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(71) Applicant (for all designated States except US): **PO-LITECNICO DI MILANO** [IT/IT]; Piazza Leonardo Da Vinci 32, I-20133 Milano (MI) (IT).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **LENA, Luca** [IT/IT]; Via Venezian G. 75, I-24068 Seriate (BG) (IT).

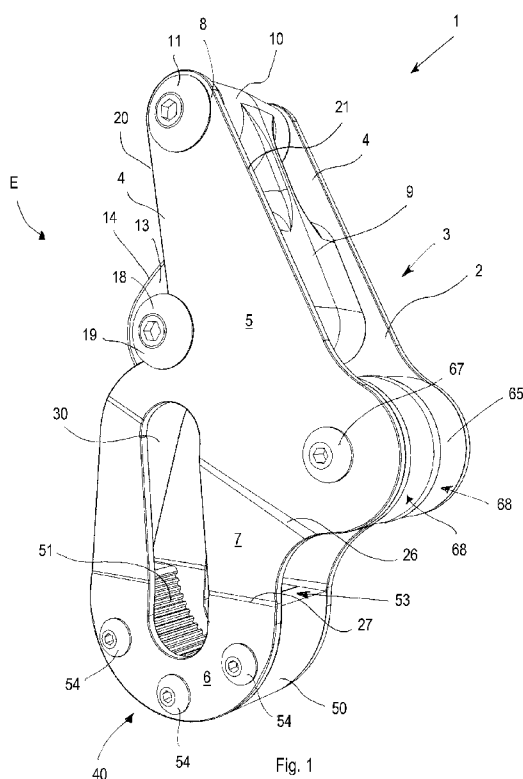
(74) Agents: **CRUGNOLA, Pietro** et al; Luppi Crugnola & Partners S.r.L, Viale Corassori 54, I-41124 Modena (IT).

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(54) Title: SAFETY DEVICE FOR ROPES



(57) Abstract: A safety device that is suitable for being coupled with one or more ropes (70) comprises a supporting structure (2) defining a gap (3) suitable for housing part of said one or more ropes (70) and suitable for coupling with a snap-hook (60), first deflecting means (10) shaped for imposing on one or more ropes (70) a first curve (C1), second deflecting means (13) shaped for imposing on one or more ropes (70) a second curve (C2), third deflecting means (50) shaped for imposing on one or more ropes (70) a third curve (C3) and suitable for cooperating with said snap-hook (60) to lock said one or more ropes (70) in a locking zone (B), and fourth deflecting means (65) fixed to said supporting structure (2) in a stationary position that is distinct from said locking zone (B) and shaped for imposing on one or more ropes (70) a fourth curve (C4) that is variable to control the braking effect of said device (1) on said one or more ropes (70).

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Safety device for ropes

The invention relates to a safety device for ropes, which is usable in multiple applicational fields, such as the sporting, industrial sector or in the rescue field. The safety device is particularly suitable for being used for climbing, mountaineering, caving and other activities in which the use of ropes is required for supporting and/or moving and securing a load, for example an individual. The safety device acts as a braking device, belaying device and self-locking device both in emergencies and when requested. From DE244762C a locking device for ropes is known that is equipped with a lever that acts as an element for braking the rope .

A self-locking safety device is known that is disclosed in FR2875707A1, which is used in the field of climbing, mountaineering or caving, which is coupled with a rope to secure a climber during a climb, for example on a rock face. The device is connectable to the harness of a user, such as a so-called belayer, which has the function of assisting the climber during the ascent along the aforesaid rock face. In the event of the climber accidentally falling off the face, the device acts in such a manner as to stop sharply the playing out of the rope with respect to the device, stopping the fall of the climber downwards and placing the climber in safety.

The self-locking safety device comprises two plates shaped as a rectangular triangle, fixed together by spacer bushes or pins, positioned near the tops of the plates. The two plates are mutually parallel and spaced apart from one another by spacing pins, such as to define a gap that is suitable for being traversed by a rope.

The two plates define three distinct sides of the device, i.e. a first shorter side, a second side, which is substantially orthogonal to the first side, and a third side that is tilted with respect to the first side and to the second side and connects the latter.

The spacer pins, in addition to connecting the two plates in a spaced manner, are arranged in such a manner as to impose a winding path on the rope. The winding path causes the generation of surface friction between the rope and pins. The spacer pins comprise in particular a first pin, arranged near a first summit that connects the second side with the third side, a second pin, arranged near a second summit that connects the second side with the first side, and a third pin, arranged near a third summit that connects the first side with the third side of the device.

On each plate, there is obtained a respective slot opening that extends substantially parallel to the second side from a zone that is near the first side to approximately near a central zone of the third side. The two slot openings are shaped to couple with a snap-hook intended for being connected to the harness of the user, in particular of the belayer .

The self-locking device comprises a bar that is suitable for going to rest from the exterior on the second side of the plates, such as to be arranged orthogonally with respect to the planes defined by the plates. The bar contributes to defining the aforesaid said winding path and has the function of generating friction on the rope, maintaining a rope loop outside the device.

The self-locking device further comprises a lever that is movable with respect to the two plates. The lever is partially housed between the two plates and partially projects from the third side to the outside of the device.

The lever and the bar are mutually connected with two elastic bands, to prevent them being separated from the device. Nevertheless, such a connection configuration is not very reliable and is not very secure, and is further very inconvenient for the user as the various parts of the device are not kept together securely. There is also a great risk that the bar and/or the lever will separate from the device and compromise the operation thereof, jeopardising the safety

of the climber and/or of the belayer, in particular when it is no longer possible to recover the various parts of the device, for example, slipping away at a great height from the ground .

5 The lever can be operated to release the rope from the device after the rope has locked, for example, after the climber has started to fall, or after a tug on the rope by the climber. The lever comprises a locking end, placed further inside the device, on which a hole is obtained, the axis of which
10 traverses the two slot openings of the plates. This hole has a diameter that is such as to be able to receive internally a snap-hook to connect to the harness of the belayer. The locking end is shaped for cooperating with the second pin and with the third pin in order to lock the rope in the event of
15 a sudden fall of the climber. In particular, if the device is subjected to a sudden traction action coming from the climber, the locking portion, which in turn undergoes a reaction force from the snap-hook connected to the harness of the belayer, is moved towards a zone interposed between the
20 second pin and the third pin, pressing the rope against the latter and increasing the friction that is generated between the rope and the pins. In this manner, the sliding of the rope is prevented, which is thus locked on the device.

The lever comprises a handle portion that projects outside
25 the gap defined by the two plates. The handle portion projects noticeably outside the device in such a way as to provide the user with a lever arm that makes it easier for the user to release the rope. The device is provided with a pair of fulcrum protrusions, provided on the internal faces
30 of the two plates and facing one another, on which the lever rests when it is operated to release the rope. The lever, by rotating around the aforesaid fulcrum protrusions, makes the locking portion move away from the second pin and from the third pin, releasing the rope, which in this way can resume
35 sliding through the device.

At an external end of the locking lever, at the handle portion, a stake is provided that projects orthogonally with respect to a longitudinal axis of the lever and parallel to the axes of the spacer pins. The stake is placed at a relatively great distance from the third pin, and, being provided on the lever, is movable with respect to the plates. The stake can be partially wound by the rope, imposing on the latter, a further variation of the route. In this configuration, the device can be used by the belayer to check the locking action that the lever causes by interacting with the second pin and the third pin, as will be seen below.

In order to use the safety self-locking device, a rope is inserted therein that enters and exits the gap through the third side. Once the rope is inserted into the device, a first rope portions defined that is interposed between the first pin and the bar, a second rope portion that extends from the bar to the locking end of the lever and is interposed between the latter and the second pin, and a third rope portion that extends from the locking end to the outside of the device, exiting through the third side and which is interposed between the locking end and the third pin. The rope can further comprise a fourth portion that extends as far as the stake, when the user decides to wind partially with the rope around the latter. The fourth portion, given the distance of the stake from the third pin, has a length that is noticeably greater than the first portion and/or the second and/or the third portion.

The first pin and the bar respectively define a first deviator and a second deviator that respectively give the rope a first path curve and a second path curve. The second pin and the third together define a third deviator that imposes on the rope respectively a third path curve.

During operation, the belayer progressively supplies rope to the climber to enable the climber to move upwards. In order to do this, the belayer, gripping the device, pulls the rope to make the rope slide in relation to the device. The belayer

grasps the upper rope portion that directly connects the device to the climber. The rope is grasped in a zone upstream of the device, i.e. near the first pin, and is pulled horizontally in such a manner as to modify the path by
5 reducing the windiness thereof and thus reducing the friction that opposes the advancing of the rope with respect to the device. In the meanwhile, the climber fixes along the ascent path and on the rock face safety anchoring elements, with which the rope is coupled.

10 If the climber accidentally loses hold and falls downwards, the rope that is connected to him and is coupled with an anchoring element that is previously fixed to the wall, makes the upper rope portions suddenly subjected to a traction element. This traction action compels in a forced and sudden
15 manner the part of rope held by the belayer to move in a substantially vertical position. This occurs rather rapidly, over a few seconds or fractions of a second and if the belayer is distracted he may not notice the sudden fall of the climber. In this circumstance, when the originally
20 horizontal rope part moves suddenly to a substantially vertical position, the hand of the belayer gripping that part of rope may be crushed between the rope and the edge of the device near the first top or the first pin, causing pain and also possible injuries to the belayer. Thus one defect of
25 this device is that the use thereof is dangerous and not very secure for the belayer.

In the aforesaid situation of a sudden fall of the climber, the rope part in the hand of the belayer passes from a horizontal position to a substantially vertical position. By
30 doing so, the windiness of the rope inside the device is increased and thus friction on the contact zones of the rope with the device is increased. Consequently, the device tends to be dragged upwards but prevented therein by the snap-hook connected to the harness of the belayer. The exchange of
35 forces between the snap-hook and device is such as to suddenly clamp the rope, which is locked between the locking

lever and the second pin and third pin. The rope is locked cleanly and very sharply so as to stop the fall of the climber in a manner that is anything but comfortable and which on the contrary subjects the climber to rapid
5 deceleration that is very harmful to the human body. In order to try to overcome in some way this drawback and to try to soften the fall of the climber, the belayer can grasp the lower rope portion, wind the lower rope portion around the stake and exert on the rope portion certain downward
10 traction, in such a way that the action of the rope on the stake is such as to rotate the lever by a minimum quantity that is sufficient to avoid sharp locking over the rope against the second pin and the third pin, in such a manner as to exert a braking action in order to stop the rope
15 gradually. Nevertheless, such operations require the belayer to be constantly vigilant, never to take his eyes off the climber and to have rapid reflexes to grasp the lower rope portion and wind the rope around the stake. Further, great ability is required on the part of the belayer to calibrate
20 the traction force that he exerts with his hand on the rope portion. In particular, the traction force exerted on the lower rope portion must be adjusted precisely in order to rotate the lever by a quantity that is neither too small, which would not enable the rope to slide properly and to be
25 correctly braked, or too large, because the rope would otherwise continue to slide freely in relation to the device, allowing the climber to fall and causing the climber to crash onto the ground. In addition to all this it must be added that often in agitated emergency situations panic can easily
30 occur and the belayer might not be at all able or might not be able to correctly perform the aforesaid operations aimed at breaking the climber's fall gently. Another drawback of the aforesaid device is that it is difficult to use and requires great dexterity, experience and familiarity from the
35 user, who also has to have quick reactions and be vigilant at all times. It should be further noted that the coupling

between rope and stake is not stable, and an action that is not extremely precise of the user on the grasped part of the rope could move the rope along the stake until it is made to disengage from the latter, also causing an undesired kickback
5 to the user with loss of control of the device.

Thus the safety self-locking device disclosed above has clear limits of use and is not sufficiently versatile.

A further drawback of the known device disclosed above is that it is structurally complex and therefore costly to make.

10 A still further drawback of the known device is that it is rather heavy because of the structural complexity thereof. The device is thus inconvenient to carry, also because of the great bulkiness thereof, which is aggravated by the presence of the protruding lever. Further, the lever, by protruding in
15 the manner disclosed above, in extreme situations wherein a possible fall of the climber or a sudden pull by the latter on the rope and thus on the device can transform the lever into a blunt instrument that is dangerous for the belayer.

One object of the invention is to improve known safety
20 devices for ropes .

A further object of the invention is to provide a safety device that is handlable and easy to use even by an inexperienced user that is safe and not dangerous for the latter.

A further object of the invention is to provide a safety
25 device that enables a user to gently stop the fall of a climber extremely easily and reliably but which is also able to stop promptly the fall of the climber automatically if, for example, the user is taken ill or if the latter is unable to act .

30 A further object of the invention is to provide a safety device for ropes that is structurally simplified, compact and thus very reliable and cheap to be used.

According to the invention, a safety device as defined in claim 1 is provided.

Owing to the invention, it is possible to obtain a device that is able to remedy all the aforementioned drawbacks of the prior art.

The invention can be better understood and implemented with reference to the attached drawings, which illustrate an embodiment thereof by way of non-limitative example, in which :

Figure 1 is a perspective view of the safety device for ropes according to the invention;

10 Figure 2 is an exploded view of the safety device in Figure 1;

Figure 3 is a side view of the device according to the invention :

15 Figure 4 is a front view of the device according to the invention;

Figure 5 is a further front view of the device in a different configuration from Figure 4;

Figure 6 is a frontal view of a portion of the safety device according to the invention;

20 Figure 7 is a side view of the portion in Figure 6;

Figure 8 is a section taken along the plane VIII-VIII in Figure 6;

Figures 9 and 10 are respectively a front view and a side view of a further portion of the device;

25 Figures 11 and 12 are respectively a front view and a bottom view of a part of the device;

Figure 13 is a top view of a further part of the device;

Figures 14 to 18 show in sequence various steps for coupling the device according to the invention with a couple of ropes and with a snap-hook;

30 Figures 19 to 22 show the steps of an operating mode of the safety device according to the invention, in which the rope is given to the climber to maintain the latter in security;

Figures 23 and 24 show the steps of another operating mode according to which the device acts, in the event of an emergency, as a brake for dynamically stopping, i.e. gently

stopping, a possible fall of the climber until the climber is definitively stopped;

Figures 25 to 27 show a further automatic stop operating mode of the device in the event that a belayer is not operational;

5 Figures 28 to 30 show a further operating mode of the device in which the belayer, before performing other operations, has to obtain intentionally static and secure locking of the climber;

10 Figure 31 shows how the device is used to enable the climber to descend according to the so-called double-rope technique; Figure 32 shows the device in a configuration in which the rope is locked automatically during the descent of the climber;

15 Figure 33 shows the device in a configuration in which it acts as a self-locking device, cooperating with a snap-hook to lock the rope;

Figures 34 to 36 show the device in various steps during so-called use of the "double rope", in which a more gradual and gentle stop and locking are obtained;

20 Figure 37 shows how it is possible to connect the device according to the invention in such a manner as to enable a leading climber in a group of roped climbers to recover the second climber in a group of roped climbers;

25 Figures 38 to 40 show the device respectively during recovery of the second climber in a group of roped climbers, in a self-locking position, and in a release position that enables rope to be given to the second climber in the group of roped climbers if necessary.

30 With reference to Figures 1 to 5, there is shown a safety device 1 for ropes 70 that is suitable for being used in various sectors, such as the sporting sector, the industrial sector, or in the emergency rescue sector. In particular, the safety device 1 is particularly suitable for being used for climbing, mountaineering, caving and in general in all
35 activities that require the use of ropes to which to connect a load or individual securely to be supported and/or moved

and/or secured during a movement, for example an ascent or descent movement with respect to a wall. The safety device 1 acts as a braking device, lowering device and as a self-locking device both in cases of emergency and necessity.

5 The device 1 that will be disclosed below is shaped for being able to be coupled with one or two ropes 70. Nevertheless, the device can be suitably modified to enable coupling with any number of ropes and according to particular needs.

10 In a first use, the device 1 is used by a user, called belayer, to assist a climber during the ascent, for example of a rock wall. The belayer wears a harness to which the device 1 is connectable by means of a snap-hook 60, as will be disclosed further on.

15 The device 1 comprises a supporting structure 2 defining a gap 3 inside that is suitable for housing part of the ropes 70.

20 The supporting structure 2 comprises a pair of suitably shaped plate elements 4 arranged mutually parallel and connected and spaced apart from one another by suitable elements that perform several functions, as will be disclosed in greater detail below.

25 Each plate element 4 has a relatively small thickness in relation to the other dimensions. Each plate element 4 comprises a first zone 5, a second zone 6 that are spaced apart from one another and a third zone 7 that connects the first zone 5 to the second zone 6. The first zones 5 of the two plate elements 4 extend on respective first planes P_1 that are parallel to one another. The first zones 5 are spaced apart from one another by a first distance D_1 .

30 The second zones 6 of the two plate elements 4 extend on respective second planes P_2 that are parallel to one another. The second zones 6 are distant from one another by a second distance D_2 . In particular, the second distance D_2 is less than the first distance D_1 .

35 The third zones 7 extend along surfaces S arranged transversely to the first planes P_1 and to the second planes

P2 and converge mutually. In particular, the surfaces S converge on one another in a direction that goes from the first zones 5 to the second zones 6.

5 The lie between the first zone 5 and the third zone 7 varies at a first connecting strip 26.

The lie between the second zone 6 and the third zone 7 varies at a second connecting strip 27.

10 The third zones 7 are arranged in such a manner as to bound, inside the gap 3, a zone that narrows progressively to the second zones 6. A wedging zone is thus defined. In other words, as the ropes 70 approach the second zones 6, they are wedged between the plate elements 4, receiving from the latter a braking or also locking effect. This happens above with ropes 70 having a diameter that is not excessively
15 small, as will be seen below.

Each first zone 5 comprises a first free end 8, which is further than the third zone 7. The first zone 5 is bounded on one side by a first edge 20 and, on the opposite side, by a second edge 21.

20 The first edge 20, at the fourth edge 23, has a notch zone 25 the function of which will be disclosed below.

Each second zone 6 is bounded by a third edge 22, in particular and not limitingly of circular shape, that is positioned at a second end 40 opposite the first end 8.

25 Each third zone 7 is bounded on one side by a fourth edge 23 and on the opposite side by a fifth edge 24.

On each plate element 4 a slot opening 30 is obtained by means of which it is possible to couple a snap-hook with the device 1. The slot opening 30 extends partially in the first
30 zone 5, partially in the second zone 6 and partially in the third zone 7, along a longitudinal axis K (shown in Figures 4 and 9).

The plate elements 4 can be made of metal, for example stainless steel, or any other material with great mechanical
35 properties and reduced weight.

The profile and the thickness of the plate elements 4, and the shape of the slot openings 30 are such as simultaneously to bestow great mechanical resistance and a very small weight .

5 The first ends 8 are shaped for coupling with a first member 9, suitable for coming into contact with the rope/s 70. The first member 9, better shown in Figures 6 to 8, performs different functions, as will be disclosed below.

10 The first member 9 comprises a first portion 10 that has the shape of a bush and defines a first deviating element 10. The first portion 10 comprises a coupling cavity for coupling, on opposite sides, with respective first fixing elements 11. In particular the coupling cavities comprise a first threaded coupling hole 16 for coupling with first screws 11, or other
15 equivalent fixing elements. On the two plate elements 4 respective first apertures 12 are obtained that are suitable for receiving the first screws 11 to enable the connection between the plate elements 4 and first member 9.

The first deviating element 10 defines part of a path that is
20 followed by the ropes 70 inside the gap 3. The first deviating element 10 is shaped for imposing on the ropes 70 a first curve C1, as shown in Figures 16, 17, 18.

The first deviating element 10 is suitable for being partially wound by the ropes 70 and has a function of
25 generating friction in contact with the ropes 70, such as to slow the sliding of the ropes 70 with respect to the device 1 to a greater or lesser degree according to a given operating condition, as will be seen below.

The first deviating element 10, having a bush shape, also has
30 the function of acting as a spacer for the two plate elements 4. In other words, the first deviating element 10 connects the two plate elements 4, maintaining the two plate elements 4 spaced apart from one another by the first distance D1.

The first member 9 comprises a second portion 13 that is
35 shaped in such a manner as to define a second deviating element 13. The second deviating element 13 comprises a

curved deviating surface 14 that is suitable for receiving the rope/s 70 in contact.

The second portion 13 comprises both hollow zones and full zones that are suitably distributed in such a manner as to meet desired mechanical resistance and lightness characteristics .

In the second portion 13, in a zone nearer the curved deviating surface 14, an opening 17 is obtained that is arranged orthogonally to the plate elements 4 . In particular the opening 17 comprises a second coupling hole 17, which is in particular threaded, for coupling with respective coupling elements, such as second screws 18, or other equivalent fixing elements, the function of which will be disclosed further one. The second screws 18 may be, in a non-limiting manner, of hexagonal type.

As more clearly visible in Figures 6 to 8, the second portion 13 is fixed to the first bush portion 10 by a baffle portion 15 that extends orthogonally with respect to the a longitudinal axis of the first portion 10. The baffle portion 15 extends along a symmetrical plane Ps that intercepts the first portion 10 and the second portion 13 substantially in respective median zones. In particular, but not limitingly, the first portion 10, the second portion 13 and the baffle portion 15 are parts of a single body.

The first member 9 is coupled with the two plate elements 4 in such a manner as to be rotatably movable with respect thereto. In particular, the first member 9 is movable from an opening position A, shown in Figures 5, 15, 16, 17, in which the second portion 13 is extracted from the gap 3, to a closed position E, shown in Figures 1, 3, 4, 14, 18, 19-40, in which at least part of the deviating element 13 is housed inside the gap 3.

Owing to the possibility of rotating the first member 9, inserting the ropes 70 inside the gap 3 is facilitated.

Further, rotatable coupling of the second deviating element 13 with the plate elements 4 prevents the second deviating

element 13 from separating from the device 1, thus increasing safety of use.

The second screws 18 are received in the recess zones 25 that act as resting elements that limit rotation of the first member 9 with respect to a direction that goes from the first edge 20 to the second edge 21. During operation, the thrust of the rope 70 on the second deviating element 13 is contrasted by the recess zones 25 on which the second screws 18 come to rest.

The second screws 18 are provided with respective heads 19 that perform a further reinforcing function for the supporting structure 2. In particular, the heads 19, in the closed position ϵ , prevents the plate elements 4 from moving away from one another. This enables the device 1 to be reinforced further.

In the closed position ϵ , the curved deviating surface 14 protrudes through the first edge 20 outside the gap 3.

The second deviating element 13 defines, similarly to the first deviating element 10, a further part of the path that is followed by the ropes 70 inside the gap 3. The second deviating element 13 is shaped for imposing on the ropes 70 a second curve C2, is shown in Figures 16, 17, 18.

The second deviating element 13 is suitable for being partially wound by the ropes 70, in particular on the curved deviating surface 14, and has a function of generating friction in contact with the ropes 70 so as to contrast the sliding of the ropes 70 with respect to the device 1.

The second deviating element 13, when the first member 9 is in the closed position ϵ , also has the function of acting as a spacer for the two plate elements 4 and preventing the latter moving together, for example because of possible stress during use, contributing to maintain the latter spaced apart from one another by the first distance D1.

The first member 9, in non limiting manner, can be made in a single body, for example steel, or die-cast aluminium or

another suitable light material that has high mechanical resistance .

The safety device 1 comprises a second member 50 arranged near the second end 40 of each plate element 4. The second member 50 is configured for performing various functions as disclosed below. The second member 50 acts as a third deviating element 50. The third deviating element 50 is shaped for cooperating with a snap-hook 60 (visible in Figures 17 to 40), or other similar means, to define a further part of the path that is followed by the ropes 70 inside the gap 3. The rope 70, or the ropes 70, near the third deviating element 50, is forced to follow a third path curve c3. The third deviating element 50 may or may not be in contact with the ropes 70, depending on the particular operating condition in which the device 1 finds itself, as will be specified below. In all cases, in one contact position between the third deviating element 50 and the ropes 70, the third deviating element 50 contributes to imposing the aforesaid third curve c3 on the ropes 70.

The third deviating element 50, in a condition in which it is in contact with the ropes 70, stops movement of the latter. In one particular operating condition, the third deviating element 50 can also act as a braking element. In other words, in contact with the ropes 70, friction is generated that slows the corresponding sliding thereof with respect to the device 1.

In normal operating conditions, the third deviating element 50, when it comes into contact with the ropes 70, has the function of locking the latter. Thus, in normal operating conditions, the third deviating element 50 acts as a locking element 50.

In one embodiment that is better shown in Figures 1, 2, 11, the third deviating element 50 comprises a friction surface 51, facing the inside of the gap 3. The friction surface 51 is in particular concave towards the inside of the device 1, and more specifically, is substantially cylindrical to mate

better with the curves that the ropes 70 adopt near the third deviating element 50. Nevertheless, the friction surface 51 can also have other desired shapes.

On the friction surface 51 attrition promoting means 51 can
5 be provided that are suitable for increasing the braking effect or for reinforcing the locking effect of the third deviating element 50 in relation to the rope/s 70. In one embodiment, the attrition promoting means comprises ridge zones and/or recess zones that are suitable distributed and
10 distanced such as to define knurling 51 on the friction surface 50. The recess zones and/or the ridge zones extend transversely in relation to the second planes P2. In other words the recess zones and/or the ridge zones extend transversely, in particular, orthogonally, with respect to a
15 direction U along which the ropes 70 can move, such as to intensify, in a mutual contact position, the braking or locking effect on the ropes 70.

On the third deviating element 50 openings or third coupling holes 52 are obtained, which are angularly or equally
20 distributed, in particular threaded for coupling with respective fixing elements, in particular third screws 54 or other equivalent fixing elements. On the two plate elements 4 there are obtained respective second openings 31 that are suitable for receiving the third screws 54 to enable the
25 deviating element 50 to be fixed to the plate elements 4.

The third deviating element 50 can be made of steel, or of cast aluminium or another suitable material that is light and provided with great mechanical resistance.

In one set operating condition, which will be disclosed
30 above, the third deviating element 50 acts as a locking element for the ropes 70. In particular, the third deviating element 50, cooperating with the snap-hook 60, locks the ropes 70 preventing the sliding thereof with respect to the device 1. The ropes 70 can lock when the snap-hook 60 and the
35 third deviating element 50 are moved together to a position of reduced distance that means that the ropes 70 are squeezed

between the third deviating element 50 and the snap-hook 60, in a locking region B. The device 1 is thus arranged in a locking configuration L (shown in Figures 27, 30, 33, 36, 39) .

5 The third deviating element 50, as more clearly visible in Figures 3, 11 and 12, has a semiannular shape, and also has the function of acting as a spacing element for the two plate elements 4. The third deviating element 50 firmly connects the two plate elements 4, maintaining the two plate elements
10 spaced apart by the second distance D2.

The third deviating element 50, or locking element 50, has a thickness that is substantially equal to the second distance D2. The thickness of the third deviating element 50, and thus the second distance D2, are preferably less than the first
15 distance D1 that separates the first two zones 5 of the plate elements 5 in such a manner that it defines, between the third zones 7, a zone of progressive narrowing R that gets narrower the nearer it gets to the third deviating element 50. This has the function of generating an effect of wedging
20 the ropes 70 between the third zones 7, which accentuates the braking effect that the ropes 70 undergo. This effect is achieved particularly when the diameter of the rope 70, or the sum of the diameters of the ropes 70 is relatively great, i.e. is greater than the second distance D2. Nevertheless,
25 this wedging effect can also occur even when the ropes 70, despite having diameters the sum of which is less than the second distance D2, are subjected to crushing between the snap-hook 60 and the third deviating element 50, which is such as to cause transverse expansion of the ropes 70 as far
30 as contact and interference with the third zones 7 of the plate elements 4.

The particular geometric configuration of the device 1 thus has the advantage of obtaining braking of the ropes 70 or also locking of the latter by means of the plate elements 4,
35 in particular of the third zones 7 against which the ropes 70 go to press.

During operation, on the one side the ropes 70 are subject to the action of the snap-hook 60 and, if the latter is moved towards the third deviating element 50, the ropes 70 are brought into contact with the third deviating element 50 and/or with the third zones 7, in such a manner as to undergo braking that can be transformed into locking, depending on the intensity with which the ropes 70 are clamped. If the diameter of the rope 70, or the sum of the diameters of the ropes 70 is less than the second distance D2, the ropes 70 first come to rest on the friction surface 51 and subsequently, possibly, through the effect of the crushing experienced, they come into contact laterally also with the plate elements 4.

If the diameter of the rope 70 or the sum of the diameters of the ropes 70 is greater than the second distance D2, the ropes 70 first come to rest on the third zones 7, undergoing the braking or locking effect of the plate elements 4. If the clamping force on the ropes 70 increases, the ropes 70 may also go to press against the friction surface 51, receiving a further braking or locking action.

The device 1 comprises a third member 65, better shown in Figure 13, which acts as a fourth deviating element 65. The fourth deviating element 65 is fixed at both ends to the two plate elements 4, in such a way as to be in a stationary position, in particular in a zone that is distinct from the locking zone B or from the zone in which the third deviating element 50 is located.

The rope 70, in the path inside the gap 3, arriving from the second member 50 partially winds the third member 65 and subsequently exits the device 1, defining a free portion 80 of rope that can be grasped by the user.

The third member or fourth deviating element 65 acts as a braking element 65 for the rope/s 70. The deviating or braking element 65 is shaped for deviating the rope/s 70 by imposing thereupon a fourth variable curve C4 that enables a

braking effect to be calibrated that the braking element 65 exerts on the rope/s 70.

In particular, the fourth curve C4 can be modified by varying the lay or direction along which the free portion 80 of the rope/s 70 is arranged. By varying the position of the free portion 80 the length of the contact zone of the rope 70 on the braking element 65 is also varied, varying in this manner also the intensity of the braking effect. Owing to the fact that the fourth curve C4 can be varied, it is possible to control the braking effect of the device 1 on the rope 70, as can be seen in Figures 18-21, 23, 24, 28, 29, 31.

The fourth deviating element 65 also acts as a spacing element for the two plate elements 4. In other words, the fourth deviating element 65 connects the two plate elements 4 by maintaining the two plate elements 4 spaced apart from one another by the first distance D1. The fourth deviating element 65 contributes to reinforcing structurally the device 1, by acting in this manner as a reinforcing element. Owing to the fact that the braking element 65 is bounded on both sides by the plate elements 4, the risk is eliminated that the free portion 80 can escape and lose contact with the braking element 65, thus facilitating braking operations for the belayer.

With reference to Figures 4 and 5, the braking element 65 is positioned by considering a dimension that is parallel to the longitudinal axis κ , to a position that is substantially intermediate between the first deviating element 10 and the third deviating element 50. Further, a decentring distance G of the braking element 65 from the longitudinal axis κ , or from a substantially central zone of the supporting structure 2 is noticeably less than an end distance H between the first deviating element 10 and the third deviating element 50. Further, the braking element 65 is nearer the third deviating element or locking element 50 than the first deviating element 10. Owing to this first geometrical configuration, optimal interaction between the device 1 and the rope/s 70 is

obtained. In particular, the rope 70 slides appropriately with respect to the device 1 without offering great resistance and at the same time, when requested, the device 1 assures effective braking and locking action on the rope 70.

5 The braking element 65, in one non-limiting embodiment shown in attached Figures, comprises a non-rotatable pulley element 65 fixed on both sides to the plate elements 4. In the pulley element 65 an opening is obtained, in particular a fourth threaded coupling hole 66 that is coupled on opposite sides
10 with respective fixing elements, such as fourth screws 67 or other equivalent fixing elements. On the plate elements 4 third openings 32 are obtained that are traversed by the fourth screws 67 and permit the plate elements 4 to be reciprocally fixed to the pulley element 65.

15 With reference to figure 4, the threaded coupling hole 66 is positioned with respect to an edge 53 of the nearest friction surface 51, at a distance that comprises a first distance component x , measured orthogonally with respect to the longitudinal axis κ , and a second distance component y ,
20 measured parallel to the longitudinal axis κ . The position of the pulley element 65, as previously disclosed, is suitably chosen to impose an optimal path curve on the rope 70 permitting better control thereof. The pulley element 65 is arranged substantially at an intermediate position between
25 the first deviating element 10 and the third deviating element 50, but decentred by a certain amount with respect to the longitudinal axis κ .

Also the diameter of the pulley element 65 is suitably chosen in such a manner as to ensure correct operation with ropes 70
30 of various diameters.

The pulley element 65, as better shown in Figure 13, comprises two throats 68 alongside one another, each of which is suitable for interacting with a respective rope 70. The throats 68 are bound laterally by tilted surfaces, in such a
35 manner that the throats 68 are flared. The flared shape of the throats 68 is such that the further the rope 70

penetrates the throats 68 the more the rope 70 receives a clamping action that increases the braking effect. When the user desires to decrease or increase the braking effect on the rope 70, he can act by varying an angle of tilt I of the free portion 80 measured with respect to a connecting portion of the rope/s 70 that connects the device 1 directly to the climber, as shown in Figures 23 and 24.

In this manner, the angular extent of contact of the rope 70 with the braking element 65 or pulley element 65, or the winding length of the latter is varied, consequently varying the intensity of the braking effect on the rope 70. Great contact and winding of the rope 70 on the braking element 65 and therefore a high braking effect corresponds to a small angle of tilt α .

On the other hand, the greater the angle of tilt I the less the extent of contact and winding of the rope 70 on the braking element 65 and thus the less the braking effect that the braking element 65 exerts on the ropes 70.

Instead of having two throats 68, the braking element 65 can have only one, or another desired number of throats, depending on the number of ropes with which it is desired to associate the device 1.

Instead of being formed with the throats 68, the braking element 65 can have other equivalents and suitable means for calibrating the braking effect. For example, on the braking element 65 surfaces provided with a suitable friction coefficient can be provided that may be variable from zone to zone according to the winding arch of the rope 70 on the surfaces.

The third member 65 can be made of steel or aluminium or of another suitable material that is light and mechanically tough at the same time.

Some manners of use and operation of the device 1 are briefly disclosed below.

Once the ropes 70 are inserted into the device 1 and once the snap-hook 60 is coupled with the latter, as shown in Figures 15 to 18, the device 1 is ready for use.

Figures 19 to 22 show the steps that follow during a manner of use in which the user, i.e. the belayer, supplies rope to the climber to enable the climber to continue the ascent. With one hand the belayer grasps the device 1, so as to maintain the snap-hook 60 spaced away from the second member 50, and with the other hand the belayer feeds out the rope 70 from the device 1 to the climber. During this operation the belayer can hold the free portion 80 of rope constantly to be sure to be able to intervene constantly in the event of the climber falling, to be able to ensure that the stop in flight of the latter is not sharp but gentle and progressive, using the device 1 in brake mode. Brake mode is schematised in Figure 23. As the belayer reduces the angle of tilt 1, as shown in Figure 24, the free portion 80 winds increasingly around the braking element 65 and the braking effect is increased, which progressively reduces sliding of the rope 70 until the latter stops completely. The arrest is thus dynamic, i.e. gradual. At the point the rope 70 is locked and the climber is safe without having suffered excessive undesired deceleration.

Figures 25 to 27 show the behaviour of the device 1 and the steps that follow one another in a manner of use of automatic locking in case of emergency, i.e. when an objective event makes the belayer non-operative. If both hands of the belayer, owing, for example, to unwellness, or the fall of a rock or another unexpected event, lose hold of the rope 70 and of the device 1, as shown in Figure 26, the device 1 acts automatically, going into a self-locking configuration. In particular, when the rope 70, owing to the fall of the climber, is pulled upwards, the friction that is generated, and which is due to the windiness of the path inside the gap 3, is such as to drag the device 1, moving the device away from the snap-hook 60. Nevertheless, the movement of the

device 1 upwards stops when the snap-hook 60 comes to interact with the third deviating element 50, pressing the rope 70 against the latter. In this position, as figure 27 shows, the rope 70 is locked and is no longer able to slide
5 in relation to the device 1. The fall of the climber is thus terminated in total security.

The device 1 thus advantageously enables the safety of the climber to be safeguarded also in the event of the belayer being out of action, unlike prior-art braking devices, which
10 in the event of the belayer being out of action cannot prevent potentially serious accidents from happening.

Figures 28 to 30 show the steps of a manner of use of locking in the event of necessity, i.e. when the belayer needs intentionally to lock the climber, to perform an activity,
15 for example undoing a knot, taking a photograph, or any other activity that requires the hands to be used.

In this manner of use, the belayer, as figure 29 shows, accompanies the device 1 from a base or normal operating position (shown in Figure 28) to a static locking position,
20 shown in Figure 30, in such a manner that the third deviating element 50 works as a locking element cooperating with the snap-hook 60. In this configuration the snap-hook 60 and the third deviating element 50 are near to one another and lock the rope 70, preventing the rope 70 from sliding with respect
25 to the device 1. The climber is secured in a stationary position for all the time necessary for the belayer to complete the task in complete serenity.

Figures 31 to 33 show the steps of a manner of use of the device 1 in the so-called "double rope technique", i.e. a
30 descent technique of the climber.

As shown in Figure 31, with one hand the belayer holds the device 1 and with the other acts on the free portion 80, giving rope to the climber to enable him to descend with respect to the waiting point provided on the wall. During
35 this step, the snap-hook 60 and the locking element 50 are kept away from one another, to enable the rope 70 to slide,

but at the same time the belayer acts, by exploiting the braking element 65. In other words, the free portion 80 is subjected to suitable traction, such as to maintain the free portion 80 in contact with the braking element 65, and also
5 the contact or winding extension is regulated in order to dose the braking effect on the rope 70. If at a certain point the belayer, for example because of unwellness, lets hold with both hands, the rope 70 starts to slide for a few fractions of a second compared with the device 1, as shown in
10 Figure 32, until the latter is arranged in the locking position, in which the snap-hook 60 and the locking element 50 are near one another. The transition from the initial position, in which the device 1 acts as a braking descending device, to the final position shown in Figure 33, in which
15 the device 1 acts as a self-locking device, is rather instantaneous but not excessively sudden. This thus causes a stop that is not unpleasant for the user who is making the descent. The device 1 in this manner enables special and distinct devices or other means to be dispensed with that are
20 usually used in the prior art, such as, for example, the self-locking knot, which is also rather difficult to undo and retie and causes time delays that are not negligible. The device 1 is thus easier to use and safer and also enables a faster descent of the climber to be obtained.

25 It order to resume the descent, it is sufficient for the belayer to draw to himself the device 1 in such a manner as to remove the snap-hook 60 from the locking element 50, and act as already disclosed with reference to Figure 31.

In Figures 34 to 36 a use of the device 1 in the "double rope
30 technique" is shown, in which, unlike what is disclosed with reference to Figures 31 to 33, a very gradual and gentle stop and locking are achieved. In this case, the belayer does not suddenly release the free portion 80 of the rope 70 but assists the device 1 by accompanying it gradually to the
35 locking configuration L. In this manner, the climber is not subjected to any sharp deceleration.

Figure 37 shows another manner of use of the device 1 that allows the climber, in this case said first climber in a group of roped climbers, to recover his companion, in this case said second climber in a group of roped climbers. In this case, the device 1 is in an overturned position with respect to what has been disclosed up until now and the snap-hook 60 is connected, by a further rope 71, to further snap hooks 61 that are in turn connected to anchoring elements 62 fixed to the wall. By pulling the free portion 80 downwards the rope 70 is recovered to which the second climber in the roped group is attached, as is visible in Figure 38. If the grip on the free portion 80 is released, the second climber in the roped group falls, the device 1 is arranged in the self-locking position shown in Figure 39, in which the snap-hook 60 and the locking element 50 lock sliding of the rope 70. If the second climber in the roped group, requests for some reason rope for moving backwards, as shown in Figure 40, it is sufficient to raise the device 1, in such a manner as to remove the snap-hook 60 from the locking element 50, and at the same time it is sufficient to provide rope by exploiting the braking element 65 to calibrate the braking effect on the rope to prevent the second climber in the roped group from escaping control. In order to obtain a correct braking effect, the user acts in such a manner as to make the rope 70 interact with the braking element 65, by raising the rope 70, as visible in Figure 40, more or less according to the required braking force. When the device 1 is raised with respect to the snap-hook 60 to release the rope 70, the user can firmly grip the free portion 80, raising the latter more or less according to necessity.

From what has been disclosed above, it is thus clear that the use of the device 1 in the so-called "technique for recovering the second climber in the roped group" is much easier, reliable and safe than prior-art devices.

As can be gathered from what has been disclosed above, in normal operating conditions the device 1 is used and behaves

as a brake but in the event of necessity or when required it can easily and reliably operate and be used as a self-locking device. Owing only to the device 1, in this way the advantages and utility of a brake and the advantages and utility of a self-locking device are obtained simultaneously. The device 1 can also be used only as a self-locking device, without having to vary the arrangement of the rope/s 70 with respect thereto, or can be used only as a braking device, in such a manner that the rope/s 70 does not pass through the snap-hook 60. The device 1 is further very safe inasmuch as is anyway acts as a braking device if the user by mistake does not insert the rope/s 70 into the snap-hook 60.

Further, unlike some prior-art devices, the device 1 according to the invention is rather compact and does not include movable levers or protruding bodies that could act as blunt instruments during possible improvised manoeuvres or pulls, thus being dangerous for a user.

Variations on and/or additions to what has been disclosed and illustrated above in the attached drawings are possible. In one embodiment that is not shown, the supporting structure 2, instead of comprising the two plate elements 4, can be made of a single body. It is further possible to provide for the first deviating element 10, and/or the second deviating element 13, and/or the third deviating element 50 and/or the fourth deviating element 65 being part of the aforesaid single body. It is possible to configure and dimension the device 1 in a desired manner in function of the multiple applications to which the device 1 can be intended.

CLAIMS

1. Safety device suitable for being coupled with one or more ropes (70), comprising a supporting structure (2) defining a gap (3) suitable for housing part of said one or more ropes (70) and suitable for coupling with a snap-hook (60), first deflecting means (10) shaped for imposing on one or more ropes (70) a first curve (c1), second deflecting means (13) shaped for imposing on one or more ropes (70) a second curve (c2), third deflecting means (50) shaped for imposing on one or more ropes (70) a third curve (c3) and suitable for cooperating with said snap-hook (60) to lock said one or more ropes (70) in a locking zone (B), and fourth deflecting means (65) fixed to said supporting structure (2) in a stationary position that is distinct from said locking zone (B), said fourth deflecting means (65) being shaped for imposing on one or more ropes (70) a fourth curve (c4) that is variable to control the braking effect of said device (1) on said one or more ropes (70), characterised in that said third deflecting means (50) comprises a semiannular portion (50) that is suitable for cooperating with said snap-hook (6) to act as a locking element for said one or more ropes (70).
2. Safety device according to claim 1, wherein said supporting structure (2) is defined by first plate means (4) and second plate means (4) that are mutually connected and spaced apart by said first deflecting means (10), said third deflecting means (50) and said fourth deflecting means (65).
3. Safety device according to claim 2, wherein said first plate means (4) and said second plate means (4) comprise respective first zones (5) that are mutually spaced apart by a first distance (D1), and respective second zones (6) that are mutually spaced apart by a second distance (D2) less than said first distance (D1),

between said second zones (6) there being interposed said third deflecting means (50) .

4. Safety device according to claim 3, wherein said first plate means (4) and said second plate means (4) comprise
5 respective third zones (7) that connect said first zones (5) to said second zones (6), said third zones (7) extending along mutually converging respective surfaces (5), so as to define a braking and/or locking wedging zone for said one or more ropes (70) .

10 5. Device according to any one of claims 2 to 4, wherein on said first plate means (4) and said second plate means (4) respective slot openings (30) are obtained to enable said snap-hook (60) to be coupled with said one or more ropes (70) and with said supporting structure (2).

15 6. Device according to claim 5, wherein said slot openings (30) extend along a longitudinal axis (κ) from said first zones (5) to said second zones (6), passing through said third zones (7) .

20 7. Safety device according to any one of claims 1 to 6, wherein said second deflecting means (14) is fixed to said first deflecting means (10), and said first deflecting means (10) is rotatably coupled with said supporting structure (2) so as to enable said second deflecting means (13) to move from an opening position
25 (A), in which it is outside said gap (3) to facilitate the insertion of said one or more ropes (7) into said device (1), to a closed position (E), wherein said second deflecting means (13) is at least partially housed in said gap (3) .

30 8. Safety device according to any one of claims 1 to 7, wherein said semiannular portion (50) comprises a knurled friction surface (51) .

35 9. Safety device according to any one of claims 1 to 8, wherein said first deflecting means (10) and said third deflecting means (50) are arranged respectively at a

first end (8) and at a second end (40) of said supporting structure (2) that are opposite one another.

10. Safety device according to claim 5 or 6, or according to any one of claims 7 to 9 as appended to claim 5 or 6, wherein said second deflecting means (13), during operation, is positioned substantially between said slot openings (30) and said first deflecting means (10).

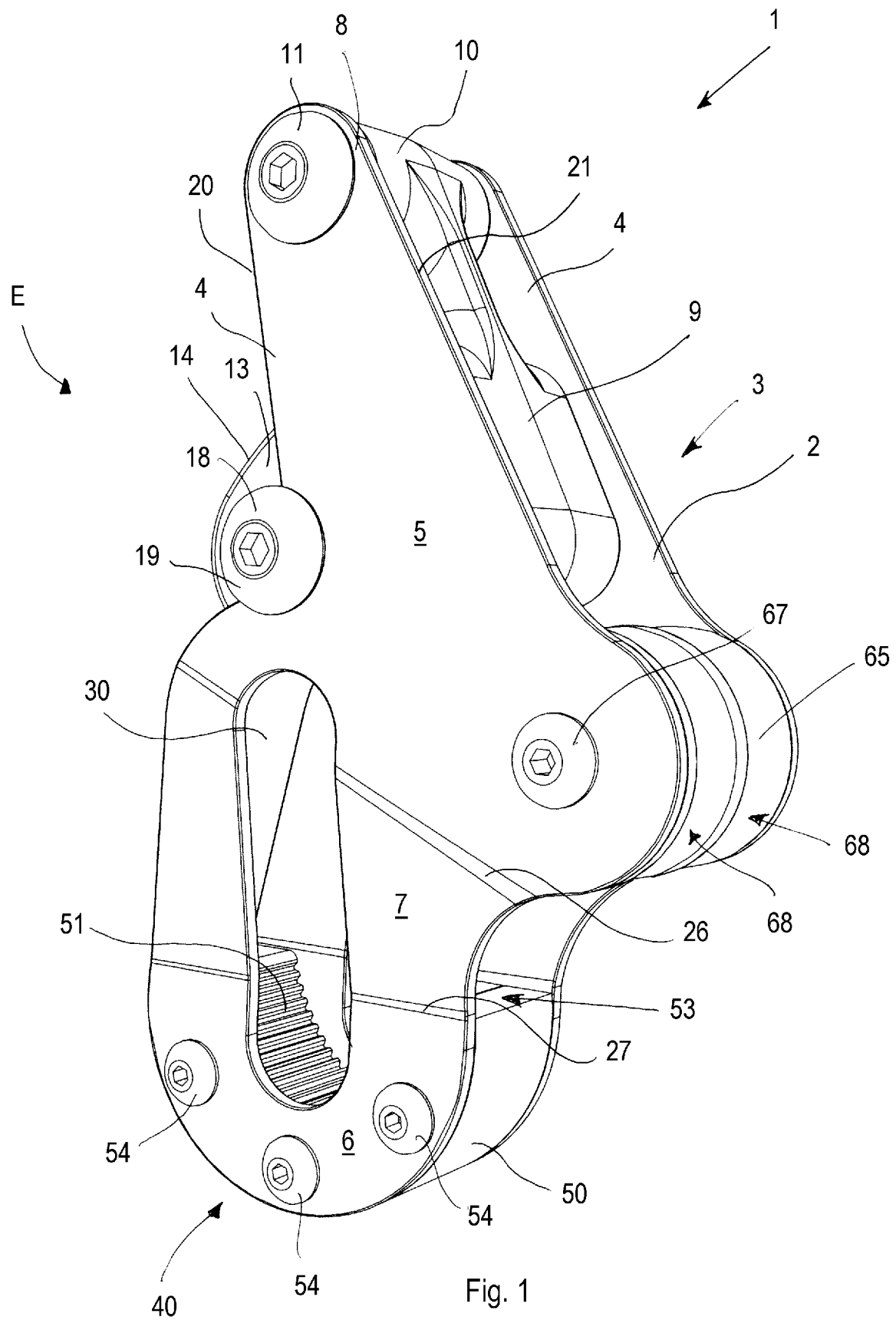
11. Safety device according to any one of claims 1 to 10, wherein said fourth deflecting means (65) is arranged, with respect to a longitudinal dimension of said supporting structure (2), in an intermediate position between said first deflecting means (10) and said third deflecting means (50).

12. Safety device according to any one of claims 1 to 11, wherein a decentring distance (6) of said fourth deflecting means (65) from a substantially central zone of said supporting structure (2) is less than an end distance (H) between said first deflecting means (10) and said third deflecting means (50), said fourth deflecting means (65) being nearer said third deflecting means (50) than said first deflecting means (10).

13. Safety device according to any one of claims 1 to 12, wherein said fourth deflecting means comprises a stationary pulley element (65), fixed at both opposite ends to said supporting structure (2), on said pulley element (65) flared throat means (68) being obtained to receive said one or more ropes (70), said pulley element being arranged to act as a braking element (65) that is able to brake said one or more ropes (70) with an intensity that is variable in function of a winding length or angle of said one or more ropes (70) on said braking element (65).

14. Safety device according to any one of claims 1 to 13, wherein said first deflecting means (10), and/or said second deflecting means (13) and/or said third deflecting means (50) and/or said fourth deflecting

means (65) and said supporting structure (2) are made of a single body.



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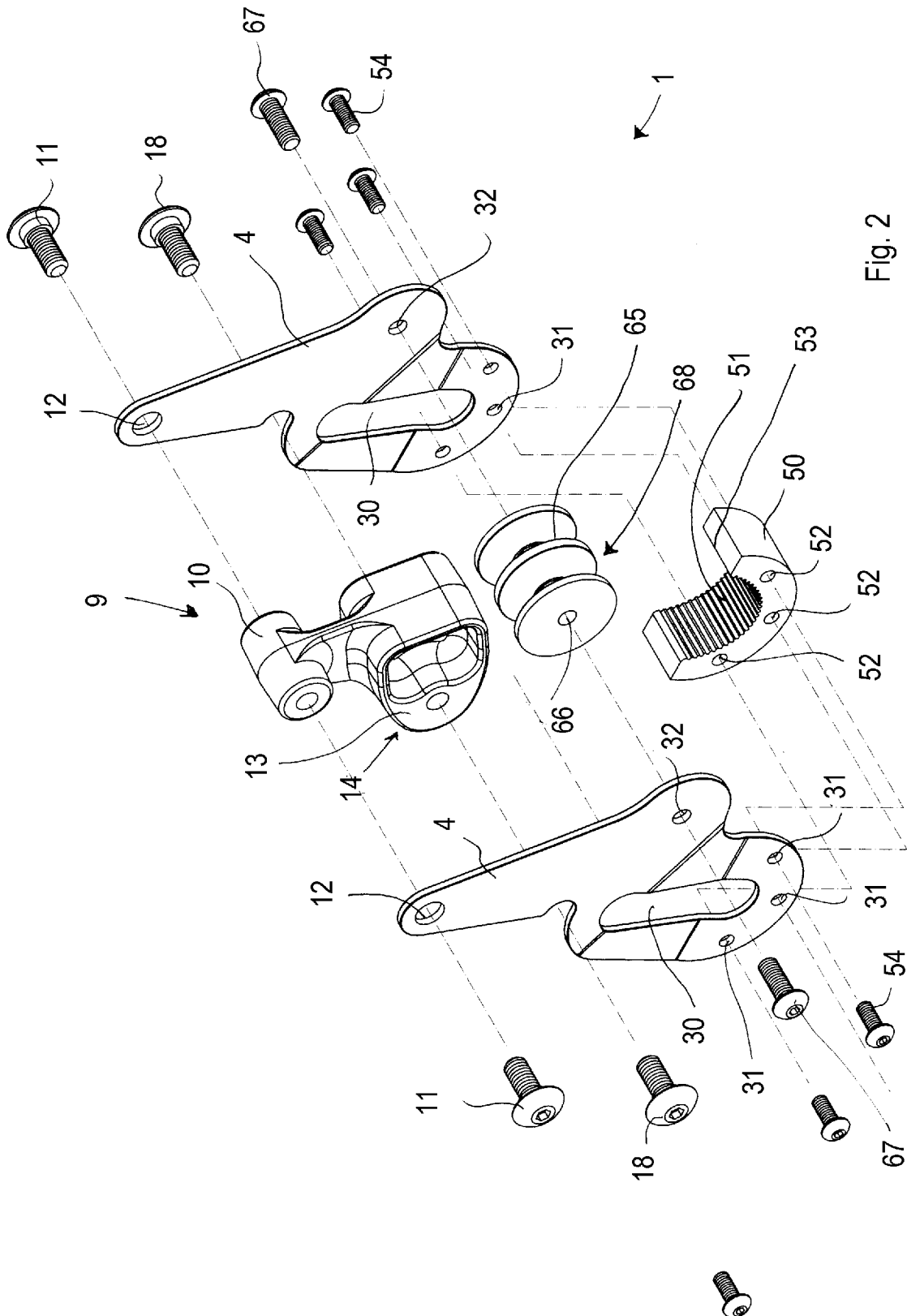


Fig. 2

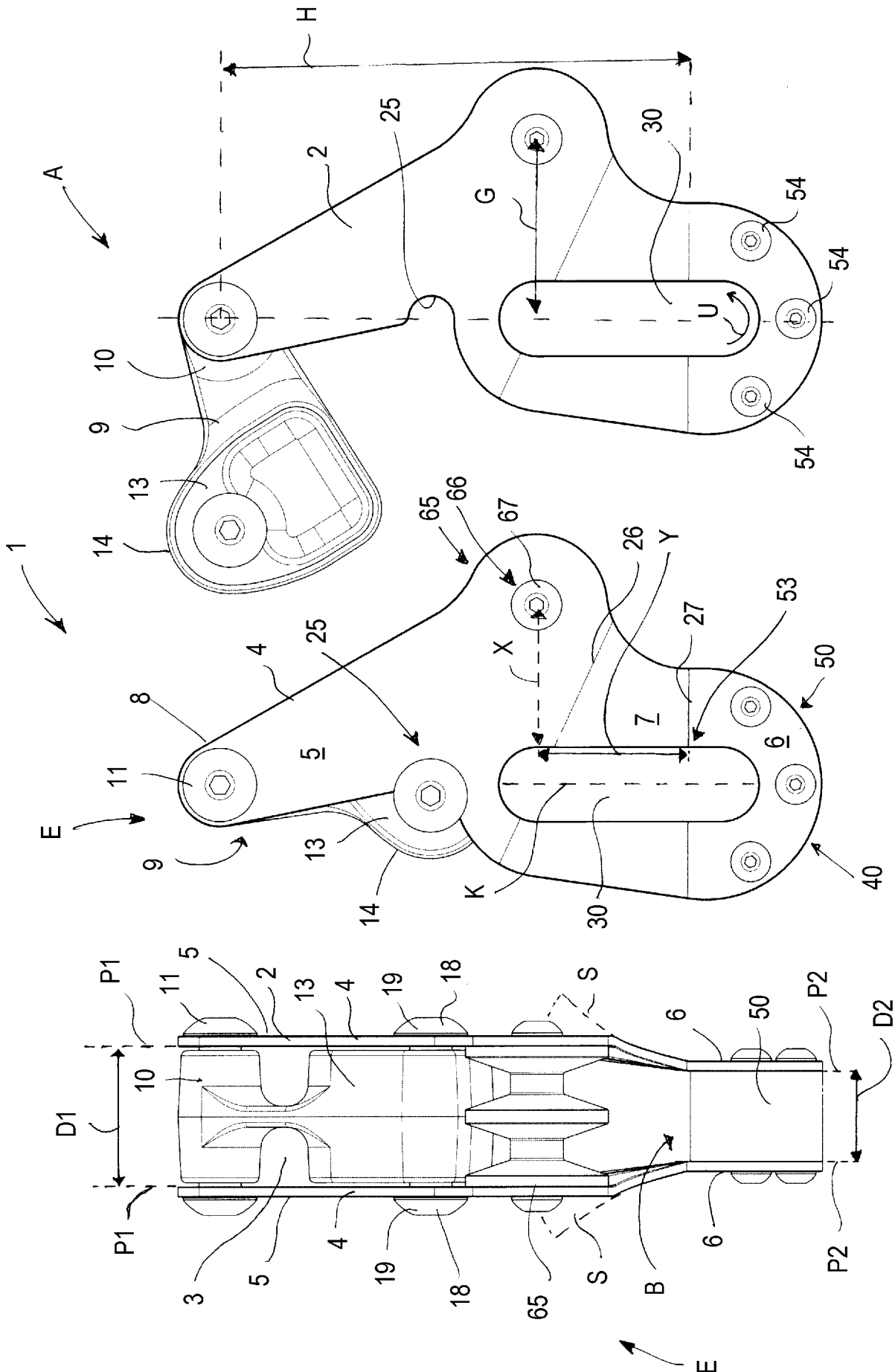


Fig. 5

Fig. 4

Fig. 3

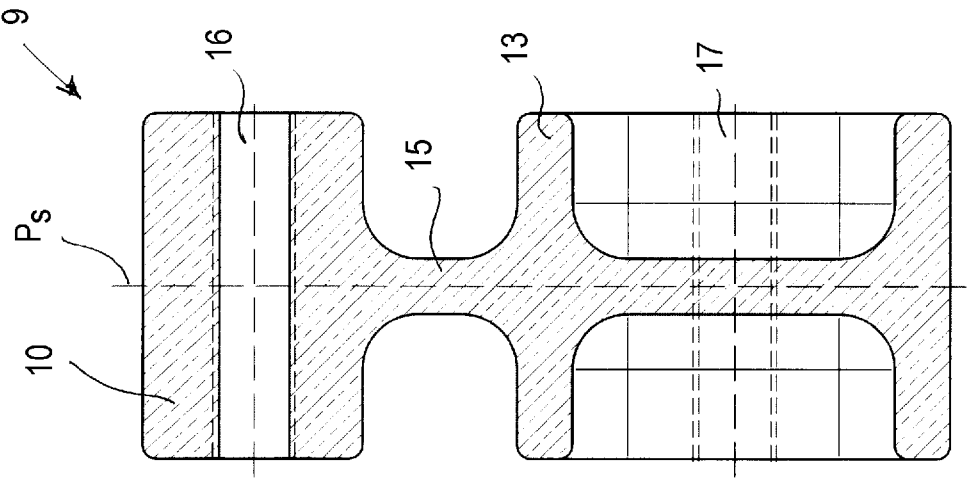


Fig. 8

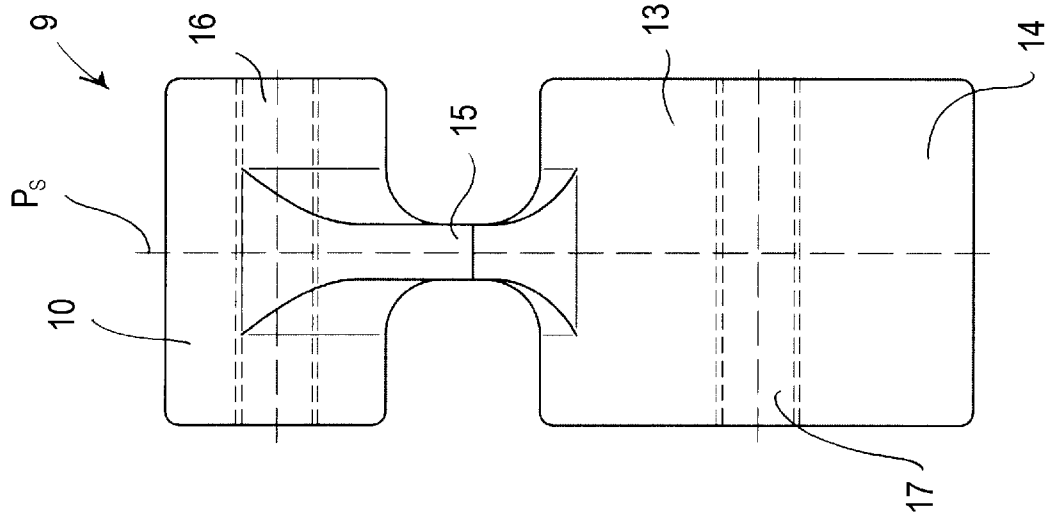


Fig. 7

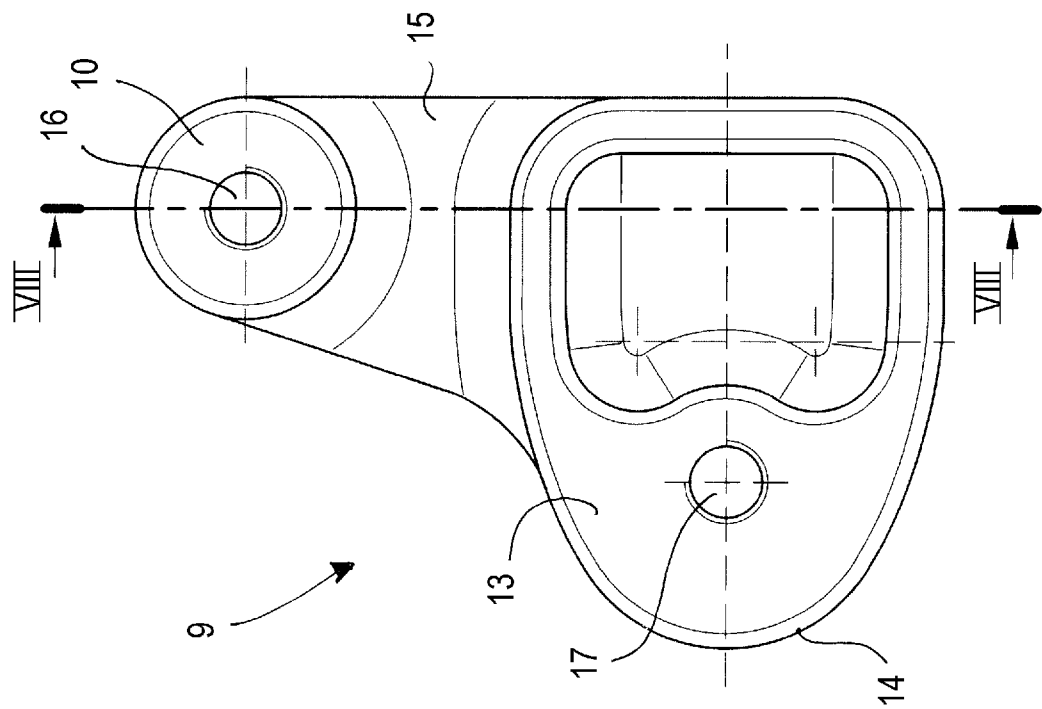
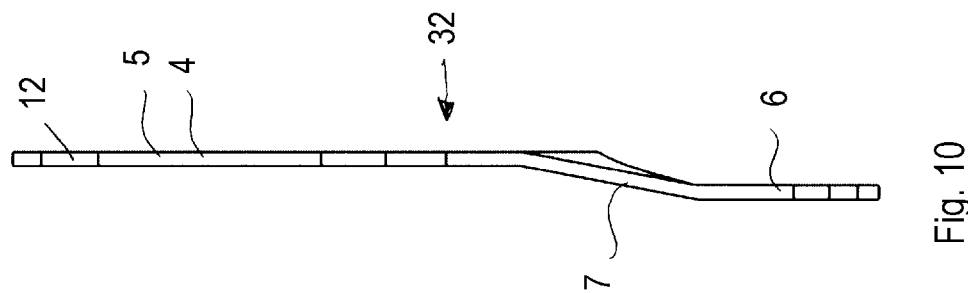
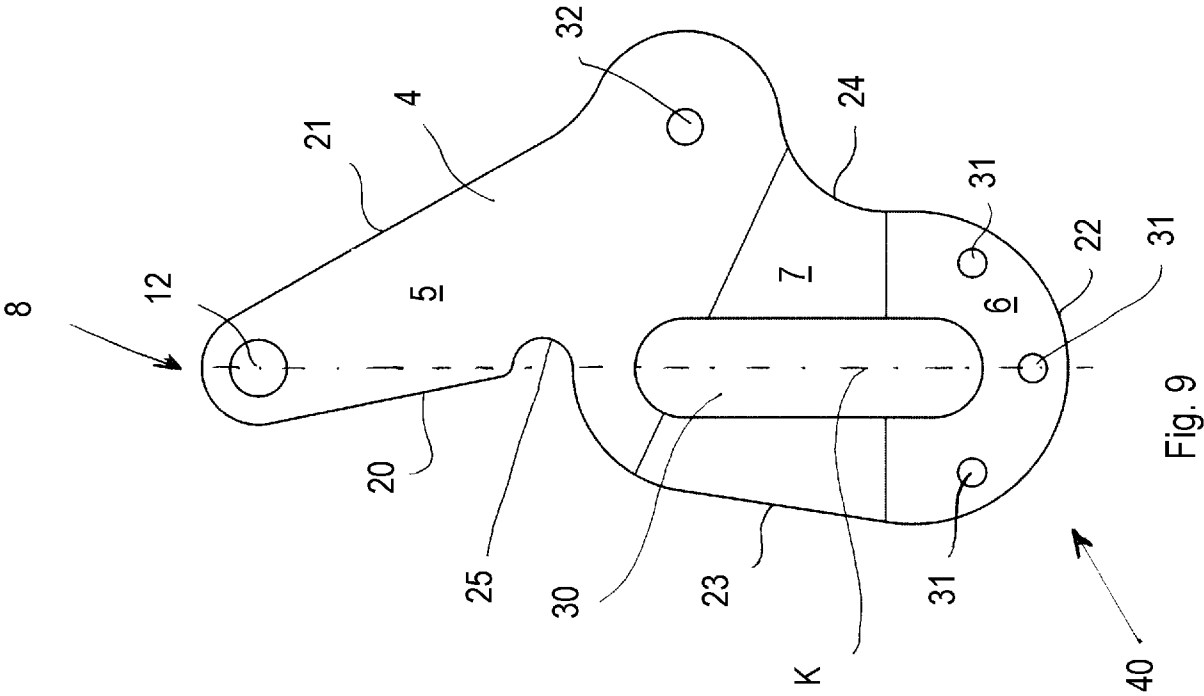


Fig. 6



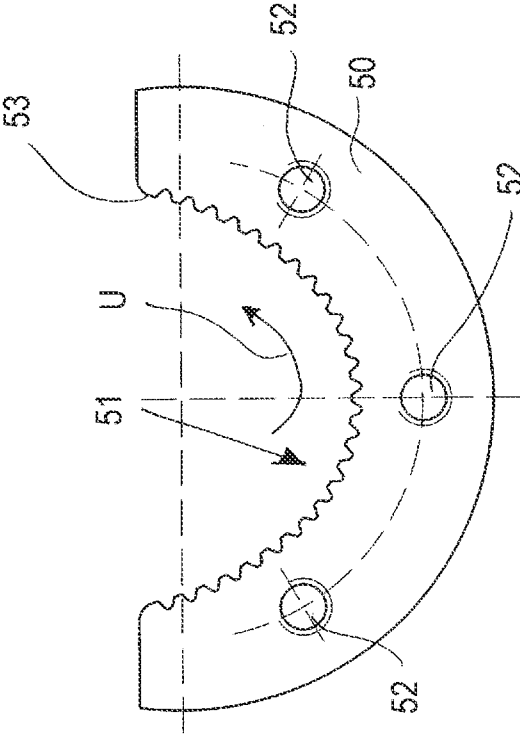


Fig. 11

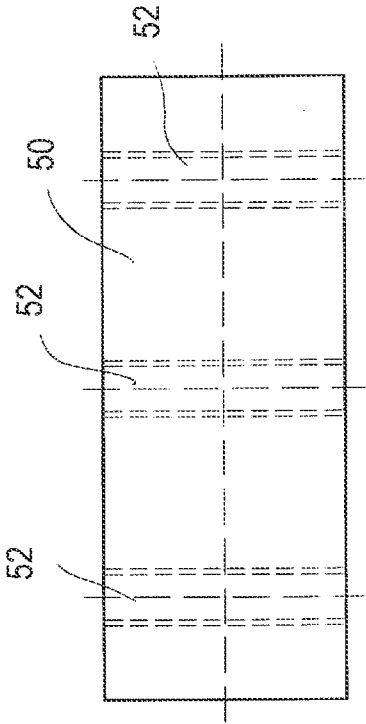


Fig. 12

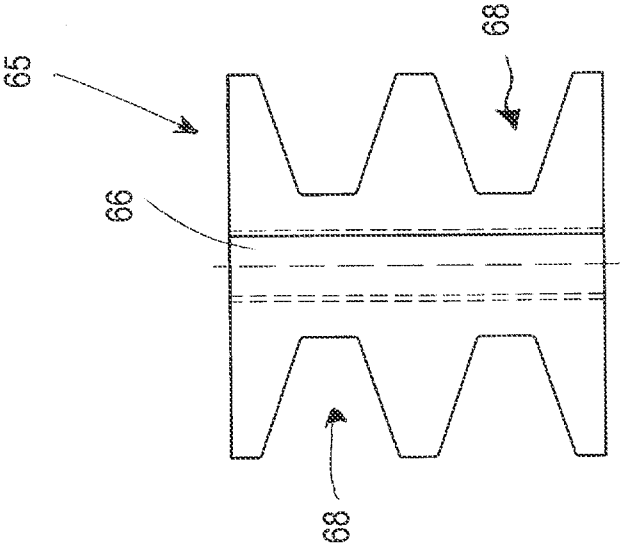


Fig. 13

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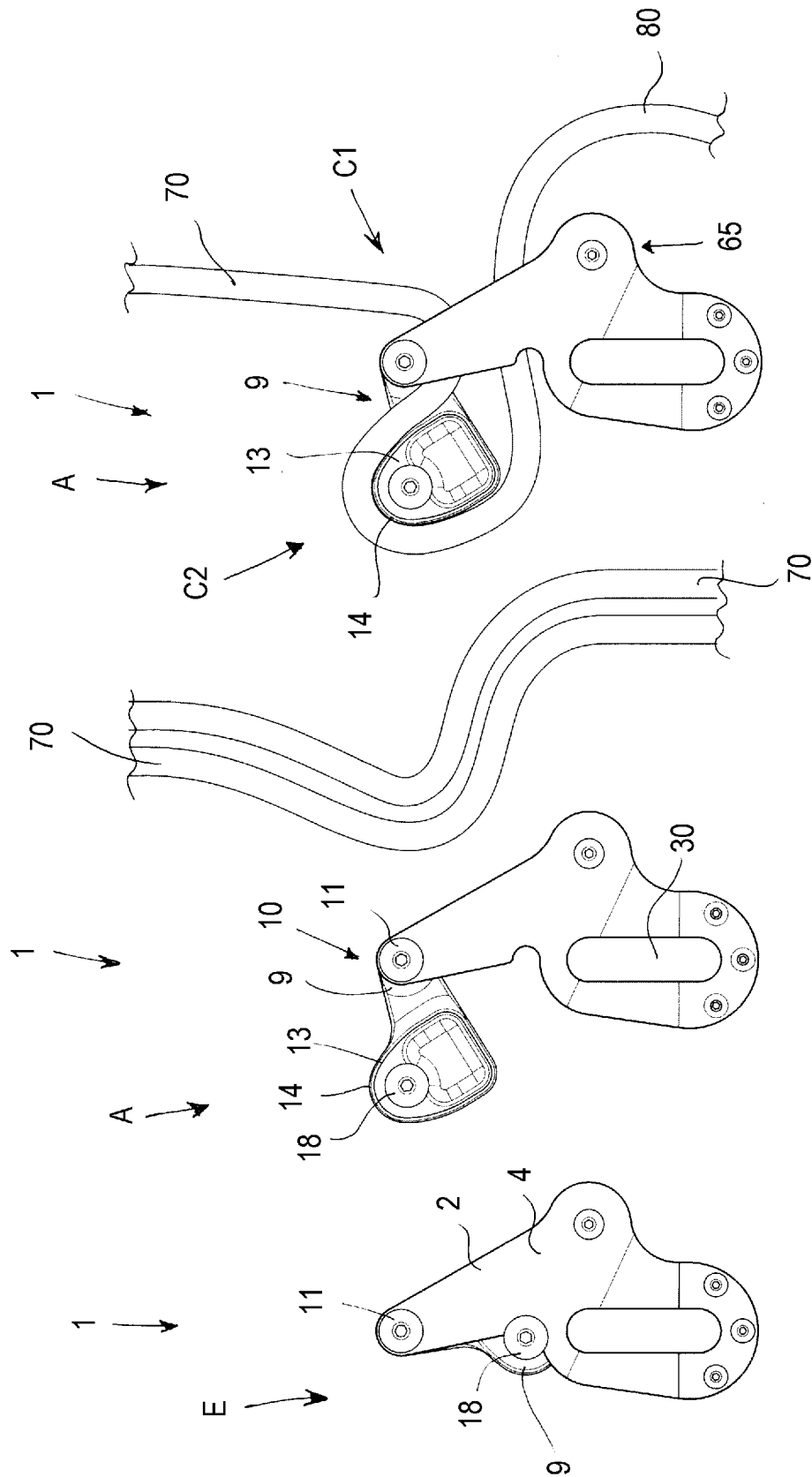


Fig. 16

Fig. 15

Fig. 14

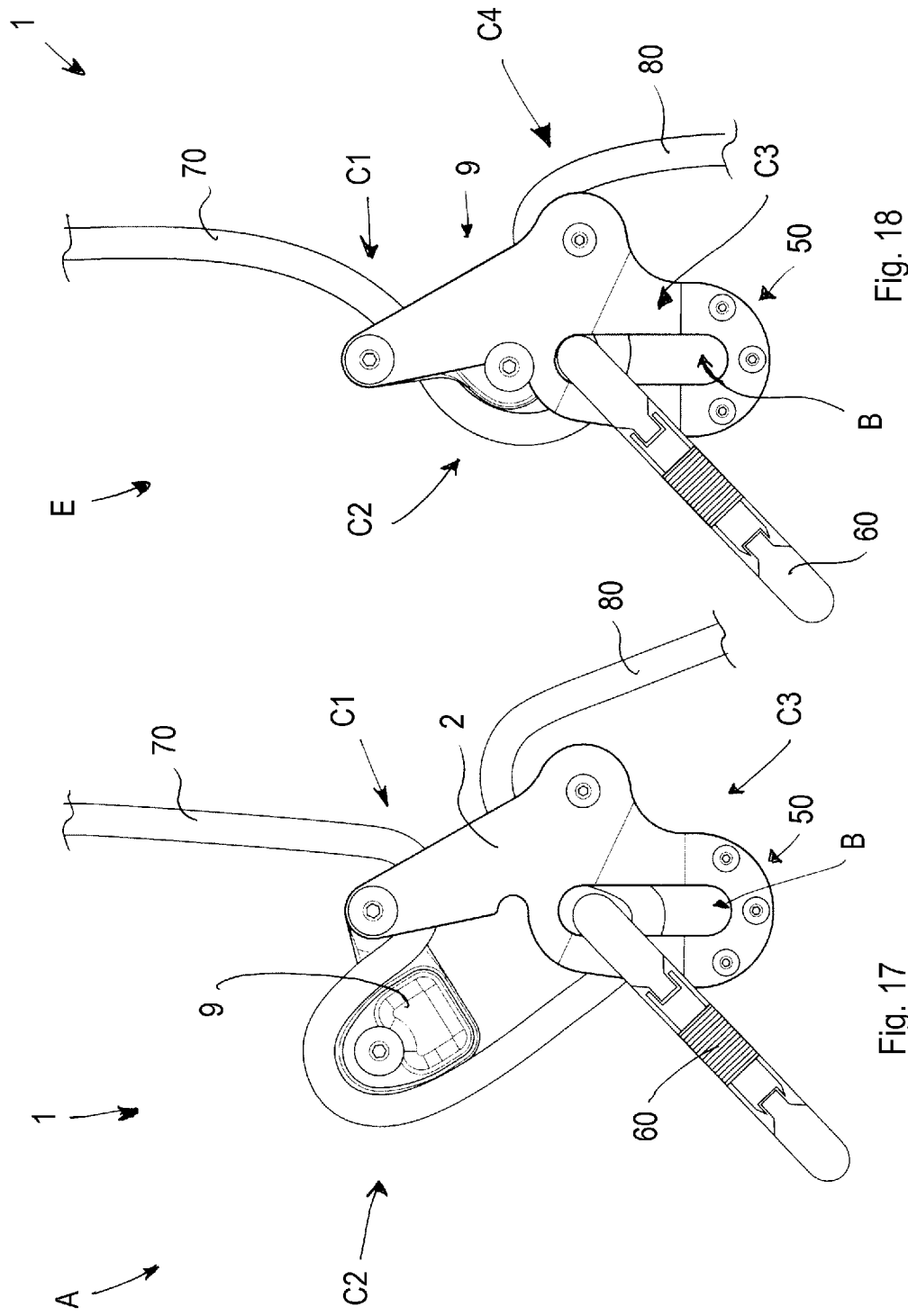


Fig. 18

Fig. 17

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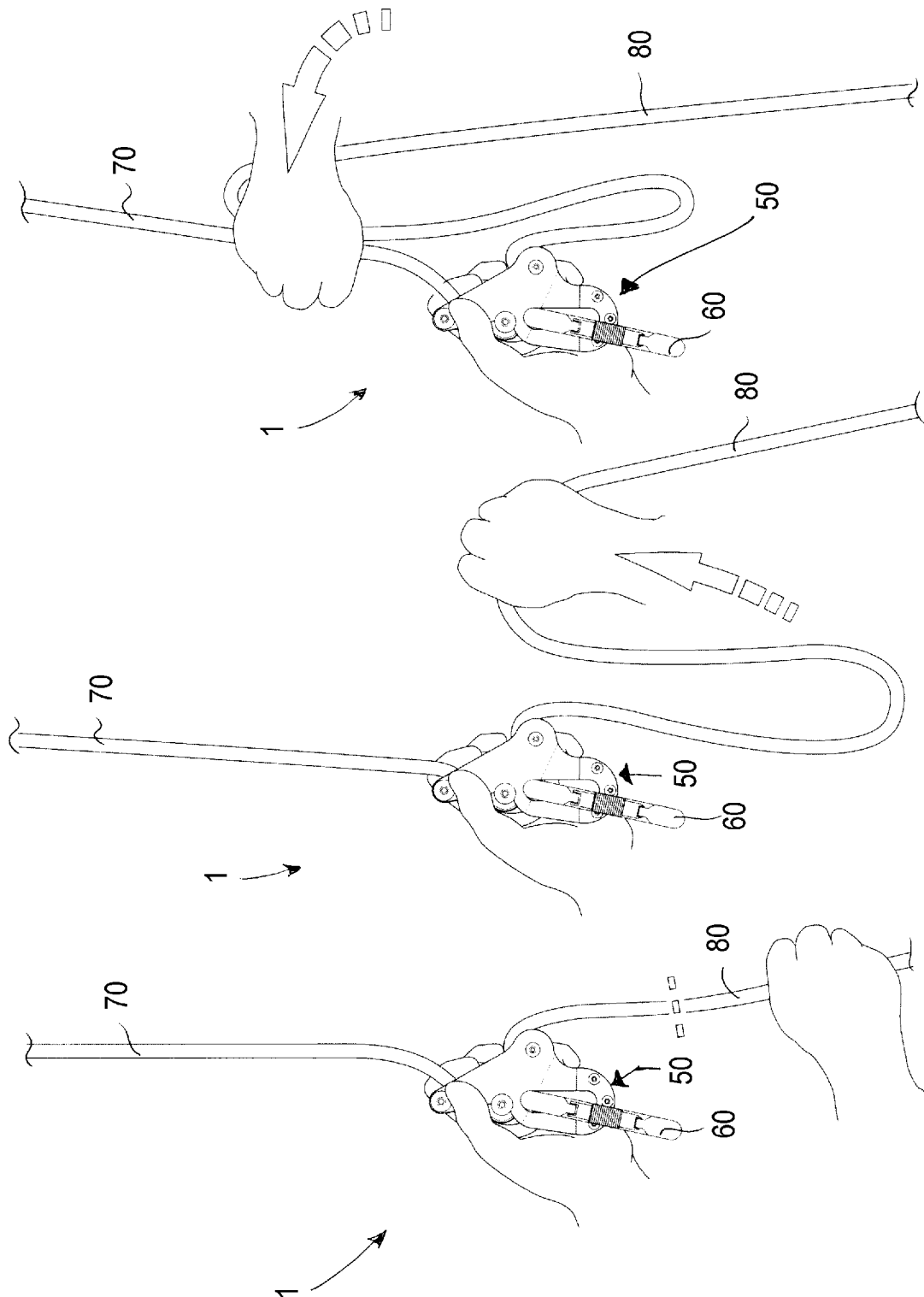


Fig. 21

Fig. 20

Fig. 19

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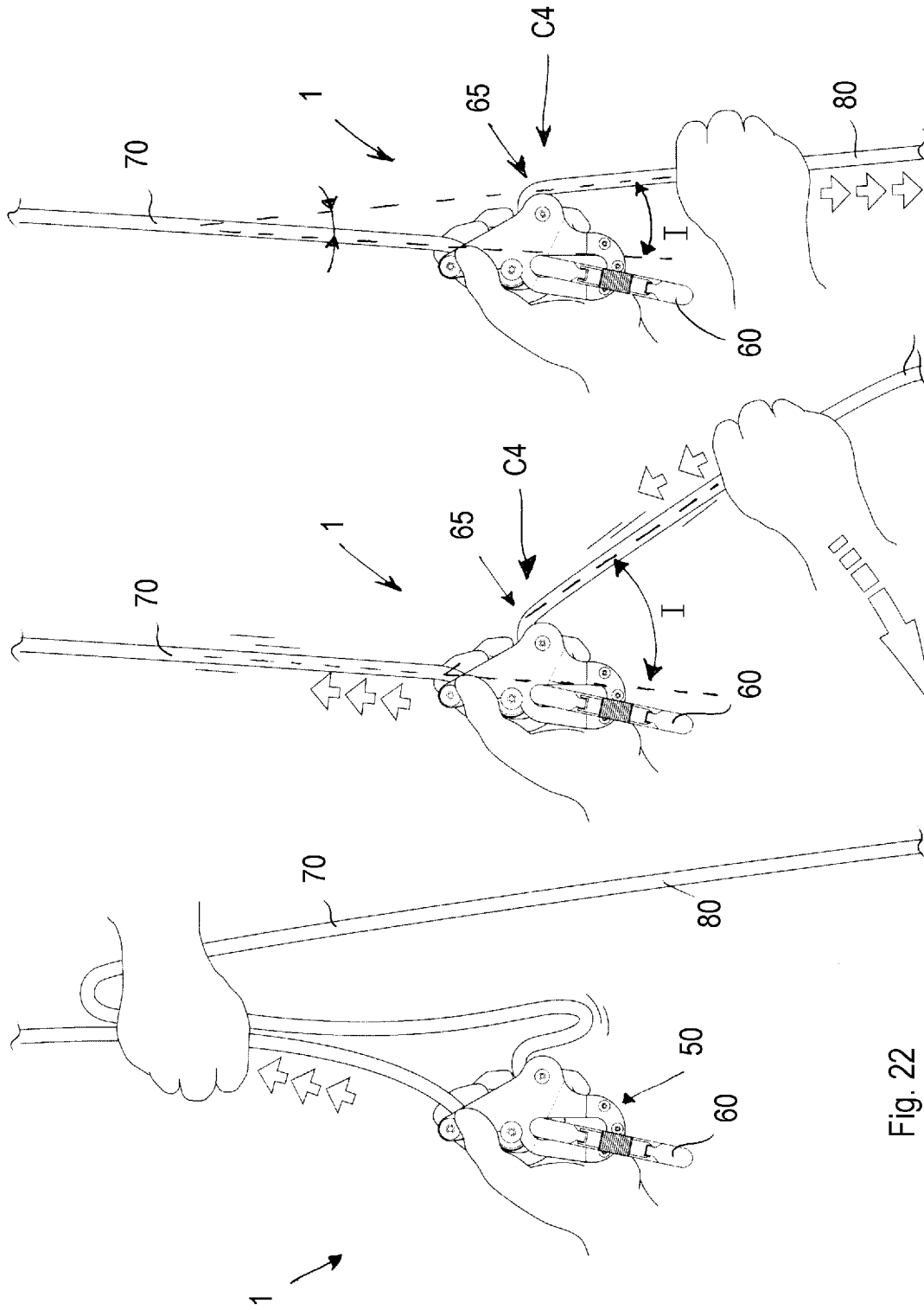


Fig. 23

Fig. 24

Fig. 22

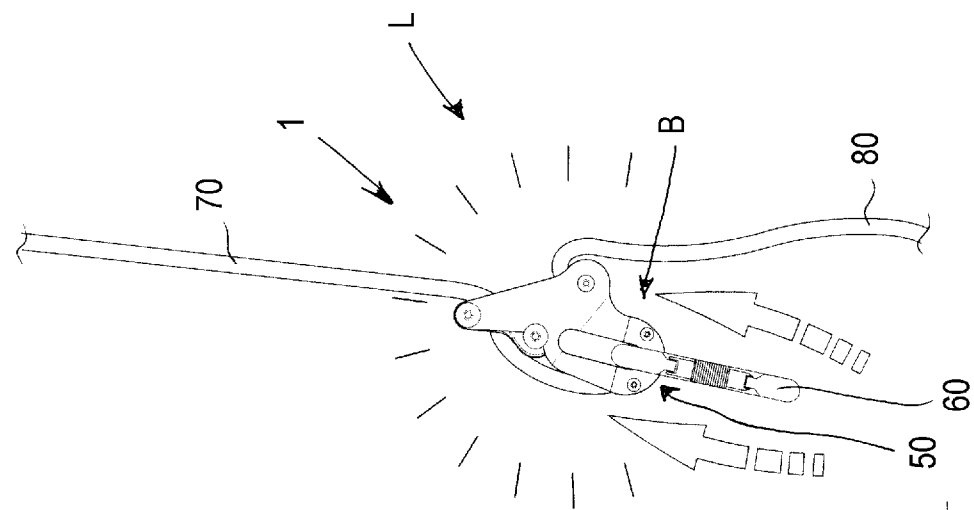


Fig. 27

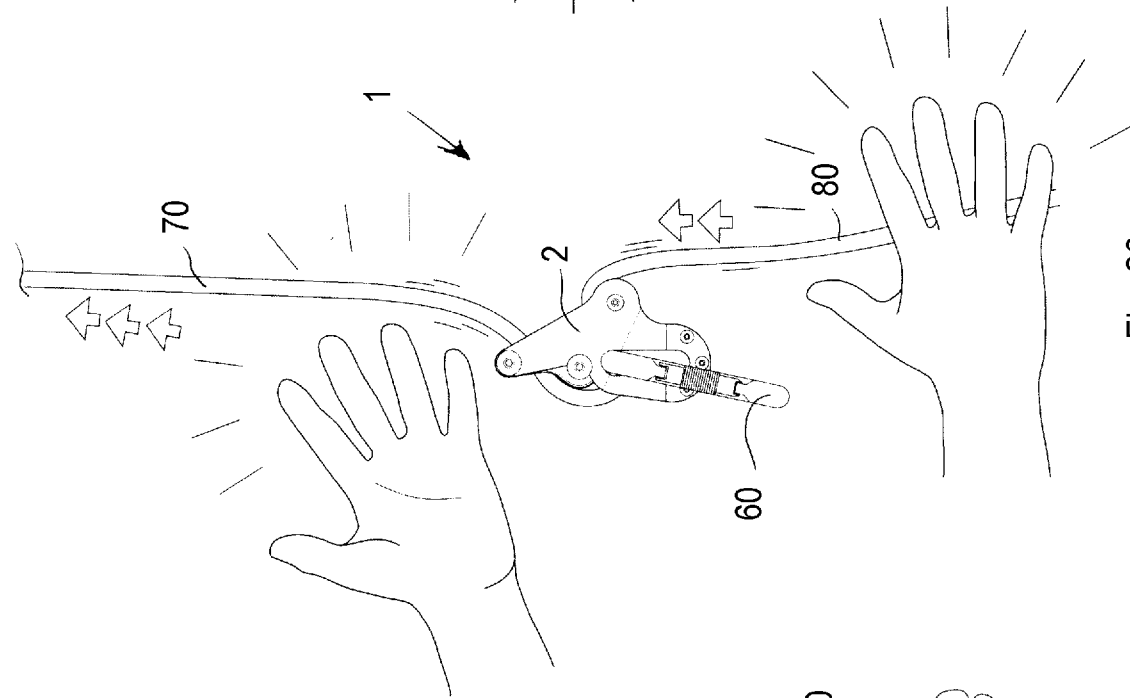


Fig. 26

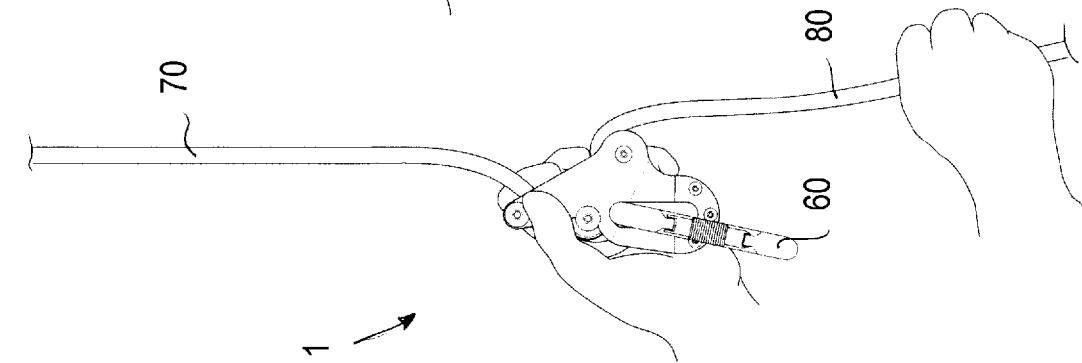


Fig. 25

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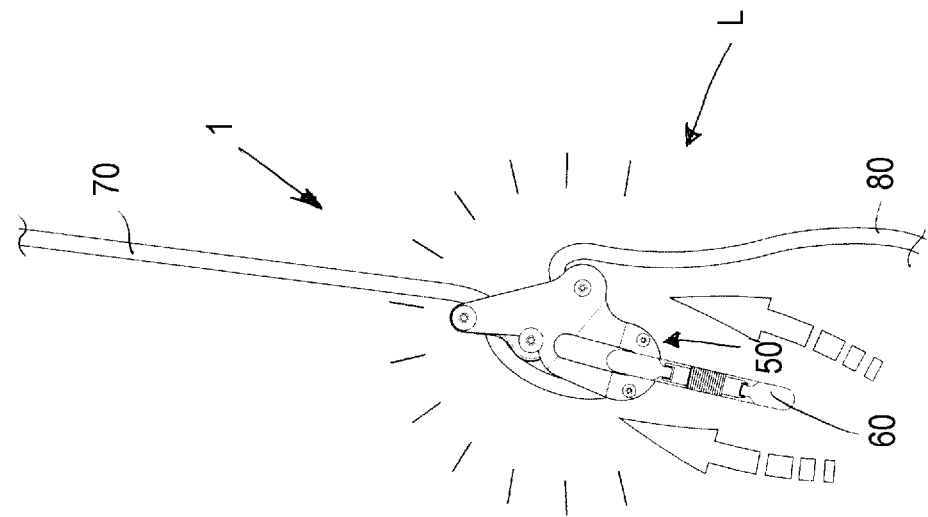


Fig. 30

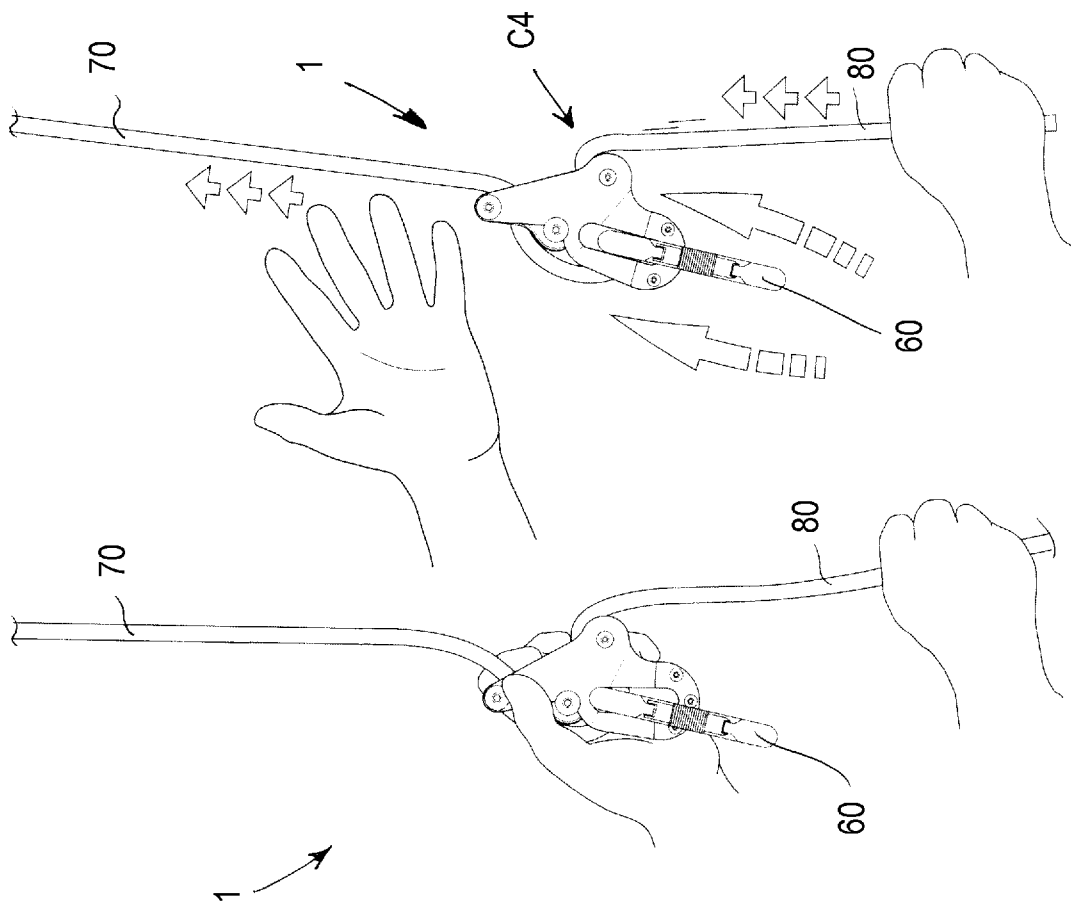


Fig. 29

Fig. 28

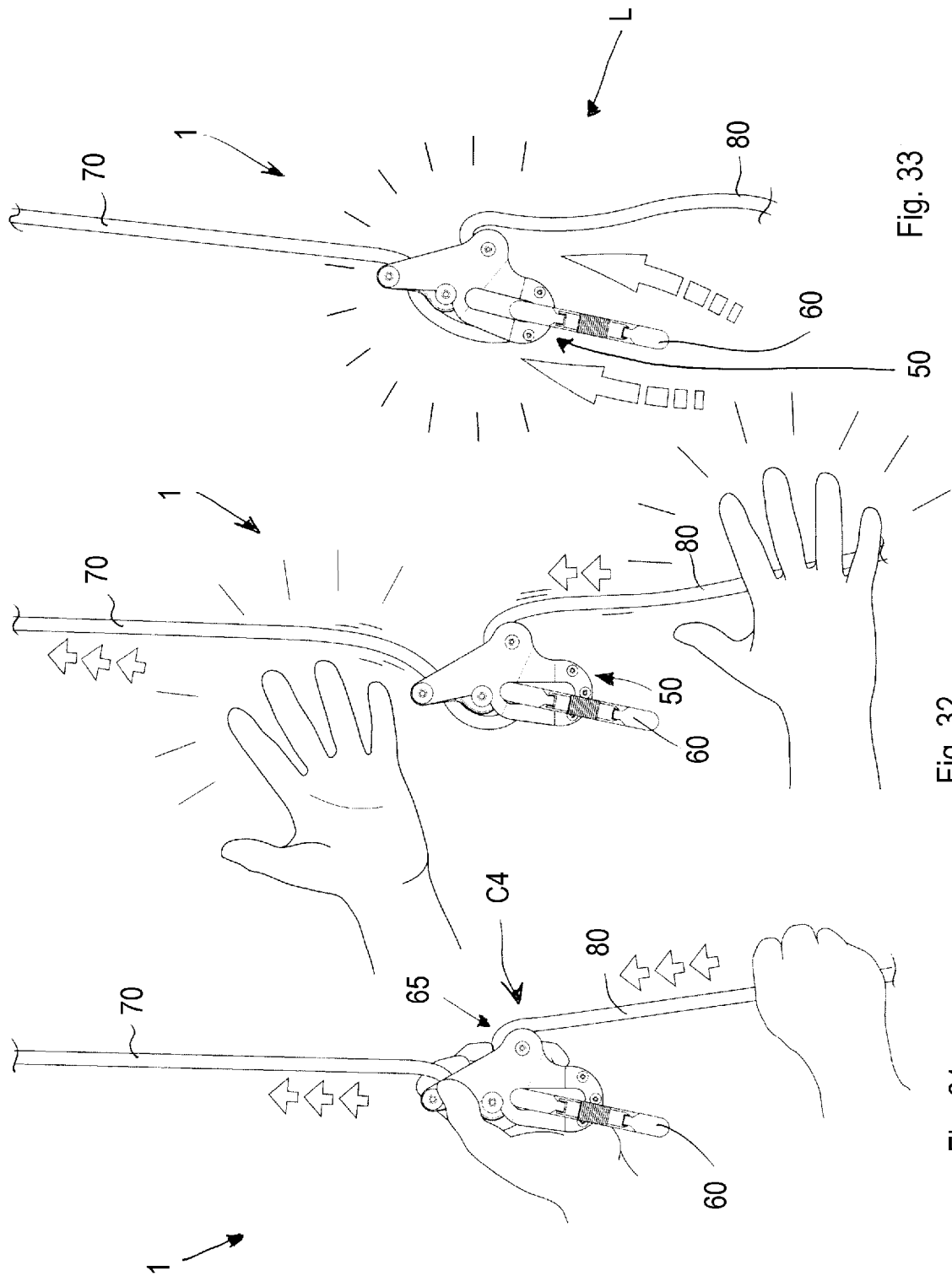
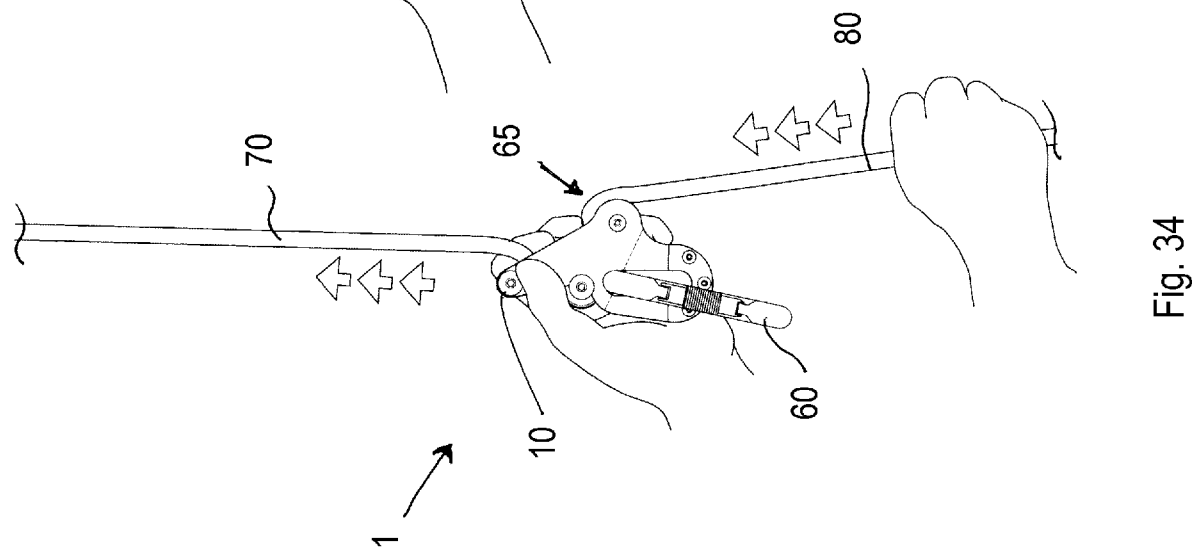
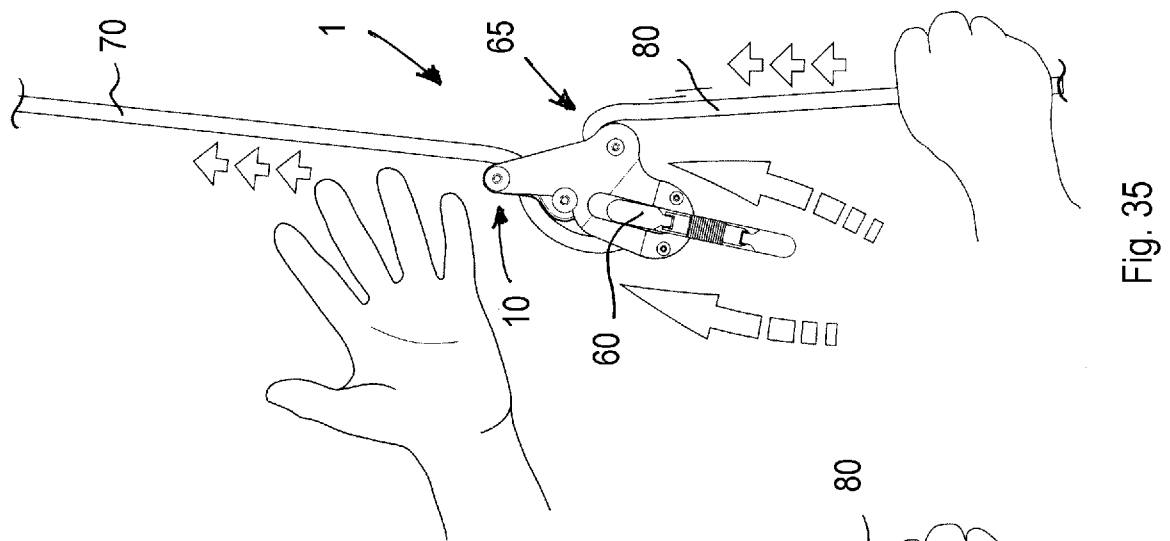
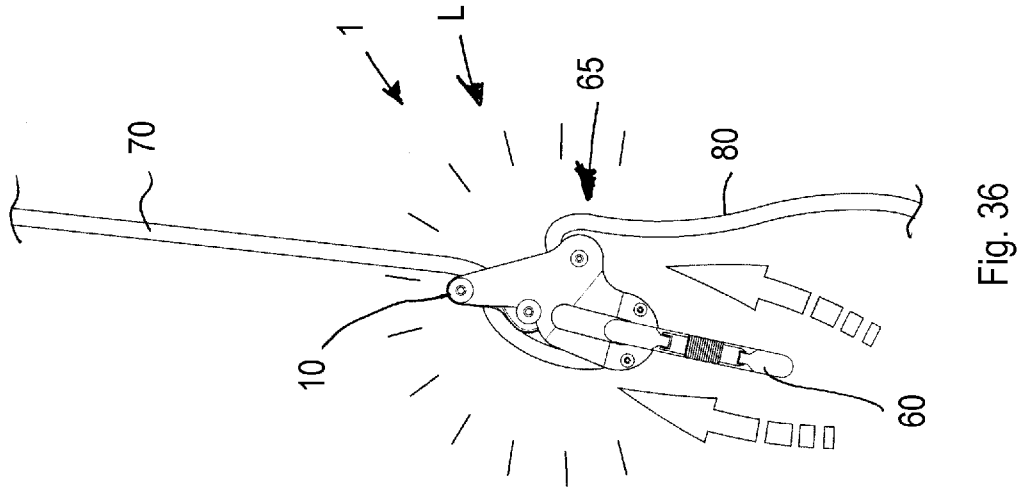


Fig. 33

Fig. 32

Fig. 31

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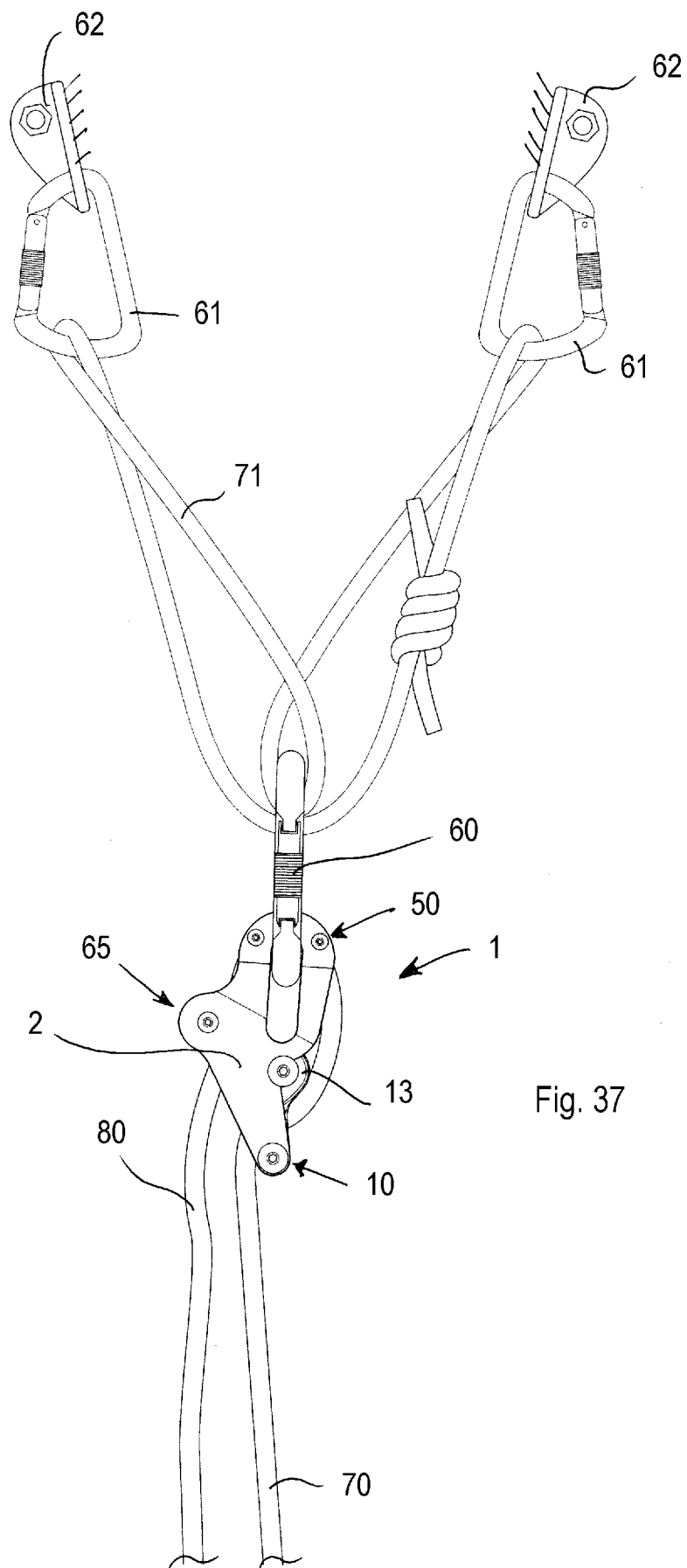


Fig. 37

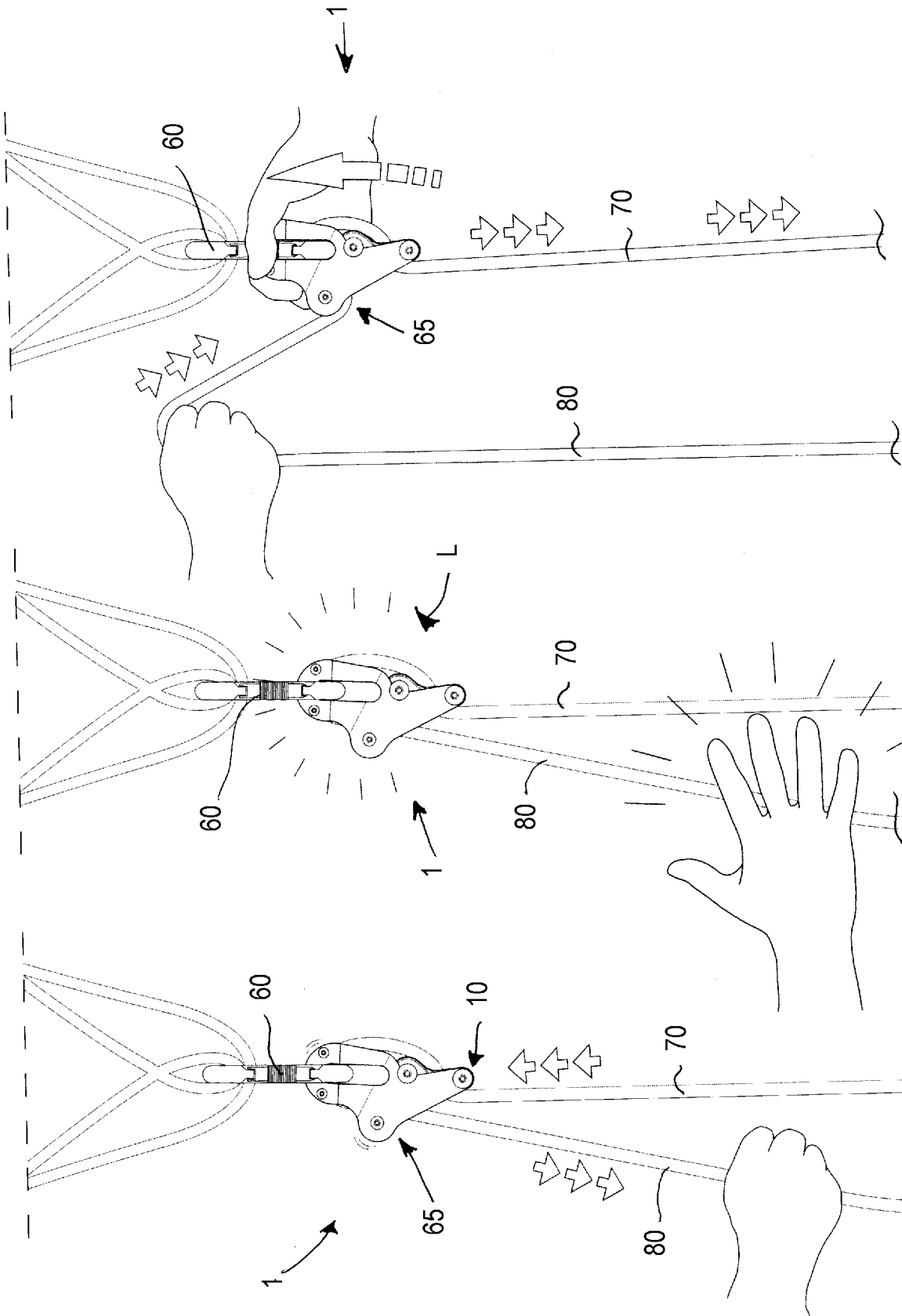


Fig. 40

Fig. 39

Fig. 38

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2011/052910

A. CLASSIFICATION OF SUBJECT MATTER INV. A62B1/14 A63B29/00 A63B69/00 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 A63B		
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 practical, search terms used) EPO-Internal		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 244 762 C (TAGGER JOSEF, BACHMANN MARTIN) 16 March 1912 (1912-03-16) the whole document -----	1
A	FR 2 875 707 A1 (GRESSIER FRANCK PAUL LUCIEN [FR]) 31 March 2006 (2006-03-31) figures 1-4, 7, 8 -----	1
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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