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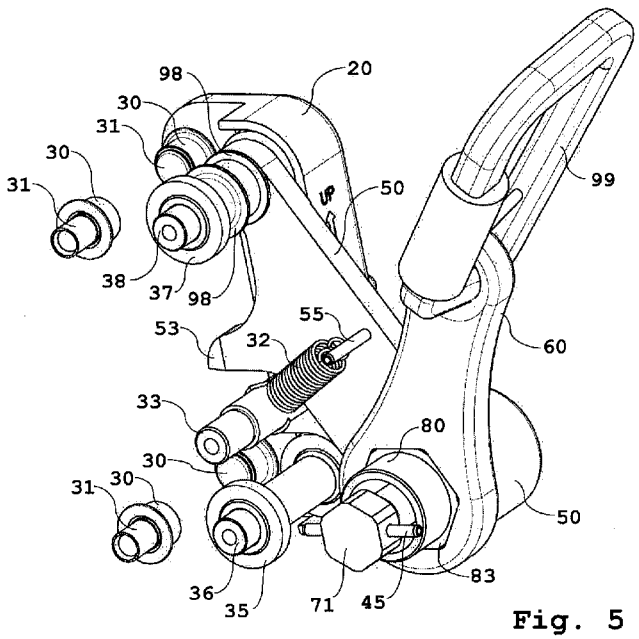


Fig. 5

(57) Abstract: A fall arrester with torsional energy absorbing means, capable of sliding along a guide rail is disclosed. Fall arrester is composed of left housing (10) and the mirror shaped right housing (20) which are permanently connected together via shafts (33, 38, 38); pawls (40, 50) that are pressed towards the guide rail (90) via spring (32); and lever (60) for engaging the energy absorbing means. The energy absorbing means is composed of the torsion stick (70) attached by its one end (71) to the pawl (40) and with another end (72) with the cylinder (80) that can freely rotate within the pawl (50). When lever (60) is engaged, it rotates cylinder (80) which transmits the force to the end (72) of the torsion stick (70), while the opposite end (71) remains stationary, causing that torsion stick (70) absorbs the energy of a falling body.

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FALL ARRESTER WITH TORSIONAL ENERGY ABSORBING MEANS

DESCRIPTION

Technical Field

The present invention discloses a novel fall arrester with torsional energy absorbing means. Therefore, the technical filed of the invention belongs to the life-saving devices, more particular to fall arresters capable of sliding along a guide rail with energy absorbing means.

Technical Problem

Fall arresters are known to be movable along a guide rail of a climbing protection system and to have one or more rotatable mounted pawls which, in the event of a fall, engage against catching stops or slots in the guide rail. By engaging the catching stops or slots, the fall arrester is stopped in the guide rail to arrest a user from falling further. A connecting element of the fall arrester transmits the force to pawls from the user which is secured to the connecting element by a lanyard or other suitable attaching device.

Several types of energy absorbing means are known in the art to be used in fall arresters. The most used are energy absorbing means where permanent deformation of material is used at the energy absorbing means. Another class of solutions use elastic property of material, in the form of elastomers, to absorb the energy of a falling body. All of the mentioned fall arresters work well with the presumption that energy absorbing means is durable enough to absorb the energy without being broken. Considering the fact that deformation properties and elastic properties of any material are highly temperature dependent such presumption can be dangerous. The elastic properties are rather different at +50°C and -30°C; and the motivation for the present invention is to overcome this potentially dangerous issue.
The first technical problem solved with the present invention is to make fall arrester safe regarding the sudden braking of the energy

absorbing means into two or more pieces. Even if the energy absorbing means broke the fall arrester have to remain safe, eventually producing stronger whiplash injuries. The present invention solves that issue by incorporating the energy absorbing means into the structural parts of the arrester in the way that the absence or damage of the absorbing means, i.e. torsion stick, does not alter the functional properties of the fall arrester.

As noted above, whiplash injuries can arise from the fact that falling body is abruptly stopped from falling and the body inertia produces injuries under rapid deceleration. The idea behind the energy absorbing means is to minimise the stopping force, i.e. force used for material deformation or the force used to stretch the material. Available kinetic energy of the falling body has to be converted in the work that is the path integral of scalar product of the stopping force vector and the differential of the said path vector; which is absorbed by the energy absorbing means. The natural way to control the stopping force is to increase the path on which the work is done. Also, it is important that the stopping force is as constant as possible in time - that is hard to achieve by deformations that include twisting or tearing of the material used for the energy absorbing means.

The second technical problem solved with the present invention is the construction of the energy absorbing means, in the form of torsion stick. Namely such torsion stick is capable to absorb the stopping energy in the uniform manner and to elongate the stopping force path of the torsion lever to which the falling body acts.

Previous State of Art

The previous state of art has many documents discussing the improvements in the field of fall arresters with energy absorbing means.

Document US 2015/0129357 A1 „Guided type fall arrester - body control system"; inventor Roth M.; discloses the fall arrester where C-shaped connecting element is deformed under the energy of a falling body. It is obvious that if connecting element breaks the safety is compromised. It should be noted that this may happen due to the structural defects in the material which is not detectable by the standard visual inspection.

Document EP 2318635 B1 „Electronically controlled catching device for a fall protection system"; inventors Faye N. et al., discloses advanced fall arrester. However, the energy absorption means is still C-shaped connecting element that is deformed under the energy of a falling body.

Document US 2014/0020988 A1 „Rope grab"; inventors Sacebolt C. S. et al.; discloses fall arrester with the S-shaped connecting element which is deformed under the energy of a falling body and serves as the energy absorption means.

Document WO 99/49939 A1 „Catching device for a system for protecting persons working at heights"; inventors Skade T. et al.; discloses series of differently shaped connecting elements for the fall arresters, which are deformable under the energy of a falling body. The connecting elements are equipped with the web that should be teared before the deformation occurs - defining by that the minimum activation force of device.

Document DE 202009017362 U1 „Falldämpfer für ein Steig- oder Kletterschutzsystem"; discloses variously shaped connecting elements, made of reinforced elastomers, which are deformed under the energy of falling body and absorb the energy.

Document WO 2010/079344 A1 „Fall arrest system"; inventor Jones K.; discloses a fall arrest safety where an energy absorbing means is connected intermediately between the traveller and the user, the energy absorber means including a plastically deformable energy

absorber deployable in response to a fall event to plastically deform from a stowed orientation to a deployed orientation. The energy absorbing means may have a coil-form portion and an elongate tongue portion extending in a linear direction at the periphery of the coil-form portion.

All of cited documents have the already discussed disadvantage in that the connecting elements can break and so the user's safety is compromised. The part of the previous state of art is devoted to solutions that use elastic media for storing, i.e. absorbing, the energy of a falling body.

Document CN 101559267 A „Device and system for preventing falling"; inventor Chen J.; discloses fall arrester where spring is used as the energy absorbing device. Such solution has advantages over the earlier cited solutions which use material deformation. It is known that spring compression force is almost constant, i.e. proportional with the displacement. Moreover, if the compression spring brakes, the cited fall arrester will still continue to work but without energy absorption. The main disadvantage of the cited solution is in the force magnitude produced by a falling body which is not parallel with compression spring direction. It is doubtful how such solution works under mentioned condition.

The disclosed invention uses torsion stick as the energy absorbing means which offers highly linear response to the torsion force; similar to those with springs. In addition, the disclosed invention works equally reliable no matter to which direction the external force is applied.

It is possible to say that disclosed invention takes advantages from solutions using deformations we discussed and the solution using spring as the energy absorbing means that is safe against breaking the energy absorbing means.

Summary of invention

The invention discloses a fall arrester with torsional energy absorbing means which is capable of sliding along a guide rail. Mentioned fall arrester is composed of left and right housings which are permanently connected together. Said connection is achieved by spring shaft, connecting shaft and load shaft. Connecting shaft and load shaft are equipped with the rollers on its ends. Two pairs of additional rollers are fixed by their corresponding axles to the housings. Parallel profile of the said guide rail is sandwiched by the mentioned rollers.

Said load shaft is passing through load shaft bores on the left pawl and the right pawl allowing circular motion of the said pawls around the load shaft in the plane parallel to the housings. Other ends of said pawls are equipped with the cavities which form a part of the torsional energy absorbing means. Said pawls are pressed towards the parallel profile via spring spanned between the spring shaft and the spring pin that connects pawls, and by which force pawl tips engage simultaneously a pair of slots formed on said parallel profile.

Torsional energy absorbing means consists of a torsion lever with a carabiner that engages the fall arrester, a torsion stick - to which the torsion is exerted; and a cylinder that stiffens the energy absorbing means. The torsion stick is fixed by one end to the left pawl and its opposite end is fixed within the cylinder. Cylinder partially enters left pawl cavity and nests fully into right pawl cavity where it can rotate freely. The cylinder is equipped with the polygonal portion on which torsion lever is mounted with its polygonal hole. The torsion lever is sandwiched between the pawls, and its relative motion, with respect to the pawls, rotates cylinder. Rotation of the cylinder within the pawl cavities exerts the force onto the torsion stick end fixed within the said cylinder. The cylinder starts to rotate relative to the torsion stick end which is fixed to the left pawl and torsion stick begins to absorb the energy of the falling body.

The torsion stick left end oriented towards the left pawl is formed as the polygonal head with cross-section identical to the cross section bore made on the outer wall of the left pawl. Left torsion stick end is fixed to the left pawl by the fixation pin that enters cavity wall through firs fixation pin bore, passes the fixation pin bore formed on said left stick end, and comes out of the cavity through another fixation pin bore. The torsion right stick end oriented to the right pawl is formed as the polygonal head with cross-section identical to the cross section of the cylinder bore, made in the cylinder. Said cylinder is nested into the right pawl cavity. The maximum torsion angle by which torsion stick ends can relatively rotate when engaged by the torsion laver action is less than 180°.

In the preferred embodiment; the spring shaft, connecting shaft and load shaft are fixed via screws to the housings, where said screws are inserted into the bores made on said housings. The additional axles carrying rollers are fixed to the housings by riveting said axles ends within the housing's bores. Each roller of the said fall arrester rotates independently. The carabiner is fixed to the torsion lever via hole situated on the opposite side of the polygonal hole for engaging the cylinder.

Brief Description of the Drawings

Fig. 1 shows the fall arrester from its right side, Fig. 2 shows the fall arrester from the bottom side which is turned to the guide rail. Fig. 3 shows the fall arrester from its right side already positioned on the guide rail, Fig. 4 shows the fall arrester from the bottom side with the guide rail sandwiched between the rollers.

Fig. 5 shows fall arrester where left pawl is removed and inner parts can be easily seen. Fig. 6 shows the fall arrester where left pawl is removed and in position where fall arrester is mounted on the guide rail. Fig. 7 shows exploded view of the fall arrester with all parts visible. Fig. 8 shows the way torsion lever engages the cylinder. Fig.

9 shows the fall arrester stretched after being in operation, mounted on the guide rail.

Detailed Description

The present invention discloses a novel fall arrester with torsional energy absorbing means. The preferred embodiment is descripted below.

According to the preferred embodiment; the fall arrester with improved energy absorbing means consists of left housing (10) and right housing (20), Figs. 1 and 2. Housings (10) is shaped as a mirror image of housing (20). Each housing is formed as elongated U-letter shaped metal piece with two rows of borings. First row of bores (11, 12) formed on the left housing (10) are designed to receive axles (31) for carrying a pair of rear rollers (30). Similarly, first row borings (21, 22) formed on the right housing (20) are designed also to receive axles (31) for carrying another pair of rear rollers (30). Said axles (31) are riveted with its ends to the said housings (10, 20) in a manner that rollers (31) can freely rotate. The axles can be also fixed by screws or any other technique that is reliable and which enables rollers (31) to rotate freely and secure fall arrester to the rail guide (90).

Second rows of bores (13, 14, 15; 23, 24, 25) made on respective housings (10; 20) are designed to receive screws needed for fixation of said housings (10, 20) one to another. Three shafts are used for said purpose; connecting shaft (36), spring shaft (33) and load shaft (38). Connecting shaft (36) is fixed by screwing the ends of said shaft via screws inserted into bores (13, 23). By that, first rigid connection between the housings (10, 20) is established. Similarly, the spring shaft (33) is fixed by screwing the ends of said shaft via screws inserted into bores (15, 25) made on housings (10, 20) by which the second rigid connection between the housings (10, 20) is established. The third connection is achieved by the load shaft (38) that is fixed by screwing the ends of said shaft via screws inserted into bores (14, 24) made on housings (10, 20). Those rigid connections

between the housings (10, 20) are visible on Figs. 2, 6 and 7 and form the frame of disclosed fall arrester.

Connecting shaft (36) and the load shaft (38) have on its ends dedicated parts that form axles for the rollers (35, 37) respectively. Said rollers (35, 37) can freely rotate around said shafts (36, 38) and are nested within the housings (10, 20) as depicted on Figs. 2 and 6.

Typical T-shaped guide rail (90) is depicted on Figs. 3 and 4; it consists of two profiles, parallel profile (91) and perpendicular profile (92) that are joined together. Parallel profile (91) is equipped with the slots (93), in our case said slots (93) are paired and distributed along the rail (90) in equal distances. Perpendicular profile (92) is equipped with auxiliary bores (94) distributed along the said profile (92), and do not interact with the fall arrester.

Two pairs of previously mentioned rollers (30) are positioned on the parallel profile's (91) side which is oriented toward the side where perpendicular profile (92) is joined to it. Pair of rollers (37) and pair of rollers (35) are situated on the opposite side of the mentioned parallel profile (91). The rollers (30, 35, 37) are sandwiching the parallel profile (91) of the said guide rail (90) together with the housings (10, 20) and are allowing the fall arrester to be guided along it "up" and "down", Figs. 3, 6 and 9; in the manner that is well known in the art.

Fall arrester's insertion direction in the guide rail (90) is very important for normal operation. The fall arrester has mark "up" and the arrow indicating the insertion direction on the right housing (20), but this is not sufficient in practice. According to the safety standards, much safer solution has to be implemented. So, the pin (27) is inserted into bore (26), Fig. 1, formed on the housing (20). It allows the mentioned fall arrester to be inserted on the guide rail (90) in only one direction. If the fall arrester is inserted

oppositely, the pin (27) prevents further sliding of the fall arrester across the guide rail (90).

It is known in the art that the disclosed type of fall arresters have one or more rotatable mounted pawls which, in the event of a fall, engage against catching stops or slots in the guide rail (90). In the disclosed invention a pair of pawls (40, 50) are used as depicted on Figs. 2, 4 and 6.

Left pawl (40) geometry is best visible on Figs. 3 and 7. On one end it is mounted on the load shaft (38) that is passing through the load shaft bore (41). For better mechanical properties, it is possible to insert flanged plain bearing (98) between the load shaft (38) and the shaft bore (41), as visible on Fig. 5 for the pawl (50). Another end of the left pawl (40) is formed as the cylinder with cavity (42) inside the cylinder. The cylinder base which encloses cavity (42), and which is oriented oppositely from the torsion lever (60), see Fig. 6, has a bore for receiving torsion stick end (71). Left pawl (40) is equipped with two fixation pin bores (46) situated on the cylinder. Central part of the left pawl (40) has a tip (43). Left pawl tip (43) is the part which actually engages slots (93) distributed along the parallel profile (91) of the guide rail (90), Fig. 6.

The right pawl (50) geometry is best visible on the Fig. 5. Essentially the right pawl (50) is mirror image of the left pawl (40); having right pawl tip (53), load shaft bore (51) and a cavity (52) formed within the cylinder situated on the opposite side form the load shaft bore (51). As explained, it is possible to insert flanged plain bearing (98) between the load shaft (38) and the shaft bore (51). The difference between left pawl (40) and right pawl (50) is that the cylinder base of the right pawl (50), which is oriented oppositely from the torsion lever (60), is hollow - as visible on the Fig. 1. It is worth to note that pawl tips (43, 53) simultaneously engage the slots (93) as depicted on the Fig. 4.

The left pawl (40) and the right pawl (50) are connected via the spring pin (55) that is inserted through pin bores (44, 54) formed on said pawls (40, 50). Spring (32) is stretched between the spring pin (55) and spring shaft (33) as depicted on Fig. 5. The force produced by the spring (32) presses pawls (40, 50), and their corresponding tips (43, 53) towards the parallel profile (91); Fig. 4. Once the pawl tips (43, 53) are positioned above the slots (93) they enter the slots and engage parallel profile (91) by which the fall arrester is secured on the guide rail (90). Pawl tips (43, 53), see Fig. 5, are designed to allow forward, i.e. UP movement of the arrester while the movement DOWN is possible only if the operator overcomes the spring (32) force. This system is well described in the related art and it will not be discusses further here.

The much more interesting part is torsional energy absorbing means. Energy absorbing means consists of: a lever (60) with a carabiner (99) that engages the fall arrester, a torsion stick (70) to which the torsion is exerted and the cylinder (80) which stiffens the energy absorbing means. The pawl cylinders and their corresponding cavities (42, 52) are also a part of the torsional energy absorbing means. The central element is torsion stick (70), which is made of metal with carefully chosen mechanical properties. The torsion stick (70) has two ends, left end (71) is equipped with the fixation pin bore (73). Both ends (71, 72), according to the preferred embodiment, have polygonal shaped cross section. The torsion stick left end (71) cross section is dimensioned to be compatible with the pawl (40) cylinder base which encloses cavity (42), Figs. 5 and 6. The torsion stick end (71) nests into the said pawl (40) cylinder base and is locked there. However, for assembly purpose and real use, this position of the torsion stick end (71) has to be secured further. This torsion stick left end (71) is locked within the pawl cavity (42) via fixation pin (45). Fixation pin (45) is inserted through the first bore (46), formed on the cylinder part of the pawl (40), and is passing through the fixation pin bore (73) formed on said torsion stick left end (71), and again comes out through second bore (46). By that torsion stick

left end (71) can be inserted and removed from its nest made in the pawl (40) cylinder, Figs. 5 and 6.

On the opposite side, the torsion stick end (72) is inserted into the cylinder (80). Cylinder (80) is equipped with the bore (82) having cross section geometry that is capable to receive cross section geometry of the torsion stick end (72). Cylinder (80) diameter is dimensioned to enter into both cavities (42, 52) made in pawls (40, 50) cylinders, and to form a sliding bearing with it. Part of the cylinder (80), that has to be inserted into the cavity (42) - Fig. 7 and 5, is shortened due to the space consumed by the fixation pin (45). Part of the cylinder (80) is equipped with the polygonal portion (83) which serves to actuate the cylinder (80) by the torsion lever (60), see Fig. 8.

Torsion lever (60) has on one end carabiner hole (61) to which the carabiner (99) is mounted, and on the opposite side said lever (60) is equipped with the polygonal hole (63). This polygonal hole (63) has dimensions that are compatible with the polygonal portion (83) formed on the cylinder (80). The torsion lever (60) is therefore sandwiched between the pawls (40, 50) as depicted on Figs. 5 and 6, and mounted on the cylinder (80). By pulling the torsion lever (60) down, as indicate on the Fig. 9, cylinder (80) starts to rotate around its main axis, see Fig 8. Then the part of the cylinder (80) situated within the right pawl cavity (52), Figs. 1 and 8, rotates the torsion stick end (72) relative to the right pawl cavity (52), while the opposite torsion stick end (71) is still secured to left pawl (40) cylinder base, Fig. 9, and its left pawl cavity (42). Such movement produces torsion force on the torsion stick (70) and absorbs the energy of a falling body. During the performed tests, the maximum torsion angle by which torsion stick ends (71, 72) respectively rotate is found to be less than 180°.

It has to be noted that the cylinder (80), to which the torsion lever (60) is mounted, stiffens the energy absorbing means. It is done by

the outer cylinder (80) diameter which allows to cylinder (80) to be almost perfectly nested into the pawls cavities (42, 52).

The interesting situation occurs when the torsion stick (70) breaks. Then, the torsion lever (60) is still connected to the cylinder (80) that is nested within the pawls cavities (42, 52). Having no torsion counterforce, the torsion lever (60) can freely rotate together with the cylinder (80) within the pawls cavities (42, 52). Therefore the user is still secured to the rail via disclosed fall arrester, except that the energy absorbing means is functionless. Surly it will produce serious whiplash injuries, but the body will not fall any further.

The person skilled in the art will certainly recognise the potential of this invention described with this preferred embodiment, considering the way the energy is absorbed and considering the safety advances it has over the cited prior art. It is possible to contemplate about other fall arresters that are of the "rope grab" type where similar torsional energy absorbing means can be used.

Industrial Applicability

The industrial applicability of the disclosed fall arrester with torsional energy absorbing means is obvious. The disclosed fall arrester is functional safety device, especially suitable to be used whenever is possible to have sliding guides.

References

10	left housing
11, 12, 13, 14, 15	left housing bore
20	right housing
21, 22, 23, 24, 25, 26	right housing bore
27	pin
30	rear roller
31	axle for rear roller
32	spring
33	spring shaft
35	front roller
36	connecting shaft
37	front roller
38	load shaft
40	left pawl
41	load shaft bore
42	cavity
43	left pawl tip
44	spring pin bore
45	fixation pin
46	fixation pin bore
50	right pawl
51	load shaft bore
52	cavity
53	right pawl tip
54	spring pin bore
55	spring pin
60	torsion lever
61	carabiner hole
63	polygonal hole
70	torsion stick
71, 72	torsion stick end
73	fixation pin bore
80	cylinder
82	cylinder bore

83	polygonal portion
90	guide rail
91	parallel profile
92	perpendicular profile
93	slot
94	bore
98	flanged plain bearing
99	carabiner

CLAIMS

1. A fall arrester with torsional energy absorbing means, capable of sliding along a guide rail (90); where said fall arrester is composed of:
   - left housing (10) and right housing (20) which are permanently connected together by spring shaft (33), connecting shaft (36) and load shaft (38); where connecting shaft (36) and load shaft (38) are equipped with rollers (35, 37) on its ends; two pairs of additional rollers (30) are fixed by the corresponding axles (31) to the said housings (10, 20);
   - wherein parallel profile (91) of the said guide rail (90) is sandwiched by the rollers (30) from one side and rollers (35, 37) from the opposite side;
   - wherein the load shaft (38) is passing through the load shaft bores (41, 51) formed on the left pawl (40) and the right pawl (50) allowing circular motion of the said pawls (40, 50) around the load shaft (38) in the plane parallel to the housings (10, 20); while other ends of said pawls (40, 50) are equipped with the cavities (42, 52) which form a part of the torsional energy absorbing means;
   - wherein said pawls (40, 50) are pressed towards the parallel profile (91) via spring (32) spanned between the spring shaft (33) and the spring pin (55) that connect said pawls (40, 50), by which spring (32) forces pawl tips (43, 53) to engage simultaneously pair of slots (93) formed on said parallel profile (91);
   - wherein torsion energy absorbing means consists of a lever (60) with a carabiner (99) that engages the fall arrester, a torsion stick (70) to which the torsion is exerted and a cylinder (80) that stiffens the energy absorbing means;

   where torsional energy absorbing means is **characterised by that,**
   - the torsion stick (70) is fixed by one end (71) to the left pawl (40) and its opposite end (72) is fixed to the cylinder (80);

- said cylinder (80) partially enters left pawl cavity (42) and nests fully into right pawl cavity (52) into which said cylinder (80) can rotate freely;
- said cylinder (80) is equipped with the polygonal portion (83) on which torsion lever (60), with its polygonal hole (63), is mounted; said torsion lever (60) is sandwiched between the pawls (40, 50); and

relative movement of the lever (60) in respect to the pawls (40, 50) rotates the cylinder (80) within the pawl cavities (42, 52); said cylinder (80) exerts the force to the torsion stick end (72) fixed within the said cylinder (80) which starts to rotate relative to the torsion stick end (71), which is fixed to the left pawl (40); torsion stick (70) begins to absorb the energy of the falling body.

2. A fall arrester with torsional energy absorbing means as claimed in claim 1, **characterised by that**, the torsion stick left end (71) oriented to the left pawl (40) is formed as the polygonal head with cross-section identical to the cross section bore made on the outer wall of the left pawl (40) that is oriented to the left housing (10); wherein said torsion stick left end (71) is fixed to the said left pawl (40) by the fixation pin (45).

3. A fall arrester with torsional energy absorbing means as claimed in claim 2, **characterised by that**, the torsion stick right end (72) oriented to the right pawl (50) is formed as the polygonal head with cross-section identical to the cross section cylinder bore (82) made in the cylinder (80) that is nested into the right pawl cavity (52).

4. A fall arrester with torsional energy absorbing means as claimed in claim 3, **characterised by that**, the maximum torsion angle by which torsion stick ends (71, 72) can relatively rotate when engaged by the laver (60) action is less than 180°.

5. A fall arrester with torsional energy absorbing means as claimed in any preceding claim, **characterised by that** the spring shaft (33), connecting shaft (36) and load shaft (38) are fixed via screws to the housings (10, 20) inserted into the bores (13, 15, 14) and bores (23, 25, 24) respectively.

6. A fall arrester with torsional energy absorbing means as claimed in any preceding claim, **characterised by that**, the axles (31) carrying rollers (30) are fixed to the housings (10, 20) by riveting the axles (31) ends within the bores (11, 12, 21, 22).

7. A fall arrester with torsional energy absorbing means as claimed in any preceding claim, **characterised by that**, each roller (30, 35, 37) mounted on said fall arrester rotates independently.

8. A fall arrester with torsional energy absorbing means as claimed in any preceding claim, **characterised by that**, the carabiner (99) is fixed to the lever (60) via hole (61) situated on the opposite side of the polygonal hole (63) which engages the cylinder (80).

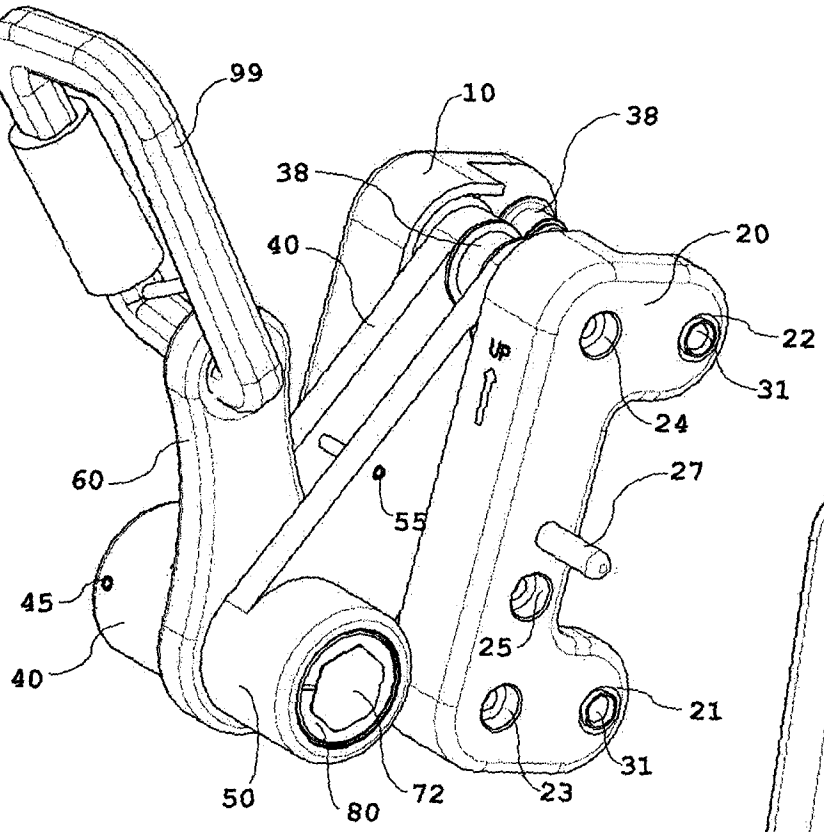

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Fig. 1

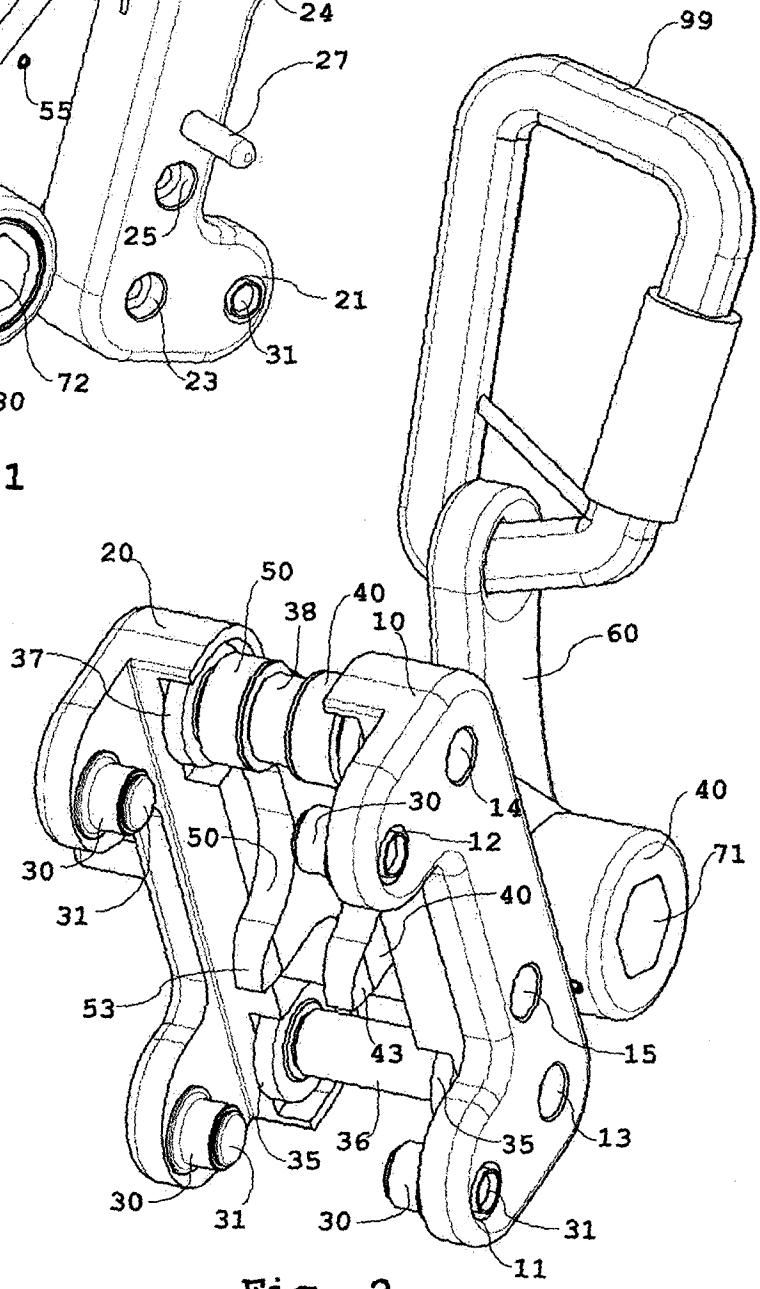

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Fig. 2

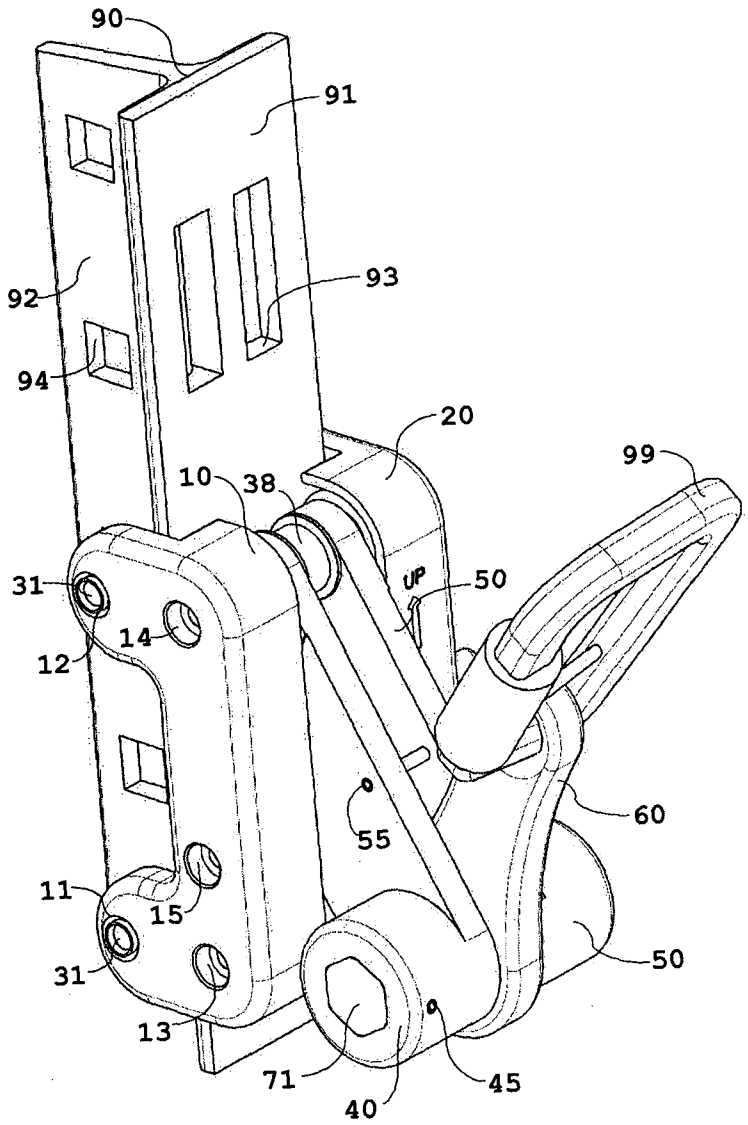

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Fig. 3

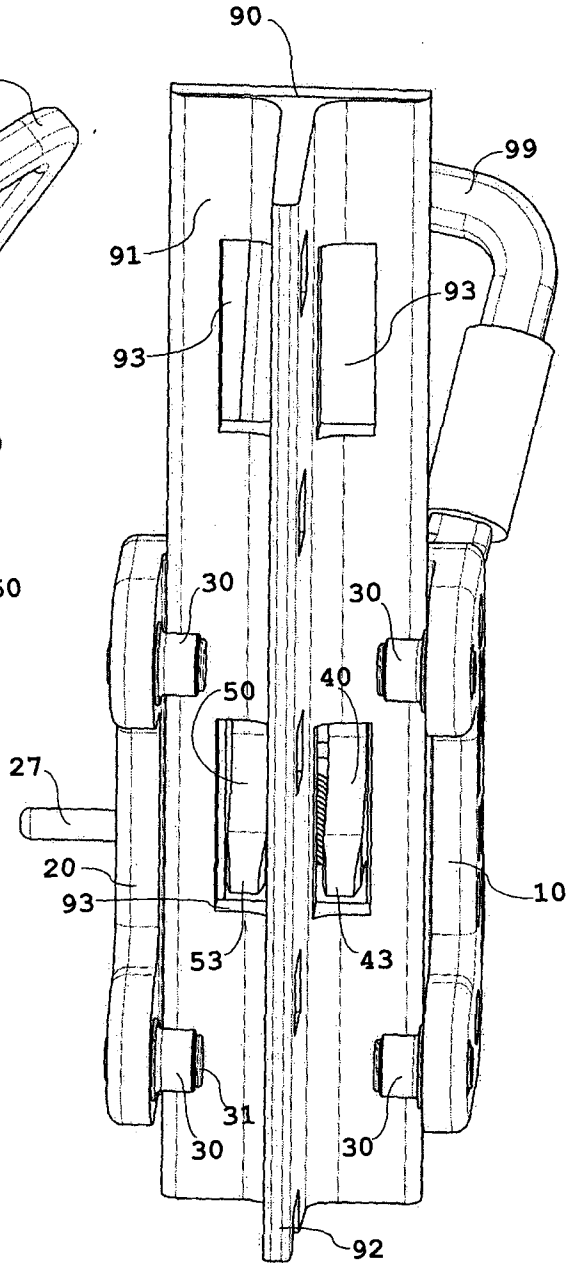

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Fig. 4

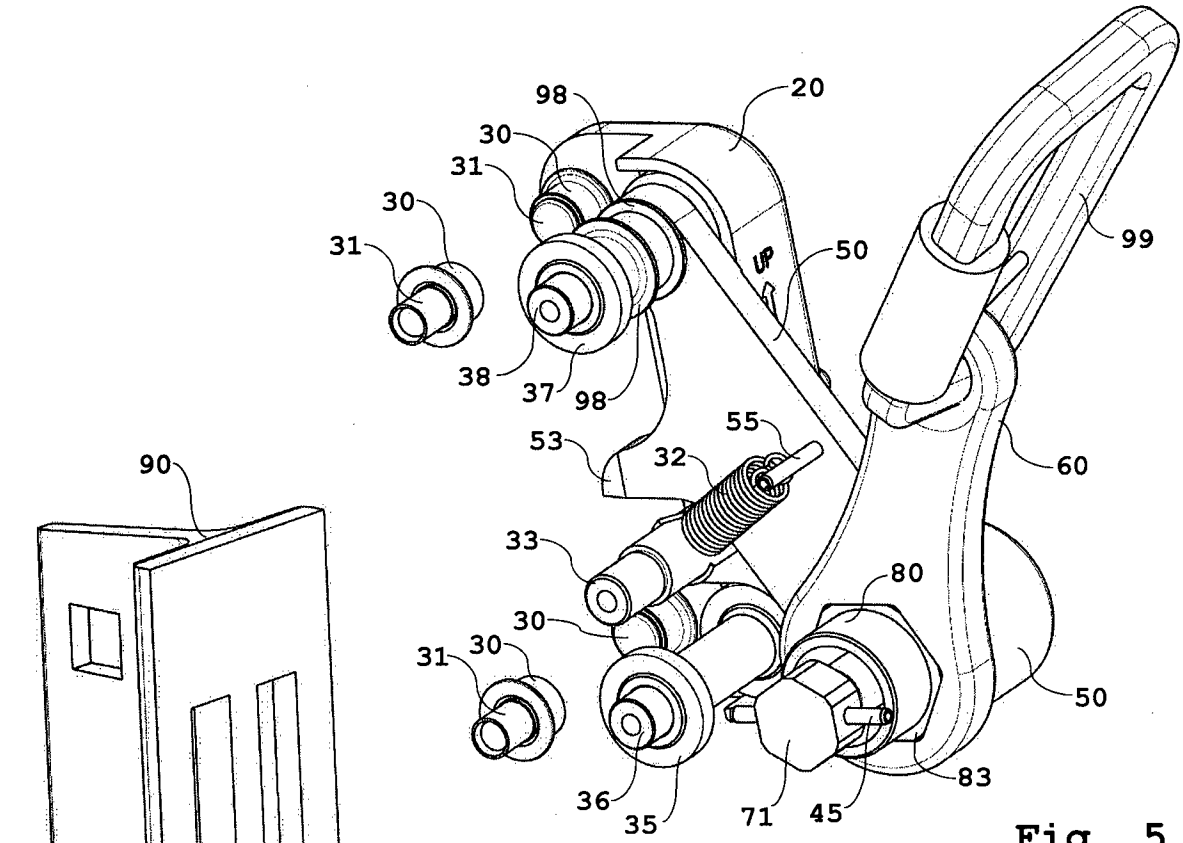

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Fig. 5

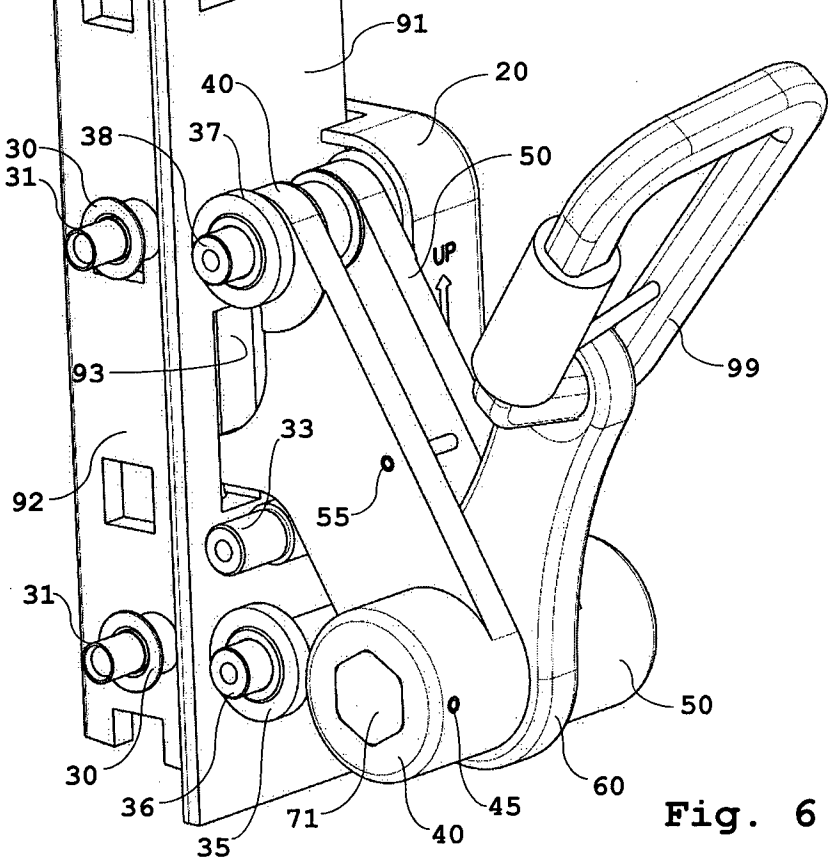

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Fig. 6

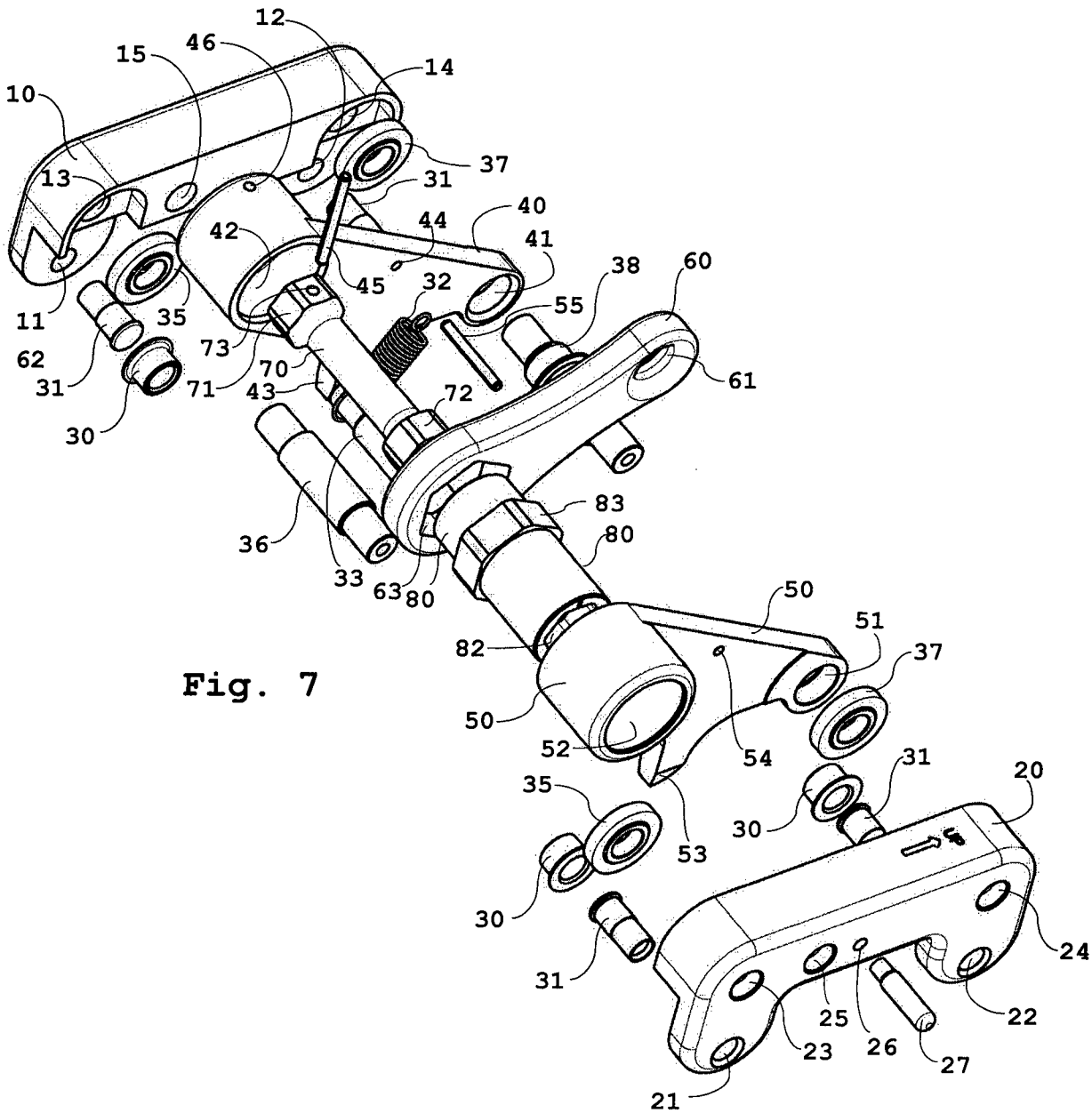

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Fig. 7

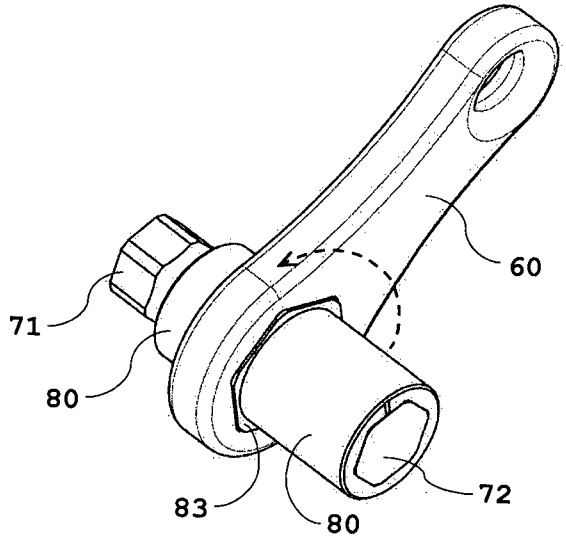


Fig. 8

Fig. 9

INTERNATIONAL SEARCH REPORT

International application No
PCT/HR2016/000001

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

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

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.
A	CN 101 559 267 A (JINPENG CHEN [CN]) 21 October 2009 (2009-10-21) cited in the application the whole document	1-8
A	DE 295 01 716 U1 (SOELL GMBH [DE]) 16 March 1995 (1995-03-16) page 2, line 21 - page 3, line 9 page 3, line 16 - page 4, line 37 figures 1, 2	1-8
A	US 2014/346312 A1 (SMALL GREG [CA]) 27 November 2014 (2014-11-27) paragraph [0025] paragraphs [0064] - [0075] figures 1A-5	1-8

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
6 September 2016	15/09/2016

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Zupancic, Gregor

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INTERNATIONAL SEARCH REPORT

International application No
PCT/HR2016/000001

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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A	WO 2013/003402 A2 (KEY SAFETY SYSTEMS INC [US]; MACY PHILIP J [US]) 3 January 2013 (2013-01-03) paragraph [0002] paragraphs [0016] - [0017] paragraph [0019] paragraph [0021] figures 1-3, 5, 6	1-8
A	WO 2015/060990 A1 (HONEYWELL INT INC [US]) 30 April 2015 (2015-04-30) paragraphs [0019] - [0022] figures 1-3B	1-8

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INTERNATIONAL SEARCH REPORT

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