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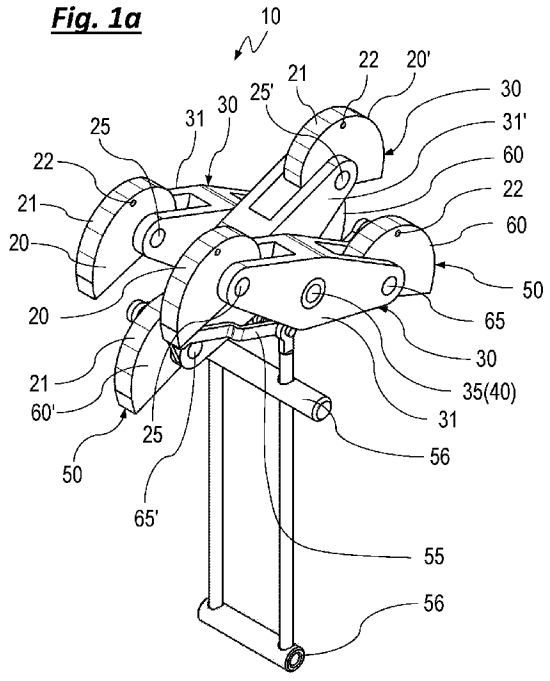


(57) Abstract: An anchoring and support device (10) for climbing, suitable for being connected to a safety rope, comprises: - at least two opposite first cams (20, 20'), rotatably hinged to a rotation pin (25, 25') and suitable for operating by exchanging forces along a first line (11) crossing the points wherein said cams (20, 20') contact the opposite walls (100', 100") of a crack or fissure (100) in a rock; - movement means (30) of said rotation pins (25, 25') suitable for increasing the extension distance of the cams (20, 20') between a minimum size limit position and a maximum size limit position of the cams (20, 20'); - locking means (40) for the movement means (30), suitable for locking said rotation pins (25, 25') in a fixed position; and comprises one or more stabilizing means (50) provided with movement means (30) and locking means (40), said stabilizing means (50) being suitable for operating according to an exchange of forces along a second line (12) crossing at least one further contact point (S) with the walls (100', 100"), in order to stabilize and prevent said anchoring and supporting device (10) from rotating inside said crack or fissure (100).

"ANCHORING AND SUPPORT CLIMBING DEVICE";

DESCRIPTION

TECHNICAL FIELD

The present invention relates to an anchoring and support climbing device.

More particularly, the present invention relates to a rock anchoring and support device for the passive safety of mountaineers and climbers during wall or slope climbing.

PRIOR ART BACKGROUND

Portable and removable spring loaded cam mechanical safety devices, commonly known as friends, are widely known and used in the field of climbing and mountaineering, which are suitable for being inserted in a steady manner in cracks or fissures of the rock walls in such a way as to guarantee anchoring and steady and secure support to the wall for the mountaineer or climber and to be subsequently and easily removed.

During climbing progression, the mountaineer or climber must always be properly secured to the vertical wall by means of ropes or wires, typically dynamic safety ropes, which must be fixed to the rock support at regular intervals so as to limit the same climber's fall in case of loss of wall adhesion or anchoring. Said dynamic safety ropes are typically connected and secured in a sliding manner to the rock walls by means of traditional anchoring means or devices, comprising said removable cam devices such as friends, for example.

A great advantage of the removable type anchoring devices is that they can be reused several times by the climber during the ascent, compared to the classic rock pressure nails or bolts.

Said traditional anchoring and support cam devices or friends typically comprise a body

or a central bearing structure, able to be connected at one of its ends with a typical dynamic mountaineering rope. On said central body or structure a plurality of movable cams are rotatably hinged, symmetrically opposed and defining generally on their outer contact surface facing the rock, a typically logarithmic spiral or round involute shaped profile. This particular spiral conformation allows to have an optimal working angle β on each point of the contact profile, typically equal to about 14°, measured between a straight line perpendicular to the tensile force and passing through the cam contact point and the straight line joining the rotation centre and the same contact point, as shown with preliminary reference to figure 27. The optimal working angle β is chosen in such a way as to define a compromise that combines a good cam travel distance and a good incidence of the transverse force component, and therefore of the friction force, on the rock face.

Said cams are generally held in a maximum open steady position by means of traditional spring loaded elastic elements and are brought into the closed position by acting on tie rods by means of a handle, so as to overcome the resistance of the elastic elements and bring the cams into closed position. In the closed position the cams have a minimum sizes dimension that allows them to be easily inserted into the crack or fissure of the rock wall.

To fit to the various sizes and widths of the cracks in the rock said cam devices are generally made in series of proportionately standardized sizes in such a way as to cover a range of sizes traditionally extended from a few tens of millimetres to some tens of centimetres. Each friend's cam dimension suitable for covering a given crack size range is typically indicated with a specific colour so as to be immediately recognizable to the climber or user.

Usually in a group or set of climbing friends there are a plurality of devices, each provided with a group of cams of increasing size and proportion, so that the climber can progressively cover rising gaps or ranges of cracks or fissures in the rock.

A typical example of these known anchoring and support cam devices is described in document US 4.184.657 (A) which refers to a climbing aid device with a support bar, a pin mounted on the same support bar, two pairs of cams rotatably mounted on the same pin and suitable for rotating in an opposite manner from a closed position to an open position. Spring elements are mounted on the pin between each pair of cams and are suitable for applying a force to each cam so as to push it into its open position. An operating bar is slidably mounted on the support bar and is connected to each cam, while an attachment point for a climbing wire is formed on the opposite end to the pin of the support bar. Applying a downward force on the operating bar brings the cams into the closed position so that the device can be inserted into a crack formed in the rocks or the like. The operating bar is then released, and the spring elements push the cams into the open position, locking the device inside the crack. The document also describes a support bar which can also comprise means for holding the operating bar in a position where the cams are in the closed position.

A limitation, however, is due that it is not possible to proportionally increase the cams' dimension beyond a certain size with respect to the body or support structure of the friend in order to be able to fit the anchor device to cracks or fissures in the rock with a width of the order of tens of centimeters. To try to overcome this drawback, in some known embodiments, the cams are advantageously and rotatably hinged with their respective rotation pins to movement means of the same rotation pins, said movement means being configured to move the same rotation pins of the cams in opposite directions in such a way as to increase or decrease the gap or opening range of the same cams.

These movement means of the rotation pins can be advantageously provided by means of mobile support arms or appendages, externally projecting to the friend's body and such as to project or protrude the rotation pin and the respective cam to the outside in order

to allow the device to fit to space of size gradually larger than the cracks or fissures, without increasing the size of the cams.

A typical example of this type of technical solution is described in the international application WO 2006/125942 which refers to a cam climbing device comprising two support arms rotatably mounted around an axis, where each arm is provided at its free end with at least two rotatably arranged cams and locking means suitable to prevent the arms from rotating with respect to each other when a predetermined angle is reached.

An important limitation of these traditional cam anchoring devices provided with cam's pins movement means, such as arms or support appendages, is due to the fact that they tend to be very unsteady and the instability increases proportionally with the size and the distance covered by the same movement means of the pins.

With preliminary reference to figures from 8a to 9c, the increasing in size or in operating length of the pins' movement means, such as the arms in the figures example, while the cam size remains unchanged, causes a transverse component T_1 of the force T not longitudinally directed along to the vertical direction (gravity) or along to the longitudinal development of the crack or fissure, produces a moment M, proportional to the distance of the pins, which destabilizes the anchoring support device or friend leading to dangerous losses of contact with the rock surface.

OBJECTS OF THE INVENTION

The object of this invention is to overcome and resolve, at least in part, the above-mentioned drawbacks and operating limits.

More specifically, the object of the present invention is to provide an anchoring and support climbing device capable of adapting to a greater size range of rock cracks, openings or fissures.

A further object of the present invention is to provide an anchoring and support climbing

device suitable to remaining steady without losing adherence to the rocky surface even in the event of a tensile force that has a component transversal to the longitudinal axis of the crack or fissure of the rock.

A further object of the present invention is to give to the user a climbing anchoring and support device provided with a fine and gradual adjustment to accurately fit in the various sizes of the cracks in the rock.

A further object of the present invention is to provide an anchoring and support climbing device able to guarantee a high level of resistance and reliability over time, such as to be easily and inexpensively produced.

These and other objects are achieved by the anchoring and support climbing device object of the present invention in accordance with the independent claim.

The constructive and functional characteristics of the anchoring and support climbing device can be better understood from the following detailed description, in which reference is made to the attached drawings which represent some preferred and non-limiting embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

The following figures shown in the drawings are schematic and simplified, different crosshatched and fillings style of the areas can highlight, in addition to a particular sectioned part, different elements and for greater clarity the element lines or hidden features or to which other elements are overlapped are also made visible.

Moreover, for better clarity, some known elements and components that are not essential to this patent description are not shown and, in some views of some figures, lines of elements or features that are hidden or to which other elements are superimposed are also made visible in a simplified and schematic way.

Figure 1a is a schematic representation of an axonometric view of the anchoring and

support climbing device of the present invention in an opening cams position and in the limit configuration of maximum size of the movement means of the rotation pins of the same cams and of the cam stabilization means;

Figure 1b is a schematic representation of an axonometric view of the anchoring and support climbing device of the present invention in a closing cams position and in the limit configuration of maximum size of the movement means of the rotation pins of the same cams and of the cam stabilization means;

Figure 2a is a schematic representation of an axonometric view of the anchoring and support climbing device of the present invention in an closing cams position and in the limit configuration of minimum size of the movement means of the rotation pins of the same cams and of the cam stabilization means;

Figure 2b is a schematic representation of an axonometric view of the anchoring and support climbing device of the present invention in a opening cams position and in the limit configuration of minimum size of the movement means of the rotation pins of the same cams and of the cam stabilization means;

Figure 3a is a schematic representation of an axonometric view of a further embodiment of the anchoring and support climbing device of the present invention in an opening position of the cams and in the limit configuration of minimum size of the movement means of the rotation pins of the same cams and of the stabilization means with shaped appendix;

Figure 3b is a schematic representation of an axonometric view from a different viewpoint of the anchoring and support climbing device embodiment shown in figure 3a, in an opening cam position and in the limit configuration of minimum sizes of the movement means of the rotation pins of the same cams and of the stabilization means with shaped appendix;

Figure 4a is a schematic representation of a frontal elevation view of the anchoring and support climbing device of the present invention in a maximum opening position or extension of the cams and in the limit configuration of maximum sizes of movement means of the rotation pins of the same cams;

Figure 4b is a schematic representation of a frontal elevation view of the anchoring and support climbing device of the present invention in a maximum opening position or extension of the cams and in an intermediate transition configuration between maximum and minimum size limit configuration of movement means of the rotation pins of the same cams;

Figure 5a is a schematic representation of a frontal elevation view of the anchoring and support climbing device of the present invention in a maximum opening position or extension of the cams and in the limit configuration of minimum sizes of movement means of the rotation pins of the same cams;

the figure 5b is a schematic representation of a frontal elevation view of the anchoring and support climbing device of the present invention in a closing position of the cams and in the limit configuration of minimum sizes of movement means of the rotation pins of the same cams;

Figures 6a and 7a are a generalized schematic representation of a frontal view of the anchoring and support climbing device of the present invention with stabilization means of the strut type, respectively in the minimum and maximum size limit configurations of the rotation pins;

Figures 6b and 7b are a generalized schematic representation of a frontal view of the anchoring and support climbing device of the present invention with stabilization means comprising only a cam, respectively in the minimum and maximum size limit configurations of the rotation pins;

The figures 6c and 7c are a generalized schematic representation of a frontal view of the anchoring and support climbing device of the present invention with stabilization means comprising a pair of opposite cams, respectively in the minimum and maximum size limit configurations of the rotation pins;

Figures 8a to 8c are a generalized schematic representation of a frontal view of an anchoring and support climbing device according to the prior art in an operational working configuration;

Figures 9a to 9c are a generalized schematic representation of a frontal view of an anchoring and support climbing device according to the prior art in a different operational working configuration;

Figure 10a is a schematic representation of a side view of the anchoring and support climbing device embodiment of figure 3a with shaped appendix stabilization means;

Figures 10b to 10c and 11a to 11b are schematic representations of frontal views of the anchoring and support climbing device embodiment of figure 3a with shaped appendix stabilization means respectively in sequence from a configuration of minimum size of figure 10b to a configuration of maximum size of figure 11b passing through two intermediate configurations of figures 10c and 11a;

Figure 12a is a schematic representation of a side view of the shape of the anchoring and support climbing device embodiment of figure 3a with stabilization means provided with abutment elements with shaped appendix, in an operating condition in a crack or fissure in the rock;

Figure 12b is a schematic representation of a frontal view of the anchoring and support climbing device embodiment of figure 3a with stabilization means provided with separable abutment elements, in an operating condition in a crack or fissure in the rock;

Figure 13a is a schematic representation of a lateral view of a further embodiment of the

anchoring and support climbing device of the present invention with movement means of the pins and stabilization means formed by a plurality of rocker arms hinged to a central pin;

Figures 13b to 13c and 14a to 14b are schematic representations of frontal views of the anchoring and support device embodiment of figure 13a with movement means of the pins and stabilization means formed by a plurality of rocker arms hinged to a central pin respectively in sequence from a configuration of minimum size of figure 13b to a configuration of maximum size of figure 14b passing through two intermediate configurations of figures 13c and 14a;

Figures 15a, 15b and 15c are schematic representations of partial frontal views of an embodiment of rocker arms of the anchoring and support climbing device of the present invention, with locking means provided with a ratchet mechanism and in the steps of transition from the minimum size limit position of the pins and maximum opening of the cams of figure 15a to the maximum size limit position of the rotation pins and maximum opening of the cams of figure 15c, passing through a generic intermediate position of figure 15b;

Figures 16a,16b and 16c are schematic representations of frontal and lateral views of the same embodiment of the rocker arms of the climbing anchoring and support device of Figures 15, representing the conjugate crown gears shaping of the ratchet locking means formed on the same rocker arms;

Figure 17a is a schematic representation of a lateral view of a further embodiment of the anchoring and support climbing device of the present invention with movement means of pins and stabilization means formed by a plurality of rocker arms arranged in a deformable articulated quadrilateral and with ratchet means locking on central pins;

Figures 17b to 17c and 18a to 18b are schematic representations of lateral views of the anchoring and support device embodiment of figure 17a with movement means of pins and stabilization means of formed by a plurality of rocker arms arranged in a deformable articulated quadrilateral and with ratchet locking means on the central pins, respectively in sequence from a minimum size configuration of figure 17b to a maximum size configuration of figure 18b passing through two intermediate configurations of figures 17c and 18a;

Figures 19a to 20a are schematic representations of lateral views of a further embodiment of the anchoring and support device of the present invention, with movement means of pins and the stabilization means formed by a plurality of rocker arms arranged in a deformable articulated quadrilateral and with the locking means with sliding rod, respectively in sequence from a minimum size configuration of figure 19a to a maximum size configuration of figure 20a, passing through two intermediate configurations of figures 19b and 19c;

Figure 20b is a schematic representation of a side view of a variant embodiment of anchoring and support device object of the present invention, with the movement means of the pins and the stabilization means formed by a plurality of rocker arms arranged in a deformable double articulated quadrilateral and with the locking means with sliding rod;

Figures 21a, 21b, 21c and 21d are a schematic representation of plan views of a further embodiment of the anchoring and support climbing device of the present invention with the rotation pins of the cams and the cam stabilization means formed on a crankshaft and, respectively, in the operational transition from a minimum size configuration and minimum cam opening to a maximum size configuration and in the position of maximum cam opening, through two generic intermediate positions;

Figures 22a, 22b, 22c and 22d are a schematic representation of frontal views of the

previous embodiment of figures 21 of the anchoring and support climbing device, with the cam rotation pins formed on a crankshaft and, respectively, in the operational transition from a minimum size configuration and minimum cam opening to a configuration of maximum size and in the position of maximum cam opening, through two generic intermediate positions;

Figure 23a is a schematic representation of a side view of a further embodiment of the anchoring and support device for climbing of the present invention with the movement means of the cam pins and cam stabilization means comprising a plurality of slotted openings for the sliding of rotation pins;

figures 23b, and 23c are a schematic representation of frontal views of the further embodiment of figure 23a of the anchoring and support device for climbing of the present invention in the transition from the minimum size limit position and minimum opening of figure 23b to the maximum size position of and maximum opening of the cams of figure 23c;

Figures 24a, 24b and 24c are a schematic representation of partial frontal views of the same embodiment of figures 23 of the anchoring and support device for climbing of the present invention, in the exemplifying operative transition of the rotation pin of first cams of the movement means and of the second cams of the stabilization means, from the blocked configuration of maximum size of figure 24a, to the blocked configuration of minimum size of figure 24c, passing through the free configuration of figure 24b;

Figures 25a, 25b, 25c and 25d are a partial schematic representation of front views of a further variant embodiment of the anchoring and support climbing device of the present invention with cam's movement means and stabilization means comprising a plurality of sliding slotted opening of rotation pins, respectively, in the operational example of transitional passage relating to a single cam, from a minimum sizes locked configuration

of figure 25a and in the position of minimum opening of the cams to a maximum sizes locked configuration and maximum opening of the cams of figure 25d passing through two generic free sliding intermediate configurations of figures 25b and 25c;

Figures 26a, 26b, 25c and 25d are a partial schematic representation of frontal views of a further variant embodiment of the anchoring and climbing support device of the present invention with the cam movement means and stabilization means comprising a plurality of U-shaped sliding slotted opening of rotation pins, respectively, in the exemplifying operational transition relating to a single cam, from a maximum overall blocked dimension configuration of figure 26a and in the position of maximum cam opening to a minimum overall blocked configuration of and maximum cam opening of figure 26d passing through two generic intermediate free sliding configurations of figures 26b and 26c;

Figure 27 is a schematic example representation of the operation to a generic cam according to prior art with the working angle β constant at different points of the contact profile with the rock surface corresponding to different opening positions or extension of the cam itself rotatable around its pin.

DETAILED DESCRIPTION OF THE INVENTION

Below are described, with reference to the attached figures, some possible preferred embodiments of the anchoring and support device for climbing object of the present invention. In the following description the terms "maximum size" and "minimum size" of the opening, extension or closing positions of the cams, are referring to the different possible working configurations of the anchoring and support device, i.e. the horizontal dimension perpendicular along to the development of the crack, opening or fissure in the rock which is the width or working dimension to which the device must fit. The other dimensions of the same crack, such as height and depth are generally much larger than

the width.

Although the following description is limited in the examples, for simplicity and clarity of description, to a minimum number of opposing cams, it will be evident to the skilled person how the same teaching can be in an obvious way extended to multiple configurations with multiple cams or pairs of cams arranged side by side and or in series, as for the previously mentioned traditional devices of the prior art.

With initial reference to all the figures and particularly to figures from 6a to 7c is represented in a generalized embodiment the anchoring and support device for climbing object of the present invention, in the assembly specified with reference number 10, said device comprising:

- At least two opposite first cams 20, 20', rotatably hinged to a rotation pin 25, 25' and suitable to operating by exchanging forces along a first line 11 or straight line that crossing the contact points P_1 and P_2 wherein the cams contact the opposite walls 100', 100" of a crack or fissure 100 of the rock;
- movement means 30 of said rotation pins 25, 25' suitable for increasing the extension distance of the cams 20, 20' between a minimum size limit position and maximum size limit position of the cams 20, 20';
- locking means 40 for the movement means 30, suitable for locking said rotation pins 25, 25' in a fixed position.

Innovative feature of said anchoring and support device 10 is to comprise one or more stabilization means 50 provided with said movement means 30 and said locking means 40, said stabilization means 50 being suitable for operating according to an exchange of forces along a second line 12 crossing at least one further contact point S with walls 100', 100" of said crack or fissure 100 of said rock, said second line 12 being placed at a different distance from said first line 11 in order to stabilize and prevent at the same time a possible

rotation of said anchoring and support device 10 inside said crack or fissure 100.

With particular reference to Figures 6a and 7a, where the anchoring and support device is shown, for example, in the maximum size B and minimum size A configurations of movement means 30 and also in Figures 3a and 3b, said 50 mobile stabilization means can simply comprise one abutment element 70 of a rod type, a strut or a shaped appendage (figure 6a 7a) suitable to define, in cooperation with said movement means 30 of the cam rotation pins, at least one further point of contact S with the wall surfaces 100', 100" beyond those defined by the cams 20, 20'.

With reference to figures 6b to 7b, said stabilization means 50 can also comprise at least one second cam 60, 60', in case the application point O of the tensile force is not placed on the axis of symmetry of the anchoring and support device 10, or a plurality of opposed second cams 60, 60' (figures 6c and 7c), hinged by means of a second rotation pin 65, 65' in case the point O of application of the tensile force is placed on the axis of symmetry of the same anchoring and support device 10.

Said locking means 40 of movement means 30 of the rotation pins, can be suitable for locking simultaneously in fixed position both said rotation pins 25, 25' and said stabilization means 50, like the abutment elements 70 or the second cams 60, 60'. In other embodiments, instead, said stabilization means of can be provided with their own movement means 30 and locking means.

Said locking means 40 can be suitable to locking in fixed position said second rotation pins 65, 65' in a steady and fixed way with respect to said anchoring and support device 10, allowing the rotation of first cams 20, 20' and second cams 60, 60' with respect to their own axis.

In the embodiments of this description, shown in the attached drawings, given only as a non-limitative example, the cams 20, 20' and the opposed second cams 60, 60' are of equal

dimensions and with the centers of the rotation pins 25, 25' and of the second rotation pins 65, 65' joined by a substantially horizontal straight line; it will result however evident to the skilled person as the invention is also enabling with cams 20, 20' and second cams 60, 60' of different dimensions between them and with the centers of the rotation pins 25, 25' and second rotation pins 65, 65' not disposed on a perfectly horizontal straight line.

This anchoring and support device 10 can also comprise connection means 17 (figures 22a to 25d) such as a slotted shank or an opening suitable for attaching and connecting a safety rope ropes or equivalent to which tensile force is applied.

Said movement means 30 of the rotation pins, can be suitable to advantageously move the rotation pins 25, 25' of the first cams 20, 20' and, at the same time, also the second rotation pins 65, 65' of the second cams 60, 60'.

With particular reference to the main embodiment of the figures from 1a to 5b and in particular to figures 4a and 4b, said movement means 30 can be rocker arms 31 hinged by means of a central pin 35 with the first cams 20, 20' and the second cams 60, 60', hinged on the ends of said rocker arms 31 by means of said first and second rotation pins 25, 25', 65', so as to configure said first line 11 of force exchange in correspondence of said first cams 20, 20' and said second line 12 of force exchange in correspondence of said second cams 60, 60' of said stabilization means 50. Said second cams 60, 60' are generally arranged on portions or extensions of the same rocker arms 31 in a distal position in comparison to said first cams 20, 20'.

First cams 20, 20' and the second cams 60, 60' can comprise, in all embodiments, a typical contact profile 21, traditionally having a logarithmic spiral or evolving development, said contact profile 21 being suitable for anchoring to a wall 100, 100' of rock, said first cams 20, 20' and said second cams 60, 60' being suitable to dispose between a closed limit

position with reduced size, gathered on said anchoring and support device 10, and a maximum opening limit position extended and protruding from the body of said anchoring and support device.

Each cam 20, 20' and second cam 60, 60' is generally maintained in a monosteady rest position of and maximum extension or opening by means of an elastic element, not shown, such as a helical torsion spring coaxially arranged with respect to the rotation pin 25, 25' or the second rotation pin 65, 65'.

Said rotation pins 25, 25' and said second rotation pins 65, 65' can be joined by an axis or straight line passing through the central pin 35 of said rocker arms 31, 31' but can also have a different conformation wherein said straight line or axis does not pass through the central pin 35 and wherein the rocker arm 31, 31' have an arched development.

With reference instead to figures 3a, 3b and from 10a to 12, said stabilization means 50 can comprise at least a simple abutment element 70 type strut or shaped appendix disposed to the opposite ends of the first cams 20, 20' and formed on extensions of said rocker arms 31, 31'.

Said abutment elements 70 can be advantageously curved in the shape of a scythe, mezzaluna or hook, wherein the extremity of said abutment element 70, suitable to contacting with the rock wall, is preferably bent towards the inside of the anchoring and support device 10.

In a further embodiment, shown in figure 12b, said stabilization means 50 can comprise one or more separate abutment elements 70, for example in the shape of a cone or wedge, cooperating in surface contact with the anchoring and support device 10 in such a way as to ensure said additional point of contact S with the walls 100', 100" for the exchange of forces along said a second line 12, so as to prevent the moment of rotation of said anchoring and support device 10 inside said crack or fissure 100. Said abutment elements

70 separated from the stabilization elements 50 can, moreover, be also connectable or pluggable in the anchoring and support device 10 in correspondence of the rocker arms of the movement means 30 or of the body of the same anchoring and support device 10. The outer surface of the inclined portions of said abutment elements 70, which are suitable for rock contacting, can be advantageously engrailed or knurled to improve adhesion, as with the outer contact surfaces of traditional cams.

In a further variant embodiment, illustrated in Figures 13a to 14b, said anchoring and support device 10 can comprise a plurality of rocker arms 31, 31' hinged on a central pin 35 and having different lengths. Each rocker arm 31. 31' is provided with a first cam 20, 20' hinged on the relative rotation pin 25, 25', or, if the rocker arm 31, 31' is suitable to work as a stabilizing medium 50, a second cam 60, 60' hinged on the relative second rotation pin 65, 65'.

In a variant embodiment, not shown, said rocker arms 31, 31' can also be hinged to a central body on several central pins 35.

With reference again to figures 1a to 5b, said rocker arms 31, 31' can be operated in rotation by means of said first tie rods 55 and handle 56, in such a way as to be arranged in the minimum size configuration of rotation pins 25, 25' and second rotation pins 65, 65'. Subsequently, each rocker arm 31, 31', having a length compatible with the size of the crack or fissure of the rock, will be disposed once released with the first cams 20, 20' in working position according to said first line 11 of force exchange, while the rocker arms 31, 31' of the stabilization means 50 will be disposed such a way as to operate with the relative cams 60, 60' according to said second line 12 of force exchange with the facing surfaces of the rock walls.

Said first tie rods 55 can be of the cable type, or shaped battens in metal or composite material and are generally connected with said handle 56 sliding disposed to a handle or

to connection means of 17 of the anchoring and support device 10.

With reference to all embodiments provided of cams stabilization means 50, said movement means 40 of said rotation pins 25, 25', suitable to stabilize said rotation pin 25, 25' in a steady and fixed way with respect to the same anchoring and support device 10, can also be suitable to simultaneously locking of said second rotation pins 65, 65' of said second cams 60, 60' of said stabilization means 50.

In other embodiment forms described below, the rotation pins 25, 25' and the second rotation pins 65, 65' of said second cams 50 stabilization means can each be provided with its own locking means 40.

With reference to the previous embodiments described above, said central pin 35 can advantageously be hollow in such a way as to be suitable for thoroughly housing a rope or elastic safety rope 95 suitable for applying the tensile force T to the anchoring and support device, as shown for example in figures 12a and 12b.

Always with reference to all the figures, a common feature of the anchoring and support device 10 of the present invention is to be provided with known movement means 30 arranged in cooperation with said stabilization means 50, in such a way to positioning or displacing at the same time said rotation pins 25, 25' of the first cams 20, 20' and said stabilization means 50, with respect to the same anchoring and support device 10, between a minimum size position or configuration of rotation pins 25, 25' and of stabilization means 50, indicated in the figures with the letter A, and a maximum size position of rotation pins 25, 25' and of stabilization means 50, indicated in the figures with the letter B, moving the relative position of said pins 25, 25' and of said stabilization means 50 among them, until also inverting the position of the same pins.

In this way, the anchoring and support device 10 can be fitting to cracks or fissures 100 of the rock with minimum dimensions, in the limit configuration with rotation pins 25,

25' and stabilizing means 50 in a minimum size configuration marked with the letter A and with a closed position of cams 20, 20' and stabilization means 50 and, at the same time, accommodate the same anchoring and support device 10 to larger and larger cracks or fissures 100 of the rock in the limit configuration with the rotation pins 25, 25' and the stabilization means 50 moved or displaced in a maximum size position, marked with the letter B and with a maximum opening or extension of the cams 20, 20' and the stabilization means 50, compared to the minimum size configuration.

To leading cams 20, 20' and the 50 stabilization means, comprising for example the second cams 60, 60', in the closed position gathered on the anchoring and support device 10, are traditionally used second tie rods (not shown) of the type wires or cables metal or polymeric material generally tied to the same cams 20, 20', and the second cams 60, 60' at openings 22, so as to create a moment of force with respect to the rotation pin 25, 25' and the second rotation pin 65, 65' and overcome the resistance of the elastic element. Said tie-rods are preferably fixed to a second handle 56' slidingly arranged with respect to a handle or connection means 17 of said anchoring and support device 10.

Said rocker arms 31, 31' or arms can be further provided with an elastic element 90, type elastic torsion spring, suitable to maintaining the same rocker arms in a steady position at one of the limit configurations, said elastic elements being placed in correspondence of the central pin 35 or of the tie rods 55 as shown in figure 90.

With particular reference now to figures 17a to 20b, in a further alternative embodiment of the anchoring and support device 10, said movement means 30 of said pins 25, 25' and of said second pins 65, 65' of the stabilization means 50, can comprise a plurality of rocker arms 31, 31' hinged for their respective ends in such a way as to define one or more deformable polygons, typically diamond-shaped or deformable articulated quadrilateral 80.

Said deformable articulated quadrilateral 80 can comprise two second central pins 35' disposed at two opposite vertices of said deformable articulated quadrilateral 80, while at the remaining vertices, said deformable articulated quadrilateral 80 comprises the rotation pins 25, 25' to which the respective first cams 20, 20' are hinged.

With reference again to the same figures, said rotation pins 25, 25' are also rotatably hinged, in a generally central portion, of the additional second rocker arms 75, 75' comprising on their distal ends the stabilization means 50, as for example said second cams 60, 60' hinged to the same second rocker arms 75, 75' by means of the relative second rotation pins 65, 65'.

In a further variant embodiment, with reference now to figure 20b only, said movement means 30 can comprise a plurality of rocker arms 31, 31' rotatably hinged at their respective ends in such a way as to define two or more superimposed deformable polygons, for example in the form of a double lozenge or double deformable articulated quadrilateral 80, as shown in the above figures. Said double deformable articulated quadrilateral e 80 can comprise at least three second central pins 35', if the two articulated quadrilateral 80 are joined by a vertex, or four second central pins 35' arranged in correspondence of the four opposite vertices of said double quadrilateral deformable 80, while in correspondence of the remaining vertices said double deformable articulated quadrilateral 80 comprises said second rotation pins 65, 65' to which are hinged the respective first second cams 60, 60' of the stabilization means 50.

Always with reference to the same figures, said rotation pins 25, 25' are always rotatably hinged in a generally central portion of said second rocker arms 75, 75', which in correspondence of their distal ends are hinged to the second rotation pins 65, 65' of said second cams 60, 60' of said stabilization means 50.

With reference now to figures 23a to 25d, in a further embodiment of the anchoring and

support device 10, said movement means 30 can comprise one or more elongated slotted openings 36, formed in a body 15 of the anchoring and support device 10, inside of which openings the rotation pin 25, 25' of the first cams 20, 20' and the second rotation pin 65, 65' of one or more second cams 60, 60' are slidably and rotatably arranged. This slotted opening 36 defines two opposite ends 37, 37', generally circular or semi-circular shaped and suitable to rotatably housing the rotation pin 25, 25' in the minimum and maximum size limit positions A and B.

In a possible variant of this further embodiment, with particular reference to figures from 25a to 25d that shown for clarity of description only cams relative to one side of the device, said the locking means 40 of the rotation pin 25, 25' can comprise a narrow portion of said slotted opening 36 connecting said ends 37, 37', said narrow portion having a limited passage section with respect to said passage ends 37, 37' and suitable to be placed in cooperation of movement with a flattening obtained on the external surface of the rotation pin 25, 25'. In correspondence of said flattering said rotation pin 25, 25' has a reduced diametrical section suitable for be rotatably aligned with the narrow portion of said slotted opening 36, so that in said alignment position the pin 25, 25' can freely slide without rotating inside said slotted opening 36 between the ends 37, 37' defining the limit positions of configurations A and B.

Said rotation pin 25, 25' is advantageously returned back in steady position inside one of the ends 37, 37', by means of traditional spring elements or equivalent. When the first cam 20, 20' rotates in the position suitable for bring the diametrical section of the rotation pin 25, 25' with the flattering aligned to said narrow portion 38 of the slotted opening 36, the same rotation pin 25, 25' can be manually moved towards the end 37, 37' opposite, in a different overall configuration, overcoming the force of the elastic element. By subsequently rotating the pin at the destination end 37, 37' and misaligning the flattering

26, the pin 25, 25' shows a diametric section larger than the narrow portion 38 such as to maintaining it in position and prevent the spring element 60 from recalling it back in the starting steady configuration position through the narrow portion 38.

This embodiment can advantageously be applied to all 25, 25' pins of the anchoring support device 10 or only to the 25' pin of cam 20 or, vice versa, to the 25' pin of cam 20.

With reference also to figures 23a to 24c, in a further embodiment of the anchoring and support device 10, said locking means 40 comprise at least one locking element 45 slidingly placed, by means of a second elastic element 61 of return, in a channel 46 formed in the body 15, said channel 46 being open and intersecting the slotted opening 36, so as to block and prevent the sliding of the pin 25, 25' between the two ends 37, 37' of the same slotted opening 36.

The user manoeuvring on a third tie rod 94 with a force in the direction of the arrow F of figures 24a and 24b and overcoming the force of the second elastic element 61, moves the block element 45 along the direction and the direction of the arrow P of figure 11f unlocking the sliding pin 25' allowing it to move from the position of figure 24a, defining a maximum size configuration B, to the position of figure 24c defining a minimum size configuration A. Releasing the third tie rod 94, the blocking element 45 returns to the original position moving in the direction of the arrow P' by means of the second elastic element 61, blocking the rotation pin 25' stably in the configuration of figure 24c.

With reference now to figures 26a to 26d, in a further variant of this last embodiment of the anchoring and support device 10, said locking means 40 can comprise a U shaped slotted opening 36 formed in the body 15 with a portion of material 36' placed so that the ends 37, 37' of slotted opening 36 are not directly connected and facing and defining a diametral section substantially equal to that of slotted opening 36.

Always with reference to the exemplificative shape of the same figures, referring for clarity

only to the rotation pin 25 and cam 20, the rotation pin 25 is manually moved by means of the tie rods 55 overcoming the force of the elastic element 60, in order to leading the same rotation pin 25 with cam 20 from the maximum size limit position B of figure 10a, to the minimum size limit position A of figure 10d, passing through the intermediate configurations of figures 10b and 10c.

With reference now to figures 21a to 22d in a further possible embodiment of the anchoring and support device 10, said movement means 30 can comprise a crankshaft 27, rotatably arranged in body 15 with respect to an axis of rotation x, as shown in figures 21a to 21d, where the rotation pins 25, 25' and the second rotation pins 65, 65' are advantageously formed directly on said crankshaft and define the crank pins of said crankshaft 27. In addition, the central pin 35 can be advantageously formed on said crankshaft 27 and define one or more main journals. The rotation of the crankshaft 27 leads the rotation pins 25, 25', which correspond to the crank pins of said crankshaft 27, to rotate with respect to the body 15. After a 180° rotation, rotation pins 25, 25' and the relative cams 20, 20' hinged to them, shifting from the minimum size limit configuration A of figure 21a and 22a, with the cams 20, 20' closed and gathered on the body 15, to the maximum size limit configuration B of figure 21d and 22d, with the cams 20, 20' completely open and extended, passing through some generic intermediate configurations showed for example in figures 21b, 22b and 21c, 22c.

With particular reference to figures 22a to 22d, the locking means 40 of the pin 25, 25' can comprise at least one locking pin 52, stabilized to the body 15 and suitable to engage with said crankshaft 27 in correspondence of a recess 32, so as to prevent the rotation of the same. Always with reference to the same figures, said locking means 40 can further comprise a selector 53 preferably disc-shaped, integral to said crankshaft 27, where on said selector 53 a plurality of recesses 32 are formed so that said crankshaft 27 can be

locked with pins 25, 25' in steady position, in the minimum size limit configuration A (figures 22a and 22b) or in the maximum size limit configuration of (figure 22c, 22d). By moving away the locking pin 52 in the direction of the arrow F in figures 22a and 22b, the crankshaft 27 can be rotate with the selector 53 in the direction of the arrow R in figure 22d, displacing the same in the position corresponding to the desired configuration. One advantage of this embodiment is that both pins 25, 25' can be moved and repositioned at the same time and in a steady manner using a single locking element 40.

A further advantage of this embodiment described above is to be suitable for locking the rotation pins 25, 25' in several intermediate positions in addition to the limit positions of configurations A and B by increasing the number of recesses 32 formed on selector 53.

The movement and rotation of the cams 20, 20' is always obtained also in this embodiment by means of traditional tie rods, for clarity not shown, generally displaced in correspondence of the connection means 17 of the anchoring and support device 10.

With reference now again to the embodiments of the figures from 1a to 5b, from 10a to 14b and from 17 to 20b, said locking means 40 of the rotation pin 25, 25' and of the stabilization means 50, can comprise a ratchet locking mechanism (also said jack mechanism) configured to allow, in operative conditions, the rotation in a single direction with respect to the central pin 35, so as to prevent the rotation movement of the rocker arms 31, 31' in the direction of rotation that leads to the closure of the same anchoring and support device 10 with consequent loss of contact between the walls of the rock surface.

With particular reference to figures 15a to 16c, in all embodiments comprising movement means 30 with rocker arms 31, 31', said ratchet locking means 40 of the anchoring and support device 10 for climbing, shown for clarity only on a rocker arm, comprising a plurality of recesses 110' and tilted teeth 110' arranged alternately in order to define at

least one radial circular development and toothed crown 115, 115' formed on the facing surfaces of the respective rocker arms 31, 31', said crown 115, 115' being centered in correspondence of the housing hole of the central pin 35.

The crown 115' formed on the rocker arm 31 is suitable to engage in rotation cooperation at least one conjugate crown 115' of the rocker arm 31.

The asymmetrical shape and orientation of the tilted teeth 110' of the crowns 115 and 115', engaged in surface contact with each other, allows the relative rotation between said rocker arm 31, 31' in a direction of rotation concordant with the orientation direction of tilted teeth 110' of the crown 115, 115' opposite to the considered direction, while it is prevented in the opposite direction wherein tilted teeth 110' engaging with the 110' recesses. The relative rotation of the rocker arms 31, 31' is also associated with an axial translation of one of the rocker arms 31, 31' with respect to the second rotation pin 50, in such a way as to allow the disengagement of said tilted teeth 110' with the conjugate recesses 110' and the subsequent engagement of the same with their subsequent counterparts in the direction of rotation of the ratchet mechanism.

With reference again to the embodiments of figures 17a to 18b, said locking means 40 comprising at least two ratchet o jack locking mechanisms, each comprising a plurality of recesses 110' and tilted teeth 110' arranged alternately according to two radially circular developed crowns 115, 115' formed on the facing surfaces of the respective rocker arms 31, 31', said crowns 115, 115' each being centered in correspondence of the housing hole of the second central pins 35'.

With reference to all embodiments comprising ratchet type locking means 40, said rocker arms 31, 31' are advantageously held with the surfaces of the respective crowns 115, 115' engaged and in contact by means of at least one contrast elastic element, such as for example a spiral spring coaxially arranged on said central pin 35 or on said second central

pins 35' between the external surface of the rocker arm 31, 31'. In order to be able to rotate with respect to each other at least one of the rocker arms 31, 31' has to axially move to disengage the crowns 115, 115' in order to allow the tilted teeth 110' to snapping in the next engagement position.

With reference again to the forms of realization of figures 19a to 20b, said locking means 40 can also comprise a rod 82 radially arranged through said second central pins 35'. Said rod 82 can be advantageously threaded in such a way that in response to a rotation of the same rod imposed from the user resulting a variation of the angle between the rocker arms 31, 31' keeping them steady in the reached position.

In a variant form, said rod 82 can also comprise a diametrically smooth surface so that said pins and said rocker arms 31, 31' can be free to move by varying the angle between them. Rod 82 is also advantageously equipped with calipers or locking brakes, not shown, so as to block the relative sliding of the same rod 82 with said rocker arms 31, 31' so as to remain attached to it and keep the angle between them steady.

From the description of embodiments of the anchoring and support device 10 above described, the operation described below can be seen.

As generally happens in the operating of all embodiments of the anchoring and support device 10 for climbing described above, also in this case, manoeuvring on a handle 56 connected to tie rods 55 the resisting force of the elastic elements of the movement means 30 of the rotation pins 25, 25' is overcoming, bringing cams 20, 20' and stabilization means 50 into the closed position and the anchoring and support device 10 into the minimum size configuration A, as shown for example in figure 2a, i.e. in the configuration of insertion it into a crack or fissure in the rock.

The elastic elements of the cams 20, 20', coaxially arranged on the first rotation pins 25, 25, and possibly the second cams 60, 60' have a lower elastic stiffness than the possible

elastic elements 90 of the rocker arms 31, 31' of the torsion spring type, coaxially arranged on the central pin 35, so that the same rocker arms 31, 31' cannot be leaded in rotation until the cams 20, 20' have reached the closed position.

Once the limit closing position of the cams 20, 20' of figure 1b has been reached, continuing to apply a tensile force on the handle 56 the resisting force of the elastic elements of the rocker arms 31, 31' is overcoming, leading in rotation the same ones with respect to each other in such a way as to vary the angle α identified between the same rocker arms (figure 4a) and allow the adjustment of the anchoring and support device 10 to the greater dimensions of cracks or fissures of the rock.

By continuing to apply force to the handle 56, a plurality of steady intermediate positions can be reached in sequence by operating and releasing the locking means 40 in succession, thus allowing the anchoring and support device 10 to be progressively adjusted to a plurality of intermediate positions (figure 2b) so that it can be easily adapted with one hand to different sizes of cracks or fissures on the rock surface.

When using the anchoring and support device of this invention on cracks or fissures in the rock surface of shallower depths, the anchoring and support device can be inserted only at the first cams 20, 20', leaving the stabilization means 50 out of the cracks or fissure. In this case, the anchor device is suitable to operate as a traditional climbing device according to the known art. To return the device to the starting position, the user must manually unlock the locking means 40 and return them to the starting position.

In the main embodiment, with the locking means 40 preferably defining a ratchet or jack mechanism locking, during the rotation of the rocker arms 31, 31' the tilted teeth 110' and the recesses 110 radially arranged on the respective crowns 115, 115' disengage themselves allowing the external rocker arm 31' to simultaneously move axially overcoming the reaction of a contrast elastic element , until progressively engaging the next tilted teeth

110' with the conjugate recesses 110 of the respective crown 115, 115', so as to bring the anchoring and support device 10, for example, from a minimum size limit position of configuration A of figure 15a to a maximum size limit position of configuration B of figure 15c.

In the passage between the two limit configurations A and B the device can advantageously be arranged in a plurality of positions corresponding to intermediate and progressively increasing configurations, corresponding to each single position between the recesses 110 and the tilted teeth 110' of the conjugate crowns 115 115' thus allowing, also in this particular embodiment, a progressive adaptation of the anchoring and support device 10 in a plurality of intermediate positions so that it can be easily adapted with one hand to different sizes of cracks or fissures of the rock surface. Once the appropriate adjustment has been reached, the cams 20, 20' opening brings them into contact with the rock support by making the final accurate adjustment.

With particular reference to Figures 4a, 4b, 12 and Figures 6a to 7c, the stabilization means 50 of the anchoring and support device, unloading on the wall 100', 100', at the S point, the transverse component of the tensile force T with respect to the longitudinal development of the crack or fissure 100 of the rock, thus preventing a rotational moment M from occurring on the anchoring and support device 10 which would tend to destabilize it and cause it to lose grip on the rock surface.

As can be seen from the foregoing, the operation and the advantages that the anchoring and support climbing device 10 object of the present invention achieves are evident.

The anchoring and support device 10 for climbing object of the present invention is particularly advantageous because it makes possible to provide the user with a device with greater safety, able to function by the stabilization means 50 even when the tensile force of the applied load is not substantially perpendicular to the vertical or to the development

of the crack or fissure of the rock.

The anchoring and support device 10 for climbing object of the present invention is also particularly advantageous because, thanks to its stability, it allows the user to adapt to larger intervals of crack or fissure size in the rock, allowing the user to carry a smaller number of devices in a climb and therefore a reduced weight, also allowing him to reuse the same anchoring and support device 10 several times.

The anchoring and support device 10 for climbing of the present invention is also particularly advantageous because it allows gradual and accurate adjustment, for example, by means of the ratchet or jack locking means 40, which allow it to adapt precisely and optimally to the different width dimensions of cracks or fissures in the rock.

A further advantage of the anchoring and support device 10 object of the present invention is that the use of movement means 30 able to cover the size ranges of larger cracks or fissures in the rock also makes it possible to use a smaller working angle β and such as to guarantee the discharge on the rock face of a greater transverse component of the tensile force with a consequent and advantageous increase in the friction force and stability of the device itself.

A further advantage of the anchoring and support device 10 object of the present invention is due to the use of movement means 30 of pins and stabilization means 50, gives the device adaptation and stability at wide measuring ranges of the size of cracks or fissures 100, the β working angle of the first cams 20, 20' and the second cams 60, 60' determined in the design phase, can be advantageously chosen lower than a traditional cam thus increasing the normal component at the rock surface and advantageously increasing the friction force of the cam on the rock.

Although the invention has been described above with particular reference to a series of preferred embodiments, given as an example and not limited purpose, many further

modifications and variations will appear obvious to the skilled person in the light of the above description. The present invention, therefore, intends to embrace all modifications and variants that fall within the protective scope of the following claims.

CLAIMS

1. An anchoring and support device (10) for climbing, suitable for being connected to a safety rope, comprising:
   - at least two opposite first cams (20, 20'), rotatably hinged to a rotation pin (25, 25') and suitable for operating by exchanging forces along a first line (11) crossing the points wherein said cams (20, 20') contact the opposite walls (100', 100") of a crack or fissure (100) in a rock;
   - movement means (30) of said rotation pins (25, 25') suitable for increasing the extension distance of the cams (20, 20') between a minimum size limit position and a maximum size limit position of the cams (20, 20');
   - locking means (40) for the movement means (30), suitable for locking said rotation pins (25, 25') in a fixed position;

   characterized in that it comprises one or more stabilizing means (50) provided with movement means (30) and locking means (40), said stabilizing means (50) being suitable for operating according to an exchange of forces along a second line (12) crossing at least one further contact point (S) with the walls (100', 100"), in order to stabilize and prevent said anchoring and supporting device (10) from rotating inside said crack or fissure (100).

2. The anchoring and support device (10) according to claim 1, wherein said movement means (30) and said locking means (40) are both suitable for moving and locking said rotation pins (25, 25') and for moving and locking said stabilizing means (50).

3. The anchoring and support device (10) according to claim 2, wherein said stabilizing means (50) comprise at least one abutment element (70) suitable for unloading a force on at least one wall (100', 100") of a crack or fissure (100) in the rock.

4. The anchoring and support device (10) according to claim 2, wherein said stabilizing means (50) comprise at least one second cam (60, 60').

5. The anchoring and support device (10) according to claim 3, wherein said cams (60, 60') of said stabilizing means (50) are rotatably hinged to rocker arms (31, 31') by a second rotation pin (65, 65').

6. The anchoring and support device (10) according to claim 5, wherein said locking means (40) are suitable for locking in a fixed position said second rotation pins (65, 65') of the second cams (60, 60').

7. The anchoring and support device (10) according to claim 3, wherein said at least one abutment element (70) comprises a strut or a shaped appendage formed on extensions of said rocker arms (31, 31').

8. The anchoring and support device (10) according to claim 6, comprising a plurality of rocker arms (31, 31') hinged to a central pin (35) and having lengths different from each other, each rocker arm (31, 31') being provided, at an end distal from the central pin (35), with a first cam (20, 20') hinged to a respective rotation pin (25, 25') or a second cam (60, 60') hinged to a respective second rotation pin (65, 65').

9. The anchoring and support device (10) according to claim 8, wherein said plurality of rocker arms (31, 31') are hinged to a central body at several central pins (35).

10. The anchoring and support device (10) according to claim 1, comprising first tension rods (55) and a handle (56) suitable for actuating said movement means (30).

11. The anchoring and support device (10) according to claim 8, wherein said central pin (35) is hollow and suitable for thoroughly housing a safety elastic cord or rope (95).

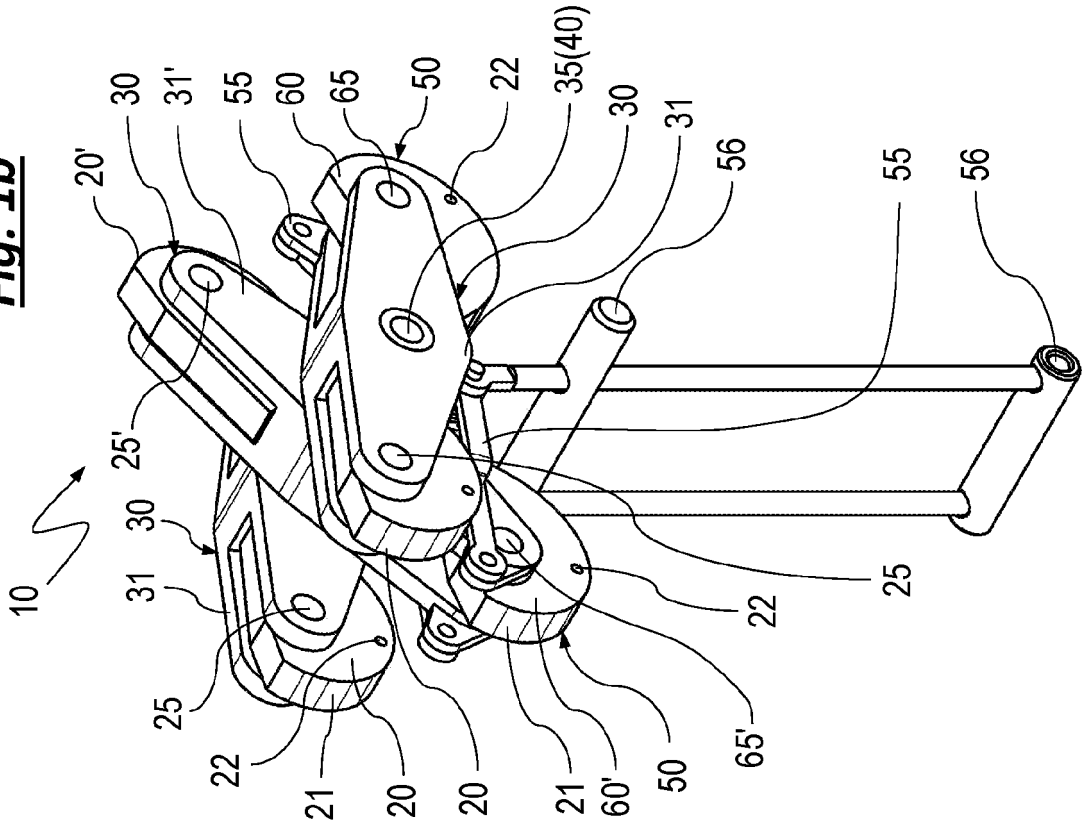
12. The anchoring and support device (10) according to claim 1, wherein said

movement means (30) comprise one or more slotted elongated openings (36), formed in a body (15) of the anchoring and supporting device (10), the rotation pin (25, 25') of the first cams (20, 20') and the second rotation pin (65, 65') of the one or more second cams being slidingly rotatably disposed inside said openings.

13. The anchoring and support device (10) according to claim 1, wherein said movement means (30) comprise a crank shaft (27) rotatably disposed in a body (15) and wherein said rotation pins (25, 25') and said second rotation pins (65, 65') are directly formed on said shaft and define the crankpins of said crank shaft (27).

14. The anchoring and support device (10) according to claim 2, wherein said locking means (40) comprise a locking ratchet or jack mechanism suitable for enabling, under operative conditions, the rotation only in one direction with respect to the central pin (35), in order to pre-vent the rocker arms (31, 31') to rotatably move.

Fig. 1b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60
65
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30
31
56
55
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25'
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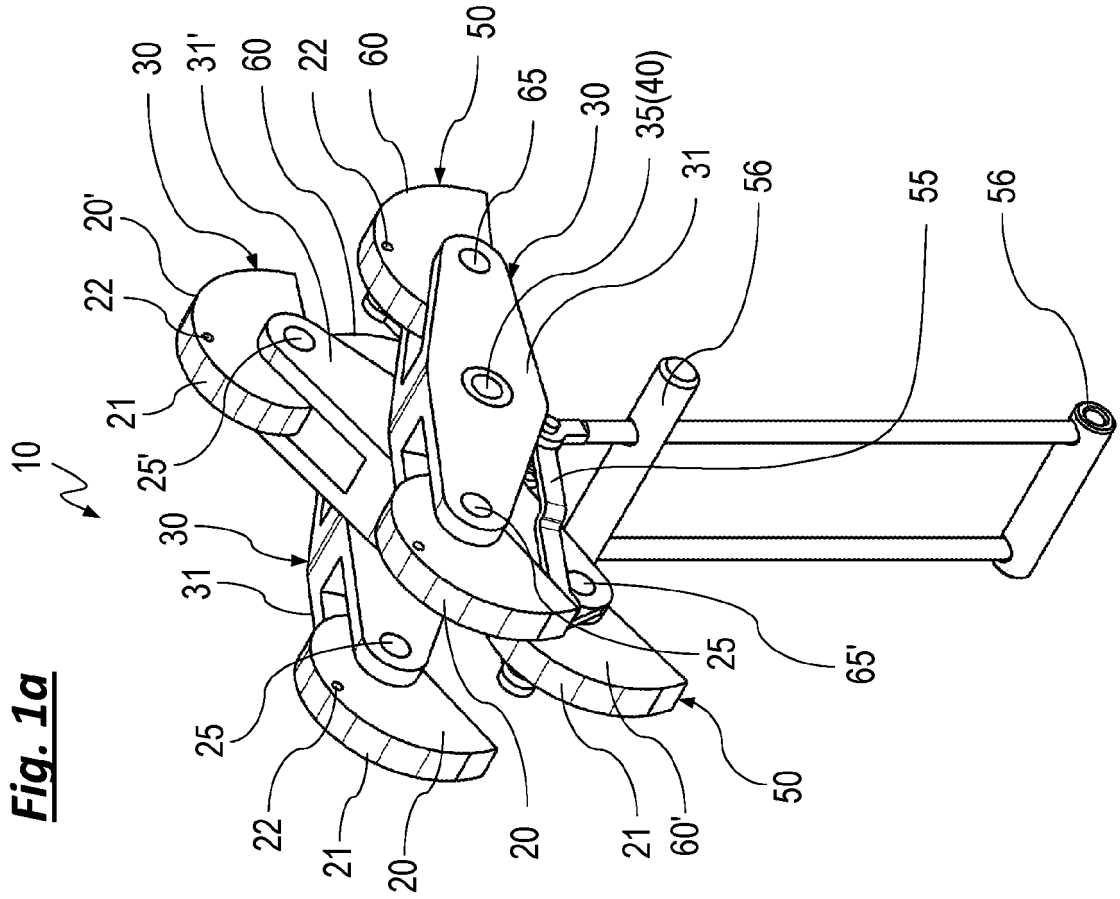
25
22
65'
50
60'
21
20
20
21
22
25

Fig. 1a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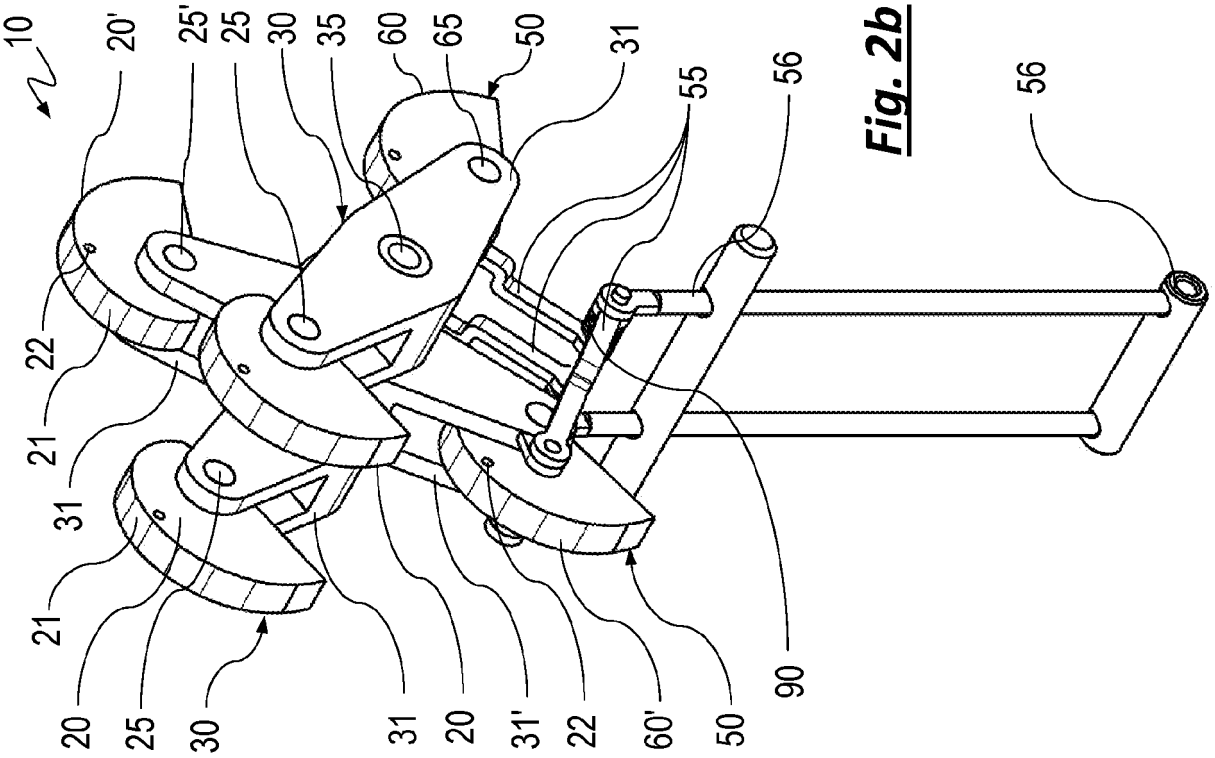
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60'
50
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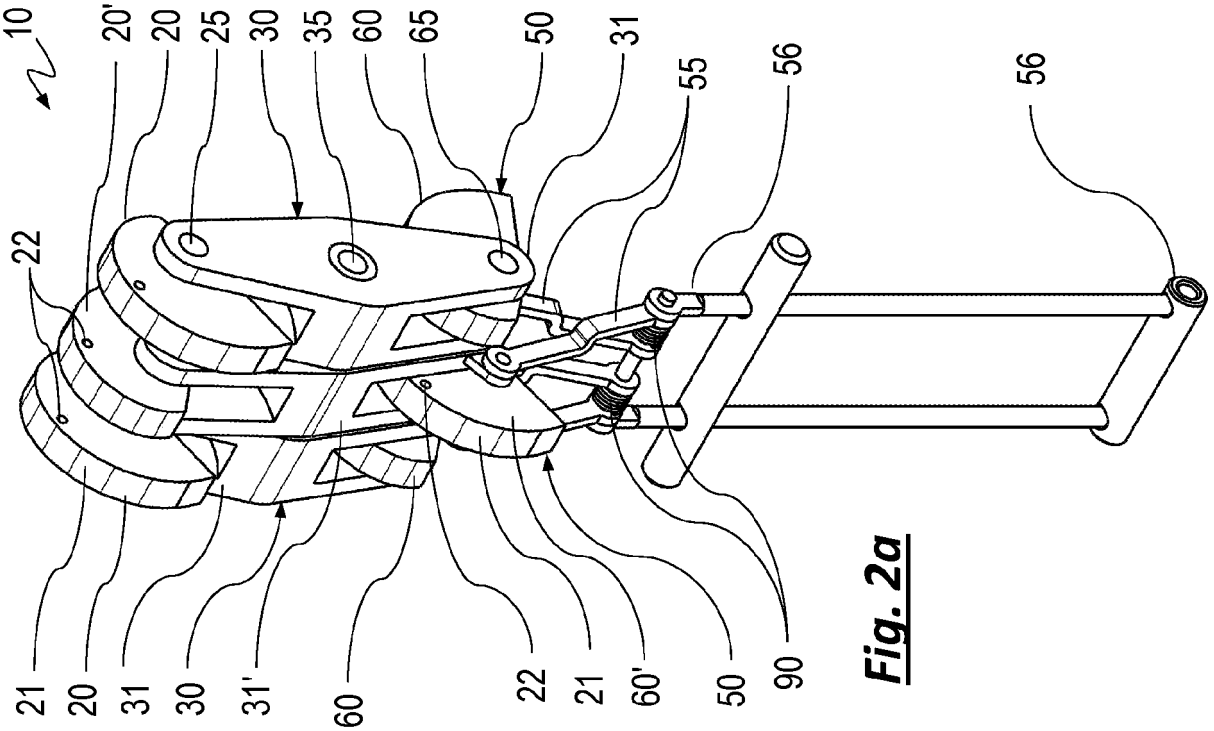
Fig. 2b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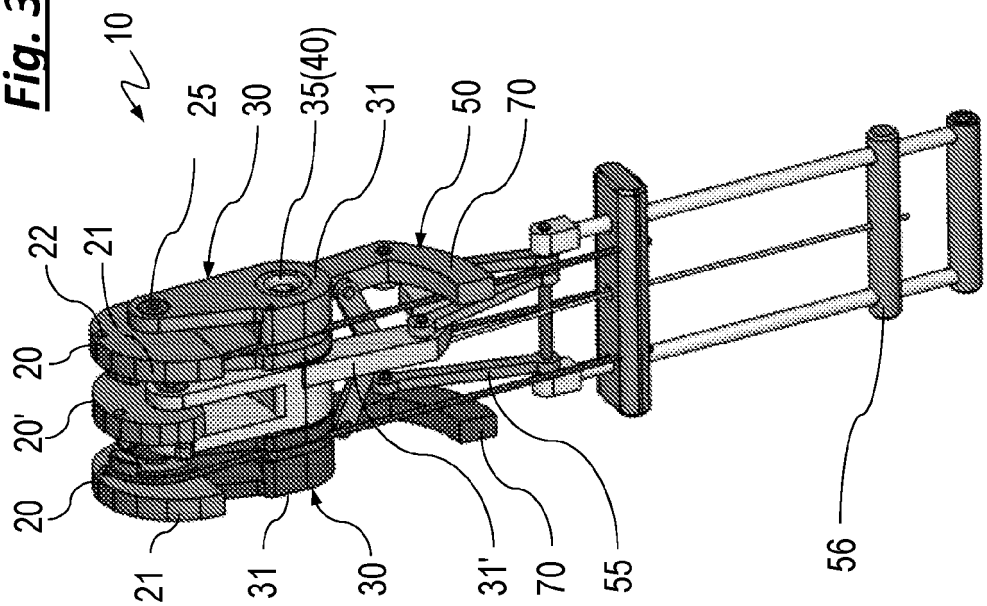
60
22
21
60'
50
90

Fig. 2a

Fig. 3b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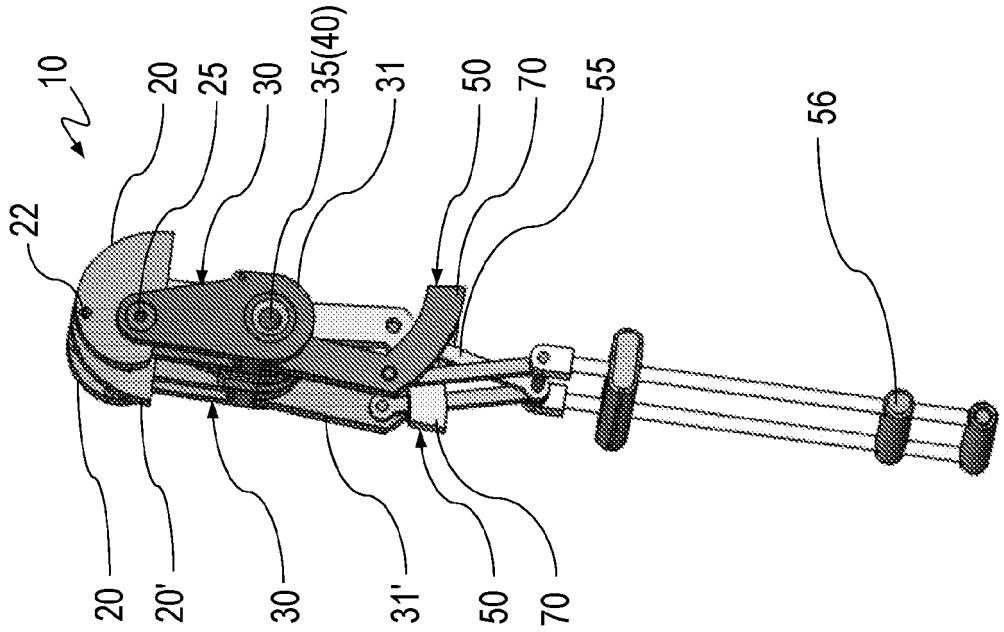
25
30
35(40)
31
50
70
22
21
20
20'
20
21
31
30
31'
70
55
56

Fig. 3a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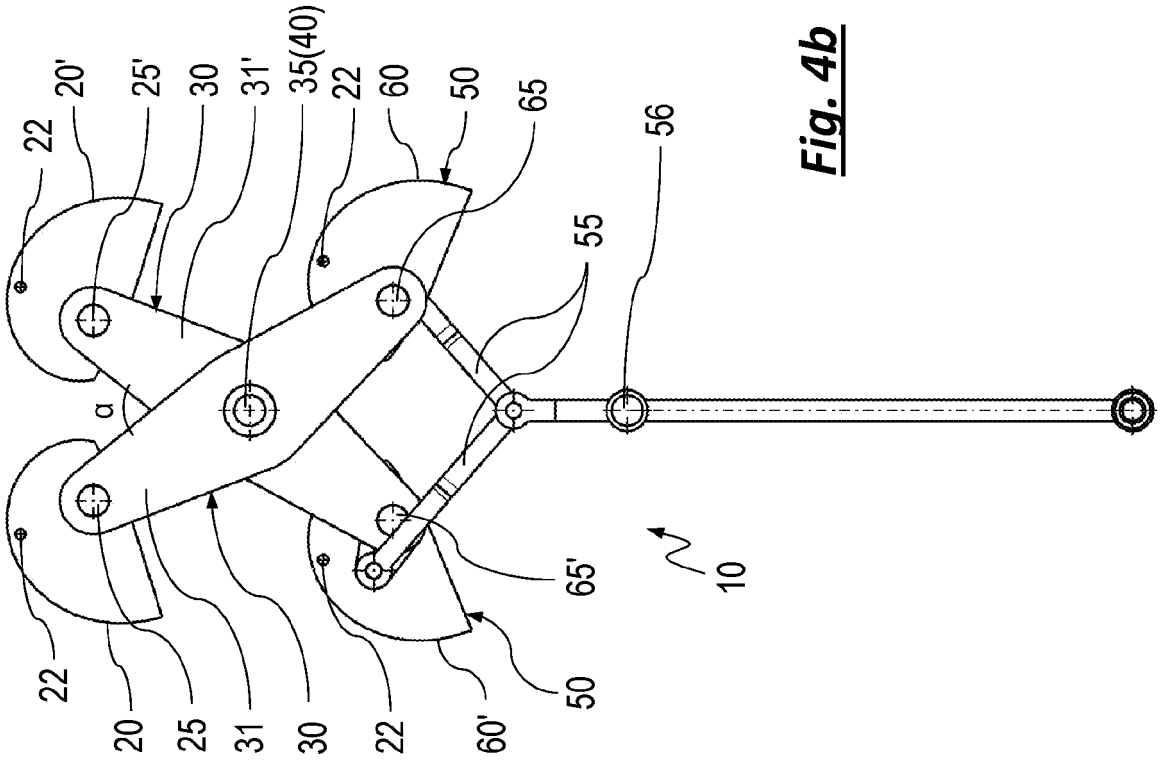
70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20'
25'
30
31'
35(40)
22
60
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65
56
55
α
65'
10
22
20
25
31
30
22
60'
50

Fig. 4b

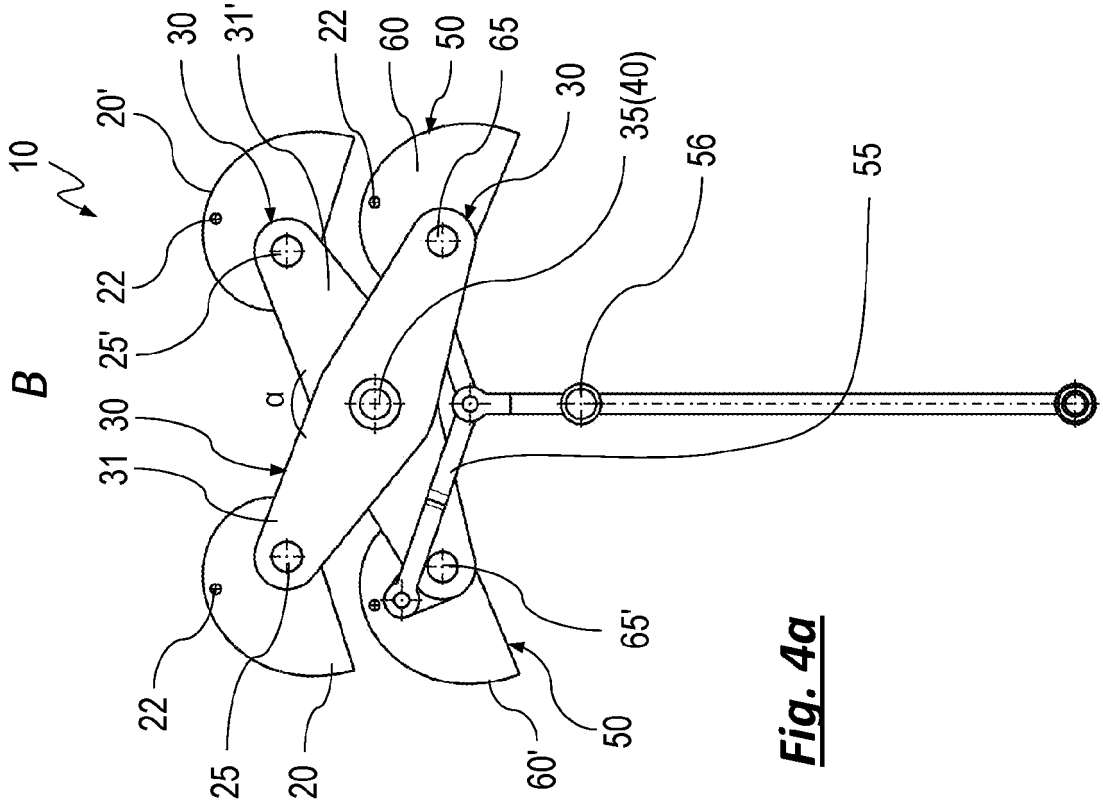

B
10
20'
22
25'
30
31
30
31'
22
60
50
65
30
35(40)
56
55
α
65'
22
25
20
60'
50

Fig. 4a

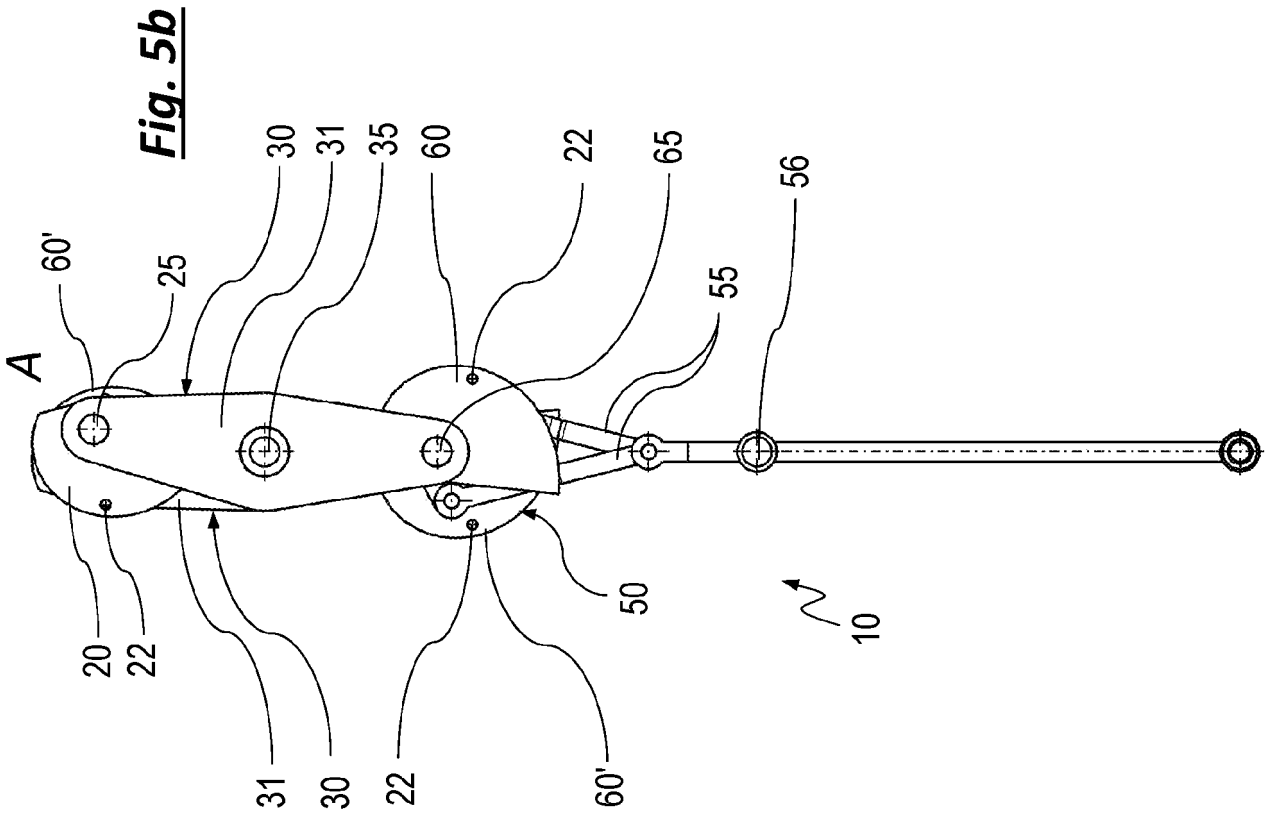

A
60'
25
30
31
35
60
22
65
56
55
20
22
31
30
22
60'
50
10

Fig. 5b

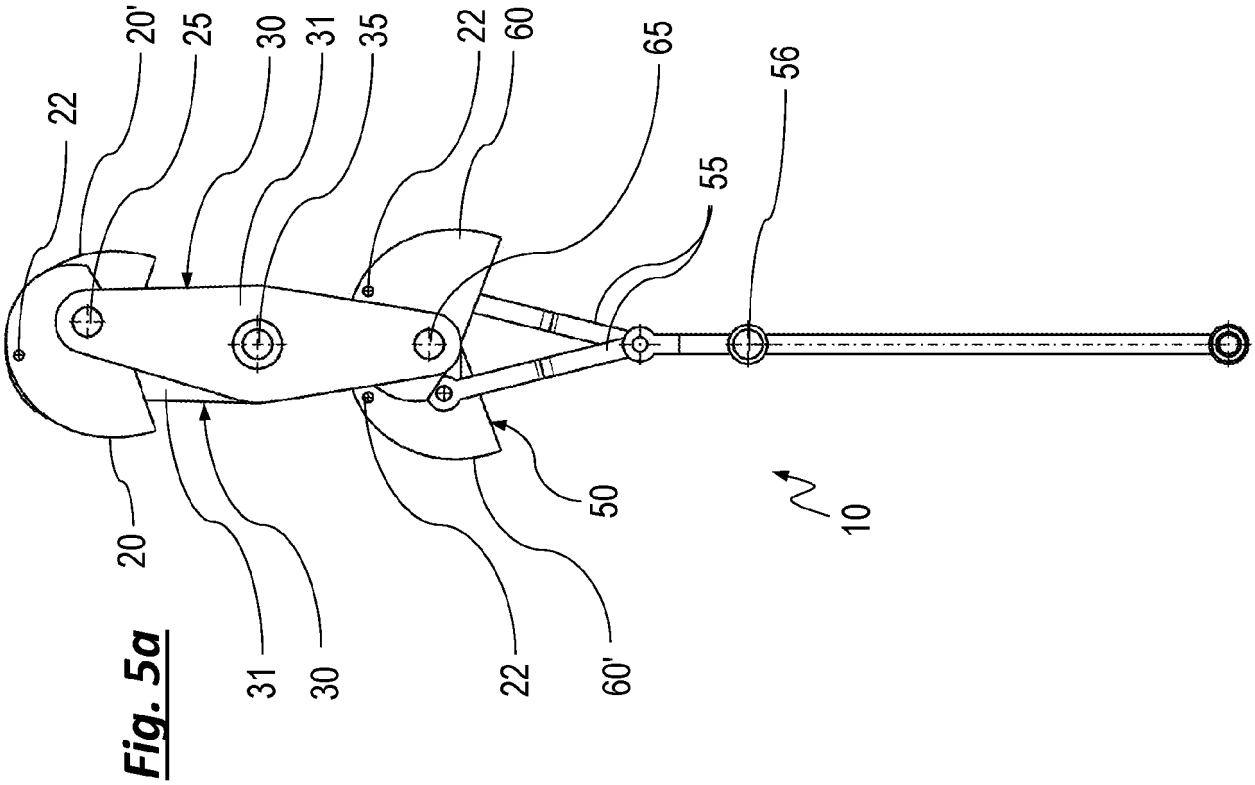

22
20'
25
30
31
35
22
60
65
56
55
20
31
30
22
60'
50
10

Fig. 5a

Fig. 6a

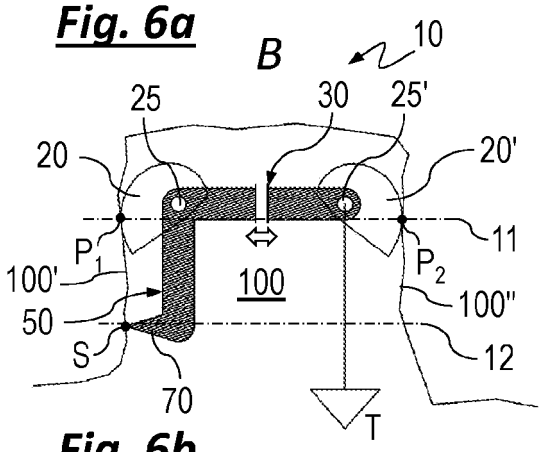


Fig. 6b

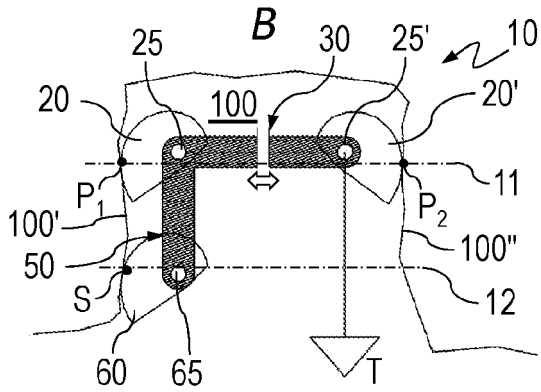


Fig. 6c

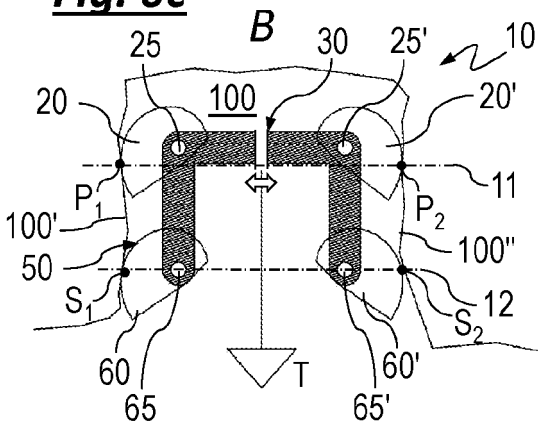


Fig. 7a

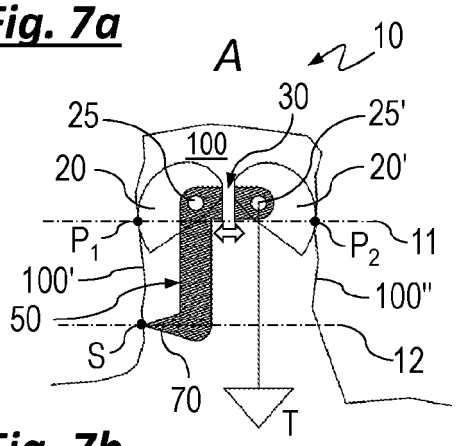


Fig. 7b

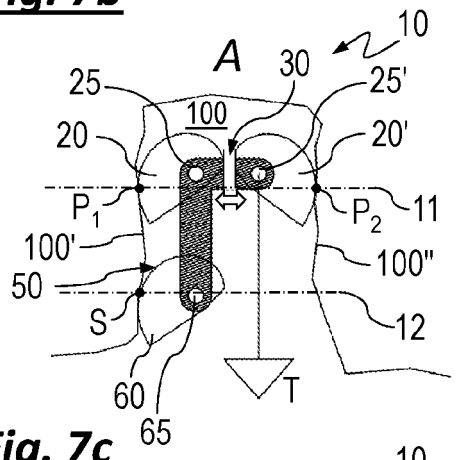
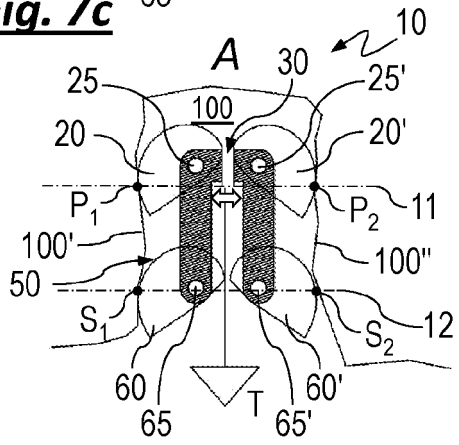


Fig. 7c



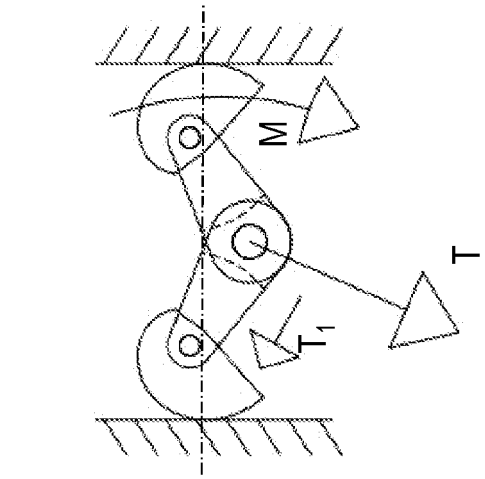


Fig. 8c

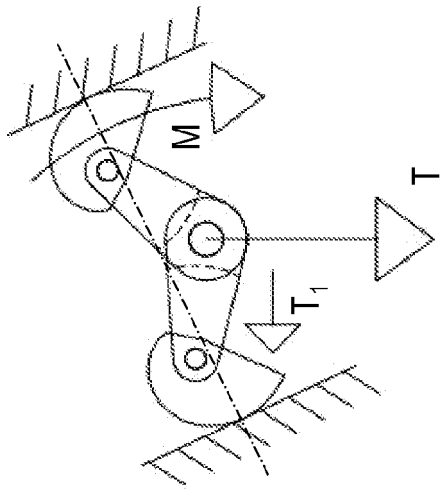


Fig. 8b

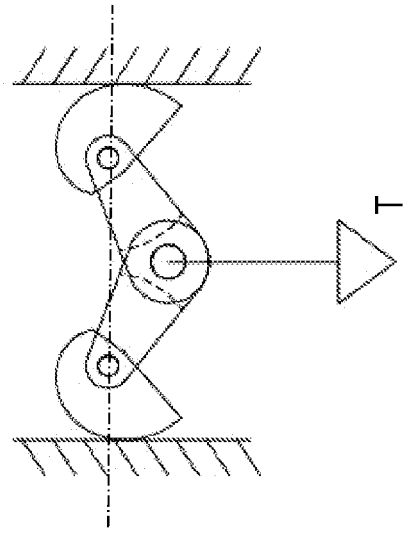


Fig. 8a

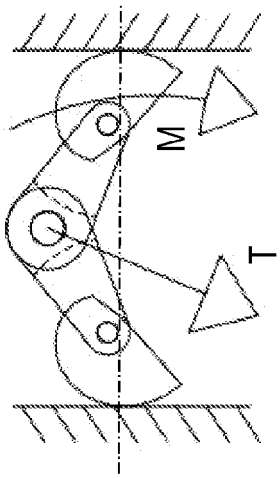


Fig. 9c

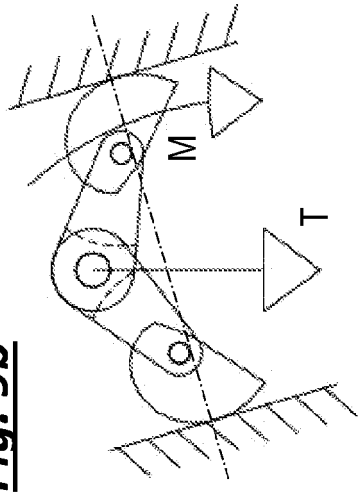


Fig. 9b

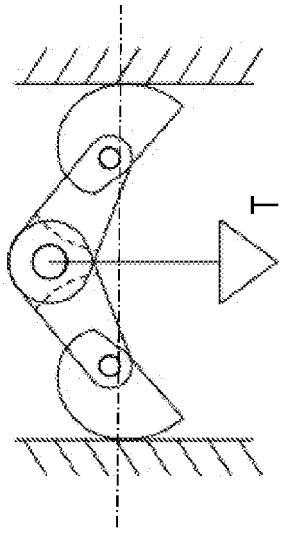


Fig. 9a

Fig. 10c

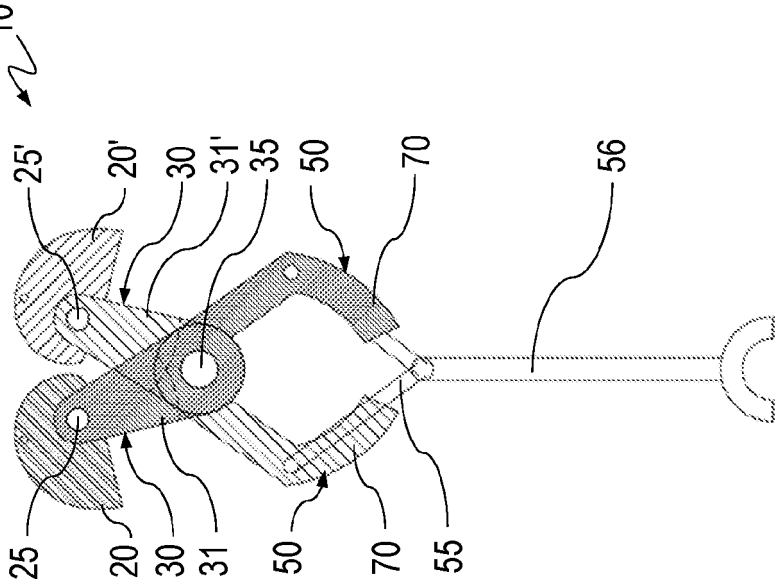


Fig. 10b

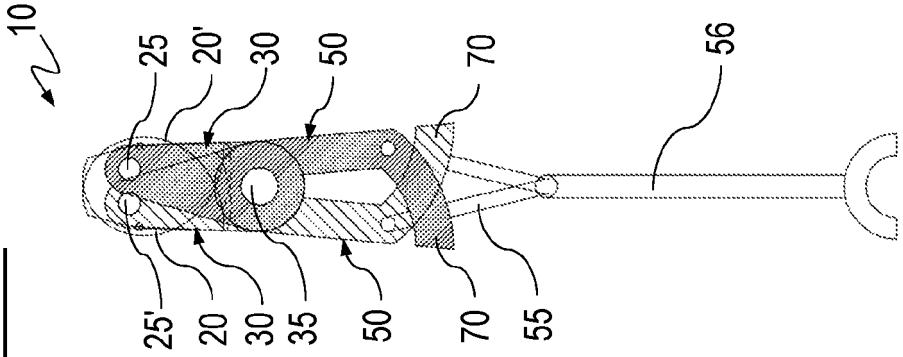


Fig. 10a

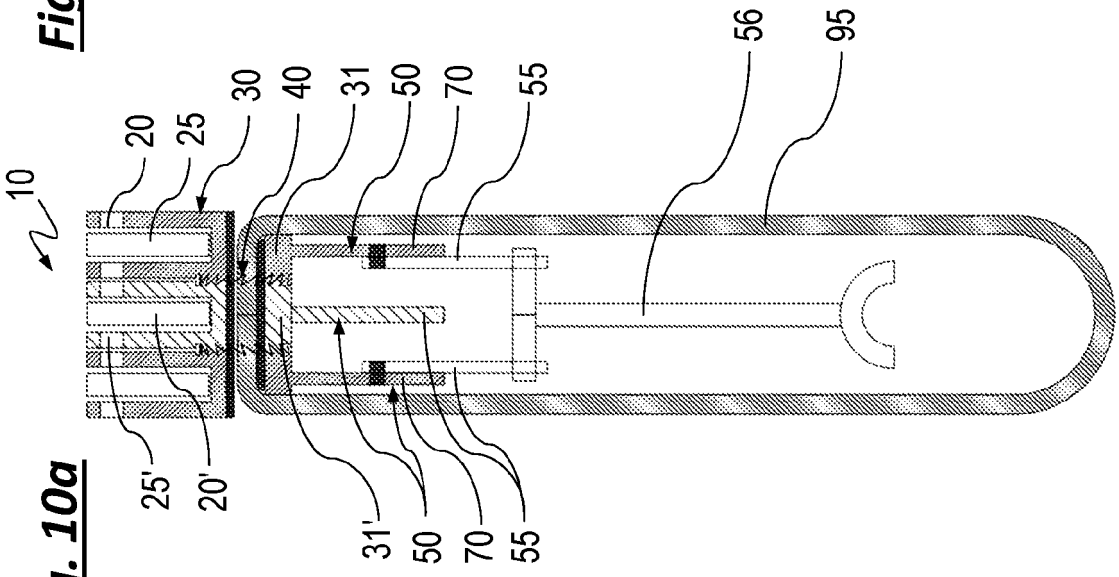


Fig. 11b

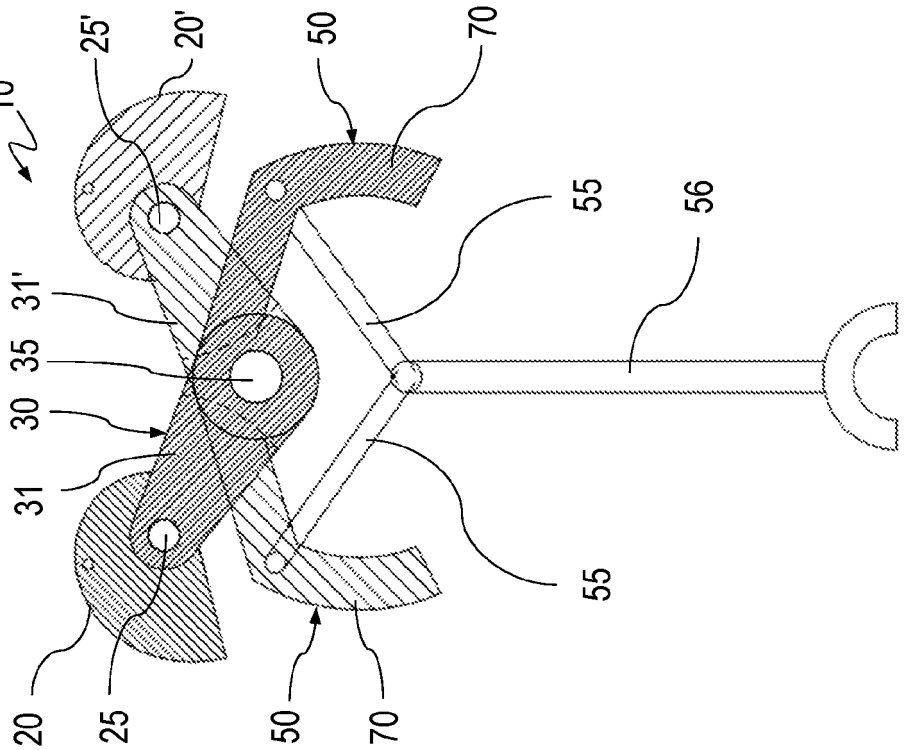
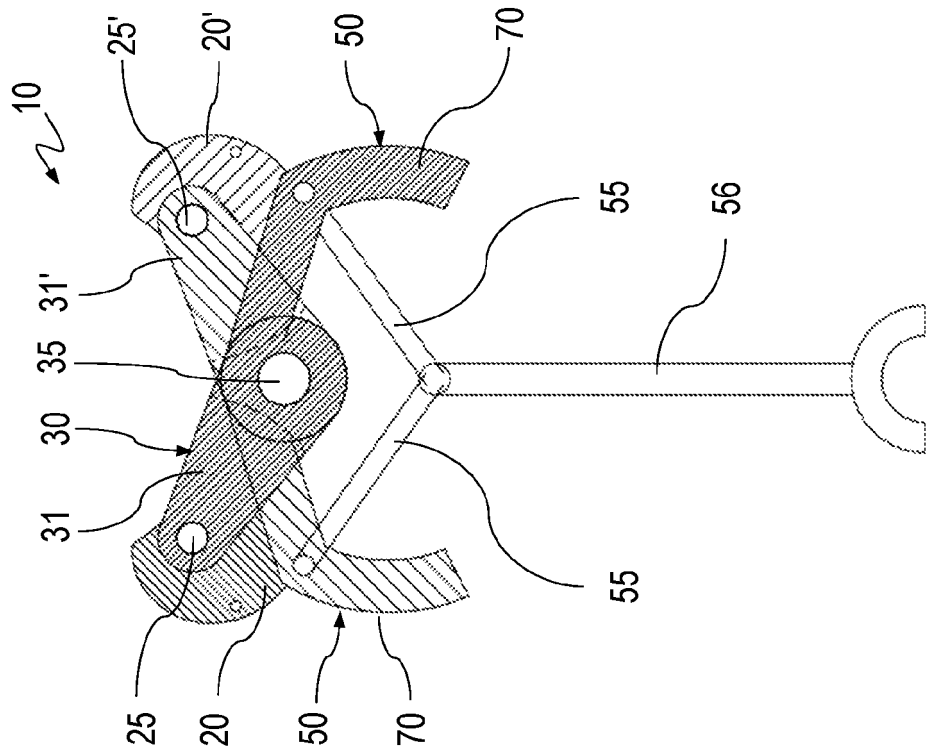


Fig. 11a



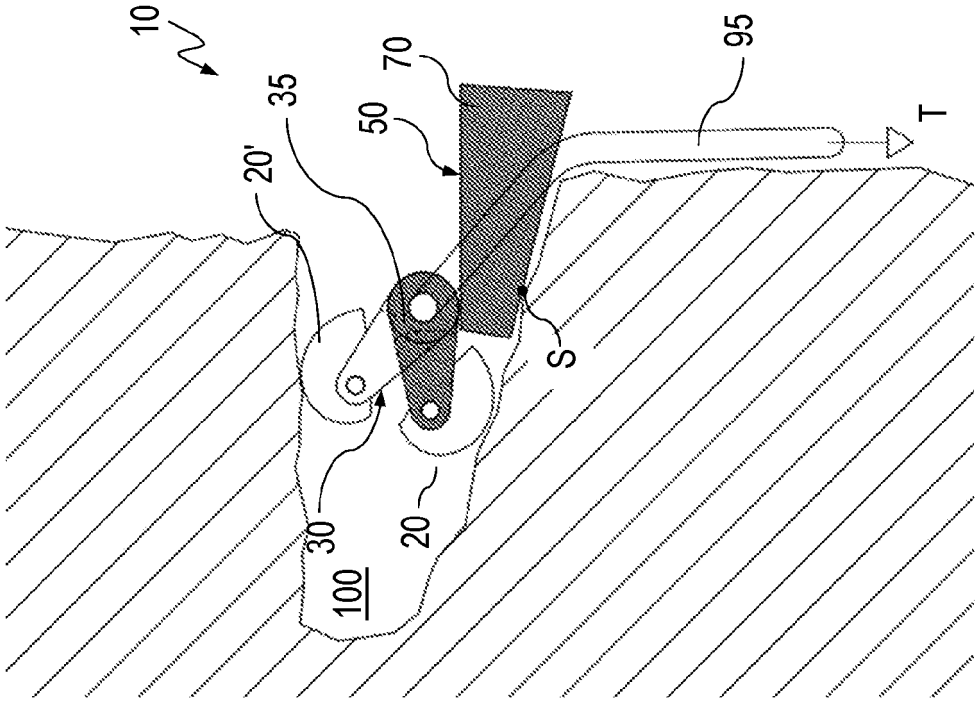


Fig. 12b

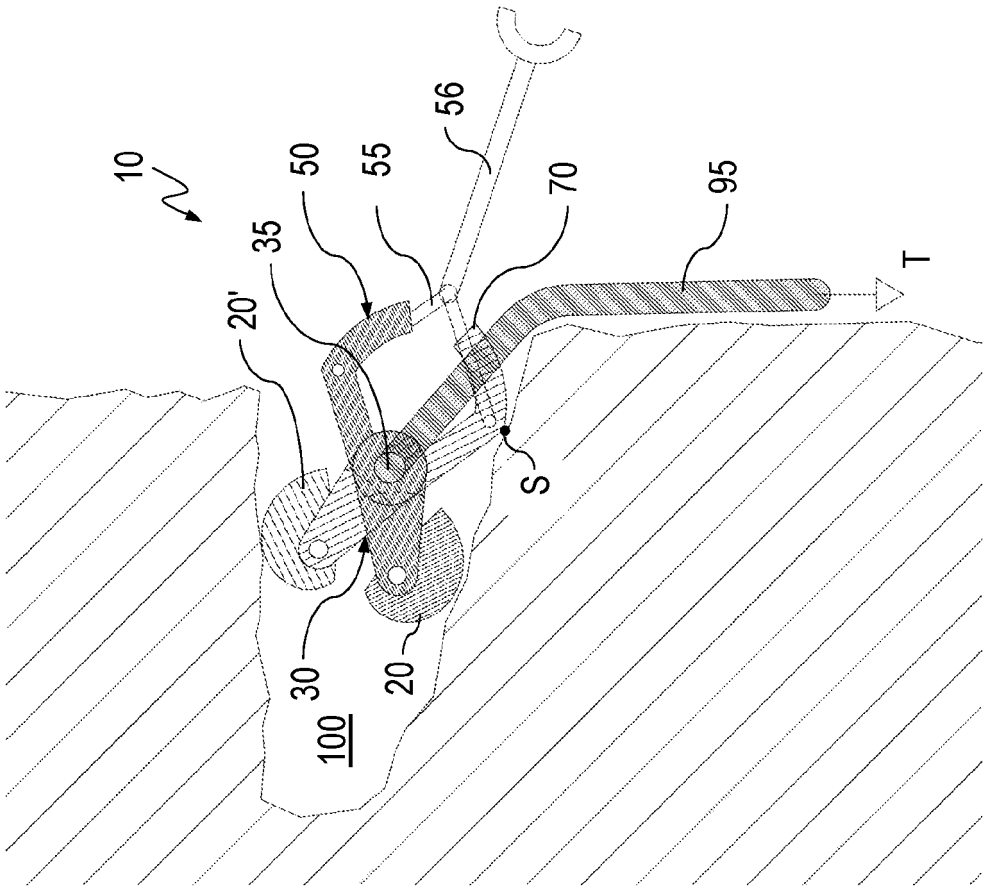


Fig. 12a

Fig. 13c

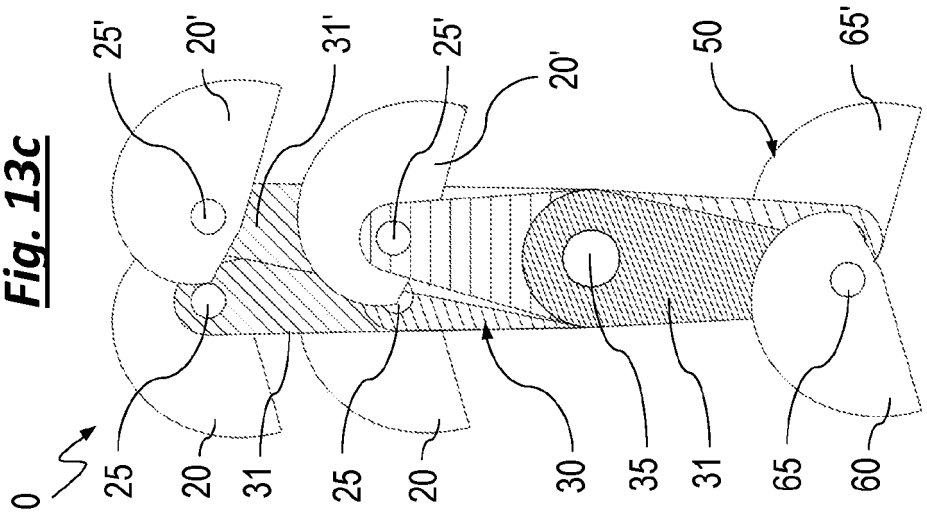


Fig. 13b

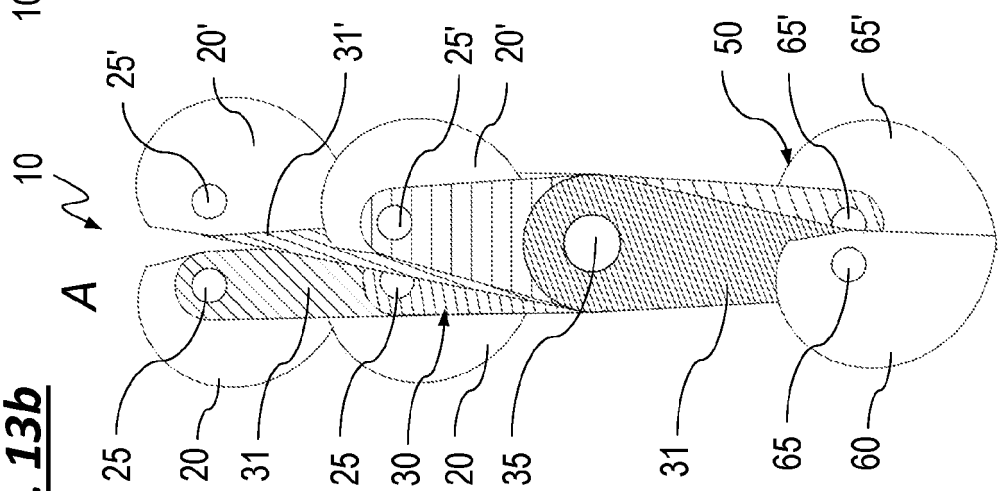


Fig. 13a

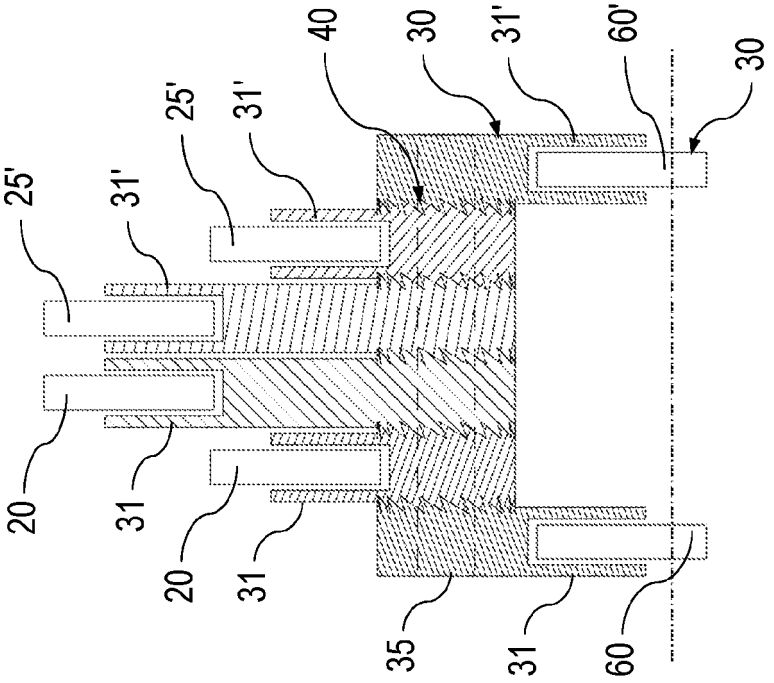


Fig. 14b

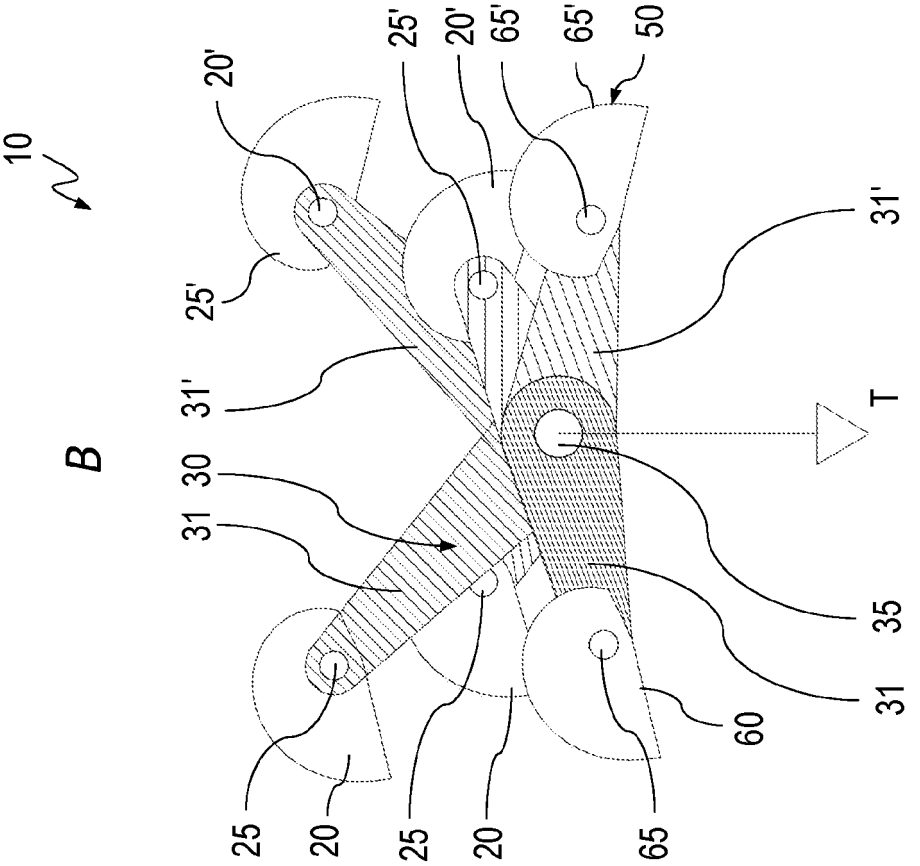


Fig. 14a

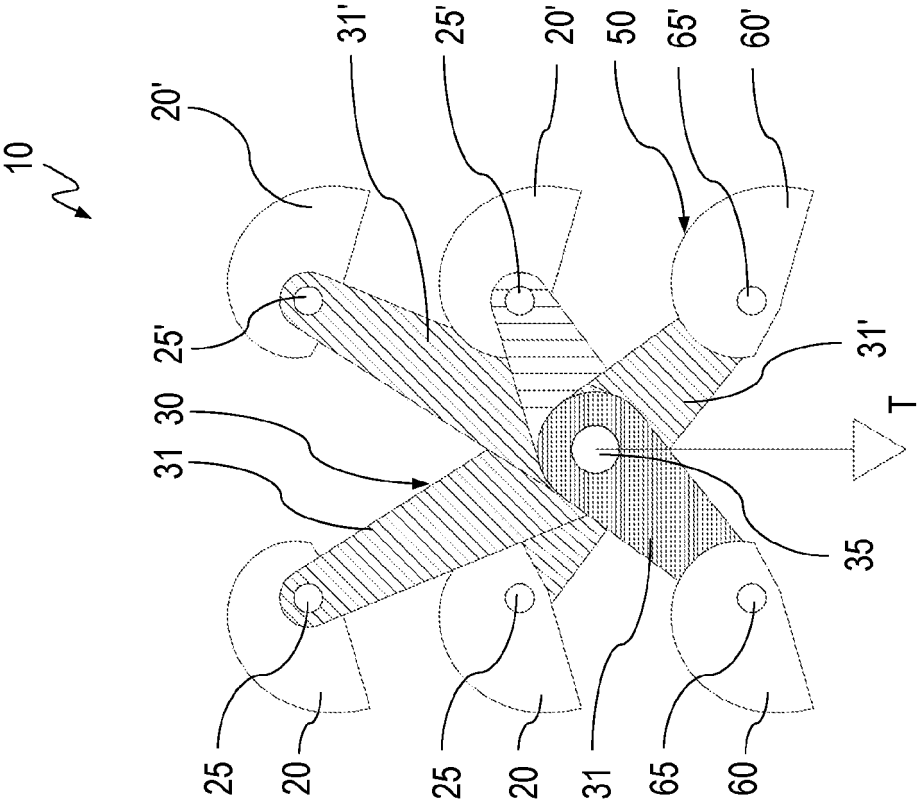


Fig. 15a

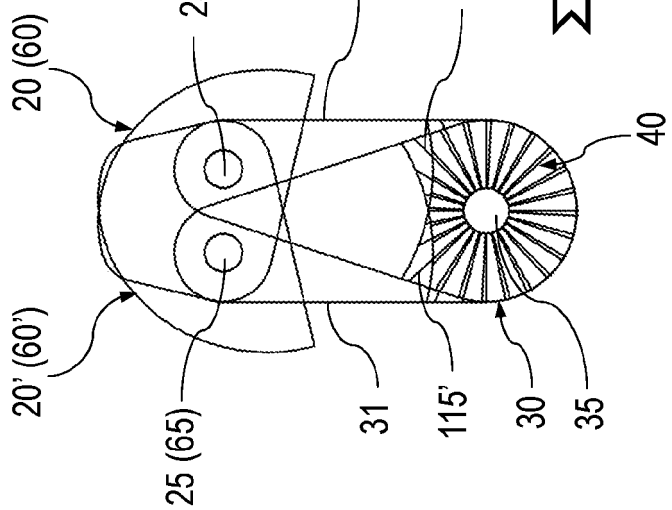


Fig. 15b

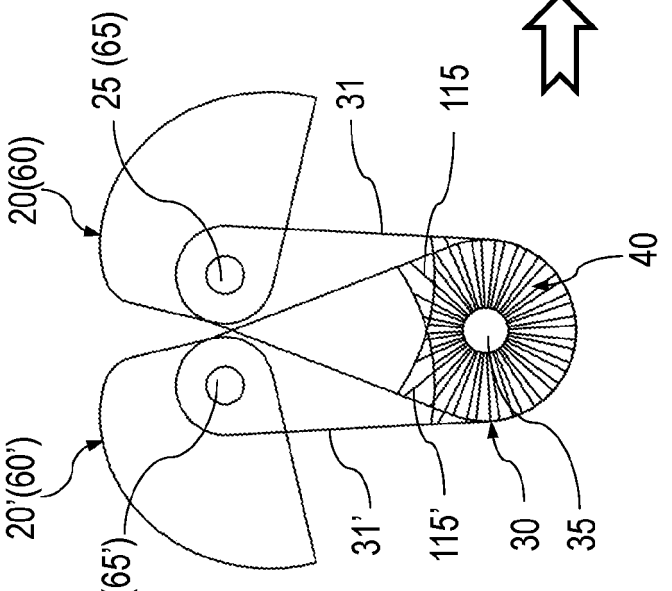


Fig. 15c

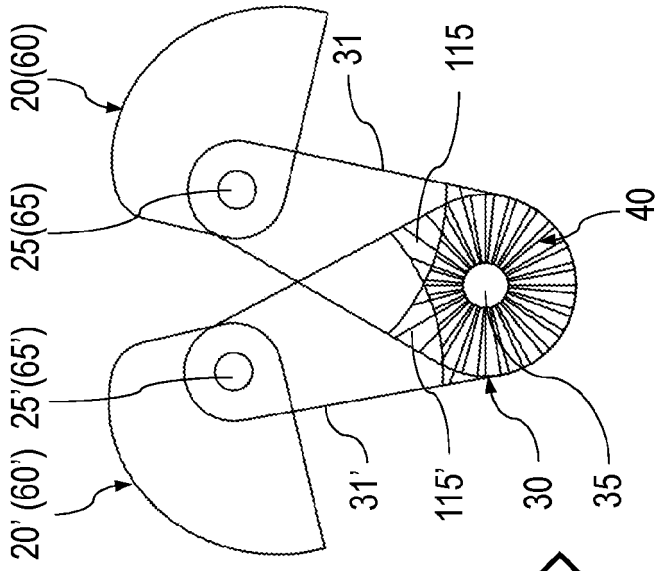


Fig. 16c

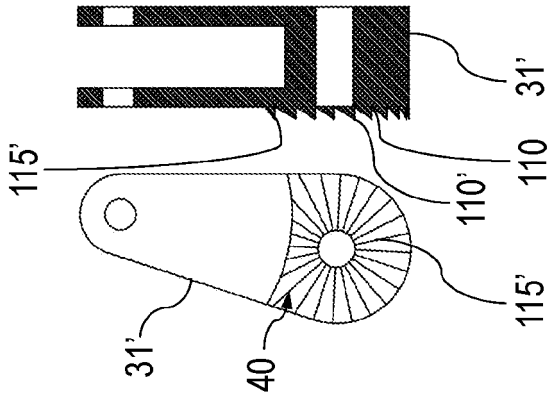


Fig. 16b

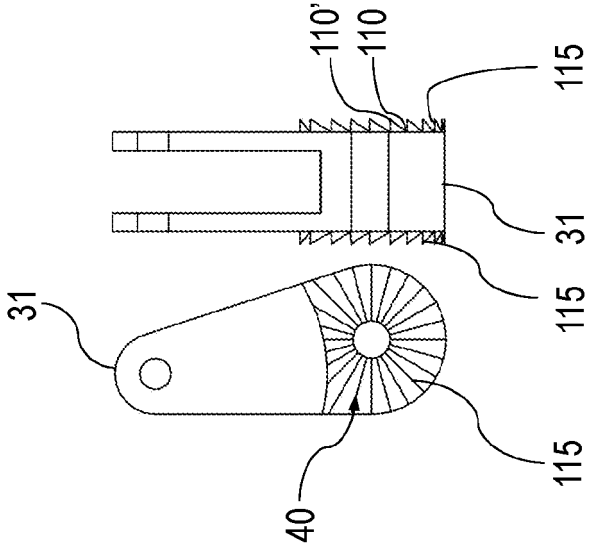


Fig. 16a

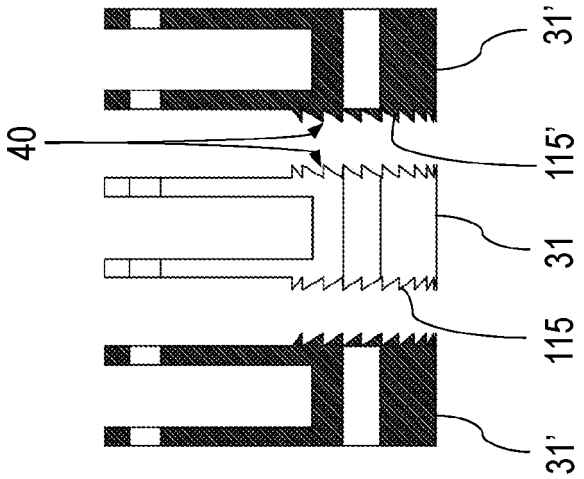


Fig. 17c

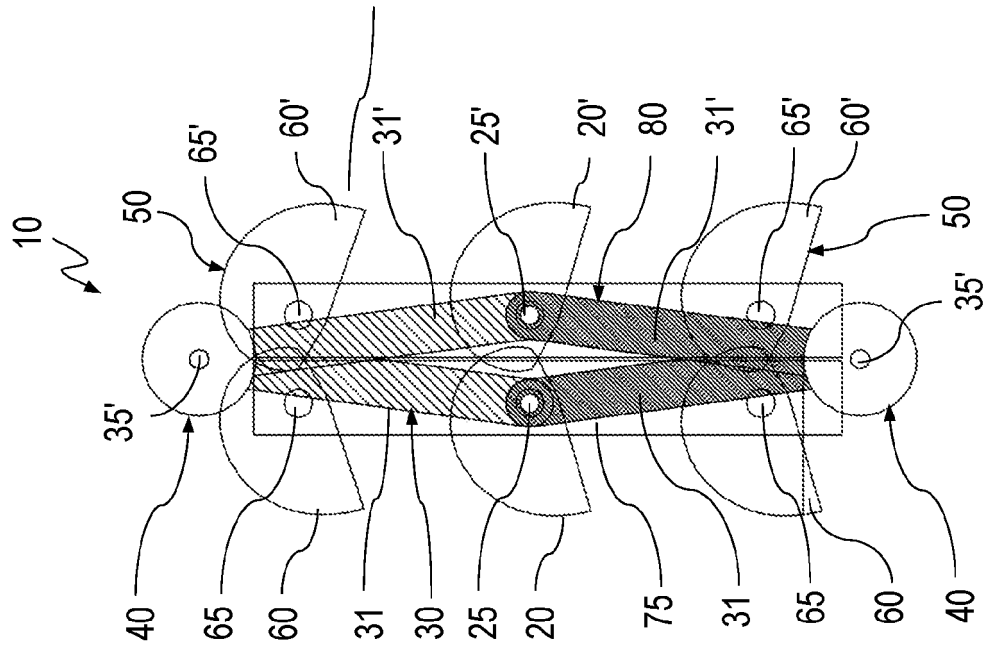


Fig. 17b

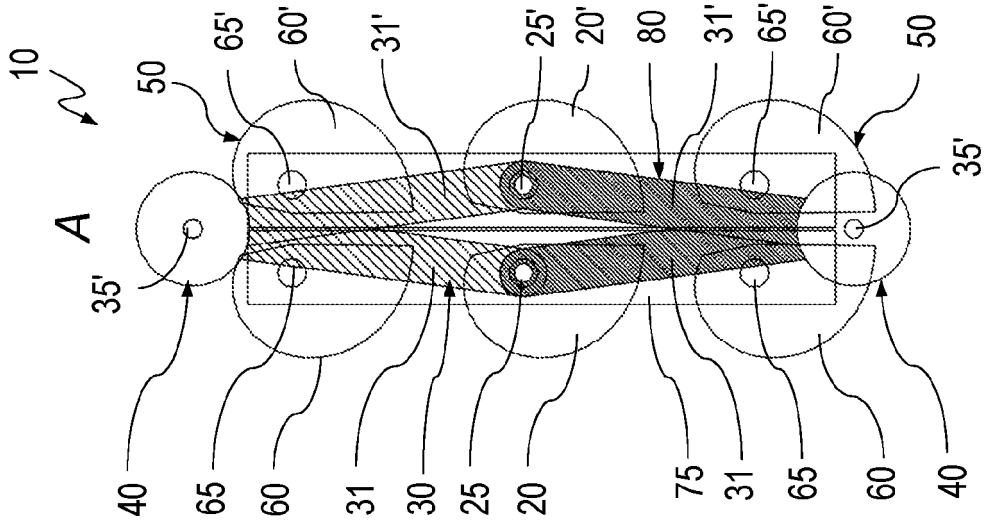


Fig. 17a

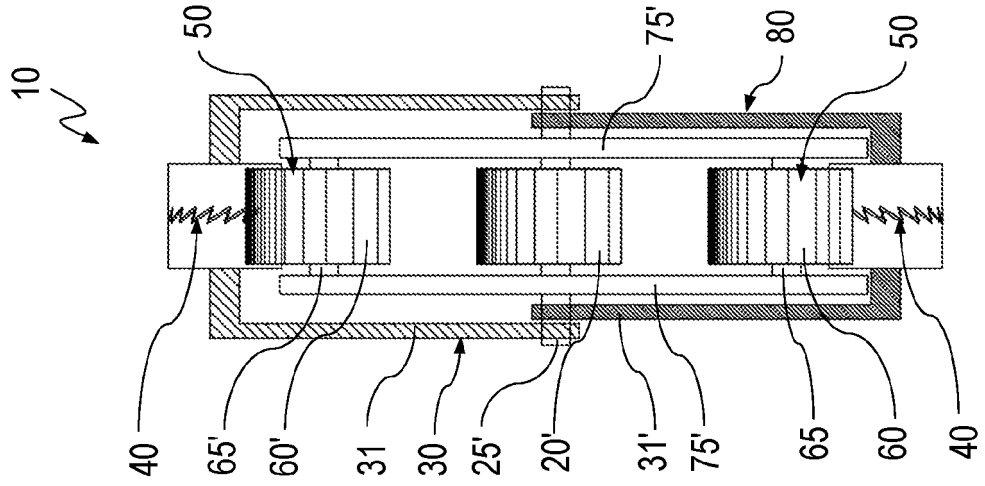


Fig. 18b

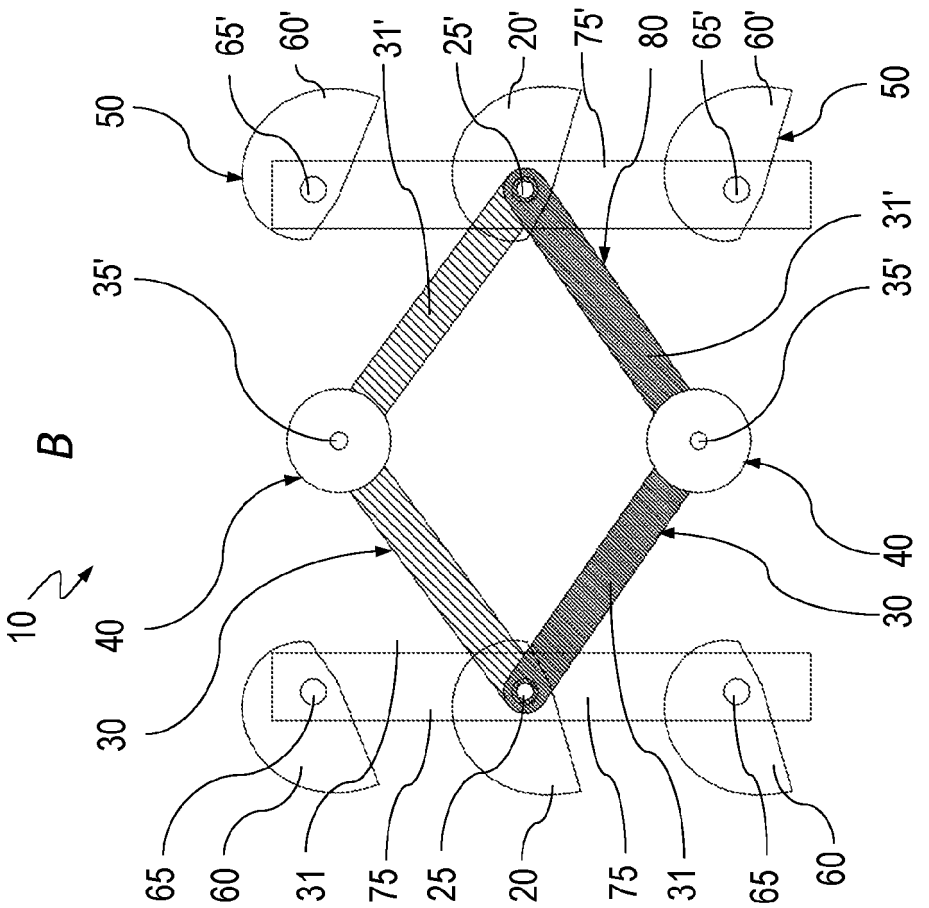


Fig. 18a

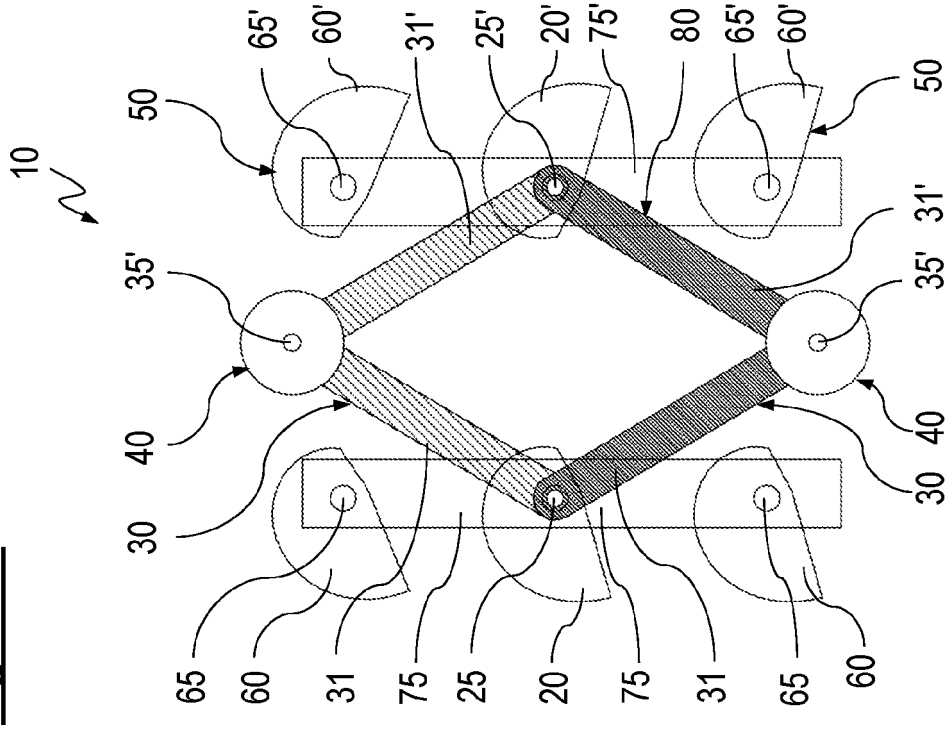


Fig. 19c

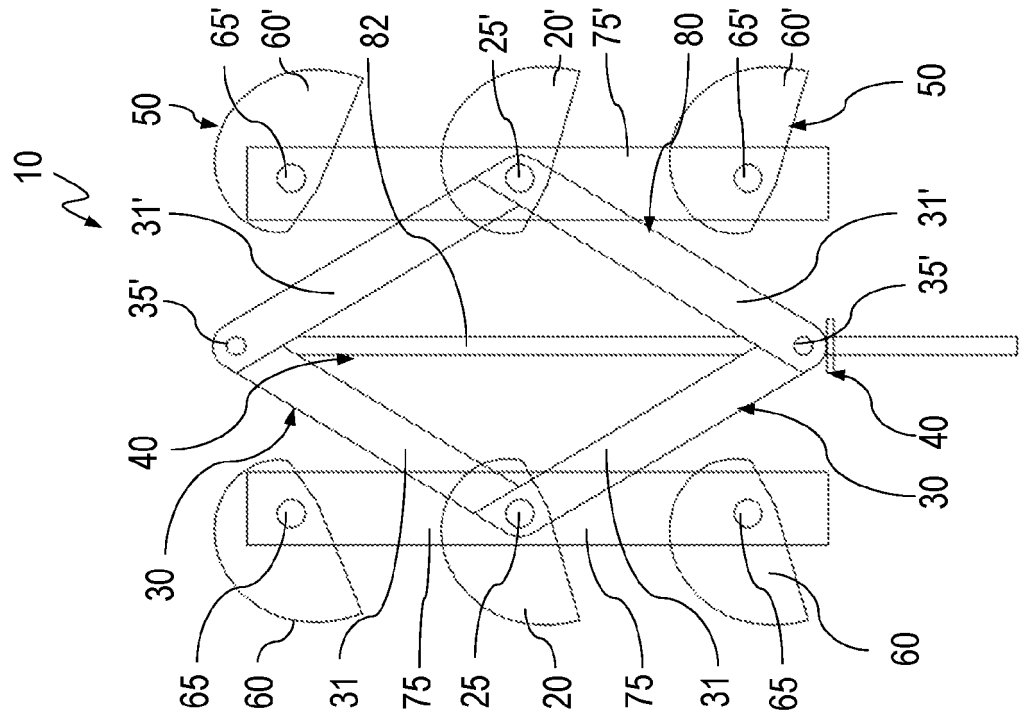


Fig. 19b

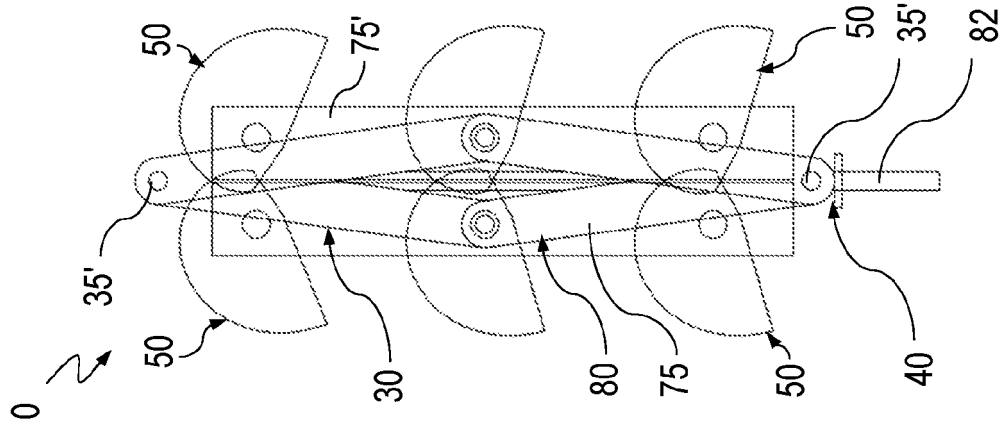


Fig. 19a

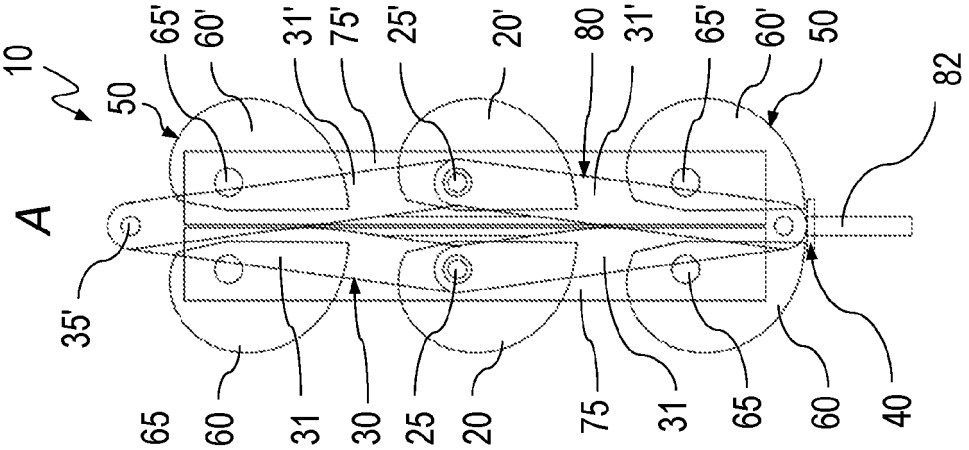


Fig. 20b

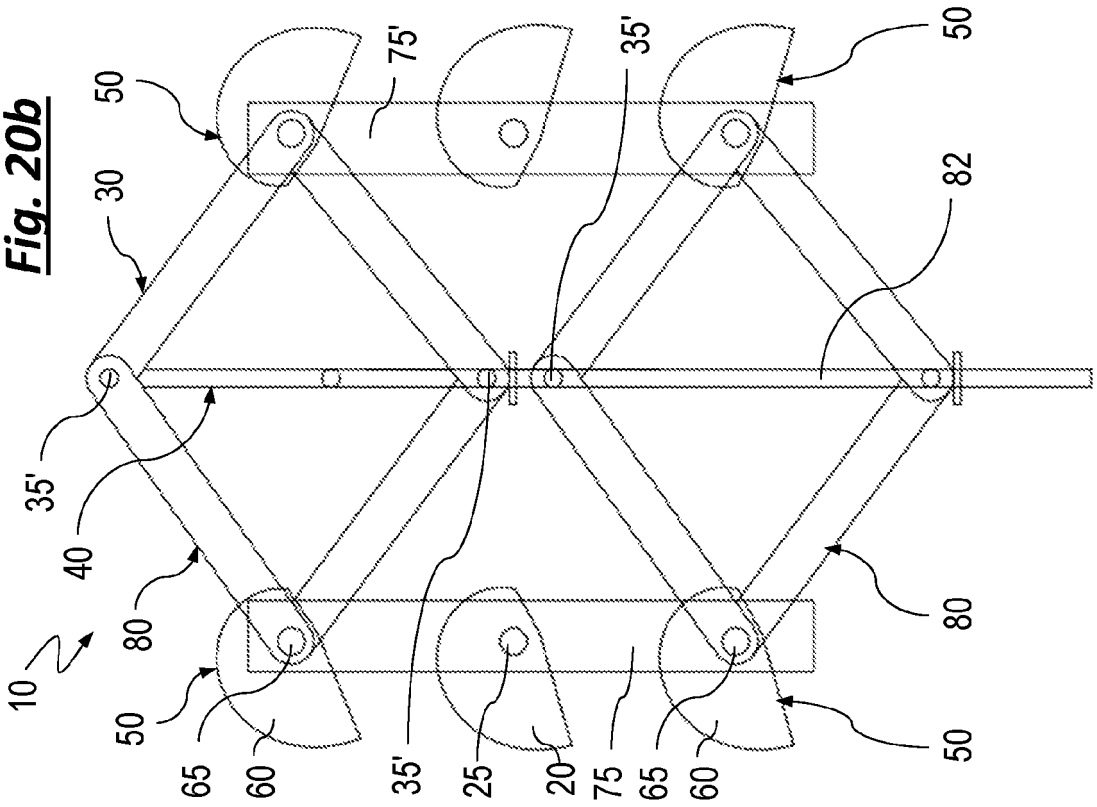
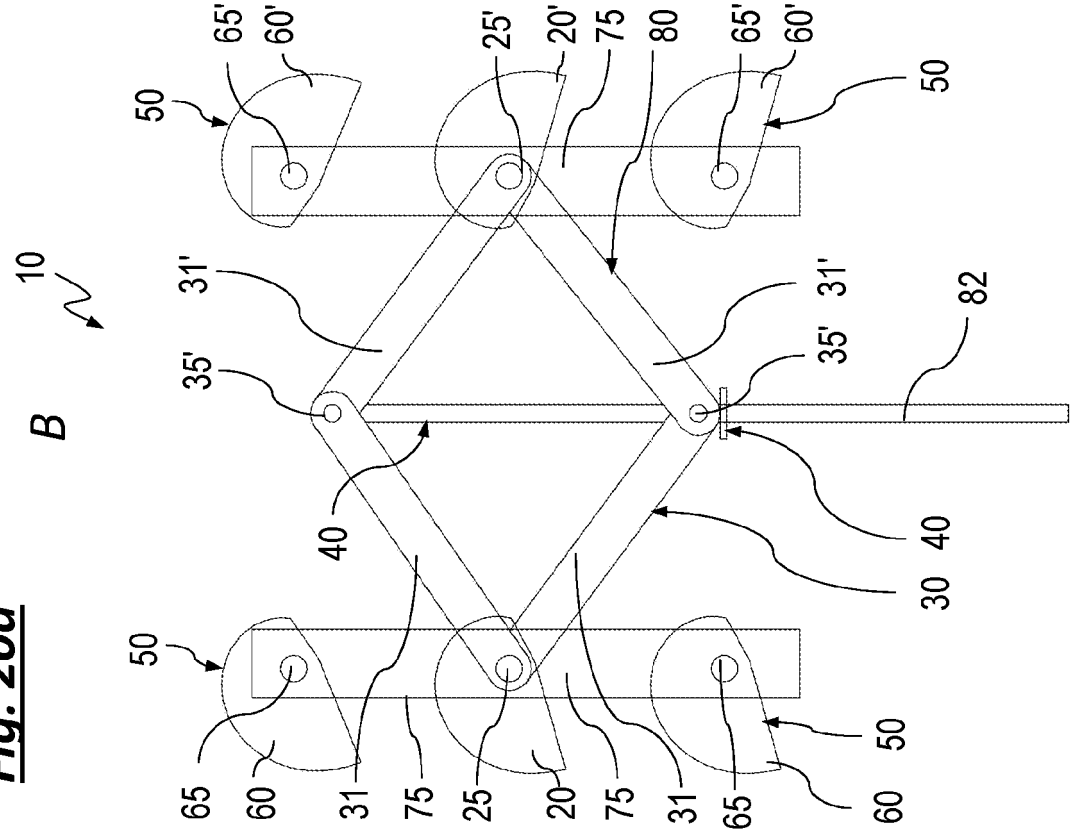


Fig. 20a



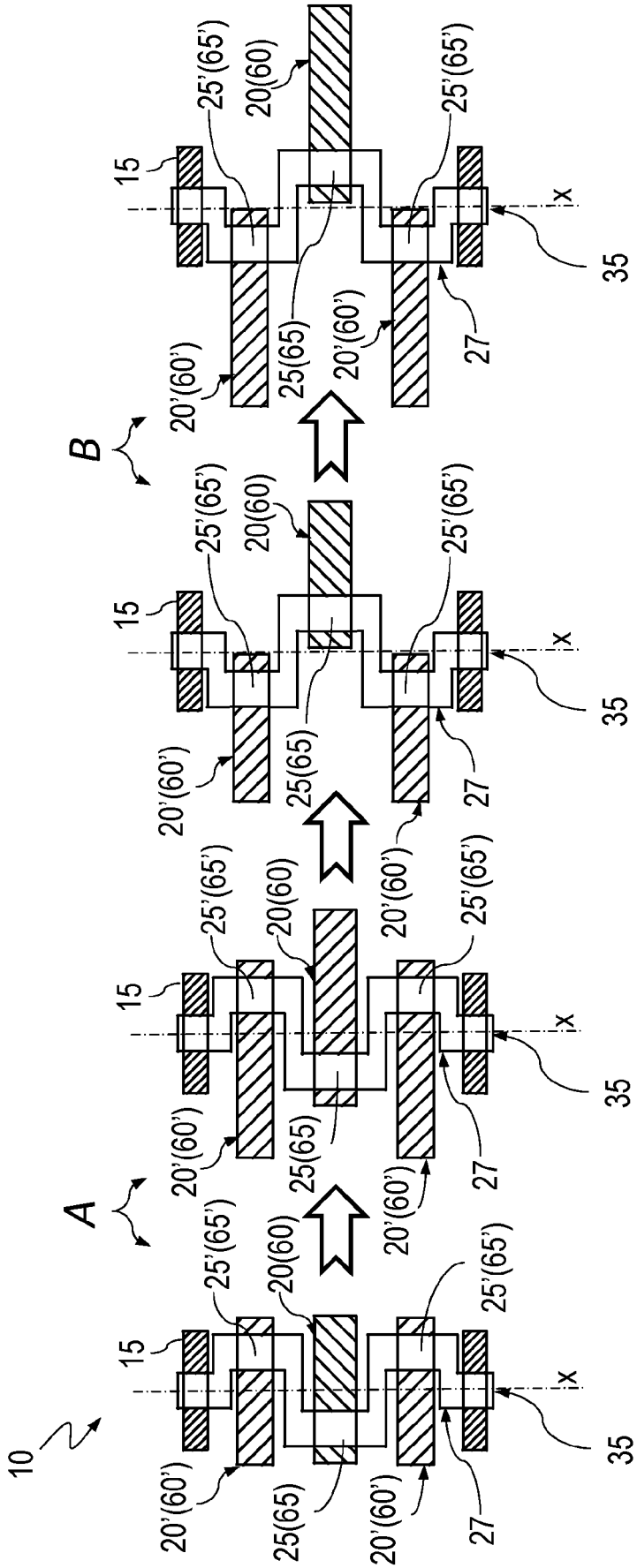


Fig. 21a
Fig. 21b
Fig. 21c
Fig. 21d
10
A
B
15
20'(60')
25(65)
20(60)
25'(65')
27
35
x

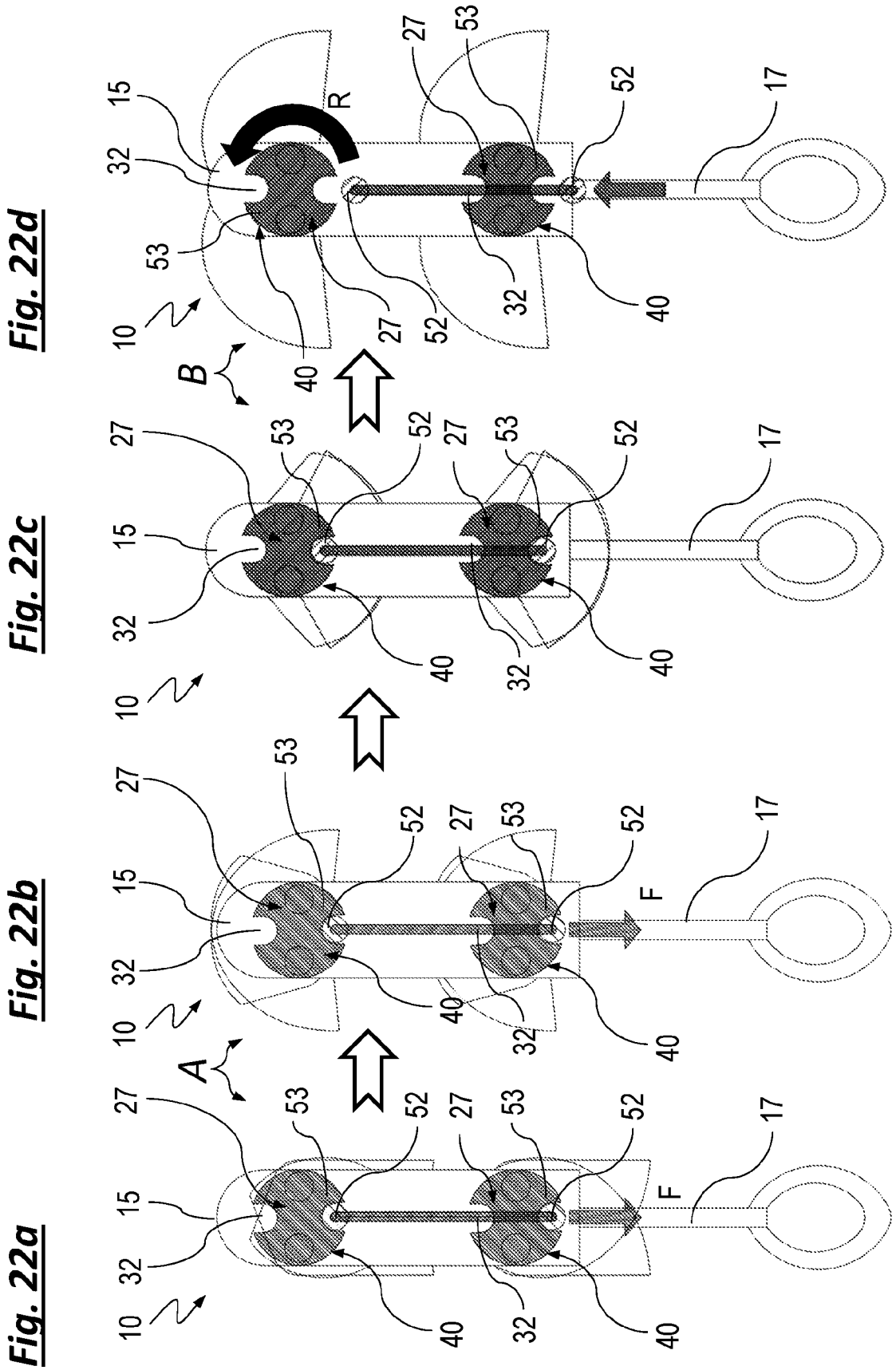


Fig. 22a
Fig. 22b
Fig. 22c
Fig. 22d
A
B
F
R
10
15
17
27
32
40
52
53

Fig. 23c

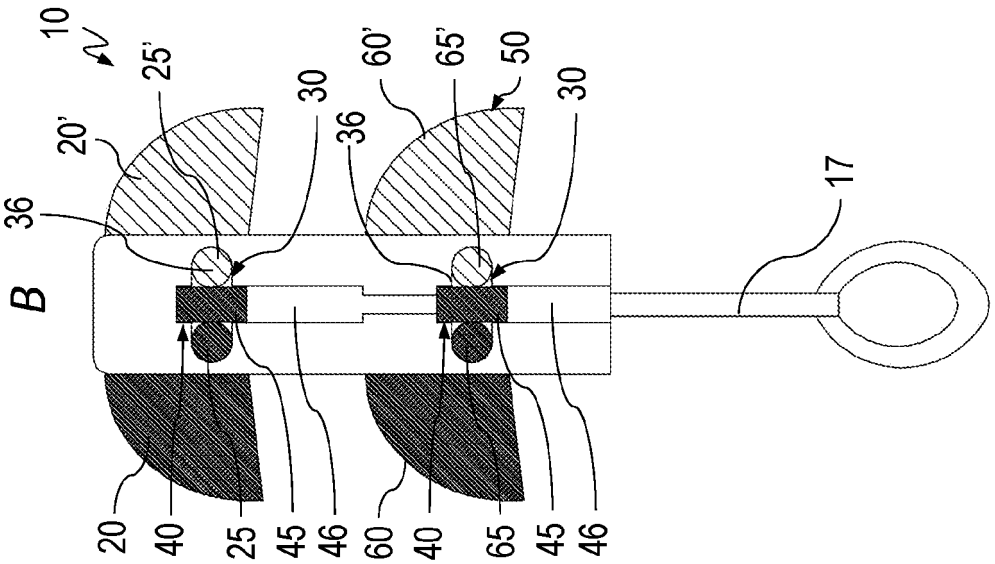


Fig. 23b

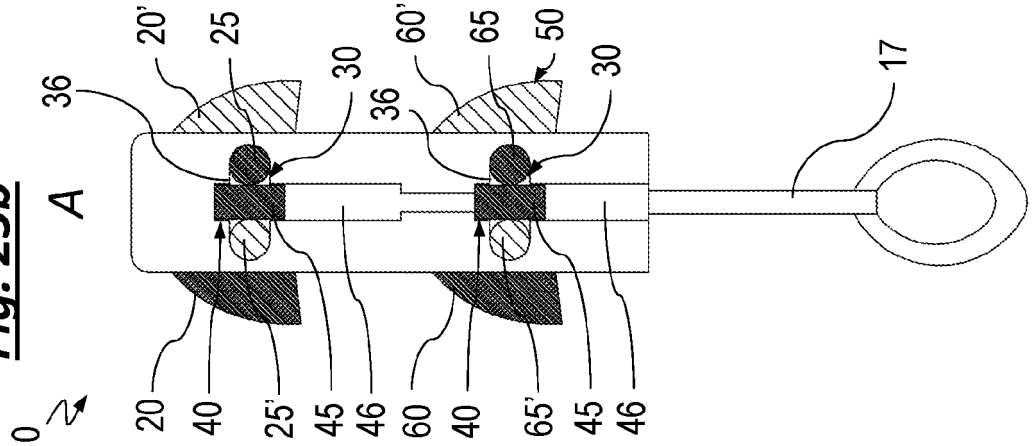
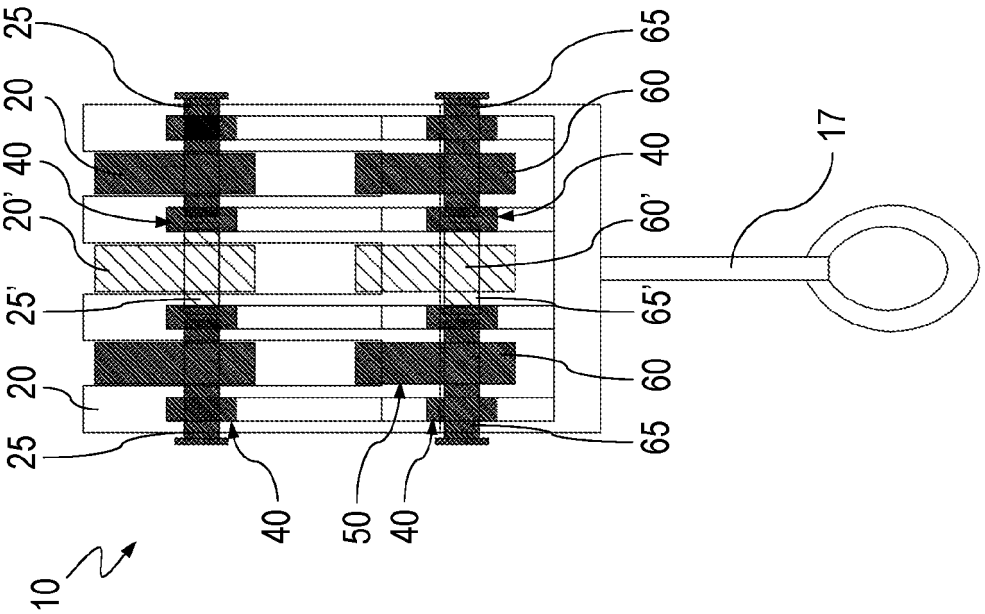


Fig. 23a



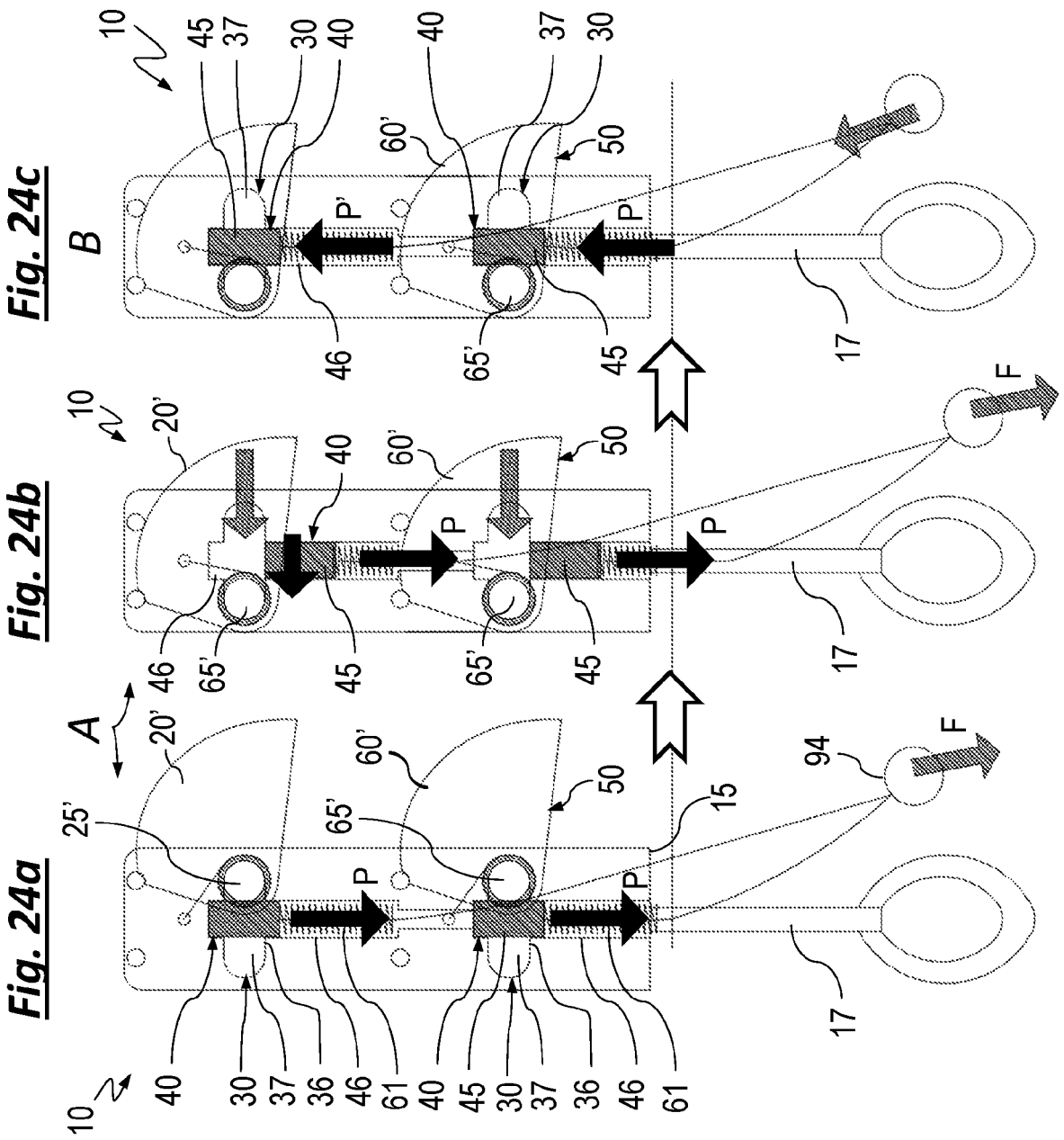


Fig. 24a
Fig. 24b
Fig. 24c
A
B
10
20'
25'
60'
65'
50
15
94
F
P
P'
40
30
37
36
46
61
45
17

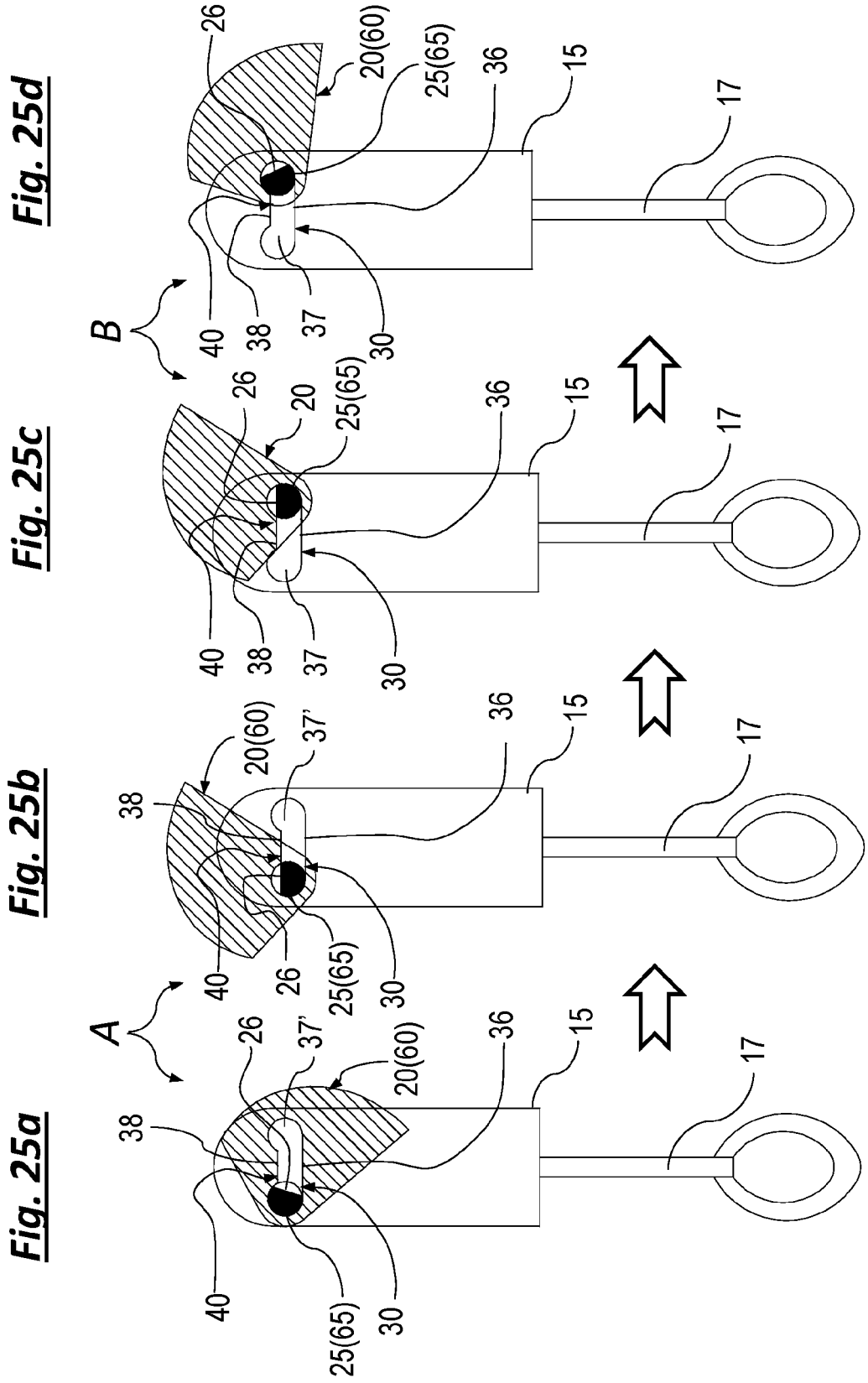


Fig. 25a
Fig. 25b
Fig. 25c
Fig. 25d
A
B
38
40
26
37'
20(60)
25(65)
30
36
15
17
37
20

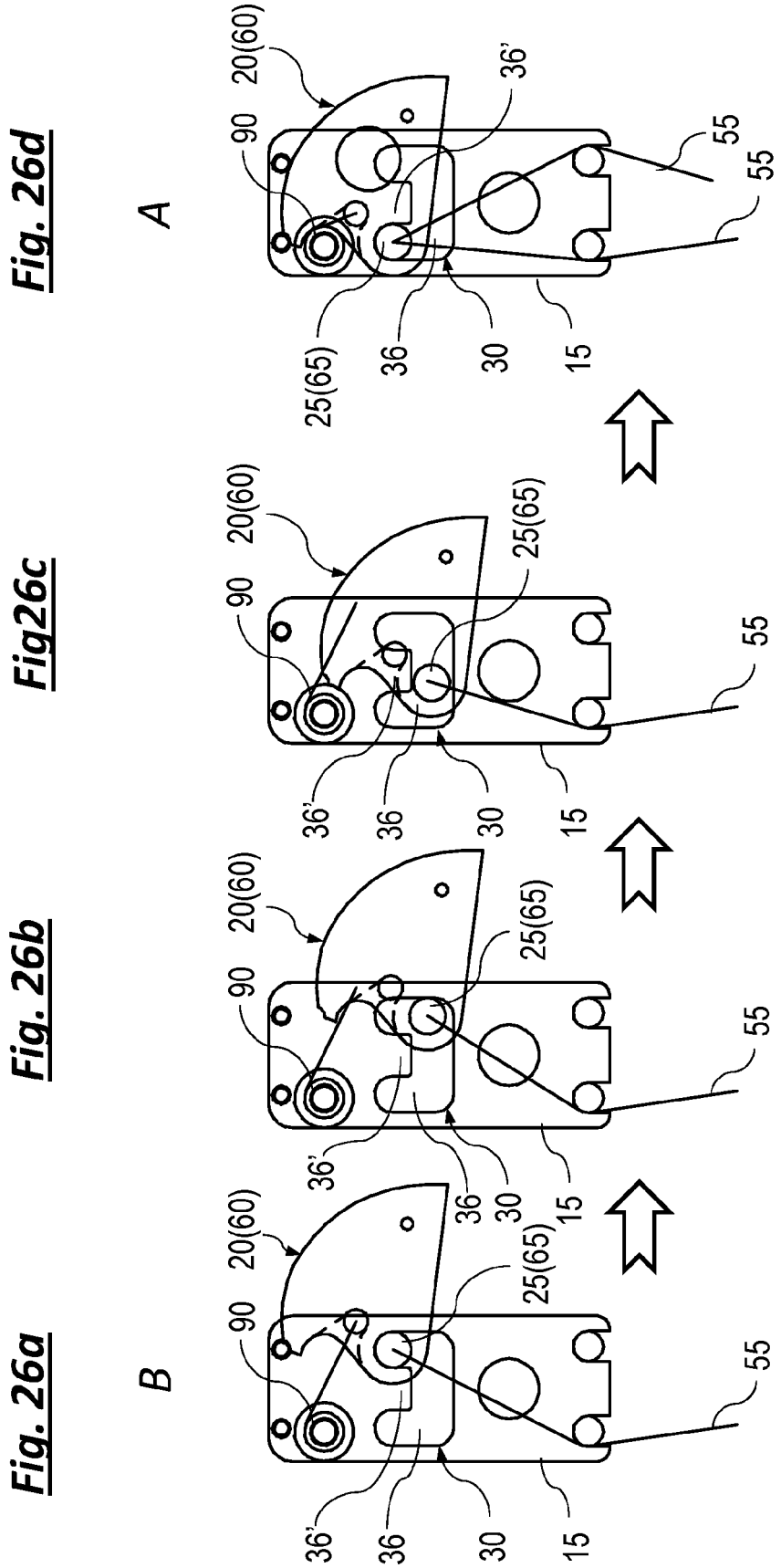


Fig. 26a
Fig. 26b
Fig26c
Fig. 26d
A
B
20(60)
90
25(65)
36'
36
30
15
55

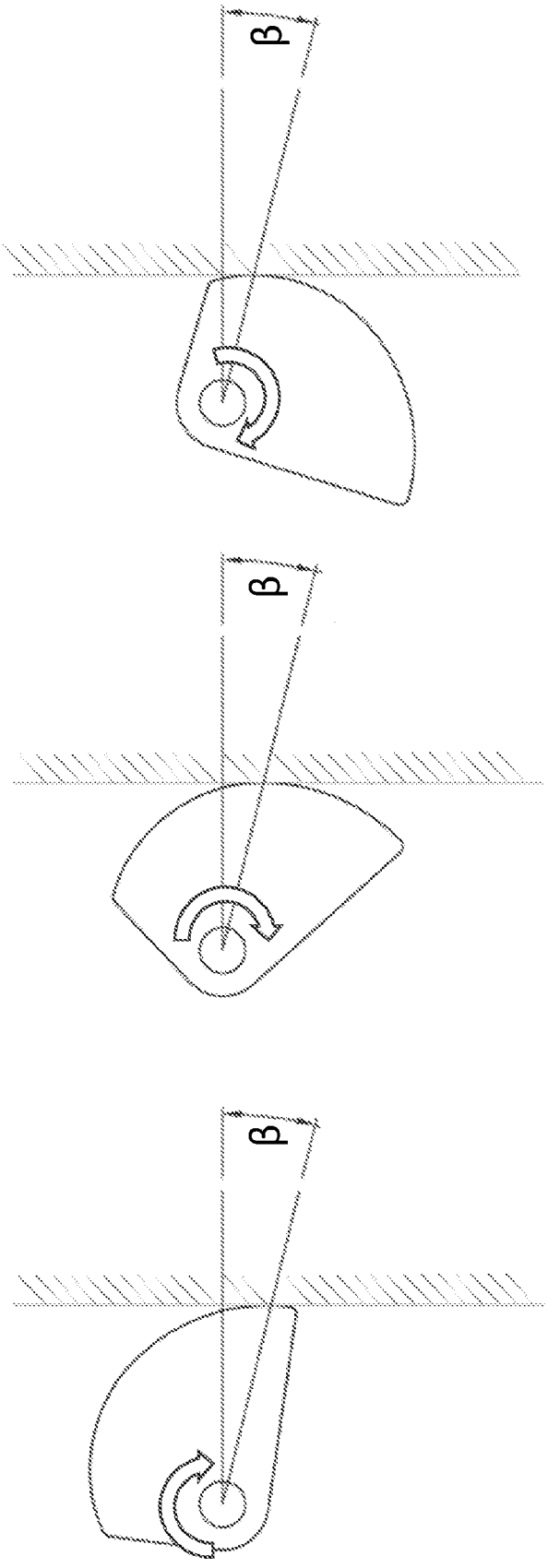


Fig. 27

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2020/057276

A. CLASSIFICATION OF SUBJECT MATTER
INV. A63B29/02
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)
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 practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR 2 551 981 A1 (FRECHIN JEAN PAUL [FR]) 22 March 1985 (1985-03-22)	1-7
A	pages 3-5; claims; figures	8-14

X	WO 2006/125942 A1 (UNIV LIVERPOOL JOHN MOORES [GB]; HEMSLEY DAVID [GB]) 30 November 2006 (2006-11-30) cited in the application	1-7,10
A	pages 6-11; claims; figures	8,9, 11-14

X	US 2005/098696 A1 (LOWE GREGORY E [US]) 12 May 2005 (2005-05-12)	1-7,10
A	paragraphs [0024] - [0039]; claims; figures	8,9, 11-14

	-/--	

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

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
2 November 2020	13/11/2020

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

1

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2020/057276

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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