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(54) EARTHING SWITCH AND SWITCHGEAR COMPRISING SUCH SWITCH

(57) The present invention relates to an earthing switch (1) for a medium voltage switchgear wherein said earthing switch comprises a frame (5) supporting a mechanism (4) for rotating a plurality of moving contacts (2) between a first reference position and a second reference position. Said mechanism comprises a first shaft (11) on which the moving contacts (2) are rigidly mounted, said first shaft (11) rotating around a longitudinal axis (101) in a closing direction (W1) for which said moving contacts (2) reach said second reference position and in an opening direction (W2) for which said moving contacts (2) reach said first reference position. According to the invention, the mechanism comprises also a second shaft (12) coaxial to said first shaft (11) and connectable to an operating mechanism for the control of said second shaft (12). The mechanism further comprises first coupling means (15A, 15B) of said shafts (11,12) configured so that said second shaft (12) is free to rotate with respect to said first shaft (11), for at least a first rotational phase, when said second shaft (12) rotates according to said closing direction (W1). Said mechanism also comprises spring means (13A,13B) operatively connected to said first coupling means (15A, 15B), wherein said spring means (13A, 13B) are loaded during said first rotational phase and release their elastic energy on the two shafts (11, 12) by means of said first coupling means (15A, 15B) when said first rotational phase has been completed.

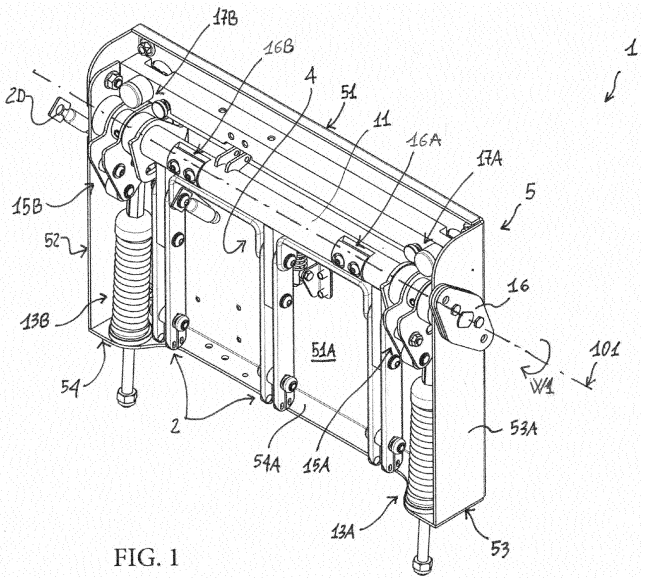

FIG. 1

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Description

[0001] The present invention relates to an earthing switch assembly for medium-voltage applications. More particularly, the present invention relates to an earthing switch of a medium voltage electric switchgear.

[0002] Electric switchgears are well known in electric power transmission and distribution grids. They usually comprise a metallic cabinet internally divided into several compartments or cells accommodating various apparatuses and equipment. In many applications, electric switchgears include a switching apparatus (e.g. a circuit breaker) of the withdrawable type, i.e. reversibly movable between a first position (inserted position), in which the switching apparatus is electrically connected with the disconnection contacts of the switchgear, and a second position (withdrawn position), in which the switching apparatus is electrically disconnected from said disconnection contacts.

[0003] Electric switchgears of the above-mentioned type generally include also an earthing switch assembly. The latter typically comprises an earthing switch, an operating mechanism for controlling the earthing switch and mechanical connection means, typically connection levers, which operatively connect the earthing switch to the operating mechanism. More precisely, the earthing has the general purpose of earthing the cables or the main bars. An earthing switch comprises a mechanism for moving a plurality of moving contacts between a first reference position, characteristic of an open condition of the switch, and a second reference position characteristic of a closing condition of the earthing switch. In the second reference position, the moving contacts engage fixed contacts each of one electrically connected an electric line.

[0004] In some known solutions, the mechanism comprises a shaft on which the moving contacts are rigidly mounted. The shaft rotates about a longitudinal axis so that also the moving contacts can rotate correspondingly between said reference positions. The rotation in a first direction identifies a closing movement of the earthing switch, while the rotation in a second direction (opposite to the first one) identifies an opening movement of the earthing switch.

[0005] The rotation of the shaft is controlled by an operating mechanism above cited. The latter typically comprises an actuating element on which an operator can intervene to change the condition of the earthing switch. For safety reasons, the actuating element is located far enough away from the earthing switch (1000-2000 mm) and it is operatively connected to the shaft of the earthing switch mechanism by connection means. According to a known embodiment, the actuating element is a rotating disk and connected to the main shaft of the earthing switch mechanism by means of a control lever. A rotation of the disk, caused by an action on the lever, results into a rotation of the shaft of the earthing switch mechanism. The control lever movable from a first end position to a second position which correspond, respectively, to said opening condition and to said closing condition of the earthing switch.

[0006] Usually, the mechanism comprises spring means operatively connected to the shaft that supports the moving contacts. The spring means are loaded during a first phase of the closing movement, i.e. during a first phase of rotation of the shaft and of the moving contacts mounted thereof. As soon as the rotation angle overcome a pre-established value, the spring means discharge their elastic energy on the shaft so as to bring the moving contacts instantly and correctly in the second reference position, i.e. in electrical connection with the fixed contacts.

[0007] Therefore, it is possible to identify a first phase of the closing movement which is completed by means of an action of an operator, i.e. a phase totally controlled by an operator, and a second phase, subsequent to the first one, that is carried out exclusively by the spring means, i.e. a phase that cannot be controlled by the operator anymore.

[0008] As a matter of fact, the first phase depends exclusively on the will of the operator. That means, after having gripped the control lever and begun its opening movement from the first position (opening condition) to the second position (closing condition), the operator could change his mind and decide to bring back the lever in the first position. However, in some operative condition of the switchgear this decision could be very dangerous.

[0009] Indeed, during the first phase of the rotation, the moving contacts are rotated in direction of the fixed contacts, i.e. they are approached to the fixed contacts. If one or more apparatus of the switchgear is working, i. e. if some parts are under voltage, also a rotation of initial rotation of the shaft (within said first phase) could be sufficient, in case of a line overvoltage, to trigger an electric arc between the moving contacts and the fixed contacts. Therefore, if the operator decides to stop the closing movement and to restore the opening condition of the earthing switch, this could lead to an extension of the electric arc with unpredictable consequences.

[0010] Consequently, a new solution that avoids the formation of an electric arc during the closing movement of the moving contacts, more precisely during the phase of the movement depending on the operators, is needed. A possible solution, could be that of making the closing movement totally independent from the operator. However, this solution can be adopted only for a circuit breaker whose operating mechanism is very close thereof, but not in the case of an earthing switch wherein the movement of the moving contacts is determined by means of an operating mechanism installed in a position remarkably away from the earthing switch. As a fact, the function of the earthing switch and the arrangement of the operating mechanism thereof require necessarily that at least a phase of the closing movement is dependent, i.e. controlled by an operator. On the other hand, an earthing switch provided with elastic spring means and able to

performed a closing movement totally independent would require large spaces and a complex design of the entire switchgear. This aspect would result into remarkable costs.

SUMMARY

[0011] The main aim of the present invention is providing an earthing switch, which makes it possible to overcome or mitigate the aforementioned problems of the known art.

[0012] In the context of this aim, an object of the present invention is providing an earthing switch that make it possible to contain the electric arc that could develop, in case of a line overvoltage, during the phase of the closing movement controlled by the operator.

[0013] Another object of the present invention is providing an earthing switch easy to manufacture at industrial level, at competitive costs with similar installations of the state of the art.

[0014] This aim and these objects, together with other objects that will become evident from the following description and accompanying drawings, are achieved, according to the present invention, by an earthing switch, according to claim 1 and the related dependent claims set out below.

[0015] In a general definition, the earthing switch, according to the invention, comprises:

- a plurality of moving contacts and a plurality of fixed contacts;
- a frame supporting a mechanism for rotating the moving contacts between a first reference position, at which they are separated from said fixed contacts, and a second reference position at which they are electrically connected to said fixed contacts, wherein said mechanism comprises a first shaft on which the said moving contacts are rigidly mounted, said first shaft rotating around a longitudinal axis in a closing direction for which said moving contacts reach said second reference position and in an opening direction for which said moving contacts reach said first reference position.

[0016] According to the invention the mechanism comprises:

- a second shaft coaxial to the first shaft and connectable to an operating mechanism for the control of the second shaft, wherein said first shaft is internally hollow and defines a longitudinal cavity inside which said second shaft is at least partially arranged,
- first coupling means of said shafts configured so that the second shaft is free to rotate with respect to said first shaft, for at least a first rotational phase, when the second shaft rotates according to said closing direction starting from said first reference position; said first coupling means are configured so as to make the shafts rotationally connected after the first rotational phase is completed.
- spring means operatively connected to said first coupling means, wherein said spring means are loaded during said first rotational phase and release their elastic energy on the two shafts by means of said first coupling means when said first rotational phase has been completed.

[0017] Preferably, in the first reference position, the moving contacts lay on a first reference plane and in said second reference position said moving contacts lay substantially on a second reference plane, wherein said reference planes are mutually orthogonal.

[0018] According to a possible embodiment of the invention, the frame comprises a main wall and two side walls which develop from the main wall at opposite ends so as to face each other; said main wall comprises an inner surface to which the mechanism is faced. The two side walls support the shafts at opposite ends so that said longitudinal axis is substantially parallel to the main wall.

[0019] According to a preferred embodiment, the first coupling means comprise a first coupling assembly and a second coupling assembly operatively arranged at opposite terminal parts of the two shafts. The spring means comprises a first spring assembly and a second spring assembly, wherein said first coupling assembly interacts with said first spring assembly and said second coupling assembly interacts with said second spring assembly.

[0020] Preferably, at least one of the coupling assembly includes:

- a first cam portion rigidly connected to the first shaft and comprising a first slot through the entire longitudinal thickness of said first cam portion, said first slot developing according to a curved profile;
- a second cam portion rigidly connect to said second shaft and comprising a second slot which develops through the entire longitudinal thickness of said second cam portion, said second slot developing according to a curved profile, said first slot and said second slot being only partially overlapped with respect to a lateral view of the mechanism;
- a transmission pin longitudinally inserted in said first slot and in said second slot, wherein said transmission pin is operatively connected to a spring assembly of said spring means so that said spring assembly is loaded or release its elastic energy as a function of the position of said pin.

[0021] According to a possible embodiment, the spring assembly comprises a rod hinged to the pin so as to rotate about an axis parallel to said longitudinal axis, said rod comprising an abutment portion on which a first end of a spring element abuts on, such spring element comprising a second end which abuts on a portion of said frame.

[0022] According to a preferred embodiment, the earthing switch further comprises second coupling means that operatively connect the second shaft to the first shaft when the moving contacts reach the second reference position; the second coupling means making the first shaft rigidly connected to the second shaft during the rotation in said opening direction.

[0023] According to a possible embodiment, the second coupling means comprises:

- a plurality of pushing plates rigidly connected to the external surface of the second shaft, wherein each of said pushing plates comprises a longitudinal edge;
- a plurality of openings defined through the external surface of the first shaft, each of said openings comprising a longitudinal edge;

wherein, when said moving contacts reach said first reference position, said longitudinal edge of each pushing plates abuts against a corresponding longitudinal edge of a corresponding opening.

[0024] Preferably, the earthing switch comprises elastic means operatively arranged between said frame and said first shaft, wherein said elastic means exert a force that opposes to the closing movement to avoid any oscillation/vibration of the first shaft during the first rotational phase, in the closing direction, of said second shaft.

[0025] Preferably, the earthing switch is provided with first damping means installed on said frame in order to damp the closing movement of the two shafts when the moving contacts reach the second reference position.

[0026] According to a possible embodiment, the damping means comprise a first damping assembly which interacts with a first coupling assembly and a second damping assembly which interacts with a second coupling assembly of said first coupling means, wherein each of said damping assembly is installed on the frame.

[0027] Preferably, at least one of said damping assemblies comprises a first damper element and a second damper element that provide an abutment surface, respectively, for the first cam portion and for the second cam portion of a corresponding coupling assembly.

[0028] Preferably, the earthing switch comprises stopping means connected to the frame in order to stop the opening movement of the two shafts when the moving contacts reach the first reference position.

[0029] According to a possible embodiment, the transmission pin is inserted in a rotating bushing that can rotate with respect to the same pin sliding on the surfaces of said slots.

[0030] According to another possible embodiment, a pin holder portion is mounted on said first shaft in a longitudinally position comprised between said first cam portion, rigidly connected to the first shaft, and said second cam portion, rigidly connected to the second shaft, said pin holder portion comprising a through hole in which a section of said pin is inserted.

DRAWINGS

[0031] Further characteristics and advantages of the invention will emerge from the description of preferred, but not exclusive embodiments of an earthing switch according to the present disclosure, non-limiting examples of which are provided in the attached drawings, wherein:

- figure 1 is a view of an embodiment of the earthing switch according to the invention in an opening condition;
- figures 2 is a front view of the earthing switch of Figure 1;
- figures 3 and 4 are two opposite side views of the earthing switch of figure 1;
- figure 5 is a view of the earthing switch of figure 1 in a closing condition;
- figure 6 and 7 are two opposite side views of the earthing switch of figure 5;
- figure 8 is a top view of the earthing switch of figure 5;
- figure 9 and 10 are prospective view of components of the earthing switch of figure 8;
- figure 11 is an exploded view of the earthing device of Figure 8;
- figure 12 is a detail of the earthing switch of Figure 8;
- figure 13 is a section view of the detail of figure 12;
- figure 14 is a perspective view of some components of the earthing switch of Figure 8;
- figure 15 and 16 show respectively a first group and a second group of the components shown in Figure 14;
- figure 17 is a section view of a mechanism of the earthing switch of figure 1 according to the section line C-B of Figure 8;
- figures 18-19 are section views of a mechanism of the earthing switch of figure 1 according to the section line C-A of Figure 8 each referred to an instant of a closing movement of the earthing switch from the opening condition to the closing condition;
- figures 20-21 are perspective views of a mechanism of the earthing switch of figure 1 each of which relative to an instant of a closing movement of the earthing switch from the opening condition to the closing condition;
- figure 22-26 are views of the mechanism of the earthing switch of figure 1 each of one referred to a different instant of an opening movement of the earthing switch from the closing condition to the opening condition.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

[0032] Referring to the above-mentioned figures, the present invention relates to an earthing switch 1 for medium-voltage applications. For the purposes of the present invention, the term "low voltage" (LV) relates to operating voltages lower than 1 kV AC whereas the term

"medium voltage" (MV) relates to operating voltages higher than 1 kV up to some tens of kV, e.g. 52 kV AC.

[0033] The earthing switch 1 comprises a frame 5 supporting a mechanism 4 configured for moving a plurality of moving contacts 2 with respect to fixed contacts 3 (schematically shown only in figures 6 and 7). More precisely, the mechanism 4 is configured to rotate the moving contacts 2 between a first reference position, at which the moving contacts 2 are separated and away from the fixed contacts 3, and a second reference position at which the moving contacts 2 are electrically connected to the fixed contacts 3. Therefore, the first reference position and the second reference position identify, respectively, an open condition and a closing condition of the earthing switch 1.

[0034] Figures 1-4 show a possible embodiment of the earthing switch 1 in the open condition, while Figures 5-8 show the same switch 1 in the closing condition. According to the invention, the mechanism 4 comprises a first shaft 11 (named also as *"conducted shaft 11"*) rotating about a longitudinal axis 101. The moving contacts 2 are rigidly mounted on the first shaft 11 so as to be rotated between said reference positions. More precisely, according to a closing movement of the earthing switch 1, the first shaft 11 is rotated in a first direction W1 (or closing direction W1) so that the moving contacts 2 rotate from the first reference position to the second reference position (see Figure 1). According to an opening movement of the earthing switch 1, the first shaft 11 can be rotated in a second direction W2 (or opening direction W2), so that the moving contacts 2 rotate from the second reference position to the first reference position (see Figure 5).

[0035] According to the present invention, the mechanism 4 also comprises a second shaft 12 (named also *"conductor shaft 12"*) coaxial to the first shaft 11, i.e. rotating about said axis 101. As below better clarified, the second shaft 12 is connectable to an operating mechanism (not shown in the figures) which is controlled by an operator.

[0036] The first shaft 11 is internally hollow preferably along its entire longitudinal length. The second shaft 12 is arranged, at least partially, in the longitudinal cavity of the first shaft 11. In particular, bearing means (not shown in the figures) support the second shaft 12 in such a longitudinal cavity allowing the rotation of the second shaft 12 with respect to the first shaft 11.

[0037] The mechanism 4 comprises first coupling means 15A, 15B between the two shafts 11, 12. The coupling means are configured so that the second shaft 12 is free to rotate, for a first rotation phase (i.e. for a preestablished rotation angle), with respect to the first shaft 11 when its direction of rotation corresponds to said closing direction W1. After such a first rotation phase is completed, the coupling means make the shafts 11, 12 rotationally engaged (rigidly coupled in rotation) so that they can rotate synchronously around the common axis 101. Therefore, due to the coupling means, the two shaft 11, 12 rotate together only after the second shaft 12 has completed a preestablished rotation angle, indicate with α_1 in Figure 18. Such an angle α_1 defines the first rotation phase during which the first shaft 11 does not rotate, i.e. during which the moving contacts 2 keep the first reference position (open condition of the switch 1).

[0038] According to the invention, the mechanism 4 also comprises spring means 13A, 13B that are loaded by the second shaft 12 during its first rotation phase and that discharge their load (i.e. release their elastic energy) on the shafts 11, 12 after that the first rotation phase is completed, that is when the two shafts 11, 12 are rotationally engaged by means of the first coupling means 15A, 15B. When the spring means 13A, 13B discharge their elastic energy, the moving contacts 2 are rotated with the first shaft 11 so as to reach the second reference position, i.e. so as to close the switch 1.

[0039] According to a preferred embodiment, in the first reference position (switch 1 opened) the moving contacts 2 lay substantially on a first reference plane PV, for example a vertical plane. In the second reference position (switch 1 closed) the moving contact 2 lay substantially on a second reference plane PH (ad example horizontal) which is orthogonal to the first reference plane PV. Therefore, during the closing movement and following the release of the elastic energy of the spring means 15A, 15B, the moving contacts 2 are rotated of an angle of 90 degree.

[0040] According to a possible embodiment, the frame 5 comprises a main wall 51 and two side walls 52, 53 which develop from said main wall 51 at opposite ends so as to face each other. The main wall 51 comprises an inner surface 51A to which the mechanism 4 is faced. The two side walls 52, 53 support the shaft 11, 12 at opposite ends. Preferably, the two side walls 52, 53 develop orthogonally from the inner surface 51A of the main wall 51 (see for example figures 1 and 8). The longitudinal axis 101 of the two shafts 11, 12 is substantially orthogonal to the side walls 52,53 and parallel to the main wall 51. The frame 5 also comprises a bottom wall 54 with an inner surface 54A (facing the mechanism 4) useful for loading the spring means as below better described.

[0041] According to a possible embodiment, the moving contacts 2 protrude radially from the main shaft 12 on a radial plane containing the longitudinal axis 101. When the moving contacts 2 are in the first reference position, they are contained in a volume limited by the main wall 51 and the lateral walls 52, 53 as clearly shown also in Figures 2 and 3.

[0042] In accordance to a known solution, for each of the moving contacts 2, a central support element 2A is provided and two copper plates 2B are arranged on opposite sides of the support element 2A. For each of the moving contacts 2, at least one on the copper plates 2B is electrically connected to a corresponding plate of an adjacent contacts by means of connecting copper plate 2C (see Figure 2). One or more of these plates 2B, 2C made of copper are electrically connected to cables 2D for earthing.

[0043] The coupling means comprise a first coupling assembly 15A and a second coupling assembly 15B operatively arranged at opposite terminal parts of the two shafts 11, 12. Analogously, also the spring means comprise a first spring assembly 13A and a second spring assembly 13B located at opposite terminal parts of the two shaft 11, 12. As clearly shown in Figures 1 and 5, for example, the first coupling assembly 15A interacts with the first spring assembly 13A and both are arranged close to a first side wall 53 of the frame 5. Analogously, the second coupling assembly 15B interacts with the second spring assembly 13B and both are arranged close to a second side wall 52. The description below refers mainly to the first coupling assembly 15A and the first spring assembly 13A. However, the technical solutions, the working principle and/or the relative considerations are valid, *mutatis mutandis,* also for the second coupling assembly 15B and the second spring assembly 13B.

[0044] According to a preferred embodiment, on a first end 12A of the second shaft 12 a control lever 16 is mounted. Such a control lever 16 is connectable, for example by means of connecting levers (not shown), to an operating mechanism (not shown) that can be controlled by an operator. The control lever 16 is located adjacent to an outside face 53A of a side wall 53 (see Figure 3 and 6) of the frame 5 from which said first end 12A protrudes. A rotation of the control lever 16, in one of the possible directions W1 or W2 (clockwise or counterclockwise) causes a corresponding rotation of the second shaft 12 in the same direction. Obviously, the direction of rotation of the first shaft 11 depends on the condition of the mechanism 4, i.e. on the position of the moving contacts 2.

[0045] With reference to the figures 8-16, according to a possible embodiment, the first coupling assembly 15A comprises at least a first cam portion 151 rigidly connected to the first shaft 11 (see figure 10) to rotate about the longitudinal axis 101. The first cam portion 151 comprises a first slot 151B which extends along the entire thickness, wherein such a thickness is considered along the longitudinal direction (namely a direction parallel to the longitudinal axis 101). The first slot 151B develops according to a curved profile.

[0046] The first coupling assembly 15A also comprises a second cam portion 152 rigidly connected to the second shaft 12 (see figure 9). Therefore, the second cam portion 152 and the second shaft 12 rotate always together about the longitudinal axis 101. According to a possible embodiment shown in the figures, the second cam portion 152 comprises a first plate 153A and a second plate 153B both protruding from the second shaft 12. The two plates 153A, 153B are axially distanced by a reinforcing element 154. Alternatively, the second cam portion 152 could be defined by a single body connected to the second shaft 12.

[0047] In any case, the second cam portion 152 comprises a second slot 152B which develops through the entire longitudinal thickness of the second cam portion 152, i.e. parallelly to the longitudinal axis 101. In the embodiment shown in the figures, each of the cited plates 153A, 153B has a slot faced and corresponding (in both shape and size) to the slot of the other plate 153B, 153A. Therefore, in the case shown in the figures, the second slot 152B is actually defined by two distanced slots each one of a corresponding plate 153B, 153A. Alternatively, the second cam portion 152 could be define a sole plate longitudinally crossed by a sole second slot 152B.

[0048] As for the first slot 151B above, also the second slot 152B develops according to a curved profile. The profile of the second slot 152B is only partially overlapped to the profile of the first slot 151B with respect to a lateral view, that is a point of view indicated in Figure 8 by the arrow T. Each of said slots 151B, 152B comprise an inner end 112, 142 and an outer end 111, 141 respectively close and distal from the main wall 51 of the frame 5, considering the earthing switch in the open condition.

[0049] The first coupling assembly 15A further comprises a transmission pin 85 which is longitudinally inserted both the first slot 151B and in the second slot 152B. Therefore, a movement of the second cam portion 152 can be transmitted to the first cam portion 151 by means of the pin 85. At the same time, also a movement of the pin 85, determined by an external action on it, can be transmitted to both the cam portions 151, 152 Therefore, on one hand, the position of the connecting pin 85 depends on the angular position of the two cam portions 151, 152. On the other hand, an external force applied on the pin 85 can determine the rotation of the cam portions 151, 152 and consequently of the shafts 11, 12.

[0050] Always with reference to a lateral point of view, the pin 85 is oriented along a direction which is substantially parallel to the longitudinal axis 101. This because the slots 151B, 152B have the same distance from the longitudinal axis X and are partially overlapped with respect to a lateral point of view (T).

[0051] The first spring assembly 13A is operatively connected to the pin 85 so that it is loaded or unloaded as a function of the position of the pin 85. More precisely, when the second shaft 12 is rotated in the closing direction W1, during the first rotational phase, the first spring assembly 13A is compressed, i.e. loaded, between the connecting pin 85 and the frame 5. During such a first rotational phase, the pin 85 is pushed by the second cam portion 152 rotating integral with the second shaft 12. At the same time, the pin 85 moves with respect to the second slot 152B, i.e. with respect to the first cam portion 151. The latter does not move since it is integral with the first shaft 11.

[0052] As above indicated, the first rotation phase ends after the first cam portion 151 has rotated of a pre-established rotation angle α_1. In such a condition, the spring assembly 13A reaches its maximum load/compression. As soon as the rotation angle α_1 is overpassed, the spring assembly 13A releases its elastic energy on the pin 85 that transmits it, exploiting the respective slots 151B, 152B, to the two cam portions 151, 152 of the first cou-

pling assembly 15A. This results in a rotation of both the shafts 11,12 in the closing direction W1.

[0053] According to a possible embodiment clearly shown in the figures, the first spring assembly 13A comprises a rod 131 that is hinged to the pin 85 (see for example figures 14-16). In particular, the first spring assembly 13A is free to rotate with respect to the axis of the pin 85 around an axis parallel to the longitudinal axis 101. The rod 131 comprises an abutment portion 131A on which a first end 133A of a spring element 133 abuts on. Such a spring element 133 develops around the rod 131 and comprises a second end 133B which abuts on a portion of the frame 5. As shown in the figures, preferably, the second end 133B abuts on the inner portion 54A of the bottom wall 54 of the frame 5. Therefore, the spring element 133 is comprised between such a bottom wall 54 and the abutment portion 131A of the rod 131.

[0054] In the embodiment shown in the figures (see in particular figures 1-7), the rod 131 crosses the bottom wall 54 so that at least a portion 131B protrudes below it. The rod 131 is constantly pushed upwards by the spring element 133. Being hinged to the pin 85, the rod 131 is free to rotate with respect to the frame 5 and such a rotation, depending on the position of the pin 85, causes the compression or the release of the spring element 133.

[0055] According to an embodiment shown in the figures, the rod 131 is hinged to pin 85 at (or close to) its upper end 131C. Preferably, the first spring assembly 13A is arranged so that the upper end 131C is placed between the two plates 153A, 153B defining the second cam portion 152. Consequently, the upper end 131C is connected to a first longitudinal section 85A of the pin 85 longitudinally comprised between the two plates 153A, 153B (see figures 12 and 13). That means, this first longitudinal section 85A crosses the second cam portion 152. A second longitudinal section 85B of the pin 85 is longitudinally comprised between the first cam portion 151 and the second cam portion 152, while a third section 85C crosses the first cam portion 151 (see figure 13).

[0056] According to an embodiment of the present invention, the earthing switch 1 also comprises second coupling means 16A, 16B that operatively connect the second shaft 12 to the first shaft 11 when the closing movement is completed, i.e. when the moving contacts 2 reach the second reference position. More precisely, the second coupling means 16A, 16B make the first shaft 11 rigidly connected to the second shaft 12 during the opening movement so that the two shafts 11,12 rotate synchronously, at least for a first rotational phase, around the longitudinal axis 101.

[0057] According to a preferred embodiment shown in the figures, the second coupling means comprise a plurality of pushing plates 161A, 161B which are connected rigidly connected to the external surface of the second shaft 12, for example by means of screws. The second coupling means 16A, 16B comprise a plurality of openings 161, 162 defined through the external surface of the first shaft 11 (see Figure 10). Each of the plates 161A, 161B is arranged in a corresponding opening 161, 162 and comprises a longitudinal edge 165A, 165B (see Figure 8) parallel to the longitudinal axis 101. In the second reference position of the moving contacts 2, each of the longitudinal edges 165A, 165B abuts against a corresponding longitudinal edge 166A, 166B of the corresponding opening 161, 162 (see Figure 10). Starting from the condition in Figure 5 (earthing switch 1 closed), when the second shaft 12 is rotated, by means of the control lever 16, in the opening direction W2, each of the pushing plate 161A, 161B pushes the first shaft 11, at the longitudinal edge 166A, 166B of the corresponding opening 161, 162, causing its rotation. This leads to a synchronous rotation of the two coaxial shaft 11, 12.

[0058] According to an embodiment of the present invention, the earthing switch 1 also comprises elastic means 60 operatively connected between the frame 5 and the first shaft 12. The elastic means 60 exert a constant force that opposes to the closing movement, i.e. to the rotation of the first shaft 11 in the closing direction W1. The function of the elastic means 60 is to avoid any rotation of the first shaft 11 during the first rotational phase in the closing direction W1 of the second shaft 12. Indeed, because of the use, the bearings that support and allow two mutual rotation of the two shafts 11,12 could be subjected to friction. As a consequence, during the first rotational phase, the first shaft 11 could oscillate/vibrate around the longitudinal axis 101. This would result in a corresponding oscillation/vibration of the moving contacts 2. Exerting a force that tends to rotate the first shaft 11 in the opening direction W2, the elastic means 60 keep the first shaft 11 stopped avoiding any vibration during the phase in which the spring assemblies 13A, 13B are compressed. This solution allows to further increase the safety of the earthing switch 1.

[0059] According to a preferred embodiment shown in the figures, the elastic means 60 comprises a spring 66 having a first end 60A connected to the first shaft 11 and a second end 60B connected to the main wall 51 of the frame 5 so that the spring exerts a force that tends to rotate the first shaft 11 according to the opening direction W2, i.e. that tends to keep the moving contacts 2 in the first reference position.

[0060] According to an embodiment, the earthing switch 1 is provided with first damping means 17A, 17B installed on said frame 5 in order to damp the closing movement of the two shafts 11, 12 when the moving contacts 2 reach the second reference position.

[0061] According to the embodiment shown in the figures, the damping means 17A, 17B comprise a first damping assembly 17A which interacts with the first coupling assembly 13A and a second damping assembly 17B which interacts with the second coupling assembly 13B. Each of said damping assembly 17A, 17B is installed on the frame 5, preferably on the inner face 51A of the main wall 51, so as to be contacted by the first cam portion 151 and by the second cam portion 152 of a corresponding coupling assemblies 13A, 13B, when the

moving contacts 2 reach the second reference position.

[0062] With reference in particular to Figure 2, the first damping assembly 17A comprises a first damper element 121 and a second damper element 122 that provide an abutment surface, respectively, for the first cam portion 151 and for the second cam portion 152 of the first coupling assembly 15A. Preferably, the damper elements 121, 122 comprise a spring and/or an elastomeric body. According to a preferred embodiment, the first damper element 121 comprises a spring arranged between the frame 5 and an enlarged head of a first pin on which a section of the first cam portion 151 abuts. Instead, the second damper element 122 comprises an elastomeric body arranged between the frame and an enlarged head of a second pin that defines an abutment surface for a section of the second cam portion 152.

[0063] On this regard, the perspective view of Figure 5 shows how the cam portions 151, 152 abuts against the corresponding damper element 121, 122 when the earthing switch 1 reaches the closing condition. The considerations and the solutions above for the first damping assembly 17A are valid also for the second damping assembly 17B, as clearly evident just from Figure 5.

[0064] As shown in Figures 10 and 11, for each of the coupling assemblies 15A, 15B, the profile of the first cam portion 151 comprises a first abutment section 178A that contacts the first damper element 121 at the end of the closing movement. Analogously, the second cam portion 152, in particular each one of the plates 153A, 153B, comprises a corresponding abutment section 178B that contacts the second damper element 122 at the end of the closing movement. The abutments sections 178A, 178B are substantially rectilinear. The cam portions 151, 152 are shaped so that the corresponding first abutment section 178A, 178B is substantially parallel to the second reference plane PH when the switch 1 is opened and substantially parallel to the first reference plane PV when the switch 1 is closed.

[0065] Preferably, the earthing switch 1 comprises also stopping means connected to the frame 5 in order to stop the closing movement of the two shafts 11, 12 when the moving contacts 2 reach the second reference position. The stopping means 18A, 18B interact, directly or indirectly, with two shafts 11, 12 to avoid their rotation other than a pre-established angle corresponding to the arrangement of the moving contacts 2 on the first reference plane PV.

[0066] According to a preferred embodiment, schematized in Figures 17-18, the stopping means 18A, 18B comprise a plurality of openings 181, 182 defined trough the main wall 51 of the frame 5. Each of such openings 181, 182 is vertically limited by an edge 181B, 182B, parallel to the longitudinal axis 101. Each edge 181B, 182B is a stop for a reference element rigidly connected with a corresponding shaft 11, 12.

[0067] According to the embodiment (see Figure 9 and 10), a reference element of the first shaft 11 is defined by a second abutment section 179A of the first cam portion 151, while a second reference element and a third reference element of the second shaft 12 are defined respectively by a second abutment section 179B of one of the two plates 153A, 153B

[0068] With reference to Figure 17, when the switch 1 is opened the second abutment section 179A of the first cam portion 151 and the second abutments sections 179B of the second cam portion 152 are kept, respectively, against an edge 181B of a first opening 181 and an edge 182B of a second opening 182 (in the section view of Figure 17 only components 182B-182-179B are shown). With reference to figure 18, during the first rotation phase of the second shaft 11, that precedes the movement of the moving contacts 2 to the second reference position, the second abutment section 179A of the first cam portion 151 keeps its position against the edge 181B of the first opening 181.

[0069] According to an embodiment shown in the figures, the pin 85 above defined is preferably inserted in a rotating bushing that can rotate with respect to the same pin 85. The bushing is substantially an outer shell (not shown) of the pin 85 that slides on the surfaces of the first slot 151B and of the second slot 152B. This solution advantageously improves the durability and reliability of the earthing switch 1.

[0070] Preferably, for each of the coupling assembly 15A, 15B, a pin holder portion 90 is mounted on the first shaft 11 in a longitudinally position comprised between the first cam portion 151, rigidly connected to the first shaft 11, and the second cam portion 152, rigidly connected to the second shaft 12. As clearly shown in the exploded view of figure 11, the pin holder portion 90 comprises a through hole in which the second section 85B of the pin 85 is inserted. This pin holder portion 90 is free to rotate with respect to the second shaft 12 on which it is mounted. Its function is to support the pin 85 and to increase the rotational stiffness of said second section 85B of the pin itself. More precisely, the pin holder portion 90 is also free to rotate with respect to the first shaft 11. Being rotationally integral with the pin 85, the pin holder portion 90 reduces possible flexions and deformations during the coupling of the two shafts 11 deriving from the release of elastic energy. Advantageously, the pin holder portion 90 reduces the bending moment on the second section 85B of the pin 85 so that it can work in shear.

[0071] With reference in particular to figures 5 and 12 according to a possible embodiment, the second cam portion 152 comprises an opening roller 185 disposed between the two plates 153A, 153B. Such a roller 185 is free to rotate about an axis substantially parallel to the longitudinal axis 101. The opening roller 185 pushes the rod 131 of the assembly 13A, and consequently the pin 85 during a second phase of the opening movement, i. e. as soon as the spring element 133 reaches the dead point. As a fact, the opening roller 185 is the part of the second cam portion 152 which pushes the rod 131 from the neutral position (dead point of the spring assemblies 13A, 13B) to a position characteristic of the open condi-

tion of the earthing switch 1 (see figures 25 and 26 below explained). In detail, the action of the opening roller 185 results in a rotational movement of the rod 131 of the spring assembly 13A, 13B.

[0072] Figures 17-21 are lateral views of the mechanism 4 of the earthing switch 1 each of one characteristic of an instant of the closing movement. In these figures, the frame 5 has been removed for clarity. Figure 17 shows the mechanism 4 in the open condition when the moving contacts 2 are separated from the fixed contacts 3 (first reference position). For convenience, in the following, the description will refer only to the first coupling assembly 15A and to the first spring assembly 13A. However, the considerations are valid also for the second coupling assembly 15B and for the second spring assembly 13B.

[0073] In the condition shown in Figure 17, the pin 85 of the first coupling assembly 15A is in contact with the inner end 142 of the second slot 152B and the rod 131 is oriented towards the main wall 51 (schematized). More in detail, the rod 131 is inclined of angle β_1 with respect to the first reference plane PV on which the moving contacts 2 lay. The spring element 133 keeps the reference elements (sections 179A, 179B) of the cam portions 151, 152 against the stopping means (edge 181B, 182B of the openings 181, 182) associated to the main wall 51 of the frame 5. At the same time, also the opening roller 185 of the second cam portion 152 abuts against a side on the rod 131 opposite to the side facing the main wall 51.

[0074] As above indicated, the closing of the switch 1 is activated by an operator that controls, via an operating mechanism (not shown) the control lever 16 (not shown in Figures 17-19) integral with the second shaft 12. From the configuration shown in Figure 17, the lever 16 is rotated in the closing direction W1. Such a rotation causes the rotation, in the same direction, of the second shaft 12, while the first shaft 11 does not rotate being independent, in this phase, from the second one (12). On this regard, the elastic means 60 avoids the first shaft 11 to oscillate during the first rotational phase of the second shaft 12.

[0075] With reference to Figure 18, the second shaft 12 rotates of a first angle α_1 until the spring assembly 13A reaches the dead point, namely the neutral position above indicated for which the axis of the rod 131 is aligned with the first reference plane PV (β_1=0). During such a first rotation phase, the first cam portion 151 of the first shaft 11 keeps its position against the stopping means 18A (second abutment section 179A against the edge 181B of the first opening 181). This because the pin 85 of the first coupling assembly 13A moves with respect the first slot 151B of the first cam portion 151. At the same time, the rod 131 of the spring assembly 13A rotates in an opposite direction W2 so that the spring element 133 is compressed between the inner surface 54A of the bottom wall 54 of the frame 5 and the abutment portion 131A of the rod 131. As a fact, the rotation of the angle α_1 corresponds to a loading phase of the spring element 133.

[0076] In the condition shown in Figure 18, the pin 85 of the coupling assembly 13A is always in contact with the inner end 142 of the second slot 152B of the second cam portion 152. Instead, in such a condition, a gap (defined by a second angle α_2) exists between the axis of the pin 85 and the outer end 111 of the first slot 151B of the first cam portion 151. Such a gap allows the correct loading of the spring element 133 and the stop of the moving contacts 2 when the spring assembly 13 is at its dead point. This condition guarantees that the spring element 133 releases its elastic energy after the dead point is passed. Indeed, only in such a condition the pin 85 will contact the outer end 111 of the first slot 151 so that the closing movement is of the moving contacts 2 is totally independent from the operator.

[0077] As soon as the dead point is passed, the spring element 133 releases its load. This triggers the movement of the pin 85 with respect to both the slots 151B, 152B. The pin 85 contacts the outer end 111 of the first slot 151B and determines the rotation of the first shaft 11, that is the rotation of the moving contacts 2 thereof. Analogously, the second shaft 12 is rotated by the action of the pin 85 on the outer end 141 of the second slot 152B.

[0078] Figure 19 shows the mechanism at the instant in which when the pin 85, moved by the spring element 133, contacts the outer end 111 of the first slot 151B causing the rotation of the first shaft 11. This contact takes places after a rotation of the pin 85 equal to the second angle α_2 above indicated.

[0079] Overall, the sum of the first angle $\alpha 1$ and of the second angle $\alpha 2$ defines the rotation angle wherein the second shaft 12 rotates independently from the first shaft 11. As above indicated, the first angle $\alpha 1$ is characteristic of the first rotational phase controlled by the operator, i. e. the phase dependent from the will of the operator. If, during such a phase, the operator decided to stop the closing manoeuvre, the spring element 133 would force the second shaft 12 to return to the condition shown in Figure 17 (moving contacts 2 in the first reference position). In any case, during such a phase the first shaft 11 and the moving contacts 2 do not rotate.

[0080] The angle $\alpha 2$ is characteristic of a rotational phase of the closing movement wherein the second shaft 11 is not controlled anymore by the operator. However, also during this further phase the first shaft 11 does not move with respect to the second shaft 12.

[0081] Figure 20 shows the mechanism at an instant where both the shafts 11, 12 rotate together in the first direction W1 until the moving contacts 2 reaches the second reference position, namely until the switch 1 is closed (see Figure 21). The configuration shown in Figure 20 is subsequent to that of Figure 19. The pin 85 contacts, and consequently pushes, the outer end 111, 141 of both the slots 151B, 152B of the first coupling assembly 15A.

[0082] With reference to Figure 21, when the mechanism reaches the closing configuration (switch 1 closed)

the moving contacts 2 lay on the second reference plane PH. The slots 151B, 152B of the cam portions 151, 152 are aligned as shown by the position of the pin 85 which still contacts the outer end 111, 141 of each of the slots 151B, 152B. The rod 131 of the spring assembly 13A is inclined with respect to the first reference plane PV of an angle $\beta 2$, while the first cam portion 151 as well as the second cam portion 152 are rotated on an angle of 90° with respect to the configuration shown in Figure 17 (switch open condition).

[0083] Always with reference to Figure 21, during the closing movement and up to the dead point of the first spring assembly 13A (that is during the first rotational phase), the elastic means 60 actually contrast the closing action exerted by the spring element 133. However, the spring element 133 is designed so that its action on the pin 85 and on the shafts 11,12 is not affected by the elastic means 60. When the spring assembly 13A passes the dead point, more precisely when the pin 85 touches the outer end 111 of the first a slot 151B, the elastic means 60 do not contrast anymore the closing movement. On the contrary, the elastic means 60 release their elastic energy cooperating with the spring element 133 to rotate the first shaft 11 and the moving contacts 2 up to the closing condition of the earthing switch 1.

[0084] Figure 21 also shows how the cam portions 151, 152 are stopped by the respective damper elements 121, 122 (schematized by square elements in dashed line).

[0085] Figures 22-26 refer to the opening movement of the switch 1 which is obtained by means of a rotation of both the shafts 11, 12 in the second direction W2 (counter-clock wise in the Figures). As above indicated, such an opening movement is obtained by means of the second coupling means 16A, 16B which make the two shafts 11,12 rotationally coupled. In detail, in the conditions shown in Figure 22, for each of the pushing plates 161A, 161B connected to the second shaft 12, the longitudinal edge 165A, 165B abuts against a longitudinal edge 166A, 166B of the corresponding opening 161, 162 of the first shaft 11. Therefore, when the opening movements begins - following an action on the lever 16 (not shown in Figure 21), the two shafts 11, 12 rotates synchronously in contrast to the spring elements 133 of the two spring assemblies 13A, 13B. Therefore, by the lever 16, the operator has to exert a torque on the two shafts 11, 12 sufficient to load/compress the spring elements 133 of the spring assemblies 13A, 13B and also to load/compress the spring means 60 above indicated.

[0086] In this regard, Figures 23 and 24 are, respectively, a perspective view and a lateral view of the mechanism 4 at two different instants of a first rotational phase of the opening movement wherein the two shafts 11,12 rotates synchronously. In this phase, for each of the coupling assembly 15A, 15B, the pin 85 is pushed by both the corresponding cam portions 151, 152 in particular at the outer end 111, 141 of the slots 151B, 152B. As above, during such a first rotational phase the spring elements 133 of the spring assembly 13A, 13B are loaded/compressed and the rod 131 rotates towards the main wall 51 of the frame 5.

[0087] With reference to Figure 24, after a rotation a first angle $\delta 1$ in the second direction W2, the opening roller 185 begins to push the rod 131. As soon as the spring assembly 13A approaches the end point, the pin 85 moves with respect to the outer end 111, 141 of the slots 151B, 152B being pushed exclusively by the opening roller 185.

[0088] Figure 25 shows the mechanism 4 when the spring assemblies 13A, 13B reach their dead point, after a further rotation of a second angle $\delta 2$ in the opening direction W2, with respect to the condition of Figure 24. For both of the spring assemblies 13A, 13B, the rod 131 is still pushed by the opening roller 185. Overall, the two angles $\delta 1$, $\delta 2$ define the first rotation phase controlled by an operator acting on the control lever 16.

[0089] As soon as the condition in Figure 25 is passed, the spring assemblies 13A, 13B release their elastic energy on the pin 85. For each coupling assembly 15A, 15B, this results in a pushing action on the two cam portions 151, 152 and consequently in a rotation of the shafts 11, 12 as to achieve the condition shown in Figure 26 (corresponding to the condition of Figure 17) for which the moving contacts 2 are in the first reference position. In the condition of Figure 25, the spring assemblies 13A, 13B exert a force on the coupling assemblies 15A, 15B that keeps the same against the stopping means associated to the frame 5. More precisely, the spring assemblies 13A, 13B pushes the pin 85 against the inner end 112, 142 of the slots 151B; 152B of the cam portions 151, 152 causing the rotation of the shafts 11, 12.

[0090] Therefore, after the dead point, the movement of the two shafts 11, 12 is not controlled by the operator anymore, but it is determined only by the action of the spring assemblies 13A, 13B.

[0091] The earthing switch can be easily realized at industrial levels. Thus, it can be easily manufactured at competitive costs with similar installations of the state of the art.

Claims

1. Earthing switch (1) for a medium voltage electric switchgear (1) wherein said earthing switch comprises:

   - a plurality of moving contacts (2) and a plurality of fixed contacts (3);
   - a frame (5) which supports a mechanism (4) for rotating said moving contacts (2) between a first reference position, at which they are separated from said fixed contacts (3), and a second reference position at which they are electrically connected to said fixed contacts (3), wherein said mechanism comprises a first shaft (11) on which said moving contacts (2) are rigidly

mounted, said first shaft (11) rotating around a longitudinal axis (101) in a closing direction (W1) for which said moving contacts (2) reach said second reference position and in an opening direction (W2) for which said moving contacts (2) reach said first reference position,

characterized in that said mechanism (3) comprises:

- a second shaft (12) coaxial to said first shaft (11) and connectable to an operating mechanism for the control of said second shaft (12), wherein said first shaft (11) is internally hollow and defines a longitudinal cavity inside which said second shaft (12) is at least partially arranged,
- first coupling means (15A, 15B) of said shafts (11,12) configured so that said second shaft (12) is free to rotate with respect to said first shaft (11), for at least a first rotational phase, when said second shaft (12) rotates according to said closing direction (W1), said first coupling means (15A, 15B) making said shafts (11,12) rotationally connected after said first rotational phase is completed;
- spring means (13A,13B) operatively connected to said first coupling means (15A, 15B), wherein said spring means (13A, 13B) are loaded during said first rotational phase and release their elastic energy on the two shafts (11, 12) by means of said first coupling means (15A, 15B) when said first rotational phase has been completed.

2. Earthing switch (1) according to claim 1, wherein, in said first reference position said moving contacts (2) lay on a first reference plane (PV) and in said second reference position, said moving contacts (2) lay substantially on a second reference (PH), wherein said reference planes are mutually orthogonal.

3. Earthing switch (1) according to claim 1 or 2, wherein said frame (5) comprises a main wall (51) and two side walls (52, 53) which develop from said main wall (51) at opposite ends so as to face each other, wherein said main wall (51) comprises an inner surface (51A) to which the mechanism (4) is faced, said two side walls (52, 53) supporting said shafts (11, 12) at opposite ends so that said longitudinal axis (101) is substantially parallel to said main wall (51).

4. Earthing switch (1) according to anyone of the claims 1-3, wherein said first coupling means (15A, 15B) comprise a first coupling assembly (15A) and a second coupling assembly (15B) operatively arranged at opposite terminal parts of the two shafts (11, 12), said spring means (13A, 13B) comprises a first spring assembly (13A) and a second spring assembly (13B), wherein said first coupling assembly (15A) interacts with said first spring assembly (13A) and said second coupling assembly (15B) interacts with said second spring assembly (13B).

5. Earthing switch (1) according to anyone of the claims 1 - 4, wherein said first coupling means comprises at least a coupling assembly (15A, 15B) including:

- a first cam portion (151) rigidly connected to said first shaft (11) and comprising a first slot (151B) through the entire longitudinal thickness of said first cam portion (151), said first slot (151B) developing according to a curved profile;
- a second cam portion (152) rigidly connect to said second shaft (12) and comprising a second slot (152B) which develops through the entire longitudinal thickness of said second cam portion (152), said second slot (152B) developing according to a curved profile, said first slot (151B) and said second slot (152) being only partially overlapped with respect to a lateral view of the mechanism (4);
- a transmission pin (85) longitudinally inserted in said first slot (151B) and in said second slot (152B), wherein said transmission pin (85) is operatively connected to a spring assembly (13A, 13B) of said spring means so that said spring assembly (13A) is loaded or unloaded as a function of the position of said transmission pin (85).

6. Earthing switch (1) according to claim 5, wherein said spring assembly (13A,13B) comprises a rod (131) hinged to the pin (85) so as to rotate about an axis parallel to said longitudinal axis (101), said rod (131) comprising an abutment portion (131A) on which a first end (133A) of a spring element (133) abuts on, such spring element (133) comprising a second end (133B) which abuts on a portion of said frame (5).

7. Earthing switch (1) according to anyone of the claims 1-6, wherein said earthing switch (1) further comprises second coupling means (16A, 16B) that operatively connect said second shaft (12) to said first shaft (11) when the moving contacts (2) reach said second reference position, said second coupling means (16A, 16B) making the first shaft (11) rigidly connected to said second shaft (12) during the rotation in said opening direction (W2).

8. Earthing switch (1) according to claim 7, wherein said second coupling means comprises:

- a plurality of pushing plates (161A, 161B) rigidly connected to the external surface of said second shaft (12), wherein each of said pushing plates (161A, 161B) comprises a longitudinal

edge (165A, 165B);
- a plurality of openings (162A, 162B) defined through the external surface of said first shaft (11), each of said openings (162A, 162B) comprising a longitudinal edge (166A, 166B);

wherein, when said moving contacts (2) reach said second reference position, said longitudinal edge (165A, 165B) of each pushing plates (161A, 161B) abuts against a corresponding longitudinal edge (165A, 165B) of a corresponding opening (161, 162).

9. Earthing switch (1) according to any of the claims 1-8, wherein said earthing switch (1) comprises elastic means (60) operatively arranged between said frame (5) and said first shaft (11), wherein said elastic means (60) exert a force that opposes to the closing movement to avoid any oscillation/vibration of the first shaft (11) during the first rotational phase, in the closing direction (W1), of said second shaft (12).

10. Earthing switch (1) according to anyone of the claims 1-9, wherein said earthing switch (1) is provided with first damping means (17A, 17B) installed on said frame (5) in order to damp the closing movement of the two shafts (11, 12) when said moving contacts (2) reach the second reference position.

11. Earthing switch (1) according to claim 10 when dependent on claim 5, wherein said damping means (17A, 17B) comprise a first damping assembly (17A) which interacts with a first coupling assembly (13A) and a second damping assembly (17B) which interacts with a second coupling assembly (13B) of said first coupling means, wherein each of said damping assembly (17A, 17B) is installed on said frame (5).

12. Earthing switch (1) according to claim 11, wherein at least one of said damping assemblies (17A, 17B) comprises a first damper element (121) and a second damper element (122) that provide an abutment surface, respectively, for said first cam portion (151) and for said second cam portion (152) of a corresponding coupling assembly (15A, 15B).

13. Earthing switch (1) according to any of the claims 1-12, wherein said earthing switch (1) comprises stopping means (18A, 18B) connected to said frame (5) in order to stop the opening movement of said two shafts (11, 12) when the moving contacts (2) reach the first reference position.

14. Earthing switch (1) according to any of the claims 5-13, wherein said pin (85) is inserted in a rotating bushing that can rotate with respect to said same pin (85) sliding on the surfaces of said slots (151B, 152B).

15. Earthing switch (1) according to any of the claims 4-14, wherein a pin holder portion (90) is mounted on said first shaft (11) in a longitudinally position comprised between said first cam portion (151), rigidly connected to said first shaft (11), and said second cam portion (152), rigidly connected to said second shaft (12), said pin holder portion (90) comprising a through hole in which a section (85A) of said pin (85) is inserted.

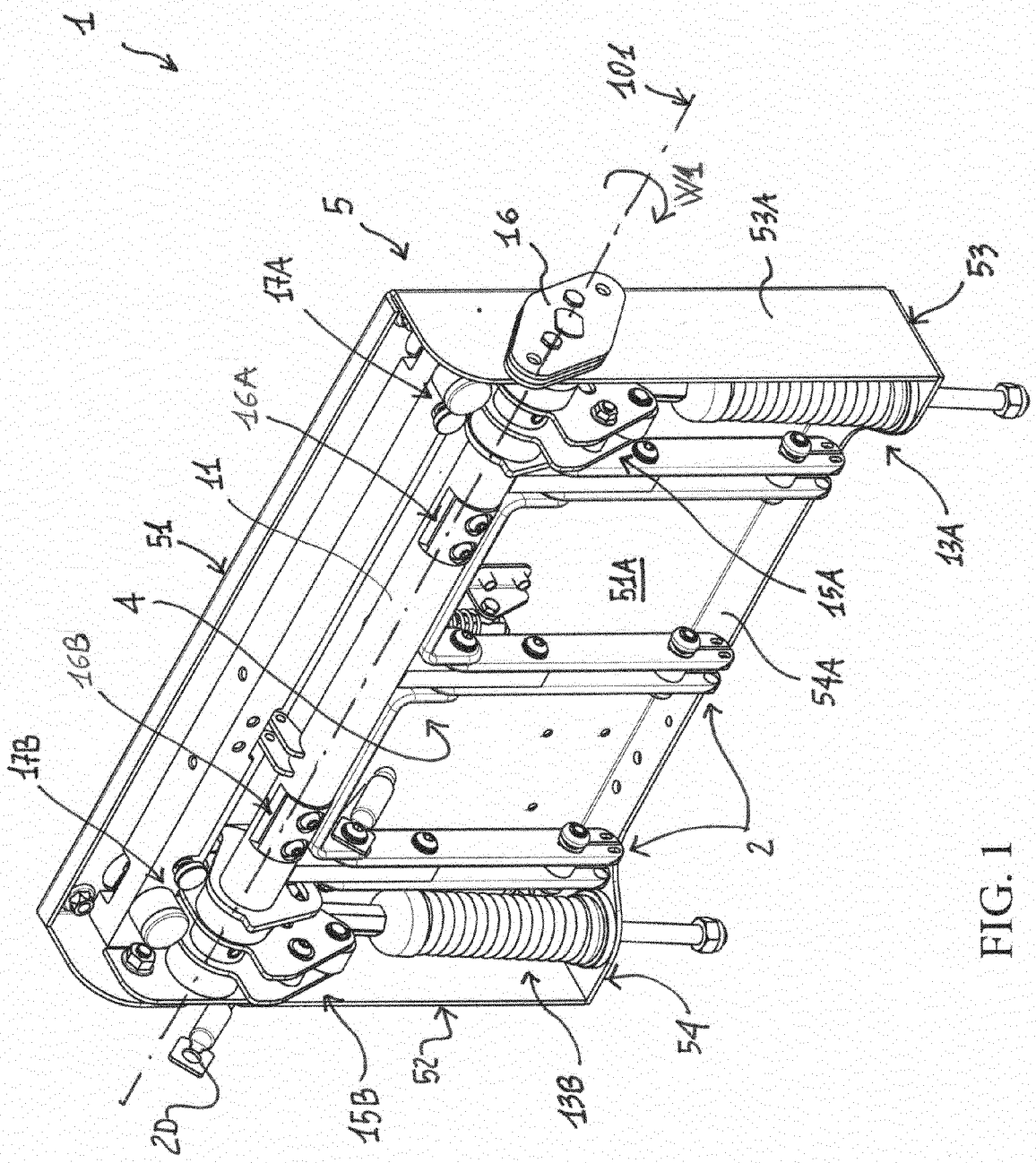
1
101
W1
5
16
53A
53
17A
16A
11
51
4
16B
17B
51A
15A
54A
13A
2
2D
15B
52
13B
54

FIG. 1

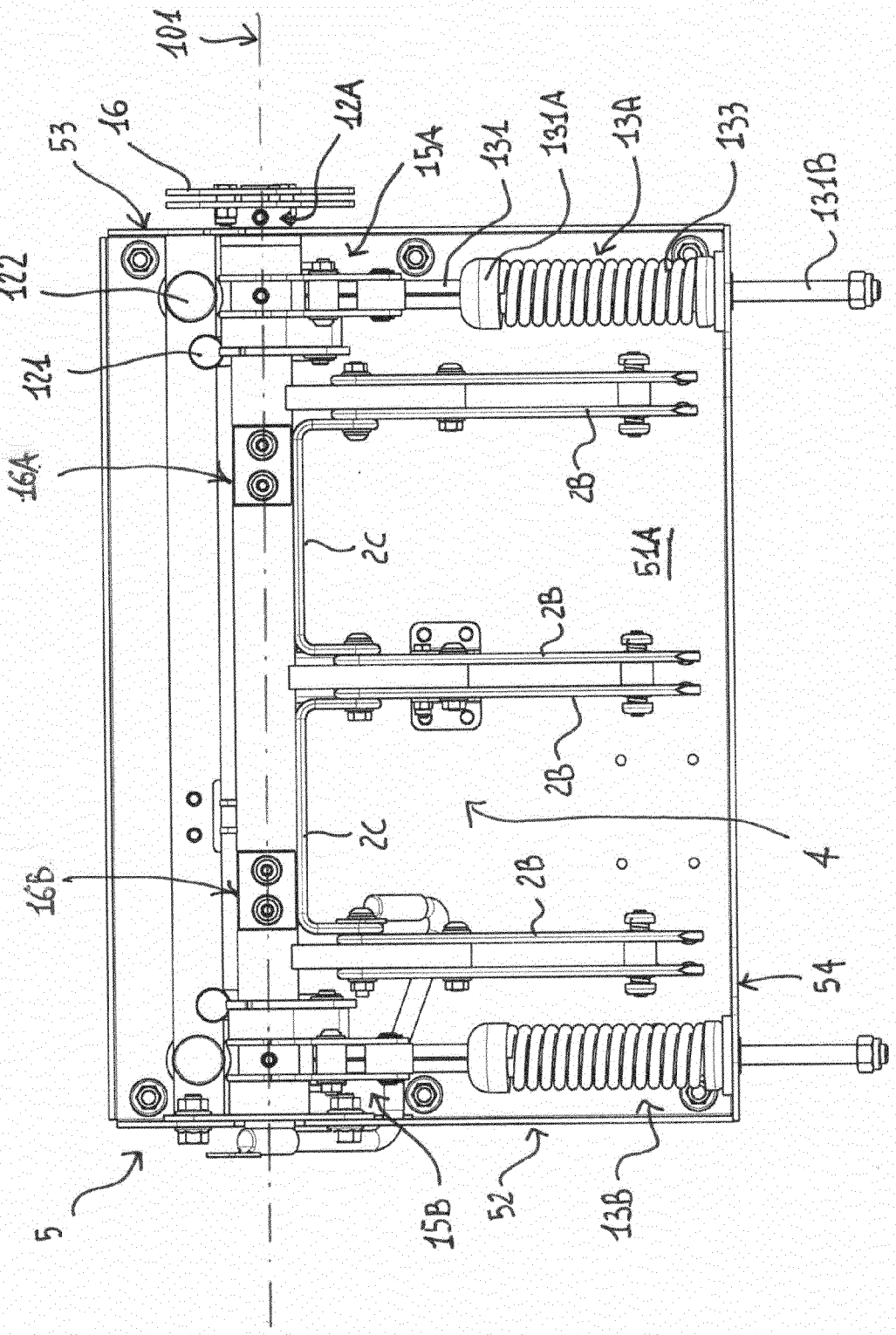
101
53
16
12A
15A
131
131A
13A
133
131B
122
121
16A
2B
2C
51A
2B
2B
2C
4
16B
2B
54
5
15B
52
13B

FIG. 2

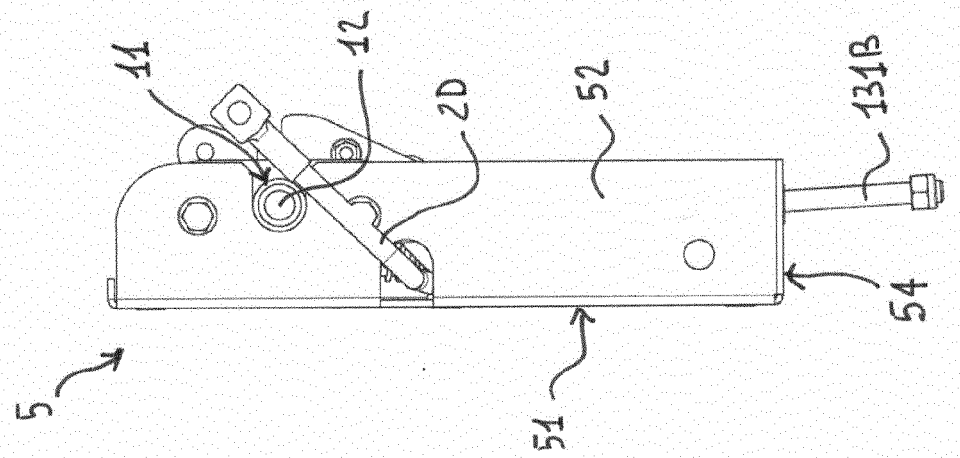

FIG. 4

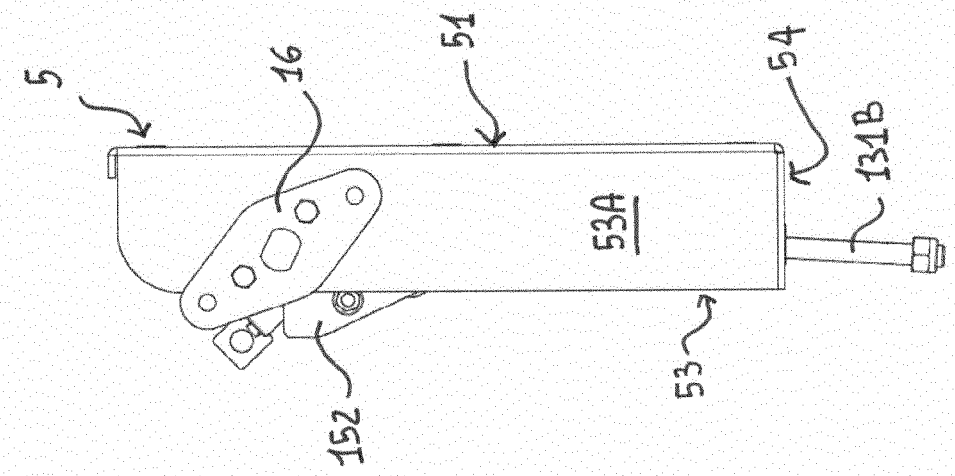

FIG. 3

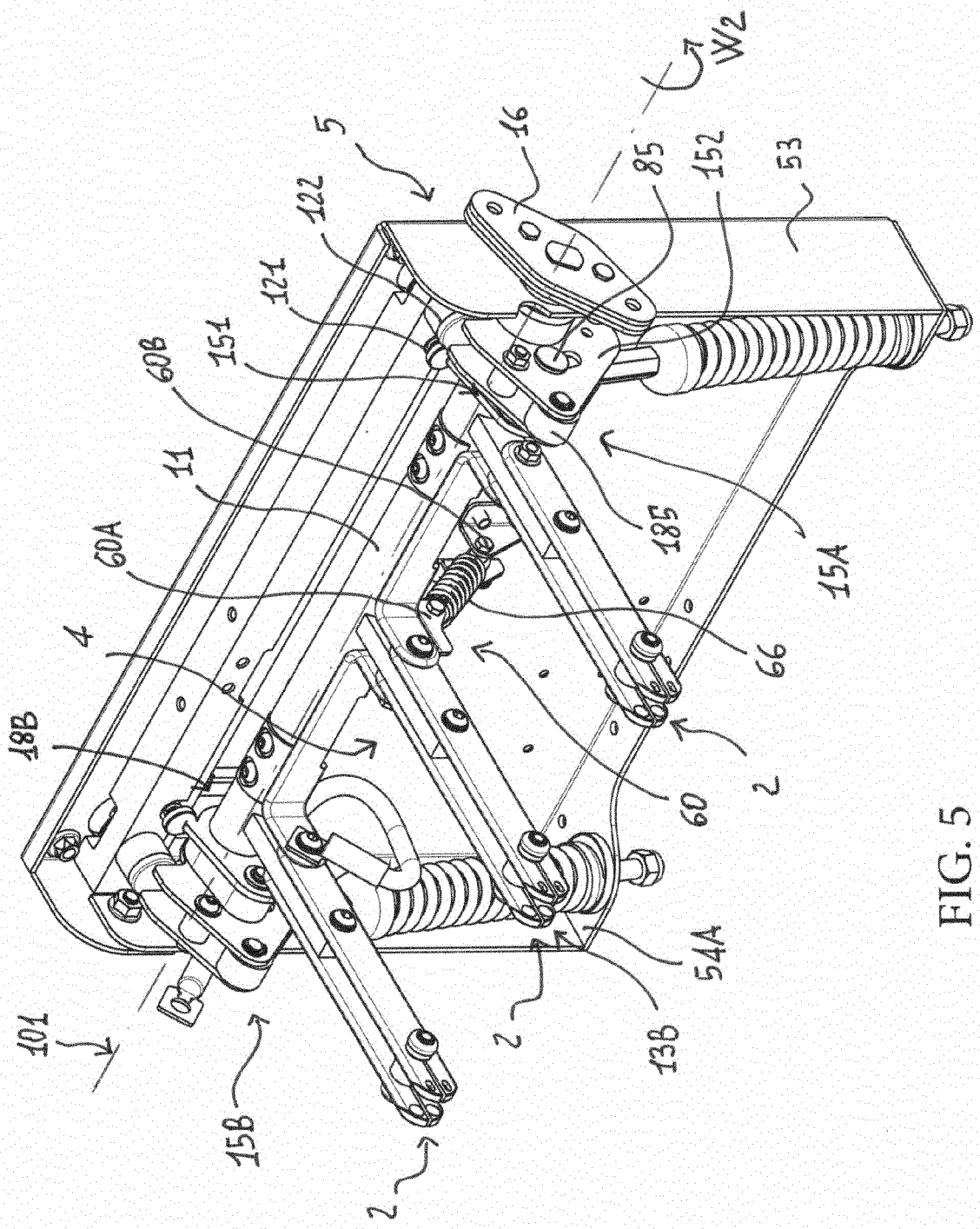
W2
16
85
152
53
5
122
121
151
60B
11
60A
4
18B
101
15B
2
2
13B
54A
60
2
66
15A
185

FIG. 5

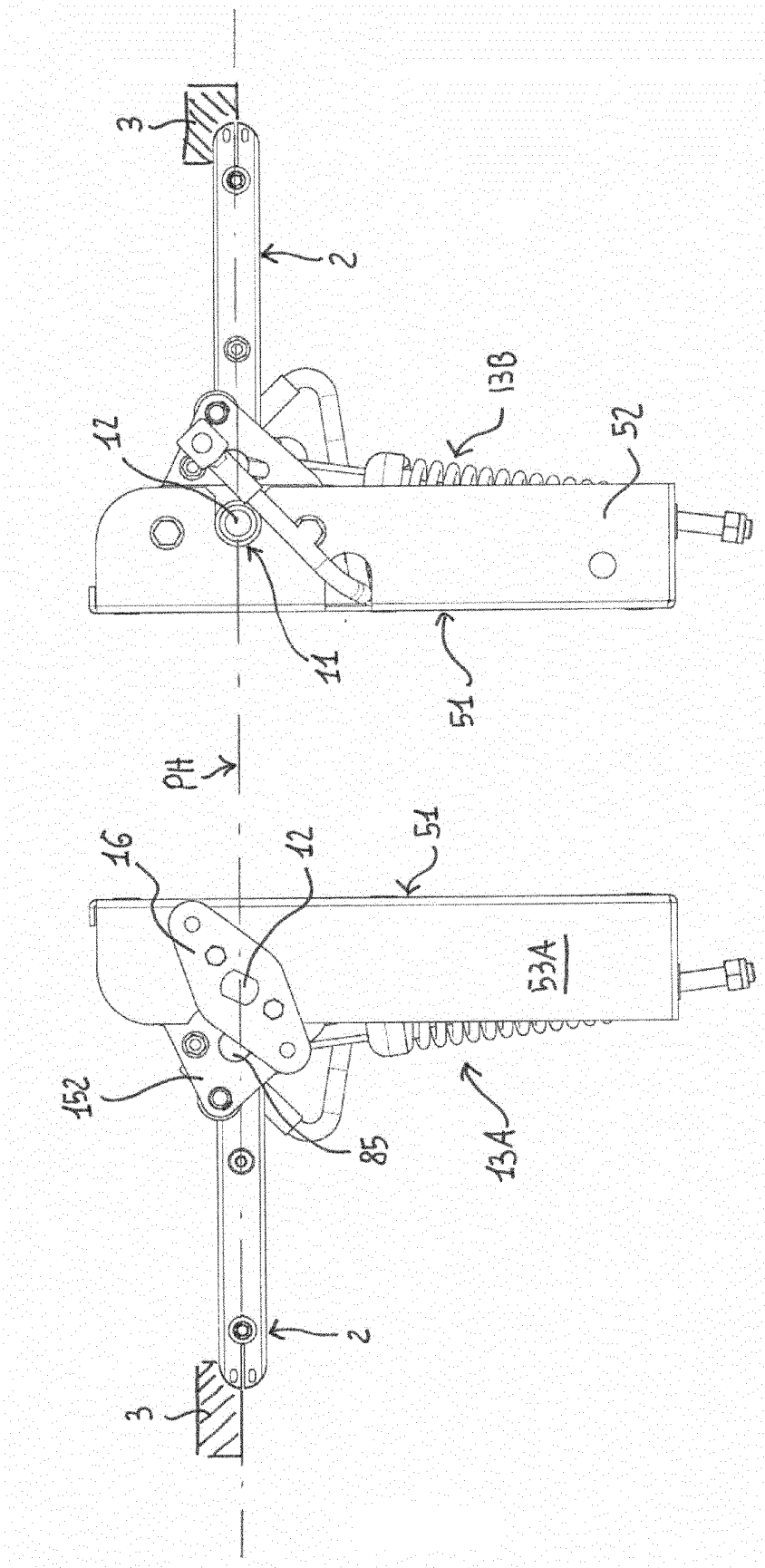

FIG. 7

FIG. 6

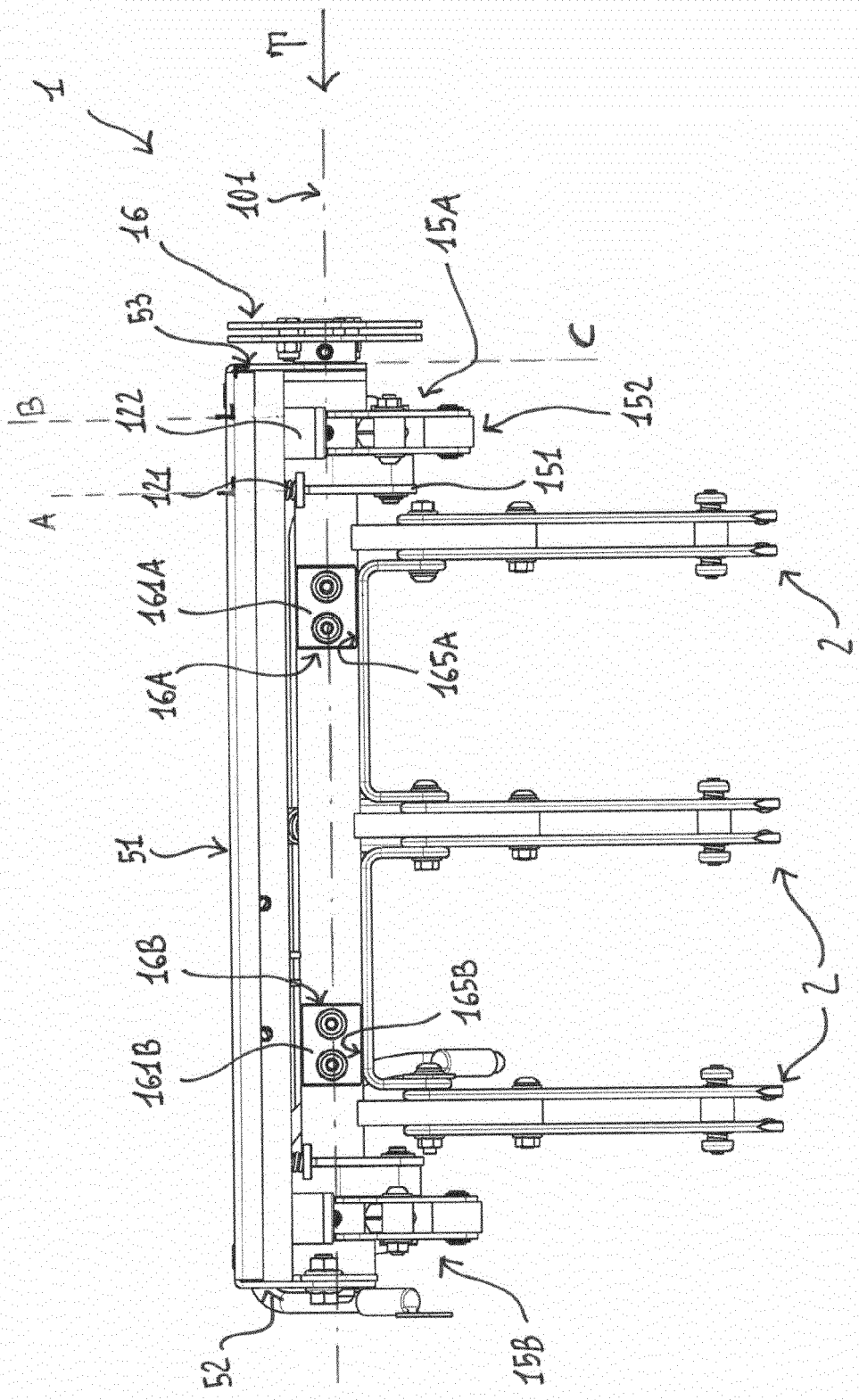
1
T
101
16
53
15A
C
B
122
152
A
124
151
161A
165A
16A
2
51
16B
165B
161B
2
52
15B

FIG. 8

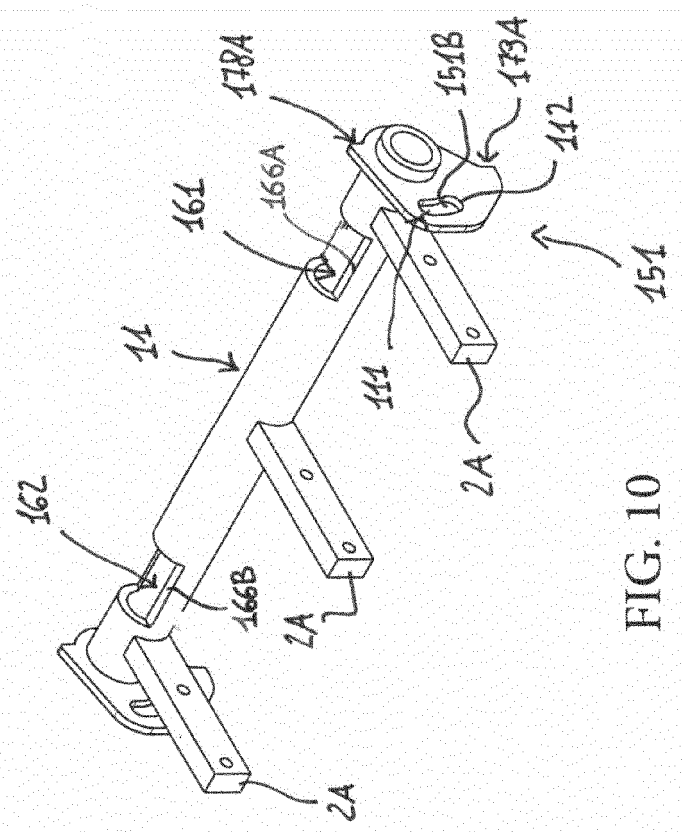
178A
151B
173A
112
166A
161
151
11
111
2A
162
166B
2A
2A

FIG. 10

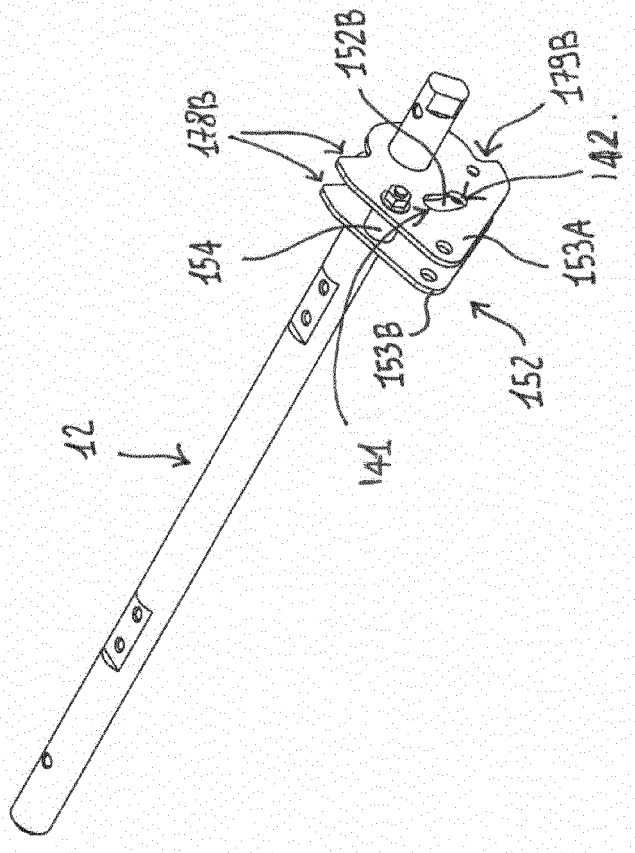
152B
179B
178B
142
154
153A
153B
152
12
141

FIG. 9

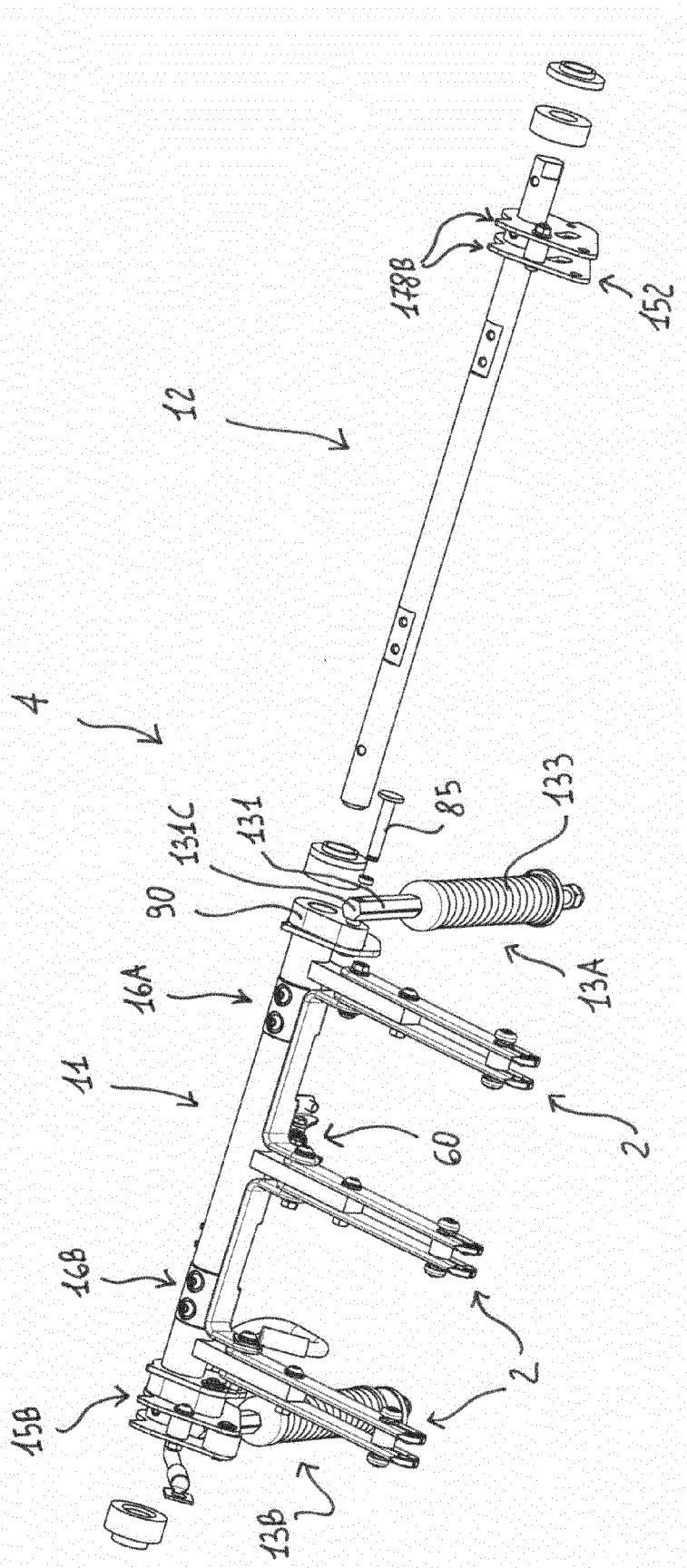

FIG. 11

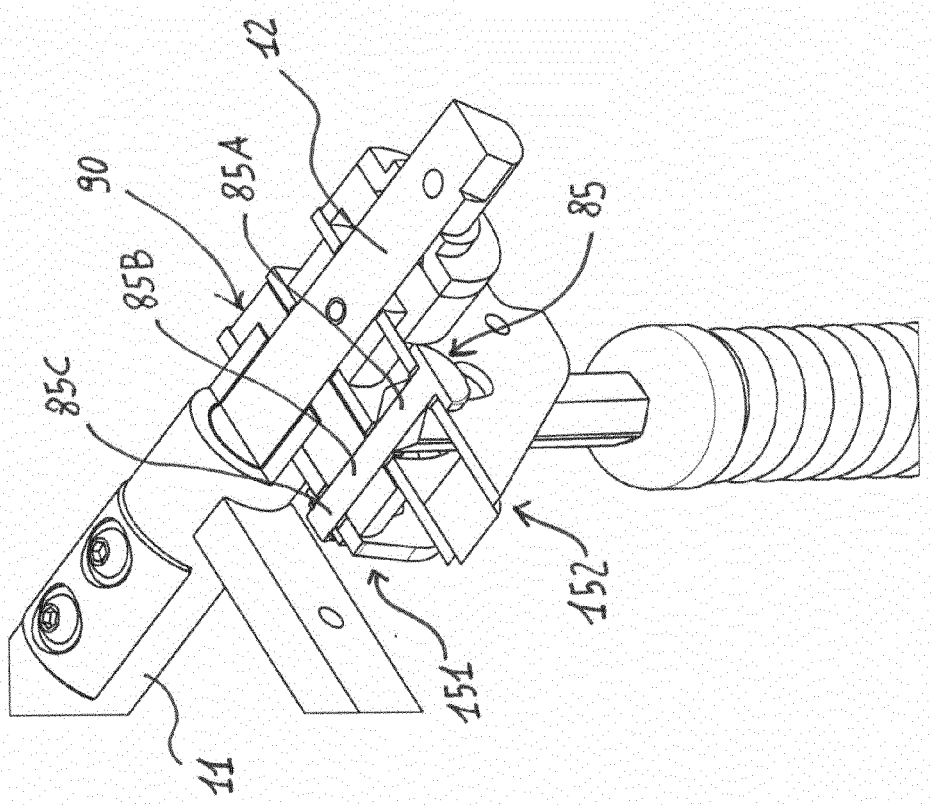
12
90
85A
85B
85C
85
11
151
152

FIG. 13

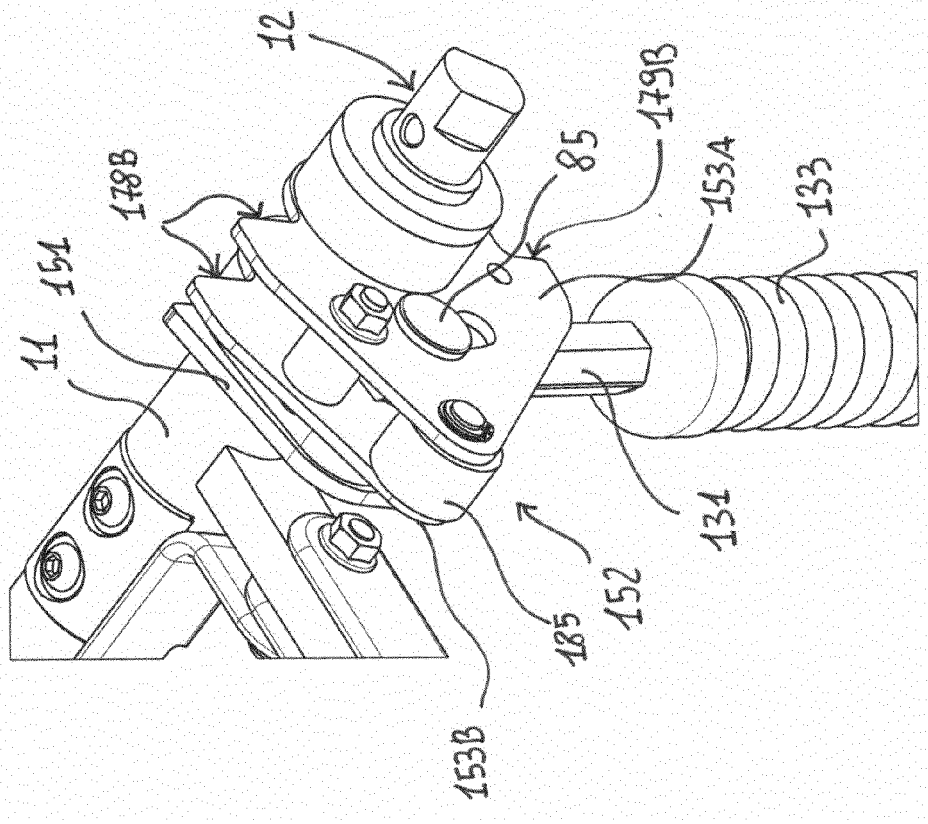
12
178B
151
11
85
179B
153A
133
153B
185
152
131

FIG. 12

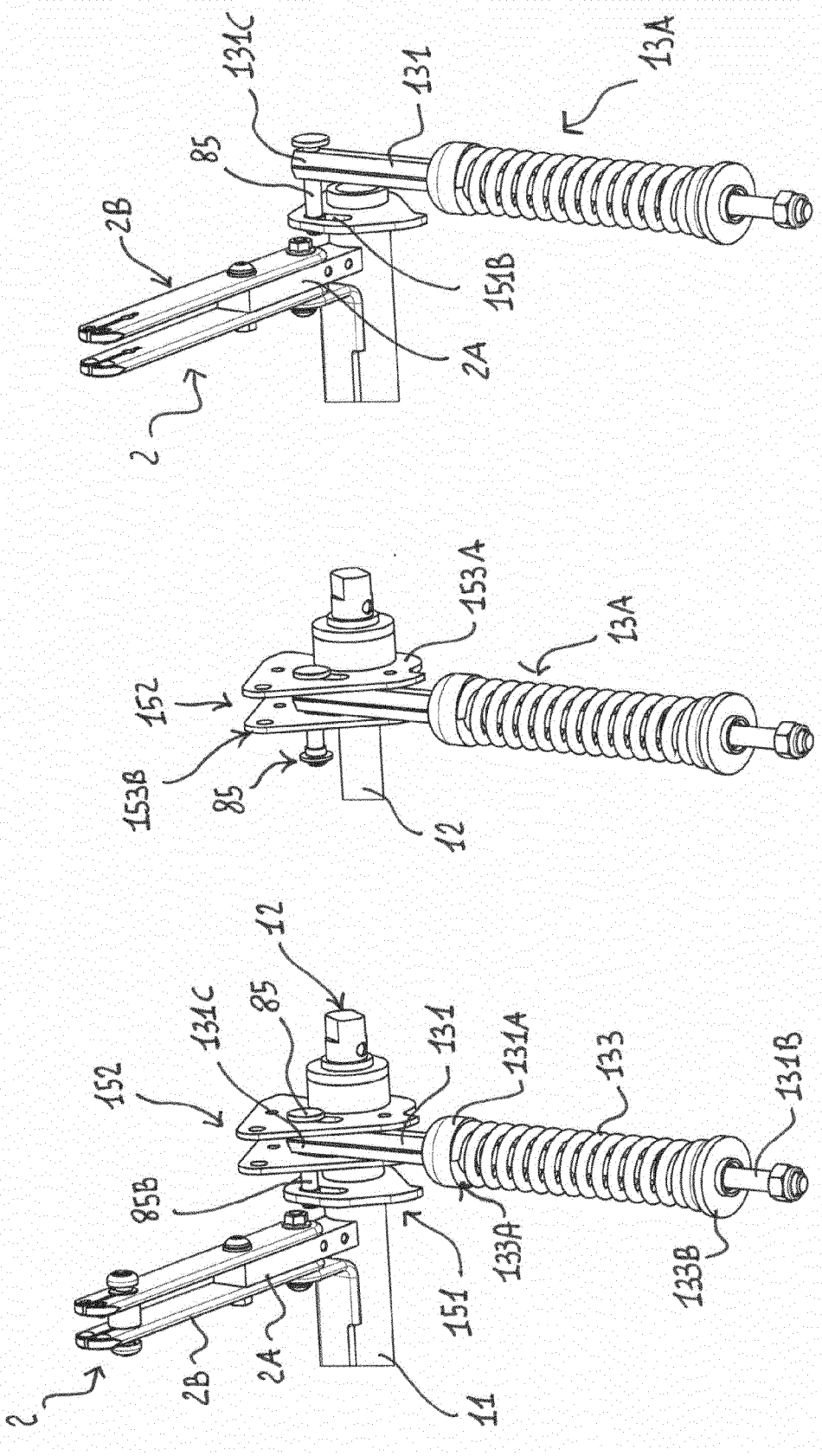

FIG. 16

FIG. 15

FIG. 14

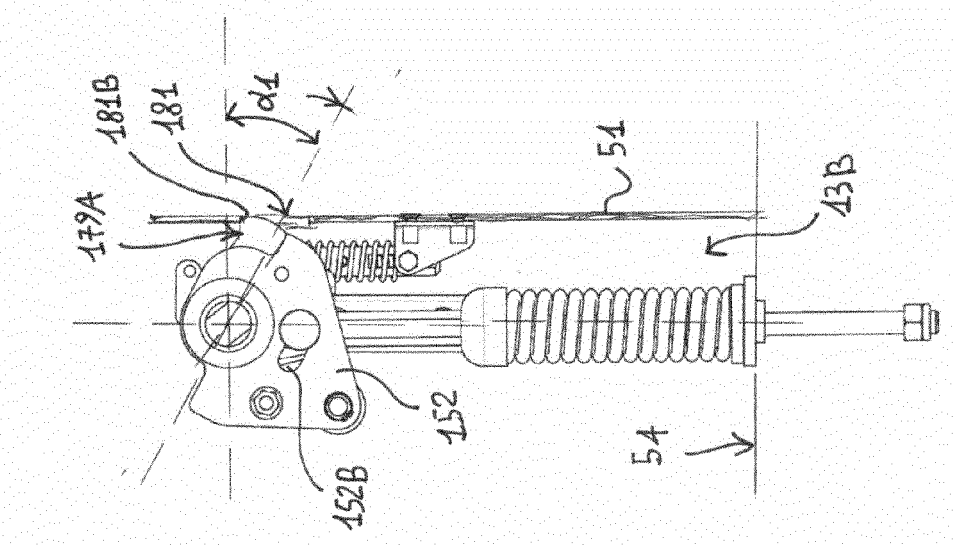

FIG. 19

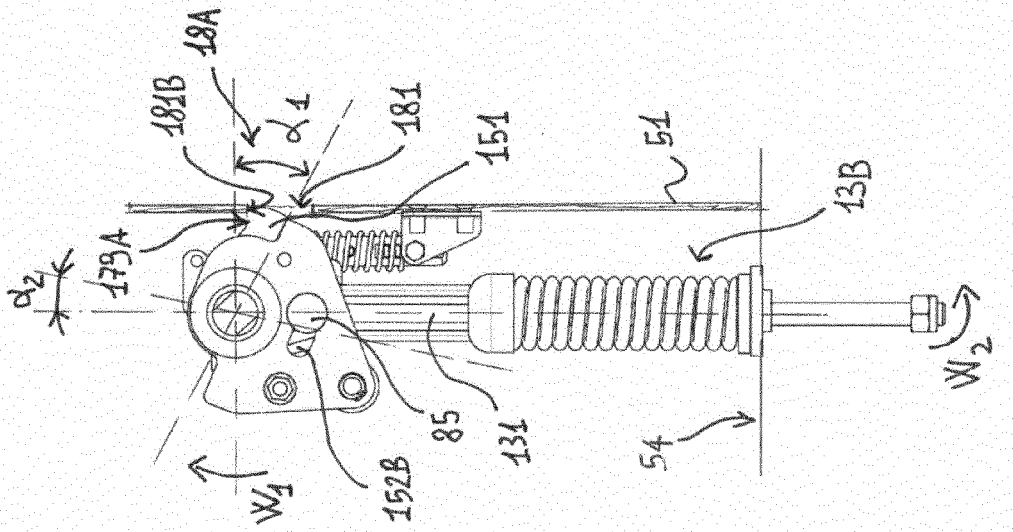

FIG. 18

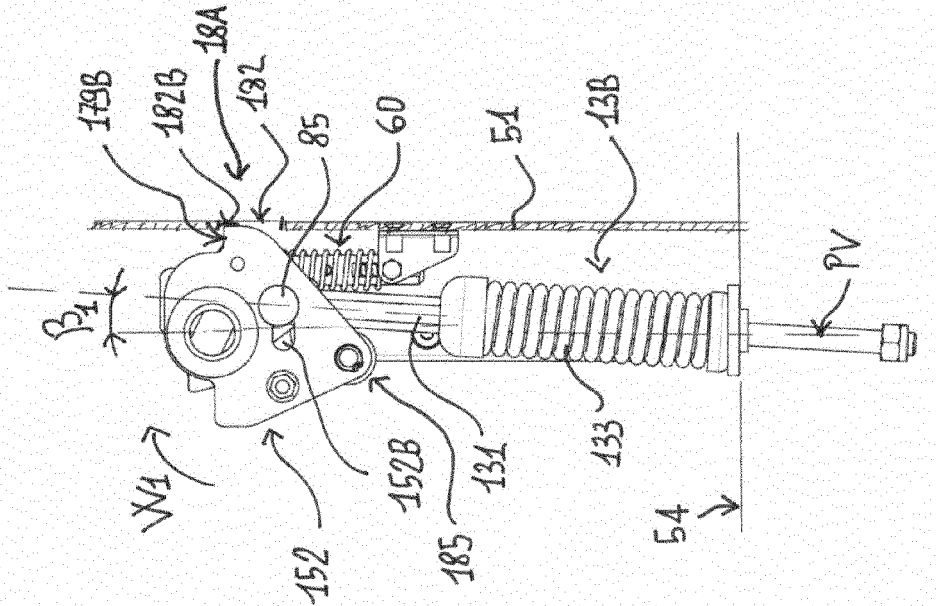

FIG. 17

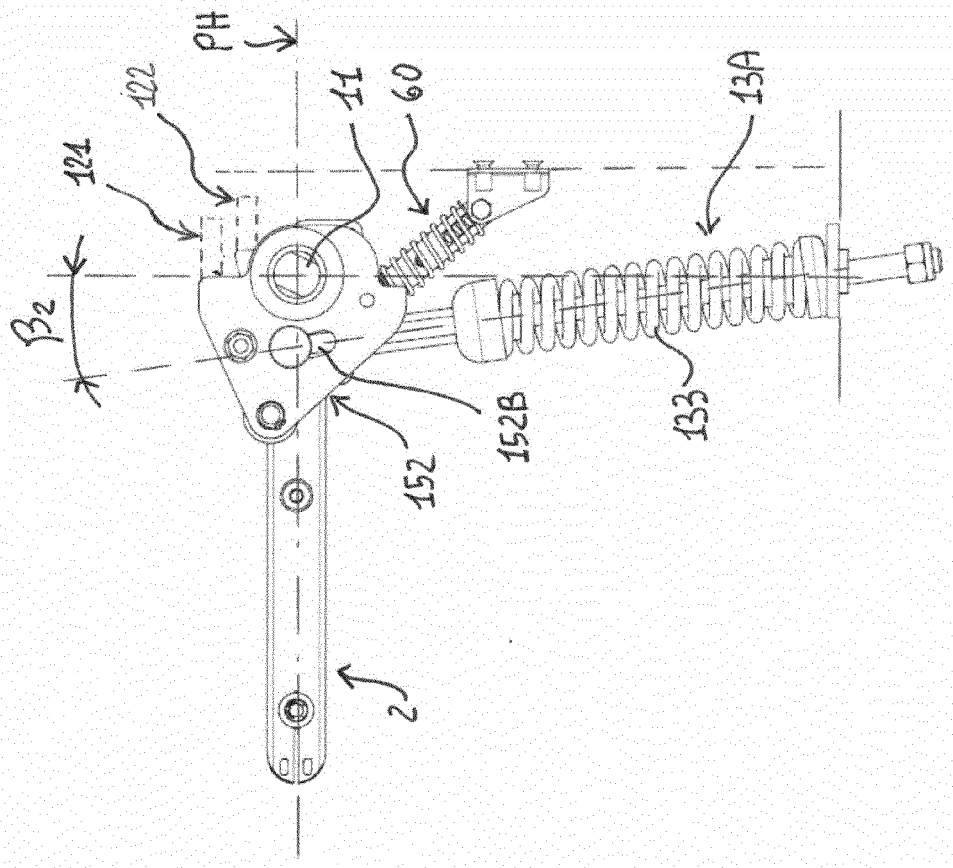
PH
122
124
11
60
13A
B2
152B
133
152
2

FIG. 21

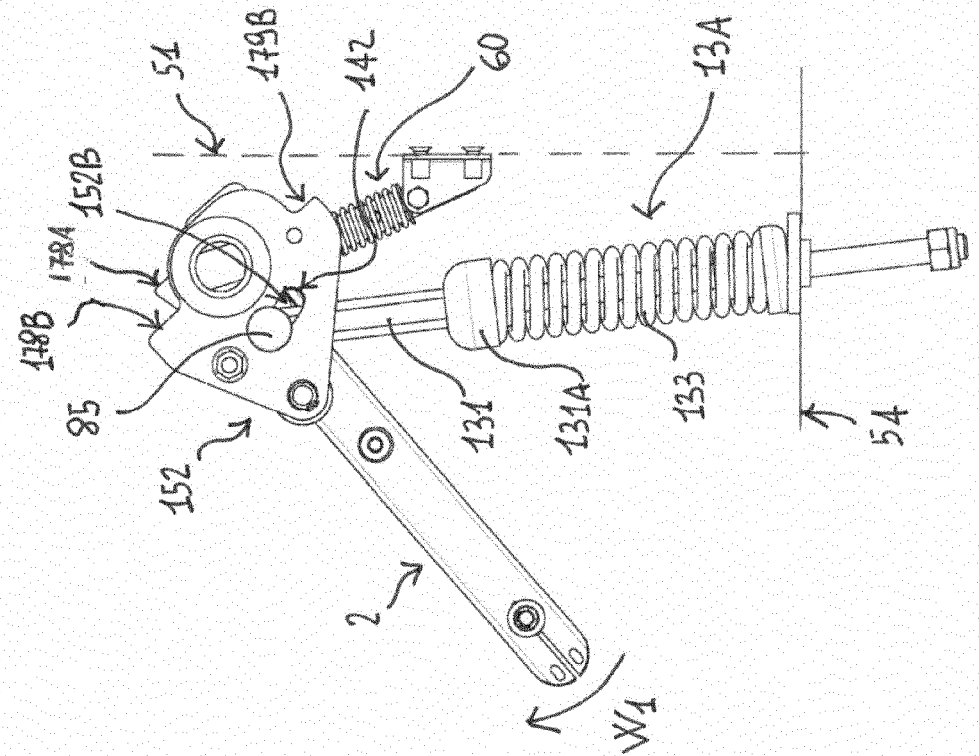
51
179B
142
60
13A
152B
178A
179B
85
152
131
131A
133
54
2
W1

FIG. 20

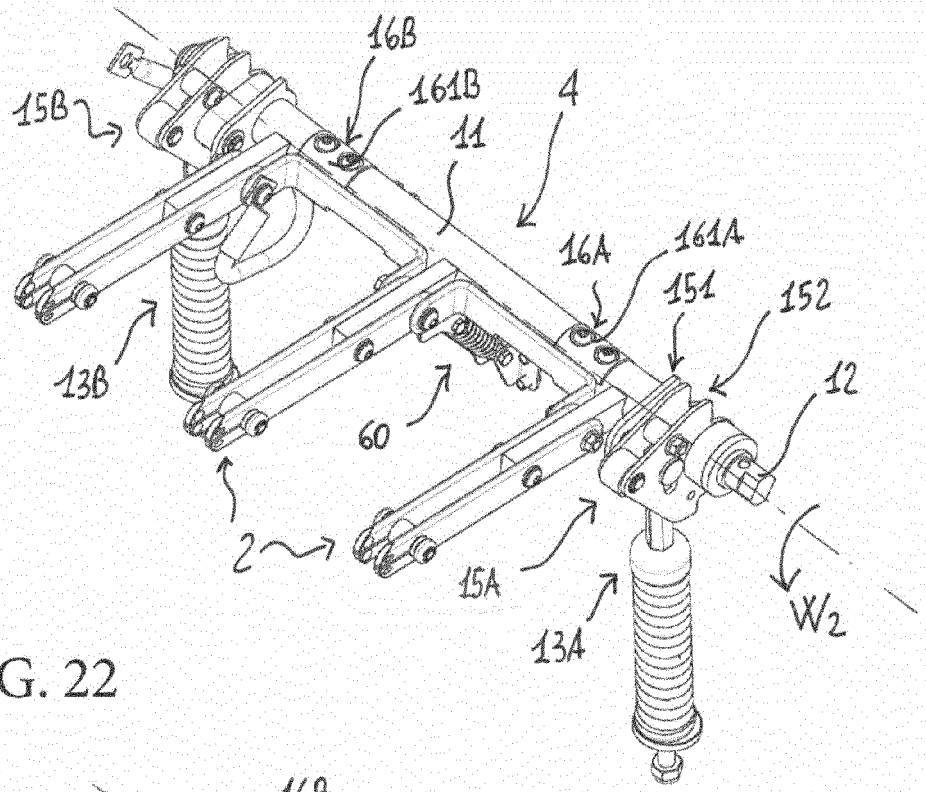
16B
161B
15B
11
4
16A
161A
151
152
13B
60
12
2
15A
13A
W2

FIG. 22

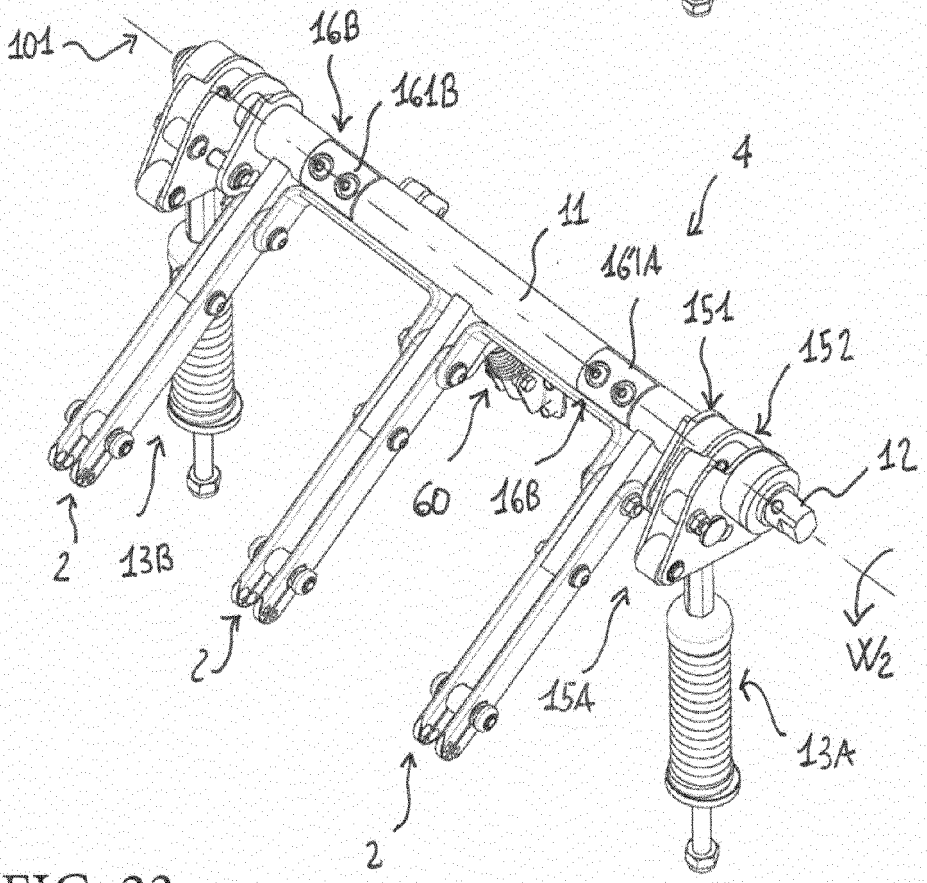
101
16B
161B
4
11
161A
151
152
12
60
16B
2
13B
W2
15A
13A

FIG. 23

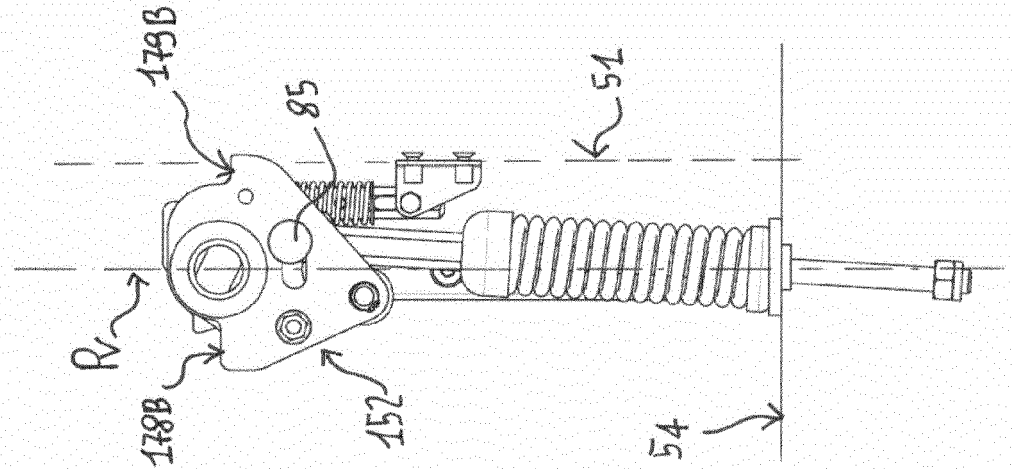

FIG. 26

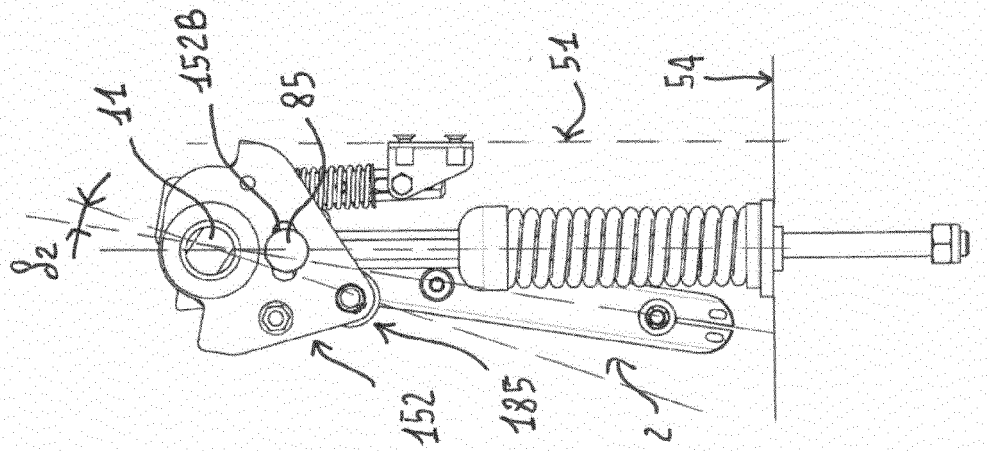

FIG. 25

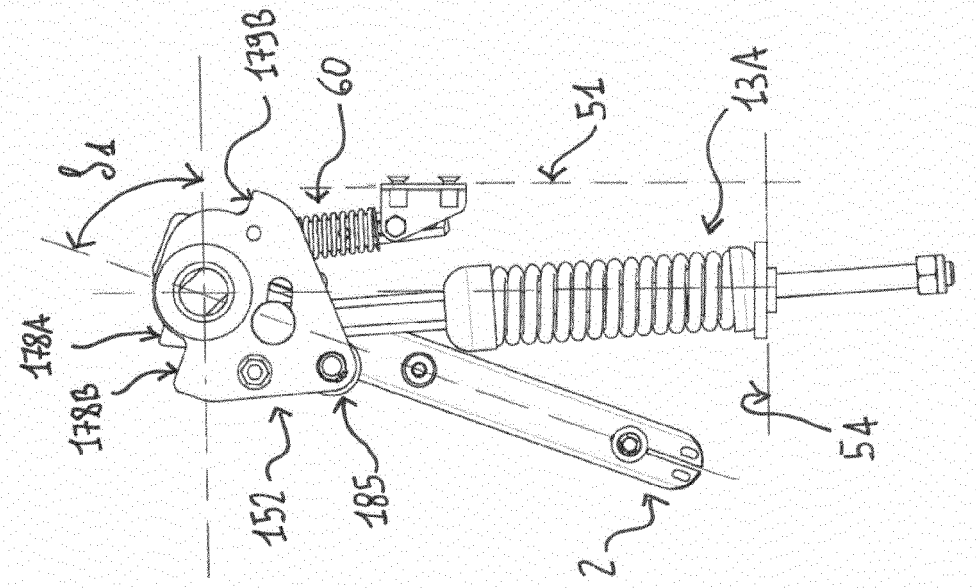

FIG. 24

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EUROPEAN SEARCH REPORT

Application Number
EP 20 17 0796

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2 820 862 A (CARMICHAEL ROBERT D ET AL) 21 January 1958 (1958-01-21) * column 1, line 58 - column 4, line 57; figures *	1-15	INV. H01H3/30 H01H31/00 H01H31/28
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H01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	19 August 2020	Findeli, Luc

CATEGORY OF CITED DOCUMENTS

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