06 25 3515

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 02/29180 A (PRICE CHRISTOPHER GEORGE) 11 April 2002 (2002-04-11)  * abstract; figures 1,2,6 * * page 1, line 20 - line 24 * * page 2, line 10 - line 11 * * page 3, line 1 - line 5 * * page 3, line 16 - line 21 * * page 4, line 15 - line 18 * * page 6, line 6 *	1,3-11, 14, 19-23, 25-27	INV. A62B1/22
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The present search report has been drawn up for all claims			
Place of search <b>The Hague</b>		Date of completion of the search <b>24 October 2006</b>	Examiner <b>Tempels, Marco</b>
<b>CATEGORY OF CITED DOCUMENTS</b> X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ..... & : member of the same patent family, corresponding document	

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
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EP 06 25 3515

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
The members are as contained in the European Patent Office EDP file on  
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