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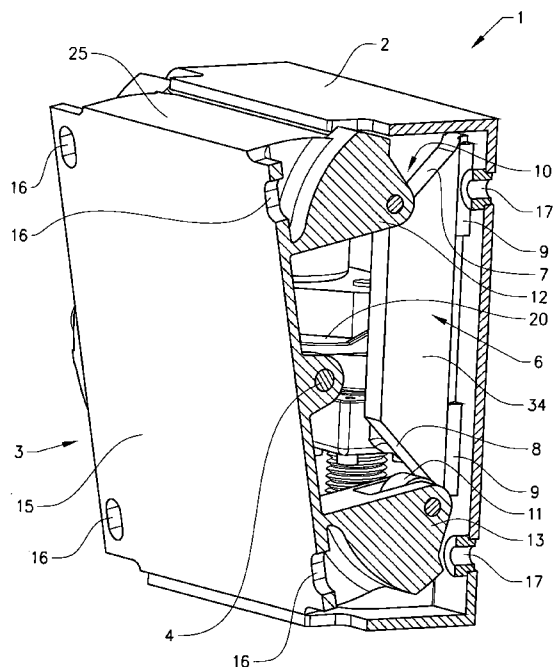


FIG. 1

(57) **Abstract:** The invention relates to an actuator, comprising a housing (2), a plate element (3) and a moveable element (6) disposed in the housing, wherein the plate element is pivotally coupled to the housing, the plate element comprising at least a first support means (10) that bears on an inclined surface (7) of the moveable element, which inclined surface inclines towards a front surface (15) of the plate element (3). The moveable element is linearly moveable within the housing (2) in a direction perpendicular to the pivot axis (5) in a plane parallel to a plane of the pivot axis (5). The first support means (10) is adapted to ride on the inclined surface (7) when the moveable element (6) is displaced, which linear displacement causes a rotational displacement of the plate element (3) about its pivot axis (5). The advantage of the invention is an actuator that is compact and reliable.

ACTUATOR

5 TECHNICAL FIELD

The present invention relates to an actuator, usable for e.g. tilting or rotating objects. The actuator may be controllable from an external control source. The actuator may be used for different purposes and in different positions, e.g. for tilting an object positioned in a vertical direction, such as
10 a flat-screen TV.

BACKGROUND ART

Television units having flat screens are becoming increasingly popular. Units with plasma or LCD-displays are widely used in homes. As the technology progresses, the size of the screens is becoming larger and
15 larger. With the size, the weight of the TV screens increases.

A standard CRT television is normally placed on a stand or on furniture in such a way that the height of the television screen corresponds to the height of the viewers eyes. Systems that can rotate the television are known. Such a rotation is done either to line up the screen perpendicular
20 with the viewer or to align the screen in order to avoid reflections from e.g. windows. A tilt functionality may also be desirable to avoid such reflections. It may also be that the user prefers to have the screen positioned with a specific rest angle for interior decoration purposes, e.g. it looks better to have the TV set parallel to the wall when it is switched off.

25 Flat screen televisions are often placed near the wall, either on furniture or on a wall mounted stand. Some wall mounted supports allow a fixed position, but some are extendable which allows for a rotation of the

screen. There may also be a tilt function integrated in the wall mounted stand. Since a wall mounted flat-screen TV is often mounted higher than an ordinary CRT screen, a tilt function for the flat screen is desirable. The tilt device can either be manually operated or remotely operated, in which
5 case the tilt means incorporate an electric motor. With a remote controlled tilt device, the flat screen can be moved to a rest position when it is switched off. With a memory function integrated in the tilt device or in the control system controlling the tilt device, the screen can assume its viewing position automatically when it is switched on and revert to the rest
10 position when it is switched off. It is also possible to integrate an automatic rotation in the system.

In other systems, the flat screen is enclosed in an enclosure, and is raised out of the enclosure when it is switched on. In this case, a raising device, a rotation device and a tilting device is required in order to set the flat screen
15 in an optimal viewing position. Also in this case, a compact and robust tilt device is of advantage. Most tilting devices for use with flat screens are manual. In one known electric tilt device, the flat screen is pivotally supported at the bottom of the screen, with an extendable mechanism acting on the top of the screen. This allows for some tilting but the solution
20 is not very compact, either in depth or height.

Other tilt devices have been proposed, but there is still room for an improved swivel actuator that is compact and easy to use.

DISCLOSURE OF INVENTION

An object of the invention is therefore to provide an actuator that is
25 compact, robust and capable of swivelling a lightweight or heavyweight mounted object. A further object of the invention is to provide an actuator that is insensitive to mounting orientation. A further object of the invention is to provide an actuator that may be readily adapted for remote control

operation. Another object of the invention is to provide an actuator that can be safely used by consumers.

The aforementioned objects are achieved according to the invention by means of an actuator comprising a housing, a plate element coupled to the housing so as to be pivotable about a pivot axis, and a moveable element disposed within the housing, whereby the plate element comprises at least a first support means that bears on a surface of the moveable element at a contact point and whereby the plate element is caused to swivel about the pivot axis due to an acting force applied at the contact point. The aforementioned objects are further achieved in that the moveable element is linearly moveable in a direction perpendicular to the pivot axis and perpendicular to the acting force, and in that the moveable element comprises at least one runner having at least a first inclined surface, which surface inclines towards a neutral plane of the plate element. The first support means is arranged to ride on the first inclined surface when the moveable element is linearly displaced, and thus, a linear displacement of the moveable element causes a perpendicular linear displacement of the contact point, which in turn causes a rotational displacement of the plate element.

In an advantageous development of the actuator according to the invention, the at least one runner comprises a second inclined surface having an angle of inclination equal to, but oppositely oriented from, the first inclined surface. The plate element then further comprises a corresponding second support means that is adapted to ride on the second inclined surface. The moveable element may also comprise a plurality of such runners, and the plate element may comprise a plurality of corresponding support means arranged to ride on the plurality of inclined surfaces. The advantage of using several runners is that it allows for a correspondingly higher load capacity. The advantage of runners with oppositely oriented inclined surfaces is that the actuator will be steady and

robust regardless of its mounting orientation. For example, the actuator may be mounted such that the pivot axis is a horizontal axis and an object such as a flat-screen TV mounted to the plate element may be tilted up and down. Alternatively, the pivot axis can be a vertical axis, which would
5 allow e.g. a flat-screen TV to be swivelled from side to side.

In one embodiment of the actuator according to the invention, the support means are rollers rotatably suspended in roller brackets of the plate element. The advantage of this is reduced friction and enhanced wear resistance. Alternatively, the support means may be sliding blocks
10 attached to the plate element. Sliding blocks also reduce friction and are cheap and easy to replace. The plate element may be pivotably attached to the housing by means of e.g. pivot pins.

In an advantageous further development of the actuator according to the invention, a driving device is used to effect the linear displacement of the
15 moveable element. The driving device may be an electric motor coupled to a screw shaft and the moveable element may be provided with a threaded section that is adapted to engage with the screw shaft. Alternatively, the screw shaft may be adapted for rotation by a manual driving device such as a hex wrench. Thus, a rotational motion of the
20 driving device is translated into a linear motion of the moveable element. Suitably, the pitch of the screw shaft and of the threaded section may be selected such that the screw shaft is locked against rotation when an external force is applied to the moveable element in the linear direction. This provides the screw shaft with a self-locking function, which obviates
25 the need to use a brake or excessive power to keep the actuator in a desired position. The advantage of an electric motor is that a user interface can be implemented in a straightforward manner, to enable remote control of the actuator.

In an advantageous further development of the actuator according to the
30 invention, the actuator further comprises a position sensor. The advantage

of this is that a position value can be fed back to the control system, which will improve the controllability of the actuator.

In an advantageous further development of the actuator according to the invention, the motor comprises a transmission. The advantage of this is
5 that a motor with a low torque can be used even when the load on the actuator is high. Another advantage is that the motor will not be damaged by a load impulse on the actuator, since the load will be reduced by the gear ratio-factor. This is further enhanced by the use of a screw shaft and a threaded section to displace the moveable element, which also have a
10 certain gear ratio.

In an advantageous further development of the actuator according to the invention, the motor is mounted in the housing of the actuator. In this way, a compact and self contained actuator is obtained, that can be mounted in any position.

15 The actuator according to the invention is suitable for home use, and it is therefore important for safety reasons that the actuator housing is completely enclosed so that, for example, a child's finger cannot get trapped between moving parts. Consequently, in a further advantageous development, the plate element is provided with side portions and shield
20 portions that extend towards the housing and which are adapted to fit inside the housing such that the interior of the housing is always covered, regardless of the angled position of the plate element.

BRIEF DESCRIPTION OF DRAWINGS

25 The invention will be described in greater detail in the following, with reference to the embodiments that are shown in the attached drawings, in which

- Fig. 1 shows a cut-away perspective view of an actuator according to the invention,
- Fig. 2 shows a perspective view of an actuator according to the invention without the housing,
- 5 Fig. 3 shows a rear view of an actuator according to the invention,
- Fig. 4a shows a side view of an actuator according to the invention,
- Fig. 4b shows a side view of an actuator according to the invention with a positive swivel angle, and
- Fig. 4c shows a side view of an actuator according to the invention with a negative swivel angle.
- 10

MODES FOR CARRYING OUT THE INVENTION

The embodiments of the invention with further developments described in the following are to be regarded only as examples and are in no way to limit the scope of the protection provided by the patent claims.

15

In the following, an actuator powered by an internal electrical motor is described. The actuator may also be powered by an external power source, such as an external electrical motor. This may be advantageous in e.g. a positioning system that incorporates other actuators to enable positioning of an object in several degrees of freedom. The actuator may also be operated by a manual driving device, such as a screw that is operated by a hex wrench or a thumb screw. This may be advantageous if the actuator need only be set up once or a few times.

20

The actuator may be used in a vertical, horizontal or in a selected angled position. The actuator may thus be used to swivel an object where it is of advantage to be able to swivel the object by, for example, +20 and -20

25

degrees relative to a neutral position. The actuator may e.g. be used at home or in an industry to tilt, rotate or adjust an object to a desired angular position.

5 Figs. 1, 2 and 3 show an example of one embodiment of an actuator according to the invention. In fig.1, a perspective view of a front side of the actuator is shown, in which one side has been cut away. Fig. 2 shows a perspective view of a rear side of the actuator, with the housing removed. Fig. 3 shows a rear view of the actuator.

10 The actuator 1 comprises a housing 2, a plate element 3 and a moveable element 6. The plate element is pivotably journaled in the housing by means of e.g. two pivot pins 4, making the plate element pivotable about a pivot axis 5 created by the two pivot pins. The plate element further comprises at least a first support means 10 that bears on a surface of the moveable element 6 at a first contact point. A front surface 15 of the plate element 3 comprises means to enable an object to be mounted to the actuator, e.g. mounting holes 16. The moveable element is linearly moveable within the housing, in a direction 36 perpendicular to the pivot axis 5, and in a plane parallel to a neutral plane of the pivot axis 5 in which the plate element 3 has a swivel angle of zero degrees. The moveable element 20 comprises at least a first runner 34 that suitably runs along linear guide means 31, which guide means may be integral with the housing 2, or may be affixed to the housing. The moveable element further comprises receiving means 18 for a driving device, to enable linear displacement of the moveable element 6 relative to the housing 2.

25 According to the invention, a linear displacement of the moveable element 6 is translated into a rotational displacement of the plate element 3. This is achieved in that the first runner 34 of the moveable element 6 has at least a first inclined surface 7, where the surface is inclined towards the front surface 15 of the plate element 3. Furthermore, the first support means 10 bears on the inclined surface at a contact point, and is arranged 30

to ride on the inclined surface 7 when the moveable element 6 is displaced. Thus, a linear displacement of the moveable element 6 causes a change in the position of the contact point relative to the pivot axis 5, causing a change in the swivel angle of the plate element 3.

- 5 As shown in the embodiment illustrated in figs. 1-3, the first runner 34 may comprise a second inclined surface 8 having an equal angle of inclination to, but oppositely oriented from, the first inclined surface 7. The plate element then comprises a corresponding second support means 11 that is arranged to ride on the second inclined surface when the moveable
- 10 element 6 is displaced. Again as shown in the embodiment illustrated in figs. 1-3, the moveable element 6 may comprise a second runner 35 which may have a first 28 and/or second inclined surface 29. The plate element 3 correspondingly comprises further support means 26, 27 that are arranged to ride on the inclined surfaces 28, 29 of the second runner 35.
- 15 As will be understood, when an actuator comprises more than one runner, the first and second inclined surfaces of each runner should have an equal angle of inclination, and each set of inclined surfaces and corresponding support means should have identical relative positions, in order to avoid play.
- 20 The number of support means and corresponding inclined surfaces may be adapted to the load that the actuator must support and to the mounted orientation of the pivot axis. Further, the actuator is dimensioned according to the desired swivel range. This will be explained with reference to Fig. 4a – 4c and using a coordinate system in which the pivot
- 25 axis is coincident with the z axis.

Fig. 4a illustrates a side view of a portion of an actuator according to the invention, where the plate element 3 lies in a neutral position, i.e. has a swivel angle of 0 degrees relative to a neutral plane 42. The first support means 10 bears on the first inclined surface 7 at a first contact point 38

30 and the second support means 11 bears on the second inclined surface 8

at a second contact point 39. In fig. 4a, the system is in equilibrium. In order to produce motion of the plate element 3 about the pivot axis 5, a moment must be applied, by applying an overcoming force to the plate element in the y-direction at a radial distance from the pivot axis 5, the radial distance being defined in the x-direction. According to the invention, this occurs when the runner 34 is displaced. When displaced in a first direction of travel 40, as shown in fig. 4b, an overcoming force is exerted on the support means 10 at the first contact point 38, which becomes the force action point. The perpendicular component of the force acts on the plate element 3 at a radial distance from the pivot axis 5, producing a moment which allows the plate element to swivel. The magnitude of the swivel angle is governed by the magnitude of the perpendicular displacement of the force action point 38 in the y-direction. In fig. 4a, a perpendicular distance d exists between the pivot axis 5 and the first contact point 38. In fig 4b, a perpendicular distance of d' exists between the pivot axis and the first contact point 38 (force action point). Thus, a perpendicular displacement of $d - d'$ in the force action point relative to the pivot axis has resulted in an angular displacement of the plate element 3 of $+\alpha$ degrees.

The reverse situation is shown in fig. 4c, where a linear displacement of the runner 34 in a second direction of travel 41 has caused a perpendicular displacement of the second contact point 39 (force action point). A perpendicular distance d'' exists between the pivot axis 5 and the force action point 39. Assuming the situation shown in fig. 4a as a starting point, a perpendicular displacement of $d - d''$ in the force action point relative to the pivot axis 5 has resulted in an angular displacement of the plate element 3 of $-\alpha$ degrees. The maximum swivel range of the actuator in one direction is therefore governed by the maximum perpendicular displacement of the force action point in the y-direction.

The maximum perpendicular displacement that is possible therefore depends on the "height" of the runner 34, but also on the stroke of the runner. If desired, an actuator according to the invention could therefore be configured to allow a longer stroke in the first direction of travel 40 than
5 in the second direction of travel 41, which would result in a larger positive swivel range than a negative swivel range.

In the illustrated embodiment, the plate element 3 is supported on both sides of the runner 34. This enables a stable swivel action in both directions of rotation, regardless of the mounting orientation of the actuator
10 and the orientation of the pivot axis. The plate element can also be adapted to bear on several runners, for increased stability and load-carrying capacity.

In one development of the inventive actuator, the actuator is adapted for mounting relatively lightweight objects to the actuator. This may e.g.
15 include smaller TV sets. In this example of an actuator, it is enough to use one set of support means and oppositely oriented inclined surfaces, i.e. support means 10, 11 and runner 34 with inclined surfaces 7, 8 are used. Such a moveable element having one runner may be positioned anywhere in the housing, either on one side or in a central section of the housing.
20 Since the actuator is adapted for relatively lightweight objects, the load on the pivot pins and the plate element will be small. In this case, with two inclined surfaces on one runner, the actuator is indifferent to the mounting orientation. When one runner 34 is used, it is advantageous to improve the guiding of the runner, e.g. by using one rim 31 on each side of the runner.

25 In another development of the inventive actuator, the actuator is mounted to a support structure such that the pivot axis is horizontal. The actuator may then be used as a tilt actuator, to adjust the tilt angle of a mounted object like a flat-screen TV. Taking the situation shown in fig. 4c as an example and assuming that the direction of travel 41 is also the direction
30 in which gravity acts, the weight of the mounted object exerts a load on the

second support means 11 and on the second inclined surface 8 only. If the moveable element has a second runner and the plate element 3 has corresponding support means, the load will also act on the 'lower' inclined surface of the second runner. This means that there will be no play in the system when the object is mounted, due to the load exerted by the mounted object. In this case, with reference to fig. 2, it is enough to use e.g. two support means 11, 26 and corresponding inclined surfaces 8, 28. If the actuator is adapted for lightweight objects, only one support means and one inclined surface may suffice. In this example, it is possible to use a spring to preload the plate element so that the support means are preloaded also when no load is applied to the actuator, i.e. when no object is mounted. When one inclined surface is used, it may be positioned either in the middle of the housing or asymmetrically.

The maximum swivel range of the actuator depends on the maximum perpendicular displacement of a force action point that is geometrically possible, and thus, the actuator may be designed according to the desired swivel range. The speed of the angular motion also depends on geometry. The angular speed of the plate element 3 is dependent on the rate of change in the perpendicular displacement of the force action point. Consequently, an actuator in which the at least one inclined surface has a steep gradient produces a faster angular motion than an actuator in which the at least one inclined surface has a shallow gradient (assuming the same stroke speed of the moveable element). A shallow gradient would be advantageous when the swivel angle of the plate element 3 needs to be adjustable with precision. When, as shown in the illustrated embodiment, the at least one inclined surface 7 is a straight surface, i.e. has a constant angle of inclination, the angular speed of the plate element is constant. In an alternative embodiment of the inventive actuator, where the moveable element has one or more runners with only a first inclined surface, the inclined surface could be curved and have a variable gradient.

This would enable precision adjustment of the angular position of the plate element in a particular portion of the swivel range.

With reference to figs. 1 to 3, the support means of the plate element 3 may be rollers 10, 11, 26, 27, which are located so as to bear on the
5 corresponding inclined surfaces 7, 8, 28, 29 of the moveable element 6. The rollers are made from a suitable material, e.g. metal or plastic, and can be supported by roller brackets 12, 13 of the plate element. When the moveable element 6 is displaced, the rollers will roll on the inclined surfaces, causing the plate element to swivel about the pivot axis 5. It is of
10 advantage that each roller bears on each corresponding inclined surface in order to avoid play in the actuator and thus in the swivel action. The inclined surfaces are preferably machined to obtain a smooth surface, and/or may be treated with a low-friction treatment. It is also possible to fasten a low-friction material on the inclined surface in order to minimise
15 wear and friction. This is especially advantageous when the support means are not rollers but sliding blocks.

Thus, the support means can also be sliding means, e.g. in the form of sliding blocks, made from a low-friction material, e.g. a plastic compound, such as polyamide or polyacetal, or a metal compound, such as bronze.
20 The material may be self-lubricating. The support means may be somewhat resilient in order to take up tolerances between the plate element and the moveable element. In this way, the play is reduced. One way of achieving this is to incorporate rubber in the support means, which can be done both for sliding and rolling support means.

25 The housing 2 in the illustrated embodiment is box-shaped with four side walls and a base wall, against which the moveable element 6 may move. Other designs, e.g. circular and elliptical shapes, are also possible. The base wall may be provided with linear guide means in the form of rims 31 which are adapted to guide the moveable element in a linear movement.
30 The housing is further provided with two pivot inserts 33 in which the pivot

pins 4 are to be mounted. The pivot inserts are positioned opposite each other along the desired pivot axis 5. The inserts are in this example provided with threads, in which the pivot pins may be screwed. It is also possible to supply the thread directly in the housing. The pivot pins 4 will in
5 this case be provided with a first section having a thread and a second section on which the tilt plate element will rotate. There are also other suitable solutions to attach the pivot pins to the housing or the plate element, such as clamps or clips. Depending on the direction in which the actuator will be used, one or both pivot pins may be adapted to carry both
10 axial and radial forces.

The housing 2 may be die-cast in a metal, e.g. an aluminium alloy, or a plastic compound, e.g. fibreglass reinforced polyamide. Preferably, the base wall is the portion of the housing that is mounted to a support structure, such as a wall or a stand. The housing 2 may then comprise a
15 number of mounting inserts 17 as shown in Fig. 1. A front surface 15 of the plate element 3 constitutes the front surface of the actuator. On this surface, the object that is to be swivelled can be mounted. The object, e.g. a flat screen TV, can be mounted directly to the front surface or be mounted on an adapter that is mounted to the plate element. It is also
20 possible to integrate an appropriate adapter in the plate element in order to facilitate the mounting of the object. This is especially advantageous if the object is heavy.

The plate element 3 has side portions 14, in which one or more of the support means may be incorporated. Perpendicular to the side portions
25 14, the plate element 3 is further provided with shield portions 25. The side portions 14 and shield portions 25 extend towards the base wall of the housing 2, and are suitably dimensioned and shaped to ensure that, regardless of the swivel angle of the plate element, there is always an overlap between the side walls of the housing and the side portions 14
30 and shield portions 25. In other words, the interior of the housing always

remains covered and there are no gaps through which foreign objects could be squeezed. This makes the actuator safe, as well as enhancing operational reliability.

The moveable element may be further provided with glide sleeves 9, which are arranged on the underside of each runner, bearing on the base of the housing. The glide sleeves are preferably also made from a low-friction material, such as a plastic compound. The corresponding glide surface of the base of the housing is preferably flat and smooth and may be treated with a low-friction treatment in order to reduce the friction between the runners and the housing. A glide sleeve 9 will preferably be somewhat wider than a runner of the moveable element. In this way, the glide sleeve will also be able to glide with low friction against the rim 31 that supports and guides the moveable element sideways. It is also possible to form the glide sleeve with a protrusion that can glide in a corresponding groove in the base in order to support the moveable element in a sideways manner. The glide sleeves may also be replaced with rollers in order to reduce the friction further.

In the illustrated embodiment, the moveable element 6 comprises two runners 34, 35 connected with a mid section 18. In this way, a rigid and rugged actuator is provided for. The mid section 18 comprises a threaded section 19, through which a screw shaft 30 is lead. The screw shaft is supported in the threaded section by a threaded insert made of e.g. a plastic or metal. A rotation of the screw shaft 30 therefore causes a linear displacement of the moveable element in the housing 2. The moveable element is preferably moved in a direction parallel to the screw shaft. This gives a simple and rugged solution.

The pitch of thread of the screw shaft and the threaded section may be selected such that a self-locking feature is obtained. In this way, the moveable element 6 is moved when the screw shaft 30 is rotated, but the screw shaft will not rotate when a force is applied to the moveable element

in the linear direction 36. This gives a self-locking effect and allows the actuator to be loaded and still to be kept in the desired position without using a brake or without applying power to e.g. a motor. It is also possible to use a brake to lock the moveable element in position. The brake is
5 preferably released when the screw shaft is rotated.

The screw shaft is rotated by a driving device. The driving device may be rotated manually by an operator in order to set the desired swivel angle of the actuator. In this example, the screw shaft may incorporate a suitable mechanical interface such as a key grip 37 that can cooperate with a
10 screw driver, a wrench or the like. The mechanical interface is preferably positioned in the screw shaft so that it is reachable from the outside of the housing. In this way, a cheap and reliable solution is obtained.

The screw shaft may also be rotated by an electric motor. In one embodiment of the inventive actuator, the motor is positioned inside the
15 housing. The motor 21, in this example provided with a transmission 22, is mounted in the housing by using the motor bracket 20. The gear ratio of the transmission is dependent e.g. on the used motor, the required swivel speed and the pitch of thread. The screw shaft 30 is mounted to the output shaft 23 of the motor or transmission with an attachment means 24. The
20 attachment means 24 may also comprise a slip clutch that slips at a predefined torque. This is useful in order to protect the motor, e.g. when an end position is reached or if the screw shaft is operated manually. When the screw shaft is rotated, the threaded section of the moveable element will either be screwed towards or away from the motor bracket. In
25 this way, the moveable element is moved inside the housing, causing the rollers to ride on the inclined surfaces. The section of the screw shaft opposite the motor is supported in the bearing bracket 32. The bearing bracket may, depending on the design, comprise some sort of rotational bearing to support the screw shaft in the radial and/or axial direction.

In a further embodiment of the actuator, the moveable element is powered by an external motor. In this embodiment, the screw shaft is connected to an external shaft or the like interconnecting the screw shaft with the external motor. The external motor may in this embodiment be positioned
5 in the support structure on which the actuator is mounted. Such a solution may be advantageous e.g. when a stand comprises both a rotational function and a tilt function. In this case, the same motor may in some embodiments be used for both functions.

The swivel angle of the actuator may be set by an external control unit that
10 controls the rotation of the motor. In this case, a position sensor (not shown) of some kind may be integrated in the actuator, which can give a feedback signal to the control unit. Such a sensor may e.g. be a rotational sensor giving an analogue or digital signal as output. An optical encoder may be a suitable sensor.

15 The actuator may also comprise an electronic interface that can control the motor and thus the swivel angle depending on external control signals. In this case, the control unit is comprised in the actuator together with a position sensor giving a position feedback signal. The control unit can receive remote control signals either through a cable or from a wireless
20 source, using e.g. an optical or a radio technique. By using an infrared receiver in the interface, a conventional programmable remote control can be used to control the swivel angle of the actuator. When the actuator is provided with a position sensor, different memory functions may also be incorporated in the control unit. In an example, when a TV set is mounted
25 to the actuator, the TV set can be set in a first rest position when it is switched off, and in a second active position when it is switched on. When the TV set is switched on, it will resume the active position it had last time it was switched on.

In the described examples, an actuator having a moveable element with
30 four inclined surfaces and a plate element with four support means is

described. With such a solution, the actuator will be insensitive to the mounting position and the load direction from the object when in use. If the mounting position and the load, i.e. the object, are known, fewer support means and inclined surfaces may be used.

- 5 The invention is not to be regarded as being limited to the embodiments described above, a number of additional variants and modifications being possible within the scope of the subsequent patent claims.

REFERENCE SIGNS

	1:	Actuator
	2:	Housing
	3:	Plate element
5	4:	Pivot pin
	5:	Pivot axis
	6:	Moveable element
	7:	First inclined surface
	8:	Second inclined surface
10	9:	Glide sleeve
	10:	First roller element
	11:	Second roller element
	12:	First roller bracket
	13:	Second roller bracket
15	14:	Side portion of plate element
	15:	Plate surface
	16:	Mounting hole
	17:	Mounting insert
	18:	Mid section
20	19:	Threaded section
	20:	Motor bracket
	21:	Motor
	22:	Transmission
	23:	Output shaft
25	24:	Attachment means
	25:	Shield portion of plate element
	26:	Third roller element
	27:	Fourth roller element
	28:	Third inclined surface
30	29:	Fourth inclined surface
	30:	Screw shaft
	31:	Rim
	32:	Bearing bracket
	33:	Pivot insert
35	34:	First runner

	35:	Second runner
	36:	Direction of linear motion of moveable element
	37:	Key grip
	38:	First contact point
5	39:	Second contact point
	40:	First direction of travel
	41:	Second direction of travel
	42:	Neutral plane of pivot axis
10	d, d', d''	Perpendicular distance between contact point and pivot axis
	α :	Swivel angle

CLAIMS

- 5 1. Actuator, comprising a moveable element (6), a housing (2) and a plate element (3) coupled to the housing (2) so as to be pivotable about a pivot axis (5), the plate element comprising at least a first support means (10) that bears on a surface of the moveable element, c h a r a c t e r i z e d i n t h a t
- 10 the moveable element (6) is linearly moveable within the housing (2) in a plane of movement parallel to a plane of the pivot axis (5) in a direction perpendicular to the pivot axis (5), wherein the moveable element comprises at least one runner (34) having a first inclined surface (7), wherein the first support means (10) is arranged to ride
- 15 on the first inclined surface (7) when the moveable element (6) is displaced.
2. Actuator according to claim 1, c h a r a c t e r i z e d i n t h a t the plane of movement of the moveable element (6) is parallel to a neutral plane (42) of the pivot axis (5) in which plane the plate
- 20 element (3) lies in a non-pivoted position, and the first inclined surface (7) inclines towards the neutral plane (42).
3. Actuator according to claim 1 or 2, c h a r a c t e r i z e d i n t h a t the at least one runner (34) comprises a second inclined surface (8) having an equal and opposite angle of inclination relative to the first
- 25 inclined surface (7), and the plate element (3) further comprises a second support means (11) arranged to ride on the second inclined surface.

4. Actuator according to any of the preceding claims, characterized in that the moveable element (6) comprises a plurality of runners (34, 35) with first inclined surfaces (7, 29) and/or second inclined surfaces (8, 28), and the plate element (3)
5 comprises a corresponding plurality of support means (10, 11, 26, 27) arranged to ride on the inclined surfaces (7, 8, 28, 29).
5. Actuator according to any of the preceding claims, characterized in that the actuator further comprises translation means that translate a rotational motion into a linear
10 motion of the moveable element (6)
6. Actuator according to claim 5, characterized in that the translation means comprises a screw shaft (30) running in a threaded section (19) of the moveable element (6), whereby a rotation of the screw shaft (30) linearly displaces the moveable
15 element (6).
7. Actuator according to claim 6, characterized in that a pitch of thread of the screw shaft (30) and the threaded section (19) is such that the screw shaft (30) is locked against rotation when a force is applied to the moveable element (6) in the linear direction
20 (40, 41).
8. Actuator according to any claim 6 or 7, characterized in that the actuator further comprises a driving device (21, 37) coupled to the screw shaft (30)
9. Actuator according to claim 8, characterized in that the
25 driving device (21) is an electrical motor.
10. Actuator according to claim 9, characterized in that the motor (21) is mounted in the housing (2).

11. Actuator according to claim 9 or 10, characterized in that the motor (21) comprises a transmission (22).
12. Actuator according to any of the preceding claims, characterized in that the support means are rollers (10, 11, 26, 27) rotatably suspended in roller brackets (12, 13) of the plate element (3).
13. Actuator according any of claims 1 to 11, characterized in that the support means are sliding blocks attached to the plate element (3).
14. Actuator according to any of the preceding claims, characterized in that the actuator further comprises a position sensor.
15. Actuator according to any of the preceding claims, characterized in that plate element (3) comprises side portions (14) and shield portions (25) which conceal the inside of the housing (2), regardless of the position of the plate element (3) relative to the neutral plane (42).
16. A positioning system comprising an actuator according to any of the preceding claims.

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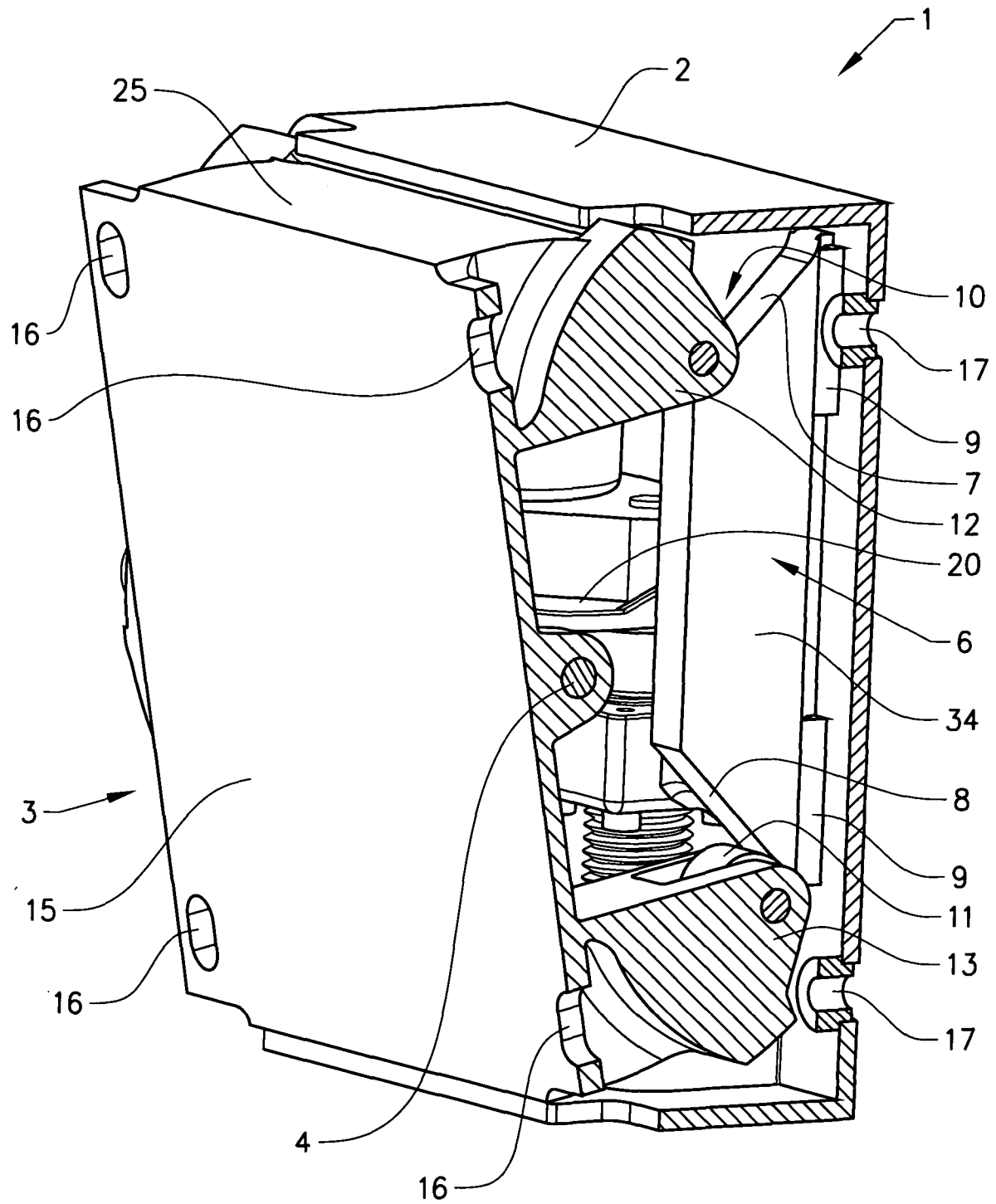


FIG. 1

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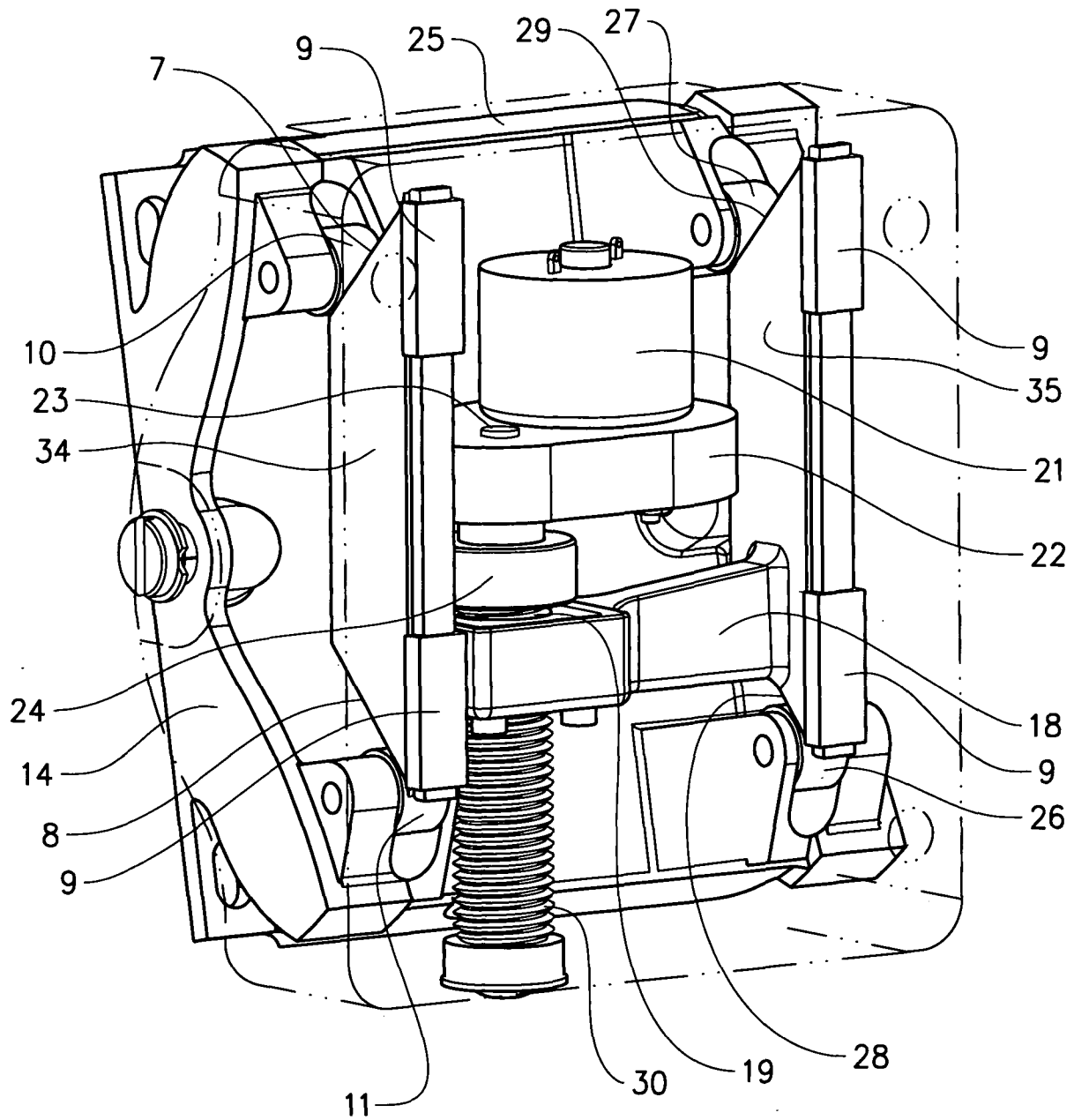


FIG. 2

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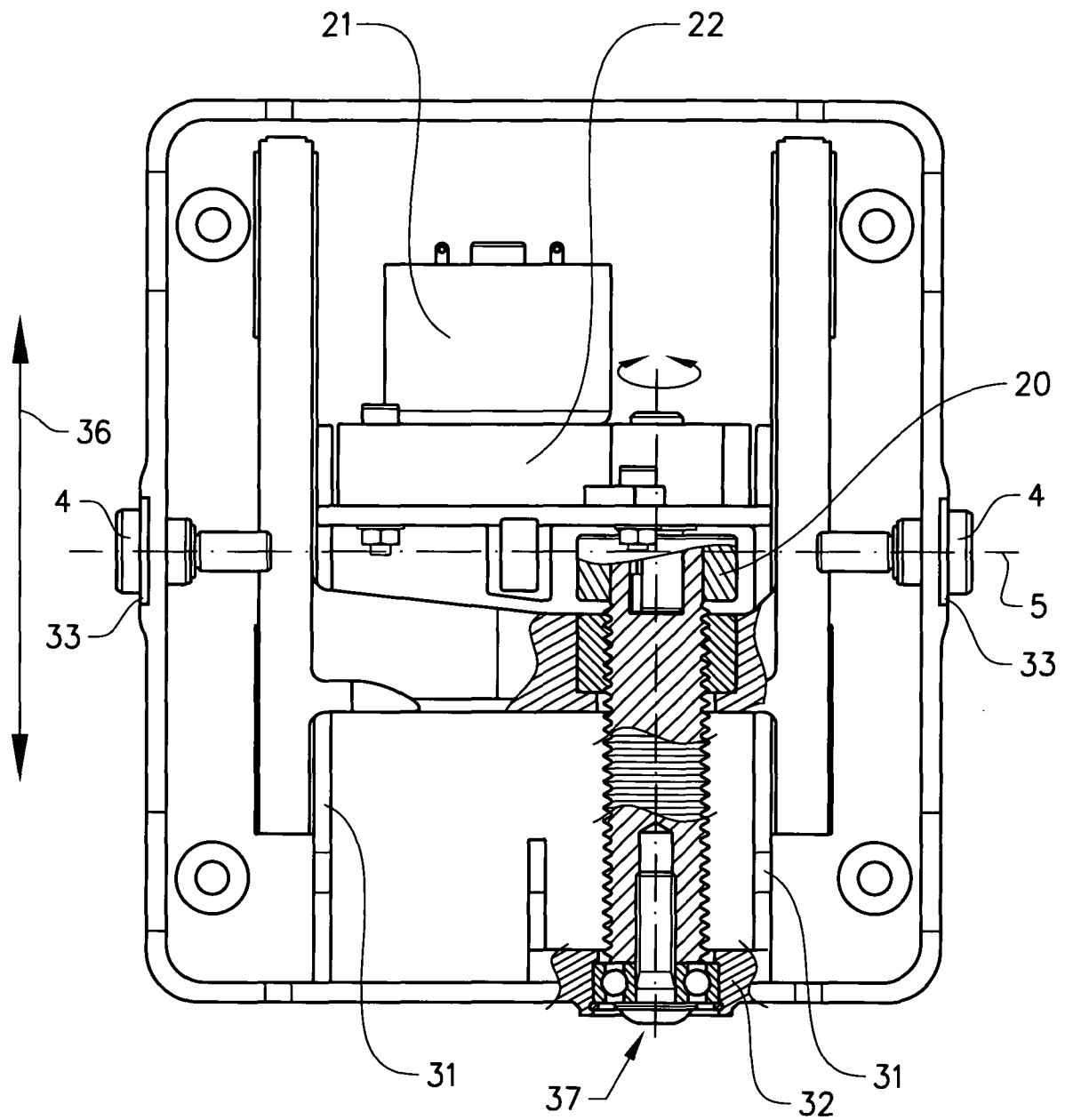
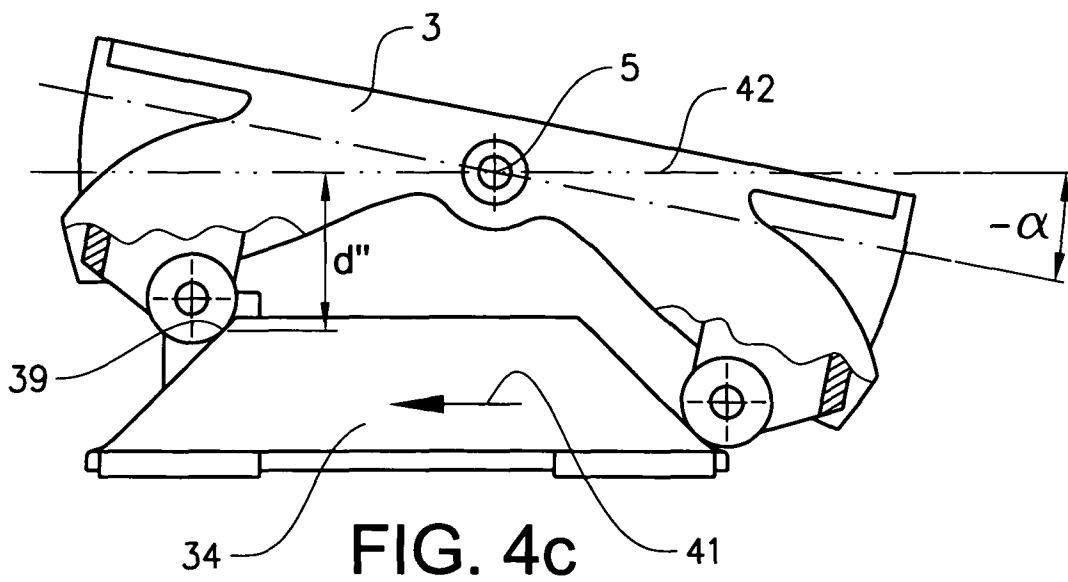
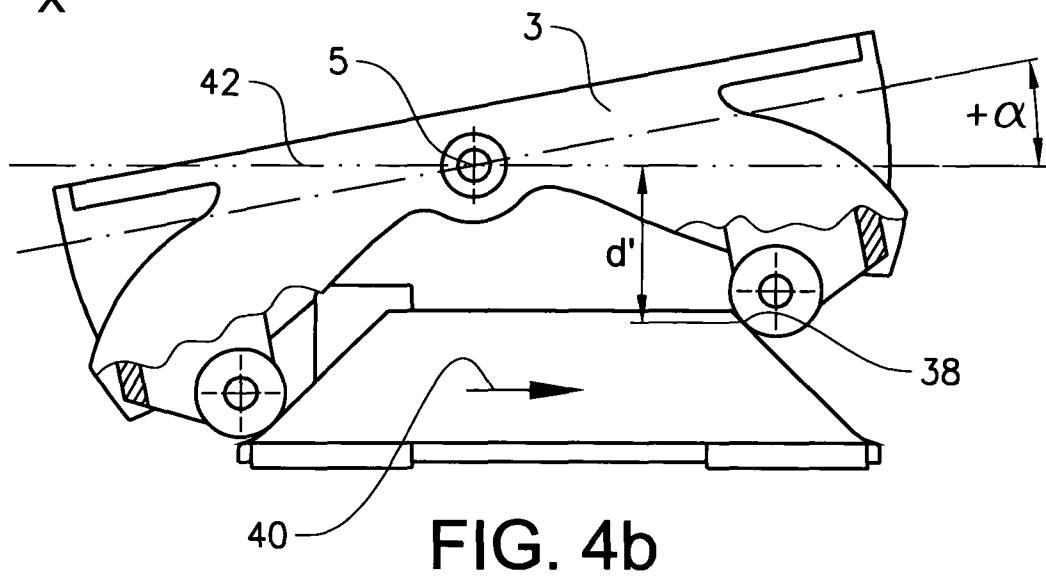
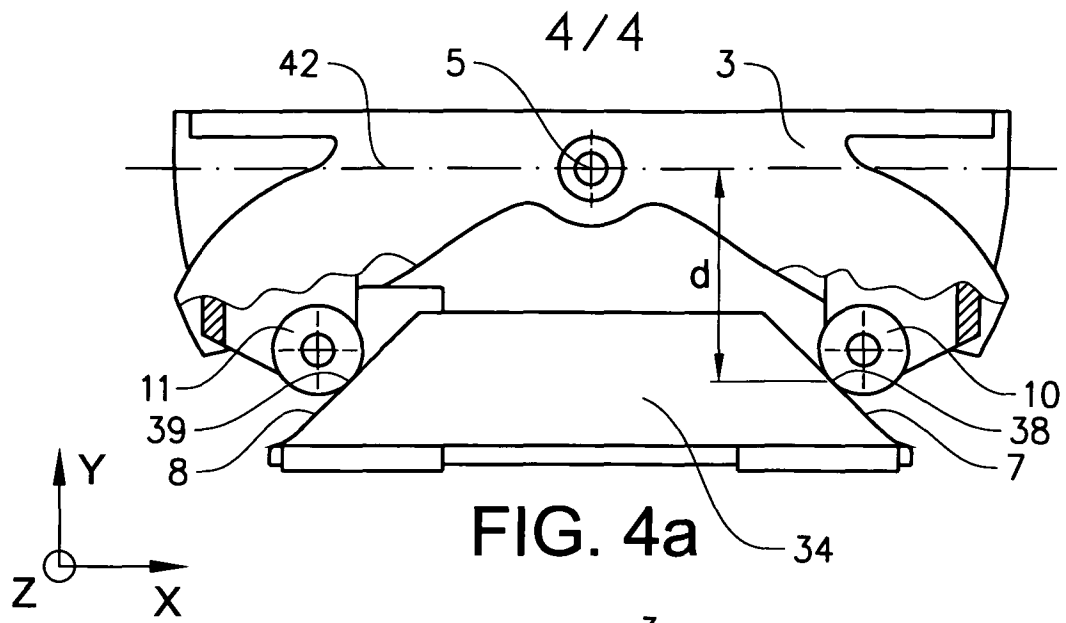


FIG. 3



INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2008/001049

A. CLASSIFICATION OF SUBJECT MATTER

INV. F16M11/10

ADD. F16M11/18

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F16M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 113 851 A (NIXDORF COMPUTER AG [DE]) 25 July 1984 (1984-07-25) page 1, line 1 - line 4; figures 1-4 page 4, line 24 - page 5, line 24	1-4, 13, 16
X	GB 902 746 A (PYE LTD) 9 August 1962 (1962-08-09) figure 2	1-4, 12, 16
X	GB 274 272 A (DAVID WILLIAMSON DORRANCE) 21 July 1927 (1927-07-21) figures 1-3	1-5, 13, 16
A	DE 10 2004 057939 A1 (BAUMANN FRANZ [DE]) 1 June 2006 (2006-06-01) claims 9-12; figures 1-16	5-11, 14-16
	-/-	

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search

26 November 2008

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INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2008/001049

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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