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(71) Applicant: **ROBUST Ellåsning AB**
213 74 Malmö (SE)

(72) Inventors:
- **SJÖHOLM, Jan**
  Limhamn (SE)
- **LARSSON, Fredrik**
  Hasslarp (SE)
- **FINNHULT, Mikael**
  Malmö (SE)

(74) Representative: **Bjerkén Hynell KB**
P.O. Box 1061
101 39 Stockholm (SE)

(54) LOCK ASSEMBLY

(57) A lock assembly (1) comprising one or two drop lock plunger(s) (2) configured to be in a locked operation state and in an unlocked operation state, a locking member (3) arranged to be moveable between an outer and an inner position, a pressure body (4) mounted to linearly cooperate with said locking member (3), a holding arm having an elongated shape and arranged to be rotatable about a rotation axis at one of its ends, and
- an electromagnetic member (14) that upon activation is arranged to apply a pulling force to a release arm (7). The lock assembly further comprises an amplifier arm (6) having an elongated shape and arranged to be rotatable about a rotation axis at one of its ends, the other end is structured to cooperate with said release arm (7). The amplifier arm is provided with two contact surfaces, a first contact surface (20) in an indentation (16) intended to be in contact with the contact surface at other end of said holding arm (5), and a second contact surface (19) intended to be in contact with a contact surface of said pressure body protrusion (15), and wherein, when in the locked state and external pressure is supplied to the drop lock plunger (1), the external pressure is resulting in that a rotational force is applied to said amplifier arm (6) in a first direction. Upon activation of said electromagnetic member (14), the rotational force provides movement to the amplifier arm (6) such that the first contact surface (19) is released from the holding arm, thereby allowing the locking member (3) to move inwards that in turn will transfer the drop lock plunger into their unlocked operation state.

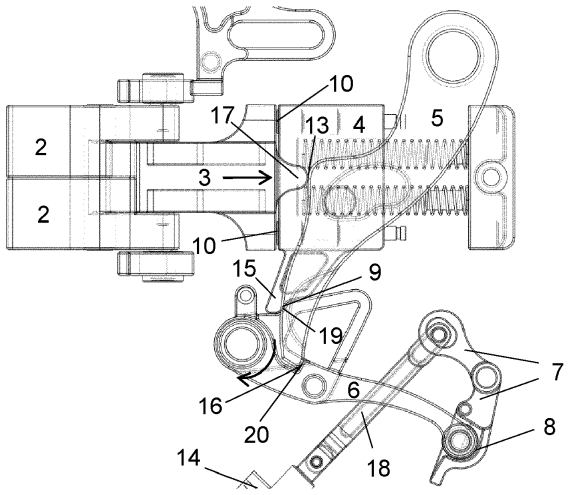

FIG. 4

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Description

Technical field

[0001] The present application discloses a mechanism that allows a lock assembly comprising one or two drop lock plungers to be set in an unlocked state from a locked state in particular when the drop lock plunger is subjected to a door frame pressure, i.e. when a static force is applied to the drop lock plunger from a door frame.

Background

[0002] A problem with door frame pressure is that there is a very limited amount of energy, and thus power, available when moving the locking mechanisms into the unlocked state. Particularly, the amount of energy used to be applied to an electromagnetic member, e.g. a solenoid, of the lock to move the locking mechanism to the unlocked state from the locked state should be kept at a minimum. The larger the force applied to the mechanism from the outside, the larger is the force required to move the locking mechanisms and thus, in this type of lock, to release the drop lock plunger and set the lock assembly into an unlocked state.

[0003] The object of the present invention is to be able to change operation state from the locked operation state to the unlocked operation state using as little energy as possible, i.e. keeping the electrical energy needed to be supplied to the electromagnet member (a solenoid) as low as possible. In particular the object of the present invention is to change operation state from a locked operation state to an unlocked operation state by using minimum of energy even if the drop lock plunger is subjected to high pressure from the door frame.

Summary

[0004] The above-mentioned object is achieved by the present invention according to the independent claims.

[0005] Preferred embodiments are set forth in the dependent claims.

[0006] The basic principle of the present invention is to use the applied force (i.e. the force that is externally applied to the drop lock plunger via pressure from the door frame) as the "power source" to the release mechanism, and to simultaneously ensure that the "release force" in the mechanism is kept within a well-defined range. Two variations of the lock assembly according to the present invention will be disclosed, and defined by the appended claims.

[0007] When the lock assembly is in the unlocked (released) operation state, it is possible to open the door with a slight pressure on the door.

Brief description of the drawings

[0008] Figures 1-17 relate to a first variation of the lock assembly, and figures 18-32 relate to a second version of the lock assembly.

Figure 1 is a perspective view of a first variation of the lock assembly in a locked operation state according to the present invention.

Figure 2 is a perspective view of embodiments of the lock assembly.

Figure 3 shows side views of embodiments of the lock assembly.

Figures 4-6 show side views of embodiments of the lock assembly.

Figure 7 is a perspective view of embodiments of the lock assembly.

Figure 8 is a perspective view of the lock assembly in an unlocked operation state according to the present invention.

Figure 9 shows various views of the lock assembly according to the present invention.

Figure 10 shows perspective views of embodiments of parts of the lock assembly.

Figure 11 shows a view from above and a perspective view of embodiments of a part of the lock assembly.

Figure 12 shows a side view and a perspective view of embodiments of parts of the lock assembly.

Figure 13 shows perspective views of embodiments of parts of the lock assembly.

Figure 14 shows a side view and a perspective view of embodiments of parts of the lock assembly.

Figure 15 shows a side view and a perspective view of embodiments of parts of the lock assembly.

Figure 16 shows a side view of details regarding embodiments of the amplifier arm.

Figure 17 shows a side view of other details regarding embodiments of the amplifier arm.

Figure 18 is a perspective view of a second variation of the lock assembly in a locked operation state according to the present invention.

Figure 19 is a perspective view of embodiments of the second variation of the lock assembly.

Figures 20-22 shows side views of embodiments of the second variation of the lock assembly.

Figure 23 is a perspective view of the lock assembly in an unlocked operation state according to a second version of the present invention.

Figure 24 shows various views of the second version of the lock assembly according to the present invention.

Figures 25-30 show various views of embodiments of second version of the lock assembly.

Figure 31 and 32 show side views of details regarding embodiments of the second version of the lock assembly according to the present invention.

Detailed description

[0009] The lock assembly will now be described in de-

tail with references to the appended figures. Throughout the figures the same, or similar, items have the same reference signs. Moreover, the items and the figures are not necessarily to scale, emphasis instead being placed upon illustrating the principles of the invention.

[0010] The lock assembly to be described herein may be transferred into an unlocked state where the drop lock plunger is in an unlocked position, i.e. the plunger is released, in three different ways:

1) When a locking piston is in its outer position.
2) When turning a cylinder activation member clockwise or counterclockwise.
3) When an electromagnet member (a solenoid) is magnetized.

[0011] The present application relates to the third alternative, i.e. how the lock assembly is transferred from a locked state into an unlocked state by means of an electromagnet member using a minimum of electrical energy.

[0012] The lock assembly disclosed herein is provided with an enclosure for enclosing the mechanism, e.g. the mechanism provided for operating the drop lock plunger, and other functions of the lock assembly. In the figures are disclosed numerous details and parts which are important for the overall function of the lock assembly, but not being directly involved in the function for operating the drop lock plunger. These numerous details and parts will be disclosed in the figures, but not be described herein, unless they are important for the function of the drop lock plunger. The lock assembly has a conventional shape which is illustrated e.g. in figures 1, 9, 18, and 24, and is structured to be mounted in the door and intended to cooperate with mating mechanisms mounted in a door frame.

[0013] As mentioned above, the present invention is realized by two versions of the lock assembly. These two versions will be described separately. The overall functionality of the two versions is the same, and many items have exactly the same shape and function, and those items will have the same names and reference signs. For the items of the second variation having different shapes or functions, in comparison with that of the first variation, but a similar functionality, will be denoted "second" before the name.

[0014] In the illustrated embodiments, a dual drop lock plunger 2 is shown, where two symmetrically arranged drop lock plungers 2 are arranged. The solution according to the present invention as defined in the claims, is equally applicable for a single drop lock plunger, i.e. a lock assembly provided with only one drop lock plunger.

[0015] The first variation of the lock assembly according the present invention will now be described in detail with references to figures 1-17.

[0016] Figure 1 illustrates the lock assembly 1 in the locked operation state where the drop lock plungers 2 are in their outer position, to the left in the figure, and also in their locked positions, i.e. they cannot move to the right, and cannot perform a rotational movement, i.e. a "dropping movement".

[0017] Figure 8 illustrates the lock assembly 1 in the unlocked operation state. In this state the drop lock plungers 2 are moved to be in their inner position, to the right in the figure, and the lower drop lock plunger 2 has performed a dropping movement.

[0018] The lock assembly 1 comprises a drop lock plunger 2, which, in the illustrated embodiment is a dual drop lock plunger, a locking member 3, a pressure body 4, a holding arm 5, and amplifier arm 6, and a release arm 7. In addition is shown an electromagnetic member 14, e.g. a solenoid, and a straight arm 18 connected to the electromagnetic member 14 for transferring an activation movement to the release arm 7. Upon activation of the electromagnetic member 14, the arm 18 is pulled a predetermined distance into the electromagnetic member, thereby providing a pulling force to the release arm 7.

[0019] Figures 2-7 are intended to illustrate the procedure performed when changing the state from a locked operation state to an unlocked operation state, and only parts directly involved in that procedure are shown in those figures, in order to give a clear explanation of the procedure.

[0020] In figure 2, the lock assembly 1 is shown in its locked state, i.e. the drop lock plunger is in its locked position. When an external force, e.g. door frame pressure, is applied to one or the other of the plungers, (they work in the opposite direction) in this case the lower plunger 2, the plunger wants to move according to the arrow shown in the figure, i.e. downwards in this case. This turning force is transferred into a linear movement of the locking member 3 via a cam fixedly attached to the lock assembly enclosure at a point of contact 30. The movement, indicated by an arrow on the locking member 3, is prevented by the pressure body 4, which is illustrated in figure 3 where all parts are shown involved for holding the lock assembly in its locked state.

[0021] With references to figure 3, it is illustrated how the locking member 3 is locked in several steps, and hereafter the mechanism is described from behind, where the movement is locked in the last step. In figure 3 two figures are shown, the figure at the top shows a side view, whereas the figure at the bottom shows the lock assembly in the same position, but hidden items are also indicated in the figure.

[0022] Starting from the electromagnetic member 14, that, via arm 18, holds the release arm 7 in a locked position. The release arm 7 is configured to rotate about an axis preferably provided at a mid-position of the release arm. The release arm 7 prevents the amplifier arm 6 at a first contact point 8 from turning clockwise about an axis at an end opposite the end of the contact point 8 with the release arm 7. This in turn prevents a movement of the pressure body 4 to the right, in a second contact point 9, where a pressure body protrusion 15 of the pressure body 4 is in contact with the amplifier arm 6. One or

two pressure pins 10 are provided, and are configured to slide linearly in and out of the pressure body 4, and are urged to their outer position(s) by means of two strong springs 11 provided within the pressure body 4 and shown at the figure at the bottom. These pressure pins 10 finally prevent, at third contact points 12, the movement of the locking member 3 to the right.

[0023] In figure 4 it is illustrated a situation where a door frame pressure is applied to the drop plunger 2.

[0024] If a door frame pressure is applied to the drop plunger 2 when the mechanism is in the locked position, the locking member 3 will be pressed to the right as illustrated by an arrow. It will then push the pressure pins 10 to the right and thus compress the hard springs 11 and apply a force to the right on the pressure body 4. The pressure body 4 is prevented from moving to the right in the second contact point 9 where the pressure body protrusion is in contact with the amplifier arm 6. The locking member 3 will be able to be pressed to the right until a cam-shaped protrusion 17 of the locking member 3 reaches the holding arm 5 where it is stopped at the fourth contact point 13.

[0025] Now the mechanism is in an important position.

[0026] The pressure body 4 applies a force to the amplifier arm 6 equal to the spring force of the pressure pins 10, at the second contact point 9. This well-defined force is converted at the second contact point 9 into a rotating force about the rotation axis of the amplifier arm 6, which is indicated by an arrow, which also becomes well-defined. The force that must be applied to the release arm 7 to release it from the amplifier arm 6 is therefore also well-defined. The force which, in addition to this, is applied to the locking member 3, will be applied to the holding arm 5 by the cam-shaped protrusion 17 at the locking member 3.

[0027] The holding arm 5 applies this force to the amplifier arm 6, which is provided with an indentation 16 adapted to receive the outer part of the holding arm, but radially in relation to the rotation axis of the amplifier arm 6, so it will not contribute to clockwise rotation of it.

[0028] Figure 5 illustrates the situation when the lock is about to be released.

[0029] When the lock is to be released, the electromagnetic member 14 is magnetized, which causes it to draw in the magnetic core, which is connected to the straight arm 18 as shown in figure 5. This motion pulls in and turns the release arm 7 counterclockwise, which is indicated by an arrow. When the release arm is turned counterclockwise, it releases the grip on the amplifier arm 6 at the first contact point 8.

[0030] When the first contact point 8 at the release arm 7 passes the center of a ball bearing mounted in the outer part of the amplifier arm 6, the amplifier arm 6 is released and can begin its clockwise rotation. This rotation is illustrated by an arrow in figure 6.

[0031] Figure 6 illustrates how the pressure body 4 presses down the amplifier arm 6, and more particularly, the pressure body 4 is provided with the pressure body protrusion 15 structured and arranged to be in contact with a part of the amplifier arm 6.

[0032] Here the release arm 7 has completely released the amplifier arm 6. The springs that push out the pressure pins 10 from the pressure body 4 push the pressure body 4 to the right because the locking member 3 is kept still by the door frame pressure. The pressure body 4 will thus press the amplifier arm 6 clockwise, illustrated by an arrow, at the second contact point 9. As the amplifier arm 6 is turned, the amplifier arm 6 will slide off and release the outer part of the holding arm 5 that is held in the indentation 16. The holding arm 5 can thus be turned counterclockwise which is illustrated by an arrow in figure 7.

[0033] The pressure body protrusion 15 of the pressure body 4 has a contact surface configured to be in contact with a mating contact surface on the amplifier arm, which has an elongated shape running through the rotation axis of amplifier arm.

[0034] Figure 15 shows the amplifier arm 6, in a side view to the left, and in a perspective view to the right. The amplifier arm 6 is provided with two contact surfaces, a first contact surface 20 in an indentation 16 intended to be in contact with the contact surface at the other end of the holder arm 5, and a second contact surface 19 intended to be in contact with a contact surface of the pressure body protrusion 15. The first contact surface 20 has an extension in a plane essentially perpendicular, e.g. approximately 90 degrees (v2) to a line r2 radially extending from the rotation axis of the amplifier arm.

[0035] In one variation, illustrated in figure 16, the angle v2 is 91 degrees, and the first contact surface 20 is 1.4 mm perpendicular to the line r2. This will result in that the first contact surface 20 will gradually move in the distal direction of the holder arm during clockwise movement of the amplifier arm 6. The friction between the contacting surfaces is such that the relationship between the sliding movement, and the releasing movement is 10:1, i.e. 10 mm sliding corresponds to 1 mm releasing.

[0036] The second contact surface 19 has an extension in a plane inclined in the range of 15-60 degrees (v1) in relation to a line r1 radially extending from the rotation axis of said amplifier arm 6. The inclination is preferably in the range 20-50 degrees, more preferably in the range of 23-40 degrees, and most preferred approximately 28 degrees.

[0037] In one variation, illustrated in figure17, the angle v1 is 28 degrees. In figure 17 is also shown an angle v3, being the angle of the surface of the pressure body protrusion 15 facing the second contact surface 19. In this illustrated variation, v3 is approximately 14 degrees. The angles v1 and v3 are chosen based upon two different condition which are contradictory. One condition is that it is desirable to have angle v1 as large as possible because a large rotational force to the amplifier arm is desired. Another condition is that the linear movement of the pressure body 4 should be as short as possible. The reason to have as short linear movement as possible is

that the drop plungers 2 should be allowed to move as little as possible when subjected to maximum door frame pressure, i.e. in a state where the strong springs 11 are fully depressed. In one application the spring constants for the springs 11 are approximately 9 N/mm.

[0038] Thus, when a pressure is supplied by the contact surface of the pressure body protrusion to the second contact surface 19 of the amplifier arm, the amplifier arm is subjected to a clockwise rotational force which is indicated by an arrow in figure 6 due to the inclination of the contact surfaces.

[0039] As mentioned above, the amplifier arm 6 is provided with an indentation 16 having a contact surface essentially in a plane perpendicular to the longitudinal axis of the amplifier arm 6. This contact surface is structured to be in contact with a contact surface of the outer part of the holding arm 5, thus provided to receive pressure from the holding arm 5 in the longitudinal direction of the amplifier arm, i.e. in the radial direction in relation to the rotation axis of the amplifier arm.

[0040] In figure 7, the lock assembly is in its unlocked operation state, where all parts are released and the drop lock plunger moved inside the lock assembly.

[0041] In this step, illustrated in figure 7, the amplifier arm 6 has completely released the holding arm 5, and it can now freely move counter-clockwise, see arrow. This means that the locking member 3 can move freely to the right, see arrow. This in turn means that the drop lock plunger can turn fully to its end position, see arrow, and then move fully to the right until the entire drop lock plunger is inside the locking box.

[0042] In figure 8 is illustrated a fully open lock position, where the drop lock plungers are pushed in to their innermost positions, and the lock is thus fully open.

[0043] Figure 9 shows various views of the lock assembly according to the invention. To the left a perspective view is shown of a lock assembly ready for use, in the middle, a perspective view where a cover has been removed in order to illustrate the mechanism, and to the right a side view of the lock assembly where the cover being removed.

[0044] Figure 10 illustrates the drop lock plungers 2 and the locking member 3, in an exploded view to the left and assembled together to the right. The drop lock plungers 2 are mounted to the locking member 3 at a mounting axle shown to the left of the locking member. The drop lock plungers may then rotate about the mounting axle between two positions. The rotation is performed during linear movement to the right and left of the locking member when bearings provided on the outer sides of the drop lock plungers cooperate with cams (also shown in figure 10) fixedly mounted to the lock assembly enclosure.

[0045] Figure 11 illustrates the locking member 3, in a view from above to the left, and a perspective view to the right. As discussed above, the locking member 3 is provided with a cam-shaped protrusion 17.

[0046] Figure 12 illustrates the pressure body 4. A side view is shown to the left, and a perspective view is shown to the right. The pressure body is provided with bores for receiving springs.

[0047] Figure 13 illustrates the pressure body 4 including pressure pins 10, strong springs 11, and also other parts used in connection with the pressure body, e.g. springs to the right provided to perform a pressure directed to the left of the pressure body 4, i.e. in a direction towards the drop lock plungers. The right parts of these springs cooperate with fastening means arranged to the lock assembly enclosure. These springs being soft springs, having considerably less spring constants than the hard springs 11 Above in figure 13 is shown the pressure body and related parts in an exploded view, and below it is shown as assembled.

[0048] Figure 14 illustrates the holding arm 5, in a side view to the left, and in a perspective view to the right. Specifically, it is shown a part of the locking member provided with a contact surface 30 structured to cooperate with the cam-shaped protrusion 17 at the pressure body 4. The contact surface 30 has an extension that is essentially perpendicular to the movement direction of the pressure body 4.

[0049] Figure 15 illustrates the amplifier arm 6, in a side view to the left, and in a perspective view to the right. This has been discussed in detail above.

[0050] Thus, the present invention relates to a lock assembly 1 comprising one or two drop lock plunger(s) 2 configured to be in a locked operation state and in an unlocked operation state, and a locking member 3 arranged to be moveable between an outer and an inner position in relation the lock assembly enclosure, and provided with means, e.g. axles, to move the drop lock plunger between the locked and unlocked operation states in dependence of the movement between the outer and inner positions.

[0051] The lock assembly further comprises a pressure body 4 mounted to linearly cooperate with the locking member 3. The pressure body is provided with at least one pressure pin 10 arranged in the direction of the locking member and to be in contact with the locking member, and urged, by a predetermined spring force, in the direction of the locking member by at least one spring arranged within the locking member. In addition, the pressure body 4 is provided with a pressure body protrusion 15.

[0052] A holder arm 5 is provided, having an elongated shape and arranged to be rotatable about a rotation axis at one of its ends, and provided with a contact surface 30 arranged to cooperate with a cam-shaped protrusion 17 at the locking member, and also, at the other of its ends, provided with a contact surface.

[0053] The lock assembly also comprises an electromagnetic member 14 that upon activation is arranged to apply a pulling force to a release arm 7.

[0054] The lock assembly further comprises an amplifier arm 6 having an elongated shape and arranged to be rotatable about a rotation axis at one of its ends, the

other end is structured to cooperate with the release arm 7.

[0055] The amplifier arm is provided with two contact surfaces, a first contact surface 20 in an indentation 16 intended to be in contact with the contact surface at other end of the holding arm 5, and a second contact surface 19 intended to be in contact with a contact surface of the pressure body protrusion 15.

[0056] When the lock assembly is in its locked state, and external pressure is supplied to the drop lock plunger 1, the external pressure is transferred through the mechanism in the following way. It is transferred to a linear movement of the locking member 3 that in turn is transferred to the pressure body 4 via the at least one pressure pin 10 resulting in that a rotational force is applied to the amplifier arm 6 in a first direction (a clockwise direction in the figures) by the pressure body protrusion 15 via the contact surface of the pressure body protrusion being in contact with the second contact surface 19.

[0057] Upon activation of the electromagnetic member 14, the rotational force provides movement to the amplifier arm 6 such that the first contact surface 20 is released from the holding arm, thereby allowing the locking member 3 to move inwards that in turn will transfer the drop lock plunger into their unlocked operation state.

[0058] In one embodiment, the first contact surface 20 has an extension in a plane essentially perpendicular (v2) to a line r2 radially extending from the rotation axis of the amplifier arm 6. The second contact surface 19 has an extension in a plane inclined in the range of 30-60 degrees (v1) in relation to a line r1 radially extending from the rotation axis of the amplifier arm 6. This is specifically illustrated in figure 15.

[0059] According to another embodiment, an inwardly directed force on the locking member 3, provided by the drop lock plunger 2 being subjected to external pressure, e.g. by door frame pressure, is applied to the holder arm 5 via a cam-shaped protrusion 17 on the locking member 3 and will be applied towards the first contact surface 19 at the amplifier arm 6 when in the locked operation state, The inwardly directed force on the locking member 3 will also be transferred via the pressure pins 10 to the pressure body protrusion 15 that in turn will provide a rotational force to the amplifier arm to release the first contact surface from the holding arm 5 and thereby set the drop lock plunger 2 into the unlocked operation state.

[0060] The second variation of the lock assembly according the present invention will now be described in detail with references to figures 18-32. For description of items having the same similar functionalities in both versions it is referred to the above description of the first version of the lock assembly.

[0061] Figures 18-20 show side views of the lock assembly.

[0062] Figure 18 illustrates the lock assembly 1 in the locked operation state where the drop lock plungers 2 are in their outer position, to the left in the figure, and also in their locked positions, i.e. they cannot move to the right, and cannot perform a rotational movement, i.e. a "dropping movement".

[0063] Figure 23 illustrates the lock assembly 1 in the unlocked operation state. In this state the drop lock plungers 2 are moved to be in their inner position, to the right in the figure, and the lower drop lock plunger 2 has performed a dropping movement.

[0064] With references e.g. to figures 18 and 19, the lock assembly comprises a second locking member 40 arranged to be moveable between an outer and an inner position, and provided with means to move the drop lock plunger between the locked and unlocked operation state in dependence of the movement between the outer and inner positions. This has been discussed in relation to the first version of the lock assembly. The second locking member 40 comprises a pressure body part 41 provided with a pressure body part protrusion 42, see e.g. figures 20-22. Thus, the pressure body part 41 is an integral part of the second locking member 40.

[0065] The lock assembly further comprises a holder arm 5 having an elongated shape and arranged to be rotatable about a holder arm rotation axis 25 at one of its ends, and provided with a contact surface arranged to cooperate with a cam-shaped protrusion 17 at the second locking member 40 via a contact point 30 (see figure 21), and also, at the other of its ends, provided with another contact surface.

[0066] An electromagnetic member 14 is provided, e.g. a solenoid, that upon activation is arranged to apply a pulling force to a release arm 7 via a straight arm 18.

[0067] Furthermore, the lock assembly comprises a second amplifier arm 43 having an elongated shape and arranged to be rotatable about a second amplifier arm rotation axis 44, and comprising one end structured to cooperate with the release arm 7.

[0068] The amplifier arm is provided with a first contact surface 20 (see e.g. figure 20) in an indentation 16 (see figure 29) intended to be in contact with the contact surface at the other end of said holder arm 5, the second amplifier arm 43 comprises another end providing a seat for a spring member 45.

[0069] The lock assembly also comprises a preload activator arm 46 arranged to be rotatable about the second amplifier arm rotation axis 44.

[0070] The preload activator arm 46 is specifically illustrated in figure 30 and is elongated and comprises a first end 47 and a second end 48 at opposite sides of the rotation axis 44, the first end 47 is provided with a seat for the spring member 45, and the second end 48 is provided with an activator arm contact surface 49 intended to be in contact with a contact surface of the pressure body part protrusion 42, which is illustrated in figure 32.

[0071] When the lock assembly is in the locked operation state and external pressure is supplied to the drop lock plunger 1, the external pressure is transferred to a linear movement of the second locking member 40, illustrated by the arrow on the second locking member in the left drawing in figure 20, and further transferred to the

preload activator arm 46 via said pressure body part protrusion 42, resulting in that a rotational force, illustrated by an arrow about the second amplifier arm rotation axis, is applied to said second amplifier arm 43 in a first direction by the preload activator arm 46 providing a pressure to said second amplifier arm 43 via said spring member 45 arranged in the seats supporting the spring member 45, illustrated by an arrow.

[0072] Upon activation of the electromagnetic member 14, the rotational force provides movement to the second amplifier arm 43 such that the first contact surface 20 is released from the holder arm 5, thereby allowing the second locking member 40 to move inwardly that in turn will transfer the drop lock plunger(s) into their unlocked operation state. Figure 22 illustrates the activation procedure, which will be described more in detail below.

[0073] Figures 20 shows the lock assembly in a locked operation state. The left illustration is a side view, and the right illustration is the same side view where also invisible items are indicated. The same applies for figure 21.

[0074] Starting from the electromagnetic member 14, that, via arm 18, holds the release arm 7 in a locked position, see figures 20 and 21. The release arm 7 is configured to rotate about an axis preferably provided at a mid-position of the release arm. The release arm 7 prevents the second amplifier arm 6 at a first contact point 8 from turning clockwise about an axis at an end opposite the end of the contact point 8 with the release arm 7. This in turn prevents a movement of the pressure body part 41, i.e. movement of the second locking member 40, to the right, where the pressure body part protrusion 42 of the pressure body 41 is in contact with the preload activator arm 46.

[0075] If a door frame pressure is applied to the drop plunger 2 when the mechanism is in the locked position, the second locking member 40 will be pressed to the right as illustrated by an arrow in figure 20. It will then apply a force to the preload activator arm 46, that in turn will provide a force to the second amplifier arm 43 via the spring member 45. The second locking member 40 will be able to be pressed to the right until the cam-shaped protrusion 17 of the locking member 3 reaches the holding arm 5 where it is stopped at the contact point 30.

[0076] Now the mechanism is in an important position.

[0077] The pressure body part 41 applies a force, via the preload activator arm 46 to the second amplifier arm 43 equal to the spring force of the spring member 45. This well-defined force is converted into a rotating force about the rotation axis of the second amplifier arm 43, which is indicated by an arrow, which also becomes well-defined. The force that must be applied to the release arm 7 to release it from the second amplifier arm 43 is therefore also well-defined. The force which, in addition to this, is applied to the second locking member 40, will be applied to the holding arm 5 by the cam-shaped protrusion 17 at the locking member 40. The holding arm 5 applies this force to the second amplifier arm 43, which is provided with the indentation 16 adapted to receive the outer part of the holding arm, but radially in relation to the rotation axis of the second amplifier arm 43, so it will not contribute to clockwise rotation of it.

[0078] Figure 22, left drawing, illustrates the situation when the lock is about to be released. When the lock is to be released, the electromagnetic member 14 is magnetized, which causes it to draw in the magnetic core, which is connected to the straight arm 18 as shown in figure 22. This motion pulls in and turns the release arm 7 counterclockwise, which is indicated by an arrow. When the release arm 7 is turned counterclockwise, it releases the grip on the second amplifier arm 43 at the first contact point 8.

[0079] When the first contact point 8 at the release arm 7 passes the center of a ball bearing mounted in the outer part of the second amplifier arm 43, the second amplifier arm 43 is released and can begin its clockwise rotation. This rotation is illustrated by an arrow in the right drawing of figure 22, which illustrates the lock assembly in the unlocked state.

[0080] Here the release arm 7 has completely released the second amplifier arm 43. As the second amplifier arm 43 is turned, it will slide off and release the outer part of the holder arm 5 that is held in the indentation. The holder arm 5 can thus be turned counterclockwise.

[0081] The pressure body part protrusion 42 of the pressure body 41 has a contact surface configured to be in contact with a mating contact surface 49 of the second end 48 of the preload activator arm 46, which is illustrated in figure 32.

[0082] Figure 24 shows various views of the lock assembly according to the invention. To the left a perspective view is shown of a lock assembly ready for use, in the middle, a perspective view where a cover has been removed in order to illustrate the mechanism, and to the right a side view of the lock assembly where the cover being removed.

[0083] Figure 25 illustrates the drop lock plungers 2 and the second locking member 40, in an exploded view to the left and assembled together to the right. The drop lock plungers 2 are mounted to the locking member 3 at a mounting axle shown to the left of the locking member. The drop lock plungers may then rotate about the mounting axle between two positions. The rotation is performed during linear movement to the right and left of the locking member when bearings provided on the outer sides of the drop lock plungers cooperate with cams fixedly mounted to the lock assembly enclosure.

[0084] Figure 26 illustrates the second locking member 40, in a view from above to the left, and a perspective view to the right. As discussed above, the second locking member 40 is provided with a cam-shaped protrusion 17.

[0085] Figure 27 illustrates the holder arm 5, above, in a side view, and below, in a perspective view. Specifically, it is shown a part of the locking member provided with a contact surface 30 structured to cooperate with the cam-shaped protrusion 17 at the second locking member

40. The contact surface 30 has an extension that is essentially perpendicular to the movement direction of the second locking member 40.

[0086] Figure 28 is a perspective view that illustrates the second amplifier arm 43, the preload activator arm 46, and the spring member 45. It is specifically indicated how these parts are mounted in relation to each other at a common axis, and the spring member 45 arranged between seats at the arms.

[0087] A side view, and a perspective view of the second amplifier arm 43, and of the preload amplifier arm 46, are respectively shown in figures 29, and 30.

[0088] Figure 31 shows a side view illustrating details regarding the second amplifier arm 43, and the preload actuator arm 46 in relation to the release arm 7.

[0089] According to still another embodiment, and as illustrated in the figures, the one or two drop lock plunger(s) is a dual drop lock plunger comprising two symmetrically arranged drop lock plungers.

[0090] The present invention is not limited to the above-described preferred embodiments. Various alternatives, modifications and equivalents may be used. Therefore, the above embodiments should not be taken as limiting the scope of the invention, which is defined by the appending claims.

Claims

1. A lock assembly (1) comprising:

- one or two drop lock plunger(s) (2) configured to be in a locked operation state and in an unlocked operation state;
- a locking member (3) arranged to be moveable between an outer and an inner position, and provided with means to move said drop lock plunger between the locked and unlocked operation state in dependence of the movement between the outer and inner positions;
- a pressure body (4) mounted to linearly cooperate with said locking member (3), the pressure body is provided with at least one pressure pin (10) arranged in the direction of the locking member and to be in contact with the locking member, and urged, by a predetermined spring force, in the direction of the locking member by at least one spring arranged within said pressure body, the pressure body (4) is provided with a pressure body protrusion (15);
- a holder arm (5) having an elongated shape and arranged to be rotatable about a holder arm rotation axis (25) at one of its ends, and provided with a contact surface arranged to cooperate with a cam-shaped protrusion (17) at said locking member, and also, at the other of its ends, provided with another contact surface;
- an electromagnetic member (14) that upon activation is arranged to apply a pulling force to a release arm (7), and
- an amplifier arm (6) having an elongated shape and arranged to be rotatable about a rotation axis at one of its ends, the other end is structured to cooperate with said release arm (7), the amplifier arm is provided with two contact surfaces, a first contact surface (20) in an indentation (16) intended to be in contact with the contact surface at the other end of said holder arm (5), and a second contact surface (19) intended to be in contact with a contact surface of said pressure body protrusion (15),

wherein, when in the locked operation state and external pressure is supplied to the drop lock plunger (1), the external pressure is transferred to a linear movement of said locking member (3) and that in turn is transferred to said pressure body via said at least one pressure pin (10) resulting in that a rotational force is applied to said amplifier arm (6) in a first direction by said pressure body protrusion (15) via said contact surface of the pressure body protrusion being in contact with said second contact surface (19), and upon activation of said electromagnetic member (14), the rotational force provides movement to the amplifier arm (6) such that the first contact surface (20) is released from the holder arm (5), thereby allowing the locking member (3) to move inwardly that in turn will transfer the drop lock plunger into their unlocked operation state.

2. The lock assembly according to claim 1, wherein the first contact surface (20) has an extension in a plane essentially perpendicular (v2) to a line (r2) radially extending from the rotation axis of said amplifier arm (6), and the second contact surface (19) has an extension in a plane inclined in the range of 15-60 degrees (v1) in relation to a line (r1) radially extending from the rotation axis of said amplifier arm (6).

3. The lock assembly according to claim 1 or 2, wherein an inwardly directed force on said locking member (3), provided by said drop lock plunger (2) being subjected to external pressure, is applied to the holder arm (5) via a cam-shaped protrusion (17) on said locking member (3) when in the locked operation state, and wherein the inwardly directed force on said locking member (3) will also be transferred via the pressure pins (10) to the pressure body protrusion (15) that in turn will provide a rotational force to the amplifier arm applied towards the second contact surface (19) at the amplifier arm (6) to release the first contact surface (20) from the holding arm (5) and thereby set the drop lock plunger (2) into the unlocked operation state upon activation of said electromagnetic member (14).

4. A lock assembly (1) comprising:

- one or two drop lock plunger(s) (2) configured to be in a locked operation state and in an unlocked operation state;
- a second locking member (40) arranged to be moveable between an outer and an inner position, and provided with means to move said drop lock plunger between the locked and unlocked operation state in dependence of the movement between the outer and inner positions, and comprising a pressure body part (41) provided with a pressure body part protrusion (42);
- a holder arm (5) having an elongated shape and arranged to be rotatable about a holder arm rotation axis (25) at one of its ends, and provided with a contact surface arranged to cooperate with a cam-shaped protrusion (17) at said second locking member (40), and also, at the other of its ends, provided with another contact surface;
- an electromagnetic member (14) that upon activation is arranged to apply a pulling force to a release arm (7);
- a second amplifier arm (43) having an elongated shape and arranged to be rotatable about a second amplifier arm rotation axis (44), and comprising one end structured to cooperate with said release arm (7), the amplifier arm is provided with a first contact surface (20) in an indentation (16) intended to be in contact with the contact surface at the other end of said holder arm (5), the second amplifier arm (43) comprises another end providing a seat for a spring member (45), and
- a preload activator arm (46) arranged to be rotatable about said second amplifier arm rotation axis (44), wherein said activator arm is elongated and comprises a first end (47) and a second end (48) at opposite sides of said rotation axis (44), said first end (47) is provided with a seat for said spring member, and said second end (48) is provided with an activator arm contact surface (49) intended to be in contact with a contact surface of said pressure body part protrusion (42),

wherein, when in the locked operation state and external pressure is supplied to the drop lock plunger (1), the external pressure is transferred to a linear movement of said second locking member (40) and further transferred to said preload activator arm (46) via said pressure body part protrusion (42), resulting in that a rotational force is applied to said second amplifier arm (43) in a first direction by said preload activator arm (46) providing a pressure to said second amplifier arm (43) via said spring member arranged in said seats, and, upon activation of said electromagnetic member (14), the rotational force provides movement to the second amplifier arm (43) such that the first contact surface (20) is released from the holder arm (5), thereby allowing the second locking member (40) to move inwardly that in turn will transfer the drop lock plunger(s) into their unlocked operation state.

5. The lock assembly according to any of claims 1-3, comprising a dual drop lock plunger comprising two symmetrically arranged drop lock plungers.

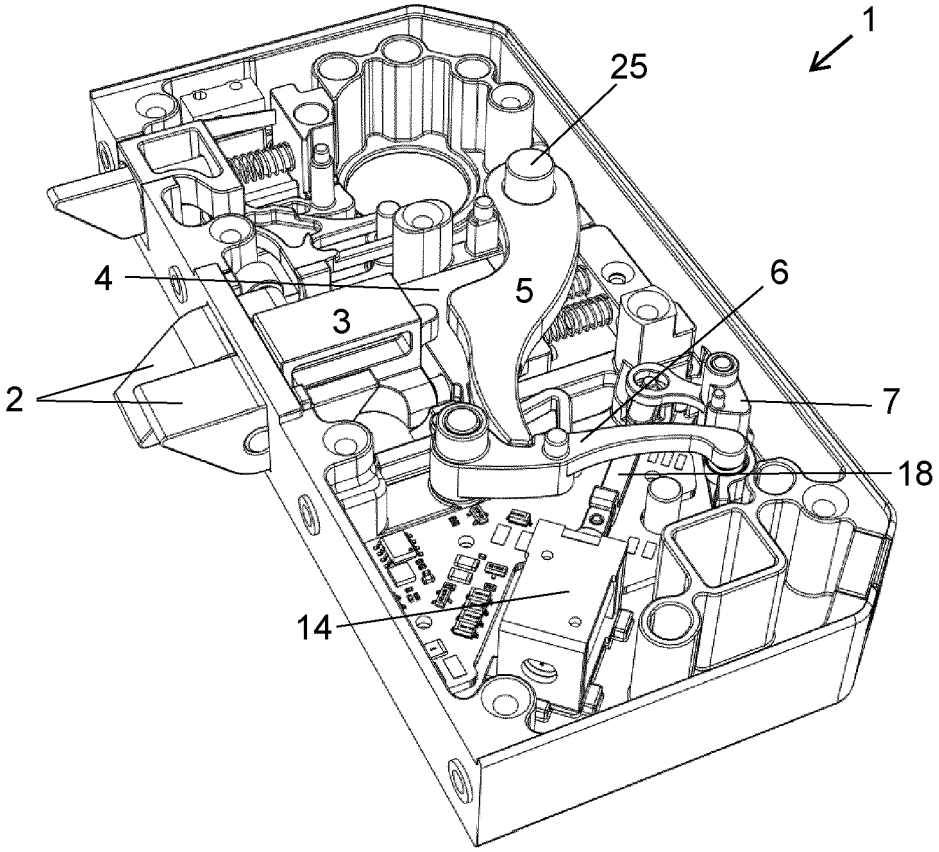
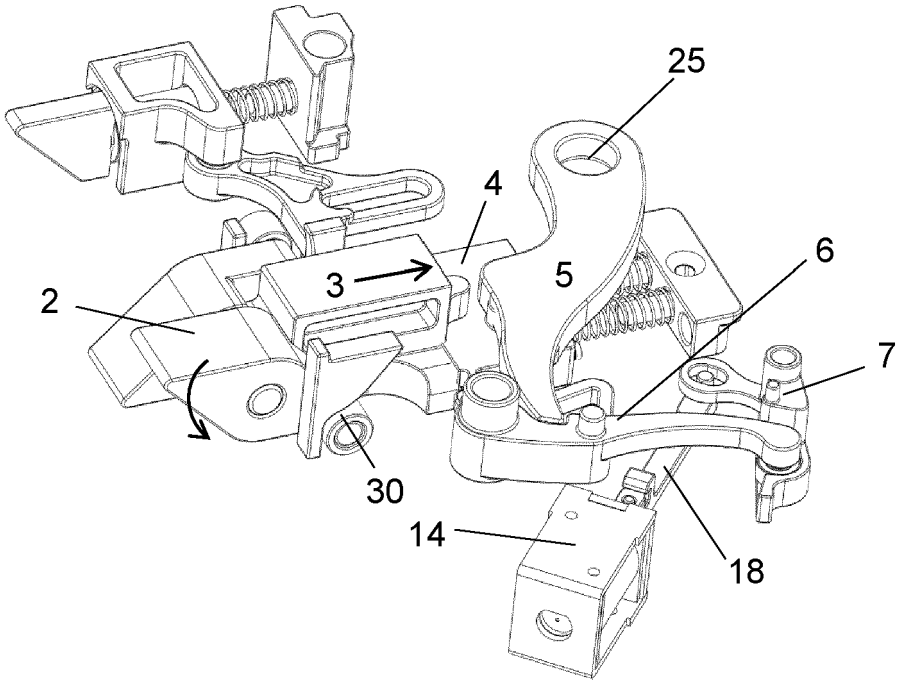


FIG. 1



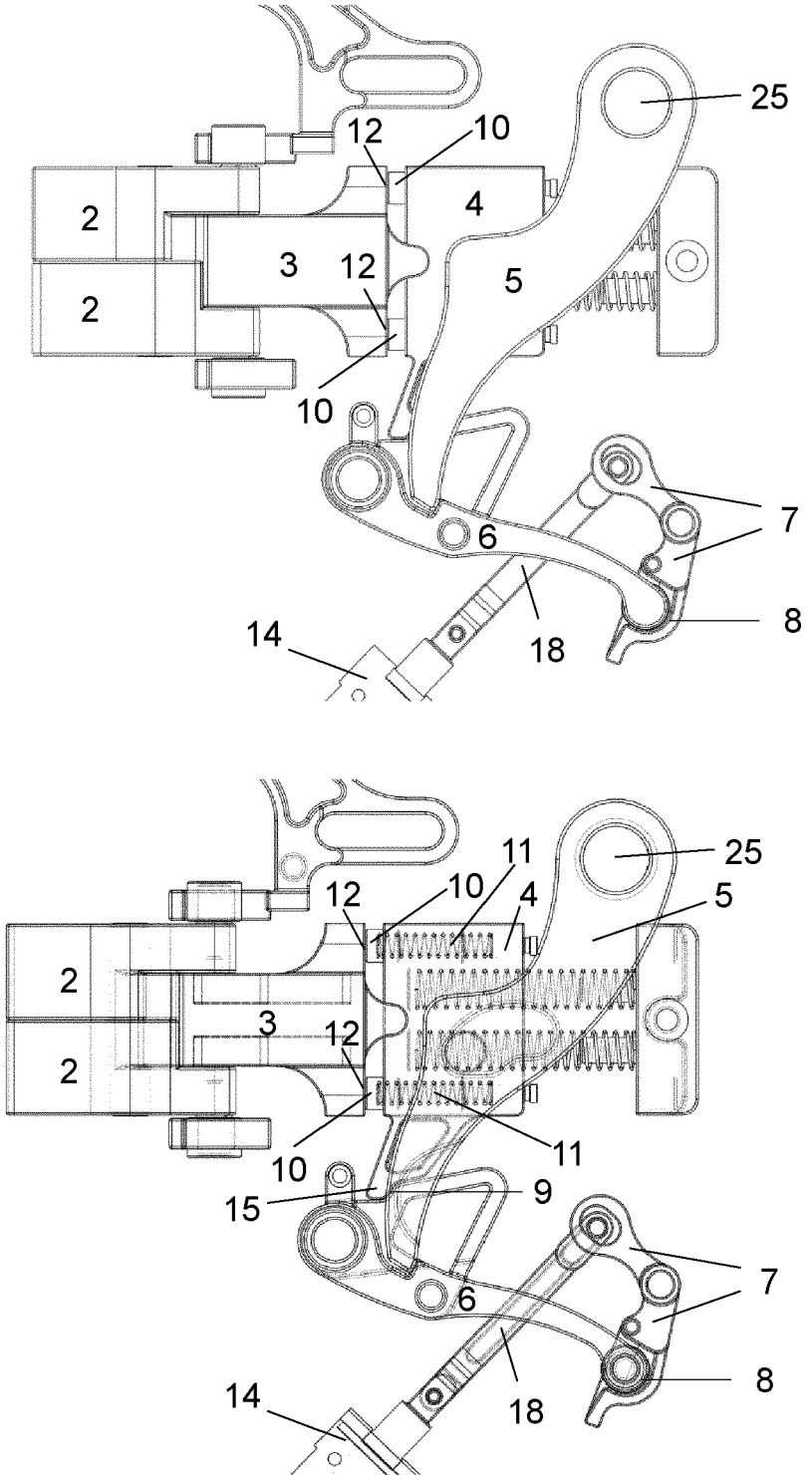

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FIG. 3

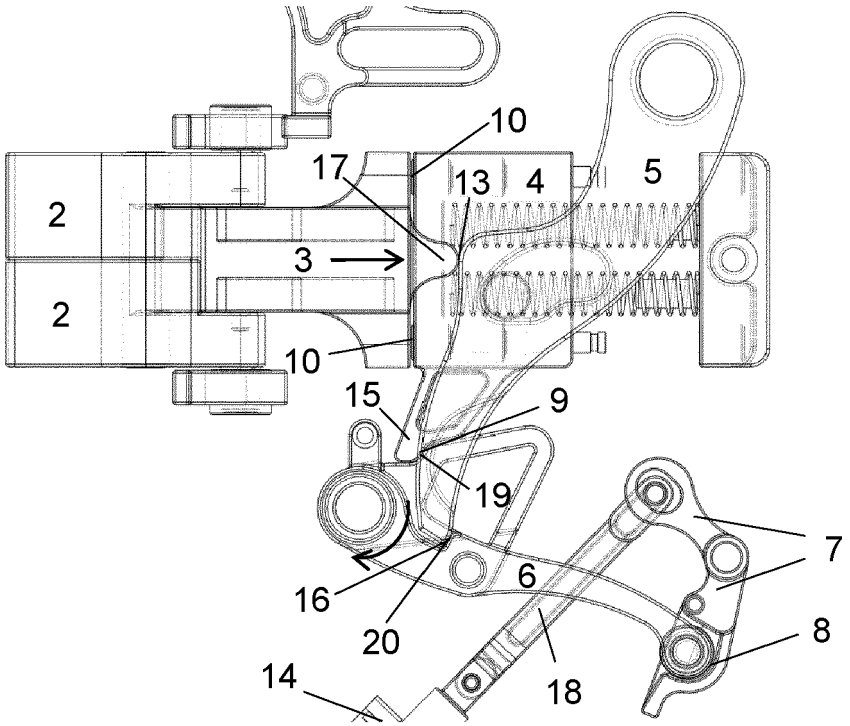
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FIG. 4

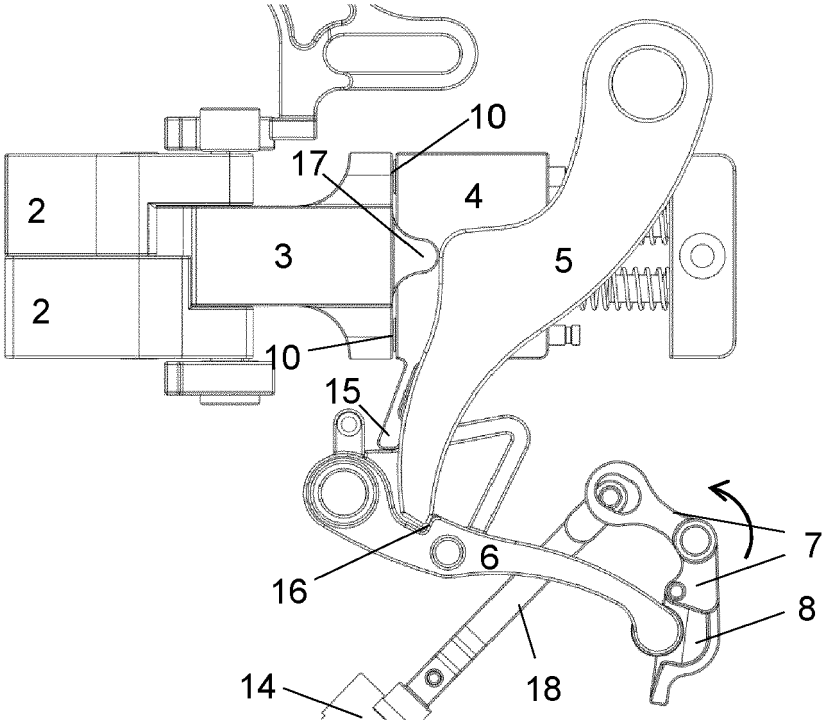
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FIG. 5

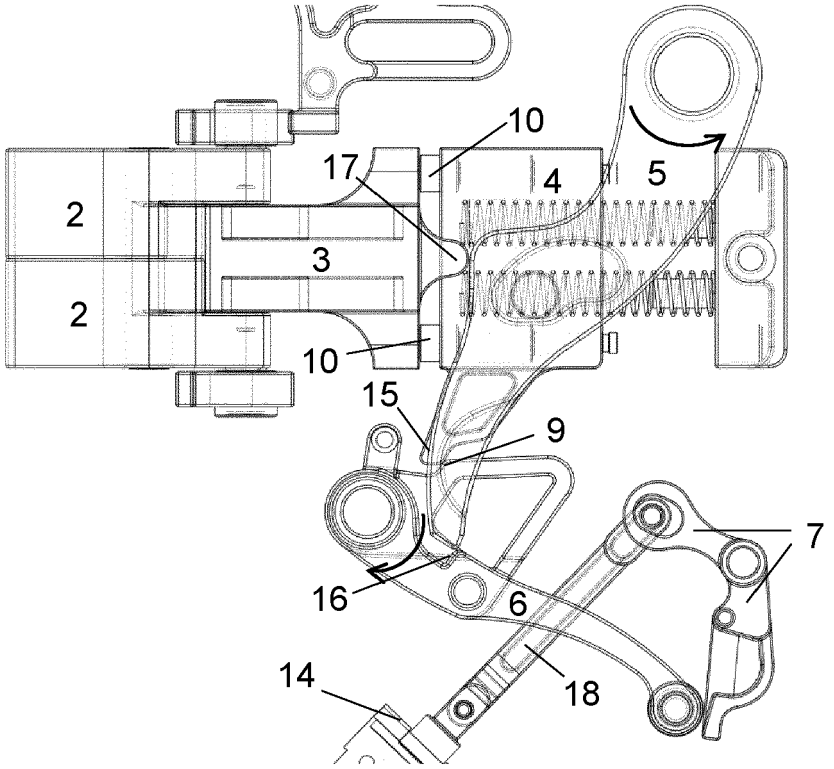


FIG. 6

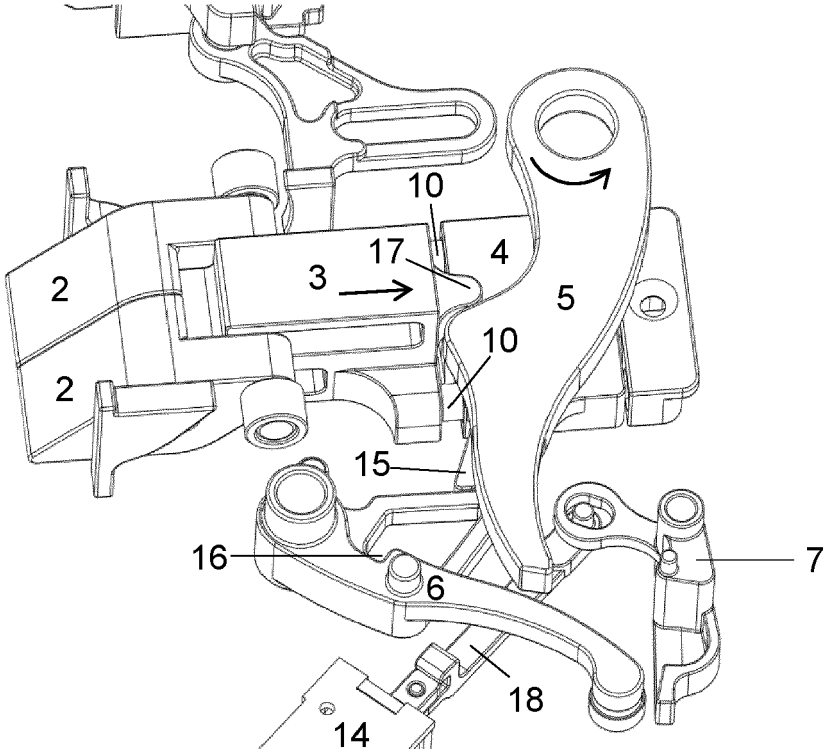


FIG. 7

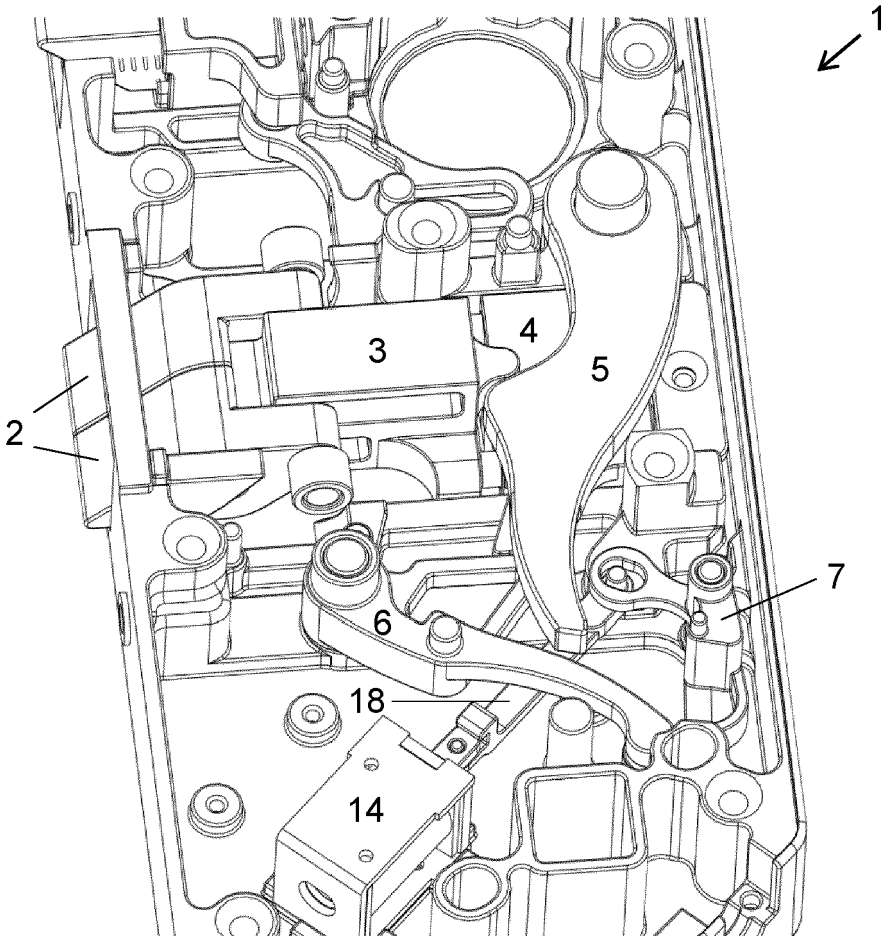


FIG. 8

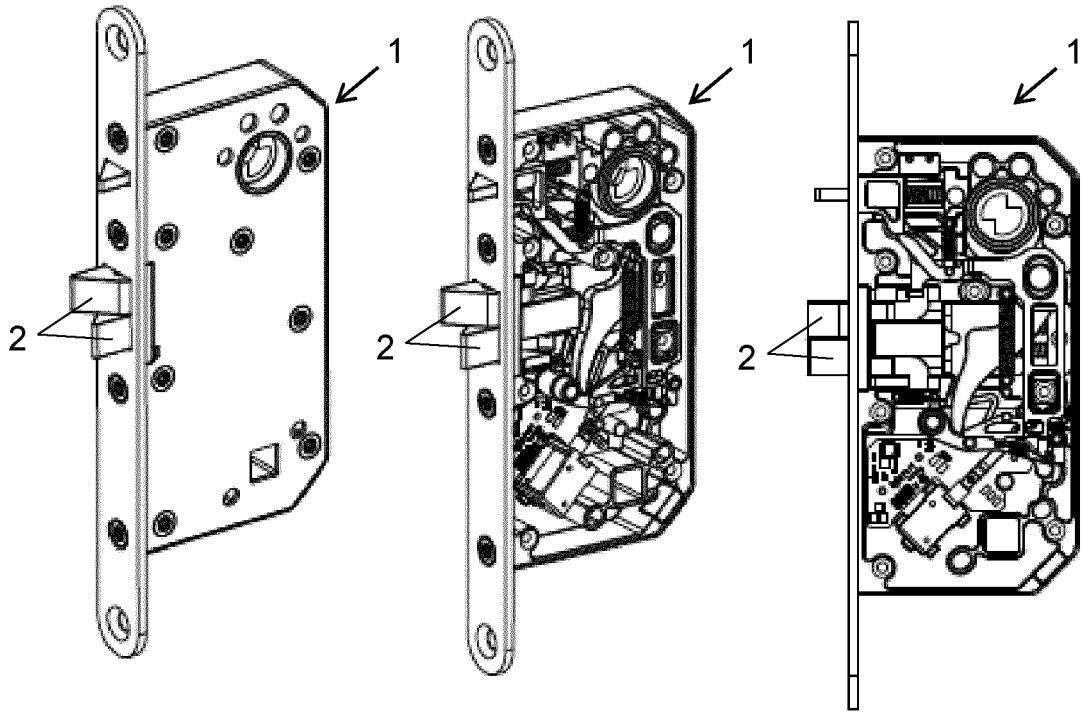
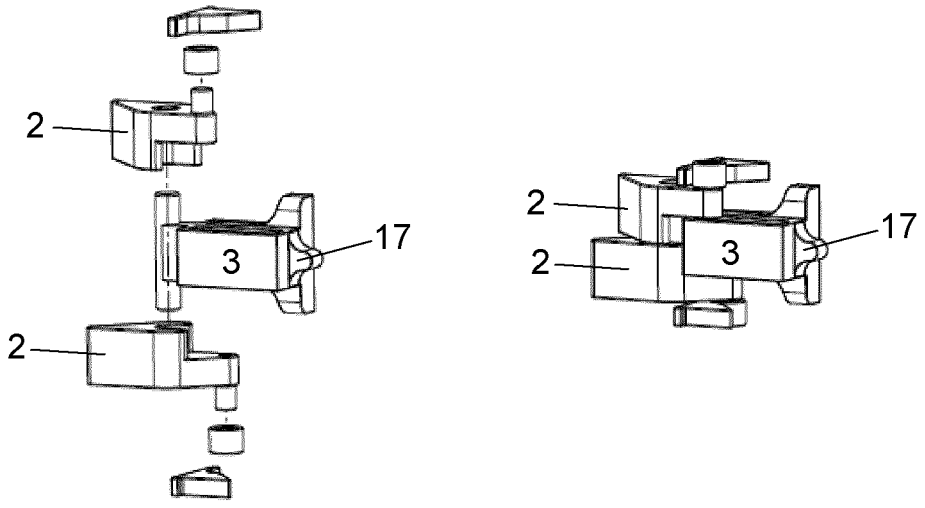


FIG. 9



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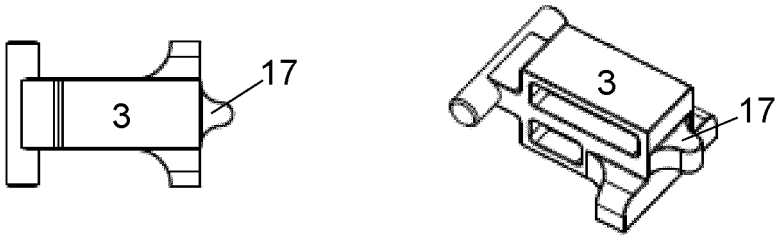

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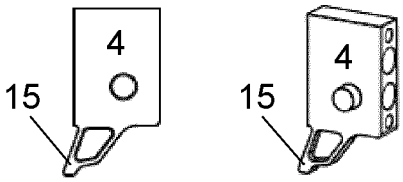

FIG. 12

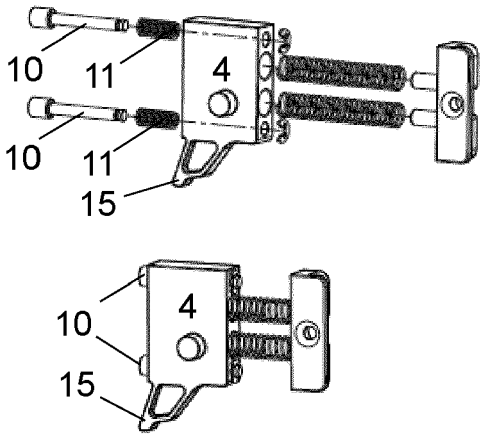

FIG. 13

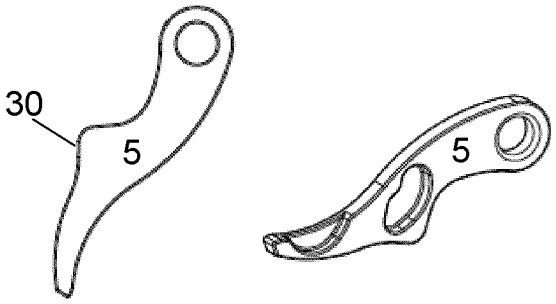

FIG. 14

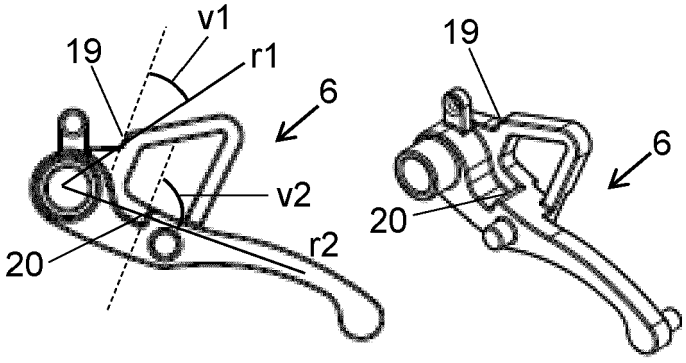

FIG. 15

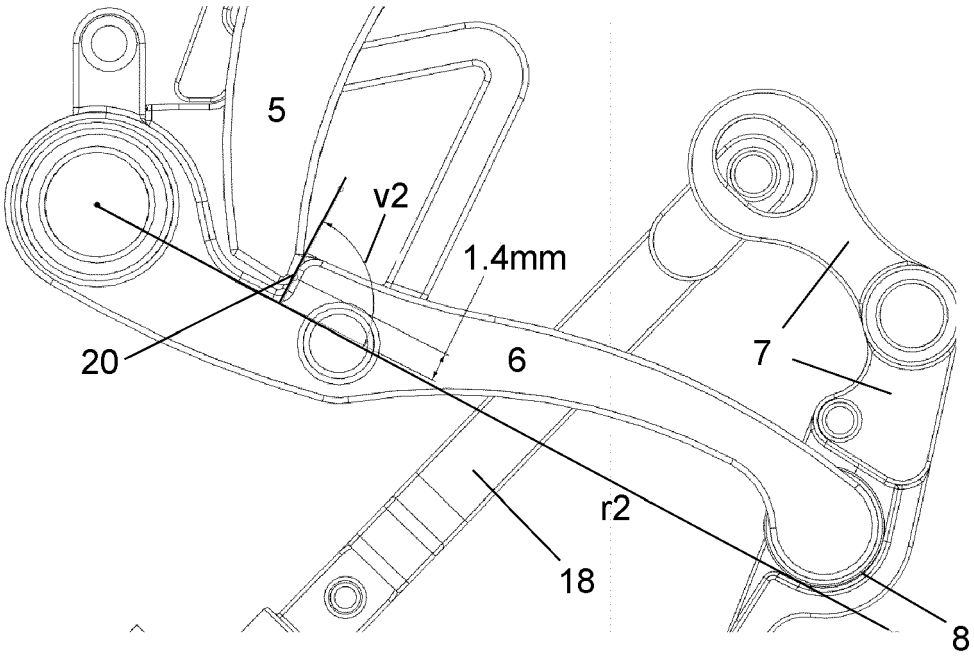

FIG. 16

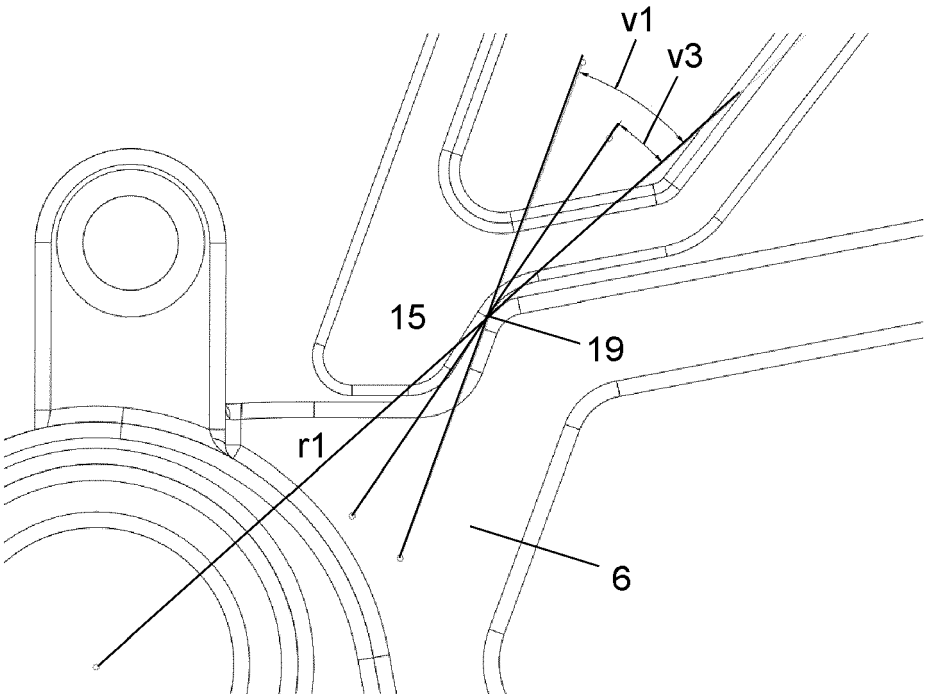

FIG. 17

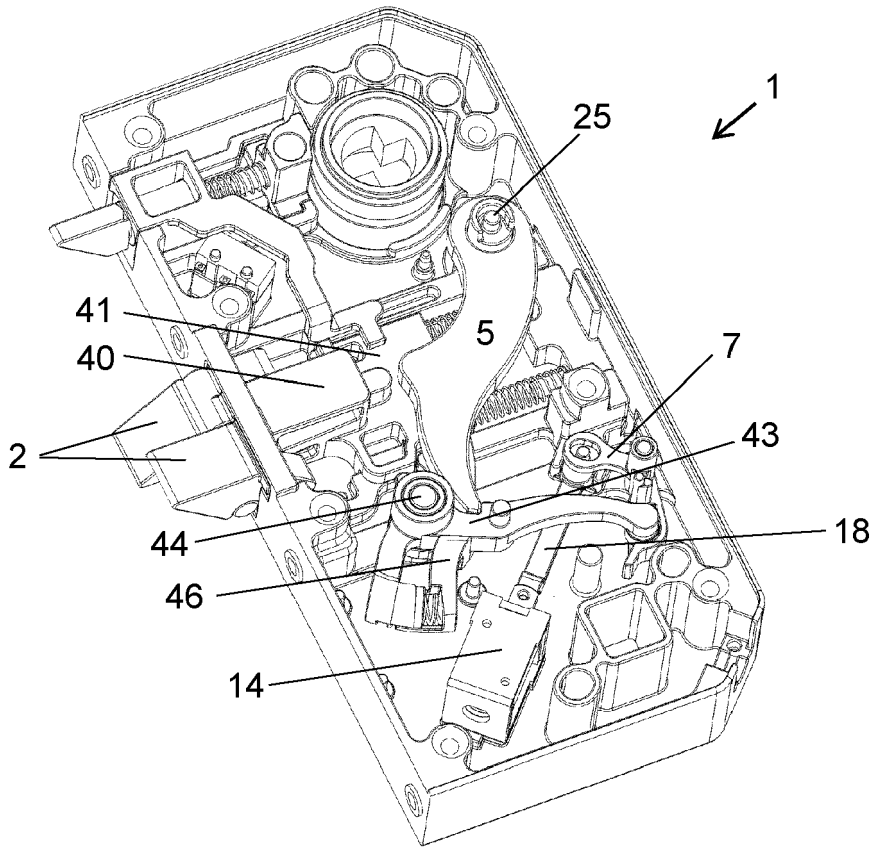

FIG. 18

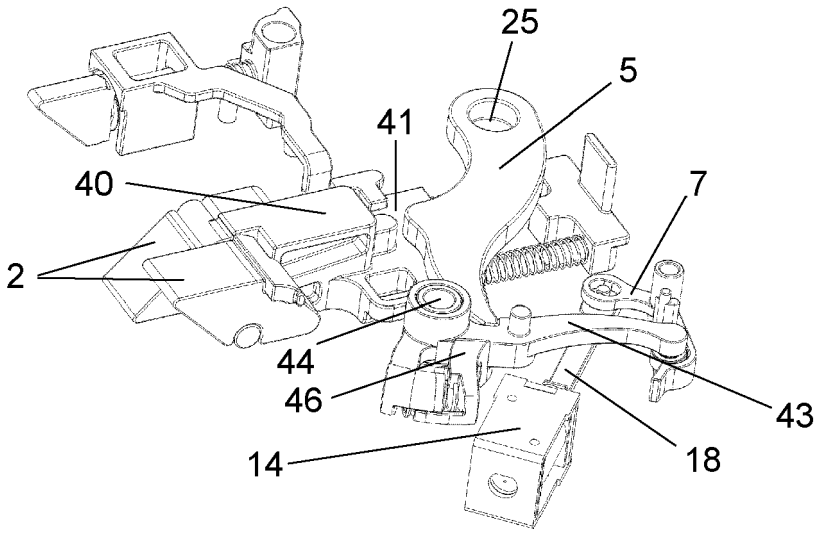

FIG. 19

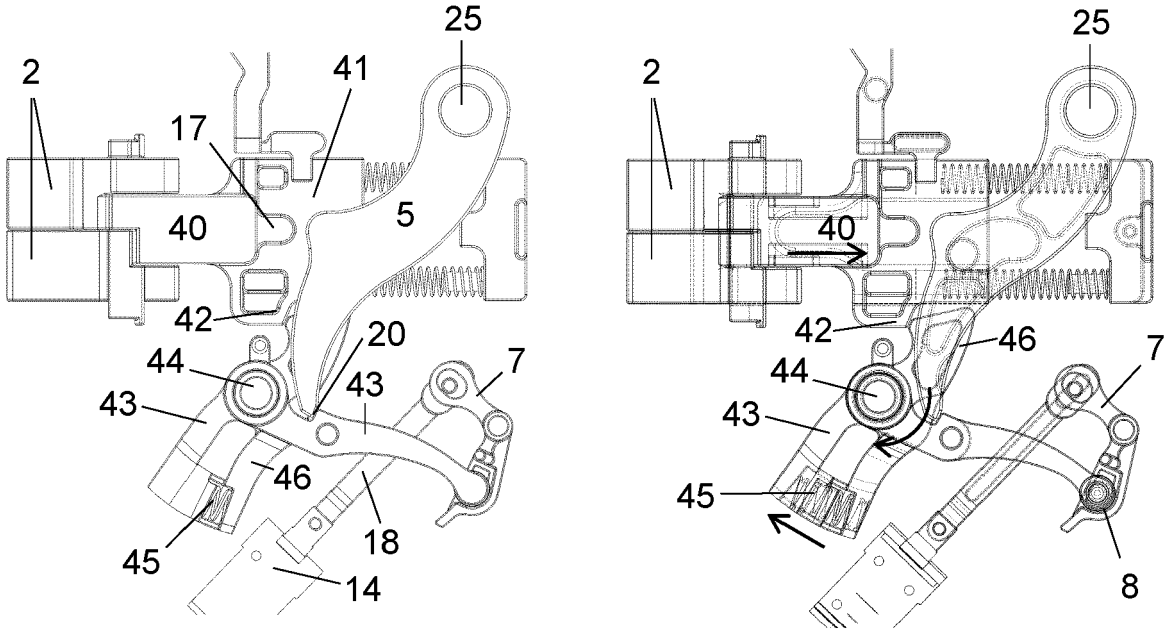
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FIG. 20

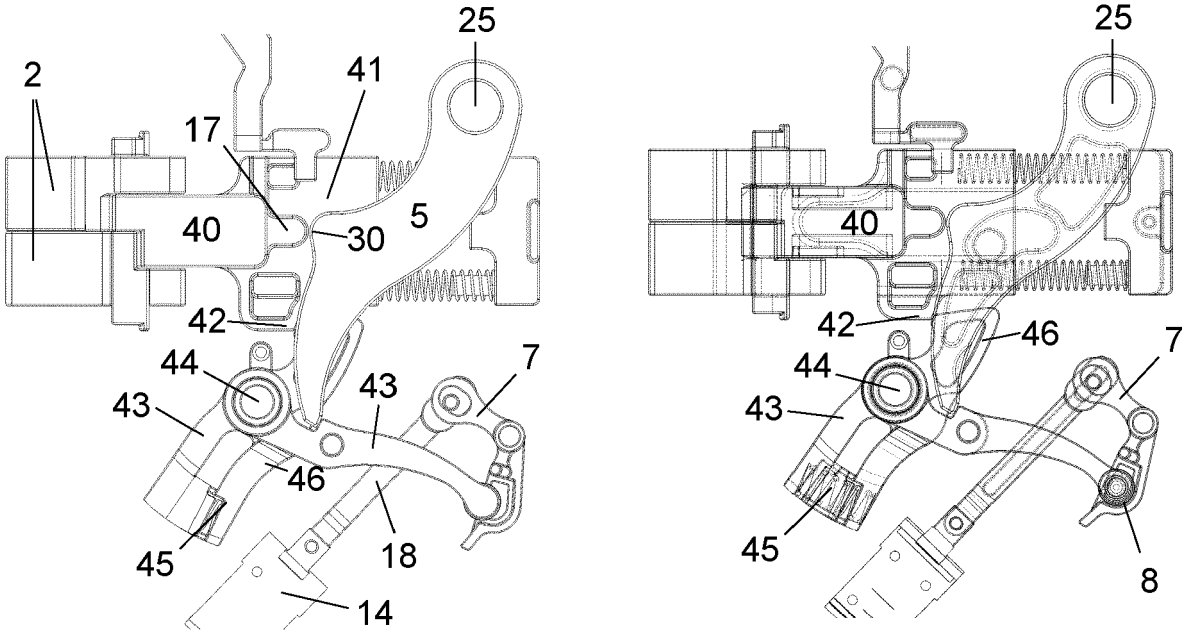
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FIG. 21

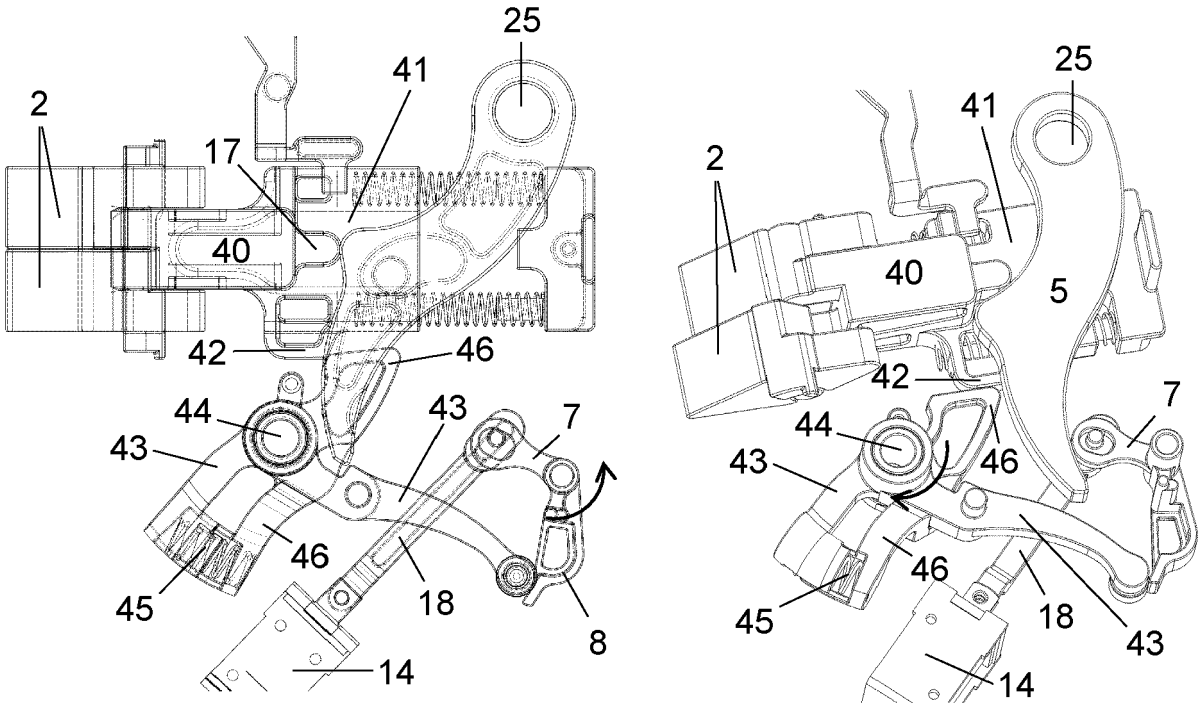
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FIG. 22

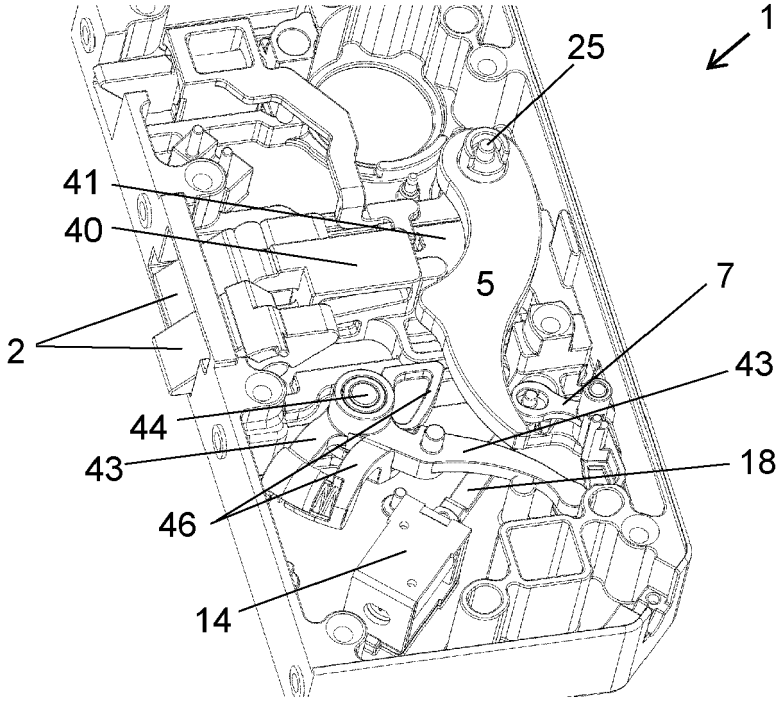
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FIG. 23

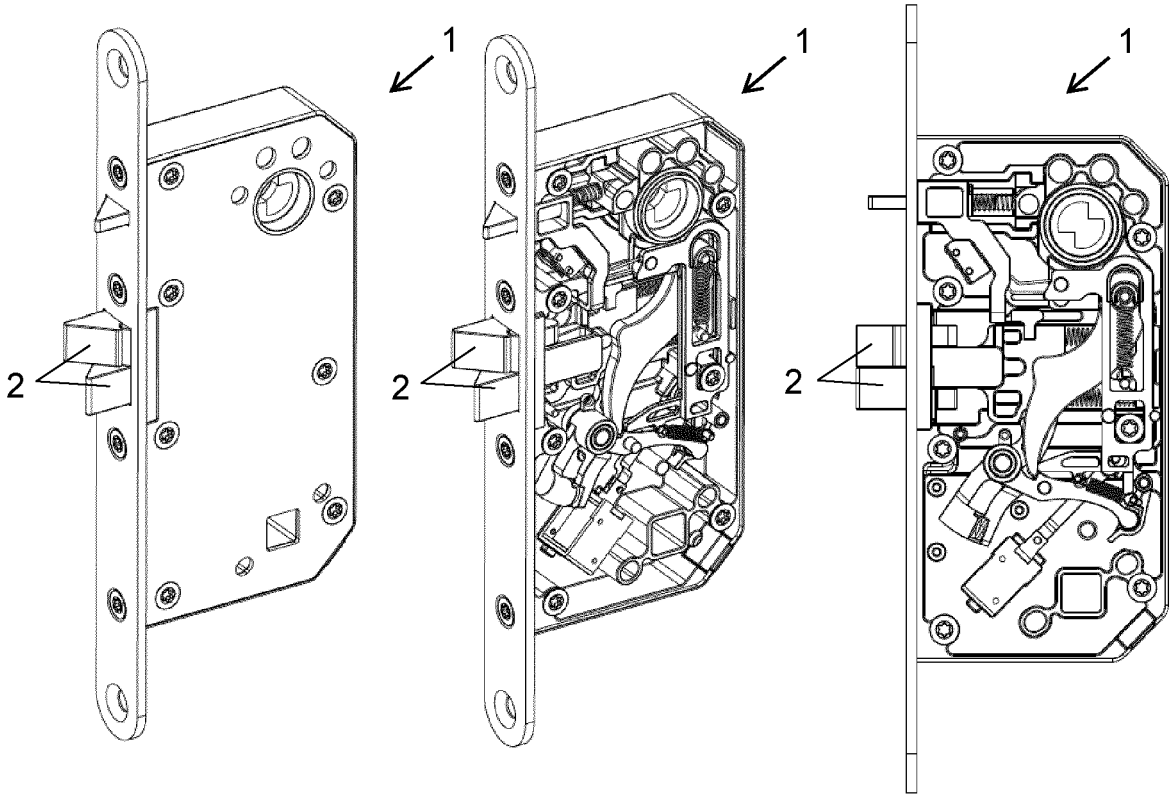
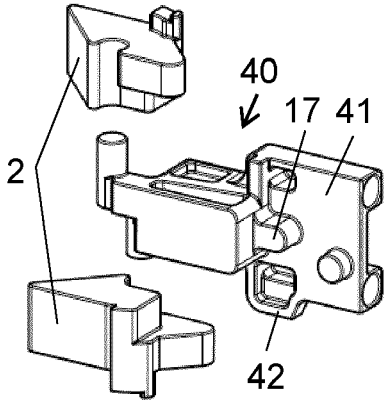


FIG. 24



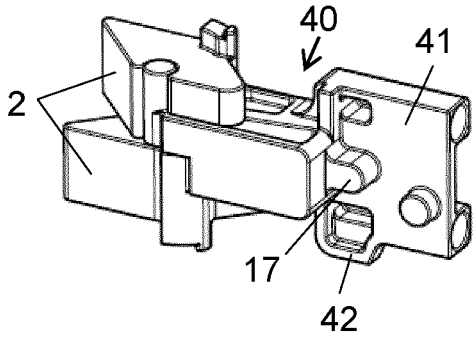
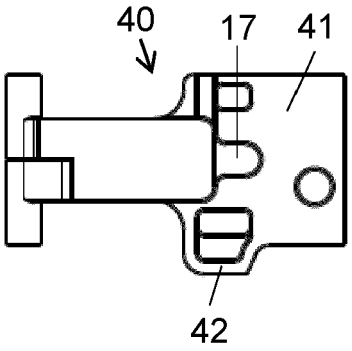


FIG. 25



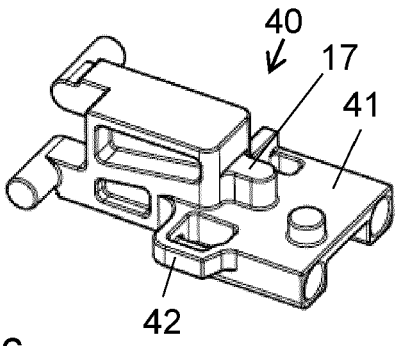


FIG. 26

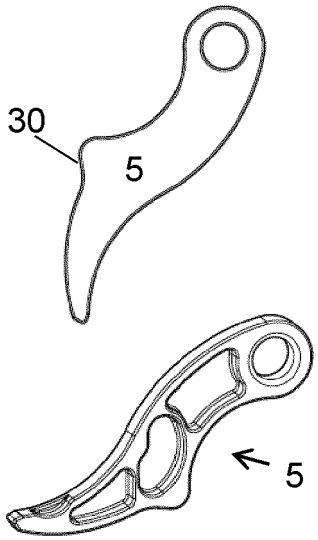


FIG. 27

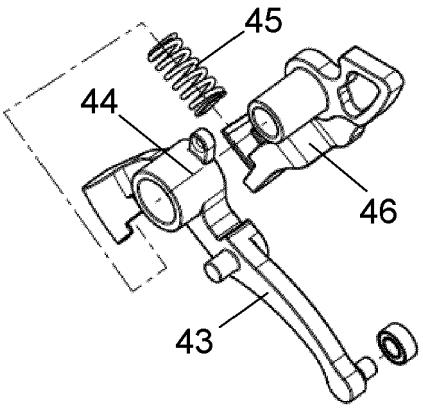


FIG. 28

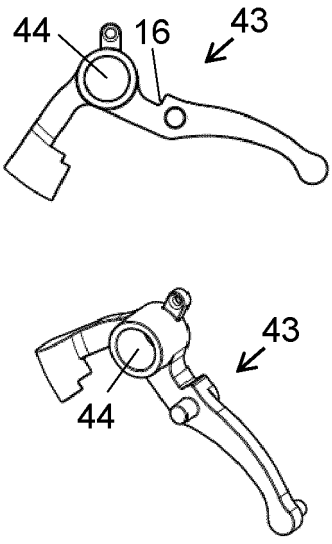


FIG. 29

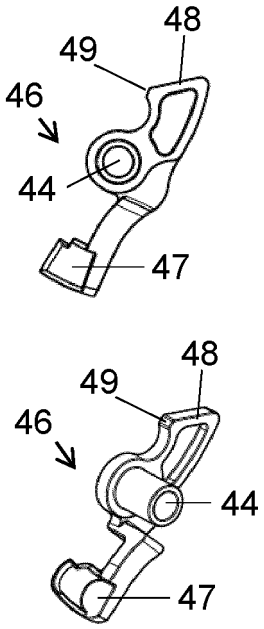


FIG. 30

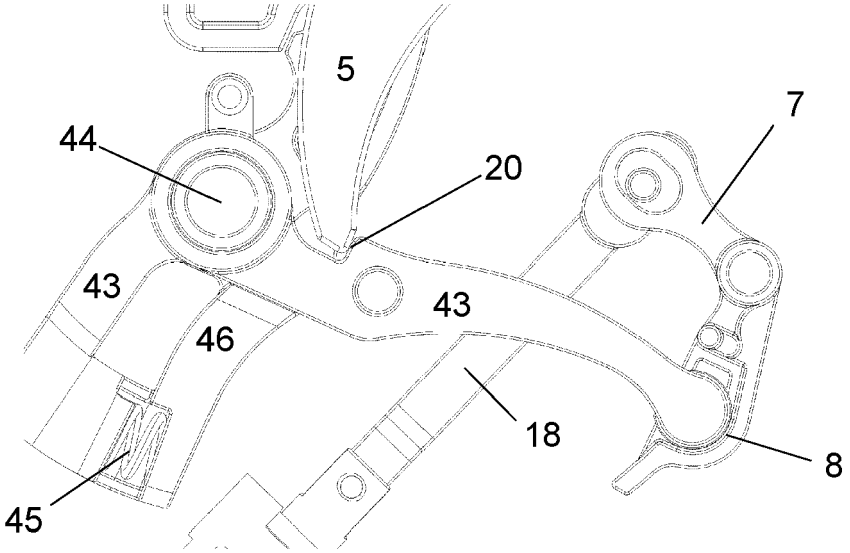


FIG. 31

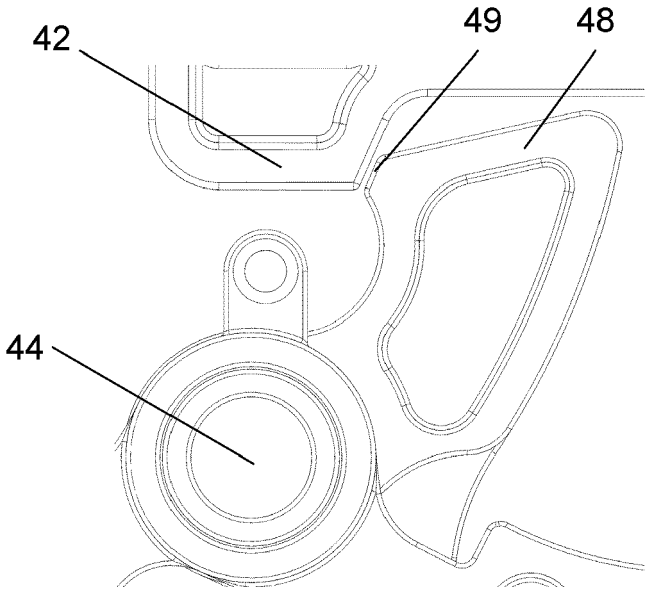


FIG. 32

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European Patent Office
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EUROPEAN SEARCH REPORT

Application Number
EP 24 17 1520

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 2 792 826 A2 (GEZE GMBH [DE]) 22 October 2014 (2014-10-22) * the whole document * -----	1-5	INV. E05B55/00 E05B15/10 E05B47/00
A	US 2011/252709 A1 (UYEDA ALAN K [US]) 20 October 2011 (2011-10-20) * the whole document * -----	1-5	

TECHNICAL FIELDS SEARCHED (IPC)

E05B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	12 September 2024	Geerts, Arnold

CATEGORY OF CITED DOCUMENTS

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12-09-2024

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2792826 A2	22-10-2014	DE 102013206694 A1	16-10-2014
		EP 2792826 A2	22-10-2014
		ES 2732842 T3	26-11-2019
		PL 2792826 T3	30-09-2019
US 2011252709 A1	20-10-2011	CA 2796705 A1	27-10-2011
		CN 102918220 A	06-02-2013
		GB 2492295 A	26-12-2012
		TW 201202529 A	16-01-2012
		US 2011252709 A1	20-10-2011
		WO 2011133324 A1	27-10-2011

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