Sept. 25, 1962 D. STOEHR 3,055,300

ROCKET FLARE HEAD

Filed April 6, 1956 3 Sheets-Sheet 1

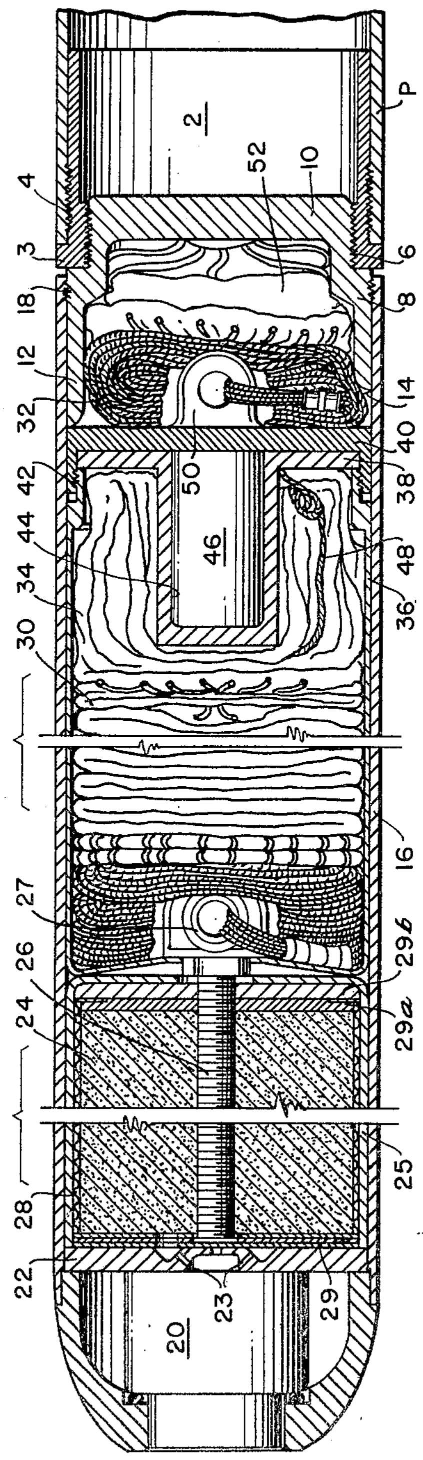

Fig. 1

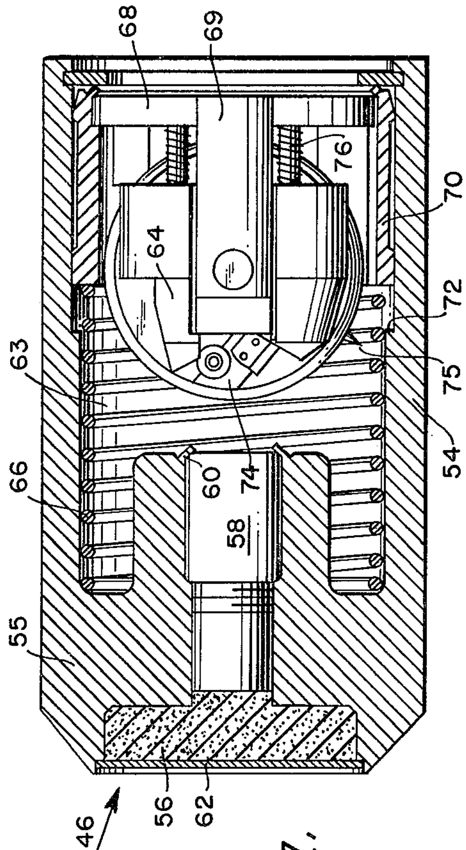

Fig. 2

INVENTOR.
DONALD STOEHR

BY G. R. O'Brien
T. L. Stamm
ATTORNEYS

Sept. 25, 1962 D. STOEHR 3,055,300

ROCKET FLARE HEAD

Filed April 6, 1956 3 Sheets-Sheet 2

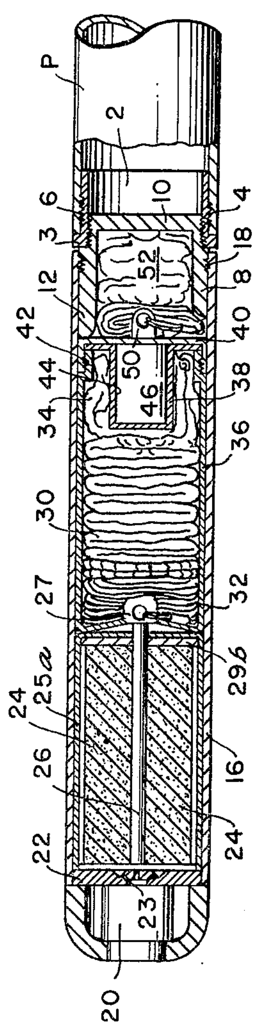

Fig. 3

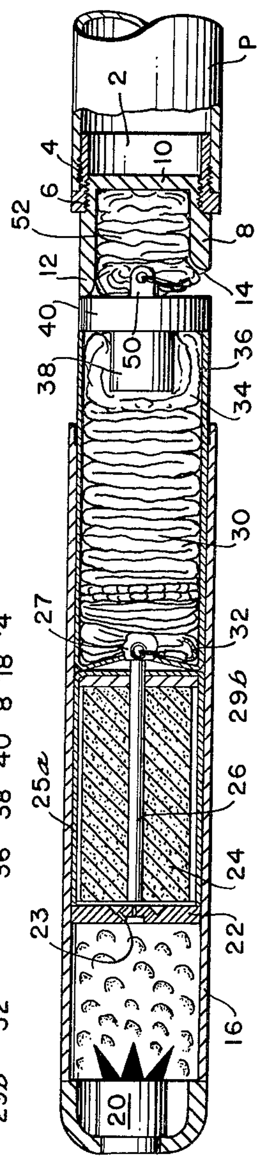

Fig. 4

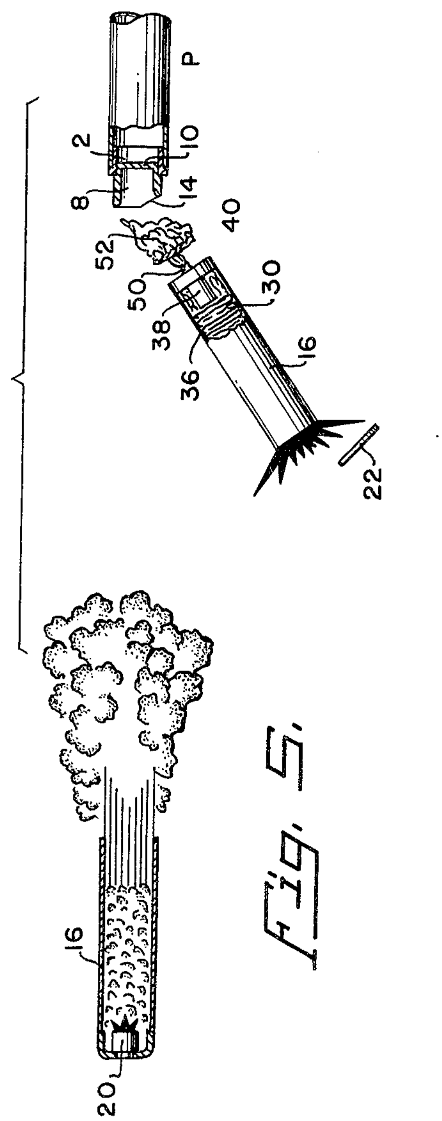

Fig. 5

INVENTOR.
DONALD STOEHR

BY G. D. O'Brien
T. L. Stam
ATTORNEYS

Sept. 25, 1962 D. STOEHR 3,055,300

ROCKET FLARE HEAD

Filed April 6, 1956 3 Sheets-Sheet 3

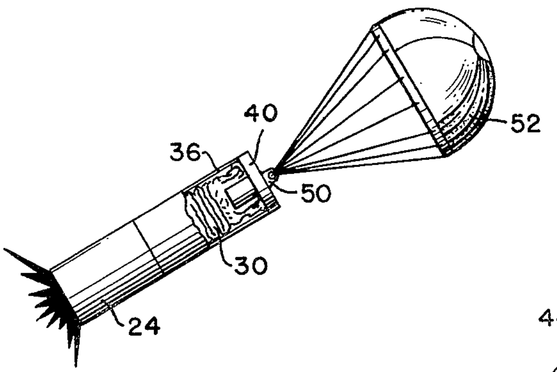

Fig. 6.

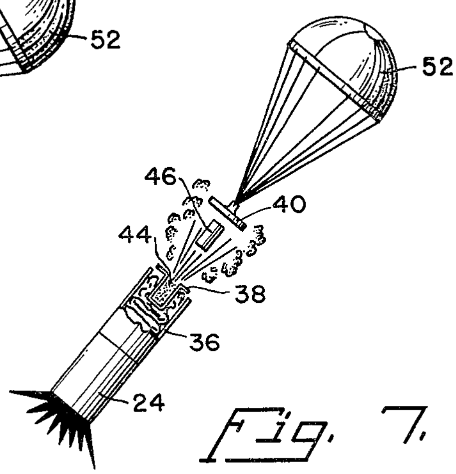

Fig. 7.

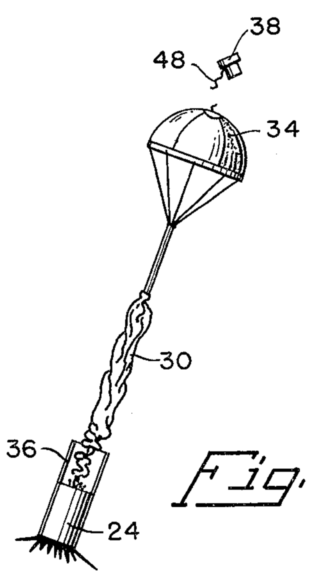

Fig. 8.

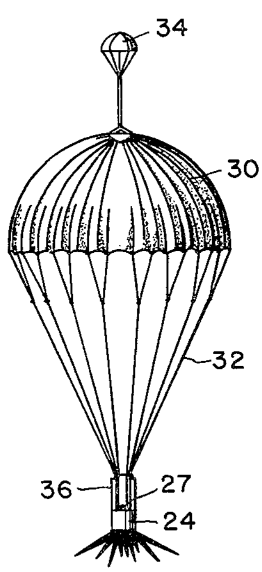

Fig. 9.

INVENTOR.
DONALD STOEHR

BY G. D. O'Brien
T. L. Stam
ATTORNEYS

United States Patent Office

3,055,300

Patented Sept. 25, 1962

3,055,300
ROCKET FLARE HEAD

Donald Stoehr, China Lake, Calif., assignor to the United States of America as represented by the Secretary of the Navy

Filed Apr. 6, 1956, Ser. No. 576,753
3 Claims. (Cl. 102—35.4)
(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention relates to aerial flares, and more particularly to projectile conveyed flare heads of the type in which a projectile, as a rocket, is used to convey a flare carrying head to a desired altitude and area where a lighted flare is released and supported by parachute means to light up a desired ground objective for reconnaissance, for aerial photography, or for other purposes.

For various purposes, both military and civilian, it is desirable to light up a ground area by means of elevated illuminating candle or flare means. It has become common practice to achieve this result with parachute supported illuminating flare means which are conveyed to a desired altitude and area by projectiles of various types, as for example, by rockets. In such arrangements, the projectile is provided with means allowing separation of the parachute and flare therefrom at a desired time or distance after firing of the projectile, and with means for igniting the flare and for causing or facilitating the opening of the parachute.

A common difficulty with such devices has been in the fact that excessive speeds at the time of parachute operation often resulted in general mechanical failure, in tearing or fouling of the parachutes, and sometimes even in complete disconnection thereof. Many efforts have been made to overcome these difficulties, as by utilization of auxiliary drag parachutes to slow down the flare assembly prior to opening of the main or suspension parachute. Generally, devices resulting from these efforts involved mechanical arrangements based upon forces exerted by a lanyard connected to the projectile body at one end and to the drag parachute of the flare assembly to open the drag parachute upon separation of the flare assembly from the projectile, and depended upon a second lanyard, either to directly pull out the main suspension parachute or to actuate a striker to initiate a pyrotechnic delay train to operate to release or expel the main parachute after a desired delay interval. Such dependency upon tension forces developed in these lanyards resulted in poor performance and lack of dependability since the forces involved were quite violent and necessarily not uniform in strength or direction, causing parts breakage or entanglement and malfunction. Moreover, in such arrangements wherein a pyrotechnic delay train was utilized, assembly and handling were hazardous because the firing mechanism thereof was always essentially armed.

This invention depends upon the discovery that drag parachute and delayed main parachute release could be effected without resorting to the undependable lanyard system hitherto relied upon in the prior art. The necessity for a drag parachute operating lanyard is obviated by novel design of the adapter coupling by which the flare is attached to the projectile for conveyance thereby, said novel design resulting in release of the flare assembly and opening of the drag parachute upon separation of the flare assembly from the adapter coupling without dependence upon a lanyard. Similarly, there is no dependence upon a lanyard for main suspension parachute operation in this invention, this function being performed by the novel combination of acceleration-deceleration op-

erated time delay fuze means in the flare assembly, said fuze means responding to acceleration in flight (of the projectile) and to deceleration upon separation of the flare assembly from the projectile to initiate a time delay pyrotechnic train which operates the main suspension parachute after a predetermined time interval (during which the flare assembly container decelerates to a safer velocity).

It is, therefore, an object of this invention to provide novel projectile-conveyed, parachute-supported flare means of greater reliability of operation than was possible in the prior art.

A further object of this invention is to provide novel projectile-conveyed, parachute-supported flare means wherein the use of tension lanyards to cause separation from the projectile and initiate parachute operation is obviated, thus greatly improving dependability of such devices.

A still further object of this invention is to provide projectile-conveyed flare head means wherein a flare assembly may be separated from a projectile without the use of a lanyard, by virtue of novel design of the adapter coupling means connecting the flare head assembly of the projectile.

Still another object of this invention is to provide novel flare head means wherein ejection of the main suspension parachute is effected by means entirely responsive to acceleration and deceleration forces of the assembly rather than by lanyard means or other mechanical connections, as in the prior art, thereby overcoming the lack of reliability resulting from excessive and non-uniform forces occurring in the use of such prior art devices.

Still another object of this invention is to provide new and improved flare head means adapted to be rocket projected to desired altitudes and areas for use.

A further object of this invention is to provide mechanical timing means responsive to acceleration to be armed and responsive to deceleration to be actuated to initiate a time delay device to operate a supporting parachute, such means being effective, as an element of a flare head, to replace lanyards or other tension operated mechanical means in initiating main suspension parachute operation in such a flare head.

These and other objects and many of the attendant advantages of the present invention will become apparent as the same become better understood from the following detailed description, taken in conjunction with accompanying drawings, in which:

FIG. 1 is a longitudinal sectional view through a flare head incorporating the principles of this invention, the conveying projectile being shown in fragmentary fashion;

FIG. 2 is a longitudinal sectional view through the delay mechanism of the flare head of FIG. 1;

FIGS. 3 to 9, in order, are representations of the sequence of operation of the flare head which is the subject matter of the invention, FIG. 3 being a sectional view (similar to FIG. 1) of the flare head, as conveyed by a rocket projectile, prior to operation of the nose timer to cause separation of the flare assembly; FIG. 4 being a view similar to FIG. 3 illustrating the initial separation of the flare assembly from the projectile body; and FIGS. 5 to 8 are schematic elevational representations of the remaining steps involved in the operation of the flare assembly.

Referring now to the drawings, in which like reference numerals have been appended to like parts throughout, attention is directed to FIG. 1 which is a sectional representation of the flare head assembly as attached to a projectile casing P, by means of adaptor coupling means **2**. Adaptor coupling means **2** is comprised of a portion engaging the inner wall of the projectile casing as, for example, a rocket motor tube as illustrated, and screw threadedly connected thereto, as shown at **4**. Coupling **2** has an expanded forward portion **3** of outer diameter matching that of the motor tube and screw threaded internally, as at **6**, to engage the head base member **8** of the flare head assembly.

Head base member **8** is a stepped cap-shaped member having a transverse wall **10** which serves as a closure for the rocket motor or other projectile casing P, the transverse wall being at the after end of a reduced portion which is of a size to fit internally of the forward portion **3** of adaptor coupling **2** and which is screw threaded for engagement with the threads **6**, as illustrated. Head base member **8** has a forwardly extending skirt **12** forming a pocket for a drag parachute to be later described. The skirt **12** is of an outer diameter substantially equal to the inner diameter of projectile casing P for engagement with a canister **16** which is of external and internal diameter substantially similar to that of the projectile casing P. Such relative proportions of the parts are not critical but are preferable in order that better streamlining and aerodynamic efficiency be attained.

The interior of canister **16** and the exterior of the skirt **12** are provided with matching screw threads of limited depth and length so as to be shearable upon the application of relative axial forces to the pieces, such threads being shown at **18**. Canister **16** contains a flare assembly which is releasable upon shearing of the threads **18** in response to axial forces applied against the canister by fuze means contained therein, as will be fully described hereinafter. In connection with this separation of canister **16** and head base **8** attention is directed to the configuration of the skirt **12** of the head base member. Skirt **12** is beveled, as by being cut away along an angular plane, to provide a pivotal surface **14** about which the flare assembly (to be described hereinafter) turns in being released from the head base **8** after separation of the canister from the head base as described, thus doing away with the need for drag parachute operating lanyard means as utilized in the prior art.

The canister **16** has a thickened forward wall in the ogival nose section thereof providing a shoulder which serves as a seat for a disc **22**, as shown. Disc **22** holds the nose fuze **20** in the forward ogival chamber and serves as the forward closure for the remainder of the flare assembly with which it is slidable relative to the interior of the canister **16**. Disc **22** is provided with through passageways **23** to conduct gases and flame from the fuze to a flare candle **24** which is supported in proximity to the disc. The flare candle **24** is attached to a main suspension parachute **30** by any suitable means, as by attachment of the shroud lines **32** thereof to a ring **27** formed in a post **26** imbedded in flare candle **24**, as illustrated.

The specific composition and construction of flare candle **24** is not critical, any known illuminating pyrotechnic being suitable, and any known covering or other side burning inhibiting material being usable as desired to control the nature of the burning of the candle. Two different variations of flare candle are depicted, by way of examples, in FIG. 1 and in FIGS. 3 and 4. In each instance a suitable pyrotechnic (such as a mixture of finely divided magnesium powder and an oxidizer held together by a plastic binder) material is molded about post **26** as previously described, the post being threaded or knurled (as in FIG. 1) if desired. The flare candle of FIG. 1 is wrapped circumferentially with corrugated paper or cardboard, which may be impregnated with an inhibiting compound, if desired, and has its ends covered by paper discs **29**, ***29a***, with openings in the forward disc **29** matching the passageways **23** in the pressure disc **22** to allow gas passage therethrough. This assembly, provided with a cardboard backing ***29b***, is enclosed in a steel outer casing **25** which is open at the front end as illustrated, this casing being fitted within canister **16**, as shown.

The flare candle of FIGS. 3 and 4 is of simpler construction and has been found suitable in use. It comprises a pyrotechnic compound molded about a post **26** having a backing piece ***29b*** and an open ended paper covering ***25a***.

The suspension parachute **30** has a pilot parachute **34** attached thereto, and these parachutes are folded and compressed within an inner case member **36**, being retained in this position by a closure member **38**, the closure member in turn being clamped into position as a closure for inner casing **36** by a retaining cap **40**. Retaining cap **40** is internally threaded, as at **42** for connection with corresponding threads on the outer surface of the inner case **36** and the threads are of such extent and depth as to be frangible or shearable upon the application of relative force between the cap member **42** and the retaining cap **40** by means and for purposes to be later described.

The inner case closure member **38** is of generally stepped configuration to provide a chamber **44** in which a delay timing device **46** is retained. Time delay device **46** is illustrated in detail in FIG. 2 and will be described in detail hereinafter, it being sufficient at this stage to merely describe the function thereof, i.e., to generate gas pressure at a given time to cause separation of retaining cap **40** from the inner case **36**, expulsion of the delay device from chamber **44**, and separation of closure **38** from inner case **36** with resulting withdrawal of pilot parachute **34** from the inner case as graphically represented in FIG. 7. Pilot parachute withdrawal is facilitated by attaching a string leader element **48** to the closure member **38** and loosely interfolding said string leader element within the folds of the pilot parachute **34** so that the said parachute is pulled out of the inner case to some extent as the closure **38** falls away from the remainder of the assembly.

The rearward external wall of retaining cap **40** is provided with an integral ring **50** to which are attached the shroud lines of a drag parachute **52** which is folded within the space provided within the skirt portion **12** of the head base **8** as illustrated in the drawing. At this point attention is again directed to the function of the bevel surface **14** of head base **8** and to the fact that the flare assembly is pivotally released over this surface **14** upon separation of canister **16** and head base **8** as shown in a comparison of FIGS. 4 and 5.

As discussed hereinabove, two separate fuze or time delay means are utilized in this invention, namely the nose fuze **20** and the time delay **46**. Considering the present invention in its broadest aspects the specific nature of these fuzes is less important than the functions required thereof and fuzes other than those disclosed herein are available for performance of such functions. The function of nose fuze **20** is to insure a time or distance delay between the firing of the rocket or other projectile and the operation of the flare. Such devices, well known in the prior art, have long been utilized to initiate warhead explosion or flare operation, and generally include a timing mechanism and a pyrotechnic train operated thereby to cause the evolution of hot gases and or flame, either to ignite a warhead material or to perform some other function. Such fuzes are described, for example, in page 592 of "Elements of Ordnance" by T. J. Hayes, published in 1938 by John Wiley & Sons, Inc.

The time delay device **46** has the function of interjecting a time delay between the operation of the nose fuze and the evolution of gases to effect release of the main suspension parachute so that deceleration forces (made possible by the operation of the nose fuze) may be effective to slow down the assembly so that said parachute may be safely operated. For this purpose, many expedients could be utilized, as for example, means similar to nose fuze **20** but operating on a longer preset time period or including a longer delay in the powder train thereof. The particular novel time delay device illustrated in FIG. 2 has been developed particularly for safer and more efficient performance of the time delay function and is preferred over prior art time delay devices because it incorporates a plurality of safety features not available in combination in such prior art devices, although, as stated hereinabove, prior art time delays of various types could be used if desired.

Time delay device **46** comprises an outer casing **54** of a size to fit within the chamber **44** of closure member **38**. Casing **54** is open at both ends, the forward wall **55** being thickened and shaped to provide a forward facing chamber and a connecting narrower passageway, the chamber being filled with a gas producing black powder charge **56** and the passageway having a time delay pyrotechnic train assembly **58** suitably held therein, as by the turning in of a portion of the wall adjoining the passageway, as at **60**. Black powder charge **56** is retained in the forward chamber by a frangible closure seal **62**. The rearward portion of the casing **54** is hollow, providing a chamber **63** for housing a time delay rotor **64** and its associated operating parts, the central portion of forward wall **55** extending into said chamber **63** to provide a seat for coil spring **66**, as shown. Rotor **64** is a known type of acceleration responsive integrating timing device forming the basis for a widely used family of fuzes and timing devices and forms a part of the disclosure in the application of W. F. Sapp, Serial No. 342,039, filed March 12, 1953, now Patent No. 2,948,219, in which the operation and construction thereof is fully described. Rotor **64** is mounted for rotary movement on stanchions **69** which are rigidly connected to a member **68** fixed in an annular sleeve member **70** which is free for axial sliding movement within the casing **54**. Such movement of the sleeve **70** is limited by the shoulder **72** formed on the casing wall, and is opposed by the coil spring **66**.

As is common in such devices (as more fully explained in the Sapp application identified above) rotor **64** is provided with rotor locking means in the form of a motion restraining assembly or rotor lock **74** and set back spring means **76** which urge the rotor into locking engagement with motion restraining assembly **74** to restrain rotary motion of the rotor. The arrangement of the set back springs, rotor and rotor lock is such that upon firing of the projectile acceleration forces cause the rotor **64** to move rearwardly (compressing set back springs **76**) to be disengaged from rotor lock **74**, and to be simultaneously rotated. Rotor **64** is thus rotated clockwise, as seen in FIG. 2, to a position in which a firing pin **75** thereon is aligned with pyrotechnic delay train **58**. At the end of the acceleration period, as the projectile is decelerated by ejection of the outer canister the annular sleeve **70**, carrying the rotor assembly, is forced forward by deceleration forces (inertia) against the force of spring **66** until it contacts the shoulder **72** at which point the firing pin strikes the detonator of delay train **58** to initiate burning thereof. The rotor is so shaped and its parts so positioned that, with the annulus **70** in contact with shoulder **72**, no portion of the rotor other than an extending firing pin (in the rotated position of the rotor) can possibly strike the detonator of the pyrotechnic delay train. Thus, in order for the pyrotechnic train **58** to be ignited three conditions or events must occur in a definite order, namely, initial acceleration to free the rotor for rotation by set-back forces on springs **76**; continued acceleration for a predeterminable period sufficient to allow acceleration forces to turn the rotor **64** to align a firing pin with the delay train; and deceleration to permit the timing mechanism to move forward against the pressure of spring **66** to cause the firing pin to cause ignition of the delay train **58**.

Delay train **58** may be variously constituted of known pyrotechnics to give any desired delay time and such delay is, of course, instituted by deceleration of the flare assembly in response to recoil forces exerted on the assembly by ejection of canister **16**. The operating times of the various fuzes and time delay trains are, of course, optional. For example, the nose fuze **20** could be arranged to have a ten second time delay and the delay element **46** to have about a five second delay, and the over-all operation of the device will now be described, using such time intervals as exemplary. FIGS. 3 to 9 of the drawing illustrate the various phases of operation, FIG. 3 showing the flare head assembly attached to a projectile (as a rocket motor) prior to firing (or prior to operation of nose fuze **20**). When the projectile is launched, the delay timer rotor **64** is released by setback and rotated and the operation of the timing means in nose fuze **20** is initiated. Ten seconds later the fuze **20** functions causing hot gases under pressure to be formed inside the forward fuze compartment of the canister **16**. Such hot gases pass through the passageways **23** in the disc **22**, ignite the flare candle **24**, and serve to apply pressure against disc **22** to vigorously push the outer canister forward, shearing off the screw threads **18** in the process, as depicted in FIG. 4. This gas pressure is sufficient to impel or eject the canister completely away from the flare assembly as shown in FIG. 5 and recoil from this ejection causes a momentary high deceleration in the remainder of the round to cause the rotor element **64** of delay timer **46** (which had been previously released by firing set back and rotated by acceleration) to act under inertia forces to overcome the force of spring **66** and slide forward so that the rotor's firing pin strikes initiating detonating means on delay train **58** to institute the five second delay period therein.

As soon as the outer case is ejected the flare load tumbles free of the projectile casing P as a result of the bevel **14** on head base **8**, the flare candle **24** having been ignited by this time, and the disc **22** falling away, all as illustrated in FIG. 5. As the flare load tumbles, the drag parachute **52** withdrawn from the cavity in head base **8**, opens (see FIG. 6) and serves to reduce the forward velocity of the flare load from its released velocity (about 1000 feet per second) to a velocity which the main parachute can withstand, (about 400 feet per second, or less). This deceleration of the flare load by drag parachute **52** occurs during the five second delay action of delay train **58** of the time delay device **46**. At the end of the five second delay period the delay train **58** burns through to the powder charge **56** (see FIG. 2) and ignites said charge causing the evolution of gases which rupture closure seal **62** and pressurize the chamber **44** to cause the threads **42** to be sheared and ejecting cap **40** to which drag parachute **52** is attached, the delay device **46** being also released or blown from chamber **44**, as shown in FIG. 7. The closure member **38** then falls away and withdraws the pilot parachute **34** by means of the string leader **48** loosely enfolded within the pilot parachute, as shown in FIG. 8, said pilot parachute then opening to withdraw the main suspension parachute **30** to the final flare supporting posi- delay means operative to allow deceleration of the flare candles having burning times in the order of slightly more than one minute in such devices and this affords illumination suitable for photographic reconnaissance, or other purposes.

It should be obvious from the above that the present invention provides novel flare head means for rockets and other projectiles, said flare head means being characterized in their efficiency and dependability of operation by virtue of the elimination of the lanyard drag and pilot parachute opening means generally utilized in prior art devices of this type, and by virtue of the provision of time delay means operative to allow decelerations of the flare means to a safe speed before operation of the main suspension parachute of the flare.

While only one basic illustrative example of devices according to the present invention has been specifically described herein, it is obvious that many variations and modifications thereof are possible within the scope of the teachings of this disclosure. It is therefore to be understood that the scope of the invention is not intended to be limited by the specific illustrative example described but rather by the scope and language of the appended claims.

What is claimed is:

1. In combination, a projectile body, an outer canister, a head end assembly attached to the projectile body, said head end assembly having a relatively short forwardly protruding cylindrical hollow skirt portion, said canister and skirt portion having interengaging frangible connecting means, a flare assembly contained in said canister with a portion thereof within the hollow skirt portion, said canister having a chamber in the forward end thereof, fuze means in said chamber responsive to acceleration forces to develop pressure gases within said canister to ignite said flare assembly and to cause said frangible connecting means to be broken and said canister to be ejected forwardly away from said head end assembly and said flare assembly freeing said flare assembly to fall out of said hollow skirt portion for independent operation, the cylindrical hollow skirt portion of said head end assembly also having an angular cut-away portion providing a beveled surface over which the flare assembly pivots in falling from the skirt portion, thereby facilitating separation of the flare assembly from the skirt portion.

2. In combination, a projectile body, an outer canister, a head end assembly attached to the projectile body, said head end assembly having a relatively short forwardly protruding cylindrical hollow skirt portion, said canister and skirt portion having interengaging frangible connecting means, a flare assembly contained in said canister with a portion thereof within the hollow skirt portion, said canister having a chamber in the forward end thereof, fuze means in said chamber responsive to acceleration forces to develop pressure gases within said canister to ignite said flare assembly and to cause said frangible connecting means to be broken and said canister to be ejected forwardly away from said head assembly and said flare assembly freeing said flare assembly to fall out of said hollow skirt portion for independent operation, said flare assembly comprising an open ended tubular flare assembly container, a flare candle in one open end of said container in proximity to said chamber whereby to be ignited by said gases generated by said fuze means, a main parachute assembly attached to said flare candle and enfolded within the other end of said container, cap means closing said other end of said container, said cap means having a drag parachute attached thereto externally of said container, said drag parachute being positioned in the hollow skirt portion of said head end assembly whereby said drag parachute opens to assist deceleration of the closed flare assembly container when said container falls free of said projectile.

3. The combination of claim 1, in which said flare assembly comprises a tubular container having a closure cap member at the end thereof in proximity to said hollow skirt portion, said closure cap member having a drag parachute attached thereto, externally of the container, said drag parachute being positioned within said hollow skirt portion and serving to assist in decelerating said flare assembly when it falls free from said hollow skirt portion.

References Cited in the file of this patent

UNITED STATES PATENTS

1,365,865	Svejda	Jan. 18, 1921
1,434,784	Lucas	Nov. 7, 1922