Dec. 19, 1961 C. J. FLETCHER 3,013,493

AERIAL FLARE

Filed June 13, 1960 2 Sheets-Sheet 1

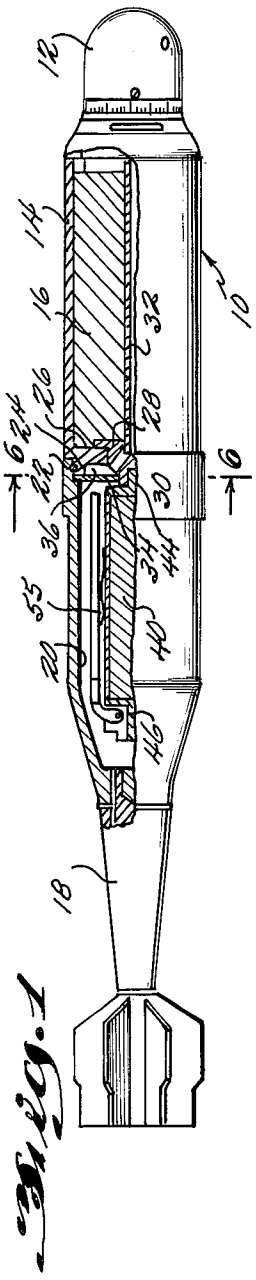


Fig. 1

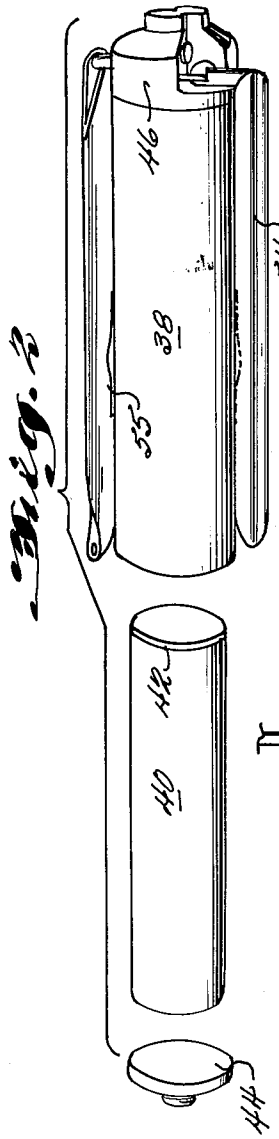


Fig. 2

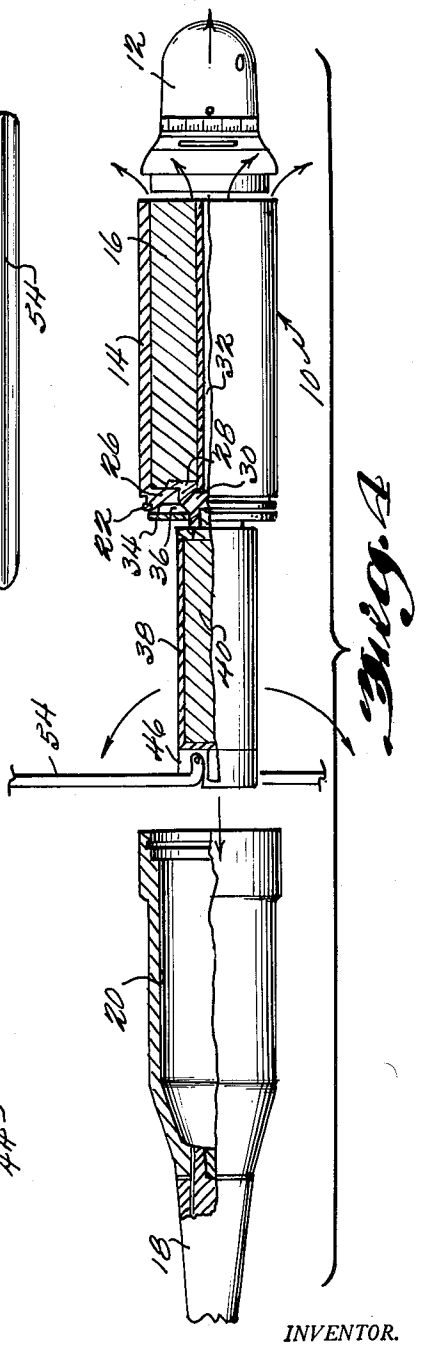


Fig. 3

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AERIAL FLARE

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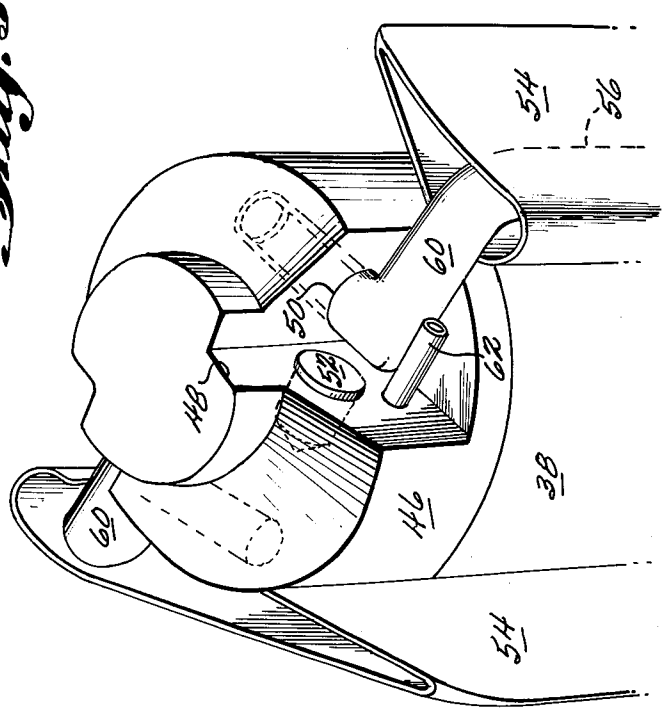


Fig. 4

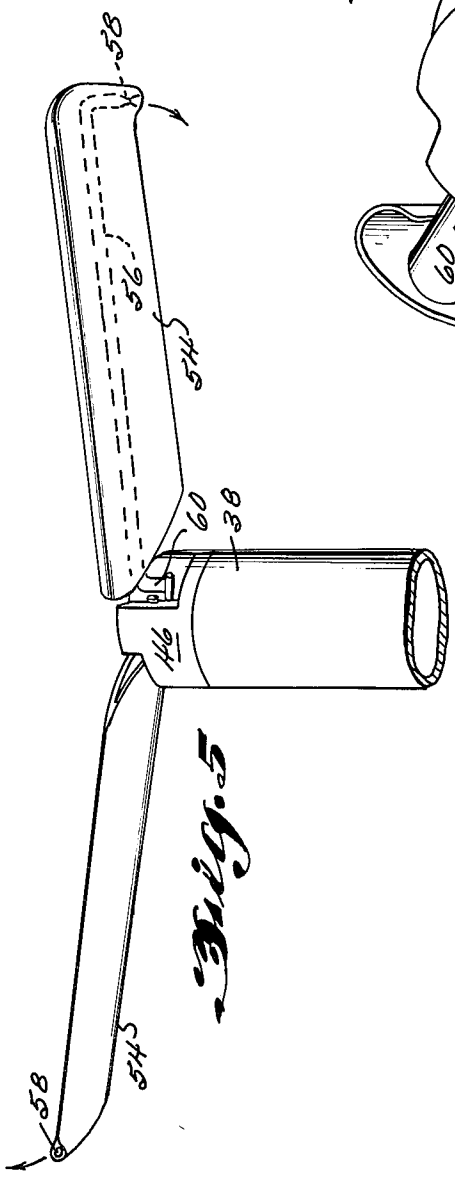


Fig. 5

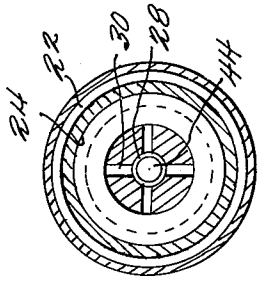


Fig. 6

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3,013,493

AERIAL FLARE

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12 Claims. (Cl. 102—35.6)

This invention relates generally to illuminating devices and more particularly to an improved illuminating shell or flare adapted to be fired from a mortar etc. into the air to illuminate a large area of sky and ground.

Devices of this general type are well known in the art. For example, an 81 mm. illuminating shell is presently in use having a compartment for carrying a parachute which is ejected at an altitude of approximately 2600 feet and permits the flare to drop at a rate of descent on the order of 20 to 25 feet per second. Although the parachute method of descent has provided a relatively low cost system in combination with a tolerable degree of performance, it is believed that the present invention will provide a number of advantages not heretofore realized.

For instance, it is anticipated that the rotor blade system will improve the reliability by eliminating the unsuccessful firings caused by tearing or fouling of the parachute as a result of opening at its critical velocity of 200–300 feet per second. Failures have also been known to occur because of the tail cone's overshooting the open parachute in the path of trajectory due to the latter's large opening envelope and high drag characteristics.

While it is a recognized fact that the conventional parachute suspends the flare over a specific area for a limited duration, it is also realized that the rate of descent is such that the flare burns over the maximum illumination area for only a small portion of the total burning time due to its relatively high rate of descent of 20 to 25 feet per second. On the other hand, the advantages of this invention lie in the fact that the powered rotor will permit the flare to drop at a substantially lower rate of descent at maximum flare payload; then will rise to its initial design altitude as both rotor power and flare payload is expended in the form of burning gases. The end result is that the flare will provide a maximum of illumination, since it is capable of operating near the design altitude for the full burning duration of the flare.

It has also been established that the parachute when ejected under a relatively high wind condition will tend to drift the flare considerably away from the illuminating target zone. The rotary wing concept of this invention alleviates this tendency, since the relative wind acting on the flare body tilts the rotor axis into the wind in such a manner that resultant thrust counteracts the wind-drifting effects.

In considering parachute ejection in relatively no wind conditions, the flare often passes through a smoke stagnation region resulting in poor illumination. The rotary wing concept of this invention, however, will provide a down wash flow of air which will tend to disperse flare smoke stagnation and thereby improve target area illumination.

Accordingly, the main object of the present invention is to provide an improved illuminating shell or flare which will obviate the objectionable features characterizing known structures.

An important object of the present invention is to provide an improved illuminating shell which, being expendable, is reliable in operation but inexpensive in cost.

Another important object of the present invention is to provide an improved illuminating shell which will

substantially maintain peak altitude or greater during the normal burning time of the flare.

A further important object of the present invention is to provide an improved illuminating shell which will be automatically operable at a peak altitude to ignite its flare and sustain itself in the air by means of extended rotor blades rotated by power means during the burning of the flare.

Other objects and advantages of the present invention will become apparent during the course of the following description.

In the drawings I have shown one embodiment of the invention. In this showing:

FIGURE 1 is a side elevational view of the assembled illuminating shell comprising the present invention;

FIGURE 2 is an elevational exploded view of the apparatus and its propelling charge which sustains the flare at peak altitude during its burning;

FIGURE 3 is a fragmentary perspective view of the right end of the apparatus as seen in FIGURE 2;

FIGURE 4 is an exploded view of the invention showing how both the head containing the fuse timer and the tail cone separate from the rest of the illuminating shell at the peak altitude;

FIGURE 5 is an elevational view showing the solid sustaining charge cartridge and its attached rotor blades; and

FIGURE 6 is a transverse sectional view taken on the line 6—6 of FIGURE 1.

Referring to the drawings, numeral **10** designates the illuminating shell or flare as a whole which includes a nose **12** having a conventional fuse timer arranged therein, a body portion **14** containing a compacted charge of flare powder **16**, and a tail cone **18** having a compartment **20** in its forward portion.

The nose **12** has a tight friction fit within the forward end of the body **14** while the tail-cone **18** is secured to the body by means of a shear ring **22** seated in recesses formed in the wall of the compartment **20** and in the outer periphery of an annular flange **24** formed on the end wall **26** of the body **14**. The wall **26** is provided with a central aperture into which is screwed an adaptor plug **28** having a plurality of angularly spaced passages **30** which afford communication with a centrally positioned, axially extending passage **32** formed in the solid flare powder **16**. An annular plate **34** closely fitting around the plug **28** is clamped between the face of the flange **24** and a shoulder of the chamber **20** to define a pressure cavity **36** for reasons to be explained.

The means for sustaining the flare **10** at peak altitude is a rocket powered rotor assembly which is snugly housed in the compartment **20** and includes a cylinder **38** within which a solid rocket propellant charge **40** is inserted. The charge **40** has a first stage portion **42** which is ignited by the heat from an initiator **52** and in turn starts the main charge **40** burning.

The charge is retained in the cylinder **38** by an aft closure **44** which is screwed into the adaptor plug **28** to thus attach the rotor assembly to the body of the flare. The cylinder is closed at its other end by a hollow head **46** and its exterior end surface includes a pair of diametrically opposed recesses **48** in a side of each of which is a bore **50** communicating with the interior of the head. Also mounted in a bore in the side of a recess **48** is an initiator cartridge **52**.

A rotor blade **54** is mounted in each of the bores **50** by means of tubes **56** (FIGURES 3 and 5) which extend from thrust producing nozzles **58** horizontally through the blades to which they are fixed, to the recesses **48** and vertically downward as at **60** to the bores **50** and horizontally therewithin with a snug journal fit. They

are retained in their mounting in the bores **50** by means of stop pins **62** which lightly bear against the tube portions **60**. The blades are moved from their positions folded along side of the cylinder **38** (FIGURES 1–3 inclusive) to the extended position of FIGURES 4 and 5 by means of compression springs **55** inserted between the cylinder and the blades just before installation of the tail cone compartment **20** thereover.

Operation

In use, the assembled illuminating shell **10** (FIGURE 1) is inserted tail cone first into a mortar from which it is fired at angles from 45° to 75°. At an altitude of 2600 feet, the fuse timer in the nose **12** ignites and starts the burning of the solid flare powder **16**, the generated combustion gases immediately blowing off the nose **12**. The flare powder burns from the forward end to the rear end and the pressure gases pass by way of the central passage **32** and the adaptor plug passages **30** into the pressure cavity **36** and act against the annular plate **34** which is forced rearwardly.

The movement of the plate **34** effects failure of the shear ring **22**, and the tail cone **18** and the compartment **20** is driven rearwardly off of the body of the flare **10** to expose the rotor blades **54**. As the tail cone leaves the assembly (FIGURE 4), the compression springs **55** force the rotor blades **54** to fly open. In moving to the open position (FIGURE 5), the portion **60**, acting as a firing pin, of one of the rotor blade mounting tubes **56** strikes the initiator cartridge **52** which causes the first stage **42** of the solid charge **40** to start burning.

The burning gases from the charge **42** and subsequently from the charge **40**—exhaust through the head **46**, the tubes **56**, and out of the thrust nozzles **58** to drive the rotor. Acting as a retroactive brake, the resultant rearward lifting thrust effects deceleration of the flare to zero and the weight of the solid flare powder **16** turns the flare into upright vertical position (FIGURE 5) thereby permitting the rotor to suspend the burning flare.

Since the payload—the solid flare powder **16**—is rapidly expended during the approximately 100 second operation period, the rotor will not be required to lift the maximum weight (2.5 lbs.) for the entire operating period. Thus, the rotor and flare may lose a few hundred feet of altitude during the initial 25–50 seconds of operation but will then regain the lost altitude due to the decreased payload.

It is to be noted that existing 81 mm. illuminating shells or flares can readily be converted to ROR (rocket on rotor) operation as described herein by merely removing the existing parachute and substituting therefor the ROR assembly as shown in FIGURE 2 in the compartment **20**.

It will now be readily apparent that the present invention provides a compact illuminating shell having an automatic, self-energizing solid charge power system which operates independently of the solid flare charge upon ejection of the tail cone to suspend the flare at peak altitude for the duration of the illumination.

It is to be understood that the form of the invention herewith shown and described is to be taken as a preferred example of the same and that various changes in the shape, size, and arrangement of parts may be resorted to without departing from the spirit of the invention or the scope of the subjoined claims.

I claim:

1. An illuminating shell adapted to be fired from a mortar comprising a body having an ignitable flare charge therein, a nose fitted to one end of said body and including means for automatically igniting said charge, a tail including a compartment detachably connected to the other end of said body, means associated with said body and responsive to pressure gases of said charge when burning for causing separation of said tail from said body, and a power rotor assembly including power means drivably connected to the rotor blades and activating means for said power means all arranged in said compartment and connected to said body to sustain it in the air upon separation of said tail from said body and activation of said power means.

2. A device as recited in claim 1 wherein said assembly includes folded rotor blades, and spring means mounted between said assembly and said blades operable to unfold said blades upon said separation.

3. A device as recited in claim 2 wherein said activating means comprises initiating means communicating with said power means and operable by an unfolding blade to activate said power means to effect rotation of said assembly.

4. A device as recited in claim 3 wherein said power means comprises a solid rocket charge, a rocket exhaust nozzle mounted in said blades, and tubes connecting said charge with said nozzles.

5. An illuminating shell adapted to be fired from a mortar comprising a body including a solid propellant, a nose fitted to one end of said body and including means for automatically igniting said propellant, a tail including an open compartment in the forward portion thereof connected to the other end of said body and closing the compartment, frangible locking means retaining said tail and said body in connected relationship, means associated with said body and responsive to pressure gases of said propellant when burning for causing separation of said tail from said body and a power rotor assembly including power means drivably connected to the rotor blades and activating means for said power means all arranged in said compartment and connected to said body to sustain it in the air upon separation of said tail from said body and activation of said power means.

6. A device as recited in claim 5 wherein said separation means comprises a pressure cavity including a movable wall formed in said body adjacent said frangible locking means and having communication with an axial passage in said solid propellant, and gases from said solid propellant during burning are conducted to said cavity and act against said movable wall to shear said locking means and effect separation of the tail from the body.

7. A device as recited in claim 5 wherein said assembly and power and activating means comprises a cylinder having a hollow head, a propellant in said cylinder, an initiator mounted in said head to ignite said propellant, a pair of rotor blades including rocket nozzles pivoted to said head, and tubes in said blades communicating with said head for conducting gases of the propellant when burning to said nozzles to effect rotation of said assembly.

8. A device as recited in claim 7 wherein said blades move from a folded position in said compartment to an unfolded position upon said separation, and one of said tubes strikes and activates said initiator during the move.

9. An illuminating shell adapted to be fired from a mortar comprising in combination a tubular body having an ignitable flare charge therein, a nose fitted to the forward end of said body and including means for automatically igniting said charge, a tail having a compartment in its forward end, frangible means detachably connecting said body to said tail to close said compartment, means arranged in said body for breaking said frangible means to effect separation of said tail from said body upon ignition of said charge, and a power rotor assembly including power means drivably connected to the rotor blades and activating means for said power means all arranged in said compartment and connected to said body to sustain it in the air upon separation of said tail from said body, said power means being automatically activated upon said separation.

10. A device as recited in claim 9 wherein a cavity is formed in the rear end of said body and has communication with said flare charge, and said braking means

comprises an annular disk bearing against a forward portion of said tail and closing said cavity, said disk being movable rearwardly by gas pressure in said cavity from said flare charge.

11. A device as recited in claim 9 wherein said rotor assembly and power and activating means comprises a cylinder having a hollow head, a propellant in said cylinder, an initiator mounted in said head to ignite said propellant, a pair of oppositely disposed rotor blades, a rocket nozzle in the tip of each of said blades and arranged normal to the longitudinal axis thereof, and a pair of tubes pivotally mounting said blades in said head and communicating with said nozzles to conduct gases of the propellant when burning thereto to effect rotation of said assembly.

12. A device as recited in claim 11, wherein said blades move from a folded position in said compartment to unfolded position upon said separation and one of said tubes strikes and activates said initiator when said blades arrive at said unfolded position.

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