Sept. 14, 1948. J. B. MacLEAN ET AL 2,449,170

BOMB FUSE

Filed Nov. 8, 1943 2 Sheets-Sheet 1

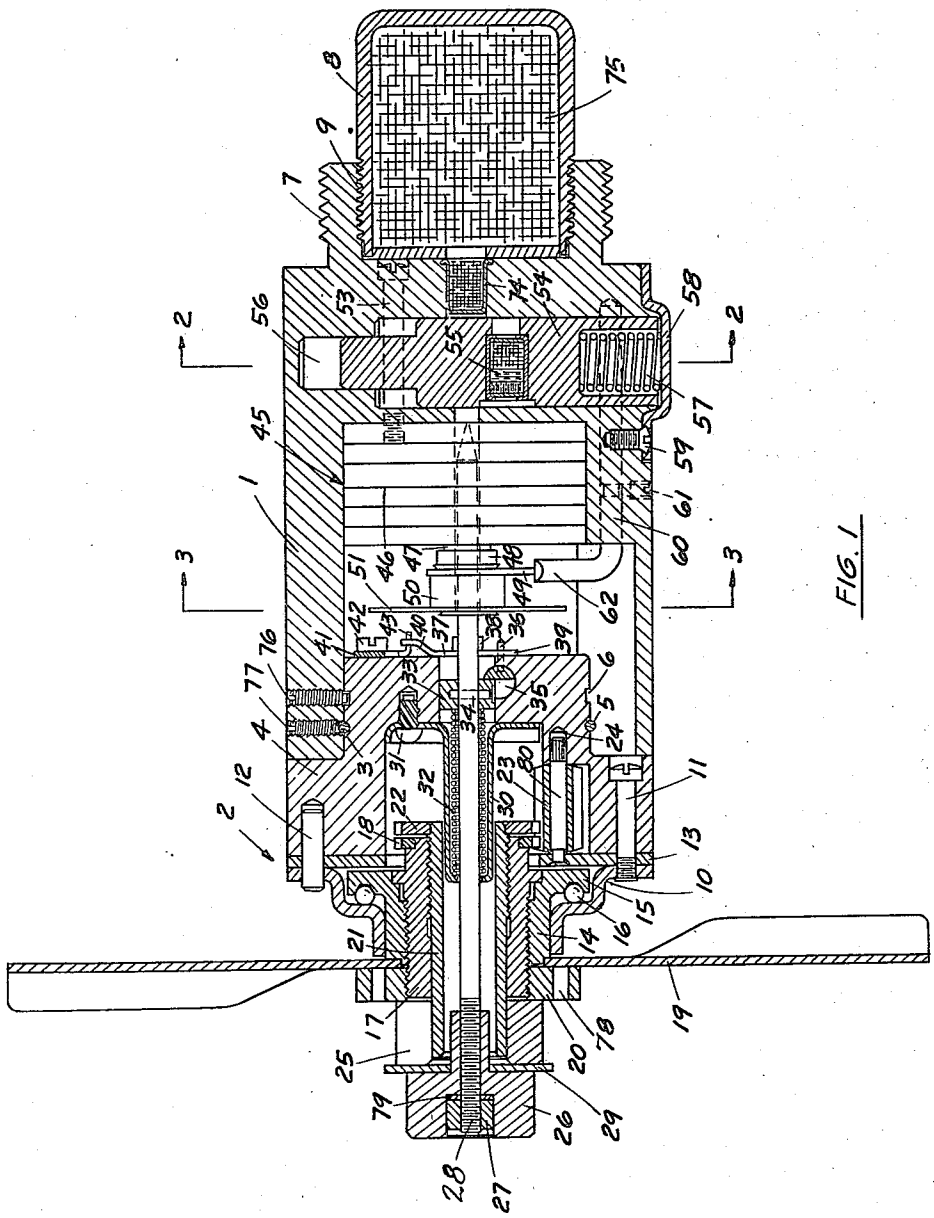


FIG. 1

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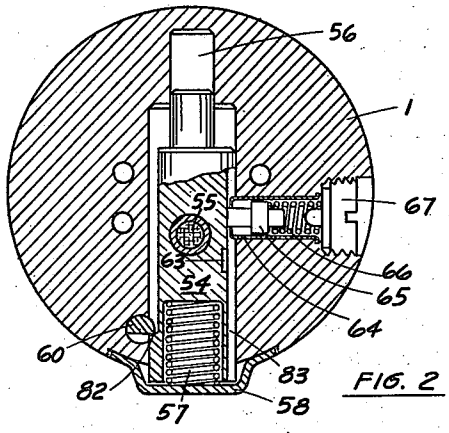


FIG. 2

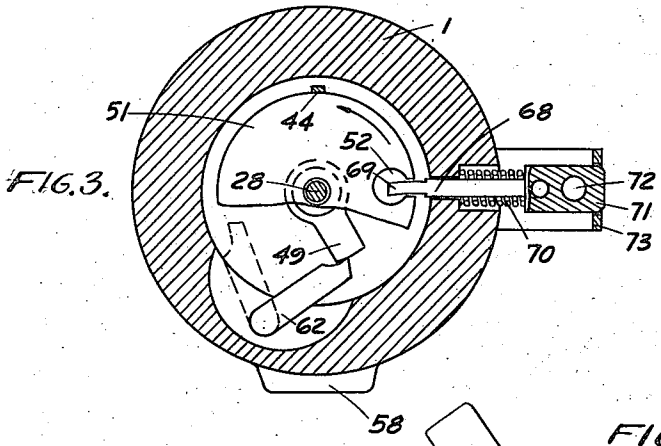


FIG. 3.

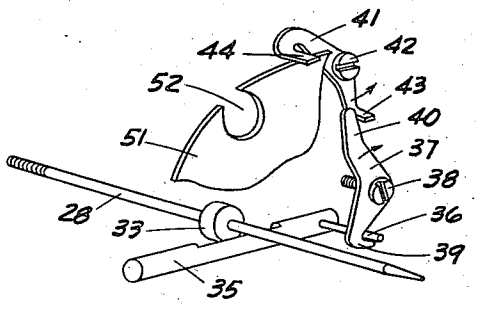
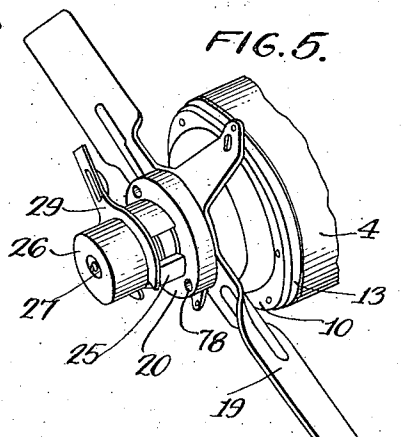


FIG. 4

FIG. 5.



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BOMB FUSE

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4 Claims. (Cl. 102—84)

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This invention relates in general to bomb fuzes and more particularly to fuzes for aerial drop bombs arranged to detonate a predetermined time interval after being dropped from a plane. The main object of the invention is to provide a mechanical time fuze of this type which is normally safe and which arms only a predetermined interval after the bomb leaves the plane.

According to one feature of the invention, the detonator is carried by a movable member and is normally held in a safe position out of the path of movement of the firing pin. The release of the detonator to armed position is controlled by the same timing movement which controls the release of the firing pin to detonate the bomb.

Another feature of the invention resides in the manner in which the detonator slider is held in safety position and released by the timing movement.

According to a further feature of the invention, the timing movement releases the detonator slider to armed position after a predetermined fixed interval which is less than the shortest interval to which the firing pin release mechanism may be adjusted.

In some cases with certain types of bombs it is the practice to install a fuze on the tail of the bomb as well as on the nose of the bomb. This is an added precaution to insure detonation of the bomb at the desired time since if one fuze should fail the other will detonate the bomb. The fuzes may be similar in all respects except that the vane for the tail fuze is somewhat longer to insure its proper operation by the air stream, and the arrangement of the ball bearing assembly is reversed from that of the nose fuze. For the purpose of illustration, a tail fuze is disclosed and described herein.

The aforementioned objects and features of the invention and others not specifically pointed out above will become apparent and a clear understanding of the invention may be had from a perusal of the following specification when read in connection with the accompanying drawing, comprising Figs. 1 to 4, inclusive, in which

Fig. 1 is a cross-sectional view of a complete tail fuze embodying the present invention;

Fig. 2 is a cross-section taken along the line 2—2 of Fig. 1;

Fig. 3 is a cross-section taken along the line 3—3 of Fig. 1;

Fig. 4 is a schematic diagram illustrating the relationship and operation of the firing pin release mechanism; and

Fig. 5 is a perspective view of the head end of the fuze.

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Referring in detail to the drawing, the fuze consists essentially of a body section 1 and a head assembly 2 rotatably secured thereto. The head assembly 2 comprises a casing head 4 having a projecting portion which extends into the cavity within the body 1. The head is retained within the body by means of a spring wire 5 which normally lies within the groove 3 in the inner surface of body 1. When the head is inserted in the body a plurality of screws such as 17 are screwed down in order to push the spring wire 5 part way into a complementary groove in the cylindrical surface of head 4. This spring wire 5, therefore, holds the head and body together and at the same time permits the head to be rotated in order to adjust the time setting of the fuze as will be explained later.

As an additional precaution the cylindrical surface of the reduced portion of head 4 is provided with a further groove 6 and the body 1 is provided with a plurality of screws 16 having reduced end portions which fit into the groove 6 thereby insuring that the head 4 will not become separated from body 1.

The left hand end of the head 4 as seen in Figs. 1 and 5, mounts the vane assembly which is utilized to prepare the fuze for detonation. This vane assembly includes an inner ball race 14 which is in threaded engagement with the hub 17. The vane 19 fits over the hub 17, the hub being slabbed on one side so that the vane can not turn thereon. The vane 19 is retained against a shoulder on the inner ball race 14 by means of the vane nut 20. The vane nut 20 is provided with holes 18 adapted to receive a suitable wrench so that the nut may be tightened on the hub to securely clamp the vane onto the inner ball race.

The inner ball race member has a flange portion 15 which forms the race for the balls 16. This assembly is held onto the head 4 by means of the outer ball race 10 which is secured to the head 4 by means of screws such as 11. A locating pin 12 is provided to facilitate the assembly in proper relationship.

From the foregoing it will be seen that the vane assembly is rotatable within the head assembly.

The fuse disclosed in this application is designed for use on the tail of a bomb. Thus, as the bomb is dropped, the air stream past the

fuze will be from right to left as viewed in Fig. 1. This air stream against the vane 19 will move the vane to rotate in a clockwise direction as viewed from the left in Fig. 1 and the relative rotation between the vane assembly and fuze head is at the bearing surfaces of the balls 16.

Extending through the center bore of the hub 17 is a sleeve 21 having external threads which are in threaded engagement with internal threads in hub 17. The right hand end of hub 17 is provided with a gear wheel 18 and the right hand end of sleeve 21 is provided with a gear wheel 22. Both of these gear wheels are in mesh with an elongated pinion 23 mounted on the pinion pin 80 whose right hand end is driven into the head portion 4 and whose left hand end is supported in a hole in the plate 13 which is clamped between the outer ball race 10 and the head 4. Gear wheel 22 has one more tooth than gear wheel 18 and as the vane assembly is rotated by the air stream as the bomb is falling, the rotation of gear wheel 18 rotates pinion 23 which in turn rotates the gear 22. In view of the difference in number of teeth, the gear 22 and the sleeve upon which it is mounted gradually rotates relative to the hub 17 and as it rotates its left hand thread screws out of the hub 17 moving the sleeve to the right as viewed in Fig. 1. The pinion 23 is long enough so that both gear wheels stay in mesh therewith until the sleeve 21 has been completely screwed out of hub 17.

The sleeve 21 is provided with a center bore through which extends the firing pin 28. This firing pin is provided with a striker 26 in threaded engagement therewith and the striker is locked on to the pin by means of the striker nut 27 and lock washer 79.

The sleeve 21 as shown in Figs. 1 and 5 extends beyond the vane nut 20 and into the central hole of a safety block 25. This circular safety block has part of its wall cut away so that it can become disengaged from the head assembly when the sleeve 21 is moved to the right by the rotation of the vane assembly. However, as long as the sleeve is in the position shown in the drawing the safety block can not be removed and it serves as a safety device to prevent operation of the firing pin.

A striker stop 29 is normally wedged between the striker and the safety block to keep the tension of the firing pin spring from the cocking pin. This striker stop is removed when the bomb is mounted on the plane.

Fastened within the cavity in head 4 is a firing pin spring sleeve 30 which is retained in the head by means of screws 31. This sleeve is crimped over at its left hand end to form a bearing surface for the firing pin spring 32. The other end of this spring bears against the firing pin ring 33 which is pinned to the firing pin by pin 34. In its set position, as shown in Fig. 1, the firing pin ring 33 is in engagement with the slabbed surface of a cocking pin 35 rotatably mounted within the head 4. This cocking pin 35 is provided with a cocking pin screw 36 which extends beyond the head 4 into the space within body 1.

A channel is provided in head 4 for the passage of the cocking pin screw 36 when the cocking pin is rotated.

Mounted within the body 1 is a timing unit indicated generally by the reference character 45. This timing unit is made up of a number of plates such as 46 which are held together by means of suitable screws. The timing unit 45 is retained in the body 1 by means of screws such as 53. This timing unit forms no part of the present invention and has, therefore, merely been indicated in the drawings.

It is sufficient for the purpose of this application to state that the hub 47 is rotated by the timing unit at a predetermined rate determined by the time range desired for the particular fuze. Secured to the hub 47 is a cam and disc assembly comprising the timing disc 51, the hub portion 50, and the cam 49 which is mounted on the hub 48. The firing pin 28 extends through a central hole in the disc, hubs and plates of the timing unit.

As illustrated more clearly in Fig. 4, the firing pin is held in its cocked position by means of the engagement of the firing pin ring 33 with the slabbed portion of the cocking pin 35. The cocking pin screw 36 is retained by the hook 39 of the firing lever 37 which is mounted on the head 4 by means of screw 38.

The tail 40 of this firing lever is in engagement with a laterally extending projection 43 of the timing disc lever 41 which is also mounted on the head 4 by means of screw 42. The bent up portion 44 of lever 41 serves as a cam rider and is in engagement with the periphery of the timing disc 51. Thus the spring pressure of the firing pin spring 32 tends to rotate the cocking pin 35 in a clockwise direction as viewed from the left in Fig. 4 and the pressure of the cocking pin screw 36 against the inner camming surface of hook 39 tends to rotate lever 37 in the direction indicated by the arrow. This force is in turn transmitted to lever 41 tending to rotate this lever in a counterclockwise direction as indicated by the arrow, thereby maintaining the cam rider 44 against the edge of the timing disc 51. The timing movement 45 is in wound condition and tends to turn the hub and cams mounted thereon in a counterclockwise direction as seen in Fig. 3. The movement is prevented from operating by means of an arming pin 68 which has a reduced end portion 69 normally in engagement with the notch 52 in the timing disc 51. This arming pin 68 has an enlarged head portion 71 which is retained in position by an arming wire (not shown) passing through the hole 72 and holes in the arming pin bracket 73. The arming pin is urged to the right by means of the arming pin spring 70.

The body 1 is provided with a transverse bore in which is contained the detonator slider 54. Slider 54 carries the detonator 55 and is normally held in the position shown in Figs. 1 and 2 of the drawing with the detonator out of the path of operation of the firing pin. The slider is held in this position by engagement of the shoulder 82 (Fig. 2) with a slabbed portion of the arming stem 60 which is rotatably mounted in the body 1. This arming stem 60 is bent over at its left hand end as seen in Fig. 1 to form a cam rider portion 62 which normally rests on the cam 49 as seen in full lines in Fig. 3 of the drawing.

The arming stem 60 is provided with a groove engaged by a screw 61 in order to retain it in proper position. The detonator slider 54 is urged to its armed position by means of the slider spring 57 which is contained in the hollowed out end of the slider 54 and bears against the slider retaining plate 58 which is held to the body 1 by means of screws 59. The other end of the slider is reduced in cross section and is adapted to slide in and is guided by the bore 56 when the slider is moved to armed position. A groove 83 is provided in the slider body and this groove

is engaged by a slider guide member 64 extending through a bore in the fuze body 1 at right angles to the slider. Within the guide member 64 is contained a slider lock pin 65 which is adapted to enter the depression 63 and lock the slider in armed position when it is moved to such armed position by means of spring 57. The pin 65 is urged to the left as seen in Fig. 2 by means of the locking pin spring 66 which is maintained in position by the closure screw 67.

The right hand end of the fuze body is provided with external threads 7 by means of which the fuze is screwed into the body of a bomb. The fuze is also provided with a booster cup 8 threaded into the fuze body at 9 and this booster cup is filled with a booster charge indicated at 75. A hole is provided through the right end wall of the fuze body 1 to communicate between the detonator 55 and the booster charge 75 and this hole is provided with a closure cup 74 to prevent the booster charge from entering the fuze body.

Referring particularly to Fig. 3 of the drawing, it will be seen that the time of detonation of the fuze after the arming pin 68 is removed depends upon the relative position of the cam rider 44 with respect to the notch 52 in the timing disc. This relative position may be adjusted by rotating the head assembly within the fuze body 1. A scale is provided on the fuze head which scale cooperates with a zero index on the fuze body to indicate the time setting of the fuze. When the bomb to which this fuze is attached is loaded in the plane, the striker stop 29 is manually removed. The arming wire which retains the arming pin 68 in position and which also passes through a hole in vane 19 is then attached to the bomb rack.

When the fuze is dropped this arming wire is pulled out, thereby releasing the arming pin 68 which is forced out of the notch in timing disc 51 by means of spring 70. The timing movement 45 therefore begins to operate, turning the timing disc 51 and cam 49 in a counterclockwise direction as seen in Fig. 3. Approximately three seconds later the cam rider portion 62 of the arming stem 60 drops off the cam 49 and assumes the position shown by the dotted lines in Fig. 3. Rotation of the arming stem 60 releases the shoulder 62 of the detonator slider and this slider is moved to armed position by spring 57 carrying the detonator 55 directly into line with the firing pin 28. As soon as the bomb begins to fall through the air, the air stream rotates vane 19 and by means of the differential action between gear wheel 18, pinion 23, and gear wheel 22, the sleeve 21 is screwed out of the hub 17 moving to the right to withdraw the left hand end thereof out of the safety block 25. As soon as the sleeve is removed from the safety block, the latter drops off of the fuze, being thrown out by centrifugal force, thereby clearing the striker head so that the firing pin can operate to detonate the fuze after the elapse of the set time interval.

The timing disc 51 continues to be rotated by the timing movement until the notch 52 is engaged by the cam rider 44. The rider 44 drops into the notch causing lever 41 to rotate and the projection 43 to disengage the tail 40 of lever 37. The cocking pin screw 36 therefore cams the hook 39 out of the way and permits the cocking pin 35 to rotate, disengaging its slabbed latching edge from the firing pin ring 33. As soon as the firing pin is released the spring 32 forces

the firing pin 28 to the right as seen in Fig. 1, causing the pointer end of the pin to enter the detonator 55, exploding the charge which is transmitted to the booster charge 75. This in turn detonates the bomb.

Referring to Fig. 3, the fuze can be adjusted to a minimum time interval of approximately 5 seconds. Thus the rider 44 which is in engagement with the timing disc 51 can be rotated to a position seen above the notch 52, but even with this setting it will be apparent that the arming stem cam rider 62 will disengage cam 49 in order to arm the fuze before rider 44 enters notch 52 to detonate the fuze. Thus, the delay interval for moving the detonator from safety to armed position is fixed whereas the time interval between the release of the bomb and detonation of the bomb may be adjusted to suit the particular requirements. However, the detonator is always moved to armed position before the firing pin can be released by the timing disc 51.

The particular embodiment of the invention disclosed and described in this application is a fuze adapted to be used on the tail of a bomb. However, as pointed out above, the fuze is equally adaptable for use as a nose fuze, it merely being necessary in this case to reverse the ball race to provide the proper bearing surface for rotation of the vane assembly. A shorter vane may be used when the fuze is used as a nose fuze.

Although only a particular embodiment of the invention has been disclosed herein, it will be apparent to those skilled in the art that various modifications and changes may be made without departing from the spirit of the invention as defined in the following claims.

What is claimed is:

1. In a bomb fuze, a spring biased firing pin, a latch for holding said pin in cocked position, a mechanical time movement and a cam driven thereby, means controlled by said cam for releasing said latch, detonator carrying means and means for moving same to armed position, and a second cam driven by said time movement for releasing said detonator carrying means.

2. In a bomb fuze, a spring biased firing pin, a latch for holding said pin in cocked position, detonator carrying means and means for moving same to armed position, a mechanical time movement, a cam controlled by said time movement for releasing said detonator carrying means after a fixed interval, and a second cam controlled by said time movement for releasing said latch after a predetermined adjustable interval.

3. In a bomb fuze, a spring biased firing pin, a latch for holding said pin in cocked position, a detonator carrying means and means for moving same to armed position, a timing device and a shaft rotated thereby, means normally holding said shaft in a zero position, means for releasing said shaft to start said timing device, a cam on said shaft for controlling said latch to release said firing pin after a predetermined adjustable interval, and a second cam on said shaft for releasing said detonator carrying means after a definite fixed interval.

4. In a bomb fuze; a spring biased firing pin axially mounted in said fuze; a detonator carrying means normally held in safety position with the detonator out of alignment with said firing pin; a timing device; a shaft surrounding said firing pin and rotatable by said timing device; a cam cooperating with a follower for releasing said detonator carrying means, said cam being secured to said shaft; a second cam cooperat-

ing with a cam follower for releasing said firing pin also secured to said shaft, said cams and cam followers being so positioned that the former cam and follower must release the detonator carrying means to firing position before the latter cam and follower can release said firing pin; means to prevent the movement of said cams from zero position before the bomb has left the bomb rack; and means to adjust the interval between the start of said cam movement from zero position and the release of said firing pin.

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