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(54) **LOCK ASSEMBLY**

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Description

BACKGROUND

[0001] The invention relates to a lock assembly, in particular for locking and unlocking a door, a window or the like.

[0002] A known lock assembly comprises a lock housing and a bolt which is placed within the housing. The lock assembly is provided with an internal mechanism which can be operated to cause the bolt to move back and forth between a retracted position and an extended position. When a high pressure force is exerted on the door, the window or the like, the pressure force is transmitted via the bolt onto the internal mechanism of the lock assembly. The internal mechanism of the known lock assembly generates friction, which is known to cause the lock assembly to malfunction when the pressure force exceeds a threshold value.

[0003] The pressure force can exceed the threshold value during an emergency, for example due to a panic or fire. Another example are lock assemblies which are installed in prison doors. These lock assemblies are known to be deliberately disabled by prisoners by exerting pressure on the door, for example to prevent guards from being able to open the door during an emergency in which they should intervene. Malfunctioning of the lock assembly in case of the emergencies as described above can lead to unsafe situations or even loss of life.

[0004] DE 209 718 C discloses a lock assembly according to the preamble of claim 1. DE 88 15 891 U1 and JP 50 041990 U disclose other examples of lock assemblies.

[0005] It is an object of the present invention to provide a lock assembly that can remain operational under a high pressure force.

SUMMARY OF THE INVENTION

[0006] The invention provides a lock assembly according to claim 1.

[0007] With known lock assemblies, the internal mechanism of the lock assembly malfunctions due to friction when a large pressure force is applied to the bolt assembly. Such a pressure force can occur when a human applies pressure to the door to which the lock assembly is fitted, or when a fire increases the pressure in a room adjacent to the door to which the lock assembly is fitted. The lock assembly according to the invention can remain operational, even under such a large pressure force, thereby increasing the safety of the lock assembly. The offset angle of the normal vector of the abutting abutment surfaces at the primary abutment point can deflect part of the force exerted by the bolt assembly on the primary blocking element in a direction other than the bolt path. Therefore, the force in the direction of the bolt path is smaller than the force which would be exerted in the direction of the bolt path if the normal vector would be aligned with the bolt path. The reduced force in the direction of the bolt path can reduce the friction occurring at the primary abutment point, thereby increasing the threshold value of the pressure force at which the lock assembly starts to malfunction. Due to the offset angle of the normal vector of the abutting abutment surfaces at the secondary abutment point, part of the force exerted by the primary blocking element on the secondary blocking element can be deflected in a direction other than the primary blocking path. Therefore, the force in the direction of the primary blocking path is smaller than the force which would be exerted in the direction of the primary blocking path if the normal vector would be aligned with the primary blocking path. The reduced force in the direction of the primary blocking path can lead to reduced friction generated by the forces occurring at the secondary abutment point, thereby increasing the threshold value of the pressure force at which the lock assembly could start to malfunction.

[0008] In an embodiment the angle of the normal vector with respect to the bolt path causes the forces occurring between the abutting abutment surfaces at the primary abutment point to be resolved into a force component acting in the direction of the bolt path and a force component acting in a direction perpendicular to the bolt path, wherein the force component in the direction of the bolt path is larger than the force component in the direction perpendicular to the bolt path. With known lock assemblies a force component in a direction other than the bolt path would be undesired because the internal mechanism is only adapted to handle forces in the direction of the bolt path. However, in the lock assembly according to the invention, the force component in the direction other than the bolt path, in particular a force component acting in a direction perpendicular to the bolt path, thus in the direction of the primary blocking path at the primary abutment point, can be used to aid the movement of the primary blocking element along the primary blocking path from the primary blocking position to the primary unblocking position.

[0009] In an embodiment the angle of the normal vector with respect to the bolt path of abutting abutment surfaces at the primary abutment point causes part of the forces occurring between the abutting abutment surfaces at the primary abutment point to be deflected in a direction other than the bolt path. The force component in the direction other than the bolt path, in particular a force component acting in the direction of the primary blocking path can be used to aid the movement of the primary blocking element along the primary blocking path from the primary blocking position to the primary unblocking position.

[0010] In an embodiment one of the abutment surfaces of the group comprising the first abutment surface and the second abutment surface is a substantially flat or straight surface, wherein the other abutment surface is a cylindrical surface. The cylindrical surface only abuts the flat or straight surface at one position along its circumference, thereby substantially reducing the contact surface. This reduction in contact surface can reduce the friction between the first abutment surface and the second abutment surface.

[0011] In an embodiment the cylindrical surface is formed by a rotatable bearing, preferably an abutment wheel. Instead of sliding the abutment surfaces over each other, which would cause a lot of friction, the abutment wheel can rotate under the influence of the force component to facilitate the movement of the primary blocking element in the direction of the primary blocking path.

[0012] In an embodiment the primary blocking bearing which bears the primary blocking element is a rotational bearing. The rotational bearing prevents friction from occurring between the primary blocking element and the primary blocking bearing as the primary blocking element moves along the primary blocking path.

[0013] In an embodiment the bolt path is rectilinear, so that the bolt assembly can be moved in a rectilinear or translatory manner between the retracted position and the extended position.

[0014] In an embodiment the primary blocking path is rectilinear, so that the primary blocking element can be moved in a rectilinear or translatory manner between the primary blocking position and the primary unblocking position.

[0015] In an embodiment the primary blocking path extends substantially perpendicular to the bolt path. The primary blocking element is fixed with respect to the housing against translation in the direction of the bolt path, so that it can effectively block the movement of the bolt assembly in the direction of the bolt path.

[0016] In an embodiment the primary blocking path is a curve, preferably a circular arc, wherein the primary blocking path extends transverse, preferably substantially perpendicular to the bolt path at the primary abutment point, so that the primary blocking element can be moved in a rotary manner between the primary blocking position and the primary unblocking position.

[0017] Preferably, the normal vector of the abutting abutment surfaces at the secondary abutment point is under an angle in a range of five to twenty degrees with respect to the direction of the primary blocking path at the secondary abutment point.

[0018] In an embodiment the angle between the normal vector of the abutting abutment surfaces and the direction of the primary blocking path at the secondary abutment point is measured with respect to tangent of the primary blocking path at the secondary abutment point. Due to the curvature of the primary blocking path, its direction is variable along its length. Therefore, for the purpose of determining the direction of the normal vector with respect to the primary blocking path, the direction of the primary blocking path at the primary abutment point is determined by its vector or tangent at the primary abutment point.

[0019] In an embodiment the angle of the normal vector of the abutting abutment surfaces at the secondary abutment point with respect the direction of the primary blocking path at the secondary abutment point causes the forces occurring between the abutting abutment surfaces at the secondary abutment point to be resolved into a force component acting in the direction of the secondary blocking path and a force component acting in a direction perpendicular to the secondary blocking path, wherein the force component in a direction perpendicular to the secondary blocking path is larger than the force component in the direction of the secondary blocking path. The force component in the direction other than the primary blocking path, in particular a force component acting in the direction of the secondary blocking path can be used to aid the movement of the secondary blocking element along the secondary blocking path from the secondary blocking position to the secondary unblocking position.

[0020] In an embodiment the angle of the normal vector with respect to the primary blocking path of the abutting abutment surfaces at the secondary abutment point causes part of the forces occurring between the abutting abutment surfaces at the secondary abutment point to be deflected in a direction other than the primary blocking path. The force component in the direction other than the primary blocking path, in particular a force component acting in the direction of the secondary blocking path can be used to aid the movement of the secondary blocking element along the secondary blocking path from the secondary blocking position to the secondary unblocking position.

[0021] In an embodiment, one of the abutment surfaces of the group comprising the third abutment surface and the fourth abutment surface is a substantially flat or straight surface, wherein the other abutment surface is a cylindrical surface. The cylindrical surface only abuts the flat or straight surface at one position along its circumference, thereby substantially reducing the contact surface. This reduction in contact surface can reduce the friction between the third abutment surface and the fourth abutment surface.

[0022] In an embodiment the cylindrical surface is formed by a rotatable bearing, preferably an abutment wheel. Instead of sliding the abutment surfaces over each other, which would cause a lot of friction, the abutment wheel can rotate under the influence of the force component to facilitate the movement of the secondary blocking element in the direction of the secondary blocking path. The rolling motion of the abutment wheel can substantially reduce or substantially eliminate the friction between the first abutment surface and the second abutment surface.

[0023] In an embodiment the secondary blocking path is rectilinear, so that the secondary blocking element can be moved in a rectilinear or translatory manner between the secondary blocking position and the secondary unblocking position.

[0024] In an embodiment the secondary blocking path extends substantially perpendicular to the primary blocking path. The secondary blocking element is fixed with respect to the housing against movement in the direction of the primary blocking path, so that it can effectively block the movement of the primary blocking element in the direction of the primary blocking path.

[0025] In an embodiment the lock assembly comprises a first electromechanical actuator which is operationally coupled to the primary blocking element for moving the primary blocking element along the primary blocking path between the primary blocking position and the primary unblocking position. The electromechanical actuator can be used to electrically trigger the blocking or unblocking of the lock assembly. Due to the reduced forces occurring at the primary abutment surface, the driving force required from the first actuator to move the primary blocking element can be reduced, thereby reducing the size of the first actuator, preferably to such a dimension that it can be fitted in a standard lock housing.

[0026] In an embodiment the lock assembly comprises a second electromechanical actuator which is operationally coupled to the secondary blocking element for moving the secondary blocking element along the secondary blocking path between the secondary blocking position and the secondary unblocking position. The electromechanical actuator can be used to electrically trigger the blocking or unblocking of the lock assembly. Due to the reduced forces occurring at the secondary abutment surface, the driving force required from the second actuator to move the secondary blocking element can be reduced, thereby reducing the size of the second actuator, preferably to such a dimension that it can be fitted in a standard lock housing.

[0027] In an embodiment the lock assembly comprises a mechanically operated unblocking mechanism of the group comprising a key operated mechanism, a handle, a knob, a panic bar or the like. The mechanically operated unblocking mechanism can provide an alternative to the electrical unblocking of the lock assembly.

[0028] In an embodiment the extended position of the bolt assembly is a dead bolt position. In the deadbolt position, the bolt assembly is blocked by the primary blocking element against retracting along the bolt path, thereby preventing that the part of the bolt assembly extending from the housing can be manipulated to retract the bolt assembly.

[0029] In an embodiment the bolt assembly comprises a bolt head, a bolt tail and a frame or coupling part that couples the bolt head to the bolt tail, wherein the bolt head is mounted to the frame or the coupling part so as to be rotatable with respect to the bolt tail around a vertical axis, wherein the bolt tail is mounted to the frame or the coupling part so at to be translatable in the direction of the bolt path with respect to the bolt head. The bolt tail can be displaced with respect to the bolt head when the bolt head is rotated or flipped.

[0030] In an embodiment the bolt head has a substantially symmetrical cross section, preferably a rhombus shaped cross section, wherein the bolt head is operationally coupled to the frame or the coupling part via a bolt axle, wherein the bolt head is provided with a central bore, preferably a symmetrically located bore for receiving the bolt axle. The symmetrical location of the bore and the bolt axle received therein can improve the transfer of the pressure force applied sideways on the bolt head into a pressure force that is transmitted from the bolt head onto the bolt tail in the direction of the bolt path.

[0031] In an embodiment the bolt head acts as a flip bolt or flip latch. The flip bolt or flip latch can rotate about the bolt axle once the primary blocking and/or the secondary blocking element have moved to their unblocking position, thereby reducing the distance over which the bolt head extends from the housing past the front plate. The distance over which the bolt assembly has to be retracted in order to move the bolt head out of the strike box or strike plate with which the bolt head engaged in the deadbolt position, can therefore be reduced.

[0032] The various aspects and features described and shown in the specification can be applied, individually, wherever possible. These individual aspects, in particular the aspects and features described in the attached dependent claims, can be made subject of divisional patent applications.

BRIEF DESCRIPTION OF THE DRAWINGS

[0033] The invention will be elucidated on the basis of an exemplary embodiment as shown in the attached schematic drawings, in which:

- figure 1 shows an isometric view of an electromechanical lock assembly with a bolt assembly according to a first embodiment of the invention;
- figure 2 shows an exploded view of the lock assembly according to figure 1;
- figures 3A and 3B show a side view and a cross section view according to the line IIIB-IIIB in figure 3A, respectively, of the lock assembly according to figure 1 in idling current mode, wherein the lock assembly is electromechanically operated to block the bolt assembly;
- figure 3C shows a schematic of the major forces occurring during operation of the lock assembly according to figure 3A;
- figures 4A and 4B show a side view and a cross section view according to the line IVB-IVB in figure 4A, respectively, of the lock assembly according to figure 1 in idling current mode, wherein the lock assembly is electromechanically operated to unblock the bolt assembly;
- figures 5A and 5B show a side view and a cross section view according to the line VB-VB in figure 5A, respectively, of the lock assembly according to figure 1 in idling current mode, wherein the bolt assembly is retracted;
- figure 6 shows the lock assembly according to figure 1 in idling current mode, wherein the lock assembly is key operated to unblock the bolt assembly;
- figure 7 shows the lock assembly according to figure

1 in operating current mode, wherein the lock assembly is key operated to unblock the bolt assembly;

figure 8 shows the lock assembly according to figure 7 in operating current mode, wherein the bolt assembly is retracted;

figure 9 shows an isometric view of an alternative electromechanical lock assembly with a bolt assembly according to a second embodiment of the invention;

figure 10 shows an exploded view of the alternative lock assembly according to figure 9;

figure 11A shows a side view of the alternative lock assembly according to figure 9, wherein the bolt assembly is electromechanically operated to block the bolt assembly;

figures 11B and 11C show schematics of the major forces occurring during operation of the alternative lock assembly according to figure 11A; and

figure 12 shows a side view of the alternative lock assembly according to figure 9, wherein the bolt assembly is electromechanically operated to unblock the bolt assembly.

DETAILED DESCRIPTION OF THE INVENTION

[0034] Figures 1-8 show a self locking, electromechanical mortise lock assembly 1 with a bolt assembly 2 and an auxiliary latch 3 according to an exemplary first embodiment of the invention. The lock assembly 1 can be electromechanically operated and/or key operated in a manner which will be described hereafter.

[0035] The lock assembly 1 is placed in a door or a window or the like (not shown). The bolt assembly 2 can be moved relative to the door or window in an extension or locking direction L and a retraction or unlocking direction U to engage with a strike plate or a strike box in a jamb of a corresponding frame (not shown).

[0036] As shown in figure 1, the lock assembly 1 comprises a bolt housing 10 and a rectangular, vertically elongate front plate 11 at one side of the housing 10. In figure 1, one side cover plate of the housing 10 has been removed to schematically expose the internal components of the lock assembly 1. The remaining side cover plate has holes in which some of the internal components engage. The lock assembly 1 is provided with a first rectangular opening 12 and a second rectangular opening 13 in the front plate 11 which allow for translatory passage of the bolt assembly 2 and the auxiliary latch 3, respectively. Furthermore, the lock assembly 1 comprises a third opening 14 in the side of the housing 10 for receiving an insert cylinder (not shown) for the aforementioned key operation of the lock assembly 1.

[0037] As shown in figures 1 and 2, the bolt assembly 2 comprises a bolt frame 4 that extends in the locking direction L. At one end, the bolt frame 4 is guided by the first opening 12 in the front plate 11. At the opposite end, the bolt frame 4 is guided by a bolt bearing formed by the upper two pop rivets 19 which bear the bolt frame 4 as indicated by the dashed lines in figure 2. The pop rivets 19 are fixedly mounted to the housing 10. The guidance allows the bolt assembly 2 to move in a translatory manner along a rectilinear bolt path X in the locking direction L and the unlocking direction U between a deadbolt position and a retracted position.

[0038] As shown in exploded view in figure 2, the bolt frame 4 comprises a first flat frame member 40 and a second flat frame member 41 which extend at a distance from each other and parallel to the locking direction L. The frame members 40, 41 are connected by a first spacer 42 and a second spacer 43 which extend at a distance from each other and transverse the frame members 40, 41. Together, the frame members 40, 41 and the spacers 42, 43 form a rigid box-like frame structure. The frame members 40, 41 are each provided with guide slots 44 and a symmetrically located axle opening 45. The bolt assembly 2 comprises a bolt axle 46 which is connected to the bolt frame 4 at the axle openings 45.

[0039] The bolt assembly 2 is provided with a bolt head 20 which is placed between the frame members 40, 41 at the front of the bolt frame 4 and a bolt tail 5 which is placed between the frame members 40, 41 and the spacers 42, 43 at the rear of the bolt frame 4. The bolt head 20 is provided with a straight, vertical locking surface 21 at one side and a sloped run-on surface or striking surface 22 at the opposite side. The locking surface 21 and the striking surface 22 converge into a vertical leading edge 23 and together form a wedge shaped front section 24 which points in the locking direction L. The locking surface 21 extends over at least twelve millimeters and preferably over at least twenty millimeters into the locking direction L. In the deadbolt position of the bolt assembly 2, the bolt head 20 extends with a substantial part of its locking surface 21 and the striking surface 22 outside the front plate 11. In the retracted position of the bolt assembly 2, the bolt head 20 is substantially fully retracted within the housing 10.

[0040] At the rear of the bolt head 20, facing in the unlocking direction U, the bolt head 20 is provided with a wedged shaped rear section 25. When viewed parallel to the elongate direction of the front plate 11, the rear section 25, together with the wedge shaped front section 24, forms a substantially quadrilateral rhombus shaped cross section. The rear section 25 comprises a first cam surface 26 which is located diagonally opposite to the leading edge 23 and second cam surfaces 27 which are recessed with respect to the first cam surface 26 on both sides of the first cam surface 26.

[0041] The bolt head 20 comprises a cylindrical bore 28 that extends vertically through the bolt head 20 at the center of the rhombus shaped cross section. The bolt head 20 is placed with its bore 28 on the bolt axle 46 so as to be rotatable in a bolt rotation direction K with respect to the bolt frame 4 about a vertical bolt rotational axis S. The rotation about the bolt rotational axis S allows the bolt head 20 to act as a flip latch or a flip bolt, which flips when a pressure force P1 is applied to the locking surface

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[0042] As shown in figure 2, the bolt tail 5 is provided with a rectangular body 50 with a recess 51 directly opposite to the first cam surface 26 of the bolt head 20. The recess 51 comprises a deflection surface 53 which allows the first cam surface 26 to slide into the recess 53 when the bolt head 20 is rotated around the bolt axle 46 in the bolt rotation direction K. On both sides of the recess 51, the bolt tail 5 is provided with inclined run-on surfaces 52 which are located directly opposite to the second cam surfaces 27 of the bolt head 2. The run-on surfaces 52 are in abutment with and guide the second cam surfaces 27 as the bolt head 20 is rotated or flipped around the bolt axle 46 in the bolt rotation direction K.

[0043] The bolt tail 5 further comprises a first guiding channel 54 and a second guiding channel 55 which accommodate the first spacer 42 and the second spacer 43, respectively, when the bolt tail 5 is mounted within the bolt frame 4 as shown in figure 1. When viewed in the direction of the bolt path X, the guiding channels 54, 55 have a width that is wider than the width of the spacers 42, 43. As shown in figures 4B and 5B, the bolt tail 5 can therefore slide in the direction of the bolt path X within the boundaries of the guiding channels 54, 55. As shown in figure 2, the bolt tail 5 is provided with four guiding protrusions 56 which fit in the guide slots 44 of the bolt frame 4, thereby limiting the movement of the bolt tail 5 to a translatory movement in the direction of the bolt path X. The lock assembly 1 is provided with a bolt spring 37 which spring-loads or biases the bolt tail 5 to move in the locking direction L.

[0044] The bolt tail 5 is provided with a protrusion 57 extending in the unlocking direction U from the rear of the bolt tail 5. The rear protrusion 57 holds an abutment wheel 58 which is rotatable with respect to the bolt tail 5. The abutment wheel 58 is provided with circumferential or cylindrical first abutment surface 59.

[0045] As shown in figure 2 the auxiliary latch 3 is mounted to move in a reciprocating manner through the second opening 13 in the front plate 11. The auxiliary latch 3 is arranged for detecting a situation wherein the lock assembly 1 is positioned directly in front of a strike plate (not shown) and for triggering functionality of the lock assembly 1 which corresponds to such a position. For example, the auxiliary latch 3 could be used to detect a closing order as described later in this description. The auxiliary latch 3 comprises an auxiliary latch head 30 which fits through the second opening 13 in the front plate and an auxiliary latch tail 31 which extends rearwards in the unlocking direction U. The auxiliary latch 3 is guided by a auxiliary latch guide 32 which is fixedly mounted to the housing 10. The lock assembly 1 is provided with a auxiliary latch spring 38 which spring-loads or biases the auxiliary latch 3 to move in the locking direction L.

[0046] As shown in figure 2, the lock assembly 1 is provided with a primary blocking element 6 and a secondary blocking element 8 which in cooperation block the translatory movement of the bolt assembly 2 along the bolt path X. The primary blocking element 6 is coupled via a transmission assembly 7 to a first electromechanical actuator in the form of a first solenoid actuator 90, which drives the primary blocking element 6 along a primary blocking path Y between a primary blocking position and a primary unblocking position. The secondary blocking element 8 is coupled to a second electromechanical actuator in the form of a second solenoid actuator 91, which drives the secondary blocking element 8 along a secondary blocking path Z between a secondary blocking position and a secondary unblocking position.

[0047] The primary blocking element 6 comprises a plate 60 which is provided with a number of guide slots 61. The primary blocking bearings 15 extend through the guide slots 61 and bear the plate 60, as indicated with dashed lines in figure 2. The guide slots 61 are elongate in the direction of the primary blocking path Y, transverse or perpendicular to the bolt path X. The primary blocking element 6 can be moved over a limited distance with respect to the primary blocking bearings 15, within the boundaries of the guide slots 61. Because of the elongate direction of the guide slots61, the primary blocking element 6 is only able to move transverse to the bolt path X in a translatory manner along the rectilinear primary blocking path Y in a blocking direction H or an unblocking direction G between the primary blocking position and the primary unblocking position, respectively. The primary blocking element 6 is fixed on the primary blocking bearings 15 against translation in the direction of the bolt path X with respect to the housing 10.

[0048] The primary blocking element 6 comprises a protrusion 67 which forms an extension of the plate 60 in the locking direction L. At its distal end, the protrusion 67 is provided with a second, straight and flat abutment surface 68 which faces towards the dead bolt position. The normal vector of the second abutment surface 68 extends under an angle of approximately seventeen degrees with respect to the bolt path X. The second abutment surface 68 thus extends at a non-perpendicular angle with respect to the bolt path X. The primary blocking element 6 further comprises a third abutment surface 65 and an alternate third abutment surface 66 near the secondary blocking element 8, facing in the unblocking direction G. The normal vectors of the third abutment surfaces 65, 66 extend under an angle of approximately seventeen degrees with respect to the primary blocking path Y. The third abutment surfaces 65, 66 thus extend at a non-perpendicular angle with respect to the primary blocking path Y.

[0049] The primary blocking element 6 is provided with a coupling opening 64 which couples the primary blocking element 6 to the transmission assembly 7. As shown in figure 2, the transmission assembly 7 is provided with a first plate 70 and a second plate 71 which extend parallel to each other. The plates 70, 71 each comprise guide slots 72, a first opening 73, a second opening 74 and a third opening 75. The guide slots 72 engage with a pop rivet 19 which is fixedly mounted to the housing 10. The guide slots 72 are elongated, so that the plates 70, 71 can be moved over a limited distance with respect to the pop rivet 19, within the boundaries of the guide slots 72. The first opening 73 holds a first coupling pin 78 which couples the plates 70, 71 to the plunger 92 of the first solenoid actuator 90. The first solenoid actuator 90 can be electrically operated to move the plates 70, 71 in a translatory and reciprocating manner in either the extending direction A or the retracting direction B of the first solenoid 90. The first plate 70 is provided with a protrusion 34 that extends in the retracting direction B of the first solenoid 90. The protrusion 34 holds a transmission assembly spring 36 that biases or spring loads the transmission assembly 7 to move with respect to housing 10 into the extension direction A of the first solenoid 90.

[0050] The transmission assembly 7 comprises a tumbler 76 which is placed between the plates 70, 71. The tumbler 76 is rotatably mounted about a tumbler rotational axis M on the same pop rivet 19 as the plates 70, 71. The plates 70, 71 engage the tumbler 76 with a hinge pin 77 at a distance from the pop rivet 19, so that a translatory movement of the plates 70, 71 relative to the tumbler 76 in the extending direction A or the retracting direction B of the first solenoid actuator 90 will cause the tumbler 76 to be rotated about the pop rivet 19 in a tumbler rotation direction N about the tumbler rotation axis M. In this example, the hinge pin 77 is mounted in the second opening 74 of the plates 70, 71. Alternatively, for the purpose of switching the lock assembly 1 between idling current mode and operating current mode, the hinge pin 77 can be mounted in the third opening 75 of the plates 70, 71 opposite to the second opening 74 with respect to the pop rivet 19, thereby inverting the rotary movement of the tumbler 76 about the tumbler rotational axis M. The tumbler 76 is coupled, at its distal end with respect to the pop rivet 19, to the coupling opening 64 via a second coupling pin 79.

[0051] The transmission assembly 7 allows for the bottom end 69 of the primary blocking element 6 to remain free, so that it can be engaged by other mechanisms, such as a mechanism to allow for key operated unlocking or locking of the locking assembly 1. An exemplary embodiment of such a mechanism will be elucidated later in this description. If such a functionality is not required, the first solenoid actuator 90 could also be coupled directly in-line to the primary blocking element 6, thereby eliminating the need for the aforementioned transmission assembly 7.

[0052] The secondary blocking element 8 comprises a first plate 80 and a second plate 81 which extend parallel to each other. As shown in figure 1 the primary blocking element 6 extends between the plates 80, 81, in particular at the section of the primary blocking element 6 that holds the third abutment surface 65 and the alternate third abutment surface 66. The plates 80, 81 each comprise guide slots 82, a first opening 83, a second opening 84 and a third opening 85. The lock assembly 1 is provided with secondary blocking bearings 16 which bear the guide slots 82 and which are fixedly mounted to the housing 10. The guide slots 82 are elongated, so that the plates 80, 81 can be moved over a limited distance with respect to the secondary blocking bearings 16, within the boundaries of the guide slots 82. The secondary blocking element 8 is fixed on the secondary blocking bearings 16 with respect to the housing 10 against movement in the direction of the primary blocking path Y.

[0053] As shown in figure 2, the first opening 83 holds a coupling pin 87 which couples the plates 80, 81 to the plunger 93 of the second solenoid actuator 91. The second solenoid actuator 91 can be electrically operated to move the plates 80, 81 in a translatory and reciprocating manner in a direction transverse or perpendicular to the primary blocking path Y along the secondary blocking path Z in either the extending direction C or the retracting direction D of the second solenoid 91. The second plate 81 is provided with a protrusion 33 that extends in the retracting direction C of the second solenoid 91. The protrusion 33 holds a secondary blocking element spring 35 that biases or spring loads the secondary blocking element 8 to move with respect to housing 10 along the secondary blocking path Z into the extension direction C of the second solenoid 91.

[0054] The secondary blocking element 8 is provided with a blocking pin 86 with a circumferential fourth abutment surface 88. In this example, the blocking pin 86 is mounted in the second opening 84 and extends between the plates 80, 81 so that, when the secondary blocking element 8 is retracted in the retracting direction D of the second solenoid actuator 91, comes into contact with the third abutment surface 65 of the primary blocking element 6. Alternatively, for the purpose of switching the lock assembly 1 between idling current mode and operating current mode, the blocking pin 86 can be mounted in the third opening 85 so that, when the secondary blocking element 8 is extended in the extending direction C of the second solenoid actuator 91, the fourth abutment surface 88 comes into abutment with the alternate third abutment surface 66 instead of the third abutment surface 65.

[0055] As shown in figures 3A and 6, the lock assembly 1 comprises a key operation assembly with a key lever rotation part 100 and a key lever pushing part 110 which cooperate to transfer a key operated movement of a standard insert cylinder (not shown) which is inserted in the third opening 14 onto the primary blocking element 6. The key lever rotation part 100 comprises a key lever rotation plate 101 which is mounted on a follower axle 102. The follower axle 102 is fixedly mounted to the housing 10. The key lever rotation plate 101 is provided with a cam surface 103 which faces towards the insert cylinder and which is adapted to be displaced by a pin or nose extending from the insert cylinder. A follower spring 39 biases or spring loads the key lever rotation plate 101 to move in a follower rotational direction AA, opposite to the direction in which the cylinder displaces the key lever rotation plate 101, thereby ensuring that after the nose of the cylinder is returned to its original position, the key lever rotation plate 101 returns to its original position as well. The key lever rotation plate 101 is provided with a drive surface 104 and a retraction surface 105 which engage with the key lever pushing part 110 in a manner which will be described hereafter.

[0056] As shown in figure 2, the key lever pushing part 110 comprises a pushing plate 111 with several guide slots 112 which engage with pop rivets 19 of the housing 10 as indicated with dashed lines. The guide slots 112 are elongate in a vertical direction, transverse or perpendicular to the bolt path X. The guide slots 112 therefore only allow the pushing plate 111 to move in a translatory manner along a rectilinear key operation path BB. The pushing plate 111 is provided with a first abutment flange 115 in the form of a lip that extends above and is arranged to engage with the drive surface 104 of the key lever rotation plate 101. The first abutment flange 115 is arranged to, at its opposite side with respect to the pushing plate 111, engage with the bottom end 69 of the primary blocking element 6. The pushing plate 111 comprises a second abutment flange 116 in the form of a lip that extends underneath and is arranged to engage with the retraction surface 105 of the key lever rotation plate 101.

[0057] The key lever pushing part 110 is only shown in figures 1, 2 and 6-8. In figures 3A-5B, the key lever pushing part 110 is removed to expose the underlying components.

[0058] As shown in figures 3A and 4A, the lock assembly 1 comprises a series of electronic switches 94-97. The first switch 94 is mounted in the secondary blocking path Z to detect the extension of the secondary blocking element 8 in the extension direction C of the second solenoid 91. As shown in figures 6, 7 and 8, the second switch 95 is located in the key operation path BB to detect the retraction of the key lever pushing part 110. As shown in figures 3A and 4A, the third switch 96 is located in the primary blocking path Y to detect the movement of the primary blocking element 6 in the unblocking direction G into its unblocking position. As shown in figures 4A and 5A, the fourth switch 97 is located in the path of the auxiliary latch 3 to detect a retraction of the auxiliary latch 3 into the trigger bolt direction T. The detection of the retraction of the auxiliary latch 3 can be used in the detecting of a closing order, as described later in this description.

[0059] Figures 3A-5B show the lock assembly 1 in idling current mode during different stages of operation, wherein the lock assembly is electromechanically operated. In idling current mode, a constant electrical current is required to keep the lock assembly 1 in a blocked state. Once the current supply is interrupted, for example due to a fire, the lock assembly 1 should automatically become unblocked and unlockable without the need for further current, which, at the time of the emergency, might not be available anymore. Idling current mode is therefore mainly applied in buildings where the possibility of unlocking the lock assembly 1 is to be ensured in case of an emergency.

[0060] With known lock assemblies, the internal mechanism of the lock assembly can malfunction due to friction when a large pressure force is applied to the bolt assembly. Such a pressure force can occur when a human applies pressure to the door to which the lock assembly is fitted, or when a fire increases the pressure in a room adjacent to the door to which the lock assembly 1 is fitted. The following description illustrates how the lock assembly 1 according to the invention becomes unblocked and unlockable, even under such a large pressure force.

[0061] Figures 3A and 3B show the situation wherein the lock assembly 1 is in the blocked state. The bolt assembly 2 is extended into the locking direction L with the bolt head 20 protruding into the deadbolt position through the first opening 12 in the front plate 11. The bolt spring 37 biases the bolt assembly 2 with a biasing force in the locking direction L. The first solenoid 90 is powered by current, causing the corresponding plunger 92 to be retracted into the retraction direction B of the first solenoid 90. As a result the tumbler 76 of the transmission assembly 7 is rotated clockwise in the transmission rotation direction N. The coupling between the tumbler 76 and the primary blocking element 6 has caused the primary blocking element 6 to move downwards in the blocking direction H along the primary blocking path Y into the primary blocking position. In the primary blocking position, the second abutment surface 68 is positioned in the bolt path X, directly opposite to and in abutment with the first abutment surface 59 of the abutment wheel 58 in a primary abutment point AP1. The bolt tail 5 can therefore not be moved backwards in the unlocking direction U. The bolt head 20, which is dependent on the displacement of the bolt tail 5 to be able to rotate about the bolt rotational axis S is also blocked against rotation in the bolt rotational direction K. This way, the bolt head 20 can not be manipulated to unlock the lock assembly 1.

[0062] The second solenoid 91 is powered by current, causing the corresponding plunger 93 to be retracted against the biasing force of the transmission assembly spring 36 into the retraction direction D of the second solenoid 91. As a result the secondary blocking element 8 coupled to the plunger 93 is moved along the secondary blocking path Z in the retraction direction D of the second solenoid 91 into the secondary blocking position. In the secondary blocking position, the fourth abutment surface 88 of the secondary blocking element 8 is positioned in the primary blocking path Y, directly opposite to and in abutment with the third abutment surface 65 in a secondary abutment point AP2.

[0063] As shown schematically in figure 3B, a pressure force P1 is exerted on the locking surface 21 of the bolt head 20. The pressure force P1 is transmitted via the rotation K of the bolt head 20 around the bolt rotational axis S as a pressure force P2 which acts on the bolt tail 5. As shown in schematically in figure 3C, the pressure force P2 causes the bolt tail 5 to exert a major force F1 parallel to the normal vector of the second abutment surface 68 onto the second abutment surface 68. The offset angle of the normal vector of the second abutment surface 68 with respect to the bolt path X at the primary abutment point AP1, causes the major force F1 exerted by the bolt assembly 5 on the primary blocking element 6 to be resolved into a force component F2 in the direction of the bolt path X and a force component F3 in the direction of the primary blocking path Y.

[0064] Due to the aforementioned offset angle, the force component F2 in the direction of the bolt path X is considerably larger than the force component F3 in the direction of the primary blocking path Y. The force component F2 in the direction of the bolt path X causes an opposite reaction force exerted by the primary blocking element 6 on the bolt assembly 2, thereby blocking the bolt assembly 2 from being retracted along the bolt path X in the unlocking direction U. The minor force component F3 in the direction of the primary blocking path Y acts on the second blocking element 8 in a manner which will be described hereafter. The force component F3 in the direction of the primary blocking path Y does normally not exceed the force S1 of the first solenoid 90 holding the primary blocking element 6 in the primary blocking position. The primary blocking element 6 thus remains in place as long as a current is supplied to the first solenoid 90, so that the lock assembly 1 can not be manipulated to unblock or unlock when the current is still continuous.

[0065] As shown in figure 3C, the minor force component F3 in the direction of the primary blocking path Y causes a force F4 parallel to the normal vector of the second abutment surface 65 at the second abutment point AP2. The offset angle of the normal vector of the second abutment surface 65 with respect to the primary blocking path Y at the secondary abutment point AP2, causes the force F4 exerted by the primary blocking element 6 on the secondary blocking element 8 to be resolved into a force component F5 in the direction of the primary blocking path Y and a force component F6 in the direction of the secondary blocking path Z. Due to the aforementioned offset angle, the force component F5 in the direction of the primary blocking path Y is considerably larger than the force component F6 in the direction of the secondary blocking path Z. The force component F5 in the direction of the primary blocking path Y causes an opposite reaction force exerted by the secondary blocking element 8 on the primary blocking element 6, thereby blocking the primary blocking element 6 from being moved along the primary bolt path Y in the unblocking direction G towards the primary unblocking position.

[0066] The force component F6 in the direction of the secondary blocking path Z does normally not exceed the force S2 of the second solenoid 91 holding the secondary blocking element 8 in the secondary blocking position. The secondary blocking element 8 thus remains in place as long as a current is supplied to the second solenoid 91, so that the lock assembly 1 can not be manipulated to unblock or unlock when the current is still continuous.

[0067] Starting from the situation as shown in figures 3A, 3B and 3C, an interruption in the supply of current to the solenoids 90, 91 will cause the plungers 92, 93 to no longer be retracted by the solenoids 90, 91 in the retraction direction B, D. Instead, the biasing forces of the second blocking element spring 35 and the transmission assembly spring 36 will cause the second blocking element 8 and the transmission assembly 7, respectively, to move into the respective extension directions A, C of the solenoids 90, 91. The secondary blocking element 8 will start move along the secondary blocking path Z into the secondary unblocking position. At approximately the same time, the tumbler 76 of the transmission assembly 7 will start turning anti-clockwise in the transmission rotation direction N. The coupling between the tumbler 76 and the primary blocking element 6 will cause the primary blocking element 6 to start moving upwards in the unblocking direction G along the primary blocking path Y towards the primary unblocking position.

[0068] Because of the pressure force P1 being applied to the bolt head 20, the forces F1-F3 and F4-F6 occurring between the abutting abutment surfaces 59, 68, 65, 88 can lead to friction, which could influence the ability of the primary blocking element 6 and the secondary blocking element 8 to move to their respective unblocking positions, resulting in the lock assembly 1 malfunctioning. The following description illustrates how the lock assembly 1 according to the invention is engineered to cope with these forces F1-F3 and F4-F6 by minimizing friction and ensuring the operation of the lock assembly 1 under a high pressure force P1.

[0069] As shown in figure 3C, the force component F2 in the direction of the bolt path X at the primary abutment point AP1 is considerably larger than the force component F3 in the direction of the primary blocking path Y. It is nonetheless still smaller than the force which would be exerted by the bolt tail 5 on the primary blocking element 6 if the normal vector of the second abutment surface 68 would be aligned with the bolt path X. Thus, by deflecting a part of the major force F1 in a direction other than the bolt path X, the forces occurring in the direction of the bolt path X can be reduced. The friction generated at the primary abutment point AP1 is reduced, thereby increasing the threshold value of the pressure force P1 at which the lock assembly 1 starts to malfunction.

[0070] Additionally, the cylindrical form of the first abutment surface 59 only abuts the second abutment surface 68 at one position along its circumference, thereby substantially reducing the contact surface and thus further reducing the friction between the first abutment surface 59 and the second abutment surface 68. Furthermore, the abutment wheel 58 will start to roll as primary blocking element 6 starts to move with respect to the bolt assembly 2, thereby further reducing or even substantially eliminating the friction between the first abutment surface 59 and the second abutment surface 68. The primary blocking bearings 15 which bear the primary blocking element 6 can rotate as well to prevent that friction occurs between the primary blocking bearings 15 and the guide slots 61.

[0071] The minor force component F3 in the direction of the primary blocking path Y at the primary abutment point AP1 aids or contributes to the movement of the primary blocking element 6 along the primary blocking path Y from the primary blocking position to the primary unblocking position. With the aid of the force component F3 in the direction of the primary blocking path Y, the remaining friction due to the force component F2 in the direction of the bolt path X can be overcome, thereby preventing that the lock assembly 1 malfunctions under a high pressure force P1.

[0072] In a similar way, the force F4 at the secondary abutment point AP2 can be reduced. The offset angle of the third abutment surface 65 deflects a part of the major force F4 in a direction other than the primary blocking path Y. The forces occurring in the direction of the primary blocking path Y can be therefore reduced. The friction generated at the secondary abutment point AP2 is reduced, thereby increasing the threshold value of the pressure force P1 at which the lock assembly 1 starts to malfunction. Additionally, the cylindrical form of the fourth abutment surface 88 only abuts the third abutment surface 65 at one position along its circumference, thereby substantially reducing the contact surface and thus further reducing the friction between the third abutment surface 65 and the fourth abutment surface 88.

[0073] The minor force component F6 in the direction of the secondary blocking path Z at the secondary abutment point AP2 aids or contributes to the movement of the secondary blocking element 8 along the secondary blocking path Z from the secondary blocking position to the secondary unblocking position. With the aid of the force component F6 in the direction of the secondary blocking path Z, the remaining friction due to the force component F5 in the direction of the primary blocking path Y can be overcome, thereby preventing that the lock assembly 1 malfunctions under a high pressure force P1.

[0074] Preferably, the reduction in friction due to the cooperation between the primary blocking element 6 and the secondary blocking element 8 and their offset angles at the abutment point AP1, AP2, results in a pressure force P1 up to 1900 Newton, most preferably up to 3000 Newton that can be exerted on the bolt head 20 without the lock assembly 1 malfunctioning due to friction. Thus, the lock assembly 1 remains electromechanically operable up to a pressure force P1 up to 1900 Newton, most preferably up to 3000 Newton.

[0075] Figures 4A and 4B show the situation after the secondary blocking element 8 has moved along the secondary blocking path Z into the secondary unblocking position. In the secondary unblocking position, the fourth abutment surface 88 in no longer in front of the third abutment surface 65 when viewed in the direction of the primary blocking path Y. The primary blocking element 6 is therefore free to move and has moved upwards in the unblocking direction G along the primary blocking path Y into the primary unblocking position. In the primary unblocking position, the second abutment surface 68 is no longer in front of the first abutment surface 59 when viewed in the direction of the bolt path X. The bolt assembly 2 is therefore free to move and has just started to move in the unlocking direction U towards the retracted position.

[0076] Figures 5A and 5B show the situation wherein the bolt assembly 2 has moved in the unlocking direction U into its retracted position. The backwards movement of the bolt tail 5 in the unlocking direction U has allowed for rotation R of the bolt head 20. The lock assembly 1 is now unlocked.

[0077] Figure 6 shows the lock assembly 1 in idling current mode, wherein the lock assembly is key operated. In this example, key operation is only possible when the current supply to the solenoids 90, 91 is interrupted. During key operation, a key is used to rotate the nose of the insert cylinder, which nose displaces the key lever rotation plate 101. The displacement causes the key lever rotation plate 101 to rotate in the follower rotational direction AA about key operation axis E. The drive surface 105 then abuts the bottom side of the first abutment flange 115 of the key lever pushing part 110 which in turn at its top side abuts the bottom end 69 of the primary blocking element 6. As the key lever pushing part 110 starts to move upwards, the bottom end of the key lever pushing part 110 leaves the switch 95, which triggers the current supply to the solenoids 90, 91 to be interrupted. The primary blocking element 6 is pushed by the key lever pushing part 110 into the unblocking position, thereby allowing the bolt assembly 2 to be moved in the unlocking direction U to the retracted position thereof.

[0078] Figure 7 shows the lock assembly 1 in operating current mode, wherein the lock assembly is electromechanically operated. In operating current mode, the absence of current keeps the lock assembly 1 in a locked state. Once a current is supplied, the lock assembly 1 unlocks. Operating current mode is applied in buildings where certain areas have to remain sealed during an emergency, for example to contain a fire.

[0079] As shown in figure 7, the hinge pin 77 is moved from the second opening 74 to the third opening 75 of the plates 70, 71, thereby inverting the rotary movement of the tumbler 76. Thus, where the tumbler 76 moved clockwise with the retraction of the plunger 92 of the first solenoid 90 in the retraction direction B, it will now move anti-clockwise. In the same manner, where the tumbler 76 moved anti-clockwise with the extension of the plunger 92 of the first solenoid 90 in the extension direction A, it will now move clockwise. Thus, when no current is supplied to the first solenoid 90, the plunger 92 of the first solenoid 90 is extended in the extension direction A and the tumbler 76 moves clockwise, thereby pulling the primary blocking element 6 downwards in the blocking direction H. In the primary blocking position, the second abutment surface 68 is positioned in the bolt path X, directly opposite to and in abutment with the first abutment surface 59 of the abutment wheel 58 in the primary abutment point AP1.

[0080] In the situation as shown in figure 7, a current is supplied to the first solenoid 90 and, as a result, the plunger 92 of the first solenoid 90 is retracted in the retraction direction B. This will cause the tumbler 76 to move anti-clockwise, thereby moving the primary blocking element 6 in the unblocking direction G from the primary blocking position into the primary unblocking position. This movement is similar to and has the same effect as the movement of the primary blocking element 6 from the primary blocking position into the primary unblocking position in the idling current mode of the lock assembly 1.

[0081] In the operating current mode according to figure 7, the blocking pin 86 is mounted in the third opening 85 instead of the second opening 84. Thus, when no current is supplied to the second solenoid 91 and, as a result, the plunger 93 of the second solenoid 91 is extended in the extending direction C, the fourth abutment surface 88 of the blocking pin 86 comes into abutment with the alternate third abutment surface 66 in the secondary abutment point AP2.

[0082] In the situation as shown in figure 7, a current is supplied to the second solenoid 91 and, as a result, the plunger 93 of the second solenoid 91 is retracted in the retraction direction D. The second blocking element 8 is moved in the retraction direction D of the second solenoid 91 from its secondary blocking position into its secondary unblocking position. The blocking pin 86 is moved out of the primary blocking path Y and leaves the abutment with the alternate third abutment surface 66 in the secondary abutment point AP2. The primary blocking element 6 is therefore free to move to the primary unblocked position as described above.

[0083] As shown in figure 8 the lock assembly 1 can be key operated in operating current mode, in a similar manner as described before in relation to figure 6. The only difference is that in this example, key operation is only possible when current is supplied to the solenoids 90, 91, thereby moving the primary blocking element 6 and the second blocking element 8 to their respective unblocked positions.

[0084] Figures 9 and 10 show an alternative electromechanical lock assembly 201 with a bolt assembly 202 according to an exemplary second embodiment of the invention. The alternative lock assembly 201, although different in terms of mechanical components, has similar functionality as the aforementioned lock assembly 1 according to figures 1-8, in that it has a primary blocking element 206 and a secondary blocking element 208 which can be electromechanically operated by a first solenoid 290 and a second solenoid 291, respectively, to block or unblock a bolt assembly 202. The description below mainly focuses on the differences of the alternative lock assembly 201 with respect to the lock assembly 1. Components of the alternative lock assembly 201 which are substantially similar to those of the lock assembly 1 are only briefly discussed.

[0085] As shown in figure 9, the alternative lock assembly 201 comprises a bolt housing 210 and a front plate 211 with a rectangular opening 212 in the front plate 211 which allows for translatory passage of the bolt assembly 202 along the bolt path X. Furthermore, the alternative lock assembly 201 comprises a third opening 214 in the side of the housing 210 for receiving an insert cylinder (not shown) for the aforementioned key operation of the alternative lock assembly 201.

[0086] As shown in figures 9 and 10, the bolt assembly 202 is provided with a bolt head 220, a coupling part 203 and a bolt tail 205. The bolt head 220 comprises a locking surface 221 and a striking surface 222 that converge into a leading edge 223 and together form a wedge shaped front section 224 which points in the locking direction L. At the rear of the bolt head 220, facing in the unlocking direction U, the bolt head 220 is provided with a wedge shaped rear section 225. The bolt head 220 differs from the bolt head 220 as shown in figure 2 in that it comprises a recess 226 and two cam surfaces 227 on both sides of the recess 226. The bolt head 220 comprises a bore 228 which holds a bolt axle 246 so as to be rotatable in a bolt rotation direction K with respect to the coupling part 203 about a bolt rotational axis S.

[0087] The coupling part 203 is provided with a coupling body 231 having a bore 238 for receiving the bolt axle 246. At the end of the coupling body 231 facing in the unlocking direction U, the coupling part 203 is provided with a guiding protrusion 232 that extends towards the bolt tail 205.

[0088] The bolt tail 205 is provided with a rectangular body 250 with a recess 251 directly opposite to recess 226 of the bolt head 220 and the coupling part 203. Directly opposite to the guiding protrusion 232, the bolt tail 205 is provided with a guiding opening 256 which receives the guiding protrusion 232. On both sides of the recess 251, the bolt tail 205 is provided with inclined run-on surfaces 252 which are located directly opposite to the cam surfaces 227 of the bolt head 202. The run-on surfaces 252 are in abutment with and guide the cam surfaces 227 as the bolt head 220 is rotated around the bolt axle 246 in the bolt rotation direction K. The cam surfaces 227 displace the bolt tail 205 in the unlocking direction U, wherein the guiding protrusion 232 ensures that the bolt tail 205 remains coupled to the coupling part 203.

[0089] At the rear end of the bolt tail 205, facing in the unlocking direction U, the bolt tail 205 is provided with a first abutment surface 258 which, as shown in figure 11A, has a normal vector which extends under an angle of approximately seventeen degrees with respect to the bolt path X.

[0090] As shown in figure 10, the primary blocking element 206 comprises a first plate 260 and a second plate 261 which extend parallel to each other. Each plate 260, 261 is provided with a first opening 262, a second opening 263 and a third opening 264. The first opening 262 engages with a primary blocking element axle 265 with a blocking axis CC which is fixed to the housing 210. The primary blocking element axle 265 only allows the primary blocking element 206 to rotate in a rotary manner along an arced primary blocking path with an outer boundary Y1 and an inner boundary Y2 around the blocking axis CC in a blocking direction H or an unblocking direction G between a primary blocking position and a primary unblocking position, respectively. The outer primary blocking path Y1 extends transverse to bolt path X at the primary abutment point AP1, so that the initial rotary movement of the primary blocking element 206 from the primary blocking position to the primary unblocking position is in a direction transverse, preferably perpendicular to the bolt path X. The alternative lock assembly 201 is provided with a primary blocking element spring 235 that spring loads or biases the primary blocking element 206 to rotate in the blocking direction H to the primary blocking position.

[0091] The primary blocking element 206 is fixed on the blocking axle 265 against translation in the direction of the bolt path X with respect to the housing 210. Hence, the first main difference between the alternative lock assembly 201 according to figures 1-8 and the alternative lock assembly according to figures 9-12 is that the primary blocking element 206 rotates along the arced primary blocking path Y1, Y2 instead of moving in a translatory manner along the rectilinear primary blocking path Y as shown in figures 1-8.

[0092] At its distal end with respect to the blocking axle 265, the primary blocking element 206 is provided with a rotatable bearing wheel 268 which is rotatably suspended on a roller bearing axle 267 that is fitted to the third openings 264 of the plates 260, 261. The rotatable bearing wheel 268 comprises a circumferential or cylindrical second abutment surface 269. Hence, the second main difference between the lock assembly 1 according to figures 1-8 and the alternative lock assembly according to figures 9-12 is that the first abutment surface 258 is now a flat surface instead of a cylindrical surface and that the second abutment surface is now a cylindrical surface on a bearing rotatable wheel 268 instead of a flat surface. The primary blocking element 206 further comprises protrusions 364 extending from each of the plates 260, 261. The protrusions 364 comprise a curved third abutment surface 365 which faces towards the secondary blocking element 208.

[0093] The second openings 263 in the plates 260, 261 of the primary blocking element 206 hold a first coupling pin 279 that couples the primary blocking element 206 to a first transmission assembly 207. The first transmission assembly 207 converts the movement of the plunger 292 of the first solenoid 290 into a movement of the primary blocking element 206 along the primary blocking path Y1, Y2. The first transmission assembly 207 is provided with plates 270, 271 similar in construction to the plates 270, 271 of the lock assembly 1 according to figures 1-8. The first transmission assembly 207 is provided with a tumbler in the form of a lever 276. Depending on the holes of the plates 270, 271 through which the hinge pin 277 is fitted, the rotation direction of the lever 276 can be inverted for the purpose of switching the lock assembly 201 between idling current mode and operating current mode.

[0094] The lever 276 is connected to a pulling arm 300 with a first opening 301 and a second opening 302. The first opening 301 holds a second coupling pin 279 that couples the pulling arm 300 to the end of the lever 276 opposite to the plates 270, 271. The second opening 302 holds the first coupling pin 277 that couples the pulling arm 300 to the second openings 263 of the plates 260, 261 at a distance from the blocking axle 267. Thus, the movement of the pulling arm 300 in the vertical direction is converted in a pulling or pushing force on the primary blocking element 206, thereby causing the primary blocking element 206 to rotate along the primary blocking path Y1, Y2 between the primary blocking position and the primary unblocking position.

[0095] The secondary blocking element 208 comprises a first plate 280 and a second plate 281 which extend parallel to each other. As shown in figure 9 the plates 280, 281 of the secondary blocking element 208 extend in the same plane as the plates 260, 261 of the primary blocking element 206. The plates 280, 281 each comprise a fourth flat abutment surface 288. The normal vectors of the fourth abutment surfaces 288 extend under an angle of approximately seventeen degrees with respect to the tangent of the primary blocking path Y1, Y2 at the fourth abutment surfaces 288. The plates 280, 281 each further comprise guide slots 282 and an opening 283. The guide slots 282 engage with a secondary blocking secondary blocking bearing 216 which are fixedly mounted to the housing 210. The guide slot 282 is elongated, so that the plates 280, 281 can be moved over a limited distance with respect to the secondary blocking bearing 216 along the secondary blocking path Z, within the boundaries of the guide slots 282. In this embodiment, the secondary blocking path Z extends perpendicular to the bolt path X. The secondary blocking element 208 is fixed on the secondary blocking bearing 216 with respect to the housing 210 against movement in the direction of the primary blocking path Y.

[0096] The openings 283 hold a coupling pin 287 which couples the plates 280, 281 to a second transmission assembly 307. The second transmission assembly 307 converts the movement of the plunger 293 of the second solenoid 291 into a movement of the secondary blocking element 208 along the secondary blocking path Z. The second transmission assembly 307 is provided with plates 370, 371 and a tumbler in the form of a lever 376, similar in construction to the plates 270, 271 and the lever 276 of the first transmission assembly 207. Depending on the holes of the plates 370, 371 through which the hinge pin 377 is fitted, the rotation direction of the lever 376 can be inverted for the purpose of switching the alternative lock assembly 201 between idling current mode and operating current mode.

[0097] Figures 11A-C and 12 show the alternative lock assembly 201 in operating current mode during different stages of operation, wherein the alternative lock assembly 201 is electromechanically operated.

[0098] Figure 11A shows the situation wherein the alternative lock assembly 201 is in a blocked state. The bolt assembly 202 is extended into the locking direction L with the bolt head 220 protruding into the deadbolt position through the first opening 212 in the front plate 211. The primary blocking element 206 has moved in the blocking direction H along the primary blocking path Y1, Y2 into the primary blocking position. In the primary blocking position, the second abutment surface 269 is positioned in the bolt path X, directly opposite to and in abutment with the first abutment surface 258 in the primary abutment point AP1. The secondary blocking element 208 is moved along the secondary blocking path Z into the secondary blocking position. In the secondary blocking position, the fourth abutment surface 288 of the secondary blocking element 208 is positioned in the inner primary blocking path Y2, directly opposite to and in abutment with the third abutment surface 365 in a secondary abutment point AP2.

[0099] As shown schematically in figures 11B and 11C, a pressure force P2 is exerted by the bolt head 220 onto the bolt tail 205. The pressure force P2 causes the bolt tail 205 to exert a major force F1 parallel to the normal vector of the first abutment surface 258 onto the second abutment surface 269 of the primary blocking element 206.

[0100] The major force F1 can be resolved as described before into a force component F2 in the direction of the bolt path X and a force component F3 substantially in the direction of tangent of the outer primary blocking path Y1 at the primary abutment point AP1. The force component F2 in the direction of the bolt path X is considerably larger than the force component F3 in the direction of the outer primary blocking path Y1. The force component F2 in the direction of the bolt path X causes an opposite reaction force R2 exerted by the primary blocking element 206 on the bolt assembly 202, thereby blocking the bolt assembly 202 from being retracted along the bolt path X in the unlocking direction U. The minor force component F3 in the direction of the outer primary blocking path Y1 acts on the second blocking element 208 in a manner which will be described hereafter.

[0101] As shown in figures 11B and 11C, the minor force component F3 in the direction of the outer primary blocking path Y1 causes a force F4 parallel to the normal vector of the fourth abutment surface 288 at the second abutment point AP2. The force F4 can be resolved into a force component F5 in a direction perpendicular to the secondary blocking path Z and a force component F6 in the direction of the secondary blocking path Z. The force component F5 in the direction perpendicular to the secondary blocking path Z is considerably larger than the force component F6 in the direction of the secondary blocking path Z. The force component F5 in the direction perpendicular to the secondary blocking path Z causes an opposite reaction force exerted by the secondary blocking element 208 on the primary blocking element 206, thereby blocking the primary blocking element 206 from being moved along the primary bolt path Y1, Y2 in the unblocking direction G towards the primary unblocking position.

[0102] The abutment surfaces 258, 269, 365, 288 of the alternative lock assembly 201 have similar effects as the abutment surfaces 59, 68, 65, 88 of the lock assembly 1 according to figures 1-8, in that the major forces F1, F4 are deflected and friction is reduced. Therefore, the cooperation between the primary blocking element 206 and the secondary blocking element 208 of the alternative lock assembly 201 and their offset angles at the abutment point AP1, AP2, result in a pressure force P1 up to 1900 Newton, most preferably up to 3000 Newton that can be exerted on the bolt head 220 without the alternative lock assembly 201 malfunctioning due to friction.

[0103] Figure 12 shows the situation wherein the bolt assembly 202 has moved in the unlocking direction U into its retracted position. The backwards movement of the bolt tail 205 in the unlocking direction U has allowed for rotation R of the bolt head 220. The lock assembly 201 is now unlocked.

[0104] A further alternative embodiment of a lock assembly according to the invention comprises a housing, a bolt head and an auxiliary latch, similar to those of the lock assembly 1 according to figures 1-8. The further alternative lock assembly further comprises switches or sensors for detecting the positions of the bolt head and the auxiliary latch and a computing and/or processing unit for processing the signals sent by the switches or sensor upon detecting the positions of the bolt head and the auxiliary latch. The computing and/or processing unit is specifically arranged for detecting a chronological order in which the signals are detected during the closing of the further alternative lock assembly. Based on the detected chronological order in which the signals are detected, the computing and/or processing unit can establish the state of the further alternative lock assembly.

[0105] For example, the computing and/or processing unit receives signals in the following order; a first signal indicating that the auxiliary latch is retracted, a second signal indicating that the bolt head is retracted and a third signal that the bolt head is extended again. If between the second signal and the third signal no signal is received that the auxiliary latch is extended again, the computing and/or processing unit will conclude that the auxiliary latch is still in front of the door jamb and the only explanation for the bolt head being extended again is that it has engaged with the strike plate or strike box in the door or window jamb. Thus the further alternative lock assembly has engaged the strike plate.

[0106] It is to be understood that the above description is included to illustrate the operation of the preferred embodiments and is not meant to limit the scope of the invention. From the above discussion, many variations will be apparent to one skilled in the art that would yet be encompassed by the scope of the present invention if defined by the appended claims.

[0107] For example, alternatively, the various springs 35-39, 235 can be replaced by any other suitable biasing parts or biasing assemblies which exerts a force in a direction similar to pressure force of the springs 35-39.

[0108] The solenoids 90, 91, 290, 291 can be replaced by electromagnets, piezo actors, an electric motor or any other magnetic or electromechanical actuator that can cause a movement as described above. In the case of an electric motor, the motor has to be actively controlled to move the primary blocking element 6 or the secondary blocking element 8 back and forth. To ensure that the motor is still able to operate during at least one more locking/unlocking cycle after current has been interrupted, the lock assembly would feature a storage component like a battery or a capacitor for temporarily storing electrical energy which can be supplied to the motor in case of loss of the external current supply.

[0109] Additionally, the key operated insert cylinder can be replaced by a handle, a knob, a panic bar or the like to allow for a greater force to be applied by a human on the mechanism of the lock assembly 1, 201.

Claims

1. Lock assembly (1, 201) comprising a housing (10, 210), a front plate (11, 211) at one side of the housing (10, 210), a first opening (12, 212) in the front plate (11, 211) and a bolt assembly (2, 202) which is placed within the housing (10, 210), wherein the lock assembly (1) is provided with a bolt bearing (19) that bears the bolt assembly (2, 202) with respect to the housing (10, 210), wherein the bolt bearing (19) allows for a translation of the bolt assembly (2, 202) with respect to the housing (10, 210) along a bolt path (X) between a retracted position wherein the bolt assembly (2, 202) is substantially retracted into the housing (10, 210) and an extended position wherein the bolt assembly (2, 202) extends from the housing (10, 210) through the first opening (12), wherein the lock assembly (1, 201) is provided with a primary blocking element (6, 206) and a primary blocking bearing (15) that bears the primary blocking element (6, 206) with respect to the housing (10), wherein the primary blocking bearing (6, 206) allows for a movement of the primary blocking element (6, 206) with respect to the housing (10, 210) along a primary blocking path (Y) transverse to the bolt path (X) between a primary blocking position and a primary unblocking position, wherein the primary blocking element (6, 206) is fixed with respect to the housing (10, 210) against translation in the direction of the bolt path (X), wherein the bolt assembly (2, 202) and the primary blocking element (6, 206) comprise a first abutment surface (59, 258) and a second abutment surface (68, 269), respectively, wherein the second abutment surface (68, 269), when the bolt assembly (2, 202) is in the extended position and the primary blocking element (6, 206) is in the primary blocking position, abuts the first abutment surface (59, 258) in a primary abutment point (AP1), wherein the normal vector of the abutting abutment surfaces (59, 68, 258, 269) at the primary abutment point (AP1) is under an angle in a range of one to thirty degrees with respect to the bolt path (X), **characterized in that** the lock assembly (1, 201) comprises a secondary blocking element (8, 208) and a secondary blocking bearing (16) that bears the secondary blocking element (8, 208) with respect to the housing (10, 210), wherein the secondary blocking bearing (16) allows for a movement of the secondary blocking element (8, 208) with respect to the housing (10, 210) along a secondary blocking path (Z) transverse to the primary blocking path (Y) between a secondary blocking position and a secondary unblocking position, wherein the secondary blocking element (8, 208) is fixed with respect to the housing (10, 210) against movement in the direction of the primary blocking path (Y), wherein the primary blocking element (6, 206) and the secondary blocking element (8, 208) comprise a third abutment surface (65, 365) and a fourth abutment surface (88, 288), respectively, wherein the fourth abutment surface (88, 288), when the primary blocking element (6, 206) is in the primary blocking position and the secondary blocking element (8, 208) is in the secondary blocking position, abuts the third abutment surface (65, 365) in a secondary abutment point (AP2), wherein the normal vector of the abutting abutment surfaces (65, 88, 288, 365) at the secondary abutment point (AP2) is under an angle in a range of one to thirty degrees with respect to the direction of the primary blocking path (Y) at the secondary abutment point (AP2).

2. Lock assembly according to claim 1, wherein the normal vector of the abutting abutment surfaces at the primary abutment point is under an angle in a range of five to twenty degrees with respect to the bolt path.

3. Lock assembly according to claim 1 or 2, wherein the angle of the normal vector with respect to the bolt path causes the forces occurring between the abutting abutment surfaces at the primary abutment point to be resolved into a force component acting in the direction of the bolt path and a force component acting in a direction perpendicular to the bolt path, wherein the force component in the direction of the bolt path is larger than the force component in the direction perpendicular to the bolt path.

4. Lock assembly according to any one of the preceding claims, wherein the angle of the normal vector with respect to the bolt path of abutting abutment surfaces

at the primary abutment point causes part of the forces occurring between the abutting abutment surfaces at the primary abutment point to be deflected in a direction other than the bolt path.

5. Lock assembly according to any one of the preceding claims, wherein one of the abutment surfaces of the group comprising the first abutment surface and the second abutment surface is a substantially flat or straight surface, wherein the other abutment surface is a cylindrical surface, preferably wherein the cylindrical surface is formed by a rotatable bearing, preferably an abutment wheel.

6. Lock assembly according to any one of the preceding claims, wherein the primary blocking bearing which bears the primary blocking element is a rotational bearing.

7. Lock assembly according to any one of the preceding claims, wherein the bolt path is rectilinear and/or wherein the primary blocking path is rectilinear, preferably wherein the primary blocking path extends substantially perpendicular to the bolt path.

8. Lock assembly according any one of claims 1-6, wherein the primary blocking path is a curve, preferably a circular arc, wherein the primary blocking path extends transverse, preferably substantially perpendicular to the bolt path at the primary abutment point.

9. Lock assembly according to any one of the preceding claims, wherein the normal vector of the abutting abutment surfaces at the secondary abutment point is under an angle in a range of five to twenty degrees with respect to the direction of the primary blocking path at the secondary abutment point.

10. Lock assembly according to claim 8, wherein the angle between the normal vector of the abutting abutment surfaces and the direction of the primary blocking path at the secondary abutment point is measured with respect to tangent of the primary blocking path at the secondary abutment point.

11. Lock assembly according to any one of the preceding claims, wherein the angle of the normal vector of the abutting abutment surfaces at the secondary abutment point with respect the direction of the primary blocking path at the secondary abutment point causes the forces occurring between the abutting abutment surfaces at the secondary abutment point to be resolved into a force component acting in the direction of the secondary blocking path and a force component acting in a direction perpendicular to the secondary blocking path, wherein the force component in a direction perpendicular to the secondary blocking path is larger than the force component in the direction of the secondary blocking path.

12. Lock assembly according to any one of the preceding claims, wherein the angle of the normal vector of the abutting abutment surfaces at the secondary abutment point with respect to the primary blocking path causes part of the forces occurring between the abutting abutment surfaces at the secondary abutment point to be deflected in a direction other than the primary blocking path.

13. Lock assembly according to any one of the preceding claims, wherein, one of the abutment surfaces of the group comprising the third abutment surface and the fourth abutment surface is a substantially flat or straight surface, wherein the other abutment surface is a cylindrical surface, preferably wherein the cylindrical surface is formed by a rotatable bearing, preferably an abutment wheel.

14. Lock assembly according to any one of the preceding claims, wherein the secondary blocking path is rectilinear, preferably wherein the secondary blocking path extends substantially perpendicular to the primary blocking path.

15. Lock assembly according to any one of the preceding claims, wherein the lock assembly comprises a first electromechanical actuator which is operationally coupled to the primary blocking element for moving the primary blocking element along the primary blocking path between the primary blocking position and the primary unblocking position.

16. Lock assembly according to any one of the preceding claims, wherein the lock assembly comprises a second electromechanical actuator which is operationally coupled to the secondary blocking element for moving the secondary blocking element along the secondary blocking path between the secondary blocking position and the secondary unblocking position.

17. Lock assembly according to any one of the preceding claims, wherein the lock assembly comprises a mechanically operated unblocking mechanism of the group comprising a key operated mechanism, a handle, a knob, a panic bar or the like.

18. Lock assembly according to any one of the preceding claims, wherein the extended position of the bolt assembly is a dead bolt position.

19. Lock assembly according to any one of the preceding claims, wherein the bolt assembly comprises a bolt head, a bolt tail and a frame or coupling part that couples the bolt head to the bolt tail, wherein the bolt

head is mounted to the frame or the coupling part so as to be rotatable with respect to the bolt tail around a vertical axis, wherein the bolt tail is mounted to the frame or the coupling part so at to be translatable in the direction of the bolt path with respect to the bolt head, preferably wherein the bolt head has a substantially symmetrical cross section, most preferably a rhombus shaped cross section, wherein the bolt head is operationally coupled to the frame or the coupling part via a bolt axle, wherein the bolt head is provided with a central bore, preferably a symmetrically located bore for receiving the bolt axle, preferably wherein the bolt head acts as a flip bolt or flip latch.

Patentansprüche

1. Verriegelungsanordnung (1, 201) umfassend ein Gehäuse, eine Frontplatte (11, 211) auf einer Seite des Gehäuses (10, 210), eine erste Öffnung (12, 212) in der Frontplatte (11, 211) und eine Bolzenanordnung (2, 202), die innerhalb des Gehäuses (10, 210) angeordnet ist, wobei die Verriegelungsanordnung (1) mit einem Bolzenlager (19) versehen ist, das die Bolzenanordnung (2, 202) in Bezug auf das Gehäuse (10, 210) trägt, wobei das Bolzenlager (19) eine Verschiebung der Bolzenanordnung (2, 202) in Bezug auf das Gehäuse (10, 210) entlang eines Bolzenpfads (X) ermöglicht zwischen einer eingefahrenen Position, in der die Bolzenanordnung (2, 202) im Wesentlichen in das Gehäuse (10, 210) eingefahren ist, und einer ausgefahrenen Position, in der sich die Bolzenanordnung (2, 202) vom Gehäuse (10, 210) durch die erste Öffnung (12) erstreckt, wobei die Verriegelungsanordnung (1, 201) mit einem primären Blockierelement (6, 206) und einem primären Blockierlager (15) versehen ist, welches das primäre Blockierelement (6, 206) in Bezug auf das Gehäuse (10) trägt, wobei das primäre Blockierlager (6, 206) eine Bewegung des primären Blockierelements (6, 206) in Bezug auf das Gehäuse (10, 210) entlang eines primären Blockierpfads (Y) quer zum Bolzenpfad (X) zwischen einer primären Blockierposition und einer primären Freigabeposition ermöglicht, wobei das primäre Blockierelement (6, 206) in Bezug auf das Gehäuse (10, 210) gegen Verschiebung in Richtung des Bolzenpfades (X) fixiert ist, wobei die Bolzenanordnung (2, 202) und das primäre Blockierelement (6, 206) jeweils eine erste Anlagefläche (59, 258) und eine zweite Anlagefläche (68, 269) aufweisen, wobei die zweite Anlagefläche (68, 269), wenn sich die Bolzenanordnung (2, 202) in der ausgefahrenen Position befindet und das primäre Blockierelement (6, 206) sich in der primären Blockierposition befindet, an der ersten Anlagefläche (59, 258) in einem primären Anlagepunkt (AP1) anliegt, wobei der Normalenvektor der anliegenden Anlageflächen (59, 68, 258, 269) an dem primären Anlagepunkt (AP1) unter einem Winkel in einem Bereich von ein bis dreißig Grad in Bezug auf den Bolzenpfad (X) liegt, **dadurch gekennzeichnet, dass** die Verriegelungsanordnung (1, 201) ein sekundäres Blockierelement (8, 208) und ein sekundäres Blockierlager (16) umfasst, welches das sekundäre Blockierelement (8, 208) in Bezug auf das Gehäuse (10, 210) trägt, wobei das sekundäre Blockierlager (16) eine Bewegung des sekundären Blockierelements (8, 208) in Bezug auf das Gehäuse (10, 210) entlang eines sekundären Blockierpfads (Z) quer zum primären Blockierpfad (Y) zwischen einer sekundären Blockierposition und einer sekundären Freigabeposition ermöglicht, wobei das sekundäre Blockierelement (8, 208) in Bezug auf das Gehäuse (10, 210) gegen Bewegung in Richtung des primären Blockierpfades (Y) fixiert ist, wobei das primäre Blockierelement (6, 206) und das sekundäre Blockierelement (8, 208) jeweils eine dritte Anlagefläche (65, 365) und eine vierte Anlagefläche (88, 288) aufweisen, wobei die vierte Anlagefläche (88, 288), wenn sich das primäre Blockierelement (6, 206) in der primären Blockierposition befindet und das sekundäre Blockierelement (8, 208) sich in der sekundären Blockierposition befindet, an der dritten Anlagefläche (65, 365) in einem sekundären Anlagepunkt (AP2) anliegt, wobei der Normalenvektor der anliegenden Anlageflächen (65, 88, 288, 365) an dem sekundären Anlagepunkt (AP2) unter einem Winkel in einem Bereich von ein bis dreißig Grad in Bezug auf die Richtung des primären Blockierpfads (Y) an dem sekundären Anlagepunkt (AP2) liegt.

2. Verriegelungsanordnung nach Anspruch 1, wobei der Normalenvektor der anliegenden Anlageflächen an dem primären Anlagepunkt unter einem Winkel in einem Bereich von fünf bis zwanzig Grad in Bezug auf den Bolzenpfad liegt.

3. Verriegelungsanordnung nach Anspruch 1 oder 2, wobei der Winkel des Normalenvektors in Bezug auf den Bolzenpfad bewirkt, dass die zwischen den anliegenden Anlageflächen am primären Anlagepunkt auftretenden Kräfte in eine in Richtung des Bolzenpfades wirkende Kraftkomponente und eine in Richtung senkrecht zum Bolzenpfad wirkende Kraftkomponente aufgelöst werden, wobei die Kraftkomponente in Richtung des Bolzenpfades größer ist als die Kraftkomponente in Richtung senkrecht zum Bolzenpfad.

4. Verriegelungsanordnung nach einem der vorhergehenden Ansprüche, wobei der Winkel des Normalenvektors in Bezug auf den Bolzenpfad von anliegenden Anlageflächen an dem primären Anlagepunkt bewirkt, dass ein Teil der zwischen den anliegenden Anlageflächen an dem primären Anlage-

punkt auftretenden Kräfte in eine andere Richtung als den Bolzenpfad abgelenkt wird.

5. Verriegelungsanordnung nach einem der vorhergehenden Ansprüche, wobei eine der Anlageflächen der Gruppe, welche die erste Anlagefläche und die zweite Anlagefläche umfasst, eine im Wesentlichen ebene oder gerade Fläche ist, wobei die andere Anlagefläche eine zylindrische Fläche ist, vorzugsweise wobei die zylindrische Fläche durch ein drehbares Lager, vorzugsweise ein Anlagerad, gebildet ist.

6. Verriegelungsanordnung nach einem der vorstehenden Ansprüche, wobei das primäre Blockierlager, welches das primäre Blockierelement trägt, ein Drehlager ist.

7. Verriegelungsanordnung nach einem der vorhergehenden Ansprüche, wobei der Bolzenpfad geradlinig ist und/oder wobei der primäre Blockierpfad geradlinig ist, vorzugsweise wobei sich der primäre Blockierpfad im Wesentlichen senkrecht zum Bolzenpfad erstreckt.

8. Verriegelungsanordnung nach einem der Ansprüche 1-6, wobei der primäre Blockierpfad eine Kurve, vorzugsweise ein Kreisbogen, ist, wobei sich der primäre Blockierpfad quer, vorzugsweise im Wesentlichen senkrecht zum Bolzenpfad am primären Anlagepunkt erstreckt.

9. Verriegelungsanordnung nach einem der vorstehenden Ansprüche, wobei der Normalenvektor der anliegenden Anlageflächen an dem sekundären Anlagepunkt unter einem Winkel in einem Bereich von fünf bis zwanzig Grad in Bezug auf die Richtung des primären Blockierpfades an dem sekundären Anlagepunkt liegt.

10. Verriegelungsanordnung nach Anspruch 8, wobei der Winkel zwischen dem Normalenvektor der anliegenden Anlageflächen und der Richtung des primären Blockierpfades an dem sekundären Anlagepunkt in Bezug auf die Tangente des primären Blockierpfades an dem sekundären Anlagepunkt gemessen wird.

11. Verriegelungsanordnung nach einem der vorhergehenden Ansprüche, wobei der Winkel des Normalenvektors der anliegenden Anlageflächen am sekundären Anlagepunkt in Bezug auf die Richtung des primären Blockierpfads am sekundären Anlagepunkt bewirkt, dass die zwischen den anliegenden Anlageflächen am sekundären Anlagepunkt auftretenden Kräfte in eine in Richtung des sekundären Blockierpfads wirkende Kraftkomponente und eine in Richtung senkrecht zum sekundären Blockierpfad wirkende Kraftkomponente aufgelöst werden, wobei die Kraftkomponente in einer Richtung senkrecht zum sekundären Blockierpfad größer ist als die Kraftkomponente in Richtung des sekundären Blockierpfads.

12. Verriegelungsanordnung nach einem der vorhergehenden Ansprüche, wobei der Winkel des Normalenvektors der anliegenden Anlageflächen am sekundären Anlagepunkt in Bezug auf den primären Blockierpfad bewirkt, dass ein Teil der zwischen den anliegenden Anlageflächen am sekundären Anlagepunkt auftretenden Kräfte in eine andere Richtung als den primären Blockierpfad abgelenkt wird.

13. Verriegelungsanordnung nach einem der vorhergehenden Ansprüche, wobei eine der Anlageflächen der Gruppe, welche die dritte Anlagefläche und die vierte Anlagefläche umfasst, eine im Wesentlichen ebene oder gerade Fläche ist, wobei die andere Anlagefläche eine zylindrische Fläche ist, vorzugsweise wobei die zylindrische Fläche durch ein drehbares Lager, vorzugsweise ein Anlagerad, gebildet ist.

14. Verriegelungsanordnung nach einem der vorhergehenden Ansprüche, wobei der sekundäre Blockierpfad geradlinig ist, vorzugsweise wobei sich der sekundäre Blockierpfad im Wesentlichen senkrecht zum primären Blockierpfad erstreckt.

15. Verriegelungsanordnung nach einem der vorhergehenden Ansprüche, wobei die Verriegelungsanordnung ein erstes elektromechanisches Stellglied umfasst, das funktionsfähig mit dem primären Blockierelement gekoppelt ist, um das primäre Blockierelement entlang des primären Blockierpfades zwischen der primären Blockierposition und der primären Freigabeposition zu bewegen.

16. Verriegelungsanordnung nach einem der vorhergehenden Ansprüche, wobei die Verriegelungsanordnung ein zweites elektromechanisches Stellglied umfasst, das funktionsfähig mit dem sekundären Blockierelement gekoppelt ist, um das sekundäre Blockierelement entlang des sekundären Blockierpfades zwischen der sekundären Blockierposition und der sekundären Freigabestellung zu bewegen.

17. Verriegelungsanordnung nach einem der vorhergehenden Ansprüche, wobei die Verriegelungsanordnung einen mechanisch betätigten Freigabemechanismus der Gruppe umfasst, der einen schlüsselbetätigten Mechanismus, einen Griff, einen Knopf, einen Panikstange oder dergleichen umfasst.

18. Verriegelungsanordnung nach einem der vorhergehenden Ansprüche, wobei die ausgefahrene Position der Bolzenanordnung eine Riegelposition ist.

19. Verriegelungsanordnung nach einem der vorstehenden Ansprüche, wobei die Verriegelungsanordnung einen Bolzenkopf, einen Bolzenschwanz und einen Rahmen oder ein Kupplungsteil umfasst, der den Bolzenkopf mit dem Bolzenschwanz koppelt, wobei der Bolzenkopf am Rahmen oder Kupplungsteil drehbar in Bezug auf den Bolzenschwanz um eine vertikale Achse montiert ist, wobei der Bolzenschwanz am Rahmen oder Kupplungsteil so montiert ist, dass er in Richtung des Bolzenpfads in Bezug auf den Bolzenkopf verschiebbar ist, vorzugsweise wobei der Bolzenkopf einen im Wesentlichen symmetrischen Querschnitt, besonders bevorzugt einen rautenförmigen Querschnitt, aufweist, wobei der Bolzenkopf über eine Bolzenachse mit dem Rahmen oder dem Kupplungsteil funktionsfähig gekoppelt ist, wobei der Bolzenkopf mit einer zentralen Bohrung, vorzugsweise einer symmetrisch angeordneten Bohrung zur Aufnahme der Bolzenachse, versehen ist, vorzugsweise wobei der Bolzenkopf als Klappbolzen oder Klappverschluss wirkt.

Revendications

1. Ensemble de verrouillage (1, 201) comprenant un boîtier (10, 210), une plaque avant (11, 211) au niveau d'un côté du boîtier (10, 210), une première ouverture (12, 212) dans la plaque avant (11, 211) et un ensemble de pêne (2, 202) qui est positionné à l'intérieur du boîtier (10, 210), dans lequel l'ensemble de verrouillage (1) est muni d'un support de pêne (19) qui supporte l'ensemble de pêne (2, 202) par rapport au boîtier (10, 210), dans lequel le support de pêne (19) permet une translation de l'ensemble de pêne (2, 202) par rapport au boîtier (10, 210) suivant une voie de pêne (X) entre une position rétractée dans laquelle l'ensemble de pêne (2, 202) est sensiblement rétracté à l'intérieur du boîtier (10, 210) et une position étendue dans laquelle l'ensemble de pêne (2, 202) s'étend depuis le boîtier (10, 210) au travers de la première ouverture (12), dans lequel l'ensemble de verrouillage (1, 201) est muni d'un élément de blocage primaire (6, 206) et d'un support de blocage primaire (15) qui supporte l'élément de blocage primaire (6, 206) par rapport au boîtier (10), dans lequel le support de blocage primaire (15) permet un déplacement de l'élément de blocage primaire (6, 206) par rapport au boîtier (10, 210) suivant une voie de blocage primaire (Y) transversale à la voie de pêne (X) entre une position de blocage primaire et une position de déblocage primaire, dans lequel l'élément de blocage primaire (6, 206) est fixe par rapport au boîtier (10, 210) à l'encontre d'une translation dans la direction de la voie de pêne (X), dans lequel l'ensemble de pêne (2, 202) et l'élément de blocage primaire (6, 206) comprennent respectivement une première surface de butée (59, 258) et une deuxième surface de butée (68, 269), dans lequel la deuxième surface de butée (68, 269), lorsque l'ensemble de pêne (2, 202) est dans la position étendue et que l'élément de blocage primaire (6, 206) est dans la position de blocage primaire, vient en butée contre la première surface de butée (59, 258) au niveau d'un point de butée primaire (AP1), dans lequel le vecteur normal des surfaces de butée en butée (59, 68, 258, 269) au niveau du point de butée primaire (AP1) est sous un angle dans une plage qui va d'un degré à trente degrés par rapport à la voie de pêne (X), **caractérisé en ce que** l'ensemble de verrouillage (1, 201) comprend un élément de blocage secondaire (8, 208) et un support de blocage secondaire (16) qui supporte l'élément de blocage secondaire (8, 208) par rapport au boîtier (10, 210), dans lequel le support de blocage secondaire (16) permet un déplacement de l'élément de blocage secondaire (8, 208) par rapport au boîtier (10, 210) suivant une voie de blocage secondaire (Z) transversale à la voie de blocage primaire (Y) entre une position de blocage secondaire et une position de déblocage secondaire, dans lequel l'élément de blocage secondaire (8, 208) est fixe par rapport au boîtier (10, 210) à l'encontre d'un déplacement dans la direction de la voie de blocage primaire (Y), dans lequel l'élément de blocage primaire (6, 206) et l'élément de blocage secondaire (8, 208) comprennent respectivement une troisième surface de butée (65, 365) et une quatrième surface de butée (88, 288), dans lequel la quatrième surface de butée (88, 288), lorsque l'élément de blocage primaire (6, 206) est dans la position de blocage primaire et que l'élément de blocage secondaire (8, 208) est dans la position de blocage secondaire, vient en butée contre la troisième surface de butée (65, 365) au niveau d'un point de butée secondaire (AP2), dans lequel le vecteur normal des surfaces de butée en butée (65, 88, 288, 365) au niveau du point de butée secondaire (AP2) est sous un angle dans une plage qui va d'un degré à trente degrés par rapport à la direction de la voie de blocage primaire (Y) au niveau du point de butée secondaire (AP2).

2. Ensemble de verrouillage selon la revendication 1, dans lequel le vecteur normal des surfaces de butée en butée au niveau du point de butée primaire est sous un angle dans une plage qui va de cinq degrés à vingt degrés par rapport à la voie de pêne.

3. Ensemble de verrouillage selon la revendication 1 ou 2, dans lequel l'angle du vecteur normal par rapport à la voie de pêne a pour effet que les forces qui sont observées entre les surfaces de butée en butée au niveau du point de butée primaire sont décomposées en une composante de force qui opère dans la direction de la voie de pêne et en une composante de force qui opère dans une direction qui est perpendiculaire à la voie de pêne, dans lequel la composante de force dans la direction de la voie de pêne est plus importante que la composante de force dans la direction qui est perpendiculaire à la voie de pêne.

4. Ensemble de verrouillage selon l'une quelconque des revendications précédentes, dans lequel l'angle du vecteur normal par rapport à la voie de pêne de surfaces de butée en butée au niveau du point de butée primaire a pour effet qu'une partie des forces qui sont observées entre les surfaces de butée en butée au niveau du point de butée primaire est déviée dans une direction autre que la voie de pêne.

5. Ensemble de verrouillage selon l'une quelconque des revendications précédentes, dans lequel l'une des surfaces de butée du groupe qui comprend la première surface de butée et la deuxième surface de butée est une surface sensiblement plane ou rectiligne, dans lequel l'autre surface de butée est une surface cylindrique, de préférence dans lequel la surface cylindrique est formée par un support pouvant être entraîné en rotation, de préférence une roue de support.

6. Ensemble de verrouillage selon l'une quelconque des revendications précédentes, dans lequel le support de blocage primaire qui supporte l'élément de blocage primaire est un support rotationnel.

7. Ensemble de verrouillage selon l'une quelconque des revendications précédentes, dans lequel la voie de pêne est rectiligne et/ou dans lequel la voie de blocage primaire est rectiligne, de préférence dans lequel la voie de blocage primaire s'étend sensiblement perpendiculairement à la voie de pêne.

8. Ensemble de verrouillage selon l'une quelconque des revendications 1 à 6, dans lequel la voie de blocage primaire est une courbe, de préférence un arc circulaire, dans lequel la voie de blocage primaire s'étend transversalement, de préférence sensiblement perpendiculairement, par rapport à la voie de pêne au niveau du point de butée primaire.

9. Ensemble de verrouillage selon l'une quelconque des revendications précédentes, dans lequel le vecteur normal des surfaces de butée en butée au niveau du point de butée secondaire est sous un angle dans une plage qui va de cinq degrés à vingt degrés par rapport à la direction de la voie de blocage primaire au niveau du point de butée secondaire.

10. Ensemble de verrouillage selon la revendication 8, dans lequel l'angle entre le vecteur normal des surfaces de butée en butée et la direction de la voie de blocage primaire au niveau du point de butée secondaire est mesuré par rapport à une tangente de la voie de blocage primaire au niveau du point de butée secondaire.

11. Ensemble de verrouillage selon l'une quelconque des revendications précédentes, dans lequel l'angle du vecteur normal des surfaces de butée en butée au niveau du point de butée secondaire par rapport à la direction de la voie de blocage primaire au niveau du point de butée secondaire a pour effet que les forces qui sont observées entre les surfaces de butée en butée au niveau du point de butée secondaire sont décomposées en une composante de force qui opère dans la direction de la voie de blocage secondaire et en une composante de force qui opère dans une direction qui est perpendiculaire à la voie de blocage secondaire, dans lequel la composante de force dans une direction qui est perpendiculaire à la voie de blocage secondaire est plus importante que la composante de force dans la direction de la voie de blocage secondaire.

12. Ensemble de verrouillage selon l'une quelconque des revendications précédentes, dans lequel l'angle du vecteur normal des surfaces de butée en butée au niveau du point de butée secondaire par rapport à la voie de blocage primaire a pour effet qu'une partie des forces qui sont observées entre les surfaces de butée en butée au niveau du point de butée secondaire est déviée dans une direction autre que la voie de blocage primaire.

13. Ensemble de verrouillage selon l'une quelconque des revendications précédentes, dans lequel l'une des surfaces de butée du groupe qui comprend la troisième surface de butée et la quatrième surface de butée est une surface sensiblement plane ou rectiligne, dans lequel l'autre surface de butée est une surface cylindrique, de préférence dans lequel la surface cylindrique est formée par un support pouvant être entraîné en rotation, de préférence une roue de support.

14. Ensemble de verrouillage selon l'une quelconque des revendications précédentes, dans lequel la voie de blocage secondaire est rectiligne, de préférence dans lequel la voie de blocage secondaire s'étend sensiblement perpendiculairement à la voie de blocage primaire.

15. Ensemble de verrouillage selon l'une quelconque des revendications précédentes, dans lequel l'ensemble de verrouillage comprend un premier actionneur électromécanique qui est couplé de manière opérationnelle à l'élément de blocage primaire pour déplacer l'élément de blocage primaire suivant la voie de blocage primaire entre la position de blocage primaire et la position de déblocage primaire.

16. Ensemble de verrouillage selon l'une quelconque des revendications précédentes, dans lequel l'ensemble de verrouillage comprend un second actionneur électromécanique qui est couplé de manière opérationnelle à l'élément de blocage secondaire pour déplacer l'élément de blocage secondaire suivant la voie de blocage secondaire entre la position de blocage secondaire et la position de déblocage secondaire.

17. Ensemble de verrouillage selon l'une quelconque des revendications précédentes, dans lequel l'ensemble de verrouillage comprend un mécanisme de déblocage actionné mécaniquement du groupe qui comprend un mécanisme actionné par clé, une poignée, un bouton, une barre anti-panique ou similaire.

18. Ensemble de verrouillage selon l'une quelconque des revendications précédentes, dans lequel la position étendue de l'ensemble de pêne est une position de pêne dormant.

19. Ensemble de verrouillage selon l'une quelconque des revendications précédentes, dans lequel l'ensemble de pêne comprend une tête de pêne, une queue de pêne et une monture ou une partie de couplage qui couple la tête de pêne à la queue de pêne, dans lequel la tête de pêne est montée sur la monture ou la partie de couplage de manière à ce qu'elle puisse être entraînée en rotation par rapport à la queue de pêne autour d'un axe vertical, dans lequel la queue de pêne est montée sur la monture ou la partie de couplage de manière à ce qu'elle puisse être translatée dans la direction de la voie de pêne par rapport à la tête de pêne, de préférence dans lequel la tête de pêne présente une section en coupe transversale sensiblement symétrique, de la façon la plus préférable, une section en coupe transversale de forme rhomboïde, dans lequel la tête de pêne est couplée de façon opérationnelle à la monture ou à la partie de couplage via un axe de pêne, dans lequel la tête de pêne est munie d'un alésage central, de préférence un alésage positionné de façon symétrique pour qu'il reçoive l'axe de pêne, de préférence dans lequel la tête de pêne joue le rôle de pêne à basculement ou de moyen de verrouillage à basculement.

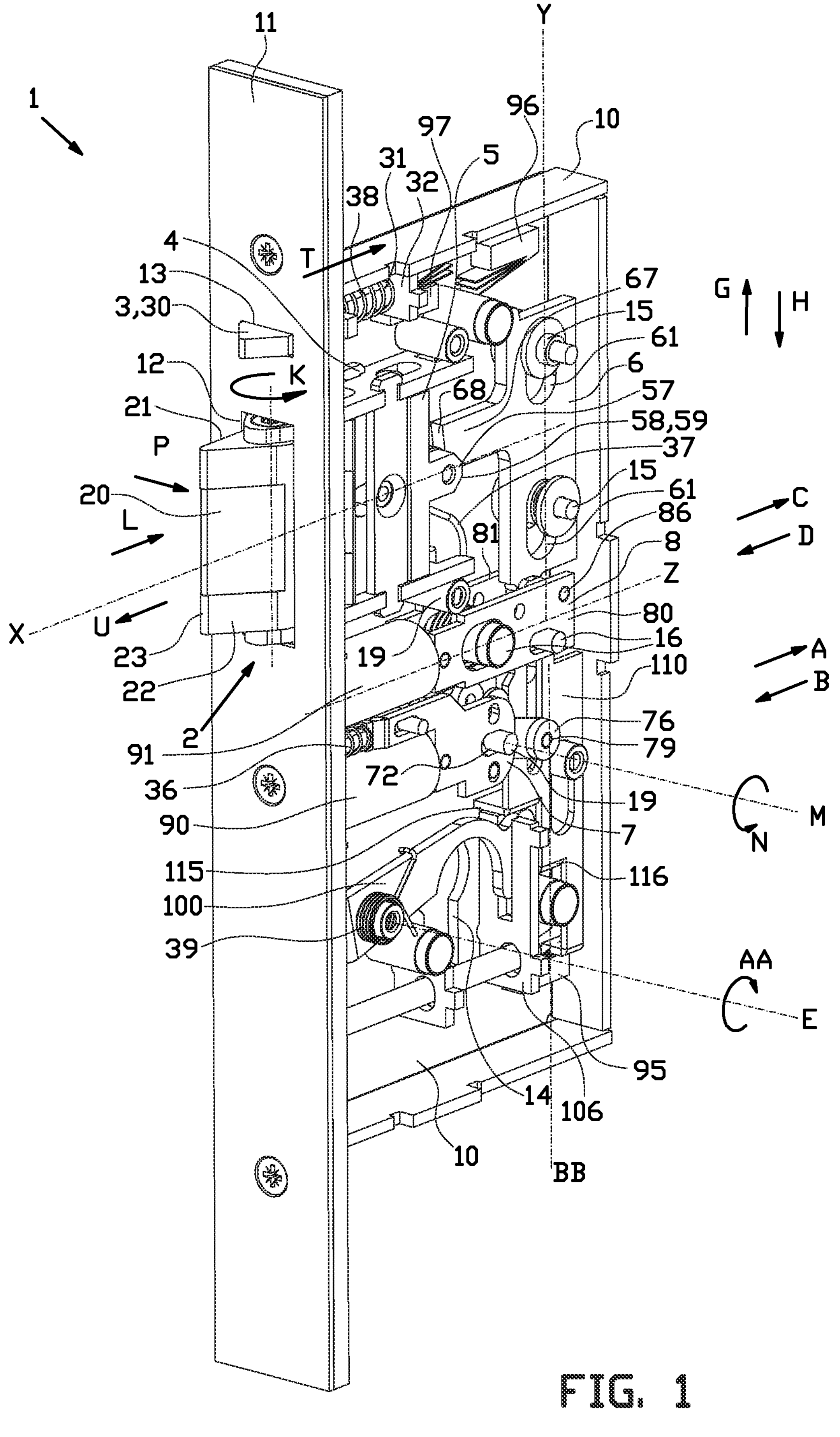
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FIG. 1

2/14

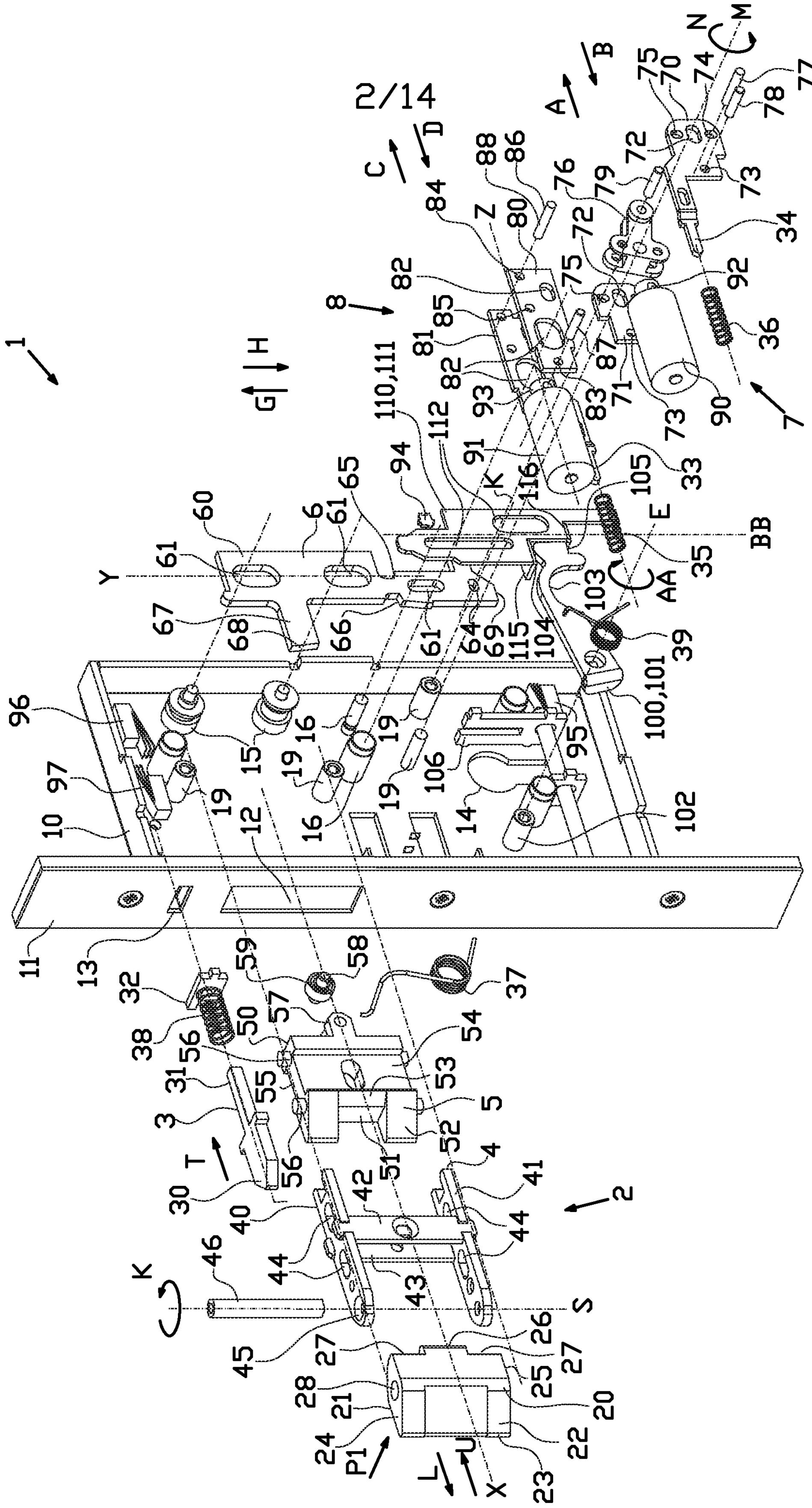

FIG. 2

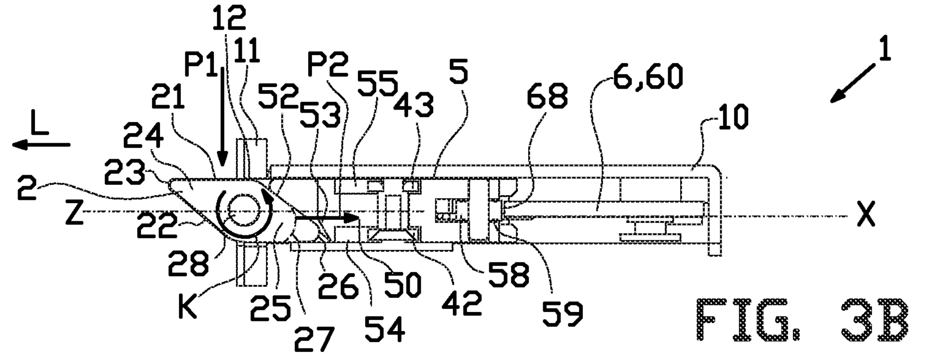
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FIG. 3B

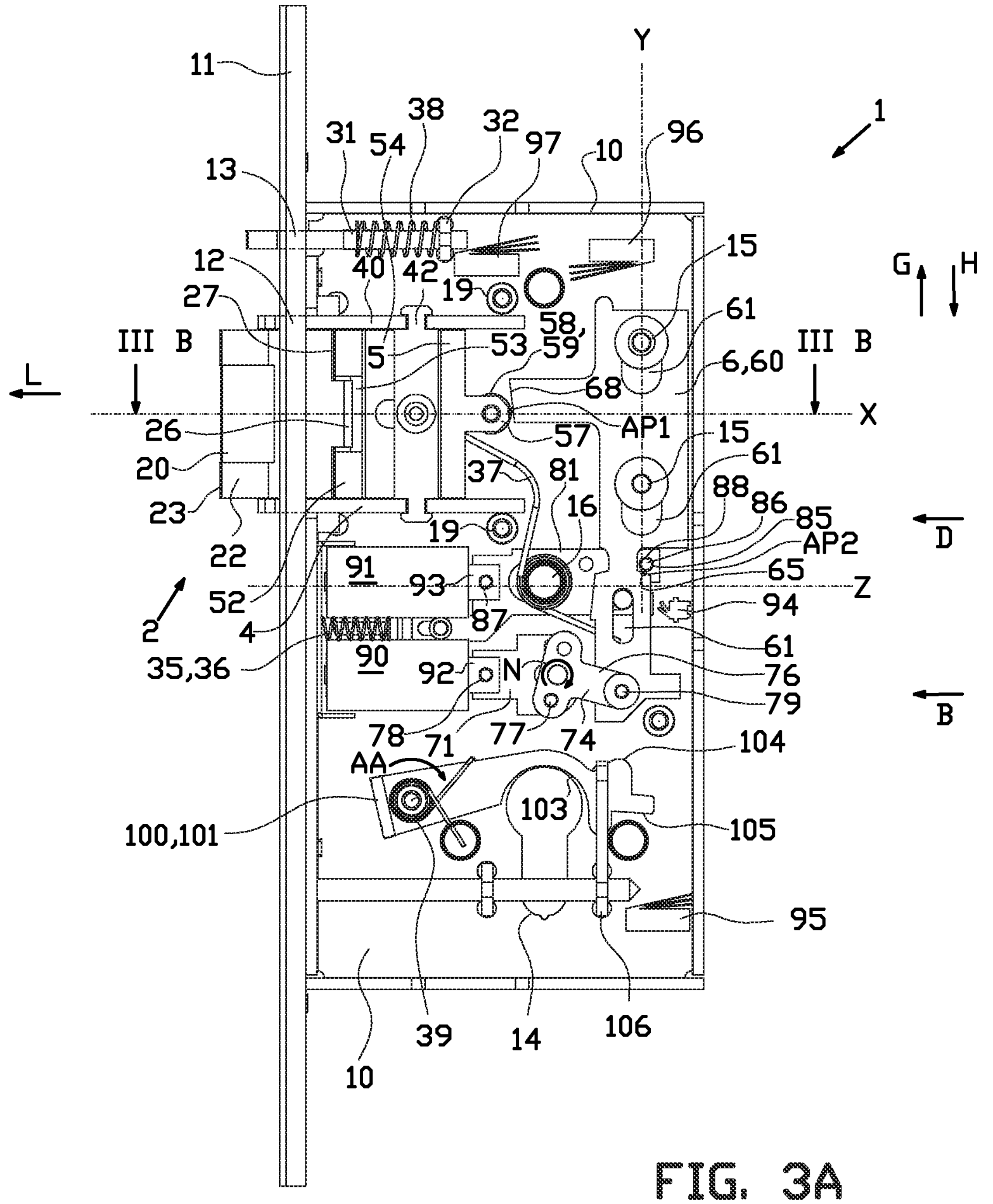
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FIG. 3A

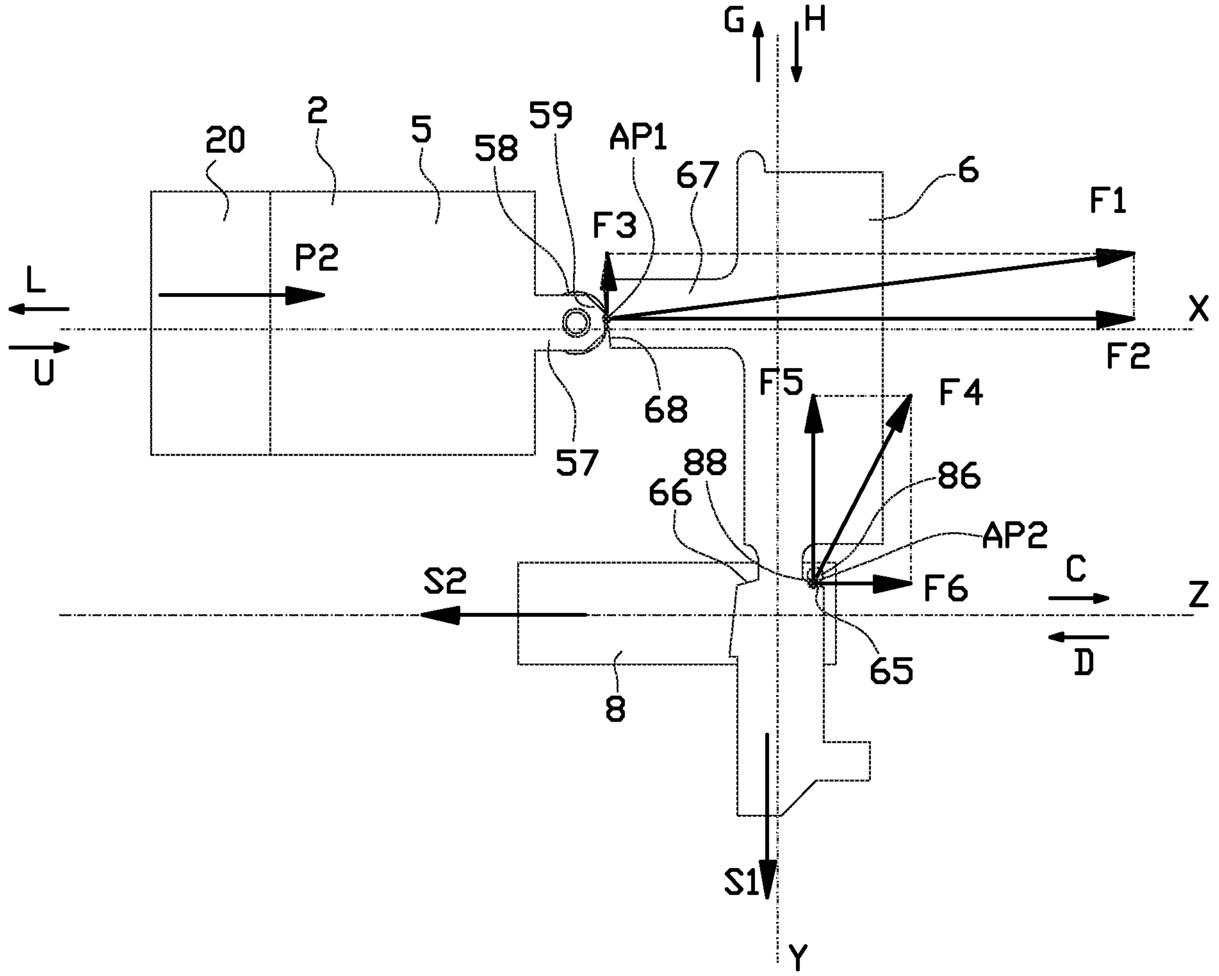
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FIG. 3C

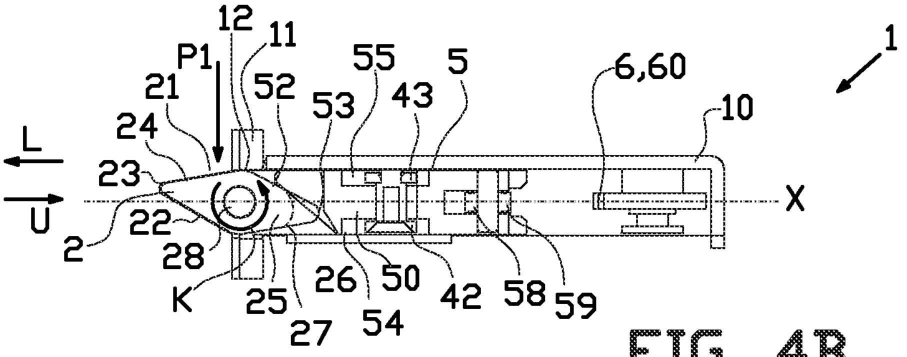
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FIG. 4B

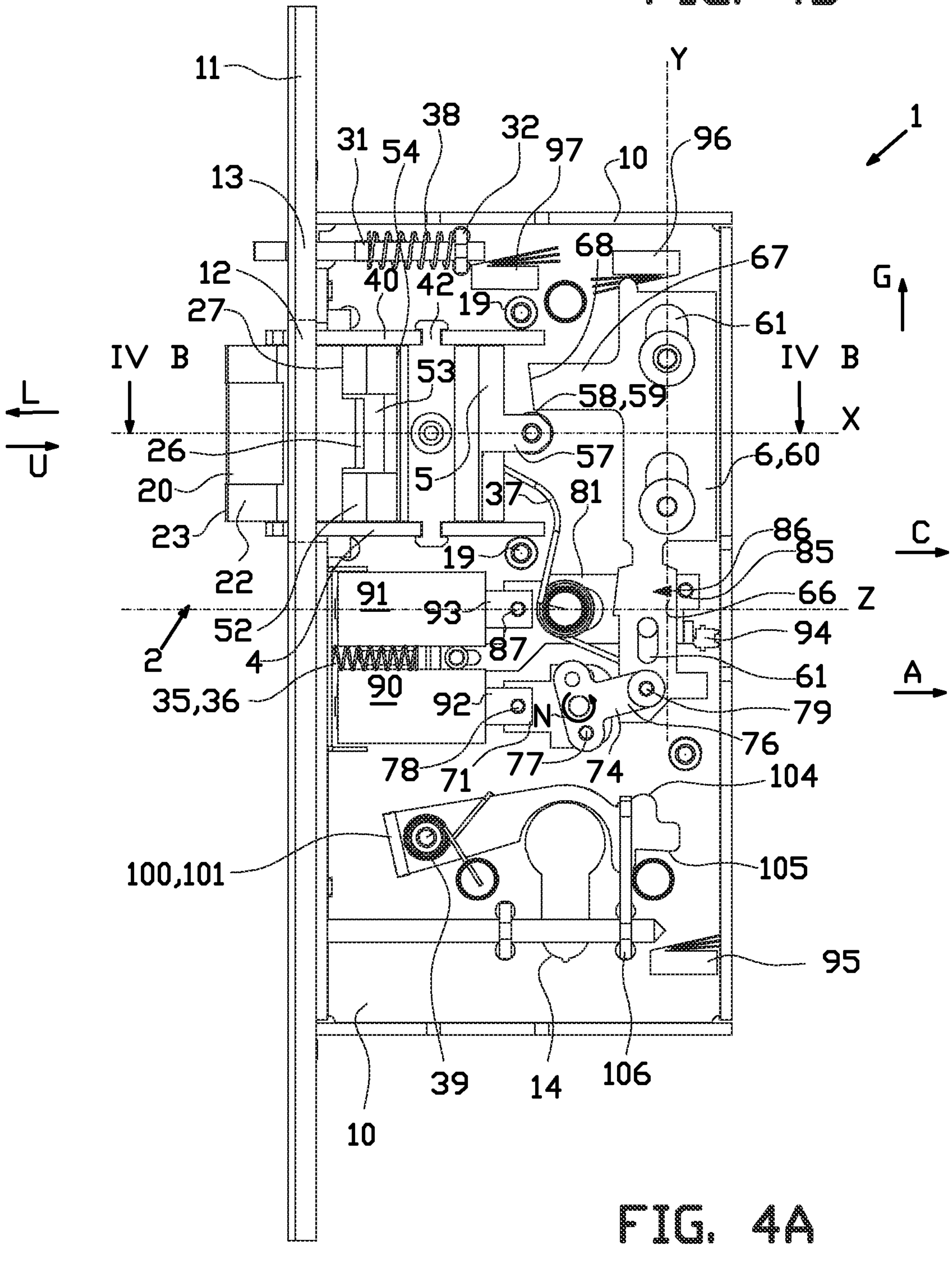
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FIG. 4A

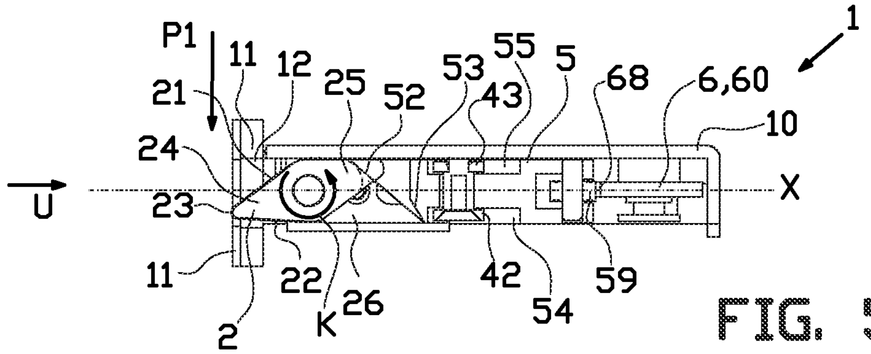
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FIG. 5B

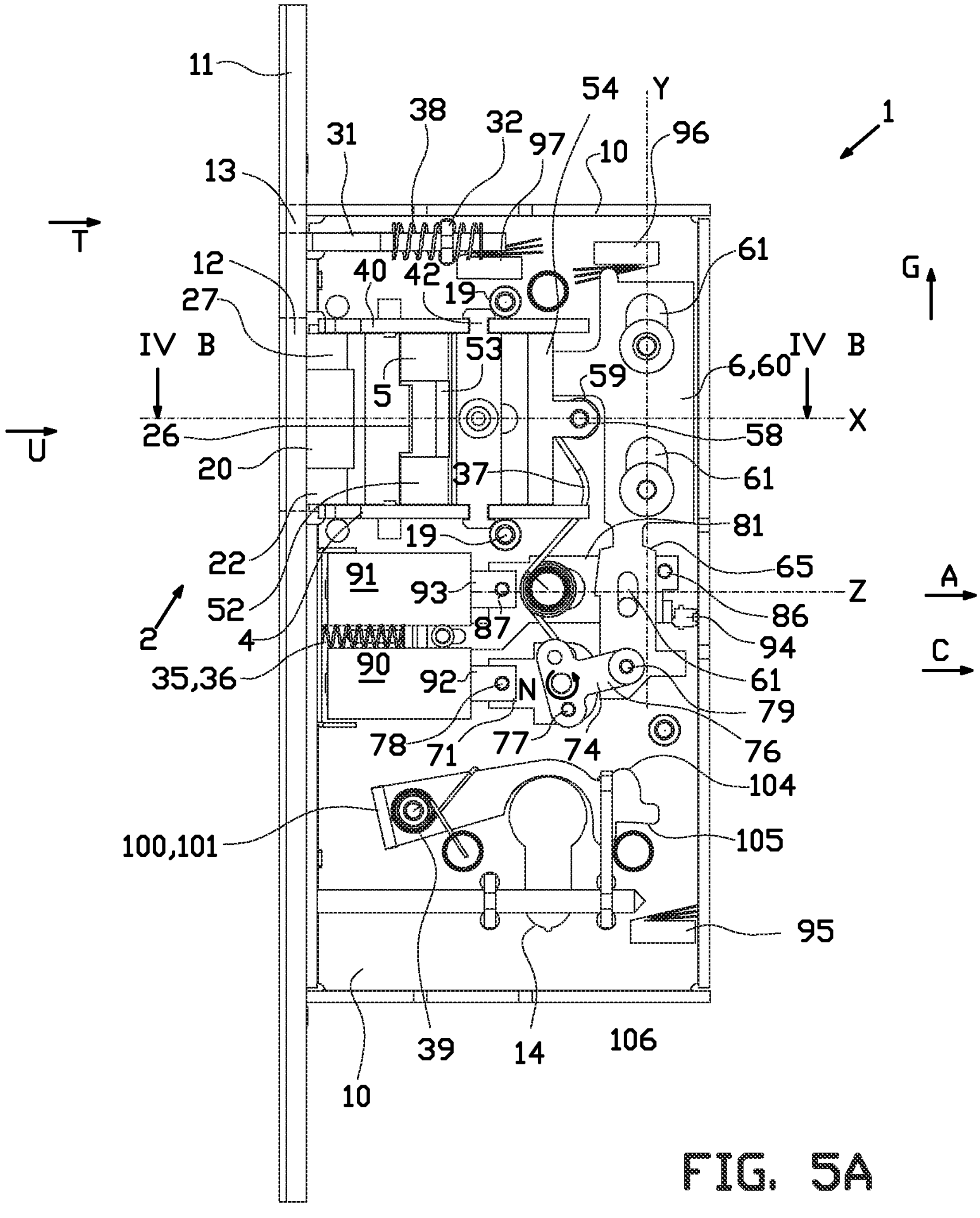
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FIG. 5A

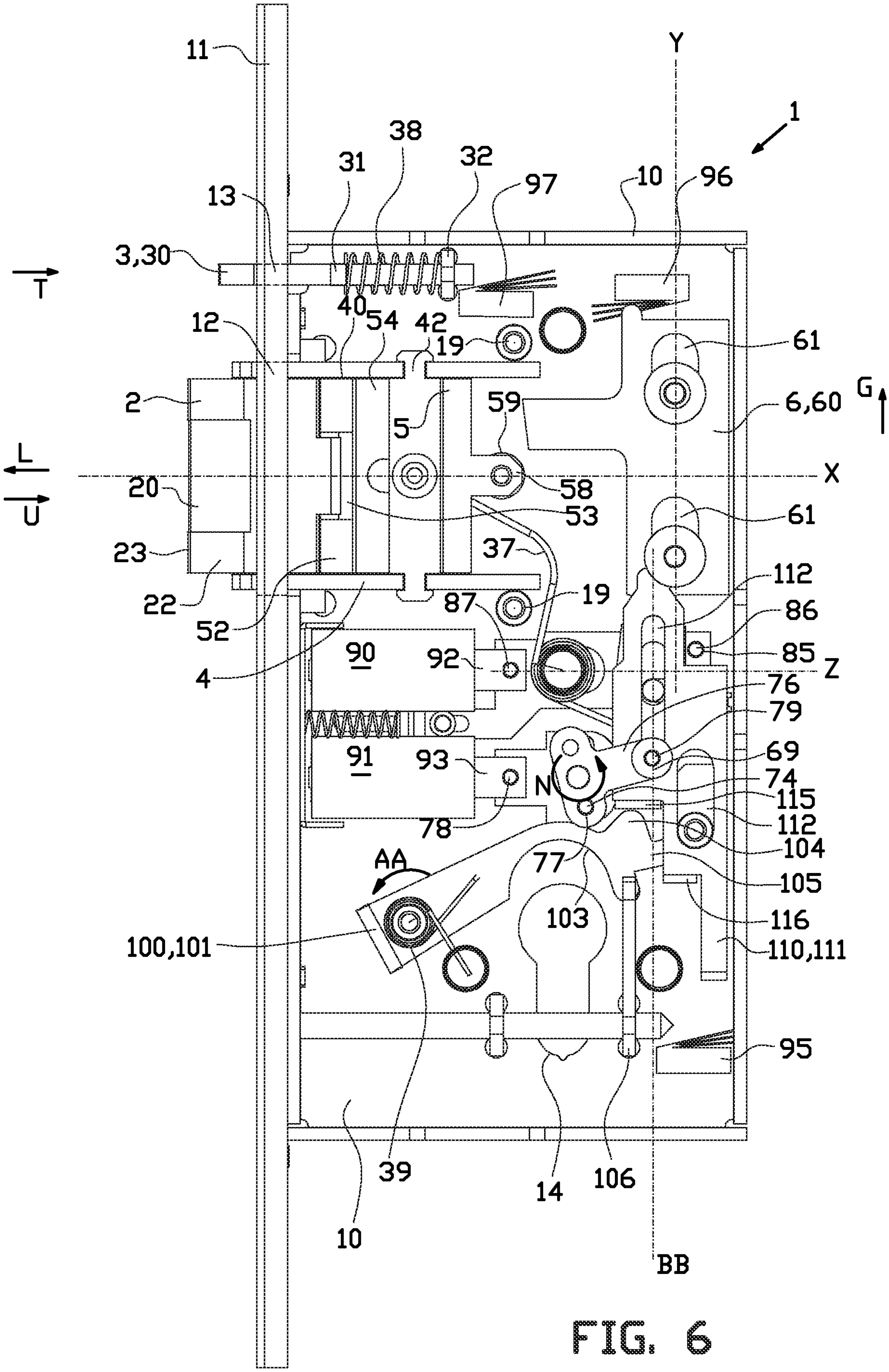
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FIG. 6

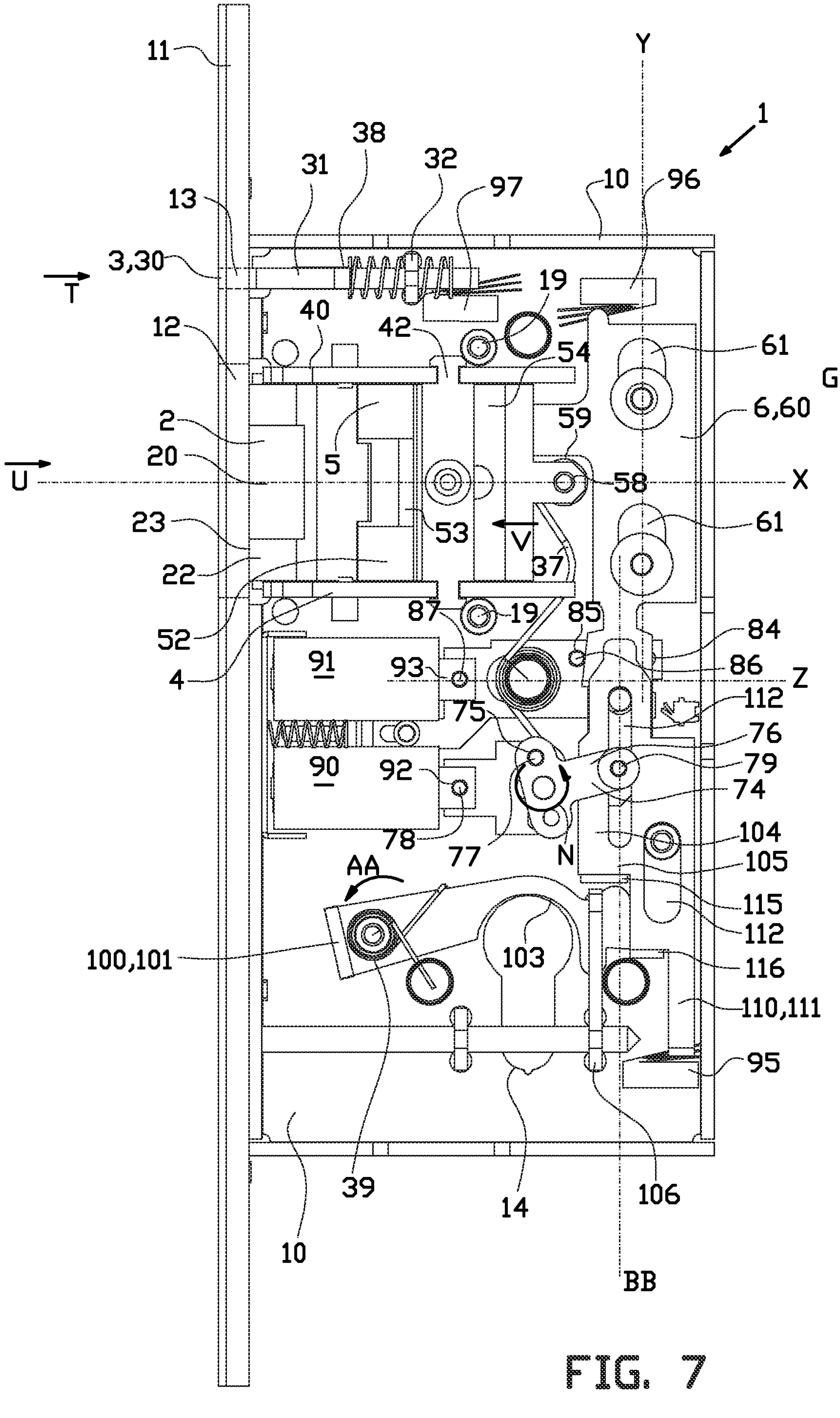

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FIG. 7

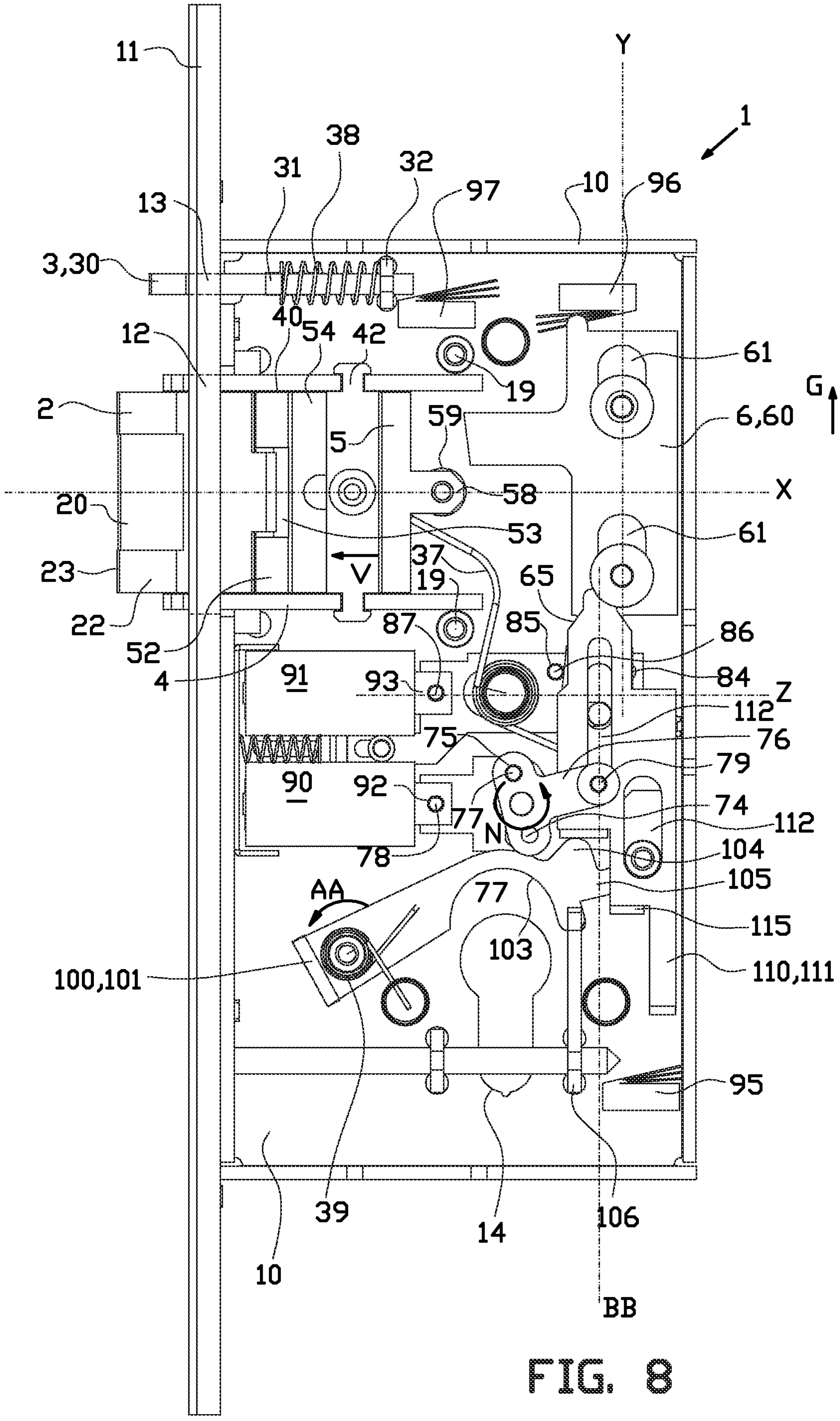
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FIG. 8

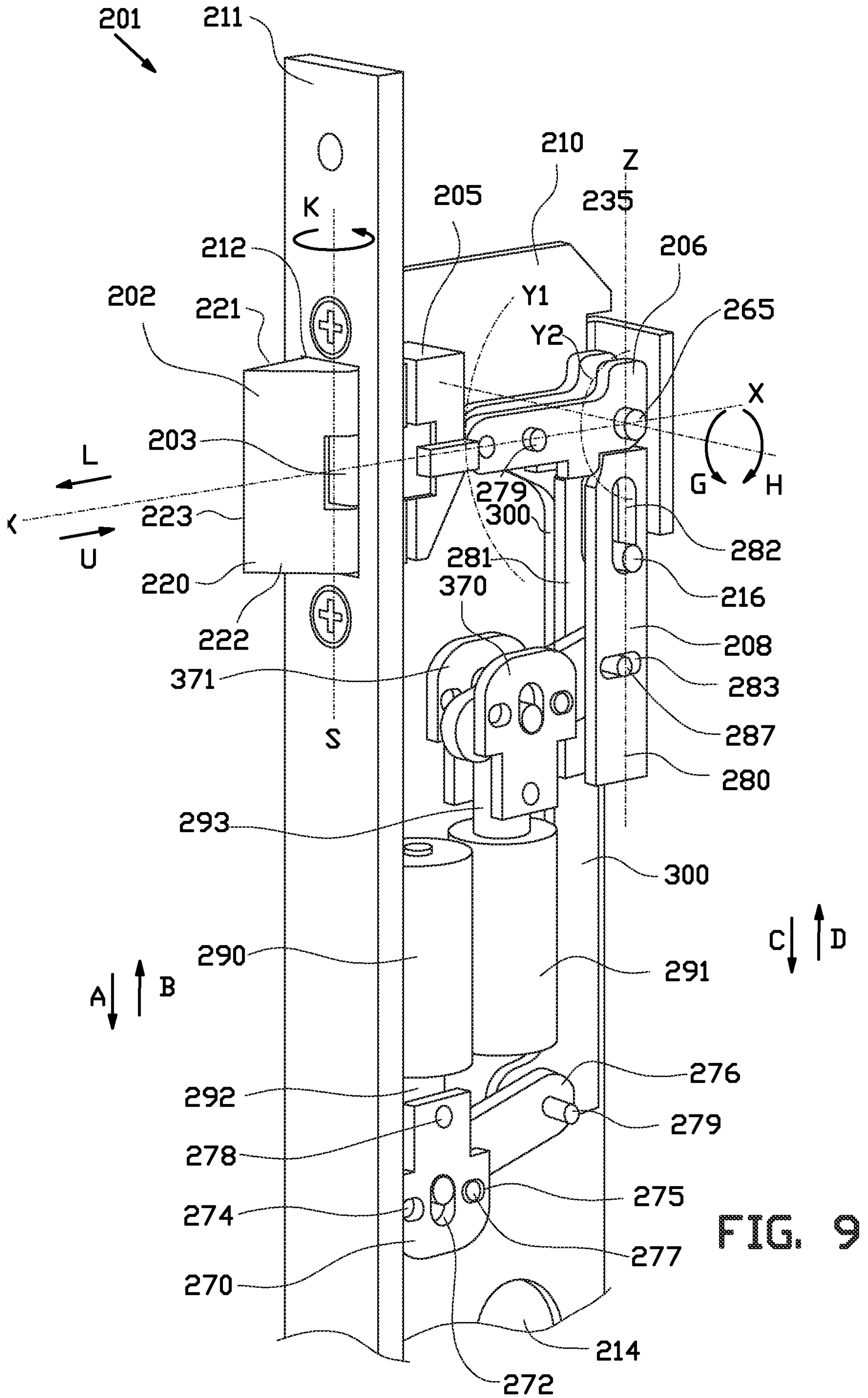
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FIG. 9

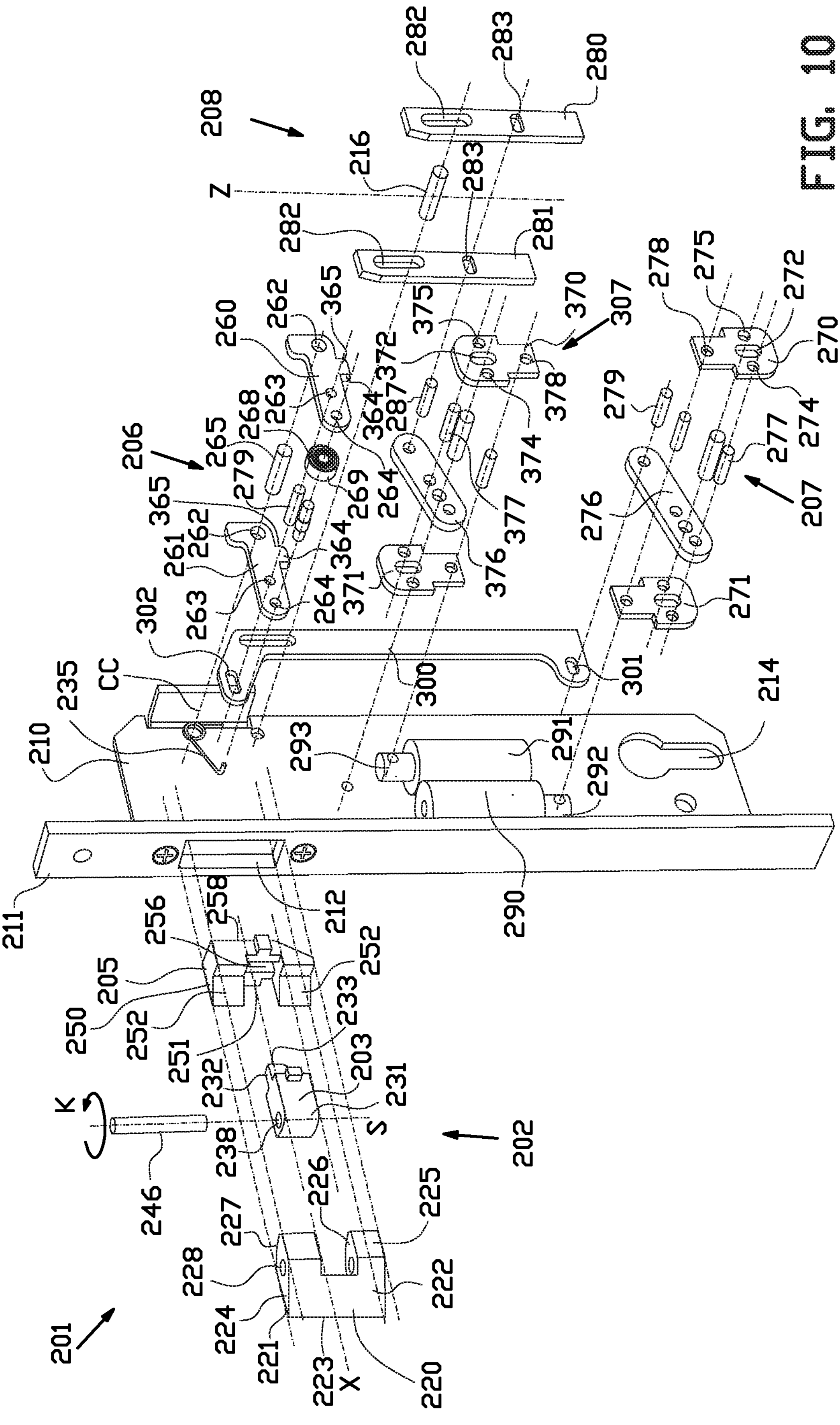

FIG. 10

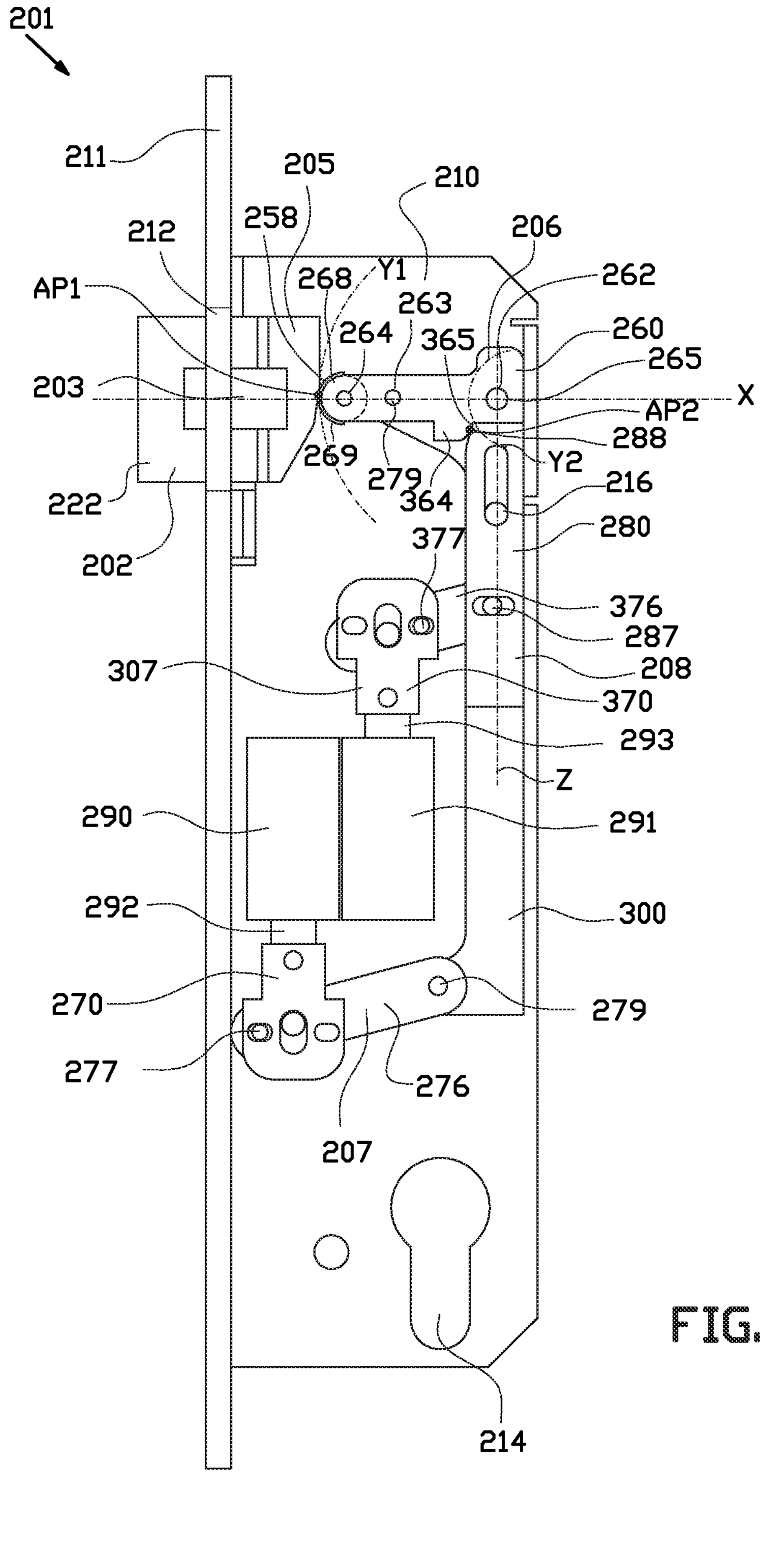
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FIG. 11A

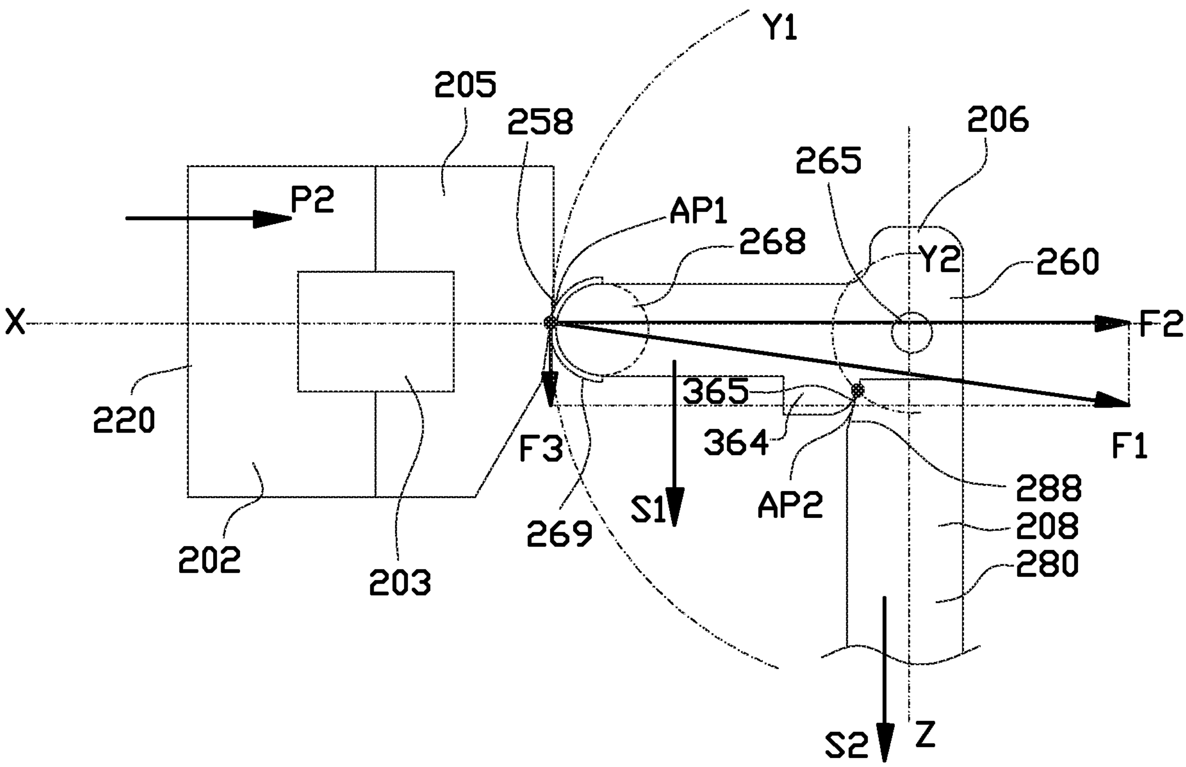

FIG. 11B

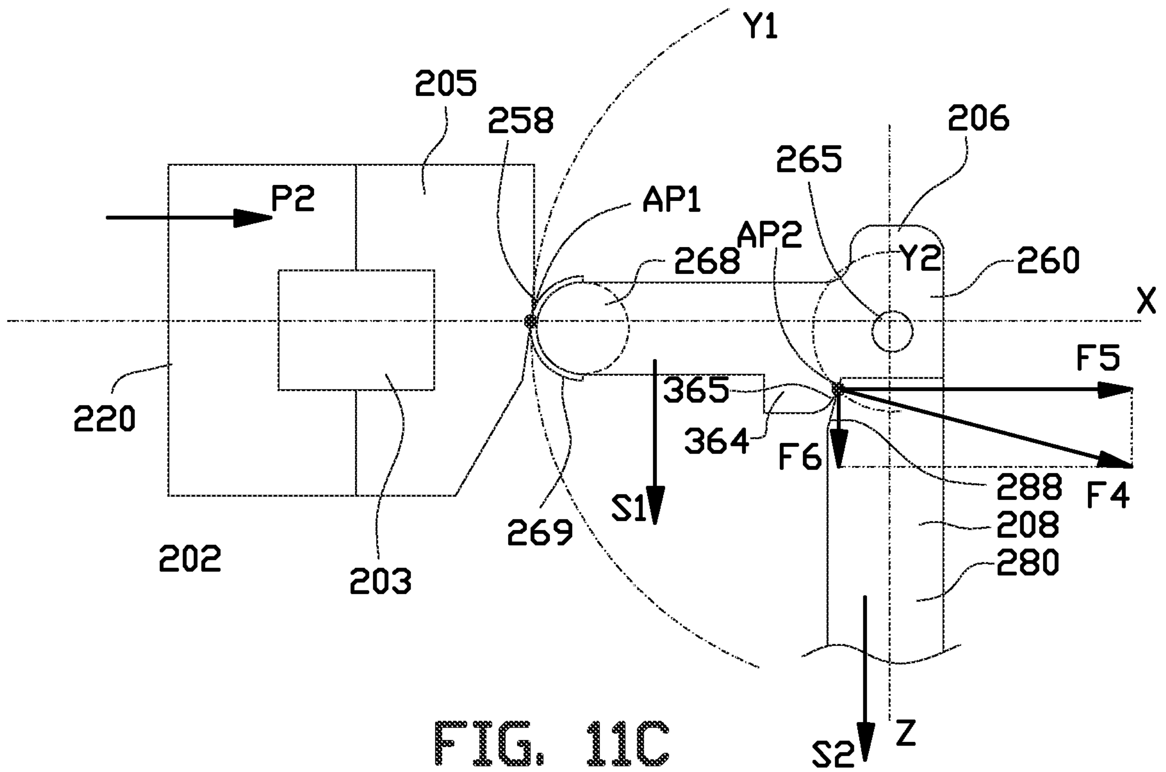

FIG. 11C

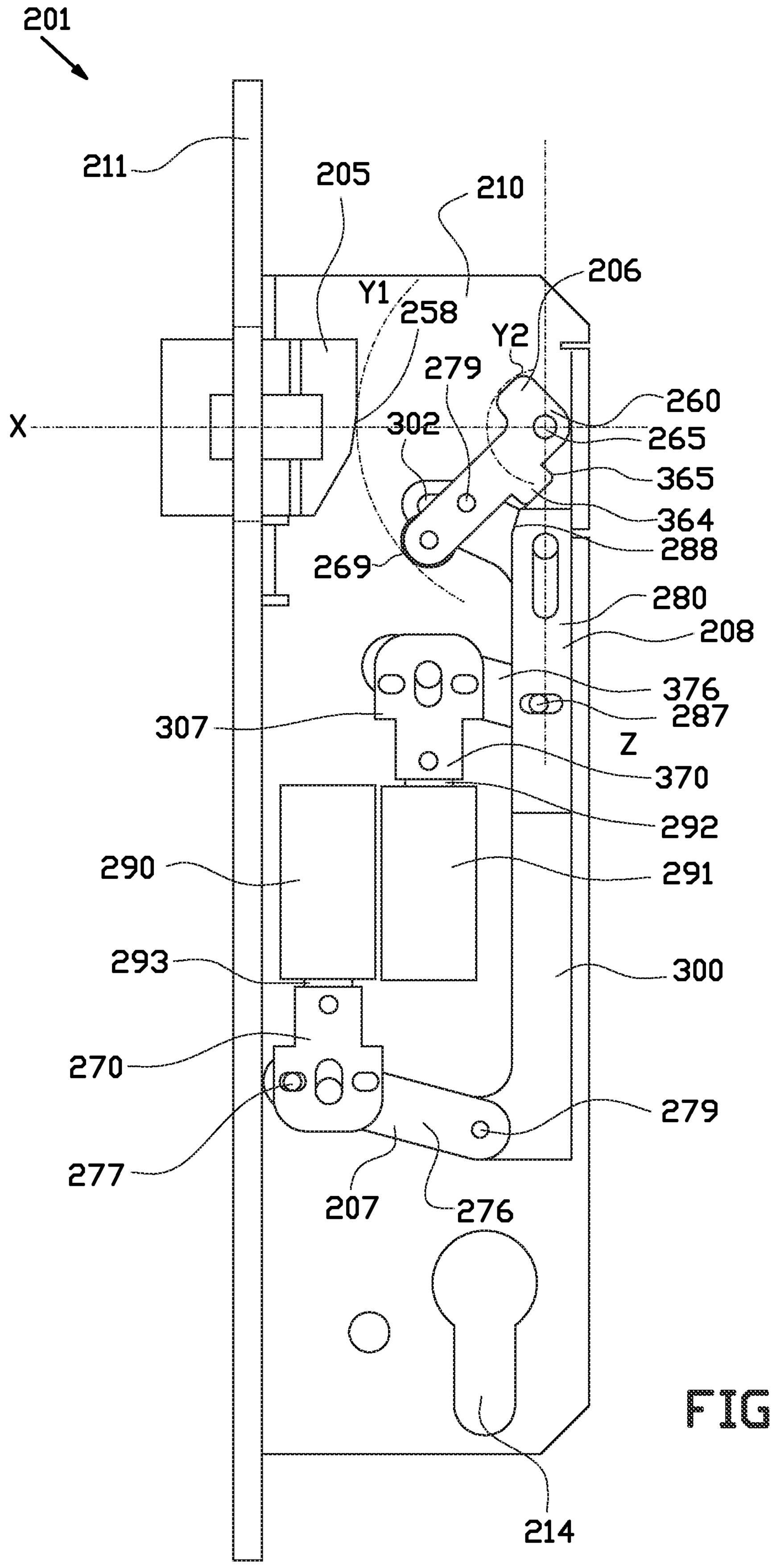
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FIG. 12

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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- DE 8815891 U1 **[0004]**
- JP 50041990 U **[0004]**