Feb. 13, 1945. G. CAHILL 2,369,337

TIME SHELL

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Fig. 5.

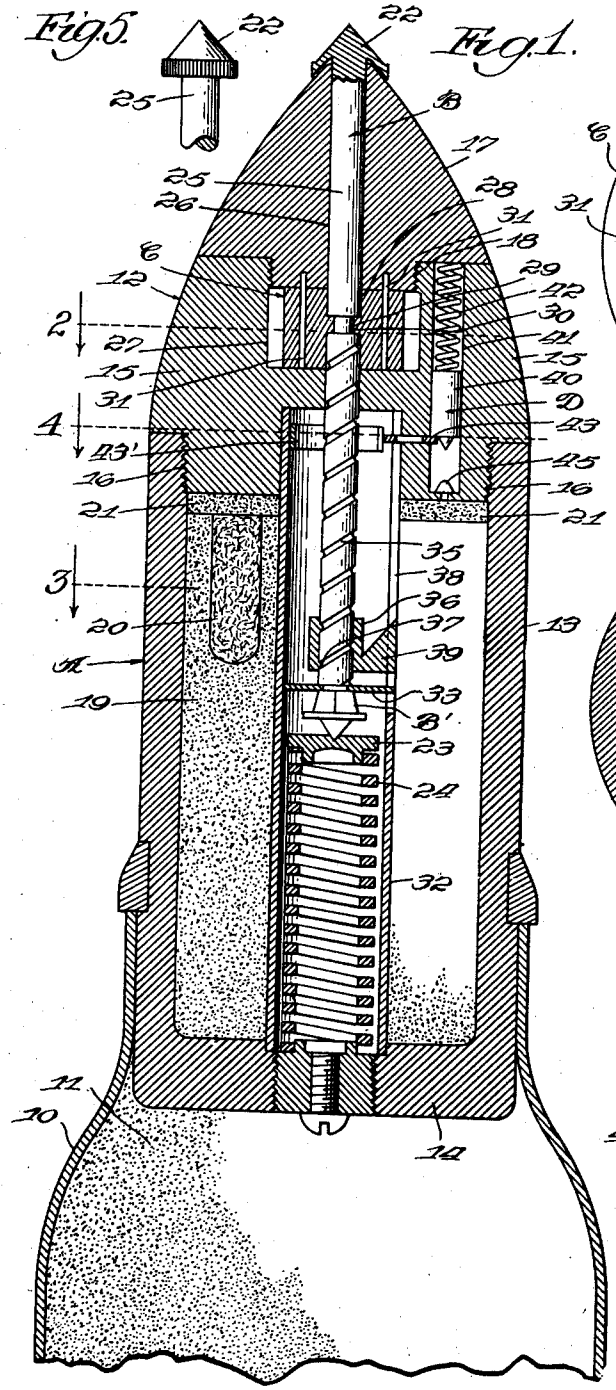



Fig. 1.

Fig. 2.

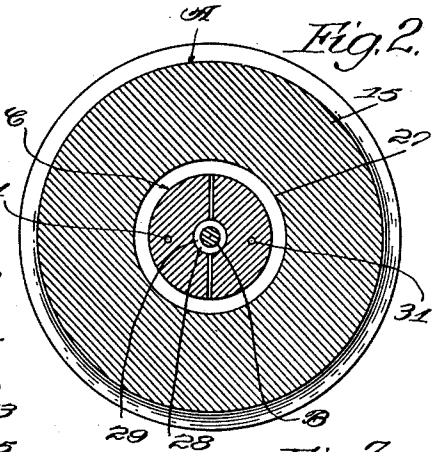



Fig. 3.

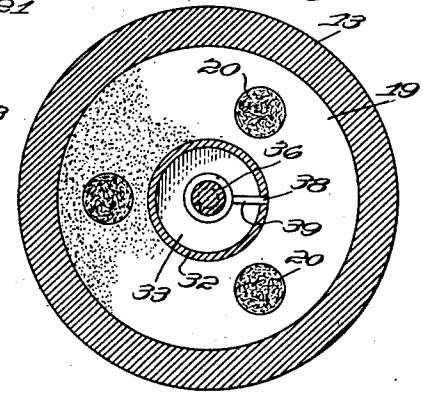
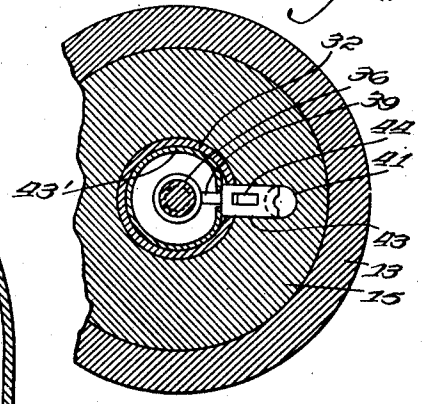



Fig. 4.




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Fig. 6.

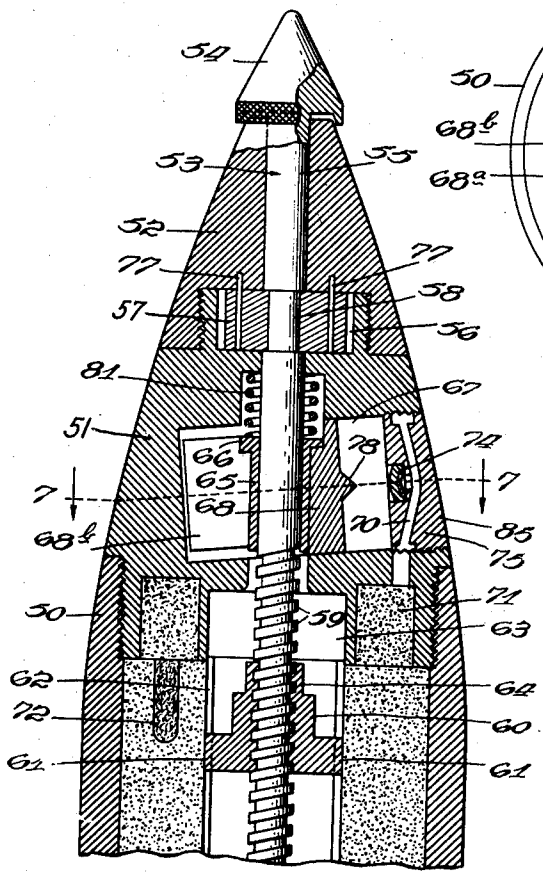



Fig. 7.

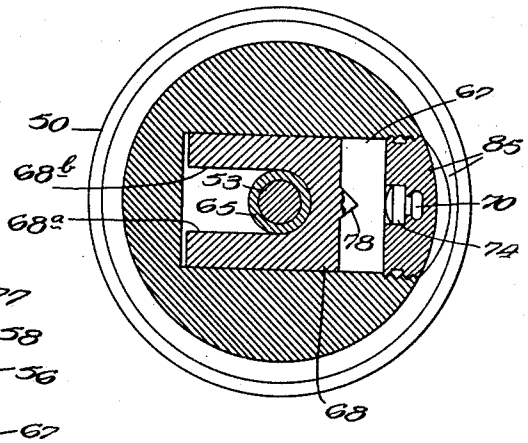



Fig. 9.

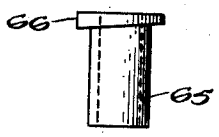
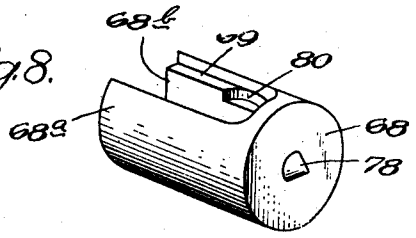



Fig. 8.




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# UNITED STATES PATENT OFFICE

2,369,337

## TIME SHELL

Gerald Cahill, Michigan City, Ind.

Application March 24, 1941, Serial No. 384,819

5 Claims. (Cl. 102—82)

This invention relates to an explosive shell, and more particularly to mechanism whereby the explosion of the shell is effected at a desired distance from the point of projection.

In the past, two general methods have been used for causing the explosion of shells after projection. One method involves the use of a train of powder one end being ignited when the gun is fired, the other end of the train being connected with the body of the explosive, so that the time required for this train of powder to burn represents the time elapsing between projection and explosion of the shell. The other method which has been used involves a clock mechanism which begins to operate upon projection of the shell.

An object of the present invention is to provide an improved shell having mechanism for controlling the time of explosion which is more accurate and dependable than prior devices like those above mentioned.

More specifically, an object of the invention is to provide mechanism for controlling the explosion of shells which is sensitive to the velocity of the shells in flight, and which will produce explosion when the velocity of the shell has decreased to some predetermined value below the muzzle velocity. Another object is to provide such mechanism which is readily adjustable to produce bursting of the shell at any desired distance from the gun which projects it. Further objects and advantages of the invention will be apparent as the specification proceeds.

In the drawings, Figure 1 is a longitudinal sectional view of one embodiment of the invention; Figure 2, a transverse sectional view taken as indicated at line 2 of Figure 1; Figure 3, a transverse sectional view taken as indicated at line 3 of Figure 1; Figure 4, a broken transverse sectional view taken as indicated at line 4 of Figure 1; Figure 5, a detail view of the front end of the pressure pin; Figure 6, a broken longitudinal sectional view of a second embodiment of the invention; Figure 7, a sectional view taken as indicated at line 7 of Figure 6; Figure 8, a perspective view of the firing pin shown in Figure 6; and Figure 9, a detail view of the firing pin release bushing also shown in Figure 6.

As illustrated in Figure 1, the shell A is carried in the casing 10 within which is the explosive 11 for projecting the shell from the gun. Only the topmost part of casing 10 is here shown since this forms no part of the present invention.

The shell A has the casing 12 which comprises the cylindrical portion 13 and rear wall 14. A forward portion 15 is attached to the cylindrical part 13 by means of the threads 16, and a front part 17 is secured to portion 15 by means of the threads 18. The shell is filled largely with the explosive material 19, and contained in this material are the sticks 20 of detonating explosive which serves to set off the main body of the explosive 19. At the forward end of the cavity is a booster ring of black powder 21 which serves the function of setting off the detonator explosive 20.

Located axially within the shell casing is a pressure pin B. At its front end pin B extends beyond front casing part 17 and is equipped with the knurled knob 22. The rearward end of the pin rests against the spring plate 23 which is urged forwardly against the pin by the compression spring 24. The spring 24 is backed by the rear wall 14 of the casing and is of such strength that when so compressed it urges the pressure pin B forwardly with the same pressure as would be exerted by air against the front knob 22 when the shell leaves the muzzle of a gun after having been shot under conditions for which the shell is intended.

The front stem 25 of the pin B is slidably carried in the central axial channel 26 of the part 17. Normally, however, and until the shell is projected, pin B is held fixed in its rearward position as shown in Fig. 1 by the split collar C. This collar is disposed within the cavity 27 rearward of part 17, and as more clearly illustrated by Figure 2, is formed of two parts. It has a central hole 28 so as to fit about the stem 25, and has also a constriction 29 which fits into the neck 30 of the stem 25. Thus when the halves of the collar C are together about pin B, this pin is fixed and held against longitudinal movement. A pair of shearable pins 31 extend through collar C and into the metal part 15 so as normally to hold the halves of the collar in place.

The lower part of pin B and the spring 24 are encased in the tubular member 32 which is mounted axially within the shell between wall 14 and forward part 15. A lock plate 33 is attached to the lower end portion of pin B and extends to the walls and into the slot 38 of tube 32. The setback incident to firing the shell will force the lock plate 33 over the pyramidal part B' of the stem B thus preventing the stem being rotated by the air pressure against it when the shell is in flight. The lower portion of pin B is provided with spiral groove or thread 35 and carries a nut member 36 which has a stud or thread 37 en-

gaging the thread 35. The nut member 36 carries a side arm 39 having an upwardly inclined top surface and extending into a longitudinal slot 38 in the top portion of the tube 32. The engagement with this slot prevents the nut 36 from rotating with the pin B and causes the nut to move forward and back along the pin as the pin is rotated. Also this nut is caused to move forwardly and rearwardly along with longitudinal movement of the pin itself.

The firing mechanism D comprises the firing pin 40 carried in the cylindrical cavity 41 in part 15. This pin is urged rearwardly by the spring 42 based against the front part 17. The firing pin 40 is normally retained in retracted position against spring 42 by trigger mechanism. This mechanism comprises the key 43 which is slidable transversely and extends inwardly through a slot in tube 32, this key being more clearly shown in Figure 4 of the drawings. The outer end of key 43 extends to a position beneath the lower shoulder of the firing pin and so withholds this pin. Centrally of the key 43 is a slot 44, and as will be more clearly seen from Figure 1, when the nut 36 moves forwardly the tip of the arm 39 will engage the slot 44 and serve to move the key inwardly so as to release the firing pin. The release of the firing pin 40 punctures the percussion cap 45 and so serves to set off the powder. The key is held in its normal position by the flat retaining spring 43'.

In operation, when the improved shell is projected, the rifling of the gun imparts to it a whirling or rotating motion, and this serves to shear the pins 31 of the collar C permitting the halves of this collar to separate and move outwardly. This action releases the pin B for longitudinal movement. However, as the pressure exerted against the pressure pin B by the spring 24 balances the air pressure against the knob 22 as the shell leaves the muzzle of the gun, there will be no forward movement of pin B at this time.

The speed of the shell, and consequently the air pressure at its front end, will be greatest at the time it leaves the muzzle of the gun, and from this instant its speed and the pressure against its front end decreases. As the air pressure against knob 22 decreases the pin B will be moved by the spring 24 to a forward position at which there is less pressure by spring 24 there being maintained a balance between the air pressure at the front and the spring pressure at the rear. Thus, as the shell moves in its flight the pressure pin B moves forwardly the distance traversed by the shell being measured by the forward movement of pin B.

When the pressure pin B has moved forwardly far enough to cause the arm 39 of nut 36 to engage the slot 44 of the slide member 43 and pull this member inwardly, the firing pin 40 will be released, will puncture the percussion cap 45 and thus set off the explosive materials.

It will be apparent that the position of the nut 36 on the pressure pin will determine how far forward this pin has to move in order to release the trigger mechanism comprising the slide member 43. Thus by adjusting the position of the nut 36 along the pin B the shell can be made to explode at different distances from the point of projection.

It is an important feature of the invention that the position of the nut member 36 can be adjusted by simply turning the knurled knob 22. This operates through the engagement of threads 35 and 37, on the pin and nut respectively to move the nut forwardly or rearwardly on the pin. This enables setting of the shell to explode near or far from the point of projection simply by turning the pin at the nose of the shell.

A second construction is illustrated in the Figures 5 to 9 of the drawings. In this modification the casing comprises the side wall 50, into which is screwed the forward portion 51, to which in turn is attached the front piece 52.

The pressure pin 53 has a front knob or nose piece 54 and has its stem 55 extending axially through the shell. A cavity 56 in forward portion 51 contains the collar 57 formed in equal halves and which engages the neck portion 58 of the pressure pin. The rearward portion of pin 53 carries the screw threads 59, and carried on and engaging these threads is the nut member 60 which has its side arms 61 engaging the slots 62 in the central tube 63. Nut member 60 has a forward extension 64 which is adapted, when the pin 53 moves forwardly, to about the rear end of the firing pin release bushing 65. This bushing, as shown more clearly in Figure 9, is tubular and has at its forward end an outwardly extending flange 66 and the lower or rearward edge of this flange is slightly inclined. The reason for this will be more apparent after a description of the firing pin employed in this embodiment.

The forward part 51 contains a cylindrical cavity 67 the axis of which is inclined. In this cavity is the U-shaped firing pin 68. The legs 68a and 68b of this pin extend about the release bushing 65 and have at their top portion the groove 69 which will permit the flange 66 to slide therein. A socket 80 is contained in the crotch of the firing pin into which the flange 66 may seat to hold the pin in retracted position until time for explosion. When the parts are assembled, a spring 81 normally holds the flange 66 in position within socket 80.

A flash passage 70 extends in the tapped stopper 85 and connects with the black powder booster 71 which is intended to incite, in turn, the detonator sticks 72 and the high explosive 73. The flash passage 70 is of tapered form, and in order to have the percussion cap 74 at a right angle with this fuse passage, the percussion cap holder 75 is set at an angle with the shell's axis. It is for this reason that the firing pin 68 is, in this embodiment, set at such an angle to conform with this arrangement.

In the operation of the shell shown in Figures 5 to 9, the shell, upon being projected is rotated and the centrifugal force thus produced operates to shear the pins 77 in the collar 57, thus to release the pressure pin 53. When the speed of the shell slackens, the pin moves forwardly as in the first embodiment described. The nut member 60 advances to bring the extension 64 against the rear end of the firing pin release bushing 65 to move this bushing forwardly against spring 81. This operates to release the firing pin 68 to the action of centrifugal force which then throws the pin outwardly, the flange 66 of the release bushing riding in the groove 69, bringing its point 78 against the percussion cap 74, with the consequent explosion of the shell.

As in the first embodiment described, the nose 54 of the pressure pin may be turned to adjust the position of the nut 60, thus to make the shell explode at the desired distance from the point of projection.

An important advantage of the new structure is that the knurled or ribbed knob 22 can be read-

ily rotated by mechanism associated with the gun but not described herein for instantaneously adjusting the nut to the desired position. In other words, the knob structure disclosed enables setting of the shell to explode near or far from the point of projection, the knob being manipulated by simple mechanism not here shown but accessible for manipulation by the gunner.

Though in the foregoing detailed description I have described only two modifications of my invention, it will be apparent that the improved shell may be constructed in many other embodiments with widely differing structures, all within the spirit of the invention. The foregoing illustrations and specific descriptions are intended as explanatory only, and no unnecessary limitations should be understood therefrom.

I claim:

1. In an explosive shell, mechanism for exploding said shell at a distance from the point of projection comprising a rotatable pin movable axially of said shell and having its front end exposed at the front of the shell, a locking member engaging said pin and holding it in rearward position, said member being movable through centrifugal action upon rotation of said shell to release said pin for axial movement, a coil spring urging said pin forward with a force balancing the air pressure against the front end of said pin as shell is in flight and being adapted to move said pin forwardly as said air pressure decreases upon movement of the shell from the gun, firing mechanism for setting off the explosives within said shell, trigger means controlling the operation of said firing mechanism, and trigger release means carried by said pin for releasing said trigger means when said pin has moved forwardly to bring such release means into contact with said trigger means, said release means being adjustable as to position along said pin by rotation of said pin.

2. In an explosive shell, mechanism for exploding said shell at a distance from the point of projection, comprising a rotatable pin mounted in said shell for axial movement with respect thereto and having its front end provided with a diaphragm exposed at the front of the shell, means carried by the shell holding said pin in a rearward position until after said shell has started its flight, a coil spring within the shell urging said pin forward with a force balancing the air pressure against said diaphragm as the shell starts its flight and being adapted to move said pin forwardly as said pressure diminishes, firing mechanism for setting off explosive material within said shell, means for actuating said firing mechanism, and means carried by said rotatable pin for controlling said actuating mechanism, said control means being shiftable upon said pin upon rotation thereof to vary the timing of the explosion.

3. In an explosive shell, means for exploding said shell at a distance from the point of projection, comprising a member mounted in said shell for axial movement with respect thereto and having a diaphragm at the front end thereof extending beyond said shell, spring means in said shell engaging said member for urging the same forwardly with pressure balancing the air pressure against the front of the diaphragm when the shell is in flight and effective to move said member forwardly as the air pressure against it decreases during flight, means for locking said member against forward movement until the shell is in flight, firing mechanism within said shell for producing an explosion of the shell, and means carried by said member for actuating said firing mechanism when the member has been moved forwardly to a predetermined position, said means being adjustable axially of said member whereby the predetermined position of the member at which the firing mechanism is actuated may be changed.

4. In an explosive shell, mechanism for exploding said shell at a distance from the point of projection, comprising a member mounted within said shell for axial movement with respect thereto and having its front end exposed at the front of the shell, locking means engaging said member and holding it in rearward position until the shell is in flight, spring means urging said member forwardly with a force balancing the air pressure against the front end of the member as the shell is in flight and being adapted to move the member forwardly as the air pressure decreases upon the movement of the shell from the gun, firing mechanism for setting off the explosive within the shell, trigger means controlling the operation of said firing mechanism, and trigger release means carried by said member for releasing said trigger means when the member has moved forwardly to bring such release means into contact with said trigger means, said release means being adjustable as to position along said member.

5. In an explosive shell, mechanism for exploding said shell at a distance from the point of projection, comprising a pin mounted within said shell for axial movement with respect thereto and having its front end exposed at the front of the shell, a locking member carried by the shell engaging said pin and holding it in rearward position, said member being movable through centrifugal action upon rotation of the shell to release said pin for axial movement, spring means supported within said shell in actuating relation with respect to said pin for urging said pin forwardly with a force balancing the air pressure against the front end of said pin as the shell is in flight and being adapted to move said pin forwardly as said air pressure decreases, a sleeve extending about said pin within the shell and longitudinally movable thereon, said sleeve being provided with an enlarged head, a firing hammer carried within said shell disposed adjacent said pin and provided with a recess for receiving the enlarged head of said sleeve in interlocking engagement, said hammer being movable to firing position by centrifugal force upon rotation of said shell when released from said interlocking engagement with the head of said sleeve, means carried by the pin for engaging said sleeve when the pin advances to move the head of the sleeve from interlocking engagement with the recess in said hammer, and releasing said hammer for movement to firing position whereby said hammer moves to firing position to set off explosive material within said shell.

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