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(54) **SAFETY LINE SUPPORT, PERSONNEL FALL-ARREST SYSTEM, AND METHOD OF SUPPORTING SAFETY LINE**

(57) A safety line support, personnel fall-arrest system, and method for supporting a safety line to a structure of a construction. The support (3) comprises a connecting part (7) through which a safety line (2) is arranged, and a bracket part (8) for supporting the connecting part to structure of a construction (10). The connecting part comprises two or more ring-shaped elements (11) which are located at an axial distance from each other and are clamped around the safety line. Then the safety line is mounted immovably relative to the support.

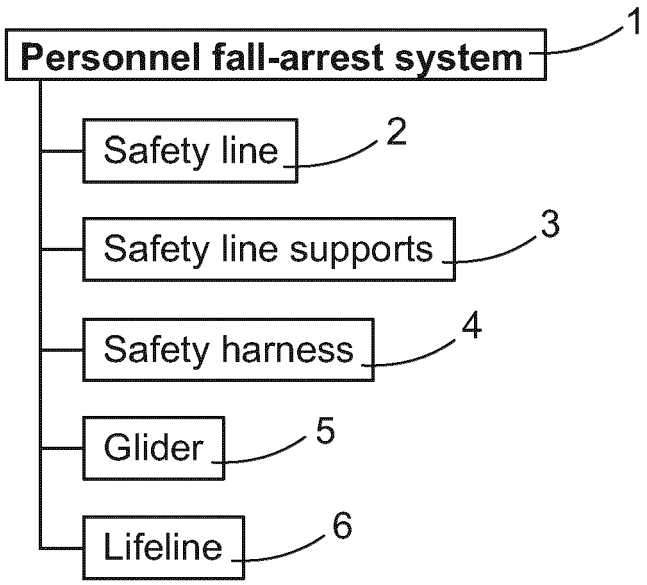

FIG. 1

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Description

Background of the invention

[0001] The invention relates to a height safety system and more particularly to a safety line support for anchoring the safety system to a structure of a building or other construction.

[0002] The invention further relates to a personnel fall-arrest system and a method for supporting a safety line.

[0003] The field of the invention is defined more specifically in the preambles of the independent claims.

[0004] When working in heights personnel fall arrest systems need to be used. Such systems serve to protect workers in situations where they would otherwise be exposed to risk of serious injury or death by falling. For example, they can be used for protecting workers on walkways running along the exteriors of structures, high above the ground. Several solutions have been proposed for providing anchor points on a roof or building structure for safety lines. However, the present solutions have shown to contain some disadvantages.

Brief description of the invention

[0005] An object of the invention is to provide a novel and improved safety line support, personnel fall-arrest system, and method for supporting a safety line to a fixed structure of a construction.

[0006] The safety line support according to the invention is characterized by the characterizing features of the first independent apparatus claim.

[0007] The personnel fall-arrest system according to the invention is characterized by the characterizing features of the second independent apparatus claim.

[0008] The method according to the invention is characterized by the characterizing features of the independent method claim.

[0009] An idea of the disclosed solution is that the safety line support comprises a connecting part through which safety line is arrangeable so that the connecting part is configured to surround the safety line, and a bracket part supporting the connecting part and comprising fastening means for anchoring the safety line support to a structure of a construction. The support has a single piece configuration, and it is formed of sheet material. Further, the connecting part comprises at least two ring-shaped elements having a common axial central line and being located at an axial distance from each other so that there is an empty space between the two ring-shaped elements. The at least two ring-shaped elements are configured to be clamped around the safety line whereby the safety line is mounted immovably relative to the support.

[0010] In other words, the safety line passes through two or more ring-shaped elements and is visible at the empty spaces between the ring-shaped elements. Thus, the connecting part is not provided with one single tube, tubular element, or continuous longitudinal opening, but instead, there are several shorter elements discontinuously arranged so that they together form a longitudinal passage for the safety line.

[0011] An advantage of the disclosed solution is that the several ring-shaped elements clamp properly around the safety line and provide firm connection between the support and the safety line. Since the connecting part comprises several ring-shaped elements, it withstands well possible deforming forces in fall situations.

[0012] A further advantage of the disclosed solution is that manufacture of the disclosed safety line support is easy and inexpensive.

[0013] According to an embodiment, width of the empty space of the connecting part of the safety line support is at least twofold compared to width of the ring-shaped element. Typically, the width of the empty space is at least threefold.

[0014] According to an embodiment, the safety line is anchored to the connecting part and is thereby immovably mounted.

[0015] According to an embodiment, the safety line support has a symmetrical structure. An advantage of this is that the symmetrical safety line support operates properly in different orientations and positions.

[0016] According to an embodiment, the connecting part has an open position for receiving the safety line in transverse direction inside the ring shaped elements, and a closed position wherein the safety line is locked immovably inside the connecting part. The safety line is easy and quick to push laterally inside the open connecting part, compared to a solution where the safety line needs to be threaded through the connecting part for the remaining length of the safety line.

[0017] According to an embodiment, the connecting part is forced to the open position by means of an internal spring force based on a bend plate material of the support. Thus, the structure is provided with a self-opening structure, which is normally open and is configured to be pressed into the closed position by means of separate fastening screws or corresponding force elements after the safety line is mounted in place.

[0018] According to an embodiment, the connecting part comprises in its open position an opening, or an open gap, which is dimensioned so that the safety line can be pushed easily inside the connecting part and it remains inside there temporarily without easily escaping out of there. Since the safety line remains inside the connecting part with this temporary hold, mounting of the safety line is facilitated. Final mounting of the safety line is executed by pressing the structure into the closed position.

[0019] According to an embodiment, each of the mentioned ring-shaped elements of the connecting part is provided with a lateral mounting opening facing towards the bracket part. The safety line is mountable inside a free space limited by the ring-shaped element through the lateral mounting opening when the connecting part is in the open position. The connecting part further comprises a locking plate protruding laterally adjacent the

mounting opening. The locking plate is configured to be forced against the bracket part by means of fastening screws for closing the mounting opening, and for setting the connecting part into the closed position.

[0020] According to an embodiment, the connecting part can be reopened, and the safety line can be removed from the support. Further, the support can be demounted from the fixed structure and can be remounted to a new location. Furthermore, also the safety line may be remounted respectively to a new location.

[0021] According to an embodiment, shape of an inner surface of each ring-shaped element is circular in a closed position of the connecting part.

[0022] According to an embodiment, the ring shaped element has cylindrical configuration wherein outer and inner cylinder surfaces are flat surfaces.

[0023] According to an embodiment, transverse dimensions of each ring shaped element are dimensioned in accordance with transverse dimensions of the safety line so that in the closed position of the connecting part a press coupling is formed between the coupling part and the safety line. In other words, the ring-shaped element comprises an inner diameter in the closed position and the safety line has a substantially circular cross-section with an outer diameter. The inner diameter of the ring-shaped element in the closed position may be dimensioned to be slightly smaller compared to an outer diameter of the safety line. Thus, when the connecting part is forced to its closed position, then press force is generated between the ring shaped element and the safety line.

[0024] According to an embodiment, the support comprises three ring-shaped elements, whereby the support comprises two edge rings, an intermediate ring between them, and two empty spaces.

[0025] According to an embodiment, the support comprises at least one tooth which is located between the ring-shaped elements and is facing towards the safety line mountable inside the ring-shaped elements.

[0026] According to an embodiment, there may be several teeth between the ring-shaped elements. Number of the teeth may be 2 - 4, for example.

[0027] According to an embodiment, the locking plate comprises at least one first fastening opening and the bracket comprises at least one second fastening opening whereby at least one fastening screw is mountable through the openings and is configured to move the locking plate against the bracket in response to tightening of the fastening screw. The locking plate has slanted orientation in the opened position of the connecting part. Further, the tightening of the fastening screw is configured to generate pressing force to the locking plate and is configured to press the slanted upper surface of the locking plate downwards and is configured to simultaneously generate lateral force component for the ring-shaped elements towards the bracket portion thereby generating tightening lateral forces to the ring-shaped elements of the coupling part.

[0028] According to an embodiment, shape of the at least one first fastening opening of the locking plate is elongated and is orientated so that its longitudinal axis is transverse to the axial direction of the connecting part. Then, relative lateral movement between the fastening screw and the locking plate is possible when the slanted locking plate is turned from the opened position to the closed position.

[0029] According to an embodiment, the disclosed support can be mounted with conventional hand tools, such as with battery driven screw drivers. No special tools and skills are needed in the mounting measures.

[0030] According to an embodiment, the locking plate of the support comprises opposite slanted axial end surfaces whereby the locking plate tapers towards its free end. An advantage of the disclosed embodiment is that a glider arranged to glide along the safety line passes smoothly the support in both travelling directions due to the slanted end surfaces.

[0031] According to an embodiment, the bracket of the support comprises a mounting part provided with at least one through opening for anchoring screws whereby the support is mountable to the fixed structure by means of screw fastening. In other words, the support is mountable in place by means of conventional hand tools. Also, the connection of the safety wire is based on screw tightening, whereby the entire system is easy and fast to mount by means of normal tools and the mounting requires no special skills.

[0032] According to an embodiment, the disclosed solution relates to a personnel fall-arrest system. The system comprises: at least one safety line; two or more safety line supports for mounting the system to a fixed structure of a construction; at least one safety harness for at least one user; at least one glider mounted movably to the safety line and allowed to pass the supports; and at least one lifeline for connecting the glider to the safety harness. The safety line support is in accordance with the features and embodiments disclosed in this document.

[0033] According to an embodiment, the safety line extends as a continuous element between several supports belonging to the system.

[0034] According to an embodiment, the safety line is a metal wire.

[0035] According to an embodiment, the safety line is a stainless steel wire.

[0036] According to an embodiment, diameter of the safety line is 4-14 mm.

[0037] According to an embodiment, the system is without any separate end terminals at distal ends of the safety line. That is because the supports are fixed to the safety line and can thereby serve as a kind of end terminals.

[0038] According to an embodiment, the system is easy to reposition. Then the connecting elements of the supports are opened, and the safety line is removed from the support. Thereafter, the supports are removed and mounted to a new place.

[0039] According to an embodiment, the supports are

mountable to an accessory structure of a roof of a building, wherein the accessory structure is a service bridge, walkway, or ladder.

[0040] According to an embodiment, the supports can be alternatively mounted directly to a roof or wall structure, or cladding. The roof or wall cladding may comprise several metallic panels fixed on a roof or wall of a building. Also, in this case the supports are mounted to a fixed structure.

[0041] According to an embodiment, the system is dimensioned to withstand load of several simultaneous users. In other words, multiple users can be simultaneously attached to the system.

[0042] According to an embodiment, the disclosed solution relates to a method for supporting a safety line to a structure of a construction. The method comprises: fastening at least two safety line supports to the fixed structure at a distance from each other; and coupling a safety line to connecting parts of the supports. The method further comprises using supports provided with at least two ring-shaped elements at their connecting parts, and forming a press coupling with the safety line and the support by pressing the ring shaped elements against the safety line.

[0043] According to an embodiment, strengthening grip between the safety wire and the support by means of at least one tooth on inner surface side of the connecting part of each support.

[0044] The above disclosed embodiments may be combined in order to form suitable solutions having those of the above features that are needed.

Brief description of the figures

[0045] Some embodiments are described in more detail in the accompanying drawings, in which

Figure 1 is a schematic diagram of a personnel fall-arrest system and its components,

Figure 2 is a schematic top view of a safety line support,

Figure 3 is a schematic view of a part of a safety line support,

Figure 4 is a schematic top view of a safety line support provided with four ring-shaped elements,

Figure 5 is a schematic side view of a safety line support in open position, and in Figure 6 the same support is in closed position,

Figure 7 is a schematic side view of a connecting part of a safety line support and a temporary locking of a safety line, and

Figure 8 is a schematic side view of a connecting part of a safety line support and operating principle of a locking protrusion.

[0046] For the sake of clarity, the figures show some embodiments of the disclosed solution in a simplified manner. In the figures, like reference numerals identify like elements.

Detailed description of some embodiments

[0047] Figure 1 discloses basic components of a personnel fall-arrest system 1. The system system comprises one or more safety lines 2 which can be mounted to a building or corresponding construction by means of two or more safety line supports 3. A user wears a safety harness 4 which is connectable to the safety line 2 by means of a glider 5 and a lifeline 6. The glider can slide along the safety line 2 in accordance with normal movements of the user on a walkway, for example. If the user falls, then the user is supported by the system. The glider is designed so that it can pass the safety line supports. Then the safety line may be long and there may be several supports at designed distances from each other. One or more user may be connected to the same system.

[0048] Figure 2 discloses a safety line support 3 comprising a connecting part 7 through which a safety line 2 is arranged. The support 3 further comprises a bracket part 8 for supporting the connecting part 7 and comprising fastening means 9 for anchoring the support 3 to a structure of a construction 10. The fastening means may comprise holes, screws, rivets, or other mechanical fastening elements for providing permanent or releasable mounting. The connecting part 7 and the bracket part 8 are inseparately connected to each other i.e., the support 3 has a single piece construction. The support 3 is made of sheet material by means or normal bending, cutting and other sheet metal work processes and tools. The support 3 may be made of steel material, such as stainless steel.

[0049] The connecting part 7 comprises two ring-shaped elements 11 having a common axial central line and being located at an axial distance from each other so that there is an empty space 12 between the two ring-shaped elements 11. The ring-shaped elements 11 are clamped around the safety line 2 so that the safety line 2 is immovable relative to the support 3. An advantage of the ring-shaped elements 11 is that when their width is relatively narrow, they deform relatively easily and can therefore be pressed against the safety line for producing the effective clamping.

[0050] Figure 3 discloses a connecting part 7 of another support 3. There are three ring-shaped elements 11a - 11c and two empty spaces 12. Further, at the empty spaces 12 may be teeth 13a, 13b or other protruding elements, or shapes for further intensifying fastening strength of the safety line. In Figure 3 there are teeth 13a, 13b in two different layers or edges on top of each other, but it may be sufficient to have the teeth only in one layer or edge. In a further embodiment, the teeth may be located on the inner and/or side surfaces of the ring-shaped elements. In Figure 3 the connecting part 7 is in its closed position CP wherein lateral mounting openings 14 are closed. The connecting part 7 can be closed by pressing a locking plate 16 against the bracket part 8 by means

of fastening screws 17.

[0051] The locking plate 16 comprises one or more first fastening openings 18 and the bracket part 8 comprises one or more second fastening openings 19 whereby one or more fastening screws 17 can be mounted and screwed through the openings 18, 19 for moving the locking plate 16. As it is shown in Figure 5 the locking plate 16 has slanted orientation in the opened position OP of the connecting part 7. In Figure 6 it is shown that tightening of the fastening screw (not shown) generates pressing force to the locking plate 16 and thereby presses the locking plate 16 downwards. Then lateral force component F (shown in Figure 3) is generated for the ring-shaped elements 11 towards the bracket portion 8 thereby generating tightening lateral forces to the ring-shaped elements of the coupling part. This tightening lateral force F is shown in Figure 3.

[0052] Figure 3 further discloses that the locking plate 16 may comprise slanted axial end surfaces 20. Then the locking plate 16 tapers towards its free end. The slanted surfaces facilitate the glider to pass the support 3.

[0053] Figure 4 discloses a support 3 wherein a connecting part 7 comprises four ring-shaped elements 11.

[0054] The bracket part 8 may comprise a mounting part 21 provided with one or more through openings for anchoring screws 9, 22 whereby the support 3 is mountable to the fixed structure by means of screw fastening.

[0055] Figure 7 shows a connecting part 7 of a support 3 in an open position OP. A safety line 2 is inserted inside ring-shaped elements 11 through their mounting openings 14. Diameter of the safety line 2 is slightly greater than size of the mounting openings 14. The safety line 2 can still be pushed inside the ring-shaped elements 11 since a locking plate 16 may yield and allow the mounting. The safety line 2 stays inside the coupling part 7 temporarily until the final fastening is done. This way mounting is quickened and facilitated.

[0056] Figure 8 shown that a protrusion or tooth 13 may move together with a locking plate 16 and may be pushed in a closed position CP against a safety line 2.

[0057] The drawings and the related description are only intended to illustrate the idea of the invention. In its details, the invention may vary within the scope of the claims.

Claims

1. A safety line support (3) comprising:

   a connecting part (7) through which a safety line (2) is arrangeable so that the connecting part (7) is configured to surround the safety line (2); and
   a bracket part (8) supporting the connecting part (7) and comprising fastening means (9) for anchoring the safety line support (3) to a structure of a construction (10) ;
   characterized in that
   the support (3) has a single piece configuration and is formed of sheet material;
   the connecting part (7) comprises at least two ring-shaped elements (11) having a common axial central line and being located at an axial distance from each other so that there is an empty space (12) between the two ring-shaped elements (11); and
   the at least two ring-shaped elements (11) are configured to be clamped around the safety line (2) whereby the safety line (2) is mounted immovably relative to the support (3).

2. The support as claimed in claim 1, **characterized in that**
   the connecting part (7) has an open position (OP) for receiving the safety line (2) in transverse direction inside the ring shaped elements (11), and a closed position (CP) wherein the safety line (2) is locked immovably inside the connecting part (7).

3. The support as claimed in claim 2, **characterized in that**

   each of the ring-shaped elements (11) of the connecting part is provided with a lateral mounting opening (14) facing towards the bracket part (8);
   the safety line (2) is mountable inside a free space (15) limited by the ring-shaped element (11) through the lateral mounting opening (14) when the connecting part (7) is in the open position (OP);
   the connecting part (7) further comprises a locking plate (16) protruding laterally adjacent the mounting opening (14); and
   the locking plate (16) is configured to be forced against the bracket part (8) by means of fastening screws (17) for closing the mounting opening (14), and for setting the connecting part (7) into the closed position (CP).

4. The support as claimed in any one of the preceding claims 1 - 3, **characterized in that**
   shape of an inner surface of each ring-shaped element (11) is circular in a closed position (CP) of the connecting part (7).

5. The support as claimed in any one of the preceding claims 1 - 4, **characterized in that**
   transverse dimensions of each ring shaped element (11) are dimensioned in accordance with transverse dimensions of the safety line (2) so that in the closed position (CP) of the connecting part (7) a press coupling is formed between the connecting part (7) and the safety line (2).

6. The support as claimed in any one of the preceding

claims 1 - 5, **characterized in that**
the support (3) comprises three ring-shaped elements (11), whereby the support (3) comprises two edge rings (11a, 11c), an intermediate ring (11b) between them, and two empty spaces (12).

7. The support as claimed in any one of the preceding claims 1 - 6, **characterized in that**
the support (3) comprises at least one tooth (13, 13a, 13b) which is located between the ring-shaped elements (11) and is facing towards the safety line (2) mountable inside the ring-shaped elements (11).

8. The support as claimed in any one of the preceding claims 3 - 7, **characterized in that**

the locking plate (16) comprises at least one first fastening opening (18) and the bracket part (8) comprises at least one second fastening opening (19) whereby at least one fastening screw (17) is mountable through the openings (18, 19) and is configured to move the locking plate (16) against the bracket part (8) in response to tightening of the fastening screw (17);
the locking plate (16) has slanted orientation in the opened position (OP) of the connecting part (7); and
the tightening of the fastening screw (17) is configured to generate pressing force to the locking plate and is configured to press the slanted upper surface of the locking plate (16) downwards and is configured to simultaneously generate lateral force component (F) for the ring-shaped elements (11) towards the bracket portion (8) thereby generating tightening lateral forces to the ring-shaped elements (11) of the connecting part (7).

9. The support as claimed in any one of the preceding claims 1 - 8, **characterized in that**
the locking plate (16) comprises opposite slanted axial end surfaces (20) whereby the locking plate (16) tapers towards its free end.

10. The support as claimed in any one of the preceding claims 1 - 9, **characterized in that**
the bracket part (8) comprises a mounting part provided with at least one through opening for anchoring screws (9, 22) whereby the support (3) is mountable to the structure by means of screw fastening.

11. A personnel fall-arrest system (1) comprising:

at least one safety line (2);
at least two safety line supports (3) for mounting the system (1) to a structure of a construction (10);
at least one safety harness (4) for at least one user;
at least one glider (5) mounted movably to the safety line (2) and allowed to pass the supports (3); and
at least one lifeline (6) for connecting the glider (5) to the safety harness (4);
characterized in that
the safety line support (3) is in accordance with any one of the preceding claims 1 - 10.

12. The system as claimed in claim 11, **characterized in that**
the supports (3) are mountable to an accessory structure of a roof of a building, wherein the accessory structure is a walkway or ladder.

13. The system as claimed in claim 11 or 12, **characterized in that**
the system (1) is dimensioned to withstand load of several simultaneous users.

14. A method for supporting a safety line (2) to a structure of a construction (10),
wherein the method comprises:

fastening at least two safety line supports (3) to the structure (10) at a distance from each other; and
coupling a safety line (2) to connecting parts (7) of the supports (3);
characterized by
using supports (3) provided with at least two ring-shaped elements (11) at their connecting parts (7); and
forming a press coupling with the safety line (2) and the support (3) by pressing the ring shaped elements (11) against the safety line (2).

15. The method as claimed in claim 14, **characterized by**
strengthening grip between the safety line (2) and the support (3) by means of at least one tooth (13, 13a, 13b) on inner surface side of the connecting part (7) of each support (3).

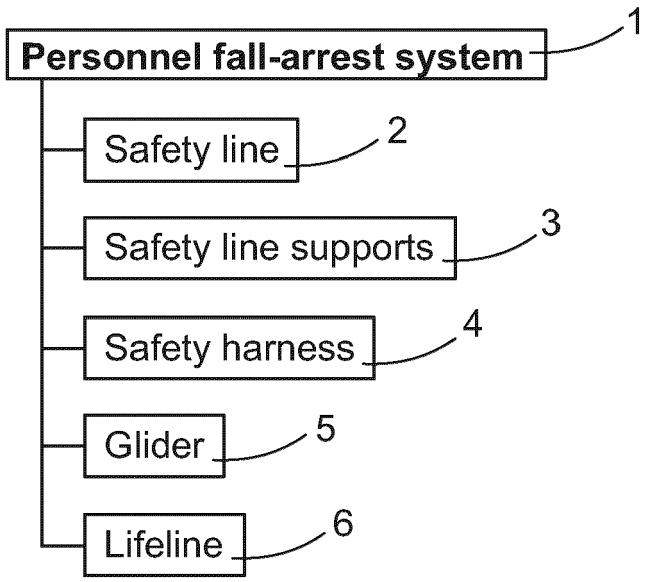
Personnel fall-arrest system
1
Safety line
2
Safety line supports
3
Safety harness
4
Glider
5
Lifeline
6

FIG. 1

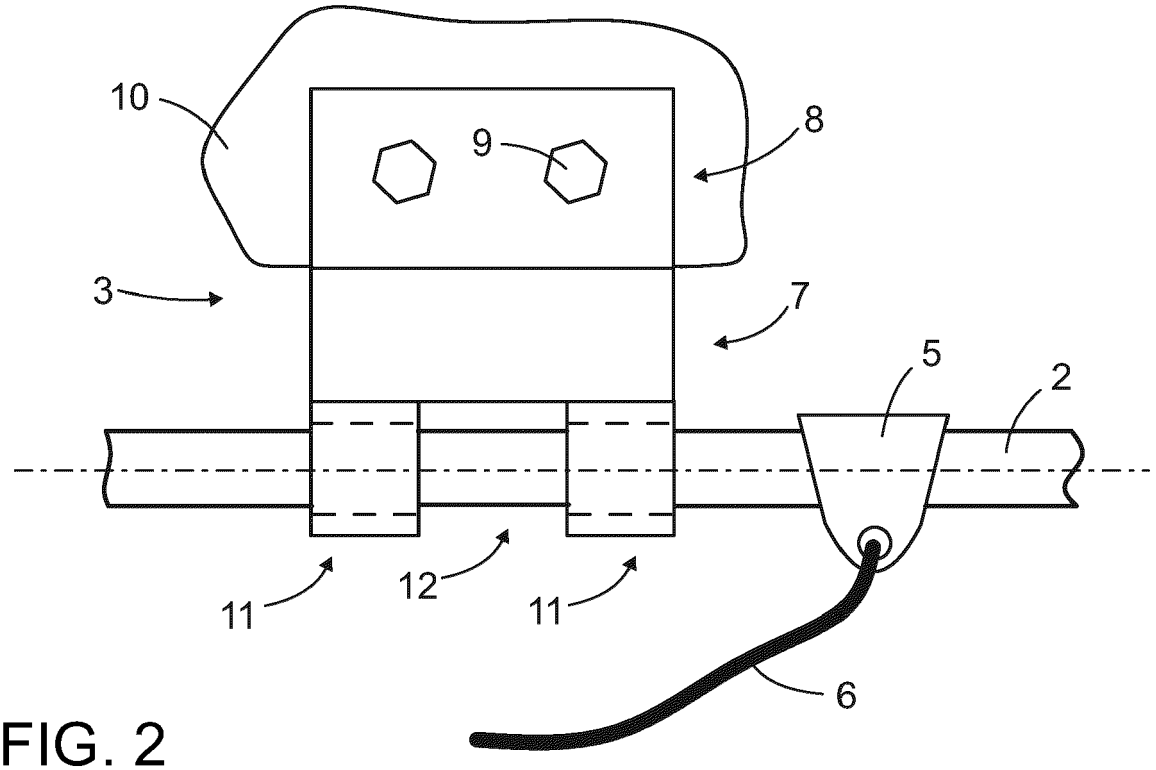
10
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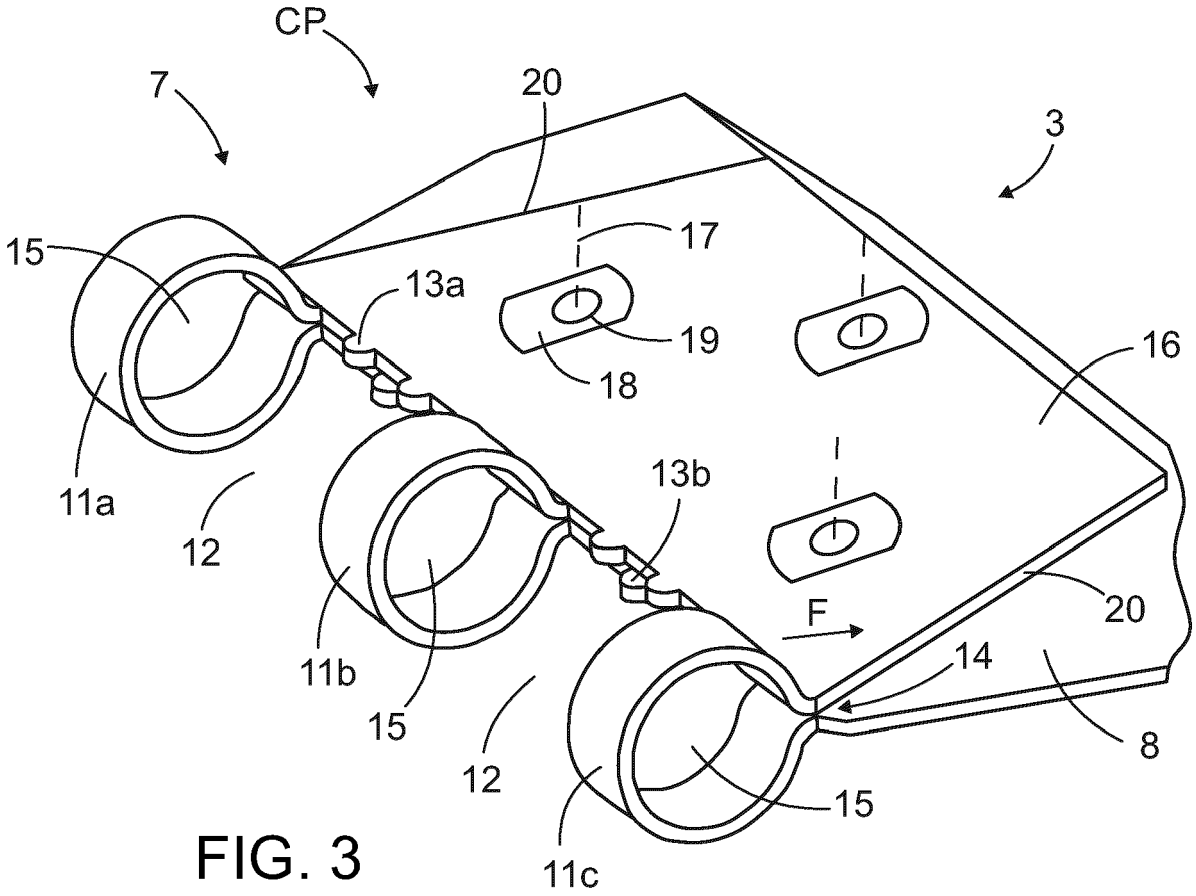
FIG. 2


CP
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13b
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11b
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12
8
15
11c

FIG. 3

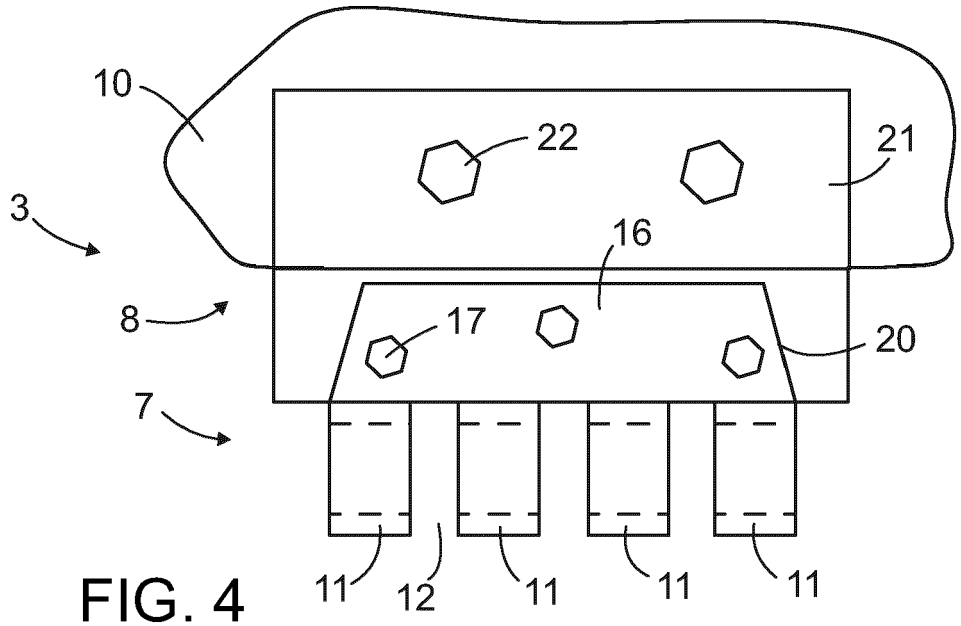
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FIG. 4

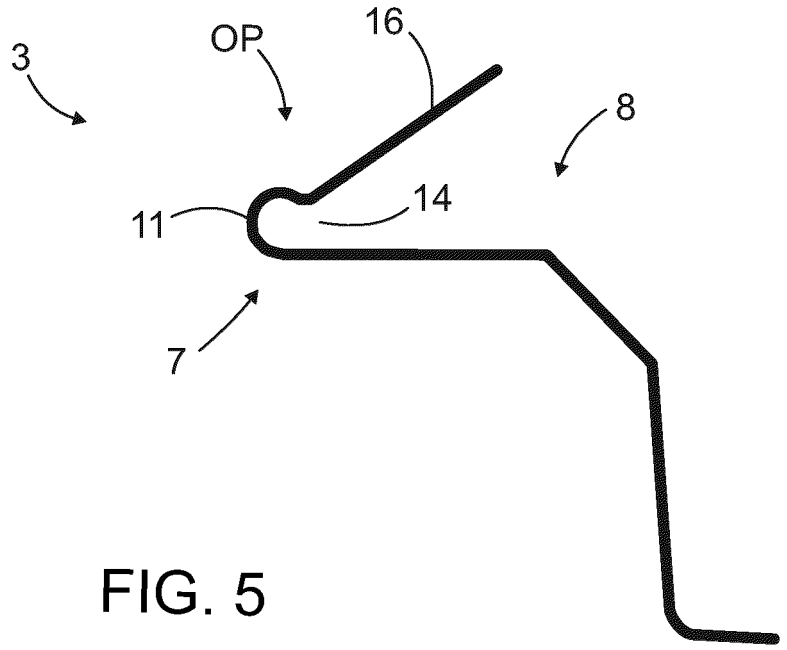

FIG. 5

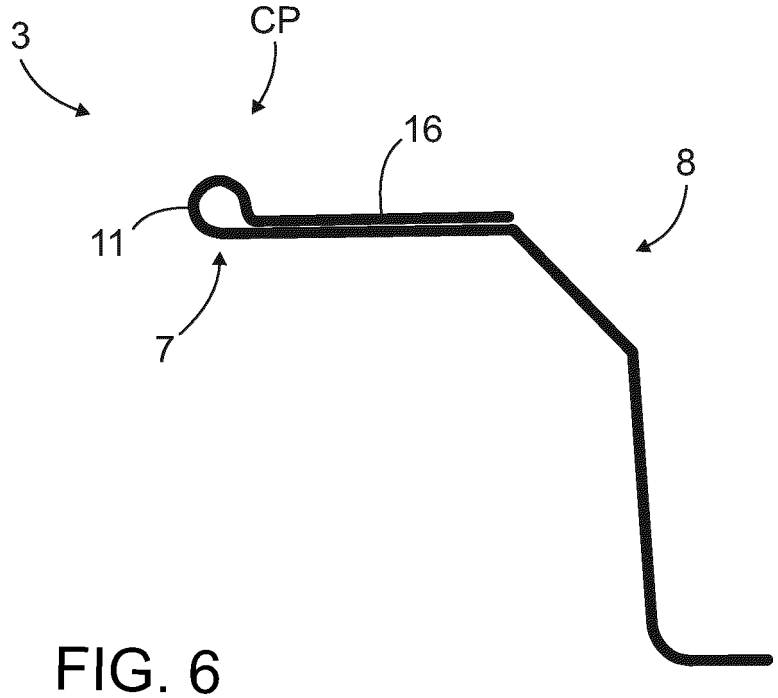

FIG. 6

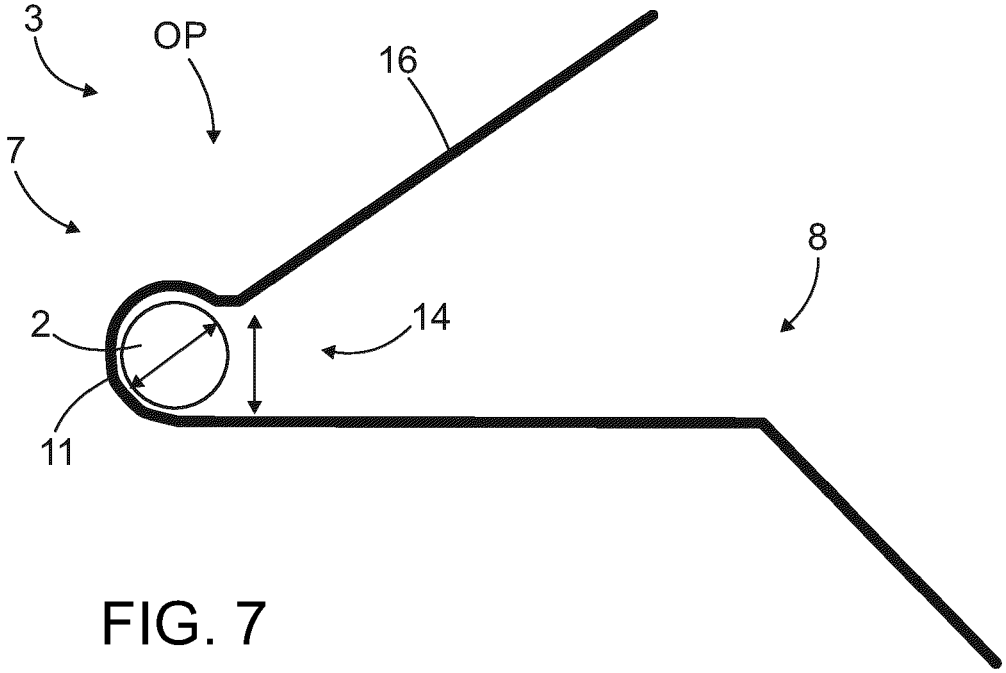

FIG. 7

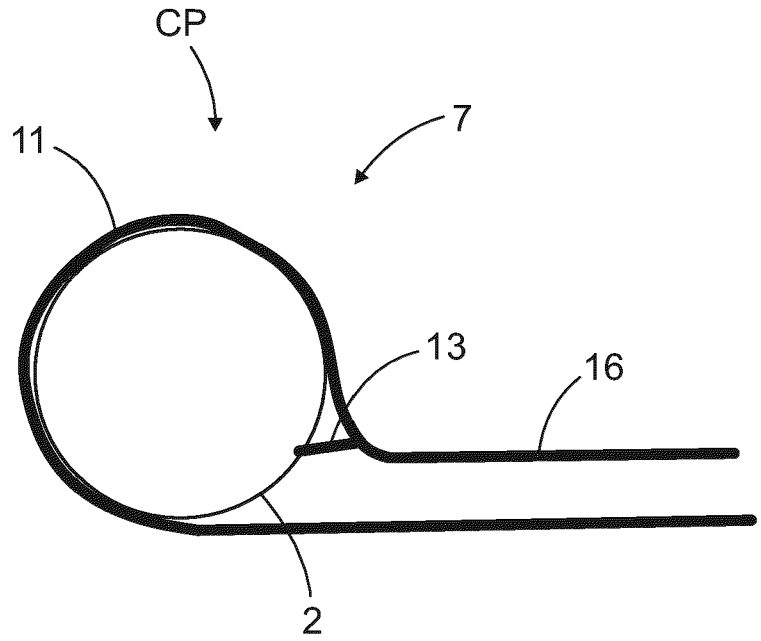

FIG. 8

Europäisches Patentamt
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EUROPEAN SEARCH REPORT

Application Number
EP 21 20 2996

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y A	DE 10 2012 110659 B4 (BORNACK GMBH & CO KG [DE]) 4 September 2014 (2014-09-04) * paragraph [0054] - paragraph [0056] * * paragraph [0060] - paragraph [0061] * * figures 3,5 *	1-6,8, 10-14 7,9,15	INV. A62B35/00
Y A	EP 1 632 271 B1 (FALLPROTEC S A [LU]) 16 February 2011 (2011-02-16) * paragraph [0018]; figure 1 *	1-6,8, 10-14 7,9,15	
A	US 2020/392748 A1 (FABBI CHRISTOPHER [CA]) 17 December 2020 (2020-12-17) * figures *	1,12,13	
			TECHNICAL FIELDS SEARCHED (IPC) A62B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	17 March 2022	Nehrdich, Martin

CATEGORY OF CITED DOCUMENTS

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17-03-2022

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