United States Patent [19]

Gause et al.

[11] **3,788,163**

[45] **Jan. 29, 1974**

[54] **MANUAL ACTUATOR**

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[73] Assignee: **The United States of America as represented by the Administrator of the National Aeronautics and Space Administration,** Washington, D.C.

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[52] **U.S. Cl.**..... **74/594.6,** 74/594.7, 128/25 R, 272/73, 272/80

[51] **Int. Cl.**..... **G05g 1/16**

[58] **Field of Search**..... 74/594.6, 594.4, 594.7; 272/58, 73, 79 R, 80; 128/25 R

[56] **References Cited**

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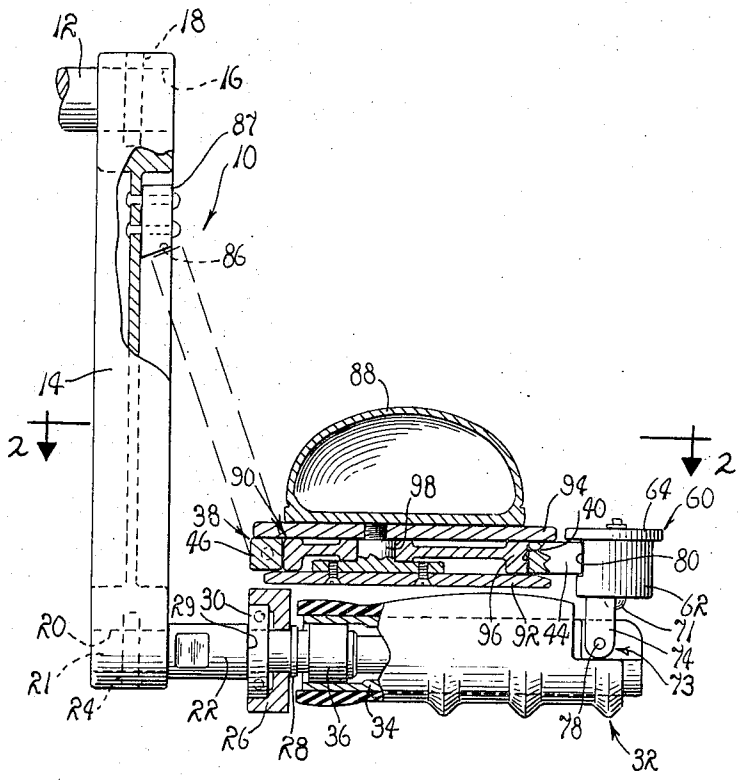
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Assistant Examiner—F. D. Shoemaker
Attorney, Agent, or Firm—L. D. Wofford, Jr. et al.

[57] **ABSTRACT**

An actuator for an exercising machine employable by a crewman aboard a manned spacecraft. The actuator is characterized by a force delivery arm projected from a rotary input shaft of an exercising machine and having a force input handle extended orthogonally from its distal end. The handle includes a hand-grip configured to be received within the palm of the crewman's hand and a grid pivotally supported for angular displacement between a first position, wherein the grid is disposed in an overlying juxtaposition with the hand-grip, and a second position, angularly displaced from the first position, for affording access to the hand-grip, and a latching mechanism fixed to the sole of a shoe worn by the crewman for latching the shoe to the grid when the grid is in the first position.

4 Claims, 6 Drawing Figures



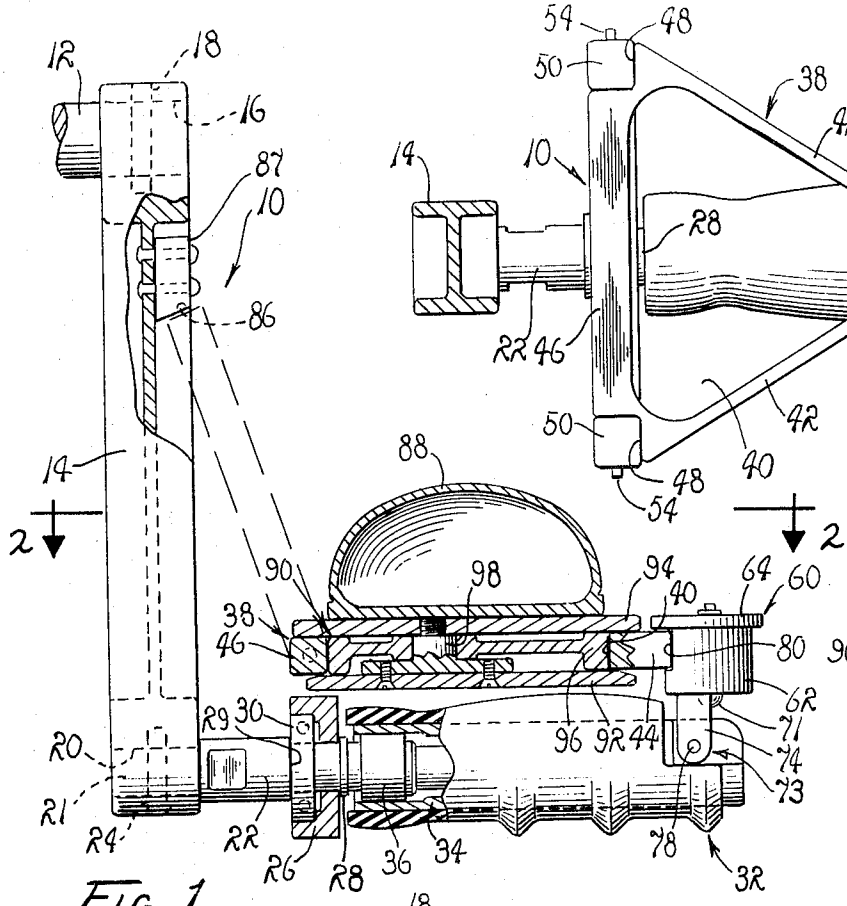


FIG. 1.

FIG. 2.

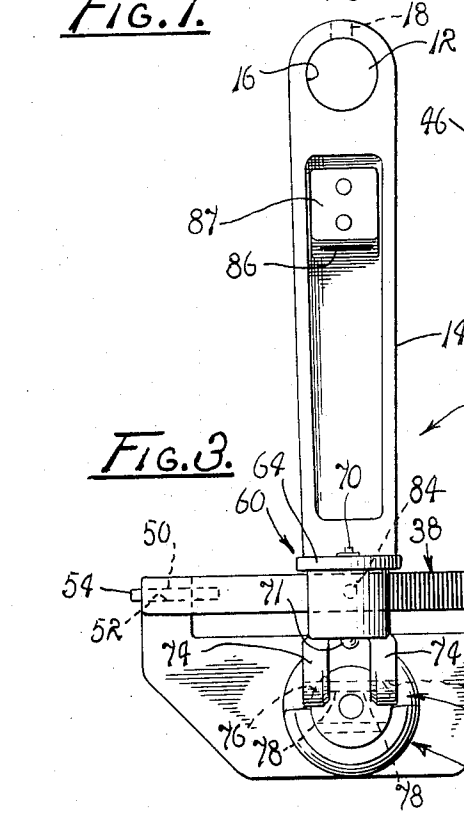


FIG. 3.

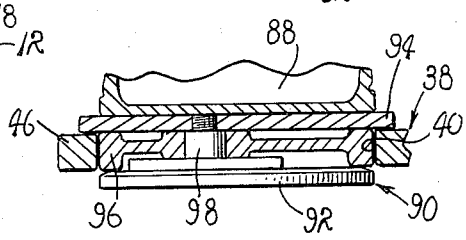


FIG. 6.

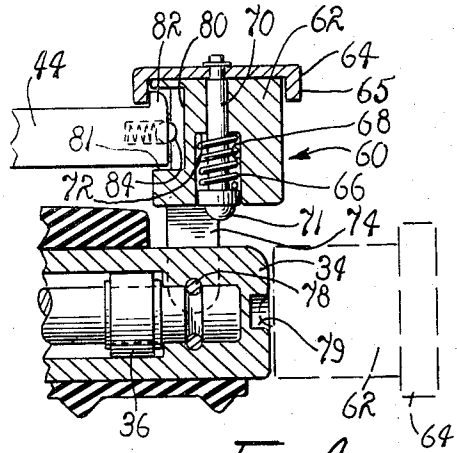


FIG. 4.

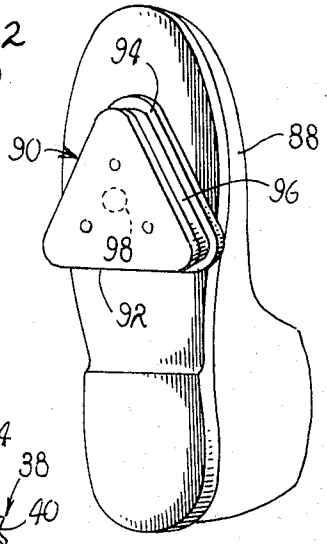


FIG. 5.

MANUAL ACTUATOR

ORIGIN OF INVENTION

The invention described herein was made by employees of the United States Government and may be manufactured and used by or for the Government for governmental purposes without the payment of any royalties or therefor.

BACKGROUND OF THE INVENTION

The invention relates to input devices for exercising machines, ergometers and the like, and more particularly to a manual actuator selectively configured for use by a crewman aboard spacecraft selectively employing his hand or his foot.

The prior art is replete with exercising machines and similar mechanisms having manually operable input devices utilized in exercising the muscles of the human body and its limbs. Such machines are typified by a machine disclosed in the United States Letters Patent, No. 2,783,044, which issued Feb. 26, 1957 to D. G. Sbarra. The prior art devices, however, fail to fully satisfy the existing needs of crewmen confined aboard operative spacecraft, particularly those engaged in conducting missions of extended durations.

As can readily be appreciated by those familiar with spacecraft operations, a zero gravity environment, accompanied by a lack of suitable facilities for accommodating sufficient muscular activity, tends to have debilitating effects on crewmen manning spacecraft. Consequently, it is highly desirable to provide aboard spacecraft suitable mechanisms for affording the crewmen opposrtunities to exercise the muscles located within their bodies and limbs. Of course, in view of prevailing bulk and weight requirements, any mechanism provided for this purpose aboard a spacecraft preferably is of a compact, lightweight construction, simple to operate and practical to employ.

Therefore, it is the purpose of the instant invention to provide an actuator for a manually operable exercising machine which is practical, compact, of lightweight and durable construction, and one which can readily be converted for efficient and safe operation when using either a crewman's hand or his foot.

OBJECTS AND SUMMARY OF THE INVENTION

It is therefore an object of the instant invention to provide an improved actuator for use with manually operable exercising machines.

It is another object to provide an improved actuator for use by crewmen in exercising the muscles within their bodies and limbs while confined aboard spacecraft.

It is another object to provide an improved actuator for exercising machines, adapted to be manually driven employing either a hand or a foot.

It is another object to provide an actuator for a manually operable exercising machine which includes a force delivery arm, coupled with a rotary input of an exercising machine, and a hand-grip configured to be received within the palm of an operator's hand, and a latching mechanism for coupling a foot of an operator thereto.

These and other objects and advantages are achieved through the use of a force delivery arm coupled at its base with a rotary input shaft and having at its distal

end a normally related hand-grip configured to be received within the palm of a crewman's hand, and a restraining mechanism for releasably coupling the crewman's foot with the handle, as will become more readily apparent by reference to the following description and claims in light of the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a partially sectioned, fragmented view of an actuator, which embodies the principles of the instant invention illustrating a handle coupled with a force input arm and a restraining mechanism through which a foot of a crewman is coupled with the actuator.

FIG. **2** is a partially sectioned top plan view taken generally along line **2—2** of FIG. **1**, the crewman shoe and attached coupling mechanism being omitted for clarity.

FIG. **3** is a partial side elevation of the actuator.

FIG. **4** is a fragmented view, partially in phantom, illustrating locking means employed in supporting the restraining mechanism in an operative position relative to the handle.

FIG. **5** is a perspective view of the restraining mechanism through which a foot of the crewman operatively is coupled with the handle.

FIG. **6** is a cross-sectional view of the plates shown in FIG. **5**.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings wherein like reference characters designate like or corresponding parts throughout the several views, there is shown in FIG. **1** a partially sectioned view of an actuator, generally designated **10**, which embodies the principles of the instant invention.

While not shown, it is to be understood that the actuator **10** is coupled with an exercising machine, an ergometer or any similar device, through a rotary input shaft **12**. As a practical matter, the base of a force delivery arm **14** which includes a bore **16**, receives therein the shaft **12** and is affixed thereto by a suitable locking pin **18**. Since the particular manner in which the force delivery arm **14** is coupled with the shaft **12** is deemed a matter of convenience only, a detailed description of the coupling is omitted in the interest of brevity. However, it is to be understood that the base of the arm **14** is rigidly fixed to the input shaft **12** so that, in operation, the distal end thereof is caused to describe a circle concentric with the longitudinal axis of symmetry of the shaft **12**.

The distal end of the arm **14** also includes a bore, designated **20**. The longitudinal axis of the bore **20** is arranged in parallelism with the longitudinal axis of the bore **16** and is normally related to the longitudinal axis of symmetry of the arm **14**. Within the bore **20** there is seated, in fixed relationship, the base **21** of a stub shaft **22**. While the stub shaft **22** can be screw-threadedly received within the bore **20**, a locking pin **24** serves quite satisfactorily for fixedly coupling the stub shaft **22** with the arm **14**.

Supported for rotation about the stub shaft **22** there is a bracket **26**. This bracket is maintained in an operative position by a suitable lock-ring **28**, seated in an appropriately formed groove, and an annular thrust bearing **29**. A race **30** is seated in the bracket **26** and sup-

ports the bracket for rotation about the longitudinal axis of the stub shaft **22.**

The stub shaft **22** supports a concentrically related hand-grip, generally designated **32.** As a practical matter, the hand-grip **32** includes a sleeve **34** concentrically related to the stub shaft and supported by a pair of coaxially spaced bearings **36** which are, in turn, concentrically related to the opposite end portions of the sleeve **34.** About the sleeve **34** there is received a tubular portion of the hand-grip **32** formed of a suitable material and having an external surface particularly configured to be received within the hand of a crewman for facilitating a grasping of the handle.

Also supported by the bracket **26** is a grid **38** having formed therein an opening **40** of a triangular configuration. As a practical matter, the grid **38** includes a pair of legs **42** converging toward an apex **44** and extending from a common base **46.** The base **46,** as best shown in FIG. **2,** is provided with a pair of coaxially aligned reliefs **48** which serve to receive therein a pair of laterally spaced, coplanar legs **50.** These legs project from opposite ends of the bracket **26** and terminate in a coplanar relation with one surface of the base **46.**

The distal end portions of the legs **50** are provided with a pair of coaxially aligned bores **52** which receive therein pivot pins **54.** These pins extend into a pair of blind bores **56** coaxially aligned within the opposite ends of the base **46** of the grid **38.** Accordingly, it can be appreciated that the grid **38** is supported for pivotal rotation from a first position, as illustrated in FIG. **1** to a second position angularly related to the first position, as indicated in phantom in FIG. **1.**

In order to maintain the grid **38** in the first position, as illustrated in FIG. **1,** there is provided a latching mechanism generally designated **60.** This mechanism serves to engage the apex portion **44** of the grid **38** and retains the grid against pivotal displacement about the pins **54.**

The latching mechanism **60** includes an elongated body **62** having extended across one end face thereof a normally related latching member **64** of a cap-like configuration. The latching member **64** is of a disk-shaped configuration and includes an annular lip **65.** This lip serves to engage an adjacent surface of the apex portion **44** of the grid **38** for retaining the grid against pivotal displacement.

In practice, the latching member **64** is supported for axial displacement relative to the body **62** and is spring-biased toward the body by a compression spring **66** of a helical configuration. The spring **66** is seated in a concentric bore **68** which extends through the body **62.** The spring **66,** in turn, concentrically receives a pin **70** is maintained under compression between the head **71,** and the annular shoulder **72** formed within the bore **68.** The pin **70** extends through the bore **68** and is affixed to the central portion of the latching member **64** by a suitable lock-ring, also not designated. It should therefore readily be apparent that axial displacement of the latching member **64** away from the body **62** is opposed by the spring **66.**

In practice, the body **62** is pivotally supported for rotation about the distal end of the hand-grip **32** by a suitable clevis coupling, generally designated **73.** The clevis coupling **73** includes a pair of arms **74** having formed therein a pair of coaxially aligned, pin-receiving bores **76.** The bores **76** serve to receive a pin **78** which extends through the distal end of the sleeve **34,** FIG. **4.**

It will, therefore, be appreciated that the latching member **64** is supported for pivotal displacement from a first position wherein the body **62** is coaxially aligned with the hand-grip **32,** to a second position wherein the body **62** is orthogonally related with respect to the longitudinal axis of symmetry of the hand-grip. At the second position, the body **62** is in juxtaposition with the apex portion **44** of the grid **38** with the annular lip **65** extended into engaging relationship with the adjacent surface of the grid **38.**

The head **71** of the pin **70** also functions as a locking protuberance and is received within a detent **79** formed in the adjacent end surface of the sleeve **34,** when the body **62** is positioned in its first position. Thus the latching mechanism **60** is retained in coaxial alignment with the hand-grip **32** as a consequence of the seating of the head **71** within the detent **79.**

As a practical matter, the body **62** also is provided with a relief **80,** having a shoulder **81,** within which there is received the adjacent portion of the apex portion **44** of the grid **38.** The shoulder lends additional support to the grid **38** so that the grid is supported against pivotal displacement when it is received within the releif **80.** Furthermore, a lip **82** is extended from the apex portion **44** into locking engagement with the lip **65** of the latching member **64** in order to assure that a positive coupling between the latching mechanism **60** and the grid is achieved when the grid and the latching mechanism are brought into a coupling relationship.

As best shown in FIG. **4,** the apex portion **44** of the grid **38** also is provided with a spring-loaded ball **84** configured to be received within a detent **86** in a block **87** provided along the surface of the arm **14.** The block is positioned adjacent to the apex portion **44** of the grid **38** when the grid is in its second position, angularly displaced from it first position. Thus, the ball **84** and the detent **86** cooperatively serve as a coupling means for supporting the grid **38** against pivotal displacement toward the hand-grip **32** in order to support the grid in a stowed configuration when the actuator **10** is operated employing a hand.

It is important here to note that the grid **38** is selectively coupled with an operator's shoe **88** through a stack of latching plates, generally designated **90.** As a practical matter, the stack of plates **90** includes a pair of coupling plates **92** and **94** between which is sandwiched an aligning plate **96,** each being of a triangular configuration. The plates **92** and **94** are maintained in coincidence through a concentric shaft **98** extended therebetween, while the aligning plate **96** is free to rotate relative to the shaft **98.** The plate **94** is fixed to the sole of the shoe **88,** while the aligning plate **96** frictionally engages the shaft **98** in order that rotation of the aligning plate relative to the shaft **98** is, for practical reasons, inhibited by frictional forces.

It is to be understood that the plates **92** and **96** are configured to be received within the opening **40** of the grid **38,** while the plate **94** is dimensioned to engage the adjacent surface of the grid **38,** when the grid is supported at its first position by the latching mechanism **60.** However, the legs **42** are spaced from the adjacent surface of the hand-grip **32** a distance such that the plate **92** is afforded angular displacement for repositioning the adjacent apexes of the triangular plate **92** into misalignment with the opening **40** and into locking engagement with the adjacent surfaces of the legs **42** and base **46** of the grid **38,** FIG. **1.**

The thickness of the legs **42** and the base **46** is such that the aligning plate **96** is supported against rotation thereby as the plates **92** and **96** are rotated with respect to the grid. Since the plates **92** and **94** are maintained in a fixed mutual relationship, through the shaft **98**, it is to be understood that the shaft is supported by the shoe **88** of the crewman.

It will, of course, be appreciated that the plate **94** is affixed to the sole of the shoe **88** in any appropriate fashion. Therefore, a detailed description of the mounting of the plate **94** is omitted in the interest of brevity, particularly since the manner in which the stack of plates **90** is coupled with the shoe can be varied as found desirable.

It should, therefore, readily be apparent that the stack of plates **90** serves as a coupling means for uniting the shoe **88** with the grid **38** and that such a union can readily be effected simply by inserting the plates **92** and **96**, of the stack of plates **90**, into the opening **40** and thereafter angularly displacing the shoe **88** about an axis concentric with the longitudinal axis of the shaft **98**. A reversing displacement of the foot, of course, serves to effect disengagement of the shoe from the grid.

OPERATION

It is believed that in view of the foregoing description, the operation of the device will be readily understood and it will be briefly reviewed at this point.

It is to be understood that the actuator **10** is particularly suited for use with exercising machines, ergometers and the like particularly suited to be mounted aboard spacecraft and employed by the feet or the hands, depending upon which operation is preferred in exercising a crewman. Furthermore, it is intended that the actuator **10** serve as an input to the exercising machine, however, in the event the machine is a motorized machine it is entirely feasible to employ the actuator in a reverse mode so that the actuator **10**, in effect, becomes the output side for the machine.

In those instances wherein the actuator **10** is to be employed utilizing the hands of a crewman grasping the hand-grip **32**, the grid **38** is pivotally displaced to its second position wherein the ball **84** is seated within the detent **86** for supporting the grid **38** in angular displacement relative to the hand-grip **32**. With the grid **38** thus supported, the crewman merely grasps the hand-grip **32** and applies a rotating force about the longitudinal axis of the shaft **12** for delivering a rotating force to the shaft **12**.

In instances wherein it is desirable to couple a crewman's foot with the actuator **10**, the grid **38** is pivotally displaced into juxtaposition with the hand-grip **32** and the latching member **64** pivotally displaced into juxtaposition with the apex portion **44** of the grid. In this position, the adjacent apex portion **44** of the grid **38** is received within the relief **80** of the body **62** and the lip **65** is caused to engage the lip **82**. Thus, the grid is positively restrained against rotation about the pins **54**. The crewman now inserts the plates **92** and **96** of the stack of plates **90** within the opening **40**, within the grid **38**, and imparts rotation thereto for causing the plates **92** and **94** to rotate into a misaligned relation with the opening **40** for sandwiching adjacent portions of the legs **42** and the base **46** between their apex portions. Thus, the stack of plates **90** is positively united with the grid **38**. As a practical matter, rotation of approximately 12° is sufficient to establish the desired union between the stack of plates and the grid.

Of course, disassociation of the stack of plates from the grid **38** can be readily achieved simply by rotating the stack in an opposite direction for again aligning the plates with the opening **40** and thereafter extracting the plates therefrom.

In view of the foregoing, it should readily be apparent that the device of the instant invention provides a practical solution to the perplexing problem of providing a suitable mechanism for accommodating an exercise of crewmen aboard spacecraft during missions of extended duration.

Although the invention has been herein shown and described in what is conceived to be the most practical and preferred embodiment, it is recognized that departures may be made therefrom within the scope of the invention, which is not to be limited to the illustrative details disclosed.

We claim:

1. An actuator for a manually operable exercising machine adapted to be employed by a crewman confined aboard an operative spacecraft comprising:

A. a force delivery arm;

B. means for coupling the base of the force delivery arm with an exercising machine;

C. a force input handle including a shaft normally extended from the distal end of said arm and a hand-grip supported by said shaft configured to be received within the palm of a crewman's hand;

D. said shaft being concentrically related to said hand-grip;

E. bearing means supporting said hand-grip for rotation relative to said shaft;

F. a support bracket rotatably coupled to said shaft;

G. grid means pivotally coupled with said bracket, including means defining therein an opening of a preselected configuration, and supported for angular displacement between a first position adjacent to said hand-grip, and a second position angularly displaced from said first position;

H. latching means for restraining said grid means against angular displacement between said first and second positions;

I. locking means receivable in said opening for releasably uniting said grid means with a foot of the crewman.

2. The actuator of claim **1** wherein said latching means includes:

A. a spring-loaded projection supported for pivotal displacement from coaxial alignment with said shaft into an overlying relationship with said grid means when the grid means is in said first position; and

B. a spring-loaded protuberance projected from said grid means, and means defining a detent for receiving said spring-loaded protuberance when said grid is in said second position.

3. The actuator of claim **1** wherein the locking means includes a plurality of superimposed plates supported for mutual rotation, selected plates being configured to be received within said opening, and means for coupling said plates with a shoe worn upon the foot of the crewman.

4. The actuator of claim **2** wherein said opening and said plates are of a triangular configuration.

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