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(54) SHUTTER LOCKING MECHANISM

(57) The present invention relates to a cost effective, easily operable, and highly adaptable locking system for fire-retardant shutters. In particular, the invention concerns a system for locking a shutter or a mechanism that opens or closes a fire shutter, said system comprising at least two movable plates (100,200) coupled together by means of a magnet (201), and an actuation member

(320,302), such as a pawl or a pin, coupled to either of the plates. The first plate (100) is responsive to tension or pressure that builds in said mechanism for opening or closing the shutter, and moves in response to said tension or pressure thus causing the movement of the magnetically coupled thereto second plate (200) and of the actuation member (320,302) coupled to the latter.

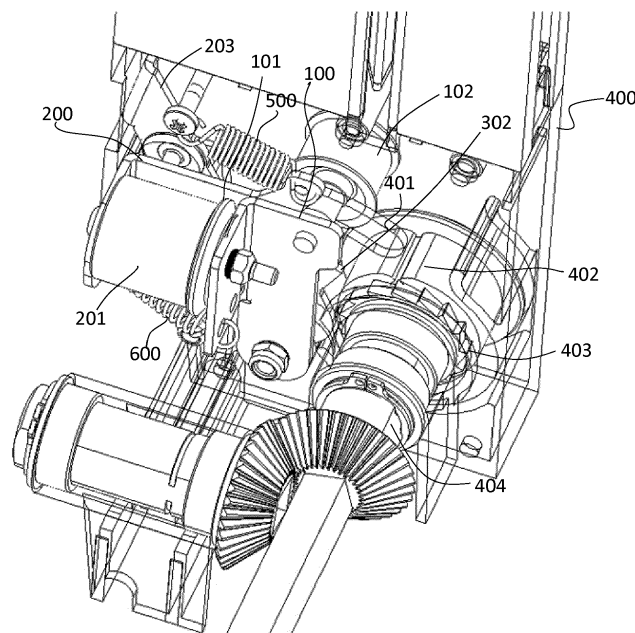


FIG. 5

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Description

Technical Field

[0001] The present invention relates to a cost effective, easily operable, and highly adaptable locking system for fire-retardant shutters. In particular, the invention concerns a system for locking a fire shutter or a mechanism that opens or closes a fire shutter, said system comprising at least two movable plates coupled together by means of a magnet, and an actuation member, such as a pawl or a pin.

Background for the invention

[0002] Fire spreads in a matter of minutes to seconds, generating hazardous fumes that can render people disoriented or even unconscious. Therefore, during fire in a building a quick intervention to ensure the advancing smoke is locked off and the fire progression is delayed provides a key factor in saving lives.

[0003] For this and more reasons, there is a constant need for developing faster reacting and more efficient active fire barriers in order to buy as much time as possible for a safe escape of fire victims.

[0004] Active barriers are any barriers that move in the event of fire into their fire operational position. Usually, they range from 600°C-sustaining barriers (smoke barriers) to full four-hour to two-hour fire resistance (fire barriers). Traditionally, active fire barriers contain a housing, or a frame, that can be mounted in an architectural opening and a shutter door movable in the housing.

[0005] The importance of being able to quickly change between open and closed position of the barrier door accounts for the fact that in most fire shutters the door movement is designed to be light, effortless, and swift. Consequently, without proper locking systems for capturing the shutter door in a desired position inside the housing, the door could be easily moved due to e.g. falling objects or pressures caused by the difference of temperatures on both of sides of the door. For this reason, efficient locking of the shutter door or of the mechanism for moving the shutter door is paramount for the shutter's function as a smoke or fire barrier because any undue leakiness could lead to spreading of toxic fumes and quicker passing of flames.

[0006] On the other hand, it is desirable for the locking system to be reversible, i.e. to be reversible to a disengaged state once the locking system is engaged and *vice versa*. This allows for reusing undamaged shutters following e.g. fire drills or false alarms, and thus has the advantage of being more economical.

[0007] The reversibility of locking can be achieved by the use of a magnet or an electromagnet. An example of a mechanism employing a magnet can be found e.g. in US5245879. The document teaches a break for closing a fire shutter coupled to a time-delay mechanism that acts upon said break to prevent it from closing the shutter

in case of a regular power failure and not fire. The mechanism includes an electromagnet, a timer connected to the electromagnet, and an actuation member also connected to the electromagnet. The actuation member is movable between an engaged position and a released position. The actuation member is engageable with the fire barrier such that when it is in an engaged position, the actuation member prevents closure of the fire barrier; conversely, when the actuation member is in a released position, it allows closing of the fire barrier. The electromagnet connected to the actuation member maintains it in the engaged position when power is supplied to the electromagnet and moves the actuation member to the released position when power is no longer supplied to the magnet. Furthermore, the electromagnet returns the actuation member to the engaged position when power is restored, thereby automatically resetting the brake actuation member.

[0008] As another example, US5850865 teaches a locking device for a fire curtain comprising two solenoids - an AC solenoid and a DC solenoid. For example, the DC solenoid is coupled to a spring that acts against the magnetic force produced by said solenoid and is further coupled to additional mechanical elements such as swinging pins or rods that change their position dependently on the activation state of the solenoid.

[0009] Then, GB768127 discloses a locking device for a rolling shutter, said device being mounted in the frame of the shutter and consisting of paired bolts that are releasable and retractable by means of magnetic force generated by a solenoid. The bolts are urged to their locking positions by springs that counteract the magnetic force generated by the solenoid.

[0010] Similarly, US7448426 discloses a locking device for a fire-proof door, said mechanism comprising a braking pin actuatable by a spring in response to powering off a solenoid.

[0011] The locking mechanism in the above documents respond to an external trigger generated from outside the shutter. For example, they are triggered by an electrical impulse supplied to the shutter from a power supply station. Such dependence on external triggers makes them more complex to manufacture as well as vulnerable to conditions of power failure during fire.

[0012] The present invention addresses this drawback by providing a mechanically simple locking system that is coupled to and movable with an element directly responding to tension (for example of a band or a band) or pressure building in mechanism that actuates closing or opening the shutter as this mechanism operates. As the locking system according to the invention moves in direct response to the pressure or tension arising inside the shutter mechanism, it triggers a change in position of an actuation member that, as a result, becomes engaged (or disengaged) with the same shutter mechanism, preventing it from further movement.

[0013] As such, the locking system of the presented-herein invention responds directly to tension or pressure

that arises in the shutter-closing or opening mechanism during its operation and therefore it will be triggered even under emergency conditions wherein the shutter is operated manually. Another advantage of the present locking system that by simple modification it can easily be made re-usable through automatic rearming. These and further advantages of the present invention are explained in continuation.

Summary of the invention

[0014] The present invention is defined in the appended independent claims. Preferred embodiments are defined in the dependent claims. In particular, the present invention concerns a system for a belt or chain driven opening and closing mechanism, said locking system comprising:

(a) a first plate (100) movably mounted in a first guide way of a support structure (400) between a first position and a second position, said first plate (100) comprising:

- (a.1) a first element (101) from a pair of a magnet and its target, said pair of the magnet and its target being controllable such as to allow controlling of the magnetic force exerted between the magnet and its target when both are coupled;
- (a.2) a tension or pressure actuator (102);

(b) a second plate (200) movably mounted along a second guide way of the support structure (400) between a first position and a second position, the second plate (200) comprising:

- (b.1) a second element (201) from a pair of a magnet and its target;
- (b.2) a first resilient means (500) biasing the second plate (200) in a first position in view of the support structure (400);
- (b.3) a means providing a force biasing said second plate (200) towards the first plate (100) allowing engagement of the magnet and its target, said means comprising at least the magnet and its target;
- (b.4) an actuation member (320, 302) allowing interaction with the opening and closing mechanism to lock said opening and closing mechanism;

characterized in that the locking system comprises:

(c) a tension or pressure transmitter allowing transmitting of a tension or pressure that builds in said opening and closing mechanism onto the tension actuator of the first plate (100), thereby biasing the locking system for movement in a direction opposite to the direction of the force exerted by the first resilient means (500) on the second plate (200) when the first

(100) and second plate (200) are coupled by the magnetic force exerted between the magnet and its target; and

(d) a control unit (900) allowing controlling of the magnetic force exerted between the magnet and its target between

- a first strength such that the force biasing said second plate (200) towards the first plate (100) when coupled, is larger than the force exerted by the first resilient means (500) on the second plate (200) when said second plate (200) is positioned in the second position, and
- a second strength such that the force biasing said second plate (200) towards the first plate (100) when coupled, is smaller than the force exerted by the first resilient means (500) on the second plate (200) when said first plate (200) is in positioned in the second position.

[0015] In a further aspect, the present invention also provides a fire or smoke shutter comprising a frame, a shutter door, preferably being a rollable shutter door, and a locking system according to the invention.

[0016] Finally, the present invention also provides a use of the locking system, as described above, in locking a shutter opening and closing mechanism, preferably being a belt or chain driven mechanism.

Brief description of the Figures

[0017] For a fuller understanding of the nature of the present invention, reference is made to the following detailed description taken in conjunction with the accompanying drawings in which:

Figure 1A and B - schematically shows a side view of one embodiment of the present invention, wherein *panel A* shows the initial state of the locking system according to the invention; *panel B* shows the displacement of two magnetically coupled plates (100 & 200) and stretching of a tension-responsive resilient means (spring 500) in response to tensing of a belt (405) that guides movement of a shutter door (not shown), followed by the engagement of an actuation member (320) with a cogwheel (403) coupled to a mandrel (402) around which the band (405) rotates and folds; *panel C* shows the withdrawal of the second plate (200) caused by cancelling of the magnetic force between a magnet and its target (101 & 102) comprised in the two plates (100 & 200), and by contracting of the tension-responsive spring (500), which in turn causes disengagement of the actuation member (320) from the cogwheel (403) and stretching of a rearming spring (600) between the first (100) and the second plate (200); *panel D* shows the return of the locking system of the invention to the initial state due to restoration of the mag-

netic force between the magnet (201) and its target (101), and removal of the tension on the band (405) that allows rearming movement of the first plate (100) and contracting of the rearming spring (600). Arrows indicate direction of movement of the indicated elements.

Figure 2 schematically shows the same embodiment of the invention as showed in Figure 1 from a frontal view. Panels A-D correspond to the panels A-D shown in Figure 1.

Figure 3A and B schematically shows another embodiment of the invention, wherein the actuation member (302) which is separate from and coupled to the second plate (200) by means of an extension or a coupling bolt (203). Panels A-D show the same stages of the locking system operation as shown in panels A-D in Figures 1 and 2.

Figure 4 schematically shows a perspective projection of another embodiment of the locking system of the invention, wherein the actuation member (302) is further coupled by a resilient means (700) to the first plate (100).

Figure 5 shows a perspective projection of the embodiment shown in Figure 4 providing a more detailed view of the system elements positioned inside of the support structure (400).

Figure 6 shows a perspective projection of the embodiment shown in Figures 4 and 5 as seen from the behind, which provides a better view on the coupling extension (203) that couples the actuation member (302) to the second plate (200).

Definitions

[0018] As used herein, the term "*fire shutter*" is to be construed as any active fire- or smoke-retardant barrier comprising a shutter door, e.g. in a form of a roller or a curtain, which in given conditions can open or close for smoke-evacuation purposes or to counteract spreading of fire or smoke. Similarly, the term "*fire shutter assembly*", or "*shutter assembly*" is to be understood as referring to a fire shutter in addition to the shutter door also comprising support structure, such as a housing or a frame, for facilitating positioning said shutter in an opening such as an architectural opening or a duct opening.

[0019] Further, as used herein the term "*mechanism for opening or closing a shutter*", "*opening and closing mechanism*" or in short just "*shutter mechanism*", is to be understood as any plurality of elements that assist, actuate, or guide the opening or closing of a shutter door mounted in a shutter assembly. Usually, such shutter mechanism will be comprised or mountable in a shutter housing, and can be of any type known in the art of man-

ufacturing fire shutters. Where rolling shutters are concerned, i.e. comprising shutter door in a form of a roll that can wind or unwind around a rotatable mandrel, preferably the shutter mechanism will comprise a band (a band, or a strap) that can wind and unwind simultaneously with the rolling shutter door, potentially serving as a guiding element for said door.

[0020] As used herein the term "*resilient means*" shall be understood as any elastic element or an assembly of elements that can regain its original shape after being bent, compressed, stretched or otherwise extended, e.g. a spring or an elastic band.

[0021] Also, as used herein the term "*immobilised*" will be as fixed to support structure such as a wall or a shutter frame.

[0022] Lastly, the term "*locking system*" as used herein is to be construed as an assembly of a plurality of interconnected elements that can respond to a given change and actuate a change of a position or a state of at least one element, further referred to as "*actuation member*", capable of interacting with either the shutter door, housing, or preferably shutter mechanism, which interaction results in either locking the ability of the shutter door to move or unleashing said ability of a shutter door that was previously prevented from moving due to engagement with said actuation member.

Detailed description of the invention

[0023] The present invention provides a system for locking a fire shutter via a direct engagement of an actuation member comprised in said system with a corresponding register provided in a shutter door, part of a frame housing said shutter door, or preferably in the mechanism that guides opening or closing of said shutter, further referred to as the opening and closing mechanism. The system according to the invention comprises:

(a) a first plate (100) movably mounted in a first guide way of a support structure (400) between a first position and a second position, said first plate (100) comprising:

- (a.1) a first element (101) from a pair of a magnet and its target, said pair of the magnet and its target being controllable such as to allow controlling of the magnetic force exerted between the magnet and its target when both are coupled;
- (a.2) a tension or pressure actuator (102);

(b) a second plate (200) movably mounted along a second guide way of the support structure (400) between a first position and a second position, the second plate (200) comprising:

- (b.1) a second element (201) from a pair of a magnet and its target;
- (b.2) a first resilient means (500) biasing the sec-

ond plate (200) in a first position in view of the support structure (400);

(b.3) a means providing a force biasing said second plate (200) towards the first plate (100) allowing engagement of the magnet and its target, said means comprising at least the magnet and its target;

(b.4) an actuation member (320, 302) allowing interaction with the opening and closing mechanism to lock said opening and closing mechanism;

characterized in that the locking system comprises:

(c) a tension or pressure transmitter allowing transmitting of a tension or pressure that builds in said opening and closing mechanism onto the tension actuator of the first plate (100), thereby biasing the locking system for movement in a direction opposite to the direction of the force exerted by the first resilient means (500) on the second plate (200) when the first (100) and second plate (200) are coupled by the magnetic force exerted between the magnet and its target; and

(d) a control unit (900) allowing controlling of the magnetic force exerted between the magnet and its target between

- a first strength such that the force biasing said second plate (200) towards the first plate (100) when coupled, is larger than the force exerted by the first resilient means (500) on the second plate (200) when said second plate (200) is positioned in the second position, and
- a second strength such that the force biasing said second plate (200) towards the first plate (100) when coupled, is smaller than the force exerted by the first resilient means (500) on the second plate (200) when said first plate (200) is in positioned in the second position.

[0024] In the system according to present invention, the actuation member (320, 302) together with the first (100) and the second plate (200) are initially held in one position, further referred to as the "initial position", by the tension responsive resilient means (500). In response to sufficient tension or pressure that built up in the shutter mechanism, the two magnetically coupled plates (100 and 200) are moved together with the actuation member (320, 302) to a position other than the initial one, which also results in stretching of the tension responsive resilient means (500). Depending of the set-up of the locking system according to the invention, said movement of the actuation member (320, 302) to a position other than the initial one may result in either engaging or disengaging of said actuation member with respect to a corresponding register within the shutter assembly (i.e. the assembly comprising at least a shutter door, frame housing said shutter door, and the shutter mechanism), that, also de-

pending on the desired set-up, can result in either locking or unlocking the movement of the shutter door.

[0025] The shutter mechanism can be of any type known in the art, such as a gear-box or a band- or a chain-based mechanism such as the band-based shutter guiding mechanisms known in rolling shutters. The first plate (100) comprises and interacts with the shutter mechanism, through zone of said plate (100) or an element coupled thereto, further referred to as the tension or pressure actuator (102). The tension or pressure actuator (102) can in turn either be directly connected to the shutter mechanism or can be pressed, pulled, or pushed by said mechanism or an element forming part of said mechanism.

[0026] In one preferred embodiment, as schematically shown in Figures 1 to 6, the opening and closing mechanism can advantageously be a band-based mechanism that comprises a band (405) rollable around a mandrel (402) which can be actuated by any suitable and known in the art motor, e.g. of an actuator-type, or manually. For example, a suitable actuator can actuate the rotational movement of the mandrel (402) through an axle shaft (404), thus controlling the winding and unwinding of the band (405) around the mandrel (402). In such embodiment, the tension or pressure actuator (102) of the first plate (100) could be a pressure actuator (102) in a form of, for example a bolt, that extends behind the band (405) and enters in direct contact with said band (405). Once said band (405) becomes maximally stretched due to becoming maximally wound around the mandrel (404), the band (405) will push on the pressure actuator (102) driving its movement in view of the support structure (400), for example inside of a slot (401) provided in said support structure (400).

[0027] In a preferred embodiment, the opening and closing mechanism is provided as a belt or chain-driven opening and closing mechanism and wherein the tension transmitter comprises:

- at least two spaced apart guides (407, 402) fixed to the support structure (400); and
- the tension actuator (102) of the first plate (100), said tension actuator (102) being movable with the first plate (100) between a first position substantially in line with the spaced apart guides (407, 402) and a second position distant from the straight line between both said spaced guides (407, 402),

whereby the belt or chain (405) is guided along said spaced guides (407, 402) and said tension actuator (102) such that upon tensing the belt or chain (405), the tension actuator (102) and first plate (100) are forced into or maintained in said first position wherein the tension actuator (102) is substantially in line with said spaced apart guides (407, 402). For better understanding, the above-described situation is schematically shown in Figure 1A, 2, and 3A in the transition from panels A to B.

[0028] In an initial state of the embodiment shown in

Figures 1 and 2 (panel A), the tension-responsive resilient means (500) holds the two magnetically-coupled plates (100 and 200) and the actuation member (310) in the first, or initial position. In response to the band (405) becoming sufficiently tensed in its section comprised between the band stabilising bolts (406 and 407) and the fully rotated mandrel (402), the magnetically coupled plates (100 and 200) move, which causes stretching of the tension-responsive resilient spring (500) and change in the position of the actuation member (310) to the second position. As a consequence, the actuation member (310) will, dependently on the locking system's arrangement vis-à-vis the other parts of the shutter assembly, either engage or disengage with respect to a corresponding element or register within the shutter mechanism, or shutter door, or even a shutter housing, thus locking or unlocking the movement of the shutter door.

[0029] In a particularly preferred embodiment, the locking system of the invention comprises or is connected to control unit (900) allowing to cancel the magnetic force that holds the first (100) and the second (200) plate together, which allows to separate the second plate (200) from the first plate (100) due to action of the tension responsive resilient means (500). In a situation where the first plate (100) is displaced from the first or initial position to the second position, due to the tension accumulated on the band (405), the cancelling of the magnetic force between the two plates (100 & 200) will enable the previously-stretched tension responsive resilient means (500) to contract to its resting state, thus allowing to pull the second plate (200) away from the first plate (100), and consequently also to return the actuation member (320) to its initial position. This is schematically shown in Figures 1B, 2, and 3B in panel C.

[0030] In a possible embodiment the magnet is an electromagnet and the control unit (900) allowing controlling of the magnetic force is a source of an electric current that is supplied to said electromagnet. In such arrangement, the electromagnet may be a regular electromagnet, i.e. a temporary magnet powered by electricity in order to maintain its magnetic field; or a reversed electromagnet that comprises a constant magnet that is on when no electric current is generated but can be reversibly demagnetised when an electric current is supplied to it such that the electromagnetic field generated by the flowing electric current cancels out the magnetic field produced by said constant magnet. Different solutions for coupling magnets with source of electricity are broadly known in the art and therefore will not be further discussed herein.

[0031] In an alternative embodiment in accordance with the afore-listed embodiments, the target of the electromagnet can be a conventional magnet or another electromagnet. Like this, the cancelling the magnetic force can also be understood as generation of a negative magnetic force (i.e. repulsion between the electromagnet and its target magnet or target electromagnet) that can be obtained by changing the direction of the current in one

electromagnet, which results in reversal of the poles of said electromagnet.

[0032] In a different embodiment, the control unit (900) allowing controlling of the magnetic force can also be a mechanical element, such as a wedge, capable of engaging between the magnet and its target and separating them physically, thus leading to decoupling of the first and the second plate.

[0033] In a highly advantageous embodiment in accordance with any of the previous embodiments, the means providing the force biasing said second plate (200) towards the first plate (100) further comprises a second resilient means (600), further referred to as "arming resilient means (600)", that is coupled to both the first and the second plate (100 & 200) from its opposite ends and acts in support of the magnetic force between the magnet and its target.

[0034] The arming resilient means (600) provides a force acting in the same direction as the magnetic force, i.e. acting to bring the magnet and its target together. It should be noted, that the force provided by the arming spring (600) is smaller than the force provided by the tension-responsive spring (500). Consequently, the arming resilient means (600) can act as an arming mechanism for bringing the two plates (100 & 200) together in the situations where they have been disengaged, like for example due to cancelling the magnetic force between the two plates (100 & 200) where the tension responsive resilient means (500) tends to contract and pull the second plate (200) away from the first plate (100). As described *supra* and shown in panel C in Figures 1-3, such situation causes stretching of the arming resilient means (600). Once stretched, said means (600) will tend to contract to its resting state and will do so when the first plate (100) is released from the shutter opening and closing mechanism and thus allowed to return to its first or initial position, as shown in panel D in Figures 1-3. Thanks to this contracting action, the arming resilient means (600) facilitates the rearming of the locking system of the invention according to the above-described embodiment, thus allowing effective preparation of said system for another locking cycle.

[0035] In line with the above, the combination of the arming spring (600) and selective cancelling of the magnetic force between the plates (100 and 200) provides an advantageous way for controlling engagement status of the actuation member (302). In particular, it provides for such locking control even under the conditions where the shutter mechanism remains under constant pressure or tension.

[0036] In the embodiment exemplified in the Figures 1 and 2, the actuation member (320) is shown as a simple extension of the second plate (200), which in the locked position engages with a toothed gear or a cogwheel (403) fixedly coupled to the mandrel (402) around which the band (405) rotates. By engagement with said cogwheel (403), the actuation member (320) simply prevents the mandrel (402) from rotating, which in turn prevents the

rolling of the band (405) and thus the movement of the shutter door guided by said band (405).

[0037] In another advantageous embodiment of the present invention, as schematically illustrated in Figure 3, the actuation member (302) is movably mounted in a third guide way of the support structure (400) and is connected to the second plate (200) by an extension (203) allowing relative movement of the actuation member (320, 302) in view of the second plate (200). In such an embodiment, the extension (203) can be of any known in the art form of linking means, such as a bolt, or a linking plate, and will preferably be a joint, a hinge, or a bearing. Similarly as in case of the previously described embodiment, as illustrated in Figures 1 and 2, the actuation member (302) of Figure 3 is at first held together with the two magnetically coupled plates (100 & 200) in the first or initial position by the contracted tension responsive resilient means (500) (panel A). Then, once the first plate (100) is moved due to tensing of the band (405) that pushes on the pressure actuator (102), it pulls the second plate (200) behind, which in turn pushes the actuation member (302) into the engagement position with the cogwheel (403) (panel B). Said engagement of the actuation member (302) can then be removed at will through cancelling of the magnetic force between the first and the second plate (100 & 200), which results in withdrawing of the second plate (200) away from the first plate (100) via the contracting action of the tension responsive resilient means (500), and consequently also in disengaging of the actuation member (302) from the cogwheel (403) (panel C). As a result, the mandrel (402) around which the band (405) rotates is unlocked, allowing to unroll the band (405) and thus remove some tension from it; the locking system can now entirely return to its initial position and rearm through the contracting action of the rearming resilient means (600) and restoration of the magnetic force between the first and the second plate (100 & 200) (panel D).

[0038] As can be readily appreciated by any skilled person, the engagement of the actuation member (320, 302) with a cogwheel (403) provides only one possible example of how locking by the system of the invention can be executed. In preferred alternative embodiments of the invention, the actuation member (320, 302) allowing interaction with the opening and closing mechanism is selected from a group comprising:

- a pawl engageable with a ratchet coupled to said opening and closing mechanism, or
- a locking pin or a blot engageable with a corresponding register provided in said opening and closing mechanism, or
- a frictional brake, such as a shoe or pad brake engageable with a corresponding wear surface provided in said opening and closing mechanism.

[0039] Locking pins or bolts are well known in the art and were used in locking mechanism of prior art docu-

ments such as US5850865, GB768127, or US7448426. Friction pads or shoes are another option and often include rotating devices with a stationary pad and a rotating wear surface. Their common configurations include shoes that contract to rub on the outside of a rotating drum, such as a band brake; a rotating drum with shoes that expand to rub the inside of a drum, commonly known as "drum brakes", although other drum configurations are possible; and pads that pinch a rotating disc, commonly called "disc brakes". Other brake configurations are also known in the art but used less often. For example, PCC trolley brakes include a flat shoe which is clamped to the rail with an electromagnet; the Murphy brake that pinches a rotating drum, and the Ausco-Lambert disc brake that uses a hollow disc with shoes that sit between the disc surfaces and expand laterally. An actuation member of the system according to the invention can take any form compatible to form part of such configurations.

[0040] A particularly advantageous form for the actuation member of the invention is a pawl that can be engaged with a ratchet coupled to the shutter mechanism. Pawl-ratchet arrangements allow continuous rotary or linear motion in only one direction while preventing motion in the opposite direction, which can be very useful for selectively biasing the direction in which the mechanism of the rolling shutter is desired to be firmly locked. A pawl can be described as any elongated pivotable, often springloaded, extension, whereas a ratchet is usually provided as a round gear or linear rack with teeth spaced such that an end of the pawl can compatibly engage with them. The teeth are uniform but asymmetrical, with each tooth having a moderate slope on one edge and a much steeper slope on the other edge. When the teeth of the ratchet are moving in the unrestricted direction, the pawl easily slides up and over the moderately sloped edges of the teeth, with a resilient means (usually a helical spring) forcing it into the depression between the teeth as it passes the tip of each tooth. However, when the teeth move in the opposite direction, the pawl will catch against the steeply sloped edge of the first tooth it encounters, thereby locking it against the tooth and preventing any further motion in that direction.

[0041] Thus, in one preferred embodiment of the present invention, the actuation member (320, 302) is a pawl engageable with a ratchet (403) coupled to the shutter mechanism, as schematically shown in a possible embodiment of the system according to the invention, as shown in Figures 4-6.

[0042] In a preferred embodiment, the actuation member (301, 302) can be further coupled to the first plate (100) by an additional resilient means (700) biasing the actuation member (302) in the direction of the opening and closing mechanism, said additional resilient means (700) being further referred to as the loading resilient means (700). An example of such loading resilient means (700) is schematically shown in Figure 4 as a spring (700) that couples the first plate (100) with a pawl (302), thus providing a springloaded pawl (302), which thanks to the

loading resilient means (700) points in the direction of the ratchet (403) coupled to the band-based shutter mechanism.

[0043] A further advantage of an actuation member (302) that coupled to the second plate (200) by means of an extension (203) that provides said actuation member (302) with a certain degree of movement (e.g. a pivoting or a sliding movement) independent of the movement and/or position of the second plate (200), is that in such arrangement, the exact position of the actuation member (302) can be controlled by additional means other than through manipulation of the force that biases said second plate (200) versus the position of the first plate (100). That is to say that in such embodiments of the invention, the position of the actuation member (302) can be adjustable independently of or even without affecting the position of the coupled thereto second plate (200). Such adjustability could for example be achieved by a provision of a reachable from outside the support structure (400) surface or element which, when moved or pressed by a user, would affect e.g. the shape of the extension (302) so as to retract the actuation member (302) with respect the second plate and possibly relative to its corresponding register (403) in the shutter mechanism. In line with the above, in a preferred embodiment, the extension (203) could comprise a pressing surface (800) which when pressed results in changing of the position of the actuation member (302) relative to the position of the second plate (200). An example of such pressing surface (800), forming part of the extension (203) that couples the actuation member (302) with the second plate (200), is shown in Figure 6 providing a detailed rear view of one embodiment of the invention.

[0044] As also exemplified in Figure 6, pressing surface (600) could advantageously be accessible from outside of the shutter frame (400), e.g. via pushing on a button or a specifically designated zone (800), so as to allow direct manual control over the position and engagement status of the actuation member (302) in emergency situations.

[0045] In an alternative embodiment, the extension (203) can be coupled to a motor and operable by means of an electric signal. Thus, in accordance with previous embodiments, that actuation member (302) comprises the extension (203) that can either:

- be manually operable and comprising a pressing surface (800) or an otherwise easily reachable to a user element, which when activated affects the extension (203) such that it changes the position of the actuation member (302) relative to the second plate, or
- coupled to a motor and operable by a means of an external signal, such as via pushing a button on the external side of the shutter, or in a control station at a distance from the shutter, or over a network by executing a command on a computer etc.; such that when said motor is activated it exerts a change in the position of the actuation member (302) relative

to the second plate

- both of the above.

[0046] In another preferred embodiment, the present invention provides the locking system according to any of the afore-described embodiments, wherein the support structure (400) is a frame for housing a shutter door. Due to the nature of the invention, naturally such frame will preferably be manufactured of a fire-resistant material, i.e. a material that does not degrade at 300°C for at least 30 minutes, for example inox (stainless steel), aluminium, or various alloys thereof.

[0047] In a further aspect, the present invention also provides a shutter assembly comprising a frame, a rollable shutter door, and a belt or chain driven opening and closing mechanism for operating said rollable shutter door, said fire shutter characterised in that it comprises a locking system according to any of the afore-described embodiments.

[0048] In particular, the present invention provides a shutter assembly comprising:

- a shutter frame defining a generally rectangular area to be closed by a shutter door, said frame comprising at least three, preferably four profiles;
- a locking system according to any of the afore-mentioned embodiments of the invention, said locking system mounted in at least one profile of said frame serving as its support structure (400);
- preferably, a shutter opening and closing mechanism coupled said locking system and/or to said frame;
- preferably, also a shutter door.

[0049] In another preferred embodiment, a shutter assembly is provided, wherein the opening and closing mechanism comprises a mandrel (402) for rolling said shutter door thereon, whereby the roller shutter is at least partially attached to belt or chain fixed to and rollable on said mandrel and whereby the actuation member of the locking mechanism interacts with said mandrel for locking the opening and closing mechanism.

[0050] In another preferred embodiment in line with the above embodiments, the shutter assembly is a fire- or smoke-retardant shutter assembly. Consequently, as it will be appreciated by any skilled person, the shutter mechanism may comprise any of the different arrangements, manual or automated alike, known in the art that are capable of setting a fire-retardant shutter door into motion as to close or open the area defined by the shutter frame. The shutter mechanism can be triggered in response to any an internal or external signal relayed from an initiating device either integrated in the assembly, or nearby, or more distant. Examples of initiating devices are also well known in the art and are not within the scope of the present invention, they include e.g. pull stations, break-glass stations, heat detectors, fusible links, smoke detectors, flame detectors, water-flow detectors, camer-

as etc.

[0051] In a preferred embodiment, the shutter door is a rolling shutter door, i.e. a rollable door coupled to a mandrel and extending by means of rotational motion of said mandrel in the housing. In a particularly preferred embodiment, the shutter mechanism for opening or closing such door comprises a band-based guiding system for guiding at least one lateral edge of said rolling shutter door, preferably both lateral edges during the unwinding of the door. Examples of such guiding systems include guide bands, guide rails, or guiding cables, which advantageously can be coupled to a motor and actively contribute to the opening or closing of the shutter.

[0052] Lastly, the present invention also provides a use of the locking system according to any of the above-listed embodiments, in locking an opening and closing mechanism of a shutter, preferably a fire shutter, wherein said mechanism is most a belt or chain driven shutter mechanism.

Claims

1. A locking system for a belt or chain driven opening and closing mechanism, said locking system comprising:

(a) a first plate (100) movably mounted in a first guide way of a support structure (400) between a first position and a second position, said first plate (100) comprising:

- (a. 1) a first element (101) from a pair of a magnet and its target, said pair of the magnet and its target being controllable such as to allow controlling of the magnetic force exerted between the magnet and its target when both are coupled;
- (a. 2) a tension or pressure actuator (102);

(b) a second plate (200) movably mounted along a second guide way of the support structure (400) between a first position and a second position, the second plate (200) comprising:

- (b.1) a second element (201) from a pair of a magnet and its target;
- (b.2) a first resilient means (500) biasing the second plate (200) in a first position in view of the support structure (400);
- (b.3) a means providing a force biasing said second plate (200) towards the first plate (100) allowing engagement of the magnet and its target, said means comprising at least the magnet and its target;
- (b.4) an actuation member (320, 302) allowing interaction with the opening and closing mechanism to lock said opening and closing

mechanism;

characterized in that the locking system comprises:

- (c) a tension or pressure transmitter allowing transmitting of a tension or pressure that builds in said opening and closing mechanism onto the tension actuator of the first plate (100), thereby biasing the locking system for movement in a direction opposite to the direction of the force exerted by the first resilient means (500) on the second plate (200) when the first (100) and second plate (200) are coupled by the magnetic force exerted between the magnet and its target; and
- (d) a control unit (900) allowing controlling of the magnetic force exerted between the magnet and its target between

- a first strength such that the force biasing said second plate (200) towards the first plate (100) when coupled, is larger than the force exerted by the first resilient means (500) on the second plate (200) when said second plate (200) is positioned in the second position, and
- a second strength such that the force biasing said second plate (200) towards the first plate (100) when coupled, is smaller than the force exerted by the first resilient means (500) on the second plate (200) when said first plate (200) is in positioned in the second position.

2. Locking system according to claim 1, wherein the magnet is an electromagnet.
3. Locking system according to any of the preceding claims, wherein the means providing the force biasing said second plate (200) towards the first plate (100) further comprises a second resilient means (600).
4. Locking system according to any of the preceding claims, wherein the the actuation member (302) is movably mounted in a third guide way of the support structure (400) and is connected to the second plate (200) by an extension (203) allowing relative movement of the actuation member (320, 302) in view of the second plate (200).
5. Locking system according to claim 4, wherein the extension (302) is a joint, a hinge, or a bearing.
6. Locking system according to claim 4 or 5, wherein the actuation member (302) is further coupled to the first plate (100) by an additional resilient means (700) biasing the actuation member (302) in the direction

of the opening and closing mechanism.

7. Locking system according to any of the claims 4 to 6, wherein the extension (203) comprises a pressing surface (800) which when pressed results in changing of the position of the actuation member (302) relative to the position of the second plate (200). 5
8. Locking system according to any of the claims 4 to 7, wherein the extension (203) is coupled to a motor operable by means of an electric signal. 10
9. Locking system according to any of the preceding claims, wherein the actuation member (320, 302) allowing interaction with the opening and closing mechanism is selected from a group comprising: 15
 - a pawl engageable with a ratchet coupled to said opening and closing mechanism, or
 - a locking pin or a blot engageable with a corresponding register provided in said opening and closing mechanism, or
 - a frictional brake, such as a shoe or pad brake engageable with a corresponding wear surface provided in said opening and closing mechanism. 20 25
10. Locking system according to any of the preceding claims, wherein the opening and closing mechanism is a belt or chain driven opening and closing mechanism or a gear box. 30
11. Locking system according to claim 10, wherein the opening and closing mechanism is a belt or chain driven opening and closing mechanism and wherein the tension transmitter comprises: 35
 - at least two spaced apart guides (407, 402) fixed to the support structure (400); and
 - the tension actuator (1 02) of the first plate (100), said tension actuator being movable with the first plate between a first position substantially in line with the spaced guides (407, 402) and a second position distant from the straight line between both said spaced guides (407, 402), 40 45

whereby the belt or chain (405) is guided along said guides and said tension actuator such that upon tensioning the belt or chain, the tension actuator and first plate are forced into or maintained in said first position wherein the tension actuator is substantially in line with said spaced apart guides (407, 402). 50

12. Fire shutter assembly comprising a frame, a rollable shutter door, and a belt or chain driven opening and closing mechanism for operating said rollable shutter door, said fire shutter **characterised in that** it com- 55

prises a locking system according to any of the claims 1 - 11.

13. Fire shutter assembly according to claim 12, wherein the opening and closing mechanism comprises a mandrel (402) for rolling said shutter door thereon, whereby the roller shutter is at least partially attached to belt or chain fixed to androllable on said mandrel and whereby the actuation member of the locking mechanism interacts with said mandrel for locking the opening and closing mechanism.
14. Use of the locking system according to any of the claims 1-11 in locking an opening and closing shutter mechanism, preferably being a belt or chain driven shutter mechanism.

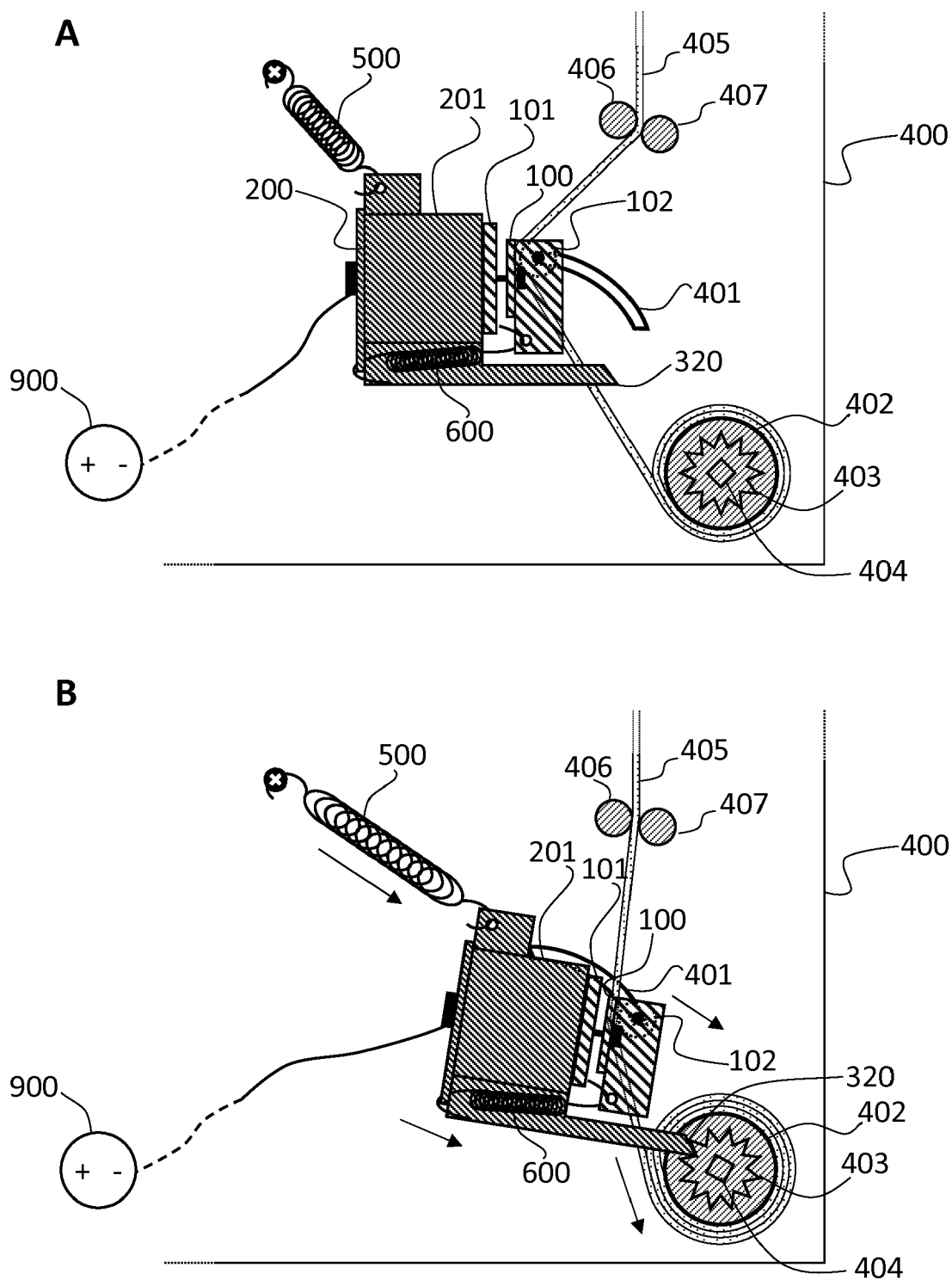


FIG. 1A

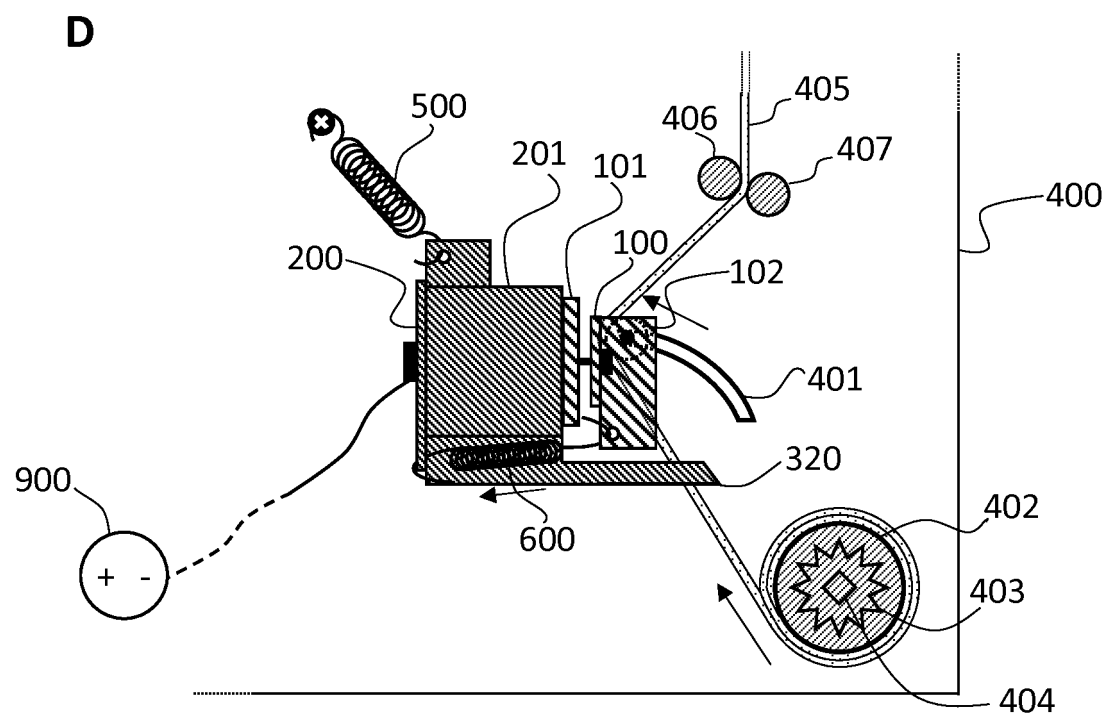
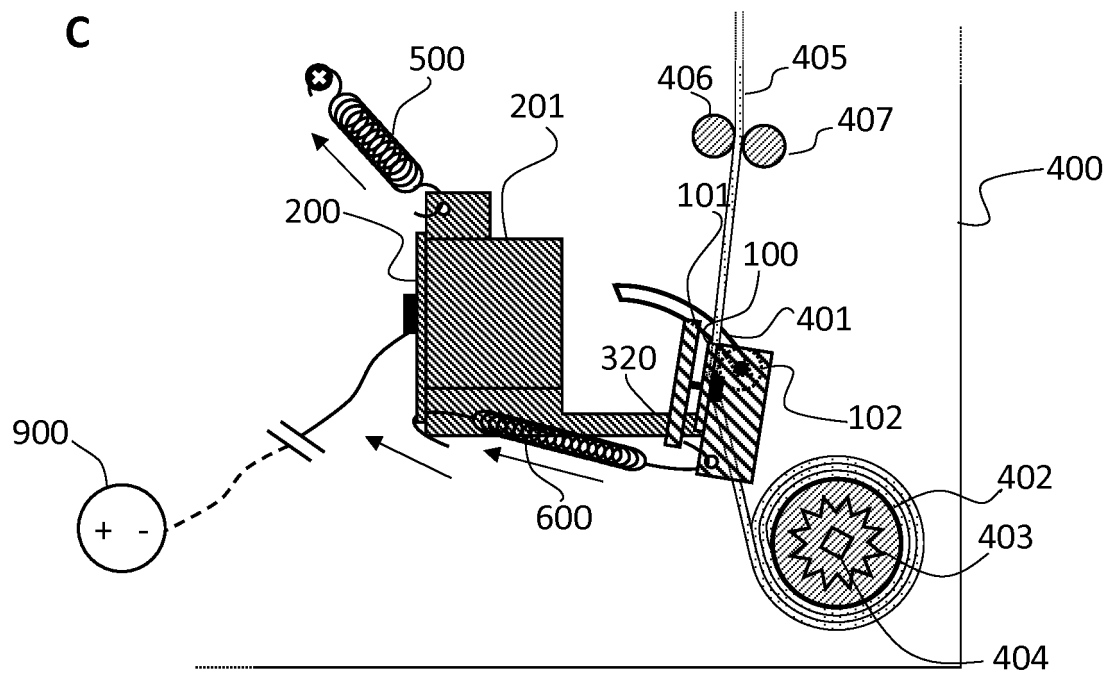


FIG. 1B

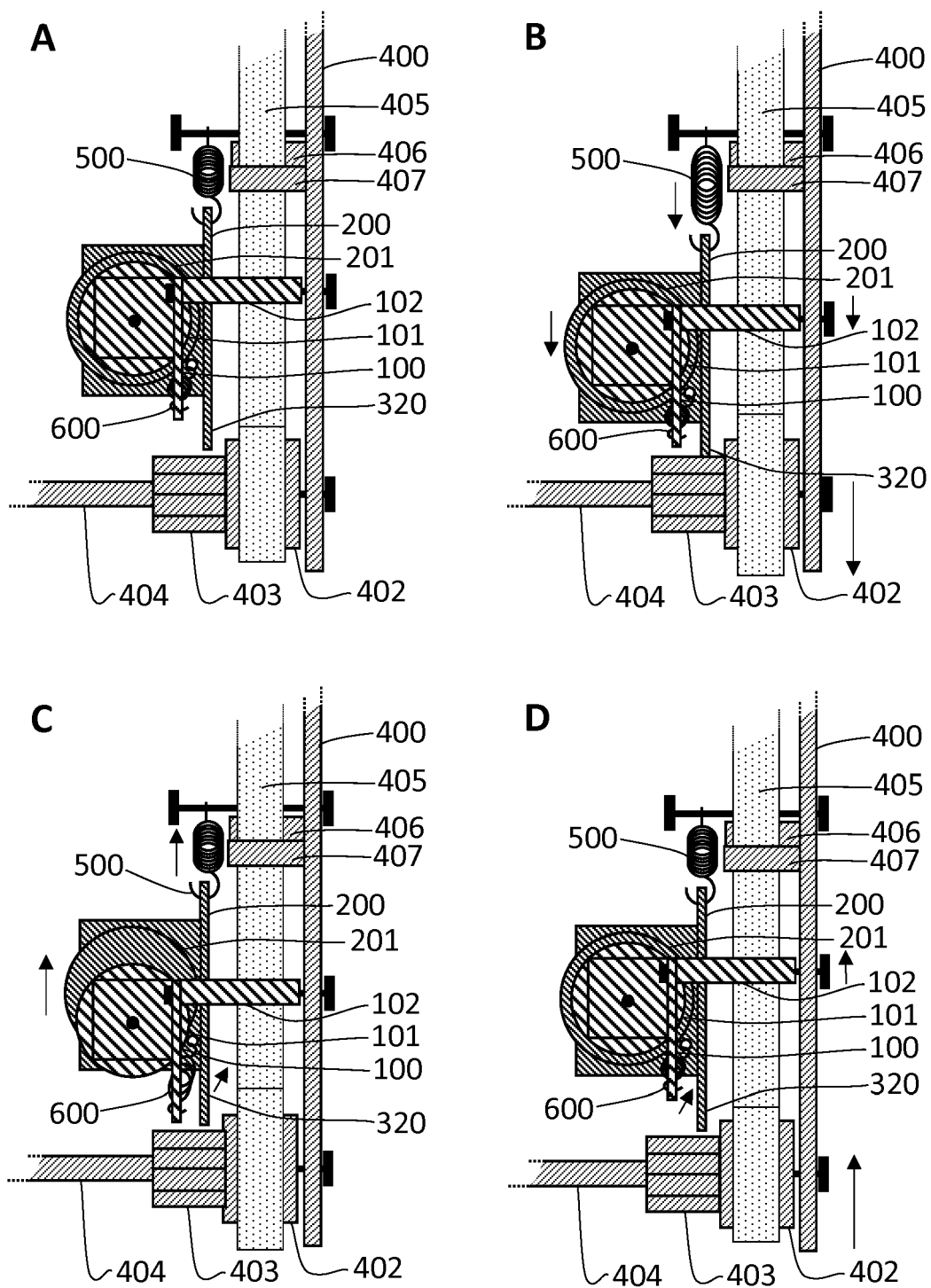


FIG. 2

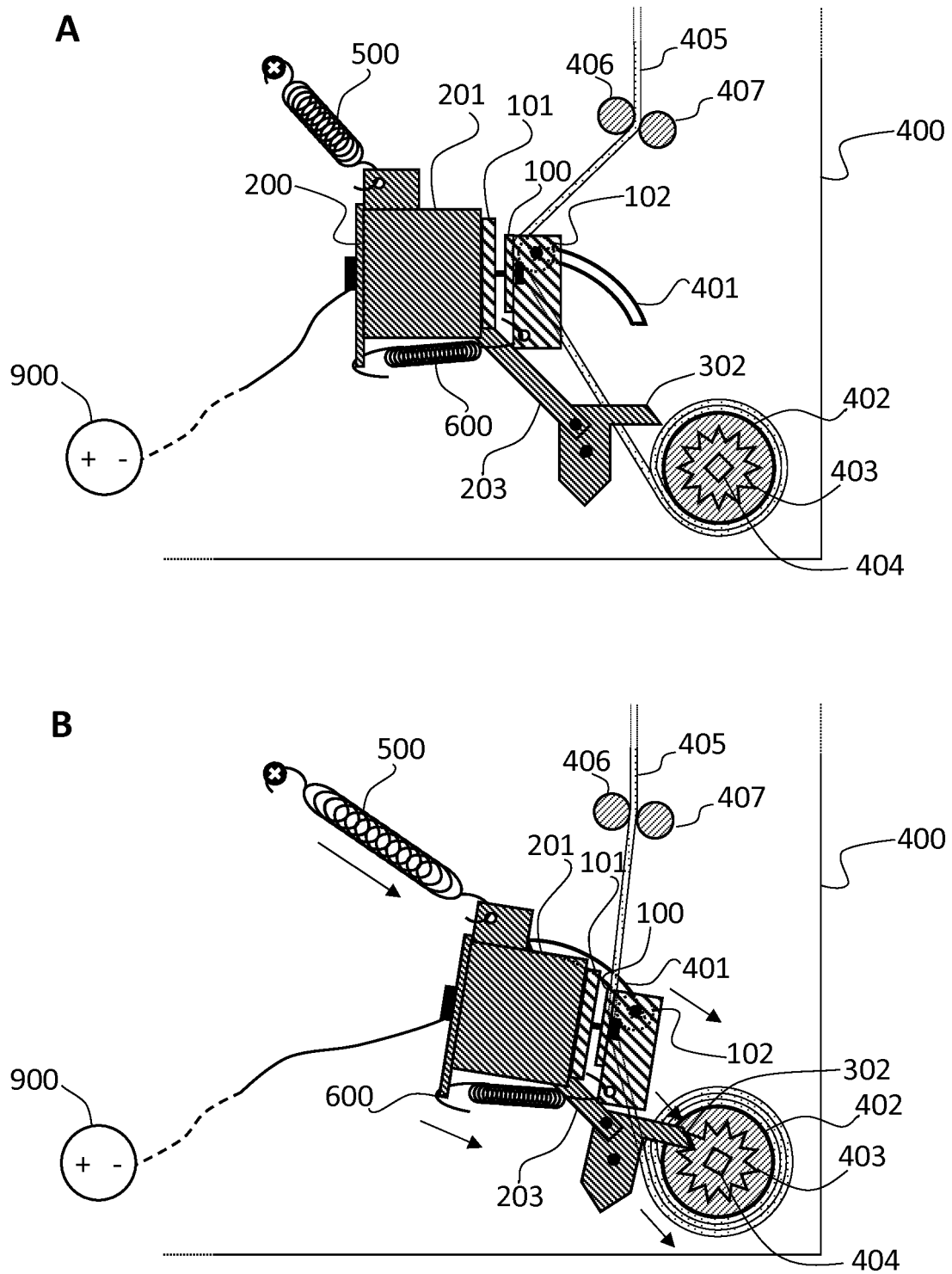


FIG. 3A

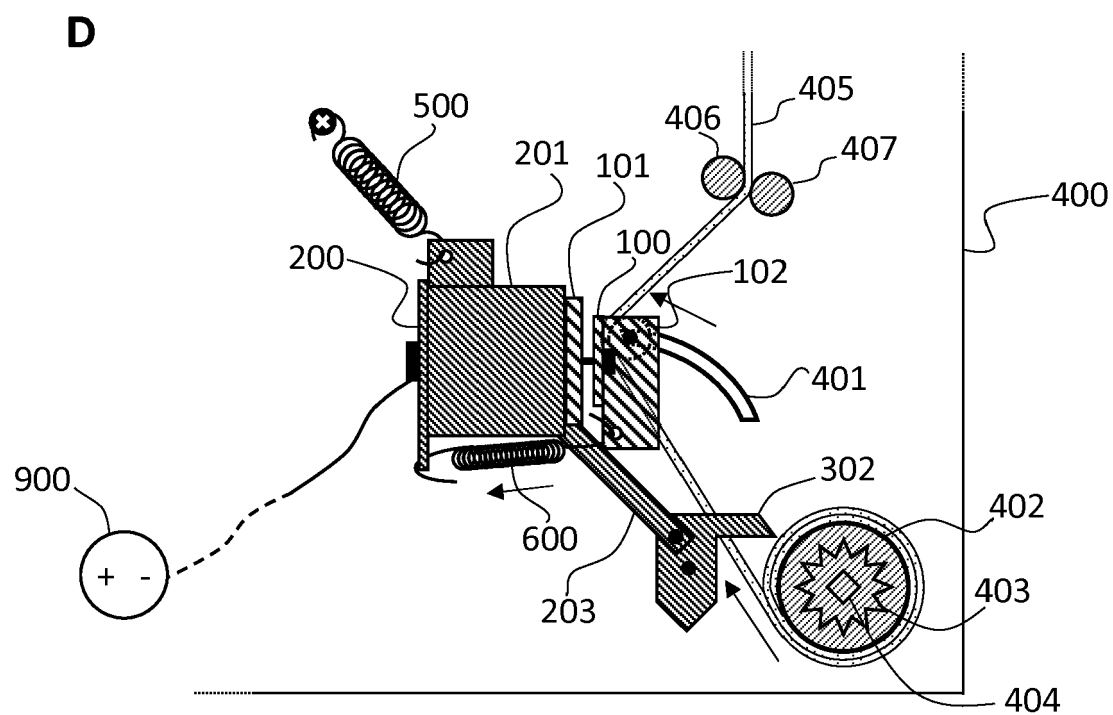
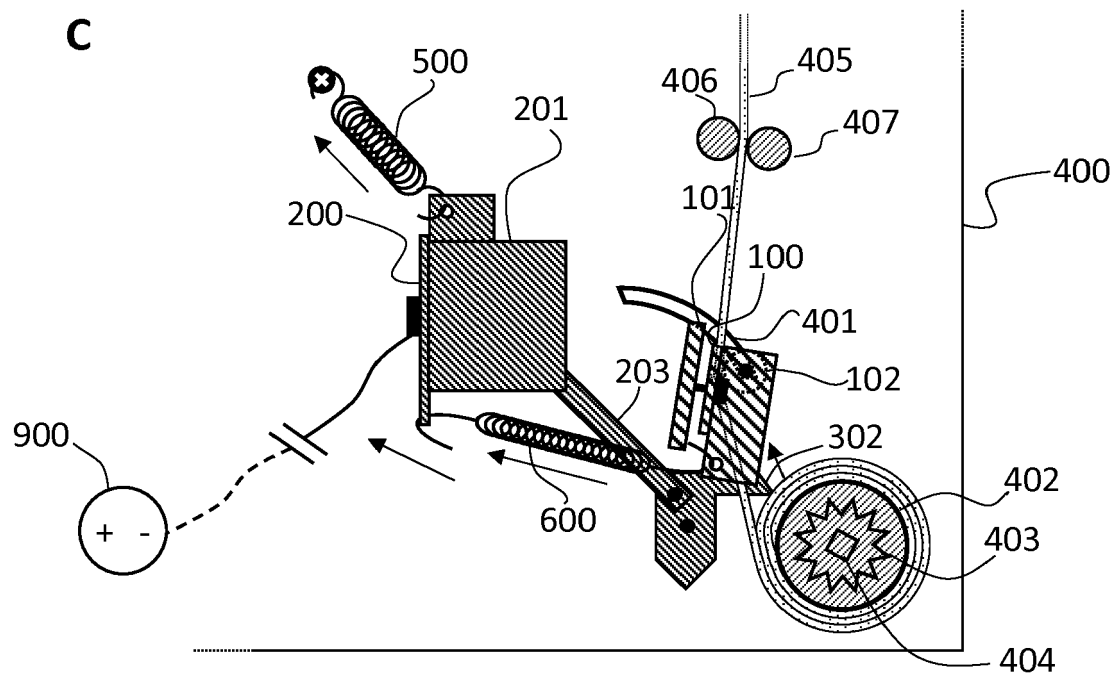


FIG. 3B

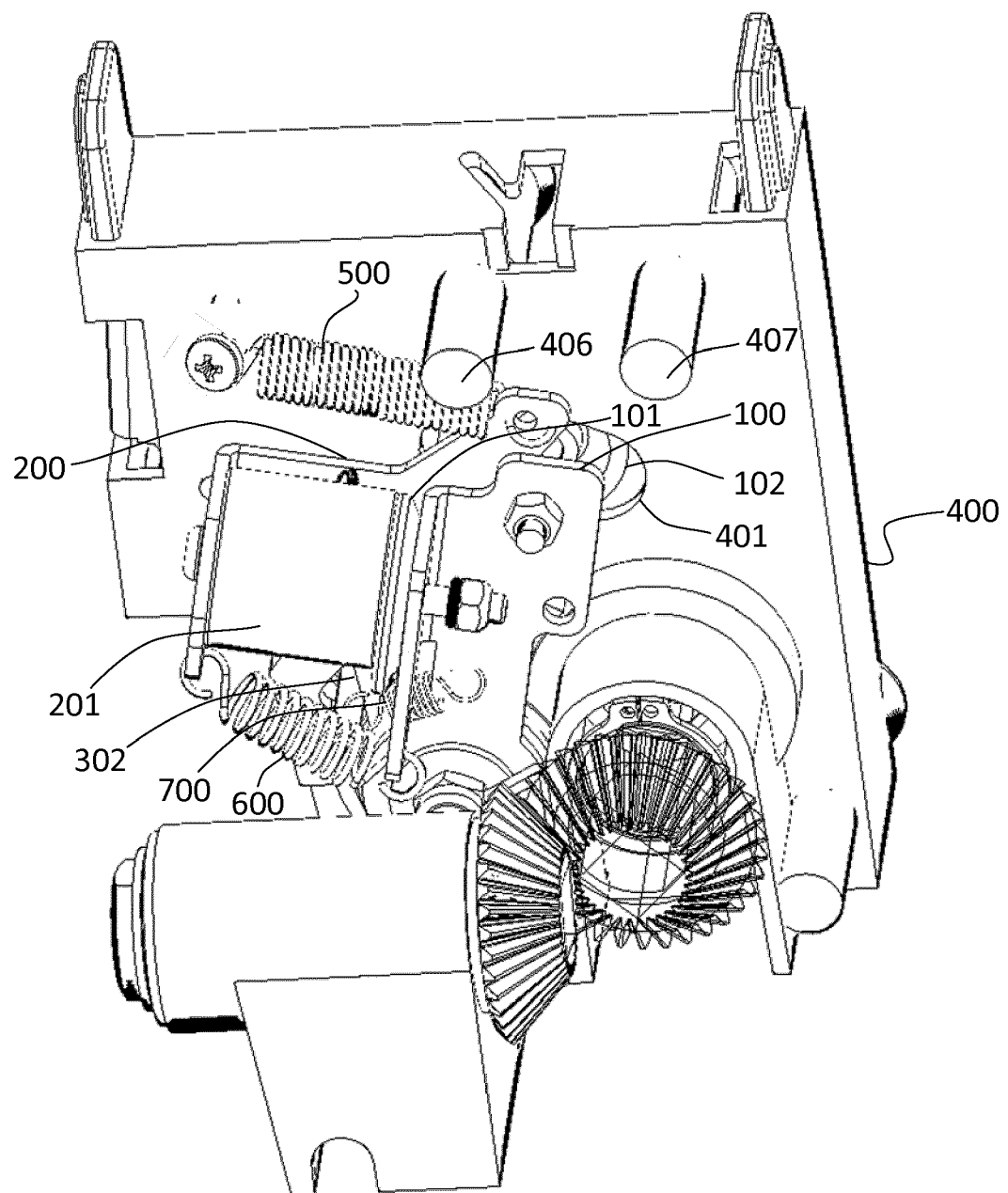


FIG. 4

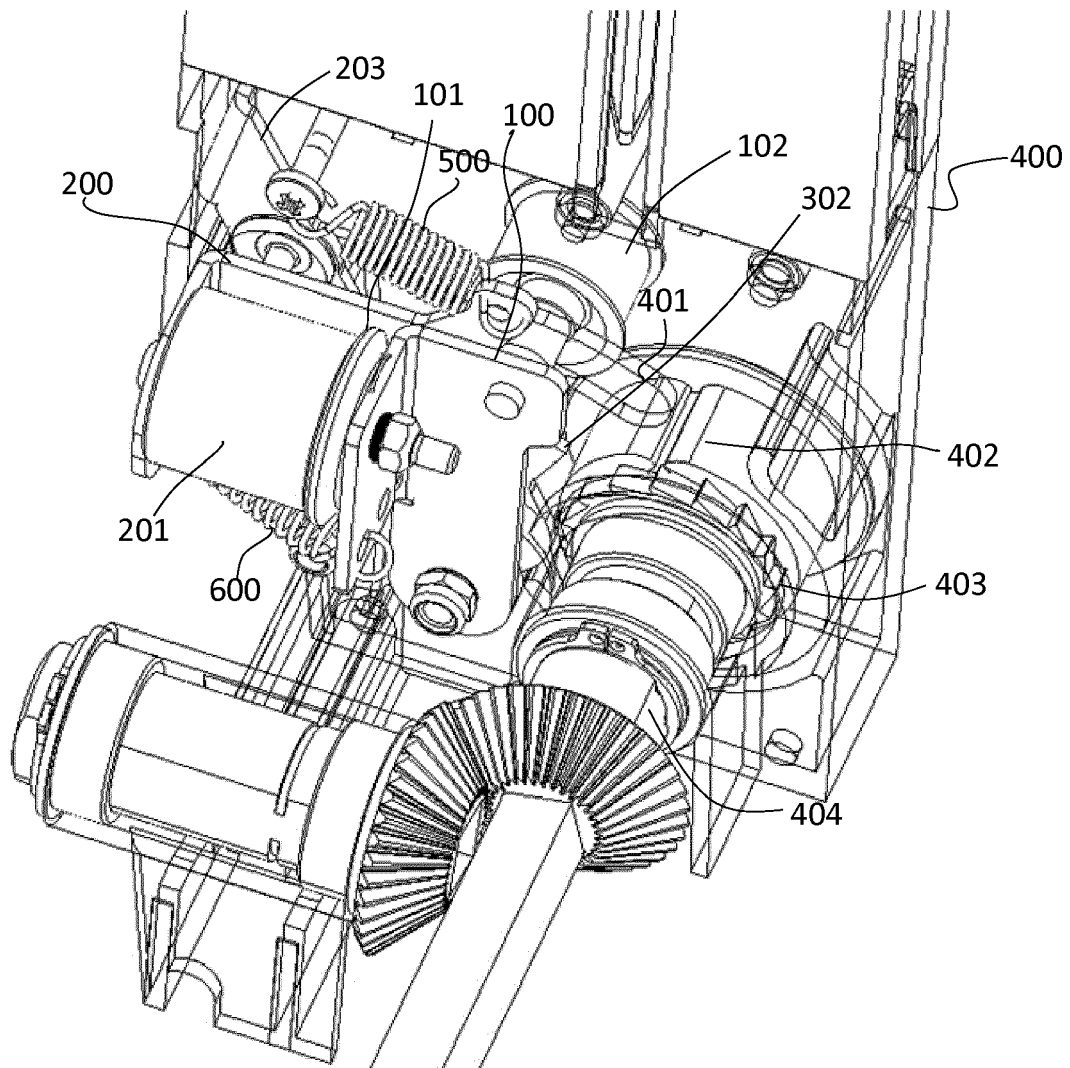


FIG. 5

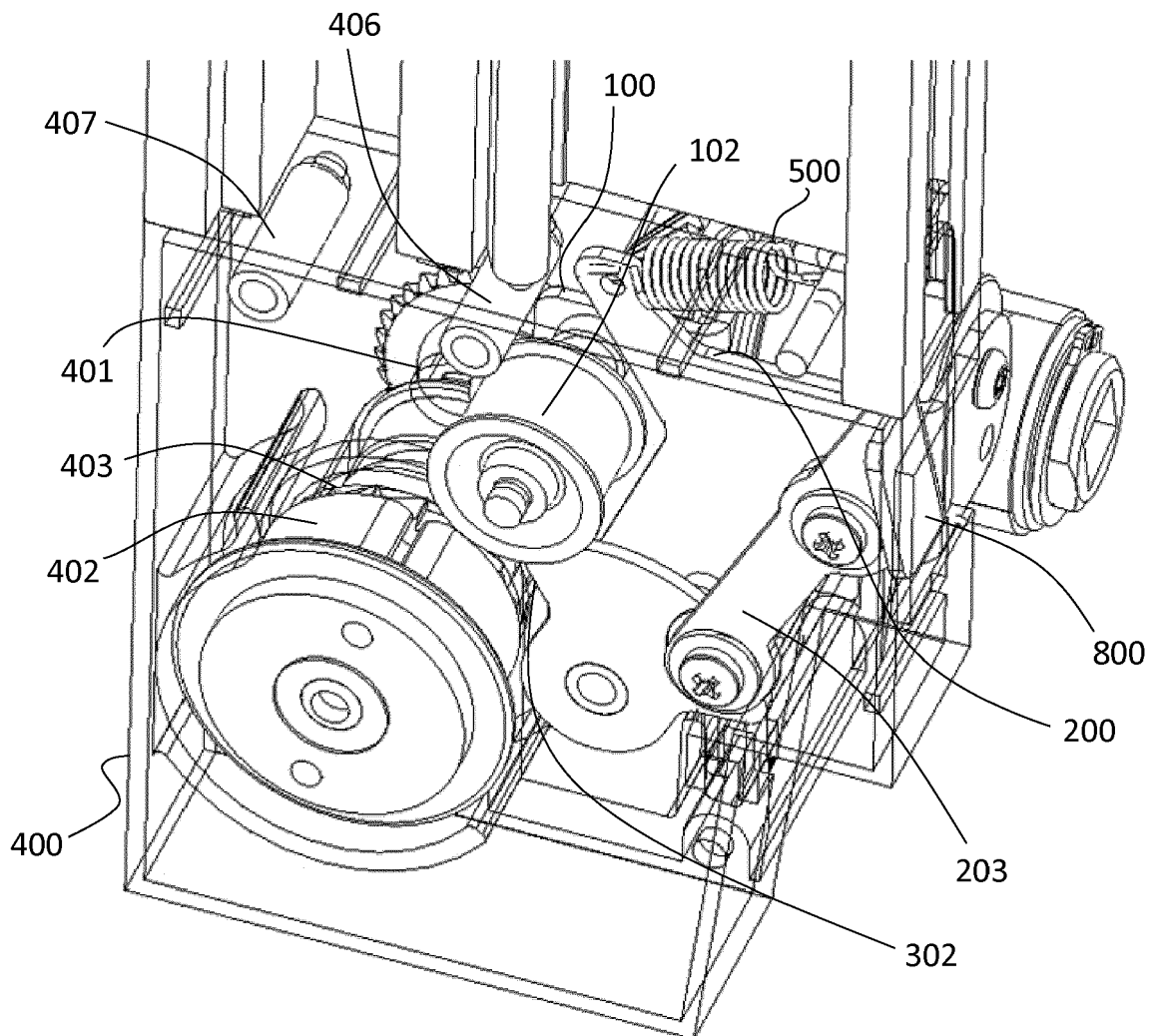


FIG. 6



EUROPEAN SEARCH REPORT

Application Number
EP 15 15 8532

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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,D	US 7 448 426 B2 (HSIEH CHUNG-HSIEN [TW]) 11 November 2008 (2008-11-11) * figure 2 *	1-14	INV. E06B9/68 A62C2/24 E06B9/78 E06B9/80
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			TECHNICAL FIELDS SEARCHED (IPC)
			E06B A62C
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 5 October 2015	Examiner Merz, Wolfgang
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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05-10-2015

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