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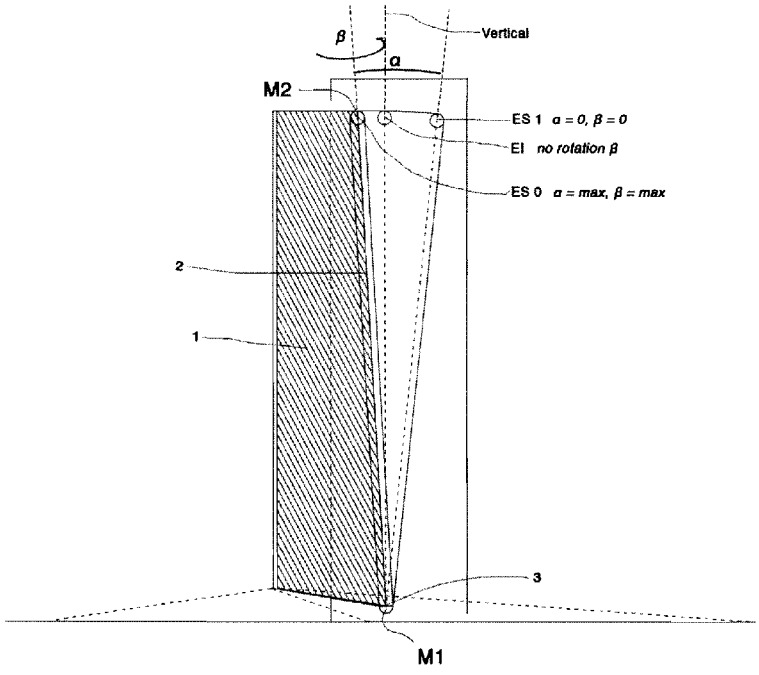
(54) **Title:** DOUBLE ARTICULATED DEVICE AND SYSTEM

FIG. 1



(57) **Abstract:** The invention relates to a double articulated device and system comprising at least one active element provided with an edge (M), with two points (M1) and (M2), where (M1) is different from (M2), a rotating element connected to the edge (M) and a rotating fixture positioned in the point (M1) of the edge (M) and connected to the rotating element, in which, during actuation, the active element simultaneously describes a rotational movement with an angle β around the rotating element, and a partial pivoting movement in the vertical plane around the rotating fixture, so that the point (M2) of the edge (M) describes an angle a between a value α_{max} corresponding to the "open" position ES0 and a value α_{min} which corresponds to an ES1 "closed" position of the device.

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DOUBLE ARTICULATED DEVICE AND SYSTEM

DESCRIPTION

The invention relates to a double articulated device and system used in objects with functionality dependent on some of their component parts coming closer to each other, moving away from each other, or pivoting between each other.

PRIOR ART

Several objects are known, such as a folding hanger, window shutters, vertical blinds, water dam, flood barrier, valve or other types of hydrotechnical constructions, access doors and so on, which are composed of active elements that close or fold, such as gates, lids, arms, doors, wings, slats, rods etc.

These mechanical elements are connected to the systems to which they belong using hinged joints or other types of pivoting devices which do not make use of the mass, the center of gravity or the variation of the contextual forces characterizing those mechanical elements, in order to facilitate their closing and opening.

Moreover, the non-use of these forces and variations of forces present in the system leads to the need to counteract their effects, which not only does not lower energy consumption during operation, but it also complicates the systems by introducing levers, joints, blockers, locking systems and other additional mechanisms that eventually lead to increased production costs and decreased lifespan of components and even of the system itself.

Further more, the need to develop products as constructively simple as possible, with a minimal number of moving components, which as much as possible use the presence of forces already existing in the system during operation, is generally known.

This continuous necessity derives from needs such as increased efficiency in the manufacturing and operation of systems, safe and predictable operability, device reliability, cost minimization in production, operation and maintenance, and the lowest possible energy consumption during production and operation.

The prior art comprises patent applications such as EP3095358A1, US5687888A, WO2018230944A1, US5690257A in the field of folding hangers, GB792587 (U), US20130022402 (A1), MX2016010362 (A), US2699652(A), SG65874(A1) in the field of hydrotechnics, GB2509209 (A), TWM468563 (U) in the field of vertical blinds. These documents disclose objects that contain mechanical elements that close or fold, such as gates, lids, arms, wings, doors, slats, rods etc.

In the field of folding hangers, several documents are known, such as patent applications EP3095358A1 or US5687888A, which refer to clothing hangers folding around a vertical axis, provided with various locking systems to block the hanger in the "open" position, located in the vicinity of the central vertical hinge.

The disadvantage of these tehnical solutions is that a hanger according to any of the patents above is operable through a relatively difficult or awkward sequence of actions, some of them simultaneous, disregarding the forces in the system that, through better design, could have replaced a significant part of these actions.

Also in the field of folding hangers, patent applications such as WO2018230944A1 or US5690257A are known, which refer to folding hangers around a horizontal axis, provided with various locking systems to block the hanger in the "open" position, located in the vicinity of the central horizontal hinge.

The disadvantages of such solutions are in the sphere of manufacturing efficiency

and product reliability on one hand, and on the other hand in the sphere of utility and ease of use.
The fact that, through its own form, a hanger according to US5690257A has a built-in locking device exposes the hanger to a major risk of deterioration due to the fragility of the locking device, instead of using a force present in the system, such as its own weight or the weight of the coat stored on it.
The hanger according to document WO2018230944A1 uses two springs for the relative locking in the "open" position, which in addition to the risk of accidental closure due to storing an excessively heavy garment, has the disadvantage of a very complicated construction, hence a high production cost and a short lifespan of the product, given the 15 moving components of the assembly.
In the field of hydraulic engineering, several patents are known such as GB792587 (U), US20130022402 (A1), US2699652 (A), MX2016010362 (A), SG65874 (A1), representing dams or water flow control systems, used mainly for protection against floods. Gate systems of varying degrees of complexity, such as those in US20130022402 (A1) or GB792587 (U) use complex devices such as hydraulic pumps, electric or ignition engines for activation and require human or computer control.
The disadvantage of these systems is that they cannot operate autonomously. By their design, they ignore the fact that the variation of contextually existing forces, such as the increase of the water level or flow, could deploy and implement the activation of the dam system naturally, which would make that system able to be located in areas without infrastructure and at the same time be operational in emergency conditions such as electrical surges or a faulty central control system.
Other patent applications in this field are also known, such as MX2016010362 (A), US2699652 (A) or SG65874 (A1), representing dams or water flow control systems that are able to operate autonomously, in direct accordance with the change of the water level in a certain area. They have the disadvantage that after their setup on a watercourse, that course is no longer navigable, so the protection of a populated area against floods by using these systems can lead to commercial or transport disadvantages.
In the field of vertical blinds, the prior art contains patent applications such as GB2509209 (A) or TWM468563 (U) representing mechanisms for folding, transporting on a rail or twisting the slats of a vertical blind. The disadvantage of these solutions is the very complicated construction, so implicitly the high manufacturing cost and the low lifespan of the components, given the degree of miniaturization, as well as the large number of moving components of the systems.

TECHNICAL PROBLEM

The technical problem solved by the invention consists in developing a simple, reliable and cheap double articulated device and system, which is at the same time operable with minimum energy consumption, with a low general cost, compared to other solutions available in the prior art.

DESCRIPTION OF THE INVENTION

The invention relates to a double articulated device and system comprising at least one active element provided with an edge (**M**), having two points (**M1**) and (**M2**), where (**M1**) is different from (**M2**), a rotating element connected to the edge (**M**), and a rotating fixture positioned at the point (**M1**) of the edge (**M**) and connected to the rotating element, in which, during actuation, the active element has simultaneously a

rotational movement with an angle ß around the rotating element and a partial pivoting movement in the vertical plane around a rotating fixture, so that the point (**M2**) of the edge (**M**) describes an angle **α** between a value α_{max} corresponding to the "open" position **ES0** and a value α_{min} corresponding to an **ES1** "closed" position of the device.
In the context of the invention, the double articulated device can have the active element of a substantially flat, trapezoidal shape.
At the same time, in the preferred embodiments, the pivoting angle **α** has values between 5° and 20°, and the rotation angle ß can have values between 90° and 110° in the case of the embodiment of an access door or gate, values between 100° and 120° in the embodiment of a foldable hanger, or values between 90° and 135° in the case of a flood barrier gates.
In the double articulated device according to the invention, the pivoting movement of the point (**M2**) of the edge (**M**) can be performed by external means such as lever systems, with counterweights or motorized systems.
In the case of the hanger and the flood barrier, the embodiments comprise two active elements, each of these elements having the edge (**M**) connected to the rotating element, and the two "mirrored" active elements are mounted symmetrically to the rotating element so that the points (**M1**) and (**M2**) of the edge **M** are collinear. At the same time, the double-articulated devices of these embodiments are provided with means that ensure the limitation of the range of motion described by the two active elements at a predefined angle $ß_{max}$.
In another embodiment of the hanger type device, the two hanger arms are provided at the outer extremities with two endings having shapes similar to the section of human hips, and the two hanger arms can be provided with mechanisms that ensure the adjustment of the length of the arms, such as spacers, telescopes, springs, sliding rails etc. in order to adjust the total width of the hanger in the "open" position.
The double articulated access gate type device may further comprise shock absorbers at the ends of the range of motion **α** of the active element.
Also, the double articulated device according to the invention can be used in the manufacture of folding hangers, vertical blinds or shutters, in hydro-technical constructions such as flood gates, wings, valves or for liquid flow regulation, or in access doors or gates.

BRIEF DESCRIPTION OF THE DRAWINGS

The description of the principle of operation of the double articulated device and system as well as other features and advantages of the invention will be presented in the following embodiments, without limitation, referring to the attached drawings, in which:

Fig. 1 represents a schematic view of a device and system according to the invention, with the active element in the form of a trapezoidal wing, the rotating fixture to the reference system being by exemple arranged in the lower end of the axis of rotation supporting the active element.

The elements of **Fig. 1** are:
1 - the active element, **2** - the relatively vertical axis of rotation around which the active element **1** is mobile, **3** - the rotating fixture to the reference system of the axis of rotation **2**, around which the axis of rotation **2** is mobile, **M** - the edge with points **M1** and **M2**, **α** - the pivoting angle described by the edge **M** around the rotating fixture

3, with the values α_{min} and α_{max}, ß - the rotation angle described by the edge **M** around the axis of rotation **2**, with the values ß $_{min}$ and ß $_{max}$, **ES 0** - initial stable equilibrium point, in which the double articulated system is in a certain operating stage, such as "open", **EI** - unstable equilibrium point on the trajectory between any two stable equilibrium points representing different stages of operation of the system, **ES 1** - the desired stable equilibrium point, representing another stage of operation of the system such as "closed", towards which the system will move alone, without energy consumption, after being pushed on the path **ES 0** - **ES 1**, only until the **EI** point is exceeded.
The invention consists of a double articulated device and system comprising one or more active elements **1** such as gates, covers, arms, doors, wings, slats, rods, provided with an edge (**M**) having two points (**M1**, **M2**), connected to a rotating element **2**, which open or close by partial rotation about the rotating element **2**, the axis of rotation being pivotally mobile around a rotating fixture **3**. The double articulated device according to the invention is able to move from one operating stage to another, such as from "closed" **ES 0** to "open" **ES 1**, by applying a minimal force to move the center of gravity of the device from one side of the rotating fixture **3** to another, by pivoting the point (**M2**) of the edge (**M**) achieving a movement at an angle **α** between a value α_{max} corresponding to the "open" position **ES0** and an α_{min} corresponding to a "closed" position **ES1** of the device.
The particular feature of the device of being in unstable equilibrium **EI** when its center of gravity and the rotating fixture **3** are the closest possible, means that when a minimum force is applied to the device which immediately after passing the unstable equilibrium **EI** will horizontally move the center of gravity of the device away from its rotating fixture **3** in a certain direction, the double articulated device will have the tendency to fall naturally and without energy consumption into other points of stable equilibrium, like "device fully closed" **ES 0**, " device fully open" **ES 1**, or stable or indifferent equilibrium like "device partially open", equilibrium points that are located close to the direction of gravity relative to the rotating fixture **3**.

ADVANTAGES OF THE INVENTION

The present invention has the advantage of moving a double articulated device between the "closed" **ES 0** and "open" **ES 1** positions with a minimum energy consumption, depending on how short the distance is between the initial stable equilibrium point **ES 0** of the device and the unique point of unstable equilibrium **EI**, so that after exceeding the unstable equilibrium **EI**, the device falls by itself into the desired stable equilibrium point **ES 1**.

DETAILED DESCRIPTION OF THE EMBODIMENTS

Throughout this document, terms such as "comprises" or variations thereof, such as "consists of", "contains" and so on, will be interpreted as the implicit and non-exclusive inclusion of the elements, steps, procedures, groups of elements, steps or procedures disclosed.

The four objects that serve as embodiments described below, that is a foldable hanger **Fig. 2-9**, a vertical shutter or window blind **Fig.10-13**, a flood barrier gate **Fig. 14-18**, and an access gate **Fig.19-26**, are presented as examples.
The materials and shapes used in the embodiments of this invention are given as exemples and have been preferred for reasons such as reliability, efficiency in production and operation; the inventive concept for which protection is claimed in this

document refers to the principle of functioning and not to the shapes or materials used in the embodiments.
The embodiments disclosed in this document can be manufactured using existing production technologies such as but not limited to thermoforming, cutting, welding, grinding, milling using specific machines and tools with manual or computer control.
The invention covers any other system that could use the concept disclosed in this document in order to take advantage of the variation of the resultant forces related to the elements in a mobile system, in order to change their position in the system to which they belong.

EMBODIMENTS OF THE INVENTION

I - FOLDABLE HANGER ACCORDING TO THE INVENTION

The first embodiment relates to a foldable hanger comprising a rotating fixture **101** connected to two active elements in the form of hanger arms **103** and **104** by a rotating joint type element with an axis of rotation **102** that is vertical in relation to the hanger, joint that is disposed in the central area of the hanger, characterized in that the change of the center of gravity of the hanger towards the front **A** or towards the rear **B** determines the tendency of the hanger to fall into one of the "open" or "folded" positions, positions which approximately coincide with the ends of the range of motion **ß** of the central joint with the relatively vertical axis **102** of the hanger. The active elements in the form of hangeer arms **103** and **104** are provided with an edge **M**, with two points **M1** and **M2**, and have a rotational movement with an angle **ß** around the axis **102** and a partial pivoting movement in vertical plane, with an angle **α** between a maximum value α_{max} and a minimum value α_{min}. The folding hanger is an embodiment of the invention, in the sense that the two arms of the hanger **103** and **104** represent the active elements of the system, which open or close by partially rotating around the axis of rotation **102** of the joint present in the central area of the hanger, axis of rotation which in turn, by means of the hanger hook **101**, is pivotable around a rotating fixture to the reference system, that is the point of contact between the inside of the hanger hook and a horizontal hanger rod inside a closet.

The hanger was described referring to **Fig. 2, 3, 3a, 4, 5, 6.a, 6.b, 6.c, 6.d, 6.e, 7, 8** and **9.**

Fig. 2 is a top view of the hanger according to the invention in the "open" position, corresponding to a rotation angle $ß_{max}$ and a pivoting angle α_{max}.

Fig. 3 is a front view of the hanger according to the invention, in the "open" position.

Fig. 3a is a front view of the foldable hanger for skirts and trousers according to the invention, provided at the outer extremities with mechanisms such as terminations **108** and **109**, shaped similar to the section of a human hip, to fix a garment like skirt or trousers, and with spacers **110** and **111**, mounted in the body of the arms **103** and **104**, which ensure the adjustment of the length of the arms **103** and **104** and meant to adapt the width of the hanger to the size of the waist of the clothing items.

Fig. 4 is a view of the hanger according to the invention, in the "folded" position.

Fig. 5 represents a detailed view from the area of the axis of rotation of the hanger

according to the invention, in which the connection of the edge **M** in the two points **M1** and **M2** is highlighted.

Fig. 6.a, **6.b**, **6.c**, **6.d**, and **6.e** represent successive transitory stages on the trajectory of movement that the folding hanger according to the invention traverses between the "open" position - **Fig. 6.a** and the "folded" position - **Fig. 6.e**.

Fig. 7 is a view of the hanger according to the invention, in the "folded" position.
Fig. 8 represents a side view of a pair of arms of the hanger according to the invention, placed superimposed, in the way in which they occupy together the smallest volume.

Fig. 9 represents a perspective view of a pair of hanger arms according to the invention, placed superimposed, in the variant in which they occupy together the smallest volume.

The notation of the elements in the drawings represents: **A** - the area considered to be in front of the hanger, where in the "open" position the angle formed by arms **103** and **104** is less than 180 degrees, **B** - the area considered to be behind the hanger, where in the "folded" position the angle formed by the arms **103** and **104** is greater than 180 degrees, **101** – rotating fixture for holding the hanger connected to the reference system, **102** - prolongation of the support **101** which forms the axis of rotation of the central articulation of the hanger, **103** - right arm of the hanger, **104** - the left arm of the hanger, **105** - the right element of the central joint of the hanger, **106** - the left element of the central joint of the hanger, **107** - the blocker at the end of the axis of rotation **102**, holding together the elements **105** and **106**, **M** - the edge with the two points **M1** and **M2**, the angles **α** and **ß** of pivoting and rotation respectively, of the arms **103** and **104**.
The hanger is in unstable equilibrium when its center of gravity and the point of connection to the reference system are superimposed, as illustrated in **Fig. 6.b**.
Pushing or twisting the hanger vertically forward **A** moves away the center of gravity of the device horizontally from its rotating fixture to the reference system forward **A**, so that the hanger according to the invention tends to fall into the "open" position shown in **Fig. 6.a**, as this represents the stable equilibrium point close to the direction in which the center of gravity is directed in relation to the rotating fixture to the reference system.
Pushing or twisting the hanger vertically backwards **B** moves away the center of gravity of the device horizontally from its rotating fixture to the reference system backwards **B**, so that the hanger according to the invention tends to fall into the "folded" position shown in **Fig. 6.e**, rapidly passing through intermediate instantaneous positions illustrated in **Fig. 6.c** and **Fig. 6.d**, as this represents the stable equilibrium point close to the direction in which the center of gravity is directed in relation to the rotating fixture to the reference system.
The arms **103** and **104** of the hanger incorporate the elements **105** and **106** respectively, of a rotating joint such as a hinge, whereby the rotating fixture, in this case the hook **101**, is continued with the portion **102** which acts as a central rotating axis, which after it passes through the hinge barrels, is being fixed below with a blocker **107** which may be for example in the form of a rivet, a grover washer around a groove dug around the shaft, or a nut around a threaded end of the shaft.

The inner faces of the arms **103** and **104**, which come into contact when the hanger is in the "open" position, form with the front and rear faces of the arms of which they are part, respectively, an angle which allows them when the hanger is in the "open" position, to rest against each other, so that both the weight of the hanger and the weight of the garment placed on the hanger prevent the hanger from accidentally falling into the "folded" position which would facilitate the unwanted fall of the coat from the hanger.

When the hanger, in the "open" position as shown in **Fig. 6.a**, is storing a garment in anatomical position, for example while attached to a horizontal rod inside a wardrobe, it is enough for the user to grip the garment from its more accessible shoulder and to make a twisting movement towards the back of the hanger **B**, so that the hanger falls into its "folded" position illustrated in **Fig. 6.e**, in order to instantly release the coat in the user's hand and remain hooked on the horizontal rod of the closet, in "folded" position.

The problem solved by the invention is a simple and inexpensive hanger in terms of production costs, which makes putting and removing clothes in and out of the anatomical position of storage with one hand possible, with significantly less effort and significantly greater speed than any solution found in prior art, without the need to remove the hanger from the closet in order to remove the stored garment off the hanger.

The foldability of the hanger according to the invention also brings the advantage of a much smaller volume occupied when it does not perform the function of holding a garment.

Thus, in the embodiment of the present document, locking the central rotary shaft **102** of the hanger with a grover washer, nut or other removable device **107** has been preferred, so that the hanger is easy to disassemble and reassemble.

For storing several hangers according to the invention so that they occupy the least volume possible, especially when they have the hooks removed, it was preferred that the upper face of the arms **103** and **104** be complementary to itself. Thus, two hanger arms according to the invention can be stored superimposed, as illustrated in **Fig. 8** and **Fig. 9**.

II - WINDOW SHUTTERS OR BLINDS ACCORDING TO THE INVENTION

The second embodiment relates to a gravitationally adjustable window shutter system comprising one or more active elements in the form of rotary closure blades or slats **201** provided with the edge **M** represented by the rotating elements **202** and **302** respectively, connected in two points to the edge **M**: **203** representing the point **M1** and **204** representing the point **M2**, one of the points **203** being on a common fixed rail **207** and operating as the rotating fixture to the reference system and the other **204** being on a common rod **205**, to which some auxiliary rotating sliders **204**, **304** are collinearly attached, common rod **205** attached to a guiding system **206**, so that changing the position of the rod **205**, to which all the slats **201** are attached, on the guides **206**, determines the change of the side or modifies the horizontal distance between the rotating fixture **203** of each slat **201** and the center of gravity of each slat **201**.

The gravitationally adjustable shutter system is an embodiment of a system according to the invention, in the sense that each slat **201**, together with its own rotating fixture **203** and its own auxiliary rotating slider **204** connected to a rod **205** common to all slats, constitutes a double articulated system according to the invention. Thus, any

slat **201** can rotate both horizontally around the rotating element such as its own vertical edge **202** with an angle **ß**, and in the vertical plane containing the rotating fixture **203** with an angle **α**.

The shutter was described referring to the drawings **Fig. 10, 11, 12.a, 12.b, 12.c, 12.d, 13.a, 13.b, 13.c and 13.d.**

Fig. 10 is an overview of the shutter system according to the invention, in the "closed" position, taking the form of an opaque surface that completely covers the surface of a window.

Fig. 11 is an overview of the shutter system according to the invention, in the "open" position, in which each slat is positioned perpendicular to the window, so as not to obscure the surface of a window at all.

Fig. 12.a, **12.b** and **12.c** represent successive transient stages on the trajectory of movement that the system of folding shutters according to the invention traverses between the positions "closed" - **Fig.12.a** and "open" - **Fig. 12.c**.

Fig. 12.d is an overview of the shutter system according to the invention, when the slats **201** have been brought close together and slid to the sides, on the rail **207** containing the upper rotating fixtures **203** of each slat **201** and also on the common rod **205** to which all the slats **201** are attached at their lower extremities.

Fig. 13.a, **13.b** and **13.c** represent successive transient stages on the trajectory of movement that the system of folding shutters according to the invention with blades **301**, **311** coupled two at each rotating vertical axis **302**, traverses it between the "closed" position - **Fig. 13.a** and "open" - **Fig.13.c**.

Fig. 13.d is an overview of the system of folding shutters according to the invention with slats **301**, **311** coupled two at each rotating vertical axis **302**, when the slats **301** and **311** were close to each other and sliding sideways, on the rail **307** containing the upper rotating fixtures **303** of each pair of slats and at the same time on the common rod **305** to which all the pairs of slats are fastened at their lower extremities.

Notation of the elements in the drawings: **A** - the area considered to be in front of the shutter, **B** - the area considered to be behind the shutter, **201** - rotating slat, **202** - longitudinal axis of rotation of the rotating slat **201**, **203** – rotating fixture of the axis of rotation **202** in the upper rail for sliding the slats aside **207**, **204** – auxiliary rotating slider connecting the axis of rotation **202** to the lower common rod **205** for orienting the slats, **205** - lower common rod for the orientation of the slats, **206** - guide for the rod **205**, **207** – upper rail for sliding the slats aside, **301** and **311** - pair of rotating slats, **302** - common central longitudinal axis of rotation for the pair of rotary slats **301** and **311**, **303** – rotating fixture of the axis of rotation **302** in the upper rail for sliding the slats aside **307**, **304** – auxiliary rotating slider connecting the axis of rotation **302** to the lower common rod for orienting the pairs of slats **305**, **305** - lower common rod for orienting the pairs of slats, **306** - guide for the rod **305**, **307** - upper rail for sliding the pairs of slats aside, the edge **M** - represented by the rotating elements **202**, **302** respectively, the rotation angle **ß** and the pivoting angle **α**.

The gravitationally adjustable shutter system is an embodiment of the invention, in the sense that the slats represent the active elements of the system, which open or close by a rotation with an angle ß around each one's own longitudinal axis of rotation **202**, **302**, axis which in turn, with the help of the auxiliary rotating slider **204**, the common rod **205**, is movable, describes a partial pivoting movement with an angle α around a rotating fixture to the reference system **203**, **303** so that the operating stages "closed" ,"open" or various degrees of intermediate opening of the shutter are obtained by orienting the slats in various directions under their own weight, varying the side or horizontal distance between the two points of attachment of each slat to the system which they are part of.
The shutter is in unstable equilibrium when the center of gravity of the blades **201** and their points of attachment to the reference system **203** are superimposed, as illustrated in **Figs. 12.b**.
Pushing the lower common rod **205** towards the rear **B** of the shutter horizontally moves away the center of gravity of each slat **201** from its rotating fixture to the referrence system **203** towards the back **B**, so that the shutter according to the invention tends to fall without energy consumption in the "open" position illustrated in **Fig. 11** and **Fig. 12.c**, as this represents the stable equilibrium point close to the direction of the center of gravity of each slat **201** relative to the rotating fixture to the reference system **203**. Pulling the lower common rod **205** towards the front **A** of the shutter moves away horizontally the center of gravity of each slat **201** from its rotating fixture to the reference system **203** towards the front **A**, so that the shutter according to the invention tends to fall into the "closed" position illustrated in **Fig. 10** and **Fig. 12.a**, as this is the stable equilibrium point close to the direction in which the center of gravity of each slat **201** is directed in relation to the rotating fixture to the reference system **203**.

Fig. 13.a, 13.b, 13.c and **13.d** illustrate another version of the shutter according to the invention, in which instead of a rotating slat, a pair of rotating slats was chosen, the operating principle remaining identical.

The pairs of blades **301** and **311** are constructively symmetrical, incorporating on their common vertical edge **302** the elements of a rotating joint such as a hinge, through which the rotating fixture **303** in the upper rail **307** continues with a rotating shaft, which after passing through the hinge barrels, is connected below to the lower common rod 305 with the auxiliary rotating slider **304**.
Following the implementation of the disclosed inventive concept, each pair of blades **301** and **311** can be rotated horizontally around their own common vertical axis **302** so as to stick to each other in a plane perpendicular to the window, or to open in a plane approximately parallel to the window, depending on the change in position of their center of gravity.
The change of the center of gravity is achieved by vertically rotating the common axis of rotation **302** around the rotating fixture **303** to the reference system.
For the operation of the shutter according to the inventive concept disclosed in this document, it would be sufficient for the upper rotating fixtures **203**, **303** of the slats **201** or the pairs of slats **301**, **311** to be disposed at equal distances, directly in the upper window sill or in the ceiling of the room where the shutter is installed.

However, for functional reasons, so that the area of the window or opening covered

by the shutter according to the invention can be completely cleared as illustrated in **Fig. 12.d** and **Fig. 13.d** respectively, it's been opted for the upper rails for sliding the slats aside **207** and **307**, provided with semi-locking steps predefined at distances equal to the widths of the slats **201** or the pairs of slats **301**, **311**.
The problem solved by the invention is a constructively simple window shutter, which implies a low manufacturing cost and a high degree of system reliability, as well as an easy troubleshooting in case of damage to the components.
The shutter according to the invention also makes it possible to close and open almost instantly, regardless of the area of the window or opening it covers, using the weight of the slats themselves.
Depending on the materials which the slats and all other components are made of on the one hand and its location relative to the window or the opening it covers on the other hand, the shutter according to the invention can function both inside as vertical blind to control the quantity of light, as well as outdoors as a blind or curtain-type façade installation, for protection against various meteorological phenomena such as storms, rain, blizzards, as well as "antitheft" security systems.
If the slats are made of relatively light materials and the forces that may occur in the environment, such as strong winds, could cause uncontrolled movement of the shutter, additional mechanical elements can be placed in the vicinity of the slats, for guiding or locking them in the desired position, such as stops, guide spurs, latches, etc.
The window shutter according to the invention is also functional in the absence of motorized control systems, since the force required to actuate it is minimal, the movement of the components being made mostly under the action of the weight of its own active elements.

III - FLOOD BARRIER OR LIQUID FLOW CONTROL GATE ACCORDING TO THE INVENTION

The third embodiment relates to a flood or liquid flow control gate, comprising a rotating fixture **401** which rotates at an angle **α** in a vertical plane, a plane that approximately contains the liquid flow direction, rotating fixture connected to one or more active elements such as doors or gate leaves **403** and **404**, through joints **405** and **406** and then through the rotating element of the central axis of rotation **402** which rotates vertically relative to the gate, able to activate independently, due to the occurance in the system of hydraulic forces able to move the gravity center of the gate upstream **A** or downstream **B**, causing the gate to fall into one of the "closed" **Fig. 15**, or "open" **Fig. 14** positions, which coincide approximately with the ends of movement of the rotating fixture **401** in the vertical plane of the gate.
A two-leaf **403**, **404** flood barrier or liquid flow control gate according to the invention may be designed with a central axis of rotation **402** common for both gate leaves, connected to the reference system through the rotating fixture **401**, or also with gate leaves placed similar to a "Mitre" gate, that is with one individual axis of rotation for each gate leaf, as shown in patent application US20130022402 (A1), but with axes of rotation mobile around rotating fixtures through which they are attached to the reference system, in a way similar with Embodiment IV of this document, which refers to an access gate.
A flood barrier or liquid flow control gate is an embodiment of the invention, in the sense that the two gate leaves **403** and **404** represent the active elements of the system, provided with an edge **M** with two points **M1** and **M2**, gate leaves **403** and **404** which open or close by rotating around the axis of rotation of the rotating element

402 in the central area of the gate with an angle ß, rotating element which in turn, with the help of the rotating fixture **401** corresponding to point **M2**, is pivotable around a point of connection to the reference system and has a partial pivoting motion with an angle **α** described by point **M2**.
The flood barrier or liquid flow control gate according to the invention has been described with reference to **Fig. 14**, **15**, **16**, **17.a**, **17.b**, **18.a**, and **18.b.**

Fig. 14 is an overview of the flood barrier gate according to the invention, in the "open" position.

Fig. 15 is an overview of the flood barrier gate according to the invention, in the "closed" position.

Fig. 16 is a top view of the flood barrier gate according to the invention, in the "open" position. When the forces developed by water flow from zone **B** towards zone **A** exceed the permitted levels, the gate pivots to the “closed” position, described in **Fig. 16** with dotted lines.

Fig. 17.a represents a perspective view from zone **B** of the flood barrier gate according to the invention, in the “open” position.

Fig. 17.b represents a perspective view from zone **B** of the flood barrier gate according to the invention, in the “closed” position.

Fig. 18.a represents a perspective view of zone **A** of the flood barrier gate according to the invention, in the "open" position.

Fig. 18.b represents a perspective view from zone A of the flood barrier gate according to the invention, in the “closed” position.

The notation of the elements in the drawings: **A** - the area considered to be upstream or behind the gate, **B** - the area considered to be downstream or in front of the gate, **401** – rotating fixture of the rotating element **402** of the gate, points **M1** and **M2** of the edge **M**, **402** - the rotating element, **403** - the right gate leaf of the gate, **404** - the left gate leaf of the gate, **405** - the hinge-shaped joint connecting the right gate leaf of the gate to the central rotating element **401**, **406** - the hinge-shaped joint, which connects the left gate leaf of the gate to the central rotating element **401**, **407** - longitudinal stop limiting the movement of the hinges **405** and **406**, **α** - the pivoting angle and **ß** the angle of rotation.
The shape of the gate leaves **403** and **404** is designed so that in the case of a normal water level, the gate is in the "open" position as shown in **Fig. 14** and maintain a relatively hydrodynamic shape, with the gate leaves **403** and **404** close together, not obstructing the normal water flow.
To increase resistance against water forces, the gate leaves **403** and **404** prefferably have an arc-shaped cross section. The upper area of each gate leaf prefferably has a longer length than the lower area, which together with the arc-shape, generates a flared area in the upper extremities, which gradually decreases the hydrodynamic coefficient of the entire system, increasing sensitivity to water forces as the level water rises.
When a significant volume of water comes forcefully from downstream **B** and there is

a risk of flooding areas outside the normal watercourse upstream **A**, this volume of water pushes upstream **A** the flared area of gate leaves **403** and **404** hitherto above the water, forcing the central rotating element **402** to pivot around the rotating fixture **401** towards upstream **A**, moving the center of gravity of the whole flood barrier gate upstream **A** relative to the rotating fixture to the reference system **401**.
This leads to the natural tendency of both gate leaves to fall into the "closed" position, with the ends of the gate leaves **403** and **404** resting upon the banks and the rotating element coinciding to the central axis of rotation **402** sloping upstream **A**.
The higher the water force from downstream **B** towards upstream **A**, the stronger the gate will be pushed into the "closed" position.
For situations in which the water currents are not stable in terms of direction, the central axis **402** of the flood barrier gate may be provided with a longitudinal stop **406**, which in addition to the hydrodynamic role, has the function of not allowing any of the gate leaves **403** or **404** to close over the other leaf, in case of the presence in the system of some lateral forces that would prevent the proper closing of the gate, each gate leaf in the corresponding direction.
For a high degree of responsiveness of the flood barrier gate according to the invention, lever systems with counterweights can be attached to it in order to adjust the equilibrium sensitivity, or simple hydraulic systems such as propellers, hydraulic ramps etc. can be built, at greater distances downstream **B** from the gate, systems able to actuate the flood barrier gate remotely, through cable systems, pulleys, etc. before a massive excess water flow endangers the areas to be protected.
Depending on the geographical context and needs, variations of the flood barrier gate according to the invention may be disposed at river mouths in places where they connect to larger rivers, lakes, seas or oceans, waters characterized by the ability to flood meadows, deltas, estuaries or other forms of relief near the mouths. Also, to regulate the flow or force of water currents, gates according to the invention can be installed along rivers as dams or mobile valves, or even disposed so they protect coastal areas.
The problem solved by the invention is the production of a flood barrier or liquid flow control gate that acts independently, quickly, completely mechanically and self-powered, without the need for a human or computerized control center, able to protect an area against floods, in extreme situations such as power surge, control systems destroyed or non-existent infrastructure, diminishing the impact of water flow coming from downstream **B** to upstream **A**, by redirecting water forces towards the bottom of the water and to the banks.
At the same time, the utility of the flood barrier gate according to the invention is further greater, as it works completely ecologically and offers the possibility to be designed in a form that does not impede the navigability of the watercourse where it is built.

IV - ACCESS GATE ACCORDING TO THE INVENTION

The fourth embodiment relates to an access gate comprising a vertically rotating fixture **503** connected to one or more gate leaves or access doors **501** through one or more joints with the rotating element **502** which is vertical relative to the door, enabling it to open and close quickly and with minimal energy consumption by changing its center of gravity, which determines the tendency of the door to fall into one of the "open" or "closed" positions, which coincide approximately with the ends of the movement of the fixture **503** in the vertical plane of the access gate.
The access gate represents an embodiment of the invention, in the sense that a door

501 represents the active element of the system, provided with an edge **M** with two points **M1** and **M2**, a door that opens or closes by rotation with an angle **ß** around the axis of rotation **502** of the joint in the area of the column of the gate **505**, axis of rotation which in turn, with the help of the rotating fixture **503**, has a partial pivoting movement, with an angle **α** around a point of connection to the reference system. The access gate according to the invention has been described with reference to **Fig. 19**, **20**, **21**, **22**, **23**, **24**, **25** and **26**.

Fig. 19 is a schematic view of an access gate according to the invention, with the door in the "open" position.

Fig. 20 is a schematic view of an access gate according to the invention, with the door in the unstable equilibrium position on the trajectory between the "open" and "closed" positions.

Fig. 21 is a schematic view of an access gate according to the invention, with the door in the "closed" position.

Fig. 22 is a perspective view of an access gate according to the invention, with the door in the "open" position.

Fig. 23 is a perspective view of an access gate according to the invention, with the door in the unstable equilibrium position on the trajectory between the "open" and "closed" positions.

Fig. 24 is a perspective view of an access gate according to the invention, with the door in the "closed" position.

Fig. 25 represents a perspective view, from above, of three identical access gates according to the invention, with two doors each, the gate on the left with the doors in the "open" position, the one in the middle with the doors in the unstable equilibrium position on the trajectory between the "open" and "closed" positions, and the one on the right with the doors in the "closed" position.

Fig. 26 represents a perspective view of three identical access gates according to the invention, with two doors each, the one on the top left (behind) located with the doors in the "open" position, the one in the middle (medium distance) with the doors in the position of unstable equilibrium on the trajectory between the "open" and "closed" positions, and the one on the lower right (close-up) with the doors in the "closed" position.

The notation of the elements in the drawings: **A** - the area considered to be in front of the access gate, **B** - the area considered to be behind the access gate, **501** - the gate door provided with the edge **M** with points **M1** and **M2**, **502** - the rotating element coinciding with the axis of rotation of the gate door, vertical relative to the door, **503** – rotating fixture to the reference system of the rotating element **502**, **504** - cavity inside the pillar **505** of the gate, which houses the double articulated system according to the invention and limits the pivoting angle of the element of rotation **502** around the rotating fixture **503** to the path necessary and sufficient for the proper operation of the system, **505** - the gate pillar, which houses the operation of the double articulated

system that underlies the operation of the access gate according to the invention, **α** – the pivoting angle and **ß** – the rotation angle.

As the doors of prior art access gates are generally very heavy, closing and opening them requires a relatively large human effort or strong engines in terms of the force developed. Space limitations in the case of automated access gates often lead to the decision to install engines of relatively small size and power, which leads to a very slow transition of the gate from one operating stage to another, such as from "closed" to "open" or vice versa.

By building a pillar **505** according to the disclosed inventive concept, which is either rotationally mobile aor contains a system **504** which allows the vertical rotation of the rotating element **502** to which the gate door **501** is attached, around a rotating fixture **503** by means of which it is connected to the reference system, the movement of the door between the "closed" and "open" positions can be achieved mainly under the own weight of the door, the energy consumption necessary to operate the gate being equivalent only to the effort of removing the gate from a stable equilibrium and passing it over the unstable equilibrium point in which the axis of rotation **502** of the door is in a vertical position, the gate having by construction the capacity to continue autonomously the pivotation of the axis **502** and rotation of the door towards the expected stable equilibrium point equivalent to the desired operating stage.

In order to minimize the energy consumed for actuation, the access gate according to the invention may comprise lever and/or counterweight systems for balancing or for fine tuning its sensitivity, by adjusting the forces that maintain the equilibrium state of the device.

If, for the sake of minimizing energy consumption, the access gate has reached a point of equilibrium in which it presents the risk to become accidentally actuated by forces unforeseen in the system, such as wind breeze, as well as for security reasons, it is possible to opt for the displacement of locks or automated locking systems in the vicinity of the gate doors.

According to the inventive concept disclosed, the manual or motorized movement of the upper end of the axis of rotation **502** on an arc-shaped path with the center coinciding with the center of the rotating fixture **503** and the radius equal to the height of the axis **502** from the front of the gate **A** to the area behind the gate **B**, after exceeding the unstable equilibrium point in which the axis of rotation **502** is in a vertical position, is equivalent to horizontally moving the center of gravity of the device away from its rotating fixture to the reference system to the rear **B**, so that the gate door according to the invention tends to fall into the "open" position illustrated in **Fig. 19** and **Fig. 22**, since it represents the stable equilibrium point close to the direction in which the center of gravity is directed in relation to the point of attachment to the reference system **503**.

Similarly, the manual or motorized movement of the upper end of the axis of rotation **502** on an arc-shaped trajectory with the center coinciding with the center of the rotating fixture **503** and the radius equal to the height of the axis **502** from behind the gate **B** to the area in front of the gate **A**, after passing the point of unstable equilibrium in which the axis of rotation **502** is in a vertical position, is equivalent to horizontally moving the center of gravity away from its rotating fixture to the reference system to the front **A**, so that the gate door according to the invention tends to to fall into the "closed" position illustrated in **Fig. 21** and **Fig. 24**, since it represents the stable equilibrium point close to the direction in which the center of gravity of the door **501** is directed in relation to the point of attachment to the reference system **503**.

For the situation in which the gate doors according to the invention are constructively

so heavy that their fall in one of the stable equilibrium points can produce shocks that may damage either the doors themselves, the locking systems or any other element of the environment in any way, the access gate according to the invention can be provided with shock absorbers at the ends of movement of the hinges or of the closing elements.
The problem solved by the invention is the construction of an access gate which can be operated with a minimum energy consumption and which passes very quickly from one operating stage to another, such as from "closed" to "open" or vice versa.
At the same time, given the trapezoidal shape of the door **501**, the transition from one stage of operation to another produces a slight elevation from the ground of its lower edge **M**, allowing the opening and closing of the gate regardless of the presence of small obstacles on the ground, such as snow, small stones, spontaneously grown plants or other objects that, in the case of the access gates from prior art, obstruct the rotary movement of the doors.
The present invention discloses a double articulated device and system which, both by the multitude and diversity of embodiments and by the high degree of added value brought in each area given as an example, in the form of energy saved, increased efficiency in manufacture and operation and so on, proves the industrial applicability of the disclosed inventive concept.
It is obvious that the examples just presented are only particular illustrations and they are by no means limiting in terms of scope of the invention.

CLAIMS

1. Double articulated device comprising:

- at least one active element (**1**; **103**, **104**; **201**; **301**, **311**; **403**, **404**; **501**) provided with an edge (**M**) having two points (**M1**) and (**M2**), where (**M1**) is different from (**M2**),

- a rotating element (**2**, **102**, **202**, **302**, **402**, **502**) connected to the edge (M) and

- a rotating fixture (**3**, **101**, **203**, **204**, **303**, **401**, **503**) positioned in the point (**M1**) of the edge (**M**) and connected to the rotating element (**2**, **102**, **202**, **302**, **402**, **502**)
in which, during actuation
the active element (**1**; **103**, **104**; **201**; **301**, **311**; **403**, **404**; **501**) simultaneously describes:

  - a rotational movement with an angle **ß** around the rotating element (**2**, **102**, **202**, **302**, **402**, **502**)
  and
  - a partial pivoting movement in the vertical plane around the rotating fixture (**3**, **101**, **203**, **204**, **303**, **401**, **503**) so that the point (**M2**) of the edge (**M**) describes an angle **α** between a value α_{max} which corresponds to the "open" position **ES0** and an α_{min} value corresponding to a "closed" **ES1** position of the device.

2. Double articulated device according to Claim 1, wherein the active element **(1, 501)** has a trapezoidal shape.
3. Double articulated device according to Claim 2, wherein the pivoting angle **α** has values between 5˚ and 20˚.
4. Double articulated device according to claim 1, wherein the rotation angle **ß** has values between 90° and 110°.
5. Doble articulated device according to Claim 1, wherein the pivoting movement of the point (**M2**) of the edge (**M**) is performed by external means such as lever systems, with counterweights or motorized systems.
6. Doble articulated device according to claims 1-5, wherein the active element (**1**; **201**; **301**, **311**; **501**) has a substantially flat shape.
7. Double articulated device according to Claim 1, comprising two active elements (**103**, **104**; **403**, **404**), each having the edge (**M**) connected to the rotating element (**102**, **402**).
8. Double articulated device according to Claim 7, wherein the two "mirrored" symmetrical active elements (**103**, **104**; **403**, **404**) are mounted symmetrically to the rotating element (**2**, **402**) so that the points (**M1**) and (**M2**) are collinear.
9. Double articulated device according to any one of the Claims 7 and 8, wherein the active elements (**103**, **104**; **403**, **404**) are provided with means to ensure the limitation of the range of motion of the active elements (**103**, **104**; **403**, **404**) to a predefined angle $ß_{max}$.

10. Double articulated device according to Claim 9, wherein the angle ß described in the maximum rotational position of each of the two arms (**103**, **104**) around the rotating element (**102**) has values between 100° and 120°.

11. Double articulated device according to Claim 9, wherein the angle ß described in the maximum position of rotation of the two arms (**403**, **404**) around the rotating element (**402**) has values between 90° and 135°.

12. Double articulated device according to Claims 1, 9 and 10, wherein the two active elements have the form of a hanger arm (**103**, **104**) and are provided, at the outer ends, with two terminations (**108**, **109**).

13. Double articulated device according to Claim 12, wherein the two active elements in the form of hanger arms (**103**, **104**) are provided with mechanisms (**110**, **111**) for adjusting the length of the arms (**103**, **104**) in the form of spacers, telescopes, springs, sliding rails etc.

14. A system comprising several double-articulated devices according to Claims 1-5, wherein the **M** edges of the devices are arranged parallel in the same plane and the rotating fixtures (**3**, **101**, **203**, **204**, **303**, **401**, **503**) are collinear.

15. Double articulated device according to Claims 1 or 2, further comprising shock absorbers at the ends of the range of motion of the active element (**1**, **501**).

16. The use of the double articulated device according to Claim 1 in the production of folding hangers, vertical blinds or shutters, in hydrotechnical constructions such as dams, flood gates, wings, valves or for regulating the flow of liquid, or in access doors and gates.

FIG. 1

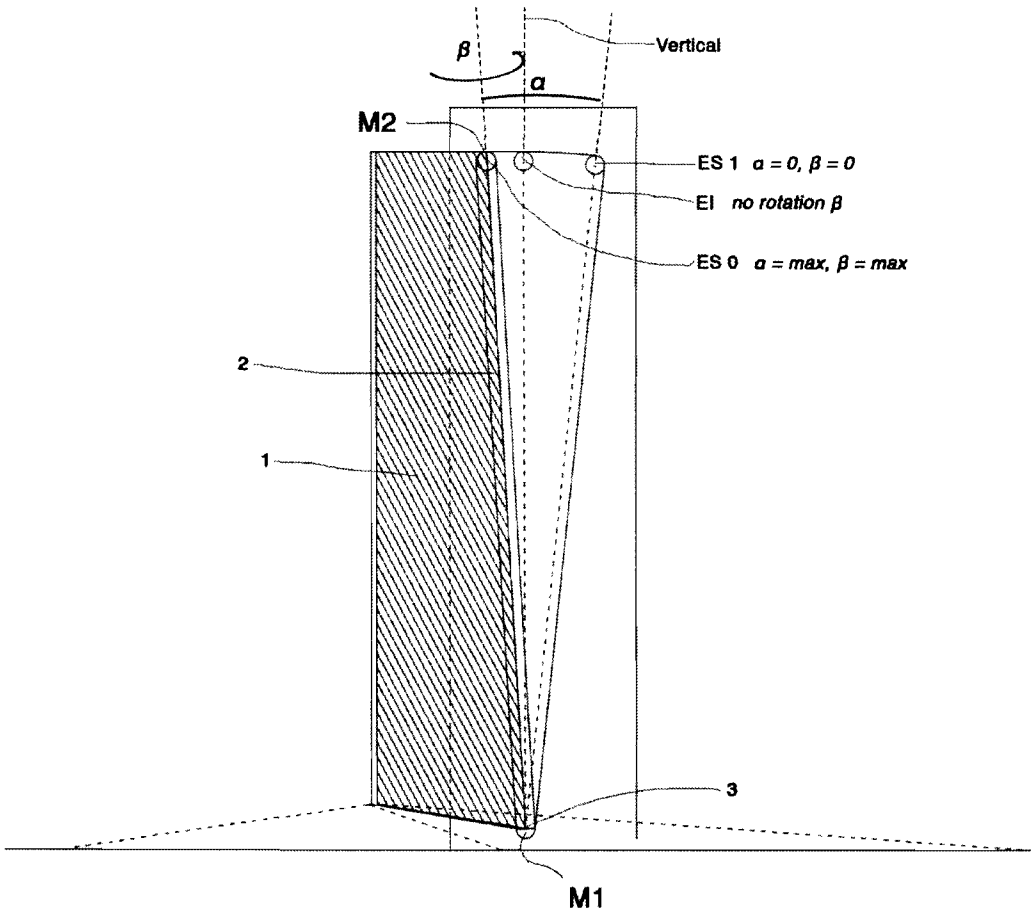

β
α
Vertical
M2
ES 1 α = 0, β = 0
EI no rotation β
ES 0 α = max, β = max
2
1
3
M1

FIG. 2

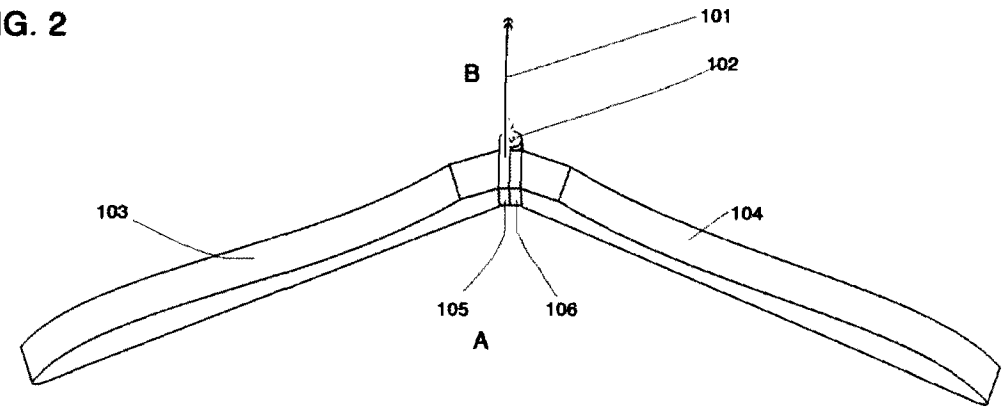

101
B
102
103
104
105
106
A

FIG. 3

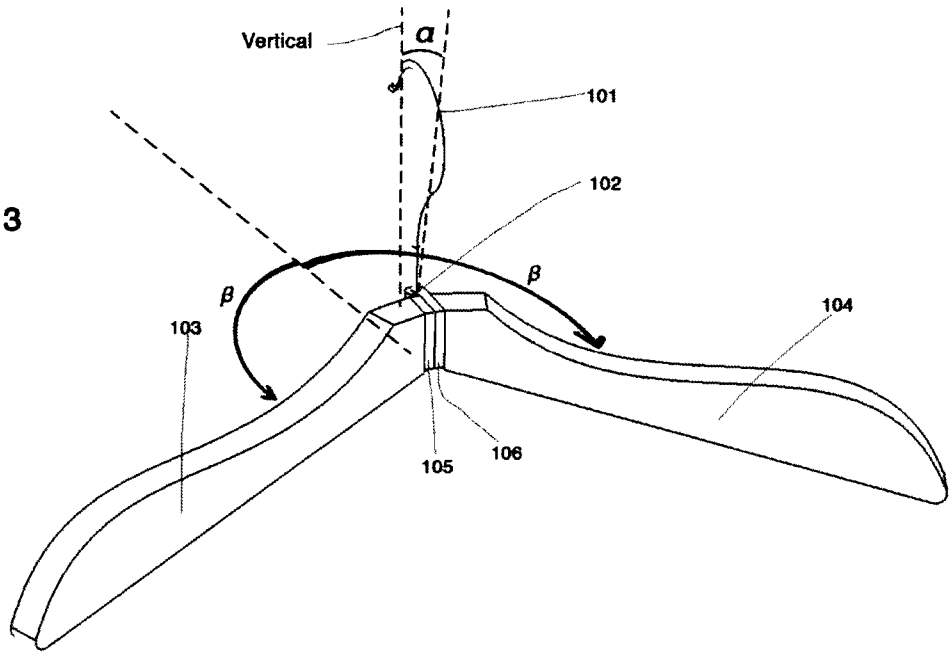


FIG. 3a

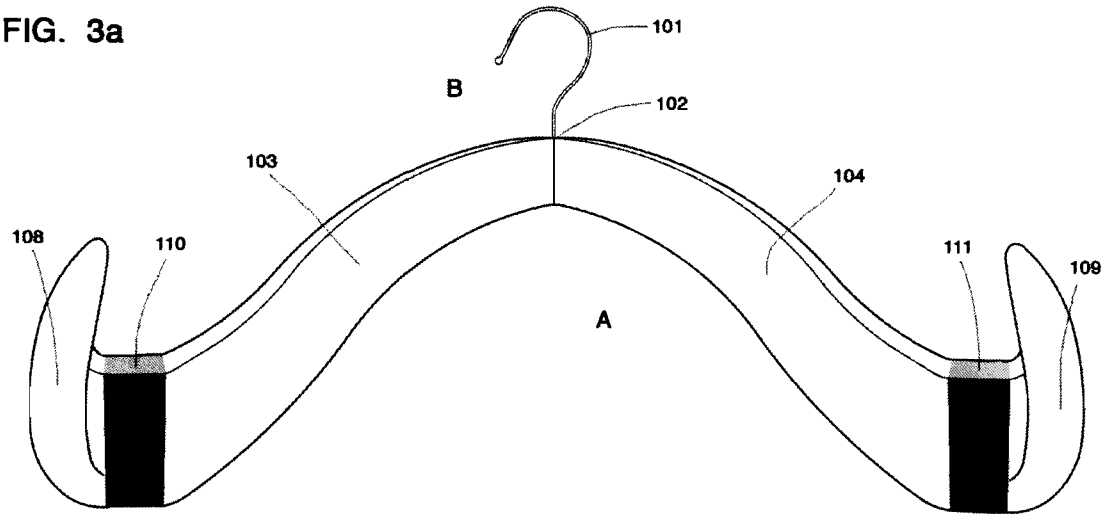


FIG. 4

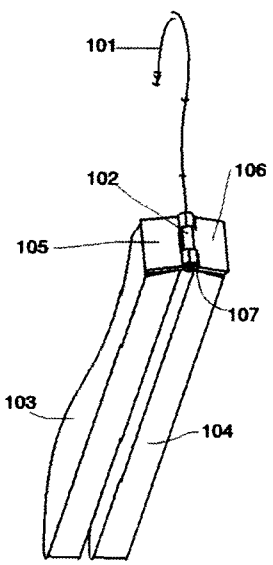


FIG. 5

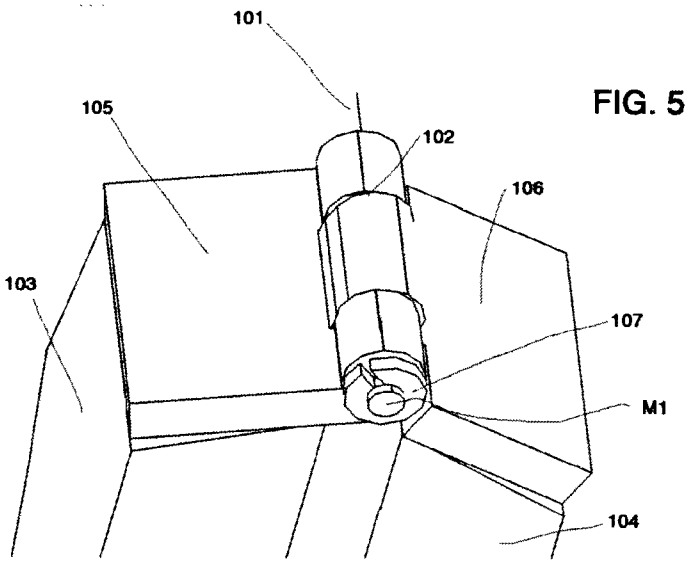


FIG. 6.a

ES 0 $\alpha = max, \beta = max$

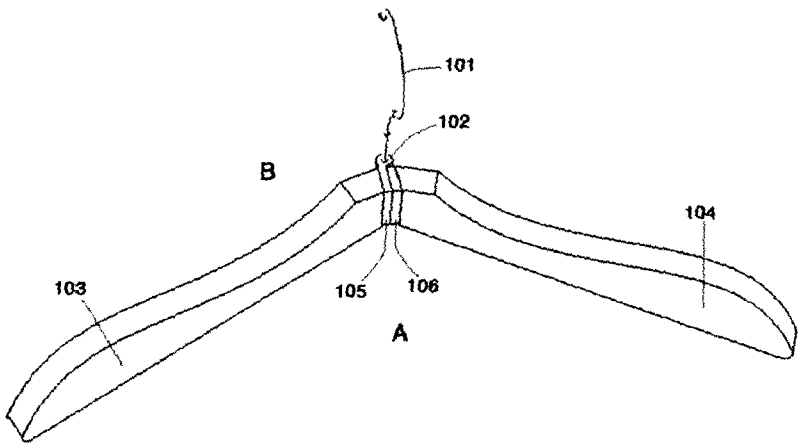


FIG. 6.b

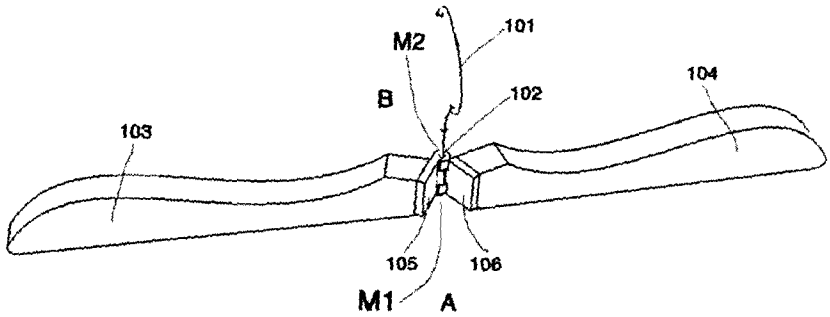


FIG. 6.c

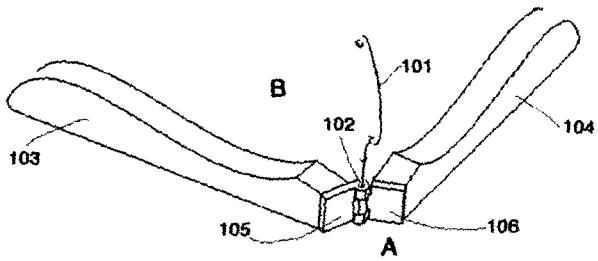


FIG. 6.d

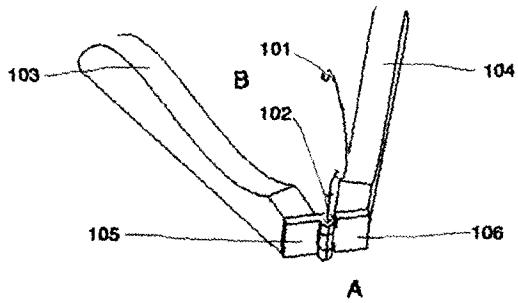


FIG. 6.e

ES 1 $\alpha = 0, \beta = 0$

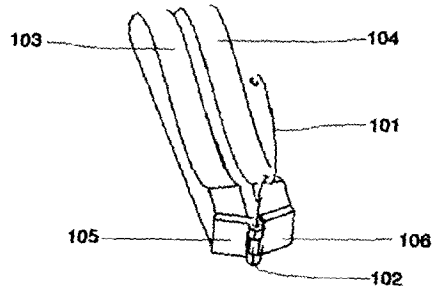


FIG. 7

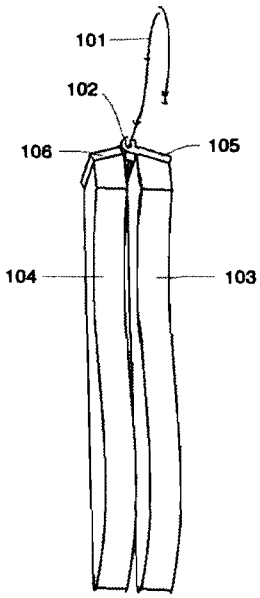


FIG. 8

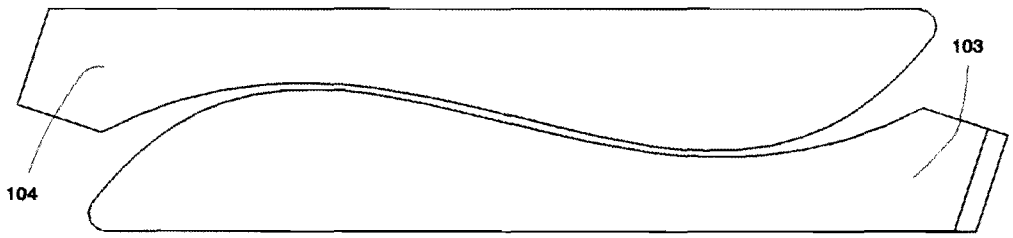


FIG. 9

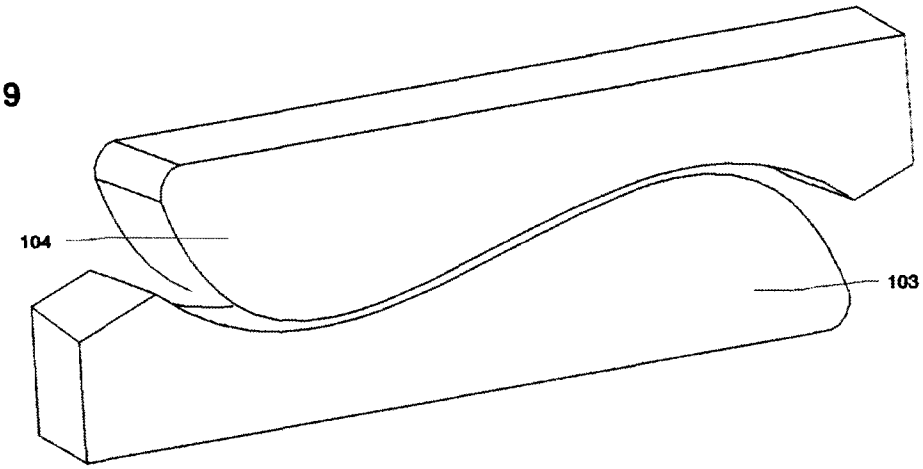


FIG. 10

ES 0 $\alpha = max$, $\beta = max$

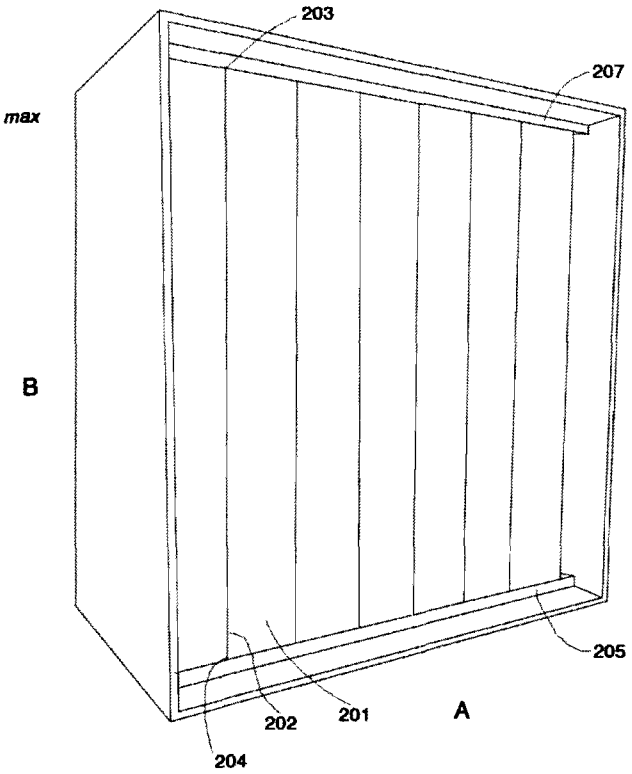


FIG. 11

ES 1 $\alpha = 0$, $\beta = 0$

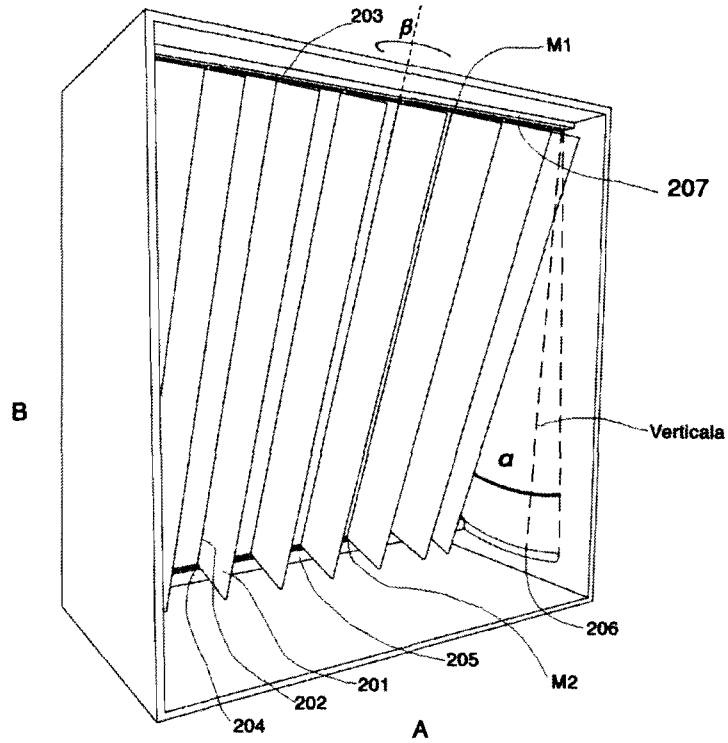


FIG. 12.a

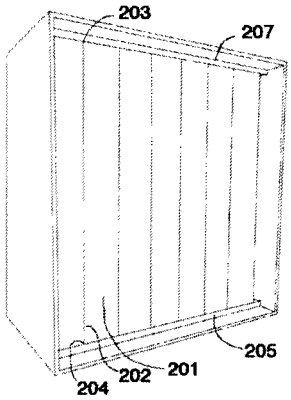


FIG. 12.b

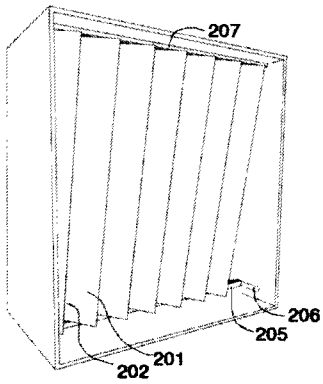


FIG. 12.c

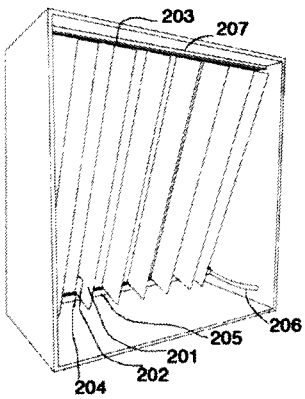


FIG. 12.d

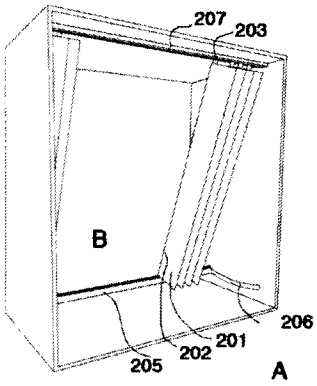


FIG. 13.a

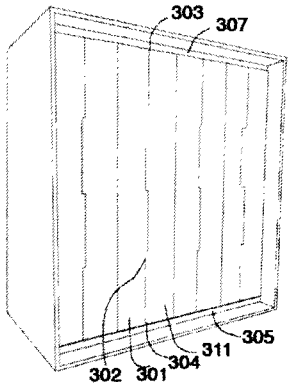


FIG. 13.b

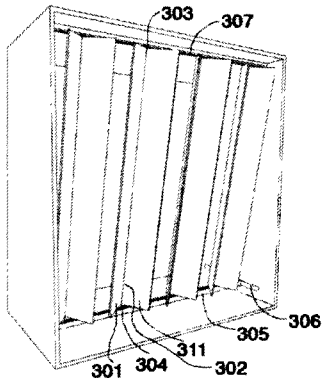


FIG. 13.c

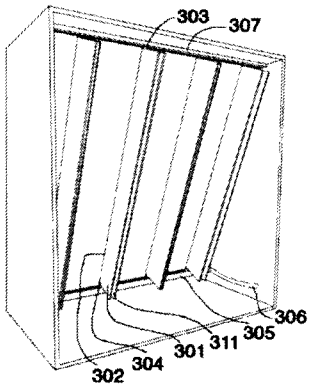


FIG. 13.d

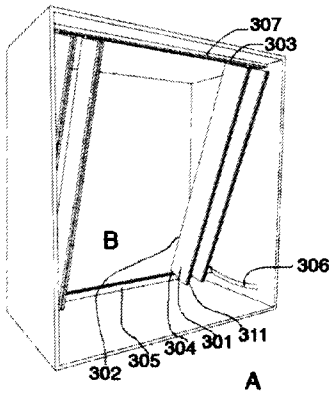
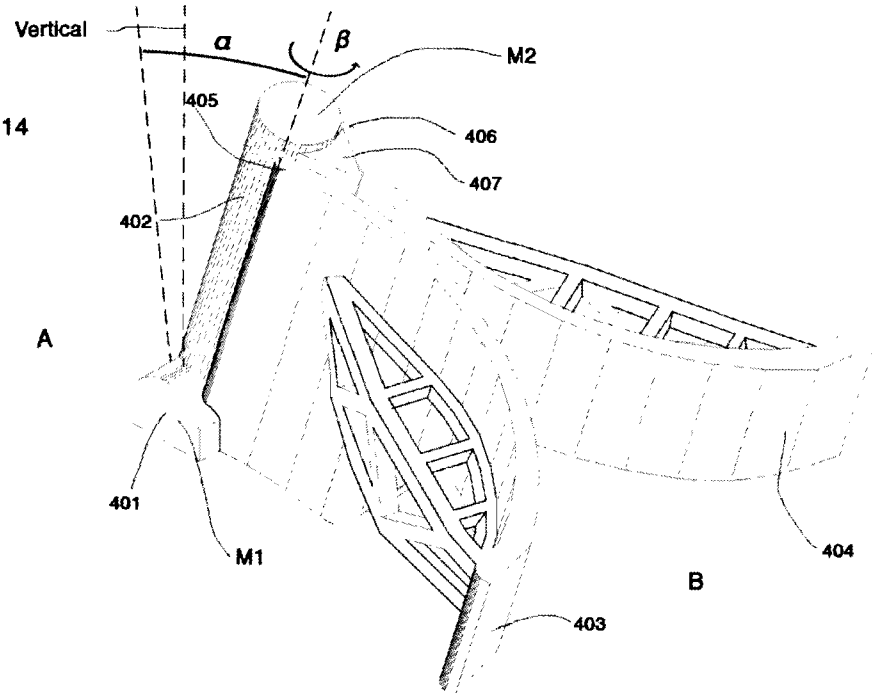
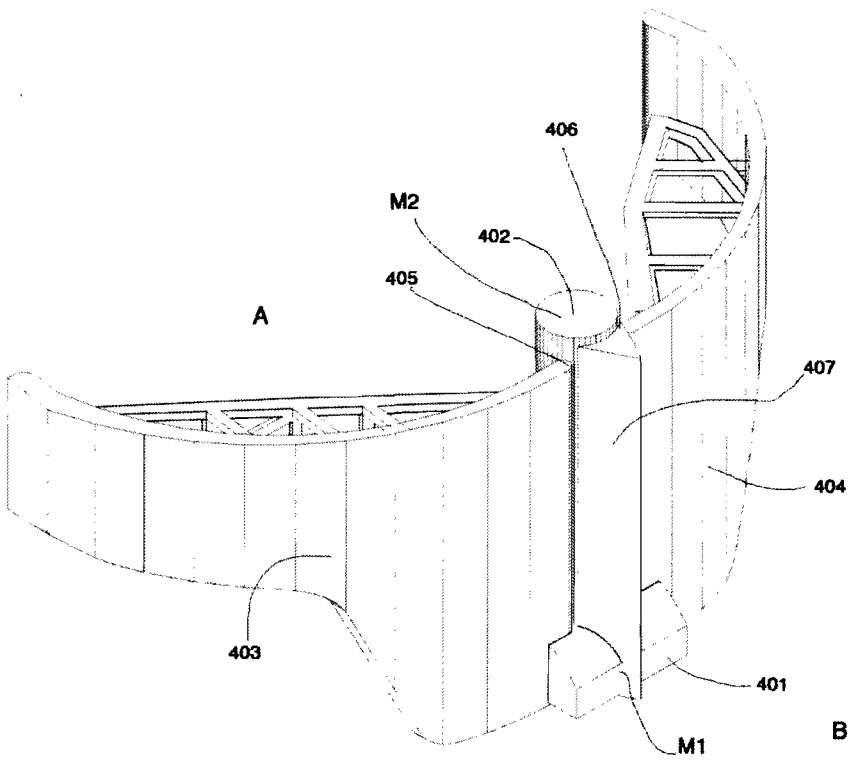


FIG. 14



ES 1 $\alpha = 0, \beta = 0$

FIG. 15



ES 0 $\alpha = max, \beta = max$

FIG. 16

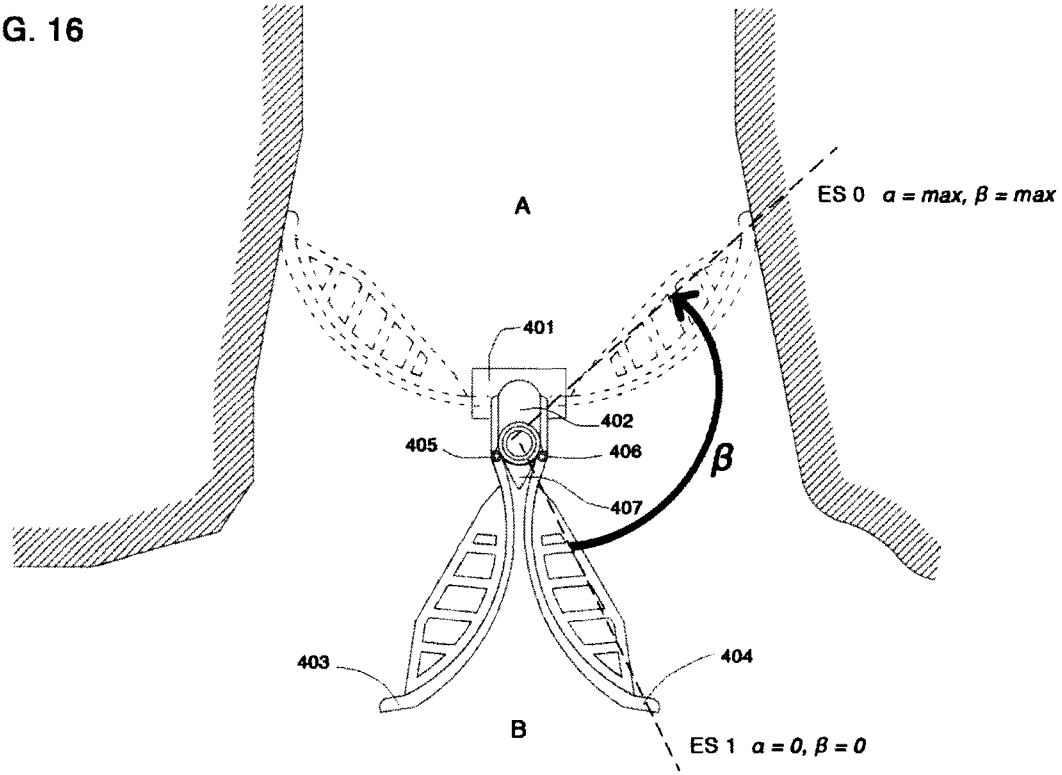


FIG. 17.a

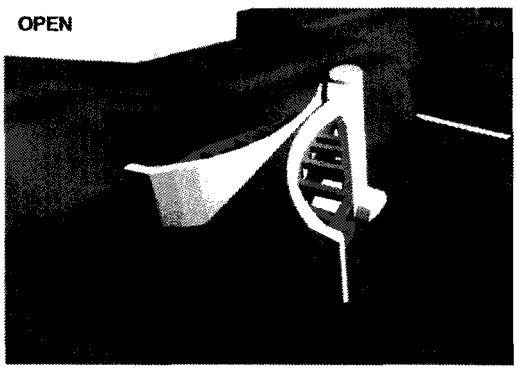


FIG. 18.a

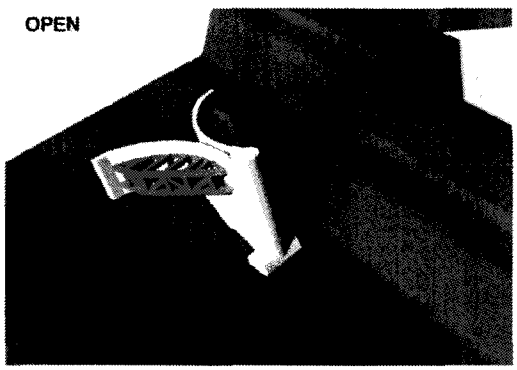


FIG. 17.b

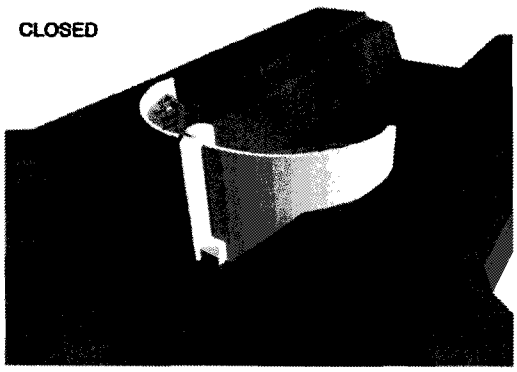


FIG. 18.b

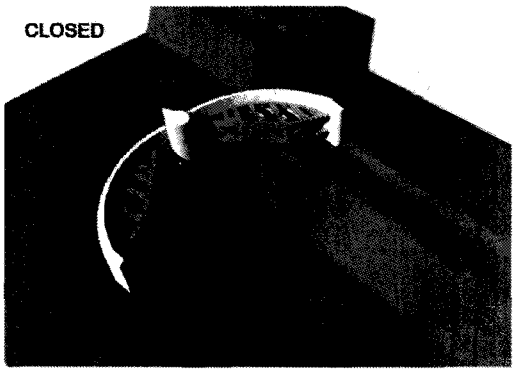


FIG. 19

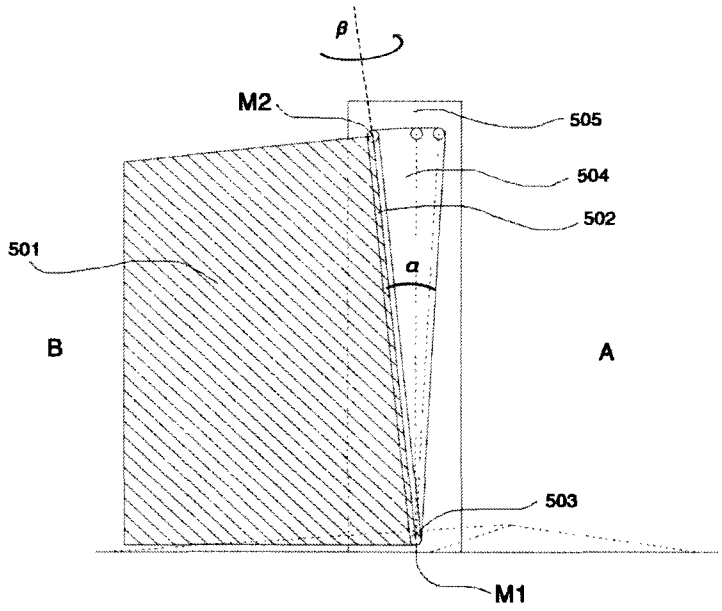


FIG. 20

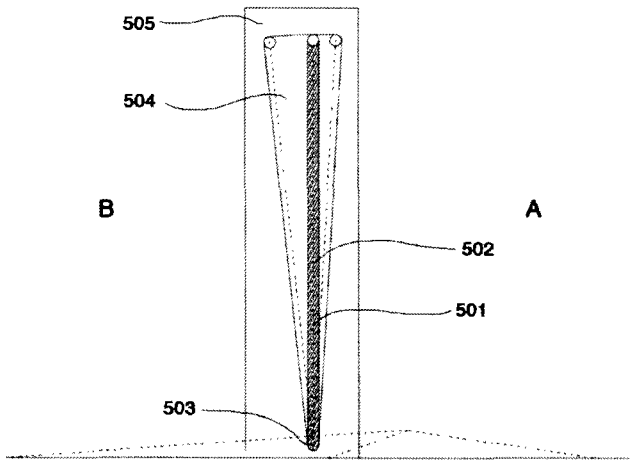


FIG. 21

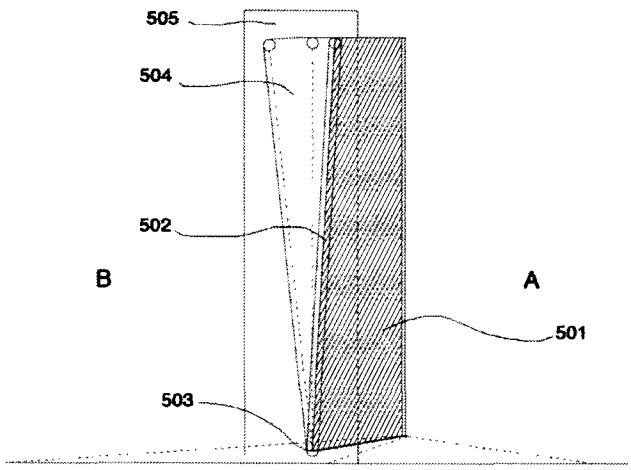
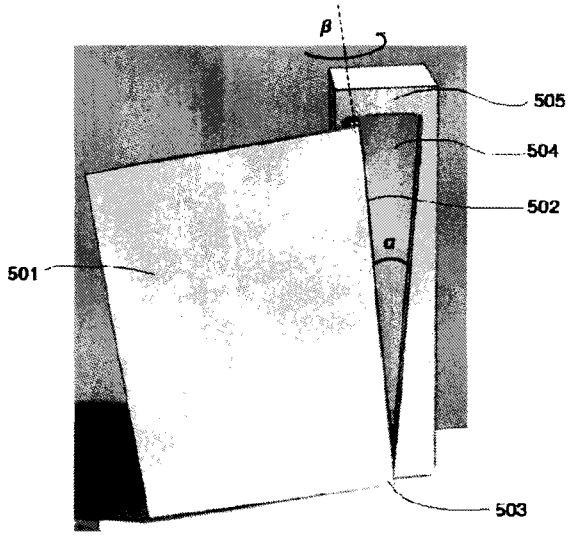
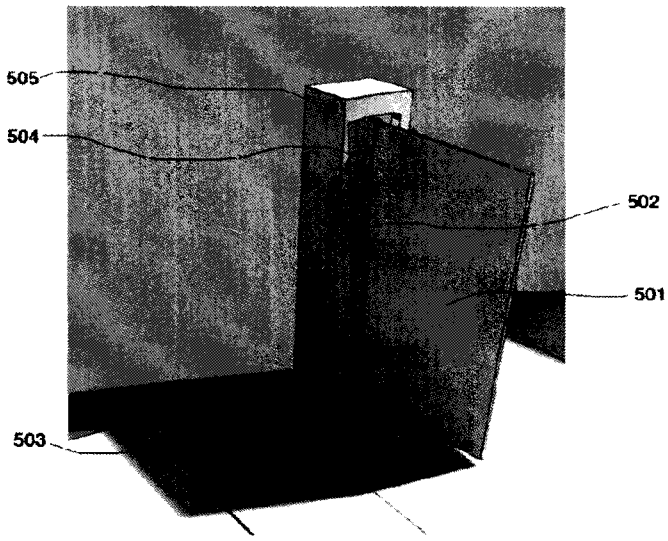


FIG. 22



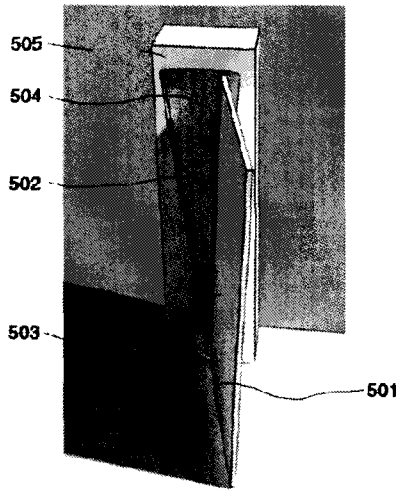
ES 0
α = max
β = max

FIG. 23



E I
no
rotation β

FIG. 24



ES 1
α = 0
β = 0

FIG. 25

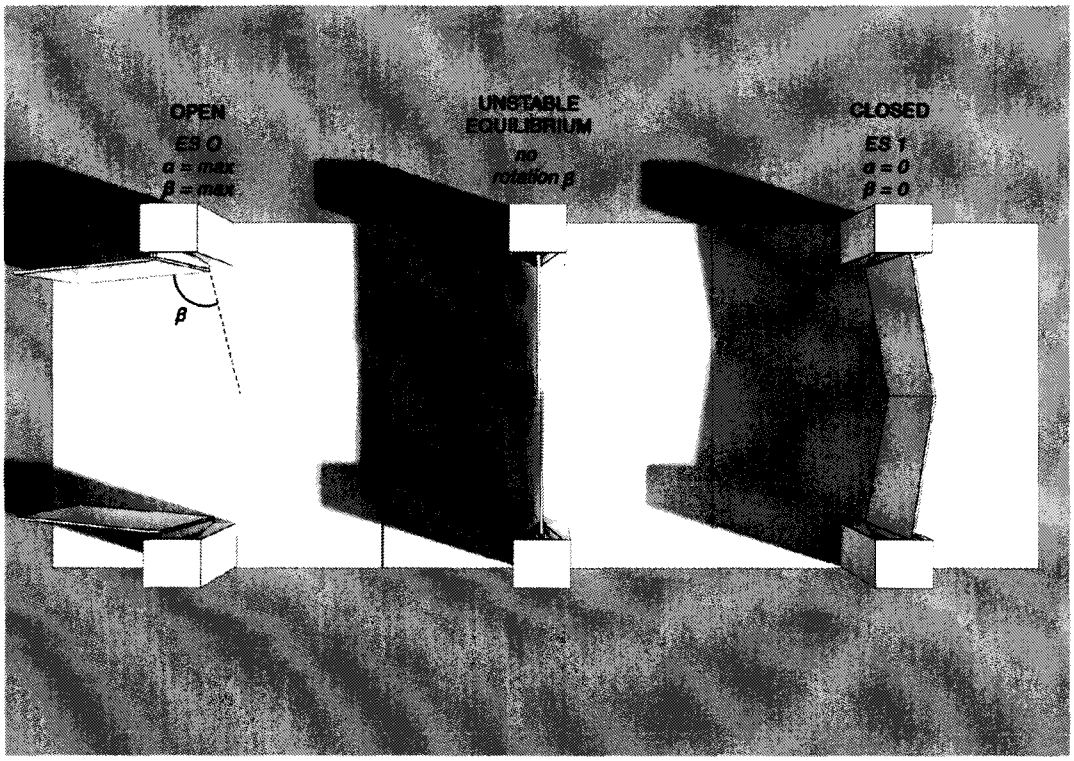
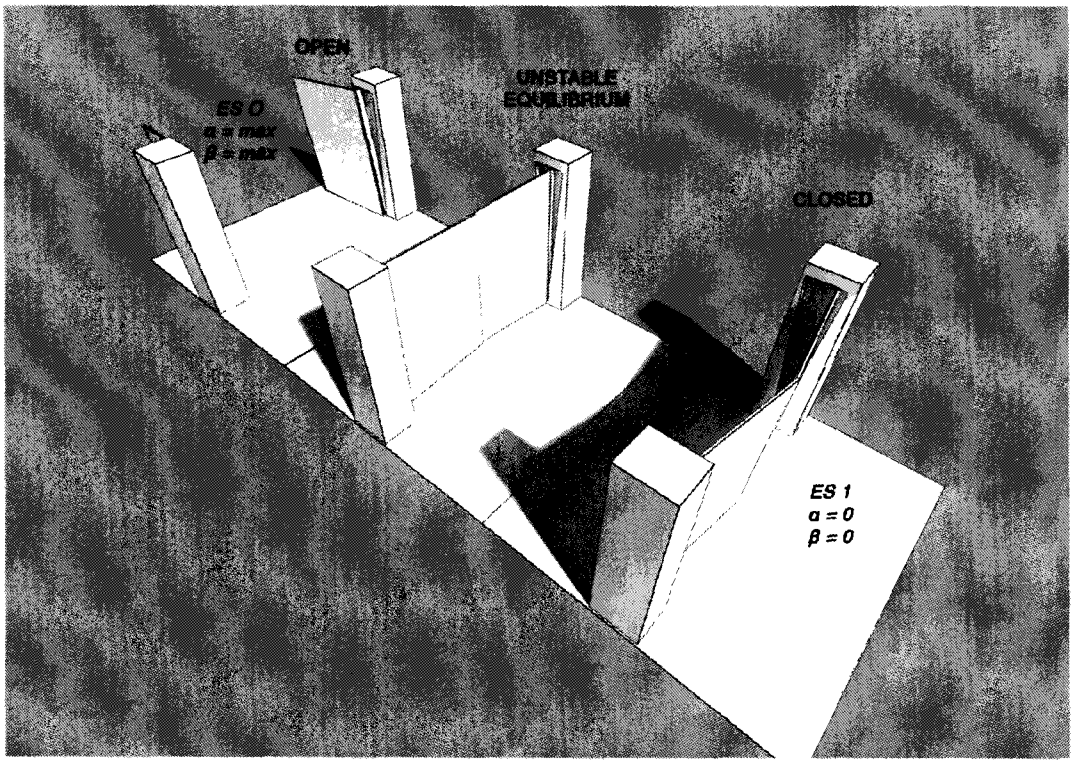

OPEN
ES 0
α = max
β = max
β
UNSTABLE
EQUILIBRIUM
no
rotation β
CLOSED
ES 1
α = 0
β = 0

FIG. 26


OPEN
ES 0
α = max
β = max
UNSTABLE
EQUILIBRIUM
CLOSED
ES 1
α = 0
β = 0