April 11, 1950 R. S. SPERRY 2,503,519

FUSE

Filed May 7, 1945

Fig. 1.

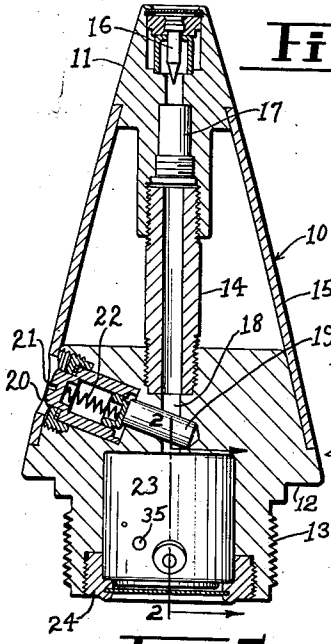



Fig. 7.

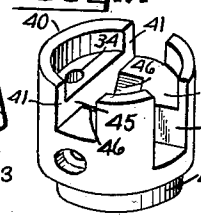



Fig. 2.

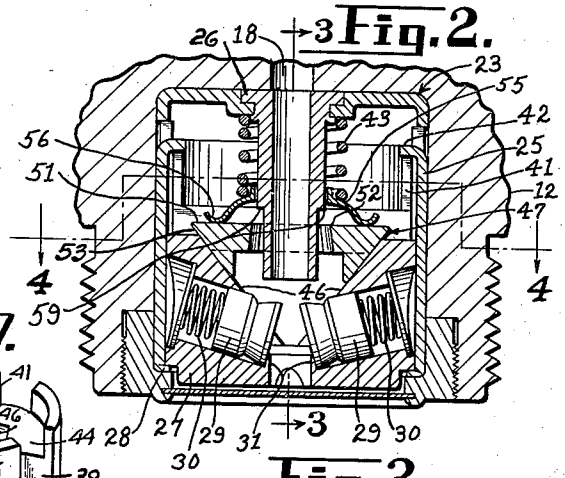



Fig. 3.

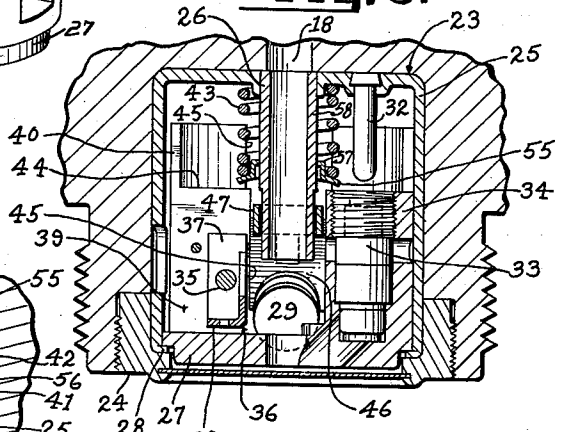



Fig. 5.

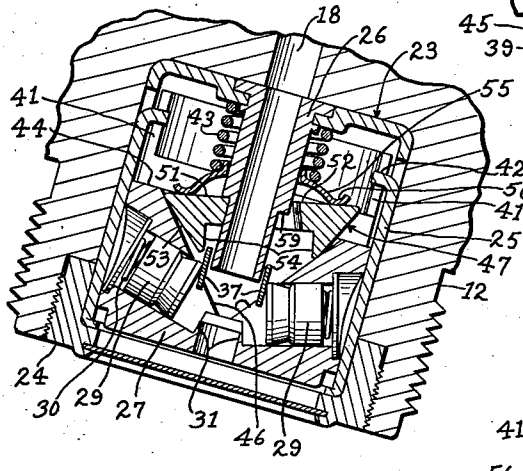



Fig. 4.

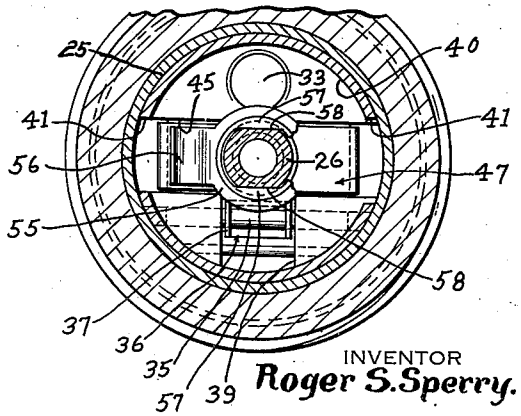
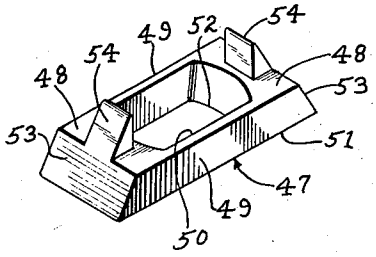



Fig. 6.

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# UNITED STATES PATENT OFFICE

2,503,519

## FUSE

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17 Claims. (Cl. 102—71)

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This invention relates to fuses for shells or projectiles. More particularly, the invention relates to a safety device incorporated in standard types of fuses, particularly of the delayed action type to automatically check the operation of the delay action mechanism of the fuse, as well as to at times prevent any action of the fuse to ignite or explode the projectile in the event that the projectile develops a wobble or yaw due to excessive wear or inaccuracies of any type or kind in the gun barrel from which the projectile is discharged. The novel features of the invention will be best understood from the following descriptions when taken together with the accompanying drawing, in which certain embodiments of the invention are disclosed and in which the separate parts are designated by suitable reference characters in each of the views; and in which:

Fig. 1 is a longitudinal sectional view through a fuse diagrammatically illustrating the general arrangement of the fuse structure and indicating the delay action mechanism in elevation.

Fig. 2 is an enlarged sectional view through the delay action mechanism of the fuse shown in Fig. 1 and taken at right angles to the illustration in Fig. 1.

Fig. 3 is a section on the line 3—3 of Fig. 2.

Fig. 4 is a cross section on the line 4—4 of Fig. 2 with spring omitted.

Fig. 5 is a view similar to Fig. 2, showing the parts in a different position and illustrating the safety device in operative position rendering the fuse inoperative; and

Fig. 6 is a perspective view of the control element of the safety device detached and on an enlarged scale, and

Figure 7 is a perspective view of the weighted detonating member shown on a reduced scale.

In fuses of the type and kind under consideration, and particularly those employing the delay action mechanism which is automatically operated by a member movable in the fuse upon impact of the fuse with an object or upon any sudden checking of the forward progress of a projectile, it has been experienced, that when shells or projectiles having these fuses are shot from worn or faulty guns, the shell or projectile develops a wobble or yaw, causing the automatically movable means of the delay action mechanism to be set in motion to explode the projectile prematurely. This premature explosion of the shell or projectile can take place at any point between the gun firing the projectile and the objective, and thus has been found to be extremely objectionable and detrimental.

In order to correct and obviate this defect and objectionable characteristics to fuses of the kind under consideration, I have provided a safety control device automatic in operation, which will

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check and lock the delayed action mechanism from functioning if an appreciable wobble or yaw prevails in the shell or projectile, so as to positively prevent firing of the shell through the agency of the delay action mechanism. Under such conditions, when a gun is known to cause wobble or yaw of projectiles fired therefrom, the fuse may, nevertheless be adjusted to detonate the shell, on impact, through the usual detonator employed in the tip of the fuse.

In order to illustrate one adaptation of the invention, I have shown in Fig. 1 of the drawing a more or less standard delay action fuse 10, comprising a tip body portion 11 and an enlarged inner body portion 12 externally threaded, as seen at 13, for attachment to a shell or projectile. The bodies 11 and 12 are joined by a center coupling tube 14 and by a conical casing 15 seating in the walls of the bodies 11 and 12, in the manner clearly shown. Supported in the outer end portion of the tip body 11 is an inwardly directed firing pin 16 adapted to strike a detonator 17 supported in the body 11 upon impact of the shell or projectile.

The body 12 has a passage 18 in alinement with the bore of the tube 14, and extending into the passage 18 is a pin 19 blocking the passage 18 to prevent the fuse from igniting or exploding the shell upon operation of the detonator 17. The pin 19 forms part of a rotary adjustable control device 20 exposed through the body 12 and having a key or screw driver slot 21 at its outer surface. In the position of the slot shown in Fig. 1, the device 20 is set for delay action of the fuse. However, by rotating the device 20 to arrange the slot at right angles to the position shown, the device will be released to allow the pin 19 to move outwardly against the action of the spring 22 by centrifugal force opening the passage 18 allowing the shell to instantaneously explode upon impact with an objective.

At 23 is shown in elevation in Fig. 1 of the drawing the delay action mechanism of the fuse which is held in place in the body 12 by a sleeve type nut 24. The mechanism 23 comprises a cup shaped casing 25, the closed end portion of which includes a center tube 26 in alinement with the passage 18, and extending into the casing 25 to the degree substantially illustrated in Figs. 2, 3 and 5 of the drawing.

A weighted member or plunger 27 is mounted to move smoothly in the casing 25 and is retained against displacement through the open end thereof by an inturned flange 28 on the casing. Two plunger type check devices 29 are oppositely seated in opposed bores in the member 27. Springs 30 normally urge each device radially inwardly against inner stops 31. These stops are in alinement with the inner end of the center tube 26 of the casing 25. It will

thus appear that these devices when in the position shown in Fig. 2, will check movement of the member 27 in the direction of the closed end of the casing, or upwardly, as seen in Fig. 2, to prevent a firing pin 32 from striking the delay action detonator 33, as will be seen from Fig. 3. The pin 32 is supported in the closed end of the casing 25 at one side of the tube 26, whereas the detonator 33 is supported in a bore 34 of the member 27, as clearly seen in Fig. 3.

Pivotally supported, as seen at 35 in the member 27 is a yoke-shaped blocking member 36, the side arms 37 of which are adapted to swing into position between the plunger devices 29 to hold them in radially outward position, as seen in Fig. 5 of the drawing, when the devices 29 are forced outwardly by centrifugal force. The cross head 38 of the blocking member 36 forms a weighted end on this member, which causes the arms 37 to swing inwardly into the operative position shown in Fig. 5 by centrifugal force. The member 36 is free to swing in a recess portion 39 formed in the member 27, as illustrated in Fig. 4 of the drawing. The member 27 includes a sleeve extension 40 which is recessed at opposite sides, as seen at 41, Figures 4 and 7, and in these recesses inturned key members 42 on the casing 25 retain the member 27 against rotation in the casing 25.

A spring 43 seats on the end wall of the cup shaped casing and, in the standard fuse detonator mechanisms 23, this spring seats upon the surface 44 of the member 27 to urge the same into safe position. In the normal use of the fuse, when the projectile strikes an object or its forward advance is retarded, the weighted member 27 will move forwardly or in the direction of the body 11 against the action of the spring 43 to bring the firing pin 32 in engagement with the detonator 33.

The above described construction deals with a more or less standard type of delayed action fuse as used by the armed forces.

Incorporating my improved automatic safety device in fuses of the kind under consideration, the following more specifically described alterations and changes in the standard fuse are made and the parts now described are added.

In the first place, the weighted end portion of the member 27 in a position at right angles to the recess 39 is provided with a recess 45 terminating in bevelled end walls 46, clearly shown in Figs. 2, 5 and 7 of the drawing. These bevelled walls converge inwardly with respect to the axis of the member 27 and are arranged in alinement with the check devices 29.

In the recess 45 is arranged a safety control element 47 shown in detail in Fig. 6 of the drawing. The element 47 may be generally described as an O shaped element comprising similar weighted ends 48 joined by narrow side walls 49 which form a large elongated opening 50 within the element. The end walls of the opening 50 are preferably contracted in the direction of the upper or outer surface 51 of the element in order to form relatively sharp pawl like edges 52 on the element at the surface 51 thereof. The ends of the element 47 have bevelled walls 53 which extend onto downwardly directed extensions 54 centrally of the ends of the lower surfaces of said element, and these bevelled walls are adapted to seat on the bevelled walls 46 of the member 27 in the manner clearly illustrated in Fig. 2 of the drawing.

The position of the element 47 shown in Fig. 2 of the drawing will be the normal position of said element, or the position assumed thereby in the normal progress of a shell or projectile. This element may be referred to as a wedge block, and the element or block is supported in his position by a yoke 55 upon which the spring 43 bears. In order to maintain the laterally extending curved arms 56 of the yoke in position to engage the surface 51 of the element 47 at the weighted ends 48 thereof, the hub portion of the yoke has inturned portions 57 (note Fig. 4), which bear against flattened sides 58 on the tube 26. The flattening of the sides 58 of the tube constitutes one of the changes in the structure of this tube. This flattening of the tube also provides free movement of the tube through the opening 50 in the element or wedge block 47 in the normal advance of the member 27 in the casing 25, with the parts in the position shown in Fig. 2. The other change in the tube 26 is the provision of the reduced end portion to form the stop shoulder 59 thereon. This shoulder is adapted to be engaged by one of the pawl like corners 52 of the element 47, as indicated in Fig. 5 in forming a wedge, checking forward movement of the weighted member 27 to such a degree as to prevent the pin 32 from engaging the cap or firing device of the detonator 33.

It will be understood that the element or wedge 47 will be in the form of a balanced device, so as to maintain the central position of the element at all times in the proper travel of a shell or projectile. However, in the event that the shell or projectile develops a wobble or yaw in its progress through the air, this action of the shell or projectile creates an unbalanced condition which will cause the element or wedge to be thrown or moved into the tilted position, such for example as indicated in Fig. 5 of the drawing, moving the same into engagement with the stop shoulder 59. The member 27 will be maintained in this position, and assuming the pin 19 to be set in the position shown in Fig. 1 to block the passage 18, a shell or projectile will become a dud and will not explode. However, when knowing that a gun is faulty and will cause the wobble or yaw in the shell or projectile, the gunner can set the device 20 so as to free the pin 19, thus permitting the shell to explode through the medium of the firing pin 16 upon impact with the objective in that the passage 18 is cleared through the fuse. At all times, however, the delay action detonator 33 becomes inoperative. In this way, the fuse becomes absolutely safe in use, and assurance is maintained that the shell will not prematurely explode due to wobble or yaw, and if adjusted to explode, it can explode only upon impact with an objective, as described.

The angularity of the bevelled surfaces or walls 46 and 53 will control to a large degree the sensitiveness of the safety or control element 47. The greater the angle on these walls or surfaces, the greater degree of distortion or wobble will be necessary to move the element into the operative blocking or wedging position. Thus by changing the angularities a control may be had to govern the functioning of the safety device. In any event, it is essential that this device is made to function when the wobble or distorted movement is sufficient to cause the member 27 to be moved forwardly in the casing 25. However, it is undesirable to render delay action mechanism of a fuse inoperative if the shell or projectile can

be brought to its objective without premature explosion. On the other hand, it is essential that the delay action mechanism be rendered inoperative as and when the wobble or distorted movement is sufficiently great to cause or bring about a premature explosion of the shell. It is preferable to render the shell or projectile entirely inoperative or a dud than to take any chances on premature explosion thereof.

It will be understood that the structure as herein shown and described illustrates one adaptation and use of the invention and is shown as what might be termed an attachment built into a standard type of fuse. It will be apparent, however, that in designing a fuse to incorporate a safety or control element of the type and kind under consideration, a structure of this element will be modified to suit a particular design and arrangement of fuse.

My invention comprises the use of a safety control element actuated upon the presence of distorted or wobble movement in a shell or projectile, sometimes referred to as a yaw, to render the fuse entirely inoperative, or at least to render delay action mechanism of a fuse inoperative. Another way to express this conception, would be to say that a fuse if provided with a safety device automatically actuated upon the presence of distorted movement in the progress of a shell will prevent premature explosion of the shell.

It will also be apparent that in my invention, as disclosed in the accompanying drawing, the entire mechanism of the safety device is built into, and constitutes part of the delay action mechanism of the fuse and in no way changes or alters the structure of the fuse as a whole. By reason of this fact, standard delay action mechanisms of fuses objectionable from the standpoint heretofore mentioned, can be reconstructed to incorporate, as attachments, my improved safety device which simply adds two parts, namely the element 47 and the yoke 55, and modifying the member 27 to provide therein the recess for the element 47 and modifying the tube 26 to put the flat surfaces 58 thereon and reduce the end of the tube to provide the stop shoulder 59. It will therefore be seen that undesirable fuses or delay action mechanisms of fuses having faulty properties as now constructed, can be revised in a simple manner to render the same practical and foolproof in operation under all existing conditions.

Having fully described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In delay action fuses of the character described, a delay action mechanism comprising a weighted plunger, a detonator mounted in and movable with the plunger, a firing pin fixed in said mechanism in axial alinement with respect to said detonator, a tube fixed in said mechanism centrally of said plunger, said plunger having a bevelled wall recess through which said tube is free to pass, a check device mounted on the tube and having bevelled end portions normally seating in the bevelled walls of the recess of said plunger, a spring supporting said check device in seated position in the plunger and the plunger with its detonator in spaced relationship to said firing pin, and said tube and check device having portions adapted to interengage in a shifted position of said check device in said plunger to check movement of the plunger longitudinally of said tube and in supporting the detonator out of engagement with the firing pin.



2. In delay action fuses of the character described, a delay action mechanism comprising a weighted plunger, a detonator mounted in and movable with the plunger, a firing pin fixed in said mechanism in axial alinement with respect to said detonator, a tube fixed in said mechanism centrally of said plunger, said plunger having a bevelled wall recess through which said tube is free to pass, a check device mounted on the tube and having bevelled end portions normally seating in the bevelled walls of the recess of said plunger, a spring supporting said check device in seated position in the plunger and the plunger with its detonator in spaced relationship to said firing pin, said tube and check device having portions adapted to interengage in a shifted position of said check device in said plunger to check movement of the plunger longitudinally of said tube and in supporting the detonator out of engagement with the firing pin, means keying the plunger against rotation in the mechanism to maintain alinement of the firing pin with said detonator, said check device comprising an elongated member, a yoke forming a seat for one end of said spring, means keying the yoke on said tube, and said yoke having ends engaging the end portions of said check device.

3. In delay action mechanisms for fuses of the class described, a casing, a tube centrally of and extending into said casing from one end wall thereof, a plunger mounted in and movable longitudinally of the casing, means keying the plunger against rotation in said casing, said end of the casing having at one side thereof a fixed firing pin, the plunger in alinement with said pin having a detonator, a spring supporting the plunger with the detonator thereof in wide spaced relationship to said firing pin, means keyed to and freely movable in said plunger and encircling said tube for checking movement of said plunger longitudinally of the casing, a yoke between said spring and said last named means for normally supporting said means in centralized position in said plunger, and interengaging means on said last named means and said tube forming the check of the plunger to maintain the detonator out of operative engagement with said firing pin in angular movement of said last named means in the plunger by the presence of distorted wobble or yaw movement contributed to said mechanism in the use thereof.

4. In delay action mechanisms for fuses of the class described, a casing, a tube centrally of and extending into said casing from one end wall thereof, a plunger mounted in and movable longitudinally of the casing, means keying the plunger against rotation in said casing, said end of the casing having at one side thereof a fixed firing pin, the plunger in alinement with said pin having a detonator, a spring supporting the plunger with the detonator thereof in wide spaced relationship to said firing pin, a check device keyed to and freely shiftable in said plunger and encircling said tube for checking movement of said plunger longitudinally of the casing, a yoke between said spring and said device for normally supporting said device in centralized position in said plunger, interengaging means on said check device and said plunger arranged to maintain said detonator out of operative engagement with said firing pin in the event said check device shifts angularly with respect to said plunger due to the presence of distorted wobble or yaw movement contributed to said mechanism in the use thereof, other means actuated under the influence of centrifugal force freeing the plunger for

movement longitudinally of the casing when said device is maintained in unshifted centralized position in said plunger, and means keying said yoke against rotation on said tube.

5. In fuses, the combination with delay action mechanisms therefor comprising a movable member supporting the detonator of said mechanism and a fixed member over which the movable member passes, of a check device having bevelled end walls, said movable member having a bevelled wall socket in which said device is adapted to seat, a spring supporting said device in seated position in said movable member and said member in predetermined position in said mechanism, said device maintaining centralized position in the movable member in the normal progress of a projectile with which the fuse is attached, said device being automatically movable into shifted position in the movable member when said projectile develops a wobble or yaw, and interengaging means on said device and fixed member in the shifted position of said device for checking movement of the movable member in said mechanism to support the detonator thereof in non-firing position.

6. An attachment for delay action mechanism, of fuses, said mechanism comprising a casing, a plunger keyed to and movable longitudinally of the casing, a detonator mounted in said plunger, a fixed tube centrally of the casing and over which said plunger is movable, a spring supporting the plunger in one end of the casing, means automatically movable under the influence of centrifugal force providing free movement of the plunger longitudinally of said casing and tube, said attachment comprising a wedge member interposed between said spring and said plunger and encircling said tube, said plunger having a bevelled wall socket, said wedge member having bevelled walls seating in said socket maintaining centralized position of the wedge member in said plunger, a shoulder on said tube adjacent the wedge member, and said wedge member having pawl-like projections adapted to engage the shoulder of said tube to support said member in position checking movement of the plunger longitudinally of said casing.

7. An attachment for delay action mechanism of fuses, said mechanism comprising a casing, a plunger keyed to and movable longitudinally of the casing, a detonator mounted in said plunger, a fixed tube centrally of the casing and over which said plunger is movable, a spring supporting the plunger in one end of the casing, means automatically movable under the influence of centrifugal force providing free movement of the plunger longitudinally of said casing and tube, said attachment comprising a wedge member interposed between said spring and said plunger and encircling said tube, said plunger having a bevelled wall socket, said wedge member having bevelled walls seating in said socket maintaining centralized position of the wedge member in said plunger, a shoulder on said tube adjacent the wedge member, said wedge member having pawl-like projections adapted to engage the shoulder of said tube to support said member in position checking movement of the plunger longitudinally of said casing, a yoke interposed between said spring and said wedge member, and means keying said yoke on said tube.

8. In mechanisms of the class described employing a fixed axial member and a plunger keyed with respect to and movable longitudinally to the axis of said member, a blocking element interposed between said member and plunger, said element and member having interengaging means for blocking movement of the plunger axially of said member when said mechanism is subjected to distorted movement radially with respect to the axis of said member, said element having balanced ends extending radially with respect to the axis of said member, said ends having bevelled surfaces, and said plunger having a bevelled wall socket forming a seat for said element.



9. In mechanisms of the class described employing a fixed axial member and a plunger keyed with respect to and movable longitudinally to the axis of said member, a blocking element interposed between said member and plunger, said element and member having interengaging means for blocking movement of the plunger axially of said member when said mechanism is subjected to distorted movement radially with respect to the axis of said member, said element having balanced ends extending radially with respect to the axis of said member, said ends having bevelled surfaces, said plunger having a bevelled wall socket forming a seat for said element, and tensional means for supporting said element in seated position in said plunger.

10. In delay action mechanisms for fuses of the class described, a casing, a tube centrally of and extending into said casing from one end thereof, said tube having a body portion and a free end portion of lesser diameter than said body portion to form a shoulder on the outer periphery of said tube, a plunger mounted in and movable longitudinally of said casing, means keying said plunger against rotation in said casing, a wedge block keyed to but freely shiftable in said plunger, said block having weighted ends and an opening for encircling said tube, a yoke having a hub portion fitted around said tube, a spring encircling said tube and contained between said yoke and a wall of said casing so as to exert pressure on said yoke, said yoke having laterally extending curved arms bearing upon said weighted ends of said wedge block, all adapted and arranged whereby the presence of distorted wobble or yaw movement contributed to the mechanism in the use thereof causes said wedge block to shift and become engaged by said tube shoulder thereby preventing any forward movement of said plunger in said casing.

11. In delay action mechanisms for fuses of the class described, a casing, a tube centrally of and extending into said casing from one end thereof, said tube having a body portion and a free end portion of lesser diameter than said body portion to form a shoulder on the outer periphery of said tube, a plunger mounted in and movable longitudinally of said casing, means keying said plunger against rotation in said casing, a detonator mounted in and movable with said plunger, a firing pin fixed in said mechanism in axial alignment with respect to said detonator, and a wedge block keyed to and freely shiftable in said plunger, said wedge block having weighted ends responsive in movement to the presence of distorted wobble or yaw contributed to the mechanism thereof, all adapted and arranged whereby said wedge block engages said tube shoulder when in a tilted position to prevent any forward movement of said plunger in said casing and consequent contact of said firing pin with said detonator.

12. In a projectile having a fuse, a delay action mechanism therefor comprising in combination, a casing, a plunger mounted in and movable lon-

gitudinally with respect to said casing, a detonator carried in said plunger, a tube fixedly mounted in said casing centrally of said plunger, a wedge-shaped block having an elongated aperture therethrough and weighted end portions on either side of said aperture, said plunger having a bevelled wall recess therein forming a seat for said block when the projectile is in steady flight, spring means for supporting said block in said seated position, and inter-engaging means on said block and said tube effective to prevent forward movement of said plunger when said block has shifted due to the presence of wobble or yaw in the projectile and thereby render said detonator inoperative.

13. In mechanisms of the class described employing a fixed axial member and a plunger keyed with respect to and movable longitudinally to the axis of said member, a blocking element interposed between said member and said plunger, said element and said member having inter-engaging means for blocking movement of the plunger axially of said member when said mechanism is subjected to distorted movement radially with respect to the axis of said member, said element having weighted ends and an aperture therebetween, said ends having bevelled surfaces, said plunger having a bevelled wall recess forming a seat for said element, a yoke supported by said fixed member, said yoke having outwardly extending arms contacting said weighted ends, and tensional means for supporting said element in seated position in said plunger against accidental displacement.

14. In projectile fuses employing an impact detonator having adjustable means for rendering the detonator inoperative or operative as desired, the combination of, a casing, a tube fixedly mounted in said casing and arranged to allow the passage of the flash from the impact detonator when such is operative, a balanced wedge block having bevelled end walls and an aperture therebetween, a plunger adapted to house a delay action detonator, said plunger arranged to move forwardly in said casing upon impact of said fuse, a firing pin fixed in said casing in alignment with said detonator, said plunger having a bevelled central recess arranged to mate with said bevelled end walls of said wedge block in normal progress of a projectile with which the fuse is coupled, and a pair of opposite plunger pins resiliently mounted in said casing beneath said fixed tube so as to prevent accidental forward movement of said plunger, said pins being adapted to slide outwardly within said casing under centrifugal force releasing said plunger for forward movement, all adapted and arranged whereby said block is responsive to conditions of wobble or yaw in the projectile and tilts in such manner as to prevent the forward movement of said plunger to detonate said delay action detonator.

15. A delay action mechanism for fuzes, comprising a casing, a plunger movable in said casing, in response to deceleration, from a first to a second or firing position, a primer carried by said plunger, a member fixed to said casing and extending centrally of said plunger, said plunger



having a beveled wall recess therein forming a seat to receive a spring-biased check device in a normal or angular locked position whereby said device in said normal position is inoperative when a projectile carrying said fuze is in steady flight, said device being loosely keyed to said plunger and having weighted ends responsive in movement to yaw or wobble of the projectile thereby moving said device in said recess to said angular position, resilient means urging said member and plunger into said first position, said device and member being adapted to interengage when said device moves angularly as aforesaid to thereby positively prevent movement of said plunger into said second position.

16. In a fuze, the combination with a delay action mechanism, a first member supporting the detonator of said mechanism and movable, under deceleration from a first position to a second, or detonating position, a second member relative to which said first member moves in passing from said first to said second position, said first member having a beveled wall recess therein forming a seat to receive a spring-biased control element in a normal or angular locked position whereby said element in said normal position is inoperative when a projectile carrying said fuze is in steady flight, said element being loosely keyed to said first member and having weighted ends responsive in movement to yaw and wobble of the projectile thereby shifting said element to said angular position relative to said first member, to thereby cause said members to interengage and positively prevent movement of said first member into detonating position.

17. In a delay action fuze, first and second members relatively translatable by and in response to deceleration of said fuze to detonate said fuze, and a control element shiftable between a normal and an angular position and seated in a beveled wall recess in one of said members, said element being loosely keyed to said member and having weighted ends responsive in movement to yaw and wobble of a projectile carrying said fuze thereby shifting said element to said angular position relative to said member, said element when so shifted, engaging the other said member to positively prevent relative translation of said members into detonating relation.

ROGER S. SPERRY.

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