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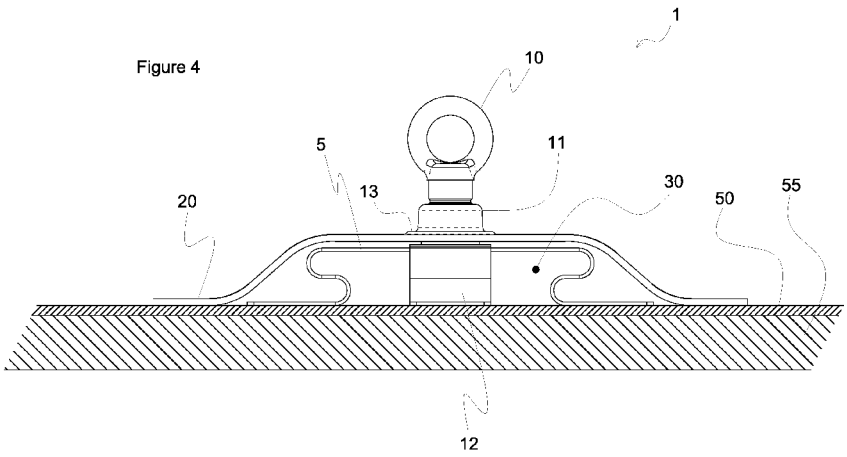
(54) Title: A FALL RESTRAINT

Figure 4



(57) Abstract: A shock absorbing roof anchor for a fall restraint. The roof anchor includes an energy absorbing base part configured to be coupled to a surface, and lanyard anchor means configured to connect a lanyard to the energy absorbing base part. The energy absorbing base part is configured to deflect in response to shock loading imposed on the lanyard anchor means. The shock absorbing roof anchor further includes a sheet of flexible covering material connected to the base part. The sheet of flexible covering material is configured to encase the base part when the shock absorbing roof anchor is mounted on a surface.

A fall restraint

The present invention relates to a safety device such as a roof anchor for a personal fall restraint or a fall arrester. The roof anchor includes anchoring means configured for receiving a lanyard interconnecting a person, via a safety harness and the roof anchor, to a surface or underlying structure. By this, a potentially lethal fall of a workman from a substantial height is prevented.

According to a first aspect, the present invention relates to a shock absorbing roof anchor for a fall restraint. The roof anchor includes:

- an energy absorbing base part configured to be coupled to a surface or underlying structure, and
- lanyard anchor means which may constitute an eyebolt. The anchor means is configured to connect a lanyard to the energy absorbing base part.

To arrest a workman's fall from an elevated surface in a controlled and non-hazardous manner, it is essential that there is sufficient energy absorption capacity built into the fall arresting system. Without built-in energy absorption, the fall of the person can only be arrested by applying large and abrupt forces to the person. The forces may easily reach a level which can result in severe injuries to the person being arrested by the system.

The most common fall arrest system is the lifeline system. The system includes a rope or lanyard which interconnects a roof anchor with a user's safety-harness.

The rope or lanyard can be a lifeline which, during arrest of a fall, stretches to lengthen the fall distance as it absorbs some of the energy.

Background

A shock absorbing roof anchor for a fall restraint of the type as described in the opening paragraphs is finding increasingly application, particularly on roofs of houses and buildings, as fastening point for a fall protection.

The shock absorbing roof anchor for a fall restraint of the type according to the present invention is first and foremost a result of the increasingly stringent regulations in respect of fall protection while work is carried out on roof tops and the like.

A safety device such as a roof anchor for a fall restraint usually comprises a base from which a fastening eye or other anchoring member extends and which is permanently fixed to the object. An example of such a safety device is known from US 5,287,944. The safety device described therein is fastened to the fixed construction of the object by means of a large number of screws and plugs. A corresponding number of holes are drilled for this purpose into the construction of the object at the set position. In this known safety device the fixing eyelet is formed as an integral part with the base.

Another example of a similar fall restraint is known from US 5,687,535.

The abovementioned two fall restraints offer solid and reliable anchor points for fall protections; they also, however, have considerable drawbacks. Owing to the rigid structure of the fall restraints, the energy of a possible fall is not absorbed by the restraints. This imposes serious forces to the falling person as any fall is stopped more or less instantaneously when the lanyard stretches.

US 2007/0144830 A discloses a fall restraint including an energy absorbing anchoring member. The anchor member constitutes a flexible floppy flap which extends substantially laterally from the anchor point of the device and which is adapted to be connected to, or be unified with, the surrounding sur-

face or roof to bring about a durable connection with same. According to the disclosure, the fall restraint further includes opposed flange like bodies accommodating in-between them a central portion of the flexible floppy flap. The flanges are configured to distribute any forces imposed on the anchor point of the fall restraint to a large area of the flexible floppy flap. The flexible floppy flap may constitute a piece of bituminous roof covering or equivalent and the flexible floppy flap may be unified with the surrounding surface by means of heat bonding or gluing etc. It is clear from the disclosure that, in case of fall of a worker, the forces are to be transferred to the roof by conveying the energy from the fall through the flexible floppy flap via the bond and then onto the roof covering material, this without interconnecting the force transferring flexible floppy flap with the roof's underlying structure. Accordingly, a fall restraint may be provided on a surface such as a roof top without compromising the integrity or tightness of the surface carrying the fall restraint. The strength or capacity of the fall restraint according to US 2007/0144830 A is, as a consequence of the on-face installation, limited to the weaker of the flexible floppy flap, the integrity of the bond and to the strength of the surrounding surface such as the surrounding roof covering material.

EP 2216466 A1 discloses a fall protection for installation on the roof of a building. This fall protection includes a thin-walled, hollow deformation part and an anchor point mounted on top of the top of the deformation part. A tensile member disposed substantially centrally inside the deformation part extends downward and is mounted so that the external force exerted to the anchor point is transferred to the fastener through the tensile member.

Brief description of the invention

The object of the present invention is to provide a fall restraint configured to:

- dampen the peak decelerating forces imposed on a person in case the person falls,
- provide maximum retaining force; the retaining force should not be limited to the integrity of a bond or to the adherence to the surrounding surface of an underlying surface,
- not compromise tightness of the surface even when the fall restraint is rigidly connected to the underlying roof, and
- allow for fast and easy installation

The above objects are met by the provision of a fall restraint according to the introductory part of this specification wherein the fall restraint further includes a sheet of flexible covering material connected to the base part. The sheet of flexible covering material is configured to encase, partially or not, the base part to define upwards closure of a cavity which, together with a surrounding surface, accommodates the energy absorbing base part when the shock absorbing roof anchor is mounted on or onto a surface.

The sheet of flexible covering material is, in accordance with the present invention, configured to comply with deflections of the base part in response to energy absorption by the base part without significantly taking up forces from the from the fall.

According to one embodiment, the outer periphery of the sheet of flexible covering material may extend beyond the outer periphery, or the legs, of base part. The outer periphery may further be configured to connect to, or with, the surface surrounding the base part.

According to one embodiment, the sheet of flexible covering material may be connected to the base part by means of the anchor fittings. The anchor fittings may extend through the flexible covering material and the base part in

one or both of the essentially central portions of one or both of the flexible covering material and the base part. Further, the anchor fittings may bring together the roof anchor under a threaded connection.

According to one embodiment, the fittings may be configured to receive, possibly in internal threads, an anchor member such as a hook or an eyebolt.

According to one embodiment, the fittings may constitute a nut disposed inside the base part, or inside a cavity or hollow defined by the base part, and a screw disposed on the outer and upper surface of the sheet of flexible covering material.

According to one embodiment, a cover support flange may be disposed in-between the base part and the sheet of flexible covering material. The support flange may be configured to guide or support the sheet of flexible covering material in the area above the base part. The flange may be connected to, or be integrated with, the sheet of flexible covering material.

According to one embodiment, the sheet of flexible covering material may constitute a sheet of bituminous roof covering. By this, easy connection, integration or bonding to a surrounding surface of bituminous roof covering may be obtained.

According to one embodiment, the base part may comprise at least three legs configured to, at their outer ends; connect to a surface, such as a roof, and to interconnect with each other to define a central portion of the base part.

According to one embodiment, the legs may be provided with one or more bends configured to at least partially unbend, and thereby absorb energy, in response to loading or shock loading imposed on the lanyard anchor means.

The one or more bends may constitute S-bends, Z-bends or C-bends or equivalent.

According to one embodiment, the base part may comprise four legs. The legs may constitute strips of metal or elongated strips of metal. The two strips may overlap each other essentially in the middle of strips such that four essentially equally sized legs are defined.

According to one embodiment, the two strips may be oriented essentially perpendicular to each other.

According to one embodiment, the legs may be joined in a central portion of the base part by fittings interconnecting the lanyard anchor means to the base part.

According to one embodiment, each of the legs may include energy absorbing zones configured to lengthen response shock loading imposed on said anchor means.

Brief description of the drawings

Figure 1 shows a principal side view of a fall restraint according to an aspect of the present invention.

Figure 2 shows a principal bottom view of a fall restraint according to an aspect of the present invention.

Figure 3 shows in perspective the top face of a fall restraint according to an aspect of the present invention.

Figure 4 shows a principal side view of a fall restraint according to an aspect of the present invention where the fall restraint is mounted on a surface.

Figure 5 shows a principal side view of a fall restraint according to an aspect of the present invention where the fall restraint is mounted on a soft roof.

Figure 6 shows a principal side view of a fall restraint according to an aspect of the present invention.

Figure 7 shows an exploded view of a fall restraint according to an aspect of the present invention.

Detailed description with reference to the figures

The invention will now be further described with reference to the figures and on basis of exemplary embodiments.

The figures are purely schematic and not drawn to scale. Some dimensions or parts may be exaggerated to a greater or lesser extent for the sake of clarity.

Corresponding parts are designated as far as possible in the figures with the same reference numerals.

Figures 1 – 5 show one embodiment of a roof anchor 1 for a fall protection according to the invention.

Figures 6 – 7 show another embodiment of a roof anchor 1 for a fall protection according to the invention.

The roof anchor comprises a base part 5 having one or more surface contacting or surface engaging feets configured for extending essentially coplanar with a surface 50 or roof top supporting the base part. The feets may be provided with through holes configured to receive screws or bolts 80 fixing the base part 5 to an underlying structure 55; possibly through insulation material 90 as shown in figure 5. The means for fixing the base part 5 to the un-

derlying structure 55 may be configured to connect to construction elements, or strength members of the surface 50 carrying the roof anchor 1.

Examples of strength members are roof rafters 55 or concrete roof decks etc.

The surface 50 may constitute a rooftop, a roofing felt, a felt roofing, an asphalt roofing, or a vertical building face and the like.

The base part 5 may, as mentioned in the introductory part of this specification, be connected to lanyard anchor means 10, 10'.

In the depicted embodiment according to figures 1–5, the lanyard anchor means 10 constitute an eyebolt 10.

In the depicted embodiment according to figures 6–7, the lanyard anchor means 10' constitute a fitting or console 10'. The fitting or console 10' may be manufactured from sheet metal and provided with two through holes; one hole for connecting means 70 configured to interconnect the base part 5, possibly via anchor fittings 11, 12, with the console 10' and one hole 75 configured to receive a not shown lanyard or equivalent.

The interconnecting means 70 may constitute a screw 70 or a rivet or equivalent.

The fitting or console 10' may be provided with bends configured orient the two through holes perpendicular to each other.

The lanyard anchor means 10, 10' may be connected to the base part 5 in a connection allowing the lanyard anchor means 10, 10' to rotate with respect to the base part 5.

In use, a not shown lanyard, or safety line, of a fall arrest harness is secured to the fixing eyelet 10, 10' extending from the base part 5. The connection

may for instance be accomplished by means of a not shown karabiner hook or snap hook.

In accordance with the invention, the shock absorbing roof anchor 1 further includes a sheet of flexible covering material 20. The sheet 20 may be connected to the base part 5 via anchor fittings 11, 12 via a through hole arranged in the sheet of flexible covering material 20.

The sheet of flexible covering material 20 may be configured to encase, or surround, the base part 5 when the shock absorbing roof anchor 1 is mounted on a surface 50 such as a roof and the like. By this, and together with the surface 50, one or more cavities 30 are defined.

As can be seen in figure 5, the base part 5 may be arranged on so-called warm roofs, or soft roofs, where the roofing membrane 50 is arranged on top of resilient insulation material 90. When the roof anchor 1 is installed on warm roofs it may be desired to provide cut-outs 91, or pockets, configured for accommodating at least partially the feets and/or the bends 6. The cut-outs 91 may or may not extend through, or partially through, the insulation material 90.

A warm roof is a type of roof construction which has an insulation layer above the structural members such as rafters or concrete decks, and immediately below its weatherproof membrane. A warm roof construction has many benefits over a traditional 'cold roof', essentially it is a 'breathable roof construction', which allows moisture to escape which in turn prevents damp and any associated decay problems. A warm roof construction allows heat to be conserved within a property – without the need for a ventilation system.

The sheet of flexible covering material 20 may be connected to a central portion of the base part 5. Further, the sheet of flexible covering material 20 may be centralised, or co aligned, with the central part of the base part 5.

The fittings connecting the sheet of flexible roof covering material 20 to the base part 5 may, in one embodiment, constitute a nut 12 and a threaded screw section 11. The threaded screw section 11 may be provided with flange means 13 configured for securing tightness between the sheet 20 and the threaded screw section 11.

In another embodiment, such as the one shown in figures 6 and 7, the sheet of flexible roof covering material 20 may be connected to the base part 5 by means of a threaded connection 76.

One part of the threaded connection, i.e. the male part or female part, may be arranged centrally on the base part 5 and extend upwards, away from any surface 50, supporting the roof anchor 1 from the base part 5. The part of the threaded connection arranged on the base part 5 may interconnect subcomponents of the base part 5, e.g. by means of welding's.

The counterpart of the threaded connection interconnects the flexible roof covering material 20 and the lanyard anchor means 10, 10' to the base part 5. By this, the base part 5 may, as an initial step, be rigidly installed a supporting structure followed by at step of mounting the roof covering material 20 on the base part by screwing the roof covering material 20 onto the base part 5.

The counter part of the threaded connection may on one end be configured for receiving the connecting means 70 configured to interconnect the base part 5 to the console and, opposite the one end, be provided with threads corresponding to the part of threaded connection provided in the base part 5.

The sheet of flexible roof covering material 20 may be configured to extend laterally from a central portion of the base part 5 and beyond any energy absorbing means 6 disposed in or on the base part 5 such that the base part 5 including any energy absorbing means 6 is enclosed completely by the sur-

face 50 carrying the roof anchor 1 and the sheet of flexible roof covering material 20.

The periphery of the sheet of flexible roof covering material 20 may, at its underside, be provided with a border or rim 22, such as shown in figure 2. The border or rim 22 may be configured for bonding with the surface 50 to which the roof anchor 1 is attached. The bonding may take place by means of application of heat, gluing, welding, bonding or by means of rigid attachment members such as screws or nails etc.

The sheet of flexible roof covering material 20 may constitute a sheet of bituminous or plastic roof-covering material or equivalent. The material chosen may be configured for fusing or gluing, at an increased temperature or not, to a similar covering material.

In the shown embodiment, the sheet of flexible roof covering material 20 extends around the outer portions of the base part 5. The sheet of flexible roof covering material 20 may constitute a square sheet. The sheet of flexible roof covering material 20 may however equally be embodied as rectangular or round or circular without departing from the present invention.

The base part 5 constitutes a base configured for transmitting loads from the lanyard anchor means 10, 11 to the surface 50 or structure to which the roof anchor 1 is mounted or connected. The base part 5 may be configured such that the base part 5 will not deflect, or deflect plastically, in response to low loads.

According to one set of regulations, the base part 5 shall be configured such that the anchor means 10, 11 is moved less than 10 mm by way of plastically deformation of the base part 5 in response to forces of 0,7 kN applied to the anchor means 10, 11.

If greater force is applied to the base part 5 via the lanyard anchor means 10, 10', 11, and it the forces are oriented approximately parallel to the bottom plane of the base part 5, the base part 5 will deflect significantly and thereby lengthen the effective stopping distance of a person falling. The base part 5 may be embodied in various ways to obtain this property however it is considered that the base part 5 according to the depicted embodiment is particularly beneficial as the base part 5 on one hand is easy and cheap to produce and, on the other hand, demonstrates satisfactory energy absorbing properties.

The depicted legs 5 are provided with bends 6 or equivalent configured to unbend or twist in response to forces applied to the anchor means 10, 11. The bends 6 may unbend or twist under plastic deformation.

As can be seen in figure 2, all four legs 5' of the base part 5 may be provided with bends 6. As the four legs 5' are rigidly connected to each other via the fittings 11, 12, which equally could constitute welds or rivets etc., all four bends 6 may facilitate dampening of the person falling. In this context, the skilled reader will realize that at least one bend 6 may at least partially unbend in response to deflection of the base part 5 while the remaining legs 5' may twist etc.

Further, the skilled reader will realize that the entire base part 5 incl. the flexible covering material 20 will deform significantly in the event a person is arrested in a fall. As a consequence, the fall restraint 1 may require replacement.

Arrangement or provision of roof anchor 1 on, for instance, a flat roof 50 provided with a bituminous roof covering, can be carried out simply and quickly with no effect on the integrity of the original roof-covering as the sheet of flexible roof covering material 20 may integrate with the surrounding roof under a heat bonding process or equivalent.

The invention has been described above on basis of only one exemplary embodiment. It will be apparent that the invention is by no means limited to this embodiment. On the contrary, many variations and embodiments are still possible within the scope of the invention for a person with ordinary skill in the art.

The different embodiments of the safety device for a fall protection according to the invention have in common that they are lightweight, easily exchangeable and can be mounted rapidly with simple means and readily available tools.

Claims

1. A shock absorbing roof anchor (1) for a fall restraint, said roof anchor (1) includes:

- an energy absorbing base part (5) configured to be coupled to an underlying structure (55), and
- lanyard anchor means (10), (10') (11) configured to connect a lanyard to said energy absorbing base part (5),

where said energy absorbing base part (5) is configured to deflect in response to shock loading imposed on said lanyard anchor means (10) **characterized in** that said shock absorbing roof anchor (1) further includes a sheet of flexible covering material (20) connected to said base part (5) and in that said sheet of flexible covering material (20) is configured to encase said base part (5) to define upwards closure of a cavity (30) which, together with a surrounding surface (50), accommodates said energy absorbing base (5) part when said shock absorbing roof anchor (1) is mounted on a surface (50).

2. The shock absorbing roof anchor according to claim 1, wherein the outer periphery of said sheet of flexible covering material (20) extend beyond the outer periphery of said base part (5) and wherein said outer periphery is configured to connect to the surface (50) surrounding said base part (5).

3. The shock absorbing roof anchor according to any one or more of the foregoing claims, wherein said sheet of flexible covering material (20) is connected to said base part (5) by means of anchor fittings (11), (12) extending through said flexible covering material (20) and said base part (5) in essentially central portions of said flexible covering material (20) and said base part (5).

4. The shock absorbing roof anchor according to claim 3, wherein said fittings (11), (12) are configured for compiling said roof anchor (1) by means of a threaded connection.

5. The shock absorbing roof anchor according to claim 3 or 4, wherein said fittings (11), (12) are configured to receive an anchor member (10).

6. The shock absorbing roof anchor according to claim 5, wherein said fittings (11), (12) constitute a nut (12) or equivalent disposed inside said base part (5) and a screw (11) disposed on the outer and upper surface of said sheet of flexible covering material (20).

7. The shock absorbing roof anchor according to any one or more of the foregoing claims, wherein a cover support flange (21) is disposed in-between said base part (5) and said sheet of flexible covering material (20).

8. The shock absorbing roof anchor according to any one or more of the foregoing claims, wherein said sheet of flexible covering material (20) constitute a sheet of bituminous roof covering.

9. The shock absorbing roof anchor according to any one or more of the foregoing claims, wherein said base part (5) comprises at least three legs (5') configured to, at their outer ends, connect to a surface (50) and to interconnect with each other to define a central portion of said base part (5).

10. The shock absorbing roof anchor according to claim 9, wherein said legs (5') are provided with one or more bends (6) configured to at least partially unbend in response to shock loading imposed on said lanyard anchor means (10), (11).

11. The shock absorbing roof anchor according to claim 9 or 10, wherein said base part (5) comprises four legs (5') defined by two strips of metal and wherein said two strips overlap each other essentially in the middle of said strips.

12. The shock absorbing roof anchor according to any one or more of the claims 9 – 11, wherein said two strips are oriented perpendicular to each other.

13. The shock absorbing roof anchor according to any one or more of the claims 9 – 12, wherein said legs (5') are joined in a central portion of said base part (5) by fittings (11), (12) interconnecting said lanyard anchor means (10) to said base part (5).

14. The shock absorbing roof anchor according to any one or more of the claims 9 – 13, wherein each of said legs (5') includes energy absorbing zones configured to lengthen response shock loading imposed on said anchor means.

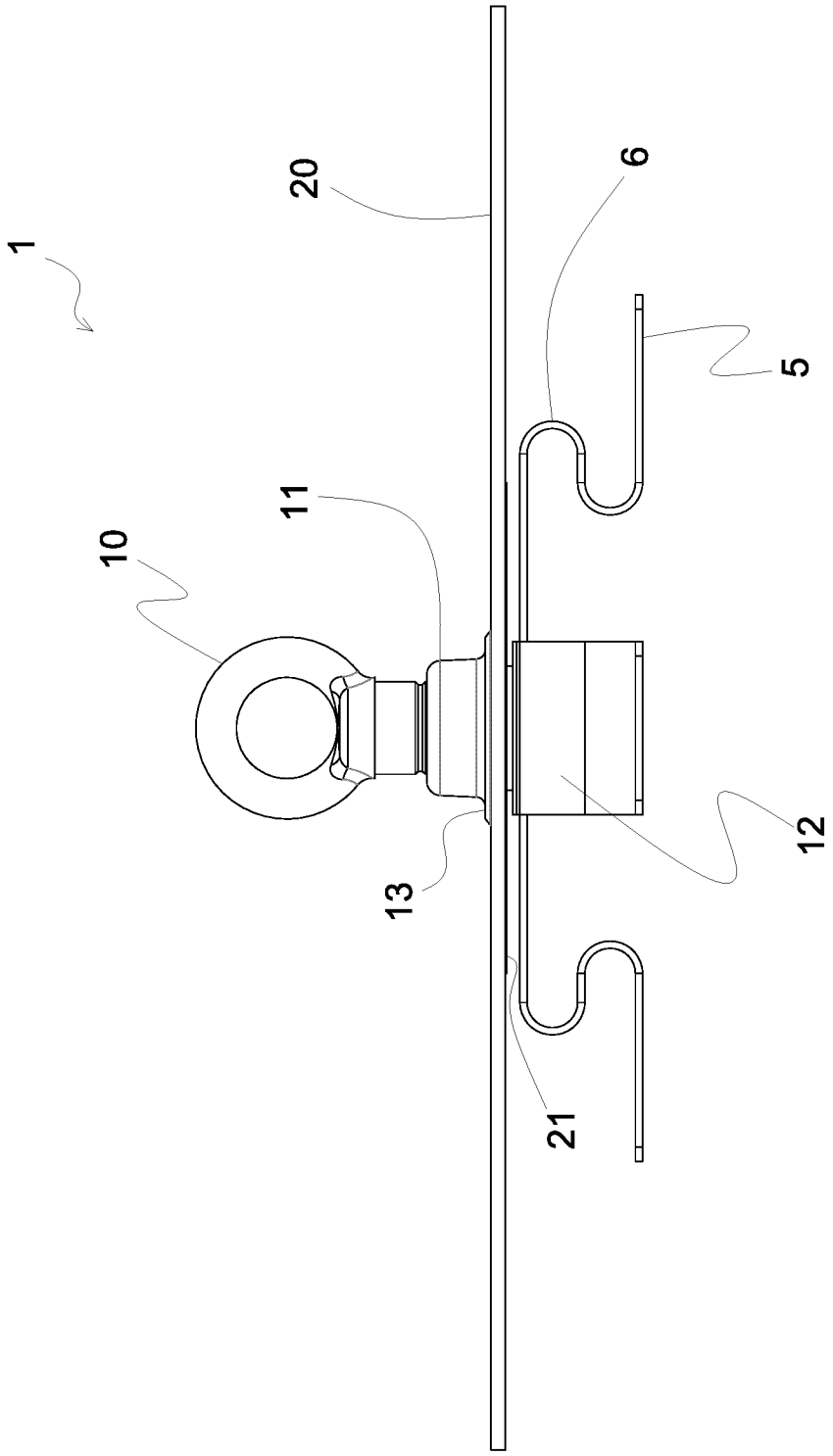
15. The shock absorbing roof anchor according to any one or more of the foregoing claims, wherein said sheet of flexible covering material (20) is configured to completely encase said base part (5) to define upwards closure of a cavity (30).

16. The shock absorbing roof anchor according to any one or more of the foregoing claims, wherein said energy absorbing base part (5) is configured to deflect plastically in response to shock loading imposed on said lanyard anchor means (10).

17. The shock absorbing roof anchor according to any one or more of the foregoing claims, wherein said lanyard anchor means (10), (10') is configured

to be 360° rotatable about an axis normal to a plane supporting said roof anchor (1).

Figure 1



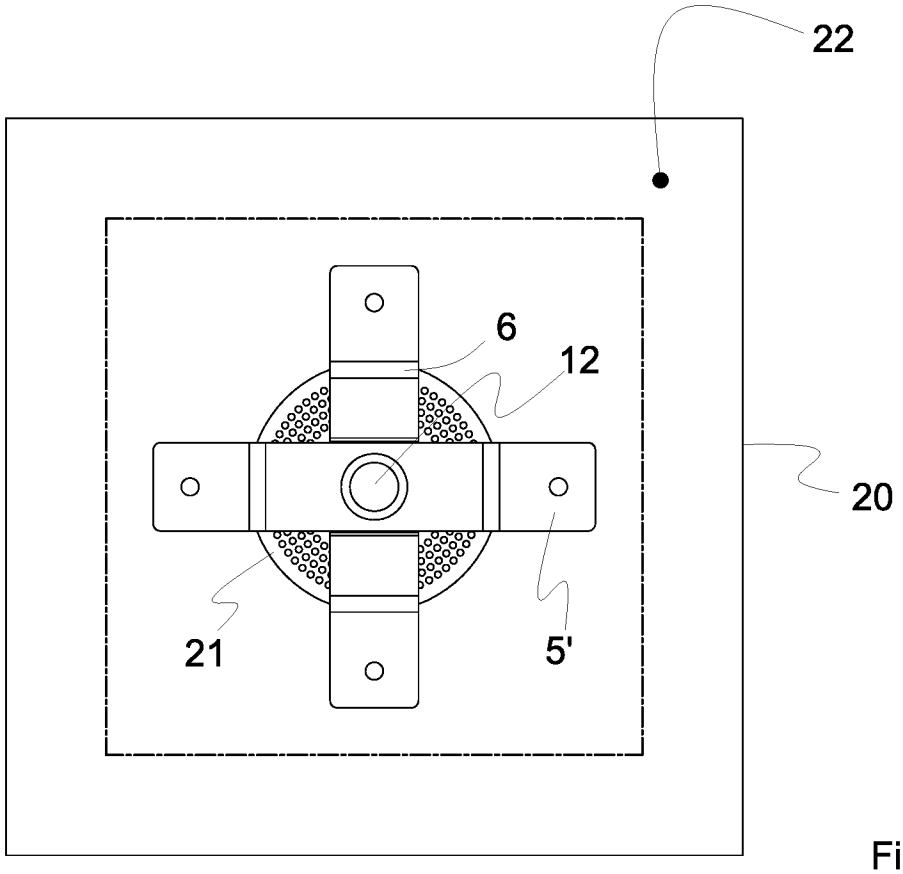


Figure 2

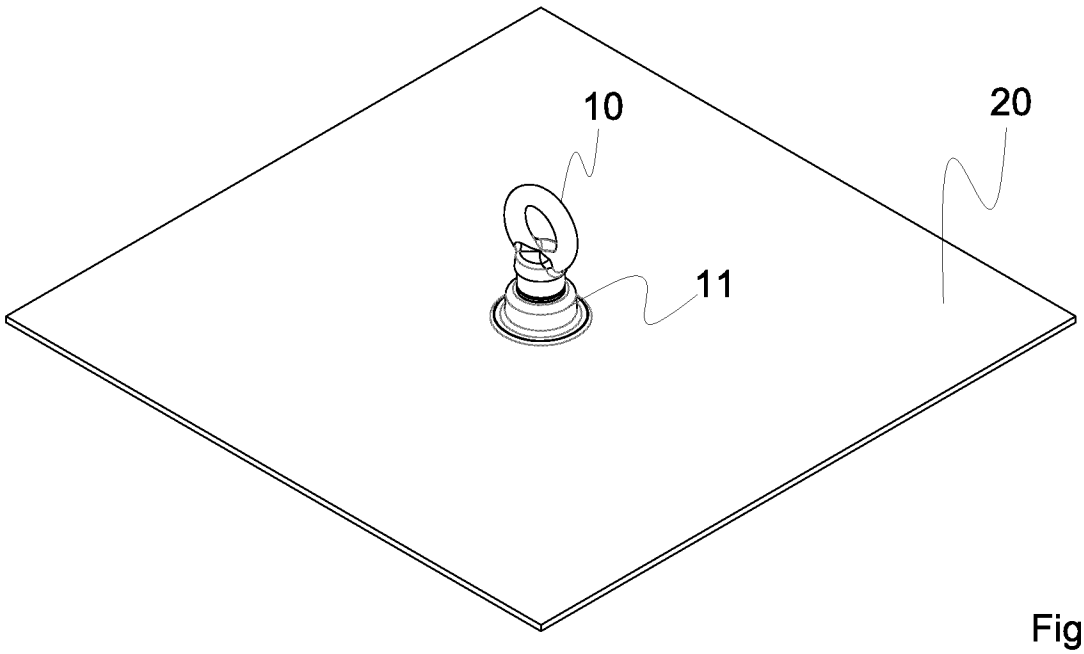


Figure 3

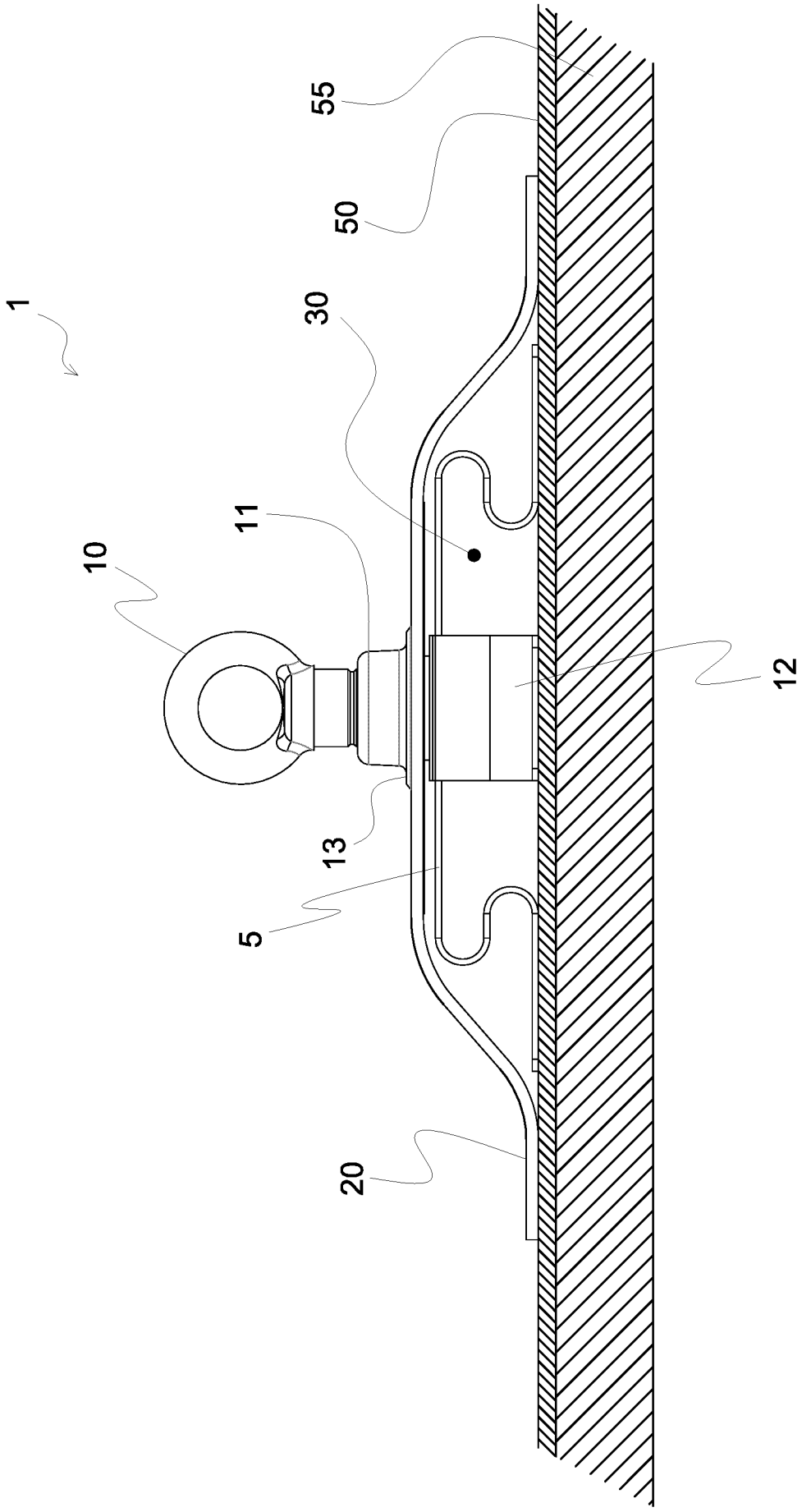


Figure 4

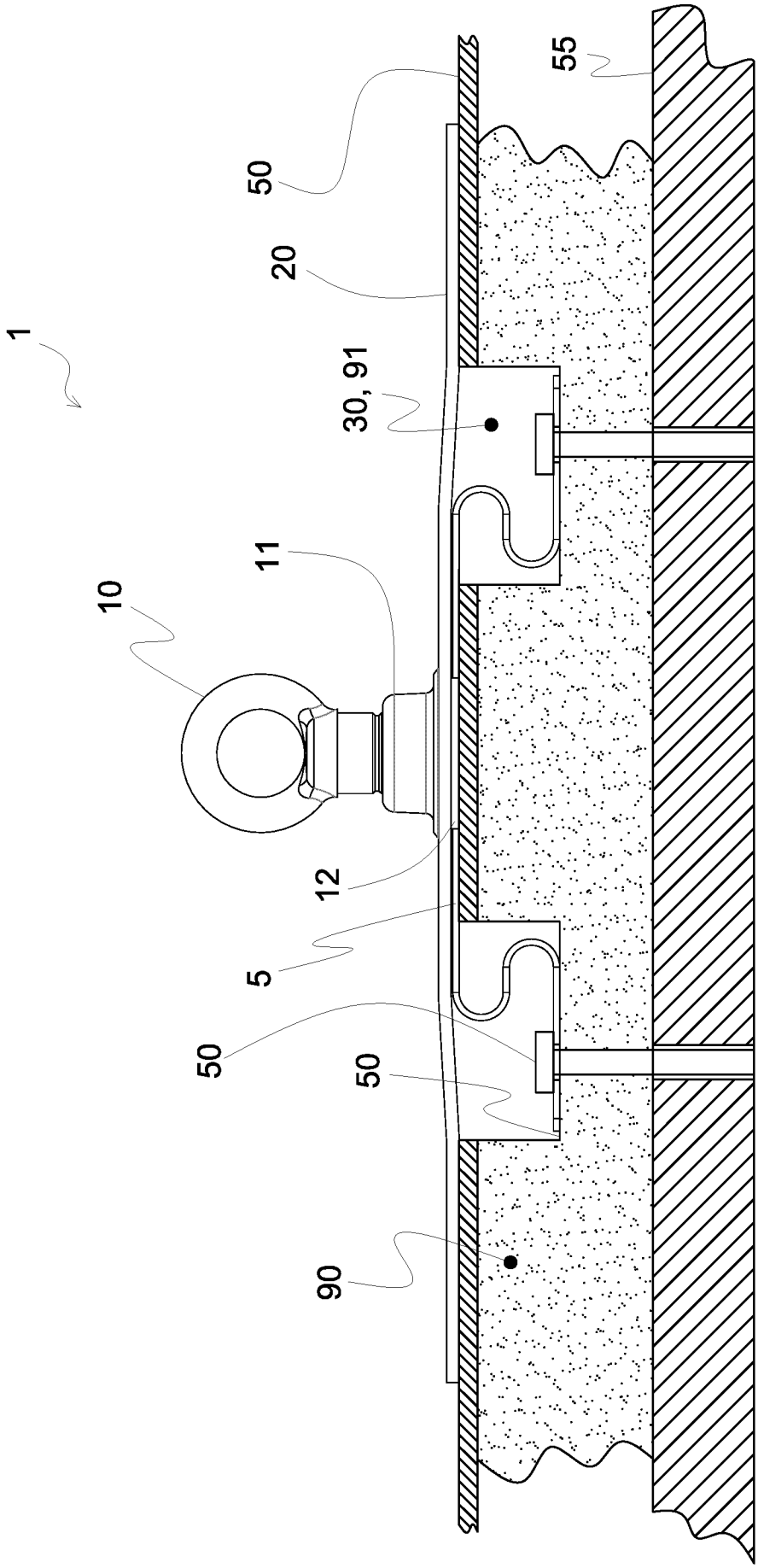
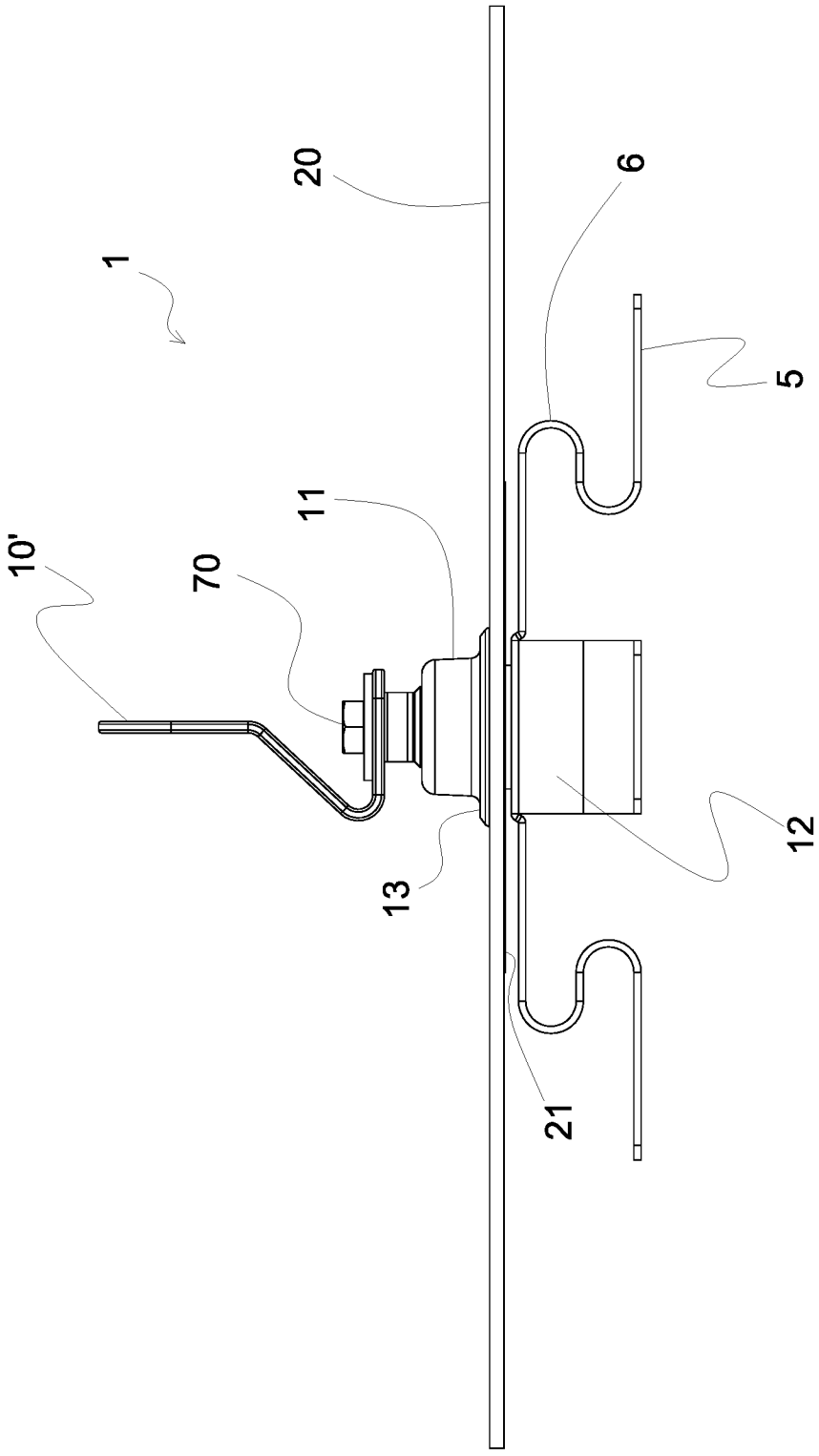


Figure 5

Figure 6



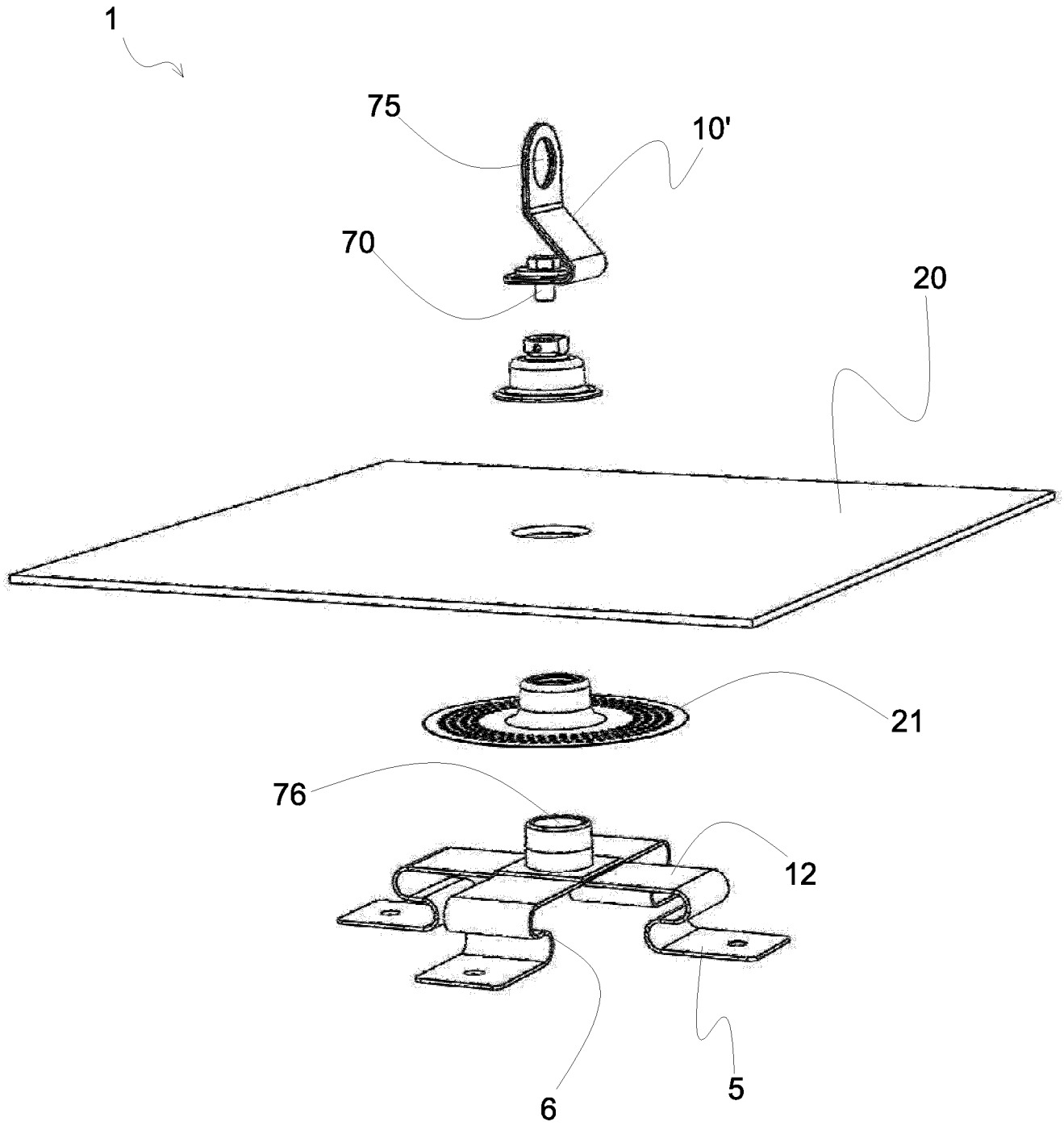


Figure 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2014/077770

A. CLASSIFICATION OF SUBJECT MATTER
INV. A62B35/00 A62B35/04 E04G21/32
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A62B E04G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1 693 533 A1 (HAERING JOERG [DE]) 23 August 2006 (2006-08-23) paragraph [0013]; figures	1-7,9-17
X	WO 2007/089139 A2 (VEILIG DAK TECHNIEK BV [NL]; VAN DER MARK HENRIK JOHANNES [NL]) 9 August 2007 (2007-08-09) page 6, line 17 - line 27; figures	1-8,15, 16
X	EP 2 317 029 A2 (VALKENHOEF BEHEER B V VAN [NL]) 4 May 2011 (2011-05-04) paragraph [0030]; figures	1-6, 15-17

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search	Date of mailing of the international search report
30 March 2015	08/04/2015

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

Information on patent family members

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