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(71) Applicant: **Scribano, Matteo**
10093 Collegno (IT)

(72) Inventor: **Scribano, Matteo**
10093 Collegno (IT)

(74) Representative: **Ausserer, Anton**
Via Isarco 6 / Eisackstrasse 6
39100 Bolzano/Bozen (IT)

(54) **BELAY DEVICE**

(57) A belay device (100) for belaying operations, climbing and/or alpine activities, characterized in that it comprises a pair of inner plates (10) and a pair of outer plates (102) parallel with respect to the inner plates (101), respectively positioned on the left and on the right of an axis of symmetry (Y) of the device (100), wherein each inner plate (10) is coupled to a respective outer plate (102) separated from the said inner plate (101) creating a first and a second room (190, 195) for housing the passage of a rope (700) along a tortuous path defined on a plane parallel to the plane of said inner plate (10) and of said outer plate (102); said belay device (100) comprising also a rope sliding control lever (103) rotating with respect to said inner and outer plates (101, 102) that comprises a plurality of engagement pins (103p) of said rope (700); said engagement pins (103p) protrude within said first, second space (190, 195) defining at least a pinching point of said rope (700), said pinching point being a groove (198) with variable span created between an engagement pin (103p) and a brake shoe (105) frontally positioned on each of said inner plates (10) with respect to said at least an engagement pin (1 03p).

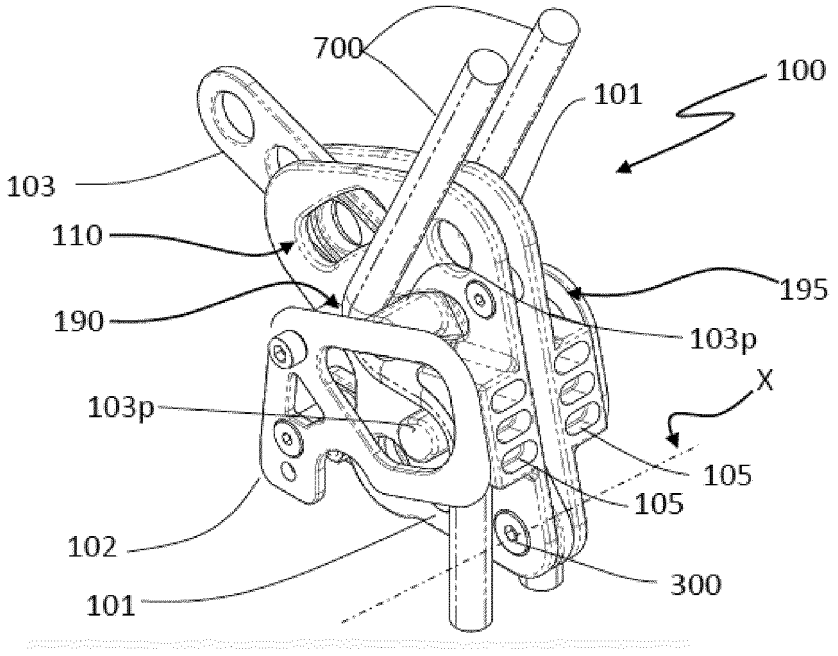

Fig.1

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Description

Technical field

[0001] The present invention concerns a belay device and in details concerns a belay device usable both in single and double rope.

Background art

[0002] In climbing are known belay devices which are used for belaying onself to a wall trough the use of a rope. For example, are well known figure 8 belay devices, which are used both to belay the lead climber and as descending means when it is needed to descend down a wall using double rope.

[0003] The traditional figure 8 belay devices have some drawbacks: their braking power is reduced, they twist the rope and are not capable of providing an automatic locking of the rope sliding in case of fall of the climber. In particular, when a figure 8 belay device is used to belay from below a climber, a "resting" of him is possible only if his climbing partner constantly continues to exert an action of pulling on the rope, or alternatively make a locking knot.

[0004] During the years, belay devices, mainly addressed to belay from below the lead climber or the second climber when they climb in "top rope", developed toward movable cam devices, which are equipped with a cam pivoted on the body of the belay device, having a groove where a rope slides. The rope when is brusquely pulled by the climber, causes the rotation of the cam with the abrupt progressive pinching of the rope.

[0005] Said belay devices are expensive and complicated and are not typically usable by acting on two ropes. These devices are then not flexible in the use; being mainly conceived for the use as belay or lock devices for sport climbing, are not suitable to be used in double rope or on alpine territory.

[0006] Nevertheless, some belay devices with movable cam dissipate all the stopping force on a unique body small in size. This tends to locally warm the rope, with the considerable risk to burn its outer sheath. This is an event particularly known if the belay devices are used for stopping big falls or for long descents or with abrasive ropes.

[0007] The purpose of the present invention is to describe a belay device that permits to solve the above described drawbacks.

Summary of the invention

[0008] According to the present invention, it is realized a belay device for belay operations, climbing and/or for alpine activity in single or double rope; the device is characterized in that it comprises a pair of inner plates and a rope sliding control lever rotating with respect to said inner plates and comprising a plurality of engagement pins of at least a rope or two ropes protruding themselves orthogonally with respect to the inner plates; said engagement pins protrude themselves through slotted holes of the inner plates defining a pair of pinching areas against at least a brake shoe for each of the two ropes for locking and/or exerting a slowing down friction alternatively on a unique rope or on two ropes simultaneously following an automatic rotation of said rope sliding control lever caused by a pulling of at least one of the two ropes. Therefore, the belay device object of the present invention can be defined "autolocking".

[0009] In a first preferred and not limiting embodiment, said rope sliding control lever is grasped by the user during the use of the device.

[0010] Advantageously, each pinching area defines a variable light groove created between an engagement pin and at least the brake shoe positioned on each of said inner plates frontally with respect to at least an engagement pin; the plurality of pins, which are integral with the rope sliding control lever, creates a first and a second space for housing the passage of ropes along a tortuous path defined on a plane parallel to the plane of said inner plates.

[0011] Advantageously, said device also comprises a pair of outer plates parallel with respect to the inner plates, respectively positioned on the left and on the right of an axis of symmetry Y of the device, wherein each inner plate is coupled to a respective outer plate separated from said inner plate creating said first and second space.

[0012] Advantageously, said rope sliding control lever is interposed between said pair of inner plates and rotates around a pivot axis X on said pair of inner plates in correspondence with a pivoting point; the rotation of said rope sliding control lever taking place along a plane parallel to the planes of said inner plates and causing the variation of the light of said groove through the rotation of said plurality of engagement pins.

[0013] Advantageously:

- said plurality of engagement pins comprises more than one pair of engagement pins; each pair comprises a pin for each side of said rope sliding control lever,
- each pin of each pair is axially mounted with respect to its opposite;
- the engagement pins on both sides of control lever of rope sliding are configured for making the rope or the ropes wind around themselves on an arc of curve of at least one pin of a first pair of pins in a direction opposite with respect to the direction in which said rope winds on at least one pin of another pair of engagement pins; at least one pair of engagement pins realizing a plurality of pulling means of the rope sliding control lever towards said shoe in case of exertion of a pulling force on the ends of the ropes exiting from at least an engagement pin of said first pair of pins.

[0014] Advantageously, at least part of said engagement pins show a shape with curvilinear section.

[0015] Advantageously, said outer plates show at least a degree of freedom with respect to said inner plates between a first position of introduction of ropes and a second position of use wherein they limit said spaces resulting to be side by side with at least a portion of each inner plate and/or with said shoes and show a perimeter detecting a recess which, when in said position of use, surrounds a hole on said inner plates within which a carabiner, ring or locking pin, susceptible of avoiding the opening of said outer plates during the functioning is introduced.

[0016] Advantageously, said device comprises a safety element firmly jointed to at least one of said outer plates; said safety element has a main hole; said safety element rotating together with said outer plates, when said outer plates are in said second position of use and are coaxial to the passage hole of said carabiner, ring or locking pin.

[0017] Advantageously, each outer plate comprises a recess surrounding a hole realized on said safety plate and which serves for the connection with a carabiner or anchoring ring to the belaying person or to his harness; when said outer plate is in said position of use, said hole finds itself axially aligned to a lower hole of inner plates.

[0018] Advantageously, each inner plate comprises one or more holes orthogonal with respect to axis of symmetry Y and positioned between a pair of pins and the free side of ropes, above said shoes and of diameter sufficient to let pass a carabiner or an additional braking ring, which is oriented with a portion of the body substantially orthogonal with respect to the axis of symmetry Y of said device.

[0019] Advantageously, said inner plates comprise a plurality of elongated slotted holes having each one an arched shape detecting a circumference arc centered in correspondence to said pivot axis X, and wherein said plurality of elongated slotted holes comprises at least a first and a second slotted hole within which is introduced said plurality of engagement pins; said first slotted hole being positioned at a radius from pivot axis X which is higher than the radius upon which is positioned said second slotted hole.

[0020] Advantageously, at least part of said plurality of slotted holes realizes a means of sliding and of end stop of rotation of said rope sliding control lever, stopping against said engagement pins.

[0021] Advantageously, said device also comprises a second command lever, protruding from the shape of said inner plate and pivoted on said inner plate in correspondence to a pivoting point; said command lever graspable by the user comprising a portion eccentric with respect to said pivoting point; said eccentric portion being conceived for contacting an upper side of the first command lever and for exerting on it a pushing action for disengaging said at least one rope.

[0022] In the second form of embodiment, the pivoting point of the command lever is the one wherein passes a longitudinal axis Z of the command lever.

[0023] In another preferred and not limiting form of embodiment, said second command lever is a lever actuated and then controlled by the hand of the user during the use of the device.

[0024] Advantageously, said pushing action causes the rotation of the first rope sliding control lever in a same rotation direction of the second command lever.

[0025] Substantially, in the first form of embodiment the braking command of the ropes is directly given to the opening of the rope sliding control lever, whereas in the second and third form of embodiment is given to the second command lever with eccentric profile and/or cam which acts on the rope sliding control lever.

[0026] In the second and third form of embodiment, then, said device comprises also a second command lever, protruding from the shape of said inner plate and pivoted on said inner plate in correspondence to a pivot point; said second command lever graspable by the user comprising a portion which is eccentric with respect to said pivot point; said eccentric portion being conceived for coming into contact with an upper side of the first control lever and for exerting on it a pushing action for disengaging said at least one rope.

[0027] Said second command lever is a lever actuated and then controlled by the hand of the user during the use of the device.

[0028] Advantageously, said pushing action causes the rotation of the first rope sliding control lever in a same rotation direction of the second command lever.

[0029] Advantageously, said brake shoe presents a collar arched in transversal direction, and precisely orthogonal, with respect to a sliding direction of ropes. The bending recalls the radius of the ropes.

[0030] In combination or in alternative to said arched collar is present a recess acting as supplementary friction zone for said rope; said recess is arranged, on the brake shoe, in correspondence to the front braking wall, and is in front of an engagement pin and respective slot.

[0031] Advantageously, finally, any of the forms of embodiment of the device comprises anti-twisting means retaining said outer plate in correspondence with an end opposed with respect to the pivoting one and configured for keeping said outer plate on a plane parallel to the one of the inner plate.

Description of the figures.

[0032] Other characteristics and details of a preferred and not limiting embodiment of the invention described hereby shown will be clearer in the following description and with reference to the annexed figures wherein:

- figure 1 shows a whole perspective view of a belay device object of the present invention;
- figure 2 shows a lateral view of the belay device object of the present invention;

- figure 3 shows an upper view of the device of figure 2;
- figure 4 shows a first view of an inner plate belonging to the belay device of figure 2;
- figure 5 shows a second view of an inner plate belonging to the belay device of figure 2;
- figure 6 shows a perspective view of a control lever, grasped in use by the user, belonging to the belay device of figure 2;
- figure 7 shows a perspective view of an outer plate belonging to the belay device of figure 2;
- figure 8 shows another perspective view of an outer plate belonging to the belay device of figure 2;
- figure 9 shows another section view of a safety lock plate belonging to the belay device of figure 2;
- figure 10 shows a lateral view of the belay device object of the present invention in a rope insertion mode (outer plates in opening position), in a first configuration wherein it lets the rope free to slide;
- figure 11 shows a lateral view of the belay device object of the present invention, without an outer plate, in a second configuration wherein it pinches the rope in a groove obtained between a movable engagement pin and integrally united to a command lever and a shoe with bended wall;
- figure 12 shows a lateral view of a second form of embodiment of the belay device object of the present invention;
- figure 13 shows a lateral view of the device of figure 12, observed without one of the inner walls in such a way as to show a first and a second command lever;
- figure 14 shows a perspective view of part of the belay device in its second form of embodiment shown in figure 12;
- figure 15 shows a lateral view of the second form of embodiment of the device object of the present invention, in a configuration of use wherein ropes are further braked by an auxiliary carabiner;
- figure 16 shows a perspective view of a third form of embodiment of the device object of the present invention;
- figure 17 shows a perspective view of a control lever provided with opposing pins, belonging to the third form of embodiment of the belay device object of the present invention;
- figure 18 shows a perspective view of the inner plate of the third form of embodiment of the device object of the present invention;
- figure 19 shows a lateral view of the third form of embodiment of the belay device object of the present invention, with the outer plate in opening position for allowing the introduction of ropes;
- figure 20 shows a lateral view of the third form of embodiment of the belay device object of the present invention, partially without elements in such a way as to show the relative position of a rope locking control lever and a command lever when in a sliding configuration;
- figure 21 shows a lateral view of the third form of embodiment of the belay device object of the present invention, partially without elements in such a way as to show the related position of a control lever of rope locking and a command lever when in a locking configuration;
- figure 22 shows a lateral view of the third form of embodiment of the belay device object of the present invention in a configuration of auxiliary braking of ropes, with an auxiliary carabiner;
- figure 23 shows a perspective view of a variant applicable to the first, second or third form of embodiment, wherein to the brake shoe is applied an L-shaped anti-twisting plate; and
- figure 24 shows a perspective view of a variant of the belay device, concerning the brake shoe.

Detailed description of the invention.

[0033] As shown in figure 1, with reference number 100 is indicated in its entirety a belay device. The belay device 100 is conceived for being used in climbing, for example sport climbing, and more generally in sporting or rescue activities as locking device of the rope during the belaying from below of the lead climber and/or of the second climber, with single or double rope.

[0034] It is also conceived for permitting the braking and/or the locking of the rope during the belaying from above or from below, both in single and double rope.

[0035] It is also conceived for locking or anyway limiting the free sliding of the rope during the self-belaying in descent with double rope.

[0036] Furthermore, the belay device 100 object of the present invention is conceived for providing for the use of additional braking and/or locking means for descents in double rope and in single rope. The locking/braking of the rope takes place automatically (without locking intervention of the hand on the end of the rope not connected to the climber or to the user) by means of a rotation of a rope sliding control lever.

[0037] In detail, the belay device 100 comprises a body symmetrical with respect to the movement plane of a rope sliding control lever. This body comprises a pair of outer plates 102 parallelely arranged and a pair of inner plates 101, in turn positioned on two different but parallel planes. Outer plates 102 are parallel to inner plates 101. The assembly defined by inner plates 101 and by outer plates 102 detects a pair of passages 190, 195 for a plurality of ropes 700 which slide then between an outer plate and an inner plate along a tortuous path detecting directions anyhow parallel to the plane along which lie the inner and outer plates. The two ropes 700 slide then on parallel planes and on identical tortuous paths and symmetrically arranged with respect to an axis of symmetry of the belay device itself.

[0038] The body of the belay device 100 is symmetrically realized; in this way the two outer plates 102, as well as the two inner plates 101, have respective faces which are symmetrical the one with respect to the other,

such that once assembled have prominent portions and/or matching holes.

[0039] In detail, the symmetry of the body of the belay device 100 is obtained in correspondence with the section laying on the rope sliding control lever 103 that as it will be better described hereinafter permits to modulate by means of the hand of the user the braking action on rope 700 and to unlock itself when automatically locked because of a traction on the rope. On this section develops an axis of symmetry Y which in use is horizontal and which is detected on a vertical plane passing through the rope sliding control lever 103.

[0040] As it is possible to see in figure 1, between the first and the second inner plate 101, in correspondence then with an axis of symmetry of the belay device 100, it is present an arched control lever of rope sliding 103, which is conceived for permitting to adjust the locking or braking level of ropes 700.

[0041] Each inner plate 101 comprises a spacing element 104 that protrudes itself in direction orthogonal with respect to the plane of the inner plate 101, and that shows a depth P preferably equal or higher than the diameter of the rope 700 that shall be used in the belay device 100.

[0042] The spacing element 104, that preferably but in a non-limiting extent is cylindrically shaped, in use engages in an own ending portion on a outer plate 102. For this reason it shows a groove 104s in correspondence to its ending portion, having a diameter reduced with respect to the remaining portion, such as to insert itself in a pivoting hole 102f of the outer plate 102 with the inner one. The groove 104s detects then a stopping step upon which rests the outer plate 102.

[0043] Furthermore, each inner plate 101 comprises a shoe 105 protruding itself in direction orthogonal with respect to the plane upon which lies the inner plate itself and precisely having a depth similar and preferably identical to the one detected by the non-grooved portion of the spacing element 104. In this way the outer plate 102, when mounted on the spacing element 104, will stop on the groove 104s, laying also planarly on the outer surface 105s of the shoe itself, when the outer plate is in closing position; this outer surface 105s is planar and is parallel to the plane upon which lies the inner plate 101.

[0044] Each shoe 105 shows a braking wall 105f, positioned orthogonally with respect to the inner plate 101, having a profile partly bended, an upper wall 105u, a lower wall 105i and a rear wall 105p opposed with respect to the braking wall 105f. The upper, rear and lower braking walls realize the side walls of shoe 105.

[0045] In correspondence with the rear wall 105p, substantially opposed with respect to the braking wall 105f, the shoe 105 can show lightening or heat dissipation holes. As a matter of fact, the shoe is one of the points in which in use there is higher friction with rope 700, and consequently higher heat dissipation.

[0046] Each inner plate also comprises a pivoting hole 106 for the rope sliding control lever 103; said pivoting hole is positioned in the one that in use is the lower portion of the plate itself, and lies in detail in correspondence with a corner of the inner plate, under the shoe 105.

[0047] The inner plate comprises also a tern of slotted holes 110, 111, 112 having bended and elongated shape and arranged in such a way as to detect circumference arches whose centers are in correspondence with the pivoting hole 106 and then on axis X.

[0048] Within these slotted holes in use slide the engagement pins 103p for the rope 700. In detail, the engagement pins 103p of the rope slide in the lower slotted hole 112 and in the intermediate slotted hole 111. The upper slotted hole 110 is a supporting slotted hole and finds itself at a maximum radius with respect to axis X. The intermediate 111 and lower 112 slotted holes find at decreasing radius with respect to the previous one.

[0049] The arched shape is given by the fact that the pins 103p rotate on an imaginary circumference around a pivoting point of the lever. However, by increasing the transversal thickness of slotted holes, this arched shape is not anymore necessary and then is to be intended as not limiting.

[0050] Finally, the inner plate comprises an upper hole 101s for the passage of a ring or carabiner or pin acting as additional braking means. The upper hole 101s lies substantially above the shoe 105. This position is the preferred one, because as it will be better described hereinafter is the one that ensures the most tortuous path of the rope 700 once introduced in the device, with the consequent increase of the friction.

[0051] As shown in figure 6, the rope sliding control lever 103 is realized with arched shape wherein in correspondence with a first lower end there is a pivoting hole 103i, within which in use passes a pivoting screw 300 in turn passing through the pivoting hole 106 of inner plates 101. The center of the pivoting hole delineates a pivoting axis X of the rope sliding control lever 103. The axis X is the axis around which the rope sliding control lever 103 rotates with respect to the whole formed by the inner and outer plates.

[0052] The engagement pins 103p, which protrude orthogonally with respect to the plane upon which lies the main portion of the body of the rope sliding control lever 103 and that are present on both the sides of the lever, are realized with a continuous bend shape preferably free from angular points and have an extension such that they can slide within the lower slotted hole 112 and the intermediate 111 without touching the outer plates 102. Ideally then, the length of each engagement pin 103p is equal to the distance which separates the inner plate from the outer plate plus the thickness of the inner plate.

[0053] In detail there are two opposed upper engagement pins, that in use are introduced in the intermediate slotted hole 111 and two opposed lower engagement pins that in use are introduced in the lower slotted hole 112. The ends of the intermediate and lower slotted holes detect end stop points of the rotation of the rope sliding control lever 103 with respect to the assembly formed by the inner and outer plates.

[0054] The two upper engagement pins are axially aligned, exactly as the lower engagement pins are.

[0055] The portion of lever opposed with respect to the one where there is the pivoting hole 103i is the one that in use is grasped by the user. On this portion there is a plurality of holes which have the function of lightening and of passage for a carabiner or a ring that is introduced in the upper slotted hole 110. Precisely then, at least one of the plurality of holes present on the rope sliding control lever 103 is positioned in such a way as to lay in correspondence with the upper eyelet 110 during the rotation of the rope sliding control lever around the pivoting axis X. When observed in plain view, i.e. in direction parallel to axis X, the engagement pins 103p have a not circular shape, even if this shape shall not be intended as limiting. In detail, their shape is preferably an ovoid having a first portion with higher radius, directed toward the portion of the rope sliding control lever grasped by the user, and a second portion, of lower diameter, which is on the other hand directed toward the shoe 105. In this way, advantageously, when the rope 700 is pinched in the groove 198 created between the lower engagement pin and the braking wall 105f of the shoe, there is a higher compressing effect on the rope, with consequent higher friction and higher brake. The groove 198 defines then a rope pinching zone.

[0056] As shown in figure 7 and in figure 8, each outer plate 102 comprises a lightening slotted hole 102l, a pivoting hole 102f of the outer plate 102 with the respective inner plate 101, and a second hole 102s of fastening with screws to the respective inner plate 101.

[0057] The shape of the outer plate 102 has a semicircular recess 102r. This recess, laterally observing the belay device 100, frees a lower hole 200 of the inner plates 101 within which is inserted the carabiner or the ring that in use is engaged on the harness of the belaying person.

[0058] The lower hole 200 is positioned on the side opposite with respect to the one upon which there is the shoe 105; this last in use is positioned on the side positioned in use in the more remote position with respect to the user.

[0059] The outer plate 102 in detail can rotate with respect to the inner plate 101, resulting pivoted on this last one in the pivoting hole 102f. This advantageously allows to introduce ropes 700 in the tortuous path detected by engagement pins 103 and by the shoe 105. Once the outer plate 102 is newly rotated, it remains in position of use particularly thanks to the carabiner that is introduced in the hole 200.

[0060] To one of the outer plates 102 is united a plate 140 acting as safety lock and that can then rotate integrally with this one. This safety plate 140 has a main hole 141 that in use, when the outer plate 102 is rotated in such a way as to constrain the rope 700 between itself and the inner plate 101, finds itself in correspondence with the hole 200.

[0061] As shown in figure 2 and in figure 10, the rope has a first end 701 constrained to a charge represented by an anchoring, by a dead weight or by the climber or also by a person to be rescued or to be descended, and a free second end 702. The tortuous path of the rope 700 in the belay device 100 object of the present invention is the one that follows: at first, the first end 701 passes between the braking wall 105f and the lower engaging pin that slides in the lower slotted hole 112, then it is made to pass outside of the upper engagement pin, wrapping on it on a circumference arc or bend, in such a way as to find itself directed toward the portion of device opposed with respect to the one where there is the shoe 105, and then it is made to continue upwards. The pair of upper opposed pins then sees the rope that wraps itself on an arch in direction opposed with respect to the arch along which the rope wraps on the second pair of lower opposed pins.

[0062] The outer plate 102 or the outer plates 102 then, if two ropes 700 are used, are closed again in position of use (arrow C), rotating around the pin realized by the constraint screw 102z that is introduced in the pivoting hole 102f. In particular, the screws are fixed, because if they rotate they could unscrew during the functioning of the device. For this reason, the outer plates rotate around pins 104s. The fact that there is a single screw is not to be intended as limiting as it can be equally replaced by two separate screws.

[0063] A carabiner 600 is then introduced in the hole 200; then with its body, it engages in the recess 102r and in this way it blocks the rotation of the outer plate 102.

[0064] As the portion of the belay device that includes the rope sliding control lever 103 is directed toward the belaying person, the only direction from which the first end 701 of the rope can be pulled upwards is in the opposite direction or upwards.

[0065] Through the substantially upward traction of the first end 701 of the rope 700 (force represented by the arrow 1000 in figure 10), on the upper engagement pin is exerted a force (indicated by the arrow 1001) that pushes it toward the portion opposed with respect to the one where there is the belaying person, making the engagement pin slide in the intermediate slotted hole 111. As well, also the lower engagement pin is pushed in the same direction (arrow 1002), reducing then the light of the groove 198.

[0066] The upper engagement pin 103p realizes then a traction means of the rope sliding control lever 103 toward the shoe 105 when a pulling force is exerted on the rope.

[0067] In this way, thanks to the fact that also the engagement pins are integral with the upper ones because rigidly fixed to the rope sliding control lever, also the lower engagement pin is pushed in the same direction. Sliding in the lower slotted hole 112, the lower engagement pin pinches the rope 700 against the braking wall 105f of the shoe 105, causing an increase of friction capable of braking or stopping the fall of the climber.

[0068] Alternatively, if the belay device 100 object of

the present invention is used by the user as self-belaying for example in a descent in double rope, the exertion of a pulling on the first end 701 of the rope causes a stop of the user.

[0069] At this point, as long as on the first end 701 the tension of the rope does not lack, the belay device 100 remains in a braking or stopping configuration. When the pulling force on the first end 701 is sufficient, or alternatively the weight of the user is sufficient the belay device 100 remains in an automatic locking configuration, that can disappear only if the tension on the first end of the rope 701 lacks or if the user or belaying person acts on the rope sliding control lever 103, pulling it down.

[0070] Through the action on the rope sliding control lever 103 which causes a rotation around the axis X, the engagement pins move within the respective slotted holes gradually releasing the sliding of the rope 700, that is to say progressively reducing the friction deriving from the pinching of the rope as long as it starts again to slide.

[0071] If the pulling on the rope 701 remains unmodified and anyhow sufficient to cause the stop of the rope 700, if the force exerted by the user or the belaying person on the rope sliding control lever 103 reduces or is cancelled, the belay device 100 turns again automatically in a stop condition.

[0072] It is underlined that if two ropes 700 are used, it is sufficient a charge on the first end 701 of even only one of them for causing the pinching of both the ropes against the shoes. Advantageously, then, the belay device object of the present invention can be used also for managing the ascent of independent people, each one on an its own rope.

[0073] In case it is wanted to benefit from an higher braking, within the upper hole 101 s is introduced a carabiner or ring 350. In this case, as shown in figure 11, the rope is made pass in an area 360 between the carabiner or ring 350 and the shoe 105, and precisely between the upper portion of the upper engagement pin 103p and the carabiner or ring 350. In this way, being the first end 701 substantially always pulled upwards, a new friction zone 360 is created on this curve arc detected between the initial contact point with the carabiner, which derives from the direction 370 assumed by the rope 700 after having rotated around the upper engagement pin, and the direction along which it is pulled (see in this sense figure 15).

[0074] A second form of embodiment of the belay device object of the present invention is shown in figures 12-15. The second form of embodiment differentiates itself from the first form of embodiment shown in figures 1-11 in that it comprises a first rope sliding control lever 103 and a second command lever that in use is actuated and then controlled in its stroke by the hand of the user.

[0075] As in the case of the first form of embodiment, the rope sliding control lever 103 is realized in form of a arched plate in which in correspondence with a first lower end there is a hole 103i of pivoting, within which in use passes a pivoting screw 300 in turn passing through the pivoting hole 106 of inner plates 101. As in the case of the first form of embodiment, also in the second form of embodiment, the rope sliding control lever 103 has engagement pins 103p, which are opposed two by two and slide within the intermediate 111 and the lower 112 slotted holes.

[0076] However, in the second form of embodiment, the rope sliding control lever 103 does not protrude outside of the shape of the inner plates remaining confined inside thereto.

[0077] The second form of embodiment of the device comprises also a second command lever 103s protruding itself outside of the shape of the inner plates 101; this second command lever 103s is pivoted on a pivoting point 103q in correspondence with the first portion opposite with respect to an its second portion 103k that protrudes outside of the shape of the inner plates 101. The second command lever 103s is the one in use and grasped by the user upon said second portion.

[0078] The second command lever 103s develops along a maximum direction detected by the longitudinal axis Z, and comprises an eccentric portion 103e, vaguely cam shaped, that gives it a whole triangle shape with chamfered angles. The eccentric portion 103e in use contacts an upper side 103c of the first rope sliding control lever 103.

[0079] The eccentric portion substantially corresponds to the zone of the lower side of the detected triangle and also comprises the angle comprised between the two sides of it.

[0080] In detail, when the lever is lowered, i.e. pulled toward the direction of the lower hole 200 of the inner plates, an even more eccentric portion with respect to the pivoting point 103q comes into contact with the side 103c and forces the first rope sliding control lever 103 at first to rotate around the axis X releasing the rope 700.

[0081] Substantially, when the eccentric portion of the second command lever 103s comes into contact with the side 103c, there is a rotation of the first control lever and of the second command lever 103, 103s in a same rotation direction.

[0082] The second command lever 103s is useful when the locking of the rope 700 takes place on big loads. As a matter of fact, in this case it acts as a wedge on the side 103c for facilitating its release.

[0083] Figure 15 shows the second form of embodiment of the belay device 100 object of the present invention, wherein in the lower hole 200 is introduced a carabiner 600 of engagement with a harness of the belaying person. In figure 15 the device is represented with the second command lever 103s lowered for permitting to release the ropes 700, that pass around a carabiner or auxiliary ring 350 that is introduced in the upper hole 101 s.

[0084] A third form of embodiment of the belay device 100 object of the present invention is finally shown in figures 16-23.

[0085] As in the two previous forms of embodiment, also the third one comprises a body which is symmetrical

with respect to the movement plane of a rope sliding control lever 103, and a pair of inner plates 101 parallel arranged with respect to a pair of outer plates 102, in turn positioned on two different but parallel planes. The inner plates 101 are then mounted parallel with respect to the outer plates 102. The assembly detected by the outer plates 102 and the inner plates 101 detects a pair of passages 190, 195 for a plurality of ropes 700 that slide then between an outer plate and an inner plate along a tortuous path detecting directions anyhow parallel to the plane along which lay the inner and the outer plates. The two ropes 700 slide than on parallel planes and on tortuous paths which are identical and symmetrically arranged with respect to a symmetry axis of the belay device itself.

[0086] As in the case of the second form of embodiment, the rope sliding control lever 103 remains confined in the device itself, and there is a second command lever 103s protruding itself outside of the shape of the inner plates 101; this second command lever 103s is in use grasped by the user and comprises a transversal portion 103a of grasping.

[0087] In this case the first rope sliding control lever 103, always pivoted in the pivoting point 103i between the two inner plates 101, presents a triangular shape and, as in the previous cases, two pairs of pins 103p counterposed two by two.

[0088] The two pairs of pins 103p counterposed introduce themselves in a pair of slotted holes 111, 112. In fact, each inner plate 101 comprises also a pair of slotted holes 111, 112 having arched and elongated shape and being arranged in such a way as to detect circumference arches whose centers are in correspondence with the pivoting hole 106 and then on axis X.

[0089] As shown in figure 21, the second command lever 103s has an elongated shape protruding outside of the shape detected by the pair of inner plates 101 and is provided with a cam 103e eccentric with respect to a pivoting point 103q of said second command lever 103s. The cam 103e is provided with a flattened portion that helps to realize a lock in position of free sliding of the ropes. The cam has a lateral surface subject to stop against the lateral surface of the first rope sliding control lever 103, and this permits to indirectly move the rope sliding control lever 103.

[0090] As shown in figure 18, the third form of embodiment differentiates itself also because the shoe 105 shows a braking wall 105f which is arched also transversally with respect to the sliding direction of the rope 700. This braking wall partially recalls then the radius of the rope 700 and in particular has a radius similar and preferably higher than the one of the rope 700, realizing a collar. In this way it is advantageous possible to obtain a confining of the sliding of the rope, that more unlikely moves transversally with respect to the sliding direction.

[0091] As shown in figure 19, in the third form of embodiment, the direction W of the force vector of movement of the pins 103p, causing then the reduction of the light of the groove 198, is orthogonal to the direction that connects an axis joining the pins 103p of a same side with the pivoting point of the rope sliding control lever 103. In this way, the torque that acts on upper pins 103p is maximized.

[0092] Furthermore, as shown in figure 19, the outer plates 102 have a recess 102r not anymore semicircular as in the case of the two previous forms of embodiment but, on the contrary, having only a minimum hint of curvature such as to make the outer plate 102 not interfere with the area axially detected by the lower hole 200 of the inner plates 101 (when the outer plates are in position of use or of confining of the ropes) and anyhow not interfering with the main hole 141 of the safety element, hole within which it is made pass the carabiner 600 in use belayed to the harness of the user.

[0093] Furthermore, on the inner plates 101 is integrally united a pin 109f, frontally positioned with respect to the lower hole 200; this pin 109f has a function of stopping and end stop element for the rope sliding control lever 103 in the direction of maximum sliding of the same.

[0094] As shown in figure 20, when in position of maximum locking of ropes, the rope sliding control lever 103 is clockwise rotated (direction of the arched arrow) observing the device from the right with respect to the user. The second command lever 103s, even if being always stopping against the lateral surface of the rope sliding control lever, presents the eccentric portion of the cam 103e directed in an opposite direction with respect to the control lever. Its elongated portion is substantially oriented in direction of the upper hole 101s.

[0095] Conversely, rotating the second command lever 103s toward the user, and then in the opposite direction (counterclockwise direction observing the device from the right with respect to the user), the eccentric portion of the cam 103e pushes downwards, and then with a counterclockwise rotation, also the control lever of sliding of ropes 700, such as to cause the increase of the light of the groove 198 and to release the rope.

[0096] When the second command lever 103s is released, an eventual pulling of the rope upwards causes automatically the return in locking configuration.

[0097] Finally, as shown in figure 23, the belay device object of the present invention, in any of the above described forms of embodiment, can optionally comprise also an L-shaped anti-twisting plate 500, preferably anchored by means of a pair of screws 520 on the rear wall 105p of each of the brake shoes 105. This plate 500, applicable to all the three forms of embodiment of the present invention, comprises a first wall 510 parallel to the rear wall 105p of brake shoes and a second wall 530, united to the previous one, orthogonally directed in such a way as to be parallel to the plane upon which lie the inner and outer plates. Alternatively, the anti-twisting plate can be welded to the braking shoe or also realized in a single piece with it.

[0098] This second wall 530 is spaced from the edge of the brake shoe 105 for a thickness such as to allow the outer plate 102 to insert in the middle of it, and realizes

then a constraint of the outer plate 102 which allows to maintain the parallelism with the plane on which lies the inner plate 101, so as to prevent the twisting of the outer plate 102 when the rope during the braking presses on the outer plate 102 itself toward the outside of the device. Clearly, the shape of the anti-twisting plate 500 is not to be intended as limiting and can be replaced by any equivalent anti-twisting means, for example a pin with recess or with blind recess in the brake shoe.

[0099] Finally, in figure 24 is shown a variant of the device object of the present invention, wherein the brake shoes 105 are provided with a front wall having a recessed portion 105w preferably but in a non-limiting extent with a shape of arc or circumference, positioned on the braking wall 105f in front of the corresponding pin 103p and the respective slotted hole, so that in the blocking position this can come closer to the shoe 105 with respect to the other described embodiments, guaranteeing more friction with the rope. Advantageously, in the embodiment shown in figure 24, the slotted holes can be a bit longer, in such a way to guarantee a higher approach of the pin 103p to the braking shoe 105 during the blockage or slowing of the rope.

[0100] In the embodiment shown in figure 24, the command lever 103p engages in correspondence of the hole 101s for the auxiliary carabiner 350, controlling the rope sliding control lever 103 to which the pins 103p are constrained.

[0101] Advantageously, the belay device 100 object of the present invention does not need a tilting of the body for reaching the locking of the rope 700; it can be also then used in restricted areas or leaned to the wall.

[0102] Advantageously, through the device object of the present invention it is possible to reduce also the heat dissipation for each single contact point. As a matter of fact, it is known that one of the drawbacks that can be found in the wide use of ropes in recovery, rescue or climbing environments, is the burning of the rope sheath, that being in synthetic material (nylon) typically cannot stand the high temperatures that can be found when all the stopping force is dissipated on a very reduced area or on a single cam. Conversely, the device object of the present invention, having a plurality of contact points (upper engagement pins, lower engagement pins and shoe) on different portions of the body, dissipates more easily the heat and reduces the burning risk of the rope, ensuring then a higher duration of it. Furthermore, with respect to the figure-8 belay device, owing to the fact that the rope moves on a tortuous path but anyway planar, rope twists that can bring to dangerous situations are avoided, in particular on rappels in double rope.

[0103] It is to be noticed finally that the belay device object of the present invention, as it is usable as individual protection device, for reasons of strength is preferably realised in metallic material, more preferably in aluminium or alloy thereof with surface anode covering in order to avoid oxidation events and to increase the strength of the surface exposed to scratches or hits. However, the device object of the present invention can also be realized in inox steel, if a higher strength is wanted. For safety reasons, especially in the use as individual protection device, it would be preferable if the device object of the present invention should preferably be with a strength to traction higher than 20kN, as this value substantially represents the minimum standard of force at which ropes, carabiners and harnesses can stand without breaking.

[0104] Even if in the present invention it has been explicitly made reference to a rope 700, this indication must not be intended as limiting: as a matter of fact, the rope 700, that can be of static or dynamic type, and anyhow both single, double and twin according to UIAA standards, can be replaced and consequently equally used cables made of nylon and/or of natural material susceptible of having a diameter at least minimally compressible.

[0105] It is finally clear that to what has been described in the present invention, can be applied additions, modifications or variants obvious for an expert in the art without departing from the scope of protection provided by the annexed claims.

Claims

1. A belay device (100) for belaying operations, climbing and/or alpine activities in single or double rope; the device is **characterized in that** it comprises a pair of inner plates (101) and a rope sliding control lever (103) rotating with respect to said inner plates (101) and comprising a plurality of engagement pins (103p) of at least a rope or two ropes (700) protruding orthogonally with respect to the inner plates (101); said engagement pins (103p) protrude through slotted holes (110-112) of the inner plates (101) defining a pair of pinching areas against at least a respective brake shoe (105) for each of the two ropes (700) for locking and/or exerting a friction of slowing down alternatively on one rope or two ropes simultaneously after an automatic rotation of said rope sliding control lever (103) caused by a pulling of at least one of the two ropes (700).

2. Device according to claim 1, wherein each pinching area defines a variable light groove (198) created between an engagement pin (103p) and the brake shoe (105) positioned on each of said inner plates (101) frontally with respect to at least an engagement pin (103p); the plurality of pins (103p), integral with the rope sliding control lever (103), creates a first and a second space (190, 195) for housing the passage of ropes (700) along a tortuous path defined on a plane parallel to the plane of said inner plates (101).

3. Device according to claim 1 or 2, comprising also a pair of outer plates (102) parallel with respect to the

inner plates (101), respectively positioned on the left and on the right of an axis of symmetry (Y) of the device (100), wherein each inner plate (101) is coupled to a respective outer plate (102) separated from said inner plate (101) creating said first and second room (190, 195).

4. Device according to any of the preceding claims, wherein said rope sliding control lever (103) is interposed between said pair of inner plates (101) and rotates around a pivoting axis (X) on said pair of inner plates in correspondence with a pivoting point; the rotation of said rope sliding control lever (103) taking place along a plane parallel to the planes of said inner plates (101) and causing the variations of the light of said groove (198) through the rotation of said plurality of engagement pins (103p).

5. Device according to any of the preceding claims, wherein:

- said plurality of engagement pins (103p) comprises more than one pair of engagement pins; each pair comprises a pin for each side of said rope sliding control lever,
- each pin of each pair is axially mounted with respect to its opposite; and
- the engagement pins (103p) on both the sides of the rope sliding control lever (103) are configured for making the rope or the ropes (700) wind around themselves on a arc of curve of at least a pin of a first pair of pins in a direction opposite with respect to the direction within which said rope winds on at least a pin of another pair of engagement pins; at least a pair of engagement pins realizing a plurality of pulling means of the rope sliding control lever (103) toward said shoe (105) in case of exertion of a pulling force on the ends (701) of the ropes protruding from at least an engagement pin of said first pair of pins.

6. Device according to any of the preceding claims, wherein at least part of said engagement pins (103p) show a shape with curvilinear section.

7. Device according to any of the preceding claims when depending from claim 2, wherein said outer plates (102) show at least a degree of freedom with respect to said inner plates (101) between a first position of introduction of ropes and a second position of use in which they limit said spaces (190, 195) resulting side by side to at least a portion of each inner plate (101) and/or with said shoes (105) and show a perimeter detecting a recess which, when in said position of use surrounds a hole (200) on said inner plates (101) within which it is introduced a carabiner, ring or locking pin (400), susceptible of preventing from the opening of said outer plates (102) during the functioning.

8. Device according to claim 7, comprising a safety element (140) firmly jointed to at least one of said outer plates (102); said safety element (140) has a main hole (141); said safety element (140) rotating together with said outer plates (102), when said outer plates (102) are in said second position of use and are coaxial with the hole (200) of passage of said carabiner, ring or locking pin.

9. Device according to claim 8, wherein each outer plate (102) comprises a recess (102r) surrounding a hole (141) realized on said safety plate (140) and which provides for the connection with a carabiner or anchoring ring to the belaying person or to his harness; and wherein when said outer plate (102) is in said position of use said hole (141) finds axially aligned with a lower hole (200) of inner plates (101).

10. Device according to any of the preceding claims, wherein each inner plate (101) comprises one or more holes (101s-102s) positioned between a pair of pins (103p) and the free side of the ropes (701), above said shoes (105) and with diameter sufficient to let pass a carabiner or an additional braking ring (350), oriented with a portion of the body substantially orthogonal with respect to the symmetry axis of said device.

11. Device according to any of the preceding claims when depending from claim 4, wherein said inner plates (101) comprise a plurality of elongated slotted holes (110, 111, 112) having each an arched shape detecting a circumference arc centered in correspondence with said pivoting axis (X), and wherein said plurality of elongated slotted holes comprises at least a first and a second slotted holes (111, 112) within which is introduced said plurality of engagement pins (103p); said first slotted hole being positioned at a radius from pivoting axis (X) that is higher than the radius upon which is positioned said second slotted hole (112).

12. Device according to claim 11, wherein at least part of said plurality of slotted holes (110, 111, 112) realizes a sliding and end stop means of rotation of said rope sliding control lever (103) stopping with said engagement pins (103p).

13. Device according to any of the preceding claims, comprising also a second command lever (103s) controllable by the hand of the user, protruding from the shape of said inner plate (101) and pivoted on said inner plate (101) in correspondence with a pivoting point (103q); said command lever (103s) comprising an eccentric portion (103e) with respect to

said pivoting point (103q); said eccentric portion (103e) being conceived for contacting an upper part (103c) of the first rope sliding control lever (103) and for exerting on it a pushing force for disengaging said at least a rope (700) and wherein said pushing force causes the rotation of the first rope sliding control lever (103) in a same rotation direction of the second command lever (103s).

14. Device according to any of the preceding claims, wherein said brake shoe (105) shows an arched collar in transversal direction, and precisely orthogonal, with respect to a direction of sliding of the ropes (700) and/or a recess (105w) positioned on the wall (105f) in front of a pin (103p); said recess (105w) acting as a supplementary friction zone for said rope (700).

15. Device according to any of the preceding claims, comprising anti-twisting means (500) retaining said outer plate in correspondence with an end opposed to the pivoting one and configured for keeping said outer plate on a plane parallel to the one of the inner plate (101).

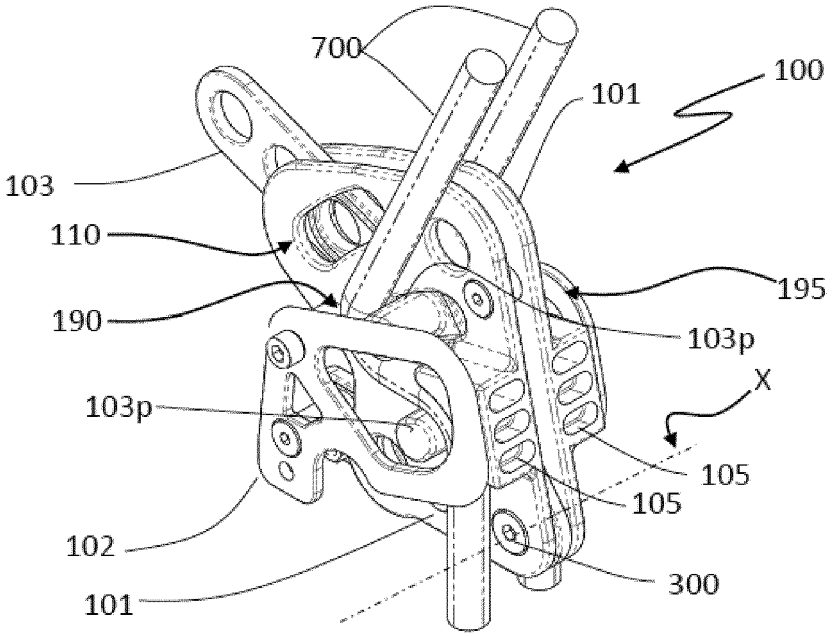

Fig.1

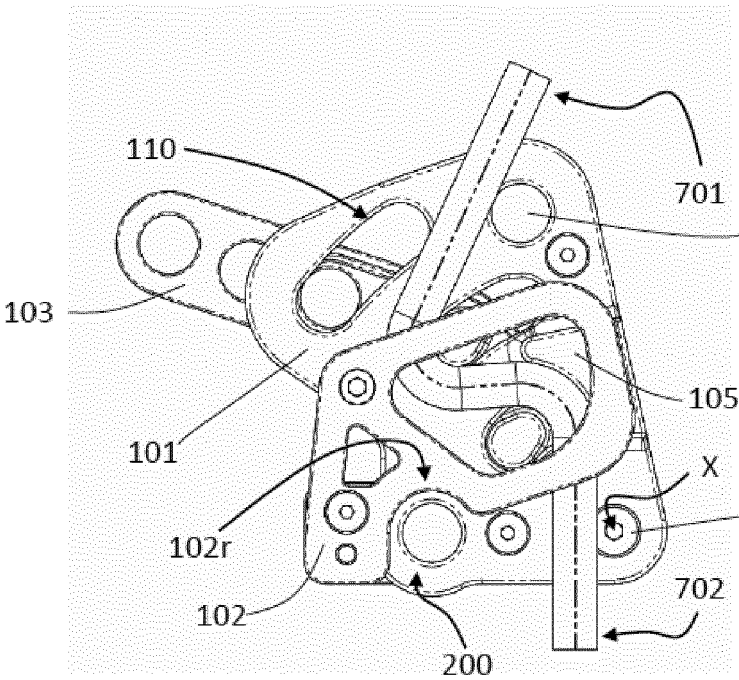

Fig.2

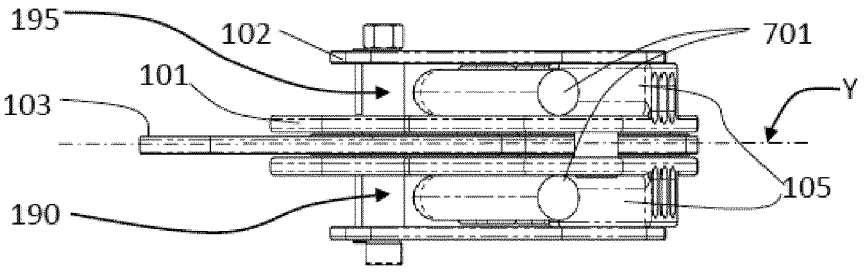

Fig.3

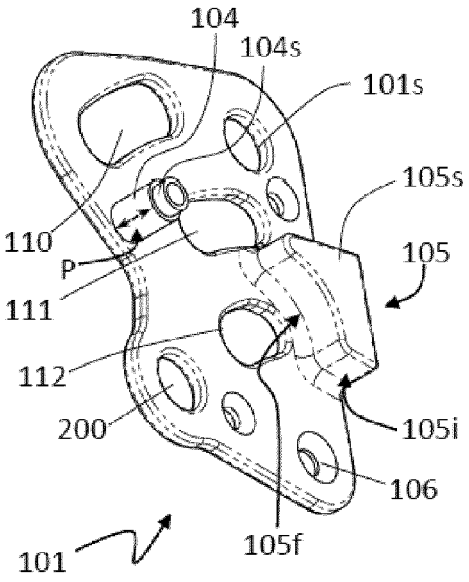

Fig.4

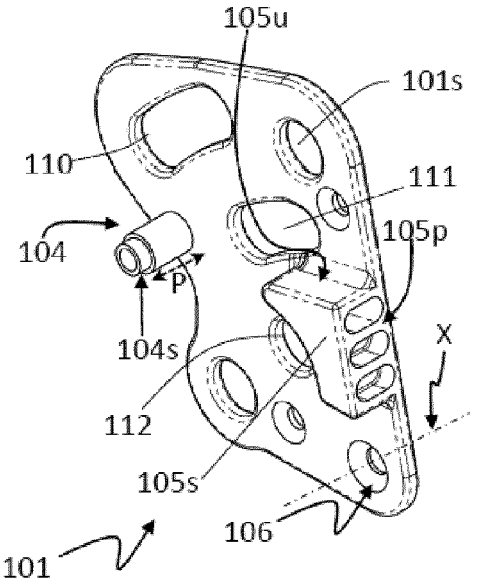

Fig.5

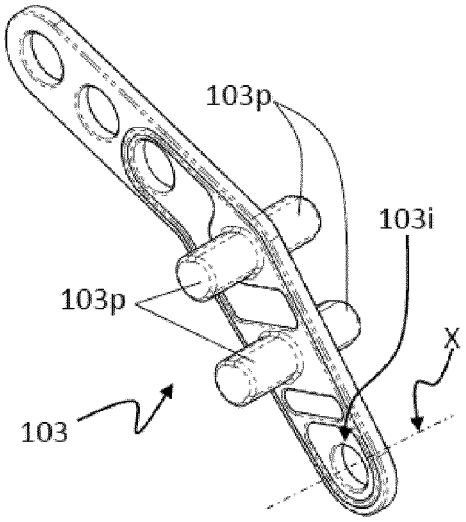

Fig.6

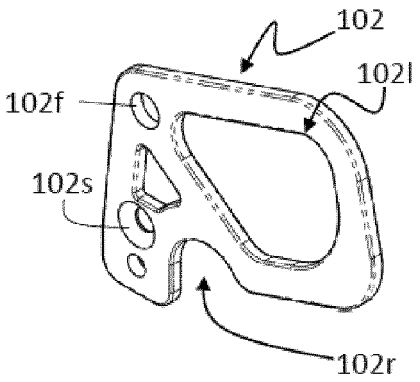

Fig.7

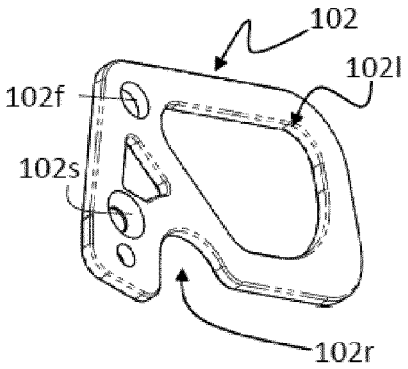

Fig.8

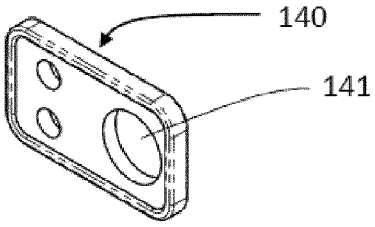

Fig.9

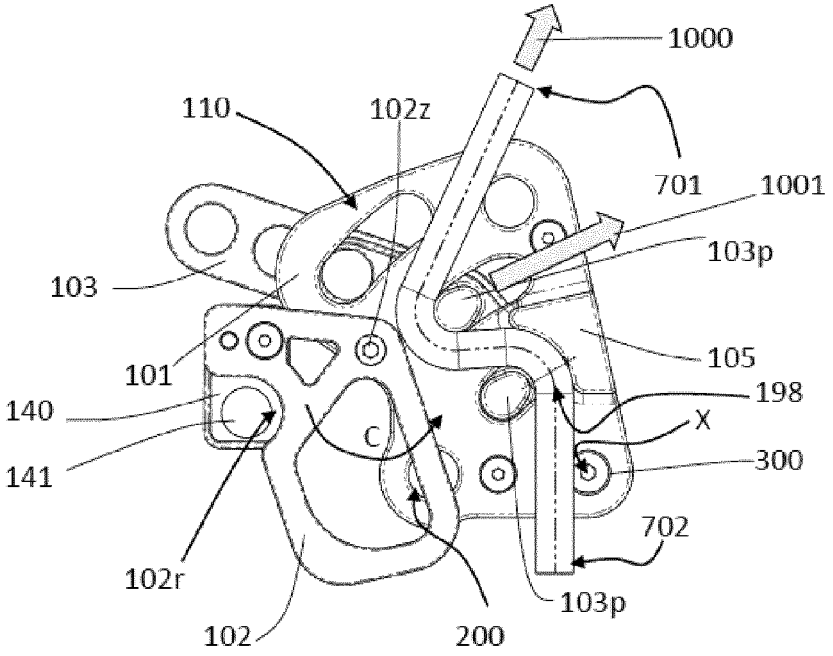

Fig.10

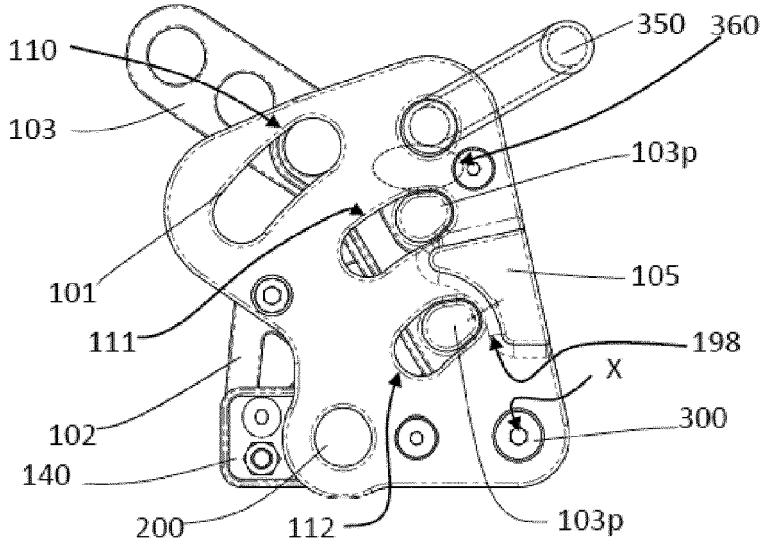

Fig.11

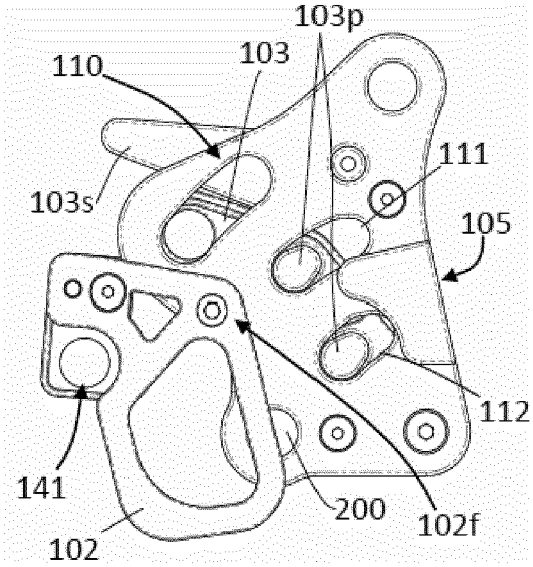

Fig.12

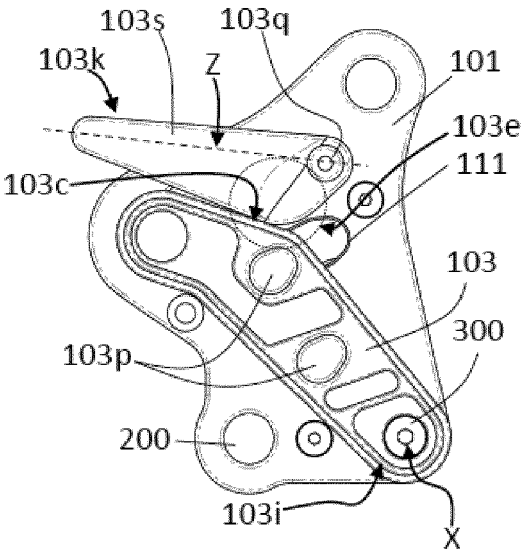

Fig.13

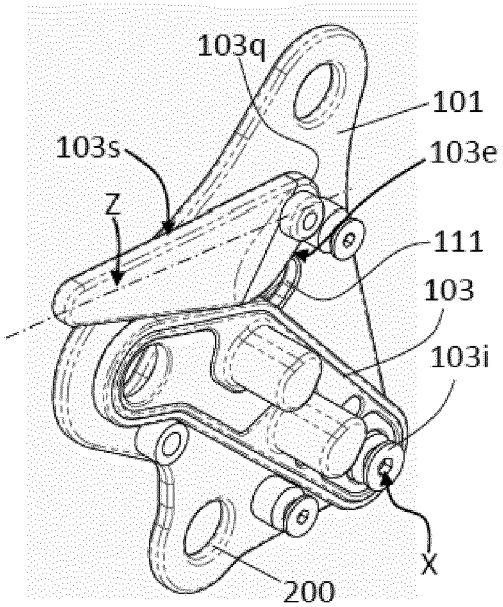

Fig.14

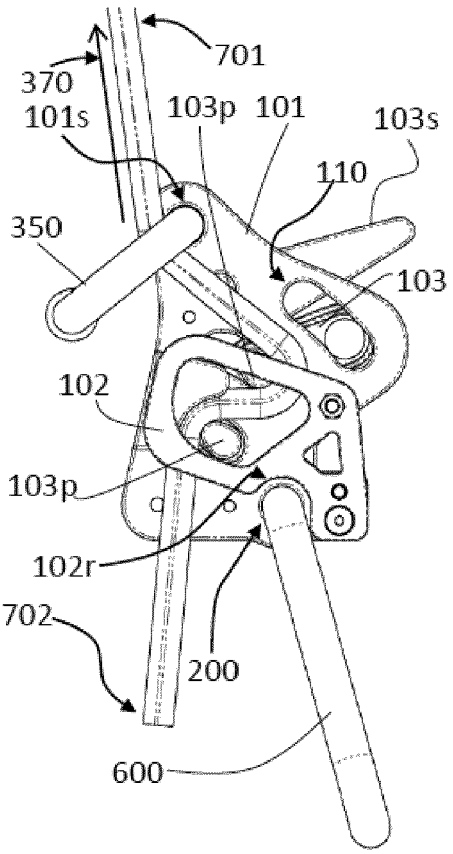

Fig.15

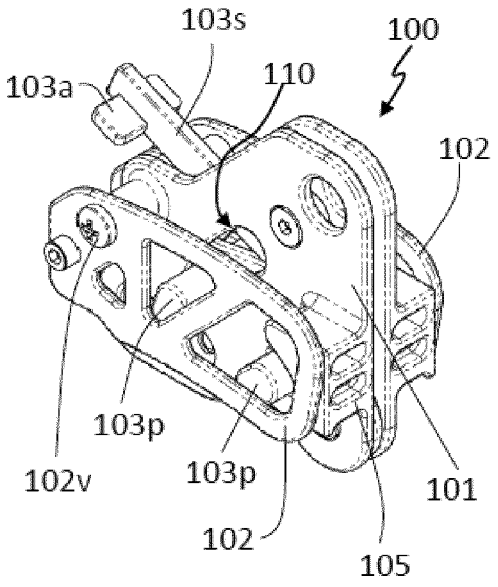

Fig.16

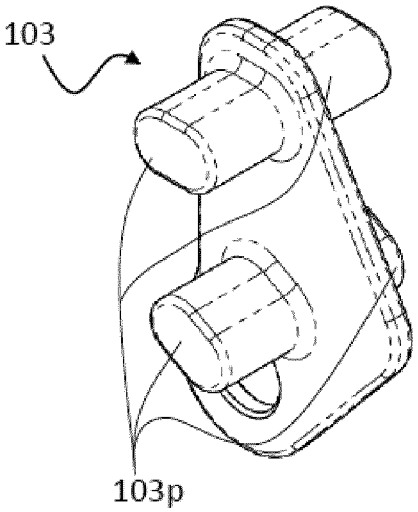

Fig.17

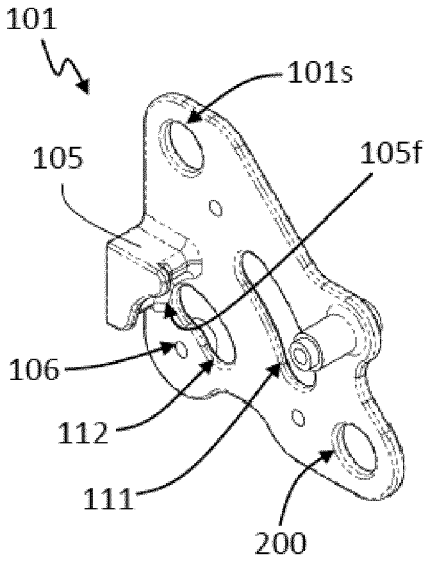

Fig.18

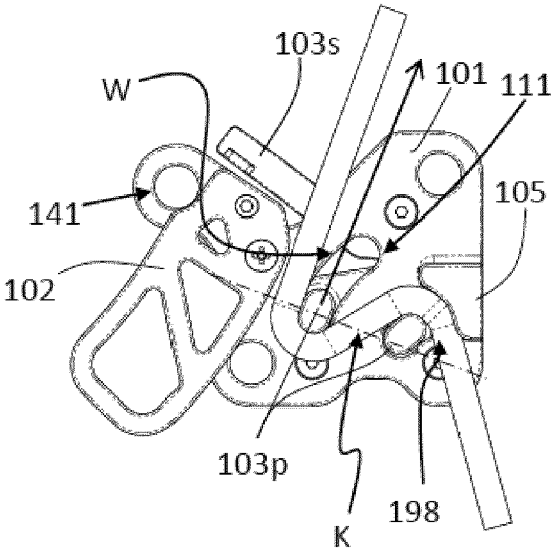

Fig.19

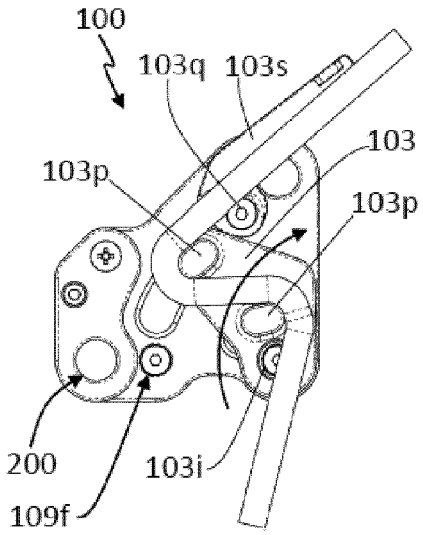

Fig.20

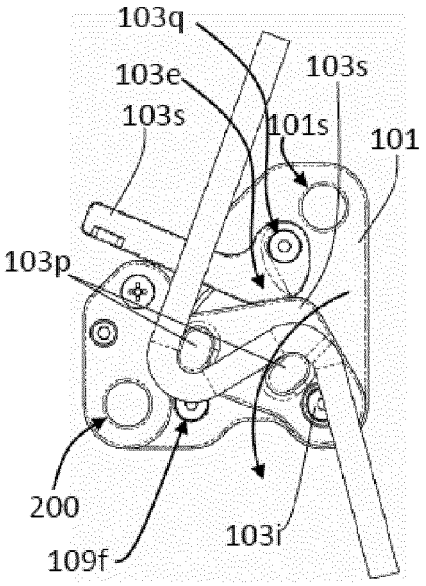

Fig.21

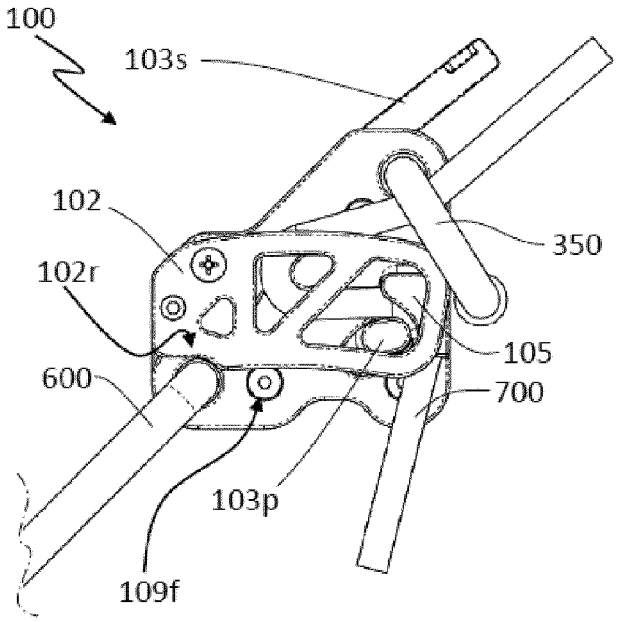

Fig.22

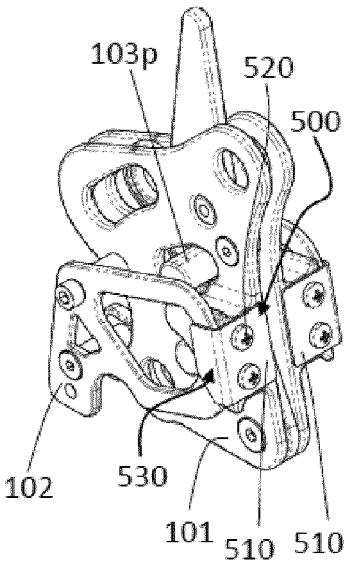

Fig.23

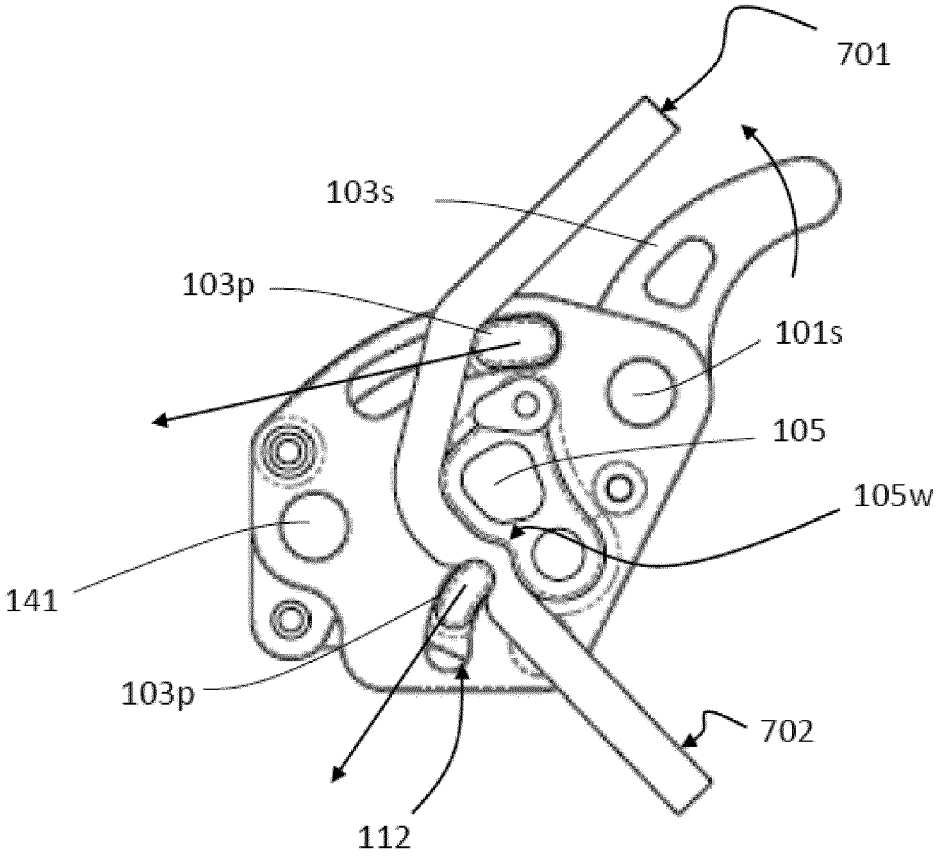

Fig.24

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EUROPEAN SEARCH REPORT

Application Number
EP 15 19 0770

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 7 757 812 B2 (BAMBERG EBERHARD [US] ET AL) 20 July 2010 (2010-07-20) * columns 4-9; figures *	1-15	INV. A63B29/02 A62B1/14
A	GB 2 290 852 A (GEMINI PLASTICS MACHINERY LTD [GB]) 10 January 1996 (1996-01-10) * pages 6-9; figures *	1-15	
A	FR 2 626 184 A1 (PETZL ETS [FR]) 28 July 1989 (1989-07-28) * pages 4-7; figures *	1-15	
A	EP 2 857 069 A2 (SIMOND ETS [FR]) 8 April 2015 (2015-04-08) * columns 6-9; figures *	1-15	

TECHNICAL FIELDS SEARCHED (IPC)

A63B
A62B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	4 April 2016	Herry, Manuel

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
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L : document cited for other reasons

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 15 19 0770

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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04-04-2016

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