United States Patent

Min

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[54] PRESSURE ACTUATED SAFETY AND ARMING DEVICE

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[73] Assignee: **The United States of America as represented by the Secretary of the Navy**

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[58] **Field of Search** 102/7, 16, 70.2, 81

[56] **References Cited**

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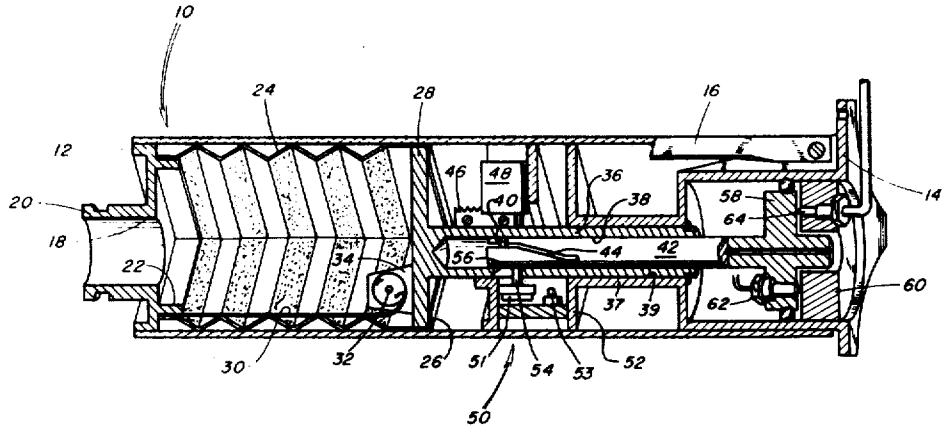
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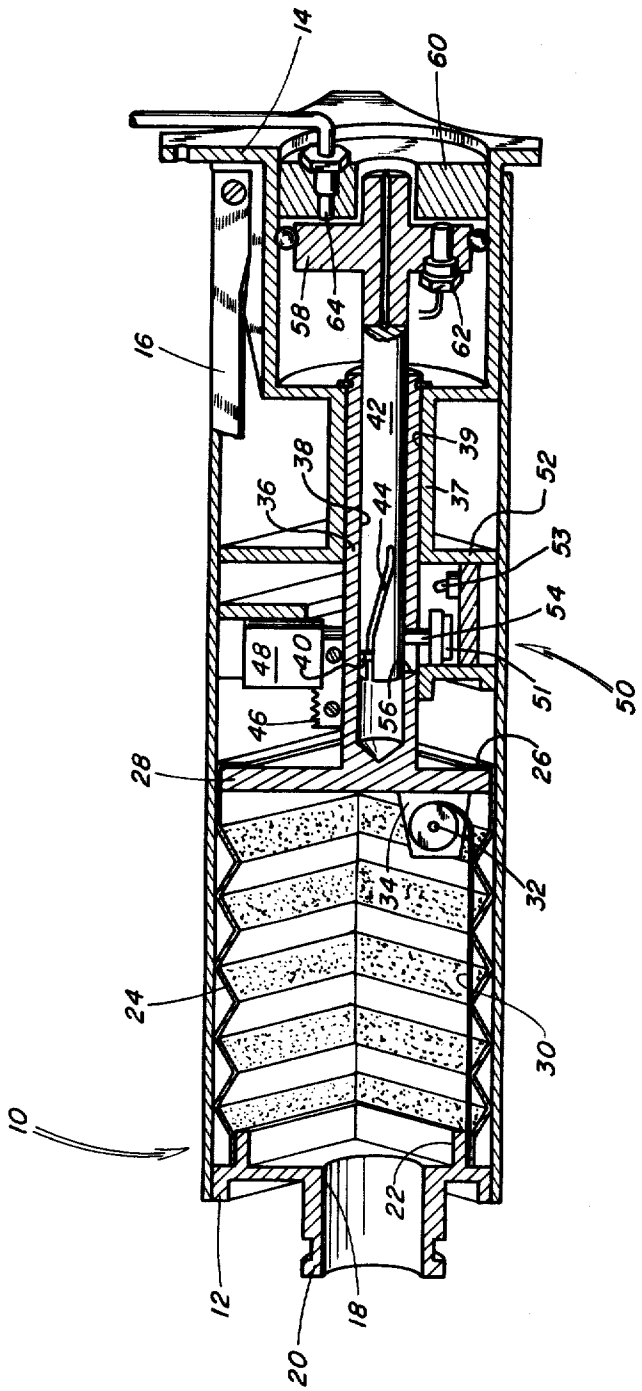
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[57] **ABSTRACT**

A safety and arming device having a spring biased bellows inflatable under air pressure of a predetermined magnitude. A tube is connected to the bellows and a stud is fixed to the inside of the tube. A shaft having a helical slot formed therein fits into the tube with the stud extending into the helical slot and an arming rotor is fixed to the end of the shaft. Under air pressure of a predetermined magnitude, the bellows expands and moves the tube which causes the stud, which is fixed to the inside of the tube and riding in the helical slot, to rotate the shaft and thereby rotate the arming rotor. A gear rack connected to the outside of the tube is in engagement with an escapement mechanism to limit the rate of travel of the bellows to preclude premature arming under the influence of shocks.

1 Claim, 1 Drawing Figure





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PRESSURE ACTUATED SAFETY AND ARMING DEVICE

BACKGROUND OF THE INVENTION

This invention generally relates to ordnance safety and arming devices, and more particularly to a safety and arming device which will arm in the presence of air pressure of a predetermined magnitude and will disarm when the air pressure decreases below that predetermined magnitude.

Ordnance safety and arming devices are added to the actuating mechanism of ordnance items to prevent detonation of the ordnance before the occurrence of a desired condition. The purpose is to render the ordnance inert or safe until it is delivered to its target. It has been recognized that a certain amount of mishandling and tampering inevitably occurs during storage and handling of the ordnance. The ultimate object is to positively preclude premature detonation of the ordnance before delivery to the target.

The design recognized by experts as the only acceptably safe design provides some sort of interruption between the initial detonator or primer and the rest of the explosive train leading to the primary charge in an ordnance device. Thus, it is common to see arrangements in which the detonator is physically shifted into alignment with a firing pin and a transfer detonator so that premature actuation of the firing pin will not cause initiation of the primer, and even premature initiation of the primer will not cause initiation of the transfer detonator because they are physically separated by an inert barrier.

Every existing safety and arming device is designed so that once it is armed, it is permanently armed. This is a desirable feature for most ordnance for which these devices were designed. For example, a bomb fuze may be designed to be armed at a high air speed, for example, 300 knots, so that when the bomb is released by the delivery aircraft at 400 knots, the bomb will arm and stay armed as it falls toward the target even though the terminal velocity of the bomb may be only 150 knots. Hence, in most ordnance where the safety and arming device is included as part of the ordnance fuze, it is not possible to design the safety and arming device to disarm itself once the critical arming condition has been sensed.

A new generation of weapons has been designed in which the fuze and the safety and arming mechanism is designed as a module which is physically separated from the ordnance. The advantage of such an arrangement is immediately obvious. For example, the safety and arming module is not expended with the ordnance and hence can be designed with much greater precision than the typical expendable safety and arming device since cost is not as critical a factor. Another advantage is that the ordnance device does not contain its own primer and hence is as safe as theoretically possible. A third and most important advantage is that the safety and arming device may be designed to disarm in the absence of delivery speeds. For example, when a delivery vehicle such as an aircraft takes off carrying ordnance of this kind, the ordnance is safe until the aircraft reaches normal operating speeds. Then if the pilot returns to base without having expended the ordnance, as the plane slows to landing speeds, the safety and arming device automatically returns to the safe position so that a crash landing or other mishandling of the ordnance will not cause detonation thereof.

SUMMARY OF THE INVENTION

Accordingly, one object of the present invention is to provide an ordnance safety and arming device which will arm in the presence of an air speed of a predetermined magnitude and will disarm when the air speed decreases below that predetermined magnitude.

Another object of this invention is to provide an ordnance safety and arming device which may be used many times over.

Yet another object of the invention is to provide an ordnance safety and arming device which interrupts both the explosive train to the ordnance and the electrical connection in the firing circuit unless a predetermined air speed is continually sensed.

Still another object of the present invention is to provide an ordnance safety and arming device which arms in the presence of a predetermined air speed and is not armed by shocks and other transitory effect.

These and other objects are attained by a safety and arming device having a pressure operated bellows which expands under air pressure and causes rotation of an arming rotor to complete an explosive train to the ordnance device. The bellows is spring biased toward a collapsed position so that when the air pressure decreases below a predetermined magnitude, the biasing spring will collapse the bellows and cause rotation of the arming rotor to interrupt the explosive train to the ordnance device.

BRIEF DESCRIPTION OF THE DRAWING

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawing wherein the sole FIGURE is a side elevation partly in section of the present invention.

Referring to the drawing the safety and arming device includes a frame **10** having a front plate **12** and a rear plate **14** connected together and held in rigid spaced parallel relationship by four corner struts **16**. The front plate **12** has formed therethrough an aperture **18** and formed on the front face of front plate **12** a tubular extension **20** surrounds aperture **18** and forms therewith an air intake. A square flange **22** is formed on the rear face of the front plate **12** and extends rearwardly therefrom a short distance. Around the outside of flange **22** is secured a square bellows unit **24** formed of am air-impervious flexible material such as rubberized fabric or plastic. The rear end **26** of bellows **24** is secured around the periphery of a square pressure plate **28** which is movably mounted in the device to shift rearwardly and forwardly as the bellows expands and contracts under the influence of air pressure. The four corner struts **16** of the frame have a right angle cross-section and slideably receive the corners of the square pressure plate to prevent rotation of the pressure plate. A coiled negator spring **30** is mounted on a shaft **32**. Spring shaft **32** is mounted for rotation in a pair of bearing blocks **34** fixed to the forward face of pressure plate **28**. Negator spring **30** exerts a constant forward force on pressure plate **28** regardless of the extent of rearward displacement of pressure plate **28**. A tube **36** is fixed to the rearward face of pressure plate **28** and has a stud **40** secured to the inner surface thereof and protruding into its hollow bore **38**.

A shaft **42** having a helical slot **44** formed therein is slideably and rotatably supported in bore **38** of tube **36**. Tube **36** is slidably supported in bore **39** of a spool bracket **37** secured to struts **16**. Stud **40** extends into helical slot **44**. A gear rack **46** is secured to the outside periphery of tube **36** and engages a pinion gear of an escapement mechanism **48** for the purpose of governing the rate of rearward travel of pressure plate **28** and tube **36** to prevent arming of the ordnance during short intervals of high inertial forces such as those encountered during catapult take-offs and arresting gear landings of a launching vehicle. A sliding switch mechanism **50** fits into a switch housing **52**. Switch mechanism **50** includes a switch actuating stud **54** which extends into a slot **56** in the side of tube **36** so that when bellows unit **24** expands under the influence of air pressure collected through tubular extension **20**, pressure plate **28** slides rearwardly at a rate governed by escapement mechanism **48** and sliding switch blade **51** is moved rearwardly into engagement with switch contact **53** through the agent of slot **56** engaging switch stud **54** and moving switch blade **51** rearwardly. Stud **40** is fixed to the inside of tube **36** and travels in helical slot **44** in a directly rearward line and translates the linear movement of tube **36** to rotational movement shaft **42** of approximately 45° thereby rotating arming rotor **58** by 45°, which aligns the detonators **62** (one shown) in arming rotor **58** with mild detonating fuze fittings **64** (one shown) in end block **60**. A firing signal from the aircraft must

pass through the sliding switch to reach a detonator in the arming rotor **58**. Consequently, while the bellows of the safety and arming device is in its contracted position prior to reaching the predetermined air pressure necessary for extending the bellows, the firing circuit is interrupted because the sliding switch is open and the explosive train is interrupted because the detonators within the arming rotor are not aligned with the mild detonating fuze fittings. Upon attaining the predetermined ram air pressure necessary to extend the bellows however, the firing circuit switch is closed and the arming rotor is rotated 45° to align the detonators with the mild detonating fuze fittings to complete the explosive trains of the ordnance devices.

When the aircraft returns to base and prepares to land, the landing speed of the aircraft is below the speed required to maintain the inflated condition of bellows **24**. Therefore, negator springs **30** return pressure plate **28** and the connected tube **36** to its forward most position. As pressure plate **28** advances forwardly, slot **56** engages stud **54** which causes switch blade **51** to slide out of engagement with switch contact **53** thereby breaking the electrical firing circuit. Simultaneously, stud **40** riding in helical slot **44** causes a 45° rotation of shaft **42** and arming rotor **58** attached thereto to affect misalignment of the detonators in arming rotor **58** with the mild detonating fuze fitting in end block **60**.

It will be understood that the safety and arming device of the present invention may be used to control the arming of a plurality of ordnance devices by interposing a conventional intervalometer between the sliding switch mechanism **50** and a plurality of detonators in the arming rotor, each detonator having a respective mild detonating fuze fitting in end block **60** completing the explosive train to each of the ordnance devices.

Obviously, many modifications and variations of the present invention are possible in the 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 as new and desired to be secured by Letters Patent of the United States is:

1. A safety and arming device for an ordnance comprising:

fluid pressure operated means for changing from a first position to a second position under the influence of fluid pressure above a predetermined magnitude;

biasing means acting on said fluid pressure operated means in opposition to the fluid pressure for returning said fluid pressure operated means to a first position when the fluid pressure decreases below a predetermined magnitude;

arming means movable between an unarmed position wherein an explosive train to the ordnance is interrupted and an armed position wherein the explosive train to the ordnance is complete; and

transmission means connecting said fluid pressure operated means to said arming for causing movement of said arming means from an unarmed position to an armed position when said fluid pressure operated means changes from the first position to the second position under influence of fluid pressure above said predetermined magnitude and for returning said arming means to an unarmed position when said fluid pressure operated means is returned to the first position; and

switch means coupled to said first fluid pressure operated means for establishing electrical contact between a delivery vehicle and an ordnance only while said fluid pressure operated means is located in the second position.

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