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(54) **CONTROL UNIT FOR CONTROLLING A FIRE DAMPER OR SMOKE EVACUATION SHUTTER COMPRISING LOCKING MEANS**

(57) Control unit for controlling a fire damper or smoke evacuation shutter, said control unit comprising:

- an incoming axis;
- an outgoing axis designed to be coupled to the damper/shutter for opening and closing thereof;
- a gear box coupling the incoming and outgoing axes in rotation;

- a spring biasing said incoming axis, gear box, outgoing axis or damper/shutter towards a safety position of the damper;
- characterized in that the control unit comprises a locking means acting on the incoming axis, gear box or outgoing axis, allowing to maintain the damper/shutter in an armed position against the force of said spring.

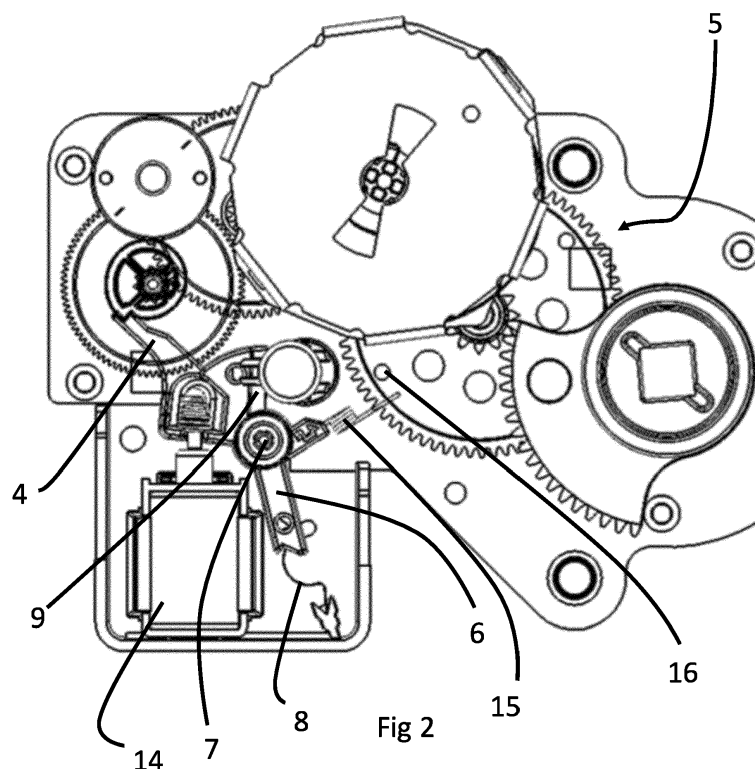


Fig 2

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Description

Technical Field

[0001] The present invention concerns a control unit for controlling a fire damper or smoke evacuation shutter, in particular a control unit comprising an actuating mechanism for opening and closing the damper or shutter upon input of external triggers.

Background to the Invention

[0002] Fire dampers and smoke evacuation shutters are a mandatory safety feature in larger buildings and currently are coupled to monitoring systems allowing checking and operating the damper or shutter position from a central point in the building or in an off-side emergency room.

[0003] In order to facilitate monitoring and controlling different fire damper or shutter, it is known to equip the damper or shutter with control units comprising a mechanism for electrically closing the damper or opening the shutter in case of a test event or an alarm. In the past, several such control units were developed based on different control protocols. In France, two major protocols exist, one which is based on closing the fire damper/opening the smoke evacuation shutter upon supply of an electric signal to the control unit and another protocol based on interrupting a signal to the control unit.

[0004] Based on the protocol chosen, a different type of control unit is to be installed on to each fire damper of smoke evacuation shutter. An inconvenience of the co-existence of both protocols is that service providers and fire damper installation companies need to know which type of protocol is used when installing the control units or when replacing control units and need to have control units of both types in stock at all times as installing a control unit of the wrong type would lead to a non-functioning of the fire damper and hence create hazardous situations.

[0005] In order to overcome the above inconvenience, there is a market need for a fire damper and/or smoke evacuation shutter control unit that can be used with both protocols.

[0006] The present invention comes forth to the above market need by providing:

Control unit for controlling a fire damper or smoke evacuation shutter, said control unit comprising:

- an incoming axis;
- an outgoing axis designed to be coupled to the damper/shutter for opening and closing thereof;
- a gear box coupling the incoming an outgoing axes in rotation;
- a spring biasing said incoming axis, gear box, outgoing axis or damper/shutter towards a safety position of the damper;

characterized in that the control unit comprises locking means acting on the incoming axis, gear box or outgoing axis, allowing to maintain the damper/shutter in an armed position against the force of said spring.

Summary of the Invention

[0007] Preferably the locking means comprise a latch interacting with either the gear box, the incoming axis or outgoing axis of the control unit, said arm provided on an actuator body integrated in the control unit and having a bi-stable position therein, one lock position, wherein the latch locks the gear box and one unlock position, wherein the latch stands clear from the gear box.

[0008] According to a preferred embodiment, the actuator body comprising a secondary arm and a mechanical unlocking mechanism comprising a spring biased notch moveable between a first position, wherein the notch interacts with the secondary arm, thereby forcing the actuator body in the unlock position and a second position, wherein the notch allows the secondary arm to move in a position corresponding to the armed position of the actuator body.

[0009] The notch may be biased by a spring coupled to a fuse, breaking/melting of the fuse (eg. thermos-mechanical fuse) resulting in the spring biasing the notch to the first position, thereby forcing the actuator body in the unlock position.

[0010] According to a preferred embodiment the notch is biased by a spring coupled to a push/pull button accessible from outside the control unit, operating the push/pull button resulting in the spring biasing the notch to the first position, thereby forcing the actuator body in the unlock position.

[0011] According to a further preferred embodiment, the spring biased notch cooperates with both the push/pull button and the fuse.

[0012] The actuator body is preferably biased by a spring having a bi-stable position, said spring forcing the actuator body into one of its bi-stable positions upon movement of the latch over a course of length L1, said length L1 being smaller than the distance D1 between two adjacent tooth of a gear wheel with which the latch cooperates or said length L1 being smaller than the depth D2 of the tooth/teeth of the gear wheel with which the latch cooperates.

[0013] The control unit preferably comprises electrical locking means such as a solenoid cooperating with the actuator body and allowing moving the actuator body from the lock position to the unlock position.

Brief description of the drawings

[0014]

FIG 1 illustrates a preferred embodiment of the housing of a smoke evacuator or fire damper.

FIG 2 schematically represents the gear box and locking means of a control unit according to the present invention;

FIG 3 represents a perspective view of a cross-section of FIG 2.

Detailed description

[0015] A control unit according to the present invention for controlling a fire damper or smoke evacuation shutter is unique in it's kind in that it can be operated in according to two different protocols for activating the fire damper or smoke evacuation shutter, whereby a simple switch on the control unit allows switching between the operating protocols.

[0016] As the control unit according to the invention can be used for both fire dampers, commonly installed in ventilation ducts and aimed to switch from an open to a closed position in case of a fire to prevent spreading of smoke and/or fire through the ventilation ducts, and smoke evacuation shutters, commonly installed between a room and a smoke evacuation duct and aimed for switching from a closed to an open position in case of smoke generation in the concerned room in order to evacuate the smoke from the concerned room, both the fire damper and the smoke evacuation shutter will be addressed as damper in this application.

[0017] The control unit comprises an outgoing axis to be coupled to the damper for opening and or closing the damper, and an incoming axis to be operated (by hand or by means of a motor) for closing and or opening the damper (to a armed position, closed for a smoke evacuation shutter and open for a fire damper).

[0018] As commonly known in the art of fire dampers and smoke evacuation shutters, the incoming and outgoing axis are coupled in rotation through a gear box, usually a mechanical gear box of several interacting gears. As is usual, a spring acts on the gear box or on the incoming or outgoing axis, biasing the outgoing axis in a rotation in the sense for driving the damper into an alarm position, ie. closed for a fire damper and open for a smoke evacuation shutter. Movement of the damper to the alarm position is prevented by locking means that blocks the rotation of the outgoing axis against the force applied by the spring. According to the present invention the locking means act on the gear box of the control unit. The locking means preferably comprise a latch that is controlled by an unlock mechanism comprising a solenoid acting on the latch that in turn acts on the gear box.

[0019] The unlock mechanism as such controls disengagement of the locking means from the incoming axis or the gear box, to allow the outgoing axis to rotate to an alarm position. Operation of the unlock mechanism, such as a solenoid, is preferably obtained by an electronic circuitry. the circuitry regulates the electric power exerted on the solenoid to change its position between an engaging position, blocking the damper in armed position, ie. open for a fire damper and closed for a smoke evac-

uation shutter, and an non-engaging position wherein the blocking of the incoming axis or gear box is interrupted.

[0020] The circuitry comprises a signal receiver, for example a pair of connectors for receiving control wires coupled to an alarm central; a microprocessor programmed to convert an incoming signal from the signal receiver to an electric signal steering the unlock mechanism such as the solenoid; and optionally a sensor for detecting the position of the damper or outgoing axis, the sensor being coupled to the microprocessor for signaling the position of the damper to the alarm central.

[0021] In a preferred embodiment the circuitry further comprises a power source or connectors for coupling the control unit to an external power source and an electrically driven motor, controlled by the microprocessor, and coupled to the incoming axis for rotating the incoming axis in a direction against the force exerted by the spring in a direction of arming the damper.

[0022] According to the invention, the circuitry further comprises a switch coupled to the microprocessor for altering the operation protocol of the microprocessor and hence the operation mode of the locking means. The operation protocols according to which the microprocessor can operate are a first protocol and a second protocol. According to the first protocol the control unit, when in an armed position, receives no signal or power. In case of an alarm, an electric signal is transmitted to the control unit, which when received by the microprocessor triggers disengagement of the locking means from the incoming axis or gear box, thereby releasing the damper that will move to an alarm position by force of the relaxing spring. According to the second protocol, the control unit is constantly powered, ideally to a level sufficient to maintain the microprocessor operational, and at the moment of a cut in power, the microprocessor activates the locking means by means of the unlock mechanism for disengaging the incoming axis or gear box, thereby releasing the damper that will move to an alarm position by force of the relaxing spring.

[0023] In this last case, the energy needed for activating the unlock mechanism (eg. solenoid) is preferably stored in the control unit by providing a capacitor in the circuitry that is loaded during normal (powered) operation and that unloads for activating the unlock mechanism. As such, the unlock mechanism, once the capacitor is loaded does not consume any further energy during normal operation (armed status) and overall energy consumption of the control unit can be limited. An example of a circuitry for driving a solenoid by means of a capacitor is disclosed in eg JP2006187524 and KR100276862 and is described in more detail below.

[0024] The control unit as described hereabove is preferably encased in a water and dust tight housing, whereby the outgoing axis is accessible from outside the housing. It is preferred that the switch is also accessible from outside the housing as are the connectors and in case needed the power supply for the electrically drive motor. The power supply of the motor can be provided by a

battery, in which case a battery connector coupled to the circuitry is preferably accessible from outside the housing.

[0025] By providing an electrical battery connector connected to the electrical circuitry that powers the motor, (re)arming the damper can be done even in case mains power supply is not available by means of power supplied by a battery. In addition, by providing connectors reachable from outside the housing, the housing does not have to be opened for connecting a battery or for replacing an empty one.

[0026] In an embodiment of the present invention, at the outside of the housing of the control unit a slot may be provided comprising battery connectors wherein a battery may be removably fixed such that the battery may be held in position during testing or (re)arming the damper. Alternatively, the battery connector may be designed to contact a battery yet not fix said battery in connection with the battery connector. In this case any type or size of battery can be used as long as it provides sufficient power and fits the connector by manual force.

[0027] Preferably as illustrated in FIG 1, a slot (2) in the housing (1) of the control unit may be provided which is designed such that the battery may be at least partially inserted for easy and efficient connection but without it being fixed therein. Thus the battery is to be kept in touch with the connectors by manual force. A benefit thereof is that a battery cannot be left in the slot after (re)arming the damper, thereby avoiding low battery issues. Moreover, such battery may simply be part of the technician's toolkit.

[0028] As represented in figure 1, the housing (1) of the control may be further designed such that the battery slot (2) can be closed by means of a cover (3), preferably snap on, to keep the slot free of moisture and dust.

[0029] In a preferred embodiment in accordance with the present invention, the housing of the smoke evacuator or fire damper may be made water and dust tight. In particular, the housing may be protected against dust ingress and water ingress due to water splash or spray. Preferably the housing may comply with an IP42 degree of protection or higher according to standard IEC60529.

[0030] In an embodiment according to the present invention, a smoke evacuator damper or fire damper may be provided comprising a motor activation switch to activate the motor after connecting a battery to the battery connector. However, preferably, connecting the battery to the battery connector may automatically trigger activation of the motor. The electrical circuit powering the motor may then be built such that if mains power supply is available, the motor may (re)arm the damper by means of mains powered, and in case mains power is not available, the motor may be powered using battery energy.

[0031] In a further embodiment in accordance with the present invention, the housing of the smoke evacuator or fire damper comprises a microcontroller coupled to the electrical circuit for selecting the power source of the motor. The microcontroller may decide to use mains power

energy or battery energy for moving the damper to armed position, depending on the availability of the respective energy source. Preferably the microcontroller may select the mains as power source for the motor in case mains power is detected. Consequently, even when a battery is connected with the battery connector and mains power is available as well or switched on during (re)arming, mains power energy will be used to (re)arm the damper.

[0032] In a preferred embodiment according to the present invention, a smoke evacuator damper or fire damper may be provided wherein connecting a battery to the battery connector automatically triggers the microcontroller to activate the motor. If mains power supply is available, connecting the battery triggers the microcontroller to activate the motor and the microcontroller decides (re)arming the damper by means of mains power. In case mains power is not available and the battery triggers the microcontroller to activate the motor, the microcontroller decides powering the motor using battery energy.

[0033] Further, a smoke evacuator or fire damper according to the present invention may comprise any type of damper actuating mechanism used in conventional smoke evacuators or fire dampers. Preferably in order to assure sufficiently quick movement of the damper from armed position to emergency position, the damper actuating mechanism is spring based combined with an electrically driven solenoid (14) unlock mechanism acting on a locking means that cooperates with the incoming axis or gear box.

[0034] As shown in more detail in figure 2, the unlock mechanism comprises a latch (4) interacting with either the gear box (5), the incoming axis or outgoing axis of the control unit, said arm (4) provided on an actuator body (6) integrated in the control unit and having a bi-stable position therein (rotation around an axis (7)), one lock position, wherein the latch (4) locks the gear box and one unlock position, wherein the latch stands clear from the gear box (5) (In figure 2, the actuator body (6) is in the lock position).

[0035] The actuator body is biased by a spring (8) having a bi-stable position, which spring (8) maintains the actuator body (6) into one of its bi-stable positions upon movement of the latch (4) over a course of length L1, said length L1 being smaller than the distance L2 between two adjacent tooth of a gear wheel with which the latch cooperates or said length L1 being smaller than the depth D2 of the tooth/teeth of the gear wheel with which the latch cooperates.

[0036] As shown in figures 2 and 3, the actuator body (6) preferably comprises a secondary arm (9) and a mechanical unlocking mechanism comprising a spring biased notch (10) moveable between a first position, wherein the notch (10) interacts with the secondary arm (9), thereby forcing the actuator body in the unlock position and a second position, wherein the notch allows the secondary arm to move in a position corresponding to

the armed position of the actuator body.

[0037] The notch (10) is preferably biased by a spring (11) coupled to a (thermo-mechanical) fuse (12). Breaking/melting of the fuse resulting in the spring (11) biasing the notch (10) to the first position, thereby forcing the actuator body (6) in the unlock position.

[0038] Alternatively or additionally, the notch is biased by a spring (may be the same spring (11)) coupled to a push/pull button (13) accessible from outside the control unit, operating the push/pull button resulting in the spring (11) biasing the notch to the first position, thereby forcing the actuator body (6) in the unlock position.

[0039] Preferably and as represented in figure 3, the spring (11) biased notch cooperates with both the push button (13) and the fuse (12). In case of a pull button, such button would cooperate with the notch biased by spring (11'). the actuator body cooperating with an electrical unlocking means allowing moving the actuator body from the lock position to the unlock position.

[0040] In unpowered state the solenoid (14) keeps the actuator body (6) and hence the latch (4) and the damper in armed position after being armed by activating the motor. Such electrically driven solenoid unlock mechanism typically comprises a coil and a moving metal rod, also known as a plunger making a linear movement within the coil, and a switching device connecting the coil to a loaded capacitor in case of alarm. Upon the capacitor providing power to the coil, the plunger is retracted by magnetic force unlocking the latch that is holding the spring loaded mechanism, the spring is activated and the damper moves from armed position to emergency position. Typically, providing power to the coil of the solenoid may be obtained in two ways: in case of alarm, either mains power is switched on for providing an electric signal loading the capacitor, followed by connecting the coil with the loaded capacitor; either mains power is switched off, following by connecting the coil with the already loaded capacitor.

[0041] Preferably, the solenoid may be switched by the electrical circuit in such way that it is only controlled by the signal and not by the battery. So upon connecting the battery to the battery connector, the motor may be triggered to move the damper towards armed position without affecting the solenoid. The plunger of the solenoid will stay in its inactivated (armed) position ready for being powered in case of emergency. Upon removing the battery again, the solenoid will stay unaffected as well. In addition, smoke evacuators or fire dampers according to the present invention, may be equipped with a thermo-electric fuse interrupting the power supply when the temperature in the air duct in connection with the evacuator or shutter exceeds a temperature limit, for example 72°C, or with a thermo-mechanical fuse mechanically unlocking the spring loaded mechanism when temperature exceeds a limit. So the mechanism by which the damper moves remotely from armed position into emergency position may be activated by a power pulse to the solenoid or a power interruption, or automatically

by the melting down of a thermic fuse due to exceeded temperature limit in the duct or by a mechanical action of pushing/pulling a button.

[0042] Preferably, the actuator body (6) comprises a re-arming latch (15) (shown in figure 2) cooperating with a pen (16) provided on one of the gears of the gear box (4). During re-arming of the damper by turning the incoming axis, the pen (16), when passing by the re-arming latch, moves the actuator body (6) to its armed position (unless overruled by the mechanical or electrical unlocking mechanism), thereby securing the correct arming of the damper and activation of the locking means, such that after arming the damper, the gear box is prevented from rotating in a direction moving the damper in a safety position again, unless the unlock mechanism is activated.

[0043] In a further embodiment, smoke evacuators or fire dampers according to the present invention may be equipped with a visual indicator, for example a light emitting diode (LED), indicating the status of the (re)arming process.

[0044] In addition, the smoke evacuator dampers or fire dampers according to the present invention may be equipped with a visual or audible indicator when the damper is not successfully armed.

[0045] The microcontroller may further be equipped for making a distinction between low battery and mechanical obstruction when the damper is not successfully armed. In case the microcontroller senses that the damper does not arrive into a specified position for being successfully actuated upon alarm, while the battery is not low or while mains power supply is available, the microcontroller will indicate mechanical obstruction.

[0046] In an additional embodiment, a ventilation system is provided using smoke evacuator dampers or fire dampers as described in the above embodiments.

Claims

1. Control unit for controlling a fire damper or smoke evacuation shutter, said control unit comprising:

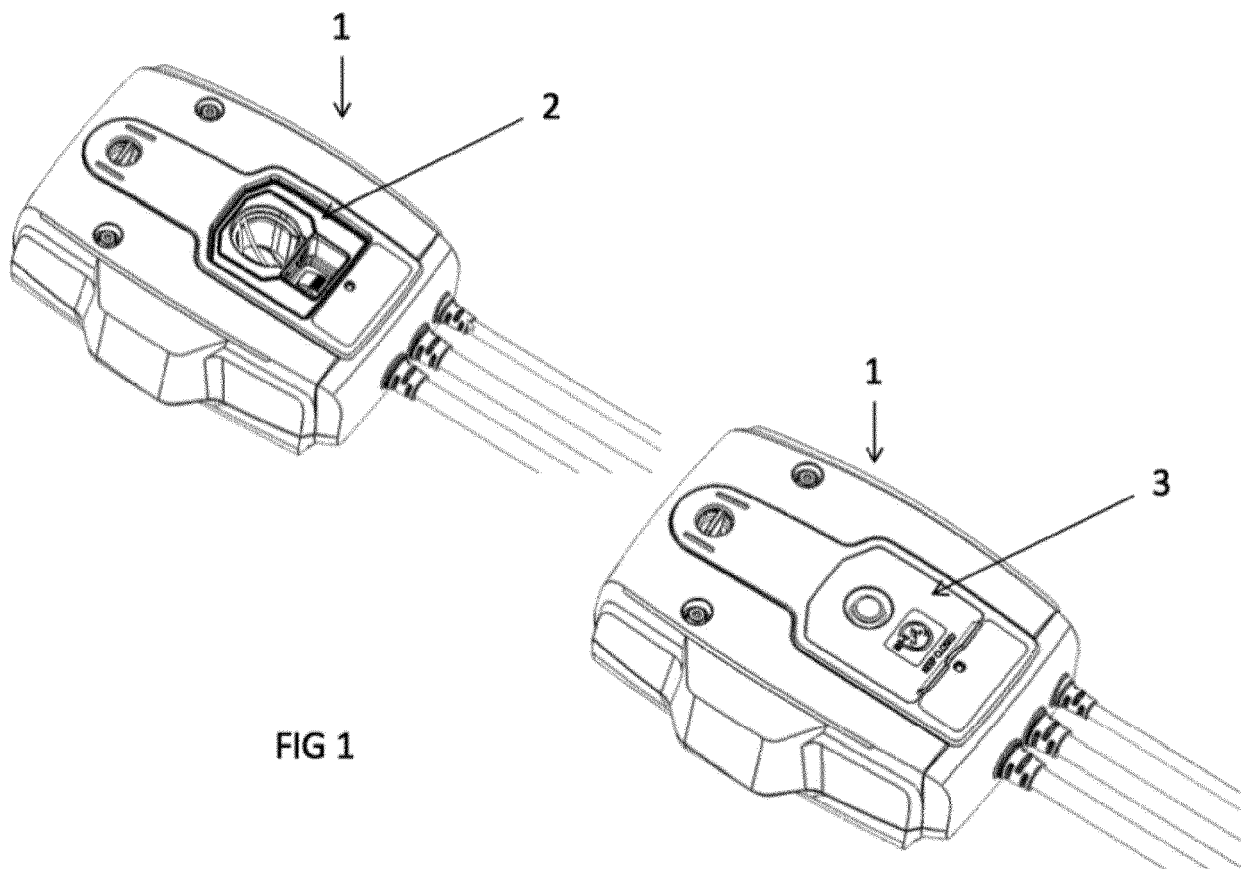
- an incoming axis;
- an outgoing axis designed to be coupled to the damper/shutter for opening and closing thereof;
- a gear box coupling the incoming an outgoing axes in rotation;
- a spring biasing said incoming axis, gear box, outgoing axis or damper/shutter towards a safety position of the damper;

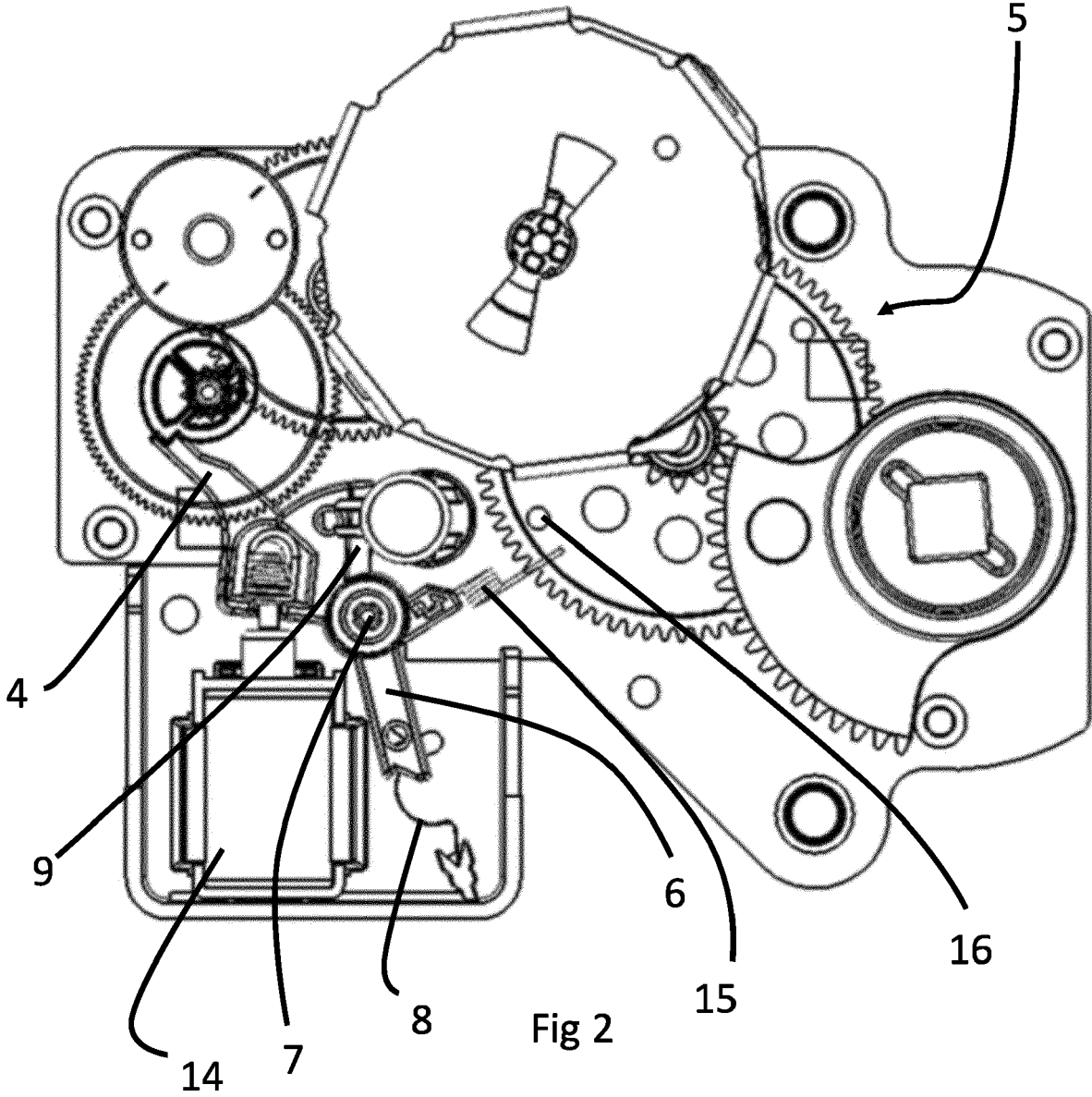
characterized in that the control unit comprises a locking means acting on the incoming axis, gear box or outgoing axis, allowing to maintain the damper/shutter in an armed position against the force of said spring.

2. Control unit according to claim 1, said locking means

comprising a latch interacting with either the gear box, the incoming axis or outgoing axis of the control unit, said arm provided on an actuator body integrated in the control unit and having a bi-stable position therein, one lock position, wherein the latch locks the gear box and one unlock position, wherein the latch stands clear from the gear box. 5

3. Control unit according to claim 1 or 2, the actuator body comprising a secondary arm and a mechanical unlocking mechanism comprising a spring biased notch moveable between a first position, wherein the notch interacts with the secondary arm, thereby forcing the actuator body in the unlock position and a second position, wherein the notch allows the secondary arm to move in a position corresponding to the armed position of the actuator body. 10 15
4. Control unit according to claim 3, wherein the notch is biased by a spring coupled to a fuse, breaking/melting of the fuse resulting in the spring biasing the notch to the first position, thereby forcing the actuator body in the unlock position. 20
5. Control unit according to claim 4, said fuse is a thermo-mechanical fuse. 25
6. Control unit according to claim 3, wherein the notch is biased by a spring coupled to a push/pull button accessible from outside the control unit, operating the push/pull button resulting in the spring biasing the notch to the first position, thereby forcing the actuator body in the unlock position. 30
7. Control unit according to claims 4 and 6, wherein the spring biased notch cooperates with both the push/pull button and the fuse. 35
8. Control unit according to any of the claims 2-7, wherein the actuator body is biased by a spring having a bi-stable position, said spring forcing the actuator body into one of its bi-stable positions upon movement of the latch over a course of length L1, said length L1 being smaller than the distance L2 between two adjacent tooth of a gear wheel with which the latch cooperates or said length L1 being smaller than the depth D2 of the tooth/teeth of the gear wheel with which the latch cooperates. 40 45
9. Control unit according to any of the preceding claims, the actuator body cooperating with an electrical unlocking means allowing moving the actuator body from the lock position to the unlock position. 50
10. Control unit according to claim 9, the electrical unlocking means comprising a solenoid. 55





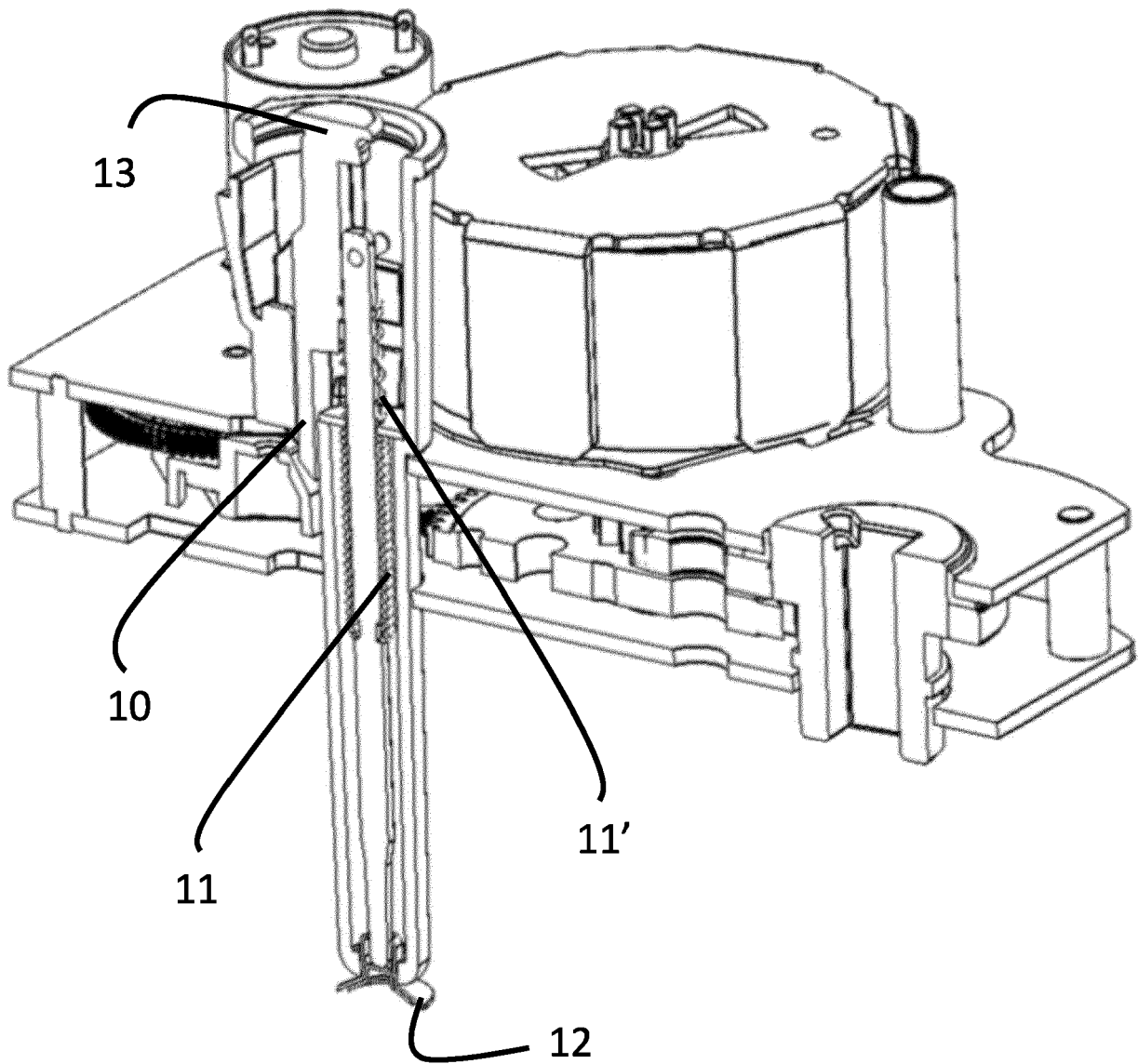


FIG 3



EUROPEAN SEARCH REPORT

 Application Number
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Y	EP 1 762 276 A2 (WILDEBOER WERNER [DE]) 14 March 2007 (2007-03-14) * the whole document *	1-10	
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			TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 9 November 2017	Examiner Douskas, K
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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