

1,336,828.

Patented Apr. 13, 1920.

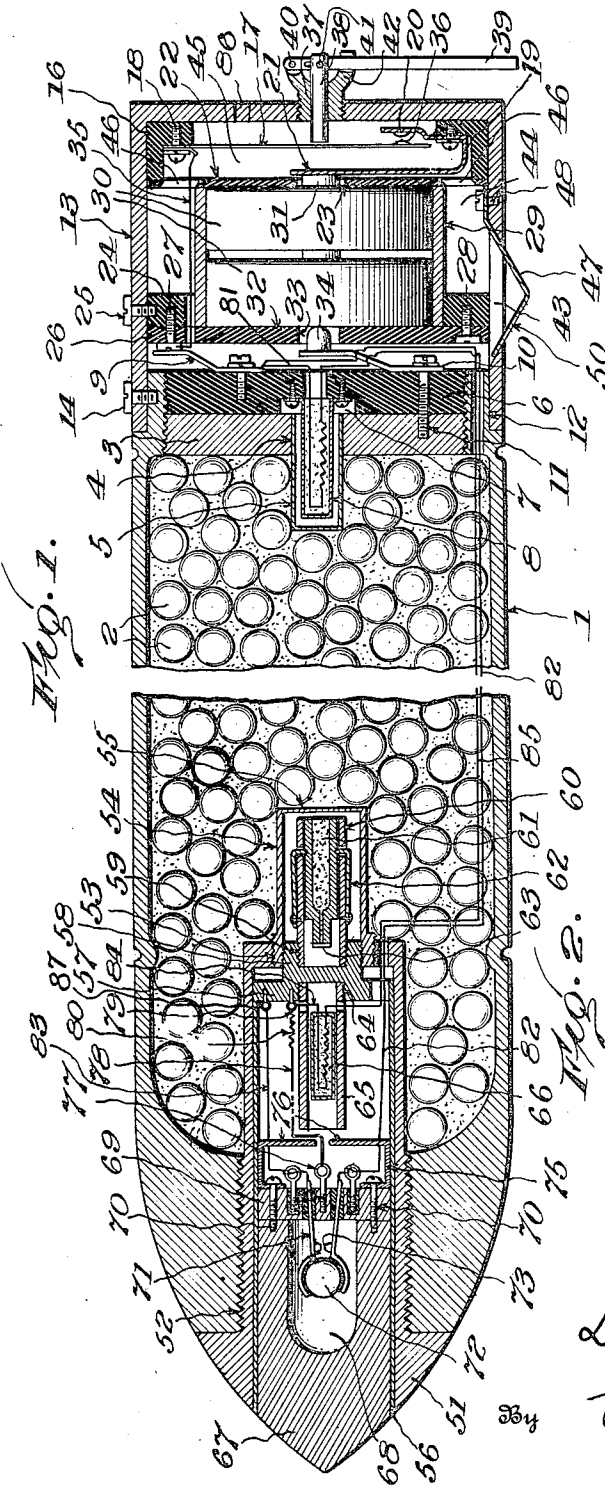
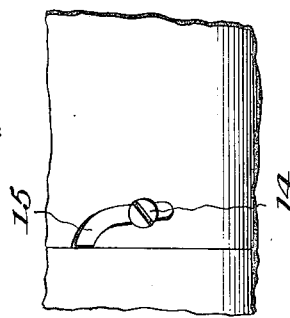
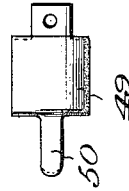


Fig. 3.



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EXPLOSIVE SHELL.

1,336,828.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, DANIEL G. EDWARDS, a citizen of the United States, residing at Woodlawn, in the county of Montgomery and State of Tennessee, have invented certain new and useful Improvements in Explosive Shells, of which the following is a specification, reference being had therein to the accompanying drawing.

My invention relates to ammunition and particularly to aerial bombs.

An object of my invention is to provide an aerial bomb in the form of a shrapnel shell arranged to be dropped from an aeroplane and to explode at a given predetermined distance from the ground or other target surface, whereby it is rendered extremely effective against infantry.

Another object is to provide an electrical ignition or detonating system normally disabled and arranged to be enabled by the discharge of the bomb from the carrier and its passage through the air.

Another object is to provide a bomb structure in which the explosive charge and detonating means may be separated during transportation and storage and readily assembled when the bomb is required for use.

Various other objects of my invention will be apparent from a perusal of the following specification and the drawings accompanying the same.

My invention is illustrated in the accompanying drawings in which:—

Figure 1 is a longitudinal section of the device assembled ready for use.

Fig. 2 is a fragmentary side view of the juncture between the shell body and the battery cap.

Fig. 3 is an outside view of the air scoop taken at right angles to Fig. 1.

Referring to the drawings in detail, 1 indicates the body or shell of the bomb loaded with the usual shrapnel charge as indicated at 2. This load is held in at the butt end of the shell by means of a metal disk 3 threaded into the end of the shell body and provided with a perforation 4 which communicates with the interior of a thin tube 5 closed at the bottom and projecting into the main charge of the shell. Outside of the disk 3 and substantially flush with the edge of the walls of the shell is a second disk 6 of electrical insulating material such as indurated fiber which also is threaded into the shell body. The disk 6 is secured

at 7 and carries a tube-form electrical detonator 8 having one end attached to the disk 6 within the recess 7 and arranged to project into the thin tube 5 surrounded by the main charge. A pair of contact springs 9 and 10 are carried by the disk 6, the spring 9 being held in place by suitable fastening means out of contact with the metal disk 3 while the spring 10 is electrically connected with the metal disk 3, and consequently the body of the shell, by the bolt 11 extending through the disk 6 into threaded engagement with the disk 3. These two contact springs serve as the main leads or connections through which current is supplied to the detonating circuits to be later described.

The butt end of the shell body 1 is reduced as indicated at 12 to receive a battery cap 13 of the same outside diameter as the end of the shell which is arranged to be fitted on to the butt end of the shell over the reduced portion in snug engagement therewith and held thereon by means of suitable clamping screws such as 14 threaded into the reduced portion 12 and taking into bayonet slots such as 15 in the lower edge of the battery cap. Fitted into the top of the battery cap is a stepped ring 16 of fiber or other insulating material having the space encircled thereby bridged by a diaphragm 17. The diaphragm 17 is fastened on to the lower step or shoulder of the ring 16 by the fastening screw 18 by means of a flexible extension which overlaps the ring so that the diaphragm may have lateral movement responsive to variations in pressure on opposite sides thereof. At a point on the lower step or shoulder diametrically opposite the anchorage of the diaphragm is fastened a battery spring contact 19 which is fastened to the ring at a point intermediate its ends and has its ends bent so as to extend toward the center to form two contact members 20 and 21, the upper contact 20 extending over the upper face of the diaphragm 17 so as to be engaged by a contact 36 carried by the diaphragm, while the lower contact end 21 extends inwardly below the diaphragm to the center of the battery cap. A circular partition 22 extends across the battery cap and is seated against the outer step or shoulder of the ring 16. This diaphragm is perforated in the center as indicated at 23, over which perforation the end of the lower spring 21

is made to extend. Spaced downwardly from the partition 22 is a shoulder ring 24 of insulating material, held in place by means of suitable set-screws such as 25 and against this ring is seated a second partition 26 which extends across the battery cap and is held on the ring 24 by means of screws 27 and 28 which extend through the partition and are threaded into the ring. A cylindrical wall section 29 is fitted between the partitions 22 and 26 coaxially with the battery cap and is held in position by the said partitions and the insulating ring 24. This cylindrical wall section together with the partitions 22 and 26 forms a battery compartment in which is placed a battery of one or more cells as indicated at 30, the battery being so designed as to have one of its contact poles 31 project through the opening 23 in the partition 22 into engagement with the spring contact 21, and to have its other terminal, which in this case is the bottom of the metal battery casing 32, exposed at a perforation 33 provided in the partition 26 centrally thereof so as to receive the plunger contact 34 of the contact spring 10. The holding screw 27 is electrically connected through a suitable conductor with the holding screw 18 of the diaphragm 17 as indicated at 35 and so arranged as to come in contact with the contact spring 9 when the battery case is fitted on to the butt end of the shell. The diaphragm 17 is of course made of conducting material which is in electrical connection with the contact 36 carried thereby so that upon engagement of the contacts 36 and 20 an electrical connection will be established between the battery terminal 31 and the screw 27.

For normally locking the diaphragm 17 in its open circuit position, that is in a position to maintain the contacts 20 and 36 out of engagement, I provide the mechanical off-normal locking device 37 which is threaded into the top wall of the battery cap and contains a plunger 38 extending into the battery cap into engagement with the diaphragm 17. This plunger is arranged to be moved into and out of locking engagement with the diaphragm by means of a lever 39 pivoted to the frame of the locking device at 40 and pivotally connected with the plunger at 41, the lever 39 being held in the position shown by frictional engagement between the tangs of the bifurcated arm 42, the lever arm 39 being arranged to extend slightly beyond the side of the shell body as shown.

An opening 43 is provided in one side of the battery cap which affords communication between the outside of the shell and the lower surface of the diaphragm 17 through the spaces 44 and 45 and openings 46 in the partition 22. For the purpose of inducing the entrance of air into this open-

ing during the downward flight of the projectile for the purpose of acting on the diaphragm 17, I provide an air scoop 47 shaped as shown in Figs. 1 and 3 and mounted in the opening 43. The air scoop is held in place in the opening by means of a suitable set-screw 48 and has its body portion 49 bent so as to extend out of the opening at an angle with the side of the shell as clearly shown in Fig. 1, so that in the downward flight of the shell it will act as a scoop to force air under pressure into the space 45 against the diaphragm 17. The guiding tongue 50 of the air scoop is bent downwardly and inwardly so as to engage the inner wall of the shell near the lower edge of the opening 43 to prevent outward displacement of the scoop and to act as a cam for moving the scoop inwardly when it encounters the edge of a discharging tube or guide, not shown. In order that the scoop may have the necessary movement in the opening without distortion or displacement it is made of resilient material such as rolled metal. The body portion 49 of the scoop is curved as indicated by the shading in Fig. 3 to conform to the outside curvature of the shell body.

The explosion control means for the shell is carried in the forward end thereof and consists of a main or outside cap or tube 51 which is provided with a shoulder arranged to engage with the forward end of the shell and extends in the form of a tubular casing into the charge in the shell through the usual threaded bore 52 in the forward end of the shell and is held therein in threaded engagement therewith. The rear end of the tubular casing 51 is provided with a threaded opening 53 into which is threaded the open end of a detonator casing 54 made of thin metal with its rear wall 55 sufficiently thin to be ruptured by the detonator in the casing. Within the outer tube 51 is mounted a pilot casing or tube 56 open at the front end and closed at the rear end by a heavy rear wall 57. The wall 57 is provided with a cylindrical extension 58 extending into the open end of the casing 54 and provided with a recess 59 in which is mounted the end of the detonator tube 60 situated within the detonator casing 54. A detonator capsule 61 is slidably mounted in the tube 60 and positively held in the position shown by the holding springs 62 carried by the tube 60 and projecting inwardly therethrough into engagement with the detonator 61. The detonator 61 carries at its lower end a detonating cap 63. The rear wall 57 of the pilot tube is provided with an inner recess 64 in which is mounted the rear end of the pilot discharge tube 65 which contains a blowing charge 66 of a suitable explosive. Within the forward end of the pilot tube 56 and in front of the forward end of the discharge tube 65, is

fitted the detonating pilot 67. The pilot 67 is provided with a chamber 68 closed at the rear end by a disk 69 held thereon by the screws 70 and which carries a pair of contact springs 71 projecting into the chamber 68 and extending through to the rear of the disk 69. The springs 71 are bowed at their forward ends within the chamber to hold the ball weight 72 and are provided with contact points 73, the springs and the ball being so arranged and proportioned in relation to each other that the ball will hold the contacts out of engagement while in place as shown and when displaced from this position between the springs, will allow the contacts to come together under tension of the springs. The disk 69 carries a pair of L-shaped resilient leaves secured to the disk by means of the screws 70 and so arranged that their sides 75 will press against the sides of the pilot tube 56 to frictionally engage therewith, while their transverse members 76 extend across the forward opening of the pilot discharge tube 65 to substantially close the same.

The disk 69 carries at its central portion, a supporting eyelet 77 to which is connected one end of a supporting or limiting wire 78 whose other end is connected to a holding eyelet 79 fixed to the rear wall 57 of the pilot tube. This holding wire 78, as indicated by the broken section intermediate its length, is of greater length than what appears from the drawing and is merely so shown for the sake of clearness, the length of this wire in practice being variable according to the distance above the ground at which the shell is to be exploded, preferably about twenty feet and is nested into the annular space between the tubes 65 and 56 in the form of a coil surrounding the inner one of said tubes. Where desirable, I may provide a suitable shock absorber in this holding wire such as the coiled spring 80.

The circuit connections, with all parts assembled as shown in Fig. 1, are as follows: The battery casing 32 which constitutes one terminal of the battery, usually the negative terminal, is connected through the contact 34, spring 10, screw 11, and metal disk 3 with the metallic frame or body 1 of the shell. The positive terminal 31 of the battery is connected through the contact end 21 of the spring 19 to the contact 20 arranged to be engaged by the contact 36. This contact 36 is in electrical connection with the contact screw 27 as above stated, which contact screw now engages with the contact spring 9. One terminal of the electrical fuse in the detonator 8 is connected to the contact 9 by a conductor 81. The other terminal of this fuse is connected by the conductor 82, leading through a suitable channel in the shell wall between the shell and the washers 3 and 6 and suitable chan-

nels in the ends of the tubes 51 and 56, to one of the pair of springs 71, the other spring being connected through conductor 83 to the rear wall of the tube 56 which is in electrical contact with the body of the shell. The detonator 66 is also provided with an electrical fuse, one terminal of which is connected through conductor 84 to the wall of the tube 65 which is in electrical contact with the body of the shell, and the other terminal of which is connected through conductor 85 with the spring contact 9. Conductor 82 has one end fixed to the pilot tube 56 by means of a suitable holding eyelet 87 fastened to the back wall 57 of the tube. The portion of the conductor 82 extending between the holding eyelet 87 and the pilot, and the conductor 83 extending between the back wall 57 of the pilot casing and the pilot are given a length a little greater than the length of the holding wire 78 and are also nested in the space between the tubes 65 and 56 in the form of concentric spirals or coils surrounding the coiled holding wire 78, adjacent coils being wound in opposite directions so as to prevent tangling when drawn out. The conductors 82 and 83 are mechanically fastened at their lower ends to the pilot by means of suitable holding eyelets or other fastening means.

In operation, the bomb is held in suitable discharging means carried by the aeroplane or other carrying device arranged to release the bombs and allow them to drop through a suitable guide tube, not shown. When the bomb is released it is carried downwardly through the guide tube by force of gravity, the air scoop 49 being moved into the opening 43 upon engagement with the guide tube or other guiding device, while the lever 39 upon engagement with the upper edge of the guide tube is thrown upwardly, swinging about its pivot 40 and withdrawing the plunger 38 from engagement with the diaphragm 17. As the projectile passes out of the guiding tube or other guiding means, the air scoop 49 moves outwardly into the position shown in Fig. 1, and as the bomb gains speed in its downward flight the air scoop 49 will act to force air into the battery cap which passing up through the space 44 and openings 46 into the space 45 will act against the diaphragm 17 to move it upwardly and bring the contact 36 into engagement with its mate 20. To prevent trapping of air and consequent back pressure above the diaphragm, I provide a suitable vent 86 in the upper wall of the battery cap. Upon engagement of the contacts 36 and 20 a circuit is completed through the fuse of the pilot blowing charge 66, as follows: Battery terminal 31, contact 21, contact spring 19, contact 20, contact 36, diaphragm 17, conductor 35, contact screw 27, contact spring 9, conductor 85 through the

fuse of the charge 66, conductor 84, the metal body of the shell 1, and contact spring 10 connected therewith to the battery terminal 32. The energization of this circuit 5 actuates the fuse charge 66 to ignite the same, which upon explosion, forces the explosion gases downwardly out of the tube 65 against the resilient leaves 76 and the pilot 67 which forces the upper horizontal 10 portions of the leaves 76 downwardly, moving the side portions 75 inwardly to reduce the friction hold on the walls of the pilot tube and at the same time blowing out the pilot 67. The blowing charge 66 is graduated 15 so that its force will be just sufficient to drive the pilot completely out of the pilot tube 56. The pilot then, owing to its greater mass in proportion to its bulk, gains in speed over the shell proper until it reaches 20 the limit determined by the length of the holding wire 78, in which spaced relation the pilot and shell continue to travel downwardly toward the target surface.

When the pilot 67 hits the target, the 25 weight ball 72 is jarred out from between the springs 77 regardless of the direction of the impact allowing the contact points 73 to engage, which completes the circuit of the fuse of the detonator 8 over the following 30 path: battery terminal 31, contact 21, contact spring 19, contact 20, 36, diaphragm 17, conductor 35, contact screw 27, contact 9, fuse of detonator 8, conductor 82, contact springs 71 and contacts 73, conductor 83, 35 and back through the metallic body of the shell 1 and contact spring 10 to the other terminal 32 of the battery. The energization of this circuit causes the fuse of the detonator 8 to fire the same and thus detonate 40 the main charge 2 thus causing the shell to explode at a distance above the ground corresponding to the length of the pilot holding wire. Should the detonation of the main charge fail at this time, upon 45 contact of the forward end of the main shell with the target surface, the detonator 61 will be forced downwardly by its momentum, jamming the cap 63 against the bottom of the recess 59 which will thereupon be 50 actuated to fire the detonator, which exploding, will rupture the thin portion 55 of the tube 54 and detonate the main charge 2.

I have not shown herein any form of carrying and discharging apparatus, it being deemed unnecessary to a sufficient disclosure of the present invention which may be successfully used with any known form of bomb carrying and discharging means. It is further to be noted that while I have 60 not shown any special flight guiding means other than the increased mass near the forward end of the complete shell, various other known means for directing the flight may be employed.

65 While I have herein shown and described

a specific embodiment of my invention for the purpose of disclosure, it is to be understood that I do not limit myself to such specific embodiment but contemplate all such variations and modifications thereof as 70 fairly fall within the scope of the appended claims.

Having thus described my invention what I claim and desire to secure by Letters Patent is: 75

1. The combination with an explosive shell, of a pilot carried in the forward end of the shell, a pilot ejecting explosive charge arranged upon detonation, to drive said pilot away from the shell in advance 80 thereof, means for holding the pilot within a given distance of the shell, and means carried by the pilot for detonating the explosive charge in the shell.

2. The combination with an explosive 85 shell, of a detonating pilot carried by the shell, explosive means reacting against the shell and operable during the flight of the shell to drive said pilot away from the shell in advance thereof, and means for limiting 90 the distance of separation of said pilot and shell.

3. The combination with an explosive shell, of a detonator therefor, a detonation control pilot normally carried by the shell, a 95 pilot ejecting explosive charge arranged upon detonation to drive said pilot away from the shell in advance thereof, means for limiting the separation of said shell and pilot, means for detonating the explosive charge in the 100 shell controlled from the pilot and operable upon contact of the pilot with a target, master controlling means normally maintaining said pilot driving means and said detonating means normally inoperative and 105 operable in response to the flight of the shell through the air to render said driving and detonating means operative, and locking means normally holding said master controlling means against operation and operable 110 in the initial movement of the shell to release said controlling means.

4. The combination with an explosive shell, of an electrical detonator therefor, a pilot carried by the shell, a pilot ejecting 115 explosive charge arranged upon detonation to drive said pilot away from the shell in advance thereof, an electrical detonator for the pilot charge, electrical circuit connections extending between the pilot and the 120 shell detonator switching means in said circuit connections carried by the pilot and operable upon contact of the pilot with an object to close the circuit of the shell detonator through said circuit, a circuit for said 125 pilot charge detonator, a source of current for said circuits, and a master switch responsive to the flight of the shell through the air to connect the circuit of the pilot charge detonator with the source for ener- 130

gization thereof and to partially complete the connection of said shell detonator with said source for final completion by said pilot switch.

5 5. The combination with an explosive shell, of an electrical detonator for the shell, a pilot normally carried by the shell, a pilot charge carried by the shell and arranged upon explosion to drive said pilot away
10 from the shell in advance thereof, an electrical detonator for said pilot charge, a source of current for said detonator, means for maintaining said pilot at a predetermined distance from said shell, controlling
15 means for said shell detonator carried by the pilot and operable upon contact of the pilot with an object to energize said detonator, a master controlling means operable in response to the movement of the shell
20 through the air above a predetermined minimum speed to cause the actuation of said pilot charge detonator and to render the said shell detonator responsive to said control means carried by the pilot, a removable
25 casing carried by the shell, said master controlling means and said source of current being carried in said casing, and complementary electrical coupling means carried respectively by said casing and the shell for
30 electrically connecting said master controlling means and the source of current with said detonator and said pilot carried controlling means.

6. The combination with an explosive
35 shell, of a main explosive charge for the shell and an electrical detonator therefor, a pilot detachably carried by said shell, a friction clutch normally holding the pilot and the
40 shell in fixed relation to each other, a secondary explosion charge and an electrical detonator therefor carried by the shell, said secondary charge being arranged upon explosion to release said friction clutch and
45 drive the pilot away from the shell in advance thereof, controlling means carried by the pilot and operatively connected with the main charge detonator for actuating the detonator upon contact of the pilot with an object, and means operable upon the passage
50 of the shell through the air in excess of a given speed to cause said secondary charge detonator to be actuated.

7. The combination with an explosive
55 shell, of a main explosive charge for the shell and an electrical detonator therefor, a

pilot detachably carried by said shell, a friction clutch normally holding the pilot and the shell in fixed relation to each other, a secondary explosion charge and an electrical detonator therefor carried by the shell, said
60 secondary charge being arranged upon explosion to release said friction clutch and drive the pilot away from the shell in advance thereof, controlling means carried by the pilot and operatively connected with the
65 main charge detonator for actuating the detonator upon contact of the pilot with an object, and means operable upon the passage of the shell through the air in excess of a given speed to cause said secondary charge
70 detonator to be actuated, together with means separate from said main charge electrical detonator for detonating the main charge upon contact of the shell with an object.

8. The combination with an explosive
75 shell, of a pilot normally carried by the shell, a main explosive charge for the shell, a secondary explosive charge arranged upon detonation to drive the pilot away from the
80 shell in advance thereof, a detonator for the main charge, means carried by the pilot for causing the actuation of said detonator upon contact of the pilot with an object, and a percussion detonator for said main
85 charge operable upon contact of the shell with an object.

9. The combination with a shell having an explosive charge with electrical controlling means and a controlling circuit there-
90 for, of a switch for said circuit comprising a pair of springs tensioned toward each other and normally held apart by a weighted ball held between the springs, said springs having sufficient tension to support the
95 weighted ball against the normal pull of gravity and having depressions fitting over the ball in a manner to cause the springs to be separated against their tension by movement of the ball in any direction, said parts
100 being so arranged that while movement of the ball in any direction will cause it to be dislodged from between the springs, and a pair of switch contact members carried by said springs and arranged to be brought into
105 engagement with each other under tension of the springs upon dislodgment of the ball.

In testimony whereof I affix my signature.

DANIEL GORDON EDWARDS.