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(54) **VEHICLE LOCK WITH ACTUATOR IN THE LOCK BOX**

(57) Vehicle lock (100) comprising: a box (1), a catch (2), a primary pawl (3), a secondary pawl (4), a motorized release lever (5) suitable for cooperating with the primary pawl (3) and with the secondary pawl (4) in order to move them to an unlocked position, a closing lever (8) suitable for cooperating with the catch (2) in order to move it to a closing position, an actuator (A) that moves a gear train (70) configured to move the motorized release lever (5) and the closing lever (8), a disengagement device (200) configured to disengage two gears (70a, 70b) of the gear train (7), and a manual release lever (9) configured to cooperate with the motorized release lever (5) and with said disengagement device (200).

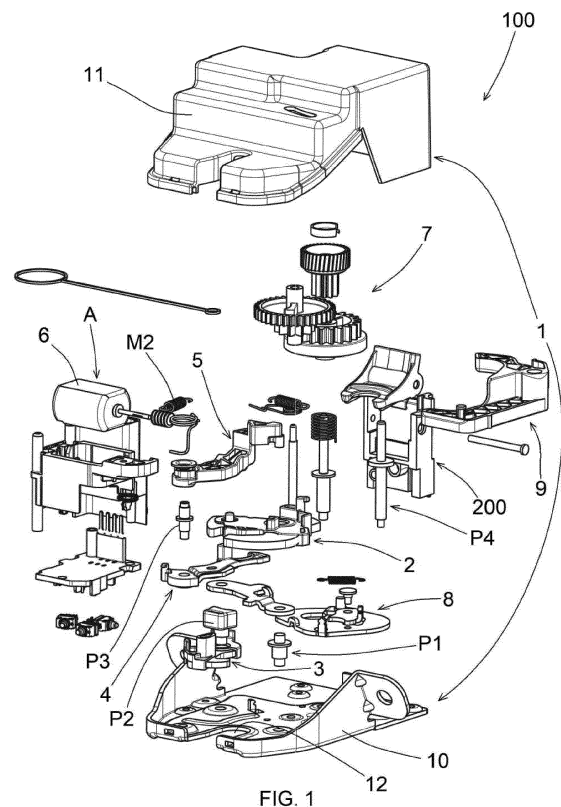


FIG. 1

Description

[0001] The present invention relates to a lock for a vehicle door, and specifically to a lock for the hatch of the vehicle.

[0002] Vehicle locks suitable for locking a striker that is integral with a body part or door of the vehicle are known.

[0003] WO2021/121883A1 discloses such a type of vehicle lock. Such a vehicle lock comprises:

- a box comprising a base plate with a slot suitable for receiving a striker,
- a catch suitable for being moved to a closing position wherein the striker is locked, and
- a pawl suitable for locking the catch in closing position.

[0004] Two actuators on the outside of the box operate the pawl in order to open the lock.

[0005] The automotive market requires locks with a single actuator that is integral with the box of the lock. In such a case, a gear train connects the motor of the actuator to levers of the lock. However, if the motor is jammed when the catch is in closing position, it becomes complicated to open the lock.

[0006] US2018087298A1 discloses a lock with an actuator that is integral with the box of the lock. In order to close the lock, the actuator operates a motorized locking lever that locks the catch. In order to open the lock, the actuator operates a motorized release lever that unlocks the pawl, releasing the catch. The lock comprises a manual release lever that disengages the gears of the actuator and moves the motorized closing lever.

[0007] Such a system is impaired by some drawbacks due to the presence of the motorized locking lever and to the fact that the manual release lever operates directly on the motorized closing lever.

[0008] US2016312499A1 describes a lock with a motorized locking mechanism comprising a manual release lever that is moved between two points along an axis of rotation.

[0009] The purpose of the present invention is to eliminate the drawbacks of the prior art by providing a vehicle lock provided with an actuator disposed in the box of the lock, said vehicle lock being efficient, safe and reliable, versatile, space-saving, and simple to operate.

[0010] These purposes are achieved in accordance with the invention with the features of the independent claim 1.

[0011] Advantageous achievements of the invention appear from the dependent claims.

[0012] The lock according to the invention is defined in claim 1.

[0013] Additional features of the invention will appear clearer from the following detailed description, which refers to a purely illustrative and therefore non-limiting embodiment, illustrated in the appended drawings, wherein:

Fig. 1 is an exploded perspective view of the various components of the lock according to the invention; Fig. 2 is an enlarged view of all the components of the lock of Fig. 1;

Fig. 2A is a perspective view showing a catch, two pawls and a reinforcing plate of the lock of Fig. 1;

Fig. 2B a perspective view showing a motorized release lever of the lock of Fig. 1;

Fig. 2C is a perspective view showing a gear train and a disengagement device of the primary gear of the lock of Fig. 1;

Fig. 2D is a perspective view showing a closing lever, a strut, the secondary gear and the tertiary gear of the gear train of the lock of Fig. 1;

Fig. 2E is an exploded view of a manual release lever;

Fig. 3 is a perspective view of the lock of Fig. 1 in assembled condition, without cover and manual release lever, in closing position;

Fig. 4 is the same view as Fig. 3, during an opening step;

Fig. 5 is the same view as Fig. 3, in an open position, also showing the manual release lever;

Fig. 6 is a bottom view of some components of the lock of Fig. 1, with the catch in an open position;

Fig. 7 is a top view of some components of the lock, with the catch in intermediate closing position;

Fig. 8 is a bottom view, just like Fig. 6, showing the movement of the catch from the intermediate closing position to the closing position;

Fig. 9 is a bottom view, just like Fig. 6, showing the catch in closing position and the reset operation of the closing lever;

Fig. 10 is a perspective view showing the lock assembled in the box in closing position;

Fig. 11 is the same view as Fig. 10, showing the lock during a first operation step of the manual release lever;

Fig. 12 is the same view as Fig. 10, showing the lock in the open position after the operation of the manual release lever;

Fig. 13 is an axial view taken along the sectional plane XIII-XIII of Fig. 12;

Fig. 14 is a perspective view showing the tertiary gear assembled to the closing lever and the shaft of the secondary gear pivoted to the closing lever, with the strut of the closing lever that pushes the catch;

Fig. 15 is a perspective top view showing the lock of the invention, with a second embodiment of the gear disengagement device;

Fig. 16 is a sectional view taken along the sectional plane XVI-XVI of Fig. 15;

Fig. 17 is a side view of the disengagement device of Fig. 15;

Fig. 18 is a perspective side view of a detail of the lock of Fig. 15, showing the primary gear disengaged from the secondary gear; and

Fig. 19 is a perspective top view of a detail of Fig.

15 showing an anti-rotation system of the disengagement device.

[0014] With reference to the Figures, a lock according to the invention is disclosed, it being generally indicated with reference numeral 100.

[0015] Now with reference to Fig. 1, the lock (100) comprises a box (1) comprising a base plate (10) and a cover (11). A catch (2), a primary pawl (3) and a secondary pawl (4) are pivoted on the base plate (10).

[0016] The base plate (10) comprises a U-shaped slot (12) suitable for receiving a striker (not shown in the figures). The lock (100) can be integral with the vehicle body and the striker can be integral with the hatch or vice versa.

[0017] A first pivoting pin (P1), a second pivoting pin (P2), and a third pivoting pin (P3) are arranged in the base plate (10) for pivoting the catch (2) around a first pivoting axis, the primary pawl (3) around a second pivoting axis, and the secondary pawl (4) around a third pivoting axis. The three pivoting axes are parallel to each other and orthogonal to the base plate (10).

[0018] Referring to Figs. 2 and 2A, the catch (2) has the shape of a plate comprising a central portion (20) arranged around the first pivoting pin (P1). A first arm (21a) and a second arm (21b) protrude from the central portion (20) of the catch so as to define a U-shaped fastening seat (22) suitable for engaging the striker, when it is in the slot (12) of the base plate, in order to close the lock, as shown in Fig. 3.

[0019] A stop tooth (23) is arranged in the first arm (21a) of the catch opposite the fastening seat (22).

[0020] A locking pin (24) protrudes from the second arm (21a).

[0021] A spring-holding pin (26) protrudes from the central body (20) in distal position from the fastening seat (22) in order to hold one end of a first spring (M1) that is fixed to the base plate.

[0022] The catch (2) has a rear end edge (27) with a loop (28) and a rounded part (29) (Fig. 6).

[0023] The catch (2) can rotate around the first pivoting axis of the first pivoting pin (P1) to go from a closing position (Fig. 3), wherein the striker is locked, to an open position (Fig. 5), wherein the striker is released.

[0024] The first spring (M1) stresses the catch (2) toward the open position.

[0025] The primary pawl (3) comprises a central portion (30) arranged around the second pivoting pin (P2). An arm (31) protrudes from the central portion (30) of the primary pawl. A stop tooth (32) is provided on the arm (31) of the primary pawl. The stop tooth (32) of the primary pawl is suitable for abutting against the stop tooth (23) of the catch disposed in the first arm (21a) of the catch in order to lock the catch (2) in closing position.

[0026] A stop protrusion (33) protrudes from the arm (31) of the primary pawl.

[0027] A spring-holding pin (34) protrudes from the arm of the primary pawl, in distal position from the second pivoting pin (P2) in order to hold one end of a second

spring (M2).

[0028] The primary pawl (3) has a back portion (35) with a rounded shape.

[0029] The second pivoting pin (P2) has a head (36) in the shape of a parallelepiped block that extends above the first arm (21a) of the catch, facing the slot (12) of the base plate, so as to receive the striker when the lock is closed.

[0030] The primary pawl (3) can rotate around the second pivoting axis of the second pivoting pin (P2) in order to go from a locked position (Fig. 9), wherein the catch (2) is locked, to an unlocked position (Fig. 6), wherein the catch (2) is released.

[0031] The primary pawl (3) is stressed in the locking position by the second spring (M2).

[0032] The secondary pawl (4) comprises a central portion (40) arranged around the third pivoting pin (P3). An arm (41) protrudes from the central portion (40) of the secondary pawl. A stop tooth (42) is provided on the arm (41) of the secondary pawl.

[0033] The arm (41) of the secondary pawl is configured in such a way to be arranged above the catch (2). The stop tooth (42) of the secondary pawl is suitable for abutting against the stop pin (24) of the catch that protrudes from the first arm (21a) of the catch in order to lock the catch (2) in intermediate closing position (Fig. 8).

[0034] A stop protrusion (43) protrudes from the arm (41) of the secondary pawl.

[0035] A spring-holding pin (44) protrudes in a rear position from the central body (40) of the primary pawl in order to hold one end of the second spring (M2), which in such a case connects the primary pawl (3) to the secondary pawl (4).

[0036] The secondary pawl (4) has a front portion (45) with a rounded shape.

[0037] The secondary pawl (4) can rotate around the third pivoting axis of the third pivoting pin (P3) in order to go from an intermediate closing position (Fig. 7), wherein the catch (2) is locked in intermediate closing position, to an unlocked position (Fig. 6), wherein the catch (2) is released.

[0038] The second spring (M2) stresses both the primary pawl (3) and secondary pawl (4) toward the locking positions.

[0039] The lock (100) comprises a reinforcing plate (300) attached to the first pivoting pin (P1) and to the second pivoting pin (P2) in such a way to pass over the secondary pawl (4) in bridge configuration. The reinforcement plate (300) comprises two holes (301, 302) crossed by the first pivoting pin (P1) and by the second pivoting pin (P2).

[0040] Referring to Fig. 2B, the lock (100) also comprises a motorized release lever (5) that operates both the primary pawl (3) and the secondary pawl (4) to move the pawls (3, 4) from the locked positions in order to release the catch (2), which can be moved to the open position.

[0041] The motorized release lever (5) is pivoted to the

base plate (10) by means of a pivoting pin, which can be the third pivoting pin (P3) to which the secondary pawl (4) is pivoted.

[0042] The motorized release lever (5) comprises a central portion (50) arranged around the third pivoting pin (P3). An arm (51) protrudes from the central portion (50) of the motorized release lever (5).

[0043] The motorized release lever (5) is arranged in such a way to be disposed above the secondary pawl (4) and the primary pawl (3) in initial idle position (Fig. 3), wherein the arm (51) of the motorized release lever (5) is close to the stop protrusions (33, 43) of the primary pawl (3) and of the secondary pawl (4). In such a way, by rotating the motorized release lever (5) around the third pivoting pin (P3) towards an operating position (Fig. 5), the arm (51) of the motorized release lever goes in contact with the stop protrusions (33, 43) of the primary pawl (3) and of secondary pawl (4) and pushes the primary pawl (3) and the secondary pawl (4) toward the unlocking positions, so that the catch (2) is released and moved to the open position.

[0044] A third spring (M3) stresses the motorized release lever (5) toward the initial idle position.

[0045] The motorized release lever (5) comprises a stop protrusion (53) that projects superiorly from a front end of the arm (51) and an actuating pin (52) that projects inferiorly from a front end of the arm (51).

[0046] Referring to Fig. 2, the motorized release lever (5) is moved by an actuator (A) by means of a gear train (7), which moves the motorized release lever (5) from the initial idle position to the operating position.

[0047] The actuator (A) comprises an electric motor (6) having a drive shaft (60) whereon a worm screw (61) is keyed.

[0048] The gear train (7) comprises a primary gear (70a) that meshes with the worm screw (61), and a secondary gear (70b) that meshes with the primary gear (70a).

[0049] The secondary gear (70b) has a radial protrusion (71) abutting against the actuating pin (52) of the motorized release lever (5) so as to push the motorized release lever to the operating position.

[0050] Referring to Fig. 2C, the primary gear (70a) has a first toothed wheel (72) with helical teeth that meshes with the worm screw (61) and a second toothed wheel (73) with straight teeth. The first toothed wheel (72) has a larger diameter than the second toothed wheel (73).

[0051] The primary gear (70a) is mounted on a first shaft (170a) mounted in the base plate (10). A fourth spring (M4) and a spring-holding ring (M4') are arranged in the primary gear (70a) in such a way to stress it to an initial idle position.

[0052] The secondary gear (70b) comprises a first toothed wheel (74) with straight teeth that meshes with the second toothed wheel (73) of the primary gear.

[0053] The secondary gear (70b) is mounted on a second shaft (170b) mounted on the base plate (10).

[0054] A fifth spring (M5) is arranged between the sec-

ondary gear (70b) and a support (400) of the motor to push the secondary gear (70b) to an initial idle position.

[0055] The function of the fourth spring (M4) and of the fifth spring (M5) is to reset the initial position of the gear train (7) in case of an electrical block of the motor (6) during the opening of the lock.

[0056] Referring to Figs. 2, 2D and 14, the lock (100) comprises a closing lever (8), in the form of a plate, pivoted to the base plate (10) by means of a pin that is formed by the second shaft (170b) of the secondary gear. For such a purpose, the second shaft (170b) has an end (175) pivoted in a hole (80) of the closing lever.

[0057] A strut (81) is pivoted on the closing lever (8) by means of a pin (82) in such a way to protrude from the closing lever and abut against the rear end edge (27) of the catch. The strut (81) has a C-shaped edge (83) that cooperates with the rounded part (29) of the rear end edge (27) of the catch.

[0058] The closing lever (8) has a slot (86).

[0059] The strut (81) has a protrusion (88) (Fig. 14) that protrudes inferiorly in order to be inserted into the slot (86), so as to define the end stop for the travel of the strut (81). In this way, the strut (81) can move from an initial non-operating position to an operating position wherein it interacts with the rear end edge (27) of the catch.

[0060] The strut (81) has a spring-holding protrusion (84) that protrudes superiorly. The closing lever (8) has a spring-holding protrusion (85). A sixth spring (M6) is arranged between the spring-holding protrusion (84) of the strut and the spring-holding protrusion (85) of the closing lever to stress the strut (81) toward the initial non-operating position.

[0061] The closing lever (8) has an operating pin (87) that protrudes superiorly.

[0062] The closing lever (8) is operated by a tertiary gear (70c) of the gear train (7). The tertiary gear (70c) comprises a toothed wheel (76) with straight teeth that engage in a second toothed wheel (75) of the secondary gear. The second toothed wheel (75) of the secondary gear has a smaller diameter than the first toothed wheel (74) of the secondary gear.

[0063] The toothed wheel (76) of the tertiary gear is integral with a discoidal flange (77).

[0064] With reference to Fig. 14, the discoidal flange (77) of the tertiary gear has a seat (78) wherein the operating pin (87) of the closing lever is arranged and a radial protrusion (79) that is suitable for abutting against the operating pin (87) of the closing lever in order to move the closing lever.

[0065] In view of the above, the closing lever (8) can move from an initial idle position, wherein the strut does not cooperate with the rear end edge (27) of the catch, to an operating position, wherein the strut (81) cooperates with the rear end edge (27) of the catch.

[0066] A seventh spring (M7) is arranged between a second spring-holding protrusion (89) of closing lever and the base plate (10) to stress the closing lever (8)

toward the initial idle position.

[0067] The tertiary gear (70c) is mounted on the first shaft (170a) under the primary gear (70a).

[0068] Referring to Fig. 2C, the first shaft (170a) has a collar (171) arranged in intermediate position so as to define an upper portion (172) on which the primary gear (70a) is mounted and a lower portion (173) on which the tertiary gear (70c) is mounted. The lower portion (173) of the first shaft ends with a lower end (174) fixed to the base plate (10).

[0069] With reference to Fig. 14, in the lower portion (173) of the first shaft, below the tertiary gear (70c) and near the lower end (174) of the first shaft, a tang (175) of the tertiary gear (70c) is crossed by the lower end (174) of the first shaft. The tang (175) of the tertiary gear (70c) is arranged in the slot (86) of the closing lever. In this way, the slot (86) of the closing lever can slide relative to the tang (175) of the tertiary gear during the movement of the closing lever.

[0070] Referring to Fig. 2C, the primary gear (70a) is mounted on a disengagement device (200) suitable for raising the primary gear (70a) so as to disengage the second toothed wheel (73) of the primary gear from the first toothed wheel (74) of the secondary gear. The disengagement of the primary gear (70a) from the secondary gear (70b) favors the reengagement of the teeth of the toothed wheels (73, 74) when resetting the gear train (7).

[0071] The disengagement device (200) comprises a support (201) mounted on the base plate (10) and a bracket (202) that protrudes from the support (201). The bracket (202) has a C-shaped seat (203) wherein the primary gear (70a) is revolvingly supported. The bracket (202) can move from an engaged position, wherein the first toothed wheel (72) of the primary gear engages the worm screw (61) of the actuator, to a disengaged position, wherein the second toothed wheel (73) of the primary gear is disengaged by the first toothed wheel (74) of the secondary gear.

[0072] The bracket (202) has an L-shaped cross section along a vertical plane and is provided with an operating tab (204) substantially orthogonal to the housing (203).

[0073] The bracket (202) is pivoted to the support (201) by means of a pin (205). A leaf spring (206) is arranged between the bracket (202) and the support (201) to hold the bracket in the engaged position.

[0074] Referring to Figs. 2 and 2E, the lock (100) comprises a manual release lever (9) that can be moved manually by the user when the electric motor (6) of the actuator does not work. The manual release lever (9) performs two functions:

- it operates the motorized release lever (5) to open the lock; and
- it operates the disengagement device (200) to disengage the primary gear (70a) from the secondary gear (70b) of the gear train (7).

[0075] A fourth pivoting pin (P4) is arranged in the base plate to pivot the manual release lever (9) around a fourth pivoting axis.

[0076] The manual release lever (9) comprises a central portion (90) arranged around a hole (99) that receives the fourth pivoting pin (P4). The manual release lever has an L-shape and comprises a first arm (91) and a second arm (92) that protrude from the central portion (90) of the manual release lever (9). The first arm (91) and the second arm (92) of the manual release lever have respective stop teeth (93, 94) suitable for abutting the stop protrusion (53) of the motorized release lever and the operating tab (204) of the disengagement device, respectively.

[0077] A pin (95) protrudes from the first arm for attaching a rope (96) that is brought out of the box (1) of the lock so that it can be pulled manually by the operator.

[0078] The manual release lever (9) is disposed above the catch (2). For this purpose, the fourth pivoting pin (P4) has a collar (191) and an upper portion (192) above the collar that threads into the hole (99) of the manual release lever.

[0079] The manual release lever (9) can be moved from an initial idle position (Fig. 10) wherein the stop teeth (93, 94) of the first arm and of the second arm are close to the stop protrusion (53) of the motorized release lever and to the operating tab (204) of the disengagement device to an operating position (Fig. 12) wherein the stop teeth (93, 94) of the first arm and of the second arm of the manual release lever push the stop protrusion (53) of the motorized release lever and the operating tab (204) of the disengagement device.

[0080] The manual release lever (9) has a leaf spring (97) that protrudes from the central portion (90) and is attached to the support (201) of the disengagement device (200) to pull the manual release lever (9) towards the initial non-operating position.

[0081] With reference to Figs. 2 and 8, the lock (100) comprises:

- a first sensor (T1) suitable for detecting the position of the primary pawl (3),
- a second sensor (T2) suitable for detecting the position of the secondary pawl (4), and
- a third sensor (T3) suitable for detecting the position of the tertiary gear (70c).

[0082] The sensors (T1, T2, T3) can be microswitches that change their state from open to closed when they are touched by the devices whose position they are to detect, respectively.

[0083] The first sensor (T1) is arranged in the box of the lock in such a way to interact with the rear portion (35) of the primary pawl (3). The first sensor (T1) is normally closed when the primary pawl (3) is in the open position and opens only when the primary pawl (3) is in the locked position (Fig. 9).

[0084] The second sensor (T2) is arranged in the box

of the lock in such a way to interact with the front portion (45) of the secondary pawl (4). The second sensor (T2) is closed when the secondary pawl is in the open position (Fig. 6) and opens when the secondary pawl (4) reaches the intermediate closing position (Fig. 7).

[0085] The third sensor (T3) is arranged in the box of the lock in such a way to interact with a peripheral edge (277) of the discoidal flange (77). For this purpose, the peripheral edge of the discoidal flange (77) has a loop (278).

[0086] The third sensor (T3) is closed when the tertiary gear (70c) is actuated and opens only when the loop (278) of the peripheral edge (277) of the discoidal flange (77) of the tertiary gear reaches the third sensor (T3) (Fig. 7), that is, when the tertiary gear (70c) is in the initial idle position.

[0087] Going back to Fig. 2, the lock (100) comprises a support (400) arranged in the box of the lock to support the electric motor (6). A printed circuit board (PCB) (401) is arranged under the support (400) for mounting an electrical connector (402) having electrical contacts (403) connected to the electric motor (6) and electrical contacts (404) connected to the sensors (T1, T2, T3).

[0088] The operation of the lock (100) is described below.

[0089] With reference to Fig. 3, the lock (100) is in closing position. The second arm (21a) of the catch is on the slot (12) of the base plate so as to hold the striker (not shown).

[0090] The primary pawl (3) is in locked position.

[0091] The motorized release lever (5) is in initial idle position wherein the arm (51) of the motorized release lever (5) is close to the stop protrusions (33, 43) of the primary pawl (3) and of the secondary pawl (4).

[0092] The secondary gear (70b) is in initial idle position wherein the radial protrusion (71) of the secondary gear is close to the operating pin (52) of the motorized release lever (5).

[0093] In order to open the lock (100), the electric motor (6) of the actuator is operated, causing a rotation of the gear train (7) and consequently a rotation of the secondary gear (70b) in an opening direction indicated by arrow F1.

[0094] With reference to Fig. 4, during the rotation of the secondary gear (70b) in the direction of arrow F1, the radial protrusion (71) of the secondary gear abuts the operating pin (52) of the motorized release lever (5) and then the motorized release lever rotates around the third pivoting pin (P3) in the direction of arrow F2.

[0095] As a result, the arm (51) of the motorized release lever abuts the stop protrusions (33, 43) of the primary pawl (3) and of the secondary pawl (4), causing the primary pawl (3) and secondary pawl (4) to move toward the release position in the direction of arrow F2.

[0096] Consequently, the primary pawl (3) and the secondary pawl (4) unlock the catch (2), which is moved toward the open position by the action of the first spring (M1), rotating around the first pivoting pin (P1) in the di-

rection of arrow F3.

[0097] Fig. 5 illustrates the catch (2) in open position, wherein the second arm (21b) of the catch clears the slot (12) of the base plate in such a way to pull the striker out of the slot (12) of the base plate.

[0098] With reference to Fig. 6, the lock (100) is in open position. In such a condition, the first sensor (T1) is closed because it is in contact with the rear portion (35) of the primary pawl that is in unlocked position. The second sensor (T2) is closed because it is in contact with the front portion (45) of the secondary pawl that is in unlock position. The third sensor (T3) is open because it is in the loop (278) of the discoidal flange (77) of the tertiary gear (70c) that is in an initial idle position.

[0099] The strut (81) of the closing lever (8) is close to the rear end edge (27) of the catch.

[0100] In order to close the vehicle hatch, the operator pushes the hatch manually and the striker abuts against the first arm (21a) of the catch, pushing the catch (2) in the direction of arrow F4. Then the catch (2) rotates around the first pivoting pin (P1) in the direction of arrow F5.

[0101] The arm (41) of the secondary pawl slides over the locking pin (24) of the catch, and the secondary pawl (4) rotates around the third pivoting pin (P3) in the direction of arrow F6, toward the intermediate locking position.

[0102] Fig. 7 illustrates the situation in which, as a result of the movement of the secondary pawl (4) in the direction of arrow F6, the locking pin (24) of the catch abuts against the stop tooth (42) of the secondary pawl. In such an intermediate closing situation, the catch (2) cannot be opened.

[0103] When the secondary pawl (4) reaches the intermediate locking position, the front end (45) of the secondary pawl disengages the second sensor (T2), which changes its state, sending a control signal to the electric motor (6) that drives the gear train (7) for the closing operation.

[0104] With reference to Fig. 8, following the actuation of the gear train (7), the radial protrusion (79) of the discoidal flange of the tertiary gear pushes the operating pin (87) of the closing lever, causing a rotation of the closing lever (8) around the second shaft (170b) in the direction of arrow F7. Such a rotation of the closing lever (8) is possible due to the slot (86) of the closing lever that slides around the first shaft (170a).

[0105] The strut (81) of the closing lever moves to the operating position and interacts with the rear end edge (27) of the catch, causing the rotation of the catch (2) in the direction of arrow F8 toward the closing position.

[0106] With reference to Fig. 9, the catch (2) rotates in the closing direction until the stop tooth (32) of the primary pawl engages with the stop tooth (23) of the catch. In such a case, the primary pawl (3) is stressed by the second spring (M2) and rotates around the second pin (P2) in the direction of arrow F9, and therefore the rear part (35) of the primary pawl is detached from the first sensor (T1), which changes its state, sending a command signal

to the electric motor (6), which drives the gear train (7) and moves the tertiary gear in the direction of arrow F10, in order to return the tertiary gear (70c) to the initial idle position that is identified when the third sensor (T3) reaches the loop (278) of the discoidal flange of the tertiary gear.

[0107] The sixth spring (M6) returns the strut (81) to the initial non-operating position.

[0108] The seventh spring (M7) moves the closing lever in the direction of arrow (F11) and returns the closing lever (8) to the initial idle position.

[0109] In such a way, the tertiary gear (70c), the closing lever (8) and the strut (81) are reset to the initial position so that a new opening cycle can be performed.

[0110] It should be noted that when the catch (2) is in closing position, the closing lever (8) returns to the initial idle position and does not lock the cath. In fact, the locking of the catch is ensured by the primary pawl (3) and by the secondary pawl (4).

[0111] With reference to Fig. 10, the lock (100) is in closing position.

[0112] The motorized release lever (5) is in initial idle position. The stop tooth (93) of the first arm of the manual release lever (9) is close to the stop protrusion (53) of the motorized release lever.

[0113] The disengagement device (200) is in initial idle position. The stop tooth (93) of the second arm of the manual release lever (9) is close to the operating tab (204) of the disengagement device.

[0114] If the electric motor (6) does not work, the operator manually pulls the rope (96) in the direction of arrow F12 in order to open the lock (100) and as a result the manual release lever (9) rotates around the fourth pin (P4) in the direction of arrow F13.

[0115] With reference to Fig. 11, the stop tooth (93) of the first arm of the manual release lever (9) pushes the stop protrusion (53) of the motorized release lever. Then the motorized release lever (5) rotates around the third pin (P3) in the direction of arrow F14. As a result, the arm (51) of the motorized release lever abuts against the stop protrusions (33, 43) of the primary pawl (3) and of the secondary pawl (4), causing the primary pawl (3) and the secondary pawl (4) to move toward the unlocked position so as to unlock the catch (2) that is moved toward the open position by the action of the first spring (M1).

[0116] Simultaneously with the movement of the motorized release lever (5), the stop tooth (93) of the second arm of the manual release lever (9) abuts against the operating tab (204) of the disengagement device, causing the operating tab (204) to move in the direction of arrow F15. Then the seat (203) of the bracket of the disengaging device is raised, thus raising the second toothed wheel (73) of the primary gear that disengages from the first wheel (74) of the secondary gear, putting in idle a gear transmission consisting of the gear train (7).

[0117] In this way, during the opening travel of the catch (2), the rear end edge (27) of the catch abuts against the strut (81) of the closing lever, causing the

closing lever (8) to move.

[0118] The movement of the closing lever (8) implies a rotation of the tertiary gear (70c) and thus of the gear train (7). Such a movement of the closing lever (8) is possible due to the fact that the second toothed wheel (73) of the primary gear is released from the first toothed wheel (74) of the secondary gear, and so the gear train (7) can move freely as a result of the movement of the closing lever (8).

[0119] Figs. 12 and 13 illustrate the lock in open position during the manual pulling of the manual release lever, wherein the first toothed wheel (72) of the primary gear is raised relative to the worm screw (61) of the electric motor.

[0120] When the operator releases the rope of the manual release lever (9), the manual release lever (9) returns to the initial idle position by the action of the spring (97).

[0121] Also the primary gear (70a) and the secondary gear (70b) return to the initial idle positions by the action of the respective springs (M4, M5).

[0122] With reference to Figs. 15 to 19, a second embodiment of a disengagement device (500) is illustrated, which again has the function of disengaging the primary gear (70a) from the secondary gear (70b). The disengagement device (200) of the first embodiment is configured in such a way to raise the primary gear (70a) from the secondary gear (70b). On the contrary, the disengagement device (500) of the second embodiment is configured in such a way to lower the primary gear (70a) from the secondary gear (70b).

[0123] Referring to Fig. 17, the disengagement device (500) comprises a first tang (501) integral with the manual release lever (9) and a second tang (503) arranged on the primary gear (70a).

[0124] The first tang (501) is internally hollow and has an internal thread (502). The second tang (503) has a pin (504) that protrudes radially outward to engage the internal thread (502) of the second tang.

[0125] Thus, when the user rotates the manual release lever (9), the pin (504) of the second tang is forced to slide in the internal thread (502) of the first tang and translate downward, pushing the primary gear (70a) down and disengaging it from the secondary gear (70b).

[0126] Fig. 18 illustrates a disengagement situation, wherein the second toothed wheel (73) of the primary gear is below the first toothed wheel (74) of the secondary gear and thus the second toothed wheel (73) of the primary gear is not threaded with the first toothed wheel (74) of the secondary gear.

[0127] With reference to Fig. 15, the gear train (7) is arranged in a casing (15) integral with the box (1).

[0128] Referring to Fig. 19, the disengagement device (500) comprises anti-rotation means (AR) to prevent a rotation of the second tang (503) relative to the casing (15). The anti-rotation means (AR) may comprise a protrusion (505) that protrudes externally from the second tang (503) and engages a channel (16) formed in the

casing (15). In this way, the protrusion (505) can slide in the channel (16), allowing only a translation of the second tang (503) and preventing a rotation of the second tang.

Claims

1. Vehicle lock (100) comprising:

- a box (1) comprising a base plate (10) with a slot (12) suitable for accommodating a striker that is integral with the body or hatch of the vehicle,
- a catch (2) having a central portion (20) and a fastening seat (22) suitable for fastening the striker when it is in the slot (12) of the base plate; said catch (2) being pivoted to said base plate (10) around a first pivoting pin (P1) for going from a closing position, wherein said striker is locked, to an opening position, wherein said striker is released,
- a primary pawl (3) for locking said catch (2) in the closing position; said primary pawl (3) being pivoted to said base plate around a second pivoting pin (P2) for going from a locked position, wherein said catch is locked, to an unlocked position, wherein said catch is unlocked,
- a secondary pawl (4) suitable for locking said catch (2) in intermediate closing position; said secondary pawl (4) being pivoted to said base plate around a third pivoting pin (P3) for going from a locked position, wherein said catch is locked in the intermediate closing position, to an unlocked position, wherein said catch is unlocked,
- a motorized release lever (5) suitable for cooperating with said primary pawl (3) and said secondary pawl (4) for moving them towards the release position in order to bring the catch to the opening position,
- a closing lever (8) suitable for cooperating with said catch (2) to move the catch (2) from said intermediate closing position to said closing position,
- an actuator (A) that moves a gear train (70) configured to move said motorized release lever (5) and said closing lever (8),
- a disengagement device (200; 500) configured to disengage two gears of the gear train (7), and
- a manual release lever (9) operable manually by the user to cooperate with said motorized release lever (5) to open the catch and with said disengagement device (200; 500) to disengage two gears of the gear train (7), so that the opening of the catch (2) can cause a movement of the closing lever (8) and of the gear train (7).

2. The lock (100) according to claim 1, wherein said

actuator (A) comprises a worm screw (61) moved by an electric motor (6) disposed in the box; said gear train (7) comprises:

- a primary gear (70a) which meshes with the worm screw (61),
 - a secondary gear (70b) which meshes with the primary gear (70a) and is configured to move said motorized release lever (5), and
 - a tertiary gear (70c) that meshes with the secondary gear (70b) and is configured to move said closing lever (8).
3. The lock (100) according to claim 2, wherein said motorized release lever (5) is pivoted to the base plate (10) and said secondary gear (70b) has a radial protrusion (71) that goes in contact with an operating pin (52) of said motorized release lever (5) to move said motorized release lever.
4. The lock (100) according to claim 2 or 3, wherein said closing lever (8) is pivoted to the base plate (10) and said tertiary gear (70c) has a radial protrusion (79) suitable for going into contact with an operating pin (87) of the closing lever to move the closing lever.
5. The lock (100) according to any one of claims 2 to 4, wherein said disengagement device (200) comprises a support (201) mounted on the base plate (10) and a bracket (202) that protrudes from the support; the bracket (202) having a seat (203) wherein the primary gear (70a) is rotatably supported, and an operating tab (204) suitable for raising the seat (203) when the manual release lever (9) is actuated so as to disengage the primary gear (70a) from the secondary gear (70b).
6. The lock (100) according to claim 5, wherein said manual release lever (9) has an L-shape and comprises:
- a central portion (90) pivoted to the base plate (10),
 - a first arm (91) having a stop tooth (93) that goes in contact with a stop protrusion (53) of the motorized release lever, and
 - a second arm (92) having a stop tooth (94) that goes in contact with the operating tab (204) of the disengagement device.
7. The lock (100) according to any one of the claims 2 to 4, wherein said disengagement device (500) comprises a first tang (501) integral with the manual release lever (9) and a second tang (503) arranged on the primary gear (70a); wherein the first tang (501) is internally hollow and has an internal thread (502) and the second tang (503) has a pin (504) that radially protrudes outward for engaging the internal

thread (502) of the second tang.

8. The lock (100) according to claim 7, wherein the gear train (7) is arranged into a casing (15) integral with the box (1) of the lock and said disengagement device (500) comprises anti-rotation means (AR) in order to prevent a rotation of the second tang with respect to the casing (15). 5

9. The lock (100) according to any one of the preceding claims, comprising a strut (81) pivoted in said closing lever (8) to cooperate with a rear end edge (27) of the catch, so as to move the catch from the intermediate closing position to the closing position. 10

10. The lock (100) according to any one of claims 2 to 9, wherein said primary and tertiary gears (70a, 70c) are mounted on a first shaft (170a) disposed in the base plate; 15
20

said secondary gear (70c) is mounted on a second shaft (170b) disposed in the base plate;
said closing lever (8) is pivoted to the second shaft (170b); and
said closing lever (8) has a slot (86) for the insertion of said first shaft (170a). 25

11. The lock (100) according to any one of claims 2 to 10, comprising: 30

- a first sensor (T1) suitable for detecting the position of the primary pawl (3),
 - a second sensor (T2) suitable for detecting the position of the secondary pawl (4), and
 - a third sensor (T3) suitable for detecting the position of the tertiary gear (70c). 35

12. The lock (100) according to claim 11, wherein 40

the second sensor (T2) is configured to detect when the secondary pawl (4) reaches the intermediate closing position and send a control signal to the actuator (A) that operates the closing lever (8); 45
the first sensor (T1) is configured to detect when the primary pawl (3) reaches the locked position and send a command signal to the actuator (A) that drives the gear train (7) in order to bring the gears to the initial idle position; 50
the third sensor (T3) is configured to detect when the tertiary gear (70c) reaches an initial idle position, in order to lock the actuator (A). 55

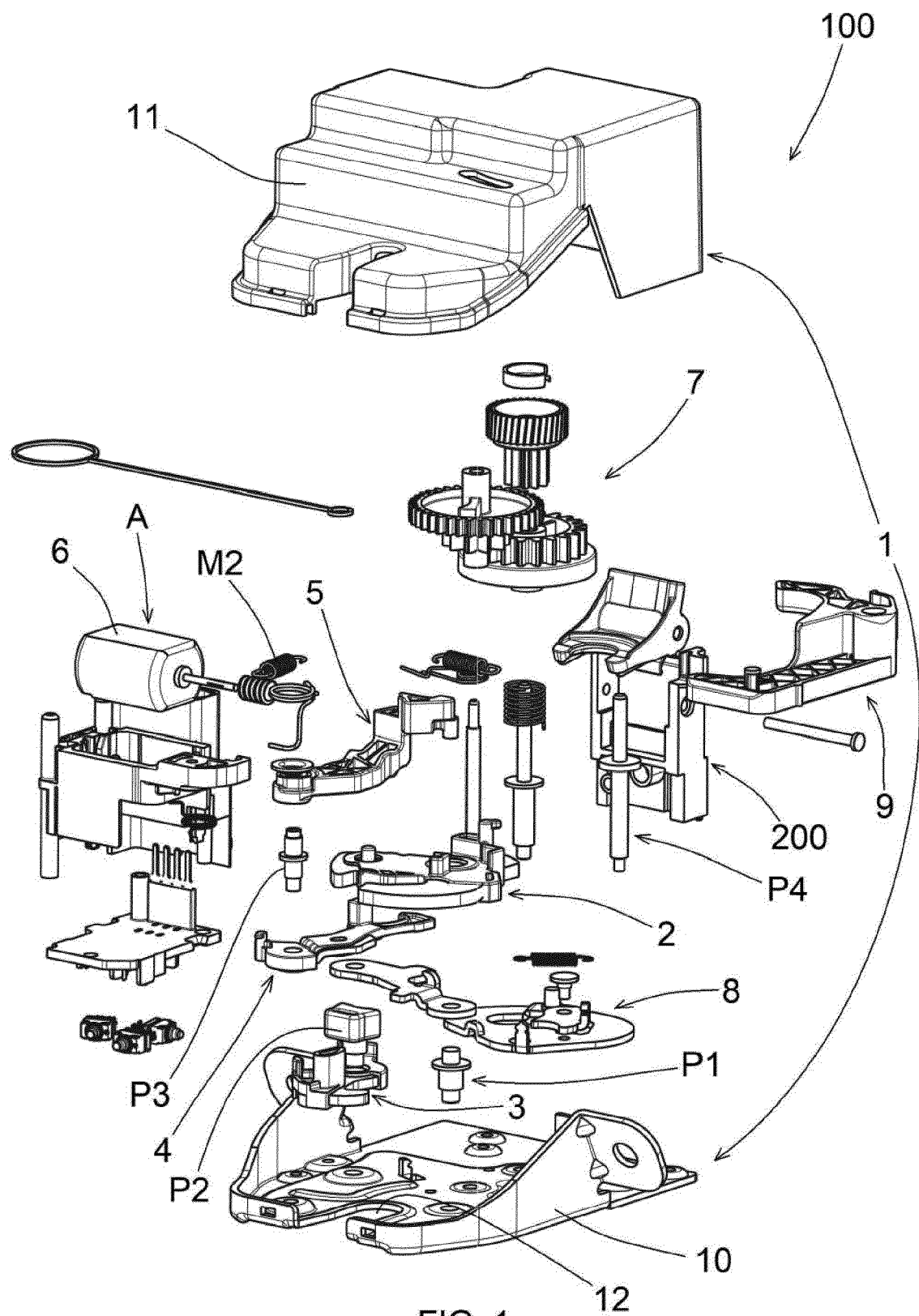


FIG. 1

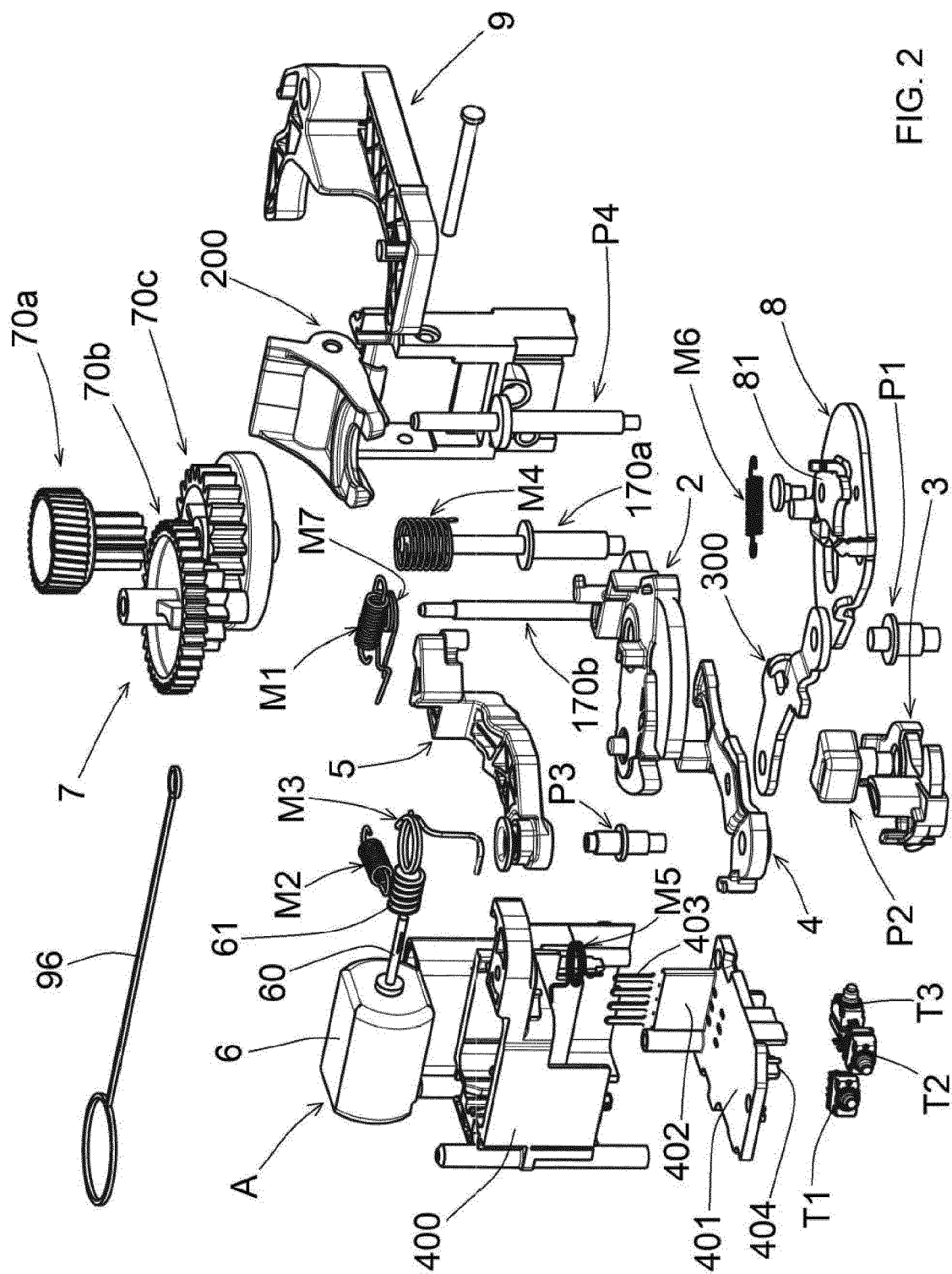


FIG. 2

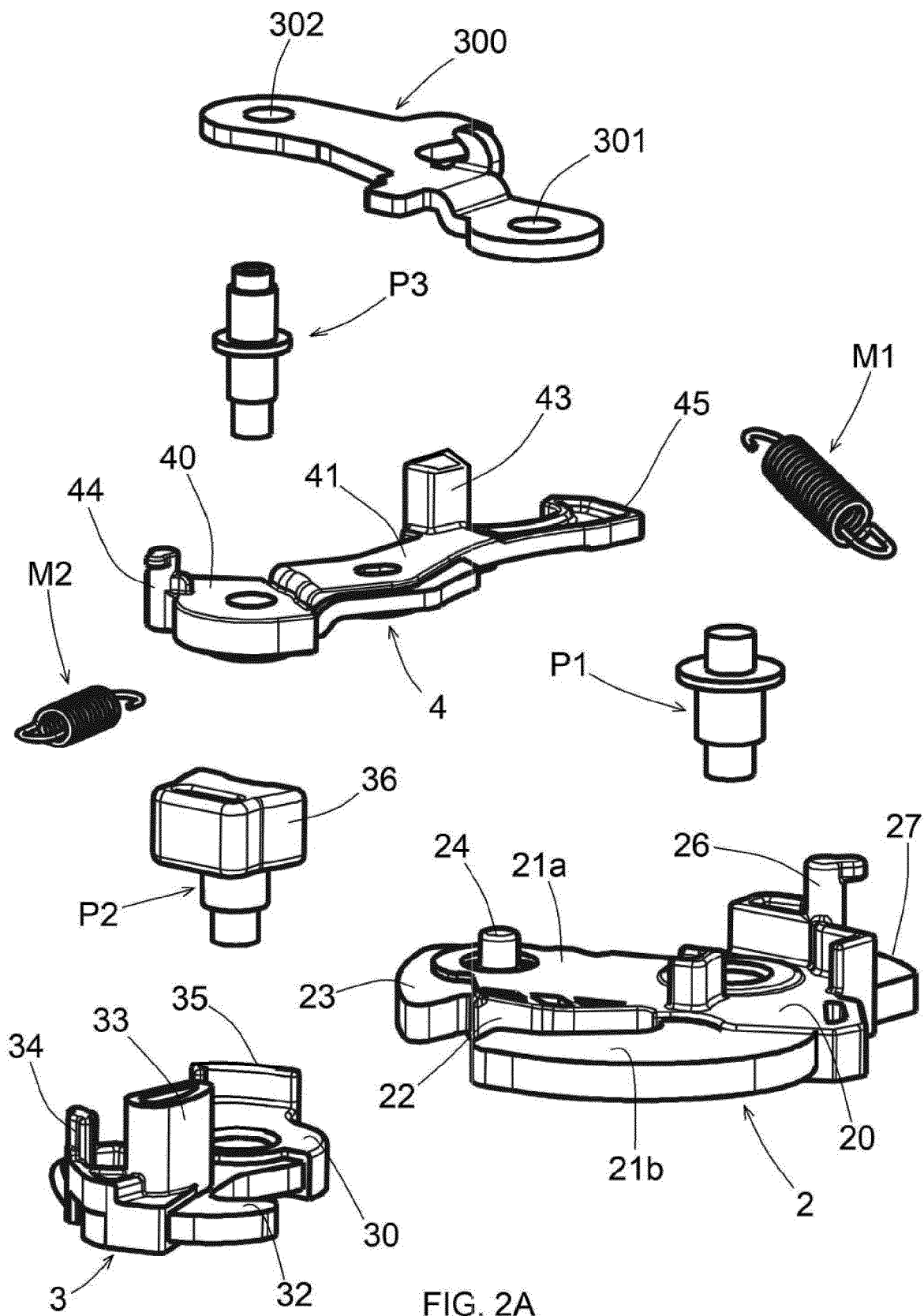


FIG. 2A

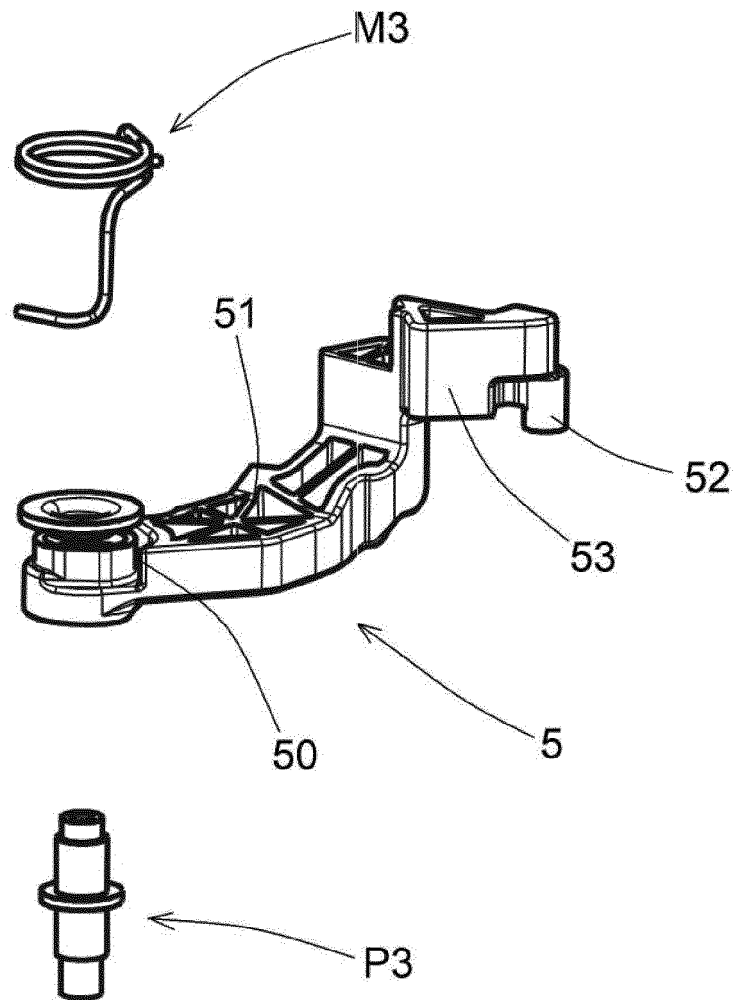


FIG. 2B

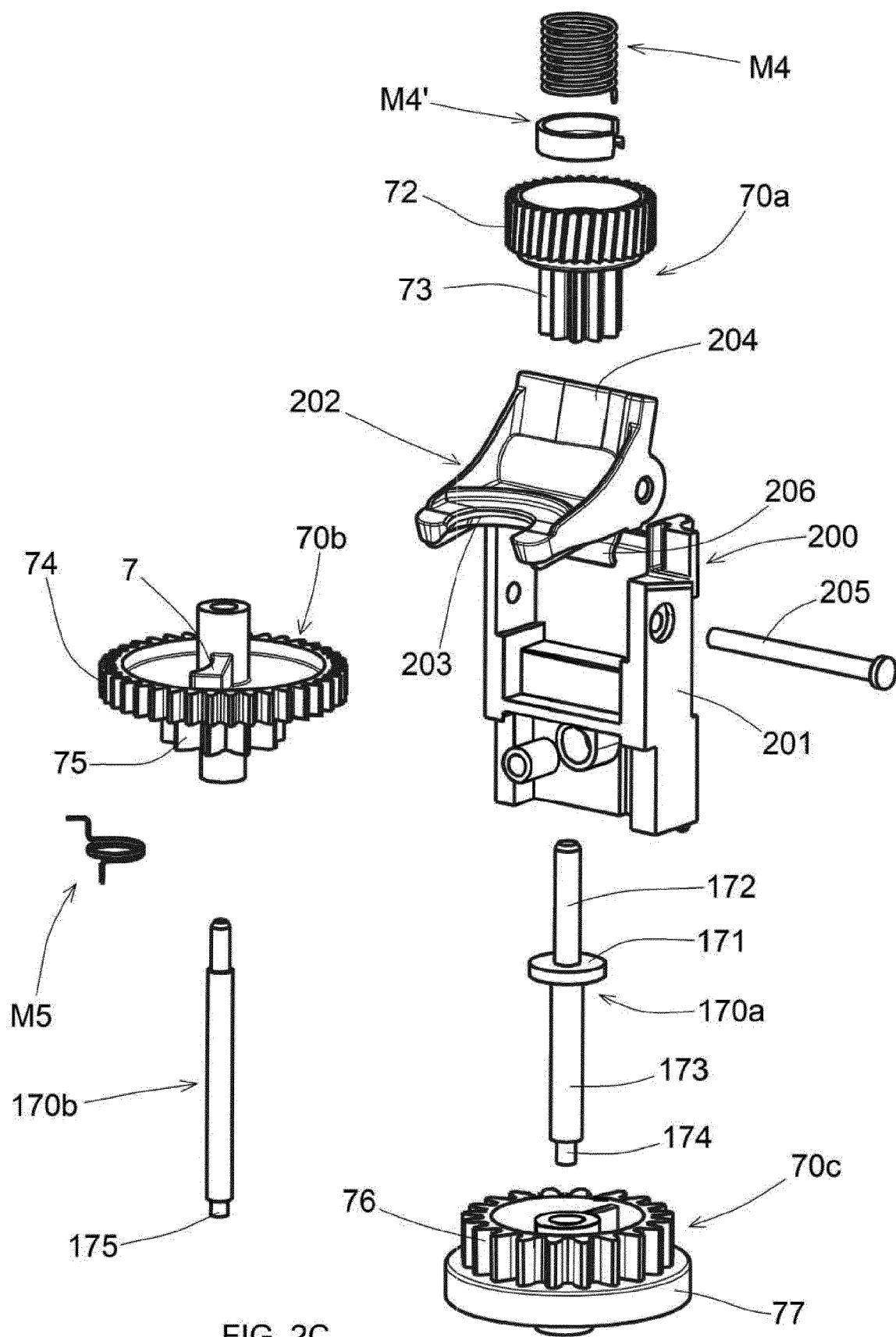


FIG. 2C

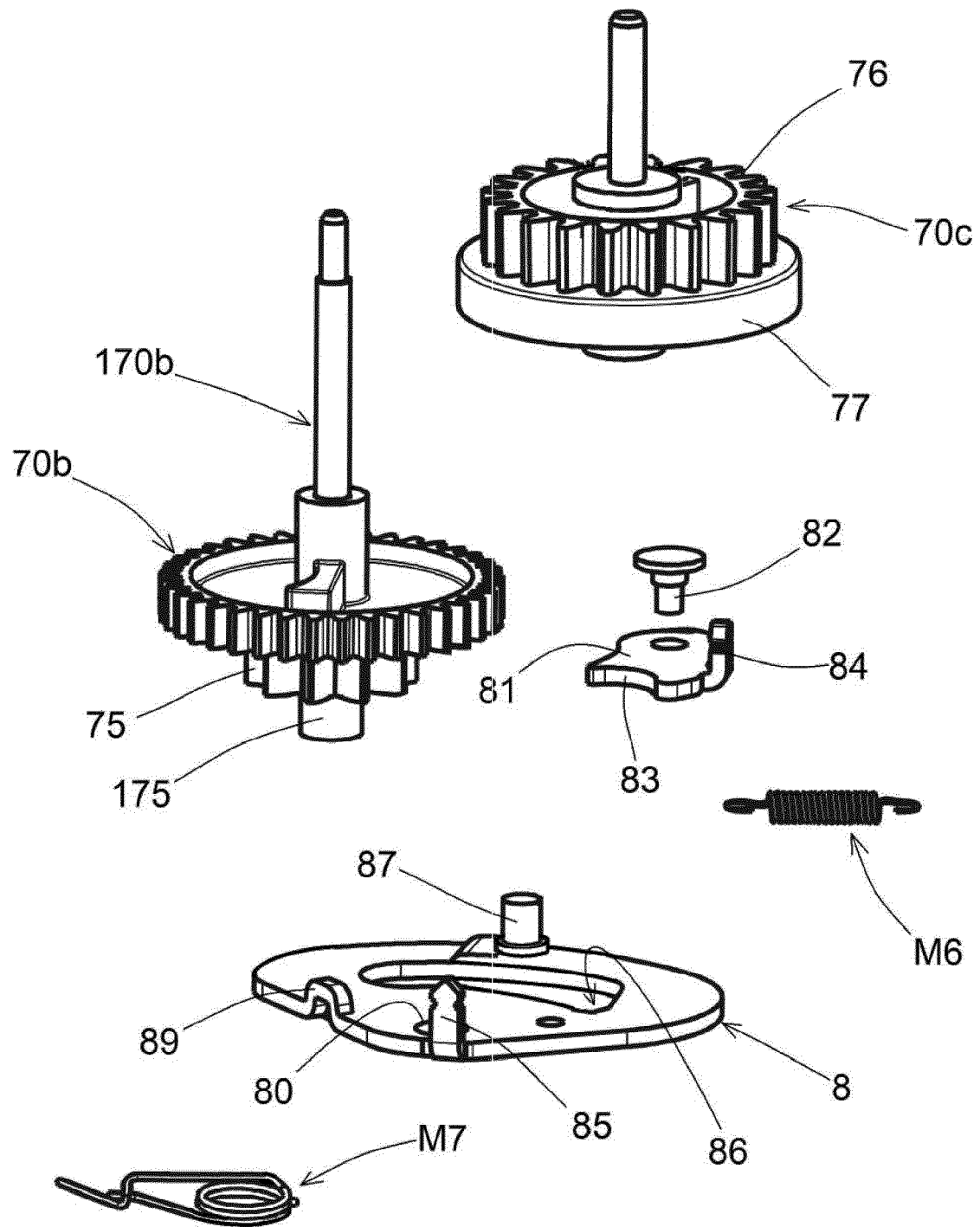


FIG. 2D

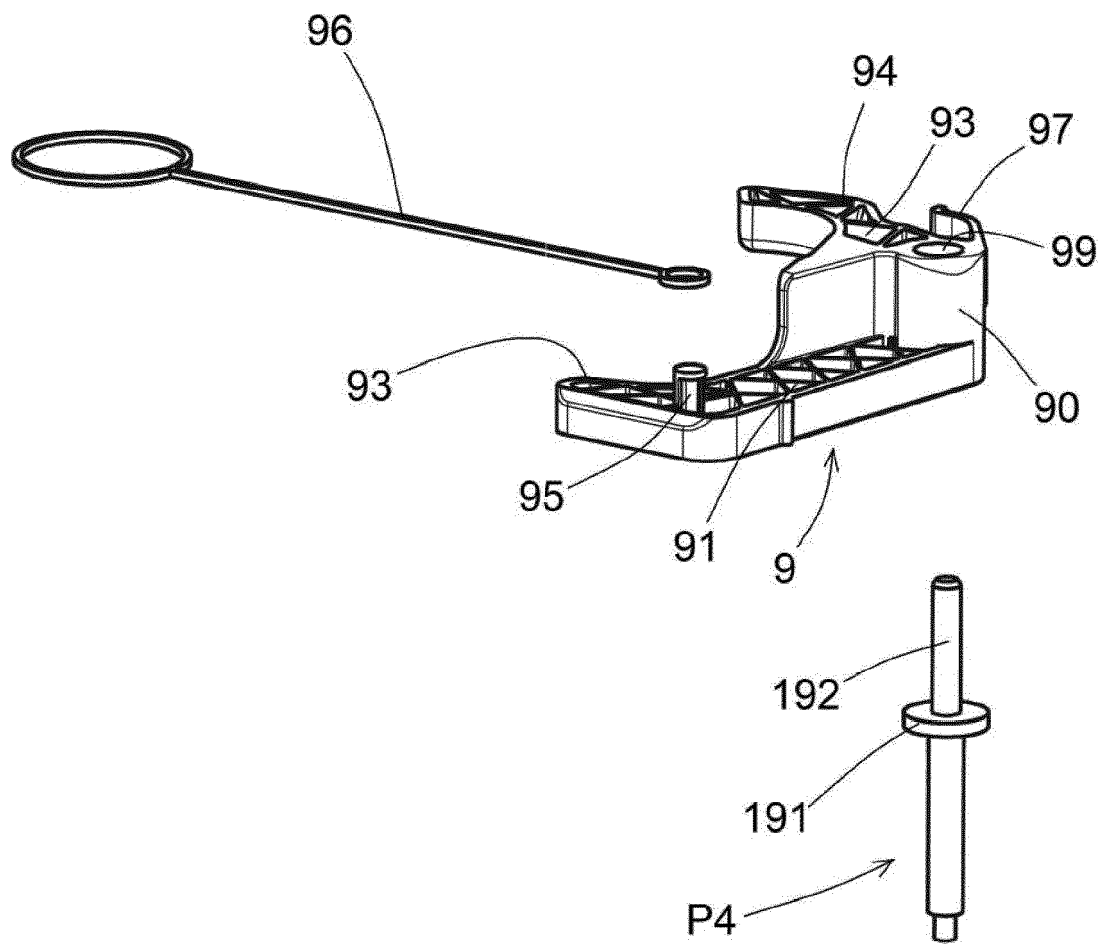


FIG. 2E

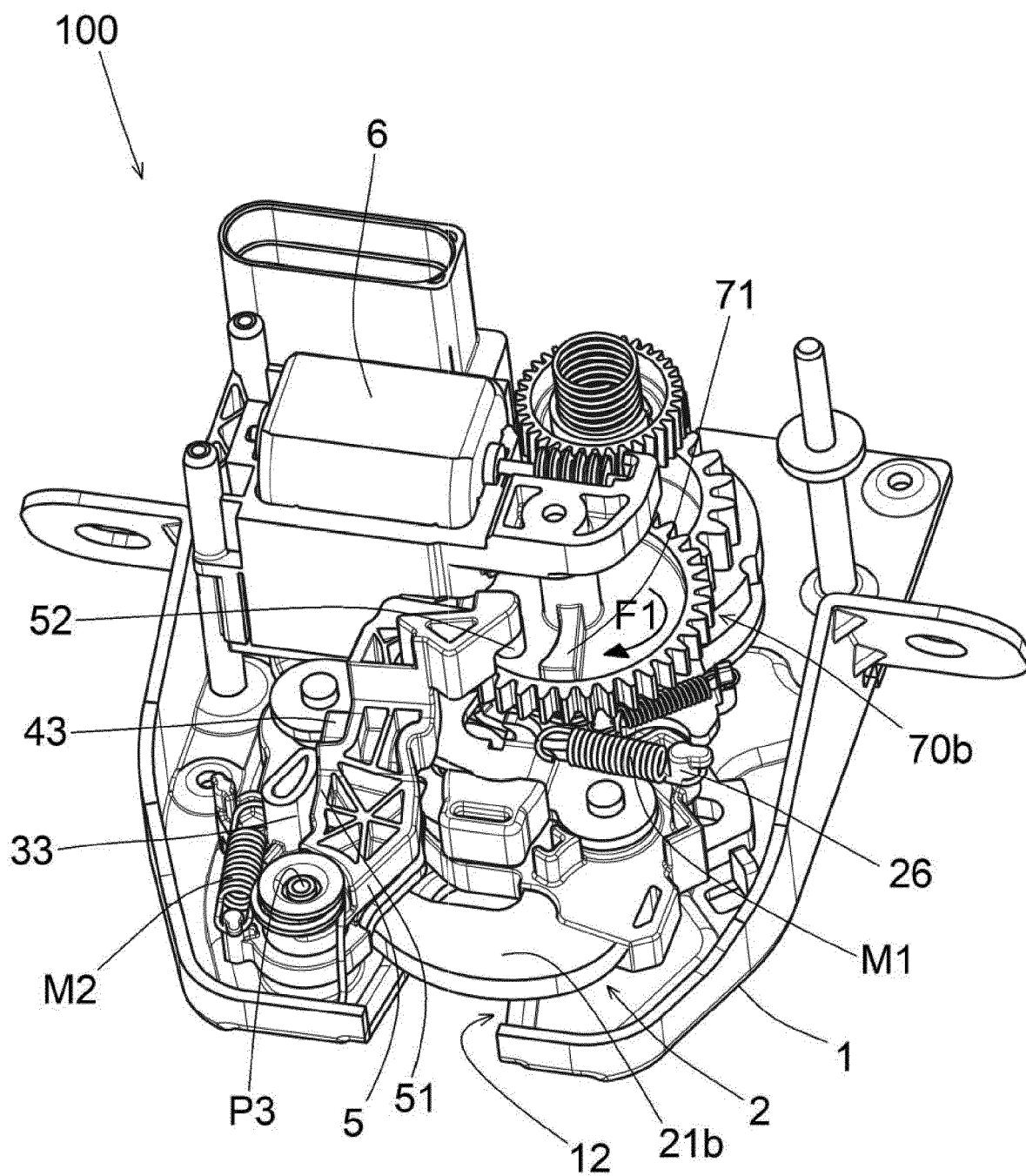


FIG. 3

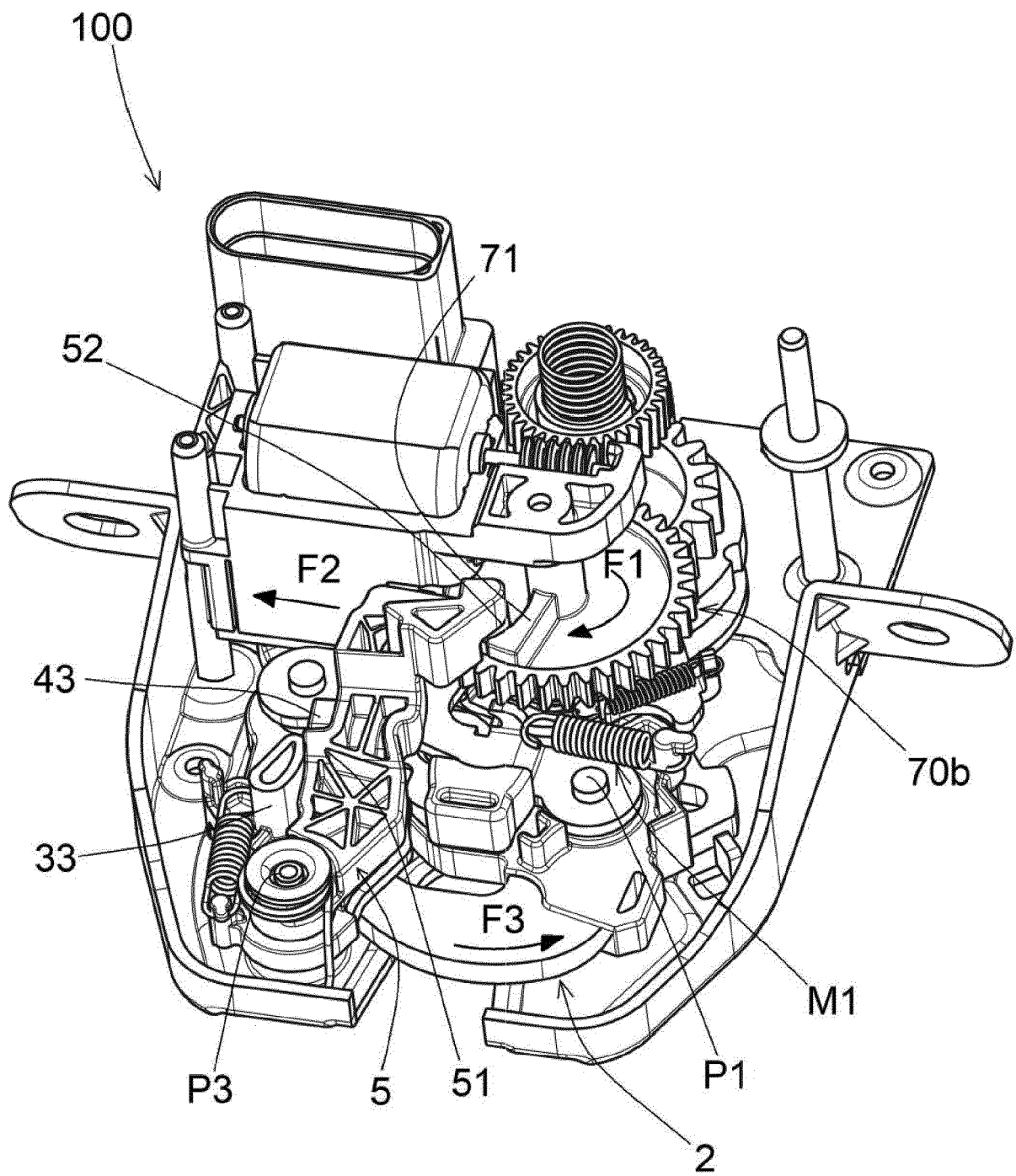


FIG. 4

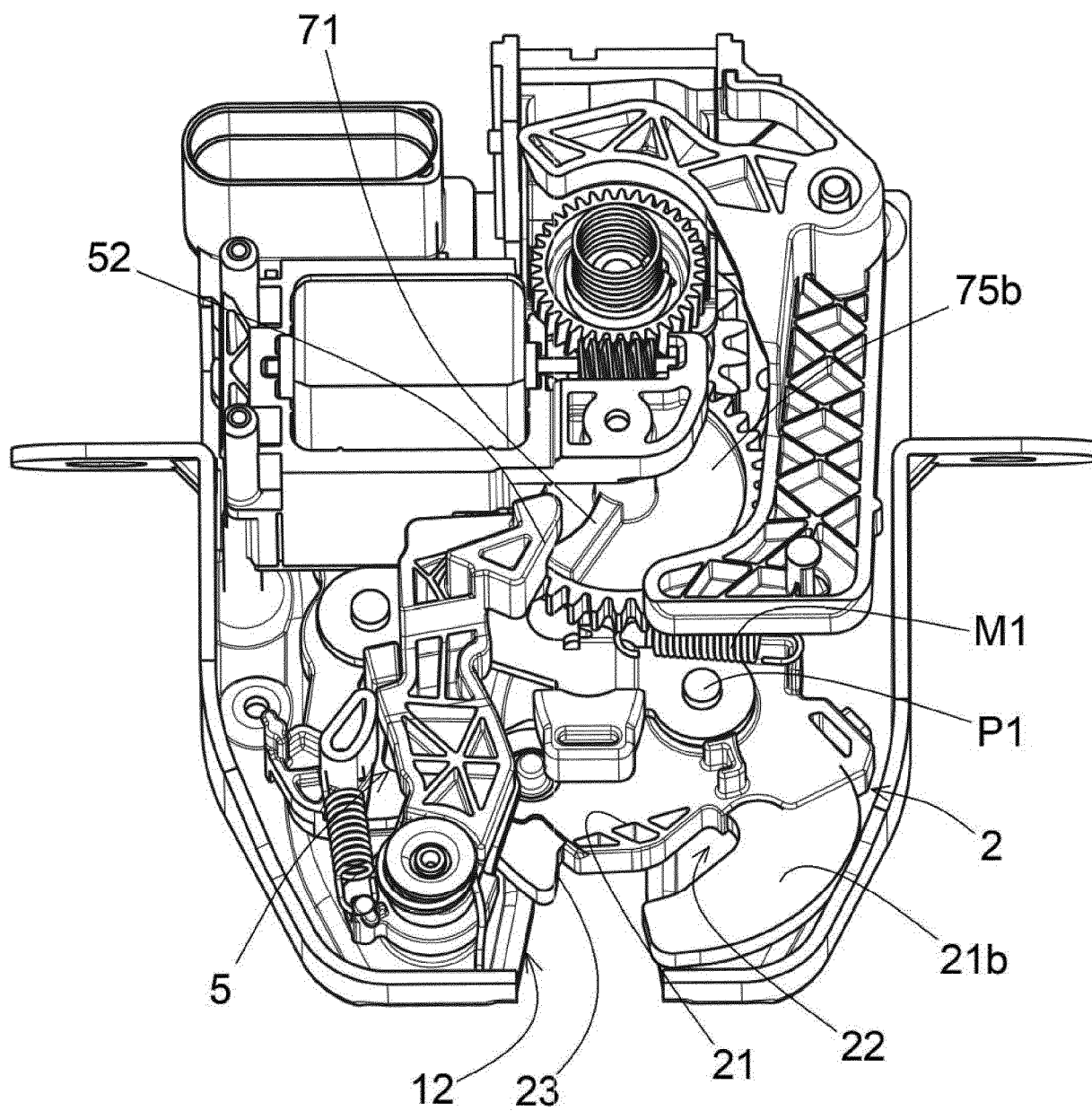


FIG. 5

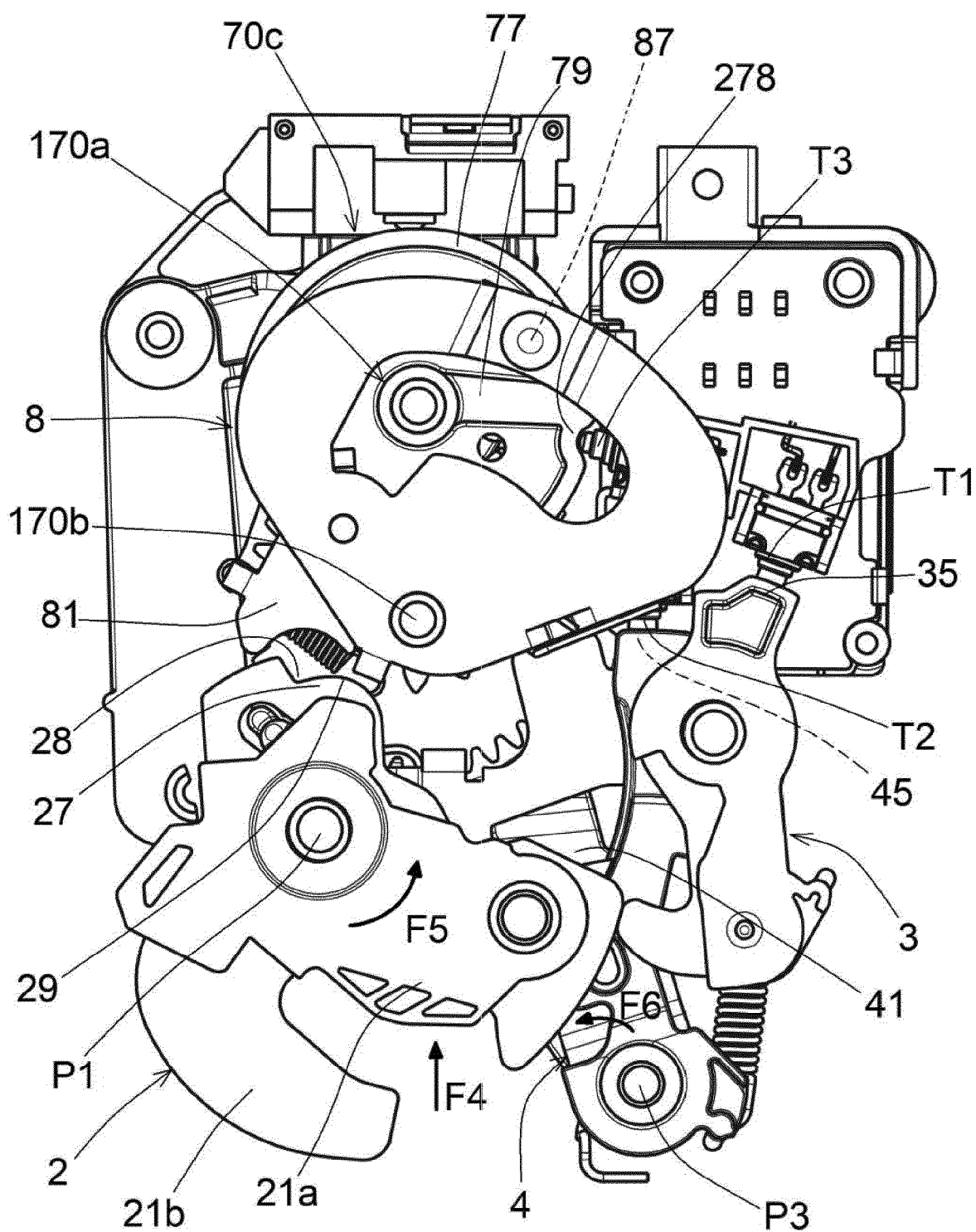


FIG. 6

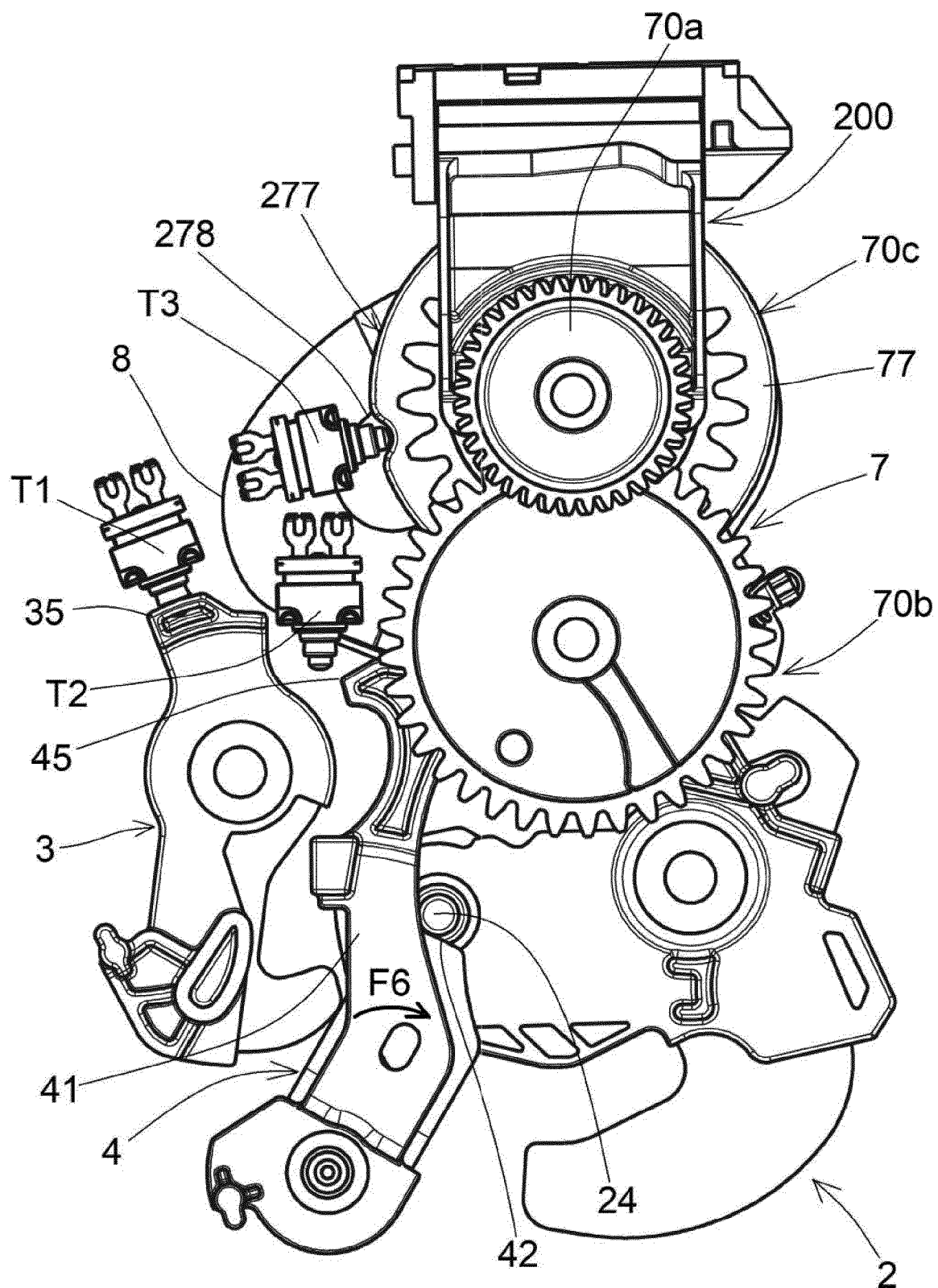
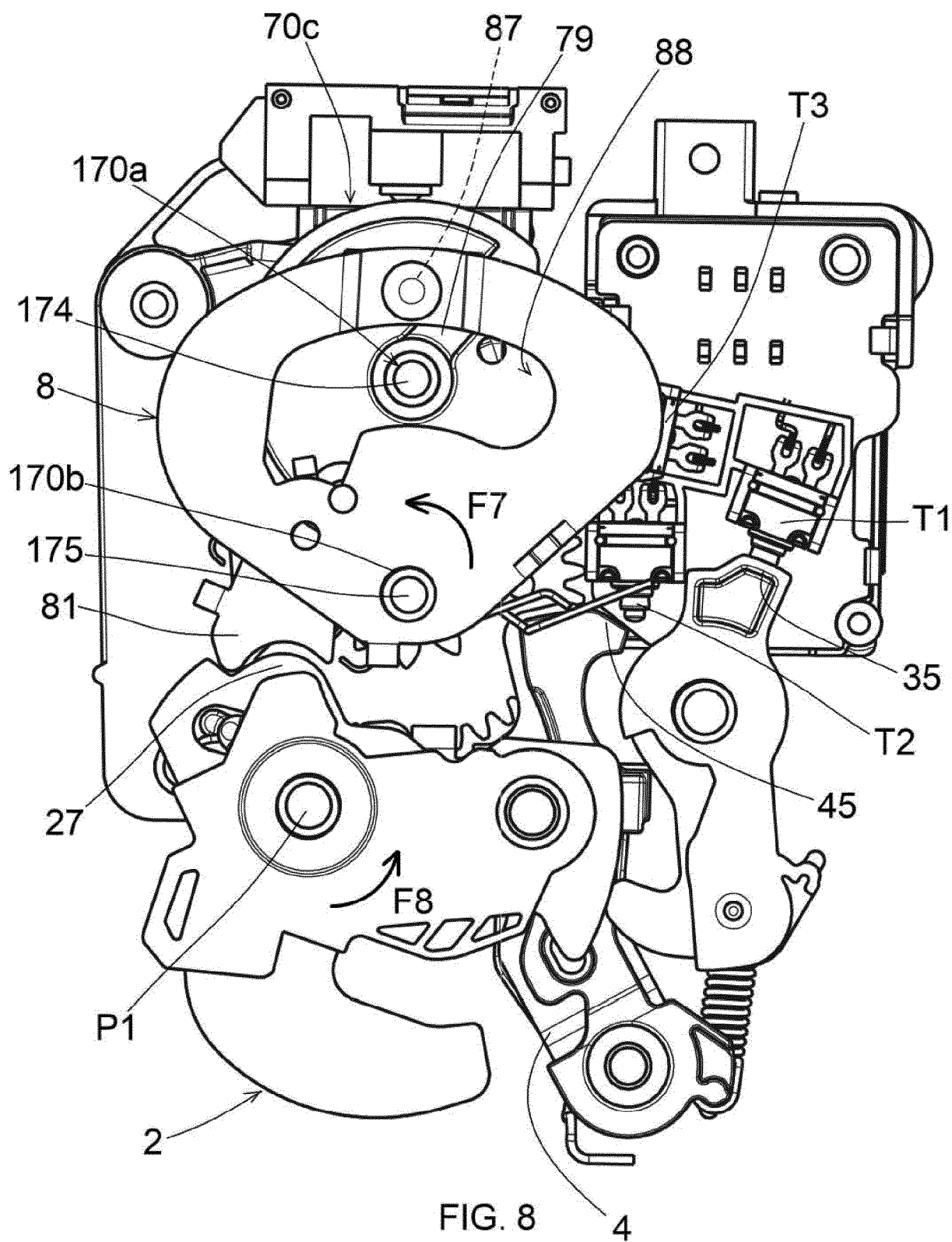


FIG. 7



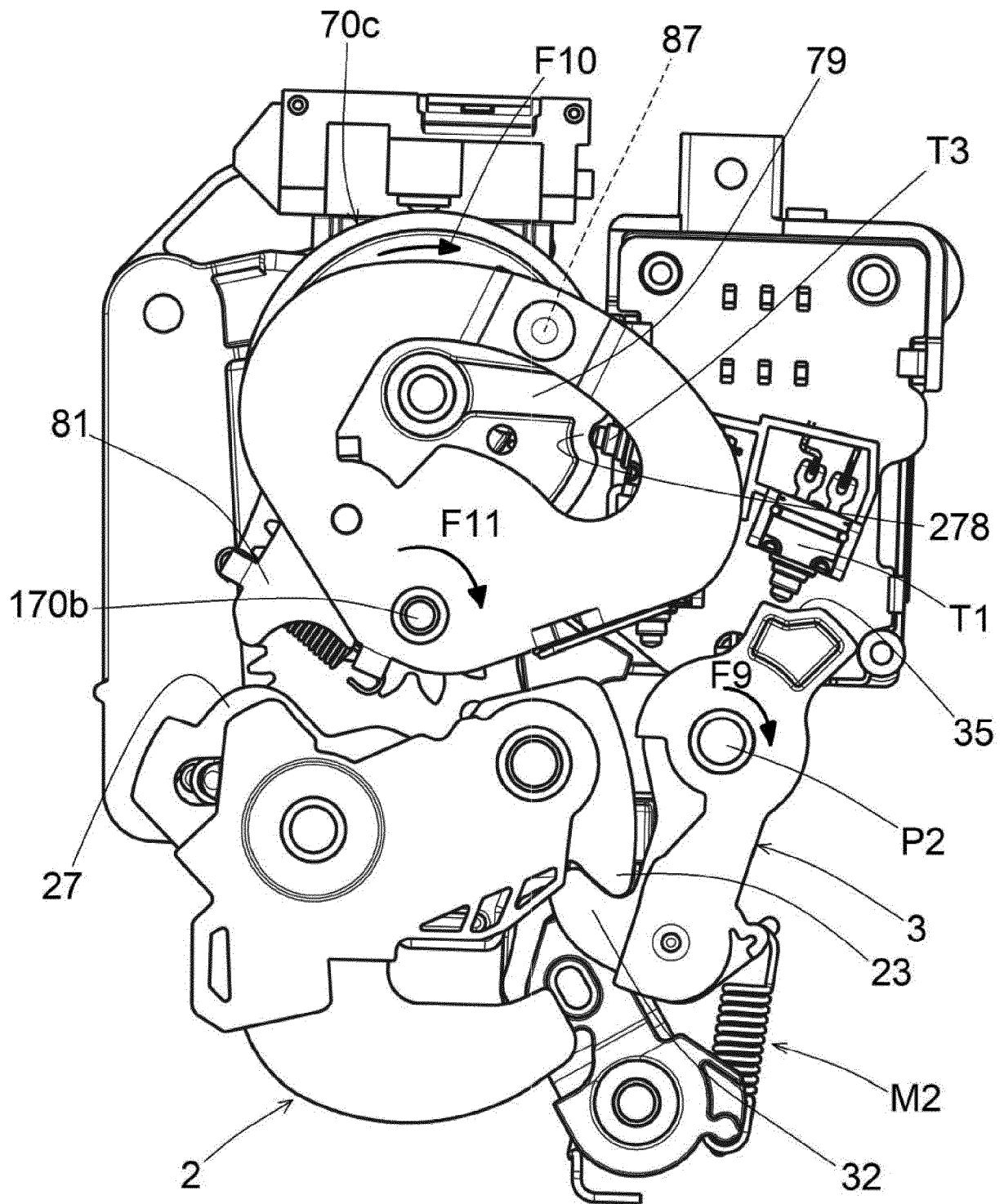


FIG. 9

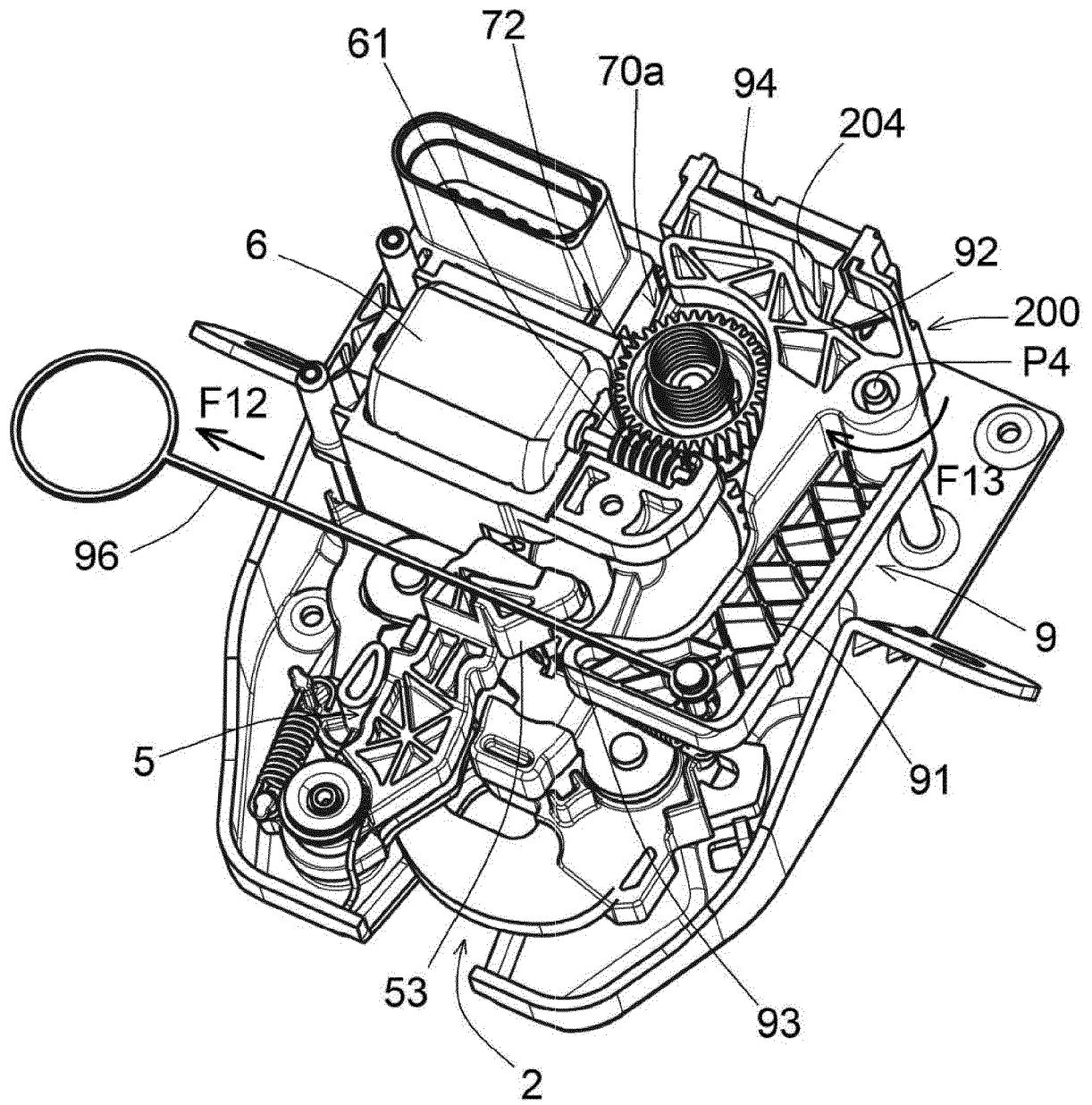


FIG. 10

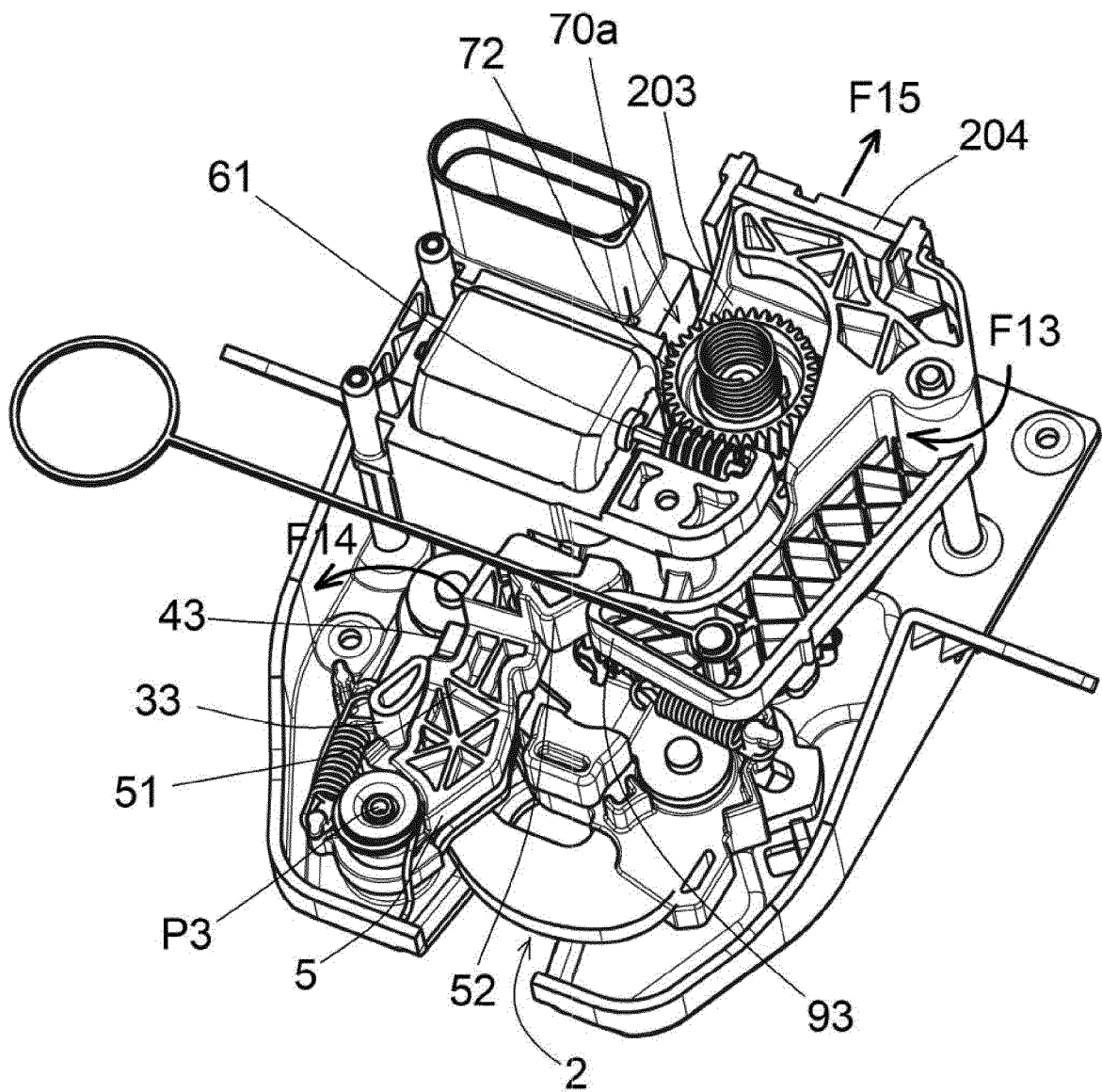


FIG. 11

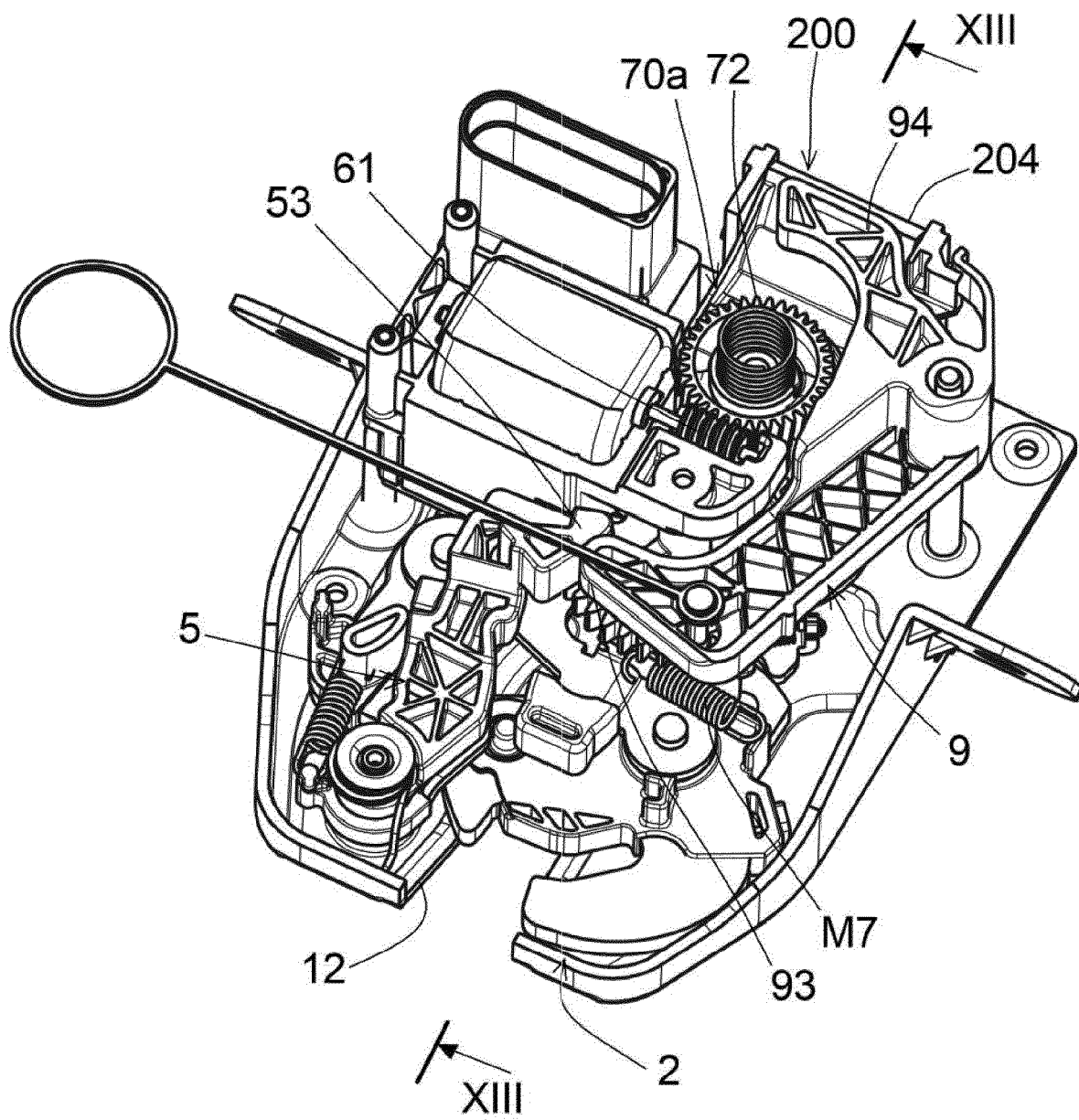


FIG. 12

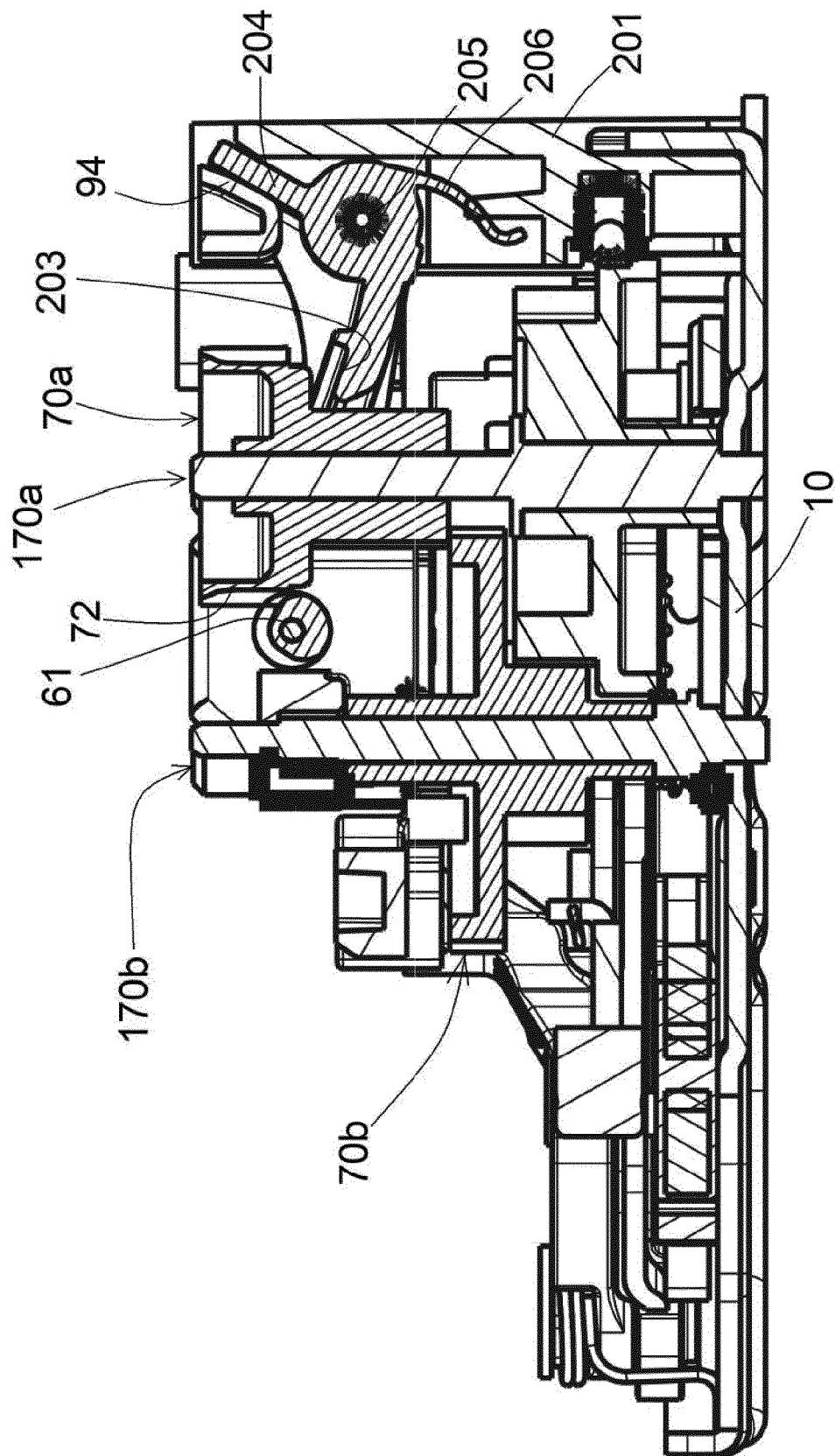


FIG. 13

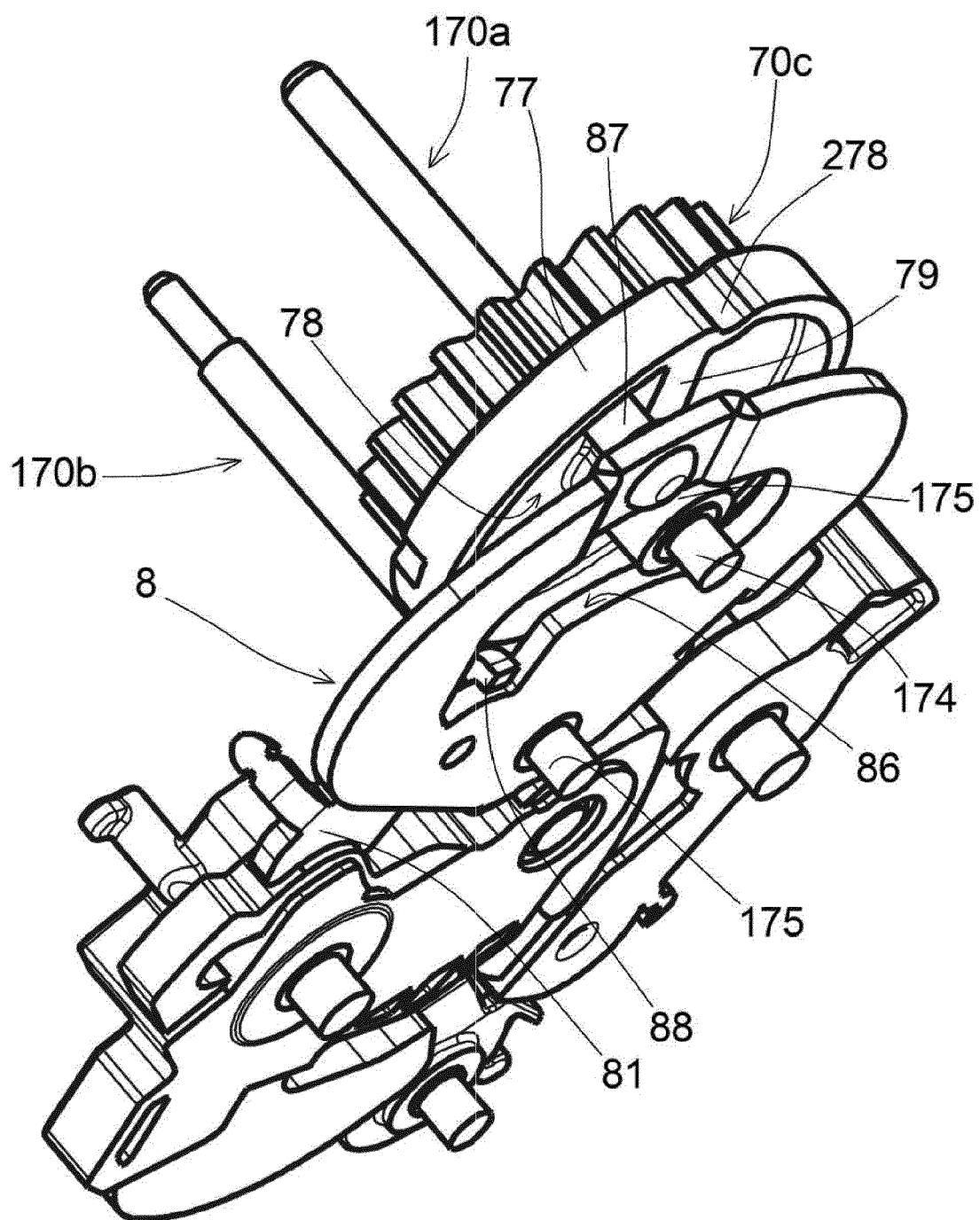


FIG. 14

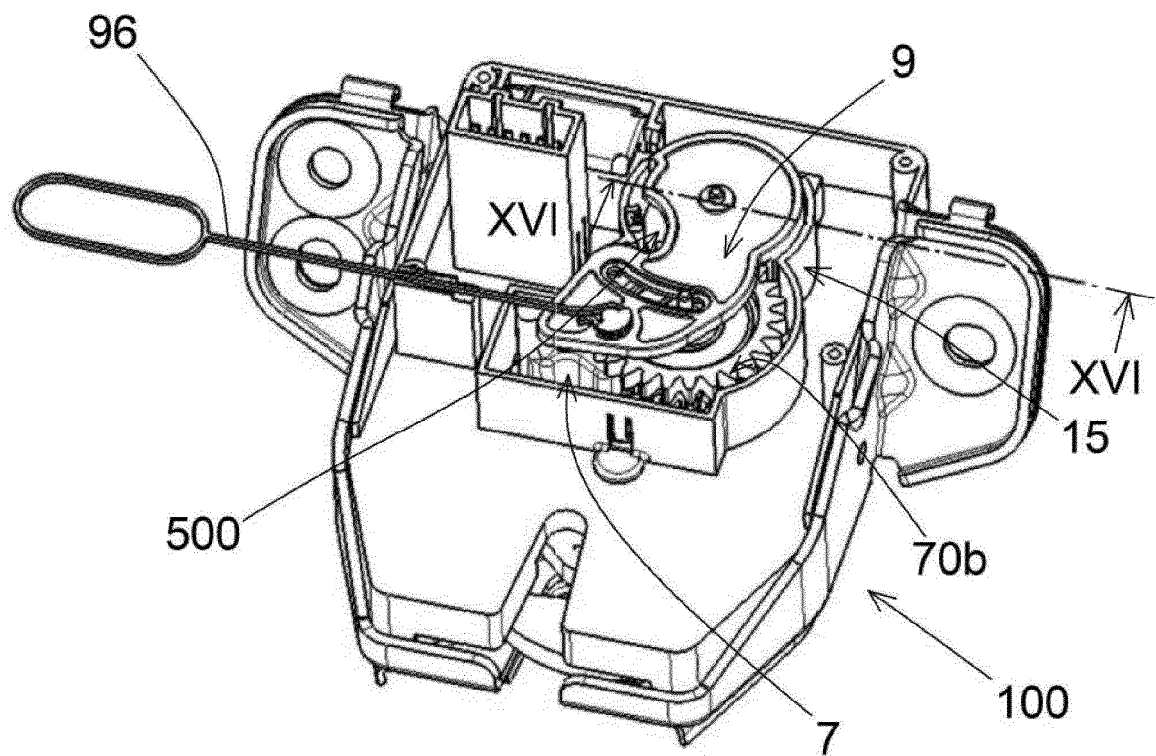


FIG. 15

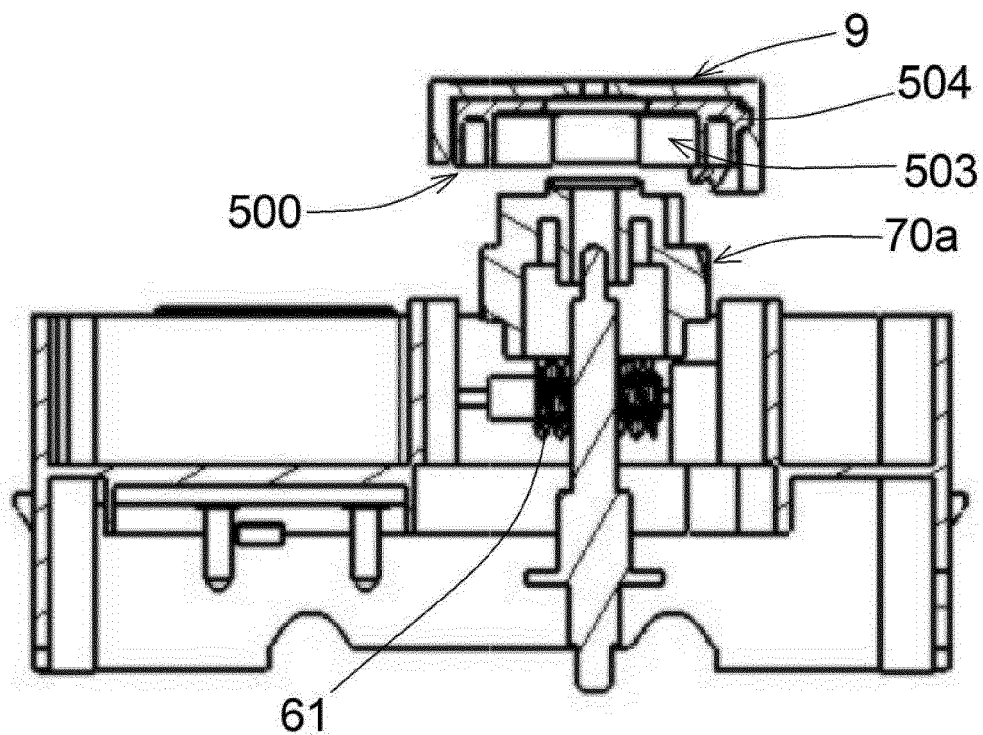
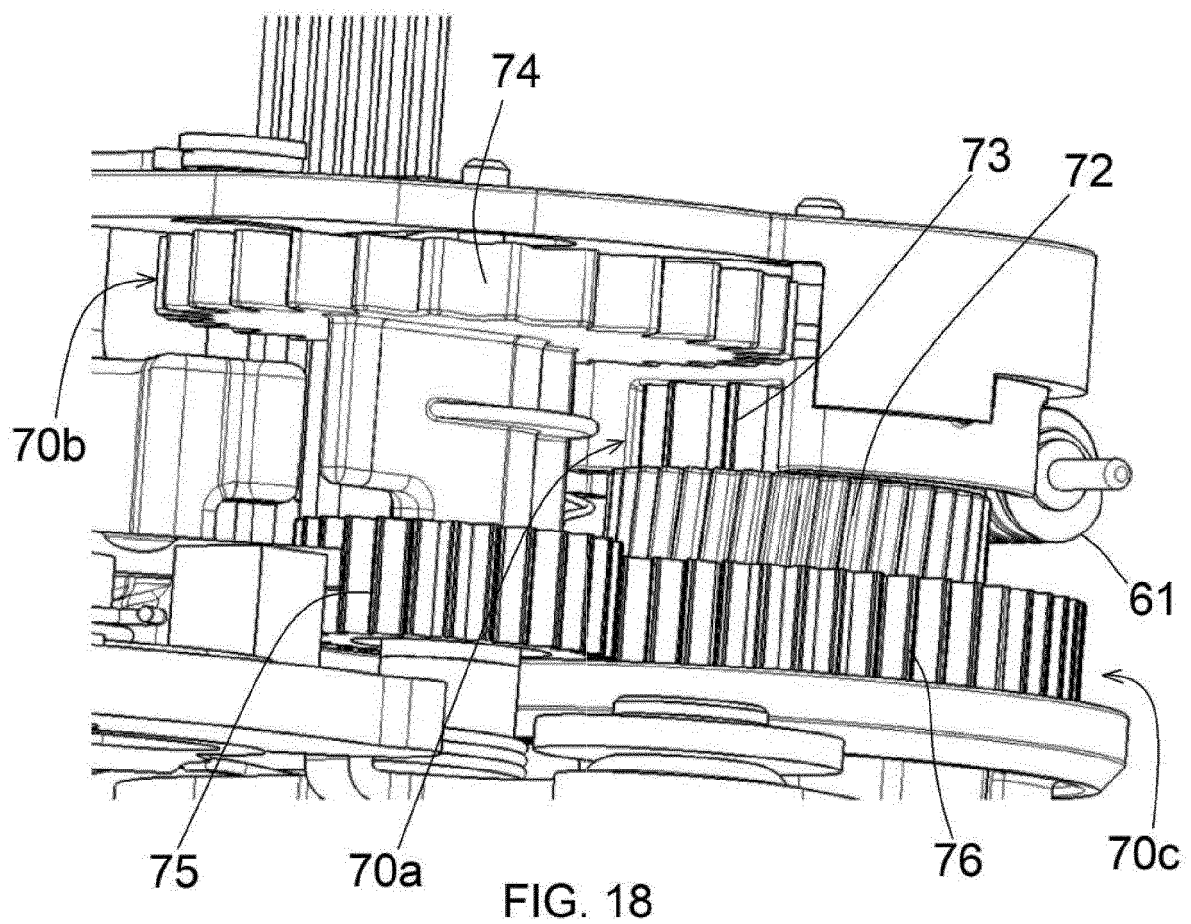
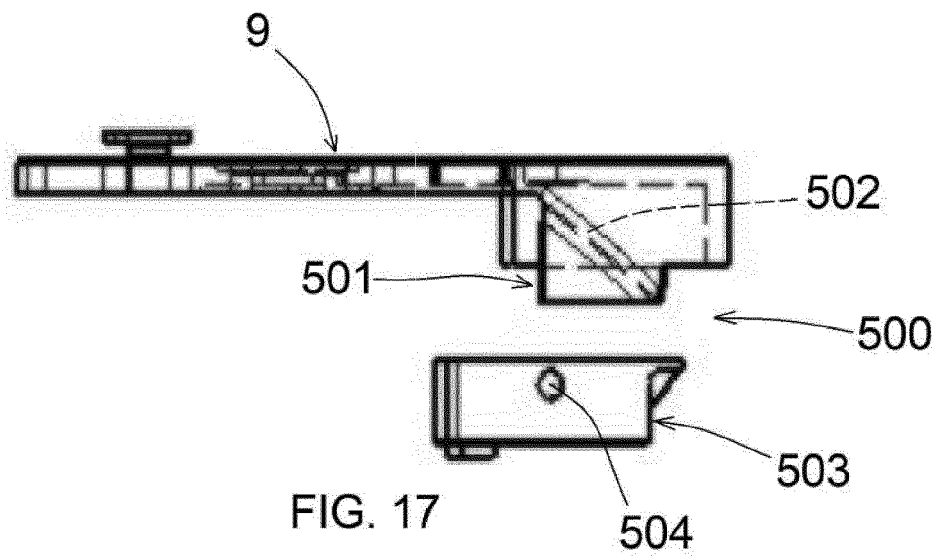


FIG. 16



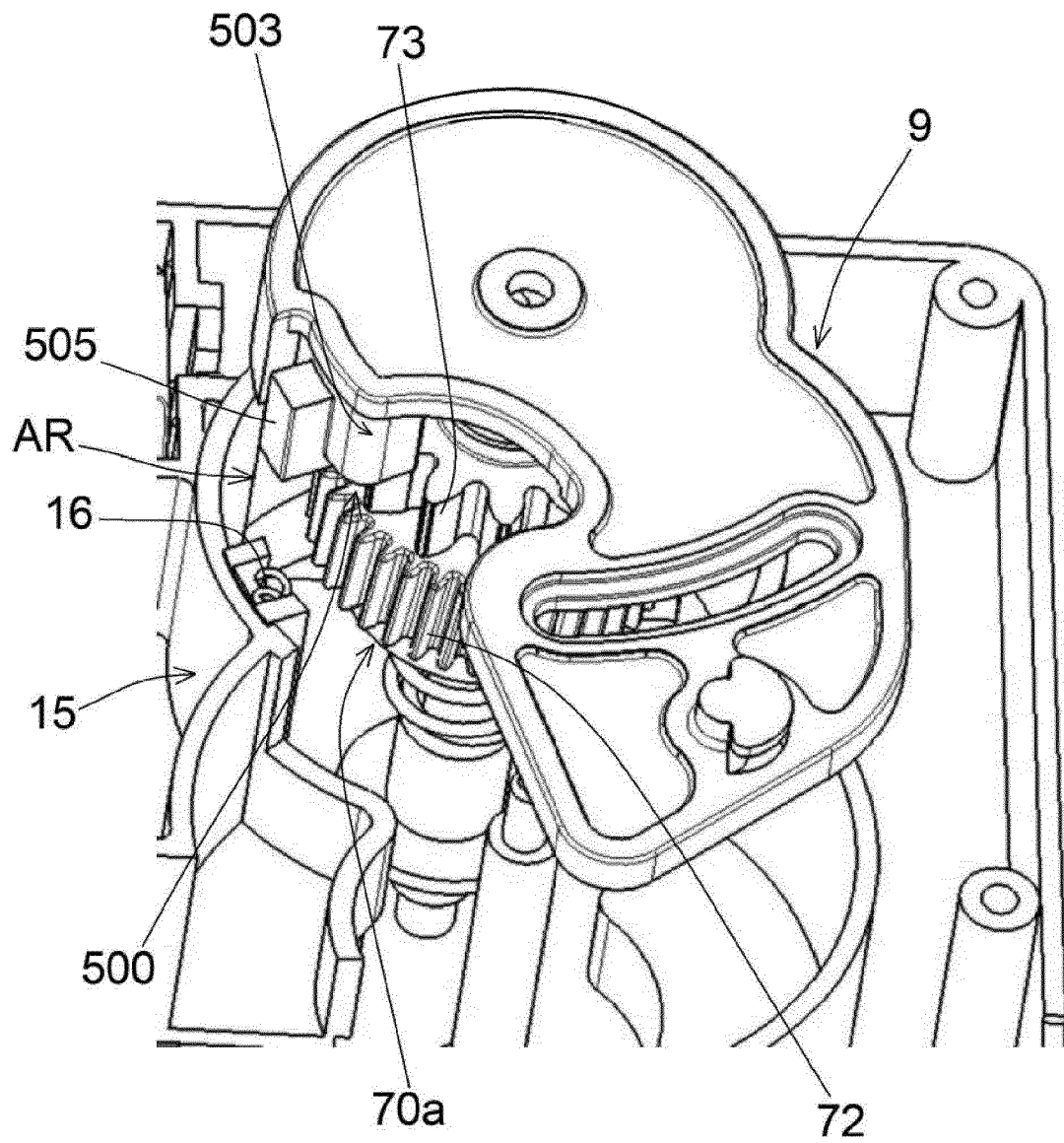


FIG. 19



EUROPEAN SEARCH REPORT

Application Number

EP 22 20 1121

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 2016/312499 A1 (FANNON JOSEPH P [US] ET AL) 27 October 2016 (2016-10-27) * the whole document *	1-12	INV. E05B83/26 E05B81/90 E05B81/46
A	US 2019/106914 A1 (TAMURA SHUNSUKE [JP] ET AL) 11 April 2019 (2019-04-11) * the whole document *	1-12	E05B83/18 E05B81/34 E05B81/14 E05B81/20
			TECHNICAL FIELDS SEARCHED (IPC)
			E05B
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		30 January 2023	Geerts, Arnold
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 22 20 1121

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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30-01-2023

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