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1,442,929.

G. E. ELIA,
AERIAL SHELL.
FILED APR. 25, 1917.

2 SHEETS—SHEET 1.

Fig. 1.

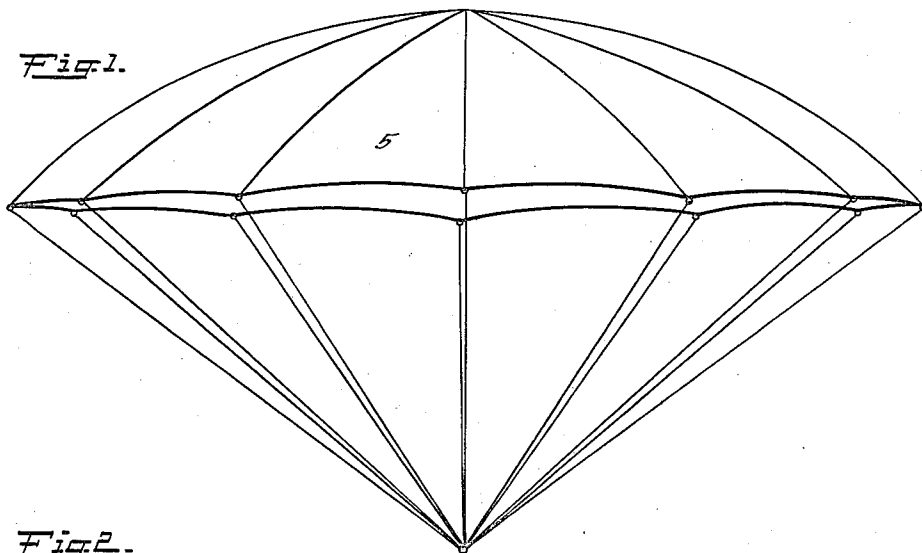
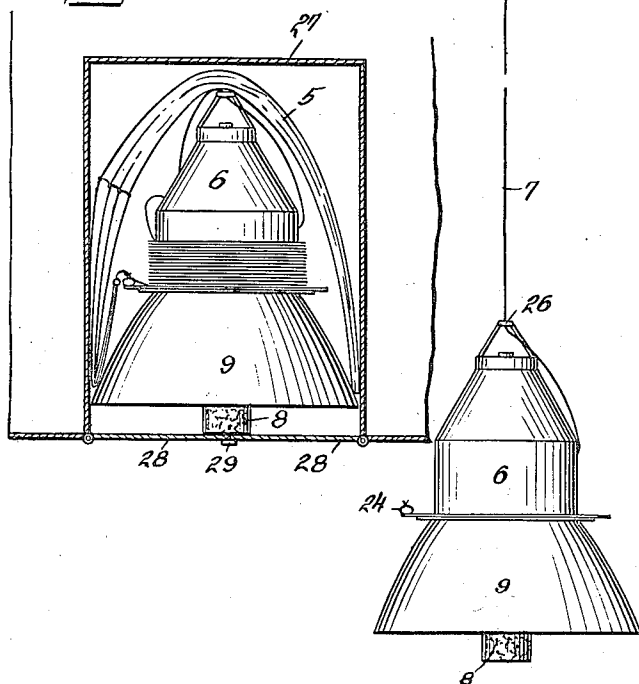


Fig. 2.



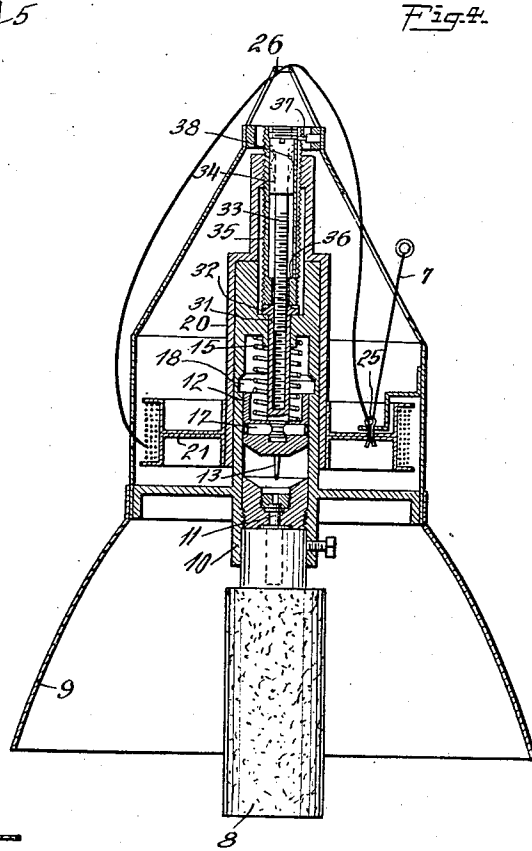
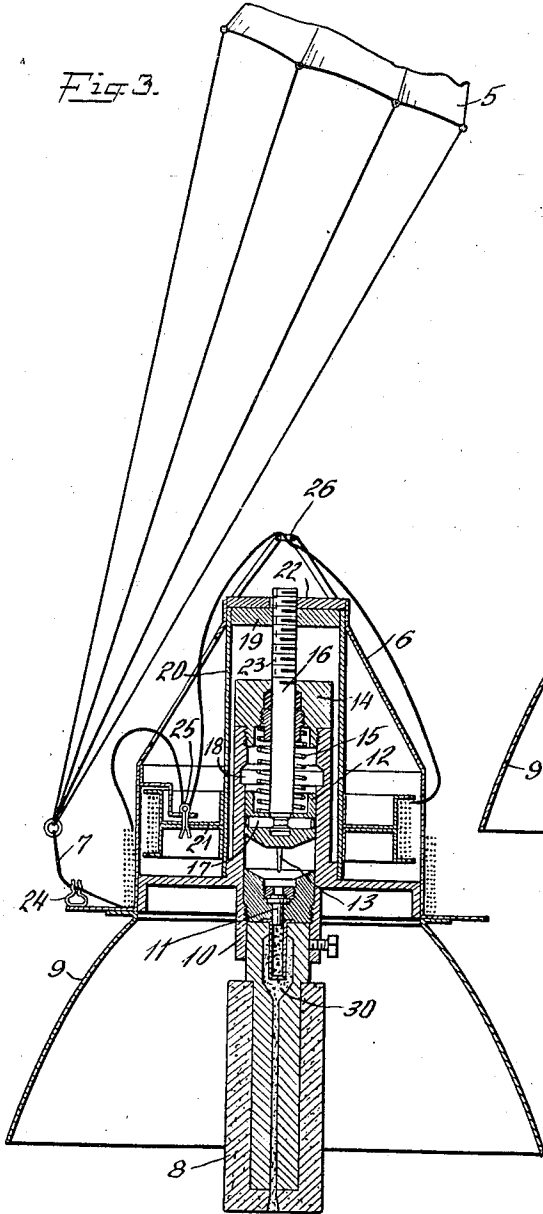
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2 SHEETS—SHEET 2.



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UNITED STATES PATENT OFFICE.

GIOVANNI EMANUELE ELIA, OF NEW YORK, N. Y.

AERIAL SHELL.

Application filed April 25, 1917. Serial No. 164,320.

To all whom it may concern:

Be it known that I, GIOVANNI EMANUELE ELIA, a subject of the King of Italy, residing at New York city, in the county of New York, State of New York, have invented certain new and useful Improvements in Aerial Shells; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to aerial shells and is directed to the provision of an improved form of automatic firing mechanism for firing the shell in the air. The invention is of special utility in aerial shells of the type commonly known as star shells employed for illuminating extended areas at night, more particularly to facilitate artillery and aeroplane operations against a hostile force. It will be understood, however, that the invention is not limited to such star shells, but, on the contrary, may be employed in shells, bombs and illuminants of various types which are to be exploded or ignited in the air.

Star shells are commonly employed in warfare for illuminating an extended area of the battlefield. For this purpose, they are launched in any suitable manner from guns or aeroplanes and are fired in the air, whereupon they burn with a strong illuminating power. Such a shell should be provided with means for sustaining it in the air for a considerable period of time, a period at least as long as the illuminant will last.

The present invention involves the provision of a star shell adapted to be launched from an aeroplane and provided with a parachute for supporting the shell in the air so that the shell will descend relatively slowly after the parachute has opened out, the parachute being of such size as to sustain the shell between the required limits of height during the entire period required for the consumption of the illuminant. For the protection of the parachute, the shell itself should be suspended at a sufficient distance below the parachute to guard against setting fire to it when the explosive or illuminant of the shell is burned; also, it may be desirable to have the shell suspended at a great distance below the parachute when the shell is fired, so that, though the shell be launched from a great height to lessen the danger from anti-aircraft guns, the shell will be

fired and will burn at the elevation at which its illuminating power will be most effective. In accordance with the invention, the firing mechanism of the shell is arranged to be actuated automatically when the shell has dropped a predetermined distance below the parachute and the cable or rope whereby the shell is suspended from the parachute is employed for effecting the actuation of the firing mechanism. A suitable length of rope is provided between the shell and the parachute and when this slack has been taken up by the downward movement of the shell relatively to the parachute, the firing mechanism of the shell is automatically actuated. For the purpose of securing a high factor of safety in the handling of the shells prior to launching and a high degree of reliability in the operation of the firing mechanism, this mechanism is preferably of a type which includes two coacting threaded members, one of which is rotated by the downward movement of the shell relatively to the parachute through the flexible connection between them and the other of which is held against rotational movement and is arranged to operate the firing mechanism by its axial movement. Thus, the cable connecting the parachute and the shell may be carried several times around a reel within the shell casing so that after the parachute opens out and the shell continues to drop, the reel is rotated by the cable being drawn from it. This rotational movement of the reel may be arranged through coacting threads to effect axial movement of a shaft to store energy in a spring operating on the firing mechanism of the shell and then release that mechanism. In this way, a strong movement of the firing pin may be obtained which insures reliability of operation of the firing mechanism and at the same time the mechanism may be so constructed as to guard very effectually against an accident resulting from premature explosion of the shell or ignition of the illuminant. Also, the mechanism may be readily adjusted for the operation of the firing mechanism when the shell has descended any desired distance from the supporting parachute.

The features of the invention will be better understood by reference to the following description taken in connection with the accompanying drawings which illustrate embodiments of the invention at present preferred. In these drawings, Fig. 1 is a view

in elevation showing the parachute and the shell suspended therefrom; Fig. 2 is a sectional elevation showing these parts enclosed within a casing in the body of an aeroplane so that the shell may be readily dropped from the plane; Fig. 3 is a longitudinal section through the shell; and Fig. 4 is a view similar to Fig. 3 but illustrating a modified construction.

Referring to these drawings, an aerial supporting means in the form of a parachute is shown at 5 and the shell is shown at 6 suspended from the parachute by means of a flexible cable or rope 7. The inflammable or explosive element within the shell may be of any suitable character and its construction and arrangement within the casing of the shell may be varied as desired. In a star shell, the inflammable material is of such a character and quantity that it will burn for a considerable period of time and will have a strong illuminating power throughout that time. Furthermore, the size of the parachute is so chosen that it will support the shell at the requisite height throughout the period required for the consumption of the illuminating material. In the drawings, the inflammable material furnishing the illumination is indicated diagrammatically at 8 and the casing of the shell may be shaped to form a reflector 9 for throwing the light rays downward in a cone.

Within the casing of the shell is a tubular frame 10 having a primer 11 mounted therein in any suitable manner. Within the frame 10 is a cylinder 12 carrying a firing pin 13 projecting downwardly so as to engage the primer 11. The upper end of the tubular frame 10 is closed by a plug 14 and a coiled spring 15 lies between the plug 14 and the cylinder 12. When this spring is compressed and the plug 12 is released, the plug is moved downwardly by the spring with considerable force so that the firing pin 13 engages the primer 11 with a sharp blow.

The cylinder 12 is lifted within the frame 10, compressing the spring 15 by a shaft 16 which is provided with a circumferential groove near its lower end. Within the cylinder 12 are a plurality of radial openings, each of which receives a locking or retaining piece 17. Each of these pieces is bevelled off at each of its ends. In the inner wall of the tubular frame 10 is a circumferential groove as shown at 18 in Fig. 3.

The shaft 16 is moved vertically by means of threads thereon coacting with threads on the interior of an opening through a rotating part which includes a disk 19 and a tube 20. This tube 20 has a reel 21 secured to it and it is adapted to rotate upon bearing surfaces formed on the frame 10 and the interior of the casing 6. The upper end of

the casing 6 is closed by a disk 22 and on this disk is a projection which enters an axial groove in the shaft 16, as shown at 23, so as to prevent rotational movement of the shaft 16 as the disk 19, tube 20, and reel 21 are rotated.

The flexible cable 7 which connects the parachute 5 to the shell is wound around the reel 21 to facilitate adjusting the distance which the shell will drop relatively to the parachute before the firing mechanism is actuated. The cable 7 may be wound several times around the exterior of the casing 6 of the shell, as is indicated in Fig. 3, as in this way the desired adjustment may be made by merely changing the number of convolutions of the cable 7 which are wound upon the casing. When this expedient is adopted for adjusting the operation of the firing mechanism, a clamp 24 is preferably provided for gripping one end of the portion of the cable wound on the casing of the shell and a pin 25 is provided at the opposite end of this portion arranged to engage with the reel 21 so as to hold the reel against rotation. The extreme end of the cable 7 is secured to the reel 21 and the portion of the cable adjacent to this end is wound around the reel 21 such a number of times as will cause the rotation of the reel required for operating the firing mechanism. From the reel the cable is carried through an opening in the side of the casing 6 and then upward through a central opening in a ring 26 at the apex of the casing. The cable then passes to the pin 25 which may be in the form of a cotter pin adapted to extend through openings in a projection on the casing 6 and on the reel 21. This pin 25 is of such shape and such material that it will be easily pulled out of the openings in the casing and reel when the cable 7 exerts a pull upon it. Beyond the pin 25 the cable 7 is wound such a number of times as may be desired upon the casing 6 of the shell and adjacent to the last convolution of this winding the cable is placed between the jaws of the spring clamp 24 mounted on the casing of the shell. The purpose of this clamp is merely to prevent accidental unwinding of these convolutions of the cable and it is so constructed that it will release the cable easily when subjected to any strain.

The complete apparatus shown in Figs. 1 and 3 may be stored in a compartment of an aeroplane and arranged to be launched therefrom quite readily. Thus, as is indicated in Fig. 2, a rectangular or round compartment 27 may be provided in the body of an aeroplane having pivoted doors 28 at the bottom thereof normally held in the closed position by a latch 29 provided with operating mechanism whereby it can be released by the pilot or observer of the aero-

plane as by depressing a pedal. The shell is disposed vertically within the compartment 27 and the parachute is laid over the upper end of the shell in such a way as will be best calculated to insure the opening of the parachute. When the doors 28 are released, the shell 6 with the parachute connected thereto drops vertically from the compartment and the air catching in the parachute causes it to open to the position shown in Fig. 1. This practically arrests the downward movement of the parachute but the downward movement of the shell continues. The first effect of this downward movement of the shell relatively to the parachute is to cause the cable 7 to be drawn out of the jaws of the clamp 24 and thereafter the convolutions of the cable wound upon the casing 6 are paid out until finally all of this portion of the cable 7 is unwound from the casing of the shell. The continued downward movement of the shell draws the cable 7 taut between the parachute and the pin 25 and the pin is at once drawn out of the openings in the reel 21 and the projection on the casing 6, thus releasing the reel 21 so that it may be rotated. Further downward movement of the shell relatively to the parachute causes the cable 7 to be drawn off from the reel 21 through the ring 26, thus turning the reel 21, the tube 20 to which the reel is affixed, and the disk 19 in the upper end of the tube 20. The turning of the disk 19 on the shaft 16 which is held against rotation by the splined connection to the disk 22 on the casing 6 causes the shaft 16 to be raised vertically carrying the cylinder 12 with it and compressing the spring 15. This continues as the shell descends until the pieces 17 are carried up to the circumferential groove 18 in the frame 10, whereupon the pieces 17 are moved outwardly by reason of the inclined surfaces upon the inner ends of the pieces and the inclined walls of the circumferential groove in shaft 16 with which those ends of the pieces coact. This leads eventually to the release of the cylinder 12 from the shaft 16 and as soon as this release occurs the spring 15 drives the cylinder 12 downwardly with considerable force, causing the firing pin 13 to engage the primer with a hammer-like blow and by means of a train of powder 30 the explosive or inflammable material 8 of the shell is ignited.

In Fig. 4 a modified construction of the firing mechanism is illustrated, differing from that illustrated in Fig. 3 with respect to the means for effecting an adjustment of the distance through which the shell will drop relatively to the parachute before the firing mechanism is operated. In Fig. 4, the frame 10, primer 11, cylinder 12, firing pin 13, spring 15, locking pieces 17, groove 18 and reel 21 are the same or substantially

the same as the correspondingly numbered elements in the Fig. 3 construction. The upper portion of the tubular frame 10 is formed to coact with the upper end of spring 15 and also to form a bearing for a hollow shaft 31 which is adapted to slide vertically within the frame 10. This hollow shaft has a circumferential groove near its lower end coacting with the inner ends of the pieces 17 in the manner described in connection with Fig. 3. The upper end of the hollow shaft 31 is enlarged as shown at 32 to form a circumferential flange which rests upon a shoulder on the interior of the frame 10. The central opening in the hollow shaft 31 is threaded and receives the end of a threaded rod 33 which extends upwardly from the hollow shaft and is enlarged at its upper end to form a head 34. The tubular member 20 to which the reel 21 is secured is extended upwardly and at its upper end is provided with an interiorly threaded opening, the threads of which coact with threads on the exterior of a tubular shaft 35, the lower end of which normally rests upon the circumferential flange 32 of the hollow shaft 31. This lower end of the hollow shaft 35 is contracted so as to form an internal shoulder 36, but the threaded rod 33 extending through this contracted lower end of the hollow shaft 35 does not make contact therewith. The hollow shaft 35 is provided with an axial groove as is indicated in Fig. 4 to receive a pin 37 on the casing of the shell so as to prevent the hollow shaft 35 from turning as the tube 20 is turned but permit that shaft to be moved vertically. The head 34 of the threaded rod 33 may be provided with grooves on opposite sides thereof in which leaf springs 38 are mounted, the function of these springs being to press outwardly against the interior wall of the hollow shaft 35 so as to prevent accidental rotational movement of the rod 33. The cable 7 from the parachute is connected to a pin 25 for locking the reel 21 against rotation and then passes through the ring 26 at the upper end of the casing of the shell and then downward through an opening in the casing of the shell, the end of the cable being wound a plurality of times around the reel 21 and then secured to the reel.

When the shell constructed as above described in connection with Fig. 4 is launched from an aeroplane and the parachute opens out, the upper length of the cable 7 is drawn taut, thus withdrawing the pin 25 from its locking position in the opening in reel 21. Thereafter, further descent of the shell causes the cable 7 to be drawn off from the reel 21 to rotate the reel. The tube 20 turns with the reel 21 and the coacting threads on this tube and the hollow shaft 35, together with the splined connection for preventing

rotational movement of the hollow shaft 35, result in axial upward movement of shaft 35. This movement continues until the shoulder 36 near the lower end of the hollow shaft 35 engages the lower end of the head 34 of the threaded rod 33, whereupon the rod is lifted with the shaft 35. When so lifted, the rod 33 carries with it the hollow shaft 31 and the latter carries with it the cylinder 12, thus compressing the spring 15. This movement continues until the pieces 17 rise to the level of the circumferential groove 18, whereupon the cylinder 12 is released and is actuated by spring 15 to fire the shell in the manner heretofore described. It will be noted that by applying a screw-driver to the slot in the end of the head 34 of rod 33 and turning that rod, an adjustment can be effected of the distance which the shell must drop before the firing mechanism is actuated to fire the shell. So turning the rod 33 regulates the distance between the shoulder 36 on the hollow shaft 35 and the lower end of the head 34 of the rod 33, that is, the distance which the shaft 35 must travel upwardly before it begins to raise the rod 33, hollow shaft 31 and cylinder 12. This mechanism therefore provides a means for effecting an adjustment of the distance which the shell must drop relatively to the parachute by means of the parts of the shell itself rather than by varying the length of the cable 7 between the pin 25 and the parachute and suitably storing that length of cable as by winding it upon the exterior of the casing of the shell. It is to be noted that this aerial shell is entirely self-contained, and that once launched by the aeroplane is entirely independent thereof. At the same time the ignition is so delayed as to enable the launching aeroplane to make good its escape beforehand, thus avoiding danger from anti-aircraft guns.

I claim:

1. An aerial shell adapted to be launched from an airship and to be sustained in the air while the combustible is being consumed to illuminate the area under the shell, comprising the combination of a parachute constituting the sustaining means for the shell, a casing containing the combustible serving as the illuminant, a cable by which the casing is suspended from the parachute, a firing mechanism for igniting the combustible, and a reel on which a portion of the cable is wound and which is arranged to actuate the firing mechanism, the downward movement of the casing and reel relatively to the parachute being arranged to cause rotation of the reel by the cable being drawn from it; substantially as described.

2. An aerial shell comprising a supporting parachute, a casing containing a combustible, a cable connecting the parachute and the casing, and capable of being paid out to permit relative movement of the casing away from the parachute, and mechanism within the casing operated by said relative movement to ignite the combustible at a predetermined time.

3. An aerial shell comprising a supporting parachute, a casing containing an illuminant, a cable connecting the parachute and the casing, a rotatable drum within the casing around which the cable is wound for a part of its length in such a manner that a relative movement of the casing away from the parachute results in the rotation of the drum, and an ignition mechanism within the casing operated by the rotation of the drum to ignite the illuminant at a predetermined time.

In testimony whereof I affix my signature.

GIOVANNI EMANUELE ELIA.