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Kongelbeck

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[54] **ACTUATOR AND LATCH**

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[73] Assignee: **The United States of America as represented by the Secretary of the Navy,** Washington, D.C.

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Related U.S. Application Data

[62] Division of Ser. No. 97,686, Dec. 14, 1970, Pat. No. 3,742,813.

[52] **U.S. Cl.** **92/10,** 92/27, 92/28, 16/51

[51] **Int. Cl.** **F15b 15/22**

[58] **Field of Search** 92/8, 10, 12, 85, 15, 23, 92/27, 28; 16/51, 52

[56] **References Cited**

UNITED STATES PATENTS

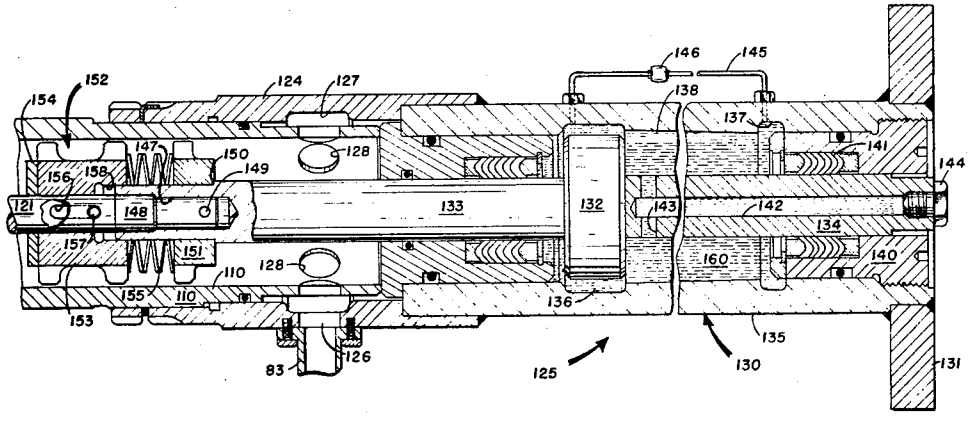
2,181,562	11/1939	De Ganahl et al.	92/27 X
2,342,812	2/1944	Matinson	92/27 X
2,821,172	1/1958	Randall	92/10 X
3,063,424	11/1962	Kutsche	92/27 X
3,143,181	8/1964	Bays et al.	92/85 X
3,193,988	7/1965	Kudlaty	92/8 X
3,398,651	8/1968	Folmer	92/27
3,431,985	3/1969	Bowen	92/85 X

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[57] **ABSTRACT**

The invention relates to actuator mechanisms and particularly provides a shock-absorbing actuator apparatus comprised of an actuator piston buffered by both a mechanical buffer and a hydraulic buffer, the mechanical buffer being comprised of stacked Belleville washers, a driven element carried on a buffer piston rod, and a driving element carried on a buffer rod, the structure acting to cushion the movement of an actuator piston.

5 Claims, 2 Drawing Figures



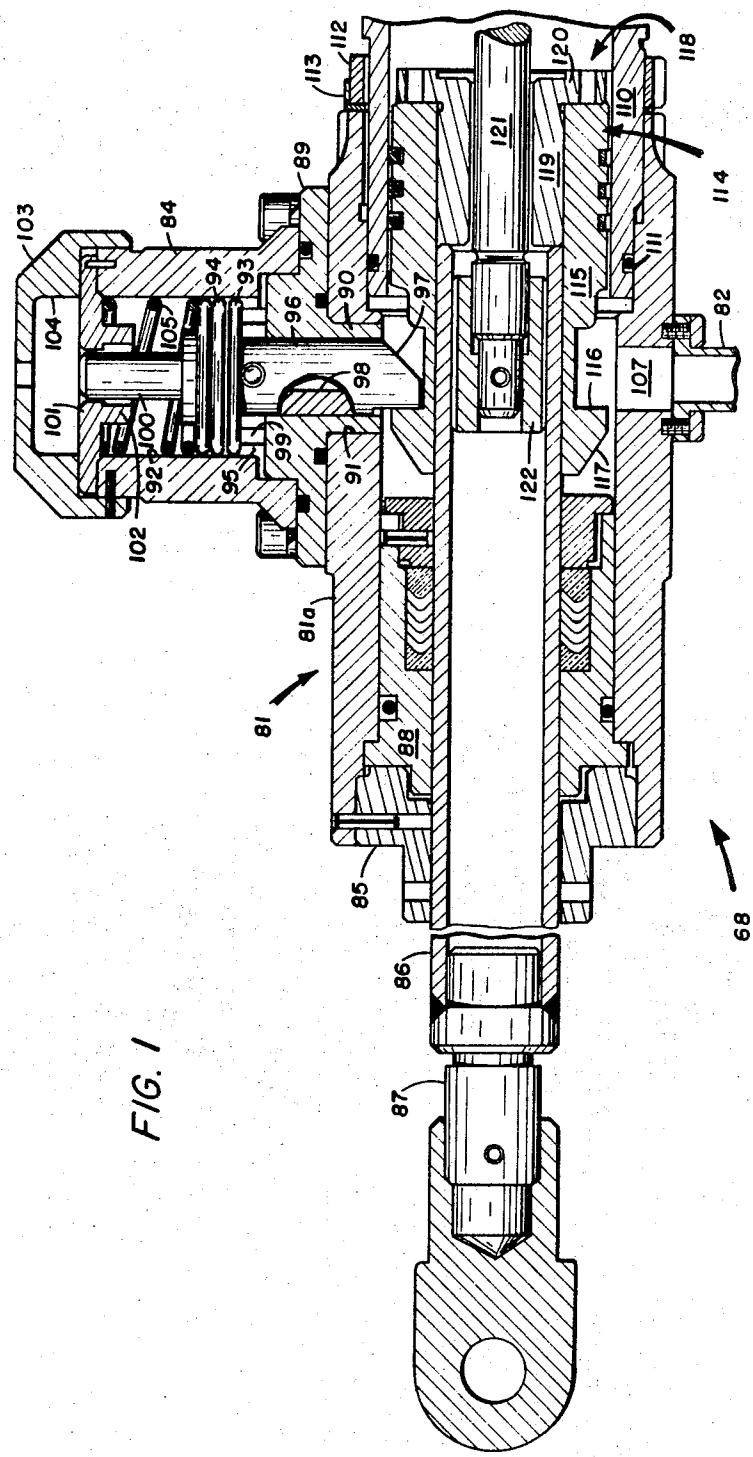

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FIG. 1

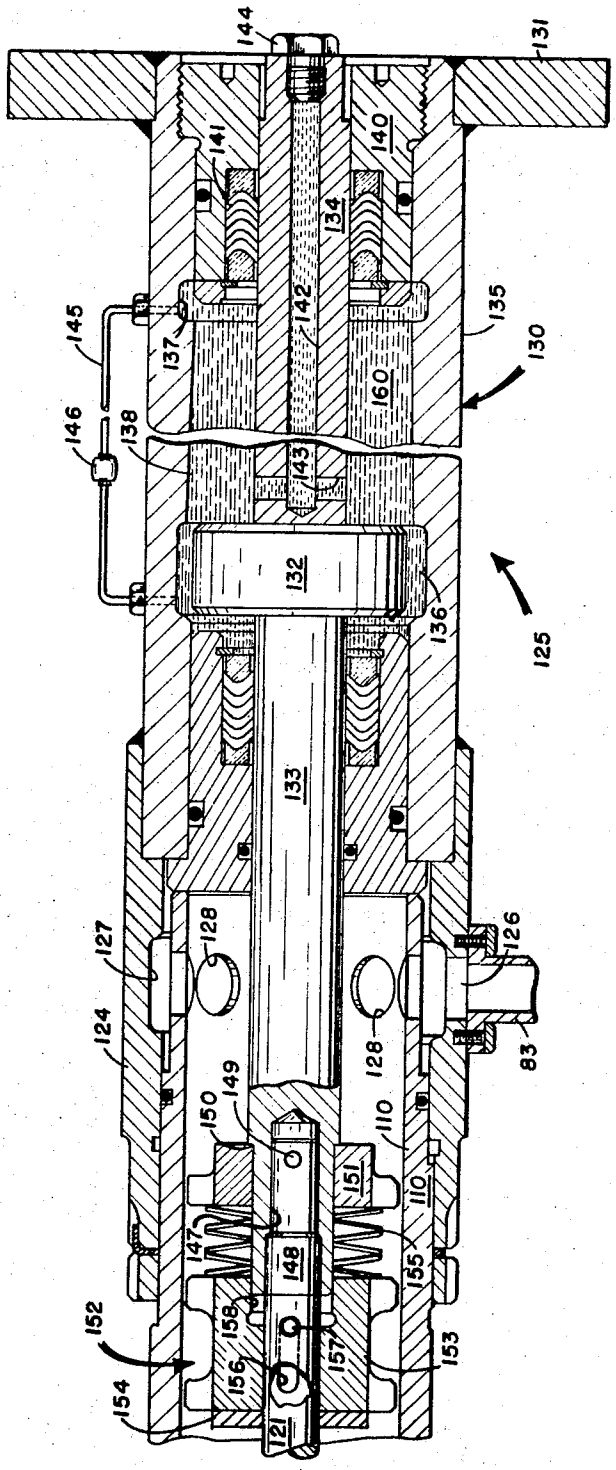

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FIG. 2

ACTUATOR AND LATCH

CROSS-REFERENCE TO RELATED APPLICATION

This is a division of application Ser. No. 97,686, filed on Dec. 14, 1970, now U.S. Pat. No. 3,742,813.

BACKGROUND AND SUMMARY OF THE INVENTION

The invention relates to actuator mechanisms and particularly comprises a shock-absorbing actuator apparatus comprised of an actuator piston buffered by both a mechanical buffer and a hydraulic buffer. The mechanical buffer consists of stacked Belleville washers, a driven element carried on a buffer piston rod, and a driving element carried on a buffer rod, the present structure acting to cushion the movement of an actuator piston.

Accordingly, it is an object of the invention to provide a shock-absorbing actuator apparatus having dual buffering capability for cushioning the movement of an actuator piston within the apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an enlarged detail section showing the forward portion of the present actuator apparatus; and,

FIG. 2 is an enlarged detail section showing the aft portion of the present actuator apparatus.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring particularly to FIG. 1, the actuator **68** includes a latch **81** having a cylindrical wall **81***a* to which is attached a latch housing **84.** The wall **81***a* is closed at its forward end by an end wall **85** which is apertured to receive a hollow piston rod **86,** the rod **86** having a fitting **87** for connection to structure (not shown) to be displaced by the rod **86.** A packing gland **88** surrounds the piston rod **86** within the forward portion of the latch **81.**

The latch housing **84** includes a base **89** which has a sleeve **90** that extends through an opening **91** in the wall **81***a,* and a cylinder **92** in which is mounted a piston **93.** The piston **93** is mounted for sliding movement in the cylinder **92** and is sealed against leakage by an O-ring **94,** the inner piston wall, the wall of the cylinder **92** and the outer wall of the sleeve **90** defining an air chamber **95.**

Mounted on the inner wall of the piston **93** is a latch bolt **96** which has a beveled inner end face **97,** and an axial bore **98** that communicates between the chamber **95** and the interior of the latch **81.** Stops **99** are formed on the inner surface of the piston **93** at each side of the latch bolt and are engageable with the base **89** for limiting inward travel of said bolt. The piston **93** has a stem **100** which extends outwardly within the latch housing **84** axially thereof and has its outer end portion slidable in an opening in an end wall **101,** said end wall having a guide flange **102** surrounding said opening. A cap **103** clamps the end wall **101** in place and is formed with a recess **104** to receive the outer end of the stem when the latch bolt is in retracted position, as will be described hereinafter. A coil spring **105** surrounds the stem **100** within the outer portion of the latch housing and between the end wall **101** and the outer surface of the piston **93** and urges said piston inwardly. Formed

in the wall **81***a* of the latch opposite the bolt **96** is a service opening **107** to which is connected the high pressure air line **82** to admit or discharge high pressure air.

The actuator **68** has a main cylinder **110** which is connected to the aft end portion of the latch **81.** More specifically, the forward end portion of the main cylinder is reduced in diameter and the aft end portion of the wall **81***a* of the latch is recessed so that said cylinder and latch may be fitted tightly together. An O-ring **111** and suitable lock nut and washer, **112** and **113,** respectively, are used to assure a tightly sealed connection.

Mounted for sliding movement in the main cylinder **110** and connected to the aft end of the piston rod **86** is a main actuator piston **114.** The main actuator piston **114** is formed with a reduced forward end portion **115** which defines a shoulder **116,** for engagement with a straight side wall of the latch bolt **96,** and a tapered forward end **117** for engagement with the tapered end wall **97** of said bolt, as will be described hereinafter.

The actuator piston **114** is hollow throughout its length and has a striker **118** mounted in its aft end, said striker comprising a hollow sleeve **119** and a flange **120,** the latter substantially covering the aft end of the piston. As best seen in FIG. **2,** the piston **114** receives the forward end portion of a buffer rod **121,** said buffer rod extending through the sleeve **119** and into the hollow piston rod **86.** A head **122** is fixed to the forward end portion of the buffer rod **121** and is engageable with the forward end of the striker sleeve **119** during a portion of the travel of the main actuator piston **114.**

The aft end portion of the main cylinder **110** is reduced to fit tightly into a coupling sleeve **124** which serves to connect a hydraulic buffer unit **125** to said cylinder. As best seen in FIG. **2,** the coupling sleeve **124** has a service port **126** to which is connected one end of the air line **83,** that portion of the wall of the sleeve which is adjacent the service port being reduced in thickness to define an annular manifold **127** that communicates with the interior of the main cylinder **110** near its lower end through openings **128** which are arranged in an annular series.

The hydraulic buffer unit **125** includes a cylindrical buffer body **130** to the aft end of which is secured a mounting plate **131.** Mounted in the body **130** is a buffer piston **132** which has a piston rod **133** and a stem **134.** The forward end of the body **130** is secured to the aft end of the coupling sleeve **124,** said body being provided with a wall **135** having a relatively wide annular sump **136** substantially medially of the body and a relatively narrow annular sump **137** near its aft end. Between the sumps the wall **135** is gradually increased in thickness, toward the aft end of the body **130,** to define a tapered section **138** and a chamber within said tapered section.

The aft end of the buffer unit **125** has a plug **140** mounted therein, the plug being screwed into position, being apertured to receive the stem **134** therethrough, and having packing **141** surrounding said stem. As will be seen in FIGS. **1** and **2,** the stem **134** has an axial bore **142** and ports **143** which communicate between the chamber **139** and the exterior of the buffer unit **125** at its aft end. The bore **142** and ports **143** permit the introduction of hydraulic fluid to the interior of the chamber within the tapered section **138.** A cap **144** closes the bore **142** at its aft end, and a by-pass **145,**

having a check valve **146**, extends between the sumps **136** and **137**.

A buffer piston rod **133** is of larger diameter than the buffer rod **121** and is provided with a stepped in diameter socket **147** which receives a stepped in diameter aft end portion **148** of said rod **121**. A pin **149** connects the two rods **121** and **133**. The forward end portion of the piston rod **133** is reduced in diameter to define a shoulder **150**, and surrounding said reduced portion and bearing against said shoulder is the driven element **151** of a primary buffer **152**. The buffer **152** includes, in addition to the driven element **151**, a driving element **153**, a cushioning disk **154** on the forward end of the driving element, and a plurality of stacked "Belleville" springs **155**. The cushioning disk **154** is of relatively soft material, such as "Teflon". The driving element **153** is slidable on the aft end portion of the buffer rod **121** and has a longitudinally extending slot **156** which receives a coupling pin **157** on said buffer rod. The slot and pin arrangement permits limited movement between the buffer rod **121** and the driven element **153**. A recess **158** in the aft end of the driving element **153** slidably receives the forwardmost portion of the buffer piston rod **133**.

The operation of the actuator **68** will now be described. Air under pressure is admitted to the interior of the latch **81** from the line **82** through the service opening **107**. This high pressure air will pass through the bore **98** in the latch bolt **96** into the chamber **95** and will act on the piston **93** for forcing it outwardly in the cylinder **92** against the compression of the coil spring **105**. This piston movement will withdraw the bolt from behind the shoulder **116**, thus allowing the actuator piston **114** to move in the main cylinder **110**.

The high pressure air that operates the latch **81**, as above described, also, and upon release of the latch, moves the main actuator piston **114** aft in the main cylinder **110**, and about the buffer rod **121**, for moving that structure (not shown) which is attached thereto.

Under normal operating conditions, with air at 250 psi acting on the main actuator piston **114**, considerable shock is experienced and is buffered by the buffer unit **125** (FIG. 2). More specifically, when the piston **114** approaches the aft end of its travel, the striker **118** thereon engages the driving element **153** of the primary buffer **152** and moves it toward the driven element **151**, against the compression of the Belleville spring **155**. The driven element **151**, acting against the shoulder **150**, moves the buffer piston rod **133** and the buffer rod **121**, which is secured thereto, in an aft direction, within the limit of travel imposed by the coupling pin **157** in the slot **156**, for moving the buffer piston **132** aft in the tapered section **138** of the buffer unit **125**. Movement of the buffer piston **132** will cause hydraulic fluid, shown at **160**, to flow about said piston and into the forward end of the buffer unit, the tapered section **138** acting on the piston, which is of uniform diameter, to provide progressively increasing restriction of the hydraulic fluid flow to enhance buffering action.

What is claimed is:

1. A shock-absorbing actuator apparatus comprising:

an actuator body having a central longitudinal chamber formed therein;

a hollow piston rod disposed within the central chamber of the actuator body and slidably movable longitudinally therein, the piston rod at a first end thereof extending externally of the actuator body and being connected to an object which is to be displaced on operation of the actuator apparatus;

an actuator piston disposed within the central chamber of the actuator body and having a centrally disposed longitudinal aperture therein, a second end of the piston rod being fixedly received within a first end of the aperture, the piston having a reduced forward end portion defining a shoulder and a tapered forward end defining a camming surface;

striker means carried by the actuator piston at a second end thereof opposite said first end;

a buffer rod disposed within the central chamber of the actuator body, a first end of the buffer rod extending through the aperture in the actuator piston at a second end of the actuator piston and being extendible into the hollow piston rod on movement of said piston rod toward the buffer rod;

latch means having a bolt engageable with the shoulder on the actuator piston, said bolt being displaceable from the shoulder by a fluid under pressure to permit movement of the actuator piston in the actuator body, the fluid acting also to displace the actuator piston; buffer means for cushioning movement of the actuator piston on movement thereof toward the second end of the actuator body, said buffer means including a primary buffer and a secondary buffer, the primary buffer comprising,

a buffer piston rod connected to the aforementioned buffer rod and axially aligned therewith,

a driven element on the buffer piston rod,

a driving element mounted for limited sliding movement on the buffer rod and on the buffer piston rod, and

spring means between the driving element and the driven element; and

means for introducing fluid under pressure into the actuator body to operate the latch means and to displace the actuator piston within the actuator body.

2. The apparatus of claim **1** wherein the latch means further comprises:

a latch housing having a cylinder therein;

a latch piston in the cylinder and mounting the bolt; and, a base for said latch housing, said base and said piston defining a fluid chamber and said bolt having a bore communicating between the interior of the latch housing and said fluid chamber, the fluid introduced into the actuator body flowing through said bore into said fluid chamber for displacing the bolt from said shoulder for releasing the actuator piston.

3. The apparatus of claim **1** wherein said spring means comprise a plurality of stacked Belleville washers.

4. The apparatus of claim **1** wherein the secondary buffer comprises:

a buffer body joined to the actuator body and having a wall formed with a sump, said wall being tapered in thickness toward one end; and,

a buffer piston on the buffer piston rod and movable therewith in the buffer body toward said tapered wall for displacing a fluid in said buffer body about said piston and through said sump, whereby the

movement of said buffer piston and buffer piston rod is buffered.

5. The apparatus of claim 4 wherein the spring means of the primary buffer comprises a plurality of stacked Belleville washers, the washers of at least one pair of said washers being positioned with their concave surfaces in opposed relation.

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