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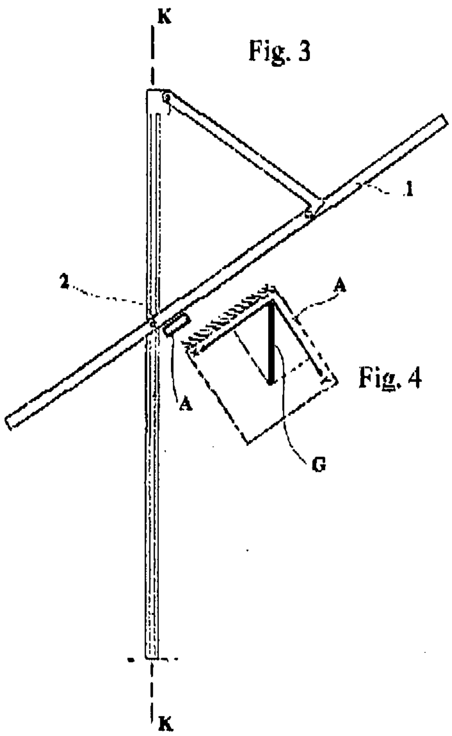
(54) Device for controlling the safety of a frame during its movement

(57) This is a device for controlling the safety of a frame during its movement, whose spatial motion includes a rotation, and which uses an electronic accelerometer (A, G) that emits signals with each bump and each obstacle encountered by said frame 1.



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Description

[0001] This patent concerns the moving parts of garage doors, also entrances to premises, like entrance frames, gates and barriers, and more generally all those parts that when moving can accidentally come into contact with people and things. It is well-known that for the above-mentioned moving parts, when moved automatically, current regulations oblige the adoption of adequate devices to ensure people or things that are near said moving parts are not harmed or damaged: among other things, such standards require that in the event of the moving part of the automated door hitting people or things, that this is limited in intensity and duration.

[0002] On the market there are 2 approaches for limiting the forces: contact sensors and motion control.

[0003] In both cases the idea is to limit or stop the movement, or reverse its direction.

[0004] In this application we will not take into consideration presence sensors that prevent access to the moving part since they do protect the moving part by getting the collision signal from the same moving part. While contact sensors are generally applied to the parts most likely to hit something, and when they intervene they react immediately, motion control intervenes through the kinematic chain. Both solutions described above have their drawbacks. There are numerous problems connected to the contact sensors.

[0005] In fact, contact sensors are not easy to apply, since they cannot cover the whole moving part that might be involved in a collision.

[0006] For an adequate and complete coverage using contact sensors the relative costs would render protection costly to install and maintain. Moreover, they intervene with a narrow angle of impact.

[0007] Motion control (or control over the force) on the other hand has the drawback of the response time, since the measuring of the force is carried out through the increase in the absorption of the current of the motors. This has a double disadvantage because the measuring is done upstream of the kinematic chain and because the measurement is indirect, sensing the results of a collision and not the collision itself.

[0008] Another drawback is the need to distinguish the increase of the force due to normal factors, like for example an increase in wear and tear, from a real bump.

[0009] The purpose of this patent is to create a device for controlling the movement of a moving part of a frame that guarantees security in a valid way, limiting the force that it might have against any obstacles in the way of people or things that it might encounter while it is moving. Another purpose of this patent is to be able to regulate the speed of the movement of the moving part in those areas where it is necessary to limit the motion in the presence of an obstacle.

[0010] This is obtained by using a device like the one described in claim 1.

[0011] Such a device, known also by the commercial name of an electronic accelerometer, can be similar to the one used in other applications on the market.

[0012] To more fully highlight the attainment of the aims mentioned above, we can consider the concrete case of the wing of an up and over door moved by one of the automated methods available on the market.

[0013] Similarly the above-mentioned device can be applied for the same purposes described above, and which will be clarified more fully in the description, also to other moving parts that have in common the requirement to control their operation following impact with people or things.

[0014] The main shortcoming in the numerous automation variants is that of the parameters taken into consideration for the movement of the wing, where the wing does not show up directly, but only shows up as a passive element that comes into play only when effected by bumps or when it encounters an obstacle during its movement. One of the drawbacks that current automated systems on the market have is the fact that they do not recognise the positions assumed by the wing during its travel, so the control of any counter forces that might present themselves at the ends is insufficient, and indeed to stop the door one of the most common solutions adopted is the use of limit stops that interrupt the power supply to the motors that power the motion.

[0015] Another drawback of currently available automated systems comes from the difficulty of intervening quickly to block the movement of the wing following a collision or the presence of an obstacle because this should provoke an increase in the supply of current that exceeds a threshold, which cannot be too low because it is counter to the normal functionality of the movement.

[0016] A further drawback of currently available automated systems is due to the fact that following a power cut one or more movements have to be carried out that are not so safe because the positions assumed by the wing during its movement are unknown.

[0017] This happens with bigger problems also in the case of the disengagement of the motors from the movable part.

[0018] Avoiding the above-mentioned drawbacks falls within the purposes of this patent and to attain said purposes an electronic accelerometer is used as mentioned earlier.

[0019] Said electronic 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.

[0020] The above-mentioned accelerometer can be the more simple linear type, where the signals emitted (voltage) refer to two Cartesian axes x and y, and whose magnitude for each angular position are equalised to the relative trigonometric sine and cosine values.

[0021] The element with the accelerometer is put securely on the wing, deciding for example that the x axis is parallel to the plane of the wing and when the wing is closed is in the vertical.

[0022] For each position assumed along the path of the movement of the wing (which goes form the initial completely closed position of the wing (vertical) to the completely open position (horizontal and vice versa) the electronic accelerometer assumes its own angular position (which in the case in question is the same as that assumed by the wing) and emits a signal (voltage) that once transduced and processed becomes, together with the other movement parameters, an integral part of the automated control.

[0023] The positions assumed by the wing during its movement, characterised by its angular positions, (taking into account that the accelerometer is solidly fixed to the wing) are clearly known because they are related to the signals emitted by the electronic accelerometer regarding its own angular positions.

[0024] So, the normal movement of the wing is regulated as speed by processing the signals emitted by the accelerometer and at the ends of the path the movement is progressively reduced so that in the closing stage the wing stops softly in the support, and in the opening stage the absorption of the current that powers the motors is regulated with a moderate push.

[0025] The main reason for this patent is that following a bump of the wing against an obstacle that the wing encounters while it is moving, the electronic accelerometer (fastened solidly to the wing) senses it as a variation in speed and emits a signal variation that when properly transduced and processed generates a rapid response with the stopping of the movement and with a possible inversion of the movement before an opposition force is established that is greater than a pre-set threshold.

[0026] In particular, surmising a constant angular movement of the wing, the above-described variation corresponds to the derivative of the wing's speed of movement: in the example, such a variation is proportional to the increase (or the diminution) of the variation of the sine of the angle formed by the position of the wing with the fixed part.

[0027] Properly analysing this latter value and its course, we can reasonably recognise the type of bump, against a non-deformable object or an supple bump and eventually consider the response to make.

[0028] One advantage of the device is that it can be fixed in a non-parallel position to the wing in such a way as to be able to use the zone of maximum sensitivity which in the case in question is proportional to the sine of the above-mentioned angle.

[0029] It should be made clear here that the intervention of the electronic accelerometer that controls the reaction force of the wing during its movement against an obstacle or following a collision, it can also not be limited to when said events effect the wing in the normal direction of the plane, but also when the above-mentioned events (collisions and obstacles) effect the wing in a crosswise direction.

[0030] In this specific case, the device can distinguish the various directions of the collision described above so as to allow the appropriate distinct actions to be undertaken.

[0031] The signal of the electronic accelerometer following a collision is used as a signal for managing the control device concerned with the collisions or bumps in a way consequent to the movement component observed, considering it a perpendicular or planar bump with respect to the frame that is moving.

[0032] The device provides the continual verification of the presence of any jamming of the wing.

[0033] This could be better implemented if the electronic accelerometer is positioned on opposite ends of the moving frame and the relative signals are combined to get more information and/or accuracy regarding identifying the collision and/or jamming of the wing.

[0034] It needs to be said that more than one device can be installed with the above-mentioned characteristics, arranging them in areas of the wing considered the most critical, and in such a way that the signal is sensitive to the collisions even when there is, for example, a wing with considerable inertia.

[0035] It should be repeated that what has been said of an up and over door, which moves along the guiderails of the fixed frame, is also valid for bar wings that are subject only to rotation (both in the vertical direction, as well as in the horizontal) or for any other part whose movement, even indirectly, is referable to a rotating component.

[0036] It should be said, finally, that this patent covers every other solution where in the place of an electronic accelerometer an angular position sensor is used that emits signal with similar functions to those of an electronic accelerometer, like a gyroscope.

[0037] Naturally the signal received from the electronic accelerometer following a collision of the frame can usefully be combined and/or compared with at least one other signal that has been observed like the signal regarding current absorption, vibration, noise, etc. so as to obtain a quick, precise control, so there are no false alarms.

[0038] What has been described can be clarified by examining the attached drawings.

[0039] Fig. 1 is a profile drawing of the wing of an up and over door in a closed position with the application of an element characterised by the fact it contains the electronic accelerometer that can emit signals according to its angular position.

[0040] Fig. 2 outlines the element relative to the electronic accelerometer fixed solidly to the wing, highlighting the signal entity as a projection of the component that experiences gravity g on the reference axis.

[0041] Fig. 3 is a representation corresponding to Fig. 1 where the wing of the door is in an intermediate position between closed and open and it establishes an angular position with respect to the vertical (different to the value of 0 degrees) which is the same angular position established by the element fixed solidly to it containing the electronic accelerometer.

[0042] Fig. 4 also shows 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. 2.

[0043] Fig. 5 is a representation corresponding to fig. 1 where the wing of the door is almost in the horizontal position of open and creates an angular position with respect to the vertical (about 90 degrees) which is the same angle established by the element fixed solidly to it containing the electronic accelerometer.

[0044] Fig. 6 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. 2.

[0045] According to the outline shown in the diagrams it is applied to the wing 1 of an up and over door, which in its movement rotates, using its two pivots 2 along the guiderails in the fixed frame, identified in the diagram with the vertical of its K-K plane, the element A that incorporates the electronic accelerometer with the two axes x and y.

[0046] 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.

[0047] The signals emitted by the electronic accelerometer relative to the x axis is determined as a function of the projection that the inertial part 4 (symbolically represented with a portion of the rod acting as a pendulum), with respect to gravity "g", effectuates on the x axis during the variation of the angular position assumed by the element 3. Because element 3 is solidly fixed to the wing 1, each signal emitted by the electronic accelerometer corresponding to each of its angular positions precisely identifies the position assumed by the wing while it is moving.

[0048] 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.

[0049] Following what has been said earlier, we can understand the enormous importance of the inventive capacity of this patent, which revolutionises the methodology used until now regarding safety, since the electronic accelerometer that is solidly fixed to the moving part, when said part is bumped or encounters a pre-fixed obstacle it emits a variation of the signal that when transduced and processed quickly blocks the movement and/or inverts the direction of the movement.

Claims

1. Device for controlling the safety of a door or window frame during its movement, **characterised by** the fact that an electronic accelerometer (A, G) is used that emits signals with each collision or each obstacle encountered by a frame (1) that is moving, and which includes a rotation component to which frame (1) said accelerometer (A, G) is joined.

2. Device for controlling the safety of a door or window frame during its movement according to claim 1, **characterised by** the fact that an electronic accelerometer (A, G) is used that emits signals with each collision or each obstacle encountered by a frame (1) that moves in a straight line, whose movement is related to a rotation movement..

3. Device for controlling the safety of a frame during its movement according claim 1 or 2, **characterised by** the fact that said moving frame (1) is the wing (1) of a loading door.

4. Device for controlling the safety of a frame during its movement according to one of the preceding claims, **characterised by** the fact that the electronic accelerometer (A, G) is directly positioned on the moving frame (1).

5. Device for controlling the safety of a frame during its movement according to one of the previous claims **characterised by** the fact that the signal of the electronic accelerometer (A, G) is related to the values of the current absorbed by the motors during the movement of the frame (1).

6. Device for controlling the safety of a frame during its movement according to one of the previous claims **characterised by** the fact that the signal of the electronic accelerometer (A, G) following a collision is used as a signal for managing the control device regarding the collisions and bumps.

7. Device for controlling the safety of a frame during its movement according to one of the previous claims **characterised by** the fact that the signal of the electronic accelerometer (A, G) following a collision is used as a signal for managing the control device regarding the collisions and bumps in a manner consequent to the moving component, considering it either a perpendicular or planar type of bump with respect to the moving frame (1).

8. Device for controlling the safety of a frame during its movement according to one or more of the preceding claims, **characterised by** the fact that the electronic accelerometer (A, G) is positioned with the x axis in a way that is not parallel to the position of the wing in such a way that it emits the maximum value signal corresponding to the positions assumed by the wing where one wants to obtain the maximum sensitivity to the effects of the collision.

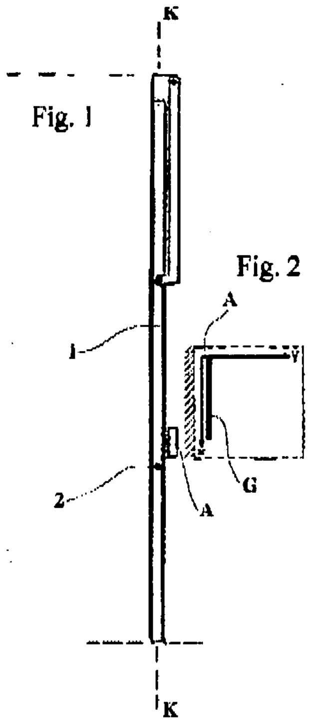
9. Device for controlling the safety of a frame during its movement according to one or more of the previous claims **characterised by** the fact that the electronic accelerometer (A, G) is an electronic accelerometer with a linear gravimetric inertia sensor (G), with at least one axis (x, y) that emits analogical and/or digital signals.

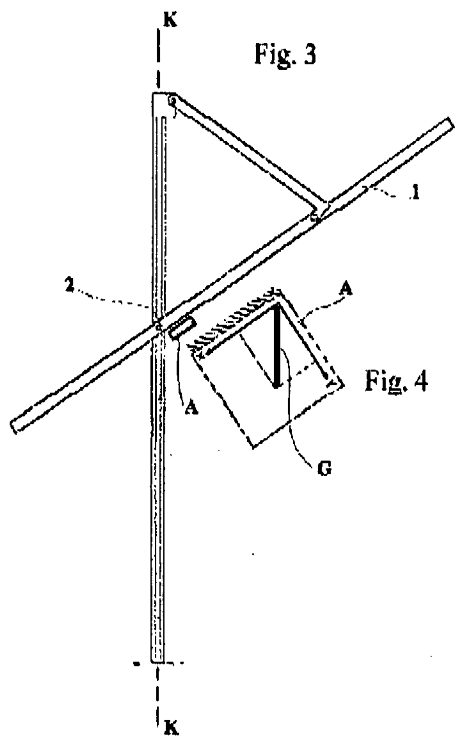
10. Device for controlling the safety of a frame during its movement according to one or more of the previous claims **characterised by** the fact that the signal from the electronic accelerometer (A, G) following a collision of the frame (1) is combined and/or compared with at least one other signal like the signal for current absorption, vibration, noise, etc.

11. Device for controlling the safety of a frame during its movement according to one or more of the previous claims **characterised by** the fact that the signal from the electronic accelerometer (A, G) is replaced by a collision or bump sensor that emits analogical signals like a gyroscope.

12. Device for controlling the safety of a frame during its movement according to one or more of the previous claims **characterised by** the fact that the electronic accelerometer (A, G) is positioned on both opposite ends of the moving frame (1) and the relative signals are combined to get more information and/or precision regarding the identification of the collision.

13. Device for controlling the safety of a frame during its movement according to one or more of the previous claims **characterised by** the fact that the signals supplied by the electronic accelerometer (A, G) relative to the various axes (x, y) are related to the direction of the collision with respect to the moving frame(1).


K
Fig. 1
Fig. 2
A
1
2
A
G
K


K
Fig. 3
1
2
A
Fig. 4
A
G
K

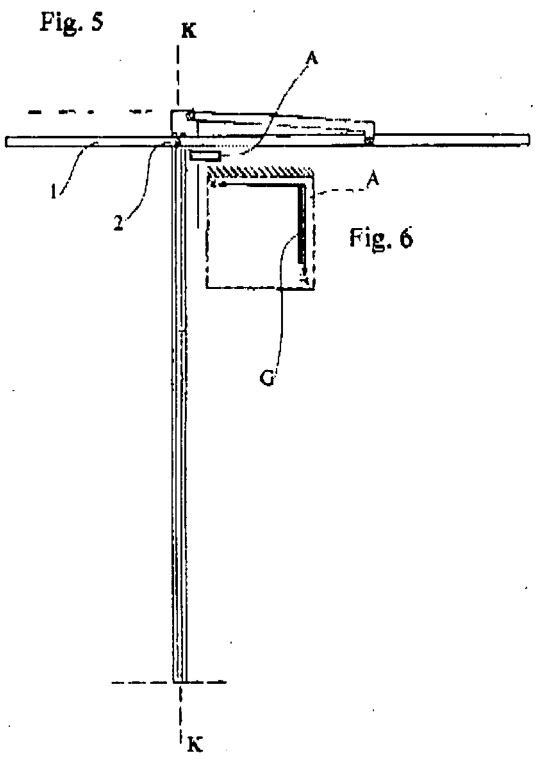


Fig. 5
K
A
1
2
A
Fig. 6
G
K