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MECHANICAL INTEGRATING FUZE (PNEUMATIC)

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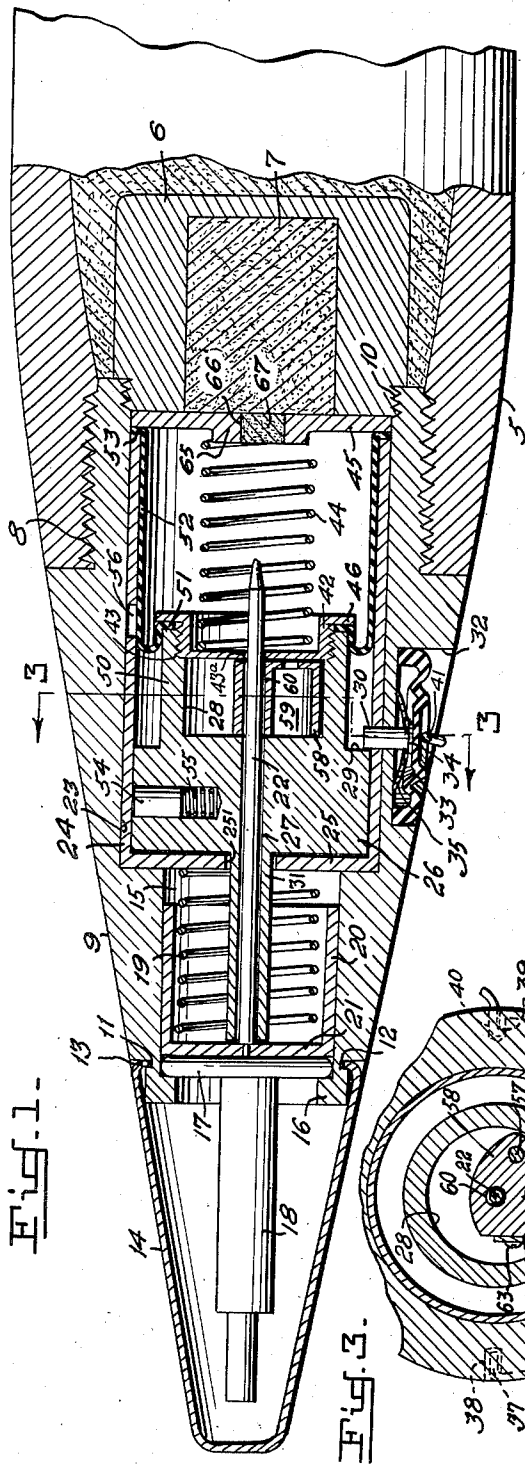


Fig. 1.

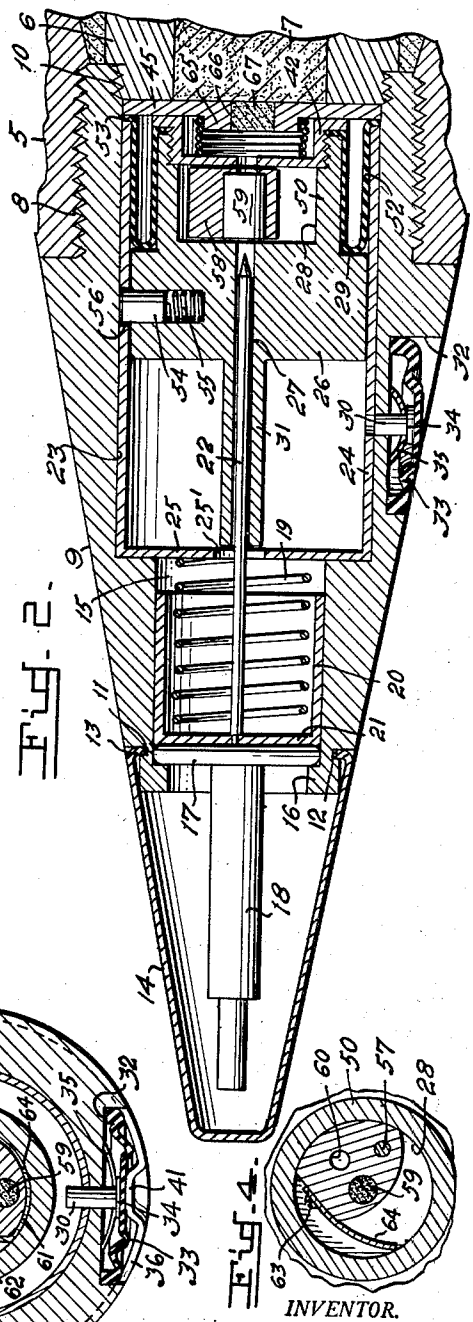


Fig. 2.

Fig. 3.

Fig. 4.

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MECHANICAL INTEGRATING FUZE (PNEUMATIC)

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15 Claims. (Cl. 102—70)

This invention is a pneumatically operated time delay mechanism for arming an artillery projectile fuze.

It has been found that liquid agents used in delay action fuzes have a common fault, namely viscosity changes when subjected to extreme ambient temperature changes, causing uncertain and unpredictable time periods to arm such devices. The structure herein disclosed is not affected by such ambient temperature changes within the ranges encountered under storage or battle conditions. Arming time is controlled by the passage of air through an orifice of predetermined size under the influence of an inertia driven air compressor. The device is simple in construction and assembly, and with the single exception of the orifice, all machining tolerances are large. The organization has the intrinsic safety and stability required in ordnance applications, and substantially all of the required fabrication steps require only automatic screw machine operations.

An object of the invention is to provide a fuze which is hermetically sealed when assembled with a projectile body to exclude dust and moisture.

Another object of the invention is to provide a fuze which is moved from unarmed to armed position, first by inertia imparted thereto by the forces of setback until a pressure equilibrium is established and secondly by inertia imparted thereto by the forward movement of the projectile.

A further object of the invention is to provide a fuze wherein the detonator is held out of armed position by the firing pin until a predetermined time has elapsed to prevent premature detonation.

Other objects and advantages will be apparent from the following detailed description and the accompanying drawings in which:

Figure 1 is a longitudinal sectional view of a portion of an artillery projectile showing a fuze embodying the present invention secured thereto and in safe unarmed position.

Figure 2 is a similar view showing the fuze in armed position.

Figure 3 is a transverse sectional view taken on the line 3—3 of Figure 1 showing the rotor in unarmed position, and

Figure 4 is a similar view showing the rotor in armed position.

Referring now to the drawings, wherein for the purpose of illustration, is shown one form of the invention. Reference character 5 indicates a projectile body of usual construction. Carried near the forward end of the projectile is a cup 6 containing a booster charge 7. The terms "forward" and "rearward" used hereinafter refer to the front and rear ends of the projectile body, regardless of the position the projectile may assume in flight. Threadedly received in the forward end of the projectile, as at 8, is a fuze body 9 which is screw threaded as at 10 to the booster cup 6. At its forward end the fuze body is reduced diametrically and grooved as at 11 to

receive a gasket 12 and the inturned flange 13 of a windshield 14.

Axially formed in the forward end of the body 9 is a first chamber 15 having its forward diameter reduced to form a flange 16 against which rests the enlarged base 17 of a firing hammer 18. Slidably received in the chamber 15 and normally urged forwardly against the firing hammer base 17 by a helical spring 19, is a first cup 20 which has a longitudinal dimension less than that of the first chamber 15. The first cup 20 is positioned in the first chamber with its closed end 21 in contact with the base of the firing hammer and has secured thereto the forward end of a firing pin 22.

Rearwardly of the first chamber 15 and concentric therewith is a second chamber 23 extending rearwardly to a point near the end of the fuze body. A second cup 24 is positioned in the second chamber with its closed end 25 sustaining the backward thrust of the spring 19. Slidably mounted within the second cup 24 in coaxial alignment with the firing pin 22 is a piston 26 having an axial bore 27 and a counterbore 28. A portion of the outer circumference of the piston is diametrically reduced at 50 to form a shoulder 29 against which a safety pin 30 presses to hold the piston 26 in forward safe position. The piston 26 is formed with a forwardly extending reduced neck portion 31 which passes through an opening 25' in the closed end 25 of the second cup to a point close to the closed end 21 of the first cup and contains a continuation of bore 27.

A recess 32 is formed in the side wall of the fuze body concentric with the safety pin 30 and has secured therein a flexible weathertight seal in the form of a diaphragm 33 of rubber or other suitable material. A flat head 34 is formed on the safety pin 30 to receive the thrust of a concave spider-like disk 35 which will act to withdraw the pin from the shoulder 29 before the projectile is placed in a gun. At all other times the pin 30 is forced into safe position (Figure 1) by pressure on head 34 to overcome the bias of spring disk 35. A clamp wire 36 is attached by inserting one bent end 37 thereof, in a cavity 38 in the fuze body and the other bent end 39 in a cavity 40 formed in the fuze body at a point 180° remote from the cavity 38. Centrally thereof the clamp wire is formed with a reentrant portion 41 which bears on the outer side of the diaphragm 33 to hold the safety pin in locked position.

When the piston 26 is held in its forward position the neck 31 projects forward into the first cup 20 and prevents rearward movement of the cup and the firing pin 22 if the projectile is accidently dropped. If the projectile is dropped with the safety pin removed the first cup 20 and firing pin can move only a short distance until the cup 20 abuts the closed end 25 of the second cup 24.

The open end of the counterbore 28 in the piston 26 is closed by a recessed plug 42 screw threaded into the piston as at 43 and having a central opening 43a for passage of the firing pin 22 therethrough. The recess retains the forward end of a helical spring 44. Secured in the rear end of the second chamber 23 by the screw threads 10 in the fuze body 9 and the booster cup 6, is a plate 45 which receives the rearward thrust of the spring 44 to normally hold the piston 26 in its forward position. The plug 42 carries a circumferential flange 46 which overlies the rear end of the diametrically reduced portion 50 of the piston and therewith forms a clamp to hold the inturned forward end 51 of a cylindrical flexible diaphragm structure 52. At its rear end the bellows terminates in an out-turned flange 53 which is clamped between the rear end of the second cup 24 and the plate 45. The diaphragm confines air within itself when positioned in chamber 23 (Figure 1), and is collapsed when

the piston **26** moves rearward in response to set back forces (Figure 2) to force the contained air through the annular metering orifice formed between the firing pin **22** and the bore **27**. Diaphragm **52** may be composed of rubber, polyethylene or "Polythene."

Normally restrained by the side wall of the second cup **24**, and seated in the piston **26** is a detent **54** slidable with the piston to the rearward position thereof, at which time the detent is forced by its spring **55** to enter a socket **56** in side wall of cup **24** (Figure 2).

Rotatably mounted on a pivot element **57** secured to the plug **42** is a rotor or carrier **58** through which is formed an opening to receive a percussion primer **59**, as is best seen in Figure 3. An opening **60** is formed in the rotor to receive the firing pin and to pass the air compressed in the diaphragm **52**. Near the end of rearward movement of the piston, due to inertia imparted thereto by setback forces the rotor **58** is removed from the firing pin **22** (Figure 2) and caused to rotate about its pivot element **57** in a clockwise direction by a flat spring **61** (Figures 3 and 4). The spring **61** has a straight portion **62** secured to the rotor **58** by screw **63**, and a free portion **64** bent by the rotor to press against the surface of the counterbore **28** in the piston **26** when the rotor is restrained by the firing pin. When the rotor **58** is removed from the firing pin the free end **64** of spring **61** will have straightened out somewhat in releasing its energy, to assume a position in frictional contact with the surface of the counterbore **28** to thereby resist counterclockwise movement of the rotor under inertial forces incident to impact.

A boss **65** is formed on the rear plate **45** and has a bore **66** formed therein to receive an explosive charge **67** to conduct fire from the percussion primer to the booster charge **7**.

The operation of the invention is as follows:

In the normal safe position of the fuze the piston **26** is held in the forward position by the safety pin **30**. On removal of the wire clamp **36** the spring disk **35** withdraws the safety pin from behind the shoulder **29** on the piston but the piston is held in forward position by the helical spring **44**. When the projectile is fired the piston will move rapidly backward until equilibrium is set up between the piston chamber pressure and the net setback force. Thereafter the piston **26** moves relatively slowly rearwardly at a constant rate. Air compressed in the diaphragm **52** escapes to the first chamber **15** through the annular orifice formed by the firing pin **22** and the bore **27** in the piston and in the reduced neck portion **31** of the piston. The exhaust air enters the first chamber **15** and passes through the opening **25'** in the closed end of the second cup **24** and into the second chamber **23**. When the piston **26** reaches its rearmost position the spring **44** is compressed and the spring pressed detent **54** is seated in the socket **56** to hold the piston securely locked against the forward bias of the spring **44**.

The time delay provided by the restricted passage of air from the diaphragm **52** to the forward end of the piston provides a bore safe device.

Just prior to reaching its rearward position the rotor **58** is removed from the firing pin **22** and is rotated by its spring **61** to bring the percussion primer **59** into axial alignment with the firing pin and the remainder of the firing train, to fully arm the fuze.

While we have disclosed a form of the invention presently preferred by us, various changes and modifications will occur to those skilled in the art after a study of the present disclosure. Hence the disclosure is to be taken in an illustrative rather than a limiting sense; and it is our desire and intention to reserve all modifications falling within the scope of the subjoined claims.

Having now fully disclosed the invention, what we claim and desire to secure by Letters Patent is:

1. An impact detonated fuze for an explosive projectile comprising in combination, a body member, an axial chamber formed in said body member, a piston slidably received within said chamber and movable axially therein, an axial bore formed in said piston, an elongated firing pin positioned in said chamber and received in part at least within said axial bore, said firing pin being of less diameter than said axial bore to form an annular fluid orifice therebetween, means distortable by sliding axial motion of said piston to compress air and force the same through said fluid orifice whereby upon start of projectile flight the force of set back causes rapid initial piston motion and thereafter relatively slower piston motion.

2. An impact detonated fuze for an explosive projectile comprising in combination a body member, an axial chamber formed in said body member, a piston slidably received within said chamber and movable axially therein, an axial bore formed in said piston, an elongated firing pin positioned in said chamber and received in part at least within said axial bore, said firing pin being of less diameter than said axial bore to form an annular orifice therebetween, a detent normally restraining said piston against motion, a spring member urging against the said piston and a diaphragm secured to said piston and distortable by motion thereof to compress air and force the same through said orifice thereby resisting the said motion.

3. An impact detonated fuze for an explosive projectile comprising in combination a body member, an axial chamber formed in said body member, a piston slidably received within said chamber and movable axially therein, an axial bore formed in said piston, an elongated firing pin positioned in said chamber and received in part at least within said axial bore, said firing pin being of less diameter than said axial bore to form an annular orifice therebetween, a diaphragm secured to said piston and distortable by motion thereof to compress air and force the same through said orifice to resist said motion, a primer carried by said piston, and means to align said primer with said firing pin upon completion of said motion.

4. An impact detonated fuze for an explosive projectile comprising in combination a body member, an axial chamber formed in said body member, a piston slidably received within said chamber and movable therein, an axial bore formed in said piston, an elongated firing pin in said chamber and received in part at least within said axial bore, said firing pin being of less diameter than said axial bore to form an annular orifice therebetween, a diaphragm secured to said piston and distortable by motion thereof to compress air and force the same through said orifice to resist said motion, a rotor pivotally supported in said piston and normally pierced by said firing pin, a primer carried by said rotor, and means responsive to withdrawal of said firing pin from said rotor upon termination of said motion to pivot the same to align the the said primer with the said firing pin.

5. The invention as set forth in claim 4 including a cup member secured to said firing pin and a spring normally urging against said cup member.

6. The invention as set forth in claim 5 including a detent member carried by said piston, and a cavity formed in said body to receive the said detent upon said termination of motion.

7. The invention as set forth in claim 6 wherein the said diaphragm comprises a flexible cylindrical sheet secured to said piston at one end thereof whereby motion of said piston turns the said sheet back upon itself.

8. In an impact fuze, a fuze body having a longitudinal axis of symmetry and a chamber in said body coaxial of said axis, a piston axially slidable in said chamber from a forward safe position to a rearward armed position, arming means carried by said piston for movement from a safe to an armed position relatively to said piston, a firing pin independently slidably mounted in said body and extending through an axial passageway in said piston from front to rear, said pin holding said arming

means in safe position only when said piston is in forward safe position.

9. An impact fuze as recited in claim 8, said piston in moving to rearward armed position freeing said arming means from said firing pin, means urging said arming means to armed position relatively to said piston and means fixed with said piston and engaging said firing pin to hold the same against movement to firing position only when said piston is in forward safe position.

10. An impact fuze as recited in claim 9, said arming means comprising a rotor pivoted on said piston on an axis parallel to and radially offset from said firing pin, and a primer carried by said rotor, said primer being moved by said rotor from safe position radially offset from said firing pin, to armed position aligned with said firing pin.

11. In an impact fuze, a fuze body having a longitudinal axis of symmetry and a cylindrical chamber coaxial of said axis, a piston slidable axially in said chamber from a forward safe position to a rearward armed position, there being a metering passageway axially through said piston, and a flexible non-metallic diaphragm in said chamber and connected with said piston to form therewith an enclosure from which gas can escape only through said passageway, the volume of said enclosure being decreased in response to movement of said piston to armed position, whereby the rate of movement of said piston to armed position is controlled.

12. A fuze as recited in claim 11, a member movably mounted on said piston from a first safe position to a second armed position, a firing pin extending rearwardly through said passageway and movable axially from a forward safe position to a rearward firing position, said firing pin in forward position engaging and holding said member in safe position only when said piston is in forward position, means limiting said firing pin to axial movement less than the corresponding movement of said piston, means connected with said piston and holding said firing pin in forward position only when said piston is in forward position, means urging said member to armed position, a primer carried by said member and aligned with said firing pin when said member is in armed position, and means yieldingly urging said piston and firing pin into forward position.

13. In an impact detonated fuze, a fuze body having a longitudinal axis of symmetry, there being forward and rearward cylindrical chambers in said body coaxial of said axis said rearward chamber defining a forward closed bottom having a concentric opening therein, a piston fitting said rearward chamber for sliding from a forward safe position to a rearward armed position, said piston having a reduced rearward end portion and a reduced central neck portion extending forwardly through said opening in the forwardly-closed bottom of said rearward chamber, there being an axial passageway through said piston and neck portion, a firing pin slidably fitting said passageway means limiting the rearward sliding movement of said firing pin to a distance less than the corresponding movement of said piston comprising a cup secured to the forward end of said firing pin and slidably mounted in said forward chamber, spring means normally biasing between the base of said cup and the forwardly-closed bottom of said rearward chamber, the base of said cup normally abutting the forward end of said neck portion when said piston is in forward safe position,

and arming means carried by said piston and held in unarmed position by said firing pin only when said piston is in forward position.

14. A fuze as in claim 13, a diaphragm of non-metallic flexible material fitting said chamber and secured about the reduced rearward end of said piston to form a fluid-tight enclosure therewith of reducing volume in response to rearward movement of said piston, the space between said firing pin and passageway forming a metering exit for gas from said enclosure.

15. An impact detonated fuze for an explosive projectile, said fuze including a body having a windshield and a booster charge secured thereto and adapted for threadable engagement with said projectile, said fuze body having forward and rearward concentric bores formed therein, said forward bore being of less diameter than said rearward bore, and having its forward diameter reduced to form a flange, a firing hammer defining an enlarged base, said base being slidably received in said forward bore, a first cup slidable in said forward bore and having a longitudinal dimension less than said second bore, a second cup fixed in said rearward bore, there being a reduced concentric opening in the base wall of said second cup, a plate carrying a concentrically disposed primer, said plate being interposed between said second cup and said booster charge, an expansion spring in said forward bore normally biasing between the base walls of said first and second cups to urge said first cup and said hammer base in a forward direction, a piston slidably received in said rearward bore defining a forwardly extending reduced stem portion and an annular reduced rearward portion having an annular chamber formed in its outer face, said stem adapted to slide in said opening in the base wall of said second cup, there being an axial bore piercing said piston and stem, an elongated firing pin slidable in said axial bore and connected at its forward end to the base wall of said first cup for reciprocal movement therewith, said firing pin being of less diameter than said axial bore in said piston and stem to form an orifice therebetween, an arming rotor carrying a primer pivotally mounted to said piston in said annular chamber adapted to be pierced by the inner end of said firing pin only when said piston is in a rearward armed position to prevent rotation of said rotor and alignment of said primer in said rotor with said primer in said plate, a flexible diaphragm secured to said piston at its annular reduced portion thereof and at its other end between said second cup and said plate, said diaphragm adapted to distort upon rearward motion of said piston to compress and force air through said orifice to impinge upon said first cup to resist rearward motion of said pin, a spring-biased detent carried by said piston adapted to snap into an opening in the wall of said second cup upon full rearward travel of said piston to lock said piston in armed position and means responsive to withdrawal of said firing pin from said rotor upon said rearward travel of said piston to permit said rotor to rotate to align said primer in said rotor with said primer in said plate.

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