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

(11) **EP 1 970 520 A2**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
17.09.2008 Bulletin 2008/38

(51) Int Cl.:
E05F 15/20 *(2006.01)* *E05D 15/40* *(2006.01)*

(21) Application number: **08004337.5**

(22) Date of filing: **10.03.2008**

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

(30) Priority: **15.03.2007 IT PD20070092**

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(54) **Device for controlling the movement of a closure element**

(57) This is a device for controlling the movement of a closure element 1, whose spatial motion includes rotation, which by means of an electronic accelerometer 3, 4, joined solidly to said closure element, emits specific signals when its angular position changes, and which being related to the angular position of closure element 1, identifies its spatial positions.

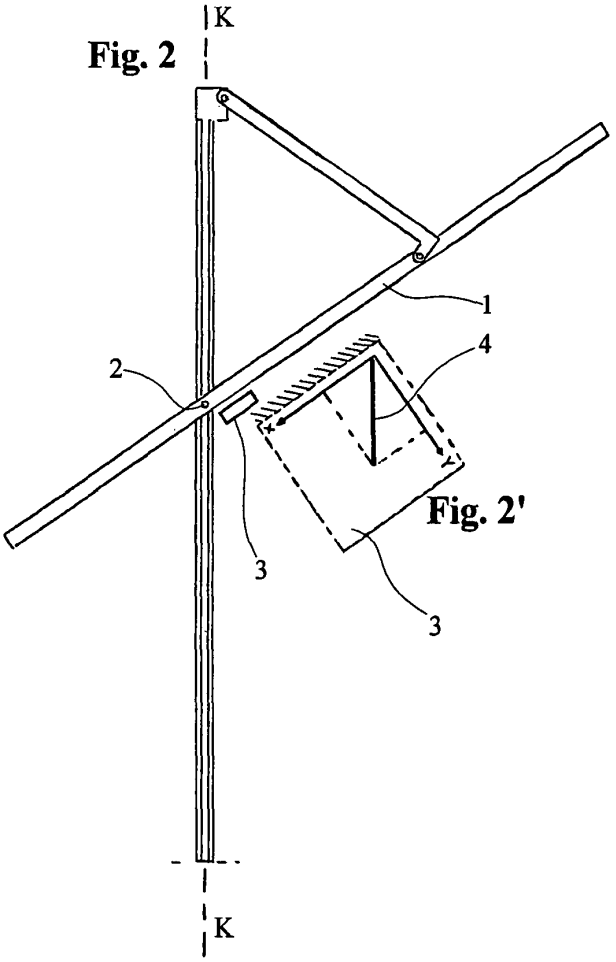

Fig. 2

Fig. 2'

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Description

[0001] It is well-known that in the field of the automated movement of closure elements that the mobile parts of said elements have to be controlled during their course and in particular at the ends of said course.

[0002] Currently the simplest control devices provide only limit stops at the end-of-travel points of the moving element.

[0003] Improved automation provides for the use, possibly combined with said limit stops, of special encoders related to the number of revs the motor makes for the movement.

[0004] There are also other control devices whose control signal is nevertheless still related to and/or a function of the revolutions of the motor.

[0005] Currently, therefore, existing control devices cannot directly recognise the position of the element during its course, especially when there is a lack of power - often where there is no battery back up - or following the disengagement of the automation with or without successive manual moving.

[0006] There area many drawbacks in the cases mentioned above: the above-mentioned control devices cannot recognise the position of the element when moving, and as a result control of the movement is inapt since it lacks references, in this case at the ends of its course, that might slow its speed down when nearing the limit stop.

[0007] In the event there is no power, the practice usually adopted now means you have to carry out uncontrolled reinstatement movements, difficult to do in compliance with current safety norms and in any event dangerous for the user (unless properly advised of the danger of such a situation).

[0008] On the other hand, in the event of a manual unblocking of the automation there are currently no solutions other than telling the user to wait for the cycles to reset.

[0009] The use of limit stops and/or encoders also have the general drawback of their possible failure; in particular, the limit stops can shift without the control system recognising this change of position.

[0010] Another drawback, in addition to possible damage to the encoder, is the high cost of installation with the drilling of the casings where the spindle comes out, the high cost of the cabling for the electrical connections coming out of said encoder.

[0011] The aim of this patent is to overcome the above-mentioned drawbacks, and this is done with the use of an electronic accelerometer that readily available on the market, though used for different purposes.

[0012] Said accelerometer provides continuous analogue and digital signals on the basis of the angular position of said element that incorporates the electrical components that render it an electronic accelerometer.

[0013] Below, by way of example, reference is made to an up and over door to refer in general to a body in movement.

[0014] Fixing said element solidly to the up and over door, the various rototranlsational positions assumed by the door wing cause corresponding variation in the angular position of said wing.

[0015] The advantage of this device is that it can be physically integrated into the electronics for controlling the movement when it is fixed to the door wing.

[0016] The signals emitted by the accelerometer that identify accurately each angular position allow the precise position of the wing to be known.

[0017] The signals emitted by the electronic accelerometer appropriately transduced corresponding to each of its angular positions, to the other movement parameters, become an integral part of the automated control, so for example the speed of the moving element can be controlled, especially at the ends of its course (excluding the classic limit stops) without any slamming.

[0018] The electronic accelerometer employed can be a more simple linear type, where the signals emitted (voltage) refer to two x and y Cartesian axes, and whose size for each angular position are equalised to the values regarding the trigonometric sine and cosine.

[0019] In the case here of an up and over door, the element incorporating the accelerometer, it is more practical to put it on the surface of the door wing itself, so that the x axis is parallel to said surface. In said conditions the x axis, with the door wing closed, coincides with the vertical, and the signal emitted has the maximum value because it is related to the cosine.

[0020] Since the variability of the signal emitted for the x axis is proportional to the trigonometric sine of the angle between the position of the wing and the fixed part, it can be advantageous to use a fixing that keeps an inclination between the plane of the accelerometer and that of the wing: for reasons of simplicity, reference will be made to the positioning represented in the drawings in the attached plates.

[0021] Because the signals emitted by the electronic accelerometer are relative to its angular position in an absolute manner, they remain so until the power is reconnected whenever there is any interruption in the supply of the above-mentioned current.

[0022] With the use of the electronic accelerometer it is possible to know all the positions of the wing from its initial completely closed position (vertical) to a completely open position (horizontal) and vice versa, and this is because the electronic accelerometer emits signals for the entire field for its angular variations that range from 0 to 90 degrees, with its operations related to the cosine (1-0).

[0023] As said previously, when there is no voltage or after the automation has been disengaged, in whatever position the wing finds itself, when the power comes back on and the automation is re-engaged, because the signal emitted by the electronic accelerometer for each angular position is transduced taking into account the other movement parameters, like the current absorbed by the motors, automation restarts from the position from where

it was interrupted as if there had not been any power outage or restarts from the position where the wing was positioned with manual movement, as if there had been no disengagement of the automation (and therefore no interruption in the power supply).

[0024] Another advantage connected to the use of the electronic accelerometer consists of the characteristics that still today such devices have in terms of operating temperature and dynamic response.

[0025] We should remember that what has been said by way of example for the wing of an up and over door, which rotates by moving along the guiderails of the fixed frame, is equally valid for barred shutters that are subject only to rotation (both in the vertical as well as in the horizontal), and for any other element whose movement is dependent on, even indirectly, a rotational component.

[0026] We should also remember that the patent includes every other solution where in the place of an electronic accelerometer (which can replace an encoder or an equivalent system or device) a sensor is used for the angular positions, which emits signals with similar functions to those of an electronic accelerometer.

[0027] It should also be noted that the position signal obtained by the device can be used for the complete control of the movement, speed, slowing down, etc., carrying out all the functions presently done by an encoder and limit stops.

[0028] What has been described is clarified by examining the attached drawings.

[0029] Fig. 1 represents schematically the wing of an up and over door seen in profile in a closed position with an element applied, characterised by the fact it contains the electronic structure regarding an accelerometer that can emit signals as a function of its angular position.

[0030] Fig. 1' shows the element relative to the electronic accelerometer fixed solidly to the wing, highlighting the signal unit as a projection of the component that experiences gravity g on the reference axis.

[0031] Fig. 2 is a representation corresponding to Fig. 1 where the wing of the up and over door is in an intermediate position between the closed and open position and establishes an angle with respect to the vertical (different to the value of 0 degrees) which is the same angle established by the element attached to it containing the electronic accelerometer.

[0032] Fig. 2' also now outlines the element relative to the electronic accelerometer fixed solidly to the wing, showing that the projection of the component that experiences gravity g on the reference axis has changed (in diminution) compared to Fig. 1'.

[0033] Fig. 3 is a representation corresponding to Fig. 1 where the wing of the up and over door is almost in an open horizontal position and it establishes an angle with respect to the vertical (about 90 degrees), which is the same angle established by the element that has the electronic accelerometer fixed to it.

[0034] Fig. 3' also here outlines the element relative to the electronic accelerometer fixed solidly to the wing, showing that the projection of the component that experiences gravity g on the reference axis has changed (towards 0) compared to Fig. 1'.

[0035] According to the drawings shown in the diagrams it is applied to the wing 1 of an up and over door, which rotates using its pivots 2 along the guiderails in the fixed frame, identified in the diagram with its vertical K-K plane, the element 3 that incorporates the electronic accelerometer with the two axes x and y.

[0036] Element 3 is installed in such a way that when the wing 1 is closed the x axis is parallel to the vertical position of the wing.

[0037] The signals emitted by the electronic accelerometer relative to the x axis is determined according to the projection that the inertial part 4 (symbolically represented with a part of the rod like a pendulum), with respect to gravity "g", effectuates on the x axis during the variation of the angular position assumed by element 3. Because element 3 is solidly connected to the wing 1, each signal emitted by the electronic accelerometer corresponding to each of its angular positions, identifies in an absolute manner the position assumed by wing 1 during its movement.

[0038] In the case of the representations of the various diagrams, because the projections of the inertial part 4 are on the x axis, corresponding to the trigonometric cosine, the value of the signal with the wing 1 closed (vertical) will be 1 and with the wing open (horizontal) it will be 0.

[0039] Following what has just been described, we can understand the enormous importance of the invention in this patent, which revolutionises the current method for sensing the positions assumed by the moveable part of an automated frame during its movements (in this case the tilting wing of a door), in that the electronic accelerometer, which has been made to be dependent on the movements of the movable part, emits signals corresponding to its various angular positions that are directly related to the angular positions (and therefore to the positions assumed) of said movable part.

Claims

1. Device for controlling the movement of a closing element whose spatial movement includes a rotation, **characterised by** the fact that the position of the rotation in which the closing element (1) finds itself is clearly given as a signal coming directly from an electronic accelerometer (3, 4).

2. Device for controlling the movement of a closure element according to claim 1 **characterised by** the fact that the position in which the closure element (1) finds itself, which moves linearly related to with a component that at the same time rotates, is given as a signal coming directly from an electronic accelerometer (3, 4) relative to the position of the rotation

of the above-mentioned component.

3. Device for controlling the movement of a closure element according to claim 1 or 2, **characterised by** the fact that said moving closing element (1) is the wing of a door.

4. Device for controlling the movement of a closure element according to one of the previous claims **characterised by** the fact that the electronic accelerometer is directly connected to the moving closing element (1).

5. Device for controlling the movement of a closure element according to one of the previous claims **characterised by** the fact that the signal from the electronic accelerometer (3, 4) is independent from the values of the current absorbed by the motors when moving the moving closing element (1).

6. Device for controlling the movement of a closure element according to one or more of the previous claims **characterised by** the fact that the electronic accelerometer (3, 4) is an electronic accelerometer with a linear gravimetric inertia sensor (4), with at least one axis (x, y) that emits analogical and/or digital signals.

7. Device for controlling the movement of a closure element according to one or more of the previous claims **characterised by** the fact that said electronic accelerometer (3, 4) is fixed solidly to the door wing (1), with a consequent correspondence of the angular position assumed by the element (3) incorporating the electronic accelerometer (4) and the positions assumed by the wing (1) during its entire movement including the end zones.

8. Device for controlling the movement of a closure element according to one or more of the previous claims **characterised by** the fact that said electronic accelerometer (3, 4) gives the exact position of the moving closing element (1), whatever the situation was before the indications of its signals, in particolar in starting the movement again after a manual interruption or an interruption due to a lack of power for moving the closing element (1).

9. Device for controlling the movement of a closure element according to one or more of the previous claims **characterised by** the fact that said electronic accelerometer (3, 4) is positioned so that the x axis is not parallel to the position of the wing in way that it emits signals with the highest values when the positions assumed by he wing are the most important.

10. Device for controlling the movement of a closure element according to one or more of the previous claims **characterised by** the fact that said electronic accelerometer (3, 4) replaces the sensor for the angular position of the moving closing element (1) that carries out similar functions (which could be an encoder).

11. Device for controlling the movement of a closure element according to one or more of the previous claims **characterised by** the fact that finding the angular position along the course of the moving closing element (1) is carried out by a angular position sensor equivalent to an electronic accelerometer (3, 4) that emits corresponding signals.

12. Device for controlling the movement of a closure element according to one or more of the previous claims **characterised by** the fact that the electronic accelerometer (3, 4) finds the starting and stopping positions of the closing element (1), carrying out the function of the usual limit stops.

13. Device for controlling the movement of a closure element according to one or more of the previous claims **characterised by** the fact that the electronic accelerometer (3, 4) is replaced by an analogical angular position sensor.

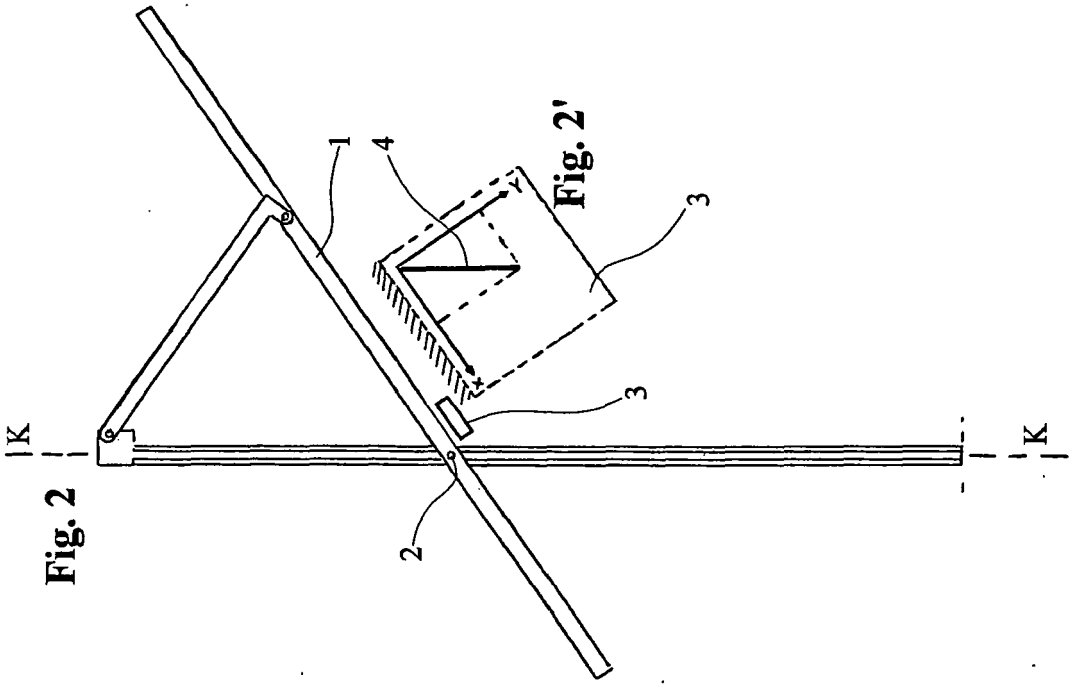

Fig. 2

Fig. 2'

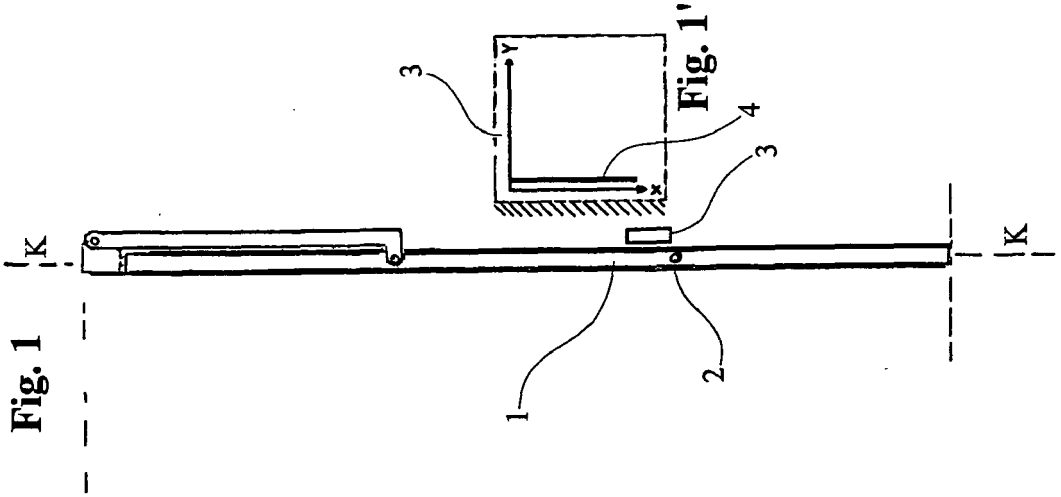

Fig. 1

Fig. 1'

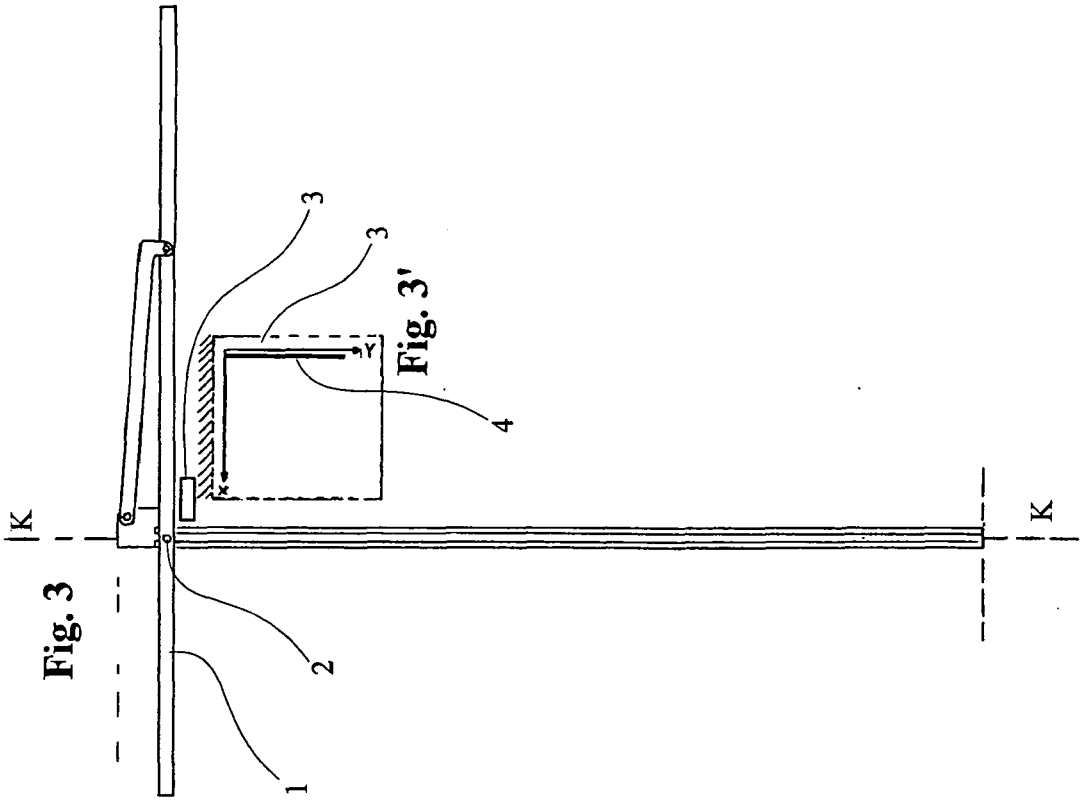

Fig. 3

Fig. 3'