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(54) Fail safe actuator

(57) A fail-safe actuator having a drive unit for both driving the barrier to one, non-operative position and holding it there with respect to its aperture, a drive transmitter and a motive power device connected to the drive-unit drive transmitter for providing drive between it and a drive output shaft, and a retarder. The retarder having a drive transmitter, a retardation device switchable between two retardation states namely a high-torque, first state, which is selectable for driving of the barrier to the non-operative position and a low-torque second state, which is a fail safe state for deployment of the barrier to the operative position. The retarder also having a three element gear mechanism arranged between the drive output shaft and the retardation device, the mechanism having three elements geared one connected to the retarder drive transmitter, the second connected to the drive output shaft and the third connected to retardable member of the retardation device.

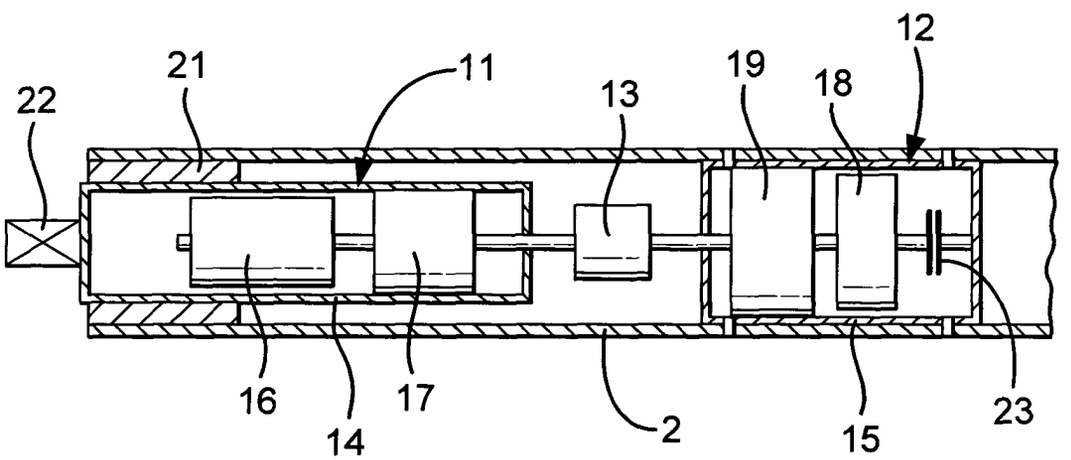

Fig.2

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Description

[0001] The present invention relates to a fail-safe actuator, particularly though not exclusively for a barrier to divide, or remove division of, two regions in event of fire.

[0002] Conventionally, a fire or smoke barrier, that is a curtain wound on a roller, must descend in the event of fire and the rate of descent must be controlled and safe. With a barrier driven by mains or auxiliary power voltage, the fire may interrupt all power sources and/or there maybe corruption to the control system. Then the barrier descends. With increasing length and weight of barriers, controlling the speed of descent is critical. Further differing sizes of barrier have in the past called for different sizes of motor and increasing use of barriers in wider applications has called for many different sizes of motors and power supplies. This causes inventory problems and requires a greater need for dry systems which are fit for purpose in a wide variety of applications.

[0003] An important factor in the design of a curtain system is the conflicting requirement for the drive mechanism for winding the screen up to be reasonably inexpensive and at the same time able to allow slow safe deployment. Winding up is in fact relatively easy to achieve. An electric motor of sufficient power coupled to a high reduction gearbox achieves wind up. However, such a gearbox is liable to inhibit deployment, due to internal friction.

[0004] It is of course well known that whereas a high reduction gear box can be driven at the input shaft with low torque to achieve a high torque output, application of that output torque to the output shaft will not necessarily result in the same low torque being available at the input. Indeed a worm reduction gearbox can act as if a brake is applied as regards torque applied to (as opposed to from) the output shaft. Epicyclic gear boxes as conventionally used in a curtain drive, generally can be driven from the output. However, the friction at the input end is at least multiplied by the gear ratio at the output end. Thus a high torque is always required to drive the output shaft. Further, not only is friction such a problem, stiction is also. The stiction to start the output shaft rotating is always higher that the friction to keep it rotating. A further intrinsic difficulty with fail safe deployment of a curtain from a roller connected to a high reduction gearbox for its re-winding is that curtain is rolled up. In this condition, it is the weight of the bottom bar only which is available to apply un-winding torque to over-come initial stiction. On the other hand, once the curtain is most way un-wound, the full weight of the curtain is contributing to the un-winding torque in addition to that of the bottom bar. Thus low torque is available to overcome the high starting stiction and high torque towards the end has to be controlled by the lower rolling friction.

[0005] In our experience, this dichotomy can be satisfactorily be overcome only by use of an expensive low friction gearbox and an equally expensive motor. Nevertheless, the inventory problem referred to above remains where a range of different curtain weight etc. needs to be overcome.

[0006] In our earlier prior patent No. 2,108,839, there is a described and claimed:

A device for installation in an elevated position in an enclosed space and operable automatically in the event of fire to partition said space and restrict the spread of fire therein, said device comprising:

- a screen of flexible fire-proof material wound upon and adapted to unwind under gravity from a rotatable roller,
- an electromagnetic unit normally connected to an electric current source and operative, when energised, to retain the screen in its wound or retracted position, and
- means, operable in response to the presence of fire, to interrupt the supply of power to said unit and permit the screen to unwind into its operative or extended position.

[0007] Further in our later prior patent No 2,320,944, there is described and claimed a brake arrangement for a blind, the arrangement comprising:

- a drum for the blind to be rolled from for deployment and rolled back onto for withdrawal,
- a motor and multi-stage reduction gearbox unit contained within the drum and arranged for rotation of the drum around it,
- the unit having:
    - a stator fixed in it,
    - a rotor drivingly connected to the gearbox,
    - a gearbox output directly connected to the drum for driving it to deploy and withdraw the blind,
- the brake arrangement including:

    Either in a first alternative

    - a brake operative between the rotor and the stator and actuatable independently of application of drive e.m.f. to the motor, and
    - a control system adapted and arranged to apply the brake when the blind is to be held withdrawn and to release the brake both when drive e.m.f. is applied to the motor and when deployment is required in the absence of motor drive e.m.f.;

    Or in a second alternative

    - a brake operative between the blind drum and a fixed structure and actuatable independently of application of drive e.m.f. to the motor, and

- a control system adapted and arranged to apply the brake when the blind is to be held withdrawn and to release the brake both when drive e.m.f. is applied to the motor and when deployment is required in the absence of motor drive e.m.f.

[0008] In the case of the first alternative, in the event of mains failure rendering motor drive e.m.f. non-available, the brake, which can be actuated by a battery backup, can hold the barrier against deployment. Should smoke be detected, the brake can be released. The barrier will fall controllably due to motor (and gearbox) friction multiplied by the gearbox ratio providing a braking effect on the drum such that the barrier does not fall out of control.

[0009] In the case of the second alternative, the function of the brake is identical to that of the first alternative, but requires a higher torque capacity, since it does not act through the gearbox to hold the deployment torque of the barrier.

[0010] For barriers of differing weights, the motor must be of the expensive type available in varying capacities.

[0011] The object of the present invention is to provide an improved fail safe actuator

[0012] According to the invention there is provided a fail-safe actuator for an aperture barrier, the actuator comprising:

- a drive unit for both driving the barrier to one, non-operative position and holding it there with respect to its aperture, the drive unit having:
  - a drive-unit drive transmitter and
  - a motive power device connected to the drive-unit drive transmitter for providing drive between it and a drive output shaft, and
- a retarder for allowing the barrier to deploy to another, operative position without movement of the drive output shaft with respect to its drive transmitter, the retarder having:
  - a retarder drive transmitter,
  - a retardation device connected to the retarder drive transmitter for providing retardation of a retardable rotatable member, the retardation device being switchable between two retardation states:
    - a high-torque, first state, which is selectable for driving of the barrier to the non-operative position and
    - a low-torque second state, which is a fail safe state for deployment of the barrier to the operative position and
  - a three element gear mechanism arranged between the drive output shaft and the retardation device, the mechanism having three elements geared together for rotation of any two elements with determined ratios when the third is fixed:
    - one element being connected to the retarder drive transmitter,
    - the second element being connected to the drive output shaft and
    - the third element being connected to retardable member of the retardation device;

the arrangement being such that:

- with the retardation device in its first state, i.e. with the third element able to rotate with respect to the retarder drive transmitter only with high torque, the gear mechanism and the retardation device act as an engaged clutch for the drive unit, whereby the drive unit can drive the barrier to its non-operative position and
- with the drive unit stopped and the retardation device in its second state, the barrier deploys under the low torque retardation provided by the retardation device acting through the three element gear mechanism.

[0013] It should be noted that the operative position of the barrier with respect to the aperture may be one in which it divides two regions on opposite sides of the aperture or it may be one in which it allows communication between the two regions. For instance in the first alternative, the barrier may be a fire door or curtain or a smoke screen for dividing the opposite sides of the aperture from each other for preventing fire and/or smoke passing from the region on one side of the barrier to the other when operative; in the second alternative, the barrier may be a window or roof vent which normally divides the inside of the building from the outside, but which opens when operative to allow escape of smoke for instance in the event of fire. Normally the aperture will be real, for instance in the case of a door or window it will be the doorway or window opening, or in the case of a curtain, an area defined by a ceiling and two walls. However, the aperture may be notional in that it is not bounded by solid boundaries all round, such a ceiling, two walls and a floor. For instance, it may stop short of a floor in the case of a smoke curtain extending part way from a ceiling to a floor. Again where a closed series of curtains are arranged to divide off an open staircase, the aperture for each individual curtain is that defined by a ceiling and a floor and the edges of two adjacent curtains in the series.

[0014] The barrier itself may be flexible or rigid. In the former case, it will generally be a curtain rolled on a roller. In the latter case, it may be a rigid door, window or

vent. For a curtain on a roller, the drive shaft will rotate many times for driving the curtain from its operative to its quiescent position. For a door or a vent the drivable member is unlikely to rotate more than 180 . It should be noted that the invention is not intended to be limited to barriers moved rotationally. Indeed in its final deployment to its operative position a curtain's movement is largely translational. Additionally a rigid barrier may be deployed by translational movement. However for such movement, the drive shaft will normally be connected to a crank acting through a connecting rod, converting rotation of the drive shaft to translation of the barrier.

[0015] Whilst it is envisaged that the three element gear mechanism could be a conventional, non-moving shaft, gearbox and indeed one having a one to one ratio between the second and third elements with the first element fixed; normally it will be a high reduction gearbox and as such it is conveniently an epicyclic (i.e. moving shaft) gearbox, due to the compact nature of the latter. Where the gearbox has a high reduction, i.e. greater than 10 to 1, retardation torque applied to the barrier during deployment is at least the low torque of the retardation device multiplied by the gear ratio. In practice, the retardation torque is likely to be higher, due to the internal friction of the gearbox. Indeed it is conceivable that the retardation device may apply no retardation torque to the third element when the barrier is deploying, all the retardation applied to the barrier originating as friction in the gearbox. In other words, the low torque may be zero.

[0016] The retardation device will normally be an electro-magnetic device. In particularly it may be an electromagnetic clutch and/or an electromagnetic motor acting as a brake. The latter can be adjusted to provide a low torque suitable to the particular barrier, by adjusting the resistance between the terminals of the motor. The high torque will normally such as to hold the retardable member stopped when the barrier is being driven to the non-operative position and held there.

[0017] However, a pneumatic or hydraulic retardation device can also be used.

[0018] The motive power device will normally be an electric motor coupled to a high reduction gearbox. Again, normally the reduction and/or the internal friction and/or the stiction will be adequate to cause the motive power device to be sufficiently irreversible that the barrier will not deploy with the retardation device in its high torque state and no power applied. Alternatively, where the electric motor is a DC motor, the apparent friction can be increased by shorting the terminals. This will normally be the fail safe condition.

[0019] However, again, the motive power device can be pneumatic or hydraulic.

[0020] Whilst in many applications, the force for deployment of the barrier will be gravitational, the invention has application in other situations, particularly where the force is spring force, either from metal or other springs or from struts such as gas struts or other stored energy devices. Stored energy devices are particularly useful where for instance the barrier is to be deployed horizontal or indeed upwards.

[0021] There are two ways that the drive unit and the retarder can be arranged. Former can be connected by its drive transmitter to the curtain roller - or the equivalent - and the latter connected by its drive transmitter to the building concerned; or vice versa.

[0022] To help understanding of the invention, a specific embodiment thereof will now be described by way of example and with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of a fire screen;
Figure 2 is a cross-sectional side view of a fire-screen barrier drum showing a drive and retarder arrangement according to the invention;
Figure 3 is a block diagram of a control circuit for the drive and retarder arrangement of the invention;
Figure 4 is a view similar to Figure 2 of an alternative drive and retarder arrangement; and
Figure 5 is a cross-sectional end view of a roof vent fitted with actuators of the invention.

[0023] Referring to the drawings, a fire screen or barrier 1 is wound on a drum 2 having a fail-safe actuator 3. The actuator is controlled by a controller 4 connected to a standby, DC power supply 5, itself connected to an AC mains trickle charge unit 6.

[0024] As shown in Figure 2, the actuator comprises two back-to-back motor and gearbox units, that is a drive unit 11 and a retarder 12. Their output shafts are interconnected by a simple connector 13. Each unit comprises a sleeve 14,15 accommodated within the drum tube 2 and respectively containing a main drive motor 16 and a numerically high reduction gearbox 17 in the sleeve 14 and a retarder motor 18 and a numerically low reduction gearbox 19 in the sleeve 15. Typically, the gearbox 17 can have a 100:1 ratio and the gearbox 19 a 10:1 ratio.

[0025] The sleeve 14 has a bearing sleeve 21 for journalling the drum tube and a square section end stub 22 for irrotational support of the sleeve and indeed support of the drum at this end. The stub comprises a drive transmitter for the drive unit 11, in that it provides for drive torque to be transmitted back or reacted to the part of the building in which the barrier is installed. The sleeve 15 is irrotationally fixed in the drum. The sleeve comprises a drive transmitter for the retarder 12, in that it provides the means by which drive torque is actually transmitted to the drum 2 and the screen 1.

[0026] An electro-mechanical brake 23 is provided in the sleeve 15 between the sleeve and the retarder motor 18. Normally, the brake is applied, whereby the retarder motor and gearbox is locked up as a whole 12. For driving of the drum, voltage is applied to the drive motor 16. Its stator is fast with the sleeve 14. Its rotor is connected to the input of the gearbox 17, whereby the connector

13 is driven at highly reduced speed. The unit 12 being locked, the drive is carried through this unit to the drum, which rotates around the unit 11.

[0027] If the voltage supply fails and/or a fire is detected, the brake is released. Torque is applied to the drum by the weight of the barrier, assuming this to be wound up such as to tend to cause the retarder motor 18 to rotate as it is free to do so, the brake having been released. The drum thus rotates with the retarder motor rotating inside it at the drum speed multiplied by the ratio of the gearbox 19. As described in more detail below, the terminals of the retarder motor are shorted, causing back e.m.f. to be generated and tending to retard the motor. This retarder torque is multiplied by the gearbox 19 and controls the decent of the barrier. The motor 18 is preferably a multi-commutator segment motor for smoothness of rotation in braking the descent of the barrier.

[0028] The free fall rotation of the drum tends to rotate the connector 13 and the gearing within the gearbox 17. However, this having a high reduction ratio, the small frictional starting torque of the drive motor 16 is multiplied by the high ratio such that the barrier torque does not rotate the motor 16. Thus the connector 13 remains stationary. The motor 16 can be a simple three commutator segment motor, which has the advantage not only of economy but also of magnetically induced free-wheel friction.

[0029] Turning now to the block diagram of the controller shown in Figure 3, the normally open circuit relay 31 controls the drive motor in connection with the polarity reversing switch 32. The normally closed relay 33 holds the brake on at all times except in the event of fire or of failure of the emergency power supply, when the relay opens. In this event the barrier free falls as described. A further normally open relay 34 holds the terminals of the retarder motor 18 open circuit until power failure, the terminals are closed to apply braking back e.m.f. To fine tune the speed of descent of the barrier, an optional resistance 35 may be included in the terminal circuit. A further feature is the application via a relay 36 of sufficient voltage to hold the retarder motor from rotating under lifting of the curtain in the event of the brake 23 being unable to apply sufficient torque, both relays 31 and 36 being operated together.

[0030] Turning to Figure 4, the drive and braking mechanism thereshown is essentially similar to that shown in Figure 2, save that the drive unit 111, is arranged inwardly of the retarder unit 112. Also the retarder unit is provided with a support stub 122 for supporting the barrier and holding its unit from rotating. A bearing sleeve 121 is provided between this unit the drum 102. The drive motor unit 111 on the other hand has the drum 102 fixed to it. This mechanism works in an exactly analogous manner to that of Figure 2. For powered operation, the brake 123 is applied and the barrier is wound up or down by the drive motor 116, possibly with the application of voltage to the retarder motor 118 to augment the action of the brake. For fail-safe, free fall operation, the brake is released and speed of descent is controlled by the back e.m.f. in the retarder motor, with the internal friction of the drive gearbox causing it to remain static.

[0031] The invention is not intended to be restricted to the details of the above described embodiment. For instance, the terminals of the drive motor can be arranged to be short circuited in the event of power failure, to further assure that it does not rotate and descent is under control of the retarder motor only.

[0032] The first, drive motor acting through the high reduction, first gearbox to drive drum can be a simple motor of the type having three segments of its commutator.

The second, retarder motor acting through the lesser reduction, second gearbox is preferably of the type having more commutator segments.

[0033] Turning now to Figure 5, a roof vent 201 is shown, having a frame 202 and a pair of upwards opening flaps 203. These are pivoted to the frame at 204 and provided with gas struts 205 for their opening. Fail safe actuators 206 are provided for closing the flaps and allowing them to open in case of need to operative positions OP under the action of the gas struts. The actuators are essentially similar to the actuator 3 of Figures 1 & 2 extending between opposite ends of the frame. The outer tubes of the actuators have cranks 207, connected to the flaps via connecting rods 208.

[0034] In event of fire or power failure, the retarders become set to their low torque state and the gas struts over-come the weight of the flaps and the low retardation torque acting through the retard gearing. The flaps are lifted open.

Claims

1. A fail-safe actuator for an aperture barrier, the actuator comprising:

- a drive unit for both driving the barrier to one, non-operative position and holding it there with respect to its aperture, the drive unit having:
  - a drive-unit drive transmitter and
  - a motive power device connected to the drive-unit drive transmitter for providing drive between it and a drive output shaft, and
- a retarder for allowing the barrier to deploy to another, operative position without movement of the drive output shaft with respect to its drive transmitter, the retarder having:
  - a retarder drive transmitter,
  - a retardation device connected to the retarder drive transmitter for providing retar-

dation of a retardable rotatable member, the retardation device being switchable between two retardation states:

- a high-torque, first state, which is selectable for driving of the barrier to the non-operative position and
- a low-torque second state, which is a fail safe state for deployment of the barrier to the operative position and

- a three element gear mechanism arranged between the drive output shaft and the retardation device, the mechanism having three elements geared together for rotation of any two elements with determined ratios when the third is fixed:

  - one element being connected to the retarder drive transmitter,
  - the second element being connected to the drive output shaft and
  - the third element being connected to retardable member of the retardation device;

the arrangement being such that:

- with the retardation device in its first state, i.e. with the third element able to rotate with respect to the retarder drive transmitter only with high torque, the gear mechanism and the retardation device act as an engaged clutch for the drive unit, whereby the drive unit can drive the barrier to its non-operative position and
- with the drive unit stopped and the retardation device in its second state, the barrier deploys under the low torque retardation provided by the retardation device acting through the three element gear mechanism.

2. A fail-safe actuator for an aperture barrier, as claimed in claim 1 wherein the aperture is real, for example in the case of a door or window it will be the doorway or window opening, or in the case of a curtain, an area defined by a ceiling and two walls.

3. A fail-safe actuator for an aperture barrier as claimed in claim 1, wherein the aperture is notional in that it is not bounded by solid boundaries all round, such a ceiling, two walls and a floor.

4. A fail-safe actuator for an aperture barrier, as claimed in any one of claim 1, claim 2, or claim 3, wherein the barrier is flexible

5. A fail-safe actuator for an aperture barrier as claimed in claim 4, wherein the barrier is a curtain rolled on a roller.

6. A fail-safe actuator for an aperture barrier as claimed in claim 5, wherein the drive shaft will rotate many times for driving the curtain from its operative to its quiescent position.

7. A fail-safe actuator for an aperture barrier, as claimed in any one of claims 1, claim 2, or claim 3, wherein the barrier is rigid.

8. A fail-safe actuator for an aperture barrier as claimed in claim 7, wherein the barrier is a rigid door, window or vent.

9. A fail-safe actuator for an aperture barrier as claimed in claim 8, wherein the drivable member rotates less than 180°.

10. A fail-safe actuator for an aperture barrier as claimed in claim 8, wherein for translational movement of a rigid barrier the drive shaft is connected to a crank acting through a connecting rod, converting rotation of the drive shaft to translation of the barrier.

11. A fail-safe actuator for an aperture barrier as claimed in any preceding claim, wherein the three-element gear mechanism is a conventional, non-moving shaft, gearbox, having a one to one ratio between the second and third elements with the first element fixed.

12. A fail-safe actuator for an aperture barrier as claimed in any one of claims 1 to 10, wherein the three-element gear mechanism is a high reduction gearbox.

13. A fail-safe actuator for an aperture barrier as claimed in claim 12, wherein the gearbox is an epicyclic (i.e. moving shaft) gearbox.

14. A fail-safe actuator for an aperture barrier as claimed in claim 12, or claim 13, wherein the gearbox has a high reduction of greater than 10 to 1.

15. A fail-safe actuator for an aperture barrier as claimed in claim 14, wherein retardation torque applied to the barrier during deployment is at least the low torque of the retardation device multiplied by the gear ratio.

16. A fail-safe actuator for an aperture barrier as claimed in claim 15, wherein the retardation device is an electro-magnetic device.

17. A fail-safe actuator for an aperture barrier as claimed in claim 16, wherein the retardation device

is an electromagnetic clutch and/or an electromagnetic motor acting as a brake.

18. A fail-safe actuator for an aperture barrier as claimed in any one of claims 1 to 15, wherein the retardation device in a pneumatic or hydraulic retardation device.

19. A fail-safe actuator for an aperture barrier as claimed in any preceding claim, wherein the motive power device is an electric motor coupled to a high reduction gearbox.

20. A fail-safe actuator for an aperture barrier as claimed in claim 19, wherein the reduction and/or the internal friction and/or the stiction cause the motive power device to be sufficiently irreversible that the barrier will not deploy with the retardation device in its high torque state and no power applied.

21. A fail-safe actuator for an aperture barrier as claimed in claim 19, wherein the electric motor is a DC motor, the apparent friction can be increased by shorting the terminals.

22. A fail-safe actuator for an aperture barrier as claimed in any one of claims 1 to 18, wherein the motive power device is pneumatic or hydraulic.

23. A fail-safe actuator for an aperture barrier as claimed in any preceding claim, wherein, the force for deployment of the barrier is gravitational

24. A fail-safe actuator for an aperture barrier as claimed in any one of claims 1 to 22, wherein the force for deployment of the barrier is spring force, either from metal or other springs or from struts such as gas struts or other stored energy devices.

25. A fail-safe actuator for an aperture barrier, as claimed in any preceding claim, wherein the retarder is connected by its drive transmitter to the curtain roller and the latter connected by its drive transmitter to the building concerned.

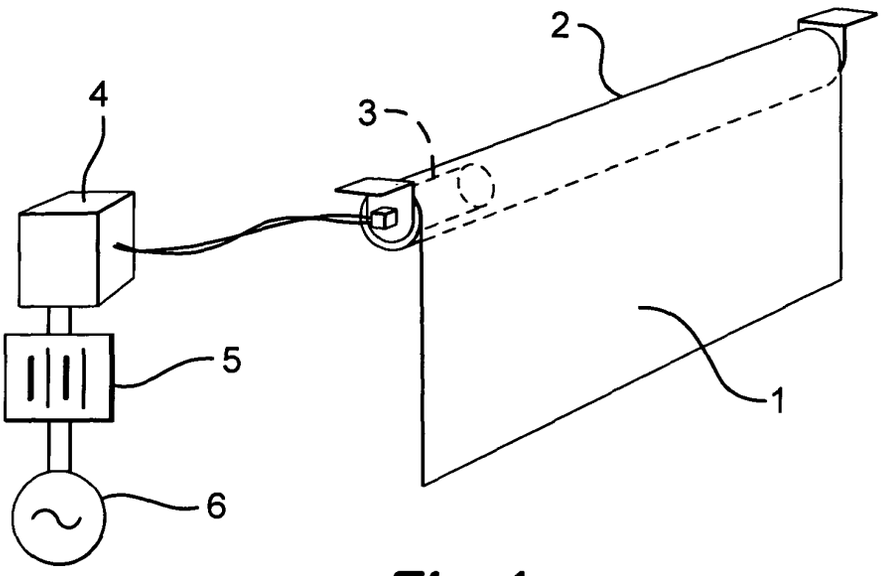

Fig.1

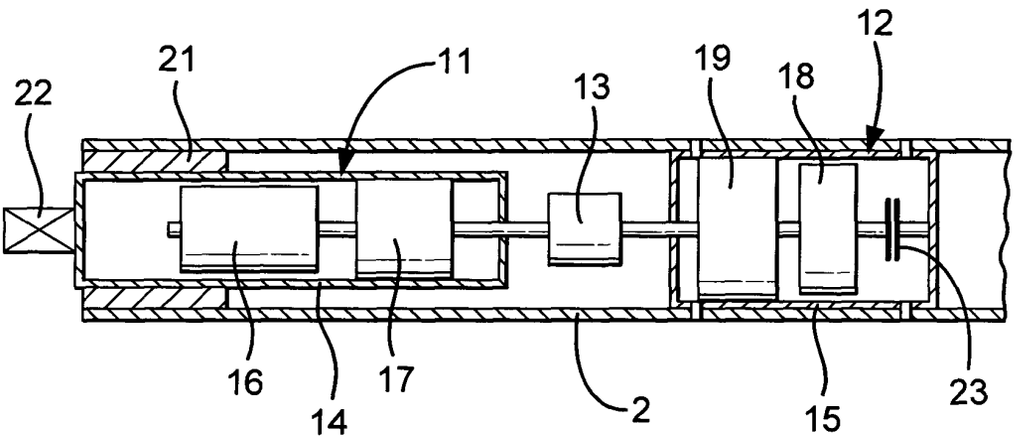

Fig.2

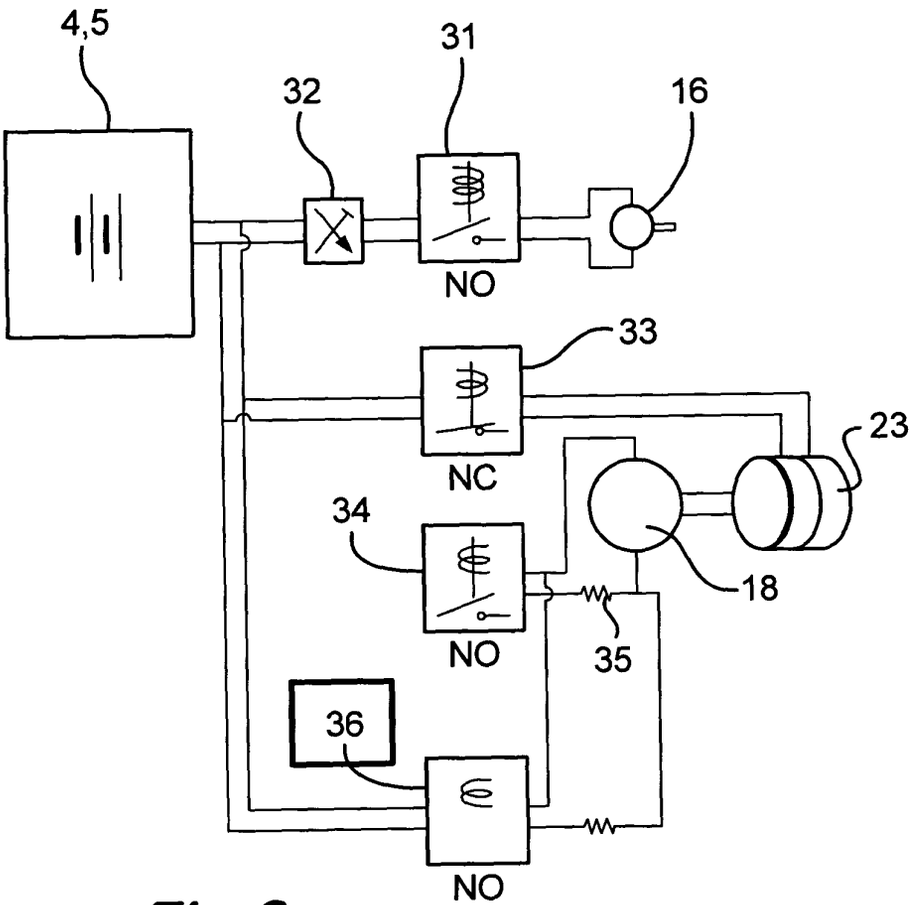
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Fig.3

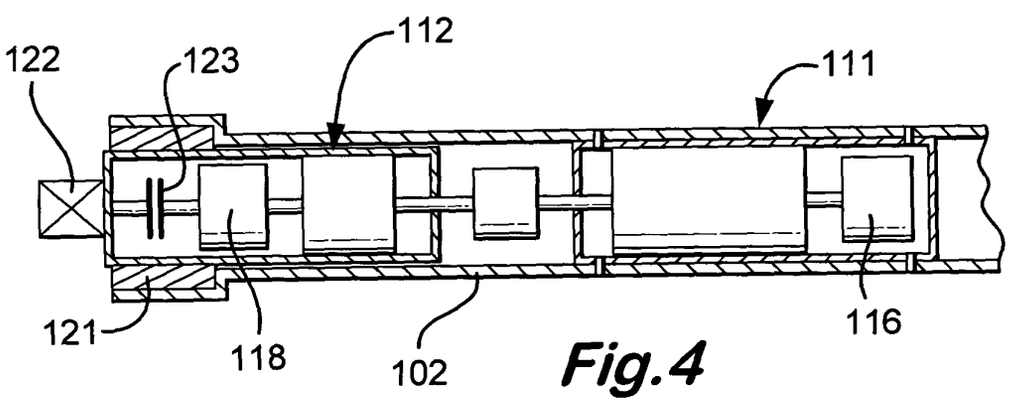
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Fig.4

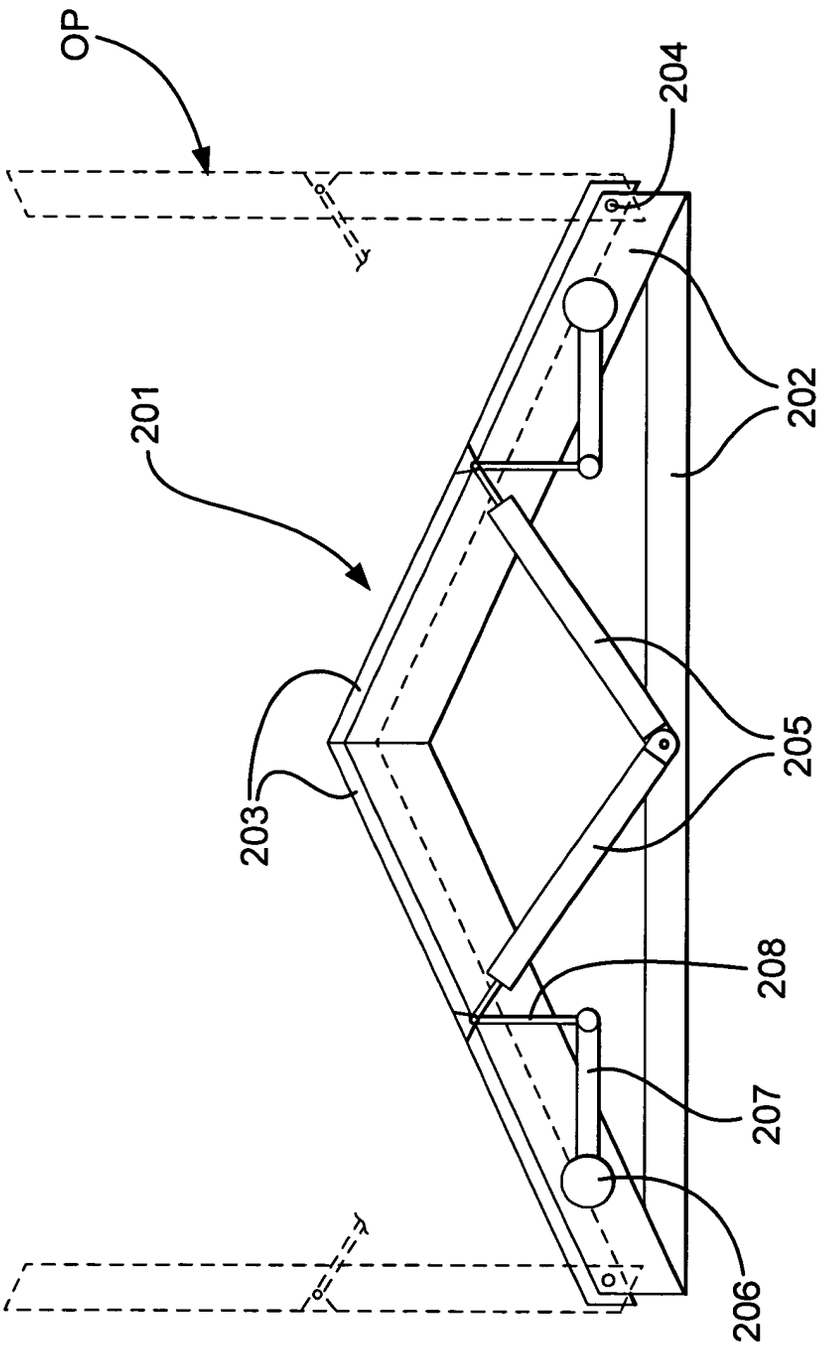

Fig.5

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 07 7196

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	US 5 383 510 A (ALLEN THOMAS H) 24 January 1995 (1995-01-24) * the whole document * ---	1-25	A62C2/10
A	DE 195 38 609 A (BRADLEY LOMAS ELECTROLOK LTD) 25 April 1996 (1996-04-25) * the whole document * ---	1-25	
A	EP 0 406 493 A (NUAIRE LTD) 9 January 1991 (1991-01-09) * the whole document * -----	1-25	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)
A62C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	25 September 2003	Neiller, F

CATEGORY OF CITED DOCUMENTS

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25-09-2003

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5383510 A	24-01-1995	US 5195594 A	23-03-1993
		WO 9535427 A1	28-12-1995
		AU 2447092 A	16-03-1993
		WO 9303795 A1	04-03-1993
		AU 7247794 A	15-01-1996
		JP 10506158 T	16-06-1998
DE 19538609 A	25-04-1996	DE 19538609 A1	25-04-1996
EP 0406493 A	09-01-1991	EP 0406493 A1	09-01-1991
		AU 4567589 A	10-01-1991
		IE 893768 A1	16-01-1991

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