

May 9, 1961

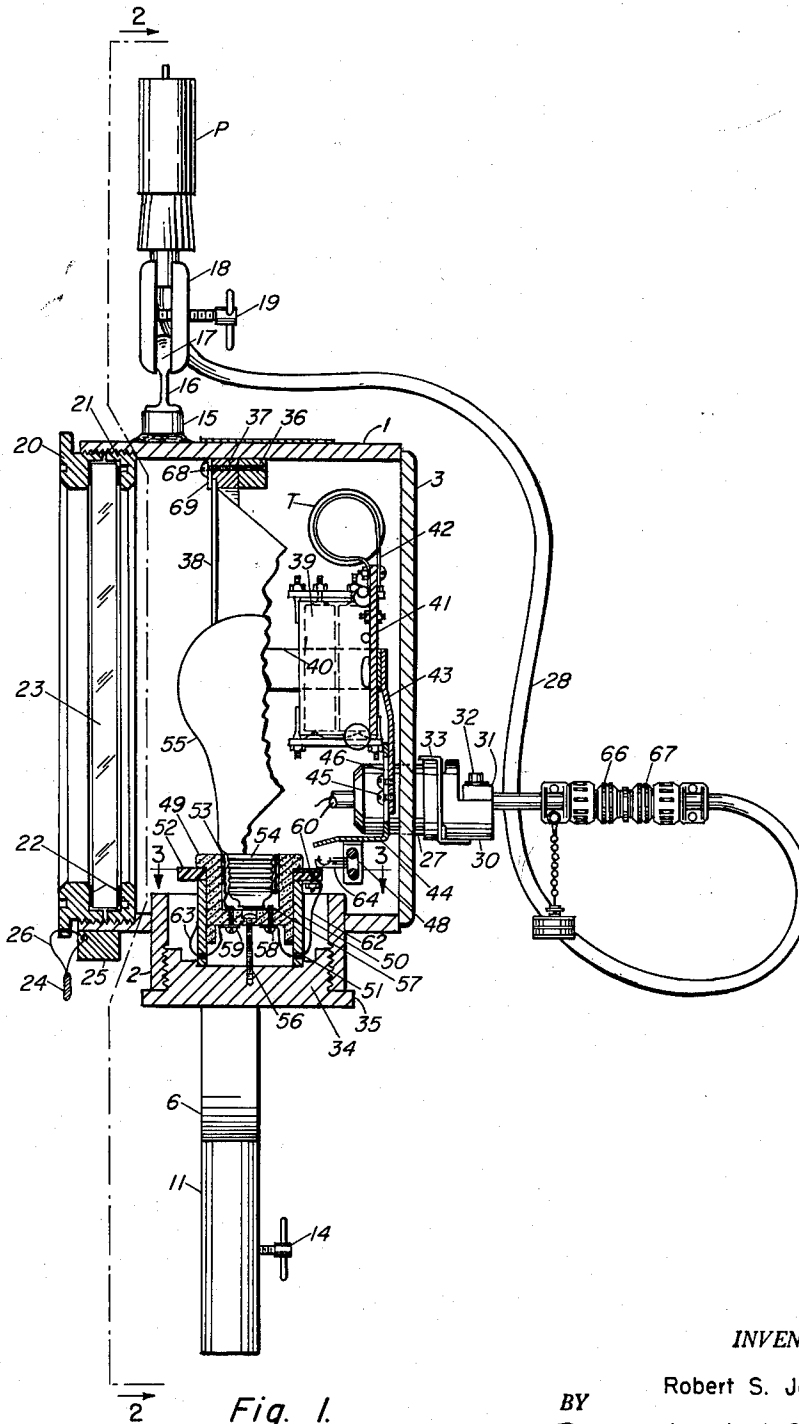
R. S. JAMES ET AL

2,983,810

PHOTOFLASH UNIT

Filed May 12, 1958

4 Sheets-Sheet 1



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4 Sheets-Sheet 2

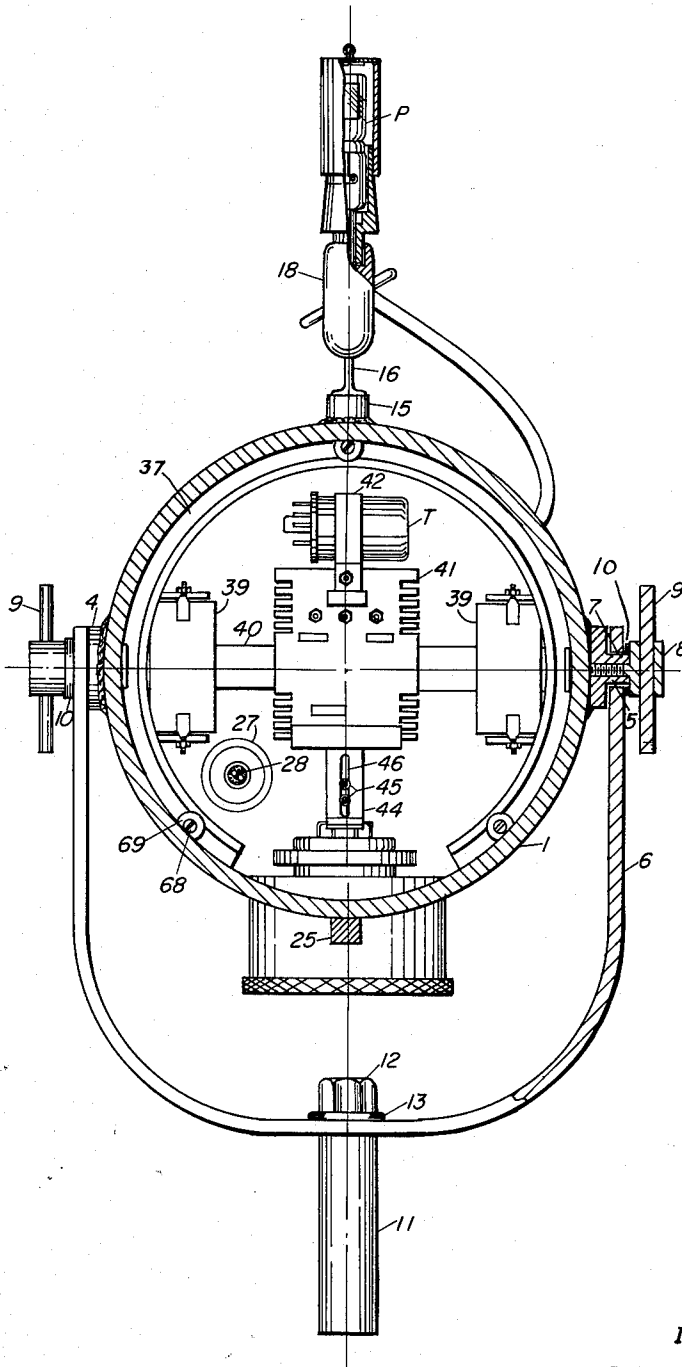


Fig. 2.

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4 Sheets-Sheet 3

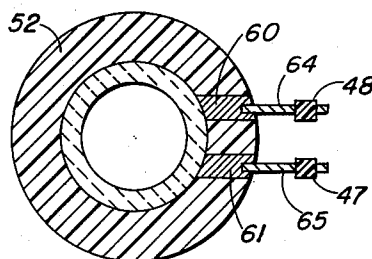


Fig. 3.

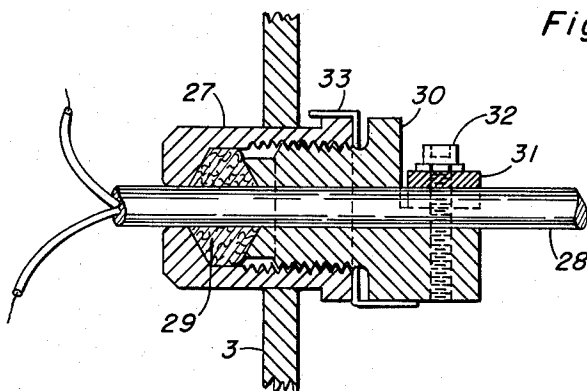


Fig. 4.

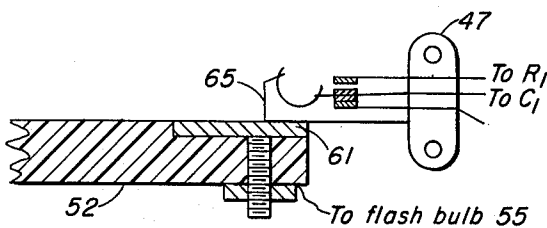


Fig. 5.

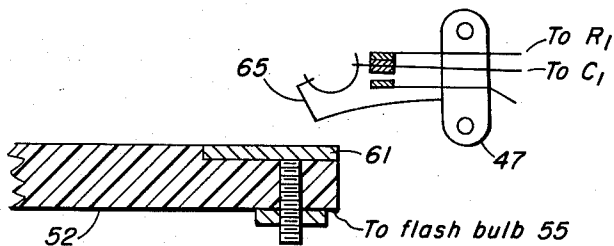


Fig. 6.

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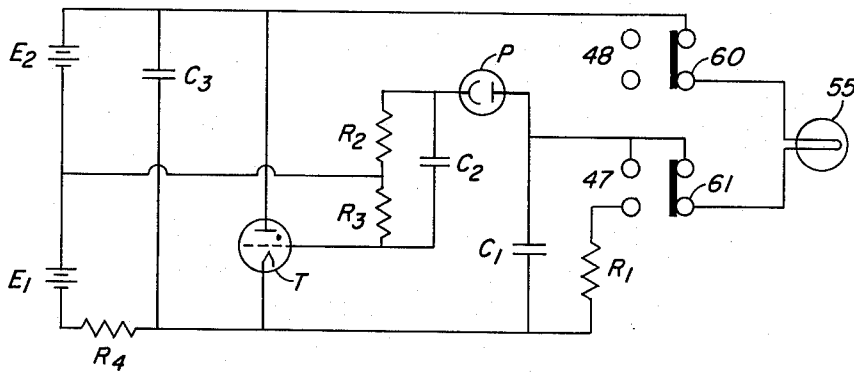


Fig. 7.

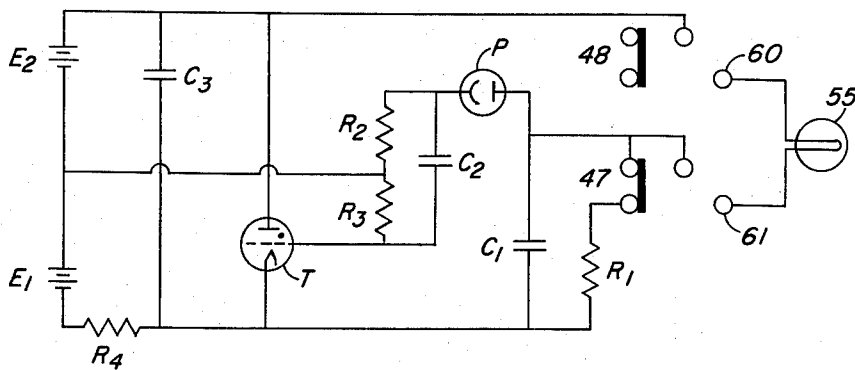


Fig. 8.

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PHOTOFLASH UNIT

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Filed May 12, 1958, Ser. No. 734,804

5 Claims. (Cl. 240—1.3)

(Granted under Title 35, U.S. Code (1952), sec. 266)

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

This invention relates to a photoflash unit which is safe to use in areas likely to contain explosive gas or dust mixtures, such as coal mines, flour mills, chemical plants, etc.

In the past, photoflash units have been constructed wherein internal parts are exposed to the surrounding atmosphere. Units so constructed when used in an explosive atmosphere might, because of arcing, sparks, or the explosion of the flash bulb, ignite the surrounding explosive atmosphere, with the result that an explosion could occur.

It is the principal object of the present invention to provide a photoflash unit which will not operate unless all parts of the unit which may ignite an explosive atmosphere are enclosed in an explosion-proof case.

It is a further object of the invention to provide an automatic circuit-controlling device, responsive to impairment of the explosion-proof feature of the case, which will deenergize the hazardous components of the circuit in the unit and permit spent flash bulbs to be removed in explosive atmospheres.

It is a further object of this invention to provide an explosion-proof photoflash lamp wherein the bulb is ignited by a circuit including a capacitance and wherein the bulb is removed from the circuit and the capacitance deenergized by having a resistance shunted across it when the device is no longer explosion-proof.

Further objects will be apparent from the following description of the invention.

The present device, which eliminates this danger, comprises a socket holding a photoflash bulb within a cylindrical flametight housing, one end of which is provided with a light permeable window removably mounted therein and sealed by suitably gasketed rings. The socket and bulb assembly is removable from the housing through an access casing located at the side of the housing socket. Safety switches are provided in circuit with an electronic firing arrangement, so that when the bulb socket is moved from a predetermined position, the device is rendered inoperative. By this means, a fired bulb may be removed with complete safety in an explosive atmosphere, and any variation from a completely sealed condition render the electrical circuit inoperative.

"Explosion-proof," as used herein, means that those parts of the unit which may ignite an explosive atmosphere are enclosed in a case capable of withstanding gas explosions which might possibly occur therein, without damage to the case or ignition of explosive atmospheres surrounding the case. The Bureau of Mines' requirements for explosion-proof lighting fixtures are set forth in Title 30, Code of the Federal Regulations and Bureau of Mines Schedule 29.

In the drawing:

Figure 1 is a vertical view, partly in section, of the

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device, some of the electrical wiring being omitted for the sake of clarity.

Figure 2 is a vertical view partly in section taken along line 2—2 of Figure 1, the flash bulb and reflector being omitted.

Figure 3 is a view taken along line 3—3 of Figure 1.

Figure 4 is a sectional view through the stuffing box.

Figures 5 and 6 are diagrammatic, exaggerated views showing the microswitch in open and closed positions respectively.

Figure 7 is a circuit diagram of the firing circuit showing the microswitches open.

Figure 8 is the same as Figure 7, but with the switches closed.

Cylindrical housing 1 is shown in Figure 1 as having a tubular access portion 2 fastened thereto, and a backplate 3. Housing 1 at the end opposite backplate 3 is threaded internally to receive externally threaded rings 20 and 21. Nonflammable gaskets 22 abut against rings 20 and 21 and act to maintain a lens 23 between them, in a flametight seal. The assembly of lens 23, gasket 22, and rings 20 and 21 are secured against displacement by seal 24, fastened by wire 26 passing through holes in outer ring 20 and tie post 25 at the bottom of housing 1.

Fastened to 1 at opposite ends of a horizontal diameter, as shown in Figure 2, are two yoke pivot bosses 4, each having a tapped hole at its central portion and a cylindrical portion of smaller diameter 5. Yoke 6 has circular apertures 7 in each of its upright arms into which members 5 fit. Screw 8 is threaded into boss 4 and has a rod 9 passing through its head for increased leverage in tightening. A friction washer 10 aids in maintaining the desired angle of deflection of the housing. At the center of the bottom of the yoke is fastened tripod mount 11, by means of nut 12 and lock washer 13, adapted to be attached to any conventional photographic tripod. Thumbscrew 14 aids in attaching the mount to its support.

Located at the top portion of housing 1 and fastened thereto is boss 15. Stem 16, which has a spherical ball 17 at its upper portion, is rigidly fastened to 15 in an upright position. Clamp 18 fits over ball 17 and holds photoelectric cell structure P in its upper jaws, pressure being applied by thumbscrew 19.

A stuffing box 27 (see Figure 4) extending through the backplate 3, receives two conductor cables 28, packing material 29, which may be asbestos, and externally threaded gland nut 30. The combination of the packing material 29, compressed by gland nut 30, and stuffing box 27, forms a flametight entrance for cable 28 to the interior of housing 1. Clamp 31 straddles conductor 28 and is drawn up tight by two screws 32, one on either side of the conductor, which are threaded into gland nut 30. Lock washer 33 prevents displacement of gland nut 30.

Tubular access portion 2 is threaded internally to receive an externally threaded cover 34 having a shoulder portion 35. When shoulder 35 is screwed tight against 2 this portion of the device is flametight. The arrangement described to this point, i.e., housing 1, tubular access portion 2, cover 34, stuffing box 27, gland nut 30, packing material 29, rings 20 and 21, gasket 22, and lens 23, all combine together to form a flametight explosion-proof case for the unit.

Fastened to the internal surface of housing 1 are three bosses 36 spaced equidistantly around the circumference. Ring 37 is fastened to bosses 36 as by bolts 68 and clamps 69, and serves as the supporting member for reflector 38. Two battery cases 39 located near the cylindrical surface, are attached to ring 37 by means of a bracket 40 fastened to the housing. Mounting board 41, of an insulating material such as Bakelite, is attached to

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bracket 40 and is the supporting means for the various firing circuit components indicated in Figure 2. A strap 42 is fastened to board 41 to hold thyatron tube T. Switch supporting bracket 43 is secured to bracket 40, and has connected to it an arm 44, which may be adjustably positioned thereon by screws 45 and slot 46. Two normally closed, single pole, double throw micro-switches 47 and 48, having conducting blades 64 and 65 are mounted on arm 44.

Lamp socket 49, made of heat resistant insulation material such as porcelain, fits into a sleeve 50 which has a pair of holes 51 near its base. Sleeve 50 fits into a recessed portion of cover 34, as shown in Figure 1. At the upper end of the sleeve is a ring 52, made of an insulating material, e.g., fiber, which serves to space the upper shoulder portion of socket 49 from sleeve 50.

Female threaded metal socket element 53 fits inside lamp socket 49 and receives the threaded base portion 54 of photoflash bulb 55. The assembly of elements 49, 50, and 53 is firmly secured to cover member 34 by machine screw 56, the head of which fits into a circular recess at the bottom of 49. The bottom of base portion 54 bears against an electrical contact 57 connected to terminal screw 58 mounted in the bottom of socket 49, while female socket element 53 is electrically connected to terminal screw 59. Copper contacts 60 and 61 (see Figure 3) are mounted flush with the upper surface of ring 52 and fastened thereto by means of a screw and nut, connected to terminal screws 58 and 59 by conducting wires 62 and 63. Conducting blades 64 and 65 are directly above contacts 60 and 61. When shoulder 35 is seated firmly against 2, blades 64 and 65 are in contact with 60 and 61, and the switches are in their open position. Contrariwise, when the shoulder is not seated firmly, the lamp assembly then not being flametight and flameproof, blades 64 and 65 do not contact 60 and 61, and the circuit to the flash bulb is broken. Further outward movement of ring 52 causes switches 47 and 48 to return to their normally closed position, the circuit then being as shown in Figure 8, as will be explained hereinafter.

The firing circuit is shown in Figure 7. Condenser C_1 charges through flash bulb 55 and resistor R_4 . When the capacitor is fully charged, a beam of light falling on photoelectric cell P will cause Thyatron tube T, which acts as a firing switch, to become conducting. The energy in condenser C_1 then discharges through flash bulb 55, causing the latter to fire. The figure is believed to be self-explanatory to those skilled in the art and need not be described further. Suitable values for the various circuit components are as follows:

Resistors, ohms: $R_1=10K$; R_2 and $R_3=22M$; $R_4=62K$; Condensers: $C_1=40$ mfd.; $C_2=.005$ mfd.; $C_3=0.25$ mfd.; Batteries: E_1 and $E_2=60$ v.

Thyatron tube T is an IC-21 and photoelectric cell P is a CE-B6-C.

The operation of the device is as follows:

When cover 34 is slightly displaced from its flametight position in relationship to access member 2, as shown in Figure 1, ring 52 will rotate and move outwardly. This rotation displaces contacts 60 and 61 on ring 52 from the conducting blades 64 and 65 of switches 47 and 48. The circuit to the flash bulb 55 is then broken. Continued outward movement of ring 52 causes switches 47 and 48 to return to their normally closed positions, thereby placing resistor R_1 across capacitor C_1 in the circuit as shown in Figures 6 and 8, and draining it. The condition of the circuit after capacitor C_1 is discharged may be defined as intrinsically safe. As used herein, intrinsically safe means that those components remaining in circuit after capacitor C_1 is discharged are incapable of forming arcs or sparks of sufficient intensity to ignite a surrounding explosive atmosphere.

After the circuit has been rendered inoperative by a

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slight displacement at cover 34 from its flametight position, the cover may be completely unscrewed and the flash bulb 55 removed.

Connectors 66 and 67 provided on cable 28 facilitate the operation of the unit by providing a simple means for operating the unit photoelectrically, manually, or in synchronization with a suitable camera shutter mechanism. To operate the unit photoelectrically, the photocell P is connected as shown in Figures 1 and 7. Light falling on photocell P will cause thyatron T to become conducting. Capacitor C_1 , previously charged by current through R_4 , will then discharge through thyatron T and flash bulb 55. For manual operation, connectors 66 and 67 are separated, thereby disconnecting the photoelectric cell P from the circuit. A moistened finger is then placed across the terminals of connector 66, causing capacitor C_1 to discharge. For operation in synchronization with a camera shutter mechanism, the latter is connected to 66 by an electrical conductor.

The current flowing in cable 28 never exceeds more than several microamperes, and is incapable of forming arcs or sparks, which can ignite an explosive atmosphere. Thus, connectors 66 and 67 may be disconnected in an explosive atmosphere without constituting explosion hazards, thereby permitting the unit to be manually operated as a primary light source for several similar units operated photoelectrically.

It is apparent that various modifications may be made in the design of the housing and the firing circuit without altering the essential features of this invention.

We claim:

1. An explosion-proof photoflash unit comprising a photoflash bulb having the usual threaded base portion and electrical terminals, a flametight housing surrounding said flash bulb including transparent window means, an access tube having inner and outer end portions connected to said housing at said inner end, retractable cover means mounted in said access tube adapted to form a flametight seal, flash bulb socket means fastened to said cover means, having an upper end portion, said flash bulb being mounted in the socket means, an insulating ring surrounding said socket means near its upper end, first electrical contact means mounted on said ring, said contact means being conductively connected with the socket means, second electrical contact means adapted for contact with said first contact means only when the cover means is in flametight sealing position, a flash bulb firing circuit mounted in said housing comprising a capacitance, a charging circuit comprising a voltage source in series with the capacitance, a discharging circuit for said capacitance including a firing switch, means including said first and second electrical contact means for electrically connecting said flash bulb to said discharge circuit whereby said flash bulb ignites when the discharge circuit is completed by the firing switch, a resistance adapted to dissipate the energy in said capacitance, and third contact means in circuit for shunting the resistance across the capacitance when the cover means is retracted from its flametight sealing position.

2. An explosion-proof photoflash unit comprising a photoflash bulb having the usual threaded base portion and electrical terminals, a flametight housing surrounding said flash bulb including transparent window means, an access tube having inner and outer end portions connected to said housing at said inner end, retractable cover means mounted in said access tube adapted to form a flametight seal, flash bulb socket means mounted on said cover means having an upper end portion, said flash bulb being mounted in the socket means, an insulating ring surrounding said socket means near its upper end, electrical contact means mounted on said ring, said contact means being conductively connected with the socket means, switch means mounted in said housing, said switch means including a conducting actuating arm movable between a switch open and a switch closed position, said actuating

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arm contacting said electrical contact means only when in switch open position and the cover is in flametight closed position, a flash bulb firing circuit mounted in said housing comprising a capacitance, a charging circuit comprising a voltage source in series with the capacitance, a discharging circuit for said capacitance including a firing switch, means including the conducting switch actuating arm and ring electrical contact means for electrically connecting said flash bulb to said discharge circuit whereby said flash bulb ignites when the discharge circuit is completed by the firing switch, a resistance adapted to dissipate the energy in said capacitance, contact means connected with the said switch means for shunting said resistance across the capacitance when the actuating arm is in switch closed position.

3. An explosion-proof photoflash unit comprising a photoflash bulb having the usual threaded base portion and electrical terminals, a flametight housing surrounding said flash bulb including transparent window means, an internally threaded access tube having inner and outer end portions, said access tube being integrally joined to said casing at its inner end, a cover means threadedly mounted in said access tube, a shoulder portion on said cover means adapted to bear against the exterior end of the access tube and form a flametight seal, flash bulb socket means mounted on said cover means having an upper end portion, the said flash bulb being mounted in said socket means, an insulating ring surrounding the socket means at the upper end thereof and detachably connected therewith, a pair of circumferentially spaced electrical contacts mounted on said ring conductively connected to the flash bulb terminals, a pair of switches mounted in said housing, each having conducting actuating arms movable between a switch open and a switch closed position, and adapted to contact said insulating ring, whereby unscrewing the cover means moves the ring axially and causes movement of the switch actuating arm, said arm contacting the ring electrical contacts only when the cover is in closed flametight position, a flash bulb firing circuit mounted in said housing comprising a capacitance, a charging circuit comprising a voltage source in series with the capacitance, a discharging circuit for said capacitance including a firing switch, means including the conducting switch actuating arms and ring electrical contacts for electrically connecting said flash to said discharge circuit whereby said flash bulb ignited when the discharge circuit is completed by the firing switch, a resistance adapted to dissipate the energy in said capacitance, contact means connected with said switches for shunting said resistance across the capacitance when the actuating switch arms are in switch closed position.

4. An explosion-proof photoflash unit comprising a photoflash bulb having a base portion and electrical terminals, a flametight housing surrounding said flash bulb including transparent window means, an access tube having inner and outer end portions connected to said housing at said inner end, retractable cover means mounted in said access tube adapted to form a flametight seal, flash bulb socket means fastened to said cover means having an upper end portion, said flash bulb being mount-

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ed in the socket means, an insulating ring surrounding said socket means near its upper end, first electrical contact means mounted on said ring, said contact means being conductively connected with the socket means, second electrical contact means adapted for contact with said first contact means only when the cover means is in flametight sealing position, a flash bulb firing circuit mounted in said housing comprising a capacitance, a charging circuit comprising a voltage source in series with said capacitance, a discharging circuit for said capacitance comprising a Thyatron tube connected in series to said capacitance, means connecting said flash bulb in said discharging circuit, means in circuit with the control grid of the Thyatron tube for causing said tube to fire, whereby said capacitance discharges and ignites the flash bulb, a resistance adapted to dissipate the energy in said capacitance, and third contact means in circuit for shunting the resistance across the capacitance when the cover means is retracted from the flametight sealing position.

5. An explosion-proof photoflash unit comprising a photoflash bulb having a base portion and electrical terminals, a flametight housing surrounding said flash bulb including transparent window means, an access tube having inner and outer end portions connected to said housing at said inner end, retractable cover means mounted in said access tube adapted to form a flametight seal, flash bulb socket means fastened to said cover means and having an upper end portion, said flash bulb being mounted in the socket means, an insulating ring surrounding said socket means near its upper end, first electrical contact means mounted on said ring, said contact means being conductively connected with the socket means, second electrical contact means adapted for contact with said first contact means only when the cover means is in flametight sealing position, a flash bulb firing circuit comprising a capacitance, a charging circuit for said capacitance including a voltage source in series with the capacitance, a discharging circuit for said capacitance comprising a Thyatron tube connected in series to the capacitance, means connecting said flash bulb in series with said discharging circuit, a light sensitive photoelectric cell in circuit with the control grid of the Thyatron tube for causing said tube to fire, whereby said capacitance discharges when the photoelectric cell is energized and ignites the flash bulb, a resistance adapted to dissipate the energy in said capacitance, and third contact means in circuit for shunting the resistance across the capacitance when the cover means is retracted from its flametight sealing position.

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