July 9, 1963 L. D. PETERSON ETAL 3,096,957

BALLISTIC ROTARY ACTUATOR

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Fig. 1

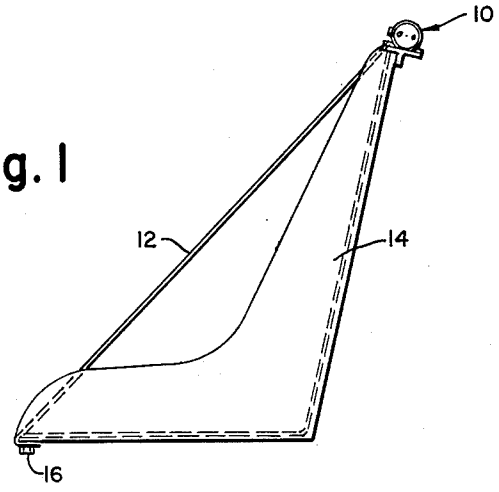
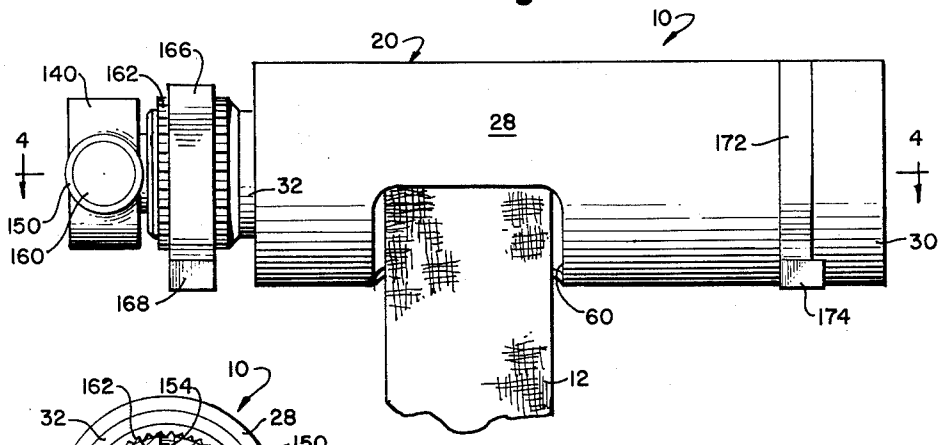


Fig. 2



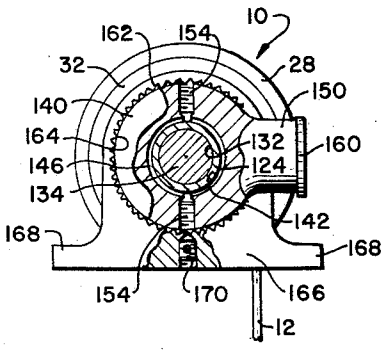


Fig. 3

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Fig. 4

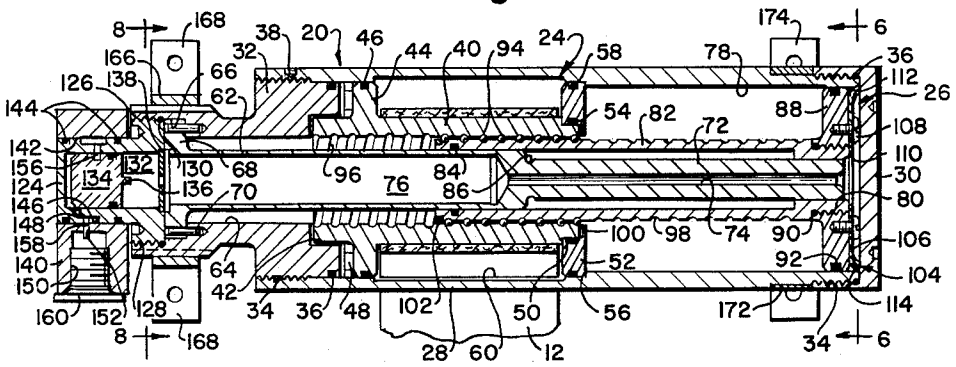
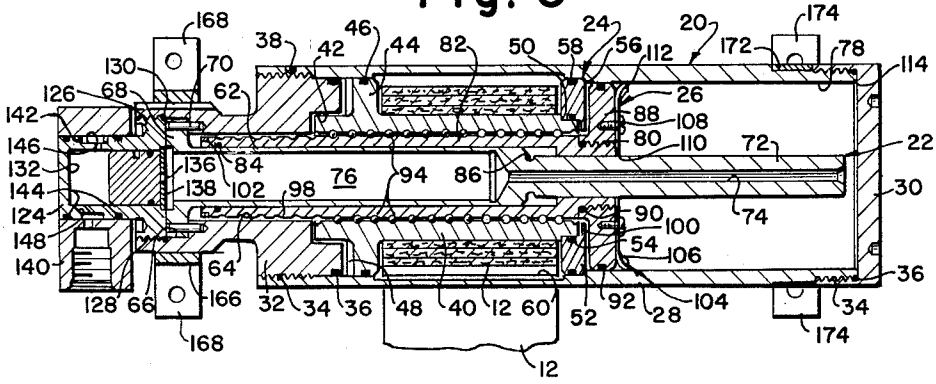


Fig. 5



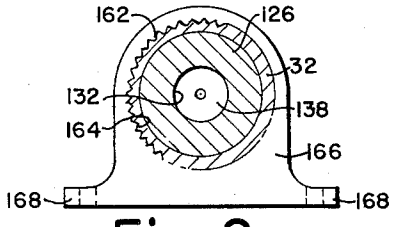


Fig. 8

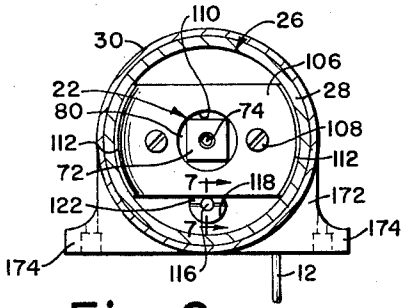


Fig. 6

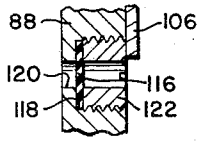


Fig. 7

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BALLISTIC ROTARY ACTUATOR

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Filed Nov. 3, 1960, Ser. No. 89,591
8 Claims. (Cl. 244—122)

This invention relates to safety devices for aircraft and more particularly to improvements in ballistic rotary actuators of the type adapted to rapidly reel in an elongated flexible element or strap associated with a catapult ejection seat of the aircraft to effect separation of the pilot from the seat after ejection.

While the present invention has general applicability to rotary actuators arranged to reel in a flexible element in response to the ignition of a ballistic charge for any purpose, the embodiment as disclosed is particularly suited for reeling in a normally loose strap positioned between an aircraft seat and the pilot so as to be retracted into a taut condition and thus effect separation between the seat and the pilot during the ejection procedure. This general mode of man-seat separation is known in the prior art and there have been proposed ballistic rotary actuators for effecting the rapid reeling in of the strap to a taut condition to effect man-seat separation. However, these proposals have not proven entirely satisfactory.

Accordingly, an object of the present invention is the provision of a ballistic rotary actuator having improved means mounted in the reel housing for receiving a ballistic charge and communicating the gases under pressure created as a result of the ignition of the ballistic charge to the reel, so as to rapidly rotate the latter in response to such ignition.

Another object of the present invention is the provision of a ballistic rotary actuator of the type described having improved means therein for preventing the application of reeling in loads to the pilot in excess of those which he is capable of withstanding.

Still another object of the present invention is the provision of a ballistic rotary actuator of the type described having improved means for retaining the reel in its normal inflight position except in response to the ignition of the ballistic charge.

Still another object of the present invention is the provision of a ballistic rotary actuator having improved mounting means thereon which is universally adjustable to accommodate various seat arrangements.

Still another object of the present invention is the provision of a ballistic rotary actuator of the type described which is simple in construction, embodied in a minimum envelope, efficient in operation, and economical to manufacture.

These and other objects of the present invention will become more apparent during the course of the following detailed description and appended claims.

The invention may best be understood with reference to the accompanying drawings wherein an illustrative embodiment is shown.

In the drawings:

FIGURE 1 is a side elevational view schematically illustrating an aircraft seat of conventional design having a ballistic rotary actuator embodying the principles of the present invention mounted thereon and a separation strap operatively connected with the seat and the rotary actuator, the strap being shown in dotted lines in its normal inflight position prior to man-seat separation and in solid lines in the position assumed after man and seat have been separated during ejection;

FIGURE 2 is a side elevational view of the rotary actuator;

FIGURE 3 is an end view of the actuator with certain parts broken away for purposes of clearer illustration;

FIGURE 4 is a cross-sectional view taken along the line 4—4 of FIGURE 2, showing the reel and associated parts in their initial position prior to ignition of the ballistic charge;

FIGURE 5 is a view similar to FIGURE 4 showing the reel and associated parts in the position assumed after the ignition of the charge;

FIGURE 6 is a cross-sectional view taken along line 6—6 of FIGURE 4;

FIGURE 7 is an enlarged fragmentary cross-sectional view taken along the line 7—7 of FIGURE 6; and

FIGURE 8 is a cross-sectional view taken along the line 8—8 of FIGURE 4.

Referring now more particularly to the drawings, there is shown in FIGURE 1 a ballistic rotary actuator, generally indicated at **10**, embodying the principles of the present invention, having a separation strap **12** operatively connected therewith, the strap and actuator being mounted in operative relation with respect to an aircraft seat **14**. It will be understood that during normal flight, the rotary actuator **10** is mounted on the back of the pilot seat **14** and the strap **12** is extended to the front of the seat so that it lays between the seat and the pilot. The strap assembly extends from the pilot's shoulders, down his back and beneath his legs, where it is attached to the forward edge of the seat pan, as indicated at **16**. It will be understood that the ballistic rotary actuator **10** is arranged to be incorporated in the entire ejection equipment of the airplane so that it will be ignited or initiated at a predetermined time after the seat has been ejected from the plane. When the ballistic rotary actuator is ignited it serves to rapidly reel in the strap **12** and pull it taut between the actuator and the attachment point **16**. This in effect forms a right triangle in which the strap is the hypotenuse and the seat back and pan are the two legs. The pilot is thus positively and forcibly separated from the seat.

Referring now more particularly to FIGURES 2–8, the rotary actuator **10** comprises a housing, generally indicated at **20**, having mounted in the central interior thereof a ballistic charge receiving assembly, generally indicated at **22**. Journaled within the housing is a reel assembly, generally indicated at **24**, which is arranged to have fixedly secured thereto one end of the strap **12**. As previously indicated, in the normal inflight condition, a maximum length of the strap is unwound or paid out from the reel assembly **24** and the rotary actuator **10** includes a pressure responsive motion transmitting assembly, generally indicated at **26**, for effecting a rapid reeling in movement of the reel assembly **24** in response to the ignition of a ballistic cartridge within the charge receiving assembly **22**.

The housing **20** comprises a main cylindrical housing member **28** having one end thereof reduced and exteriorly threaded to receive the interiorly threaded annular skirt of an end closure housing membre **30**. The opposite end of the cylindrical housing member **28** is interiorly threaded to receive a head member **32**. Preferably, the threaded connections of the cylindrical housing member **20** with the end closure **30** and the head member **32** are provided with plastic pellets **34** which serve to aid in retaining the threads in engagement in a manner well-known in the art. In addition, each connection is also provided with suitable fluid tight sealing means as, for example, O-ring seals **36**. As an added safety measure it is preferable to provide a set screw **38** in the adjacent end of the cylindrical housing member **20** for engaging the cooperating periphery of the head members **32**.

The reel assembly **24** comprises a central hollow hub portion **40**, one end of which engages within an annular recess **42** formed in the adjacent end of the head member **32**. Extending outwardly from the hub portion **40** ad-

jacent the end thereof mentioned above is an annular flange **44**, the outer periphery of which is sealingly engaged with the adjacent interior periphery of the cylindrical housing member **20**, as by O-ring seal **46**. Mounted between the flange **44** and the adjacent opposed surface of the head member **32** is a roller bearing assembly **48** which serves to journal the reel assembly within the housing rotationally and to resist thrust forces imposed upon the reel assembly in a direction toward the head member **32**.

The opposite end of the hub portion **40** of the reel assembly is provided with an annular groove **50** for receiving the inner periphery of a mounting ring **52**. Preferably, an O-ring seal **54** is provided in the interior periphery of the mounting ring for engaging the cooperating surface of the adjacent end of the hub portion **40**. The outer periphery of the mounting ring engages within a relieved portion of the interior periphery of the cylindrical housing member **20**, which relieved portion provides a shoulder **56** which faces in a direction opposed to the shoulder formed by the recess **50** and thus serves to maintain the mounting ring in proper position. Again, an O-ring seal **58** is preferably formed in the retaining ring for engaging the adjacent interior surface of the cylindrical housing member **28**. It will be understood that the outer periphery of the hub portion **40** is suitably constructed so as to fixedly receive one end of the strap **12**, the latter extending outwardly from the reel assembly through an opening **60** formed in the cylindrical housing member **28**, as best shown in FIGURE 2.

The charge receiving assembly **22** comprises a tubular member **62** which extends centrally into the housing member **28** though a central bore or opening **64** formed in the head member **32** and through the hollow hub portion **40** of the reel assembly. The head member **32** includes a portion extending outwardly from the adjacent end of the cylindrical housing member **28** and has a counterbore or recess **66** formed therein which receives a radially-extending flange **68** formed on the adjacent end of the tubular member **62**. The flange is mounted within the counterbore **66** in fixed rotational relation with respect to the head member **32**, by any suitable means, such as a plurality of circumferentially spaced dowel pins **70** extending longitudinally through registering openings in the flange and the adjacent portion of the head member.

The opposite end of the tubular member **62** has integrally formed therein an elongated portion **72** which has a reduced angularly formed or splined exterior periphery in cross-section and, as shown in FIGURE 6, is of square cross-sectional configuration. The elongated portion **72** has a central passage **74** formed therein which communicates the interior of the tubular member **62**, which defines a ballistic charge or cartridge receiving chamber **76**, with a cylindrical pressure chamber **78** defined by the adjacent end of he cylindrical housing member **28** and the end closure **30**.

The elongated portion **72** of square cross-section forms a part of the pressure-responsive motion transmitting assembly **26** and is arranged to slidably receive a corresponding interiorly apertured end portion **80** of an intermediate tubular member **82**. The member **82** is thus movable longitudinally within the housing **20** within the hub portion **40** of the reel assembly in telescoping relation to the tubular member **62** of the charge receiving assembly **22**. Rotational movement of the intermediate tubular member **82** during this longitudinal movement is prevented due to the angular registry between the interior periphery of the end portion **80** and the exterior periphery of the elongated portion **72** and the interengagement of the dowel pins **70** between the flange **68** and the head member **32**. Preferably, an O-ring seal **84** is provided in the end of the intermediate tubular member **82** opposite from the end portion **80** for engaging the exterior periphery of the charge receiving tubular member **62**. It will be noted that a load limiting groove **86** is formed in the outer periphery of the tubular member **62** at the inner end of the elongated portion **72** thereof which will result in a torsional shearing off of the elongated member in the event that excessive torsional forces are applied to the intermediate tubular member **18** during its longitudinal movement in a direction toward the head member **32**.

The outer extremity of the end portion **80** is exteriorly threaded to receive a piston or piston-like member **88** having its interior periphery sealed with respect to the end portion **80**, as by an O-ring seal **90**, and its outer periphery provided with an O-ring seal **92** for engaging the adjacent portion of the interior periphery of the cylindrical housing member **28**. It can be seen that the piston **88** will be moved in a direction toward the head member **32** together with the intermediate tubular member **82**, which constitutes in effect a hollow piston rod, in response to gas pressure within the chamber **78**.

Means is provided between the tubular member **82** and the hub portion **40** of the reel assembly for effecting a rotational movement of the reel assembly **24** is response to longitudinal movement of the intermediate tubular member **82**. As best shown in FIGURES 4 and 5, this means preferably comprises a multiplicity of balls **94** of hard material arranged to roll in cooperating helical grooves **96** and **98** formed in the interior periphery of the hub portion **40** and the exterior periphery of the intermediate tubular member **82** respectively. The balls **94** are retained within the interior helical grooves **96** of the hub portion at one end by the shoulder provided by the annular groove **42** formed in the head member **32** and at its other end by an inwardly extending radial flange **100** formed on the mounting ring **52**. A retaining ring **102** is mounted on the end of the tubular member **82** opposite from the piston **88** to prevent movement of the balls outwardly of one end of the annular grooves **98**, the opposite ends of which terminate short of the end portion **80**, thus preventing movement of the balls from the opposite ends of the helical grooves **98**.

As indicated above, in the normal inflight condition, the strap **12** will have a maximum length unwound or paid out from the reel assembly **24** and with the reel assembly in this position, the piston **88** will be disposed in its extreme outer position, as shown in FIGURE 4. In order to prevent reeling in movement of the reel assembly except under charge igniting conditions, there is provided a locking means, generally indicated at **104**, for retaining the reel assembly in the position shown in FIGURE 4. As shown, the locking means **104** comprises a plate **106**, preferably of spring metal, fixedly secured, as by bolts **108**, to the outer surface of the piston **88**. The plate **106** has a central opening **110** formed therein for receiving the elongated portion **72** and opposed opposite edges of the plate are turned outwardly, as indicated at **112**, for engaging within an annular recess **114** formed in the interior periphery of the cylindrical housing member **28** at its outer extremity.

Preferably, an additional overload preventing safety device in the form of a rupturable disk **116** is provided in the piston **88** to prevent rotation of the reel assembly where excessive loads would be applied thereto. As best shown in FIGURE 7, the rupturable disk **116** is disposed within a recess **118** formed within the piston **88**, the disk normally covering a concentric vent opening **120** formed in the piston in communication with the recess. The ruptured disk **116** is retained within the recess by a hollow plug **122** or the like threadedly engaged within the recess **118**.

It will be understood that suitable means is provided in the actuator **10** for igniting the ballistic cartridge or charge disposed within the chamber **76**. To this end, a cylindrical member **124** is disposed adjacent the flanged end of the chamber defining tubular member **62**, such member **124** having a radially outwardly extending flange **126** formed on one end thereof for threaded engagement within the counterbore **66** in abutting relation to the

flange 68. As before, a plastic pellet 128 may be provided in one of the members to engage the threads of the other and an O-ring seal 130 is mounted in sealing relation between the two members.

Formed within the cylinder member 124 is a cylindrical chamber 132 within which a firing pin in the form of an O-ring seal containing piston 134 is slidably mounted. The piston 134 has a projection 136 extending from the surface thereof facing in the direction of the chamber 76 for engaging the ballistic cartridge or charge to ignite the same. Preferably, a centrally apertured resilient pad 138 is mounted in the end of the cylindrical chamber 132 to receive the piston and permit the projection to engage through the central aperture thereof.

The firing pin 134 is arranged to move into igniting engagement with the ballistic charge by the application of suitable fluid pressure thereto in accordance with the usual practice employed in emergency ejection aircraft equipment. Such air pressure is transmitted to the chamber 132 through a rotary fitting 140. The fitting includes a cylindrical bore 142 which receives the cylinder member 124, the latter having a pair of spaced O-rings 144 formed therein for engaging the bore 142. Formed in the outer periphery of the cylinder member 124 between the O-ring seals 144 is an annular groove 146 which communicates with the outer end of the chamber 132 by means of a diagonally extending inlet passage 148. The fitting 140 also includes a radially extending socket portion 105 having an inlet opening 152 formed therein which is arranged to communicate with the annular groove 146 when the fitting is disposed in operative position on the cylinder member 124. The fitting is retained in operative position on the cylinder member 124 for rotary movement with respect thereto by any suitable means, such as set screws 154 extending therethrough and into the annular groove 146, as shown in FIGURE 3.

As best shown in FIGURE 4 a shear pin 156 extends through the cylinder member 124 into the piston 134 so as to retain the same in proper cocked position. As a safety measure in shipment, a pin 158 is disposed within the inlet opening 152 and a plug 160 is threadedly engaged within the socket portion 150.

In conjunction with the universal adaptability provided by the rotary fitting 140, the actuator 10 of the present invention is provided with mounting means which render the device universally applicable for attachment to various seat constructions. To this end, the outer periphery of the outwardly extending portion of the head member 32 is provided with a series of longitudinally extending serrations 162 arranged to receive corresponding serrations 164 formed on the interior periphery of a ring shaped mounting block 166. The mounting block includes a base having opposed apertured lugs 168 formed thereon, the central portion of the base having an interiorly threaded bore extending therethrough to receive a set screw 170 (see FIGURE 3) arranged to engage the serrations 162 and retain the mounting block 166 in any desired position of longitudinal adjustment along the serrations 162. Mounted in surrounding relation with respect to the reduced end of the cylindrical housing member 28 adjacent the end closure 30 is a ring-shaped mounting block 172 having a base provided with opposed apertured lugs 174.

It can be seen that the mounting block 166 provides for longitudinal adjustment with respect to mounting block 172 through the operation of the set screw 170. In addition, the interengagement of the serrations 162 and 164 permit the mounting block 166 to be mounted in any one of a multiplicity of relative rotational positions with respect to the housing 20. The mounting block 172 may be conveniently adjusted to correspond with the mounting block 166 merely by rotating the same into alignment.

Operation

The actuator 10 is secured to the upper portion of the back of the pilot seat by the mounting blocks 166 and 172. As noted above, the mounting block 162 can be adjusted into various positions of longitudinal movement with respect to the mounting block to accommodate seats of different construction. Moreover, both mounting blocks are such that the housing can be carried in any desired position of rotational adjustment with respect thereto. In addition, the fitting 140 enables the present actuator to be connected with the pressure actuating system of the ejection equipment in the most convenient position of rotational adjustment.

In the normal inflight condition plug 160 is removed and the socket 150 is connected to the pressure actuating equipment. Of course, safety pin 158 is also removed. The shear pin 156 is such that the firing pin will not be actuated except when a pressure above a predetermined amount is applied to the chamber 132. For example, the shear pin 156 is such that the unit will not fire when 400 p.s.i. or less is applied, but will always fire when 500 p.s.i. is applied to the chamber. Upon the application of such pressure to the chamber 132, the firing pin is moved rapidly into engagement with the ballistic charge or cartridge carried in the chamber 76 to fire the same by the engagement of the projection 136 therewith in accordance with conventional practice to ignite or fire the charge.

As previously indicated, the reel assembly 24 and the pressure actuated motion transmitting assembly 26 are disposed in the position shown in FIGURE 4 wherein the locking assembly 104 retains the piston against movement in a direction toward the head member 32 and hence rotation of the reel assembly in a direction to reel in the strap 12 until a predetermined force is applied to the piston. For example, the locking assembly is such that the piston will not move unless a pressure of 350 p.s.i. is developed within the chamber 78. Of course, when the charge within the chamber 76 is initiated, gas pressures will be produced which communicate through passage 74 to the chamber 78. This pressure will be sufficient to effect a rapid movement of the piston to the position shown in FIGURE 5. During this movement the balls 94 riding in the cooperating helical grooves 96 and 98 serve to effect a corresponding rapid rotational movement of the reel assembly in a direction to wind up the strap 12 thereabout.

As indicated, in the application of the present actuator disclosed in FIGURE 1, this rapid winding movement will bring the strap 12 to a taut condition and thus effect separation of the pilot from the seat during ejection. In this application, the system should be capable of ejecting a mass of between 100 and 400 pounds at a maximum acceleration imparted to the hundred pound mass of less than 7 *g*'s. A strap retraction of approximately 14 to 16 inches is capable of meeting these qualifications.

It will be noted that there are two safety features embodied in the actuator which would prevent such acceleration from exceeding the permissible maximum. First, it will be noted that during the longitudinal movement of the piston 88 there will be considerable torque force transmitted thereto, which torque force is resisted by the elongated portion 72, due to the helical groove and ball connection between the member 82 and hub portion 40. If this torque force is greater than the maximum permissive load, the portion 72 will shear under the torsion load along the load limiting groove 86. Second, in the event that the actuator is prevented from retracting the strap and the load limiting groove can not function, propellant gases within the chamber 78 will rupture the disk 116, thus sending these gases into the main buffer chamber of the housing. The load limiting groove is set to fail, for example, at a maximum strap load of 1700 pounds, whereas the disk will rupture at a pressure which is equivalent

to a strap load of approximately 2,000 pounds. The disk thus allows the pressure in the housing to be mounted below the maximum designed pressure of the actuator. Consequently, there will be no failure of any components of the unit other than the ruptured disk.

It will be understood that while the rotary actuator 10 of the present invention has been disclosed as being operable to reel in a strap associated with a pilot seat to effect man-seat separation, the rotary actuator 10 of the present invention may be readily employed in other combinations. Moreover, the structural features of the rotary actuator may be readily embodied in other types of reels such a harness inertia reels and the like.

It thus will be seen that the objects of this invention have been fully and effectively accomplished. It will be realized, however, that the foregoing specific embodiment has been shown and described only for the purpose of illustrating the principles of this invention and is subject to extensive change without departure from such principles. Therefore, this invention includes all modifications encompassed within the spirit and scope of the following claims.

What is claimed is:

1. A rotary actuator comprising an elongated annular housing part, a head part fixedly secured to one end of said annular housing part, a reel rotatably mounted within said annular housing part at a position adjacent said head part for receiving one end of a flexible elongated element so that the latter may be wound on said reel in response to rotation of said reel in one direction, said annular housing part having an opening therein in axial alignment with said reel for receiving the flexible elongated element extending from said reel therethrough, said head part and said reel having coaxial openings extending therethrough, an elongated rigid structure fixedly secured to said head part and extending axially therefrom within said annular housing part through the coaxial openings in said head part and said reel, said elongated rigid structure including a first portion adjacent said head part defining a chamber for receiving a ballistic charge capable of creating gases under pressure upon ignition and a second portion extending therefrom toward the opposite end of said annular housing part, one of said portions having a cylindrical exterior peripheral surface, the other of said portions having an exterior peripheral surface which is non-circular in cross-section, end closure means sealingly closing the opposite end of said annular housing part, said annular housing part having means defining an interior cylindrical surface extending from said end closure means toward said reel, a piston member mounted within said annular housing part with its periphery in sealing relation to the cylindrical interior surface thereof for axial movement from a position adjacent said end closure means away from the latter toward said reel, said piston member and said end closure means defining with the interior cylindrical surface of said annular housing part extending therebetween an expansible pressure chamber, said piston member having a central opening therein receiving the second portion of said elongated rigid structure, a hollow piston rod member disposed within said annular housing part in surrounding relation to said elongated rigid member, one of said members having an interior cylindrical surface fixed with respect to said piston member and slidably sealingly cooperating with the cylindrical exterior peripheral surface of said elongated rigid structure so as to provide an effective seal for said expansible pressure chamber between the exterior of said elongated rigid structure and said piston member opening, one of said members having means fixed with respect to said piston rod member and slidably cooperating with the non-circular peripheral surface of said elongated rigid structure for preventing free relative rotational movement between said piston rod member and said elongated rigid structure, said elongated structure including a passage extending from said charge receiving chamber through the second portion thereof in communication with said expansible pressure chamber for communicating the gases under pressure created at said charge receiving chamber with said expansible pressure chamber to effect axial movement of said piston member from said position adjacent said end closure means away from the latter and toward said reel, said piston rod member being operatively associated with said piston member for movement therewith in response to the last-mentioned axial movement of said piston member, and means acting between the exterior surface of said piston rod member and the surface defining the axial opening in said reel for effecting a rotary motion of said reel in said one direction to wind the flexible elongated element thereon in response to the axial movement of said piston rod member with said piston member.

2. A rotary actuator as defined in claim 1 wherein said piston member and said piston rod member are fixedly secured together in sealing relation.

3. A rotary actuator as defined in claim 1 wherein the cylindrical exterior peripheral surface is on the first portion of said elongated rigid structure.

4. A rotary actuator as defined in claim 1 including a cartridge charge within said charge receiving chamber, a cylinder member fixed to said head part in cooperating relation to said cartridge charge, a firing pin mounted within said cylinder member for movement into igniting engagement with said cartridge charge in response to a predetermined fluid pressure acting thereon within said cylinder member and means for introducing a gas under pressure into said cylinder member to effect the igniting movement of said firing pin.

5. A rotary actuator as defined in claim 4 wherein said last-mentioned means includes a fitting rotatably mounted about the axis of said cylinder member for communicating a source of gases under pressure with said cylinder member in any position of rotary movement thereof with respect to said cylinder member.

6. A rotary actuator as defined in claim 1 including a pair of mounting blocks for fixedly securing said rotary actuator to a support, means for securing one of said mounting blocks to said head part in different positions of axial and rotational adjustment with respect thereto and means for securing the other of said mounting blocks to said annular housing part in different positions of rotational adjustment with respect thereto.

7. In a pilot ejection system including a seat for accommodating a pilot, strap means fixed at one end to the forward lower portion of said seat and extending rearwardly and then upwardly in an inflight position to engage between the seat and a pilot sitting therein, and a rotary actuator fixed to the rearward upper portion of said seat and having the opposite end of said strap means operatively connected therewith for effecting separation of the pilot and seat during ejection by rapidly reeling in said strap means into a substantially taut condition between the one end thereof fixed to the forward lower portion of the seat and the other end thereof operatively connected to said actuator, the improvement comprising said actuator including an elongated annular housing member, a head member sealingly engaged to one end of said housing member, a reel rotatably mounted within said housing member at a position adjacent said head member receiving one end of said strap means so that the latter can be wound on said reel in response to rotation of said reel in one direction, said housing member having an opening therein in axial alignment with said reel for receiving the strap means extending from said reel therethrough, said head member and said reel having coaxial openings extending therethrough, an elongated rigid structure fixedly secured to said head member and extending axially therefrom within said housing member through the coaxial openings of said head member and said reel, said elongated rigid structure including a cylindrical portion adjacent

said head member defining a chamber for receiving a ballistic charge capable of creating gases under pressure upon ignition and a portion of non-circular exterior cross-section extending therefrom toward the opposite end of said housing member, end closure means sealingly closing the opposite end of said housing member, said housing member having means defining an interior cylindrical surface extending from said end closure means toward said reel, a piston mounted within said housing member with its periphery in sealing relation to the interior surface thereof for axial movement from a position adjacent said end closure means away from the latter toward said reel, said piston and said end closure means defining with the portion of the interior cylindrical surface of said housing member extending therebetween an expansible pressure chamber, said piston having a central opening therein receiving the non-circular portion of said elongated rigid structure, a hollow piston rod disposed within said housing member in surrounding relation to said elongated structure having one end sealingly secured to said piston rod for axial movement therewith, said piston rod extending from said piston within the axial opening in said reel and having an interior cylindrical surface slidably engaged on the cylindrical portion of said elongated rigid structure in sealing relation therewith, said piston and piston rod including a sliding connection with the non-circular portion of said elongated rigid structure preventing free relative rotational movement between said elongated rigid structure and said piston rod during the axial movement of the latter with said piston, said elongated rigid structure including a passage extending from said charge-receiving chamber through the non-circular portion thereof in communicating with said expansible pressure chamber for communicating the gases under pressure created in said charge-receiving chamber with said expansible pressure chamber to effect axial movement of said piston and piston rod in a direction away from said end closure means, and means acting between the exterior surface of said piston rod and the surface defining the axial opening in said reel for effecting a rotary movement of said reel in a direction to wind said strap means thereon in response to the axial movement of said piston rod away from said end closure means.

8. A ballistic actuated device for reeling in an elongated flexible element comprising an elongated housing including a pair of longitudinally spaced end closures and a peripheral wall extending therebetween defining an elongated chamber therein between said end closures, said housing having an opening formed in the peripheral wall thereof communicating with said chamber for receiving the elongated flexible element therethrough, a reel mounted within said housing chamber for rotational movement about a longitudinal axis, said reel being arranged to fixedly receive one end of the flexible element and having an exterior periphery around which the flexible element is arranged to be wound in response to the rotational movement of said reel in one direction, said reel having means defining a generally cylindrical opening in the interior thereof having an axis coincident with the axis of rotation of said reel, an elongated rigid structure fixedly secured to said housing and extending longitudinally from one of said end closures through said cylindrical opening and said chamber, said elongated rigid structure defining an interior chamber for receiving a ballistic charge capable of generating high pressure gases upon ignition, a tubular member mounted within said housing in surrounding relation to said elongated rigid structure for longitudinal movement within said cylindrical reel opening between a first operative position and a second operative position, interengaging helical thread means between the interior periphery of said opening and the exterior periphery of said tubular member for effecting a rotational movement of said reel in said one direction in response to the movement of said tubular member from said first operative position to said second operative position, means within said housing defining an interior cylindrical surface adjacent one of said end closures and sealed with respect thereto, a piston member mounted within said housing with the periphery thereof in sealing relation to said cylindrical interior surface for longitudinal movement therealong from a first operative position adjacent said one end closure to a second operative position spaced from said one end closure, said piston member having a central opening therein receiving said elongated rigid structure therethrough, said elongated rigid structure including a first exterior peripheral portion of cylindrical configuration having a longitudinal extent at least equal to the longitudinal distance between the first and second operative positions of said members, one of said members having an interior cylindrical surface fixed with respect to said piston member and slidably sealingly cooperating with the cylindrical exterior peripheral portion of said elongated rigid structure during the movement of said piston member from said first operative position to said second operative position, said elongated rigid structure including a second exterior peripheral portion having a longitudinal extent at least equal to the longitudinal distance between the first and second operative positions of said members, one of said members having an interior periphery fixed with respect to said tubular members and disposed in surrounding relation to the second exterior peripheral portion of said elongated rigid structure during the movement of said members from said first operative positions to said second operative positions, interengaging means between the interior periphery of said one member and the second exterior peripheral portion of said elongated structure for preventing rotational movement in said one direction of said tubular member during the longitudinal movement thereof from its first operative position to its second operative position, means in said elongated rigid structure for communicating the high pressure gases generated in said charge receiving chamber as a result of the ignition of a charge therein between said piston and said one end closure when said piston member is disposed in its first operative position to effect movement thereof into its second operative position, and means for operatively connecting said piston member with said tubular member to effect movement of said tubular member from its first operative position to its second operative position in response to the movement of said piston member from its first operative position to its second operative position whereby said reel will be rotated in said one direction to reel in the flexible element in response to the ignition of a charge in said charge receiving chamber.

References Cited in the file of this patent

UNITED STATES PATENTS

2,477,907	Smith	Aug. 2, 1949
2,736,522	Wilson	Feb. 28, 1956
2,755,042	Paddon	July 17, 1956
2,829,850	Culver	Apr. 8, 1958

FOREIGN PATENTS

1,231,466	France	Apr. 11, 1960

OTHER REFERENCES

Talco Engineering Co. brochure attached as exhibit B.

Western Aviation Magazine, page 28, June 1959 (vol. 39, No. 6).