Nov. 20, 1962 J. E. HENDERSON ETAL 3,064,578

LIGHT-SENSITIVE PROXIMITY FUZE

Filed Dec. 13, 1944 3 Sheets-Sheet 1

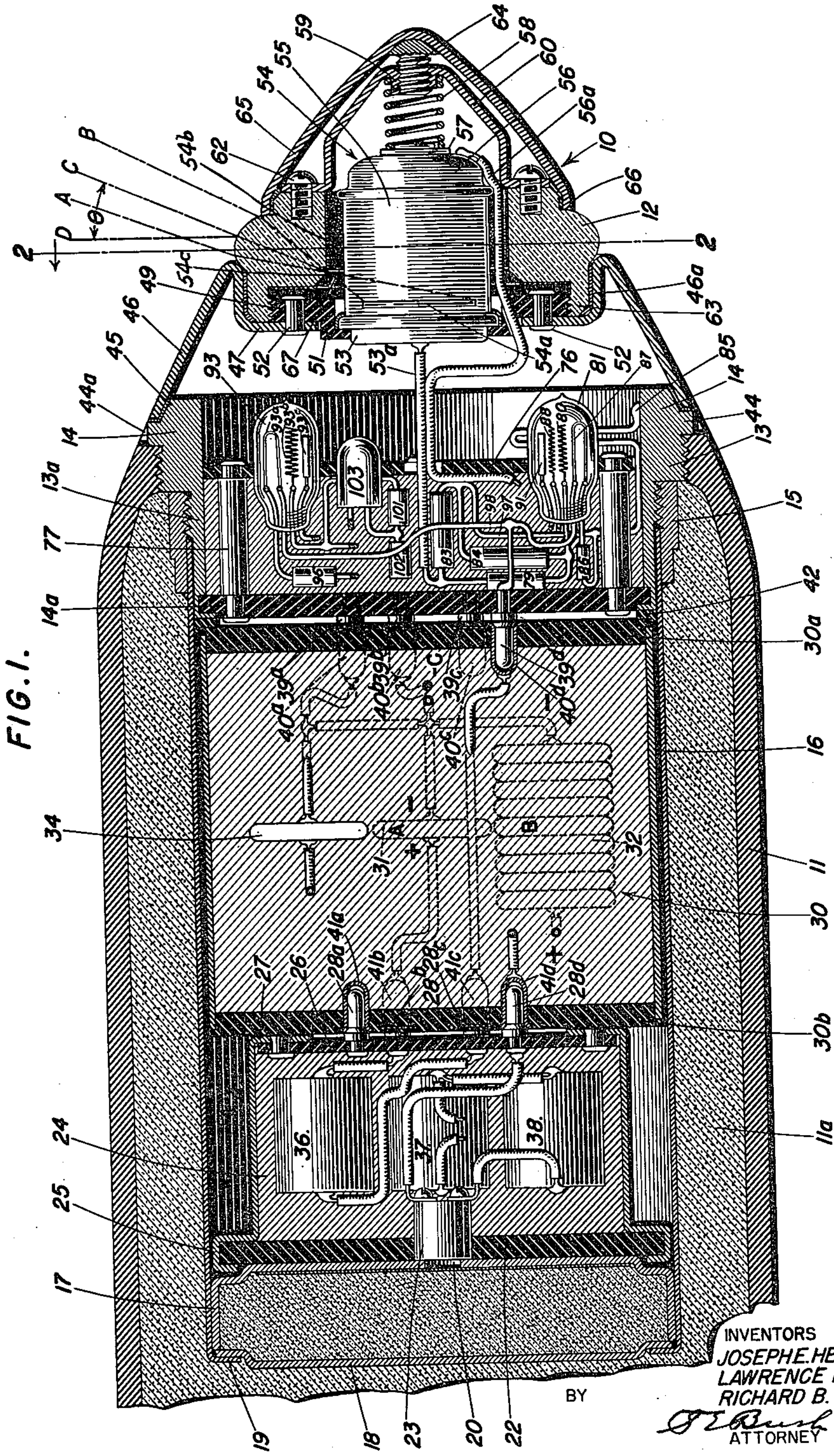

FIG. 1.

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FIG. 3.

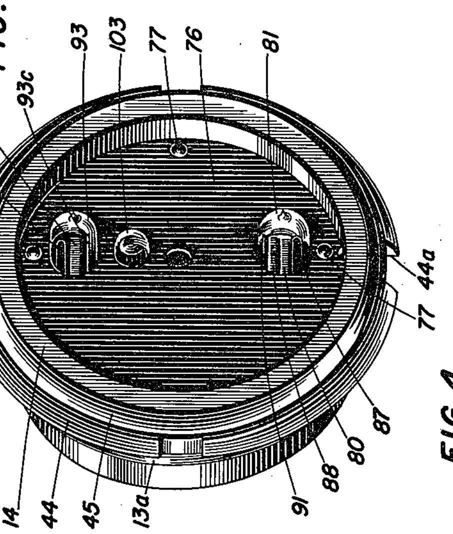


FIG. 2.

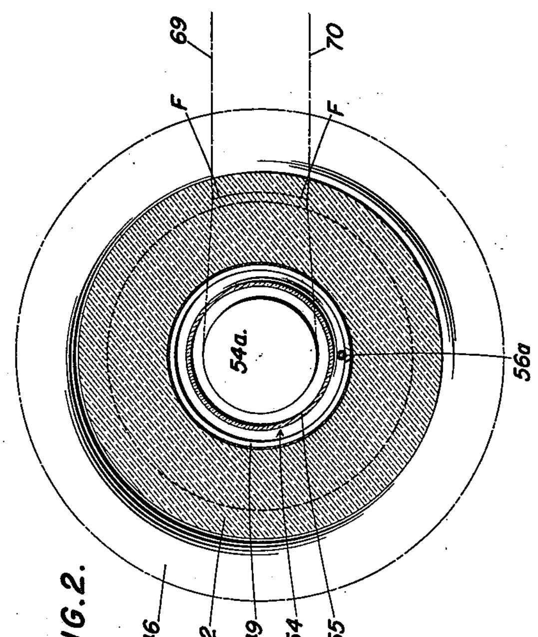
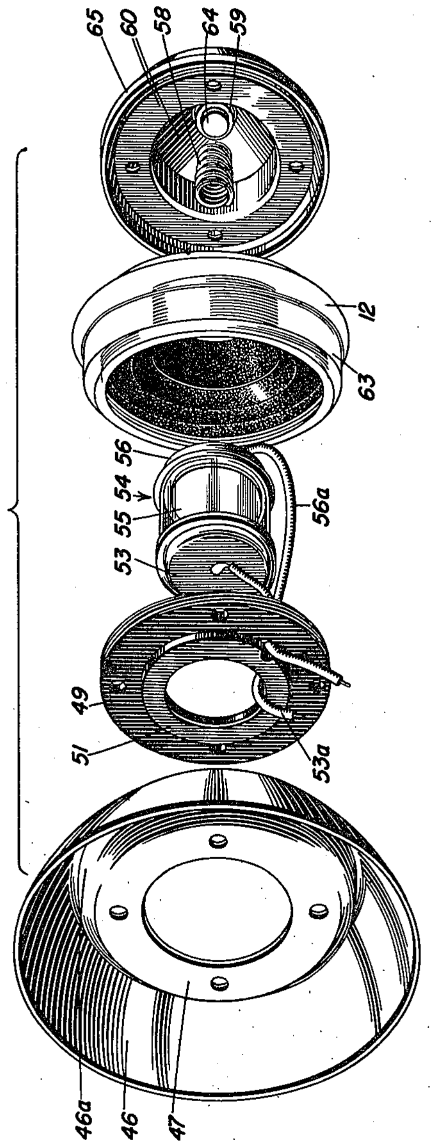


FIG. 4.



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Filed Dec. 13, 1944 3 Sheets-Sheet 3

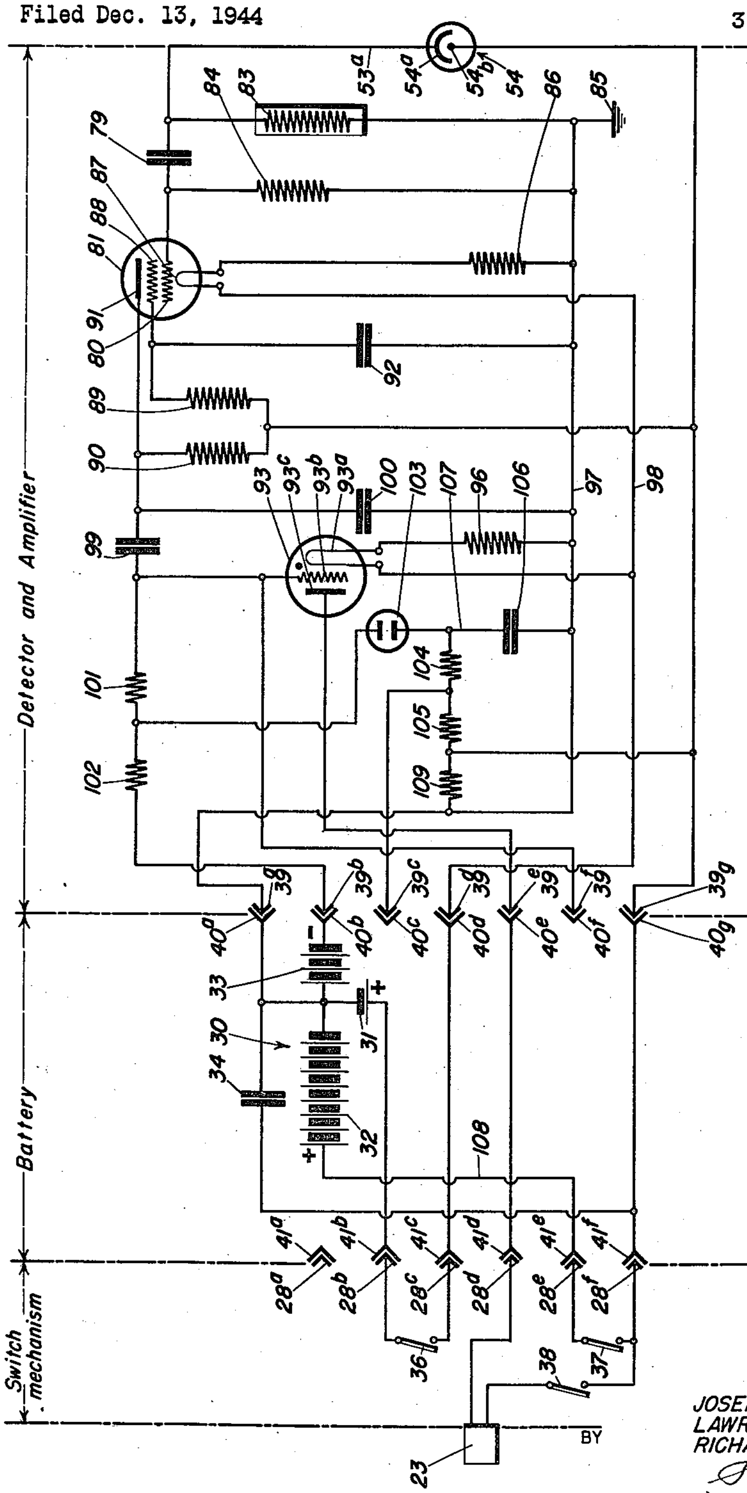

FIG. 5.

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LIGHT-SENSITIVE PROXIMITY FUZE

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3 Claims. (Cl. 102—70.2)

This invention relates to photoelectric devices and has particular reference to a novel light-sensitive fuze for explosive projectiles.

In firing a projectile at a target, such as an airplane, it is desired to cause the projectile to explode in the immediate vicinity of the target, in order to produce maximum damage.

It is, therefore, an object of the present invention to provide a fuze which can be attached readily to projectiles of various types and which will cause the projectile charge to explode when the projectile is within damaging range of an airplane, or other target, and at the proper position so that the fragment cone will intercept the target.

Another object is to provide a fuze with a light-sensitive element connected in an electrical circuit so that a change of the quantity of light striking the element, when the fuze approaches the target, will fire a detonator, thereby causing the projectile to explode.

A further object of the invention resides in the provision of a light-sensitive fuze, the sensitivity of which is largely independent of the actual light intensity but which is sensitive to give fractional changes of the light intensity occurring at the time of use.

An additional object is to provide a light-sensitive fuze having a novel window or lens which admits maximum light coming from a predetermined direction.

Another object is to provide a photoelectric cell which operates satisfactorily even after being strongly accelerated, without developing excessive electrical manifestations due to vibration or other causes.

A further object is to provide a light-sensitive device which is equally sensitive to light striking the photoelectric cell from any angular position around the axis of the cell, at a predetermined inclination to the axis.

Another object of the invention is to provide an improved electrical circuit for use with a light-sensitive fuze.

A still further object is to provide mechanical improvements for making a reliable and satisfactory light-sensitive fuze.

An additional object is to provide a light-sensitive fuze which may be used with a bomb, shell, or other explosive device so that ground approach of the bomb, for instance, will cause it to explode and scatter fragments downward, for greater effectiveness against personnel.

These and other objects of the invention may be understood by reference to the accompanying drawings, in which

FIG. 1 is an axial sectional view of one form of the new fuze mounted in a projectile can, parts of the fuze being shown in side elevation;

FIG. 2 is a sectional view on the plane indicated by the line 2—2 in FIG. 1, showing the general nature of the refraction of the admitted light;

FIG. 3 is a perspective view of the amplifier housing of the fuze;

FIG. 4 is an exploded, perspective view of nose portion of the fuze, and

FIG. 5 is a wiring diagram showing the electrical connections between the parts.

Referring to FIG. 1, the fuze, indicated generally at **10**, is shown mounted at the nose of an explosive projectile having a casing **11** and an explosive charge **11***a*, part of

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which surrounds the rear end portion of the fuze. The projectile may be of any desired type, such as a bomb or a rotary projectile, but the fuze as illustrated embodies features whereby it is particularly adapted for use in even a non-rotary type projectile.

The fuze **10** comprises a toroidal window or lens **12** made of transparent material, preferably a plastic material such as methyl methacrylate, commonly known as Lucite, or an equivalent clear and colorless, non-brittle substance. The lens or window serves the double purpose of admitting light to the photoelectric cell and converging the light upon the defining slit to be described presently. A threaded shoulder **13** on a ring **14** of the fuze is screwed into an opening in the nose of the projectile casing **11** to hold the fuze in position. To the rear of shoulder **13**, the ring **14** is provided with a threaded shoulder **13***a* of lesser diameter so that the fuze may be screwed into an internally threaded ring **15** which is welded or otherwise secured to a cylindrical can **16** to provide a moisture-proof joint. A tetryl or booster cup **17** is welded to the inner surface of can **16** at the rear end thereof, and an end closure **18** is held in place over the open rear end of cup **17** by an inwardly turned rim **19** on can **16**. A central opening **20** in the front end of cup **17** is in register with a central opening in a disc **22** which receives an end of an electrical squib or detonator **23**, the disc being made of steel or other suitable material, such as Bakelite. The disc **22** is held against the housing **24** of a set-back switch by means of a flanged, crimped rim **25** on the housing, the disc serving as a rear end plate for the switch. An insulating disc **26** is secured to an inturned flange **27** on the front end of housing **24**, by means of rivets or otherwise. Connecting plugs **28***a* to **28***f*, inclusive, which are connected to the set-back switches in the housing **24** and detonator **23**, are secured in disc **26** and are plugged into a battery unit **30** disposed in the can **16** in front of switch housing **24**. The unit **30** comprises an A battery **31**, a B battery **32**, a C battery **33**, and preferably a condenser **34**, all contained in one housing and connected as shown in FIG. 5.

Set-back closed switches **36**, **37** and **38** are disposed in the housing **24**, together with detonator **23**, and are connected as shown in FIG. 5. Switch **36** serves to connect the A battery **31** into circuit, switch **37** to connect B battery **32** into circuit, and switch **38** to connect detonator **23** into circuit, as a result of inertia or set-back forces occurring during acceleration of the fuze, as in firing the projectile **11**.

The front end of the battery unit **30** is connected to the detector and amplifier of the fuze by means of plugs **39***a*, **39***b*, **39***c*, **39***d*, **39***e*, **39***f* and **39***g*, the plugs **39***c* and **39***f* being for test purposes. These plugs are mounted on an insulating closure plate **14***a* in the rear end portion of ring **14** and are pressed into sockets **40***a*, **40***b*, **40***c*, **40***d*, **40***e*, **40***f* and **40***g* secured in a forward insulating wall **30***a* of the battery housing. The rear wall **30***b* of the battery housing is also made of insulating material and has sockets **41***a*, **41***b*, **41***c*, **41***d*, **41***e* and **41***f* connected as shown in FIG. 5 and arranged to receive the plugs **28***a*, **28***b*, **28***c*, **28***d*, **28***e* and **28***f*, respectively, on housing **24** of the set-back switches.

In assembling the device, plugs **28***a*, **28***b*, etc., may be inserted into sockets **41***a*, **41***b*, etc., and plugs **39***a*, **39***b*, etc., may then be inserted into sockets **40***a*, **40***b*, etc. A resilient, annular ring **42**, made of rubber or similar material, is preferably placed between the rear end of ring **14** and the adjacent end of the battery unit **30**. Then the assembled units may be fitted into the forward open end of can **16** and the threads **13***a* screwed into ring **15** until the end plate **22** of set-back housing **24** strikes cup **17**, and shoulder **13** of ring **14** strikes the forward end of ring

15. The resilient ring **42** is compressed between the metal ring **14** and the battery and applies pressure to hold the assembled sections tightly together.

Near its front end, the ring **14** has an external shoulder **44** which is pressed against the adjacent end of the projectile casing **11** when the fuze is screwed into the casing, whereby the shoulder acts as a stop. The shoulder **44** may be formed with recesses **44***a* to receive a spanner wrench for tightening the fuze in the projectile casing. The front end of ring **14** is tapered, as shown at **45**, and brazed or otherwise secured to the tapered portion **45** is a conical metal ring **46** surrounding the front end of ring **14**. At its front end portion, the ring **46** is turned back upon itself to form a reentrant part, as shown at **46***a*, and is then turned inwardly to form a flange or inset wall **47** defining the central opening in the ring. An externally threaded insulating ring **49** having an off-set **51** is attached to wall **47** by means of rivets **52**. The off-set **51** has a central opening in which the metal base **53** of a photoelectric cell **54** may be seated. The base **53** is sealed to the rear end of a glass or other transparent cylinder or lens **55** which is sealed at its front end to a metal cap **56** having an insulating disc **57** secured thereto by means of cement or in any other desired manner. Suitable leads **53***a* and **56***a* are soldered to the base **53** and the cap **56**, respectively, for connecting the photoelectric cell into the circuit. The details of a preferred form of the photoelectric cell **54** are described in a co-pending application of Joseph E. Henderson, Serial No. 570,690, filed December 30, 1944, now Patent 2,732,514, issued January 24, 1956. It will suffice here to state that a disc-shaped photoemissive cathode **54***a* is connected with, and lies substantially parallel to the plane of, base **53**, and that the cap **56** or an electrode connected therewith serves as the anode or collector electrode.

A compression spring **58** presses against the insulating disc **57** and is seated at its front end on an internally threaded sleeve **59** brazed or otherwise secured to a conical nose shield **60** made of steel or other suitable material. The shield **60** acts as an electrostatic shield for the photo-cell and for an amplifier to be described presently, besides being structurally useful. The base of shield **60** has an external flange which is secured to a forward flat annular surface of lens **12**, by means of screws **62**. The insulating ring **51** is screwed into an internally threaded sleeve **63** integral with lens **12** and at the rear end thereof. An externally threaded nose cap stud **64** is welded to the inner apex of a conical, metal nose cap **65**, and stud **64** is screwed into the threaded sleeve **59** until the rear edge **66** of cap **65** strikes the toroidal lens **12** in a close fit around its periphery. A yieldable sleeve **54***b*, for example made of sponge rubber or the like, surrounds the cylinder **55** to cushion the enclosed parts against shock. This sleeve **54***b* fits within the opaque coating or shield **54***c* which is applied to the inner surface of lens **12**.

The lens **12** is preferably made of clear plastic material, such as Lucite, or of other transparent material transmitting light in the region between 3500 A. and 5000 A. The inner surface of lens **12** is covered with the opaque black material **54***c* except for a circumferential slit **67**, the surface of which is generated by the revolution of a line which may be parallel to the axis of the fuze or inclined thereto, as desired. The angle of inclination of the slit surface **67** may be changed to alter the angular direction from which the cathode **54***a* of the photoelectric cell receives its effective light, due in part to the change of the angle of incidence of the refracted light upon the photoelectric cell cathode. This makes it possible to change the firing point so that the device will explode at any desired position relative to the target. The slit **67** is placed in a position to receive the focused rays of light passing through lens **12** from the outside. The slit may be produced by masking the lens before it is sprayed or otherwise coated with the opaque material, or in other

words painted, or by cutting away a circular strip of the material after the painting operation. The details of the lens **12** are described in a copending application of Fred L. Mohler, Serial No. 102,661 filed July 1, 1949, now abandoned.

For a narrow cylindrical lens, the focal length F is

$$F=\frac{n}{n-1}\cdot r=3r$$

(since $n=1.5$), where r is the radius of curvature and n is the index of refraction of the lens material. The corrected curve for a wide lens is not a circle but an ellipse produced by projecting a circle at an angle a where

$$\sin a=\frac{1}{n}$$

The minimum radius of curvature (r) of this ellipse is $R \cos a$ where R is the radius of the projected circle. The focal length of the lens is again given by

$$F=\frac{n}{n-1}\cdot r$$

wherein r is $R \cos a$.

The relation between the width W of slit **67** and the angular width w, in radians, "seen" by the slit is

$$W=(F-r)w$$

For Lucite the index of refraction $n=1.5$ so that the values may be computed readily. For an angular width of 4½ degrees or 0.0785 radian as actually used in one practical application of the invention, the slit width W is 0.0277 inch. For a lens of good resolving power, this theoretical width corresponds to the width of the angular distribution curve at half the maximum current.

As shown in FIG. 2, the focus of the toroidal lens **12** for extreme rays **69** and **70** striking the cathode **54***a* of the photoelectric cell is an arc FF concentric with the lens surface. If this is coincident with the slit **67** at the center, it is out of focus slightly at the edges. This produces an aberration which causes the image of a point source to be about 1½ degrees wide and 1 degree below the center of the slit at the edge of the beam, for the fuze mentioned.

A disc **76**, made of insulating material such as Bakelite or the like, is fitted in the front end portion of ring **14** and is secured to disc **14***a* by means of posts **77** which may be threaded into or fastened to the discs in any suitable manner. An amplifier, a thyratron and related circuit components, shown in FIG. 5, are mounted on disc **76**, the input connection from the photoelectric cell **54** being as short as possible and care being taken to keep the input lead remote from the thyratron plate lead. After the circuit components are firmly mounted, by means of screws, clamps, or otherwise, the space between the disc **14***a* and the photoelectric cell is filled with an insulating potting compound, preferably consisting of a 16 to 1 mixture of ceresin and carnauba wax or polymerized tung oil, or the like.

The junctions between cone **46** and lens **12** and between the lens and cap edge **66** are treated with waterproof cement in order to make a weather-tight fit. Likewise, the shoulder of the photoelectric cell base **53** is pressed tightly against off-set **51** to make a water-proof seal. This junction may also be cemented if desired. The junction of disc **14***a* with the ring **14** is also of water-tight construction, as are the junctions of plugs **39***a*, **39***b*, etc., with disc **14***a*. All the parts are sufficiently strong to withstand rapid acceleration, such as occurs in a projectile being fired from a gun.

It is important that the lens be of uniform clarity so that the variation of the quantity of light striking the cathode **54***a* from a uniform source is not sufficient to fire the thyratron as the lens is rotated about the axis of the fuze. It is important also, for the same reason, that the photoelectric cell be properly centered. The disc cathode **54***a* is a feature of particular value, used in conjunction with the toroidal lens, since light from all areas around the lens periphery is spread out over the whole cathode surface so that there will be an average light intensity over the cathode surface, and undesired pulses, generated due to inequalities or non-uniformity of the lens or cathode surface in the rotating projectile, will not be of sufficient amplitude to be a serious factor. It is not essential that the cathode 54*a* be a plane disc, as it may be of various contours, as long as the light from the entire lens periphery strikes the whole cathode surface. The slit 67, of course, defines the zone of light transmission.

Referring to the circuit diagram, FIG. 5, the cathode 54*a* of photoelectric cell 54, which is preferably sensitive in the blue region, is connected through a grid blocking condenser 79 to the control grid 80 of an electronic tube 81. The blocking condenser 79 passes an electrical pulsation but not a steady electrical current. The collector electrode or anode 54*b* of photoelectric cell 54 is connected with plug 39*g* which is connected with the positive terminal of B battery 32 when setback switch 37 is closed. One terminal of an impedance 83 is connected to cathode 54*a* and the other terminal is connected to ground 85. The metal fuze body, the can 16 and the carrying projectile 11, together, may constitute the ground. The impedance 83 is a resistor of the type in which the ratio of the voltage across the resistance to the current through the resistance decreases as the current increases, or, in other words, the resistance of element 83 is reduced as the current passing through it is increased. This tends to make the transient voltage input to the amplifier, for small light changes, proportional to the fractional change in light, more or less independently of the total light level.

A grid leak 84 is connected from grid 80 to ground 85 and serves to maintain the grid at a constant potential bias by allowing leakage of accumulated electrons to ground. The resistance 84 may also be considered as a portion of the input resistance, the terminal potential fluctuations of which are transferred to grid 80. A resistance 86 is in series with filament 87 of tube 81 and controls the current to the filament. A screen grid 88 is connected to plug 39*g*, and consequently to B battery 32, through a resistance 89, which is of greater value than a resistance 90 connecting the plate or anode 91 of tube 81 with battery 32 (through plug 39*g* and switch 37). The resistances are such that screen grid 88 is maintained at about the same potential, relative to filament 87, as plate 91. A condenser 92 is connected between screen grid 88 and ground and serves as a stabilizing or by-pass condenser to maintain a steady screen grid voltage.

The filament 93*a* of a thyratron 93 is connected to one terminal of a filament control resistance 96, the other terminal of which is connected to lead 97 leading to plug 39*a*. A similar terminal of resistance 86 is also connected with lead 97, and the other terminals of filaments 87 and 93*a* are connected to a lead 98 which leads to plug 39*d*. The parallel-connected filaments will therefore be supplied with current from A battery 31 through plugs 39*a* and 39*d*, after switch 36 is closed by a force of set-back.

The grid 93*b* of the thyratron is connected with the plate-connected terminal of resistance 90 through a condenser 99 which blocks steady potential between battery 32 and grid 93*b* but which will pass potential pulsations due to change of current passing through coupling resistance 90, which is connected to B battery 32, as described. A condenser 100, connected between the condenser-connected terminal of resistance 90 and the battery line 97, acts as a by-pass for the thyratron input, to reduce the response to very high frequencies or extremely sudden changes in the amplifier output, as produced by noise or other causes.

The thyratron grid 93*b* is connected to plug 39*b* and the negative side of battery 33 through series connected resistances 101 and 102 which are of sufficiently high value to apply a negative grid bias from battery 33 and yet not interfere with proper operation of the grid. It will be seen that battery 33 will apply a negative bias to grid 93*b* with respect to filament 93*a*, through plugs 39*a* and 39*b* which are connected, respectively, with the positive and negative terminals of battery 33.

A neon tube 103 forms part of a self-destruction circuit and has one electrode connected to plug 39*b* through resistance 102, the other electrode being connected to plug 39*g* through resistances 104 and 105 in series. It will be seen then that the negative terminal of batteries 33 and 32, in series, will be connected to the grid-connected electrode of neon tube 103, through resistance 102, and the other electrode of tube 103 is connected through resistances 104 and 105, in series, to plug 39*g* and thence to the positive terminal of battery 32, when switch 37 is closed. The latter electrode of tube 103 is also connected to ground 85 through a capacitance 106 and the conductor 97, so that the potential of the neon tube electrode is determined by the potential applied to capacitance 106 from the positive terminal of battery 32. The rate of charging of capacitance 106 is dependent upon the values of resistances 104 and 105. The time required, therefore, after closing switch 37, to charge capacitance 106 to a potential that will cause neon tube 103 to flash over or become conducting will depend upon the values of capacitance 106 and resistances 104 and 105, assuming a given battery potential. This time interval may be increased by increasing either the capacitance or resistance, and vice versa. The time interval usually chosen is from 6 to 12 seconds.

When neon tube 103 becomes conducting, the energy in condenser 106 is discharged through the tube, the resistance 102, battery 33 and plug 39*a* and thence to the other side of the capacitance 106, through line 97. The direction of the electron flow in the circuit will be from tube 103 to capacitance 106 through wire 107. Therefore, when tube 103 becomes conducting, electrons will be suddenly removed from thyratron grid 93*b* to render the grid less negative or more positive to a degree such that the thyratron will become conducting. When this occurs, detonator 23 will be fired, since wire 108 from the positive terminal of battery 32 is connected to detonator 23 through switches 37 and 38, the other terminal of the detonator being connected through plug 28*d* and plug 39*e* to plate 93*c* of the thyratron. The return circuit from the thyratron is from filament 93*a* through wire 97 to plug 39*a* and thence to the negative terminal of battery 32.

The capacitance 34, of relatively large value, is connected across the terminals of battery 32 when switch 37 is closed. This capacitance acts as a reservoir of accumulated energy from battery 32 and discharges the energy suddenly through the detonator 23 when the thyratron 93 is fired. It is evident, then, that the self-destruction circuit will fire the detonator to explode the booster charge in cup 17, after an interval, provided that the detonator has not been previously fired as a result of a variation of the output of photoelectric cell 54.

The object of the resistance 102, connected between tube 103 and plug 39*b*, as indicated, is to provide a relatively low resistance path for the discharge of neon tube 103 and also to provide a potential drop to impress a positive pulse on the thyratron grid 93*b* for self-destruction.

A resistance 109 is connected to plugs 39*a* and 39*g* so that the resistance is directly across what become the terminals of B battery 32 when switch 37 closes, to act as a leakage path to insure discharge of the various connected capacitances, so that they will start operation in discharged condition.

Test plugs 39*c* and 39*f* are for testing only and are connected as shown.

The operation of the fuze is dependent upon variations in the quantity of light reaching the lens 12 and the photoelectric cell **54**, within a narrow angle which may be called the "width of transmission zone" and which may be defined as the angular separation between two directions in a plane through the axis of the fuze, in each of which the transmission of the lens-slit system is half the maximum transmission. In one embodiment of the invention the width of the transmission zone is chosen as 4½ degrees. The "forward angle" is defined as the angle between a plane normal to the axis of the fuze and a line midway between the two directions defining the transmission zone. Thus, in FIG. 1, the forward angle θ is equal to the angle between line D perpendicular to the axis of the fuze and line C midway between lines A and B which are the boundary lines of the transmission zone. It is obvious, therefore, that, due to the design of the lens and slit system, light striking the photoelectric cell cathode **54***a* in appreciable quantity will come from a narrow region bounded by two conical surfaces and inclined forward. In the embodiment mentioned above, the forward angle θ is chosen as 22½ degrees. For different velocities of projectiles and different fragment velocities resulting from different high explosive loadings, this angle may differ either way.

The "percent light" signal may be expressed as the fraction or percent peak signal relative to the background light level. The "sensitivity" is defined as the voltage output at the thyratron grid **93***b*, divided by the "peak percent light signal." The "threshold" is defined as the peak percent light signal required to trigger the thyratron **93**. Sensitivity and threshold are dependent upon the form of signal, but for any given form of signal the threshold T and sensitivity S are related as follows:

$$T=\frac{Vg\ (\text{crit.})-C}{S}=\frac{V\ (\text{crit.})}{S}$$

where C is the thyratron bias voltage, V*g* (crit.) the critical bias at which the thyratron fires, and V (crit.) is the critical signal required to fire the thyratron.

In the use of the fuze, it is screwed into a rocket, shell, or other projectile **11** which is subsequently fired at a target such, for instance, as an airplane. When the fuze approaches the airplane, a certain amount of sky light which would otherwise reach the photoelectric cell cathode **54***a* through the lens **12** is obscured by the aircraft, and sudden reduction of electron output from the cathode **54***a* occurs since the fuze is traveling at high speed. This sudden decrease of electron emission from cathode **54***a* results in a diminished current through resistance **83** to ground, as previously described, with the result that the potential drop across resistance **83** is suddenly decreased, which causes a negative current pulse through condenser **79** so that grid **80** is suddenly made more negative and the current passing through plate **91**, coupling resistance **90** and battery **32** is reduced. Since battery **32** is connected in circuit with resistance **90**, between plate **91** and ground, and since thyratron grid condenser **99** is connected to the plate terminal of resistance **90**, a diminution of current through resistance **90** will result in a rise in the potential on the plate-connected terminal of resistance **90** with respect to ground, to which the negative terminal of battery **32** is connected. This produces a positive pulse through condenser **99**, thereby making thyratron grid **93***b* less negative so that it suddenly becomes conducting and fires the detonator.

The new light-sensitive fuze provides a very effective weapon for attacking and destroying enemy aircraft, when used in conjunction with explosive projectiles such as rocket devices, shells, or bombs. In addition, experiments have shown that the fuze is very effective in causing bombs to explode on ground approach, so that the fragments will be scattered downward for greater destructive effect. Such fuzes might also be used in other military applications, and various features disclosed herein could be adapted to numerous commercial photoelectric devices.

It is obvious that many changes of detail may be made without departing from the broad principles of the invention.

We claim:

1. In a proximity fuze, a casing, a photoelectric cell within said casing, an amplifier within said casing and electrically connected with said cell, an element bridged across the input of said amplifier and connected with said cell, the electrical resistance of said element being automatically reduced as the current through said element is increased, a lens carried by said device to admit light to said cell, and operating means connected with the output of said amplifier.

2. In combination with a projectile casing, a can removably mounted in one end of the casing and projecting into the casing, electronic elements disposed in the can, a frusto-conical ring connected to said end of the casing and partly inclosing said elements, the reduced end of the ring having a reentrant opening, an annular member mounted in said opening and having a seat, a photronic tube on the seat and electrically connected through said member and ring to said elements, a toroidal lens releasably connected to said member and surrounding part of the tube, biasing means on the lens for urging the tube against the seat, and a conical nose cap connected to the lens and spaced from said ring to expose part of the lens.

3. In a photoelectric proximity fuze, a cylindrical member having an externally threaded course for screwing the fuze into a projectile casing, a can secured to the rear end of said member, a battery unit in the can, a detector-amplifier unit in said member, releasable electrical connections between said units, a casing section secured to the front end of said member, a toroidal lens mounted in the front end of said section, a flange, means for securing the flange to said lens and section, a photoelectric cell disposed coaxially in the lens and seated on said flange, the cell having a light-sensitive surface adapted to receive light from the lens, electrical connections between the cell and said detector-amplifier unit, a nose section secured to the front end of the lens, and means in the nose section for urging the cell against said flange.

References Cited in the file of this patent

UNITED STATES PATENTS

2,137,598	Vos	Nov. 22, 1938
2,187,071	Bergmans	Jan. 16, 1940
2,255,245	Ferrel	Sept. 9, 1941
2,360,233	Hussey	Oct. 10, 1944
2,882,822	Crane	Apr. 21, 1959

FOREIGN PATENTS

839,407	France	Jan. 4, 1939
376,987	Italy	Dec. 4, 1939