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PNEUMATIC SAFETY AND ARMING MECHANISM FOR FUZES

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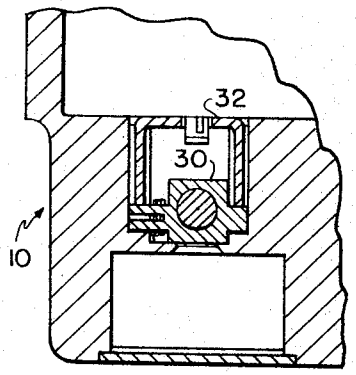


Fig 4

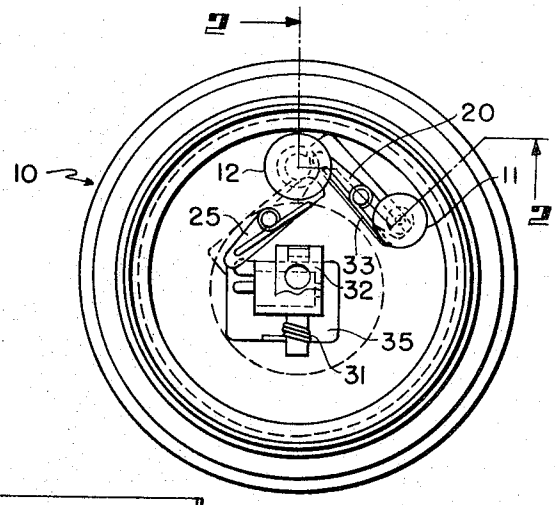


Fig 3

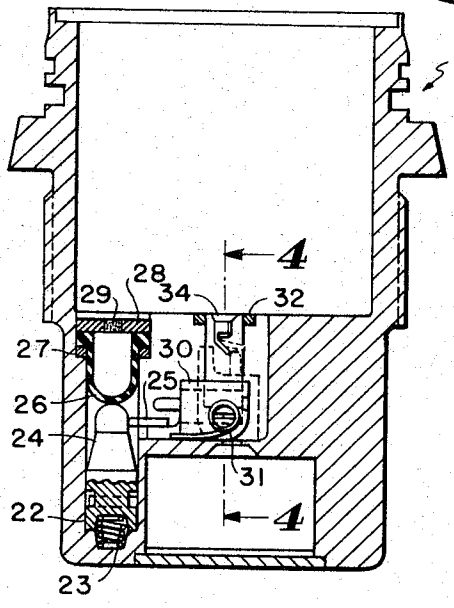


Fig 1

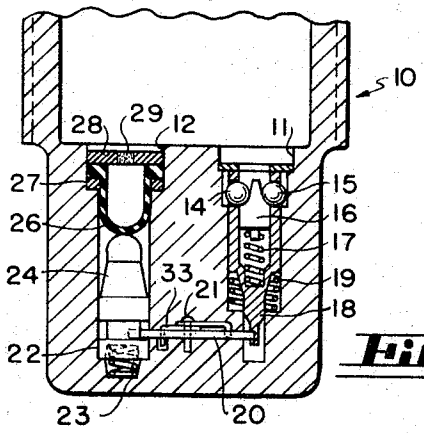


Fig 2

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PNEUMATIC SAFETY AND ARMING MECHANISM FOR FUZES

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ABSTRACT OF THE DISCLOSURE

This is a missile fuze of the type in which a setback slide mechanism and an arming delay mechanism of the pneumatic type and a detonator carrier are successively actuated. A housing is formed with two bores in spaced parallelism having a transverse passageway therebetween. A setback slide and associated components are mounted in the first of these bores and the setback slide moves rearwardly to actuate a first lever mounted in the transverse passage. When actuated the lever releases a spring urged delay arming slide member which is mounted for linear displacement in the second bore. The duration of the movement of the delay arming slide is controlled by a pneumatic regulator also mounted in the second bore. The delay arming slide in turn actuates a swingably mounted detonator carrier to arm said carrier. The arrangement is compact in that the setback slide and the delay arming slide mechanisms are in spaced parallelism. The detonator carrier is mounted in a chamber which is in communication with the second bore.

The present invention relates to fuzes, and specifically to safety and arming mechanisms for same in which a pneumatic regulating element is employed for purposes of accomplishing a time delay in arming.

It is a primary object of the invention to provide, in a fuze, the combination of three mechanisms: (1) a setback slide, which responds to setback forces developed during acceleration of a missile to enable or activate a time delay slide; (2) a time delay slide comprising an element which is linearly displaced, the displacement being delayed in time while it achieves a magnitude appropriate to permit the time delay slide to activate or enable a detonator carrier mechanism; and (3) a detonator carrier mechanism which is normally restrained to be held in an unarmed position but, when enabled or activated, swings about an axis to assume an armed position at which it places a detonator in alignment with the remainder of a firing train.

Another primary object of the invention is to provide a safety and arming fuze mechanism having wide latitude—i.e., one in which spring strengths and weights can be varied as desired in order to determine the threshold of deceleration forces which will cause arming.

Another object of the invention is to provide a fuze which has such design latitude that the requisite delay time can be varied by any one or more of a number of parameters such as spring strengths, regulator material, regulator geometry, weight of setback element, type of gas or liquid utilized in the regulator, and the characteristics of the regulator.

Another object of the invention is to provide a fuze in which the three above-mentioned mechanisms are so interlocked that the fuze will be held safe against arming until the missile in which it is installed is in flight—i.e., in its intended environment and operation.

For a better understanding of the invention, together with other and further objects, advantages, and capabilities thereof, reference is made to the following description of the appended drawings, in which:

FIG. 1 is a sectional view of a preferred form of fuze in accordance with the invention, being taken with draftsman's liberty in such manner that in the right two-thirds of the figure the observer looks toward the front of the detonator carrier **30**, but in the left side of the figure the observer looks generally into the time delay slide mechanism;

FIG. 2 is a view of the preferred form of the invention, as taken along section line **2—2** of FIG. 3;

FIG. 3 is a top plan view of the preferred form of the invention; and

FIG. 4 is a fragmentary sectional view as taken along line **4—4** of FIG. 1.

Referring now to the drawings, the principal working elements are contained in a generally cylindrical housing **10** which is adapted to be screwed onto the base of a fuze, say a proximity fuze of the type utilized in the nose of a missile or grenade. The housing is suitably machined and formed to provide suitable mountings and enclosures for the operating parts now described.

The housing may be manufactured from metal or plastic materials as required in order to comply with strength, weight, and environmental conditions to which it may be subjected. Materials presently considered are molded plastics, machined steel, and zinc or aluminum die castings.

The housing is provided with a pair of bores **11** and **12** extending from a plane near its midsection toward its closed end. A setback release mechanism is mounted in bore **11**. It comprises a pair of locking balls **14** and **15**, a wedge **16**, a wedge setback spring **17**, a setback slide **18**, and a setback slide spring **19**, all collectively referred to as the "setback release mechanism." The function of this mechanism is to respond to setback forces to change the position of a lever **20**, hereinafter described. The setback slide spring **19** is a compression spring positioned adjacent the lower portion of the bore **11** to exert a forward thrust against the setback slide **18**, which is accordingly formed with an annular shoulder against which the setback spring abuts. The setback slide **18** is mounted for linear displacement within the bore **11** and is suitably formed with the annular shoulder aforementioned, with a hollow forwardly extending cylindrical portion for concentrically slidably accepting the wedge setback spring **17**, wedge **16** and with ports for receiving the locking balls **14** and **15**. It will be apparent from what has been already said that the purpose of the setback slide **18**, with its pointed nose projecting rearwardly from the bore **11**, is to actuate the lever **20** when a sustained load having the desired number of G forces is applied.

The wedge setback spring **17** is positioned between a seat formed in setback slide **18** and the wedge, exerting a forward thrust against the wedge, thereby to exert pressure tending to push the locking balls **14** and **15** laterally outwardly and accordingly pushing them in to an enlarged portion of the bore **11** and locking the setback slide against linear displacement. The wedge **16** senses the application of G forces, which cause it to seek to decelerate on setback relative to the grenade in which it is installed. The setback release mechanism is associated with the lever **20**, pivotally mounted at **21** and biased into a normal position of engagement with the arming time delay slide **22**. When the setback slide release mechanism responds to setback forces of predetermined magnitude, it noses **20** into angular displacement and releases lower lever **20** from the pneumatic arming time delay slide **22**. Spring **33** normally holds the lever **20** against the pointed nose of the setback slide **18** and locks the arming time delay slide **22** against displacement.

Within the bore **12** of the housing **10** is mounted the pneumatic arming time delay system, which comprises a compression spring **23**, a slide member **22**, and a time delay regulator presently to be described. The slide spring

23 is a compression spring which exerts a forward thrust on the slide 22 and accelerates it forwardly when lever 20 is released from it. The arming time delay slide 22 is generally bullet-like in shape, having a blunt nose, a tapered cam surface between the nose and its main body portion, and further having a bottom body portion suitably formed to perform the functions of being engaged by lever 20 and providing a recess against which spring 23 thrusts.

The function of the arming time delay slide, during its forward displacement, is to release a lever 25 from a detonator carrier mechanism presently described, thereby to arm the fuze. The time required for the necessary displacement of slide 22 is determined primarily by the regulator, which comprises an inverted sac 26 secured between suitable washers 27 and 28, washer 28 being formed with an orifice 29. The sac is filled with a suitable gas or fluid which escapes through orifice 29 as the sac is compressed or distorted by reason of the forward thrust exerted against it by the nose of the arming time delay slide 22. This sac is also referred to as a diaphragm, and the washer 28, with orifice 29, is referred to as a restricter.

The time displacement of the arming time delay slide is a function of the viscosity of the fluid with which it is filled. It is also a function of the size, shape, and porosity of the powdered material used for the orifice 29. The diaphragm washer 27 acts as a bearing surface for the lower side of the flanged portion with which the diaphragm is formed.

The third principal mechanism is the detonator carrier mechanism. The detonator carrier 30 is mounted in cavity 35 of the housing and is locked in the safe position by the upper lever 25. When the lever is released, the detonator carrier 30 is moved to the armed position by a detonator carrier spring 31, which not only moves the detonator carrier into that position but also holds it there. The retainer 32 is a U-shaped part used to hold the detonator in place in cavity 35.

The cycle of operation of the novel fuze is as follows: (1) when the missile (such as a mortar shell) is fired, the fuze and the body 10 are accelerated; (2) the setback force which is developed moves the wedge 16 rearwardly against the force of spring 17; (3) the locking balls are no longer forced laterally outwardly, and they move inwardly, releasing the setback slide 18; (4) the setback slide is displaced rearwardly against the force of spring 19 and disengages lower lever 20 from the arming time delay slide 22, freeing the latter; (5) the slide spring 23 forces the arming time delay slide 24 forwardly; (6) as the arming time delay slide moves forwardly, it is delayed by the regulator; (7) a tapered cam surface on the arming time delay slide impacts upper lever 25 and moves it into position to release detonator carrier 30; (8) the detonator carrier, being loaded by spring 31, moves into the armed position.

The setback slide spring 19 provides a safety feature, in that, if the wedge is caused to release locking balls 14 and 15 by dropping or vibration, the wedge setback spring 17 will immediately reposition them, the spring 19 meanwhile preventing displacement of the setback slide. The setback slide will not be freed unless a sustained force is encountered, since the setback spring 17 will force the wedge forward to reposition the locking balls. This design, therefore, permits the fuze to remain in an arm-safe condition unless the preselected sustained setback force for arming is applied.

It will be understood from the foregoing that the detonator is in the armed position when the detonator carrier swings clockwise approximately 90 degrees from the position illustrated in FIG. 1, at which time the detonator is in line with an electrical contact 34 there shown. Suffice it to say that the electrical parts of a proximity fuze are disposed in the large well in front of that contact, and high explosive material in the well located below the detonator carrier mechanism illustrated in FIG. 1.

While there has been shown and described what is at

present considered to be the preferred embodiment of the invention, it will be understood by those of skill in the art that various changes and modifications may be made therein without departing from the scope of the invention as defined by the appended claims.

I claim:

1. In a missile fuze, the combination of a setback slide mechanism, an arming delay slide mechanism, a movable detonator carrier mechanism having unarmed and armed conditions, and a housing formed to mount said mechanisms,

in which the setback slide mechanism comprises:

a longitudinally extending setback slide mounted for linear displacement,

releasable locking means for normally locking the setback slide against displacement but responsive to acceleration forces to unlock said slide, said slide then being displaced by acceleration forces,

and a first lever normally engaging and restraining the arming delay slide mechanism but being cammed out of engagement therewith by the setback slide as the setback slide is displaced;

in which the arming time delay mechanism is in spaced parallelism and in a row with the setback slide mechanism and comprises:

a longitudinally extending delay slide member engaged by said first lever, a first spring means tending to displace the delay slide,

regulating means for delaying the displacement of the delay slide member, and a second lever normally engaging and restraining the detonator carrier mechanism but being cammed out of engagement with the detonator carrier mechanism by the delay slide as the delay slide is displaced;

and in which the detonator carrier mechanism comprises:

a detonator carrier normally disposed in unarmed position,

and a second spring means for urging the detonator carrier into armed position when the second lever is disengaged from the detonator carrier.

2. The combination in accordance with claim 1 in which the setback slide is mounted to be displaced rearwardly by setback forces, and in which the arming delay slide is adapted to be displaced forwardly by the first spring means.

3. The combination in accordance with claim 2, and a third spring means positioned yieldably to oppose displacement of the setback slide.

4. The combination in accordance with claim 3 in which the releasable locking means comprises a wedge element slidably mounted within the setback slide, a pair of locking balls normally wedged by the wedge element to lock the setback slide, and a fourth spring means for normally urging the wedge element into locking position.

5. The combination in accordance with claim 4 in which the regulating means comprises a fluid-filled sac adapted to be compressed by the arming delay slide, and an orifice through which the fluid flows as the sac is compressed.

6. In a missile fuze of the type in which a setback slide mechanism and an arming delay mechanism and a detonator carrier are successively actuated, the combination of:

a housing formed with first and second longitudinally extending parallel bores, arranged in a row and having interior walls, and a chamber communicating with the second bore and a transversely extending passageway between and behind said bores;

a setback slide mechanism comprising

a longitudinally extending piston-like setback slide member formed with a rearwardly extending nose and mounted for linear displacement within the first of said bores,

a first spring disposed between said housing and said setback slide member for preventing rearward displacement of the slide except in response to sustained setback forces, and

releasable locking means, comprising locking balls and a wedge member and a second and wedge-biasing spring mounted within the setback slide member, for locking the setback slide member against displacement, the locking means being responsive to acceleration forces of setback to unlock the setback slide member, whereupon the setback slide member is displaced rearwardly by the continued acceleration forces of setback;

a first lever pivotally mounted in said passageway;

means for normally biasing said first lever to engage and restrain the arming delay slide member until said first lever is cammed out of engagement with the arming delay slide mechanism by the nose of the setback slide member as the setback slide member is displaced rearwardly;

an arming delay mechanism comprising

a longitudinally extending delay slide member mounted in the second of said bores and normally engaged by said first lever,

a third spring disposed between said delay slide member and said housing for urging the delay slide member forwardly, and

pneumatic regulating means comprising a sac mounted in said second bore and formed with a rearwardly extending bulge adapted to be depressed as the delay slide member moves forward, thereby to delay the displacement of said delay slide member and to establish a predetermined time differential between setback and arming;

and a detonator carrier mechanism comprising

a detonator carrier normally disposed in unarmed position in said chamber,

a second pivotally mounted lever, and

means for normally biasing said second lever to engage and restrain the detonator carrier until said second lever is cammed out of engagement with the detonator carrier by the arming delay slide member as said arming delay slide member is displaced forwardly.

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