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(54) **Electric rotary actuator for an entry and exit device, in particular a door**

(57) A rotary actuator (1) for a door (52) comprising an electric motor (3), a reduction unit (4), and a decoupler (9) connected to the reduction unit (4) and having a cam - lever mechanism for the reduction of the decoupling motion.

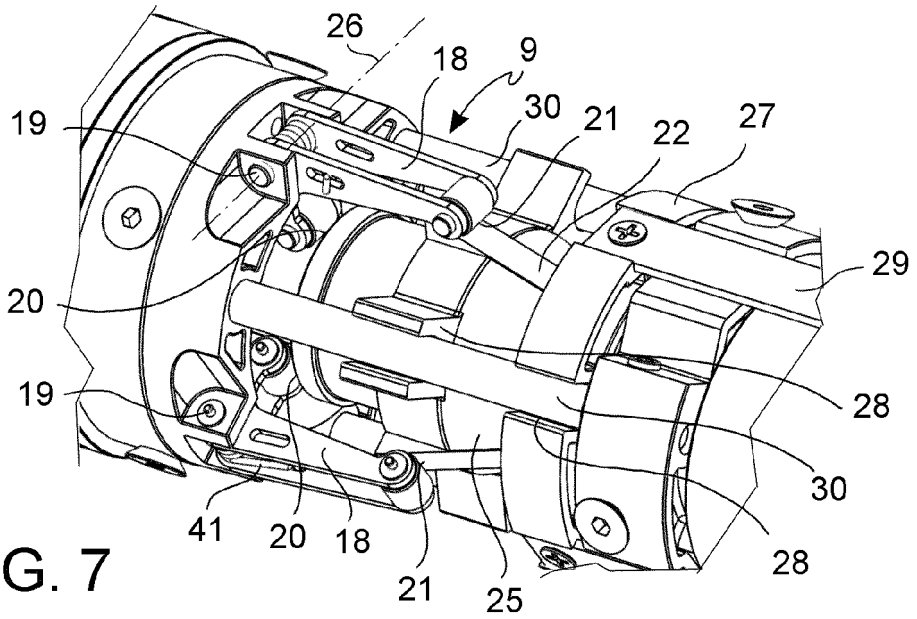

FIG. 7

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Description

[0001] The present invention relates to a rotary actuator for moving a door with an orientable or roto-translatable shutter, in particular for vehicles, e.g., buses and trains.

[0002] The orientable shutter of a vehicle door, for example, of a bus, is connected by orientable arms, or directly, to a rotating column, and it is displaceable, through a rotatory movement of the rotating column, from an opening position to a closure position.

[0003] In a first known configuration, the movement of the rotating column occurs through a rotary actuator with an outer housing constrained to the vehicle structure and an output shaft supported in the outer housing and connected to the rotating column integrally in rotation. Therefore, the movement of the shutter occurs in response to a rotation of the output shaft, while the housing is stationary. In this first configuration, the use is known, of a rotary actuator with a pneumatic linear actuator and a screw transmission converting the linear movement of the linear actuator into a rotatory movement of the output shaft.

[0004] In a second known configuration, the movement of the rotating column occurs through a rotary actuator with an outer housing that forms itself the rotating column or that is constrained integrally in rotation with the rotating column, as well as with a stationary shaft supported in the outer housing and constrained to the structure of the vehicle. Unlike the first configuration, the movement of the shutter here occurs in response to a rotation of the outer housing, while the shaft is stationary.

[0005] In this second configuration, the use is preferred of a compact electric rotary actuator, since the known fluid-dynamic actuators have diameters that are too large to act themselves as a rotating column.

[0006] The known electric rotary actuators are provided with an electromagnetic "negative" brake that is permanently elastically pushed in a locking position to maintain the closure of the door when the electric actuator is turned off, and electrically releasable during the operation of the rotary actuator.

[0007] Furthermore, the known electric rotary actuators have to be provided with a mechanical emergency opening device that, in the case of electric power interruption, allows opening the door in spite of the impossibility to release the electromagnetic "negative" brake.

[0008] As an emergency opening device, it is known to provide a mechanical decoupler between due reduction stages of the rotary actuator, which allows decoupling the motion, for example, by manual actuation of a Bowden cable.

[0009] Rotary actuators have to develop high closure torques, ranging between about 120Nm ... 250Nm, to oppose violent impacts due to acts of vandalism, and especially on extra-urban transport means traveling at high speeds, to oppose the fluid-dynamic depression tending to open the doors.

[0010] However, the high closure torque considerably increases the friction between the components of the decoupler, the decoupling of which requires a force that is to high for children, the elderly, or women.

[0011] Therefore, the object of the present invention is to provide a decoupler for an electric rotary actuator and an electric rotary actuator for moving a door with an orientable shutter, in particular for vehicles, e.g., autobuses, having such characteristics as to obviate the drawbacks of the prior art.

[0012] A particular object of the invention is to provide a decoupler that allows overcoming high frictions between its components, by applying a reduced manual force.

[0013] A further particular object of the invention is to provide a decoupler having a robust, easy structure and with compact dimensions.

[0014] These and other objects are achieved by a rotary actuator for an entry/exit device, in particular an orientable and/or translatable door or ramp and the like in public transport vehicles, comprising:

[0015] - an electric motor;

[0016] - a reduction unit having an input member connected to an output member of the electric motor and an output member connected to an output shaft of the rotary actuator,

[0017] - a decoupler connected to the reduction unit and actuatable to uncouple the motion of the output shaft from the motor output shaft,

[0018] wherein the decoupler comprises:

[0019] - a first shaft having a tubular wall forming an inner cavity and one or more through holes,

[0020] - a second shaft received into the inner cavity of the tubular wall rotatably about a rotational axis and forming one or more locking cavities that may overlap with the through holes,

[0021] - one or more locking members received in the through holes of the tubular wall and displaceable between:

> a radially inner position in engagement with the through hole and with the locking cavity, preventing the relative rotation between the first shaft and the second shaft,
>
> and a radially outer position outside the locking cavities, allowing the relative rotation between the first shaft and the second shaft,

[0022] - a control sleeve inserted on the tubular wall and axially slidable between a locking position and a release position, in which a control surface of the control sleeve faces the through holes and it is shaped so that, when the control sleeve is in the locking position, the control surface locks the locking members in the radially inner position, and, when the control sleeve is in the release position, the control surface allows displacing the locking members in the radially outer position,

[0023] - at least one lever rotatable about a fulcrum

and having a first end to engage the control sleeve and a second end in contact with a cam shaped and displaceable from a rest position to an operative position, so as to displace the lever second end in a direction transversal to the rotational axis and the lever first end in a direction (prevalently parallel to the rotational axis) such as to displace the control sleeve from the locking position at least along an initial length towards the release position, in which a first distance between the lever first end and the fulcrum is less than a second distance between the lever second end and the fulcrum.

[0024] By virtue of the reduction of the decoupling motion, the stroke of the control sleeve from the locking position to the release position, and vice versa, is less than the corresponding stroke of the cam from the rest position to the operative position, and vice versa.

[0025] By virtue of the combination of the control sleeve with a reduction unit cam - lever, a strong reduction of the force necessary to carry out the manual uncoupling of the rotary actuator, as well as a reduction of the overall dimensions transversal to the rotational axis are obtained.

[0026] In order to better understand the invention and appreciate the advantages thereof, some exemplary, non-limiting embodiments thereof will be described herein below, with reference to the drawings, in which:

- Fig. 1 is a perspective view of an electric rotary actuator with a decoupler according to an embodiment;
- Fig. 2 is a perspective view of the actuator of Fig. 1 with an outer wall removed;
- Fig. 3 is a longitudinal sectional view of the actuator in Fig. 1;
- Fig. 4 is an enlarged view of the detail IV in Fig. 3;
- Figs. 5, 6, 7 are enlarged views of the details V, VI in Fig. 2;
- Figs. 8A, 8B, and 8C illustrate an uncoupling sequence of the rotational motion in the rotary actuator according to an embodiment;
- Figs. 9A and 9B are sectional views according to a transversal plane IX in the Figures 8A and 8B;
- Fig. 10 illustrates the electric rotary actuator integrated in a rotating column of a door for public transport means;
- Figs. 11A and 11B illustrate embodiments of entry/exit devices for public transport means.

[0027] With reference to the Figures, a rotary actuator 1 for an entry/exit device, in particular an orientable and/or translatable door or ramp and the like in public transport vehicles, comprises a housing 2, an electric motor 3, a reduction unit 4 having a reducer input member 5 connected to a motor output member 6 of the electric motor 3 and a reducer output member 7 connected to an output shaft 8 of the rotary actuator 1, as well as a decoupler 9 connected to the reduction unit 4 and actuatable to uncouple the motion of the output shaft 8 from the motor output member 6 of the electric motor 3.

[0028] In accordance with an aspect of the invention, the decoupler 9 comprises a first shaft 10 having a tubular wall 11 forming an inner cavity and one or more through holes 12, a second shaft 13 received into the inner cavity of the tubular wall 11 rotatably about a rotational axis R and forming one or more locking cavities 14 in position suitable to overlap with the through holes 12.

[0029] In the through holes 12 of the tubular wall 11, one or more locking members 15 are received, for example rolling members, rollers, spheres, etc., displaceable between a radially inner position (Figs. 8A, 9A) in engagement with the through hole 12 and the locking cavity 14, preventing the relative rotation between the first shaft 10 and the second shaft 13, and a radially outer position (Figs. 8C,9B) externally to the locking cavities, allowing the relative rotation between the first shaft 10 and the second shaft 13.

[0030] On the tubular wall 11, a control sleeve 16 is inserted, which is axially slidable between a locking position (Fig. 8A) and a release position (Fig. 8C). A control surface 17 of the control sleeve 16 faces the through holes 12 and it is shaped so that, when the control sleeve 16 is in the locking position, the control surface 17 locks the locking members 15 in the radially inner position, and, when the control sleeve 16 is in the release position, the control surface 17 allows displacing the locking members in the radially outer position.

[0031] For displacing the control sleeve 16, a reduction unit of the decoupling motion is provided with at least one lever 18 rotatable about a fulcrum 19 and having a first end 20 to engage the control sleeve 16 and a second end 21 in contact with a cam 22 displaceable from a rest position (Fig. 8A) to an operative position (Fig. 8B). The cam 22 and the lever 18 are arranged and shaped so that, during a displacement of the cam 22 from the rest position to the operative position thereof, it pushes the lever second end 21 to a direction transversal to the rotational axis R and the lever first end 20 moves accordingly, in a direction mainly parallel to the rotational axis R and pushes the control sleeve 16 from the locking position along at least one initial stroke length towards the release position.

[0032] By selecting the cam 22 shape and the lever ratio, i.e., the ratio between the distances from the lever ends 20, 21 and the fulcrum 19, it is possible to obtain two reduction stages of the decoupling motion in order to obtain a high reduction of the force necessary to perform the manual uncoupling of the rotary actuator 1, as well as a reduction of the overall dimensions transversal to the rotational axis R.

[0033] In fact, by virtue of the reduction of the decoupling motion, the stroke of the control sleeve 16 from the locking position to the release position, and vice versa, can be much less than the corresponding stroke of the cam 22 from the rest position to the operative position, and vice versa.

[0034] In an embodiment, a first distance between the lever first end 20 and the fulcrum 19 is less than a second

distance between the lever second end 21 and the fulcrum 19.

[0035] In a further embodiment, a cam surface or track 23 of the cam 22 engaged by the lever second end 21 is inclined so that the lever second end 21 stroke is less than the corresponding cam 22 stroke.

[0036] This allows reducing the overall radial dimensions to be able to integrate the rotary actuator 1 in a rotating column 50 (Fig. 10) of a door and in any case to overcome the friction between the locking members 15 and the first 10 and second 13 shafts by a manual uncoupling.

[0037] According to an embodiment, the cam 22 comprises a reduction sleeve 25 inserted on the control sleeve 16 and axially slidable between the rest position and the operative position. The reduction sleeve 25 forms a plurality of ramp- or wedge-shaped cam tracks 23, inclined with respect to the rotational axis R by an inclination angle that is less than 45°, preferably less than 30°. Advantageously, the cam tracks 23 can be three, and they can be arranged at a constant angular pitch.

[0038] The reduction sleeve 25 further comprises a connection flange 27 for the connection of one or more actuating transmitters or tie-rods 29.

[0039] In the embodiment illustrated in the Figures, three tie-rods 29, in particular elongate flattened metal bars, are arranged at an angular pitch of 120° and extending in a direction parallel to the rotational axis R from the connection flange 27 along an external side of the electric motor 3 up to a Bowden connector 31 arranged at one side of the electric motor 3 opposite the decoupler 9 and connected to a Bowden cable 32 for the decoupler 9 manual actuation.

[0040] Furthermore, the reduction sleeve 25 may form at least one, preferably a plurality of rotation-preventing seats 28 engaging corresponding rotation-preventing portions, for example, rotation-preventing bars 30, of the support and housing structure 2 so as to prevent a rotation of the reduction sleeve 25 with respect to the support and housing structure 2, yet allowing a relative sliding thereof parallel to the rotational axis R.

[0041] In the areas between the connection flange 27, the cam tracks 23 and the rotation-preventing seats 28, the reduction sleeve 25 preferably forms lightening cavities to reduce the weight thereof and the material cost.

[0042] To each cam track 23, one of the above-mentioned levers 18 is associated, which can be hinged to the support and housing structure 2. The swivel axes 26 of the levers 18 are transversal, preferably perpendicular to the rotational axis R. Furthermore, the levers 18 are preferably constrained to be able to oscillate only in planes radial to the rotational axis R. This is an optimal condition to convert the cam 22 radial thrust against the levers 18 into an axial thrust of the levers 18 against the control sleeve 16.

[0043] The levers 18 form a first arm extending from the lever first end 20 to the fulcrum 19, and a second arm extending from the lever second end 21 to the fulcrum 19.

[0044] A first plane containing the swivel axis 26 and the lever first end 20 and a second plane containing the swivel axis 26 and the lever second end 21 include therebetween a lever angle ranging between 70° and 110°, preferably between 85° and 95°. The lever ratio between the first and second arms ranges between 1:1.8 ... 1:2.4 ... 1:3.0.

[0045] The first and second lever ends 20, 21 can comprise rollers for a rolling engagement with the respective cam track 23 and the control sleeve 16.

[0046] In accordance with an embodiment, the control surface 17 can be annular and circumferential with respect to the rotational axis R or, alternatively, discrete control surfaces 17 can be provided only at the through holes 12 receiving the locking members, e.g., spheres 15. In a cross-sectional plane radial to the rotational axis R, the control surface 17 has a first length 33 (locking length) substantially parallel to the rotational axis R and having a minimum distance from the rotational axis R (such as to prevent the locking spheres 15 from coming out from the locking cavities 14 of the second shaft 13), an intermediate length 34 (disengagement length) jointed to the first length 33 and inclined with respect to the rotational axis R such as to widen up to a third length 35 (release and containment length) substantially parallel to the rotational axis R and having a maximum distance from the rotational axis R (such as to allow the locking spheres 15 coming out from the locking cavities 14 of the second shaft 13 and such as to prevent them from completely coming out from the through holes 12 of the first shaft 10).

[0047] On a front side (the side of the third release and containment length 35), the control sleeve 16 forms a front surface 36 facing the first lever end(s) 20 and engageable thereby to push the control sleeve 16 out of the locking position.

[0048] According to a further aspect of the invention, the cam 22 forms a thrust surface 37 abutting, in a final stroke length between an intermediate position and the operative position of the cam 22, directly against the control sleeve 16 to push the control sleeve 16 to the release position without reducing the decoupling motion.

[0049] In this manner, decoupling occurs by an initial demultiplied thrust phase of the levers 18 with a high thrust force and a low sliding speed of the control sleeve 16, such as to overcome the friction of the locking members 15, and a successive direct end thrust phase of the cam 22 with a relatively low thrust force and a high sliding speed. This allows reducing the overall dimensions of the decoupler 9 to the bare minimum.

[0050] In the embodiment illustrated in Fig. 4, the thrust surface 37 is formed on a rear side of the cam 22, and precisely in the connection flange 27 of the reduction sleeve 25, and it is suitable to engage in a pushing contact, between the intermediate position and the operative position, a shoulder 38 of the control sleeve 16, for example, a steel elastic ring fitted in a circumferential groove, preferably on a rear side of the control sleeve 16

opposite the front side thereof.

[0051] According to an aspect of the invention, elastic means 39, 40 can be provided permanently urging the control sleeve 16 in the locking position and the cam 22 in the rest position. The elastic means 39, 40 can comprise a first spring 39 permanently urging the control sleeve 16 in the locking position, and a second spring permanently urging the cam 22 in the rest position.

[0052] Alternatively, a single spring permanently urges the cam 22 in the rest position and the cam 22 forms a further thrust surface suitable to abut against the control sleeve 16 to transmit the thrust of the single spring thereto.

[0053] In the embodiment illustrated in the Figures, the first spring 39 is connected while it is precompressed between a spring seat 42 of the connection flange 27 of the reduction sleeve 25 and the support and housing structure 2. Therefore, the first spring 39 does not rotate together with the first or second shafts; instead, it remains stationary and integrally in rotation together with the reduction sleeve 25 and the housing 2.

[0054] The second spring 40 is connected while it is precompressed between a rear end of the control sleeve 16 and a shoulder 43 of the first shaft 10, for example, a steel elastic ring in fitted in a circumferential groove of the first shaft 10. Therefore, the second spring 40 rotates together with the second shaft and, where applicable, to the control sleeve 16. Both springs 39, 40 push the reduction sleeve 25 and the control sleeve 16 in the same direction (towards the front side thereof).

[0055] While it is not crucial, in order to avoid the noise, at least one third spring 41 may be provided, permanently urging the lever 18 to rest against the cam 22.

[0056] The decoupler 9 operates as follows: by actuating the Bowden cable by a manual emergency lever arranged in the public transport means, the reduction sleeve 25 translates from the rest position thereof to the operative position, thus displacing the lever 18 that pushes the control sleeve 16 (with a multiplied force and a demultiplied speed) from the locking position along an initial stroke length towards the release position. In this initial length, the frictional resistance of the locking spheres 15 is overcome, and a space begins being created, for a displacement thereof in the radially outer position, in an intermediate position of the stroke of the reduction sleeve 25 the latter abuts directly against the control sleeve 16 and pushes it (without a demultiplied force) in the release position that allows the locking spheres 15 completely coming out from the locking cavities of the second shaft 13. Such getting out is simplified by the inclination of the edges of the locking cavity 14 that, in the case of a relative rotation between the two shafts (due to the manual thrust against the vehicle door) exert a wedge effect on the spheres, thus pushing them outwardly. By releasing the Bowden cable, the springs 39, 40 urge the control sleeve and the reduction sleeve to their respective locking and rest positions, and by aligning the locking cavities with the through holes, the locking spheres are automatically pushed back to their radially inner position.

[0057] In accordance with an embodiment, the reduction unit 4 may comprise a first reduction gear 44, for example, an epicycloidal gear, and a second reduction gear, for example, an epicycloidal gear, and the decoupler is arranged between the first 44 and the second 45 reduction gears. In particular the first shaft 10 is coupled integrally in rotation to an output shaft 46 of the first reduction gear 44, e.g., the tubular wall 11 is inserted on the output shaft 46 and locked therewith by a locking tab 47. The second shaft 13 is formed directly by the toothed input shaft 48 of the second reduction gear 45.

[0058] An automatic locking brake (elastically preloaded) with an electromagnetic release, the so-called negative brake, is associated to the drive shaft, preferably on the opposite side of the electric motor 3 with respect to the reduction unit 4, to preserve the rotating position of the actuator 1 and to prevent the door from opening when the actuator is turned off.

[0059] The housing 2 may comprise, in the proximity of the Bowden connector 31, an inspection opening that may be closed by a lid 54.

[0060] In accordance with embodiments:

[0061] - the housing 2 of the rotary actuator 1 is an integral part of the rotating column 50 of the entry/exit device, e.g., of a door 52, and it rotates together with the rotating column 50, while the output shaft 8 is constrained integrally in rotation with a frame 51 of the vehicle, e.g., for internal roto-translating doors (Figs. 10, 11A);

[0062] - the housing 2 of the rotary actuator 1 comprises a connecting portion for a connection integrally in rotation with a frame 51 of the vehicle, while the output shaft 8 is constrained integrally in rotation with the rotating column 50 of the door 52, for example, for external roto-translating doors (Fig. 11B).

[0063] In accordance with a further embodiment (Figure 1A, 3), the output shaft 8 may form a helicoidal cam 53 suitable to engage the rotating column (when the actuator is stationary constrained to the frame 51) or the frame 51 (when the actuator is supported so as to rotate together with the rotating column 50) for lifting the door 52 in the closed position, in which a further rotation of the output shaft 8 involves a translation (of the linear screw-nut actuation type) of the component connected thereto. In particular, in a first closure step, the weight force of the door prevents a rotation between the helicoidal cam 53 of the output shaft 8 and the column or frame constrained thereto (with a connection of the screw-nut type), and when the door reaches its closure abutment, the torsion transmitted by the output shaft 8 to the door exceeds the reaction torque generated by the door weight and lifts it to the locking position preventing its opening.

[0064] In this manner, the rotary actuator 1 provides for both the rotation and the translation of the door in due distinct steps, hence it provides for the orientation, locking lifting and release lowering of the door on which it is

mounted.

[0065] It shall be apparent that, to the rotary actuator and the decoupler according to the present invention, those of ordinary skill in the art, in order to meet contingent, specific needs, will be able to make further modifications and variations, all of which fall in any case within the protection scope of the invention, as defined by the following claims.

Claims

1. A rotary actuator (1) for an entry/exit device, in particular orientable and/or translatable door (52) or ramp and the like in public transport vehicles, the actuator comprising a support and housing structure (2), an electric motor (3), a reduction unit (4) connected to the motor (3), and a decoupler (9) connected to the reduction unit (4), and comprising:

   - a first shaft (10) having a tubular wall (11) forming an inner cavity and one or more through holes (12),
   - a second shaft (13) received in the inner cavity of the tubular wall (11) rotatably about a rotational axis (R) and forming one or more locking cavities (14) in a position suitable to overlap with the through holes (12),
   - one or more locking members (15) received in the through holes (12) of the tubular wall (11) and displaceable between a radially inner position in engagement with the through hole (12) and with the locking cavity (14), preventing the relative rotation between the first shaft (10) and the second shaft (13), and a radially outer position outside the locking cavities, allowing the relative rotation between the first shaft (10) and the second shaft (13),
   - a control sleeve (16) inserted on the tubular wall (11) and axially slidable between a locking position and a release position, in which a control surface (17) of the control sleeve (16) faces the through holes (12) and is shaped so that, when the control sleeve (16) is in the locking position, the control surface (17) locks the locking members (15) in the radially inner position and, when the control sleeve (16) is in the release position, the control surface (17) allows displacing the locking members (15) in the radially outer position,
   - a cam (22) displaceable from a rest position to an operative position and at least one lever (18) rotatable about a fulcrum (19) and having a first end (20) for engaging the control sleeve (16) and a second end (21) in contact with the cam (22) so that the displacement of the cam (22) from the rest position to the operative position pushes the lever second end (21) in a direction transversal to the rotational axis (R) and the lever first end (20) pushes the control sleeve 16 from the locking position along at least one initial stroke length towards the release position.

2. The rotary actuator (1) according to claim 1, wherein:

   - a first distance between the lever first end (20) and the fulcrum (19) is less than a second distance between the lever second end (21) and the fulcrum (19),
   - a surface or cam track (23) of the cam (22) engaged by the lever second end (21) is inclined so that the stroke of the lever second end (21) is less than the corresponding stroke of the cam (22).

3. The rotary actuator (1) according to one of the previous claims, wherein the cam (22) comprises a reduction sleeve (25) inserted on the control sleeve (16) and axially slidable between the rest position and the operative position, said reduction sleeve (25) forming a plurality of ramp-shaped cam tracks (23), inclined with respect to the rotational axis (R) by an inclination angle less than 45°, preferably less than 30°.

4. The rotary actuator (1) according to claim 3, in which the reduction sleeve (25) comprises a connection flange (27) for the connection of one or more tie-rods (29) extending from the connection flange (27) along an external side of the electric motor (3) up to a Bowden connector (31) arranged on a side of the electric motor (3) opposite the decoupler (9) and connected to a Bowden cable (32) for the manual actuation of the decoupler (9).

5. The rotary actuator (1) according to claim 3 or 4, in which the reduction sleeve (25) forms one or more rotation-preventing seats (28) engaging corresponding rotation-preventing portions (30) of the support and housing structure (2) so as to prevent a rotation of the reduction sleeve (25) with respect to the support and housing structure (2), yet allowing a relative sliding thereof parallel to the rotational axis (R).

6. The rotary actuator (1) according to one of the previous claims, wherein the levers (18) are orientable in planes that are radial to the rotational axis (R) and form a first arm extending from the lever first end (20) to the fulcrum (19) and a second arm extending from the lever second end (21) to the fulcrum (19) and a first plane containing the swivel axis (26) and the lever first end (20) and a second plane containing the swivel axis (26) and the lever second end (21) include therebetween a lever angle ranging between 70° and 110°, preferably between 85° and 95°.

7. The rotary actuator (1) according to claim 6, in which the lever ratio between the first and second arm ranges between 1:1.8 ... 1:2.4 ... 1:3.0.

8. The rotary actuator (1) according to one of the previous claims, wherein the first and second lever ends (20, 21) comprise rollers for a rolling engagement with the cam (22) and the control sleeve (16).

9. The rotary actuator (1) according to one of the previous claims, wherein the cam (22) forms a thrust surface (37) abutting, in a final stroke length between an intermediate position and the operative position of the cam (22), directly against the control sleeve (16) to push the control sleeve (16) to the release position without the reduction of the decoupling motion.

10. The rotary actuator (1) according to one of the previous claims, comprising elastic means (39, 40) permanently urging the control sleeve (16) in the locking position and the cam (22) in the rest position.

11. The rotary actuator (1) according to claim 10, wherein the elastic means (39, 40) comprise:

- a first spring (39) precompressed between a spring seat (42) on a rear side of the reduction sleeve (25) and the support and housing structure (2), and
- a second spring (40) precompressed between a rear end of the control sleeve (16) and a shoulder (43) of the first shaft (10),

in which said first (39) and second (40) springs push the reduction sleeve (25) and the control sleeve (16) in the same direction towards a front side thereof.

12. The rotary actuator (1) according to one of the previous claims, wherein the decoupler is arranged between a first reduction gear (44) and a second reduction gear (45) of the reduction unit (4).

13. The rotary actuator (1) according to one of the previous claims, comprising an automatic locking brake that is releasable electrically, associated to the shaft motor on a side of the electric motor (3) opposite the reduction unit (4).

14. The rotary actuator (1) according to one of the previous claims, comprising an output shaft (8) connected to the reduction unit (4), wherein said output shaft (8) forms a helicoidal cam (53) suitable to engage a rotating column or the frame (51) of a door (52) by a screw-nut coupling for rotating the door (52) from an open position to a closed position and a successive lifting of the door (52) from the closed position to a locking position.

15. The rotary actuator (1) according to one of the previous claims, wherein the support and housing structure (2) is part of a rotating column (50) of a door (52) and rotates together with the rotating column (50), while the output shaft (8) is constrained integrally in rotation to a frame (51) of the door or, alternatively, wherein the support and housing structure (2) is connected integrally in rotation with the frame (51) of the door (52), while the output shaft (8) is constrained integrally in rotation with the rotating column (50) of the door (52).

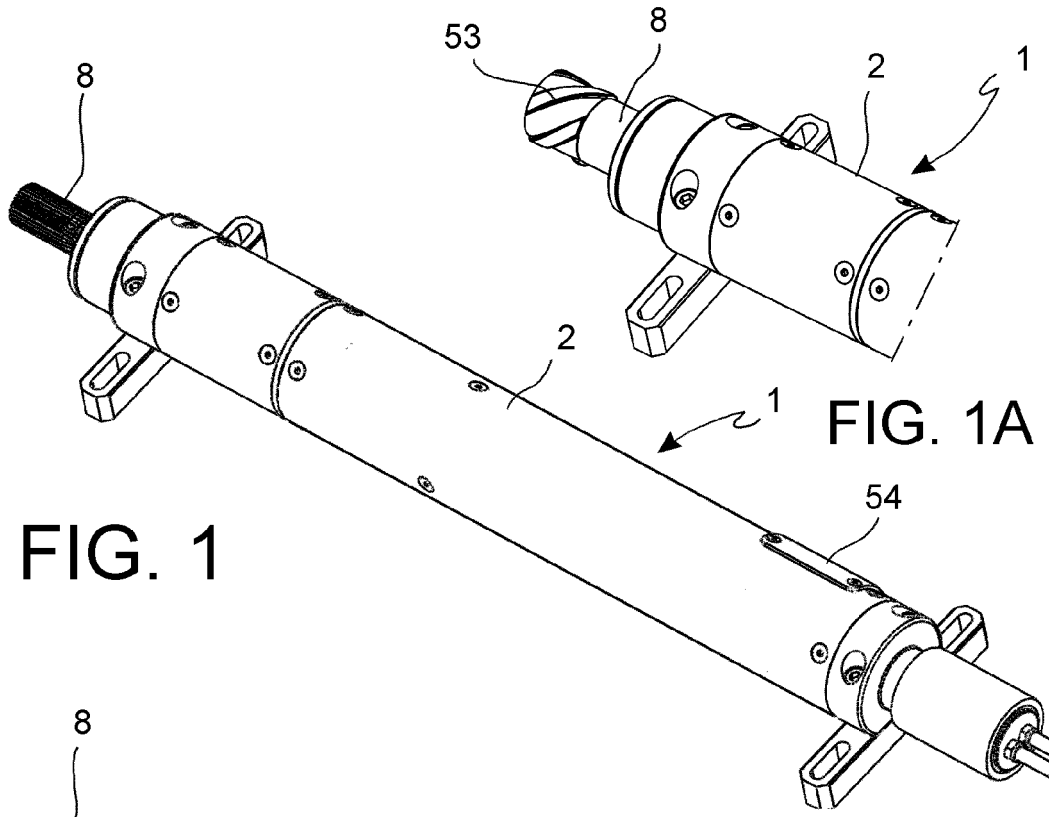

FIG. 1A

FIG. 1

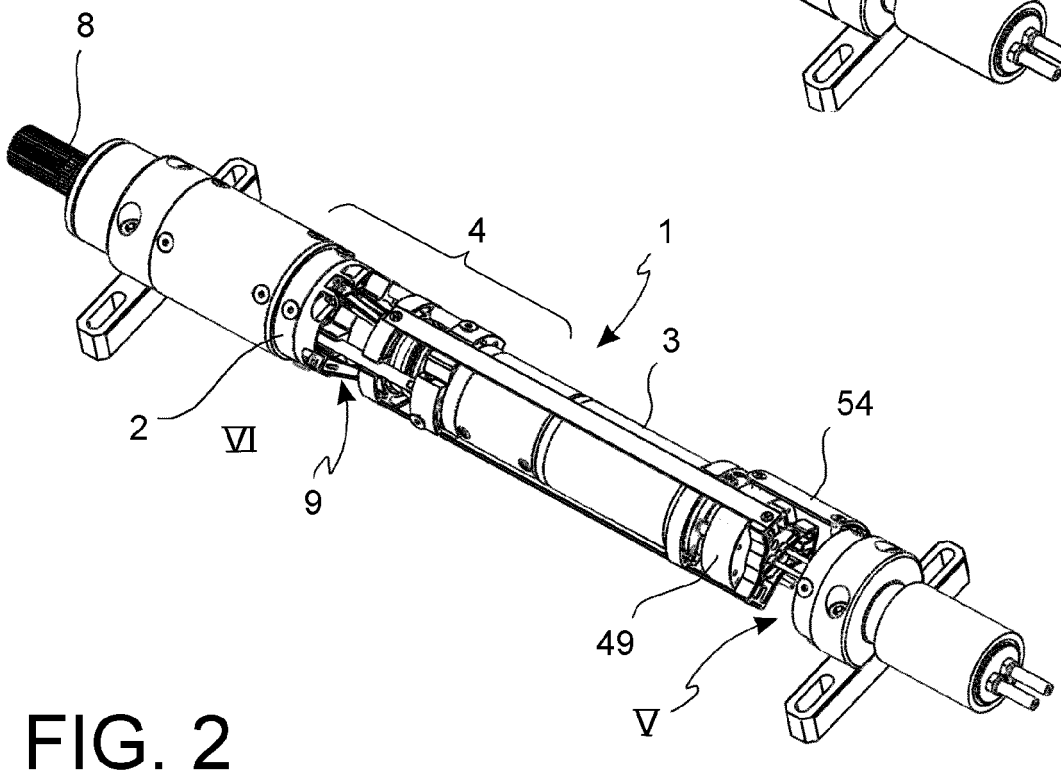

FIG. 2

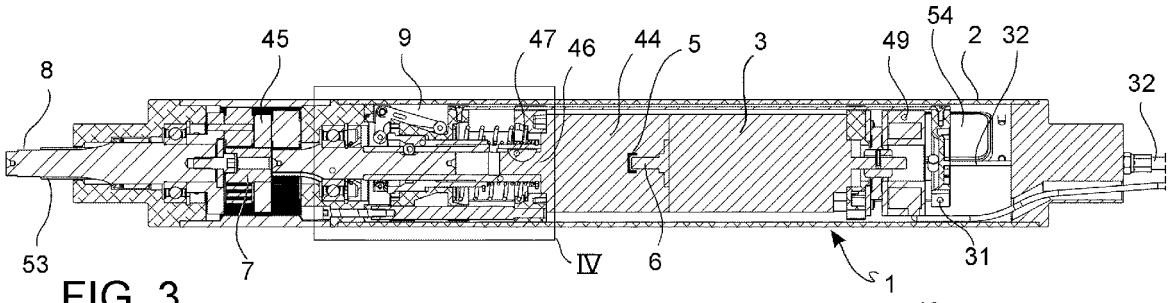
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FIG. 3

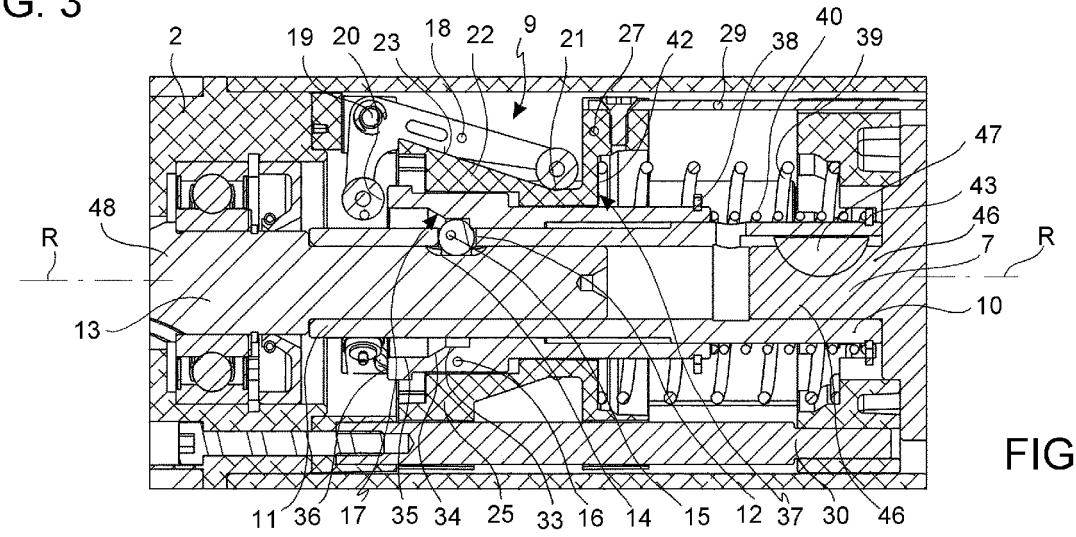
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FIG. 4

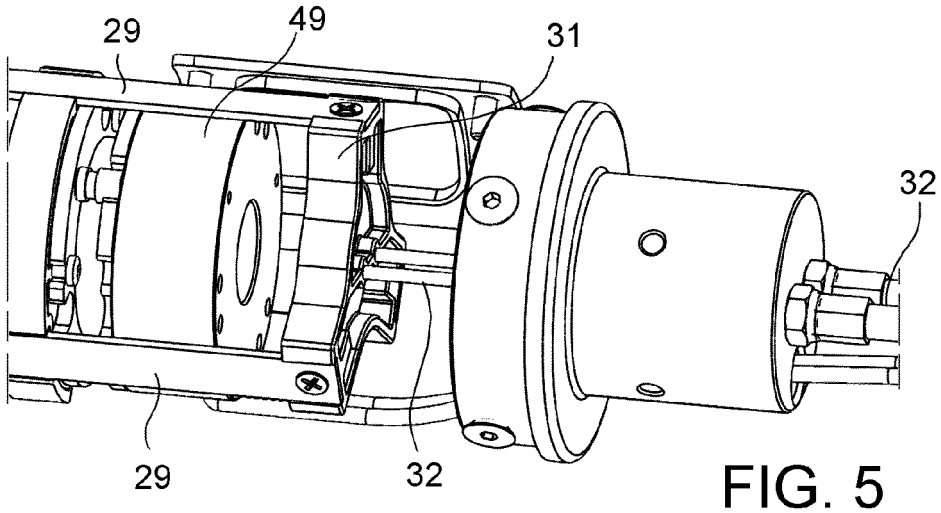

FIG. 5

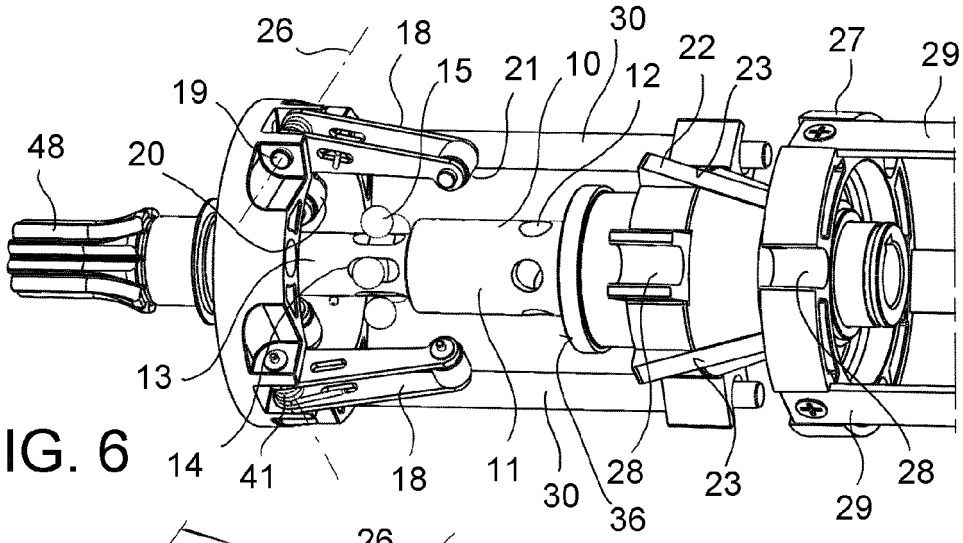

FIG. 6

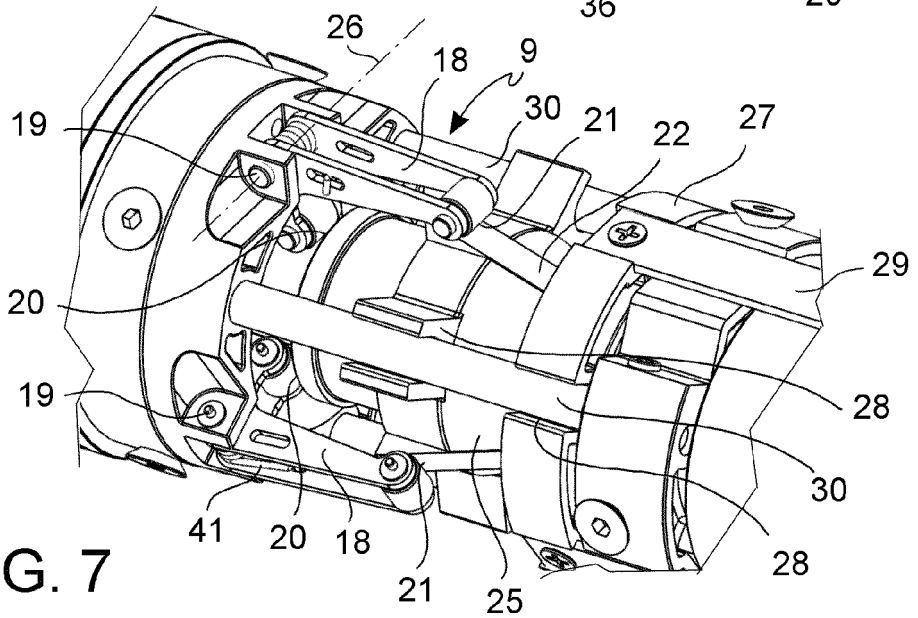

FIG. 7

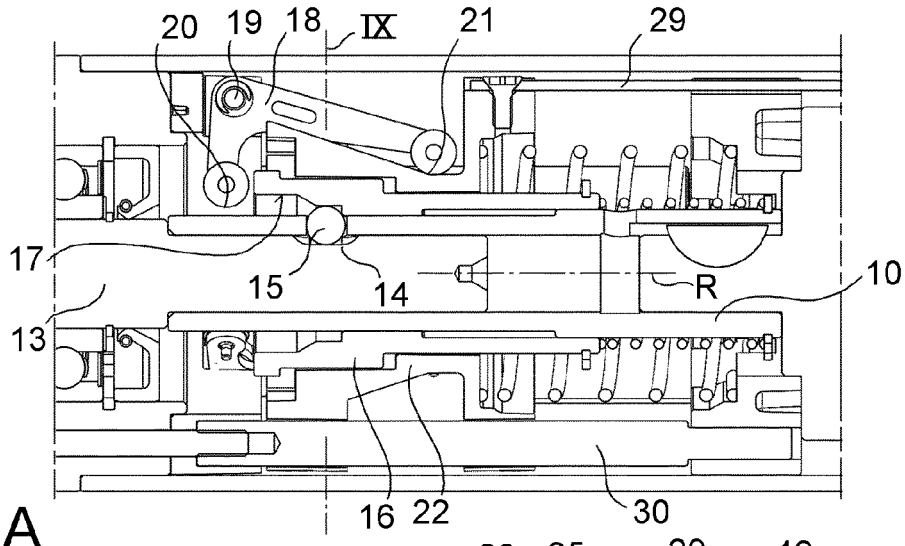

FIG. 8A

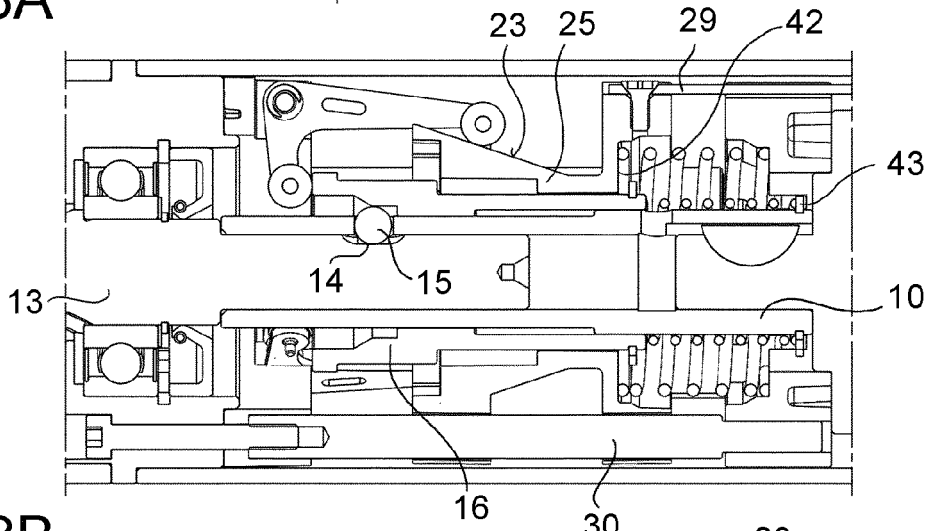

FIG. 8B

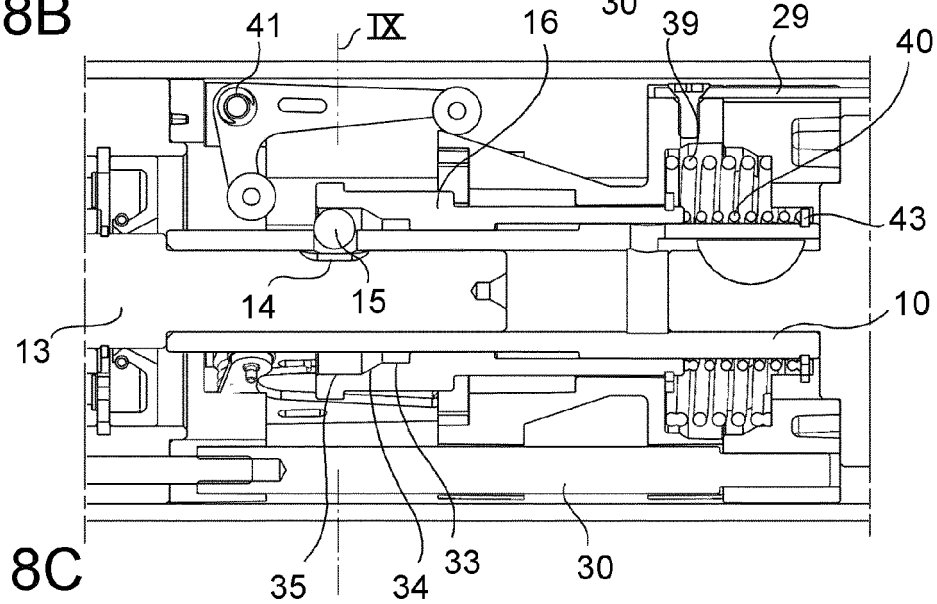

FIG. 8C

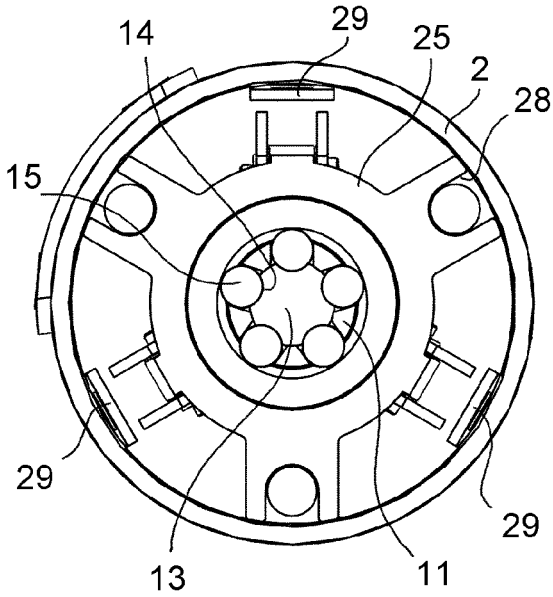

FIG. 9A

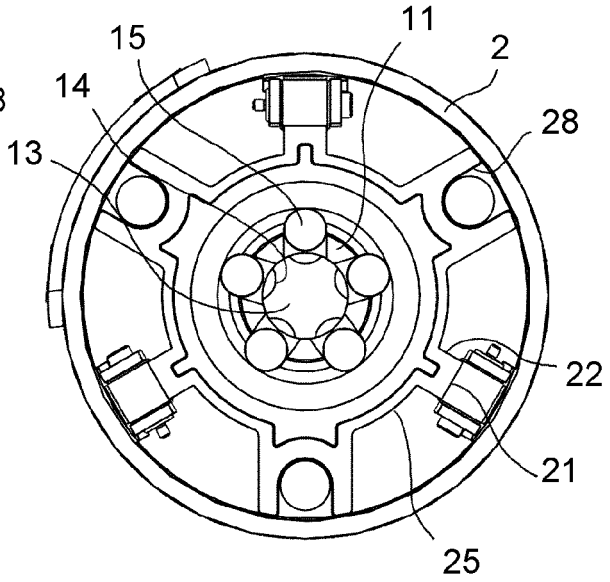

FIG. 9B

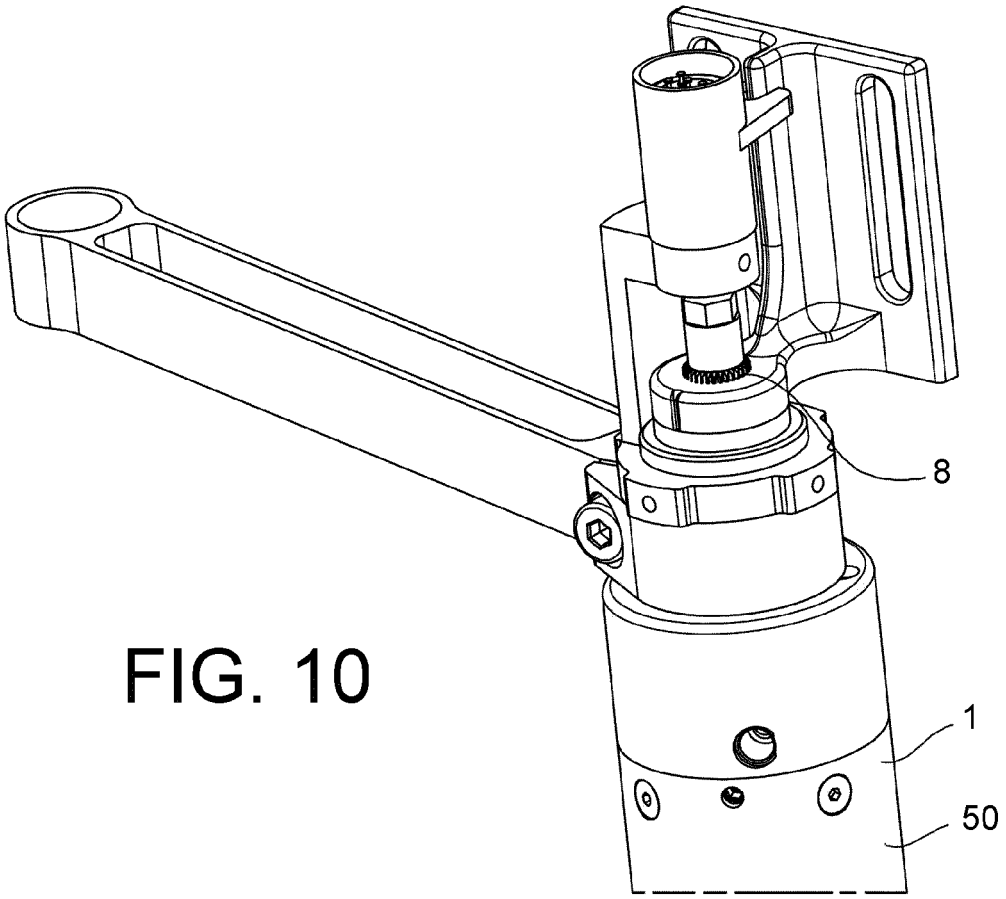

FIG. 10

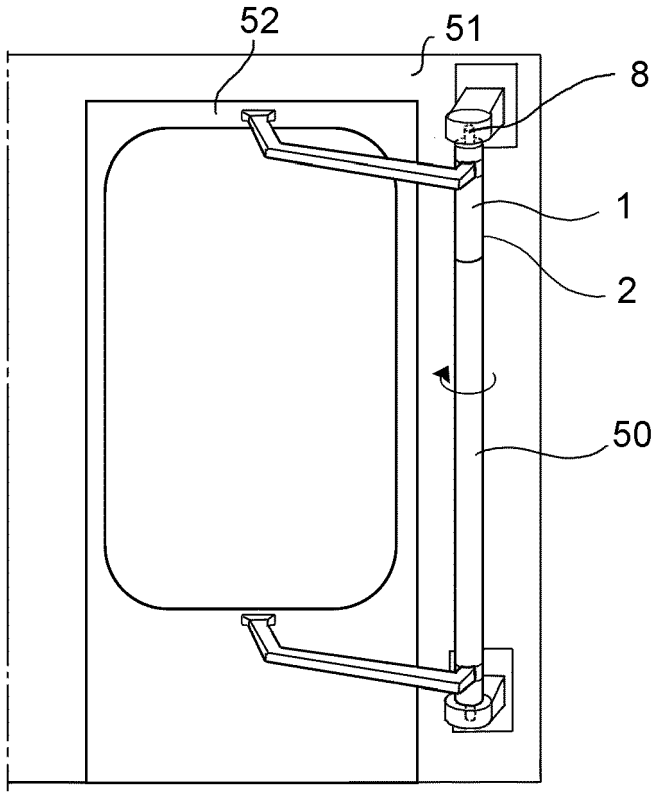

FIG. 11A

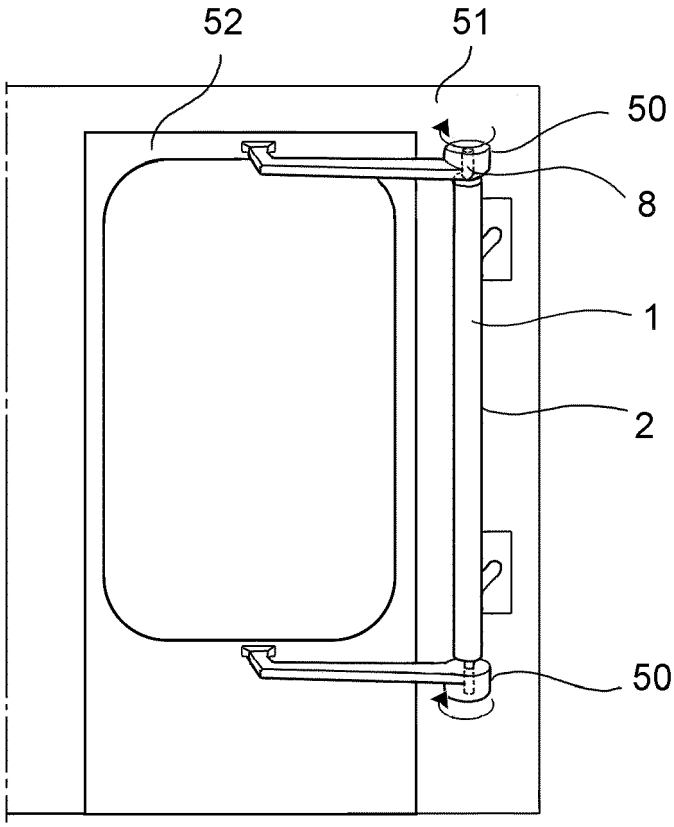

FIG. 11B

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EUROPEAN SEARCH REPORT

Application Number
EP 13 42 5075

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 0 217 228 A2 (BODE & CO GEB [DE]) 8 April 1987 (1987-04-08) * paragraphs [0017] - [0026]; figures 1,3,5,7 *	1-15	INV. E05F15/00 E05F15/04 E05F15/12 E05D15/30

TECHNICAL FIELDS SEARCHED (IPC)

E05F
E05D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	23 August 2013	Berote, Marc

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