(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 040 506 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
06.07.2016 Bulletin 2016/27

(51) Int Cl.:
E06B 9/68 *(2006.01)*

(21) Application number: **15202789.2**

(22) Date of filing: **28.12.2015**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD

(30) Priority: **30.12.2014 IT VE20140074**

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(54) MONITORING DEVICE WITH A LASER SENSOR FOR MOTORIZED DOORS

(57) A monitoring device for a vertically moving door operated by an electric motor (4) provided with internal limit switches and controlled by a fixed control unit (6) which communicates with a microcontroller (12) and is programmed to interrupt rotation of said motor and then to reverse it in the case of impact of the descending door (2) against an accidental obstacle, characterised by comprising:
- laser sensor (10) mounted on said door (2) for sensing its position relative to a fixed point while said door (2) gradually descends,
- a comparator (12) configured to compare, in sequence, the values representative of said sensed position, with the corresponding values representative of the theoretical position which said laser sensor (10) would have in the case of regular descent, said values representative of said theoretical position being memorized in said microcontroller (12) and being related to the characteristics of said motor (4) and of said door (2),
- means (14) controlled by said microcontroller (12), and acting on said control unit (6), to cause this latter to act on said motor (4) when the difference, calculated by said comparator, between said sensed position and said theoretical position exceeds a predetermined quantity.

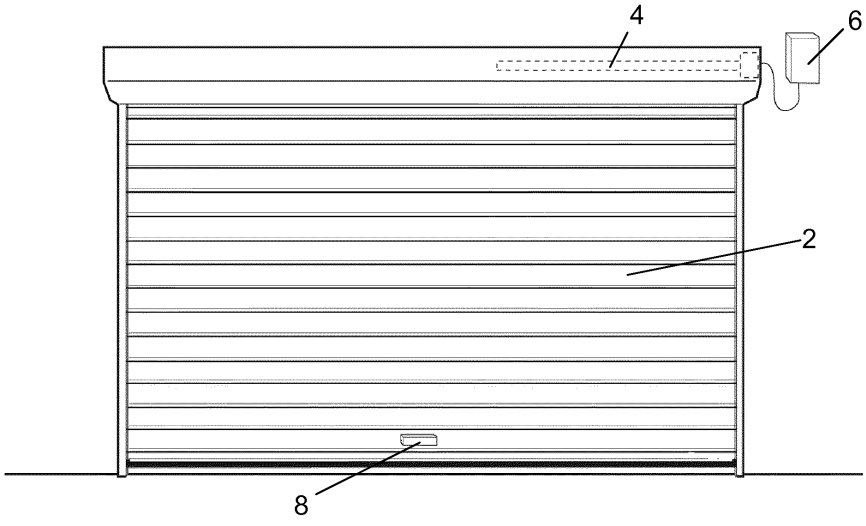

FIG. 1

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Description

[0001] The present invention relates to a monitoring device for a vertically moving door.

[0002] Vertically moving doors are known, such as gates, roll shutters, slatted doors, sectional doors, etc. These known doors generally comprise a closure element, which can be rigid, flexible, of hinged segments, etc., which can be rolled up and unrolled by a motorized shaft, and be guided by its lateral edges along vertical guides formed in or applied to the two lateral doorposts of the passageway with which the door is associated.

[0003] The movement of the closure element and hence the operation of the motor applied to the door winding shaft are under the control of a control unit, with which a pushbutton unit is generally associated for controlling the door opening and closure, together with a radio receiver unit for remote control by a radio transmitter unit.

[0004] Current safety regulations require the door to be fitted with means to prevent an obstacle accidentally present in the descent path of the closure element from being able to damage persons and/or objects, i.e. to damage the obstacle and the motorized door. More particularly, current regulations require that when the lower edge of a vertically moving door undergoing descent movement strikes an obstacle (a person or an object), the door descent movement must be immediately halted and immediately afterwards be reversed.

[0005] This requires the presence of a sensor which senses the impact of the door against the obstacle, and a control unit which transforms the signal generated by the sensor at the moment of impact into a stop command and reverses the rotation direction of the motor which drives the door closure element.

[0006] Different types of sensors are currently known, but the most widespread are a so-called safety edge, which is applied to the lower edge of the closure element and consists of a tubular element of rubber or similar elastically yieldable material, internally housing devices of various types able to transform the elastic yielding of the tubular element, at the moment of impact with an obstacle, into activation of an electric contact which itself feeds a signal to the control unit.

[0007] The electric contact can be activated in various ways, and in particular can be mechanical, by acting on a metal wire extending inside the tubular element and stressed mechanically by its deformation, or be optical, by interrupting a light ray extending within the tubular element which this latter deforms, or pneumatic by transforming the pressure increase which occurs within the tubular element on deformation, into an electric contact.

[0008] Independently of the manner in which the impact between the safety edge and an obstacle in these known vertically moving doors causes stoppage and reversal of the door movement, the actual presence of an elastic safety edge involves problems related to the perishability and alteration of the elastic material forming the tubular element, with time, and to the consequent need for its periodical replacement, with complicated removal and remounting operations and consequently high costs.

[0009] EP2071119 describes a motorized door provided along its lower edge with a traditional safety edge provided with electric contacts which are activated when the door encounters an obstacle. A device for measuring the distance between a lateral prolongation of the door lower edge and a fixed monitoring device associated with the motor are also installed within the door lateral guides.

[0010] Again in this case, contact of the door with the floor (limit stop) or with an obstacle is sensed and always communicated to the motor control unit by activation of the electric contacts provided in the safety edge. In this solution, the information provided by the measurement device on the distance between the door lower edge and the fixed reference serves only to determine whether the activation of the electric contacts of the safety edge is caused by contact with the floor (to cause only motor stoppage) or by contact with an obstacle (to cause stoppage and reversal of the motor rotation direction, to hence withdraw the door lower edge from the obstacle).

[0011] In other words, in this motorized door, the presence of the safety edge remains essential and unavoidable, to hence give rise to the aforestated problems, in that the information relative to the position of the door lower edge is used only when the safety edge is activated.

[0012] Moreover, the manner of constructing and installing the device for measuring the distance between the door lower edge and the fixed reference is fairly complicated, and in particular makes it difficult if not impossible to install the device in already existing motorized doors, given the characteristics which the lateral guides must possess in order to be able to house it.

[0013] Italian utility model 273111 describes a motorized door provided with a safety device consisting of an accelerometer, which senses door velocity variations during its descent movement, and in particular the passage from rated velocity to zero velocity on impact against an obstacle.

[0014] This solution has proved advantageous because it has eliminated the safety edge, and because it has enabled the safety sensor to be installed in positions different from its lower edge; at the same time it has proved to have limits, and in particular an excessive sensitivity to vibrations and hence to the risk of false obstacle indications and intervention of the control unit, to cause the closure element to reverse its movement not because of impact against an obstacle, but because of vibrations thereof due to incorrect and irregular sliding along its guides.

[0015] An object of the invention is to eliminate this problem by providing a monitoring device for a vertically moving door which does not use an elastic safety edge, while at the same time is not subject to the false indications currently present in those monitoring devices using an accelerometer.

[0016] Another object of the invention is to provide a safety device for a vertically moving door, which is easy

to install, is of low cost and is of safe and reliable operation.

[0017] All these objects and others which will be apparent from the ensuing description are attained, according to the invention, by a monitoring device for a vertically moving door having the characteristics indicated in claim 1.

[0018] The present invention is further clarified hereinafter in terms of a preferred embodiment thereof with reference to the accompanying drawings, in which:

Figure 1 is a front view of a vertically moving door provided with the monitoring device according to the invention, and

Figure 2 shows a block scheme of the monitoring device.

[0019] As can be seen from the figures, the monitoring device according to the invention is applied to a vertically moving door 2, which in the illustrated example is a roll shutter, but could equally be a flexible fabric sheet provided lowerly with a stiffening bar, or a slatted door, or a sectional door with rigid elements hinged along adjacent horizontal edges. In all cases, the door 2 is without a safety edge.

[0020] The door is driven in traditional manner by an electric motor 4 provided with mechanical or electronic limit switches and controlled by a fixed control unit 6 connected to it. It is provided with a radio receiver for receiving commands from a radio transmitter installed, as described hereinafter, in the device according to the invention applied to the door 2. Preferably, a transceiver is applied to the control unit 6 to communicate bidirectionally with the device according to the invention.

[0021] In the case of a roll-up door, the electric motor 4 rotates a roller about which the door is wound during the opening of the corresponding passageway, and from which it is unwound during closure of the passageway.

[0022] Instead, in the case of sectional doors or other types of door, opening is achieved by sliding this latter in the horizontal plane overlying the passageway, in proximity to a ceiling of the room associated with this passageway.

[0023] Independently of the type of door to which it is applied, preferably but not necessarily in the vicinity of its free horizontal edge, the device according to the invention, indicated overall by 8, comprises a laser sensor 10 for measuring the distance between the device 8 and a fixed point, in particularly on the floor, a microcontroller 12, in which the functions for correct operation of the device are implemented, functions which are further described hereinafter during the description of the device operation, a transceiver 14 for radio communication between the device 8 and the control unit 6, a pushbutton 16 for setting the device 8 in the programming state, an LED 18 for indicating this programming state, and a powering battery 20. This battery can be single or multiple, and be of standard, alkaline or lithium type, or be rechargeable in traditional manner or by a photovoltaic panel.

[0024] Advantageously, the laser sensor 10, the microcontroller 12, the transceiver 14, the pushbutton 16, the LED 18 and the powering battery 20 are housed in a suitable container mounted in proximity to the free horizontal edge of the door 3.

[0025] The device according to the invention operates in the following manner: when the control unit 6 rotates the motor 4 in the direction causing the door 2 to descend, it also activates the laser sensor 10, which by virtue of a particular optical system with which it is provided, measures the distance between it and the floor. This measurement is continually transmitted to the microcontroller 12, the internal memory of which contains the theoretical descent and sensor reference relationship under normal and regular door movement conditions (i.e. in the absence of accidental obstacles within its downward path).

[0026] At a predetermined frequency, for example between every 1 ms and every 30 ms, and preferably every 20 ms, the microcontroller 12 samples the signal generated by the laser sensor 10 expressive of its effective distance from the floor and, by means of a comparator, compares this at each sampling moment with the memorized theoretical distance value.

[0027] Hence essentially, the comparator provided in the microcontroller is configured to compare, in sequence, a plurality of values representative of the position measured by the sensor 10 with the corresponding values representative of the theoretical position which the laser sensor 10 would possess in the case of regular descent.

[0028] Should this comparison show that, at a determined moment of sampling and/or for several consecutive moments, there is a difference (i.e. a positive or negative difference between the distance measured and the theoretical distance) greater than a predetermined maximum value, linked obviously to inevitable constructional and/or operational inaccuracies of the system, the microcontroller 12 causes the transceiver 14 to feed to the control unit 6 a command for halting the motor 4 and reversing its rotation direction. For example, this maximum difference value can be 10% of the theoretical value at the moment of sampling.

[0029] During installation the device 8 according to the invention must be programmed for adaptation to the descent velocity of the door 2, this velocity depending both on the characteristics of the motor 4 (for example in terms of motor power and r.p.m.) and on those of the door itself (for example in terms of weight). This is accomplished by a traditional self-learning technique, which comprises firstly operating the pushbutton 16 to switch from the operation stage to the programming stage, indicated by lighting of the LED 18. In this stage the door 2 is made to descend under conditions of verified absence of obstacles within the passageway closed by the door, such that the microcontroller 12 acquires the velocity data (i.e. a plurality of pairs of time-distance values) of descent of

the door 2, data measured by the sensor 10 precisely under conditions of regular door descent.

[0030] When this acquisition is terminated, the device according to the invention is ready to operate in the manner already described.

[0031] If the motor 4 needs to be replaced by another of different characteristics, the door descent velocity could possibly change, with consequent modification of the relationship governing the variation of the distance of the descending sensor 10 from the floor.

[0032] This means that the velocity values (or a plurality of pairs of time-distance values) which define the theoretical optimal descent relationship must be newly acquired, in the manner already described.

[0033] From the aforegoing, it is apparent that the described monitoring device is particularly advantageous, as it eliminates the problems present in traditional devices.

[0034] In particular, the monitoring device according to the invention:

- eliminates the need to use safety edges, with all the limitations which these imply,
- is very easily and quickly installed,
- it can be adapted to almost any type of vertically moving door, and to almost any drive system applied to it,
- it eliminates the need to use accelerometers with consequent elimination of false indications due to these,
- it can be applied to the door virtually without any limitation on the point of application, provided evidently that this in a region subject to vertical movement,
- it can be easily applied to already existing motorized doors.

Claims

1. A monitoring device for a vertically moving door operated by an electric motor (4) provided with internal limit switches and controlled by a fixed control unit (6) which communicates with a microcontroller (12) and is programmed to interrupt rotation of said motor and then to reverse it in the case of impact of the descending door (2) against an accidental obstacle, **characterised by** comprising:

   - laser sensor (10) mounted on said door (2) for sensing its position relative to a fixed point while said door (2) gradually descends,
   - a comparator (12) configured to compare, in sequence, the values representative of said sensed position, with the corresponding values representative of the theoretical position which said laser sensor (10) would have in the case of regular descent, said values representative of said theoretical position being memorized in said microcontroller (12) and being related to the characteristics of said motor (4) and of said door (2),
   - means (14) controlled by said microcontroller (12), and acting on said control unit (6), to cause this latter to act on said motor (4) when the difference, calculated by said comparator, between said sensed position and said theoretical position exceeds a predetermined quantity.

2. A device as claimed in claim 1, **characterised in that** said laser sensor (10) is configured in such a manner as to measure its own distance from the floor.

3. A device as claimed in one or more of the preceding claims, **characterised by** comprising a container housing:

   - said laser sensor (10),
   - powering means (20),
   - said microcontroller (12) provided with a transmitter (14) tuned to a receiver pertaining to said control unit (6).
   - said comparator, which is implemented within said microcontroller (12).

4. A device as claimed in one or more of the preceding claims, **characterised in that** said microcontroller (12) is configured to conduct a series of samplings of the signal which is sensed by said laser sensor (10) during the descent of the door (2), at a rate of one sampling every 1 - 30ms, preferably every 20 ms.

5. A device as claimed in one or more of the preceding claims, **characterised in that** said means (14) for causing the control unit (6) to act on said motor (4) are configured such as to intervene when the difference between the value representative of said sensed position and the value representative of said theoretical position exceeds, in absolute value, 10% of the value representative of said theoretical position.

6. A device as claimed in one or more of the preceding claims, **characterised in that** said laser sensor (10) is provided with a specific optical system for reading and measuring its distance from said fixed point.

7. A device as claimed in one or more of the preceding claims, **characterised by** comprising a programming condition for acquiring and memorizing in said microcontroller (12) the corresponding values of the theoretical position which said laser sensor (10) would have during regular descent of said door (2).

8. A device as claimed in one or more of the preceding claims, **characterised by** comprising means (16) for switching said microcontroller (12) from the normal operating condition to the programming condition, and vice versa.

9. A device as claimed in one or more of the preceding claims, **characterised by** comprising an indicator light (18) for indicating when the microcontroller (12) is in the programming state.

10. A device as claimed in one or more of the preceding claims, **characterised by** comprising rechargeable powering batteries (20).

11. A device as claimed in one or more of the preceding claims, **characterised by** comprising a photovoltaic panel for recharging said rechargeable batteries (20).

12. A device as claimed in one or more of the preceding claims, **characterised by** comprising a transceiver (14) tuned to a transceiver pertaining to said control unit (6) for bidirectional communications between the two via radio.

13. A device as claimed in one or more of the preceding claims, **characterised in that** said container, housing said laser sensor (10) and said microcontroller (12), is applied in proximity to the free horizontal edge of said door (2).

14. A device as claimed in one or more of the preceding claims, **characterised in that** said door (2) does not comprise a safety edge able to transform its elastic yielding, following impact with an obstacle, into activation of an electric contact to feed a signal to the control unit.

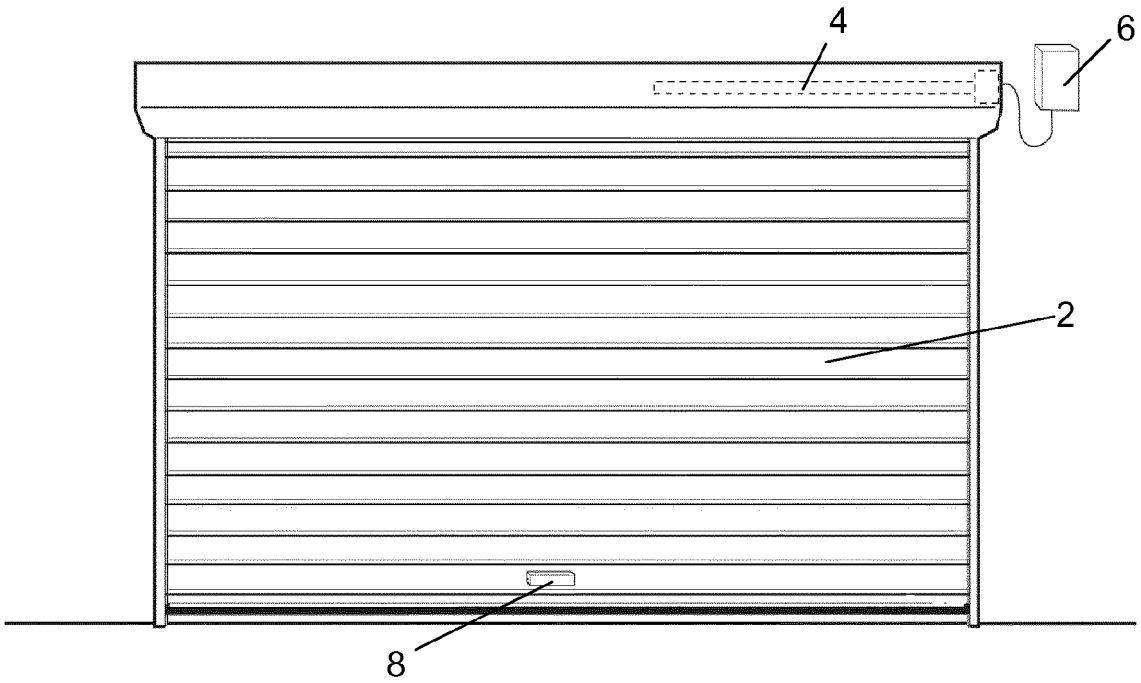

FIG. 1

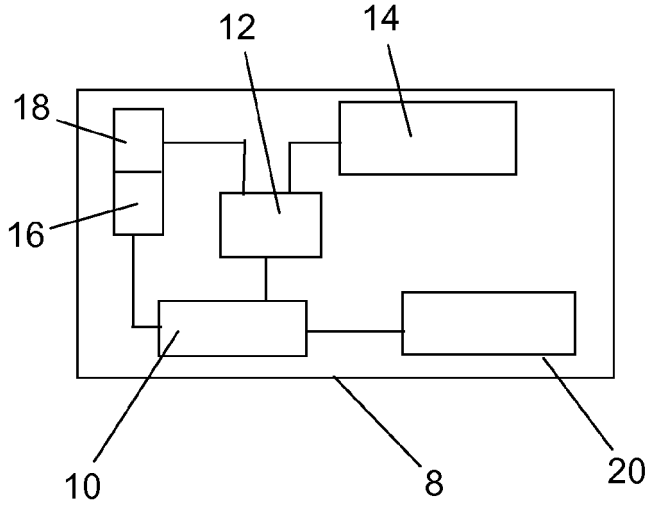

FIG. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 15 20 2789

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 2 071 119 A2 (HOERMANN KG DISSEN [DE]) 17 June 2009 (2009-06-17) * figures 1,2 * * paragraph [0037] - paragraph [0051] * * paragraph [0057] - paragraph [0058] * * claims 1,11,14 *	1-14	INV. E06B9/68
X	BE 1 020 066 A3 (GUELER MUZAFFER [BE]) 2 April 2013 (2013-04-02) * figure 1 * * page 4 - page 20 *	1-14	
A	EP 2 075 399 A2 (TELECO AUTOMATION S R L [IT]) 1 July 2009 (2009-07-01) * the whole document *	1-14	

TECHNICAL FIELDS SEARCHED (IPC)

E06B
E05F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	22 April 2016	Tänzler, Ansgar

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 15 20 2789

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22-04-2016

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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EP 2075399 A2	01-07-2009	NONE	

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 2071119 A **[0009]**
- IT 273111 **[0013]**