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(54) ACTUATING UNIT

(57) The present invention relates to an actuating unit (10) of the articulated lever or cam type comprising an actuator arm (12) rotatable between an open position and a closed operating position; a housing body (11) inside of which a closing device configured to bring the actuator arm (12) into rotation between the open position and the closed operating position is housed, wherein the closing device comprises a mechanism of movement irreversibility configured to trigger when the actuator arm (12) reaches the closed operating position; and a fluid-dynamic actuator (20) configured to control the movement of the closing device, the fluid-dynamic actuator (20) comprising a cylindrical body (21) extending between a first head (22) located at a free end of the cylindrical body (21) and a second head (23) for connection to the housing (11); and a piston translatably housed inside the cylindrical body (21). The piston carries a first retaining element (27) configured to engage a second retaining element (28) housed inside the free head (22), the second retaining element (28) being movable between an engagement position and a position of disengagement from the first retaining element (27). According to the invention, the actuating unit comprises a pusher element (30) configured to move the second retaining element (28) into the disengagement position.

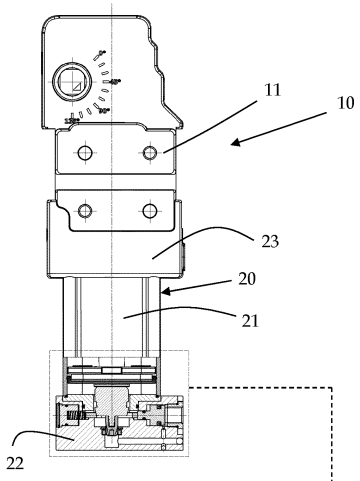

FIG. 2

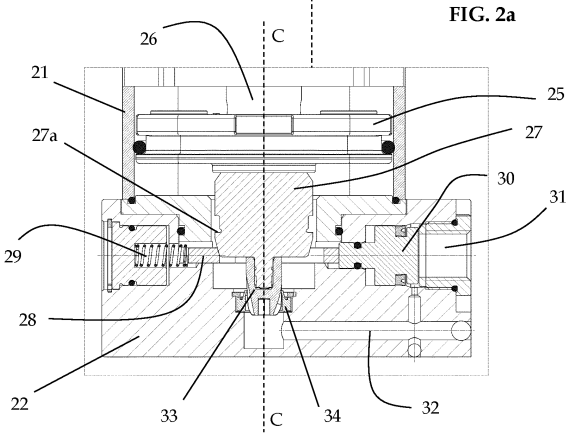

FIG. 2a

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Description

TECHNICAL FIELD

[0001] The present invention generally relates to an actuating unit of the articulated lever or cam type with an integrated self-retaining unit. In particular, the present invention relates to a clamping unit and a handling unit typically used for processing metal sheets, for example for forming bodies of motor vehicles.

[0002] Within the scope of forming bodies of motor vehicles, it is known to use actuating units for the movement and the keeping in position of the metal sheets during the processing. Such mechanical processing operations require a highly accurate positioning of the elements to be processed and also for such positioning to be kept over time. For such a purpose, the actuating units comprise a closing device capable of bringing an actuating arm connected to such a device to an exact closed operating position and once reached, of keeping it in such a position, thus triggering an irreversibility mechanism capable of ensuring the position also in the absence of control, for example in the absence of compressed air in the case of pneumatic control.

[0003] Such actuating units can be mounted in any spatial orientation, so that it is not always guaranteed that the actuating unit is capable of stably maintaining its opening position. In fact, in such a position the actuating arm is free to move, e.g., under the action of gravity.

BACKGROUND

[0004] In order to ensure that the open position of the actuating arm is maintained irrespective of the spatial orientation according to which the actuating unit has been mounted, it is known to equip actuating units with self-retaining groups mounted outside the body of the unit, generally consisting of a pair of complementary retaining elements which engage each other when the actuating arm reaches its open position, thus bringing about a releasable stop of the arm in such a position and, consequently, a safety against unintentional movements of the arm. This makes it possible to mount the actuating unit in any orientation.

[0005] An example of a self-retaining group outside the body of the actuating unit is known from document DE29817335U1. The actuating unit described in DE29817335U1 has a pin constrained to the actuating arm which is dragged by the movement of the actuating arm to fit in an elastic retaining seat when the actuating arm reaches the open position.

[0006] In such a solution, the constraint and release coupling between the first and second retaining elements (pin and retaining seat) leads to an unacceptable degree of wear and therefore the need for frequent replacement of parts. Furthermore, the positioning outside the body of the actuating unit leads to an alteration of the overall dimensions generally envisaged for actuating units.

[0007] Actuating units are also known which comprise a self-retaining group integrated inside the unit itself, without therefore influencing the overall dimensions of the unit.

[0008] A first example, described in document DE202004019495U1, involves a pair of return valves which prevent air from escaping from the cylinder, thereby maintaining an internal pressure condition even in the absence of a compressed air supply. Such a solution, besides being quite complex from a constructional point of view, may not be particularly effective in maintaining an open condition in the event of a prolonged power failure.

[0009] A different solution, described in document DE29920639U, comprises a shock absorber and stop group consisting of an axial extension of the closing device fork with an enlarged end intended to be accommodated in an elastic retaining seat when the closing device reaches its opening configuration. In order to allow reversibility from the elastic retaining condition, the shock absorber and stop group described in DE29920639U must necessarily be sized so as to be able to ensure that the enlarged end can be released once an axial force is applied to the fork to actuate the closing device. There is therefore no guarantee that the open condition will be reliably maintained.

[0010] Another known solution described in document US2002017751A1 involves an obstacle element to the travel of the fork which is pressed transversely against the fork by an elastic pusher element. Also in this case, the need to dimension the elastic pusher element so as to allow the movement of the fork once an axial force is applied thereto, does not allow a high degree of reliability on the maintenance of the opening condition even in the presence of significant stresses.

[0011] Finally, it is known from document US3889576A that a pneumatic cylinder piston locking element is used, comprising a pin held in engagement with the piston by an elastic element. When the pneumatic cylinder is fed, the force exerted by the elastic element is counteracted by the input compressed air. This causes the pin to retract and thus disengage from the piston, allowing the translation thereof. Such a solution, while offering a high degree of reliability, has the disadvantage that a sufficiently high level of pressure must be reached to disengage the pin from the piston. The delay in the release, due to the time needed to reach a level of pressure sufficient to disengage the pin, means that, once free, the piston starts to translate at an already high speed, consequently moving the actuating arm at a speed which may result in a risk of accident for the personnel in charge and/or damage to the object to be handled and/or locked. In fact, during the delay interval the opposite chamber of the piston discharges the pressure, thus not allowing the actuating arm to move in a controlled manner downstream of the release.

[0012] Therefore, the Applicant has perceived the need for an actuating unit with an integrated self-retaining

group which is not subject to the aforesaid drawbacks.

OBJECTS AND SUMMARY OF THE INVENTION

[0013] In view of the foregoing, the problem underlying the present invention is to devise an actuating unit with an integrated self-retaining group which offers a high degree of reliability in maintaining the open condition regardless of the installation orientation of the unit, while ensuring safe operation of the unit.

[0014] In the context of such a problem, an object of the present invention is to create an actuating unit with an integrated self-retaining group which is capable of moving the actuating arm in a manner fully comparable to conventional pneumatically operated actuating units, while offering a self-retaining function with a high degree of reliability.

[0015] A further object of the present invention is to create an actuating unit with an integrated self-retaining group of low structural complexity and feasible compact size.

[0016] In accordance with a first aspect thereof, the invention thus relates to an actuating unit of the articulated lever or cam type comprising an actuator arm rotatable between an open position and a closed operating position; a housing body within which a closing device configured to rotate the actuator arm between the open position and the closed operating position is housed, in which the closing device comprises a mechanism of movement irreversibility configured to engage when the actuator arm reaches the closed operating position; and a fluid-dynamic actuator configured to control the movement of the closing device, the fluid-dynamic actuator comprising a cylindrical body extending between a first head located at a free end of the cylindrical body and a second head for connection to the housing body, and a piston housed in a translatable manner inside the cylindrical body. In particular, the piston carries a first retaining element configured to engage a second retaining element housed in the free end, the second retaining element being movable between an engagement position and a position of disengagement from the first retaining element. According to the invention, a pusher element is also included which is configured to bring the second retaining element into the disengagement position.

[0017] In this description and in the appended claims, "cylindrical body" means a body extending along an axis and having the same cross-sectional area along the axis at each point of its extension, the cross-section being of any shape, not necessarily circular.

[0018] The Applicant has found that by using a special pusher element acting on the second retaining element to bring it to the disengagement position, it is possible to avoid the release occurring by the direct action of the pressurized fluid on the second retaining element. Thereby, unlocking the piston does not require the generation of high pressure inside the piston chamber, which would result in a dangerous sudden start of the piston.

[0019] This avoids dangerous situations and results in a soft piston start, which is similar to actuators without a retaining block.

[0020] At the same time, however, the use of a pair of retaining elements which engage with each other to prevent the piston from moving away from the free cylinder head ensures a reliable self-retaining function, even under significant axial stresses.

[0021] The present invention can have at least one of the preferred following features; the latter can in particular be combined with one another as desired in order to meet specific application needs.

[0022] Preferably, the pusher element is configured and/or housed in the fluid-dynamic actuator, in particular, in the free head of the fluid-dynamic actuator, so as to be operable by means of a pressurized fluid.

[0023] Advantageously, this allows to use the same power source as the actuator, as there is no need for dedicated power supplies to move the pusher element.

[0024] In a variant of the invention, the pusher element is housed in the free head so as to intercept a flow between a supply mouth of a pressurized fluid and an inner chamber of the cylindrical body in which the piston is housed.

[0025] Such a configuration allows, on the one hand, to reduce the space required to house the pusher element and, on the other, to exploit the pressurized fluid supplied to the actuator through the inlet to move the pusher element.

[0026] Preferably, the pusher element is movable between a rest position in which it obstructs the passage of pressurized fluid to the inner chamber of the cylindrical body and a thrust position in which it frees the passage of pressurized fluid to the inner chamber of the cylindrical body.

[0027] Advantageously, as the pusher element can switch between an obstructed position and a position in which it frees the passage of fluid, the supplied fluid is able to act in two distinct steps, first to move the pressurized fluid and then to move the actuator piston.

[0028] Preferably, the pusher element is housed in the free head at the pressurized fluid inlet.

[0029] More preferably, the free head comprises a pressurized fluid supply pipe connecting the supply mouth to the inner chamber of the cylindrical body, the inlet to the supply pipe being obstructed by the pusher element when it is in the rest position and being cleared by the pusher element when it is in the thrust position.

[0030] Such arrangements make it possible to optimize the overall dimensions without substantially altering the overall dimensions of the actuating unit.

[0031] In a variant of the invention, the second retaining element is a perforated plate-like element in which the hole is of such a size that the first retaining element is accommodated therein with clearance.

[0032] Advantageously, such an embodiment of the second retaining element allows two opposing forces to act thereon, one to push it towards the engaged position

and a second, opposing the first, to return it to the disengagement position.

[0033] In a variant of the invention, the first retaining element has a tapered conformation in the direction facing the free head to facilitate reaching an engagement configuration with the second retaining element.

[0034] In a variant of the invention, an abutting projection is made in the first retaining element configured to engage the second retaining element so as to prevent the translation of the piston away from the free head.

[0035] Preferably, the abutting projection is a wall which at least partially delimits a seat obtained in the first retaining element, the seat being configured to accommodate the second retaining element therein when it is in the engaged position thereof.

[0036] More preferably, the seat extends along at least a portion of the surface of the first retaining element.

[0037] Even more preferably, the seat extends around the first retaining element.

[0038] In a variant of the invention, the piston comprises a base sealingly coupled to the inner wall of the body and a control rod extending from the base along an axis of the cylindrical body towards the interface head, in which the first retaining element carried by the piston extends from the base towards the free head.

[0039] In a variant of the invention, the first retaining element carries a shock-absorbing cone intended to be housed in a seal housed in the free end.

[0040] In a variant of the invention, the second retaining element is housed in the free end translatably in a transverse plane to the axis of the cylindrical body between the engagement position and the disengagement position from the first retaining element.

[0041] Preferably, the pusher element is translatable in the translation plane of the second retaining element under the action exerted by the pressurized fluid.

[0042] In a variant of the invention, the second retaining element is forced into the engaged position against the abutting projection by an elastic return element.

[0043] Preferably, the pusher element exerts a counter force to the elastic force exerted by the elastic return element.

[0044] Preferably, the fluid-dynamic actuator is a pneumatic actuator.

BRIEF DESCRIPTION OF THE DRAWINGS

[0045] Further features and advantages of the present invention will be more evident from the following detailed description of certain preferred embodiments thereof made with reference to the appended drawings.

[0046] The different features in the individual configurations may be combined with one another as desired according to the preceding description, should there be advantages specifically resulting from a specific combination.

[0047] In such drawings,

- figures 1a and 1b are seen in side elevation of a preferred embodiment of an actuating unit of the articulated lever or cam type according to the invention, specifically a clamping unit, in the closed configuration with irreversibility mechanism triggered and in the open configuration, respectively;
- figure 2 is a partially cross-sectional side elevation view of the actuating unit in figures 1a and 1b from which the actuating arm has been removed for representational simplicity;
- figure 2a is an enlarged detail of figure 2;
- figure 3a is the same view as figure 2a in a different operating configuration;
- figure 3b is a sectional view of the detail in figure 3a along section line A-A;
- figure 4a is the same view as figures 2a and 3a in a different operating configuration; and
- figure 4b is a sectional view of the detail in figure 4a along section line B-B.

DETAILED DESCRIPTION OF THE INVENTION

[0048] For the illustration of the drawings, use is made in the following description of identical numerals or symbols to indicate construction elements with the same function. Moreover, for clarity of illustration, certain references may not be repeated in all drawings.

[0049] While the invention is susceptible to various modifications and alternative constructions, certain preferred embodiments are shown in the drawings and are described hereinbelow in detail. It is in any case to be noted that there is no intention to limit the invention to the specific embodiment illustrated rather on the contrary, the invention intends covering all the modifications, alternative and equivalent constructions that fall within the scope of the invention as defined in the claims.

[0050] The use of "for example", "etc.", "or" indicates non-exclusive alternatives without limitation, unless otherwise indicated. The use of "comprises" and "includes" means "comprises or includes, but not limited to", unless otherwise indicated.

[0051] With reference to figures 1a and 1b, a preferred embodiment of an actuating unit with articulated lever or cam according to the present invention, indicated as a whole with 10, specifically made in the form of a clamping unit is illustrated.

[0052] The clamping unit 10 comprises a housing body 11 within which a locking device of the articulated lever or cam type (not shown) is arranged, switchable between a first configuration, in which an actuating arm 12 is brought into an angular open position, illustrated in fig. 1a, and a second configuration, in which the actuating

arm 12 is brought into an angular closed position, illustrated in fig. 1b.

[0053] The locking device is actuated by means of a pneumatic actuator 20 comprising a cylindrical body 21 having a centre-line axis C extending between a pair of heads 22,23 of which a first one 22 located at a free end of the cylinder 21 and incorporating at least one connection mouth 31 to a pressurized fluid supply, and a second one 23 acting as a connection interface with the housing body 11 of the locking device.

[0054] A piston provided with a base 25 sealingly coupled to the inner wall of the body 21, a control rod 26 extending from the base 25 along the axis C towards the interface head 23 and a first retaining element 27 extending from the base 25 towards the free head 22 are translatably housed inside the cylindrical body 21.

[0055] The first retaining element 27 preferably has a tapered shape in the direction towards the free end 22. In addition, a shock-absorbing cone 33 intended to be accommodated in a seal 34 housed in the free head 22 is included on the first retaining element 27.

[0056] An abutting projection 27a configured to engage a second retaining element 28 is provided in the first retaining element 27 so as to prevent the translation of the piston away from the free head 22. The second retaining element 28 is housed in the free head 22 translatably in a plane transverse to the axis C between a position of engagement with the abutting projection 27a (illustrated in figure 3a) and a position of disengagement from the abutting projection 27a (illustrated in figure 4a).

[0057] In the illustrated embodiment, the abutting projection 27a is a wall of a seat made in the first retaining element, within which the second retaining element 28 is received when in its engaged position. More in detail, in the illustrated embodiment, the abutting projection 27a is a wall of a receiving seat of a second retaining element 28 extending along at least a surface portion of the first retaining element 27, preferably extending around the first retaining element 27.

[0058] The second retaining element 28 is forced into the engaged position against the abutting projection 27a by an elastic return element 29 acting in the translation plane of the second retaining element 28.

[0059] According to the present invention, the second retaining element 28 is further acted upon, in opposition to the elastic return element 29, by a release pusher 30 housed at a supply mouth 31 of a pressurized fluid.

[0060] In particular, the release pusher 30 is housed in the supply mouth 31 so as to be translatable in the translation plane of the second retaining element 28 under the action exerted by the pressurized fluid, exerting on the second retaining element 28 a force counteracting the elastic force exerted by the elastic return element 29. Thereby, the second retaining element 28 can be pushed by the release pusher 30 into the disengagement position from the projection 27a (illustrated in figure 4a).

[0061] In the illustrated embodiment, the release pusher 30 is advantageously housed in the supply mouth 31 so that it is free to translate between a rest position in which the pusher 30 is more distanced from the elastic return element 29, allowing the latter to keep the second retaining element 28 in the engaged position, and a compression position, in which the pusher 30 pushes the second retaining element 28 to approach the elastic return element 29 by the compression of the latter.

[0062] In particular, in the spaced position (illustrated in figures 2a and 3a), the pusher 30 obstructs a supply pipe 32 of the pressurized fluid to the piston 25,26,27, while in the compression position (illustrated in figure 4a), the pusher 30 does not obstruct the supply pipe 32, allowing the pressurized fluid to reach the piston.

[0063] In the embodiment illustrated, the second retaining element 28 is advantageously obtained in the form of a perforated plate in which the hole has a sufficient diameter to accommodate the first retaining element 27 with clearance. In alternative embodiments, however, the second retaining element 28 can assume different conformations, for example by having a housing for the first retaining element 27 which is not necessarily closed.

[0064] The operation of the articulated lever or cam actuating unit 10 according to the present invention is as follows.

[0065] In the open condition, illustrated in figures 3a and 3b, the piston is fully retracted with the shock-absorbing cone 33 fully inserted in the seal 34 in the free end 22.

[0066] In this condition, the pneumatic actuator 20 is not energized and therefore the release pusher 30 is not forced by the pressurized fluid to counteract the force exerted by the elastic return element 29, thus being in the position distanced from said element 29. This allows the elastic return element 29 to force the second retaining element 28 into the engaged position against the abutting projection 27a.

[0067] In this configuration, the piston is locked in its position against the free end 22, ensuring that it maintains such a position even when subjected to axial stress. This ensures that the actuating arm 12 is reliably maintained in its open position (illustrated in figure 1a).

[0068] The movement of the piston and thus operation of the locking device is only possible after the piston has been released. Such a release is achieved by the action of the pressurized fluid fed to the pneumatic actuator.

[0069] The pressurized fluid initially acts on the release pusher 30 because, in the initial configuration, the supply pipe 32 of the pressurized fluid to the piston 25,26,27 is obstructed by the pusher 30 itself. In particular, the pressurized fluid exerts a thrust force sufficient to counteract the force exerted by the elastic return element 29, allowing the release pusher 30 and the second retaining element 28 to translate.

[0070] In fact, the release pusher 30 acts on the second retaining element 28, overcoming the force exerted by the elastic return element 29 and pushing the second retaining element 28 towards its disengagement position from the projection 27a (illustrated in figures 4a and 4b).

Thereby the piston is free to move.

[0071] The movement of the release pusher 30 also causes the opening of the supply pipe 32 and thus a gradual increase in the pressure exerted on the piston until it moves.

[0072] In the absence of a pressurized fluid supply, the release pusher 30 returns to its distanced position from the spring return element 29, allowing said spring return element 29 to push the second retaining element 28 towards the engagement position (see figure 2a).

[0073] In such a condition, if the piston is not already against the free end 22, it can still reach the open position thanks to the tapered shape of the first retaining element 27 which facilitates the passage of the abutting projection 27a beyond the second retaining element 28. Thereby, once the open position has been reached, the retaining engagement is directly created, ensuring that the piston maintains this position.

Claims

1. Actuating unit (10) of the articulated lever or cam type comprising

- an actuator arm (12) rotatable between an open position and a closed operating position;
- a housing body (11) inside of which a closing device configured to bring the actuator arm (12) into rotation between the open position and the closed operating position is housed, wherein the closing device comprises a mechanism of movement irreversibility configured to trigger when the actuator arm (12) reaches the closed operating position; and

a fluid-dynamic actuator (20) configured to control the movement of the closing device, the fluid-dynamic actuator (20) comprising a cylindrical body (21) which extends between a first free head (22) located at a free end of the cylindrical body (21) and a second head (23) for connection with the housing body (11); and a piston housed in a translatable manner inside the cylindrical body (21),

wherein the piston carries a first retaining element (27) configured to engage a second retaining element (28) housed inside the free head (22), the second retaining element (28) being movable between an engagement position and a position of disengagement from the first retaining element (27),

characterized in that it comprises a pusher element (30) configured to bring the second retaining element (28) into the position of disengagement from the first retaining element (27).

2. Actuating unit (10) according to claim 1, wherein the pusher element (30) is configured and/or housed in the fluid-dynamic actuator (20) such that it is operable by means of a pressurized fluid.

3. Actuating unit (10) according to claim 1 or 2, wherein the pusher element (30) is housed in the free head (22) so as to intercept a fluid between a pressurized fluid supply mouth (31) and an inner chamber of the cylindrical body (21) in which the piston is housed.

4. Actuating unit (10) according to claim 3, wherein the pusher element (30) is movable between a rest position in which it obstructs the passage of pressurized fluid to the inner chamber of the cylindrical body (21) and a thrust position in which it frees the passage of pressurized fluid to the inner chamber of the cylindrical body (21).

5. Actuating unit (10) according to claim 3 or 4, wherein the pusher element (30) is housed in the free head (22) at the pressurized fluid supply mouth (31).

6. Actuating unit (10) according to claim 5, wherein the free head (22) comprises a pressurized fluid supply pipe (32) connecting the supply mouth (31) to the inner chamber of the cylindrical body (21), the inlet to the supply pipe (32) being blocked by the pusher element (30) when this is in the rest position and being released by the pusher element (30) when this is in the thrust position.

7. Actuating unit (10) according to any one of the preceding claims, wherein the second retaining element (28) is a perforated plate-like element in which the hole has dimensions such to accommodate the first retaining element (27) with clearance.

8. Actuating unit (10) according to any one of the preceding claims, wherein the first retaining element (27) is tapered towards the free head (22) to facilitate reaching an engagement configuration with the second retaining element (28).

9. Actuating unit (10) according to any one of the preceding claims, wherein a abutting projection (27a) is obtained in the first retaining element (27) configured to engage the second retaining element (28) so as to prevent the translation of the piston away from the free head (22).

10. Actuating unit (10) according to claim 9, wherein the abutting projection (27a) is a wall at least partially delimiting a seat obtained in the first retaining element (27), the seat being configured to accommodate the second retaining element (28) therein when

it is in its engagement position, the seat preferably extending along at least a surface portion of the first retaining element (27), more preferably extending around the first retaining element (27).

11. Actuating unit (10) according to any one of the preceding claims, wherein the piston comprises a base (25) sealingly coupled to an inner wall of the cylindrical body (21) and a control rod (26) extending from the base (25) along an axis (C) of the cylindrical body (21) towards the connecting head (23), wherein the first retaining element (27) carried by the piston extends from the base (25) extending towards the free head (22).

12. Actuating unit (10) according to any one of the preceding claims, wherein the first retaining element (27) carries a shock-absorbing cone (33) configured to be received in a seal (34) housed in the free head (22).

13. Actuating unit (10) according to any one of the preceding claims, wherein the second retaining element (28) is housed in the free head (22) translatably in a plane transverse to the axis (C) of the cylindrical body (21) between the engagement position and the position of disengagement from the first retaining element (27).

14. Actuating unit (10) according to claim 13, wherein the pusher element (30) is configured to be translatable in the translation plane of the second retaining element (28) under the action exerted by the pressurized fluid.

15. Actuating unit (10) according to any one of the preceding claims, comprising an elastic return element (29) configured to force the second retaining element (28) into the engagement position with the first retaining element (27), wherein preferably the pusher element (30) is configured to exert a counter force to the elastic force exerted by the elastic return element (29).

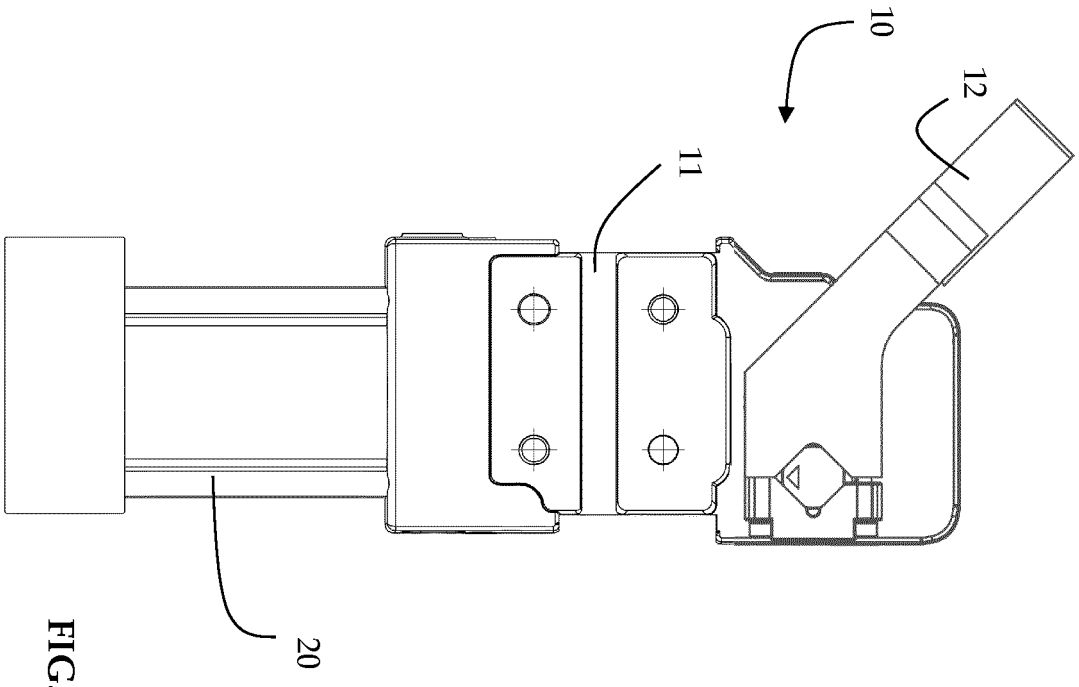

FIG. 1a

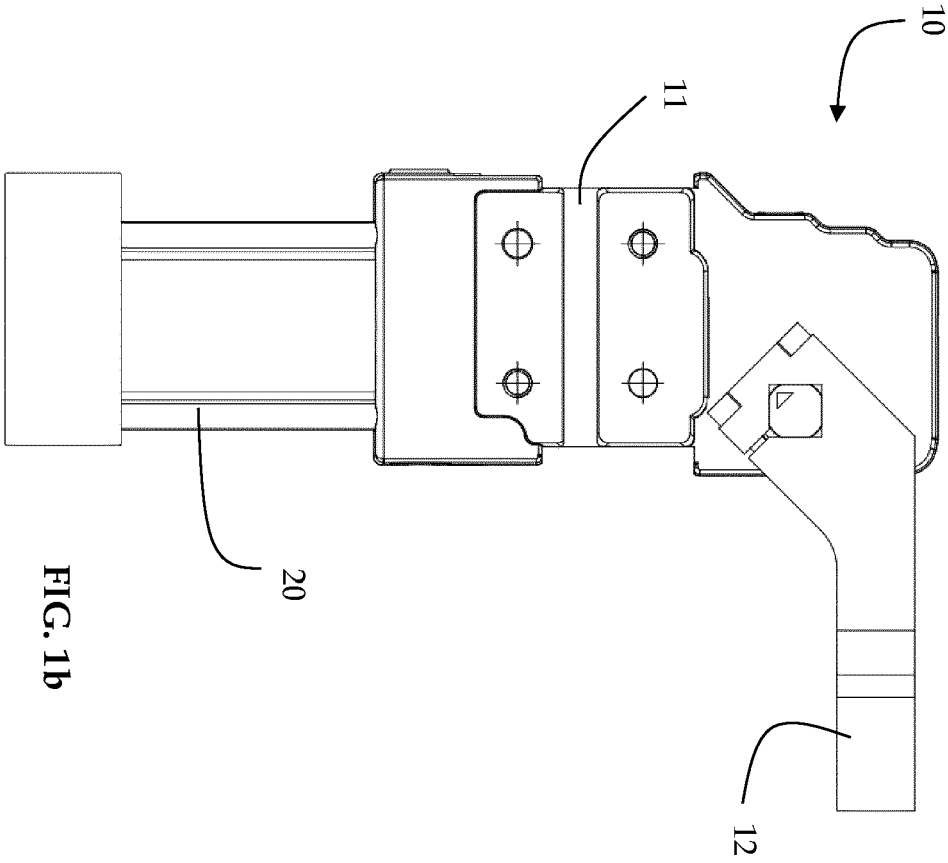

FIG. 1b

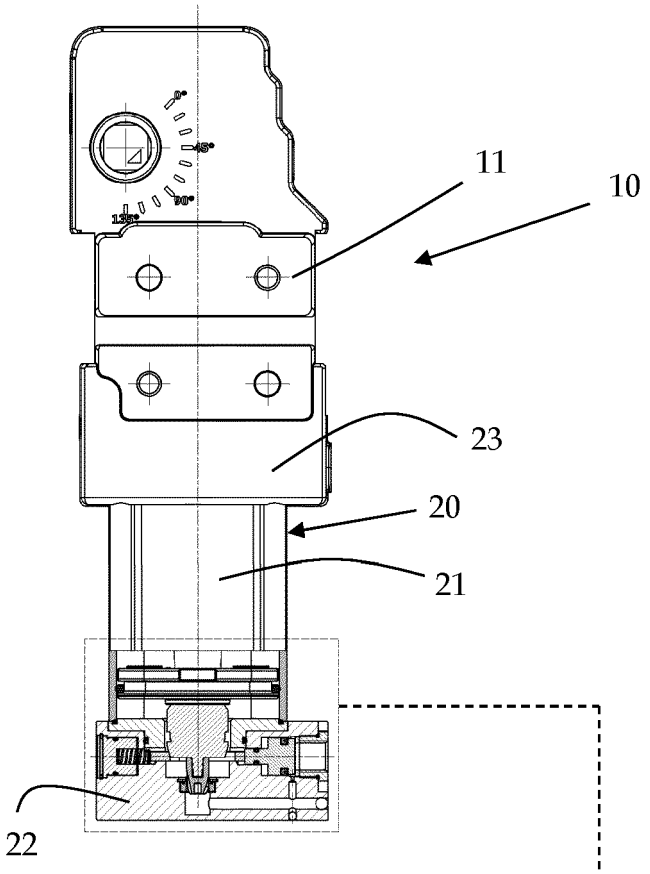

FIG. 2

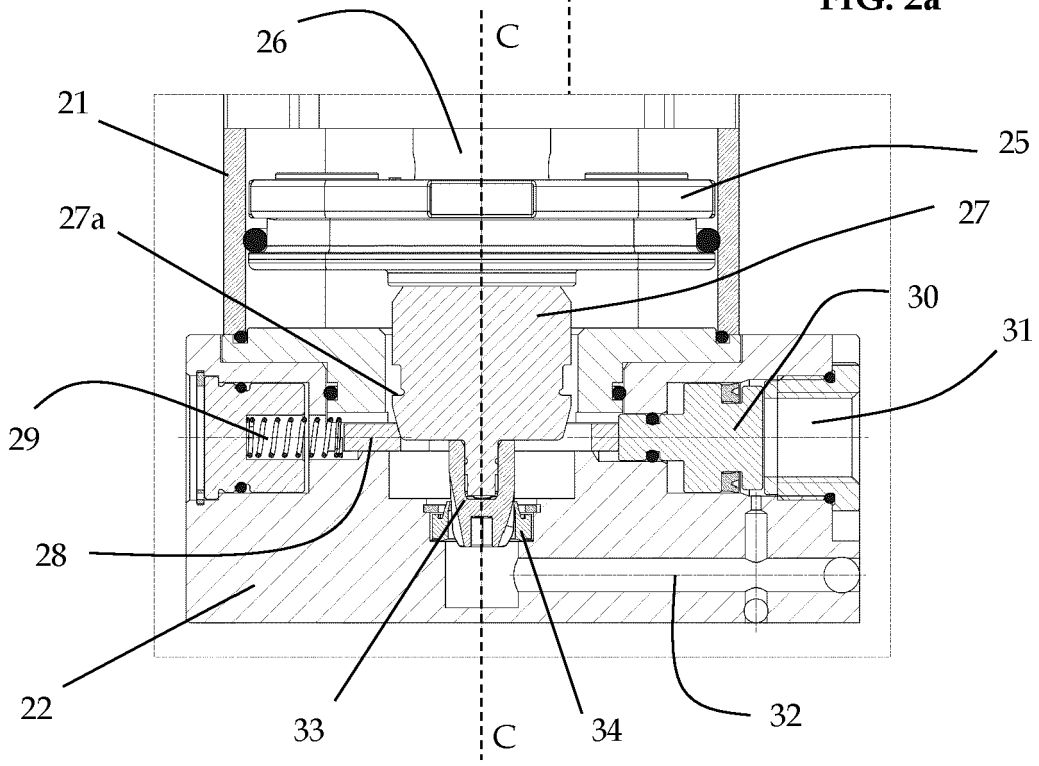

FIG. 2a

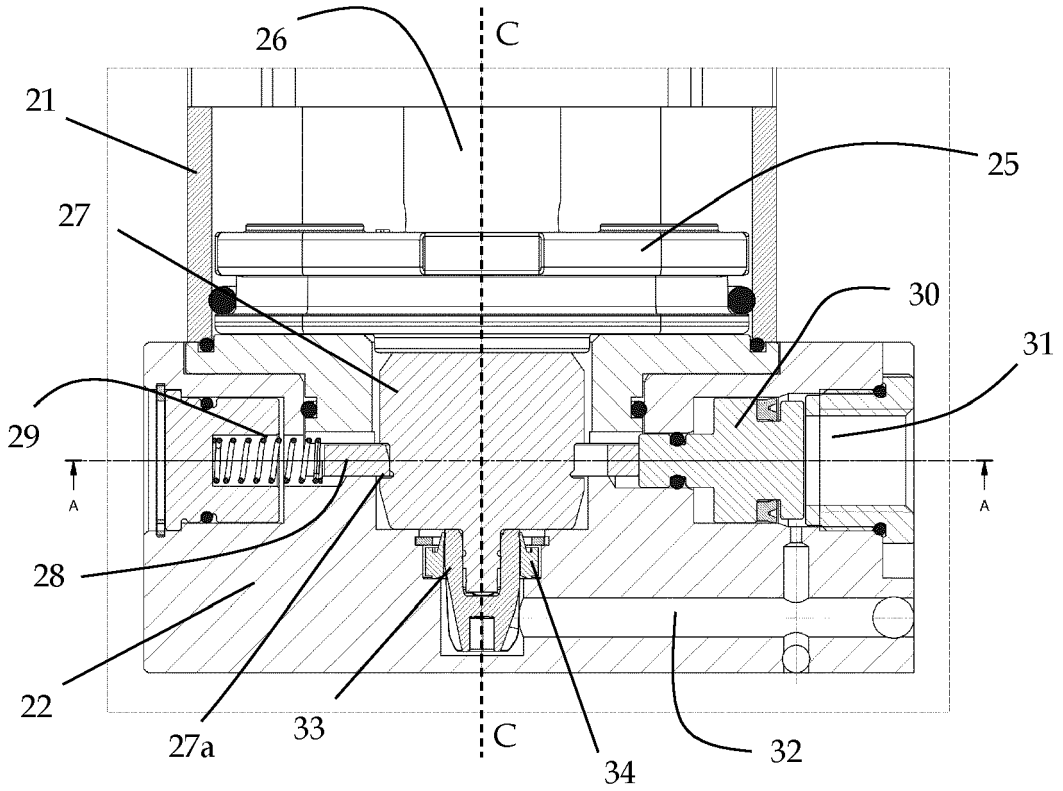

FIG. 3a

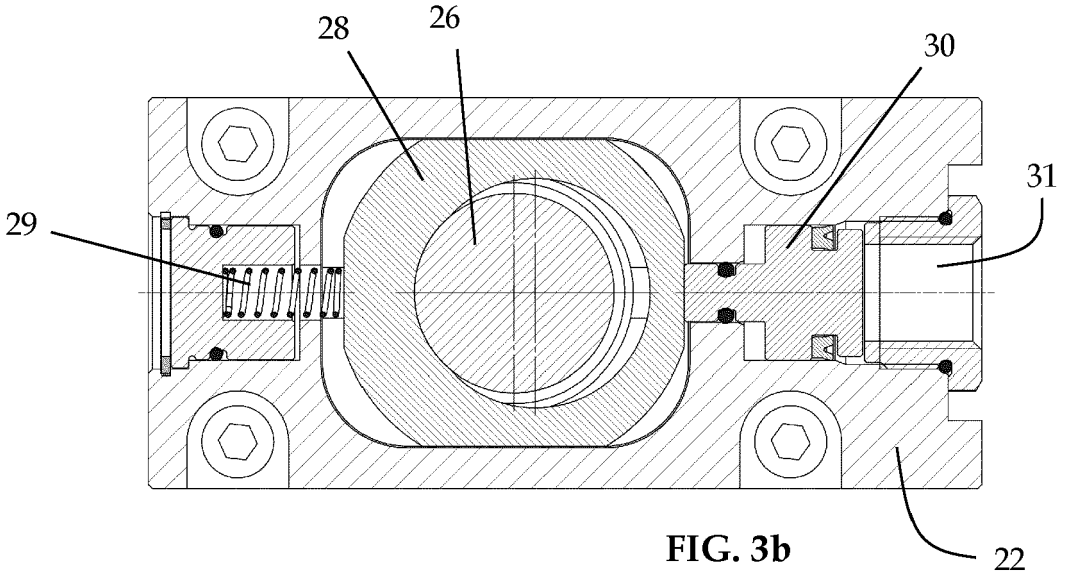

FIG. 3b

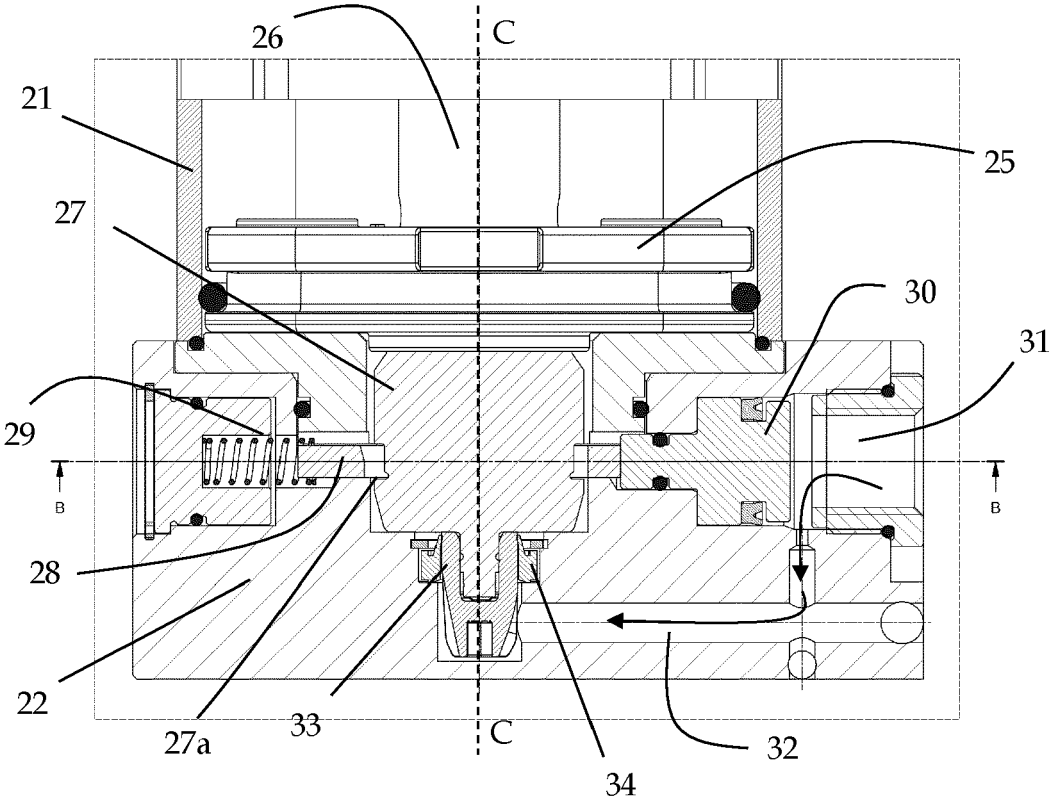

FIG. 4a

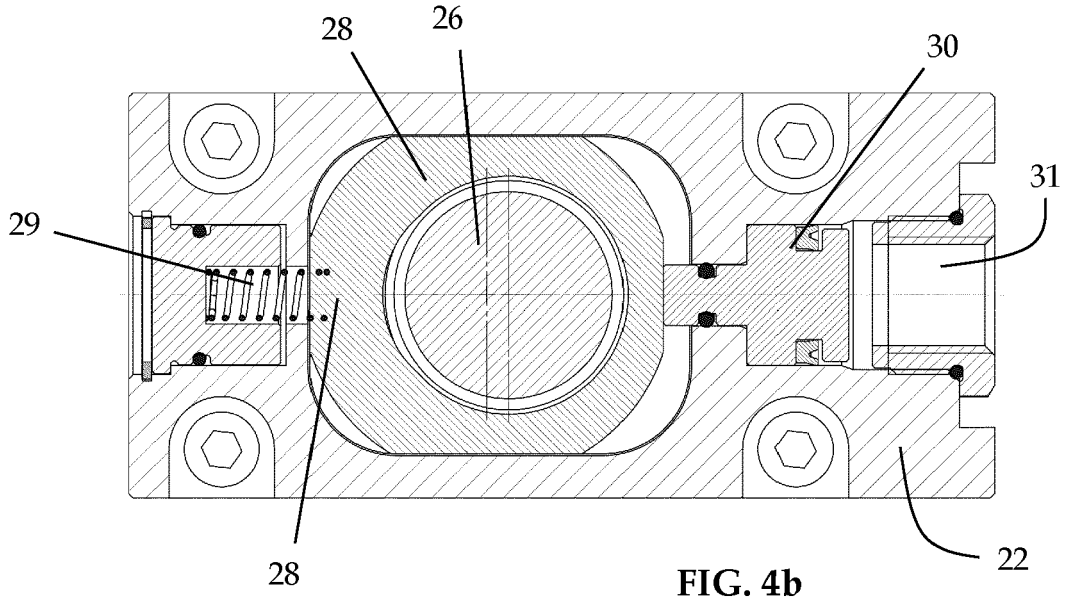

FIG. 4b

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EUROPEAN SEARCH REPORT

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