Oct. 6, 1959 L. R. PROUT 2,907,871

PORTABLE ELECTRIC BATTERY LAMPS

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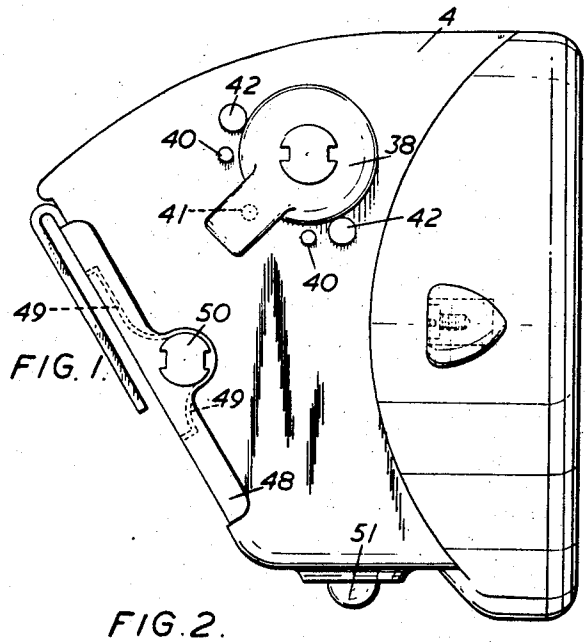
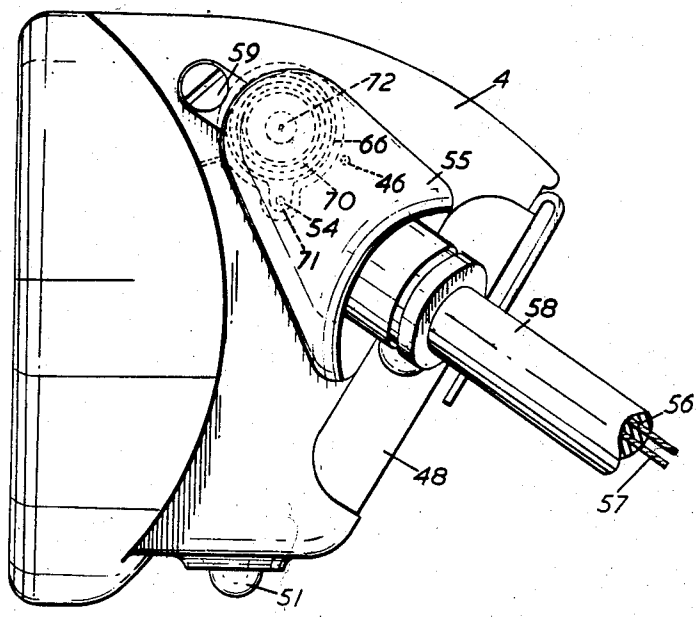


FIG. 1.

FIG. 2.



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FIG. 3.

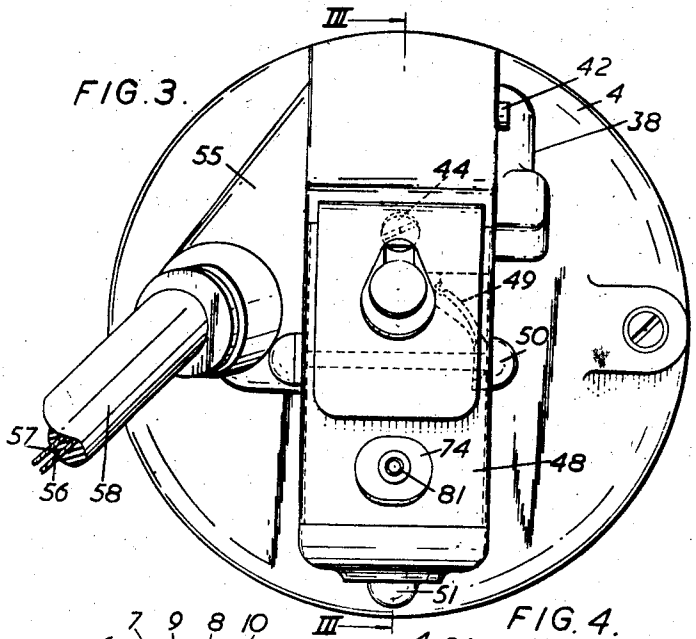
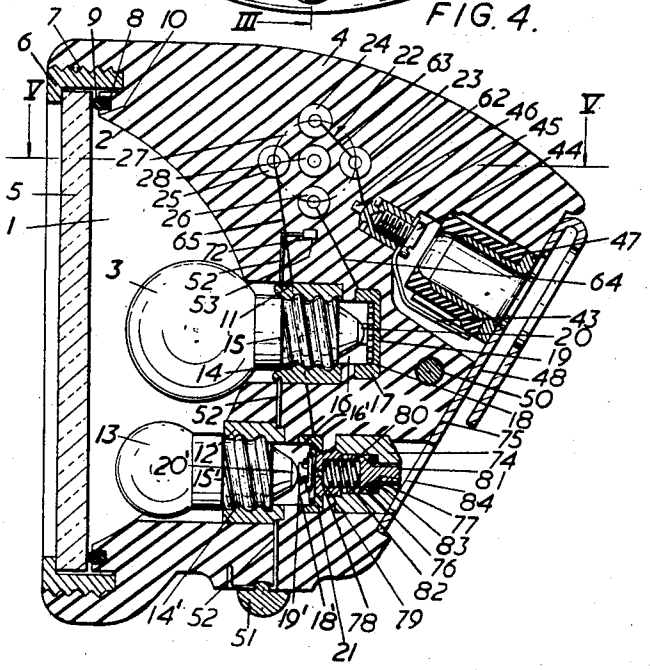


FIG. 4.



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FIG. 5.

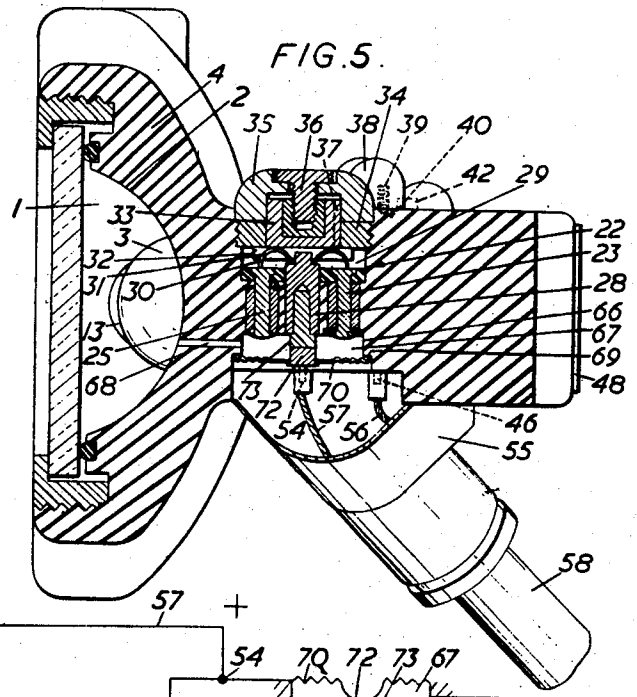
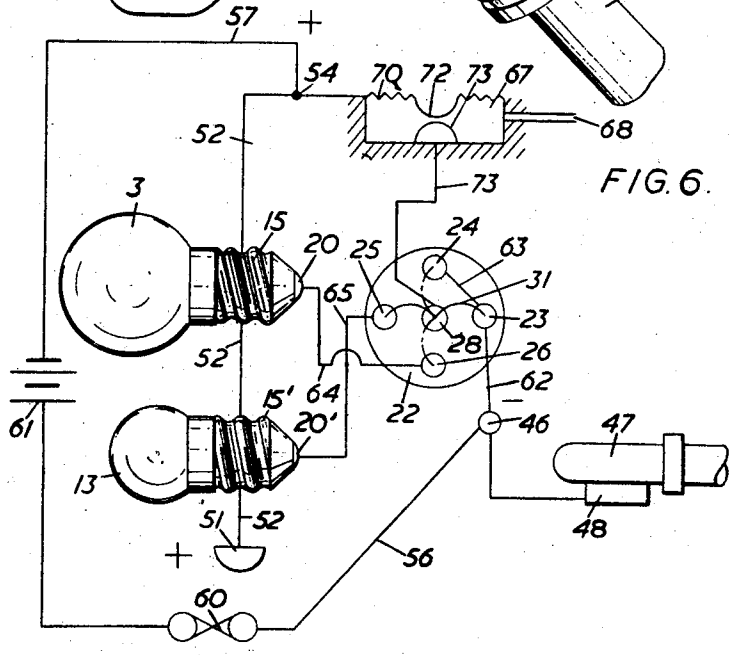


FIG. 6.



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PORTABLE ELECTRIC BATTERY LAMPS

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Claims priority, application Great Britain January 20, 1955

3 Claims. (Cl. 240—11.3)

This invention relates to portable electric battery lamps.

Such lamps find a particular use in miner's electric cap-lamps, and may be used in atmospheres containing explosive gases such as methane. Such cap-lamps contain a bulb which usually has a tungsten filament. If the cap-lamp is in use and the bulb envelope is broken, exposing the glowing tungsten filament to the explosive atmosphere, a danger of explosion arises.

It has heretofore been proposed to provide an hermetically seated lamp unit for such lamps which is filled with a non-combustion supporting gas and has a lens, a bulb holder and a reflector whereby the propagation of flame, initiated from the glowing filament when the bulb envelope is broken, is prevented. Further it has been proposed to provide the lamp unit with non-combustion supporting gas under pressure and to connect the unit interior to a pressure-sensitive switch in the electric circuit of the bulb which operates to cut off the flow of electric current to the bulb upon a predetermined fall of pressure within the lamp unit, such for example as would occur if the lens were broken. By such arrangements a considerable factor of safety is provided.

The main object of the present invention is to provide a simplified construction of lamp which has few separable parts so that the risk of damage to the lamp in use is greatly reduced, and the process of manufacture is simplified.

A subsidiary object is to provide such a lamp having an hermetically sealed bulb chamber with the bulb surrounded by non-combustion supporting gas or other gas, such as air for example, under pressure in which, upon such damage to the lamp that the filament would become exposed to an explosive atmosphere, the supply of current to the bulb is effectively cut off if the filament of the bulb becomes exposed to an explosive atmosphere, even if the filament remains intact.

According to the invention a portable electric battery lamp comprises a body formed as a single moulding with a reflector shape having a light reflecting surface thereon, a bulb holder, a lens, and electric conducting elements for connecting the bulb in circuit with a battery, both the bulb holder and the conducting elements being moulded into the body during the moulding operation.

In a preferred construction the reflecting surface is formed on the reflector shape by vacuum deposition of a light reflecting material thereon such as aluminium, silver or rhodium. Where a highly polished or specular surfaced reflector is required the surface of the reflector shape is coated with lacquer prior to the deposition of the light reflecting material thereon. Further the lens may be of etched glass.

Also in the preferred construction the moulding of the lamp has an hermetically sealed bulb chamber filled with a non-combustion supporting gas or other gas under pressure, a bulb in the bulb holder, a pressure sensitive switch body in communication with the bulb chamber and a pressure-sensitive member sealed into the switch body in circuit with the electric conducting elements of the bulb. The lamp body preferably has a main and a pilot bulb each in a holder moulded as an insert in the moulded body; main switch contacts, a positive charging contact and charging switch contacts are also preferably insert moulded into the non-pressurised or pressurised lamp body during the moulding operation, the mechanism of the main switch being secured to the lamp body and disposed so that the contacts of the mechanism engage in predetermined positions with the insert moulded main switch contacts whereby the lamp circuits may be closed and opened.

In order that the invention may be more clearly understood two constructions in accordance therewith will now be described, by way of example, with reference to the accompanying drawings, in which:

Fig. 1 is a right hand side elevation of a miner's cap lamp, which may have a pressurised bulb chamber filled with non-combustion supporting gas,

Fig. 2 is a left hand side elevation of the lamp,

Fig. 3 is a rear elevation of the lamp,

Fig. 4 is a cross section from front to rear of the lamp on the line III—III in Fig. 3, looking in the direction of the arrows,

Fig. 5 is a cross section on the line V—V of Fig. 4 looking in the direction of the arrows, and

Fig. 6 is a wiring diagram of the lamp and battery circuit.

The same numerals are used to show the same parts in all the figures.

The cap lamp in the drawings has a bulb chamber **1**, with a reflector **2** and a main bulb **3**.

The body **4** of the lamp consists of a single moulding of an electrically insulating plastic material into which all the fixed lamp parts are moulded as inserts during the moulding process. The front of the chamber **1** is closed by a lens **5** secured in position by a bezel ring **6** which is externally screw threaded and is screwed into an internal screw thread **7** formed in the moulded body **4**. An annular channel **8** is formed, during the moulding of the body **4**, in a ledge **10** at the front of the reflector **2** and a toroidally shaped O-ring **9** is seated in this channel.

The internal diameter of the bezel ring **6** is chosen so that light from the main bulb **3** which avoids reflection by the reflector **2**, by passing just clear of the internal diameter of the ledge **10** of the reflector, is refracted to pass out of the lens **5** just clear of the internal diameter of the bezel ring **6**.

The lamp body **4** has a moulded reflector shape on which a reflector is formed by vacuum deposition of a light reflecting material directly onto the surface of the moulded material of the body.

Referring to Figure 4 two bulb holders **11**, **12**, one for the main bulb **3** and the other for a pilot bulb **13** are shown moulded into the body **4**. The holder **11** comprises a tubular member secured at the centre of the reflector **2** and internally screw threaded at **14** to receive the threaded external contact **15** of the main bulb **3**. The centre of the reflector **2** has a cylindrical recess, in the base of which the holder **11** is arranged. Behind the holder **11**, a chamber **16** is provided, in the base of which a contact member **17** is moulded. A coiled spring **18** is located on the member **17** and at its centre has a contact nipple **19**. When the bulb **3** is screwed into the holder **11** its central contact **20** engages the contact nipple **19** and compresses the spring **18** which holds the bulb against the screw thread of the holder **11** and thus prevents movement of the bulb due to vibration.

The spring **18** is sufficiently strong to provide the required holding pressure between the bulb **3** and the holder **11** over a long axial travel of the bulb base in the holder, so that the bulb can be screwed in either

direction in the holder whereby the bulb filament can be located at the correct focal point of the reflecting surface 2 thus providing a simple inherent focussing arrangement.

The holder 12 of the pilot bulb 13 is similar to the main bulb holder and is moulded with a separate base member 21 into the body 4 to one side of the main holder 11. Corresponding parts of the pilot bulb holder having similar functions to the parts of the main bulb holder are designated as prime numerals.

A switch unit 22 (Fig. 5) is moulded into the body 1 and consists of four contacts 23, 24, 25, 26 equally spaced round an imaginary circle 27 and moulded into and across the body 4, and a central bearing member 28 similarly moulded into the body 4.

One end of each of the contacts 23—26 is exposed in the bottom of a switch recess 29 in the side of the body 4 and a rotary switch member 30 of electric-conducting material such as copper is rotatably mounted on the member 28 and has bows 31 which engage in a transverse slot 32 on the underside of a rotary element 33 held in the recess 29 by a ring nut 34, an operating knob 35 being fixed to it by a screw 36. The element 33 has a flat shank 37 which engages a similarly shaped recess on the underside of the knob 35 which has a handle 38 with a spring pressed plunger 39 for engaging in dimples 40, 41 on the body 4 to locate the switch in the selected position. The body 4 has stops 42 to limit movement of the knob between the three operative positions.

A spring charging terminal 43 is fixed by a screw 44 to an insert 45 moulded into the body 4, the insert having a contact pin 46 extending out of the side of the body opposite to the switch unit 22. The spring charging terminal 43 is provided for lock protection similar to that described in Patent No. 2,312,613. The lock body 47 is insert moulded into the body 4 and is in electric contact with the clip 48 for fixing the lamp to a miner's headgear or other support. A spring clip 49 is also provided, earthing the lock body 47 to the clip 48 and held in place by a clamping screw 50.

A second metal charging contact 51 is riveted to an electric strip conduit 52 inserted in the moulded body 4 and is exposed to engage a charging circuit connection (not shown). The conduit 52 is connected to the bulb holders 11, 12 and to an insert 53 in the moulding, the latter having a pin 54 which extends out of the body 4 adjacent to the contact pin 46 (Figs. 2 and 5).

The pins 46 and 54 are so positioned that two sockets in a connector 55 are engaged by them so that twin electric conduits 56, 57 in a cable lead 58 are connected into the lamp circuits. The connector is held on the body by a screw 59 and a lip of the clip 48.

Referring to Fig. 6 the conduits 56, 57 are connected to the pins 46 and 54 respectively and a fuse 60 is included in the conduit 56 and is normally mounted on the battery 61. The pin 46 is connected by a strip conduit 62 of electric conducting material to the contact 23 which is permanently connected to the contact 24 by a bar 63. The contacts 25 and 26 are connected to the holders 11, 12 by strip conduits 64, 65 respectively both of electric conducting material moulded into the body 4.

In operation when the switch handle 38 is on the dimple 41 the switch member 30 is out of engagement with the contacts 23—26 so that both bulbs are out. If the handle is moved to the pilot position the member 30 will bridge the gap between the contacts 23, 25 so that current will flow through the bulb 13 and back to the battery through the pin 54. With the handle in the main position the member 30 bridges the contacts 24, 26 and the current will flow through the bulb 3 and thence to the battery through the pin 54.

In an alternative construction not shown, the bulb holders are not moulded as inserts into the body 4. In this case the body 4 is provided during the moulding with recesses to receive the bulb holders as push fits for example, or the recesses may be moulded with a screw thread or other shape to receive screw-threaded or otherwise shaped holders or the actual screw-threaded or otherwise shaped shanks of the bulbs. In either of these constructions the electric conducting elements 52 in the moulding of Figs. 1–5 contacting the bulb holders, are exposed in the recesses to make contact with the sides of the bulb holders or bulbs respectively.

As shown in the drawings the lamp may be provided with a pressurised bulb chamber 1 which is filled with a non-combustion supporting gas such as nitrogen, carbon dioxide, argon or neon, under pressure; the chamber may however be filled with another gas such as air under pressure in the pressurised construction. A pressure sensitive switch (Fig. 5) is then provided in communication with the bulb chamber 1 and operates to cut off the flow of electric current to the bulb 3 upon a predetermined fall of pressure within the chamber 1. In this construction when the bezel ring is screwed into the body 4, the rear face of the lens 5 will make a hermetic seal against the ring 9 which also makes a gas-tight seal in the channel 8.

The pressure sensitive switch 66 consists of a chamber 67 formed in the moulded body 4 and connected to the chamber 1 by a passage 68 through the body 4; a ledge 69 is provided in the chamber 67 and a circular aneroid diaphragm 70 is supported thereon round its periphery. The diaphragm has a lobe 71 at one edge (Fig. 2) having an aperture through which passes the contact 54 (Figs. 2, 5 and 6). A second contact 72 is secured to the diaphragm centre and is disposed to engage a nipple 73 on the contact member 28, moulded into the body 4 at the bottom of the chamber 67. The diaphragm is of resilient material such as beryllium copper or Phosphor bronze.

The non-combustion supporting gas is introduced into the chamber 1, the passage 68, the chamber 67 and the chambers 16 behind the two bulbs through a filler plug 74, Fig. 4, moulded into the body 4. The rear face of this plug is recessed in the back surface 75 of the body 4, but is open to the atmosphere. The plug has a central boring 76, the front end of which is of greater diameter than the rear portion 77. The plug is screwed at its front end on to a connecting piece 78 itself screwed at its other end into the centre of the holder base 21, the parts all being insert moulded into the body 4. The connecting piece 78 has a central bore 79 communicating with the chamber 16 of the pilot bulb holder 12. A valve 80 is slidably arranged in the boring 76 with a stem 81 passing through the boring 77 and is held by a compression spring 82 against the seating 83 at the rear of the boring 76, a sealing member 84 being arranged between the valve and the seating so that the interior of the body is hermetically sealed, the pressure of the gas within the body 4 pressing against the valve 80 and thus aiding the spring 82 in keeping the valve closed. The interior of the body 4 is filled with the gas from a high pressure supply through a connector (not shown) temporarily fixed to the plug 74 so that the pressure of the gas will raise the valve and the gas will flow into the bulb chamber 1 through the connecting piece 78, through the chamber 16 of the pilot bulb holder 12 and between the threads 14, 15 of the pilot bulb 13 and its holder 12.

The member 28 as shown in Figure 5 is in the form of a contact member and extends through the body from the chamber 29 and has one end exposed in the chamber 69 of the pressure sensitive switch 4, the nipple 73 being integral therewith and protruding towards the contact 72 on the diaphragm 70, so that when the gas pressure in the body 5 falls below a predetermined pressure and the diaphragm flexes towards the nipple 73, the contact 72 will complete an electric circuit to be described.

The contact pin 46 extends out of the side of the body adjacent to but is insulated electrically from the contact 72 and the clip 48 is in electric contact with the plug 74.

The pin 54 extends through the lobe of the recess 67, passing through an aperture in the diaphragm lobe 71 with which it makees electric contact (Figs. 2 and 5).

Thus should the lens 6 be broken the drop in pressure in the bulb chamber 1 will be communicated to the chamber 67 through the passage 68 and the diaphragm 70 will flex to move the contact against the contact 73. If the switch 22 is in either the pilot or the main position the current will short circuit the bulb 13 or the bulb 3 respectively through the diaphragm to pin 54 and thus the fuze 60 will blow. Should the lens break, the gas under pressure within the chamber 1 will be forced out of the chamber 1 so that no dangerous external gas such as methane can enter the bulb chamber 1 before the fuze 60 has blown and before the lamp filaments have cooled down.

Preferably the light reflecting surface in either construction, i.e., without or with a pressurised bulb chamber, is formed on the reflector shape by depositing aluminium thereon; other light reflecting materials such as rhodium may however be deposited on the reflector surface for this purpose. Silver may also be deposited on the reflector shape which is more suitable for a pressurised bulb chamber, particularly a pressurised chamber filled with a non-combustion supporting gas, rather than for a non-pressurised chamber. The finished surface of the reflector 2 may be varied from a highly polished, i.e. specular, to a matt surface; for a specular finish the reflector shape of the moulded body is coated with a lacquer prior to the vacuum deposition of the reflecting material, but where a matt surface is required the lacquering process is omitted. The degree of light diffusion from the reflector may be varied by using moulding tools having different finishes in the moulding of the body.

Experiments have shown that suitable reflecting surfaces can be obtained by the above methods on mouldings of phenolic resins, rubber phenolic resins, acrylic resins, polystyrene resins, rubber polystyrene resins, urea-formaldehyde resins, cellulose acetate and cellulose nitrate, any of which may be used in making the moulded body 4.

With specular finish reflectors, the lens 5 may be of lightly etched glass which it has been found provides a satisfactory light output distribution and has the additional important result that to a person facing the lighted lamp the concentration of light at the bulb filament is not visible; thus a lesser sense of glare is experienced than with other combinations of lens glasses and reflectors, which is of importance to persons such as miners who often work in the dark. Further less loss of light is achieved by using etched lenses in which both faces are etched.

The exposed surface of the light reflecting material deposited on the reflector shape is unlacquered which is advantageous since it then has a higher reflective co-efficient; with silver for example this is very advantageous as silver has the highest reflective co-efficient of all metals. Although silver tarnishes when exposed to sulphiding agents found in the atmosphere, tarnishing in the present lamp construction is prevented when, the bulb chamber is hermetically sealed and filled with a non-combustion supporting gas which in addition is inert to the light reflecting material. The same applies to a less degree to other reflecting materials such as aluminium or rhodium.

The lamp constructions described are extremely simple to manufacture since a normal insert moulding process is employed which avoids the use of a number of separate parts and in the finished article with a pressurised bulb chamber there is a very small number of points at which leaks can occur in the hermetically sealed body. Thus these constructions, especially that having a pressurised bulb chamber, are particularly safe for use in atmospheres containing explosive gases, and a highly efficient light output is obtained since the reflector is satisfactorily protected from contamination by tarnishing agents.

I claim:

1. A portable electric battery lamp comprising a body having a lamp chamber cavity with a reflector surface, at least one bulb socket disposed to support a bulb in said chamber, a pressure-sensitive switch cavity and a duct communicating with the two cavities formed in the body, a bulb holder in said socket, four switch contacts exposed in said switch cavity, a positive charging contact, charging switch contacts, and electric conducting elements forming electric circuits between the bulb holder, the contacts of the two switches and the positive charging contact being mounted in the body, a lens closing in a gas-tight manner the front of the lamp chamber cavity in front of the bulb holder, said lamp chamber and pressure-sensitive switch cavities and said duct being filled with noncombustion supporting gas under pressure, said four switch contacts being exposed in the switch cavity and spaced around a central bearing member disposed in said switch cavity, and a rotary switch member rotatably mounted on the bearing member and operable from outside the body so as to bridge the gap between at least two of the switch contacts to complete and break the circuits, a pressure-sensitive member sealed in a gas-tight manner into the pressure-sensitive switch cavity and having a contact disposed when the pressure in the cavities and duct falls below a predetermined value to engage a switch contact to short circuit the bulb circuit.

2. A portable electric battery lamp for connection to an electric storage battery, comprising a lamp body formed with a reflector shape having a light reflecting surface thereon, a bulb holder in the lamp body positioned so as to support a bulb with its filament in front of said shape, a lens closing the lamp body in front of the bulb holder and the reflector shape to form a hermetically sealed chamber, a pressure-sensitive switch body having contacts and disposed in the lamp body and in communication with the sealed chamber, four main switch contacts in the lamp body and exposed in a recess in the lamp body, said four contacts being spaced around a central bearing member, charging contacts in the lamp body, electric conducting elements in the lamp body and connecting the main switch contacts, the bulb holder, the charging contacts and the pressure switch contacts, and a main switch mechanism secured to the lamp body and including a rotary main switch member within said recess and operable from outside the lamp body so as to bridge the gap between at least two of the main switch contacts to complete and break the bulb and charging circuits, the pressure-sensitive switch being so constructed that when the pressure in the sealed chamber drops below a predetermined value the pressure sensitive switch will cut off the flow of current from the battery to the bulb.

3. A portable electric lamp comprising a body, a reflector shape molded into said molding, a light reflecting surface on said shape, a lens attached to said body in front of said shape, a bulb holder disposed behind said lens, said body having a hermetically sealed bulb chamber filled with gas under pressure, a bulb in said bulb holder in said chamber, a pressure-sensitive switch body in communication with said chamber, electric conducting elements connected to said bulb holder and having portions exposed to the outside of the body for connection in use to an external electric circuit, a pressure-sensitive member sealed into the pressure-sensitive switch body in circuit with said elements, a switch unit disposed within a recess in the exterior part of the lamp body and having four electric contacts spaced around a central bearing member, each contact being exposed in the recess, conducting elements connecting the switch contacts with the lamp and pressure switch contacts and disposed within the body, and a rotary switch member rotatably mounted on the bearing member within the recess and having a portion exposed to the outside of the body so as to be

operable to bridge the gap between at least two of the contacts to complete the bulb circuits.

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