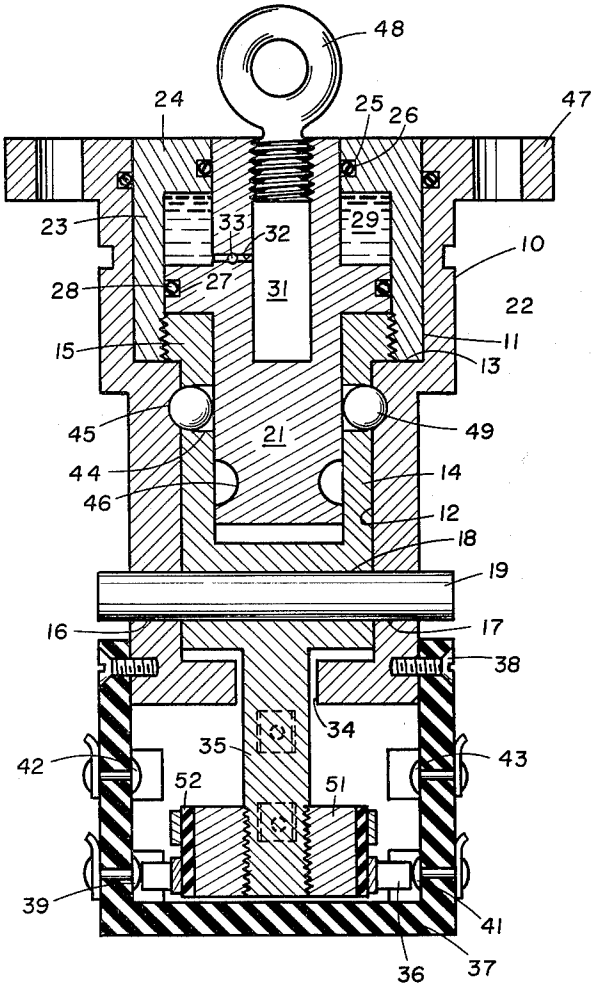
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RETARD SENSOR FOR RETARDED BOMBS

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RETARD SENSOR FOR RETARDED BOMBS

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

This invention relates to a safe and arming mechanism for a parachute retarded drop bomb, and more specifically to a device electrically connected to the bomb's fuze timer to sense the retarding force of the drop bomb to determine whether or not the parachute has fully deployed and which accordingly changes the fuze arming timing from a long interval to a short interval if the parachute has fully deployed.

During very low level bombing operations, a released free-falling drop bomb will assume an initial trajectory path very close to the path of travel of the airplane and can therefore explode substantially directly below the aircraft. Under these conditions, it is necessary to provide the drop bomb with a motion retarding means such as a parachute to decelerate the bomb and permit the aircraft to escape to a safe distance from the target before the detonation of the bomb. It is desirable to have the fuze arming timing interval as short as possible, and yet permit the aircraft to advance to a safe distance from the target before the bomb is detonated, so that the bomb may be set to explode above the ground in certain circumstances and at ground impact in others. If the bomb retarding parachute is fully deployed and sufficiently decelerates the free-falling bomb, the aircraft will have sufficient time to escape the target area; but if the parachute does not fully deploy and does not sufficiently decelerate the bomb, the aircraft is likely to be damaged by the explosion. It is therefore necessary to provide a device which is capable of determining whether or not the parachute has fully deployed and which then may be used to control the duration of the fuze timing interval. It has been attempted to sense retardation of a drop bomb and control the duration of the fuze timing interval by means of an integrating accelerometer with G weights connected to an escapement mechanism but such devices have been, by necessity, structurally complex and intricate and therefore do not have a high resistance to shock nor a desirable degree of reliability. Moreover, such devices have been expensive to manufacture and are not feasible for use in large quantities of conventional bombs.

It is an object of the present invention to provide a simple, rugged, and reliable device to sense the deceleration forces on a parachute retarded drop bomb and to control the fuze timing duration accordingly.

Another object of the invention is to provide a device to shorten the fuze timing duration of a free-falling drop bomb only if a retarding force has been exerted upon said bomb for a predetermined interval of time and the magnitude of said force exceeds a predetermined minimum at the conclusion of the predetermined period of time.

Various other objects and advantages will appear from the following description of one embodiment of the invention, and the novel features will be particularly pointed out hereinafter in connection with the appended claims.

The features characteristic of the present invention, as well as additional objects and advantages thereof, will be understood better from the following detailed description when read in conjunction with the accompanying drawing in which:

The figure is a central longitudinal section of a preferred embodiment of the present invention.

As seen in the figure of the drawings, the arming control device of the present invention comprises a housing **10** having an axial bore **11** formed therein and a counterbore **12** formed therein to define an annular shoulder **13** between said bores. A cup-shaped member **14** is slidably received within the counterbore **12** and has, at its open end, an annular flange **15** formed thereon extending radially outwardly for engagement with the annular shoulder **13**. The housing **10** has a pair of opposed apertures **16** and **17** formed therein while the base portion of the cup-shaped member **14** has a transverse aperture **18** formed therein for alignment with apertures **16** and **17** in the housing to receive a shear pin **19**, for reasons which will be explained. Slidably received within the interior of the cup-shaped member, is a piston assembly having a piston rod **21** which extends into and slidably engages the cylindrical inner wall of the cup-shaped member and extends to the open end of the housing. Formed on a portion of the piston rod along the length thereof is an annular collar **22**. Received within the axial bore **11** in housing **10**, is a cylindrical sleeve **23** of a length equal to the depth of the axial bore and being threadedly coupled to the annular flange **15** on the open end of the cup-shaped member. The sleeve has an annular flange **24** formed on the outer end thereof which extends radially inwardly to engage the outer peripheral surface of the piston rod. An annular groove **25** is formed on the inner peripheral surface of flange **24** to receive an O-ring **26** for sealing engagement with the piston rod. Similarly, an annular groove **27** is formed in the outer peripheral surface of the annular collar **22** to receive an O-ring **28** for sealing engagement with the inner peripheral surface of the sleeve **23**. Sleeve **23**, its annular flange **24**, and collar **22** define an annular cylinder **29** about the piston rod. The piston rod has an axial bore therein which is closed at one end by an eye hook threadedly connected to the piston rod to define a fluid reservoir **31** within the interior of the piston rod. A small diameter radial through aperture **32** is formed in a transverse wall of the piston rod to provide fluid communication between annular cylinder **29** and the fluid reservoir **31**, this radial aperture **32** being normally blocked by a spherical plug **33** to entrap a quantity of hydraulic fluid within the annular cylinder until the fluid is pressurized and the plug unseated.

A second counterbore **34** is formed in the housing through which extends a longitudinal arm connected to the base portion of the cup-shaped member **14** and upon which is mounted two sets of movable electrical contacts **36** displaced 90° from each other. An end closure cap **37** is connected to the end of the housing by means of screws **38** and provides a support upon which a plurality of sets of fixed contacts may be mounted for cooperation with movable contacts **36**. For example, a first set of fixed contacts **39** and **41** are shown in contact with movable contact **36**, which is in its normal position, while a second set of fixed contacts **42** and **43** are mounted upon the closure cap in a position longitudinally spaced from the first set of contacts and are so positioned as to come in contact with movable contacts **36** when the piston assembly is moved from its first position to its second position in a manner which will be described. The fixed contacts **36** are on a ring and insulated from the body by insulating material **52**.

The cup-shaped member is releasably secured to the housing by means of a ball-lock mechanism. When the cup-shaped member **14** is received within the housing within the counterbore of the housing, and the shear pin is inserted within the aligned apertures **16**, **17** and **18** in

the housing and cup-shaped member respectively, a set of radial apertures **44** formed within and circumferentially spaced about the cylindrical wall of the cup-shaped member are aligned with corresponding detents **45** formed in the inner peripheral surface of the counterbore. A plurality of spherical balls **49** are positioned within the radial apertures **44** and extend into the detents **45** and are held in that position by means of the piston rod **21**, thus preventing any relative movement between the housing and the cup-shaped member and thereby relieving the shear pin of any mechanical stresses. The piston rod has an annular recess **46** formed in the outer peripheral surface thereof adjacent its lower end and which, when brought into alignment with the radial apertures **44**, will receive the spherical balls and thereby release the cup-shaped member from the housing and transfer the force to the shear pin.

The operation of the device is as follows:

The device of the present invention is inserted into an aperture or well formed in the bomb structure and is secured thereto by bolts extending through apertures formed in the flange **47** on the open end of the housing, while the eye hook **48**, which is threadedly received in the central aperture formed in the piston rod, is used to connect the piston rod assembly to the shroud lines of a parachute. The fixed contacts are connected to the fuze timing mechanism in such a manner that the pair of contacts **39** and **41** will, when closed by the movable contact **36**, cause the fuze timing mechanism to operate for a predetermined period of time before the bomb is armed while the pair of contacts **42** and **43** will, when closed by the movable contact **36**, control the fuze timing mechanism to operate for a shorter interval of time. When the bomb is released from the aircraft and the parachute is opened, a tensile force is developed between the bomb and the parachute, to which the housing and the piston rod are attached, respectively; the tensile force tending to pull or withdraw the piston assembly out of the housing, thus pressurizing the hydraulic fluid in the annular cylinder **29**. The pressurized hydraulic fluid causes the spherical plug **33** in the radial aperture **32** to be displaced and blown into the reservoir **31** in the interior of the piston rod to provide open fluid communication between the annular cylinder and the reservoir. Due to the fact that the radial aperture **32** is of small diameter, the flow of hydraulic fluid from the cylinder into the reservoir is restricted and the piston assembly acts as a dashpot. If the parachute remains open for a time sufficient to cause the piston to be displaced a distance equivalent to its full stroke, the annular groove **46** in the piston rod is brought into alignment with the radial apertures **44** in the cup-shaped member and the balls **49** are then permitted to be moved radially inwardly into the annular groove **46** and thereby release the cup-shaped member from the locked engagement with the counterbore portion of the housing. Having completed a full stroke, the annular collar **22** on the piston rod is in abutting contact with the annular flange **24** of sleeve **23** thus transmitting the tensile force directly to the sleeve. This tensile force is in turn transmitted to the cup-shaped member by virtue of the threaded coupling of the sleeve to the cup-shaped member, thus tending to withdraw the sleeve and cup-shaped member from the interior of the housing and thereby apply a stress to the shear pin **19**. If the parachute has been fully deployed, the magnitude of the tensile force will be sufficiently great to shear the pin **19** thereby permitting the piston rod assembly to withdraw the sleeve and the cup-shaped member from the housing **10** and hence causing movable electrical contact **36** to disengage the first set of fixed contacts **39** and **41** and to close the second set of fixed contacts **42** and **43**. It is noted that the collar **51** upon which movable electrical contacts **36** are mounted, comes into engagement with the lower portion of the housing **10** when the piston has been displaced from its first position to its second position and that the collar **51** then acts in cooperation with the lower portion of the housing structure as a stop means to assure that the movable contact remains in alignment with the second set of fixed contacts. If however the parachute had not been fully deployed and had not imparted sufficient deceleration to the bomb, the tensile force developed between the parachute and the bomb may have been of sufficient magnitude to cause the piston assembly to move from its first position to its second position but would not be sufficiently great to cause the shear pin to break. Therefore the cup-shaped member would not be displaced relative to the housing and the first set of fixed contacts would remain closed and would cause the fuze timing mechanism to operate for its longer time interval and thereby permit the aircraft to escape from the target zone before the bomb is detonated.

From the foregoing description, it is seen that the device of the present invention guarantees the safety of the pilot by normally setting a relatively long time interval into the fuze timing mechanism for the bomb to permit the pilot to escape from the danger zone before the bomb is detonated and shortens the fuzing arming time interval only if the parachute has sufficiently decelerated the bomb. The dashpot and the ball-lock mechanism cooperate to prevent the shear pin from being sheared by the snatch force developed when the parachute initially pops open. The dashpot and ball-lock mechanisms do not uncouple the cup-shaped member from the housing until the snatch force has completely subsided, and if the remaining force is not strong enough to break the shear pin, i.e. if the parachute is not fully deployed, the movable contact is maintained in contact with the first set of fixed contacts which cause the fuze timer to operate for its longer interval. But if the parachute is fully deployed, the resulting force is great enough to shear the pin and displace the movable contact from its first position to its second position to close the second set of fixed contacts and thereby shorten the fuze timing interval.

Obviously many modifications and variations of the present invention are possible in light of the above teachings. It is therefore to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A switch responsive to the retarding force of a parachute retarded drop bomb for controlling the timing of a fuze arming timing mechanism comprising,

a housing connected to said bomb,

a dashpot assembly having a piston and a cylinder,

said piston having means at one end thereof for attachment to a parachute,

said cylinder being releasably coupled to said housing,

said housing and cylinder having aligned through apertures formed therein to receive a shear pin,

a shear pin positioned within and extending through said aligned through apertures,

a contact arm mounted upon said cylinder for movement therewith and having movable electric contacts mounted thereon,

a contact support connected to said housing and having mounted thereon at least one pair of fixed electrical contacts disposed for operative cooperation with the movable contact,

whereby the piston of the dashpot is moved from a first position to a second position by the retarding force created when the parachute is deployed to release the ball-lock mechanism and transfer the force to the shear pin which will remain integral and prevent movement of the movable contact and operation of the switch unless the force applied thereto exceeds a predetermined magnitude.

2. The switch defined in claim **1** wherein

the cylinder of the dashpot assembly is releasably coupled to the housing by means of a ball-lock mechanism which locks the cylinder to the housing and isolates the shear pin from mechanical stress until the piston has been displaced by the retarding force.

3. A safe and arming mechanism for a parachute retarded drop bomb comprising

a housing having means thereon for attachment to said bomb and having an axial bore formed therein,

a cylinder sleeve assembly slidably received within said axial bore and releasably secured to said housing by means of a releasable coupling mechanism,

a piston slidably received within the cylinder sleeve and having means on one end for cooperation with said coupling mechanism to release said coupling when the piston is displaced from a first to a second position and having means at the other end thereof for attachment to a parachute,

said housing and said cylinder sleeve having aligned through apertures formed therein,

a sear pin received within said aligned through apertures,

fixed electrical contacts mounted upon said housing for connection to a fuze arming timing mechanism of a bomb,

a movable electrical contact mounted upon said cylinder sleeve assembly for cooperation with said fixed contacts,

said piston and said sleeve defining a hydraulic cylinder,

said piston having a small diameter radial aperture formed therein to provide fluid communication between said cylinder and a reservoir formed within the piston, said cylinder being filled with hydraulic fluid.

4. A switch responsive to the retarding force of a free-falling retarded drop bomb for controlling the timing of a fuze arming timing mechanism comprising

a housing having axial bore therein and having means for attaching the housing to a drop bomb,

a cylinder sleeve assembly slidably received within said axial bore and being releasably secured thereto by means of a ball-lock mechanism,

a piston slidably received within said cylinder sleeve assembly and having means at one end thereof for attachment to a parachute,

said piston having a small diameter aperture formed therein and being in fluid communication with an annular chamber defined by said cylinder sleeve and said piston to serve as a bleed for said hydraulic fluid within said cylinder,

said housing and said cylinder sleeve assembly having aligned through apertures formed therein,

a shear pin disposed within said aligned through apertures,

a movable electric contact mounted upon a portion of said cylinder sleeve assembly,

at least a pair of fixed electrical contacts mounted upon said housing for operative cooperation with said movable contact,

whereby the piston and annular cylinder cooperate as a dashpot assembly and permit the piston to travel a full stroke in response to the retarding force of the bomb and, upon completion of the stroke of the piston, the ball-lock mechanism releases the cylinder sleeve assembly from the housing to transfer the retarding force to said shear pin which will break only if the force exceeds a predetermined magnitude.

5. A safe and arming mechanism for a parachute retarded drop bomb comprising,

a housing having an axial bore formed therein and a

first counterbore formed therein defining an annular shoulder therebetween,

a cup-shaped member slidably received within said first counterbore and having an annular flange formed on the open end thereof extending radially outwardly and engaging said annular shoulder,

an annular sleeve disposed within said axial bore and being coupled at one end to the flange on the cup-shaped member,

said sleeve having an annular flange formed on its other end extending radially inwardly,

a piston rod slidably received within said cup-shaped member and projecting outwardly of said housing,

said rod having an annular collar formed on the outer peripheral wall thereof to define an annular piston for sliding engagement with said sleeve,

said collar and said annular flange on the sleeve forming an annular cylinder therebetween, said cylinder being filled with hydraulic fluid,

said piston being movable between said first and second positions upon actuation by a force of predetermined magnitude,

said rod having an axial recess formed therein and having a small diameter radial bore extending therethrough to provide fluid communication between said cylinder and said recess,

said housing having a second counterbore formed therein and extending through the other end of the housing,

said cup-shaped member having an extension arm formed thereon and extending through the second counterbore externally of the housing,

first and second sets of fixed electrical contacts mounted upon support means connected to the housing for connection to an arming mechanism of a bomb,

movable electric contacts mounted upon said arm for movement therewith and cooperation with said fixed contacts,

said housing and said cup-shaped member having aligned through apertures formed in a portion thereof,

a shear pin disposed within and extending through said aligned through apertures,

and releasable coupling means for normally locking the cup-shaped member to the housing and for releasing the cup-shaped member from the housing when the piston is moved from its first to its second position.

6. The safe and arming mechanism of claim 5 wherein said releasable coupling means comprises a ball-lock mechanism, and

said radial bore has a removable plug positioned therein to retain the hydraulic fluid within the cylinder until said fluid is compressed by the piston.

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